Federal Register

Wednesday
August 27, 1997

Part II

Department of Energy

Office of Energy Efficiency and Renewable Energy

10 CFR Part 430

Energy Conservation Program for Consumer Products: Test Procedure for Clothes Washers and Reporting Requirements for Clothes Washers, Clothes Dryers, and Dishwashers; Final Rule

DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

10 CFR Part 430

[Docket No. EE–RM–94–230A]

RIN 1904–AA68

Energy Conservation Program for Consumer Products: Test Procedure for Clothes Washers and Reporting Requirements for Clothes Washers, Clothes Dryers, and Dishwashers

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

ACTION: Final rule.

SUMMARY: This rule amends the Department of Energy clothes washer test procedure to test for compliance with the existing energy conservation standard. It also establishes a new clothes washer test procedure which will be used to analyze, and will apply to, anticipated revisions to the existing clothes washer energy conservation standards. This rule also modifies reporting requirements for clothes washers, clothes dryers, and dishwashers, requiring manufacturers and private labelers to submit energy factor data on their certification reports to the Department.

DATES: This rule is effective February 23, 1998.

ADDRESSES: Copies of the transcripts of the public hearings and the public comments received on any of the proposed rules, may be read and photocopied at the Department of Energy Freedom of Information Reading Room, U.S. Department of Energy, Forrestal Building, Room 1E–190, 1000 Independence Avenue, SW, Washington, DC 20585, (202) 586–6020 between the hours of 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT:

Bryan Berringer and P. Marc LaFrance, U.S. Department of Energy, Energy Efficiency and Renewable Energy, Mail Station EE–43, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC 20585–0121, (202) 586–0371.

Edward Levy, Esq., U.S. Department of Energy, Office of General Counsel, Mail Station GC–72, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC 20585–0103, (202) 586–9507.

SUPPLEMENTARY INFORMATION:

I. Introduction

Part B of Title III of the Energy Policy and Conservation Act as amended (EPCA), establishes the Energy Conservation Program for Consumer Products Other Than Automobiles (Program).[1] The products currently subject to this Program (often referred to hereinafter as ''covered products'') include clothes washers, clothes dryers and dishwashers, the subjects of today's notice.

Under the Act, the Program consists essentially of three parts: testing, labeling, and the Federal energy conservation standards. The Department, in consultation with the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards), is required to establish new test procedures or amend existing test procedures, as appropriate, for each of the covered products. EPCA, section 323. The purposes of the test procedures are to provide uniform methods that generally must be used as the basis for any representations concerning the energy consumption of a product, and for determining whether the product complies with the applicable energy conservation standard. See EPCA, sections 323(c), 324(c), and 325(s). Test procedures appear at 10 Code of Federal Regulation (CFR) part 430, Subpart B.

A test procedure promulgated under section 323 of the Act must be reasonably designed to produce test results which measure energy efficiency, energy use, water use (in the case of shower heads, faucets, water closets and urinals), or estimated annual operating cost of a covered product during a representative average use cycle or period of use, and must not be unduly burdensome to conduct. EPCA, section 323(b)(3). A test procedure is not required if DOE determines by rule that one cannot be developed. EPCA, section 323(d)(1). One hundred and eighty days after a test procedure for a product is adopted, no manufacturer may make representations with respect to energy use, efficiency or water use of such product, or the cost of energy consumed by such product, except as reflected in tests conducted according to the DOE procedure. EPCA, section 323(c)(2). This 180-day period may be extended for up to an additional 180 days if the Secretary determines that the requirements of section 323(c)(2) would impose undue burden. EPCA, section 323(c)(3).

Section 323(e) of the Act requires DOE to determine to what extent, if any, a proposed test procedure would alter the measured energy efficiency, measured energy use or measured water use of any covered product as

[1] Part B of Title III of EPCA, as amended, is referred to in this final rule as the ''Act'' and provisions of the Act are referred to either as ''Section__of the Act.'' Part B of Title III is codified at 42 U.S.C. 6291–6309.

determined under the existing test procedure. If DOE determines that an amended test procedure would alter the measured efficiency or measured use of a covered product, DOE is required to amend the applicable energy conservation standard accordingly. EPCA, section 323(e)(2).

II. Background

Today's final rule reflects the Department's consideration of several proposed rules issued since December 1993 concerning DOE clothes washer test procedures, and of the public comment and testimony received in response to those proposals. The Department's action consolidates the issues pertaining to these proposals and reflects the most recent data submitted by clothes washer manufacturers.

The initial proposal, published on December 22, 1993, proposed to amend the clothes washer test procedure to address temperature selections that are locked out of the normal cycle (formerly Docket Number EE–RM–93–701). 58 FR 67710 (December 22, 1993) (hereinafter referred to as the December 1993 proposed rule). A public hearing was held on February 24, 1994.

The Department proposed the following approach for a clothes washer equipped with this feature: for each temperature combination in the normal cycle from which a temperature selection is locked out, hot water consumption would be prorated between the temperature combination in that cycle and the corresponding temperature combination in the cycle with the greatest hot water consumption. The unknown factor in the calculation was the frequency with which users would choose the normal versus other cycles for a particular temperature combination selection, i.e., the proration value. As stated in the December 1993 proposed rule, clothes washers equipped with a temperature selection ''lockout'' design feature had not been available previously in the marketplace. Therefore, no data regarding the effect of this feature on consumer cycle selection were available. The Department proposed a proration value representative of normal cycle use for all clothes washers (normal cycle would be selected 75 percent of the time). Many of the commenters objected to the proposed value.

Following review of the comments, on May 24, 1995, the Department revised the proposal, specifically requesting usage data for clothes washers with ''lockouts,'' and, absent receipt of valid usage data, proposing to reduce the proration value (normal cycle would be used 20 percent). 60 FR 27441 (May 24, 1995) (hereinafter referred to as the May 1995 proposed rule). The Department received data from the Whirlpool Corporation (Whirlpool), and comments from White Consolidated Industries Inc. (White Consolidated), Maytag Corporation (Maytag), and Whirlpool.

On March 23, 1995, the Department published another proposed rule to amend the clothes washer test procedure (former Docket Number EE–RM–94–230). 60 FR 15330 (hereinafter referred to as the March 1995 proposed rule). This proposal addressed: innovative technologies (high spin speed and adaptive (automatic) water fill control); water heating clothes washers; annual number of clothes washer cycles; and other general revisions.

The March 1995 proposed rule also proposed the reporting of energy factor data on manufacturer certification reports for clothes washers, clothes dryers and dishwashers. On July 12, 1995, a hearing on the proposed rule was held in Washington, DC. The Department received comments from 10 interested parties: the Association of Home Appliance Manufacturers (AHAM), General Electric Appliances (GEA), Eugene Water and Electric Board (EWEB), Miele Appliance Inc. (Miele), Proctor and Gamble (P&G), Maytag, Speed Queen Company (Speed Queen), Clorox Company (Clorox), American Council for an Energy Efficient Economy (ACEEE), and Whirlpool.

The Department believes that the existing test procedure, Appendix J, overstates the average annual energy consumption for clothes washers because of changes in consumer habits since the current test procedure was adopted.[2] The Department had planned on initiating a subsequent clothes washer test procedure rulemaking, at a later date, which would take into account current consumer habits, and would be used as the basis for considering revision of the clothes washer energy conservation standards.[3]

In its comments on the March 1995 proposed rule, however, AHAM included and requested that DOE adopt an additional new test procedure, based on current consumer habits, which would be used in considering revision of the clothes washer energy conservation standards, and would take effect when new standards take effect. On April 22, 1996, the Department proposed such a new clothes washer test procedure, Appendix J1, as well as certain additional revisions to the currently applicable test procedure in Appendix J to Subpart B of 10 CFR part 430. 61 FR 17589 (hereinafter referred to as the supplemental proposed rule). Appendix J1 would be codified in the CFR for informational purposes, would be used in the analysis and review of revised efficiency standards, and would replace Appendix J upon the effective date of such revised standards. The revised Appendix J would be a revision of the current test procedure, consistent with the existing standards, and would become effective 180 days after issuance of the final rule.

In response to the supplemental proposed rule, the Department received comments from 11 interested parties: The Consortium for Energy Efficiency (CEE), National Resources Defense Council (NRDC), Miele, Frigidaire Company (Frigidaire), Lever Brothers Company (Lever), AHAM, Maytag, Raytheon Appliances (Raytheon), Whirlpool, Fisher and Paykel Limited (Fisher and Paykel), and White Consolidated.

Since publication of the March 1995 proposed rule, several new issues emerged that were neither covered by the existing clothes washer test procedure contained in Appendix J nor addressed in the supplemental proposed rule. These issues arose in the context of interim waivers from the clothes washer test procedure, granted by DOE with respect to clothes washer features not covered by the current test procedure. Specifically, the Department granted GEA Interim Waivers for its clothes washers with unique adaptive water fill control and temperature selection features. 61 FR 18129 (April 6, 1996) and 61 FR 47115 (September 6, 1996).

Therefore, on November 8, 1996, the Department issued a notice to reopen the comment period to invite comment on options the Department was considering to address issues raised by these waiver applications. 61 FR 57794 (hereinafter referred to as the reopening notice rule). In response to the reopening notice, DOE received two comments, from Fisher and Paykel, and AHAM.

[2] Proctor & Gamble data indicates a decrease in the use of hot water.

[3] The second round of clothes washer standards rulemaking was initiated by the publication of an Advance Notice of Proposed Rulemaking (ANOPR). (59 FR 56423, November 14, 1994.) The Department has initiated the process for issuing a Supplemental ANOPR, having conducted an initial workshop in November 1996, with another workshop scheduled for July 23, 1997.

III. Discussion

A. Clothes Washer Test Procedures—Issues Related to Both Appendices J and J1

1. Adaptive Water Fill Control System

An adaptive water fill control system (AWFCS) in a clothes washer is a control scheme which determines automatically, without operator intervention, the amount of water used to wash a particular load of clothing, based on the size or weight of that clothing load. The existing test procedure provides only for testing machines with manual fill controls. In the March 1995 proposed rule, the Department proposed to amend Appendix J to include test provisions for a clothes washer that had an AWFCS [4] instead of manual controls. In the reopening notice, the Department also proposed to include test provisions for clothes washers that had both adaptive and manual water fill control capability, as well as test provisions for clothes washers with multiple AWFCS settings.

In the supplemental proposed rule, the Department proposed provisions for clothes washers with AWFCS features. Appendix J1 requires testing with maximum, average, and minimum size test loads, whereas the proposed Appendix J requires testing with only maximum and minimum size test loads. Appendices J and J1 specify different load usage factors (used to prorate energy results from various tests) for the different size loads. In addition, Appendix J1 has a new test load table with variable size loads based on clothes washer capacity, which are generally larger than the Appendix J fixed size test loads.

AWFCS Provisions for Appendix J

In response to the March 1995 proposed rule, Speed Queen commented that it supports the Department's proposal and rejects the adoption of AHAM's future AWFCS provisions (subsequently proposed for Appendix J1) for Appendix J. (Speed Queen, No. 29 at 3, Docket 230).[5] GEA cautioned the Department not to adopt any AWFCS provisions for Appendix J because ''adverse competitive impact is simply too great if notice through the waiver procedure is not available.'' (GEA, No. 36 at 3, Docket 230). Whirlpool supported incorporation into Appendix J of AHAM's proposed test provisions concerning AWFCS. The company stated that ''the AHAM proposed procedure will provide a usage that more closely approximates the consumer use habits, and since there are not currently any vertical-axis product[s] that utilize AFC [automatic fill control] and horizontal-axis product is not required to meet a specific energy standard, this would not require a new standard to be established.'' (Whirlpool, No. 37 at 3, Docket 230).

The Department rejects GEA's argument not to promulgate AWFCS test provisions in Appendix J. The Department has the responsibility to provide codified test provisions for issues that have been addressed previously by waivers. At the time of the March 1995 proposed rule, the Department had already granted a waiver to Asko Incorporated (Asko) for its clothes washers with AWFCS capability. 59 FR 15710 (April 4, 1994). Since the publication of the March 1995 proposed rule, the Department has granted a Waiver to Miele and an Interim Waiver to GEA for their clothes washers with AWFCS capability. 61 FR 11201 (March 19, 1996) and 61 FR 18125 (April 24, 1996).

The Department believes that the Appendix J1 AWFCS test provisions, which specify a new test load table based on current consumer habits, will provide more accurate results for clothes washers equipped with AWFCS. In the supplemental proposed rule, the Department requested additional information regarding the possible adoption of the proposed Appendix J1 test load table for Appendix J. If adopted, the test load table would have been applicable only to front-loader and top-loader clothes washers with AWFCS capability. The Department received an overwhelming negative response to this suggestion. Miele, AHAM, Maytag, Raytheon and White Consolidated opposed the use of the Appendix J1 test load table for any testing other than Remaining Moisture Content (RMC) testing (which is voluntary for Appendix J) because of test burden concerns and disparity of test results between front-loader and traditional top-loader clothes washers. (Miele, No. 4 at 1; AHAM, No. 7 at 1, 4, 5; Maytag, No. 8 at 3; Raytheon, No. 9 at 4; and White Consolidated, No. 11 at 1, 2 and No. 12 at 1, all Docket 230A). In response to the supplemental proposed rule, the Department did not receive any comments supporting the adoption, other than for RMC testing, of the new test load table for Appendix J.

The Department believes that the promulgation of the March 1995 proposed rule AWFCS test provisions, which use test loads that do not reflect current consumer usage habits, most likely will provide an artificial credit for clothes washers with AWFCS capability. The Department also believes, however, that the artificial credit, or reduced energy consumption rating, will be offset by the Appendix J's current overstating of energy consumption. Consequently, the rating depicted to consumers for AWFCS clothes washers generally will be representative of the actual energy consumption. Therefore, the Department is maintaining the test load requirements for energy consumption testing as proposed in the March 1995 proposed rule.

In the reopening notice, with regard to clothes washers with multiple AWFCS settings, [6] the Department proposed test provisions to average the results from the most and least energy intensive settings. AHAM commented that it supported the Department's proposal. (AHAM, No. 19 at 1, Docket 230A). Fisher and Paykel commented that this proposal would add test burden but indicated that it had no alternative. (Fisher and Paykel, No.22 at 3, Docket 230A). Based on the comments received, DOE has determined that for clothes washers with multiple AWFCS settings the test provisions proposed in the reopening notice are appropriate. Therefore they are incorporated into today's final rule for Appendix J.

AWFCS Provisions for Both Appendices J and J1

In the reopening notice, with regard to a clothes washer that had both AWFCS and manual water fill control, [7] the Department proposed requirements to test both features and to average the results. AHAM comment supported the Department's proposal. (AHAM, No. 19 at 1, Docket 230A). Fisher and Paykel stated that it believed the AWFCS

[4] In the March 1995 proposed rule, the terminology used for this feature was ''machine-controlled water fill,'' although the Department is adopting language used in the supplemental proposed rule, ''adaptive water fill control system.''

[5] Comments have been assigned to docket numbers and have been numbered consecutively. A Comment in response to the May 1995 proposed rule, Docket number EE-RM–93–701, will have its appropriate number followed by ''Docket 701'', a comment in response to the March 1995 proposed rule, Docket number EE-RM–94–230, will have its appropriate number followed by ''Docket 230'', and a comment in response to the supplemental proposed rule or reopening notice, Docket number EE-RM–94–230A, will have its appropriate number followed by ''Docket 230A.'' Statements that were presented at the July 12, 1995, public hearing are identified as Testimony.

[6] Multiple AWFCS settings allow a consumer to adjust the ''sensitivity'' of the AWFCS feature so as to permit different amounts of water for a given load of clothing and corresponding different amounts of energy consumption.

[7] In Appendix J, two types of manual fill control are defined, ''sensor filled'' and ''timed filled.''

feature would be used more frequently than the manual mode. Fisher and Paykel added, however, that it has no data concerning use of the AWFCS feature in the U.S. (Fisher and Paykel, No. 22 at 3, Docket 230A). The Department had proposed the same testing and averaging requirements for Appendix J1 in the supplemental proposed rule and received no negative comments. Based on all of these factors, the test provisions proposed for clothes washers with both AWFCS and manual water fill control are incorporated into today's final rule for Appendices J and J1.

Fisher and Paykel commented that the proposed definition of ''adaptive control system'' is ambiguous and suggested that the definition state explicitly that it does not include ''AWFCS.'' (Fisher and Paykel, No. 16 at 1, Docket 230A). The Department agrees with Fisher and Paykel. Therefore, the Department has adopted language for the ''adaptive control system'' definition for Appendices J and J1 as suggested by Fisher and Paykel. In addition, to prevent any ambiguity, the Department has made minor revisions to the rule language where the terms ''adaptive control system'' and ''adaptive water fill control system'' are used.

AWFCS Provisions for Appendix J1

In the supplemental proposed rule, with regard to clothes washers with multiple AWFCS settings, the Department proposed test provisions to average the results from tests of the most and least energy intensive settings. AHAM and Raytheon opposed this proposal and suggested an alternative method to reduce test burden. (AHAM, No. 14 at 1; and Raytheon, No. 9 at 4 and No. 13 at 2; both Docket 230A).

The alternative method would require testing the most energy intensive setting with a maximum size test load, the most and least energy intensive settings with an average size test load, and the least energy intensive setting with a minimum size test load. The Department's proposal would have required testing of the most and least energy intensive settings for the maximum, average, and minimum size test loads. Since an average size test load would be used by consumers most of the time (74 percent), the Department has determined that AHAM's proposal would account for 87 percent of the energy consumption test results (of the full compliment of tests results proposed by the Department), while only requiring 66 percent of the number of tests. In addition, the AHAM proposal would ensure that the combination of settings with the lowest possible energy consumption, i.e., the lowest energy intensive setting with a minimum size test load, and with the highest possible energy consumption, i.e., the highest energy intensive setting with a maximum size test load, would be tested. Therefore, the Department is adopting the test methodology for Appendix J1 suggested by AHAM and supported by Raytheon.

Based on AHAM's suggested test procedure, the supplemental proposed rule also specified that additional test loads be tested if an AWFCS clothes washer does not have linear results for average size test loads, i.e., non-linear between the maximum and minimum size test load results. For a clothes washer that generates non-linear test results, additional tests would be required for ''above average'' and ''below average'' test load sizes. AHAM, Fisher and Paykel, and Raytheon believe that the additional testing requirements would create an unnecessary test burden. (AHAM, No. 14 at 2, 3; Fisher and Paykel, No. 16 at 6, 10; and Raytheon, No. 13 at 2; all Docket 230A). In addition, AHAM provided an analysis which indicates that, with a worst case non-linear result, the change in resulting energy factor or modified energy factor would be small, an average of some four to five percent. (AHAM, No. 21, Docket 230A). The Department has reviewed the analysis provided by AHAM and agrees that the additional test burden is not warranted for the potential improvement in test accuracy. Furthermore, the worst case scenario analyzed by AHAM does not appear to be likely, and thus actual test result disparity would be less than four or five percent. Therefore, Appendix J1 as promulgated today does not require testing of ''above average'' and ''below average'' test loads for AWFCS clothes washers that generate non-linear test results.

2. Electrical Supply Requirements

The March 1995 proposed rule proposed deleting a provision in the existing test procedures (Appendix J) that allowed turning off console lights that did not consume more than 10 watts of power during the clothes washer test cycle. Similarly, the supplemental proposed rule did not propose to include such a provision in Appendix J1. Speed Queen supported the Department's proposal to delete the provision from Appendix J. (Speed Queen, No. 29 at 4, Docket 230). NRDC, Maytag, and Raytheon supported the Department's proposal not to include this provision in Appendix J1. (NRDC, No. 2 at 2; Maytag, No. 8 at 2; and Raytheon, No. 9 at 1; all Docket 230A). Today's final rule is consistent with the March 1995 proposed rule and supplemental proposed rule, and excludes this provision.

3. Field Testing

In the supplemental proposed rule, the Department proposed that both Appendices J and J1 would require manufacturers to field test a non-conventional clothes washer (such as one with automatic control of features other than water fill) as a basis for requesting a test procedure waiver pursuant to 10 CFR 430.27. The Department stated that field test data would be used to support the petition for waiver. Both the preamble and rule language indicate that a test procedure waiver would be required in order to test a non-conventional clothes washer, and the field testing proposal clearly assumes that a waiver would be needed to test such a machine. The supplemental proposed rule would also require field testing if a manufacturer believes that a clothes washer with both manual and adaptive fill controls is being used by consumers, in the adaptive mode, more than 50 percent of the time, and seeks a waiver from the provision of the test procedure that assumes such 50% usage. AHAM had recommended the proposed field testing provisions for both Appendices J and J1, to provide data to support waiver applications. (AHAM, No. 5 at 5, Docket 230).

