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DEPARTMENT OF ENERGY

10 CFR Parts 429, 430 and 431

[EERE-2016-BT-TP-0011]

RIN 1904-AD95

Energy Conservation Program: Test Procedures for Residential and Commercial Clothes Washers

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

ACTION: Final rule.

SUMMARY: This final rule amends the U.S. Department of Energy's ("DOE") test procedures for residential and commercial clothes washers to further specify test conditions, instrument specifications, and test settings; address large clothes container capacities; add product-specific enforcement provisions; delete obsolete provisions; and consolidate all test cloth-related provisions and codify additional test cloth material verification procedures used by industry. This final rule also establishes a new test procedure for residential and commercial clothes washers with additional modifications for certain test conditions, measurement of average cycle time, required test cycles, tested load sizes, semi-automatic clothes washer provisions, new performance metrics, and updated usage factors. The new test procedure will be used for the evaluation and issuance of updated efficiency standards, as well as to determine compliance with the updated standards, should such standards be established.

DATES: The effective date of this rule is **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. The amendments will be mandatory for product testing starting [**INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. Manufacturers will be required to use the amended test procedure until the compliance date of any final rule establishing

amended energy conservation standards based on the newly established test procedure. At such time, manufacturers will be required to begin using the newly established test procedure.

The incorporation by reference of certain materials listed in this rule is approved by the Director of the Federal Register on [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***].

ADDRESSES: The docket, which includes *Federal Register* notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at *www.regulations.gov*. All documents in the docket are listed in the *www.regulations.gov* index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

A link to the docket web page can be found at *www.regulations.gov/docket/EERE2016-BT-TP-0011*. The docket 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 the Appliance and Equipment Standards Program staff at (202) 287-1445 or by e-mail: *ApplianceStandardsQuestions@ee.doe.gov*.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION:

DOE incorporates by reference the following standards into part 430.

American Association of Textile Chemists and Colorists ("AATCC") Test Method 79–2010, "Absorbency of Textiles," Revised 2010.

AATCC Test Method 118–2007, "Oil Repellency: Hydrocarbon Resistance Test," Revised 2007.

AATCC Test Method 135–2010, "Dimensional Changes of Fabrics after Home Laundering," Revised 2010.

Copies of AATCC test methods can be obtained from AATCC, P.O. Box 12215, Research Triangle Park, NC 27709, (919) 549–3526, or by going to *www.aatcc.org*.

International Electrotechnical Commission ("IEC") 62301, "Household electrical appliances—Measurement of standby power," (Edition 2.0, 2011–01).

Copies of IEC 62301 are available from the American National Standards Institute, 25 W. 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4900, or by going to *webstore.ansi.org*.

For a further discussion of these standards, see section IV.N of this document.

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I. Authority and Background

Consumer (residential) clothes washers ("RCWs") are included in the list of "covered products" for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6292(a)(7)) DOE's test procedures for RCWs are currently prescribed at title 10 of the Code of Federal Regulations ("CFR") part 430 Section 23(j), and subpart B appendices J1 ("appendix J1") and J2 ("appendix J2"). DOE also prescribes a test method for measuring the moisture absorption and retention characteristics of new lots of energy test cloth, which is used in testing clothes washers, at appendix J3 to subpart B ("appendix J3"). Commercial clothes washers ("CCWs") are included in the list of "covered equipment" for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6311(1)(H)) The test procedures for CCWs must be the same as those established for RCWs. (42 U.S.C. 6314(a)(8)) The following sections discuss DOE's authority to establish test procedures for RCWs and CCWs and relevant background information regarding DOE's consideration of test procedures for these products and equipment.

A. Authority

The Energy Policy and Conservation Act, as amended ("EPCA"),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part B[2] of EPCA established the Energy Conservation Program for Consumer Products Other Than Automobiles, which

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[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Pub. L. 116-260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A-1 of EPCA.
[2] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

sets forth a variety of provisions designed to improve energy efficiency. These products include RCWs. (42 U.S.C. 6292(a)(7)) Title III, Part C[3] of EPCA, added by Public Law 95-619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment. This equipment includes CCWs. (42 U.S.C. 6311(1)(H)) Both RCWs and CCWs are the subject of this document.

The energy conservation program under EPCA consists essentially of four parts: (1) testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of EPCA specifically include definitions (42 U.S.C. 6291; 42 U.S.C. 6311), test procedures (42 U.S.C. 6293; 42 U.S.C. 6314), labeling provisions (42 U.S.C. 6294; 42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6295; 42 U.S.C. 6313), and the authority to require information and reports from manufacturers (42 U.S.C. 6296; 42 U.S.C. 6316).

The Federal testing requirements consist of test procedures that manufacturers of covered products must use as the basis for (1) certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA (42 U.S.C. 6295(s); 42 U.S.C. 6316(a)), and (2) making other representations about the efficiency of those products (42 U.S.C. 6293(c); 42 U.S.C. 6314(d)). Similarly, DOE must use these test procedures to determine whether the products comply with any relevant standards promulgated under EPCA. (42 U.S.C. 6295(s); 42 U.S.C. 6316(a))

Federal energy efficiency requirements for covered products and equipment established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297; 42 U.S.C. 6316(a) and (b)) DOE may, however, grant waivers of Federal preemption for particular State

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[3] For editorial reasons, upon codification in the U.S. Code, Part C was redesignated Part A-1.

laws or regulations, in accordance with the procedures and other provisions of EPCA. (42 U.S.C. 6297(d); 42 U.S.C. 6316(b)(2)(D))

Under 42 U.S.C. 6293 and 42 U.S.C. 6314, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered products and equipment, respectively. EPCA requires 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 or equipment during a representative average use cycle (as determined by the Secretary) or period of use and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3); 42 U.S.C. 6314(a)(2))

In addition, EPCA requires that DOE 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 the standby mode and off mode energy consumption, or if such integration is technically infeasible. (42 U.S.C. 6295(gg)(2)(A))[4] If an integrated test procedure is technically infeasible, DOE must prescribe separate standby mode and off mode energy use test procedures for the covered product, if a separate test is technically feasible. (42 U.S.C. 6295(gg)(2)(A)(ii)) Any such amendment must consider the most current versions of the International Electrotechnical Commission ("IEC") Standard 62301[5] and IEC Standard 62087[6] as applicable. (42 U.S.C. 6295(gg)(2)(A))

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered product, including RCWs, to determine whether

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[4] EPCA does not contain an analogous provision for commercial equipment.
[5] IEC 62301, *Household electrical appliances—Measurement of standby power* (Edition 2.0, 2011-01).
[6] IEC 62087, *Audio, video and related equipment—Methods of measurement for power consumption* (Edition 1.0, Parts 1–6: 2015, Part 7: 2018).

amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(1)(A))

If the Secretary determines, on her own behalf or in response to a petition by any interested person, that a test procedure should be prescribed or amended, the Secretary shall promptly publish in the *Federal Register* proposed test procedures and afford interested persons an opportunity to present oral and written data, views, and arguments with respect to such procedures. The comment period on a proposed rule to amend a test procedure shall be at least 60 days and may not exceed 270 days. In prescribing or amending a test procedure, the Secretary shall take into account such information as the Secretary determines relevant to such procedure, including technological developments relating to energy use or energy efficiency of the type (or class) of covered products involved. (42 U.S.C. 6293(b)(2)). If DOE determines that test procedure revisions are not appropriate, DOE must publish its determination not to amend the test procedures.

EPCA requires the test procedures for CCWs to be the same as the test procedures established for RCWs. (42 U.S.C. 6314(a)(8)) As with the test procedures for RCWs, EPCA requires that DOE evaluate, at least once every 7 years, the test procedures for CCWs to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle. (42 U.S.C. 6314(a)(1))

DOE is publishing this final rule in satisfaction of the 7-year review requirement specified in EPCA. (42 U.S.C. 6293(b)(1)(A); 42 U.S.C. 6314(a)(1))

B. Background

As discussed, DOE's existing test procedures for clothes washers appear in appendix J1, appendix J2, and appendix J3.

DOE originally established its clothes washer test procedure, codified at 10 CFR part 430, subpart B, appendix J ("appendix J"), in a final rule published Sept. 28, 1977. 42 FR 49802 ("September 1977 Final Rule"). Since that time, the test procedure has undergone several amendments that are relevant to this rulemaking, summarized as follows and described in additional detail in a notice of proposed rulemaking ("NOPR") that DOE published on September 1, 2021. 86 FR 49140 ("September 2021 NOPR").

DOE amended appendix J in August 1997 (62 FR 45484 (Aug. 27, 1997); ("August 1997 Final Rule") and January 2001 (66 FR 3313 (Jan. 12, 2001); "January 2001 Final Rule"). The August 1997 Final Rule also established an appendix J1. 62 FR 45484. DOE amended appendix J1 in the January 2001 Final Rule (66 FR 3313) and in March 2012. 77 FR 13888 (Mar. 7, 2012) ("March 2012 Final Rule"). The March 2012 Final Rule also established a new test procedure at appendix J2 and removed the obsolete appendix J.[7] *Id.*

DOE most recently amended both appendix J1 and appendix J2 in a final rule published on August 5, 2015. 80 FR 46729 ("August 2015 Final Rule"). The August 2015 Final Rule also moved the test cloth qualification procedures from appendix J1 and appendix J2 to the newly created appendix J3. 80 FR 46729, 46735. The current version of the test procedure at appendix J2 includes provisions for determining modified energy

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[7] In that rulemaking, DOE also adopted procedures to measure standby mode and off mode energy consumption into the energy efficiency metrics in the then-newly created appendix J2. Manufacturers were not required to incorporate those changes until the compliance date of an amended standard. 77 FR 13888, 13932. Amended standards were then adopted through a direct final rule that required the use of appendix J2 for RCWs manufactured on or after the 2015 compliance date. 77 FR 32308, 32313 (May 31, 2012). The appendix J follows a similar approach because manufacturers would not be required to incorporate the amendments proposed in appendix J until the compliance date of an amended standard.

factor ("MEF_{J2}")[8] and integrated modified energy factor ("IMEF") in cubic feet per kilowatt-hour per cycle ("ft^3/kWh/cycle"); and water factor ("WF") and integrated water factor ("IWF") in gallons per cycle per cubic feet ("gal/cycle/ft^3"). RCWs manufactured on or after January 1, 2018, must meet current energy conservation standards, which are based on IMEF and IWF, determined using appendix J2. 10 CFR 430.32(g)(4); 10 CFR 430.23(j)(2)(ii) and (4)(ii). CCWs manufactured on or after January 1, 2018, must meet current energy conservation standards, which are based on MEF_{J2} and IWF, determined using appendix J2. 10 CFR 431.154 and 10 CFR 431.156(b).

On May 22, 2020, DOE published a request for information ("RFI") ("May 2020 RFI") to initiate an effort to determine whether to amend the current test procedures for clothes washers. 85 FR 31065. In the September 2021 NOPR, DOE responded to stakeholders' comments on the May 2020 RFI, and proposed amendments to appendix J2 and appendix J3 as well as to establish a new test procedure at 10 CFR part 430, subpart B, appendix J ("appendix J") that would establish new energy efficiency metrics: the energy efficiency ratio ("EER") as the energy efficiency metric for RCWs (replacing IMEF); active-mode energy efficiency ratio ("AEER") as the energy efficiency metric for CCWs (replacing MEF_{J2}); and the water efficiency ratio ("WER") as the water efficiency metric for both RCWs and CCWs (replacing IWF); as well as incorporate a number of revisions to improve test procedure representativeness and reduce test burden. 86 FR 49140.

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[8] The current appendix J2 test procedure defines modified energy factor as "MEF" (*i.e.*, without the "J2" subscript). In the CCW test procedure regulations at 10 CFR 431.152, DOE defines the term "MEF_{J2}" to mean modified energy factor as determined in section 4.5 of appendix J2. As discussed in a CCW test procedure final rule published December 3, 2014, since the calculated value of modified energy factor in appendix J2 is not equivalent to the calculated value of modified energy factor in appendix J1, DOE added the "J2" subscript to the appendix J2 MEF descriptor to avoid any potential ambiguity that would result from using the same energy descriptor for both test procedures. 79 FR 71624, 71626. To maintain consistency with this approach, this final rule adds the "J2" subscript to the MEF metric defined in section 4.5 of appendix J2. See section III.H.10 of this document.

On December 16, 2020, DOE established separate product classes for top-loading RCWs with a cycle time of less than 30 minutes and for front-loading RCWs with a cycle time of less than 45 minutes. 85 FR 81359 ("December 2020 Final Rule"). DOE re-evaluated the new short-cycle product classes in response to Executive Order 13900, "Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis." 86 FR 7037 (Jan. 25, 2021). In addition, stakeholders and interested parties filed multiple lawsuits challenging the December 2020 Final Rule, and DOE received several petitions for reconsideration of the December 2020 Final Rule. Following the re-evaluation of the December 2020 Final Rule, DOE published a NOPR on August 11, 2021, that proposed to repeal the short-cycle product classes. 86 FR 43970. DOE repealed the short-cycle product classes in a final rule published on January 19, 2022. 87 FR 2673.

The comment period of the September 2021 NOPR was initially set to close on November 1, 2021. 86 FR 49140. In response to a stakeholder request,[9] on October 28, 2021, DOE published a notice ("October 2021 Notice") extending the comment period until November 29, 2021. 86 FR 59652.

DOE received comments in response to the September 2021 NOPR from the interested parties listed in Table I.1.

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[9] Request from Association of Home Appliance Manufacturers (EERE-2016-BT-TP-0011-0020) available at *www.regulations.gov/comment/EERE-2016-BT-TP-0011-0020*.

Table I.1 List of Commenters with Written Submissions in Response to September 2021 NOPR

Commenter(s)	Reference in this Final Rule	Commenter Type
Anonymous	Anonymous	Individual
John Oeisratnas	Oeisratnas	Individual
Kenneth Warren	Warren	Individual
Micah Mutrux	Mutrux	Individual
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, Consumer Federation of America, and Natural Resources Defense Council	Joint Efficiency Advocates	Efficiency Organizations
Ameren, ComEd, and Northwest Energy Efficiency Alliance	Joint Commenters	Efficiency Organization & Utilities
Association of Home Appliance Manufacturers	AHAM	Trade Association
GE Appliances	GEA	Manufacturer
Pacific Gas and Electric Company, Sempra Energy, Southern California Edison (collectively, the California Investor-Owned Utilities)	CA IOUs	Utilities
People's Republic of China	P.R. China	Nation
Samsung Electronics America	Samsung	Manufacturer
Whirlpool Corporation	Whirlpool	Manufacturer

Whirlpool commented that it supports AHAM's comments on the September 2021 NOPR. (Whirlpool, No. 26 at p. 2) GEA also commented that it supports AHAM's comments on the September 2021 NOPR, and incorporated AHAM's comments by reference. (GEA, No. 32 at p. 2)

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[10]

II. Synopsis of the Final Rule

In this final rule, DOE amends appendix J2 as follows:

(1) Further specify supply water temperature test conditions and water meter resolution requirements;

[10] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop test procedures for RCWs and CCWs. (Docket No. EERE-2016-BT-TP-0011, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

(2) Add specifications for measuring wash water temperature using submersible data loggers;

(3) Expand the load size table to accommodate clothes container capacities up to 8.0 cubic feet ("ft^3");

(4) Define "user-adjustable adaptive water fill control;"

(5) Specify the applicability of the wash time setting for clothes washers with a range of wash time settings;

(6) Specify how the energy test cycle flow charts apply to clothes washers that internally generate hot water;

(7) Specify that the energy test cycle flow charts are to be evaluated using the Maximum load size;

(8) Specify that testing is to be conducted with any network settings disabled if instructions are available to the user to disable these functions;

(9) Further specify the conditions under which data from a test cycle would be discarded;

(10) Add product-specific enforcement provisions to accommodate the potential for test cloth lot-to-lot variation in remaining moisture content ("RMC");

(11) Delete or correct obsolete definitions, metrics, and the clothes washer-specific waiver section; and

(12) Move additional test cloth related specifications to appendix J3.

In this final rule, DOE also updates 10 CFR part 430, subpart B, appendix J3, "Uniform Test Method for Measuring the Moisture Absorption and Retention Characteristics," as follows:

(1) Consolidate all test cloth-related provisions, including those moved from appendix J2;

(2) Reorganize sections for improved readability; and

(3) Codify the test cloth material verification procedure as used by industry.

In this final rule, DOE also adds appendix J to 10 CFR part 430, subpart B, "Uniform Test Method for Measuring the Energy Consumption of Automatic and Semi-Automatic Clothes Washers," which will be used for the evaluation and issuance of any updated efficiency standards, as well as to determine compliance with the updated standards, should DOE determine that amended standards are warranted based on the criteria established by EPCA.[11] The new appendix J will include the following additional provisions beyond the amendments to appendix J2:

(1) Modify the hot water supply temperature range;

(2) Modify the clothes washer pre-conditioning requirements;

(3) Modify the Extra-Hot Wash threshold temperature;

(4) Add measurement and calculation of average cycle time;

(5) Reduce the number of required test cycles by requiring the use of no more than two Warm Wash/Cold Rinse cycles, and no more than two Warm Wash/Warm Rinse cycles;

(6) Reduce the number of required test cycles by removing the need for one or more cycles used for measuring RMC;

(7) Reduce the number of load sizes from three to two for units currently tested with three load sizes;

(8) Modify the load size definitions consistent with two, rather than three, load sizes;

(9) Update the water fill levels to be used for testing to reflect the modified load size definitions;

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[11] Information regarding the ongoing RCW and CCW energy conservation standards rulemakings can be found at docket numbers EERE–2017–BT–STD–0014 and EERE–2019–BT–STD–0044, respectively.

(10) Specify the installation of single-inlet clothes washers, and simplify the test procedure for semi-automatic clothes washers;

(11) Define new performance metrics that are based on the weighted-average load size rather than clothes container capacity: "energy efficiency ratio," "active-mode energy efficiency ratio," and "water efficiency ratio;"

(12) Update the final moisture content assumption in the drying energy formula;

(13) Update the number of annual clothes washer cycles from 295 to 234; and

(14) Update the number of hours assigned to low-power mode to be based on the clothes washer's measured cycle time rather than an assumed fixed value.

Finally, in this final rule, DOE is removing appendix J1 and updating the relevant sections of 10 CFR parts 429, 430 and 431 in accordance with the edits discussed previously, and modifying the product-specific enforcement provisions regarding the determination of RMC.

The adopted amendments are summarized in Table II.1 compared to the test procedure provision prior to the amendment, as well as the reason for the adopted change.

Table II.1 Summary of Changes in Appendix J2 Test Procedure

Current Appendix J2 Test Procedure	Amended Appendix J2 Test Procedure	Attribution
Specifies a water meter resolution of no larger than 0.1 gallons	Requires a water meter with a resolution no larger than 0.01 gallons if the hot water use is less than 0.1 gallons	Improve representativeness of test results
Specifies a target water supply temperature at the high end of the water supply temperature range	Specifies the midpoint of the allowable range as the target water temperature	Reduce test burden
Specifically allows the use of temperature indicating labels for measuring wash water temperature	Adds specification for using a submersible temperature logger to measure wash water temperature	Reduce test burden
Specifies the test load sizes for clothes container capacities up to 6.0 ft^3	Specifies the test load sizes for clothes container capacities up to 8.0 ft^3	Response to waiver
Provides product-specific enforcement provisions to address anomalous RMC results that are not representative of a basic model's performance	Provides additional product-specific enforcement provisions to accommodate differences in RMC values that may result from DOE using a different test cloth lot than was used by the manufacturer for testing and certifying the basic model	Accommodate potential source of variation in enforcement testing
Specifies discarding data from a wash cycle that provides a visual or audio indicator to alert the user that an out-of-balance condition has been detected, or that terminates prematurely if an out-of-balance condition is detected	Specifies discarding the test data if during a wash cycle the clothes washer signals the user by means of a visual or audio alert that an out-of-balance condition has been detected or terminates prematurely	Response to test laboratory question

Current Appendix J2 Test Procedure	Amended Appendix J2 Test Procedure	Attribution
Does not explicitly address the required configuration for network-connected functionality	Specifies that clothes washers with connected functionality shall be tested with the network-connected functions disabled if such settings can be disabled by the end-user, and the product's user manual provides instructions on how to do so	Improve reproducibility of test results
Does not provide an explicit definition for "user-adjustable adaptive water fill controls" or "wash time"	Provides a definition for "user-adjustable adaptive water fill controls" and for "wash time"	Improve readability
Specifies that user-adjustable automatic clothes washers must be tested with the water fill setting in the most or least energy-intensive setting without defining energy-intensive	Changes the wording to specify selecting the setting based on the most, or least, amount of water used	Response to test laboratory question
Does not specify on which load size to evaluate the energy test cycle flow charts	Specifies evaluating the flow charts using the maximum load size	Response to test laboratory question, improve reproducibility of test results
Does not explicitly address how to evaluate the Cold/Cold energy test cycle flow chart for clothes washers that internally generate hot water	Explicitly addresses clothes washers that internally generate hot water	Response to test laboratory question
Does not provide direction for all control panel styles on clothes washers that offer a range of wash time settings	Clarifies how to test cycles with a range of wash time settings	Improve readability
Includes test cloth verification specifications in appendix J2	Moves all test cloth related provisions to appendix J3	Improve readability
Contains obsolete provisions	Updates or deletes obsolete provisions, including appendix J1 in its entirety	Improve readability

Table II.2 Summary of Changes in Appendix J Test Procedure in Comparison to Appendix J2

Current Appendix J2 Test Procedure	New Appendix J Test Procedure	Attribution
Specifies a water meter resolution of no larger than 0.1 gallons	Requires a water meter with a resolution no larger than 0.01 gallons if the hot water use is less than 0.1 gallons	Improve representativeness of test results
Does not specify how to install clothes washers with a single inlet	Specifies installing clothes washers with a single inlet to the cold water inlet	Provide further direction for unaddressed feature
Specifies a hot water supply temperature of 130–135°F	Specifies a hot water supply temperature of 120–125°F	Improve representativeness of test results
Defines the Extra-Hot Wash threshold as 135°F	Specifies an Extra-Hot Wash threshold of 140°F	Improve representativeness of test results and reduce test burden
Specifies a target water supply temperature at the high end of the water supply temperature range	Specifies the midpoint of the allowable range as the target water temperature	Reduce test burden
Specifically allows the use of temperature indicating labels for measuring wash water temperature	Adds specification for using a submersible temperature logger to measure wash water temperature	Reduce test burden
Specifies different pre-conditioning requirements for water-heating and non-water-heating clothes washers	Requires the same pre-conditioning requirements for all clothes washers	Improve reproducibility of test results

Current Appendix J2 Test Procedure	New Appendix J Test Procedure	Attribution
Specifies the test load sizes for clothes container capacities up to 6.0 ft^3	Specifies the test load sizes for clothes container capacities up to 8.0 ft^3	Response to waiver
Requires 3 tested load sizes on clothes washers with automatic water fill control systems	Reduces the number of load sizes to test to 2, and specifies new load sizes	Reduce test burden
Defines load sizes for each 0.1 ft^3 increment in clothes container capacity	Redefines load sizes for each increment in clothes container capacity, consistent with reduction from 3 to 2 load sizes	Maintain representativeness
Defines water fill levels to use with each tested load sizes on clothes washers with manual water fill control systems	Changes the water fill levels consistent with the updated load sizes	Maintain representativeness
Requires testing up to 3 Warm Wash temperature selections	Requires testing a maximum of 2 Warm Wash temperature selections	Reduce test burden
Specifies that the RMC is to be measured on separate cycle(s) from the energy test cycle	Specifies that the RMC is to be measured on all energy test cycles	Reduce test burden, improve representativeness of test results
Provides product-specific enforcement provisions to address anomalous RMC results that are not representative of a basic model's performance	Provides additional product-specific enforcement provisions to accommodate differences in RMC values that may result from DOE using a different test cloth lot than was used by the manufacturer for testing and certifying the basic model	Accommodate potential source of variation in enforcement testing
Does not specify a measure of cycle time	Specifies provisions for measuring cycle time	Improve representativeness of test results
Specifies discarding data from a wash cycle that provides a visual or audio indicator to alert the user that an out-of-balance condition has been detected, or that terminates prematurely if an out-of-balance condition is detected	Specifies discarding the test data if during a wash cycle the clothes washer signals the user by means of a visual or audio alert that an out-of-balance condition has been detected or terminates prematurely	Response to test laboratory question
Does not explicitly state how to test semi-automatic clothes washers	Provides explicit test provisions for testing semi-automatic clothes washers	Provide further direction for unaddressed feature
Does not explicitly address the required configuration for network-connected functionality	Specifies that clothes washers with connected functionality shall be tested with the network-connected functions disabled if such settings can be disabled by the end-user, and the product's user manual provides instructions on how to do so	Improve reproducibility of test results
Defines metrics that are based on clothes container capacity (IMEF, MEF_{J2}, IWF)	Specifies new metrics that are based on the weighted-average load size (EER, AEER, WER)	Improve representativeness of test results
Calculates the energy required for a clothes dryer to remove the remaining moisture of the test load assuming a final moisture content of 4 percent	Updates the assumed final moisture content to 2 percent	Improve representativeness of test results
Estimates the number of annual use cycles for clothes washers as 295, based on the 2005 Residential Energy Consumption Survey ("RECS") data	Updates the estimate to 234 cycles per year, based on the latest available 2015 RECS data	Update with more recent consumer usage data
Estimates the number of hours spent in low-power mode as 8,465, based on 295 cycles per year and an assumed 1-hour cycle time	Calculates the number of hours spent in low-power mode for each clothes washer based on 234 cycles per year and measured cycle time	Improve representativeness of test results
Does not specify how to test a clothes washer that does not provide water inlet hoses	Specifies using a water inlet hose length of no more than 72 inches	Response to test laboratory question

Current Appendix J2 Test Procedure	New Appendix J Test Procedure	Attribution
Does not provide an explicit definition for "user-adjustable adaptive water fill controls" or "wash time"	Provides a definition for "user-adjustable adaptive water fill controls" and for "wash time"	Improve readability
Categorizes water fill control systems into automatic fill or manual fill categories	Categorizes water fill control systems based on how the user interacts with the controls and whether the water fill level is based on the size or weight of the clothing load	Improve readability
Specifies that user-adjustable automatic clothes washers must be tested with the water fill setting in the most or least energy-intensive setting without defining energy-intensive	Changes the wording to specify selecting the setting based on the most, or least, amount of water used	Response to test laboratory question
Does not specify on which load size to evaluate the energy test cycle flow charts	Specifies evaluating the flow charts using the large load size	Response to test laboratory question, improve reproducibility of test results
Does not explicitly address how to evaluate the Cold/Cold energy test cycle flow chart for clothes washers that internally generate hot water	Explicitly addresses clothes washers that internally generate hot water	Response to test laboratory question
Does not provide direction for all control panel styles on clothes washers that offer a range of wash time settings	Clarifies how to test cycles with a range of wash time settings	Improve readability

Table II.3 Summary of Changes in Appendix J3 Test Procedure

Current Appendix J3 Test Procedure	Amended Appendix J3 Test Procedure	Attribution
Includes test cloth verification specifications in appendix J2	Moves all test cloth related provisions to appendix J3	Improve readability
Does not include all aspects of test cloth verification procedures performed by industry	Codifies additional test cloth verification procedures performed by industry, in appendix J3	Codify industry practice

DOE has determined that the amendments to appendix J2 and appendix J3 described in section III of this document and adopted in this document will not alter the measured efficiency of clothes washers or require retesting or recertification solely as a result of DOE's adoption of the amendments to the test procedures, and that the proposed test procedures would not be unduly burdensome to conduct.

DOE has determined that the amendments in the new appendix J would alter the measured efficiency of clothes washers, in part because the amended test procedure adopts a different energy efficiency metric and water efficiency metric than in the current test procedures. However, use of new appendix J is not required until the compliance date of any standards amended based on the test procedure in appendix J, should such

amendments be adopted. Discussion of DOE's actions are addressed in detail in section III of this document.

The effective date for the amendments adopted in this final rule is 30 days after publication of this document in the *Federal Register*. Representations of energy use or energy efficiency must be based on testing in accordance with the amended appendix J2 test procedures beginning 180 days after the publication of this final rule. Manufacturers will be required to certify compliance using the new appendix J test procedure beginning on the compliance date of any final rule establishing amended energy conservation standards for clothes washers that are published after the effective date of this final rule.

III. Discussion

In the following sections, DOE describes the amendments made to the test procedures for residential and commercial clothes washers.

A. General Comments

DOE received a number of general comments from stakeholders, as summarized below.

Oeiratnas, Warren, and an anonymous commenter expressed general support of the September 2021 NOPR. (Oeisratnas, No. 24 at p. 1; Warren, No. 15 at p. 1; Anonymous, No. 23 at p. 1) Another anonymous commenter expressed general support of improving efficiency in clothes washers. (Anonymous, No. 21 at p. 1)

AHAM commented in opposition to DOE publishing the RCW energy conservation standards preliminary analysis on September 29, 2021 ("September 2021 RCW Standards Preliminary Analysis"; 86 FR 53886) before finalizing a test procedure, or before the comment period on the September 2021 NOPR closed. (AHAM, No. 27 at p. 3) AHAM stated that although DOE provided some additional time for comment on both the test procedure and the preliminary analysis for standards, having both rules open for comment at the same time and before commenters have had sufficient time to

evaluate and conduct the proposed test procedure does not allow commenters to meaningfully comment on either the proposed test procedure or the preliminary analysis. (*Id*.) AHAM also commented that, while it recognizes and supports DOE's interest in moving the clothes washer energy conservation standards and test procedure rulemakings forward, DOE should have released its test procedure proposal before conducting its RCW Standards Preliminary Analysis so that DOE could receive feedback on the test procedure proposal before proceeding with its analysis. (*Id*.) AHAM concluded that it is likely that DOE will need to conduct additional analyses based on the finalized test procedure before proposing a new energy conservation standard. (*Id*.)

GEA expressed concern with the development of an energy conservation standard for a product without a set test procedure. (GEA, No. 32 at p. 2) GEA stated that without a finalized test procedure, it is difficult to effectively comment on the September 2021 RCW Standards Preliminary Analysis, particularly due to complexities of comparing data between new appendix J and appendix J2 test procedures. (*Id*.) GEA recommended that DOE accept and consider feedback generated by the testing program coordinated by AHAM, and that DOE complete the ongoing test procedure rulemaking before moving forward with the RCW standards rulemaking. (*Id*.)

In response to AHAM and GEA's comments regarding the publication of the September 2021 NOPR and the September 2021 RCW Standards Preliminary Analysis, neither the prior version nor the current version of DOE's "Procedures, Interpretations, and Policies for Consideration of New or Revised Energy Conservation Standards and Test Procedures for Consumer Products and Certain Commercial/Industrial Equipment" found in appendix A ("appendix A") specify that a final amended test procedure will be issued prior to issuing standards pre-NOPR rulemaking documents (*e.g*., a standards preliminary analysis). *See* 10 CFR part 430, subpart C, appendix A (Jan. 1, 2020 edition); 86 FR 70892, 70928 (Dec. 13, 2021). Rather, the prior version of the Process

Rule provided that test procedure rulemakings establishing methodologies used to evaluate proposed energy conservation standards would be finalized at least 180 days prior to publication of a NOPR proposing new or amended energy conservation standards. Section 8(d) of appendix A of 10 CFR part 430 subpart C (Jan. 1, 2020 edition). The current version of the Process Rule generally provides that new test procedures and amended test procedures that impact measured energy use or efficiency will be finalized at least 180 days prior to the close of the comment period for a NOPR proposing new or amended energy conservation standards. 86 FR 70892, 70928. DOE will continue to conduct additional analyses based on this finalized test procedure before proposing any new energy conservation standards, and stakeholders will be provided an opportunity to comment on any updated analysis as part of any proposal published regarding amended standards.

AHAM commented that DOE should not proceed with its determination on a clothes washer energy conservation standard until there is adequate data showing the accuracy, repeatability, and reproducibility of new appendix J and changes to appendix J2. (AHAM, No. 27 at pp. 2–3) AHAM added that it is currently unable to provide detailed comment on the accuracy, repeatability, reproducibility, and test burden associated with the new test procedure. (*Id.*) In particular, AHAM stated that it cannot provide detailed comment on the following topics: pre-conditioning requirements (see section III.C.6 of this document), defining new test load sizes and their associated load usage factors (see section III.D.1.b of this document), water fill setting selections for the proposed load sizes (see section III.D.2 of this document), the revised calculation of RMC (see section III.D.4.a of this document), semi-automatic clothes washers[12] (see

[12] AHAM's comments on semi-automatic clothes washers include comments on temperature selection, temperature usage factors, cycles required for test, and the general implementation of the proposed test provisions for semi-automatic clothes washers. All of these aspects are discussed in section III.D.8 of this document.

section III.D.8 of this document), replacing capacity with weighted-average load sizes in the efficiency metrics (see section III.E.1 of this document), and inverting the water efficiency metric (see section III.E.2 of this document). (AHAM, No. 27 at pp. 4–8) AHAM stated that it and its members have developed a robust testing plan to evaluate the proposed test procedure changes, but will not have the testing completed until the end of 2021, and will need much of January 2022 to aggregate and present the results to DOE. (AHAM, No. 27 at pp. 2–3) AHAM commented that, while AHAM appreciates DOE's consideration of AHAM's October 11, 2021 comment extension request,[13] the 28-day comment period extension DOE provided as part of the October 2021 Notice is still not sufficient for AHAM and its members to provide a full set of meaningful comments. (*Id.*) AHAM stated that it plans to continue testing and, when it is complete, will provide an additional comment to DOE based on the test results. (*Id.*)

Whirlpool commented that industry testing regarding proposed new appendix J is ongoing. (Whirlpool, No. 26 at pp. 2–3) Whirlpool commented that, given the magnitude of changes proposed for the new appendix J test procedure, Whirlpool did not have adequate time to complete and analyze all desired testing during the comment period for the September 2021 NOPR. (*Id.*) Whirlpool also commented that it is taking appropriate steps in its test laboratory to ensure proper testing to new appendix J. (*Id.*) Whirlpool added that its comments on the September 2021 NOPR are preliminary, and that its comments may need to be supplemented or corrected once investigative testing is completed. (*Id.*) In particular, Whirlpool stated that it cannot provide detailed comments on the following topics: tested load sizes (see section III.D.1 of this document), the efficiency metrics (see section III.E of this document), and consumer usage assumptions (see section III.G of this document). (Whirlpool, No. 26 at pp. 7–11)

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[13] Available at *www.regulations.gov/comment/EERE-2016-BT-TP-0011-0020*.

GEA commented that it is participating in testing organized by AHAM to test 26 models across seven test laboratories to evaluate the proposed changes to the clothes washer test procedure. (GEA, No. 32 at p. 2) GEA expressed concern that GEA and other AHAM members are devoting substantial financial resources to this testing, and that DOE is not accommodating this test plan by failing to provide the February 1, 2021 comment deadline extension originally proposed by AHAM. (*Id.*) GEA added that it is particularly concerned about the impact of the proposed new metrics, which are based on weighted-average load size instead of capacity, and the impact of DOE's proposed changes to the load usage factors. (*Id.*)

DOE appreciates the efforts described by AHAM and manufacturers in conducting testing to evaluate the proposed changes to the clothes washer test procedure. DOE welcomes and encourages interested parties to submit test data in support of the RCW standards rulemaking. DOE notes that much of the reservation expressed by AHAM and manufacturers was with regard to the impact on measured energy as a result of the proposed amendments to the test procedure. Impacts on measured energy use between the then-current appendix J2 and the proposed appendix J test procedures were factored into the September 2021 RCW Standards Preliminary Analysis and presented in the accompanying Technical Support Document ("TSD").[14] Specifically, testing and modeling of results between the two test procedures were used to generate preliminary translations (*i.e.*, "crosswalks") between the appendix J2 and appendix J metrics for each defined efficiency level. To the extent that provisions of appendix J result in higher measured energy compared to appendix J2, such impacts were factored into the

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[14] See, for example, Table 5.3.7 in chapter 5 of the RCW preliminary analysis TSD describes the impact of each proposed test procedure revision on each individual component of the efficiency metrics. The Residential Clothes Washers Energy Conservation Standards Preliminary Technical Support Document is available at *www.regulations.gov/document/EERE-2017-BT-STD-0014-0030*.

crosswalk of baseline[15] and higher efficiency levels. As stated in chapter 5, section 5.3.3.3 of the preliminary analysis TSD, DOE plans to continue testing additional units to appendix J as finalized in this document and will continue to refine its approach for determining appropriate crosswalk translations in future stages of the standards rulemaking. Details regarding the expected impacts on measured energy are discussed in greater detail throughout sections III.C, III.D, and III.E of this document.

In the September 2021 NOPR, DOE proposed introductory text to both appendix J2 and the proposed new appendix J that provides the timeline for use of appendix J2 and appendix J. 86 FR 49140, 49146, 49205, 49218.

P.R. China recommended that DOE clarify the relationship between new appendix J and appendix J2, and the implementation timeline of new appendix J and appendix J2. (P.R. China, No. 25 at p. 3)

As discussed, DOE is establishing a new test procedure at a new appendix J at 10 CFR part 430 subpart B, which DOE would use for the evaluation and issuance of updated efficiency standards. Use of new appendix J is not required until the compliance date of any new or amended standards that are based on new appendix J. (42 U.S.C. 6295(gg)(2)(C)).

This final rule maintains the introductory notes in appendix J and appendix J2 as proposed in the September 2021 NOPR, while updating the reference date from January 1, 2021, to January 1, 2022. Specifically:

- Manufacturers must use the results of testing under appendix J2 to determine compliance with the relevant standards for clothes washers from §430.32(g)(4) and from §431.156(b) as they appeared in the January 1, 2022 edition of 10 CFR parts 200-499.

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[15] DOE uses the term "baseline" to refer to performance that is minimally compliant with the applicable standard.

- Before the date 180 days following publication of this final rule, representations must be based upon results generated either under appendix J2 as amended in this final rule or under appendix J2 as it appeared in the 10 CFR parts 200-499 edition revised as of January 1, 2022.
- On or after 180 days following publication of this final rule, but before the compliance date of any amended standards for clothes washers, any representations must be made based upon results generated using appendix J2 as amended in this final rule.
- On or after the compliance date of any future amended standards provided in §430.32(g) or in §431.156 that are published after January 1, 2022, any representations must be based upon results generated using appendix J.

DOE further notes that any representations related to energy or water consumption of RCWs or CCWs must be made in accordance with the appropriate appendix that applies (*i.e.*, appendix J or appendix J2) when determining compliance with the relevant standard and that manufacturers may also use appendix J to certify compliance with any amended standards prior to the applicable compliance date for those standards.

Warren suggested that DOE be more specific in how the proposed regulations would be enforced, including who would be responsible to verify regulation requirements, the necessary amount of funding to support this rule, and the expected process by which clothes washers are to be inspected. (Warren, No. 15 at p. 1)

DOE specifies certification, compliance, and enforcement regulations for consumer products and commercial and industry equipment covered by DOE's energy conservation standards program at 10 CFR part 429. Subpart A to part 429 specifies general provisions; subpart B to part 429 ("Certification") sets forth the procedures for manufacturers to certify that their covered products and covered equipment comply with

the applicable energy conservation standards; and subpart C to part 429 ("Enforcement") describes the enforcement authority of DOE to ensure compliance with the conservation standards and regulations.

B. Scope of Applicability

This final rule covers those consumer products that meet the definition of "clothes washer," as codified at 10 CFR 430.2.

EPCA does not define the term "clothes washer." DOE has defined a "clothes washer" as a consumer product designed to clean clothes, utilizing a water solution of soap and/or detergent and mechanical agitation or other movement, that must be one of the following classes: automatic clothes washers, semi-automatic clothes washers, and other clothes washers. 10 CFR 430.2.

An "automatic clothes washer" is a class of clothes washer that has a control system that 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. *Id.*

A "semi-automatic clothes washer" is 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. *Id.*

"Other clothes washer" means a class of clothes washer that is not an automatic or semi-automatic clothes washer. *Id.*

This final rule also covers commercial equipment that meets the definition of "commercial clothes washer." "Commercial clothes washer" is defined as a soft-mount front-loading or soft-mount top-loading clothes washer that—

(A) Has a clothes container compartment that–

(i) For horizontal-axis clothes washers, is not more than 3.5 cubic feet; and

(ii) For vertical-axis clothes washers, is not more than 4.0 cubic feet; and

(B) Is designed for use in–

(i) Applications in which the occupants of more than one household will be using the clothes washer, such as multi-family housing common areas and coin laundries; or

(ii) Other commercial applications.

(42 U.S.C. 6311(21); 10 CFR 431.452)

DOE is not changing the scope of products and equipment covered by its clothes washer test procedures, or the relevant definitions, in this final rule.

C. Testing Conditions and Instrumentation

1. Water Meter Resolution

Section 2.5.5 of the previous appendix J2 required the use of water meters (in both the hot and cold water lines) with a resolution no larger than 0.1 gallons and a maximum error no greater than 2 percent of the measured flow rate. As discussed in the September 2021 NOPR, DOE has observed that some clothes washers use very small amounts of hot water on some temperature selections, on the order of 0.1 gallons or less. 86 FR 49140, 49146. For example, some clothes washers have both Cold and Tap Cold temperature selections, and the Cold selection may use a fraction of a gallon of hot water. *Id*.

In DOE's experience with such clothes washers, the maximum load size typically uses more than 0.1 gallons of hot water on each of the available temperature selections

(providing indication of which temperature selections use hot water), whereas the average and minimum load sizes may use a quantity less than 0.1 gallons. *Id*. For these clothes washers, a water meter resolution of 0.1 gallons would be insufficient to provide an accurate measurement of hot water consumption because the volume of hot water measured would be less than the resolution of the water meter. *Id*. As discussed in the September 2021 NOPR, DOE's testing suggests that clothes washers that use such low volumes of heated water represent a minority of units on the market. *Id.* DOE tentatively concluded that requiring greater water meter precision for all clothes washers would represent an undue burden for those clothes washer models for which water meters with the currently required level of precision provide representative results. *Id.* DOE therefore proposed the use of a hot water meter with more precise resolution only for clothes washers with hot water usage less than 0.1 gallons in any of the individual cycles within the energy test cycle.

Specifically, DOE proposed to specify in section 2.5.5 of both appendix J2 and new appendix J that if the volume of hot water for any individual cycle within the energy test cycle is less than 0.1 gallons (0.4 liters), the hot water meter must have a resolution no larger than 0.01 gallons (0.04 liters). 86 FR 49140, 49147. DOE requested comment on this proposal, and on the extent to which manufacturers and test laboratories already use water meters with this greater resolution. *Id.* DOE also requested comment on whether this proposal would require manufacturers to retest any basic models that have already been certified under the existing water meter resolution requirements. *Id.*

The Joint Efficiency Advocates commented that they support DOE's proposal to require higher water meter resolution for hot water use measurements. (Joint Efficiency Advocates, No. 28 at pp. 3–4) However, the Joint Efficiency Advocates recommended that instead of requiring a water meter resolution of 0.01 gallons for clothes washers that use less than 0.1 gallons of water, DOE should require a water meter resolution of 0.01

gallons for all hot water use measurements. (*Id.*) The Joint Efficiency Advocates added that requiring a resolution no larger than 0.01 gallons if hot water use is less than 0.1 gallons suggests that hot water usage is known prior to testing. (*Id.*) The Joint Efficiency Advocates concluded that requiring a 0.01-gallon resolution would more accurately reflect hot water and energy usage. (*Id.*)

The CA IOUs commented that they support DOE's proposal to require a water meter resolution of 0.01 gallons for clothes washers that use less than 0.1 gallons of water. (CA IOUs, No. 29 at p. 6) However, the CA IOUs stated that it is difficult to discern whether the higher resolution provision would be required, since the test laboratory would need previous knowledge that there is a low-level use of hot water prior to the test. (*Id.*) The CA IOUs encouraged DOE to consider requiring the 0.01-gallon resolution for all products tested under appendix J2 and new appendix J, or alternatively provide clarification for how a testing laboratory would know prior to testing that it would need to use 0.01-gallon-resolution water meters. (*Id.*)

AHAM commented that DOE's proposal to require a water meter resolution of 0.01 gallons for clothes washers that use less than 0.1 gallons of hot water could provide a benefit by increasing the accuracy of the measurements, but could increase test burden due to the cost of obtaining higher-resolution meters. (AHAM, No. 27 at p. 8) AHAM additionally commented that DOE's water meter resolution proposal may not be practical, since laboratories outside of those operated by manufacturers may not have insight into which cycles use less than 0.1 gallons of hot water. (*Id.*)

In response to comments that the volume of hot water would need to be known prior to testing in order to use a water meter with the correct resolution, DOE notes that this concern would likely apply only to third-party laboratories, since manufacturers would have advance knowledge of the expected water usage of their own products. DOE acknowledges that it may not be possible for a third-party test laboratory to know in

advance the expected water usage of a clothes washer. In DOE's experience, in practice, an examination of test results during testing can yield insights as to whether a clothes washer is using less than 0.1 gallons of hot water. As one example, as described earlier in this section, if the maximum load size uses close to 0.1 gallons of hot water on a particular temperature setting, the average and minimum load sizes are likely to use a quantity less than 0.1 gallons. As another example, laboratories may be aware of trends among models from the same product lines, such as models containing both "Tap Cold" and "Cold" settings that use very little hot water on the "Cold" setting. As yet another example, other measured parameters such as water pressure can indicate when a water valve is opened on the clothes washer; *e.g.*, a test cycle that indicates no hot water use (in the case where a water meter with 0.1 gallon resolution is used), but for which the water pressure data indicated a brief opening of the hot water valve, would suggest that a smaller quantity of hot water may have been used and that a more precise water meter resolution is required.

DOE tentatively concluded in the September 2021 NOPR that most, if not all, third-party laboratories already have water meters with the more precise resolution. DOE also estimated the cost of a water meter that provides the proposed resolution, including associated hardware, to be around $600 for each device. 86 FR 49140, 49191. DOE reiterates these cost estimates in section III.K.1 of this document. DOE received no comments in response to the September 2021 NOPR regarding DOE's estimated cost of a water meter.

DOE determines in this final rule that for clothes washers that use less than 0.1 gallons of hot water on certain temperature selections required for testing, the use of the more precise water meters would improve the reproducibility of testing and the representativeness of the results without being unduly burdensome. DOE also determines that requiring greater water meter precision for all clothes washers (*i.e.*, as opposed to

only those that use less than 0.1 gallons of hot water on certain temperature selections) would represent an undue burden for those clothes washer models for which water meters with the currently required level of precision provide representative results. For these reasons and those discussed above, DOE is finalizing its proposal, consistent with the September 2021 NOPR, by amending section 2.5.5 of both appendix J2 and new appendix J to specify that if the volume of hot water for any individual cycle within the energy test cycle is less than 0.1 gallons (0.4 liters), the hot water meter must have a resolution no larger than 0.01 gallons (0.04 liters).

2. Installation of Single-Inlet Machines

Section 2.10 of appendix J2 provides specifications for installing a clothes washer, referencing both the hot water and cold water inlets. Additionally, section 2.5.5 of appendix J2 specifies that a water meter must be installed in both the hot and cold water lines. DOE is aware of RCWs on the market that have a single water inlet rather than separate hot and cold water inlets. 86 FR 49140, 49147. DOE has observed two types of single-inlet RCWs: (1) semi-automatic clothes washers, which are generally intended to be connected to a kitchen or bathroom faucet and which require user intervention to regulate the water temperature by adjusting the external water faucet valves; and (2) automatic clothes washers intended to be connected only to a cold water inlet, and which regulate the water temperature through the use of an internal heating element to generate any hot water used during the cycle. *Id*.

For single-inlet *semi-automatic* clothes washers, DOE has observed that these clothes washers are most often designed to be connected to a kitchen or bathroom faucet, with a single hose connecting the faucet to the single inlet on the clothes washer (*i.e.,* both cold and hot water are supplied to the clothes washer through a single hose).[16] The

[16] As noted, some models may provide or accommodate a Y-shaped hose to connect the separate cold and hot water faucets or supply lines.

user regulates the water temperature externally by adjusting the faucet(s) to provide cold, warm, or hot water temperatures for the wash and rinse portions of the cycle.

In the September 2021 NOPR, DOE stated that additional direction in the test procedure is warranted to produce test results that reflect representative consumer usage of cold, warm, and hot wash/rinse temperatures. *Id*. DOE therefore proposed for testing of semi-automatic RCWs to require connection to only the cold water supply in new appendix J, enabling testing of only the Cold/Cold wash/rinse temperature, and proposed to calculate the energy and water performance at other wash/rinse temperatures formulaically from the Cold Wash/Cold Rinse ("Cold/Cold") cycle data. 86 FR 49140, 49148. DOE asserted that the energy and water performance at temperatures other than Cold/Cold could be calculated numerically using test data from the Cold/Cold cycle, because the measured characteristics[17] of a semi-automatic clothes washer cycle do not depend on the inlet water temperature. 86 FR 49140, 49148. DOE proposed to make this change only in the new appendix J because connecting to only the cold water inlet may differ from how such units are currently being tested by manufacturers and laboratories under appendix J2. *Id*. DOE requested information about implementing this change to appendix J2 as well, specifically regarding how single-inlet semi-automatic clothes washers are being tested and any potential impact on the measured energy use of these clothes washers on the market. *Id*.

For single-inlet *automatic* clothes washers, in the September 2021 NOPR, DOE proposed to specify that all single-inlet automatic clothes washers be installed to the cold water supply only, based on a review of user manuals. 86 FR 49140, 49148. DOE proposed to include this provision in the new appendix J only. *Id*. The proposed edit to

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[17] Measured characteristics of a semi-automatic clothes washer cycle include total water consumption, electrical energy consumption, cycle time, and bone-dry and cycle complete load weights. See section III.D.8 of this document for more details.

section 2.10.1 of the new appendix J is that if the clothes washer has only one water inlet, the inlet would be connected to the cold water supply in accordance with the manufacturer's instructions. *Id*. DOE requested comment on this proposal, and on whether this requirement should be included in only the new appendix J, or whether, if adopted, it should be included as an amendment to appendix J2. *Id*.

P.R. China commented in support of requiring single-inlet clothes washers to be installed to the cold water supply only. (P.R. China, No. 25 at p. 3) P.R. China also recommended that DOE add test methods that would evaluate single-inlet clothes washers' heating functions using different programs where the water is heated to different temperatures. *(Id.)* DOE received no comments regarding how single-inlet clothes washers are being tested currently to appendix J2 or whether the proposed amendments should also be adopted in appendix J2.

In response to P.R. China's recommendation, DOE notes that a single-inlet clothes washer with a heating function would be classified as an *automatic* single-inlet clothes washer and as such would be tested using the temperature selections determined to be part of the energy test cycle using the flowcharts provided in section 2.12 of appendix J2 or new appendix J.

For the reasons discussed, DOE is finalizing its proposal to require in section 2.10.1 of the new appendix J that a clothes washer with only one water inlet be connected to the cold water supply in accordance with the manufacturer's instructions. DOE is unable to determine whether these amendments would change how such units are currently being tested by manufacturers and laboratories under appendix J2 and therefore is not adopting these amendments in appendix J2. As described further in section III.D.8 of this document, DOE is also finalizing its proposal for semi-automatic clothes washers in new appendix J to require testing of only the Cold/Cold wash/rinse temperature and to

calculate the energy and water performance at other wash/rinse temperatures formulaically from the Cold/Cold cycle data.

3. Water Supply Temperatures

a. Hot Water Supply Temperature

Section 2.2 of appendix J2 requires maintaining the hot water supply temperature between 130 degrees Fahrenheit ("°F") (54.4 degrees Celsius ("°C")) and 135 °F (57.2 °C), using 135 °F as the target temperature.

DOE has revised the hot water supply temperature requirements several times throughout the history of the clothes washer test procedures to remain representative of household water temperatures at the time of each analysis. When establishing the original clothes washer test procedure at appendix J in 1977, DOE specified a hot water supply temperature of 140 °F ± 5 °F for clothes washers equipped with thermostatically controlled inlet water valves. 42 FR 49802, 49808. In the August 1997 Final Rule, DOE specified in appendix J1 that for clothes washers in which electrical energy consumption or water energy consumption is affected by the inlet water temperatures,[18] the hot water supply temperature cannot exceed 135 °F (57.2 °C); and for other clothes washers, the hot water supply temperature is to be maintained at 135 °F ±5 °F (57.2 °C ± 2.8 °C). 62 FR 45484, 45497. DOE maintained these same requirements in the original version of appendix J2. In the August 2015 Final Rule, DOE adjusted the allowable tolerance of the hot water supply temperature in section 2.2 of appendix J2 to between 130 °F (54.4 °C) and 135 °F (57.2 °C) for all clothes washers, but maintained 135 °F as the target temperature. 80 FR 46729, 46734–46735.

As noted in the September 2021 NOPR, DOE analyzed household water temperatures as part of the test procedure final rule for residential and commercial water

[18] For example, water-heating clothes washers or clothes washers with thermostatically controlled water valves.

heaters published July 11, 2014. 79 FR 40541 ("July 2014 Water Heater Final Rule"). In the July 2014 Water Heater Final Rule, DOE revised the hot water delivery temperature from 135 °F to 125 °F based on an analysis of data showing that the average set point temperature for consumer water heaters in the field is 124.2 °F (51.2 °C), which was rounded to the nearest 5 °F, resulting in a test set point temperature of 125 °F. 79 FR 40541, 40554. Additionally, a 2011 compilation of field data across the United States and southern Ontario by Lawrence Berkeley National Laboratory ("LBNL")[19] found a median daily outlet water temperature of 122.7 °F (50.4 °C). *Id*. Further, DOE noted in the July 2014 Water Heater Final Rule that water heaters are commonly set with temperatures in the range of 120 °F to 125 °F. *Id*.

Additionally, section 2.3.2. of DOE's consumer dishwasher test procedure, codified at 10 CFR part 430 subpart B, appendix C1 ("appendix C1"), specifies a hot water supply temperature of 120 °F ± 2 °F for water-heating dishwashers designed for heating water with a nominal inlet temperature of 120 °F, which includes nearly all consumer dishwashers currently on the U.S. market. This water supply temperature is intended to be representative of household hot water temperatures.

In the September 2021 NOPR, DOE proposed to update the hot water supply temperature in the new appendix J from 130–135 °F to 120–125 °F. *Id*. Additionally, DOE proposed to change the value of "T," the temperature rise that represents the nominal difference between the hot and cold water inlet temperatures, from 75 °F to 65 °F, consistent with the differential between the nominal values for the proposed hot water supply temperature (120–125 °F) and the cold water supply temperature (55–60 °F). 86 FR 49140, 49149–49150. DOE requested comment on any potential impact

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[19] Lutz, JD, Renaldi, Lekov A, Qin Y, and Melody M, "Hot Water Draw Patterns in Single Family Houses: Findings from Field Studies," LBNL Report number LBNL–4830E (May 2011). Available at *www.escholarship.org/uc/item/2k24v1kj*.

to testing costs that may occur by harmonizing temperatures between the clothes washer and dishwasher test procedures, and the impacts on manufacturer burden associated with any changes to the hot water supply temperature. 86 FR 49140, 49150.

The Joint Efficiency Advocates commented in support of DOE specifying a hot water supply temperature of 120–125 °F and decreasing the temperature rise from 75 °F to 65 °F accordingly. (Joint Efficiency Advocates, No. 28 at p. 3) Referencing DOE's discussion in the July 2014 Water Heater Final Rule and the September 2021 NOPR, the Joint Efficiency Advocates stated that a hot water supply temperature of 120–125 °F would better reflect current clothes washer usage conditions than the 135 °F temperature specified in the current test procedure. (*Id.*) The comment also noted that the proposed reduction of the hot water temperature rise for appendix J was reasonable. (*Id.*)

The Joint Commenters commented in support of DOE's proposal to specify the clothes washer hot water supply temperature range from 120 to 125 °F, stating that it is a reasonable representation of real-world supply temperatures. (Joint Commenters, No. 31 at p. 10)

AHAM commented that if DOE proceeds with adjusting the hot water temperature to 125 °F, all provisions within the test procedure relating to maximum water temperature should be adjusted to 125 °F as well, including the flow charts within the test procedure. (AHAM, No. 27 at p. 9) AHAM added that the flow charts have been helpful to manufacturers and test laboratories, and that it is therefore critical that they be properly adjusted to account for the temperature change. (*Id.*) AHAM also commented that this change could limit customer choice with respect to temperature controls, asserting that since the proposed temperature requirement for the Extra-hot Wash/Cold Rinse cycle would be 140 °F, but the Hot Wash/Cold Rinse cycle would not be able to get above 125 °F without the use of an internal water heater, a clothes washer with a temperature setting between 125 °F and 140 °F would experience a negative impact to its energy use. (*Id.*)

AHAM added that this change would mean that manufacturers would no longer realistically be able to offer consumers temperatures between 125 °F and 140 °F, and that product redesign would be required. (*Id.*) AHAM added that additional testing may illuminate this concern and, if so, AHAM would provide DOE with more information. (*Id.*)

In response to AHAM's comment that decreasing the hot inlet supply temperature to a range of 120 to 125 °F would result in greater measured energy for a clothes washer with a temperature setting between 125 °F and 140 °F due to the need to use an internal water heater, DOE expects that the overall measured energy use of a temperature setting between 125 °F and 140 °F would remain roughly the same even with the reduced hot water inlet temperature. The total measured energy for each cycle includes both the machine electrical energy (which includes any energy expended for internal water heating) as well as the energy used to heat the water externally in a water heater (*i.e.*, the water heating energy). As discussed further in section III.G.6 of this document, the calculation of water heating energy assumes a 100 percent efficient external electric water heater. DOE would expect an internal water heater within a clothes washer to operate similarly at a thermal efficiency of roughly 100 percent. Accordingly, for a given wash temperature, the amount of thermal energy measured by the test procedure is roughly the same regardless of whether the heated water is supplied by an external water heater or an internal water heating element within the clothes washer, or a combination of both.

As an example, consider a clothes washer with a hot wash temperature of 135 °F and a test cycle that uses 20 gallons of water. Under the appendix J2 test procedure with a nominal hot water supply temperature of 135 °F, all 20 gallons would be hot water,

externally heated with an associated water heating energy of 3.6 kWh.[20] Using instead a nominal hot water supply temperature of 125 °F, the same test cycle would similarly use 20 gallons of externally-heated water (heated to 125 °F rather than 135 °F), plus additional internal water heating to increase the temperature by an additional 10 °F to 135 °F. In this scenario, the external water heating energy would be calculated as 3.12 kWh,[21] and the internal water heater would be expected to use around 0.48 kWh,[22] for a total of 3.6 kWh (matching the first scenario).

As exemplified, DOE concludes that any change in the balance between externally heated water and internally heated water as a result of changing the inlet supply temperature would have negligible, if any, impact on overall energy use and therefore would not limit a manufacturer's ability to continue to offer wash temperatures between 125 °F and 140 °F. As discussed previously, any impacts to measured energy, however minor, as a result of changes to the hot water supply inlet temperature were accounted for in the crosswalk between the appendix J2 and appendix J metrics developed for the September 2021 RCW Standards Preliminary Analysis. DOE will continue to consider any such impacts in future stages of the standards rulemaking. Furthermore, given DOE's determination that a hot water supply temperature range of 120 °F to 125 °F is more representative of household hot water temperatures, any change in measured energy as a result of changing the hot water supply inlet temperature would be more representative of consumer use.

