DEPARTMENT OF ENERGY

10 CFR Parts 429 and 431

[EERE–2017–BT–TP–0029]

RIN 1904–AE05

Energy Conservation Program: Test Procedure for Water-Source Heat Pumps

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

ACTION: Notice of proposed rulemaking and request for comment.

SUMMARY: The U.S. Department of Energy (''DOE'') proposes to amend its test procedures for water-source heat pumps, with the main changes being ones to expand the scope of applicability of the test procedure, reference different industry standards than currently referenced, change to a seasonal cooling efficiency metric, and change the test conditions used for the heating metric. DOE has tentatively determined that the amended test procedure would produce results that are more representative of an average use cycle and more consistent with current industry practice without being unduly burdensome to conduct. DOE seeks comment from interested parties on this proposal.

DATES:

Comments: DOE will accept comments, data, and information regarding this proposal no later than October 31, 2022. See section V, ''Public Participation,'' for details.

Public Meeting: DOE will hold a public meeting via webinar on Wednesday, September 14, 2022, from 1:00 p.m. to 3:00 p.m. See section V, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *www.regulations.gov,* under docket number EERE–2017–BT–TP–0029. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2017–BT–TP–0029 and/or RIN 1904–AE05, by any of the following methods:

Email: WSHP2017TP0029@ee.doe.gov. Include the docket number EERE–2017–BT–TP–0029 and/or RIN 1904–AE05 in the subject line of the message.

Postal Mail: Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. If possible, please submit all items on a compact disc (''CD''), in which case it is not necessary to include printed copies.

Hand Delivery/Courier: Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza SW, 6th Floor, Washington, DC 20024. Telephone: (202) 287–1445. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

No telefacsimiles (''faxes'') will be accepted. For detailed instructions on submitting comments and additional information on this process, see section V of this document (Public Participation).

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

The docket web page can be found at *www.regulations.gov/docket?D=EERE-2017-BT-TP-0029.* The docket web page contains instructions on how to access all documents, including public comments, in the docket. See section V (Public Participation) for information on how to submit comments through *www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT:

Ms. Catherine Rivest, 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. Telephone: (202) 586–7335. Email: *ApplianceStandardsQuestions@ee.doe.gov.*

Mr. Eric Stas, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–5827. Email: *Eric.Stas@hq.doe.gov.*

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting webinar, contact the Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

SUPPLEMENTARY INFORMATION: DOE proposes to incorporate by reference already-approved industry standards, an update to one of those standards, and a standard not previously-approved.

ANSI/ASHRAE Standard 37–2009, ''Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment,'' including errata sheet issued March 27, 2019, ASHRAE approved June 24, 2009.

Copies of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (''ASHRAE'') ANSI/ASHRAE Standard 37–2009 are available from the American National Standards Institute (''ANSI''), 25 W. 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4900, or online at: *https://webstore.ansi.org/.*

ASHRAE errata sheet to ANSI/ASHRAE Standard 37–2009—Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment, ANSI/ASHRAE Approved March 27, 2019.

Copies of ASHRAE errata sheet to ANSI/ASHRAE Standard 37–2009 are available from ASHRAE, 180 Technology Parkway NW, Peachtree Corners, GA 30092, (404)–636–8400, or online at *https://ashrae.org/.*

ISO Standard 13256–1:1998, ''Water-source heat pumps—Testing and rating for performance—Part 1: Water-to-air and brine-to-air heat pumps,'' ISO approved 1998.

Copies of ISO Standard 13256–1:1998 can be obtained from the International Organization for Standardization (''ISO''), Chemin de Blandonnet 8 CP 401, 1214 Vernier, Geneva, Switzerland, +41 22 749 01 11, or online at: *https://webstore.ansi.org/.*

AHRI Standard 340/360–2022 (I–P), ''2022 Standard for Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment,'' AHRI-approved January 26, 2022.

Copies of AHRI Standard 340/360–2022 (I–P) can be obtained from the Air-Conditioning, Heating, and Refrigeration Institute (''AHRI''), 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, (703) 524–8800, or online at: *www.ahrinet.org/search-standards.aspx.*

See section IV.M of this document for further discussion of these standards.

Table of Contents

I. Authority and Background

Water-source heat pumps (''WSHPs'') are a category of small, large, and very large commercial package air-conditioning and heating equipment,[1] which are included in the list of ''covered equipment'' for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6311(1)(B)–(D)) DOE's energy conservation standards and test procedures for WSHPs are currently prescribed in title 10 of the Code of Federal Regulations (''CFR'') at 10 CFR 431.97 and 10 CFR 431.96, respectively. The following sections discuss DOE's authority to establish and amend test procedures for WSHPs, as well as relevant background information regarding DOE's consideration of test procedures for this equipment.

A. Authority

The Energy Policy and Conservation Act, as amended (''EPCA''),[2] Public Law 94–163 (42 U.S.C. 6291–6317, as codified), among other things, authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, Part C[3] of EPCA, added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. This equipment includes small, large, and very large commercial package air-conditioning and heating equipment, including WSHPs. (42 U.S.C. 6311(1)(B)–(D))

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

The Federal testing requirements consist of test procedures that manufacturers of covered equipment must use as the basis for: (1) certifying to DOE that their equipment complies with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6316(b); 42 U.S.C. 6296), and (2) making representations about the efficiency of that equipment (42 U.S.C. 6314(d)). Similarly, DOE uses these test procedures to determine whether the equipment complies with relevant standards promulgated under EPCA.

Federal energy efficiency requirements for covered equipment established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6316(a) and (b); 42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions of EPCA. (42 U.S.C. 6316(b)(2)(D))

Under 42 U.S.C. 6314, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered equipment. EPCA requires that any test procedures prescribed or amended under this section must be reasonably designed to produce test results which reflect energy efficiency, energy use, or estimated annual operating cost of covered equipment during a representative average use cycle and requires that test procedures not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

[1] The Energy Policy and Conservation Act, as amended (''EPCA'') defines ''commercial package air conditioning and heating equipment'' as air-cooled, water-cooled, evaporatively-cooled, or water-source (not including ground-water-source) electrically operated unitary central air conditioners and central air conditioning heat pumps for commercial application. (42 U.S.C. 6311(8)(A)) EPCA further defines ''small commercial package air conditioning and heating equipment'' as commercial package air conditioning and heating equipment that is rated below 135,000 Btu per hour (cooling capacity); ''large commercial package air conditioning and heating equipment'' as commercial package air conditioning and heating equipment that is rated at or above 135,000 Btu per hour and below 240,000 Btu per hour (cooling capacity); and ''very large commercial package air conditioning and heating equipment'' as commercial package air conditioning and heating equipment that is rated at or above 240,000 Btu per hour and below 760,000 Btu per hour (cooling capacity). (42 U.S.C. 6311(8)(B)–(D))

[2] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116–260 (Dec. 27, 2020), which reflects the last statutory amendments that impact Parts A and A–1 of EPCA.

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

With respect to WSHPs, EPCA requires that the test procedures shall be those generally accepted industry testing procedures or rating procedures developed or recognized by the Air-Conditioning, Heating, and Refrigeration Institute (''AHRI'') or by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (''ASHRAE''), as referenced in ASHRAE Standard 90.1, ''Energy Standard for Buildings Except Low-Rise Residential Buildings'' (''ASHRAE Standard 90.1''). (42 U.S.C. 6314(a)(4)(A)) Further, if such an industry test procedure is amended, DOE must amend its test procedure to be consistent with the amended industry test procedure, unless DOE determines, by rule published in the **Federal Register** and supported by clear and convincing evidence, that the amended test procedure would not produce test results that reflect the energy efficiency, energy use, and estimated operating costs of that equipment during a representative average use cycle or would be unduly burdensome to conduct. (42 U.S.C. 6314(a)(4)(B))

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered equipment, including WSHPs, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle. (42 U.S.C. 6314(a)(1))

In addition, if the Secretary determines that a test procedure amendment is warranted, DOE must publish proposed test procedures in the **Federal Register** and afford interested persons an opportunity (of not less than 45 days duration) to present oral and written data, views, and comments on the proposed test procedures. (42 U.S.C. 6314(b)) If DOE determines that test procedure revisions are not appropriate, DOE must publish in the **Federal Register** its determination not to amend the test procedures. (42 U.S.C. 6314(a)(1)(A)(ii))

In this notice of proposed rulemaking (''NOPR''), DOE is proposing amendments to the test procedures for WSHPs in satisfaction of the 7-year-lookback obligations under EPCA. (42 U.S.C. 6314(a)(1))

B. Background

DOE's existing test procedure for WSHPs is specified at 10 CFR 431.96 (''Uniform test method for the measurement of energy efficiency of commercial air conditioners and heat pumps''). The Federal test procedure currently incorporates by reference International Organization for Standardization (''ISO'') Standard 13256–1 (1998), ''Water-source heat pumps—Testing and rating for performance—Part 1: Water-to-air and brine-to-air heat pumps,'' (''ISO 13256–1:1998''). This is the test procedure specified by ASHRAE Standard 90.1 for water-source heat pumps.

DOE initially incorporated ISO 13256–1:1998 as the referenced test procedure for WSHPs on October 21, 2004 (69 FR 61962), and DOE last reviewed the test procedure for WSHPs as part of a final rule for commercial package air conditioners and heat pumps published in the **Federal Register** on May 16, 2012 (''May 2012 final rule''; 77 FR 28928). In the May 2012 final rule, DOE retained the reference to ISO 13256–1:1998 but adopted additional provisions for equipment set-up at 10 CFR 431.96(e), which provide specifications for addressing key information typically found in the installation and operation manuals. *Id* at 77 FR 28991.

On June 22, 2018, DOE published a request for information (''RFI'') in the **Federal Register** to collect information and data to consider amendments to DOE's test procedures for WSHPs. 83 FR 29048 (''June 2018 RFI'').[4] As part of the June 2018 RFI, DOE identified and requested comment on several issues associated with the currently applicable Federal test procedures, in particular concerning methods that are adopted through incorporation by reference of the applicable industry standard; efficiency metrics and calculations; additional specifications for the test methods; and any additional topics that may inform DOE's decisions in a future test procedure rulemaking, including methods to reduce regulatory burden while ensuring the test procedure's accuracy. *Id.*

DOE received comments in response to the June 2018 RFI from the interested parties listed in Table I–1.

TABLE I–1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE JUNE 2018 RFI

Commenter(s)	Reference in this NOPR	Commenter type
Air-Conditioning, Heating, and Refrigeration Institute	AHRI	IR.
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, Natural Resources Defense Council.	Joint Advocates	EA.
Northwest Energy Efficiency Alliance	NEEA	EA.
Pacific Gas and Electric Company, San Diego Gas and Electric, and Southern California Edison; collectively referred to as the California Investor-Owned Utilities.	CA IOUs	U.
Trane Technologies	Trane	M.
WaterFurnace International	WaterFurnace	M.

EA: Efficiency/Environmental Advocate; IR: Industry Representative; M: Manufacturer; U: Utility.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[5]

In May 2021, ISO published an updated version of Standard 13256–1, ISO Standard 13256–1 (2021), ''Water-source heat pumps—Testing and rating for performance—Part 1: Water-to-air and brine-to-air heat pumps,'' (''ISO 13256–1:2021''). ISO 13256–1:2021 is discussed further in section III.D of this NOPR.

II. Synopsis of the Notice of Proposed Rulemaking

In this NOPR, DOE is proposing to amend the Federal test procedures for WSHPs as follows: (1) expand the scope of the test procedure to include WSHPs

[4] An extension of the comment period for the June 2018 RFI was published in the **Federal Register** on July 9, 2018. 83 FR 31704.

[5] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop test procedures for WSHPs. (Docket No. EERE–2017–BT–TP–0029, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

with capacities between 135,000 and 760,000 British thermal units per hour (''Btu/h''); (2) incorporate by reference AHRI Standard 340/360–2022 (I–P), ''2022 Standard for Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment'' (''AHRI 340/360–2022''), and ANSI/ASHRAE Standard 37–2009, ''Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment'' (''ANSI/ASHRAE 37–2009'') as the applicable test procedures for WSHPs, instead of the currently referenced industry test procedure ISO 13256–1:1998; (3) establish provisions for a new cooling efficiency metric, integrated energy efficiency ratio (''IEER''), for WSHPs and provide an alternative method of calculating IEER using interpolation from test conditions commonly used for WSHPs; (4) modify the test conditions for measuring the heating coefficient of performance (''COP'') and provide an alternative method of calculating COP using interpolation from test conditions commonly used for WSHPs; (5) include additional specification of setting airflow and external static pressure (''ESP'') for non-ducted units and ducted units with discrete-step fans; (6) specify liquid ESP requirements for units with integral pumps and include a method to account for total pumping effect for units without integral pumps; (7) specify components that must be present for testing; and (8) amend certain provisions related to representations and enforcement in 10 CFR part 429.

DOE proposes to implement these changes by adding new appendices C and C1 to subpart F of part 431, with both to be titled ''Uniform Test Method for Measuring the Energy Consumption of Water-Source Heat Pumps,'' (''appendix C'' and ''appendix C1,'' respectively). The current DOE test procedure for WSHPs would be relocated to appendix C without change, and the new test procedure adopting AHRI 340/360–2022 and ANSI/ASHRAE 37–2009 and any other amendments would be set forth in proposed appendix C1 for determining IEER. As discussed elsewhere in this NOPR, DOE has tentatively concluded, supported by clear and convincing evidence, that the proposed amended test procedure in appendix C1 (relying on AHRI 340/360–2022 and ASHRAE 37–2009) would provide more representative results and more fully comply with the requirements of 42 U.S.C. 6314(a)(2) than testing with the current Federal test procedure (relying on ISO 13256–1:1998). However, use of proposed appendix C1 would not be required until such time as compliance is required with amended energy conservation standards for WSHPs based on IEER, should DOE adopt such standards, although a manufacturer would need to make any voluntary early representations of IEER in accordance with appendix C1.

DOE's proposed actions are summarized in Table II–1 and addressed in detail in section III of this document.

TABLE II–1—SUMMARY OF CHANGES IN THE PROPOSED TEST PROCEDURE RELATIVE TO THE CURRENT TEST PROCEDURE FOR WSHPS

Current DOE test procedure	Proposed test procedure in Appendix C1	Attribution
Scope is limited to units with cooling capacity less than 135,000 Btu/h.	Expands the scope of the test procedure to additionally include units with cooling capacity greater than or equal to 135,000 Btu/h and less than 760,000 Btu/h.	Harmonize with scope of test procedure for water-cooled commercial unitary air conditioners.
Incorporates by reference ISO 13256–1:1998	Incorporates by reference AHRI 340/360–2022 and ANSI/ASHRAE 37–2009.	Improve representativeness of test procedure.
Includes provisions for determining EER metric	Includes provisions for determining IEER, and specifies an alternative method of calculating IEER using interpolation and extrapolation from results of testing at ISO 13256–1:1998 temperatures.	Improve representativeness of test procedure.
Specifies test condition of 68 °F for measuring COP.	Changes the test condition for COP to 55 °F and provides an alternative method of calculating COP using interpolation from results of testing at ISO 13256–1:1998 temperatures.	Improve representativeness of test procedure.
Does not include specification of setting airflow and ESP for non-ducted units or ducted units with discrete-step fans.	Includes additional specification of setting airflow and ESP for non-ducted units and for ducted units with discrete-step fans.	Improve representativeness of test procedure.
Allows for testing at any liquid ESP with an adjustment to include the pump power to overcome liquid internal static pressure.	Specifies liquid ESP requirements for units with integral pumps, and includes a method for accounting for the total pumping effect for units without integral pumps.	Improve representativeness of test procedure.
Does not include WSHP-specific provisions for determination of represented values in 10 CFR 429.43.	Includes provisions in 10 CFR 429.43 specific to WSHPs to prevent cooling capacity over-rating and to determine represented values for models with specific components.	Establish WSHP-specific provisions for determination of represented values.
Does not include WSHP-specific enforcement provisions in 10 CFR 429.134.	Adopts product-specific enforcement provisions for WSHPs regarding verification of cooling capacity, testing of systems with specific components, and DOE IEER testing.	Establish provisions for DOE testing of WSHPs.

DOE has tentatively determined that the proposed amendments described in section III of this NOPR regarding the establishment of appendix C would not alter the measured efficiency of WSHPs or require retesting solely as a result of DOE's adoption of the proposed amendments to the test procedure, if made final. DOE has tentatively determined that the proposed test procedure amendments in appendix C1 would, if adopted, alter the measured efficiency of WSHPs. DOE has tentatively determined that the proposed amendments would increase the cost of testing relative to the current Federal test procedure. Use of the proposed appendix C1 and the proposed amendments to the representation requirements in 10 CFR 429.43 would not be required until the compliance date of amended standards denominated in terms of IEER, although manufacturers would need to use appendix C1 if they choose to make voluntary representations of IEER prior to the compliance date. DOE's proposed actions are discussed in further detail in section III of this NOPR.

III. Discussion

In the following sections, DOE proposes certain amendments to the Federal test procedure for WSHPs. For each proposed amendment, DOE provides relevant background information, explains why the amendment merits consideration, discusses any relevant public comments, and proposes a potential approach.

A. Scope of Applicability

This rulemaking applies to WSHPs, which are a category of small, large, and very large commercial package air-conditioning and heating equipment. (*See* 42 U.S.C. 6311(1)(B)–(D)) In its regulations, DOE defines WSHP as ''a single-phase or three-phase reverse-cycle heat pump that uses a circulating water loop as the heat source for heating and as the heat sink for cooling. The main components are a compressor, refrigerant-to-water heat exchanger, refrigerant-to-air heat exchanger, refrigerant expansion devices, refrigerant reversing valve, and indoor fan. Such equipment includes, but is not limited to, water-to-air water-loop heat pumps.'' 10 CFR 431.92.

The current Federal test procedure and energy conservation standards apply to WSHPs with a rated cooling capacity below 135,000 Btu/h. 10 CFR 431.96, Table 1 and 431.97, Table 3. However, DOE has identified WSHPs on the market with cooling capacities equal to or greater than 135,000 Btu/h.[6] In the June 2018 RFI, DOE sought data and information on the size of the market for WSHPs with a cooling capacity over 135,000 Btu/h and any potential limitations to testing such units. 83 FR 29048, 29050 (June 22, 2018).

The Joint Advocates encouraged DOE to include WSHPs over 135,000 Btu/h within the scope of the test procedure. (Joint Advocates, No. 10 at p. 1)

AHRI, Trane, and WaterFurnace stated that the market for WSHPs over 135,000 Btu/h is very small—around 0.7 percent of the market—and that finding a lab to test these units would be difficult for the reasons that follow. AHRI commented that manufacturers have limitations on the size of units that can be tested in their own labs, so the proposed expanded scope of the WSHP test procedure to encompass units with higher rated capacities would necessitate the use of third-party labs, resulting in additional costs for testing. AHRI and WaterFurnace further commented that WSHPs in this capacity range are highly customized for their application and asserted that testing them would incur significant costs. Trane added that no independent test labs are currently certified to test WSHPs over 135,000 Btu/h. (Trane, No. 8 at p. 2; AHRI, No. 12 at pp. 3–4; WaterFurnace, No. 7 at pp. 2–3)

Furthermore, AHRI and WaterFurnace argued that units with capacity over 135,000 Btu/h are out of the scope of ISO 13256–1:1998. (AHRI, No. 12 at p. 4; WaterFurnace, No. 7 at p.2) WaterFurnace also commented that AHRI certification costs would be extreme for such a small market due to the need to test three larger and more expensive units for sampling selection of each basic model group, and the likely need to scrap the units after testing due the significant extent of customization of larger units. (WaterFurnace, No. 7 at pp. 2–3)

In response, DOE notes that contrary to the assertions of AHRI and WaterFurnace, no capacity limitation is expressed in ISO 13256–1:1998—the industry standard currently incorporated by reference—or ISO 13256–1:2021. Once again, DOE has identified numerous model lines of WSHPs with cooling capacity over 135,000 Btu/h from a wide variety of manufacturers. The manufacturer literature for all identified model lines includes efficiency representations that are explicitly based on ISO 13256–1:1998.

Additionally, DOE is aware of several independent test labs that have the capability to test WSHPs with cooling capacity over 135,000 Btu/h. DOE conducted investigative testing on multiple WSHP models with cooling capacity over 135,000 Btu/h at one such independent test lab and did not encounter any difficulties specific to units in this capacity range.

Further, AHRI 340/360–2022 and ANSI/ASHRAE 37–2009 include provisions for testing units with capacities over 135,000 Btu/h. Both ASHRAE Standard 90.1 and DOE regulations cover other categories of commercial air conditioning and heating equipment, including water-cooled commercial unitary air conditioners (''WCUACs''), with cooling capacity up to 760,000 Btu/h. DOE has tentatively determined that testing WSHPs with cooling capacity over 135,000 Btu/h would be of comparable burden to testing other commercial air conditioning and heating equipment of similar capacity.

Regarding WaterFurnace's comment that an expansion of test procedure scope would mean that many large units would need to be tested, DOE notes that expanding the scope of the test procedure would not necessitate certification unless DOE were to establish standards for such equipment. Until such a time, an expansion of scope for the test procedure would simplify require that if manufacturers choose to make optional representations of WSHPs with cooling capacity over 135,000 Btu/h, that such optional representations be made in accordance with the DOE test procedure. Further, representations for WSHPs can be made either based on testing (in accordance with 10 CFR 429.43(a)(1)) or based on alternative efficiency determination methods (''AEDMs'') (in accordance with 10 CFR 429.43(a)(2)). An AEDM is a computer modeling or mathematical tool that predicts the performance of non-tested basic models. These computer modeling and mathematical tools, when properly developed, can provide a means to predict the energy usage or efficiency characteristics of a basic model of a given covered product or equipment and reduce the burden and cost associated with testing. Whereas DOE requires at least two units to be tested per basic model when represented values are determined through testing, DOE requires each AEDM to be validated by tests of only two WSHP basic models of any capacity (in accordance with 10 CFR 429.70(c)(2)). Therefore, an expansion of scope for the DOE test procedure would not necessitate the testing of many large units.

For these reasons, DOE has tentatively concluded that testing units with cooling capacity over 135,000 Btu/h is feasible. Moreover, based on the presence on the market of units over 135,000 Btu/h with efficiency ratings and the identification of laboratories capable of testing such units, DOE has tentatively determined that such testing would not be unduly burdensome. Additionally, expanding the scope of DOE's test procedure for WSHPs to include equipment with cooling capacity between 135,000 Btu/h and 760,000 Btu/h would ensure that representations for all WSHPs are made using the same test procedure and that ratings for equipment in this cooling

[6] For simplicity in this NOPR, DOE refers to cooling capacity equal to or greater than 135,000 Btu/h as ''over 135,000'' Btu/h.

capacity range are appropriately representative. Therefore, DOE proposes in this NOPR to expand the scope of applicability of the test procedure to include WSHPs with a cooling capacity between 135,000 and 760,000 Btu/h. Specifically, DOE proposes to update table 1 to 10 CFR 431.96 to include WSHPs with cooling capacity greater than or equal to 135,000 Btu/h and less than 240,000 Btu/h under Large Commercial Package Air-Conditioning and Heating Equipment; and to include WSHPs with cooling capacity greater than or equal to 240,000 Btu/h and less than 760,000 Btu/h under Very Large Commercial Package Air-Conditioning and Heating Equipment. For both capacity ranges, the specified test procedure would be the proposed appendix C, and DOE proposes that any voluntary representations with respect to the energy use or energy efficiency must be made in accordance with appendix C starting 360 days after a test procedure final rule is published in the **Federal Register**. DOE also proposes that, starting 360 days after a test procedure final rule is published in the **Federal Register**, any voluntary representations of IEER must be made in accordance with the proposed appendix C1.

DOE does not currently specify energy conservation standards for WSHPs with cooling capacity over 135,000 Btu/h. DOE would consider any future standards applicable to WSHPs over 135,000 Btu/h in a separate energy conservation standards rulemaking. Manufacturers of WSHPs with cooling capacity over 135,000 Btu/h would not be required to test WSHPs with a cooling capacity over 135,000 Btu/h until such time as compliance with standards for this equipment were required, should DOE adopt such standards, although any voluntary EER representations would need to be based on the test procedure in appendix C, and any voluntary IEER representations would need to be based on the test procedure in appendix C1 starting 360 days after the publication of a test procedure final rule. Additionally, if DOE were to adopt standards for WSHPs in terms of IEER, after the compliance date for those standards, any representations for WSHPs would be required to be made according to appendix C1.

Issue 1: DOE requests comments on the proposed expansion of the scope of applicability of the Federal test procedure to include WSHPs with cooling capacity between 135,000 and 760,000 Btu/h.

B. Definition

As discussed, WSHPs are a category of commercial package air-conditioning and heating equipment. The current definition for ''water-source heat pump'' does not explicitly state that it is ''commercial package air-conditioning and heating equipment.'' This is inconsistent with the definitions of most other categories of commercial package air-conditioning and heating equipment (*e.g.,* computer room air conditioner, single package vertical air conditioner, variable refrigerant flow multi-split air conditioner). 10 CFR 431.92. To provide consistency with other definitions of specific categories of commercial package air-conditioning and heating equipment, DOE proposes to amend the definition of ''water-source heat pump'' to explicitly indicate that WSHPs are a category of commercial package air-conditioning and heating equipment. This proposed clarification to the ''water-source heat pump'' definition would not change the scope of equipment covered by the definition.

In addition, DOE is proposing to amend the WSHP definition to clarify that an indoor fan is not an included component for coil-only WSHPs. The current definition lists the main components of a WSHP, and it includes ''indoor fan'' on that list. However, DOE has identified coil-only WSHPs on the market that rely on a separately installed furnace or modular blower for indoor air movement. To clarify that coil-only WSHPs are indeed covered under the WSHP definition, DOE is proposing to include the parenthesized statement ''except that coil-only units do not include an indoor fan'' in the sentence listing the main components in the WSHP definition.

In summary, DOE proposes to amend the definition of WSHP as follows:

''*Water-source heat pump* means commercial package air-conditioning and heating equipment that is a single-phase or three-phase reverse-cycle heat pump that uses a circulating water loop as the heat source for heating and as the heat sink for cooling. The main components are a compressor, refrigerant-to-water heat exchanger, refrigerant-to-air heat exchanger, refrigerant expansion devices, refrigerant reversing valve, and indoor fan (except that coil-only units do not include an indoor fan). Such equipment includes, but is not limited to, water-to-air water-loop heat pumps.''

Issue 2: DOE requests comments on the proposed change to the definition of WSHP to explicitly indicate that WSHP is a category of commercial package air-conditioning and heating equipment and to clarify that the presence of an indoor fan does not apply to coil-only units.

C. Proposed Organization of the WSHP Test Procedure

DOE is proposing to relocate and centralize the current test procedure for WSHPs to a new appendix C to subpart F of part 431. As proposed, appendix C would maintain the substance of the current test procedure. The test procedure as proposed in newly proposed appendix C would continue to reference ISO 13256–1:1998 and provide for determining energy efficiency ratio (''EER'') and COP. The proposed appendix C would centralize the additional test provisions currently applicable under 10 CFR 431.96, *i.e.,* additional provisions for equipment set-up (10 CFR 431.96(e)). As proposed, WSHPs would be required to be tested according to appendix C until such time as compliance is required with an amended energy conservation standard that relies on the IEER metric, should DOE adopt such a standard.

DOE is also proposing to establish a test procedure for WSHPs in a new appendix C1 to subpart F of part 431 that would incorporate by reference AHRI 340/360–2022 and ASHRAE 37–2009 along with additional provisions, as discussed in greater detail in the following sections. As proposed, WSHPs would not be required to test according to the test procedure in proposed appendix C1 until such time as compliance is required with an amended energy conservation standard that relies on the IEER metric, should DOE adopt such a standard, although any voluntary representations of IEER prior to the compliance date must be based on testing according to appendix C1.

D. Industry Standards

1. Applicable Industry Test Procedures

a. ISO Standard 13256–1

As noted in section I.B of this document, the DOE test procedure currently incorporates by reference ISO 13256–1:1998 and includes additional provisions for equipment set-up at 10 CFR 431.96(e), which provide specifications for addressing key information typically found in the installation and operation manuals.

ISO 13256–1:1998 specifies the cooling efficiency metric, EER,[7] which is the ratio of the net total cooling capacity to the effective power input at

[7] DOE defines ''EER'' at 10 CFR 431.92 as the ratio of the produced cooling effect of an air conditioner or heat pump to its net work input, expressed in BTU/watt-hour.

a single set of operating conditions. Table 1 of ISO 13256–1:1998 specifies six sets of operating conditions for determining EER values based on variation in entering water temperature (''EWT'') [8] and, for models with capacity control (*i.e.,* multiple compressor stages), whether the test is a full-load or part-load test. The initial three sets, referred to as ''standard rating test'' conditions in Table 1 of ISO 13256–1:1998, are used to determine full-load EER values, which represent the cooling efficiency for a WSHP operating at its maximum capacity in the most demanding conditions (*i.e.,* highest EWT) that the WSHP would regularly encounter. The three standard rating test conditions in Table 1 of ISO 13256–1:1998 differ in terms of EWT, in that they represent the highest EWT that would be regularly encountered in different specific applications (*i.e.,* 86 °F for water-loop, 59 °F for ground-water, and 77 °F for ground-loop heat pumps).[9] The standard rating test conditions specified for water-loop heat pumps are used in the current DOE test procedure.

The next three sets of operating conditions for determining EER, referred to as ''part-load rating test'' conditions in Table 1 of ISO 13256–1:1998, are specified to determine EER values at less than full capacity for models with capacity control. As with the standard rating test conditions, Table 1 of ISO 13256–1:1998 specifies part-load rating test conditions for different specific applications (*i.e.,* 86 °F for water-loop, 59 °F for ground-water, and 68 °F for ground-loop heat pumps). None of the part-load rating test conditions are used in the current DOE test procedure. Although Table 1 of ISO 13256–1:1998 specifies conditions for determining EER for multiple applications and (as applicable) capacity levels, ISO 13256–1:1998 does not include any seasonal cooling efficiency metrics.

Additionally, unlike the test methods for other categories of commercial package air conditioners and heat pumps (*e.g.,* AHRI 340/360–2022 for commercial unitary air conditioners and heat pumps (''CUAC/HPs''); AHRI Standard 1230–2021, ''2021 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment'' (''AHRI 1230–2021''), for variable refrigerant flow air conditioners (''VRF multi-split systems''); AHRI Standard 390–2021, ''2021 Standard for Performance Rating of Single Package Vertical Air-Conditioners and Heat Pumps'' (''AHRI 390–2021''), for single package vertical units (''SPVUs''); and AHRI Standard 210/240–2023, ''2023 Standard for Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment'' (''AHRI 210/240–2023''), for central air conditioners and heat pumps (''CAC/HPs'')), for ducted units ISO 13256–1:1998 does not produce ratings that reflect indoor fan power needed to overcome ESP from ductwork. Instead, section 4.1.3 of ISO 13256–1:1998 includes a fan power adjustment (which assumes a fan efficiency of 0.3 for all units) to be applied such that only the fan power required to overcome the internal static pressure (''ISP'') of the unit is taken into account. The exclusion of fan power to overcome ESP from ductwork in ISO 13256–1:1998 ratings results in higher EER ratings than would be measured if ratings reflected fan power to overcome ESP, thereby being more representative of field applications.

Similar to the treatment of fan power, ISO 13256–1:1998 does not produce ratings that reflect the pump power needed to overcome liquid ESP from the water loop that pipes water to and from the WSHP. Instead, section 4.1.4 of ISO 13256–1:1998 includes a pump power adjustment (which assumes a pump efficiency of 0.3 for all units) to be applied such that only the pump power required to overcome the liquid ISP of the unit is taken into account. ISO 13256–1:1998 also does not specify any liquid ESP requirements for testing. The exclusion of pump power to overcome ESP from system water loop piping in ISO 13256–1:1998 ratings results in higher EER ratings than would be measured if ratings reflected pump power to overcome ESP, thereby being more representative of field applications.

An updated version of ISO Standard 13256–1 (*i.e.,* ISO 13256–1:2021) was published in 2021. While there are numerous changes in ISO 13256–1:2021 (discussed in detail in subsequent sections of this NOPR), the 2021 version maintains provisions for determining EER, and it does not include provisions for determining a seasonal metric that incorporates tests at multiple conditions. ISO 13256–1:2021 also maintains the same indoor fan power adjustment and pump power adjustment as in the 1998 version (see sections 5.1.3 and 5.1.4 of ISO 13256–1:2021), thus continuing to produce ratings that do not reflect fan power and pump power associated with overcoming ESP. As discussed in subsequent sections of this document, DOE is proposing provisions in its test procedures for WSHPs to address the identified shortcomings in ISO 13256–1:1998 and ISO 13256–1:2021.

b. AHRI 340/360–2022 and ASHRAE 37–2009

AHRI 340/360–2022 is the industry test procedure used for testing CUAC/HPs. AHRI 340/360–2022 includes the seasonal cooling metric IEER (see section 6.2 of AHRI 340/360–2022), which reflects cooling performance across a range of operating conditions and load levels. Specifically, IEER is a weighted average of the EER at full-load and several part-load conditions intended to represent the range of conditions that a unit would encounter over a full cooling season. The vast majority of operating hours for commercial air conditioners and heat pumps (including CUAC/HPs and WSHPs) occur when conditions are less demanding than full-load conditions. For example, the IEER metric in section 6.2.2 of AHRI 340/360–2022 specifies that full-load conditions account for only 2 percent of operation. AHRI 340/360–2022 also includes minimum ESP requirements that are intended to reflect ESPs in field installations and includes all indoor fan power needed to overcome the tested ESP in the calculation of IEER (see section 6.1.3.3 of AHRI 340/360–2022). AHRI 340/360–2022 also includes a power adder to account for the power of cooling tower fan motor(s) and circulating water pump(s). Similar to other industry test procedures for commercial package air-conditioning and heating equipment, AHRI 340/360–2022 references ANSI/ASHRAE 37–2009 (see section 5.1.1 of AHRI 340/360–2022), which provides a method of test applicable to many categories of air conditioning and heating equipment. In particular, sections 5 and 6 and appendices C, D, E, and I of AHRI 340/360–2022 reference methods of test in ANSI/ASHRAE 37–2009. As discussed in subsequent sections of this notice, DOE has tentatively concluded that AHRI 340/360–2022 addresses many of the identified shortcomings in ISO 13256–1:1998 and ISO 13256–1:2021.

c. AHRI 600

AHRI is in the process of developing a new industry test standard for WSHPs titled ''AHRI Standard 600 IEER & SCHE Performance Rating of Water/Brine Source Heat Pumps'' (''AHRI 600''). This was formerly designated as AHRI Standard 500P (''AHRI 500P''). DOE has

[8] ''EWT'' is used to describe the entering liquid temperature for WSHPs, which may be water or a brine solution, depending on the liquid temperature used for test.

[9] EWTs are specified in degrees Celsius in ISO 13256–1:1998, but they are referred to by their equivalent values of degrees Fahrenheit in this NOPR to ease comparison with other temperatures discussed elsewhere in this document.

participated in AHRI committee meetings working to develop AHRI 600 since 2019. Based on its interactions with the AHRI committee, DOE understands that AHRI 600 would not include any provisions for testing, but rather would provide a method for calculation of a seasonal cooling efficiency metric for WSHPs (*i.e.,* IEER) based on testing conducted according to ISO 13256–1:1998. Specifically, DOE understands that AHRI 600 would provide for the calculation of IEER for WSHPs via interpolation and extrapolation of test results reflecting the testing temperatures specified in Table 1 of ISO 13256–1:1998, and the rating conditions for the IEER calculation would be based on the EWTs and weighting factors specified in Table 9 and section 6.2 of AHRI 340/360–2022 for determining IEER for water-cooled CUACs. AHRI 600 is still in development and has not yet published. As discussed in subsequent sections of this notice, DOE has tentatively concluded that the general methodology in AHRI 600 for determining IEER is appropriate, although DOE has identified several aspects of the methodology that warrant further modifications.

2. Comments Received on Industry Standards and DOE Responses

In the June 2018 RFI, DOE discussed how the test method used in ISO 13256–1:1998 is similar to ANSI/ASHRAE 37–2009 and that ANSI/ASHRAE 37–2009 is the method referenced by the 2015 version of AHRI 340/360 (the most current version at the time; ''AHRI 340/360–2015''). 83 FR 29048, 29052 (June 22, 2018). DOE also discussed how AHRI 340/360–2015 is referenced by ASHRAE Standard 90.1 for testing WCUACs, and that DOE was considering whether using the same method of test for WSHPs and WCUACs would be appropriate, given the similarities in the design of WSHPs and WCUACs. *Id.* DOE requested comment on whether a single test method could be used for both WSHPs and WCUACs. *Id.* DOE also sought comment on any aspects of design, installation, and application of WSHPs that would make the use of ANSI/ASHRAE 37–2009 infeasible for WSHPs. *Id.*

In response to the June 2018 RFI, AHRI and Trane stated that because ASHRAE Standard 90.1 reaffirmed the ISO 13256–1:1998 standard on October 26, 2018, the statutory trigger provisions of 42 U.S.C. 6314(a)(4)(B) do not provide a basis for DOE to review its WSHP test procedure at that time. (AHRI, No. 12 at p. 1, Trane, No. 8 at p. 1)

In response, DOE notes that in addition to the statutory trigger provisions of 42 U.S.C. 6314(a)(4)(B), the Department is statutorily required to review its test procedures every seven years per the 7-year-lookback requirements at 42 U.S.C. 6314(a)(1), as outlined in section I.A of this NOPR.

AHRI, WaterFurnace, and Trane recommended that DOE wait for the ISO revision process to be completed and adopt the revised version of ISO 13256–1:1998 following a second RFI. (AHRI, No. 12 at p. 6; WaterFurnace, No. 7 at p. 2; Trane, No. 8 at p. 3) AHRI and WaterFurnace further commented that the next version of ISO 13256–1 was expected to publish in early 2019, and these commenters recommended that DOE should support the development of the next version of ISO 13256–1:1998. (AHRI, No. 12 at pp. 3, 12–13; WaterFurnace, No. 7 at pp. 2, 10) AHRI and WaterFurnace also stated that many key authors of ANSI/ASHRAE 37–2009 are on the ISO working group, and that the working group was planning to add clarity to the test method with the next revision of ISO 13256–1:1998. The commenters also stated that minimum ESPs were being considered for inclusion in the revised version of ISO 13256–1:1998. *Id.*

AHRI and WaterFurnace further stated that for international standards, each nation requires slight deviations from the written ISO standard and that the AHRI WSHP/Geothermal Operations Manual[10] provides the U.S. national deviations from ISO 13256–1:1998. (AHRI, No. 12 at p. 2; WaterFurnace, No. 7 at p. 2) They further stated that the AHRI WSHP/Geothermal Operations Manual addresses multiple issues raised by DOE in the June 2018 RFI. *Id.*

In response, DOE notes that ISO 13256–1:2021 also lacks a seasonal cooling efficiency metric and does not produce ratings that reflect fan power and pump power associated with overcoming ESP. As discussed, a seasonal cooling efficiency metric would account for the range of conditions that a unit would encounter over a full cooling season. In addition, the inclusion of fan and pump power associated with overcoming ESP would provide ratings that would be more representative of the power consumption in field applications needed to overcome pressure from ductwork and water piping. Section III.D.3 of this document provides further discussion of these considerations and DOE's preliminary conclusion that alternate test methods that address these key issues would provide a more representative measure of a WSHP's overall energy efficiency.

