DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket No. EERE–2010–BT–TP–0021]

RIN 1904–AC08

Energy Conservation Program: Test Procedures for Residential Clothes Washers

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Final rule.

SUMMARY: The U.S. Department of Energy (DOE) establishes new test procedures for residential clothes washers under the Energy Policy and Conservation Act. The new test procedures include provisions for measuring standby mode and off mode energy consumption, and update the provisions for measuring active mode energy and water consumption. This final rule also amends the certification, compliance, and enforcement requirements for residential clothes washers, amends provisions for calculating the estimated annual operating cost for clothes washers, eliminates an obsolete clothes washer test procedure, and amends certain provisions in the currently applicable test procedure.

DATES: This final rule is effective April 6, 2012. Manufacturers will be required to certify compliance using the appendix J2 test procedure beginning on the compliance date of any final rule establishing amended energy conservation standards that address standby and off mode power for residential clothes washers. Before that time, manufacturers may continue to certify compliance using the test procedure at appendix J1.

The incorporation by reference of certain publications listed in this rulemaking is approved by the Director of the Office of the Federal Register as of April 6, 2012.

ADDRESSES: The docket is available for review at *http://www.regulations.gov*, including **Federal Register** notices, framework documents, public meeting attendee lists and transcripts, comments, and other supporting documents/materials. All documents in the docket are listed in the regulations.gov index. However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure. A link to the docket Web page can be found at: *www.regulations.gov/#!docketDetail;D=EERE-2010-BT-TP-0021*. The *regulations.gov* Web page contains instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov*.

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SUPPLEMENTARY INFORMATION: This final rule incorporates by reference into part 430 the following industry test standards:

(1) AATCC Test Method 79–2010, Absorbency of Textiles, Revised 2010.

(2) AATCC Test Method 118–2007, Oil Repellency: Hydrocarbon Resistance Test, Revised 2007.

(3) AATCC Test Method 135–2010, Dimensional Changes of Fabrics After Home Laundering, Revised 2010.

(4) IEC Standard 62301, Household Electrical Appliances—Measurement of Standby Power, Edition 2.0, 2011–01.

Copies of AATCC standards can be obtained from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709, (919) 549–3526, or *www.aatcc.org*.

Copies of IEC standards can be obtained from the American National Standards Institute, 25 W. 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4900, or *http://webstore.ansi.org/*.

Table of Contents

I. Authority and Background

Title III of the Energy Policy and Conservation Act (42 U.S.C. 6291, *et seq.;* ''EPCA'') sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the Energy Independence and Security Act of 2007 (EISA 2007), Public Law 110–140 (Dec. 19, 2007)). Part B of title III, which for editorial reasons was redesignated as Part A upon incorporation into the U.S. Code (42 U.S.C. 6291–6309), establishes the ''Energy Conservation Program for Consumer Products Other Than Automobiles.'' These include residential clothes washers, the subject of this final rule. (42 U.S.C. 6292(a)(7))

Under EPCA, this program consists essentially of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. The testing requirements consist of test procedures that manufacturers of covered products must use as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA, and for making representations about the efficiency of those products. Similarly, DOE must use these test requirements to determine whether the products comply with any relevant standards promulgated under EPCA.

A. General Test Procedure Rulemaking Process

Under 42 U.S.C. 6293, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered products. EPCA provides that any test procedures prescribed or amended under this section shall be reasonably designed to produce test results which measure energy efficiency, energy use or estimated annual operating cost of a covered product during a representative average use cycle or period of use and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) If DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures and offer the public an opportunity to present oral and written comments on them. (42 U.S.C. 6293(b)(2))

DOE is codifying these changes to the clothes washer test procedure as a new appendix J2 in 10 CFR part 430 subpart B. Manufacturers will not be required to use appendix J2 to demonstrate compliance with clothes washer energy conservation standards until the compliance date of amended energy conservation standards that consider the methods and measurements included in the new test procedure. Until that time, manufacturers may continue to use appendix J1.

EPCA requires DOE to review its test procedures at least once every seven years to determine whether amendments are warranted. (42 U.S.C. 6293(b)(1)) This rulemaking satisfies EPCA's periodic review requirement. Table I.1 provides a summary of prior key regulatory and legislative actions regarding the residential clothes washer test procedure and energy conservation standards, which are relevant to this final rule. The first column contains the abbreviated names used in this preamble to refer to each action.

TABLE I.1—SUMMARY OF RELEVANT REGULATORY AND LEGISLATIVE ACTIONS FOR RESIDENTIAL CLOTHES WASHERS

Name	Action	Citation and date	Summary of action
TEST PROCEDURES			
August 1997 Final Rule	Final Rule	62 FR 45484 (August 27, 1997).	Established new test procedure at appendix J1.
September 2010 NOPR	Notice of Proposed Rulemaking.	75 FR 57556 (September 21, 2010).	Proposed new appendix J2 to incorporate standby and off mode and to amend certain active mode provisions; proposed changes to appendix J1; proposed removal of appendix J.
October 2010 public meeting.	Public meeting	October 28, 2010	Public meeting to discuss proposed test procedure amendments.
August 2011 SNOPR	Supplementary Notice of Proposed Rulemaking.	76 FR 49238 (August 9, 2011).	Proposed revisions to new appendix J2 to incorporate provisions of IEC Standard 62301 (2nd Ed.); proposed minor amendments to appendix J1.

TABLE I.1—SUMMARY OF RELEVANT REGULATORY AND LEGISLATIVE ACTIONS FOR RESIDENTIAL CLOTHES WASHERS—Continued

Name	Action	Citation and date	Summary of action
November 2011 SNOPR	Supplementary Notice of Proposed Rulemaking.	76 FR 69870 (November 9, 2011).	Proposed amended definition of the energy test cycle for the proposed new appendix J2.
ENERGY CONSERVATION STANDARDS			
January 2001 standards Final Rule.	Final Rule	66 FR 3314 (January 12, 2001).	Required use of appendix J1 to demonstrate compliance with amended energy conservation standards as of January 1, 2004; amended test procedure provisions related to remaining moisture content and test cloth.
August 2009 standards framework document.	Framework document	74 FR 44306 (August 28, 2009).	Developed to consider amended energy conservation standards.
September 2009 standards public meeting.	Public meeting	September 21, 2009	Public meeting to discuss energy conservation standards rulemaking; included test procedure issues.
LEGISLATION			
EPCA	Legislation	Energy Policy and Conservation Act, Pub. L. 94–163.	Established authority for energy conservation standards and test procedures.
EISA 2007	Legislation	Energy Independence and Security Act of 2007, Pub. L. 110–140.	Required standby and off mode energy to be integrated into overall energy descriptors for residential clothes washers, if technically feasible.

B. DOE Test Procedure at Appendix J1

The DOE test procedure for clothes washers currently being manufactured is found at 10 CFR part 430, subpart B, appendix J1, which was adopted by DOE in the August 1997 Final Rule. DOE added the new appendix J1 so that appendix J could still be used until DOE amended the residential clothes washer conservation standards [1], which DOE published in the January 2001 standards Final Rule. Until the compliance date of any amended standards for residential clothes washers, manufacturers may continue to use the appendix J1 test procedure to demonstrate compliance with current energy conservation standards.

The test procedure at appendix J1 includes provisions for determining the modified energy factor (MEF) and water factor (WF). The test procedure at appendix J1 does not address energy use in standby or off modes.

C. Clothes Washer Test Procedure Updates: Authority and Regulatory Background

EISA 2007 amended EPCA to require DOE to amend its test procedures for all covered products to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor, unless the current test procedure already incorporates standby and off mode energy consumption, or if such integration is technically infeasible. If an integrated test procedure is technically infeasible, DOE must prescribe a separate standby mode and off mode energy use test procedure for the covered product, if a separate test is technically feasible. (42 U.S.C. 6295(gg)(2)(A)) Any such amendment must consider the most current versions of International Electrotechnical Commission (IEC) Standard 62301, ''Household electrical appliances—Measurement of standby power'' (''IEC Standard 62301 (Second Edition)'' or ''Second Edition'') and IEC Standard 62087, ''Methods of measurement for the power consumption of audio, video, and related equipment.'' [2] Amendments to test procedures to include standby and off mode energy consumption are not used to determine compliance with previously-established standards. (42 U.S.C. 6295(gg)(2)(C))

DOE is considering amending standards for clothes washers in a separate rulemaking, including amendments to the water consumption standards established in EISA 2007.[3] (42 U.S.C. 9295(g)(9) In the August 2009 standards framework document, available at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/clothes_washers_framework.pdf*, DOE requested comments on revising the clothes washer test procedure. Issues presented in the framework document, including issues related to the test procedure, were discussed at the September 2009 standards public meeting.

In response to the August 2009 standards framework document, DOE received comments stating that it should consider changes to the active mode test procedure for clothes washers. As a result, DOE proposed in the September 2010 NOPR to address issues regarding the active mode provisions of the test procedure, in addition to proposing the inclusion of measures for standby and off mode power. The proposals are discussed in greater detail below.

DOE proposed a number of revisions and additions to the test procedure in the September 2010 NOPR, including: (1) Incorporating standby and off mode power into a combined energy metric; (2) addressing technologies not covered by the appendix J1 test procedure, such as steam wash cycles and self-clean cycles; (3) revising the number of annual wash cycles; (4) updating use factors; (5) revising the procedures and specifications for test cloth; (6) redefining the appropriate water fill level for the capacity measurement method; (7) establishing a new measure of water consumption; and (8) revising the definition of the energy test cycle. DOE requested comment on the proposals in the September 2010 NOPR and discussed the proposals at the October 2010 public meeting.

[1] Because appendix J applies only to clothes washers manufactured before January 1, 2004, appendix J is now obsolete.

[2] IEC standards are available online at *www.iec.ch*.

[3] EISA 2007 amended EPCA, in relevant part, to revise the energy conservation standards for residential clothes washers. The revised standards established a maximum water consumption factor (WF) of 9.5, effective January 1, 2011.

The August 2011 SNOPR proposed to incorporate certain provisions of IEC Standard 62301 (Second Edition), as well as additional amendments addressing the following: (1) The energy test cycle definition; (2) the load adjustment factor; (3) the wash time setting for certain clothes washers; (4) the calculation of annual energy cost; (5) extension of the test load size table; (6) the definition of cold rinse; (7) redundant sections for test cloth specifications; (8) the detergent specification; (9) the definition of cold wash; and (10) the calculations for per-cycle self-clean water consumption. DOE requested comment on the proposals in the August 2011 SNOPR.

The November 2011 SNOPR proposed a revised definition for the energy test cycle. DOE requested additional comment on its proposal.

In today's final rule, DOE addresses comments it received on the September 2010 NOPR that were not previously addressed in the August 2011 SNOPR, as well as comments received in response to the August 2011 SNOPR and November 2011 SNOPR. DOE responds to these comments in section III.

II. Summary of the Final Rule

In this final rule, DOE establishes a new clothes washer test procedure (in a new appendix J2) that integrates measures of standby mode and off mode energy consumption, as well as measures of energy consumption in certain additional modes determined to be part of active mode. This final rule also: (1) Introduces a new efficiency metric for water consumption; (2) more accurately reflects current consumer usage patterns; (3) revises the energy test cycle definition; (4) revises the capacity measurement method; (5) addresses issues related to the test cloth, including the preconditioning detergent and test equipment; (6) clarifies certain testing conditions; (7) provides additional clarifications and corrections to certain provisions of the test procedure; (8) revises the calculation for annual operating cost; (9) revises and clarifies certain provisions in appendix J1; (10) removes the obsolete appendix J to subpart B of 10 CFR part 430; and (11) amends the certification, compliance, and enforcement requirements for residential clothes washers. The following paragraphs summarize these changes.

A. Standby and Off Mode

The new clothes washer test procedure includes provisions for measuring energy consumption in standby and off modes. DOE incorporates by reference IEC Standard 62301 (Second Edition). In the new test procedure, DOE includes language to clarify the application of clauses from the Second Edition regarding test conditions and test procedures for measuring standby mode and off mode energy consumption. The new test procedure includes definitions of ''active mode,'' ''standby mode,'' and ''off mode'' based on the definitions provided in the Second Edition. It also incorporates a simplified measurement approach that accounts for energy consumption in all low-power modes—including standby, off, delay start, and cycle finished modes—by means of a single power measurement. DOE also adopts a new measure of energy efficiency, the integrated modified energy factor (IMEF), which includes the energy used in the active, standby, and off modes.

B. Water Consumption

The new test procedure establishes a new measure of efficiency, the integrated water consumption factor (IWF), which incorporates the water consumption of all wash/rinse test cycles.

C. Updated Consumer Usage Patterns

The new test procedure updates certain values from the existing test procedure to reflect current consumer usage patterns and capabilities. This final rule: (1) Updates the number of annual wash cycles and incorporates it into the calculation for combined low-power mode energy consumption; (2) extends the test load sizes table to accommodate test loads for large-capacity clothes washers; (3) updates the temperature use factors for the warm/cold and warm/warm temperature combinations to accommodate the warm/warm cycle as a complete cycle; (4) updates the dryer usage factor; and (5) replaces the current representative load size calculation in the drying energy equation, which is based on the load adjustment factor, with a weighted-average load size based on the minimum, average, and maximum load sizes and the load usage factors.

D. Energy Test Cycle Definition

The new test procedure modifies the definition of the energy test cycle to improve clarity, which DOE believes will result in more accurate, repeatable, and reproducible results within and among all test laboratories.

E. Capacity Measurement Method

The new test procedure modifies the capacity measurement method to improve clarity, repeatability, and reproducibility, and to more appropriately represent the usable volume of the clothes washer during operation.

F. Test Cloth, Detergent, and Preconditioning Test Equipment

The new test procedure: (1) Includes new test cloth definitions; (2) establishes tolerances for the size and weight of the test cloth; (3) updates the detergent specification to reflect the current industry-standard detergent; (4) updates the test cloth preconditioning wash requirements; (5) updates the industry test methods referenced in the test procedure to reflect the current versions of each standard; (6) adds a new industry test method for measuring test cloth shrinkage; (7) adds a requirement to conduct extractor tests at the 650 g-force level; (8) updates the extractor specification; (9) adds specifications for the dryer to be used for bone-drying the test cloth; (10) clarifies the procedures for preparing and handling test cloth bundles; (11) clarifies the remaining moisture content (RMC) nomenclature used throughout the test procedure; (12) clarifies the application of the RMC correction curve; and (13) removes redundant sections regarding test cloth specifications and preconditioning, which were made obsolete by the January 2001 standards Final Rule.

G. Testing Conditions

Today's final rule clarifies the water supply pressure specification.

H. Clarifications and Corrections

This final rule: (1) Corrects the definition of ''cold rinse''; (2) clarifies the method for setting the wash time on clothes washers with electromechanical dials; (3) clarifies the definition of ''cold wash'' for clothes washers that offer multiple cold wash settings; (4) removes an obsolete note in the water factor calculation section; (5) corrects a typographical error in the equation for calculating per-cycle hot water consumption using gas-heated or oil-heated water; (6) removes the obsolete calculation of energy factor (EF); (7) clarifies the procedures recommended for conducting field tests in support of a test procedure waiver; (8) clarifies the water factor metric terminology; and (9) corrects typographical errors in materials incorporated by reference.

I. Annual Operating Cost Calculation

Today's final rule amends the annual operating cost calculation in 10 CFR 430.23(j) to incorporate the cost of energy consumed in standby and off modes, and to reflect an updated number of annual use cycles.

J. Revisions to Appendix J1

This final rule revises and clarifies certain provisions in appendix J1, some of which are identical to revisions made in appendix J2. Manufacturers will continue to use the amended version of appendix J1 to certify compliance until use of appendix J2 is required for certification.

Specifically, this final rule: (1) Revises the introductory text to appendix J1; (2) corrects typographical errors in materials incorporated by reference; (3) corrects the definition of ''cold rinse''; (4) removes redundant sections regarding test cloth specifications and preconditioning, which were made obsolete by the January 2001 standards Final Rule; (5) updates the test cloth preconditioning detergent specification to reflect the current industry-standard detergent; (6) clarifies the method for setting the wash time for clothes washers with electromechanical dials; (7) clarifies the definition of ''cold wash'' for clothes washers that offer multiple cold wash settings; (8) removes an obsolete note in the water factor calculation section; (9) corrects a typographical error in the equation for calculating per-cycle hot water consumption using gas-heated or oil-heated water; (10) extends the load size table to accommodate test loads for large-capacity clothes washers; (11) clarifies the procedures recommended for conducting field tests in support of a test procedure waiver; and (12) corrects and clarifies provisions for calculating the RMC correction curve.

K. Removal of Appendix J

Today's final rule removes appendix J to subpart B of 10 CFR part 430, which became obsolete when appendix J1 became effective.

L. Certification, Compliance, and Enforcement Requirements

Today's final rule modifies the reporting requirements in 10 CFR 429.20(b)(2) by specifying that a certification report shall include publicly available information including MEF, WF, and capacity; as well the list of cycle settings comprising the complete energy test cycle for each basic model, which would not be made publicly available as part of the report. The requirement to provide the list of cycle settings comprising the complete energy test cycle will apply only to test results obtained using appendix J2.

III. Discussion

A. Products Covered by This Test Procedure Final Rule

Today's final rule covers residential clothes washers, defined as follows in 10 CFR 430.2:

Clothes washer means a consumer product designed to clean clothes, utilizing a water solution of soap and/or detergent and mechanical agitation or other movement, and must be one of the following classes: Automatic clothes washers, semi-automatic clothes washers, and other clothes washers.

Automatic clothes washer means a class of clothes washer which has a control system which is capable of scheduling a preselected combination of operations, such as regulation of water temperature, regulation of the water fill level, and performance of wash, rinse, drain, and spin functions without the need for user intervention subsequent to the initiation of machine operation. Some models may require user intervention to initiate these different segments of the cycle after the machine has begun operation, but they do not require the user to intervene to regulate the water temperature by adjusting the external water faucet valves.

Semi-automatic clothes washer means a class of clothes washer that is the same as an automatic clothes washer except that user intervention is required to regulate the water temperature by adjusting the external water faucet valves.

Other clothes washer means a class of clothes washer which is not an automatic or semi-automatic clothes washer.

Pursuant to 42 U.S.C. 6295(q), existing energy conservation standards divide residential clothes washers into five product classes (10 CFR 430.32(g)):

- Top-loading, Compact (less than 1.6 cubic feet capacity)
- Top-loading, Standard (1.6 cubic feet or greater capacity)
- Top-loading, Semiautomatic
- Front-loading
- Suds-saving

DOE received comments from interested parties regarding clothes washer product classes in response to the September 2010 NOPR. BSH Home Appliances (BSH) commented that it supports removing the distinction between front-loading and top-loading clothes washers. DOE notes that the amended test procedure contains provisions for testing both top-loading and front-loading clothes washers of varying capacities. DOE is considering the issue of how clothes washers should be grouped into product classes in the separate rulemaking addressing energy conservation standards for residential clothes washers (Docket EERE–2008–BT–STD–0019).

The People's Republic of China (China) commented that DOE did not specifically consider non-detergent types of clothes washers, and that DOE should set appropriate energy efficiency requirements for such non-detergent machines. (China, No. 19 at p. 4) DOE does not have any information on residential clothes washers currently available in the United States that use cleaning mechanisms other than the combination of water, detergent, and mechanical agitation. Therefore, DOE is not incorporating any changes to the definitions of covered products in today's final rule.

B. Standby Mode and Off Mode Test Procedure Provisions

This section describes the standby and off mode test procedure provisions adopted in today's final rule. DOE received a number of comments from interested parties regarding the standby and off mode definitions and test procedure provisions in IEC Standard 62301 proposed in the September 2010 NOPR. DOE responded to many of these comments in the August 2011 SNOPR and addresses additional comments from the September 2010 NOPR and the August 2011 SNOPR in the discussion that follows.

1. Version of IEC Standard 62301

DOE proposed in the September 2010 NOPR to incorporate by reference certain provisions from sections 4 and 5 of IEC Standard 62301 (First Edition), as well as certain provisions from the Committee Draft for Vote (CDV) version and the Final Draft International Standard (FDIS) version, developed prior to the issuance of the Second Edition. DOE received numerous comments in response to the September 2010 NOPR regarding the version of IEC Standard 62301, and provided responses to comments in the August 2011 SNOPR.

Based on comments from interested parties, DOE proposed in the August 2011 SNOPR to incorporate by reference the Second Edition of IEC Standard 62301 for measuring standby and off mode power. Specifically, DOE proposed referencing the following sections in the Second Edition: (1) The room ambient air conditions specified in section 4, paragraph 4.2; (2) the electrical supply voltage waveform specified in section 4, paragraph 4.3.2; (3) the power meter requirements specified in section 4, paragraph 4.4; (4) the note regarding the time required to enter a stable power state in section 5, paragraph 5.1, note 1; (5) the installation instructions in section 5, paragraph 5.2; and (6) the power sampling method specified in section 5, paragraph 5.3.2.

DOE received the following comments in response to the August 2011 SNOPR: The Association of Home Appliance Manufacturers (AHAM), Alliance Laundry Systems (ALS), the Northwest Energy Efficiency Alliance (NEEA), and Whirlpool Corporation (Whirlpool) reiterated their support for incorporating by reference the Second Edition of IEC Standard 62301. AHAM and ALS stated that the Second Edition contains a number of important clarifications not present in the First Edition. Furthermore, AHAM and ALS stated that adopting the Second Edition will allow for international harmonization, which will give clarity and consistency to the regulated community. AHAM also stated that the Second Edition decreases testing burden. Whirlpool stated that the incorporation of the Second Edition should not be applicable until the effective date of appendix J2. (AHAM, No. 24 at p. 2; ALS, No. 22 at p. 1; NEEA, No. 26 at p. 2; Whirlpool, No. 27 at p. 1)

In this final rule, DOE incorporates by reference IEC Standard 62301 (Second Edition) for the test procedure in appendix J2. DOE believes that the new test procedures provide improved accuracy and representativeness of the resulting power measurement, and are not unduly burdensome to conduct, as described further in sections III.B.6 and III.G.1.

This final rule also amends 10 CFR 430.3 by adding a reference to IEC Standard 62301 (Second Edition). DOE retains the reference to the First Edition in 10 CFR 430.3 because several test procedures for other covered products not addressed in this final rule incorporate provisions from the First Edition.

Today's final rule also corrects the address and telephone number listed for the American National Standards Institute (ANSI) under the newly designated section for IEC standards in 10 CFR 430.3(m). The current address and phone number for ANSI is 25 W. 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4900. This correction is consistent with the address and phone number currently listed for ANSI in 10 CFR 430.3(c).

2. Determination of Modes To Be Incorporated

EPCA provides mode definitions for active mode, standby mode, and off mode, but authorizes DOE to amend these mode definitions by taking into consideration the most current version of IEC Standard 62301. (42 U.S.C. 6295(gg)(1)(B)) In the September 2010 NOPR, DOE noted that the mode definitions provided in IEC Standard 62301 (First Edition) and EPCA (as amended by EISA 2007) were designed to be broadly applicable for many energy-using products and could be subject to multiple interpretations. Therefore, DOE proposed mode definitions based on those provided in IEC Standard 62301 (FDIS), but with added clarifications specific to clothes washers.

In response to the September 2010 NOPR, NEEA commented that DOE's proposed modes and definitions would systematically exclude significant potential sources of annual energy use in many clothes washers. (NEEA, No. 12 at p. 2) NEEA also commented that DOE did not incorporate the ''Definitions'' section of IEC Standard 62301, and expressed concern about possible discrepancies between the modes specified in IEC Standard 62301 and the modes that are defined in EPCA. (NEEA, Public Meeting Transcript, No. 20 at pp. 22–23) NEEA added that not defining the modes identically with the IEC definitions could create inconsistencies in the way the modes are measured. (NEEA, Public Meeting Transcript, No. 20 at p. 24) NEEA's comments regarding specific modes and definitions are addressed in the relevant sections that follow.

For the reasons stated above, DOE maintained the mode definitions proposed in the September 2010 NOPR in the August 2011 SNOPR. DOE further proposed an ''alternate approach'' for measuring total energy consumption. In the alternate approach, the energy consumption of all low-power modes would be measured only in the inactive and off modes, and all low-power mode hours would be allocated to the inactive and off modes, depending on which of these modes is present.

In response to the August 2011 SNOPR, AHAM agreed that the Second Edition definitions are identical to those in the FDIS version and, thus, do not need to be revised. AHAM added that if DOE chooses to reference IEC Standard 62301 for those definitions, it should reference the Second Edition, not the FDIS, because the Second Edition is the final, published, and most current version of the standard. (AHAM, No. 24 at pp. 2–3)

DOE also proposed in the August 2011 SNOPR that certain installation instructions in IEC Standard 62301 (Second Edition) regarding the determination, classification, and testing of relevant modes were not appropriate for the clothes washer test procedure. Section 5, paragraph 5.2 of the Second Edition requires that where instructions for use provide configuration options, each relevant option should be separately tested. As stated in the August 2011 SNOPR, DOE is concerned that this requirement to separately test each configuration option could substantially increase test burden. It also potentially conflicts with the requirement in paragraph 5.2 to set up the product in accordance with the instructions for use or, if no such instructions are available, to use the factory or default settings. Accordingly, DOE proposed qualifying language in the test procedure amendments to disregard those portions of the installation instructions. For these reasons, DOE adopts language in today's final rule to disregard the provisions of paragraph 5.2 regarding the determination, classification, and testing of relevant modes.

The sections below provide additional details regarding the definition and inclusion of each specific mode within the revised test procedure.

Active Mode

DOE proposed in the September 2010 NOPR to define active mode as a mode in which the clothes washer is connected to a main power source; has been activated; and is performing one or more of the main functions of washing, soaking, tumbling, agitating, rinsing, and/or removing water from the clothing, or is involved in functions necessary for these main functions, such as admitting water into the washer or pumping water out of the washer. DOE also proposed including three additional modes within active mode: Delay start mode, cycle finished mode, and self-clean mode.

AHAM and the Pacific Gas and Electric Company (PG&E), Southern California Gas Company (SCG), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE) (collectively, the ''California Utilities'') support the active mode definition proposed in the September 2010 NOPR, which would include delay start, cycle finished, and self-clean modes. (AHAM, No. 14 at p. 4; California Utilities, No 18 at p. 2) However, AHAM stated that it opposes DOE's proposal to measure the energy use in delay start and cycle finished modes separately from the energy use of the active washing mode because delay start and cycle finished modes represent a very small contribution to the annual energy use. (AHAM, No. 14 at pp. 3–4) The California Utilities expressed concern about how the power in these modes is measured and included in the proposed test procedure. (California Utilities, No 18 at p. 2)

NEEA agreed with the proposal to define delay start and cycle finished modes as active modes, but commented that the point at which the active washing mode ends and the inactive mode begins is not clear. NEEA recommended that DOE define the end of the active washing mode so that manufacturers will know when to stop the energy measurement. (NEEA, Public Meeting Transcript, No. 20 at p. 97; NEEA, No. 12 at pp. 2, 4, 5; NEEA, No. 26 at pp. 2, 4–5) NEEA further commented that the spin cycle is typically the last element of an active wash mode, and access to the clothes washing compartment is prevented until this part of the cycle has concluded; thus, the point at which the user can gain access to the wash compartment is one possible definition for the end of the active washing mode. (NEEA, No. 12 at p. 7; NEEA, No. 26 at p. 6)

NEEA also suggested that active mode could be defined as starting with the activation of the delayed start mode, if any (with the duration of delayed start mode specified), and ending with the beginning of the inactive mode (with the duration of the cycle finished mode, if any, specified, either in minutes or number of cycles or both). (NEEA, No. 12 at p. 4–5) NEEA expressed concern that the definition of the active washing mode leaves out functions that might occur in delay start, cycle finished, or self-clean modes. (NEEA, No. 12 at p. 4) NEEA further suggested that if delay start and cycle finished modes are defined as part of the active mode, DOE could include them in the definition of the active mode energy test cycle and specify their durations. NEEA noted that while this would lengthen the test cycle, it would probably result in an overall reduction in test procedure time by eliminating the setup time and separate measurement time required for measuring energy consumption in these two modes. (NEEA, No. 12 at p. 13–14)

The Natural Resources Defense Council (NRDC) questioned whether the active washing mode includes the pre- and post-parts of the active cycle. (NRDC, Public Meeting Transcript, No. 20 at pp. 96–97)

DOE notes that the adopted definition of active washing mode includes the main function of removing water from the clothing; *i.e.,* the final spin cycle, which is typically the last operation of a wash cycle. DOE infers from NEEA's comments that its concern about defining the end of active washing mode relates to clothes washers in which there may be additional energy-consuming functions other than a continuous status display in cycle finished mode, such as periodic tumbling or air circulation. As discussed in section III.B.2.c, this final rule does not require the testing of any cycle-finished activity. Thus, for the purpose of measuring energy consumption in the energy test cycle, the end of the active washing mode occurs at the end of the final spin to remove moisture.

This final rule also accounts for the energy use of delay start mode by allocating the hours not associated with active washing mode (which include those associated with delay start mode) to the inactive and off modes, as described in section III.B.7. The energy use of delay start mode is therefore not separately measured, as discussed in section III.B.2.b.

Delay Start Mode

In the September 2010 NOPR, DOE proposed to define delay start mode as an active mode in which the start of the active washing mode is facilitated by a timer. Because delay start mode is not a mode that may persist for an indefinite time, and is uniquely associated with the initiation of a main function (*i.e.,* washing cycle), DOE determined that it would not be considered as part of standby mode.[4] For this final rule, DOE has determined that because delay start is of limited duration and is uniquely associated with the initiation of a primary function, it should be considered part of active mode.

DOE proposed in the September 2010 NOPR to measure delay start mode by setting the delay start time to 5 hours, allowing at least a 5-minute stabilization period, and then measuring and recording the average power over a 60-minute measurement period.

In the August 2011 SNOPR, DOE proposed not to adopt provisions to measure delay start mode separately or as part of the active washing mode. Instead, DOE proposed adopting the ''alternate approach,'' in which all low-power mode hours would be allocated to the inactive and off modes, and the low-power mode energy consumption would be measured only in the inactive and off modes, depending on which of these modes is present.

ALS, AHAM, and Whirlpool supported DOE's proposal to consider delay start mode as part of active mode. (ALS, No. 10 at p. 1; AHAM, No. 14 at p. 3; Whirlpool No. 13 at p. 2) BSH supported the proposed delay start mode definition, and agreed that this mode should be included in the test procedure. (BSH, No. 17 at p. 2) AHAM and ALS supported using the ''alternate approach'' for measuring power in low-power modes. AHAM opposed separately measuring delay start mode, stating that the additional complexities of the test significantly add to the testing burden without a corresponding benefit to the public interest. AHAM stated that the *de minimus* amount of energy that will be measured, 0.04 to 0.2 kWh annually per DOE's data, will not add significantly, or possibly at all, to national consumption figures. (AHAM, No. 14 at p. 6; AHAM, No. 24 at p. 3; ALS, No. 22 at p. 2)

Whirlpool commented that the LED-based technology on which DOE proposed a 60-minute delay start mode is rapidly disappearing from new product introductions. (Whirlpool No. 13 at p. 3) Whirlpool also commented that the 60-minute delay start mode test would add substantial test burden (6–7 percent), with little or no impact on overall measured energy consumption. Whirlpool believes that this would create an unacceptable test burden for manufacturers and strongly urged the Department to drop this proposal. (Whirlpool No. 13 at p. 4)

NEEA agreed that delay start mode is an active mode, but stated that the measurement of energy consumption in this mode should be folded into the measurements during the active washing mode. (NEEA, No. 12 at p. 5; NEEA, No. 26 at pp. 2, 7) NEEA indicated that it would support the proposed methodology of setting a 5-hour delay and measuring for one hour if DOE continued with the proposal to measure the energy use of delay start mode separately. NEEA also stated that the warm-up period should be 10 minutes to be consistent with IEC Standard 62301 general procedures, rather than the proposed 5 minute warm-up period. (NEEA, No. 12 at p. 5) NEEA commented that DOE did not fully understand the reasons why delay start mode would be used in a

[4] DOE noted in the September 2010 NOPR that section 3.8 of IEC Standard 62301 Committee Draft 2 (IEC Standard 62301 CD2) provided the additional clarification that ''delay start mode is a one-off user-initiated short-duration function that is associated with an active mode.'' The subsequent IEC Standard 62301 CDV removed this clarification based on a comment from a committee member that the clarification conflicted with the proposed definition of ''standby mode,'' which would include ''activation of * * * active mode by * * * timer.'' In its response to that comment, however, the IEC reiterated that delay start mode is a one-off function of limited duration, even though it took action to delete the clarification in IEC Standard 62301 CDV. DOE inferred this to mean that that delay start mode should, therefore, be considered part of active mode. DOE also notes that Annex A of IEC Standard 62301 (Second Edition) classifies delay start as a secondary function and therefore not part of active mode.

household; according to NEEA, in some households the delayed start function is used to allow time for stain-removal compounds to work before the wash cycle starts. The delayed start time is based on the stain-removal compound manufacturer's recommendation for a soak time of 30 minutes. NEEA suggested that DOE acquire consumer data regarding usage of this feature, including the average time spent in delay start mode. (NEEA, No. 12 at pp. 5–6; NEEA, No. 26 at p. 7)

BSH commented that delay start mode contributes a negligible amount of energy consumption to consumers due to low usage and low energy consumption during usage. According to BSH, measuring this energy is not a valuable use of DOE or manufacturer lab resources. (BSH, No. 17 at p. 2) However, should measurement of delay start mode be required, BSH agrees with the proposed method. (BSH, No. 17 at p. 3)

Upon consideration of the data and estimates provided in the September 2010 NOPR, the uncertainty regarding consumer usage patterns, and the additional test burden that would be required, DOE has determined that measuring the energy consumption of delay start mode separately would introduce significant test burden without a corresponding improvement in a representative measure of annual energy consumption. Therefore, this final rule adopts the ''alternate approach,'' in which the energy use in all low-power modes (including delay start mode) is accounted for by allocating all low-power mode hours to the inactive and off modes. Low-power mode energy consumption is then measured in the inactive and off modes, depending on which of these modes is present. Section III.B.7 provides additional information regarding the measurement of low-power mode. As a result, this final rule does not include provisions to measure delay start mode separately as part of the active washing mode.

Cycle Finished Mode

DOE proposed in the September 2010 NOPR to define cycle finished mode as an active mode that provides continuous status display following operation in the active washing mode. As with delay start mode, cycle finished mode is not a mode that may persist for an indefinite time. Operation in cycle finished mode occurs only after operation in the active washing mode. Therefore, DOE considered cycle finished mode as a short-duration function associated with active mode and proposed to define cycle finished mode as a part of active mode.

DOE noted that some clothes washers available at the time of publication of the September 2010 NOPR offered energy-consuming features other than a continuous status display in cycle finished mode. For example, certain models may periodically tumble the clothes to prevent wrinkles for up to 10 hours after the completion of the wash cycle. Some models may also use a low-power fan to circulate air around the damp clothes to prevent odors. These functions, while enabled, would use more energy than the continuous display normally associated with cycle finished mode. However, DOE research indicated that the number of residential clothes washers equipped with such features represents less than 10 percent of the residential clothes washer market. In addition, review of product literature for the clothes washers equipped with such features shows that these features are typically consumer-selected options. DOE determined that measuring the energy use from these functions would significantly increase the test cycle duration to capture a negligible contributor to annual energy consumption. Therefore, DOE did not propose to amend the test procedure to address these specific cycle finished mode functions.

DOE received numerous comments in response to the September 2010 NOPR regarding cycle finished mode. ALS, Whirlpool, and AHAM stated that cycle finished mode should be considered a part of active mode. (ALS, No. 10 at p. 1; Whirlpool, No. 13 at p. 2; AHAM, No. 14 at p. 3) Whirlpool supported DOE's proposal to exclude cycle finished mode energy consumption due to air circulation or periodic tumbling because these functions are very limited in their application, and the measurement burden would substantially outweigh the value. (Whirlpool, No. 13 at p. 2) AHAM commented that it does not support measuring cycle finished mode separately from the rest of the active mode. (AHAM, No. 14 at p. 6)

NEEA disagreed with DOE's proposed cycle finished definition. NEEA commented that the proposed cycle finished mode definition comprises only a display function, which could exclude other energy-consuming features in a cycle finished mode. (NEEA, No. 12 at p. 2) Additionally, NEEA commented that it did not understand how DOE proposed to measure energy consumption in cycle finished mode for clothes washers with energy-consuming features other than a continuous status display, such as tumbling of the drum or a fan circulating air. (NEEA, Public Meeting Transcript, No. 20 at pp. 35–36) NEEA stated that, based on information from a clothes washer tax credit program conducted in the state of Oregon, it is aware of thousands of clothes washers that include tumbling after the end of the wash cycle. (NEEA, Public Meeting Transcript, No. 20 at p.37)

To address these concerns, NEEA proposed the following alternate definition of cycle finished mode: ''Cycle finished mode means the portion of the active mode between the end of the active washing mode and the beginning of the inactive mode.'' (NEEA, No. 12 at p. 2; NEEA, No. 26 at p. 4) NEEA also suggested that DOE create a methodology to measure cycle finished activity, which IEC Standard 62301 is attempting to do, so that any energy consumption that occurs during that period can be measured. (NEEA, Public Meeting Transcript, No. 20 at pp. 40–41) NEEA suggested that an appropriate temperature use factor (TUF) should be applied to delayed start and cycle finished modes. (NEEA, No. 31 at p. 2)

NRDC, the American Council for an Energy Efficient Economy (ACEEE), and the Appliance Standards Awareness Project (ASAP), jointly (hereafter, the ''Joint Commenters'') suggested that DOE expand the definition of cycle finished mode to include any energy-consuming features following operation in the active washing mode. The Joint Commenters stated that to avoid additional testing burden for clothes washers that only have a continuous display in cycle finished mode, DOE could specify a separate test procedure and a different number of annual hours to cycle finished mode for clothes washers with additional energy-consuming features. Additionally, this comment noted that if these features are not captured in the test procedure, manufacturers will have no incentive to reduce their energy consumption in cycle finished mode while providing the additional functionality. (Joint Commenters, No. 16 at p. 4) The Joint Commenters and the California Utilities also noted that machines having these additional features in cycle finished mode are likely to become more available in the marketplace in the future, and therefore it is not appropriate to exclude the energy consumption from these features in the test procedure. (Joint Commenters, No. 16 at pp. 3–4; California Utilities, No. 18 at p. 2)

BSH commented that DOE needs to define cycle finished mode more clearly. According to BSH, the proposed definition attempts to differentiate the end-of-cycle signal from a ''left-on mode.'' BSH stated that it is unclear what is considered cycle finished mode and what is inactive mode, and that more clarity and detail is needed in the definition (BSH, No. 17 at p. 2)

In the August 2011 SNOPR, DOE presented results from additional laboratory testing to quantify the energy consumption in cycle finished mode. The test results indicated that including specific measurement of a cycle finished feature that incorporates intermittent tumbling and air circulation would not significantly impact the total annual energy consumption. Furthermore, measuring the energy use over the entire duration of the cycle finished mode could increase the test duration by up to 10 hours, depending on the maximum duration of the cycle finished mode provided on the clothes washer. Therefore, DOE proposed not to adopt provisions to measure cycle finished mode separately as part of the active washing mode.

In response to the August 2011 SNOPR, Whirlpool agreed with DOE's proposal not to adopt measurement of cycle finished mode, stating that the test burden would be substantially greater with virtually no consumer benefit. (Whirlpool, No. 27 at pp. 1–2)

NEEA disagreed with the definition of cycle finished mode and reiterated its proposal to define cycle finished mode as follows: ''Cycle finished mode means the portion of active mode between the end of the active washing mode and the beginning of the inactive mode.'' NEEA opposed ignoring cycle finished mode hours and energy use, and stated that the energy associated with cycle finished mode should be included as part of active mode. NEEA stated that in the worst case scenario, the energy use in cycle finished mode consumes around 20 percent of the total clothes washer machine energy, when dryer energy use is excluded. NEEA stated that cutting the cycle finished energy to one-third of the worst-case scenario would still represent 7 percent of the total machine energy consumption. NEEA stated that if energy use in cycle finished mode is considered to be insignificant, the same logic could be applied to standby and off modes, which is an argument Congress already rejected. (NEEA, No. 26 at pp. 2–7)

The Joint Commenters stated that the demonstrated potential consumption of energy in cycle finished mode warrants the testing of cycle finished mode in the test procedure. The Joint Commenters further stated that the amount of energy consumed in cycle finished mode is considerable when dryer energy is disregarded. The Joint Commenters stated that when dryer energy use is disregarded, inclusion of cycle finished mode doubles the amount of energy consumed while in low-power mode, causing the energy consumption to approach the energy consumed in active mode. The Joint Commenters believe that future clothes washers will likely incorporate more features in cycle finished mode, causing the energy consumption in that mode to increase to a more significant portion of the total per-cycle energy. The Joint Commenters support folding cycle finished mode into the existing active mode test cycle by either letting the clothes washer run through the completed cycle finished mode, or, alternatively, by terminating the test one hour after the clothes washer enters cycle finished mode. The Joint Commenters do not believe that this would significantly increase the test burden, as it would lengthen the test by one hour and would not require additional setup or test preparation. Finally, the Joint Commenters commented that the uncertainty of consumer usage patterns is an invalid argument against its inclusion in the test procedure, and that substituting reasonable estimates as proxies would suffice. (Joint Commenters, No. 23 at pp. 2–4)

The California Utilities suggested requiring separate measurements for cycle finished mode. The California Utilities stated that while they recognize that cycle finished mode represents a small percentage of energy consumption when compared to dryer energy, they believe it is a significant amount of energy and similar in magnitude to the electrical energy of the washer cycle. The California Utilities further commented in response to November 2011 SNOPR that they do not agree with DOE's assertion that cycle finished mode is activated only by the consumer, and that they possess knowledge that cycle finished mode is the default setting for certain clothes washer models, and cannot be deactivated or turned off. In addition, the California Utilities stated that there are other units that tumble more frequently than the model DOE tested. Furthermore, the California Utilities commented that the test procedure should measure all low-power modes, and that measuring all energy-consuming modes will encourage manufacturers to take efficiency into account at the beginning of their research and development efforts. (California Utilities, No. 25 at p. 2; California Utilities, No. 36 at pp. 1–2)

Upon consideration of the features that may be energized during the time period after the active washing mode and before the clothes washer enters inactive or off mode, DOE agrees that the proposed definition does not fully describe the possible functions in cycle finished mode. DOE concludes that periodic tumbling of the clothing or air circulation by means of a fan or blower constitute additional active mode functions outside the active washing mode, and thus should be included in the definition of cycle finished mode. Therefore, today's final rule adopts an expanded definition of cycle finished mode as ''an active mode that provides continuous status display, intermittent tumbling, or air circulation following operation in active washing mode.''

However, upon consideration of the data and estimates provided in the September 2010 NOPR, the additional energy consumption estimates provided in the August 2011 SNOPR, the uncertainty regarding consumer usage patterns, and the additional test burden required, today's final rule adopts the ''alternate approach'' to account for the energy use in cycle finished mode. Under this approach, all low-power mode hours are allocated to the inactive and off modes, and the low-power mode power is then measured in the inactive and off modes, depending on which of these modes is present. Section III.B.7 provides additional information regarding the measurement of low-power mode. DOE does not include provisions to measure cycle finished mode separately as part of the active washing mode.

Self-Clean Mode

In the September 2010 NOPR, DOE proposed to define self-clean mode as an active clothes washer operating mode that is (a) Dedicated to cleaning, deodorizing, or sanitizing the clothes washer by eliminating sources of odor, bacteria, mold, and mildew; (b) recommended to be run intermittently by the manufacturer; and (c) separate from clothes washing cycles. DOE considered self-clean mode as a part of the active mode because it is a function necessary for the main functions associated with washing clothes. A clothes washer with excessive bacteria, mildew, or odor cannot wash clothes effectively.