For the reasons discussed previously, DOE is finalizing its proposal to update the hot water supply temperature in the new appendix J from 130–135 °F to 120–125 °F, and to update the value of "T" to 65 °F accordingly, consistent with the September 2021

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[20] Calculated as 20 gallons (gal) × 75 °F temperature rise × 0.0024 kWh/gal/°F specific heat of water, per section 4.1.2 of appendix J2.
[21] Calculated as 20 gal × 65 °F temperature rise × 0.0024 kWh/gal/°F.
[22] Calculated as 20 gal × 10 °F temperature rise × 0.0024 kWh/gal/°F × 100% assumed efficiency.

NOPR. DOE reiterates that any impacts to measured energy as a result of changes to the hot water inlet supply temperature will be accounted for in the crosswalk between the appendix J2 and appendix J metrics as part of the ongoing standards analysis, such that DOE does not expect the changes implemented in this final rule to require significant product redesign.

b. Target Water Supply Temperatures

Section 2.2 of appendix J2 specified that the hot water supply temperature must be maintained between 130 °F (54.4 °C) and 135 °F (57.2 °C), using 135 °F as the target temperature. Section 2.2 of appendix J2 specified maintaining a cold water temperature between 55 °F and 60 °F, using 60 °F as the target temperature.

In the September 2021 NOPR, DOE proposed to remove the "target" temperature associated with each water supply temperature range, and to instead define only the allowable temperature range. 86 FR 49140, 49151. Based on experience working with third-party test laboratories, as well as its own testing experience, DOE recognizes that maintaining a target temperature for the water supply that represents one edge of the allowable temperature range, rather than the midpoint, may be difficult. *Id*. On electronic temperature-mixing valves commonly used by test laboratories, the output water temperature is maintained within an approximately 2-degree tolerance above or below a target temperature programmed by the user (*e.g.*, if the target temperature is set at 135 °F, the controller may provide water temperatures ranging from 133 °F to 137 °F). *Id.* To ensure that the water inlet temperature remains within the allowable range, such a temperature controller would need to be set to around the midpoint of the range, which conflicts with the test procedure requirement. *Id*.

Specifically, DOE proposed in the September 2021 NOPR that the cold water supply temperature range be defined as 55 °F to 60 °F in both appendix J2 and the new appendix J; the hot water supply temperature range in appendix J2 be defined as 130 °F

to 135 °F; and the hot water supply temperature range in the new appendix J be defined as 120 °F to 125 °F. *Id.*

DOE requested comment on its proposal to remove the target temperatures and instead specify water supply temperature ranges as 55 °F to 60 °F for cold water in both appendix J2 and the new appendix J, 130 °F to 135 °F for hot water in appendix J2, and 120 °F to 125 °F for hot water in the new appendix J. *Id*.

Whirlpool stated that it opposes DOE's proposal to remove the target temperatures from the proposed hot or cold water supply temperature requirements, stating that DOE provided no strong rationale to remove them. (Whirlpool, No. 26 at pp. 5–6) Whirlpool further commented that removing the target condition could reduce reproducibility by increasing the chances that test laboratories will conduct testing throughout the entire allowable range, rather than test at or near a single target temperature. (*Id*.) For example, as stated by Whirlpool, the absence of a target temperature may force manufacturers to be extremely conservative in the testing and certification of products and always test at the part of the range that produces the least energy efficient results. (*Id*.) Whirlpool expressed concern that removing the target temperature could increase the overall variation between laboratory test results. (*Id*.)

AHAM commented that it opposes DOE's proposal to specify a target temperature range instead of a target temperature. (AHAM, No. 27 at pp. 9–10) AHAM recommended that DOE align its proposed test procedure with other DOE test procedures in which the target temperature has a tolerance and nominal target, rather than any temperature within a specified range (*e.g.*, X ± Y with nominal X as the target), in order to increase reproducibility. (*Id*.) AHAM commented that while it recognizes that any value within a temperature range would be a valid test, a target nominal temperature would discourage test laboratories from testing at one end of the range or the other. (*Id*.) AHAM further commented that a need for a repeatable, reproducible test is increasing

since manufacturers' ability to conservatively rate and ensure continued compliance with standards decreases as energy conservation standards get more stringent. (*Id.*) AHAM also added that removing the target temperature would have an impact on calculating the water heating energy, since the temperature rise between the cold and hot water supply temperatures would be less certain. (*Id.*)

Considering comments received, DOE recognizes that specifying a target temperature for the supply water may be helpful in ensuring reproducible test results. DOE also recognizes, as discussed, that best practice by laboratories is to configure the water temperature controller setpoint to the midpoint of the temperature range in order to accommodate fluctuations both above and below the setpoint, thus ensuring that the water inlet temperature remains within the allowable range throughout the duration of testing. For these reasons, in this final rule, DOE is amending the temperature supply specifications to specify targeting the midpoint of each range. DOE reiterates that specifying a target temperature setpoint is intended to promote reproducibility of results and does not invalidate test data that is not centered around the target temperature but remains within the specified allowable range.

DOE further notes that by targeting the midpoint of both the hot water temperature range and the cold water temperature range, the value of "T" used in the water heating energy formula (as discussed in section III.C.3.a of this document) represents the difference between the targeted values for both appendix J2 and new appendix J.

4. Extra-Hot Wash Determination

Clothes washers are tested using an energy test cycle determined by taking into consideration all cycle settings available to the end user. Section 2.12 of appendix J2. Figure 2.12.5 of appendix J2 specifies that for the energy test cycle to include an Extra-Hot Wash/Cold Rinse, the clothes washer must have an internal heater and the Normal

cycle[23] must, in part, contain a wash/rinse temperature selection that has a wash temperature greater than 135 °F. The 135 °F threshold matches the high end of the hot water inlet temperature range specified in section 2.2 of appendix J2.

DOE has revised the Extra-Hot wash temperature parameters previously. In the August 1997 Final Rule, DOE revised the threshold temperature for Extra-Hot Wash from 140 °F to 135 °F in conjunction with changing the minimum hot water supply temperature in appendix J from 140 °F in appendix J to 135 °F. 62 FR 45484, 45497. As noted, appendix J2 retains this threshold temperature of 135 °F for Extra-Hot Wash.

As described in the September 2021 NOPR, the proposal to update the hot water inlet temperature from 130–135 °F to 120–125 °F in new appendix J prompted DOE to reassess the threshold temperature for the Extra-Hot wash temperature in new appendix J. 86 FR 49140, 49150. Because the inclusion of an Extra-Hot Wash/Cold Rinse in the energy test cycle requires the clothes washer to have an internal heater, the threshold temperature is not limited to the input temperature. *Id*.

In the September 2021 NOPR, DOE indicated that based on test data from a broad range of clothes washers, over 70 percent of Extra-Hot cycles have a wash water temperature that exceeds 140 °F. 86 FR 49140, 49150. Furthermore, DOE research indicated that 140 °F is widely cited as a threshold for achieving sanitization. *Id*. DOE therefore proposed specifying in new appendix J that the Extra-Hot Wash threshold be 140 °F. *Id*. DOE preliminarily concluded that a temperature threshold of 140 °F would align with 140 °F as an accepted temperature threshold for sanitization, and therefore

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[23] Section 1.25 of appendix J2 defines the Normal cycle as the cycle recommended by the manufacturer (considering manufacturer instructions, control panel labeling, and other markings on the clothes washer) for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing. For machines where multiple cycle settings are recommended by the manufacturer for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing, then the Normal cycle is the cycle selection that results in the lowest IMEF or MEF_{J2} value.

may be more representative of consumer expectations and usage of an Extra-Hot Wash cycle, than the current 135 °F threshold. *Id.*

In addition to improving representativeness, DOE noted in the September 2021 NOPR that changing the Extra-Hot Wash temperature threshold to 140 °F could potentially reduce test burden. *Id.* As discussed more fully in section III.C.5 of this document, a threshold of 140 °F would enable easier confirmation that an Extra-Hot temperature has been achieved when measuring wash temperature with non-reversible temperature indicator labels, as permitted by section 3.3 of appendix J2.

In the September 2021 NOPR, DOE requested comment on its proposal to specify in the new appendix J that the Extra-Hot Wash/Cold Rinse designation would apply to a wash temperature greater than or equal to 140 °F. 86 FR 49140, 49151. DOE also requested any additional data on the wash temperature of cycles that meet the appendix J2 definition of Extra-Hot Wash/Cold Rinse. *Id*. DOE also expressed interest in data and information on any potential impact to testing costs that may occur by changing the Extra-Hot Wash temperature threshold, and the impacts on manufacturer burden associated with any changes to the Extra-Hot Wash/Cold Rinse definition. *Id*.

Whirlpool commented that it supports DOE's proposal to change the Extra-Hot Wash temperature threshold to 140 °F because that is the minimum threshold temperature for various international clothes sanitization standards, including the standards published by the World Health Organization. (Whirlpool, No. 26 at p. 5) Whirlpool additionally suggested that there should be consideration of some tolerance on top of this threshold temperature at 140 °F (*e.g.*, 2 °F). (*Id*.) Whirlpool further explained that without including a tolerance, a manufacturer using this Extra-Hot temperature setting for sanitization may be penalized for conservatively setting higher Extra-Hot temperature settings beyond 140 °F to account for temperature variation during a sanitization period. (*Id*.) Whirlpool added that, using submersible temperature loggers to measure water

temperatures, as proposed in the September 2021 NOPR,[24] there should be no issue identifying when such an Extra-Hot water temperature threshold (*e.g.*, 142 °F or 143 °F) is reached. (*Id.*)

DOE notes that the Extra-Hot Wash temperature is a threshold temperature, rather than a target temperature; as such, defining a tolerance on the 140 °F threshold, as suggested by Whirlpool, would not be appropriate. Adding a tolerance to the threshold value would effectively result in raising the threshold value by the tolerance amount. DOE notes that the current Extra-Hot Wash threshold of 135 °F does not have a defined tolerance. Any wash temperature that meets or exceeds the threshold temperature would be considered an Extra-Hot Wash. For these reasons, DOE is not adding a tolerance to the threshold value for the Extra-Hot Wash water temperature in this final rule.

As discussed previously, any impacts to measured energy as a result of changes to the definition of Extra-Hot Wash were accounted for in the crosswalk between the appendix J2 and appendix J metrics developed for the September 2021 RCW Standards Preliminary Analysis. DOE will continue to consider any such impacts in future stages of the standards rulemaking.

For the reasons discussed above, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to specify in the new appendix J that the minimum temperature threshold for the Extra-Hot Wash/Cold Rinse is 140 °F. This change is reflected in the Extra-Hot Wash/Cold Rinse flowchart and the Hot Wash/Cold Rinse flowchart in section 2.12.1 of the new appendix J, as well as any references to this temperature threshold elsewhere throughout the new appendix J. DOE reiterates that any impacts to measured energy as a result of changes to the definition of Extra-Hot Wash will be accounted for in the crosswalk between the appendix J2 and appendix J metrics as

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[24] See discussion of wash temperature measurements in section III.C.4 of this document.

part of the ongoing standards analysis, such that DOE does not expect the changes implemented in this final rule to require significant product redesign.

5. Wash Water Temperature Measurement

Section 3.3 of appendix J2 allows the use of non-reversible temperature indicator labels to confirm that a wash temperature greater than the Extra-Hot Wash threshold temperature of 135 °F has been achieved. As discussed in the September 2021 NOPR, DOE is aware that none of the temperature indicator labels on the market provide an indicator at 135 °F, the current Extra-Hot Wash water temperature threshold. 86 FR 49140, 49152. Because of this, temperature indicator labels can be used to confirm that the water temperature reached 135 °F only if the water temperature exceeds 140 °F. *Id*. Such temperature indicator labels are unable to identify an Extra-Hot Wash/Cold Rinse cycle if the temperature of the cycle is greater than 135 °F but less than 140 °F. *Id*. DOE recognizes the potential benefit of other methods of measurement to supplement or replace the temperature indicator labels. *Id*.

In the September 2021 NOPR, DOE proposed to allow the use of a submersible temperature logger as an additional temperature measurement option to confirm that an Extra-Hot Wash temperature greater than 135 °F has been achieved during the wash cycle for appendix J2, and greater than 140 °F for new appendix J. *Id*. DOE proposed that the submersible temperature logger must have a time resolution of at least one data point every 5 seconds and a temperature measurement accuracy of ±1 °F. *Id*. As described currently for temperature indicator labels, the proposed amendment included a note that failure to measure a temperature of 135 °F would not necessarily indicate of the lack of an Extra-Hot Wash temperature. *Id*. However, such a result would not be conclusive due to the lack of verification of that the required water temperature was achieved, in which case an alternative method must be used to confirm that an Extra-Hot Wash temperature greater than 135 °F has been achieved during the wash cycle. *Id*.

DOE requested comment on its proposal to allow the use of a submersible temperature logger in appendix J2 and new appendix J as an option to confirm that an Extra-Hot Wash temperature greater than the Extra-Hot Wash threshold has been achieved during the wash cycle. *Id*. DOE also requested data and information confirming (or disputing) DOE's discussion of the benefits and limitations of using a submersible temperature logger, including DOE's determination that a submersible logger's failure to measure a temperature greater than the Extra-Hot Wash threshold does not necessarily indicate that the cycle under test does not meet the definition of an Extra-Hot Wash/Cold Rinse cycle. *Id*.

AHAM commented in support of DOE's proposal to allow the use of a submersible temperature logger, but noted that the shift in the Extra-Hot Wash temperature threshold makes this change less necessary than it may have been in the past. (AHAM, No. 27 at p. 10)

Whirlpool commented in support of DOE's proposal to allow for the use of a submersible temperature logger as an additional temperature measurement option to confirm that the Extra-Hot Wash temperature threshold has been achieved during the wash cycle. (Whirlpool, No. 26 at p. 6)

DOE also proposed in the September 2021 NOPR to move the description of allowable temperature measuring devices from section 3.3 of appendix J2 to section 2.5.4 of both appendix J2 and the proposed new appendix J ("Water and air temperature measuring devices"), specifying the use of non-reversible temperature indicator labels in new section 2.5.4.1, and adding specifications for the use of submersible temperature loggers to new section 2.5.4.2 of both appendix J2 and the proposed new appendix J. 86 FR 49140, 49152.

DOE received no comments in response to its proposal to move the description of allowable temperature measuring devices.

For the reasons discussed above, DOE finalizes its proposal, consistent with the September 2021 NOPR, to allow the use of a submersible temperature logger in appendix J2 and new appendix J as an option to confirm that an Extra-Hot Wash temperature greater than the Extra-Hot Wash threshold has been achieved during the wash cycle. DOE also finalizes its proposal, consistent with the September 2021 NOPR, to restructure section 2.5.4 of appendix J2 and new appendix J as described.

6. Pre-Conditioning Requirements

Section 2.11 of appendix J2 specifies the procedure for clothes washer pre-conditioning. The current preconditioning procedure requires that any clothes washer that has not been filled with water in the preceding 96 hours, or any water-heating clothes washer that has not been in the test room at the specified ambient conditions for 8 hours, must be preconditioned by running it through a Cold Rinse cycle and then draining it to ensure that the hose, pump, and sump are filled with water. The purpose of pre-conditioning is to promote repeatability and reproducibility of test results by ensuring a consistent starting state for each test, as well as to promote the representativeness of test results by ensuring that the clothes washer is operated consistent with the defined ambient conditions. In particular, the additional specification for water-heating clothes washers was first suggested in a supplemental NOPR published on April 22, 1996, ("April 1996 SNOPR"), in which DOE expressed concern about the testing of water-heating clothes washers that may have been stored at a temperature outside of the specified ambient temperature range (75 °F ± 5° F) prior to testing. 61 FR 17589, 17594–17595. DOE stated that the energy consumed in a water-heating clothes washer may be affected by the ambient temperature. *Id.* Thus, if the ambient temperature prior to and during testing is relatively hot, then less energy will be consumed than under typical operating conditions, *i.e.*, the test would understate the clothes washer's energy consumption. *Id*. Conversely, if the ambient temperature prior to and during the test is

relatively cold, then the test would overstate the clothes washer's energy consumption. *Id*. In the subsequent August 1997 Final Rule, DOE added the pre-conditioning requirement for water-heating clothes washers, which requires water-heating units to be pre-conditioned if they had not been in the test room at ambient conditions for 8 hours. 62 FR 45484, 45002, 45009, 45010.

In the September 2021 NOPR, DOE expressed concern that the energy use of non-water-heating clothes washers could also be affected by the starting temperature of the clothes washer, particularly those that implement temperature control by measuring internal water temperatures during the wash cycle. 86 FR 49140, 49153. For example, if the ambient temperature prior to testing is relatively hot, causing the internal components of the clothes washer to be at a higher temperature than the specified ambient temperature range, less hot water may be consumed during the test than otherwise would be if the starting temperature of the clothes washer is within the specified ambient temperature range. *Id*. Noting that third-party test laboratories cannot necessarily identify whether a unit is a water-heating clothes washer or not, DOE proposed to require pre-conditioning for all clothes washers that have not been in the test room at the specified ambient condition for 8 hours, regardless of whether the clothes washer is water-heating or non-water-heating. 86 FR 49140, 49153. DOE proposed to make this change only in new appendix J, due to the potential impact on the measured energy use. *Id*.

DOE requested comment on this proposal and requested information regarding whether test laboratories typically pre-condition water-heating and non-water-heating clothes washers using the same procedure. *Id*.

DOE also proposed in the September 2021 NOPR to remove the definitions of "water-heating clothes washer" and "non-water-heating clothes washer" from section 1 of the proposed new appendix J, since the differentiation between these terms would no longer be needed.

The Joint Commenters commented in support of DOE's proposal to specify preconditioning of all clothes washers before measurement in order to ensure reproducibility. (Joint Commenters, No. 31 at p. 10)

Whirlpool commented that, pending results from investigative testing, Whirlpool tentatively agrees with DOE's proposal to require the pre-conditioning procedure for all clothes washers because it would reduce overall variation, and would remove any possible small advantage from leftover warm water or warmer components from the previous cycle(s). (Whirlpool, No. 26 at p. 6)

For the reasons discussed above, DOE finalizes its proposal, consistent with the September 2021 NOPR, to require pre-conditioning for all clothes washers that have not been in the test room at the specified ambient condition for 8 hours, regardless of whether the clothes washer is water-heating or non-water-heating, in new appendix J. DOE also finalizes its proposal, consistent with the September 2021 NOPR, to remove the definitions of "water-heating clothes washer" and "non-water-heating clothes washer" from section 1 of new appendix J.

D. Cycle Selection and Test Conduct

1. Tested Load Sizes

Table 5.1 of appendix J2 provides the minimum, average, and maximum load sizes to be used for testing based on the measured capacity of the clothes washer. The table defines capacity "bins" in 0.1 ft^3 increments. The load sizes for each capacity bin are determined as follows:

- Minimum load is 3 pounds ("lb") for all capacity bins;
- Maximum load (in lb) is equal to 4.1 times the mean clothes washer capacity of each capacity bin (in ft^3); and
- Average load is the arithmetic mean of the minimum load and maximum load.

These three load sizes are used for testing clothes washers with automatic water fill control systems ("WFCS"). Clothes washers with manual WFCS are tested with only the minimum and maximum load sizes.

a. Expanding the Load Size Table

Table 5.1 of appendix J2 previously accommodated clothes washers with capacities up to 6.0 ft^3. On May 2, 2016 and April 10, 2017, DOE granted waivers to Whirlpool and Samsung, respectively, for testing RCWs[25] with capacities between 6.0 and 8.0 ft^3, by further extrapolating Table 5.1 using the same equations to define the maximum and average load sizes as described above. 81 FR 26215; 82 FR 17229. DOE's regulations in 10 CFR 430.27 contain provisions allowing any interested person to seek a waiver from the test procedure requirements if certain conditions are met. A waiver requires manufacturers to use an alternate test procedure in situations where the DOE test procedure cannot be used to test the product or equipment, or where use of the DOE test procedure would generate unrepresentative results. 10 CFR 430.27(a)(1). DOE's regulations at 10 CFR 430.27(l) require that as soon as practicable after the granting of any waiver, DOE will publish in the *Federal Register* a NOPR to amend its regulations so as to eliminate any need for the continuation of such waiver. As soon thereafter as practicable, DOE will publish in the *Federal Register* a final rule. 10 CFR 430.27(l).

In the September 2021 NOPR, DOE proposed to expand Table 5.1 in both appendix J2 and the new appendix J to accommodate clothes washers with capacities up to 8.0 ft^3. 86 FR 49140, 49153. In appendix J2, DOE proposed to expand Table 5.1 using the same equations as the current table, as described above, and consistent with the load size tables provided in the two granted waivers. *Id*. For the new appendix J, DOE

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[25] As noted, CCWs are limited under the statutory definition to a maximum capacity of 3.5 cubic feet for horizontal-axis CCWs and 4.0 cubic feet for vertical-axis CCWs. (42 U.S.C. 6311(21))

proposed to expand Table 5.1 based on a revised methodology for defining the load sizes, as further discussed in section III.D.1.b of this document. *Id*. DOE requested comment on its proposal to expand the load size table in both appendix J2 and the new appendix J to accommodate RCWs with capacities up to 8.0 ft^3. *Id*.

AHAM commented in support of DOE's proposal to expand the load size table in appendix J2 and new appendix J to accommodate clothes washers with capacities up to 8.0 ft^3. (AHAM, No. 27 at p. 10)

For the reasons stated above, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to expand Table 5.1 in both appendix J2 and the new appendix J to accommodate clothes washers with capacities up to 8.0 ft^3. DOE further discusses the termination of the subject waivers in section III.L of this document.

b. Defining New Load Sizes

As discussed in the previous section, appendix J2 currently defines three load sizes for automatic clothes washers (minimum, average, and maximum) for each capacity bin in Table 5.1 of the appendix. The current load size definitions (*i.e.*, the defining of three load sizes, and the equations used to determine each of the three load sizes) are based on consumer usage data analyzed during the test procedure rulemaking that culminated in the August 1997 Final Rule. As part of that rulemaking, AHAM presented to DOE data from the Procter & Gamble Company ("P&G") showing the distribution of consumer load sizes for 2.4 ft^3 and 2.8 ft^3 clothes washers, which represented typical clothes washer capacities at the time ("1995 P&G data").[26] The 1995 P&G data indicated that the distribution of consumer load sizes followed an approximate normal distribution slightly skewed towards the lower end of the size range.

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[26] The full data set presented by AHAM is available at *www.regulations.gov/document/EERE-2006-TP-0065-0027*.

In response to the May 2020 RFI, the Northwest Energy Efficiency Alliance ("NEEA") submitted a comment that cited data from a 2014 Field Study published on November 10, 2014 ("2014 NEEA Field Study").[27] 86 FR 49140, 49156. The 2014 NEEA Field Study found an average clothes washer load size of 7.6 lb, which NEEA characterized as being close to the average load size of 8.5 lb that corresponds with the 2010 market-weighted average capacity of 3.5 ft^3. *Id*. NEEA stated, however, that the market-weighted average capacity as of 2019 has increased to 4.4 ft^3, for which appendix J2 defines an average load size of 10.4 lb.[28] *Id.* NEEA asserted that using a fixed average load size of 7.6 lb would increase representativeness, stating that the growing inconsistency between field-measured average load size and appendix J2-calculated average load size indicates that average load size is independent of clothes washer capacity and is relatively small. *Id.* NEEA also stated that using a fixed average load size would reduce test burden, since less work would be required by the laboratory to build an inventory of custom appendix J2-defined average loads for each clothes washer capacity. *Id*.

As stated in the September 2021 NOPR, DOE did not agree with NEEA's conclusion that the 2014 NEEA field study confirms that the field average load size is independent of clothes container size and is relatively small. *Id*. In particular, NEEA did not present any field data demonstrating average consumer load sizes for a sample of clothes washers with an average capacity of 4.4 ft^3. *Id*. Therefore, DOE stated in the September 2021 NOPR that no conclusions could be drawn from the 2014 NEEA Field Study regarding how consumer load sizes may have changed as average clothes washer capacity has increased from around 3.5 ft^3 in 2010 to 4.4 ft^3 in 2019. *Id*. While DOE

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[27] Hannas, Benjamin; Gilman, Lucinda. 2014. *Dryer Field Study* (Report#E14 287). Portland, OR. Northwest Energy Efficiency Alliance. Available online at: *neea.org/resources/rbsa-laundry-study*.
[28] NEEA's estimate of 4.4 ft^3 average capacity in 2019 is based on NEEA's 2019 ENERGY STAR Retail Products Platform data.

agreed that using a fixed average load size could decrease test burden by avoiding the need to inventory different average load sizes for each possible capacity, for the reasons described above, DOE preliminarily concluded that the data provided by NEEA do not justify using a fixed average load size across all clothes container capacities. *Id*. DOE stated in the September 2021 NOPR that it is not aware of any more recent, nationally representative field data indicating that the consumer load size distribution in relation to clothes washer capacity has changed since the introduction of the three load sizes in the August 1997 Final Rule. 86 FR 49140, 49158.

Given the increasing prevalence of more feature-rich clothes washer models that require a higher number of test cycles under appendix J2, DOE proposed in the September 2021 NOPR to reduce test burden by reducing the number of defined load sizes for the proposed new appendix J from three to two for clothes washers with automatic WFCS. Specifically, DOE proposed to replace the minimum, maximum, and average load sizes for automatic clothes washers with two new load sizes in the new appendix J, designated as "small" and "large." 86 FR 49140, 49157. The new proposed small and large load sizes would continue to represent the same roughly normal distribution presented in the 1995 P&G data described previously. The weighted-average load size using the proposed small and large load sizes would match the weighted-average load size using the current minimum, average, and maximum load sizes. The small and large load sizes would represent approximately the 25th and 75th percentiles of the normal distribution, respectively. As proposed, the small and large load sizes would have equal load usage factors ("LUFs")[29] of 0.5.

Specifically, DOE proposed to calculate the "small" and "large" load sizes using Equation III.1 and Equation III.2, respectively. 86 FR 49140, 49158.

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[29] LUFs are weighting factors that represent the percentage of wash cycles that consumers run with a given load size and are discussed further in section III.G.5 of this document.

$$\text{Small load size } [lb] = 0.90 \times \text{Capacity } [ft^3] + 2.34$$

Equation III.1 Proposed Determination of the Small Test Load Size

$$\text{Large load size } [lb] = 3.12 \times \text{Capacity } [ft^3] + 0.72$$

Equation III.2 Proposed Determination of the Large Test Load Size

In the September 2021 NOPR, DOE tentatively concluded that the new small and large load sizes would substantially reduce test burden while maintaining or improving representativeness. 86 FR 49140, 49153. DOE's proposal would reduce test burden under the new appendix J by requiring only two load sizes to be tested instead of three for clothes washers with automatic WFCS. *Id*. 86 FR at 49158. Specifically, the number of cycles tested would be reduced by 33 percent for clothes washers with automatic WFCS, which represent a large majority of clothes washers on the market. *Id*. DOE tentatively concluded that this proposal would maintain representativeness because the new proposed small and large load sizes would continue to represent the same roughly normal distribution presented in the 1995 P&G data described previously. *Id*. at 86 FR 49157. The weighted-average load size using the proposed small and large load sizes would match the weighted-average load size using the current minimum, average, and maximum load sizes, and thus would produce test results with equivalent representativeness. 86 FR 49140, 49158. Further, defining the small and large loads to represent approximately the 25th and 75th percentiles of the normal distribution could improve representativeness by balancing the goal of capturing as large of a load size range as possible while remaining representative of the "peak" of the load distribution curve, which represents the most frequently used load sizes. *Id*.

As noted in the September 2021 NOPR, clothes washers with manual WFCS are tested only with the minimum and maximum load sizes, in contrast to clothes washers with automatic WFCS, which are tested with all three load sizes in appendix J2. 86 FR 49140, 49158. Given DOE's proposal to define only two load sizes in the proposed new

appendix J, DOE proposed in the September 2021 NOPR that the same two load sizes be used for all clothes washers, regardless of whether a clothes washer's WFCS is automatic or manual. *Id*.

DOE requested comment on its proposal to replace the minimum, maximum, and average load sizes with the small and large load sizes in the new appendix J. 86 FR 49140, 49158–49159. DOE sought comment on how reducing the number of load sizes tested would impact the representativeness of test results. *Id*. DOE also requested data and information to quantify the reduction in test burden that would result from reducing the number of load sizes from three to two for clothes washers with automatic WFCS. *Id*.

The Joint Commenters, CA IOUs, and Joint Efficiency Advocates expressed concern that the 1995 P&G data used to determine the representative load sizes for new appendix J are out of date. (Joint Commenters, No. 31 at pp. 8–9; CA IOUs, No. 29 at pp. 3–5; Joint Efficiency Advocates, No. 28 at pp. 4–5) The Joint Commenters and Joint Efficiency Advocates further commented that capacities represented in the P&G study (2.4 and 2.8 ft^3) are much smaller than the current market average of 4.4 ft^3, and asserted that extrapolation of the P&G data may not be appropriate, especially as DOE proposes to extend its test procedure to include basket sizes from 6.0 to 8.0 ft^3. (Joint Commenters, No. 31 at pp. 8–9; Joint Efficiency Advocates, No. 28 at pp. 4–5) The CA IOUs noted that, at the time of the 1995 P&G Study, the "regular" 2.4 ft^3 and "large" 2.8 ft^3 clothes washers had average load sizes of 5.7 lb and 6.7 lb, respectively; but as the average tub volume has since increased to almost 4.0 ft^3, the average clothes washer on the market today uses a weighted-average test load size of 9.7 lb. (CA IOUs, No. 29 at pp. 3–5) The Joint Commenters also commented that clothes washers in 1995, when the P&G study was published, were much less feature rich than today, and that the P&G study may not represent consumer choice about load size on modern clothes washers. (Joint Commenters, No. 31 at pp. 8–9) The Joint Commenters stated as an example that

consumers may separate a single load into multiple smaller loads to tailor the available washing cycles to the textiles. (*Id.*)

The CA IOUs presented data from a forthcoming paper titled "PG&E Home Energy Use Study—Laundry Weight Report," ("2021 PG&E data"), which surveyed 97 California households and which the CA IOUs characterized as finding no significant relationship between clothes washer capacity and load size. (CA IOUs, No. 29 at pp. 3–5) The CA IOUs commented that these findings from the PG&E study align with comments made by NEEA and the Joint Efficiency Advocates[30] in response to the May 2020 RFI, which the CA IOUs characterized as also finding no correlation between clothes washer capacity and load size. (*Id.*) The CA IOUs further commented that the findings from the 2021 PG&E data do not reflect what is represented in Table 5.1 of appendix J2 and new appendix J. (*Id.*) In their comment on the September 2021 NOPR, the CA IOUs categorized the 2021 PG&E data by capacity: clothes washers with capacities less than 4.0 ft^3, clothes washers with capacities between 4.0 and 5.0 ft^3, and clothes washers with capacities greater than 5.0 ft^3. (*Id.*) Each capacity category showed a roughly normal distribution in load size, but the average load size was roughly the same for all three categories: 8.01 lb for clothes washers smaller than 4.0 ft^3, 8.34 lb for clothes washers between 4.0 and 5.0 ft^3, and 7.17 for clothes washers larger than 5.0 ft^3. (*Id.*) The CA IOUs commented that, in contrast, Table 5.1 in new appendix J would define load sizes of 8.25 lb for clothes washers smaller than 4.0 ft^3, 10.28 lb for clothes washers between 4.0 and 5.0 ft^3, and 12.28 for clothes washers larger than 5.0 ft^3. (*Id.*)

The Joint Efficiency Advocates also commented that using the proposed large and small load sizes continues to result in test loads for large-capacity washers being

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[30] In the September 2021 NOPR, the set of joint commenters including Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, Consumer Federation of America, and Natural Resources Defense Council was abbreviated as the "Joint Commenters" and this is how the CA IOUs refer to them in their comment. In this document, that same set of commenters is abbreviated as the "Joint Efficiency Advocates," and are therefore referred to as such here.

significantly greater than those for smaller clothes washers. (Joint Efficiency Advocates, No. 28 at pp. 4–5) For example, the small and large loads for a 6.0 ft^3 clothes washer are 7.74 and 19.44 lb, respectively, compared to load sizes of 5.49 and 11.64 lb, respectively, for a 3.5 ft^3 clothes washer. (*Id.*) The Joint Efficiency Advocates commented that a large difference in load sizes between capacities is not consistent with the 2014 NEEA Field Study or with the 2021 PG&E data presented by the CA IOUs in response to the September 2021 NOPR. *(Id.)* The Joint Efficiency Advocates expressed concern that larger capacity clothes washers may be less efficient than smaller capacity clothes washers when washing a load of 7 to 8 lb, which they asserted is a load size more representative of real-world conditions. (*Id.*) The Joint Efficiency Advocates also referenced a 2020 report published by NEEA titled "Coming Clean: Revealing Real-World Efficiency of Clothes Washers"[31] ("2020 NEEA Report"), which presented test results from 12 RCWs and suggested that an efficiency rank order change was observed when testing the appendix J2-specified maximum load versus a constant load of 8.45 lb. (*Id.*) The Joint Efficiency Advocates summarized an example from the 2020 NEEA Report showing that among front-loading RCWs, the largest unit in the sample demonstrated the most efficient performance at the maximum load, but the least efficient performance using the constant 8.45 lb load. (*Id.*)

The Joint Commenters commented that they understand DOE's reasons for rejecting the data from the 2014 NEEA Field Study on the grounds that they are regional and seasonal in nature, and that they represent a limited sample size. (Joint Commenters, No. 31 at pp. 8–9) The CA IOUs expressed a similar sentiment, and stated that they acknowledge DOE's concerns regarding the potential limitations of regional studies such

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[31] Foster Porter, Suzanne; Denkenberger, Dave. 2020. *Coming Clean: Revealing Real-World Efficiency of Clothes Washers*. Portland, OR. Northwest Energy Efficiency Alliance. Available online at: *neea.org/resources/coming-clean-revealing-real-world-efficiency-of-clothes-washers*.

as the ones presented by the CA IOUs' in response to the May 2020 RFI. (CA IOUs, NO. 29 at pp. 3–5)

The Joint Commenters, CA IOUs, and Joint Efficiency Advocates recommended that DOE conduct further investigation regarding load sizes. (Joint Commenters, No. 31 at pp. 8–9; CA IOUs, No. 29 at pp. 3–5; Joint Efficiency Advocates, No. 28 at pp. 4–5) The Joint Commenters and CA IOUs recommended that, before the next clothes washer test procedure update, DOE should commission a nationally representative field laundry study to improve representativeness of modern load sizes. (Joint Commenters, No. 31 at pp. 8–9; CA IOUs, No. 29 at pp. 3–5) The Joint Efficiency Advocates encouraged DOE to investigate the relationship between clothes washer capacity and energy/water use at a constant load size and to consider specifying constant load sizes across all capacities. (Joint Efficiency Advocates, No. 28 at pp. 4–5)

Additionally, the Joint Commenters commented that there was no information available on the 1995 P&G study to confirm whether the study was nationally, annually, and statistically representative of households in the U.S. (Joint Commenters, No. 31 at pp. 8–9) The Joint Commenters expressed concern that the P&G study may not be more geographically and seasonally relevant than the more recent NEEA laundry study. (*Id.*) The Joint Commenters also added that NEEA is planning to update its regional laundry study and would welcome a conversation with DOE to determine how its regional data could be made more relevant or complementary to DOE's own study. (*Id.*)

AHAM commented that it appreciates DOE's proposal to reduce the number of load sizes tested from three to two, stating that at a first glance, it appears that DOE's proposed new load sizes will reduce test burden. (AHAM, No. 27 at p. 4) AHAM commented, however, that it must complete its testing in order to more holistically evaluate DOE's proposal and provide feedback to DOE on the reduction in test burden and the representativeness of test results. (*Id.*) AHAM added that the proposed new load

sizes could lead to a need for significant product redesign, and could potentially impact RMC. (*Id.*)

Samsung recommended that DOE continue to use three test load sizes. (Samsung, No. 30 at pp. 2–3) Samsung explained that while reducing the number of load sizes would reduce test burden and represent the same statistical load usage distribution as in appendix J2, automatic WFCSs have been generally designed to detect three to four discrete load levels (*e.g.*, minimum, average, maximum, and full). (*Id.*) Samsung expressed concern that reducing the test load to two sizes could result in manufacturers changing the load detection algorithm designs to detect a lower number of discrete load levels, which could increase the amount of water and energy use by consumers. (*Id.*) Samsung further explained that changing from three to two load sizes could result in clothes washers using a larger amount of water than necessary for loads smaller than the "small" load, and more water for loads larger than the "large" load. (*Id.*)

P.R. China recommended that DOE increase the proposed large load size. (P.R. China, No. 25 at p. 3) P.R. China commented that, since the proposed small and large load sizes are relatively smaller than the current average and maximum load sizes, they only evaluate the energy consumption of a clothes washer that is loaded with half or less of the full capacity. (*Id.*) P.R. China expressed concern that using the proposed small and large load sizes would not be reflective of energy consumption for a clothes washer that is heavily or fully loaded, which P.R. China asserted is more common in normal use. (*Id.*)

DOE greatly appreciates the additional consumer usage data provided by commenters and submitted to the docket for DOE's consideration. The 2021 PG&E data suggests that a roughly normal distribution of load sizes remains applicable across the range of clothes washer capacities represented in the report (roughly 3.3 to 5.3 ft^3), consistent with the trend from the 1995 P&G data. DOE also acknowledges that the

results of the 2021 PG&E data are suggestive that consumers may not be consistently loading larger capacity machines with proportionately larger load sizes (on average), as is implied by the relationship between load sizes and capacity defined in Table 5.1 of appendix J2. DOE remains concerned, however, that the 2021 PG&E data is not nationally representative. DOE would expect clothing load composition to vary significantly among regions of the United States (*e.g.*, warmer and colder climates, urban and rural households), which could coincide with different load size patterns in clothes washer usage. DOE is also mindful that population demographics (*e.g.*, household size, age of household members, *etc.*) could also affect laundry usage patterns. DOE also notes that the results from the 2021 PG&E data conflict with 2016 PG&E data presented previously by the CA IOUs in response to the May 2020 RFI, which suggested that consumer average load sizes for clothes washers in the range of 2 to 5 ft^3 capacity are *larger* than the appendix J2 load sizes. 86 FR 49140, 49157. The conflicting conclusions between the submitted reports as well as their limited geographic representation do not provide sufficient justification for DOE to change the relationship of load size with capacity at this time.

DOE continues to welcome additional data that could be used to inform future changes to the test load sizes. DOE potentially would consider a collection of diverse regional studies as a proxy for a single nationally representative data set. As suggested by the Joint Commenters, DOE welcomes further dialogue to determine how additional regional data could be made more relevant or complementary to DOE's consideration of potential further amendments to the test procedure.

DOE also appreciates AHAM's intention to provide test data for DOE to consider when it becomes available. DOE reiterates that any impacts to measured energy, however minor, as a result of changes to the load size definitions were accounted for in the crosswalk between the appendix J2 and appendix J metrics developed for the

September 2021 RCW Standards Preliminary Analysis. DOE will continue to consider any such impacts in future stages of the standards rulemaking.

In response to Samsung's concern that reducing the number of load sizes to two could result in manufacturers changing the load detection algorithms in way that could increase water and energy use, DOE acknowledges that the small and large load sizes proposed for appendix J represent a narrower range than the range represented by the minimum and maximum load sizes specified in appendix J2.[32] DOE expects that any changes that manufacturers would make to the load detection algorithms to optimize performance when tested to appendix J (which Samsung asserted could result in fewer discrete water fill levels) would be balanced against consumer expectation that when using an adaptive fill setting, the quantity of water determined by the clothes washer appropriately matches the size of the load. Changing the test procedure load size definitions does not preclude clothes washer manufacturers from designing load sensing algorithms from detecting any number of discrete load levels. DOE further notes that the historical data and more recent data discussed in this section indicate that consumer load size distribution follows a roughly normal distribution. Any impacts due to the type of load detection changes described by Samsung would be expected to affect the "tail ends" of the normal distribution, which by definition represent relatively low consumer usage; *i.e.*, the very small and very large load sizes that could be impacted are not as representative of average consumer use as the range of load sizes represented by the small and large load sizes as proposed. Weighing all of these factors, DOE has determined that the use of two load sizes as proposed in the September 2021 NOPR

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[32] As discussed, the small and load sizes proposed for appendix J are defined at approximately the 25th and 75th percentiles of the normal distribution, respectively; whereas the minimum and maximum load sizes under appendix J2 are defined at approximately the 14th and 88th percentiles of the normal distribution, respectively, as described in the September 2021 NOPR. 86 FR 49140, 49154.

provides a reasonable balance between considerations of representativeness and test burden as required by EPCA. 42 U.S.C. 6293(b)(3); 42 U.S.C. 6314(a)(2)

In response to P.R. China's comment on the distribution of load sizes, DOE does not agree with the assertion that small and large load sizes as proposed in the September 2021 NOPR represent half or less than half of the full capacity. As proposed, the large load size in appendix J represents roughly 80 percent of the maximum load size defined in appendix J2; *i.e.*, roughly 80 percent of the full capacity of a clothes washer.[33] As discussed, historical and recent data indicate that U.S. consumer load size distribution follows a roughly normal distribution, such that the maximum load size is much less commonly used than the load sizes proposed for appendix J.

Taking into consideration the discussion presented in the September 2021 NOPR, comments submitted by interested parties in response to DOE's proposals, and DOE's analysis and response to comments, DOE finalizes its proposal, consistent with the September 2021 NOPR, to replace the minimum, maximum, and average load sizes with the small and large load sizes in new appendix J. As discussed, DOE welcomes any opportunities to continue working with interested parties to collect nationally representative data on the relationship between load size and capacity. DOE reiterates that any impacts to measured energy as a result of changes to the tested load sizes will be accounted for in the crosswalk between the appendix J2 and appendix J metrics as part of the ongoing standards analysis, such that DOE does not expect the changes implemented in this final rule to require significant product redesign.

2. Water Fill Setting Selections for the Proposed Load Sizes

Section 3.2.6 of appendix J2 prescribes the water fill setting selections to use with each load size based on the type of WFCS on the clothes washer. As discussed in section

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[33] DOE assumes that the maximum load size defined in appendix J2 represents 100 percent full capacity.

III.D.1.b of this document, consistent with the proposal in the September 2021 NOPR, DOE is defining new small and large load sizes in appendix J, in contrast to the minimum, maximum, and average load sizes defined in appendix J2. 86 FR 49140, 49159–49160. To test clothes washers using these new small and large load sizes, the appropriate water fill setting selections also needs to be provided in the new appendix J for each load size for each type of WFCS.

Appendix J2 defines two main types of WFCS: manual WFCS, which "requires the user to determine or select the water fill level," and automatic WFCS, which "does not allow or require the user to determine or select the water fill level, and includes adaptive WFCS and fixed WFCS." Sections 1.22 and 1.5 of appendix J2, respectively. Section 3.2.6.2 of appendix J2 further distinguishes between user-adjustable and not-user-adjustable automatic WFCS. Additionally, section 3.2.6.3 of appendix J2 accommodates clothes washers that have both an automatic WFCS and an alternate manual WFCS. Amendments to the definitions of fixed WFCS and user-adjustable WFCS are further discussed in section III.H.3.a of this document.

Section 3.2.6.1 of appendix J2 specifies that clothes washers with a manual WFCS are set to the maximum water level available for the wash cycle under test for the maximum test load size and the minimum water level available for the wash cycle under test for the minimum test load size.

Section 3.2.6.2.1 of appendix J2 specifies that clothes washers with non-user-adjustable automatic WFCS are tested using the specified maximum, minimum, and average test load sizes, and that the maximum, minimum, and average water levels are selected by the control system when the respective test loads are used (*i.e.*, no selection of water fill level is required by the user).

Section 3.2.6.2.2 of appendix J2 specifies that clothes washers with user-adjustable automatic WFCS undergo four tests. The first test is conducted using the

maximum test load and with the automatic WFCS set in the setting that will give the most energy intensive result. The second test is conducted with the minimum test load and with the automatic WFCS set in the setting that will give the least energy intensive result. The third test is conducted with the average test load and with the automatic WFCS set in the setting that will give the most energy intensive result for the given test load. The fourth test is conducted with the average test load and with the automatic WFCS 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 are calculated as the average of the third and fourth tests.

In the September 2021 NOPR, DOE proposed to specify the use of the second-lowest water fill level setting for the proposed small load size, and the maximum water fill level setting for the proposed large load size for clothes washers with manual WFCS. 86 FR 49140, 49159. DOE proposed to use the second-lowest water fill level setting for the proposed small size because the proposed small load is larger than the current minimum load, and using the minimum water fill setting for the larger-sized "small" load may not be representative of consumer use, particularly because consumers tend to select more water than is minimally necessary for the size of the load being washed. *Id*. Although DOE was not aware of any clothes washers with manual WFCS currently on the market with only two water fill level settings available, DOE also proposed to accommodate such a design by specifying that if the water fill level selector has two settings available for the wash cycle under test, the minimum water fill level setting would be selected for the small load size, consistent with the current specification in appendix J2. *Id*.

To accommodate the proposed "small" and "large" load sizes in the new appendix J, DOE proposed to require testing clothes washers with user-adjustable WFCS using the

small test load size at the setting that provides the least energy-intensive[34] result, and the large test load size at the setting that provides the most energy-intensive result. *Id*. This proposal captures the same range of water fill performance as the current test procedure (*i.e.*, capturing the range of least-intensive to most-intensive results). *Id*.

For clothes washers with non-user-adjustable automatic WFCS, no changes are required because the water fill levels are determined automatically by the WFCS.

DOE requested comment on its proposal to change the water fill level selections in the new appendix J for clothes washers with manual and user-adjustable automatic WFCS to reflect the proposed small and large test load sizes. 86 FR 49140, 49160.

The Joint Commenters commented in support of DOE's proposed water fill level selections for manual WFCSs in new appendix J. (Joint Commenters, No. 31 at p. 10). The Joint Commenters commented that DOE's proposal establishes a reasonable representation of normal consumer use given the load sizes proposed in new appendix J. *(Id.)*

Although AHAM did not comment specifically on the proposed changes to the water fill level selections, AHAM did comment on DOE's proposed definitions for certain types of WFCSs. DOE summarizes and addresses these comments in section III.H.3.a of this document.

For the reasons stated above, DOE finalizes its proposal, consistent with the September 2021 NOPR, to change the water fill level selections in the new appendix J for clothes washers with manual and user-adjustable automatic WFCS to reflect the proposed small and large test load sizes.

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[34] As described in section III.H.3.b of this document, DOE is updating the phrase "the setting that will give the most energy-intensive result" to "the setting that uses the most water" (and likewise for the setting that will give the least energy-intensive result) to reflect the original intent of this provision.

3. Determination of Warm Wash Tested Settings

Section 3.5 of appendix J2 states that if a clothes washer has four or more Warm Wash/Cold Rinse ("Warm/Cold") temperature selections, either all discrete selections shall be tested, or the clothes washer shall be tested at the 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, the next warmer temperature selection shall be used. DOE refers to the latter provision as the "25/50/75 test." Section 3.6 of appendix J2 states that the 25/50/75 test provision also applies to the Warm Wash/Warm Rinse ("Warm/Warm") temperature selection.

DOE first established the 25/50/75 test in appendix J1 as part of the August 1997 Final Rule to address the test burden for clothes washers that offer a large number of warm wash temperature selections, if the test procedure were to require testing all warm temperature selections. 62 FR 45484, 45497. In the August 1997 Final Rule, DOE considered clothes washers with more than three warm wash temperatures to be clothes washers with infinite warm wash temperature selections, therefore allowing them to also use the 25/50/75 test. 62 FR 45484, 45498. DOE concluded at that time that testing at the various test points of the temperature range, with a requirement to test to the next higher selection if a temperature selection is not available at a specified test point, would provide data representative of the warm wash temperature selection offerings. *Id*.

In the September 2021 NOPR, DOE noted that the 25/50/75 test was adopted before the widespread use of electronic controls, which now allow for the assignment of wash water temperatures that may not reflect the physical spacing between temperature selections on the control panel. 86 FR 49140, 49160. For example, with electronic controls, the 25-percent, 50-percent, and 75-percent positions on the dial may not necessarily correspond to 25-percent, 50-percent, and 75-percent temperature differences

between the hottest and coldest selections. *Id*. DOE is aware of clothes washers on the market with four or more warm wash temperature selections, in which the temperature selections located at the 25-, 50-, and 75- percent positions are low-temperature cycles that have wash temperatures only a few degrees higher than the coldest wash temperature; whereas the temperature selection labeled "Warm" is located beyond the 75-percent position on the temperature selection dial and is therefore not included for testing under the 25/50/75 test. *Id*.

In the September 2021 NOPR, DOE proposed to require testing of both the hottest Warm/Cold setting and the coldest Warm/Cold setting for all clothes washers in the new appendix J instead of the current provisions to either test all warm wash selections or conduct the 25/50/75 test. 86 FR 49140, 49161. Water consumption, electrical energy consumption, and all other measured values[35] would be averaged between the two tested cycles to represent the Warm/Cold cycle. *Id*. DOE proposed to make the same changes to the Warm/Warm cycle in the new appendix J. *Id*. DOE's proposal would decrease the test burden under the new appendix J for clothes washers that offer more than two Warm/Cold or Warm/Warm temperature settings, which DOE estimates represent around half of the market, by reducing the number of Warm/Cold and Warm/Warm tested cycles from three to two. *Id*.

Because this proposed approach may change the measured energy use of clothes washers that offer more than two Warm/Cold or Warm/Warm settings, the proposed edits were not proposed for appendix J2 and therefore would not affect the measured efficiency of existing clothes washers. *Id*. As discussed previously, any impacts to measured energy as a result of changes to the required warm wash settings were accounted for in the crosswalk between the appendix J2 and appendix J metrics

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[35] As discussed in sections III.D.4.a and III.D.5 of this document, DOE is requiring measurements of wet weight, and cycle time for each tested cycle under new appendix J.

developed for the September 2021 RCW Standards Preliminary Analysis. DOE will continue to consider any such impacts in future stages of the standards rulemaking.

In the September 2021 NOPR, DOE tentatively concluded that the proposed approach in the new appendix J would maintain representativeness by continuing to capture the complete range of Warm Wash temperatures available for selection (*i.e.*, by relying on an average of the hottest Warm/Cold setting and the coldest Warm/Cold setting). *Id*. For models that are currently tested using the 25/50/75 test and for which certain "Warm" settings are located beyond the 75-percent position on the temperature selection dial and therefore not included for testing, DOE's proposal would capture entire range of available Warm Wash temperatures available to the consumer, and therefore would improve representativeness. *Id*.

In the September 2021 NOPR, DOE requested comment on the proposal to require in the new appendix J testing only the hottest and the coldest Warm/Cold settings. *Id*. DOE also requested data and information on how this proposed change to the Warm Wash temperature settings required for testing would impact representativeness, testing costs, and manufacturer burden. *Id*.

The Joint Efficiency Advocates commented that DOE's proposal to require testing on the hottest Warm/Cold and coldest Warm/Cold settings for all clothes washers instead of the "25/50/75" test will more accurately reflect energy usage of Warm Wash settings while decreasing burden. (Joint Efficiency Advocates, No. 28 at pp. 2–3)

The Joint Commenters commented in support of DOE's proposal to test and average the hottest and coldest Warm/Cold temperatures and encouraged DOE to apply an identical approach to clothes washers with Warm/Warm settings. (Joint Commenters, No. 31 at pp. 3–4) The Joint Commenters further agreed with DOE's tentative determination that DOE's proposal concerning Warm/Cold testing would reduce test burden by eliminating test runs for clothes washers with more than two Warm/Cold

settings, and increase representation of typical hot water use of clothes washer by testing temperature selections that would not have been tested using the 25/50/75 rule. (*Id*.)

AHAM commented that, while it appreciates DOE's attempt to ease testing burden in its proposal by only requiring testing on the hottest and coldest Warm/Cold settings for all clothes washers, using only coldest and hottest of the warm cycles could increase the measured water heating energy in the IMEF calculation. (AHAM, No. 27 at pp. 10–11) AHAM asserted that in order to offset this increase in water heating energy, the hottest warm setting would need to be redesigned with a reduced temperature, resulting in the hottest warm setting being cooler than what consumers expect for a warm setting. (*Id*.) AHAM also commented that additional testing is required to determine whether detergents, especially laundry pods, will dissolve as well at lower temperatures. (*Id*.) Lastly, AHAM stated that this change will impact measured energy and commented that this impact needs to be accounted for in any energy conservation standard that DOE develops. (*Id*.)

Whirlpool commented that DOE's proposal to require testing on the hottest and coldest Warm/Cold temperatures may eliminate the ability of manufacturers to offer a warm and/or hot wash setting for consumers that meets the temperature level(s) and performance that they expect on their clothes washer, especially from Warm/Cold temperature settings. (Whirlpool, No. 26 at pp. 7–8) Whirlpool added that these impacts could also become compounded by any amendment to clothes washer standards. (*Id*.) Whirlpool also expressed concern that lower warm and/or hot wash temperatures could impact cleaning performance since most detergents, especially lower cost detergents and laundry pods, are designed to be most effective at current wash temperatures. (*Id*.)

DOE notes that the reservations expressed by AHAM and Whirlpool are related to the impact on measured energy as a result of this proposed amendment to the test procedure. As discussed previously, impacts on measured energy use between the then-

current appendix J2 and the proposed appendix J test procedures were factored into the crosswalk relating the appendix J2 and appendix J metrics developed for the September 2021 RCW Standards Preliminary Analysis, such that DOE does not expect the changes implemented in this final rule to require any significant changes to wash water temperatures. In particular, any increase in measured energy as a result of this amendment would be factored into the crosswalk (*i.e.*, manufacturers would not necessarily be required to decrease wash temperatures to "offset" any increase in measured energy under appendix J).

Specifically, as presented in Table 5.3.7 in chapter 5 of the preliminary TSD, DOE determined through testing that this amendment would result in a 17 percent increase, on average, in the water heating energy use for clothes washers with 3 or more Warm/Cold temperature settings, in which the two coldest Warm/Cold temperatures use much less hot water than the hottest Warm/Cold temperature. This increase was factored into the metric translations.

In response to the Joint Commenters' request that DOE consider applying an identical approach to clothes washers with Warm/Warm settings, DOE's proposal in the September 2021 NOPR applied to both Warm/Cold and Warm/Warm settings.

For the reasons discussed, DOE finalizes its proposal, consistent with the September 2021 NOPR, to require in the new appendix J testing only the hottest and the coldest Warm/Cold and Warm/Warm settings. DOE reiterates that any impacts to measured energy as a result of changes to the tested warm wash settings will be accounted for in the crosswalk between the appendix J2 and appendix J metrics as part of the ongoing standards analysis, such that DOE does not expect the changes implemented in this final rule to require any significant changes to wash water temperatures.

4. Remaining Moisture Content

Section 3.8.4 of appendix J2 requires that for clothes washers that have multiple spin settings[36] available within the energy test cycle that result in different RMC values, the maximum and minimum extremes of the available spin settings must be tested with the maximum load size on the Cold/Cold temperature selection.[37] The final RMC is the weighted average of the maximum and minimum spin settings, with the maximum spin setting weighted at 75 percent and the minimum spin setting weighted at 25 percent. The RMC measurement is used to calculate the drying energy component of IMEF. On most clothes washers, the drying energy component represents the largest portion of energy captured in the MEF_{J2} and IMEF metrics.

a. Revised Calculation

In the September 2021 NOPR, DOE tentatively concluded that the current method of measuring RMC may no longer produce test results that measure energy and water use during a representative average use cycle or period of use, particularly as the prevalence of clothes washers with complex electronic controls continues to increase in the market. 86 FR 49140, 49162. On a clothes washer with basic controls (*e.g.*, in which the available spin settings are the same regardless of what wash/rinse temperature is selected), measuring RMC using only the Cold/Cold cycle would be expected to provide RMC results that are equally representative of the other available wash/rinse temperatures, which as noted comprise the majority of consumer cycle selections. *Id*. However, on a clothes washer in which the selection of wash/rinse temperature affects which spin settings are available to be selected, measuring RMC using only the

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[36] The term "spin settings" refers to spin times or spin speeds. The maximum spin setting results in a lower (better) RMC.

[37] On clothes washers that provide a Warm Rinse option, appendix J2 requires that RMC be measured on both Cold Rinse and Warm Rinse, with the final RMC calculated as a weighted average using TUFs of 73 percent for Cold Rinse and 27 percent for Warm Rinse. DOE has observed very few clothes washer models on the market that offer Warm Rinse. For simplicity throughout this discussion, DOE references the testing requirements for clothes washers that offer Cold Rinse only.

Cold/Cold cycle may not necessarily provide results that measure energy and water use during a representative average use cycle or period of use (*i.e.*, across the range of wash/rinse temperature options selected by consumers, as represented by the temperature use factors). *Id*. For example, data presented by NEEA in response to the May 2020 RFI suggested that the specific cycle configuration from which RMC is measured is programed with a longer spin time than other temperature settings available to the consumer, resulting in a significantly better RMC measurement than would be experienced by the consumer on the majority of wash cycles performed. *Id*.

In the September 2021 NOPR, DOE proposed an amended method for measuring RMC in the new appendix J that would require measuring RMC on each of the energy test cycles using the default spin settings, and determining the final RMC by weighting the individual RMC measurements using the same Temperature Usage Factors ("TUFs")[38] and LUFs that apply to the water and energy measurements. *Id*. DOE asserted that the proposed update to the RMC measurement would provide a more representative measure of RMC than the current test procedures because RMC would be measured on all of the energy test cycles rather than only the Cold/Cold cycles, which represent only 37 percent of consumer cycles and may not share the same RMC performance as the other 63 percent of consumer cycles.[39] *Id*. DOE also tentatively concluded that this proposal would reduce overall test burden. 86 FR 49140, 49163. The proposal would require weighing the cloth before and after each test cycle, but would avoid the need to perform extra cycles for capturing both the maximum and minimum spin settings available on the clothes washer if such spin settings are not activated by default as part of the energy test cycle. *Id*. To DOE's knowledge, many laboratories

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[38] As described in more detail in section III.G.4 of this document, TUFs are weighting factors that represent the percentage of time that consumers choose a particular wash/rinse temperature selection for the wash cycle.

[39] 37 percent is the TUF for the Cold/Cold temperature selection as specified in Table 4.1.1 of appendix J2.

already measure and record the test load weight after each test cycle as a means for identifying potential cycle anomalies or to provide additional data that can be used to verify quality control retrospectively. *Id*. In cases where a laboratory currently does not measure the weight after completion of the cycle, DOE's proposal would incur a *de minimis* amount of additional time to weigh the load after the cycle, which can be performed using the same scale used to weigh the load at the beginning of the cycle.

DOE acknowledged that its proposal would likely impact the measured RMC value and thus would impact a clothes washer's IMEF value. 86 FR 49140, 49163. Therefore, DOE proposed the revised RMC procedure only in the proposed new appendix J and not in appendix J2. *Id*.

