Appliance Standards Awareness Project
American Council for an Energy-Efficient Economy
Natural Resources Defense Council

July 20, 2020

Mr. Jeremy Dommu
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Office, EE–5B
1000 Independence Avenue SW
Washington, DC 20585–0121

RE: Test Procedure for Electric Motors; Request for Information (Docket number EERE-2020-BT-TP-0011)

Dear Mr. Dommu:

This letter provides comments from the Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy and Natural Resources Defense Council in response to the Request for Information related to electric motor standards. 85 Federal Register 34111 (June 3, 2020). We appreciate the opportunity to provide input.

We urge DOE to use its broad authority to extend the electric motors test procedure to a much wider range of motors than currently covered, including additional motor topologies and horsepower ratings. In addition, air-over and submersible motors, which are currently exempt from DOE test procedures, should now be included. DOE currently rates motor efficiency at full load, but this approach fails to adequately represent typical usage. We urge DOE to adopt a motor efficiency metric based on a range of representative load conditions. In addition, DOE should consider how speed control, which can provide very large energy savings, can be incorporated into the test procedure and ratings. Finally, we urge DOE to clearly define key terms used in motor testing and rating to ensure fair comparisons between models and prevent gaming of the test procedure. We elaborate each of these recommendations below.

DOE has expansive authority to establish standards and test procedures for electric motors.

The Energy Policy and Conservation Act (EPCA) authorizes DOE to regulate "other motors," granting the Department very broad authority to set standards for any motor. (42 US Code 6311(2)(B)(xiii). The Code of Federal Regulations defines electric motor as "a machine that converts electrical power into rotational mechanical power." (10 CFR 431.12). DOE recognized its very broad authority to establish test procedures for all types of motors throughout a test procedure Request for Information (RFI) published

in 2017.[1] Given that motors account for 53% of world electricity demand[2] and current DOE standards cover only a relatively narrow portion of motors sold, DOE can significantly advance the energy conservation purposes of EPCA by exercising this authority.

DOE should extend the motors test procedure to a wider range of horsepower ratings for single and polyphase motors and include additional frame sizes.

The 2017 test procedure RFI contemplated significantly expanding the scope of coverage for DOE test procedures to encompass many more motors. We urge DOE to apply the general approach outlined in that RFI across an even broader range of horsepower ratings. In the 2017 RFI, DOE primarily focused on motors considered "small" by the market.[3] DOE identified motors under consideration for expanded scope in Table II-1, which we reproduce here:

TABLE II–1—MOTORS UNDER CONSIDERATION FOR A POTENTIAL TEST PROCEDURE RULEMAKING

Phase count	Horsepower	Frame size
Single	≥0.125 hp and ≤15 hp	All.
Polyphase	≥0.125 hp and ≤5 hp	2-digit.*
Polyphase	<1 hp	All.

We continue to support DOE's consideration of test procedures for single and polyphase motors within these horsepower ranges and frame sizes. In 2017, DOE explained that it was evaluating whether test procedures for additional motors should be included within the "small motors" test procedure or the "electric motors" test procedure. DOE subsequently proposed to leave the scope of the small motors test procedure unchanged.[4] Since DOE has broad authority to cover "other motors," DOE should now focus on using the current docket, concerning "electric motors," as the venue for expanding test procedures to additional motors considered small by the market.

In addition, DOE should now also consider other motors that are not currently subject to the DOE test procedure with higher horsepower ratings, including the full range of horsepower ratings covered by the current "electric motor" test procedure (i.e., up to 500 hp). We also note that the European Union's motor standards cover motors up to 1000 kW (1,341 hp). DOE should consider extending the range of DOE test procedures to cover motors greater than 500 hp.

DOE should consider additional motor topologies for test procedure coverage.

