Appliance Standards Awareness Project
American Council for an Energy-Efficient Economy
Consumer Federation of America
Natural Resources Defense Council

November 29, 2021

Mr. Bryan Berringer
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Office, EE-5B
1000 Independence Avenue SW
Washington, DC 20585

**RE: Docket Number EERE–2016–BT–TP–0011/RIN 1904-AD95: Proposed Rule for Test Procedures for Residential and Commercial Clothes Washers**

Dear Mr. Berringer:

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), Consumer Federation of America (CFA), and the Natural Resources Defense Council (NRDC) on the notice of proposed rulemaking (NOPR) for test procedures for residential and commercial clothes washers. 86 Fed. Reg. 49140 (September 1, 2021). We appreciate the opportunity to provide input to the Department.

In the NOPR, DOE has proposed amended test procedures that would significantly improve representativeness. Most critically, the proposal to base efficiency metrics on load size rather than capacity is an important step towards eliminating the current bias towards large-capacity washers. Additionally, the proposed amendment to measure remaining moisture content (RMC) for all cycles tested rather than on a single cold-cold test cycle will more accurately estimate drying energy usage. Finally, we believe the proposal to require testing on the hottest warm wash/cold rinse and coldest warm wash/cold rinse settings for all clothes washers instead of the "25/50/75" test will more accurately reflect energy usage of warm wash settings. We strongly support these proposed changes and believe they will provide a more accurate representation of real-world usage for clothes washers.

We also urge DOE to address several other issues to improve the representativeness of the test procedure and clarify certain proposed amendments. First, we urge DOE to require that washers with network-connected functionality be tested in their as-shipped configurations. We also encourage DOE to investigate the relationship between washer capacity and energy/water usage at a constant load size and to consider specifying constant load sizes across capacities. Finally, we encourage DOE to include remaining moisture content (RMC) adjustment factors to account for the difference in RMCs between test and real-world clothing and to amend the final RMC value in the drying energy calculation to align with the clothes dryer test procedure in Appendix D2. We address these and other issues in more detail below. An improved, clearly outlined test procedure for washers that better reflects real-world use will ultimately lead to more accurate information for consumers about energy and water use.

**We support amending the efficiency metrics to be based on lbs. of clothes washed rather than washer capacity.** Currently, energy use (denominator of the IMEF/MEF equations) scales with weighted-average load, while capacity (numerator of the IMEF/MEF equations) scales with maximum load. Similar relationships exist for the water efficiency metric (IWF). As DOE states in the NOPR, this provides an inherent numerical advantage to large-capacity clothes washers that is disproportionate to the efficiency advantage gained by the ability to wash larger loads.[1] ***This advantage means that a larger clothes washer consumes more energy and water to wash a lb. of clothes than a smaller washer with the same IMEF and IWF ratings***. To avoid this inherent advantage of large-capacity machines, DOE is proposing to replace the capacity term in the numerator by the weighted-average load size. As we suggested in our 2020 RFI comments,[2] the use of load weight-based efficiency metrics will mitigate the current bias in the test procedure towards large-capacity washing machines. This change, which will alter the relative efficiency rankings of machines, will provide a more accurate representation of real-world efficiency across models and help consumers make more informed purchasing decisions.

**We support amending the test procedure to measure RMC for all test cycles**. Drying energy is the most important component of the energy use metrics. Based on DOE's analysis for the 2012 residential clothes washer (RCW) direct final rule, for models that just meet the current standards, drying energy, estimated from calculated RMCs, represents 56% and 72% of total energy use for top-loading and front-loading washers, respectively.[3] Currently, RMC is calculated as a weighted average of measured RMCs on the minimum and maximum spin settings on the cold/cold setting. However, the NOPR notes that DOE is aware of clothes washers that offer the maximum spin setting only on the cold/cold setting.[4] This results in lower spin settings at non-cold/cold cycles not being factored into the RMC calculation even though these non-cold/cold cycles represent the majority of cycles according to the temperature use factors (TUFs).[5] Furthermore, a recent NEEA study showed significant IMEF rank order changes between washers when comparing cold/cold RMCs and warm/cold RMCs for the same test loads.[6]

DOE is thus proposing an amended method to measure RMC for each energy test cycle at the default spin setting. An overall RMC will then be calculated from these measured cycle-specific RMCs using the same load usage factors (LUFs) and TUFs that apply to the water and energy measurements. Using the LUFs and TUFs for calculating overall RMC will make dryer energy usage calculations more consistent with the other energy and water usage calculations. Overall, the proposed amendment should improve representativeness and provide more accurate relative rankings of machines by better capturing real-world RMC and drying energy usage.

