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: Final rule.

SUMMARY: The U.S. Department of Energy (''DOE'') is amending its test procedure for water-source heat pumps to expand the scope of applicability of the test procedure, incorporate by reference a new industry consensus test standard for water-source heat pumps, adopt a seasonal cooling efficiency metric, and specify more representative test conditions used for measuring heating performance. DOE has determined that the amended test procedure will produce results that are more representative of an average use cycle and be more consistent with current industry practice without being unduly burdensome to conduct. Additionally, DOE is adopting provisions governing public representations of efficiency for this equipment.

DATES: The effective date of this rule is January 3, 2024. The amendments will be mandatory for product testing starting November 29, 2024.

The incorporation by reference of certain material listed in the rule is approved by the Director of the Federal Register on January 3, 2024.

ADDRESSES: The docket, which includes **Federal Register** notices, public meeting 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, not all documents listed in the index may be publicly available, such as those containing information that is exempt from public disclosure.

A link to the docket web page can be found at *www.regulations.gov/docket/EERE-2017-BT-TP-0029.* The docket web page contains instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket contact the Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

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SUPPLEMENTARY INFORMATION: DOE incorporates by reference the following material into 10 CFR parts 429 and 431:

AHRI Standard 600–2023 (I–P), *2023 Standard for Performance Rating of Water/Brine to Air Heat Pump Equipment,* approved September 11, 2023 (''AHRI 600–2023'').

ANSI/ASHRAE Standard 37–2009, *Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment,* ASHRAE-approved June 24, 2009 (''ANSI/ASHRAE 37–2009'').

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

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 (''ISO 13256–1:1998'').

Properties of Secondary Working Fluids for Indirect Systems, including Section 2.3 Errata Sheet, Melinder, published 2010 (''Melinder 2010'').

Copies of AHRI 600–2023 are available from the Air-Conditioning, Heating, and Refrigeration Institute (''AHRI''), 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, (703) 524–8800, or by going to *www.ahrinet.org.*

Copies of ANSI/ASHRAE 37–2009 and Errata sheet for ANSI/ASHRAE Standard 37–2009 are available from the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (''ASHRAE''), 180 Technology Parkway NW, Peachtree Corners, GA 30092, (404) 636–8400, or by going to *www.ashrae.org.* (ASHRAE standards are co-published with American National Standards Institute (''ANSI'')).

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: *www.iso.org/store.html.*

Copies of Melinder 2010 are available from the International Institute of Refrigeration (''IIR''), 177 Boulevard Malesherbes 75017 Paris, France; +33 (0)1 42 27 32 35; *www.iifiir.org.*

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

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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); 6313(a)(1)(G)–(I)) DOE's test procedure for WSHPs is currently prescribed at title 10 of the Code of Federal Regulations (''CFR'') part 431.96. The following sections discuss DOE's authority to establish and amend a test procedure for WSHPs and relevant background information regarding DOE's consideration of a test procedure for this equipment.

A. Authority

The Energy Policy and Conservation Act, Public Law 94–163, as amended (''EPCA''),[2] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part C of EPCA,[3] 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 WSHPs, the subject of this document. (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 include definitions (42 U.S.C. 6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), 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 other 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 42 U.S.C. 6316(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 a given type of covered equipment during a representative average use cycle (as determined by the Secretary) and requires that test procedures not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

EPCA requires that the test procedures for commercial package air conditioning and heating equipment 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 90.1, ''Energy Standard for Buildings Except Low-Rise Residential Buildings'' (''ASHRAE 90.1''). (42 U.S.C. 6314(a)(4)(A)) Further, if such an industry test procedure is amended, DOE must update 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 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))

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, the Secretary 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 arguments 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))

DOE undertook this rulemaking in satisfaction of the 7-year-lookback obligations under EPCA. (42 U.S.C. 6314(a)(1)). As discussed previously in this document, WSHPs are a category of commercial package air conditioning and heating equipment. EPCA requires the DOE test procedures for commercial package air conditioning and heating

[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 reflect 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.

equipment to be the generally accepted industry testing procedure developed or recognized by AHRI or by ASHRAE, as referenced in ASHRAE 90.1. (42 U.S.C. 6314(a)(4)(A)) EPCA further requires that each time the referenced industry test procedure is amended in ASHRAE 90.1, DOE must amend its test procedure to be consistent with the industry update, unless DOE determines in a rulemaking that there is clear and convincing evidence that the updated update 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)(C)) However, under the 7-year-lookback obligations, there is no ''clear and convincing evidence'' required in EPCA. Rather, EPCA only requires that DOE determine whether the amended test procedure would more accurately or fully comply with the requirements for the test procedure 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))

DOE is publishing this final rule in satisfaction of its statutory obligations under EPCA. (42 U.S.C. 6314(a)(1)(A))

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'').

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 setup at 10 CFR 431.96(e), which provide specifications for addressing key information typically found in the installation and operation manuals. 77 FR 28928, 28991.

On June 22, 2018, DOE published a request for information (''RFI'') to collect information and data to consider amendments to DOE's test procedure for WSHPs (''June 2018 RFI''). 83 FR 29048.[4] Subsequently, on August 30, 2022, DOE published a notice of proposed rulemaking (''NOPR'') in which DOE responded to stakeholders' comments on the June 2018 RFI and proposed amendments to its test procedure for WSHPs (''August 2022 NOPR'') 87 FR 53302. In the August 2022 NOPR, DOE proposed to amend the test procedures for WSHPs to 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''). *Id.* at 87 FR 53348. Specifically, DOE proposed to implement these changes by adding 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). *Id.* at 87 FR 53351–52252. 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. *Id.* at 87 FR 53352–53353. DOE held a public meeting on September 14, 2022 (''NOPR public meeting'') to present the key proposals from the August 2022 NOPR.

DOE received comments in response to the August 2022 NOPR from the interested parties listed in Table I.1.

TABLE I.1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE AUGUST 2022 NOPR

Commenter(s)	Reference in this final rule	Comment No. in the docket	Commenter type
Air-Conditioning, Heating and Refrigeration Institute	AHRI	24	Trade Association.
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy.	Joint Commenters	27	Efficiency Organizations.
Northwest Energy Efficiency Alliance	NEEA	25	Efficiency Organization.
New York State Energy Research and Development Authority.	NYSERDA	21	State Agency.
ClimateMaster, Inc	ClimateMaster	22	Manufacturer.
WaterFurnace International	WaterFurnace	20	Manufacturer.
Enertech Global, LLC	Enertech	19	Manufacturer.
Florida Heat Pump Manufacturing	FHP	26	Manufacturer.
The Geothermal Exchange Organization	GeoExchange	29	Trade Association.
Madison Indoor Air Quality	MIAQ	23	Manufacturer.
Trane Technologies	Trane	28	Manufacturer.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[5] In addition to the comments listed in Table I.1, DOE also received 2 comments from anonymous individuals, which were considered in the development of this final rule, but not cited individually. To the extent that interested parties have provided written comments that are substantively consistent with any oral comments provided during the NOPR public meeting, DOE cites the written comments throughout this final rule.

[4] An extension of the comment period for the June 2018 RFI was published 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 an amended test procedure 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).

Any oral comments provided during the webinar that are not substantively addressed by written comments are summarized and cited separately throughout this final rule.

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''). In January 2023, ASHRAE published ASHRAE 90.1–2022. ASHRAE 90.1–2022 did not update the referenced test procedure for WSHPs.[6]

On September 11, 2023, AHRI published a new industry test standard for WSHPs, titled AHRI Standard 600, ''Standard for Performance Rating of Water/Brine to Air Heat Pump Equipment'' (''AHRI 600–2023''). DOE worked with stakeholders (including WSHP manufacturers and efficiency advocates) as part of the AHRI Geothermal and WSHP standards technical committee (''STC'') to develop AHRI 600–2023, which addresses many of the issues in the current WSHP test procedure that DOE raised in the August 2022 NOPR. The intent of the Geothermal and WSHP STC was for AHRI 600–2023 to be used for testing WSHPs instead of any versions of ISO Standards 13256–1.

II. Synopsis of the Final Rule

In this final rule DOE is establishing new appendices C and C1 to subpart F of part 431. The current DOE test procedure for WSHPs is relocated to appendix C without change. The amended test procedure for WSHPs is established in a new appendix C1, which includes the following amended test procedure requirements for WSHPs for measuring the updated efficiency metrics: (1) integrated energy efficiency ratio (''IEER'') for WSHPs using AHRI 600–2023; and (2) applied coefficient of performance (''ACOP'') using AHRI 600–2023. Use of the amended test procedure in appendix C1 will not be required until such time as compliance is required with amended energy conservation standards for WSHPs denominated in terms of IEER, should DOE adopt such standards.

Additionally, DOE is expanding the scope of the test procedure to include WSHPs with capacities between 135,000 and 760,000 British thermal units per hour (''Btu/h''), as well as specifying the components that must be present for testing and amending certain provisions related to representations and enforcement in 10 CFR part 429.

As discussed in this final rule, DOE has concluded that the amended test procedure in appendix C1 (incorporating by reference the most recent industry consensus test standard for WSHPs, AHRI 600–2023) provides more representative results and more fully complies with the requirements of 42 U.S.C. 6314(a)(2) than testing with the current Federal test procedure (based on ISO 13256–1:1998).

The adopted amendments are summarized in Table II.1 and compared to the test procedure provisions in place prior to the amendment, as well as the reason for the adopted change.

TABLE II.1—SUMMARY OF CHANGES IN THE AMENDED TEST PROCEDURE

Current DOE test procedure	Amended test procedure	Attribution
Located in 10 CFR 431.96	Current test procedure moved to appendix C to 10 CFR 431.96 and amended test procedure established in appendix C1 to 10 CFR 431.96.	Readability of test procedure.
Scope is limited to units with a cooling capacity less than 135,000 Btu/h.	Expands the scope of the test procedure to additionally include units with a cooling capacity greater than or equal to 135,000 Btu/h and less than 760,000 Btu/h in 10 CFR 431.96.	Harmonize with scope of test procedure for water-cooled commercial unitary air conditioners.
Incorporates by reference ISO 13256–1:1998	Incorporates by reference AHRI 600–2023 into appendix C1.	Improve representativeness of test procedure.
Includes provisions for determining EER metric	Includes provisions for determining IEER by incorporating by reference AHRI 600–2023 into appendix C1.	Improve representativeness of test procedure.
Specifies test condition of 68 °F for measuring coefficient of performance (''COP'').	Changes the test condition for ACOP to 50 °F, by incorporating by reference AHRI 600–2023 into appendix C1.	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 for determining represented values.	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 IEER testing conducted by DOE.	Establish enforcement provisions for DOE testing of WSHPs.

DOE has determined that the test procedure in appendix C, as described in section III of this final rule regarding the establishment of appendix C, does not alter the measured efficiency of WSHPs or require retesting solely as a result of the establishment of appendix C. Additionally, DOE has determined that the establishment of appendix C will not increase the cost of testing.

DOE has determined that the amended test procedure adopted in appendix C1 does alter the measured efficiency of WSHPs and would increase the cost of testing relative to the current Federal test procedure, as discussed further in section III.I of this document. However, as stated, use of appendix C1 will not be required until the compliance date of any amended standards denominated in terms of IEER, should DOE adopt such standards. DOE has also determined that the amended test procedure will not be unduly burdensome to conduct.

For units with cooling capacity greater than or equal to 135,000 Btu/h and less than 760,000 Btu/h newly added within scope of the WSHP test procedure, testing according to the established test procedure for purposes of certifications of compliance will not

[6] ASHRAE 90.1–2022 lists ANSI/AHRI/ASHRAE 13256–1: 1998 (2021) as the test procedure for WSHPs. However, DOE believes ASHRAE intended to include ''2012'' in the parentheses as that was the most recent year in which the 1998 version of 13256–1 was redesignated.

be required until the compliance date of any energy conservation standards for such equipment, should DOE adopt such standards. However, if a manufacturer chooses to make representations of the energy efficiency or energy use of such equipment, beginning 360 days after publication of the final rule in the **Federal Register**, the manufacturer will be required to base such representations on the DOE test procedure. (42 U.S.C. 6314(d)(1))

The effective date for the amended test procedure adopted in this final rule is 30 days after publication of this document in the **Federal Register**. Discussion of DOE's actions are addressed in detail in section III of this document.

III. Discussion

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.

1. WSHPs With a Cooling Capacity Greater Than or Equal to 135,000 Btu/h

The current Federal WSHP 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 10 CFR 431.97, Table 3. In the August 2022 NOPR, DOE proposed 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. 87 FR 53302, 53307. Specifically, DOE proposed to update Table 1 to 10 CFR 431.96 to include WSHPs with a 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 a 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. *Id.* In the August 2022 NOPR, DOE tentatively determined that, 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, such testing would not be unduly burdensome. *Id.* at 87 FR 53306. Additionally, DOE stated that expanding the scope of DOE's test procedure for WSHPs to include equipment with a 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 capacity range are appropriately representative. *Id.* at 87 FR 53306–53307. DOE requested comments on the proposed expansion of the scope of applicability of the Federal test procedure to include WSHPs with a cooling capacity between 135,000 and 760,000 Btu/h. *Id.* at 87 FR 53307.

In response to the June 2022 NOPR, some commenters expressed concern with the proposal to expand the scope of the test procedure. AHRI commented that it is concerned with DOE's proposal to expand testing coverage and update test procedures without taking steps to measure the impact on manufacturers and third-party test labs. (AHRI, No. 24 at pp. 2–3) AHRI asserted that the August 2022 NOPR does not show evidence of DOE's participation in the critical consensus process required for developing test procedures and improving efficiency for ASHRAE 90.1, which involves conversations regarding lab capabilities, product availability, and product efficiencies. (*Id.*)

AHRI further commented that the impact on manufacturers of DOE's proposed test coverage expansion has not been quantified. (*Id.* at p. 3) AHRI stated that it expects third-party test labs will not be able to accommodate the expanded scope to include equipment up to 760,000 Btu/h, as such an expansion of scope would require test labs to increase their testing capacity from 3 gallons per minute (''GPM'') per ton (''GPM/ton'') at 50 °F to nearly 200 GPM. (*Id.*) AHRI commented that the additional constraints placed on test labs would cause delays in testing other equipment as well as WSHPs. (*Id.*)

Similarly, ClimateMaster opposed DOE's proposal to include WSHP equipment with capacities greater than 135,000 Btu/h within the scope of the test procedure due to the cost burden that ClimateMaster asserted would be imposed on manufacturers and consumers. (ClimateMaster, No. 22 at p. 2) ClimateMaster stated that these larger model sizes account for only 0.4 percent of its overall market volume from 2019 to 2021. (*Id.*) ClimateMaster presented data showing that adding the higher-capacity models to the scope of the test procedure would increase the certification cost by $184,000 per year to accommodate testing and equipment costs. (*Id.*) ClimateMaster further commented that third-party compliance labs are unable to test equipment above 420,000 Btu/h, which would render DOE's proposal to test WSHPs that reach 760,000 Btu/h impossible. (*Id.*) ClimateMaster noted that the increased cost burden needed to accommodate such a small percentage of affected equipment would negatively affect consumers as well as manufacturers. (*Id.*) ClimateMaster recommended that DOE maintain the scope of applicability of the Federal test procedure to only include WSHPs with cooling capacity below 135,000 Btu/h. (*Id.* at p. 3)

FHP commented that its main concern regarding DOE's proposal to expand the scope of applicability is lab availability. (FHP, No. 26 at p. 2) FHP stated that it has found only a limited supply of WSHP testing facilities, none of which have a capacity to test equipment over 480,000 Btu/h. (*Id.*) FHP recommended that DOE provide a list of testing facilities for WSHPs with a cooling capacity greater than 135,000 Btu/h, stating that multiple testing facilities must be available to ensure that an increased demand for large unit testing does not also cause spikes in testing costs due to supply and demand pressures. (*Id.*) FHP further commented that WSHPs with capacities above 135,000 Btu/h account for less than 1 percent of the market share. (*Id.*)

MIAQ commented that it is concerned DOE has not quantified the impact on manufacturers and third-party labs of expanding the scope of coverage to larger equipment. (MIAQ, No. 23 at p. 3) MIAQ stated that conversations regarding lab capabilities and product availability and efficiency occur during the consensus process required for developing test procedures in ASHRAE 90.1. (*Id.*) MIAQ stated that the water volume required for testing larger capacities up to 760,000 Btu/h may limit testing. (*Id.*) More specifically, MIAQ stated that testing a 760,000 Btu/h WSHP would require approximately 200 GPM of 50 °F water, which MIAQ stated would require large chillers to maintain the water at the correct temperature. (*Id.*) MIAQ also noted that due to the increased need for larger spaces capable of testing such equipment, there could be bottlenecks at third-party test labs, which also test other categories of commercial package air conditioning and heating equipment. (*Id.*)

WaterFurnace stated that there are no known WSHP products with a cooling capacity above approximately 360,000 Btu/h nor any test facilities capable of testing such WSHPs at the required conditions for IEER. (WaterFurnace, No. 20 at p. 6) WaterFurnace commented that DOE did not justify regulating this larger equipment and that doing so would be a burden on the industry and testing facilities. (*Id.*)

Other commenters supported the proposal to expand the scope of the WSHP test procedure. The Joint Commenters, NEEA, and NYSERDA supported DOE's proposal to include WSHPs with cooling capacities between 135,000 and 760,000 Btu/h in the scope of the test procedure. (Joint Commenters, No. 27 at p. 1; NEEA, No. 25 at p. 2; NYSERDA, No. 21 at p. 2) The Joint Commenters stated that they believe it is important that equipment in this capacity range be testing using a standardized test procedure and that expanding the scope of the test procedure would bring it into alignment with test procedures for other commercial package air-conditioning and heating equipment. (Joint Commenters, No. 27 at p. 1)

NEEA commented that, while this size range may account for relatively few annual sales, expanding the test procedure to larger capacity equipment would ensure that large equipment is fairly rated and regulated and held to the same standards as smaller equipment of the same type. (NEEA, No. 25 at p. 2)

NYSERDA asserted that expanding the scope is a feasible and necessary change to ensure that WSHPs of varying sizes are consistently tested according to industry standards, which will demonstrate to customers that WSHPs—especially geothermal WSHPs—are reliable and thus enable WSHP market growth. (NYSERDA, No. 21 at p. 2)

As discussed in the August 2022 NOPR, DOE has identified numerous model lines of WSHPs with a cooling capacity over 135,000 Btu/h from a wide variety of manufacturers. 87 FR 53302, 53306. The manufacturer literature for all identified model lines includes efficiency representations that are explicitly based on ISO 13256–1:1998, the current industry standard, indicating efficiency representations can be made for these models using an industry consensus test procedure for WSHPs. *Id.*

In response to comments from AHRI, Climate Master, and WaterFurnace, as discussed in the August 2022 NOPR, DOE is aware of several independent test labs that have the capability to test WSHPs with a cooling capacity over 135,000 Btu/h. *Id.* DOE conducted investigative testing on multiple WSHP models with a 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. *Id.* Regarding comments by ClimateMaster and FHP stating that test labs cannot test units greater than 420,000 Btu/h and 480,000 Btu/h, respectively, comments submitted by WaterFurnace indicate that the largest models currently available on the market are 360,000 Btu/h, which DOE research corroborates. As such, any capacity limitations for testing as asserted by ClimateMaster and FHP would not impact any models currently on the market.

Further, DOE notes that AHRI 600–2023 includes provisions for testing units with capacities over 135,000 Btu/h. Both ASHRAE 90.1 and DOE regulations cover other categories of commercial air conditioning and heating equipment, including water-cooled commercial unitary air conditioners (''WCUACs''), with a cooling capacity up to 760,000 Btu/h. As discussed in the August 2022 NOPR, DOE has determined that testing WSHPs with a cooling capacity over 135,000 Btu/h would be of comparable burden to testing other commercial air conditioning and heating equipment of similar capacity, such as WCUACs. *Id.*

Regarding comments on the potential burden of testing such units, EPCA does not require DOE to consider only burden-reducing options, but rather requires only that the test procedure must not be unduly burdensome to conduct. Expanding the scope of the test procedure to include larger equipment 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 require only that if manufacturers choose to make optional representations of efficiency for WSHPs with a cooling capacity over 135,000 Btu/h, that such optional representations be made in accordance with the DOE test procedure. Further, DOE notes that 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)). Based on DOE's observation of the prevalence of use of AEDMs for WSHP and similar equipment for which energy conservation standards currently apply (*i.e.,* for equipment with a cooling capacity no greater than 135,000 Btu/h), DOE expects that representations of efficiency could be determined through the use of AEDMs for the majority of models with a cooling capacity over 135,000 Btu/h. As such, DOE expects an expansion of scope for the DOE test procedure to include equipment with a cooling capacity over 135,000 Btu/h would not necessitate the testing of many such larger units. Therefore, testing would not be as burdensome as noted by commenters.

Based on the presence on the market of units over 135,000 Btu/h, the identification of laboratories capable of testing such units, DOE's observation that representations of efficiency for such equipment are currently being made, and the inclusion of units over 135,000 Btu/h within the scope of the most recent industry consensus test standard for WSHPs (AHRI 600–2023), DOE has determined that testing units with a cooling capacity over 135,000 Btu/h is feasible and would not be unduly burdensome. As discussed, expanding the scope of DOE's test procedure for WSHPs to include equipment with a 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 capacity range are appropriately representative.

For the reasons discussed in the proceeding paragraphs and in the August 2022 NOPR, DOE is expanding the scope of applicability of the WSHP test procedure to include WSHPs with a cooling capacity between 135,000 and 760,000 Btu/h consistent with the scope of AHRI 600–2023. Specifically, DOE is updating Table 1 to 10 CFR 431.96 to include WSHPs with a 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 a 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.

As previously discussed, DOE does not currently specify energy conservation standards for WSHPs with a 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 a 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. DOE notes, however, that beginning 360 days after this final rule publishes in the **Federal Register**, any voluntary representations with respect to energy use or efficiency must be based on the test procedure in appendix C, and any voluntary representations of IEER or ACOP must be based on the test procedure in appendix C1.

2. Representations for Residential Applications

Sections 6.5 and 6.6 of AHRI 600–2023 state that provisions for determination of residential cooling capacity and efficiency are to be added in a future revision. In the August 2022 NOPR, DOE proposed to allow optional energy efficiency ratio (''EER'') and COP representations at the full-load and part-load EWT conditions specified in Table 1 of ISO 13256–1:1998 per the DOE test procedure proposed in appendix C1. 87 FR 53302, 53313. DOE notes that the residential representations discussed in AHRI 600–2023 are separate from the proposed optional representations from the August 2022 NOPR, as test provisions in AHRI 600–2023 specify separate air and liquid external static pressures to be used during testing to develop ratings for residential applications. However, the residential representations have not yet been fully developed for WSHPs, as indicated in sections 6.5 and 6.6 of AHRI 600–2023. Therefore, DOE is not adding any provisions regarding residential representations in this final rule but will continue to work with the AHRI 600 committee to develop such provisions.

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). *See* 10 CFR 431.92.

To provide consistency with other definitions of specific categories of commercial package air-conditioning and heating equipment, DOE proposed in the August 2022 NOPR 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. 87 FR 53302, 53307. This proposed clarification to the ''water-source heat pump'' definition would not change the scope of equipment covered by the definition.

In addition, the current definition for WSHPs lists the main components of a WSHP and it includes ''indoor fan'' on that list. *See* 10 CFR 431.92. DOE discussed in the August 2022 NOPR that it has identified coil-only WSHPs on the market that rely on a separately installed furnace or modular blower for indoor air movement. 87 FR 53302, 53307. To clarify that coil-only WSHPs are covered under the WSHP definition, DOE proposed to amend the WSHP definition to make clear that an indoor fan is not an included component for coil-only WSHPs. *Id.* Specifically, DOE proposed 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 proposed WSHP definition. *Id.*

DOE requested comment 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. *Id.*

ClimateMaster generally agreed with DOE's proposed definition of WSHP, but requested clarity on what constitutes a commercial system. (ClimateMaster, No. 22 at p. 3) ClimateMaster commented that other industry test programs clearly demarcate the difference between systems through listed capacity. (*Id.*) ClimateMaster noted that the current definition includes only packaged systems but that DOE's proposed amendments in the August 2022 NOPR specified procedures for testing split systems. (*Id.*) ClimateMaster stated that it is not able to determine with the current definition what exact products would fall under the certification program and how DOE would enforce which products are covered by the applicable standards. (*Id.*) ClimateMaster also stated that there were non-reversible WSHP products that operate as either cooling only units or utilize a hydronic coil that are not covered by the current definition. ClimateMaster stated that provisions should be made for this equipment type. (*Id.*)

WaterFurnace questioned whether it would be necessary to change the definition of WSHP if DOE were to maintain the method of test based on ISO 13256 and AHRI 600. (WaterFurnace, No. 20 at p. 6) WaterFurnace recommended using the term ''heat pump'' in lieu of ''air conditioner and heating equipment,'' which WaterFurnace asserted is technically inaccurate. (*Id.*)

Regarding ClimateMaster's request for clarity regarding the definition, DOE notes that all products that meet the WSHP definition, with sizes less than 760,000 Btu/h cooling capacity (see discussion in section III.A of this final rule), would be considered a WSHP, regardless of whether the models are marketed and distributed in commerce for commercial or residential applications. The definition of WSHPs includes both single-package and split-system equipment.

