DEPARTMENT OF ENERGY

10 CFR Parts 429 and 431

[EERE–2021–BT–TP–0019]

RIN 1904–AE43

Energy Conservation Program: Test Procedure for VRF Multi-Split Systems

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

ACTION: Final rule.

SUMMARY: This final rule amends the test procedure for variable refrigerant flow (''VRF'') multi-split air conditioners and heat pumps (''VRF multi-split systems'') to incorporate by reference the latest version of the applicable industry test standard. This final rule also adopts the integrated energy efficiency ratio metric in its test procedures for VRF multi-split systems. Additionally, this final rule adopts provisions in the updated industry test procedure relevant to certification and enforcement, including a controls verification procedure.

DATES: The effective date of this rule is November 21, 2022. The final rule changes will be mandatory for VRF multi-split systems equipment testing October 16, 2023. The incorporation by reference of certain publications listed in this rule is approved by the Director of the Federal Register on November 21, 2022. The incorporation by reference of certain other publications listed in this rule was approved by the Director of the Federal Register as of July 30, 2015, and July 16, 2012.

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

A link to the docket web page can be found at *www.regulations.gov/docket/EERE–2021–BT–TP–0019.* 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 industry standards as follows:

AHRI Standard 1230 (I–P), ''2021 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment;'' copyright 2021 (''AHRI 1230–2021'')—into parts 429 and 431.

ANSI/AHRI 1230–2010, 2010 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment,'' approved August 2, 2010 and updated by addendum 1 in March 2011 (''ANSI/AHRI 1230–2010'')—into part 431.

Copies of AHRI 1230–2021 and ANSI/AHRI 1230–2010 can be obtained from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI), 2311 Wilson Blvd., Suite 400, Arlington, VA 22201, (703) 524–8800, or online at: *www.ahrinet.org/search-standards.aspx.*

ANSIASHRAE 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'')—into part 431.

ASHRAE Errata Sheet for ANSI/ASHRAE Standard 37–2009—Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment, ASHRAE approved March 27, 2019, (''ASHRAE Errata Sheet for ANSI/ASHRAE Standard 37–2009'').

Copies of ANSI/ASHRAE Standard 37–2009 and ASHRAE Errata Sheet for ANSI/ASHRAE Standard 37–2009 are available from ASHRAE, 180 Technology Parkway NW, Peachtree Corners, GA 30092, (404)–636–8400, or online at *www.ashrae.org/.*

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

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I. Authority and Background

Commercial package air conditioning and heating equipment is included in the list of ''covered equipment'' for which the U.S. Department of Energy (''DOE'') is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6311(1)(B)–(D)) Commercial package air conditioning and heating equipment includes variable refrigerant flow multi-split air conditioners and heat pumps (''VRF multi-split systems''). DOE's energy conservation standards and test procedure for VRF multi-split systems are currently prescribed at 10 CFR 431.97 and 10 CFR 431.96, respectively. The following sections discuss DOE's authority to establish test procedures for VRF multi-split systems and relevant background information regarding DOE's consideration of test procedures for this equipment.

A. Authority

The Energy Policy and Conservation Act, as amended (''EPCA''),[1] Public Law 94–163 (42 U.S.C. 6291–6317, as codified), among other things, authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. Title III, Part C[2] of EPCA, added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. This equipment includes small, large, and very large commercial package air conditioning and heating equipment, which includes VRF multi-split systems, 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), energy conservation standards (42 U.S.C. 6313), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), and the authority to require information and reports from manufacturers (42 U.S.C. 6316; 42 U.S.C. 6296).

The Federal testing requirements consist of test procedures that manufacturers of covered equipment must use as the basis for: (1) certifying to DOE that their equipment complies with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6316(b); 42 U.S.C. 6296), and (2) making 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 (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 and requires that test procedures not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

With respect to VRF multi-split systems, EPCA requires that the test procedures shall be those generally accepted industry testing procedures or rating procedures developed or recognized by AHRI or the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (''ASHRAE''), as referenced in ASHRAE/IES Standard 90.1, ''Energy Standard for Buildings Except Low-Rise Residential Buildings'' (''ASHRAE Standard 90.1''). (42 U.S.C. 6314(a)(4)(A)) Further, if such an industry test procedure is amended, DOE must amend its test procedure to be consistent with the amended industry test procedure unless DOE determines, by a rule published in the **Federal Register** and supported by clear and convincing evidence, that the amended test procedure would be unduly burdensome to conduct or would not produce test results that reflect the energy efficiency, energy use, and estimated operating costs of that equipment during a representative average use cycle. (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 VRF multi-split systems, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle. (42 U.S.C. 6314(a)(1))

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

DOE is publishing this final rule amending the test procedure for VRF multi-split systems in satisfaction of its statutory obligations under EPCA.

B. Background

DOE's existing test procedure for VRF multi-split systems appears 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 for VRF multi-split systems was last amended in a final rule for standards and test procedures for certain commercial heating, air conditioning, and water heating equipment published in the **Federal Register** on May 16, 2012 (''May 2012 Final Rule''). 77 FR 28928. With regard to VRF multi-split systems, the May 2012 Final Rule adopted the test procedure ANSI/AHRI 1230–2010, ''*2010 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment,*'' approved August 2, 2010 and updated by Addendum 1 in March 2011 (''ANSI/AHRI 1230–2010''). 77 FR 28928, 28945–28946 (May 16, 2012); *see* 10 CFR 431.96, Table 1. Specifically, the DOE test procedure for VRF multi-split systems was modified to reference ANSI/AHRI 1230–2010 with Addendum 1 but omitting sections 5.1.2 and 6.6. 77 FR 28928, 28990–28991 (May 16, 2012). The May 2012 Final Rule also adopted additional requirements, listed in 10 CFR 431.96(c) through (f), for measuring the energy efficiency ratio (''EER'') and coefficient of performance (''COP'') for air-cooled VRF multi-split systems with a cooling

[1] 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.

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

capacity between 65,000 Btu/h and 760,000 Btu/h and water-source VRF multi-split systems with a cooling capacity less than 760,000 Btu/h. *Id.* These additional requirements specify provisions for equipment set-up and provide for limited involvement of manufacturer representatives during testing. 77 FR 28928, 28991 (May 16, 2012).

In 2016,[3] ASHRAE Standard 90.1 was updated, but the 2016 update did not make changes to the test procedure references in ASHRAE Standard 90.1–2013 for VRF multi-split systems. On July 25, 2017, DOE published in the **Federal Register** a request for information (''RFI'') (''July 2017 ASHRAE TP RFI'') to collect information and data to consider amendments to DOE's test procedures for commercial package air conditioning and heating equipment with the test procedure updates included in ASHRAE Standard 90.1–2016. 82 FR 34427. As part of the July 2017 ASHRAE TP RFI, DOE requested comment on the VRF multi-split systems test procedure, under the 7-year-lookback review requirement. 82 FR 34427, 34429 (July 25, 2017). DOE identified several issues that might have warranted modifications to the applicable VRF multi-split systems test procedure, in particular concerning incorporation by reference of the most recent version of the relevant industry standard(s); efficiency metrics and calculations; and clarification of test methods. 82 FR 34427, 34427 (July 25, 2017).