**We support amending the test procedure so that it better represents the energy use of all clothes washers on the "warm wash/cold rinse" temperature selection.** The current test procedure states that for washers with four or more warm wash/cold rinse temperature selections, a manufacturer can either

[1]86 Fed. Reg. 49172.
[2]https://www.regulations.gov/comment/EERE-2016-BT-TP-0011-0010.
[3]https://www.regulations.gov/document/EERE-2008-BT-STD-0019-0047, pp. 7-4, 7-5.
[4]86 Fed. Reg. 49161.
[5]The sum of the TUFs for non-cold/cold cycles is 63%. TUFs are weighting factors that represent the percentage of time that consumers choose a particular wash/rinse temperature selection for the wash cycle.
[6]#20-317, Coming Clean: Revealing Real-World Efficiency of Clothing Washers, 2020.
https://neea.org/resources/coming-clean-revealing-real-world-efficiency-of-clothes-washers

test all selections or the 25%, 50%, and 75% positions between the hottest wash and the coldest wash (referred to as the "25/50/75 test"). However, DOE explains in the NOPR that the 25/50/75 test was adopted before the widespread use of electronic controls and that those dial positions may not correspond to the 25%, 50%, and 75% temperatures between the hottest and coldest selections in contemporary washers.[7] For example, DOE is aware of models where each of the 25/50/75 test positions are low-temperature wash cycles that have wash temperatures only a few degrees above the coldest setting while the "warm" setting is beyond the 75% position and is thus excluded from testing. Therefore, DOE is proposing to require testing on the hottest warm wash/cold rinse and coldest warm wash/cold rinse settings for all clothes washers. We believe this change will more accurately reflect energy usage of warm wash settings while decreasing test burden.

**We support DOE specifying a hot water supply temperature of 120-125 °F and decreasing the temperature rise from 75°F to 65°F.** Prior DOE analysis of household hot water temperatures, discussed in the 2014 test procedure final rule for water heaters, found that the average set point for water heaters was 124.2 °F.[8] As discussed in the NOPR, this temperature value is more consistent with other field surveys as well as Appendix C1 for dishwashers, which specifies an inlet temperature of 120±2 °F. We believe that a hot water supply temperature of 120-125 °F will better reflect current clothes washer usage conditions than the 135°F temperature specified in the current test procedure. Concurrently, given the decrease in the hot water supply temperature, we believe the proposed reduction of the hot water temperature rise for Appendix J, from 75°F to 65°F, is reasonable.

**We encourage DOE to use assumptions for water heater efficiencies that better reflect typical water heater efficiencies.** In the current test procedure, the calculation of hot water energy use assumes water heater efficiencies of 100% for electric water heaters and 75% for gas water heaters. Based on shipment data from the last water heaters rulemaking and current models in the Compliance Certification database, we estimate that shipment-weighted efficiencies for new water heaters are about 92% for electric water heaters and 64% for gas water heaters.[9] We suggest that DOE consider using water heater efficiencies based on the most recent analysis for water heaters. Such a change would improve representativeness and more accurately reflect the relative contribution of water heating energy use to total clothes washer energy use.

**We encourage DOE to require a water meter resolution no larger than 0.01 gallons for all hot water use measurements.** The NOPR notes that DOE has observed washers that use 0.1 gallons or less of hot water on some temperature selections and is thus concerned that the current test procedure may not provide the necessary resolution to measure such hot water usage. We agree that improved hot water meter resolution will more accurately reflect water and energy usage. However, as written, the proposed test procedure, requiring a resolution no larger than 0.01 gallons if hot water use is less than 0.1 gallons, suggests that hot water usage is known prior to testing. Thus, we suggest that DOE require a

