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

April 14, 2023

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

RE: Docket Number EERE-2022-BT-TP-0019: Test Procedures for Compressors

Dear Mr. Dommu:

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), and the Natural Resources Defense Council (NRDC) on the notice of proposed rulemaking (NOPR) for test procedures for compressors. 88 Fed. Reg. 9199 (February 13, 2023). We appreciate the opportunity to provide input to the Department.

In the NOPR, DOE has proposed only two minor amendments to the air compressors test procedure: 1) correcting an error in the pressure ratio at full-load operating pressure formula and 2) clarifying in the definition of "air compressor" [1] that a compressor may comprise of one or more compressor elements. We continue to encourage DOE to expand the test procedure scope to include compressors greater than 200 hp as well as reciprocating compressors, centrifugal compressors, lubricant-free compressors, and compressors with brushed motors. We also encourage DOE to explore including both fixed speed unloaded power measurements and voluntary part-load testing of variable-airflow fixed speed compressors into the test procedure. Each of these considerations is discussed in more detail below.

We encourage DOE to expand the test procedure scope to include rotary air compressors greater than 200 hp. The current air compressors test procedure applies to lubricated rotary air compressors that are driven by three-phase brushless electric motors, have a full-load operating pressure of 75-200 psig, full-load volume flow rates of 35-1250 CFM, are 10-200 hp, and do not meet American Petroleum Institute Standard 619 specifications.[2] According to prior comments from the California Investor-Owned Utilities (CA IOUs), compressors in the 200-500 hp range represent one-quarter of all compressor energy usage.[3] In the 2016 test procedure NOPR, DOE proposed to include compressors up to 500 hp within the test procedure scope, and the CA IOUs,[4] Atlas Copco,[5] and the Edison Electric Institute[6] previously expressed

[1]Amended definition: A compressor designed to compress air that has an inlet open to the atmosphere or other source of air, and is made up of ~~a compression element~~ one or more compression elements (bare compressors), driver(s), mechanical equipment to drive the compression elements, and any ancillary equipment.
[2]88 Fed. Reg. 9202.
[3]p. 6, www.regulations.gov/comment/EERE-2022-BT-TP-0019-0014
[4]p. 4, www.regulations.gov/comment/EERE-2014-BT-TP-0054-0012
[5]p. 11, www.regulations.gov/comment/EERE-2014-BT-TP-0054-0009
[6]p. 3, www.regulations.gov/comment/EERE-2013-BT-STD-0040-0012

support for coverage of compressors greater than 500 hp. However, in the 2017 Final Rule DOE ultimately limited the scope to 200 hp.

DOE has tentatively determined in the NOPR that the same burden concerns discussed in the January 2017 Final Rule exist in the current compressor market.[7] In the final rule, DOE stated that the provisions required by the test procedure may cause significant burden for compressors greater than 200 hp since many of the larger horsepower models are custom or infrequently built.[8] Additionally, DOE stated that inclusion of rotary compressors beyond the current scope (10-200 hp) could create a competitive disadvantage for manufacturers, as other compressor types (centrifugal, reciprocating, and scroll compressors) that may compete with included rotary compressors are not within scope.

We disagree with DOE's rationale for excluding rotary compressors greater than 200 hp for several reasons. First, Compressed Air & Gas Institute (CAGI) performance data is already available for many of these larger models.[9] Second, while we acknowledge that larger compressors have lower shipment numbers, DOE has recently expanded the scope of the electric motors test procedure to 750 hp;[10] very large electric motors are also often low volume, custom products. Next, we understand that most compressor manufacturers make both in-scope rotary compressors and out-of-scope compressors. Thus, it is unclear whether certain manufacturers would be disadvantaged by inclusion of larger rotary compressors. Finally, as discussed below, DOE should consider expanding the test procedure scope to currently out-of-scope compressor types; this would mitigate concern over disadvantaging certain manufacturers or pushing the market towards out-of-scope substitutions.

We encourage DOE to further consider expansion of the test procedure scope to include additional air compressor types. There are several additional air compressor types excluded from the current test procedure that represent a significant portion of the market. In some cases, these currently out-of-scope air compressors may serve as unregulated substitutes for in-scope rotary compressors. Expanding the test procedure scope to these additional air compressor types will ensure that purchasers have access to consistent information about compressor efficiency and that DOE's regulations do not distort market demand towards unregulated compressors.