In September 2017, AHRI published an update to ANSI/AHRI 1230–2010, *i.e.,* ANSI/AHRI 1230–2014 with Addendum 1 (although published in 2017, the update uses a 2014 designation).

On April 11, 2018, DOE published in the **Federal Register** a notice of its intent to establish a negotiated rulemaking working group (''Working Group'') under the Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC''), in accordance with the Federal Advisory Committee Act[4] and the Negotiated Rulemaking Act,[5] to negotiate the proposed test procedure and amended energy conservation standards for VRF multi-split systems. 83 FR 15514. The purpose of the Working Group was to discuss and, if possible, reach consensus on a proposed rule regarding the test procedure and energy conservation standards for VRF multi-split systems, as authorized by EPCA. *Id.* at 83 FR 15514.

The Working Group comprised 21 voting members including manufacturers, energy efficiency advocates, utilities, and trade organizations.[6] On October 1, 2019, the Working Group reached consensus on a term sheet (''VRF TP Term Sheet''; Docket No. EERE–2018–BT–STD–0003–0044) that includes the following recommendations, which highlight the most substantial changes:

(1) VRF multi-split systems should be rated with the Integrated Energy Efficiency Ratio (''IEER'') metric to allow consumers to make consistent comparisons with rooftop air conditioner ratings.

(2) The amended test procedure should not be required until the compliance date of amended energy conservation standards.

(3) The Federal test procedure for VRF multi-split systems should be consistent with the September 20, 2019 draft version of AHRI 1230, with additional amendments to be implemented after the conclusion of ASRAC negotiations. (*Id.* at pp. 1–3)

On May 18, 2021, AHRI published an updated industry test standard for VRF multi-split systems AHRI Standard 1230 (I–P), ''*2021 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment*'' (''AHRI 1230–2021''). AHRI 1230–2021 references ANSI/ASHRAE Standard 37–2009, ''*Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment*'' (''ANSI/ASHRAE 37–2009''), as corrected by the Errata Sheet issued March 27, 2019, for additional test set-up and methodology specifications.

These changes, along with comments received in response to the July 2017 ASHRAE TP RFI, were addressed in a test procedure NOPR for VRF multi-split systems published in the **Federal Register** on December 10, 2021 (''December 2021 VRF TP NOPR''). 86 FR 70644. In that NOPR, DOE proposed to incorporate by reference AHRI 1230–2021 and ANSI/ASHRAE 37–2009, as corrected by the Errata Sheet issued March 27, 2019) and establish provisions for determining IEER for VRF multi-split systems. *Id.* DOE also proposed to update its certification, compliance, and enforcement (''CCE'') provisions for VRF multi-split systems to provide information that is necessary for testing VRF multi-split systems consistent with the updated industry test procedure AHRI 1230–2021. DOE held a public meeting related to this NOPR on January 20, 2022 (hereafter, the ''NOPR public meeting'').

DOE received comments in response to the December 2021 VRF TP NOPR from the interested parties listed in Table I.1.

TABLE I–1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE DECEMBER 2021 VRF TP NOPR

Commenter(s)	Reference in this final rule	Docket entry No.	Commenter type
Air-Conditioning, Heating, & Refrigeration Institute	AHRI	12	Trade Association.
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, and Natural Resources Defense Council.	Joint Advocates	9	Efficiency Advocacy Organization.
California Energy Commission	CEC	10	State Official/Agency.
California Investor-Owned Utilities	CA IOUs	11	Utilities.
Carrier Global Corporation	Carrier	7	Manufacturer.
Daikin North America LLC	Daikin	13	Manufacturer.
Lennox International	Lennox	8	Manufacturer.
Northwest Energy Efficiency Analysis	NEEA	14	Efficiency Advocacy Organization.
New York State Energy Research and Development Authority	NYSERDA	6	State Official/Agency.

[3] No publication date is printed on ASHRAE Standard 90.1–2016, but ASHRAE issued a press release on October 26, 2016, which is available at *www.ashrae.org/news/2016/ashrae-ies-publish-2016-energy-efficiency-standard* (Last accessed April 30, 2021).

[4] 5 U.S.C. App. 2, Public Law 92–463.

[5] 5 U.S.C. 561–570, Public Law 104–320.

[6] A complete list of the ASRAC VRF Working Group members is available at: *www.energy.gov/eere/buildings/appliance-standards-and-rulemaking-federal-advisory-committee#Variable%20Refrigerant%20Flow%20Multi-Split%20Air%20Conditioners%20and%20Heat%20Pumps%20Working%20Group.*

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[7] 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. DOE did not identify any oral comments provided during the webinar that are not substantively addressed by written comments.

On March 1, 2022, DOE published in the **Federal Register** an energy conservation standards NOPR (''March 2022 VRF ECS NOPR'') that proposed amended energy conservation standards for VRF multi-split systems that rely on the new IEER cooling metric and are equivalent to the levels specified in ASHRAE Standard 90.1–2019. 87 FR 11335.

[7] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop test procedures for VRF multi-split systems. (Docket No. EERE–2021–BT–TP–0019, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

II. Synopsis of the Final Rule

In this final rule, DOE is amending 10 CFR 431.96, ''Uniform test method for the measurement of energy efficiency of commercial air conditioners and heat pumps,'' to revise the relevant references to the most recent version of the industry test procedure as follows: (1) incorporating by reference AHRI 1230–2021 and ANSI/ASHRAE 37–2009, as corrected by the Errata Sheet issued March 27, 2019; and (2) establishing provisions for determining IEER for VRF multi-split systems. DOE is also adding new appendices D and D1 to subpart F of part 431, both titled ''Uniform test method for measuring the energy consumption of variable refrigerant flow multi-split air conditioners and heat pumps (other than air-cooled with rated cooling capacity less than 65,000 Btu/h),'' (''appendix D'' and ''appendix D1,'' respectively). The current DOE test procedure for VRF multi-split systems is relocated from 10 CFR 431.96 to 10 CFR part 431, subpart F, appendix D without change, and the new test procedure adopting AHRI 1230–2021 is established in appendix D1 for determining IEER. Compliance with appendix D1 is not required until such time as compliance is required with amended energy conservation standards for VRF multi-split systems that rely on IEER, should DOE adopt such standards.