While an updated version of ISO Standard 13256–1 has published (*i.e.,* ISO 13256–1:2021), DOE is not aware of a deviation process being initiated for the U.S. (*i.e.,* development of the version designated with ''AHRI/ASHRAE'' that is intended for use for testing in the U.S.). DOE understands that the national deviation process will be initiated by a WSHP industry committee, but DOE does not know when that will begin or how long the national deviation process will take. DOE notes that in the past, the WSHP industry committees have taken years longer than expected to develop the revised version of ISO 13256–1, as well as AHRI 600. Specifically, in their RFI comments, AHRI and WaterFurnace stated that they expected the revised ISO 13256–1 to publish in ''early 2019'' and AHRI 600 to publish in 2019, whereas in reality, the revised ISO 13256–1 published in 2021 and AHRI 600 remains as yet unpublished. Therefore, DOE expects that the national deviation process will not be completed for several years, and the Department cannot speculate as to the substantive output of those efforts or a final completion date. Given EPCA's statutory requirement to review the appropriate test procedures for WSHPs every seven years, DOE has tentatively concluded that it would be neither appropriate nor permissible to delay the current rulemaking for the WSHP test procedure until after the completion of the national deviation process (which the Department understands has not yet even begun).

DOE further notes that the AHRI WSHP/Geothermal Operations Manual is not incorporated by reference into the DOE test procedure, nor is it referenced in ASHRAE Standard 90.1. Therefore, the deviations from the ISO standard included in the AHRI WSHP/Geothermal Operations Manual are not reflected in the current DOE test procedure. However, DOE has nonetheless reviewed the AHRI WSHP/Geothermal Operations Manual as part of its consideration of potential amended test procedure provisions in this NOPR.

With regards to use of a part-load efficiency metric, Trane, AHRI, and WaterFurnace commented that industry is currently developing an IEER metric for WSHPs. (Trane, No. 8 at p. 4; AHRI, No. 12 at p. 11; WaterFurnace, No. 7 at p. 9) AHRI and WaterFurnace commented further that the IEER metric

[10] DOE notes that the AHRI geothermal operations manual is available at: *https://www.ahrinet.org/App_Content/ahri/files/Certification/OM%20pdfs/WSHP_OM.pdf* (Last accessed July 29, 2022).

is included in the draft of AHRI 500P [11] and is calculated using performance data from ISO 13256–1:1998. In addition, AHRI and WaterFurnace stated that WSHPs in water-loop applications (*i.e.,* installed with cooling towers) operate with similar water-loop conditions to WCUACs. Therefore, the commenters argued that the provisions used for determining IEER for WSHPs in the draft of AHRI 500P are similar to those included in AHRI 340/360 and AHRI 1230; specifically, the commenters included a table showing that the IEER EWT conditions in the draft of AHRI 500P align with those specified in AHRI 340/360. Both AHRI and WaterFurnace commented that they anticipated AHRI 500P to be completed in 2019. (AHRI, No. 12 at pp. 11–12; WaterFurnace, No. 7 at p. 9)

Once again, DOE notes that AHRI 600 [12] has not yet published, and the Department is unaware as to when that document will be completed. Accordingly, for this NOPR, in addition to proposing a method to determine IEER by testing at the IEER test points specified in Table 9 of AHRI 340/360–2022, DOE is proposing an alternate method of calculating IEER (based on interpolation and extrapolation from results of testing to EWTs specified in Table 1 of ISO 13256–1:1998, rather than testing directly at the EWTs specified for the IEER metric in Table 9 of AHRI 340/360–2022) that DOE understands to be consistent with the approach in the current draft version of AHRI 600. Section III.E.1.b of this NOPR includes further details on the proposed optional approach for calculation of IEER based on interpolation and extrapolation.

DOE also received comments from AHRI, Trane, and WaterFurnace that cautioned against using a different test standard, such as AHRI 340/360, for testing WSHPs instead of ISO 13256–1 as currently specified. (Trane, No. 8 at p. 4; AHRI, No. 12 at p. 12; WaterFurnace, No. 7 at p. 10) AHRI, Trane, and WaterFurnace argued that AHRI 340/360 does not include several important features that are included in ISO 13256–1:1998 such as: provisions for heating performance, performance mapping [13] across a wide temperature range, part-load ratings, application ratings for well water and geothermal, and provisions for testing units with variable-speed compressors. (Trane, No. 8 at p. 4; AHRI, No. 12 at p. 12; WaterFurnace, No. 7 at p. 10) Trane stated that AHRI 340/360 covers only cooling-mode operation of water-cooled units, and that WSHPs require a test procedure that includes both cooling and heating cycle operation. (Trane, No. 8 at p. 4) AHRI and WaterFurnace additionally stated that certain aspects of ISO 13256–1:1998, such as standard rating conditions, are not included in ANSI/ASHRAE 37–2009 because ANSI/ASHRAE 37–2009 is a method of test rather than a test standard. (AHRI, No. 12 at pp. 12–13; WaterFurnace, No. 7 at pp. 10–11) AHRI, Trane, and WaterFurnace further commented that that many aspects of ANSI/ASHRAE 37–2009 are accounted for in ISO 13256–1:1998. (AHRI, No. 12 at p. 13; Trane, No. 8 at p. 4; WaterFurnace, No. 7 at p. 10) AHRI and WaterFurnace also stated that several Environmental Protection Agency (''EPA''), State, utility, and building code requirements reference ISO 13256–1:1998, and they asserted that removing reference to it would have a significant negative impact on the industry and consumers who use efficiency programs and tax credits when selecting equipment. (AHRI, No. 12 at p. 12; WaterFurnace, No. 7 at p. 10)

The following paragraphs provide DOE's responses to concerns expressed by commenters that AHRI 340/360 and ANSI/ASHRAE 37–2009 lack certain provisions that are present in ISO 13256–1 and that are needed for testing WSHPs.

Regarding provisions for heating tests, DOE acknowledges that AHRI 340/360–2022 does not include certain provisions needed for heating-mode testing of WSHPs because WCUACs, the water-cooled units for which AHRI 340/360–2022 is intended to apply, are not heat pumps. Specifically, AHRI 340/360–2022 does not specify the following provisions for a heating test: an EWT test condition, provisions for setting liquid flow rate, or how pump effects are accounted for. Therefore, DOE is proposing additional provisions that would address these aspects of heating-mode tests of WSHPs, as discussed further in sections III.E.2, III.F.4, III.F.5, and III.F.6 of this document. DOE notes that AHRI 340/360–2022 does include provisions appropriate for air-side measurements in heating tests because AHRI 340/360–2022 covers air-cooled commercial unitary heat pumps. Furthermore, ANSI/ASHRAE 37–2009 provides appropriate provisions for a method of test for WSHPs. DOE has tentatively concluded that its proposals for heating provisions for WSHPs would, when combined with the provisions in AHRI 340/360–2022, produce test results representative of an average use cycle.

Regarding performance mapping across a wide temperature range, part-load ratings, and ratings for ground-water and geothermal applications, DOE acknowledges that AHRI 340/360–2022 does not include EWTs specific to multiple applications of WSHPs. By contrast, Table 1 of ISO 13256–1:1998 provides separate EWTs for water-loop, ground-water, and ground-loop WSHP applications (see discussion in section III.D.1.a of this NOPR). AHRI 340/360–2022 includes full-load and part-load cooling EWTs for only water-loop applications of WCUACs, but the EWT for water-loop applications in Table 1 of ISO 13256–1:1998 is the only EWT test condition used in the current DOE test procedure. As discussed in sections III.D.3 and III.E.1 of this NOPR, DOE has tentatively concluded that the seasonal integrated cooling metric IEER specified in section 6.2 of AHRI 340/360–2022 would be more representative of field applications and provide consumers with a better understanding of year-round performance of WSHPs than the EER metric measured at a single temperature and load level. However, DOE recognizes the potential benefits to consumers of allowing manufacturers to continue to provide performance ratings at the temperatures and load levels specified in Table 1 of ISO 13256–1:1998, in addition to providing the proposed IEER ratings which are more representative of year-round performance. Therefore, as discussed in section III.E.1.a of this NOPR, DOE is proposing in section 5.2 of proposed appendix C1 to provide for optional representations of EER at the EWTs and load levels specified in Table 1 of ISO 13256–1:1998. Consequently, DOE has tentatively concluded that the proposals in this NOPR would continue to provide manufacturers the flexibility to offer full-load and part-load EER ratings at multiple temperatures that can be used for performance mapping, representations of part-load performance, and representations of performance for ground-water and geothermal applications.

Regarding variable-speed compressors, section 6.2 of AHRI 340/360–2022 includes appropriate provisions for testing and determining IEER for units with all compressor

[11] As discussed, after DOE received comments in response to the June 2018 RFI, the draft AHRI Standard 500P was redesignated as the draft AHRI Standard 600.

[12] As discussed, after DOE received comments in response to the June 2018 RFI, the draft AHRI Standard 500P was redesignated as the draft AHRI Standard 600.

[13] DOE understands use of the term ''performance mapping'' as referring to making representations of performance across a range of temperature conditions, typically achieved by interpolating or extrapolating from test results obtained at specifically defined test conditions.

types, including variable-speed compressors. Specifically, Section 6.2.6 of AHRI 340/360–2022 includes provisions addressing ''proportionally capacity controlled units,'' which is defined in section 3.22 of AHRI 340/360–2022 to include units incorporating one or more variable-capacity compressors where the compressor capacity can be modulated continuously or in steps not more than 5 percent of the full-load cooling capacity. Section 6.2.6 of AHRI 340/360–2022 includes steps for setting capacity of these units for each IEER test point.

With regards to EPA, State, utility, and building code requirements that reference ISO 13256–1:1998, DOE does not expect that an update to the DOE test procedure for WSHPs would create any particular challenges for any other agency or organization that references the performance ratings as measured by the DOE test procedure. EPCA directs DOE to establish and amend test procedures to be reasonably designed to produce test results which reflect energy efficiency, energy use, and estimated operating costs of covered equipment during a representative average use cycle (as determined by the Secretary), and not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2)) DOE test procedures are updated regularly, across many products and equipment types, and other agencies and organizations have historically updated their requirements as needed in response to those changes. With regard to EPA specifically, DOE has responsibility for developing and revising the test procedures that provide the basis for ratings under EPA's ENERGY STAR program. DOE and EPA work closely together to update ENERGY STAR specifications in response to any changes to the relevant DOE test procedure. Furthermore, DOE is proposing that the amended test procedure would not be required for use until the effective date of any future energy conservation standards based on the IEER metric, thereby providing sufficient advance notice for any agency or organization to adapt program requirements accordingly.

3. Proposal for DOE Test Procedure

As discussed, EPCA requires that test procedures for covered equipment, including WSHPs, be reasonably designed to produce test results which reflect energy efficiency, energy use, and estimated operating costs of a type of industrial equipment (or class thereof) during a representative average use cycle (as determined by the Secretary), and shall not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

For the reasons presented in the remainder of this section, DOE has tentatively determined that the test procedure for WSHPs as proposed would improve the representativeness of the current Federal test procedure for WSHPs and would not be unduly burdensome. Specifically, DOE has tentatively concluded, supported by clear and convincing evidence as discussed in the following paragraphs, that testing WSHPs in accordance with the industry test standards AHRI 340/360–2022 and ASHRAE 37–2009 would provide more representative results and more fully comply with the requirements of paragraph (2) of 42 U.S.C. 6314(a) than testing in accordance with the currently referenced standard ISO 13256–1:1998. Therefore, DOE is proposing to amend the test procedure for WSHPs so as to incorporate by reference in the proposed new appendix C1 the test provisions in AHRI 340/360–2022 and ASHRAE 37–2009, along with certain additional provisions.

Throughout the remainder of the discussion in section III of this NOPR, DOE presents the details and justifications for the proposed test procedure and deviation from the currently referenced industry test procedure, ISO 13256–1:1998 (*i.e.,* the industry test standard referenced in ASHRAE Standard 90.1). The following paragraphs summarize the key areas in which DOE has tentatively concluded, supported by clear and convincing evidence, that the proposal would improve the representativeness of the test procedure:

(1) Cooling efficiency metric: As discussed, the cooling metric specified in the current DOE test procedure (which references ISO 13256–1:1998) is EER, which reflects full-load performance only at a single operating condition. In contrast, IEER, the metric specified in section 6.2 of AHRI 340/360–2022, is a seasonal metric that is a weighted average of the full- and part-load performance at different outdoor conditions intended to represent average efficiency over a full cooling season. For the vast majority of operating hours for WSHPs and other commercial air conditioners and heat pumps installed in the field, loads are at less than full-load capacity. This is because units are sized to be able to provide sufficient air conditioning capacity at the hottest time on the hottest day of the year, but the vast majority of annual cooling hours are at significantly lower outdoor temperatures (and thus lower EWTs), with correspondingly lower cooling loads. This is demonstrated in the IEER metric specified in section 6.2.2 of AHRI 340/360–2022, which specifies a weighting factor for full-load conditions of only 2 percent of the hours included in the IEER metric, with the remaining 98 percent of hours assigned to lower load levels and lower outdoor temperatures. As discussed, from RFI comments and DOE's participation in AHRI 600 committee meetings, DOE understands that the AHRI 340/360–2022 IEER weighting factors are also included in the draft AHRI 600. Therefore, DOE has tentatively concluded that IEER would be more representative of an average use cycle than the EER metric. This topic is discussed further in section III.E.1 of this NOPR.

(2) Fan power and indoor air external static pressure: As discussed, for ducted units, ISO 13256–1:1998 does not produce ratings that reflect the fan power needed to overcome ESP. Further, that ISO standard does not specify ESP requirements for ducted units and instead uses a fan power adjustment, such that ratings reflect only the fan power needed to overcome internal static pressure within the unit and not the ESP from the ductwork that would be installed in the field. In contrast, Table 7 of AHRI 340/360–2022 specifies minimum ESP requirements at which performance is measured. Because ducted WSHPs are manufactured to be installed in the field with ductwork, DOE has tentatively concluded that a WSHP rating that reflects the indoor fan power needed to overcome ESP representative of typical installations (*i.e.,* the approach taken by AHRI 340/360–2022) would produce test results that are more representative of an average use cycle than testing in accordance with ISO 13256–1:1998, the standard currently incorporated by reference.

(3) Pump power and liquid external static pressure: ISO 13256–1:1998 does not produce ratings that reflect the pump power needed to overcome liquid ESP. Further, for units with integral pumps, ISO 13256–1:1998 does not specify ESP requirements and uses a pump power adjustment such that ratings reflect only the pump power needed to overcome internal static pressure within the unit. For units with integral pumps, DOE has tentatively concluded that ratings would be more representative if based on testing at a liquid ESP that is representative of the ESP from water piping in typical installations. For units without integral pumps, DOE has tentatively concluded that ratings would be more

representative if a pump power adder is included in the rating that reflects pump power needed to overcome a field-representative liquid ESP. More discussion on this topic is provided in section III.F.4 of this document.

DOE is proposing to adopt in its WSHP test procedure the following specific sections of AHRI 340/360–2022:

(1) Section 3: Definitions, excluding sections 3.2, 3.4, 3.5, 3.7, 3.8, 3.12, 3.14, 3.15, 3.17, 3.23, 3.26, 3.27, 3.29, 3.30, and 3.36;
(2) Section 5: Test Requirements;
(3) Section 6: Rating Requirements, excluding sections 6.1.1.7, 6.1.2.1, 6.1.3.4.5, 6.1.3.5.4, 6.1.3.5.5, 6.5, 6.6, and 6.7;
(4) Appendix A. References—Normative;
(5) Appendix C. Indoor and Outdoor Air Condition Measurement—Normative;
(6) Appendix E. Method of Testing Unitary Air Conditioning Products—Normative;

The key substantive changes that would result from DOE's proposal to adopt AHRI 340/360–2022 for testing WSHPs include the following:

(1) A new energy efficiency descriptor, IEER, which incorporates part-load cooling performance (see section 6.2 of AHRI 340/360–2022);
(2) Minimum ESP requirements, instructions for setting airflow and ESP, and tolerances for airflow and ESP (see sections 6.1.3.3, 6.1.3.4, and Table 6 of AHRI 340/360–2022);
(3) Fixed inlet and outlet water temperature conditions (see Table 5 of AHRI 340/360–2022);
(4) Operating tolerance for voltage (see Table 10 of AHRI 340/360–2022);
(5) Different indoor air conditions used for testing (see Table 5 of AHRI 340/360–2022);
(6) Refrigerant charging instructions for cases where they are not provided by the manufacturer (see section 5.8 of AHRI 340/360–2022), and
(7) Use of the primary capacity measurement (*i.e.,* indoor air enthalpy method) as the value for capacity, and different provisions for required agreement between primary and secondary capacity measurements (see section E6 of Appendix E to AHRI 340/360–2022).

Appendix E of AHRI 340/360–2022 specifies the method of test, including the use of specified provisions of ANSI/ASHRAE 37–2009. Consistent with AHRI 340/360–2022, DOE is proposing to incorporate by reference ANSI/ASHRAE 37–2009 in its test procedure for WSHPs. Specifically, in section 1 of the proposed test procedure for WSHPs in the proposed appendix C1, DOE is proposing to adopt all sections except sections 1, 2, and 4 of ANSI/ASHRAE 37–2009. The key substantive changes that would result from DOE's proposal to adopt ANSI/ASHRAE 37–2009 for testing WSHPs include the following:

(1) Provisions for split systems, such as accounting for compressor heat and refrigerant line losses (see sections 7.3.3.4, 7.3.4.4, and 7.6.1.2 of ASHRAE 37–2009);
(2) Measurement of duct losses for ducted units (see section 7.3.3.3 of ASHRAE 37–2009);
(3) Standardized heat capacity of water and brine (see section 12.2 of ASHRAE 37–2009), and
(4) A calculation for discharge coefficients (see section 6.3.2 of ASHRAE 37–2009).

Throughout the remainder of this NOPR, DOE discusses substantive differences between the proposed test procedure (including references to AHRI 340/360–2022 and ASHRAE 37–2009) and the current DOE test procedure (which incorporates by reference ISO 13256–1:1998). DOE also identified and considered provisions in the updated industry test procedure ISO 13256–1:2021 that substantively differ from ISO 13256–1:1998.

E. Efficiency Metrics

1. IEER

a. General Discussion

As discussed previously, DOE's current test procedure for WSHPs measures cooling-mode performance in terms of the EER metric, the current regulatory metric. 10 CFR 431.96. EER captures WSHP performance at a single, full-load operating point in cooling mode (*i.e.,* a single EWT) and does not provide a seasonal or load-weighted measure of energy efficiency. A seasonal metric is a weighted average of the performance of cooling or heating systems at different outdoor conditions intended to represent average efficiency over a full cooling or heating season. Several categories of commercial package air-conditioning and heating equipment are rated using a seasonal or part-load metric, such as IEER for CUACs specified in section 6.2 of AHRI 340/360–2022. IEER is a weighted average of efficiency at four load levels representing 100, 75, 50, and 25 percent of full-load capacity, each measured at a specified outdoor condition that is representative of field operation at the given load level. In general, the IEER metric provides a more representative measure of field performance than EER by weighting the full-load and part-load efficiencies by the average amount of time equipment spends operating at each load level. Table 1 of ISO 13256–1:1998, the industry test standard incorporated by reference into DOE's current WSHP test procedure, and Table 2 of ISO 13256–1:2021 both specify entering water temperature conditions to be used for developing part-load ratings of EER for WSHPs with capacity control (tested at minimum compressor speed). However, part-load EER ratings are not addressed in the current DOE test procedure. Further, each part-load rating captures operation only at a single compressor speed and entering water temperature, not operation across a range of temperatures and compressor speeds. Neither ISO 13256–1:1998 nor ISO 13256–1:2021 include seasonal metrics.

In the June 2018 RFI, DOE requested comment on whether a seasonal metric that accounts for part-load performance would be appropriate for WSHPs, and the Department sought information on the specific details of a seasonal metric that would best represent average cooling efficiency for WSHPs. 83 FR 29048, 29051 (June 22, 2018).

NEEA encouraged DOE to consider adopting IEER for WSHPs and to improve the metric so as to make it more representative of an average use cycle by including changes to more accurately represent fan energy use in field applications, accounting for all modes of operation, and including ventilating and economizing. (NEEA, No. 11 at p. 2)

The Joint Advocates recommended that DOE should consider seasonal efficiency metrics for WSHPs to better reflect field energy consumption, including part-load operation. The Joint Advocates stated that it was their understanding that WSHPs operate most of the time at part-load, and that, therefore, full-load efficiency ratings do not provide sufficient information to consumers. The Joint Advocates also stated that the current metrics do not demonstrate the potential savings associated with technologies that improve part-load efficiency, such as variable-speed compressors. (Joint Advocates, No. 10 at p. 2)

The CA IOUs stated that while the IEER metric provides a valuable measure of annual efficiency, the EER metric is important for achieving reductions in peak loads. These commenters remarked that because the IEER metric uses a low weighting (*i.e.,* 2 percent) for the full-load condition, a standard based only on the IEER metric would incentivize manufacturers to optimize equipment at the part-load conditions and could potentially result in equipment that is designed with lower full-load EERs than the current standards for this equipment. To prevent poor equipment performance at full-load conditions, the CA IOUs supported using the IEER metric that measures part-load efficiencies in conjunction with the currently regulated full-load EER metric. (CA IOUs, No. 9 at pp. 1–2) The CA IOUs further commented that the prevalence of economizers in buildings with WSHPs should be investigated and that modifications to the IEER metric should be informed by the outcome of such research before the IEER metric is implemented as the efficiency metric for WSHPs. (CA IOUs, No. 9 at p. 1)

Trane, AHRI, and WaterFurnace commented that industry is currently developing an IEER metric for WSHPs (Trane, No. 8 at p. 4; AHRI, No. 12 at p. 11; WaterFurnace, No. 7 at p. 9). AHRI and WaterFurnace explained further that the IEER metric is included in the draft version of AHRI 500P,[14] and as drafted, IEER is calculated using performance data from ISO 13256–1:1998. AHRI and WaterFurnace commented that the provisions used for determining IEER for WSHPs in the draft version of AHRI 500P are similar to those included in AHRI 340/360 and AHRI 1230. Both AHRI and WaterFurnace commented that they anticipated AHRI 500P to be completed in 2019. (AHRI, No. 12 at p. 11; WaterFurnace, No. 7 at p. 9)

As explained previously, DOE notes that the EER metric in DOE's current test procedure for WSHPs measures only full-load performance, and the revised industry test procedure ISO 13256–1:2021 does not include a seasonal metric. For the vast majority of operating hours of WSHPs installed in the field, loads are less than full-load capacity, thus causing single-stage WSHPs to cycle and multi-stage WSHPs to operate at part-load (*i.e.,* less than designed full capacity). Because a seasonal metric reflects operation at a range of conditions experienced over the period of a cooling season, DOE has tentatively concluded that a cooling metric that accounts for part-load performance across a range of temperatures (such as IEER specified in section 6.2 of AHRI 340/360–2022) would be more representative of an average use cycle than the full-load EER metric, which reflects operation at a single condition. Further, a seasonal metric that reflects varying load levels representative of a full cooling season would better incentivize use of modulating components (*e.g.,* multi-stage and variable-speed compressors) that can reduce annual energy consumption in field installations.

DOE has been participating in AHRI committee meetings to develop AHRI 600 with the goal of specifying an IEER metric for WSHPs. It is DOE's understanding that the committee's work is ongoing, and its completion date is uncertain. However, based on comments received on the June 2018 RFI, manufacturer feedback obtained via DOE's participation in AHRI 600 committee meetings, and DOE's own research, the Department has tentatively concluded that the EWTs and weighting factors specified in Table 9 and equation 3 of AHRI 340/360–2022 for water-cooled CUACs would be representative for WSHPs. DOE's understanding based on a review of market literature and available studies is that in the past, WSHP installations were more typically controlled such that water-loop temperatures were maintained at temperatures above 60 °F through heat provided by a system boiler. From manufacturer feedback provided in AHRI 600 committee meetings, DOE understands that in current practice, WSHP installations are typically controlled to allow water-loop temperatures to drop to temperatures closer to 50 °F. Manufacturers indicated that this change in how WSHP system loops are typically controlled in the field is because of multiple factors. One factor provided by manufacturers is that because commercial buildings with WSHP installations are typically cooling-dominated (*i.e.,* most WSHPs spend more time in cooling mode than heating mode), building engineers have increasingly optimized overall WSHP system performance by using the cooling tower to decrease EWTs below 60 °F even when some WSHPs in the loop are in heating mode, thereby improving efficiency for the WSHPs in cooling mode at the expense of reducing efficiency for the fewer WSHPs in heating mode. Additionally, manufacturers indicated that the market penetration of WSHPs with water-side economizers has significantly increased in recent years, largely related to requirements in ASHRAE Standard 90.1 regarding presence of economizers in HVAC systems. Water-side economizers provide compressor-free cooling when supplied with water of sufficiently low temperature; therefore, manufacturers have indicated that building engineers are increasingly maintaining WSHP loop temperatures below 60 °F to take advantage of water-side economizer cooling.[15] Given this feedback provided by manufacturers on the WSHP loop water temperatures typically used in the field, DOE has tentatively concluded that the IEER EWTs specified in Table 9 of AHRI 340/360–2022 (*i.e.,* 85 °F, 73.5 °F, 62 °F, and 55 °F) are representative of current installations of WSHPs. Section III.E.4 of this NOPR includes discussion on other operating modes other than mechanical cooling and heating, such as ventilation and economizing.

Based on the discussion in the preceding paragraphs, DOE has tentatively determined that use of a seasonal efficiency metric, specifically IEER based on AHRI 340/360–2022, would be more representative of the average use cycle of a unit as compared to the current EER metric. Once again, DOE notes that while it may have been expected that AHRI 600 was to publish in 2019, the draft standard has not yet been finalized. Accordingly, DOE is moving forward and proposing to adopt certain provisions of AHRI 340/360–2022 and use the IEER metric specified in section 6.2 of AHRI 340/360–2022 for WSHPs. DOE is proposing to specify the relevant test procedure requirements for WSHPs for measuring IEER in section 5.1 of proposed appendix C1.

As discussed, the proposed IEER test procedure for WSHPs would not be required until such a time as DOE adopts energy conservation standards for WSHPs denominated in terms of IEER, should DOE adopt such standards. If DOE were to adopt such standards, such shift to the IEER metric for WSHPs would require all WSHPs to be re-rated in terms of the IEER metric. Further, beginning 360 days after final rule publication, manufacturers would be required to use the proposed test procedure in appendix C1 to make optional representations of IEER for WSHPs. The cost and impacts to manufacturers of the proposed test procedure are discussed further in section III.I of this document. Additionally, adopting the IEER metric for WSHPs would increase the number of required cooling-mode tests from one to four. However, as discussed, DOE understands that AHRI 600 would provide for calculating IEER from test results measured at the EWTs specified in Table 1 of ISO 13256–1:1998. Consistent with this approach and as discussed in the following section, DOE is proposing to allow determination of IEER via interpolation and extrapolation from testing at the full-load and part-load EWT conditions specified in Table 1 of ISO 13256–1:1998.

[14] As discussed, after DOE received comments in response to the June 2018 RFI, the draft AHRI Standard 500P was redesignated as the draft AHRI Standard 600.

[15] In WSHPs with water-side economizers, if the EWT is sufficiently low in cooling mode, some or all of the entering water that would otherwise enter the water-to-refrigerant condenser coil instead enters the economizer coil, in which the cool water is used to directly cool indoor air, reducing the need for mechanical cooling from the compressor.

In response to the CA IOUs' suggestion, although EPCA limits the agency to promulgation of a single performance standard (*see* 42 U.S.C. 6311(18)), DOE is proposing to provide for optional representations of EER conducted per the proposed test procedure (sections 2 through 4 and 7 of proposed appendix C1) at the full-load and part-load EWT conditions specified in Table 1 of ISO 13256–1:1998 (*i.e.,* full load tests at 86 °F, 77 °F, and 59 °F and part-load tests at 86 °F, 68 °F, and 59 °F).

Issue 3: DOE requests comment on its proposal to adopt the test methods specified in AHRI 340/360–2022 for calculating the IEER of WSHPs. DOE also requests comment on its proposal that all EER tests at full-load and part-load conditions specified in Table 1 of ISO 13256–1:1998 (*i.e.,* full-load tests at 86 °F, 77 °F, and 59 °F and part-load tests at 86 °F, 68 °F, and 59 °F) are optional.

b. Determination of IEER Via Interpolation and Extrapolation

As discussed, DOE understands that the draft AHRI 600 would provide a mechanism for calculating IEER from test results measured at the EWTs specified in Table 1 of ISO 13256–1:1998. Specifically, interpolation and extrapolation [16] from ISO 13256–1:1998 test results would be used to calculate performance at the EWTs specified in Table 9 of AHRI 340/360–2022 for WCUACs, allowing calculation of IEER for WSHPs using the weighting factors specified in section 6.2.2 of AHRI 340/360–2022. Under this approach, AHRI 600 would not include any provisions for testing, but rather would provide a method for calculation of IEER based on results of testing under ISO 13256–1:1998. DOE recognizes that there may be a value for stakeholders in representations of full-load and part-load EER ratings at the temperatures specified in Table 1 of ISO 13256–1:1998. Specifically, these EWTs represent different applications, and manufacturers may prefer to provide representations of performance specific to different applications.

The ability to determine EER ratings at the ISO 13256–1:1998 EWTs (in accordance with the proposed test procedure, at section 5.2 of the proposed appendix C1), and to determine IEER via interpolation and extrapolation from testing at the ISO 13256–1:1998 EWTs, rather than from additional testing at the IEER EWTs specified in AHRI 340/360–2022, may reduce overall testing burden for manufacturers. Consequently, DOE investigated the AHRI 600 method of calculating IEER.

To evaluate the draft AHRI 600 method of calculating IEER, DOE conducted investigative testing on a sample of WSHPs. DOE presents the results of testing 15 WSHPs in the following paragraphs. This testing compared the interpolation and extrapolation method of calculating IEER at the ISO 13256–1:1998 EWTs to testing at the IEER EWTs specified in AHRI 340/360–2022. In summary and for the reasons discussed in the following paragraphs, DOE has tentatively determined that an interpolation and extrapolation approach, similar to that in draft AHRI 600 with certain modifications, is appropriately representative to calculate IEER.

To determine if the interpolation and extrapolation method is appropriate for WSHPs, DOE evaluated whether the components needed to calculate IEER can be linearly interpolated across EWT. Specifically, the parameters necessary for the calculation of IEER are EER, capacity, total power, and all components of power (*i.e.,* compressor power, fan power, condenser section power, controls power). DOE tested 15 units at different EWTs to compare physical tested results and interpolated and extrapolated values. The method evaluated by DOE determines IEER ratings for WSHPs by interpolation and extrapolation from full-load tests at liquid inlet temperatures of 86 °F, 77 °F, and 59 °F and, for two-stage and variable-speed units, part-load tests at 86 °F, 68 °F, and 59 °F. DOE first evaluated the accuracy of interpolating to a different EWT for full-load tests. For each of the 15 units tested, DOE conducted full-load tests to measure EER at 86 °F, 77 °F, and 59 °F. DOE then used the results from the 86 °F and 59 °F tests to linearly interpolate to performance at 77 °F, and compared these interpolated results to the results of testing at 77 °F. Table 3 presents a summary of the percentage differences between the interpolated and measured values. Positive values in the average, minimum, and maximum columns of Table 3 indicate that the values interpolated to 77 °F from results measured at 86 °F and 59 °F were higher than the values measured at 77 °F, and negative values indicate the opposite.

TABLE 3—PERCENTAGE DIFFERENCES OF INTERPOLATED RESULTS FROM MEASURED RESULTS FOR CAPACITY, POWER, AND EER

Parameter	Average	Minimum	Maximum	Average absolute value
Cooling Capacity	−0.2	−1.4	2.2	0.9
Total Power	−0.4	−2.6	1.5	0.8
Interpolated EER	2.3	0.3	4.8	2.3
EER calculated from interpolated capacity and power	0.2	−1.7	2.9	1.0

Note: Positive values in the average, minimum, and maximum columns indicate that the values interpolated to 77 °F from results measured at 86 °F and 59 °F were higher than the values measured at 77 °F. Negative values in the average, minimum, and maximum columns indicate that the values interpolated to 77 °F from results measured at 86 °F and 59 °F were lower than the values measured at 77 °F.

As shown in Table 3, the interpolated values for cooling capacity and total power differed from the corresponding tested values by an average of less than 1 percent. Therefore, DOE has determined that interpolating capacity and total power results in representative values of capacity and total power, respectively. However, the interpolated EER value at 77 °F was higher than the tested EER value at 77 °F for all tested units, with an average difference of 2.3 percent (ranging from 0.3 percent to 4.8 percent higher). Because of the consistent bias in the results showing interpolated EER higher than tested

[16] Per the draft AHRI 600 method, performance at IEER EWTs can be determined using test results at two different temperature conditions (specified in ISO 13256–1:1998). Interpolation is used if the IEER EWT is between the two tested EWTs, and extrapolation is used if the IEER EWT is outside the range of the two tested results.

EER,[17] DOE considered an alternate approach of calculating EER based on interpolated values of cooling capacity and total power rather than interpolating EER directly. The bottom row of Table 3 shows the results of calculating EER at 77 °F using the interpolated values of cooling capacity and total power. As shown in in the bottom row of Table 3, calculating EER at 77 °F using interpolated values of cooling capacity and total power resulted in EER values that were on average 0.2 percent higher than the tested EER value at 77 °F (ranging from 1.7 percent lower to 2.9 percent higher). Because determining EER by interpolating cooling capacity and total power results in closer agreement to tested values than directly interpolating EER (and does not consistently bias results toward higher interpolated EER values), DOE used the former approach in the calculation of IEER values discussed in the following paragraphs.

For determining IEER for single-stage units, this interpolation and extrapolation approach would be used to determine EER at the EWTs for all 4 IEER points, and the EER results for the part-load points (*i.e.,* test points designated as B, C, and D in AHRI 340/360–2022) would also be adjusted for cyclic degradation (see discussion in section III.F.2.b of this document).

For two-stage and variable-speed WSHPs, DOE evaluated a method that tests at the minimum compressor speed at the EWTs specified in Table 1 of ISO 13256–1:1998 for part-load tests (*i.e.,* at 86 °F, 68 °F, and 59 °F). As with the draft AHRI 600 method, the method evaluated by DOE then provides for interpolating to the IEER liquid inlet temperatures from these part-load tests, and IEER is determined using interpolated results for the IEER EWTs for both full-load and part-load tests.[18] To evaluate the accuracy of this methodology for calculating IEER for staged WSHPs, DOE conducted additional investigative testing on 10 of the 15 tested WSHPs (6 two-stage WSHPs and 4 variable-speed WSHPs). Specifically, these 10 units were tested to calculate IEER via the interpolation and extrapolation method (by conducting full-load and part-load tests at the EWTs specified in Table 1 of ISO 13256–1:1998 and using interpolation and extrapolation to calculate IEER) and were tested to determine IEER per section 6.2 of AHRI 340/360–2022 by testing at the IEER EWTs and target load levels specified in Table 9 of AHRI 340/360–2022. Consistent with the discussion in the previous paragraphs, when interpolating to determine performance at a different EWT for a given compressor stage for staged units, DOE calculated the EER values by interpolating and extrapolating values of cooling capacity and total power, rather than directly interpolating and extrapolating values of EER. Table 4 presents a summary of the results. Positive values in the average, minimum, and maximum columns of Table 4 indicate that the IEER values determined via the interpolation and extrapolation method were higher than the IEER values determined through testing at the EWTs and load levels specified in section 6.2 of AHRI 340/360–2022, and negative values indicate the opposite.

TABLE 4—PERCENTAGE DIFFERENCES OF INTERPOLATED IEER FROM MEASURED IEER FOR TWO-STAGE AND VARIABLE-SPEED UNITS

Capacity control type	Average	Minimum	Maximum	Average absolute value
Two-Stage	−0.9	−2.7	−0.0	0.9
Variable-Speed	−6.3	−13.6	0.2	6.4

Note: Positive values in the average, minimum, and maximum columns indicate that the IEER values determined via the interpolation and extrapolation method were higher than the IEER values determined through testing at the EWTs and load levels specified in section 6.2 of AHRI 340/360–2022. Negative values in the average, minimum, and maximum columns indicate that the IEER values determined via the interpolation and extrapolation method were lower than the IEER values determined through testing at the EWTs and load levels specified in section 6.2 of AHRI 340/360–2022.

As shown in Table 4, for the six tested two-stage WSHPs, the IEER values calculated using the described interpolation and extrapolation method were on average 0.9 percent lower than the IEER value measured from testing per AHRI 340/360–2022 (ranging from 0.0 percent to 2.7 percent lower).

For the four variable-speed units, the IEER values calculated using the described interpolation and extrapolation method were on average 6.3 percent lower than the IEER value measured from testing per AHRI 340/360–2022 (ranging from 0.2 percent higher to 13.6 percent lower). These results demonstrate a wider discrepancy from AHRI 340/360–2022 results than for single-stage or two-stage WSHPs. This discrepancy is likely because the interpolation and extrapolation method described only includes testing at maximum and minimum compressor speed, whereas the AHRI 340/360–2022 approach includes testing at compressor speeds to operate at each of the part-load test points (*i.e.,* 75 percent, 50 percent, and 25 percent load). Therefore, for variable-speed WSHPs with higher EER at intermediate compressor speeds than at maximum or minimum compressor speeds, the interpolation and extrapolation method described results in a lower calculated IEER than testing at the IEER conditions specified in AHRI 340/360–2022, which was the case for three of the four tested units. While for certain tested variable-speed units calculating IEER via interpolation and extrapolation resulted in a lower IEER value, from participation in AHRI 600 committee

[17] As presented in Table 3, the results from DOE's testing show that that linear interpolation across EWT results in close agreement for cooling capacity and total power. Because EER = Cooling Capacity/Total Power, if linear equations are used to represent the relationship between cooling capacity and EWT, as well as between total power and EWT, the resulting equation for EER has equations linearly dependent on EWT in the numerator and denominator. Such an equation simplifies to an inverse function (*i.e.,* the variable (EWT) is in the denominator), which is concave up (*i.e.,* the slope of the EER vs EWT curve increases with increasing EWT), such that between any two points on the curve, the curve is always below a line drawn between the two points. Therefore, calculating EER by linearly interpolating EER values across EWT consistently results in an interpolated EER value that is higher than the EER value measured by testing or determined by linearly interpolating cooling capacity and total power.

[18] After interpolating the full-load and part-load interpolated across EWT, the AHRI 340/360–2022 IEER calculation methodology is then used. The interpolated results would either need cyclic degradation (see discussion in section III.F.2.b of this NOPR) or interpolation across compressor staging to determine the specific load EER values to be used in the IEER calculation, unless the EWT interpolation yields a calculated percent load that meets the 3 percent tolerance for the respective IEER load point.

meetings, DOE understands that many manufacturers would prefer the option to use the interpolation and extrapolation method for variable-speed WSHPs even if it results in lower IEER ratings, because it would result in less overall testing burden than testing at each of the AHRI 340/360–2022 conditions.