NEEA supports DOE's proposal to include self-clean mode as a part of active mode, and to include energy and water consumption in this mode in the test procedure. (NEEA, No. 12 at pp. 5, 9; NEEA, No. 26 at pp. 5–6) However, NEEA suggests the following definition of self-clean mode to clarify the proposed version: ''Self-cleaning mode means an active clothes washer operating mode that is recommended by the manufacturer to be run for the purpose of cleaning, deodorizing, or sanitizing the clothes washer by eliminating sources of odor, bacteria, mold and mildew.'' (NEEA, No. 12 at p. 5; NEEA, No. 26 at pp. 6) NEEA stated that the number of self-clean annual cycles should be based on the recommendations of the manufacturer because consumers are unlikely to use these cycles in a way that is different than recommended. NEEA also strongly recommended that whatever cycle is recommended by a manufacturer for a self-cleaning function should be the one measured as the self-cleaning cycle. (NEEA, No. 12 at p. 9) NEEA also urged DOE to acquire consumer usage data on how self-clean cycles are actually used. (NEEA, No. 12 at p. 9; NEEA, No. 26 at p. 8)

The Joint Commenters support the inclusion of self-clean mode in the test procedure. The Joint Commenters stated that the definition should not be limited to machines equipped with an explicitly designated self-clean cycle, because self-cleaning may be undertaken with an appropriate cleaning compound through the use of a standard cycle available for washing clothes. (Joint Commenters, No. 16 at p. 3; Joint Commenters, No. 23 at p. 5)

The Joint Commenters also recommended that a usage factor of 12 cycles per year should not be uniformly applied to all washers, but rather should be based on the level of usage recommended by the manufacturer, converted as necessary to the appropriate number of cycles per year for the test procedure. This would provide further encouragement for manufacturers to develop approaches to sanitizing and deodorizing issues that are less energy- and water-intensive than current practices. (Joint Commenters, No. 16 at p. 3; Joint Commenters, No. 23 at p. 5)

The California Utilities commented that the proposed definition is potentially too restrictive because manufacturers may recommend intermittent self-clean cycles on machines without a dedicated self-clean feature or control. The California Utilities also commented that the calculation of self-clean cycles per year should be based on manufacturer recommendations in the product literature, rather than on a fixed number of annual self-clean cycles for all clothes washers. The California Utilities suggested that for clothes washer models that meet the definition of self-clean, but for which the manufacturer does not recommend a specific usage frequency for the self-clean cycle, the test procedure should assume the default value of 12 self-clean cycles per year. (California Utilities, No. 18 at p. 3; California Utilities, No. 25 at p. 3)

NRDC expressed concern that if a manufacturer recommends a periodic sanitizing regimen on a machine with no hardware or software dedicated to self-cleaning, these cycles would not be captured by the proposed definition. NRDC also commented that self-clean mode should be based on the manufacturer's recommendation, and not on design features. (NRDC, Public Meeting Transcript, No. 20 at pp. 47–48, 79–80)

Whirlpool commented that DOE should not include self-clean cycles in the clothes washer test procedure. Whirlpool stated that including this mode for clothes washers with such functionality, while not including it for other machines, disadvantages machines that include a self-clean cycle. According to Whirlpool, some consumer publications and manufacturers recommend running periodic cleaning cycles with baking soda or vinegar, and there is no known data on the consumer use of such practice. (Whirlpool, No. 13 at p. 2) Whirlpool proprietary data indicates that actual consumer use of a self-clean cycle is substantially less than the 12 times per year that DOE proposed, and that this data supports exclusion of self-clean energy from the test procedure. (Whirlpool, No. 13 at p. 5–6) Whirlpool also commented that if the self-clean cycle is included at the frequency of use recommended by the manufacturer, this could lead to manufacturers suggesting less frequent use. (Whirlpool, No. 13 at p. 5–6) Whirlpool estimated that the inclusion of a self-clean cycle in the test procedure would add approximately 8 percent to the overall test burden, or 8 hours, and that the amount of energy and water used by the average Whirlpool clothes washer during such cycles per year would be less than 1 percent of annual energy consumption and 3 percent of annual water consumption. Whirlpool believes that the added test burden outweighs the added benefit of including self-clean cycles in the test procedure. (Whirlpool, No. 13 at pp. 2, 6) However, Whirlpool agreed that if self-clean mode were included in the test procedure, it would be a part of active mode. (Whirlpool, No. 13 at p. 2).

AHAM opposes the inclusion of self-clean mode in the test procedure, but stated that if DOE decides to include it, AHAM agrees with the proposed definition as the best way to ensure measurement of all machines with a self-clean feature. (AHAM, No. 14 at p. 4) AHAM also notes that self-clean cycles have become necessary in large part due to the increasingly stringent energy and water consumption standards which, in practice, require many machines to use cold water instead of hot or warm water, and to use less water. (AHAM, No. 14 at p. 10) AHAM commented that there is no consumer use data to show whether and/or how often consumers use self-clean cycles, and that test procedures must be representative of actual consumer use, not manufacturer recommendations. AHAM believes that DOE should not include additional energy measurements in the test procedure without consumer data to support its addition and to quantify the energy impact. (AHAM, No .14 at p. 10) AHAM also commented that DOE's proposal to include self-clean cycles unfairly disadvantages clothes washers with a self-clean feature, which may dis-incentivize the feature, the result of which would not benefit consumers. AHAM stated that it is difficult to define an approach that would not encourage test procedure circumvention. (AHAM, No. 14 at p. 11).

BSH stated that self-clean mode should include only cycles specifically designed and provided for such activities. According to BSH, consumers are less likely to perform such activities without a dedicated program or option. (BSH, No 17 at p. 2) BSH commented that should the self-clean cycle be included, the number of cycles per year should be specified to match the manufacturer's suggestion to the customer. Otherwise, the motivation to reduce the need for such cycles is not present and manufacturers may not pursue innovations to reduce this need. (BSH, No. 17 at p. 2) However, BSH commented that it does not see the value to the consumer or DOE in assessing self-clean mode energy consumption, and suggests that these hours be removed or allocated to the active washing mode according to the self-cleaning cycles per year specified by the manufacturer. (BSH, No. 17 at p. 3) BSH stated that including the self-cleaning cycles will not significantly contribute to the annual energy consumption of residential washing machines. BSH suggests that instead of testing the self-clean cycle, the total number of annual active-mode cycles per year in the current energy calculations could be increased by a small value. (BSH, No. 17 at p. 2) Additionally, BSH does not agree that self-clean modes are necessary for the main functions associated with clothes washing, otherwise all clothes washers would need such cycles. (BSH, No. 17 at p. 2).

ALS opposes DOE's proposed definition of self-clean mode as being part of active mode, and commented that DOE should not propose an energy test measurement without consumer use data to support it. (ALS, No. 10 at p. 1) ALS stated that self-clean cycles should not be added to the test procedure until there is reliable consumer data and an understanding of the energy consumed in self-clean cycles. ALS also stated that the test burden on manufacturers outweighs the public benefit at this time. (ALS, No. 10 at p. 3).

China does not support DOE's proposal to include self-clean mode in the test procedure. China commented that self-clean functions reduce bacteria and mildew that may harm the user, and thus are significant for health reasons. China stated that if self-clean mode were included in the test procedure, manufacturers might reduce the temperature or shorten the cycle time of a self-clean cycle to improve energy performance, which would be detrimental to consumers. China also expressed concern that this standard would lead to differences in energy consumption between units with and without self-cleaning functions, and stated that such distinct types of clothes washers should not be subject to the same energy standard. China noted that, as DOE proposed, self-clean mode represents a very short use time of only 16 hours per year, or 1.3 hours per month. Because of this minimal use time, China recommends not including the energy and water consumption during a self-clean cycle in the test procedure. (China, No. 19 at p. 3).

GE commented that it does not disagree with DOE's assumption of 12 self-clean cycles per year, but stated that consumers would be dissatisfied to have to use this feature monthly. GE expects that manufacturers will be working to reduce the required number of self-clean cycles per year. GE suggested that DOE use the manufacturer's recommendation for the number of self-clean cycles. (GE, Public Meeting Transcript, No. 20 at pp. 77–78, 107).

In reviewing these comments, DOE recognizes a lack of consensus regarding whether a self-clean mode is uniquely associated with a dedicated feature provided on a clothes washer, or whether self-clean mode may describe a consumer-initiated function associated with a normal wash cycle. DOE recognizes that a cleaning or deodorizing action in the clothes container may be achieved in either case, but that it is not clear whether such a cycle would be differentiable from a normal wash cycle in the event that a self-clean feature is not provided. In addition, DOE lacks information on the consumer usage of self-clean features or typical cycles run solely for self-clean purposes, including whether consumer usage reflects manufacturer recommendations. In light of this uncertainty, and considering that the annual energy use associated with self-clean mode would be relatively small, DOE has determined for today's final rule that self-clean mode should not be addressed in the amended test procedure. Therefore, DOE is not adopting a definition for a self-clean cycle, and is not adding any provisions to the test procedure for measuring self-clean energy and water consumption. In addition, today's final rule adds a clarifying statement that the energy test cycle shall not include any cycle, if available, that is dedicated for cleaning, deodorizing, or sanitizing the clothes washer, and is separate from clothes washing cycles.

Standby Mode

In the September 2010 NOPR, DOE proposed to define standby mode as any mode in which the clothes washer is connected to a main power source and offers one or more of the following user-oriented or protective functions, which may persist for an indefinite time: (a) To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer; (b) continuous functions, including information or status displays (including clocks) and sensor-based functions.

DOE proposed an additional clarification that a timer should be considered a continuous clock function (which may be associated with a display) that provides regular scheduled tasks (*e.g.,* switching) and that operates on a continuous basis. This proposed definition was developed based on the definition provided in IEC Standard 62301 FDIS.

As proposed, the definition of standby mode allowed for multiple modes to be considered a standby mode. DOE had identified only one mode that would be considered a standby mode under the proposed definition. DOE proposed to define ''inactive mode'' as a standby mode that facilitates the activation of active mode by remote switch (including remote control), internal sensor, or timer, or that provides continuous status display. Although it identified only this one particular standby mode, DOE remained open to consideration of additional standby modes. DOE retained this definition of standby mode in the August 2011 SNOPR.

ALS supported DOE's proposal for inactive mode to be the only standby mode. ALS also stated that it is unaware of any modes for clothes washers that represent significant energy use, other than those proposed by DOE. (ALS, No. 10 at p. 1) AHAM commented that it does not support the inclusion of one-way remote control energy in the definition of standby mode. According to AHAM, standard remote controls power down products rather than powering them off, such that the product can be turned on again through use of the remote. AHAM contrasted that to one-way remote controls, which turn a product off completely, such that it cannot be turned on again through use of the remote control. AHAM stated that one-way remote controls should be included under the definition of off mode to encourage manufacturers to design products with this feature, which could result in decreased energy use. (AHAM, No. 14 at p. 5).

Whirlpool stated that the test burden for inactive mode testing is significant (approximately an 8 percent increase) with virtually no consumer benefit. (Whirlpool, No. 13 at p. 4).

DOE notes that the definition of standby mode proposed in the September 2010 NOPR states that standby mode includes user-oriented or protective functions to facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer. If the clothes washer is consuming energy to power an infrared sensor used to receive signals from a remote control (while not operating in the active mode), such a function would be considered part of standby mode, regardless of whether the remote is classified as ''one-way'' or ''two-way.'' However, if a ''one-way'' remote control powers down the clothes washer, including turning off any infrared sensors to receive signals from a remote control, the unit would transition to off mode once it is powered down, if no other standby mode functions within the clothes washer are energized. Depending on whether the unit is capable of operating in both a standby mode and off mode or just the off mode, the annual hours associated with standby and off modes would be allocated accordingly.

In today's final rule, DOE retains the definitions of standby mode and inactive mode as proposed in the September 2010 NOPR and August 2011 SNOPR. Section III.B.7 provides further details on the test method for standby mode adopted in the revised test procedure. As described further in section III.G.1, DOE believes that by adopting the ''alternate approach'' for measuring standby and off mode power, this final rule will not impose significant additional test burden on manufacturers.

Off Mode

DOE proposed in the September 2010 NOPR to define ''off mode'' as any mode in which the clothes washer is connected to a mains power source and is not providing any standby mode or active mode function, and the mode may persist for an indefinite time. An indicator that only shows the user that the product is in the off position would be included within the proposed off mode classification. This definition was developed based on the definitions provided in IEC Standard 62301 FDIS. DOE retained this definition of off mode in the August 2011 SNOPR.

Under the definitions proposed in the September 2010 NOPR, a clothes washer equipped with a mechanical on/off switch that can disconnect power to the display and/or control components would be considered as operating in the off mode when the switch is in the ''off'' position, provided that no other standby or active mode functions are energized. An energized light-emitting diode (LED) or other indicator that shows the user only that the product is in the off position would be considered part of off mode under the proposed definition, provided that no other standby or active mode functions are energized.

Other than those comments addressed in the August 2011 SNOPR, DOE did not receive any additional comments on the proposed definition of off mode. Therefore, for the reasons stated above and in the August 2011 SNOPR, DOE adopts this definition for the amended clothes washer test procedure in this final rule.

Network Mode

DOE noted in the September 2010 NOPR that IEC Standard 62301 FDIS provides definitions for network mode that DOE determined were not applicable to the clothes washer test procedure. Section 3.7 of IEC Standard 62301 FDIS defines network mode as a mode category that includes ''any product modes where the energy using product is connected to a mains power source and at least one network function is activated (such as reactivation via network command or network integrity communication) but where the primary function is not active.'' IEC Standard 62301 FDIS also provided a note, stating that ''[w]here a network function is provided, but is not active and/or not connected to a network, then this mode is not applicable. A network function could become active intermittently according to a fixed schedule or in response to a network requirement. A 'network' in this context includes communication between two or more separate independently powered devices or products. A network does not include one or more controls which are dedicated to a single product. Network mode may include one or more standby functions.'' DOE did not propose any amendments to include provisions for testing network mode energy consumption in clothes washers.

AHAM, ALS, BSH, and Whirlpool stated that network mode should not be included in the test procedure at this time because no products are currently available on the market with such a feature. (AHAM, No. 14 at pp. 5, 11; ALS, No. 10 at p. 3; BSH, No. 17 at pp. 3–4; Whirlpool, No. 13 at p. 2) Whirlpool, AHAM, and NRDC further commented that DOE could consider network mode by creating a ''placeholder'' for it in the test procedure, so that when there is sufficient volume of network-capable clothes washers in the market, this mode could be addressed. (Whirlpool, Public Meeting Transcript, No. 20 at pp. 42–43, 46; AHAM, Public Meeting Transcript, No. 20 at pp. 43–44, 109; NRDC, Public Meeting Transcript, No. 20 at pp. 109–110).

NEEA disagreed with DOE's proposal to not include provisions for network mode in the test procedure. NEEA stated that, although no clothes washers currently on the market are capable of this mode, it has communicated with microprocessor manufacturers who intend to sell the hardware that would allow such a mode. According to NEEA, informal estimates in these conversations revealed that network mode could significantly increase the energy consumption in the inactive mode. NEEA suggested that DOE define and allow for measuring the energy use of network mode, as defined in IEC Standard 62301, and recommended that DOE include network mode under the inactive mode definition. (NEEA, No. 12 at pp. 2, 4, 10; NEEA Public Meeting Transcript, No. 20 at pp. 38–41, 45–46; NEEA, No. 26 at p. 4) NEEA supports including the definitions and methodology for network mode energy from IEC Standard 62301 (Second Edition). NEEA also commented that if DOE chooses to incorporate a network mode definition different from that in IEC Standard 62301, there could be inconsistencies when the test method from IEC Standard 62301 is applied using DOE's mode definitions. (NEEA, Public Meeting Transcript, No. 20 at pp. 22–24; NEEA, No. 26 at p. 9).

The Joint Commenters stated that clothes washers with a network mode may become common by 2015 when the new standards take effect, and multiple manufacturers have indicated their plans to introduce these features. Therefore, the Joint Commenters believe it is important for the test procedure to capture at a minimum the standby energy consumption associated with a network mode. The Joint Commenters further stated that network mode could require power consumption of 2–5 Watts, corresponding to 18–44 kWh per year. According to the Joint Commenters, if network mode is not captured by the test procedures, manufacturers will have no incentive to employ lower-power technologies for this feature. (Joint Commenters, No. 16 at pp. 1–2) The Joint Commenters and the California Utilities stated that, due to the lack of sufficient data associated with development of a test method for network mode, DOE should develop a sufficiently broad definition for inactive or standby mode to ensure that the standby test method would capture any energy consumption associated with network functionality, regardless of whether the product is connected to a network. (Joint Commenters, No. 16 at p. 2; California Utilities, No. 18 at pp. 1–2; California Utilities, No. 25 at p. 2).

NRDC commented that the AHAM–ACEEE Agreement on Minimum Federal Efficiency Standards, Smart Appliances, Federal Incentives and Related Matters for Specified Appliances[5] includes an explicit commitment to recognize network functionality for major appliances in the ENERGY STAR context, so the test procedure should be prepared to assess whatever energy consumption is associated with that functionality. (NRDC, Public Meeting Transcript, No. 20 at pp. 41–42) The California Utilities further commented that DOE should include the definition of network mode to harmonize with the IEC Standard, and that it should act swiftly to issue an amendment to include a test method for network mode when it becomes aware of clothes washer models with this feature in the marketplace. The California Utilities expect network mode to become a regular feature in the future. The California Utilities stated that if DOE cannot develop a test procedure in this

[5] The AHAM–ACEEE Agreement on Minimum Federal Efficiency Standards, Smart Appliances, Federal Incentives and Related Matters for Specified Appliances is available at DOE Docket No. EERE–2010–BT–TP–0021, Comment No. 2.

rulemaking for products connected to networks, DOE should amend the test procedure as soon as it becomes aware of commercially available clothes washer models with this feature. (California Utilities, No. 18 at pp. 1–2; California Utilities, No. 25 at pp. 1–2).

DOE interprets the network mode provisions in IEC Standard 62301 (Second Edition) to be a forward-thinking attempt by the IEC to anticipate and/or promote technological change by industry. DOE is unaware, however, of any clothes washers currently on the market with network mode capabilities as of the date of today's final rule. Consequently, DOE can not thoroughly evaluate these network mode provisions, as would be required to justify their incorporation into DOE's test procedures at this time. DOE notes that although an individual appliance may consume some small amount of power in network mode, the potential exists for energy-related benefits that more than offset this additional power consumption if the appliance can be controlled by the ''smart grid'' to consume power during non-peak periods. Although DOE is supportive of efforts to develop smart-grid and other network-enabled technologies in clothes washers, today's final rule does not incorporate the network mode provisions due to the lack of available data that would be required to justify their inclusion.

Disconnected Mode

DOE noted in the September 2010 NOPR that section 3.9 of IEC Standard 62301 FDIS provided a definition of ''disconnected mode,'' which is ''the state where all connections to mains power sources of the energy using product are removed or interrupted.'' IEC Standard 62301 FDIS also added a note that common terms such as ''unplugged'' or ''cut off from mains'' also describe this mode, and that this mode is not part of the low-power mode category. Since there would be no energy use in a disconnected mode, DOE did not propose a definition or testing methods for such a mode.

AHAM agreed with DOE's proposal to not include test procedures for disconnected mode, because there would be no energy use in this mode. (AHAM, No. 14 at p. 5).

For the reasons stated in the September 2010 NOPR, DOE is not adopting a definition or testing methods for disconnected mode in this final rule.

3. Power Stabilization Criteria and Measurement Methods

In the September 2010 NOPR, DOE proposed to require measurement of standby mode and off mode power using section 5, paragraph 5.3 of the First Edition, clarified by requiring the product to stabilize for at least 30 minutes, and using a measurement period of not less than 10 minutes for cycle finished mode, inactive mode, and off mode. For instances where the power varies over a cycle, as described in section 5, paragraph 5.3.2 of the First Edition, DOE proposed to require the use of the average power approach in section 5, paragraph 5.3.2(a).

The Second Edition contains more detailed techniques for evaluating the stability of the power and measuring the power consumption of loads with different stability characteristics. In the Second Edition, the user is given a choice of measurement procedures, including a sampling method, average reading method, and direct meter reading method. In the August 2011 SNOPR, DOE evaluated these new methods in terms of test burden and improvement in results as compared to the methods provided in the First Edition. Based on this analysis, DOE proposed using the sampling method for all measurements of standby mode and off mode power. The following sections provide additional details on each power stability scenario.

Stable, Non-Cyclic Power

In the September 2010 NOPR, DOE proposed measuring stable, non-cyclic power by allowing the product to stabilize for at least 30 minutes, followed by a measurement period of at least 10 minutes using the test procedure specified in section 5, paragraph 5.3.1 of the First Edition. This method defines stable power as varying less than 5 percent over a 5 minute period. If the load is considered stable, the power can be recorded directly from the power-measuring instrument at the end of the measurement period.

In the August 2011 SNOPR, DOE proposed measuring stable, non-cyclic power by allowing the product sufficient time to reach its low power state and then following the test procedure for the sampling method specified in section 5, paragraph 5.3.2 of the Second Edition. The sampling method requires measuring and recording the power over a period of at least 15 minutes. Data from the first third of the measurement period are discarded, and stability is evaluated by a linear regression through all power readings in the second two-thirds of the data. If the slope of the linear regression satisfies the stability criterion, power consumption is calculated as the average of the power readings during the second two-thirds of the measurement period. If the slope of the linear regression does not satisfy the stability criterion, the total period is continuously extended—up to a maximum of 3 hours—until the stability criterion is satisfied for the second two-thirds of the data taken over the total period.

In response to the August 2011 SNOPR, NEEA supports DOE's proposal to require the use of the sampling method for measuring power consumption in the inactive and off modes. (NEEA, No. 26 at p. 2).

For the reasons stated in the August 2011 SNOPR, DOE specifies the use of the sampling method in section 5, paragraph 5.3.2 of the Second Edition for all measurements of standby and off mode power, including stable, non-cyclic power.

Unstable (Varying), Non-Cyclic Power

In the September 2010 NOPR, DOE proposed measuring unstable (varying), non-cyclic power by allowing the product to stabilize for at least 30 minutes, followed by a measurement period of at least 10 minutes using the average power approach described in section 5, paragraph 5.3.2(a) of the First Edition. The average power approach requires using an instrument that can measure the true average power over a period of at least 5 minutes (which DOE proposed to extend to a minimum of 10 minutes). The average power can be recorded directly from the power-measuring instrument at the end of the measurement period.

In the August 2011 SNOPR, DOE proposed measuring unstable (varying), non-cyclic power by allowing the product sufficient time to reach its low power state and then following the test procedure for the sampling method specified in section 5, paragraph 5.3.2 of the Second Edition. Using the sampling method, for modes that are known to be non-cyclic and unstable (varying), the test period must be long enough so that the cumulative average of all data points taken during the second two thirds of the total period fall within a band of ±0.2%.[6] When testing such modes, the total period must be at least 60 minutes.

For the reasons stated in the August 2011 SNOPR, DOE specifies the use of the sampling method in section 5, paragraph 5.3.2 of the Second Edition for all measurements of standby and off mode power, including unstable (varying), non-cyclic power.

[6] DOE interprets this provision as follows: The cumulative average is the mean of all data points up to and including the most recent data point. Each data point collected has a cumulative average associated with it, and the variation of those averages must remain within the given band.

Cyclic Power

In the September 2010 NOPR, DOE proposed measuring cyclic power by allowing the product to stabilize for at least 30 minutes, followed by a measurement period of at least 10 minutes using the average power approach described in section 5, paragraph 5.3.2(a) of the First Edition. The average power approach requires using an instrument that can measure the true average power over a period of at least 5 minutes (which DOE proposed to extend to a minimum of 10 minutes). The average power can be recorded directly from the power-measuring instrument at the end of the measurement period. For cyclic power, section 5.3.2(a) specifies that the test period shall be one or more complete cycles to get a representative average value.

In response to the September 2010 NOPR, NEEA commented that DOE should refer to the relevant sections of IEC Standard 62301 rather than try to simplify the language in section 3.11 of appendix J2, which could be potentially misleading or confusing. NEEA described a potential conflict between the language in DOE's proposed Section 3.11 of appendix J2 and that in the referenced IEC Standard 62301 test procedure: In the case of cycle finished mode, which often may involve more than just a display, cyclic power consumption may persist for a limited duration, which would require using the ''sampling approach'' for power measurement rather than the ''average power approach'' as proposed in section 3.11.2 of appendix J2. (NEEA, No. 12 at pp. 3–4) NEEA also stated that IEC Standard 62301 CDV specifications for a longer 30-minute stabilization period are superior to the shorter 10-minute period specified in the FDIS version. In addition, NEEA believes that if cyclic power changes are discovered during the stabilization period, the power measurement period should extend for at least four cycles or one hour, whichever is longer, noting that the sampling method in Section 5.3.1 of the IEC Standard 62301 FDIS calls for measurement over a minimum of four cycles in such circumstances. (NEEA, No.12 at p. 6).

In the August 2011 SNOPR, DOE proposed measuring cyclic power by allowing the product sufficient time to reach its low power state and then following the test procedure for the sampling method specified in section 5, paragraph 5.3.2 of the Second Edition. For cyclic power modes, the sampling method requires a measurement period of at least four complete cycles (for a total of at least 40 minutes), divided into two comparison periods. Stability is established by dividing the difference in average power measured in each comparison period by the time difference of the mid-point of each comparison period. This ''slope'' must satisfy the specified stability criterion. If the appropriate stability criterion is not satisfied, additional cycles are added to each comparison period until stability is achieved. Once stability has been achieved, the power is calculated as the average of all readings from both comparison periods.

As described in the August 2011 SNOPR, DOE believes that the methodology for measuring cyclic power in the Second Edition produces an improved measurement over the methodology from the First Edition.

DOE received no comments on this issue in response to the proposal in the August 2011 SNOPR. Therefore, for the reasons specified in the August 2011 SNOPR, DOE specifies the use of the sampling method in section 5, paragraph 5.3.2 of the Second Edition for all measurements of standby and off mode power, including cyclic power.

4. Use of Default Settings

In the September 2010 NOPR, DOE proposed that the clothes washer be installed according to the manufacturer's instructions, but did not propose additional provisions to require the use of default settings for testing standby energy consumption because it did not have information regarding the likelihood that consumers will alter the default display settings.

In the August 2011 SNOPR, DOE proposed incorporating by reference the installation instructions in section 5, paragraph 5.2 of the Second Edition. The Second Edition adds certain clarifications to the installation and setup procedures in section 5, paragraph 5.2 of the First Edition. The First Edition required that the product be installed in accordance with the manufacturer's instructions, except if those instructions conflict with the requirements of the standard, and that if no instructions are given, the factory or default settings must be used. The Second Edition adds provisions regarding products equipped with battery recharging circuits, as well as instructions for testing each relevant configuration option identified in the product's instructions for use. DOE is not aware of any clothes washers with a battery recharging circuit. DOE agreed with commenters that testing a clothes washer for standby mode energy use at the default setting, or as-shipped if a default setting is not indicated, would ensure consistency of results from test to test and among test laboratories.

NEEA supported DOE's proposal to disregard the portions of the installation instructions in section 5, paragraph 5.2 of IEC Standard 62301 that are not appropriate for the clothes washer test procedure; *i.e.,* those pertaining to batteries and the determination, classification, and testing of relevant modes. (NEEA, No. 26 at p. 2).

For the reasons stated in the August 2011 SNOPR, DOE adopts language in this final rule to disregard the provisions of paragraph 5.2 regarding batteries and, as described in section III.B.2, the provisions regarding the determination, classification, and testing of relevant modes. This final rule incorporates by reference, with qualification as discussed above, the installation instructions in section 5, paragraph 5.2 of the Second Edition.

5. Test Room Ambient Temperature Conditions for Standby Power Testing

DOE proposed in the September 2010 NOPR that test room ambient temperatures for standby mode and off mode testing be specified according to section 4, paragraph 4.2 of IEC Standard 62301 (First Edition). The current DOE test procedure includes a test room ambient air specification of 75 ± 5 °F, for water-heating clothes washers only. This specification is narrower than the range specified by IEC Standard 62301 of 73.4 ± 9 °F. The September 2010 NOPR proposal would require manufacturers of water-heating clothes washers to use the more stringent ambient temperature range in the current DOE test procedure if all active mode, standby mode, and off mode testing is conducted simultaneously in the same test room on multiple clothes washers. Alternatively, the temperature specifications in IEC Standard 62301 would allow a manufacturer that opts to conduct standby and off mode testing separately from active mode testing more latitude in maintaining ambient conditions. The test room ambient conditions specified in IEC Standard 62301 (Second Edition) are identical to those specified in the First Edition.

BSH and NEEA support DOE's proposals regarding test room ambient temperature range. (BSH, No. 17 at p. 3; NEEA, No. 12 at p. 6) AHAM, ALS, and Whirlpool support using 75 ± 5 °F as the test room ambient temperature. (AHAM, No. 14 at p. 7; ALS, No. 10 at p. 2; Whirlpool, No. 13 at p. 3) Whirlpool and AHAM believe that this requirement should apply to all clothes washer products, not just those that include water-heating capability, because ambient temperature significantly impacts test procedure results and should be consistent across all machines. Whirlpool and AHAM stated that this tighter tolerance will help drive consistency, repeatability and reproducibility across machines and laboratories. (Whirlpool, No. 13 at p. 3; AHAM, No. 14 at p. 7; AHAM, Public Meeting Transcript, No. 20 at p. 58) AHAM commented further that should DOE proceed with its proposal for water-heating clothes washers only, it does not support allowing the use of the less stringent IEC range (73 ± 9 °F) because the more stringent DOE range (75 ± 5 °F) falls within the IEC range. Thus, there is no added test burden when the more stringent DOE range is used for testing standby and off modes. (AHAM, No. 14 at p. 7).

Whirlpool and AHAM commented that there appears to be some inconsistency between DOE's proposal and the proposed language from section 2.11.2 in appendix J2, as to whether DOE is proposing to allow use of the more stringent or less stringent ambient temperature range. It appears to Whirlpool and AHAM, based on the proposed language in section 2.11.2, that DOE's intent is to allow use of the less stringent IEC Standard 62301, First Edition ambient air temperature conditions of 73 ± 9 °F for measurement of standby, off, delay start, and cycle finished mode testing. (Whirlpool, No. 13 at p. 3; AHAM, No. 14 at p. 6) AHAM commented that DOE should reference IEC Standard 62301 Second Edition, FDIS version rather than the First Edition. (AHAM, No. 14 at p. 6).

After considering comments from interested parties, DOE has determined that the same ambient test room temperature requirement should apply to all clothes washer products, not just those that include water-heating capability. Because the temperature of the internal clothes washer components will be the same as the ambient room air temperature at the start of a test, maintaining the same ambient test room temperature would ensure that any heat loss from water in the machine during the test would be factored into the measured energy and water use in a consistent manner across all machines, both water-heating and non-water-heating. DOE also concurs with some commenters that the more stringent temperature range of 75 ± 5 °F will produce more accurate, repeatable, and reproducible results compared to the 73 ± 9 °F range. DOE also notes that the current test procedure requires a temperature range of 75 ± 5 °F for active mode testing. Therefore, performing standby and off mode testing at 75 ± 5 °F should not result in any additional test burden for manufacturers. For these reasons, today's final rule includes a test room ambient temperature specification of 75 ± 5 °F for both water-heating and non-water heating clothes washers. The amended test procedure does not adopt the test room ambient temperature range specified in IEC Standard 62031 (Second Edition) for standby and off mode testing.

6. Power Supply and Power Measuring Instruments

In the August 2011 SNOPR, DOE proposed to incorporate by reference the power supply and power-measuring instrument specifications in section 4, paragraphs 4.3 and 4.4 of the Second Edition. Specifically, paragraph 4.3.2 requires that the value of the harmonic content[7] of the voltage supply be recorded during the test and reported. Paragraph 4.4.1 requires the crest factor and maximum current ratio (MCR) to be determined. The value of MCR determines the maximum permitted uncertainty for the power measurement. Paragraph 4.4.3 requires the instrument to be capable of measuring the average power or integrated total energy consumption over any operator-selected time interval.

As described in the August 2011 SNOPR, DOE believes that the test burden associated with the additional measurements and calculations in the Second Edition is offset by the more reasonable requirements for testing equipment, while maintaining acceptable measurement accuracy. DOE also proposed in the August 2011 SNOPR for it to be acceptable to measure the total harmonic content, crest factor, and MCR before and after the actual test measurement if the power-measuring instrument is unable to perform these measurements during the actual test measurement.

AHAM, ALS, Whirlpool, and NEEA support DOE's proposed interpretation to allow measurement of the total harmonic content, crest factor, and maximum current ratio before and after the actual test measurement if the power-measuring instrument is unable to perform these measurements during the actual test measurement. (AHAM, No. 24 at p. 2; ALS, No. 22 at p. 1; NEEA, No. 26 at p. 2; Whirlpool, No. 27 at p. 1) Whirlpool added that individual manufacturers should decide whether to measure these parameters during the test, and that measuring the power parameters during the test would require some manufacturers to purchase new test equipment. Whirlpool believes that such economic burden should not be placed on manufacturers where an appropriate alternative exists. Whirlpool also commented that these test provisions should not be applicable until the effective date of appendix J2. (Whirlpool, No. 27 at p. 1).

DOE noted in the August 2011 SNOPR that performing the continuous linear regression analysis required by the sampling method in the Second Edition may require the use of data acquisition software with the capability of performing real-time data analysis. DOE requested comment on the potential test burden for a laboratory that would be required to upgrade its data acquisition system software to enable real-time data analysis capabilities.

AHAM stated that few laboratories currently have the real-time statistical analysis capabilities that DOE believed would be required to perform the continuous linear regression analysis of the stable, non-cyclic power test. AHAM added that several laboratories will need to invest both time and money to add a real-time statistical analysis capability to their data acquisition systems. AHAM further stated that updating data acquisition systems to enable real-time statistical analysis capabilities will require a significant upgrade. Whirlpool opposes the requirement to perform real-time statistical analysis because that such a requirement could require a significant capital investment by manufacturers. In addition, Whirlpool stated that the phrase ''real-time statistical analysis'' is vague and would require clarification if it were to be implemented. ALS stated that it has already equipped its lab to measure standby power per IEC Standard 62301 (First Edition) and understands that only a minimal software update expense would be needed to comply with the Second Edition. (AHAM, No. 24 at p. 2; ALS, No. 22 at p. 1; Whirlpool, No. 27 at p. 1).

After further testing and examination of the sampling method described in the Second Edition, DOE has determined that the analyses required by the sampling method could be performed without the need for real-time data analysis software. For example, a laboratory could acquire data for a discreet period of time and determine afterward whether the data satisfied the appropriate stability criteria. If these criteria were not satisfied, the laboratory could resume testing for a longer discrete period of time, followed by analysis of the data, and so on, until the

[7] As defined in the Second Edition, harmonic content (or total harmonic content) is equivalent to total harmonic distortion (on an amplitude, not power, basis; i.e., using the square root of the squares of the RMS voltages of the harmonics in the numerator).

stability criteria are satisfied. Therefore, a manufacturer or test laboratory could conduct standby and off mode testing using the sampling method in the Second Edition without being required to upgrade its software with real-time data analysis capabilities. DOE notes, however, that having such real-time data analysis capabilities would facilitate this testing.

In today's final rule, DOE specifies the use of the power supply and power-measuring instrument specifications in section 4, paragraphs 4.3.2 and 4.4 of the Second Edition. The amended test procedure also includes notes in section 2.2.2 (supply voltage waveform) and section 2.5.3 (power meter) stating that if the power-measuring instrument used for testing is unable to measure the total harmonic content, crest factor, power factor, or maximum current ratio during the measurement period, it is acceptable to measure and record these properties immediately before and after the test measurement period.

7. Calculation of Energy Consumption in Each Mode

In the September 2010 NOPR, DOE proposed two possible approaches for measuring energy consumption in modes other than active washing mode; *i.e.,* inactive (standby) mode, off mode, delay start mode, and cycle finished mode[8] (hereafter, collectively referred to as low-power modes). For the first approach, DOE proposed allocating 295 hours per year to the active washing mode, 16 hours to self-clean mode (if applicable), 25 hours per year to delay start mode (if applicable), 15 hours per year to cycle finished mode (if applicable), and the remainder to off and/or inactive mode. Using this approach, the energy use per cycle associated with inactive, off, delay start, and cycle finished modes would be calculated by (1) calculating the product of wattage and allocated hours for all possible inactive, off, delay start and cycle finished modes; (2) summing the results; (3) dividing the sum by 1,000 to convert from Wh to kWh; and (4) dividing by the proposed 295 use cycles per year. For clothes washers with electronic controls and a mechanical on/off switch, DOE proposed to allocate half of the inactive/off mode hours each to inactive and off modes.

For the second ''alternate approach,'' for the purpose of calculating the total energy consumed in all low-power modes, DOE proposed allocating all the hours not associated with active washing mode to the inactive and off modes and then measuring power consumption for the inactive and off modes. Using this approach, separate measurements of delay start and cycle finished mode energy consumption would not be required. This approach would allocate one hour to each active mode cycle, for a total of 295 active mode hours and 8,465 inactive/off mode hours. For clothes washers with electronic controls and a mechanical on/off switch, half of the inactive/off mode hours would be allocated each to inactive and off modes. DOE proposed using the alternate approach in the August 2011 SNOPR.

ALS commented that it supports DOE's proposal to allocate one hour to each active mode cycle. ALS also supports DOE's proposal to allocate half of the inactive/off hours each to inactive and off modes, for machines with electronic controls plus a mechanical on/off switch. (ALS, No. 10 at p. 2).

The Joint Commenters and ASAP support allocating a portion of the inactive/off hours to off mode for clothes washers with a mechanical on/off switch because of the potential energy-saving benefits that allow the consumer to reduce the energy consumption of the washer when not in use. The Joint Commenters and ASAP are concerned, however, about the lack of a specification regarding where the switch must be placed on the machine in order to receive credit. For example, a manufacturer could place a switch in a hidden location such as the back of the machine, where it would obviously not be intended for consumer use. (Joint Commenters, No. 16 at p. 4; ASAP, Public Meeting Transcript, No. 20 at p. 82) The Joint Commenters encourage DOE to specify that the switch must be placed on the front panel of the machine in order for half of the inactive/off mode hours to be allocated to off mode. (Joint Commenters, No. 16 at p. 4).

NEEA supports DOE's proposed alternate approach, with the caveat that delay start and cycle finished modes should be measured and included as part of the active wash mode. NEEA does not support DOE's proposal for using a one-hour average cycle time to determine annual active wash mode hours. NEEA stated that DOE's estimate, which was based on the behavior of a very limited sample of clothes washers, characterizes the behavior and energy use of the ''average'' clothes washer available in the market today, rather than measuring the actual performance of individual models. NEEA stated that the active washing mode hours should be based on the test results of the individual clothes washer model being tested. NEEA further commented that the energy use calculation could be greatly simplified if the calculation simply involved ''active mode'' and ''inactive mode hours,'' as measured for each model tested. Furthermore, NEEA does not support DOE's proposal to create a new class of modes called ''low-power modes,'' and stated that delay start and cycle finished modes should only be considered part of active mode and/or active washing mode. (NEEA, No. 12 at pp. 6–7; NEEA, No. 26 at pp. 2, 4, 6).

Whirlpool commented that it does not support DOE's proposal to split the non-active mode hours in half between inactive and off modes for washers with a mechanical or hard on/off switch. Whirlpool stated that such a device would add little benefit compared to its additional cost. Further, consumers are unlikely to utilize such a device unless it automatically defaults to the ''off'' mode at the end of each cycle (requiring the consumer to turn it to ''on'' for each new cycle initiated). According to Whirlpool, such an approach would be an annoyance to consumers and would cause consumers to postpone replacement purchases, thereby negating or delaying the resultant energy savings. Whirlpool stated that for any washer with a mechanical on/off switch, all of the non-active hours should be allocated to inactive mode. (Whirlpool, No. 13 at p. 4).

AHAM commented that it does not oppose using the estimate of one hour per cycle because it would be too burdensome and complicated to determine a more refined number, and there would be little corresponding benefit in accuracy. (AHAM, No. 14 at p. 7) AHAM also commented that it does not oppose DOE's proposal to allocate half of the inactive/off hours each to inactive and off modes for clothes washers with electronic controls plus a mechanical on/off switch. AHAM proposed that DOE add a requirement that the on/off switch must be accessible by the consumer, because a switch that is hidden such that the consumer might never find or use it should not be given this ''credit.'' AHAM further commented that this does not mean that DOE should specify product design by dictating where the switch should be placed on the machine. Furthermore, AHAM stated that there may be situations that warrant allocating all of the inactive/off hours to off mode; for example, there are machines that electronically turn off certain modes at the end of the active wash cycle and require the consumer to manually turn that mode back on to use it. (AHAM, No. 14 at p. 8).

[8] Self-clean mode, delay start mode, and cycle finished mode are considered part of the active mode.

DOE based its proposal to adopt an estimate of one hour per active mode wash cycle on the test data available. DOE concurs with AHAM's comment that performing additional testing to determine a more refined number would be too burdensome and complicated, with little corresponding benefit in overall accuracy. Basing the active washing mode hours on test results of the individual clothes washer model being tested would not be feasible because the energy test cycle includes numerous different wash cycles, each with a different cycle time. Calculating the average cycle time across all cycles for an individual washer would increase test burden with little or no corresponding increase in the accuracy of the results. Therefore, today's final rule allocates one hour to each active mode cycle, with 8,465 hours allocated to all other non-active mode cycles.

As described previously in section III.B.2, DOE adopts the ''alternate approach,'' in today's final rule, in which all low-power modes are allocated to the inactive and off modes, depending on which of these modes is present. The aggregate power of the low-power modes is represented by a single energy metric called ''combined low-power mode.'' DOE's analysis indicates that the assumption that the power in each low-power mode is similar, which DOE set forth in the September 2010 NOPR, remains valid, and that measuring the power of each mode separately would introduce significant test burden without a corresponding improvement in a representative measure of annual energy use.

Regarding the allocation of hours between inactive mode and off mode, the proposed definition of off mode as applied to residential clothes washers will primarily apply to units with mechanical controls. The proposed definition of inactive mode will primarily apply to units with electronic controls, in which reactivation of the clothes washer occurs through a pushbutton sensor, touch sensor, or other similar device that consumes power. DOE is not aware of any clothes washers on the market with electronic controls and an additional mechanical on/off switch. However, DOE believes that the test procedure should accommodate this option because of the potential energy-saving benefits provided by a mechanical on/off switch. DOE further notes that for units with all hours allocated to either inactive or off mode, the power measurement procedure and calculation of low-power mode energy consumption are identical. For these reasons, DOE adopts the proposal in the August 2011 SNOPR, which allocates 8,465 hours to off mode if no inactive mode is possible, 8,465 hours to inactive mode if no off mode is possible, and 4,232.5 hours to both inactive mode and off mode if both modes are possible.

DOE believes that manufacturers would be unlikely to install a mechanical on/off switch in an inaccessible location, because such a device would add little consumer benefit compared to its additional cost to the manufacturer. Therefore, today's final rule does address the location for an on/off switch.

8. Integrated Modified Energy Factor (IMEF)

The DOE test procedure for clothes washers currently provides a calculation for modified energy factor (MEF), which equals the clothes container capacity in cubic feet divided by the sum, expressed in kWh, of (1) the total weighted per-cycle hot water energy consumption, (2) the total weighted per-cycle machine electrical energy consumption, and (3) the per-cycle energy consumption for removing the remaining moisture from a test load. (See section 4.4 of appendix J1). The current Federal energy conservation standards for clothes washers are expressed in MEF. (10 CFR 430.32(g)(3))

As described previously in section I.C, EISA 2007 amended EPCA to require DOE to amend its test procedures for all covered products to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor unless the current test procedure already incorporates standby and off mode energy consumption, or such integration is technically infeasible.

In the September 2010 NOPR, DOE proposed to establish an ''integrated modified energy factor'' (IMEF) for residential clothes washers. DOE proposed to calculate IMEF as the clothes container capacity in cubic feet divided by the sum, expressed in kWh, of:

- The total weighted per-cycle hot water energy consumption;
- The total weighted per-cycle machine electrical energy consumption;
- The per-cycle energy consumption for removing moisture from a test load;
- The per-cycle standby, off, delay start, and cycle finished mode energy consumption; and
- The per-cycle self-clean mode energy consumption, as applicable.

In the August 2011 SNOPR, DOE proposed not to allocate the hours for delay start and cycle finished modes to the inactive and off modes, and not require separate measurements for delay start and cycle finished mode energy consumption. Therefore, DOE modified the proposed IMEF calculation by incorporating per-cycle combined low-power mode energy consumption instead of separate measurements of per-cycle standby, off, delay start and cycle finished mode energy consumption.

NEEA and the California Utilities support the IMEF calculation proposed in the September 2010 NOPR. (NEEA, No. 12 at p. 8; California Utilities, No. 18 at p. 2) The California Utilities further commented that although the low-power modes represent a relatively small portion of annual energy and water use, they should be measured in the test procedure because these loads will become an increasingly significant portion of overall energy use as clothes washers and other appliances make efficiency gains in their primary active mode. (California Utilities, No. 18 at p. 2).