In this final rule, DOE is also updating its certification, compliance, and enforcement (''CCE'') provisions for VRF multi-split systems, to require reporting of information that is necessary for testing VRF multi-split systems consistent with the updated industry test procedure AHRI 1230–2021. Most significantly, these changes include the incorporation of the controls verification procedure (''CVP'') from AHRI 1230–2021 into DOE's product-specific enforcement provisions at 10 CFR 429.134, as well as accompanying certification requirements at 10 CFR 429.43. Additionally, DOE is specifying tested combinations to align with AHRI 1230–2021, clarifying the role of manufacturer involvement during testing, and specifying how to determine represented values for systems using different indoor unit combinations DOE is not reducing the enforcement testing sample size from four units to two units, as was proposed in the December 2021 VRF TP NOPR. Figure 1 presents a process diagram for DOE's certification, compliance, and enforcement regulations for VRF multi-split systems, as described in this final rule.

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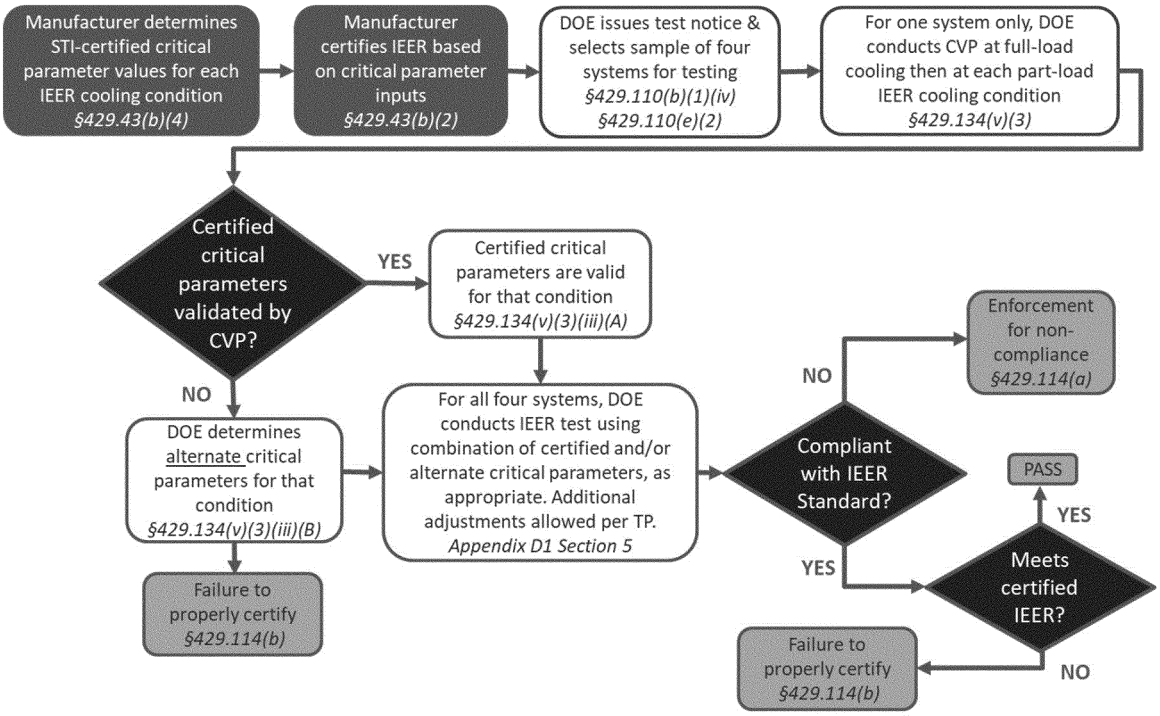

Figure II-1: CCE Process Diagram for VRF Multi-split Systems

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

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

DOE test procedure prior to amendment	Amended test procedure	Attribution
Incorporates by reference ANSI/AHRI 1230–2010.	Incorporates by reference in a new Appendix D1 AHRI 1230–2021 and ANSI/ASHRAE 37–2009 as corrected by the Errata Sheet issued March 27, 2019.	Updates to the applicable industry test procedures.
Includes provisions for determining EER.	Includes provisions for determining both EER and IEER	Updates to the applicable industry test procedures.
Does not include VRF-specific provisions for determination of represented values in 10 CFR 429.43.	Includes provisions in 10 CFR 429.43 specific to VRF multi-split systems to determine represented values for models with specific components, and determine represented values for different indoor unit combinations.	Establish VRF-specific provisions for determination of represented values.
Includes certification requirements in 10 CFR 429.43 consistent with testing to EER per ANSI/AHRI 1230–2010.	Adopts reporting requirements consistent with new test requirements of AHRI 1230–2021, including tested combination, certified critical parameter values, and instructions for conducting the controls verification procedure (“CVP”).	Establish reporting requirements consistent with updated industry test method.
Does not include VRF-specific enforcement provisions in 10 CFR 429.134.	Adopts product-specific enforcement provisions for VRF multi-split systems including: verification of cooling capacity, testing of systems with specific components, break-in period, manufacturer involvement in assessment or enforcement testing, provisions for when DOE would conduct a CVP, and how CVP results would affect critical parameters used in IEER enforcement testing by DOE.	Establish provisions for DOE testing of VRF multi-split systems.
Does not provide VRF-specific instruction for validating alternative methods for determining energy efficiency and energy use (“AEDM”) at 10 CFR 429.70.	Specifies VRF-specific AEDM validation criteria that are dependent on indoor unit combinations offered by the manufacturer.	Establish AEDM instructions specific to VRF multi-split systems.

DOE has determined that the amendments described in section III of this document regarding the establishment of appendix D do not alter the measured efficiency of VRF multi-split systems or require retesting solely as a result of DOE's adoption of the amendments to the test procedure. DOE has determined that the amendments regarding the test procedure in appendix D1 do alter the measured efficiency and are consistent with the updated industry test procedure AHRI 1230–2021. Further, use of the updated industry test procedure provisions and amended representation requirements in 10 CFR 429.43 and 10 CFR 429.70 would not be required until the compliance date of any amended standards based on IEER. Additionally, DOE has determined that the finalized amendments will not increase the cost of testing relative to the updated industry test procedure. The effective date for the amended test procedures 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 variable refrigerant flow multi-split air conditioners and heat pumps. DOE defines variable refrigerant flow multi-split air conditioners and heat pumps as units of commercial package air conditioning and heating equipment that are configured as a split system air conditioner or heat pump incorporating a single refrigerant circuit, with one or more outdoor units, at least one variable-speed compressor or an alternate compressor combination for varying the capacity of the system by three or more steps, and multiple indoor fan coil units, each of which is individually metered and individually controlled by an integral control device and common communications network and which can operate independently in response to multiple indoor thermostats. 10 CFR 431.92. Variable refrigerant flow implies three or more steps of capacity control on common, inter-connecting piping. *Id.* VRF multi-split heat pumps use reverse cycle refrigeration as its primary heating source and may include second supplemental heating by means of electrical resistance, steam, hot water, or gas. *Id.*