We support DOE's consideration of all motor topologies included in Table II-2 of the 2017 RFI. Table II-3 identified, "a shorter list of categories of motors that DOE has preliminarily identified as representing potential interest because of their volume of shipments, ability to be tested using existing test procedures, and energy consumption."[5] We appreciate that DOE has already identified those motors

[1] 82 Fed. Reg. 35468. See for example 35469 stating that DOE is considering "establishing new test procedures for electric motors beyond those currently subject to existing test procedures."
[2] International Energy Agency, "World Energy Outlook 2016". See Figure 7.9. available at iea.org.
[3] 82 Fed. Reg. 35470.
[4] 84 Fed. Reg. 17004.
[5] 82 Fed. Reg. 35471.

that should be the highest priority for inclusion in the motors test procedure and urge DOE to address each of these motor topologies. Motor types included in table II-3 have enormous differences in energy efficiency performance and energy consumption. DOE test procedures that enable buyers to make fair comparisons among various electric motors would be extremely valuable to the marketplace.

We note that some of the motor designs in Table II-3 did not even exist when the original DOE test procedures for motors were adopted. Many of the advanced motor technologies and designs in the table provide substantial efficiency and customer utility benefits in most applications when compared with older motor types. Test procedures, by enabling products to distinguish themselves in a fair manner, help manufacturers differentiate new technologies in the marketplace. To the extent possible, DOE's test procedures should provide a basis for any new motor technology to be rated on a fair basis with existing motor technologies.

DOE should extend the motor test procedure to cover air-over and submersible motors.

We support DOE adoption of test procedures for air-over motors. As DOE noted in the 2017 RFI, there are no clear differences in physical construction between air-over motors and non-air-over motors.[6] We understand that there are many applications where either an air-over motor or a currently-regulated motor could be used, and yet there is no way to reliably compare the performance of the two options since there is no DOE test procedure for air-over motors. A test procedure for air-over motors would allow purchasers to make informed decisions when considering both air-over and non-air-over motor options. In 2017, NEMA published a test procedure for air over motors.[7] DOE should consider the NEMA test procedure as the potential basis for a DOE test procedure for air-over motors.

Similarly, DOE should develop a test procedure for submersible motors. In comments filed to this docket, the California Investor Owned Utilities (CA IOUs) describe the significant market size for residential and water and wastewater system submersible pumps. DOE should investigate options for a test procedure that would achieve a fair approach for rating these products. Ideally, DOE would provide for testing in conditions that approximate their typical operating conditions. We also note that manufacturers already are using Premium Efficiency (i.e., motors compliant with current U.S. minimum standards) in submersible pump applications. The publication "Modern Pumping Today" reported in 2017 that, "most submersible motor pump manufacturers are developing or have released premium efficient motors for their pumps…"[8] As the CA IOU comments point out, Grundfos offers a line of pumps with Premium Efficiency Motors. The marketing of Premium Efficiency motors for submersible applications suggests that submersible motors can perhaps be tested with current test procedures without using a specialized setup.

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[6] Ibid., 35472.

[7] "NEMA Motors and Generators Standard Adds New Efficiency Test for Air-Over Motors." https://www.nema.org/news/Pages/NEMA-Motors-and-Generators-Standard-Adds-New-Efficiency-Test-for-Air-Over-Motors.aspx last accessed on 6/13/20 and see discussion in 2017 test procedure RFI at 82 Fed. Reg. 35475.

[8] "Understanding Test Standards for Submersible Pumps" Modern Pumping Today. at https://modernpumpingtoday.com/understanding-test-standards-submersible-pumps/ last accessed 6/12/20.

DOE should amend the test procedure to capture efficiency at multiple load points.

The current test procedure for motors is based on performance at full load. However, motors typically operate at loads that are significantly less than full load, and motor loading varies across individual applications. In the 2014 final rule for standards for electric motors, DOE used motor load distributions based on 21,500 field measurements. Based on these data, DOE found that the average motor load for four typical applications (air compressors, fans, pumps, and material handling) ranges from 59% to 72% of full load, with the standard deviations ranging from 17% to 25%.[9] Current motor ratings at full load are therefore not representative of performance in typical applications. Furthermore, we understand that many advanced motor technologies can better maintain efficiency at low loads compared to induction motors. However, the current test procedure would not capture this potential energy-saving benefit.

We urge DOE to amend the test procedure to capture efficiency at multiple load points to improve representativeness. For example, motor efficiency could be calculated as the average of efficiency at 25%, 50%, 75%, and 100% of full load. We understand that manufacturers today are testing and providing information to their customers about efficiency over a range of load points.[10]

DOE should consider test procedure modifications that would account for speed control.