In the September 2021 NOPR, DOE requested comment on its proposal to revise the RMC procedure so that RMC would be measured at the default spin setting for each temperature selection and load size, and the individual RMC values would be averaged using TUFs and LUFs to calculate the final RMC. *Id*. DOE sought data and information regarding how this change to the RMC calculation would impact testing costs and manufacturer test burden. *Id*. DOE further requested comment on whether DOE should implement any changes to the RMC calculation in appendix J2 to address clothes washers with spin settings that are available only on certain temperature selections. *Id*.

Samsung commented in support of DOE's proposed changes to the RMC measurement, stating that the changes would make the metric more representative of real-world usage. (Samsung, No. 30 at p. 3)

The CA IOUs commented in support of DOE's proposal to measure RMC as a part of all energy test cycles, stating that it would improve the representativeness of the drying energy measurement, which is the largest component of energy use. (CA IOUs, No. 29 at p. 2)

The Joint Efficiency Advocates commented that DOE's proposed amendment to measure RMC for all cycles tested rather than on a single cold-cold test cycle would more accurately estimate drying energy usage than the current method. (Joint Efficiency Advocates, No. 28 at p. 2) The Joint Efficiency Advocates noted that, using appendix J2, clothes washers that only offer the maximum spin speed on the Cold/Cold cycle have lower spin settings at other temperature settings that are not being factored into the RMC calculation, even though these cycles represent the majority of cycles used by consumers, according to the TUFs. (*Id*.) The Joint Efficiency Advocates also cited data from the 2020 NEEA Report that showed significant IMEF rank order changes between washers when comparing RMC values measured on Cold/Cold cycles and RMC values measured on Warm/Cold cycles for the same test loads. (*Id*.) The Joint Efficiency Advocates concluded that DOE's proposal to measure RMC for each energy test cycle at the default spin setting and calculate an overall RMC using TUF- and LUF-weighted averages would make drying energy usage calculations more consistent with the other energy and water usage calculations, and that the proposed amendment would improve representativeness and provide more accurate relative rankings of clothes washers by better capturing real-world RMC and drying energy usage. (*Id*.)

The Joint Commenters commented in support of DOE's proposal to measure RMC at the default spin setting for each test cycle. (Joint Commenters, No. 31 at pp. 2–3) The Joint Commenters added that measuring RMC at the default setting would reduce test burden, increase representativeness, and could potentially result in an estimated 1.0 quad of energy savings for clothes dryers.[40] (*Id*.) The Joint Commenters further commented that DOE's proposed RMC measurement changes would be one of the best

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[40] The Joint Commenters referenced NEEA's comment on the May 2020 RFI in which NEEA estimated the potential savings over a 30-year period, assuming the change in the RMC measurement would lead to clothes washer manufacturers changing their machines to make the spin portion of all temperature settings match the current spin portion of the Cold/Cold setting.

opportunities to improve the test procedure for three reasons: drying energy use is the largest and most important contributor to IMEF, and would remain the most significant contributor to the proposed EER and AEER metrics; according to the Joint Commenters, default spin settings are more representative of real-world use instead of the "best case" scenario; and testing RMC under different temperature settings and load sizes revealed substantial rank order changes. (*Id*.)

Whirlpool commented that DOE's proposed change to the RMC measurement would likely have significant implications on Whirlpool's product design, cost, performance, and customer satisfaction. (Whirlpool, No. 26 at pp. 8–9) Whirlpool also noted that RMC accounts for over 70 to 75 percent of energy measured by the IMEF. (*Id*.) Whirlpool further commented that, since today's clothes washers are designed and tested for appendix J2, product redesign would be necessary because, without modifying clothes washer spinning strategies for the proposed RMC measurement method in new appendix J, Whirlpool expects the measured RMC of its clothes washer models under the proposed amendments to increase significantly. (Whirlpool, No. 26 at p. 9) Specifically, Whirlpool explained that measuring RMC on smaller loads leads to a higher RMC because smaller loads do not experience as much compression against the drum during spinning as larger loads. (*Id*.) Whirlpool also commented that their concern about RMC measurement is especially pronounced for baseline top-loading clothes washers, which do not spin as fast as front-loading clothes washers for a variety of technical reasons. (*Id*.) Whirlpool explained that in order to address DOE's proposed RMC change, Whirlpool would need to increase spin speeds and have longer high-spin plateau times. (*Id*.) Whirlpool noted that these changes would ultimately lead to enormous stress placed on the clothes washers and would degrade their overall reliability. (*Id*.) Whirlpool commented that they would need to make changes to the motor, tub composition, and other structural changes to the washer, all of which would add product cost. (*Id*.)

Whirlpool also expressed concerns related to consumers' perception of these changes, including increased cost and performance concerns such as increased vibration and noise from faster and longer spins, in addition to longer cycle times from longer high-spin plateaus. (*Id.*) Whirlpool also stated that consumers may also notice that the overall electrical energy of the clothes washer increases as clothes washers spin longer and faster. (*Id.*) Whirlpool also commented that an increase in measured mechanical energy could lead to the annual energy consumption reported on the Federal Trade Commission ("FTC") EnergyGuide label showing that a new model uses more energy (*i.e.*, appears less efficient) than a model currently owned by a consumer. (*Id.*)

AHAM commented that it opposes changing the RMC calculation in appendix J2, stating that the proposed changes would impact measured energy. (AHAM, No. 27 at p. 11)

DOE also received comments from interested parties suggesting that DOE add an RMC adjustment factor to account for test cloth material composition. These comments are discussed in section III.I.1 of this document.

DOE notes that the reservations expressed by AHAM and Whirlpool, particularly with regard to implications for product design and performance, stem from the impact on measured energy as a result of this proposed amendment to the test procedure. As discussed previously, impacts on measured energy use between the then-current appendix J2 and the proposed appendix J test procedures were factored into the crosswalk relating to the appendix J2 and appendix J metrics developed for the September 2021 RCW Standards Preliminary Analysis. Specifically, as presented in Table 5.3.7 in chapter 5 of the preliminary TSD, DOE determined through testing that this amendment would result in a 3.8 percent increase in drying energy for units in which the spin cycle is consistent across temperature selections and thus the primary factor affecting measured RMC is the smaller load sizes; a 27 percent increase in drying energy for units in which the spin cycle

is significantly faster or longer on the Cold/Cold setting (which would be tested under appendix J2) than on the other temperature settings (which would all be tested under appendix J); and a 21 percent increase in drying energy for units in which the default spin speed setting on the Normal cycle (which would be tested under appendix J) is not the maximum spin speed setting (which would be tested under appendix J2). These increases in RMC under appendix J were factored into the metric translations. As stated in the September 2021 RCW Standards Preliminary Analysis, DOE plans to continue testing additional units to appendix J and will continue to refine its approach for determining appropriate crosswalk translations in future stages of the standards rulemaking.

For the reasons discussed, DOE finalizes its proposal, consistent with the September 2021 NOPR, to require measuring RMC on each of the energy test cycles in appendix J using the default spin settings, and determining the final RMC by weighting the individual RMC measurements using the same TUFs and LUFs that apply to the water and energy measurements. DOE has determined that the amendment to the RMC measurement provides a more representative measure of RMC because RMC is measured on all of the energy test cycles. DOE also concludes that this amendment reduces overall test burden. DOE reiterates that any impacts to measured energy as a result of changes to the RMC calculation will be accounted for in the crosswalk between the appendix J2 and appendix J metrics as part of the ongoing standards analysis, such that DOE does not expect the changes implemented in this final rule to require significant product redesign.

b. Definition of Bone-Dry

In section 1.6 of appendix J2, the term “bone-dry” is defined as a condition of a load of test cloth that 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.

In the absence of data or information indicating any problems with the current procedure, DOE did not propose any changes to the bone-dry definition or associated dryer temperature measurement method in the September 2021 NOPR. 86 FR 49140, 49163. DOE requested comment on its tentative conclusion not to propose changes to the bone-dry definition and associated dryer temperature measurement method. *Id*.

AHAM commented in support of DOE's proposal not to change the bone-dry definition and associated dryer temperature measurement method, stating that changes would be unnecessary. (AHAM, No. 27 at p. 11)

For the reasons discussed, this final rule does not make any changes to the bone-dry definition or associated dryer temperature measurement method.

c. Starting Moisture Content

Section 2.9.1 of appendix J2 requires the test load for energy and water consumption measurements to be bone-dry prior to the first cycle of the test, and allows the test load to be dried to a maximum of 104 percent of the bone-dry weight for subsequent testing. In the September 2021 NOPR, DOE noted that this allowance effectively allows for an increase to the starting moisture content of the load from 1 percent moisture (as implied in the definition of "bone-dry" in section 1 of appendix J2) to 4 percent moisture, which creates two concerns. 86 FR 49140, 49163.

First, for the largest clothes washers on the market, which use the largest test load sizes, a 4 percent tolerance can represent up to 1 lb of additional water weight in a starting test load. *Id*. DOE expressed concern that the range of starting water weights that this provision allows could reduce the repeatability and reproducibility of test results, particularly for larger clothes washers. *Id*.

Second, as described in section III.D.4.a of this document, DOE is requiring the measurement of RMC for all tested cycles in the new appendix J. *Id*. The RMC of each tested cycle is calculated based on the bone-dry weight at the start of the cycle. *Id*.

Allowing the bone-dry weight to vary within a range of 1 percent to 4 percent moisture at the beginning of each tested cycle would introduce variability into the RMC calculation. *Id*.

Therefore, to improve repeatability and reproducibility of test results, DOE proposed in new appendix J to remove the provision that allows for a starting test load weight of 104 percent of the bone-dry weight, and instead require that each test cycle use a bone-dry test load. *Id*. In DOE's experience, most test laboratories use the bone-dry weight as the starting weight of each test load rather than a starting weight up to 104 percent of bone-dry, as allowed by section 2.9.1 of appendix J2. *Id*. DOE estimated that if a test laboratory does make use of this provision in section 2.9.1 of appendix J2, the requirement to use the bone-dry weight would add no more than 10 minutes of drying time per cycle to ensure that the test load has reached the bone-dry requirement. *Id*. DOE did not anticipate that this proposal would increase test burden because, in DOE's experience, most test laboratories dry the load from the previous test cycle while the next cycle is being tested on the clothes washer, such that a minor increase in drying time would not affect the overall time required to conduct the test procedure. *Id*.

DOE requested comment on its proposal to require that each test cycle use a bone-dry test load in the new appendix J. *Id*. DOE requested comment on whether test laboratories start test cycles with the test load at bone-dry or at up to 104 percent of the bone-dry weight. 86 FR 49140, 49163–49164. DOE further requested feedback on its assessment that this change would not affect test burden. 86 FR 49140, 49164.

The Joint Commenters commented in support of DOE's proposal to require bone-drying of textile loads before the start of each test run. (Joint Commenters, No. 31 at p. 10) The Joint Commenters further asserted that bone-drying the test load before each run would improve repeatability and reproducibility, given that RMC would be measured for each test run. (*Id*.) The Joint Commenters concluded that, since test laboratories must

dry the test load before using it, DOE's proposal represents minimal to no additional test burden. (*Id*.)

AHAM commented in opposition to DOE's proposal to require each test cycle to use a bone-dry test load. (AHAM, No. 27 at p. 12) AHAM commented that while it understands the theoretical reason for this proposal, it may not be practically possible because as soon as the load cools, it starts to collect humidity. Therefore, AHAM asserted that it would not be possible for test laboratories to meet this requirement. (*Id*.)

P.R. China recommended that if each test cycle uses a bone-dry test load, DOE should add requirements to the temperature of the test load to make sure the test cloth is at ambient temperature prior to testing. (P.R. China, No. 25 at p. 3)

In response to AHAM's comments, DOE acknowledges that the concerns DOE expressed regarding the potential for over 1 lb of moisture in the starting "dry" load would apply only to the largest load sizes, and that for the large majority of tested loads, the potential amount of moisture in the starting dry load would be a smaller weight. DOE notes that the "large" test load sizes in appendix J implemented in this final rule are smaller than the "maximum" test load sizes defined in appendix J2 (as discussed in section III.D.1.b of this document), which partially alleviates this concern. DOE's testing experience also confirms AHAM's statement that a test cloth load begins to collect moisture as soon as the drying cycle is complete. DOE therefore concludes that logistical constraints during testing could create challenges for test laboratories to meet a bone-dry requirement for each individual test cycle.

In response to P.R. China's comment on adding a requirement that the load be at ambient temperature prior to testing, DOE does not expect that the temperature of the load prior to the start of the test cycle would have a significant impact on energy use for two reasons. First, DOE's teardowns of clothes washers conducted for the standards preliminary analysis indicate that most clothes washers measure wash water temperature

either as the water enters the clothes washer through the inlet valves or within the detergent mixing chamber, such that the temperature of the test load would not affect the relative amounts of hot and cold water usage. Second, even for clothes washers that may measure the water temperature near the bottom of the wash tub in proximity to the load, the thermal mass of the test cloth fabric is significantly less than thermal mass of the amount of water used during the wash portion of the cycle, such that any residual heat contained within the test cloth would have a negligible impact on the temperature of the water.[41]

For these reasons, DOE is not adopting the proposal from the September 2021 NOPR and is including in appendix J the provision from section 2.9.1 of appendix J2 to allow the test load to be dried to a maximum of 104 percent of the bone-dry weight for subsequent testing. Because each subsequent test load may not always start at the bone-dry weight, DOE is also not adopting the proposal from the September 2021 NOPR to require recording the bone-dry weight of the test load weight prior to each cycle. DOE notes that it is continuing to require that the bone-dry weight of each test load (which would be measured once at the start of testing) be used in calculating the RMC for each test cycle.

5. Cycle Time

a. Inclusion of a Cycle Time Measurement

The current test procedure does not specify a measurement for average cycle time. In the September 2021 NOPR, DOE is proposed to base the allocation of annual combined low-power mode hours on the measured average cycle time rather than a fixed value of 8,465 hours, for the new appendix J (see section III.G.3 of this document). 86

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[41] For example, DOE testing indicates that a typical clothes washer may use a gallon or more of water (*i.e.*, over 8.3 lb of water) per lb of test cloth load. Furthermore, the specific heat of cotton and polyester fiber is around one-third of the specific heat of water. Based on these parameters, each 1 °F of elevated temperature in a given test load would result in no more than a 0.04 °F temperature rise in the wash water used for that cycle. (Calculated as 1 ÷ 8.3 ÷ 3).

FR 49140, 49164. DOE therefore also proposed to require the measurement of average cycle time for the new appendix J. *Id*. Calculating the annual standby mode and off mode hours using the measured average cycle time would provide a more representative basis for determining the energy consumption in the combined low-power modes for the specific clothes washer under test. *Id*.

DOE proposed to define the overall average cycle time of a clothes washer model in new appendix J as the weighted average of the individual cycle times for each wash cycle configuration conducted as part of the test procedure, using the TUFs and LUFs for the weighting. *Id*. Using the weighted-average approach would align the average cycle time calculation with the calculations for determining weighted-average energy and water use. *Id*.

DOE noted that it does not expect the measurement of cycle time to increase test burden. *Id*. To DOE's knowledge, test laboratories are either already measuring cycle time for all tested cycles or using data acquisition systems to record electronic logs of each cycle, from which determining the cycle time would require minimal additional work. *Id*.

DOE requested comment on its proposal to add cycle time measurements and to calculate average cycle time using the weighted-average method in the new appendix J. *Id*. DOE also requested comment on its assertion that adding cycle time measurements and a calculation of a weighted-average cycle time would not increase testing costs or overall test burden. *Id*.

Samsung commented in support of DOE's proposal to require reporting of weighted-average cycle time, stating that it would provide useful information for consumers comparing average cycle time differences between clothes washer models. (Samsung, No. 30 at p. 3)

The CA IOUs commented in support of DOE's proposal to measure cycle time on all test cycles and to include an average cycle time calculation, stating that there are significant consumer benefits in this information being disclosed. (CA IOUs, No. 29 at p. 2) The CA IOUs also recommended that DOE report average cycle time in the Compliance Certification Management System ("CCMS") database, and that DOE work with the FTC to incorporate average cycle time into product labeling. (*Id.*)

The Joint Commenters commented in support of DOE's proposal to measure the cycle time of each test cycle and to calculate a weighted-average cycle time. (Joint Commenters, No 31 at p. 5) The Joint Commenters further agreed with DOE's tentative determination that DOE's cycle time measurement proposal would create no additional test burden since most test laboratories use time series data acquisition systems that obtain cycle time measurements automatically. (*Id.*) The Joint Commenters also commented that DOE's cycle time proposal would increase the representativeness of the low-power-mode energy usage, and would standardize cycle time marketing claims by establishing a standardized approach for measuring cycle times. (*Id.*) The Joint Commenters also encouraged DOE to require the reporting of average cycle time as part of clothes washer certification, stating that it would increase consumers' access to relevant information on cycle time, which the Joint Commenters asserted is an important aspect of clothes washer performance; increase transparency of reported energy efficiency metrics by clarifying how the energy efficiency metric is derived for a given clothes washer; and lead to continuous improvement of the test procedure over time since having access to additional data on cycle time would enable DOE and other stakeholders to continually evaluate the value of cycle time measurement in future rulemakings. (*Id.*)

AHAM commented in opposition to DOE's proposal to include a measurement of cycle time and a calculation of weighted-average cycle time. (AHAM, No. 27 at p. 12) AHAM commented that while cycle time is a key consideration for consumer utility,

DOE properly accounts for cycle time in its evaluation of possible amended standards. (*Id*.)

For the reasons stated above, DOE determines that requiring test laboratories to include cycle time measurement would not increase test burden. DOE also determines that defining the annual standby mode and off mode hours using the measured average cycle time would provide a more representative basis for determining the energy consumption in the combined low-power modes for the specific clothes washer under test.

With regard to AHAM's comment opposing the proposed cycle time measurement on the basis that DOE accounts for cycle time in its evaluation of possible amended standards, DOE notes that the purpose of implementing a measurement of cycle time in the test procedure would differ from the purpose of evaluating cycle time as part of an energy conservation standards analysis. In an energy conservation standards analysis, cycle time could be evaluated, for example, to determine whether higher efficiency levels under consideration would require longer cycle times. Whereas, the purpose of the cycle time measurement as proposed in the September 2021 NOPR is to provide a more representative allocation of standby and off mode hours for a unit under test. Evaluating cycle time as part of an energy conservation standards analysis would not contribute to providing more representative test results when testing to the DOE test procedure.

For the reasons discussed in the September 2021 NOPR and in the preceding paragraphs, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to require cycle time measurement in new appendix J. As discussed in section III.G.3 of this document, also consistent with the September 2021 NOPR, DOE finalizes its proposal to base the allocation of annual combined low-power mode hours on the

measured average cycle time rather than a fixed value of 8,465 hours, for the new appendix J.

DOE notes it is not amending the certification or reporting requirements for clothes washers in this final rule to require reporting of cycle time measurements. Instead, DOE may consider proposals to amend the certification requirements and reporting for RCWs and CCWs under a separate rulemaking regarding appliance and equipment certification.

b. Definition of Cycle Time

Section 3.2.8 of appendix J2 specifies that for each wash cycle tested, include the entire active washing mode and exclude any delay start or cycle finished modes. "Active washing mode" is defined in section 1.2 of appendix J2 as "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." "Delay start mode" is defined in section 1.12 of appendix J2 as "an active mode in which activation of washing mode is facilitated by a timer." "Cycle finished mode" is defined in section 1.11 of appendix J2 as "an active mode that provides continuous status display, intermittent tumbling, or air circulation following operation in active washing mode."

The Joint Efficiency Advocates recommended that DOE further clarify the definition of a clothes washer cycle. (Joint Efficiency Advocates, No. 28 at p. 6) The Joint Efficiency Advocates commented that some clothes washers may enter a new mode between the completion of the main cycle and subsequent standby mode. (*Id.*) The Joint Efficiency Advocates asserted that it is not clear whether energy usage in these scenarios is being captured by either the active mode or standby mode testing. (*Id.*) The Joint Efficiency Advocates also noted that, while the DOE test procedure for clothes dryers codified at 10 CFR part 430, subpart B, appendix D2 ("appendix D2") specifies when the

cycle shall be considered complete, there is no clear definition of what constitutes the beginning and end of a clothes washer cycle in the new appendix J. (*Id*.)

The CA IOUs recommended that DOE provide additional details in new appendix J to better define cycle time, stating that on some clothes washers the end of the cycle is unclear. (CA IOUs, No. 29 at p. 2) For example, the CA IOUs noted that some clothes washers have wrinkle-free settings in which the clothes washer tumbles the clothes once every 15 minutes for up to 12 hours after the cycle has finished. (*Id*.) The CA IOUs suggested that, similar to the way appendix D2 treats clothes dryers with similar wrinkle-free settings, DOE should include these types of extended cycle operations in the test procedure if they are activated by default or instructed by the manufacturer for normal use. (*Id*.)

In response to the Joint Efficiency Advocates and the CA IOUs' requests to clarify the cycle time definition, DOE reiterates that the requirement of section 3.2.8 in appendix J2 (and section 3.2.5 of appendix J as proposed) states explicitly that each wash cycle must include the entire active washing mode and exclude any delay start or cycle finished modes. A mode between completion of the main cycle and subsequent standby mode (including, for example, a wrinkle-free setting described by the CA IOUs), would be considered a cycle finished mode. DOE determines that the specification in section 3.2.8 of appendix J2 and section 3.2.5 of new appendix J to include only active washing mode, and to exclude delay start and cycle finish modes, provides sufficient specification regarding the wash cycle operations that comprise a complete cycle, and on which the measurement of cycle time is to be based.

For these reasons, DOE is not adding a definition of cycle time to either appendix J2 or new appendix J.

Regarding the suggestion by CA IOUs that DOE include extended cycle operations in the test procedure if they are activated by default or instructed by the

manufacturer for normal use, DOE addressed the exclusion of cycle finished mode in the March 2012 Final Rule. Upon consideration of data and estimates provided in the NOPR published September 21, 2010 (75 FR 57556), additional energy consumption estimates provided in the supplemental NOPR published August 9, 2011 (76 FR 49238), the uncertainty regarding consumer usage patterns, and the additional test burden that would be required, DOE determined in the March 2012 Final Rule to adopt an "alternate approach" to account for the energy use in cycle finished mode. 77 FR 13888, 13896. 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. *Id*. None of the information provided in comments in response to the September 2021 NOPR would lead DOE to a different conclusion regarding the exclusion of cycle finished mode.

For these reasons, DOE is not amending in appendix J2 or implementing in new appendix J any provisions for measuring operation in cycle finished mode.

6. Capacity Measurement

Section 3.1 of appendix J2 provides the procedure for measuring the clothes container capacity, which represents the maximum usable volume for washing clothes. The clothes container capacity is measured by filling the clothes container with water and using the weight of the water to determine the volume of the clothes container. For front-loading clothes washers, this procedure requires positioning the clothes washer on its back surface such that the door opening of the clothes container faces upwards and is leveled horizontally. For all clothes washers, any volume that cannot be occupied by clothing load during operation is excluded.

In the March 2012 Final Rule, DOE revised the clothes container capacity measurement to better reflect the actual usable capacity compared to the previous measurement procedures. 77 FR 13888, 13917. In the August 2015 Final Rule, DOE

further added to the capacity measurement procedure a revised description of the maximum fill volume for front-loading clothes washers, as well as illustrations of the boundaries defining the uppermost edge of the clothes container for top-loading vertical-axis clothes washers and the maximum fill volume for horizontal-axis clothes washers. 80 FR 46729, 46733.

For top-loading vertical-axis clothes washers, DOE defined the uppermost edge of the clothes container as the uppermost edge of the rotating portion of the wash basket. 77 FR 13888, 13917–13918. DOE also concluded that the uppermost edge is the highest horizontal plane that a dry clothes load could occupy in a top-loading vertical-axis clothes washer that would allow clothing to interact with the water and detergent properly. *Id*.

As discussed in the September 2021 NOPR, DOE is not aware of any changes to product designs since the March 2012 Final Rule that would cause DOE to reevaluate its conclusions about the most appropriate capacity fill level. 86 FR 49140, 49165. In DOE's experience, since the March 2012 Final Rule, the existing capacity fill definition is implemented consistently by test laboratories and results in repeatable and reproducible measurements of capacity. *Id*. DOE therefore did not propose any changes to the existing capacity measurement method. *Id*.

DOE requested comment on its tentative determination to maintain the current capacity measurement method. *Id*.

AHAM commented in support of DOE's proposal to not specify any alternatives to the current capacity measurement procedure, stating that it is accurate, repeatable, and reproducible. (AHAM, No. 27 at p. 12)

The Joint Commenters commented in support of DOE's proposal to retain the current capacity measurement test procedure, stating that it ensures reproducibility and enables third-party verification. (Joint Commenters, No. 31 at p. 11)

P.R. China recommended that DOE emphasize in the capacity measurement procedure that the groove on the rubber door seal of front-loading clothes washers should not be included in the capacity calculation. (P.R. China, No. 25 at pp. 3–4)

In response to P.R. China's recommendation, DOE notes that the groove on the rubber door seal of front-loading clothes washers cannot be occupied by the clothing load during operation, and therefore is already excluded from the capacity measurement. In practice, during the measurement of a front-loading clothes washer's capacity, the groove on the rubber door seal would be covered by the plastic bag specified in section 3.1.2 of appendix J2 for lining the inside of the clothes container for the purpose of the capacity measurement, and therefore would not be included in the capacity measurement.

For the reasons stated previously, DOE makes no changes to the capacity measurement method in this final rule.

7. Identifying and Addressing Anomalous Cycles

Section 3.2.9 of appendix J2 previously specified discarding the data from a wash cycle that "provides a visual or audio indicator to alert the user that an out-of-balance condition has been detected, or that terminates prematurely if an out-of-balance condition is detected, and thus does not include the agitation/tumble operation, spin speed(s), wash times, and rinse times applicable to the wash cycle under test."

In the September 2021 NOPR, DOE discussed that as clothes washer technology has improved, certain clothes washers are designed to self-correct out-of-balance loads or make other adjustments to the operation of the unit to complete the cycle without alerting the consumer or requiring user intervention. 86 FR 49140, 49166. DOE also recognized the benefit of objective and observable criteria to determine when an anomalous cycle has occurred, based on a single test, such that the data from that anomalous cycle should be discarded. *Id*.

To provide more objective and observable criteria, DOE proposed that data from a wash cycle would be discarded if either: the washing machine signals to the user by means of an audio or visual alert that an off-balance condition has occurred; or the wash cycle terminates prematurely and thus does not include the agitation/tumble operation, spin speed(s), wash times, and rinse times applicable to the wash cycle under test. *Id*. The proposed reference to an audio or visual alert refers to a warning sound initiated by the clothes washer, or visual cue such as a flashing light or persistent error code, that is provided to the user to actively inform the user that a problem has occurred; as opposed to a more passive indication such as the drum hitting the side of the cabinet or a change in the projected cycle duration, which could go unnoticed by the user or which itself may not be an indication of an out-of-balance load that warrants discarding the data for a test cycle. *Id*. To emphasize this intent, DOE proposed to change the current phrase "provides a visual or audio indicator to alert the user" to "signals to the user by means of a visual or audio alert" in both section 3.2.9 of appendix J2 and section 3.2.6 of the new appendix J. *Id*.

DOE also proposed to change the current phrase "terminates prematurely if an out-of-balance condition is detected" to simply "terminates prematurely," in recognition that other factors beyond an out-of-balance condition could also cause a wash cycle to terminate prematurely (*e.g.*, a clogged filter, mechanical malfunction, *etc.*), and that for any such reason, the data from that wash cycle would be discarded. *Id*.

DOE further proposed non-substantive wording changes to section 3.2.9 of appendix J2 and section 3.2.6 of the new appendix J to make explicit that if data are discarded for the reasons described in these sections, the wash cycle is repeated. *Id*.

DOE requested comment on the proposed criteria for determining whether test data are to be discarded. *Id*. Specifically, DOE requested comment on the proposal that test data are discarded if a washing machine either signals to the user by means of a

visual or audio alert that an out-of-balance condition has occurred or terminates prematurely. *Id*. DOE requested comment on whether additional or alternate criteria would provide objective and observable indication during a single test that test data are to be discarded. *Id*.

AHAM commented in support of DOE's proposed definition for anomalous test cycles, but with one suggested change to replace "…b) terminates prematurely and thus does not include the agitation/tumble operation…" with "…b) terminates prematurely; or c) does not include the agitation/tumble operation..." (AHAM, No. 27 at pp. 12–13) AHAM commented that an anomalous cycle may not always terminate prematurely, but may instead only be apparent from the objective and observable criteria such as agitation/tumble operation, spin speeds, wash times, and rinse times applicable to the cycle under test. (*Id*.) AHAM further commented that a cycle may not terminate prematurely due to anomalous behavior because, in order to benefit the consumer, the clothes washer will address the anomalous behavior and finish the cycle without alerting the consumer or requiring consumer interaction. (*Id*.) AHAM noted that, in addition to benefitting the consumer, addressing anomalous behavior often saves energy and water by finishing the cycle with some incrementally increased water or energy usage instead of requiring a cycle to be canceled and completely re-run. (*Id*.) AHAM recommended that test cycles exhibiting signs of anomalous behavior without alerting the consumer should be considered invalid because they will likely impact test results if they occur during a test cycle by increasing energy and/or water consumption for that particular test, and it is unlikely that anomalous conditions happen frequently when consumers use the clothes washer. (*Id*.) While AHAM recognizes that third-party test laboratories may not know when a clothes washer changes its operation due to anomalous behavior without an audio/visual indicator, a proposal to require such an indicator would necessitate product changes that add unnecessary product cost. (*Id*.) AHAM further asserted that consumers

may be dissatisfied if their clothes washer presents an audio/visual alert instead of fixing anomalous behavior automatically for the user because the user may have to fix the issue themselves, or make a service call. (*Id*.) GEA provided specific support of AHAM's comments regarding this proposed amendment. (GEA, No. 32 at p. 3)

Whirlpool commented in agreement with DOE's proposal on anomalous cycles to recognize that there may be other factors beyond an out-of-balance condition that could cause a wash cycle to terminate prematurely. (Whirlpool, No. 26 at p. 10) Whirlpool suggested, however, that DOE adopt AHAM's recommendation presented in its comments from the May 2020 RFI to determine anomalous cycles even when there are no visual or audio alerts to the user to indicate that something anomalous has occurred during the cycle. (*Id*.) Whirlpool commented that not alerting the user to anomalous clothes washer behavior is beneficial to the consumer, since alerting the consumer to anomalous behavior may result in the consumer incorrectly believing something is seriously wrong with the unit, which could lead to a service call or visit from the manufacturer. (*Id*.) Since consumer intervention may not be needed to fix anomalous behavior, Whirlpool suggested that DOE should not require that the clothes washer signal the user by means of a visual or audio alert. (*Id*.) Whirlpool also commented that adding a visual or audio alert adds unnecessary costs. (*Id*.)

GEA commented that it appreciates DOE's evaluation of the issue of anomalous cycles during testing. (GEA, No. 32 at pp. 2–3) GEA specified that the high spin speeds required by current energy conservation standards combined with increasing clothes washer capacity can lead to the need for clothes washers to adjust their normal cycle to ensure safe and effective cycles. (*Id*.) GEA also commented that handling of anomalous cycles without notifying the user is an important consumer feature that saves energy and consumers' time. (*Id*.) GEA further explained that requiring a consumer notification for

an anomalous cycle that otherwise successfully washes and spins the load may lead to unnecessary rewash of cleaned clothing, which could lead to a waste of energy. (*Id.*)

DOE did not intend its proposal to be a design requirement. Rather, the intent of the proposal was to specify objective and observable criteria that—if observed on a particular unit under test—would indicate that the test data are to be discarded. The proposal would not require all clothes washers to provide audio or visual alerts if anomalies are detected. As stated above, DOE acknowledges the consumer benefit and potential energy savings benefit of clothes washers that are able to address anomalous behavior and finish the cycle without requiring consumer interaction. DOE expects that such anomalous cycles would occur infrequently and only under limited circumstances; more frequent occurrence would potentially indicate that such cycle behavior may be representative of what a consumer of that model would experience.

For the purpose of specifying criteria by which test data *must* be discarded, DOE reiterates the importance of specifying objective and observable criteria that could be used by an independent laboratory to determine when an anomalous cycle has occurred, based on a single test, such that the data from that anomalous cycle would be discarded.

For these reasons, DOE finalizes its proposal, consistent with the September 2021 NOPR, to further specify objective and observable criteria that, if were to occur during testing, require the test data to be discarded, and the test cycle repeated. This amendment applies to both appendix J2 and appendix J.

8. Semi-Automatic Clothes Washers

Section III.C.2 of this document discussed the installation of semi-automatic clothes washers for testing. This section discusses the wash/rinse temperature selections and TUFs applicable to semi-automatic clothes washers. As noted, semi-automatic clothes washers are defined at 10 CFR 430.2 as 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. DOE's test procedure requirements at 10 CFR 430.23(j)(2)(ii) state that the use of appendix J2 is required to determine IMEF for both automatic and semi-automatic clothes washers.

Semi-automatic clothes washers inherently do not provide wash/rinse temperature selections on the control panel, as any combination of cold, warm, and hot wash temperatures and rinse temperatures are provided by the user's adjustment of the external water faucet valves. As discussed in the September 2021 NOPR, inherently, testing the Hot/Hot, Warm/Warm, and Cold/Cold wash/rinse temperature combinations require no changes to the water faucet valve positions between the wash and rinse portions of the cycle. However, testing the Hot/Warm, Hot/Cold, and Warm/Cold temperature combinations requires the test administrator to manually adjust the external water faucet valves between the wash and rinse portions of the cycle by. As reflected in DOE's definition of semi-automatic clothes washer, user intervention is required to regulate the water temperature of all semi-automatic clothes washers (*i.e.*, user regulation of water temperature is the distinguishing characteristic of a semi-automatic clothes washer). *See* 10 CFR 430.2.

Table 4.1.1 in appendix J2 contains columns that list TUFs based on the temperature selections available in the energy test cycle. Table 4.1.1 does not state which column(s) of the table are applicable to semi-automatic clothes washers. In the May 2012 Direct Final Rule, DOE stated that it was not aware of any semi-automatic clothes washers on the market. 77 FR 32307, 32317. However, DOE is currently aware of several semi-automatic clothes washer models available in the U.S. market.

a. Temperature Selections and Usage Factors

Appendix J as established in the September 1977 Final Rule required testing six wash/rinse temperature combinations: Hot/Hot, Hot/Warm, Hot/Cold, Warm/Warm, Warm/Cold and Cold/Cold. The TUFs in Table 6.1 of the 1977 version of appendix J

used the same general usage factors for semi-automatic clothes washers as for automatic clothes washers. 42 FR 49802, 49810. For example, the Cold/Cold TUF of 0.15 was the same for both types, and the sum of Hot/Hot, Hot/Warm and Hot/Cold (with a total TUF of 0.30) for semi-automatic clothes washers was the same as the TUF for Hot/Cold on an automatic clothes washer with only three temperature selections.

DOE updated the TUFs in the August 1997 Final Rule, based on P&G data provided by AHAM. 62 FR 45484, 45491. Currently, Table 4.1.1 of appendix J2 does not include TUFs for all six of the temperatures required for testing in the 1977 version of appendix J.

In the September 2021 NOPR, DOE considered requiring that semi-automatic clothes washers be tested with the same six temperature settings as in the 1977 version of appendix J. 86 FR 49140, 49167.

By including all six possible temperature combinations, Table 6.1 of the 1977 version of appendix J included wash/rinse temperature settings that require the water temperature to be changed between the wash portion and the rinse portion of the cycle (*i.e.*, Hot/Warm, Hot/Cold, and Warm/Cold), and wash/rinse temperature settings that do not require any water temperature change (*i.e.*, Hot/Hot, Warm/Warm, and Cold/Cold). 86 FR 49140, 49167–49168. In Table 6.1 of the 1977 version of appendix J, temperature settings that do not require a water temperature change had higher usage factors than temperatures settings that do require a water temperature change, reflecting that consumers are more likely to use a single temperature for the entire duration of the cycle than to change the temperature between the wash and rinse portions of the cycle. 86 FR 49140, 49168.

In the September 2021 NOPR, DOE proposed to require testing only those temperature settings that do not require a water temperature change (*i.e.*, Hot/Hot, Warm/Warm, and Cold/Cold) for semi-automatic clothes washers in new appendix J. As

indicated by the TUFs from the 1977 version of appendix J, consumers are more likely to use a single temperature for the entire duration of the cycle than to change the temperature between the wash and rinse portions of the cycle. *Id*. Changing the temperature between the wash and rinse portions of the cycle would require the consumer to monitor the operation of the clothes washer and adjust the temperature at the appropriate time. *Id*. DOE expects that consumers are more likely not to interact with the operation of the clothes washer during operation of the unit, once it has been started. *Id*. Not requiring testing of temperature combinations that would require the user to change the temperature between wash and rinse would reduce test burden significantly, while producing results that are representative of consumer usage. *Id*. DOE tentatively concluded that requiring testing all six possible temperature combinations would present undue burden compared to testing only those temperature combinations that do not require a water temperature change. *Id*.

In the September 2021 NOPR, DOE requested comment on its proposal for testing semi-automatic clothes washers in the proposed new appendix J that would require testing only the wash/rinse temperature combinations that do not require a wash temperature change between the wash and rinse portions of the cycle (*i.e.*, Hot/Hot, Warm/Warm, and Cold/Cold). *Id*.

To define the TUFs for these three temperature combinations, DOE proposed to use the TUFs from the existing column of Table 4.1.1 of appendix J2 specified for testing clothes washers with Hot/Cold, Warm/Cold, and Cold/Cold temperature selections, and presented in Table III.1. To further simplify the test procedure, since DOE proposed to require testing only those temperature selections that do not require a change in the water temperature, DOE proposed to label these selections "Hot," "Warm," and "Cold," respectively (as opposed to "Hot/Hot", "Warm/Warm", and "Cold/Cold").

Table III.1 Temperature Usage Factors for Semi-Automatic Clothes Washers Reflecting Three Required Temperature Combinations Proposed in the September 2021 NOPR

Wash/rinse temperature selection	Proposed TUF Values
Hot	0.14
Warm	0.49
Cold	0.37

DOE requested feedback on its proposal to test semi-automatic clothes washers using TUF values of 0.14 for Hot, 0.49 for Warm, and 0.37 for Cold. *Id*. DOE further requested comment on whether the temperature selections and TUFs that DOE proposed for semi-automatic clothes washers would be representative of consumer use; and if not, which temperature selections and TUF values would better reflect consumer use. *Id*.

The Joint Commenters commented in support of DOE's proposal regarding temperature selection for semi-automatic clothes washers. (Joint Commenters, No. 31 at p. 11) The Joint Commenters further commented that consumers are unlikely to monitor the progress of a semi-automatic clothes washer cycle to change inlet water temperature mid-cycle. (*Id*.)

P.R. China recommended that DOE use different TUFs for automatic and semi-automatic clothes washers, and that DOE investigate more consumer usage data before determining TUF values for semi-automatic clothes washers. (P.R. China, No. 25 at p. 4) P.R. China commented that, as far as it knows, hot water is rarely used in semi-automatic clothes washers. (*Id*.)

AHAM commented that if AHAM's test data supports DOE's proposal, the proposal should apply only to products plumbed to both hot and cold water supplies to avoid penalizing products designed to be plumbed with only cold water. (AHAM, No. 27 at p. 7)

In response to P.R. China's comment that DOE should use different TUFs for automatic and semi-automatic clothes washers, the history of DOE's test specifications

for semi-automatic clothes washers reflects DOE's historical understanding that consumers of semi-automatic clothes washers select among cold, warm, and hot wash temperatures with similar frequencies as consumers of automatic clothes washer. As discussed above, in the 1977 version of appendix J, the TUFs for automatic and semi-automatic clothes washers were aligned. DOE maintained this general alignment in appendix J through subsequent revisions of the test procedure in the August 1997 Final Rule and January 2001 Final Rule. In the initial version of appendix J1 established in the August 1997 Final Rule, DOE further maintained this alignment in combining the TUFs for both automatic and semi-automatic clothes washers into a single table of TUFs applicable to all types of clothes washers. DOE maintained this single table in subsequent versions of appendix J1 as amended by the January 2001 Final Rule, March 2012 Final Rule, and August 2015 Final Rule; as well as appendix J2 as established in the March 2012 Final Rule and subsequently amended in the August 2015 Final Rule. P.R. China presented no data to support its assertion that the TUFs for semi-automatic clothes washers should be different than for automatic clothes washers. Lacking any more recent data or information to suggest that DOE's historical understanding of consumer usage of semi-automatic clothes washers has changed in this regard, DOE maintains the alignment of the TUFs between semi-automatic and automatic clothes washers, as proposed in the September 2021 NOPR.

In response to AHAM's comment that the proposed TUFs should apply to only products plumbed to both hot and cold water supplies, DOE is not aware of any semi-automatic clothes washers that are plumbed to both hot and cold water supplies. In DOE's review of products on the market, all semi-automatic clothes washers are designed with a single water inlet that consumers connect to a water faucet, such as a kitchen faucet, that has the ability to provide water at a range of temperatures. Therefore, DOE does not make a distinction between semi-automatic clothes washers plumbed to

both hot and cold water supplies—were such products to be brought to the market—and those plumbed with only cold water. To the extent that provisions of appendix J for semi-automatic clothes washers result in higher measured energy compared to appendix J2, impacts on measured energy use between the then-current appendix J2 and the proposed appendix J test procedures would be factored into the crosswalk relating the appendix J2 and appendix J metrics as part of the ongoing standards analysis.

For the reasons discussed above, DOE finalizes its proposal, consistent with the September 2021 NOPR, to test semi-automatic clothes washers under appendix J using only the wash/rinse temperature combinations that do not require a temperature change between the wash and rinse portions of the cycle (*i.e.*, Hot/Hot, Warm/Warm, and Cold/Cold). Also consistent with the September 2021 NOPR, DOE finalizes its proposal to define TUF values of 0.14 for Hot, 0.49 for Warm, and 0.37 for Cold in appendix J for semi-automatic clothes washers.

b. Cycles Required for Test

Inherent to semi-automatic clothes washer operation is that the clothes washer provides the same cycle operation for a given load size and cycle setting, regardless of the water temperature that the user provides. 86 FR 49140, 49168. As a result, when testing a semi-automatic clothes washer, machine energy consumption, total water consumption, bone-dry weight, cycle-completion weight, and cycle time for a given load size are unaffected by wash/rinse temperature. *Id*. When testing a given load size, only the relative amount of cold and hot water consumption is based on the water temperature provided by the user. *Id*. For the Cold cycle as proposed, all of the water used is cold; for the Hot cycle as proposed, all of the water used is hot; and for the Warm cycle as

proposed, half of the water used is cold and half is hot.[42] Based on these relationships, for a given load size, once one of the test cycles has been performed and the total water consumption determined, the relative amounts of cold and hot water for the other required cycles can be determined formulaically rather than needing to be determined through testing. *Id*. Therefore, DOE tentatively determined that testing all three of the proposed temperature selections would be unnecessary, and that only a single test cycle is required for a given load size. *Id*. In the September 2021 NOPR, DOE proposed in new appendix J to require testing only the Cold cycle, and to determine the representative values for the Hot and Warm cycles formulaically based on the values measured for the Cold cycle. *Id*. This approach would reduce the test burden for semi-automatic clothes washers by requiring only two test cycles to be conducted (using the small and large test loads with the Cold cycle) as opposed to six cycles (using the small and large test loads with the Cold, Warm, and Hot cycles) and obtaining the other required values through calculation. *Id*.

DOE also noted that if it were to require measuring six temperature selections (Hot/Hot, Hot/Warm, Hot/Cold, Warm/Warm, Warm/Cold, and Cold/Cold), the determination of hot and cold water use would be more complicated for temperature selections that require a water temperature change. 86 FR 49140, 49168–49169. The tester would first need to determine the proportion of wash water to rinse water, in order to be able to apportion the total volume of cold and hot water used between wash and rinse for each of the temperature selections determined formulaically. 86 FR 49140, 49169.

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[42] These water use determinations are based on the water faucet positions specified in section 3.2.3.2 of appendix J2, which specifies that to obtain a hot inlet water temperature, open the hot water faucet completely and close the cold water faucet; for a warm inlet water temperature, open both hot and cold water faucets completely; and for a cold inlet water temperature, close the hot water faucet and open the cold water faucet completely.

In the September 2021 NOPR, DOE requested comment on its proposal to require semi-automatic clothes washers to be tested using only the Cold cycle, and to determine the representative values for the Warm and Hot cycles formulaically, for the proposed new appendix J. 86 FR 49140, 49168.

DOE did not receive any comments regarding the proposal to require semi-automatic clothes washers to test only the Cold cycle, and to determine the representative values for the Warm and Hot cycles formulaically, for the proposed new appendix J.

For the reasons stated above, DOE finalizes its proposal, consistent with the September 2021 NOPR, to require semi-automatic clothes washers to be tested using only the Cold cycle, and to determine the representative values for the Warm and Hot cycles formulaically, for the proposed new appendix J.

c. Implementation

To implement the changes described above for semi-automatic clothes washers, DOE proposed in the September 2021 NOPR to create a section 3.4 in the new appendix J (see discussion in section III.H.7 of this document for an explanation of how section 3 of the new appendix J was proposed to be structured) specifying the cycles required for testing semi-automatic clothes washers. 86 FR 49140, 49169. DOE proposed a new section 3.4.1 that would specify the required test measurements for the Cold cycle and would define variables for each measured value and a new section 3.4.2 that would specify the formulas used to calculate the representative values for the Warm and Hot cycles, based on the measured values from the Cold cycle. *Id*.

DOE also proposed to create a section 2.12.2 in the new appendix J to state that the energy test cycle for semi-automatic clothes washers includes only the Cold Wash/Cold Rinse ("Cold") test cycle. *Id*. DOE also proposed to create a section 2.12.1, which would parallel the current section 2.12 in appendix J2 and would be identified as applying to automatic clothes washers. *Id*. DOE further proposed to specify that section

3.2.1 of the new appendix J (which would mirror section 3.2.4 of appendix J2) would apply only to automatic clothes washers. *Id*.

In the September 2021 NOPR, DOE requested comment on whether to include explicit instructions for how to test semi-automatic clothes washers in appendix J2, and if so, whether DOE should implement the same procedures being proposed for the proposed new appendix J. 86 FR 49140, 49168. DOE also requested feedback on how manufacturers of semi-automatic clothes washers are currently testing their products using appendix J2. *Id*.

DOE did not receive any comments regarding the proposed implementation details for including explicit instructions on how to test semi-automatic clothes washers in appendix J. DOE also did not receive any comments on how manufacturers of semi-automatic clothes washers are currently testing their products using appendix J2 or whether to include explicit instructions for how to test semi-automatic clothes washers in appendix J2.

For the reasons stated above, DOE finalizes its proposal, consistent with the September 2021 NOPR, to create a section 3.4 in the new appendix J specifying the cycles required for testing semi-automatic clothes washers, including a new section 3.4.1 that specifies the required test measurements for the Cold cycle and defines variables for each measured value; and a new section 3.4.2 that specifies the formulas used to calculate the representative values for the Warm and Hot cycles, based on the measured values from the Cold cycle. DOE also finalizes its proposal, consistent with the September 2021 NOPR, to create a section 2.12.2 in the new appendix J to state that the energy test cycle for semi-automatic clothes washers includes only the Cold test cycle.

9. Optional Cycle Modifiers

Section 3.2.7 of appendix J2 previously stated that for clothes washers with electronic control systems, the manufacturer default settings must be used for any cycle

selections, except for (1) the temperature selection, (2) the wash water fill levels, or (3) if necessary, the spin speeds on wash cycles used to determine RMC. Specifically, the manufacturer default settings must be used for wash conditions such as agitation/tumble operation, soil level, spin speed on wash cycles used to determine energy and water consumption, wash times, rinse times, optional rinse settings, water heating time for water-heating clothes washers, and all other wash parameters or optional features applicable to that wash cycle. Any optional wash cycle feature or setting (other than wash/rinse temperature, water fill level selection, or spin speed on wash cycles used to determine RMC) that is activated by default on the wash cycle under test must be included for testing unless the manufacturer instructions recommend not selecting this option, or recommend selecting a different option, for washing normally soiled cotton clothing.

DOE has observed a trend towards increased availability of optional cycle modifiers. 86 FR 49140, 49169. These optional settings may significantly impact the water and/or energy consumption of the clothes washer when activated. *Id*. DOE has observed that the default setting of these optional settings on the Normal cycle is most often in the off position; *i.e.*, the least energy- and water-intensive setting. *Id*. DOE suggested that the growing presence of such features may, however, be indicative of an increase in consumer demand and/or usage of these features. *Id*.

As noted in the September 2021 NOPR, DOE is not aware of any consumer usage data concerning the use of optional cycle modifiers, nor did interested parties provide any such data. 86 FR 49140, 49170. Although DOE maintains that the growing presence of such features may be indicative of an increase in consumer usage of these features, DOE lacks consumer usage data that would be required to incorporate the testing of such features in the test procedure. *Id*. Therefore, DOE did not propose to change the current requirement to use the manufacturer default settings for optional cycle modifiers. *Id*.

As discussed in section III.D.4 of this document, new appendix J requires measuring RMC on each tested cycle using the default spin settings for each cycle. *Id*. Consistent with this change from appendix J2, DOE proposed in the September 2021 NOPR to remove "spin speeds on wash cycles used to determine RMC" from the list of cycle settings that are excluded from the requirement to use the manufacturer default settings in section 3.2.4 (Manufacturer default settings) of the new appendix J. *Id*.

DOE requested comment on maintaining the current requirement to use the manufacturer default settings for optional cycle modifiers. *Id*.

The Joint Efficiency Advocates encouraged DOE to investigate the usage of cycle modifiers and consumer spin cycle selection behaviors, and their impact on energy and water use. (Joint Efficiency Advocates, No. 28 at p. 7) The Joint Efficiency Advocates stated that they agree with DOE's statement in the September 2021 NOPR that cycle modifiers have a growing presence, as evidenced by the fact that "deep fill" is a clothes washer selection filter on certain appliance vendors' websites. (*Id*.) The Joint Efficiency Advocates asserted that cycle modifiers such as "deep fill" are being captured by the test procedure only in certain cases. (*e.g.*, user-adjustable automatic clothes washers that have the "deep fill" setting on the water level control, which would be captured by the provision in section 3.2.6.2.2 of appendix J2, versus clothes washers that have a separate "deep fill" button that would be considered a cycle modifier and would not be tested under the proposed amended test procedure). (*Id*.) The Joint Efficiency Advocates also restated their comments in response to the May 2020 RFI, that if the test procedure requires testing of optional cycle modifiers only in their default position, and the default settings for optional modifiers are most often in the "off" position, the test procedure effectively assigns a value of zero to the energy and water use of those features, which the Joint Efficiency Advocates asserted is not representative of consumer use. (*Id*.) Additionally, the Joint Efficiency Advocates commented that while DOE's proposal to

measure RMC on each energy test cycle using the default spin setting is an improvement upon the current RMC testing method, consumers may still select spin settings that are not the default setting, and that the proposed amended test procedure may not accurately reflect real-world energy usage. (*Id*.) The Joint Efficiency Advocates therefore concluded that DOE should pursue data regarding consumer behavior for spin setting selection at different temperature cycles. (*Id*.)

The CA IOUs recommended that DOE conduct exploratory research testing on cycle modifiers and consider future amendments to the test procedure to ensure that the energy conservation standards are representative of actual field energy and water use. (CA IOUs, No. 29 at p. 6) The CA IOUs also recommended that DOE invest in a national study to determine how consumers use additional cycle modifiers on a national scale. (*Id*.)

AHAM commented in support of DOE's proposal to maintain the current requirement to use the manufacturer default settings for optional cycle modifiers. (AHAM, No. 27 at p. 14) AHAM also commented that it agrees with DOE's proposal to remove "spin speeds on wash cycles used to determine RMC" from the list of cycle settings that are excluded from the requirement to use the manufacturer default settings. (*Id*.)

Regarding the Joint Efficiency Advocates' assertion that certain implementations of "deep fill" would be captured by the test procedure but that a separate deep fill button would be considered a cycle modifier and not be tested, the language of section 3.2.7 regarding use of default settings during testing does not apply to wash water fill levels.[43] Irrespective of how a deep fill feature is implemented on the control panel (*e.g.*, whether

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[43] Section 3.2.7 of appendix J2 states that for clothes washers with electronic control systems, use the manufacturer default settings for any cycle selections, *except for* (1) the temperature selection, (2) *the wash water fill levels*, or (3) if necessary, the spin speeds on wash cycles used to determine remaining moisture content. (emphasis added)

as a setting on the water level control or as separate "deep fill" button), the "deep fill" option would be tested if the feature meets the definition of a user-adjustable adaptive WFCS (see further discussion of this definition in section III.H.3.a of this document).

DOE recognizes, as discussed, that clothes washer control panels continue to become more complex. The plethora of cycle modifiers available—implemented differently by each manufacturer—creates a significant challenge in collecting data on consumer usage and in considering test procedures for these features that would be representative of an average use cycle or period of use without being unduly burdensome to conduct, as required by EPCA. DOE lacks data and information that could provide insights into average consumer use of cycle modifiers.

For the reasons stated above, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to specify in section 3.2.4 of new appendix J the use of manufacturer default settings for optional cycle modifiers other than temperature selections and wash water fill levels, and to remove "spin speeds on wash cycles used to determine RMC" from the list of cycle settings that are excluded from the requirement to use the manufacturer default settings.

10. Clothes Washers with Connected Functionality

DOE is aware of several "connected" RCW models currently on the market, from at least six major manufacturers. As discussed in the September 2021 NOPR, these products offer optional wireless network connectivity to enable features such as remote monitoring and control via smartphone, as well as certain demand response features[44] available through partnerships with a small number of local electric utilities. 86 FR 49140, 49170. In addition, connected features are available via certain external

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[44] "Demand response features" refers to product functionality that can be controlled by the "smart grid" to improve the overall operation of the electrical grid, for example by reducing energy consumption during peak periods and/or shifting power consumption to off-peak periods.

communication modules for CCWs. *Id*. However, DOE is not aware of any CCW models currently on the market that incorporate connected features directly into the unit. *Id*.

As noted previously, section 3.2.7 of appendix J2 previously specified using the manufacturer default settings for any cycle selections except temperature selection, wash water fill level, or spin speed. Furthermore, section 3.9.1 of appendix J2 specifies performing the combined low-power mode testing without changing any control panel settings used for the active mode wash cycle.

As discussed in the September 2021 NOPR, if connected features on a clothes washer affect its inactive mode power consumption in the as-shipped configuration (*e.g.*, by energizing a wireless communication chip on the circuit board by default), such impact would be measured by the current test procedure provisions in section 3.9 of appendix J2 for measuring combined low-power mode power. *Id*. Whereas, if the inactive mode power consumption is not affected unless the consumer actively enables the connected functionality on the unit, any incremental inactive mode power consumption resulting from the connected features would not be measured by the current test procedure, because the test procedure does not include instructions for activating any such features before performing the low-power mode measurement. *Id*. Similarly, any incremental energy consumption in active mode, or any other modes of operation impacted by the product's connected features, would not be measured as part of the current DOE test procedure, because the test cycle requirements in section 3.2.7 of appendix J2 do not include instructions for activating any such features before performing the active mode test cycles. *Id*.

In the September 2021 NOPR, DOE recognized the potential benefits that could be provided by connected capability, such as providing energy saving benefits to consumers, enabling peak load shifting on the electrical grid, and other consumer-related

benefits. 86 FR 49140, 49171. While a number of connected clothes washers are currently on the market with varying implementations of connected features, DOE is not aware of any data available regarding the consumer use of connected features. *Id*.

DOE also noted that while the current test procedure does not specifically consider energy use of network features, the test procedure may result in the measurement of the energy use of connected features in inactive mode. 86 FR 49140, 49171. Specifically, as discussed, any energy use of connected features would be measured in section 3.9 of appendix J2 for measuring combined low-power mode power if the connected features are enabled in the "as-shipped" configuration. *Id*. If the consumer is required to actively enable the connected functionality, however, such energy consumption would not be measured. *Id*. Similarly, any incremental energy consumption in active mode, or any other modes of operation impacted by the product's connected features, would not be measured because the test cycle requirements in section 3.2.7 of appendix J2 do not include instructions for activating any such features before performing the active mode test cycles. *Id*.

Given the lack of data to establish a test configuration that would be representative of consumer use of connected features on clothes washers, DOE proposed to amend section 3.2.7 of appendix J2 and section 3.2.4 of the new appendix J to specify that network settings (on clothes washers with network capabilities) must be disabled during testing if such settings can be disabled by the end-user, and the product's user manual provides instructions on how to do so. *Id*.

If, however, connected functionality cannot be disabled by the end-user or the product's user manual does not provide instruction for disabling connected functionality that is enabled by default, DOE proposed that the unit must be tested with the network capability in the factory default setting as specified in the current test procedure. *Id*. DOE preliminarily determined that if connected functionality cannot be disabled, or the

product's user manual does not provide instruction for disabling the function, it is more representative to include the energy consumption of the clothes washer in the default condition, including the enabled connected function, than to exclude the energy consumption associated with the connected feature. *Id*. As such, the energy consumption of a connected function that cannot be disabled would continue to be measured, as in the current test procedure. *Id*. This approach is consistent with the microwave ovens supplemental NOPR published on August 3, 2021, and with the consumer clothes dryer final rule published on October 8, 2021. 86 FR 41759 and 86 FR 56608.

DOE requested comment on its proposed amendment to appendix J2 and the proposed new appendix J to specify that network settings (on clothes washers with network capabilities) must be disabled during testing if such settings can be disabled by the end-user, and the product's user manual provides instructions on how to do so. 86 FR 49140, 49171. DOE also requested information and data regarding connected clothes washers that could inform future test procedure considerations. *Id*.