In response to the supplemental proposed rule, AHAM commented that the field testing requirements should be optional, not mandatory, and recommended specific rule language revisions. (AHAM, No. 7 at 1 & 5 and No. 14 at 4, Docket 230A). AHAM's position was supported by several manufacturers. (Miele, No. 4 at 2; Maytag, No. 8 at 3; Fisher and Paykel, No. 16 at 12, 13; and Raytheon, No. 9 at 3; all Docket 230A). Neither AHAM nor the other commenters, however, questioned the need for a waiver to establish test procedures for a non-conventional clothes washer.

The Department agrees with AHAM and the commenting manufacturers that the field testing provisions should not be mandatory. For a non-conventional clothes washer such as one with an adaptive control system, the test procedures in proposed Appendices J and J1 would provide materially inaccurate data as to energy consumption. Therefore, a test procedure waiver would be required. A waiver in effect creates a new test procedure for a machine, specifying inapplicable provisions of the required test procedure and additional

requirements necessary for testing or analysis of test results, thus providing a basis for determining compliance with efficiency standards and for making efficiency representations. The proposed field testing was intended to support a test procedure waiver, by providing a generally accepted method for collecting data and adjusting test results. Although the Department continues to believe that field testing can serve this purpose, it recognizes the possibility that a waiver could be supported by means other than field testing, and by field test methods other than those in the supplemental proposed rule. Moreover, there may be instances where the proposed field testing methods are inadequate.

Therefore, today's final rule provides that the proposed field testing requirements are guidelines, rather than mandatory procedures that a manufacturer must use to gather information to support each waiver application. Although field testing should be used where appropriate, the Department will still consider a petition for waiver that is not based on field testing. In addition, the Department may reject field testing results, if warranted. As in the proposed rule, however, the final rule makes clear that a manufacturer must obtain a test procedure waiver for non-conventional clothes washers, including machines with adaptive control systems.

Fisher and Paykel provided additional comments regarding field testing provisions. The company is concerned about (1) whether the proposed rule is intended to permit field testing outside of the U.S., (2) the equation to correlate field testing results with laboratory test ratings, and (3) a requirement to record the dry clothing weight prior to washing. (Fisher and Paykel, No. 16 at 12, 13; Docket 230A). Fisher and Paykel assumes that field testing could be performed in any location, including outside of the U.S. The company did not comment whether manufacturers should be required to perform field testing in the U.S.

The Department contemplates that field testing would determine consumer behavior relative to a particular clothes washer. Such consumer behavior would be a basis for determining compliance with DOE efficiency standards (and whether the clothes washer could be sold in the U.S.) and for representations within the U.S. concerning the machine's efficiency. Thus, consumer usage data derived in the U.S. would be most applicable. Nevertheless, since today's rule makes field testing provisions optional, the Department does not believe it needs to address whether field tests should be restricted to the U.S. Field test results, however, will be subject to competitor and Department review as part of the Petition for Waiver process found at 10 CFR 430.27. A petitioner submitting consumer usage data derived outside of the U.S. most likely would be expected to show that the data applies to, and is valid for, U.S. consumer usage patterns. Therefore, today's final rule does not add a requirement to restrict field testing to the U.S. and is being promulgated as proposed.

Fisher and Paykel also questioned the field testing equation used to develop an acceptable rating of a ''test'' clothes washer (section 6.1 of the supplemental proposed rule). (Fisher and Paykel, No. 16 at 13, Docket 230A). The following paragraph is an excerpt from section 6.1 of the supplemental proposed rule.

''The field test results will be used to determine the best method to correlate the rating of the test clothes washer to the rating of the base clothes washer. If the base clothes washer is rated at A kWh per year, but field tests at B kWh per year, and the test clothes washer field tests at D kWh per year, the test unit would be rated as follows:

A×(D/B)=GkWh per year''

Fisher and Paykel suggested an alternate mathematical expression which provides the same result but ''better indicates that a ratio of the base clothes washer [8] laboratory and field energy measurements are used to correct the test clothes washer field results.'' Fisher and Paykel misunderstood the intent of the equation. The Department maintains that the rating of the ''test'' clothes washer should be derived by adjusting the established ''base'' clothes washer rating. Thus, the ''base'' clothes washer rating would be multiplied by the ratio of the field results for a ''test'' clothes washer divided by the field results of a ''base'' clothes washer. Therefore, the Department is promulgating the proposed mathematical expression without revision.

Fisher and Paykel opposed a field testing requirement to have consumers dry the clothing load prior to washing. According to Fisher and Paykel, the result may affect consumer behavior, i.e., a consumer may choose different clothes washer settings if the actual weight of the clothing is known. The company also maintains that it is unrealistic to have consumers dry dirty clothing, and that the calculations do not use the dry weight of the clothing. (Fisher and Paykel, No. 16 at 13, Docket 230A). The Department agrees with Fisher and Paykel that it is impracticable to have consumers dry soiled clothing in their clothes dryers prior to washing. This would waste energy, soil the clothes dryer for future use, and may make it more difficult to clean the clothing. Fisher and Paykel is incorrect, however, in asserting that the dry clothing weight is not required. Data regarding load size is useful to correlate tests in the field with laboratory tests which use fixed test loads. In addition, the dry clothing weight is required when a calculation is needed of the remaining moisture content result. The Department believes that this measurement can be obtained at the end of the clothes dryer drying cycle. Therefore, to establish more practicable requirements, today's final rule specifies the measurement of the dry clothing weight at the end of the laundry process.

4. Remaining Moisture Content

The March 1995 proposed rule proposed to include an optional test provision in Appendix J to address the moisture content of clothing at the completion of the clothes washer cycle (referred to herein as ''remaining moisture content'' or ''RMC'' [9]). This provision included a calculation to determine the energy required to fully dry the clothing. AHAM recommended a revised test provision to test the RMC of a test load for its suggested future use test procedure, and suggested adoption of these same test provisions, on an optional basis, for Appendix J. (AHAM, No. 5 at 3, 7 and No. 8 at 1, both Docket 230). This was supported by Raytheon. (Raytheon, No. 29 at 2, Docket 230). The Department accepted AHAM's recommended test provisions to address the RMC of clothing at the completion of the clothes washer cycle, and proposed to incorporate them into Appendix J1.

The Department believes these provisions are superior to the provisions proposed in the March 1995 proposed rule, Appendix J, for calculating the energy required to remove moisture from clothing. The Appendix J1 approach is based on current consumer usage habits which reflect larger loads, account for wash loads that are not dried in clothes dryers, i.e., 16 percent of wash loads, and account for residual moisture, i.e., 4 percent remaining in the clothing at the completion of a typical clothes dryer cycle. Thus, DOE

[8] A ''base'' clothes washer refers to a machine already being sold in commerce without the unique feature being field tested.

[9] RMC represents a percentage derived by dividing the moisture weight that is remaining in the clothing at the completion of the clothes washer cycle by the weight of the dry clothes prior to the clothes washing cycle.

believes the Appendix J1 test methodology is more representative of a consumer's energy use. The provisions of Appendix J1 also provide a means to assess the water extraction capability of a clothes washer independent of any other descriptor, i.e., a RMC percentage value. Accordingly, today's final rule incorporates consistent test provisions for RMC and the energy required to remove the moisture from the clothing for both Appendices J and J1. This includes the adoption of a new test load table for testing RMC in Appendix J.

The Department also received comments concerning aspects of RMC which were addressed in the supplemental proposed rule. The following issues relate to RMC and are applicable to both Appendices J and J1.

a. Energy Required to Remove Moisture from the Test Load. The RMC value is used to calculate the energy required to remove moisture from the test load, ''D_E''. The ''D_E'' is calculated using the maximum size test load, load adjustment factor (LAF) (P&G ratio of maximum load size to average load size), nominal energy required to remove moisture from clothes (assumed constant for all clothes dryers, 0.5 kWh/lb), and the clothes dryer utilization factor (DUF) (percentage of clothes washer loads that are dried by clothes dryers). AHAM originally recommended a DUF of 83 percent, although P&G calculates the DUF to be 84.4 percent.[10] The Department stated in the supplemental proposed rule that it planned on using 84 percent for the DUF. Raytheon and Maytag support the Department's use of 84 percent for the DUF. (Maytag, No. 8 at 2; and Raytheon, No. 9 at 1, both Docket 230A). Today's final rule incorporates a DUF of 84 percent for Appendices J and J1.

b. Spin Speed and Spin Time. GEA expressed concern about the possibility of manufacturers providing manually selectable options to consumers, e.g., multiple spin speed and time selections, which would affect the resulting RMC of consumer wash loads. GEA believes that the Department should not use the lowest RMC level achieved in a clothes washer for the future minimum energy conservation standard analysis or for energy reporting, and that there should be some type of ''discounting of the RMC credit.'' According to GEA, consumers may not always choose the setting which would result in the lowest RMC value. (Testimony at 157). In response, the Department stated in the supplemental proposed rule that it was considering a requirement to average the extreme values of the multiple selections, e.g., spin speeds and times, that are available in the energy test cycle. The Department requested comments regarding this issue.

Several comments were received. AHAM provided a revised method to prorate multiple consumer options affecting RMC. AHAM believes that settings for the lowest RMC value , i.e., greatest extraction of moisture, will be used by consumers 75 percent of the time and that the highest RMC value will be used 25 percent of the time. This is based on P&G usage data for delicate and permanent press cycles. (AHAM, No. 7 at 2 and No. 14 at 4, both Docket 230A). The AHAM methodology was supported by Miele, Maytag, and Raytheon. (Miele, No. 4 at 3; Maytag, No. 8 at 2; and Raytheon, No. 9 at 1; all Docket 230A). NRDC supports some type of ''averaging'' to address this issue and believes the concern ''would be mitigated'' as proposed in the supplemental proposed rule. (NRDC, No. 2 at 2, Docket 230A). Fisher and Paykel believes that the factory default spin speed should be used for the RMC test, although in the absence of a factory default it supported the AHAM methodology. (Fisher and Paykel, No. 16 at 12, Docket 230A).

White Consolidated opposed conducting the RMC test at any speed other than the maximum spin speed because testing momie cloth (the specified test cloth) at low spin speeds does not reflect actual consumer usage. White Consolidated also indicated that mismatching the wash cycle, load size, and load type can produce RMC measurements that miss ''real world'' results by as much as 35 percent. (White Consolidated, No. 12 at 1, 2, Docket 230A).

The Department believes that some consumers will choose spin speed and spin duration options which achieve RMC values above the lowest attainable in the energy test cycle, although consumer usage habits are not known. For this reason, the Department proposed to require averaging the lowest and highest RMC values. Almost all the commenters advocated a proration of 75 percent for the lowest RMC value and 25 percent for the highest RMC value. These values are based on the use of the delicate and permanent press cycles. Use of these cycles may not correlate exactly to the use of optional spin speed and spin duration selections in the energy test cycle. This approach, however, seems reasonable because consumers who wash less durable articles of clothing in the energy test cycle to prevent possible fabric damage probably will refrain from extracting the maximum amount of water in the clothes washer. There may be some merit to White Consolidated's concern that consumer use of cycles, load size, and load type must be more accurately gauged in order to accurately represent RMC. Until such data is available, however, the optimum choice appears to be the use of the 75/25 percent proration based on delicate and permanent press cycle usage. Today's final rule incorporates the 75/25 percent proration into Appendices J and J1.

Miele expressed concern about excluding an option for no spin speed from the minimum spin speed test requirement. Miele indicated that for front loader clothes washers which have a no spin speed option, the clothing will remain submerged in water and the door will remain locked until a spin speed selection is made. (Miele, No. 4 at 3 and No. 17 at 1, both Docket 230A).

The Department agrees with Miele that, if a clothes washer is equipped with an optional no spin speed selection in the energy test cycle, such selection should not constitute the lowest spin speed selection for RMC calculations. The Department believes that a no spin speed selection is a unique feature intended for rare use by consumers. Moreover, it is unlikely that consumers would place wet clothing, without any partial drying by the clothes washer, directly into a clothes dryer. Therefore, today's final rule includes language to exclude a no spin selection from RMC testing requirements for Appendices J and J1.

c. Load Size for RMC. In response to the March 1995 proposed rule, GEA provided a graph with RMC on the ''Y'' axis and Load Size on the ''X'' axis. (GEA, No. 6 at appendix E, Docket 230). Although not quantified, the graph depicted a relatively large negative slope of approximately 0.5. Thus, according to the graph, as load size gets larger the RMC level decreases substantially.[11] If GEA's graph accurately depicts the slope, this would have a major impact on the expected energy savings to consumers and on manufacturer efficiency/energy consumption representations, because the data show that consumers use their clothes washers with an average size load 74 percent of the time. Under the proposed test procedure, RMC is first determined for a maximum size load. The RMC thus determined is then adjusted in order to determine the moisture content that would remain in an average size load. The adjustment

[10] Comment 32 on Docket number EE–RM–94–403.

[11] RMC is a percentage which decreases, although the actual remaining moisture weight increases because the larger load retains more moisture.

formula is based on the assumption, which GEA disputes, that RMC, as a percentage amount, is the same for different load sizes. If GEA is correct, the anticipated energy consumption to remove the moisture from the clothing, as determined under the foregoing calculation, would be artificially low. In the supplemental proposed rule, the Department requested data and comments concerning this issue.

The Department received confidential data from Miele and Whirlpool, and publicly available data from Raytheon and Maytag. (Miele, No. 4; Whirlpool, No. 10; Raytheon, No. 9 at 1; and Maytag, No. 15 at 1, 2; all Docket 230A). AHAM believes that the maximum test load should be used for RMC testing because the difference (RMC percentage value) with an average test load is small. (AHAM, No. 7 at 3, Docket 230A). Raytheon and Maytag support AHAM's position. Maytag also indicated that a maximum test load produces more consistent and repeatable test results. (Maytag, No. 15 at 1, 2). Miele believes that an average test load should be tested in addition to the maximum test load because RMC as a percentage is not the same for different size loads and may vary significantly for various machines. Furthermore, Miele believes the improved test results outweigh the additional test burden. (Miele, No. 4 at 4).

The Department has analyzed the individual data submissions and has determined that there is a general correlation between RMC (as a percentage value) and load size. As load size increases, RMC (percentage value) decreases. On average, the relationship appears to have a negative slope of approximately 0.05, much smaller than on GEA's graph. The data, however, show that in some cases, as load size increases, RMC actually increases (with a small positive slope). Considering the range of data received, the relatively small variation of RMC for average and maximum load sizes, the additional test burden of testing average loads, and the greater consistency of RMC test results with larger loads, the Department is maintaining the requirement to test RMC only with the maximum test load. Therefore, today's final rule maintains the test load requirements for Appendix J1 as proposed, and incorporates into Appendix J a new test load table identical to the maximum test load table requirements of Appendix J1.

5. Thermostatically Controlled Water Valves

The Department proposed a definition for thermostatically controlled water valves in the March 1995 proposed rule. AHAM provided a revised definition in its recommended test procedure, and requested adoption of this definition for the Appendix J test procedure. (AHAM, No. 8 at 1, Docket 230). Miele and Speed Queen supported the adoption of the AHAM's suggested definition. (Speed Queen, No. 29 at 5; and Miele, No. 10 at 1; both Docket 230). In the supplemental proposed rule, the Department proposed to adopt a slightly revised version of the AHAM definition language.

In response to the supplemental proposed rule, AHAM objected to the Department's revised definition. The revised definition specified that the ''valves'' sensed the water temperature and adjusted the supply water to maintain a desired temperature. AHAM wants the definition to apply to a ''clothes washer's'' ability versus the ''valve's'' ability to sense and adjust the water temperature. The predominant design concepts for thermostatically controlled water valves operate internally within the valve, but new design strategies include an interface between the valve and a clothes washer electronic controller. (AHAM, No. 7 at 5, Docket 230A). Miele, Maytag, and Raytheon support AHAM's definition. (Miele, No. 4 at 5; Maytag, No. 8 at 3; and Raytheon, No. 9 at 3, 4; all Docket 230A). Fisher and Paykel shared AHAM's concern and also believes that the definition should reflect only the clothes washer's ability to ''achieve'' a desired water temperature, rather than to ''maintain'' a desired water temperature. (Fisher and Paykel, No. 16 at 3, Docket 230A).

The Department agrees with the intent of AHAM's definition for thermostatically controlled water valves because it allows greater flexibility in achieving the desired result. Whether a particular water temperature results from the water valve's operation or the clothes washer electronic control is immaterial, as long as the clothes washer has the ability to sense and adjust the supply water temperature.

Finally the suggestion from Fisher and Paykel to change the definition from ''maintain'' to ''achieve'' a desired mixed water temperature has caused the Department to re-examine the definition. The fundamental purpose of this feature is to adjust the supply temperature in order to obtain a desired supply water temperature, or a desired wash tub temperature. In light of this purpose, the Department believes that the proposed definition and the suggested AHAM definition are too specific. To simply change the definition to ''achieve'' as suggested by Fisher and Paykel would be inappropriate because some clothes washers with this feature attempt to maintain the supply water temperature, and others seek to maintain the wash water temperature. Furthermore, this definition is used in the test procedure only to ensure that a clothes washer with these characteristics is tested with appropriate supply water temperatures. Therefore, the Department believes the definition can be simplified to be more generic, and still serve its intended purpose in the test procedure. The Department is adopting the following definition in today's final rule for Appendices J and J1: ''*Thermostatically controlled water valves* means clothes washer controls that have the ability to sense and adjust the hot and cold supply water.''

6. Water Consumption Factor

In the March 1995 proposed rule, the Department proposed a Water Consumption Factor (WCF), expressed in clothes washer capacity per gallon per cycle. The Department believes that providing a means of determining WCF may allow consumers, utilities or other organizations to compare clothes washer water consumption independent of clothes washer capacity.

In response to the March 1995 proposed rule, the Department received several comments regarding inclusion of the WCF in Appendix J. Miele and Speed Queen indicated that the WCF should be the inverse of what was proposed because many utilities already use that factor (gallons per cycle per cubic foot capacity). (Miele, No. 10 at 2; and Speed Queen, No. 29 at 3; both Docket 230). AHAM indicated that WCF on a per cycle basis can be expressed as cubic feet per gallon. (AHAM, No. 33 at 5, Docket 230) . The Department agrees with Miele and Speed Queen that the WCF should be consistent with existing utility programs and represented on a per cycle basis as gallons (weighted water consumption) per cubic foot capacity.

Accordingly, the Department proposed a revised WCF for Appendix J1 in the supplemental proposed rule, which was the inverse of the WCF in the March 1995 proposed rule. In response, the Department received positive comments. (AHAM, No. 7 at 4; Maytag No. 8 at 3; and Raytheon, No. 9 at 3; all Docket 230A). Therefore, today's final rule incorporates a WCF expressed as gallons per cycle per cubic feet in Appendices J and J1. In addition, the definition for WCF in Appendix J has been revised to be consistent with the new expression.

B. Clothes Washer Test Procedures—Issues Related to Appendix J

1. Agitator and Spin Speed Settings

In the March 1995 proposed rule, the Department proposed requirements for agitator and spin speed settings to conduct energy consumption testing because they are not addressed in the current test procedure. Speed Queen supported the Department's proposal. (Speed Queen, No. 29 at 4, Docket 230). The Department received no negative comments, and therefore DOE is adopting this proposal.

In addition, the Department is making minor language revisions with respect to these terms. The term ''agitator'' is being changed to ''agitation'' to be more generic.[12] Certain provisions relating to spin speed are being modified to address concerns regarding optional RMC testing, as discussed above.

2. Capacity Measurements

In the March 1995 proposed rule, the Department proposed minor revisions to the requirements regarding measurement of capacity to hold clothing (section 3.1). These changes were non-substantive in nature and did not attempt to change any clothes washer's capacity rating. AHAM recommended that the Department adopt simpler rule language which was generic both to front-loader and top-loader clothes washers. (AHAM, No. 5 at 3, 6 and No. 8 at 1, both Docket 230).