ALS opposes the IMEF calculation proposed in the September 2010 NOPR, which separates out per-cycle standby, off, delay start, and cycle finished mode energy consumption. ALS noted that there is little public benefit to including these modes, and that DOE has no reliable consumer use data on which to base the calculations. ALS stated there is no need for a new IMEF metric. (ALS, No. 10 at p. 2).

AHAM also objected to the new IMEF measure of energy consumption due to the significant time, resource, and cost impacts associated with it. AHAM also stated that the added test burden provides no corresponding public benefit. (AHAM, No. 14 at p. 8).

NRDC questioned DOE's decision to retain a metric based on a per-cycle measure rather than an annual metric, such as for dishwashers. (NRDC, Public Meeting Transcript, No. 20 at pp. 91–92).

DOE determined in the September 2010 NOPR that it is technically feasible to integrate standby mode and off mode energy consumption into the overall energy consumption metric for clothes washers, which for the current energy conservation standards is based on the per-cycle MEF.

The current test procedure does not provide an additional energy descriptor for annual energy consumption. Any new descriptor for annual energy consumption would be based on the same per-cycle energy use measurements from which MEF or IMEF is calculated, multiplied by the number of annual use cycles; therefore, an annual energy use metric incorporating standby and off mode energy use would not be inherently more accurate or representative than MEF or IMEF. The analogous change from a per-cycle metric to annual energy use for the energy conservation standards for dishwashers was required by Congress in the provisions of EISA 2007.

As described in section III.B.2.d, this final rule does not adopt a definition for a self-clean cycle and is not adding any provisions to the test procedure for measuring the energy and water consumption of a self-clean cycle. Today's final rule also implements the alternate approach for measuring energy consumption in low-power modes. Therefore, today's final rule calculates IMEF as the clothes container capacity in cubic feet divided by the sum, expressed in kWh, of:

- The total weighted per-cycle hot water energy consumption;
- The total weighted per-cycle machine electrical energy consumption;
- The per-cycle energy consumption for removing moisture from a test load; and
- The per-cycle combined low-power mode energy consumption.

C. Active Mode Test Procedure Provisions

1. Integrated Water Consumption Factor (IWF)

The existing calculation of water factor (WF) in the appendix J1 test procedure accounts only for the water consumed during the cold wash/cold rinse cycle. Hot water consumption is measured for all wash cycles, including warm, hot, and extra-hot washes, but it is used only to determine the energy needed to heat the water. If the cold wash water consumption is set disproportionately low, while more water is used at higher temperatures, the WF metric may not accurately reflect the average water consumption of the machine.

In the September 2010 NOPR, DOE proposed a new water consumption metric, integrated water consumption factor (IWF). This proposed metric would account for both the hot and cold water consumption of each test cycle, including any steam or self-clean cycles. As proposed, IWF would equal the sum of the total weighted per-cycle water consumption for all wash cycles and the per-cycle self-clean water consumption, divided by the clothes container volume. As proposed, the total weighted per-cycle water consumption for all wash cycles would be calculated as the TUF-weighted sum of the total per-cycle water consumption for each test cycle.

In the August 2011 SNOPR, DOE proposed a correction to the calculation for per-cycle self-clean water consumption. The proposed calculations in the newly-proposed sections 4.1.8 (per-cycle self-clean hot water energy consumption) and 4.2.14 (total per-cycle self-clean water consumption) did not contain the numeric multipliers required to apportion the total annual self-clean water consumption over the 295 representative average number of clothes washer cycles in a year. The August 2011 SNOPR proposal adjusted the calculations in section 4.1.8 and 4.2.14 by including a multiplier of 12/295, where 12 represents the average number of clothes washer self-clean cycles in a year, and 295 represents the average number of clothes washer cycles in a year.

ALS, the Joint Commenters, and NEEA expressed support for the proposal to measure water consumption for all active mode energy test cycles as part of the IWF metric. NEEA also supported DOE's proposed use of TUFs and load usage factors to derive the active mode water consumption. (ALS, No. 10 at p. 4; Joint Commenters, No. 16 at p. 8; Joint Commenters, No. 23 at p. 5; NEEA, No. 12 at p. 13) AHAM, the California Utilities, and Whirlpool specifically stated support for the inclusion in an IWF metric of hot and cold water measurements from all cycles tested. AHAM and the Joint Commenters noted that those values are already measured as part of the test procedure, and thus would not add to test burden. NEEA similarly commented that the proposed methodology for IWF would not add significant new test burden on manufacturers. Whirlpool stated that the proposal to include all water usage would prevent manufacturers from varying the amount of rinse water used at different temperatures, and that this would justify any additional test burden. (AHAM, No. 14 at p. 15; California Utilities, No. 18 at p. 5; Joint Commenters, No. 16 at p. 8; NEEA, No. 12 at p. 13; Whirlpool, No. 13 at p. 13) BSH stated that if the standards are adjusted appropriately, cold water consumption from all tests can be used in calculations. (BSH, No. 17 at p. 4) NRDC agreed with the IWF in concept. (NRDC, Public Meeting Transcript, No. 20 at pp. 182–183) The California Utilities and NEEA support the inclusion of water use from self-clean cycles in the IWF measurement. (California Utilities, No. 18 at p. 5; NEEA, No. 12 at p. 13) The Joint Commenters stated that DOE's proposal would provide a more representative depiction of water consumption. (Joint Commenters, No. 16 at p. 8).

AHAM, ALS, and Whirlpool do not support including the water use in self-clean cycles in the IWF metric. AHAM agrees, however, with the proposed correction to adjust the calculation using a multiplier of 12/295, if DOE determines that self-clean cycles should be included in the energy and water calculations. ALS also opposes the inclusion of water use in steam cycles in IWF. ALS stated that until DOE has a reliable understanding of the consumer usage and water consumed in self-clean and steam cycles, it should not include these in the test procedure. (AHAM, No. 14 at p. 15; AHAM, No. 24 at p. 5; ALS, No. 10 at pp. 4–5; Whirlpool, No. 13 at p. 13) According to BSH, inclusion of self-clean and steam cycles in the test procedure would lead to minimal improvement in IWF but would increase the test burden. (BSH, No. 17 at p. 3).

As described in sections III.B.2.d, III.C.2.a and III.C.2.b, DOE did not adopt provisions for measuring the water and energy consumption of self-clean cycles or steam cycles. In today's final rule, DOE includes an integrated water factor (IWF) metric that is based on the total weighted per-cycle water consumption of both hot and cold water for all wash cycles comprising the energy test cycle. Because these values are already measured as part of the test procedure, and no new test equipment would be required to measure these values, manufacturer test burden would not increase. DOE believes that an IWF defined in this way provides a more representative measure of total water consumption for a clothes washer.

2. Technologies Not Covered by the Current Test Procedure

Steam Wash Cycles

DOE is aware of multiple clothes washer models currently available on the market offering steam functions via pre-set cycles, or as an optional addition to conventional wash cycles. During these cycles, steam is injected into the basket, which manufacturers claim provides enhanced cleaning and/or sterilization. The steam is produced in a generator that requires a significant amount of energy to heat and vaporize the water. The current clothes washer test procedure does not account for energy or water consumption during this type of wash cycle.

In the September 2010 NOPR, DOE proposed amending the test procedure to include additional measurement of energy and water consumption during a steam wash cycle for clothes washers offering this feature. In the proposed amendments, an additional set of steam cycle tests would be required for clothes washers that offer such a feature. The test sections required for clothes washers without a steam wash cycle would remain unchanged.

DOE also proposed in the September 2010 NOPR to include the energy and water consumption from steam wash cycles in the final calculations for the energy and water use metrics. For clothes washers capable of steam wash cycles, the measurements of energy and water consumption from the steam wash cycle with the hottest wash temperature would be included in the overall energy and water use calculations, based on the TUF for steam wash. Table 4.1.1 (Temperature Use Factors) of appendix J1 specifies the current weighting factor applied to the consumption measurements for the different wash cycles. DOE proposed to update Table 4.1.1 to include 0.02 as the TUF of a steam wash cycle, when available. DOE assumed these cycles would decrease the use of extra-hot cycles, but would leave the use of hot, warm, and cold cycles unchanged. DOE believed that the steam wash cycles would be selected somewhat fewer times than the extra hot cycle because on some models steam is available as an option only on certain settings. DOE therefore estimated that the 0.02 TUF associated with steam washes would correspond to a 0.02 decrease in the TUFs associated with extra-hot cycles, for a steam-capable clothes washer.

The California Utilities, the Joint Commenters, and NEEA expressed qualified support for DOE's proposal to include the energy and water use of steam wash cycles in the test procedure, and raised concerns about the definition of ''steam wash cycle.'' The California Utilities and NEEA commented that DOE may need to refine the definition of steam wash cycle for clarity and consistency. The Joint Commenters stated that the definition of ''steam wash cycle'' should include not only the injection of ''steam'' (vaporized water) but also any superheated water injected in the form of mist or fine droplets. The Joint Commenters also stated that all energy and water use resulting from steam wash cycles should be accounted for, including any injections made after the conclusion of the final spin cycle. (California Utilities, No 18 at p. 3; Joint Commenters, No. 16 at p. 3; Joint Commenters, No. 23 at pp. 4–5; NEEA, No. 12 at p. 9; NEEA, No. 26 at pp. 7–8) NEEA suggested that DOE gather data on steam cycles to more clearly define what constitutes a steam cycle. (NEEA, No. 12 at p. 9; NEEA, No. 26 at p. 8).

AHAM, ALS, BSH, and Whirlpool oppose adding measures of the energy and water consumption of steam wash cycles to the clothes washer test procedure without sufficient data on consumer usage patterns of such cycles. (AHAM, No. 14 at p. 9; ALS, No. 10 at p. 3; BSH, No. 17 at p. 3; Whirlpool, No. 13 at p. 5) ALS, BSH, and Whirlpool also oppose the inclusion of steam wash cycles due to the added manufacturer test burden, particularly because the energy use in these cycles represents such a small amount of the total annual energy. Whirlpool commented that the test burden would increase by about 10 percent. (ALS, No. 10 at p. 3; BSH, No. 17 at p. 3; Whirlpool, No. 13 at p. 5) AHAM and Whirlpool also noted that DOE does not have data on the percentage of clothes washers on the market with a steam feature. Whirlpool estimates that this percentage is likely in the single digits. (AHAM, No. 14 at p. 9; Whirlpool, No. 13 at p. 5; Whirlpool, Public Meeting Transcript, No. 20 at pp. 102–103) BSH further opposes the inclusion of steam wash cycles in the energy and water test methods because the longevity of these features in the market has yet to be proven. (BSH, No. 17 at p. 3).

GE and LG also commented that DOE needs to clarify the definition of steam wash cycle. GE suggested modifying the definition of steam cycle as: ''Steam cycle means a wash cycle in which water is heated to the point of boiling to produce steam and in which that steam is injected into the clothes container.'' (GE, Public Meeting Transcript, No. 20 at p. 104; GE, No. 35 at p. 2; LG, Public Meeting Transcript, No. 20 at p. 103).

AHAM questioned whether a definition of steam wash cycle would include a required temperature to which water must be heated for steam to be generated in the cycle, a representative duration of time for which steam must be injected into the drum, and a definition of the term ''injected''. AHAM stated that it would be difficult to define ''steam wash cycle'' in a clear, repeatable, reproducible, and uniformly applicable way. According to AHAM, without a better definition of steam wash cycle, there will be confusion among manufacturers, which will lead to confusion in the market as consumers attempt to compare products. (AHAM, No. 14 at pp. 9–10) Springboard Engineering (Springboard) requested clarification as to whether steam would be tested at the hottest temperature available in the ''normal'' cycle, or whether it would be tested at the hottest temperature available on any cycle, such as a sanitize cycle. Springboard also noted that some clothes washers have cycles with wash temperatures greater than 135°F and steam, and stated that it is not clear how these cycles should be tested. (Springboard, No. 11 at pp. 2–3).

DOE also received comments in response to the proposed TUF for steam wash cycles. AHAM, ALS, NEEA, and Whirlpool do not support DOE's proposed steam wash cycle TUF. AHAM stated that because it does not support the inclusion of steam wash cycles in the DOE test procedure, it also opposes the revision of the TUFs to account for steam wash cycles. AHAM also questioned the assumption that the steam wash cycle TUF affects only the extra-hot TUF. (AHAM, No. 14 at p. 12) Similarly, NEEA questioned the basis on which DOE assumed that a steam wash cycle would mostly or always be associated with a hot wash cycle. According to NEEA, some consumers use a hot or extra-hot wash to kill dust mites and other allergens, not just for heavily soiled loads, and it is not clear whether such users would select a cooler wash cycle with a steam feature to accomplish the same thing. ALS, NEEA and Whirlpool objected to DOE's assignment of a TUF for steam wash cycles without supporting data. (ALS, No. 10 at p. 4; NEEA, No. 12 at p. 9; NEEA, No. 26 at p. 8; Whirlpool, No. 13 at pp. 5, 8) Whirlpool also stated that the usage of steam wash cycles is quite limited, since they are specialized cycles designed for removal of difficult stains. (Whirlpool, No. 13 at pp. 5, 8) Springboard questioned whether there are machines on the market that have a steam wash cycle but do not have a hot wash cycle. (Springboard, No. 11 at p. 3).

DOE notes that the implementation of ''steam cycles'' may vary among manufacturers, and that the proposed definition may lead to inconsistent interpretations of whether a certain feature constitutes a ''steam cycle'' to be included in the energy test cycle. In addition, consumer usage of steam features is likely to be low. For these reasons, DOE does not adopt provisions to measure the energy and water use in steam wash cycles, and therefore is not amending the TUFs in the clothes washer test procedure to include a TUF for steam wash cycles that would occur in place of certain extra-hot wash cycles.

Self-Clean Cycles

DOE is aware that some residential clothes washers currently on the market offer a self-clean cycle. These cycles are used periodically with bleach and/or detergent—but no clothes load—to clean, deodorize, or sanitize the components that come into contact with water by preventing or eliminating the formation of mold, bacteria, and mildew. Self-clean cycles may require higher water temperatures and greater volumes of water than a normal cycle, and therefore could potentially consume a substantial amount of energy. The current test procedure does not account for energy or water consumption attributable to self-clean cycles.

As described previously in section III.B.2.d, DOE proposed in the September 2010 NOPR to define a ''self-clean mode'' as a clothes washer operating mode that:

- Is dedicated to cleaning, deodorizing, or sanitizing the clothes washer by eliminating sources of odor, bacteria, mold, and mildew;
- Is recommended to be run intermittently by the manufacturer; and
- Is separate from clothes washing cycles.

As described in the September 2010 NOPR, DOE observed that manufacturers typically recommended running a self-clean cycle once a month. Some manufacturers also recommend a self-clean cycle after a defined number of clothes washing cycles. Because these self-clean cycles are not accounted for in the proposed 295 wash cycles per year, DOE proposed to integrate the energy and water consumption of self-clean cycles into the overall energy efficiency metrics, under the assumption that these cycles are typically run once per month.

DOE received comments in response to the proposal to account for energy and water consumption of self-clean cycles in the overall calculations for IMEF and IWF, which are discussed in III.B.2.d, III.B.8, and III.C.1. For the reasons presented in those sections, DOE is not adopting provisions in today's final rule to include measures of self-clean energy and water use in the clothes washer test procedure.

Adaptive Control Technologies

Adaptive control technologies can adjust parameters such as agitation intensity, number of rinses, wash time, and wash and rinse temperatures based on the size, fabric mix, and soil level of a wash load. The current test procedure accounts for adaptive fill technologies, but no other types of adaptive controls.

DOE is aware that other consumer products employ adaptive controls, and that these are addressed in their respective test procedures. For example, many dishwashers incorporate adaptive controls by means of a turbidity sensor which adjusts the number and duration of wash and rinse cycles. The dishwasher test procedure accounts for these models through the use of soiled dishware loads. (10 CFR part 430, subpart B, appendix C).

In the September 2010 NOPR, DOE noted that it was not aware of any clothes washers available on the market that incorporate adaptive controls using a turbidity sensor. If clothes washers become available that offer adaptive controls using a turbidity sensor, DOE could consider amending the clothes washer test procedure to measure energy and water consumption with a soiled wash load. However, because it was not aware of any clothes washers incorporating this technology, DOE did not propose to address adaptive controls other than adaptive fill control in the test procedure.

AHAM, BSH, NEEA, and Whirlpool supported DOE's proposal that no adaptive control provisions other than the existing adaptive fill control methodology be adopted in the clothes washer test procedure at this time. (AHAM, No. 14 at p. 11; BSH, No. 17 at p. 4; NEEA, No. 12 at p. 9; NEEA, No. 26 at pp. 8–9; Whirlpool, No. 13 at p. 6) According to BSH and Whirlpool, there are currently no clothes washers on the market with soil-sensing technology. (BSH, No. 17 at p. 4; Whirlpool, No. 13 at p. 6) Whirlpool stated that if a soil-sensing clothes washer were to exist, it would require some form of sensor, which in turn would require a soiled test load to activate the sensor and properly record the energy used (analogous to the test procedure for soil-sensing dishwashers). According to Whirlpool, DOE would need to develop a uniform, consistent, repeatable, and reproducible soil load, which could take 3 or more years. (Whirlpool, No. 13 at p. 6) NEEA agreed that turbidity sensors for soil-sensing are unlikely to be found in clothes washers, but the increasing complexity of control capabilities should not be ignored. NEEA urged DOE to gather enough statistically valid data to inform a decision on whether to adopt provisions for measuring adaptive control technologies. NEEA further commented that, in the absence of information on clothes washer models with adaptive control technologies other than adaptive fill control, DOE should state how the presence of such technologies might affect the test procedure results. (NEEA, No. 12 at pp. 9–10; NEEA, No. 26 at pp. 8–9).

DOE observes that manufacturers representing approximately 65 percent of the U.S. clothes washer market stated that they are unaware of soil-sensing clothes washers currently available, supporting DOE's preliminary conclusion. For this reason, DOE is unable to evaluate any technical approaches towards adaptive control outside of adaptive fill control, nor can it develop appropriate methodology for evaluating the energy use of such features. Therefore, DOE is not adopting new provisions addressing adaptive control technologies in today's final rule.

Demand Response Technologies

Demand response technology enables an appliance to shift its activity based on interaction with the electric grid, utilities, or user programming. Appliances that can communicate with the electric grid or any other network would be considered to have a network mode as defined by IEC Standard 62301 Second Edition. As described previously in section III.B.2.g, the Second Edition defines network mode as a mode category that includes ''any product modes where the energy using product is connected to a mains power source and at least one network function is activated (such as reactivation via network command or network integrity communication) but where the primary function is not active.'' IEC Standard 62301 Second Edition also provides a note stating, ''[w]here a network function is provided but is not active and/or not connected to a network, then this mode is not applicable. A network function could become active intermittently according to a fixed schedule or in response to a network requirement. A 'network' in this context includes communication between two or more separate independently powered devices or products. A network does not include one or more controls which are dedicated to a single product. Network mode may include one or more standby functions.''

As discussed in section III.B.2.g, DOE did not propose in the September 2010 NOPR to amend the clothes washer test procedure to include any provisions for measuring energy consumption in network mode, because it was unaware of any clothes washers currently available on the market that incorporate a networking function. Additionally, DOE was unaware of any data regarding network mode in clothes washers that would enable it to determine appropriate testing procedures and mode definitions for incorporation into the test procedure.

AHAM commented that there is currently insufficient data regarding demand response features in clothes washers, but that when these features become available, DOE should address them in the test procedure. AHAM noted that it is currently working with energy and water efficiency advocates to develop a definition of ''smart appliances,'' including a definition of ''smart'' clothes washers. (AHAM, No. 14 at p. 11; AHAM, Public Meeting Transcript, No. 20 at p. 109) NEEA doubted whether any significant fraction of laundry activities take place at peak hours, and thus it is skeptical whether households would shift their laundry schedules in response to time-of-use rates or a signal from a ''smart grid'' system. Even so, NEEA supported including provisions for network mode in the clothes washer test procedure for use when machines with such capabilities appear on the market. (NEEA, No. 12 at p. 10).

For the reasons stated in the September 2010 NOPR, this final rule does not incorporate provisions for clothes washers with demand response technologies. However, DOE is generally supportive of efforts to develop smart-grid and other network-enabled technologies in clothes washers. Provisions for testing power consumption in network mode could be incorporated into the test procedure through future amendments, once the appropriate data and testing methodologies become available.

3. Consumer Usage Patterns

In the September 2010 NOPR and August 2011 SNOPR, DOE proposed updating some of the consumer usage patterns contained in the test procedure. General comments on the proposals are discussed immediately below, and comments related to the specific consumer usage patterns for which DOE proposed changes are discussed in the sections that follow.

AHAM commented generally that DOE should gather or develop information on contemporary laundry practices in the United States for incorporation into the test procedure, including temperature settings, average cycles per year, special-purpose machine cycles (such as steam and self-clean), the size of a minimum laundry load, the size of an average load, and the frequency distribution of various laundry loads. (AHAM, No. 2 at p. 23; AHAM, No. 14 at pp. 1–2). EarthJustice and NRDC support this recommendation. (EarthJustice, No. 3 at p. 1; NRDC, No. 8 at p. 1) Whirlpool stated that a test procedure proposal would not be valid, meaningful, or representative of consumer practices without data to validate the underlying assumptions. Whirlpool requests that DOE accept input from manufacturers and/or initiate primary research efforts of its own to obtain updated consumer usage data, as necessary. (Whirlpool, No. 13 at p. 1).

NEEA commented that, because the revised test procedure will not be required for use before the effective date of any revised efficiency standards, DOE should take the time now to acquire enough statistically valid data to properly specify the usage patterns and calculations within the test procedure. (NEEA, No. 12 at pp. 1, 10, 16) NEEA added that DOE should consider more systematic efforts to gather field data in advance of the start of future rulemakings where test procedure changes are expected. (NEEA, No. 31 at p. 3) NEEA commented that it is currently gathering field data on the laundry habits from households participating in the Residential Building Stock Assessment, expected to be complete by mid-2013. By June 2012, field data on clothes washer and dryer energy use, the nature and size of laundry loads, washer and dryer cycle choices, and number of cycles per year will become available. (NEEA, No. 31 at p. 2).

NEEA also stated that it believes DOE is moving toward a test procedure that delivers performance results for an ''average'' product, rather than the specific clothes washer models being tested. NEEA believes that this approach would undermine the basic intent of the test procedure and the standards, which it believes should reasonably reflect energy and water use for each model. (NEEA, No. 12 at pp. 1–2).

DOE is aware of ongoing and future planned field studies by DOE and other parties, which are expected to provide relevant data regarding current consumer usage patterns. DOE will consider any relevant data resulting from these studies in future test procedure rulemakings.

Number of Annual Wash Cycles

In the January 2001 standards Final Rule, DOE estimated the representative number of annual wash cycles per clothes washer as 392. This number is not used in the calculations for the current energy efficiency metric, because MEF is calculated on a per-cycle basis. To include energy consumption from modes other than active washing mode in the energy efficiency metric requires an estimate of the time a typical clothes washer spends in active washing and all other non-active washing modes. The number of annual wash cycles is used to determine the time spent in the active washing mode, and also determines the remaining time to be allocated to the other possible modes.

In the September 2010 NOPR, DOE proposed 295 as the representative number of wash cycles per year, based on the 2005 Residential Energy Consumption Survey (RECS) data. DOE determined preliminarily that this was a more representative value than the results of the California Residential Appliance Saturation Survey (California RASS), which indicated 283 annual cycles, because the RECS survey was nationwide rather than limited to a single state. DOE also made a preliminary determination that the 2005 RECS value was more representative of average use than the value based on a Procter & Gamble (P&G) study, which indicated 308 annual cycles, due to the household size distributions of the data sets. Overall, however, the relatively small variation among the three estimates of annual clothes washer cycles supported DOE's conclusion that 295 cycles per year was a reasonable value to include in its clothes washer test procedure.

DOE received multiple comments in response to the proposed value of 295 annual cycles. ALS, the Joint Commenters, and Whirlpool support the proposed number of annual cycles. (ALS, No. 10 at p. 2; Joint Commenters, No. 16 at pp. 4–5; Whirlpool, No. 13 at p. 7) BSH also agrees with a value of 295 annual cycles, with the caveat that, if DOE decides to include measurement of self-clean energy and water use in the test procedure, the number of annual cycles will need to be adjusted upwards by the number of self-clean cycles per year suggested by the manufacturer in the product's user manual. (BSH, No. 17 at p. 4) ALS and AHAM questioned the validity of the 2005 RECS data, and requested that DOE work with P&G to secure more recent data. AHAM stated that P&G would be updating the clothes washer use study based on 2010 data. However, AHAM supports the proposed 295 annual cycles because it is likely that the number of cycles has decreased since the P&G data from 2005. (AHAM, No. 14 at pp. 11–12; ALS, No. 10 at pp. 2–3) However, NEEA and the National Institute of Standards and Testing (NIST) noted that the RECS and P&G data both dated from about 2005. (NEEA, Public Meeting Transcript, No. 20 at p. 112; NIST, Public Meeting Transcript, No. 20 at p. 112). Whirlpool stated that 295 cycles per year is consistent with the reduction in average household size. (Whirlpool, No. 13 at p. 7) The Joint Commenters stated that they had conducted their own analysis using the 2005 RECS data, which also resulted in an estimate of 295 annual clothes washer cycles. The Joint Commenters believe that the 2005 RECS data provide a reasonably accurate value in the absence of better data, and that the 2005 RECS data, derived from a national survey, are more representative than the California RASS data that captured usage from one state. (Joint Commenters, No. 16 at pp. 4–5).

NEEA objected to DOE's proposal for 295 annual clothes washer use cycles because NEEA believes that the 2005 RECS survey methods are flawed. According to NEEA, the relatively large bin sizes provided in the survey for the number of laundry loads per week introduces too much uncertainty regarding the average weekly number within each bin. NEEA further stated that it would not automatically discount California RASS data on the basis that the survey represents only one state. NEEA added, however, that it is not familiar enough with the California RASS data, and can not comment on the suitability of using the data to determine average annual use cycles. NEEA commented that it supports using P&G data due to P&G's longtime work in this area and the scope and detail in its survey. NEEA's interpretation of the P&G data results in an estimate of 308 annual clothes washer use cycles, which according to NEEA is similar to the approximately 310 annual cycles derived from recent data collected by the California Public Utilities Commission (CPUC). NEEA noted that while the average household size in the P&G sample is larger than those indicated by the U.S. Census and the American Housing Survey in 2007, it would be logical for households with clothes washers to be larger than average. NEEA also recommended that DOE acquire field data itself to determine annual clothes washer use cycles. (NEEA, No. 12 at pp. 10–11; NEEA, Public Meeting Transcript, No. 20 at pp. 113–114; NEEA, No. 26 at pp. 9–10).

In considering these comments, DOE notes that an independent analysis of the 2005 RECS data by the Joint Commenters resulted in essentially an identical estimate of the number of annual clothes washer cycles as DOE proposed in the September 2010 NOPR. This suggests that DOE's calculation of average annual cycles based on the weekly usage data did not introduce any systematic error in the final value of annual clothes washer cycles. DOE has also reviewed the clothes washer data recently collected in Southern California as part of SDG&E's ''High Efficiency Clothes Washer Voucher Incentive Program'' and PG&E's ''Mass Markets Residential Program.''[9] Both programs used a combination of telephone surveys and onsite metering to determine the impact of high efficiency clothes washers on energy and water consumption. As part of the telephone surveys, program participants were asked to self-report the number of weekly wash loads. The results for these surveys, from Table 30 in the CPUC report, are shown in Table III.1 below.

TABLE III.1—SELF-REPORTED WASH LOADS FROM 2009 SOUTHERN CALIFORNIA TELEPHONE SURVEYS

Utility	Number of participants	Average number wash loads/week
PG&E	422	5.84
SDG&E	301	5.80
Total	723	5.82

Multiplying the average self-reported number of wash loads per week by 52 weeks per year would result in 303 annual clothes washer use cycles. This value can be compared to the results of the onsite metering studies conducted under the PG&E and SDG&E programs during the spring and early summer of 2009. These programs also recorded the actual number of wash loads per week, based on energy and water meter data, at 115 residential sites chosen to include both participants and non-participants in the utility incentive programs. The results from Table 20 in the CPUC report, disaggregated by participant status as well as clothes washer efficiency, are presented in Table III.2.

TABLE III.2—MEASURED WASH LOADS FROM 2009 SOUTHERN CALIFORNIA METERING STUDIES

Category	Efficiency	Number. of sites	Number wash loads/week
Non-Participants	Non-ENERGY STAR	24	4.77
	ENERGY STAR	17	6.23
	Sub-Total	41	5.38
Participants	ENERGY STAR	74	4.80
Weighted Average for all Sites			5.01

On average, subjects in the metering studies performed (5.01 loads per week) × (52 weeks per year) = 261 annual clothes washer loads, which is lower than the self-reported annual use cycles. Although in general, metering data has a higher confidence level than survey results, DOE also notes that the sample size of the onsite study was relatively small, and there was significant variation within that sample. For example, the annual use cycles for non-participants was found to range from 248 for consumers with non-ENERGY STAR clothes washers to 324 for consumers with ENERGY–STAR clothes washers. Further, the data were also collected in a limited geographical region and over only a portion of the year, and may not be fully representative of national clothes washer usage over a complete year.

For these reasons, DOE has determined that the 2005 RECS report is the most representative source of information on annual clothes washer cycles, and is adopting a value of 295 annual cycles in today's final rule.

ASAP questioned whether the proposed value of 295 annual clothes washer cycles corresponds to the number of clothes dryer cycles proposed in the amended DOE clothes dryer test procedure, accounting for the dryer usage factor. (ASAP, Public Meeting Transcript, No. 20 at p. 115) DOE adopted an amended clothes dryer test procedure in a final rule published in the **Federal Register** on January 6, 2011. (76 FR 972) In the amended test procedure, DOE revised the number of clothes dryer annual use cycles from the 416 cycles per year, previously specified by the clothes dryer test procedure, to 283 cycles. (10 CFR 430.23(d)) DOE based this revision on analysis of data from the 2005 RECS for the number of clothes washer cycles and the frequency of clothes dryer use. According to DOE's analysis of 2005 RECS data, for households with both a clothes washer and clothes dryer, the percentage of

[9] The results of these and other 2006–2008 residential energy efficiency programs run by the Investor-Owned Utilities in California are summarized in a report to the CPUC: ''Residential Retrofit High Impact Measure Evaluation Report'', The Cadmus Group, Inc., Itron, Jai J. Mitchell Analytics, KEMA, PA Consulting Group, and Summit Blue Consulting, LLC, February 8, 2010.

clothes washer loads dried in a clothes dryer is 96 percent. Therefore, adopting 295 annual clothes washer use cycles in today's final rule is consistent with the amended clothes dryer test procedure.

DOE also notes that the dryer usage factor in the clothes washer test procedure adopted in today's final rule is 0.91. This value is also based on analysis of 2005 RECS data, but applies to all households with a clothes washer, as explained in more detail in section III.C.3.e of this rule.

Test Load Size Specifications

The current DOE clothes washer test procedure specifies the test load size for the active washing mode energy tests based on the clothes washer's container volume. The table specifying the test load sizes in the test procedure, Table 5.1, currently covers clothes washer container volumes only up to 3.8 ft^3. DOE is aware that multiple clothes washers available on the market have container volumes exceeding 3.8 ft^3.

In the September 2010 NOPR, DOE proposed extending Table 5.1 to accommodate larger clothes washer capacities, up to 6.0 cubic feet. The relationship between test load size and clothes washer volume is linear in Table 5.1 in appendix J1; DOE determined preliminarily that these values were appropriate, and that using a linear extension for larger load sizes would be valid. The proposed amendment extended the linear relationship between test load size and clothes washer container volume currently in the DOE clothes washer test procedure.

In the August 2011 SNOPR, DOE proposed some minor adjustments to the proposed extension of Table 5.1 to correct for inconsistent decimal places in the minimum and maximum load size values, which subsequently affected the calculation of some of the average load sizes. DOE proposed to amend the extension to Table 5.1 by specifying each load size value to the hundredths decimal place.

AHAM, ALS, and Whirlpool support the proposed linear extension of the test load size in Table 5.1. AHAM, ALS, EarthJustice, and NRDC agreed that DOE should extend Table 5.1 to accommodate clothes container volumes up to 6.0 ft^3. Whirlpool stated that test load size has been the subject of several test procedure waivers granted by DOE over the last six years, and that DOE's responses have been consistent with the proposed extension of Table 5.1. According to Whirlpool, the linear relationship remains valid because the majority of clothes washers sold today are adaptive fill machines, which use only the amount of water required by the load size. Furthermore, consumers continue to wash some small loads in the higher-capacity machines. For that reason, Whirlpool suggested, for example, that the 7.8 percent increase in average test load size from a 3.0 ft^3 to 3.3 ft^3 clothes washer is reasonable even though capacity increased by 10 percent. Whirlpool does not believe that the test procedure is biased to favor large-capacity clothes washers. AHAM stated that DOE should ensure that the test procedure does not contain a bias towards large-capacity machines. (AHAM, No. 2 at p. 23) EarthJustice and NRDC support AHAM's statement. (AHAM, No. 2 at p. 23; AHAM, No. 4 at p. 4; AHAM, No. 14 at p. 12; AHAM, Public Meeting Transcript, No. 20 at pp. 122–123; AHAM, No. 24 at p. 3; ALS, No. 10 at p. 3; Whirlpool, No. 13 at p. 7; Whirlpool, No. 27 at p. 4; EarthJustice, No. 3 at p. 1; NRDC, No. 8 at p. 1).

LG stated that it supports DOE's proposal for load sizes, but also stated that the maximum load size in Table 5.1 should be the same for all clothes container volumes, with annual usage cycles decreased for machines with larger volumes to reflect a reduced number of loads per year. (LG, Public Meeting Transcript, No. 20 at pp. 122, 124–126).

NIST recommended collecting additional load size data, because consumers who need to do more laundry may purchase the larger clothes washers. (NIST, Public Meeting Transcript, No. 20 at pp. 128–129).

NEEA does not support the proposed linear extension of Table 5.1 up to clothes container volumes of 6.0 ft^3. NEEA commented that there are no data to suggest that maximum load sizes would extend to 24 pounds, and that there is no demonstrable correlation at this time between clothes container volume and load weight or load volume. NEEA stated that many households do some laundry loads when they run out of clean clothes, or particular clothing items, regardless of the load size or clothes washer capacity. NEEA recommended that DOE prescribe an average test load size that is based on P&G data. (NEEA, No. 12 at p. 11; NEEA, No. 26 at p. 10).

The California Utilities, Energy Solutions (ES), the Joint Commenters, NEEA, and NRDC commented that the test load sizes in Table 5.1 may create an unwarranted bias towards larger-capacity clothes washers. The California Utilities and NRDC objected to the maximum load sizes being a fixed percentage of total capacity, while the average test load size is calculated as the average of a fixed minimum load and the maximum load. The California Utilities, NRDC, and the Joint Commenters provided values for the average test load size as a percentage of capacity, which ranged from 63–68 percent for smaller-capacity clothes washers but 54–57 percent for large-capacity machines. NRDC commented that the relationship of load size to capacity may be linear, but it is not proportionate, suggesting that consumers who purchase larger-capacity clothes washers leave more capacity unused. NRDC further commented that it is not sure that there is data to support this conclusion. The California Utilities commented that the average load size is the primary driver of the energy test load due to the load usage factors, and that average load sizes increases with capacity at a slower rate than the increase in maximum load size because the minimum load size remains constant. The California Utilities stated it was not aware of any recent consumer usage data on test load size. ES also expressed concern about the fixed minimum load size for all capacities. (California Utilities, No. 18 at pp. 3–4; California Utilities, No. 25 at pp. 2–3; ES, Public Meeting Transcript, No. 20 at p. 124; Joint Commenters, No. 16 at p. 5; Joint Commenters, No. 23 at p. 1; NEEA, No. 12 at p. 12; NEEA, No. 26 at pp. 10–11; NRDC, No. 8 at p. 1; NRDC, Public Meeting Transcript, No. 20 at pp. 14, 119–121; 126–127).

The Joint Commenters provided calculations for the allowably energy and water consumed per pound of clothes for clothes washers with capacities ranging from 3.0 to 5.5 ft^3, based on the weighted-average test load size and assuming a fixed MEF of 2.0 and a fixed WF of 6.0. According to the Joint Commenters' calculations, under those conditions a 5.5 ft^3 clothes washer with MEF = 2.0 is allowed 10 percent more energy and water per pound of clothes than a 3.0 ft^3 clothes washer with the same MEF rating. The Joint Commenters stated that this could have implications for the ENERGY STAR ratings, if large-capacity clothes washers can more easily achieve ENERGY STAR certification without ensuring better real-world energy and water use. (Joint Commenters, No. 16 at p. 5).

The California Utilities and the Joint Commenters suggested approaches for DOE to revise Table 5.1 to eliminate a possible bias towards larger-capacity clothes washers. The California Utilities recommended that DOE base average test load size on a fixed percentage of clothes container volume, and suggested a value of approximately 65 percent of capacity. The California Utilities further recommended that DOE develop a new metric based on energy use per pound of clothing washed, rather than energy use as a function of capacity. The California Utilities acknowledged the substantial input required from interested parties and the attendant significant negative impact on the clothes washer test procedure rulemaking schedule, and therefore recommended that DOE consider this approach for a future test procedure rulemaking. (California Utilities, No. 18 at p. 4).

The Joint Commenters suggested three possible alternatives for revising the test load sizes in Table 5.1:

1. Base the average test load size for all washers in a particular product class on the percentage of capacity used by the average test load of the average-sized clothes washer in that product class. The Joint Commenters noted that, according to AHAM, the average shipment-weighted capacity in 2009 was 4.03 ft^3 for front-loaders and 3.66 ft^3 for top-loaders, yielding a capacity utilization (*i.e.,* ratio of average test load weight to maximum test load weight) for the average test load of 59 percent for front-loaders and 60 percent for top-loaders. Maximum test load weights for other clothes washer capacities would be derived using the scaling factor currently used in Table 5.1, approximately 4 pounds per cubic foot of capacity.[10]

2. Base the average test load size for all clothes washers on the average test load size assumed in the RMC calculation in the test procedure (*i.e.,* the average test load size would be 52 percent of the maximum load size).

3. Use the test load sizes in the current Table 5.1, but calculate the average test load size for clothes washers with capacities between 3.8 ft^3 and 6.0 ft^3 using the capacity utilization of the largest machine in the current table (*i.e.,* the average test load size would be fixed at 59.7 percent of the maximum test load size for clothes washers in this capacity range.)

The Joint Commenters requested that DOE test a sample of front-loading and top-loading clothes washers of various capacities using the above-suggested alternatives to compare the resulting energy and water factors with the test results obtained using the proposed test procedure, and if there are substantial differences, DOE should consider revisions to Table 5.1 to reduce the potential for unwarranted bias toward large capacity clothes washers. (Joint Commenters, No. 16 at pp. 6–7).

In the September 2010 NOPR, DOE requested additional consumer data regarding current test load sizes, but it did not receive any such data from interested parties. DOE carefully considered the existing data sources for evaluating minimum, maximum, and average test loads. As noted above, P&G provided data indicating that, in 2003, average consumer load sizes were 7.2 lb for all top-loading clothes washers and 8.4 lb for all front-loading clothes washers. However, the P&G data does not identify average load size as a function of machine capacity, and therefore DOE cannot infer that these values are representative of average consumer load sizes for clothes washers of all capacities available on the market today.

Under the current formulation of the test load sizes, the average load size represents a decreasing percentage of maximum load size as the capacity of the clothes washer increases. Larger-capacity machines can therefore achieve a given MEF/WF rating using larger amounts of water and energy per pound of clothing than smaller-capacity machines with the same MEF/WF rating. Information to suggest that this scenario does not reflect true consumer usage was not available for this rulemaking. Information that would indicate that average consumer clothing load sizes are a fixed percentage of clothes container capacity (and, thus, maximum clothes load size) was also not available. Updated consumer usage data will be necessary to determine whether the numerical advantage for large-capacity clothes washers is justified by real-world use. DOE is aware of ongoing and future planned field studies that are expected to provide updated data regarding the relationship between clothes washer capacity and clothing load size. DOE will consider using data from these field studies in future clothes washer test procedure rulemakings.

Based on available data, DOE determined that a fixed minimum load size is appropriate, given that consumers may desire to wash only a few articles of clothing regardless of the size of their clothes washer. In considering maximum test load sizes, DOE reviewed user manuals for clothes washer models from multiple manufacturers, and noted that the instructions generally included a notation that the clothes container could, and for some cycles, should, be loaded to the point that the clothes container is loosely filled. DOE infers that some consumers will follow these instructions, which will result in a maximum test load size that is proportional to the volume of the clothes container.

For these reasons, DOE has determined that the linear extension of Table 5.1, including the proportional relationship of maximum test load size to clothes washer capacity, a fixed minimum test load size, and calculation of average test load size, currently represents the best possible approach for determining these load sizes. Therefore, today's final rule extends Table 5.1 as proposed in the August 2011 SNOPR in appendix J1 and the new appendix J2. If DOE receives new data that would lead to a different conclusion for the test load sizes specified in Table 5.1, DOE will consider updating the test procedure at that time. The extension of Table 5.1 will also address the waivers and interim waivers currently granted to several manufacturers for testing clothes washers with capacities greater than 3.8 cubic feet.

Load Usage Factors

The load usage factors in the DOE test procedure represent the fraction of all wash cycles a typical consumer runs for the minimum, average, and maximum load sizes. At the time of publication of the September 2010 NOPR, DOE was not aware of any recent data characterizing such usage patterns. Therefore, DOE did not propose any changes to the load usage factors.

NEEA stated that, in the absence of updated data, the existing load usage factors are acceptable, but that DOE should acquire contemporory data to support a validation of the current numbers. (NEEA, No. 12 at p. 10, 12; NEEA, No. 26 at p. 11) AHAM commented that it is not aware of recent data characterizing load size usage patterns, and thus it supports DOE's proposal not to change the load usage factors. (AHAM, No. 14 at p. 12).

For the reasons stated in the September 2010 NOPR, DOE has determined that the load usage factors are the best estimate of usage patterns available at this time. Therefore, DOE is not revising the load usage factors in today's final rule.

Temperature Use Factors

DOE proposed in the September 2010 NOPR to amend the TUFs in the clothes washer test procedure to account for

[10] The comment states that the *average* test load weight should be scaled, but this may be an editing error: In Table 5.1 the scaling factor for average test load weight ranges from 3.5 lb/ft^3 for small capacity to 2.3 lb/ft^3 for large capacity, whereas the scaling factor for maximum test load weight is a constant 4.10 ± 0.03 lb/ft^3.

steam wash cycles, and to revise the warm rinse TUF. Table III.3 shows the TUFs proposed in the September 2010 NOPR.

TABLE III.3—TEMPERATURE USE FACTORS PROPOSED IN THE SEPTEMBER 2010 NOPR

Max wash temp available	≤135 °F (57.2 °C)			>135 °F (57.2 °C)		Steam	
No. wash temp selections	Single	2 Temps	>2 Temps	3 Temps	>3 Temps	3 Temps	>3 Temps
TUF_s (steam)	....	....	....	....	....	0.02	0.02
TUF_m (extra hot)	....	....	....	0.14	0.05	0.12	0.03
TUF_h (hot)	....	0.63	0.14	....	0.09	....	0.09
TUF_{ww} (warm/warm)	....	....	*0.27	*0.27	*0.27	*0.27	*0.27
TUF_w (warm)	....	....	0.22	0.22	0.22	0.22	0.22
TUF_c (cold)	1.00	0.37	0.37	0.37	0.37	0.37	0.37

* Only applicable to machines offering a warm/warm cycle. For machines with no warm/warm cycle, this value should be zero and the warm TUF (TUF_w) should be increased by 0.27.

DOE assumed that the steam wash cycle TUF would affect only the extra-hot TUF, leaving the other TUFs unchanged. DOE discussed its analysis of the data on consumer wash and rinse temperature selections from the 2005 RECS and the 2004 California RASS, both of which provide information on temperature selections. Because the temperature use factors from each source demonstrated general agreement, DOE determined that the current TUFs in its test procedure are a reasonable estimate of current consumer use. DOE therefore proposed to keep the TUFs for cold wash, warm wash, and hot wash unchanged. DOE incorporated the steam cycle TUF by decreasing the value of the extra-hot TUF.