Whirlpool stated that it supports DOE's proposal to specify that network settings on clothes washers with connected functionality should be disabled during testing if such settings can be disabled by the end user, and if the product's user manual provides instructions on how to do so. (Whirlpool, No. 26 at p. 11)

AHAM commented that it does not oppose the intent behind DOE's proposal regarding network-connected clothes washers, but recommended that DOE refrain from using the term "disabled" and instead adopt terminology consistent with IEC Standard 62301, "Household electrical appliances—Measurement of standby power," Edition 2.0, 2011-01. (AHAM, No. 27 at p. 14) Specifically, AHAM noted that the definition of "low power mode" in IEC 62301 has three conditions: off, standby, and network. (*Id*.) AHAM added that the power consumption in standby and network modes are often negligible, but are not always zero. (*Id*.) AHAM expressed concern that DOE's use of

the term "disable" could mean that power consumption must be zero, which may lead to confusion and inaccurate testing. (*Id.*) AHAM recommended that instead of calling for connected functionality to be disabled, DOE should adopt the use of "low power mode" as defined in IEC 62301 as a setting in which the testing of connected products may occur. (*Id.*) AHAM added that the approach in IEC 62301 is desirable because connected functionalities are still evolving, as are the use cases that connected devices employ, and the low power definition in IEC 62301 allows for more flexibility while offering the clarity DOE seeks when it comes to connected functionality testing for clothes washers. (*Id.*)

The Joint Efficiency Advocates recommended that DOE test clothes washers with network-connected functionality in their as-shipped setting for both the active cycle and low-power modes. (Joint Efficiency Advocates, No. 28 at p. 4) The Joint Efficiency Advocates commented that while they support clarifying the instructions for network-connected functionality testing, they are concerned that DOE's proposal to test clothes washers with the network-connected functions disabled if such settings can be disabled by the end-user via user manual instructions would allow many clothes washers to be tested with connected functionality disabled even though those functions may not be disabled in the field. (*Id.*) The Joint Efficiency Advocates asserted that if a clothes washer with connected functionality is shipped with those features enabled, it is unlikely that most consumers will take the necessary steps to disable those features. (*Id.*) The Joint Efficiency Advocates therefore concluded that DOE's proposal for testing network-connected functionality would not be representative of the model's standby power consumption. (*Id.*)

The CA IOUs commented that they support testing all products with connected functionality in their as-shipped configuration. (CA IOUs, No. 29 at p. 7) The CA IOUs added that there is existing precedent for testing network-connected functions in their as-

shipped configurations that was established under the October 12, 2021 test procedure final rule for refrigeration products.[45] (*Id.*) The CA IOUs also commented that for clothes washers that have directions to disable network-connected functionality, there is no information available to confirm whether consumers disable these functions and at what rate they do so. (*Id.*) The CA IOUs further asserted that without specific consumer use information, it is reasonable to assume consumers will operate network-connected clothes washers in their as-shipped condition, and that anything to the contrary would imply a direct action by the consumer for which no supporting data exists. (*Id.*) The CA IOUs requested that if such data does exist, DOE should publish this information for all stakeholders to view. (*Id.*)

The Joint Commenters commented that they disagree with DOE's proposal to disable connected functionality during testing. (Joint Commenters, No. 31 at pp. 5–6) The Joint Commenters instead recommended that DOE require testing connected functionality for all clothes washers in the as-shipped configuration. (*Id.*) The Joint Commenters commented that their technical research shows that clothes washers with connected functionality may use varying amounts of energy on low power mode, and that data trends predict that connected functionality will likely be present in 25 percent of RCWs by 2023. (*Id.*) The Joint Commenters further commented that testing connected functionality for all clothes washers in the as-shipped condition would reduce test burden since the test technician would not need to disable connected functionality before low power mode testing. (*Id.*) The Joint Commenters also stated that testing connected functionality in the as-shipped configuration would be more representative of typical use, asserting that consumers are more likely to use the clothes washer as shipped, instead of making extra efforts to disable connected functionality, even if they choose not to use it.

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[45] The October 12, 2021 test procedure final rule for refrigeration products is available online at *www.regulations.gov/document/EERE-2017-BT-TP-0004-0029*.

(*Id*.) The Joint Commenters also added that DOE's general approach in clothes washers and in other product categories is to use the default position for most features. (*Id*.)

Mutrux recommended that DOE implement a more nuanced tracking of the standby states of connected appliances since, according to the Electronics Device & Networks Annex ("EDNA"), network-connected clothes washers are expected to see a "high rate of proliferation." (Mutrux, No. 19 at pp. 1–2) Mutrux cited EDNA data showing that smart appliances draw an average of 0.4 watts on standby mode, and that the worldwide energy consumption of standby power by smart appliances is predicted to be 7 terawatt-hours in 2025. (*Id*.) Mutrux recommended that DOE test the three standby configurations proposed by the Edison Electric Institute to amend energy conservation standards for appliances: standby non-connected (for traditional clothes washers that do not have "smart" features and cannot connect to any external network or device); standby connected (for "smart" clothes washers that connect to smart home networks or smart devices); and standby disconnected (for "smart" clothes washers that have the ability to disconnect from smart home networks and smart devices based on user command or as a default mode if it detects problems with the communication network). (*Id*.) Mutrux suggested test procedure provisions that would address the configuration for network-connected functionality. (*Id*.) Mutrux's proposal specified that clothes washers should be tested either (1) without any connectivity if the washing machine does not have "smart" features and cannot connect to any external network or device, or (2) both (a) with network-connected settings disabled (if connected settings can be disabled by the end-user and the product's user manual provides instructions on how to do so) or on their "default mode" if the clothes washer detects problems with the communication network and (b) with their network-connected functions enabled. (*Id*.)

As discussed, DOE is aware of a number of clothes washers on the market with varying implementations of connected functionality. On such products, DOE has

observed inconsistent implementations of these connected features across different brands, and that the design and operation of these features is continuously evolving as the nascent market continues to grow for these products.

DOE remains unaware of any data available, nor did interested parties provide any such data, regarding the consumer use of connected features. Therefore, DOE is unable to establish a representative test configuration for assessing the energy consumption of connected functionality for clothes washers during an average period of use.

Furthermore, as noted, while DOE's prior test procedure did not explicitly require the measurement of energy use associated with any connected features, the previous test procedure, in its required measurement of standby mode and off mode power, may have captured the energy used by features that provide connected functionality. Specifically, any energy use of such connected features may have been measured in section 3.9 of previous appendix J2 if manufacturers' instructions specify that the features be turned on, or if the connected functionality is enabled by default when the unit is powered on. If, however, a manufacturer does not provide such an instruction, and the product ships with connected features disabled, then such energy consumption would not have been measured under the prior test procedure because the test cycle requirements in section 3.2.7 of appendix J2 did not include instructions for activating any such features before performing the active mode test cycles.

Therefore, to ensure the repeatability and comparability of test results between models, especially those with connected functionality, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to specify in section 3.2.7 of appendix J2 and section 3.2.4 of the new appendix J that network settings (on clothes washers with network capabilities) must be disabled during testing if such settings can be disabled by the end-user, and the product's user manual provides instructions on how to do so.

DOE has determined that if network functionality cannot be disabled by the consumer, or if the manufacturer's user manual does not provide instruction for disabling the function, including the energy consumption of the enabled network function is more representative than excluding the energy consumption associated with the network function. For such products, the energy consumption of a connected function that cannot be disabled will continue to be measured, as in the previous test procedure.

Regarding AHAM's comment on use of the term "disabled," DOE does not agree that the term "disable" implies that the power consumption must be zero. The wording implemented in this final rule specifies that "…the network settings must be disabled throughout testing if such settings can be disabled by the end-user…" No implication regarding the resulting power consumption is intended by this instruction. DOE also notes that this wording maintains consistency with the clothes dryer test procedures as amended by the final rule published October 8, 2021 ("October 2021 clothes dryer Final Rule").[46] 86 FR 56608.

Regarding consideration of alternate methodologies for categorizing and testing low power modes (*e.g.*, through further reference to IEC 62301 or to procedures developed by Edison Electric Institute, as suggested by commenters), DOE developed its low-power mode definitions and test provisions in the March 2012 Final Rule consistent with the requirements of EPCA to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor, while considering the most current version of IEC 62301; (42 U.S.C. 6295(gg)(2)(A)) while also considering EPCA requirements that any test procedures shall be reasonably designed to produce test results which measure energy efficiency, energy use or estimated annual operating cost of a covered product or equipment during a

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[46] The October 2021 consumer clothes dryers test procedure final rule is available online at: *www.regulations.gov/document/EERE-2014-BT-TP-0034-0039*.

representative average use cycle or period of use and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3); 42 U.S.C. 6314(a)(2))

E. Metrics

1. Replacing Capacity with Weighted-Average Load Size

As discussed, the current energy efficiency standards for RCWs are based on the IMEF metric, measured in ft^3/kWh/cycle, as calculated in section 4.6 of appendix J2. IMEF is calculated as the capacity of the clothes container (in ft^3) divided by the total clothes washer energy consumption (in kWh) per cycle. The total clothes washer energy consumption per cycle is the sum of: (a) The machine electrical energy consumption; (b) the water heating 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.

The current energy efficiency standards for CCWs are based on the MEF_{J2} metric, measured in ft^3/kWh/cycle, as determined in section 4.5 of appendix J2. The MEF_{J2} metric differs from the IMEF metric by not including the combined low-power mode energy consumption in the total clothes washer energy consumption per cycle.

The current water efficiency standards for both RCWs and CCWs are based on the IWF metric, measured in gal/cycle/ft^3, as calculated in section 4.2.13 of appendix J2. IWF is calculated as the total weighted per-cycle water consumption (in gallons) for all wash cycles divided by the capacity of the clothes container (in ft^3).

In the September 2021 NOPR, DOE noted that energy use (the denominator of the IMEF and MEF_{J2} equations) scales with weighted-average load size, whereas capacity (the numerator of the IMEF and MEF_{J2} equations) scales with maximum load size. 86 FR 49140, 49172. This provides an inherent numerical advantage to large-capacity clothes washers that is disproportionate to the efficiency advantage that can be achieved through "economies of scale" associated with washing larger loads. *Id*. This advantage

means that a larger-capacity clothes washer consumes more energy to wash a pound of clothes than a smaller-capacity clothes washer with the same IMEF rating. *Id*. This relationship applies similarly to water efficiency through the IWF equation. *Id*. As noted in the comments summarized in the September 2021 NOPR, this disproportionate benefit increases as average clothes washer capacity increases over time. *Id*. To avoid providing bias for large-capacity clothes washers, DOE proposed to change the energy and water efficiency metrics in the new appendix J by replacing the capacity term with the weighted-average load size, in pounds. *Id*. Under this proposed change, energy and water use would scale proportionally with weighted-average load size in the IMEF, MEF_{J2}, and IWF formulas and thus eliminate the efficiency bias currently provided to large-capacity clothes washers. *Id*.

EPCA defines energy efficiency as "the ratio of the useful output of services from a consumer product to the energy use of such product." (42 U.S.C. 6291(5); 42 U.S.C. 6311(3)) In the current efficiency metrics, clothes washer capacity is used to represent the measure of useful output. In the September 2021 NOPR, DOE tentatively determined that clothing load size (*i.e.*, the weight of clothes cleaned), expressed as the weighted-average load size, may better represent the "useful output" of a clothes washer. 86 FR 49140, 49172.

DOE clarified that were DOE to finalize the proposed metric change, changes to the energy conservation standards would be addressed in an energy conservation standards rulemaking. *Id*.

In the September 2021 NOPR, DOE requested comment on its proposal to replace the capacity term with weighted-average load size in the energy efficiency metrics and the water efficiency metric in the new appendix J. *Id*.

Samsung commented that it supports DOE's proposal to base the efficiency metrics on load size instead of clothes washer capacity. (Samsung, No. 30 at p. 3)

Samsung added that this proposed change will be better understood by consumers and will result in only a numerical change since the clothes washer volume and weighted-average load size relationship is linear. (*Id*.)

The CA IOUs commented in support of DOE's proposal to define the efficiency metrics based on the weighted-average load size instead of clothes washer capacity, stating that it would help eliminate part of the inherent bias toward larger-capacity clothes washers. (CA IOUs, No. 29 at p. 2; CA IOUs, No. 18 at p. 16)

The Joint Commenters commented in support of DOE's proposal to replace the capacity term in the efficiency metrics with a weighted-average load size term in new appendix J. (Joint Commenters, No. 31 at p. 4) The Joint Commenters further commented that as the average basket volume has increased from 2.7 ft^3 when the test procedure was first developed to 4.4 ft^3 in 2019, aspects of the current test procedure and efficiency metrics created unintended advantages for larger capacity clothes washers. (*Id*.) The Joint Commenters specifically noted that larger capacity clothes washers could use more energy and water per pound of textile washed than smaller capacity clothes washers with the same IMEF ratings, without necessarily being more efficient than smaller clothes washers. (*Id*.) The Joint Commenters additionally commented in support of DOE's proposed new efficiency metrics due to the EER and WER metrics being similar to the appendix D2 efficiency metrics for clothes dryers, which also express efficiency in pounds of textile per kWh. (*Id*.)

The Joint Efficiency Advocates commented that DOE's proposal to base efficiency metrics on load size instead of capacity is an important step towards eliminating the current bias towards large-capacity washers and that it will alter the relative efficiency rankings of machines, will provide a more accurate representation of real-world efficiency across models, and will help consumers make more informed purchasing decisions. (Joint Efficiency Advocates, No. 28 at p. 1)

AHAM commented that DOE does not need to change the efficiency metrics. (AHAM, No. 27 at pp. 7–8) AHAM also commented that in order to provide fully formed comments to DOE on its proposal to introduce new efficiency metrics, AHAM needs to understand the impact of the proposed changes on products as well as on consumer understanding of the metrics. (*Id.*) Additionally, AHAM commented that since DOE will not be able to easily "crosswalk" current standards to account for the changes in measured efficiency use, DOE's proposals will require significant testing and data gathering, which AHAM is just beginning. (*Id.*) AHAM emphasized that the main reason AHAM opposes DOE's process of issuing the proposed test procedure and standards preliminary analysis concurrently is because it needs more time to understand the new metrics' impact on products, consumers and manufacturers. (*Id.*)

As discussed previously, the impacts to measured energy as a result of changing the metrics were accounted for in the crosswalk between the then-current appendix J2 and appendix J metrics developed for the September 2021 RCW Standards Preliminary Analysis. As stated in the preliminary analysis, DOE plans to continue testing additional units to appendix J and will continue to refine its approach for determining appropriate crosswalk translations in future stages of the standards rulemaking. DOE also welcomes any additional data submitted by interested parties as part of the ongoing standards rulemaking process.

Considering the discussion presented in the September 2021 NOPR and comments received from interested parties, DOE has determined that clothing load size (*i.e.*, the weight of clothes cleaned), expressed as the weighted-average load size, better represent the "useful output" of a clothes washer. As stated, the current metrics provide an inherent numerical advantage to large-capacity clothes washers that is disproportionate to the efficiency advantage that can be achieved through "economies of scale" associated with washing larger loads. Also as stated, under the new metrics adopted in new

appendix J, energy and water use scale proportionally with weighted-average load size in the EER, AEER, and WER formulas and thus eliminate the efficiency bias currently provided to large-capacity clothes washers.

For the reasons discussed, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to change the energy and water efficiency metrics in the new appendix J by replacing the capacity term with the weighted-average load size, in pounds.

In the September 2021 NOPR, DOE proposed to rename the efficiency metrics in the new appendix J to avoid any confusion between the proposed new metrics and the existing metrics. *Id*. DOE proposed to designate EER as the energy efficiency metric for RCWs (replacing IMEF); AEER as the energy efficiency metric for CCWs (replacing MEF_{J2}) and WER as the water efficiency metric for both RCWs and CCWs (replacing IWF). As proposed, EER would be calculated as the quotient of the weighted-average load size (in lb) divided by the total clothes washer energy consumption (in kWh) per cycle; and AEER would be calculated as the quotient of the weighted-average load size (in lb) divided by the total clothes washer energy consumption (in kWh) per cycle not including the combined low-power mode energy consumption. *Id*. Section III.E.2 of this document describes how WER would be calculated.

DOE also proposed to establish provisions in 10 CFR 430.23(j) to specify the procedure for determining EER and WER for RCWs, and in 10 CFR 431.154 to specify the procedure for determining AEER and WER for CCWs. *Id*.

DOE requested comment on its proposed names for the proposed new efficiency metrics in new appendix J: energy efficiency ratio (EER), active-mode energy efficiency ratio (AEER), and water efficiency ratio (WER).

The CA IOUs and the Joint Commenters supported DOE renaming the efficiency metrics to EER and WER. (CA IOUs, No. 29 at p. 2; Joint Commenters, No. 31 at p. 4) No other comments were received with regard to the name changes for the metrics.

For the reasons discussed above, DOE is finalizing its proposals, consistent with the September 2021 NOPR, to rename the efficiency metrics in new appendix J and to establish provisions in 10 CFR 430.23(j) to specify the procedure for determining EER and WER for RCWs, and in 10 CFR 431.154 to specify the procedure for determining AEER and WER for CCWs.

2. Inverting the Water Metric

As described previously, IWF is calculated in section 4.2.13 of appendix J2 as the total weighted per-cycle water consumption (in gallons) for all wash cycles divided by the capacity of the clothes container (in ft^3). Unlike the IMEF metric, in which a higher number indicates more efficient performance, a lower IWF value indicates more efficient performance.

In the September 2021 NOPR, DOE proposed to invert the water metric, in conjunction with replacing the capacity term with weighted-average load size, as described in the previous section. 86 FR 49140, 49173. By inverting the metric, a higher value would represent more efficient performance, consistent with the energy efficiency metrics. In addition, by inverting the metric, the proposed WER metric would represent the ratio of the useful output of services to the water use of the product, consistent with EPCA's definition of energy efficiency as described. *Id*.

DOE proposed to define WER in the new appendix J as the quotient of the weighted-average load size (in lb) divided by the total weighted per-cycle water consumption for all wash cycles (in gallons). *Id*.

DOE requested comment on its proposal to invert the water efficiency metric in new appendix J and calculate the newly defined WER metric as the quotient of the weighted-average load size divided by the total weighted per-cycle water consumption for all wash cycles. *Id*.

AHAM commented that upon initial review, inversion makes sense from a theoretical standpoint given the other proposed changes to the test procedure. (AHAM, No. 27 at p. 8)

The CA IOUs commented in support of DOE's proposal to invert the water metric so that it is aligns with the energy metric, for which higher values will equate to more efficient products. (CA IOUs, No. 29 at p. 1) The CA IOUs stated that they believe this will provide better clarity to consumer seeking efficient products. (*Id*.)

The Joint Commenters commented in support of DOE's proposal to invert the water efficiency metric so that a higher number signifies increased efficiency, stating that it is more intuitive to pair higher numbers with higher efficiency. (Joint Commenters, No. 31 at p. 11) The Joint Commenters also added that there is value in aligning the appendix J2 metrics so that higher is better for both metrics. (*Id*.)

For the reasons stated above, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to invert the water metric in the new appendix J and thereby define WER as the quotient of the weighted-average load size (in lb) divided by the total weighted per-cycle water consumption for all wash cycles (in gallons).

DOE considered whether to invert to the IWF metric in appendix J2 to align with the MEF_{J2} and IMEF metrics such that a higher value would indicate higher efficiency. While doing so would provide the same benefits described previously as justification for inverting the water metric in new appendix J, changing the metric would require manufacturers to recertify every model, would require DOE to amend its standards according to the new metric, and would not provide information to the consumer that is any more representative than the current metric. Accordingly, DOE has determined that the burdens imposed by inverting the water metric in appendix J2 would outweigh the benefits; *i.e.*, such a change would be unduly burdensome. This final rule makes no change to the IWF water metric in appendix J2.

3. Representation Requirements

Representation requirements for RCWs and CCWs are codified at 10 CFR 429.20(a) and 10 CFR 429.46(a), respectively.

In the September 2021 NOPR, DOE proposed to specify that the sampling requirements for RCWs specified at 10 CFR 429.20(a)(2)(ii) would also apply to the new proposed EER and WER metrics when using the new appendix J. 86 FR 49140, 49174. DOE also proposed to clarify that the capacity specified in 10 CFR 429.20(a)(3) is the clothes *container capacity* (emphasis added). *Id*.

DOE further proposed to specify that the sampling requirements specified for CCWs at 10 CFR 429.46(a)(2)(ii) would also apply to the new proposed AEER and WER metrics when using the new appendix J. *Id*.

DOE requested comment on its proposed representation and sampling requirements for RCWs and CCWs when tested according to new appendix J and the proposed clarification. *Id*.

DOE did not receive any comments regarding is proposal regarding representation and sampling requirements for RCWs and CCWs.

DOE is finalizing its proposal, consistent with the September 2021 NOPR, to specify that the sampling requirements for RCWs specified at 10 CFR 429.20(a)(2)(ii) also apply to the new EER and WER metrics when using the new appendix J; to clarify that the capacity specified in 10 CFR 429.20(a)(3) is the clothes container capacity; and to specify that the sampling requirements specified for CCWs at 10 CFR 429.46(a)(2)(ii) also apply to the new AEER and WER metrics when using the new appendix J.

F. Cleaning Performance

EPCA requires DOE to consider any lessening of the utility or the performance of the covered products (and certain commercial equipment, including CCWs) likely to result from the imposition of potential new or amended standards. (42 U.S.C.

6295(o)(2)(B)(i)(IV); 42 U.S.C. 6316(a)) EPCA prohibits DOE from prescribing an amended or new standard if the Secretary finds that interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States in any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States at the time of the Secretary's finding. (42 U.S.C. 6295(o)(4))[47]

EPCA authorizes DOE to design test procedures that measure energy efficiency, energy use, water use (in the case of showerheads, faucets, water closets and urinals), or estimated annual operating cost of a covered product during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(3)) DOE regulates only the energy and water efficiency of clothes washers, and DOE's clothes washer test procedures do not prescribe a method for testing clothes washer cleaning performance.

In the September 2021 NOPR, DOE noted that, as indicated by stakeholder comments, multiple test procedures from industry and international organizations are available for measuring clothes washer cleaning performance (among other attributes). 86 FR 49140, 49175. DOE stated that it may conduct research and testing that uses these or other established test methods as part of an energy conservation standards rulemaking to evaluate any lessening of the utility or the performance of the covered products likely to result from the imposition of potential new or amended standards, as required by EPCA. *Id*. For example, in the most recent energy conservation standards final rule for CCWs, published on December 15, 2014 ("December 2014 Final Rule"), DOE conducted performance testing using AHAM's HLW–1–2010 test procedure to quantitatively

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[47] The unavailability provision is applicable to CCWs under 42 U.S.C. 6316(a).

evaluate potential impacts on cleaning performance, rinsing performance, and solid particle removal as a result of higher standard levels. 79 FR 74492, 74506.

In the September 2021 NOPR, DOE did not propose to add a cleaning performance test procedure to new appendix J or to appendix J2. 86 FR 49140, 49175.

Samsung suggested that DOE's test procedure should ensure a product performs its basic function. (Samsung, No. 30 at p. 2) Samsung commented that DOE has already established such a test procedure for ENERGY STAR called the "Test Method for Determining Residential Clothes Washer Cleaning Performance"[48] ("the ENERGY STAR cleaning performance test"). (*Id.*) Samsung added that the ENERGY STAR test method uses similar conditions to appendix J2 and could serve as a uniform test procedure for DOE, manufacturers, and other stakeholders to ensure that products perform their basic functionality while reaching new minimum efficiency thresholds. (*Id.*) Samsung suggested that DOE add the ENERGY STAR test method as an informative appendix to the clothes washer test procedure. (*Id.*)

Whirlpool commented in support of DOE's preliminary determination not to propose a cleaning performance test procedure to the proposed appendix J or updated appendix J2 test procedures. (Whirlpool, No. 26 at p. 11) Whirlpool recommended that DOE consider the performance impacts of any new or amended standards and test procedures, but specified that a cleaning performance test method does not need to be developed. (*Id.*)

AHAM commented that it agrees with DOE's proposal not to add a cleaning performance test procedure to appendix J2 and new appendix J, asserting that it is not within DOE's authority under EPCA to include a performance metric or test. (AHAM,

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[48] The ENERGY STAR "Test Method for Determining Residential Clothes Washer Cleaning Performance" is available online at: *www.energystar.gov/sites/default/files/asset/document/Test%20Method%20for%20Determining%20Residential%20Clothes%20Washer%20Cleaning%20Performance%20-%20July%202018_0.pdf*.

No. 27 at p. 15) AHAM commented, however, that cleaning performance is a critical consideration in the development of energy conservation standards because, under EPCA, DOE must consider the impact of potential new or amended efficiency standards on performance and consumer utility. (*Id.*) AHAM therefore commented that it supports a robust analysis of the potential impact of proposed new or amended standards on product performance and utility. (*Id.*) AHAM specifically recommended test procedures, such as AHAM HLW-2-2020: "Performance Evaluation Procedures for Household Clothes Washers"[49] to evaluate cleaning performance, and recommended that DOE consider testing that would evaluate other performance concerns, consumer feedback, and other input. (*Id.*)

As discussed, EPCA requires DOE to establish test procedures that are reasonably designed to produce test results that measure energy efficiency, energy use, water use (for certain products), or estimated annual operating cost of a covered product during a representative average use cycle or period of use, as determined by the Secretary, and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) DOE's test procedure for clothes washers identifies the "normal cycle" as the cycle representative of consumer use, defines the term "normal cycle," requires testing using the "normal cycle," and compliance with the applicable standards is determined based on the measured energy and water use of the "normal cycle." 10 CFR 430.23(j) and 10 CFR 430 subpart B appendix J2. The "normal cycle" is defined as the cycle recommended by the manufacturer (considering manufacturer instructions, control panel labeling, and other markings on the clothes washer) for normal, regular, or typical use for washing up to a

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[49] AHAM HLW-2-2020: "Performance Evaluation Procedures for Household Clothes Washers" is available for purchase online at: *www.aham.org/ItemDetail?iProductCode=20002&Category=MADSTD*.

full load of normally soiled cotton clothing.[50] Section 1.25 of appendix J2. As such, the existing test procedure does not define what constitutes "washing" up to a full load of normally soiled cotton clothing (*i.e.*, the cleaning performance).

For clothes washers, the cleaning performance at the completion of a cycle influences how a consumer uses the product. If the cleanliness of the clothing after completion of a wash cycle does not meet consumer expectations, consumers may alter their use of the clothes washer. For example, consumers may alter the use of the product by choosing cycle modifiers to enhance the performance of the selected cycle; selecting an alternate cycle that consumes more energy and water to provide a higher level of cleaning; operating the selected cycle multiple times; or pre-treating (*e.g.*, pre-soaking in water) clothing items before loading into the clothes washer to achieve an acceptable level of cleaning. As summarized in the September 2021 NOPR, DOE received comment from Samsung in response to the May 2020 RFI expressing concern that unless clothes washers perform at a minimum level of acceptable functionality on the Normal cycle, consumers may use other energy- or water-intensive modes and unknowingly sacrifice energy efficiency. (Samsung, No. 6 at p. 2) 86 FR 49140, 49174.

In general, a consumer-acceptable level of cleaning performance (*i.e.*, a representative average use cycle) can be easier to achieve through the use of higher amounts of energy and water use during the clothes washer cycle.[51] Conversely, maintaining acceptable cleaning performance can be more difficult as energy and water levels are reduced. Improving one aspect of clothes performance, such as reducing energy and/or water use as a result of energy conservation standards, may require a trade-

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[50] The definition of "normal cycle" also specifies that for machines where multiple cycle settings are recommended by the manufacturer for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing, then the normal cycle is the cycle selection that results in the lowest IMEF or MEF_{J2} value.

[51] Higher energy use may provide increased thermal and mechanical action for removing soils. Similarly, higher water use may provide better rinsing performance by reducing the amount of soil re-deposition on the clothing.

off with one or more other aspects of performance, such as cleaning performance. DOE expects, however, that consumers maintain the same expectations of cleaning performance regardless of the efficiency of the clothes washer. As the clothes washer market continuously evolves to higher levels of efficiency—either as a result of mandatory minimum standards or in response to voluntary programs such as ENERGY STAR—it becomes increasingly more important that DOE ensures that its test procedure continues to reflect representative use. As such, the normal cycle that is used to test the clothes washer for energy and water performance must be one that provides a consumer-acceptable level of cleaning performance, even as efficiency increases.

DOE considered, in order to ensure that DOE's clothes washer test procedure accurately and fully tests clothes washers during a representative average use cycle, whether to propose amendments to the test procedure to define what constitutes "washing up to a full load of normally soiled cotton clothing" (*i.e.*, the cleaning performance) to better represent consumer use of the product. DOE notes that it proposed amendments in this regard to its dishwasher test procedure in a NOPR published December 21, 2021 ("December 2021 dishwasher NOPR"). 86 FR 72738. Specifically, in the December 2021 dishwasher NOPR, DOE proposed to include a methodology for calculating a per-cycle cleaning index metric—using a methodology defined in the relevant industry standard—and to establish a minimum cleaning index threshold as a condition for a test cycle to be valid. *Id*.

The ENERGY STAR cleaning performance test has been developed by DOE in partnership with U.S. Environmental Protection Agency ("EPA") to determine cleaning performance for clothes washers that meet the ENERGY STAR Most Efficient criteria. Cleaning performance is determined on the same test units immediately following the energy and water consumption tests for ENERGY STAR qualification.

The ENERGY STAR cleaning performance test is based largely on the procedures specified in AHAM HLW-1-2013, but using DOE test cloth rather than the 100 percent cotton materials specified in AHAM HLW-1-2013. The test uses standardized soil/stain removal test strips specified in AHAM HLW-1-2013, which are attached to individual pieces of test cloth within the load. Testing is performed using the specific detergent formulation specified in AHAM HLW-1-2013. The test is performed three times on the hottest Warm/Cold temperature selection with the maximum load size. After each test, the test strips are separated from the cloth, allowed to dry, and the post-wash reflectance of each strip is measured to determine how much of each stain was removed. A total cleaning score is calculated based on the post-wash reflectance values. In order to qualify for ENERGY STAR Most Efficient, clothes washers must achieve a minimum total cleaning score of 85.0.

Since the ENERGY STAR cleaning performance test requires a separate set of tests conducted after the DOE energy and water consumption tests, it introduces additional test burden beyond the testing required to determine compliance with minimum standards. The use of soil/stain strips and detergent, and the instrumentation required to measure post-wash reflectance, also introduce additional material and equipment requirements beyond the requirements of the DOE test procedure.

As discussed, the AHAM HLW-2-2020 test procedure specifies use of a 100-percent cotton load for testing, which is inconsistent with the test load prescribed by the DOE test procedure. Requiring different load materials would increase test burden, and given the prevalence of adaptive water fill clothes washers (particularly among ENERGY STAR-qualified clothes washers), the energy and water use associated with the AHAM cleaning performance measurement would not be consistent with the energy and water use associated with the DOE test procedure. Test load composition is further discussed in section III.I.1 of this document.

As stated previously, EPCA requires DOE to establish test procedures that are reasonably designed to produce test results that measure energy efficiency, energy use, water use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use, and not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) DOE is unable to make a determination at this time as to whether the ENERGY STAR test procedure for determining cleaning performance or the AHAM HLW-2-2020 test procedure would produce results for DOE's purposes that are representative of an average use cycle, as required by EPCA. Furthermore, both test procedures would introduce additional test burden, and DOE is unable to assess whether the additional burden would be outweighed by the benefits of incorporating either test.

For these reasons, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to not include a measure of cleaning performance in the new appendix J or appendix J2 at this time.

G. Consumer Usage Assumptions

Discussion and consideration of consumer usage assumptions are provided in the following paragraphs.

1. Annual Number of Wash Cycles

Section 4.4 of appendix J2 provides the representative average number of annual clothes washer cycles to translate the annualized inactive and off mode energy consumption measurements into a per-cycle value applied to each active mode wash cycle. Separately, the number of annual wash cycles is also referenced in DOE's test procedure provisions at 10 CFR 430.23(j)(1)(i)(A) and (B), (j)(1)(ii)(A) and (B), and (j)(3)(i) and (ii) to calculate annual operating cost and annual water consumption of a clothes washer. This value was most recently updated in the March 2012 Final Rule, to 295 wash cycles per year based on an analysis of the 2005 RECS data. 77 FR 13888, 13909.

Based on the data from the 2015 RECS survey (the most recent data available), DOE proposed in the September 2021 NOPR to update the number of annual wash cycles to 234 in the new appendix J. 86 FR 49140, 49154. In proposing this update, DOE considered comments received from AHAM and NEEA in response to the May 2020 RFI. *Id*. The proposed updated value would impact the per-cycle low-power mode energy consumption value included in the calculation of IMEF and EER. *Id*. The per-cycle low-power mode energy consumption would be divided by a smaller number (*i.e.*, 234 instead of 295), and would therefore increase by around 25 percent. *Id*. See further discussion of the proposed changes to the calculation of low-power mode energy in section III.G.3 of this document.

In addition to other changes discussed in section III.H.6 of this document, DOE proposed to update 10 CFR 430.23(j)(1)(i) and (j)(3)(i) such that the annual operating cost and annual water consumption calculation would reflect the new proposed number of annual wash cycles when a clothes washer is tested using the new appendix J, if finalized. *Id*.

DOE requested comment on its proposal to update the number of annual wash cycles to 234 in the new appendix J and 10 CFR 430.23(j)(1)(i) and (j)(3)(i).

DOE did not receive any further comments in response to the September 2021 NOPR regarding its proposal to update the number of annual wash cycles.

For the reasons discussed, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to update the number of annual wash cycles to 234 in the low-power mode formula in section 4.6.2 of the new appendix J, in 10 CFR 430.23(j)(1)(i), and in 10 CFR 430.23(j)(3)(i).

2. Drying Energy Assumptions

Section 4.3 of appendix J2 provides an equation for calculating total per-cycle energy consumption for removal of moisture from the clothes washer test load in a

clothes dryer, *i.e.*, the "drying energy." DOE first introduced the drying energy equation in appendix J1 as part of the August 1997 Final Rule. The drying energy calculation is based on the following three assumed values: (1) A clothes dryer final moisture content of 4 percent; (2) the nominal energy required for a clothes dryer to remove moisture from a pound of clothes ("DEF") of 0.5 kWh/lb; and (3) a clothes dryer usage factor ("DUF") of 0.91, representing the percentage of clothes washer loads dried in a clothes dryer.

DOE did not propose to make any changes to the values of DEF or DUF and received no comments in response to the September 2021 NOPR on its preliminary determination to maintain those values. DOE is maintaining these values in this final rule.

Regarding the dryer final moisture content, DOE's test procedure for clothes dryers, codified at 10 CFR part 430, subpart B, appendix D1 ("appendix D1"), prescribes a final moisture content between 2.5 and 5.0 percent, which is consistent with the 4-percent final moisture content value in the clothes washer test procedure for determining the drying energy.

However, DOE's alternate clothes dryer test procedure at appendix D2, prescribes a final moisture content between 1 and 2.5 percent for timer dryers, which are clothes dryers that can be preset to carry out at least one operation that is terminated by a timer, but may also be manually controlled without including any automatic termination function. For automatic termination control dryers, which can be preset to carry out at least one sequence of operations to be terminated by means of a system assessing, directly or indirectly, the moisture content of the load, the test cycle is deemed invalid if the clothes dryer terminates the cycle at a final moisture content greater than 2 percent. Section 3.3.2 of appendix D2. In the October 2021 clothes dryer Final Rile, DOE stated that the current 2-percent final moisture content requirement using the DOE test cloth was adopted as representative of approximately 5-percent final moisture content for

"real-world" clothing, based on data submitted in a joint petition for rulemaking.[52] DOE determined that the specified 2-percent final moisture content using the DOE test load was representative of consumer expectations for dryness of clothing in field use. 86 FR 56608, 56626.

In both appendix D1 and appendix D2, timer dryers are allowed a range of final moisture contents during the test because DOE concluded that it would be unduly burdensome to require the tester to dry the test load to an exact final moisture content; however, the measured test cycle energy consumption for timer dryers is normalized to calculate the energy consumption required to dry the test load to a final moisture content of 4 percent in appendix D1 and 2-percent in appendix D2.

Manufacturers may elect to use appendix D2 to demonstrate compliance with the January 1, 2015, energy conservation standards; however, the procedures in appendix D2 need not be performed to determine compliance with energy conservation standards for clothes dryers at this time. See introductory paragraph to appendix D1. Use of appendix D2 is, however, required for ENERGY STAR certification.[53] Although clothes dryer manufacturers may optionally use appendix D2 to demonstrate compliance with the current energy conservation standards, appendix D1 provides the basis for the current clothes dryer energy conservation standard levels and is the test procedure used as the basis for certification for the majority of models on the market.

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[52] The petition was submitted by AHAM, Whirlpool Corporation, General Electric Company, Electrolux, LG Electronics, Inc., BSH, Alliance Laundry Systems, Viking Range, Sub-Zero Wolf, Friedrich A/C, U-Line, Samsung, Sharp Electronics, Miele, Heat Controller, AGA Marvel, Brown Stove, Haier, Fagor America, Airwell Group, Arcelik, Fisher & Paykel, Scotsman Ice, Indesit, Kuppersbusch, Kelon, DeLonghi, American Council for an Energy Efficient Economy, Appliance Standards Awareness Project, Natural Resources Defense Council, Alliance to Save Energy, Alliance for Water Efficiency, Northwest Power and Conservation Council, and Northeast Energy Efficiency Partnerships, Consumer Federation of America and the National Consumer Law Center. See Docket No. EERE-2011-BT-TP-0054, No. 3.

[53] The ENERGY STAR Specification of Clothes Dryer Requirements Version 1.1 requires the use of appendix D2 for clothes dryers to obtain ENERGY STAR certification.

In the September 2021 NOPR, DOE did not propose to change the assumed final moisture content of 4 percent in the drying energy calculation. 86 FR 49140, 49176.

The Joint Efficiency Advocates recommended that DOE amend the final RMC value in the drying energy calculation to align with the clothes dryer test procedure in appendix D2, asserting that this would improve the representativeness of the test procedure. (Joint Efficiency Advocates, No. 28 at pp. 5–6)

The CA IOUs commented that they recommend reducing the current final remaining moisture content from 4 percent to 2 percent to align with the clothes dryer final remaining moisture content specified in the appendix D2 test procedure. (CA IOUs, No. 29 at pp. 8–9; CA IOUs, No. 18 at pp. 28–29) The CA IOUs also commented that, as stated in the October 2021 clothes dryer Final Rule, a final remaining moisture content of 2 percent is representative of the "consumer-acceptable" dryness level for real-life clothing loads with varying weights, composition, and load size. (*Id*.)

On April 19, 2021, DOE published an energy conservation standards preliminary analysis for consumer clothes dryers ("April 2021 clothes dryer standards preliminary analysis") and an accompanying TSD.[54] 86 FR 20327. In the April 2021 clothes dryer preliminary analysis, DOE relied on test data using appendix D2 to establish efficiency levels, indicating use of appendix D2 to define future amended standards for clothes dryers. *Id*. at 20333; *see also* chapter 5 of the accompanying TSD. Updating the final moisture content assumption in the drying energy formula in appendix J to 2 percent would ensure consistency between the clothes washer and clothes dryer test procedures to be used as the basis for future standards for clothes washers and clothes dryers, respectively.

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[54] The TSD for the April 2021 clothes dryer standards preliminary analysis is available at *www.regulations.gov/document/EERE-2014-BT-STD-0058-0016*.

For these reasons, in this final rule DOE is defining the final moisture content in section 4.4 of the new appendix J as 2 percent.

3. Low-Power Mode Assumptions

Section 4.4 of appendix J2 allocates 8,465 combined annual hours for inactive and off modes. The allocation of 8,465 hours to combined inactive and off modes is based on assumptions of 1 hour per cycle and 295 cycles per year, resulting in 295 active mode hours (for a total of 8,760 hours per year for all operating modes). As described in the September 2010 NOPR and confirmed in the March 2012 Final Rule, the estimate of 1 hour per cycle was based on a 2005 report from the EPA[55] that summarized test data from three issues of the Consumer Reports magazine, which showed top-loading clothes washers with "normal" cycle times of 37–55 minutes and frontloading clothes washers with "normal" cycle times of 51–105 minutes.[56]

For the new appendix J, DOE proposed in the September 2021 NOPR to update the number of hours spent in low-power mode from a fixed 8,465 total hours to a formula based on the clothes washer's measured cycle time, as discussed in section III.D.5 of this document, and the updated number of annual cycles, as discussed in section III.G.1 of this document. 86 FR 49140, 49177. This proposal would provide for a more representative allocation of hours between active mode and low-power mode. *Id*. DOE did not propose to make these changes to appendix J2 because doing so would likely change the measured efficiency, and DOE proposed to make such changes only in the new appendix J, which would be used for the evaluation and issuance of updated efficiency standards, and for determining compliance with those standards. *Id*.

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[55] C. Wilkes *et al.* 2005. "Quantification of Exposure-Related Water Uses for Various U.S. Subpopulations." U.S. Environmental Protection Agency, Office of Research and Development. Report No. EPA/600/R–06/003. Washington, DC. December 2005. Available at *www.wilkestech.com/205edrb06_Final_Water_Use_Report.pdf.*

[56] These studies appeared in the July 1998, July 1999, and August 2000 issues of Consumer Reports, as cited by EPA.

DOE requested comment on its proposal to update the number of hours spent in low-power mode in the new appendix J from a fixed 8,465 total hours to a formula based on measured cycle time and an assumed number of annual cycles. *Id*.

AHAM commented that there is little or no benefit to consumers or energy savings associated with including the cycle time measurement in the test procedure since standby energy use is such a small component of overall measured efficiency. (AHAM, No. 27 at p. 12) AHAM also noted that the European Union does not calculate standby power for its energy label. (*Id*.)

DOE acknowledges that for most clothes washer models, the low-power mode energy consumption is the smallest of the four energy components that comprise the EER equation.[57] However, at higher efficiency levels, the low-power mode energy consumption represents a larger portion of the total energy consumption than at lower efficiency levels. Depending on the low-power mode energy use and its relation to the other three energy components, a difference in average cycle time of, for example, 30 minutes, 60 minutes, or 90 minutes can have a measurable impact on the calculated value of EER, which this final rule requires to be rounded to the nearest 0.01 pound per kilowatt-hour per cycle (as discussed in section III.E.3 of this document). Further, as discussed in section III.D.5.a of this document, DOE has determined that requiring test laboratories to measure cycle time will not increase test burden. As discussed previously in this section, basing the number of hours spent in low-power mode in part on cycle time would provide a more representative allocation of hours between active mode and low-power mode.

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[57] See, for example, Tables 7.2.1 through 7.2.4 in chapter 7 of the RCW preliminary analysis TSD, which present the breakdown in energy consumption among the four energy components at each analyzed efficiency level. Available at *www.regulations.gov/document/EERE-2017-BT-STD-0014-0030.*

For these reasons, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to update the number of hours spent in low-power mode in the new appendix J from a fixed 8,465 total hours to a formula based on measured cycle time and an assumed number of annual cycles.

4. Temperature Usage Factors

TUFs are weighting factors that represent the percentage of wash cycles for which consumers choose a particular wash/rinse temperature selection. The TUFs in Table 4.1.1 of appendix J2 are based on the TUFs established in appendix J1 as part of the August 1997 Final Rule. As described in the April 1996 SNOPR, DOE established the TUFs in appendix J1 based on an analysis of consumer usage data provided by P&G, AHAM, General Electric Company, and Whirlpool, as well as linear regression analyses performed by P&G and the National Institute of Standards and Technology ("NIST"). 61 FR 17589, 17593.

As noted in the September 2021 NOPR, DOE is not aware of any nationally representative consumer usage data that demonstrate a change in temperature setting usage; therefore, DOE did not propose any changes to the TUF values. 86 FR 49140, 49178.

DOE requested comment on maintaining the current TUF values. *Id*.

The Joint Commenters commented in support of DOE's proposal to maintain the current TUF values, stating that the current TUF values are similar to the TUF values found in the 2014 NEEA Field Study. (Joint Commenters, No. 31 at p. 11)

The CA IOUs commented that new appendix J does not adequately account for the impact of control panel designs and optional cycle modifiers that may result in more energy-intensive wash settings. (CA IOUs, No. 29 at p. 6) The CA IOUs asserted that in cases where a clothes washer's cycle settings are continually reset when turned to the on position (*e.g.*, if a product always reverts to the default temperatures of Warm/Cold), it is

likely that the existing TUFs are less representative since users are more likely to use the default settings. (*Id.*) The CA IOUs expressed concern that the prevalence of clothes washers with default settings today may be considerably different from the initial studies used to develop the TUFs in the August 1997 Final Rule, which was created when clothes washers more commonly used electromechanical controls for water temperature settings instead of using electronic controls that revert to defaults. (*Id.*) The CA IOUs additionally commented that, despite the increasing proliferation of additional cycle modifiers, DOE proposed not to require testing of any settings that are left "off" under the default as-shipped settings in new appendix J. (*Id.*)

DOE notes that the CA IOUs did not provide any data to support the assertion that consumers are more likely to use the default wash/rinse temperature setting in cases where a clothes washer's cycle settings are continually reset when turned to the on position. DOE's general understanding of consumer laundry habits, based on decades of conversations with manufacturers and evaluating consumer usage studies, is that cycle time (*e.g.*, Normal, Heavy Duty, *etc.*) and wash/rinse temperature are the two foundational decisions that consumers make for each wash cycle based on the composition of the load being washed. DOE notes, for example, that clothing items often include labels indicating the appropriate wash temperature to use. DOE further notes that as summarized by the Joint Commenters, the TUF values found in the 2014 NEEA Field Study are similar to the TUF values in appendix J2. (Joint Commenters, No. 31 at p. 11)

For these reasons, in this final rule DOE does not make any changes to the TUF values, consistent with the September 2021 NOPR.

5. Load Usage Factors

As described previously, LUFs are weighting factors that represent the percentage of wash cycles that consumers run with a given load size. Table 4.1.3 of appendix J2

provides two sets of LUFs based on whether the clothes washer has a manual WFCS or automatic WFCS.

For a clothes washer with a manual WFCS, the two LUFs represent the percentage of wash cycles for which consumers choose the maximum water fill level and minimum water fill level in conjunction with the maximum and minimum load sizes, respectively. For a clothes washer with an automatic WFCS, the three LUFs represent the percentage of cycles for which the consumer washes a minimum-size, average-size, and maximum-size load (for which the clothes washer determines the water fill level). As discussed in section III.D.1.b of this document, the values of these LUFs are intended to approximate a normal distribution that is slightly skewed towards the minimum load size.

As previously discussed in section III.D.1.b of this document, DOE proposed in the September 2021 NOPR to replace the minimum, maximum, and average load sizes with the small and large load sizes in the new appendix J. DOE has defined the small and large load sizes such that the small and large load sizes each have an equal (50–50) weighting. As such, DOE proposed to update the LUFs in the new appendix J to 0.5 for both the small and the large load size. 86 FR 49140, 49178. Because this proposal simplified the LUF definitions by using the same LUFs regardless of clothes washer WFCS, a separate LUF table would no longer be needed. *Id*. DOE therefore proposed to remove the LUF Table 4.1.3 and to define the LUFs as 0.5 in the equations where the LUFs are first used in section 4.1.3 of the new appendix J. *Id*.

DOE requested comment on its proposal to update the LUFs for the small and large load sizes to be equal to 0.5, consistent with the proposed load size definitions in the new appendix J. *Id*.

DOE received no comments on the updated LUFs for the new appendix J.

For the reasons stated above, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to update the LUFs for the small and large load sizes to be equal to 0.5 in the new appendix J and to remove the LUF table and instead define the LUFs as 0.5 in the equations where the LUFs are first used.

6. Water Heater Assumptions

Section 4.1.2 of appendix J2 provides equations for calculating total per-cycle water heating energy consumption for all water fill levels tested. The water heating energy consumption is calculated by multiplying the measured volume of hot water by a constant fixed temperature rise of 75 °F and by the specific heat of water, defined as 0.00240 kilowatt-hours per gallon per degree Fahrenheit ("kWh/gal-°F"). No efficiency or loss factor is included in this calculation, which implies an electric water heater efficiency of 100 percent. Similarly, section 4.1.4 of appendix J2 provides an equation for calculating total per-cycle water heating energy consumption using gas-heated or oil-heated water, for product labeling requirements.[58] This equation includes a multiplication factor "e," representing the nominal gas or oil water heater efficiency, defined as 0.75. These water-heating energy equations estimate the energy required by the household water heater to heat the hot water used by the clothes washer. Per-cycle water heating energy consumption is one of the four energy components in the IMEF metric.

As stated in the September 2021 NOPR, DOE is unaware of any nationally representative data regarding heat losses in residential water distribution systems. 86 FR 49140, 49179. In the absence of such data, DOE did not propose any changes to the assumed water heater efficiency factors in the clothes washer test procedure. *Id*.

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[58] The Federal Trade Commission's EnergyGuide label for RCWs includes the estimated annual operating cost using natural gas water heating.

DOE requested comment on maintaining the current water heater efficiency assumptions. *Id*.

The Joint Efficiency Advocates recommended that DOE use what they described as more realistic assumptions about water heater efficiencies. (Joint Efficiency Advocates, No. 28 at p. 3) The Joint Efficiency Advocates commented that while the current test procedure uses a 100 percent efficiency for electric heaters and a 75 percent efficiency for gas water heaters, the Joint Efficiency Advocates estimated that, based on shipment data from the last water heaters rulemaking and current models in the CCMS database,[59] the shipment-weighted efficiencies for new water heaters are about 92 percent for electric water heaters and 64 percent for gas water heaters. (*Id*.) The Joint Efficiency Advocates asserted that making this change would improve representativeness and would more accurately reflect the relative contribution of water heating energy use to total clothes washer energy use. (*Id*.)

Based on the values presented, DOE interprets the Joint Efficiency Advocates' comments as referring to a value of uniform energy factor ("UEF"). DOE notes that the UEF is a measure of efficiency based in part on a 24-hour simulated use test that measures both energy use associated with recovery periods (*i.e*., the energy embedded within each water draw) and energy losses during the time in which water is not being withdrawn from the water heater (*i.e.*, standby energy losses), and incorporates simulated household water draw patterns. In a residential household, numerous appliances draw hot water from the water heater, including showers, faucets, and dishwashers, in addition to clothes washers. Given the number of factors not directly related to clothes washer usage that factor into the current UEF metric, DOE has determined that it would not be

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[59] The Joint Efficiency Advocates noted that their analysis excluded tankless and heat pump water heaters.

appropriate to use UEF as the basis for determining an estimate of water heating energy in the clothes washer test procedure.

Instead, the appropriate efficiency value to use in the clothes washer test procedure would be the recovery efficiency, which represents the ratio of energy delivered to the water to the energy content of the fuel consumed by the water heater. DOE is not aware of any data regarding the efficiency distribution of installed water heaters on the basis of recovery efficiency. Recover efficiency is, however, a reported value in DOE's CCMS database. DOE assessed the representativeness of the currently defined efficiency values qualitatively as follows. For electric water heaters, the majority of the market has a recovery efficiency of 98 percent. Heat pump models have recovery efficiencies greater than 100 percent; however, these products represent a small market share and an even smaller share of the installed stock of water heaters. For gas water heaters, CCMS lists a range of recovery efficiencies from 72 to 92 percent, with the vast majority within the range of 72 to 80 percent. Given these ranges, DOE determines that the current clothes washer test procedure assumptions of 100 percent efficiency for electric water heaters and 75 percent efficiency for gas water heaters are representative of the current water heater market. This final rule maintains the currently specified values.

For these reasons, in this final rule DOE does not make any changes to the water heater efficiency assumptions, consistent with the September 2021 NOPR.

7. Commercial Clothes Washer Usage

As mentioned in section I of this document, CCWs are included in the list of "covered equipment" for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6311(1)(H)) EPCA requires the test procedures for CCWs to be the same as those established for RCWs. (42 U.S.C. 6314(a)(8))

In response to the May 2020 RFI, several stakeholders requested that DOE develop separate usage factors for CCWs, and that DOE require standby/low power mode testing for CCWs and that low-power mode energy consumption should be incorporated into the energy efficiency metric for CCWs. (CA IOUs, No. 8 at pp. 8–14; NEEA, No. 12 at p. 18; Joint Commenters, No. 10 at p. 2)

As part of its market assessment and engineering analysis for the December 2014 Final Rule, DOE performed an in-depth evaluation of the standby and off mode power characteristics of a representative sample of CCWs spanning a wide range of display types, payment systems, and communication features. 79 FR 74492, 74501. DOE observed that manufacturers offer a variety of display and payment functionalities that can be selected independently from the basic model. The standby power associated with these different display and payment functionalities varies from 0.88 to 11.77 watts.

In the December 2014 Final Rule, DOE determined not to include low-power mode energy in the CCW energy efficiency metric. *Id*. DOE determined that promulgating an amended standard that included low-power mode energy could enable backsliding and that the IMEF metric would not provide a useful means for differentiating the active mode characteristics of different CCW models. *Id*. Because of the wide variations in standby power, CCWs with significantly different active mode ratings could have similar IMEF ratings depending on their control panel functionalities, and vice versa. This would diminish the usefulness of the IMEF metric as a means for differentiating the active mode characteristics of different CCW models. *Id*.

Moreover, as noted, EPCA requires the test procedures for CCWs to be the same as those established for RCWs. (42 U.S.C. 6314(a)(8)) Creating load, temperature, or dryer usage factors specific to CCWs within the RCW test procedure would effectively create a separate test procedure for CCWs because the LUF, TUF, DUF, and DEF values

are integral to the calculations of per-cycle energy and water use, on which the regulated metrics for RCWs and CCWs are based.

DOE did not propose any changes to CCW usage factors or to the CCW energy efficiency metric in the September 2021 NOPR. 86 FR 49140, 49180.

The Joint Efficiency Advocates, the CA IOUs, and the Joint Commenters recommended that DOE consider capturing low-power energy consumption in the energy efficiency metric for CCWs. (Joint Efficiency Advocates, No. 28 at p. 6; CA IOUs, No. 29 at pp. 7–8; Joint Commenters, No. 31 at p. 6) The Joint Efficiency Advocates commented that they understand that no further change to the test procedure would be necessary to include low-power energy use in the efficiency standards for CCWs. (Joint Efficiency Advocates, No. 28 at p. 6) The Joint Commenters commented that they understand that DOE will determine whether low power mode should be measured on CCWs in the CCW energy conservation standards rulemaking. (Joint Commenters, No. 31 at p. 6) The Joint Commenters added that, according to EPCA, test procedures for CCWs must be the same as those established for RCWs and therefore encouraged DOE to also make the low power mode energy use approach identical for CCWs and RCWs. (*Id.*)

The Joint Efficiency Advocates and the CA IOUs commented that they understand DOE's stated concerns in the December 2014 Final Rule regarding the potential for backsliding that could result from incorporating standby mode power consumption into the overall efficiency metric for CCWs. (Joint Efficiency Advocates, No. 28 at p. 6; CA IOUs, No. 29 at p. 8) The Joint Efficiency Advocates commented that strengthening the existing standards for CCWs would likely alleviate the backsliding concern. (Joint Efficiency Advocates, No. 28 at p. 6) The CA IOUs commented that the incorporation of a minimum standard level for discrete system functions, such as previously established for consumer refrigerated products with automatic icemakers or

for varying payment mechanisms in refrigerated vending machines, would limit the risk of backsliding. (CA IOUs, No. 29 at p. 8) The CA IOUs commented that they would strongly prefer to have these functions measured as part of a standby power test, rather than with default adders, to encourage cost-effective designs to reduce energy consumption. (*Id.*)

DOE reiterates that any decision regarding the inclusion or exclusion of low-power mode energy consumption in the CCW energy metric—including reconsideration whether promulgating an amended standard that includes low-power mode energy could enable backsliding, and whether an integrated metric would provide a useful means for differentiating the active mode characteristics of different CCW models—would be made as part of an energy conservation standards rulemaking for CCWs. 86 FR 49140, 49180. This final rule does not implement any changes specific to CCWs in either appendix J2 or the new appendix J in this regard.

H. Clarifications

1. Water Inlet Hose Length

As noted in the September 2021 NOPR, DOE has observed an increasing trend of water inlet hoses not being included with the purchase of a new clothes washer. 86 FR 49140, 49180. DOE has received questions from test laboratories asking how to install a clothes washer that does not include water inlet hoses among the installation hardware. *Id*.

Multiple styles of water inlet hoses (different materials, lengths, durability, etc.) are commercially available from appliance and hardware retailers. *Id*. While most such products intended for consumer use would be appropriate for installing a clothes washer, DOE seeks to provide additional direction to avoid the use of a hose designed for niche purposes (*i.e.*, to ensure representativeness) as well as to ensure reproducible results among different laboratories. *Id*. Specifically, DOE observes a wide range of hose

lengths available on the market, and recognizes that using an excessively long hose could result in the water temperature or pressure at the clothes washer inlet deviating significantly from the temperature and pressure at the test fixture. *Id*. Based on a review of water inlet hoses available at major retailers, the most common lengths for clothes washer hoses range from 3–6 feet ("ft"). In the September 2021 NOPR, DOE proposed to specify the use of hoses that do not exceed 72 inches in length (6 ft) in section 2.10.1 of the new appendix J. *Id*.

DOE requested comment on its proposal to specify the use of hoses not to exceed 72 inches in length in the new appendix J. *Id*. DOE also requested comment on the length of inlet hose typically used for testing. *Id*.

The Joint Commenters commented in support of DOE's proposal to standardize water inlet hose length, stating that it would increase reproducibility of the test procedure. (Joint Commenters, No 31 at p. 11)

AHAM recommended that DOE specify that its water hose length proposal is intended for third-party testing only. (AHAM, No. 27 at p. 15) AHAM also recommended a more reasonable hose length of 48 inches, stating that a 72-inch long hose would still retain a significant amount of water. (*Id*.)

In response to AHAM's suggestion to shorten the proposed maximum hose length from 72 to 48 inches, DOE notes that the difference in retained water between a 72-inch hose and a 48-inch hose is around 0.01 gal, which would have a negligible, if any impact on measured results.[60] As discussed above, representative consumer clothes washer hoses range from 36 to 72 inches in length. Any length longer than this would not be

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[60] Calculated as the internal volume of 24 inches of hose with an inner diameter of 0.375 inches, which based on DOE research is a typical inner diameter for a clothes washer hose. $24 \times \pi \times (0.375 \div 2)^2 = 2.65$ cubic inches = 0.01 gal.

representative of a consumer clothes washer hose; and any length shorter than this would not be practical for installing a clothes washer to the inlet water supply.

Regarding AHAM's recommendation that DOE specify hose length only for third-party testing only, DOE reiterates that the hose specifications would only apply in instances in which a clothes washer is shipped without inlet hoses. In such instances, the justification for specifying a hose length is applicable regardless of whether a clothes washer is tested at a third-party laboratory or a manufacturer laboratory.

For these reasons, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to specify the use of hoses not to exceed 72 inches in length in the new appendix J.

2. Water Fill Selection Availability

Table 2.8 within section 2.8 of appendix J2 requires that, for clothes washers with manual WFCS, each temperature selection that is part of the energy test cycle be tested using both the minimum and maximum water fill levels, using the minimum and maximum load sizes, respectively. Section 3.2.6 of appendix J2 describes these water fill levels as the minimum and maximum water levels available for the wash cycle under test. DOE has observed one RCW model with electronic controls in which the maximum water fill level on the unit cannot be selected with all of the temperature selections required for testing.; *i.e.*, on at least one temperature setting, the maximum water fill that can be selected is one of the intermediate fill levels on the unit. In such cases generally, the "reduced maximum" water fill level for a particular temperature setting may not be appropriate for use with the maximum load size required for that particular cycle under test. Using a maximum load size with a reduced maximum water fill level may not provide results that measure energy efficiency and water use during a representative average use cycle or period of use, since the unavailability of the "full maximum" water

fill level for that particular cycle under test would suggest that the particular temperature selection is not intended to be used with a maximum load size.

The RCW model with this characteristic is no longer available on the market, and DOE is not aware of any other clothes washer models currently on the market with this characteristic. DOE did not propose, in the September 2021 NOPR, any amendments to address the potential for the maximum load size required by the test procedure to conflict with the maximum load size intended or able to be washed on such a cycle. 86 FR 49140, 49181.

DOE requested comment on whether it should amend the test procedure to accommodate potential future clothes washer models for which the maximum load size required by the test procedure conflicts with the maximum load size intended or able to be washed with the cycle required for testing. *Id*. If so, DOE sought additional comment on the approaches it has considered, or on any other approaches that could be considered, that would address this issue in the test procedure. *Id*.