Based on the investigative testing conducted, DOE has tentatively concluded that determining IEER via interpolation and extrapolation from testing at the ISO 13256–1:1998 EWTs (in accordance with DOE's proposed test procedure), similar to the method in the draft AHRI 600, provides appropriately representative results that are comparable to testing at the EWTs (and for staged units, load levels) specified in Table 9 of AHRI 340/360–2022. Therefore, DOE is proposing in section 5 of the proposed appendix C1 to allow that IEER for WSHPs can be calculated from either of two methods: (1) ''option 1''—testing in accordance with AHRI 340/360–2022 (at EWTs of 85 °F, 73.5 °F, 62 °F, and 55 °F); or (2) ''option 2''—interpolation and extrapolation of cooling capacity and power values based on testing in accordance with the proposed test procedure at EWTs of 86 °F, 77 °F, and 59 °F for full-load tests and (for staged units) EWTs of 86 °F, 68 °F, and 59 °F for part-load tests. For single speed units, option 2 would require three full-load tests at entering liquid temperatures of 86 °F, 77 °F, and 59 °F. For two-stage and variable-speed units, three additional tests at the minimum compressor speed would be required, at entering liquid temperature of 86 °F, 68 °F, and 59 °F.

Specifically for option 2, aside from the EWTs, the tests for option 2 would be performed using the same test provisions from AHRI 340/360–2022, ANSI/ASHRAE 37–2009, and sections 2 through 4 and 7 of proposed appendix C1 as the tests for option 1. As discussed, DOE has tentatively determined that results from the interpolation and extrapolation method have greater agreement with, and, therefore, are comparably representative to, the tested results by interpolating values of cooling capacity and total power rather than interpolating values of EER; therefore, DOE is proposing that the alternative method specify interpolation using the cooling capacity and total power. The proposed provisions for option 2 in section 5.1.2 of proposed appendix C1 are otherwise generally consistent with the draft AHRI 600 method, except for the cyclic degradation approach, which is discussed in section III.F.2.b of this NOPR.

DOE notes that representations for WSHPs can be made either based on testing (in accordance with 10 CFR 429.43(a)(1)) or AEDMs (in accordance with 10 CFR 429.43(a)(2)). If represented values for a basic model are determined with an AEDM, the AEDM could use either option 1 or option 2 for determining IEER per the proposed test procedure in appendix C1.

Issue 4: DOE requests comment on the proposal to allow determination of IEER using two different methods: (1) testing in accordance with AHRI 340/360–2022; or (2) interpolation and extrapolation of cooling capacity and power values based on testing in accordance with the proposed test procedure at the EWTs specified in Table 1 of ISO 13256–1:1998. Specifically, DOE seeks feedback on the proposed method for calculating IEER via interpolation and extrapolation, and on whether this approach would serve as a potential burden-reducing option as compared to testing at the AHRI 340/360–2022 conditions.

Issue 5: DOE requests comment on whether the proposed methodology to determine IEER based on interpolation and extrapolation is appropriate for variable-speed units. DOE would consider requiring variable-speed equipment be tested only according to AHRI 340/360–2022 and, thus, testing physically at the IEER EWTs, if suggested by commenters.

DOE is aware that ISO 13256–1:2021 includes changes from ISO 13256–1:1998 with respect to the EWTs specified for cooling tests. Specifically, Table 2 of ISO 13256–1:2021 specifies full-load cooling temperatures of 86 °F, 68 °F, and 50 °F, and part-load cooling temperatures of 77 °F, 59 °F, and 41 °F. Consistent with the draft AHRI 600 method, DOE is proposing to use the temperatures specified in Table 1 of ISO 13256–1:1998 for option 2 tests; however, it is expected that the results under the proposed interpolation and extrapolation method would provide comparable results using the EWTs specified in Table 2 of ISO 13256–1:2021.

Issue 6: DOE seeks feedback on whether the proposed interpolation and extrapolation method should be based on testing at the ISO 13256–1:2021 EWTs.

2. COP

a. General Discussion

DOE's current test procedure for WSHPs measures heating-mode performance in terms of the COP metric, based on testing with a 68 °F EWT. 10 CFR 431.96. For the reasons explained in the following paragraphs, DOE is proposing in section 6.2 of proposed appendix C1 to use an EWT of 55 °F for the COP metric because DOE has tentatively concluded that 55 °F is more representative of field operation than the current EWT of 68 °F.

COP is a full-load heating efficiency metric for WSHP water-loop applications, meaning that it represents the heating efficiency for a WSHP operating at its maximum capacity at an EWT that is typical of heating operation in water-loop applications. Because commercial buildings served by WSHPs in water-loop applications are typically cooling-dominated, DOE understands that the majority of heating hours in these applications occur in simultaneous cooling and heating operation—in which certain WSHPs (*e.g.,* servicing zones around the perimeter of the building) are in heating mode while other WSHPs (*e.g.,* servicing interior zones closer to the center of the building) are in cooling mode. Because all WSHPs in the system loop are provided water with the same EWT, at any given time, WSHPs that are in heating mode operate at the same EWT as WSHPs in cooling mode. As discussed in section III.E.1.a of this NOPR, from manufacturer feedback provided in AHRI 600 committee meetings, DOE understands that while in the past water-loop temperatures were maintained at temperatures above 60 °F via heat provided by a system boiler, in current practice, WSHP installations are typically controlled to allow water-loop temperatures to drop to temperatures closer to 50 °F. Correspondingly, DOE is proposing part-load IEER EWTs that align with AHRI 340/360–2022 and the draft AHRI 600, including 62 °F for the 50-percent load point and 55 °F for the 25-percent load point.

Because DOE understands that WSHP water-loop temperatures are typically controlled to drop closer to 50 °F (as represented by the 55 °F EWT for the 25-percent load point), the Department understands that most hours of heating mode operation for WSHPs in water-loop applications occur with EWTs closer to 50 °F. Therefore, while the current 68 °F EWT for the COP metric may have been more representative of how WSHP systems were controlled in the past (*i.e.,* with a boiler maintaining water-loop temperatures above 60 °F), DOE has tentatively determined that the COP EWT should be no higher than the lowest EWT used in the IEER metric, which is 55 °F (for the 25-percent load point), because most heating hours occur when outdoor air temperatures are lower and, thus, cooling loads are lower. Therefore, DOE has tentatively concluded that the COP metric would be more representative of water-loop WSHP applications if based on an EWT of 55 °F.

DOE also considered whether an EWT below 55 °F, specifically 50 °F, might be more representative for determining COP, depending upon typical heating conditions for water-loop WSHPs. However, DOE currently lacks data or evidence indicating that 50 °F would be a more representative heating EWT than 55 °F for WSHPs. Therefore, in the absence of any data suggesting a lower EWT would be more representative of heating operation of WSHPs, DOE is proposing an EWT of 55 °F, which aligns with the lowest IEER EWT as proposed.

Issue 7: DOE seeks comment and data on the representativeness of 55 °F as the EWT condition for determining COP. Specifically, DOE requests feedback and data on whether a lower EWT, such as 50 °F, would be more representative of heating operation of WSHPs. DOE will further consider any alternate EWT suggested by comments in developing any final rule.

Additionally, DOE is proposing provisions in section 6.3 of proposed appendix C1 to provide for optional representations of COP based on testing conducted per the proposed test procedure (sections 2 through 4 and 7 of proposed appendix C1) at the full-load and part-load EWT conditions specified in Table 2 of ISO 13256–1:1998 (*i.e.,* 68 °F, 50 °F, 41 °F, and 32 °F).

b. Determination of COP Via Interpolation

As discussed in section III.E.1.b of this NOPR, DOE is proposing to include an alternate method for determining IEER that allows manufacturers to perform tests at the EWTs in Table 1 of ISO 13256–1:1998 and interpolate efficiency metrics to the EWTs specified in Table 9 of AHRI 340/360–2022. This method would reduce overall testing burden for manufacturers who choose to make optional EER representations at the EWTs specified in Table 1 of ISO 13256–1:1998, by allowing them to avoid additional testing at the IEER EWTs.

In order to provide comparable flexibility for measuring COP, DOE is proposing a similar alternative test method in section 6.2.2 of appendix C1 for determining COP by interpolation from results of testing at the EWTs specified in Table 2 of ISO 13256–1:1998. To evaluate the interpolation method for COP, DOE conducted investigative testing on five WSHPs at the three heating EWTs specified in Table 1 of ISO 13256–1:1998: 68 °F, 50 °F and 32 °F. DOE interpolated the cooling capacity and total power results from 68 °F and 32 °F to 50 °F, and then calculated COP at 50 °F using the interpolated values of cooling capacity and total power.[19] Finally, DOE compared these interpolated values to the results of testing at 50 °F. Table 5 presents a summary of the percentage differences between the interpolated and measured values. Positive values in the average, minimum, and maximum columns of Table 5 indicate that the values interpolated to 50 °F from results measured at 68 °F and 32 °F were higher than the values measured at 50 °F, and negative values indicate the opposite.

TABLE 5—PERCENTAGE DIFFERENCES OF INTERPOLATED RESULTS FROM MEASURED RESULTS FOR CAPACITY, POWER, AND COP

Parameter	Average	Minimum	Maximum	Average absolute value
Cooling Capacity	−0.4	−1.9	0.6	0.9
Total Power	0.3	−1.2	2.1	0.9
COP calculated from interpolated capacity and power	−0.7	−3.9	0.9	1.1

Note: Positive values in the average, minimum, and maximum columns indicate that the values interpolated to 50 °F from results measured at 68 °F and 32 °F were higher than the values measured at 50 °F. Negative values in the average, minimum, and maximum columns indicate that the values interpolated to 50 °F from results measured at 68 °F and 32 °F were lower than the values measured at 50 °F.

As shown in Table 4, the COP calculated from interpolated values of cooling capacity and total power differed from measured COP by an average of less than 1 percent. Therefore, DOE has tentatively concluded that determining COP via interpolation in this temperature range from testing at the ISO 13256–1:1998 EWTs (in accordance with DOE's proposed test procedure) provides appropriately representative results that are comparable to testing at 55 °F. Therefore, DOE is proposing in section 6.2 of the proposed appendix C1 to allow that COP for WSHPs can be calculated from either of two methods: (1) ''option A''—testing at 55 °F; or (2) ''option B''—interpolation of heating capacity and power values based on testing in accordance with the proposed test procedure at EWTs of 50 °F and 68 °F. Aside from the EWTs, the tests for option B would be performed using the same test provisions from AHRI 340/360–2022, ANSI/ASHRAE 37–2009, and sections 2 through 4 and 7 of proposed appendix C1 as the tests for option A.

Issue 8: DOE requests comment on the proposal to allow determination of COP using two different methods: (1) testing at 55 °F; or (2) interpolation of heating capacity and power values based on testing in accordance with the proposed test procedure at EWTs specified for heating tests in Table 2 of ISO 13256–1:1998 (*i.e.,* 50 °F and 68 °F). Specifically, DOE seeks feedback on the proposed method for calculating COP via interpolation, and on whether this approach would serve as a potential burden-reducing option as compared to testing at 55 °F.

3. Entering Air Conditions

The current DOE test procedure references ISO 13256–1:1998, which specifies in Table 1 that EER is measured with entering air at 27 °C (80.6 °F) dry-bulb temperature and 19 °C (66.2 °F) wet-bulb temperature and in Table 2 that COP is measured with entering air at 20 °C (68 °F) dry-bulb temperature and 15 °C (59 °F) wet-bulb temperature. Table 2 and Table 3 of ISO 13256–1:2021 specify the same entering air conditions as ISO 13256–1:1998. As

[19] As discussed in section III.E.1.b of this NOPR, DOE tentatively determined that interpolation of EER directly results in a consistent bias, and that more representative results are obtained by calculating EER using interpolated values of cooling capacity and total power. Similarly, for COP, DOE is proposing that COP can be determined using interpolated values of heating capacity and total power, rather than interpolating COP values directly.

discussed in section III.D.3 of this NOPR, DOE proposes to adopt AHRI 340/360–2022 as the test procedure for WSHPs. Table 6 of AHRI 340/360–2022 specifies entering indoor air conditions for standard rating cooling tests to be 80 °F dry-bulb temperature and a maximum of 67 °F wet-bulb temperature and standard rating heating tests to be 70 °F dry-bulb temperature and a maximum of 60 °F wet-bulb temperature.

The entering air conditions specified in AHRI 340/360–2022 are similar to the conditions specified in ISO 13256–1:1998 and ISO 13256–1:2021, differing for cooling by 0.6 °F for dry-bulb temperature and 0.8 °F for wet-bulb temperature and for heating by 2 °F for dry-bulb temperature and 1 °F for wet-bulb temperature. DOE surmises that these differences are likely due to the conditions in ISO 13256–1 (1998 and 2021 versions) being specified in terms of degrees Celsius, whereas the conditions in AHRI 340/360–2022 are specified in degrees Fahrenheit. The entering air conditions specified in AHRI 340/360–2022 are the same as in previous versions of AHRI 340/360, including AHRI 340/360–2007, which is referenced in the current DOE test procedure for CUAC/HPs. Further, the most common application for WSHPs (and the application DOE understands that the WSHP industry is intending to represent via use of the IEER metric in AHRI 600) is commercial buildings, similar to CUAC/HPs. Therefore, DOE has tentatively determined that the entering air conditions in AHRI 340/360–2022 are appropriately representative of the average conditions in which WSHPs operate in the field. DOE is proposing in sections 5 and 6 of proposed appendix C1 to use entering air conditions from Table 6 of AHRI 340/360–2022 for both cooling (IEER) and heating (COP) tests.

Issue 9: DOE requests comment on its proposal to specify in proposed appendix C1 use of the cooling entering air conditions from AHRI 340/360–2022 (*i.e.,* 80 °F dry-bulb temperature and 67 °F wet-bulb temperature) and the heating entering air conditions from AHRI 340/360–2022 (*i.e.,* 70 °F dry-bulb temperature and a maximum of 60 °F wet-bulb temperature).

4. Operating Modes Other Than Mechanical Cooling and Heating

On April 1, 2015, DOE published in the **Federal Register** a notification of its intent to establish a working group under the Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC'') Commercial and Industrial Fans and Blowers Working Group (''ASRAC Working Group'') to discuss and, if possible, reach consensus on the scope of the rulemaking, certain key aspects of a proposed test procedure, and proposed energy conservation standard for fans and blowers. 80 FR 17359. The ASRAC Working Group term sheet for commercial and industrial fans and blowers was approved (Docket No. EERE–2013–BT–STD–0006–0179).[20] Recommendation #3 of the term sheet addressed supply and condenser fans that are embedded in certain covered equipment. (*Id.* at p. 3) The ASRAC Working Group recommended that DOE consider revising efficiency metrics that include energy use of supply fans in order to include the energy consumption during all relevant operating modes (*e.g.,* auxiliary heating mode, ventilation mode, and part-load operation) in the next round of test procedure rulemakings. (*Id.* at p. 4) The ASRAC Working Group included WSHPs in its list of regulated equipment for which fan energy use should be considered. (*Id.* at p. 16)

As part of the June 2018 RFI, DOE stated that it was investigating whether changes to the WSHP test procedure are needed to properly characterize a representative average use cycle, including changes to more accurately represent fan energy use in field applications. 83 FR 29048, 29050 (June 22, 2018). DOE requested information as to the extent that accounting for the energy use of fans in commercial equipment such as WSHPs would be additive of other existing accountings of fan energy use. *Id.*

In the June 2018 RFI, DOE also sought comment on whether accounting for the energy use of fan operation in WSHPs would alter measured efficiency, and if so, to what extent. *Id.* DOE also requested data and information regarding what forms of auxiliary heating are installed in WSHPs, how frequently they operate, and whether they operate independently of the WSHP. *Id.* Additionally, DOE requested data and information on how frequently WSHP supply fans are operated when there is no demand for heating or cooling, such as for fresh air ventilation or air circulation or filtration. *Id.*

The Joint Advocates and NEEA commented that DOE should amend the test procedure to account for fan energy use outside of mechanical cooling and heating for fans in regulated equipment to more fully capture fan energy use. (Joint Advocates, No. 10 at p. 1; NEEA, No. 11 at p. 1) The Joint Advocates asserted that by failing to capture fan operation for economizing, ventilation, and other functions outside of cooling mode, the test procedure may be significantly underestimating fan energy consumption. (Joint Advocates, No. 10 at p. 1)

NEEA commented that the commercial prototype building models used by Pacific Northwest National Laboratory in the analysis in support of ASHRAE Standard 90.1 include information on the operation of fans in ventilation mode and economizer mode and could be used to develop national average fan operating hours outside of heating and cooling. (NEEA, No. 11 at pp. 3) Furthermore, NEEA stated that the vast majority of WSHPs are installed in commercial buildings, thereby subjecting them to ASHRAE Standard 90.1 code requirements such as the requirement of water side economizers in many U.S. climate zones. *Id.* NEEA added that details of requirements for certain control and component features are provided in ASHRAE Standard 90.1 and should be an indicator of prevalence of these features in WSHPs on the market. *Id.*

NEEA further stated that ANSI and the Air Movement Control Association (''AMCA'') developed ANSI/AMCA 208–18, ''Calculation of the Fan Energy Index,'' which provides a potential way to measure embedded fan performance in WSHPs using the fan energy index (''FEI''). According to NEEA, DOE could develop a revised IEER-type metric that weighs together cooling performance (using the IEER test) and fan efficiency (using an FEI-based metric). NEEA argued that accounting for the energy use of fan operation in WSHPs does not need to alter measured efficiency, and that to reduce burden on manufacturers, DOE could combine the FEI and IEER metrics such that manufacturers would have multiple viable design option pathways to achieve the minimum IEER efficiency standard without improving the embedded fan efficiency above the minimum FEI efficiency standard. (NEEA, No. 11 at p. 2)

Trane commented that there are some applications in which a WSHP would be used for ventilation, but that ventilation is not the main use, and that using a WSHP for purposes other than heating and cooling is rare. Trane stated further that typical practice is for ventilation air to be provided by a dedicated outdoor air system (''DOAS'') using a separate ductwork system, whereas the WSHP system provides the heating and cooling. Finally, Trane commented that for installations in which the DOAS and WSHPs supply to common ductwork, WSHP fans would operate when

[20] Available at: *www.regulations.gov/document/EERE-2013-BT-STD-0006-0179.*

ventilation is needed, but rarely would this be needed without heating or cooling. (Trane, No. 8 at pp. 2, 5)

AHRI and WaterFurnace both stated that a high percentage of WSHP systems offer a continuous fan mode to circulate fresh air but did not have data on how often. (AHRI, No. 12 at pp. 4–5; WaterFurnace, No. 7 at p. 3) However, both estimated that a typical WSHP would operate in continuous fan mode (*i.e.,* without cooling or heating) for approximately 1,300 hours per year. The commenters estimated total cooling and heating mode operation of 3,300 hours per year. (AHRI, No. 12 at pp. 9; WaterFurnace, No. 7 at p. 9)

Further, AHRI and WaterFurnace commented that fan power is largely dependent on motor type and typically represents 13 to 18 percent of total power. (AHRI, No. 12 at pp. 4, 8–9; WaterFurnace, No. 7 at pp. 3, 8–9) AHRI asserted that EPCA imposes a one-metric-per-product limitation and that efforts to capture the energy use of a fan during a mode other than cooling (or heating) would result in an impermissible design requirement. (AHRI, No. 12 at pp. 5, 10)

AHRI stated that DOE has the authority to include certain fans and blowers, by rule, as ''covered equipment'' if such products meet all the requirements of EPCA at 42 U.S.C. 6311(2). AHRI asserted that if DOE developed a standard for stand-alone industrial fans, it would not be appropriate to apply that standard to fans embedded in regulated equipment. Furthermore, AHRI argued that the fact that Congress granted a specific provision of authority to DOE for a consumer furnace ventilation metric affirms that DOE is without general authority to create overlapping ventilation requirements for other regulated products. (AHRI, No. 12 at pp. 10–11)

Trane and WaterFurnace also commented that regulation of WSHP fans would produce unnecessary overlapping regulations, and that system-level efficiency metrics allow for optimization of the entire system. (Trane, No. 8 at p. 4; WaterFurnace, No. 7 at p. 8) AHRI and WaterFurnace stated that fan energy in cooling and heating are accounted for in the current test procedure and that fans are optimized for these modes because they account for the majority of operational time. (AHRI, No. 12 at p. 8; WaterFurnace, No. 7 at p. 9)

AHRI and WaterFurnace commented that auxiliary heating is not common in WSHPs and estimated that electric heat is included in less than one percent of WSHP shipments. AHRI and WaterFurnace further commented that the primary mode of operation of most WSHPs is cooling and that heating requirements are limited, such that adequate heating can be supplied through heat pump operation alone. (AHRI, No. 12 at p. 4; WaterFurnace, No. 7 at p. 3) Trane stated that for their WSHPs, electric heat is provided only when heat pump operation alone cannot meet the heating demand. Trane further stated that the compressors are locked out while back-up electric heating is used for most WSHPs, with the exception of rooftop WSHP equipment, which allows auxiliary electric heat to supplement the heating provided by the heat pump. (Trane, No. 8 at p. 2)

In response, DOE emphasizes that its request for information regarding fan energy use was in investigation of energy use of WSHPs in operational modes other than those currently evaluated by the test procedure (*i.e.,* operational modes other than cooling and heating). DOE understands that much of the energy use attributable to these other modes is likely a product of fan operation. Provisions to measure energy use for ancillary functions (*e.g.,* economizing, ventilation, filtration, and auxiliary heat) when there is no heating or cooling are not included in ISO 13256–1:1998 or AHRI 340/360–2022. As discussed in section III.D.3 of this NOPR, DOE is proposing to adopt AHRI 340/360–2022 for testing WSHPs. Additionally, provisions addressing other operational modes have not been included in the updated ISO 13256–1:2021. In light of the above, at this time, DOE lacks sufficient information on the number of units capable of operating in these other modes or the frequency of operation of these modes during field conditions to determine whether such testing would be appropriate for WSHPs and/or to develop a test method capable of accounting for energy use of such auxiliary functions of WSHPs. To the extent that data and further information are developed regarding operation of WSHPs in modes other than mechanical cooling and heating, DOE would consider such developments in a future WSHP test procedure rulemaking.

5. Dynamic Load-Based Test Procedure

In response to the June 2018 RFI, both NEEA and the Joint Advocates encouraged DOE to investigate a load-based test method that could allow more sophisticated and inclusive efficiency metrics. Both NEEA and Joint Advocates commented that the Canadian Standards Association (''CSA'') group is developing CSA EXP07 (''Load-based and climate-specific testing and rating procedures for heat pumps and air conditioners''), which is a dynamic, load-based test procedure expected to better capture performance in the field, including the capturing of cycling losses, benefits of variable-speed operation, and importance of control strategies. (NEEA, No. 11 at p. 2; Joint Advocates, No. 10 at p. 2)

DOE is aware of the dynamic, load-based test procedure being developed by CSA. However, at this time, DOE understands that CSA EXP07 has not been validated and finalized. Furthermore, the CSA EXP07 test procedure is applicable to CAC/HPs, and that test procedure has not yet been evaluated for WSHPs. Further, DOE is not aware of data showing that any dynamic, load-based test procedure produces repeatable and reproducible test results. Therefore, DOE has tentatively concluded that further consideration of CSA EXP07 would be premature at this time, and accordingly, the Department is not proposing to adopt any dynamic, load-based test procedures in this NOPR.

F. Test Method

1. Airflow and External Static Pressure

a. Fan Power Adjustment and Required Air External Static Pressure

As discussed in section III.D.1.a of this NOPR, for ducted units, sections 4.1.3.1 and 4.1.3.2 of ISO 13256–1:1998 specify a fan power adjustment calculation that does not account for fan power used for overcoming external resistance. As a result, the calculation of efficiency includes only the fan power required to overcome the internal resistance of the unit. In addition, ISO 13256–1:1998 does not specify ESP requirements for ducted equipment, instead allowing manufacturers to specify a rated ESP. While Table 9 of ISO 13256–1:1998 includes an operating tolerance (*i.e.,* maximum variation of individual reading from rating conditions) and a condition tolerance (*i.e.,* maximum variation of arithmetical average values from specified test conditions) for external resistance to airflow, the test standard does not specify to which values of ESP these tolerances are intended to apply.

In the June 2018 RFI, DOE requested comment on whether minimum ESP requirements should be included for ducted WSHPs, and if so, what values would be appropriate. 83 FR 29048, 29050 (June 22, 2018). DOE also requested information on whether field ESP values typically vary with capacity, and whether fan power used for overcoming ESP should be included in the efficiency calculation for WSHPs intended to be used with ducting. *Id.* DOE asked for comment and data on whether the fan/motor efficiency factor used in the calculation of fan power for WSHPs is representative of units currently on the market and whether the value accurately represents the efficiency of existing fans that are not replaced in WSHP installations. *Id* at 83 FR 29051. Additionally, DOE requested comment on whether indoor fans are typically replaced when coil-only WSHPs are installed. *Id.*

In response to DOE's request for information, the Joint Advocates encouraged DOE to establish minimum ESP values for ducted equipment and to include the fan power used for overcoming external resistance in efficiency calculations for WSHPs. (Joint Advocates, No. 10 at pp. 1–2) NEEA commented that representative ESPs for WSHPs are higher than zero ESP, and the commenter recommended that DOE should ensure the WSHP ESP requirements reflect field installations, stating that otherwise, WSHP ratings will neither provide an adequate representation of actual efficiency nor provide good information to consumers. (NEEA, No. 11 at p. 3) NEEA also reminded that the ASRAC Working Group recommended that test procedures for regulated equipment, including WSHPs, be revised to better capture fan energy use. NEEA further commented that adding minimum ESP values would not increase test burden. *Id.*

AHRI, Trane, and WaterFurnace stated that the AHRI WSHP certification program does require minimum ESPs that increase with rated capacity for ducted units with fans driven by an electronically-commutated motor (''ECM''), and that these minimum ESPs are being considered for inclusion in the revised version of ISO 13256–1. (AHRI, No. 12 at pp. 5–6; Trane, No. 8 at p. 3; WaterFurnace, No. 7 at p. 5) AHRI and WaterFurnace commented that the field ESP of commercial WSHPs is largely tied to the ductwork and a single filter, typically resulting in ESPs less than 0.50 inches water column (''in H_2O''), but the commenters noted that some larger systems (>60,000 Btu/h) may be installed such that ESP values are as much as 1.0 in H_2O. (AHRI, No. 12 at p. 5; WaterFurnace, No. 7 at p. 4) AHRI also mentioned that commercial WSHPs are not typically installed with substantial ancillary filters or other high-static accessories found in larger air handlers. (AHRI, No. 12 at p. 5)

Trane and AHRI commented that fan power for overcoming ESP should not be included in the efficiency calculation. (AHRI, No. 12 at p. 6; Trane, No. 8 at pp. 2–3) AHRI further commented that the ISO 13256–1:1998 approach (of including a fan power adjustment down to zero ESP) results from the acknowledgment of the variability of ESP in the wide variety of WSHP applications that range from cooling towers/boilers to dry coolers to geothermal earth loop systems. (AHRI, No. 12 at p. 5) Trane and WaterFurnace further commented that excluding the fan power for overcoming ESP from the efficiency calculation ensures that units with indoor fans that produce higher static pressure are not penalized for having a stronger fan motor. (Trane, No. 8 at pp. 2–3; WaterFurnace, No. 7 at p. 4) WaterFurnace added that because more powerful fans to overcome higher field ESPs results in lower certified efficiency, most manufacturers design to the minimum ESP to avoid the excess fan power, and that in field applications, this results in low airflow and poor performance. WaterFurnace commented that their typical WSHP product is tested at higher ESP (greater than 0.4 in H_2O) but then corrected to zero ESP. (WaterFurnace, No. 7 at pp. 1, 4) AHRI stated that fewer than 10 percent of all installed WSHPs have a cooling capacity greater than 5 tons, and the organization further noted that the table of ESP requirements in AHRI WSHP/Geothermal Operations Manual specifies an ESP of 0.20 in H_2O for 5-ton models, suggesting that 90 percent of WSHPs would have an ESP less than 0.2 in H_2O. (AHRI, No. 12 at p. 8)

AHRI and WaterFurnace commented that the AHRI WSHP/Geothermal Operations Manual limits the fan power correction to three percent on the cooling capacity to prevent any application of the correction as a way to inflate efficiencies. (AHRI, No. 12 at p. 8; WaterFurnace, No. 7 at p. 8) AHRI and WaterFurnace further commented that aligning ESP requirements for different equipment categories (with different conditions and applications) is futile and that there will always be differences in HVAC test standards. (AHRI, No. 12 at p. 8; WaterFurnace, No. 7 at p. 7) AHRI, Trane, and WaterFurnace stated that the fan power adjustment factor in ISO 13256–1:1998 is representative for WSHPs. (AHRI, No. 12 at p. 8; Trane, No. 8 at p. 4; WaterFurnace, No. 7 at p. 8) AHRI, Trane, and WaterFurnace also stated that the fan power adjustment factor provides the ability to predict performance at any ESP level. (AHRI, No. 12 at p. 3; Trane, No. 8 at p. 3; WaterFurnace, No. 7 at p. 5)

AHRI and WaterFurnace also stated that the fan efficiency factor noted in the RFI is the same for all current fan motor designs, both permanent magnet variable speed and induction technologies, and they have found them to be reasonable. (AHRI, No. 12 at p. 8; WaterFurnace, No. 7 at p. 7) WaterFurnace further stated that the fan and pump correction factors were developed in 1998 after high-efficiency permanent split capacitor (''PSC'') and ECM fan motor technology were both deployed into the market and that the factor is intended to cover a number of technologies. (WaterFurnace, No. 7 at p. 7)

Regarding whether indoor fans are typically replaced when coil-only WSHPs are installed, AHRI and WaterFurnace commented that they are not aware of any coil-only WSHPs, and, therefore, that test procedure revisions to address such units are unnecessary. (AHRI, No. 12 at p. 8; WaterFurnace, No. 7 at p. 8) AHRI and WaterFurnace also stated that all commercial WSHPs are packaged units and that split systems are not commercially used. *Id.*

In response to those comments on the June 2018 RFI, DOE would clarify that ducted WSHPs installed in the field must overcome ESP from ductwork. As noted, the method used in ISO 13256–1:1998 and ISO 13256–1:2021 excludes the power to overcome ESP via the fan power adjustment, which adjusts the fan power down to reflect zero ESP. In contrast, testing per AHRI 340/360–2022 requires testing at a minimum ESP requirement (specified in Table 7 of AHRI 340/360–2022) and does not include any adjustments to the fan power. In other words, ratings in accordance with AHRI 340/360–2022 reflect performance at the applicable minimum ESP requirement. DOE has tentatively concluded that testing ducted WSHPs in accordance with AHRI 340/360–2022 (*i.e.,* testing at minimum ESP requirements with no fan power adjustment) would be more representative of field installations than the method used in ISO 13256–1:1998, for the following three reasons:

(1) Use of the fan power adjustment in ISO 13256–1:1998 results in ratings that do not reflect the fan power needed to overcome ESP;

(2) The fan power adjustment in ISO 13256–1:1998 assumes a fan efficiency of 0.3, which underestimates the efficiency of fans in WSHPs, and, thus, underestimates the fan power that would be needed for the fan to operate at zero ESP; and

(3) Rated ESP values that manufacturers use when testing to ISO 13256–1:1998 are typically significantly higher than ESPs representative of water-loop WSHP installations. Because, as stated, the fan power

adjustment subtracts fan power to reflect performance at zero ESP, assuming a low fan efficiency, testing at ESPs higher than representative values subtracts more fan power than would typically be needed to overcome that high tested ESP, and, thus, it further results in efficiency ratings that underestimate fan power needed to operate at zero ESP.

DOE conducted investigative testing on five WSHPs to determine the extent to which ISO 13256–1:1998 accounts for fan energy use compared to testing at representative ESP requirements per AHRI 340/360–2022. DOE also determined the fan efficiency of these five units. Of the five tested units, three had constant airflow ECM motors and two had constant torque ECM motors.

TABLE 6—INVESTIGATIVE TESTING RESULTS REGARDING FAN POWER AND FAN EFFICIENCY

Fan Power at AHRI 340/360 ESP Requirement (W)	262.04
Fan Power Determined According to ISO 13256–1:1998 (W)	139.57
Average Measured Fan Efficiency	0.46
Measured Fan Efficiency Range	0.34–0.71

DOE determined the relationship between ESP and fan power for the five WSHPs by conducting several tests with varying ESP at the rated airflow. As shown in Table 5, DOE determined the fan power for each of the five units at the applicable ESP requirement in AHRI 340/360–2022. These data show that the method in ISO 13256–1:1998 accounts for an average of only 53 percent of the fan power required to overcome the ESP specified in AHRI 340/360–2022.

DOE also calculated the fan efficiency for each unit based on tests conducted with varying ESP at the rated airflow. As shown in Table 5, DOE found that the measured fan efficiency for all five units is higher than the fan efficiency value assumed in ISO 13256–1:1998 (30 percent). Specifically, the average measured efficiency (46 percent) is over 50 percent higher than the ISO 13256–1:1998 value, and the highest measured efficiency is more than double the ISO 13256–1:1998 value. The consistent underestimation of fan efficiency by the ISO 13256–1:1998 fan power adjustment equation for the five tested units results in a larger amount of fan power being subtracted from the measured value when adjusting down to zero ESP than would be representative of the actual fan's operation. In other words, when adjusting the measured fan power down to zero ESP, the fan power adjustment's assumption of a fan efficiency that is lower than is typical in WSHPs results in more power being subtracted than the fan would actually have needed to overcome that level of ESP (because lower-efficiency fans consume more power to provide the same level of output). Therefore, for these five units the resulting rating determined per ISO 13256–1:1998 underestimates the fan power needed to operate at zero ESP because too much fan power is subtracted using the fan power adjustment.

The low fan efficiency value in the ISO 13256–1:1998 fan power adjustment equation results in an incentive for manufacturers to test at a higher ESP than would be representative for WSHPs, to take more advantage of the fan power adjustment by subtracting a larger calculated adjustment from the measured fan power (when adjusting fan power down to reflect performance at zero ESP). DOE's examination of rated ESP values in supplemental test instructions (''STI'') indicates that WSHPs are being rated based on testing with ESPs higher than would be representative. Specifically, DOE examined the STI for 15 WSHPs and found that the average rated ESP was 0.51 in H_2O. In contrast, the rated ESPs in the STI exceeded the AHRI 340/360–2022 ESP requirements (which, as discussed, align with the ESP levels included in the AHRI WSHP/Geothermal Operations Manual and are very similar to the ESP levels in included in ISO 13256:1–2021) by more than the +0.05 in H_2O tolerance for 13 of the 15 units. Given the low fan efficiency assumed in the ISO 13256–1:1998 fan power adjustment, testing at ESPs higher than representative for WSHPs results in efficiency ratings that underestimate fan power needed to operate at zero ESP.

Regarding comments received about ESP requirements in the revised version of ISO 13256–1, DOE acknowledges that Table 1 of ISO 13256–1:2021 does include minimum ESPs for all fan motor types, and that those minimum ESPs are generally consistent with the values in Table 7 of AHRI 340/360–2022, albeit with slight differences due to rounding. However, ISO 13256–1:2021 does not include an upper tolerance on ESP (*i.e.,* tests can still be conducted at any ESP above the minimum) and maintains the fan power correction to adjust down to zero ESP. Again, DOE tentatively finds that its proposed approach based on AHRI 340/360–2022 would produce results more representative of an average WSHP use cycle, so the Department is not proposing to use ISO 13256–1:2021 in this context.

Because the fan power adjustment method used in ISO 13256–1:1998 and ISO 13256–1:2021 does not capture the fan power to overcome ESP, and underestimates the fan power needed to operate at zero ESP for many units (as determined from DOE's testing and examination of rated ESPs from STI), DOE has tentatively concluded that ratings based on performance at a representative ESP requirement (as is the case in AHRI 340/360–2022) are more representative of the total fan power that would be consumed in field installations.

The minimum ESP requirements specified in Table 7 of AHRI 340/360–2022 align with the minimum ESP requirements specified in Table B2 of the AHRI WSHP/Geothermal Operations Manual and are generally consistent with the minimum ESPs specified in Table 1 of ISO 13256–1:2021, with slight differences due to rounding. Based on the inclusion of similar minimum ESP requirements in the AHRI WSHP/Geothermal Operations Manual and ISO 13256–1:2021, DOE has tentatively concluded that the minimum ESP requirements specified in AHRI 340/360–2022 are representative of water-loop WSHP field installations.

To account for the impacts of ESP typically encountered in the field, DOE is proposing provisions to reflect fan power to overcome a representative ESP when calculating efficiency. As per the discussion in this section and in section III.D.2 of this NOPR, DOE has tentatively determined that to best reflect field operation, WSHPs should be tested with minimum ESPs; the power for overcoming ESP should be included in efficiency calculations; and all equipment should be tested with an ESP upper tolerance. Therefore, DOE has tentatively determined that for WSHPs the method in AHRI 340/360–2022 is more representative of field energy use than the methods used in ISO 13256–1:1998 or ISO 13256–1:2021. As such, DOE is proposing to adopt AHRI 340/360–2022 for WSHPs, including section 6.1.3.3 and Table 7 of AHRI 340/360–2022, which specify minimum ESPs for ducted units, a tolerance on ESP of −0.00/+0.05 in H_2O, and no fan power adjustment. In the following sections (sections III.F.1.b and III.F.1.b.i of this document), DOE provides further detail on proposed provisions for setting airflow and ESP for units intended to be installed both with and without ducts.

Regarding comments received about WSHPs with higher-static fan motors, DOE is proposing an approach for representations and enforcement of units with non-standard indoor fan motors (*i.e.,* more powerful fan motors intended for operation with ESPs higher than the ESP requirements in the test procedure). This approach would allow for an individual model with a non-standard indoor fan motor to be included in the same basic model as an individual model with a standard indoor fan motor, with the rating based on performance with the standard indoor fan motor, as long as the non-standard indoor fan motor has the same or better relative efficiency performance as compared to the standard motor. DOE has tentatively concluded that this proposed approach addresses the concerns raised by commenters that ESP requirements would penalize units with higher-static indoor fan motors. Section III.G.3 of this NOPR includes additional discussion on DOE's proposed approach for non-standard indoor fan motors.

Regarding comments received about the AHRI WSHP/Geothermal Operations Manual, DOE notes that the Operations Manual is not incorporated by reference in the DOE test procedure and is not referenced in ASHRAE Standard 90.1. Therefore, the provisions included in the AHRI WSHP/Geothermal Operations Manual are not reflected in the current DOE test procedure. However, DOE has nonetheless reviewed the AHRI WSHP/Geothermal Operations Manual as part of its consideration of potential amended test procedure provisions in this NOPR. DOE notes that Table B2 of the AHRI WSHP/Geothermal Operations Manual does specify ESP requirements that align with the ESP requirements specified in Table 7 of AHRI 340/360–2022; however, the ESP requirements in the AHRI WSHP/Geothermal Operations Manual only apply to ducted units with ECM fan motors. DOE has tentatively concluded that specification of ESP requirements would provide for more representative ratings for all ducted WSHPs, not just units with ECM fan motors. Additionally, DOE notes that section A5 of the AHRI WSHP/Geothermal Operations Manual limits the fan power correction to no more than 3 percent of the measured cooling capacity. However, because the fan power correction is applied to both the capacity and total power when calculating EER or COP, the effect of a fan power correction of 3 percent on the calculated efficiency would be significantly more than 3 percent. Further, as discussed, DOE has tentatively concluded that ratings based on minimum ESP requirements would be more representative than ratings based on zero ESP (developed using the fan power correction). For these reasons, DOE is not proposing to incorporate by reference or otherwise adopt the AHRI WSHP/Geothermal Operations Manual as part of the DOE WSHP test procedure.

Regarding comments received about coil-only units, DOE has identified at least one coil-only unit that would meet the definition of a WSHP. In accordance with DOE's proposal to adopt AHRI 340/360–2022, coil-only WSHPs would be subject to the test provisions for setting airflow for coil-only units specified in sections 6.1.3.3 and 6.1.3.4 of AHRI 340/360–2022.