DOE is not amending the scope of the Federal test procedure for VRF multi-split systems. DOE's current test procedure regulations for commercial air conditioners and heat pumps at 10 CFR 431.96 include test procedures that apply to air-cooled VRF multi-split air conditioners, air-cooled VRF multi-split heat pumps, and water-source VRF multi-split heat pumps,[8] all with cooling capacity less than 760,000 Btu/h. Table 1 of 10 CFR 431.96. Single-phase, air-cooled VRF multi-split air conditioners and heat pumps with cooling capacity less than 65,000 Btu/h are subject to DOE's consumer product regulations for central air conditioners, and test procedures for these products are specified in appendices M and M1 to subpart B of part 430. Test procedures for three-phase, air-cooled VRF multi-split systems with cooling capacity less than 65,000 Btu/h are not addressed in this final rule and are instead addressed in a separate test procedure rulemaking for air-cooled, three-phase, small commercial package air conditioning and heating equipment with a cooling capacity of less than 65,000 Btu/h (*see* Docket No. EERE–2017–BT–TP–0031).

B. Organization of the VRF Multi-Split System Test Procedure

In the December 2021 VRF TP NOPR, DOE proposed to relocate and centralize the current test procedure for VRF multi-split systems to a new appendix D to subpart F of part 431, such that appendix D would not amend the current test procedure. 86 FR 70644, 70649 (Dec. 10, 2021). The proposed appendix D would also centralize the additional test provisions currently applicable under 10 CFR 431.96 (*i.e.,* optional break-in period for tests conducted using ANSI/AHRI 1230–2010 (10 CFR 431.96(c)); refrigerant line length corrections for tests conducted using ANSI/AHRI 1230–2010 (10 CFR 431.96(d); additional provisions for equipment set-up (10 CFR 431.96(e); and manufacturer involvement in assessment or enforcement testing for variable refrigerant flow systems (10 CFR 431.96(f))). As proposed, VRF multi-split systems would be required to be tested according to appendix D until such time as compliance is required with an amended energy conservation standard that relies on the IEER metric, should DOE adopt such a standard. *Id.*

Similarly, DOE proposed to amend the test procedure for VRF multi-split systems by adopting AHRI 1230–2021 in a new appendix D1 to subpart F of part 431. DOE proposed to adopt the updated version of AHRI 1230, including the IEER metric. *Id.* As proposed, VRF multi-split systems would not be required to be tested according to the test procedure in proposed appendix D1 until such time as compliance is required with an amended energy conservation standard that relies on the IEER metric, should DOE adopt such a standard. *Id.*

DOE did not receive any comments in response to the proposed organization of the test procedure. Accordingly, for the reasons discussed in the December 2021 VRF TP NOPR and as discussed in the preceding paragraphs, DOE is finalizing the proposed organization of the test procedure by establishing appendices D and D1 for testing VRF multi-split systems.

C. Industry Standards

1. Updates to AHRI 1230

As discussed in section I.B of this document, the VRF TP Term Sheet recommended that DOE adopt the 2019 draft version of AHRI 1230 with several changes, including:

- Adding a hierarchy of instructions for how to set up the unit under test, and a clarification that ''as-shipped'' settings should be used as a last resort when instructions are not provided in the supplemental testing instructions (''STI'') and/or the manufacturer's installation instructions (''MII'').
- Providing equations and example calculations of adjustments to measured results for steady-state tests if sensible heat ratio (''SHR'')[9] limits are not met at the 100-percent full-load and/or 75-percent part-load cooling test points.
- Amending the definition of the draft CVP to include a definition of time periods for determining critical parameter validation and allowable critical parameter tolerances using manufacturer-provided data. (Docket No. EERE–2018–BT–STD–0003–0044 at p. 2)

After the VRF ASRAC Working Group meetings in 2019, DOE provided technical support in an AHRI 1230 Technical Committee to address the three outstanding items identified in the VRF TP Term Sheet. For the last item—determining critical parameter tolerances—DOE compiled anonymized, aggregated test data to share with the committee. In a presentation to the AHRI 1230 Technical Committee on September 10, 2020, DOE shared data

[8] The EPCA definition for ''commercial package air conditioning and heating equipment'' specifically excludes ground water source equipment. (42 U.S.C. 6311(8)(A)).

[9] Cooling load is composed of both sensible and latent portions. The sensible load is the energy required to reduce the temperature of the incoming air, without any phase change. The latent load is the energy required to change the moisture in the air from water vapor into a liquid phase as it condenses on the cooling coil. Sensible heat ratio is a ratio of the sensible cooling capacity to the total cooling capacity at a given test condition.

on the variability of critical parameter results as measured during different CVP runs, as well as data on how the measured IEER changed in response to changes in critical parameters. (EERE–2018–BT–STD–0003–0063) DOE presented options that could be considered to express the maximum allowable variation in critical parameters as a ''budget.'' The AHRI 1230 Technical Committee incorporated a budget of 70 points (a measure of critical parameter variation) in the draft AHRI 1230, which is outlined in section III.E.1 of this document.

Following the completion of the AHRI 1230 Technical Committee meetings, in May 2021, AHRI published AHRI 1230–2021, which incorporated the changes consistent with those recommended in the VRF TP Term Sheet. The following list includes substantive changes in AHRI 1230–2021 as compared to ANSI/AHRI 1230–2010, the version currently used for certification:

- Air-cooled VRF multi-split systems with cooling capacity less than 65,000 Btu/h were removed from the scope of the industry test standard. These systems are addressed by AHRI 210/240–2023, ''Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment.''
- Maximum SHR limits of 0.82 and 0.85 were added for full-load and 75-percent part-load conditions, respectively.
- A CVP was added that verifies that the values certified in the STI for setting critical parameters during steady-state testing are within the range of critical parameters that would be used by the system's native controls at the same conditions. A 70-point budget was also added as the criteria for critical parameter validation during the CVP.
- A hierarchy was added indicating which sources of manufacturer's instructions to use during testing in the case of conflicting information among different sources.
- Provisions were updated for refrigerant piping length requirements and for the correction factors applied in the case of excess refrigerant piping length used during testing.
- For water-source equipment, the maximum water flow rate was reduced and part-load entering water temperatures were modified.
- New provisions were added to specify test methods and conditions for cases in which condenser head pressure controls result in unstable operation in part-load cooling tests.
- The provisions for tested combinations, which specify the indoor unit combination to be used for testing, were updated to replace ''highest sales volume'' requirements with a specific hierarchy based on ''indoor unit model family'' (*e.g.,* wall-mounted, compact 4-way ceiling cassette, mid-static ducted).
- A maximum airflow rate of 55 standard cubic feet per minute (''scfm'') per 1,000 Btu/h was added for non-ducted indoor units, and the maximum airflow rate was increased for ducted indoor units from 37.5 scfm per 1,000 Btu/h to 42 scfm per 1,000 Btu/h.
- Test tolerances for indoor air entering wet-bulb temperatures were increased. Specifically, the indoor wet-bulb temperature operating tolerance was increased from 1 °F to 1.8 °F. The indoor wet-bulb temperature condition tolerance was also increased from 0.30 °F to 0.36 °F. Additionally, the operating tolerance for external static pressure (''ESP'') for ducted units was changed from 0.05 in H_2O to 10 percent of the ESP reading.
- Appendix D to ANSI/AHRI 1230–2010 with Addendum 1, ''Test Requirements,'' was amended in ANSI/AHRI 1230–2021 and redesignated as Appendix E, ''ANSI/ASHRAE Standard 37–2009 Clarifications/Exceptions.'' This appendix provides additional instruction and exceptions to the use of ANSI/ASHRAE 37–2009.
- Informative appendices were added that show example calculations for IEER and the CVP ''budget'' method, which calculates the variation between measured critical parameter values and STI-reported critical parameter values.

As part of the December 2021 VRF TP NOPR, DOE evaluated the extent to which a test procedure based on AHRI 1230–2021 would meet the EPCA requirements to produce test results that reflect the energy efficiency, energy use, and estimated operating costs of that equipment during a representative average use cycle, and for such test procedure to not be unduly burdensome to conduct. DOE tentatively concluded that the changes in AHRI 1230–2021 better reflect the field performance of VRF multi-split systems and provide additional clarification for testing provisions. 86 FR 70644, 70650, 70669 (Dec. 10, 2021). DOE also tentatively determined that a test procedure based on AHRI 1230–2021 would not be unduly burdensome to conduct. 86 FR 70644, 70669 (Dec. 10, 2021).

Therefore, DOE proposed to adopt the updated version of AHRI 1230, including the IEER metric, and to incorporate by reference AHRI 1230–2021 in a new appendix D1 to subpart F of part 431. 86 FR 70644, 70650 (Dec. 10, 2021). DOE proposed to reference the following sections from AHRI 1230–2021: Section 3 (except 3.11),[10] Section 5 (except 5.1.2), Section 6 (except 6.3.3 and 6.5), Section 11, Section 12, and Appendix E. 86 FR 70644, 70650–70651 (Dec. 10, 2021). The remaining sections were excluded as either: (1) informative appendices not needed in the DOE test procedure; (2) procedures specific to the AHRI verification program that are not warranted for a DOE test procedure, or (3) sections for which DOE proposed modifications. *Id.*

In the December 2021 VRF TP NOPR, DOE included discussion on several test method topics about which DOE requested comment in the July 2017 ASHRAE TP RFI and received stakeholder comments in response to that RFI. These topics included setting indoor airflow and external static pressure, condenser head pressure controls, indoor unit operation during part-load tests, oil recovery mode during transient testing, secondary methods for capacity measurement, and heat recovery. All of these test method topics were addressed in AHRI 1230–2021, and DOE did not propose any deviations from AHRI 1230–2021 on any of the topics. 86 FR 70644, 70653–70656 (Dec. 10, 2021). DOE did not receive any comments regarding these test method topics in response to the December 2021 VRF TP NOPR, but as discussed, the Department did receive comments generally supportive of DOE's proposal to adopt AHRI 1230–2021. Along these lines, Carrier, Lennox, the CA IOUs, AHRI, Daikin, and NEEA all commented that they support DOE's proposal to adopt AHRI 1230–2021. (Carrier, No. 7 at p. 1; Lennox, No. 8 at pp. 1–2; CA IOUs, No. 11 at p. 3; AHRI, No. 12 at p. 2; Daikin, No. 13 at p. 2; NEEA, No. 14 at p. 2) NEEA further commented that AHRI 1230–2021 adds clarifying provisions that will reduce variability in results. (NEEA, No. 14 at p. 2)

For the reasons discussed in the December 2021 VRF TP NOPR and consistent with the comments received in support of DOE adopting AHRI 1230–2021, DOE concludes that as compared to previous versions of AHRI 1230 (including ANSI/AHRI 1230–2010 which is referenced in the current Federal test procedure), AHRI 1230–2021 generally provides results that are more representative of an average use cycle for VRF multi-split systems, provides additional clarification for

[10] The CA IOUs stated that in proposed updates to 10 CFR 431.97, subpart F, appendix D1, DOE states that critical parameter(s) are defined in section 3.10 of AHRI 1230–2021, but the correct reference should be to section 3.11 of that industry standard. (CA IOUs, No. 11 at p. 4) DOE acknowledges this typographical error and has corrected the section references in this final rule.

testing provisions, and is not unduly burdensome to conduct. In particular, DOE finds that AHRI 1230–2021 includes several test procedure amendments that better reflect typical operation and performance of VRF indoor units, including the addition of SHR limits, further specification of indoor airflow, and changes to indoor unit tested combinations. DOE also finds that the addition of the CVP in AHRI 1230–2021 (which DOE is adopting in enforcement provisions) will improve representativeness by more closely tying controls behavior during testing to controls behavior that would be expected to occur in a field installation under native controls. Therefore, in this final rule DOE is incorporating by reference AHRI 1230–2021 and adopting specific sections for testing VRF multi-split systems as proposed. Sections of AHRI 1230–2021 for which DOE is adopting modifications are discussed in following sections of this final rule.

2. ASHRAE 37

ANSI/ASHRAE Standard 37, which provides a method of test for many categories of air conditioning and heating equipment, is referenced for testing VRF multi-split systems by ANSI/AHRI 1230–2010, ANSI/AHRI 1230–2014 with Addendum 1, and AHRI 1230–2021. ANSI/ASHRAE 37–2005 is referenced in ANSI/AHRI 1230–2010, which is the currently referenced industry test standard in the DOE test procedure for VRF multi-split systems.[11] ANSI/ASHRAE 37–2009 is referenced in ANSI/AHRI 1230–2014 with Addendum 1 and AHRI 1230–2021. To reflect the use of ANSI/ASHRAE 37–2009 in conducting testing according to AHRI 1230–2021, DOE proposed in the December 2021 VRF TP NOPR to incorporate by reference ANSI/ASHRAE 37–2009 (except for sections 1, 2, and 4) including the errata sheet issued March 27, 2019 (which corrected the total heating capacity equations for the outdoor liquid coil method in section 7.6.5.1 of that test standard)[12] in the proposed appendix D1 for the VRF multi-split systems test procedure. 86 FR 70644, 70651 (Dec. 10, 2021). DOE did not receive any comments in response to its proposal to reference ASHRAE 37–2009 in the test method for VRF multi-split systems. Accordingly, DOE concludes that ASHRAE 37–2009 is an integral component of testing VRF multi-split systems (per the 2014 and 2021 versions of AHRI 1230) and that it ensures representativeness and repeatability of the test procedure by specifying instrumentation requirements, test set-up provisions, calculation methods, and test tolerances. Therefore, DOE incorporates by reference ANSI/ASHRAE 37–2009 (as corrected by the most recent errata sheet issued March 27, 2019) and adopts the relevant sections for testing VRF multi-split systems, as proposed.