AHAM commented that it is not necessary to amend the test procedure to include directions for testing clothes washers with water fill levels that are only available at certain temperature settings. (AHAM, No. 27 at pp. 15–16) AHAM added that while consumers have options available for other needs, the Normal cycle remains the most representative of consumer use, and there have not been any data to prove otherwise. (*Id*.)

The Joint Commenters recommended that DOE specify in new appendix J that for possible future clothes washer models where the maximum load size conflicts with the cycle required for testing, DOE should not allow an alternate test load size. (Joint Commenters, No. 31 at p. 10) The Joint Commenters commented that an alternate, smaller test load would lower the clothes washer's measured water and drying energy use to the extent that test results would no longer be comparable to test results from other

clothes washers of the same load size. (*Id*.) Instead, the Joint Commenters recommended that DOE specify that such a clothes washer should be tested with the next most similar program that enables the required load size. (*Id*.)

As noted, the RCW model for which the maximum water fill level cannot be selected with all of the temperature selections required for testing is no longer available on the market, and DOE is not aware of any other clothes washer models currently on the market with this characteristic. To the extent that models with this characteristic were to be reintroduced the market, more research would be needed to address any potential concerns regarding representative use. DOE also notes that the amended load sizes defined for new appendix J (in which the "large" load size is smaller than the "maximum" load size currently defined by appendix J2) would obviate the need for any changes to the test procedure for the one RCW model of concern.

For these reasons, DOE makes no changes to the test procedure to accommodate this potential characteristic, consistent with the September 2021 NOPR.

3. Water Fill Control Systems

a. Definitions

Section 1.5 of appendix J2 previously defined "automatic water fill control system" as a clothes washer WFCS that does not allow or require the user to determine or select the water fill level, and includes adaptive WFCS and fixed WFCS. Section 1.4 of appendix J2 previously defined "adaptive water fill control system" as a clothes washer automatic WFCS that is capable of automatically adjusting the water fill level based on the size or weight of the clothes load placed in the clothes container. Section 1.14 of appendix J2 previously defined "fixed water fill control system" as a clothes washer automatic WFCS that automatically terminates the fill when the water reaches an appropriate level in the clothes container. Section 3.2.6.2.2 of appendix J2 previously provided testing instructions for a "user-adjustable" automatic WFCS, which were

described in that section as an automatic water fill control that affects the relative wash water levels.

To provide additional specificity to both appendix J2 and the new appendix J, in the September 2021 NOPR DOE proposed revisions to some of the WFCS definitions, as follows. 86 FR 49140, 49181.

DOE proposed to amend the definition of "fixed water fill control system" to mean "a clothes washer automatic water fill control system that automatically terminates the fill when the water reaches a pre-defined level that is not based on the size or weight of the clothes load placed in the clothes container, without allowing or requiring the user to determine or select the water fill level." *Id*. This proposed amendment to the definition would specify that the water fill level for this type of WFCS is pre-defined (*i.e.*, fixed) and does not vary based on the size or weight of the load. *Id*. The proposal would incorporate the same terminology used in the other WFCS definitions so as to more clearly articulate how a fixed WFCS relates to the other defined WFCS. *Id*. This amended definition was proposed for inclusion in the new appendix J as well. *Id*.

To provide greater specificity regarding user-adjustable automatic WFCS, DOE proposed to add a definition of a "user-adjustable automatic water fill control system" to section 1 of both appendix J2 and the new appendix J. *Id*. DOE proposed to define a user-adjustable automatic WFCS as "an automatic clothes washer fill control system that allows the user to adjust the amount of water that the machine provides, which is based on the size or weight of the clothes load placed in the clothes container." *Id*. Given DOE's proposal to create a definition of user-adjustable automatic WFCS, DOE proposed to simplify the wording of section 3.2.6.2.2 of appendix J2 from "[c]onduct four tests on clothes washers with user adjustable automatic water fill controls that affect the relative wash water levels" to "[c]onduct four tests on clothes washers with user-adjustable automatic water fill controls." *Id*. For the new appendix J, section 3.2.3.2.2 would state

"For the large test load size, set the water fill selector to the setting that uses the most water. *Id*. For the small test load size, set the water fill selector to the setting that uses the least water." *Id*.

DOE requested comment on its proposed changes to the definition of "fixed water fill control system" and on its proposal to add a definition for "user-adjustable automatic water fill control system." *Id*.

AHAM commented that it agrees that a better definition for a "user-adjustable automatic water fill control system" is needed since there is no specific definition for it in appendix J2. (AHAM, No. 27 at pp. 5–6) However, AHAM opposed DOE's proposed definition for "user-adjustable automatic water fill control system." (*Id*.) AHAM commented that the wording used in DOE's proposed definition uses the language in the current definition of an "adaptive water fill control system." (*Id*.) AHAM stated that a definition that implies that a "user-adjustable adaptive water fill control system" represents all "user-adjustable automatic water fill control systems" would narrow the current scope so that they no longer include "user-adjustable fixed water fill control systems." (*Id*.) AHAM added that DOE's proposed definition would also leave a "user-adjustable fixed water fill control system" undefined. (*Id*.) AHAM therefore proposed the following definition for "user-adjustable automatic water fill control system": "User-adjustable automatic water fill control system means an automatic clothes washer fill control system that allows the user to adjust the relative amount of water that the machine provides." (*Id*.) AHAM stated that its proposed definition would reduce redundancy by removing the last clause of DOE's proposed definition, which duplicates the definition of "adaptive water fill control system," and would add the word "relative." (*Id*.) AHAM commentated that it believes that its proposed definition is consistent with DOE's intent and urged DOE to adopt it. (*Id*.)

DOE notes that at the creation of the user-adjustable distinction in the August 1997 Final Rule, section 3.2.3.2.2 of appendix J2[61] referred to clothes washers with "adaptive" WFCS that were user-adjustable. 62 FR 45484, 45510. In the August 2015 Final Rule, DOE added a new definition for "automatic water fill control system," which included both fixed WFCS and adaptive WFCS, both of which do not require user action to determine the water fill level. In creating the new definition for automatic WFCS, DOE replaced all instances of "adaptive" WFCS with "automatic" WFCS to indicate that such testing provisions apply to both adaptive water fill control systems and fixed water fill control systems. 80 FR 46730, 46749. As part of these changes, reference to "user adjustable adaptive water fill controls that affect the relative wash water level" in section 3.2.6.2.2 of appendix J2 ("User adjustable") was amended to refer instead to "user adjustable *automatic* water fill controls that affect the relative wash water level" (emphasis added). AHAM's comment has prompted DOE to re-evaluate this wording change. *Id*. Reference to user-adjustable *automatic* WFCS implies that the term encompasses both user-adjustable *adaptive* and user-adjustable *fixed* WFCS. However, DOE asserts that a WFCS that provides user-adjustable fixed fill water levels is essentially a manual WFCS, in the sense that a manual fill WFCS automatically terminates the fill when the water reaches the level in the clothes container corresponding to the level select by the user (*i.e.*, a "fixed" water level that is not automatically determined based on the size or weight of the clothes load and is selectable (*i.e.*, adjustable) by the user). Furthermore, DOE notes that the phrase "controls that affect the *relative* wash water levels" (emphasis added) in section 3.2.6.2.2 of appendix J2 necessarily applies only to a clothes washer with relative wash water levels (*i.e.*, wash water levels that are determined based on the size or weight of the clothes load). A fixed

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[61] Which has since been renumbered as 3.2.6.2.2.

WFCS does not provide *relative* wash water levels. For these reasons, DOE asserts that the word "automatic" was incorrectly applied in section 3.2.6.2.2, and that section 3.2.6.2.2 pertaining to user-adjustable WFCSs applies only to clothes washer with user-adjustable *adaptive* WFCS.

In this final rule, DOE corrects this error and amends section 3.2.6.2.2 of appendix J2 to revert each instance of "automatic" to "adaptive." Accordingly, in both appendix J2 and new appendix J, DOE finalizes the definition of the term "user-adjustable adaptive water fill control system" consistent with the definition DOE had proposed for "user-adjustable automatic water fill control system" in the September 2021 NOPR, except to replace the word "automatic" with "adaptive."

In reviewing this matter, DOE has further determined that the grouping of fixed WFCS and adaptive WFCS into the single term "automatic" WFCS for the sake of simplicity has potentially created ambiguity with certain WFCS types, as evidence by the previous example in this discussion. In order to provide greater clarity regarding the identification of WFCS type and the corresponding test provisions that apply, DOE is removing the "automatic WFCS" distinction from appendix J and creating a new table that distinguishes WFCS based on how the user interacts with the controls (*i.e.*, whether the settings are adjustable by the user) and whether the size or weight of the clothing load affects the water level, as shown in Table III.2 (implemented as Table 3.2.3 in new appendix J).

Table III.2 Water Fill Control Systems

	Settings are user-adjustable	**Settings are not user-adjustable**
Water fill level unaffected by the size or weight of the clothing load	Manual water fill	Fixed water fill
Water fill level is determined automatically by the clothes washer based on the size and weight of the clothing load	User-adjustable adaptive water fill	Non-user-adjustable adaptive water fill

With these clarifications, DOE is not changing how any WFCS is classified or tested in appendix J in comparison to the proposed version of appendix J presented in the September 2021 NOPR. Rather, DOE expects that these changes will help more easily distinguish the different types of WFCSs and thus better ensure reproducibility of test results.

As part of this clarification, DOE is removing the definition for automatic water fill control system from appendix J, and is removing the term "automatic" from the definitions for adaptive water fill control system, fixed water fill control system, and user-adjustable adaptive water fill control system. DOE is also relabeling the definition of adaptive water fill control system as non-user-adjustable adaptive water fill control system to match how this WFCS is presented in new table 3.2.3 of appendix J.

Further, DOE is establishing subsections within section 3.2.3 of appendix J to provide water fill level instructions that align more directly with the terminology presented in new table 3.2.3 of appendix J, as follows:

- Section 3.2.3.1 "Clothes washers with a manual water fill control system" (consistent with the September 2021 NOPR);
- Section 3.2.3.2 "Clothes washers with a fixed water fill control system" (as compared to the proposed section 3.2.3.2.1 from the September 2021 NOPR titled "Not user-adjustable" within section 3.2.3.2 titled "Clothes washers with automatic water fill control system");
- Section 3.2.3.3 "Clothes washers with a user-adjustable adaptive water fill control system" (as compared to the proposed section 3.2.3.2.2 from the September 2021 NOPR titled "User-adjustable" within section 3.2.3.2 titled "Clothes washers with automatic water fill control system");
- Section 3.2.3.4 "Clothes washers with a non-user-adjustable adaptive water fill control system" (as compared to the proposed section 3.2.3.2.1

from the September 2021 NOPR titled "Not user-adjustable" within section 3.2.3.2 titled "Clothes washers with automatic water fill control system"); and

- Section 3.2.3.5 "Clothes washers with multiple water fill control systems" (as compared to the proposed section 3.2.3.3 from the September 2021 NOPR titled "Clothes washers with automatic water fill controls system and alternate manual water fill control system"). DOE is further establishing new section 3.2.3.5 to read "If a clothes washer allows user selection among multiple water fill control systems, test all water fill control systems and, for each one, calculate the energy consumption (HE_T, ME_T, and DE_T) and water consumption (Q_T) values as set forth in section 4 of this appendix. Then, calculate the average of the tested values (one from each water fill control system) for each variable (HE_T, ME_T, DE_T, and Q_T) and use the average value for each variable in the final calculations in section 4 of this appendix."

b. "Most Energy Intensive" Wording for User-Adjustable Automatic Water Fill Control Systems

As discussed, section 3.2.6.2.2 of appendix J2 previously specified how to test clothes washers with user-adjustable automatic WFCS. Four tests were required:

- a test using the maximum test load size and with the WFCS set in the setting that will give the most energy intensive result;
- a test using the minimum test load size and with the WFCS set in the setting that will give the least energy intensive result;
- a test using the average test load size and with the WFCS set in the setting that will give the most energy intensive result; and

- a test using the average test load size and with the WFCS set in the setting that will give the least energy intensive result.

The provisions requiring testing the most and least energy intensive settings were initially adopted in the August 1997 Final Rule. 62 FR 45484, 45487. As evident throughout the discussions in the August 1997 Final Rule, absent the consideration of drying energy and water efficiency,[62] DOE used the terms "most energy intensive" and "least energy intensive" synonymously with discussing the water fill amounts.[63] The terms "most energy intensive" and "least energy intensive" were originally employed to provide direction of the water fill amounts required for testing of the adaptive WFCS.

As the test procedures and energy conservation standards have been amended, the measured energy use accounts for more than just that which correlates to the water fill level. However, use of the energy intensity terminology remained in the user-adjustable automatic WFCS provisions. Given the evolution of clothes washer control systems and operation since the August 1997 Final Rule, more precise language is needed to avoid an unnecessary determination of whether the highest (or lowest) water fill amount on a user-adjustable automatic WFCS corresponds to the most (or least) energy intensive setting. Therefore, in the September 2021 NOPR, DOE proposed to change the wording in section 3.2.6.2.2 of appendix J2 to update the phrase "the setting that will give the most energy intensive result" to "the setting that uses the most water" to reflect the original intent of this provision and to use the same updated language in section 3.2.3.2.2 of the new appendix J. 86 FR 49140, 49182. Similarly, DOE proposed to update the phrase

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[62] At the time of the August 1997 Final Rule, the applicable energy efficiency metric did not include the drying energy component, and the energy conservation standards at the time did not regulate the water efficiency of clothes washers.

[63] For example, in an interim waiver granted to GEA on April 24, 1996, DOE stated the following: however, the "sensitivity" or relative fill amounts of the automatic water fill mode can be reprogrammed in the secondary programming mode, thus resulting in an increase in energy consumption above the manual mode result. 61 FR 18125, 18127.

"the setting that will give the least energy intensive result" to "the setting that uses the least water."

DOE requested comment on its proposal to update the wording of section 3.2.6.2.2 of appendix J2 and section 3.2.3.2.2 of the new appendix J from "the setting that will give the most energy intensive result" to "the setting that uses the most water;" and from "the setting that will give the least energy intensive result" to "the setting that uses the least water." *Id*.

AHAM commented that it supports DOE's proposal to update the wording in section 3.2.6.2.2 of appendix J2 and section 3.2.3.2.2 of new appendix J from "the setting that will give the most energy intensive result" to "the setting that uses the most water," and from "the setting that will give the least energy intensive result" to "the setting that uses the least water," stating that using the most and least "energy-intensive result" conflates an energy metric with a water use metric, which may lead to confusion. (AHAM, No. 27 at p. 5)

Based on the reasons discussed in the preceding paragraphs, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to update the wording of section 3.2.6.2.2 of appendix J2 and section 3.2.3.2.2 of the new appendix J from "the setting that will give the most energy intensive result" to "the setting that uses the most water;" and from "the setting that will give the least energy intensive result" to "the setting that uses the least water."

4. Energy Test Cycle Flowcharts

In the August 2015 Final Rule, DOE implemented a series of flowcharts to determine the wash/rinse temperature selections required for testing in section 2.12 of appendix J2. 80 FR 46730, 46744.

a. Clarification of Load Size to be Used for Temperature Comparisons

Figure 2.12.5 of appendix J2, which is the flow chart used for the determination of the Extra-Hot Wash/Cold Rinse temperature selection, asks if the wash/rinse temperature selection has a wash temperature greater than 135 °F. DOE is aware that for some clothes washers on the market, the answer to that question could differ depending on what load size is used, *i.e.*, the wash temperature may exceed 135 °F only on certain load sizes, meaning that the determination of whether the temperature selection is classified as Hot Wash/Cold Rinse or Extra-Hot Wash/Cold Rinse would depend on the load size used for making the determination. More generally, all of the flowcharts in section 2.12 require comparing wash and rinse water temperatures across different temperature selections, without specifying a load size to be used for making these comparisons.

In the September 2021 NOPR, DOE proposed to specify using the maximum load size to evaluate the flow chart for clothes washers tested to appendix J2, and the large load size for the new appendix J.[64] 86 FR 49140, 49182. The maximum/large load size is the load size expected to use the most water (compared to the other load sizes) under each appendix, and in DOE's experience, larger quantities of water (particularly hot water) provide a more reliable determination of the relative differences in water temperature among the various temperature settings. *Id*. Therefore, the maximum/large load size is likely to provide the most repeatable and reproducible end result for each flowchart. *Id*.

DOE notes that Figure 2.12.1 of appendix J2, which is the flow chart used for the determination of the Cold/Cold temperature selection, provides direction for cases where multiple wash temperature selections in the Normal cycle do not use any hot water for

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[64] See section III.D.1.b of this document for a discussion of the definition of the new "large" test load size.

any of the water fill levels or test load sizes required for testing. *Id*. For appendix J2, DOE proposed that the new clarifying language would not apply to the Cold/Cold temperature settings in order to avoid the potential need for retesting under appendix J2 if a clothes washer was tested in a manner inconsistent with this proposed change. *Id*. For the new appendix J, DOE proposed to delete from the Cold/Cold flowchart (Figure 2.12.1) the clause applying it to all tested load sizes, and to instead require the use of the large size, consistent with all the other wash/rinse temperature selection flowcharts. 86 FR 49140, 49182–49183.

DOE requested comment on its proposal to require that the energy test cycle flow charts be evaluated using the large load size for all wash/rinse temperature settings in the new appendix J. 86 FR 49140, 49183. DOE also requested comment on its proposal to require that the energy test cycle flow charts be evaluated using the maximum load size, except for the Cold/Cold flow chart, in appendix J2. *Id*.

DOE received no comments on its proposal to require that the energy test cycle flow charts be evaluated using the large load size for all wash/rinse temperature settings in the new appendix J and using the maximum load size, except for the Cold/Cold flow chart, in appendix J2.

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to require that the energy test cycle flow charts be evaluated using the large load size for all wash/rinse temperature settings in the new appendix J and using the maximum load size, except for the Cold/Cold flow chart, in appendix J2.

P.R. China noted an inconsistency between section 2.12.1 of the proposed new appendix J (which P.R. China characterized as prescribing that test evaluations be completed using only a large load) and Table 3.3 of the proposed new appendix J (which

prescribes the use of both a large and small load), and recommended that DOE fix the inconsistency. (P.R. China, No. 25 at p. 3)

With regard to the comment from P.R. China that the proposed test procedure contains an inconsistency, DOE further explains here the intended difference between *evaluating* the flow charts and conducting *testing* of each wash-rinse temperature selection determined to be available on the unit under test. Section 2.12.1 of new appendix J specifies that the large load is to be used to *evaluate* each flow chart (*i.e.*, to answer the questions presented in each flow chart) to determine which wash/rinse temperatures are present on the unit under test. Although only the large load size is used to evaluate the flow charts, both the small and large load sizes must be used to *test* each wash/rinse temperature selection. For example, in Figure 2.12.1.5 (Determination of Extra-Hot Wash/Cold Rinse), the question "Does the Normal cycle contain any wash/rinse temperature selections that [have a] wash temperature greater than or equal to 140 °F?" must be evaluated. As discussed in the previous paragraphs, the answer to that question could differ for each load size (*e.g.*, using the small load size could yield an answer of "No", whereas using the large load size could yield an answer if "Yes.") By specifying that the flow charts are *evaluated* using the large load size, in this example, the answer to the question would be the answer "Yes" associated with the large load size (*i.e.*, the unit under test has an Extra-Hot Wash/Cold Rinse). Having made this determination, both the small and large load sizes would be tested to the Extra-Hot Wash/Cold Rinse temperature selection.

b. Clothes Washers that Generate All Hot Water Internally

As described in section III.C.2 of this document, DOE is aware of single-inlet clothes washers on the market that intake only cold water and internally generate all hot water required for a cycle by means of an internal heating element. As observed on the market, these clothes washers offer Cold, Warm, Hot, and/or Extra-Hot temperature

selections. As part of determining the Cold/Cold temperature selection, the instruction box in the flowchart in Figure 2.12.1 of appendix J2 referred to "…multiple wash temperature selections in the Normal cycle [that] do not use any hot water for any of the water fill levels or test load sizes required for testing[.]"

In the September 2021 NOPR, DOE proposed the text in Figure 2.12.1 of both appendix J2 and the new appendix J to state "…use *or internally generate* any heated water…" (emphasis added) so that the wording of the Cold/Cold flowchart in both appendices explicitly addresses clothes washers that internally generate hot water. 85 FR 31065, 31074. This change would be consistent with DOE's interpretation of the current Cold/Cold flowchart and subsequent flowcharts for the Warm Wash and Hot Wash temperature selections for this type of clothes washer. *Id*. DOE further proposed to phrase the description of Warm/Warm in Figure 2.12.4 of both appendix J2 and the new appendix J to state "…rinse temperature selections that add *or internally generate* hot water…" (emphasis added), for the same reasons. 86 FR 49140, 49183.

DOE requested comments on its proposal to update the flowcharts for Cold/Cold and Warm/Warm in both appendix J2 and the new appendix J to explicitly address clothes washers that internally generate hot water. *Id*.

In the September 2021 NOPR, DOE summarized comments from Underwriters Laboratories ("UL") and AHAM supporting this change. DOE received no additional comments in response to the September 2021 NOPR on its proposal to update the flowcharts to explicitly address clothes washers that internally generate hot water. *Id*.

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to update the flowcharts to explicitly address clothes washers that internally generate hot water.

5. Wash Time Setting

Section 3.2.5 of appendix J2 defines how to select the wash time setting on a clothes washer. If no one wash time is prescribed for the wash cycle under test, the wash time setting is the higher of either the minimum or 70 percent of the maximum wash time available, regardless of the labeling of suggested dial locations. Hereafter in this document, DOE refers to this provision as the "70-percent test."

a. Electronic vs. Electromechanical Dials

DOE has observed on the market clothes washers that have an electronic cycle selection dial designed to visually simulate a conventional electromechanical dial.[65] *Id*. Although the electronic dial simulates the visual appearance of an electromechanical dial, the electronic dial is programmed with a pre-established set of wash cycle parameters, including wash time, for each of the discrete cycle selections presented on the machine. *Id*. For this type of cycle selection dial, each of the discrete cycle selection options represents a selectable "wash cycle" as referred to in section 3.2.5 of appendix J2, and a wash time is prescribed for each available wash cycle. *Id*. Therefore, for clothes washers with this type of electronic dial, the wash cycle selected for testing must correspond to the wash cycle that meets the definition of Normal cycle in section 1.25 of appendix J2. The wash time setting thus would be the prescribed wash time for the selected wash cycle; *i.e.*, the 70- percent test would not apply to this type of dial. *Id*.

In the September 2021 NOPR, DOE proposed to include in section 3.2.5.3 of both appendix J2 and the new appendix J the words "or timer" after the words "electromechanical dial" in order to clarify the application of the instructions to electronic cycle selection dials. *Id*.

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[65] On most electromechanical dials, the rotational position of the dial corresponds to the desired wash time. The user rotates the dial from the initial "off" position to the desired wash time position, and after starting the wash cycle, the dial rotates throughout the progression of the wash cycle until it reaches the "off" position at the end of the cycle. In contrast, an electronic dial contains a fixed number of selectable positions, and the dial remains in the selected position for the duration of the wash cycle.

DOE further proposed in section 3.2.5 of appendix J2 and section 3.2.2 of the new appendix J[66]that the first sentence of the section would read, "*If the cycle under test offers a range of wash time settings*, the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available for the wash cycle under test, regardless of the labeling of suggested dial locations" (emphasis added). 86 FR 49140, 49183–49184. DOE also proposed to separate section 3.2.5 of appendix J2 and section 3.2.2 of the new appendix J into two subsections: section 3.2.5.1 (in appendix J2) and section 3.2.2.1 (in the new appendix J), which specifies the wash time setting for a clothes washer cycle with a range of wash time settings; and section 3.2.5.2 (in appendix J2) and 3.2.2.2 (in the new appendix J), which specifies the dial rotation procedure for a clothes washer equipped with an electromechanical dial or timer that rotates in both directions. 86 FR 49140, 49184.

DOE requested comment on its proposal to clarify the wording of the wash time setting specifications in section 3.2.5 of appendix J2 and section 3.2.2 of the new appendix J. *Id*.

AHAM commented in support of DOE's proposed changes concerning electromechanical dials. (AHAM, No. 27 at p. 16)

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to include in section 3.2.5.3 of both appendix J2 and the new appendix J the words "or timer" after the words "electromechanical dial" in order to clarify the application of the instructions to electronic cycle selection dials. DOE is also finalizing its proposal, consistent with the September 2021 NOPR, that in section 3.2.5 of appendix J2 and section 3.2.2 of the new appendix J the first sentence of the section reads, "If the cycle

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[66] See section III.H.7 of this document for a discussion of the structure of section 3 of the new appendix J.

under test offers a range of wash time settings, the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available for the wash cycle under test, regardless of the labeling of suggested dial locations." DOE is also finalizing its proposal, consistent with the September 2021 NOPR, to separate section 3.2.5 of appendix J2 and section 3.2.2 of the new appendix J into two subsections each.

b. Direction of Dial Rotation

Section 3.2.5 of appendix J2 states that, for clothes washers with electromechanical dials controlling wash time, the dial must be turned in the direction of increasing wash time to reach the appropriate wash time setting. DOE is aware that not all electromechanical dials currently on the market can be turned in the direction of increasing wash time. 86 FR 49140, 49184. On such models, the dial can only be turned in the direction of decreasing wash time. Accordingly, DOE asserted that the direction of rotation need only be prescribed on a clothes washer with an electromechanical dial that can rotate in both directions. *Id*.

In the September 2021 NOPR, DOE proposed to add in section 3.2.5.2 of appendix J2 and include in section 3.2.2.2 of the new appendix J a clause that would specify that the requirement to rotate the dial in the direction of increasing wash time would only apply to dials that can rotate in both directions. *Id*.

DOE requested comment on its proposal to include a clause in section 3.2.5.2 of appendix J2 and section 3.2.2.2 of the new appendix J stating that the requirement to rotate the dial in the direction of increasing wash time would apply only to dials that can rotate in both directions. *Id*.

In the September 2021 NOPR, DOE summarized comments from UL and AHAM supporting this change. DOE received no additional comments in response to the September 2021 NOPR on its proposal to state that the requirement to rotate the dial in

the direction of increasing wash time would apply only to dials that can rotate in both directions.

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to include a clause in section 3.2.5.2 of appendix J2 and section 3.2.2.2 of the new appendix J that specifies that the requirement to rotate the dial in the direction of increasing wash time applies only to dials that can rotate in both directions.

c. "Wash Time" Definition

The 70-percent test described above does not explicitly define how to calculate "wash time." In the May 2020 RFI, DOE considered whether to state that the phrase "wash time" in section 3.2.5 of appendix J2 refers to the period of agitation or tumble. 85 FR 31065, 31975. This clarification would be consistent with the historical context of this section of the test procedure. In the August 1997 Final Rule, DOE specified that section 2.10 of appendix J *Clothes washer setting* refers to "actual wash time" as the "period of agitation." In the 2001 Final Rule, DOE renamed section 2.10 of appendix J *Wash time (period of agitation or tumble) setting*.[67] 66 FR 3313, 3330. When establishing appendix J1 in the August 1997 Final Rule, DOE did not include reference to "period of agitation or tumble" in section 2.10 of appendix J1. 62 FR 45484, 45510. DOE did not address this difference from the 1977 version of appendix J in the preamble of the August 1997 Final Rule or the NOPRs that preceded that final rule, but given the continued reference to "wash time" in appendix J1, did not intend to change the general understanding that wash time refers to the wash portion of the cycle, which includes agitation or tumble time. 86 FR 49140, 49184. DOE has since further amended section 2.10 of both appendix J1 and appendix J2 as part of the March 2012 Final Rule and

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[67] In this context, "agitation" refers to the wash action of a top-loading clothes washer, whereas "tumble" refers to the wash action of a front-loading clothes washer.

August 2015 Final Rule (in which section 2.10 was renumbered as section 3.2.5), with no discussion in these final rules of the statement that remained in the 2001 version of appendix J, where wash time was referred to in the title of section 2.10 as the period of agitation or tumble time. *Id.* DOE further noted in the September 2021 NOPR that in current RCW models on the market, agitation or tumble may be periodic or continuous during the wash portion of the cycle. *Id.*

In order to provide further clarity in evaluating the wash time setting requirements of section 3.2.5 of appendix J2 and section 3.2.2 of the new appendix J, DOE proposed in the September 2021 NOPR to define the term "wash time" in section 1 of both appendix J2 and the new appendix J as "the wash portion of the cycle, which begins when the cycle is initiated and includes the agitation or tumble time, which may be periodic or continuous during the wash portion of the cycle." 86 FR 49140, 49184.

DOE requested comment on its proposal to add a definition of "wash time" to section 1 of both appendix J2 and the new appendix J. *Id*.

AHAM commented in support of DOE's proposed definition of "wash time." (AHAM, No. 27 at p. 16)

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal to add a definition of "wash time" to section 1 of both appendix J2 and the new appendix J in order to add more clarity in evaluating the wash time setting requirements. To provide greater specificity by referencing other defined terms, this final rule changes the wording "wash portion of *the cycle*" as proposed in the September 2021 NOPR to "wash portion of *active washing mode*." This change does not affect the substance of the September 2021 NOPR proposal.

6. Annual Operating Cost Calculation

DOE provides in 10 CFR 430.23(j)(1)(ii) the method for calculating the estimated annual operating cost for automatic and semiautomatic clothes washers, when using

appendix J2. In the March 2012 Final Rule, DOE assigned the symbol "E_{TLP}" to represent combined low-power mode energy consumption. However, in that rule, DOE used a different symbol ("E_{TSO}") in updating section 10 CFR 430.23(j)(1)(ii) to represent the same value. 77 FR 12888, 13937–13948. In the September 2021 NOPR, DOE proposed to update the symbol nomenclature in 10 CFR 430.23(j)(1)(ii) to match the symbol nomenclature in appendix J2. 86 FR 49140, 49184.

In addition, to differentiate between values determined using appendix J2 from values determined using the new appendix J throughout 10 CFR 430.23(j), DOE proposed to add a number "2" to each of the symbols representing values derived from appendix J2 (*e.g.*, E_{TLP2}) that are not already designated accordingly. *Id*.

DOE further noted that the formula for calculating the estimated annual operating cost for automatic and semiautomatic clothes washers when gas-heated or oil-heated water is used, provided in 10 CFR 430.23(j)(1)(ii)(B), was missing a pair of parentheses. 86 FR 49140, 49185. The "N_2" multiplier is intended to apply to all of the other factors in the equation, but the lack of parentheses around the "ME_{T2}" through "C_{BTU}" terms erroneously applied it to only the first term of the sum. DOE proposed to correct this error in the September 2021 NOPR. *Id*.

Since DOE proposed to remove appendix J1 as part of the September 2021 NOPR, DOE also proposed to update 10 CFR 430.23(j)(1)(i), which specified the formulas for calculating the estimated annual operating cost for automatic and semiautomatic clothes washers when using appendix J1, with the formulas for calculating the estimated annual operating cost for automatic and semiautomatic clothes washers when using the new appendix J. *Id*. These proposed formulas were analogous to the formulas in 10 CFR 430.23(j)(1)(ii). *Id*. As discussed further in section III.H.7 of this document, the new appendix J does not include a separate calculation for "E_{TE}" (the sum of machine electrical energy ("ME_T") and water heating energy ("HE_T"), as defined in

section 4.1.7 of appendix J2). Therefore, DOE's proposed revisions to 10 CFR 430.23(j)(1)(i) would replace E_{TE} with the individual components $ME_T + HE_T$. *Id*.

DOE requested comment on its proposed updates to the annual operating cost calculations in 10 CFR 430.23(j)(1). *Id*.

DOE received no comments on its proposal to update the annual operating cost.

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to update the annual operating cost calculations in 10 CFR 430.23(j)(1).

7. Structure of the New Appendix J

DOE proposed a number of changes to the structure of the test procedure as part of the creation of the new appendix J to improve readability. 86 FR 49140, 49185.

In the September 2021 NOPR, DOE proposed to better organize section 2.8 of the proposed new appendix J, as compared to the parallel section in appendix J2. *Id.* Section 2.8 of appendix J2 cross-references the load size table to determine the three load sizes, specifies the allowable composition of energy test cloths and energy stuffer cloths in each load,[68] and provides a table showing required test load sizes and water fill settings for each type of WFCS. *Id*. DOE proposed that, in new appendix J, section 2.8.1 would contain the specifications for determining the load sizes; section 2.8.2 would contain the specifications describing the allowable composition of energy test cloths and energy stuffer cloths in each load; and the table specifying the required test load sizes and water fill settings for each type of WFCS would not be included. *Id*. This table would be no longer needed in new appendix J because the same two load sizes (small and large) would be used for all WFCS types. *Id.*

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[68] Test loads must consist of energy test cloths and no more than five energy stuffer clothes per load to achieve the proper weight.

Section 2.9 of appendix J2 is named "Use of test loads" and provides specifications for drying each load to bone-dry prior to use and instructions for loading the test cloth into the clothes washer. In the 2021 NOPR, DOE proposed to title section 2.9 of the proposed new appendix J "Preparation and loading of test loads" and to include a statement that the procedures described in section 2.9 to prepare and load each test load are applicable when performing the testing procedures in section 3 of the appendix. *Id.*

Section 3.2 of appendix J2 is titled "Procedure for measuring water and energy consumption values on all automatic and semi-automatic washers" and specifies conducting testing under the energy test cycle (3.2.1); provides a table that cross-references to each relevant test section in section 3 of the appendix (3.2.2); and provides specifications for: configuring the hot and cold water faucets (3.2.3); selecting the wash/rinse temperature selection (3.2.4); selecting the wash time setting (3.2.5); selecting water fill levels for each type of WFCS (3.2.6); using manufacturer default settings (3.2.7); testing active washing mode only (3.2.8); and discarding anomalous data (3.2.9). In the 2021 NOPR, DOE proposed to title section 3.2 of the new appendix J as simply "Cycle settings" and to organize the section as follows: the contents in section 3.2.1 of appendix J2 would be instead included within the instructions of a new section 3.3 (as described below); the contents of section 3.2 of appendix J2, including the table, would not be included as the contents would be redundant with the proposed sections 3.3 and 3.4; the contents of section 3.2.3 of appendix J2 would not be included, as the hot and cold water faucet instructions would no longer be necessary given the proposed changes described in section III.C.2 of this document regarding the installation of single-inlet clothes washers; and sections 3.2.4 through 3.2.9 of appendix J2 would be included as sections 3.2.1 through 3.2.6, respectively, and include any relevant edits as discussed throughout this document. *Id.*

Sections 3.3 through 3.7 of appendix J2 contain detailed instructions for testing each wash/rinse temperature available in the energy test cycle: Extra-Hot/Cold (3.3); Hot/Cold (3.4); Warm/Cold (3.5); Warm/Warm (3.6); and Cold/Cold (3.7). The content and structure of each of these sections is nearly identical, except for two caveats: (1) describing the use of temperature indicator labels in section 3.3 of appendix J2 to verify the presence of an Extra-Hot wash; and (2) describing the 25/50/75 test, described in section III.D.3 of this document, for clothes washers that offer four or more Warm/Cold or Warm/Warm selections. To significantly simplify this part of test procedure, and because the use of temperature indicator labels would be moved to section 2.5.4 of the proposed new appendix J and the 25/50/75 test would no longer be applicable under the proposals outlined in section III.D.3 of this document, DOE proposed to combine the common language from sections 3.3 through 3.7 in appendix J2 into a single section 3.3 in the new appendix J for automatic clothes washers and an analogous section 3.4 in the new appendix J for semi-automatic clothes washers. *Id.* Section 3.3 of the proposed new appendix J would also provide a table designating the symbol definitions of each required measured value for each wash/rinse temperature selection and load size. *Id.* As discussed in section III.D.8.c of this document, section 3.4 of the proposed new appendix J would provide the same information for semi-automatic clothes washers. *Id*.

Section 3.8 of appendix J2 specifies the procedure for measuring and calculating RMC. As described in section III.D.4 of this document, DOE proposed in the new appendix J to require measuring the RMC of each tested cycle within the energy test cycle, and to calculate final RMC using TUFs and LUFs, consistent with how water heating energy, electrical energy, and water usage are calculated. *Id.* Under this proposed change, the RMC values would be calculated in section 4 ("Calculation of Derived Results From Test Measurements") of the proposed new appendix J. *Id*. Given these proposed changes, the current specifications in section 3.8 of appendix J2 would

not apply to the proposed new appendix J. *Id*. In the September 2021 NOPR, DOE therefore proposed not to include the RMC provisions from section 3 in appendix J2 in the new appendix J. *Id.*

In the September 2021 NOPR, DOE proposed to include sections 3.9 and 3.10 of appendix J2 in the proposed new appendix J as sections 3.5 and 3.6, respectively, and to provide the appropriate cross-references. *Id.*

Section 3.10 of appendix J2 (section 3.6 in the proposed new appendix J) is titled "Energy consumption for the purpose of determining the cycle selection(s) to be included in the energy test cycle" and specifies the following: establishing the test conditions and setting the cycle selections (3.10.1); using the maximum test load size (3.10.2); using the maximum water fill level available (3.10.3); including only the active washing mode (3.10.4); and calculating "total energy consumption" using a defined equation (3.10.5). In the September 2021 NOPR, DOE proposed to simplify section 3.6 in the proposed new appendix J by condensing the specifications of sections 3.10.1 through 3.10.4 in appendix J2 into a single statement in section 3.6.1 of the new appendix J to use the cycle settings as described in section 3.2 of the proposed new appendix J. 86 FR 49140, 49186. Section 3.10.5 of appendix J2 would be included in the proposed new appendix J as section 3.6.2. *Id.*

Sections 3 and 4 of appendix J2 assign various different subscripts to each symbol definition to denote load size and wash/rinse temperature selection, among other attributes. Appendix J2 uses the subscript "x" to denote the maximum load size and the subscript "m" to denote the Extra-Hot/Cold temperature selection. In the September 2021 NOPR, DOE proposed to use new subscripts to represent the large load size ("L") and the small load size ("S") in the new appendix J. *Id.* Because the maximum load size would no longer apply in the proposed new appendix J, DOE proposed to update the subscript for Extra-Hot/Cold temperature selection from "m" to "x" (since "x" is more

intuitive in representing "Extra"). *Id*. These changes would apply to sections 3.3, 3.4, 3.6 and 4 in the proposed new appendix J. *Id.* Additionally, throughout section 4 of appendix J2, the symbol "F" is used to refer to load usage factors. For greater clarity in the new appendix J, DOE proposed to use the symbol "LUF" throughout section 4 to represent the load usage factors, rather than the symbol "F."

Section 4.1.7 of appendix J2 specifies calculating "Total per-cycle energy consumption when electrically heated water is used," assigned as symbol "E_{TE}," as the sum of machine electrical energy and water heating energy. *Id.* E_{TE} was originally defined in the 1977 Final Rule in section 4.6 of appendix J and at the time represented the total measured energy consumption, since the drying energy ("D_E") and E_{TLP} were not yet included as part of the clothes washer test procedure. Currently, however, the total measured energy consumption would be more accurately represented by the sum of H_{ET}, M_{ET}, D_E, and E_{TLP}. Because the calculation of E_{TE} as an intermediate step is now obsolete, DOE proposed to not include the definition of E_{TE} from section 4.1.7 of new appendix J, as well as to edit all cross-references to E_{TE} (within sections 4.5 and 4.6 of the proposed new appendix J and 10 CFR 430.23(j)(1)(i)(A) as proposed). *Id.* In these instances, DOE proposed to replace E_{TE} with its component parts: HE_T and ME_T. *Id.*

Section 4.2 of appendix J2 provides the calculation of water consumption and is structured with multiple subsections. Sections 4.2.1 through 4.2.5 of appendix J2 provide for the calculation of total water consumption for each load size within each wash/rinse temperature selection by summing the measured values of hot water and cold water: Extra-Hot/Cold (4.2.1); Hot/Cold (4.2.2); Warm/Cold (4.2.3); Warm/Warm (4.2.4); and Cold/Cold (4.2.5). In sections 4.2.6 through 4.2.10 of appendix J2, the total weighted water consumption for each wash/rinse temperature selection is calculated by combining the water consumption values for each load size as calculated in sections 4.2.1 through 4.2.5 using the LUFs. In section 4.2.11 of appendix J2, the total weighted water

consumption for all wash cycles is calculated by combining the values calculated in sections 4.2.6 through 4.2.10 (representing each wash/rinse temperature) using the TUFs. In the September 2021 NOPR, DOE noted that this order of calculations (which combines the measured values from the individual cycles first using LUFs, then combines the resulting values using TUFs) is the reverse order used for the machine electrical and water heating energy calculations in section 4.1 of appendix J2 (which combines the measured values from the individual cycles first using TUFs, then combines the resulting values using LUFs). *Id.* In the new appendix J, DOE proposed to organize section 4.2 to simplify the calculations and to provide consistency between the water consumption calculations and the energy calculations (*i.e.,* to combine the measured values from the individual cycles first using TUFs, then combine the resulting values using LUFs). *Id.* Accordingly, section 4.2.1 of the proposed new appendix J would define the per-cycle total water consumption for each large load size tested (summing the hot and cold water consumption for each load size and temperature setting), and section 4.2.2 would similarly define the per-cycle total water consumption for each large and small size tested. *Id.* Section 4.2.3 of the proposed new appendix J would provide for the calculation of the per-cycle total water consumption for all load sizes, using the TUFs to calculate the weighted average of all temperature settings for each load size. *Id.* Finally, section 4.2.4 of the proposed new appendix J would calculate the total weighted per-cycle water consumption, using the LUFs to calculate the weighted average over the two load sizes. *Id*.

In the September 2021 NOPR, DOE requested comment on its proposed structure of the new appendix J to simplify and improve readability as compared to appendix J2. *Id*.

DOE received no comments on its proposed structure for the new appendix J.

DOE is finalizing its proposal, consistent with the September 2021 NOPR, to restructure the new appendix J to simplify and improve readability as compared to appendix J2.

8. Proposed Deletions and Simplifications

In the September 2021 NOPR, DOE proposed to remove appendix J1 to subpart B of 10 CFR part 430 along with all references to appendix J1 in 10 CFR parts 429, 430, and 431. 86 FR 49140, 49186. Appendix J1 applied only to RCWs manufactured before March 7, 2015, and CCWs manufactured before January 1, 2018, and is therefore not applicable to models manufactured on or after those dates. *Id*. Use of appendix J2 to subpart B of 10 CFR part 430 is currently required for any representations of energy or water consumption of both RCWs and CCWs, including demonstrating compliance with the currently applicable energy conservation standards. *Id*. As discussed, DOE proposed to maintain the current naming of appendix J2, and to establish a new test procedure at appendix J, which would be used for the evaluation and issuance of updated efficiency standards, and for determining compliance with those standards. *Id*.

DOE requested comment on its proposal to remove appendix J1 to subpart B of 10 CFR part 430 along with all references to appendix J1 in 10 CFR parts 429, 430, and 431. *Id*.

The Joint Commenters commented in support of deleting appendix J1 and all references to it in 10 CFR parts 429, 430, and 431. (Joint Commenters, No. 31 at p. 11)

DOE is finalizing its proposal, consistent with the September 2021 NOPR, to remove appendix J1 to subpart B of 10 CFR part 430 along with all references to appendix J1 in 10 CFR parts 429, 430, and 431.

Given DOE's proposal to update the energy and water metrics in the new appendix J, as described in section III.E of this document, DOE proposed to include references to the proposed new metrics EER, AEER, and WER in place of references to

the WF, IWF, MEF_{J2}, and IMEF metrics, as appropriate, in the new appendix J. 86 FR 49140, 49186. Given that the WF metric is no longer the basis for energy conservation standards for either RCWs or CCWs, DOE proposed to remove the calculation of WF from section 4.2.12 of appendix J2, as well as any references to WF in 10 CFR parts 429, 430, and 431. *Id*. Similarly, given that MEF_{J2} is no longer the basis for energy conservation standards for RCWs, DOE proposed to remove references to "MEF" from 10 CFR 429.20 and 10 CFR 430.23. *Id*.

DOE requested comment on its proposal to remove obsolete metric definitions. 86 FR 49140, 49187.

DOE received no comments in response to its proposal to remove obsolete metric definitions.

DOE is finalizing its proposal, consistent with the September 2021 NOPR, to remove obsolete metric definitions.

DOE proposed to delete the following definitions from section 1 of appendix J2 because they were either no longer used within the then-current appendix, or would no longer be used given DOE's proposed amendments in the September 2021 NOPR: "adaptive control system," "compact," "manual control system," "standard," and "thermostatically controlled water valves." 86 FR 49140, 49187.

Section 1.13 of appendix J2 defined the energy test cycle as follows: energy test cycle means the complete set of wash/rinse temperature selections required for testing, as determined according to section 2.12 [of appendix J2]. Within the energy test cycle, the following definitions applied:

(a) Cold Wash/Cold Rinse is the wash/rinse temperature selection determined by evaluating the flowchart in Figure 2.12.1 of this appendix.

(b) Hot Wash/Cold Rinse is the wash/rinse temperature selection determined by evaluating the flowchart in Figure 2.12.2 of this appendix.

(c) Warm Wash/Cold Rinse is the wash/rinse temperature selection determined by evaluating the flowchart in Figure 2.12.3 of this appendix.

(d) Warm Wash/Warm Rinse is the wash/rinse temperature selection determined by evaluating the flowchart in Figure 2.12.4 of this appendix.

(e) Extra-Hot Wash/Cold Rinse is the wash/rinse temperature selection determined by evaluating the flowchart in Figure 2.12.5 of this appendix.

Parts (a) through (e) of this definition were redundant with the flowchart definitions provided in section 2.12 of appendix J2. Therefore, DOE proposed to simplify the definition of energy test cycle in both appendix J2 and the new appendix J by keeping only the first sentence of the current definition: energy test cycle means the complete set of wash/rinse temperature selections required for testing, as determined according to section 2.12. *Id*.

DOE also proposed to remove section 1.30 of appendix J2, "Symbol usage," to rename section 1 of appendix J2 (previously "Definitions and Symbols") "Definitions," and name section 1 of the new appendix J "Definitions" accordingly. *Id*. Throughout the appendices, each symbol is defined at each usage, making this section unnecessary for executing the test procedure. DOE noted that most other test procedures in subpart B to part 430 do not include a symbol usage section. *Id*.

DOE also proposed to remove the numbering of all definitions in section 1 of appendix J2, and in section 2 of appendix J3, and instead list the definitions in alphabetical order, to simplify cross-references to defined terms and allow for easier editing in the future by avoiding the need to renumber all the definitions (and associated cross-references) any time a definition is added or deleted. *Id*.

DOE requested comment on its proposal to delete the following definitions from section 1 of appendix J2: "adaptive control system," "compact," "manual control system," "standard," and "thermostatically controlled water valves." *Id*. DOE also

requested comment on its proposal to simplify the definition of "energy test cycle." *Id*. DOE also requested comment on its proposal to remove section 1.30 "Symbol usage" from appendix J2. *Id*. Lastly, DOE requested comment on its proposal to remove the numbering of all definitions in section 1 of appendix J2 and section 2 of appendix J3, and to instead list the definitions in alphabetical order. *Id*.

P.R. China commented that DOE should not delete the definitions of "compact" and "standard." (P.R. China, No. 25 at p. 4) P.R. China specifically requested that DOE re-define the "compact" product class to include units with capacity less than 45 liters, and re-define the "standard" product class to include clothes washers with a capacity above 45 liters. (*Id*.) P.R. China further stated that large-capacity machines have inherent advantages in energy efficiency performance over smaller-capacity machines. (*Id*.) P.R. China concluded that it is therefore unfair to compare compact and standard clothes washers using the same criteria. (*Id*.)

In response to P.R. China, DOE notes that its deletion of the "compact" and "standard" product class definitions from appendix J2 does not affect the definition of RCW product classes, which are defined in 10 CFR 430.32(g) and include: top-loading compact, top-loading standard, front-loading compact, and front-loading standard. The product class definitions in 10 CFR 430.32(g) include capacity thresholds at 1.6 ft^3, or 45 liters, and are not being amended in this final rule.[69] In this final rule, DOE is removing the definitions of the terms "compact" and "standard" only from appendix J2 because they are no longer used within the appendix itself.

For these reasons, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to delete the following definitions from section 1 of appendix J2: "adaptive

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[69] In the RCW Standards Preliminary Analysis, DOE analyzed an updated capacity threshold of 3.0 ft^3 (85 liters) between the front-loading compact and front-loading standard product classes. Any new definitions of product classes would be finalized in the standards rulemaking.

control system," "compact," "manual control system," "standard," and "thermostatically controlled water valves." DOE is also finalizing its proposals, consistent with the September 2021 NOPR, to simplify the definition of "energy test cycle," and remove section 1.30 "Symbol usage" from appendix J2. DOE is further finalizing its proposal, consistent with the September 2021 NOPR to remove the numbering of all definitions in section 1 of appendix J2 and section 2 of appendix J3, and to instead list the definitions in alphabetical order.

DOE further proposed to remove section 6, Waivers and Field Testing, from appendix J2 and not include a parallel section in the new appendix J. 86 FR 49140, 49187. The language of section 6 of appendix J2 was first introduced as section 7 in the 1997 version of appendix J and has been maintained through successive amendments of the test procedures. DOE noted in the September 2021 NOPR, however, that none of the waivers sought by manufacturers to date have made use of these provisions. *Id*. Instead, the provisions of 10 CFR 430.27 (Petitions for waiver and interim waiver) provide comprehensive instructions regarding DOE's waiver process. *Id*. DOE tentatively concluded that the information presented in section 6 of appendix J2 was unnecessary given the regulatory language of 10 CFR 430.27. *Id*.

DOE requested comment on its proposal to remove section 6, Waivers and Field Testing, of appendix J2 and proposal not to include a parallel section in the new appendix J. *Id*.

DOE received no comments on its proposal to remove section 6, Waivers and Field Testing, of appendix J2.

DOE is finalizing its proposal, consistent with the September 2021 NOPR, to remove section 6, Waivers and Field Testing, of appendix J2 and to not include a parallel section in the new appendix J.

9. Typographical Errors

In an effort to improve the readability of the text in certain sections of 10 CFR 430.23 and appendix J2, DOE proposed to make minor typographical corrections and formatting modifications as follows. 86 FR 49140, 49187. These minor proposed modifications were not intended to change the substance of the test methods or descriptions provided in these sections. *Id.* The language of the proposed new appendix J reflects these corrections. *Id.*

The test procedure provisions at 10 CFR 430.23(j)(1)(ii)(B) contain a definition for "C_{KWH}," which is duplicative with the same definition provided in 10 CFR 430.23(j)(1)(ii)(A). In the September 2021 NOPR, DOE proposed to remove the duplicate definition of C_{KWH} from 10 CFR 430.23(j)(1)(ii)(B). *Id.*

DOE proposed to correct two misspellings in section 2.8 of appendix J2 referring to energy stuffer cloths (previously "clothes") and test load sizes (previously "siszes"). *Id.* DOE also proposed to correct the spelling of "discrete" in section 3.2.5 of appendix J2 (previously "discreet") and of "test cycle" in section 3.6 of appendix J2 (previously "testy cycle"). *Id.* DOE also proposed to spell out the word "percent" in the paragraph in section 3.2.5 of appendix J2. *Id.*

Currently in appendix J2, the drying energy abbreviation is D_E. This notation is inconsistent with the notation used for machine electrical energy and water heating energy (ME_T and HE_T, respectively). DOE proposed to standardize the notation used for drying energy throughout sections 3 and 4 of new appendix J, such that it is listed as DE_T. *Id*. DOE stated in the September 2021 NOPR that it could consider also making this change in appendix J2, but that it understood that changing the symbol definition could require test laboratories to update test templates that use the D_E symbol as currently defined in appendix J2. *Id.*

DOE also proposed to rename section 2 in appendix J2 from "Testing Conditions" to "Testing Conditions and Instrumentation" to more fully reflect the contents of this section. *Id.*

In several instances throughout appendix J2, the qualifier "of this appendix" was missing in section cross-references. DOE proposed to rectify these omissions. *Id*. DOE also proposed to clarify references to appendix J3 in appendix J2, and *vice-versa*, by using "to this subpart." *Id*. Finally, DOE proposed to update all cross-references as needed, following the edits proposed in the September 2021 NOPR. *Id*.

DOE received no comments in response to its proposed corrections.

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to make the minor typographical corrections and formatting modifications described previously to improve the readability of the text in certain sections of 10 CFR 430.23 and appendix J2.

10. Symbology

As discussed in section I.B of this document, in the CCW test procedure regulations at 10 CFR 431.152, DOE defines the term "MEF_{J2}" to mean modified energy factor as determined in section 4.5 of appendix J2. Since the calculated value of modified energy factor in appendix J2 is not equivalent to the calculated value of modified energy factor in appendix J1, DOE added the "J2" subscript to the appendix J2 MEF descriptor to avoid any potential ambiguity that would result from using the same energy descriptor for both test procedures. 79 FR 71624, 71626. To maintain consistency with this approach, this final rule adds the "J2" subscript to the MEF metric defined in section 4.5 of appendix J2.

I. Test Cloth Provisions

Appendix J2 requires using specialized test cloth as the material comprising each tested load. The final specifications for the energy test cloth were developed to be representative of the range of fabrics comprising consumer wash loads: a 50-percent cotton/50-percent polyester blended material was specified to approximate the typical mix of cotton, cotton/polyester blend, and synthetic articles that are machine-washed by consumers. In developing the test cloth specifications, DOE also considered:

- Manufacturability: A 50/50 cotton-polyester momie weave was specified because at the time, such cloth was produced in high volume, had been produced to a consistent specification for many years, and was expected to be produced on this basis for the foreseeable future. 66 FR 3314, 3331.
- Consistency in test cloth production: The cloth material properties were specified in detail, including fiber content, thread count, and fabric weight; as well as requirements to verify that water repellent finishes are not applied to the cloth. *Id*.
- Consistency of the RMC measurement among different lots: A procedure was developed to generate correction factors for each new "lot" (i.e., batch) of test cloth to normalize test results and ensure consistent RMC measurements regardless of which lot is used for testing. *Id*.

1. Test Cloth Specification

In the September 2021 NOPR, DOE did not propose any changes to the test cloth specification.

The Joint Commenters recommended that DOE mathematically adjust clothes washer RMC in the proposed new appendix J to more realistically account for drying energy use associated with 100-percent cotton loads. (Joint Commenters, No. 31 at pp. 7–8) The Joint Commenters referenced the 2020 NEEA Report, which developed a

linear mathematical relationship between the RMCs of two different types of textiles: the 50-percent cotton/50-percent polyester DOE test cloth defined in appendix J2, and the 100-percent cotton textiles defined in AHAM HLW-1-2013 and IEC 60456 (2010). The 2020 NEEA Report analyzed the RMC values of both types of textiles across a broad range of clothes washer efficiency levels and technology types. (*Id*.) The Joint Commenters commented that NEEA's study found what the Joint Commenters characterized as excellent R-squared values that could be used to adjust the RMC of DOE test cloth to the RMC that would be expected by using AHAM-specified 100-percent cotton textiles. (*Id*.) The Joint Commenters commented that adjusting RMC to account for drying energy use associated with 100-percent cotton loads would more realistically account for RCW and CCW impacts on drying energy use because, according to the Joint Commenters, most typical laundry loads have a cotton content higher than 50 percent. (*Id*.) The Joint Commenters also commented that adjusting RMC would increase alignment between the proposed new appendix J clothes washer procedure and the appendix D2 clothes dryer test procedure, asserting that the drying energy currently calculated in appendix J2 is much lower than the energy consumed by a typical clothes dryer. (*Id*.) The Joint Commenters further explained that using NEEA's mathematical adjustment to increase RMC before calculating drying energy would make the drying energy estimated in the clothes washer test procedure more similar to the measured drying energy in the clothes dryer test procedure, since the RMC calculated in new appendix J would be closer to the initial moisture content of 57.5 percent specified in appendix D2. (*Id*.) The Joint Commenters also added that their proposed RMC adjustment calculation would not add any test burden since the calculation would only affect the post-processing of the data, which could be automated. (*Id*.)

The Joint Efficiency Advocates similarly recommended that DOE include RMC adjustment factors to account for the difference in RMCs between DOE test cloth load

and "real-world" clothing. (Joint Efficiency Advocates, No. 28 at p. 5) The Joint Efficiency Advocates cited findings from the 2020 NEEA Report that clothes washers removed substantially more water from the DOE test cloth loads (36 percent RMC, on average) than the AHAM cotton test loads (65 percent RMC, on average). (*Id.*) The Joint Efficiency Advocates therefore concluded that RMC and the resulting drying energy are likely being underestimated in the current test procedure. (*Id.*) The Joint Efficiency Advocates commented that it is important for each of the components of clothes washer energy use (drying energy, water heating energy, *etc.*) to be correctly weighted. (*Id.*) The Joint Efficiency Advocates further explained that if two clothes washers have the same efficiency rating, but one optimizes hot water usage and the other optimizes spin speed or duration to lower the RMC, then the models that optimize spin speed/duration may have different real-world efficiencies if RMC is underestimated. (*Id.*) The Joint Efficiency Advocates recommended implementing an RMC adjustment factor similar to the one presented in the 2020 NEEA Report. (*Id.*)

In response to the Joint Commenters' and Joint Efficiency Advocates' recommendations that DOE include RMC adjustment factors to account for the difference in RMC values between DOE test cloth load and what the commenters described as "real-world" clothing, DOE reiterates that the current test cloth was developed to be representative of the range of fabrics comprising consumer wash loads, including 100-percent cotton, cotton/polyester blend, and 100-percent synthetic articles. As such, DOE intends for the specified test load to be nationally and seasonally representative of clothing used across all regions of the United States. DOE recognizes that consumer clothing (including fabric composition) likely differs between warmer and colder climates, between urban and rural households, between regions that do and do not experience seasonal changes, and among population demographics (*e.g.*, household size, age of household members, *etc.*). While DOE acknowledges that 100-percent cotton

clothing may be more common among certain regions or demographics, the commenters have not presented any data—nor is DOE aware of any data—indicating that 100-percent cotton clothing is nationally, seasonally, or demographically representative across the United States. DOE asserts that the 50-percent cotton/50-percent polyester material currently specified represents the middle of the spectrum between 100-percent cotton and 100-percent synthetic fabric types and therefore is representative of an average use cycle or period of use.

For these reasons, DOE is not implementing an RMC adjustment factor to account for the difference in RMC between the DOE test cloth and a 100-percent cotton load. However, in light of the feedback received regarding test cloth specifications, DOE will continue to evaluate the representativeness of test results obtained through the use of the current test cloth requirements in the DOE test procedures. DOE will also continue to monitor the development of industry standards and other efforts related to test cloth and test load composition.

2. Consolidation to Appendix J3

Appendix J3 specifies a qualification procedure that must be conducted on all new lots of energy test cloth prior to the use of such test cloths in any clothes washer test procedure. This qualification procedure provides a set of correction factors that correlate the measured RMC values of the new test cloth lot with a set of standard RMC values established as the historical reference point. These correction factors are applied to the RMC test results in section 3.8.2.6 of appendix J2 to ensure the repeatability and reproducibility of test results performed using different lots of test cloth. The measured RMC of each clothes washer has a significant impact on the final IMEF value.