Issue 10: DOE requests comment on the proposal to adopt provisions from AHRI 340/360–2022 such that testing would be conducted within tolerance of the AHRI 340/360–2022 minimum ESP requirements, and efficiency ratings would include the fan power measured to overcome the tested ESP.

b. Setting Airflow and ESP

ISO 13256–1:1998 specifies airflow rates in section 4.1.5 of that document, including that: (a) non-ducted heat pumps shall be tested at airflow rates obtained at zero ESP; (b) ducted heat pumps with internal fans or with designated air movers shall be tested at the airflow rates obtained at zero ESP or the manufacturer-specified airflow rate, whichever is lower, and (c) ducted heat pumps without internal fans shall be tested at the manufacturer-specified airflow rate subject to a maximum internal pressure drop. Additionally, paragraph (e)(2) of 10 CFR 431.96 requires that the airflow rate used for testing must be specified by the manufacturer in the installation and operation manuals being shipped to the commercial customer, and that if a rated air flow value for testing is not clearly identified, a value of 400 standard cubic feet per minute per ton shall be used.

ISO 13256–1:1998 does not indicate which speed setting should be used to achieve specified airflow for a fan with more than one speed setting. Also, in some cases, the airflow rate and pressure conditions specified for a given ducted heat pump without an internal fan may not be achievable simultaneously. ISO 13256–1:1998 does not provide an approach for simultaneously achieving the specified airflow rate and pressure conditions in cases where the airflow may not be achievable below the maximum internal pressure drop. In the June 2018 RFI, DOE requested comment on whether indoor fans typically have multiple speed settings for WSHPs, and if so, how manufacturers choose the speed to use during testing. DOE also requested comment on how specified airflow is achieved if none of the speed settings produce that airflow at the specified internal or external static pressure. 83 FR 29048, 29051 (June 22, 2018).

AHRI and WaterFurnace commented that most WSHP fans have at least three speeds. (AHRI, No. 12 at p. 7; WaterFurnace, No. 7 at p. 7) Trane commented that their company offers single-speed and multi-speed units. (Trane, No. 8 at p. 4) AHRI, Trane, and WaterFurnace stated that as part of AHRI's certification program, the test facility utilizes the blower speed specified by the manufacturer in literature and submission data. (AHRI, No. 12 at p. 7; Trane, No. 8 at p. 4; WaterFurnace, No. 7 at p. 7) AHRI and WaterFurnace further stated that manufacturers select an airflow that is advantageous for the specifications they are trying to achieve; for example, low airflows are beneficial for humidity removal. *Id.* The commenters also indicated that the AHRI WSHP/Geothermal Operations Manual specifies steps to be taken if the manufacturer's specified airflow is not met with the initial fan settings, which include reducing ESP to a minimum value set forth in the AHRI WSHP/Geothermal Operations Manual. *Id.*

AHRI acknowledged that in some cases, the airflow rate and pressure conditions specified by ISO 13256–1:1998 for a given ducted heat pump without an internal fan may not be achievable simultaneously. As an example, AHRI described a scenario in which the manufacturer-specified airflow may not be achievable below the maximum internal pressure drop specified in section 4.1.5.3 of ISO 13256–1:1998. AHRI stated that ISO 13256–1:1998 does not provide an approach for simultaneously achieving the specified airflow rate and pressure conditions in such a case. (AHRI, No. 12 at p. 7) In such cases, AHRI and WaterFurnace stated that provisions in Appendix B of the AHRI WSHP/Geothermal Operations Manual are used that permit a tolerance for achieving the specified airflow within 10 percent of the manufacturers specified flow rate. (AHRI, No. 12 at p. 7; WaterFurnace, No. 7 at p. 6)

On this topic, DOE notes that the provisions of ISO 13256–1:2021 are equivalent to those in ISO 13256–1:1998 for setting airflow of non-ducted units and ducted units without internal fans. For ducted units with internal fans, ISO 13256–1:2021 provides additional specifications beyond those in ISO 13256–1:1998. Table 1 of ISO 13256–1:2021 provides minimum ESP values and explains that airflow should be set as specified by the manufacturer with an ESP greater than or equal to the minimum ESP value set forth in ISO 13256–1:2021. For units with non-constant airflow fans and adjustable speed, ISO 13256–1:2021 states that the speed may be adjusted as needed to the lowest speed that provides at least the minimum ESP at the specified airflow rate. In cases where the airflow rate cannot be maintained within tolerance with an ESP greater than or equal to the minimum ESP, the test must be run at the airflow achieved with an ESP equal to the minimum ESP.

As noted in section III.F.1.a of this document, DOE is proposing to adopt the minimum ESP requirements in Table 7 of AHRI 340/360–2022 and condition tolerances in Table 6 of AHRI 340/360–2022. For the reasons that follow, DOE has tentatively concluded that AHRI 340/360–2022 is superior to available alternatives in terms of these objectives. To start, DOE has tentatively determined that more specification than provided in ISO 13256–1:1998 is needed to ensure consistent and repeatable setting of airflow and ESP for testing, thereby ensuring the representativeness of the results. For example, ISO 13256–1:1998 does not specify what to do in certain circumstances when instructions provided are unclear or conflict (*e.g.,* if no fan control setting is certified and multiple combinations of ESP and fan speed can provide the manufacturer-specified airflow). Although ISO 13256–1:2021 provides more specification than ISO 13256–1:1998 for setting airflow in ducted units with an internal fan, it still does not address situations in which instructions are missing, are unclear, or conflict. In addition, neither version of the ISO test procedure specifies an upper tolerance on ESP for ducted units. As such, further detail than what is provided in ISO 13256–1:1998 and ISO 13256–1:2021 is warranted. Furthermore, the AHRI WSHP/Geothermal Operations Manual includes some provisions on fan settings, but these provisions are likewise insufficient for setting airflow and ESP with minimum ESPs and condition tolerances, as that manual relies on communication and agreement between the manufacturer and AHRI in situations in which both ESP and airflow tolerances cannot be met. Such approach is inappropriate in a regulatory context.

Therefore, as stated previously in this NOPR, DOE is proposing to incorporate by reference AHRI 340/360–2022, including adoption of sections 6.1.3.3 through 6.1.3.5, which specify a 3 percent condition tolerance for airflow rate, a −0.00/+0.05 in H_2O condition tolerance for ESP, and instructions on setting airflow and ESP during testing. These sections additionally provide guidance on what to do during testing if one or both of the conditions cannot be met. DOE preliminarily finds that these provisions would improve test repeatability, provide test conditions that are more representative of field operation, and appropriately address the issue where none of the speed settings produce the specified airflow at the specified internal or external static pressure.

DOE notes, however, that the relevant provisions in AHRI 340/360–2022 were generally developed for ducted units with continuously variable-speed fans. Accordingly, additional provisions specific to testing ducted units with discrete-step fans and non-ducted units are necessary. The following sub-sections discuss the proposed additional provisions for such WSHPs.

Issue 11: DOE requests comment on the proposed adoption of provisions from AHRI 340/360–2022 for setting airflow and ESP for WSHP testing.

(i) Ducted Units With Discrete-Step Fans

Many ducted WSHPs have fans with discrete steps in speed. In situations where both airflow and ESP tolerances cannot be met, the instructions in section 6.1.3.5 of AHRI 340/360–2022 can result in ducted units with discrete-step fans operating with ESPs that are higher than the tolerance on the ESP requirements due to the difference in fan speed between each step.

Section 6.1.3.5 of AHRI 340/360–2022 specifies that the measured airflow during test must be within 3 percent of the rated airflow and that the ESP during test must be within −0.00/+0.05 in H_2O of the minimum ESP specified in Table 6. Section 6.1.3.5.2.4 specifies that for two adjacent fan control settings, if the lower setting is too low (such that ESP or airflow are lower than the tolerance range) and the higher setting is too high (such that ESP or airflow are higher than the tolerance range), then the higher fan control setting should be used. At this higher fan control setting, section 6.1.3.5.2.4 specifies to maintain airflow within tolerance, which would result in an ESP higher than the +0.05 in H_2O tolerance. However, WSHPs with discrete-step fans may have a limited number of fan control settings, such that testing at the higher fan speed in this case may result in testing with an ESP that significantly exceeds the minimum ESP requirement. For such units, in a case in which operating at the lower fan control setting with the ESP in tolerance results in an airflow slightly lower than 97 percent of the rated airflow, it would be more representative to test at the lower fan control setting with the airflow slightly below the 97 percent tolerance, rather than test at the higher fan control setting with an ESP potentially significantly exceeding the minimum ESP requirement. In such a case, the industry test procedures for SPVUs (AHRI 390–2021; section 5.7.3.4.1.4) and CAC/HPs (AHRI 210/240–2023; section 6.1.5.1.6) allow airflow to drop to 90 percent of the rated airflow while maintaining ESP within tolerance. DOE has tentatively concluded that adopting this approach for WSHPs would result in testing at conditions more representative of field applications.

Therefore, for ducted units with discrete-step fans, DOE is proposing in section 3.2 of proposed appendix C1 instructions for setting the fan speed in the scenario in which: (1) tolerances for airflow and ESP cannot be met simultaneously, and (2) adjacent fan control settings result in airflow or ESP too low at the lower fan control setting and too high at the higher fan control setting. These proposed instructions specify to exclude sections 6.1.3.5.2.4 and 6.1.3.5.3.2.3 of AHRI 340/360–2022, and to allow airflow to drop to 90 percent of the specified airflow rate while maintaining ESP within tolerance. If ESP cannot be maintained within tolerance at 90 percent of the specified airflow rate, the proposed instructions specify to use the next highest fan speed and allow ESP to exceed the tolerance while maintaining airflow within tolerance.

Issue 12: DOE requests comment on its proposed instructions for setting airflow and ESP for ducted WSHP units with discrete-step fans.

(ii) Non-Ducted Units

DOE is aware that some WSHPs may be installed without indoor air distribution ducts in the field. Depending on the type of installation, the test method specified in ISO 13256–1:1998 differs; section 4.1.2 of ISO 13256–1:1998 specifies provisions for WSHPs installed without ducts, and section 4.1.3 of the standard specifies provisions for WSHPs installed with ducts. ISO 13256–1:1998 does not specify how to distinguish whether a unit is ducted or non-ducted. The provisions of ISO 13256–1:2021 are the same as those of ISO 13256–1:1998 in this regard.

In the June 2018 RFI, DOE requested comment on the physical characteristics that distinguish ducted and non-ducted WSHPs. DOE also requested comment on whether any WSHP models can be installed either with or without indoor distribution ducts, and if such models exist, DOE requested comment on whether manufacturers test these models to the non-ducted provisions in section 4.1.2 of ISO 13256–1:1998 or the ducted provisions in section 4.1.3 of ISO 13256–1:1998, or whether these models are tested using both provisions of section 4.1.2 and 4.1.3. 83 FR 29048, 29050–29051 (June 22, 2018).

In response to DOE's request for information, AHRI and WaterFurnace commented that WSHPs may be designed for use either with or without indoor air distribution ducts, and that while the specified test set-ups are different, the non-ducted test simulates the conditions of the ducted test using a hood with zero static to accumulate the supply air for volumetric and enthalpy measurements. (AHRI, No. 12 at pp. 6–7; WaterFurnace, No. 7 at pp. 5–6)

AHRI and WaterFurnace also commented that the majority of WSHPs are designed for use with ductwork but that there are some console units designed to ''free blow'' into the space with no ductwork at zero ESP. (AHRI, No. 12 at pp. 6–7; WaterFurnace, No. 7 at pp. 5–6) AHRI added that such non-ducted WSHPs typically include a tangential blower (similar to packaged terminal air conditioners) meant for low-static operation and free discharge into the conditioned space. (AHRI, No. 12 at pp. 6–7) Trane commented that motor horsepower and fan size are designed to deliver zero ESP for non-ducted units and that units that are required to be ducted will require a different motor horsepower and fan size. (Trane, No. 8 at p. 4)

Additionally, AHRI and Trane pointed out that WSHPs are certified to AHRI as either ''ducted'' or ''non-ducted'' and that the equipment is tested to the appropriate section of ISO 13256–1:1998. AHRI and WaterFurnace commented that there are no known WSHP models designed for both ducted and non-ducted application. (AHRI, No. 12 at pp. 6–7; WaterFurnace, No. 7 at pp. 5–6) In contrast, Trane stated that although it does not offer any equipment that can be installed as either ducted or non-ducted, there is a selection of WSHP equipment that is designed for both ducted and non-ducted applications. (Trane, No. 8 at pp. 3–4)

Consistent with AHRI's, WaterFurnace's, and Trane's comments, DOE has identified some WSHPs, marketed as ''console units,'' which would operate without a duct. As noted previously, AHRI 340/360–2022 does not have any instructions for setting up airflow and ESP for non-ducted units. (AHRI 340/360–2022 is the industry test procedure for testing CUACs and there are no non-ducted CUACs.) Section 4.1.5 of ISO 13256–1:1998 and section 5.1.5 of ISO 13256–1:2021 include provisions for setting airflow for non-ducted units at zero ESP, but the provisions in ISO 13256–1:1998 and ISO 13256–1:2021 do not specify the settings to use or how to address situations in which test procedure instructions are missing or conflict (also see discussion in section III.F.1.b of this NOPR). Therefore, DOE has tentatively concluded that specific provisions for non-ducted WSHPs are warranted.

To address testing of non-ducted WSHPs, DOE proposes separate provisions for setting airflow and ESP for non-ducted units in section 3.1 of proposed appendix C1. Consistent with ISO 13256–1:1998 and ISO 13256–1:2021, DOE proposes that non-ducted units be tested at zero ESP, because non-ducted units would not be installed with ductwork in the field. DOE proposes that these provisions would apply to all units that are not configured exclusively for delivery of conditioned air to the indoor space without a duct(s). Units that are configured for delivery of conditioned air to the indoor space without a duct(s) would be required to use the provisions for setting airflow and ESP in section 6.1.3 of AHRI 340/360–2022 and section 3.2 of proposed appendix C1, as applicable.

DOE is proposing in section 3.1 of proposed appendix C1 that WSHP units that are not configured exclusively for delivery of conditioned air to the indoor space without a duct(s) would be tested with a target ESP of 0.00 in H_2O (consistent with ISO 13256–1:1998 and ISO 13256–1:2021) within a tolerance of −0.00/+0.05 in H_2O in place of the ESP specified in Table 7 of AHRI 340/360–2022 (because the ESP requirements in AHRI 340/360–2022 are intended to reflect the pressure drop in ductwork for ducted units). The proposed ESP tolerance for non-ducted units aligns with the tolerance for ducted units in AHRI 340/360–2022. Instead of the instructions for setting airflow and ESP in section 6.1.3.5 of AHRI 340/360–2022, DOE proposes that if both the ESP and airflow cannot be simultaneously maintained within tolerance for any test, to maintain the ESP within the required tolerance and use an airflow as close to the target value as possible (*i.e.,* prioritize maintaining ESP in tolerance over maintaining airflow in tolerance). This is because testing an ESP of more than 0.05 in H_2O would not be representative for a non-ducted unit which would not be installed with ductwork in the field. Finally, DOE proposes that if an airflow out of tolerance is used for the full-load cooling test, then the measured full-load cooling airflow is to be used as the target airflow for all subsequent tests that call for the full-load cooling airflow within a tolerance of +/−3 percent. These provisions are similar to those included for testing non-ducted units in other industry test standards for comparable categories of commercial air conditioners and heat pumps, such as AHRI 390–2021 for testing SPVUs.

DOE has tentatively determined that these provisions would provide a representative and repeatable test procedure for non-ducted WSHPs, and that they would be appropriate for testing WSHPs because they are the generally accepted industry method used for testing similar equipment such as SPVUs. This proposed approach remedies some of the shortcomings identified with the current WSHP test procedure which incorporates by reference ISO 13256–1:1998.

Issue 13: DOE requests comment on its proposal for setting airflow and ESP for non-ducted WSHP units.

2. Capacity Measurement

a. Primary and Secondary Methods

The current DOE test procedure, through adoption of section 6.1 of ISO 13256–1:1998, specifies that total cooling and heating capacities are to be determined by averaging the results obtained using two test methods: the liquid enthalpy test method for the liquid side tests and the indoor air enthalpy test method for the air side tests. For non-ducted equipment, section 6.1 of ISO 13256–1:1998 includes an option for conducting the air-side tests using the calorimeter room test method instead of the air enthalpy test method. Section 6.1 of ISO 13256–1:1998 also specifies that, for a test to be valid, the results obtained by the two methods used must agree within 5 percent.

In the June 2018 RFI, DOE discussed how ANSI/ASHRAE 37–2009 is similar to the test method in ISO 13256–1:1998, and that DOE was considering whether testing to ANSI/ASHRAE 37–2009 would be appropriate for WSHPs. DOE further discussed how ANSI/ASHRAE 37–2009 requires two capacity measurements for units with cooling capacity less than 135,000 Btu/h; the first method of measurement (*i.e.,* the primary method) is used as the determination of the unit's capacity, while the second measurement (*i.e.,* the secondary method) is used to confirm rather than to be averaged with the primary measurement (see section 10.1 and Table 1 of ANSI/ASHRAE 37–2009). 83 FR 29048, 29052 (June 22, 2018).

In the June 2018 RFI, DOE requested information on whether one of the two capacity measurements prescribed in ISO 13256–1:1998 gives a consistently higher or lower result than the other, or whether one of the methods can be considered more accurate for a range of different WSHP configurations and models. *Id.* Additionally, DOE requested comment on whether the ANSI/ASHRAE 37–2009 approach for determination of rated capacity (*i.e.,* using the primary method's measurement as the rated capacity rather than averaging the two capacity measurements) would result in more representative ratings than the ISO 13256–1:1998 approach. *Id.*

Trane commented that the capacity value measured by the liquid enthalpy method is generally higher than the value measured by the indoor air enthalpy method, stating that air-side measurements have more opportunity for losses than water-side measurements. (Trane, No. 8 at p. 5) AHRI and WaterFurnace commented that the water side test is generally simpler to conduct and also more accurate than the air enthalpy method, because the uncertainties of measurement are much lower in the water-side calculations. (AHRI, No. 12 at p. 13; WaterFurnace, No. 7 at p. 11)

AHRI, Trane, and WaterFurnace recommended continuing to use the average of the air-side and water-side measurements as the basis for capacity ratings. (AHRI, No. 12 at p. 13; Trane, No. 8 at p. 5; WaterFurnace, No. 7 at p. 11) AHRI and WaterFurnace stated that the current approach in ISO 13256–1:1998 represents a compromise that helps ensure best testing procedures. (AHRI, No. 12 at p. 13; WaterFurnace, No. 7 at p. 11) AHRI argued that the ANSI/ASHRAE 37–2009 approach does not yield more representative ratings compared to the ISO 13256–1:1998 method. (AHRI, No. 12 at p. 13) Trane further asserted that the average of the methods is more accurate than the measurement from either single method alone. (Trane, No. 8 at p. 5) AHRI and WaterFurnace also stated that ANSI/ASHRAE 37–2009 does not include the liquid enthalpy method of test required on the source side for all WSHPs. (AHRI, No. 12 at p. 13; WaterFurnace, No. 7 at p. 10)

In response, DOE notes first that the capacity measurement provisions in section 7.1 of ISO 13256–1:2021 differ from those in section 6.1 of ISO 13256–1:1998 in several ways. Instead of averaging the two capacity measurements, section 7.1 of ISO 13256–1:2021 specifies that the capacity rating is equal to the value determined from the air side (referred to as the load side in ISO 13256–1:2021), consistent with the approach used in section 10.1.2 of ANSI/ASHRAE 37–2009. ISO 13256–1:2021 also does not allow use of the calorimeter method in place of the indoor air enthalpy method for measuring capacity on the load side, but section 7.1 of ISO 13256–1:2021 allows use of the refrigerant enthalpy method for configurations that cannot use the indoor air enthalpy method. Section 7.1 of ISO 13256–1:2021 continues to require the liquid enthalpy method for measuring capacity on the liquid side (referred to as the source side in ISO 13256–1:2021). Section 7.1 of ISO 13256–1:2021 also continues to require the two capacity measurements to agree within 5 percent for the test to be valid.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 for use in the WSHP test procedure, including section E6, which specifies test methods for capacity measurement. Section E6.1 of AHRI 340/360–2022 requires use of the indoor air enthalpy method specified in section 7.3 of ANSI/ASHRAE 37–2009 as the primary method for capacity measurement. This is the measurement used to determine capacity, as required in section 10.1.2 of ANSI/ASHRAE 37–2009. Section E6.2.2 of AHRI 340/360–2022 requires use of one of the applicable ''Group B'' methods specified in Table 1 of ANSI/ASHRAE 37–2009 as a secondary method for capacity measurement. The group B methods that are applicable to WSHPs are the outdoor liquid coil method (similar to the liquid enthalpy method included in the 1998 and 2021 versions of ISO 13256–1), the refrigerant enthalpy method, and the compressor calibration method. Section E6.4.2 of AHRI 340/360–2022 requires that the primary and secondary measurements match for full-load cooling and heating tests, within 6 percent of the primary measurement. No match is required between primary and secondary measurements for part-load cooling tests.

Regarding commenters' claims that ANSI/ASHRAE 37–2009 does not include the liquid enthalpy method of test required on the source side for all WSHPs, as discussed, ANSI/ASHRAE 37–2009 does include a liquid enthalpy method of test. The liquid enthalpy method is referred to as the outdoor liquid coil method in section 7 of ANSI/ASHRAE 37–2009, and it provides a measurement of liquid enthalpy that is similar to the measurement provided by the liquid enthalpy method in normative appendix C of ISO 13256–1:1998. As discussed, Table 1 of ANSI/ASHRAE 37–2009 specifies three secondary capacity measurement methods (*i.e.,* outdoor liquid coil, refrigerant enthalpy, and compressor calibration methods) that may be used to conduct the secondary measurements that are required for testing WSHPs with cooling capacity less than 135,000 Btu/h, rather than requiring the outdoor liquid coil for all water-source units (as is the case in section 6.1 of ISO 13256–1:1998). Table 1 of ANSI/ASHRAE 37–2009 also specifies the applicability of each secondary capacity method based on the configuration of the unit being tested. This specification of applicable secondary capacity measurement methods in ANSI/ASHRAE 37–2009 ensures that the chosen secondary capacity measurement is accurate because the outdoor liquid coil method in ANSI/ASHRAE 37–2009 is not applicable for certain unit configurations in which the compressor heat would not be sufficiently accounted for. Specifically, section 7.6.1.2 and note g to Table 1 of ANSI/ASHRAE 37–2009 specify that the outdoor liquid coil method may not be used if the system has a compressor that is ventilated by outdoor air or a remote outdoor compressor that is not insulated per section 7.6.1.2 of ANSI/ASHRAE 37–2009. Section III.F.2.b of this NOPR includes further discussion on this topic.

As part of DOE's proposal generally to adopt the test provisions in section E6 of AHRI 340/360–2022, DOE is proposing to adopt the provisions for measuring capacity in AHRI 340/360–2022 instead of those in section 6.1 of ISO 13256–1:1998. Using the indoor air enthalpy measurement as the measurement of capacity ensures that actual output of the WSHP—the cooling or heating of air—is used as the measure of capacity. The approach used in section 6.1 of ISO 13256–1:1998, in which the indoor air enthalpy measurement is averaged with the liquid enthalpy measurement, has the potential to result in capacity values that are higher than the actual delivered capacity because of heat transfer to/from the ambient air (either through heat transfer through the WSHP cabinet walls or air leakage). This potential is consistent with Trane's comment that the capacity value measured by the liquid enthalpy method is generally higher than the value measured by the indoor air enthalpy method. In addition, the approach used in section E6 of AHRI 340/360–2022 is consistent with the approach in section 7.1 of ISO 13256–1:2021, in that the indoor air enthalpy measurement is used as the capacity measurement in ISO 13256–1:2021. It is also consistent with the industry test procedures for other categories of air conditioning and heating equipment (*e.g.,* AHRI Standard 1230, AHRI Standard 390, and AHRI Standard 210/240). Therefore, DOE has tentatively concluded that it is more representative for the capacity rating of WSHPs to be determined with the indoor air enthalpy method, and for the secondary measurement to serve only as a verification of the indoor enthalpy measurement, rather than being averaged with the indoor air enthalpy method result to determine the capacity rating.

The proposed provisions do not permit use of the calorimeter method or refrigerant enthalpy method in place of the indoor enthalpy method, which is allowed in section 6.1 of ISO 13256–1:1998 and section 7.1 of ISO 13256–1:2021. However, DOE has tentatively concluded that alternatives to the indoor air enthalpy method are not necessary because DOE is not aware of any WSHPs that are unable to use the indoor enthalpy method as specified in ANSI/ASHRAE 37–2009 (with additional provisions in AHRI 340/360–2022).

The proposed provisions also allow a difference in capacity measurements of up to 6 percent in section E6.4.2 of AHRI 340/360–2022 instead of the 5 percent allowed in section 6.1 of ISO 13256–1:1998. DOE has tentatively concluded that this reduces burden while still ensuring accurate measurements of indoor air enthalpy. Once again, this proposal is consistent with the industry test procedures for other categories of air conditioning and heating equipment (*e.g.,* AHRI Standard 1230, AHRI Standard 390, and AHRI Standard 210/240).

Issue 14: DOE requests comment on its proposed approach to adopt the provisions in AHRI 340/360–2022 and ANSI/ASHRAE 37–2009 regarding primary and secondary capacity measurements.

b. Compressor Heat

DOE has identified split-system WSHPs available on the market. For at least one of these split systems WSHPs, the unit containing the compressor is intended for either indoor or outdoor installation. The installed location of the compressor, in relation to the conditioned space and other system components, impacts the capacity of a WSHP system and the provisions necessary for accurately measuring system capacity due to the generation of heat during compressor operation.

As discussed in section III.F.2.a of this NOPR, the current DOE test procedure, through adoption of ISO 13256–1:1998, requires use of two methods to measure space-conditioning capacity provided by a WSHP. One of these methods, the indoor air enthalpy method (see normative annex B of ISO 13256–1:1998), measures capacity directly by measuring mass flow and enthalpy change of the indoor air.[21] The second method, the liquid enthalpy test method (see normative annex C of ISO 13256–1:1998), measures heat transferred at the liquid coil. The liquid enthalpy measurement is adjusted by adding or subtracting the total unit input power (including the compressor input power) from the measured liquid side capacity in the heating or cooling mode tests, respectively, using the equations in sections C3.1 and C3.2 of ISO 13256–1:1998.

The liquid enthalpy adjustment in sections C3.1 and C3.2 of ISO 13256–1:1998 assumes that all compressor heat is absorbed and ultimately transferred to the conditioned space, thereby increasing heating capacity or decreasing cooling capacity. However, this fails to account for any heat transferred from the compressor or other components to their surroundings that does not contribute to space conditioning. For example, in the case of a split-system WSHP with an uninsulated compressor/liquid coil section installed outdoors, the air that absorbs compressor heat would not directly affect the conditioned space. In this case, adding or subtracting the entire compressor input power to or from the capacity calculated based on liquid temperature change likely overestimates the impact of compressor power input on the indoor-side capacity that is calculated using the liquid enthalpy-based method.

In the June 2018 RFI, DOE requested comment on whether there are split-system WSHP models on the market for which the unit containing the compressor is intended only for outdoor installation or only for indoor installation. DOE further requested comment on manufacturers' practices for testing split-system WSHPs for which the compressor is not housed in the section containing the indoor refrigerant-to-air coil, including which test rooms are used for the compressor section, and whether any adjustments are made to properly account for the compressor heat. 83 FR 29048, 29053 (June 22, 2018).

In response to DOE's requests for comment, AHRI, Trane, and WaterFurnace commented that accounting for compressor heat would not be a relevant issue because there are very few, if any, split-system WSHPs in the commercial market. (AHRI, No. 12 at p. 13; Trane, No. 8 at p. 5; WaterFurnace, No. 7 at pp. 11–12) The CA IOUs commented that, based on the AHRI directory, 90 percent of WSHPs are single-package units. (CA IOUs, No. 9 at p. 2)

As stated previously, DOE has identified a number of split-system WSHPs, several of which are certified in the DOE Compliance Certification Database, and the Federal test procedure[22] applies to any WSHP that meets DOE's definition of a WSHP. Further, because split-system WSHPs are available on the market, test procedure provisions are needed for testing them, regardless of their share of the WSHP market.

Sections D.4 and D.5 of ISO 13256–1:2021 use the same adjustment of the liquid enthalpy method as sections C3.1 and C3.2 of ISO 13256–1:1998. Thus, ISO 13256–1:2021 provides no additional methods to address compressor heat for split systems with the compressor in the liquid coil section.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. AHRI 340/360–2022 in turn references the test method in ANSI/ASHRAE 37–2009. Sections 6.1.3 and 6.1.5 of ANSI/ASHRAE 37–2009 contain provisions for addressing compressor heat in the indoor air enthalpy method that are similar to the provisions in sections F7.3 and F7.5 of ISO 13256–1:1998. For secondary capacity measurements, however, ANSI/ASHRAE 37–2009 has provisions that go beyond the provisions in ISO 13256–1:1998 to ensure that capacity is measured more accurately than it is by ISO 13256–1:1998, as discussed in the following paragraphs.

Section 7.6 of ANSI/ASHRAE 37–2009 includes a liquid enthalpy measurement method (referred to as the

[21] The alternative calorimeter room test method (see normative annex E of ISO 13256–1:1998), allowed to be used instead of the indoor air enthalpy method for non-ducted WSHPs, also measures indoor space-conditioning capacity directly.

[22] Currently, the DOE test procedure applies to all WSHPs with a capacity less than 135,000 Btu/h. However, DOE is proposing in section III.A of this NOPR to increase the scope of the Federal test procedure to include all WSHPs with a capacity less than 760,000 Btu/h.

''outdoor liquid coil method'' and applicable to both single-package units and split systems) that is similar to the method in normative annex C of ISO 13256–1:1998 in that it adjusts the liquid enthalpy measurement by the total input power of the WSHP. For split-system WSHPs, ANSI/ASHRAE 37–2009 includes the outdoor liquid coil method, the refrigerant enthalpy method, and the compressor calibration method as options for conducting the secondary measurements that are required for testing WSHPs with cooling capacity less than 135,000 Btu/h. However, ANSI/ASHRAE 37–2009 limits use of the outdoor liquid coil method so that it does not apply for certain unit configurations in which the compressor heat would not be sufficiently accounted for. Specifically, Section 7.6.1.2 and note g to Table 1 of ANSI/ASHRAE 37–2009 specify that the outdoor liquid coil method may not be used if the system has a compressor that is ventilated by outdoor air or a remote outdoor compressor that is not insulated per section 7.6.1.2 of ANSI/ASHRAE 37–2009. These limits on the applicability of the outdoor liquid coil method in ANSI/ASHRAE 37–2009 minimize discrepancy between measurements from the indoor air enthalpy method and liquid coil method by ensuring that either: (1) compressor heat is captured in indoor air enthalpy measurements, or (2) compressor heat loss to outdoor air is minimal because the compressor is sufficiently insulated.

For split-system WSHPs for which the outdoor liquid coil method in ANSI/ASHRAE 37–2009 cannot be used (*i.e.,* the system has a compressor that is ventilated by outdoor air or a remote outdoor compressor that is not insulated per section 7.6.1.2 of ANSI/ASHRAE 37–2009), ANSI/ASHRAE 37–2009 requires the use of either the refrigerant enthalpy method specified in section 7.5 of ANSI/ASHRAE 37–2009 or the compressor calibration method specified in section 7.4 of ANSI/ASHRAE 37–2009. For both of these methods, measured capacity is adjusted by only the input power of the indoor section of the WSHP, and not the total input power. Therefore, for both methods, the compressor heat lost to outdoor air from a remote outdoor compressor or compressor ventilated by outdoor air would appropriately be excluded from capacity measurements, similar to the indoor air enthalpy method. Therefore, for WSHPs with those configurations, the refrigerant enthalpy method and compressor calibration method specified in sections 7.5 and 7.4 (respectively) of ANSI/ASHRAE 37–2009 would provide a more representative result as compared to the approach used in normative annex C of ISO 13256–1:1998 (*i.e.,* liquid enthalpy method).

Based on the discussion in the prior paragraphs, DOE tentatively concludes that the proposed test procedure would provide an accurate secondary measure of capacity for all equipment configurations and would provide a more representative secondary measure of capacity than ISO 13256–1:1998 or ISO 13256–1:2021 for split systems with the compressor mounted in the outdoor section.

3. Cyclic Degradation

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs, including section 6.2.3.2 of that industry standard. Equation 4 in section 6.2.3.2 of AHRI 340/360–2022 is used to calculate part-load EER for a unit that needs to cycle in order to meet the 75-percent, 50-percent, and/or 25-percent load conditions required for the IEER metric. Cycling is the term used to describe the process in which a unit's compressor is repeatedly turned off and on in order to meet a load that is lower than the unit's capacity at its lowest compressor stage.

Equation 4 of AHRI 340/360–2022 multiplies only the compressor power and condenser section power by the load factor and the coefficient of degradation, while the indoor fan power and controls power are not multiplied by these variables. This means that equation 4 of AHRI 340/360–2022 assumes that the indoor fan continues to operate when the compressor cycles off. DOE understands that the draft of AHRI 600 has an equation similar to equation 4 of AHRI 340/360–2022, but the equation in draft of AHRI 600 assumes that the indoor fan stops operating whenever the compressor cycles off.

As discussed previously in section III.E.4 of this NOPR, stakeholders provided comment regarding the operation of a WSHP, including operation of the fan, in modes other than mechanical heating and cooling. (AHRI, No. 12 at pp. 4–5, 9; WaterFurnace, No. 7 at pp. 3, 9; Trane, No. 8 at pp. 2, 5) These comments on fan operation specifically referred to operation when there is no heating or cooling, but they might also be applicable to the issue of fan operation during compressor cycling under part-load conditions. Certain comments indicated that it is common for WSHP fans to operate continuously to provide air circulation or ventilation air. (AHRI, No. 12 at pp. 4–5; WaterFurnace, No. 7 at p. 3) Continuous operation of WSHP fans indicates that the fan would continue to run when the compressor cycles off.

In addition, the cyclic degradation approach used in equation 4 of AHRI 340/360–2022 is used in the IEER metric for multiple other categories of commercial HVAC equipment, indicating that it is common for the indoor fan to continue operating while the compressor cycles off. AHRI 340/360–2022 is used for testing CUAC/HPs, and equation 4 of AHRI 340/360–2022 is equivalent to equation 10 of AHRI 1230–2021 (which is used for testing VRF multi-split systems) and equation 3 of AHRI 390–2021 (which is used for testing SPVUs). These other equipment categories typically operate in similar environments to WSHPs (*i.e.,* commercial buildings with ventilation air requirements). Similar to these other equipment categories, DOE acknowledges that not all WSHPs are installed in the same manner, and the Department understands that fans operate continuously for many, but not all, installed WSHPs. However, comments received suggest that continuous operation of fans is representative of operation of many WSHPs, and adopting a cyclic degradation approach that assumes continuous fan operation is consistent with the IEER approach used for other equipment categories that use the IEER metric.

For the foregoing reasons, DOE has tentatively concluded that the cyclic degradation approach in equation 4 of AHRI 340/360–2022 is representative of WSHP operation. Therefore, DOE is proposing to adopt the approach in AHRI 340/360–2022 in proposed appendix C1. DOE is also proposing in section 5.1.2.5.4 of proposed appendix C1 that the same approach for cyclic degradation be used when determining IEER through interpolation and extrapolation (see discussion in section III.E.1.b of this NOPR).

Due to the nature of the method to determine IEER through the proposed interpolation and extrapolation in section 5.1.2 of proposed appendix C1, each component of the cyclic degradation equation in proposed section 5.1.2.5.4 of proposed appendix C1 (*i.e.,* cooling capacity, compressor power, condenser section power, indoor fan power, and controls power) would be measured and interpolated from the tested EWTs to the IEER EWTs. Furthermore, DOE is proposing that the condenser section power for units without integral pumps includes a total pumping effect to better account for the energy consumption of liquid pumps needed for operation of water-loop WSHP systems. See section III.F.4 of this document for more details on the proposed total pumping effect, which reflects pump power needed to overcome external static pressure in the water loop.

Issue 15: DOE requests comment on the proposal to adopt the cyclic degradation equation specified in section 6.2.3.2 of AHRI 340/360–2022 for WSHPs, which assumes continuous indoor fan operation when the compressor cycles off.

4. Pump Power Adjustment and Liquid External Static Pressure

As described in section III.D.2 of this NOPR, the efficiency calculations in ISO 13256–1:1998 include only the liquid pump power required to overcome the internal resistance of the unit; pump power required to overcome ESP of the water loop is not included in the effective power input. ISO 13256–1:1998 also does not specify a minimum liquid ESP during testing for units with integral pumps. For units without integral pumps, the pump power adjustment in ISO 13256–1:1998 estimates pump power at zero liquid external static pressure.

In the June 2018 RFI, DOE requested information on typical ESP values for the liquid pump and if any allowance for external pressure drop should be considered in the efficiency metric. 83 FR 29048, 29050 (June 22, 2018). On this topic, AHRI, Trane, and WaterFurnace stated that integral pumps are rare but can be found on some residential WSHPs. (AHRI, No. 12 at p. 6; Trane, No. 8, at p. 3; WaterFurnace, No. 7 at p. 5) AHRI and Trane further stated that because nearly all WSHPs do not have an integral pump, pump power to overcome liquid ESP should not be considered in the efficiency metric. (AHRI, No. 12 at p. 6; Trane, No. 8, at p. 3)

As discussed previously, since the June 2018 RFI, ISO 13256–1 was updated. However, the pump power and liquid ESP provisions in sections 5.1.4 and 5.1.6 of ISO 13256–1:2021 are the same as those in sections 4.1.4 and 4.1.6 of ISO 13256–1:1998.

In response to comments, DOE notes that all WSHPs are installed with liquid loops such that a pump (either integral to the WSHP or a separate part of the water loop) must overcome external resistance from the liquid loop. Therefore, as described in section III.D.2 of this NOPR, DOE has tentatively concluded that efficiency metrics that reflect the power needed for the liquid pump to overcome a representative liquid ESP would be more representative than metrics that only include the pump power needed to overcome the internal static pressure of the WSHP (as is the case in efficiency metrics determined per ISO 13256–1:1998 and ISO 13256–1:2021). DOE has identified several WSHPs with integral pumps and has, therefore, tentatively determined that provisions for testing units with integral pumps, including liquid ESP requirements, are warranted. Even though most WSHP models do not include integral pumps, as discussed, such models are installed with system pumps that must overcome external resistance of the water loop, and thus, including pump power to overcome a representative liquid ESP in the efficiency metrics for all WSHPs provides a more representative measure of field energy use. DOE has also tentatively determined that representative ratings for WSHPs with and without integral pumps should reflect the same level of liquid ESP (*i.e.,* WSHPs without integral pumps should include a power adder that reflects the pump power needed to overcome a level of liquid ESP that aligns with the liquid ESP used to test WSHPs with integral pumps). Further, inclusion of pump power to overcome a representative liquid ESP provides for more representative comparisons with other equipment categories (*e.g.,* air-cooled equipment) for which there are no additional power-consuming heat rejection components.