[7]86 Fed. Reg. 49160.
[8]79 Fed. Reg. 40554.
[9]We calculated average water heater efficiencies by size class (< 30 gal, 31-49 gal, and 50+ gal) for database models excluding tankless and heat pump water heaters found at: https://www.regulations.doe.gov/certification-data/CCMS-4-Water_Heaters.html#q=Product_Group_s%3A%22Water%20Heaters%22, then calculated weighted-averages based on shipment estimates by size class from: https://www.regulations.gov/document/EERE-2006-STD-0129-0149, p. 7-7

water meter resolution no larger than 0.01 gallons for all hot water usage as we believe this change would more accurately reflect hot water and energy usage. DOE states in the NOPR that based on GEA's comments and their experience with third-party laboratories, many manufacturers and laboratories are already using water meters with resolutions no larger than 0.01 gallons.[10]

**We urge DOE to test clothes washers with network-connected functionality in their as-shipped setting for both the active cycle and low-power modes.** DOE notes in the NOPR that they are aware of "connected" clothes washers on the market from at least four major manufacturers.[11] The current Appendix J2 specifies using the manufacturer default settings for all selections except temperature, fill level, and spin speed and further specifies performing low-power testing without changing any of these default settings. In the NOPR, DOE is proposing that connected washers be tested with the network-connected functions disabled if such settings can be disabled by the end-user via user manual instructions. While we support clarifying the instructions for network-connected functionality testing, we believe that all appliances should be tested as they are shipped, i.e., with network connectivity enabled for many connected washers. We are concerned that DOE's proposal would allow many washers to be tested with network functions disabled even though those functions may be unlikely to be disabled in the field. Specifically, if a washer with connected features is shipped with those features enabled, we believe that it is unlikely that most consumers will take the necessary steps to disable those features. Such a scenario would result in the test procedure being unrepresentative of the model's standby power consumption. We therefore urge DOE to require that all washers be tested "as shipped," regardless of whether the user manual provides instructions for disabling the network functions. Testing all washers "as shipped" will help provide a more representative measurement of energy use.

**We encourage DOE to investigate the relationship between capacity and energy/water usage at a constant load size and to consider specifying constant load sizes across capacities.** The proposed amended test procedure uses a small and large load, both of which are heavily dependent on washer capacity. An average of these small and large loads is nearly identical to the current test procedure's average load at a given capacity. In other words, while the number of loads has been reduced from three to two, load sizing in the amended procedure closely resembles that of the current procedure, which relies on 1996 Procter & Gamble data.[12] We are concerned with extrapolating the usage patterns from 25 years ago to estimate contemporary load sizes. In particular, the introduction of large-capacity washers (e.g., 6+ cu. ft.) to the market and the structure of the load size table, which was originally based on washer capacities ranging from only 2.4 to 2.8 cu. ft., has resulted in test loads for large-capacity washers being significantly greater than those for smaller washers. For example, the small and large loads for a 6.0 cu. ft. washer, 7.74 and 19.44 lbs. respectively, are 41 and 67% larger than those for a 3.5 cu. ft. washer, 5.49 and 11.64 lbs., respectively.

A 2014 NEEA field study found that there was no clear correlation between washer capacity and load size.[13] The average field load size found in their study, 7.64 lbs., is smaller than the proposed "small" load for a 6.0 cu. ft. washer (7.74 lbs.). The NOPR states that "no conclusions can be drawn from the 2014 NEEA laundry study regarding how consumer load sizes may have changed as average clothes

[10]86 Fed. Reg. 49147.
[11]86 Fed. Reg. 49170.
[12]Full data set presented by AHAM is available at www.regulations.gov/document/EERE-2006-TP-0065-0027
[13]#E14-287, Dryer Field Study, 2014. https://neea.org/resources/rbsa-laundry-study

washer capacity has increased from around 3.5 $ft^3$ in 2010 to 4.4 $ft^3$ in 2019."[14] However, as described in comments on this NOPR from the California IOUs, their recent field study, which included washer capacities up to > 5 cu. ft., also did not find any clear relationship between washer capacity and load size.