In the September 2021 NOPR, DOE proposed several structural changes to appendix J3 to consolidate all of the test cloth specifications and procedures (some of which were previously located in appendix J2) that must be evaluated on each new lot of

test cloth. 86 FR 49140, 49188. Consolidating into a single test procedure would improve the overall logical flow of both test procedures and clarify that the test cloth procedures need not be conducted for each clothes washer under test. *Id*. As described further, the proposed changes would remove from appendix J2 those specifications and procedures that were not intended to be completed for every clothes washer test. *Id*. The proposed edits also would formally codify additional qualification procedures that are currently conducted for every new lot of test cloth. *Id*.

a. Test Cloth Requirements in Appendix J2

Section 2.7 of appendix J2 ("Test cloths") previously contained specifications and procedures regarding the test cloth. Sections 2.7.1 and 2.7.2 specified the unfinished and finished dimensions, maximum lifetime, and marking requirements for energy test cloth and energy stuffer cloths, respectively. These sections also specified that mixed lots of material must not be used for testing. Section 2.7.3 specified a procedure for preconditioning new test cloth, which requires performing a series of five wash cycles on all new (unused) test cloths before the cloth can be used for clothes washer tests. Section 2.7.4 provided the material specifications (fabric type, fabric weight, thread count, and fiber content) for the energy test cloths and energy stuffer cloths, as well as three industry test methods that must be performed to confirm the absence of any water-repellent finishes and to measure the cloth shrinkage after preconditioning. Section 2.7.5 referenced appendix J3 for performing the standard extractor procedure to measure the moisture absorption and retention characteristic of each new lot of cloth.

Several of these provisions previously contained within section 2.7 of appendix J2 are not intended to be conducted as part of each individual clothes washer test performed under appendix J2. Based on discussions with the AHAM Test Cloth Task Force, DOE is aware that some of the test cloth provisions previously in section 2.7 of appendix J2 are performed by a third-party laboratory on each new lot of test cloth, avoiding the need for

manufacturers and test laboratories to perform the same procedures for each individual clothes washer test. 85 FR 31065, 31071.

In the September 2021 NOPR, DOE proposed to move most of the specifications from section 2.7 of appendix J2 to appendix J3. 86 FR 49140, 49188. Section 2.7 of appendix J2 would retain the following specifications, which are relevant to the conduct of individual clothes washer tests: the maximum lifetime specification, marking requirements, and the requirement that mixed lots of material must not be used for testing. 86 FR 49140, 49188–49189. All other specifications from section 2.7 of appendix J2 would be moved to appendix J3. 86 FR 49140, 49189. DOE proposed to add a general statement in section 2.7 of appendix J2 that the test cloth material and dimensions must conform to the specifications in appendix J3. *Id*. These proposed changes would also be reflected in the proposed new appendix J. *Id*.

In the September 2021 NOPR, DOE requested comment on its proposal to consolidate into appendix J3 the test cloth specifications and procedures from section 2.7 of appendix J2 that are not intended to be conducted as part of each individual clothes washer test performed under appendix J2. *Id*.

The Joint Commenters commented in support of consolidating test cloth instructions into appendix J3, stating that it would increase clarity of the test procedure. (Joint Commenters, No. 31 at p. 11)

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to consolidate into appendix J3 the test cloth specifications and procedures from section 2.7 of appendix J2 that are not intended to be conducted as part of each individual clothes washer test performed under appendix J2.

b. Test Cloth Requirements in Appendix J3

Industry has developed a process by which the qualification procedure described above is performed by a third-party laboratory, and the results are reviewed and approved by the AHAM Test Cloth Task Force, after which the new lot of test cloth is made available for purchase by manufacturers and test laboratories. 85 FR 31065, 31071.

As noted in the September 2021 NOPR, DOE received a request from members of the AHAM Test Cloth Task Force to add to appendix J3 additional steps to the qualification procedure that have historically been performed on each new lot of test cloth to ensure uniformity of RMC test results on test cloths from the beginning, middle, and end of each new lot. *Id*. Industry practice is to perform this "uniformity check" before conducting the procedure to develop the RMC correction factors currently specified in the DOE test procedure, as described previously. *Id*. Specifically, the uniformity check involves performing an RMC measurement on nine bundles of sample cloth representing the beginning, middle, and end locations of the first, middle, and last rolls of cloth in a new lot. *Id*. The coefficient of variation across the nine RMC values must be less than or equal to 1 percent for the test cloth lot to be considered acceptable for use. *Id*.

In the September 2021 NOPR, DOE proposed to codify in appendix J3 this "uniformity check" and to restructure appendix J3 to improve the overall logical flow of the procedure. 86 FR 49140, 49189.

The sections of appendix J3 were previously structured as follows: (1) Objective; (2) Definitions; (3) Testing Conditions; (4) Test Loads; (5) Test Measurements; (6) Calculation of RMC Correction Curve; and (7) Application of the RMC Correction Curve.

In the September 2021 NOPR, DOE proposed to update the objectives included in section 1 to specify that appendix J3 now includes: (1) specifications for the energy test

cloth to be used for testing clothes washers; (2) procedures for verifying that new lots of energy test cloth meet the defined material specifications; and (3) procedures for developing the RMC correction coefficients. *Id.*

In section 2 of appendix J3, DOE proposed to add a definition for the term "roll," which refers to a subset of a lot, and to remove the definition of roll from appendix J2. *Id*.

DOE proposed to create a new section 3, "Energy Test Cloth Specifications," that would specify the test cloth material, dimensions, and use requirements as previously specified in section 2.7 of appendix J2. *Id.*

DOE proposed to change the title of previous section 3 of appendix J3, newly renumbered as section 4, from "Testing Conditions" to "Equipment Specifications." *Id.* This section would contain the specifications for the extractor (previously specified in section 3.2) and the bone-dryer (previously specified in section 3.3). *Id*. DOE proposed to merge the previous specification in section 3.1 of appendix J3 (which specified the extractor spin conditions to be used) with the proposed edits to newly renumbered section 8 ("RMC Correction Curve Procedure"), as described below. *Id*.

DOE proposed to create a new section 5, "Pre-Conditioning Instructions," in appendix J3 that would specify the instructions for preconditioning test cloth, as previously specified in section 4.1 of appendix J3, with a clarifying wording change. *Id*. The second paragraph of section 4.1 in appendix J3 previously specified "Perform five complete wash-rinse-spin cycles, the first two with current AHAM Standard detergent Formula 3 and the last three without detergent." The last sentence of that paragraph specified: "Repeat the cycle with detergent and then repeat the cycle three additional times without detergent, bone drying the load between cycles (for a total of five complete wash-rinse-spin cycles)." In the September 2021 NOPR, DOE expressed concern that the wording of the last sentence could be misconstrued as requiring the repeating of the entire

sequence of five wash-rinse-spin cycles specified in the first sentence. *Id*. To avoid this potential misinterpretation, DOE proposed to replace the last sentence with the following: "Dry the load to bone-dry between each of the five wash/rinse-spin cycles." *Id*.

DOE proposed to create a new section 6, "Extractor Run Instructions," in appendix J3 that would specify the instructions for testing test cloth in the extractor at specific spin speed and time conditions, as previously listed in sections 5.1 through 5.10 of appendix J3, with some minor organizational changes. *Id*.

DOE proposed to create a new section 7, "Test Cloth Material Verification Procedure," in appendix J3 that codifies the "uniformity check" procedure described above. *Id*.

DOE proposed to add a new section 8, "RMC Correction Curve Procedure," in appendix J3, which would consolidate the provisions previously specified in sections 5 and 6 of appendix J3. 86 FR 49140, 49189–49190.

DOE proposed to renumber section 7 to section 9 in appendix J3 and to update any applicable cross references. 86 FR 49140, 49190.

Finally, given the broader scope of appendix J3 as proposed by these amendments, DOE proposed to rename appendix J3 from "Uniform Test Method for Measuring the Moisture Absorption and Retention Characteristics of New Energy Test Cloth Lots" to "Energy Test Cloth Specifications and Procedures for Determining Correction Coefficients of New Energy Test Cloth Lots." *Id.*

DOE requested comment on its proposed edits to appendix J3 to codify the "uniformity check" procedure and to restructure appendix J3 to improve the overall logical flow of the procedure. *Id*.

AHAM commented in support of DOE's proposed structural changes to appendix J3, and added that DOE's proposed changes are consistent with AHAM's work on this topic. (AHAM, No. 27 at p. 16)

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE is finalizing its proposal, consistent with the September 2021 NOPR, to codify the "uniformity check" procedure and to restructure appendix J3 to improve the overall logical flow of the procedure.

J. Product-Specific RMC Enforcement Provisions

DOE provides product-specific enforcement provisions for all clothes washers at 10 CFR 429.134(c), which specify provisions for determining RMC. 10 CFR 429.134(c)(1)(i) specifies that the measured RMC value of a tested unit will be considered the tested unit's final RMC value if the measured RMC value is within two RMC percentage points of the certified RMC value of the basic model (expressed as a percentage), or is lower than the certified RMC value. 10 CFR 429.134(c)(1)(ii) specifies that if the measured RMC value of a tested unit is more than two RMC percentage points higher than the certified RMC value of the basic model, DOE will perform two additional replications of the RMC measurement procedure, each pursuant to the provisions of section 3.8.5 of appendix J2, for a total of three independent RMC measurements of the tested unit. The average of the three RMC measurements will be the tested unit's final RMC value and will be used as the basis for the calculation of per-cycle energy consumption for removal of moisture from the test load for that unit.

As described in sections I.B and III.I of this document, DOE uses the procedures specified in appendix J3 to evaluate the moisture absorption and retention characteristics of each new lot of test cloth. The results are used to develop a unique correction curve for each new lot of test cloth, which helps ensure that a consistent RMC measurement is obtained for any test cloth lot used during testing. The correction factors developed for each new cloth lot are used to adjust the "uncorrected" RMC measurements obtained

when performing an appendix J2 test on an individual clothes washer model.[70] Without the application of correction factors, the uncorrected RMC values for a given spin setting can vary by more than 10 RMC percentage points. The application of correction factors is intended to significantly reduce this lot-to-lot variation in RMC results.

In the September 2021 NOPR, DOE noted that multiple interested parties have presented confidential data to DOE suggesting that despite the application of correction factors, the "corrected" RMC values can vary by up to three RMC percentage points among different test cloth lots. 86 FR 49140, 49190. A variation of three RMC percentage points can lead to over a 5-percent variation in IMEF rating.[71] DOE conducted an internal analysis of the confidential data, in which DOE investigated three potential sources of the observed variation in corrected RMC values: (1) test-to-test variation masking as lot-to-lot variation; (2) spin cycle anomalies masking as lot-to-lot variation; and (3) choice of Lot 3 as the reference lot.[72] *Id*. Based on DOE's investigations, none of these three hypotheses explained the observed lot-to-lot variation in corrected RMC values in the data presented by the interested parties. *Id*.

Based on these investigations, DOE preliminarily concluded in the September 2021 NOPR that although the application of correction factors for each test cloth lot significantly reduces the lot-to-lot variation in RMC (from over 10 percentage points uncorrected), the current methodology may be limited to reducing lot-to-lot variation in corrected RMC to around three RMC percentage points. *Id*.

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[70] DOE maintains an historical record of the standard extractor test data and final correction curve coefficients for each approved lot of energy test cloth. These are available through DOE's web page for standards and test procedures for residential clothes washers at *www.energy.gov/eere/buildings/downloads/clothes-washer-test-clothcorrection-factor-information.*

[71] See discussion in the August 2015 Final Rule in which DOE described that limiting RMC variation to 2 RMC percentage points would limit the variation in the overall MEF_{J2} or IMEF calculation to roughly 5 percent. 80 FR 46730, 46756.

[72] The RMC characteristics of historical Lot 3 represent the "standard RMC values" defined in Table 6.1 of appendix J3.

Recognizing this potential for lot-to-lot variation of up to three RMC percentage points (corrected), DOE proposed to extend its product-specific enforcement provisions for clothes washers to accommodate up to a 3-percentage point variation in the corrected RMC measurement based on the test cloth lot used for testing. *Id*. The following paragraphs describe the approach proposed by DOE in the September 2021 NOPR.

DOE proposed to modify the text of 10 CFR 429.134(c)(1) to state that its provisions address anomalous RMC results that are not representative of a basic model's performance, as well as differences in RMC values that may result from DOE using a different test cloth lot than was used by the manufacturer for testing and certifying the basic model. *Id*.

DOE proposed to specify the enforcement provisions when testing according to the proposed new appendix J at 10 CFR 429.134(c)(1)(i), and when testing according to appendix J2 at 10 CFR 429.134(c)(1)(ii). *Id*.

Under the provisions for appendix J2, DOE proposed new paragraph (ii)(A), which would specify that the procedure for determining RMC will be performed once in its entirety, pursuant to the test requirements of section 3.8 of appendix J2, for each unit tested (as currently specified at 10 CFR 429.134(c)(1)). *Id*.

DOE proposed new paragraph (ii)(B), which would specify that if the measured RMC value of a tested unit is equal to or lower than the certified RMC value of the basic model (expressed as a percentage), the measured RMC value will be considered the tested unit's final RMC value and will be used as the basis for the calculation of per-cycle energy consumption for removal of moisture from the test load for that unit (consistent with the current specifications at 10 CFR 429.134(c)(1)(i)). *Id.*

DOE proposed new paragraph (ii)(C), which would specify that if the difference between the measured RMC value and the certified RMC value of the basic model is less than or equal to two RMC percentage points, the measured RMC value of a tested unit

will be considered the tested unit's final RMC value unless DOE used a different test cloth lot than was used by the manufacturer for testing and certifying the basic model; in which case, DOE may apply the proposed new paragraph (c)(1)(ii)(E) of the same section if the difference between the measured and certified RMC values would affect the unit's compliance with the applicable standards. *Id*.

DOE proposed new paragraph (ii)(D)—which would address anomalous RMC results that are not representative of a basic model's performance—specifying that if the measured RMC value of a tested unit is more than two RMC percentage points higher than the certified RMC value of the basic model, DOE will perform two replications of the RMC measurement procedure, each pursuant to the provisions of section 3.8.5 of appendix J2, for a total of three independent RMC measurements of the tested unit; and that average of the three RMC measurements will be calculated (as currently specified at 10 CFR 429.134(c)(1)(ii)). 86 FR 49140, 49190–49191. Within this section, DOE proposed a new paragraph (ii)(D)(1) that would specify that if the average of the three RMC measurements is equal to or lower than the certified RMC value of the basic model, the average RMC value will be considered the tested unit's final RMC value. 86 FR 49140, 49191. A new proposed paragraph (ii)(D)(2) would specify that if the average of the three RMC measurements is higher than the certified RMC value of the basic model, the average RMC value will be considered the tested unit's final RMC value unless DOE used a different test cloth lot than was used by the manufacturer for testing and certifying the basic model; in which case, DOE may apply a new proposed paragraph (c)(1)(ii)(E) of the same section if the difference between the average and certified RMC values would affect the unit's compliance with the applicable standards. *Id*.

The proposed new paragraph (ii)(E)—which would address differences in RMC values that may result from DOE using a different test cloth lot—would specify two potential courses of action if DOE uses a different test cloth lot than was used by the

manufacturer for testing and certifying the basic model. *Id*. New paragraph (ii)(E)(1) would specify that if the difference between the tested unit's measured RMC value (or average RMC value pursuant to the new proposed paragraph (c)(1)(ii)(D) of the same section) and the certified RMC value of the basic model is less than or equal to three RMC percentage points, then the certified RMC value of the basic model may be considered the tested unit's final RMC value. *Id*. New proposed paragraph (ii)(E)(2) would specify that if the tested unit's measured RMC value (or average RMC value pursuant to paragraph (c)(1)(ii)(D) of the same section) is more than three RMC percentage points higher than the certified RMC value of the basic model, then a value three RMC percentage points less than the measured RMC value may be considered the tested unit's final RMC value. *Id*.

For testing conducted according to the proposed new appendix J, several modifications would be made to the procedures described for appendix J2 due to the revised methodology for measuring RMC in the proposed new appendix J, as described in section III.D.4 of this document (specifically, that in the proposed new appendix J, RMC would be measured for each individual test cycle as opposed to measured using a separate set of additional test cycles, as is required by appendix J2). *Id*. The provisions for the proposed new appendix J would not include the specifications for 10 CFR 429.134(c)(1)(ii)(A) or 10 CFR 429.134(c)(1)(ii)(D) as described previously. *Id*.

In the September 2021 NOPR, DOE requested comment on its proposal to extend its product-specific enforcement provisions for clothes washers to accommodate up to a 3-percentage point variation in the corrected RMC measurement based on the test cloth lot used for testing. *Id*. DOE also requested comment on alternate enforcement approaches that could be implemented. *Id*.

The CA IOUs recommended that DOE consider obtaining samples from each test cloth lot and use the applicable lot when conducting compliance testing to reduce the

need to use the three percent tolerance for the RMC enforcement provisions, as was proposed in new appendix J. (CA IOUs, No. 29 at p. 7) The CA IOUs also recommended that DOE add the test cloth lot number to the certification data collection sheets for RCWs and CCWs to aid in DOE's compliance efforts. (*Id.*)

Whirlpool recommended that DOE use decision tree flow charts for the product-specific RMC enforcement provisions, similar to the charts used in Figures 2.12.1-2.12.5 in section 2.12 of appendix J2. (Whirlpool, No. 26 at pp. 11–13) Whirlpool commented that a flowchart would help provide further clarity for stakeholders. (*Id.*) Whirlpool also attached drafts of the two suggested flow charts for initial consideration by DOE. (*Id.*)

Whirlpool also suggested edits to the wording of the proposed product-specific enforcement provisions found in 10 CFR 429.134(c) in order to add clarity. (Whirlpool, No. 26 at pp. 13–14) In 10 CFR 429.134(c)(i)(C)(1), Whirlpool suggested that instead of, "If the difference between the tested unit's measured RMC value and the certified RMC value of the basic model is less than or equal to three RMC percentage points, then the certified RMC value of the basic model may be considered the tested unit's final RMC value," DOE should use the following wording, "If the tested unit's measured RMC value is more than the certified RMC value of the basic model and is less than or equal to three RMC percentage points higher than the certified RMC value, then the certified RMC value of the basic model may be considered the tested unit's final RMC value." (*Id.*) Whirlpool suggested similar wording changes to increase the parallelism of the language for 10 CFR 429.134(c)(ii)(C) and 10 CFR 429.134(c)(ii)(E)(1). (*Id.*)

Whirlpool also suggested that instead of using the word "may" in 10 CFR 429.134(c)(i)(B), 10 CFR 429.134(c)(i)(C)(1), 10 CFR 429.134(c)(i)(C)(2), 10 CFR 429.134(c)(ii)(C), 10 CFR 429.134(c)(ii)(E)(1) and 10 CFR 429.134(c)(ii)(E)(2), DOE should use the word "will." (*Id.*) Whirlpool stated that using "may" is troublesome

because of its ambiguous nature in particular due to its use in an enforcement provision. (*Id*.)

DOE notes it is not amending the certification or reporting requirements for clothes washers in this final rule to require reporting of test cloth lot. Instead, DOE may consider proposals to amend the certification requirements and reporting for RCWs and CCWs under a separate rulemaking regarding appliance and equipment certification.

In response to the CA IOUs' suggestion that DOE obtain samples from each test cloth lot and use the applicable lot when conducting compliance testing, DOE notes that this approach would not be feasible due to the nature of how test laboratories acquire and use test cloth. Test cloth is produced in large batches (*i.e.*, lots) by a single textile manufacturer. A new test cloth lot is produced roughly every year. Test laboratories typically purchase in bulk whichever test cloth lot is available at the time of purchase. Depending on a laboratory's testing throughput, each bulk purchase of a particular lot may provide enough material for several years of testing. As a result, in DOE's experience, test laboratories typically do not have test cloth available from every test cloth lot, and will typically only have a few lots available at a time. DOE conducts enforcement testing using certified third-party test laboratories, and therefore during such testing only has access to that test laboratory's supply of any given test cloth lot.

DOE appreciates Whirlpool's detailed suggested edits the wording of the product-specific RMC enforcement provisions, has reviewed Whirlpool's proposals, and is making some clarifying changes to the wording to 10 CFR 429.134(c)(1) consistent with the intent of the wording as presented in the September 2021 NOPR.

In the September 2021 NOPR, DOE proposed to use the phrase "may apply," as opposed to "will apply" (or "shall apply") to allow for appropriate discretion by DOE and allow DOE to not need to seek the test cloth lot information from the manufacturer in every such case, since lot number is not a reported value. 86 FR 49140, 49190. In this

final rule, DOE has determined that the wording of 10 CFR 429.134 would require DOE to seek test cloth lot information from the manufacturer only for cases in which the difference between the measured and certified RMC values would affect the unit's compliance with the applicable standards. DOE agrees that use of the word "will" instead of "may" would provide greater certainty to describe DOE's course of action during enforcement testing. Therefore, DOE is revising the wording of the language in proposed 10 CFR 429.134(c)(i)(B), 10 CFR 429.134(c)(i)(C)(1), 10 CFR 429.134(c)(i)(C)(2), 10 CFR 429.134(c)(ii)(C), 10 CFR 429.134(c)(ii)(E)(1) and 10 CFR 429.134(c)(ii)(E)(2) to use the phrase "will" instead of "may."

In this final rule, DOE is also re-ordering the RMC enforcement provisions within 10 CFR 429.134(c)(1) to improve the logical flow of the revised enforcement provisions. Furthermore, to aid in understanding these product-specific RMC enforcement provisions via visual representation, DOE is providing informative flow charts in the docket for this rulemaking, available at *www.regulations.gov/docket/EERE-2016-BT-TP-0011/document*. The logical flow through the finalized RMC enforcement provisions matches the logical flow through the flow chart.

In reviewing the language in 10 CFR 429.134, DOE determined an incompatibility in the language, which it is removing in this final rule. In the language as proposed in the September 2021 NOPR, paragraph (ii)(C)—which applied if the difference between the measured and certified RMC values is less than or equal to two RMC percentage points—cross-referenced proposed paragraph (ii)(E) if DOE used a different test cloth lot than was used by the manufacturer for testing and certifying the basic model and the difference between the measured and certified RMC values would affect the unit's compliance with the applicable standards. Within paragraph (ii)(E), paragraph (ii)(E)(*2*) as proposed applied to cases in which the measured RMC value is more than three RMC percentage points higher than the certified RMC value. DOE notes

that it would be impossible for a situation to arise in which the difference between the measured and certified RMC values is less than or equal to two RMC percentage points and in which the measured RMC value is more than three RMC percentage points higher than the certified RMC value (*i.e.*, it would be impossible for the provisions at proposed paragraph (ii)(C) to lead to proposed paragraph (ii)(E)(*2*)). DOE removes this incompatibility in this final rule.

This final rule also implements non-substantive wording changes to use more consistent language among each paragraph within 10 CFR 429.134(c)(1).

K. Test Procedure Costs, Harmonization

1. Test Procedure Costs and Impact

EPCA requires that test procedures proposed by DOE not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) The following sections discuss DOE's evaluation of estimated costs and savings associated with the amendments in this final rule.

a. Appendix J2 and Appendix J3 Amendments

In this document, DOE amends the existing test procedure for clothes washers by:

(1) Further specifying supply water temperature test conditions and water meter resolution requirements;

(2) Adding specifications for measuring wash water temperature using submersible data loggers;

(3) Expanding the load size table to accommodate clothes container capacities up to 8.0 ft^3;

(4) Defining user-adjustable adaptive WFCS;

(5) Specifying the applicability of the wash time setting for clothes washers with a range of wash time settings;

(6) Specifying how the energy test cycle flow charts apply to clothes washers that internally generate hot water;

(7) Specifying that the energy test cycle flow charts be evaluated using the Maximum load size;

(8) Specifying that testing is to be conducted with any network settings disabled if instructions are available to the user to disable these functions;

(9) Further specifying the conditions under which data from a test cycle would be discarded;

(10) Adding a product-specific enforcement provision to accommodate the potential for test cloth lot-to-lot variation in RMC;

(11) Deleting obsolete definitions, metrics, and the clothes washer-specific waiver section;

(12) Consolidating all test cloth-related specifications in appendix J3;

(13) Reorganizing sections of appendix J3 for improved readability; and

(14) Codifying the test cloth material verification procedure as used by industry.

In the September 2021 NOPR, DOE tentatively determined that the proposed amendments to appendix J2 and appendix J3 would not be unduly burdensome for manufacturers to conduct and would not result in the need for any re-testing. 86 FR 49140, 49191.

DOE requested comment on its characterization of the expected costs of the proposed amendments to appendix J2 and appendix J3 and on DOE's preliminary determination that the proposed amendments would not be unduly burdensome. *Id*. DOE received no comments on its characterization of the expected costs of the proposed amendments to appendix J2 and appendix J3. DOE has addressed in the preceding sections of this document comments regarding the related test procedure burdens associated with the amendments adopted in this final rule.

DOE has determined that the amendment to change the target inlet water temperatures to the midpoint of each defined range may reduce test burden by reducing

the potential for invalid cycles to occur due to a deviation in water temperatures outside the specified range.

DOE has determined that the amendment to require more precise hot water meters for clothes washers with hot water usage less than 0.1 gallons in any of the energy test cycles would require additional cost to upgrade existing water meters if a manufacturer or test laboratory expects to test such clothes washers but does not already have a water meter with the proposed more precise resolution. Based on a market survey of water meters, DOE determined the cost of a water meter that provides the proposed resolution, including associated hardware, to be around $600 for each device. DOE recognizes that laboratories may have multiple test stands, and that each test stand would likely be upgraded with the more precise hot water meter (if such an upgrade is required). As an example, for a laboratory with 10 test stands, the material cost associated with installing a more precise hot water meter would total approximately $6,000. However, as discussed, at least one manufacturer already uses water meters with the proposed more precise resolution, and DOE's experience working with third-party laboratories indicates that most, if not all, third-party laboratories already use water meters with this resolution. DOE has not included the potential costs associated with this amendment based on stakeholders' comments and DOE's knowledge of third-party laboratory capabilities that suggest that laboratories that test clothes washers with hot water usage less than 0.1 gallons already use water meters with the proposed more precise resolution.

The amendment to explicitly allow for the use of submersible temperature loggers specifies an additional means for determining wash water temperatures to confirm whether a wash temperature greater than 135 °F (defined as an Extra-Hot Wash) has been achieved during the wash cycle. As discussed, other methods for measuring wash water temperatures may provide inconclusive results, thus requiring retesting of cycles or additional "exploratory" testing to accurately determine the wash water temperature.

Explicitly providing for the use of submersible temperature loggers may avoid the need for such additional testing. Based on a market survey of submersible data loggers, the cost of a submersible data logger is around $230 for each device. As discussed, laboratories may have multiple test stands, and DOE expects that a laboratory would purchase a separate data logger for each test stand. As an example, for a laboratory with 10 test stands, the material cost associated with purchasing submersible data loggers for each test stand would total around $2,300. DOE expects that the recurring cost savings enabled by the use of submersible temperature loggers (due to reducing the need for re-testing certain cycles or performing additional exploratory testing) would substantially outweigh the one-time purchase cost associated with each device and therefore has not included this cost in its summary of costs associated with this final rule.

The amendment to extend the load size table applies only to clothes washers with capacities exceeding 6.0 ft^3. Any such clothes washers currently on the market have already been granted a test procedure waiver from DOE, which specifies the same extended capacity table.

The amendment to more explicitly define user-adjustable adaptive WFCS provides greater specification of DOE's existing definitions and could potentially alleviate test burden resulting from an incorrect application of the existing language. The amendments specifying updated language regarding cycle selection for clothes washers with a range of wash time settings are expected to improve repeatability and reproducibility without imposing any additional test burden. The amendment to specify how the energy test cycle flow charts apply to clothes washers that internally generate hot water reflects DOE's interpretation of the current Cold/Cold flowchart and subsequent flowcharts for the Warm Rinse temperature selections for this type of clothes washer; in addition, comments from interested parties suggest that this interpretation is generally consistent with that of manufacturers and third-party laboratories. The amendment to

specify that the energy test cycle flow charts be evaluated using the Maximum load size are expected to improve repeatability and reproducibility without imposing any additional test burden.

The amendment to specify that network settings must be disabled for testing under appendix J2 will impact only clothes washers with network settings that are enabled by default. DOE is not aware of any clothes washers currently on the market that meet these characteristics, and as such DOE does not expect this proposal to change how any current models are tested.

The amendment to add product-specific enforcement provisions to accommodate the potential for lot-to-lot variation in RMC will extend current product-specific enforcement provisions for clothes washers to accommodate up to a 3-percentage point variation in the corrected RMC measurement based on the test cloth lot used for testing, and will not impact manufacturers' testing costs.

The amendments to delete obsolete definitions, metrics, and the waiver section will not impact manufacturers' testing costs because these sections of the test procedure are no longer in use.

The amendment to move all test cloth-related sections of the test procedures into appendix J3 will simplify appendix J2 without any changes to the test conduct or cost to manufacturers. The amendment to add additional test cloth qualification procedures to appendix J3 will not affect manufacturer cost because the proposal would codify existing industry-standard practices.

For the reasons discussed in the preceding paragraphs and in the September 2021 NOPR, DOE has determined that the amendments to appendix J2 and appendix J3 adopted in this final rule are not unduly burdensome. Moreover, DOE has determined that the amendments to appendix J2 and appendix J3 would not alter the measure energy

and water efficiency of currently certified clothes washers and therefore would not require retesting or recertification.

b. Appendix J Test Procedure

In this document, DOE is creating a new appendix J that includes, in addition to the amendments discussed previously for appendix J2, significant additional changes that will affect the measured efficiency of a clothes washer. Because DOE will use the new appendix J for the evaluation and issuance of any updated efficiency standards, and for determining compliance with those standards, the use of the new appendix J will not be required until such a time as compliance with any amended energy conservation standards that are developed with consideration of new appendix J are required. The differences between appendix J2 and new appendix J are the following:

(1) Modifying the hot water supply temperature range;

(2) Modifying the clothes washer preconditioning requirements;

(3) Modifying the Extra-Hot Wash threshold temperature;

(4) Adding a measurement and calculation of average cycle time;

(5) Requiring the testing of no more than two Warm Wash/Cold Rinse cycles, and no more than two Warm Wash/Warm Rinse cycles;

(6) Measuring RMC on each cycle within the energy test cycle, rather than on cycles specifically dedicated to measuring RMC;

(7) Reducing the number of load sizes from three to two for units currently tested with three load sizes;

(8) Modifying the load size definitions consistent with two, rather than three, load sizes;

(9) Updating the water fill levels to be used for testing to reflect the modified load size definitions;

(10) Specifying the installation of single-inlet clothes washers, and simplifying the test procedure for semi-automatic clothes washers;

(11) Defining new performance metrics that are based on the weighted-average load size rather than clothes container capacity;

(12) Updating the final moisture content assumption in the drying energy formula;

(13) Updating the number of annual clothes washer cycles from 295 to 234; and

(14) Updating the number of hours assigned to low-power mode to be based on the clothes washer's average measured cycle time rather than an assumed fixed value.

In the September 2021 NOPR, DOE preliminarily concluded that the proposal to require measurement of cycle time is unlikely to result in an increase in test burden. 86 FR 49140, 49193. The proposal to require the measurement of cycle time could result in an increase in test burden if a laboratory is not currently measuring cycle time. However, although cycle time is not currently required to be measured, it is DOE's understanding that test laboratories already measure cycle time or use a data acquisition system to record electronic logs of each test cycle, from which average cycle time can be readily determined such that any increase in test burden would be *de minimis*.

DOE further tentatively concluded in the September 2021 NOPR that none of the other proposed changes for appendix J would result in an increase in test burden. 86 FR 49140, 49193. In the September 2021 NOPR, DOE tentatively determined that several of the proposed changes would result in a substantial decrease in test burden, an average savings of $348 per basic model of RCW and $153 per basic model of CCW. 86 FR 49140, 49193–49194.

DOE did not receive any comments regarding the test burden, average costs or savings of the proposed appendix J. In this final rule, DOE determines, consistent with the September 2021 NOPR, that the new appendix J will not result in any increase in test

burden, as compared to appendix J2, and that it will result in a decrease in test burden. DOE based its determination on the following.

To determine the potential savings to manufacturers, DOE first estimated the number of RCW and CCW models that are currently certified, using data from DOE's publicly available CCMS database.[73] DOE identified approximately 25 manufacturers selling an estimated 718 basic models of RCWs and 43 basic models of CCWs.

To enable an estimate of cost savings associated with specific features, as described in the paragraphs that follow, DOE developed representative market samples consisting of 100 basic models of RCWs and 10 basic models of CCWs (representing approximately 15 percent of the total basic models for each) that capture the range of available functionalities and options available to consumers. To develop these market samples, DOE selected a sample of basic models for which detailed product features could be determined from product brochures and other marketing materials, representing all major manufacturers and product designs currently on the market, and spanning all available efficiency levels.

Reducing the number of load sizes from three to two for units with an automatic WFCS will reduce test burden for all clothes washers with an automatic WFCS. DOE's representative market sample suggests that 11 percent of RCWs have a manual WFCS and therefore will experience no change in test burden as a result of this change. This being the case, 89 percent of RCWs on the market will experience a reduction in test burden as follows: 20 percent of RCWs will experience a reduction in test burden of 2 to 4 cycles; 54 percent of RCWs will experience a reduction in test burden of 5 to 8 cycles; and 15 percent of RCWs will experience a reduction in test burden of more than 9 cycles. DOE's representative market sample suggests that all CCWs have an automatic WFCS

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[73] *www.regulations.doe.gov/certification-data*. Last accessed on January 12, 2022.

and therefore DOE estimates that 70 percent of CCWs will experience a reduction in test burden of 3 or 4 cycles and that 30 percent of CCWs will experience a reduction in test burden of 5 cycles. *Id*. Based on these estimates, DOE estimates a weighted-average test burden reduction of 5.1 cycles per RCW, and 3.7 cycles per CCW.

Reducing the number of required test cycles by requiring the use of no more than two Warm/Cold cycles, and no more than two Warm/Warm cycles, will reduce the number of tested cycles for any clothes washer offering more than two Warm Wash temperatures. Based on DOE's representative market sample, DOE estimates that 49 percent of RCWs offer two or fewer Warm Wash temperature options and therefore will experience no change; 44 percent of RCWs will experience a reduction in test burden of 2 cycles; and 7 percent of RCWs will experience a reduction in test burden of 4 cycles. *Id*. DOE estimates that 70 percent of CCWs will experience no change and that 30 percent of CCWs will experience a reduction in test burden of 4 cycles. *Id*. Based on these estimates, DOE estimates a weighted-average additional test burden reduction of 1.2 cycles per RCW, and 0.6 cycles per CCW.[74]

Reducing the number of required test cycles by measuring RMC on each tested cycle instead of measuring it on dedicated RMC cycles will remove the need for one or more cycles used for measuring RMC for any clothes washer offering more than one spin speed selectable on the Normal cycle. Based on DOE's representative market sample, DOE estimates that 45 percent of RCWs will experience no change; 27 percent of RCWs will experience a reduction in test burden of 1 cycle; 27 percent of RCWs will experience a reduction in test burden of 2 cycles; and 1 percent of RCWs will experience a reduction in test burden of 4 cycles. DOE estimates that no CCWs will experience a reduction in

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[74] These savings assume the savings from reducing the number of load sizes have already been implemented.

test burden from this change. Based on these estimates, DOE estimates a weighted-average additional test burden reduction of 0.9 cycles per RCW.[75]

Simplifying the test procedure for semi-automatic clothes washers will reduce test burden for all semi-automatic clothes washers by 10 cycles. DOE has determined that approximately 2 percent of RCW basic models in the CCMS database are semi-automatic and is not aware of any semi-automatic CCWs. DOE therefore estimates a weighted-average additional test burden reduction of 0.2 cycles per RCW.

To estimate the cost savings associated with the changes that are expected to reduce the number of cycles required for testing, DOE estimated each RCW cycle to have a duration of 1 hour, and each CCW cycle to have a duration of 45 minutes. Based on data from the Bureau of Labor Statistics' ("BLS's") Occupational Employment and Wage Statistics, the mean hourly wage for mechanical engineering technologists and technicians is $29.27.[76] Additionally, DOE used data from BLS's Employer Costs for Employee Compensation to estimate the percent that wages comprise the total compensation for an employee. DOE estimates that wages make up 70.8 percent of the total compensation for private industry employees.[77] Therefore, DOE estimated that the total hourly compensation (including all fringe benefits) of a technician performing the testing is $41.34.[78]

Based on a January 2022 price list from the test cloth manufacturer, the cost of the test cloth required for performing testing is $7.16 per cloth.[79] Based on an average RCW

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[75] These savings assume the savings from reducing the number of load sizes and from reducing the number of Warm Wash temperature selections under test have already been implemented.
[76] DOE used the mean hourly wage of the "17– 3027 Mechanical Engineering Technologists and Technicians" from the most recent BLS Occupational Employment and Wage Statistics (May 2020) to estimate the hourly wage rate of a technician assumed to perform this testing. See *www.bls.gov/oes/current/oes173027.htm*. Last accessed on January 11, 2022.
[77] DOE used the September 2021 "Employer Costs for Employee Compensation" to estimate that for "Private Industry Workers," "Wages and Salaries" are 70.8 percent of the total employee compensation. See *www.bls.gov/news.release/pdf/ecec.pdf*. Last accessed on January 11, 2022.
[78] $29.27 ÷ 0.708 = $41.34.
[79] *testgewebe.de/en/products/ballast-loads-base-load-textiles/doe-energy-test-cloth/*. Last accessed and converted to U.S. dollars on January 11, 2022.

capacity of 4.14 ft^3,[80] the load sizes associated with testing an average-capacity RCW,[81] and the maximum allowable usage of 60 test cycles per cloth,[82] DOE estimates a total material cost of $5.13 per wash cycle on average across all RCWs on the market. 86 FR 49140, 49193–49194. Using these material costs, labor rates and time estimates, DOE estimates that the reduction in burden of a single test cycle on an RCW will provide $46.47 in costs savings[83] for tests conducted at an in-house test facility. Based on discussions with manufacturers over the course of multiple rulemakings, DOE understands that the majority of manufacturer testing is conducted at in-house test facilities.

Based on an average CCW capacity of 3.17 ft^3,[84] the load sizes associated with testing an average-capacity CCW,[85] and the maximum allowable usage of 60 test cycles per cloth, DOE estimates a total material cost of $4.18 per wash cycle on average across all CCWs on the market. Using these material costs, labor rates and time estimates, DOE estimates that the reduction in burden of a single test cycle on a CCW will provide $35.19 in costs savings[86] for tests conducted at an in-house test facility.

Based on these estimates, DOE has determined that the use of new appendix J will result in a total burden reduction of 7.4 cycles per RCW on average, which results in an average saving of $344 per basic model of RCW.[87] For CCWs, use of new appendix J

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[80] AHAM Trends in Energy Efficiency, 2018.
[81] The load sizes associated with a 4.14 ft^3 clothes washer are 3.0 lb (minimum), 10.0 lb (average), and 17.0 lb (maximum) under appendix J2; and 6.1 lb (small) and 13.65 lb (large) under new appendix J, resulting in an average load size of 10.0 lb under appendix J2 or 9.9 lb under appendix J. For the purpose of the calculations in this analysis, DOE used 10.0 lb to represent the average load size.
[82] Section 2.7.1 of appendix J2 specifies that each energy test cloth must not be used for more than 60 test runs (after preconditioning).
[83] 1 × $41.34 + $5.13 = $46.47.
[84] DOE calculated the average CCW capacity based on the average capacity of the representative sample of CCWs presented in chapter 5 of the technical support document accompanying the December 2014 Final Rule. Available at *www.regulations.gov/document/EERE-2012-BTSTD-0020-0036*.
[85] The load sizes associated with a 3.17 ft^3 clothes washer are 3.0 lb (minimum), 7.95 lb (average), and 12.9 lb (maximum) under appendix J2; and 5.2 lb (small) and 10.55 lb (large) under new appendix J, resulting in an average load size of 7.95 lb under appendix J2 or 7.9 lb under appendix J. For the purpose of the calculations in this analysis, DOE used 7.95 lb to represent the average load size.
[86] 0.75 × $41.34 + $4.18 = $35.19.
[87] 7.4 × $46.47 = $344.

will result in a total burden reduction of 4.3 cycles per CCW on average, which results in an average saving of $151 per basic model of CCW.[88]

Based on these estimates, DOE determines that the new test procedure at appendix J is not unduly burdensome for manufacturers to conduct.

2. Harmonization with Industry Standards

DOE's established practice is to adopt relevant industry standards as DOE test procedures unless such methodology would be unduly burdensome to conduct or would not produce test results that reflect the energy efficiency, energy use, water use (as specified in EPCA) or estimated operating costs of that product during a representative average use cycle or period of use. Section 8(c) of appendix A of 10 CFR part 430 subpart C; 10 CFR 431.4. In cases where the industry standard does not meet EPCA statutory criteria for test procedures, DOE will make modifications through the rulemaking process to these standards as the DOE test procedures.

The test procedures for clothes washers at the new appendix J and appendix J2 and appendix J3 incorporate by reference certain provisions of IEC Standard 62301 that provide test conditions, testing equipment, and methods for measuring standby mode and off mode power consumption. These appendices also reference AATCC test methods for qualifying new batches of test cloth, and AHAM Standard Test Detergent Formula 3 for preconditioning new test cloths. DOE is not aware of any existing industry test procedures for clothes washers that measure energy and water efficiency.

DOE is aware of two clothes washer test procedures established by industry: AHAM HLW–2–2020 and IEC 60456. AHAM's existing clothes washer procedure, AHAM HLW–2–2020, does not include a procedure for measuring energy and water. IEC 60456 includes tests for water and energy use, water extraction (*i.e.*, RMC), washing

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[88] 4.3 × $35.19 = $151.

performance, rinsing performance, and wool shrinkage. DOE noted several key differences between IEC 60456 and DOE's test procedure, including:

(1) IEC 60456 uses manufacturer-declared capacity or, in the absence of a declared capacity, specifies two alternative capacity measurement procedures: a table tennis ball method (in which the drum is filled with table tennis balls) and a water fill method, which more closely resembles DOE's capacity measurement method. However, the water fill method for top-loading clothes washers corresponds to "Fill Level 1," as defined in the March 2012 Final Rule, in contrast to DOE's currently specified "Fill Level 2."

(2) IEC 60456 defines two types of load materials that can be used: a 100- percent cotton load, consisting of sheets, pillowcases, and towels; or a synthetics/blends load (65-percent polyester, 35-percent cotton), consistent of men's shirt and pillowcases. IEC 60456 requires a distribution in age (*i.e.*, number of cycles that have been performed) for each different item type comprising the load.

(3) The procedure for determining water and energy consumption (Section 8.6 of IEC 60456) specifies that the test load shall be subjected to "performance" testing, which requires operating a reference clothes washer in parallel with the unit under test; using a test load that includes stain strips used to evaluate cleaning performance; and using detergent as specified.

(4) IEC 60456 does not define the "Normal" cycle or energy test cycle; rather, the procedures in IEC 60456 are generic and can be applied to any wash program or cycle selections defined by the tester.

In the September 2021 NOPR, DOE tentatively concluded that IEC 60456 does not meet EPCA statutory criteria, in that IEC 60456 would be unduly burdensome to conduct and would not produce test results that reflect the energy efficiency, energy use,

water use, or estimated operating costs of a clothes washer during a representative average use cycle or period of use for a U.S. consumer. 86 FR 49140, 49194.

The Joint Commenters commented in disagreement with DOE's assessment that the industry-developed IEC 60456 test procedure is significantly more burdensome to conduct and less representative than DOE's own test procedure. (Joint Commenters, No. 31 at pp. 9–10) The Joint Commenters commented that IEC 60456 has the benefit of industry familiarity, asserting that U.S. and European manufacturers use this test procedure to verify that their European models meet European energy standards. (*Id.*) The Joint Commenters also commented that IEC 60456 can represent U.S.-specific test conditions, including use of the Normal cycle and specific load sizes. (*Id.*) The Joint Commenters added that IEC 60456 uses a more representative 100 percent cotton test cloth, which the Joint Commenters asserted is more representative of real textiles. (*Id.*) The Joint Commenters also commented that using IEC 60456 could possibly increase the availability of European models in the U.S. market, since reducing the U.S.-specific testing burden may enable manufacturers to build models for U.S. markets. (*Id.*) Lastly, the Joint Commenters commented that because the IEC 60456 test procedure is updated by industry, DOE could expend less effort on maintaining repeatability and reproducibility, and instead focus updates on additional instructions needed to ensure representation of U.S. consumer use. (*Id.*)

In response to the Joint Commenters' comments, DOE continues to assert that a test load that is 100 percent cotton is not more representative of consumer usage (as discussed in section III.I.1 of this document). For the reasons discussed, DOE maintains its conclusion from the September 2021 NOPR that IEC 60456 would be unduly burdensome to conduct and would not produce test results that reflect the energy efficiency, energy use, water use, or estimated operating costs of a clothes washer during a representative average use cycle or period of use for a U.S. consumer.

L. Effective and Compliance Dates

The effective date for the adopted test procedure amendments is 30 days after publication of this final rule in the *Federal Register*. EPCA prescribes that all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with an amended test procedure, beginning 180 days after publication of the final rule in the *Federal Register*. (42 U.S.C. 6293(c)(2); 42 U.S.C. 6314(d)(1)) EPCA provides an allowance for individual manufacturers to petition DOE for an extension of the 180-day period if the manufacturer may experience undue hardship in meeting the deadline. (42 U.S.C. 6293(c)(3); 42 U.S.C. 6314(d)(2)) To receive such an extension, petitions must be filed with DOE no later than 60 days before the end of the 180-day period and must detail how the manufacturer will experience undue hardship. (*Id.*) To the extent the modified test procedure adopted in this final rule is required only for the evaluation and issuance of updated efficiency standards, compliance with the amended test procedure does not require use of such modified test procedure provisions until the compliance date of updated standards.

Upon the compliance date of test procedure provisions in this final rule, any waivers that had been previously issued and are in effect that pertain to issues addressed by such provisions are terminated. 10 CFR 430.27(h)(3); 10 CFR 431.401(h)(3). Recipients of any such waivers are required to test the products subject to the waiver according to the amended test procedure as of the compliance date of the amended test procedure. The amendments adopted in this document pertain to issues addressed by waivers granted to Whirlpool and Samsung on May 2, 2016, and April 10, 2017, respectively. 81 FR 26215 (Case No. CW–026); 82 FR 17229 (Case No. CW–027). Specifically, both waivers specified load sizes for basic models with capacity larger than 6.0 ft^3. As discussed in section III.D.1.a of this document, this final rule expands Table

5.1 in both appendix J2 and the new appendix J to accommodate clothes washers with capacities up to 8.0 ft^3. Per 10 CFR 430.27(*l*), the publication of this final rule eliminates the need for the continuation of granted waivers. The publication of this final rule terminates these waivers consistent with 10 CFR 430.27(h)(3) and 10 CFR 430.27(*l*). Under 10 CFR 430.27(h)(3), the waivers automatically terminate on the date on which use of the amended appendix J2 test procedure is required to demonstrate compliance (*i.e.*, 180 days after publication of the final rule in the *Federal Register*).

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866 and 13563

Executive Order ("E.O.") 12866, "Regulatory Planning and Review," as supplemented and reaffirmed by E.O. 13563, "Improving Regulation and Regulatory Review, 76 FR 3821 (Jan. 21, 2011), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In

its guidance, the Office of Information and Regulatory Affairs ("OIRA") in the Office of Management and Budget ("OMB") has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit "significant regulatory actions" to OIRA for review. OIRA has determined that this final regulatory action does not constitute a "significant regulatory action" under section 3(f) of E.O. 12866. Accordingly, this action was not submitted to OIRA for review under E.O. 12866.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq*.) requires preparation of a final regulatory flexibility analysis ("FRFA") for any final rule where the agency was first required by law to publish a proposed rule 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 E.O. 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 website: *energy.gov/gc/office-general-counsel*.

DOE reviewed this final rule under the provisions of the Regulatory Flexibility Act and the policies and procedures 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.

DOE uses the Small Business Administration's ("SBA") small business size standards to determine whether manufacturers qualify as small businesses, which are listed by the North American Industry Classification System ("NAICS"). The SBA considers a business entity to be a small business if, together with its affiliates, it employs less than a threshold number of workers specified in 13 CFR part 121. The NAICS code for clothes washers is 335220, "Major Household Appliance Manufacturing." The threshold number for NAICS code 335220 is 1,500 employees.[89] This employee threshold includes all employees in a business's parent company and any other subsidiaries.

DOE reviewed its CCMS database and other publicly available data to identify original equipment manufacturers ("OEMs") of the products and equipment covered by this rulemaking. DOE then consulted individual company websites and subscription-based market research tools (*e.g.,* reports from Dun & Bradstreet[90]), to determine whether they meet the SBA's definition of a small business manufacturer. DOE screened out companies that do not offer products or equipment covered by this rulemaking, do not meet the definition of a "small business," or are foreign-owned and operated.

DOE identified 25 companies that import, private label, produce, or manufacture clothes washers. Of those 25 companies, DOE determined 15 are OEMs of the covered products and equipment. Of those 15 companies, one is a small domestic OEM that offers a single model of RCWs. DOE determined no small domestic OEMs manufacture CCWs.

In this final rule, DOE amends appendix J2 by (1) Further specifying supply water temperature test conditions and water meter resolution requirements; (2) Adding

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[89] Available online at: *www.sba.gov/document/support--table-size-standards*.
[90] The Dun & Bradstreet Hoovers subscription login is available at *app.dnbhoovers.com/*.

specifications for measuring wash water temperature using submersible data loggers; (3) Expanding the load size table to accommodate clothes container capacities up to 8.0 ft^3; (4) Defining "user-adjustable adaptive water fill control;" (5) Specifying the applicability of the wash time setting for clothes washers with a range of wash time settings; (6) Specifying how the energy test cycle flow charts apply to clothes washers that internally generate hot water; (7) Specifying that the energy test cycle flow charts are to be evaluated using the Maximum load size; (8) Specifying that testing is to be conducted with any network settings disabled if instructions are available to the user to disable these functions; (9) Further specifying the conditions under which data from a test cycle would be discarded; (10) Adding product-specific enforcement provisions to accommodate the potential for test cloth lot-to-lot variation in remaining moisture content ("RMC"); (11) Deleting obsolete definitions, metrics, and the clothes washer-specific waiver section; and (12) Moving additional test cloth related specifications to appendix J3.

In this final rule, DOE also updates 10 CFR part 430, subpart B, appendix J3, "Uniform Test Method for Measuring the Moisture Absorption and Retention Characteristics," by: (1) Consolidating all test cloth-related provisions, including those proposed to be moved from appendix J2; (2) Reorganizing sections for improved readability; and (3) Codifying the test cloth material verification procedure as used by industry.

DOE has determined that these amendments to appendix J2 and appendix J3 would not result in manufacturers needing to re-rate clothes washers. The amendment (1) to appendix J2 (*i.e.*, further specifying water meter resolution requirements) may require more precise hot water meters for clothes washers with hot water usage less than 0.1 gallons in any of the energy test cycles. However, DOE's analysis of the small manufacturer's product offering indicates that the amendment will not apply and no capital expenditures would be necessary for the business.

In this final rule, DOE also adds appendix J to 10 CFR part 430, subpart B, "Uniform Test Method for Measuring the Energy Consumption of Automatic and Semi-Automatic Clothes Washers," which will be used for the evaluation and issuance of any updated efficiency standards, as well as to determine compliance with the updated standards, should DOE determine that amended standards are warranted based on the criteria established by EPCA.[91] The new appendix J will include the following additional provisions beyond the amendments to appendix J2 that: (1) Modify the hot water supply temperature range; (2) Modify the clothes washer pre-conditioning requirements; (3) Modify the Extra-Hot Wash threshold temperature; (4) Add measurement and calculation of average cycle time; (5) Reduce the number of required test cycles by requiring the use of no more than two Warm Wash/Cold Rinse cycles, and no more than two Warm Wash/Warm Rinse cycles; (6) Reduce the number of required test cycles by removing the need for one or more cycles used for measuring RMC; (7) Reduce the number of load sizes from three to two for units currently tested with three load sizes; (8) Modify the load size definitions consistent with two, rather than three, load sizes; (9) Update the water fill levels to be used for testing to reflect the modified load size definitions; (10) Specify the installation of single-inlet clothes washers, and simplify the test procedure for semi-automatic clothes washers; (11) Define new performance metrics that are based on the weighted-average load size rather than clothes container capacity: "energy efficiency ratio," "active-mode energy efficiency ratio," and "water efficiency ratio;" (12) Update the final moisture content assumption in the drying energy formula; (13) Update the number of annual clothes washer cycles from 295 to 234; and (14) Update the number of hours assigned to low-power mode to be based on the clothes washer's measured cycle time rather than an assumed fixed value.

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[91] Information regarding the ongoing RCW and CCW energy conservation standards rulemakings can be found at docket numbers EERE–2017–BT–STD–0014 and EERE–2019–BT–STD–0044, respectively.

Due to the reduction in number of loads and number of wash cycles, the proposed new appendix J would be less burdensome than appendix J2 for industry. However, the small manufacturer would need to re-rate its one model when any future amended energy conservation standard requires the use of the proposed new appendix J. Taking into account the fully-burdened wage of a technician ($41.34/hour), the estimated time per wash cycle (1 hour for a RCW), the average cost of test cloth per RCW wash cycle ($5.13 of cloth), the estimated number of test cycles for the small entity's basic model (6 cycles), and the number of test units (2 units tested), DOE estimates the cost of re-rating one model would be less than $1,000.[92] Using subscription-based market research tools, DOE found the small business annual revenue to be approximately $6 million. DOE calculates the cost of re-rating one model to Appendix J to be less than 0.1 percent of revenue for the small manufacturer.

DOE identified 15 OEMs affected by this final rule. One OEM is a small entity that certifies a single basic model of RCW, in an industry with 718 basic models of RCWs. As discussed previously, the amendments to appendix J2 will result in zero costs to the small manufacturer and the proposed new appendix J would be less burdensome to conduct than appendix J2 for all manufacturers. Additionally, the new appendix J will have no impact before an amended energy conservation standard is adopted.

If and when amended energy conservation standards are adopted, DOE expects the new appendix J to have de minimis cost impacts on the small manufacturer. DOE estimated the cost to re-test the small entity's basic model to appendix J would be less than $1,000. DOE calculates this potential cost to be less than 0.1 percent of revenue for the one small manufacturer. Based on this analysis, DOE certifies that this final rule does not have a "significant economic impact on a substantial number of small entities," and

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[92] Additional detail can be found in section III.K.1.b "Test Procedure Costs and Impacts" of the test procedure Final Rule notice.

determined that the preparation of a FRFA is not warranted. DOE will transmit a certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of RCWs and CCWs must certify to DOE that their products comply with any applicable energy conservation standards. To certify compliance, manufacturers must first obtain test data for their products according to the DOE test procedures, 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 RCWs and CCWs. (See generally 10 CFR part 429.) 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 35 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.

DOE is not amending the certification or reporting requirements for RCWs or CCWs in this final rule. Instead, DOE may consider proposals to amend the certification requirements and reporting for RCWs and CCWs under a separate rulemaking regarding appliance and equipment certification. DOE will address changes to OMB Control Number 1910-1400 at that time, as necessary.

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 establishes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for RCWs and CCWs. 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, DOE has determined that adopting test procedures for measuring energy efficiency of consumer products and industrial equipment is consistent with activities identified in 10 CFR part 1021, appendix A to subpart D, A5 and A6. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

E.O. 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 E.O. 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 E.O. 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 this 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 E.O. 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of E.O. 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 E.O. 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 E.O. 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 E.O. 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. Pub. L. 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 *energy.gov/gc/office-general-counsel*. DOE examined this 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. This 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 E.O. 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). Pursuant to OMB Memorandum M-19-15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at *www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf*. DOE has reviewed this 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

E.O. 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 E.O. 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.

This regulatory action is not a significant regulatory action under E.O. 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 FTC concerning the impact of the commercial or industry standards on competition.

The modifications to the test procedure for clothes washers adopted in this final rule incorporates testing methods contained in certain sections of the following commercial standards: AATCC Test Method 79-2010, AATCC Test Method 118-2007, AATCC Test Method 135-2010, and IEC 62031. DOE has evaluated these standards and is unable to conclude whether it fully complies with the requirements of section 32(b) of the FEAA (*i.e.*, whether it was 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 competition of 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 this 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. Description of Materials Incorporated by Reference

In this final rule, DOE incorporates by reference the test standard published by AATCC, titled "Absorbency of Textiles," AATCC Test Method 79-2010. DOE also incorporates by reference the test standard published by AATCC, titled "Oil Repellency: Hydrocarbon Resistance Test," AATCC Test Method 118-2007. AATCC 79-2010 and AATCC 118-2007 are industry-accepted test procedure that verify the presence or absence of water repellent finishes on fabric by measuring the water absorbency and oil repellency of the fabric, respectively.

In this final rule, DOE incorporates by reference the test standard published by AATCC, titled "Dimensional Changes of Fabrics after Home Laundering," AATCC Test Method 135-2010. AATCC 135-2010 is an industry-accepted test procedure for measuring dimensional changes in fabric (*i.e.*, "shrinkage") due to laundering.

All three of these AATCC test methods are currently incorporated by reference for use in appendix J2. This final rule transfers the references to these test methods to appendix J3. Copies of AATCC test methods can be obtained from AATCC, P.O. Box 12215, Research Triangle Park, NC 27709, (919) 549-3526, or by going to www.aatcc.org.

In this final rule, DOE incorporates by reference the test standard published by IEC, titled "Household electrical appliances—Measurement of standby power," (Edition 2.0, 2011-01), IEC 62301. IEC 62301 is an industry-accepted test procedure for measuring standby energy consumption. IEC 62301 is currently incorporated by reference for use in appendix J2, which references specific provisions of the industry

standard. See 10 CFR 430.3(o)(6). This final rule includes the same references in the new appendix J.

Copies of IEC 62301 available from the American National Standards Institute, 25 W. 43rd Street, 4th Floor, New York, NY 10036, (212) 642-4900, or by going to webstore.ansi.org.

In this final rule, DOE adds a new section 0 (Incorporation by Reference) to appendix J2 listing the applicable sections of the incorporated test standard and specifying that in cases in which there is a conflict, the language of the DOE test procedure takes precedence over the referenced test standards. DOE also includes a similar section 0 in appendix J. This approach is consistent with the approach taken by DOE in other recent consumer product test procedure amendments (see, for example, test procedure final rules for consumer clothes dryers (October 8, 2021; 86 FR 56608) and water closets and urinals (March 23, 2022; 87 FR 16375)).

V. 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

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

10 CFR Part 430

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

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation test procedures, and Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on May 13, 2022, by Kelly J. Speakes-Backman, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the *Federal Register*.

Signed in Washington, DC, on May 13, 2022.

_____
Treena V. Garrett
Federal Register Liaison Officer,
U.S. Department of Energy

For the reasons stated in the preamble, DOE amends parts 429, 430, and 431 of Chapter II of Title 10, 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; 28 U.S.C. 2461 note.