As such, in this NOPR, DOE is proposing provisions to account for the power to overcome a representative liquid ESP for WSHPs with and without integral pumps. As described in section III.D.3 of this document, DOE is proposing generally to incorporate by reference AHRI 340/360–2022 as the test procedure for WSHPs. Section 6.1.1.7 of AHRI 340/360–2022 specifies that for WCUACs with cooling capacity less than 135,000 Btu/h, an adder of 10 W per 1,000 Btu/h cooling capacity must be added to the power of WCUACs to account for cooling tower fan motor and circulating water pump power consumption. However, AHRI 340/360–2022 does not specify how to test units with integral pumps. Because the provisions in section 6.1.1.7 of AHRI 340/360–2022 do not specify the level of liquid ESP that correspond to the specified adder, it is unclear what test provisions for units with integral pumps would align with the AHRI 340/360–2022 provisions. Further, DOE has tentatively concluded that pump power to overcome a representative liquid ESP should also be accounted for in WSHPs with cooling capacity greater than 135,000 Btu/h.[23] Given these limitations of AHRI 340/360–2022 in terms of addressing WSHPs with integral pumps, DOE reviewed other sources with the potential to fill this identified gap.

In the course of such review, DOE found that AHRI Standard 920–2020, ''Performance Rating of Direct Expansion-Dedicated Outdoor Air System Units'' (''AHRI 920–2020''), includes a pump power adder (referred to as ''water pump effect'' in AHRI 920–2020) for water-source DOASes without integral pumps. Specifically, section 6.1.6.4 of AHRI 920–2020 specifies that the pump power adder is calculated with an equation dependent on the water flow rate and liquid pressure drop across the heat exchanger, including a term that assumes a liquid ESP of 20 ft head. However, AHRI 920–2020 does not include provisions specific to testing water-source DOASes with integral pumps. In a test procedure final rule for DOASes published in the **Federal Register** on July 27, 2022, DOE adopted the AHRI 920–2020 pump power adder for water-source DOASes without integral pumps and adopted an additional requirement that water-source DOASes with integral pumps be tested with a liquid ESP of 20 ft of water column, consistent with the liquid ESP assumed in the AHRI 920–2020 equation for pump power adder for units without integral pumps. 87 FR 45164, 45181.

DOE understands that water-source DOASes and WSHPs are generally installed in similar types of commercial building applications that include water loops with similar external liquid ESPs (*e.g.,* similar water piping). Therefore, DOE has tentatively concluded that the level of liquid ESP assumed in the DOAS provisions (*i.e.,* 20 ft of water column) would be representative for WSHPs. So that ratings are based on the same level of representative liquid ESP for WSHPs with and without integral pumps, DOE is proposing to exclude section 6.1.1.7 of AHRI 340/360–2022 and instead adopt provisions that align with the recently adopted provisions for water-source DOASes. Specifically, DOE is proposing to require in section 4 of appendix C1 that all WSHPs with an integral pump be tested with a liquid ESP of 20 ft of water column, with a −0/+1 ft condition tolerance and a 1 ft operating tolerance.

For units without integral pumps, DOE is proposing to require in section

[23] Currently, the DOE test procedure applies to all WSHPs with a cooling capacity less than 135,000 Btu/h. DOE is proposing in section III.A of this NOPR to increase the scope of the DOE test procedure to include all WSHPs with a cooling capacity less than 760,000 Btu/h.

4.3 of proposed appendix C1 that a ''total pumping effect'' (calculated using the same equation as in section 6.1.6.4 of AHRI 920–2020) be added to the unit's measured power to account for the pump power to overcome the internal static pressure of the unit and a liquid ESP of 20 ft of water column. Further, DOE is proposing to require in section 4.4 of appendix C1 that the measured pump power or the pump effect addition, as applicable, be included in the condenser section power for units of all capacities when performing cyclic degradation during calculation of IEER.

By accounting for liquid ESP conditions encountered during field use, DOE has tentatively concluded that the proposals would make the resulting efficiency metrics more representative of an average use cycle than the efficiency metrics calculated in ISO 13256–1:1998 and ISO 13256–1:2021.

Issue 16: DOE requests comment on the proposed provisions to account for pump power to overcome both internal pressure drop and a representative level of liquid ESP for WSHPs with and without integral pumps. DOE specifically requests comment on the representativeness of 20 ft of water column as the liquid ESP for WSHPs.

5. Test Liquid and Specific Heat Capacity

The current DOE WSHP test procedure, through adoption of section 4.1.9 of ISO 13256–1:1998, requires the test liquid for water-loop heat pumps and ground-water heat pumps to be water, and the test liquid for ground-loop heat pumps to be a 15 percent solution by mass of sodium chloride in water (*i.e.,* brine). Further, the liquid enthalpy test method in Annex C of ISO 13256–1:1998, which is included in the current DOE test procedure, requires the use of the specific heat capacity of the test liquid for calculating cooling and heating capacity but does not specify a value or method for calculating the specific heat capacity.

In the June 2018 RFI, DOE requested comment on whether a standard value or calculation method for the specific heat capacity of water should be specified in the WSHP test procedure. If a standard value should be specified, DOE requested comment on what value should be used. 83 FR 29048, 29053 (June 22, 2018).

In response to DOE's request for comment, AHRI, Trane, and WaterFurnace commented that the then draft revision of ISO 13256–1:1998 included an annex for addressing the specific heat capacity of water when using the liquid enthalpy method. These commenters further added that antifreeze use is common in WSHPs. They stated that the then-draft revision of ISO 13256–1:1998 allows innovation by not prescribing a particular antifreeze composition or concentration, but the draft standard requires input as to the relevant thermal properties of the test fluid for the proper calculation of heat capacity. (Trane, No. 8 at p. 5; AHRI, No. 12 at pp. 13–14; WaterFurnace, No. 7 at p. 12)

Section 5.1.7 of ISO 13256–1:2021 requires that the test liquid for the low temperature heating test (*i.e.,* EWT of 32 °F) must be a brine of the manufacturer's specification, while the test liquid for all other tests may be water or a brine of a composition and concentration specified by the manufacturer. Contrary to the comments received from industry stakeholders about the inclusion of provision for specific heat capacity in the then draft revision, ISO 13256–1:2021 does not specify a value or method for calculating the specific heat capacity of any test liquids.

In response to these considerations and comments, DOE is proposing in section 4.1 of proposed appendix C1 that the test liquid for all tests other than the proposed optional ''HFL3'' [24] low temperature heating test (*i.e.,* EWT of 32 °F) must be water, unless the manufacturer specifies to use a brine of 15-percent solution by mass of sodium chloride in water. DOE is proposing in section 4.1 of proposed appendix C1 that the test liquid for the optional HFL3 low temperature heating test must be a brine of 15-percent solution by mass of sodium chloride in water. Ground-loop applications of WSHPs typically use brine in the liquid loop, because in cold weather, the liquid temperature can reach 32 °F (*i.e.,* the temperature at which water freezes) in places. A 15-percent solution by mass of sodium chloride in water can withstand temperatures as low as 14 °F before freezing. Allowing the use of brine for testing also provides manufacturers the flexibility of providing ratings more representative of ground-loop applications. Therefore, DOE proposes to require brine as the liquid for the optional HFL3 low temperature heating test (conducted with an EWT of 32 °F), consistent with section 4.1.9 of ISO 13256–1:1998 and section 5.1.7 of ISO 13256–1:2021, to avoid the liquid freezing during the test.

DOE has tentatively concluded that a 15-percent solution by mass of sodium chloride, as specified in section 4.1.9.2 of ISO 13256–1:1998, is a representative brine composition and concentration for applications needing brine (*e.g.,* ground-loop), and that consumers can make more representative comparisons between models when all models are rated with the same brine composition and concentration.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. AHRI 340/360–2022 in turn references the test method in ANSI/ASHRAE 37–2009, in which section 12.2.1 requires that thermodynamic properties of liquids be obtained from the ASHRAE Handbook—Fundamentals.[25] The ASHRAE Handbook—Fundamentals specifies specific heat capacity values for water and for a brine of 15-percent solution by mass of sodium chloride at multiple temperatures. The absence of provisions in ISO 13256–1:1998 for how to determine specific heat capacity for test liquids creates the potential for variation in measured values based on how specific heat capacity is determined. Therefore, to minimize any such variation, DOE is instead proposing to adopt relevant provisions of ANSI/ASHRAE 37–2009. DOE has tentatively determined that the specifications in ANSI/ASHRAE 37–2009 would be appropriate for testing WSHPs because they are the generally accepted industry method used for testing similar equipment, such as WCUACs.

Issue 17: DOE requests comment on the proposed requirements for using water or a brine of 15-percent solution by mass of sodium chloride as the test liquid. DOE also requests comment on the representativeness and test burden associated with permitting the use of different liquids for different tests.

Issue 18: DOE requests comments on the proposal to utilize the thermodynamic properties specified in ANSI/ASHRAE 37–2009 through DOE's proposed incorporation by reference of AHRI 340/360–2022.

6. Liquid Flow Rate

a. Full-Load Cooling Tests

The current DOE test procedure, through adoption of section 4.1.6.2 of ISO 13256–1:1998, requires units with an integral liquid pump to be tested at the liquid flow rates specified by the manufacturer or those obtained at zero ESP difference, whichever provides the lower liquid flow rate. Section 4.1.6.3 of

[24] ''HFL3'' is the nomenclature used to define the 32 °F full load heating test that DOE is proposing to add in Appendix D.

[25] The ASHRAE Handbook—Fundamentals is available at: *https://www.ashrae.org/technical-resources/ashrae-handbook.*

ISO 13256–1:1998 requires that units without an integral liquid pump be tested at a liquid flow rate specified by the manufacturer.

In contrast to the ISO 13256–1:1998 approach, DOE noted in the June 2018 RFI that AHRI 340/360–2007 does not use a manufacturer-specified liquid flow rate, and instead specifies inlet and outlet water temperatures for WCUACs to be 85 °F and 95 °F, respectively, for standard-rating full-capacity operation. The temperature difference between inlet and outlet determines the liquid flow rate for the test. 83 FR 29048, 29054 (June 22, 2018).

In the June 2018 RFI, DOE requested comment on how manufacturers are selecting water flow rates when testing WSHPs in cases where multiple flow rates are provided in product literature. DOE further requested comment on what the typical water temperature rise during testing is and whether the typical test temperature rise is representative of field operation. *Id.*

In response to DOE's request for comment, AHRI discussed how the AHRI certification program requires a flow rate to be certified, and that the flow rate is available on the product certificate and also in the supplemental PDF. AHRI stated that certified flow rate makes clear which points to use for testing WSHPs, if multiple flow rates are provided in the product literature. (AHRI, No. 12 at p. 15) Trane commented that only one water flow rate is used to set the rating point of each WSHP basic model, and that any other water flow rates provided in the catalog literature are simply other application points for customers to use. (Trane, No. 8 at p. 5)

Trane commented that typical values of flow rate and temperature rise are 3 gallons per minute (''GPM'') per ton and a 10 °F temperature rise in cooling mode. (Trane, No. 8 at p. 5) AHRI and WaterFurnace stated that a typical rated water flow rate is 3 GPM/ton and field application flow rates are typically 2.25–3 GPM/ton, and that this range results in a field temperature rise of 9–14 °F for water-loop applications. (AHRI, No. 12 at p. 14; WaterFurnace, No. 7 at p. 13)

Further, AHRI and WaterFurnace stated that the current test procedure (which does not specify the outlet water temperature) allows the manufacturer to design a more suitable and efficient system by having the freedom to innovate systems that perform more efficiently with lower pressure drop or perhaps a heat exchanger allowing a high flow rate but lower pressure drop. (AHRI, No. 12 at p. 14; WaterFurnace, No. 7 at p. 13) AHRI also stated that for PSC pump motors,[26] specifying water flow is more accurate than specifying a temperature rise, and that fixing the temperature change would be a more difficult approach for these units. (AHRI, No. 12 at p. 14) Trane stated that it would be difficult to set a single value of flow rate or temperature rise for WSHP testing that would be representative of all field applications. (Trane, No. 8 at p. 5) Trane also encouraged DOE to not limit the rated water flow rate, indicating that this would severely limit the marketplace and be unrepresentative of real-world applications. *Id.* WaterFurnace stated that changing to a constant temperature difference approach (*i.e.,* specifying both inlet and outlet water temperature) would add undue complication to the certification program because the pump power adjustment requires a manufacturer-specified water flow rate. (WaterFurnace, No. 7 at p. 4)

Sections 5.1.6.3 and 5.1.6.4 of ISO 13256–1:2021 include provisions for setting water flow rate that are equivalent to the provisions in sections 4.1.6.2 and 4.1.6.3 of ISO 13256–1:1998. However, DOE is concerned that these provisions of ISO 13256–1 have the potential to allow manufacturers to specify very high flow rates that may not be representative of field operation. An overly high flow rate would result in a liquid temperature rise that is lower than what is representative of field operating conditions and a liquid heat transfer efficiency that is higher than what is representative of field operation. In addition, this would result in a measured efficiency that is higher than what is representative. Section 4.1.6.2 of ISO 13256–1:1998 specifies that the flow rate for integral pumps can be no higher than the flow rate resulting in zero liquid ESP, but this does not ensure that the resulting flow rate is representative of field use. For units without integral pumps, ISO 13256–1:1998 has no limits on flow rate.

In consideration of the preceding information and public comments, DOE proposes the following. As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs, including Table 6. Table 6 of AHRI 340/360–2022 specifies inlet and outlet liquid temperatures of 85 °F and 95 °F, respectively, for standard-rating cooling full-capacity operation. This requires that liquid flow rate for the full-load cooling test is set at a level that results in a 10 °F temperature rise from the 85 °F inlet to the 95 °F outlet temperature.

DOE notes that Trane commented that a 10 °F temperature rise is typical of field operation, and AHRI and WaterFurnace commented that a 9–14 °F temperature rise is typical. (Trane, No. 8 at p. 5; AHRI, No. 12 at p. 14; WaterFurnace, No. 7 at p. 13) These comments indicate that the temperature rise specified in Table 6 of AHRI 340/360–2022 is representative of field operation. In addition, specifying a fixed temperature rise for all WSHPs ensures that all models are tested with a temperature rise that is representative of field operating conditions. Therefore, DOE has tentatively concluded that testing with the required temperature rise specified in Table 6 of AHRI 340/360–2022 would produce more representative results than allowing manufacturers to continue specifying a liquid flow rate.

Regarding WaterFurnace's comment on the need for a manufacturer-specified flow rate for the pump power correction, DOE is not proposing in section III.F.4 of this NOPR to adopt the pump power correction specified in the 1998 and 2021 versions of ISO 13256–1; instead, DOE is proposing to include pump power to overcome a representative liquid ESP in the calculation of WSHP efficiency (see discussion in section III.F.4 of this NOPR). As a result, DOE has tentatively concluded that DOE's proposed approach for setting liquid flow rate would not add any additional complication to certification.

Regarding AHRI's and WaterFurnace's comment that the use of manufacturer-specified flow rates allows innovation in design, DOE has tentatively concluded that setting full-load liquid flow rate based on a 10 °F temperature rise would not impede the ability of manufacturers to innovate. The requirements of the DOE test procedure place no requirements on the design of a WSHP; they only specify requirements used to measure the performance of WSHPs in conditions that are representative of an average use cycle. As discussed, commenters stated that 10 °F is within the range of temperature rise values that is representative of water-loop applications. Therefore, DOE has tentatively concluded that setting full-load liquid flow rate to achieve a 10 °F temperature rise would ensure that all WSHPs are tested with a full-load flow rate that is representative of an average use cycle.

For the method of calculating IEER through interpolation and extrapolation, DOE is proposing in section 5.1.2 of

[26] A permanent split-capacitor (PSC) motor is a type of electric motor that can be used to power water pumps in WSHPs.

proposed appendix C1 (see section III.E.1.b of this NOPR) to align with the provisions in AHRI 340/360–2022, as follows. For the ''CFL3 high temperature'' test specified in Table 2 of appendix C1 [27] for the alternative method of calculating IEER, DOE is proposing to specify a fixed 10 °F temperature rise, thus specifying 86 °F and 96 °F, respectively, for the inlet and outlet liquid temperatures. For the rest of the full-load tests required in Table 2 of appendix C1 for the alternative method of calculating IEER, DOE is proposing that the liquid flow rate achieved during the CFL3 full load test be used. This proposal for full-load tests is consistent with Table 6 of AHRI 340/360–2022, because it requires a 10 °F temperature rise from inlet to outlet, which is the same amount of temperature rise required for full-load testing in Table 6 of AHRI 340/360–2022.

Issue 19: DOE requests comment on its proposal to adopt the AHRI 340/360–2022 approach for setting liquid flow rate for the full-load cooling test, namely by specifying inlet and outlet liquid temperature conditions rather than using a manufacturer-specified flow rate.

b. Part-Load Cooling Tests

In this NOPR, DOE is specifying part-load testing as part of the IEER test metric (see section III.E.1 of this NOPR), so provisions are necessary for determining the liquid flow rate to use during part-load tests. Table 9 of AHRI 340/360–2022 specifies use of manufacturer-specified part-load water flow rates for part-load tests. This is similar to the requirements in sections 4.1.6.2 and 4.1.6.3 of ISO 13256–1:1998 and sections 5.1.6.3 and 5.1.6.4 of ISO 13256–1:2021, which specify testing at manufacturer-specified flow rates for all tests (see also discussion in section III.F.6.a of this NOPR). Therefore, DOE is proposing to incorporate by reference Table 9 of AHRI 340/360–2022 and also to state in sections 5.1.1 and 5.1.2.1.2 of appendix C1 the requirements (from Table 9 of AHRI 340/360–2022) for setting part-load liquid flow rate. These requirements apply to both IEER determination methods specified in appendix C1 (*i.e.,* Option 1 and Option 2).

Section E7 of AHRI 340/360–2022, which addresses units with condenser head pressure control, states that part-load liquid flow rate shall not exceed the liquid flow rate used for the full-load tests. This requirement is not stated anywhere else in AHRI 340/360–2022, but DOE has tentatively concluded that it provides a valuable control on the upper limit of liquid flow rates for part-load tests. As a result, DOE is proposing in sections 5.1.1 and 5.1.2.1.2 of appendix C1 that this requirement apply to all part-load tests for WSHPs.

AHRI 340/360–2022 does not specify the liquid flow rate to use when the unit is operating at part load should the manufacturer not provide one. Therefore, DOE is proposing in sections 5.1.1 and 5.1.2.1.2 of appendix C1 to use the liquid flow rate from full-load testing if the manufacturer does not specify a part-load liquid flow rate.

Issue 20: DOE requests feedback on its proposals to use manufacturer-specified part-load liquid flow rates for part-load tests, that the part-load flow rate be no higher than the full-load flow rate, and to use the full-load liquid flow rate if no part-load liquid flow rate is specified.

c. Heating Tests

Consistent with the proposal in section III.F.6.a of this NOPR for a method of determining full-load cooling liquid flow rate of WSHPs based on outlet water temperature, rather than using a manufacturer-specified flow rate as specified by the current Federal test procedure, DOE is proposing provisions for setting liquid flow rate during heating tests. More specifically, DOE is proposing that the liquid flow rate determined from the full-load cooling test be used for all heating tests. DOE has tentatively concluded that full-load heating flow rates would generally be the same as full-load cooling flow rates for WSHPs installed in field applications, as the compressor(s) would be operating at full load in both cases. Therefore, DOE has tentatively concluded that the liquid flow rate used for the full-load cooling test is a representative flow rate to use for heating tests.

Specifically, DOE is proposing to specify in section 6.1 of proposed appendix C1 that if IEER is determined using option 1 in section 5.1 of proposed appendix C1, the liquid flow rate determined from the ''Standard Rating Conditions Cooling'' test for water-cooled equipment, as defined in Table 6 of AHRI 340/360–2022, must be used for all heating tests. If IEER is determined using option 2 in section 5.1 of proposed appendix C1, DOE is proposing in section 5.1.2.1.1 of proposed appendix C1 to use the liquid flow rate determined from the CFL3 high temperature cooling test for all heating tests.

Issue 21: DOE requests comment on its proposal to use the liquid flow rate determined from the full-load cooling test for all heating tests.

d. Condition Tolerance

Table 9 of ISO 13256–1:1998 and Table 11 of ISO 13256–1:2021 both include an operating tolerance of 2 percent and a condition tolerance of 1 percent for the liquid flow rate of WSHPs.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. AHRI 340/360–2022 in turn references the test method in ANSI/ASHRAE 37–2009. Table 11 of AHRI 340/360–2022 includes an operating tolerance of 2 percent for liquid flow rate, but neither AHRI 340/360–2022 nor ANSI/ASHRAE 37–2009 include a condition tolerance on liquid flow rate.

It is DOE's understanding that a condition tolerance is needed for all tests with a target liquid flow rate. As discussed in sections III.F.6.a through III.F.6.c of this NOPR, DOE is proposing that the full-load cooling test (if using option 1 for determining IEER, the ''standard rating conditions cooling'' test in Table 5 of AHRI 340/360–2022; if using option 2 for determining IEER, the ''CFL3 high temperature'' test in Table 2 of appendix C1) would be conducted with a liquid flow rate determined via a specified temperature rise rather than via a target liquid flow rate, while other cooling tests and all heating tests would have target liquid flow rates (manufacturer-specified for part-load cooling tests, and a target flow rate the same as the flow rate determined from the full-load cooling test for all other cooling and heating tests). Therefore, DOE is proposing a liquid flow rate condition tolerance that applies for all tests with target liquid flow rates (*i.e.,* excluding the tests conducted with a specified temperature rise—the ''standard rating conditions cooling'' test in Table 5 of AHRI 340/360–2022 and the ''CFL3 high temperature'' test in Table 2 of appendix C1).

Specifically, DOE is proposing to require in sections 5.1.1, 5.1.2.1.2, and 6.1 of appendix C1 a condition tolerance of 1 percent for liquid flow rate, consistent with the condition tolerance specified in Table 9 of ISO 13256–1:1998. This requirement is in addition to DOE's proposed adoption of Table 11 of AHRI 340/360–2022, which specifies an operating tolerance of 2 percent for liquid flow rate.

Issue 22: DOE requests comment on its proposal to specify an operating tolerance of 2 percent and a condition tolerance of 1 percent for liquid flow

[27] ''CFL3'' is the nomenclature used in Appendix C1 to define a full load cooling test at 86 °F.

rate in all tests with a target liquid flow rate.

7. Refrigerant Line Losses

Split-system WSHPs have refrigerant lines that can transfer heat to and from their surroundings, which can incrementally affect measured capacity. To account for this transfer of heat (referred to as ''line losses''), the current DOE test procedure, through adoption of ISO 13256–1:1998, provides that if line loss corrections are to be made, they shall be included in the capacity calculations (in section B4.2 for the indoor air enthalpy method and in section C3.3 for the liquid enthalpy test method of ISO 13256–1:1998). ISO 13256–1:1998 does not specify the circumstances that require line loss corrections nor the method to use to determine an appropriate correction.

Section 7.3.3.4 of ANSI/ASHRAE 37–2009, the method of test referenced in AHRI 340/360–2022, specifies more detailed provisions to account for line losses of split systems in the outdoor air enthalpy method, and section 7.6.7.1 of ANSI/ASHRAE 37–2009 specifies to use the same provisions for the outdoor liquid coil method.

In the June 2018 RFI, DOE requested comment on whether the provisions for line losses in ANSI/ASHRAE 37–2009 would be appropriate for testing WSHPs. Furthermore, DOE requested comment on what modifications to ISO 13256–1:1998 might be necessary to further address line losses and how manufacturers of split-system WSHPs currently incorporate line loss adjustments into both heating and cooling capacity calculations. 83 FR 29048, 29052–29053 (June 22, 2018).

In commenting on DOE's June 2018 RFI, AHRI, Trane, and WaterFurnace stated that refrigerant line losses would not be a relevant issue because there are very few, if any, split-system WSHPs in the commercial market. (AHRI, No. 12 at p. 13; Trane, No. 8 at p. 5; WaterFurnace, No. 7 at pp. 11–12)

Section E.3.3 of ISO 13256–1:2021 contains the same statement about line loss correction as sections B4.2 and C3.3 in ISO 13256–1:1998. Thus, ISO 13256–1:2021 contains no additional provisions regarding line loss corrections.

As stated previously, DOE has identified a number of split-system WSHPs, several of which are certified in the DOE Compliance Certification Database, and the Federal test procedure [28] applies to any WSHP that meets DOE's definition of a WSHP. Further, because split-system WSHPs are available on the market, test procedure provisions are needed for testing them, regardless of their share of the WSHP market.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. AHRI 340/360–2022 in turn references the test method in ANSI/ASHRAE 37–2009. As described earlier in this section, section 7.6.7.1 of ANSI/ASHRAE 37–2009 specifies to use the provisions in section 7.3.3.4 of ANSI/ASHRAE 37–2009 for making line loss adjustments when using the outdoor liquid coil method. Section 7.3.3.4 of ANSI/ASHRAE 37–2009 specifies calculations for determining the line losses for bare copper or insulated lines. The absence of provisions in ISO 13256–1:1998 for how to determine refrigerant line losses creates the potential for variation in measured values based on how line losses are determined. To minimize any such variation, DOE is proposing to adopt the relevant provisions in ANSI/ASHRAE 37–2009. DOE has tentatively determined that the specifications in ANSI/ASHRAE 37–2009 would be appropriate for testing WSHPs because they are the generally accepted industry method used for testing similar equipment, such as WCUACs.

Issue 23: DOE requests comments on the proposal to adopt the provisions for line loss adjustments included in sections 7.6.7.1 and 7.3.3.4 of ANSI/ASHRAE 37–2009 through incorporation by reference of AHRI 340/360–2022.

8. Airflow Measurement

The current DOE WSHP test procedure, through adoption of section D.1 of ISO 13256–1:1998, requires airflow measurements to be made in accordance with the provisions specified in several different industry test standards, ''as appropriate.'' [29] However, ISO 13256–1:1998 is not explicit regarding the circumstances under which the different airflow measurement approaches included in these industry test standards should be used.

Section F8 of ISO 13256–1:1998 specifies the requirements for the nozzle apparatus used to measure airflow. This device determines airflow by measuring the change in pressure across a nozzle of known geometry. Airflow derivations using this approach often include a discharge coefficient (*i.e.,* the ratio of actual discharge air to theoretical discharge air) to account for factors that reduce the actual discharge air, such as nozzle resistance and airflow turbulence. In general, as the nozzle throat diameter decreases, nozzle resistance increases, thereby reducing actual discharge which is characterized by a lower discharge coefficient. Turbulent airflow (as characterized by Reynolds numbers [30]) and temperature also impact the discharge coefficient.

Section F8.9 of ISO 13256–1:1998 specifies that it is preferable to calibrate the nozzles in the nozzle apparatus, but that nozzles of a specific geometry may be used without calibration and by using the appropriate discharge coefficient specified in a lookup table in section F8.9 of ISO 13256–1:1998. ISO 13256–1:1998 does not specify the method that should be applied, however, to determine the coefficient of discharge for conditions that do not exactly match the values provided in the look-up table.

Elsewhere, sections 6.2 and 6.3 of ANSI/ASHRAE 37–2009 includes provisions regarding the nozzle airflow measuring apparatus that are identical to the provisions in section F8 of ISO 13256–1:1998, except for the method used to determine the coefficient of discharge. Section 6.3.3 of ANSI/ASHRAE 37–2009 uses a calculation in place of the look-up table used in ISO 13256–1:1998, thereby allowing determination of the coefficient of discharge at any point within the specified range.

In the June 2018 RFI, DOE requested comment on which of the methods specified in ISO 13256–1:1998 (*i.e.,* ISO 3966:1977, ISO 5167–1:1991, and ISO 5221:1984) are used by manufacturers to measure airflow of WSHPs, and whether this varies based on WSHP capacity or configuration. 83 FR 29048, 29054 (June 22, 2018). DOE further requested information on how manufacturers determine the coefficient of discharge for air temperatures and Reynolds numbers that fall between the values

[28] Currently, the DOE test procedure applies to all WSHPs with a cooling capacity less than 135,000 Btu/h. However, DOE is proposing in section III.A of this NOPR to increase the scope of the Federal test procedure to include all WSHPs with a cooling capacity less than 760,000 Btu/h.

[29] The cited industry test standards include: ISO 3966:1977, ''Measurement of fluid flow in closed conduits—Velocity area method using Pitot static tubes;'' ISO 5167–1:1991, ''Measurement of fluid flow by means of pressure differential devices—Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full;'' and ISO 5221:1984, ''Air Distribution and air diffusion—Rules to methods of measuring airflow rate in an air handling duct.'' These standards can be purchased from the ISO store at *https://www.iso.org/store.html.*

[30] ''Reynolds number'' is a dimensionless number that characterizes the flow properties of a fluid. Section F8.9 of ISO 13256–1:1998 includes an equation for calculating Reynolds number that depends on a temperature factor, air velocity, and throat diameter.

specified in the look-up table in section F8.9 Annex F to ISO 13256–1:1998. *Id.* DOE also requested comment on whether it should incorporate by reference additional industry test standards that specify the calculation method for airflow, such as ANSI/ASHRAE 37–2009. *Id.*

On this topic, AHRI, Trane, and WaterFurnace commented that manufacturers generally calibrate each nozzle to determine the coefficient of discharge, consistent with the ISO 13256–1:1998 conditions. These commenters also stated that most manufacturers use air tunnels for airside measurements based upon ANSI/ASHRAE 37–2009 and ANSI/AMCA Standard 210–16, *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating* (''ANSI/AMCA 210''),[31] and that these tunnels generally satisfy the requirements of ISO 5221, ISO 3966, and ISO 5167. Furthermore, these commenters stated that the draft revision of ISO 13256–1:1998 enhanced the method of test annexes, as ISO standards cannot reference national standards. (Trane, No. 8 at p. 5; AHRI, No. 12 at pp. 3, 14; WaterFurnace, No. 7 at p. 12)

To the point raised by commenters, Annex B of ISO 13256–1:2021 specifies requirements for airflow measurement and nozzle apparatus that are consistent with the requirements in section F8 of ISO 13256–1:1998, and section B.3.5.3 of ISO 13256–1:2021 contains equations for determining discharge coefficients that are equivalent to the equations in section 6.3.3 of ANSI/ASHRAE 37–2009.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. AHRI 340/360–2022 in turn references the test method in ANSI/ASHRAE 37–2009. As stated earlier in this section, the provisions of ANSI/ASHRAE 37–2009 provide more specificity in the determination of airflow characteristics than the provisions of ISO 13256–1:1998, but they otherwise align with the corresponding provisions in ISO 13256–1:1998. The provisions of ANSI/ASHRAE 37–2009 are also equivalent to those in ISO 13256–1:2021. In addition, as commenters stated, air measurement apparatuses based upon ANSI/ASHRAE 37–2009 satisfy the requirements of ISO 13256–1:1998. Therefore, DOE has tentatively concluded that the proposed test procedure would provide a representative and repeatable method for measuring airflow.

Issue 24: DOE requests comments on the proposal to adopt the calculation of discharge coefficients and air measurement apparatus requirements of ANSI/ASHRAE 37–2009.

9. Air Condition Measurements

Indoor air temperature and humidity are key parameters that affect WSHP performance, and for this reason, ISO 13256–1:1998 requires accurate indoor air condition measurements. However, informative annexes E and F of ISO 13256–1:1998 specify few requirements for the methods used to measure indoor air temperature and humidity.

In the June 2018 RFI, DOE identified that Appendix C of AHRI 340/360–2015 (the most current version of AHRI 340/360 at the time) provides details on entering outdoor air temperature measurement for air-cooled and evaporatively-cooled CUACs, including air sampling tree and aspirating psychrometer requirements, but that AHRI 340/360–2015 does not state that these provisions apply for measurement of entering indoor air temperature and leaving indoor air temperature. 83 FR 29048, 29054 (June 22, 2018). DOE requested comment on whether the requirements for outdoor entering air measurements in Appendix C of AHRI 340/360–2015 (excluding the temperature uniformity requirements in Table C2), such as air sampling requirements and aspirating psychrometer requirements, would be appropriate for measurement of indoor air entering and leaving temperatures for WSHPs. *Id.*

On this topic, Trane, AHRI, and WaterFurnace commented that the ISO working group agreed on revised method of test annexes with further provisions for air sampling, based off provisions in ASHRAE 37; ASHRAE 41.1, *Standard Methods for Temperature Measurement;* ASHRAE 41.2, *Standard Methods for Air Velocity and Airflow Measurement;* and ASHRAE 41.3, *Standard Methods for Pressure Measurement.*[32] (Trane, No. 8 at p. 5; AHRI, No. 12 at p. 15; WaterFurnace, No. 7 at p. 13)

After its subsequent publication, DOE reviewed ISO 13256–1:2021, but in contrast to the commenters' expressed expectations, the Department found that the updated ISO standard specifies no requirements for the methods used to measure indoor air temperature and humidity, including no provisions for air sampling and aspirating psychrometers.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. Appendix C of AHRI 340/360–2022 provides more detailed specifications for the measurement of air conditions (including indoor air) than ISO 13256–1:1998, including aspirating psychrometer requirements in section C3.2.1 of AHRI 340/360–2022 and sampling requirements in section C3.3 of AHRI 340/360–2022. The absence of provisions in ISO 13256–1:1998 for how indoor air condition measurements are conducted creates the potential for variation in measured values based on how indoor air condition measurements are taken. To minimize any such variation, DOE is proposing to specify the measurement provisions in Appendix C of AHRI 340/360–2022. DOE has tentatively determined that the specifications in AHRI 340/360–2022 would be appropriate for testing WSHPs because they are the generally accepted industry method used for testing similar equipment, such as WCUACs.

Issue 25: DOE requests comments on the proposal to adopt the air condition measurement provisions in Appendix C of AHRI 340/360–2022.

10. Duct Losses

In the calculations for cooling and heating capacities for the indoor air enthalpy test method of ISO 13256–1:1998, the test standard includes a footnote in sections B3 and B4 of annex B stating that the equations do not provide allowances for heat leakage in the test equipment (*i.e.,* duct losses). In contrast, section 7.3.3.3 of ANSI/ASHRAE 37–2009 requires adjustments for such heat leakages and specifies methods to calculate appropriate values for the adjustments.

In the June 2018 RFI, DOE requested comment on whether the duct loss adjustments as described in section 7.3.3.3 of ANSI/ASHRAE 37–2009 or any other duct loss adjustments are used to adjust capacity measured using the indoor air enthalpy method when testing WSHPs. 83 FR 29048, 29054 (June 22, 2018).

In response to DOE's request for comment, AHRI, WaterFurnace, and Trane commented that manufacturers typically adjust capacity for duct losses consistent with ANSI/ASHRAE 37–2009, and that these provisions are being included in the revised version of ISO 13256–1:1998. (AHRI, No. 12 at p. 14; WaterFurnace, No. 7 at pp. 12–13; Trane, No. 8 at p. 5)

[31] ANSI/AMCA 210–16 is available at: *https://www.amca.org/assets/resources/public/pdf/Education%20Modules/AMCA%20210-16.pdf.*

[32] All ASHRAE standards can be found at: *https://webstore.ansi.org/sdo/ashrae.*

Despite commenters' expressed expectations, DOE notes that similar to ISO 13256–1:1998, ISO 13256–1:2021 does not address duct losses. Specifically, section C.4 of ISO 13256–1:2021 includes a note that states that the formulas for calculating cooling and heating capacity in sections C.3 and C.4 do not provide allowance for heat leakage in the test duct and the discharge chamber. Further, ISO 13256–1:2021 does not specify a method for calculating the duct losses.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. AHRI 340/360–2022 in turn references the test method in ANSI/ASHRAE 37–2009. As discussed earlier in this section, section 7.3.3.3 of ANSI/ASHRAE 37–2009 requires, and provides equations for, duct loss adjustments. The absence of provisions in ISO 13256–1:1998 for how to determine duct losses creates the potential for variation in measured values based on how and whether duct losses are accounted for. To minimize any such variation, DOE is proposing to adopt the provisions in ANSI/ASHRAE 37–2009. DOE has tentatively determined that the specifications in ANSI/ASHRAE 37–2009 would be appropriate for testing WSHPs because they are the generally accepted industry method used for testing similar equipment, such as WCUACs.

Issue 26: DOE requests comments on the proposal to adopt the duct loss provisions in section 7.3.3.3 of ASHRAE 37–2009.

11. Refrigerant Charging

The amount of refrigerant can have a significant impact on the system performance of air conditioners and heat pumps. DOE's current test procedure for WSHPs requires that units be set up for test in accordance with the manufacturer installation and operation manuals. 10 CFR 431.96(e). In addition, the current DOE test procedure states that if the manufacturer specifies a range of superheat, sub-cooling, and/or refrigerant pressures in the installation and operation manual, any value within that range may be used to determine refrigerant charge or mass of refrigerant, unless the manufacturer clearly specifies a rating value in its installation or operation manual, in which case the specified rating value shall be used. *Id.* However, the current DOE test procedure does not provide charging instructions to be used if the manufacturer does not provide instructions in the manual that is shipped with the unit or if the provided instructions are unclear or incomplete. In addition, ISO 13256–1:1998 does not provide any specific guidance on setting and verifying the refrigerant charge of a unit aside from stating in section A2.3 of that standard that equipment shall be evacuated and charged with the type and amount of refrigerant specified in the manufacturer's instructions, where necessary.

DOE noted in the June 2018 RFI that the test procedure final rule for CAC/HPs published in the **Federal Register** on June 8, 2016 (81 FR 36992, ''June 2016 CAC TP final rule'') established a comprehensive approach for refrigerant charging to improve test reproducibility. 83 FR 29048, 29054 (June 22, 2018). The approach specifies which set of installation instructions to use for charging, explains what to do if no instructions are provided, specifies that target values of parameters are the centers of the ranges allowed by installation instructions, and specifies tolerances for the measured values. *See* 10 CFR part 430, subpart B, appendix M, section 2.2.5. The approach also requires that refrigerant line pressure gauges be installed for single-package units, unless otherwise specified in manufacturer instructions. *Id.* As part of the June 2018 RFI, DOE sought comment on whether it would be appropriate to adopt an approach for charging requirements for WSHPs similar to the approach adopted in the June 2016 CAC TP final rule. 83 FR 29048, 29055 (June 22, 2018).

The CA IOUs commented that only about 10 percent of WSHPs are split systems, and that many of the charging requirements in the June 2016 CAC TP final rule are for split systems and do not apply to single-package units. However, the CA IOUs went on to state that adopting provisions from the June 2016 CAC TP final rule would be useful for single-package units, specifically aspects that relate to pressure gauges for package units and banning charge adjustment during testing. The CA IOUs also suggested that DOE should develop language to address equipment that arrives at the test laboratory with damage, possibly giving some allowance to recharge WSHPs with minor damage but requiring a new unit to be shipped in the case of major damage. The CA IOUs further stated that adopting provisions similar to the June 2016 CAC TP final rule would be beneficial for the minority of WSHPs that require charging in the laboratory. (CA IOUs, No. 9 at p. 2)

Trane commented that all of its WSHP offerings are single-package units that are charged at the factory, so charging requirements would not be necessary. Trane added that packaged equipment requires no external refrigerant lines, and, therefore, superheat and subcooling do not need to be considered. (Trane, No. 8 at p. 6) WaterFurnace stated that split-system WSHPs are not sold for commercial applications, and, therefore, commercial WSHPs are not field-charged. (WaterFurnace, No. 7 at p. 14) AHRI and Trane commented that adopting charging requirements would not be appropriate, because many WSHPs have no service ports, and that units that do have service ports are charged by weight to the specification on the nameplate. (AHRI, No. 12 at p. 15; Trane, No. 8 at p. 6)

DOE notes that the subsequently published ISO 13256–1:2021 does not include any provisions regarding refrigerant charging that differ from ISO 13256–1:1998; the provisions in section A.2.4 of ISO 13256–1:2021 align with section A2.3 of ISO 13256–1:1998.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs, including section 5.8. Section 5.8 of AHRI 340/360–2022 specifies a comprehensive set of provisions regarding refrigerant charging that is similar to the approach adopted in the June 2016 CAC TP final rule. 81 FR 36992, 37030–37031 (June 8, 2016). DOE has tentatively concluded that these provisions provide sufficient guidance for setting and verifying the refrigerant charge of a WSHP. Section 5.8 requires that units be charged at conditions specified by the manufacturer in accordance with the manufacturer installation instructions or labels applied to the unit. If no manufacturer-specified charging conditions are provided, section 5.8 specifies charging at the standard rating conditions (as defined in Table 6 of AHRI 340/360–2022). Section 5.8 also provides additional charging instructions to be used if the manufacturer does not provide instructions or if the provided instructions are unclear or incomplete (*e.g.,* specifying default charging targets to use if none are provided by the manufacturer, specifying an instruction priority to be used in the event of conflicting information between multiple manufacturer-provided charging instructions).