Regarding WaterFurnace's comment on whether it would be necessary to change the definition of WSHP if DOE were to maintain the method of test based on ISO 13256 and AHRI 600, the DOE definition of WSHP serves to specify models that are within the scope of coverage of DOE's regulations and is independent of the test procedure being used for WSHPs. DOE also notes in response to WaterFurnace's comment that the definition of WSHP already uses the term ''heat pump'' to define WSHP and that the term ''commercial package air-conditioning and heating equipment'' is being added to the definition only to indicate the larger type of equipment, as defined in the EPCA, of which WSHPs are a category.

Regarding ClimateMaster's comment that the current definition does not cover units that are not reversible, DOE considers water-source heat pumps to include only models with reverse-cycle heating; therefore, DOE is not removing the ''reverse-cycle'' provision from the WSHP definition.

For the reasons discussed, DOE is adopting an amended definition of WSHP that is identical to the definition proposed in the August 2022 NOPR, 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.

C. Organization of the Amended DOE Test Procedures

In this final rule, DOE is relocating and centralizing the current test procedure for WSHPs to a new appendix C to subpart F of part 431 and establishing an amended test procedure for WSHPs in a new appendix C1 to subpart F of part 431. Appendix C maintains the substance of the current test procedure and continues to reference ISO 13256–1:1998 and provide for determining EER and COP. Appendix C also includes the additional test provisions for equipment set-up currently codified at 10 CFR 431.96(e). As discussed, WSHPs are required to be tested according to appendix C until such time as compliance is required with an amended energy conservation standard based on the amended test procedure in appendix C1, should DOE adopt such a standard.

DOE is also establishing an amended test procedure for WSHPs in a new appendix C1 to subpart F of part 431 that includes provisions for determining IEER and ACOP by incorporating by reference AHRI 600–2023, as discussed further throughout this document. WSHPs are not required to be tested according to appendix C1 until such time as compliance is required with an amended energy conservation standard denominated in terms of the IEER metric, should DOE adopt such a standard; although, any voluntary representations of IEER prior to the compliance date of any such standard must be based on testing according to appendix C1.

D. Updates to Industry Standards

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. In the August 2022 NOPR, DOE proposed to adopt an amended test procedure for WSHPs in a new appendix C1 that would incorporate by reference AHRI 340/360–2022 for measuring efficiency using IEER. 87 FR 53302, 53311. Because AHRI 340/360–2022 references ANSI/ASHRAE 37–2009 for test provisions, DOE also proposed to incorporate by reference relevant sections of ANSI/ASHRAE 37–2009 in its amended test procedure for WSHPs. *Id.* at 87 FR 53312. Compared to the current test procedure, the key substantive changes that would result from DOE adopting the proposed test procedure included the following:

(1) A new energy efficiency descriptor, IEER, which incorporates part-load cooling performance;

(2) Modified test conditions for determining COP;

(3) Minimum external static pressure (''ESP'') requirements, instructions for setting airflow and ESP, and tolerances for airflow and ESP, and

(4) Specified liquid ESP requirements for units with integral pumps and a method to account for total pumping effect for units without integral pumps. *Id.* at 87 FR 53305.

In response to this proposal, DOE received multiple comments (summarized in the following sub-sections) urging DOE not to incorporate by reference AHRI 340/360–2022 as the test procedure for WSHPs, to continue to collaborate with industry on finalizing AHRI 600, and to instead adopt the revised industry test standard resulting from work on AHRI 600. As previously noted, after publication of the August 2022 NOPR, DOE worked with the AHRI Geothermal and WSHP STC to develop a revised version of AHRI 600 (AHRI 600–2023) to address the issues DOE raised in the August 2022 NOPR. As discussed further throughout this section, AHRI 600–2023 includes a method to determine IEER for WSHPs similar to that proposed in the August 2022 NOPR and addresses many of the concerns expressed by commenters in response to the August 2022 NOPR. As discussed, AHRI 600–2023 is intended to serve as the primary industry test procedure for WSHPs going forward and it does not reference any versions of ISO Standard 13256–1. Instead, AHRI 600–2023 references ANSI/ASHRAE 37–2009 and includes sufficient provisions for testing WSHPs that references to test provisions in ISO Standard 13256–1 or AHRI 340/360–2022 are not needed.

As discussed further throughout this section, in this final rule, DOE is adopting an amended test procedure that incorporates by reference AHRI 600–2023, with minor differences as explained further throughout the following sections of this document.

In the following sections, DOE summarizes comments received in response to the August 2022 NOPR with regard to industry standards.

1. Comments Regarding DOE's Authority

As discussed previously in this document, with respect to small, large, and very large commercial package air conditioning and heating equipment (of which WSHPs are a category), EPCA directs that when the generally accepted industry testing procedures or rating procedures developed or recognized by AHRI or by ASHRAE, as referenced in ASHRAE 90.1, are amended, the Secretary shall amend the DOE test procedure consistent with the amended industry test procedure or rating procedure unless the Secretary determines, by clear and convincing evidence, that to do so would not meet the requirements for test procedures to produce results representative of an average use cycle and is not unduly burdensome to conduct. (42 U.S.C. 6314(a)(4)(A)–(B))

In response to the August 2022 NOPR, AHRI, MIAQ, and WaterFurnace expressed concern with DOE's proposal to adopt a test procedure different from the industry standard (*i.e.,* ISO 13256–1:1998 and the not yet published AHRI 600 standard), and the procedure cited in ASHRAE 90.1. (AHRI, No. 24 at pp. 1–2; MIAQ, No. 23 at pp. 1–2; WaterFurnace, No. 20 at p. 1) AHRI, MIAQ, and WaterFurnace noted that EPCA explicitly directs DOE to adopt the industry consensus test procedure cited in ASHRAE 90.1 and asserted that EPCA precludes DOE from adopting as a national standard a wholly different test procedure from that cited in ASHRAE 90.1. (*Id.*) These commenters urged DOE to adopt a revised test method only after it has been published by AHRI and adopted by ASHRAE in ASHRAE 90.1. (*Id.*)

MIAQ asserted further that EPCA requires DOE to justify by clear and convincing evidence each amendment or difference between AHRI 340/360–2022 and ISO 13256–1:1998. (MIAQ, No. 23 at p. 2) MIAQ commented that DOE has determined in past rulemakings that ISO 13256–1 is cost effective and representative of energy use. (*Id.*) MIAQ stated that any deviation from ASHRAE 90.1 requires quantification of the burden and that only modifications that reduce testing burden on manufacturers can be considered. (*Id.* at p. 3)

AHRI and MIAQ commented that DOE and outside stakeholders have been developing a consensus-based revision to the test procedure for commercial packaged air conditioners and heat pumps (''CUAC/HPs''). (AHRI,

No. 24 at p. 2; MIAQ, No. 23 at p. 2) AHRI and MIAQ further stated that after AHRI 600 has been finalized and adopted, AHRI will introduce the new test procedure to ASHRAE 90.1 to begin the procedural process for updates. (AHRI, No. 24 at p. 3; MIAQ, No. 23 at p. 2) AHRI and MIAQ commented that waiting to harmonize standards would establish consistent energy efficiency levels and design requirements between industry and Federal requirements, as well as comparable metrics and scope. (AHRI, No. 24 at p. 3; MIAQ, No. 23 at pp. 2–3) AHRI and MIAQ recommended that DOE continue to work with AHRI and other stakeholders to finalize AHRI 600 and support a proposed amendment to ASHRAE 90.1, which DOE could adopt as the national test procedure during the next rulemaking. (AHRI, No. 24 at p. 4; MIAQ, No. 23 at pp. 3, 9)

ClimateMaster commented that DOE has not followed a cooperative approach to improve the test methods as proposed in the August 2022 NOPR. (ClimateMaster, No. 22 at p. 1) ClimateMaster asserted that this seems to violate EPCA, which requires DOE to adopt the test procedure cited in ASHRAE 90.1. (*Id.*)

With regard to comments asserting that DOE does not have the authority to adopt a test procedure prior to its inclusion in ASHRAE 90.1, EPCA provides DOE with authority to adopt an amended test procedure in satisfaction of EPCA's 7-year-lookback review requirement for test procedures. (42 U.S.C. 6314(a)(1)(A)). Under its 7-year-lookback review, DOE must ensure that test procedures established are reasonably designed to produce test results which reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle and are not unduly burdensome to conduct. (42 U.S.C. 6314(a)(2)) During its 7-year lookback review, DOE is directed by EPCA to evaluate whether an amended test procedure would more accurately or fully comply with those requirements, and if DOE determines an amended test procedure would do so, then DOE is required to prescribe such test procedures for the equipment class. (42 U.S.C. 6314(a)(1)(A)) It is important to note that under the 7-year lookback DOE does not need clear and convincing evidence that an amended test procedure would more accurately or fully comply with EPCA's requirements. (*Id.*) Rather, DOE must show that the amended test procedure is reasonably designed to produce test results which reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle and are not unduly burdensome to conduct. (42 U.S.C. 6314(a)(2)) For example, a test procedure referenced by ASHRAE 90.1 may not be reasonably representative because more representative test procedures are available. And a test procedure that was reasonably representative in the past may become unreasonably representative when newly available test procedures allow for better, more complete measurements. DOE's 7-year-lookback review under EPCA ensures that DOE is not bound to an industry test procedure that has not been updated and is no longer representative of current equipment.

DOE notes that submitted comments from AHRI, WaterFurnace, ClimateMaster, and MIAQ do not mention DOE's 7-year-lookback review and therefore only engaged with the review process under 42 U.S.C. 6314(a)(4)(A). AHRI stated in its written comment that DOE is mandated to adopt an industry test procedure only after that test procedure is adopted in ASHRAE 90.1 but identified no such mandate within the statute itself. It is important to note that the 7-year-lookback review language at issue here was added to EPCA in EISA 2007, well after the relevant ASHRAE 90.1 test procedure language was added in 1992. (*Compare* Sec. 302 of EISA 2007, Pub. L. 110–140, 121 STAT. 1552 (Dec. 19, 2007) with Sec. 121 of the Energy Policy Act of 1992, Pub. L. 106–486, 106 STAT. 2808 (Oct. 24, 1992)). Therefore, the most natural reading of the two provisions together is that Congress intended to add the 7-year-lookback review to those triggers for review of test procedures that already existed. The language of the 7-year-lookback review applies generally to all covered equipment. Rather than restrict DOE to an outdated test procedure in the manner the industry commenters suggest, EPCA instead compels DOE to use due diligence to review the totality of relevant and available information before settling on appropriate energy conservation standards and test procedures.

As a result, it is appropriate for DOE to consider in its 7-year-lookback whether amendments to the test procedure would more accurately produce test results which reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle and would not be unduly burdensome to conduct even without an update to AHSRAE 90–1. DOE finds here that the test procedure provided in the updated industry consensus test standard for WSHPs (AHRI 600–2023), and therefore the test procedure specified in the regulatory text of this final rule, is more representative without incurring undue burden, as discussed below, thereby satisfying EPCA's requirements.

DOE acknowledges that DOE has previously stated that it will only consider an update to ASHRAE 90.1 that modifies the referenced industry test procedure to be a trigger under that provision of the statute, as opposed to an update of just the industry test procedure itself. (*See e.g.,* 86 FR 35668, 35676 (July 7, 2021)). DOE stands by that position regarding what constitutes a triggering event in the context of ASHRAE equipment and does not consider the provisions in 42 U.S.C. 6314(a)(4) to have been triggered. However, that does not preclude DOE from considering an amended test procedure when reviewing DOE's test procedures under EPCA's 7-year-lookback provision. Not only does DOE have discretion to do so, but it has a statutory duty to do so, to ensure that its test procedures produce results that are representative of an average use cycle and are not unduly burdensome to conduct.

DOE has determined that the test procedure adopted in this final rule for WSHPs would improve the representativeness of the current Federal test procedure for WSHPs and would not be unduly burdensome. Specifically, DOE has concluded that testing WSHPs in accordance with AHRI 600–2023 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, as discussed in more detail in section III.D.6 of this final rule. And while clear and convincing evidence is not needed when amending a test procedure under the 7-year-lookback, DOE finds that the test procedure amendments adopted here are supported by clear and convincing evidence as outlined in this final rule. DOE discusses the specific test procedure updates included in appendix C1, resulting from the incorporation by reference of AHRI 600–2023, in sections III.E and III.F of this final rule. Therefore, DOE is adopting an amended test procedure for WSHPs that incorporates by reference AHRI 600–2023, with minor deviations. With regard to the assertion by AHRI and MIAQ that any deviation from ASHRAE 90.1 requires quantification of the burden, and MIAQ's assertion that only modifications that reduce testing burden on manufacturers can be considered, DOE does not agree that EPCA requires DOE to consider only deviations that

would reduce burden. Rather, EPCA requires only that DOE ensure that test procedures established are not unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

With regard to the assertion by AHRI and MIAQ that EPCA requires DOE to justify by clear and convincing evidence each amendment or difference from the industry test procedure referenced by ASHRAE 90.1, DOE does not agree that EPCA requires such a line-by-line assessment of an amended test procedure. First, as stated previously, there is no requirement for clear and convincing evidence in EPCA for a test procedure amendment under the 7-year-lookback. Additionally, if DOE were amending a test procedure pursuant to the ASHRAE trigger, EPCA requires only that DOE shall amend the test procedure for the product as necessary to be consistent with the amended industry test procedure or rating procedure unless it determines, supported by clear and convincing evidence, that to do so would not meet the requirements of EPCA (42 U.S.C. 6314 (a)(4)(B)). If DOE makes such a determination, DOE may establish an amended test procedure, but there is no requirement for DOE to show, by clear and convincing evidence, that DOE's amended test procedure is reasonably designed to produce test results which reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle and are not unduly burdensome to conduct. (*See* 42 U.S.C. 6314(a)(2)). Additionally, if DOE does not make such a determination, there is no requirement that DOE show, by clear and convincing evidence, that an amended test procedure, which is consistent with the industry test procedure, is reasonably designed to produce test results which reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle and are not unduly burdensome to conduct.

2. Comments Regarding DOE's Test Procedure Development Process

In response to the June 2022 NOPR, DOE received comments regarding its rulemaking development process. AHRI recommended that DOE follow a transparent, cooperative, or consensus-based regulatory development process. (AHRI, No. 24 at p. 4) AHRI commented that, in the past, DOE has had difficulty duplicating test results without the help and guidance of manufacturers and AHRI testing facilities and that the complex controls and operational characteristics of WSHP equipment require manufacturer and testing facility experience to test properly. (*Id.*) AHRI acknowledged that DOE has tested 15 units from the WSHP industry but stated that DOE did not release the data and results of the testing. (*Id.*) AHRI expressed further concern that the testing cited in the August 2022 NOPR was not shared with the relevant AHRI committee and requested that DOE share the results of its findings with stakeholders in order to allow for validation and review. (*Id.* at pp. 2, 4)

AHRI recommended that DOE work with industry on finalizing AHRI 600, conduct any necessary testing or calculations to develop a document agreed upon by DOE and relevant stakeholders, and follow the proper procedures to introduce the finalized test procedure and updated efficiency standards in ASHRAE 90.1. (*Id.*) AHRI commented that it will support the necessary updates to the Federal procedure and metrics after DOE takes the aforementioned steps. (*Id.*)

ClimateMaster commented that DOE did not follow a cooperative process to improve the test methods for WSHPs and that neither AHRI nor the WSHP industry was consulted in a working group setting with other stakeholders, which was inconsistent with past and current industry approaches. (ClimateMaster, No. 22 at p. 1)

WaterFurnace commented that it believed a more transparent and consensus-based development process is warranted before DOE implements new WSHP test procedures and that DOE should seek industry and AHRI input in order to validate and review the testing results. (WaterFurnace, No. 20 p. 2) WaterFurnace recommended that DOE implement an Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC'') Working Group for all future undertakings to propose substantial changes in regulatory policy so as to work out complex issues in a common forum with industry and AHRI. (*Id.*)

With respect to the comments from AHRI, ClimateMaster, and WaterFurnace, DOE notes that it may establish a negotiated rulemaking working group under ASRAC in accordance with the Federal Advisory Committee Act (''FACA'') and the Negotiated Rulemaking Act (''NRA'') (5 U.S.C. 561–570, Pub. L. 104–320) to negotiate proposed test procedures and amended energy conservation standards if DOE determines that the use of the negotiated rulemaking process is in the public interest according to the requirements of FACA and in a manner consistent with the requirements of the NRA. However, in this rulemaking, DOE is following the traditional rulemaking notice-and-comment process.

DOE recognizes the benefits of developing test procedures through a consensus-based process and notes that DOE has participated in the AHRI process and has worked with the AHRI Geothermal and WSHP STC in developing AHRI 600–2023, which is incorporated by reference in this final rule. As noted in the August 2022 NOPR, DOE has participated in AHRI committee meetings working to develop AHRI 600 since 2019. *See* 87 FR 53302, 53308–53309. In particular, DOE brought up many of the concerns raised in August 2022 NOPR in ISO 13256–1 and AHRI 600 meetings for several years prior to the publication of the August 2022 NOPR, but the committees declined to address these issues in the draft industry test procedures at that time. At the time of drafting of the August 2022 NOPR, AHRI 600 was still in development and had not yet published. In the August 2022 NOPR, DOE outlined its understanding that the intent of AHRI 600 would be to provide a method for calculation of IEER for WSHPs based on testing conducted according to ISO 13256–1:1998. *Id.* at 87 FR 53309. In the August 2022 NOPR, DOE tentatively concluded that the general methodology in AHRI 600 for determining IEER is appropriate. *Id.* However, DOE identified several aspects of the methodology that warrant further modifications. *Id.* In the August 2022 NOPR, DOE noted that it could not speculate as to the substantive outputs of the ISO 13256–1 National deviation and the AHRI 600 committee's efforts. *Id.* Consistent with DOE's procedure for notice-and-comment rulemakings, DOE also conducted the NOPR public meeting that provided opportunity for stakeholders to provide feedback on DOE's proposals. The feedback DOE received in both NOPR public meeting comments and written comments was considered in subsequent AHRI 600 committee meetings and drafting of this final rule.

Since the publication of the August 2022 NOPR, DOE continued to work with industry in AHRI 600 committee, as recommended by commenters, to address the test procedure concerns DOE raised in the August 2022 NOPR with the intent that a revised industry test procedure specific to WSHPs could be adopted in a final rule. Rather than continue to simultaneously modify and maintain ISO 13256–1 and AHRI–600, the committee members voted to merge them into a comprehensive unified test procedure, AHRI 600. More specifically, the methodology specified in ISO 13256–1 has been incorporated into

AHRI 600–2023. Therefore, AHRI 600–2023 does not reference ISO 13256–1.

Regarding AHRI's comment about sharing data, DOE presented the results of its testing in the August 2022 NOPR. *Id.* at 87 FR 53314–53317. Based on participation in AHRI 600 committee meetings following the August 2022 NOPR, additional data from DOE's investigative testing was not needed for the committee to reach resolution on the content of AHRI 600–2023.

On September 11, 2023, AHRI 600–2023 was published. DOE notes that the statutory deadline for publishing a test procedure final rule for WSHPs was May 16, 2019. (42 U.S.C. 6314(a)(1)) Given EPCA's statutory requirement to review the appropriate test procedures for WSHPs every seven years, DOE has concluded that it would be neither appropriate nor permissible to delay the current rulemaking for the WSHP test procedure until after ASHRAE 90.1 adopts AHRI 600–2023 as the test procedure for WSHPs. To avoid any further delay, DOE is adopting a test procedure for WSHPs that incorporates by reference AHRI 600–2023, with minor deviations.

3. Comments Supporting the Adoption of AHRI 340/360–2022

In response to the June 2022 NOPR, some commenters supported adopting AHRI 340/360–2022 in the WSHP test procedure. NEEA generally supported DOE's efforts to align the WSHP test procedure with other water-cooled unitary systems, including by integrating fan energy into the test procedure for ducted WSHPs. (NEEA, No. 25 at p. 1) In particular, NEEA supported DOE's proposal to align the WSHP test procedure with AHRI 340/360–2022 and ANSI/ASHRAE 37–2009. (*Id.* at p. 2) NEEA stated that aligning the testing of WSHPs with ANSI/ASHRAE 37–2009 would ensure that WSHP ratings will be consistent with other water-cooled and direct expansion cooling systems. (*Id.*) NEEA also supported the introduction of an IEER metric rather than rating only with EER. (*Id.*) NEEA stated that the proposed test procedure would impact the current modeling approach for WSHP standard reference systems used to determine total system performance ratio in the 2018 Washington State Energy Code, but NEEA acknowledged that potential advancements to the test procedure and ratings metric would provide an important improvement in representativeness for this equipment. (*Id.* at p. 1)

NYSERDA generally supported DOE's proposed amendments for the WSHP test procedure and concurred with DOE's tentative determination that the changes would improve the representativeness of the WSHP test procedure. (NYSERDA, No. 21 at pp. 1–2) NYSERDA asserted that this would spur growth in the market for WSHPs, including geothermal heat pumps. (*Id.* at p.2)

As discussed previously, in this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1 in lieu of incorporating by reference AHRI 340/360–2022 as proposed in the August 2022 NOPR. DOE notes, however, that the majority of the technical content from the proposed test procedure in the August 2022 NOPR remains consistent in the test procedure finalized in this final rule. Any changes to technical provisions from the August 2022 NOPR proposal were due to industry consensus culminating in the AHRI 600–2023 standard. Throughout this final rule, DOE discusses in detail the technical differences between the test procedure proposed in the August 2022 NOPR and the version finalized in this final rule.