2. Section 429.20 is amended by revising paragraphs (a)(2)(i) introductory text, (a)(2)(ii) introductory text, and (a)(3) to read as follows:

§429.20 Residential clothes washers.

(a) * * *

(2) * * *

(i) Any represented value of the 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 integrated modified energy factor, energy efficiency ratio, water efficiency ratio, 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:

* * * * *

(3) The clothes container capacity of a basic model reported in accordance with paragraph (b)(2) of this section shall be the mean of the measured clothes container capacity, C, of all tested units of the basic model.

* * * * *.

3. Section 429.46 is amended by revising paragraph (a)(2)(ii) introductory text to read as follows:

§429.46 Commercial clothes washers.

(a) * * *

(2) * * *

(ii) Any represented value of the modified energy factor, active-mode energy efficiency ratio, water efficiency ratio, or other measure of energy or water consumption

of a basic model for which consumers would favor higher values shall be greater than or equal to the higher of:

* * * * *

4. Section 429.134 is amended by revising paragraph (c)(1) to read as follows:

§429.134 Product-specific enforcement provisions.

* * * * *

(c) *Clothes washers*--(1) *Determination of Remaining Moisture Content*. These provisions address anomalous remaining moisture content (RMC) results that are not representative of a basic model's performance, as well as differences in RMC values that may result from DOE using a different test cloth lot than was used by the manufacturer for testing and certifying the basic model.

(i) When testing according to appendix J to subpart B of part 430:

(A) If the measured RMC value of a tested unit is equal to or lower than the certified RMC value of the basic model (expressed as a percentage), then the measured RMC value will be considered the tested unit's final RMC value and will be used as the basis for the calculation of per-cycle energy consumption for removal of moisture from the test load for that unit.

(B) If the measured RMC value of a tested unit is higher than the certified RMC value of the basic model but the difference between the measured and certified RMC values would not affect the unit's compliance with the applicable standards, then the measured RMC value will be considered the tested unit's final RMC value.

(C) If the measured RMC value of a tested unit is higher than the certified RMC value of the basic model and the difference between the measured and certified RMC values would affect the unit's compliance with the applicable standards, then:

(*1*) If DOE used the same test cloth lot that was used by the manufacturer for testing and certifying the basic model, then the measured RMC value will be considered the tested unit's final RMC value.

(*2*) If DOE used a different test cloth lot than was used by the manufacturer for testing and certifying the basic model, then:

(*i*) If the measured RMC value of a tested unit is higher than the certified RMC value of the basic model by more than three RMC percentage points, then a value three RMC percentage points less than the measured RMC value will be considered the tested unit's final RMC value.

(*ii*) If the measured RMC value of a tested unit is higher than the certified RMC value of the basic model, but by no more than three RMC percentage points, then the certified RMC value of the basic model will be considered the tested unit's final RMC value.

(ii) When testing according to appendix J2 to subpart B of part 430:

(A) The procedure for determining remaining moisture content (RMC) will be performed once in its entirety, pursuant to the test requirements of section 3.8 of appendix J2 to subpart B of part 430, for each unit tested.

(B) If the measured RMC value of a tested unit is equal to or lower than the certified RMC value of the basic model (expressed as a percentage), then the measured RMC value will be considered the tested unit's final RMC value and will be used as the basis for the calculation of per-cycle energy consumption for removal of moisture from the test load for that unit.

(C) If the measured RMC value of a tested unit is higher than the certified RMC value of the basic model but by no more than two RMC percentage points and the difference between the measured and certified RMC values would not affect the unit's

compliance with the applicable standards, then the measured RMC value will be considered the tested unit's final RMC value.

(D) If the measured RMC value of a tested unit is higher than the certified RMC value of the basic model but by no more than two RMC percentage points and the difference between the measured and certified RMC values would affect the unit's compliance with the applicable standards, then:

(*1*) If DOE used the same test cloth lot that was used by the manufacturer for testing and certifying the basic model, then the measured RMC value will be considered the tested unit's final RMC value.

(*2*) If DOE used a different test cloth lot than was used by the manufacturer for testing and certifying the basic model, then the certified RMC value of the basic model would be considered the tested unit's final RMC value.

(E) If the measured RMC value of a tested unit is higher than the certified RMC value of the basic model by more than two RMC percentage points, then DOE will perform two replications of the RMC measurement procedure, each pursuant to the provisions of section 3.8.5 of appendix J2 to subpart B of part 430, for a total of three independent RMC measurements of the tested unit. The average of the three RMC measurements will be calculated.

(*1*) If the average of the three RMC measurements is equal to or lower than the certified RMC value of the basic model, then the average RMC value will be considered the tested unit's final RMC value.

(*2*) If the average of the three RMC measurements is higher than the certified RMC value of the basic model but the difference between the measured and certified RMC values would not affect the unit's compliance with the applicable standards, then the average RMC value will be considered the tested unit's final RMC value.

(*3*) If the average of the three RMC measurements is higher than the certified RMC value of the basic model and the difference between the measured and certified RMC values would affect the unit's compliance with the applicable standards, then DOE will apply paragraph (c)(1)(ii)(F) of this section.

(F) If the average of the three RMC measurements is higher than the certified RMC value of the basic model and the difference between the measured and certified RMC values would affect the unit's compliance with the applicable standards, then:

(*1*) If DOE used the same test cloth lot that was used by the manufacturer for testing and certifying the basic model, then the average RMC pursuant to paragraph (c)(1)(ii)(E) of this section will be considered the tested unit's final RMC value.

(*2*) If DOE used a different test cloth lot than was used by the manufacturer for testing and certifying the basic model, then:

(*i*) If the average RMC value pursuant to paragraph (c)(1)(ii)(D) of this section is higher than the certified valued of the basic model by more than three RMC percentage points, then a value three RMC percentage points less than the average RMC value will be considered the tested unit's final RMC value.

(*ii*) If the average RMC value pursuant to paragraph (c)(1)(ii)(D) of this section is higher than the certified RMC value of the basic model, but by no more than three RMC percentage points, then the certified RMC value of the basic model will be considered the tested unit's final RMC value.

* * * * *

PART 430 -- ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

§430.3 [Amended]

6. Section 430.3 is amended as follows:

a. In paragraphs (d)(1) through (3), remove the text “J2” and add, in its place, the text “J3” wherever it appears; and

b. In paragraph (o)(6), remove the text “J2” and add, in its place, the text “J, J2”.

7. Section 430.23 is amended by:

a. Revising paragraphs (j)(1)(i) and (ii);

b. Removing paragraph (j)(2)(i);

c. Redesignating paragraph (j)(2)(ii) as (j)(2)(i);

d. Adding a new paragraph (j)(2)(ii);

e. Revising paragraph (j)(3)(i);

f. Removing paragraph (j)(4)(i);

g. Redesignating paragraph (j)(4)(ii) as (j)(4)(i);

h. Revising newly redesignated paragraph (j)(4)(i);

i. Adding a new paragraph (j)(4)(ii); and

j. Revising paragraph (j)(5).

The additions and revisions read as follows:

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

* * * * *

(j) * * *

(1) * * *

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

(A) When electrically heated water is used,

$(N \times (ME_T + HE_T + E_{TLP}) \times C_{KWH})$

Where:

N = the representative average residential clothes washer use of 234 cycles per year according to appendix J,

ME_T = the total weighted per-cycle machine electrical energy consumption, in kilowatt-hours per cycle, determined according to section 4.1.6 of appendix J,

HE_T = the total weighted per-cycle hot water energy consumption using an electrical water heater, in kilowatt-hours per cycle, determined according to section 4.1.3 of appendix J,

E_{TLP} = the per-cycle combined low-power mode energy consumption, in kilowatt-hours per cycle, determined according to section 4.6.2 of appendix J, 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,

$(N \times (((ME_T + E_{TLP}) \times C_{KWH}) + (HE_{TG} \times C_{BTU})))$

Where:

N, ME_T, E_{TLP}, and C_{KWH} are defined in paragraph (j)(1)(i)(A) of this section,

HE_{TG} = 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 J, 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 (see the note at the beginning of appendix J2),

(A) When electrically heated water is used

$(N_2 \times (E_{TE2} + E_{TLP2}) \times C_{KWH})$

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_{TLP2} = 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,

$(N_2 \times (((ME_{T2} + E_{TLP2}) \times C_{KWH}) + (HE_{TG2} \times C_{BTU})))$

Where:

N_2, E_{TLP2}, and C_{KWH} are defined in paragraph (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,

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, and

C_{BTU} = the representative average unit cost, in dollars per Btu for oil or gas, as appropriate, as provided by the Secretary.

(2) * * *

(ii) The energy efficiency ratio for automatic and semi-automatic clothes washers is determined according to section 4.9 of appendix J (when using appendix J). The result shall be rounded to the nearest 0.01 pound per kilowatt-hour per cycle.

(3) * * *

(i) When using appendix J, the product of the representative average-use of 234 cycles per year and the total weighted per-cycle water consumption in gallons per cycle determined according to section 4.2.4 of appendix J.

* * * * *

(4)(i) The integrated water factor must be determined according to section 4.2.12 of appendix J2, with the result rounded to the nearest 0.1 gallons per cycle per cubic foot.

(ii) The water efficiency ratio for automatic and semi-automatic clothes washers is determined according to section 4.7 of appendix J (when using appendix J). The result shall be rounded to the nearest 0.01 pound per gallon per cycle.

(5) Other useful measures of energy consumption for automatic or semi-automatic clothes washers shall be those measures of energy consumption that the Secretary determines are likely to assist consumers in making purchasing decisions and that are derived from the application of appendix J or appendix J2, as appropriate.

* * * * *

8. Add Appendix J to subpart B of part 430 to read as follows:

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

NOTE: Manufacturers must use the results of testing under Appendix J2 to determine compliance with the relevant standards for clothes washers from §430.32(g)(4) and from §431.156(b) as they appeared in January 1, 2022 edition of 10 CFR parts 200-499. Specifically, before [**INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] representations must be based upon results generated either under Appendix J2 as codified on [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] or under Appendix J2 as it appeared in the 10 CFR parts 200-499 edition revised as of January 1, 2022. Any representations made on or after [**INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] but before the compliance date of any amended standards for clothes washers must be made based upon results generated using Appendix J2 as codified on [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***].

Manufacturers must use the results of testing under this appendix to determine compliance with any amended standards for clothes washers provided in §430.32(g) and in §431.156 that are published after January 1, 2022. Any representations related to energy or water consumption of residential or commercial clothes washers must be made in accordance with the appropriate appendix that applies (*i.e.*, this appendix or Appendix J2) when determining compliance with the relevant standard. Manufacturers may also use this appendix to certify compliance with any amended standards prior to the applicable compliance date for those standards.

0. Incorporation by Reference

DOE incorporated by reference in §430.3, the entire test standard for IEC 62301.

However, only enumerated provisions of this standard are applicable to this appendix, as

follows. In cases in which there is a conflict, the language of the test procedure in this appendix takes precedence over the referenced test standard.

0.1 IEC 62301:

(a) Section 4.2 as referenced in section 2.4 of this appendix;

(b) Section 4.3.2 as referenced in section 2.1.2 of this appendix;

(c) Section 4.4 as referenced in section 2.5.3 of this appendix;

(d) Section 5.1 as referenced in section 3.5.2 of this appendix;

(e) Section 5.2 as referenced in section 2.10.2 of this appendix; and

(f) Section 5.3.2 as referenced in section 3.5.3 of this appendix.

0.2 [Reserved]

1. Definitions

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.

Active-mode energy efficiency ratio means the quotient of the weighted-average load size 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.

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.

Bone-dry means a condition of a load of test cloth that 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.

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

Cold rinse means the coldest rinse temperature available on the machine, as indicated to the user on the clothes washer control panel.

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.

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

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

Energy efficiency ratio means the quotient of the weighted-average load size 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.

Energy test cycle means the complete set of wash/rinse temperature selections required for testing, as determined according to section 2.12 of this appendix.

Fixed water fill control system means a clothes washer water fill control system that automatically terminates the fill when the water reaches a pre-defined level that is not

based on the size or weight of the clothes load placed in the clothes container, without allowing or requiring the user to determine or select the water fill level.

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.

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

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

Manual water fill control system means a clothes washer water fill control system that requires the user to determine or select the water fill level.

Non-user-adjustable adaptive water fill control system means a clothes washer water fill control system that is capable of automatically adjusting the water fill level based on the size or weight of the clothes load placed in the clothes container.

Normal cycle means the cycle recommended by the manufacturer (considering manufacturer instructions, control panel labeling, and other markings on the clothes washer) for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing. For machines where multiple cycle settings are recommended by the manufacturer for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing, then the Normal cycle is the cycle selection that results in the lowest EER or AEER value.

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.

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) Facilitating 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.

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.

User-adjustable adaptive water fill control system means a clothes washer fill control system that allows the user to adjust the amount of water that the machine provides, which is based on the size or weight of the clothes load placed in the clothes container.

Wash time means the wash portion of active washing mode, which begins when the cycle is initiated and includes the agitation or tumble time, which may be periodic or continuous during the wash portion of active washing mode.

Water efficiency ratio means the quotient of the weighted-average load size divided by the total weighted per-cycle water consumption for all wash cycles in gallons.

2. Testing Conditions and Instrumentation

2.1 *Electrical energy supply*.

2.1.1 *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.

2.1.2 *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, total harmonic content may be measured and recorded immediately before and after the test measurement period.

2.2 *Supply water*. Maintain the temperature of the hot water supply at the water inlets between 120 °F (48.9 °C) and 125 °F (51.7 °C), targeting the midpoint of the range. Maintain the temperature of the cold water supply at the water inlets between 55 °F (12.8 °C) and 60 °F (15.6 °C), targeting the midpoint of the range.

2.3 *Water pressure*. Maintain the static water pressure at the hot and cold water inlet connection of the clothes washer at 35 pounds per square inch gauge (psig) ± 2.5 psig (241.3 kPa ± 17.2 kPa) when the water is flowing.

2.4 *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.

2.5 *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 used for weighing test cloth must 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 used for performing the clothes container capacity measurement must 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 used to measure electrical energy consumption must 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 must 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, the crest factor, power factor, and maximum current ratio may be measured and recorded immediately before and after the test measurement period.

2.5.4 *Water and air temperature measuring devices*. The temperature devices used to measure water and air temperature must have an error no greater than ±1 °F (±0.6 °C) over the range being measured.

2.5.4.1 Non-reversible temperature indicator labels, adhered to the inside of the clothes container, may be used to confirm that an extra-hot wash temperature greater than or equal to 140 °F has been achieved during the wash cycle, under the following conditions. The label must remain waterproof, intact, and adhered to the wash drum throughout an entire wash cycle; provide consistent maximum temperature readings; and provide repeatable temperature indications sufficient to demonstrate that a wash temperature of greater than or equal to 140 °F has been achieved. The label must have been verified to consistently indicate temperature measurements with an accuracy of ±1 °F. If using a temperature indicator label to test a front-loading clothes washer, adhere the label along the interior surface of the clothes container drum, midway between the front and the back of the drum, adjacent to one of the baffles. If using a temperature indicator label to test a

top-loading clothes washer, adhere the label along the interior surface of the clothes container drum, on the vertical portion of the sidewall, as close to the bottom of the container as possible.

2.5.4.2 Submersible temperature loggers placed inside the wash drum may be used to confirm that an extra-hot wash temperature greater than or equal to 140 °F has been achieved during the wash cycle, under the following conditions. The submersible temperature logger must have a time resolution of at least 1 data point every 5 seconds and a temperature measurement accuracy of ±1 °F. Due to the potential for a waterproof capsule to provide a thermal insulating effect, failure to measure a temperature of 140 °F does not necessarily indicate the lack of an extra-hot wash temperature. However, such a result would not be conclusive due to the lack of verification of the water temperature requirement, in which case an alternative method must be used to confirm that an extra-hot wash temperature greater than or equal to 140 °F has been achieved during the wash cycle.

2.5.5 *Water meter*. A water meter must be installed in both the hot and cold water lines to measure water flow and/or water consumption. The water meters must 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. If the volume of hot water for any individual cycle within the energy test cycle is less than 0.1 gallons (0.4 liters), the hot water meter must have a resolution no larger than 0.01 gallons (0.04 liters).

2.5.6 *Water pressure gauge*. A water pressure gauge must be installed in both the hot and cold water lines to measure water pressure. The water pressure gauges must have a resolution of 1 pound per square inch gauge (psig) (6.9 kPa) and a maximum error no greater than 5 percent of any measured value.

2.6 *Bone-dryer*. The dryer used for drying the cloth to bone-dry must heat the test cloth load above 210 °F (99 °C).

2.7 *Test cloths*. The test cloth material and dimensions must conform to the specifications in appendix J3 to this subpart. The energy test cloth and the energy stuffer cloths must be clean and must not be used for more than 60 test runs (after preconditioning as specified in section 5 of appendix J3 to this subpart). All energy test cloth must be permanently marked identifying the lot number of the material. Mixed lots of material must not be used for testing a clothes washer. The moisture absorption and retention must be evaluated for each new lot of test cloth using the standard extractor Remaining Moisture Content (RMC) procedure specified in appendix J3 to this subpart.

2.8 *Test Loads*.

2.8.1 *Test load sizes*. Create small and large test loads as defined in Table 5.1 of this appendix based on the clothes container capacity as measured in section 3.1 of this appendix. Record the bone-dry weight for each test load.

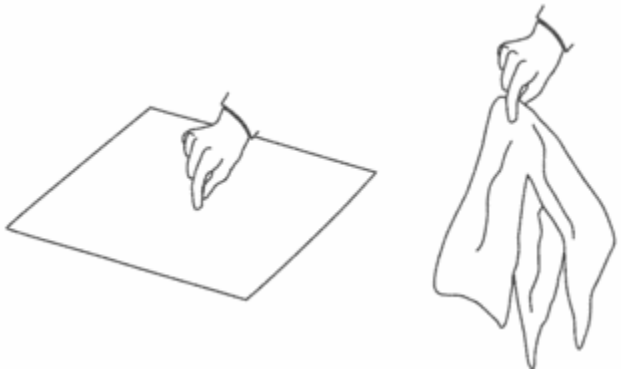
2.8.2 *Test load composition*. Test loads must consist primarily of energy test cloths and no more than five energy stuffer cloths per load to achieve the proper weight.

2.9 *Preparation and loading of test loads*. Use the following procedures to prepare and load each test load for testing in section 3 of this appendix.

2.9.1 Test loads for energy and water consumption measurements must 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.

2.9.2 Prepare the energy test cloths for loading by grasping them in the center, lifting, and shaking them to hang loosely, as illustrated in Figure 2.9.2 of this appendix.

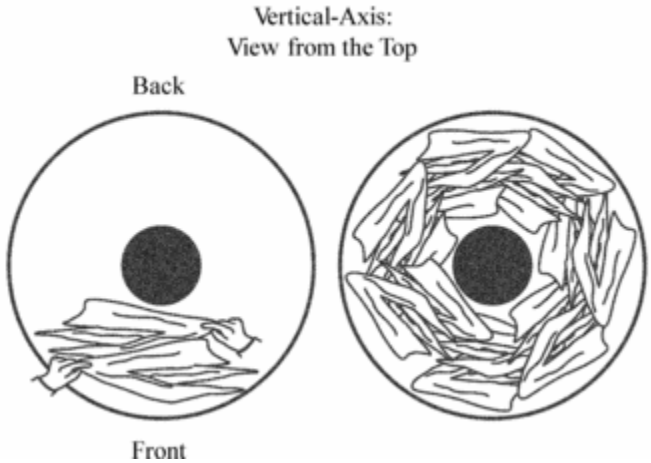
Figure 2.9.2—Grasping Energy Test Cloths in the Center, Lifting, and Shaking to Hang Loosely



For all clothes washers, follow any manufacturer loading instructions provided to the user regarding the placement of clothing within the clothes container. In the absence of any manufacturer instructions regarding the placement of clothing within the clothes container, the following loading instructions apply.

2.9.2.1 To load the energy test cloths in a top-loading clothes washer, arrange the cloths circumferentially around the axis of rotation of the clothes container, using alternating lengthwise orientations for adjacent pieces of cloth. Complete each cloth layer across its horizontal plane within the clothes container before adding a new layer. Figure 2.9.2.1 of this appendix illustrates the correct loading technique for a vertical-axis clothes washer.

Figure 2.9.2.1—Loading Energy Test Cloths into a Top-Loading Clothes Washer



2.9.2.2 To load the energy test cloths in a front-loading clothes washer, grasp each test cloth in the center as indicted in section 2.9.2 of this appendix, and then place each cloth into the clothes container prior to activating the clothes washer.

2.10 *Clothes washer installation.* Install the clothes washer in accordance with manufacturer's instructions.

2.10.1 *Water inlet connections*. If the clothes washer has 2 water inlets, connect the inlets to the hot water and cold water supplies, in accordance with the manufacturer's instructions. If the clothes washer has only 1 water inlet, connect the inlet to the cold water supply, in accordance with the manufacturer's instructions. Use the water inlet hoses provided with the clothes washer; otherwise use commercially available water inlet hoses, not to exceed 72 inches in length, in accordance with manufacturer's instructions.

2.10.2 *Low-power mode testing*. For combined low-power mode testing, install the clothes washer in accordance with Section 5, Paragraph 5.2 of IEC 62301, disregarding the provisions regarding batteries and the determination, classification, and testing of relevant modes.

2.11 *Clothes washer pre-conditioning.* 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.

2.12 *Determining the energy test cycle*

2.12.1 *Automatic clothes washers*. To determine the energy test cycle, evaluate the wash/rinse temperature selection flowcharts in the order in which they are presented in this section. Use the large load size to evaluate each flowchart. The determination of the energy test cycle must take into consideration all cycle settings available to the end user, including any cycle selections or cycle modifications provided by the manufacturer via software or firmware updates to the product, for the basic model under test. The energy test cycle does not include any cycle that is recommended by the manufacturer exclusively for cleaning, deodorizing, or sanitizing the clothes washer.

Figure 2.12.1.1—Determination of Cold Wash/Cold Rinse

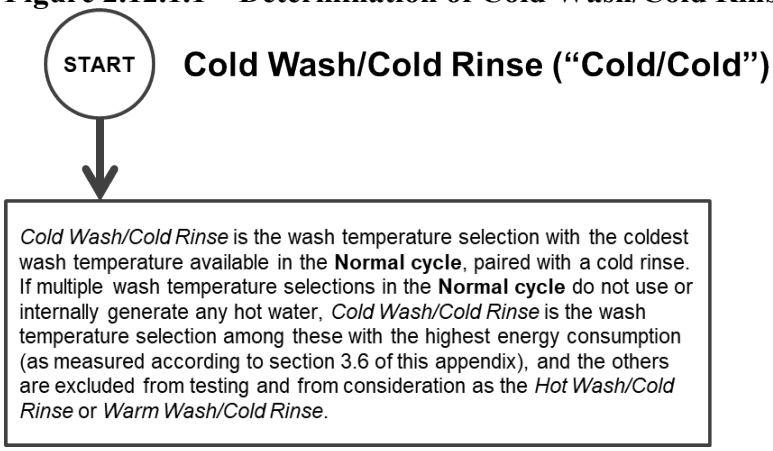


Figure 2.12.1.2—Determination of Hot Wash/Cold Rinse

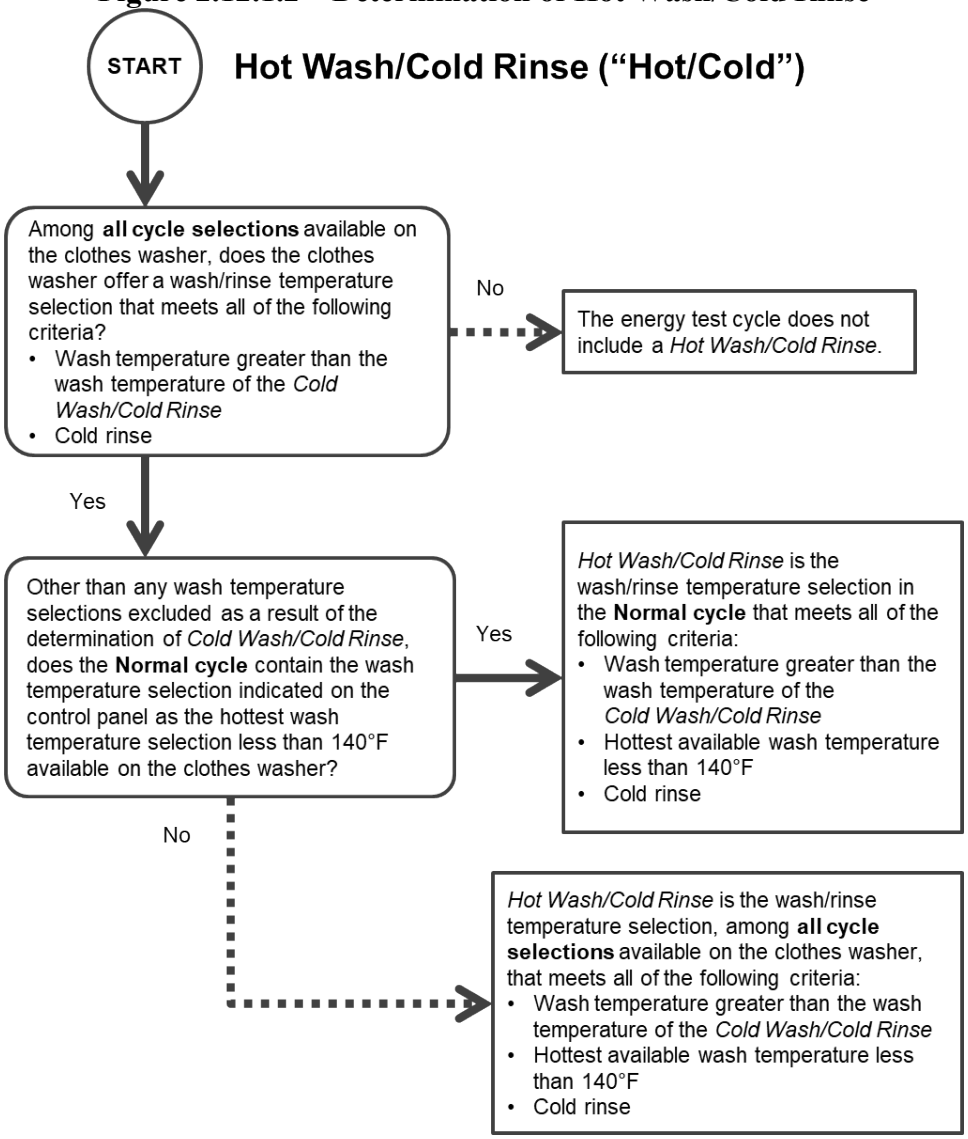


Figure 2.12.1.3—Determination of Warm Wash/Cold Rinse

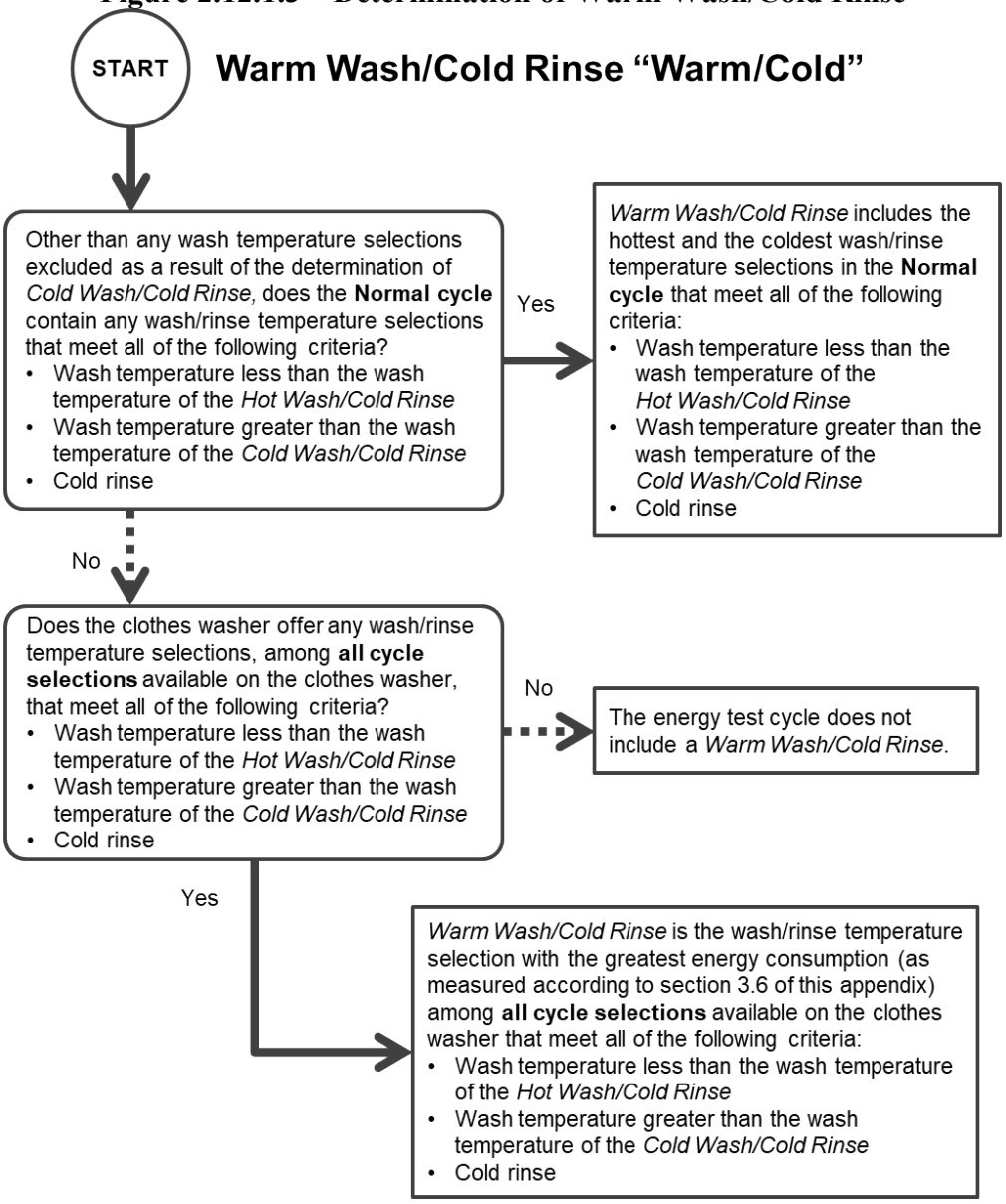


Figure 2.12.1.4—Determination of Warm Wash/Warm Rinse

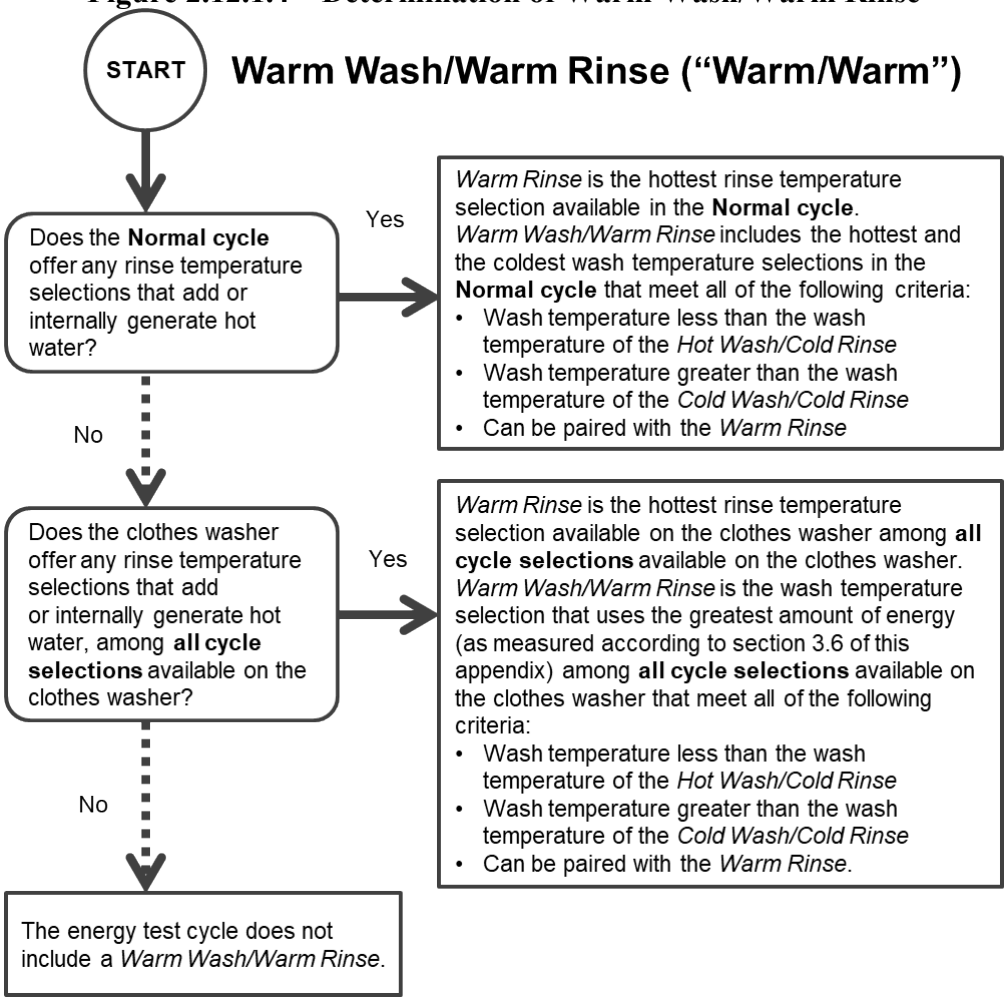
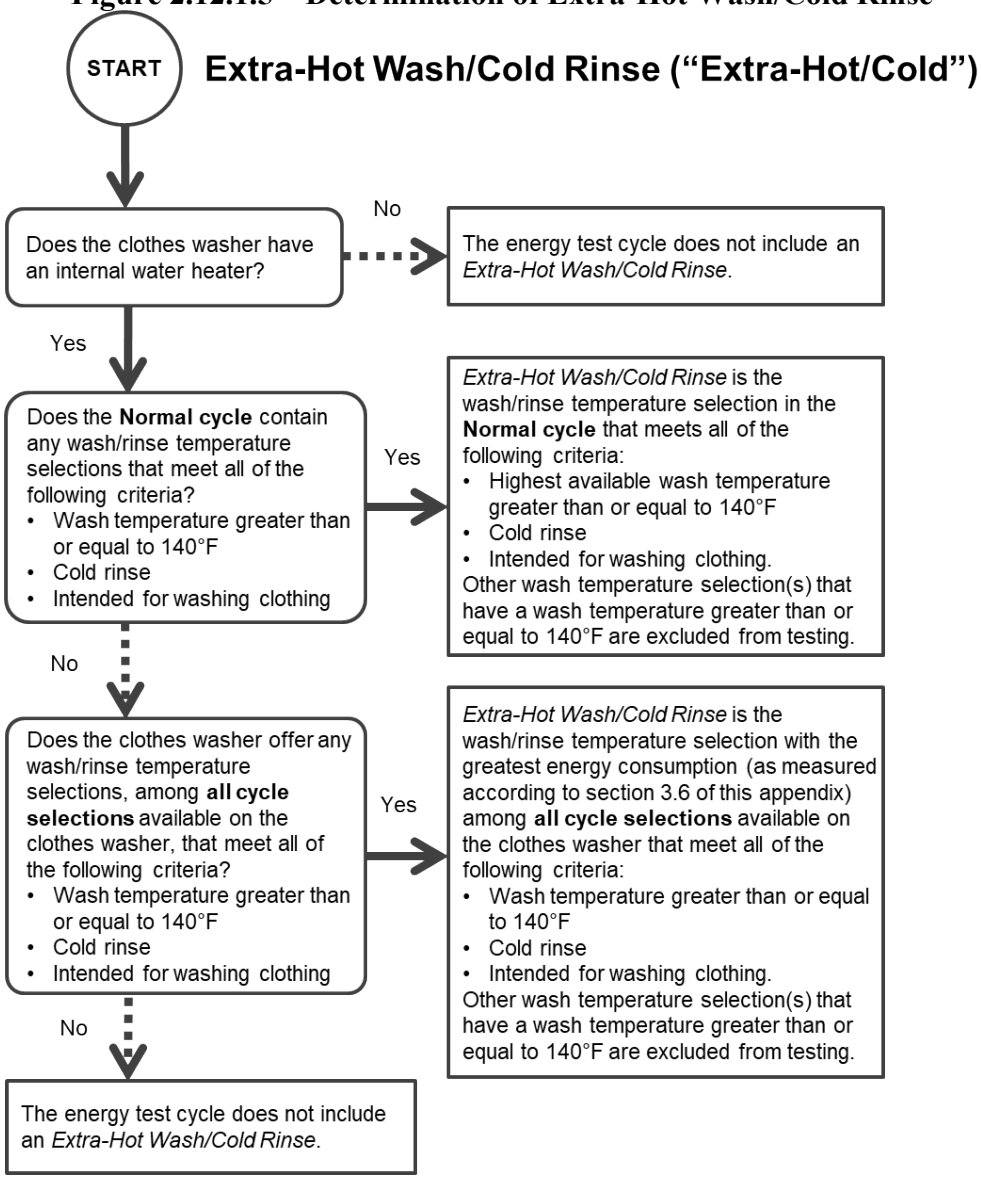


Figure 2.12.1.5—Determination of Extra-Hot Wash/Cold Rinse



2.12.2. *Semi-automatic clothes washers.* The energy test cycle for semi-automatic clothes washers includes only the Cold Wash/Cold Rinse ("Cold") test cycle. Energy and water use for all other wash/rinse temperature combinations are calculated numerically in section 3.4.2 of this appendix.

3. Test Measurements

3.1 *Clothes container capacity.* Measure the entire volume that 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 door seal and shipping bolts or other forms of bracing hardware to support the wash drum during shipping must remain in place during the capacity measurement. If the design of a front-loading clothes washer does not include shipping bolts or other forms of bracing hardware to support the wash drum during shipping, a laboratory may support the wash drum by other means, including temporary bracing or support beams. Any temporary bracing or support beams must keep the wash drum in a fixed position, relative to the geometry of the door and door seal components, that is representative of the position of the wash drum during normal operation. The method used must avoid damage to the unit that would affect the results of the energy and water testing. For a front-loading clothes washer that does not include shipping bolts or other forms of bracing hardware to support the wash drum during shipping, the laboratory must fully document the alternative method used to support the wash drum during capacity measurement, include such documentation in the final test report, and pursuant to §429.71 of this chapter, the manufacturer must retain such documentation as part its test records.

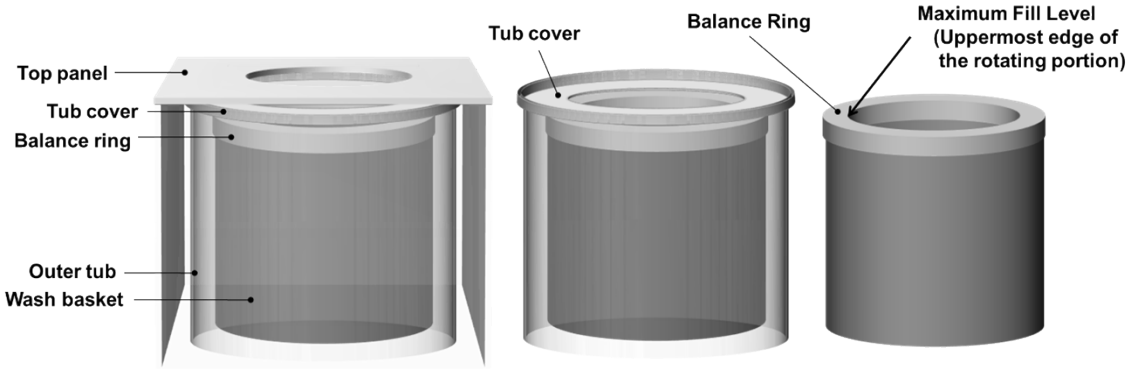
3.1.2 Line the inside of the clothes container with a 2 mil thickness (0.051 mm) plastic bag. All clothes washer components that occupy space within the clothes container and that are recommended for use during a wash cycle must be in place and must be lined with a 2 mil thickness (0.051 mm) plastic bag 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

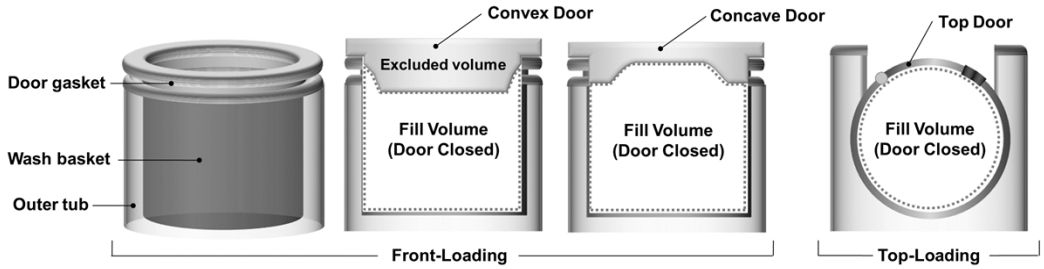
portion, including any balance ring. Figure 3.1.4.1 of this appendix illustrates the maximum fill level for top-loading clothes washers.

Figure 3.1.4.1—Maximum Fill Level for the Clothes Container Capacity Measurement of Top-Loading Vertical-Axis Clothes Washers



For a front-loading horizontal-axis clothes washer, fill the clothes container to the highest point of contact between the door and the door gasket. If any portion of the door or gasket would occupy the measured volume space when the door is closed, exclude from the measurement the volume that the door or gasket portion would occupy. For a front-loading horizontal-axis clothes washer with a concave door shape, include any additional volume above the plane defined by the highest point of contact between the door and the door gasket, if that area can be occupied by clothing during washer operation. For a top-loading horizontal-axis clothes washer, include any additional volume above the plane of the door hinge that clothing could occupy during washer operation. Figure 3.1.4.2 of this appendix illustrates the maximum fill volumes for all horizontal-axis clothes washer types.

Figure 3.1.4.2—Maximum Fill Level for the Clothes Container Capacity Measurement of Horizontal-Axis Clothes Washers



For all clothes washers, exclude any volume that cannot be occupied by the clothing load during operation.

3.1.5 Measure and record the weight of water, W, in pounds.

3.1.6 Calculate the clothes container capacity 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/ft^3 for 100 °F (993 kg/m^3 for 37.8 °C) or 62.3 lbs/ft^3 for 60 °F (998 kg/m^3 for 15.6 °C)).

3.1.7 Calculate the clothes container capacity, C, to the nearest 0.01 cubic foot for the purpose of determining test load sizes per Table 5.1 of this appendix and for all subsequent calculations that include the clothes container capacity.

3.2 *Cycle settings.*

3.2.1 *Wash/rinse temperature selection.* For automatic clothes washers, set the wash/rinse temperature selection control to obtain the desired wash/rinse temperature selection within the energy test cycle.

3.2.2 *Wash time setting.*

3.2.2.1 If the cycle under test offers a range of wash time settings, the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available for the wash cycle under test, regardless of the labeling of suggested dial locations. If 70 percent of the maximum wash time is not available on a dial with a discrete number of wash time settings, choose the next-highest setting greater than 70 percent.

3.2.2.2 If the clothes washer is equipped with an electromechanical dial or timer controlling wash time that rotates in both directions, 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 appropriate setting is reached.

3.2.3 *Water fill level settings.* The water fill level settings depend on the clothes washer's water fill control system, as determined in Table 3.2.3.

TABLE 3.2.3—CLOTHES WASHER WATER FILL CONTROL SETTINGS

	Settings are user-adjustable	**Settings are not user-adjustable**
Water fill level unaffected by the size or weight of the clothing load	Manual water fill	Fixed water fill
Water fill level is determined automatically by the clothes washer based on the size and weight of the clothing load	User-adjustable adaptive water fill	Non-user-adjustable adaptive water fill

3.2.3.1 *Clothes washers with a manual water fill control system.* For the large test load size, set the water fill level selector to the maximum water fill level setting available for the wash cycle under test. If the water fill level selector has two settings available for the wash cycle under test, for the small test load size, select the minimum water fill level setting available for the wash cycle under test.

If the water fill level selector has more than two settings available for the wash cycle under test, for the small test load size, select the second-lowest water fill level setting.

3.2.3.2 *Clothes washers with a fixed water fill control system.* The water level is automatically determined by the water fill control system.

3.2.3.3 *Clothes washers with a user-adjustable adaptive water fill control system.* For the large test load size, set the water fill selector to the setting that uses the most water. For the small test load size, set the water fill selector to the setting that uses the least water.

3.2.3.4 *Clothes washers with a non-user-adjustable adaptive water fill control system.* The water level is automatically determined by the water fill control system.

3.2.3.5 *Clothes washers with multiple water fill control systems.* If a clothes washer allows user selection among multiple water fill control systems, test all water fill control

systems and, for each one, calculate the energy consumption (HE_T, ME_T, and DE_T) and water consumption (Q_T) values as set forth in section 4 of this appendix. Then, calculate the average of the tested values (one from each water fill control system) for each variable (HE_T, ME_T, DE_T, and Q_T) and use the average value for each variable in the final calculations in section 4 of this appendix.

3.2.4 *Manufacturer default settings.* For clothes washers with electronic control systems, use the manufacturer default settings for any cycle selections, except for (1) the temperature selection, (2) the wash water fill levels, or (3) network settings. If the clothes washer has network capabilities, the network settings must be disabled throughout testing if such settings can be disabled by the end-user and the product's user manual provides instructions on how to do so. For all other cycle selections, the manufacturer default settings must be used for wash conditions such as agitation/tumble operation, soil level, spin speed, wash times, rinse times, optional rinse settings, water heating time for water heating clothes washers, and all other wash parameters or optional features applicable to that wash cycle. Any optional wash cycle feature or setting (other than wash/rinse temperature, water fill level selection, or network settings on clothes washers with network capabilities) that is activated by default on the wash cycle under test must be included for testing unless the manufacturer instructions recommend not selecting this option, or recommend selecting a different option, for washing normally soiled cotton clothing. For clothes washers with control panels containing mechanical switches or dials, any optional settings, except for the temperature selection or the wash water fill levels, must be in the position recommended by the manufacturer for washing normally soiled cotton clothing. If the manufacturer instructions do not recommend a particular switch or dial position to be used for washing normally soiled cotton clothing, the setting switch or dial must remain in its as-shipped position.

3.2.5 For each wash cycle tested, include the entire active washing mode and exclude any delay start or cycle finished modes.

3.2.6 *Anomalous Test Cycles.* If during a wash cycle the clothes washer: a) signals to the user by means of a visual or audio alert that an out-of-balance condition has been detected; or b) terminates prematurely and thus does not include the agitation/tumble operation, spin speed(s), wash times, and rinse times applicable to the wash cycle under test, discard the test data and repeat the wash cycle. Document in the test report the rejection of data from any wash cycle during testing and the reason for the rejection.

3.3 *Test cycles for automatic clothes washers.* Perform testing on each wash/rinse temperature selection available in the energy test cycle was defined in section 2.12.1 of this appendix. Test each load size as defined in section 2.8 of this appendix with its associated water fill level defined in section 3.2.3 of this appendix. Assign the bone-dry weight according to the value measured in section 2.8 of this appendix. Place the test load in the clothes washer and initiate the cycle under test. Measure the values for hot water consumption, cold water consumption, electrical energy consumption, and cycle time for the complete cycle. Record the weight of the test load immediately after completion of the cycle. Table 3.3 of this appendix provides the symbol definitions for each measured value.

TABLE 3.3—SYMBOL DEFINITIONS OF MEASURED VALUES FOR AUTOMATIC CLOTHES WASHER TEST CYCLES

Wash/Rinse Temperature Selection	Load Size	Bone-Dry Weight	Hot Water	Cold Water	Electrical Energy	Cycle Time	Cycle Complete Weight
Extra-Hot/Cold	Large	WIx_L	Hx_L	Cx_L	Ex_L	Tx_L	WCx_L
	Small	WIx_S	Hx_S	Cx_S	Ex_S	Tx_S	WCx_S
Hot/Cold	Large	WIh_L	Hh_L	Ch_L	Eh_L	Th_L	WCh_L
	Small	WIh_S	Hh_S	Ch_S	Eh_S	Th_S	WCh_S
Warm/Cold*	Large	WIw_L	Hw_L	Cw_L	Ew_L	Tw_L	WCw_L
	Small	WIw_S	Hw_S	Cw_S	Ew_S	Tw_S	WCw_S
Warm/Warm*	Large	$WIww_L$	Hww_L	Cww_L	Eww_L	Tww_L	$WCww_L$
	Small	$WIww_S$	Hww_S	Cww_S	Eww_S	Tww_S	$WCww_S$

Cold/Cold	Large	WIc_L	Hc_L	Cc_L	Ec_L	Tc_L	WCc_L
	Small	WIc_S	Hc_S	Cc_S	Ec_S	Tc_S	WCc_S

* If two cycles are tested to represent the Warm/Cold selection or the Warm/Warm selection, calculate the average of the two tested cycles and use that value for all further calculations.

3.4 *Test cycles for semi-automatic clothes washers.*

3.4.1 *Test Measurements.* Perform testing on each wash/rinse temperature selection available in the energy test cycle as defined in section 2.12.2 of this appendix. Test each load size as defined in section 2.8 of this appendix with the associated water fill level defined in section 3.2.3 of this appendix. Assign the bone-dry weight according to the value measured in section 2.8 of this appendix. Place the test load in the clothes washer and initiate the cycle under test. Measure the values for cold water consumption, electrical energy consumption, and cycle time for the complete cycle. Record the weight of the test load immediately after completion of the cycle. Table 3.4.1 of this appendix provides symbol definitions for each measured value for the Cold temperature selection.

TABLE 3.4.1—SYMBOL DEFINITIONS OF MEASURED VALUES FOR SEMI-AUTOMATIC CLOTHES WASHER TEST CYCLES

Temperature Selection	Load Size	Bone-Dry Weight	Hot Water	Cold Water	Electrical Energy	Cycle Time	Cycle Complete Weight
Cold	Large	WIc_L	not measured	Cc_L	Ec_L	Tc_L	WCc_L
	Small	WIc_S	not measured	Cc_S	Ec_S	Tc_S	WCc_S

3.4.2 *Calculation of Hot and Warm measured values*. In lieu of testing, the measured values for the Hot and Warm cycles are calculated based on the measured values for the Cold cycle, as defined in section 3.4.1 of this appendix. Table 3.4.2 of this appendix provides the symbol definitions and calculations for each value for the Hot and Warm temperature selections.

TABLE 3.4.2—SYMBOL DEFINITIONS AND CALCULATION OF MEASURED VALUES FOR SEMI-AUTOMATIC CLOTHES WASHER TEST CYCLES

Temperature Selection	Load Size	Bone-Dry Weight	Hot Water	Cold Water	Electrical Energy	Cycle Time	Cycle Complete Weight
Hot	Large	$WIh_L = WIc_L$	$Hh_L = Cc_L$	-	$Eh_L = Ec_L$	$Th_L = Tc_L$	$WCh_L = WCc_L$
	Small	$WIh_S = WIc_S$	$Hh_S = Cc_S$	-	$Eh_S = Ec_S$	$Th_S = Tc_S$	$WCh_S = WCc_S$
Warm	Large	$WIw_L = WIc_L$	$Hw_L = Cc_L \div 2$	$Cw_L = Cc_L \div 2$	$Ew_L = Ec_L$	$Tw_L = Tc_L$	$WCw_L = WCc_L$
	Small	$WIw_S = WIc_S$	$Hw_S = Cc_S \div 2$	$Cw_S = Cc_S \div 2$	$Ew_S = Ec_S$	$Tw_S = Tc_S$	$WCw_S = WCc_S$

3.5 *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, 2.4, and 2.10.2 of this appendix.

3.5.1 Perform combined low-power mode testing after completion of an active mode wash cycle included as part of the energy test cycle; after removing the test load; without changing the control panel settings used for the active mode wash cycle; with the door closed; and without disconnecting the electrical energy supply to the clothes washer between completion of the active mode wash cycle and the start of combined low-power mode testing.

3.5.2 For a clothes washer that takes some time to automatically enter a stable inactive mode or off mode state from a higher power state as discussed in Section 5, Paragraph 5.1, note 1 of IEC 62301, allow sufficient time for the clothes washer to automatically reach the default inactive/off mode state before proceeding with the test measurement.

3.5.3 Once the stable inactive/off mode state has been reached, measure and record the default inactive/off mode power, $P_{default}$, in watts, following the test procedure for the sampling method specified in Section 5, Paragraph 5.3.2 of IEC 62301.

3.5.4 For a clothes washer with a switch, dial, or button that can be optionally selected by the end user to achieve a lower-power inactive/off mode state than the default inactive/off mode state measured in section 3.5.3 of this appendix, after performing the measurement in section 3.5.3 of this appendix, activate the switch, dial, or button to the position

resulting in the lowest power consumption and repeat the measurement procedure described in section 3.5.3 of this appendix. Measure and record the lowest-power inactive/off mode power, P_{lowest}, in Watts.

3.6 *Energy consumption for the purpose of determining the cycle selection(s) to be included in the energy test cycle.* This section is implemented only in cases where the energy test cycle flowcharts in section 2.12.1 of this appendix require the determination of the wash/rinse temperature selection with the highest energy consumption.

3.6.1 For the wash/rinse temperature selection being considered under this section, establish the testing conditions set forth in section 2 of this appendix. Select the applicable cycle selection and wash/rinse temperature selection. For all wash/rinse temperature selections, select the cycle settings as described in section 3.2 of this appendix.

3.6.2 Measure each wash cycle's electrical energy consumption (E_L) and hot water consumption (H_L). Calculate the total energy consumption for each cycle selection (E_{TL}), as follows:

$E_{TL} = E_L + (H_L \times T \times K)$

where:

E_L is the electrical energy consumption, expressed in kilowatt-hours per cycle.

H_L is the hot water consumption, expressed in gallons per cycle.

T = nominal temperature rise = 65 °F (36.1 °C).

K = Water specific heat in kilowatt-hours per gallon per degree F = 0.00240 kWh/gal - °F (0.00114 kWh/L - °C).

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 all load sizes tested.* Calculate the per-cycle temperature-weighted hot water consumption for the large

test load size, Vh_L, and the small test load size, Vh_S, expressed in gallons per cycle (or liters per cycle) and defined as:

(a) $Vh_L = [Hx_L \times TUF_x] + [Hh_L \times TUF_h] + [Hw_L \times TUF_w] + [Hww_L \times TUF_{ww}] + [Hc_L \times TUF_c]$

(b) $Vh_S = [Hx_S \times TUF_x] + [Hh_S \times TUF_h] + [Hw_S \times TUF_w] + [Hww_S \times TUF_{ww}] + [Hc_S \times TUF_c]$

where:

Hx_L, Hh_L, Hw_L, Hww_L, Hc_L, Hx_S, Hh_S, Hw_S, Hww_S, and Hc_S are the hot water consumption values, in gallons per-cycle (or liters per cycle) as measured in section 3.3 of this appendix for automatic clothes washers or section 3.4 of this appendix for semi-automatic clothes washers.

TUF_x, TUF_h, TUF_w, TUF_{ww}, and TUF_c are temperature use factors for Extra-Hot Wash/Cold Rinse, Hot Wash/Cold Rinse, Warm Wash/Cold Rinse, Warm Wash/Warm Rinse, and Cold Wash/Cold Rinse temperature selections, respectively, as defined in Table 4.1.1 of this appendix.

TABLE 4.1.1—TEMPERATURE USE FACTORS

Wash/Rinse Temperature Selections Available in the Energy Test Cycle	Clothes washers with cold rinse only					Clothes washers with both cold and warm rinse		
	C/C	H/C C/C	H/C W/C C/C *	XH/C H/C C/C	XH/C H/C W/C C/C	H/C W/C W/W C/C	XH/C H/C W/W C/C	XH/C H/C W/C W/W C/C
TUFx (Extra-Hot/Cold)				0.14	0.05		0.14	0.05
TUFh (Hot/Cold)		0.63	0.14	**0.49	0.09	0.14	**0.22	0.09
TUFw (Warm/Cold)			0.49		0.49	0.22		0.22
TUFww (Warm/Warm)						0.27	0.27	0.27
TUFc (Cold/Cold)	1.00	0.37	0.37	0.37	0.37	0.37	0.37	0.37

* This column applies to all semi-automatic clothes washers.

** On clothes washers with only two wash temperature selections <140 °F, the higher of the two wash temperatures is classified as a Hot Wash/Cold Rinse, in accordance with the wash/rinse temperature definitions within the energy test cycle.

4.1.2 *Total per-cycle hot water energy consumption for all load sizes tested.* Calculate the total per-cycle hot water energy consumption for the large test load size, HE_L, and the small test load size, HE_S, expressed in kilowatt-hours per cycle and defined as:

(a) $HE_L = [Vh_L \times T \times K]$ = Total energy when the large test load is tested.

(b) $HE_S = [Vh_S \times T \times K]$ = Total energy when the small test load is tested.

where:

Vh_L and Vh_S are defined in section 4.1.1 of this appendix.

T = Temperature rise = 65 °F (36.1 °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:

$HE_T = [HE_L \times LUF_L] + [HE_S \times LUF_S]$

where:

HE_L and HE_S are defined in section 4.1.2 of this appendix.

LUF_L = Load usage factor for the large test load = 0.5.

LUF_S = Load usage factor for the small test load = 0.5.

4.1.4 *Total per-cycle hot water energy consumption using gas-heated or oil-heated water, for product labeling requirements.* 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 section 4.1.3 of this appendix.

4.1.5 *Per-cycle machine electrical energy consumption for all load sizes tested.* Calculate the total per-cycle machine electrical energy consumption for the large test load size, ME_L, and the small test load size, ME_S, expressed in kilowatt-hours per cycle and defined as:

(a) $ME_L = [Ex_L \times TUF_x] + [Eh_L \times TUF_h] + [Ew_L \times TUF_w] + [Eww_L \times TUF_{ww}] + [Ec_L \times TUF_c]$

(b) $ME_S = [Ex_S \times TUF_x] + [Eh_S \times TUF_h] + [Ew_S \times TUF_w] + [Eww_S \times TUF_{ww}] + [Ec_S \times TUF_c]$

where:

Ex_L, Eh_L, Ew_L, Eww_L, Ec_L, Ex_S, Eh_S, Ew_S, Eww_S, and Ec_S are the electrical energy consumption values, in kilowatt-hours per cycle as measured in section 3.3 of this appendix for automatic clothes washers or section 3.4 of this appendix for semi-automatic clothes washers.

TUF_x, TUF_h, TUF_w, TUF_{ww}, and TUF_c are 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:

$ME_T = [ME_L \times LUF_L] + [ME_S \times LUF_S]$

where:

ME_L and ME_S are defined in section 4.1.5 of this appendix.