DOE disagrees with the commenters' assertions that charging requirements are not appropriate for WSHPs. While DOE acknowledges that most WSHP models are single-package units, the Department tentatively concludes that charging provisions are warranted for single-package units. DOE notes that AHRI 210/240–2023 (in section 5.1.8), AHRI 340/360–2022 (in section 5.8), and AHRI 390–2021 (in section 5.6.3) include charging provisions that apply to single-package units. Additionally, as stated previously, DOE has identified a number of split-system WSHPs, several of which are certified in the DOE Compliance Certification Database, and the Federal test procedure [33] applies to any WSHP that meets DOE's definition of a WSHP. Further, because split-system WSHPs exist, test procedure provisions are needed for testing them, regardless of their share of the WSHP market.

Further, while the use of pressure gauges is not necessary to adjust charge if charging is based only on parameters such as charge weight that do not require measurement of refrigerant pressure, installation of pressure gauges would be warranted for charge adjustment if charging is based on parameters that require measurement of refrigerant pressure such as subcooling or superheat. Additionally, DOE has identified several WSHP service manuals that allow for charge adjustment in the field, indicate the presence of pressure ports, and provide guidance for confirmation of charge based on sub-cooling or superheat.

Therefore, DOE has tentatively concluded that the provisions regarding refrigerant charging in section 5.8 of AHRI 340/360–2022, including the provisions specific to installation of pressure gauges for single-package units in section 5.8.4 of AHRI 340/360–2022, are warranted for testing WSHPs. DOE has tentatively determined that these provisions ensure that WSHPs are set up for testing with refrigerant charging instructions that are representative of field installations, and that testing is conducted in a repeatable manner. DOE also notes that the refrigerant charging provisions in AHRI 340/360–2022 are generally consistent with the industry consensus test procedures for testing several categories of air conditioning and heating equipment (*e.g.,* AHRI 340/360 for CUAC/HPs, AHRI 210/240–2023 for CAC/HPs, AHRI 1230–2021 for VRF multi-split systems, AHRI 390 for SPVUs), and DOE has tentatively concluded that there is no aspect of WSHPs that differs from all other types of air conditioners and heat pumps that would indicate such provisions are not needed.

Issue 27: DOE requests comments on the proposal to adopt the refrigerant charging requirements in section 5.8 of AHRI 340/360–2022.

12. Voltage

Operating voltage can affect the measured efficiency of air conditioners. The current DOE WSHP test procedure, through adoption of Tables 1 and 2 of ISO 13256–1:1998, requires units rated with dual nameplate voltages to be tested at both voltages or at the lower voltage if only a single rating is to be published.

In the June 2018 RFI, DOE requested data and information on the extent of the effect that voltage has on air conditioning equipment and if there is a consistent relationship between voltage and efficiency. DOE also requested comment on whether certain voltages within common dual nameplate voltages (*e.g.,* 208/230 V) are more representative of typical field conditions. 83 FR 29048, 29055 (June 22, 2018).

On this topic, Trane commented that performance varies slightly with voltage, and that to be conservative, Trane tests its units at multiple voltages and rates at the lowest measured efficiency. (Trane, No. 8 at p. 6) AHRI and WaterFurnace had a somewhat different viewpoint, commenting that performance at each voltage is not normally measured and that the effect of voltage varies by compressor line (*e.g.,* stating that in the most recent generation Copeland Scroll product, the 208V model is 1–2 percent less efficient than the corresponding 230V model). AHRI and WaterFurnace also stated that there are several voltage options available commercially, and that voltage selection depends on several different aspects of the installed application. (AHRI, No. 12 at pp. 15–16; WaterFurnace, No. 7 at p. 14)

DOE notes that tables 2 and 3 of ISO 13256–1:2021 specify the same voltage requirements for testing units rated with dual nameplate voltages as tables 1 and 2 of ISO 13256–1:1998.

As discussed in section III.D.2 of this NOPR, DOE proposes to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs, including section 6.1.3.1. Section 6.1.3.1 of AHRI 340/360–2022 specifies that units with dual nameplate voltage ratings must be tested at the lower of the two voltages if only a single standard rating is to be published, or at both voltages if two standard ratings are to be published. This approach is equivalent to the approach for dual nameplate voltages specified in tables 1 and 2 of ISO 13256–1:1998 and tables 2 and 3 of ISO 13256–1:2021.

Issue 28: DOE requests comments on the proposal to adopt the voltage provisions in section 6.1.3.1 of AHRI 340/360–2022.

G. Configuration of Unit Under Test

1. Summary

WSHPs are sold with a wide variety of components, including many that can optionally be installed on or within the unit both in the factory and in the field. The following sections address the required configuration of units under test. In all cases, these components are distributed in commerce with the WSHP but can be packaged or shipped in different ways from the point of manufacturer for ease of transportation. Each optional component may or may not affect a model's measured efficiency when tested to the DOE test procedure proposed in this NOPR. For certain components not directly addressed in the DOE test procedure, this NOPR proposes more specific instructions on how each component should be handled for the purposes of making representations in 10 CFR part 429. Specifically, these proposed instructions would provide manufacturers clarity on how components should be treated and how to group individual models with and without optional components for the purposes of representations to reduce burden. DOE is proposing these provisions in 10 CFR part 429 to allow for testing of certain individual models that can be used as a proxy to represent the performance of equipment with multiple combinations of components.

DOE is proposing to handle WSHP components in two distinct ways in this NOPR to help manufacturers better understand their options for developing representations for their differing product offerings. First, DOE proposes that the treatment of certain components is specified by the test procedure, such that their impact on measured efficiency is limited. For example, a fresh air damper must be set in the closed position and sealed during testing, resulting in a measured efficiency that would be similar or identical to the measured efficiency for a unit without a fresh air damper. Second, DOE is proposing provisions expressly allowing certain models to be grouped together for the purposes of making representations and allowing the performance of a model without certain optional components to be used as a proxy for models with any combinations of the specified components, even if such components would impact the measured efficiency of a model. A steam/hydronic coil is an example of

[33] Currently, the DOE test procedure applies to all WSHPs with a cooling capacity less than 135,000 Btu/h. However, DOE is proposing in section III.A of this NOPR to increase the scope of the Federal test procedure to include all WSHPs with a capacity less than 760,000 Btu/h.

such a component. The efficiency representation for a model with a steam/hydronic coil is based on the measured performance of the WSHP as tested without the component installed because the steam/hydronic coil is not easily removed from the WSHP for testing.[34]

2. Background

In 2013, the Appliance Standards and Rulemaking Federal Advisory Committee formed the Commercial HVAC Working Group to engage in a negotiated rulemaking effort regarding the certification of certain commercial heating, ventilating, and air conditioning equipment, including WSHPs. (*See* 78 FR 15653 (March 12, 2013)) This Commercial HVAC Working Group submitted a term sheet (''Commercial HVAC Term Sheet'') providing the Commercial HVAC Working Group's recommendations. (Docket No. EERE–2013–BT–NOC–0023, No. 52) [35] The Commercial HVAC Working Group recommended that DOE issue guidance under current regulations on how to test certain equipment features when included in a basic model, until such time as the testing of such features can be addressed through a test procedure rulemaking. The Commercial HVAC Term Sheet listed the subject features under the heading ''Equipment Features Requiring Test Procedure Action.'' (*Id* at pp. 3–9) The Commercial HVAC Working Group also recommended that DOE issue an enforcement policy stating that DOE would exclude certain equipment with specified features from Departmental testing, but only when the manufacturer offers for sale at all times a model that is identical in all other features; otherwise, the model with that feature would be eligible for Departmental testing. These features were listed under the heading ''Equipment Features Subject to Enforcement Policy.'' (*Id.* at pp. 9–15)

On January 30, 2015, DOE issued a Commercial HVAC Enforcement Policy addressing the treatment of specific features during Departmental testing of commercial HVAC equipment. (*See www.energy.gov/gc/downloads/commercial-equipment-testing-enforcement-policies*) The Commercial HVAC Enforcement Policy stated that—for the purposes of assessment testing pursuant to 10 CFR 429.104, verification testing pursuant to 10 CFR 429.70(c)(5), and enforcement testing pursuant to 10 CFR 429.110—DOE would not test a unit with one of the optional features listed for a specified equipment type if a manufacturer distributes in commerce an otherwise identical unit that does not include one of the optional features. (*Id* at p. 1) The objective of the Commercial HVAC Enforcement Policy is to ensure that each basic model has a commercially available version eligible for DOE testing. That is, each basic model includes a model either without the optional feature(s) listed in the policy or that is eligible for testing with the feature(s). *Id.* The features in the Commercial HVAC Enforcement Policy for WSHPs (*Id* at pp. 1–3 and 5–6) align with the Commercial HVAC Term Sheet's list designated ''Equipment Features Subject to Enforcement Policy.''

By way of comparison, AHRI 340/360–2022 includes Appendix D, ''Unit Configuration for Standard Efficiency Determination—Normative.'' Section D3 of AHRI 340/360–2022 includes a list of features that are optional for testing, and it further specifies the following general provisions regarding testing of units with optional features:

- If an otherwise identical model (within the basic model) without the feature is not distributed in commerce, conduct tests with the feature according to the individual provisions specified in section D3 of AHRI 340/360–2022.
- For each optional feature, section D3 of AHRI 340/360–2022 includes explicit instructions on how to conduct testing for equipment with the optional feature present.

The optional features provisions in AHRI 340/360–2022 are generally consistent with DOE's Commercial HVAC Enforcement Policy, but the optional features in section D3 of AHRI 340/360–2022 do not entirely align with the list of features included for WSHPs in the Commercial HVAC Enforcement Policy.

DOE notes that the list of features and provisions in section D3 of Appendix D of AHRI 340/360–2022 conflates components that can be addressed by testing provisions with components that if present on a unit under test, could have a substantive impact on test results and that cannot be disabled or otherwise mitigated. This differentiation was central to the Commercial HVAC Term Sheet, which as noted previously, included separate lists for ''Equipment Features Requiring Test Procedure Action'' and ''Equipment Features Subject to Enforcement Policy,'' and remains central to providing clarity in DOE's regulations. Further, provisions more explicit than included in section D3 of AHRI 340/360–2022 are warranted to clarify treatment of models that include more than one optional component.

In order to provide clarity between test procedure provisions (*i.e.,* how to test a specific unit) and certification and enforcement provisions (*e.g.,* which model to test), DOE is not proposing to adopt Appendix D of AHRI 340/360–2022 and instead is proposing related provisions in 10 CFR 429.43, 10 CFR 429.134, and 10 CFR part 431, subpart F, appendix C1.

3. Proposed Approach for Exclusion of Certain Components

DOE's proposals for addressing treatment of certain components are discussed in the following sub-sections. Were DOE to adopt the provisions in 10 CFR 429.43, 10 CFR 429.134, and 10 CFR part 431, subpart F, appendix C1 as proposed, DOE would rescind the Commercial HVAC Enforcement Policy to the extent it is applicable to WSHPs.

Issue 29: DOE seeks comment on its proposals regarding specific components in 10 CFR 429.43, 10 CFR 429.134, and 10 CFR part 431, subpart F, appendix C1.

a. Components Addressed Through Test Provisions of 10 CFR Part 431, Subpart F, Appendix C1

In 10 CFR part 430, subpart F, appendix C1, DOE proposes test provisions for specific components, including all of the components listed in section D3 of AHRI 340/360–2022 for which there is a test procedure action which limits the impacts on measured efficiency (*i.e.,* test procedure provisions specific to the component that are not addressed by general provisions in AHRI 340/360–2022 that negates the component's impact on performance). These provisions would specify how to test a unit with such a component (*e.g.,* for a unit with hail guards, remove hail guards for testing). These proposed test provisions are consistent with the provision in section D3 of AHRI 340/360–2022 but include revisions for further clarity and specificity (*e.g.,* adding clarifying provisions for how to test units with modular economizers as opposed to units shipped with economizers installed). Specifically, DOE is proposing to require in appendix C1 that steps be taken during unit set-up and testing to limit the impacts on the measurement of these components:

- Desiccant Dehumidification Components
- Air Economizers
- Fresh Air Dampers
- Power Correction Capacitors

[34] Note that in certain cases, as explained further in section III.G.3.b of this document, the representation may have to be based on an individual model with a steam/hydronic coil.

[35] Available at *www.regulations.gov/document/EERE-2013-BT-NOC-0023-0052.*

- Ventilation Energy Recovery Systems (VERS)
- Barometric Relief Dampers
- UV Lights
- Steam/Hydronic Coils
- Refrigerant Reheat
- Fire/Smoke/Isolation Dampers
- Process Heat Recovery/Reclaim Coils/Thermal Storage

The components are listed and described in Table 12 in section 7 of the newly proposed Appendix C1, and test provisions for them are provided in the table.

b. Components Addressed Through Representation Provisions of 10 CFR 429.43

Consistent with the Commercial HVAC Term Sheet and the Commercial HVAC Enforcement Policy, DOE is proposing provisions that explicitly allow representations for individual models with certain components to be based on testing for individual models without those components—DOE is proposing a table (''Table 1 to 10 CFR 429.43'') at 10 CFR 429.43(a)(3)(ii)(A) listing the components for which these provisions would apply. There are three components specified explicitly for WSHPs in the Commercial HVAC Enforcement Policy that are not included in section D3 of AHRI 340/360–2022: (1) Condenser Pumps/Valves/Fittings; (2) Condenser Water Reheat; and (3) Electric Resistance Heaters. DOE has tentatively concluded that the inclusion of these components as optional components for WSHPs is appropriate, except for electric resistance heaters. DOE has tentatively determined that electric resistance heaters would have a negligible effect on tested efficiency as they would be turned off for test and not impose a significant pressure drop. DOE is proposing the following components be listed in Table 1 to 10 CFR 429.43:

- Desiccant Dehumidification Components,
- Air Economizers,
- Ventilation Energy Recovery Systems (VERS),
- Steam/Hydronic Heat Coils,
- Refrigerant Reheat, Fire/Smoke/Isolation Dampers,
- Powered Exhaust/Powered Return Air Fans,
- Sound Traps/Sound Attenuators,
- Process Heat Recovery/Reclaim Coils/Thermal Storage,
- Indirect/Direct Evaporative Cooling of Ventilation Air,
- Condenser Pumps/Valves/Fittings,
- Condenser Water Reheat,
- Grill Options,
- Non-Standard Indoor Fan Motors

In this NOPR, DOE is proposing to specify that the basic model representation must be based on the least efficient individual model that is a part of the basic model and clarifying how this long-standing basic model provision interacts with the component treatment in 10 CFR 429.43 that is being proposed. DOE believes regulated entities may benefit from clarity in the regulatory text as to how the least-efficient individual model within a basic model provision works with the component treatment for WSHPs. The amendments in this NOPR explicitly state that the exclusion of the specified components from consideration in determining basic model efficiency in certain scenarios is an exception to basing representations on the least efficient individual model within a basic model. In other words, the components listed in 10 CFR 429.43 are not being considered as part of the representation under DOE's regulatory framework if certain conditions are met as discussed in the following paragraphs, and, thus, their impact on efficiency is not reflected in the representation. In this case, the basic model's representation is generally determined by applying the testing and sampling provisions to the least-efficient individual model in the basic model that does not have a component listed in 10 CFR 429.43.

DOE is proposing clarifying instructions for instances when individual models within a basic model may have more than one of the specified components and there may be no individual model without any of the specified components. DOE is proposing the concept of an ''otherwise comparable model group'' (''OCMG''). An OCMG is a group of individual models within the basic model that do not differ in components that affect energy consumption as measured according to the applicable test procedure other than the specific components listed in Table 1 to 10 CFR 429.43 but may include individual models with any combination of such specified components. Therefore, a basic model can be composed of multiple OCMGs, each representing a unique combination of components that affect energy consumption as measured according to the applicable test procedure, other than the specified excluded components listed in Table 1 to 10 CFR 429.43. For example, a manufacturer might include two tiers of control system within the same basic model, in which one of the control systems has sophisticated diagnostics capabilities that require a more powerful control board with a higher wattage input. WSHP individual models with the ''standard'' control system would be part of OCMG A, while individual models with the ''premium'' control system would be part of a different OCMG B, because the control system is not one of the specified exempt components listed in Table 1 to 10 CFR 429.43. However, both OCMGs may include different combinations of specified exempt components. Also, both OCMGs may include any combination of characteristics that do not affect the efficiency measurement, such as paint color.

An OCMG is used to determine which individual models are used to determine a represented value. Specifically, when identifying the individual model within an OCMG for the purpose of determining a representation for the basic model, only the individual model(s) with the least number (which could be zero) of the specific components listed in Table 1 to 10 CFR 429.43 is considered. This clarifies which individual models are exempted from consideration for determination of represented values in the case of an OCMG with multiple specified components and no individual models with zero specific components listed in Table 1 to 10 CFR 429.43 (*i.e.,* models with a number of specific components listed in Table 1 to 10 CFR 429.43 greater than the least number in the OCMG are exempted). In the case that the OCMG includes an individual model with no specific components listed in Table 1 to 10 CFR 429.43, then all individual models in the OCMG with specified components would be exempted from consideration. The least-efficient individual model across the OCMGs within a basic model would be used to determine the representation of the basic model. In the case where there are multiple individual models within a single OCMG with the same non-zero least number of specified components, the least efficient of these would be considered.

DOE relies on the term ''comparable'' as opposed to ''identical'' to indicate that for the purpose of representations, the components that impact energy consumption as measured by the applicable test procedure are the relevant components to consider. In other words, differences that do not impact energy consumption, such as unit color and presence of utility outlets, would not warrant separate OCMGs.

The use of the OCMG concept results in the represented values of performance that are representative of the individual model(s) with the lowest efficiency found within the basic model, excluding certain individual models with the specific components listed in Table 1 to 10 CFR 429.43. Further, the approach, as proposed, is structured to more explicitly address individual models with more than one of the specific components listed in Table 1 to 10 CFR 429.43, as well as instances in which there is no comparable model without any of the specified components. DOE developed a document of examples to illustrate the approach proposed in this NOPR for determining represented values for WSHPs with specific components, and in particular the OCMG concept. See EERE–2017–BT–TP–0029.

DOE's proposed provisions in 10 CFR 429.43(a)(3)(ii)(A) include each of the components specified in section D3 of AHRI 340/360–2022 for which the test provisions for testing a unit with these components may result in differences in ratings compared to testing a unit without these components, except for the following features: (1) Evaporative Pre-cooling of Condenser Intake Air; (2) Non-Standard Ducted Condenser Fans; and (3) Coated Coils. Because WSHPs do not have condenser intake air or condenser fans, DOE is not including provisions addressing these components for WSHPs. Non-standards indoor fan motors and coated coils are discussed in the following sub-sections.

(i) Non-Standard Indoor Fan Motors

The Commercial HVAC Enforcement Policy includes high-static indoor blowers/oversized motors as an optional feature for WSHPs, among other equipment. The Commercial HVAC Enforcement Policy states that when selecting a unit of a basic model for DOE-initiated testing, if the basic model includes a variety of high-static indoor blowers or oversized motor options,[36] DOE will test a unit that has a standard indoor fan assembly (as described in the STI that is part of the manufacturer's certification, including information about the standard motor and associated drive that was used in determining the certified rating). This policy only applies where: (a) the manufacturer distributes in commerce a model within the basic model with the standard indoor fan assembly (*i.e.,* standard motor and drive), and (b) all models in the basic model have a motor with the same or better relative efficiency performance as the standard motor included in the test unit, as described in a separate guidance document discussed subsequently. If the manufacturer does not offer models with the standard motor identified in the STI or offers models with high-static motors that do not comply with the comparable efficiency guidance, DOE will test any indoor fan assembly offered for sale by the manufacturer.

DOE subsequently issued a draft guidance document (''Draft Commercial HVAC Guidance Document'') on June 29, 2015 to request comment on a method for comparing the efficiencies of a standard motor and a high-static indoor blower/oversized motor.[37] As presented in the Draft Commercial HVAC Guidance Document, the relative efficiency of an indoor fan motor would be determined by comparing the percent losses of the standard indoor fan motor to the percent losses of the non-standard (oversized) indoor fan motor. The percent losses would be determined by comparing each motor's wattage losses to the wattage losses of a corresponding reference motor. Additionally, the draft method contains a table that includes a number of situations with different combinations of characteristics of the standard motor and oversized motor (*e.g.,* whether each motor is subject to Federal standards for motors, whether each motor can be tested to the Federal test procedure for motors, whether each motor horsepower is less than one) and specifies for each combination whether the non-standard fan enforcement policy would apply (*i.e.,* whether DOE would not test a model with an oversized motor, as long as the relative efficiency of the oversized motor is at least as good as performance of the standard motor). DOE has not issued a final guidance document and is instead addressing the issue for WSHPs in this test procedure rulemaking.

Neither ISO 13256–1:1998 nor ISO 13256–1:2021 address this issue. Section D4.1 of AHRI 340/360–2022 provides an approach for including an individual model with a non-standard indoor fan motor as part of the same basic model as an individual model with a standard indoor fan motor. Under the approach in section D4.1 of AHRI 340/360–2022, the non-standard indoor fan motor efficiency must exceed the minimum value calculated using Equation D1 of AHRI 340/360–2022. This minimum non-standard motor efficiency calculation is dependent on the efficiency of the standard fan motor and the reference efficiencies (determined per Table D1 of AHRI 340/360–2022) of the standard and non-standard fan motors.

Section D4.2 of AHRI 340/360–2022 contains a method for how to compare performance for integrated fans and motors (''IFMs''). Because the fan motor in an IFM is not separately rated from the fan, this method compares the performance of the entire fan-motor assemblies for the standard and non-standard IFMs, rather than just the fan motors. This approach enables comparing relative performance of standard and non-standard IFMs, for which motor efficiencies could otherwise not be compared using the method specified in section D4.1 of AHRI 340/360–2022. Specifically, this method determines the ratio of the input power of the non-standard IFM to the input power of the standard IFM at the same duty point as defined in section D4.2 (*i.e.,* operating at the maximum ESP for the standard IFM at the rated airflow). If the input power ratio does not exceed the maximum ratio specified in Table D3 of AHRI 340/360–2022, the individual model with the non-standard IFM may be included within the same basic model as the individual model with the standard IFM. Section D4.2 of AHRI 340/360–2022 allows these calculations to be conducted using either test data or simulated performance data.

The approaches in section D4 of AHRI 340/360–2022 for non-standard indoor fan motors and non-standard indoor IFMs generally align with the approaches of the Commercial HVAC Term Sheet, the Commercial HVAC Enforcement Policy, and the Draft Commercial HVAC Guidance Document, while providing greater detail and accommodating a wider range of fan motor options. For the reasons presented in the preceding paragraphs DOE proposes to adopt the provisions for comparing performance of standard and non-standard indoor fan motors/IFMs in section D4 of AHRI 340/360–2022 [38] for the determination of the represented efficiency value for WSHPs at 10 CFR 429.43(a)(3) and for DOE assessment and enforcement testing of WSHPs at 10 CFR 429.134(t)(2). Were DOE to adopt the provisions of section D4 of Appendix D of AHRI 340/360–2022 as proposed, the Commercial

[36] The Commercial HVAC Enforcement Policy defines ''high static indoors blower or oversized motor'' as an indoor fan assembly, including a motor, that drives the fan and can deliver higher external static pressure than the standard indoor fan assembly sold with the equipment.

[37] Available at *www1.eere.energy.gov/buildings/appliance_standards/pdfs/draft-commercial-hvac-motor-faq-2015-06-29.pdf.*

[38] Per DOE's existing certification regulations, if a manufacturer were to use the proposed approach to certify a basic model, the manufacturer would be required to maintain documentation of how the relative efficiencies of the standard and non-standard fan motors or the input powers of the standard and non-standard IFMs were determined as well as the supporting calculations. *See* 10 CFR 429.71.

HVAC Enforcement Policy and draft guidance document, to the extent applicable to WSHPs, would no longer apply.

Issue 30: DOE requests comment on its proposal to adopt the methods for comparing relative efficiency of standard and non-standard indoor fan motors and integrated fan and motor combinations specified in section D4 of AHRI 340/360–2022 in the provisions for determination of represented values in 10 CFR 429.43(a) and provisions for DOE assessment and enforcement testing in 10 CFR 429.134.

(ii) Coated Coils

DOE is proposing to exclude coated coils from the specific components list specified in 10 CFR 429.43 because DOE has tentatively concluded that the presence of coated coils does not result in a significant impact to performance of WSHPs, and, therefore, models with coated coils should be rated based on performance of models with coated coils present (rather than based on performance of an individual model within an OCMG without coated coils).

c. Enforcement Provisions of 10 CFR 429.134

Consistent with the Commercial HVAC Term Sheet and the Commercial HVAC Enforcement Policy, DOE is proposing provisions in the newly proposed 10 CFR 429.134(t)(1) regarding how DOE would assess compliance for basic models that include individual models distributed in commerce if DOE cannot obtain for testing individual models without the components that are the basis of representation. Specifically, DOE proposes that if a basic model includes individual models with components listed at Table 1 to 10 CFR 429.43 and DOE is not able to obtain an individual model with the least number of those components within an OCMG (as defined in 10 CFR 429.43(a)(3) and discussed in section III.G.3.b of this NOPR), DOE may test any individual model within the OCMG.

d. Testing Specially-Built Units That Are Not Distributed in Commerce

Unlike section D3 of AHRI 340/360–2022, DOE's Commercial HVAC Enforcement Policy does not allow a manufacturer to test a specially-built model for testing models without a feature that are not distributed in commerce. Because testing such specially-built models would not provide ratings representative of equipment distributed in commerce, DOE has tentatively concluded that this approach is not appropriate. Therefore, consistent with the Commercial HVAC Enforcement Policy, DOE is not proposing to allow testing of specially-built units in its representation and enforcement provisions.

H. Represented Values and Enforcement

1. Cooling Capacity

For WSHPs, cooling capacity determines equipment class, which in turn determines the applicable energy conservation standard. 10 CFR 431.97. While cooling capacity is a required represented value for WSHPs, DOE does not currently specify any provisions for WSHPs regarding how close the represented value of cooling capacity must be to the tested or AEDM-simulated cooling capacity, or whether DOE will use measured or certified cooling capacity to determine equipment class for enforcement testing. In contrast, at paragraphs (a)(1)(iv) and (a)(2)(ii) of 10 CFR 429.43 and paragraph (g) of 10 CFR 429.134, DOE specifies such provisions regarding the cooling capacity for air-cooled CUACs (''ACUACs''). Because energy conservation standards for WSHPs are dependent on cooling capacity, inconsistent approaches to the application of cooling capacity between basic models could result in inconsistent determinations of equipment class and, in turn, inconsistent applications of the energy conservation standards.

Accordingly, DOE is proposing to add the following provisions regarding cooling capacity for WSHPs: (1) a requirement that the represented cooling capacity be between 95 percent and 100 percent of the tested or AEDM-simulated cooling capacity; and (2) an enforcement provision stating that DOE would use the mean of measured cooling capacity values from assessment and enforcement testing, rather than the certified cooling capacity, to determine the applicable standards.

First, DOE proposes to require in 10 CFR 429.43(a)(3)(ii)(B) that the represented value of cooling capacity must be between 95 percent and 100 percent of the mean of the cooling capacity values measured for the units in the sample (if determined through testing), or between 95 percent and 100 percent of the net sensible cooling capacity output simulated by an AEDM. This tolerance would help to ensure that equipment: (1) is capable of performing at the cooling capacity for which it is represented to commercial consumers and (2) certified in the appropriate equipment class for the cooling capacity the equipment is capable of providing. This tolerance would also enable manufacturers to conservatively rate the cooling capacity to allow for minor variations in the capacity measurements from different units tested at different laboratories.

Second, DOE is proposing in its product-specific enforcement provisions at 10 CFR 429.134(t)(1) that the cooling capacity of each tested unit of the basic model will be measured pursuant to the test requirements of part 431 and that the mean of the measurements will be used to determine compliance with the applicable standards.

As discussed in this section, applicable energy conservation standards for WSHPs are dependent on the rated cooling capacity. Consequently, in certain cases, over-rating a system could result in decreased stringency by incorrectly applying a more lenient standard prescribed for a higher capacity equipment class. DOE has tentatively concluded that these proposals would result in more accurate ratings of cooling capacity, thereby ensuring appropriate application of the energy conservation standards, while providing flexibility for conservatively rating cooling capacity to ensure that equipment is capable of delivering the cooling capacity that is represented to commercial consumers.

Issue 31: DOE requests comment on its proposals related to represented values and verification testing of cooling capacity for WSHPs.

2. Enforcement of IEER

As discussed in section III.E.1 of this document, DOE is proposing two options for determining IEER. The first option, ''Option 1'' as specified in section 5.1.1 of appendix C1, is based on testing at the IEER entering water temperatures. The second option, ''Option 2'' as specified in section 5.1.2 of appendix C1, is based on testing at alternate entering water temperatures and then using interpolation and extrapolation to determine performance at IEER entering water temperatures. For assessment or enforcement testing, DOE is proposing provisions in § 429.134(t)(3) specifying that that the Department will determine IEER according to the ''Option 1'' approach, unless the manufacturer has specified that the ''Option 2'' approach should be used for the purposes of enforcement, in which case the Department will determine IEER according to the ''Option 2'' approach.

I. Test Procedure Costs and Impact

EPCA requires that the test procedures for commercial package air conditioning and heating equipment, which includes WSHPs, be those generally accepted industry testing procedures or rating procedures developed or recognized by AHRI or by ASHRAE, as referenced in ASHRAE Standard 90.1. (42 U.S.C. 6314(a)(4)(A)) Further, if such an industry test procedure is amended, DOE must amend its test procedure to be consistent with the amended industry test procedure, unless DOE determines, by rule published in the **Federal Register** and supported by clear and convincing evidence, that such amended test procedure would not meet the requirements in 42 U.S.C. 6314(a)(2) and (3) related to representative use and test burden. (42 U.S.C. 6314(a)(4)(B)) DOE proposes to reorganize the current test procedure in proposed appendix C and to adopt generally through incorporation by reference the industry standard AHRI 340/360–2022 in proposed appendix C1. As discussed, the proposed test procedure in proposed appendix C1 would rely on the IEER metric. Testing pursuant to proposed appendix C1 would be required only at such time as compliance is required with amended energy conservation standards based on IEER and the amended COP, should DOE adopt such standards, or if a manufacturer chooses to make voluntary representations of IEER before the compliance date.

As discussed in section III.D.3 of this NOPR, DOE has tentatively determined that the proposed test procedure in proposed appendix C1 would improve representativeness, accuracy, and reproducibility as compared to the current DOE test procedure and would not be unduly burdensome to conduct.

Because the current DOE test procedure for WSHPs would be relocated to appendix C without change, the proposed test procedure in appendix C for measuring EER and COP would result in no change in testing practices or burden.

DOE tentatively concludes that the proposed test procedure in proposed appendix C1 for measuring IEER and COP would increase testing costs per unit compared to the current DOE test procedure. DOE estimates to cost for third-party laboratory testing of WSHPs according to the current test procedure to be $2,200 per unit for units with a cooling capacity of less than 135,000 Btu/h. DOE estimates the cost for third-party lab testing according to the proposed appendix C1 for measuring IEER and COP would be $4,450 per unit for units with a cooling capacity of less than 135,000 Btu/h. This increase is due to the increased number of tests associated with the IEER metric compared to the current metric, EER. IEER requires four tests, whereas EER only requires one.

Additionally, DOE is proposing to increase in the scope of applicability of the test procedure to include all WSHPs with full-load cooling capacity between 135,000 Btu/h and 760,000 Btu/h. DOE estimates the cost for third-party lab testing of large and very large WSHPs according to the proposed appendix C1 for measuring IEER and COP would be $12,000 per unit. DOE estimates a substantially higher cost for larger WSHPs because they are generally more difficult to set up due to size and larger units typically would need to be set up in larger and rarer test chambers.

As discussed, in accordance with 10 CFR 429.70, WSHP manufacturers may elect to use AEDMs. An AEDM is a computer modeling or mathematical tool that predicts the performance of non-tested basic models. These computer modeling and mathematical tools, when properly developed, can provide a means to predict the energy usage or efficiency characteristics of a basic model of a given covered product or equipment and reduce the burden and cost associated with testing. DOE estimates the per-manufacturer cost to develop and validate an AEDM to be used for all WSHP equipment with a cooling capacity less than 135,000 Btu/h would be $12,800. DOE estimates the per-manufacturer cost to develop and validate an AEDM to be used for all WSHPs with a cooling capacity between 135,000 Btu/h and 760,000 Btu/h would be $27,900. DOE estimates an additional cost of approximately $41 per basic model for determining energy efficiency using the validated AEDM.[39]

As discussed in section III.J of this NOPR, the proposed test procedure provisions regarding IEER would not be mandatory until compliance is required with amended energy conservation standards that rely on IEER, should DOE adopt such standards, although any voluntary early representations of IEER must be based on the proposed appendix C1. DOE has tentatively determined that the test procedure amendments, if finalized, would not require manufacturers to redesign any of the covered equipment or require changes to how the equipment is manufactured, solely as result of the test procedure amendments. In section IV.B of this TP NOPR, DOE assesses the impact to domestic, small manufacturers of WSHPs from the test procedure provisions proposed in this NOPR.

Issue 32: DOE requests comment on its understanding of the impact of the test procedure proposals in this NOPR. DOE also seeks specific feedback on the estimated costs to rate WSHP models with an AEDM.

J. Compliance Date

EPCA prescribes that, if DOE amends a test procedure, all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with that amended test procedure, beginning 360 days after publication of such a test procedure final rule in the **Federal Register**. (42 U.S.C. 6314(d)(1))

Starting 360 days after publication of a test procedure final rule in the **Federal Register**, and prior to the compliance date of amended standards for water-source heat pumps that rely on IEER, representations would need to be based the proposed appendix C. Starting on the compliance date of amended standards for water-source heat pumps that rely on IEER, if adopted, representations would need to be based the proposed appendix C1.

Any voluntary representations of IEER made prior to the compliance date of amended standards for water-source heat pumps that rely on IEER would need to be based on the proposed appendix C1 starting 360 days after publication of such a test procedure final rule in the **Federal Register**, and manufacturers may use appendix C1 to certify compliance with any amended standards based on IEER, if adopted, prior to the applicable compliance date those energy conservation standards.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Executive Order (''E.O.'') 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review,'' 76 FR 3821 (Jan. 21, 2011), requires agencies, to the extent permitted by law, to: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to

[39] DOE estimated initial costs to validate an AEDM assuming 80 hours of general time to develop an AEDM based on existing simulation tools and 16 hours to validate two basic models within that AEDM at the cost of a engineering technician wage of $41 per hour plus the cost of third-party physical testing of two units per validation class (as required in 10 CFR 429.70(c)(2)(iv)). DOE estimated the additional per basic model cost to determine efficiency using an AEDM assuming 1 hour per basic model at the cost of an engineering technician wage of $41 per hour.

impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget (''OMB'') has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this proposed regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit ''significant regulatory actions'' to OIRA for review. OIRA has determined that this proposed regulatory action does not constitute a ''significant regulatory action'' under section 3(f) of E.O. 12866. Accordingly, this action was not submitted to OIRA for review under E.O. 12866.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (''IRFA'') for any rule that 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. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website: *www.energy.gov/gc/office-general-counsel.* DOE reviewed this proposed rule to amend the test procedure of WSHPs under the provisions of the Regulatory Flexibility Act and the policies and procedures published on February 19, 2003.

The following sections detail DOE's IRFA for this test procedure rulemaking.

1. Description of Reasons Why Action Is Being Considered

DOE is proposing to amend the existing DOE test procedures for water-source heat pumps (''WSHPs''). DOE must update the Federal test procedures to be consistent with relevant industry test procedures unless DOE determines by rule published in the **Federal Register** and supported by clear and convincing evidence that the industry test procedure would not be representative of an average use cycle or would be unduly burdensome to conduct. (42 U.S.C. 6314(a)(4)(B))

2. Objective of, and Legal Basis for, Rule

Under 42 U.S.C. 6314, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered equipment. EPCA requires that any test procedures prescribed or amended under this section must be reasonably designed to produce test results which reflect energy efficiency, energy use, or estimated annual operating cost of covered equipment during a representative average use cycle and requires that test procedures not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

With respect to WSHPs, EPCA requires that the test procedures shall be those generally accepted industry testing procedures or rating procedures developed or recognized by the Air-Conditioning, Heating, and Refrigeration Institute (''AHRI'') or by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (''ASHRAE''), as referenced in ASHRAE Standard 90.1, ''Energy Standard for Buildings Except Low-Rise Residential Buildings'' (''ASHRAE Standard 90.1''). (42 U.S.C. 6314(a)(4)(A)) Further, if such an industry test procedure is amended, DOE must amend its test procedure to be consistent with the amended industry test procedure, unless DOE determines, by rule published in the **Federal Register** and supported by clear and convincing evidence, that the amended test procedure would not produce test results that reflect the energy efficiency, energy use, and estimated operating costs of that equipment during a representative average use cycle or would be unduly burdensome to conduct. (42 U.S.C. 6314(a)(4)(B))

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered equipment including WSHPs, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle and not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(1)(A))

DOE is proposing amendments to the test procedures for WSHPs in satisfaction of its statutory obligations under EPCA.

3. Description and Estimate of Small Entities Regulated

DOE uses the Small Business Administration (''SBA'') small business size standards to determine whether manufacturers qualify as ''small businesses,'' which are listed by the North American Industry Classification System (''NAICS'').[40] The SBA considers a business entity to be small business if, together with its affiliates, it employs less than a threshold number of workers specified in 13 CFR part 121.

WSHP manufacturers, who produce the equipment covered by this rule, are classified under NAICS code 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.'' In 13 CFR 121.201, the SBA sets a threshold of 1,250 employees or fewer for an entity to be considered as a small business for this category. This employee threshold includes all employees in a business's parent company and any other subsidiaries.

DOE reviewed the test procedures proposed in this NOPR under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. The Department conducted a focused inquiry into small business manufacturers of the equipment covered by this rulemaking. DOE's analysis relied on publicly available information and databases to identify potential small businesses that manufacture WSHPs domestically. DOE utilized the California Energy Commission's Modernized Appliance Efficiency

[40] The size standards are listed by NAICS code and industry description and are available at: *www.sba.gov/document/support--table-size-standards* (Last accessed on July 16, 2021).

Database System (''MAEDbS'') [41] and the DOE's Certification Compliance Database (''CCD'') [42] in identifying manufacturers. DOE screened out private labelers because original equipment manufacturers (''OEMs'') would likely be responsible for any costs associated with testing to the proposed test procedure. As a result of this inquiry, DOE identified a total of 25 OEMs of WSHPs in the United States affected by this rulemaking. DOE screened out companies that do not meet the definition of a ''small business'' or are foreign-owned and operated. Of these 25 OEMs of WSHPs, DOE identified seven as small, domestic manufacturers for consideration. DOE used subscription-based business information tools to determine headcount and revenue of these small businesses.