Motors with speed control can provide very large energy savings in many applications. For example, in a pumping system with varying loads, if the pump is driven by a motor with speed control, the motor speed can be continuously adjusted so that the pump can match the flow requirement of the system. The power required by a pump or a fan varies with the cube of the speed, which means that reducing speed by half reduces the pump or fan power required by a factor of eight. In addition, motors with speed control can save energy even in constant-load applications by providing the ability to "right-size" a pump, for example. However, the current test procedure for motors does not capture the energy-saving benefits of speed control. We urge DOE to consider test procedure modifications that would account for speed control.

DOE must define "rated horsepower."

The applicable standard for a given motor depends on its rated load (i.e., horsepower). DOE must define motor horsepower to ensure that motors are tested and rated in a fair and consistent manner. Absent a clear definition, any one manufacturer could potentially claim a horsepower rating different from that claimed by a competitor with an equivalent motor. We support DOE's proposal to use breakdown torque to define rated output power. DOE has separately proposed this approach for small electric motors. Providing a standardized method for determining rated load will ensure that purchasers can make fair comparisons among models.

We support DOE specifying that all electric motor tests be performed using a rated frequency of 60 Hz.

DOE explains in the RFI that motors can be designed and marketed as capable of operating at

[9] https://www.regulations.gov/document?D=EERE-2010-BT-STD-0027-0108. p. 7-8; https://www.regulations.gov/document?D=EERE-2010-BT-STD-0027-0110.

[10] See, for example: https://www.baldor.com/catalog/CEDM3710T#tab=%22performance%22.

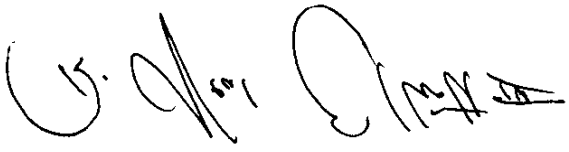
frequencies other than 60 Hz.[11] In such a case, it is unclear which frequency should be used for testing. We support DOE defining "rated frequency" as "60 Hz" to remove any ambiguity in the test procedure and to ensure that the test procedure reflects the operating frequency in the U.S. DOE has proposed 60 Hz as the rated frequency in the small motors test procedure docket and should do the same in this docket.

We support DOE defining "rated load" as "the rated motor horsepower of an electric motor."
DOE explains in the RFI that industry standards use "rated load" to represent output power (horsepower). Since these terms are used for determining the applicable efficiency requirement, they must be clearly defined. This specification will help clarify the meaning of "rated load" and ensure that test procedures are applied consistently.

Motors should be tested at all nameplate voltages.
In response to the 2017 RFI, motor manufacturers and motor testing experts (UL and Advanced Energy), wrote that voltage affects motor efficiency.[12] We understand that motors often have more than one nameplate voltage. We are concerned that allowing the manufacturer to select the voltage for testing will result in inconsistent ratings across products and allow for gaming of the test procedure. A manufacturer could rate at a favorable voltage, even if the motor is unlikely to be used at that voltage. Also, allowing the manufacturer to select the voltage for testing would mean that efficiency ratings would not be comparable across products since different manufacturers may choose different voltages for testing. For example, one manufacturer could choose to test at the least-efficient voltage, while another could test at the most-efficient voltage. Yet purchasers would have no way of knowing that the two product ratings are not comparable. Furthermore, a manufacturer choosing to test at the most-efficient voltage may gain an unfair price advantage over a manufacturer that provides a rating that reflects all the nameplate voltages (i.e. based on the least-efficient voltage). We urge DOE to require that electric motors be tested at all nameplate voltages and meet the minimum efficiency standards at all nameplate voltages. Alternatively, if the relationship between voltage and efficiency is known, DOE could require certification at the least efficient voltage, which would protect against over-representation of efficiency performance. We understand that the lowest rated voltage may be the least efficient voltage.

Thank you for considering these comments.

Sincerely,



Andrew deLaski
Executive Director
Appliance Standards Awareness Project

R. Neal Elliott
Senior Director for Research
American Council for an Energy-Efficient Economy

[11] 85 Fed. Reg. 34116.
[12] Ibid., 17017-18.

Lauren Urbanek
Senior Energy Policy Advocate
Natural Resources Defense Council