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

4.2 Water consumption of clothes washers.

4.2.1 *Per cycle total water consumption for each large load size tested.* Calculate the per-cycle total water consumption of the large test load for the Extra-Hot Wash/Cold Rinse cycle, Qx_L, Hot Wash/Cold Rinse cycle, Qh_L, Warm Wash/Cold Rinse cycle, Qw_L, Warm Wash/Warm Rinse cycle, Qww_L, and Cold Wash/Cold Rinse cycle, Qc_L, defined as:

(a) $Qx_L = Hx_L + Cx_L$

(b) $Qh_L = Hh_L + Ch_L$

(c) $Qw_L = Hw_L + Cw_L$

(d) $Qww_L = Hww_L + Cww_L$

(e) $Qc_L = Hc_L + Cc_L$

where:

Hx_L, Hh_L, Hw_L, Hww_L, Hc_L, Cx_L, Ch_L, Cw_L, Cww_L, and Cc_L are defined in section 3.3 of this appendix for automatic clothes washers or section 3.4 of this appendix for semi-automatic clothes washers.

4.2.2 *Per cycle total water consumption for each small load size tested.* Calculate the per-cycle total water consumption of the small test load for the Extra-Hot Wash/Cold Rinse cycle, Qx_S, Hot Wash/Cold Rinse cycle, Qh_S, Warm Wash/Cold Rinse cycle, Qw_S, Warm Wash/Warm Rinse cycle, Qww_S, and Cold Wash/Cold Rinse cycle, Qc_S, defined as:

(a) $Qx_S = Hx_S + Cx_S$

(b) $Qh_S = Hh_S + Ch_S$

(c) $Qw_S = Hw_S + Cw_S$

(d) $Qww_S = Hww_S + Cww_S$

(e) $Qc_S = Hc_S + Cc_S$

where:

Hx_S, Hh_S, Hw_S, Hww_S, Hc_S, Cx_S, Ch_S, Cw_S, Cww_S, and Cc_S are defined in section 3.3 of this appendix for automatic clothes washers or section 3.4 of this appendix for semi-automatic clothes washers.

4.2.3 *Per-cycle total water consumption for all load sizes tested.* Calculate the total per-cycle water consumption for the large test load size, Q_L, and the small test load size, Q_S, expressed in gallons per cycle (or liters per cycle) and defined as:

(a) $Q_L = [Qx_L \times TUFx] + [Qh_L \times TUFh] + [Qw_L \times TUFw] + [Qww_L \times TUFww] + [Qc_L \times TUFc]$

(b) $Q_S = [Qx_S \times TUFx] + [Qh_S \times TUFh] + [Qw_S \times TUFw] + [Qww_S \times TUFww] + [Qc_S \times TUFc]$

where:

Qx_L, Qh_L, Qw_L, Qww_L, and Qc_L are defined in section 4.2.1 of this appendix.

Qx_S, Qh_S, Qw_S, Qww_S, and Qc_S are defined in section 4.2.2 of this appendix.

TUFx, TUFh, TUFw, TUFww, and TUFc are defined in Table 4.1.1 of this appendix.

4.2.4 *Total weighted per-cycle water consumption.* Calculate the total per-cycle water consumption, Q_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Q_T = [Q_L \times LUF_L] + [Q_S \times LUF_S]$

where:

Q_L and Q_S are defined in section 4.2.3 of this appendix.

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

4.3 *Remaining moisture content (RMC)*.

4.3.1 *Per cycle remaining moisture content for each large load size tested.* Calculate the per-cycle remaining moisture content of the large test load for the Extra-Hot Wash/Cold Rinse cycle, $RMCx_L$, Hot Wash/Cold Rinse cycle, $RMCh_L$, Warm Wash/Cold Rinse cycle, $RMCw_L$, Warm Wash/Warm Rinse cycle, $RMCww_L$, and Cold Wash/Cold Rinse cycle, $RMCc_L$, defined as:

(a) $RMCx_L = (WCx_L - WIx_L) / WIx_L$

(b) $RMCh_L = (WCh_L - WIh_L) / WIh_L$

(c) $RMCw_L = (WCw_L - WIw_L) / WIw_L$

(d) $RMCww_L = (WCww_L - WIww_L) / WIww_L$

(e) $RMCc_L = (WCc_L - WIc_L) / WIc_L$

where:

WCx_L, WCh_L, WCw_L, $WCww_L$, WCc_L, WIx_L, WIh_L, WIw_L, $WIww_L$, and WIc_L are the bone-dry weights and cycle completion weights as measured in section 3.3 of this appendix for automatic clothes washers or section 3.4 of this appendix for semi-automatic clothes washers.

4.3.2 *Per cycle remaining moisture content for each small load size tested.* Calculate the per-cycle remaining moisture content of the small test load for the Extra-Hot Wash/Cold Rinse cycle, $RMCx_S$, Hot Wash/Cold Rinse cycle, $RMCh_S$, Warm Wash/Cold Rinse cycle, $RMCw_S$, Warm Wash/Warm Rinse cycle, $RMCww_S$, and Cold Wash/Cold Rinse cycle, $RMCc_S$, defined as:

(a) $RMCx_S = (WCx_S - WIx_S) / WIx_S$

(b) $RMCh_S = (WCh_S - WIh_S) / WIh_S$

(c) $RMCw_S = (WCw_S - WIw_S) / WIw_S$

(d) $RMCww_S = (WCww_S - WIww_S) / WIww_S$

(e) $RMCc_S = (WCc_S - WIc_S) / WIc_S$

where:

WCx_S, WCh_S, WCw_S, $WCww_S$, WCc_S, WIx_S, WIh_S, WIw_S, $WIww_S$, and WIc_S are the bone-dry weights and cycle completion weights as measured in section 3.3 of this appendix for automatic clothes washers or section 3.4 of this appendix for semi-automatic clothes washers.

4.3.3 *Per-cycle remaining moisture content for all load sizes tested.* Calculate the per-cycle temperature-weighted remaining moisture content for the large test load size, RMC_L, and the small test load size, RMC_S, defined as:

(a) $RMC_L = [RMCx_L \times TUF_x] + [RMCh_L \times TUF_h] + [RMCw_L \times TUF_w] + [RMCww_L \times TUF_{ww}] + [RMCc_L \times TUF_c]$

(b) $RMC_S = [RMCx_S \times TUF_x] + [RMCh_S \times TUF_h] + [RMCw_S \times TUF_w] + [RMCww_S \times TUF_{ww}] + [RMCc_S \times TUF_c]$

where:

$RMCx_L$, $RMCh_L$, $RMCw_L$, $RMCww_L$, and $RMCc_L$ are defined in section 4.3.1 of this appendix.

$RMCx_S$, $RMCh_S$, $RMCw_S$, $RMCww_S$, and $RMCc_S$ are defined in section 4.3.2 of this appendix.

TUF_x, TUF_h, TUF_w, TUF_{ww}, and TUF_c are defined in Table 4.1.1 of this appendix.

4.3.4 *Weighted per-cycle remaining moisture content.* Calculate the weighted per-cycle remaining moisture content, RMC_T, defined as:

$RMC_T = [RMC_L \times LUF_L] + [RMC_S \times LUF_S]$

where:

RMC_L and RMC_S are defined in section 4.3.3 of this appendix.

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

4.3.5 Apply the RMC correction curve as described in section 9 of appendix J3 to this subpart to calculate the corrected remaining moisture content, RMC_{corr}, expressed as a percentage as follows:

$RMC_{corr} = (A \times RMC_T + B) \times 100\%$

where:

A and B are the coefficients of the RMC correction curve as defined in section 8.7 of appendix J3 to this subpart.

RMC_T = As defined in section 4.3.4 of this appendix.

4.4 *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, DE_T, expressed in kilowatt-hours per cycle and defined as:

$DE_T = [(LUF_L \times \text{Large test load weight}) + (LUF_S \times \text{Small test load weight})] \times (RMC_{corr} - 2\%) \times (DEF) \times (DUF)$

where:

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

Large and small test load weights are defined in Table 5.1 of this appendix.

RMC_{corr} = As defined in section 4.3.5 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.

4.5 *Cycle time.*

4.5.1 *Per-cycle temperature-weighted cycle time for all load sizes tested.* Calculate the per-cycle temperature-weighted cycle time for the large test load size, T_L, and the small test load size, T_S, expressed in minutes, and defined as:

(a) $T_L = [Tx_L \times TUF_x] + [Th_L \times TUF_h] + [Tw_L \times TUF_w] + [Tww_L \times TUF_{ww}] + [Tc_L \times TUF_c]$

(b) $T_S = [Tx_S \times TUF_x] + [Th_S \times TUF_h] + [Tw_S \times TUF_w] + [Tww_S \times TUF_{ww}] + [Tc_S \times TUF_c]$

where:

Tx_L, Th_L, Tw_L, Tww_L, Tc_L, Tx_S, Th_S, Tw_S, Tww_S, and Tc_S are the cycle time values, in minutes as measured in section 3.3 of this appendix for automatic clothes washers or section 3.4 of this appendix for semi-automatic clothes washers.

TUF_x, TUF_h, TUF_w, TUF_{ww}, and TUF_c are temperature use factors for Extra-Hot Wash/Cold Rinse, Hot Wash/Cold Rinse, Warm Wash/Cold Rinse, Warm Wash/Warm

Rinse, and Cold Wash/Cold Rinse temperature selections, respectively, as defined in Table 4.1.1 of this appendix.

4.5.2 *Total weighted per-cycle cycle time.* Calculate the total weighted per-cycle cycle time, T_T, expressed in minutes, rounded to the nearest minute, and defined as:

$T_T = [T_L \times LUF_L] + [T_S \times LUF_S]$

where:

T_L and T_S are defined in section 4.5.1 of this appendix.

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

4.6 Combined low-power mode energy consumption.

4.6.1 *Annual hours in default inactive/off mode*. Calculate the annual hours spent in default inactive/off mode, $S_{default}$, expressed in hours and defined as:

$S_{default} = [8{,}760 – (234 \times T_T / 60)] / N$

where:

T_T = As defined in section 4.5.2 of this appendix, in minutes.

N = Number of inactive/off modes, defined as 1 if no optional lowest-power inactive/off mode is available; otherwise 2.

8,760 = Total number of hours in a year.

234 = Representative average number of clothes washer cycles in a year.

60 = Conversion from minutes to hours.

4.6.2 *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:

$E_{TLP} = [(P_{default} \times S_{default}) + (P_{lowest} \times S_{lowest})] \times K_p / 234$

where:

$P_{default}$ = Default inactive/off mode power, in watts, as measured in section 3.5.3 of this appendix.

P_{lowest} = Lowest-power inactive/off mode power, in watts, as measured in section 3.5.4 of this appendix for clothes washers with a switch, dial, or button that can be optionally selected by the end user to achieve a lower-power inactive/off mode than the default inactive/off mode; otherwise, P_{lowest}=0.

$S_{default}$= Annual hours in default inactive/off mode, as calculated in section 4.6.1 of this appendix.

S_{lowest}= Annual hours in lowest-power inactive/off mode, defined as 0 if no optional lowest-power inactive/off mode is available; otherwise equal to $S_{default}$, as calculated in section 4.6.1 of this appendix.

K_p = Conversion factor of watt-hours to kilowatt-hours = 0.001.

234 = Representative average number of clothes washer cycles in a year.

4.7 *Water efficiency ratio.* Calculate the water efficiency ratio, WER, expressed in pounds per gallon per cycle (or kilograms per liter per cycle), as:

$WER = [(LUF_L \times \text{Large test load weight}) + (LUF_S \times \text{Small test load weight})] / Q_T$

where:

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

Large and small test load weights are defined in Table 5.1 of this appendix.

Q_T = As defined in section 4.2.4 of this appendix.

4.8 *Active-mode energy efficiency ratio.* Calculate the active-mode energy efficiency ratio, AEER, expressed in pounds per kilowatt-hour per cycle (or kilograms per kilowatt-hour per cycle) and defined as:

$AEER = [(LUF_L \times \text{Large test load weight}) + (LUF_S \times \text{Small test load weight})] / (ME_T + HE_T + DE_T)$

where:

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

Large and small test load weights are defined in Table 5.1 of this appendix.

ME_T = As defined in section 4.1.6 of this appendix.

HE_T = As defined in section 4.1.3 of this appendix.

DE_T = As defined in section 4.4 of this appendix.

4.9 *Energy efficiency ratio.* Calculate the energy efficiency ratio, EER, expressed in pounds per kilowatt-hour per cycle (or kilograms per kilowatt-hour per cycle) and defined as:

$EER = [(LUF_L \times \text{Large test load weight}) + (LUF_S \times \text{Small test load weight})] / (ME_T + HE_T + DE_T + E_{TLP})$

where:

LUF_L and LUF_S are defined in section 4.1.3 of this appendix.

Large and small test load weights are defined in Table 5.1 of this appendix.

ME_T = As defined in section 4.1.6 of this appendix.

HE_T = As defined in section 4.1.3 of this appendix.

DE_T = As defined in section 4.4 of this appendix.

E_{TLP} = As defined in section 4.6.2 of this appendix.

5. Test Loads

TABLE 5.1—TEST LOAD SIZES

Container volume		Small load		Large load	
cu. ft.	liter				
≥ <	≥ <	lb	kg	lb	kg
0.00-0.80	0.00-22.7	3.00	1.36	3.00	1.36
0.80-0.90	22.7-25.5	3.10	1.41	3.35	1.52
0.90-1.00	25.5-28.3	3.20	1.45	3.70	1.68
1.00-1.10	28.3-31.1	3.30	1.50	4.00	1.81
1.10-1.20	31.1-34.0	3.40	1.54	4.30	1.95
1.20-1.30	34.0-36.8	3.45	1.56	4.60	2.09
1.30-1.40	36.8-39.6	3.55	1.61	4.95	2.25
1.40-1.50	39.6-42.5	3.65	1.66	5.25	2.38

1.50-1.60	42.5-45.3	3.75	1.70	5.55	2.52
1.60-1.70	45.3-48.1	3.80	1.72	5.85	2.65
1.70-1.80	48.1-51.0	3.90	1.77	6.20	2.81
1.80-1.90	51.0-53.8	4.00	1.81	6.50	2.95
1.90-2.00	53.8-56.6	4.10	1.86	6.80	3.08
2.00-2.10	56.6-59.5	4.20	1.91	7.10	3.22
2.10-2.20	59.5-62.3	4.30	1.95	7.45	3.38
2.20-2.30	62.3-65.1	4.35	1.97	7.75	3.52
2.30-2.40	65.1-68.0	4.45	2.02	8.05	3.65
2.40-2.50	68.0-70.8	4.55	2.06	8.35	3.79
2.50-2.60	70.8-73.6	4.65	2.11	8.70	3.95
2.60-2.70	73.6-76.5	4.70	2.13	9.00	4.08
2.70-2.80	76.5-79.3	4.80	2.18	9.30	4.22
2.80-2.90	79.3-82.1	4.90	2.22	9.60	4.35
2.90-3.00	82.1-85.0	5.00	2.27	9.90	4.49
3.00-3.10	85.0-87.8	5.10	2.31	10.25	4.65
3.10-3.20	87.8-90.6	5.20	2.36	10.55	4.79
3.20-3.30	90.6-93.4	5.25	2.38	10.85	4.92
3.30-3.40	93.4-96.3	5.35	2.43	11.15	5.06
3.40-3.50	96.3-99.1	5.45	2.47	11.50	5.22
3.50-3.60	99.1-101.9	5.55	2.52	11.80	5.35
3.60-3.70	101.9-104.8	5.65	2.56	12.10	5.49
3.70-3.80	104.8-107.6	5.70	2.59	12.40	5.62
3.80-3.90	107.6-110.4	5.80	2.63	12.75	5.78
3.90-4.00	110.4-113.3	5.90	2.68	13.05	5.92
4.00-4.10	113.3-116.1	6.00	2.72	13.35	6.06
4.10-4.20	116.1-118.9	6.10	2.77	13.65	6.19
4.20-4.30	118.9-121.8	6.15	2.79	14.00	6.35
4.30-4.40	121.8-124.6	6.25	2.83	14.30	6.49
4.40-4.50	124.6-127.4	6.35	2.88	14.60	6.62
4.50-4.60	127.4-130.3	6.45	2.93	14.90	6.76
4.60-4.70	130.3-133.1	6.55	2.97	15.25	6.92
4.70-4.80	133.1-135.9	6.60	2.99	15.55	7.05

4.80-4.90	135.9-138.8	6.70	3.04	15.85	7.19
4.90-5.00	138.8-141.6	6.80	3.08	16.15	7.33
5.00-5.10	141.6-144.4	6.90	3.13	16.50	7.48
5.10-5.20	144.4-147.2	7.00	3.18	16.80	7.62
5.20-5.30	147.2-150.1	7.05	3.20	17.10	7.76
5.30-5.40	150.1-152.9	7.15	3.24	17.40	7.89
5.40-5.50	152.9-155.7	7.25	3.29	17.70	8.03
5.50-5.60	155.7-158.6	7.35	3.33	18.05	8.19
5.60-5.70	158.6-161.4	7.45	3.38	18.35	8.32
5.70-5.80	161.4-164.2	7.50	3.40	18.65	8.46
5.80-5.90	164.2-167.1	7.60	3.45	18.95	8.60
5.90-6.00	167.1-169.9	7.70	3.49	19.30	8.75
6.00-6.10	169.9-172.7	7.80	3.54	19.60	8.89
6.10-6.20	172.7-175.6	7.90	3.58	19.90	9.03
6.20-6.30	175.6-178.4	7.95	3.61	20.20	9.16
6.30-6.40	178.4-181.2	8.05	3.65	20.55	9.32
6.40-6.50	181.2-184.1	8.15	3.70	20.85	9.46
6.50-6.60	184.1-186.9	8.25	3.74	21.15	9.59
6.60-6.70	186.9-189.7	8.30	3.76	21.45	9.73
6.70-6.80	189.7-192.6	8.40	3.81	21.80	9.89
6.80-6.90	192.6-195.4	8.50	3.86	22.10	10.02
6.90-7.00	195.4-198.2	8.60	3.90	22.40	10.16
7.00-7.10	198.2-201.0	8.70	3.95	22.70	10.30
7.10-7.20	201.0-203.9	8.80	3.99	23.05	10.46
7.20-7.30	203.9-206.7	8.85	4.01	23.35	10.59
7.30-7.40	206.7-209.5	8.95	4.06	23.65	10.73
7.40-7.50	209.5-212.4	9.05	4.11	23.95	10.86
7.50-7.60	212.4-215.2	9.15	4.15	24.30	11.02
7.60-7.70	215.2-218.0	9.25	4.20	24.60	11.16
7.70-7.80	218.0-220.9	9.30	4.22	24.90	11.29
7.80-7.90	220.9-223.7	9.40	4.26	25.20	11.43
7.90-8.00	223.7-226.5	9.50	4.31	25.50	11.57

Notes: (1) All test load weights are bone-dry weights.

(2) Allowable tolerance on the test load weights is ±0.10 lbs (0.05 kg).

Appendix J1 [Removed and Reserved]

9. Remove and reserve Appendix J1 to subpart B of part 430.

10. Appendix J2 to subpart B of part 430 is amended by:

a. Revising the introductory note;

b. Adding section 0;

c. Revising section 1;

d. Revising the heading for section 2;

e. Revising section 2.2;

f. Adding sections 2.5.4.1 and 2.5.4.2;

g. Revising sections 2.5.5, 2.7 and 2.12;

h. Removing sections 2.7.1, 2.7.2, 2.7.3, 2.7.4, 2.7.4.1, 2.7.4.2, 2.7.4.3, 2.7.4.4, 2.7.4.5, 2.7.4.6, 2.7.4.6.1, 2.7.4.6.2, 2.7.4.7, and 2.7.5;

i. Removing “energy stuffer clothes” and adding in its place, “energy stuffer cloths” in section 2.8;

j. Revising section 3.2.5;

k. Adding sections 3.2.5.1 and 3.2.5.2;

l. Revising sections 3.2.6.2.2, 3.2.7 and 3.2.9;

m. Revising sections 3.3 and 3.6;

n. In sections 3.8.2.6, 3.8.3.2, and 3.8.3.4 removing “section 7 of appendix J3” and adding in its place, “section 9 of appendix J3”, and removing “section 6.1 of appendix J3” and adding in its place, “section 8.7 of appendix J3”;

o. Removing section 4.2.12;

p. Redesignating section 4.2.13 as 4.2.12;

q. Removing “MEF” and adding in its place “MEF_{J2}” in all instances in section 4.5;

r. Revising Table 5.1; and

s. Removing section 6.

The additions and revisions 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

NOTE: Manufacturers must use the results of testing under this appendix to determine compliance with the relevant standards for clothes washers from §430.32(g)(4) and from §431.156(b) as they appeared in January 1, 2022 edition of 10 CFR parts 200-499. Specifically, before [**INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] representations must be based upon results generated either under this appendix as codified on [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] or under this appendix as it appeared in the 10 CFR parts 200-499 edition revised as of January 1, 2022. Any representations made on or after [**INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] but before the compliance date of any amended standards for clothes washers must be made based upon results generated using this appendix as codified on [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***]. Manufacturers must use the results of testing under Appendix J to determine compliance with any amended standards for clothes washers provided in 10 CFR 430.32(g) and in §431.156 that are published after January 1, 2022. Any representations related to energy or water consumption of residential or commercial clothes washers must be made in accordance with the appropriate appendix that applies (*i.e.*, Appendix J or this appendix) when determining compliance with the relevant standard. Manufacturers may also use Appendix J to certify compliance with any amended standards prior to the applicable compliance date for those standards.

0. Incorporation by Reference

DOE incorporated by reference in §430.3, the entire test standard for IEC 62301.

However, only enumerated provisions of this standard are applicable to this appendix, as follows. In cases in which there is a conflict, the language of the test procedure in this appendix takes precedence over the referenced test standard.

0.1 IEC 62301:

(a) Section 4.2 as referenced in section 2.4 of this appendix;

(b) Section 4.3.2 as referenced in section 2.1.2 of this appendix;

(c) Section 4.4 as referenced in section 2.5.3 of this appendix;

(d) Section 5.1 as referenced in section 3.9.2 of this appendix;

(e) Section 5.2 as referenced in section 2.10 of this appendix; and

(f) Section 5.3.2 as referenced in section 3.9.3 of this appendix.

0.2 [Reserved]

1. Definitions

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.

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.

Adaptive water fill control system means a clothes washer automatic water fill control system that is capable of automatically adjusting the water fill level based on the size or weight of the clothes load placed in the clothes container.

Automatic water fill control system means a clothes washer water fill control system that does not allow or require the user to determine or select the water fill level, and includes adaptive water fill control systems and fixed water fill control systems.

Bone-dry means a condition of a load of test cloth that 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.

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

Cold rinse means the coldest rinse temperature available on the machine, as indicated to the user on the clothes washer control panel.

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.

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

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

Energy test cycle means the complete set of wash/rinse temperature selections required for testing, as determined according to section 2.12 of this appendix.

Fixed water fill control system means a clothes washer automatic water fill control system that automatically terminates the fill when the water reaches a pre-defined level that is not based on the size or weight of the clothes load placed in the clothes container, without allowing or requiring the user to determine or select the water fill level.

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.

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.

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.

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

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

Manual water fill control system means a clothes washer water fill control system that requires the user to determine or select the water fill level.

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.

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

Normal cycle means the cycle recommended by the manufacturer (considering manufacturer instructions, control panel labeling, and other markings on the clothes washer) for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing. For machines where multiple cycle settings are recommended by the manufacturer for normal, regular, or typical use for washing up to a full load of normally soiled cotton clothing, then the Normal cycle is the cycle selection that results in the lowest IMEF or MEF_{J2} value.

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.

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) Facilitating 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.

(c) 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.

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.

User-adjustable adaptive water fill control system means a clothes washer fill control system that allows the user to adjust the amount of water that the machine provides, which is based on the size or weight of the clothes load placed in the clothes container.

Wash time means the wash portion of active washing mode, which begins when the cycle is initiated and includes the agitation or tumble time, which may be periodic or continuous during the wash portion of active washing mode.

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.

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 and Instrumentation

* * * * *

2.2 *Supply water.* Maintain the temperature of the hot water supply at the water inlets between 130 °F (54.4 °C) and 135 °F (57.2 °C), targeting the midpoint of the range. Maintain the temperature of the cold water supply at the water inlets between 55 °F (12.8 °C) and 60 °F (15.6 °C), targeting the midpoint of the range.

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2.5.4 * * *

2.5.4.1 Non-reversible temperature indicator labels, adhered to the inside of the clothes container, may be used to confirm that an extra-hot wash temperature greater than 135 °F has been achieved during the wash cycle, under the following conditions. The label must remain waterproof, intact, and adhered to the wash drum throughout an entire wash cycle; provide consistent maximum temperature readings; and provide repeatable temperature indications sufficient to demonstrate that a wash temperature of greater than 135 °F has been achieved. The label must have been verified to consistently indicate temperature measurements with an accuracy of ±1 °F if the label provides a temperature indicator at 135 °F. If the label does not provide a temperature indicator at 135 °F, the label must have been verified to consistently indicate temperature measurements with an accuracy of ±1 °F if the next-highest temperature indicator is greater than 135 °F and less than 140 °F, or ±3 °F if the next-highest temperature indicator is 140 °F or greater. If the label does not provide a temperature indicator at 135 °F, failure to activate the next-highest temperature indicator does not necessarily indicate the lack of an extra-hot wash temperature. However, such a result would not be conclusive due to the lack of verification of the water temperature requirement, in which case an alternative method must be used to confirm that an extra-hot wash temperature greater than 135 °F has been achieved during the wash cycle. If using a temperature indicator label to test a front-loading clothes washer, adhere the label along the interior surface of the clothes container drum, midway between the front and the back of the drum, adjacent to one of the baffles.

If using a temperature indicator label to test a top-loading clothes washer, adhere the label along the interior surface of the clothes container drum, on the vertical portion of the sidewall, as close to the bottom of the container as possible.

2.5.4.2 Submersible temperature loggers placed inside the wash drum may be used to confirm that an extra-hot wash temperature greater than 135 °F has been achieved during the wash cycle, under the following conditions. The submersible temperature logger must have a time resolution of at least 1 data point every 5 seconds and a temperature measurement accuracy of ±1 °F. Due to the potential for a waterproof capsule to provide a thermal insulating effect, failure to measure a temperature of 135 °F does not necessarily indicate the lack of an extra-hot wash temperature. However, such a result would not be conclusive due to the lack of verification of the water temperature requirement, in which case an alternative method must be used to confirm that an extra-hot wash temperature greater than 135 °F has been achieved during the wash cycle.

2.5.5 *Water meter.* A water meter must be installed in both the hot and cold water lines to measure water flow and/or water consumption. The water meters must 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. If the volume of hot water for any individual cycle within the energy test cycle is less than 0.1 gallons (0.4 liters), the hot water meter must have a resolution no larger than 0.01 gallons (0.04 liters).

* * * * *

2.7 *Test cloths.* The test cloth material and dimensions must conform to the specifications in appendix J3 to this subpart. The energy test cloth and the energy stuffer cloths must be clean and must not be used for more than 60 test runs (after preconditioning as specified in section 5 of appendix J3 to this subpart). All energy test cloth must be permanently marked identifying the lot number of the material. Mixed lots of material must not be used for testing a clothes washer. The moisture absorption and retention must be

evaluated for each new lot of test cloth using the standard extractor Remaining Moisture Content (RMC) procedure specified in appendix J3 to this subpart.

* * * * *

2.12 *Determining the energy test cycle.* To determine the energy test cycle, evaluate the wash/rinse temperature selection flowcharts in the order in which they are presented in this section. Except for Cold Wash/Cold Rinse, use the maximum load size to evaluate each flowchart. The determination of the energy test cycle must take into consideration all cycle settings available to the end user, including any cycle selections or cycle modifications provided by the manufacturer via software or firmware updates to the product, for the basic model under test. The energy test cycle does not include any cycle that is recommended by the manufacturer exclusively for cleaning, deodorizing, or sanitizing the clothes washer.

Figure 2.12.1—Determination of Cold Wash/Cold Rinse

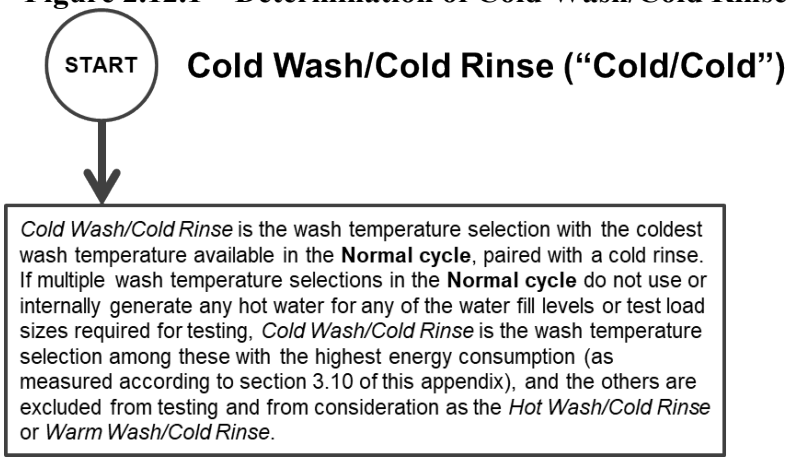


Figure 2.12.2—Determination of Hot Wash/Cold Rinse

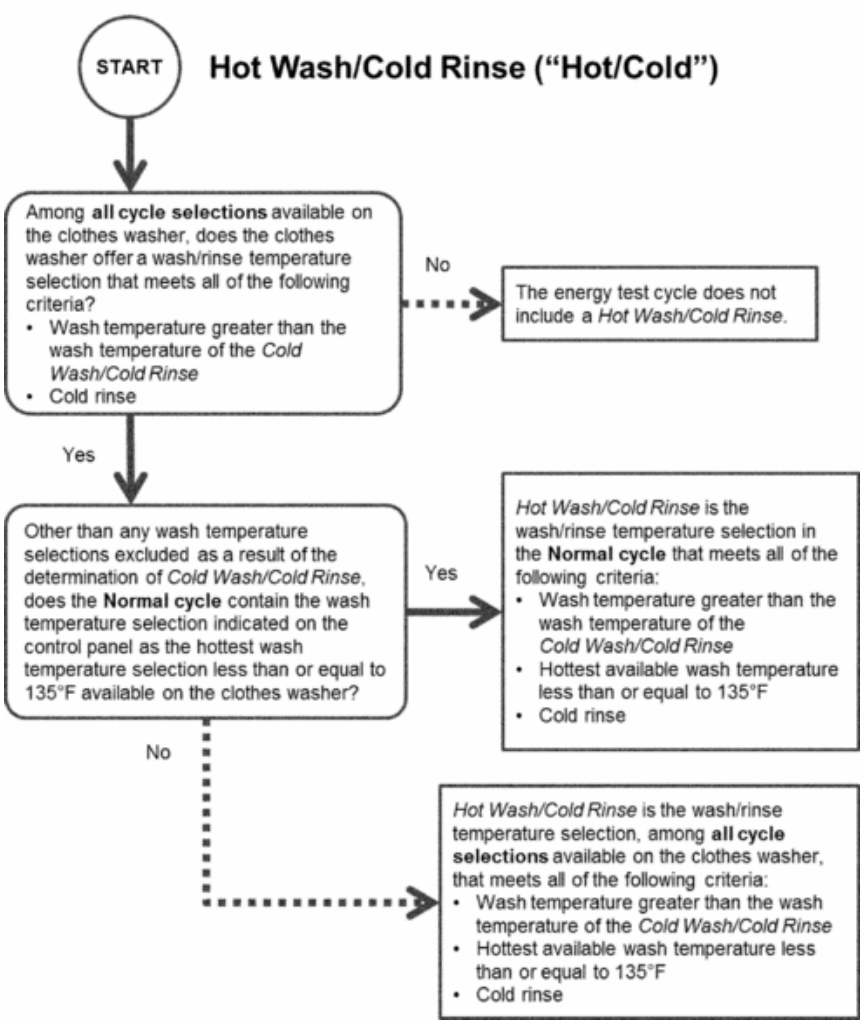


Figure 2.12.3—Determination of Warm Wash/Cold Rinse

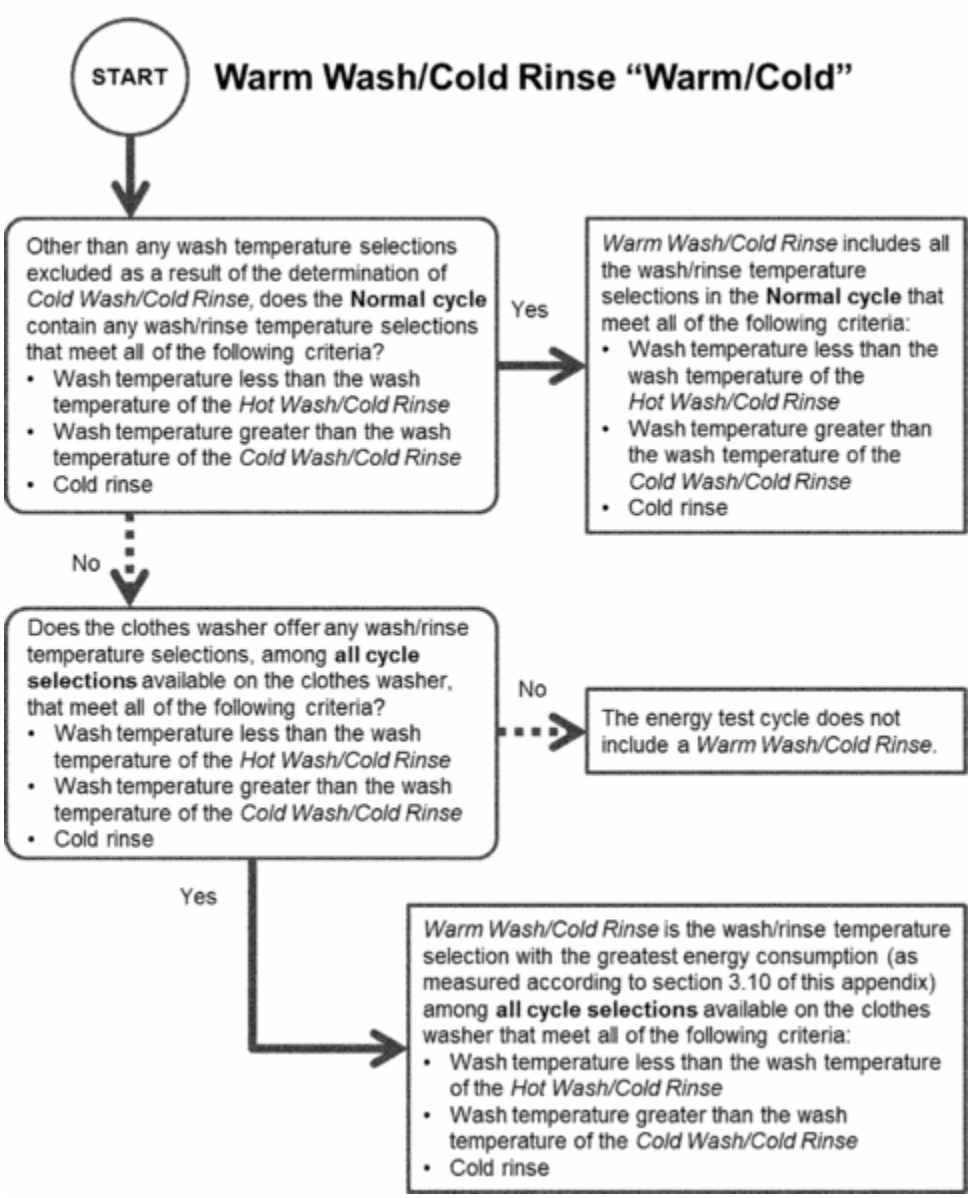


Figure 2.12.4—Determination of Warm Wash/Warm Rinse

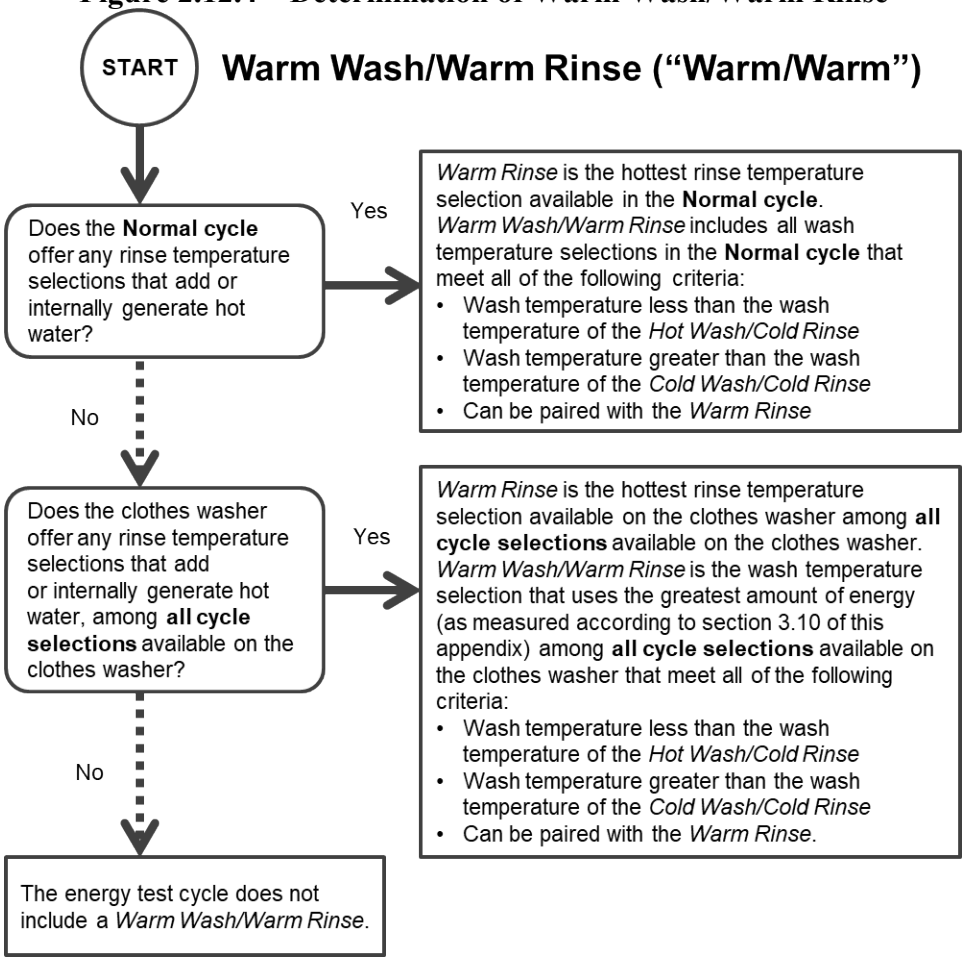
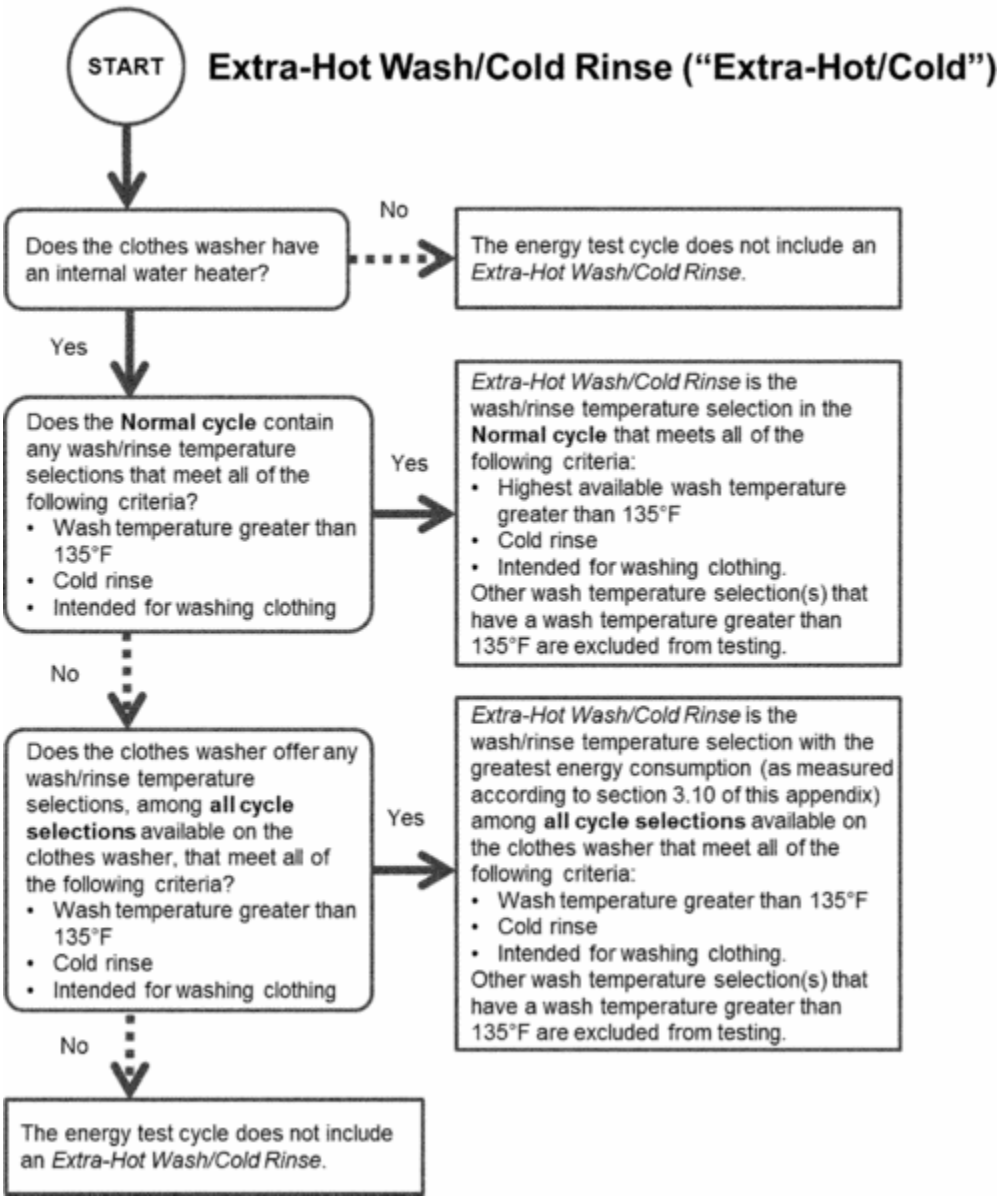


Figure 2.12.5—Determination of Extra-Hot Wash/Cold Rinse



3. Test Measurements

* * * * *

3.2.5 *Wash time setting*.

3.2.5.1 If the cycle under test offers a range of wash time settings, the wash time setting shall be the higher of either the minimum or 70 percent of the maximum wash time available for the wash cycle under test, regardless of the labeling of suggested dial locations. If 70 percent of the maximum wash time is not available on a dial with a discrete number of wash time settings, choose the next-highest setting greater than 70 percent.

3.2.5.2 If the clothes washer is equipped with an electromechanical dial or timer controlling wash time that rotates in both directions, 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 appropriate setting is reached.

* * * * *

3.2.6 * * *

* * * * *

3.2.6.2.2 *User-adjustable adaptive.* Conduct four tests on clothes washers with user-adjustable adaptive water fill controls. Conduct the first test using the maximum test load and with the adaptive water fill control system set in the setting that uses the most water. Conduct the second test using the minimum test load and with the adaptive water fill control system set in the setting that uses the least water. Conduct the third test using the average test load and with the adaptive water fill control system set in the setting that uses the most water. Conduct the fourth test using the average test load and with the adaptive water fill control system set in the setting that uses the least water. Average the results of the third and fourth tests to obtain the energy and water consumption values for the average test load size.

* * * * *

3.2.7 *Manufacturer default settings.* For clothes washers with electronic control systems, use the manufacturer default settings for any cycle selections, except for (1) the temperature selection, (2) the wash water fill levels, (3) if necessary, the spin speeds on wash cycles used to determine remaining moisture content, or (4) network settings. If the clothes washer has network capabilities, the network settings must be disabled throughout testing if such settings can be disabled by the end-user and the product's user manual provides instructions on how to do so. For all other cycle selections, the manufacturer

default settings must be used for wash conditions such as agitation/tumble operation, soil level, spin speed on wash cycles used to determine energy and water consumption, wash times, rinse times, optional rinse settings, water heating time for water heating clothes washers, and all other wash parameters or optional features applicable to that wash cycle. Any optional wash cycle feature or setting (other than wash/rinse temperature, water fill level selection, spin speed on wash cycles used to determine remaining moisture content, or network settings on clothes washers with network capabilities) that is activated by default on the wash cycle under test must be included for testing unless the manufacturer instructions recommend not selecting this option, or recommend selecting a different option, for washing normally soiled cotton clothing. For clothes washers with control panels containing mechanical switches or dials, any optional settings, except for (1) the temperature selection, (2) the wash water fill levels, or (3) if necessary, the spin speeds on wash cycles used to determine remaining moisture content, must be in the position recommended by the manufacturer for washing normally soiled cotton clothing. If the manufacturer instructions do not recommend a particular switch or dial position to be used for washing normally soiled cotton clothing, the setting switch or dial must remain in its as-shipped position.

* * * * *

3.2.9 *Anomalous Test Cycles*. If during a wash cycle the clothes washer: (a) signals to the user by means of a visual or audio alert that an out-of-balance condition has been detected; or (b) terminates prematurely and thus does not include the agitation/tumble operation, spin speed(s), wash times, and rinse times applicable to the wash cycle under test, discard the test data and repeat the wash cycle. Document in the test report the rejection of data from any wash cycle during testing and the reason for the rejection.

3.3 *Extra-Hot Wash/Cold Rinse.* Measure the water and electrical energy consumption for each water fill level and test load size as specified in sections 3.3.1 through 3.3.3 of this appendix for the Extra-Hot Wash/Cold Rinse as defined within the energy test cycle.

* * * * *

3.6 *Warm Wash/Warm Rinse.* Measure the water and electrical energy consumption 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 applicable Warm Wash/Warm Rinse temperature selection(s), as defined within the energy test cycle. For a clothes washer with fewer than four discrete Warm Wash/Warm Rinse temperature selections, test all Warm Wash/Warm Rinse selections. For a clothes washer that offers four or more Warm Wash/Warm Rinse 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. For each reportable value to be used for the Warm Wash/Warm Rinse temperature selection, calculate the average of all Warm Wash/Warm Rinse temperature selections tested pursuant to this section.

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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
0.00-0.80	0.00-22.7	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
6.00-6.10	169.9-172.7	3.00	1.36	24.80	11.25	13.90	6.30
6.10-6.20	172.7-175.6	3.00	1.36	25.20	11.43	14.10	6.40
6.20-6.30	175.6-178.4	3.00	1.36	25.60	11.61	14.30	6.49
6.30-6.40	178.4-181.2	3.00	1.36	26.00	11.79	14.50	6.58
6.40-6.50	181.2-184.1	3.00	1.36	26.40	11.97	14.70	6.67
6.50-6.60	184.1-186.9	3.00	1.36	26.90	12.20	14.95	6.78
6.60-6.70	186.9-189.7	3.00	1.36	27.30	12.38	15.15	6.87
6.70-6.80	189.7-192.6	3.00	1.36	27.70	12.56	15.35	6.96
6.80-6.90	192.6-195.4	3.00	1.36	28.10	12.75	15.55	7.05
6.90-7.00	195.4-198.2	3.00	1.36	28.50	12.93	15.75	7.14
7.00-7.10	198.2-201.0	3.00	1.36	28.90	13.11	15.95	7.23
7.10-7.20	201.0-203.9	3.00	1.36	29.30	13.29	16.15	7.33
7.20-7.30	203.9-206.7	3.00	1.36	29.70	13.47	16.35	7.42
7.30-7.40	206.7-209.5	3.00	1.36	30.10	13.65	16.55	7.51
7.40-7.50	209.5-212.4	3.00	1.36	30.50	13.83	16.75	7.60
7.50-7.60	212.4-215.2	3.00	1.36	31.00	14.06	17.00	7.71
7.60-7.70	215.2-218.0	3.00	1.36	31.40	14.24	17.20	7.80

7.70-7.80	218.0-220.9	3.00	1.36	31.80	14.42	17.40	7.89
7.80-7.90	220.9-223.7	3.00	1.36	32.20	14.61	17.60	7.98
7.90-8.00	223.7-226.5	3.00	1.36	32.60	14.79	17.80	8.07

11. Appendix J3 to subpart B of part 430 is revised to read as follows:

Appendix J3 to Subpart B of Part 430—Energy Test Cloth Specifications and Procedures for Determining Correction Coefficients of New Energy Test Cloth Lots

NOTE: DOE maintains an historical record of the standard extractor test data and final correction curve coefficients for each approved lot of energy test cloth. These can be accessed through DOE's web page for standards and test procedures for residential clothes washers at DOE's Building Technologies Office Appliance and Equipment Standards website.

1. Objective

This appendix includes the following: (1) specifications for the energy test cloth to be used for testing clothes washers; (2) procedures for verifying that new lots of energy test cloth meet the defined material specifications; and (3) procedures for developing a set of correction coefficients that correlate the measured remaining moisture content (RMC) values of each new test cloth lot with a set of standard RMC values established as an historical reference point. These correction coefficients are applied to the RMC measurements performed during testing according to appendix J or appendix J2 to this subpart, ensuring that the final corrected RMC measurement for a clothes washer remains independent of the test cloth lot used for testing.

2. Definitions

AHAM means the Association of Home Appliance Manufacturers.

Bone-dry means a condition of a load of test cloth that 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.

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

Roll means a subset of a lot.

3. Energy Test Cloth Specifications

The energy test cloths and energy stuffer cloths must meet the following specifications:

3.1 The test cloth 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 the test cloth material meets the specifications listed in sections 3.2 through 3.6 of this appendix.

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

3.3 *Fabric weight*. 5.60 ± 0.25 ounces per square yard (190.0 ± 8.4 g/m2).

3.4 *Thread count*. 65 x 57 per inch (warp × fill), ±2 percent.

3.5 *Fiber content of warp and filling yarn*. 50 percent ±4 percent cotton, with the balance being polyester, open end spun, 15/1 ±5 percent cotton count blended yarn.

3.6 Water repellent finishes, such as fluoropolymer stain resistant finishes, must not be applied to the test cloth.

3.7. *Test cloth dimensions*.

3.7.1 *Energy test cloth.* The energy test cloth must be made from energy test cloth material, as specified in section 3.1 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.

3.7.2 *Energy stuffer cloth.* The energy stuffer cloth must be made from energy test cloth material, as specified in section 3.1 of this appendix, that is 12 ± ¼ inches by

12 ± ¼ inches (30.5 ± 0.6 cm by 30.5 ± 0.6 cm) and has been hemmed to 10 ± ¼ inches by 10 ± ¼ inches (25.4 ± 0.6 cm by 25.4 ± 0.6 cm) before washing.

3.8 The test cloth must be clean and must not be used for more than 60 test runs (after pre-conditioning as specified in section 5 of this appendix). All test cloth must be permanently marked identifying the lot number of the material. Mixed lots of material must not be used for testing a clothes washer according to appendix J or appendix J2 to this subpart.

4. Equipment Specifications

4.1 *Extractor*. Use 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 4.1 of this appendix shows the extractor spin speed, in revolutions per minute (RPM), that must be used to attain each required g-force level.

TABLE 4.1—EXTRACTOR SPIN SPEEDS FOR EACH TEST CONDITION

"g Force"	RPM
100	594 ± 1
200	840 ± 1
350	1,111 ± 1
500	1,328 ± 1
650	1,514 ± 1

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

5. Test Cloth Pre-Conditioning Instructions

Use the following instructions for performing pre-conditioning of new energy test cloths and energy stuffer cloths as specified throughout section 7 and section 8 of this appendix, and before any clothes washer testing using appendix J or appendix J2 to this subpart: Perform five complete 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). Dry the load to bone-dry between each of the five wash-rinse-spin cycles. The maximum shrinkage after preconditioning must not be more than 5 percent of the length and width. Measure per AATCC Test Method 135-2010 (incorporated by reference; see §430.3).

6. Extractor Run Instructions

Use the following instructions for performing each of the extractor runs specified throughout section 7 and section 8 of this appendix:

6.1 *Test load size.* Use a test load size of 8.4 lbs.

6.2 Measure the average RMC for each sample loads as follows:

6.2.1 Dry the test cloth until it is bone-dry according to the definition in section 2 of this appendix. Record the bone-dry weight of the test load (WI).

6.2.2 Prepare the test load for soak by grouping four test cloths into loose bundles. Create the bundles 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. Then place the bundles 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.

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

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

6.2.5 Manually place the test cloth bundles in the basket of the extractor, distributing them evenly by eye. The draining and loading process must 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. Begin the timer when the extractor meets the required spin speed for each test.

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

6.2.7 Calculate the remaining moisture content of the test load as (WC-WI)/WI.

6.2.8 Draining the soak tub is not necessary if the water bath is corrected for water level and temperature before the next extraction.

6.2.9 Drying the test load in between extraction runs is not necessary. However, the bone-dry weight must be checked after every 12 extraction runs to make sure the bone-dry weight is within tolerance (8.4 ± 0.1 lbs). Following this, the test load must be soaked and extracted once before continuing with the remaining extraction runs. Perform this extraction at the same spin speed used for the extraction run prior to checking the bone-dry weight, for a time period of 4 minutes. Either warm or cold soak temperature may be used.

7. Test Cloth Material Verification Procedure

7.1 *Material Properties Verification*. The test cloth manufacturer must supply a certificate of conformance to ensure that the energy test cloth and stuffer cloth samples used for prequalification testing meet the specifications in section 3 of this appendix. The

material properties of one energy test cloth from each of the first, middle, and last rolls must be evaluated as follows, prior to pre-conditioning:

7.1.1 *Dimensions*. Each hemmed energy test cloth must meet the size specifications in section 3.7.1 of this appendix. Each hemmed stuffer cloth must meet the size specifications in section 3.7.2 of this appendix.

7.1.2 *Oil repellency*. Perform AATCC Test Method 118-2007, Oil Repellency: Hydrocarbon Resistance Test, (incorporated by reference, see §430.3), to confirm the absence of Scotchguard™ or other water-repellent finish. An Oil Repellency Grade of 0 (Fails Kaydol) is required.

7.1.3 *Absorbency*. Perform AATCC Test Method 79-2010, Absorbency of Textiles, (incorporated by reference, see §430.3), to confirm the absence of Scotchguard™ or other water-repellent finish. The time to absorb one drop must be on the order of 1 second.

7.2 *Uniformity Verification*. The uniformity of each test cloth lot must be evaluated as follows.

7.2.1 *Pre-conditioning*. Pre-condition the energy test cloths and energy stuffer cloths used for uniformity verification, as specified in section 5 of this appendix.

7.2.2 *Distribution of samples*. Test loads must be comprised of cloth from three different rolls from the sample lot. Each roll from a lot must be marked in the run order that it was made. The three rolls are selected based on the run order such that the first, middle, and last rolls are used. As the rolls are cut into cloth, fabric must be selected from the beginning, middle, and end of the roll to create separate loads from each location, for a total of nine sample loads according to Table 7.2.2.

TABLE 7.2.2—DISTRIBUTION OF SAMPLE LOADS FOR PREQUALIFICATION TESTING

Roll No.	Roll Location
First	Beginning
	Middle
	End

Middle	Beginning
	Middle
	End
Last	Beginning
	Middle
	End

7.2.3 Measure the remaining moisture content of each of the nine sample test loads, as specified in section 6 of this appendix, using a centripetal acceleration of 350g (corresponding to 1111 ± 1 RPM) and a spin duration of 15 minutes ± 5 seconds.

7.2.4 Repeat section 7.2.3 of this appendix an additional two times and calculate the arithmetic average of the three RMC values to determine the average RMC value for each sample load. It is not necessary to dry the load to bone-dry the load before the second and third replications.

7.2.5 Calculate the coefficient of variation (CV) of the nine average RMC values from each sample load. The CV must be less than or equal to 1 percent for the test cloth lot to be considered acceptable and to perform the standard extractor RMC testing.

8. RMC Correction Curve Procedure

8.1 *Pre-conditioning*. Pre-condition the energy test cloths and energy stuffer cloths used for RMC correction curve measurements, as specified in section 5 of this appendix.

8.2 *Distribution of samples.* Test loads must be comprised of randomly selected cloth at the beginning, middle and end of a lot. Two test loads may be used, with each load used for half of the total number of required tests. Separate test loads must be used from the loads used for uniformity verification.

8.3 Measure the remaining moisture content of the test load, as specified in section 6 of this appendix at five g-force 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. Table 4.1 of this appendix provides the corresponding spin speeds for each g-force level.

8.4 Repeat section 8.3 of this appendix using soft (<17 ppm) water at 60 °F ± 5 °F (15.6 °C ± 2.8 °C).

8.5 Repeat sections 8.3.3 and 8.3.4 of this appendix an additional two times, so that three replications at each extractor condition are performed. When this procedure is performed in its entirety, a total of 60 extractor RMC test runs are required.

8.6 Average the values of the 3 replications performed for each extractor condition specified in section 8.3 of this appendix.

8.7 Perform a linear least-squares fit to determine coefficients A and B such that the standard RMC values shown in Table 8.7 of this appendix ($RMC_{standard}$) are linearly related to the average RMC values calculated in section 8.6 of this appendix (RMC_{cloth}):

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

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

TABLE 8.7—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

8.8 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 section 8.6 of this appendix and Table 8.7 of this appendix in the calculation. The "P" value of the F-statistic for interaction between spin speed and lot in the variance analysis must 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.

9. Application of the RMC Correction Curve

9.1 Using the coefficients A and B calculated in section 8.7 of this appendix:

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

9.2 Apply this RMC correction curve to measured RMC values in appendix J and appendix J2 to this subpart.

PART 431 - ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

12. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291−6317; 28 U.S.C. 2461 note.

13. Section 431.152 is revised to read as follows:

§431.152 Definitions concerning commercial clothes washers.

AEER means active-mode energy efficiency ratio, in pounds per kilowatt-hour per cycle (lbs/kWh/cycle), as determined in section 4.8 of appendix J to subpart B of part 430 (when using appendix J).

Basic model means all units of a given type of covered product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency.

Commercial clothes washer means a soft-mounted front-loading or soft-mounted top-loading clothes washer that—

(1) Has a clothes container compartment that—

(i) For horizontal-axis clothes washers, is not more than 3.5 cubic feet; and

(ii) For vertical-axis clothes washers, is not more than 4.0 cubic feet; and

(2) Is designed for use in—

(i) Applications in which the occupants of more than one household will be using the clothes washer, such as multi-family housing common areas and coin laundries; or

(ii) Other commercial applications.

IWF means integrated water factor, in gallons per cubic feet per cycle (gal/cu ft/cycle), as determined in section 4.2.12 of appendix J2 to subpart B of part 430 (when using appendix J2).

MEF_{J2} means modified energy factor, in cu ft/kWh/cycle, as determined in section 4.5 of appendix J2 to subpart B of part 430 (when using appendix J2).

WER means water efficiency ratio, in pounds per gallon per cycle (lbs/gal/cycle), as determined in section 4.7 of appendix J to subpart B of part 430 (when using appendix J).

14. Section 431.154 is revised to read as follows:

§431.154 Test procedures.

The test procedures for clothes washers in appendix J2 to subpart B of part 430 must be used to determine compliance with the energy conservation standards at §431.156(b).

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