4. Description and Estimate of Compliance Requirements

In this NOPR, DOE proposes to add new appendices C and C1 to subpart F of part 431, both titled ''Uniform test method for measuring the energy consumption of water-source heat pumps,'' (''appendix C'' and ''appendix C1,'' respectively). The current DOE test procedure for WSHPs would be relocated to appendix C without change. DOE is proposing in appendix C1 to adopt generally the industry test standard AHRI 340/360–2022 for WSHPs, with certain additional provisions regarding test conditions to improve representativeness, accuracy, and repeatability. Appendix C1 would be for determining IEER, and use of appendix C1 would not be required until such time as compliance is required with amended energy conservation standards for WSHPs based on IEER (should DOE adopt such standards) or should a manufacturer choose to make voluntary representations of IEER. Additionally, DOE is proposing to increase the scope of applicability of the test procedure (including both appendices C and C1) to include all WSHPs with a full-load cooling capacity between 135,000 Btu/h and 760,000 Btu/h. Lastly, this NOPR seeks to amend certain representation and enforcement provisions for WSHPs in 10 CFR part 429.

Appendix C does not contain any changes from the current Federal test procedure, and, therefore, would have no cost to industry and would not require retesting solely as a result of DOE's adoption of this proposed amendment to the test procedure, if made final.

In appendix C1, DOE is proposing to adopt generally AHRI 340/360–2022 as the test procedure for WSHPs. The proposed test procedure in appendix C1 includes provisions for measuring efficiency of WSHPs in terms of the IEER metric for cooling mode and the COP metric for heating mode. Appendix C1 is not mandatory at this point in time. Should DOE adopt energy conservation standards based on the proposed metrics in appendix C1 (IEER and COP) in the future, DOE anticipates manufacturers would incur costs to re-rate models as a result of the standards. The current DOE test procedure (applicable only to WSHP with cooling capacity less than 135,000 Btu/h) results in costs of approximately $2,200 per unit for third-party laboratory testing. DOE estimates the cost for third-party laboratory testing according to the proposed appendix C1 to be $4,450 per unit.

Furthermore, as mentioned, DOE is proposing to increase in the scope of applicability of the test procedure to include all WSHPs with a full-load cooling capacity between 135,000 Btu/h and 760,000 Btu/h. However, testing for these WSHPs is not currently mandatory because there are no energy conservation standards for WSHPs at or above 135,000 Btu/h at the present time. Consequently, manufacturers would not incur costs as result of this TP NOPR unless they choose to make voluntary representations regarding the IEER of the subject equipment. Any voluntary representations would need to be based on the test procedure in appendix C starting 360 days after the publication of a test procedure final rule. Should DOE adopt future energy conservation standards denominated in terms of IEER to expand coverage of WSHPs with a full-load cooling capacity between 135,000 Btu/h and 760,000 Btu/h, DOE manufacturers could incur first-time rating costs as a result of the standard. DOE estimates the cost for third-party lab testing according to the proposed appendix C1 for measuring IEER and COP of WSHPs with a cooling capacity between 135,000 Btu/h and 760,000 Btu/h to be $12,000 per unit.

If WSHP manufacturers conduct physical testing to certify a basic model, two units are required to be tested per basic model. The physical test cost, according to the proposed amendments, would range between $8,900 to $24,000 per basic model.[43] However, manufacturers may elect to use AEDMs.[44] An AEDM is a computer modeling or mathematical tool that predicts the performance of non-tested basic models. These computer modeling and mathematical tools, when properly developed, can provide a means to predict the energy usage or efficiency characteristics of a basic model of a given covered product or equipment and reduce the burden and cost associated with testing. DOE's requirements for validation of AEDMs at 10 CFR 429.70(c)(2)(iv) specify that an AEDM validated with testing of two WSHP basic models can be used to develop ratings for WSHPs of any cooling capacity. If a manufacturer chooses to update and validate an AEDM for WSHPs based on testing a model with a cooling capacity less than 135,000 Btu/h, DOE estimates the cost would be $12,800. If a manufacturer chooses to update and validate an AEDM for WSHPs based on testing a model with a cooling capacity greater than or equal to 135,000 Btu/h, DOE estimates the cost would be $27,900.[45] Additionally, DOE estimates a cost of approximately $41 per basic model for determining energy efficiency using the validated AEDM.

When developing cost estimates for the small OEMs, DOE considers the cost to update the existing AEDM simulation tool, the costs to validate the AEDM through physical testing, and the cost to rate basic models using the AEDM. DOE assumes that small business manufacturers will afford themselves of the cost-saving opportunity associated with use of an AEDM.

DOE identified seven small, domestic OEMs of WSHPs that manufacture equipment impacted by DOE's proposal to adopt metrics in terms of IEER and COP. Additionally, of these manufacturers, DOE identified one OEM that currently manufactures equipment with a cooling capacity between 135,000 Btu/h and 760,000 Btu/h. DOE estimates

[41] MAEDbS is available at *www.cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx* (Last accessed Dec. 1, 2021).

[42] Certified equipment in the CCD are listed by product class and can be accessed at *www.regulations.doe.gov/certification-data/* (Last accessed Dec. 1, 2021).

[43] The cost to test one unit with a cooling capacity less than 135,000 Btu/h is $4,450, so the cost to test two units is $8,900. The cost to test one unit with a cooling capacity greater than 135,000 Btu/h is $12,000, so the cost to test two units is $24,000.

[44] In accordance with 10 CFR 429.70.

[45] DOE estimated initial costs to validate an AEDM assuming 80 hours of general time to develop an AEDM based on existing simulation tools and 16 hours to validate two basic models within that AEDM at the cost of a engineering technician wage of $41 per hour plus the cost of third-party physical testing of two units per validation class (as required in 10 CFR 429.70(c)(2)(iv)). DOE estimated the additional per basic model cost to determine efficiency using an AEDM assuming 1 hour per basic model at the cost of an engineering technician wage of $41 per hour.

the range of potential costs to these small businesses as follows.

Given the potential for DOE to adopt energy conservation standards based on the proposed metrics in 10 CFR part 431, subpart F, appendix C1 (IEER and COP) in the future, DOE estimates here the range of potential re-rating costs for the seven small, domestic OEMs. The small, domestic OEMs manufacture an average of 38 basic models per manufacturer and average $14.0 million in annual revenue. DOE estimates that the associated re-rating costs for these seven manufacturers would be approximately $14,400 per manufacturer, when utilizing AEDMs. Therefore, the average cost to re-rate all basic models is estimated to be less than 1 percent of annual revenue for these small businesses.

Should DOE adopt future energy conservation standards to include all WSHPs with a cooling capacity between 135,000 Btu/h and 760,000 Btu/h, DOE estimates that the one small, domestic manufacturer of this equipment-type would incur first-time rating costs of $28,100 while making use of an AEDM. DOE estimates this manufacturer to have an annual revenue of $11.0 million. Therefore, should DOE adopt future energy conservation standards to include all WSHPs with a cooling capacity between 135,000 Btu/h and 760,000 Btu/h and this manufacturer were required to re-rate all its models to the proposed metrics in 10 CFR part 431, subpart F, appendix C1 (IEER and COP). DOE estimates the cost would be less than 1 percent of annual revenue for this small business.[46]

Issue 33: DOE requests comment on the number of small OEMs DOE identified. DOE also seeks comment on the Department's estimates of potential costs these small manufacturers may incur as a result of its proposed amendments to the WSHP test procedure.

5. Duplication Overlap, and Conflict with Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being considered.

6. Significant Alternatives to the Rule

The discussion in the previous section analyzes impacts on small businesses that would be expected to result from DOE's proposed test rule, if finalized. The Department has tentatively determined that there are no better alternatives than the test procedure proposed in this NOPR, in terms of both meeting the agency's objectives pursuant to EPCA and reducing burden. Whenever possible, DOE seeks to utilize applicable industry test procedures as a way to minimize burdens on regulated parties. In reviewing alternatives to the proposed test procedure, DOE examined other industry test procedures when applicable. Ultimately, DOE proposes to amend the test procedure for WSHPs to incorporate by reference AHRI 340/360–2022, the industry test procedure for testing CUAC/HPs. Furthermore, AHRI 340/360–2022 in turn references ANSI/ASHRAE 37–2009, which provides a method of test applicable to many categories of air conditioning and heating equipment. DOE has tentatively concluded that incorporation by reference of these industry test standards would best achieve the statutory objectives of representativeness and not being unduly burdensome on manufacturers, including small businesses.

Additionally, DOE proposes to reduce burden on manufacturers, including small businesses, by allowing AEDMs in lieu of physically testing all basic models. The use of an AEDM is less costly than physical testing WSHP models. Without AEDMs, DOE estimates the typical cost to physically test all WSHP basic models for an average small manufacturer would be $340,000.

Additional compliance flexibilities may be available through other means. Manufacturers subject to DOE's energy conservation standards may apply to DOE's Office of Hearings and Appeals for exception relief under certain circumstances. Manufacturers should refer to 10 CFR part 1003 for additional details.

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of WSHPs must certify to DOE that their equipment complies with any applicable energy conservation standards. To certify compliance, manufacturers must first obtain test data for their equipment according to the DOE test procedures, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including WSHPs. (*See generally* 10 CFR part 429.) The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (''PRA''). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 35 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

DOE is not proposing to amend the certification or reporting requirements for WSHPs in this NOPR. Instead, DOE may consider proposals to amend the certification requirements and reporting for WSHPs under a separate rulemaking regarding appliance and equipment certification. DOE will address changes to OMB Control Number 1910–1400 at that time, as necessary.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

In this NOPR, DOE proposes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for WSHPs. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, DOE has determined that adopting test procedures for measuring energy efficiency of consumer products and industrial equipment is consistent with activities identified in 10 CFR part 1021, appendix A to subpart D, A5 and A6. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 10, 1999), imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism

[46] DOE estimated the cumulative burden to represent $42,500.

implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard, and (4) promote simplification and burden reduction. Section 3(b) of 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(c) of Executive Order 12988 requires executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or if 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 proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (''UMRA'') requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *www.energy.gov/gc/office-general-counsel.* DOE examined this proposed rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This proposed rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (March 18, 1988), that this proposed regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M–19–15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at: *www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf.* DOE has reviewed this proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB, a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

The proposed regulatory action to amend the test procedure for measuring the energy efficiency of WSHPs is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; ''FEAA'') Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (''FTC'') concerning the impact of the commercial or industry standards on competition.

The proposed modifications to the Federal test procedure for WSHPs would incorporate testing methods contained in certain sections of the following applicable commercial test standards: AHRI 340/360–2022 and ANSI/ASHRAE 37–2009. DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (*i.e.,* whether they were developed in a manner that fully provides for public participation, comment, and review.) DOE will consult with both the Attorney General and the Chairman of the FTC concerning the impact of these test procedures on competition, prior to prescribing a final rule.

M. Description of Materials Incorporated by Reference

In this NOPR, DOE proposes to incorporate by reference the following test standards:

AHRI 340/360–2022 is an industry-accepted test procedure for measuring the performance of unitary air-conditioning & air-source heat pump equipment. AHRI Standard 340/360–2022 is reasonably available on AHRI's website at: *www.ahrinet.org/.*

ANSI/ASHRAE 37–2009, as updated by the errata sheet, is an industry-accepted test procedure for measuring the performance of electrically driven unitary air-conditioning and heat pump equipment. ANSI/ASHRAE 37–2009 is reasonably available on ANSI's website at: *https://webstore.ansi.org/.*

ASHRAE errata sheet to ANSI/ASHRAE Standard 37–2009 is a technical corrections sheet for ANSI/ASHRAE 37–2009. The errata sheet for ANSI/ASHRAE 37–2009 is reasonably available on ASHRAE's website at: *www.ashrae.org/.*

ISO Standard 13256–1:1998 is an industry-accepted test procedure for measuring the performance of water-source heat pump equipment. ISO Standard 13256–1:1998 is reasonably available on ISO's website at: *https://webstore.ansi.org/.*

The following standards were previously-approved for incorporation by reference in the locations where they appear in the regulatory text: AHRI 210/240–2008, AHRI 340/360–2007, AHRAE 127–2007, AHRI 1230–2010, AHRI 390–2003.

V. Public Participation

A. Participation in the Public Meeting Webinar

The time and date of the webinar are listed in the **DATES** section at the beginning of this document. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's website: *https://www.energy.gov/eere/buildings/public-meetings-and-comment-deadlines.* Participants are responsible for ensuring their systems are compatible with the webinar software.

Additionally, you may request an in-person meeting to be held prior to the close of the request period provided in the **DATES** section of this document. Requests for an in-person meeting may be made by contacting Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *Appliance_Standards_Public_Meetings@ee.doe.gov.*

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has an interest in the topics addressed in this NOPR, or who is representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation at the public meeting webinar. Such persons may submit requests to speak via email to the Appliance and Equipment Standards Program at: *ApplianceStandardsQuestions@ee.doe.gov.* Persons who wish to speak should include with their request a computer file in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format that briefly describes the nature of their interest in this rulemaking and the topics they wish to discuss. Such persons should also provide a daytime telephone number where they can be reached.

DOE requests persons selected to make an oral presentation to submit an advance copy of their statement at least two weeks before the webinar. At its discretion, DOE may permit persons who cannot supply an advance copy of their statement to participate, if those persons have made advance alternative arrangements with the Building Technologies Office. As necessary, requests to give an oral presentation should ask for such alternative arrangements.

C. Conduct of the Public Meeting Webinar

DOE will designate a DOE official to preside at the public meeting webinar and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting webinar. There shall not be discussion of proprietary information, costs or prices, market share, or other commercial matters regulated by U.S. anti-trust laws. After the public meeting webinar and until the end of the comment period, interested parties may submit further comments on the proceedings and any aspect of the rulemaking.

The webinar will be conducted in an informal, conference style. DOE will present a general overview of the topics addressed in this rulemaking, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will allow, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the webinar will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the procedures that may be needed for the proper conduct of the public meeting webinar.

A transcript of the public meeting webinar will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this document. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule no later than the date provided in the **DATES** section at the beginning of this proposed rule.[47] Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this document.

Submitting comments via www.regulations.gov. The *www.regulations.gov* web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment itself or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Otherwise, persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to *www.regulations.gov* information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (''CBI'')). Comments submitted through *www.regulations.gov* cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through *www.regulations.gov* before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that *www.regulations.gov* provides after you have successfully uploaded your comment.

Submitting comments via email. Comments and documents submitted via email also will be posted to *www.regulations.gov.* If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. With this instruction followed, the cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. No telefacsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English, and free of any defects or viruses. Documents should not contain special characters or any form of encryption, and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email two well-marked copies: one copy of the document marked ''confidential'' including all the information believed to be confidential, and one copy of the document marked ''non-confidential'' with the information believed to be confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

Issue 1: DOE requests comments on the proposed expansion of the scope of applicability of the Federal test procedure to include WSHPs with cooling capacity between 135,000 and 760,000 Btu/h.

Issue 2: DOE requests comments on the proposed change to the definition of WSHP to explicitly indicate that WSHP is a category of commercial package air-conditioning and heating equipment, and to clarify that the presence of an indoor fan does not apply to coil-only units.

Issue 3: DOE requests comment on its proposal to adopt the test methods specified in AHRI 340/360–2022 for calculating the IEER of WSHPs. DOE also requests comment on its proposal that all EER tests at full-load and part-load conditions specified in Table 1 of ISO 13256–1:1998 (*i.e.,* full-load tests at 86 °F, 77 °F, and 59 °F and part-load tests at 86 °F, 68 °F, and 59 °F) are optional.

Issue 4: DOE requests comment on the proposal to allow determination of IEER using two different methods: (1) testing in accordance with AHRI 340/360–2022; or (2) interpolation and extrapolation of cooling capacity and power values based on testing in accordance with the proposed test procedure at the EWTs specified in Table 1 of ISO 13256–1:1998. Specifically, DOE seeks feedback on the proposed method for calculating IEER via interpolation and extrapolation, and on whether this approach would serve as a potential burden-reducing option as compared to

[47] DOE has historically provided a 75-day comment period for test procedure NOPRs pursuant to the North American Free Trade Agreement, U.S.-Canada-Mexico (''NAFTA''), Dec. 17, 1992, 32 I.L.M. 289 (1993); the North American Free Trade Agreement Implementation Act, Public Law 103–182, 107 Stat. 2057 (1993) (codified as amended at 10 U.S.C.A. 2576) (1993) (''NAFTA Implementation Act''); and Executive Order 12889, ''Implementation of the North American Free Trade Agreement,'' 58 FR 69681 (Dec. 30, 1993). However, on July 1, 2020, the Agreement between the United States of America, the United Mexican States, and the United Canadian States (''USMCA''), Nov. 30, 2018, 134 Stat. 11 (*i.e.,* the successor to NAFTA), went into effect, and Congress's action in replacing NAFTA through the USMCA Implementation Act, 19 U.S.C. 4501 *et seq.* (2020), implies the repeal of E.O. 12889 and its 75-day comment period requirement for technical regulations. Thus, the controlling laws are EPCA and the USMCA Implementation Act. Consistent with EPCA's public comment period requirements for consumer products, the USMCA only requires a minimum comment period of 60 days. Consequently, DOE now provides a 60-day public comment period for test procedure NOPRs.

testing at the AHRI 340/360–2022 conditions.

Issue 5: DOE requests comment on whether the proposed methodology to determine IEER based on interpolation and extrapolation is appropriate for variable-speed units. DOE would consider requiring variable-speed equipment be tested only according to AHRI 340/360–2022 and, thus, testing physically at the IEER EWTs, if suggested by commenters.

Issue 6: DOE seeks feedback on whether the proposed interpolation and extrapolation method should be based on testing at the ISO 13256–1:2021 EWTs.

Issue 7: DOE seeks comment and data on the representativeness of 55 °F as the EWT condition for determining COP. Specifically, DOE requests feedback and data on whether a lower EWT, such as 50 °F, would be more representative of heating operation of WSHPs. DOE will further consider any alternate EWT suggested by comments in developing any final rule.

Issue 8: DOE requests comment on the proposal to allow determination of COP using two different methods: (1) testing at 55 °F; or (2) interpolation of heating capacity and power values based on testing in accordance with the proposed test procedure at EWTs specified for heating tests in Table 2 of ISO 13256–1:1998 (*i.e.,* 50 °F and 68 °F). Specifically, DOE seeks feedback on the proposed method for calculating COP via interpolation, and on whether this approach would serve as a potential burden-reducing option as compared to testing at 55 °F.

Issue 9: DOE requests comment on its proposal to specify in proposed appendix C1 use of the cooling entering air conditions from AHRI 340/360–2022 (*i.e.,* 80 °F dry-bulb temperature and 67 °F wet-bulb temperature) and the heating entering air conditions from AHRI 340/360–2022 (*i.e.,* 70 °F dry-bulb temperature and a maximum of 60 °F wet-bulb temperature).

Issue 10: DOE requests comment on the proposal to adopt provisions from AHRI 340/360–2022 such that testing would be conducted within tolerance of the AHRI 340/360–2022 minimum ESP requirements, and efficiency ratings would include the fan power measured to overcome the tested ESP.

Issue 11: DOE requests comment on the proposed adoption of provisions from AHRI 340/360–2022 for setting airflow and ESP for WSHP testing.

Issue 12: DOE requests comment on its proposed instructions for setting airflow and ESP for ducted WSHP units with discrete-step fans.

Issue 13: DOE requests comment on its proposal for setting airflow and ESP for non-ducted WSHP units.

Issue 14: DOE requests comment on its proposed approach to adopt the provisions in AHRI 340/360–2022 and ANSI/ASHRAE 37–2009 regarding primary and secondary capacity measurements.

Issue 15: DOE requests comment on the proposal to adopt the cyclic degradation equation specified in Section 6.2.3.2 of AHRI 340/360–2022 for WSHPs, which assumes continuous indoor fan operation when the compressor cycles off.

Issue 16: DOE requests comment on the proposed provisions to account for pump power to overcome both internal pressure drop and a representative level of liquid ESP for WSHPs with and without integral pumps. DOE specifically requests comment on the representativeness of 20 ft of water column as the liquid ESP for WSHPs.

Issue 17: DOE requests comment on the proposed requirements for using water or a brine of 15-percent solution by mass of sodium chloride as the test liquid. DOE also requests comment on the representativeness and test burden associated with permitting the use of different liquids for different tests.

Issue 18: DOE requests comments on the proposal to utilize the thermodynamic properties specified in ANSI/ASHRAE 37–2009 through DOE's proposed incorporation by reference of AHRI 340/360–2022.

Issue 19: DOE requests comment on its proposal to adopt the AHRI 340/360–2022 approach for setting liquid flow rate for the full-load cooling test, namely by specifying inlet and outlet liquid temperature conditions rather than using a manufacturer-specified flow rate.

Issue 20: DOE requests feedback on its proposals to use manufacturer-specified part-load liquid flow rates for part-load tests, that the part-load flow rate be no higher than the full-load flow rate, and to use the full-load liquid flow rate if no part-load liquid flow rate is specified.

Issue 21: DOE requests comment on its proposal to use the liquid flow rate determined from the full-load cooling test for all heating tests.

Issue 22: DOE requests comment on its proposal to specify an operating tolerance of 2 percent and a condition tolerance of 1 percent for liquid flow rate in all tests with a target liquid flow rate.

Issue 23: DOE requests comments on the proposal to adopt the provisions for line loss adjustments included in Sections 7.6.7.1 and 7.3.3.4 of ANSI/ASHRAE 37–2009 through incorporation by reference of AHRI 340/360–2022.

Issue 24: DOE requests comments on the proposal to adopt the calculation of discharge coefficients and air measurement apparatus requirements of ANSI/ASHRAE 37–2009.

Issue 25: DOE requests comments on the proposal to adopt the air condition measurement provisions in Appendix C of AHRI 340/360–2022.

Issue 26: DOE requests comments on the proposal to adopt the duct loss provisions in Section 7.3.3.3 of ASHRAE 37–2009.

Issue 27: DOE requests comments on the proposal to adopt the refrigerant charging requirements in Section 5.8 of AHRI 340/360–2022.

Issue 28: DOE requests comments on the proposal to adopt the voltage provisions in Section 6.1.3.1 of AHRI 340/360–2022.

Issue 29: DOE seeks comment on its proposals regarding specific components in 10 CFR 429.43, 10 CFR 429.134, and 10 CFR part 431, subpart F, appendix C1.

Issue 30: DOE requests comment on its proposal to adopt the methods for comparing relative efficiency of standard and non-standard indoor fan motors and integrated fan and motor combinations specified in Section D4 of AHRI 340/360–2022 in the proposed test procedure in 10 CFR part 431, subpart F, appendix C1, as well as in provisions for determination of represented values in 10 CFR 429.43(a) and provisions for DOE assessment and enforcement testing in 10 CFR 429.134.

Issue 31: DOE requests comment on its proposals related to represented values and verification testing of cooling capacity for WSHPs.

Issue 32: DOE requests comment on its understanding of the impact of the test procedure proposals in this NOPR. DOE also seeks specific feedback on the estimated costs to rate WSHP models with an AEDM.

Issue 33: DOE requests comment on the number of small OEMs DOE identified. DOE also seeks comment on the Department's estimates of potential costs these small manufacturers may incur as a result of its proposed amendments to the WSHP test procedure.

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notice of proposed rulemaking and request for comment.

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Laboratories, Reporting and recordkeeping requirements, Small businesses.

Signing Authority

This document of the Department of Energy was signed on August 3, 2022, by Kelly J. Speakes-Backman, Principal Deputy Assistant for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on August 4, 2022.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

For the reasons stated in the preamble, DOE is proposing to amend parts 429 and 431 of Chapter II of Title 10, Code of Federal Regulations, as amended on July 27, 2022 (published at 87 FR 45164), as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 2. Amend § 429.4 by:

■ a. Revising paragraph (a);

■ b. Redesignating paragraph (c)(2) as paragraph (c)(3); and

■ c. Adding new paragraph (c)(2).

The revision and addition read as follows:

§ 429.4 Materials incorporated by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, the U.S. Department of Energy (DOE) must publish a document in the **Federal Register** and the material must be available to the public. All approved material is available for inspection at the DOE and at the National Archives and Records Administration (NARA). Contact DOE at: The U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, Sixth Floor, 950 L'Enfant Plaza SW, Washington, DC 20024, (202) 586–9127, *Buildings@ee.doe.gov, https://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program.* For information on the availability of this material at NARA, email: *fr.inspection@nara.gov,* or go to: *www.archives.gov/federal-register/cfr/ibr-locations.html.* The material may be obtained from the sources in the following paragraphs of this section.

* * * * *

(c) * * *

(2) AHRI Standard 340/360–2022 (I–P) (''AHRI 340/360–2022''), *2022 Standard for Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment,* AHRI-approved January 26, 2022; IBR approved for § 429.43.

* * * * *

■ 3. Amend § 429.43 by adding paragraph (a)(3)(ii) to read as follows:

§ 429.43 Commercial heating, ventilating, air conditioning (HVAC) equipment.

(a) * * *

(3) * * *

(ii) Water-Source Heat Pumps. When certifying to standards in terms of IEER, the following provisions apply.

(A) Individual model selection:

(1) Representations for a basic model must be based on the least efficient individual model(s) distributed in commerce among all otherwise comparable model groups comprising the basic model, except as provided in paragraph (a)(3)(ii)(A)(*2*) of this section for individual models that include components listed in table 1 to paragraph (a)(3)(ii)(A) of this section. For the purpose of this paragraph (a)(3)(ii)(A)(*1*), ''otherwise comparable model group'' means a group of individual models distributed in commerce within the basic model that do not differ in components that affect energy consumption as measured according to the applicable test procedure specified at 10 CFR 431.96 other than those listed in table 1 to paragraph (a)(3)(ii)(A) of this section. An otherwise comparable model group may include individual models distributed in commerce with any combination of the components listed in table 1 (or none of the components listed in table 1). An otherwise comparable model group may consist of only one individual model.

(2) For a basic model that includes individual models distributed in commerce with components listed in table 1 to paragraph (a)(3)(ii)(A) of this section, the requirements for determining representations apply only to the individual model(s) of a specific otherwise comparable model group distributed in commerce with the least number (which could be zero) of components listed in table 1 included in individual models of the group. Testing under this paragraph shall be consistent with any component-specific test provisions specified in section 7 of appendix C1 to subpart F of part 431.

TABLE 2 TO PARAGRAPH (a)(3)

Component	Description
Desiccant Dehumidification Components	An assembly that reduces the moisture content of the supply air through moisture transfer with solid or liquid desiccants.
Air Economizers	An automatic system that enables a cooling system to supply outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

TABLE 2 TO PARAGRAPH (a)(3)—Continued

Component	Description
Ventilation Energy Recovery System (VERS)	An assembly that preconditions outdoor air entering the equipment through direct or indirect thermal and/or moisture exchange with the exhaust air, which is defined as the building air being exhausted to the outside from the equipment.
Steam/Hydronic Heat Coils	Coils used to provide supplemental heating.
Refrigerant Reheat	A heat exchanger located downstream of the indoor coil that heats the supply air during cooling operation using high-pressure refrigerant in order to increase the ratio of moisture removal to cooling capacity provided by the equipment.
Fire/Smoke/Isolation Dampers	A damper assembly including means to open and close the damper mounted at the supply or return duct opening of the equipment.
Powered Exhaust/Powered Return Air Fans	A powered exhaust fan is a fan that transfers directly to the outside a portion of the building air that is returning to the unit, rather than allowing it to recirculate to the indoor coil and back to the building. A powered return fan is a fan that draws building air into the equipment.
Sound Traps/Sound Attenuators	An assembly of structures through which the supply air passes before leaving the equipment or through which the return air from the building passes immediately after entering the equipment for which the sound insertion loss is at least 6 dB for the 125 Hz octave band frequency range.
Process Heat Recovery/Reclaim Coils/Thermal Storage.	A heat exchanger located inside the unit that conditions the equipment's supply air using energy transferred from an external source using a vapor, gas, or liquid.
Indirect/Direct Evaporative Cooling of Ventilation Air.	Water is used indirectly or directly to cool ventilation air. In a direct system the water is introduced directly into the ventilation air and in an indirect system the water is evaporated in secondary air stream and the heat is removed through a heat exchanger.
Condenser Pumps/Valves/Fittings	Additional components in the water circuit for water control or filtering.
Condenser Water Reheat	A heat exchanger located downstream of the indoor coil that heats the supply air during cooling operation using water from the condenser coil in order to increase the ratio of moisture removal to cooling capacity provided by the equipment.
Grill Options	Special grills used to direct airflow in unique applications (such as up and away from a rear wall).
Non-Standard Indoor Fan Motors	The standard indoor fan motor is the motor specified in the manufacturer's installation instructions for testing and shall be distributed in commerce as part of a particular model. A non-standard motor is an indoor fan motor that is not the standard indoor fan motor and that is distributed in commerce as part of an individual model within the same basic model. For a non-standard indoor fan motor(s) to be considered a specific component for a basic model (and thus subject to the provisions of (a)(3)(ii)(A)(*2*) of this section), the following provisions must be met: Non-standard indoor fan motor(s) must meet the minimum allowable efficiency determined per Section D4.1 of AHRI 340/360–2022 (incorporated by reference, see § 429.4) (i.e., for non-standard indoor fan motors) or per Section D4.2 of AHRI 340/360–2022 for non-standard indoor integrated fan and motor combinations). If the standard indoor fan motor can vary fan speed through control system adjustment of motor speed, all non-standard indoor fan motors must also allow speed control (including with the use of a variable-frequency drive).

(B) The represented value of cooling capacity must be between 95 percent and 100 percent of the mean of the cooling capacities measured for the units in the sample selected as described in paragraph (a)(1)(ii) of this section, or between 95 percent and 100 percent of the cooling capacity output simulated by the AEDM as described in paragraph (a)(2) of this section.

* * * * *

■ 4. Amend § 429.134 by adding paragraph (t) to read as follows:

§ 429.134 Product-specific enforcement provisions.

* * * * *

(t) *Water-Source Heat Pumps.* The following provisions apply for assessment and enforcement testing of models subject to standards in terms of IEER.

(1) *Verification of Cooling Capacity.* The cooling capacity of each tested unit of the basic model will be measured pursuant to the test requirements of appendix C1 to subpart F of 10 CFR part 431. The mean of the measurements will be used to determine the applicable standards for purposes of compliance.

(2) *Specific Components.* If a basic model includes individual models with components listed at table 1 to § 429.43(a)(3)(ii)(A) and DOE is not able to obtain an individual model with the least number (which could be zero) of those components within an otherwise comparable model group (as defined in § 429.43(a)(3)(ii)(A)(*1*)), DOE may test any individual model within the otherwise comparable model group.

(3) *Approach for Determining IEER.* If the manufacturer specifies that they used ''Option 2'' as described in section 5.1.2 of appendix C1 (*i.e.,* using interpolation and extrapolation to determine performance at IEER entering water temperatures), DOE will assess compliance for the basic model based on testing in accordance with ''Option 2'' as described in section 5.1.2 of appendix C1. If the manufacturer does not specify that they used ''Option 2'' as described in section 5.1.2 of appendix C1, DOE will assess compliance for IEER for the basic model based on testing in accordance ''Option 1'' as described in section 5.1.1 of appendix C1.

PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 5. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 6. Amend § 431.92 by revising the definition for ''Water-source heat pump'' to read as follows:

§ 431.92 Definitions concerning commercial air conditioners and heat pumps.

* * * * *

Water-source heat pump means commercial package air-conditioning and heating equipment that is a single-phase or three-phase reverse-cycle heat pump that uses a circulating water loop as the heat source for heating and as the heat sink for cooling. The main components are a compressor, refrigerant-to-water heat exchanger, refrigerant-to-air heat exchanger, refrigerant expansion devices, refrigerant reversing valve, and indoor fan (except that coil-only units do not include an indoor fan). Such equipment includes, but is not limited to, water-to-air water-loop heat pumps.

■ 7. Amend § 431.95 by:

■ a. Redesignating paragraphs (b)(4) through (b)(7) as paragraphs (b)(5) through (b)(8);

■ b. Adding new paragraph (b)(4);

■ c. Revising paragraphs (c)(2);

■ d. Redesignating paragraphs (c)(3) through (7) as paragraphs (c)(5) through (8);

■ e. Adding new paragraph (c)(3);

■ f. In the introductory text to (d), remove the text ''http://''; and

■ g. Revise paragraph (d)(1).

The additions and revisions read as follows:

§ 431.95 Materials incorporated by reference.

* * * * *

(b) * * *

(4) AHRI Standard 340/360–2022 (I–P) (''AHRI 340/360–2022''), *2022 Standard for Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment,* AHRI-approved January 26, 2022: IBR approved for appendix C1 to this subpart.

* * * * *

(c) * * *

(2) ANSI/ASHRAE Standard 37–2009 (''ANSI/ASHRAE 37–2009''), *Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment,* ASHRAE approved June 24, 2009; IBR approved -for § 431.96 and appendices A, B, and C1 to this subpart.

(3) ASHRAE errata sheet to ANSI/ASHRAE Standard 37–2009 (''ASHRAE 37–2009 TE''), issued March 27, 2019; IBR approved -for appendix C1 to this subpart.

* * * * *

(d) * * *

(1) ISO Standard 13256–1 (''ISO Standard 13256–1:1998''), ''Water-source heat pumps—Testing and rating for performance—Part 1: Water-to-air and brine-to-air heat pumps,'' approved 1998, IBR approved for appendix C to this subpart.

* * * * *

■ 8. Amend § 431.96 by revising paragraph (b)(1) and table 1 to paragraph (b) to read as follows:

§ 431.96 Uniform test method for the measurement of energy efficiency of commercial air conditioners and heat pumps.

* * * * *

(b) * * * (1) Determine the energy efficiency and capacity of each category of covered equipment by conducting the test procedure(s) listed in table 1 to this paragraph (b) along with any additional testing provisions set forth in paragraphs (c) through (g) of this section and appendices A through C1 to this subpart, that apply to the energy efficiency descriptor for that equipment, category, and cooling capacity. The omitted sections of the test procedures listed in table 1 to this paragraph (b) must not be used.

* * * * *

TABLE 1 TO PARAGRAPH (b)—TEST PROCEDURES FOR COMMERCIAL AIR CONDITIONERS AND HEAT PUMPS

Equipment type	Category	Cooling capacity or moisture removal capacity [2]	Energy efficiency descriptor	Use tests, conditions, and procedures [1] in	Additional test procedure provisions as indicated in the listed paragraphs of this section
Small Commercial Package Air-Conditioning and Heating Equipment.	Air-Cooled, 3-Phase, AC and HP.	<65,000 Btu/h	SEER and HSPF	AHRI 210/240–2008 (omit section 6.5).	Paragraphs (c) and (e).
	Air-Cooled AC and HP.	≥65,000 Btu/h and <135,000 Btu/h.	EER, IEER, and COP	Appendix A to this subpart.	None.
	Water-Cooled and Evaporatively-Cooled AC.	<65,000 Btu/h	EER	AHRI 210/240–2008 (omit section 6.5).	Paragraphs (c) and (e).
		≥65,000 Btu/h and <135,000 Btu/h.	EER	AHRI 340/360–2007 (omit section 6.3).	Paragraphs (c) and (e).
	Water-Source HP	<135,000 Btu/h	EER and COP	Appendix C to this subpart[3].	None.
	Water-Source HP	<135,000 Btu/h	IEER and COP	Appendix C1 to this subpart[3].	None.
Large Commercial Package Air-Conditioning and Heating Equipment.	Air-Cooled AC and HP.	≥135,000 Btu/h and <240,000 Btu/h.	EER, IEER and COP	Appendix A to this subpart.	None.
	Water-Cooled and Evaporatively-Cooled AC.	≥135,000 Btu/h and <240,000 Btu/h.	EER	AHRI 340/360–2007 (omit section 6.3).	Paragraphs (c) and (e).
	Water-Source HP	≥135,000 Btu/h and <240,000 Btu/h.	EER and COP	Appendix C to this subpart[3].	None.
	Water-Source HP	≥135,000 Btu/h and <240,000 Btu/h.	IEER and COP	Appendix C1 to this subpart[3].	None.
Very Large Commercial Package Air-Conditioning and Heating Equipment.	Air-Cooled AC and HP.	≥240,000 Btu/h and <760,000 Btu/h.	EER, IEER and COP	Appendix A to this subpart.	None.

TABLE 1 TO PARAGRAPH (b)—TEST PROCEDURES FOR COMMERCIAL AIR CONDITIONERS AND HEAT PUMPS—Continued

Equipment type	Category	Cooling capacity or moisture removal capacity [2]	Energy efficiency descriptor	Use tests, conditions, and procedures [1] in	Additional test procedure provisions as indicated in the listed paragraphs of this section
	Water-Cooled and Evaporatively-Cooled AC.	≥240,000 Btu/h and <760,000 Btu/h.	EER	AHRI 340/360–2007 (omit section 6.3).	Paragraphs (c) and (e).
	Water-Source HP	≥240,000 Btu/h and <760,000 Btu/h.	EER and COP	Appendix C to this subpart[3].	None.
	Water-Source HP	≥240,000 Btu/h and <760,000 Btu/h.	IEER and COP	Appendix C1 to this subpart[3].	None.
Packaged Terminal Air Conditioners and Heat Pumps.	AC and HP	<760,000 Btu/h	EER and COP	Paragraph (g) of this section.	Paragraphs (c), (e), and (g).
Computer Room Air Conditioners.	AC	<65,000 Btu/h	SCOP	ASHRAE 127–2007 (omit section 5.11).	Paragraphs (c) and (e).
		≥65,000 Btu/h and <760,000 Btu/h.	SCOP	ASHRAE 127–2007 (omit section 5.11).	Paragraphs (c) and (e).
Variable Refrigerant Flow Multi-split Systems.	AC	<65,000 Btu/h (3-phase).	SEER	AHRI 1230–2010 (omit sections 5.1.2 and 6.6).	Paragraphs (c), (d), (e), and (f).
		≥65,000 Btu/h and <760,000 Btu/h.	EER	AHRI 1230–2010 (omit sections 5.1.2 and 6.6).	Paragraphs (c), (d), (e), and (f).
Variable Refrigerant Flow Multi-split Systems, Air-cooled.	HP	<65,000 Btu/h (3-phase).	SEER and HSPF	AHRI 1230–2010 (omit sections 5.1.2 and 6.6).	Paragraphs (c), (d), (e), and (f).
		≥65,000 Btu/h and <760,000 Btu/h.	EER and COP	AHRI 1230–2010 (omit sections 5.1.2 and 6.6).	Paragraphs (c), (d), (e), and (f).
Variable Refrigerant Flow Multi-split Systems, Water-source.	HP	<760,000 Btu/h	EER and COP	AHRI 1230–2010 (omit sections 5.1.2 and 6.6).	Paragraphs (c), (d), (e), and (f).
Single Package Vertical Air Conditioners and Single Package Vertical Heat Pumps.	AC and HP	<760,000 Btu/h	EER and COP	AHRI 390–2003 (omit section 6.4).	Paragraphs (c) and (e).
Direct Expansion-Dedicated Outdoor Air Systems.	All	<324 lbs. of moisture removal/hr.	ISMRE2 and ISCOP2	Appendix B to this subpart.	None.

[1] Incorporated by reference; see § 431.95.
[2] Moisture removal capacity is determined according to appendix B of this subpart.
[3] For equipment with multiple appendices listed in this table 1, consult the notes at the beginning of those appendices to determine the applicable appendix to use for testing.