The Department agrees that AHAM's suggested rule language for clothes washer capacity measurement is simpler and most likely will achieve the same result. The Department, however, believes that the suggested language is not specific enough concerning the orientation of the clothes container opening during testing. The Department believes that it is reasonable to assume that a clothes washer will be placed in a position so that its opening is horizontal to the ground to conduct the capacity measurement. However, DOE prefers to remove any vagueness from the test procedure. Therefore, the Department is adding the following procedural step to the AHAM suggested language: ''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.'' Therefore, the Department is adopting the language recommended by AHAM, with the above revision, in today's final rule for Appendix J. In addition, since the term ''agitator'' is no longer mentioned in the capacity measurement section, the Department is deleting the proposed ''agitator'' definition from Appendix J. The deletion of the ''agitator'' definition was supported by Speed Queen. (Speed Queen, No. 29 at 4, Docket 230).

3. Modified Energy Factor Definition

In the March 1995 proposed rule, the Department proposed to add to Appendix J an additional energy descriptor, called a modified energy factor (MEF), which would include moisture removal energy. This new descriptor would provide more comprehensive determinations, and comparisons, of the energy efficiency of clothes washers in the marketplace. It would be used for informational purposes only, such as rebate programs. The MEF was also proposed in Appendix J1 for possible future use.

The definition for the modified energy factor, as proposed in the March 1995 proposed rule, referred to both water-heating and non-water-heating clothes washers. Miele has suggested a more generic definition that excludes mention of specific types of clothes washers. (Miele, No. 10 at 2, Docket 230). The Department proposed this generic version of the definition in the supplemental proposed rule for Appendix J1 and received no negative comments. The Department believes the definition suggested by Miele is more versatile and applicable to all clothes washers, including water-heating clothes washers that use externally heated hot water. Therefore, today's final rule incorporates a definition for ''modified energy factor'' in Appendix J, which is identical to the definition which was proposed and is being adopted in Appendix J1.

4. Other Issues

In both the March 1995 proposed rule and the reopening notice, the Department proposed several minor modifications to Appendix J. The Department did not receive any negative comment relative to these proposals. Therefore, today's final rule maintains the rule language as proposed in the March 1995 proposed rule, and adopts changes discussed in the reopening notice. These modifications are provided in tabular form as follows:

Proposal	Source	Sections in appendix J
Deletion of AHAM Test Procedure References	March 1995 proposed rule	Not Applicable (Deletion of sections 1.7 & 1.8 in current Appendix J).
Clarification of Maximum Fill Testing (''available on the clothes washer'').	March 1995 proposed rule	Sections 3.2.1.2.1 & 3.2.2.1.
Similarly Labeled Temperature Use Factors (TUFs).	March 1995 proposed rule	Section 4.1.1.1.
One and Two Temperature Clothes Washer TUF Values.	Reopening notice	Section 5.

The Department also received suggestions for several minor clarifications to the rule language. The following table provides these suggested modifications:

March 1995 proposed rule section/issue	Comment	DOE action/ response
Sections 2.8.2.1 and 2.8.2.2: remove ambiguity for use of test loads.	Miele, No. 10 at 2, Docket 230	Intent incorporated.
Section 3.2.2.4: variable callouts	Miele, No. 10 at 3, Docket 230	Intent incorporated.
Section 4.1.1.2: concern about temperature rise of 90° F instead of 80° F.	Miele, No. 10 at 3, Docket 230	Not incorporated: adoption would affect efficiency ratings of existing models. (Appendix J1 has a temperature rise of 75° F.)
Section 4.3.3: reference callouts	Miele, No. 10 at 3, Docket 230	Intent incorporated.

[12] See discussion below regarding ''capacity'' where the definition for ''agitator'' is no longer required.

March 1995 proposed rule section/issue	Comment	DOE action/ response
Section 5: clarification for water-heating and non-water-heating clothes washer titles.	Miele, No. 10 at 3, Docket 230	Intent incorporated.
Need definitions for ''automatic'' and ''semi-automatic'' clothes washers.	Miele, No. 10 at 1, Docket 230	Not incorporated: these terms are already defined in 10 CFR 430.2.

5. Temperature Measuring (Sensing) Device

The March 1995 proposed rule proposed essentially to maintain the existing temperature equipment requirements, while changing its nomenclature from ''thermometer'' to ''temperature sensing device'' (section 2.5.3). AHAM suggested a revision of these requirements, both for its recommended test procedure and Appendix J. AHAM's language specified in part, that accuracy of equipment would be maintained over the range of temperatures being measured, rather than over a broader range as is currently required. AHAM also suggested revision of nomenclature in the proposed test procedure from ''Temperature sensing device'' to ''Temperature measuring device.'' (AHAM, No. 8 at 1, Docket 230). The Department believes that the revised AHAM language, on which comments were solicited in the supplemental proposed rule, will eliminate a requirement that is irrelevant to the test procedure, while maintaining its accuracy and providing manufacturer equipment flexibility. Therefore, today's rule incorporates into Appendix J the supplemental proposed rule language for a temperature measuring device.

6. Temperature Selections

Currently, and as proposed, Appendix J allows for the testing of three basic wash temperatures, cold, warm, and hot, in several combinations with two rinse temperatures, cold and warm. The test procedures set forth percentages, called temperature use factors (TUFs), that represent the proportion of time that each temperature combination selection (TCS) (wash/rinse combination offered to a consumer) is used. However, some new clothes washers have new TCSs which are not explicitly covered by the Appendix J test procedure.

a. Multiple Warm Wash Temperatures. Currently, there are clothes washers on the market that have multiple warm wash TCSs. The Department's understanding is that these TCSs are relatively straightforward. The warm wash temperatures of the TCSs are spaced so that the temperature of the middle warm wash TCS is at the mid-point between the temperatures of the warmest warm wash TCS and the coolest warm wash TCS. Also, for any other TCS above the middle warm wash TCS, there is a corresponding TCS that is an equal number of degrees below the middle warm wash TCS. In the reopening notice, the Department proposed requirements to test only the middle warm wash TCS. In addition, if a middle TCS does not exist, then the next hotter TCS above the mid-point would be tested.

AHAM agreed generally with the above proposal. Fisher and Paykel provided comments and agreed with the requirement to test only the middle TCS. (Fisher and Paykel, No. 22 at 1, 2, Docket 230A). Therefore, today's final rule includes the above described test provisions for Appendix J.

The Department's proposal also addressed situations where TCSs are not spaced equally by temperature. The Department is unaware of any current clothes washers with these types of TCSs, but wants to provide test provisions in the event they are included on future models. The Department's proposal in the reopening notice would require testing at the next hotter warm wash TCS above the mean of the temperature range for multiple warm wash TCS.

Fisher and Paykel questioned whether the reference to the mean referred to the mean temperature or to the TCS with the mean position on the control panel. Fisher and Paykel suggested that it should be applicable to the temperature and that DOE should require that the mean temperature be determined. In addition, Fisher and Paykel stated that the TCS with the mean temperature should be tested if available on the clothes washer model, or if such a TCS is not available, the next higher warm wash TCS above a theoretical mean should be tested. (Fisher and Paykel, No. 22 at 2, 3, Docket 230A).

Fisher and Paykel maintains that the actual mean TCS of the temperature range should be tested, if available, whereas the Department believes the next higher TCS should be tested. The Department believes the next higher TCS should be tested in lieu of the actual mean TCS because it is concerned about the way TCSs may be displayed to consumers. The rationale for testing the middle TCS for clothes washers with multiple warm wash TCSs, spaced equally by temperature, is that consumers are just as likely to select a TCS above the middle TCS as they are to select one below the middle TCS. In the case of clothes washers with TCSs that are not spaced equally by temperature, consumers may be given, for example, multiple selections above an actual mean TCS of the temperature range and only one selection below it. In this case, consumers may select warm wash TCSs above the mean TCS more frequently than the one warm wash TCS below the mean TCS. To test the mean TCS could give a relatively low, and hence unrepresentative, picture of the energy consumption of the clothes washer. Therefore, the Departments proposed that the next higher TCS be tested. Today's final rule includes requirements for Appendix J as stated in the reopening notice and reiterated above.

In the reopening notice, the Department also proposed test provisions for clothes washers with multiple temperature settings, i.e., a range of temperatures from which a consumer can make a selection within a specific TCS. Section 3.2.2.2 of the current test procedure requires that the ''hottest setting available'' be used for testing a hot wash TCS. In the reopening notice, the Department proposed a test methodology which requires that the hottest temperature setting within a hot, warm or cold TCS be tested.

This approach is similar to the Department's proposal in the March 1995 proposed rule for addressing similar TCSs that are labeled so as to appear to the consumer to be virtually identical. In essence, the similarly labeled TCSs are two temperature settings for one basic TCS. For example, on a given clothes washer, one cold wash/cold rinse TCS may be labeled ''cold/cold,'' with a wash temperature that is never heated, and another can be labeled ''auto cold/cold'' with a wash temperature that uses some hot water. The March 1995 proposed rule proposed that the hottest of these two selections be used for testing. The Department believes this proposal is consistent with the industry's basic interpretation of the existing test

procedure. The Department did not receive any negative comment regarding the March 1995 proposed rule's provision for similarly labeled TCSs.

Shortly before the publication of the reopening notice, Fisher & Paykel asserted that for DOE to require testing at the hottest temperature setting available within a TCS would be inconsistent with the test methodology regarding multiple warm wash TCSs (discussed above).[13] The two approaches may appear to be inconsistent, but the Department believes they would establish the best solution considering that the hottest setting available must be used in tests involving a hot wash TCS or similarly labeled TCSs. To the greatest extent possible, the Department wants to ensure that all models are tested and rated on a comparable basis.

In response to the reopening notice, AHAM commented that, in general, it supports the Department's proposal. AHAM believes that the rule language should make specific reference to a secondary control, which is how the temperature of the TCS (selected with the primary control) would be adjusted. AHAM supports the rationale to test the hottest temperature available for a TCS. (AHAM, No. 19 at 2, Docket 230A). Fisher and Paykel stated that its comments provided in response to Waiver CW–004 (discussed above) remain essentially the same. (Fisher and Paykel, No. 22 at 1, Docket 230A).

The Department agrees with AHAM that manufacturers most likely would present multiple temperature selections within a TCS with a secondary control. Therefore, today's final rule incorporates rule language to clarify this point. The Department sees some merit in Fisher and Paykel's concern about testing multiple temperature settings within a TCS at the hottest setting available. For the reasons stated above, however, the Department believes that today's rule is the best solution considering the test procedures currently in effect. Moreover, the future test procedure, Appendix J1, establishes even more consistent test procedures to address this issue. Therefore, today's final rule adopts the requirement proposed in the reopening notice to test the hottest temperature setting available within a TCS in Appendix J.

b. Temperature Selections Locked Out of the Normal Cycle. In the May 1995 proposed rule, the Department proposed that, for a clothes washer with a normal cycle temperature selection ''lockout'' feature, the hot water consumption be prorated between the TCS that has the ''lockout'' in the normal cycle and the same TCS in the cycle with the greatest hot water consumption. The unknown factor in the calculation is the frequency with which users would choose the normal versus other cycles when a temperature selection is selected, i.e., the proration values.

The Department proposed to set the proration values at 20 percent for the normal cycle and 80 percent for the most energy intensive cycle (the cycle other than normal that consumes the maximum amount of energy), unless consumer usage data becomes available that support other values. The proposed values were based on an assumption that 80 percent of the time a consumer wants the locked out temperature, it will choose a cycle that offers that particular temperature selection, and the remaining 20 percent of the time consumers will not alter the cycle and will accept the locked out temperature selection.

The frequency with which consumers use the normal cycle is important if a clothes washer is equipped with a temperature selection ''lockout.'' The clothes washer test procedure requires testing at the normal cycle because this is believed to be representative of how consumers use their clothes washers. Traditionally, consumers select the normal cycle most of the time and the remaining cycles, either more or less energy intensive, the remainder of the time. Hot water energy constitutes the greatest component of the energy consumption, approximately 90 percent or more, and the energy consumption for the various cycles, e.g. ''normal,'' ''heavy duty,'' ''delicate,'' etc., on a typical clothes washer without lockouts may not vary much from one cycle to the next, for a given temperature and fill selection. This is not true for a clothes washer with a temperature selection lockout feature. For such a clothes washer, temperature selections that appear to be the same in different cycles are in fact different, and result in consumption of different amounts of energy.

Whirlpool utilized an independent consultant to conduct a consumer survey regarding the use of clothes washers with and without the ''lockout'' feature. Whirlpool submitted a summary of the results of the survey to the Department. (Whirlpool, No. 13, Docket 701). The Department made this summary available to stakeholders for review and comment.

White Consolidated commented that it disagreed with the concept of prorating the energy consumption results from the normal and most energy intensive cycles, including the proposed 20/80 percent values. In essence, White Consolidated believes that a TCS with a lockout should be tested in the most energy intensive cycle, and the result used 100 percent for the calculations. White Consolidated believes that normal cycle operation on a particular clothes washer may be represented to consumers in such a manner that they use it significantly less than they would on a traditional clothes washer.[14] White Consolidated also asserted that the data submitted by Whirlpool did not indicate the frequency with which consumers select the normal cycle. (White Consolidated, No. 14, Docket 701). Whirlpool provided comment that the proration value for the use of the normal cycle should be 75 percent. Whirlpool believes that its survey shows no significant difference between consumers' use of the normal cycle with or without a lockout. (Whirlpool, No. 16, Docket 701). Maytag stated that it supports the Department's proposal to use 20 percent as the proration value for the normal cycle. Maytag also indicated that it believes the survey conducted by Whirlpool had minimal value because the survey did not include any Sears Kenmore models, which have the highest market share in the clothes washer industry. Maytag also stated that (1) the way the cycle selections are depicted to the consumer will have a significant impact on how often a consumer will select a normal cycle, and (2) as the normal cycle is depicted on the Whirlpool clothes washers, consumers will use the normal cycle less frequently. (Maytag, No. 17, Docket 701).

The Department reviewed the publicly available survey summary and confidential raw survey data provided by Whirlpool. The survey data indicate that consumers select a normal cycle, with a temperature selection lockout, slightly less often than they select a normal cycle without a temperature selection lockout. This supports Whirlpool's claim that the lockout feature had minimal impact on the use of the normal cycle. The results also showed, however, that consumers' overall use of the normal cycle of Whirlpool clothes washers is significantly less than their use of the normal cycle for typical clothes washers (use of the normal cycle for the industry

[13] Fisher & Paykel provided this comment to the Department regarding Interim Waiver CW–004 (61 FR 18129 on April 6, 1996) which addresses this same issue.

[14] P&G data indicates that the normal cycle on a typical clothes washer is used approximately 75 percent of the time. The DOE test procedure uses the normal cycle to approximate typical use by consumers.

is estimated to be 75 percent, based on P & G survey data). This result supports the statements made by White Consolidated and Maytag regarding use of the normal cycle.

Whirlpool, after consultation with the Department regarding its confidential data, provided public information which indicated that consumers selected the normal cycle on its clothes washers equipped with temperature selection lockouts 32 percent of the time. (Whirlpool, No. 18, Docket 701).

The Department believes that the proration value for the use of the normal cycle should reflect the frequency of consumer choice of that cycle. The Department believes that the confidential survey data, provided by Whirlpool, indicating the actual use of the normal cycle by consumers with a temperature selection lockout feature does exactly that. Therefore, the Department is promulgating today's final rule with proration values of 32 percent for the normal cycle and 68 percent for the most energy intensive cycle for the Appendix J test procedure.

7. Water-Heating Clothes Washers

Traditionally, clothes washers in the U.S. have used water heated outside of the machine, in a dwelling's water heating source. These are defined as non-water-heating clothes washers. New, predominantly imported, clothes washers have their own internal heaters which heat cold water supplied for washing. These are referred to as water-heating clothes washers. In addition, some water-heating clothes washers have the capability of using water heated externally, and can use their internal heater to increase the temperature of such water, or to maintain the temperature of water in the wash tub.

The March 1995 proposed rule proposed test provisions for water-heating clothes washers that do not use externally heated water. The test provisions included definitions for water-heating and non-water-heating clothes washers. In the supplemental proposed rule, the Department proposed to include in Appendix J provisions to test water-heating clothes washers that use externally heated water. Under the proposed Appendix J1 definition, these clothes washers are treated as water-heating clothes washers because they are equipped with an internal heater, although they are tested with a combination of test provisions for water-heating and non-water-heating clothes washers.

Generally, commenters supported these proposals, although a few modifications were suggested. AHAM requested the Department adopt in Appendix J the definitions for water-heating and non-water-heating clothes washers that AHAM suggested for Appendix J1. The AHAM definitions are generic and applicable to water-heating clothes washers that use externally heated water. (AHAM, No. 8 at 1, Docket 230). The intent of the AHAM definitions was supported by Miele. (Miele, No. 10 at 1, Docket 230). Commenters agreed that the Department should incorporate into Appendix J test provisions for water-heating clothes washers that use externally heated water. (AHAM, No. 7 at 1, 4, 5; Miele, No. 4 at 2; Maytag, No. 8 at 3; and Raytheon, No. 9 at 3: all Docket 230A).

The Department agrees with AHAM and Miele that the definitions for water-heating and non-water-heating clothes washers should address water-heating clothes washers that use externally heated water. Furthermore, the Department proposed AHAM's definitions for the Appendix J1 test procedure in the supplemental proposed rule and did not receive any negative comments. Therefore, today's final rule incorporates revised definitions in Appendix J, identical to those proposed for Appendix J1. Today's final rule also incorporates procedural steps into Appendix J for water-heating clothes washers that use externally heated water.

8. Weighing Scales for Test Cloth and Clothes Container

In the March 1995 proposed rule, the Department also proposed to maintain existing requirements for the weighing scales which are used to measure the weight of test cloth and clothes washers (for container capacity determination). AHAM revised the requirements for weighing scales in its recommended test procedure. AHAM also recommended that its rule language be adopted for Appendix J. The AHAM language eliminates requirements to have specific measuring ranges for the weighing scales, and specifies instead a maximum allowable percentage of error for a particular measured value. (AHAM, No. 8 at 1, Docket 230). The Department believes the AHAM language, on which the Department sought comments in the supplemental proposed rule but received none, will maintain the accuracy of the existing test procedure while providing manufacturer equipment flexibility, thus eliminating an unnecessary test burden. Therefore, today's rule incorporates the supplemental proposed rule language for weighing scales into Appendix J.

C. Clothes Washer Test Procedures—Issues Related to Appendix J1

1. Capacity Measurement

Both the proposed Appendix J and proposed Appendix J1 required testing to determine the capacity of the clothes container. This capacity is defined as the maximum volume which a dry clothes load could occupy. The capacity is then used as a significant component in the calculation of the Energy Factor and Modified Energy Factor, which are used to rate the efficiency of the clothes washer on a per cycle basis. The actual load, in pounds of clothing, that a clothes washer can wash is a function of many variables including the portion of the container's volume which is actually available for clothes washing, the agitation system and the motor torque. But the Department has used the measured clothes container capacity as a proxy for the actual load a clothes washer is capable of washing, and this has worked well for purposes of comparing vertical-axis clothes washers to each other. The Department believes that measured container capacity will serve the same function for horizontal-axis clothes washers. However, it is unclear whether the relationship of measured capacity to load capability is the same for vertical-axis and horizontal-axis clothes washers.

The proposed Appendix J and proposed Appendix J1 test procedures require measuring the capacity to the upper most part of the clothes washer container, which includes the volume encompassed by a ring that may be attached to the top of the clothes container. The maximum water level in any vertical-axis clothes washer may vary, but the water level cannot go to the top of the ring attached to the top of the clothes container. Maytag calculated that this current method of measuring capacity results in the measured volume of vertical-axis clothes washers exceeding the wetted volume [15] by a minimum of 15 percent to well over 20 percent. (Maytag, No. 13 at 1, Docket 230). AHAM, commenting on behalf of clothes washer manufacturers, including Maytag, asserts the current method for measuring vertical-axis clothes washer capacity is sufficient and should not be changed. (AHAM, No. 33 at 5, Docket 230).