4. Comments Opposing the Adoption of AHRI 340/360–2022

Other commenters opposed the proposal in the August 2022 NOPR to adopt AHRI 340/360–2022 in the WSHP test procedure. AHRI and MIAQ expressed concern that the impact on manufacturers of DOE's proposal to update the WSHP test procedure has not been quantified. (AHRI, No. 24 at p. 2; MIAQ, No. 23 at p. 3) AHRI and MIAQ stated that the capability of testing WSHPs to AHRI 340/360–2022 has not been assessed by third-part test labs. (*Id.*)

AHRI and MIAQ noted that an ASRAC Working Group has been formed in an effort to negotiate test procedures and energy efficiency standards for CUAC/HPs, the scope of which stands to result in significant modifications to AHRI 340/360–2022 and the efficiency measures for such equipment. (AHRI, No. 24, at p. 2; MIAQ, No. 23 at p. 2) AHRI and MIAQ further noted, however, that WSHPs are outside the scope of these efforts, potentially leaving a significant gap in ratings (*i.e.,* were WSHPs to be rated using AHRI 340/360). (*Id.*)

WaterFurnace expressed concern regarding DOE's sampling and testing procedure for modifying AHRI 340/360, especially considering the complexity of the product's controls and operational characteristics and taking into account past instances in which DOE has struggled to duplicate test results without manufacturer and AHRI testing support. (WaterFurnace, No. 20 at p. 2)

WaterFurnace agreed with AHRI's concerns that the impact on manufacturers of DOE's proposal to update test procedures has not been adequately quantified, nor was it clear whether third-party test labs have the capability to accommodate the proposed changes. (*Id.* at p. 2)

WaterFurnace, ClimateMaster, Enertech, and FHP all expressed concern that DOE's proposal to test WSHPs using AHRI 340/360–2022 would require manufacturers to test WSHPs to two different test standards because geothermal applications for WSHPs would still require testing to ISO 13256–1. (WaterFurnace, No. 20 at p. 3; ClimateMaster, No. 22 at p. 1; Enertech, No. 19 at p. 1; FHP, No. 26 at p. 3) WaterFurnace noted that ISO 13256–1 is already referenced in several Federal, State, and local codes. (WaterFurnace, No. 20 at p. 3) WaterFurnace and ClimateMaster stated that implementing a dual certification process would be burdensome for manufacturers. (WaterFurnace, No. 20 at p. 3; ClimateMaster, No. 22 p. 1) Enertech also noted that Federal and State tax credits specifically reference ISO/AHRI 13256–1:1998 for efficiency ratings and that the ENERGY STAR specifications directly reference the ISO 13256–1:1998 standard for the ENERGY STAR Tier 3 efficiency requirements. (Enertech, No. 19 at p. 1)

WaterFurnace asserted that DOE underestimated the significance and the burden that the proposed changes to the WSHP test procedure would impose upon manufacturers and industry players. (WaterFurnace, No. 20 at p. 3) WaterFurnace identified the following assumptions and shortcomings in AHRI 340/360–2022 that it stated were not appropriately addressed in the August 2022 NOPR:

(1) While the August 2022 NOPR stated that IEER can be calculated and an interpolation can be performed using existing data from ISO 13256–1, WaterFurnace determined that the entering air, water flow, external static and airflow conditions differ from AHRI 340/360–2022, which will therefore require additional testing by the manufacturer and the implementation of a new certification program;

(2) Currently, performance mapping capability is available across a wide range of entering water temperatures (''EWT'') used in modeling software such as EQuest and DOE's EnergyPlus, and all of this detail would be lost with the implementation of AHRI 340/360–2022 because it only presents a single IEER cooling metric and a single heating point;

(3) Provisions should be added under AHRI 340/360–2022 for hybrid heat pumps, which are unique in their capability for refrigerant cooling with other non-refrigerant heating capability;

(4) Provisions should be added under AHRI 340/360–2022 for split configurations, which are offered for smaller WSHPs;

(5) Provisions should be added under AHRI 340/360–2022 for small WSHPs with non-ducted applications (*e.g.,* console units), along with language that takes into account the fact that many of these units are installed into residential buildings with substantial heating that would not fit the AHRI 340/360–2022 conditions;

(6) While DOE proposed to adopt heating test conditions for WSHPs that are not specified in AHRI 340/360–2022, this overlooks other testing requirements and language that would need to be addressed (*e.g.,* minimum and maximum operating conditions) in order to adequately add heating tests to a cooling-only standard;

(7) Provisions should be added under AHRI 340/360–2022 for antifreeze blends and their fluid characteristics (*i.e.,* alcohols, salts, and glycols);

(8) Test procedures would need to be modified to account for smaller WSHP units, as AHRI 340/360–2022 requires an airflow tolerance of less than 3 percent and is thus designed around larger product designs with drives and adjustable sheaves that accommodate this airflow capability;

(9) Although AHRI 340/360–2022 is primarily an air-source standard that utilizes air and refrigerant enthalpy test methods, water-source equipment is more consistently and accurately tested with a liquid enthalpy test method and would need to use air or refrigerant enthalpy only as secondary methods—and, furthermore, this process would be inconsistent with part load measurements under AHRI 340/360–2022;

(10) Manufacturer-specified liquid flow rate is preferred over the AHRI 340/360–2022 method of setting liquid flow rate using a 10 °F temperature rise to establish flow rates;

(11) Continuous 24/7 fan operation is an outdated idea according to ASHRAE 90.1; and

(12) Issues addressed by Working Groups under ASRAC will likely result in massive changes to AHRI 340/360 regarding air-side measurements and will take focus away from necessary modifications to provisions for water-cooled units and, thus, changes for water-cooled units to AHRI 340/360 will likely be of secondary importance to the ASRAC committee. (*Id.* at pp. 3–4)

WaterFurnace also commented that because AHRI 340/360–2022 is primarily an air-source standard, AHRI 340/360–2022's comparatively small water-cooled section is used to certify approximately 1,000 units per year in contrast to the 200,000 unit sales per year under the AHRI/ISO 13256 certification programs. (*Id.* at p. 5) Therefore, WaterFurnace noted that moving testing of WSHPs (with much higher shipments) to the smaller water-cooled section of AHRI 340/360–2022 would not be logical considering the noted changes required. (*Id.*)

WaterFurnace commented that changing to a different AHRI 340/360–2022 standard and separating out geothermal applications to ISO 13256 would be disruptive to both the water-source and geothermal industries at a time when the use of heat pumps is being encouraged by national, state, and local regulations as a carbon-reduction solution. (*Id.*) WaterFurnace stated that tax credits and rebates based upon AHRI/ISO 13256 performance have been legislatively codified and will be difficult to change, and further noted that the Inflation Reduction Act references ASHRAE 90.1 and AHRI/ISO 13256 as a measurement of performance. (*Id.* at p. 6) WaterFurnace stated that other governmental programs such as ENERGY STAR have specifications and benefits based on AHRI/ISO 13256 performance certification and that decarbonization policy programs by utilities, cities, and states rely on such certification as well. (*Id.*)

ClimateMaster commented that DOE would need to address the following issues with AHRI 340/360–2022:

(1) AHRI 340/360–2022 needs to be updated to include the appendix C1 additions, a process that will likely be delayed by a current ASRAC working group undertaking to amend the current AHRI 340/360–2022 test procedures with a focus on air-source equipment;

(2) AHRI 340/360–2022 does not include test requirements for water-source heating;

(3) AHRI 340/360–2022 does not include test provisions for non-ducted equipment;

(4) The airflow setting and tolerance specified by AHRI 340/360–2022 does not cover or is incompatible with current WSHP equipment;

(5) AHRI 340/360–2022 does not include a pump power adder for all equipment sizes, nor is DOE's proposal to utilize the pump power adder in AHRI 920 representative of installed WSHP systems;

(6) AHRI 340/360–2022 does not include glycols or antifreeze solutions in the method of test, and the recommended solution is not representative of the fluids used for WSHPs in the field or test laboratories currently used in the development, qualification, and compliance processes; and

(7) The refrigerant charging requirements included in AHRI 340/360–2022 are not applicable, accurate, or relevant to WSHP systems. (ClimateMaster, No. 22 at pp. 1–2)

Enertech commented that AHRI 340/360–2022 lacks testing parameters for water source heating, testing parameters for non-ducted equipment, testing methods utilizing antifreeze blends, and parameters for pump power adder for small equipment. (Enertech, No. 19 at p. 1) Enertech noted that AHRI 340/360–2022 requires a ±3 percent airflow tolerance during testing, which Enertech asserted is unrealistic for small-capacity equipment. (*Id.*) For these reasons, Enertech disagreed that new efficiency ratings could be interpolated from conditions common to the WSHP industry and asserted that new testing would be required for all products offered by any manufacturer. (*Id.*) Enertech stated that adopting AHRI 340/360–2022 as the DOE test procedure for WSHPs would result in long-term disruptions to the geothermal and WSHP industries. (*Id.* at p. 2)

FHP commented that adopting test methods per AHRI 340/360–2022 would require additional testing effort, time, and resources, and would result in additional costs to the industry. (FHP, No. 26 at p. 3) FHP commented further that AHRI 340/360–2022 contains differences in standard test conditions that would require additional testing as well as changes to (1) the design of the units to ensure 10 °F temperature rise on the water side and (2) the fan/motor selections and programs to maintain the proper air flow at defined static pressures and airflow tolerances. (*Id.*) FHP stated that the use of two standards may split the current WSHP product designs, thereby adding permanent design burden to current product offerings. (*Id.*)

FHP stated that the proposed changes to the WSHP test procedure could be the most impactful regulatory issue for the WSHP industry and that the industry's resources are completely dedicated to the development of equipment that uses low-global warming potential refrigerants through January 1, 2025. (FHP, No. 26 at p. 5) FHP expressed concern about the impact of moving to an entirely new test procedure that would require re-testing, re-designing, and potentially re-certifying most of its basic model groups. (*Id.*) FHP also

expressed concerns about the additional resources and maintenance potentially required by having two separate product designs and validations for WSHPs. (*Id.*)

FHP also stated that current AEDMs are based on the leading industry standard for these types of equipment. (*Id.* at p. 2) More specifically, FHP stated that its current AEDM is based on the ISO 13256–1:1998 test standard and that DOE's proposal to reference AHRI 340/360–2022 as the test procedure for WSHPs would require additional testing and new AEDMs. (*Id.*) FHP commented that even reduced testing to validate AEDMs would be unduly burdensome for such a small market. (*Id.*)

During the public meeting, AAON commented that the amount of testing in the proposed test procedure was rather extreme and asked DOE to share the testing burden assessment. (Public Meeting Transcript, No. 17 at p. 60)

GeoExchange commented that manufacturers of geothermal heat pumps have significant concerns with the August 2022 NOPR as written and believe it will subject WSHPs and geothermal heat pumps to competing and inconsistent certification standards. (GeoExchange, No. 29 at p. 1) GeoExchange commented that these issues will complicate production of these products and increase costs for consumers. (*Id.*) GeoExchange stated that the timing of the August 2022 NOPR coincides with efforts by the industry to complete work on its development of a standard that recognizes the overlap between different applications of heat pump technology and minimizes unnecessary disruptions for manufacturers. (*Id.*)

DOE appreciates these comments regarding the proposal to adopt AHRI 340/360–2022 in the WSHP test procedure. As discussed, in this final rule, DOE is no longer adopting AHRI 340–360–2022 and is adopting instead an amended test procedure for WSHPs that incorporates by reference AHRI 600–2023. Because AHRI 600–2023 was developed through an industry consensus process subsequent to the timing of the August 2022 NOPR comment period, DOE surmises that the testing approach specified in AHRI 600–2023 represents the prevailing industry consensus regarding the most appropriate method of testing WSHPs and addresses the issues raised by commenters regarding DOE's proposal to adopt AHRI 340/360–2022 as the test procedure for WSHPs. See sections III.E and III.F of this final rule for discussion of specific test procedure topics raised by interested parties in response to the August 2022 NOPR.

Further, in response to the test burden comments, DOE did quantify per-test burden of the proposed test procedure in the August 2022 NOPR and found that the proposed test procedure was not unduly burdensome to conduct. 87 FR 53302, 53340. A similar analysis is presented in this final rule (see section III.I of this document for details), and the same conclusion is reached. Additionally, as discussed in this document, DOE is adopting a test procedure incorporating by reference the industry consensus test standard, AHRI 600–2023. Therefore, DOE has determined that the amended test procedure will not increase burden as compared to the latest draft industry consensus test standard.

5. Comments Encouraging the Adoption of AHRI 600

Numerous commenters encouraged DOE to adopt AHRI 600 in an amended WSHP test procedure in response to the August 2022 NOPR. AHRI recommended that DOE refrain from adopting AHRI 340/360–2022 for WSHPs in favor of continuing to collaborate with industry on finalizing AHRI 600. (AHRI, No. 24 at p. 4) AHRI commented that AHRI 600 has been under development for several years and that, despite some delays, is steadily progressing. (*Id.*) AHRI commented that during the discussions for the development of AHRI 600, the committee considered applying AHRI 340/360–2022 to calculate IEER. (*Id.*) AHRI commented that it continues to improve AHRI 600 test procedures (*e.g.,* by resolving issues to fan power, external static pressure, water temperature, and subsequent efficiency levels) and that AHRI will continue committing to frequent meetings to satisfactorily resolve the issues raised in August 2022 NOPR. (*Id.*)

WaterFurnace stated that AHRI 600 draft standard was released in October 2022 and achieves the objectives of the August 2022 NOPR without industry distractions. (WaterFurnace, No. 20 p. 5) WaterFurnace commented that AHRI 600 standard is on track for committee review by October 31, 2023. (*Id.*)

WaterFurnace stated that the quickest way to implement appropriate changes to WSHP test procedures would be to adopt versions of AHRI 600 and ISO 13256–1, as modifying test procedures to comply with AHRI 340/360–2022 would entail substantial changes that will delay the implementation process. (*Id.* at p. 4)

WaterFurnace commented that it supports development of AHRI 600 test procedure and recommended that the DOE test procedure reference it directly instead of AHRI 340/360–2022. (*Id.* at p. 5) WaterFurnace stated that the AHRI 600 standard can resolve most of the issues DOE identified in the August 2022 NOPR regarding the current WSHP test procedure. (*Id.*) WaterFurnace recommended that DOE re-evaluate the August 2022 NOPR proposal and support WaterFurnace's proposal to quickly adopt AHRI 600 and the national deviation updates to AHRI/ISO 13256. (*Id.* at p. 11) WaterFurnace commented that doing so will help industry achieve DOE's desired goals faster and with less disruption. (*Id.*)

WaterFurnace commented that it supports implementation of an updated AHRI/ISO 13256:1998 with a targeted national deviation and revised annexes. (*Id.* at p. 5) WaterFurnace commented that an updated AHRI/ISO 13256:1998 with a targeted national deviation can solve specific issues mentioned in the August 2022 NOPR regarding AHRI/ISO 13256 with changes that would not be substantial, stating that the method of testing WaterFurnace follows aligns with the August 2022 NOPR. (*Id.*) WaterFurnace commented that many of the issues raised by DOE center on specific issues and test methods currently in use that can be documented and solved with a national deviation from AHRI/ISO 13256. (*Id.*) WaterFurnace stated that it has developed a draft of this national deviation that will address the noted shortcomings and can be completed in a similar time frame as AHRI 600 approval. (*Id.*)

ClimateMaster commented that DOE's proposal to move WSHPs to AHRI 340/360–2022 would create too significant a change in the industry and instead recommended considering AHRI 600, which uses existing ISO/AHRI 13256–1 certified data to mathematically calculate the system IEER. (ClimateMaster, No. 22 at p. 1) ClimateMaster further commented that DOE should consider updating the ISO/AHRI 13256–1:1998 standard to include national deviations to address specific issues such as: (1) modifying refrigerant charging and airflow/ESP requirements; and (2) the need to include a reference to ASHRAE 37 and provisions for air sampling for air-side capacity measurements. (*Id.* at p. 2)

Enertech suggested adopting AHRI 600 for calculating IEER rather than the AHRI 340/360–2022 method. (Enertech, No. 19 at p. 2)

MIAQ recommended that DOE work with industry to finalize AHRI Standard 600, conduct any necessary testing/calculations to develop a crosswalk, and follow proper procedures to introduce the finalized procedure and updated

efficiency standards in ASHRAE 90.1. (MIAQ, No. 23 at p. 9)

Trane recommended that DOE move from a full-load metric and test procedure to one that is more representative of an energy use cycle, such as a part-load test procedure. (Trane, No. 28 at p. 3) Trane commented that the most accurate and representative test procedure is AHRI 600, not AHRI 340/360–2022 as proposed in the August 2022 NOPR. (*Id.*) Trane noted that AHRI 600 draft is now published and seeking public comments for the final version. (*Id.* at p. 2)

As discussed, in this final rule, DOE is adopting an amended test procedure for WSHPs incorporating by reference AHRI 600–2023. As noted in the previous discussion, the methodology specified in ISO 13256–1 has been incorporated into the AHRI 600–2023, which represents the latest industry consensus test standard for WSHPs and moves away from using ISO 13256–1, thus rendering unnecessary a national deviation to ISO 13256–1. Having been developed through an industry consensus process subsequent to the timing of the August 2022 NOPR comment period, DOE surmises that the testing approach specified in AHRI 600–2023 represents the prevailing industry consensus regarding the most appropriate method of testing WSHPs.

6. Finalized DOE Test Procedure

In summary, DOE is adopting an amended test procedure for WSHPs that incorporates by reference AHRI 600–2023, with minor deviations, in this final rule. DOE has determined that the test methods specified in AHRI 600–2023 (which are largely consistent with the provisions adopted in appendix C1 of this final rule) would produce test results that better reflect energy efficiency of WSHPs during a representative average use cycle than the current DOE test procedure and ISO 13256–1:1998. DOE notes that the IEER metric is representative of cooling efficiency for WSHPs on an annual basis and is more representative than the current EER metric, which captures the system performance at a single, full-load operating point. DOE also notes that the other test procedure amendments incorporated in this final rule better ensure accurate and repeatable measurements and ensure that representative test conditions are maintained during testing. These changes include:

(1) Minimum ESP requirements, instructions for setting airflow and ESP, and tolerances for airflow and ESP;

(2) Operating tolerance for voltage;

(3) Different indoor air conditions for testing;

(4) Refrigerant charging instructions for cases where they are not provided by the manufacturer;

(5) 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;

(6) Provisions for split systems, such as accounting for compressor heat and refrigerant line losses;

(7) Measurement of duct losses for ducted units;

(8) Standardized heat capacity of water and brine; and

(9) A calculation for discharge coefficients.

The subsequent sections of this final rule discuss aspects of the finalized test procedure that differ from the proposal in the August 2022 NOPR. DOE has determined that these updates improve the representativeness of the test procedure for WSHPs. These include but are not limited to:

(1) Updated pump power adder, developed during the AHRI 600–2023 process;

(2) ESP requirements for large units >65,000 Btu/h consistent with levels from the December 2022 term sheet of recommendations regarding test procedures for air-cooled commercial unitary air conditioners and heat pumps (''ACUACs and ACUHPs''), referred to hereafter as ''the ACUAC and ACUHP Working Group TP Term Sheet'' (See Document No. 65 in Docket No. EERE–2022–BT–STD–0015);

(3) No option to physically test at the IEER conditions and to instead require testing at all three ISO 13256–1:1998 conditions;

(4) Updated part-load EWT;

(5) Specifying a maximum water flow rate instead of fixed inlet and outlet water conditions;

(6) Different test provisions for coil-only units, including adjustments to default fan power;

(7) Different required fluid—a methanol solution—and different fluid properties specified;

(8) Some changes to airflow provisions, which are consistent with DOE's test procedure for central air conditioners and heat pumps at appendix M1 to subpart B of 10 CFR part 430 instead of AHRI 340/360–2022;

(9) IEER cyclic degradation equation that does not assume continuous fan operation; and

(10) Heating test temperature of 50 °F instead of 55 °F.

As discussed, DOE recognizes that the test method in AHRI 600–2023 and incorporated by reference into appendix C1 represents an industry consensus test procedure that is likely to be considered for future updates to ASHRAE 90.1.

Accordingly, for the foregoing reasons and those discussed in the subsequent sections of this final rule, DOE is incorporating by reference AHRI 600–2023 into the amended Federal test procedure for WSHPs. DOE has determined that the amended test procedure is reasonably designed to produce results that are representative of the energy efficiency of that covered equipment during an average use cycle and is not unduly burdensome to conduct. DOE notes also that use of appendix C1 will not be required until the compliance date of any amended standards denominated in terms of IEER, should DOE adopt such standards.

E. Efficiency Metrics

1. IEER

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. 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 EWT 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 EWT

condition rather than operation across a range of temperatures and compressor speeds, as would be captured by an IEER metric. Neither ISO 13256–1:1998 nor ISO 13256–1:2021 include seasonal metrics.

In the August 2022 NOPR, DOE tentatively determined that use of a seasonal efficiency metric would be more representative of the average use cycle of a unit as compared to the current EER metric. 87 FR 53302, 53313. Accordingly, DOE proposed 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. *Id.* Specifically, DOE proposed that IEER for WSHPs be calculated based on the EWT conditions specified in Table 9 of AHRI 340/360–2022 (*i.e.,* 85 °F, 73.5 °F, 62 °F, and 55 °F). *Id.* DOE referred to the approach of testing at these AHRI 340/360–2022 EWTs as ''option 1'' in the August 2022 NOPR. *Id.* at 87 FR 53316.

In addition, DOE acknowledged in the August 2022 NOPR that adopting the IEER metric for WSHPs would increase the number of required cooling-mode tests from one to four. *Id.* at 87 FR 53313. DOE also discussed its understanding that the future updated version of AHRI 600 would provide for calculating IEER from test results measured at the EWTs specified in Table 1 of ISO 13256–1:1998. *Id.* DOE stated that determining 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. *Id.* at 87 FR 53314. Consistent with this approach, DOE also proposed to allow determination of IEER via interpolation and extrapolation (''option 2'') based on testing at the full-load and part-load EWT conditions specified in Table 1 of ISO 13256–1:1998 (*i.e.,* 86 °F, 77 °F, and 59 °F for full-load tests and 86 °F, 68 °F, and 59 °F for part-load tests). *Id.* at 87 FR 53316. DOE proposed that the tests for option 2 would be performed using the same test provisions (aside from the EWTs) 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. *Id.*

In the August 2022 NOPR, DOE presented test data that indicated that determining EER by interpolating/extrapolating cooling capacity and total power would result in closer agreement to tested values than directly interpolating/extrapolating EER. *Id.* at 87 FR 53314–53315. Based on these findings, DOE proposed to specify interpolation/extrapolation using the cooling capacity and total power as opposed to EER directly. *Id.* at 87 FR 53316. DOE also presented data in the August 2022 NOPR indicating that for variable-speed WSHPs with higher (*i.e.,* better) EER performance at intermediate compressor speeds than at maximum or minimum compressor speeds, the proposed interpolation and extrapolation method would result in a lower (*i.e.,* worse) calculated IEER than testing at the IEER conditions specified in AHRI 340/360–2022. *Id.* at 87 FR 53315–53316. DOE discussed its understanding from participation in AHRI 600 committee meetings 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. *Id.* at 87 FR 53316.

DOE also proposed that 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. *Id.*

DOE requested 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. *Id.* DOE sought 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. *Id.* DOE also requested comment on whether the proposed methodology to determine IEER based on interpolation and extrapolation is appropriate for variable-speed units. *Id.* DOE noted it 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. *Id.* Finally, DOE sought feedback on whether the proposed interpolation and extrapolation method should be based on testing at the ISO 13256–1:2021 EWTs (which differ from the ISO 13256–1:1998 EWTs for certain test points). *Id.*

Some commenters opposed DOE's proposals regarding the IEER metric in the August 2022 NOPR. ClimateMaster, MIAQ, and WaterFurnace recommended that DOE adopt the test methods specified in AHRI 600 instead of AHRI 340/360–2022 for calculating the IEER of WSHPs. (ClimateMaster, No. 22 at pp. 3–5; MIAQ, No. 23 at p. 4; Waterfurnace, No. 20 at pp. 6–7) MIAQ stated that AHRI 600 will provide a method for calculating a seasonal cooling efficiency metric for WSHPs (*i.e.,* IEER) based on testing conducted according to ISO 13256–1:1998. (MIAQ, No. 23 at p. 4) MIAQ stated that that the estimated AHRI 600 approval date of October 1, 2023 would meet DOE's timeline for adopting the standard. (*Id.*) ClimateMaster commented that adopting the test methods specified in AHRI 340/360–2022 would require manufacturers to certify products under two programs (*i.e.,* AHRI 340–360 and ISO/AHRI 13256), which is unprecedented in the industry, and would pose challenges for manufacturers, third-party labs, and partners to test and maintain two certification programs. (ClimateMaster, No. 22 at p. 3)

ClimateMaster recommended that DOE utilize data created through ISO 13256–1:1998 to interpolate per the procedure provided in AHRI 600. (ClimateMaster, No. 22 at p. 4) ClimateMaster disagreed with DOE's proposal for ''option 2'' to interpolate and extrapolate cooling capacity and total power instead of directly interpolating/extrapolating EER and argued that the method in the draft AHRI 600 at the time should be used, which is based on directly interpolating/extrapolating EER. (*Id.*) ClimateMaster further argued that the difference between the two methodologies is within the uncertainty of measurement for testing WSHPs and, therefore, that DOE's proposed deviation from the methodology in AHRI 600 (at the time) is unnecessary. (*Id.*) ClimateMaster further commented that their analysis of a random sample of performance data for five systems tested in their labs showed that, on average, interpolating/extrapolating based on EER resulted in slightly more accurate numbers than interpolating/extrapolating based on capacity and power. (*Id.* at pp. 4–5)

ClimateMaster recommended that DOE maintain the existing ISO 13256–1:1998 standard until the WSHP industry adopts the updated standard and suggested that DOE adopting a national deviation of ISO 13256–1:2021 would be practical as long manufacturers are given significant time to adopt the new test procedure. (ClimateMaster, No. 22 at p. 5) ClimateMaster commented that there are several changes introduced in ISO 13256–1:2021 that it believes provide a more effective performance map for a

WSHP system, but that this standard has not yet been adopted by the WSHP industry. (*Id.*) ClimateMaster further commented that the EWTs utilized for determining IEER via interpolation/extrapolation are irrelevant as long as DOE requires that the entering air temperatures and other items are inconsistent from the current ISO 13256–1:1998 test program. (*Id.*)

Regarding DOE's request for comment on variable-speed unit testing, ClimateMaster commented that DOE's test results from the units sampled and tested at a third-party lab should be shared with stakeholders for review and comment—particularly regarding variable speed units, as most of these require hardware and software from the manufacturer to allow for proper testing, and test instructions were not provided to DOE for the department's testing of variable-speed units as would be done for normal certification testing. (ClimateMaster, No. 22 at p. 4)

MIAQ commented that the proposed interpolation and extrapolation method should be based on testing at the ISO 13256–1:2021 EWTs. (MIAQ, NO. 23 at p. 4) Regarding the proposed ''option 2'' approach for determining IEER via interpolation/extrapolation for variable-speed units, MIAQ recommended DOE use the latest edition of ISO 13256–1:2021 as the test procedure and continue to use AHRI 340/360–2022 for IEER calculations. (*Id.*)

Other commenters supported DOE's proposals regarding the IEER metric in the August 2022 NOPR. The Joint Commenters supported adopting a part-load metric to measure cooling efficiency performance, stating that WSHPs, like many other commercial air conditioners and heat pumps, operate a significant percent of the time at part-load conditions, and that a part-load metric could incentivize designs that reduce annual energy consumption. (Joint Commenters, No. 27 at pp. 1–2) The Joint Commenters recommended DOE ensure that an adopted part-load metric reflects the total cooling provided divided by the total energy consumed and noted that they have previously commented that the IEER metric likely does not reflect the total cooling provided divided by the total energy consumed, and instead weights efficiencies calculated at different load-points. (*Id.*)

NEEA supported DOE's proposed transition from regulating WSHP efficiency based on a full-load EER metric to a multi-capacity IEER metric. (NEEA, No. 25 at p. 2) NEEA commented that an IEER metric is more representative of overall equipment performance, and that optimizing part-load efficiencies is beneficial to both consumers and utilities because heating/cooling equipment operates at peak capacity for a small number of hours. (*Id.*) NEEA recommended that DOE move to the IEER metric for regulatory purposes while still encouraging manufacturers to also publish full-load EER data, given the importance of EER data for peak load performance and planning for utilities. (*Id.*) NEEA commented that it is encouraged by DOE's monitoring of the development of the AHRI Standard 600 and stated that this standard will allow for even more representative ratings of regional seasonal heating and cooling efficiencies. (*Id.*)

NYSERDA supported DOE's proposal to adopt for WSHPs the testing methods specified in AHRI 340/360–2022 for calculating IEER, stating that a seasonal efficiency metric is more representative of the part-load operation and varying temperature conditions seen in actual field performance of WSHPs. (NYSERDA, No. 21 at p. 2)

As discussed in section III.D, DOE is incorporating by reference AHRI 600–2023 into its amended WSHP test procedure. Section 6.3 of AHRI 600–2023 uses a method for determining IEER that is similar to the interpolation method proposed in the August 2022 NOPR, including tests at three EWTs, interpolating from those EWTs to the IEER EWTs specified in AHRI 340/360–2022, and adjusting the efficiency from the tested and interpolated load percentages to the IEER load percentages.