In the September 2010 NOPR, DOE also proposed to revise the methods for measuring warm rinse and to incorporate the revised measurement into the test procedure's calculations. DOE observed that most clothes washers available on the market allow users to select a warm rinse only when it is coupled with a warm wash cycle. DOE, therefore, proposed to establish a TUF for a full warm wash/warm rinse cycle. DOE also proposed to eliminate the incremental use factor attributed to warm rinse, requiring instead the measurement of energy and water consumption over an entire wash/rinse cycle that utilizes warm rinse. DOE proposed using the same warm rinse TUF of 0.27 for the complete warm wash/warm rinse cycle. For those clothes washers with such an option, DOE also proposed to reduce the warm wash/cold rinse TUF by a corresponding amount, lowering it from 0.49 to 0.22. DOE further proposed that the warm wash/warm rinse TUF would not be applicable for clothes washers with one or two wash temperature settings, because those washers would not provide a warm wash/warm rinse cycle. DOE did not propose to amend the TUFs for wash temperature selections other than the warm wash, except for units offering a steam wash cycle as previously described. Additionally, the proposed TUFs for warm/cold and warm/warm would sum to the existing warm wash TUF; overall, the warm wash temperature selection would receive the same weight in the energy and water consumption calculations.

DOE received multiple comments from interested parties in response to the proposed temperature use factors. NEEA expressed concern over the lack of recent consumer usage pattern data, but stated that the existing data do not support changing the TUFs currently provided in the test procedure. NEEA commented that the most important reason to acquire more recent data is that ''hot'', ''warm'', and ''cold'' designations for the energy test cycle do not reflect the current range of options for wash and rinse temperatures. NEEA also expressed concern that the California RASS data may be outdated and the fact that it is based on survey data rather than field data. However, NEEA stated that the most recent California usage data would likely support the current TUFs. (NEEA, No. 12 at p. 12; NEEA, Public Meeting Transcript, No. 20 at p. 131).

NEEA also supports the proposed methodology for measuring water and energy consumption for warm rinse over a complete cycle, with one exception. NEEA does not agree that most clothes washers currently available allow users to select a warm rinse only with a warm wash cycle. NEEA stated it may be appropriate to specify that a separate TUF be established for a hot wash/warm rinse cycle, a hot wash/warm rinse/steam cycle, or a warm wash/warm rinse/steam cycle. (NEEA, No. 12 at p. 12).

BSH commented that consumer use is well-represented by measuring cold, warm, and possibly hot wash cycles specified for cotton or ''normal'' fabrics, for the following reasons:

1. Many customers run one low-energy cycle, such as a ''delicates'' or ''hand-wash'' program, per week.
2. Many customers also run one or more ''permanent press'' or similar program per week, which is typically equal to or lower in energy than the cotton program.
3. Other special programs that use more or less energy or water than the cotton program are run very infrequently.
4. Basing MEF on only the cotton or normal programs is already over-reporting energy use versus actual consumer behavior.

(BSH, No. 17 at p. 5).

Whirlpool commented that DOE must use data that are representative of currently manufactured clothes washers rather than data that are 15 or more years old. Whirlpool stated that it had provided data to DOE that suggested a TUF of 0.016 (1.6 percent) for warm rinse, and that this percentage is representative of its clothes washers. Whirlpool also noted that it is the largest manufacturer of clothes washers in the United States, with a 64 percent market share, and it only offers a warm rinse option on approximately 9 percent of its clothes washers. According to Whirlpool, for the 27 percent TUF for warm rinse to be valid, its competitors would have to offer warm rinse on over 60 percent of their machines and all consumers would have to select warm rinse if it were offered. (Whirlpool, No. 13 at pp. 8–11).

AHAM, ALS, and Whirlpool stated that the proposed warm wash/warm rinse TUF of 0.27 is too high, and that a warm rinse option has become increasingly rare in clothes washers currently available on the market. ALS, AHAM, and Whirlpool further commented that data from Natural

Resources Canada (NRCan) show that both wash and rinse temperatures are decreasing over time. According to AHAM and Whirlpool, for all clothes washers in 2007, the NRCan data shows warm rinse to be the most frequent selection only 16 percent of the time, which is a decrease from 23 percent in 1993. AHAM, ALS, and Whirlpool commented that NRCan data is relevant to U.S. consumer usage patterns because Canadian clothes washer designs are the same as those in the United States and consumer practices are similar. (AHAM, No. 14 at pp. 12–13; ALS, No. 10 at p. 4; Whirlpool, No. 13 at pp. 8–11; Whirlpool, Public Meeting Transcript, No. 20 at pp. 133–134).

BSH commented that it supports the use of the NRCan data for determining the TUFs, and that the conclusions AHAM has drawn from the data agree well with BSH's customer feedback. (BSH, No. 17 at p. 4) LG stated that DOE could infer warm rinse usage from the percentage of detergent purchases that are cold water formulations. According to LG, if, for example, 85 percent of the detergent purchased in the United States were cold-water detergent, DOE could assume that the warm rinse TUF is very low. (LG, Public Meeting Transcript, No. 20 at p. 133) China requested that DOE clarify the TUF for steam, extra-hot, hot, warm, and cold wash cycles as well as warm wash/warm rinse and other wash modes. (China, No. 19 at p. 4).

DOE re-examined the 2005 RECS data to determine whether the usage patterns show a reduction in warm rinse usage for newer machines, of which, according to Whirlpool, a smaller percentage are including a warm rinse option. As shown in Table III.4, there is no correlation in the 2005 RECS data between the age of the clothes washer and the percentage of users reporting that they usually select warm rinse. The percentage of users reporting that they usually select warm rinse ranged from 19.1 to 21.5 percent. These data suggest that the introduction of newer models to the installed base did not affect consumer usage of warm rinse, at least during the time frame covered by the survey (*i.e.,* until 2005).

TABLE III.4—2005 RECS DATA ON THE USE OF WARM RINSE BY AGE OF THE CLOTHES WASHER

Age of clothes washer	Percentage of users that usually use warm rinse
Less than 2 years old	21.5
2 to 4 years old	19.1
5 to 9 years old	19.2
10 to 19 years old	19.9
20 years or older	21.4

DOE further notes that the TUF for warm rinse is applicable only to those clothes washers that provide a warm rinse option (i.e., the warm rinse TUF represents the percentage of laundry loads for which a consumer selects the warm wash/warm rinse temperature combination on machines that offer a warm rinse option). Therefore, DOE disagrees with Whirlpool's statement that for the 27-percent TUF for warm rinse to be valid, its competitors would have to offer warm rinse on over 60 percent of their machines and all consumers would have to select warm rinse if it were offered. The intention of the TUFs is to represent typical consumer usage patterns of individual clothes washer models with a specific set of temperature options, not the average consumer usage patterns across all types of clothes washer models.

DOE also reiterates that the survey data indicating warm rinse usage of 1.6 percent are based on a single clothes washer model from a single manufacturer, and that this clothes washer model does not offer the warm rinse option on the cycle recommended for cotton or linen clothes. Commenters provided no additional data to demonstrate that this conclusion would be valid for all clothes washer models offering a warm rinse, including clothes washers that offer a warm rinse option on the cycle recommended for cotton or linen clothes.

DOE does not have any information to determine what percentage of respondents in either the NRCan or 2005 RECS surveys who stated that they usually used cold rinse cycles were using machines equipped with a warm rinse option. DOE believes it is reasonable to assume that at least some consumers with cold rinse-only clothes washers were included in the survey samples, and thus, if those respondents were discounted, the percentage of users selecting warm rinse would be even higher than the estimates shown above. Given the disparity between the results for warm rinse usage from the NRCan and 2005 RECS surveys and the data submitted by Whirlpool, DOE concludes that there is a lack of evidence on which to base a decrease in the existing TUF value, as suggested by Whirlpool.

As discussed in section III.C.2.a, DOE is not amending the test procedure to measure energy and water use in steam wash cycles. Thus, in the absence of sufficient data on recent consumer usage patterns to warrant changing the TUFs, and because DOE is not adopting provisions to measure steam wash cycles, DOE is retaining the TUFs that are provided in the existing test procedure at appendix J1, with the modification that the warm/warm TUF will be treated as a complete wash/rinse cycle, and the warm/cold TUF adjusted accordingly when a warm/warm cycle is available on the clothes washer.

DOE considered the possibility of requiring measurement of a hot wash/warm rinse cycle as part of the energy test cycle, and assigning a TUF accordingly. DOE's analysis of 2005 RECS data indicates that the percentage of all respondents who usually select a hot wash/warm rinse cycle is 1.8 percent. DOE does not believe that this small percentage would warrant the additional test burden associated with measuring a hot wash/warm rinse cycle and including such energy and water consumption in the test procedure calculations. Accordingly, DOE is not adopting a TUF for hot wash/warm rinse in today's final rule.

Dryer Usage Factor

DOE proposed in the September 2010 NOPR to amend its clothes washer test procedure to include a dryer usage factor (DUF) of 0.91, based on the 2005 RECS. DOE proposed to use the value derived from the 2005 RECS, rather than the 2004 California RASS, because the 2004 California RASS is inconsistent with the proposed number of wash cycles per year and because the 2005 RECS data represent the entire country rather than one state.

NEEA agreed with DOE's methodology for deriving the proposed DUF. (NEEA, No. 12 at p. 12) AHAM stated that it does not oppose the proposed DUF, but commented that DOE should be relying on more representative data than that in the 2005 RECS. (AHAM, No. 14 at p. 13) ALS opposed the proposed DUF, questioning the validity of the 2005 RECS data. ALS supports retaining the existing value of 0.84, in the absence of other data. (ALS, No. 10 at p. 4) ALS did not provide any further information on why it believes the 2005 RECS data may be invalid. DOE has determined that 2005 RECS data is the best available data that reasonably captures the dryer usage practices of consumers using residential clothes dryers, and is thus adopting a revised DUF of 0.91 in the amended test procedure in this final rule.

Load Adjustment Factor

The load adjustment factor (LAF) represents the ratio of maximum load size to average load size. This ratio is used in the calculation of the energy required to remove moisture from the test load. The RMC value used in this calculation is based only on tests using the maximum test load, and the LAF is used to scale this value down to represent the average load size. In the September 2010 NOPR, DOE noted that it lacked information warranting adjustment of this value or a change from a fixed value to one that varies as a function of average load size, and therefore did not propose to amend the LAF in the test procedure.

In response to the September 2010 NOPR, DOE received numerous comments regarding the LAF, which were summarized in the August 2011 SNOPR. Upon consideration of these comments, DOE determined that the LAF is duplicative of, yet inconsistent with, the load usage factors. Therefore, for consistency with other relevant provisions of the test procedure, DOE proposed in the August 2011 SNOPR that the representative load size calculation in the equation for drying energy incorporate the load usage factors rather than a separate LAF. DOE proposed that the current representative load size calculation be replaced by the weighted-average load size calculated by multiplying the minimum, average, and maximum load usage factors by the minimum, average, and maximum load sizes, respectively, and summing the products.

DOE received the following comments in response to the proposed elimination of the LAF in the August 2011 SNOPR:

AHAM and ALS support the approach of using a weighted-average load size in the calculation of dryer energy use, but note that the new approach will increase the measured energy. AHAM and ALS added that DOE must revise the relevant energy conservation standard to reflect the new test procedure, ensuring that there is no change in the stringency of the standards based on average energy consumption calculations before and after the changes to the test procedure. ALS suggested revising only appendix J2 with this change, noting that there is still time to consider this impact in the updated minimum efficiency standards. (AHAM, No. 24 at p. 4; ALS, No. 22 at pp. 2–3).

Whirlpool stated that it would oppose the proposal to use a weighted-average load size for the purposes of calculating drying energy if it would require testing for RMC on the average and minimum load sizes in addition to the maximum load size. Whirlpool stated that such a requirement, if adopted, would triple the RMC testing required, adding at least one full day to the test time for each base model. Whirlpool added that DOE's proposal would not increase the test burden if it requires only testing RMC at the maximum load size. Whirlpool also recommended that this amendment be made only to appendix J2. (Whirlpool, No. 27 at p. 3).

The Joint Commenters, California Utilities, and NEEA support DOE's proposal to replace the representative load size based on the load adjustment factor with a weighted-average load size to calculate dryer energy use. The Joint Commenters and the California Utilities noted, however, that this proposed change would result in a greater increase in the representative load size used to calculate dryer energy consumption for small capacity washers than for large-capacity washers, which would therefore make any potential bias towards large-capacity washers more significant. The Joint Commenters added that they are not aware of any data indicating that consumers utilize a smaller percentage of the washer capacity when using large-capacity machines compared to smaller machines, nor of any data indicating it is more difficult for larger-capacity machines to achieve high efficiency ratings. In the absence of such data, the Joint Commenters recommended that the weighted-average load size as a percentage of total capacity be kept constant across all washer capacities. (Joint Commenters, No. 23 at p. 4; California Utilities, No. 25 at p. 3; NEEA, No. 26 at p. 5).

For the reasons stated in the August 2011 SNOPR, DOE replaces the representative load size calculation with the weighted average load size calculated using the load usage factors. This change applies only to the newly created appendix J2. This approach will not require measuring the RMC for any additional load sizes, and therefore will not increase manufacturer test burden.

4. Energy Test Cycle Definition

The ''energy test cycle'' consists of the wash cycles currently used in determining the modified energy factor (MEF) and water factor (WF) for a clothes washer, and proposed to be used for determining integrated modified energy factor (IMEF) and integrated water consumption factor (IWF). The energy test cycle is defined in section 1.7 of the current clothes washer test procedure as follows:

''1.7 *Energy test cycle* for a basic model means (A) the cycle recommended by the manufacturer for washing cotton or linen clothes, and includes all wash/rinse temperature selections and water levels offered in that cycle, and (B) for each other wash/rinse temperature selection or water level available on that basic model, the portion(s) of other cycle(s) with that temperature selection or water level that, when tested pursuant to these test procedures, will contribute to an accurate representation of the energy consumption of the basic model as used by consumers. Any cycle under (A) or (B) shall include the agitation/tumble operation, spin speed(s), wash times, and rinse times applicable to that cycle, including water heating time for water heating clothes washers.''

In the September 2010 NOPR, DOE proposed to amend Part (B) of the energy test cycle definition to clarify the wash parameters that should be considered to determine which cycle settings should be included under Part (B) of the definition.

In additional testing after the publication of the September 2010 NOPR, DOE observed that some clothes washers retain in memory the most recent options selected for a cycle setting the next time that cycle is run. To ensure repeatability of test results, particularly for cycles under Part (B) of the energy test cycle definition, DOE proposed in the August 2011 SNOPR to provide further clarification that the manufacturer default conditions for each cycle setting shall be used, except for the temperature selection, if necessary.

DOE received multiple comments from interested parties regarding its proposed changes to the energy test cycle definition. The comments generally indicated that the proposed revisions to the definition still lacked clarity. In response to the August 2011 SNOPR, Whirlpool, GE, and ALS jointly proposed a modified definition of the energy test cycle which eliminated what these commenters perceived as a primary source of ambiguity in DOE's previously proposed definition. (GE, Whirlpool, & ALS, No. 28 at pp. 1–2) Because of the scope of the manufacturers' proposed changes, and because the energy test cycle definition is a critical component of the test procedure, DOE incorporated the manufacturers' suggestions into a new definition, proposed in the November 2011 SNOPR. The most notable proposed change involved Part (B) of the energy test cycle definition, which DOE proposed as follows:

''(B) If the cycle setting described in (A) does not include all wash/rinse temperature combinations available on the clothes washer, the energy test cycle shall also include the alternate cycle setting(s) offering these wash/rinse temperature combination(s), tested at the wash/rinse temperature combinations not available on the cycle setting described in (A).

Where multiple alternate cycle settings offer a wash/rinse temperature combination that is not available on the cycle setting recommended by the manufacturer for washing cotton or linen clothes, the cycle setting certified by the manufacturer to have the highest energy consumption, as measured according to section 2.13, shall be included in the energy test cycle.''

DOE stated that this proposed new definition would provide further clarity and produce more accurate, repeatable, and reproducible results within and among all test laboratories.

DOE also proposed a new section 2.13, which would provide instructions for determining the cycle setting with the highest energy consumption in the case where multiple alternate cycle settings offer a wash/rinse temperature combination not available on the cycle setting recommended by the manufacturer for washing cotton or linen clothes.

In the November 2011 SNOPR, DOE responded to prior comments received in response to the September 2010 NOPR and August 2011 SNOPR. DOE received the following comments in response to the November 2011 SNOPR:

NEEA commented that it supports DOE's decision to keep Part (B) of the energy test cycle definition, and stated that all cycle selections for which a TUF has been developed should be included in the energy test cycle. NEEA recommended that DOE ensure that manufacturer default settings are chosen for selections other than water temperature, particularly for parameters that would affect RMC, since a large fraction of total energy use is derived from RMC. NEEA believes this is especially important since DOE proposed to use only machine and hot water energy use as the criteria for determining which of the alternate cycle settings has the highest energy use. NEEA added that it believes DOE adequately evaluated the potential test burden impact on manufacturers, and it does not believe that the proposed test procedure modifications will create additional test burden on any manufacturers. (NEEA, No. 31 at p. 2).

AHAM commented that the newly proposed energy test cycle definition would not provide any further clarity to manufacturers. AHAM and GE suggested that further clarification of the language in several areas would be necessary to ensure the test procedure is repeatable and representative of consumer behavior. In particular, AHAM suggested that the definition should explicitly state that all temperature selections corresponding to the TUFs, which are available on a product, be tested only once, and that they should be tested only during the ''Normal'' cycle if possible. (AHAM, No. 34 at p. 2; GE, No. 35 at p. 1).

Whirlpool reiterated its comment from the August 2011 SNOPR that the language of Part (A) of the current energy test cycle definition in appendix J1 is adequate and that Part (B) does not add value. Whirlpool also stated, however, that it agrees with DOE that the language in Part (B) of the current energy test cycle definition in appendix J1 is unclear and subject to varying interpretations. Whirlpool commented that as written, DOE's proposal would not reflect real-world consumer use and would increase manufacturer test burden by 3–4 times. Whirlpool stated that it believes DOE did not intend in its proposed language to require testing the maximum energy-consuming cycles for all possible temperature combinations on a product; rather, the scope for inclusion of test cycles beyond the ''Normal'' cycle should logically be limited to temperature selections for which a TUF has been developed. Whirlpool added that limiting cycle selection to already-existing TUFs would eliminate the need for exhaustive testing, which would reduce test burden and be more representative of consumer usage. (Whirlpool, No. 33 at pp. 1–2).

After reviewing comments from interested parties, DOE notes that it intended its proposed definition to require the testing of all temperature selections available on a product for which a TUF has been developed. *See* 76 FR 69870, 69875. DOE also agrees with commenters who suggested that each TUF should be tested only once and that each TUF should be tested using the ''Normal'' cycle if possible. DOE did not intend for the revised definition to require the testing of all temperature combinations within all the cycle selections available on a machine. DOE concurs that this would have resulted in a significant increase in test burden.

DOE has amended the language of the energy test cycle in today's final rule accordingly. These amendments are largely consistent with the suggested amendments from manufacturers, as described in more detail in the following sections.

Regarding the use of manufacturer default settings, DOE concurs with NEEA that the manufacturer default settings for selections other than water temperature should be used, including during testing under the new section 2.13 to determine which of the alternate cycle settings has the highest energy use. Today's final rule specifies in both the energy test cycle definition and in section 2.13 that the manufacturer default settings should be used for all wash parameters other than temperature selection.

The following sections describe comments received in regard to each of the individual parts of DOE's proposed definition of the energy test cycle, as well as comments regarding the new section 2.13 and the proposed revision to manufacturer reporting requirements. DOE's responses to comments are provided in each section.

Part (A) of the Proposed Definition

AHAM proposed modifying Part (A) to clarify that it applies only to temperature selections for which TUFs have been developed, as follows:

''(A) The cycle setting recommended by the manufacturer for washing cotton or linen clothes, including all wash/rinse temperature selections for each of the temperature use factors (TUFs) offered in that cycle setting, and''

(AHAM, No. 34 at p. 6)

DOE believes that AHAM's proposed modification would add clarity to the energy test cycle definition while maintaining consistency with the intent of DOE's proposed definition. The proposed modification would also maintain consistency with the original intent of Part (A) as defined in the current test procedure at appendix J1. Therefore, this final rule adopts AHAM's proposed clarification for Part (A) of the energy test cycle definition in appendix J2.

Part (B) of the Proposed Definition

AHAM and GE requested clarification of the term ''temperature combination'' in the second paragraph of Part (B) in relation to the term ''temperature selection'' in Part (A). AHAM proposed maintaining consistency in the language in order to avoid ambiguity from using two words with the same meaning. AHAM requested that the term ''temperature selection'' be used instead, believing that it is clearer and more representative. (AHAM, No. 34 at p. 2; GE, No. 35 at p. 2).

AHAM, ALS, and GE requested clarification of the phrase ''shall also include'' in Part (B) of the energy test cycle definition. ALS commented that it is unclear as to whether the phrase ''shall be included'' means to directly add the energy of Part (B) to Part (A), or to average the energy from Parts (A) & (B), or to apply an unknown usage factor to Part (B). (AHAM, No. 34 at p. 2; ALS, No. 32 at p. 1; GE, No. 35 at p. 2) Whirlpool commented that averaging all cycles used by consumers would be unduly burdensome and would not provide any appreciable difference in results than would be derived from Part (A) of the current energy test cycle definition in appendix J1. (Whirlpool, No. 33 at p. 1).

AHAM proposed modifying Part (B) by specifying that Part (B) applies only to temperature selections for which TUFs have been developed, and that each TUF available on the product should be tested only once. GE commented that it agrees with AHAM's proposed modifications. Whirlpool also suggested specifying that Part (B) applies only to temperature selections for which TUFs have been developed. (AHAM, No. 34 at p. 6; GE, No. 35 at p. 2; Whirlpool, No. 33 at p. 2).

AHAM proposed the following language for Part (B), which also incorporates the suggested edits of Whirlpool:

''(B) If the cycle setting described in Part (A) does not include all wash/rinse temperature selections for each of the TUFs available on the clothes washer, the energy test cycle shall also include the alternate cycle setting(s) offering these remaining wash/rinse temperature selection(s), tested at the wash/rinse temperature selections for each TUF or TUFs not available on the cycle setting described in Part (A).

Where multiple alternate cycle settings offer a wash/rinse temperature selection for which a TUF has been developed and that is not available on the cycle setting recommended by the manufacturer for washing cotton or linen clothes described in Part (A), the alternate cycle setting certified by the manufacturer to have the highest energy consumption for that TUF, as measured according to section 2.13, shall be included in the energy test cycle so that each TUF that is available on the product has been tested once.''

(AHAM, No. 34 at p. 6)

DOE notes that Part (B) of its proposed definition uses the term ''temperature combination'' instead of the term ''temperature selection,'' which is used in Part (A). In addition, the term ''temperature selection'' implies a setting on the machine that a user would select, whereas ''temperature combination'' could be interpreted to mean the actual temperature experienced inside the wash drum for a given temperature selection. This could create confusion if a temperature selection on the machine provides different actual temperatures depending on which cycle selection is chosen. For example, a hot/cold temperature selection could provide a wash temperature of 120 °F on the Cottons setting with a 60 °F rinse temperature, yet provide a higher wash temperature of 135 °F on the Heavy Duty setting with a 60 °F rinse temperature. In this case, ''temperate selection'' would refer to the single labeled hot/cold selection on the machine, whereas ''temperature combination'' could be interpreted to mean both the 120/60 °F wash/rinse temperature combination and the 135/60 °F temperature combination. The intent of DOE's proposed definition of the energy test cycle is to require the testing of each wash/rinse temperature selection as labeled on the machine's control panel, rather than requiring the testing of every single temperature combination that occurs among all the different cycle selections on the machine. Therefore, today's final rule uses the term ''temperature selection'' consistently throughout the energy test cycle definition.

Similarly, DOE is concerned that the term ''cycle setting'' could also introduce ambiguity into the definition. DOE had proposed to use the term ''cycle setting'' rather than the term ''cycle,'' which is used in the current appendix J1 definition, to differentiate between the labeled cycles on a machine (*i.e.,* Normal, Whites, Colors, Heavy Duty, etc.) and a single active mode laundry cycle, which is commonly referred to as a ''cycle.'' DOE has observed that user manuals from manufacturers representing a significant portion of the market refer to the labeled cycles as ''cycles'' (*i.e.,* the ''Normal cycle'', ''Whites cycle'', ''Colors cycle,'' etc.). Because of this, a ''cycle setting'' could be interpreted to mean a specific temperature, soil level, spin speed, or other setting within the labeled cycle. Therefore, to prevent this possible ambiguity, today's final rule instead uses the term ''cycle selection'' to mean the labeled cycle on the machine.

As discussed previously, DOE intended its proposed definition to require the testing of all temperature selections available on a product for which a TUF has been developed. DOE also agrees with commenters that each TUF should be tested only once and that each TUF should be tested using the ''Normal'' cycle if available. Therefore, DOE supports AHAM and the manufacturers' suggested modifications to Part (B), which specify that Part (B) applies only to temperature selections for which TUFs have been developed, and that each TUF available on the product should be tested only once. Therefore, today's final rule adopts AHAM's proposed clarifications for Part (B) of the energy test cycle definition in appendix J2.

Based on comments from AHAM and manufacturers regarding confusion about how the energy results from Part (B) are to be included in the energy test cycle, today's final rule replaces the phrase ''shall also include * * *'' with the phrase ''shall include, in addition to Part (A) * * *.'' DOE believes that this change, coupled with the clarification that Part (B) applies only to the TUFs not available in the cycle selection used for Part (A), will remove ambiguity about how to include the test results for Part (B). Consistent with the current appendix J1 test procedure, the energy and water consumption measured under Part (B) of the energy test cycle should be weighted by the appropriate TUF and added to the weighted energy and water consumption measured under Part (A).

Part (C) of the Proposed Definition

DOE did not receive any comments from interested parties regarding Part (C) of the proposed definition of the energy test cycle. Today's final rule modifies DOE's proposed language for Part (C) by revising the reference to ''Part (A) and Part (B)'' so that Part (C) reads as follows:

''All cycle selections included under Part (A) and all cycle selections included under Part (B) shall be tested using each appropriate load size as defined in section 2.8 and Table 5.1 of this appendix.''

Because Part (A) refers to the specific cycle selection recommended by the manufacturer for washing cotton or linen clothes, and Part (B) refers to other alternate cycle selection(s), none of the cycle selections included in the energy test cycle would be tested under both Part (A) and Part (B). The revised Part (C) is applicable to the cycle selected under Part (A) and all cycles included separately under Part (B).

Part (D) and Part (E) of the Proposed Definition

Whirlpool agrees with DOE's proposal to specify that each cycle included as part of the energy test cycle comprises the entire active washing mode, and excludes any delay start or cycle finished modes. (Whirlpool, No. 33 at p. 2)

NEEA disagrees with DOE's proposal to exclude delay start and cycle finished modes as part of the active mode in the energy test cycle definition. NEEA believes that these modes should be tested and assigned appropriate usage factors. NEEA stated that certain clothes washers offer delayed start and cycle finished mode options not available in the normal cycle. NEEA acknowledged, however, the lack of available data on delayed start and cycle finished mode, and stated its intention to gather data on these modes for inclusion in the energy test cycle definition during the next opportunity to improve the test procedure. (NEEA, No. 31 at p. 2).

For the reasons described previously in sections III.B.2.b and III.B.2.c, today's final rule does not require testing of delayed start or cycle finished modes. Therefore, today's final rule is consistent with DOE's proposal to specify that each wash cycle included as part of the energy test cycle comprises the entire active washing mode, and excludes any delay start or cycle finished modes. In today's final rule, this clarification is provided in a new Part (E) of the energy test cycle definition.

In addition, as described previously in section III.B.2.d, today's final rule also does not require the testing of self-clean mode. Therefore, today's final clarifies that the energy test cycle shall not include any cycle, if available, that is dedicated for cleaning, deodorizing, or sanitizing the clothes washer, and is separate from clothes washing cycles. This should prevent confusion as to whether the self-clean cycle should be considered eligible for testing under Part (B) if, for example, the self-clean cycle used one of the temperature selections not available in the cycle tested in Part (A) (*e.g.* extra-hot). In today's final rule, this clarification is provided in a new Part (F) of the energy test cycle definition.

New Section 2.13

AHAM proposed modifying the language in the newly proposed section 2.13 by: (1) Using the term ''temperature selection'' instead of ''temperature combination''; (2) specifying that testing under section 2.13 applies only to temperature selections for which TUFs have been developed and TUFs not represented in the cycle setting represented in Part (A) of the energy test cycle definition; and (3) specifying that each TUF available on the product should be tested only once. Whirlpool also suggested clarifying that section 2.13 applies only to temperature selections for which TUFs have been developed. GE commented that it agrees with AHAM's proposed modifications for section 2.13. (AHAM, No. 34 at pp. 6–7; Whirlpool, No. 33 at p. 2; GE, No. 35 at p. 2)

For the reasons described in the previous sections regarding the energy test cycle definition, DOE concurs with AHAM and manufacturers' suggestions regarding the term ''temperature selection'' and the need to specify that testing under section 2.13 applies only to temperature selections for which TUFs have been developed and which are not represented in the cycle tested under Part (A).

DOE has determined that it is unnecessary and potentially confusing to modify the language in section 2.13 to specify that each TUF available on the product should be tested only once. The provisions set forth in Part (B) of the revised definition of energy cycle clarify that each TUF shall be tested once. DOE notes, however, that each TUF being considered under the exploratory testing provisions of section 2.13 might need to be tested on different cycle selections to determine which cycle selection uses the most energy. For these reasons, DOE does not adopt the proposed clarification in section 2.13 that each TUF available on the product should be tested only once.

Today's final rule also modifies the structure of section 2.13 by separating the individual provisions into subsections 2.13.1 through 2.13.5, which should improve the clarity of this section.

Reporting Requirements

AHAM and GE requested clarification on what specific data will be made public with regards to the alternate cycle settings tested in Part (B). (AHAM, No. 34 at p. 7; GE, No. 35 at p. 2) Similarly, ALS requested clarification regarding the requirement for manufacturers to provide a list of all cycle settings comprising the complete energy test cycle for each basic model. ALS requested that DOE make this information publicly available to all interested parties. (ALS, No. 32 at p. 1).

DOE does not intend to make the list of all cycle settings comprising the energy test cycle for each clothes washer publicly available as part of a manufacturer's certification report. DOE will respond to requests for this information pursuant to its Freedom of Information Act regulations at 10 CFR part 1004. DOE acknowledges that making this list publicly available could reveal a manufacturer's proprietary strategies for achieving a competitive advantage over its rivals. In addition, the information could be used to reverse-engineer the products or test results of competitors. Irrespective of requests from the public for this information, DOE notes that it may make this information available to third party laboratories that would be involved in future DOE-initiated compliance verification and enforcement testing.

Today's final rule modifies the reporting requirements in 10 CFR 429.20 by specifying that a certification report shall include publicly available information including MEF, WF, and capacity. The report would also include the list of cycle settings comprising the complete energy test cycle for each basic model, which DOE does not intend to make publicly available as part of the report. The requirement to provide the list of cycle settings comprising the complete energy test cycle will apply only to test results obtained using appendix J2.

5. Capacity Measurement Method

The test procedure in appendix J1 requires measuring clothes container capacity as ''the entire volume which a dry clothes load could occupy within the clothes container during washer operation.'' The procedure involves filling the clothes container with water, and determining the volume based on the weight of the added water divided by its density. Specifically, the test procedure requires that the clothes container be filled manually with either 60 °F ± 5 °F (15.6 °C ± 2.8 °C) or 100 °F ± 10 °F (37.8 °C ± 5.5 °C) water to its ''uppermost edge.''

DOE recognized that this specification of the water fill level could lead to multiple interpretations and, in some cases, capacity measurements that may not reflect the actual volume in which cleaning performance of the clothes could be maintained. After considering comments from interested parties on a proposed interpretation of the existing methodology in appendix J1, DOE issued guidance on identifying the maximum fill level using the appendix J1 test procedure. This guidance, issued on July 26, 2010, is available at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/cw_guidance_faq.pdf*, hereafter referred to as the ''capacity guidance.'' Figure III.1 and Figure III.2 show the schematics presented in the capacity guidance, which indicate possible interpretations of the maximum fill level in appendix J1.

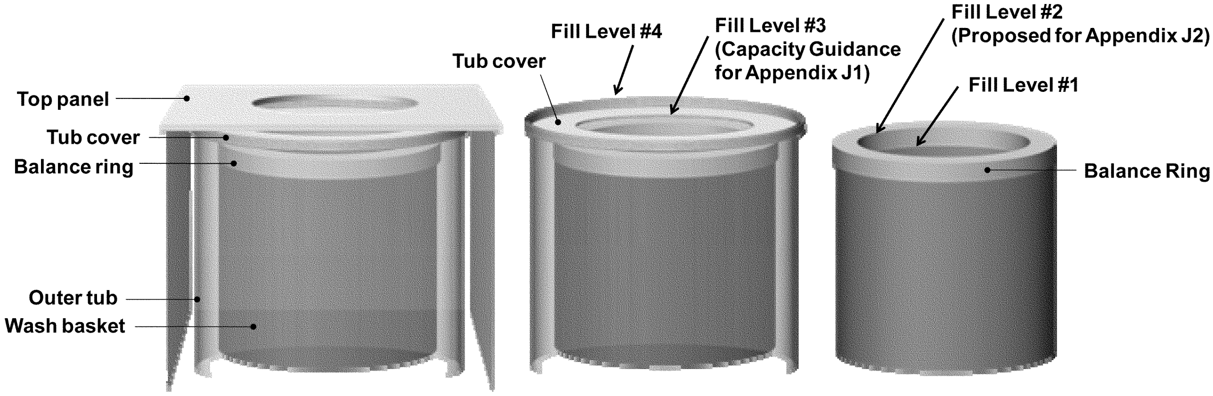

Figure III.1 Representation of Fill Levels for the Clothes Container Capacity Measurement for Vertical-Axis (Top-Loading) Clothes Washers

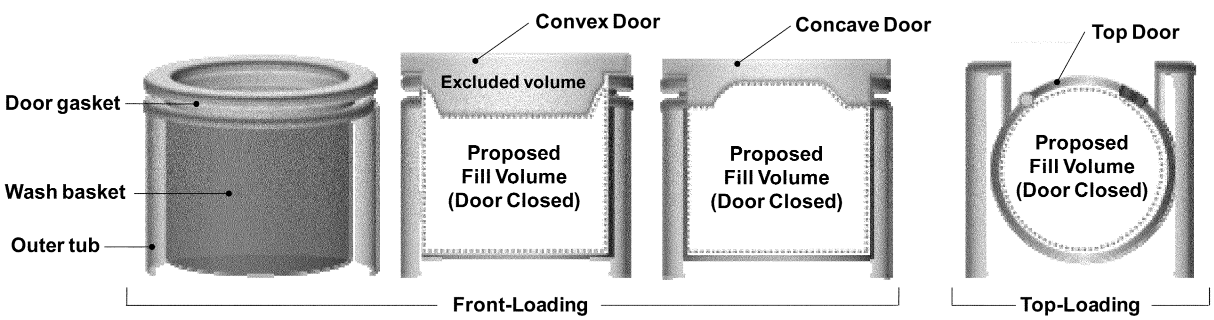

Figure III.2 Representation of Fill Volumes for the Clothes Container Capacity Measurement for Horizontal-Axis (Front-Loading and Top-Loading) Clothes Washers[11]

Figure III.1 indicates four possible fill levels for vertical axis (top-loading) clothes washers:

• ''Fill Level 1'' represents the level immediately below the bottom edge of the balance ring, which typically corresponds to the recommended maximum fill level according to manufacturer instructions.

• ''Fill Level 2'' represents the uppermost edge of the rotating portion of the wash basket, which corresponds to the fill level proposed in the September 2010 NOPR.

• ''Fill Level 3'' represents the highest point of the inner-most diameter of the tub cover.

• ''Fill Level 4'' represents the highest edge on the tub cover.

For the purpose of issuing guidance, DOE determined that the maximum fill level referred to in the appendix J1 test procedure (*i.e.,* the ''uppermost edge'') is the highest horizontal plane that a dry clothes load could occupy with the clothes container oriented vertically. For top-loading clothes washers, this is identified as Fill Level 3 in Figure III.1.

In Figure III.2, the volumes contained within the dotted lines indicate the fill volumes for horizontal-axis (both front-loading and top-loading) clothes washers with convex doors, concave doors, or top-loading doors.

DOE considered whether to amend the fill level specification in this rulemaking to provide additional clarity and ensure that the capacity is representative of the volume available to achieve real-world cleaning performance. Prior to publication of the September 2010 NOPR, DOE conducted capacity tests on a sample of residential clothes washers to observe how different interpretations of the maximum fill level could lead to different measured capacities for the same machine. For top-loading clothes washers, DOE's test sample showed that the majority of rated capacity values varied from the Fill Level 3 value, some by as much as 0.5 ft^3. For front-loading clothes washers, the majority of rated capacity values closely corresponded to DOE's measured values according to the fill volume shown in the capacity guidance.

DOE also tentatively concluded for top-loading clothes washers that Fill Level 3, which was specified in the capacity guidance, may not reflect the actual usable capacity for washing a load of clothes while maintaining cleaning performance. This is because Fill Level 3 may include space above the upper surface of the rotating wash tub or balance ring. In most cases, if

1 DOE is aware of at least one top-loading, horizontal-axis clothes washer on the market. Based on its geometry, the capacity guidance for this type of clothes washer would be the same as the guidance for front-loading, horizontal-axis clothes washers.

clothes were located in that region during a wash cycle, that portion of the load would likely not interact with water and detergent properly, particularly since wash water cannot be contained between Fill Level 2 and Fill Level 3 during operation. Entanglement of the clothing could also occur.

Therefore, in the September 2010 NOPR, DOE proposed the following fill levels to provide for a more representative capacity measurement:

• For top-loading clothes washers, DOE proposed that the clothes container be filled to the uppermost edge of the rotating portion, including any balance ring. This corresponds to Fill Level 2 in Figure III.1.

• For front-loading clothes washers, DOE proposed that the clothes container be filled to the uppermost edge that is in contact with the door seal.

For both top-loading and front-loading clothes washers, any volume within the clothes container that a clothing load could not occupy during active washing mode operation would be excluded from the measurement.

BSH, the California Utilities, the Joint Commenters, and NEEA support the proposal for measuring the volume of the clothes container. BSH stated that if clothing should not occupy an area, that volume should be excluded from the clothes container capacity measurement. According to BSH, if an area not occupied by clothing were to be measured, top-loading washers would have an unfair advantage over front-loading washers, which have no such area. According to BSH, due to the space needed for agitation, the volume of the clothes container can be larger in top-loading washers, yet offer the consumer a smaller available space to load clothing. (BSH, No. 17 at p. 4) The California Utilities and NEEA agree that the capacity measurement should include the entire volume that a dry clothes load could occupy within the clothes container during washer operation. NEEA stated that this method is an improvement over the previous guidance and will result in consistent, accurate measurements for all clothes washer models. (California Utilities, No. 18 at pp. 4–5; NEEA, No. 12 at p. 13; NEEA, Public Meeting Transcript, No. 20 at p. 177) The Joint Commenters stated that the proposed methodology would ensure that only the space that is capable of being filled with clothes while maintaining proper wash performance is included in the capacity measurement. (Joint Commenters, No. 16 at p. 8).

AHAM, ALS, and Whirlpool oppose the proposed clothes container capacity measurement. AHAM stated that the proposed methodology is ambiguous and does not provide for a representative, repeatable, or reproducible measurement of clothes container volume. AHAM stated that DOE appears to be applying a new interpretation to an existing definition, as there is no change in the definition of the clothes container from the existing appendix J1 to the proposed appendix J2. According to AHAM, there is significant harm in DOE continuing to change its position on the capacity measurement procedure, as it results in a lack of clarity and certainty to the industry, which in turn creates confusion for consumers since machines need to be re-tested and potentially re-rated (and thus, re-labeled) each time the capacity measurement changes. AHAM further commented that the cost associated with re-testing, re-rating, and re-labeling is significant. (AHAM, No. 14 at p. 14) AHAM proposes that DOE codify the final capacity guidance on clothes container capacity measurement without change. AHAM and Whirlpool noted that a significant amount of work on the part of DOE and stakeholders went into the capacity guidance, and the result was a clear, repeatable, reproducible method for measuring drum volume. AHAM and Whirlpool also stated that the capacity guidance addresses the objective that the clothing remain within the clothes container for an entire operating cycle, noting that filling the clothes container slightly above the balance ring with dry clothing will cause the clothing to remain in the clothes container during the entire operating cycle, because clothes sink as they are wetted. (AHAM, No. 14 at pp. 14–15; AHAM, Public Meeting Transcript, No. 20 at pp. 165–167; Whirlpool, No. 13 at p. 12; Whirlpool, Public Meeting Transcript, No. 20 at pp. 167–168, 173–174) Whirlpool stated that its field use studies have shown that customers load the clothes container above the fill level specified in the capacity guidance, and that the maximum load size specified in the DOE test procedure, when loosely loaded, exceeds that fill level. Whirlpool further noted that the Underwriters Laboratories (UL) safety test limit for clothes washers is an even higher fill level. Whirlpool commented that measurements at the fill level specified in the capacity guidance can be as repeatable and reproducible as the proposed fill level. Whirlpool suggested that if DOE questions repeatability and reproducibility, it could require manufacturers to mold a mark at the point on the tub cover at which the clothes container capacity measurement is taken. (Whirlpool, No. 13 at p. 12) ALS opposes the proposed clothes container capacity measurement, stating that manufacturers have based their designs on DOE's capacity guidance for appendix J1. According to ALS, top-loading clothes washers would be rated as having a lower capacity under DOE's proposal because ''the uppermost edge of the rotating portion'' is typically below the fill level defined in the capacity guidance. (ALS, No. 10 at p. 4).

DOE believes that the procedure for measuring clothes washer capacity should reflect the actual usable capacity for washing clothes while maintaining cleaning performance. For front-loading clothes washers, interested parties generally support the proposed methodology for measuring clothes container capacity. For top-loading clothes washers, DOE acknowledges the effort that went into developing the capacity guidance for the current appendix J1 test procedure. DOE believes that, given the construct of the capacity measurement procedure in appendix J1, the capacity guidance provides improved clarity, repeatability, and reproducibility to the current test procedure. For this rulemaking, however, DOE re-evaluated all aspects of the clothes container capacity measurement and concluded that the capacity measurement specified in appendix J2 maximizes clarity, repeatability, reproducibility, and consumer relevance.

First, while DOE did not change the definition of ''clothes container'', the upper boundary of the ''clothes container'' is not explicitly defined in the current clothes washer test procedure at appendix J1. Section 3.1 of appendix J1 requires the measurement of ''the entire volume which a dry clothes load could occupy within the clothes container during washer operation.'' DOE did not propose to change the language in section 3.1 for appendix J2 in the September 2010 NOPR. After considering comments on the related proposal to amend the fill level in section 3.1.4, however, DOE acknowledges that a volume of dry clothing may not correspond to the same volume of wet clothing in a clothes washer, because loosely packed clothing often compacts once it becomes wet. The maximum volume of a dry clothing load could vary considerably based on the density, stiffness, absorption, and other properties of the material composition. Therefore, DOE concludes that it is not meaningful to base the capacity measurement on the volume that dry clothes could occupy. Instead, the revised capacity measurement provisions in today's final rule, particularly those for top-loading clothes washers, more appropriately represent the actual usable volume of the clothes container during the active mode portion of washer operation. Today's final rule provides revised language in section 3.1 of appendix J2 that removes the qualification that the clothes load be dry, and instead specifies that the clothes load could occupy the volume during ''active mode washer operation.''

In determining the appropriate fill level for the capacity measurement, DOE notes that the current capacity guidance is accompanied by a set of diagrams illustrating Fill Level 3 for a variety of top-loading clothes washer tub cover designs. DOE has, however, observed significant variation in tub cover designs among products from different manufacturers, as well as within individual manufacturers' product lines, and DOE continues to receive requests for clarification on tub cover shapes not included in the diagrams. In addition, DOE has observed some tub covers with varying heights around the inner-most diameter, and in these cases, the ''highest point of the inner-most diameter'' may not be the most appropriate fill height. For these machines, determining the maximum fill level can require the subjective judgment of the test laboratory. DOE's testing indicates that Fill Level 2, as proposed in the September 2010 NOPR and defined as ''the uppermost edge of the rotating portion, including any balance ring,'' provides a much clearer reference point. DOE has observed significantly less variation in balance ring designs among manufacturers compared to tub cover designs. For these reasons, DOE has determined that Fill Level 2 offers greater clarity than Fill Level 3, which would also result in greater repeatability and reproducibility.