In a horizontal-axis clothes washer, washing and rinsing occur in the entire volume of the clothes container. Thus, the measured and wetted volumes of a

[15] DOE uses the term ''wetted volume'' to refer to the space in a clothes washer within which washing and rinsing occur.

horizontal-axis clothes washer are the same, and Maytag proposed multiplying the measured volume of a horizontal-axis clothes washer by a factor of 1.2. (Maytag, No. 13 at 2, Docket 230). This factor would mathematically increase the ''measured capacity'' of horizontal-axis clothes washers and would result in a 20 percent increase in the Energy Factor and Modified Energy Factor for horizontal-axis clothes washers. A similar factor is included in the International Electrotechnical Commission (IEC) 456 test procedure for clothes washers. ACEEE supports a capacity credit for horizontal-axis clothes washers.[16] ACEEE stated that the IEC test procedure has a 15 percent credit and believes the credit may be too low. ACEEE believes the credit should be 21 percent. (ACEEE, No. 32 at 3, Docket 230).

Speed Queen opposes a horizontal-axis clothes washer capacity adjustment factor, stating that adequate time for discussion and comment is needed on this ''recently raised issue.'' (Speed Queen, No. 29 at 3, Docket 230). GEA opposes any horizontal-axis clothes washer capacity credit stating, ''In view of the evidence, from P & G, that American consumer washing habits are driven in large part by their perception of capacity, proponents of a European adjustment factor must provide hard data of its applicability to the U.S. market.'' (GEA, No. 36 at 2, Docket 230). Whirlpool also opposes any credit for horizontal-axis clothes washer capacity because there are no data that would demonstrate American loading habits for horizontal-axis clothes washers. (Whirlpool, No. 37 at 4, Docket 230).

The Department notes that the measured volume of a vertical-axis clothes washer is larger than the wetted volume, whereas, these two volumes are the same for horizontal-axis clothes washers. This suggests that, for these two types of machines, a difference may exist in the relationship of measured capacity to the amount of clothes a clothes washer is capable of washing. However, the Department has no data to indicate that this possible difference translates into an actual difference in load size capability when the other variables that affect load size are considered, or as to how U.S. consumers will use horizontal-axis clothes washers.

In the supplemental proposed rule, the Department did not propose a capacity credit for horizontal-axis clothes washers. The Department stated that, if data became available, it would consider making adjustments to the test procedures for either vertical or horizontal-axis clothes washers to ensure that the comparisons are relatively accurate. In Appendix J1, the Department did not make any changes to the measurement procedures, or adjust any calculations regarding capacity. Maytag indicated that data to support a credit, or adjustment, for horizontal-axis clothes washers currently were not available, but that it may submit subsequent comments if such data became available. (Maytag, No. 8 at 1 and No. 15 at 2, Docket 230A). Raytheon supported the Department's proposal to retain the established capacity measurement requirements. (Raytheon, No. 9 at 1, Docket 230A).

Based on the foregoing, today's final rule retains the same basic approach to capacity as was proposed in the supplemental proposed rule. However, minor language revisions were incorporated, as discussed above in section III.B.2 of this notice. If data become available which would indicate a significant impact on the comparisons between vertical and horizontal-axis clothes washers, the Department will consider initiating a rulemaking to make appropriate revisions to the test procedure.

2. Consumer Selectable Options for the Energy Test Cycle

In the supplemental proposed rule, the Department proposed test provisions for clothes washers equipped with consumer selectable options available in the energy test cycle (supplemental proposed rule Section 3.2.3.5). These provisions were proposed primarily because of the possibility that manufacturers would provide multiple spin speed and spin time selections for the energy test cycle. (See the discussion above regarding spin speed and spin time in section III.A.4b of this notice.) The proposal however, was applicable to all possible consumer selectable options available in the energy test cycle, other than wash time (which was addressed in section 2.10). The language included examples of selectable options, such as various spin speeds or adaptive water fill selections, and required testing of the extremities of the available selections and averaging of the results.

AHAM, NRDC, and clothes washer manufacturers provided specific comments regarding multiple consumer selectable options for spin speed and spin time. These comments and the Department's response, including revised requirements for these features, are discussed fully in section III.A.4b of this notice. AHAM and clothes washer manufacturers also provided specific comments regarding multiple consumer selectable options for adaptive water fill control systems. These comments and the Department's response, including revised requirements for adaptive water fill control systems, are discussed fully in section III.A.1.

AHAM recommended that the Department revise section 3.2.3.5 regarding consumer options for the energy test cycle to exclude wash time, temperature, fill levels, and extraction. AHAM also recommended that the tests be conducted on the combined maximum and combined minimum energy intensities for all such consumer options. (AHAM, No. 14, Docket 230A). Raytheon supported AHAM's recommendation. (Raytheon, No. 13 at 2, Docket 230A). Fisher and Paykel recommended that the Department convert section 3.2.3.5 into six procedural steps. Fisher and Paykel's recommended changes were consistent with AHAM's recommendation to exclude wash time, temperature, fill levels, and extraction from this section. Fisher and Paykel also recommended that other options be tested in the factory default setting or in the manufacturers ''recommended positions for a cotton and/or linen clothes cycle.'' Fisher and Paykel recommended language including exclusions for non-energy related features, as well as comprehensive testing provisions for special circumstances not covered by the generic provisions. (Fisher and Paykel, No. 16 at 9, 10, Docket 230A).

Having reviewed the AHAM and manufacturer comments, the Department sees no need to include in Appendix J1 general provisions for ''consumer options for the energy test cycle.'' In the supplemental proposed rule, the Department expressed concern regarding consumer options for multiple spin speed, spin time, and multiple adaptive water fill control system selections. These options have now been addressed in other sections of the rule language as discussed above. The Department is concerned about adopting specific test provisions to address unknown, potential options. The commenters did not provide a rationale as to why the suggested provisions were needed in the test procedure, other than that the Department had originally proposed them. The Department believes that any other feature which affects the energy consumption of clothes washers should be subject to the public comment provisions of the waiver process found at 10 CFR 430.27.

The Department acknowledges that in the supplemental proposed rule it proposed a procedure to address

[16] Commenters have used both terms ''factor'' and ''credit'' which are intended to mean the same thing.

generally consumer options in the energy test cycle. This proposal was primarily designed, however, to address specific concerns stated in the proposed rule and to elicit comment on procedures for other possible consumer options. The specific concerns have been addressed elsewhere and no other consumer options were identified in the comments. Therefore, the Department sees no reason to include in the test procedure a generic test provision for consumer options in the energy test cycle, and today's rule contains no such provision.

3. Energy Test Cloth

The supplemental proposed rule proposed requirements to precondition the energy test cloth prior to its use for energy consumption testing. These requirements generally were based on the AHAM recommended test provisions, except that the Department changed the requirement for detergent from an AHAM specification to a generic specification (commercially available detergent).

AHAM, Maytag, and Raytheon supported the Department's proposal to use commercially available detergent, although they recommended that the Department change the requirement from a specific dosage of detergent (6 grams per gallon of water) to a dosage as recommended by the manufacturer. (AHAM, No. 7 at 3; Maytag No. 8 at 2: and Raytheon No. 9 at 2; all Docket 230A). The Department agrees with the commenters that the dosage should be specified as recommended by the manufacturer because of different types and sizes of clothes washers in the marketplace. A specific dosage, such as 6 grams per gallon of water, may be too small or too large for a particular clothes washer. Therefore, today's final rule revises the requirement for clothes washer detergent dosage, as indicated above, in Appendix J1.

4. Energy Test Cycle Definition

In the supplemental proposed rule, the Department proposed a definition for ''energy test cycle,'' for Appendix J1. The energy test cycle definition is used to define the cycle on which the energy consumption tests are to be conducted, and corresponds to the cycle the manufacturer recommends for washing cotton or linen clothes. The energy test cycle is comparable to the ''normal cycle'' defined in Appendix J.

Fisher and Paykel objected to inclusion of the following language in the energy test cycle definition: ''all temperature selections available on the model, regardless of whether the wash/rinse temperature selections or water levels are available in the cycle recommended for cottons and/or linens.'' Fisher and Paykel believes it is unfair to impose testing requirements of temperature selections that are available only in other cycles, e.g., warm rinse for the delicate cycle, because the other cycles are not used as frequently as the cycle recommended for cotton and/or linen clothes. (Fisher and Paykel, No. 16 at 2, Docket 230A).

The Department believes Fisher and Paykel's comment regarding the energy test cycle raises an issue that is essentially the same as the normal cycle temperature selection lockout issue, discussed above, for Appendix J. The temperature selection lockout issue caused significant controversy among U.S. clothes washer manufacturers, and was the subject of extensive debate. (See Docket Number EE–RM–93–701).

The energy test cycle is intended to be representative of typical consumer use of a clothes washer. Absence of temperature selections from the energy test cycle of a clothes washer may mean that cycle is not representative and may lead to manufacturer representations that do not reflect true energy consumption. This may not be the case for all clothes washers with temperature selections available in cycles other than the energy test cycle, but the issue remains a significant concern to the Department. Therefore, today's final rule maintains the substance of the definition for energy test cycle, as proposed in the supplemental proposed rule. Certain changes however, solely for purposes of clarification, have been made in the definition as promulgated in today's final rule.

5. Other Issues

The supplemental proposed rule proposed several minor changes in AHAM's suggested test procedure, about which DOE received no negative comment. Therefore, in these respects, today's final rule maintains the rule language in Appendix J1 as proposed in the supplemental proposed rule. These minor changes are provided in tabular form as follows:

Proposal	Rule sections
Maximum use of five energy stuffer cloths	Section 2.7.
Water-heating clothes washer test provisions, including test room temperature requirements and externally heated water use.	Sections 2.11, 3, and 4.
Not to include a suds-saver test provision	N/A.
Temperature Use Factors	Section 4.

6. Supply Water Temperature

Under the Department's proposal in the supplemental proposed rule, supply water temperature would affect the energy consumption of water-heating clothes washers and clothes washers with thermostatically controlled water valves, whereas other non-water-heating clothes washers would not be affected by the supply water temperature. The Department's proposal, based on AHAM's recommendation, specified different tolerances for the supply water temperatures for these two situations. Clothes washers whose energy consumption is affected by the supply water temperature were required to be tested with a hot water supply of 135°F with a tolerance (+0°F − 10°F), and cold water supply of 60°F with a tolerance (+0°F − 10°F). Clothes washers whose energy consumption is not affected by the supply water temperature were required to be tested with a hot water supply of 135°F with a tolerance (± 5°F), and cold water supply of 60°F with a tolerance (± 5°F).

Fisher and Paykel asserted that, since one type of machine is not affected by supply temperature, there is no reason to specify different tolerances for the two types of clothes washers while using the same tolerance range (10°F). Fisher and Paykel also believes that in a laboratory it is easier to set a temperature to a ± 5°F tolerance than a +0°F − 10°F tolerance. Fisher and Paykel recommended that the requirements for supply water be combined for both types of clothes washers. The hot water supply would be set at 130°F with a tolerance (±5°F), and the cold water supply would be set at 55°F with a tolerance (±5°F). (Fisher and Paykel, No. 16 at 5, Docket 230A).

The Department is concerned, however, about unnecessary test burden. In many areas of the U.S., during much of the year, the temperature of the ground water remains above 60°F. Setting cold water

requirements below 65°F for clothes washers not affected by supply temperatures, which represent a majority of the current clothes washer market, would impose an unnecessary test burden. The Department also believes that the ability to establish a temperature within a 10°F tolerance range is the same regardless of how it is specified.

In light of Fisher and Paykel's comments, however, the Department agrees it is warranted to revise the proposed provisions for supply water temperatures. In order to establish an appropriate and readily apparent difference between those clothes washers affected by supply water temperatures and those which are not, the Department is eliminating the specified tolerances for clothes washers affected by supply water temperatures. In today's final rule, the Department is adopting revised requirements such that the hot water supply shall not exceed 135°F (57.2°C), and the cold water supply shall not exceed 60°F (15.6°C) for clothes washers affected by supply temperatures in Appendix J1.

7. Test Load Tolerances

In the supplemental proposed rule, the Department proposed a test load table which has loads that vary with clothes washer capacity. The table was based on the AHAM recommended test procedure, except that the Department changed the tolerance from AHAM's suggested value of ±0.10 pounds to ±0.05 pounds. The Department made this change because it believed that a tolerance of ±0.05 pounds enabled the required test load sizes to be achieved through the use of energy stuffer cloths that weigh approximately 0.04 pounds each. The Department requested comment on this proposal.

AHAM, Maytag, and Raytheon opposed the Department's proposal to establish a tolerance of ±0.05 pounds. Their concern is that the tighter tolerance has minimal impact (0.66 percent) on the test results. They also believe that the tighter tolerance imposes an unnecessary test burden because ambient, humid air, causes a dry test load to gain weight. (AHAM, No. 7 at 2; Maytag, No. 8 at 2; and Raytheon, No. 9 at 2; all Docket 230A). NRDC supported the Department's proposal to establish a tolerance of ±0.05 pounds. (NRDC, No. 2 at 2, Docket 230A).

The Department agrees that the concern raised by AHAM and manufacturers has merit because the test procedure requires the test load to be ''bone dry,'' meaning that the weight of the test load is stable within one percent after 10 minutes in a clothes dryer. Since the test procedure does not have a low humidity requirement, it is likely that the test load will gain weight during the time period after it is removed from the clothes dryer and before its weight is measured. Therefore, given the practical considerations of the testing environment, a theoretical weight for energy stuffer cloth cannot be used. For these reasons, today's final rule changes the test load table tolerance to ±0.10 pounds in Appendix J1.

8. Warm Wash Temperature Selections

The supplemental proposed rule proposed test provisions for warm wash temperature selections. These provisions included definitions for ''warm wash'' and ''uniformly distributed warm wash,'' as well as testing requirements for clothes washers with various types of intermediate warm wash temperatures. In proposed Appendix J1, if a clothes washer has uniformly distributed warm wash temperature selections (wash temperatures have a linear relationship with all discrete warm wash selections and are equally spaced, or infinite in number), the energy consumption value is determined by a calculation rather than a test. If the warm wash temperature selections are not uniformly distributed, the Department proposed testing all discrete intermediate warm wash temperature selections (i.e., all temperature selections that are below the hottest hot (≤135 °F (≤57.2 °C)) and above the coldest cold). In the case of infinite non-uniformly distributed temperature selections, testing would be conducted at the 20, 40, 60, and 80 percent positions of the temperature selection device.

The Department did not receive any comments regarding the proposed ''warm wash'' definition. AHAM, Maytag, and Raytheon stated that they supported the Department's definition for ''uniformly distributed warm wash,'' but they expressed concern about the application of the definition and about the requirements for testing. (AHAM, No. 7 at 4; Maytag, No. 8 at 3; and Raytheon, No. 9 at 2; all Docket 230A). Fisher and Paykel stated that the portion of the definition for ''uniformly distributed warm wash'' which describes the criteria for a ''linear relationship'' is unclear. The definition, in Appendix J1, stated ''In all cases, the mean of the water temperature of the warmest and the coldest warm selections must coincide with the mean of the hot and cold water temperature.'' Fisher and Paykel believes the term ''hot and cold water temperature'' is ambiguous and could refer to hot and cold wash temperatures, or could apply to hot and cold supply water temperatures. In addition, due to various temperature settings and tolerances throughout the test procedure, Fisher and Paykel suggested that a tolerance (±8 °F (±4.4 °C)) be established to qualify the term ''must coincide.'' (Fisher and Paykel, No. 16 at 3, Docket 230A).

The Department agrees with Fisher and Paykel and has revised the ''uniformly distributed warm wash'' definition, regarding the criteria for ''linear relationship,'' to remove any ambiguity. The linear relationship criterion is applicable over the temperature range between the ''hot wash'' and the ''cold wash.'' Therefore, today's final rule revises this section in Appendix J1 from ''* * * mean of the hot and cold water temperature'' to ''* * * mean of the hot wash and cold wash water temperatures.''

With regard to Fisher and Paykel's suggestion of a tolerance, the Department believes that some acceptable tolerance should be established because having the terminology ''must coincide,'' without a tolerance, would mean the linear relationship requirement would not be satisfied if any deviation existed, however slight. The Department, however, believes Fisher and Paykel's suggested tolerance value is too large. In Appendix J1, within the definition of ''uniformly distributed warm wash,'' a tolerance of ''± 5 percent'' was proposed in the sentence prior to the one that is the subject of Fisher and Paykel's comment. This tolerance was not objected to by any commenters. The Department believes this same value should be applied to the sentence where Fisher and Paykel believes a tolerance should be added. The nominal temperature range between a ''hot wash'' and ''cold wash'' is 75°F. Five percent of this range results in a tolerance of ± 3.8°F. Therefore, the Department is adopting ''± 3.8°F(± 2.1°C)'' as a tolerance for the criteria for a linear relationship in Appendix J1.

AHAM, Fisher and Paykel, and Raytheon support in part and oppose in part the Department's proposed testing method for warm wash temperature selections that are not uniformly distributed. They agree that where a clothes washer has less than three such selections, all should be tested. But they oppose testing all selections where a machine has more than three such selections, based primarily on a claim of excessive test burden. For clothes washers with more than three discrete

warm wash temperature selections, they suggest DOE give manufacturers the option of either testing all of the selections or treating this category as if it were a clothes washer with ''infinite'' temperature selections. This would reduce significantly the number of required tests if a clothes washer were equipped with numerous discrete warm wash temperature selections. In addition, AHAM, Fisher and Paykel, and Raytheon believe the number of test points for clothes washers with infinite temperature selections should be reduced from four to three, and a requirement should be added to test to the next higher temperature selection if a particular test point is not available. (AHAM, No. 14 at 2; Fisher and Paykel, No. 16 at 11, 12; and Raytheon, No. 13 at 1; all Docket 230A).

The Department is concerned with the test burden imposed by the test procedures. For example, the Department is aware of a current clothes washer model that has 32 intermediate warm wash temperature selections. To test all 32 temperature selections with all of the other test procedure provisions would be expensive, and could be considered excessive test burden. The Department agrees with the suggested option to consider clothes washers with more than three warm wash temperatures as clothes washers with infinite warm wash temperature selections. The Department believes 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, will provide representative data of the warm wash temperature selection offerings. In addition, DOE agrees that manufacturers should have the option of testing all temperature selections if they choose to. Therefore, the Department is adopting in Appendix J1 the suggested treatment of clothes washers with more than three warm wash temperature selections that are not uniformly distributed.

The question of whether clothes washers with infinite warm wash temperature selections should be tested at four points (20, 40, 60, and 80 percent of the temperature range) as proposed by the Department, or at three points (25, 50, and 75 percent of the temperature range) as suggested by commenters, raises a number of issues. First, the Department believes that although the accuracy of the test results will increase with more test points, the test burden also will increase. In addition, manufacturers of clothes washers with numerous discrete warm wash temperature selections would most likely provide a discrete warm wash temperature selection at approximately the 50 percent location of the temperature range, which would not be tested with the four test point requirement proposed by the Department. Therefore, today's final rule incorporates into Appendix J1 a requirement that clothes washers with infinite temperature selections be tested at three points (25, 50, and 75 percent) of the temperature range. However, if the Department were to obtain data indicating that today's requirements result in representations not reflective of a clothes washer's true energy consumption, then the Department would consider a rulemaking to reevaluate these requirements.

In addition to the above comments regarding warm wash temperature selections, AHAM and Raytheon suggested the adoption of a new procedural step with equations to determine the temperatures of warm wash water in a non-water-heating clothes washer, based on proration of hot water consumption. (AHAM, No. 14 at 1, and Raytheon, No. 13 at 3, both Docket 230A). The Department has reviewed the suggestion and believes it would be beneficial to include this in the procedure for determining warm wash water temperatures for non-water-heating clothes washers. The definition for uniformly distributed warm wash temperature selections requires the plotting of warm wash temperatures with the position of the temperature selection device. The suggestion by AHAM and Raytheon is one method which is acceptable and will be transparent to users of the test procedure. Therefore, today's final rule incorporates AHAM and Raytheon's suggestion for a procedural step to determine the temperature of a non-water-heating clothes washer warm wash temperature selection in Appendix J1.