With regards to ClimateMaster's comment on the interpolation methodology (*i.e.,* interpolating the capacity and power vs. interpolating EER directly), DOE discussed this issue with stakeholders in AHRI 600 meetings after publication of the August 2022 NOPR, and section 6.3.4 of AHRI 600–2023 includes interpolation of capacity and power, consistent with the approach proposed in the August 2022 NOPR.[7] Having been developed through an industry consensus process subsequent to the timing of the August 2022 NOPR comment period, DOE surmises that the interpolation approach specified in AHRI 600–2023 represents the prevailing industry consensus regarding the most appropriate method of performing the interpolation of capacity and power and addresses the issues raised by commenters regarding DOE's proposed methodology for the interpolation method in the August 2022 NOPR.

With regards to the comment from the Joint Commenters recommending that DOE adopt a part-load metric that reflects the total cooling provided divided by the total energy consumed, DOE notes that no industry test procedures for WSHPs include a metric using such an equation format instead of the equation format for IEER (which is a weighted average of EERs at four different EWTs) and the Joint Commenters did not provide sufficient information to support development of such an equation format for WSHPs. Therefore, at this time, DOE has concluded that it lacks the necessary information to adopt an integrated metric other than IEER for WSHPs.

While much of the methodology to determine IEER adopted in this final rule is consistent technically with the proposal from the August 2022 NOPR, DOE notes the following differences between the approach adopted in this final rule (consistent with AHRI 600–2023) and the proposals in the August 2022 NOPR:

(1) *Removal of option for testing directly at IEER EWTs.* In this final rule, DOE is not adopting the proposed option 1 methodology of directly testing at the IEER EWTs (*i.e.,* 85 °F, 73.5 °F, 62 °F, 55 °F). Rather, consistent with section 6.3 of AHRI 600–2023, the test procedure adopted in this final rule specifies that IEER is determined via interpolation from tests at ISO 13256–1 EWTs, which is similar to option 2 as proposed in the August 2022 NOPR. With regards to NYSERDA's comment supporting adopting AHRI 340/360–2022 to calculate IEER, DOE notes that the methodology specified in AHRI 600–2023 is very similar and produces near identical results to the methodology of AHRI 340/360–2022, as demonstrated through DOE's data presented in the August 2022 NOPR. *See* 87 FR 53302, 53316.

(2) *Change in full-load test EWTs.* The full-load test temperatures used for interpolation in section 6.2.1 of AHRI 600–2023 are consistent with ISO 13256–1:2021 (*i.e.,* 86 °F, 68 °F, 50 °F) instead of ISO 13256–1:1998 (*i.e.,* 86 °F, 77 °F, 59 °F), which was proposed in the August 2022 NOPR. This is also consistent with the comment from MIAQ that encouraged the use of ISO 13256–1:2021 EWTs.

(3) *Change in part-load test EWTs.* The part-load test EWTs used for interpolation in section 6.3.2 of AHRI 600–2023 are the same as the full-load EWTs (*i.e.,* 86 °F, 68 °F, 50 °F). This differs from the approach in the August 2022 NOPR, which proposed to align

[7] As discussed later in this section, the lowest EWT in AHRI 600–2023 is 50 °F, which is lower than the lowest IEER EWT (55 °F), such that the AHRI 600–2023 approach does not require extrapolation for determining IEER.

with the EWTs specified in ISO 13256–1:1998 (*i.e.,* 86 °F, 77 °F, and 59 °F for full-load tests; 86 °F, 68 °F, and 59 °F for part-load tests). MIAQ encouraged the use of ISO 13256–1:2021, which specifies part-load test EWTs of 77 °F, 59 °F, and 41 °F. The part-load EWTs in section 6.3.2 of AHRI 600–2023 (86 °F, 68 °F, 50 °F) are not consistent with either the 1998 or 2021 versions of ISO 13256–1, and instead reflect the conclusion of discussions in AHRI 600 committee meetings that conducting part-load tests at the same EWTs as full-load tests would reduce testing burden (by reducing the number of times the water temperature would need to be reconditioned between tests) and better align with the IEER methodology in AHRI 340/360–2022. DOE surmises that the part-load EWTs specified in section 6.3.2 of AHRI 600–2023 represent the prevailing industry consensus regarding the most appropriate EWTs for testing WSHPs. In addition, as compared to the part-load EWTs proposed in the August 2022 NOPR (the lowest of which was 59 °F), the lowest part-load EWT in AHRI 600–2023 (50 °F) is lower than the lowest IEER EWT (55 °F). Therefore, use of the part-load EWTs in AHRI 600–2023 means that all IEER EWTs can be interpolated from the tested EWTs, instead of requiring any extrapolation. As a result, in this final rule DOE is adopting the part-load EWTs as outlined in the AHRI 600–2023 through incorporation by reference.

(4) *Updated provisions for variable speed units.* The approach for determining IEER for variable-speed WSHPs specified in AHRI 600–2023 differs from the approach proposed in the August 2022 NOPR in that additional tests are required at intermediate compressor speeds. Specifically, section 6.3.2 of AHRI 600–2023 requires that three tests be performed at each EWT, at the three following compressor speeds: (1) maximum compressor speed (*i.e.,* full-load test); (2) minimum compressor speed; and (3) an intermediate compressor speed that reflects the compressor stage with a capacity closest to half-way between the capacities measured at the minimum and maximum compressor speeds. This third test reduces the range of compressor speeds over which interpolation must be conducted (*i.e.,* interpolating between intermediate compressor speed and maximum or minimum compressor speeds, instead of between maximum compressor speed and minimum compressor speed), thus reducing the extent to which interpolated results might differ from unit performance at the IEER EWTs. DOE surmises that the approach for variable speed units specified in section 6.3.2 of AHRI 600–2023 represents the prevailing industry consensus regarding the most appropriate method. Therefore, in this final rule, DOE is adopting the IEER determination method for variable-speed units from AHRI 600–2023 through incorporation by reference into appendix C1 of section 6.3.2. Additionally, DOE presumes this updated methodology resolves Climatemaster's request for DOE's variable speed test data, as DOE is adopting the industry consensus methodology.[8]

(5) *Change in cyclic degradation equation.* See section III.E.1.a of this document for detailed discussion.

Finally, DOE is defining ''IEER'' in 10 CFR 431.92 as a weighted average calculation of mechanical cooling EERs determined for four load levels and corresponding rating conditions, expressed in Btu/watt-hour and that IEER is measured per appendix C1 to subpart F of part 431 for water-source heat pumps.

a. Cyclic Degradation

In the August 2022 NOPR, DOE proposed to adopt specific sections of AHRI 340/360–2022 in its amended test procedure for WSHPs, including section 6.2.3.2. 87 FR 53302, 53327. 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. *Id.* 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. *Id.* 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. *Id.* This means that equation 4 of AHRI 340/360–2022 assumes that the indoor fan continues to operate when the compressor cycles off. *Id.*

DOE requested 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. *Id.* at 87 FR 53328.

ClimateMaster commented that the assumption of continuous fan operation in the AHRI 340/360 IEER calculations is neither representative of field operation nor is it in alignment with guidance provided by ASHRAE 90.1. (ClimateMaster, No. 22 at p. 3) ClimateMaster stated that, according to data it collected through consumer surveys, 16 percent of installed systems cycle fan operation with the compressor, 52 percent operate the fan continuously while a building is occupied but cycle the fan with the compressor when unoccupied, and only 14 percent of installed WSHPs run the fan continuously regardless of occupancy and compressor operation, while the remaining 18 percent responded that they were unaware of how their WSHP system cycles operated. (*Id.* at p. 3) ClimateMaster recommended that DOE instead use AHRI 600 method that does not assume continuous fan operation. (*Id.* at p. 8) ClimateMaster commented that, for WSHPs that are installed to operate the fan continuously, models with a multi-speed motor will operate at the cooling fan speed, while variable-speed models have an option to adjust the continuous fan speed to a lower value. (*Id.*)

WaterFurnace commented that supporting ISO 13256 and AHRI 600 would solve the issue. (WaterFurnace, No. 20 at p. 8) WaterFurnace stated that continuous indoor fan operation is not the most appropriate logic in cooling-dominated environments and recommended demand controls ventilation as a better use of energy that improves latent moisture removal. (*Id.*)

In response to these comments, DOE notes that section 6.3.6.4 of AHRI 600–2023 has an equation similar to equation 4 of AHRI 340/360–2022, but the equation in AHRI 600–2023 assumes that the indoor fan stops operating whenever the compressor cycles off. The data provided by ClimateMaster suggest that the vast majority of installed WSHPs do not operate the fan continuously in all operating modes, but that many installed WSHPs do operate the fan continuously during occupied hours (*i.e.,* regardless of whether the compressor is cycled on or off). At the time of publication of the August 2022 NOPR, there were no WSHP industry consensus test procedures that included IEER. However, at this time, DOE surmises that the method in section 6.3.6.4 of AHRI 600–2023, which assumes the fan does not run when the compressor is cycled off, represents

[8] Section 6.3.2.4 of AHRI 600–2023 further specifies that if the continuous capacities of two compressor modulation levels allowed by the controls at a single set of operating conditions are equidistant from the arithmetic mean of the capacities from the minimum and maximum compressor modulation levels at the same set of operating conditions, the intermediate compressor modulation level used for testing is the compressor modulation level with the lower capacity.

industry consensus on the appropriate method for determining IEER for WSHPs. At this time, DOE has concluded that it lacks sufficient information to justify deviating from the approach in AHRI 600–2023 regarding fan operation. DOE is therefore incorporated by reference the cyclic degradation equation from section 6.3.6.4 of AHRI 600–2023 into its amended test procedure in this final rule.

2. ACOP

DOE's current test procedure for WSHPs measures heating-mode performance in terms of the COP metric. 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. DOE's current test procedure specifies an EWT of 68 °F for measuring COP. 10 CFR 431.96.

In the August 2022 NOPR, DOE discussed its understanding 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. 87 FR 53302, 53316. Therefore, while the current EWT of 68 °F 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 tentatively determined in the August 2022 NOPR that the EWT specified for determining COP should be no higher than the lowest EWT used in the IEER metric, which is 55 °F (for the 25-percent load point). *Id.* Therefore, DOE tentatively concluded in the August 2022 NOPR that the COP metric would be more representative of water-loop WSHP applications if based on an EWT of 55 °F. *Id.* at 87 FR 53317. Accordingly, in the August 2022 NOPR, DOE proposed use an EWT of 55 °F for the COP metric in appendix C1. *Id.*

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. *Id.* However, DOE noted in the August 2022 NOPR that it lacked data or evidence indicating that 50 °F would be a more representative heating EWT than 55 °F for WSHPs. *Id.*

Additionally, DOE proposed to include an alternate method in appendix C1 that would allow manufacturers to determine COP at the proposed EWT of 55 °F by interpolation from results of testing at the EWTs specified in Table 2 of ISO 13256–1:1998 (*i.e.,* 50 °F and 68 °F). *Id.* In the August 2022 NOPR, DOE presented the results of investigative testing demonstrating that COP calculated from interpolated values of cooling capacity and total power differed from measured COP by an average of less than 1 percent. *Id.* Based on these test results, DOE tentatively concluded that determining COP at 55 °F via interpolation from testing at the ISO 13256–1:1998 EWTs (in accordance with DOE's proposed test procedure) would provide appropriately representative results that are comparable to testing at 55 °F. *Id.*

In summary, DOE proposed 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. *Id.*

DOE sought comment and data on the representativeness of 55 °F as the EWT condition for determining COP. *Id.* Specifically, DOE requested feedback and data on whether a lower EWT, such as 50 °F, would be more representative of heating operation of WSHPs. *Id.* DOE stated that it would further consider any alternate EWT suggested by comments in developing any final rule. *Id.* DOE also requested comment on the proposal to allow determination of COP using the two different methods. *Id.* Specifically, DOE sought 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. *Id.*

In response to the August 2022 NOPR, ClimateMaster recommended that DOE maintain use of the ISO 13256–1:1998 EWT of 68 °F as the basis for the regulated metric, asserting that this would take into account the fact that building designers select and simulate system equipment and performance based upon data published by manufacturers. (ClimateMaster, No. 22 at p. 5) ClimateMaster stated that the EWT used for heating operation in a WSHP is dependent on many factors (*e.g.,* building design, location, system design, system operation, and building occupancy or use) and that, due to these factors, there are no data available to determine the representativeness of 55 °F as the EWT condition in contrast to a lower or higher EWT. (*Id.*)

Regarding DOE's proposal to allow two different options for determining COP, ClimateMaster stated that it disagreed with both proposed options for allowing determination of COP, stating that neither option would provide a reduction in burden considering DOE's proposal to change entering air temperatures. (*Id.*) ClimateMaster further commented that the proposed changes would require the industry to test under multiple standards to meet both certification programs. (*Id.* at pp. 5–6)

MIAQ recommended aligning the EWT conditions with the latest edition of ISO standard EWT conditions. (MIAQ, No. 23 at p. 4)

WaterFurnace commented that non-expansion valve products typically cannot operate below an EWT of 60 °F and that a percentage of the market has always had limited water temperature range capability. (WaterFurnace, No. 20 at p. 7) WaterFurnace also commented that adopting ISO 13256–1 and AHRI 600 would solve the issue of COP test temperature. (*Id.*)

Regarding considerations for selecting the EWT condition for determining COP, FHP commented that the use of higher EWTs is focused on water loop condition only and the move to electrification for commercial buildings will shift commercial designs for water source products toward ground coupled systems, driving temperatures closer to ISO 13256–1 ground loops conditions (*e.g.,* 32 °F entering water). (FHP, No. 26 at p. 4)

NYSERDA agreed with DOE's proposal to adopt an EWT of 55 °F or lower, stating that geothermal technology research and development undertaken by NYSERDA and the Cleaner, Greener Communities Program in Syracuse revealed the average EWT for the average mixed-use building was 48 °F when heating. (NYSERDA, No. 21 at p. 3) NYSERDA commented that it had collected data supporting that the average building consistently uses EWTs of 55 °F or lower and presented these data in a table that suggested the current EWT test condition of 68 °F is unrepresentatively high. (*Id.* at pp. 3–4)

In response to WaterFurnace's comment that some products cannot operate below 60 °F, DOE notes that the heating temperatures in section 6.2.1 of AHRI 600–2023 include temperatures below 60 °F, at 50 °F and 32 °F. Inclusion of these EWTs in the updated industry standard suggests that there is industry agreement that WSHPs can generally operate below 60 °F. DOE is not aware of any WSHPs that cannot operate in heating mode at 50 °F and notes that the issue was not raised in

AHRI 600 committee meetings after the August 2022 NOPR. As discussed earlier in this section, comments from other interested parties also supported the use of a lower temperature.

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023. Section 6.2.1 of AHRI 600–2023 includes EWTs of 68 °F, 50 °F, and 32 °F for measuring COP. Additionally included in section 6.4.5 of AHRI 600–2023 is a new metric, ACOP, which is only measured at 50 °F. This new metric is similar to COP but includes provisions accounting for system pump power, which better accounts for total energy use of WSHPs and aligns with changes made to the cooling efficiency metric (see section III.F.3 of this document for more details). Further, ACOP is included in section 7.1 of AHRI 600–2023 as a minimum requirement for published ratings. Therefore, ACOP, measured at 50 °F, is the heating metric required for WSHPs according to AHRI 600–2023. Having been developed through an industry consensus process subsequent to the timing of the August 2022 NOPR comment period, DOE surmises that ACOP tested at an EWT of 50 °F specified in AHRI 600–2023 represents the prevailing industry consensus regarding the most appropriate metric for measuring heating performance. Therefore, in this final rule, DOE is incorporating by reference sections 6.2.1 and 6.4.5 of AHRI 600–2023 into appendix C1 adopting the ACOP metric, tested at an EWT of 50 °F.

DOE notes that no heating EWT of 55 °F is included in section 6.2.1 of AHRI 600–2023 and, instead, Table 8 of the document maintains the same heating test temperatures as ISO 13256–1:1998 (68 °F, 50 °F, and 32 °F). Therefore, due to the lack of support of a test temperature at 55 °F, the exclusion of that temperature in AHRI 600–2023, and the support for aligning with ISO 13256–1:1998 test temperatures (which include 50 °F), DOE is finalizing the ACOP metric based on a test at 50 °F, consistent with AHRI 600–2023.

As discussed, use of the amended test procedure in appendix C1 and rating to ACOP at 50 °F are not required until the compliance date of amended standards denominated in terms of ACOP, should DOE adopt such standards. DOE is defining ''ACOP'' in 10 CFR 431.92 as the ratio of the heating capacity to the power input, including system pump power, for water-source heat pumps and that ACOP is expressed in watts per watt and determined according to appendix C1 of subpart F of part 431.

Because AHRI 600–2023 requires a heating test at 50 °F, there is no need for an interpolation method to determine ACOP at an EWT different from the tested EWT, and, therefore, AHRI 600–2023 includes no such interpolation method for ACOP. Correspondingly, because DOE is incorporating by reference AHRI 600–2023 into appendix C1 to require a heating test be conducted at 50 °F and to adopt the ACOP metric based on the same EWT, the COP interpolation method proposed in the August 2022 NOPR is no longer applicable. Therefore, DOE is not adopting an interpolation method for determining ACOP in this final rule.

3. Optional Representations

In the August 2022 NOPR, DOE proposed provisions to allow 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). 87 FR 53302, 53314. Additionally, DOE proposed provisions 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). *Id.* at 87 FR 53317.

AHRI 600–2023 includes provisions allowing for optional representations of EER and COP in sections 6.3.12 and 6.4.7, respectively. Optional representations can be made at any of the cooling and heating full-load and part-load EWT conditions in Table 8 of AHRI 600–2023. DOE notes that the AHRI 600–2023 includes new metrics applied energy efficiency ratio (''AEER'') and ACOP (see section III.E.2 of this final rule for more details about ACOP). Each of these metrics include a power adder representing system pumps and the adder for AEER also includes cooling tower power. DOE notes that AHRI 600–2023 does not have provisions for optional representations of these metrics and instead requires them to be published. The optional representations of EER and COP allowed for by AHRI 600–2023 do not include the power adder for system pumps and cooling tower power.

As discussed in section III.E.1 and III.E.2 of this final rule, DOE is incorporating by reference AHRI 600–2023 for IEER and ACOP into appendix C1 as the cooling and heating metrics for WSHPs. The IEER metric as determined according to AHRI 600–2023 includes a power adder for system pumps and cooling tower power. DOE notes that the metrics it is adopting are intended to best reflect WSHP performance, using representative EWTs and including power for all components that are needed for operation of WSHP systems in a representative application (*i.e.,* external pumps and cooling towers). Optional representations of EER and COP are intended to provide more information to consumers across a range of temperature conditions such that performance can be assessed for specific applications. DOE is adopting the provisions for optional representations of EER and COP from sections 6.3.12 and 6.4.7 from AHRI 600–2023 by incorporating by reference AHRI 600–2023 into appendix C1. These provisions allow optional representations to be made consistent with AHRI 600–2023 at full-load or part-load at any of the standard rating conditions for WSHPs (*i.e.,* 86 °F, 68 °F, and 50 °F for cooling and 68 °F, 50 °F, and 32 °F for heating). DOE notes that these temperatures vary slightly from the proposals in the August 2022 NOPR for optional representations, but represent the same intent of allowing for optional representations of a range of operating conditions. Having been developed through an industry consensus process subsequent to the timing of the August 2022 NOPR comment period, DOE has determined that the EWTs specified in AHRI 600–2023 represent the prevailing industry consensus regarding the most appropriate EWTs for optional performance test points.

4. Entering Air Conditions

The current DOE WSHP 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.

In the August 2022 NOPR, DOE proposed to use the entering air conditions in Table 6 of AHRI 340/360–2022, which specify that cooling tests are measured with entering air at 80 °F dry-bulb temperature and 67 °F wet-bulb temperature heating tests are measured with entering air at 70 °F dry-bulb temperature and a maximum of 60 °F wet-bulb temperature. 87 FR 53302, 53318. DOE discussed in the August 2022 NOPR that 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. *Id.* DOE surmised 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. *Id.* DOE also noted that 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/HP equipment. *Id.* 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/HP equipment. *Id.* Therefore, DOE tentatively determined in the August 2022 NOPR that the entering air conditions in AHRI 340/360–2022 are appropriately representative of the average conditions in which WSHPs operate in the field. *Id.*

DOE requested comment on its proposal to specify 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). *Id.*

In response to the August 2022 NOPR, ClimateMaster recommended that DOE keep the existing entering air temperature conditions for both heating and cooling tests from ISO 13256–1:1998 to avoid the requirement to test equipment under two separate certification programs. (ClimateMaster, No. 22 at p. 6) ClimateMaster stated that the use of 80.6 °F and 66.2 °F entering air conditions for cooling would be more conservative (*i.e.,* result in lower efficiency ratings) than those at 80 °F and 67 °F as specified in AHRI 340/360–2022. (*Id.*)

WaterFurnace commented that adopting ISO 13256 and AHRI 600 would solve the issue of which entering air conditions to use. (WaterFurnace, No. 20 at p. 7) WaterFurnace further commented that DOE's proposal would essentially require all new testing due to the different entering air conditions. (*Id.*) WaterFurnace stated that the existing entering air conditions of AHRI/ISO 13256 could be used and would result in a more conservative performance prediction. (*Id.*)

MIAQ commented that it generally agrees with DOE's proposal to adopt the entering air conditions in AHRI 340/360–2022. (MIAQ, No. 23 at p. 5)

As discussed, DOE is adopting provisions for determining IEER and ACOP by incorporating by reference AHRI 600–2023 into appendix C1. The entering air conditions in section 6.2.1 of AHRI 600–2023 align with the entering air conditions specified in AHRI 340/360–2022 (and therefore align with DOE's August 2022 NOPR proposal). DOE surmises that inclusion of the AHRI 340/360–2022 entering air conditions in AHRI 600–2023 indicates industry consensus with these test conditions. Therefore, DOE is adopting provisions for determining IEER and ACOP consistent with AHRI 600–2023, including entering air conditions of 80 °F dry bulb and 67 °F wet bulb for cooling tests and 70 °F dry bulb and a maximum of 60 °F wet bulb for heating tests, in this final rule, by incorporating by reference into appendix C1 section 6.2.1 of AHRI 600–2023.