D. Metrics

1. IEER

In the December 2021 VRF TP NOPR, DOE provided considerable background on the IEER metric, and the Department proposed to adopt the IEER metric and the relevant provisions in AHRI 1230–2021 to determine IEER for VRF multi-split systems. DOE currently prescribes energy conservation standards for air-cooled VRF multi-split systems with cooling capacity greater than or equal to 65,000 Btu/h and water-source VRF multi-split heat pumps in terms of the EER metric for cooling-mode operation and in terms of the COP metric for heating-mode operation. EER and COP capture the system performance at single, full-load operating points in cooling and heating mode, respectively (*i.e.,* single outdoor air temperatures for air-cooled systems and single entering water temperatures for water-source systems). Neither metric provides a seasonal or load-weighted measure of energy efficiency. 86 FR 70644, 70651 (Dec. 10, 2021).

In contrast, the IEER metric factors in the efficiency of operating at full-load conditions as well as part-load conditions of 75-percent, 50-percent, and 25-percent of full-load capacity. In general, the IEER metric provides a more representative measure of field performance by weighting the full-load and part-load efficiencies by the average amount of time equipment spends operating at each load. *Id.*

IEER was first specified in a 2008 supplement to ASHRAE Standard 90.1–2007 for commercial air-cooled, water-cooled, and evaporatively-cooled air conditioning and heat pump equipment. ASHRAE Standard 90.1–2010 included minimum efficiency levels in terms of both EER and IEER for air-cooled VRF multi-split systems. ASHRAE Standard 90.1–2016 added IEER levels for water-source VRF multi-split heat pump systems, including systems with cooling capacity less than 65,000 Btu/h, in addition to the specified EER levels. On January 15, 2016, DOE published a direct final rule in the **Federal Register** for energy conservation standards for air-cooled commercial unitary air conditioners (air-cooled CUACs, or ACUACs), which amended the energy conservation standards for ACUACs and changed the cooling efficiency metric from EER to IEER, with compliance required starting January 1, 2018. 81 FR 2420.

The proposal to adopt the IEER metric and relevant provisions of AHRI 1230–2021 in the test procedure for VRF multi-split systems aligned with the VRF TP Term Sheet upon which the ASRAC Working Group agreed. 86 FR 70644, 70652 (Dec. 10, 2021). DOE also proposed to amend the definition for IEER at 10 CFR 431.92 to distinguish between the test procedures for ACUACs and VRF multi-split systems. *Id.*

Lennox, the CA IOUs, AHRI, Daikin, and NEEA commented that they support DOE's proposal to adopt the IEER metric for VRF multi-split systems. (Lennox, No. 8 at pp. 1–2; CA IOUs, No. 11 at p. 3; AHRI, No. 12 at p. 2; Daikin, No. 13 at p. 2; NEEA, No. 14 at p. 2) Lennox and NEEA stated that IEER improves the representativeness of the tested value for VRF multi-split systems. (Lennox, No. 8 at p. 2; NEEA, No. 14 at p. 2) The CA IOUs and NEEA commented that IEER informs consumers of the part-load performance benefits of variable speed equipment. (CA IOUs, No. 11 at p. 3; NEEA, No. 14 at p. 2) AHRI, Daikin, and Lennox supported DOE's proposed revision to the definition of IEER to differentiate between the test procedures for ACUAC and VRF multi-split systems. (AHRI, No. 12 at p. 2; Daikin, No. 13 at p. 2; Lennox, No. 8 at p. 2)

NEEA commented that DOE should investigate the differences between AHRI 1230–2021 and ANSI/AHRI 1230–2010, because manufacturers currently certify IEER measured per 1230–2010 for the AHRI certification program. The commenter stated that testing according to the new version of AHRI 1230 could result in different IEER values, which could cause market confusion, so NEEA suggested that DOE consider changing the name of the metric measured per AHRI 1230–2021 to ''IEER2.'' (NEEA, No. 14 at p. 2)

Regarding NEEA's comment, the changes in AHRI 1230–2021 as compared to ANSI/AHRI 1230–2010 better reflect typical operation and performance of VRF multi-split systems (see section III.C.1 of this document for further discussion). In particular, DOE

[11] In the December 2021 VRF TP NOPR, DOE incorrectly stated that ANSI/AHRI 1230–2010 references ANSI/ASHRAE 37–2009. 86 FR 70644, 70651 (Dec. 10, 2021).

[12] The errata sheet, which was updated on March 27, 2019, is available at: *www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20errata/standards/37-2009errata-3-27-2019-.pdf* (Last accessed Sept. 7, 2022).

finds that AHRI 1230–2021 includes several test procedure amendments that better reflect typical operation and performance of VRF indoor units, including the addition of SHR limits, further specification of indoor airflow, and changes to indoor unit tested combinations. DOE also finds that the addition of the CVP in AHRI 1230–2021 (which DOE is adopting in enforcement provisions) will improve representativeness by more closely tying controls behavior during testing to native controls behavior that would be expected to occur in a field installation. DOE also notes that the VRF TP Term Sheet included as Recommendation #1 that VRF multi-split systems should be rated with the IEER metric. (Docket No. EERE–2018–BT–STD–0003–0044) This recommendation was unanimously agreed upon by all Working Group members, as it allowed for comparisons to CUAC ratings, which also use the IEER efficiency metric. Further, DOE does not require certification of IEER as measured per ANSI/AHRI 1230–2010 nor does it include IEER in its current test procedure for VRF multi-split systems. Therefore, DOE concludes that there is not a need to deviate from the metric name ''IEER'' specified in AHRI 1230–2021 and that doing so might spawn unnecessary confusion by suggesting that there is some significant difference as to how that term is used in the context of the amended Federal test procedure as compared to AHRI 1230–2021. Consequently, DOE is adopting the IEER metric measured per AHRI 1230–2021 in the Federal test procedure for VRF multi-split systems, as proposed. Further, DOE is adopting the proposed revisions to the definition for IEER at 10 CFR 431.92 to distinguish between the test procedures for ACUACs and VRF multi-split systems.