9. Warm Rinse

In the supplemental proposed rule, the Department proposed requirements to test heated rinses (section 3.7) independent of wash temperatures. This proposal, based generally on AHAM's recommendation, required that the entire electrical energy be measured for a ''warm wash and hottest rinse cycle,'' and that the energy used in the heated rinse be derived from this measurement of the energy used in the entire clothes washer cycle. AHAM suggested, and Raytheon supported, a revision to the heated rinse testing requirements so as to measure only the energy consumption including electrical energy consumption of the warm rinse cycle. In addition, AHAM and Raytheon suggested some minor modifications to the rule language implementing these testing requirements, to make the language more consistent with the entire test procedure. (AHAM, No. 14 at 3; and Raytheon, No. 13 at 1; both Docket 230A).

The Department believes that the revisions suggested by AHAM and Raytheon will provide the same test result as DOE's proposal while reducing test burden, and will simplify the rule language in the process. Therefore, the Department is adopting these suggested revisions for warm rinse testing in Appendix J1.

D. Related Issues, Revision to 10 CFR 430.23, ''Test procedures for measures of energy consumption.''

In the March 1995 proposed rule, the Department proposed specific changes to 10 CFR 430.23(j) (1) and (2). These changes included a decrease in the number of annual cycles, changes in Appendix J section number references, and the incorporation of the Modified Energy Factor descriptor. In the supplemental proposed rule, DOE stated that if it were to adopt Appendix J1, then it would make the necessary changes to § 430.23 for Appendix J1. The Department did not receive any negative comments regarding these proposals.

In today's final rule, the Department is incorporating the proposed changes into § 430.23. In addition, the Department is making nonsubstantive changes to § 430.23 and Appendix J. The Department proposed that the Modified Energy Factor descriptor be set forth in Appendices J and J1, and referenced in § 430.23. The Department believes it would be beneficial to users of the test procedures, and would be more consistent with the foregoing proposal, if the Energy Factor descriptor now located in § 430.23, was instead referenced in § 430.23 and set forth in Appendices J and J1. Today's final rule promulgates these changes.

Section 430.23(j)(3) provides a general statement regarding other useful measures of energy consumption which are likely to assist consumers in making purchasing decisions. Currently, this section does not include any descriptors, or useful information to consumers. The Department believes that including references to the Water Consumption Factor, Remaining Moisture Content, and a calculation for annual water consumption will provide greater exposure of additional information to consumers, or users of the test procedure. These changes are nonsubstantive and provide information available in the existing test procedures.

These changes do not impose any additional requirements on manufacturers. Therefore, today's final rule includes the above references in § 430.23(j)(3).

E. Reporting Requirements, Revision to 10 CFR 430.62, ''Submission of Data''

In the March 1995 proposed rule, the Department proposed to require that, on the certification report for each basic model of a dishwasher, clothes dryer, or clothes washer the manufacturer would report the Energy Factor for the basic model. The Department did not receive any negative comments regarding this proposal. Therefore, today's final rule includes a requirement for Energy Factors to be included on manufacturers' certification reports for dishwashers, clothes dryers, and clothes washers, as proposed in the March 1995 proposed rule.

ACEEE commented, however, that the Department should require in addition the reporting of clothes washer capacity, total clothes washer water use, and RMC. ACEEE believes this data will support market incentive programs for high efficiency clothes washers. (ACEEE, No. 32 at 2). The Department already requires the reporting of clothes washer capacity in the certification report. 10 CFR 430.62(a)(2), ''Submission of Data.'' The Department believes it would not be appropriate to require manufacturers to report total water use and RMC. Today's Appendix J does not require the calculation of total water use or RMC. These criteria are provided in the test procedure for optional use by manufacturers or other testers. Imposing reporting requirements for such criteria would impose additional test burden on manufacturers. The Department does, however, support the wide dissemination of this information on a voluntary basis, as reflected in today's amendments to § 430.23(j)(3), discussed above. Therefore, today's final rule does not include reporting requirements for clothes washer total water use or RMC.

F. Effective Date

The effective date specified for today's amendments is (insert date 180 days after publication). Thus, as of that time, manufacturers must use Appendix J as amended in this rule whenever they are required to test clothes washers to determine if they comply with applicable energy conservation standards. Similarly, unless the Department receives and grants a petition for extension under section 323(c)(3) of EPCA, any representations concerning clothes washers, made after (insert date 180 days from publication) should be based on this amended test procedure.

The Department notes, in addition, that, until the amendments become effective in 180 days, they cannot be used to establish compliance with standards by clothes washers that cannot be tested under existing test procedures. Manufacturers of any products that cannot be adequately tested under the current test procedure must seek a waiver under 10 CFR 430.27 for the interim period.

As noted above and at the outset of the text of Appendix J1, Appendix J1 will not become mandatory until new energy conservation standards for clothes washers have been adopted. At that time, DOE will remove the current Appendix J. In the meantime, Appendix J1 will be used in the development of the new standards.

IV. Determination Concerning the Impact of the Amended Test Procedures on Standards

Section 323 of EPCA requires that the Department determine the extent to which an amended test procedure would alter the measured energy efficiency or measured energy use of clothes washers as compared with the existing test procedure. Such assessment is made for the purpose of assuring that revisions in test procedures do not in effect alter existing energy conservation standards by altering the compliance of existing products with those standards. Today's amendments to Appendix J would not affect measurement of the efficiency or energy use of any clothes washer, with the exception of a clothes washer with a lockout feature.

With respect to clothes washers with a lockout feature, the amendments being adopted fill a gap in the prior test procedures. Prior procedures lacked a suitable means for testing whether such clothes washers comply with applicable standards, and today's amendments provide such a means. It is the Department's understanding that very few clothes washers with a lockout feature are currently being manufactured. Moreover, the Department is not aware of any such machine that complies with applicable energy conservation standards under prior test procedures, and that would be rendered in non-compliance under Appendix J as amended today.

Appendix J1 also would not affect the measurement of compliance with existing standards. It is being promulgated for use in developing future amendments to the standards for clothes washers, and would go into effect only upon the effective date of any such future amendment.

V. Procedural Requirements

A. Environmental Review

The Department has concluded that this final rule falls into a class of actions (categorical exclusion A5) that are categorically excluded from the National Environmental Policy Act of 1969 (NEPA) review because they would not individually or cumulatively have a significant impact on the human environment, as determined by DOE's regulations (10 CFR part 1021, Subpart D) implementing NEPA [42 U.S.C. 4321, 4331–35, 4341–47 (1976)]. Therefore, this rule does not require an Environmental Impact Statement or an Environmental Assessment pursuant to NEPA.

B. Regulatory Planning and Review

DOE has determined that this is not a ''significant regulatory action'' under Executive Order 12866, ''Regulatory Planning and Review,'' (58 FR 51735, October 4, 1993). Accordingly, today's action was not subject to review by the Office of Information and Regulatory Affairs.

C. Federalism Review

Executive Order 12612 (52 FR 41685, October 30, 1987) requires that regulations or rules be reviewed for any substantial direct effects 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. If there are sufficient substantial direct effects, the Executive Order requires the preparation of a Federalism assessment to be used in decisions by senior policy makers in promulgating or implementing the regulation.

The final rule published today would not alter the distribution of authority and responsibility to regulate in this area. The final rule would only revise a currently applicable DOE test procedure to improve existing testing methods, and to add provisions that DOE would use in future standard setting. Accordingly, DOE has determined that preparation of a federation assessment is unnecessary.

D. ''Takings'' Assessment Review

It has been determined pursuant to Executive Order 12630 (52 FR 8859, March 18, 1988) that this regulation would not result in any takings which might require compensation under the Fifth Amendment to the United States Constitution.

E. Paperwork Reduction Act Review

No new information or recordkeeping requirements are imposed by this rulemaking. Accordingly, no OMB clearance is required under the Paperwork Reduction Act (44 U.S.C. 3501 et seq.).

F. Unfunded Mandates Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (''Unfunded Mandates Act'') (signed into law on March 22, 1995) requires that the Department prepare a budgetary impact statement before promulgating a rule that includes a Federal mandate that may result in expenditure by state, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more in any one year.

The Department has determined that this action does not include a Federal mandate that may result in estimated costs of $100 million or more to state, local or to tribal governments in the aggregate or to the private sector. Therefore, the requirements of Sections 203 and 204 of the Unfunded Mandates Act do not apply to this action.

G. Review Under the Regulatory Flexibility Act of 1980

The Regulatory Flexibility Act of 1980, 5 U.S.C. 603, requires the preparation of an initial regulatory flexibility analysis for every rule which by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. A regulatory flexibility analysis examines the impact of the rule on small entities and, if the impact is significant and widespread, the analysis considers alternate ways of reducing negative impacts.

In the March 1995 proposed rule and the May 1995 proposed rule, the Department certified that the proposed amendments, if adopted as final rules, would not have a significant economic impact on a substantial number of small entities. None of the comments on these proposed rules disagreed. In adopting final rules based on these proposals, the Department continues to adhere to this conclusion.

Certain provisions of Appendix J in today's final rules, and all of Appendix J1, arise out of the April 1996 supplemental proposed rule, and certain other provisions of Appendix J are based on the November 1996 reopening notice. The Department believes these provisions of the final rule also will not have a significant impact on either small or large manufacturers of clothes washers under the provisions of the Regulatory Flexibility Act. No comment indicated otherwise. These amendments to Appendix J incorporate: (1) Test procedures already in use by manufacturers pursuant to waivers that DOE previously granted to those manufacturers, (2) test provisions that expand or elaborate on amendments proposed in the March 1995 proposed rule, and (3) procedural refinements that do not affect test burden. These amendments to Appendix J will have virtually no impact on manufacturer costs. For Appendix J1, which may be used in the future, the Department is updating the test procedures to reflect current consumer usage habits. Appendix J1 will not have a significant economic impact, since the methods it incorporates are already in use by manufacturers, and will not cause manufacturers to purchase equipment, significantly increase testing time, or employ technical staff beyond what is required by existing DOE test procedures.

In addition, in some respects the test procedures in the final rule are less burdensome than the current procedures. For example:

- In Appendix J, the Department is relaxing specific equipment requirements which are irrelevant, and thus will provide greater flexibility in manufacturer equipment selection.
- In Appendix J1, manufacturers will not have to test warm wash temperature selections for clothes washers with uniformly distributed temperature selections.

In summary, DOE believes that the final rule does not have a ''significant economic impact on a substantial number of small entities,'' and that the preparation of a regulatory flexibility analysis was and is not warranted.

H. Review Under Executive Order 12988, ''Civil Justice Reform''

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (February 7, 1996), imposes on Executive agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. With regard to the review required by section 3(a), section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3© of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 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, the final regulations meet the relevant standards of Executive Order 12988.

I. Review Under Small Business Regulatory Enforcement Fairness Act of 1996

As required by 5 U.S.C. 801, DOE will report to Congress promulgation of the rule prior to its effective date. 5 U.S.C. 801. 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(3).

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

Issued in Washington, D.C., on August 20, 1997.

Brian T. Castelli,

Chief of Staff, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, Part 430 of Chapter II of Title 10, of the Code of Federal Regulations is amended as set forth below:

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

1. The authority citation for Part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309.

2. Section 430.23 of Subpart B is amended by revising paragraph (j) to read as follows:

§ 430.23 Test procedures for measures of energy consumption.

* * * * *

(j) *Clothes washers.* (1) The estimated annual operating cost for automatic and semi-automatic clothes washers shall be—

(i) When electrically heated water is used, the product of the following three factors:

(A) The representative average-use of 392 cycles per year,

(B) The total per-cycle energy consumption in kilowatt-hours per cycle determined according to 4.1.6 of appendix J before appendix J1 becomes mandatory and 4.1.7 of appendix J1 when appendix J1 becomes mandatory, (see the note at the beginning of appendix J1), and

(C) The representative average unit cost in dollars per kilowatt-hour as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year, and

(ii) When gas-heated or oil-heated water is used, the product of: the representative average-use of 392 cycles per year and the sum of both:

(A) The product of the per-cycle machine electrical energy consumption in kilowatt-hours per cycle, determined according to 4.1.5 of appendix J before the date that appendix J1 to the subpart becomes mandatory or 4.1.6 of appendix J1 upon the date that appendix J1 to this subpart becomes mandatory, and the representative average unit cost in dollars per kilowatt-hours as provided by the Secretary, and

(B) The product of the per-cycle water energy consumption for gas-heated or oil-heated water in BTU per cycle, determined according to 4.1.4 of appendix J before the date that appendix J1 becomes mandatory or 4.1.4 of appendix J1 upon the date that appendix J1 to this subpart becomes mandatory, and the representative average unit cost in dollars per Btu for oil or gas, as appropriate, as provided by the Secretary, the resulting product then being rounded off to the nearest dollar per year.

(2)(i) The energy factor for automatic and semi-automatic clothes washers is determined in accordance with 4.5 of appendix J before the date that appendix J1 becomes mandatory or 4.5 of appendix J1 upon the date that appendix J1 to this subpart becomes mandatory. The result shall be rounded off to the nearest 0.01 cubic foot per kilowatt-hours.

(ii) The modified energy factor for automatic and semi-automatic clothes washers is determined in accordance with 4.4 of appendix J before the date that appendix J1 becomes mandatory or 4.4 of appendix J1 upon the date that appendix J1 to this subpart becomes mandatory. The result shall be rounded off to the nearest 0.01 cubic foot per kilowatt-hours.

(3) Other useful measures of energy consumption for automatic or semi-automatic clothes washers shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of appendix J before the date that appendix J1 becomes mandatory or appendix J1 upon the date that appendix J1 to this subpart becomes mandatory. In addition, the annual water consumption of a clothes washer can be determined by the product of:

(A) The representative average-use of 392 cycles per year, and

(B) The total weighted per-cycle water consumption in gallons per cycle determined according to 4.3.2 of appendix J before the date that appendix J1 becomes mandatory or 4.2.2 of appendix J1 upon the date that appendix J1 to this subpart becomes mandatory. The water consumption factor can be determined in accordance with 4.3.3 of appendix J before the date that appendix J1 becomes mandatory or 4.2.3 of appendix J1 upon the date that appendix J1 to this subpart becomes mandatory. The remaining moisture content can be determined in accordance with 3.3 of appendix J before the date that appendix J1 becomes mandatory or 3.8 of appendix J1 upon the date that appendix J1 to this subpart becomes mandatory.

3. Appendix J to Subpart B of Part 430 is revised 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

The procedures and calculations in sections 3.3, 4.3, and 4.4 of this Appendix need not be performed to determine compliance with the energy conservation standards for clothes washers.

1. DEFINITIONS

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

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

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

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

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

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

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

1.7 *Front-loader clothes washer* means a clothes washer which sequentially rotates or tumbles portions of the clothes load above the water level allowing the clothes load to fall freely back into the water. The principal axis of the clothes container is in a horizontal plane and the access to the clothes container is through the front of the machine.

1.8 *Lockout* means that at least one wash/rinse water temperature combination is not available in the normal cycle that is available in another cycle on the machine.

1.9 *Make-up water* means the amount of fresh water needed to supplement the amount of stored water pumped from the external laundry tub back into the clothes washer when the suds-return feature is activated in order to achieve the required water fill level in the clothes washer.

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

1.11 *Most energy intensive cycle* means the non-normal cycle that uses the most energy for a given wash/rinse temperature combination.

1.12 *Non-normal cycle* means a cycle other than the normal cycle, but does not include any manually selected pre-wash, pre-soak, and extra-rinse option.

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

1.14 *Normal cycle* means the cycle recommended by the manufacturer for washing cotton and/or linen clothes.

1.15 *Sensor filled* means a water fill control which automatically terminates the fill when the water reaches an appropriate level in the tub.

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

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

1.18 *Suds-return* means a feature or option on a clothes washer which causes the stored wash water obtained by utilizing the suds-saver feature to be pumped from the external laundry tub back into the clothes washer.

1.19 *Suds-saver* means a feature or option on a clothes washer which allows the user to store used wash water in an external laundry tub for use with subsequent wash loads.

1.20 *Temperature use factor* means the percentage of the total number of washes a user would wash with a particular wash/rinse temperature setting.

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

1.22 *Time filled* means a water fill control which uses a combination of water flow controls in conjunction with time to terminate the water fill cycle.

1.23 *Top-loader-horizontal-axis clothes washer* means a clothes washer which: rotates or tumbles portions of the clothes load above the water level allowing the clothes load to fall freely back into the water with the principal axis in a horizontal plane and has access to the clothes container through the top of the clothes washer.

1.24 *Top-loader-vertical-axis clothes washer* means a clothes washer that: flexes and oscillates the submerged clothes load through the water by means of mechanical agitation or other movement; has a clothes container with the principal axis in a vertical plane; and has access to the clothes container through the top of the clothes washer.

1.25 *Water consumption factor* means the quotient of the total weighted per-cycle water consumption divided by the capacity of the clothes washer.

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

2. TESTING CONDITIONS

2.1 *Installation.* Install the clothes washer in accordance with manufacturer's instructions.

2.2 *Electrical energy supply.* 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 as specified by the manufacturer. If the clothes washer has a dual voltage conversion capability, conduct the test at the highest voltage specified by the manufacturer.

2.3 *Supply water.* For nonwater-heating clothes washers not equipped with thermostatically controlled water valves, the temperature of the hot and cold water supply shall be maintained at 100°F±10°F (37.8°C±5.5°C). For nonwater-heating clothes washers equipped with thermostatically controlled water valves, the temperature of the hot water supply shall be maintained at 140°F±5°F (60.0°C±2.8°C) and the cold water supply shall be maintained at 60°F±5°F (15.6°C±2.8°C). For water-heating clothes washers, the temperature of the hot water supply shall be maintained at 140°F±5°F (60.0°C±2.8°C) and the cold water supply shall not exceed 60°F (15.6°C). Water meters shall be installed in both the hot and cold water lines to measure water consumption.

2.4 *Water pressure.* The static water pressure at the hot and cold water inlet connections of the machine shall be maintained during the test at 35 pounds per square inch gauge (psig)±2.5 psig (241.3 kPa±17.2 kPa). The static water pressure for a single water inlet connection shall be maintained during the test at 35 psig±2.5 psig (241.3 kPa±17.2 kPa). Water pressure gauges shall be installed in both the hot and cold water lines to measure water pressure.

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

2.5.1 *Weighing scales.*

2.5.1.1 *Weighing scale for test cloth.* The scale shall have a resolution 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 measurements.* The scale should have a resolution no larger than 0.50 lbs (0.23 kg) and a maximum error no greater than 0.5 percent of the measured value.

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

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

2.5.4 *Water meter.* The water meter shall have a resolution no larger than 0.1 gallons (0.4 liters) and a maximum error no greater than 2 percent for all water flow rates from 1 gal/min (3.8 L/min) to 5 gal/min (18.9 L/min).

2.5.5 *Water pressure gauge.* The water pressure gauge shall have a resolution no larger than 1 psig (6.9 kPa) and shall have an error no greater than 5 percent of any measured value over the range of 32.5 psig (224.1 kPa) to 37.5 psig (258.6 kPa).

2.6 *Test cloths.*

2.6.1 *Energy test cloth.* The energy test cloth shall be clean and consist of the following:

2.6.1.1 Pure finished bleached cloth, made with a momie or granite weave, which is 50 percent cotton and 50 percent polyester and weighs 5.75 oz/yd^2 (195.0 g/m^2) and has 65 ends on the warp and 57 picks on the fill.

2.6.1.2 Cloth material that is 24 in by 36 in (61.0 cm by 91.4 cm) and has been hemmed to 22 in by 34 in (55.9 cm by 86.4 cm) before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width.

2.6.1.3 The number of test runs on the same energy test cloth shall not exceed 25 runs.

2.6.2 *Energy stuffer cloths.* The energy stuffer cloths shall be made from energy test cloth material and shall consist of pieces of material that are 12 in by 12 in (30.5 cm by 30.5 cm) and have been hemmed to 10 in by 10 in (25.4 cm by 25.4 cm) before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width. The number of test runs on the same energy stuffer cloth shall not exceed 25 runs.

2.7 *Composition of test loads.*

2.7.1 *Seven pound test load.* The seven pound test load shall consist of bone-dry energy test cloths which weigh 7 lbs ±0.07 lbs (3.18 kg ±0.03 kg). Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths.

2.7.2 *Three pound test load.* The three pound test load shall consist of bone-dry energy test cloths which weigh 3 lbs ±0.03 lbs (1.36 kg ±0.014 kg). Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths.

2.8 *Use of test loads.*

2.8.1 For a standard size clothes washer, a seven pound load, as described in section 2.7.1, shall be used to test the maximum water fill and a three pound test load, as described in section 2.7.2, shall be used to test the minimum water fill.