F. Test Method

1. Airflow and External Static Pressure

a. Fan Power Adjustment and Required Air External Static Pressures

For ducted units, the current DOE WSHP test procedure, which incorporates by reference ISO 13256–1:1998, specifies 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. In the August 2022 NOPR, DOE proposed provisions to reflect fan power to overcome a representative ESP when calculating efficiency for ducted units to account for the impacts of ESP typically encountered in the field. 87 FR 53302, 53321. DOE determined that, to best reflect field operation, ducted 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. *Id.* DOE determined that the method in AHRI 340/360–2022 is more representative of field energy use than the methods used in ISO 13256–1:1998 for WSHPs. *Id.* DOE proposed 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. *Id.* DOE requested comment on the proposal to adopt provisions from AHRI 340/360–2022 such that for ducted units 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. *Id.* at 87 FR 53322.

In response to the August 2022 NOPR, ClimateMaster recommended that DOE keep the existing ISO 13256–1:1998 standard and develop an IEER rating per AHRI 600 that offers provisions for complying with the required minimum external pressure as given in AHRI 340/360–2022. (ClimateMaster, No. 22 at p. 6) ClimateMaster stated that there are multiple reasons why the current ISO 13256–1:1998 standard excludes external static pressure, including that the methodology was created to rate different motor options for varying static requirements in the market space, which is especially problematic with non-variable speed motors as they are limited in output capability over a narrow static range. (*Id.*) MIAQ recommended DOE reference the ESP requirements in the latest edition of ISO 13256–1. (MIAQ, No. 23 at p. 5) WaterFurnace commented that supporting ISO 13256 and AHRI 600 would solve the issue and that it believes the required information can be calculated from AHRI/ISO 13256 data without retesting. (WaterFurnace, No. 20 at p. 7) WaterFurnace additionally commented that the minimum ESP requirements specified in AHRI 340/360 are adequate for most commercial WSHPs because most are installed with common plenum returns with little to no return ductwork. (*Id.*)

FHP recommended that instead of requiring testing at minimum ESP requirements, DOE develop a revised fan power adjustment that incorporates accurate fan efficiencies and allows testing at a range of ESPs but adjusts fan performance to reflect performance at the minimum ESPs specified in AHRI 340/360–2022. (FHP, No. 26 at pp. 3–4) FHP asserted that such a revised fan power adjustment would allow for variations in tested ESP to achieve rated airflow to account for limitations of the fan-motor combination and variation in manufacturing tolerances, while still ensuring ratings are based on an ESP more representative than zero ESP. (*Id.*)

The Joint Commenters supported DOE's proposal that WSHPs be tested at the ESPs specified in the proposed test procedure. (Joint Commenters, No. 27 at p. 2) The Joint Commenters stated that maintaining the current test procedure,

which applies a correction factor that adjusts fan power measured at the manufacturer-specified ESP is adjusted down to reflect fan power at zero ESP and incentivizes testing with higher-than-representative ESPs, would be inconsistent with the recommendation in the ASRAC Fans and Blowers Working Group term sheet to capture fan energy more fully across commercial HVAC product categories. (*Id.*)

NEEA supported DOE's proposal to include additional fan energy in the WSHP efficiency metric, but also encouraged DOE to consider increasing the proposed ESP requirements to be more representative of current industry practice. (NEEA, No. 25 at pp. 2–3) NEEA stated that during the 2015 CUAC/HP energy conservation standard ASRAC negotiations, DOE's energy use analysis used ESP values 2 to 3 times higher than the ESP requirements in the current test procedure because DOE found the values to be more realistic and representative of field conditions. (*Id.* at p. 3) NEEA further recommended that DOE consider aligning WSHP ESP requirements with the updated CUAC/HP ESP requirements when they are finalized by the ASRAC Working Group. (*Id.*)

With regards to these comments, DOE notes that section 5.5.1 of AHRI 600–2023 includes ESPs to be used for testing for ducted units. The ESPs are equivalent to those outlined in AHRI 340/360–2022 for units less than 75,000 Btu/h cooling capacity, but the ESPs for units above 75,000 Btu/h cooling capacity (*i.e.,* 0.75 in. H_2O for units from 75,000 Btu/h to 134,000 Btu/h; 1.00 in. H_2O for units from 135,000 Btu/h to 280,000 Btu/h; and 1.50 in. H_2O for units greater than 280,000 Btu/h) are significantly higher than those in AHRI 340/360–2022 and align with the ESP requirements recommended in the ACUAC and ACUHP Working Group TP Term Sheet. (See Document No. 65 in Docket No. EERE–2022–BT–STD–0015) Section 5.7 of AHRI 600–2023 also includes a tolerance of ESP of −0.00/+0.05 in H_2O and sections 6.3 and 6.4 of AHRI 600–2023 include no fan power adjustment. DOE notes also that the approach set forth in AHRI 600–2023 is mostly consistent with the approach proposed in the August 2022 NOPR, with the only difference being higher ESP requirements for units greater than 75,000 Btu/h in cooling capacity. DOE has determined that the inclusion of ESP requirements, an ESP tolerance, and no fan power adjustment in AHRI 600–2023 represents industry consensus that these provisions provide the most appropriate and representative method for testing WSHPs. As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1, including these ESP provisions. DOE notes that including these provisions is consistent with commenters' suggestions to adopt AHRI 600.

Regarding the higher ESP requirements for units with a cooling capacity greater than 75,000 Btu/h, adopting these values is consistent with NEEA's recommendation to align with the recommendations from the ASRAC Working Group for test procedures for CUAC/HPs. These ESP requirements were developed as part of a joint effort between manufacturers, efficiency advocates, utilities, and DOE to create a more representative efficiency metric for CUACs/HPs. DOE understands that WSHPs greater than 75,000 Btu/h are installed in similar applications to CUACs/HPs and, as such, DOE finds the AHRI 600–2023 ESP requirements to be representative for WSHPs with a cooling capacity greater than 75,000 Btu/h.

DOE notes that the ACUAC and ACUHP Working Group TP Term Sheet recommends an ESP requirement of 0.75 in. H_2O for units with a cooling capacity between 65,000 to 135,000 Btu/h, while the lower capacity limit for this requirement in section 5.5.1 of AHRI 600–2023 is 75,000 Btu/h. Based on discussions in AHRI 600 committee meetings, DOE understands that there are WSHP model lines that span up to 6 tons that typically use fan/motor combinations that are designed for lower ESP applications and cannot operate at the rated airflow at an ESP as high as 0.75 in. H_2O. Therefore, AHRI 600–2023 specifies a lower capacity limit for this ESP requirement of 75,000 Btu/h rather than 65,000 Btu/h so that these 6-ton models are tested with a more representative ESP. DOE understands this issue to be unique to WSHPs and does not apply to ACUACs and ACUHPs, for which models with a cooling capacity between 65,000 Btu/h and 75,000 Btu/h typically have different designs than three-phase ACUACs and ACUHPs (which typically have comparable designs to CAC/HPs) and are typically designed for installations for which an ESP of 0.75 in. H_2O is representative. Therefore, in this final rule, DOE is incorporating by reference the requirements specified in Table 7 of section 5.5.1 of AHRI 600–2023 for all WSHPs with a cooling capacity less than 760,000 Btu/h.

With regard to comments from ClimateMaster and FHP expressing concern over ability of different fan/motor combinations to test at an ESP requirement at the rated airflow, DOE notes that this issue is addressed by the provisions for (1) non-standard high-static indoor fan motors and fan/motor combinations proposed in the August 2022 NOPR, included in section D4 of AHRI 600–2023 (discussed in section III.G.3 of this final rule); and (2) non-standard low-static motors included in sections 3.2.30 and 5.7.4.3 of AHRI 600–2023 (discussed in section III.F.12 of this final rule). DOE has concluded that the inclusion of ESP requirements and provisions in AHRI 600–2023 for (1) non-standard high-static indoor fan motors and fan/motor combinations and (2) non-standard low-static motors reflect industry consensus that these provisions provide an appropriate method for testing and rating WSHPs.

DOE notes that section 5.5.1.2 of AHRI 600–2023 specifies a minimum ESP of 0.5 in. H_2O for residential representations, but that the residential representations have not yet been fully developed for WSHPs (see section III.A.2 of this document for more details). DOE will continue to work with AHRI 600 committee to develop provisions for determining such ratings.

b. Setting Airflow and ESP

DOE's current WSHP test procedure does not include provisions on how to simultaneously set airflow and ESP because there are no required ESPs for testing. Because DOE proposed to include minimum ESPs in its test procedure in the August 2022 NOPR, it also proposed provisions to address how to simultaneously set airflow and ESP. 87 FR 53302, 53322–53324. The proposals were broken into three groups:

(1) For ducted units with continuously variable speed fans, DOE proposed to use relevant provisions from AHRI 340/360–2022 in sections 6.1.3.3 through 6.1.3.5.

(2) For ducted units with discrete step fans, DOE proposed instructions for setting the fan speed in the scenario in which: (1) tolerances for airflow and ESP could not 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.

(3) For non-ducted units, DOE proposed units to be tested with a target ESP of 0.00 in H_2O within a tolerance of −0.00/+0.05 in H_2O.

Id.

For all three types of units, the proposed airflow tolerance was 3 percent. *Id.*

DOE requested comment on the proposed adoption of provisions from AHRI 340/360–2022 for setting airflow and ESP for testing WSHP units with

continuously variable speed fans. *Id.* at 87 FR 53323. DOE also requested comment on its proposed instructions (distinct from provisions in AHRI 340/360–2022) for setting airflow and ESP for ducted WSHP units with discrete-step fans. *Id.* Finally, DOE requested comment on its proposal for setting airflow and ESP for non-ducted WSHP units. *Id.* at 87 FR 53324.

In response to the August 2022 NOPR, ClimateMaster recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that adopts the applicable parts of AHRI 340/360 for fully variable-speed motor systems and systems with adjustable sheaves, while still providing separate provisions for setting airflow for fan motor systems that are not continuously variable. (ClimateMaster, No. 22 at p. 7) ClimateMaster stated that it disagrees with the use of AHRI 340/360–2022 for all indoor blower systems, arguing that these provisions were developed to accommodate only continuously variable-speed blower systems and asserted that the proposed 3 percent tolerance would not be feasible for larger WSHP systems without continuously variable motors or WSHPs with discrete-step or constant volume fan motors. (*Id.* at p. 6) ClimateMaster stated that Table B1 of the AHRI WSHP Operations Manual [9] specifies a 5 percent airflow tolerance for discrete-step motors. (*Id.* at p. 7) ClimateMaster further commented that the provisions for setting airflow in AHRI 210/240–2023 are more appropriate for the fan motors utilized in most WSHP systems (*i.e.,* not continuously variable), stating that the AHRI 210/240–2023 provisions use manufacturer-specified fan motor settings and allow airflow to decrease to 10 percent below the target airflow. (*Id.* at p. 7)

FHP commented that the combination of a minimum ESP requirement and a 3 percent airflow tolerance would require additional testing and significant design constraints and changes at the component level for WSHPs with direct-drive motors and questioned whether a 3 percent airflow tolerance at a minimum ESP requirement is technologically feasible. (FHP, No. 26 at p. 4) FHP further commented that units with constant-torque direct-drive fan motors (*e.g.,* permanent split capacitor (''PSC'') motors, electrically commutated motors (''ECMs'')) do not allow for adjustments to airflow without adjustments to ESP, making it difficult to consistently hit the airflow target within 3 percent. (*Id.*) FHP also noted that the AHRI WSHP Operations Manual allows for adjustments to ESP to meet a 5-percent airflow tolerance for these systems. (*Id.*)

WaterFurnace commented that adopting ISO 13256 and AHRI 600 would solve the issue. (WaterFurnace, No. 20 at p. 8) WaterFurnace stated that a test procedure for models fans with ECMs would have to be added to AHRI 340/360 because the standard does not address setting airflow and ESP for such models, which it stated are typical for smaller WSHPs. (*Id.*) MIAQ recommended DOE reference the latest edition of ISO 13256–1, stating that this standard is the industry test procedure currently used by manufacturers and laboratories for WSHP testing. (MIAQ, No. 23 at p. 5)

ClimateMaster stated that the WSHP Operations Manual covers available provisions with what they consider to be a proper allowance for airflow variation and that non-ducted WSHPs are available with motors that have multiple set speeds either through software or by utilizing a tapped motor winding. (ClimateMaster, No. 22 at p. 7) ClimateMaster stated that these provisions are slightly different from those proposed in the August 2022 NOPR and requested further clarification to the meaning of ''as close as possible''. (*Id.*) ClimateMaster noted that they expect that the speed tap specified by the manufacturer would be utilized and that, if this is the case, then there should not be any concern if the airflow is ''as close as possible'' to the rated point. (*Id.*)

In response to the comment from ClimateMaster, DOE notes that the ''as close to the target as possible'' language in the August 2022 NOPR is used in situations when the airflow and ESP requirements cannot be simultaneously met. Specifically, for non-ducted units, the August 2022 NOPR provisions specify that if airflow and ESP requirements cannot be met simultaneously, the ESP requirement takes precedence (*i.e.,* ESP must be maintained within tolerance) and the airflow is maintained as close as possible to the target airflow (but outside of tolerance). Section 5.8 of AHRI 600–2023 similarly specifies that in this situation the ESP must be maintained within tolerance and that there is no condition tolerance for airflow.

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes sections 5.7 and 5.8 of AHRI 600–2023. This language includes provisions generally consistent with provisions outlined in the August 2022 NOPR, specifically a tolerance of 3 percent for setting airflow, separate provisions for continuously variable speed fans and discrete-step fans, and a method for non-ducted units. Section 5.7 of AHRI 600–2023 also includes provisions for setting airflow and ESP for constant-volume fans, but DOE notes that these provisions were not proposed in the August 2022 NOPR and are consistent with provisions in appendix M1 for central air conditioners and heat pumps.

Regarding commenter's concerns about models with non-continuously-variable fan motors, the comments received suggest that the commenters interpreted DOE's proposal to be adopting the provisions for setting airflow and ESP in AHRI 340/360–2022 without modification. However, as discussed in the August 2022 NOPR, DOE proposed additional provisions to allow a larger airflow tolerance for models with non-continuously-variable fan motors that align more closely with the provisions for setting airflow in AHRI 210/240–2023 (as recommended by ClimateMaster). *See* 87 FR 53302, 53323. Similar provisions are included in AHRI 600–2023. DOE has concluded that these provisions, along with the previously mentioned provisions for constant-volume fans, provide an appropriate method for setting airflow and ESP for WSHPs of all fan motor types.

DOE has determined that incorporating by reference AHRI 600–2023 for setting airflow and ESP addresses commenters' concerns. DOE surmises that the inclusion of these provisions for setting airflow and ESP in AHRI 600–2023 indicates industry consensus that these provisions provide an appropriate method for testing WSHPs. Therefore, in this final rule, DOE is incorporating by reference into appendix C1 sections 5.7 and 5.8 of AHRI 600–2023 for setting airflow and ESP.

c. Coil-Only Units

For units without integral fans (*i.e.,* coil-only units), section 4.1.3.1 of ISO 13256–1:1998, which is referenced in the current DOE WSHP test procedure, specifies that a fan power adjustment be added to the total power of the unit, and that this value be added to the heating capacity and subtracted from the cooling capacity. The fan power adjustment equation to determine fan power estimates fan power to overcome internal pressure drop within the unit, using a similar methodology to the fan power adjustment equation used for

[9] DOE notes that the AHRI WSHP Certification Operations Manual is available at: *https://www.ahrinet.org/sites/default/files/2022-06/WSHP_OM.pdf* (Last accessed April 25, 2023).

units with integral fans to subtract out the fan power to overcome ESP. As discussed in section III.F.1.a of this final rule, the amended test procedure adopted in appendix C1 (incorporating by reference AHRI 600–2023) does not use a fan power adjustment for units with integral fans and requires testing at representative minimum external static pressures and ratings reflect performance at the tested ESP.

As part of DOE's proposal to adopt AHRI 340/360–2022, in the August 2022 NOPR, DOE proposed to adopt sections 6.1.1.6, 6.1.3.3 and 6.1.3.4 of AHRI 340/360–2022, which contain provisions for how to test coil-only units. 87 FR 53302, 53322. In particular, section 6.1.3.3.4 specifies that coil-only units shall not have a pressure drop exceeding 0.30 in H_2O for the full load cooling test. Section 6.1.3.4.6 outlines that coil-only units are to be tested at manufacturer specified airflow rates, not exceeding 450 standard cubic feet per minute (''scfm'') per ton of cooling capacity and if there is no manufacturer specified airflow rate, they are to be tested at 400 scfm per ton of rated cooling capacity. Finally, section 6.1.1.6 specifies that 1,250 Btu/h per 1,000 scfm is to be removed from the measured cooling capacity and 365 Watts (''W'') per 1,000 scfm is to be added to the measured power for ducted coil-only units.

AHRI 600–2023 includes provisions for coil-only units, which are defined as units without an indoor fan or separate designated air mover. The provisions are nearly identical to those proposed in the August 2022 NOPR. Section 5.5.2 specifies that coil-only units shall not have a pressure drop exceeding 0.30 in H_2O for the full-load cooling test. Section 5.6.3 outlines that coil-only units are to be tested at manufacturer specified airflow rates, not exceeding 450 scfm per ton of cooling capacity and if there is no manufacturer specified airflow rate, they are to be tested at 400 scfm per ton of rated cooling capacity. Finally, sections 6.3.3.4 and 6.4.3.4 specify that for ducted coil-only units, measured capacity is adjusted by 1,245 Btu/h per 1,000 scfm (subtracted from cooling capacity and added to heating capacity) and measured power is adjusted by adding 365 W per 1,000 scfm. Additionally, AHRI 600–2023 includes provisions for non-ducted coil only units—for these, the values are 940 Btu/h per 1,000 scfm for capacity adjustment and 275 W per 1,000 scfm for power adder respectively.

DOE notes that the provisions outlined in AHRI 600–2023 are consistent with those proposed in the August 2022 NOPR except for a minor deviation in the capacity reduction for ducted coil-only units and the inclusion of provisions for non-ducted coil-only units. Based on discussion in AHRI 600 committee meetings, DOE understands that non-ducted coil-only WSHP models exist on the market, and therefore, DOE has determined that the addition of provisions for testing such units is warranted. As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes section 5.5.2, 5.6.3, and 6.3.3.4 of AHRI 600–2023. DOE notes the inclusion of these provisions in AHRI 600–2023 indicates industry consensus with these provisions and provides an appropriate method for testing coil-only WSHPs. Therefore, DOE is incorporating by reference into appendix C1 the provisions for coil-only units from AHRI 600–2023 in this final rule.

2. Capacity Measurement

The current DOE WSHP 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. 10 CFR 431.96. 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. ANSI/ASHRAE 37–2009 is similar to the test method in ISO 13256–1:1998. 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).

In the August 2022 NOPR, DOE proposed 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. 87 FR 53302, 53325–53327. 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. DOE proposed to adopt all of these provisions by incorporating by reference AHRI 340/360–2022. *Id.* at 87 FR 53325. DOE requested comment on this approach to adopt the provisions in AHRI 340/360–2022 and ANSI/ASHRAE 37–2009 regarding primary and secondary capacity measurements. *Id.* at 87 FR 53326.

In response to the August 2022 NOPR, ClimateMaster commented that it agrees with the intent of DOE's proposed approach but disagrees with some specifics and recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that adopts the provisions of ANSI/ASHRAE 37–2009 for primary and secondary capacity measurements, with certain modifications. (ClimateMaster, No. 22 at pp. 7–8) ClimateMaster commented additionally that it disagrees with the provisions in AHRI 340/360–2022 that only require agreement between the primary and secondary capacity measurements for full-load tests. (*Id.* at p. 8) ClimateMaster noted that the current ISO standard allows for a 5 percent tolerance between the two measurements, and that in its internal testing ClimateMaster strives for agreement within 3–4 percent, stating that anything over that limit indicates an issue in equipment setup and/or the measurement system. (*Id.*) ClimateMaster commented that neglecting to include a match requirement for part-load tests could lead to inaccurate representations of system performance. (*Id.*)

ClimateMaster further commented that the uncertainty of measurement for the liquid coil method is lower than for the indoor air enthalpy method, and that the WSHP industry considers the liquid coil method to be the more accurate measurement method. (*Id.*) ClimateMaster also stated that the liquid coil method does not include the

limitations regarding refrigerant subcooling that are specified for the refrigerant enthalpy method (in section 7.5.1.3 of ANSI/ASHRAE 37–2009), and stated that low values of refrigerant subcooling are typically seen in part-load tests. (*Id.*) ClimateMaster commented that it disagrees with section 7.6.1.2 of ANSI/ASHRAE 37–2009 because this provision specifies that the outdoor liquid coil method cannot be used for outdoor compressor systems, and therefore makes the refrigerant enthalpy method necessary as the secondary capacity measurement method for such systems. (*Id.*) ClimateMaster stated that while it agrees in theory that the compressor and associated refrigerant lines will lose heat when an uninsulated compressor section is installed outdoors, requiring the use of the refrigerant enthalpy method is not representative of installed outdoor compressor systems because for testing the outdoor section of a split WSHP system is installed in the same psychrometric room as the indoor air handler. (*Id.*) ClimateMaster added that there are currently no specified outdoor conditions or requirements for placement of the outdoor unit in a differently conditioned room and that the difference between the current liquid coil method and the proposed refrigerant enthalpy method is negligible without specifying conditions more thoroughly. (*Id.*) ClimateMaster further commented that the insulation requirements in ANSI/ASHRAE 37–2009 only specify 1 inch of fiberglass insulation and do not specify a minimum R-value for the insulation. (*Id.*)

In summary, ClimateMaster recommended that DOE adopt the indoor air enthalpy method for the primary capacity measurement, and that the outdoor coil liquid method be used for the secondary capacity measurement if the unit either (1) meets the requirements of section 7.6.1.2 of ANSI/ASHRAE 37–2009 using fiberglass insulation or an equivalent material with an R-value of 8.0, or (2) is an outdoor unit installed in the same test chamber as the indoor coil. (*Id.*) ClimateMaster further recommended a requirement for agreement within 5 percent between primary and secondary capacity measurements for full-load and part-load tests. (*Id.*)

MIAQ commented that DOE's proposed approach in the August 2022 NOPR of adopting the provisions in AHRI 340/360 and ANSI/ASHRAE 37–2009 regarding primary and secondary capacity measurements deviates from the industry test procedure ISO 13256–1 and therefore will require manufactures to retest their products, resulting in increased burden. (MIAQ, No. 23 at p. 6)

WaterFurnace commented that adopting ISO 13256 and AHRI 600 would solve the issue and that the liquid enthalpy test method is widely accepted as the most accurate method for capacity measurement for WSHPs. (WaterFurnace, No. 20 at p. 8)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into Appendix C1, including provisions in Section 5.2 of AHRI 600–2023 regarding primary and secondary capacity measurement methods. Specifically, Section 5.2 states that the indoor air enthalpy method be used as the primary measurement of capacity, and that secondary capacity measurements be conducting using one of the following methods: outdoor liquid coil method, refrigerant enthalpy method, or compressor calibration method. Section 5.2.2 of AHRI 600–2023 also states that, when using the outdoor liquid coil method, the secondary measurement must agree within 6 percent of the primary measurement of capacity on all tests, including part-load tests. Incorporating by reference this language addresses comments in response to the August 2022 NOPR that DOE should adopt AHRI 600. The provisions in AHRI 600–2023 also address ClimateMaster's concerns about not having a match for part-load tests because AHRI 600–2023 does require a match between primary and secondary capacity measurements for part-load tests if the outdoor liquid coil method is used.

Regarding agreement between primary and secondary measurements, DOE has concluded that the requirement in AHRI 600–2023 that secondary capacity measurements agree within 6 percent of primary capacity measurements (consistent with AHRI 340/360–2022, which DOE proposed to reference in the August 2022 NOPR) provides a representative measure of efficiency for WSHPs.