DOE also believes that the proposed Fill Level 2 is more consumer-relevant than Fill Level 3. DOE acknowledges that if a consumer loaded a top-loading machine with clothing as high as Fill Level 3 (or higher), the clothing would likely sink to a lower level within the clothes container as the load is wetted. DOE has observed, however, that virtually all of the clothes washer user manuals it reviewed direct the consumer to load clothing no higher than the highest drain holes in the wash basket, which typically corresponds to the point at which the wash basket meets the lower edge of the balance ring (corresponding to Fill Level 1 in Figure III.1). DOE believes that, by respecting manufacturer recommendations, Fill Level 1 would best ensure wash performance is maintained, and thus is the most consumer-relevant. DOE further believes that should clothing occupy the space between Fill Level 1 and Fill Level 2 during a wash cycle, the clothing could be cleaned sufficiently because water can still be contained within that volume. Clothing above Fill Level 2, however, is not likely to be cleaned sufficiently because it would be outside the wash basket during the wash cycle. Additionally, clothing that occupies space above Fill Level 2 risks being damaged if it becomes entangled on stationary fixtures such as the tub cover or other mechanical components of the washer during the wash cycle.

Furthermore, certain design changes to the shape of the inner diameter of the tub cover (Fill Level 3) can be incorporated that would result in an increase of the measured capacity with no corresponding increase in real-world usable capacity, because wash water cannot be contained between Fill Level 2 and Fill Level 3. Increasing the height of the balance ring (Fill Level 2), however, would correspond to a real increase in usable capacity from the consumer's perspective, since the wash water could be contained up to the top of the balance ring.

For these reasons, today's final rule adopts the clothes container capacity measurement provisions for top-loading clothes washers as proposed in the September 2010 NOPR. The change will be incorporated into appendix J2, which will not need to be used to demonstrate compliance until the compliance date of any amended standards for these products.

Whirlpool stated that, to achieve parity between top-loading and front-loading machines using the proposed clothes container capacity measurement, the test procedure when applied to front-loading clothes washers must (1) require removal of the bellows prior to measurement; and (2) require that the shipping bolts remain in place, as was specified in the capacity guidance, to prevent sagging of the basket when the machine is tipped on its back. (Whirlpool, No. 13 at p. 13; Whirlpool, Public Meeting Transcript, No. 20 at pp. 178–180) BSH stated that the definition of shipping bolts is not clear. (BSH, Public Meeting Transcript, No. 20 at p. 179).

For front-loading clothes washers, DOE agrees that the shipping bolts should remain in place during the capacity measurement to prevent the clothes container from sagging downward when filled with water, which would stretch the door gasket (also referred to as the bellows), creating additional volume that the clothes load could not occupy during actual washer operation. Downward sagging could also cause damage to the clothes container structure during the test. DOE has also determined that the gasket should remain in place for the capacity measurement, because some portion of the gasket may occupy the volume available for the clothes load when the door is closed, and this volume should be excluded from the measured capacity. For these reasons, today's final rule adds to the provisions proposed in the September 2010 NOPR by specifying that the shipping bolts and door gasket shall remain in place during the capacity measurement for front-loading clothes washers.

AHAM, the California Utilities, LG, NRDC, and Springboard commented that DOE should add diagrams to the test procedure for clarity in interpreting the clothes container capacity measurement, similar to what was provided in the capacity guidance. LG further stated that the diagram for top-loading clothes washers should label the balance ring to indicate the fill level. (AHAM, Public Meeting Transcript, No. 20 at pp. 174–175; California Utilities, No. 18 at pp. 4–5; LG, Public Meeting Transcript, No. 20 at pp. 177–178; NRDC, Public Meeting Transcript, No. 20 at p. 175; Springboard, No. 11 at p. 1) NRDC requested clarification as to whether the clothes container capacity for front-loading clothes washers should be measured with the door opened or closed. (NRDC, Public Meeting Transcript, No. 20 at pp. 161–165).

DOE has observed a broad range of designs and configurations of the key components of the clothes container among products already available on the market, and expects that other designs could be introduced in future clothes washers. DOE will continue to publish the fill level diagrams, updated as necessary for new designs, on its Web site at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/clothes_washers.html*.

6. Test Cloth, Detergent, and Preconditioning Test Equipment

Multiple interested parties submitted comments regarding the use of test cloth in response to the August 2009 standards framework document. Based on these comments, DOE proposed in the September 2010 NOPR a number of amendments related to test cloth, detergent, and other preconditioning test equipment.

DOE received multiple comments that generally responded to DOE's proposed test cloth provisions. AHAM submitted recommendations for test cloth specifications, and commented that DOE should incorporate them to improve reproducibility. (AHAM, No. 2 at p. 23; AHAM, No. 14 at p. 14) Some of AHAM's comments reflect the recommendations of the AHAM Energy Test Cloth Task Force, which was formed in February 2008 to identify and address appliance manufacturers' concerns pertaining to Lot 15 test cloth. The specific objectives of the AHAM Energy Test Cloth Task Force were to investigate test cloth consistency and RMC measurement process variation. The Task Force is comprised of BSH, Electrolux, General Electric, Samsung, Whirlpool Corporation, and SDL Atlas. (AHAM, No. 4 at p. 4) ALS stated that it supports AHAM's test cloth proposal. (ALS, No. 10 at p. 4) NEEA commented that the proposed test cloth procedures and specifications are reasonable. (NEEA, No. 12 at p. 13) Whirlpool supports the proposed test cloth changes with additional recommendations for extractor testing. (Whirlpool, No. 13 at p. 11–12) The sections below provide additional details regarding each proposed amendment related to the test cloth, as well as responses to comments on specific test cloth provisions proposed in the September 2010 NOPR and August 2011 SNOPR.

Test Cloth Definitions

In response to the September 2010 NOPR, AHAM commented that a test cloth ''lot'' should be defined as ''a quantity of cloth that has been manufactured with the same batches of cotton and polyester during one continuous process. The cotton and polyester for each lot can come from only one supplier. The supplier is responsible for manufacturing the raw materials consistently to ensure uniformity.'' AHAM also recommended that ''roll'' be defined as ''a subset of a lot.'' AHAM stated that a requirement should be added to section 2.6.1 that all energy test cloth must be permanently marked, identifying the roll number as well as lot number of the material, and that in section 2.6.5.2, ''[t]est loads shall be comprised of randomly selected cloth at the beginning, middle, and end of a lot.'' AHAM commented that the test procedure should contain test cloth quality control provisions for identifying the roll number and evaluating the consistency of the lot by means of an advisory board, which would approve the lot of test cloth prior to sale, ensuring that the coefficient of variation from the average RMC value from each roll would be less than 1 percent. According to AHAM, the advisory board would consist of a representative from DOE, AHAM, each automatic washer appliance manufacturer, and test cloth supplier, and that the board's purpose would be to review and approve each new test cloth lot, new cloth suppliers, and correction factor test facilities. (AHAM, No. 4 at p. 4; AHAM, No. 14 at pp. 14, 19–20, 23, 26, 28)

DOE's test procedure is intended to define material properties of the test cloth sufficiently narrowly as to ensure accuracy and repeatability of the test procedure, and provide procedures to normalize test results to account for allowable variations in the test cloth properties. DOE notes that a supplier may elect to provide additional identifying information, including roll number, on the test cloth as it deems appropriate. DOE agrees with AHAM that definitions of ''lot'' and ''roll'' would clarify the existing provisions regarding the energy test cloth, and is adopting in today's final rule the definition of lot as ''a quantity of cloth that has been manufactured with the same batches of cotton and polyester during one continuous process.'' The specification of ''same batches of cotton and polyester during one continuous process'' essentially requires these raw materials to come from a single supplier; therefore, DOE is not including such a qualification in the definition. DOE is also adopting in today's final rule the definition of ''roll'' as ''a subset of a lot.''

Energy Test Cloth Size and Weight Tolerances

The existing clothes washer test procedure does not specify any tolerances for the size and weight of the energy test cloths. In the September 2010 NOPR, DOE proposed the following tolerances for the test cloth:

- In section 2.6.1, ''Energy Test Cloth,'' the energy test cloth shall be 24 ± ½ inches by 36 ± ½ inches (61.0 ± 1.3 cm by 91.4 ± 1.3 cm) and hemmed to 22 ± ½ inches by 34 ± ½ inches (55.9 ± 1.3 cm by 86.4 ± 1.3 cm) before washing;
- In section 2.6.2, ''Energy Stuffer Cloth,'' the energy stuffer cloth shall be 12 ± ¼ inches by 12 ± ¼ inches (30.5 ± .6 cm by 30.5 ± .6 cm) and hemmed to 10 ± ¼ inches by 10 ± ¼ inches (25.4 ± .6 cm by 25.4 ± 0.6 cm) before washing; and
- In section 2.6.4.2, the fabric weight specification shall be 5.60 ± 0.25 ounces per square yard (190.0 ± 8.4 g/m²).

In addition, DOE proposed to create a new specification for maximum shrinkage in section 2.6.4.7 based on the American Association of Textile Chemists and Colorists (AATCC) Test Method 135–2004. DOE proposed to increase the previous shrinkage limit from four percent to five percent. In the August 2011 SNOPR, DOE proposed using the most recent version of this standard, AATCC Test Method 135–2010.

AHAM commented that the test cloth dimensional properties should be refined to match supplier capability, including length, width, fabric weight, and shrinkage properties. (AHAM, No. 4 at p. 4) DOE notes that the size tolerances and test cloth weight proposed in the September 2010 NOPR are identical to those in AHAM's proposed changes to the DOE clothes washer test procedure, which AHAM included as part of its written comment. AHAM noted in the written comment that these specifications were supported by supplier data, and thus DOE is adopting the proposed test cloth dimensions and weight in today's final rule.

AHAM supports DOE's proposal to add the newly referenced AATCC Test Method 135 for measuring shrinkage of the energy test cloth, and supports increasing the shrinkage limit from four percent to five percent. Today's final rule specifies a maximum shrinkage limit of five percent, to be measured using AATCC Test Method 135–2010. (AHAM, No., 14 at p. 16; AHAM, No. 24 at p. 5).

Detergent Specification and Dosage

In the September 2010 NOPR, DOE proposed amending the clothes washer test procedure to specify the use of the AHAM standard test detergent Formula 3 in test cloth preconditioning, at a dosing of 27.0 g + 4.0 g/lb.

ALS supported DOE's proposal to specify the use of AHAM standard detergent Formula 3 in test cloth preconditioning as well as the proposal to follow the instructions included with the detergent, because it makes the dosing identical to that of the dryer test load preconditioning procedure. (ALS, No. 10 at p. 5) NEEA stated that it foresees no problem with, and some benefit from, adopting the AHAM detergent specification. (NEEA, No. 12 at p. 14) Whirlpool stated that the proposed detergent formulation and dosage changes are consistent with AHAM Standard HLD–1–2009, which Whirlpool supports. (Whirlpool, No. 13 at p. 14; Whirlpool, No. 27 at p. 4) AHAM supported DOE's proposal to amend the test procedure to specify the use of AHAM standard test detergent Formula 3 in test cloth preconditioning at a dosing of 27.0 g + 4.0 g/lb (AHAM, No. 14 at p. 15; AHAM, Public Meeting Transcript, No. 20 at pp. 194–195; AHAM, No. 24 at p. 6).

For the reasons stated above and in the September 2010 NOPR, today's final rule specifies the use of AHAM standard test detergent Formula 3 in test cloth preconditioning, at a dosing of 27.0 g + 4.0 g/lb, in both appendix J1 and the new appendix J2.

Test Cloth Preconditioning Wash Requirements

Section 2.6.3.1 of the current DOE clothes washer test procedure specifies preconditioning the test cloths using a clothes washer in which the load can be washed for 10 minutes at the maximum water level and a wash temperature of 135 °F ± 5 °F (57.2 °C ± 2.8 °C).

DOE noted in the September 2010 NOPR that multiple manufacturers expressed concern during manufacturer interviews that there are currently few clothes washers commercially available that meet these requirements. The manufacturers also expressed concern that the more stringent energy conservation standards that may result from the residential clothes washer standards rulemaking may eliminate such clothes washer models from the market entirely. DOE did not propose any updates to the preconditioning clothes washer specifications in the September 2010 NOPR, but sought information regarding an alternative specification for the clothes washer to be used for preconditioning that would allow for the use of more recent models.

DOE received the following information and comments from interested parties regarding the clothes washer requirements for test cloth preconditioning.

ALS stated that clothes washers will be available after the next DOE minimum efficiency standards for clothes washers take effect that can adequately precondition the test cloth. ALS believes there is adequate time to learn of any differences that may occur with new clothes washer designs. Furthermore, ALS suggested that manufacturers and certification test labs could purchase and maintain inventory of the current design of agitator-style, vertical-axis clothes washers that ALS manufactures. (ALS, No. 10 at p. 5).

Whirlpool stated that top-loading clothes washers with a deep-fill rinse option will continue to be available for quite some time. Agitator-based models may no longer be viable at some point in the future, but impeller-based models should be available. (Whirlpool, No. 13 at p. 14).

AHAM stated that the key attributes for the clothes washer used for preconditioning are that it be able to achieve good rinsing and be able to get the test cloth to its final size. AHAM stated that there will be clothes washers capable of good rinsing and getting the test cloth to its final size at least through year 2018. AHAM stated that manufacturers may need to select a fabric softener cycle to achieve those goals, for example, but the goals are workable with current machines. (AHAM, No. 14 at p. 16).

BSH commented that it does not foresee any problems meeting the test cloth pre-conditioning method outlined by DOE. The method asks for maximum water level and a fixed temperature for wash and rinse water. BSH stated that it can internally create a clothes washer that meets the specified temperatures. BSH added that since maximum water level is not defined as a specific quantity, using the maximum water level for washing in BSH clothes washers would meet the standard. (BSH, No. 17 at p. 5; BSH, Public Meeting Transcript, No. 20 at p. 198–199) BSH commented further that it does not want to see one specific product model specified for pre-conditioning, as this would limit the ability to keep current equipment in laboratories. As the model is replaced in the market by its manufacturer, access and ability to test would be affected in all laboratories. BSH supports AHAM's comment that the primary goals are to achieve good rinsing and assure that the cloth reaches its final size before testing. (BSH, No. 17 at p. 5) As an alternative, BSH would support the IEC test cloth pre-conditioning method if the Department believes it to be appropriate. (BSH, No. 17 at p. 5).

NEEA commented that participants at the October 2010 public meeting generally agreed that the clothes washer characteristics specified for test cloth preconditioning may no longer be available, or will soon be unavailable. According to NEEA, it was not made clear by manufacturers at the meeting exactly which characteristics were a problem, *i.e.,* relatively high water temperature, a ten minute wash, or the ability to specify the water level. NEEA believes the best course of action would be to provide the rationale for the current specifications, and then propose an alternative set of clothes washer specifications that manufacturers could assure DOE will be commonly available, yet would result in preconditioning performance that closely approximates that of the current specification. (NEEA, No. 12 at p. 14; NEEA, Public Meeting Transcript, No. 20 at pp. 200–201).

DOE's intended goals for the test cloth preconditioning are to remove any chemical residues or other finishes that may be present on the surface of the test cloth and to subject each test cloth to a series of wash/rinse/dry cycles to induce any shrinking that may occur, so that each test cloth achieves its final size before being used for testing. Achieving these goals requires the use of detergent, an adequate quantity of hot water for the wash and cold water for the rinse, and a minimum temperature in the preconditioning dryer.

In consideration of comments from interested parties, DOE expects that clothes washers capable of meeting the test cloth preconditioning requirements will continue to be available after the revised energy efficiency standards for clothes washer become effective. Based on the recommendations provided by AHAM, DOE amends the test cloth preconditioning requirements to specify that a minimum of 20 gallons of water be used in each wash/rinse/spin cycle during test cloth preconditioning. However, DOE is not otherwise changing the preconditioning requirements of section 2.6.3.1.

AATCC Test Methods

Section 2.6.4.5.3 of the existing test procedure incorporates by reference standards for verifying the absence of water repellent finishes on the energy test cloth: AATCC Test Method 118–1997, ''Oil Repellency: Hydrocarbon Resistance Test'' and AATCC Test Method 79–2000, ''Absorbency of Textiles.'' To be consistent with referenced standards in other DOE test procedures, DOE proposed in the September 2010 NOPR to remove this paragraph from the clothes washer test procedure and, instead, include these two AATCC test procedures in 10 CFR part 430.3, ''Materials Incorporated by Reference.'' In addition, DOE proposed adding to 10 CFR part 430.3 the newly-referenced AATCC Test Method 135–2004, ''Dimensional Changes of Fabrics after Home Laundering'' for measuring shrinkage of the energy test cloth, which is referenced in section 2.6.4.7 of the revised test procedure.

AHAM supports DOE's proposal to move the reference to standards incorporated by reference from the test procedure in appendix J1 to the regulatory text at 10 CFR 430.3. The reference will also be applicable to appendix J2. (AHAM, No. 14 at p. 16)

For the reasons stated above and in the September 2010 SNOPR, today's final rule implements the changes proposed in the September 2010 NOPR, as described above. Today's final rule also corrects a typographical error from the November 2011 SNOPR in the mailing address for AATCC. The correct address is P.O. Box 12215. Today's final rule also updates the contact telephone number to (919) 549–3526, which is listed on the cover page of the current versions of the AATCC standards.

Required Extractor Tests

The current DOE test procedure uses extractor tests of up to 500 units of gravitational acceleration (g, or g-force) in determining the RMC correlation curve for test cloth lots. DOE is aware of clothes washers currently available on the market capable of reaching g-forces higher than 500 g.

DOE therefore proposed in the September 2010 NOPR to include an additional set of extraction tests at 650 g. Because of the prevalence of higher spin speeds in clothes washers available on the market, DOE also proposed to remove the requirement that the 500 g condition be required only if a clothes washer can achieve spin speeds in the 500 g range. These proposed amendments would result in 60 extractor RMC test runs being required for correlation testing rather than the currently-required 48. DOE also proposed to update Table 2.6.5—Matrix of Extractor RMC Test Conditions, and Table 2.6.6.1—Standard RMC Values (RMC Standard) in the test procedure to include tests at 650 g. The proposed updated Table 2.6.6.1 is shown below as Table III.5, and it contains the additional standard RMC values at 650 g that were suggested by AHAM and supported by the AHAM Energy Test Cloth Task Force.

TABLE III.5—STANDARD RMC VALUES (RMC STANDARD)—PROPOSED IN SEPTEMBER 2010 NOPR

"g Force"	RMC percentage			
	Warm soak		Cold soak	
	15 min. spin	4 min. spin	15 min. spin	4 min. spin
100	45.9	49.9	49.7	52.8
200	35.7	40.4	37.9	43.1
350	29.6	33.1	30.7	35.8
500	24.2	28.7	25.5	30.0
650	23.0	26.4	24.1	28.0

In response to the September 2010 NOPR, AHAM reiterated its recommendation to require the 500 g condition for all test cloth lots and to add a 650 g condition to the extractor RMC test runs to reflect higher spin speeds in current clothes washers. AHAM also supported the standard RMC values proposed for each of these extraction conditions. (AHAM, No. 4 at p. 4; AHAM, No. 14 at pp. 26–28).

Today's final rule is consistent with the September 2010 NOPR. It requires the 500 g extraction for all test cloth lots and adds a 650 g extraction test in Table 2.6.5 and Table 2.6.6.1 of the revised test procedure.

Extractor Specification

In the September 2010 NOPR, DOE proposed to update the manufacturer specified for the extractor from Bock Engineered Products to North Star Engineered Products, Inc. DOE also noted that North Star Engineered Products, Inc. operates at the same location and supplies the same model of extractor as the previously specified Bock Engineered Products.

AHAM and Whirlpool agreed that the standard extractor RMC tests should be run in a North Star Engineered Products, Inc. (formerly Bock) Model 215 extractor, but added that the basket diameter should be 20 inches and the basket height should be 11.5 inches. (AHAM, No. 14 at p. 26; Whirlpool, No. 13 at p. 11) AHAM and Whirlpool stated that the extractor should be calibrated to meet the acceleration profiles shown in Table III.6 (AHAM, No. 14 at p. 26; Whirlpool, No. 13 at p. 11):

TABLE III.6—AHAM AND WHIRLPOOL-RECOMMENDED EXTRACTOR CALIBRATION

RPM	"g" Force	RPM/S (spin-up acceleration)
594 ± 5	100	46 ± 3
840 ± 5	200	42 ± 3
1111 ± 5	350	38 ± 3
1328 ± 5	500	36 ± 3
1514 ± 5	650	35 ± 3

AHAM and Whirlpool stated that the timers for different extractors made by the same manufacturer start measuring time at different conditions; *i.e.,* they may start timing immediately when the extractor starts or they may start timing only when the requested spin speed is attained. AHAM and Whirlpool requested that DOE clarify the start time for extractor tests. (AHAM, No. 14 at p. 26; Whirlpool, No. 13 at p. 11).

DOE concurs with AHAM and Whirlpool that the extractor model and basket dimensions should be updated to accurately describe the North Star Engineered Products Inc., (formerly Bock) Model 215 extractor.

Regarding AHAM and Whirlpool's suggested extractor calibration, DOE agrees that the nominal revolutions per minute (RPM) listed in Table III.6 will produce the desired g-force levels for a 20-inch diameter basket. However, DOE's analysis indicates that specifying an allowable range of ±5 RPM would result in too large of a deviation from the specified g-force. Section 2.6.5.3.3 in the current test procedure allows a ±1 g deviation from the intended centripetal acceleration level for each extractor test, and today's final rule maintains this tolerance in the amended test procedure. DOE notes that for an extractor basket with a 20-inch diameter, a deviation of ±5 RPM at the 100 g-force level would result in a ± 2 g deviation in g-force level; (i.e., a spin speed of 599 RPM—instead of the nominal 595 RPM—would result in 102 g-force). Likewise, a deviation of ±5 RPM at the 650 g-force level would result in a ±4 g deviation in g-force level. Therefore, today's final rule specifies an allowable range of ±1 RPM for the extractor spin speed. This will ensure that the maximum ±1 g deviation from the intended g-force level will be maintained for each spin speed. Based on DOE's internal extractor testing, DOE has observed that the North Star Model 215 extractor is capable of maintaining the spin speeds within ±1 RPM.

AHAM and Whirlpool also suggested specifying the allowable spin-up time for each test, implicitly determined by the acceleration noted in the column labeled RPM/S in Table III.6. This suggestion was coupled with another to start the extractor and the test timer simultaneously. However, DOE has observed that the user is unable to adjust the spin-up time on the North Star Model 215 extractor, and therefore, specifying the spin-up time in the test procedure could provide too rigid of a constraint. Additionally, because the amount of water extracted depends primarily on the g-force exerted on the test cloth, and because the g-force varies as a function of the square of RPM, the period of time spent at full spin speed will affect the amount of water extracted much more than the time spent during the extractor spin-up and spin-down periods. Therefore, DOE believes that specifying the time spent at full spin speed is more important than specifying a total test time that would include the spin-up and spin-down time. For these reasons, today's final rule specifies that the timer shall begin when the extractor reaches the full required spin speed, but does not specify an allowable spin-up time for each test. DOE believes that this approach will provide the most consistent, repeatable test results among all laboratories. DOE is aware that the timer and control system on the North Star Model 215 extractor can be upgraded, if necessary, so that the timer automatically starts when the extractor reaches full speed.

Bone Dryer Specifications

In the September 2010 NOPR, DOE proposed to update the requirements for bone drying the test cloth in preparation for determining the RMC of the test loads in the extractor tests. The proposal included a requirement in section 2.12 for using a clothes dryer capable of heating the test cloth to above 210 °F (99 °C).

AHAM and Whirlpool suggested clarifications to the methodology for the bone drying procedure used before each extractor test run. According to AHAM, the procedure would state, ''Place dry load in a dryer and dry for 10 to 40 minutes depending on the load size. Remove and weigh before cool down. Continue drying for 10 minute periods until the weight change is 1% or less.'' AHAM and Whirlpool commented that the dryer performance requirements should state, ''Dryer used for bone drying must heat cloth above 210 deg F (99 deg C).'' AHAM added the recommendation to ''[r]ecord the end of cycle bone dry test cloth temperature at the end of the cycle.'' (AHAM, No. 14 at p. 26; Whirlpool, No. 13 at p. 11).

Based on AHAM and Whirlpool's comments in support of DOE's proposal, today's final rule adds a requirement that the dryer used for bone drying must heat the test cloth above 210 °F (99 °C). DOE determined that specifying the duration and methodology of the bone drying procedure to be used during the extractor tests, as AHAM suggested, would be redundant because the definition of ''bone-dry'' already includes this information. Today's final rule specifies the bone drying methodology to be used during the extractor tests by referring to the definition of ''bone-dry'' in the definitions section of the test procedure, which will achieve the same objective as AHAM's proposal.

Today's final rule does not incorporate AHAM's recommendation to record the bone-dry test cloth temperature at the end of the cycle. DOE believes that this would add additional test burden with little corresponding benefit to the overall results of the test procedure. The temperature measurement of the test cloth at the end of the dryer cycle would need to be performed immediately upon termination of the dryer cycle, before the test cloth could begin to cool down. This could present a logistical challenge depending on the sequence of tests and the number of laboratory technicians performing the tests. In addition, AHAM did not specify a method for measuring the temperature of the test cloths, which would be necessary to ensure accuracy and repeatability. DOE believes that the amended bone dryer temperature specification, combined with the definition of ''bone-dry'' already included in the test procedure definitions section, provide a sufficient level of detail for conducting the test cloth extractor tests.

Procedures for Preparing and Handling Test Cloth Bundles

In the September 2010 NOPR, DOE proposed clarifications to the requirements for bundling and draining the test cloth prior to completing the extractor spin cycles. These clarifications included procedures to create loose bundles of four test cloths each, as well as time limits of 5 seconds for gravity draining the bundles after soaking and 1 minute for overall draining and loading of all bundles into the extractor.

AHAM's comments on the September 2010 NOPR included additional recommended specifications for test cloth preparation. Regarding the soak period for the test cloth prior to extraction testing, AHAM suggested adding the requirement to maintain the temperature ''at all times between the start and end of the soak'' to the water soak temperature requirement currently in section 2.6.5.3.2 of appendix J1. (AHAM, No. 14 at p. 27).

AHAM further provided recommended clarifications for the test cloth used in the extractor tests. According to AHAM, the test load should be comprised of randomly selected cloth at the beginning, middle, and end of a lot, and that it would be acceptable to use two test loads for standard extractor RMC tests, with each load used for half of the total of 60 tests. AHAM commented that a testing constraint is the approximate 25-minute ''soak and load'' time for the test cloth, which results in the standard RMC extractor tests taking a week to complete. AHAM stated that with two loads, one load could be soaking while the other load was spinning. (AHAM, No. 14 at p. 26).

DOE supports AHAM's suggestion to add a requirement to maintain the required temperature at all times between the start and end of the soak, which will help eliminate variability in the extractor test results. Today's final rule incorporates this requirement. DOE also supports AHAM's suggestion that the test loads for the extractor tests be comprised of randomly selected cloth from the beginning, middle and end of a lot. This requirement will provide more consistent results and will reduce variability that could occur as a result of material variations within a single test cloth lot. DOE also concurs that allowing two test loads would significantly reduce the test burden required for performing the standard extractor RMC tests. Therefore, today's final rule allows the use of two test loads for the standard extractor RMC tests.

Based on recommendations from the AHAM Energy Test Cloth Task Force, DOE proposed in the September 2010 NOPR to specify that it not be necessary to dry the test load between extraction runs; however, the bone dry weight would need to be checked after every 12 extraction runs to ensure the bone dry weight is still within tolerance. In response to the September 2010 NOPR, AHAM noted that the first test cloth soak after bone drying absorbs less water. Therefore, AHAM suggested that the test procedure require the test load to be soaked and extracted one time following bone drying, before continuing with the remaining RMC tests. This single post-bone-drying extraction would be run at the speed currently being tested, and would last for four minutes. (AHAM, No. 14 at p. 27).

Based on AHAM's comment that the first test cloth soak after bone drying absorbs less water, DOE agrees that the first soak/extraction cycle after bone drying should not be used as a data point in the standard extractor RMC tests. Therefore, DOE adopts AHAM's suggestion and requires that the test load be soaked and extracted for one time following bone drying before continuing with the remaining RMC tests.

Clarification of the RMC Nomenclature and Application of the RMC Correction Curve

In the September 2010 NOPR, DOE proposed to modify the nomenclature used for RMC values that are intermediates in the calculation of a final RMC. The proposed change clarified that the RMC values used in section 3.8.4 of appendix J1 are the values obtained from either section 3.8.2 or 3.8.3. AHAM supports this modification. (AHAM, No. 14 at p. 16).

Additionally, during DOE's ENERGY STAR testing and verification program [12] in April 2011, test laboratories raised questions regarding the application of the RMC correction factors as described in section 2.6.7 of the current appendix J1 test procedure. Specifically, the test procedure does not explicitly describe how to apply the RMC correction factors in the RMC equations in section 3.8. For example, if the calculated value of RMC_{max} in section 3.8.2.5 is 0.455 (or 45.5%), a laboratory could incorrectly apply the correction factor by applying it to the number 45.5 rather than to the fractional value 0.455, to which it should be applied. In addition, for clothes washers with both cold and warm rinse, or with multiple spin speeds, the test procedure does not instruct whether to apply the RMC correction factors before or after combining the component RMC values in sections 3.8.3.3 or 3.8.4 of appendix J1.

To resolve this ambiguity, DOE clarifies the RMC nomenclature and RMC correction calculations throughout section 3.8 of the revised test procedure. Specifically, DOE explicitly defines the RMC correction equations and clarifies the order in which the RMC corrections should be performed for clothes washers with both cold and warm rinse and/or multiple spin speeds.

DOE has also discovered a typographical error in the formula given in section 2.6.6.1 of the test procedure. That formula and the accompanying text provide the means of deriving the linear least-squares coefficients A and B, which relate the extractor-measured RMC values of section 2.6.5 (RMC_{cloth}) and the standard RMC values in Table 2.6.6.1 ($RMC_{standard}$). Currently in appendix J1, section 2.6.6.1 includes the formula (RMC_{cloth}): $RMC_{standard} \sim A * RMC_{cloth} + B$. However, the notation "(RMC_{cloth}):" was incorrectly transcribed from a DOE report cited in the January 2001 standards Final Rule.[13] The correct version of the formula should be $RMC_{standard} \sim A * RMC_{cloth} + B$. Today's final rule corrects this error and clarifies that the $RMC_{standard}$ values are linearly related to the RMC_{cloth} values through the coefficients A and B. This correction and clarification apply to both appendix J1 and appendix J2.

In addition, DOE has observed that the description of the analysis of variance test to be performed in section 2.6.6.2 is not explicit about several key details of the analysis. Currently in appendix J1, section 2.6.6.2 states, "Perform an analysis of variance test using two factors * * *". Because an analysis of variance test can be performed in multiple ways, clarification is needed to specify that an analysis of variance "with replication" test should be performed. Additionally, the current provisions state, "The 'P' value in the variance analysis shall be greater than or equal to 0.1." Because several different P-values can be determined, clarification is needed to specify that the P-value in question is "the 'P' value of the F-statistic for interaction between spin speed and lot in the variance analysis." Finally, the current provisions of 2.6.6.2 state that " 'P' is a theoretically based probability of interaction based on an analysis of variance." This is technically incorrect; while "P" does represent a measure of interaction between spin speed and lot, it does not represent the probability of interaction between the two. DOE makes these corrections and clarifications in today's final rule to both appendix J1 and appendix J2. DOE notes that these corrections and clarifications are for technical accuracy only, and they will not change how these provisions of the test procedure are conducted.

Removal of Redundant Sections

The current test procedure contains redundant sections regarding the test cloth specifications and preconditioning. DOE proposed in the September 2010 NOPR to remove the redundant sections, currently numbered 2.6.1.1–2.6.1.2.4. These sections were made obsolete by the January 2001 standards Final Rule, which added sections 2.6.3 through 2.6.7.2 into appendix J1. However, DOE proposed to maintain the thread count specification from deleted section 2.6.1.1(A), of 65 × 57 per inch (warp × fill), by moving it to section 2.6.4.3.

AHAM and Whirlpool support deleting these obsolete sections and maintaining the thread count specification of 65 × 57 per inch (warp × fill) by moving it to section 2.6.4.3. (AHAM, No. 14, pp. 23–24; AHAM, No. 24 at p. 5; Whirlpool, No. 27 at p.4) Therefore, for the reasons stated in the September 2010 NOPR, DOE incorporates these changes into both appendix J1 and the new appendix J2 test procedure in today's final rule, as proposed in the September 2010 NOPR.

7. Testing Conditions

Water Supply Pressure

Section 2.4 of the current DOE clothes washer test procedure provides the water pressure test conditions, as follows: "The static water pressure at the hot and cold water inlet connection of the clothes washer shall be maintained at 35 pounds per square inch gauge (psig) ± 2.5 psig (241.3 kPa ± 17.2 kPa) during the test. The static water pressure for a single water inlet connection shall be maintained at the 35 psig ±2.5 psig (241.3 kPa ± 17.2 kPa) during the test. A water pressure gauge shall be installed in both the hot and cold water lines to measure water pressure."

DOE notes that this description is ambiguous as to whether the nominal 35 psig water pressure is to be set under static (non-flow) conditions and allowed to drop during flow due to the head losses in the line, or whether the 35 psig is to be maintained continuously under all flow conditions during the test.

In the September 2010 NOPR, DOE discussed the test results from a sample of front- and top-loading clothes washers that indicated that water supply pressure can affect water consumption during a wash cycle, and the effect of water supply pressure on total water use can vary depending on the temperature settings selected. For tests at 10, 20, and 35 psig water supply pressure under flow conditions, water consumption varied by 10–30 percent among the different pressure conditions for either hot wash/cold rinse or cold wash/cold rinse cycles.

DOE noted that the test procedures for other residential appliances specify the 35 psig requirement as being applicable under flow conditions. For example, section 2.4 of the DOE test procedure for dishwashers (10 CFR part 430 subpart B, appendix C) specifies to "maintain the pressure of the water supply at 35 ± 2.5 pounds per square inch gauge (psig) when the water is flowing." Dishwashers and clothes washers would likely have the same water supply pressure when installed in a house, so

[12] Details about DOE's ENERGY STAR testing and verification program available at *http://www1.eere.energy.gov/buildings/appliance_standards/energy_star_testing_verification.html*.

[13] The January 2001 standards Final Rule cited a DOE report titled, "Development of a Standardized Energy Test Cloth for Measuring Remaining Moisture Content in a Residential Clothes Washer," published in May 2000. See 66 FR 3314, 3317.

the test procedures for these products should include consistent water supply pressure specifications. DOE noted, however, that the test data suggested a water supply pressure of 20 psig under flow conditions for the most consistent water use among different cycles for a given clothes washer. DOE's analysis indicated that 20 psig may represent typical static pressure under flow conditions that would result from 35 psig at non-flow conditions, and that these conditions may be more representative of water supply conditions that would be found in typical residential settings.

In the September 2010 NOPR, DOE did not propose to specify water supply pressure more closely. DOE asked for stakeholders to provide any relevant information about the conditions under which clothes washers are currently tested, and invited comment on the appropriate specification of the water supply pressure. DOE received the following information and comments from interested parties regarding the water supply pressure requirements in the existing clothes washer test procedure.

ALS and AHAM support retaining the current specifications for static water supply pressure. ALS and AHAM suggested that DOE specify a ''dynamic water pressure'' of 35 psi ± 2.5 psi. AHAM stated that dynamic water pressure affects the test results, and ALS stated that dynamic water pressure is the most important water supply pressure. (ALS, No. 10 at p. 5; AHAM, No. 14 at p. 16).

Springboard stated that clothes washers with higher flow rates could require extra-high water pressure to regulate the pressure to 35 psi during water fill. (Springboard, No. 11 at p. 3).

NEEA stated that water pressure should be specified under flow conditions (not static pressure), and the value should be the same as for the dishwasher test procedure (35 psi). NEEA presented data from research conducted by the American Water Works Association (AWWA) that indicates a range of average water system static pressures from 45 psi to 80 psi, with occasional outliers. According to NEEA, discussions with rural water systems contractors suggest normal system pressure setpoints of 25 and 55 psi for pump on and pump off, respectively. NEEA further stated that studies of municipal water system pressures tend to find a static pressure range of 45 to 100 psi, depending on where in the system one measures. NEEA stated that because municipal water system pressures are designed to maintain pressure under high flow rates at fire hydrants and standpipes, communities are unlikely to have flowing pressure conditions less than 35 psi. Therefore, NEEA believes that 35 psi is a reasonable estimate for most residential households. (NEEA, No. 12 at pp. 14–15; NEEA, Public Meeting Transcript, No. 20 at pp. 203–204) Whirlpool commented that it supports 35 psi ± 2.5 psi under ''dynamic flow conditions.'' (Whirlpool, No. 13 at p. 14).

The Joint Commenters commented that a static pressure under non-flow conditions of 35 psi is significantly lower than actual system operating pressures. They stated that a test rig calibrated to maintain a static pressure of 35 psi will yield a flowing water pressure that is significantly less than 35 psi. The Joint Commenters also noted that the California-American Water Company reports one small sub-district with an operating pressure of 40 psi, while all other service areas have average operating pressures of 60 to 80 psi. They also observed that the Philadelphia Water Department reported an average operating pressure of 55 psi during fiscal year 2008. The Joint Commenters believe that a water supply test pressure of 35 psi under flow conditions would better represent typical water supply pressures found in homes, and would align the clothes washer test procedure with the dishwasher test procedure. The Joint Commenters further commented that DOE's proposed definition of water pressure contains both ''static'' and ''flowing'' in the same sentence. NRDC suggested that the word ''static'' be removed from the definition to remove ambiguity and a potentially significant source of unintended variation in test results. (Joint Commenters, No. 16 at pp. 8–9; Joint Commenters, No. 23 at pp. 5–6).

The California Utilities recommend that DOE clarify whether the water supply pressure specified in the proposed test procedure should be maintained at flow or non-flow conditions. The California Utilities also recommend that DOE specify that the water supply pressure be maintained at 35 psig when the water is flowing, which will maintain consistency with the dishwasher test procedure. The California Utilities stated that this would be an appropriate water pressure for much of the residential sector across the country. (California Utilities, No. 18 at p. 5).

DOE notes that nearly all interested parties recommended specifying a water pressure of 35 psi during water flow conditions. DOE further notes that the clothes washer water consumption will be most heavily affected by the water pressure during flow conditions rather than the water pressure during non-flow conditions. Therefore, DOE agrees that the water pressure specification should be specified during flow conditions.

DOE recognizes that the term ''pressure'' must be further qualified to remove ambiguity regarding the water supply conditions. In referring to the pressure in fluid systems, ''static'' does not imply that the fluid is stationary; rather, the term ''static'' represents the pressure exerted in all directions by the fluid. Static pressure is the type of pressure most commonly measured by typical instrumentation. When the water is stationary, the static pressure is highest and represents the total pressure in the system. As the water begins flowing, some of the static pressure is converted to ''dynamic pressure,'' which is the kinetic energy of the fluid per unit volume. Thus, during flow conditions, the static pressure decreases at the same time that dynamic pressure increases.

Because the intent of the test procedure is to specify the typically measured pressure of the water during flow conditions, DOE believes that the definition it proposed in the September 2010 NOPR correctly specifies measuring the static water pressure while the water is flowing. Removing the term ''static water pressure'' could create ambiguity about which type of water pressure should be measured (*i.e.,* static pressure, dynamic pressure, or total pressure). Similarly, replacing the term ''static water pressure'' with ''dynamic water pressure'' could result in an incorrect measurement being performed, since ''dynamic water pressure'' has a different, specific meaning in the context of fluid flow and is not equivalent to the pressure typically measured during flow conditions. For these reasons, today's final rule incorporates the change to the water pressure specification in the new appendix J2 test procedure as proposed in the September 2010 NOPR.

Water Inlet and Drain Hoses

In response to the September 2010 NOPR, Whirlpool commented that appendix J2 should adopt three additional test setup requirements that can affect water and energy consumption. First, Whirlpool suggested that the length of the inlet water hoses be defined as the standard hose length of 48 inches, as this would avoid an inadvertent impact on hot water usage. Second, Whirlpool suggested that the length of the drain hose should be defined as not to exceed 72 inches. Third, Whirlpool suggested that the drain pipe height should be between 38 and 54 inches. Whirlpool stated that adoption of these specifications will significantly reduce variation between laboratories. (Whirlpool, No. 13 at p. 14).

DOE notes that Section 2.1 of the test procedure requires the clothes washer to be installed in accordance with manufacturer's instructions, which would include installation of the water inlet and drain hoses supplied with each new clothes washer. Therefore, DOE believes the test procedure should not separately specify the length of the inlet and drain hoses. Regarding the height of the drain pipe, DOE has no data with which to evaluate Whirlpool's suggested height requirement. Therefore, DOE is unable to determine the impact on test results due to the height of the drain pipe. For these reasons, today's final rule does not adopt Whirlpool's suggested requirements regarding water inlet and drain hoses.

8. Clarifications and Corrections

Correction of Cold Rinse Definition

After the publication of the September 2010 NOPR, DOE became aware of an error in the definition of ''cold rinse'' in the test procedure at appendix J1. Specifically, cold rinse is defined in section 1.22 of appendix J1 as ''the coldest rinse temperature available on the machine (and should be the same rinse temperature selection tested in 3.7 of this appendix).'' However, section 3.7 of appendix J1 contains provisions for testing warm rinse, which instruct that such tests be conducted with the hottest rinse temperature available. Thus, section 3.7 is inapplicable to the definition of cold rinse in section 1.22. In the August 2011 SNOPR, DOE proposed to remove reference to section 3.7 in the definition of cold rinse in both section 1.22 of appendix J1 and proposed section 1.7 of appendix J2.

Whirlpool and AHAM agree with DOE's proposal to correct the definition of cold rinse. (Whirlpool, No. 27 at p. 4; AHAM, No. 24 at p. 3) DOE received no comments on these revisions. Therefore, for the reasons stated above and in the August 2011 SNOPR, DOE incorporates these changes into the amendments to the appendix J1 test procedure and the new appendix J2 test procedure in today's final rule as proposed in the August 2011 SNOPR.

Clarification of Wash Time Setting for Electromechanical Dials

Section 2.10 of the current test procedure specifies the wash time setting to be used in the energy test cycle. If only one wash time is prescribed in the energy test cycle, that wash setting is to be used; otherwise, the wash time setting is required to be the higher of either the minimum wash time or 70 percent of the maximum wash time available in the energy test cycle. As described in the August 2011 SNOPR, DOE has become aware that, for certain clothes washers equipped with an electromechanical dial to control wash time, the dial may yield different results for the same setting depending on the direction in which the dial was turned to reach that setting. DOE's internal testing indicates that that consistency in setting the wash time in such cases may be achieved by resetting the dial to the minimum wash time and then turning it in the direction of increasing wash time to reach the desired setting. If the desired setting is passed, the dial should not be turned in the direction of decreasing wash time to reach the setting. Instead, the dial should be returned to the minimum wash time and then turned in the direction of increasing wash time until the desired setting is reached. In the August 2011 SNOPR, DOE proposed to add these clarifications to the provisions for setting the wash time in both appendix J1 and appendix J2.

To provide further consistency, DOE also proposed the additional clarification that the conditions stated in the case of more than one wash time setting—that the wash time setting shall be the higher of either the minimum, or 70 percent of the maximum wash time available in the energy test cycle—shall apply regardless of the labeling of suggested dial locations.

Springboard stated that use and care manuals sometimes do not prescribe a wash time for each cycle. Springboard also commented that currently the appendix J1 test procedure does not specify whether the 70 percent wash time provision applies to machines with electromechanical or electronic controls. Springboard questioned whether a default setting on the machine should be used, or whether the cycle and time labeled in bold on the control panel should be the prescribed setting. Springboard further noted that on a mechanical dial, it is not always possible to achieve the same wash time setting. (Springboard, No. 11 at p. 3).

AHAM does not oppose DOE's proposed clarifications to appendices J1 and J2 regarding the wash time setting. (AHAM, No. 24 at p. 4) ALS supports DOE's proposal to achieve consistency in obtaining the wash time setting on machines with electromechanical dials. ALS stated that the proposed changes would reduce variability in test results. Furthermore, ALS supports the proposal to add the phrase ''regardless of the labeling of suggested dial locations'' to clarify the existing requirement that ''the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available in the energy test cycle.'' (ALS, No. 22 at p. 3).

DOE has observed that clothes washers with electronic controls have a default wash time setting for each cycle; this default time would be considered the ''prescribed'' wash time setting. Therefore, the provision stating ''the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available in the energy test cycle'' applies only to electromechanical controls, where the user is required to manually set the wash time by turning the wash setting dial. DOE's proposal would clarify that this wash time requirement would apply ''regardless of the labeling of suggested dial locations.'' This would include any labels in bold or other markings suggesting particular locations on the dial.