We are concerned that larger capacity machines may be less efficient than smaller capacity machines at washing an average load of 7 to 8 lbs. If this were true, it would mean that larger washers may use significantly more water and energy under real-world conditions than smaller ones with the same efficiency ratings. NEEA's recent 2020 study,[15] which tested 12 residential washers, suggests these concerns may be valid as a significant efficiency rank order change was observed when testing the J2-specified maximum load versus a constant load of 8.45 lbs. In particular, the largest front-loader in their study went from the most efficient (i.e., highest IMEF) at the maximum load to the least efficient front-loader at the constant 8.45 lb. load. We encourage DOE to further investigate this potential concern using currently available testing data. For example, the proposed "small" load for a 5 cu. ft. washer and the "large" load for a 2 cu. ft. washer are both approximately 6.9 lbs. Thus, DOE should look at the energy and water usage across examples like this to better understand the efficiency of washers with varying capacities when loaded with the same amount of laundry. We further encourage DOE to consider specifying constant load sizes across capacities.

**We encourage DOE to include RMC adjustment factors in the test procedure to account for the difference in RMCs with the DOE test load vs. real-world clothing.** The same recent 2020 NEEA study compared RMC values for AHAM cotton test loads with the Appendix J2 textile loads. The results showed that all machines spin substantially more water from the J2 textiles (36% average RMC) than the more realistic AHAM cotton loads (65% average RMC). This means that RMC and the resulting drying energy, which represents most of the overall energy usage of clothes washers, are likely being significantly underestimated in the current test procedure. It is important that each of the components of energy use for washing machines (drying energy, water heating energy, etc.) are correctly weighted. For example, if two models have the same efficiency rating, but one optimizes hot water usage and the other optimizes spin speed/duration to lower the RMC, then these models may have different real-world efficiencies if RMC is underestimated. NEEA's data showed that a simple mathematical adjustment could estimate AHAM cotton RMCs from J2 RMC results, suggesting that no additional testing would be required. Thus, we encourage DOE to consider implementing an RMC adjustment factor to estimate real-world RMC values more accurately.

**We encourage DOE to amend the final RMC value in the drying energy calculation to align with the clothes dryer test procedure in Appendix D2.** DOE is proposing to retain the assumed final moisture content of 4 percent for the drying energy calculation. This value is generally consistent with the 2.5 to 5 percent final RMC prescribed in Appendix D1, which the current dryer standards are based on. Appendix D2, while optional, is required for dryer ENERGY STAR certification and requires a final RMC no greater than 2 percent.[16] DOE explains in the NOPR that a final RMC of 2 percent is intended to represent the remaining moisture level that would be acceptable to consumers based on the DOE test load. Therefore,

[14] 86 Fed. Reg. 49156.
[15] #20-317, Coming Clean: Revealing Real-World Efficiency of Clothing Washers, 2020.
[16] 86 Fed. Reg. 49176.

we encourage DOE to amend the final RMC value in the drying energy calculation to reflect the clothes dryer test procedure in Appendix D2 to improve the representativeness of the test procedure.

**We support measuring cycle time but encourage DOE to further clarify the definition of a washer cycle.** In the NOPR, DOE is proposing to add a measurement of average cycle time using TUFs and LUFs for weighting the cycle times of different cycles. This average cycle time would then be used to calculate low-power mode hours rather than using a fixed value. Measuring cycle time will permit a more accurate calculation of low-power mode energy consumption. However, while Appendix D2 for dryers specifies when the cycle shall be considered complete, there is no clear definition of what constitutes the beginning and end of a washer cycle in the new Appendix J.[17] In some models, the washer may enter a new mode that is between the completion of the high-energy main cycle and subsequent standby mode. Importantly, it is not clear whether energy usage in these scenarios is being captured by either the active mode or standby mode testing. We therefore encourage DOE to clarify the definition of a washer cycle.

**As part of the upcoming standards rulemaking for commercial clothes washers (CCWs), we encourage DOE to consider capturing low-power mode energy consumption in the energy efficiency metric.** The energy efficiency of residential clothes washers is currently represented by the IMEF metric, which incorporates low-power mode energy consumption, while commercial clothes washers are rated using MEF, which excludes low-power mode energy consumption. DOE's analysis for the 2014 direct final rule showed CCW standby powers up to 12 W for models with display screens and advanced features.[18] The prevalence of these additional features will likely continue to increase. Importantly, 12 W of standby power is more than 13x that estimated for baseline RCWs (0.7-0.9 W) based on DOE's preliminary analysis for the ongoing RCW standards rulemaking.[19]

In the December 2014 final rule for CCW standards,[20] DOE stated that establishing an amended standard that included low-power mode energy could enable backsliding and that the IMEF metric would not provide a useful means for differentiating the active mode characteristics of different CCW models. While we agree that incorporating standby power may result in a loss in differentiation in active-mode energy efficiency, the primary goal of the test procedures should be to accurately capture real-world energy use, not a subset of energy use. We appreciate DOE's concern regarding potential backsliding wherein incorporation of standby power consumption in a single overall efficiency metric could allow certain models with very low standby power usage to offer less efficient active mode performance. However, we believe that strengthening the existing standards for CCWs would likely alleviate the backsliding concern.