Regarding ClimateMaster's concerns about the outdoor liquid coil method provisions in ANSI/ASHRAE 37–2009, DOE notes that section 5.2.2.1.1 of AHRI 600–2023 specifies to follow all requirements in section 7.6 of ANSI/ASHRAE 37–2009 when using the outdoor liquid coil method and does not include any provisions that deviate from ANSI/ASHRAE 37–2009 with regard to outdoor compressor systems or insulation R-value. Regarding ClimateMaster's concern that ANSI/ASHRAE 37–2009 requires use of the refrigerant enthalpy method for secondary capacity measurements for systems in which the compressor is located outdoors, DOE further notes that for a split system WSHP with the compressor and liquid coil contained in the outdoor unit intended for outdoor installation, shell losses from the compressor could impact capacity measurements using the outdoor liquid coil method but would not impact capacity measurements using the refrigerant enthalpy method. Therefore, at this time, DOE does not have sufficient evidence or justification to deviate from the provisions in AHRI 600–2023 regarding the outdoor liquid coil method and has concluded that these provisions provide for appropriate and representative measurements of efficiency for WSHPs.

Additionally, AHRI 600–2023 was developed through an industry consensus process subsequent to the timing of the August 2022 NOPR comment period, and DOE surmises that the capacity measurement approach specified in section 5.2 of AHRI 600–2023 sufficiently addresses the concerns raised in comments to the August 2022 NOPR. Consequently, DOE is incorporating by reference into appendix C1 section 5.2 of AHRI 600–2023 regarding primary and secondary capacity measurements in this final rule.

3. Pump Power Adjustment and Liquid External Static Pressure

ISO 13256–1:1998 does not 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 internal static pressure of the unit is included in calculation of efficiency ratings. 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 efficiency ratings than would be measured if ratings reflected pump power to overcome ESP. 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.

As discussed previously, ISO 13256–1:1998 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 the August 2022 NOPR, DOE proposed to adopt provisions for WSHPs in appendix C1 that align with the recently adopted provisions for water-source dedicated outdoor air systems (''DOASes''). 87 FR 53302, 53328–53329. The proposed provisions would require 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. *Id.* at 87 FR 53328. For units without integral pumps, DOE proposed to require 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. *Id.* at 87 FR 53328–53329. Further, DOE proposed to require 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. *Id.* at 87 FR 53329. DOE requested commented 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. *Id.* DOE specifically requested comment on the representativeness of 20 ft of water column as the liquid ESP for WSHPs. *Id.*

In response to the August 20222 NOPR, ClimateMaster disagreed with DOE's proposed values for the liquid ESP for WSHPs, arguing that the pumping and cooling tower fan power adder specified in AHRI 920–2020 is incorrect. (ClimateMaster, No. 22 at p. 8) ClimateMaster commented that, according to a 2014 study conducted by S. Kavanaugh and K. Rafferty, pumping power for a closed loop ground-source heat pump (''GSHP'') system can reach 3.75 W/kBtu/h but not exceed 10 W/1kBtu/h, and that the values given in AHRI 920 are much higher than these values and are thus not representative of an installed system. (*Id.* at pp. 8–9) ClimateMaster recommended that DOE use the approach in AHRI 600, which includes pumping power for the internal pressure drop and adds a representative value for building pump and cooling tower operation. (*Id.* at p. 9) ClimateMaster commented that this AHRI 600 power adder for building pump and cooling tower energy consumption is based on the results of an analysis conducted of typical closed loop systems during the development of the AHRI 600 standard, which resulted in calculated power adders of 5.5 W/kBtu/h for full-load conditions and 1 W/kBtu/h for part-load conditions. (*Id.*)

FHP commented that the work done by the AHRI 600 working group took a more accurate approach to today's systems that allows for varying the fans and pumping energy required during part-load conditions. (FHP, No. 26 at p. 5) FHP recommended that DOE review the values assigned to tower/pump penalty in AHRI 600 for guidance on this topic, stating that a single-head pressure as a means of estimating the pumping penalty does not allow for the variations expected at part-load conditions. (*Id.*) WaterFurnace commented that adopting ISO 13256 and AHRI 600 would solve the issue, noting that the pump power is accounted for in AHRI 600. (WaterFurnace, No. 20 at p.8)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. AHRI 600–2023 includes provisions to separately account for pump power to overcome liquid internal and external static pressure.

Sections 6.3.3 and 6.4.3 of AHRI 600–2023 specify to include pump power to overcome the liquid internal static pressure of the WSHP in all cooling and heating ratings. The calculation for pump power adjustment to account for liquid internal static pressure uses a similar methodology to ISO 13256–1:1998, but uses a higher pump efficiency of 75% (as compared to 30% in ISO 13256–1:1998) to better represent the efficiency of system pumps in commercial water-loop installations. Specifically, for units without integral pumps, the AHRI 600–2023 approach adds pump power to overcome liquid internal static pressure. For units with integral pumps, section 5.4.13 of AHRI 600–2023 specifies a liquid ESP value of zero to use when testing WSHPs with an integral pump for commercial ratings and specifies to test at the minimum liquid ESP if the minimum is higher than zero ESP. In the case of testing a unit with an integral pump at a liquid ESP above zero, sections 6.3.3 and 6.4.3 of AHRI 600–2023 specify to subtract pump power to overcome liquid ESP using a similar methodology to the approach for calculating pump power adjustment for units without integral pumps.

Sections 6.3.7 (for IEER), 6.3.11 (for AEER), and 6.4.4 (for ACOP) of AHRI 600–2023 specify to include power to account for power required for a system pump to overcome liquid ESP representative of a commercial water-loop installations. As discussed in section III.E.3 of this final rule, AHRI 600–2023 specifies these provisions to account for system pump power for calculation of AEER, IEER, and ACOP, but not for optional representations of EER and COP.

The provisions for accounting for pump power (to overcome liquid internal and external static pressure) were developed in AHRI 600 committee meetings after publication of the August 2022 NOPR. While the AHRI 600–2023 approach is not the same as that proposed in the August 2022 NOPR in that it uses a different calculation method and assumes a different liquid ESP, it is consistent with the August 2022 NOPR proposal to include power to represent power consumed by pumps to overcome both liquid internal and external static pressure. The AHRI 600–2023 pump power adders are different than those suggested by ClimateMaster. However, having been developed through an industry consensus process subsequent to the timing of the August 2022 NOPR comment period, DOE surmises that the pump power approach specified in AHRI 600–2023 represents the prevailing industry consensus regarding the most appropriate method for addressing pump power. Further, DOE has concluded based on discussion in AHRI 600 committee meetings that the AHRI 600–2023 pump power approach is representative of typical water-loop WSHP applications. As a result, in this final rule, DOE is incorporating by reference into appendix C1 the methods specified in AHRI 600–2023 for accounting for pump power.

DOE notes that section 5.4.13.2 of AHRI 600–2023 specifies a minimum liquid ESP of 7.0 psi for residential representations. However, the residential representations have not yet been fully developed for WSHPs (see section III.A.2 of this document for more details). DOE will continue to work with the AHRI 600 committee to develop provisions for determining such ratings.

4. 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). 10 CFR 431.96. Further, the liquid enthalpy test method in Annex C of ISO 13256–1:1998, which is included in the current DOE WSHP 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.

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. ISO 13256–1:2021 does not specify a value or method for calculating the specific heat capacity of any test liquids.

In the August 2022 NOPR, DOE proposed in section 4.1 of proposed appendix C1 that the test liquid for all tests other than the proposed optional ''HFL3'' [10] 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. 87 FR 53302, 53329. DOE also proposed 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. *Id.* 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 would provide manufacturers the flexibility of providing ratings more representative of ground-loop applications. Therefore, DOE proposed 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. *Id.*

In the August 2022 NOPR, DOE 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. *Id.*

As discussed in section III.D.2 of the August 2022 NOPR, DOE proposed to adopt specific sections of AHRI 340/360–2022 in its test procedure for WSHPs. *Id.* 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.[11] 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 instead proposed in the August 2022 NOPR to adopt relevant provisions of ANSI/ASHRAE 37–2009. *Id.* DOE 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. *Id.*

In the August 2022 NOPR, DOE requested comment on the proposed requirements for using water or a brine of 15-percent solution by mass of sodium chloride as the test liquid. *Id.* DOE also requested comment on the representativeness and test burden associated with permitting the use of different liquids for different tests. *Id.* Finally, DOE requested 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. *Id.*

In response to the August 2022 NOPR, MIAQ commented that sodium chloride is not a common anti-freeze and that propylene and ethylene glycol are more common. (MIAQ No. 23 at p. 6) MIAQ commented that it is unsure if nationally recognized testing laboratories [12] are equipped to deal with 15-percent solution by mass of sodium chloride as the test liquid. (*Id.*) MIAQ stated that specifying a particular antifreeze rather than relevant thermal properties for the test fluid hinders innovation and generates a heavy burden to develop and test with the specified medium. (*Id.*) MIAQ argued that specifying sodium chloride as the test liquid may require redesign of the units to avoid corrosion. (*Id.*)

WaterFurnace commented that supporting ISO 13256 and AHRI 600 would solve the issue. (WaterFurnace No. 20 at p. 8) WaterFurnace stated that it prefers to use methanol or ethanol as the test liquid because sodium chloride can damage lab equipment. (*Id.*)

ClimateMaster supported DOE's proposal to make provisions for low temperature testing but disagreed with the proposed fluid for testing. (ClimateMaster, No. 22 at p. 9) ClimateMaster stated that sodium chloride is not representative of a brine solution used in water-source applications in the field and is a carryover from a test liquid used in older standards such as AHRI 330–98, which was corrosive to test lab facilities and caused premature wear of hydronic components. (*Id.*) ClimateMaster recommended that DOE work with industry to create a national deviation of 13256–1:1998 that includes provisions for the use of a 15-percent solution by mass of methanol in water involving a specific gravity of methanol at 0.976 with a solution temperature of 68 °F. (*Id.*) ClimateMaster stated that this fluid is commonly used in the industry and has been an available option in the AHRI 13256–1:1998 certification program since its inception, and if DOE does not select this solution, an alternative option would be a 20-percent solution of propylene glycol, which is also commonly used in the industry. (*Id.*)

ClimateMaster supported DOE's proposal to require a standard set of properties for consistent performance calculations but disagreed that the only reference allowed for sink or source liquids can be the 2001 ASHRAE Handbook, stating that it does not include properties for alternative testing fluids, such as methanol in water, and therefore limits the available options for testable brine solutions. (*Id.*) ClimateMaster recommended that DOE provide provisions under a national deviation of ISO 13256–1:1998 while allowing for the use of other established property databases in addition to the 2001 ASHRAE handbook, such as the published data from Melinder 2010.[13] (*Id.*) WaterFurnace agreed with the need for a specified source of properties and commented that supporting ISO 13256

[10] ''HFL3'' is the nomenclature used to define the 32 °F full-load heating test that DOE proposed to add in appendix C1.

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

[12] MIAQ used the abbreviation NRL, but DOE expects that the intended term was NRTL, the acronym for nationally recognized testing laboratory.

[13] Properties of Secondary Working Fluids for Indirect Systems, Melinder, 2010 (''Melinder 2010'').

and AHRI 600 would solve the issue. (WaterFurnace, No. 20 at p. 8)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 in appendix C1. Section 5.4.14 of AHRI 600–2023 specifies that all cooling and heating tests be conducted with a 15 percent solution by mass of methanol in water, with a tolerance of 2 percentage points on the solution concentration and requires that the concentration be verified prior to and after completion of all standard rating tests. Section 5.4.14 of AHRI 600–2023 also specifies to use Melinder 2010 as the source for all thermodynamic properties of the test liquid. Finally, sections 6.3.3.2 and 6.4.3.2 of AHRI 600–2023 include provisions to remove any influence of the methanol solution on efficiency ratings, so that values are similar to those that would result from testing using pure water, which is the most common liquid used in non-geothermal installations of WSHPs. Specifically, these provisions specify to multiply all measured capacity values by 1.01 and to multiply all measured cooling total power values by 0.99.

DOE has concluded that the provisions in AHRI 600–2023 regarding test liquid and specific heat capacity provide a representative and repeatable method for testing WSHPs. Comments received in response to the August 2022 NOPR and discussion in AHRI 600 committee meetings indicate that a methanol solution is a more representative test liquid than sodium chloride brine and is more practical for testing as it is not corrosive to laboratory equipment. Further, the AHRI 600–2023 requirement to use methanol solution for all tests ensures repeatable results and minimizes test burden by avoiding a need to change test liquid between tests. By specifying use of Melinder 2010 as the source for thermodynamic properties, AHRI 600–2023 also ensures that thermodynamic properties for the test fluid are applied consistently. Additionally, the provisions in sections 6.3.3.2 and 6.4.3.2 of AHRI 600–2023 adjust measured values to be more representative of WSHP operation in non-geothermal applications (which do not encounter freezing temperatures), without the need to change test liquids to use water for higher temperature tests and methanol for low-temperature heating tests. DOE also considers the inclusions of these provisions in AHRI 600–2023 to represent industry consensus on the most appropriate method for testing WSHPs. Therefore, for the reasons discussed, DOE is incorporating by reference into appendix C1 the test liquid provisions from AHRI 600–2023 in this final rule.

5. Liquid Flow Rate

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. 10 CFR 431.96. Section 4.1.6.3 of 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 ISO 13256–1:1998, DOE noted in the June 2018 RFI that AHRI 340/360–2022 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.

In the August 2022 NOPR, DOE proposed to incorporate by reference specific sections of AHRI 340/360–2022 in its test procedure for WSHPs, including Table 6. 87 FR 53302, 53330. 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. *Id.* 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. *Id.* Also, DOE proposed to adopt table 9 of AHRI 340/360–2022, which specifies use of manufacturer-specified part-load water flow rates for part-load tests. *Id.* at 87 FR 53331. In addition, DOE proposed that section E7 of AHRI 340/360 2022, which addresses units with condenser head pressure control stating that part-load liquid flow rate shall not exceed the liquid flow rate used for the full-load tests, be adopted in sections 5.1.1 and 5.1.2.1.2 of proposed appendix C1. *Id.* For heating tests, DOE proposed 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. *Id.* If IEER is determined using option 2 in section 5.1 of proposed appendix C1, DOE proposed 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. *Id.* Lastly, relating to tolerances, DOE proposed to require a condition tolerance of 1 percent for liquid flow rate, consistent with the condition tolerance specified in Table 9 of ISO 13256–1:1998 and adopt Table 11 of AHRI 340/360–2022, which specifies an operating tolerance of 2 percent for liquid flow rate. *Id.*

DOE requested commented 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. *Id.* Additionally, DOE requested 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. *Id.* In relation to heating tests, DOE requested comment on its proposal to use the liquid flow rate determined from the full-load cooling test for all heating tests. *Id.* Lastly, DOE requested 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. *Id.* at 87 FR 53331–53332.

In response to the August 2022 NOPR, ClimateMaster and WaterFurnace stated that they disagree with the proposal to adopt the AHRI 340/360 approach for setting liquid flow rate because it moves the test standard along a prescriptive path that would discourage innovation for improvements in pressure drop and flow rate in heat exchanger design. (ClimateMaster, No. 22 at pp. 9–10; WaterFurnace, No. 20 at pp. 8–9) ClimateMaster recommended that DOE allow manufacturers to specify a given flow rate for full-load cooling tests. (ClimateMaster, No. 22 at p. 10) ClimateMaster also commented that DOE should also specify a maximum limit of 3.5 GPM/ton, which ClimateMaster stated aligns with DOE's statements in the August 2022 NOPR that 3 GPM/ton is a typical water flow rate for WSHPs that results in a temperature rise of approximately a 10 °F. (*Id.* at pp. 9–10) ClimateMaster commented that while flowrate is typically used and specified when testing WSHP equipment, this is not the case for temperature rise. (*Id.* p. 10) MIAQ recommended that DOE continue to support ISO 13256–1. (MIAQ, No. 23 at p. 7)

Regarding the part-load liquid flow rates, ClimateMaster supported DOE's

proposal to use manufacturer-specified part-load liquid flow rates for part-load tests. (ClimateMaster, No. 22 at p. 10) ClimateMaster recommended that the full-load liquid flow rate should be used for part-load tests if the system does not automatically reduce the liquid flow rate in part-load operation to the part-load flow rate when installed. (*Id.*) WaterFurnace agreed with DOE's proposal to use manufacturer-specified part-load liquid flow rates for part-load tests and commented that supporting ISO 13256/AHRI 600 would solve the issue. (WaterFurnace, No. 20 at p. 9)

Regarding liquid flow rate for heating tests, ClimateMaster supported DOE's proposal to use the full-load cooling liquid flow rate for all full-load heating tests. (ClimateMaster, No. 22 at p. 10) MIAQ commented that using the liquid flow rate determined from the full-load cooling test for all heating tests could be a problem in conditions where the saturated suction temperature is too high, overloading the compressor. (MIAQ, No. 23 at p. 7) MIAQ stated that this may not be an issue with a low enough EWT. (*Id.*) MIAQ commented that systems with inverter-driven compressors and active head pressure control may present challenges to fulfilling these tests. (*Id.*) WaterFurnace commented that supporting ISO 13256 and AHRI 600 would solve the issue. (WaterFurnace, No. 20 at p. 9) WaterFurnace commented that most standards have abandoned the prescriptive approach of determining liquid flow rate from the full-load cooling test to allow innovation and efficiency improvement. (*Id.*) WaterFurnace stated that using manufacturer-specified flow rate is preferred. (*Id.*)

Regarding tolerances liquid flow rates, ClimateMaster, WaterFurnace, and MIAQ commented in support of DOE's 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. (ClimateMaster, No. 22 at p. 10; WaterFurnace, No. 20 at p. 9; MIAQ, No. 23 at p. 7)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. Section 5.4.15 of AHRI 600–2023 includes provisions regarding liquid flow rate. Specifically, this section specifies use of a manufacturer-specified flow rate rather than a fixed temperature rise (as recommended by commenters), but, similar to ClimateMaster's recommendation, section 5.4.15 also provides a maximum flow rate of 0.275 GPM per kBtu/h (which is equivalent to 3.3 GPM/ton, slightly lower than the 3.5 GPM/ton limit recommended in ClimateMaster's comment). Section 5.4.14 also specifies that a single manufacturer-specified flow rate be used for all tests, unless the equipment automatic adjusts flow rate or the liquid flow rate is reduced for operation at low EWTs for head pressure control, per section 5.9 of AHRI 600–2023. Further, section 5.4.15 specifies that if there is not a specified liquid flow rate and that the system does not provide automatic adjustment of the liquid flow that a liquid flow rate of 0.25 GPM per kBtu/h is used for all tests. It also specifies a liquid flow rate condition tolerance of 1 percent.

DOE has concluded that the approach for liquid flow rate specified in AHRI 600–2023 provides a representative and appropriate approach for testing WSHPs. The use of manufacturer-specified flow rate provides flexibility to manufacturers while the maximum liquid flow rate limit prevents manufacturer specification of unrepresentatively high flow rates for testing. With regards to MIAQ's concern that using the liquid flow rate determined from the full-load cooling test for all heating tests could be a problem in conditions where the saturated suction temperature is too high, overloading the compressor, DOE notes that the provisions specified in AHRI 600–2023 and incorporated by reference in this final rule allow manufacturers to specify different flow rates for tests other than the full-load cooling test so long as the specified flow rates for other tests are (a) below the maximum flow rate of 0.275 GPM per kBtu/h; and (b) achieved via automatic adjustment of the liquid flow rate by the equipment under test. Therefore, a manufacturer would have the ability to set different liquid flow rates for tests other than full-load cooling tests to ensure operation representative of how the equipment would operate under such conditions in field installations.

DOE also considers the inclusions of these provisions in AHRI 600–2023 to represent industry consensus on the most appropriate method for testing WSHPs. Therefore, for the reasons discussed, DOE is incorporating by reference into appendix C1 the liquid flow rate provisions from AHRI 600–2023 in this final rule.

6. 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 WSHP 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). 10 CFR 431.96. 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 August 2022 NOPR, DOE proposed to incorporate by reference specific sections of AHRI 340/360–2022. 87 FR 53302, 53332. AHRI 340/360–2022 in turn references sections 7.6.7.1 and 7.3.3.4 of ANSI/ASHRAE 37–2009. *Id.* Sections 7.6.7.1 and 7.3.3.4 of ANSI/ASHRAE 37–2009 specify calculations for determining the line losses for bare copper or insulated lines. *Id.* DOE requested comment 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. *Id.*

In response to the August 2022 NOPR, ClimateMaster commented that adopting the line loss adjustments in ASHRAE 37–2009 is acceptable, as it is an industry best practice, but ClimateMaster stated it does not produce any split system heat pumps for use in commercial applications. (ClimateMaster, No. 22 at p.10) ClimateMaster recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that adopts the provisions of ANSI/ASHRAE 37–2009. (*Id.*) WaterFurnace agreed with DOE's proposal. (WaterFurnace, No. 20 at p. 9)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes section 5.1 of AHRI 600–2023. This section in turn references sections 7.6.7.1 and 7.3.3.4 of ANSI/ASHRAE 37–2009, which is consistent with the proposal from the August 2022 NOPR. DOE considers the inclusion of these provisions in the AHRI 600–2023 to represent industry consensus that these provisions provide an appropriate method for testing WSHPs. As a result, DOE is incorporating by reference into appendix C1 the methods from AHRI

600–2023 for calculating line loss adjustments in this final rule.

7. 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.'' [14] 10 CFR 431.96. 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 [15]) 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 August 2022 NOPR, DOE proposed to incorporate by reference specific sections of AHRI 340/360–2022. 87 FR 53302, 53333. AHRI 340/360–2022 in turn references the test method in ANSI/ASHRAE 37–2009. *Id.* Sections 6.2 and 6.3 of ANSI/ASHRAE 37–2009 include 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. *Id.* Section 6.3.3 of ANSI/ASHRAE 37–2009 uses a calculation to determine the coefficient of discharge, thereby allowing determination of the coefficient of discharge at any point within the specified range. *Id.* DOE requested comment on the proposal to adopt the calculation of discharge coefficients and air measurement apparatus requirements as specified in ANSI/ASHRAE 37–2009. *Id.*

In response to the August 2022 NOPR, ClimateMaster supported DOE's proposal to adopt the calculation of discharge coefficients and air measurement apparatus requirements of ANSI/ASHRAE 37–2009, as it is an industry best practice, and recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that includes the provisions of ANSI/ASHRAE 37–2009. (ClimateMaster No. 22 at p. 10) WaterFurnace agreed with DOE's proposal. (WaterFurnace, No. 20 at p. 9)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes section 5.1 of AHRI 600–2023. This section in turn references the test method in ANSI/ASHRAE 37–2009, which is consistent with the proposal from the August 2022 NOPR. DOE considers the inclusion of these provisions in AHRI 600–2023 to represent industry consensus that these provisions provide an appropriate method for testing WSHPs. As a result, DOE is incorporating by reference into appendix C1 the methods from AHRI 600–2023 for measuring airflow in this final rule.

8. Air Condition Measurement

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 August 2022 NOPR, DOE proposed to incorporate by reference appendix C of AHRI 340/360–2022. 87 FR 53302, 53333. Appendix C of AHRI 340/360–2022 provides detailed specifications for the measurement of air conditions (including indoor air), 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. *Id.* DOE requested commented on the proposal to adopt the air condition measurement provisions in appendix C of AHRI 340/360–2022. *Id.*

In response to the August 2022 NOPR, ClimateMaster supported DOE's proposal to adopt the air condition measurement provisions in appendix C of AHRI 340/360–2022, as it is industry best practice, and recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that includes similar air condition measurement provisions. (ClimateMaster No. 22 at p. 11) WaterFurnace agreed with DOE's proposal. (WaterFurnace No. 20 at p. 9)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes appendix C of AHRI 600–2023. This language is consistent with appendix C of AHRI 340/360–2022, as proposed in the August 2022 NOPR, and addresses comments that DOE should adopt AHRI 600. DOE considers the air condition measurement approach specified in AHRI 600–2023 to represent industry consensus regarding the most appropriate method for measuring air conditions for WSHPs. As a result, DOE is incorporating by reference into appendix C1 the methods from AHRI 600–2023 for measuring air conditions in this final rule.

9. 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

[14] 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.*

[15] ''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.