2. Test Conditions Used for Efficiency Metrics

AHRI 1230–2021 includes a number of test conditions used to determine rated performance of VRF multi-split systems in both cooling mode and heating mode. Standard rating tests in cooling mode include the full-load cooling and three part-load cooling tests used to determine IEER. Standard rating tests in heating mode differ depending on whether the VRF multi-split heat pump is water-source or air-source. For water-source systems, there is only one heating mode standard rating test. For air-source systems, there are two heating mode standard rating tests (one at 47 °F outdoor temperature and another at 17 °F outdoor temperature).

In the December 2021 VRF TP NOPR, DOE proposed to specify in the test procedure for VRF multi-split systems which test conditions would be required for compliance with standards, were DOE to amend the energy conservation standards based on AHRI 1230–2021, and to specify additional test conditions that would be included in the DOE test procedure for making optional representations of efficiency. 86 FR 70644, 70652–70653 (Dec. 10, 2021). Specifically, for air-cooled VRF multi-split systems, DOE proposed to specify in section 3.1 of the proposed appendix D1 that the cooling test conditions used for compliance would be the ''Standard Rating Conditions, Cooling'' and ''Standard Rating Part-Load Conditions (IEER)'' conditions specified in Table 8 [13] of AHRI 1230–2021. DOE also proposed to specify in section 4.1 of the proposed appendix D1 that the heating test condition used for compliance would be the ''Standard Rating Conditions, High Temperature Steady-State Test for Heating'' conditions (47 °F) specified in Table 8 of AHRI 1230–2021. DOE also proposed to specify in section 4.1.1 of the proposed appendix D1 that representations of COP would be optional for the ''Low Temperature Steady-state Test for Heating'' conditions (17 °F), also specified in Table 8 of AHRI 1230–2021. For water-source VRF multi-split heat pumps, DOE proposed to specify in section 3.2 of the proposed appendix D1 that the test conditions used for compliance would be the standard rating test conditions for ''Water Loop Heat Pumps'' and proposed in section 4.2.1 of proposed appendix D1 that representations of EER and COP at the standard rating conditions for ''Ground-loop Heat Pumps'' would be optional. *Id.*

In response to DOE's proposed rating conditions, NYSERDA encouraged DOE to work with industry stakeholders to improve the representativeness of heating-mode performance ratings by: (1) adding rating points at colder ambient temperatures and (2) encouraging DOE to shift from regulating based on a single test point to an integrated heating metric. NYSERDA asserted that the VRF heating performance rating (COP at 47 °F) does not provide customers with sufficient information to determine equipment performance at temperatures experienced by New Yorkers during much of the winter season. Specifically, the commenter advocated that a rating condition at colder temperatures such as 5 °F or 0 °F is needed to provide colder climates with the data necessary to determine which VRF equipment is most appropriate. NYSERDA also encouraged DOE to change the test condition used for determining heating capacity from 47 °F to 17 °F (or lower). Regarding an integrated heating metric, NYSERDA commented that although integrated ratings are not reflective of any specific building type or climate zone, they provide a relative ranking of products, thereby allowing consumers to understand which models are likely to perform better than others across a range of ambient temperatures and load levels on the equipment. NYSERDA commented that an integrated heating metric for VRFs would be more representative than COP at 47 °F. (NYSERDA, No. 6 at p. 2) Furthermore, NYSERDA requested that if its comments could not be addressed in the current rulemaking, then it asked DOE to consider its comments for the next update of VRF test procedures. (NYSERDA, No. 6 at p. 3) No other comments were received as to the proposed test conditions for VRF multi-split systems.

In response, DOE notes that for VRF multi-split systems, the generally accepted industry test procedure is AHRI 1230–2021, which for air-source heat pumps only includes provisions to determine the COP rating at a high temperature point of 47 °F and at a low temperature point of 17 °F (outdoor air dry-bulb temperatures). Neither AHRI 1230–2021 nor previous versions of AHRI 1230 include the provisions needed to determine heating performance at other outdoor temperatures or specify an integrated metric for heating.

Regarding the addition of heating conditions at temperatures colder than 17 °F or adoption of an integrated heating metric (which as described by NYSERDA, would involve adding part-load heating tests), at this time, DOE lacks sufficient evidence to adopt tests for VRF multi-split systems at conditions other than those specified in the updated industry consensus test procedure, AHRI 1230–2021. Further, DOE does not have data as to representative test conditions, load levels, and weighting factors to be included in an integrated heating metric for VRF multi-split systems.

Regarding the suggestion that rated heating capacity be based on performance at 17 °F instead of 47 °F,

[13] AHRI commented in response to the December 2021 NOPR that DOE incorrectly identified the relevant table numbers of AHRI 1230–2021. They clarified that Table 8 of AHRI 1230–2021 outlines ''standard rating conditions'' for air-source VRF multi-split systems, while Tables 9 and 10 provide these conditions for water-source VRF multi-split systems for cooling mode and heating mode, respectively. (AHRI, No. 12 at p. 10) DOE has corrected these references in this final rule.

NYSERDA did not provide evidence that heating capacity measured at 17 °F would be more representative for VRF multi-split systems for the nation as a whole. Further, all other commercial heat pump equipment categories regulated by DOE also have the rated heating capacity measured at 47 °F, thus allowing comparison at the same condition across equipment categories. Additionally, the AHRI *Directory of Certified Product Performance*[14] includes heating capacity measured at both 47 °F and 17 °F; therefore, to the extent stakeholders are interested in heating capacity of VRF multi-split systems at 17 °F, they can obtain such information from the data made publicly available in the AHRI Directory for systems included in AHRI's certification program.

DOE notes that NYSERDA acknowledged that the Department is finalizing its test procedure rulemaking for VRF multi-split systems and that the commenter's suggestions may not be able to be incorporated in this rulemaking. Absent data supporting the representativeness of alternate test conditions and an alternate metric, as well as a lack of information as to which test conditions would be included in a representative integrated heating metric, DOE is not considering test conditions or metrics for VRF multi-split systems other than those proposed in the December 2021 VRF TP NOPR. Therefore, DOE is not adopting a lower-temperature heating test or an integrated heating metric for VRF multi-split systems, as recommended by NYSERDA. For the reasons discussed in the December 2021 VRF TP NOPR and in the preceding paragraphs, DOE is finalizing its proposals from the December 2021 VRF TP NOPR regarding test conditions for VRF multi-split systems.

E. Controls Verification Procedure

Section 5.1.2.1 of AHRI 1230–2021 specifies that during steady-state performance rating tests for cooling and heating efficiency, VRF multi-split systems must operate under commands from system controls except for certain components, referred to as ''critical parameters,'' which are allowed to be set by a manufacturer's representative. These critical parameters are (1) compressor speed(s), (2) outdoor fan speed(s), and (3) outdoor variable valve positions. Settings for critical parameters are allowed to be manually controlled using a manufacturer control tool, as opposed to all other components which must operate per commands from the system controls. The measured performance of VRF multi-split systems depends, in part, on the operating positions of each of these critical parameters. Accordingly, Section 5.1.2 of AHRI 1230–2021 states that operational settings for each of the critical parameters must be specified in the STI, and that each of the critical parameters must be allowed to be manually adjusted (to match the STI-certified values) during testing.