We continue to encourage DOE to consider expanding the test procedure scope to include the following air compressor types:

> Reciprocating compressors: As part of the prior energy conservation standards rulemaking, DOE estimated that standards for reciprocating compressors could net over 2 quads of energy savings,[11] but the Department ultimately did not adopt standards for reciprocating compressors. In the 2017 Final Rule, DOE concluded that establishing a test procedure for reciprocating compressors was not warranted in the absence of existing or proposed standards.[12] Given the significant potential energy savings for reciprocating compressors, we encourage DOE to consider inclusion of reciprocating compressors within the test procedure scope. Inclusion of reciprocating compressors within the test

[7] 88 Fed. Reg. 9203.
[8] 82 Fed. Reg. 1052, 1061 (January 4, 2017).
[9] See for example: www.atlascopco.com/en-us/compressors/cagi-data-sheets/ga-355-500-series; www.ingersollrand.com/en-us/air-compressor/cagi-data-sheets/contact-cooled-rotary
[10] 87 Fed. Reg. 63588 (October 19, 2022).
[11] pp. 8-27, 8-28, 10-15, www.regulations.gov/document/EERE-2013-BT-STD-0040-0037
[12] 82 Fed. Reg. 1052, 1059 (January 4, 2017).

procedure scope would allow DOE to pursue future energy conservation standards and could provide helpful efficiency data to support voluntary programs. ISO 1217, which forms the basis for DOE's test procedure, specifies methods for testing positive displacement compressors. Reciprocating compressors are a type of positive displacement compressors and thus DOE could use ISO 1217, along with additional representative test points, to test and rate reciprocating compressors.

Centrifugal compressors: Centrifugal compressors, also known as dynamic compressors, represent about one-sixth of total industrial compressor energy usage according to the 2021 AMO motors report.[13] Given the significance of their energy usage and the fact that centrifugal compressors may compete with larger rotary compressors, we encourage DOE to include them within the scope of the test procedure. ISO 5389, the industry test procedure for dynamic compressors, could potentially serve as the basis for a DOE test procedure for centrifugal compressors.

Lubricant-free compressors: In the previous test procedure NOPR, DOE did not propose to limit scope based on compressor lubrication. However, concerns were raised that dynamic compressors and scroll compressors, both of which are excluded from the test procedure scope, could become attractive substitutes for lubricant-free rotary compressors. In the 2017 Final Rule, DOE agreed, stating that including lubricant-free rotary compressors could create a risk of unregulated product substitutions and thus excluded them from the adopted test procedure.[14] While we understand this concern, we encourage DOE to mitigate the risk of unregulated product substitutions by expanding scope to include additional compressor types, rather than by excluding lubricant-free compressors.

Compressors with brushed motors: DOE's test procedure covers only compressors utilizing brushless motors. DOE noted previously that air compressors using brushed motors represent a small portion of the market, but that the Department could consider compressors using brushed motors as part of a future rulemaking.[15] We are concerned that manufacturers could consider replacing brushless motors with less efficient brushed motors to avoid compressor regulations.

We encourage DOE to explore how unloaded power measurements could be incorporated into the test procedure. Fixed speed air compressors are tested and evaluated only at full load. However, fixed speed compressors often include controls such as "load/unload" or "start/stop". Testing and evaluating fixed speed compressor efficiency at both fully loaded and fully unloaded (i.e., zero flow) conditions would be more representative of typical usage. We understand that the CAGI Performance Verification Program already specifies testing at a fully unloaded test point. DOE argues in the NOPR that, based on data from the CA IOUs, the unloaded energy consumption is only 6-14% of total energy consumption.[16] However, we believe that capturing differences in unloaded power usage (e.g., 15% vs. 35% of full load power) will become increasingly important as compressor efficiencies improve.

We encourage DOE to include voluntary testing and reporting of part-load performance of fixed speed compressors with variable-airflow controls. Fixed speed compressors sold with variable-airflow controls, such as "variable displacement" or "inlet modulation," can provide similar utility as variable-

[13]P. Rao *et al*. p. 38. U.S. Industrial and Commercial Motor System Market Assessment Report, 2021. escholarship.org/content/qt42f631k3/qt42f631k3.pdf
[14]82 Fed. Reg. 1052, 1063 (January 4, 2017).
[15]88 Fed. Reg. 9204.
[16]Available data suggests unloaded power is 15-35% of full-load power and that compressors are unloaded about 40% of the time. 15-35% x 40% = 6-14%.

speed compressors. Thus, we believe that DOE should provide specific voluntary provisions to test and rate compressors with variable-airflow controls (e.g., using the variable-speed compressor test points at 40%, 70% and 100% of full load). Part-load testing of fixed speed compressors with airflow controls would facilitate comparison of part-load efficiency among variable-airflow compressors as well as between variable-airflow and variable-speed compressors; these provisions would also ensure that any manufacturer representations of variable-airflow compressor part-load performance are consistent across the industry.

Thank you for considering these comments.

Sincerely,

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