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 August 2022 NOPR, DOE proposed to incorporate by reference specific sections of AHRI 340/360–2022. 87 FR 53302, 53334. AHRI 340/360–2022 in turn references section 7.3.3.3 of ASHRAE 37–2009, which requires and provides equations for duct loss adjustments. *Id.* 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. *Id.*

In response to the August 2022 NOPR, ClimateMaster supported DOE's proposal to adopt the duct loss provisions as it is an industry best practice for companies that produce split-system heat pumps for use in commercial applications. (ClimateMaster, No. 22 at p. 11) ClimateMaster recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that includes these provisions of ANSI/ASHRAE 37–2009. (*Id.*) WaterFurnace agreed with DOE's proposal. (WaterFurnace, No. 20 at pp. 9)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes section 5.1 of AHRI 600–2023. This section in turn references ANSI/ASHRAE 37–2009, including section 7.3.3.3, which is consistent with the proposal from the August 2022 NOPR. DOE considers the inclusion of these provisions in AHRI 600–2023 to represent industry consensus that these provisions provide an appropriate method for testing WSHPs. Therefore, DOE is incorporating by reference into appendix C1 the equations for duct loss adjustments from section 5.1 of AHRI 600–2023 in this final rule. Regarding the comment from ClimateMaster, DOE notes that these provisions for calculating duct losses apply to testing all WSHPs, not just split systems.

10. 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. 10 CFR 431.96(e)(1) However, the current DOE test procedure for WSHPs 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.

In the August 2022 NOPR, DOE proposed to incorporate by reference section 5.8 of AHRI 340/360–2022. 87 FR 53302, 53334. This section specifies refrigerant charging parameters, including specifying which set of installation instructions to use for charging, explaining what to do if no instructions are provided, specifying that target values of parameters are the centers of the ranges allowed by installation instructions, and specifying tolerances for the measured values. *Id.* The approach also requires that refrigerant line pressure gauges be installed for single-package units, unless otherwise specified in manufacturer instructions. *Id.* DOE requested comment on the proposal to adopt the refrigerant charging requirements in section 5.8 of AHRI 340/360–2022. *Id.* at 87 FR 53335.

In response to the August 2022 NOPR, ClimateMaster commented that while all commercially single package WSHP units are developed with specific factory system charge weights, the only provision DOE proposed for a charge weight tolerance is in Table 4 of section 5.8.3 of AHRI 340/360–2022, which specifies a tolerance of ±2 oz. (ClimateMaster, No. 22 at p. 11) ClimateMaster commented that it considers this tolerance unacceptable, as 2 oz can be upwards of 10 percent of the overall system charge on small capacity heat pumps. (*Id.*) ClimateMaster further stated that the procedures for charging that DOE provided in sections 5.8.4.1 and 5.8.4.2 of AHRI 340/360–2022 are not applicable as most single package systems do not contain a liquid line service connection. (*Id.*) ClimateMaster commented that the tolerances that DOE provided in Table 4 of section 5.8.3 of AHRI 340/360–2022 reference items related to outdoor air conditions, which are not applicable to WSHPs. (*Id.*) ClimateMaster commented that DOE's proposal lacks provisions for the possibility that the operating mode of the system could set the charge. (*Id.*) For these reasons, ClimateMaster recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that allows the WSHP industry to develop a list of charging provisions that meet the intent of those found in AHRI 340/360–2022. (*Id.*) WaterFurnace agreed with DOE's proposal regarding refrigerant charging. (WaterFurnace, No. 20 at p. 9)

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes section 5.4.11 of AHRI 600–2023. This language is consistent with section 5.8 of AHRI 340/360–2022, as proposed for use in the August 2022 NOPR, and addresses commenters' concerns that DOE should adopt AHRI 600. With regards to the comment from ClimateMaster regarding the refrigerant charging proposals in the August 2022 NOPR (which are consistent with the provisions in AHRI 600–2023), DOE notes that these provisions are used only if the manufacturer's charging instructions do not specify a tighter charging tolerance (as specified in section 5.4.11.4 of AHRI 600–2023). Therefore, these provisions provide flexibility to manufacturers to specify charging instructions appropriate to their models and serve mainly to address cases in which manufacturer's instructions provide inadequate, incomplete, or conflicting charging instructions. Specifically, these provisions allow manufacturers to specify tighter tolerances and/or to specify charging based on whatever method is most appropriate for a given model.

DOE considers the inclusion of these provisions in AHRI 600–2023 to represent industry consensus that these provisions provide an appropriate method for testing WSHPs. Therefore, DOE is incorporating by reference into appendix C1 the refrigerant charging requirements from section 5.4.11 of AHRI 600–2023 in this final rule.

11. Voltage

Operating voltage can affect the measured efficiency of air conditioners and heat pumps. 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. 10 CFR 431.96.

In the August 2022 NOPR, DOE proposed to incorporate by reference section 6.1.3.1 of AHRI 340/360–2022. 87 FR 53302, 53335. 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. *Id.* 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. *Id.* DOE requested commented on the proposal to adopt the voltage provisions in section 6.1.3.1 of AHRI 340/360–2022. *Id.*

In response to the August 2022 NOPR, ClimateMaster supported DOE's proposal to adopt the voltage provisions in section 6.1.3.1 of AHRI 340/360–2022 because it is industry best practice and recommended that DOE work with industry to create a national deviation of ISO 13256–1:1998 that includes the proposed language. (ClimateMaster, No. 22 at pp. 11–12) WaterFurnace agreed with DOE's proposal. (WaterFurnace, No. 20 at p. 9).

As discussed in section III.D of this final rule, DOE is incorporating by reference AHRI 600–2023 into appendix C1. This includes section 6.2.2 of AHRI 600–2023. This language is consistent with section 6.1.3.1 of AHRI 340/360–2022, which was proposed in the August 2022 NOPR, as well as with tables 1 and 2 of ISO 13256–1:1998 and tables 2 and 3 of ISO 13256–1:2021. DOE considers the inclusion of these voltage provisions in AHRI 600–2023 to represent industry consensus that these provisions provide an appropriate method for testing WSHPs. As a result, DOE is incorporating by reference into appendix C1 the voltage provisions from AHRI 600–2023 in this final rule.

12. Non-Standard Low-Static Indoor Fan Motors

As discussed in section III.F.1.a of this document, DOE is adopting higher ESPs for WSHPs with a cooling capacity greater than or equal to 75,000 Btu/h that are included in section 5.5.1.1 of AHRI 600–2023 and are consistent with the ESP levels recommended in the ACUAC and ACUHP Working Group TP Term Sheet. However, individual models of WSHPs in this capacity range with indoor fan motors intended for installation in applications with a low ESP may not be able to operate at the proposed full-load ESP requirements at the full-load indoor rated airflow. To address this situation, section 3.2.30 of AHRI 600–2023 defines ''non-standard low-static indoor fan motors'' as motors in units with cooling capacity greater than or equal to 75,000 Btu/h which cannot maintain ESP as high as specified in the test procedure when operating at the full-load rated indoor airflow and that are distributed in commerce as part of an individual model within the same basic model that is distributed in commerce with a different motor specified for testing that can maintain the required ESP. Section 5.7.4.3 of AHRI 600–2023 includes test provisions for WSHPs with non-standard low-static indoor fan motors that cannot reach the ESP within tolerance during testing, which require using the maximum available fan speed that does not overload the motor or motor drive, adjusting the airflow-measuring apparatus to maintain airflow within tolerance, and operating with an ESP as close as possible to the minimum ESP requirements for testing. This approach is consistent with the industry test standard referenced by the DOE test procedure for DX–DOASes (AHRI 920–2020, section 6.5.2.5). *See* appendix B to 10 CFR 431.96.

As discussed in section III.G.3 of this document, DOE is clarifying that representations for a WSHP basic model must be based on the least efficient individual model(s) distributed in commerce within the basic model (with the exception specified in 10 CFR 429.43(a)(3)(v)(A) for certain individual models with the components listed in Table 6 to 10 CFR 429.43(a)(3)). DOE has concluded that the combination of (1) the provisions in AHRI 600–2023 for testing models with ''non-standard low-static indoor fan motors'' with (2) the requirement that basic models be rated based on the least efficient individual model (with certain exceptions, as discussed) provides an appropriate approach for handling WSHP models with these motors because if an individual model with a non-standard low-static indoor fan motor is tested, the test would be conducted at an indoor airflow representative for that model. But because testing at the rated airflow for such an individual model would result in testing at an ESP lower than the requirement and thus a lower indoor fan power, the representations for that basic model will be required to be based on an individual model with an indoor fan motor that can achieve the ESP requirements at the rated airflow. Consistent with incorporating by reference AHRI 600–2023 into appendix C1, in this final rule, DOE is adopting the AHRI 600–2023 provisions for testing models with non-standard low-static indoor fan motors.

G. Configuration of Unit Under Test

1. Background and 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. 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 adopted in this final rule. For certain components not directly addressed in the DOE test procedure, DOE proposed to adopt more specific instructions on how each component should be handled for the purposes of making representations in 10 CFR part 429 in the August 2022 NOPR. 87 FR 53302, 53335. Specifically, the proposed instructions 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. *Id.*

As proposed in the August 2022 NOPR, DOE is handling WSHP components in two distinct ways in this final rule to help manufacturers better understand their options for developing representations for their differing product offerings. *Id.* First, as proposed in the August 2022 NOPR, the treatment of some components is specified by the test procedure to limit their impact on measured efficiency. *Id.* 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. *Id.*

Second, for certain components not directly addressed in the DOE test procedure, this final rule adopts the specific instructions proposed in the August 2022 NOPR on how each component should be handled for the purposes of making representations in 10 CFR part 429. *See Id.* at 87 FR 53335–53336. Specifically, these instructions 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, in order to reduce burden. DOE is adopting 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 adopting 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. Steam/hydronic heat coils are an example of such a component. The efficiency representation for a model with a steam/hydronic heat coil is based on the measured performance of the WSHP as tested without the component installed because the steam/hydronic heat coil is not easily removed from the WSHP for testing.[16] *Id.*

In this final rule, DOE is adopting these provisions in 10 CFR part 429 as proposed 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, though DOE is also adopting provisions that address additional components not included in the August 2022 NOPR, reflecting comments received in response to the August 2022 NOPR and provisions in AHRI 600–2023.

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

In the August 2022 NOPR, DOE proposed 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). *Id.* at 87 FR 53336. These provisions specified how to test a unit with such a component (*e.g.,* for a unit with hail guards, remove hail guards for testing). *Id.* The proposed test provisions were consistent with the provision in section D3 of AHRI 340/360–2022 but included 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). *Id.* Specifically, DOE proposed 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
- 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.

Id. at 87 FR 53336–53337.

As DOE did not receive any comments regarding this proposal in response to the August 2022 NOPR, it is adopting the provisions as proposed in this final rule.

3. Components Addressed Through Representation Provisions of 10 CFR 429.43

In the August 2022 NOPR, consistent with the Commercial HVAC Term Sheet and the Commercial HVAC Enforcement Policy, DOE proposed provisions that explicitly allow representations for individual models with certain components to be based on testing for individual models without those components and proposed a table (''Table 6 to Paragraph (a)(3)(v)(A)'')[17] at 10 CFR 429.43(a)(3) listing the components for which these provisions would apply. *Id.* at 87 FR 53337. 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. *Id.* DOE tentatively concluded that the inclusion of these components as optional components for WSHPs is appropriate, except for electric resistance heaters. *Id.* DOE 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. *Id.* DOE proposed the following components be listed in Table 6 to Paragraph (a)(3)(v)(A):

- 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.

Id.

Additionally, DOE proposed 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 clarified how this long-standing basic model provision interacts with the component treatment in 10 CFR 429.43 that was proposed. *Id.* DOE proposed 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. *Id.* DOE proposed the concept of an ''otherwise comparable model group'' (''OCMG''). *Id.*

As discussed in the August 2022 NOPR, 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 6 to Paragraph (a)(3)(v)(A) but may include individual models with any combination of such specified components. *Id.* 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 6 to Paragraph (a)(3)(v)(A). *Id.* 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. *Id.* 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

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

[17] DOE notes that in the August 2022 NOPR, DOE referred to this table as ''Table 1 to Paragraph (a)(3)(ii)(A) .'' Due to the publication of other regulatory documents, DOE is now referring to this Table as ''Table 6 to Paragraph (a)(3)(v)(A).''

control system is not one of the specified exempt components listed in Table 6 to Paragraph (a)(3)(v)(A). *Id.* However, both OCMGs may include different combinations of specified exempt components. *Id.* Also, both OCMGs may include any combination of characteristics that do not affect the efficiency measurement, such as paint color. *Id.*

Further discussed in the August 2022 NOPR, an OCMG is used to determine which individual models are used to determine a represented value. *Id.* 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 6 to Paragraph (a)(3)(v)(A) is considered. *Id.* 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 6 to (a)(3)(v)(A) *(i.e.,* models with a number of specific components listed in Table 6 to (a)(3)(v)(A) greater than the least number in the OCMG are exempted). *Id.* In the case that the OCMG includes an individual model with no specific components listed in Table 6 to Paragraph (a)(3)(v)(A), then all individual models in the OCMG with specified components would be exempted from consideration. *Id.* The least-efficient individual model across the OCMGs within a basic model would be used to determine the representation of the basic model. *Id.* 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. *Id.*

In the August 2022 NOPR, DOE relied 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. *Id.* In other words, differences that do not impact energy consumption, such as unit color and presence of utility outlets, would not warrant separate OCMGs. *Id.*

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 6 to Paragraph (a)(3)(v)(A). *Id.* at 87 FR 53337–53338. Further, the approach, as proposed, was structured to more explicitly address individual models with more than one of the specific components listed in Table 6 to Paragraph (a)(3)(v)(A), as well as instances in which there is no comparable model without any of the specified components. *Id.* at 87 FR 53338. DOE developed a document of examples to illustrate the approach proposed in the August 2022 NOPR for determining represented values for WSHPs with specific components, and in particular the OCMG concept. *See* EERE–2017–BT–TP–0029; 87 FR 53302, 53338.

In the August 2022 NOPR, DOE proposed provisions in 10 CFR 429.43(a)(3)(v)(A) that included 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. 87 FR 53302, 53338–53339.

In response to the August 2022 NOPR, ClimateMaster commented that it agrees with DOE's several proposals on this issue, but it believes that Table 6 in paragraph (a)(3) should include additional components, specifically water-side economizers and high effectiveness filters. (ClimateMaster, No. 22 at p. 12) ClimateMaster recommended that DOE create a national deviation of ISO 13256–1:1998 that adopts the proposed language with modifications to include water-side economizers and high effectiveness indoor filters. (*Id.*) WaterFurnace commented that the proposals may work for large motors but noted that the small volume of these larger motors would not justify regulation efforts and AHRI 340/360 omits smaller motors. (WaterFurnace, No. 20 at p. 10)

With regards to the comment from ClimateMaster that waterside economizers and high effectiveness filters should be included in Table 6 to Paragraph (a)(3)(v)(A), DOE notes that the impact of high effectiveness filters can be entirely mitigated by testing with a standard filter, which is required by section 5.4.5 of AHRI 600–2023. Therefore, DOE has concluded that treatment as specific components in representation provisions in 10 CFR 429.43 is not warranted for high effectiveness filters. With regards to waterside economizers, DOE has included waterside economizers and desuperheaters in the updated Table 6 to Paragraph (a)(3)(v)(A) adopted in this final rule, as DOE has determined that it is appropriate to make representations for WSHPs without these components present, consistent with the inclusion of these components in section D3 of AHRI 600–2023.

With regard to the comment from WaterFurnace that only a small portion of the market has larger motors and therefore that they are not worth regulating, DOE notes that the approach for non-standard high-static indoor fan motors (as proposed in the August 2022 NOPR and included in AHRI 600–2023) does not expand the scope of regulations to cover equipment with higher-static motors. Equipment that meets the DOE definition of WSHP is covered equipment, regardless of the size of indoor fan motor. The adopted approach reduces burden to manufacturers by allowing grouping of WSHP individual models with non-standard high-static indoor fan motors in the same basic model as corresponding individual models with standard indoor fan motors (and thus rating all individual models in the basic model based on performance with the standard indoor fan motor), as long as the non-standard high-static indoor fan motor has the same or better relative efficiency performance as the standard motor included in the individual model with the standard indoor fan motor.

4. Enforcement Provisions of 10 CFR 429.134

In the August 2022 NOPR, consistent with the Commercial HVAC Term Sheet and the Commercial HVAC Enforcement Policy, DOE proposed provisions in 10 CFR 429.134(dd)(2)[18] 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. 87 FR 53302, 53339. Specifically, DOE proposed that if a basic model includes individual models with components listed at Table 6 to Paragraph (a)(3)(v)(A) 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 final rule), DOE may test any individual model within the OCMG. *Id.*

In response to the August 2022 NOPR, ClimateMaster stated that it disagrees

[18] DOE notes that in the August 2022 NOPR, DOE referred to this section as ''10 CFR 429.134(t)(2).'' Due to the publication of other regulatory documents, DOE is now referring to this section as ''10 CFR 429.134(dd)(2).''

with the provisions proposed in 10 CFR 429.134(dd)(2) in the August 2022 NOPR, stating that most WSHPs are built for specific orders based on given configurations or options. (ClimateMaster, No. 22 at p. 12) ClimateMaster commented that if DOE requires an individual model with the lowest number of specific components, it may not be available to test, and that the proposal would allow DOE testing with a model that includes the specific component. (*Id.*) ClimateMaster recommended that DOE instead allow a manufacturer to provide an individual model with the least number of specific components within a specific and agreed-upon timeframe (*i.e.,* rather than testing a model that includes a specific component). (*Id.*)

With regards to the comment from ClimateMaster, the provisions proposed in the August 2022 NOPR at 10 CFR 429.134(dd)(2) specify that DOE may test any individual model within the otherwise comparable model group if DOE is not able to obtain an individual model with the least number (which could be zero) of those components within the otherwise comparable model group. DOE will attempt to obtain a model with the least number of those components of specific components listed at Table 6 to Paragraph (a)(3)(v)(A). However, if DOE is unable to obtain such a model, DOE must retain the option to conduct assessment testing on an available model, and thus, in this final rule, DOE is adopting the provisions from the NOPR as proposed, at 10 CFR 429.134(dd)(2).

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. In the August 2022 NOPR, DOE noted that while cooling capacity is a required represented value for WSHPs, DOE does not currently specify 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. 87 FR 53302, 53339. DOE proposed 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 testing, rather than the certified cooling capacity, to determine the applicable standards. *Id.*

In response to the August 2022 NOPR, ClimateMaster commented that it supports DOE's proposal for the published capacity to fall within 95 percent to 100 percent of the tested value or the value found through the AEDM. (ClimateMaster, No. 22 at p. 12) WaterFurnace commented that it saw no problem with DOE's proposal. (WaterFurnace, No. 20 at p. 10) MIAQ commented that it supports the tolerance of 5 percent below the rated/marked capacity, but not with the 100-percent limit. (MIAQ, No. 23 at p. 8) MIAQ stated that manufacturers must account for many tolerances in their system, causing them to rate their units conservatively, and this conservative rating will not impact customers because the unit will perform better than advertised. (*Id.*)

In response to the comment from MIAQ, DOE notes that the proposed cooling capacity provisions specify that the represented cooling capacity be between 95 percent and 100 percent of the tested or AEDM-simulated cooling capacity, which allows for conservative rating up to 5 percent—*i.e.,* the represented cooling capacity may be 5 percent lower than the tested or AEDM-simulated cooling capacity. MIAQ's comment suggests MIAQ interpreted the proposal to mean the tested or simulated capacity cannot exceed 100 percent of represented capacity, which would not allow conservative ratings. However, DOE has concluded that MIAQ's concern that conservative rating should be allowed is addressed in the proposed provisions because the cooling capacity provisions explicitly allow conservative ratings up to 5 percent. Therefore, for the reasons discussed in the August 2022 NOPR and previously in this section, DOE is adopting the cooling capacity representation and enforcement provisions as proposed at 10 CFR 429.43(a)(3)(v)(B) and 10 CFR 429.134(dd)(1), respectively.

2. Enforcement of IEER

In the August 2022 NOPR, DOE proposed two options for determination of IEER—''option 1'' based on testing at the EWTs specified in AHRI 340/360–2022 for determining IEER, and ''option 2'' based on testing at the EWTs specified in ISO 13256–1:1998 and interpolating/extrapolating performance to the EWTs specified in AHRI 340/360–2022. 87 FR 53302, 53339. For assessment or enforcement testing, DOE proposed provisions in 10 CFR 429.134(t)(3) specifying that that the Department would 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 would determine IEER according to the ''Option 2'' approach. *Id.*

As discussed in section III.E.1 of this final rule, DOE is not adopting two methods for determining IEER, and is instead adopting a single method for determining IEER by incorporating by reference AHRI 600–2023 into appendix C1. Because this final rule includes only one method for determining IEER, the proposed enforcement provisions for the method of determination of IEER are no longer applicable, and DOE is not adopting the proposed provisions.

I. Test Procedure Costs

EPCA requires that the test procedures for commercial package air conditioning and heating equipment, including WSHPs, be those generally accepted industry testing procedures or rating procedures developed or recognized by either AHRI or ASHRAE, as referenced in ASHRAE 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 an amended test procedure would not meet the requirements in 42 U.S.C. 6314(a)(2)–(3) related to representative use and test burden. (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 the August 2022 NOPR, DOE proposed 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. 87 FR 53302, 53340. The proposed amended test procedure in the proposed appendix C1 would rely on the IEER metric. *Id.* DOE tentatively determined that the proposed amended test procedure for WSHPs in appendix C1 would be

representative of an average use cycle and would not be unduly burdensome for manufacturers to conduct. *Id.* DOE also proposed to increase 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. *Id.* As part of the August 2022 NOPR, DOE presented estimates of the test costs associated with these proposals. *Id.* DOE requested comment on its understanding of the impact of the test procedure proposals in this NOPR. *Id.*

In response to the August 2022 NOPR, ClimateMaster commented that it qualifies as a small business under the Small Business Administration (''SBA'') guidelines and that the extra burden to rate through two programs, as would be required under AHRI 340/360–2022, is too costly for small businesses. (ClimateMaster, No. 22 at pp. 13–14) ClimateMaster recommended that DOE should instead use data created through the national deviation to ISO 13256–1:1998 to interpolate per the procedure given in AHRI 600. (*Id.* at p. 14)

WaterFurnace commented that that the test procedure proposed in the August 2022 NOPR referencing AHRI 340/360 (including changes to ESP requirements, flows, and entering air conditions) would approximately double its testing and certification management labor and costs. (WaterFurnace, No. 20 at p.10)

In this final rule DOE is relocating the current DOE test procedure for WSHPs to appendix C without change. The test procedure adopted in appendix C for measuring EER and COP will result in no change in testing practices or burden.

As discussed in section III.D of this final rule, DOE is incorporating by referencing AHRI 600–2023 into appendix C1 for measuring the IEER and ACOP metrics. DOE has determined that the amended test procedure is reasonably designed to produce results that are representative of the energy efficiency of that covered equipment during an average use cycle and is not unduly burdensome to conduct. The use of appendix C1 will not be required until the compliance date of any amended standards denominated in terms of IEER and ACOP, should DOE adopt such standards. DOE has concluded that the incorporation by reference AHRI 600–2023, the latest industry consensus test procedure for WSHPs, renders moot any expressed concerns related to the costs with rating to AHRI 340/360.

In this final rule, DOE estimates that the cost for units less than 135,000 Btu/h for third-party laboratory testing according to appendix C1 for measuring IEER and ACOP to be $3,700 for single speed units, $5,950 for two stage units, and $8,200 for variable speed units. The difference in test cost is attributable to the varying number of tests (*i.e.* 3, 6, or 9) required to determine IEER for units with different compressor types. Additionally, DOE is increasing 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 test procedure adopted in appendix C1 for measuring IEER and ACOP to be $10,100 for single speed units, $15,500 for two stage units, and $20,900 for variable speed units. 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 test chambers with more limited availability.