2.8.2 For a compact size clothes washer, a three pound test load as described in section 2.7.2 shall be used to test the maximum and minimum water fill levels.

2.8.3 A vertical-axis clothes washer without adaptive water fill control system also shall be tested without a test load for purposes of calculating the energy factor.

2.8.4 The test load sizes to be used to measure remaining moisture content (RMC) are specified in section 3.3.2.

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

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

2.10 *Wash time setting.* The actual wash time (period of agitation) shall be not less than 9.75 minutes.

2.11 *Agitation and spin speed settings.* Where controls are provided for agitation and spin speed selections, set them as follows:

2.11.1 For energy and water consumption tests, set at the normal cycle settings. If settings at the normal cycle are not offered, set the control settings to the maximum levels permitted on the clothes washer.

2.11.2 For remaining moisture content tests, see section 3.3.

3. TEST MEASUREMENTS

3.1 *Clothes container capacity.* Measure the entire volume which a dry clothes load could occupy within the clothes container during washer operation according to sections 3.1.1 through 3.1.5.

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.

3.1.2 Line the inside of the clothes container with 2 mil (0.051 mm) plastic sheet. All clothes washer components which

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

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

3.1.4 Fill the clothes container manually with either 60°F ±5°F (15.6°C ±2.8°C) or 100°F ±10°F (37.8°C ±5.5°C) water to its uppermost edge. Measure and record the weight of water, W, in pounds.

3.1.5 The clothes container capacity is calculated as follows:

$C=W/d$.

where:

C=Capacity in cubic feet (or liters).
W=Mass of water in pounds (or 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)).

3.2 *Test cycle.* Establish the test conditions set forth in section 2 of this Appendix.

3.2.1 A clothes washer that has infinite temperature selections shall be tested at the following temperature settings: hottest setting available on the machine, hot (a minimum of 140°F (60.0°C) and a maximum of 145°F (62.8°C)), warm (a minimum of 100°F (37.8°C) and a maximum of 105°F (40.6°C)), and coldest setting available on the machine. These temperatures must be confirmed by measurement using a temperature measuring device. If the measured final water temperature is not within the specified range, stop testing, adjust the temperature selector accordingly, and repeat the procedure.

3.2.2 *Clothes washers with adaptive water fill control system and/or unique temperature selections.*

3.2.2.1 *Clothes washers with adaptive water fill control system.* When testing a clothes washer that has adaptive water fill control, the maximum and the minimum test loads as specified in 2.8.1 and 2.8.2 shall be used. The amount of water fill shall be determined by the control system. If the clothes washer provides consumer selection of variable water fill amounts for the adaptive water fill control system, two complete sets of tests shall be conducted. The first set of tests shall be conducted with the adaptive water fill control system set in the setting that will use the greatest amount of energy. The second set of tests shall be conducted with the adaptive water fill control system set in the setting that will use the smallest amount of energy. Then, the results from these two tests shall be averaged to determine the adaptive water fill energy consumption value. If a clothes washer with an adaptive water fill control system allows consumer selection of manual controls as an alternative, both the manual and adaptive modes shall be tested and the energy consumption values, E_T, M_E, and D_E (if desired), calculated in section 4 for each mode, shall be averaged between the manual and adaptive modes.

3.2.2.2 *Clothes washers with multiple warm wash temperature combination selections.*

3.2.2.2.1 If a clothes washer's temperature combination selections are such that the temperature of each warm wash setting that is above the mean warm wash temperature (the mean temperature of the coldest and warmest warm settings) is matched by a warm wash setting that is an equal distance below the mean, then the energy test shall be conducted at the mean warm wash temperature if such a selection is provided, or if there is no position on the control that permits selection of the mean temperature, the energy test shall be conducted with the temperature selection set at the next hotter temperature setting that is available above the mean.

3.2.2.2.2 If the multiple warm wash temperature combination selections do not meet criteria in section 3.2.2.2.1, the energy test shall be conducted with the temperature selection set at the warm wash temperature setting that gives the next higher water temperature than the mean temperature of the coldest and warmest warm settings.

3.2.2.3 *Clothes washers with multiple temperature settings within a temperature combination selection.* When a clothes washer is provided with a secondary control that can modify the wash or rinse temperature within a temperature combination selection, the secondary control shall be set to provide the hottest wash temperature available and the hottest rinse temperature available. For instance, when the temperature combination selection is set for the middle warm wash temperature and a secondary control exists which allows this temperature to be increased or decreased, the secondary control shall be set to provide the hottest warm wash temperature available for the middle warm wash setting.

3.2.3 *Clothes washers that do not lockout any wash/rinse temperature combinations in the normal cycle.* Test in the normal cycle all temperature combination selections that are required to be tested.

3.2.3.1 *Hot water consumption, cold water consumption, and electrical energy consumption at maximum fill.* Set the water level selector at maximum fill available on the clothes washer, if manually controlled, and insert the appropriate test load, if applicable. Activate the normal cycle of the clothes washer and also any suds-saver switch.

3.2.3.1.1 For automatic clothes washers, set the wash/rinse temperature selector to the hottest temperature combination setting. For semi-automatic clothes washers, open the hot water faucet valve completely and close the cold water faucet valve completely to achieve the hottest temperature combination setting.

3.2.3.1.2 Measure the electrical energy consumption of the clothes washer for the complete cycle.

3.2.3.1.3 Measure the respective number of gallons (or liters) of hot and cold water used to fill the tub for the wash cycle.

3.2.3.1.4 Measure the respective number of gallons (or liters) of hot and cold water used for all deep rinse cycles.

3.2.3.1.5 Measure the respective gallons (or liters) of hot and cold water used for all spray rinse cycles.

3.2.3.1.6 For non-water-heating automatic clothes washers repeat sections 3.2.3.1.3 through 3.2.3.1.5 for each of the other wash/rinse temperature selections available that uses heated water and is required to be tested. For water-heating clothes washers, repeat sections 3.2.3.1.2 through 3.2.3.1.5 for each of the other wash/rinse temperature selections available that uses heated water and is required to be tested. (When calculating water consumption under section 4.3 for any machine covered by the previous two sentences, also test the cold wash/cold rinse selection.) For semi-automatic clothes washers, repeat sections 3.2.3.1.3 through 3.2.3.1.5 for the other wash/rinse temperature settings in section 6 with the following water faucet valve adjustments:

	Faucet position	
	Hot valve	Cold valve
Hot	Completely open	Closed.
Warm	Completely open	Completely open.
Cold	Closed	Completely open.

3.2.3.1.7 If the clothes washer is equipped with a suds-saver cycle, repeat sections 3.2.3.1.2 to 3.2.3.1.5 with suds-saver switch set to suds return for the Warm/Cold temperature setting.

3.2.3.2 *Hot water consumption, cold water consumption, and electrical energy consumption with the water level selector at minimum fill.* Set the water level selector at minimum fill, if manually controlled, and insert the appropriate test load, if applicable. Activate the normal cycle of the clothes washer and also any suds-saver switch. Repeat sections 3.2.3.1.1 through 3.2.3.1.7.

3.2.3.3 *Hot and cold water consumption for clothes washers that incorporate a partial fill during the rinse cycle.* For clothes washers that incorporate a partial fill during the rinse cycle, activate any suds-saver switch and operate the clothes washer for the complete normal cycle at both the maximum water fill level and the minimum water fill level for each of the wash/rinse temperature selections available. Measure the respective hot and cold water consumed during the complete normal cycle.

3.2.4 *Clothes washers that lockout any wash/rinse temperature combinations in the normal cycle.* In addition to the normal cycle tests in section 3.2.3, perform the following

tests on non-normal cycles for each wash/rinse temperature combination selection that is locked out in the normal cycle.

3.2.4.1 Set the cycle selector to a non-normal cycle which has the wash/rinse temperature combination selection that is locked out. Set the water level selector at maximum fill and insert the appropriate test load, if applicable. Activate the cycle of the clothes washer and also any suds-saver switch. Set the wash/rinse temperature selector to the temperature combination setting that is locked out in the normal cycle and repeat sections 3.2.3.1.2 through 3.2.3.1.5.

3.2.4.2 Repeat section 3.2.4.1 under the same temperature combination setting for all other untested non-normal cycles on the machine that have the wash/rinse temperature combination selection that is locked out.

3.2.4.3 Total the measured hot water consumption of the wash, deep rinse, and spray rinse of each non-normal cycle tested in sections 3.2.4.1 through 3.2.4.2 and compare the total for each cycle. The cycle that has the highest hot water consumption shall be the most energy intensive cycle for that particular wash/rinse temperature combination setting.

3.2.4.4 Set the water level selector at minimum fill and insert the appropriate test load, if applicable. Activate the most energy intensive cycle, as determined in section 3.2.4.3, of the clothes washer and also any suds-saver switch. Repeat tests as described in section 3.2.4.1.

3.3 *Remaining Moisture Content (RMC).*

3.3.1 The wash temperature shall be the same as the rinse temperature for all testing.

3.3.2 Determine the test load as shown in the following table:

Container volume		Test load	
cu. ft. ≥ <	liter ≥ <	lb	kg
0–0.80	0–22.7	3.00	1.36
0.80–0.90	22.7–25.5	3.50	1.59
0.90–1.00	25.5–28.3	3.90	1.77
1.00–1.10	28.3–31.1	4.30	1.95
1.10–1.20	31.1–34.0	4.70	2.13
1.20–1.30	34.0–36.8	5.10	2.31
1.30–1.40	36.8–39.6	5.50	2.49
1.40–1.50	39.6–42.5	5.90	2.68
1.50–1.60	42.5–45.3	6.40	2.90
1.60–1.70	45.3–48.1	6.80	3.08
1.70–1.80	48.1–51.0	7.20	3.27
1.80–1.90	51.0–53.8	7.60	3.45
1.90–2.00	53.8–56.6	8.00	3.63
2.00–2.10	56.6–59.5	8.40	3.81
2.10–2.20	59.5–62.3	8.80	3.99
2.20–2.30	62.3–65.1	9.20	4.17
2.30–2.40	65.1–68.0	9.60	4.35
2.40–2.50	68.0–70.8	10.00	4.54
2.50–2.60	70.8–73.6	10.50	4.76
2.60–2.70	73.6–76.5	10.90	4.94
2.70–2.80	76.5–79.3	11.30	5.13
2.80–2.90	79.3–82.1	11.70	5.31
2.90–3.00	82.1–85.0	12.10	5.49
3.00–3.10	85.0–87.8	12.50	5.67
3.10–3.20	87.8–90.6	12.90	5.85
3.20–3.30	90.6–93.4	13.30	6.03
3.30–3.40	93.4–96.3	13.70	6.21
3.40–3.50	96.3–99.1	14.10	6.40
3.50–3.60	99.1–101.9	14.60	6.62
3.60–3.70	101.9–104.8	15.00	6.80
3.70–3.80	104.8–107.6	15.40	6.99

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

3.3.3 For clothes washers with cold rinse only.

3.3.3.1 Record the actual bone dry weight of the test load (WI), then place the test load in the clothes washer.

3.3.3.2 Set water level selector to maximum fill.

3.3.3.3 Run the normal cycle.

3.3.3.4 Record the weight of the test load immediately after completion of the normal cycle (WC).

3.3.3.5 Calculate the remaining moisture content of the test load, RMC, expressed as a percentage and defined as:

$$RMC=[(WC-WI)/WI]\times 100\%$$

3.3.4 For clothes washers with cold and warm rinse options.

3.3.4.1 Complete steps 3.3.3.1 through 3.3.3.4 for the cold rinse. Calculate the remaining moisture content of the test load for cold rinse, RMC_{COLD}, expressed as a percentage and defined as:

$$RMC_{COLD}=[(WC-WI)/WI]\times 100\%$$

3.3.4.2 Complete steps 3.3.3.1 through 3.3.3.4 for the warm rinse. Calculate the remaining moisture content of the test load for warm rinse, RMC_{WARM}, expressed as a percentage and defined as:

$$RMC_{WARM}=[(WC-WI)/WI]\times 100\%$$

3.3.4.3 Calculate the remaining moisture content of the test load, RMC, expressed as a percentage and defined as:

$$RMC=0.73\times RMC_{COLD}+0.27\times RMC_{WARM}$$

3.3.5 Clothes washers which have options that result in different RMC values, such as multiple selection of spin speeds or spin times that are available in the normal cycle, shall be tested at the maximum and minimum settings of the available options, excluding any ''no spin'' (zero spin speed) settings, in accordance with requirements in 3.3.3 or 3.3.4. The calculated $RMC_{max\ extraction}$ and $RMC_{min\ extraction}$ at the maximum and minimum settings, respectively, shall be combined as follows and the final RMC to be used in section 4.2 shall be:

$$RMC=0.75\times RMC_{max\ extraction}+0.25\times RMC_{min\ extraction}$$

3.4 *Data recording.* Record for each test cycle in sections 3.2.1 through 3.3.5.

3.4.1 For non-water-heating clothes washers, record the kilowatt-hours of electrical energy, M_E, consumed during the test to operate the clothes washer in section

3.2.3.1.2. For water-heating clothes washers record the kilowatt-hours of electrical energy, Eh_i consumed at maximum fill in sections 3.2.3.1.2 and 3.2.3.1.6, and Eh_j consumed at minimum fill in section 3.2.3.2.

3.4.2 Record the individual gallons (or liters) of hot and cold water consumption, Vh_i and Vc_i, measured at maximum fill level for each wash/rinse temperature combination setting tested in section 3.2.3, or in both 3.2.3 and 3.2.4, excluding any fresh make-up water required to complete the fill during a suds-return cycle.

3.4.3 Record the individual gallons (or liters) of hot and cold water consumption, Vh_j and Vc_j, measured at minimum fill level for each wash/rinse temperature combination setting tested in section 3.2.3, or in both 3.2.3 and 3.2.4, excluding any fresh make-up water required to complete the fill during a suds-return cycle.

3.4.4 Record the individual gallons (or liters) of hot and cold water, Sh_H and Sc_H, measured at maximum fill for the suds-return cycle.

3.4.5 Record the individual gallons (or liters) of hot and cold water, Sh_L and Sc_L, measured at minimum fill for the suds-return cycle.

3.4.6 Data recording requirements for RMC tests are listed in sections 3.3.3 through 3.3.5.

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 *Energy consumption.*

4.1.1 *Per-cycle temperature-weighted hot water consumption for maximum and minimum water fill levels.* Calculate for the cycle under test the per-cycle temperature weighted hot water consumption for the maximum water fill level, Vh_{max}, and for the minimum water fill level, Vh_{min}, expressed in gallons per cycle (or liters per cycle) and defined as:

$$Vh_{max} = X_1 \sum_{i=1}^{n} \left[\left(Vh_i \times L \right) \times TUF_i \right] + X_2 \left[TUF_W \times Sh_H \right]$$

$$Vh_{min} = X_1 \sum_{j=1}^{n} \left[\left(Vh_j \times L \right) \times TUF_j \right] + X_2 \left[TUF_W \times Sh_L \right]$$

where:

Vh_i=reported hot water consumption in gallons per cycle (or liters per cycle) at maximum fill for each wash/rinse temperature combination setting, as provided in section 3.4.2. If a clothes washer is equipped with two or more different wash/rinse temperature selections that have the same basic temperature combination selection label (for example, one of them has its water temperature controlled by thermostatically controlled valves and the other one does not), then the largest Vh_i shall be used for this calculation. If a clothes washer has lockout(s), there will be ''Vh_i's'' for wash/rinse temperature combination settings available in the normal cycle and ''Vh_i's'' for wash/rinse temperature combination settings in the most energy intensive cycle.

Vh_j=reported hot water consumption in gallons per cycle (or liters per cycle) at minimum fill for each wash/rinse temperature combination setting, as provided in section 3.4.3. If a clothes washer is equipped with two or more different wash/rinse temperature selections that have the same basic temperature combination selection label (for example, one of them has its water temperature controlled by thermostatically controlled valves and the other one does not), then the largest Vh_j shall be used for the calculation. If a clothes washer has lockouts, there will be ''Vh_j's'' for wash/rinse temperature combination settings available in the normal cycle and ''Vh_j's'' for wash/rinse temperature combination settings in the most energy intensive cycle.

L=lockout factor to be applied to the reported hot water consumption. For wash/rinse temperature combination settings that are not locked out in the normal cycle, L=1. For each wash/rinse temperature combination setting that is locked out in the normal cycle, L=0.32 in the normal cycle and L=0.68, in the most energy intensive cycle.

TUF_i=applicable temperature use factor in section 5 or 6.

TUF_j=applicable temperature use factor in section 5 or 6.

n=number of wash/rinse temperature combination settings available to the user for the clothes washer under test. For clothes washers that lockout temperature selections in the normal cycle, n=the number of wash/rinse temperature combination settings on the washers plus the number of wash/rinse temperature combination settings that lockout the temperature selections in the normal cycle.

TUF_w=temperature use factor for warm wash setting.

For clothes washers equipped with the suds-saver feature:

X_1=frequency of use without the suds-saver feature=0.86.

X_2=frequency of use with the suds-saver feature=0.14.

Sh_H=fresh make-up water measured during suds-return cycle at maximum water fill level.

Sh_L=fresh hot make-up water measured during suds-return cycle at minimum water fill level.

For clothes washers not equipped with the suds-saver feature:

X_1=1.0

X_2=0.0

4.1.2 *Total per-cycle hot water energy consumption for maximum and minimum water fill levels.* Calculate the total per-cycle hot water energy consumption for the maximum water fill level, E_{max} and for the minimum water fill level, E_{min}, expressed in kilowatt-hours per cycle and defined as:

$E_{max}=[Vh_{max} \times T \times K \times MF]$

$E_{min}=[Vh_{min} \times T \times K \times MF]$

where:

T=temperature rise=90°F (50°C).

K=water specific heat=0.00240 kWh/(gal–°F) [0.00114kWh/(L–°C)].

Vh_{max}=as defined in section 4.1.1.

Vh_{min}=as defined in section 4.1.1.

MF=multiplying factor to account for absence of test load=0.94 for top-loader vertical axis clothes washers that are sensor filled, 1.0 for all other clothes washers.

4.1.3 *Total weighted per-cycle hot water energy consumption expressed in kilowatt-hours.* Calculate the total weighted per cycle hot water energy consumption, E_T, expressed in kilowatt-hours per cycle and defined as:

$E_T=[E_{max} \times F_{max}]+[E_{min} \times F_{min}]$

where:

F_{max}=usage fill factor=0.72.

F_{min}=usage fill factor=0.28.

E_{max}=as defined in section 4.1.2.

E_{min}=as defined in section 4.1.2.

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

$$E_{TG} = E_T \times \frac{1}{e} \times \left[\frac{3412 \text{ Btu}}{\text{kWh}} \right] \text{ or } E_{TG} = E_T \times \frac{1}{e} \times \left[\frac{3.6 \text{ MJ}}{\text{kWh}} \right]$$

where:
e=nominal gas or oil water heater efficiency=0.75.
E_T=as defined in section 4.1.3.

4.1.5 *Per-cycle machine electrical energy consumption.*

4.1.5.1 *Non-water-heating clothes washers.* The electrical energy value recorded for the maximum fill in section 3.4.1 is the per-cycle machine electrical energy consumption, M_E, expressed in kilowatt-hours per cycle.

4.1.5.2 *Water-heating clothes washers.*

4.1.5.2.1 Calculate for the cycle under test the per-cycle temperature weighted electrical energy consumption for the maximum water fill level, Eh_{max}, and for the minimum water fill level, Eh_{min}, expressed in kilowatt-hours per cycle and defined as:

$$Eh_{max} = \sum_{i=1}^{n}\left[Eh_i \times TUF_i\right]$$

where:
Eh_i=reported electrical energy consumption in kilowatt-hours per cycle at maximum fill for each wash/cycle temperature combination setting, as provided in section 3.4.1.
TUF_i=applicable temperature use factor in section 5 or 6.
n=number of wash/rinse temperature combination settings available to the user for the clothes washer under test.

and

$$Eh_{min} = \sum_{j=1}^{n}\left[Eh_j \times TUF_j\right]$$

where:
Eh_j=reported electrical energy consumption in kilowatt-hours per cycle at minimum fill for each wash/rinse temperature combination setting, as provided in section 3.4.1.
TUF_j=applicable temperature use factor in section 5 or 6.
n=as defined above in this section.