DOE stated in the test procedure NOPR that any determination on inclusion of low-power mode energy use in the energy efficiency metric would be made as part of the ongoing energy conservation standards rulemaking.[21] Thus, we understand that no further change to the test procedure would be necessary to include low-power energy usage in the efficiency standard for CCWs. We encourage DOE to characterize

[17] 86 Fed. Reg. 49192.
[18] https://www.regulations.gov/document/EERE-2012-BT-STD-0020-0017, p. 5-19.
[19] https://www.regulations.gov/document/EERE-2017-BT-STD-0014-0027, pp. 5-25, 5-26.
[20] 79 Fed. Reg. 74501.
[21] 86 Fed. Reg. 49179, 49180.

low-power mode energy usage of CCWs and include it in the overall energy usage metric as part of the upcoming standards rulemaking in a way that does not permit an increase in active-mode energy usage.

**We encourage DOE to investigate the usage of cycle modifiers and consumer spin cycle selection behaviors and their impact on energy and water use.** DOE commented in the NOPR that cycle modifiers such as "deep fill" and "extra spin" are increasing in availability and may significantly impact energy/water use.[22] The NOPR explains that for clothes washers with electronic controls, the default settings must be used for any cycle selections except for the temperature selection, water fill levels, and, if necessary, spin speeds (for determining RMC). The NOPR further states that DOE has observed that the default settings of these optional cycle modifiers is most often in the "off" position, which means that the energy and/or water use of these cycle modifiers is not being captured in the current test procedure. DOE notes, however, that the growing presence of these cycle modifiers may "be indicative of an increase in consumer demand and/or usage of these features." Indeed, "deep fill" is a washer selection filter on the Home Depot website.[23] For these "deep fill" models, we believe the deep fill modifier is only being captured by the test procedure in certain cases. For example, some models have the "deep fill" setting on the water level control, which would be captured by the provision to test the most and least consumptive water level setting for user-adjustable automatic water fill control systems. However, other models have a separate "deep fill" button that would be considered a cycle modifier and would not be tested under the proposed amended test procedure.

Further, as we described in our comments on the RFI,[24] if the default settings for optional cycle modifiers are most often in the "off" position, the test procedure is effectively assigning a value of zero to the energy and water use of these features, which is not representative. We are concerned that the test procedure may therefore be significantly underestimating the energy and water use of clothes washers with optional cycle modifiers. It is our understanding that some washers may default to these cycle modifiers for future cycles after being selected for a single use cycle. We encourage DOE to consider test procedure amendments that would capture the impact of these cycle modifiers on energy and water use and discourage designs where the washer defaults to these cycle modifiers.

In addition, as described above, we believe DOE's proposal to measure RMC on each energy test cycle using the default spin setting is a significant improvement over testing RMC only on a single cold-cold cycle. However, if consumers select spin settings that are not the default setting to any significant extent, the proposed amended test procedure may not accurately reflect real-world energy usage. Therefore, DOE should pursue data regarding consumer behavior for spin setting selection for different temperature cycles.

Thank you for considering these comments.

Sincerely,

[22] 86 Fed. Reg. 49169.
[23] https://www.homedepot.com/b/Appliances-Washers-Dryers/Deep-Fill/N-5yc1vZc3olZ1z1bkg5
[24] https://www.regulations.gov/comment/EERE-2016-BT-TP-0011-0010

Jeremy Dunklin, PhD
Technical Advocacy Associate
Appliance Standards Awareness Project

Hannah Bastian
Senior Research Analyst
American Council for an Energy Efficiency Economy

Richard Eckman
Energy Policy Associate
Consumer Federation of America

Edward R. Osann
Senior Policy Analyst
Natural Resources Defense Council