DOE received no comments objecting to its proposed revisions regarding the wash time setting provisions of the test procedure. Therefore, for the reasons discussed above, DOE incorporates these changes into the amendments to the appendix J1 test procedure and the new J2 test procedure in today's final rule.

Clarification of Cold Wash Definition

As described in the August 2011 SNOPR, DOE has observed multiple clothes washer models that offer a ''tap cold'' wash temperature setting in addition to a ''cold'' wash temperature setting. DOE proposed to clarify how to classify these temperature selections in appendix J1 and appendix J2.

Section 3.6 of appendix J1 defines the cold wash selection as ''the coldest wash temperature selection available.'' Additionally, section 1.18 of appendix J1 defines ''warm wash'' as ''all wash temperature selections below the hottest hot, less than 135 °F, and above the coldest cold temperature selection.'' In some cases with these models, DOE has observed that the ''cold'' setting mixes in hot water to raise the temperature above the cold water supply temperature, as defined in section 2.3 of appendix J1. In such cases, DOE proposes that the manufacturer specified ''cold'' setting should be considered a warm wash, as defined in section 1.18 of appendix J1 and section 1.34 of appendix J2; and that the ''tap cold'' setting should be considered the cold wash, as defined in section 3.6 of both appendix J1 and appendix J2. In cases where the ''cold'' setting does not add any hot water for any of the test loads required for the energy test cycle, the ''cold'' setting should be considered the cold wash; and the ''tap cold'' setting would not be required for testing.

AHAM, Whirlpool, and NEEA support the proposed clarification regarding cold wash temperature selection (AHAM, No. 24 at p. 4; Whirlpool, No. 27 at p. 3; NEEA, No. 26 at p. 7). DOE received no comments objecting to its proposed revisions regarding the clarification of the cold wash temperature. Therefore, for the reasons discussed above, DOE incorporates these changes into the amendments to the appendix J1 test procedure and the new J2 test procedure in today's final rule.

Removal of Obsolete Note in Water Factor Calculation Section

In the current test procedure at appendix J1, section 4.2 provides instructions for calculating the water consumption of clothes washers. Currently, this section includes the following note:

(The calculations in this Section need not be performed to determine compliance with the energy conservation standards for clothes washers).

EPCA established a water factor standard for top-loading and front-loading standard-size residential clothes washers, so this note is now obsolete. The calculations in section 4.2 must be performed to determine compliance with energy conservation standards for these product classes. Today's final rule removes this note in both appendix J1 and appendix J2.

Correction of Typographical Error in Hot Water Consumption Calculation

Section 4.1.4 of the existing clothes washer test procedure calculates the total per-cycle hot water energy consumption using gas-heated or oil-heated water. The equation listed in this section contains a clerical error in the symbol for total weighted per-cycle hot water energy consumption. In the September 2010 NOPR, DOE proposed amending the equation in this section to replace the incorrect symbol, H_T, with the correct symbol, HE_T. DOE would apply this amendment to both existing appendix J1 and new appendix J2.

AHAM supports DOE's proposed correction to the symbol for total weighted per-cycle hot water energy consumption. (AHAM, No. 14 at p. 16) DOE received no comments objecting to this revision. Therefore, for the reasons stated above, DOE incorporates these changes into the amendments to the appendix J1 test procedure and the new J2 test procedure.

Removal of Energy Factor Calculation

Section 4.5 of the current clothes washer test procedure provides for the calculation of Energy Factor (EF). EF was the energy efficiency metric used to establish energy conservation standards for clothes washers manufactured before January 1, 2004. (10 CFR 430.32(g)) This metric is no longer used to determine compliance with energy conservation standards, or in any other related metrics. Therefore, DOE proposed in the September 2010 NOPR to remove the obsolete calculation of EF from the clothes washer test procedure.

AHAM supports DOE's proposal to remove the obsolete calculation of EF from the clothes washer test procedure. (AHAM, No. 14 at p. 17) DOE received no comments objecting to this revision. Therefore, for the reasons stated above, DOE incorporates this change into the amendments to the appendix J1 test procedure and the new appendix J2 test procedure.

Clarification of Waiver Field Test Equation

In response to the August 2011 SNOPR, AHAM commented that section 6.2 of the test procedure regarding field testing needs clarification. AHAM stated further that the equation in section 6.2 is confusing. (AHAM, No. 24 at p. 6)

Section 6.2 in the appendix J1 test procedure provides describes one possible method for determining the energy consumption of a clothes washer with a nonconventional wash system. Generally, the method described in this section involves field testing both the nonconventional clothes washer as well as a conventional clothes washer; developing a scaling factor by comparing the conventional clothes washer's rated energy consumption and field test energy consumption; and applying this scaling factor to the nonconventional clothes washer to determine an appropriate rating based on its field test results.

The equation provided in Section 6.2 was created when EF was the only metric used to determine compliance with energy conservation standards for clothes washers. Therefore, it does not include provisions for measuring the energy required for moisture removal (*i.e.,* drying energy), which is a component of MEF, or for measuring the water consumption factor. Therefore, this equation is no longer applicable and should be removed. Today's final rule amends Section 6.2 in both appendix J1 and the newly created appendix J2 by removing the specific example, including the equation, and modifying the general provisions so that the section is applicable to MEF and WF. The amendment to appendix J2 contains an additional instruction to measure standby and off mode power according to the provisions in the relevant sections of the test procedure.

Clarification of Water Factor Terminology

DOE notes the use of inconsistent terminology to describe the water consumption factor (or water factor) among the clothes washer test procedure, clothes washer energy conservation standards, annual operating cost calculations, and certification, compliance, and enforcement requirements for clothes washers.

The clothes washer energy conservation standards use the terminology ''water factor,'' and DOE has observed that the term ''water factor'' has been used more often than ''water consumption factor'' during previous rulemakings and within public comments submitted by interested parties. DOE has also observed that ''water factor'' is the term most commonly used within the clothes washer industry. Therefore, today's final rule replaces the term ''water consumption factor'' with ''water factor'' in the appendix J1 test procedure, the newly created appendix J2 test procedure, and the annual operating cost calculations for clothes washers in 10 CFR 430.23(j). In addition, today's final rule replaces the abbreviation ''WCF'' with ''WF'' in the appendix J1 test procedure and the newly created appendix J2 test procedure.

9. Test Procedure Performance Specifications

In response to the August 2009 standards framework document, DOE received multiple comments in support of adding performance measures to the clothes washer test procedure, which it addressed in the September 2010 NOPR. DOE carefully considered these comments but did not propose to incorporate measures of wash performance into the clothes washer test procedure. DOE noted that EPCA states ''[a]ny test procedures prescribed or amended under this section shall be reasonably designed to produce test results which measure energy efficiency, energy use * * * or estimated annual operating cost of a covered product during a representative average use cycle or period of use * * * and shall not be unduly burdensome to conduct.'' 42 U.S.C. 6293(b)(3). DOE stated, however, that it would consider wash performance and related impacts to consumer utility in developing any future energy conservation standards for residential clothes washers.

In response to the September 2010 NOPR, DOE received multiple comments regarding the inclusion of performance measures in the clothes washer test procedure. AHAM and NEEA support DOE's proposal to not incorporate wash performance into the test procedure. AHAM stated that DOE should consider it later should data on the feasibility of incorporating a measure of wash performance become available. NEEA commented that there is no justification for including such metrics in a test procedure, which is required by EPCA to measure energy and water use and to provide a means to estimate annual operating cost. (AHAM, No. 14 at p. 17; NEEA, No. 12 at p. 15) ALS stated that generally, the residential clothes washer test procedure is adequate for measuring energy consumption and water consumption of both residential and commercial clothes washers, as long as the minimum efficiency standard for commercial clothes washers takes into account the consumer utility needed for the commercial washer application. (ALS, No. 10 at p. 6).

BSH commented that wash performance should be included, and that the clothes washer should be rated based on the quantity of laundry can successfully be washed rather than the physical size of the clothes container. (BSH, No. 17 at p. 4; BSH, Public Meeting Transcript, No. 20 at p. 211) BSH stated that manufacturer-rated load weight accompanied by performance assessments are the only way to fairly compare top-load and front-load clothes washer capabilities. (BSH, No. 17 at p. 4).

China commented that the testing conditions proposed by DOE for various temperature settings are different than the test conditions required by IEC Standard 60456, ''Clothes washing machines for household use–Methods for measuring the performance,'' Edition 5.0. China recommended that DOE apply the same test conditions as IEC Standard 60456, or specify testing temperatures by referencing IEC Standard 60456 test conditions, to avoid creating unnecessary barriers to trade. China stated that IEC Standard 60456 test conditions establish a clear value for the supply water temperatures, compared to the range of water temperatures provided in DOE's proposed rule, and that this could lead to confusion. (China, No. 19 at p.4).

In response, DOE reiterates that it currently considers any lessening of the utility or the performance of a covered product likely to result from the imposition of any energy conservation standard. 42 U.S.C. 6295(o)(2)(B)(i)(IV) Furthermore, DOE may not prescribe a standard that is likely to result in the unavailability in the United States of performance characteristics, including reliability. 42 U.S.C. 6295(o)(4) As stated above, EPCA requires that DOE test procedures must be reasonably designed to produce test results that measure energy efficiency, energy use, water use in specified instances, or estimated annual operating cost of a covered product during a representative use cycle or period of use. 42 U.S.C. 6293(b)(3).

D. Annual Operating Cost Calculation

DOE did not propose in the September 2010 NOPR to amend the estimated annual operating cost calculation in 10 CFR 430.23 to include the cost of energy consumed in the non-active washing modes. DOE noted that the cost of energy consumed in self-clean, standby, off, delay start, and cycle finished modes is small relative to the total annual energy cost for clothes washers and, therefore, would make little difference in the estimated annual operating cost calculation. In addition, the Federal Trade Commission's (FTC's) EnergyGuide Label for clothes washers includes as its primary indicator of product energy efficiency the estimated annual operating cost, compared to a range of annual operating costs of similar products. Appendix F1 to 16 CFR part 305. An estimated annual operating cost incorporating self-clean, standby, off, delay start, and cycle finished mode energy use would no longer be directly comparable to the minimum and maximum energy costs currently prescribed for the EnergyGuide Label.

Upon further consideration, DOE proposed in the August 2011 SNOPR to amend the annual energy cost calculations to include the cost of energy consumed in non-active washing modes. As discussed in the August 2011 SNOPR, EPCA requires that 180 days after the amended test procedure is prescribed, all representations related to the energy use, efficiency, or cost of energy consumed for residential clothes washers must reflect the results of testing according to the amended test procedure. 42 U.S.C. 6293(c)(2) Also, the definition of ''estimated annual operating cost'' is the aggregate retail cost of the energy likely to be consumed annually in representative use of a consumer product, determined in accordance with section 6293 of this title. 42 U.S.C. 6291(7) The test procedure established in today's final rule includes provisions for measuring standby and off mode energy use. Additionally, EPCA requires that any revisions to the labels for residential clothes washers include disclosure of the estimated annual operation cost (determined in accordance with DOE's test procedures prescribed under section 6293 of EPCA), unless the Secretary determines that disclosure of annual operating cost is not technologically feasible, or if the FTC determines that such disclosure is not likely to assist consumers in making purchasing decisions or is not economically feasible. 42 U.S.C. 6294(c)(1).

DOE received additional comments from interested parties in response to its proposal in the August 2011 SNOPR. AHAM opposes revision of estimated annual operating cost to incorporate standby, off and self-clean modes. AHAM stated that the cost of energy associated with each individual mode makes little difference in the annual operating cost. AHAM claims the increased test burden in measuring these modes and incorporating them in the annual energy cost is not justifiable. AHAM further stated that if, however, DOE revises the estimated annual operating cost calculation, DOE and FTC should provide adequate time for collection of data on operating costs before the new integrated approach goes into effect. (AHAM, No. 24 at p. 3) NEEA agrees with DOE's proposal to include non-active washing mode energy use in the calculation of energy cost. (NEEA, No. 26 at p. 7).

DOE notes that the revised test procedure at appendix J2 implements the ''alternate approach'' for measuring standby and off mode energy use, which minimizes the additional test burden required for performing these measurements. In addition, the revised test procedure does not require measurement of self-clean mode.

For the reasons stated in the August 2011 SNOPR, DOE amends the annual energy cost calculations in 10 CFR part 430.23 for residential clothes washers to include the cost of energy consumed in standby and off modes. Therefore, today's final rule amends the clothes washer test procedure to revise the estimated annual operating cost calculation to integrate standby and off mode energy use, as proposed in the August 2011 SNOPR.

E. Revisions to Appendix J1

The following sections describe amendments to the current appendix J1 in today's final rule. These changes are discussed in more detail previously but are set forth here to clearly describe those changes that are applicable to appendix J1, use of which is currently required to demonstrate compliance with existing energy conservation standards. In any rulemaking to amend a test procedure, DOE must determine to what extent, if any, the proposed test procedure would alter the measured energy efficiency of any covered product as determined under the existing test procedure. 42 U.S.C. 6293(e)(1) If DOE determines that the amended test procedure would alter the measured efficiency of a covered product, DOE must amend the applicable energy conservation standard accordingly. 42 U.S.C. 6293(e)(2) DOE has determined that none of the following amendments to appendix J1 would alter the measured efficiency of residential clothes washers. The amendments to appendix J1 are effective 30 days after publication of this final rule in the **Federal Register**.

1. Revision of Introductory Text

Today's final rule revises the introductory text of appendix J1 after the appendix heading to note that manufacturers may continue to use appendix J1 until the compliance date of any amended standards that address standby and off mode energy consumption for residential clothes washers. After this date, all residential clothes washers shall be tested using the provisions of appendix J2. This introductory note is also included at the beginning of appendix J2.

2. Correction of Typographical Errors in Materials Incorporated by Reference

The current DOE test procedure at appendix J1 contains an incorrect mailing address in section 2.6.4.5.3(b) for the American Association of Textile Chemists and Colorists. The correct address is P.O. Box 12215. Today's final rule corrects this typographical error. Today's final rule also updates the contact telephone number to (919) 549–3526, which is listed on the cover page of the current versions of the AATCC standards.

3. Correction of Cold Rinse Definition

As discussed previously in section III.C.8.a, today's final rule corrects the definition of cold rinse in section 1.22 of appendix J1 by removing the incorrect reference to section 3.7.

4. Removal of Redundant Sections

As discussed previously in section III.C.6.k, this final rule removes the redundant sections 2.6.1.1–2.6.1.2.4 in appendix J1, which were made obsolete by the 2001 Final Rule. Today's final rule also maintains the thread count specification from deleted section 2.6.1.1(A), of 65 x 57 per inch (warp x fill) by moving it to section 2.6.4.3.

5. Detergent Specification and Dosage

As discussed previously in section III.C.6.c, this final rule specifies the use of AHAM standard test detergent Formula 3 in test cloth preconditioning, at a dosing of 27.0g + 4.0g/lb.

6. Wash Time Setting for Electromechanical Dials

As discussed previously in section III.C.8.b, this final rule adds clarification to the wash time setting provisions in section 2.10 of appendix J1 to help ensure consistency when setting the wash time on clothes washers with electromechanical dials.

7. Clarification of Cold Wash Definition

As discussed previously in section III.C.8.c, this final rule adds clarification to the cold wash definition in section 3.6 of appendix J1 for clothes washers that offer a ''tap cold'' wash temperature setting in addition to a ''cold'' wash temperature setting.

8. Removal of Obsolete Note in Water Factor Calculation Section

As discussed previously in section III.C.8.d, this final rule removes an obsolete note in section 4.2 of appendix J1, which states that the water factor calculations need not be performed to determine compliance with the energy conservation standards for clothes washers.

9. Clarification of Water Factor Terminology

As discussed previously in section III.C.8.h, this final rule replaces the term ''water consumption factor'' with ''water factor'' in sections 1.19 and 4.2.3 of appendix J1.

10. Correction of Typographical Error in Hot Water Consumption Calculation

As discussed previously in section III.C.8.e, this final rule amends the equation in section 4.1.4 of appendix J1 to replace the incorrect symbol, H_T, with the correct symbol, HE_T.

11. Extension of Test Load Size Table

As discussed previously in section III.C.3.b, this final rule extends Table 5.1 in appendix J1 to accommodate clothes washers with capacities up to 6.0 cubic feet.

12. Clarification of Waiver Field Test Equation

As discussed previously in section III.C.8.g, this final rule modifies the provisions in section 6.2 in appendix J1 by removing the specific example, including the equation, and modifying the general provisions so that the section is applicable to MEF and WF.

13. Corrections to Provisions for Calculating the RMC Correction Curve

As discussed previously in section III.C.6.j, this final rule corrects typographical and transcription errors in the formula given in section 2.6.6.1 of appendix J1. This final rule also amends the description of the analysis of variance test to be performed in section 2.6.6.2 to make the analysis details more explicit and technically accurate.

F. Removal of Obsolete Test Procedure at Appendix J

In the September 2010 NOPR, DOE proposed to delete appendix J to subpart B of 10 CFR part 430 along with all references to appendix J in 10 CFR 430.23. Appendix J applies only to clothes washers manufactured before January 1, 2004 and is therefore obsolete. Appendix J1 to subpart B of 10 CFR part 430 provides an applicable test procedure for all clothes washers currently available on the market. DOE proposed to maintain the current naming of appendix J1, rather than renaming it as appendix J, and to establish new appendix J2 to simplify the changes required.

NEEA supports DOE's proposal to eliminate appendix J and to add appendix J2. (NEEA, No. 12 at p. 16) Therefore, for the reasons discussed above, DOE eliminates appendix J along with all references to appendix J.

G. Compliance With Other EPCA Requirements

1. Test Burden

As noted previously, under 42 U.S.C. 6293(b)(3), EPCA requires that ''[a]ny test procedures prescribed or amended under this section shall be reasonably designed to produce test results which measure energy efficiency, energy use * * * or estimated annual operating cost of a covered product during a representative average use cycle or period of use * * * and shall not be unduly burdensome to conduct.'' DOE tentatively concluded in the September 2010 NOPR that amending the relevant DOE test procedures to incorporate clauses regarding test conditions and methods found in IEC Standard 62301, along with the proposed modifications to the active washing mode test procedure, would satisfy this requirement.

DOE received numerous comments regarding test burden in response to the September 2010 NOPR. DOE addressed some of these comments specifically related to delay start mode and cycle finished mode test burden in the August 2011 SNOPR. DOE responds to the remaining comments here.

Whirlpool stated that the proposed measurement of energy and water consumption in delay start, cycle finished, self-clean, off modes, additional rinses, etc. would increase manufacturer test burden by as much as 25 percent. Whirlpool commented that it does not have sufficient ''slack'' capacity to manage such an increase in test burden because its laboratories are currently operating at full capacity on two shifts. Whirlpool stated that the cost of utilizing third-party laboratories for this added testing would be substantial and could exceed $500,000 annually. Whirlpool added that the proposed revision of the energy test cycle definition could double or quadruple the length of the test process for any clothes washer for which Part (B) of the proposed energy test cycle definition applies. Whirlpool believes that this additional test burden would not be justifiable. (Whirlpool, No. 13 at pp. 1, 13).

AHAM commented that additional measurements required by the proposed rule would be burdensome and would result in only a *de minimus* amount of additional measured energy (as little as zero additional energy in the case of cycle finished mode). AHAM stated that DOE should not substantially increase the testing burden on manufacturers when the result would not produce significant conservation of energy and thus little or no benefit to the public interest. (AHAM, No. 14 at p. 2) AHAM stated that measuring *de minimus* amount of standby power energy would require large amounts of testing time. AHAM believes that DOE's estimate of an 11 percent increase in the testing duration for clothes washers offering inactive, off, delay start, and cycle finished modes would be significant, and AHAM predicts that the increase in test duration could actually be as much as 25 percent. AHAM believes that separately measuring delay start and cycle finished mode represents a significant increase in the testing burden, without any corresponding public benefit. (AHAM, No. 14 at pp. 4, 15) Furthermore, AHAM stated that adding steam cycles to the test procedure would add substantially to the test burden. (AHAM, No. 14 at p. 10).

BSH commented that its calculations indicate appendix J1 requires three days of dedicated testing for each appliance. BSH believes this is already a significant burden for appliance testing, particularly as compared to clothes dryers and other appliances. BSH estimated that the worst-case proposal in the September 2010 NOPR would represent a 47 percent increase in testing time for each clothes washer, for a total testing time of one full work week. BSH stated that to perform this additional testing, laboratory facilities and available labor would need to be increased by around 50 percent, or external resources sought, which would delay product innovation. BSH also estimated that should self-cleaning and steam cycles be excluded from testing, and should delay start and cycle finished modes be included in off and inactive modes rather than separately measured, the increase in test burden would be approximately 15 percent. BSH believes that this level of testing increase is manageable. Finally, BSH estimated that should the definition of energy test cycle be implemented as proposed in the September 2010 NOPR, test burden could increase by 100 percent or more depending on how the phrase ''largely comparable'' is interpreted and defined. (BSH, No. 17 pp. 5–6).

NEEA believes that any increased test burden resulting from DOE's proposal will be minor in comparison to the significant amount of testing that manufacturers conduct as part of product development, and in testing their competitors' products. NEEA stated that much of the added test burden, such as burden associated with testing inactive mode, non-active wash mode power consumption, and steam cycles will be associated with only a subset of the models produced. (NEEA, No. 12 at p. 15).

The California Utilities commented that the test procedure proposed by DOE in the September 2010 NOPR represents an improvement over the current J1 test procedure, and does not appear to significantly add to the testing burden. The California Utilities stated that testing of delay start, cycle finished, and self-clean modes should apply only to those models that include those features (or in the case of self-clean mode, those models with a manufacturer recommendation for periodic self-clean cycles), and therefore would alter the testing burden only for those products. The California Utilities also stated that because measurement of hot water is already incorporated in the test procedure for the MEF calculation, inclusion of hot water in the proposed IWF calculation will not introduce any significant test burden. (California Utilities, No. 18 at pp. 1, 2, 5).

In the August 2011 SNOPR, DOE proposed supplemental amendments to the clothes washer test procedure, which incorporated the most current version of IEC Standard 62301 (Second Edition) instead of the previous version. DOE also proposed certain amendments to the active mode provisions of the test procedure. As explained in the August 2011 SNOPR, DOE tentatively concluded that the new provisions in IEC Standard 62301 (Second Edition) would improve test results without undue test burden. DOE also stated its belief that the potential for increased test burden for certain power measurements is offset by more reasonable requirements for testing equipment, while maintaining acceptable measurement accuracy. In addition, the proposed amendments to the active mode provisions consist of clarifications and would not require any additional investment, equipment purchases, or test time beyond those described in the September 2010 NOPR. Therefore, DOE tentatively concluded that the proposed active mode amendments would not impose significant burden on manufacturers.

The California Utilities support the harmonization of the test procedure with IEC Standard 62301 (Second Edition). The California Utilities stated that the potential test burden on manufacturers is outweighed by the improvement in accuracy and representativeness of the resulting power measurement. The California Utilities stated further that the increased testing time and the use of analytical software associated with using the Second Edition is required only for unstable and non-cyclical power measurements, and because the expected number of instances of unstable and non-cyclical power should be small, the added test burden should likewise remain minimal. (California Utilities, No. 25 at p. 1).

NEEA believes that the extra time required for measuring unstable power modes is justified for obtaining an accurate measurement. NEEA believes that for clothes washers requiring the most extreme increase in test burden, manufacturers will quickly learn the behavior of their products' standby and off mode behavior and choose the appropriate measurement technique accordingly. (NEEA, No. 26 at p. 2) NEEA also suggested that setting time limits on the duration of delay start and cycle finished mode can limit the test burden associated with measuring power in these modes. (NEEA, No. 26 at pp. 2–3) NEEA disagrees with Whirlpool's claim that there is virtually no consumer benefit in measuring power consumption in low-power modes. (NEEA, No. 26 at p. 3).

DOE notes that interested parties generally support harmonizing the test procedure with the Second Edition of IEC Standard 62301, and that the test procedure improves accuracy and consistency of test results and is not unduly burdensome to conduct. As described previously, DOE adopts the ''alternate approach'' in which all low-power mode hours are allocated to the inactive and off modes, and the low-power mode power is only measured in the inactive and off modes, depending on which of these modes is present. Under the alternate approach, additional measurements of delay start mode and cycle finished mode are not required. Today's final rule also does not require the separate measurement of self-clean mode. In addition, the large majority of amendments to the active mode provisions of the test procedure consist of clarifications to test conduct and revised calculations, and would not require any additional investment, equipment purchases, or test time beyond those described in the September 2010 NOPR. DOE believes that any additional test burden resulting from the revised definition of the energy test cycle will be minimal because manufacturers already possess in-depth knowledge about the energy characteristics of each wash cycle offered on their clothes washers. Other test laboratories would not be required to conduct multiple tests to determine which cycle settings should be included under Part (B) of the energy test cycle, which could actually reduce test burden. For these reasons, DOE concludes that today's amendments to the provisions for standby mode, off mode, and active mode provisions of the clothes washer test procedure will not impose significant additional test burden on manufacturers.

2. Integration of Standby Mode and Off Mode Energy Consumption Into the Energy Efficiency Metrics

As discussed previously, EPCA requires that standby mode and off mode energy consumption be integrated into the overall energy efficiency, energy consumption, or other energy descriptor for each covered product unless the current test procedures already fully account for the standby mode and off mode energy consumption or if an integrated test procedure is technically infeasible. 42 U.S.C. 6295(gg)(2)(A) As described in section III.B.8, DOE adds provisions in this final rule for calculating the integrated modified energy factor, which integrates the combined low-power mode energy consumption into the overall energy efficiency metric for clothes washers.

EPCA also provides that test procedure amendments adopted to comply with the new EPCA requirements for standby and off mode energy consumption will not be used to determine compliance with previously established standards. 42 U.S.C. 6295(gg)(2)(C) Because DOE is incorporating these changes in a new appendix J2 to 10 CFR part 430 subpart B that manufacturers would not be required to use until the compliance date of amended energy conservation standards for residential clothes washers, the test procedure amendments pertaining to standby mode and off mode energy consumption that DOE adopts in this rulemaking do not apply to, and have no effect on, existing standards.

3. Impacts on Commercial Clothes Washers

The test procedure for commercial clothes washers is required to be the same test procedure established for residential clothes washers. 42 U.S.C. 6314(a)(8) Thus, the test procedure set forth in appendix J1 of subpart B of 10 CFR part 430 is also currently used to test commercial clothes washers. 10 CFR 431.154

DOE noted in the September 2010 NOPR that the impacts on testing commercial clothes washers would be limited to the proposed amendments associated with active washing mode because commercial clothes washer standards are based on MEF and WF. These include the proposed changes to the test load size specification, TUFs, DUF, test cloth specification, capacity measurement, detergent specification, and water supply pressure specification, which would affect the measured energy and water efficiencies of a commercial clothes washer. DOE stated that the most significant impacts would be associated with the proposed amendments for capacity measurement and usage factors, but did not have information to evaluate any impacts for commercial clothes washers.

DOE received several comments on the potential impacts of an amended clothes washer test procedure on commercial clothes washers and provided responses to most of these comments in the August 2011 SNOPR. NEEA provided one additional comment on the September 2010 NOPR. NEEA stated that most of the provisions of the new appendix J2 test procedure will be relevant to the testing and rating of commercial clothes washers. NEEA notes, however, that DOE's current projected schedule for a new commercial clothes washer rulemaking estimates a final rule in 2015, which would result in an effective date of new standards for these products in 2018. NEEA suggests that DOE explore the possibility of expediting the projected rulemaking schedule for commercial clothes washers to more closely align the metrics and marketplace performance perceptions of the residential and commercial products. (NEEA, No. 12 at p. 15).

DOE also received the following comments from the August 2011 SNOPR. AHAM and ALS agree with DOE's clarification that the impact on commercial clothes washers would be limited to the proposed amendments associated with active washing mode, since commercial clothes washer standards are based on MEF and WF, which do not include standby and off mode. (AHAM, No. 24 at p. 6; ALS, No. 22 at p. 4).

For the reasons discussed above and in the August 2011 SNOPR, DOE concludes that the addition of procedures to measure the energy use in standby and off modes would be inapplicable to and would not affect the standards for commercial clothes washers pursuant to 42 U.S.C. 6293(e). For the active mode provisions of the revised test procedure that could affect the measured energy and water efficiencies of a commercial clothes washer, DOE notes that 42 U.S.C. 6293(e)(3) provides the following: Models of covered products in use before the date on which an amended energy conservation standard (developed using the amended test procedure pursuant to 42 U.S.C. 6293(e)(2)) becomes effective that comply with the energy conservation standard applicable to such covered products on the day before such date are deemed to comply with the amended standard. The same is true of revisions of such models that come into use after such date and have the same energy efficiency, energy use or water use characteristics.

4. Certification, Compliance, and Enforcement Requirements

Sections 6299–6305 and 6316 of EPCA authorize DOE to enforce compliance with the energy and water conservation standards established for certain consumer products and commercial equipment. 42 U.S.C. 6299–6305 (consumer products), 6316 (commercial equipment) On March 7, 2011, the Department revised, consolidated, and streamlined its existing certification, compliance, and enforcement regulations for certain consumer products and commercial and industrial equipment covered under EPCA, including residential clothes washers. 76 FR 12422. These regulations for residential clothes washers are codified in 10 CFR 429.20.

The certification requirements for residential clothes washers consist of a sampling plan for selection of units for testing and requirements for certification reports. In the August 2011 SNOPR, DOE proposed amending the provisions in the sampling plan in 10 CFR part 429.20(a)(2) that would include IMEF along with the existing measure of MEF, and IWF along with the existing measure of WF.

AHAM and ALS expressed support for DOE's proposal to include IMEF and IWF along with the existing measures of MEF and WF, respectively in the sampling plan in 10 CFR 429.20(a)(2). AHAM also supported DOE's proposal to not make any changes to the reporting requirements for residential clothes washers. (AHAM, No. 24 at p. 6; ALS, No. 22 at p. 4)

In the November 2011 SNOPR, DOE proposed amending the reporting requirements in 10 CFR 429.20(b)(2) to require manufacturers, when using appendix J2, to list all cycle settings comprising the complete energy test cycle for each basic model. As described previously in section III.C.4.f, DOE does not intend to make this information publicly available as part of the certification report.

Today's final rule modifies the reporting requirements in 10 CFR 429.20(b)(2) by specifying that a certification report shall include publicly available information including MEF, WF, and capacity; as well as the list of cycle settings comprising the complete energy test cycle for each basic model, which would not be made publicly available as part of the report. The requirement to provide the list of cycle settings comprising the complete energy test cycle will apply only to test results obtained using appendix J2.

H. Impacts of the Test Procedure Amendments on EnergyGuide and ENERGYSTAR

In the September 2010 NOPR, DOE determined that the proposed test procedure amendments would not affect the FTC EnergyGuide labeling program because DOE did not propose to amend the estimated annual operating cost calculation in 10 CFR 430.23. DOE received multiple comments on the impacts of test procedure amendments on the EnergyGuide and ENERGYSTAR programs.

In the August 2011 SNOPR, DOE addressed comments related to EnergyGuide impacts. DOE also received the following comment regarding impacts to the ENERGYSTAR program. NEEA stated that the ENERGYSTAR program has weathered a number of standards changes for the products promoted under its brand, and has periodically updated its program specifications in response to these changes. (NEEA, No. 12 at p. 16) DOE agrees that the ENERGYSTAR program periodically updates its program specifications for each product in response to changes in efficiency standards, as well as changes in the availability of products on the market. Therefore, DOE expects that the ENERGYSTAR program will be able to modify its program specifications for clothes washers to incorporate the integrated efficiency metrics after the compliance date of any amended standards for clothes washers.

In the August 2011 SNOPR, DOE proposed to amend the estimated annual operating cost by incorporating the cost of energy consumed in the non-active washing modes. DOE also proposed to update the number of annual use cycles, which would affect the estimated annual operating cost disclosed on the EnergyGuide label. DOE received several comments related to its proposal to update the annual operating cost, as described previously in section III.D.

For the reasons described in section III.D and the August 2011 SNOPR, today's final rule amends the estimated annual operating cost by incorporating the cost of energy consumed in the non-active wash modes. Today's final rule also updates the annual use cycles, which affects the estimated annual operating cost. Pursuant to 42 U.S.C. 6294, the FTC may revise the EnergyGuide label for residential clothes washers.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget has determined that test procedure rulemakings do not constitute ''significant regulatory actions'' under section 3(f) of Executive Order 12866, Regulatory Planning and Review, 58 FR 51735 (Oct. 4, 1993). Accordingly, this action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB).

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (IFRA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site: *www.gc.doe.gov*.

DOE reviewed today's rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. DOE has concluded that the rule would not have a significant impact on a substantial number of small entities. The factual basis for this certification is as follows:

The Small Business Administration (SBA) considers a business entity to be small business, if, together with its affiliates, it employs less than a threshold number of workers specified in 13 CFR part 121. These size standards and codes are established by the North American Industry Classification System (NAICS). The threshold number for NAICS classification code 335224, which applies to household laundry equipment manufacturers and includes clothes washer manufacturers, is 1,000 employees. Searches of the SBA Web site [14] to identify clothes washer manufacturers within these NAICS codes identified, out of approximately 17 manufacturers supplying clothes washers in the United States, one small business. This small business manufactures laundry appliances, including clothes washers. The other manufacturers supplying clothes washers are large multinational corporations.

Today's final rule would amend DOE's test procedure by incorporating testing provisions to address active mode, standby mode, and off mode energy and water consumption that will

[14] A searchable database of certified small businesses is available online at: *http://dsbs.sba.gov/dsbs/search/dsp__dsbs.cfm*.

be used to demonstrate compliance with energy conservation standards. The test procedure amendments for measuring standby and off mode power using the ''alternative method'' involve measuring power input when the clothes washer is in inactive mode or off mode, or both if both modes are available on the clothes washer under test, as a proxy for measuring power consumption in all low-power modes. These tests can be conducted in the same facilities used for the current energy testing of these products, so it is anticipated that manufacturers would not incur any additional facilities costs as a result of the proposed test procedure amendments. The power meter required for these tests might require greater accuracy than the power meter used for current energy testing, but the investment required for a possible instrumentation upgrade is expected to be approximately a few thousand dollars. The duration of each non-active washing mode test period is expected to be roughly 30–45 minutes, depending on stability of the power, using the alternate approach described previously. This is comparable to approximately one-half to two-thirds the time required to conduct a single energy test wash cycle. Each clothes washer tested requires, on average, approximately 15 test cycles for energy testing, which equates to about 3 days of testing. Using the alternate approach adopted in today's final rule, DOE estimates roughly a 3-percent increase in total test period duration. DOE notes that the provisions from IEC Standard 62301 (Second Edition) incorporated by reference in today's final rule would require longer test durations in the event that the threshold stability criteria of the power measurement are not met. However, based on DOE's observations during testing for the September 2010 NOPR and August 2011 SNOPR, the likelihood of such a longer test being required should be small.

DOE also estimates that it currently costs a manufacturer approximately $2300 on average, including the cost of consumables, to conduct energy testing for a particular clothes washer. DOE further estimates that the cost of additional testing for non-active washing modes using the alternate approach adopted in today's final rule will average $75 per machine, a 3 percent increase over current test costs.

DOE does not expect that these additional requirements for equipment and time and additional cost to conduct the non-active washing mode will impose a significant economic burden on entities subject to the applicable testing requirements. Although the small business has significantly lower sales than other manufacturers over which to amortize these additional costs, it produces only a single platform that would be subject to the proposed non-active washing mode tests.

Furthermore, the test procedure amendments for the active washing mode adopted in today's final rule will not increase test burden because they comprise revisions to calculations rather than additional, longer, or more complex methodology.

In response to the August 2011 SNOPR, ALS stated that it takes no position on DOE's tentative conclusion that the September 2010 NOPR and August 2011 SNOPR would not have a significant economic impact on a substantial number of small entities. ALS stated that it needs to conduct a significant number of tests utilizing the proposed test procedure before commenting on the additional burden that falls on manufacturers. (ALS, No. 22 at p. 3).

For the reasons discussed above, DOE concludes and certifies that today's final rule will not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE has transmitted the certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of residential clothes washers must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for clothes washers, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including residential clothes washers. (76 FR 12422 (March 7, 2011)). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

In this final rule, DOE amends its test procedure for residential clothes washers. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this rule amends an existing rule without affecting the amount, quality or distribution of energy usage, and, therefore, will not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any rulemaking that interprets or amends an existing rule without changing the environmental effect of that rule. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 4, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE examined this final rule and determined that it will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this final rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a regulatory action resulting in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *www.gc.doe.gov*. DOE examined today's final rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. Today's final rule will not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights'' 53 FR 8859 (March 18, 1988), that this regulation will not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today's final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB, a Statement of Energy Effects for any significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the regulation is implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

Today's regulatory action is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

The amendments to the test procedure in today's final rule incorporate testing methods contained in the following commercial standards:

1. AATCC Test Method 79–2010, Absorbency of Textiles, Revised 2010.
2. AATCC Test Method 118–2007, Oil Repellency: Hydrocarbon Resistance Test, Revised 2007.
3. AATCC Test Method 135–2010, Dimensional Changes of Fabrics after Home Laundering.
4. IEC Standard 62301, Household electrical appliances—Measurement of standby power, Edition 2.0, 2011–01.

DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (*i.e.,* whether they were developed in a manner that fully provides for public participation, comment, and review). DOE has consulted with both the Attorney General and the Chairman of the FTC about the impact on using the methods contained in these standards and has received no comments objecting to their use.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of today's rule before its effective date. The report will state that it has been determined that the rule is not a ''major rule'' as defined by 5 U.S.C. 804(2).

N. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this final rule.

List of Subjects

10 CFR Part 429

Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

Issued in Washington, DC, on February 22, 2012.

Kathleen Hogan,

Deputy Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons stated in the preamble, DOE amends parts 429 and 430 of title 10 of the Code of Federal Regulations, as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

■ 2. Section 429.20 is amended by:
■ a. Revising paragraph (a)(2)(i) introductory text;
■ b. Revising paragraph (a)(2)(ii) introductory text;
■ c. Adding paragraph (b)(3).

The revisions and addition read as follows:

§ 429.20 Residential clothes washers.

(a) * * *

(2) * * *

(i) Any represented value of the water factor, integrated water factor, the estimated annual operating cost, the energy or water consumption, or other measure of energy or water consumption of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of:

* * * * *

(ii) Any represented value of the modified energy factor, integrated modified energy factor, or other measure of energy or water consumption of a basic model for which consumers would favor higher values shall be less than or equal to the lower of:

* * * * *

(b) * * *

(3) Pursuant to § 429.12(b)(13), a certification report shall include the following additional product-specific information: When using appendix J2, a list of all cycle selections comprising the complete energy test cycle for each basic model.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

■ 3. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

■ 4. Section 430.3 is amended by:
■ a. Redesignating paragraphs (c) through (o) as paragraphs (d) through (p);
■ b. Adding new paragraph (c);
■ c. Revising newly designated paragraphs (m) introductory text and (m)(2).

The additions and revisions read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(c) *AATCC.* American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709, (919) 549–3526, or go to *www.aatcc.org.*

(1) AATCC Test Method 79–2010, Absorbency of Textiles, Revised 2010, IBR approved for Appendix J2 to Subpart B.

(2) AATCC Test Method 118–2007, Oil Repellency: Hydrocarbon Resistance Test, Revised 2007, IBR approved for Appendix J2 to Subpart B.

(3) AATCC Test Method 135–2010, Dimensional Changes of Fabrics after Home Laundering, Revised 2010, IBR approved for Appendix J2 to Subpart B.

* * * * *

(m) *IEC.* International Electrotechnical Commission, available from the American National Standards Institute, 25 W. 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4900, or go to *http://webstore.ansi.org.*

* * * * *

(2) IEC Standard 62301 (''IEC 62301''), *Household electrical appliances—Measurement of standby power,* Edition 2.0, 2011–01, IBR approved for Appendix J2 to Subpart B.

* * * * *

■ 5. Section 430.23 is amended by revising paragraph (j) to read as follows:

§ 430.23 Test procedures for the measurement of energy and water consumption.

* * * * *

(j) *Clothes washers.* (1) The estimated annual operating cost for automatic and semi-automatic clothes washers must be rounded off to the nearest dollar per year and is defined as follows:

(i) When using appendix J2 (see the note at the beginning of appendix J2),

(A) When electrically heated water is used,

$$(N_1 \times E_{TE1} \times C_{KWH})$$

Where:

N_1 = the representative average residential clothes washer use of 392 cycles per year according to appendix J1,

E_{TE1} = the total per-cycle energy consumption when electrically heated water is used, in kilowatt-hours per cycle, determined according to section 4.1.7 of appendix J1, and

C_{KWH} = the representative average unit cost, in dollars per kilowatt-hour, as provided by the Secretary.

(B) When gas-heated or oil-heated water is used,

$$(N_1 \times ((ME_{T1} \times C_{KWH}) + (HE_{TG1} \times C_{BTU})))$$

Where:

N_1 and C_{KWH} are defined in paragraph (j)(1)(i)(A) of this section,

ME_{T1} = the total weighted per-cycle machine electrical energy consumption, in kilowatt-hours per cycle, determined according to section 4.1.6 of appendix J1,
HE_{TG1} = the total per-cycle hot water energy consumption using gas-heated or oil-heated water, in Btu per cycle, determined according to section 4.1.4 of appendix J1, and
C_{BTU} = the representative average unit cost, in dollars per Btu for oil or gas, as appropriate, as provided by the Secretary.

(ii) When using appendix J2,

(A) When electrically heated water is used,

$$(N_2 \times (E_{TE2} + E_{TSO}) \times C_{KWH})$$

Where:

N_2 = the representative average residential clothes washer use of 295 cycles per year according to appendix J2,
E_{TE2} = the total per-cycle energy consumption when electrically heated water is used, in kilowatt-hours per cycle, determined according to section 4.1.7 of appendix J2,
E_{TSO} = the per-cycle combined low-power mode energy consumption, in kilowatt-hours per cycle, determined according to section 4.4 of appendix J2, and
C_{KWH} = the representative average unit cost, in dollars per kilowatt-hour, as provided by the Secretary.

(B) When gas-heated or oil-heated water is used,

$$(N_2 \times ((ME_{T2} + E_{TSO}) \times C_{KWH}) + (HE_{TG2} \times C_{BTU}))$$

Where:

N_2 and E_{TSO} are defined in (j)(1)(ii)(A) of this section,
ME_{T2} = the total weighted per-cycle machine electrical energy consumption, in kilowatt-hours per cycle, determined according to section 4.1.6 of appendix J2,
C_{KWH} = the representative average unit cost, in dollars per kilowatt-hour, as provided by the Secretary,
HE_{TG2} = the total per-cycle hot water energy consumption using gas-heated or oil-heated water, in Btu per cycle, determined according to section 4.1.4 of appendix J2,
C_{BTU} = the representative average unit cost, in dollars per Btu for oil or gas, as appropriate, as provided by the Secretary.

(2)(i) The modified energy factor for automatic and semi-automatic clothes washers is determined according to section 4.4 of appendix J1 (when using appendix J1) and section 4.5 of appendix J2 (when using appendix J2). The result shall be rounded off to the nearest 0.01 cubic foot per kilowatt-hour per cycle.

(ii) The integrated modified energy factor for automatic and semi-automatic clothes washers is determined according to section 4.6 of appendix J2 (when using appendix J2). The result shall be rounded off to the nearest 0.01 cubic foot per kilowatt-hour per cycle.

(3) Other useful measures of energy consumption for automatic or semi-automatic clothes washers shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of appendix J1 or appendix J2, as appropriate. In addition, the annual water consumption of a clothes washer can be determined as:

(i) When using appendix J1, the product of the representative average-use of 392 cycles per year and the total weighted per-cycle water consumption in gallons per cycle determined according to section 4.2.2 of appendix J1. The water factor can be determined according to section 4.2.3 of appendix J1, with the result rounded off to the nearest 0.1 gallons per cycle per cubic foot. The remaining moisture content can be determined according to section 3.8 of appendix J1, with the result rounded off to the nearest 0.1 percent.

(ii) When using appendix J2, the product of the representative average-use of 295 cycles per year and the total weighted per-cycle water consumption for all wash cycles, in gallons per cycle, determined according to section 4.2.11 of appendix J2. The water factor can be determined according to section 4.2.12 of appendix J2, with the result rounded off to the nearest 0.1 gallons per cycle per cubic foot. The integrated water factor can be determined according to section 4.2.13 of appendix J2, with the result rounded off to the nearest 0.1 gallons per cycle per cubic foot. The remaining moisture content can be determined according to section 3.8 of appendix J2, with the result rounded off to the nearest 0.1 percent.