4.1.5.2.2 *Weighted per-cycle machine electrical energy consumption.* Calculate the weighted per cycle machine energy consumption, M_E, expressed in kilowatt-hours per cycle and defined as:

$M_E=[Eh_{max}\times F_{max}]+[Eh_{min}\times F_{min}]$

where:
F_{max}=as defined in section 4.1.3.
F_{min}=as defined in section 4.1.3.
Eh_{max}=as defined in section 4.1.5.2.1.
Eh_{min}=as defined in section 4.1.5.2.1

4.1.6 *Total per-cycle energy consumption when electrically heated water is used.* Calculate for the normal cycle the total per-cycle energy consumption, E_{TE}, using electrically heated water, expressed in kilowatt-hours per cycle and defined as:

$E_{TE}=E_T+M_E$

where:
E_T=as defined in section 4.1.3.
M_E=as defined in section 4.1.5.1 or 4.1.5.2.2.

4.2 *Per-cycle energy consumption for removal of RMC.* Calculate the amount of energy per cycle required to remove RMC. Such amount is D_E, expressed in kilowatt-hours per cycle and defined as:

D_E=(LAF)×(test load weight)×(RMC − 4%)×(DEF)×(DUF)

where:
LAF=load adjustment factor=0.52.
Test load weight=as shown in test load table in 3.3.2 expressed in lbs/cycle.
RMC=as defined in 3.3.3.5, 3.3.4.3, or 3.3.5.
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=0.84.

4.3 *Water consumption.*

4.3.1 *Per-cycle temperature-weighted water consumption for maximum and minimum water fill levels.* To determine these amounts, calculate for the cycle under test the per-cycle temperature-weighted total water consumption for the maximum water fill level, Q_{max}, and for the minimum water fill level, Q_{min}, expressed in gallons per cycle (or liters per cycle) and defined as:

$$Q_{max} = X_1\sum_{i=1}^{n}\left[\left(Vh_i + Vc_i\right)\times TUF_i\right] + X_2\left[TUF_w \times \left(Sh_H + Sc_H\right)\right]$$

where:
Vh_i=hot water consumption in gallons per-cycle at maximum fill for each wash/rinse temperature combination setting, as provided in section 3.4.2.
Vc_i=total cold water consumption in gallons per-cycle at maximum fill for each wash/rinse temperature combination setting, cold wash/cold rinse cycle, as provided in section 3.4.2.
TUF_i=applicable temperature use factor in section 5 or 6.
n=number of wash/rinse temperature combination settings available to the user for the clothes washer under test.
TUF_w=temperature use factor for warm wash setting.

For clothes washers equipped with suds-saver feature:

X_1=frequency of use without suds-saver feature=0.86
X_2=frequency of use with suds-saver feature=0.14
Sh_H=fresh hot water make-up measured during suds-return cycle at maximum water fill level.
Sc_H=fresh cold water make-up measured during suds-return cycle at maximum water fill level.

For clothes washers not equipped with suds-saver feature:

X_1=1.0
X_2=0.0

and

$$Q_{min} = X_1\sum_{j=1}^{n}\left[\left(Vh_j + Vc_j\right)\times TUF_j\right] + X_2\left[TUF_w \times \left(Sh_L + Sc_L\right)\right]$$

where:
Vh_j=hot water consumption in gallons per cycle (or liters per cycle) at minimum fill for each wash/rinse temperature combination setting, as provided in section 3.4.3.
Vc_j=cold water consumption in gallons per cycle (or liters per cycle) at minimum fill for each wash/rinse temperature combination setting, cold wash/cold rinse cycle, as provided in section 3.4.3.
TUF_j=applicable temperature use factor in section 5 or 6.
Sh_L=fresh hot make-up water measured during suds-return cycle at minimum water fill level.
Sc_L=fresh cold make-up water measured during suds-return cycle at minimum water fill level.
n=as defined above in this section.
TUF_w=as defined above in this section.
X_1=as defined above in this section.
X_2=as defined above in this section.

4.3.2 *Total weighted per-cycle water consumption.* To determine this amount, calculate the total weighted per cycle water consumption, Q_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Q_T=[Q_{max}\times F_{max}]+[Q_{min}\times F_{min}]$

where:
F_{max}=as defined in section 4.1.3.
F_{min}=as defined in section 4.1.3.
Q_{max}=as defined in section 4.3.1.
Q_{min}=as defined in section 4.3.1.

4.3.3 *Water consumption factor.* The following calculates the water consumption factor, WCF, expressed in gallon per cycle per cubic foot (or liter per cycle per liter):

$WCF=Q_T/C$

where:

C=as defined in section 3.1.5.
Q_T=as defined in section 4.3.2.

4.4 *Modified energy factor.* The following calculates the modified energy factor, MEF, expressed in cubic feet per kilowatt-hours per cycle (or liters per kilowatt-hours per cycle):

$$MEF = \frac{C}{(M_E + E_T + D_E)}$$

where:
C=as defined in section 3.1.5.
M_E=as defined in section 4.1.5.1 or 4.1.5.2.2.
E_T=as defined in section 4.1.3.
D_E=as defined in section 4.2.

4.5 *Energy factor.* Calculate the energy factor, EF, expressed in cubic feet per kilowatt-hours per cycle (or liters per kilowatt-hours per cycle), as:

$$EF = \frac{C}{(M_E + E_T)}$$

where:
C=as defined in section 3.1.5.
M_E=as defined in section 4.1.5.1 or 4.1.5.2.2.
E_T=as defined in section 4.1.3.

5. APPLICABLE TEMPERATURE USE FACTORS FOR DETERMINING HOT WATER USAGE FOR VARIOUS WASH/RINSE TEMPERATURE SELECTIONS FOR ALL AUTOMATIC CLOTHES WASHERS

5.1 *Clothes washers with discrete temperature selections.*

5.1.1 *Five-temperature selection (n=5).*

Wash/rinse temperature setting	Temperature Use Factor (TUF)
Hot/Warm	0.18
Hot/Cold	.12
Warm/Warm	.30
Warm/Cold	.25
Cold/Cold	.15

5.1.2 *Four-temperature selection (n=4).*

Wash/rinse temperature setting	Temperature Use Factor (TUF)
Alternate I:	
Hot/Warm	0.18
Hot/Cold	.12
Warm/Cold	.55
Cold/Cold	.15
Alternate II:	
Hot/Warm	0.18
Hot/Cold	.12
Warm/Warm	.30
Warm/Cold	.40
Alternate III:	
Hot/Cold	0.12
Warm/Warm	.18
Warm/Cold	.55
Cold/Cold	.15

5.1.3 *Three-temperature selection (n=3).*

Wash/rinse temperature setting	Temperature Use Factor (TUF)
Alternate I:	
Hot/Warm	0.30
Warm/Cold	.55
Cold/Cold	.15
Alternate II:	
Hot/Cold	0.30
Warm/Cold	.55
Cold/Cold	.15
Alternate III:	
Hot/Cold	0.30
Warm/Warm	.55
Cold/Cold	.15

5.1.4 *Two-temperature selection (n=2).*

Wash/rinse temperature setting	Temperature Use Factor (TUF)
Any heated water/Cold	0.85
Cold/Cold	.15

5.1.5 *One-temperature selection (n=1).*

Wash/rinse temperature setting	Temperature Use Factor (TUF)
Any	1.00

5.2 *Clothes washers with infinite temperature selections.*

Wash/rinse temperature setting	Temperature Use Factor (TUF)	
	≤ 140°F (60°C) (n=3)	> 140°F (60°C) (n=4)
Extra-hot	.....	0.05
Hot	0.30	0.25
Warm	0.55	0.55
Cold	0.15	0.15

6. APPLICABLE TEMPERATURE USE FACTORS FOR DETERMINING HOT WATER USAGE FOR VARIOUS WASH/RINSE TEMPERATURE SETTINGS FOR ALL SEMI-AUTOMATIC, NON-WATER-HEATING, CLOTHES WASHERS

6.1 *Six-temperature settings (n=6).*

Wash/rinse temperature setting	Temperature Use Factor (TUF)
Hot/Hot	0.15
Hot/Warm	.09
Hot/Cold	.06
Warm/Warm	.42
Warm/Cold	.13
Cold/Cold	.15

7. WAIVERS AND FIELD TESTING

7.1 *Waivers and Field Testing for Non-conventional Clothes Washers.* Manufacturers of non-conventional clothes washers, such as clothes washers with adaptive control systems, must submit a petition for waiver pursuant to 10 CFR 430.27 to establish an acceptable test procedure for that clothes washer. For these and other clothes washers that have controls or systems such that the DOE test procedures yield results that are so unrepresentative of the clothes washer's true energy consumption characteristics as to provide materially inaccurate comparative data, field testing may be appropriate for establishing an acceptable test procedure. The following are guidelines for field testing which may be used by manufacturers in support of petitions for waiver. These guidelines are not mandatory and the Department may determine that they do not apply to a particular model. Depending upon a manufacturer's approach for conducting field testing, additional data may be required. Manufacturers are encouraged to communicate with the Department prior to the commencement of field tests which may be used to support a petition for waiver. Section 7.3 provides an example of field testing for a clothes washer with an adaptive water fill control system. Other features, such as the use of various spin speed selections, could be the subject of field tests.

7.2 *Non-conventional Wash System Energy Consumption Test.* The field test may consist of a minimum of 10 of the nonconventional clothes washers (''test clothes washers'') and 10 clothes washers already being distributed in commerce (''base clothes washers''). The tests should include a minimum of 50 normal test cycles per clothes washer. The test clothes washers and base clothes washers should be identical in construction except for the controls or systems being tested. Equal numbers of both the test clothes washer and the base clothes washer should be tested simultaneously in comparable settings to minimize seasonal and/or consumer laundering conditions and/or variations. The clothes washers should be monitored in such a way as to accurately record the total energy consumption per cycle. At a minimum, the following should be measured and recorded throughout the test period for each clothes washer: Hot water usage in gallons (or liters), electrical energy usage in kilowatt-hours, and the cycles of usage. The field test results would be used to determine the best method to correlate the rating of the test clothes washer to the rating of the base clothes washer. If the base clothes washer is rated at A kWh per year, but field tests at B kWh per year, and the test clothes washer field tests at D kWh per year, the test unit would be rated as follows:

A×(D/B)=G kWh per year

7.3 *Adaptive water fill control system field test.* Section 3.2.2.1 defines the test method for measuring energy consumption for clothes washers which incorporate control systems having both adaptive and alternate manual selections. Energy consumption calculated by the method defined in section 3.2.2.1 assumes the adaptive cycle will be used 50 percent of the time. This section can be used to develop field test data in support of a petition for waiver when it is believed that the adaptive cycle will be used more than 50 percent of the time. The field test sample size should be a minimum of 10 test clothes washers. The test clothes washers should be totally representative of the design, construction,

and control system that will be placed in commerce. The duration of field testing in the user's house should be a minimum of 50 normal test cycles, for each unit. No special instructions as to cycle selection or product usage should be given to the field test participants, other than inclusion of the product literature pack which should be shipped with all units, and instructions regarding filling out data collection forms, use of data collection equipment, or basic procedural methods. Prior to the test clothes washers being installed in the field test locations, baseline data should be developed for all field test units by conducting laboratory tests as defined by section 1 through section 6 of these test procedures to determine the energy consumption values. The following data should be measured and recorded for each wash load during the test period: wash cycle selected, the mode of the clothes washer (adaptive or manual), clothes load dry weight (measured after the clothes washer and clothes dryer cycles are completed) in pounds, and type of articles in the clothes load (i.e., cottons, linens, permanent press, etc.). The wash loads used in calculating the in-home percentage split between adaptive and manual cycle usage should be only those wash loads which conform to the definition of the normal test cycle.

Calculate:

T=The total number of normal test cycles run during the field test

T_a=The total number of adaptive control normal test cycles

T_m=The total number of manual control normal test cycles

The percentage weighting factors:

$P_a=(T_a/T) \times 100$ (the percentage weighting for adaptive control selection)

$P_m=(T_m/T) \times 100$ (the percentage weighting for manual control selection)

Energy consumption values, E_T, M_E, and D_E (if desired) calculated in section 4 for the manual and adaptive modes, should be combined using P_a and P_m as the weighting factors.

4. Appendix J1 is added to Subpart B of Part 430 as follows:

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

Note: Appendix J1 to subpart B of part 430 is informational. It will not become mandatory until the energy conservation standards for clothes washers at 10 CFR 430.32(g) are amended and Appendix J is removed by a rule published in the **Federal Register**.

1. DEFINITIONS AND SYMBOLS

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

Note: Appendix J1 does not provide a means for determining the energy consumption of a clothes washer with an adaptive control system. Therefore, pursuant to 10 CFR 430.27, a waiver must be obtained to establish an acceptable test procedure for each such clothes washer.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.18 *Warm wash* means all wash temperature selections that are below the hottest hot, less than 135°F (57.2°C), and above the coldest cold temperature selection.

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

1.20 *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.

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

E—Electrical Energy Consumption
H—Hot Water Consumption
C—Cold Water Consumption
R—Hot Water Consumed by Warm Rinse
ER—Electrical Energy Consumed by Warm Rinse
TUF—Temperature Use Factor
HE—Hot Water Energy Consumption
F—Load Usage Factor
Q—Total Water Consumption
ME—Machine Electrical Energy Consumption
RMC—Remaining Moisture Content
WI—Initial Weight of Dry Test Load
WC—Weight of Test Load After Extraction
m—Extra Hot Wash (maximum wash temp. >135°F (57.2°C.))
h—Hot Wash (maximum wash temp. ≤135°F (57.2°C.))
w—Warm Wash
c—Cold Wash (minimum wash temp.)
r—Warm Rinse (hottest rinse temp.)
x or max—Maximum Test Load
a or avg—Average Test Load
n or min—Minimum Test Load

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

Em_x=''Electrical Energy Consumption'' for an ''Extra Hot Wash'' and ''Maximum Test Load''
R_a=''Hot Water Consumed by Warm Rinse'' for the ''Average Test Load''
TUF_m=''Temperature Use Factor'' for an ''Extra Hot Wash''
HE_{min}=''Hot Water Energy Consumption'' for the ''Minimum Test Load''

2. TESTING CONDITIONS

2.1 *Installation.* Install the clothes washer in accordance with manufacturer's instructions.

2.2 *Electrical energy supply.* 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.

2.3 *Supply Water.*

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

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

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

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

2.5.1 *Weighing scales.*

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

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

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

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

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

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

2.6 *Test cloths.*

2.6.1 *Energy test cloth.*

2.6.1.1 The energy test cloth shall not be used for more than 25 test runs and shall be clean and consist of the following:

(A) Pure finished bleached cloth, made with a momie or granite weave, which is 50 percent cotton and 50 percent polyester and weighs 5.75 ounces per square yard (195.0 g/m^2) and has 65 ends on the warp and 57 picks on the fill; and

(B) Cloth material that is 24 inches by 36 inches (61.0 cm by 91.4 cm) and has been hemmed to 22 inches by 34 inches (55.9 cm by 86.4 cm) before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width.

2.6.1.2 The new test cloths, including energy test cloths and energy stuffer cloths, shall be pre-conditioned in a clothes washer in the following manner:

2.6.1.2.1 Wash the test cloth using a commercially available clothes washing detergent that is suitable for 135°F (57.2°C) wash water as recommended by the manufacturer, with the washer set on maximum water level. Place detergent in washer and then place the new load to be conditioned in the washer. Wash the load for ten minutes in soft water (17ppm or less). Wash water is to be hot, and controlled at 135°F±5°F (57.2°C ±2.8°C). Rinse water temperature is to be cold, and controlled at 60°F ±5°F (15.6°C ±2.8°C). Rinse the load through a second rinse using the same water temperature (if an optional second rinse is available on the clothes washer, use it).

2.6.1.2.2 Dry the load.

2.6.1.2.3 A final cycle is to be hot water wash with no detergent followed by two cold water rinses.

2.6.1.2.4 Dry the load.

2.6.2 *Energy stuffer cloth.* The energy stuffer cloth shall be made from energy test cloth material and shall consist of pieces of material that are 12 inches by 12 inches (30.5 cm by 30.5 cm) and have been hemmed to 10 inches by 10 inches (25.4 cm by 25.4 cm) before washing. The maximum shrinkage after five washes shall not be more than four percent on the length and width. The number of test runs on the same energy stuffer cloth shall not exceed 25 runs.

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

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

TABLE 2.8.—TEST LOAD SIZES AND WATER FILL SETTINGS REQUIRED

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

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

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

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

2.9 *Pre-conditioning.*

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

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

2.10 *Wash time setting.* If one wash time is prescribed in the energy test cycle, that shall be the wash time setting; otherwise, the wash time setting shall be the higher of either the minimum, or 70 percent of the maximum wash time available in the energy test cycle.

2.11 *Test room temperature for water-heating clothes washers.* Maintain the test room ambient air temperature at 75°F±5°F (23.9°C±2.8°C).

3. TEST MEASUREMENTS

3.1 *Clothes container capacity.* Measure the entire volume which a dry clothes load could occupy within the clothes container during 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.

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

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

3.1.4 Fill the clothes container manually with either 60°F±5°F (15.6°C±2.8°C) or 100°F±10°F (37.8°C±5.5°C) water to its uppermost edge. Measure and record the weight of water, W, in pounds.

3.1.5 The clothes container capacity is calculated as follows:

$C=W/d.$

where:

C=Capacity in cubic feet (liters).
W=Mass of water in pounds (kilograms).
d=Density of water (62.0 lbs/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)).

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

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

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

3.2.1.2 For semi-automatic washers: (1) For hot water temperature, open the hot water faucet completely and close the cold water faucet; (2) for warm inlet water temperature, open both hot and cold water faucets completely; (3) for cold water temperature, close the hot water faucet and open the cold water faucet completely.

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

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

$Tw(°F)=((Hw\times 135°F)+(Cw\times 60°F))/(Hw+Cw)$

or

$Tw(°C)=((Hw\times 57.2°C)+(Cw\times 15.6°C))/(Hw+Cw)$

where:

Hw=Hot water consumption of a warm wash
Cw=Cold water consumption of a warm wash

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

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

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

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

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

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

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

3.2.3.3 *Clothes washers with manual water fill control system.* In accordance with Table 2.8, the water fill selector shall be set to the maximum water level available on the clothes washer for the maximum test load size and set to the minimum water level for

TABLE 3.2.—TEST SECTION REFERENCE

Max. Wash Temp. Available	≤135°F (57.2°C)			>135°F (57.2°C) [2]	
Number of Wash Temp. Selections	1	2	>2	3	>3
Test Sections Required to be Followed	.....	.....	.....	3.3	3.3
	.....	3.4	3.4	.....	3.4
	.....	.....	3.5	3.5	3.5
	3.6	3.6	3.6	3.6	3.6
	3.7 [1]	3.7 [1]	3.7 [1]	3.7 [1]	3.7 [1]
	3.8	3.8	3.8	3.8	3.8

[1] Only applicable to machines with warm rinse in any cycle.
[2] This only applies to water hearting clothes washers on which the maximum wash temperature available exceeds 135°F (57.2°C)

the minimum test load size. The load usage factors which shall be used when calculating energy consumption values are defined in Table 4.1.3.

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

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

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

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

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

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

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

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

3.5 *''Warm Wash.''* Water and electrical energy consumption shall be determined for each water fill level and/or test load size as specified in 3.5.1 through 3.5.2.3 for the applicable warm water wash temperature(s).

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

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

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

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

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

3.6 *''Cold Wash'' (Minimum Wash Temperature Selection).* Water and electrical energy consumption shall be measured for each water fill level or test load size as specified in 3.6.1 through 3.6.3 for the coldest wash temperature selection available.

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

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

3.6.3 *Average test load and water fill.* For clothes washers with an adaptive water fill control system, measure the values for hot water consumption (Hc_a), cold water consumption (Cc_a), and electrical energy consumption (Ec_a) for a cold wash/cold rinse energy test cycle, with an average test load size as determined per Table 5.1.

3.7 *Warm Rinse.* Tests in sections 3.7.1 and 3.7.2 shall be conducted with the hottest rinse temperature available. If multiple wash temperatures are available with the hottest rinse temperature, any ''warm wash'' temperature may be selected to conduct the tests.