* * * * *

■ 9. Add appendix C to subpart F of part 431 to read as follows:

Appendix C to Subpart F of Part 431—Uniform Test Method for Measuring the Energy Consumption of Water-Source Heat Pumps

Note: Manufacturers must use the results of testing under this appendix to determine compliance with the relevant standard at § 431.97 as that standard appeared in the January 1, 2022 edition of 10 CFR parts 200–499. Specifically, representations must be based on testing according to either this appendix or 10 CFR 431.96 as it appeared in the 10 CFR parts 200–499 edition revised as of January 1, 2022.

Starting on [*Date 360 days after publication of the final rule in the **Federal Register***], voluntary representations with respect to the energy efficiency ratio (EER) of water-source heat pumps with cooling capacity greater than or equal to 135,000 Btu/h and less than 760,000 Btu/h must be based on testing according to appendix C of this subpart. Manufacturers may also use appendix C to make voluntary representations with respect to EER prior to [*Date 360 days after publication of the final rule in the **Federal Register***].

Starting on [*Date 360 days after publication of the final rule in the **Federal Register***], voluntary representations with respect to the integrated energy efficiency ratio (IEER) of water-source heat pumps must be based on testing according to appendix C1 of this subpart. Manufacturers may also use appendix C1 to make voluntary representations with respect to IEER prior to [*Date 360 days after publication of the final rule in the **Federal Register***].

Starting on the compliance date for any amended energy conservation standards for water-source heat pumps based on IEER, any representations, including compliance certifications, made with respect to the energy use or energy efficiency of water-source heat pumps must be based on testing according to appendix C1 of this subpart.

Manufacturers may also to certify compliance with any amended energy conservation standards for water-source heat pumps based on IEER prior to the applicable compliance date for those standards, and those compliance certifications must be based on testing according to appendix C1 of this subpart.

1. Incorporation by Reference.

DOE incorporated by reference in § 431.95 the entire standard for ISO 13256–1:1998. To the extent there is a conflict between the terms or provisions of a referenced industry standard and this appendix, the appendix provisions control.

2. General.

Determine the energy efficiency ratio (EER) and coefficient of performance (COP) in accordance with ISO 13256–1:1998.

Section 3 of this appendix provides additional instructions for determining EER and COP.

3. Additional Provisions for Equipment Set-up. The only additional specifications that may be used in setting up the basic model for testing are those set forth in the installation and operation manual shipped with the unit. Each unit should be set up for test in accordance with the manufacturer installation and operation manuals. Sections 3.1 through 3.2 of this appendix provide specifications for addressing key information typically found in the installation and operation manuals.

3.1. If a manufacturer specifies a range of superheat, sub-cooling, and/or refrigerant pressure in its installation and operation manual for a given basic model, any value(s) within that range may be used to determine refrigerant charge or mass of refrigerant, unless the manufacturer clearly specifies a rating value in its installation and operation manual, in which case the specified rating value must be used.

3.2. The airflow rate used for testing must be that set forth in the installation and operation manuals being shipped to the commercial customer with the basic model and clearly identified as that used to generate the DOE performance ratings. If a rated airflow value for testing is not clearly identified, a value of 400 standard cubic feet per minute (scfm) per ton must be used.

■ 10. Add appendix C1 to subpart F of part 431 to read as follows:

Appendix C1 to Subpart F of Part 431—Uniform Test Method for Measuring the Energy Consumption of Water-Source Heat Pumps

Note: Prior to the compliance date of amended standards for water-source heat pumps that rely on integrated energy efficiency ratio (IEER) published after January 1, 2022, representations with respect to the energy use or energy efficiency of water-source heat pumps, including compliance certifications, must be based on energy efficiency ratio (EER) testing according to this appendix C of this subpart.

Starting on [*Date 360 days after publication of the final rule in the* ***Federal Register***], voluntary representations with respect to the IEER of water-source heat pumps must be based on testing according to this appendix. Manufacturers may also use this appendix C1 to make voluntary representations with respect to IEER prior to [*Date 360 days after publication of the final rule in the* ***Federal Register***].

Starting on the compliance date for any amended energy conservation standards for water-source heat pumps based on IEER, any representations, including compliance certifications, made with respect to the energy use or energy efficiency of water-source heat pumps must be based on testing according to this appendix.

Manufacturers may also certify compliance with any amended energy conservation standards for water-source heat pumps based on IEER prior to the applicable compliance date for those standards, and those compliance certifications must be based on testing according to this appendix.

1. Incorporation by Reference.

DOE incorporated by reference in § 431.95 the entire standard for AHRI 340/360–2022 and ANSI/ASHRAE 37–2009 (which includes ASHRAE 37–2009 TE). However, only certain enumerated provisions of AHRI 340/360–2022 are applicable, while the enumerated provisions of ANSI/ASHRAE 37–2009 are inapplicable as set out in this section 1. To the extent there is a conflict between the terms or provisions of a referenced industry standard and this appendix, the appendix provisions control, followed by AHRI 340/360–2022, followed by ANSI/ASHRAE 37–2009.

1.1. Applicable provisions.

1.1.1. AHRI 340/360–2022:

(a) Section 3 Definitions, except the following subsections: 3.2 (Basic Model), 3.4 (Commercial and Industrial Unitary Air-conditioning Equipment), 3.5 (Commercial and Industrial Unitary Heat Pump), 3.7 (Double-duct System), 3.8 (Energy Efficiency Ratio), 3.12 (Heating Coefficient of Performance), 3.14 (Integrated Energy Efficiency Ratio), 3.15 (Indoor Single Package Air-conditioners), 3.17 (Makeup Water), 3.23 (Published Rating), 3.26 (Single Package Air-Conditioners), 3.27 (Single Package Heat Pumps), 3.29 (Split System Air-conditioners), 3.30 (Split System Heat Pump), and 3.36 (Year Round Single Package Air-conditioners);

(b) Section 5 Test Requirements;

(c) Section 6 Rating Requirements, except the following subsections: 6.1.1.7, 6.1.2.1 (Values of Standard Capacity Ratings), 6.1.3.4.5, 6.1.3.5.4 (Heating Test for MZVAV Units), 6.1.3.5.5 (Part-Load Cooling Tests for MZVAV Units), 6.5 (Ratings), 6.6 (Uncertainty), and 6.7 (Verification Testing);

(d) Appendix A References—Normative;

(e) Appendix C Indoor and Outdoor Air Condition Measurement—Normative; and

(f) Appendix E Method of Testing Unitary Air Conditioning Products—Normative.

1.1.2. [Reserved]

1.2. Inapplicable provisions.

1.2.1. ANSI/ASHRAE 37–2009

(a) Section 1 Purpose, as specified in section 2.2 of this appendix;

(b) Section 2 Scope, as specified in section 2.2 of this appendix; and

(c) Section 4 Classification, as specified in section 2.2 of this appendix.

1.2.2. [Reserved]

2. General.

Determine integrated energy efficiency ratio (IEER) and heating coefficient of performance (COP) in accordance with AHRI 340/360–2022 and ANSI/ASHRAE 37–2009; however, only the following enumerated provisions of AHRI 340/360–2022 are applicable, as set forth in section 2.1 of this appendix. All sections of ANSI/ASHRAE 37–2009 are applicable with the exception of provisions listed in section 2.2 of this appendix.

Sections 2 through 7 of this appendix provide additional instructions for testing. In cases where there is a conflict, the language of this appendix takes highest precedence, followed by AHRI 340/360–2022, followed by ANSI/ASHRAE 37–2009. Any subsequent amendment to a referenced document by the standard-setting organization will not affect the test procedure in this appendix, unless and until the test procedure is amended by DOE. Material is incorporated as it exists on the date of the approval, and a notice of any change in the incorporation will be published in the **Federal Register**.

2.1. Test requirements and test conditions specified for water-cooled equipment in AHRI 340/360–2022 and ANSI/ASHRAE 37–2009 are applicable to water-source heat pumps.

2.2. For units without integral fans, use test requirements and test conditions specified as ''coil-only'' in AHRI 340/360–2022 and ANSI/ASHRAE 37–2009.

2.3. When using the Outdoor Liquid Coil Method, when calculating the total heating capacity, use the ASHRAE 37–2009 TE heating capacity formula for section 7.6.5.1 of ANSI/ASHRAE 37–2009.

3. Airflow and External Static Pressure.

3.1. Non-Ducted Units.

These provisions apply to units that are not configured exclusively for delivery of conditioned air to the indoor space without a duct(s).

3.1.1. Target Airflow and ESP.

Determine the target airflow in accordance with Section 6.1.3.4 of AHRI 340/360–2022, using an external static pressure (ESP) of 0.00 in H_2O in place of the ESP specified in Section 6.1.3.3 of AHRI 340/360–2022. Exclude Section 6.1.3.3 of AHRI 340/360–2022.

3.1.2. Airflow and ESP Tolerances and Set-Up.

Exclude Section 6.1.3.5 of AHRI 340/360–2022, and use the provisions in this section for indoor external static pressure and airflow set-up. For each test, set indoor airflow while operating the unit at the rating conditions specified for the test. After setting the airflow, no adjustments may be made to the fan control settings during the test.

3.1.2.1. Tolerances.

All tolerances for airflow and ESP specified in section 3.1.2 of this appendix for setting airflow and ESP are condition tolerances that apply for each test. Specifically, the average value of a parameter measured over the course of the test shall vary from the target value by no more than the condition tolerance. Operating tolerances for ESP and nozzle pressure drop are specified in Table 11 of AHRI 340/360–2022.

3.1.2.2. Use the manufacturer-specified fan control settings for all tests for which they are provided. Use the full-load cooling fan control settings specified by the manufacturer for all tests for which fan control settings are not specified. If there are no manufacturer-specified fan control settings for any tests, use the as-shipped fan control settings for all tests.

3.1.2.3. For all tests, conduct the test at 0.00 in H2O with a condition tolerance of −0/+0.05 in H2O.

3.1.2.4. For heating tests and part-load cooling tests for which there is no manufacturer-specified airflow and the cooling full-load rated indoor airflow is not used as the airflow for the test because there are manufacturer-specified fan control settings or other instructions used to obtain steady-state operation for the test, per the provisions of Section 6.1.3.4 of AHRI 340/360–2022, there is no airflow condition tolerance for that test. For all other tests, the airflow condition tolerance is ±3% of the target airflow determined in section 3.1.1 of this appendix.

3.1.2.5. If both the ESP and airflow cannot be simultaneously maintained within tolerance for any test, maintain the ESP within the required tolerance and use an airflow as close to the manufacturer-specified value as possible. The average airflow rate measured over the course of the test shall be within ±3% of the airflow rate measured after setting airflow for the test.

3.1.2.6. If section 3.1.2.5 of this appendix is used to set the full-load cooling airflow, use the measured full-load cooling airflow as the target airflow for all subsequent tests that call for the full-load cooling airflow.

3.2. Ducted Units.

These provisions apply to units that are configured for delivery of conditioned air to the indoor space with a duct(s).

3.2.1. For units with continuously variable-speed fans, set airflow and external static pressure in accordance with Sections 6.1.3.3, 6.1.3.4, and 6.1.3.5 of AHRI 340/360–2022.

3.2.2. For units without continuously variable-speed fans, set airflow and external static pressure in accordance with Sections 6.1.3.3., 6.1.3.4., and 6.1.3.5 of AHRI 340/360–2022, except use section 3.2.2.1 of this appendix in place of Sections 6.1.3.5.2.4 and 6.1.3.5.3.2.3 of AHRI 340/360–2022.

3.2.2.1. For two adjacent fan control settings, if both airflow and ESP tolerances cannot be met, (*e.g.,* decreasing fan speed when the ESP or airflow are too high causes the ESP or airflow to be lower than the tolerance range, and increasing fan speed when the ESP or airflow are too low causes the ESP or airflow to be higher than the tolerance range), operate at the lower fan control setting, adjust the airflow measuring apparatus to maintain the ESP within −0.00/+0.05 in H2O of the requirement determined in Section 6.1.3.3 of AHRI 340/360–2022, and maintain the airflow at a rate no lower than 90% of the airflow rate determined in Section 6.1.3.3 of AHRI 340/360–2022. If increasing ESP to within −0.00/+0.05 in H2O of the requirement determined in Section 6.1.3.3 of AHRI 340/360–2022 reduces airflow of the unit under test to less than 90% of the manufacturer-specified airflow, then the next higher fan control setting shall be utilized to obtain rated airflow. Using this higher fan control setting, maintain airflow within tolerance and maintain the ESP as close as possible to the value determined in Section 6.1.3.3 of AHRI 340/360–2022.

4. Test Liquid, Liquid ESP, and Pump Effect.

4.1. The test liquid for all tests other than the optional HFL3 low-temperature heating test specified in Table 9 of this appendix must be water unless the manufacturer specifies to use a brine of 15% solution by mass of sodium chloride in water. The test liquid for the optional HFL3 low-temperature heating test must be a brine of 15% solution by mass of sodium chloride in water.

4.2. For units with an integral pump, set the external static pressure to 20 ft of water column, with a −0/+1 ft condition tolerance and a 1 ft operating tolerance.

4.3. For units without an integral pump, when calculating EER and COP, an addition for the pump effect, PE, must be added to the unit's measured power and determined using Equation 1 of this appendix. Use this adder in place of Section 6.1.1.7 of AHRI 340/360−2022.

Equation 1

$$\mathbf{PE} = \mathbf{WF} * \left((\mathbf{PP_B} * \Delta\mathbf{P}) + \mathbf{C} \right)$$

Where:

PE = Pump effect, W
WF = Liquid flow rate, gpm
PP_B = Basic Pumping Penalty (Table 1), W/(gpm*psi)
ΔP = Pressure drop measured across liquid heat exchanger, psi
C = 25 W/gpm based on 20 ft external head

TABLE 1—BASIC PUMPING PENALTY (PP_B) VS. LIQUID FLOW RATE (WF)

Liquid flow rate (WF), gpm	Basic pumping penalty (PP_B), W/(gpm*psi)
1.0–4.0	5.00
4.1–7.9	3.88
8.0–11.9	2.69
12.0–15.9	2.32
16.0–19.9	2.14
20.0 and above	2.02

4.4. Condenser section power (PCD) in Equation 4 of AHRI 340/360–2022 must be determined as follows (instead of determining via Section 6.2.3.2 of AHRI 340/360–2022):

4.4.1. For units with an integral pump, PCD is equal to the measured pump power.

4.4.2. For units without an integral pump, PCD is equal to the pump effect determined per section 4.3 of this appendix.

5. Cooling Rating.

5.1. Methods for Determining IEER.

Determine the integrated energy efficiency ratio (IEER) using one of two options, as described in the following sections 5.1.1 and 5.1.2 of this appendix.

5.1.1. Option 1: Determine IEER in Accordance with Section 6.2 of AHRI 340/360–2022.

Test at the four IEER inlet water temperatures specified for water-cooled equipment in Table 9 of AHRI 340/36–2022, and perform all tests according to sections 2 through 4 and section 7 of this appendix.

Except as adjusted for operation at low condenser temperatures per Section E7 of AHRI 340/360–2022, for part-load cooling tests, use manufacturer-specified liquid flow rates. For all part-load cooling tests, the liquid flow rate shall not exceed the liquid flow rate used for the cooling full-load tests. If the manufacturer-specified part-load cooling liquid flow rate is higher than the liquid flow rate used for the cooling full-load tests, use the liquid flow rate used for the cooling full-load tests. If no manufacturer-specified value for part-load cooling liquid flow rate is provided, use the liquid flow rate used for the cooling full-load tests. The condition tolerance on liquid flow rate in part-load tests is 1% of the target liquid flow rate.

5.1.2. Option 2: Determine IEER by Interpolation and Extrapolation.

Test at the inlet water temperatures described in Tables 2 and 3 of this appendix, then interpolate and extrapolate to the IEER inlet water temperatures specified in Table 4 of this appendix. Sections 5.1.2.1 through 5.1.2.6 of this appendix specify the steps required to determine IEER using Option 2.

5.1.2.1. Measure Capacity at Option 2 Inlet Water Temperatures.

For all units, conduct full-load cooling tests at the inlet water temperatures as specified in section 5.1.2.1.1 of this appendix. For staged capacity controlled and proportionally controlled units, conduct part-load cooling tests at the inlet water temperatures as specified in section 5.1.2.1.2 of this appendix. Perform all tests according to provisions outlined in sections 2 through 4 and 7 of this appendix. No part-load cooling tests are required for fixed-capacity controlled units.

For all tests, measure the following values: cooling capacity; total power; compressor power; condenser section power; control circuit power and any auxiliary loads; and indoor fan power. Condenser section power must be determined in accordance with section 4.4.1 and 4.4.2 of this appendix.

5.1.2.1.1. Full-load Tests.

For all units, perform tests to determine full-load capacity at each of the conditions specified in Table 2 of this appendix. Follow all provisions for full-load cooling airflow in section 3 of this appendix.

The full-load cooling liquid flow rate shall be determined during the ''CFL3 high temperature'' test in Table 2 of this appendix, using fixed inlet and outlet water temperatures. For the ''CFL2 medium temperature'' and ''CFL1 low temperature'' tests in Table 2 of this appendix, use the liquid flow rate obtained during the ''CFL3 high temperature'' test in Table 2 of this appendix with a condition tolerance on liquid flow rate of 1% of the target liquid flow rate.

TABLE 2—IEER OPTION 2 FULL-LOAD TEST CONDITIONS

Test name	CFL3 high temperature	CFL2 medium temperature	CFL1 low temperature
Air entering indoor side:			
Dry bulb, °F	80.0	80.0	80.0

TABLE 2—IEER OPTION 2 FULL-LOAD TEST CONDITIONS—Continued

Test name	CFL3 high temperature	CFL2 medium temperature	CFL1 low temperature
Wet bulb, °F	67.0	67.0	67.0
Condenser liquid temperature:			
Entering, °F	86.0	77.0	59.0
Leaving, °F	96.0	See note 1	See note 1

Notes

1. All full-load tests must be conducted at the liquid flow rate as determined from the CFL3 high temperature cooling test.

Where:

CFL3 = The highest temperature Cooling Full-Load test at temperature conditions as defined in Table 2

CFL2 = The medium temperature Cooling Full-Load test at temperature conditions as defined in Table 2

CFL1 = The lowest temperature Cooling Full-Load test at temperature conditions as defined in Table 2

5.1.2.1.2. Part-load Tests.

For staged-capacity controlled units and proportionally controlled units, additionally perform tests to determine part-load capacity at each of the conditions specified in Table 3 of this appendix. Perform all part-load tests using the minimum compressor speed of the unit. Follow all provisions for part-load cooling airflow in section 3 of this appendix.

Except as adjusted for operation at low condenser temperatures per Section E7 of AHRI 340/360–2022, for part-load cooling tests, use manufacturer-specified liquid flow rates. For all part-load cooling tests, the liquid flow rate shall not exceed the liquid flow rate used for the cooling full-load tests. If the manufacturer-specified part-load cooling liquid flow rate is higher than the liquid flow rate used for the cooling full-load tests, use the liquid flow rate used for the cooling full-load tests. If no manufacturer-specified value for part-load cooling liquid flow rate is provided, use the liquid flow rate used for the cooling full-load tests. The condition tolerance on liquid flow rate is 1% of the target liquid flow rate.

TABLE 3—IEER OPTION 2 PART-LOAD TEST CONDITIONS

Test name	CPL3 high temperature	CPL2 medium temperature	CPL1 low temperature
Air entering indoor side:			
Dry bulb, °F	80.0	80.0	80.0
Wet bulb, °F	67.0	67.0	67.0
Condenser liquid temperature:			
Entering, °F	86.0	68.0	59.0

Where:

CPL3 = The highest temperature Cooling Part-Load test at temperature conditions as defined in Table 3

CPL2 = The medium temperature Cooling Part-Load test at temperature conditions as defined in Table 3

CPL1 = The lowest temperature Cooling Part-Load test at temperature conditions as defined in Table 3

5.1.2.2. Interpolate and Extrapolate Measurements to IEER Entering Liquid Temperatures.

Use sections 5.1.2.2.1 and 5.1.2.2.2 of this appendix to interpolate and extrapolate the values measured in section 5.1.2.1 of this appendix from the inlet water temperatures used in Tables 2 and 3 of this appendix to the IEER inlet water temperatures specified in Table 4 of this appendix.

TABLE 4—IEER CONDITIONS

IEER point	Capacity level	Percent load	Entering liquid temperature [°F]	Weighting factor [%]
A	Full	100	85.0	2.0
B	Part	75	73.5	61.7
C	Part	50	62.0	23.8
D	Part	25	55.0	12.5

5.1.2.2.1. Full Load.

For all units, calculate the full-load capacity and total power at IEER points A through D using Equation 2 of this appendix and the parameters outlined in Table 5 of this appendix.

For fixed-capacity control units, also calculate the full-load compressor power, condenser section power, control circuit power and any auxiliary loads, and indoor fan power at IEER points B through D using Equation 2 of this appendix and the parameters outlined in Table 5 of this appendix.

The interpolated value of each parameter is designated by V_{calc} in Equation 2 of this appendix.

Equation 2

$$V_{calc} = \frac{(T_{calc} - T_{low}) * (V_{high} - V_{low})}{T_{high} - T_{low}} + V_{low}$$

TABLE 5—FULL-LOAD INTERPOLATION INPUT VALUES

IEER point	T_{low} [°F]	T_{high} [°F]	T_{calc} [°F]	V_{low} [1]	V_{high} [1]
A	77.0	86.0	85.0	Value from CFL2 Medium Temperature.	Value from CFL3 High Temperature.
B	59.0	77.0	73.5	Value from CFL1 Low Temperature	Value from CFL2 Medium Temperature.
C	59.0	77.0	62.0	Value from CFL1 Low Temperature	Value from CFL2 Medium Temperature.
D	59.0	77.0	55.0	Value from CFL1 Low Temperature	Value from CFL2 Medium Temperature.

Notes

1. For each given measured value (*i.e.*, cooling capacity; total power; compressor power; condenser section power; control circuit power and any auxiliary loads; and indoor fan power), use the measured value from the specified test in Table 2 of this appendix.

5.1.2.2.2. Part Load.

For staged-capacity controlled and proportionally controlled units, calculate the part-load capacity, total power, compressor power, condenser section power, control circuit power and any auxiliary loads, and indoor fan power at IEER points B through D using Equation 2 of this appendix and the parameters outlined in Table 6 of this appendix. The interpolated value of each parameter is designated by V_{calc} in Equation 2 of this appendix.

TABLE 6—PART-LOAD INTERPOLATION INPUT VALUES

IEER point	T_{low} [°F]	T_{high} [°F]	T_{calc} [°F]	V_{low} [1]	V_{high} [1]
B	68.0	86.0	73.5	Value from CPL2 Medium Temperature.	Value from CPL3 High Temperature.
C	59.0	68.0	62.0	Value from CPL1 Low Temperature.	Value from CPL2 Medium Temperature
D	59.0	68.0	55.0	Value from CPL1 Low Temperature.	Value from CPL2 Medium Temperature

Notes:

[1] For each given measured value (*i.e.,* cooling capacity; total power; compressor power; condenser section power; control circuit power and any auxiliary loads; and indoor fan power), use the measured value from the specified test in Table 3 of this appendix.

5.1.2.3. Calculate Full-load and Part-load EERs at IEER Points.

For all units, calculate the full-load EER for each IEER point A through D of Table 5 as the ratio of the full-load capacity in Btu/h to the full-load total power in W determined in section 5.1.2.2.1 of this appendix.

For staged capacity controlled and proportionally controlled units, also calculate the part-load EER for each IEER point B through D of Table 5 as the ratio of the part-load capacity in Btu/h to the part-load total power in W determined in section 5.1.2.2.2 of this appendix.

5.1.2.4. Determine Tested Percent Load at IEER Points B Through D.

For all units, use Equation 3 to divide the interpolated full-load capacity values at IEER points B through D (determined in section 5.1.2.2.1 of this appendix) by the full-load capacity at IEER point A (determined in section 5.1.2.2.1 of this appendix).

For staged capacity control units and proportionally controlled units, use Equation 3 to divide the interpolated part-load capacity values at IEER points B through D (determined in section 5.1.2.2.2 of this appendix), by the full-load capacity at IEER point A (determined in section 5.1.2.2.1 of this appendix).

The values calculated at this stage are referred to as ''tested percent load'' in section 5.1.2.5 of this appendix.

Equation 3

$$PL_{Tested} = \frac{q_X}{q_{A,FL}} * 100$$

Where:

PL_{Tested} = The full-load or part-load tested percent load at a given IEER point

q_x = The full-load or part-load capacity at a given IEER point calculated in sections 5.1.2.2.1 and 5.1.2.2.2 of this appendix for IEER points B through D, Btu/h

$q_{A,\ FL}$ = The full-load capacity calculated in section 5.1.2.2.1 of this appendix for IEER point A, Btu/h

5.1.2.5. Determine EER at the IEER Load Level for IEER Points B Through D.

For each of the IEER points B through D of Table 5, determine the EER at the IEER percent load specified in Table 4 of this appendix (*i.e.,* 75, 50, or 25). For each IEER point B through D of Table 5, if the full-load or part-load tested percent load calculated in section 5.1.2.4 of this appendix is within the allowed range specified in Table 7 of this appendix, use the corresponding EER determined in section 5.1.2.3 of this appendix as the EER for the IEER point. In all other cases, the EER must be determined by adjustments as described in sections 0 and 5.1.2.5.2 of this appendix.

TABLE 7—TOLERANCE ON CAPACITY PERCENTAGE

IEER point	Target percent load	Minimum allowable tested percent load	Maximum allowable tested percent load
B	75	72	78
C	50	47	53
D	25	22	28

5.1.2.5.1. Fixed-capacity Control Units.

For fixed-capacity control units, perform all adjustments of EER values by cyclic degradation of the full-load EERs to account for the impact of the compressor cycling to meet a load. Perform the adjustments as specified in section 5.1.2.5.4 of this appendix.

5.1.2.5.2. Staged Capacity Control Units and Proportionally Controlled Units.

For IEER points B through D of Table 5, if the part-load tested percent load calculated in section 5.1.2.4 of this appendix is below the minimum allowable tested percent load in Table 7 of this appendix, calculate EER for this IEER point by interpolating between the full-load EER and part-load EER as specified in section 5.1.2.5.3 of this appendix. If the part-load tested percent load calculated in section 5.1.2.4 of this appendix is above the maximum allowable tested percent load in Table 7 of this appendix, calculate EER for this point using the cyclic degradation adjustment in section 5.1.2.5.4 of this appendix.

5.1.2.5.3. Calculate EER by Interpolation Between Full Load and Part Load.

Calculate EER at a single IEER point by interpolating between the full-load tested percent load and the part-load tested percent load calculated in section 5.1.2.4 of this appendix to the IEER point load percentage specified in Table 4 of this appendix, as shown in Equation 4 of this appendix.

Equation 4

$$EER = \frac{(PL_{Target} - PL_{Tested,PL}) * (EER_{FL} - EER_{PL})}{(PL_{Tested,FL} - PL_{Tested,PL})} + EER_{PL}$$

Where:

PL_{Target} = The IEER load fraction at the desired rating condition from Table 4 of this appendix, represented as a percentage (*i.e.,* 75, 50, or 25)

$PL_{Tested,PL}$ = The part-load tested percent load at the desired rating condition calculated in section 5.1.2.4 of this appendix

$PL_{Tested,FL}$ = The full-load tested percent load at the desired rating condition calculated in section 5.1.2.4 of this appendix

EER_{PL} = The part-load EER calculated in section 5.1.2.3 of this appendix

EER_{FL} = The full-load EER calculated in section 5.1.2.3 of this appendix

5.1.2.5.4. Calculate EER by Cyclic Degradation.

For fixed capacity control units, adjust the full-load EER at a single IEER point for cyclic degradation by using Equation 5 through Equation 7 of this appendix with values calculated for full load in section 5.1.2.2.1 of this appendix.

For staged capacity control and proportionally controlled units, adjust the part-load EER at a single IEER point for cyclic degradation by using Equation 5 through Equation 7 of this appendix with values calculated for part load in section 5.1.2.2.2 of this appendix.

Equation 5

$$EER = \frac{LF * q_x}{LF * [(C_D * (P_C + P_{CD})] + P_{IF} + P_{CT}}$$

Equation 6

$$C_D = 1.13 - 0.13 * LF$$

Equation 7

$$LF = \frac{PL_{Target}}{PL_{Tested}}$$

Where:

PL_{Tested} = The tested percent load calculated in section 5.1.2.4 of this appendix

PL_{Target} = The IEER percentage of full load from Table 4 of this appendix, represented as a percentage (*i.e.,* 75, 50, or 25)

P_C = Compressor power at a given IEER point calculated in section 5.1.2.2 of this appendix for IEER points B through D, W

P_{CD} = Condenser Section power, including the total pumping effect calculated in section 4.3 of this appendix, at a given IEER point calculated in section 5.1.2.2 of this appendix for IEER points B through D, W

P_{CT} = Control circuit power and any auxiliary loads at a given IEER point calculated in section 5.1.2.2 of this appendix for IEER points B through D, W

P_{IF} = Indoor fan power at a given IEER point calculated in section 5.1.2.2 of this appendix for IEER points B through D, W

q_x = The full-load or part-load capacity at a given IEER point calculated in section 5.1.2.2 of this appendix for IEER points B through D, Btu/h

5.1.2.6. Calculate IEER.

Use Equation 8 of this appendix to calculate IEER as a weighted mean of the EERs determined at each of the IEER points.

Equation 8

$$\mathbf{IEER} = (0.020 * \mathbf{EER_A}) + (0.617 * \mathbf{EER_B}) + (0.238 * \mathbf{EER_C}) + (0.125 * \mathbf{EER_D})$$

Where:

EER_A = Full-load EER at IEER point A determined in section 5.1.2.3 of this appendix.
EER_B = EER at IEER point B determined in section 5.1.2.5 of this appendix
EER_C = EER at IEER point C determined in section 5.1.2.5 of this appendix
EER_D = ≤EER at IEER point D determined in section 5.1.2.5 of this appendix

5.2. Optional Representations of EER.

Representations of EER at any full-load or part-load conditions, made using conditions specified in section 5.1.2.1.1 or 5.1.2.1.2 of this appendix and the provisions of sections 2 through 4 and 7 of this appendix are optional.

6. Heating Rating.

6.1. Liquid Flow Rate.

If IEER was determined using Option 1 in section 5.1 of this appendix, use the liquid flow rate determined from the ''Standard Rating Conditions Cooling'' test for water-cooled equipment as defined in Table 6 of AHRI 340/360–2022 for all heating tests. If IEER was determined using Option 2 in section 5.1 of this appendix, use the liquid flow rate determined from the CFL3 high temperature cooling test in section 5.1.2.1.1 of this appendix for all heating tests in Tables 8 and 9 of this appendix. The condition tolerance on liquid flow rate is 1%.

6.2. Methods for Determining COP.

Determine the COP using one of two options, as described in the following sections 6.2.1 and 6.2.2 of this appendix.

6.2.1. Option A: Determine COP by Testing at Conditions Specified in Table 8 of this Appendix.

Determine COP according to the applicable provisions in sections 2 through 4 and 7 of this appendix using the conditions in Table 8 of this appendix. Use the liquid flow rate specified in section 6.1 of this appendix.

TABLE 8—STANDARD HEATING RATING CONDITIONS

Test name	HFL0 rating temperature
Air entering indoor side	
Dry bulb, °F	70.0
Wet bulb, °F	60.0 (max)
Liquid temperature	
Entering, °F	55.0
Leaving, °F	See note 1

Notes

1. All heating tests must be conducted at the liquid flow rate specified in section 6.1 of this appendix.

Where:

HFL0 = The standard rating condition Heating Full-Load test as defined in Table 8

6.2.2. Option B: Determine COP by Interpolation.

Test at the HFL3 and HFL2 conditions in Table 9 of this appendix, then interpolate to the HFL0 inlet water temperature specified in Table 8 of this appendix. Sections 6.2.2.1 and 6.2.2.2 of this appendix specify the steps required to determine COP using Option B.

TABLE 9—OPTIONAL HEATING RATING CONDITIONS

Test name	HFL3 high temperature	HFL2 Medium temperature	HFL1 Low temperature
Air entering indoor side			
Dry bulb, °F	70.0	70.0	70.0
Wet bulb, °F	60.0 (max)	60.0 (max)	60.0 (max)
Liquid temperature			
Entering, °F	68.0	50.0	32.0
Leaving, °F	See note 1	See note 1	See note 1

Notes

1. All heating tests must be conducted at the liquid flow rate specified in section 6.1 of this appendix.

Where:

HFL3 = The highest temperature Heating Full-Load test at temperature conditions as defined in Table 9
HFL2 = The medium temperature Heating Full-Load test at temperature conditions as defined in Table 9
HFL1 = The lowest temperature Heating Full-Load test at temperature conditions as defined in Table 9

6.2.2.2. Measure Capacity and Total Power at Option B Inlet Water Temperatures.

Conduct heating tests at the HFL3 and HFL2 conditions specified in Table 9 of this appendix according to the applicable provisions in sections 2 through 4 and 7 of this appendix. The liquid flow rate must be set as defined in section 6.1 of this appendix. For all tests, measure heating capacity and total power.

6.2.2.3. Interpolate Measurements to COP Entering Liquid Temperature.

Interpolate the heating capacity and total power values measured in section 6.2.2.1 of this appendix from the inlet liquid temperatures used in section 6.2.2.1 of this appendix to the inlet liquid temperature specified in Table 8 of this appendix. Use Equation 9 of this appendix and the parameters outlined in Table 10 of this appendix. The interpolated value of each parameter is designated by V_{calc} in Equation 9 of this appendix.

Equation 9

$$\mathbf{V_{calc}} = \frac{(\mathbf{T_{calc}} - \mathbf{T_{low}}) * (\mathbf{V_{high}} - \mathbf{V_{low}})}{\mathbf{T_{high}} - \mathbf{T_{low}}} + \mathbf{V_{low}}$$

TABLE 10—HEATING INTERPOLATION INPUT VALUES

T_{low} [°F]	T_{high} [°F]	T_{calc} [°F]	V_{low} [1]	V_{high} [1]
50.0	68.0	55.0	Value from HFL2 Medium Temperature	Value from HFL3 High Temperature

Notes

1. For each given measured value (i.e., heating capacity in W and total power in W), use the measured value from the specified test in Table 9 of this appendix.

6.2.2.4. Calculate COP as the ratio of the interpolated heating capacity in W to the interpolated total power in W calculated in section 6.2.2.2 of this appendix.

6.3. Optional Representations of COP.

Representations of COP using the conditions specified in Table 9 of this appendix are optional and are determined according to the applicable provisions of sections 2 through 4 and 7 of this appendix. The liquid flow rate must be set as defined in section 6.1 of this appendix.

Representations of part-load COP using the conditions specified in Table 11 of this appendix are optional and are determined according to the applicable provisions of sections 2 through 4 and 7 of this appendix. For part-load heating tests, use manufacturer-specified liquid flow rates. For all part-load heating tests, the liquid flow rate shall not exceed the liquid flow rate defined in section 6.1 of this appendix. If the manufacturer-specified part-load heating liquid flow rate is higher than the liquid flow rate used for the cooling full-load tests, use the liquid flow rate used for the cooling full-load tests. If no manufacturer-specified value for part-load heating liquid flow rate is provided, use the liquid flow rate defined in section 6.1 of this appendix. The condition tolerance on liquid flow rate is 1%.

TABLE 11—OPTIONAL PART-LOAD HEATING CONDITIONS

Test name	HPL3 high temperature	HPL2 medium temperature	HPL1 low temperature
Air entering indoor side:			
Dry bulb, °F	70.0	70.0	70.0
Wet bulb, °F	60.0 (max)	60.0 (max)	60.0 (max)
Liquid temperature:			
Entering, °F	68.0	50.0	41.0

Where:

HPL3 = The highest temperature Heating Part-Load test at temperature conditions as defined in Table 11

HPL2 = The medium temperature Heating Part-Load test at temperature conditions as defined in Table 11

HPL1 = The lowest temperature Heating Part-Load test at temperature conditions as defined in Table 11

7. Set-Up and Test Provisions for Specific Components.

When testing a WSHP that includes any of the features listed in Table 12 of this appendix, test in accordance with the set-up and test provisions specified in Table 12 of this appendix.

TABLE 12—TEST PROVISIONS FOR SPECIFIC COMPONENTS

Component	Description	Test provisions
Desiccant Dehumidification Components.	An assembly that reduces the moisture content of the supply air through moisture transfer with solid or liquid desiccants.	Disable desiccant dehumidification components for testing.
Air Economizers	An automatic system that enables a cooling system to supply outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather.	For any air economizer that is factory-installed, place the economizer in the 100% return position and close and seal the outside air dampers for testing. For any modular air economizer shipped with the unit but not factory-installed, do not install the economizer for testing.
Fresh Air Dampers	An assembly with dampers and means to set the damper position in a closed and one open position to allow air to be drawn into the equipment when the indoor fan is operating.	For any fresh air dampers that are factory-installed, close and seal the dampers for testing. For any modular fresh air dampers shipped with the unit but not factory-installed, do not install the dampers for testing.
Power Correction Capacitors	A capacitor that increases the power factor measured at the line connection to the equipment.	Remove power correction capacitors for testing.
Ventilation Energy Recovery System (VERS).	An assembly that preconditions outdoor air entering the equipment through direct or indirect thermal and/or moisture exchange with the exhaust air, which is defined as the building air being exhausted to the outside from the equipment.	For any VERS that is factory-installed, place the VERS in the 100% return position and close and seal the outside air dampers and exhaust air dampers for testing, and do not energize any VERS subcomponents (*e.g.*, energy recovery wheel motors). For any VERS module shipped with the unit but not factory-installed, do not install the VERS for testing.

TABLE 12—TEST PROVISIONS FOR SPECIFIC COMPONENTS—Continued

Component	Description	Test provisions
Barometric Relief Dampers	An assembly with dampers and means to automatically set the damper position in a closed position and one or more open positions to allow venting directly to the outside a portion of the building air that is returning to the unit, rather than allowing it to recirculate to the indoor coil and back to the building.	For any barometric relief dampers that are factory-installed, close and seal the dampers for testing. For any modular barometric relief dampers shipped with the unit but not factory-installed, do not install the dampers for testing.
UV Lights	A lighting fixture and lamp mounted so that it shines light on the indoor coil, that emits ultraviolet light to inhibit growth of organisms on the indoor coil surfaces, the condensate drip pan, and/other locations within the equipment.	Turn off UV lights for testing.
Steam/Hydronic Heat Coils	Coils used to provide supplemental heating	Test with steam/hydronic heat coils in place but providing no heat.
Refrigerant Reheat	A heat exchanger located downstream of the indoor coil that heats the supply air during cooling operation using high-pressure refrigerant in order to increase the ratio of moisture removal to cooling capacity provided by the equipment.	De-activate refrigerant reheat coils for testing so as to provide the minimum (none if possible) reheat achievable by the system controls.
Fire/Smoke/Isolation Dampers	A damper assembly including means to open and close the damper mounted at the supply or return duct opening of the equipment.	For any fire/smoke/isolation dampers that are factory-installed, set the dampers in the fully open position for testing. For any modular fire/smoke/isolation dampers shipped with the unit but not factory-installed, do not install the dampers for testing.
Process Heat recovery/Reclaim Coils/Thermal Storage.	A heat exchanger located inside the unit that conditions the equipment's supply air using energy transferred from an external source using a vapor, gas, or liquid.	Disconnect the heat exchanger from its heat source for testing.

[FR Doc. 2022–17075 Filed 8–29–22; 8:45 am]

BILLING CODE 6450–01–P