As discussed in the August 2022 NOPR, in accordance with 10 CFR 429.70, WSHP manufacturers may elect to use AEDMs. 87 FR 53302, 53340. 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. In the August 2022 NOPR, DOE sought specific feedback on the estimated costs to rate WSHP models with an AEDM. *Id.*

In response to the August 2022 NOPR, MIAQ agreed that AEDMs must be acceptable but stated that the need for AEDMs to be representative requires a lot of testing by manufacturers. (MIAQ, No. 23 at p. 9) MIAQ commented that DOE's proposal to include WSHP's with cooling capacities up to 760,000 Btu/h in scope increases the time and cost associated with the testing required to validate the AEDM. (*Id.*) MIAQ recommended that if an AEDM-rated unit were to fail a validation test, that only the failed unit should be derated rather than the entire AEDM-rated series. (*Id.*) MIAQ stated that the cost to test a full 30-ton WSHP qualification is around $50,000-$60,000 per basic model group, and that developing an AEDM model with sufficient trust would require as much as $1 million in capital investment. (*Id.*)

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 $12,050 for single stage units, $14,300 for two stage units, and $16,550 for variable speed units. 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 $26,000 for single stage units, $31,400 for two stage units, and $36,800 for variable speed units. DOE estimates an additional cost of approximately $41 per basic model for determining energy efficiency using the validated AEDM.[19]

DOE disagrees with MIAQ's claims on the burden of AEDM development for WSHPs with a cooling capacity greater than 135,000 Btu/h. As discussed, based on quotes from third-party test laboratories, DOE estimates a per-unit test cost to the amended test procedure adopted in appendix C1 of $10,000–$21,000 for WSHPs with a cooling capacity greater than 135,000 Btu/h. Per 10 CFR 429.70(c)(2), validation of an AEDM requires testing a minimum of only two basic models. Based on DOE's observation of the prevalence of use of AEDMs for WSHP and similar equipment for which energy conservation standards currently apply (*i.e.,* for equipment with a cooling capacity no greater than 135,000 Btu/h), DOE expects most WSHP manufacturers already have AEDMs for simulating WSHP performance. Further, as discussed in section III.A.1 of this final rule, the manufacturer literature for all identified model lines of WSHPs with a cooling capacity greater than 135,000 Btu/h includes efficiency representations that are explicitly based on ISO 13256–1:1998, indicating that all manufacturers of this equipment already have the capability to generate efficiency representations for this equipment consistent with an industry consensus test procedure for WSHPs.

Regarding the outcomes of failed DOE verification testing, in this final rule, DOE is not amending its regulations for AEDM verification, which are applicable to all equipment categories that may use AEDMs. DOE notes that 10 CFR 429.70(c)(5)(viii) outlines required manufacturer actions with regard to AEDM use if basic models certified with AEDMs are determined to have invalid

[19] 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 an 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.

ratings. Given that most WSHP manufacturers are AHRI members and that DOE is incorporating by reference the prevailing industry test procedure that was established for use in AHRI's certification program, DOE expects that manufacturers will already be testing using AHRI 600–2023 in the timeframe of any potential future energy conservation standards in terms of IEER and ACOP. Based on this, DOE has determined that the test procedure amendments adopted in this final rule are not expected to increase the testing burden on WSHP manufacturers that are AHRI members. For the minority of WSHP manufacturers that are not members of AHRI, the test procedure amendments may have costs associated with model re-rating, to the extent that the manufacturers would not already be testing to the updated industry test procedure. Additionally, DOE has determined that the test procedure amendments will not require manufacturers to redesign any of the covered equipment, will not require changes to how the equipment is manufactured, and will not impact the utility of the equipment.

J. Effective and Compliance Dates

The effective date for the adopted test procedure amendments will be 30 days after publication of this final rule in the **Federal Register**. EPCA prescribes that, for the equipment at issue, all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with an amended test procedure, beginning 360 days after publication of this 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 WSHPs that rely on IEER and ACOP, representations must be based on the test procedure in appendix C. WSHPs are not required to be tested according to the test procedure in appendix C1 (resulting in the IEER and ACOP metrics) until the compliance date of amended energy conservation standards denominated in terms of the IEER and ACOP metrics, should DOE adopt such standards.

Any voluntary representations of IEER and ACOP made prior to the compliance date of amended standards for WSHPs that rely on IEER and ACOP must be based on the test procedure in 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 and ACOP, if adopted, prior to the applicable compliance date for those energy conservation standards.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866, 13563, and 14094

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) and amended by E.O. 14094, ''Modernizing Regulatory Review,'' 88 FR 21879 (April 11, 2023), 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 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 this preamble, this final 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 final 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 (''RFA'') (5 U.S.C. 601 *et seq.*) requires preparation of a final regulatory flexibility analysis (''FRFA'') 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 E.O. 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 final rule to amend the test procedure for WSHPs under the provisions of the RFA and the policies and procedures published on February 19, 2003.

As part of the August 2022 NOPR, DOE conducted its initial regulatory flexibility analysis (''IRFA''). The following sections outline DOE's determination that this final rule does not have a ''significant economic impact on a substantial number of small entities,'' and that the preparation of a FRFA is not warranted.

DOE is amending the test procedure for WSHPs to satisfy its statutory obligations under EPCA. (42 U.S.C. 6314(a)(1)(A))

In this final rule, DOE is establishing new appendices C and C1 to subpart F of part 431. The current DOE test procedure for WSHPs is relocated to appendix C without change. The amended test procedure for WSHPs is established in a new appendix C1, which includes the following amended test procedure requirements for WSHPs for measuring the updated efficiency metrics: (1) IEER for WSHPs using the methods from AHRI 600–2023; and (2) ACOP using the methods specified in AHRI 600–2023. Use of the amended test procedure in appendix C1 will not be required until such time as compliance is required with amended energy conservation standards for WSHPs denominated in terms of IEER

and ACOP, should DOE adopt such standards.

Additionally, DOE is expanding the scope of the test procedure to include WSHPs with capacities between 135,000 and 760,000 Btu/h, as well as specifying the components that must be present for testing and amending certain provisions related to representations and enforcement in 10 CFR part 429.

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'').[20] 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 utilized the California Energy Commission's Modernized Appliance Efficiency Database System (''MAEDbS'') [21] and the DOE's Certification Compliance Database (''CCD'') [22] 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 amended 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 without substantive domestic operations. DOE used subscription-based business information tools to determine headcount and revenue of each business. Of the 25 OEMs of WSHPs, DOE identified 6 as small, domestic manufacturers.

Of the 6 small, domestic manufacturers identified, all certify their WSHP models in the AHRI Certification Directory for WSHPs.

AHRI has published a new industry test standard for WSHPs, titled AHRI Standard 600, ''2023 Standard for Performance Rating of Water/Brine to Air Heat Pump Equipment'' (''AHRI 600–2023''). DOE presumes AHRI's certification program will require rating based on AHRI 600–2023 to develop the IEER and ACOP metrics. As a result, the test procedure amendments adopted in this final rule will not add any additional testing burden to manufacturers that already certify WSHPs to AHRI's certification program. Accordingly, DOE does not expect that the identified small business manufacturers, all of whom participate in AHRI's certification program, would see increased testing costs as a result of this rulemaking.

Additionally, DOE notes these test procedure amendments will only affect voluntary representations. There is no existing energy conservation standard that requires manufacturer to certify to WSHP efficiency in terms of IEER and ACOP to DOE. Certification based on IEER and ACOP would only be required if and when DOE establishes energy conservation standards based on those metrics for WSHPs.

Therefore, for the reasons stated in the preceding paragraphs, DOE concludes and certifies that the cost effects accruing from this test procedure final rule would not have a ''significant economic impact on a substantial number of small entities,'' and that the preparation of a FRFA is not warranted. DOE has submitted a certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of WSHPs must certify to DOE that their products comply with any applicable energy conservation standards. To certify compliance, manufacturers must first obtain test data for their products 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 amending the certification or reporting requirements for WSHPs in this final rule. 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 final rule, DOE establishes 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 4, 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

[20] 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).

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

[22] Certified equipment in the CCD are listed by product class and can be accessed at *www.regulations.doe.gov/certification-data/* (Last accessed May 1, 2023).

meaningful and timely input by State and local officials in the development of regulatory policies that have federalism 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 examined this final rule and determined that it will 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 final 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. 6316(a) and 42 U.S.C. 6316(b); 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 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, this final 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 regulatory action resulting 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 final 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 final rule will 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 regulation will 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 final 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 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 significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the regulation is implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

This regulatory action 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 modifications to the test procedure for WSHPs adopted in this final rule incorporates testing methods contained in certain sections of the following commercial standards: AHRI 600–2023, ANSI/ASHRAE 37–2009, ISO 13256–1:1998, and Melinder 2010. DOE has evaluated these standards and is unable to conclude whether the standards 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 has consulted with both the Attorney General and the Chairman of the FTC about the impact on competition of using the methods contained in these standards and has received no comments objecting to their use.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule before its effective date. The report will state that it has been determined that the rule is not a ''major rule'' as defined by 5 U.S.C. 804(2).

N. Description of Materials Incorporated by Reference

In this final rule, DOE incorporates by reference the following test standards and reference document:

AHRI 600–2023 is an industry accepted test procedure for measuring the performance of water source heat pumps. AHRI 600–2023 is available on AHRI's website at: *https://www.ahrinet.org/search-standards/ahri-600-i-p-performance-rating-waterbrine-air-heat-pump-equipment.*

ANSI/ASHRAE 37–2009 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 available on ANSI's website at: *webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2FASHRAE+Standard+37-2009.*

Errata sheet for ANSI/ASHRAE Standard 37–2009 dated March 27, 2019, specifies all of the corrections to ANSI/ASHRAE 37–2009 identified from the date of publication through March 27, 2019. Errata sheet for ANSI/ASHRAE Standard 37–2009 is available on ASHRAE's website at: *https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-errata.*

Melinder 2010 is a reference booklet with properties of secondary working fluids for indirect heating and cooling systems used in air conditioning, heat pumps, and other applications. Melinder 2010 is available from the International Institute of Refrigeration website at: *www.iifiir.org.*

ISO 13256–1:1998 is an industry-accepted test procedure for measuring the performance of specific water-source heat pump equipment. ISO 13256–1:1998 is available on ISO's website at: *www.iso.org/store.html.*

The following standards are currently approved for the sections in which they appear in this final rule: AHRI 210/240–2008 and AHRI 340/360–2007.

V. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this final rule.

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 test procedures, Incorporation by reference, Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on November 17, 2023, by Jeffrey Marootian, Principal Deputy Assistant Secretary 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 November 20, 2023.

Treena V. Garrett,

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

For the reasons stated in the preamble, DOE amends parts 429 and 431 of Chapter II of Title 10, Code of Federal Regulations 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. Redesignating paragraphs (c)(4) through (6) as paragraphs (c)(5) through (7); and
■ b. Adding new paragraph (c)(4).

The addition reads as follows:

§ 429.4 Materials incorporated by reference.

* * * * *

(c) * * *

(4) AHRI Standard 600–2023 (I–P) (''AHRI 600–2023''), *2023 Standard for Performance Rating of Water/Brine to Air Heat Pump Equipment,* approved September 11, 2023; IBR approved for § 429.43.

* * * * *

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

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

(a) * * *

(3) * * *

(v) Water-Source Heat Pumps. When certifying to standards in terms of IEER and ACOP, 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)(v)(A)(*2*) of this section for individual models that include components listed in table 6 to paragraph (a)(3)(v)(A) of this section. For the purpose of this paragraph (a)(3)(v)(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 6 to paragraph (a)(3)(v)(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 6 (or none of the components listed in table 6) to paragraph (a)(3)(v)(A) of this section. 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 6 to paragraph (a)(3)(v)(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 6 to paragraph (a)(3)(v)(A) of this section included in individual models of the group. Testing under this paragraph shall be consistent with any component-specific test provisions specified in section 3 of appendix C1 to subpart F of 10 CFR part 431.

TABLE 6 TO PARAGRAPH (a)(3)(v)(A)—SPECIFIC COMPONENTS FOR WATER SOURCE HEAT PUMPS

Component	Description
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.
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.
Desiccant Dehumidification Components.	An assembly that reduces the moisture content of the supply air through moisture transfer with solid or liquid desiccants.
Desuperheater	A heat exchanger located downstream of the compressor on the high-pressure vapor line that moves heat to an external source, such as potable water.
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.
Grill Options	Special grills used to direct airflow in unique applications (such as up and away from a rear wall).
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.
Non-Standard High-Static 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 high-static 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 high-static indoor fan motor(s) to be considered a specific component for a basic model (and thus subject to the provisions of paragraph (a)(3)(v)(A)(*2*) of this section), the following 2 provisions must be met: 1. Non-standard high-static indoor fan motor(s) must meet the minimum allowable efficiency determined per section D.4.1 of AHRI 600–2023 (incorporated by reference, see § 429.4) for non-standard high-static indoor fan motors, or per section D.4.2 of AHRI 600–2023 for non-standard high-static indoor integrated fan and motor combinations. 2. If the standard indoor fan motor can vary fan speed through control system adjustment of motor speed, all non-standard high-static indoor fan motors must also allow speed control (including with the use of a variable-frequency drive).
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.
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.
Refrigerant Reheat Coils	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.
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.
Steam/Hydronic Heat Coils	Coils used to provide supplemental heating.
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.
Waterside Economizer	A heat exchanger located upstream of the indoor coil that conditions the supply air when system water loop conditions are favorable so as not to utilize compressor operation.

(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 (dd) to read as follows:

§ 429.134 Product-specific enforcement provisions.

* * * * *

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

(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 6 to § 429.43(a)(3)(v)(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)(v)(A)(*1*)), DOE may test any individual model within the otherwise comparable model group.

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:

■ a. Adding in alphabetical order a definition of ''Applied Coefficient of performance, or ACOP''; and

■ b. Revising the definitions of ''Integrated energy efficiency ratio, or IEER,'' and ''Water-source heat pump''.

The addition and revisions read as follows:

§ 431.92 Definitions concerning commercial air conditioners and heat pumps.

* * * * *

Applied Coefficient of performance, or *ACOP* means the ratio of the heating capacity to the power input, including system pump power, for water-source heat pumps. ACOP is expressed in watts per watt and determined according to appendix C1 of this subpart.

* * * * *

Integrated energy efficiency ratio, or *IEER,* means a weighted average calculation of mechanical cooling EERs determined for four load levels and corresponding rating conditions, expressed in Btu/watt-hour. IEER is measured:

(1) Per appendix A to this subpart for air-cooled small (≥65,000 Btu/h), large, and very large commercial package air conditioning and heating equipment;

(2) Per appendix C1 to this subpart for water-source heat pumps;

(3) Per appendix D1 to this subpart for variable refrigerant flow multi-split air conditioners and heat pumps (other than air-cooled with rated cooling capacity less than 65,000 Btu/h); and

(4) Per appendix G1 to this subpart for single package vertical air conditioners and single package vertical 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)(6) through (10) as paragraphs (b)(7) through (11);

■ b. Adding new paragraph (b)(6);

■ c. In paragraph (c)(2), removing the text ''B, D1'' and adding, in its place, the text ''B, C1, D1'';

■ d. In paragraph (c)(3), removing the text ''appendix D1'' and adding, in its place, the text ''appendices C1 and D1'';

■ e. Revising paragraph (d); and

■ f. Adding paragraph (e).

The additions and revision read as follows:

§ 431.95 Materials incorporated by reference.

* * * * *

(b) * * *

(6) AHRI Standard 600–2023 (I–P) (''AHRI 600–2023''), *2023 Standard for Performance Rating of Water/Brine to Air Heat Pump Equipment,* AHRI-approved September 11, 2023; IBR approved for appendix C1 to this subpart.

* * * * *

(d) *IIR.* International Institute of Refrigeration, 177 Boulevard Malesherbes 75017 Paris, France; +33 (0)1 42 27 32 35; *www.iifiir.org.*

(1) *Properties of Secondary Working Fluids for Indirect Systems,* including Section 2.3 Errata Sheet, Melinder, published 2010 (''Melinder 2010''), IBR approved for appendix C1 to this subpart.

(2) [Reserved]

(e) *ISO.* International Organization for Standardization, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland; +41 22 749 01 11; *www.iso.org/store.html.*

(1) ISO Standard 13256–1 (''ISO 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.

(2) [Reserved]

* * * * *

■ 8. Amend § 431.96 by revising 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) * * *

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 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	Appendix F to this subpart [3].	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 in	Additional test procedure provisions as indicated in the listed paragraphs of this section
			SEER2 and HSPF2	Appendix F1 to this subpart [3].	None.
	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 [1] (omit section 6.5).	Paragraphs (c) and (e).
			EER	AHRI 340/360–2007 [1] (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 ACOP	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 [1] (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 ACOP	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.
	Water-Cooled and Evaporatively-Cooled AC.	≥240,000 Btu/h and <760,000 Btu/h.	EER	AHRI 340/360–2007 [1] (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 ACOP	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	<760,000 Btu/h	SCOP	Appendix E to this subpart [3].	None.
		<760,000 Btu/h or <930,000 Btu/h [4].	NSenCOP	Appendix E1 to this subpart [3].	None.
Variable Refrigerant Flow Multi-split Systems.	AC	<65,000 Btu/h (3-phase).	SEER	Appendix F to this subpart [3].	None.
			SEER2	Appendix F1 to this subpart [3].	None.
Variable Refrigerant Flow Multi-split Systems, Air-cooled.	HP	<65,000 Btu/h (3-phase).	SEER and HSPF	Appendix F to this subpart [3].	None.
			SEER2 and HSPF2	Appendix F1 to this subpart [3].	None.
Variable Refrigerant Flow Multi-split Systems, Air-cooled.	AC and HP	≥65,000 Btu/h and <760,000 Btu/h.	EER and COP	Appendix D to this subpart [3].	None.
			IEER and COP	Appendix D1 to this subpart [3].	None.
Variable Refrigerant Flow Multi-split Systems, Water-source.	HP	<760,000 Btu/h	EER and COP	Appendix D to this subpart [3].	None.
			IEER and COP	Appendix D1 to this subpart [3].	None.
Single Package Vertical Air Conditioners and Single Package Vertical Heat Pumps.	AC and HP	<760,000 Btu/h	EER and COP	Appendix G to this subpart [3].	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 in	Additional test procedure provisions as indicated in the listed paragraphs of this section
			EER, IEER, and COP	Appendix G1 to this subpart [3].	None.
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 applies only to direct expansion-dedicated outdoor air systems.
[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.
[4] For upflow ducted and downflow floor-mounted computer room air conditioners, the test procedure in appendix E1 of this subpart applies to equipment with net sensible cooling capacity less than 930,000 Btu/h. For all other configurations of computer room air conditioners, the test procedure in appendix E1 applies to equipment with net sensible cooling capacity less than 760,000 Btu/h.

* * * * *

■ 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, 2023 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, 2023.

Starting on November 29, 2024, voluntary representations with respect to energy use or efficiency 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 this appendix. Manufacturers may also use this appendix to make voluntary representations with respect to energy use or efficiency prior to November 29, 2024.

Starting on November 29, 2024, voluntary representations with respect to the integrated energy efficiency ratio (IEER) and applied coefficient of performance (ACOP) 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 and ACOP prior to November 29, 2024.

Starting on the compliance date for any amended energy conservation standards for water-source heat pumps based on IEER and ACOP, 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 certify compliance with any amended energy conservation standards for water-source heat pumps based on IEER and ACOP 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) and applied coefficient of performance (ACOP) published after January 1, 2023, representations with respect to the energy use or energy efficiency of water-source heat pumps, including compliance certifications, must be based on testing according to appendix C of this subpart.

Starting on November 29, 2024, voluntary representations with respect to the IEER and ACOP of water-source heat pumps must be based on testing according to this appendix. Manufacturers may also use this appendix to make voluntary representations with respect to IEER and ACOP prior to November 29, 2024.

Starting on the compliance date for any amended energy conservation standards for water-source heat pumps based on IEER and ACOP, 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 and ACOP 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 standards for AHRI 600–2023, ANSI/ASHRAE 37–2009 (as corrected by the Errata sheet for ANSI/ASHRAE 37–2009), and Melinder 2010. However, certain enumerated provisions of AHRI 600–2023 and ASHRAE 37–2009, as listed in this section 1, are inapplicable.

To the extent there is a conflict between the terms or provisions of a referenced industry standard and the CFR, the CFR provisions control.

1.1. AHRI 600–2023

(a) Section 1 Purpose is inapplicable,
(b) Section 2 Scope is inapplicable,
(c) The following subsections of section 3 Definitions are inapplicable:
(1) 3.2.1 (Air Economizer),
(2) 3.2.3 (Barometric Relief Dampers),
(3) 3.2.4 (Basic Model),
(4) 3.2.5 (Coated Coils),
(5) 3.2.6 (Coefficients of Performance),
(6) 3.2.9 (Condenser Pump/Valves/Fittings),
(7) 3.2.10 (Condenser Water Reheat),
(8) 3.2.13 (Desiccant Dehumidification Components),
(9) 3.2.14 (Desuperheater),
(10) 3.2.15.1 (Energy Efficiency Ratio),
(11) 3.2.16 (Evaporative Cooling of Ventilation Air),
(12) 3.2.17 (Fire/Smoke/Isolation Dampers),
(13) 3.2.19 (Fresh Air Dampers),
(14) 3.2.21 (Grill Options),
(15) 3.2.23 (High-effectiveness Indoor Air Filtration),
(16) 3.2.24 (Hot Gas Bypass),
(17) 3.2.27 (Integrated Energy Efficiency Ratio),
(18) 3.2.28 (Low-static Heat Pump),
(19) 3.2.35 (Power Correction Capacitors),
(20) 3.2.36 (Powered Exhaust Air Fan),
(21) 3.2.37 (Powered Return Air Fan),
(22) 3.2.38 (Process Heat Recovery/Reclaim Coils/Thermal Storage),
(23) 3.2.40 (Published Rating),
(24) 3.2.42 (Refrigerant Reheat Coils),
(25) 3.2.43 (Single Package Heat Pumps),
(26) 3.2.44 (Sound Traps/Sound Attenuators),
(27) 3.2.45 (Split System Heat Pump),
(28) 3.2.51 (Steam/Hydronic Heat Coils),
(29) 3.2.53 (UV Lights),
(30) 3.2.54 (Ventilation Energy Recovery System),
(31) 3.2.55 (Water/Brine to Air Heat Pump Equipment), and
(32) 3.2.56 (Waterside Economizer),
(d) The following subsections of section 6 Rating Requirements are inapplicable:
(1) 6.5 (Residential Cooling Capacity and Efficiency),
(2) 6.6 (Residential Heating Capacity and Efficiency),
(3) 6.7 (Test Data vs Computer Simulation),
(4) 6.8 (Rounding and Precision),
(5) 6.9 (Uncertainty), and
(6) 6.10 (Verification Testing),
(e) Section 7 Minimum Data Requirements for Published Ratings is inapplicable
(f) Section 8 Operating Requirements is inapplicable,
(g) Section 9 Marking and Nameplate Data is inapplicable,
(h) Section 10 Conformance Conditions is inapplicable,
(i) Appendix B References—Informative is inapplicable,
(j) Sections D.1 (Purpose), D.2 (Configuration Requirements), and D.3 (Optional System Features) of Appendix D Unit Configuration For Standard Efficiency Determination—Normative are inapplicable, and
(k) Appendix F Example of Determination of Fan and Motor Efficiency for Non-standard Integrated Indoor Fan and Motors—Informative is inapplicable.

1.2. ANSI/ASHRAE 37–2009 (Even if Corrected by the Errata Sheet)

(a) Section 1 Purpose is inapplicable.
(b) Section 2 Scope is inapplicable.
(c) Section 4 Classification is inapplicable.

2. General

Determine integrated energy efficiency ratio (IEER) and heating applied coefficient of performance (ACOP) in accordance with this appendix and the applicable sections of AHRI 600–2023, ANSI/ASHRAE 37–2009, and Melinder 2010. Representations of AEER, EER, and COP may optionally be made.

Section 3 of this appendix provides additional instructions for testing. In cases where there is a conflict, the language of this appendix takes highest precedence, followed by AHRI 600–2023, 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 notification of any change in the incorporation must be published in the **Federal Register**.

3. Setup and Test Provisions for Specific Components

When testing a water-source heat pump that includes any of the features listed in table 1 to this appendix, test in accordance with the setup and test provisions specified in table 1 to this appendix.

TABLE 1 TO APPENDIX C1—SETUP AND TEST PROVISIONS FOR SPECIFIC COMPONENTS

Component	Description	Setup and test provisions
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 percent 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.
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.
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.

TABLE 1 TO APPENDIX C1—SETUP AND TEST PROVISIONS FOR SPECIFIC COMPONENTS—Continued

Component	Description	Setup and test provisions
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.
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.
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.
Refrigerant Reheat Coils	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.
Steam/Hydronic Heat Coils ..	Coils used to provide supplemental heating	Test with steam/hydronic heat coils in place but providing no heat.
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.
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 percent 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.

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