* * * * *

Appendix J to Subpart B of Part 430—[Removed]

■ 6. Appendix J to subpart B of part 430 is removed.

Appendix J1—[Amended]

■ 7. Appendix J1 to subpart B of part 430 is amended by:
■ a. Revising the introductory text;
■ b. Revising section 1.19;
■ c. Revising section 1.22;
■ d. Removing sections 2.6.1.1 through 2.6.1.2.4;
■ e. Revising section 2.6.3.1;
■ f. Revising section 2.6.4.3
■ g. Revising section 2.6.4.5.3(b);
■ h. Revising section 2.6.6.1;
■ i. Revising section 2.6.6.2;
■ j. Revising section 2.10;
■ k. Revising section 3.6;
■ l. Revising section 4.1.4;
■ m. Revising section 4.2;
■ n. Revising section 4.2.3;
■ o. Removing section 4.5;
■ p. Revising section 5; and
■ q. Revising section 6.2.

The revisions read as follows:

Appendix J1 to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Automatic and Semi-Automatic Clothes Washers

Manufacturers may use Appendix J1 to certify compliance with existing DOE energy conservation standards until the compliance date of any amended standards that address standby and off mode power consumption for residential clothes washers. After this date, all residential clothes washers shall be tested using the provisions of Appendix J2.

* * * * *

1.19 *Water factor* means the quotient of the total weighted per-cycle water consumption divided by the cubic foot (or liter) capacity of the clothes washer.

* * * * *

1.22 *Cold rinse* means the coldest rinse temperature available on the machine.

* * * * *

2.6.3.1 Perform 5 complete normal wash-rinse-spin cycles, the first two with current AHAM Standard detergent Formula 3 and the last three without detergent. Place the test cloth in a clothes washer set at the maximum water level. Wash the load for ten minutes in soft water (17 ppm hardness or less) using 27.0 grams + 4.0 grams per pound of cloth load of AHAM Standard detergent Formula 3. The wash temperature is to be controlled to 135 °F ± 5 °F (57.2 °C ± 2.8 °C) and the rinse temperature is to be controlled to 60 °F ± 5 °F (15.6 °C ± 2.8 °C). Repeat the cycle with detergent and then repeat the cycle three additional times without detergent, bone drying the load between cycles (total of five wash and rinse cycles).

* * * * *

2.6.4.3 The thread count shall be 65 × 57 per inch (warp × fill), ±2 percent.

* * * * *

2.6.4.5.3. * * *

(b) Copies of the above standards incorporated by reference can be obtained from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709, telephone (919) 549–3526, fax (919) 549–8933, or email: *orders@aatcc.org*.

* * * * *

2.6.6.1 Average the values of 3 test runs and fill in Table 2.6.5 of this appendix. Perform a linear least-squares fit to determine coefficients A and B such that the standard RMC values shown in Table 2.6.6.1 of this appendix ($RMC_{standard}$) are linearly related to the RMC values measured in section 2.6.5 of this appendix (RMC_{cloth}):

$$RMC_{standard} \sim A * RMC_{cloth} + B$$

where A and B are coefficients of the linear least-squares fit.

* * * * *

2.6.6.2 Perform an analysis of variance with replication test using two factors, spin speed and lot, to check the interaction of speed and lot. Use the values from Table 2.6.5 and Table 2.6.6.1 of this Appendix in the calculation. The ''P'' value of the F-statistic for interaction between spin speed and lot in the variance analysis shall be greater than or equal to 0.1. If the ''P'' value is less than 0.1, the test cloth is unacceptable. ''P'' is a theoretically based measure of interaction based on an analysis of variance.

* * * * *

2.10 *Wash time setting.* If one wash time is prescribed in the energy test cycle, that shall be the wash time setting; otherwise, the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available in the energy test cycle, regardless of the labeling of suggested dial locations. If the clothes washer is equipped with an electromechanical dial controlling wash time, reset the dial to the minimum wash time and then turn it in the direction of increasing wash time to reach the appropriate setting. If the appropriate setting is passed, return the dial to the minimum wash time and then turn in the direction of increasing wash time until the setting is reached.

* * * * *

3.6 *''Cold Wash'' (Minimum Wash Temperature Selection).* Water and electrical energy consumption shall be measured for each water fill level or test load size as specified in sections 3.6.1 through 3.6.3 of this Appendix for the coldest wash temperature selection available. For a clothes washer that offers two or more wash temperature settings labeled as cold, such as ''Cold'' and ''Tap Cold'', the setting with the minimum wash temperature shall be considered the cold wash. If any of the other cold wash temperature settings add hot water to raise the wash temperature above the cold water supply temperature, as defined in section 2.3 of this Appendix, those setting(s) shall be considered warm wash setting(s), as defined in section 1.18 of this Appendix. If none of the cold wash temperature settings add hot water for any of the water fill levels or test load sizes required for the energy test cycle, the wash temperature setting labeled as ''Cold'' shall be considered the cold wash, and the other wash temperature setting(s) labeled as cold shall not be required for testing.

* * * * *

4.1.4 *Total per-cycle hot water energy consumption using gas-heated or oil-heated water.* Calculate for the energy test cycle the per-cycle hot water consumption, HE_{TG}, using gas-heated or oil-heated water, expressed in Btu per cycle (or megajoules per cycle) and defined as:

$HE_{TG}=HE_T \times 1/e \times 3412$ Btu/kWh or
$HE_{TG}=HE_T \times 1/e \times 3.6$ MJ/kWh

Where:

e = Nominal gas or oil water heater efficiency=0.75.
HE_T = As defined in 4.1.3.

* * * * *

4.2.3 *Water factor.* Calculate the water factor, WF, expressed in gallons per cycle per cubic foot (or liters per cycle per liter), as:

$WF = Q_T/C$

Where:

Q_T = As defined in section 4.2.2.
C = As defined in section 3.1.5.

* * * * *

5. Test Loads

TABLE 5.1—TEST LOAD SIZES

Container volume		Minimum load		Maximum load		Average load	
cu. ft. ≥ <	liter ≥ <	lb	kg	lb	kg	lb	kg
0–0.80	0–22.7	3.00	1.36	3.00	1.36	3.00	1.36
0.80–0.90	22.7–25.5	3.00	1.36	3.50	1.59	3.25	1.47
0.90–1.00	25.5–28.3	3.00	1.36	3.90	1.77	3.45	1.56
1.00–1.10	28.3–31.1	3.00	1.36	4.30	1.95	3.65	1.66
1.10–1.20	31.1–34.0	3.00	1.36	4.70	2.13	3.85	1.75
1.20–1.30	34.0–36.8	3.00	1.36	5.10	2.31	4.05	1.84
1.30–1.40	36.8–39.6	3.00	1.36	5.50	2.49	4.25	1.93
1.40–1.50	39.6–42.5	3.00	1.36	5.90	2.68	4.45	2.02
1.50–1.60	42.5–45.3	3.00	1.36	6.40	2.90	4.70	2.13
1.60–1.70	45.3–48.1	3.00	1.36	6.80	3.08	4.90	2.22
1.70–1.80	48.1–51.0	3.00	1.36	7.20	3.27	5.10	2.31
1.80–1.90	51.0–53.8	3.00	1.36	7.60	3.45	5.30	2.40
1.90–2.00	53.8–56.6	3.00	1.36	8.00	3.63	5.50	2.49
2.00–2.10	56.6–59.5	3.00	1.36	8.40	3.81	5.70	2.59
2.10–2.20	59.5–62.3	3.00	1.36	8.80	3.99	5.90	2.68
2.20–2.30	62.3–65.1	3.00	1.36	9.20	4.17	6.10	2.77
2.30–2.40	65.1–68.0	3.00	1.36	9.60	4.35	6.30	2.86
2.40–2.50	68.0–70.8	3.00	1.36	10.00	4.54	6.50	2.95
2.50–2.60	70.8–73.6	3.00	1.36	10.50	4.76	6.75	3.06
2.60–2.70	73.6–76.5	3.00	1.36	10.90	4.94	6.95	3.15
2.70–2.80	76.5–79.3	3.00	1.36	11.30	5.13	7.15	3.24
2.80–2.90	79.3–82.1	3.00	1.36	11.70	5.31	7.35	3.33
2.90–3.00	82.1–85.0	3.00	1.36	12.10	5.49	7.55	3.42
3.00–3.10	85.0–87.8	3.00	1.36	12.50	5.67	7.75	3.52
3.10–3.20	87.8–90.6	3.00	1.36	12.90	5.85	7.95	3.61
3.20–3.30	90.6–93.4	3.00	1.36	13.30	6.03	8.15	3.70
3.30–3.40	93.4–96.3	3.00	1.36	13.70	6.21	8.35	3.79
3.40–3.50	96.3–99.1	3.00	1.36	14.10	6.40	8.55	3.88
3.50–3.60	99.1–101.9	3.00	1.36	14.60	6.62	8.80	3.99
3.60–3.70	101.9–104.8	3.00	1.36	15.00	6.80	9.00	4.08
3.70–3.80	104.8–107.6	3.00	1.36	15.40	6.99	9.20	4.17
3.80–3.90	107.6–110.4	3.00	1.36	15.80	7.16	9.40	4.26
3.90–4.00	110.4–113.3	3.00	1.36	16.20	7.34	9.60	4.35
4.00–4.10	113.3–116.1	3.00	1.36	16.60	7.53	9.80	4.45
4.10–4.20	116.1–118.9	3.00	1.36	17.00	7.72	10.00	4.54
4.20–4.30	118.9–121.8	3.00	1.36	17.40	7.90	10.20	4.63
4.30–4.40	121.8–124.6	3.00	1.36	17.80	8.09	10.40	4.72
4.40–4.50	124.6–127.4	3.00	1.36	18.20	8.27	10.60	4.82
4.50–4.60	127.4–130.3	3.00	1.36	18.70	8.46	10.85	4.91
4.60–4.70	130.3–133.1	3.00	1.36	19.10	8.65	11.05	5.00

TABLE 5.1—TEST LOAD SIZES—Continued

Container volume		Minimum load		Maximum load		Average load	
cu. ft. ≥ <	liter ≥ <	lb	kg	lb	kg	lb	kg
4.70–4.80	133.1–135.9	3.00	1.36	19.50	8.83	11.25	5.10
4.80–4.90	135.9–138.8	3.00	1.36	19.90	9.02	11.45	5.19
4.90–5.00	138.8–141.6	3.00	1.36	20.30	9.20	11.65	5.28
5.00–5.10	141.6–144.4	3.00	1.36	20.70	9.39	11.85	5.38
5.10–5.20	144.4–147.2	3.00	1.36	21.10	9.58	12.05	5.47
5.20–5.30	147.2–150.1	3.00	1.36	21.50	9.76	12.25	5.56
5.30–5.40	150.1–152.9	3.00	1.36	21.90	9.95	12.45	5.65
5.40–5.50	152.9–155.7	3.00	1.36	22.30	10.13	12.65	5.75
5.50–5.60	155.7–158.6	3.00	1.36	22.80	10.32	12.90	5.84
5.60–5.70	158.6–161.4	3.00	1.36	23.20	10.51	13.10	5.93
5.70–5.80	161.4–164.2	3.00	1.36	23.60	10.69	13.30	6.03
5.80–5.90	164.2–167.1	3.00	1.36	24.00	10.88	13.50	6.12
5.90–6.00	167.1–169.9	3.00	1.36	24.40	11.06	13.70	6.21

Notes: (1) All test load weights are bone dry weights.
(2) Allowable tolerance on the test load weights are ±0.10 lbs (0.05 kg).

* * * * *

6.2 *Nonconventional Wash System Energy Consumption Test.* The field test may consist of a minimum of 10 of the nonconventional clothes washers (''test clothes washers'') and 10 clothes washers already being distributed in commerce (''base clothes washers''). The tests should include a minimum of 50 energy test cycles per clothes washer. The test clothes washers and base clothes washers should be identical in construction except for the controls or systems being tested. Equal numbers of both the test clothes washer and the base clothes washer should be tested simultaneously in comparable settings to minimize seasonal or consumer laundering conditions or variations. The clothes washers should be monitored in such a way as to accurately record the average total energy and water consumption per cycle, including water heating energy when electrically heated water is used, and the energy required to remove the remaining moisture of the test load. The field test results should be used to determine the best method to correlate the rating of the test clothes washer to the rating of the base clothes washer.

* * * * *

■ 6. Add a new Appendix J2 to subpart B of part 430 to read as follows:

Appendix J2 to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Automatic and Semi-Automatic Clothes Washers

Manufacturers may use Appendix J1 to certify compliance with existing DOE energy conservation standards until the compliance date of any amended standards that address standby and off mode power consumption for residential clothes washers. After this date, all residential clothes washers shall be tested using the provisions of Appendix J2.

1. Definitions and Symbols

1.1 *Active mode* means a mode in which the clothes washer is connected to a mains power source, has been activated, and is performing one or more of the main functions of washing, soaking, tumbling, agitating, rinsing, and/or removing water from the clothing, or is involved in functions necessary for these main functions, such as admitting water into the washer or pumping water out of the washer. Active mode also includes delay start and cycle finished modes.

1.2 *Active washing mode* means a mode in which the clothes washer is performing any of the operations included in a complete cycle intended for washing a clothing load, including the main functions of washing, soaking, tumbling, agitating, rinsing, and/or removing water from the clothing.

1.3 *Adaptive control system* means a clothes washer control system, other than an adaptive water fill control system, which is capable of automatically adjusting washer operation or washing conditions based on characteristics of the clothes load placed in the clothes container, without allowing or requiring consumer intervention or actions. The automatic adjustments may, for example, include automatic selection, modification, or control of any of the following: Wash water temperature, agitation or tumble cycle time, number of rinse cycles, and spin speed. The characteristics of the clothes load, which could trigger such adjustments, could, for example, consist of or be indicated by the presence of either soil, soap, suds, or any other additive laundering substitute or complementary product.

NOTE: Appendix J2 does not provide a means for determining the energy consumption of a clothes washer with an adaptive control system. A waiver must be obtained pursuant to 10 CFR 430.27 to establish an acceptable test procedure for each such clothes washer.

1.4 *Adaptive water fill control system* means a clothes washer water fill control system which is capable of automatically adjusting the water fill level based on the size or weight of the clothes load placed in the clothes container, without allowing or requiring consumer intervention or actions.

1.5 *Bone-dry* means a condition of a load of test cloth which has been dried in a dryer at maximum temperature for a minimum of 10 minutes, removed and weighed before cool down, and then dried again for 10 minute periods until the final weight change of the load is 1 percent or less.

1.6 *Clothes container* means the compartment within the clothes washer that holds the clothes during the operation of the machine.

1.7 *Cold rinse* means the coldest rinse temperature available on the machine.

1.8 *Combined low-power mode* means the aggregate of available modes other than active washing mode, including inactive mode, off mode, delay start mode, and cycle finished mode.

1.9 *Compact* means a clothes washer which has a clothes container capacity of less than 1.6 ft^3 (45 L).

1.10 *Cycle finished mode* means an active mode which provides continuous status display, intermittent tumbling, or air circulation following operation in active washing mode.

1.11 *Deep rinse cycle* means a rinse cycle in which the clothes container is filled with water to a selected level and the clothes load is rinsed by agitating it or tumbling it through the water.

1.12 *Delay start mode* means an active mode in which activation of active washing mode is facilitated by a timer.

1.13 *Energy test cycle* for a basic model means:

(A) The cycle selection recommended by the manufacturer for washing cotton or linen clothes, and includes all wash/rinse temperature selections for each of the temperature use factors (TUFs) offered in that cycle, and

(B) If the cycle selection described in Part (A) does not include all wash/rinse temperature selections for each of the TUFs available on the clothes washer, the energy test cycle shall include, in addition to Part (A), the alternate cycle selection(s) offering these remaining wash/rinse temperature selection(s), tested only at the wash/rinse temperature selection(s) for each TUF not available on the cycle selection described in Part (A).

Where multiple alternate cycle selections offer a wash/rinse temperature selection for which a TUF has been developed, and that is not available on the cycle selection recommended by the manufacturer for washing cotton or linen clothes described in Part (A), the alternate cycle selection certified by the manufacturer to have the highest energy consumption for that TUF, as measured according to section 2.13, shall be included in the energy test cycle, so that each TUF that is available on the clothes washer has been tested once.

(C) All cycle selections included under Part (A) and all cycle selections included under Part (B) shall be tested using each appropriate load size as defined in section 2.8 and Table 5.1 of this appendix.

(D) For any cycle selection tested under (A) or (B), the manufacturer default settings shall be used, except for the temperature selection, if necessary. This includes wash conditions such as agitation/tumble operation, soil level, spin speed(s), wash times, rinse times, and all other wash parameters or optional features applicable to that cycle, including water heating time for water heating clothes washers.

(E) Each wash cycle included as part of the energy test cycle shall include the entire active washing mode and exclude any delay start or cycle finished modes.

(F) The energy test cycle shall not include any cycle, if available, that is dedicated for cleaning, deodorizing, or sanitizing the clothes washer, and is separate from clothes washing cycles.

1.14 *IEC 62301* means the test standard published by the International Electrotechnical Commission, entitled ''Household electrical appliances–Measurement of standby power,'' Publication 62301, Edition 2.0 2011–01 (incorporated by reference; see § 430.3).

1.15 *Inactive mode* means a standby mode that facilitates the activation of active mode by remote switch (including remote control), internal sensor, or timer, or that provides continuous status display.

1.16 *Integrated modified energy factor* means the quotient of the cubic foot (or liter) capacity of the clothes container divided by the total clothes washer energy consumption per cycle, with such energy consumption expressed as the sum of:

(a) The machine electrical energy consumption;

(b) The hot water energy consumption;

(c) The energy required for removal of the remaining moisture in the wash load; and

(d) The combined low-power mode energy consumption.

1.17 *Integrated water factor* means the quotient of the total weighted per-cycle water consumption for all wash cycles in gallons divided by the cubic foot (or liter) capacity of the clothes washer.

1.18 *Load usage factor* means the percentage of the total number of wash loads that a user would wash a particular size (weight) load.

1.19 *Lot* means a quantity of cloth that has been manufactured with the same batches of cotton and polyester during one continuous process.

1.20 *Manual control system* means a clothes washer control system which requires that the consumer make the choices that determine washer operation or washing conditions, such as, for example, wash/rinse temperature selections and wash time, before starting the cycle.

1.21 *Manual water fill control system* means a clothes washer water fill control system which requires the consumer to determine or select the water fill level.

1.22 *Modified energy factor* means the quotient of the cubic foot (or liter) capacity of the clothes container divided by the total clothes washer energy consumption per cycle, with such energy consumption expressed as the sum of the machine electrical energy consumption, the hot water energy consumption, and the energy required for removal of the remaining moisture in the wash load.

1.23 *Non-water-heating clothes washer* means a clothes washer which does not have an internal water heating device to generate hot water.

1.24 *Off mode* means a mode in which the clothes washer is connected to a mains power source and is not providing any active or standby mode function, and where the mode may persist for an indefinite time. An indicator that only shows the user that the product is in the off position is included within the classification of an off mode.

1.25 *Roll* means a subset of a lot.

1.26 *Spray rinse cycle* means a rinse cycle in which water is sprayed onto the clothes for a period of time without maintaining any specific water level in the clothes container.

1.27 *Standard* means a clothes washer which has a clothes container capacity of 1.6 ft^3 (45 L) or greater.

1.28 *Standby mode* means any mode in which the clothes washer is connected to a mains power source and offers one or more of the following user oriented or protective functions that may persist for an indefinite time:

(a) To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer;

(b) Continuous functions, including information or status displays (including clocks) or sensor-based functions.

A timer is a continuous clock function (which may or may not be associated with a display) that provides regular scheduled tasks (*e.g.,* switching) and that operates on a continuous basis.

1.29 *Symbol usage.* The following identity relationships are provided to help clarify the symbology used throughout this procedure.

C—Capacity
C (with subscripts)—Cold Water Consumption
D—Energy Consumption for Removal of Moisture from Test Load
E—Electrical Energy Consumption
F—Load Usage Factor
H—Hot Water Consumption
HE—Hot Water Energy Consumption
ME—Machine Electrical Energy Consumption
P—Power
Q—Water Consumption
RMC—Remaining Moisture Content
S—Annual Hours
TUF—Temperature Use Factor
V—Temperature-Weighted Hot Water Consumption
W—Mass of Water
WC—Weight of Test Load After Extraction
WI—Initial Weight of Dry Test Load

Subscripts:

a or avg—Average Test Load
B—Part B of the Energy Test Cycle
c—Cold Wash (minimum wash temp.)
corr—Corrected (RMC values)
h—Hot Wash (maximum wash temp. ≤135 °F (57.2 °C))
ia—Inactive Mode
LP—Combined Low-Power Mode
m—Extra Hot Wash (maximum wash temp. >135 °F (57.2 °C))
n—Minimum Test Load
o—Off Mode
oi—Combined Off and Inactive Modes
T—Total
w—Warm Wash
ww—Warm Wash/Warm Rinse
x—Maximum Test Load

The following examples are provided to show how the above symbols can be used to define variables:

Em_x = ''Electrical Energy Consumption'' for an ''Extra Hot Wash'' and ''Maximum Test Load''
HE_{min} = ''Hot Water Energy Consumption'' for the ''Minimum Test Load''
P_{ia} = ''Power'' in ''Inactive Mode''
Qh_{min} = ''Water Consumption'' for a ''Hot Wash'' and ''Minimum Test Load''
TUF_m = ''Temperature Use Factor'' for an ''Extra Hot Wash''

1.30 *Temperature use factor* means, for a particular wash/rinse temperature setting, the percentage of the total number of wash loads that an average user would wash with that setting.

1.31 *Thermostatically controlled water valves* means clothes washer controls that have the ability to sense and adjust the hot and cold supply water.

1.32 *Uniformly distributed warm wash temperature selection(s)* means (A) multiple warm wash selections for which the warm wash water temperatures have a linear relationship with all discrete warm wash selections when the water temperatures are plotted against equally spaced consecutive warm wash selections between the hottest warm wash and the coldest warm wash. If the warm wash has infinite selections, the warm wash water temperature has a linear relationship with the distance on the selection device (*e.g.* dial angle or slide movement) between the hottest warm wash and the coldest warm wash. The criteria for a linear relationship as specified above is that the difference between the actual water temperature at any warm wash selection and the point where that temperature is depicted on the temperature/selection line formed by connecting the warmest and the coldest warm selections is less than ±5 percent. In all cases, the mean water temperature of the warmest and the coldest warm selections must coincide with the mean of the ''hot wash'' (maximum wash temperature ≤135 °F (57.2 °C)) and ''cold wash'' (minimum wash temperature) water temperatures within ±3.8 °F (±2.1 °C); or (B) on a clothes washer with only one warm wash temperature selection, a warm wash temperature selection with a water temperature that coincides with the mean of the ''hot wash'' (maximum wash temperature ≤135 °F (57.2 °C)) and ''cold wash'' (minimum wash temperature) water temperatures within ±3.8 °F (±2.1 °C).

1.33 *Warm rinse* means the hottest rinse temperature available on the machine.

1.34 *Warm wash* means all wash temperature selections that are below the maximum wash temperature ≤135 °F (57.2 °C) and above the minimum wash temperature.

1.35 *Water factor* means the quotient of the total weighted per-cycle water consumption for cold wash divided by the cubic foot (or liter) capacity of the clothes washer.

1.36 *Water-heating clothes washer* means a clothes washer where some or all of the hot water for clothes washing is generated by a water heating device internal to the clothes washer.

2. Testing Conditions

2.1 *Installation.* Install the clothes washer in accordance with manufacturer's instructions. For combined low-power mode testing, the product shall be installed in accordance with Section 5, Paragraph 5.2 of IEC 62301 (incorporated by reference; see § 430.3), disregarding the provisions regarding batteries and the determination, classification, and testing of relevant modes.

2.2 *Electrical energy supply.*

2.2.1 *Supply voltage and frequency.* Maintain the electrical supply at the clothes washer terminal block within 2 percent of 120, 120/240, or 120/208Y volts as applicable to the particular terminal block wiring system and within 2 percent of the nameplate frequency as specified by the manufacturer. If the clothes washer has a dual voltage conversion capability, conduct test at the highest voltage specified by the manufacturer.

2.2.2 *Supply voltage waveform.* For the combined low-power mode testing, maintain the electrical supply voltage waveform indicated in Section 4, Paragraph 4.3.2 of IEC 62301. If the power measuring instrument used for testing is unable to measure and record the total harmonic content during the test measurement period, it is acceptable to measure and record the total harmonic content immediately before and after the test measurement period.

2.3 *Supply Water.*

2.3.1 *Clothes washers in which electrical energy consumption or water energy consumption are affected by the inlet water temperature. (For example, water heating clothes washers or clothes washers with thermostatically controlled water valves.).* The temperature of the hot water supply at the water inlets shall not exceed 135 °F (57.2 °C) and the cold water supply at the water inlets shall not exceed 60 °F (15.6 °C). A water meter shall be installed in both the hot and cold water lines to measure water consumption.

2.3.2 *Clothes washers in which electrical energy consumption and water energy consumption are not affected by the inlet water temperature.* The temperature of the hot water supply shall be maintained at 135 °F ± 5 °F (57.2 °C ± 2.8 °C) and the cold water supply shall be maintained at 60 °F ± 5 °F (15.6 °C ± 2.8 °C). A water meter shall be installed in both the hot and cold water lines to measure water consumption.

2.4 *Water pressure.* The static water pressure at the hot and cold water inlet connection of the clothes washer shall be maintained at 35 pounds per square inch gauge (psig) ±2.5 psig (241.3 kPa ±17.2 kPa) when the water is flowing. The static water pressure for a single water inlet connection shall be maintained at 35 psig ±2.5 psig (241.3 kPa ±17.2 kPa) when the water is flowing. A water pressure gauge shall be installed in both the hot and cold water lines to measure water pressure.

2.5 *Instrumentation.* Perform all test measurements using the following instruments, as appropriate:

2.5.1 *Weighing scales.*

2.5.1.1 *Weighing scale for test cloth.* The scale shall have a resolution of no larger than 0.2 oz (5.7 g) and a maximum error no greater than 0.3 percent of the measured value.

2.5.1.2 *Weighing scale for clothes container capacity measurement.* The scale should have a resolution no larger than 0.50 lbs (0.23 kg) and a maximum error no greater than 0.5 percent of the measured value.

2.5.2 *Watt-hour meter.* The watt-hour meter shall have a resolution no larger than 1 Wh (3.6 kJ) and a maximum error no greater than 2 percent of the measured value for any demand greater than 50 Wh (180.0 kJ).

2.5.3 *Watt meter.* The watt meter used to measure combined low-power mode power consumption shall comply with the requirements specified in Section 4, Paragraph 4.4 of IEC 62301. If the power measuring instrument used for testing is unable to measure and record the crest factor, power factor, or maximum current ratio during the test measurement period, it is acceptable to measure and record the crest factor, power factor, and maximum current ratio immediately before and after the test measurement period.

2.5.4 *Temperature measuring device.* The device shall have an error no greater than ±1 °F (±0.6 °C) over the range being measured.

2.5.5 *Water meter.* The water meter shall have a resolution no larger than 0.1 gallons (0.4 liters) and a maximum error no greater than 2 percent for the water flow rates being measured.

2.5.6 *Water pressure gauge.* The water pressure gauge shall have a resolution of 1 pound per square inch gauge (psig) (6.9 kPa) and shall have an error no greater than 5 percent of any measured value.

2.6 *Test cloths.*

2.6.1 *Energy Test Cloth.* The energy test cloth shall be made from energy test cloth material, as specified in section 2.6.4 of this Appendix, that is 24 ± ½ inches by 36 ± ½ inches (61.0 ± 1.3 cm by 91.4 ± 1.3 cm) and has been hemmed to 22 ± ½ inches by 34 ± ½ inches (55.9 ± 1.3 cm by 86.4 ± 1.3 cm) before washing. The energy test cloth shall be clean and shall not be used for more than 60 test runs (after preconditioning as specified in 2.6.3 of this appendix). All energy test cloth must be permanently marked identifying the lot number of the material. Mixed lots of material shall not be used for testing a clothes washer.

2.6.2 *Energy Stuffer Cloth.* The energy stuffer cloth shall be made from energy test cloth material, as specified in section 2.6.4 of this Appendix, and shall consist of pieces of material that are 12 ± ¼ inches by 12 ± ¼ inches (30.5 ± 0.6 cm by 30.5 ± 0.6 cm) and have been hemmed to 10 ± ¼ inches by 10 ± ¼ inches (25.4 ± 0.6 cm by 25.4 ± 0.6 cm) before washing. The energy stuffer cloth shall be clean and shall not be used for more than 60 test runs (after preconditioning as specified in section 2.6.3 of this Appendix). All energy stuffer cloth must be permanently marked identifying the lot number of the material. Mixed lots of material shall not be used for testing a clothes washer.

2.6.3 *Preconditioning of Test Cloths.* The new test cloths, including energy test cloths and energy stuffer cloths, shall be pre-conditioned in a clothes washer in the following manner:

2.6.3.1 Perform 5 complete normal wash-rinse-spin cycles, the first two with AHAM Standard detergent Formula 3 and the last three without detergent. Place the test cloth in a clothes washer set at the maximum water level. Wash the load for ten minutes with a minimum fill of 20 gallons of soft water (17 ppm hardness or less) using 27.0 grams + 4.0 grams per pound of cloth load of AHAM Standard detergent Formula 3. The wash temperature is to be controlled to 135 °F ± 5°F (57.2 °C ± 2.8 °C) and the rinse temperature is to be controlled to 60°F ± 5°F (15.6 °C ± 2.8 °C). Repeat the cycle with detergent and then repeat the cycle three additional times without detergent, bone drying the load between cycles (total of five wash and rinse cycles).

2.6.4 *Energy test cloth material.* The energy test cloths and energy stuffer cloths shall be made from fabric meeting the following specifications. The material should come from a roll of material with a width of approximately 63 inches and approximately 500 yards per roll. However, other sizes may be used if they fall within the specifications.

2.6.4.1 *Nominal fabric type.* Pure finished bleached cloth made with a momie or granite weave, which is nominally 50 percent cotton and 50 percent polyester.

2.6.4.2 The fabric weight specification shall be 5.60 ± 0.25 ounces per square yard (190.0 ± 8.4 g/m^2).

2.6.4.3 The thread count shall be 65 × 57 per inch (warp × fill), ±2 percent.

2.6.4.4 The warp yarn and filling yarn shall each have fiber content of 50 percent ±4 percent cotton, with the balance being polyester, and be open end spun, 15/1 ±5 percent cotton count blended yarn.

2.6.4.5 Water repellent finishes, such as fluoropolymer stain resistant finishes shall not be applied to the test cloth. The absence of such finishes shall be verified by:

2.6.4.5.1 AATCC Test Method 118–2007, (incorporated by reference; see § 430.3), for each new lot of test cloth (when purchased from the mill) to confirm the absence of Scotchguard ™ or other water repellent finish (required scores of ''D'' across the board).

2.6.4.5.2 AATCC Test Method 79–2010, (incorporated by reference; see § 430.3), for each new lot of test cloth (when purchased from the mill) to confirm the absence of

Scotchguard™ or other water repellent finish (time to absorb one drop should be on the order of 1 second).

2.6.4.6 The moisture absorption and retention shall be evaluated for each new lot of test cloth by the Standard Extractor Remaining Moisture Content (RMC) Test specified in section 2.6.5 of this Appendix.

2.6.4.6.1 Repeat the Standard Extractor RMC Test in section 2.6.5 of this Appendix three times.

2.6.4.6.2 An RMC correction curve shall be calculated as specified in section 2.6.6 of this Appendix.

2.6.4.7 The maximum shrinkage after preconditioning shall not be more than 5 percent of the length and width. Measure per AATCC Test Method 135–2010, (incorporated by reference; see § 430.3).

2.6.5 *Standard Extractor RMC Test Procedure.* The following procedure is used to evaluate the moisture absorption and retention characteristics of a lot of test cloth by measuring the RMC in a standard extractor at a specified set of conditions. Table 2.6.5 of this Appendix is the matrix of test conditions. In the table, ''g Force'' represents units of gravitational acceleration. When this matrix is repeated 3 times, a total of 60 extractor RMC test runs are required. For the purpose of the extractor RMC test, the test cloths may be used for up to 60 test runs (after preconditioning as specified in section 2.6.3 of this Appendix).

TABLE 2.6.5—MATRIX OF EXTRACTOR RMC TEST CONDITIONS

''g Force''	Warm soak		Cold soak	
	15 min. spin	4 min. spin	15 min. spin	4 min. spin
100				
200				
350				
500				
650				

2.6.5.1 The standard extractor RMC tests shall be run in a North Star Engineered Products Inc. (formerly Bock) Model 215 extractor (having a basket diameter of 20 inches, height of 11.5 inches, and volume of 2.09 ft^3), with a variable speed drive (North Star Engineered Products, P.O. Box 5127, Toledo, OH 43611) or an equivalent extractor with same basket design (*i.e.* diameter, height, volume, and hole configuration) and variable speed drive. Table 2.6.5.1 shows the extractor spin speed, in revolutions per minute (RPM), that shall be used to attain each required g-force level.

TABLE 2.6.5.1—EXTRACTOR SPIN SPEEDS FOR EACH TEST CONDITION

''g Force''	RPM
100	594 ± 1
200	840 ± 1
350	1111 ± 1
500	1328 ± 1
650	1514 ± 1

2.6.5.2 *Test Load.* Test loads shall be comprised of randomly selected cloth at the beginning, middle and end of a lot. Test cloths shall be preconditioned in accordance with section 2.6.3 of this Appendix. The load size shall be 8.4 lbs. It is acceptable to use two test loads for standard extractor RMC tests, with each load used for half of the total number of required tests.

2.6.5.3 *Procedure.*

2.6.5.3.1 Using a dryer that complies with the temperature requirements specified in section 2.12 of this Appendix, dry the test cloth until it is ''bone-dry'' according to the definition in section 1.5 of this Appendix. Record the ''bone-dry'' weight of the test load (WI).

2.6.5.3.2 Prepare the test load for soak by grouping four test cloths into loose bundles. Bundles are created by hanging four cloths vertically from one corner and loosely wrapping the test cloth onto itself to form the bundle. Bundles should be wrapped loosely to ensure consistency of water extraction. Bundles are then placed into the water to soak. Eight to nine bundles will be formed depending on the test load. The ninth bundle may not equal four cloths but can incorporate energy stuffer cloths to help offset the size difference.

2.6.5.3.3 Soak the test load for 20 minutes in 10 gallons of soft (<17 ppm) water. The entire test load shall be submerged. The water temperature shall be 100 °F ± 5°F (37.8 °C ± 2.8 °C) at all times between the start and end of the soak.

2.6.5.3.4 Remove the test load and allow each of the test cloth bundles to drain over the water bath for a maximum of 5 seconds.

2.6.5.3.5 Manually place the test cloth bundles in the basket of the extractor, distributing them evenly by eye. The draining and loading process shall take no longer than 1 minute. Spin the load at a fixed speed corresponding to the intended centripetal acceleration level (measured in units of the acceleration of gravity, g) ± 1g for the intended time period ± 5 seconds. The timer shall begin when the extractor meets the required spin speed for each test.

2.6.5.3.6 Record the weight of the test load immediately after the completion of the extractor spin cycle (WC).

2.6.5.3.7 Calculate the remaining moisture content of the test load as (WC–WI)/WI.

2.6.5.3.8 It is not necessary to drain the soak tub if the water bath is corrected for water level and temperature before the next extraction.

2.6.5.3.9 It is not necessary to dry the test load in between extraction runs. However, the bone dry weight shall be checked after every 12 extraction runs to make sure the bone dry weight is within tolerance (8.4 ± 0.1 lb).

2.6.5.3.10 The test load must be soaked and extracted once following bone drying, before continuing with the remaining extraction runs. This extraction shall be performed at the same spin speed used for the extraction run prior to bone drying, for a time period of 4 minutes. Either warm or cold soak temperature may be used.

2.6.5.3.11 The remaining moisture content of the test load shall be measured at five g levels: 100 g, 200 g, 350 g, 500 g, and 650 g, using two different spin times at each g level: 4 minutes and 15 minutes.

2.6.5.4 Repeat section 2.6.5.3 of this Appendix using soft (<17 ppm) water at 60 °F ± 5 °F (15.6 °C ± 2.8 °C).

2.6.6 *Calculation of RMC correction curve.*

2.6.6.1 Average the values of 3 test runs, and fill in Table 2.6.5 of this appendix. Perform a linear least-squares fit to determine coefficients A and B such that the standard RMC values shown in Table 2.6.6.1 of this appendix ($RMC_{standard}$) are linearly related to the RMC values measured in section 2.6.5 of this appendix (RMC_{cloth}):

$$RMC_{standard} \sim A * RMC_{cloth} + B$$

where A and B are coefficients of the linear least-squares fit.

TABLE 2.6.6.1—STANDARD RMC VALUES (RMC STANDARD)

"g Force"	RMC percentage			
	Warm soak		Cold soak	
	15 min. spin (percent)	4 min. spin (percent)	15 min. spin (percent)	4 min. spin (percent)
100	45.9	49.9	49.7	52.8
200	35.7	40.4	37.9	43.1
350	29.6	33.1	30.7	35.8
500	24.2	28.7	25.5	30.0
650	23.0	26.4	24.1	28.0

2.6.6.2 Perform an analysis of variance with replication test using two factors, spin speed and lot, to check the interaction of speed and lot. Use the values from Table 2.6.5 and Table 2.6.6.1 of this Appendix in the calculation. The ''P'' value of the F-statistic for interaction between spin speed and lot in the variance analysis shall be greater than or equal to 0.1. If the ''P'' value is less than 0.1, the test cloth is unacceptable. ''P'' is a theoretically based measure of interaction based on an analysis of variance.

2.6.7 *Application of the RMC correction curve.*

2.6.7.1 Using the coefficients A and B calculated in section 2.6.6.1 of this Appendix:

$RMC_{corr} = A \times RMC + B$

2.6.7.2 Apply this RMC correction curve to measured RMC values in sections 3.8.2.6, 3.8.3.2, and 3.8.3.4 of this Appendix.

2.7 *Test Load Sizes.* Maximum, minimum, and, when required, average test load sizes shall be determined using Table 5.1 of this Appendix and the clothes container capacity as measured in sections 3.1.1 through 3.1.5 of this Appendix. Test loads shall consist of energy test cloths, except that adjustments to the test loads to achieve proper weight can be made by the use of energy stuffer cloths with no more than 5 stuffer cloths per load.

2.8 *Use of Test Loads.* Table 2.8 of this Appendix defines the test load sizes and corresponding water fill settings which are to be used when measuring water and energy consumptions. Adaptive water fill control system and manual water fill control system are defined in section 1 of this Appendix:

TABLE 2.8—TEST LOAD SIZES AND WATER FILL SETTINGS REQUIRED

Manual water fill control system		Adaptive water fill control system	
Test load size	Water fill setting	Test load size	Water fill setting
Max	Max	Max	As determined by the Clothes Washer.
Min	Min	Avg Min.	

2.8.1 The test load sizes to be used to measure RMC are specified in section 3.8.1 of this Appendix.

2.8.2 Test loads for energy and water consumption measurements shall be bone dry prior to the first cycle of the test, and dried to a maximum of 104 percent of bone dry weight for subsequent testing.

2.8.3 Load the energy test cloths by grasping them in the center, shaking them to hang loosely and then put them into the clothes container prior to activating the clothes washer.

2.9 *Pre-conditioning of Clothes Washer.*

2.9.1 *Non-water-heating clothes washer.* If the clothes washer has not been filled with water in the preceding 96 hours, pre-condition it by running it through a cold rinse cycle and then draining it to ensure that the hose, pump, and sump are filled with water.

2.9.2 *Water-heating clothes washer.* If the clothes washer has not been filled with water in the preceding 96 hours, or if it has not been in the test room at the specified ambient conditions for 8 hours, pre-condition it by running it through a cold rinse cycle and then draining it to ensure that the hose, pump, and sump are filled with water.

2.10 *Wash time setting.* If one wash time is prescribed in the energy test cycle, that shall be the wash time setting; otherwise, the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available in the energy test cycle, regardless of the labeling of suggested dial locations. If the clothes washer is equipped with an electromechanical dial controlling wash time, reset the dial to the minimum wash time and then turn it in the direction of increasing wash time to reach the appropriate setting. If the appropriate setting is passed, return the dial to the minimum wash time and then turn in the direction of increasing wash time until the setting is reached.

2.11 *Test room temperature.* For all clothes washers, maintain the test room ambient air temperature at 75 ± 5 °F (23.9 ± 2.8 °C) for active mode testing and combined low-power mode testing. Do not use the test room ambient air temperature conditions specified in Section 4, Paragraph 4.2 of IEC 62301 for combined low-power mode testing.

2.12 *Bone dryer temperature.* The dryer used for bone drying must heat the test cloth and energy stuffer cloths above 210 °F (99 °C).

2.13 *Energy consumption for the purpose of certifying the cycle selection(s) to be included in Part (B) of the energy test cycle definition.* Where multiple alternate cycle selections offer a wash/rinse temperature selection for which a TUF has been developed, and that is not available on the cycle selection recommended by the manufacturer for washing cotton or linen clothes described in Part (A) of the energy test cycle definition, the alternate cycle selection with the highest energy consumption for that TUF, as measured according to this section, shall be included in the energy test cycle.

2.13.1 For the TUF being considered under this section, establish the testing conditions set forth in section 2 of this test procedure. Select the applicable cycle selection and temperature selection. Use the manufacturer default settings for agitation/tumble operation, soil level, spin speed(s), wash times, rinse times, and all other wash parameters or optional features applicable to that cycle selection, including water heating time for water heating clothes washers.

2.13.2 Use the clothes washer's maximum test load size, determined from Table 5.1, for testing under this section.

2.13.3 For clothes washers with a manual water fill control system, user-adjustable adaptive water fill control system, or adaptive water fill control system with alternate manual water fill control system, use the water fill selector setting resulting in the maximum water level available for each cycle selection for testing under this section.

2.13.4 Each wash cycle tested under this section shall include the entire active washing mode and exclude any delay start or cycle finished modes.

2.13.5 Measure each cycle selection's electrical energy consumption (E_B) and hot water consumption (H_B). Calculate the total energy consumption for each cycle selection (E_{TB}), as follows:

$E_{TB} = E_B + (H_B \times T \times K)$

Where:

E_B is the electrical energy consumption, expressed in kilowatt-hours per cycle.
H_B is the hot water consumption, expressed in gallons per cycle.
T = temperature rise = 75 °F (41.7 °C)
K = Water specific heat in kilowatt-hours per gallon per degree F = 0.00240 kWh/gal-°F (0.00114 kWh/L-°C)

3. Test Measurements

3.1 *Clothes container capacity.* Measure the entire volume which a clothes load could occupy within the clothes container during active mode washer operation according to the following procedures:

3.1.1 Place the clothes washer in such a position that the uppermost edge of the clothes container opening is leveled horizontally, so that the container will hold the maximum amount of water. For front-loading clothes washers, the shipping bolts and door seal shall remain in place during the capacity measurement.

3.1.2 Line the inside of the clothes container with 2 mil (0.051 mm) plastic sheet. All clothes washer components which occupy space within the clothes container and which are recommended for use with the energy test cycle shall be in place and shall be lined with 2 mil (0.051 mm) plastic sheet to prevent water from entering any void space.

3.1.3 Record the total weight of the machine before adding water.

3.1.4 Fill the clothes container manually with either 60 °F ± 5 °F (15.6 °C ± 2.8 °C) or 100 °F ± 10 °F (37.8 °C ± 5.5 °C) water, with the door open. For a top-loading, vertical-axis clothes washer, fill the clothes container to the uppermost edge of the rotating portion, including any balance ring. For a front-loading, horizontal-axis clothes washer, fill the clothes container to the uppermost edge that is in contact with the door seal. For all clothes washers, any volume which cannot be occupied by the clothing load during operation must be excluded from the measurement. Measure and record the weight of water, W, in pounds.

3.1.5 The clothes container capacity is calculated as follows:

C = W/d

Where:

C = Capacity in cubic feet (liters).
W = Mass of water in pounds (kilograms).
d = Density of water (62.0 lbs/ft³ for 100 °F (993 kg/m³ for 37.8 °C) or 62.3 lbs/ft³ for 60 °F (998 kg/m³ for 15.6 °C)).