3.7.1 For the rinse only, measure the amount of hot water consumed by the clothes washer including all deep and spray rinses, for the maximum (R_x), minimum (R_n), and, if required by section 3.5.2.3, average (R_a) test load sizes or water fill levels.

3.7.2 Measure the amount of electrical energy consumed by the clothes washer to heat the rinse water only, including all deep and spray rinses, for the maximum (ER_x), minimum (ER_n), and, if required by section 3.5.2.3, average (ER_a), test load sizes or water fill levels.

3.8 *Remaining Moisture Content:*

3.8.1 The wash temperature will be the same as the rinse temperature for all testing. Use the maximum test load as defined in Table 5.1 and section 3.1 for testing.

3.8.2 *For clothes washers with cold rinse only:*

3.8.2.1 Record the actual 'bone dry' weight of the test load (WI_{max}), then place the test load in the clothes washer.

3.8.2.2 Set water level selector to maximum fill.

3.8.2.3 Run the energy test cycle.

3.8.2.4 Record the weight of the test load immediately after completion of the energy test cycle (WC_{max}).

3.8.2.5 Calculate the remaining moisture content of the maximum test load, RMC_{MAX}, expressed as a percentage and defined as:

$$RMC_{max}=((WC_{max}-WI_{max})/WI_{max})\times 100\%$$

3.8.3 *For clothes washers with cold and warm rinse options:*

3.8.3.1 Complete steps 3.8.2.1 through 3.8.2.4 for cold rinse. Calculate the remaining moisture content of the maximum test load for cold rinse, RMC_{COLD}, expressed as a percentage and defined as:

$$RMC_{COLD}=((WC_{max}-WI_{max})/WI_{max})\times 100\%$$

3.8.3.2 Complete steps 3.8.2.1 through 3.8.2.4 for warm rinse. Calculate the remaining moisture content of the maximum test load for warm rinse, RMC_{WARM}, expressed as a percentage and defined as:

$$RMC_{WARM}=((WC_{max}-WI_{max})/WI_{max})\times 100\%$$

3.8.3.3 Calculate the remaining moisture content of the maximum test load, RMC_{max}, expressed as a percentage and defined as:

$$RMC_{max}=RMC_{COLD}\times(1-TUF_r)+RMC_{WARM}\times(TUF_r).$$

where:

TUF_r is the temperature use factor for warm rinse as defined in Table 4.1.1.

3.8.4 Clothes washers which have options that result in different RMC values, such as multiple selection of spin speeds or spin times, that are available in the energy test cycle, shall be tested at the maximum and minimum extremes of the available options, excluding any ''no spin'' (zero spin speed) settings, in accordance with requirements in 3.8.2 or 3.8.3. The calculated $RMC_{max\ extraction}$ and $RMC_{min\ extraction}$ at the maximum and minimum settings, respectively, shall be combined as follows and the final RMC to be used in section 4.3 shall be:

$$RMC = 0.75\times RMC_{max\ extraction}+0.25\times RMC_{min\ extraction}$$

4. CALCULATION OF DERIVED RESULTS FROM TEST MEASUREMENTS

4.1 *Hot water and machine electrical energy consumption of clothes washers.*

4.1.1 *Per-cycle temperature-weighted hot water consumption for maximum, average, and minimum water fill levels using each appropriate load size as defined in section 2.8 and Table 5.1.* Calculate for the cycle under test the per-cycle temperature weighted hot water consumption for the maximum water fill level, Vh_x, the average water fill level, Vh_a, and the minimum water fill level, Vh_n, expressed in gallons per cycle (or liters per cycle) and defined as:

(a) $Vh_x=[Hm_x\times TUF_m]+[Hh_x\times TUF_h]+[Hw_x\times TUF_w]+[Hc_x\times TUF_c]+[R_x\times TUF_r]$

(b) $Vh_a=[Hm_a\times TUF_m]+[Hh_a\times TUF_h]+[Hw_a\times TUF_w]+[Hc_a\times TUF_c]+[R_a\times TUF_r]$

(c) $Vh_n=[Hm_n\times TUF_m]+[Hh_n\times TUF_h]+[Hw_n\times TUF_w]+[Hc_n\times TUF_c]+[R_n\times TUF_r]$

where:

Hm_x, Hm_a, and Hm_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the extra-hot wash cycle with the appropriate test loads as defined in section 2.8.

Hh_x, Hh_a, and Hh_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the hot wash cycle with the appropriate test loads as defined in section 2.8.

Hw_x, Hw_a, and Hw_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the warm wash cycle with the appropriate test loads as defined in section 2.8.

Hc_x, Hc_a, and Hc_n, are reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the cold wash cycle with the appropriate test loads as defined in section 2.8.

R_x, R_a, and R_n are the reported hot water consumption values, in gallons per-cycle (or liters per cycle), at maximum, average, and minimum water fill, respectively, for the warm rinse cycle and the appropriate test loads as defined in section 2.8.

TUF_m, TUF_h, TUF_w, TUF_c, and TUF_r are temperature use factors for extra hot wash, hot wash, warm wash, cold wash, and warm rinse temperature selections, respectively, and are as defined in Table 4.1.1.

TABLE 4.1.1.—TEMPERATURE USE FACTORS

Max Wash Temp Available	≤135 °F (57.2 °C)	≤135 °F (57.2 °C)	≤135 °F (57.2 °C)	>135 °F (57.2 °C)	>135 °F (57.2 °C)
No. Wash Temp Selections	Single	2 Temps	>2 Temps	3 Temps	>3 Temps
TUF_m (extra hot)	NA	NA	NA	0.14	0.05
TUF_h (hot)	NA	0.63	0.14	NA	0.09
TUF_w (warm)	NA	NA	0.49	0.49	0.49
TUF_c (cold)	1.00	0.37	0.37	0.37	0.37
TUF_r (warm rinse)	0.27	0.27	0.27	0.27	0.27

4.1.2 *Total per-cycle hot water energy consumption for all maximum, average, and minimum water fill levels tested.* Calculate the total per-cycle hot water energy consumption for the maximum water fill level, HE_{max}, the minimum water fill level, HE_{min}, and the average water fill level, HE_{avg}, expressed in kilowatt-hours per cycle and defined as:

(a) $HE_{max} = [Vh_x\times T\times K]$=Total energy when a maximum load is tested.

(b) $HE_{avg} = [Vh_a\times T\times K]$=Total energy when an average load is tested.

(c) $HE_{min} = [Vh_n\times T\times K]$=Total energy when a minimum load is tested.

where:

T=Temperature rise=75 °F (41.7 °C).

K=Water specific heat in kilowatt-hours per gallon degree F=0.00240 (0.00114 kWh/L-°C).

Vh_x Vh_a, and Vh_n, are as defined in 4.1.1.

4.1.3 *Total weighted per-cycle hot water energy consumption.* Calculate the total weighted per cycle hot water energy consumption, HE_T, expressed in kilowatt-hours per cycle and defined as:

$HE_T=[HE_{max}\times F_{max}]+[HE_{avg}\times F_{avg}]+[HE_{mn}\times F_{min}]$

where:

HE_{max}, HE_{avg}, and HE_{min} are as defined in 4.1.2.

F_{max}, F_{avg}, and F_{min} are the load usage factors for the maximum, average, and minimum test loads based on the size and type of control system on the washer being tested. The values are as shown in table 4.1.3.

TABLE 4.1.3—LOAD USAGE FACTORS

Water fill control system	Manual	Adaptive
F_{max} =	0.72 [1]	0.12 [2]
F_{avg} =		0.74 [2]
F_{min}=	0.28 [1]	0.14 [2]

[1] Reference 3.2.3.3.
[2] Reference 3.2.3.2.

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

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

where:

e=Nominal gas or oil water heater efficiency=0.75.

HE_T=As defined in 4.1.3.

4.1.5 *Per-cycle machine electrical energy consumption for all maximum, average, and minimum test load sizes.* Calculate the total per-cycle machine electrical energy consumption for the maximum water fill level, ME_{max}, the minimum water fill level, ME_{min}, and the average water fill level, ME_{avg}, expressed in kilowatt-hours per cycle and defined as:

(a)$ME_{max}= [Em_x\times TUF_m]+ [Eh_x\times TUF_h]+ [Ew_x\times TUF_w]+ [Ec_x\times TUF_c]+ [ER_x\times TUF_r]$

(b) $ME_{avg}= [Em_a\times TUF_m]+ [Eh_a\times TUF_h]+ [Ew_a\times TUF_w]+ [Ec_a\times TUF_c]+ [ER_a\times TUF_r]$

(c) $ME_{min}= [Em_n\times TUF_m]+ [Eh_n\times TUF_h]+ [Ew_n\times TUF_w]+ [Ec_n\times xTUF_c]+ [ER_n\times TUF_r]$

where:

Em_x, Em_a, and Em_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the extra-hot wash cycle.

Eh_x, Eh_a, and Eh_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the hot wash cycle.

Ew_x, Ew_a, and Ew_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the warm wash cycle.

Ec_x, Ec_a, and Ec_n, are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the cold wash cycle.

ER_x, ER_a, and ER_n are reported electrical energy consumption values, in kilowatt-hours per cycle, at maximum, average, and minimum test loads, respectively, for the warm rinse cycle.

TUF_m, TUF_h, TUF_w, TUF_c, and TUF_r are as defined in Table 4.1.1.

4.1.6 *Total weighted per-cycle machine electrical energy consumption.* Calculate the total per cycle load size weighted energy consumption, ME_T, expressed in kilowatt-hours per cycle and defined as:

$ME_T=[ME_{max}\times F_{max}]+[ME_{avg}\times F_{avg}]+[ME_{min}\times F_{min}]$

where:

ME_{max}, ME_{avg}, and ME_{min} are as defined in 4.1.5.

F_{max}, F_{avg}, and F_{min} are as defined in Table 4.1.3.

4.1.7 *Total per-cycle energy consumption when electrically heated water is used.* Calculate for the energy test cycle the total per-cycle energy consumption, E_{TE}, using electrical heated water, expressed in kilowatt-hours per cycle and defined as:

$E_{TE}=HE_T+ME_T$

where:

ME_T=As defined in 4.1.6.

HE_T=As defined in 4.1.3.

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

4.2.1 *Per-cycle water consumption.* Calculate the maximum, average, and minimum total water consumption, expressed in gallons per cycle (or liters per cycle), for the cold wash/cold rinse cycle and defined as:

$Q_{max}=[Hc_x+Cc_x]$

$Q_{avg}=[Hc_a+Cc_a]$

$Q_{min}=[Hc_n+Cc_n]$

where:

Hc_x, Cc_x, Hc_a, Cc_a, Hc_n, and Cc_n are as defined in 3.6.

4.2.2 *Total weighted per-cycle water consumption.* Calculate the total weighted per cycle consumption, Q_T, expressed in gallons per cycle (or liters per cycle) and defined as:

$Q_T=[Q_{max}\times F_{max}]+[Q_{avg}\times F_{avg}]+[Q_{min}\times F_{min}]$

where:

Q_{max}, Q_{avg}, and Q_{min} are as defined in 4.2.1.

F_{max}, F_{avg}, and F_{min} are as defined in table 4.1.3.

4.2.3 *Water consumption factor.* Calculate the water consumption factor, WCF, expressed in gallon per cycle per cubic feet (or liter per cycle per liter), as:

$WCF=Q_T / C$

where:

Q_T=as defined in section 4.2.2.

C = as defined in section 3.1.5.

4.3 *Per-cycle energy consumption for removal of moisture from test load.* Calculate the per-cycle energy required to remove the moisture of the test load, D_E, expressed in kilowatt-hours per cycle and defined as

D_E=(LAF)×(Maximum test load weight)×(RMC—4%)×(DEF)×(DUF)

where:

LAF=Load adjustment factor=0.52.

Test load weight=As required in 3.8.1, expressed in lbs/cycle.

RMC=As defined in 3.8.2.5, 3.8.3.3 or 3.8.4.

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=0.84.

4.4 *Modified energy factor.* Calculate the modified energy factor, MEF, expressed in cubic feet per kilowatt-hour per cycle (or liters per kilowatt-hour per cycle) and defined as:

$MEF=C/(E_{TE}+D_E)$

where:

C=As defined in 3.1.5.

E_{TE}=As defined in 4.1.7.

D_E=As defined in 4.3.

4.5 *Energy factor.* Calculate the energy factor, EF, expressed in cubic feet per kilowatt-hour per cycle (or liters per kilowatt-hour per cycle) and defined as:

$EF=C/E_{TE}$

where:

C=As defined in 3.1.5.

E_{TE}=As defined in 4.1.7.

5. TEST LOADS

TABLE 5.1—TEST LOAD SIZES

Container volume		Minimum load		Maximum load		Average load	
cu. ft. ≥ <	(liter) ≥ <	lb	(kg)	lb	(kg)	lb	(kg)
0–0.8	0–22.7	3.00	1.36	3.00	1.36	3.00	1.36
0.80–0.90	22.7–25.5	3.00	1.36	3.50	1.59	3.25	1.47
0.90–1.00	25.5–28.3	3.00	1.36	3.90	1.77	3.45	1.56
1.00–1.10	28.3–31.1	3.00	1.36	4.30	1.95	3.65	1.66
1.10–1.20	31.1–34.0	3.00	1.36	4.70	2.13	3.85	1.75
1.20–1.30	34.0–36.8	3.00	1.36	5.10	2.31	4.05	1.84
1.30–1.40	36.8–39.6	3.00	1.36	5.50	2.49	4.25	1.93
1.40–1.50	39.6–42.5	3.00	1.36	5.90	2.68	4.45	2.02
1.50–1.60	42.5–45.3	3.00	1.36	6.40	2.90	4.70	2.13
1.60–1.70	45.3–48.1	3.00	1.36	6.80	3.08	4.90	2.22
1.70–1.80	48.1–51.0	3.00	1.36	7.20	3.27	5.10	2.31
1.80–1.90	51.0–53.8	3.00	1.36	7.60	3.45	5.30	2.40
1.90–2.00	53.8–56.6	3.00	1.36	8.00	3.63	5.50	2.49
2.00–2.10	56.6–59.5	3.00	1.36	8.40	3.81	5.70	2.59
2.10–2.20	59.5–62.3	3.00	1.36	8.80	3.99	5.90	2.68
2.20–2.30	62.3–65.1	3.00	1.36	9.20	4.17	6.10	2.77
2.30–2.40	65.1–68.0	3.00	1.36	9.60	4.35	6.30	2.86
2.40–2.50	68.0–70.8	3.00	1.36	10.00	4.54	6.50	2.95
2.50–2.60	70.8–73.6	3.00	1.36	10.50	4.76	6.75	3.06
2.60–2.70	73.6–76.5	3.00	1.36	10.90	4.94	6.95	3.15
2.70–2.80	76.5–79.3	3.00	1.36	11.30	5.13	7.15	3.24
2.80–2.90	79.3–82.1	3.00	1.36	11.70	5.31	7.35	3.33
2.90–3.00	82.1–85.0	3.00	1.36	12.10	5.49	7.55	3.42
3.00–3.10	85.0–87.8	3.00	1.36	12.50	5.67	7.75	3.52
3.10–3.20	87.8–90.6	3.00	1.36	12.90	5.85	7.95	3.61
3.20–3.30	90.6–93.4	3.00	1.36	13.30	6.03	8.15	3.70
3.30–3.40	93.4–96.3	3.00	1.36	13.70	6.21	8.35	3.79
3.40–3.50	96.3–99.1	3.00	1.36	14.10	6.40	8.55	3.88
3.50–3.60	99.1–101.9	3.00	1.36	14.60	6.62	8.80	3.99
3.60–3.70	101.9–104.8	3.00	1.36	15.00	6.80	9.00	4.08
3.70–3.80	104.8–107.6	3.00	1.36	15.40	6.99	9.20	4.17

Notes:

(1) All test load weights are bone dry weights.

(2) Allowable tolerance on the test load weights are +/−0.10 lbs (0.05 kg).

6. WAIVERS AND FIELD TESTING

6.1 *Waivers and Field Testing for Non-conventional Clothes Washers.* Manufacturers of nonconventional clothes washers, such as clothes washers with adaptive control systems, must submit a petition for waiver pursuant to 10 CFR 430.27 to establish an acceptable test procedure for that clothes washer. For these and other clothes washers that have controls or systems such that the DOE test procedures yield results that are so unrepresentative of the clothes washer's true energy consumption characteristics as to provide materially inaccurate comparative data, field testing may be appropriate for establishing an acceptable test procedure. The following are guidelines for field testing which may be used by manufacturers in support of petitions for waiver. These guidelines are not mandatory and the Department may determine that they do not apply to a particular model. Depending upon a manufacturer's approach for conducting field testing, additional data may be required. Manufacturers are encouraged to communicate with the Department prior to the commencement of field tests which may be used to support a petition for waiver. Section 6.3 provides an example of field testing for a clothes washer with an adaptive water fill control system. Other features, such as the use of various spin speed selections, could be the subject of field tests.

6.2 *Nonconventional Wash System Energy Consumption Test.* The field test may consist of a minimum of 10 of the nonconventional clothes washers (''test clothes washers'') and 10 clothes washers already being distributed in commerce (''base clothes washers''). The tests should include a minimum of 50 energy test cycles per clothes washer. The test clothes washers and base clothes washers should be identical in construction except for the controls or systems being tested. Equal numbers of both the test clothes washer and the base clothes washer should be tested simultaneously in comparable settings to minimize seasonal or consumer laundering conditions or variations. The clothes washers should be monitored in such a way as to accurately record the total energy consumption per cycle. At a minimum, the following should be measured and recorded throughout the test period for each clothes washer: Hot water usage in gallons (or liters), electrical energy usage in kilowatt-hours, and the cycles of usage.

The field test results would be used to determine the best method to correlate the rating of the test clothes washer to the rating of the base clothes washer. If the base clothes washer is rated at A kWh per year, but field tests at B kWh per year, and the test clothes washer field tests at D kWh per year, the test unit would be rated as follows:

$A \times (D/B) = G$ kWh per year

6.3 *Adaptive water fill control system field test.* Section 3.2.3.1 defines the test method for measuring energy consumption for clothes washers which incorporate control systems having both adaptive and alternate cycle selections. Energy consumption calculated by the method defined in section 3.2.3.1 assumes the adaptive cycle will be used 50 percent of the time. This section can be used to develop field test data in support of a petition for waiver when it is believed that the adaptive cycle will be used more than 50 percent of the time. The field test sample size should be a minimum of 10 test clothes washers. The test clothes washers should be totally representative of the design, construction, and control system that will be placed in commerce. The duration of field testing in the user's house should be a minimum of 50 energy test cycles, for each unit. No special instructions as to cycle selection or product usage should be given to the field test participants, other than inclusion of the product literature pack which would be shipped with all units, and instructions regarding filling out data collection forms, use of data collection equipment, or basic procedural methods. Prior to the test clothes washers being installed in the field test locations, baseline data should be developed for all field test units by conducting laboratory tests as defined by section 1 through section 5 of these test procedures to determine the energy consumption, water consumption, and remaining moisture content values. The following data should be measured and recorded for each wash load during the test period: wash cycle selected, the mode of the clothes washer (adaptive or manual), clothes load dry weight (measured after the clothes washer and clothes dryer cycles are completed) in pounds, and type of articles in the clothes load (e.g., cottons, linens, permanent press). The wash loads used in calculating the in-home percentage split between adaptive and manual cycle usage should be only those wash loads which conform to the definition of the energy test cycle.

Calculate:

T = The total number of energy test cycles run during the field test

T_a = The total number of adaptive control energy test cycles

T_m = The total number of manual control energy test cycles

The percentage weighting factors:

$P_a = (T_a/T) \times 100$ (the percentage weighting for adaptive control selection)

$P_m = (T_m/T) \times 100$ (the percentage weighting for manual control selection)

Energy consumption (HE_T, ME_T, and D_E) and water consumption (Q_T), values calculated in section 4 for the manual and adaptive modes, should be combined using P_a and P_m as the weighting factors.

§ 430.62 [Amended]

5. Section 430.62(a)(2) is amended by adding ''energy factor (for clothes washers, clothes dryers, and dishwashers),'' after ''(for pool heaters),'' and before ''and annual fuel utilization efficiency.''

[FR Doc. 97–22682 Filed 8–26–97; 8:45 am]

BILLING CODE 6450–01–P