3.2 *Procedure for measuring water and energy consumption values on all automatic and semi-automatic washers.* All energy consumption tests shall be performed under the energy test cycle(s), unless otherwise specified. Table 3.2 of this Appendix defines the sections below which govern tests of particular clothes washers, based on the number of wash/rinse temperature selections available on the model, and also, in some instances, method of water heating. The procedures prescribed are applicable regardless of a clothes washer's washing capacity, loading port location, primary axis of rotation of the clothes container, and type of control system.

3.2.1 *Inlet water temperature and the wash/rinse temperature settings.*

3.2.1.1 For automatic clothes washers, set the wash/rinse temperature selection control to obtain the wash water temperature selection desired (extra hot, hot, warm, or cold) and cold rinse, and open both the hot and cold water faucets.

3.2.1.2 For semi-automatic washers:

(1) For hot water temperature, open the hot water faucet completely and close the cold water faucet;

(2) For warm inlet water temperature, open both hot and cold water faucets completely;

(3) For cold water temperature, close the hot water faucet and open the cold water faucet completely.

3.2.1.3 *Determination of warm wash water temperature(s) to decide whether a clothes washer has uniformly distributed warm wash temperature selections.* The wash water temperature, Tw, of each warm water wash selection shall be calculated or measured.

(1) For non-water heating clothes washers, calculate Tw as follows:

Tw(°F) = ((Hw × 135 °F)+ (Cw × 60 °F))/(Hw + Cw)

or

Tw(°C) = ((Hw × 57.2 °C)+ (Cw × 15.6 °C))/(Hw + Cw)

Where:

Hw = Hot water consumption of a warm wash.

Cw = Cold water consumption of a warm wash.

(2) For water-heating clothes washers, measure and record the temperature of each warm wash selection after fill.

3.2.2 Total water consumption during the energy test cycle shall be measured, including hot and cold water consumption during wash, deep rinse, and spray rinse.

3.2.3 *Clothes washers with adaptive water fill/manual water fill control systems.*

3.2.3.1 *Clothes washers with adaptive water fill control system and alternate manual water fill control systems.* If a clothes washer with an adaptive water fill control system allows consumer selection of manual controls as an alternative, then both manual and adaptive modes shall be tested and, for each mode, the energy consumption (HE_T, ME_T, and D_E) and water consumption (Q_T), values shall be calculated as set forth in section 4 of this Appendix. Then the average of the two values (one from each mode, adaptive and manual) for each variable shall be used in section 4 of this Appendix for the clothes washer.

3.2.3.2 *Clothes washers with adaptive water fill control system.*

3.2.3.2.1 Not user adjustable. The maximum, minimum, and average water levels as defined in the following sections shall be interpreted to mean that amount of water fill which is selected by the control system when the respective test loads are used, as defined in Table 2.8 of this Appendix. The load usage factors which shall be used when calculating energy consumption values are defined in Table 4.1.3 of this Appendix.

3.2.3.2.2 User adjustable. Four tests shall be conducted on clothes washers with user adjustable adaptive water fill controls which affect the relative wash water levels. The first test shall be conducted with the maximum test load and with the adaptive water fill control system set in the setting that will give the most energy intensive result. The second test shall be conducted with the minimum test load and with the adaptive water fill control system set in the setting that will give the least energy intensive result. The third test shall be conducted with the average test load and with the adaptive water fill control system set in the setting that will give the most energy intensive result for the given test load. The fourth test shall be conducted with the average test load and with the adaptive water fill control system set in the setting that will give the least energy intensive result for the given test load. The energy and water consumption for the average test load and water level shall be the average of the third and fourth tests.

3.2.3.3 *Clothes washers with manual water fill control system.* In accordance with Table 2.8 of this Appendix, the water fill selector shall be set to the maximum water level available on the clothes washer for the maximum test load size and set to the minimum water level for the minimum test load size. The load usage factors which shall be used when calculating energy consumption values are defined in Table 4.1.3 of this Appendix.

TABLE 3.2—TEST SECTION REFERENCE

Max. wash temp. available	≤135 °F (57.2 °C)			>135 °F (57.2 °C)**	
Number of wash temp. selections	1	2	>2	3	>3
Test sections required to be followed	....	....	....	3.3	3.3
	....	3.4	3.4	....	3.4
	....	....	3.5	3.5	3.5
	3.6	3.6	3.6	3.6	3.6

TABLE 3.2—TEST SECTION REFERENCE—Continued

Max. wash temp. available	≤135 °F (57.2 °C)			>135 °F (57.2 °C)**	
Number of wash temp. selections	1	2	>2	3	>3
	.... 3.8	.... 3.8	*3.7 3.8	*3.7 3.8	*3.7 3.8

* Only applicable to machines with warm rinse.
** Only applicable to water heating clothes washers on which the maximum wash temperature available exceeds 135 °F (57.2 °C).

3.3 *"Extra Hot Wash" (Max Wash Temp >135 °F (57.2 °C)) for water heating clothes washers only.* Water and electrical energy consumption shall be measured for each water fill level and/or test load size as specified in sections 3.3.1 through 3.3.3 of this Appendix for the hottest wash setting available.

3.3.1 *Maximum test load and water fill.* Hot water consumption (Hm_x), cold water consumption (Cm_x), and electrical energy consumption (Em_x) shall be measured for an extra hot wash/cold rinse energy test cycle, with the controls set for the maximum water fill level. The maximum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.3.2 *Minimum test load and water fill.* Hot water consumption (Hm_n), cold water consumption (Cm_n), and electrical energy consumption (Em_n) shall be measured for an extra hot wash/cold rinse energy test cycle, with the controls set for the minimum water fill level. The minimum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.3.3 *Average test load and water fill.* For clothes washers with an adaptive water fill control system, measure the values for hot water consumption (Hm_a), cold water consumption (Cm_a), and electrical energy consumption (Em_a) for an extra hot wash/cold rinse energy test cycle, with an average test load size as determined per Table 5.1 of this Appendix.

3.4 *"Hot Wash" (Max Wash Temp ≤135 °F (57.2 °C)).* Water and electrical energy consumption shall be measured for each water fill level and/or test load size as specified in sections 3.4.1 through 3.4.3 of this Appendix for a 135 °F (57.2 °C) wash, if available, or for the hottest selection less than 135 °F (57.2 °C).

3.4.1 *Maximum test load and water fill.* Hot water consumption (Hh_x), cold water consumption (Ch_x), and electrical energy consumption (Eh_x) shall be measured for a hot wash/cold rinse energy test cycle, with the controls set for the maximum water fill level. The maximum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.4.2 *Minimum test load and water fill.* Hot water consumption (Hh_n), cold water consumption (Ch_n), and electrical energy consumption (Eh_n) shall be measured for a hot wash/cold rinse energy test cycle, with the controls set for the minimum water fill level. The minimum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.4.3 *Average test load and water fill.* For clothes washers with an adaptive water fill control system, measure the values for hot water consumption (Hh_a), cold water consumption (Ch_a), and electrical energy consumption (Eh_a) for a hot wash/cold rinse energy test cycle, with an average test load size as determined per Table 5.1 of this Appendix.

3.5 *"Warm Wash."* Water and electrical energy consumption shall be determined for each water fill level and/or test load size as specified in sections 3.5.1 through 3.5.2.3 of this Appendix for the applicable warm water wash temperature(s) with a cold rinse.

3.5.1 *Clothes washers with uniformly distributed warm wash temperature selection(s).* The reportable values to be used for the warm water wash setting shall be the arithmetic average of the measurements for the hot and cold wash selections. This is a calculation only; no testing is required.

3.5.2 *Clothes washers that lack uniformly distributed warm wash temperature selections.* For a clothes washer with fewer than four discrete warm wash selections, test all warm wash temperature selections. For a clothes washer that offers four or more warm wash selections, test at all discrete selections, or test at 25 percent, 50 percent, and 75 percent positions of the temperature selection device between the hottest hot (≤135 °F (57.2 °C)) wash and the coldest cold wash. If a selection is not available at the 25, 50 or 75 percent position, in place of each such unavailable selection use the next warmer setting. Each reportable value to be used for the warm water wash setting shall be the arithmetic average of all tests conducted pursuant to this section.

3.5.2.1 *Maximum test load and water fill.* Hot water consumption (Hw_x), cold water consumption (Cw_x), and electrical energy consumption (Ew_x) shall be measured with the controls set for the maximum water fill level. The maximum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.5.2.2 *Minimum test load and water fill.* Hot water consumption (Hw_n), cold water consumption (Cw_n), and electrical energy consumption (Ew_n) shall be measured with the controls set for the minimum water fill level. The minimum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.5.2.3 *Average test load and water fill.* For clothes washers with an adaptive water fill control system, measure the values for hot water consumption (Hw_a), cold water consumption (Cw_a), and electrical energy consumption (Ew_a) with an average test load size as determined per Table 5.1 of this Appendix.

3.6 *"Cold Wash" (Minimum Wash Temperature Selection).* Water and electrical energy consumption shall be measured for each water fill level and/or test load size as specified in sections 3.6.1 through 3.6.3 of this Appendix for the coldest wash temperature selection available. For a clothes washer that offers two or more wash temperature settings labeled as cold, such as "Cold" and "Tap Cold", the setting with the minimum wash temperature shall be considered the cold wash. If any of the other cold wash temperature settings add hot water to raise the wash temperature above the cold water supply temperature, as defined in section 2.3 of this Appendix, those setting(s) shall be considered warm wash setting(s), as defined in section 1.34 of this Appendix. If none of the cold wash temperature settings add hot water for any of the water fill levels or test load sizes required for the energy test cycle, the wash temperature setting labeled as "Cold" shall be considered the cold wash, and the other wash temperature setting(s) labeled as cold shall not be required for testing.

3.6.1 *Maximum test load and water fill.* Hot water consumption (Hc_x), cold water consumption (Cc_x), and electrical energy consumption (Ec_x) shall be measured for a cold wash/cold rinse energy test cycle, with the controls set for the maximum water fill level. The maximum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.6.2 *Minimum test load and water fill.* Hot water consumption (Hc_n), cold water consumption (Cc_n), and electrical energy consumption (Ec_n) shall be measured for a cold wash/cold rinse energy test cycle, with the controls set for the minimum water fill level. The minimum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.6.3 *Average test load and water fill.* For clothes washers with an adaptive water fill control system, measure the values for hot water consumption (Hc_a), cold water consumption (Cc_a), and electrical energy consumption (Ec_a) for a cold wash/cold rinse energy test cycle, with an average test load size as determined per Table 5.1 of this Appendix.

3.7 *"Warm Wash/Warm Rinse."* Water and electrical energy consumption shall be determined for each water fill level and/or test load size as specified in sections 3.7.2.1 through 3.7.2.3 of this Appendix for the applicable warm wash temperature selection as described in section 3.7.1 or 3.7.2 of this Appendix and the hottest available rinse temperature selection.

3.7.1 *Clothes washers with uniformly distributed warm wash temperature selection(s).* Test the warm wash/warm rinse cycle at the wash temperature selection with the temperature selection device at the 50 percent position between the hottest hot (≤135 °F (57.2 °C)) wash and the coldest cold wash.

3.7.2 *Clothes washers that lack uniformly distributed warm wash temperature selections.* For a clothes washer with fewer than four discrete warm wash selections, test all warm wash temperature selections for which a warm rinse is available. For a clothes washer that offers four or more warm wash selections, test at all discrete selections for which a warm rinse is available, or test at 25 percent, 50 percent, and 75 percent positions of the temperature selection device between the hottest hot (≤135 °F (57.2 °C)) wash and the coldest cold wash. If a selection is not available at the 25, 50, or 75 percent position, in place of each such unavailable selection use the next warmer setting. Each reportable value to be used for the warm wash/warm rinse setting shall be the arithmetic average of all tests conducted pursuant to this section.

3.7.2.1 *Maximum test load and water fill.* Hot water consumption (Hww_x), cold water consumption (Cww_x), and electrical energy consumption (Eww_x) shall be measured with the controls set for the maximum water fill level. The maximum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.7.2.2 *Minimum test load and water fill.* Hot water consumption (Hww_n), cold water consumption (Cww_n), and electrical energy consumption (Eww_n) shall be measured with the controls set for the minimum water fill level. The minimum test load size is to be used and shall be determined per Table 5.1 of this Appendix.

3.7.2.3 *Average test load and water fill.* For clothes washers with an adaptive water fill control system, measure the values for hot water consumption (Hww_a), cold water consumption (Cww_a), and electrical energy consumption (Eww_a) with an average test load size as determined per Table 5.1 of this Appendix.

3.8 *Remaining Moisture Content:*

3.8.1 The wash temperature will be the same as the rinse temperature for all testing. Use the maximum test load as defined in Table 5.1 of this Appendix for testing.

3.8.2 *For clothes washers with cold rinse only:*

3.8.2.1 Record the actual ''bone dry'' weight of the test load (WI_x), then place the test load in the clothes washer.

3.8.2.2 Set water level selector to maximum fill.

3.8.2.3 Run the energy test cycle.

3.8.2.4 Record the weight of the test load immediately after completion of the energy test cycle (WC_x).

3.8.2.5 Calculate the remaining moisture content of the maximum test load, RMC_x, defined as:

$$RMC_x = (WC_x - WI_x)/WI_x$$

3.8.2.6 Apply the RMC correction curve described in section 2.6.7 of this Appendix to calculate the corrected remaining moisture content, RMC_{corr}, expressed as a percentage, which shall be the final RMC used in section 4.3 of this Appendix:

$$RMC_{corr} = (A \times RMC_x + B) \times 100\%$$

Where:

A and B are the coefficients of the RMC correction curve as defined in section 2.6.6.1 of this Appendix.

RMC_x = As defined in section 3.8.2.5 of this Appendix.

3.8.3 *For clothes washers with cold and warm rinse options:*

3.8.3.1 Complete sections 3.8.2.1 through 3.8.2.4 of this Appendix for cold rinse.

Calculate the remaining moisture content of the maximum test load for cold rinse, RMC_{COLD}, defined as:

$$RMC_{COLD} = (WC_x - WI_x)/WI_x$$

3.8.3.2 Apply the RMC correction curve described in section 2.6.7 of this Appendix to calculate the corrected remaining moisture content for cold rinse, $RMC_{COLD,corr}$, expressed as a percentage, as follows:

$$RMC_{COLD,corr} = (A \times RMC_{COLD} + B) \times 100\%$$

Where:

A and B are the coefficients of the RMC correction curve as defined in section 2.6.6.1 of this Appendix.

RMC_{COLD} = As defined in section 3.8.3.1 of this Appendix.

3.8.3.3 Complete sections 3.8.2.1 through 3.8.2.4 of this Appendix for warm rinse. Calculate the remaining moisture content of the maximum test load for warm rinse, RMC_{WARM}, defined as:

$$RMC_{WARM} = (WC_x - WI_x)/WI_x$$

3.8.3.4 Apply the RMC correction curve described in section 2.6.7 of this Appendix to calculate the corrected remaining moisture content for warm rinse, $RMC_{WARM,corr}$, expressed as a percentage, as follows:

$$RMC_{WARM,corr} = (A \times RMC_{WARM} + B) \times 100\%$$

Where:

A and B are the coefficients of the RMC correction curve as defined in section 2.6.6.1 of this Appendix.

RMC_{WARM} = As defined in section 3.8.3.3 of this Appendix.

3.8.3.5 Calculate the corrected remaining moisture content of the maximum test load, RMC_{corr}, expressed as a percentage, which shall be the final RMC used in section 4.3 of this Appendix:

$$RMC_{corr} = RMC_{COLD,corr} \times (1 - TUF_{ww}) + RMC_{WARM,corr} \times (TUF_{ww})$$

Where:

$RMC_{COLD,corr}$ = As defined in section 3.8.3.2 of this Appendix.

$RMC_{WARM,corr}$ = As defined in section 3.8.3.4 of this Appendix.

TUF_{ww} is the temperature use factor for warm rinse as defined in Table 4.1.1 of this Appendix.

3.8.4 Clothes washers that have options such as multiple selections of spin speeds or spin times that result in different RMC values and that are available in the energy test cycle, shall be tested at the maximum and minimum extremes of the available options, excluding any ''no spin'' (zero spin speed) settings, in accordance with requirements in section 3.8.2 or 3.8.3 of this Appendix, as applicable. The calculated $RMC_{corr,max\ extraction}$ and $RMC_{corr,min\ extraction}$ at the maximum and minimum settings, respectively, shall be combined as follows and the final corrected RMC to be used in section 4.3 of this Appendix shall be:

$$RMC_{corr} = 0.75 \times RMC_{corr,max\ extraction} + 0.25 \times RMC_{corr,min\ extraction}$$

Where:

$RMC_{corr,max\ extraction}$ is the corrected remaining moisture content using the maximum spin setting, calculated according to section 3.8.2 or 3.8.3 of this Appendix, as applicable.

$RMC_{corr,min\ extraction}$ is the corrected remaining moisture content using the minimum spin setting, calculated according to section 3.8.2 or 3.8.3 of this Appendix, as applicable.

3.9 *Combined low-power mode power.* Connect the clothes washer to a watt meter as specified in section 2.5.3 of this Appendix. Establish the testing conditions set forth in sections 2.1, 2.2 and 2.11 of this Appendix. For clothes washers that take some time to enter a stable state from a higher power state as discussed in Section 5, Paragraph 5.1, note 1 of IEC 62301 (incorporated by reference; see § 430.3), allow sufficient time for the clothes washer to reach the lower power state before proceeding with the test measurement. Follow the test procedure for the sampling method specified in Section 5, Paragraph 5.3.2 of IEC 62301 for testing in each possible mode as described in sections 3.9.1 and 3.9.2 of this Appendix.

3.9.1 If a clothes washer has an inactive mode as defined in section 1.15 of this Appendix, measure and record the average inactive mode power of the clothes washer, P_{ia}, in watts.

3.9.2 If a clothes washer has an off mode as defined in section 1.24 of this Appendix, measure and record its average off mode power, P_o, in watts.

4. Calculation of Derived Results From Test Measurements

4.1 *Hot water and machine electrical energy consumption of clothes washers.*

4.1.1 *Per-cycle temperature-weighted hot water consumption for maximum, average, and minimum water fill levels using each appropriate load size as defined in section 2.8 and Table 5.1 of this Appendix.* Calculate for the cycle under test the per-cycle temperature-weighted hot water consumption for the maximum water fill level, Vh_x, the average water fill level, Vh_a, and the minimum water fill level, Vh_n, expressed in gallons per cycle (or liters per cycle) and defined as:

(a) $Vh_x = [Hm_x \times TUF_m] + [Hh_x \times TUF_h] + [Hw_x \times TUF_w] + [Hww_x \times TUF_{ww}] + [Hc_x \times TUF_c]$

(b) $Vh_a = [Hm_a \times TUF_m] + [Hh_a \times TUF_h] + [Hw_a \times TUF_w] + [Hww_a \times TUF_{ww}] + [Hc_a \times TUF_c]$

(c) $Vh_n = [Hm_n \times TUF_m] + [Hh_n \times TUF_h] + [Hw_n \times TUF_w] + [Hww_n \times TUF_{ww}] + [Hc_n \times TUF_c]$

Where:

Hm_x, Hm_a, and Hm_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the extra hot wash cycle with the appropriate test loads as defined in section 2.8 of this Appendix.

Hh_x, Hh_a, and Hh_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the hot wash cycle with the appropriate test loads as defined in section 2.8 of this Appendix.

Hw_x, Hw_a, and Hw_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the warm wash cycle with the appropriate test loads as defined in section 2.8 of this Appendix.

Hww_x, Hww_a, and Hww_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the warm wash/warm rinse cycle with the appropriate test loads as defined in section 2.8 of this Appendix.

Hc_x, Hc_a, and Hc_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the cold wash cycle with the appropriate test loads as defined in section 2.8 of this Appendix.

TUF_m, TUF_h, TUF_w, TUF_{ww}, and TUF_c are temperature use factors for extra hot wash, hot wash, warm wash, warm wash/warm rinse, and cold wash temperature selections, respectively, and are as defined in Table 4.1.1 of this Appendix.

TABLE 4.1.1—TEMPERATURE USE FACTORS

Max wash temp available	≤135 °F (57.2 °C)			>135 °F (57.2 °C)	
No. wash temp selections	Single	2 Temps	>2 Temps	3 Temps	>3 Temps
TUF_m (extra hot)	....	....	....	0.14	0.05
TUF_h (hot)	....	0.63	0.14	....	0.09
TUF_{ww} (warm/warm)	....	....	* 0.27	* 0.27	* 0.27
TUF_w (warm)	....	....	** 0.22/0.49	** 0.22/0.49	** 0.22/0.49
TUF_c (cold)	1.00	0.37	0.37	0.37	0.37

* Only applicable to machines offering a warm/warm cycle. For machines with no warm/warm cycle, TUF_{ww} (warm/warm) should be zero.

** For machines offering a warm/warm cycle, TUF_w (warm) should be 0.22. For machines with no warm/warm cycle, TUF_w (warm) should be 0.49.

4.1.2 *Total per-cycle hot water energy consumption for all maximum, average, and minimum water fill levels tested.* Calculate the total per-cycle hot water energy consumption for the maximum water fill level, HE_{max}, the minimum water fill level, HE_{min}, and the average water fill level, HE_{avg}, expressed in kilowatt-hours per cycle and defined as:

(a) $HE_{max} = [Vh_x \times T \times K]$=Total energy when a maximum load is tested.

(b) $HE_{avg} = [Vh_a \times T \times K]$=Total energy when an average load is tested.

(c) $HE_{min} = [Vh_n \times T \times K]$=Total energy when a minimum load is tested.

Where:

Vh_x, Vh_a, and Vh_n are as defined in section 4.1.1 of this Appendix.

T = Temperature rise = 75 °F (41.7 °C).

K = Water specific heat in kilowatt-hours per gallon per degree F = 0.00240 kWh/gal-°F (0.00114 kWh/L-°C).

4.1.3 *Total weighted per-cycle hot water energy consumption.* Calculate the total weighted per-cycle hot water energy consumption, HE_T, expressed in kilowatt-hours per cycle and defined as:

$$HE_T = [HE_{max} \times F_{max}] + [HE_{avg} \times F_{avg}] + HE_{min} \times F_{min}]$$

Where:

HE_{max}, HE_{avg}, and HE_{min} are as defined in section 4.1.2 of this Appendix.

F_{max}, F_{avg}, and F_{min} are the load usage factors for the maximum, average, and minimum test loads based on the size and type of the control system on the washer being tested. The values are as shown in Table 4.1.3 of this Appendix.

TABLE 4.1.3—LOAD USAGE FACTORS

Water fill control system	Manual	Adaptive
F_{max} = ...	[1] 0.72	[2] 0.12
F_{avg} = ...	....	[2] 0.74
F_{min} = ...	[1] 0.28	[2] 0.14

[1] Reference 3.2.3.3.

[2] Reference 3.2.3.2.

4.1.4 *Total per-cycle hot water energy consumption using gas-heated or oil-heated water.* Calculate for the energy test cycle the per-cycle hot water consumption, HE_{TG}, using gas-heated or oil-heated water, expressed in Btu per cycle (or megajoules per cycle) and defined as:

$$HE_{TG} = HE_T \times 1/e \times 3412 \text{ Btu/kWh or } HE_{TG} = HE_T \times 1/e \times 3.6 \text{ MJ/kWh}$$

Where:

e = Nominal gas or oil water heater efficiency = 0.75.

HE_T = As defined in section 4.1.3 of this Appendix.

4.1.5 *Per-cycle machine electrical energy consumption for all maximum, average, and minimum test load sizes.* Calculate the total per-cycle machine electrical energy consumption for the maximum water fill level, ME_{max}, the average water fill level, ME_{avg}, and the minimum water fill level, ME_{min}, expressed in kilowatt-hours per cycle and defined as:

(a) $ME_{max} =[[Em_x \times TUF_m] + [Eh_x \times TUF_h]+ + [Ew_x \times TUF_w]+ + [Eww_x \times TUF_{ww}] + [Ec_x \times TUF_c]$

(b) $ME_{avg} = [Em_a \times TUF_m] + [Eh_a \times TUF_h] + [Ew_a \times TUF_w]+ + [Eww_a \times TUF_{ww}]+ + [Ec_a \times TUF_c]$

(c) $ME_{min} = [Em_n \times TUF_m]+ + [Eh_n \times TUF_h]+ + [Ew_n \times TUF_w]+ + [Eww_n \times TUF_{ww}] + [Ec_n \times TUF_c]$

Where:

Em_x, Em_a, and Em_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the extra hot wash cycle.

Eh_x, Eh_a, and Eh_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the hot wash cycle.

Ew_x, Ew_a, and Ew_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the warm wash cycle.

Eww_x, Eww_a, and Eww_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the warm wash/warm rinse cycle.

Ec_x, Ec_a, and Ec_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the cold wash cycle.

TUF_m, TUF_h, TUF_w, TUF_{ww}, and TUF_c are as defined in Table 4.1.1 of this Appendix.

4.1.6 *Total weighted per-cycle machine electrical energy consumption.* Calculate the total weighted per-cycle machine electrical energy consumption, ME_T, expressed in kilowatt-hours per cycle and defined as:

$$ME_T = [ME_{max} \times F_{max}]+ + [ME_{avg} \times F_{avg}]+ + [ME_{min} \times F_{min}]$$

Where:

ME_{max}, ME_{avg}, and ME_{min} are as defined in section 4.1.5 of this Appendix.

F_{max}, F_{avg}, and F_{min} are as defined in Table 4.1.3 of this Appendix.

4.1.7 *Total per-cycle energy consumption when electrically heated water is used.* Calculate for the energy test cycle the total per-cycle energy consumption, E_{TE}, using electrically heated water, expressed in kilowatt-hours per cycle and defined as:

$E_{TE} = HE_T + ME_T$

Where:

ME_T = As defined in section 4.1.6 of this Appendix.

HE_T = As defined in section 4.1.3 of this Appendix.

4.2 *Water consumption of clothes washers.*

4.2.1 *Per-cycle water consumption for extra hot wash.* Calculate the maximum, average, and minimum total water consumption, expressed in gallons per cycle (or liters per cycle), for the extra hot wash cycle and defined as:

$Qm_{max} = [Hm_x + Cm_x]$
$Qm_{avg} = [Hm_a + Cm_a]$
$Qm_{min} = [Hm_n + Cm_n]$

Where:

Hm_x, Cm_x, Hm_a, Cm_a, Hm_n, and Cm_n are defined in section 3.3 of this Appendix.

4.2.2 *Per-cycle water consumption for hot wash.* Calculate the maximum, average, and minimum total water consumption, expressed in gallons per cycle (or liters per cycle), for the hot wash cycle and defined as:

$Qh_{max} = [Hh_x + Ch_x]$
$Qh_{avg} = [Hh_a + Ch_a]$
$Qh_{min} = [Hh_n + Ch_n]$

Where:

Hh_x, Ch_x, Hh_a, Ch_a, Hh_n, and Ch_n are defined in section 3.4 of this Appendix.

4.2.3 *Per-cycle water consumption for warm wash with cold rinse.* Calculate the maximum, average, and minimum total water consumption, expressed in gallons per cycle (or liters per cycle), for the warm wash/cold rinse cycle and defined as:

$Qw_{max} = [Hw_x + Cw_x]$
$Qw_{avg} = [Hw_a + Cw_a]$
$Qw_{min} = [Hw_n + Cw_n]$

Where:

Hw_x, Cw_x, Hw_a, Cw_a, Hw_n, and Cw_n are defined in section 3.5 of this Appendix.

4.2.4 *Per-cycle water consumption for warm wash with warm rinse.* Calculate the maximum, average, and minimum total water consumption, expressed in gallons per cycle (or liters per cycle), for the warm wash/warm rinse cycle and defined as:

$Qww_{max} = [Hww_x + Cww_x]$
$Qww_{avg} = [Hww_a + Cww_a]$
$Qww_{min} = [Hww_n + Cww_n]$

Where:

Hww_x, Cww_x, Hww_a, Cww_a, Hww_n, and Cww_n are defined in section 3.7 of this Appendix.

4.2.5 *Per-cycle water consumption for cold wash.* Calculate the maximum, average, and minimum total water consumption, expressed in gallons per cycle (or liters per cycle), for the cold wash cycle and defined as:

$Qc_{max} = [Hc_x + Cc_x]$
$Qc_{avg} = [Hc_a + Cc_a]$
$Qc_{min} = [Hc_n + Cc_n]$

Where:

Hc_x, Cc_x, Hc_a, Cc_a, Hc_n, and Cc_n are defined in section 3.6 of this Appendix.

4.2.6 *Total weighted per-cycle water consumption for extra hot wash.* Calculate the total weighted per-cycle water consumption for the extra hot wash cycle, Qm_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Qm_T = [Qm_{max} \times F_{max}] + [Qm_{avg} \times F_{avg}] + [Qm_{min} \times F_{min}]$

Where:

Qm_{max}, Qm_{avg}, Qm_{min} are defined in section 4.2.1 of this Appendix.

F_{max}, F_{avg}, F_{min} are defined in Table 4.1.3 of this Appendix.

4.2.7 *Total weighted per-cycle water consumption for hot wash.* Calculate the total weighted per-cycle water consumption for the hot wash cycle, Qh_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Qh_T = [Qh_{max} \times F_{max}] + [Qh_{avg} \times F_{avg}] + [Qh_{min} \times F_{min}]$

Where:

Qh_{max}, Qh_{avg}, Qh_{min} are defined in section 4.2.2 of this Appendix.

F_{max}, F_{avg}, F_{min} are defined in Table 4.1.3 of this Appendix.

4.2.8 *Total weighted per-cycle water consumption for warm wash with cold rinse.* Calculate the total weighted per-cycle water consumption for the warm wash/cold rinse cycle, Qw_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Qw_T = [Qw_{max} \times F_{max}] + [Qw_{avg} \times F_{avg}] + [Qw_{min} \times F_{min}]$

Where:

Qw_{max}, Qw_{avg}, Qw_{min} are defined in section 4.2.3 of this Appendix.

F_{max}, F_{avg}, F_{min} are defined in Table 4.1.3 of this Appendix.

4.2.9 *Total weighted per-cycle water consumption for warm wash with warm rinse.* Calculate the total weighted per-cycle water consumption for the warm wash/warm rinse cycle, Qww_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Qww_T = [Qww_{max} \times F_{max}] + [Qww_{avg} \times F_{avg}] + [Qww_{min} \times F_{min}]$

Where:

Qww_{max}, Qww_{avg}, Qww_{min} are defined in section 4.2.4 of this Appendix.

F_{max}, F_{avg}, F_{min} are defined in Table 4.1.3 of this Appendix.

4.2.10 *Total weighted per-cycle water consumption for cold wash.* Calculate the total weighted per-cycle water consumption for the cold wash cycle, Qc_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Qc_T = [Qc_{max} \times F_{max}] + [Qc_{avg} \times F_{avg}] + [Qc_{min} \times F_{min}]$

Where:

Qc_{max}, Qc_{avg}, Qc_{min} are defined in section 4.2.5 of this Appendix.

F_{max}, F_{avg}, F_{min} are defined in Table 4.1.3 of this Appendix.

4.2.11 *Total weighted per-cycle water consumption for all wash cycles.* Calculate the total weighted per-cycle water consumption for all wash cycles, Q_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Q_T = [Qm_T \times TUF_m] + [Qh_T \times TUF_h] + [Qw_T \times TUF_w] + [Qww_T \times TUF_{ww}] + [Qc_T \times TUF_c]$

Where:

Qm_T, Qh_T, Qw_T, Qww_T, and Qc_T are defined in sections 4.2.6 through 4.2.10 of this Appendix.

TUF_m, TUF_h, TUF_w, TUF_{ww}, and TUF_c are defined in Table 4.1.1 of this Appendix.

4.2.12 *Water factor.* Calculate the water factor, WF, expressed in gallons per cycle per cubic foot (or liters per cycle per liter), as:

$WF = Qc_T/C$

Where:

Qc_T = As defined in section 4.2.10 of this Appendix.

C = As defined in section 3.1.5 of this Appendix.

4.2.13 *Integrated water factor.* Calculate the integrated water factor, IWF, expressed in gallons per cycle per cubic foot (or liter per cycle per liter), as:

$IWF = Q_T/C$

Where:

Q_T = As defined in section 4.2.11 of this Appendix.

C = As defined in section 3.1.5 of this Appendix.

4.3 *Per-cycle energy consumption for removal of moisture from test load.* Calculate the per-cycle energy required to remove the remaining moisture of the test load, D_E, expressed in kilowatt-hours per cycle and defined as:

$D_E = [(F_{max} \times \text{Maximum test load weight}) + (F_{avg} \times \text{Average test load weight}) + (F_{min} \times \text{Minimum test load weight})] \times (RMC_{corr} - 4\%) \times (DEF) \times (DUF)$

Where:

F_{max}, F_{avg}, and F_{min} are as defined in Table 4.1.3 of this Appendix.

Maximum, average, and minimum test load weights are as defined in Table 5.1 of this Appendix.

RMC_{corr} = As defined in section 3.8.2.6, 3.8.3.5, or 3.8.4 of this Appendix.

DEF = Nominal energy required for a clothes dryer to remove moisture from clothes = 0.5 kWh/lb (1.1 kWh/kg).

DUF = Dryer usage factor, percentage of washer loads dried in a clothes dryer = 0.91.

4.4 *Per-cycle combined low-power mode energy consumption.* Calculate the per-cycle combined low-power mode energy consumption, E_{TLP}, expressed in kilowatt-hours per cycle and defined as:

$E_{TLP} = [(P_{ia} \times S_{ia}) + (P_o \times S_o)] \times K_p/295.$

Where:

P_{ia} = Washer inactive mode power, in watts, as defined in section 3.9.1 of this Appendix for clothes washers capable of operating in inactive mode; otherwise, $P_{ia} = 0$.

P_o = Washer off mode power, in watts, as defined in section 3.9.2 of this Appendix for clothes washers capable of operating in off mode; otherwise, $P_o=0$.

S_{ia} = Annual hours in inactive mode as defined as S_{oi} if no off mode is possible, $[S_{oi}/2]$ if both inactive mode and off mode are possible, and 0 if no inactive mode is possible.

S_o = Annual hours in off mode as defined as S_{oi} if no inactive mode is possible, $[S_{oi}/2]$ if both inactive mode and off mode are possible, and 0 if no off mode is possible.

S_{oi} = Combined annual hours for off and inactive mode = 8,465.
K_p = Conversion factor of watt-hours to kilowatt-hours = 0.001.
295 = Representative average number of clothes washer cycles in a year.

4.5 *Modified energy factor.* Calculate the modified energy factor, MEF, expressed in cubic feet per kilowatt-hour per cycle (or liters per kilowatt-hour per cycle) and defined as:

$$MEF = C/(E_{TE} + D_E)$$

Where:
C = As defined in section 3.1.5 of this Appendix.
E_{TE} = As defined in section 4.1.7 of this Appendix.
D_E = As defined in section 4.3 of this Appendix.

4.6 *Integrated modified energy factor.* Calculate the integrated modified energy factor, IMEF, expressed in cubic feet per kilowatt-hour per cycle (or liters per kilowatt-hour per cycle) and defined as:

$$IMEF = C/(E_{TE} + D_E + E_{TLP})$$

Where:
C = As defined in section 3.1.5 of this Appendix.
E_{TE} = As defined in section 4.1.7 of this Appendix.
D_E = As defined in section 4.3 of this Appendix.
E_{TLP} = As defined in section 4.4 of this Appendix.

5. Test Loads

TABLE 5.1—TEST LOAD SIZES

Container volume		Minimum load		Maximum load		Average load	
cu. ft. ≥ <	liter ≥ <	lb	kg	lb	kg	lb	kg
0–0.80	0–22.7	3.00	1.36	3.00	1.36	3.00	1.36
0.80–0.90	22.7–25.5	3.00	1.36	3.50	1.59	3.25	1.47
0.90–1.00	25.5–28.3	3.00	1.36	3.90	1.77	3.45	1.56
1.00–1.10	28.3–31.1	3.00	1.36	4.30	1.95	3.65	1.66
1.10–1.20	31.1–34.0	3.00	1.36	4.70	2.13	3.85	1.75
1.20–1.30	34.0–36.8	3.00	1.36	5.10	2.31	4.05	1.84
1.30–1.40	36.8–39.6	3.00	1.36	5.50	2.49	4.25	1.93
1.40–1.50	39.6–42.5	3.00	1.36	5.90	2.68	4.45	2.02
1.50–1.60	42.5–45.3	3.00	1.36	6.40	2.90	4.70	2.13
1.60–1.70	45.3–48.1	3.00	1.36	6.80	3.08	4.90	2.22
1.70–1.80	48.1–51.0	3.00	1.36	7.20	3.27	5.10	2.31
1.80–1.90	51.0–53.8	3.00	1.36	7.60	3.45	5.30	2.40
1.90–2.00	53.8–56.6	3.00	1.36	8.00	3.63	5.50	2.49
2.00–2.10	56.6–59.5	3.00	1.36	8.40	3.81	5.70	2.59
2.10–2.20	59.5–62.3	3.00	1.36	8.80	3.99	5.90	2.68
2.20–2.30	62.3–65.1	3.00	1.36	9.20	4.17	6.10	2.77
2.30–2.40	65.1–68.0	3.00	1.36	9.60	4.35	6.30	2.86
2.40–2.50	68.0–70.8	3.00	1.36	10.00	4.54	6.50	2.95
2.50–2.60	70.8–73.6	3.00	1.36	10.50	4.76	6.75	3.06
2.60–2.70	73.6–76.5	3.00	1.36	10.90	4.94	6.95	3.15
2.70–2.80	76.5–79.3	3.00	1.36	11.30	5.13	7.15	3.24
2.80–2.90	79.3–82.1	3.00	1.36	11.70	5.31	7.35	3.33
2.90–3.00	82.1–85.0	3.00	1.36	12.10	5.49	7.55	3.42
3.00–3.10	85.0–87.8	3.00	1.36	12.50	5.67	7.75	3.52
3.10–3.20	87.8–90.6	3.00	1.36	12.90	5.85	7.95	3.61
3.20–3.30	90.6–93.4	3.00	1.36	13.30	6.03	8.15	3.70
3.30–3.40	93.4–96.3	3.00	1.36	13.70	6.21	8.35	3.79
3.40–3.50	96.3–99.1	3.00	1.36	14.10	6.40	8.55	3.88
3.50–3.60	99.1–101.9	3.00	1.36	14.60	6.62	8.80	3.99
3.60–3.70	101.9–104.8	3.00	1.36	15.00	6.80	9.00	4.08
3.70–3.80	104.8–107.6	3.00	1.36	15.40	6.99	9.20	4.17
3.80–3.90	107.6–110.4	3.00	1.36	15.80	7.16	9.40	4.26
3.90–4.00	110.4–113.3	3.00	1.36	16.20	7.34	9.60	4.35
4.00–4.10	113.3–116.1	3.00	1.36	16.60	7.53	9.80	4.45
4.10–4.20	116.1–118.9	3.00	1.36	17.00	7.72	10.00	4.54
4.20–4.30	118.9–121.8	3.00	1.36	17.40	7.90	10.20	4.63
4.30–4.40	121.8–124.6	3.00	1.36	17.80	8.09	10.40	4.72
4.40–4.50	124.6–127.4	3.00	1.36	18.20	8.27	10.60	4.82
4.50–4.60	127.4–130.3	3.00	1.36	18.70	8.46	10.85	4.91
4.60–4.70	130.3–133.1	3.00	1.36	19.10	8.65	11.05	5.00
4.70–4.80	133.1–135.9	3.00	1.36	19.50	8.83	11.25	5.10
4.80–4.90	135.9–138.8	3.00	1.36	19.90	9.02	11.45	5.19
4.90–5.00	138.8–141.6	3.00	1.36	20.30	9.20	11.65	5.28
5.00–5.10	141.6–144.4	3.00	1.36	20.70	9.39	11.85	5.38
5.10–5.20	144.4–147.2	3.00	1.36	21.10	9.58	12.05	5.47
5.20–5.30	147.2–150.1	3.00	1.36	21.50	9.76	12.25	5.56
5.30–5.40	150.1–152.9	3.00	1.36	21.90	9.95	12.45	5.65
5.40–5.50	152.9–155.7	3.00	1.36	22.30	10.13	12.65	5.75
5.50–5.60	155.7–158.6	3.00	1.36	22.80	10.32	12.90	5.84
5.60–5.70	158.6–161.4	3.00	1.36	23.20	10.51	13.10	5.93
5.70–5.80	161.4–164.2	3.00	1.36	23.60	10.69	13.30	6.03
5.80–5.90	164.2–167.1	3.00	1.36	24.00	10.88	13.50	6.12
5.90–6.00	167.1–169.9	3.00	1.36	24.40	11.06	13.70	6.21

Notes: (1) All test load weights are bone dry weights.
(2) Allowable tolerance on the test load weights are ±0.10 lbs (0.05 kg).

6. Waivers and Field Testing

6.1 *Waivers and Field Testing for Nonconventional Clothes Washers.* Manufacturers of nonconventional clothes washers, such as clothes washers with adaptive control systems, must submit a petition for waiver pursuant to 10 CFR 430.27 to establish an acceptable test procedure for that clothes washer if the washer cannot be tested pursuant to the DOE test procedure or the DOE test procedure yields results that are so unrepresentative of the clothes washer's true energy consumption characteristics as to provide materially inaccurate comparative data. In such cases, field testing may be appropriate for establishing an acceptable test procedure. The following are guidelines for field testing which may be used by manufacturers in support of petitions for waiver. These guidelines are not mandatory and the Department may determine that they do not apply to a particular model. Depending upon a manufacturer's approach for conducting field testing, additional data may be required. Manufacturers are encouraged to communicate with the Department prior to the commencement of field tests which may be used to support a petition for waiver. Section 6.3 of this Appendix provides an example of field testing for a clothes washer with an adaptive water fill control system. Other features, such as the use of various spin speed selections, could be the subject of field tests.

6.2 *Nonconventional Wash System Energy Consumption Test.* The field test may consist of a minimum of 10 of the nonconventional clothes washers (''test clothes washers'') and 10 clothes washers already being distributed in commerce (''base clothes washers''). The tests should include a minimum of 50 energy test cycles per clothes washer. The test clothes washers and base clothes washers should be identical in construction except for the controls or systems being tested. Equal numbers of both the test clothes washer and the base clothes washer should be tested simultaneously in comparable settings to minimize seasonal or consumer laundering conditions or variations. The clothes washers should be monitored in such a way as to accurately record the average total energy and water consumption per cycle, including water heating energy when electrically heated water is used, and the energy required to remove the remaining moisture of the test load. Standby and off mode energy consumption should be measured according to section 4.4 of this test procedure. The field test results should be used to determine the best method to correlate the rating of the test clothes washer to the rating of the base clothes washer.

6.3 *Adaptive water fill control system field test.* (1) Section 3.2.3.1 of this Appendix defines the test method for measuring energy consumption for clothes washers which incorporate both adaptive and alternate manual water fill control systems. Energy consumption calculated by the method defined in section 3.2.3.1 of this Appendix assumes the adaptive cycle will be used 50 percent of the time. This section can be used to develop field test data in support of a petition for waiver when it is believed that the adaptive cycle will be used more than 50 percent of the time. The field test sample size should be a minimum of 10 test clothes washers. The test clothes washers should be representative of the design, construction, and control system that will be placed in commerce. The duration of field testing in the user's house should be a minimum of 50 energy test cycles, for each unit. No special instructions as to cycle selection or product usage should be given to the field test participants, other than inclusion of the product literature pack which would be shipped with all units, and instructions regarding filling out data collection forms, use of data collection equipment, or basic procedural methods. Prior to the test clothes washers being installed in the field test locations, baseline data should be developed for all field test units by conducting laboratory tests as defined by section 1 through section 5 of this Appendix to determine the energy consumption, water consumption, and remaining moisture content values. The following data should be measured and recorded for each wash load during the test period: Wash cycle selected, the mode of the clothes washer (adaptive or manual), clothes load dry weight (measured after the clothes washer and clothes dryer cycles are completed) in pounds, and type of articles in the clothes load (*e.g.,* cottons, linens, permanent press). The wash loads used in calculating the in-home percentage split between adaptive and manual cycle usage should be only those wash loads which conform to the definition of the energy test cycle.

Calculate:

T=The total number of energy test cycles run during the field test.

T_a=The total number of adaptive control energy test cycles.

T_m=The total number of manual control energy test cycles.

The percentage weighting factors:

$P_a=(T_a/T) \times 100\%$ (the percentage weighting for adaptive control selection)

$P_m=(T_m/T) \times 100\%$ (the percentage weighting for manual control selection)

(2) Energy consumption (HE_T, ME_T, and D_E) and water consumption (Q_T), values calculated in section 4 of this Appendix for the manual and adaptive modes, should be combined using P_a and P_m as the weighting factors.

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