AHRI 1230–2021 also includes a normative Appendix C that specifies a CVP. The purpose of the CVP is to validate that the observed positions of critical parameters during the CVP are within tolerance of the STI-certified critical parameter values that are set by the manufacturer in steady-state IEER cooling tests (see section III.E.4 of this final rule for discussion of CVP results). This ensures that the measured results of the IEER test procedure are based on critical parameter settings that are representative of critical parameter behavior that would be experienced in the field. The December 2021 VRF TP NOPR includes additional information about the CVP. *See* 86 FR 70644, 70658–70663 (Dec. 10, 2021).

1. Background

DOE's current test procedure for VRF multi-split systems includes allowances in 10 CFR 431.96(f) for limited manufacturer involvement in assessment or enforcement testing. A manufacturer's representative may adjust components such as the compressor speed, fan speeds, and valve positions for the purposes of achieving steady-state conditions during testing. 10 CFR 431.96(f). This adjustment process is provided for VRF multi-split systems because of the complexity of VRF multi-split systems and the variety of settings needed to perform a test. 77 FR 28928, 28946 (May 16, 2012). DOE's current certification requirements for VRF multi-split systems, found at 10 CFR 429.43(b)(4), specify that the STI must include compressor frequency setpoints and required dip switch/control settings for step or variable components. However, DOE's current regulations do not require these settings to match system behavior when the VRF multi-split system is operating under its own controls. Further, there are no constraints regarding the allowable range of adjustments that a manufacturer's representative may make to reach steady-state operation.

In October 2018, during the negotiation meetings of the Working Group, the CA IOUs raised concern (supported by field and laboratory test data) as to the representativeness of the ANSI/AHRI 1230–2010 method, particularly with respect to control inputs used at part-load test conditions. (Docket Nos. EERE–2018–BT–STD–0003–0011 and EERE–2018–BT–STD–0003–0013) Ultimately, the VRF TP Term Sheet from the Working Group recommended that DOE adopt an updated draft of AHRI 1230 that included a controls verification procedure as an appendix. (Docket No. EERE–2018–BT–STD–0003–0044 at pp. 1–2)

Appendix C of AHRI 1230–2021 establishes a CVP.[15] The CVP verifies whether critical parameter settings certified in the STI, implemented by the manufacturer's representative during full-load and part-load steady-state cooling tests for IEER, are within the range of settings that would be used by the system during operation in the field—the system's native controls. The behavior of each critical parameter is monitored and recorded throughout the duration of a CVP. In contrast to steady-state tests in which test conditions are held constant, the CVP is a dynamic cooling test method in which certain test conditions are intentionally varied throughout the test. Specifically, the indoor room dry-bulb temperature is steadily decreased during the CVP using the room conditioning apparatus, in order to determine how the VRF multi-split system under test responds to approaching and achieving its setpoint. Outdoor room test conditions are held constant during the CVP. The CVP may be conducted at any of the four IEER outdoor air or entering water temperature conditions. At the start of the CVP, the indoor room test chamber temperature is controlled to a manufacturer-specified value that must be between 82 °F and 86 °F, and the VRF indoor units are set to control to a constant indoor temperature, 80 °F, except as explained by Section 5.1.5 of AHRI 1230–2021. Section 5.1.5 provides instructions for adjusting the VRF indoor unit setpoints (deviating from 80 °F) to account for setpoint bias and setpoint offset.[16] VRF indoor units

[14] The AHRI directory for VRF multi-split systems is available at: *www.ahridirectory.org/NewSearch?programId=72&searchTypeId=3* (Last accessed July 8, 2022).

[15] The concept for the CVP originated from a minimum compressor speed verification procedure provided in Japanese standard JIS B 8616:2006, *Package Air Conditioners,* which is included as an informative reference in appendix B of AHRI 1230–2021, but not directly referenced within AHRI 1230–2021. Available at *www.jsajis.org/index.php?main_page=product_info&cPath=2&products_id=13290.*

[16] AHRI 1230–2021 provides the following definitions for these terms in sections 3.29 and 3.30, respectively:

Continued

typically use the calculated temperature difference between the setpoint and the measured indoor air temperature as a control parameter for determining when to shut down and become thermally inactive.

As discussed, the timing of the first indoor unit becoming thermally inactive dictates the allowable time period for determining whether certified critical parameter values have been validated, so it is crucial to account for setpoint bias and offset to ensure repeatable test results. After setting initial indoor air temperature, including any adjustments to control for setpoint bias and offset, the CVP proceeds by incrementally decreasing the indoor room test chamber temperature while the VRF multi-split system setpoint is held constant. As the indoor room temperature approaches and eventually passes below the VRF multi-split system setpoint, the VRF multi-split system controls should begin to register that the cooling demand has been satisfied, and the system will begin to ''unload,'' meaning reduce capacity.[17] VRF multi-split systems typically unload by modulating component settings, including critical parameters, from the values used when providing full-load cooling capacity.

During this unloading period and up until the time that the first indoor unit becomes thermally inactive, critical parameters are compared against the critical parameter values that are certified in the STI. Once the first indoor unit becomes thermally inactive, the indoor room dry-bulb temperature continues decreasing until the indoor room reaches 77 °F. Section C6 of AHRI 1230–2021 includes equations for determining ''RSS Points Total'' [18]—an aggregated and normalized measure of deviation of all critical parameters from their certified values—and also includes criteria for determining whether or not the CVP has validated the certified critical parameter settings. The verification criteria specified in Section C6 of AHRI 1230–2021 for critical parameters measured during the CVP constitute a ''budget method'' that applies a limit to the calculated RSS Points Total across all three critical parameters instead of applying individual tolerances to each individual critical parameter.[19] This method allows manufacturers flexibility in critical parameter control strategies while still constraining the overall variation in VRF multi-split system performance. The budget method can be applied the same way regardless of the number of critical parameters that a manufacturer certifies to their STI. For any critical parameter whose value is not certified in the STI, (*i.e.,* not designated as being controlled during the IEER cooling tests), the deviation in that parameter will be calculated as zero for the duration of the CVP. Section C6.1.2 of AHRI 1230–2021 specifies that the certified critical parameters are valid if at least one measurement period of at least three minutes and a minimum of five sample readings exists where the average RSS Points Total is less than or equal to 70 points. Section C6.1.3 specifies the converse, *i.e.,* if no such measurement period satisfying those critical parameters exists within the CVP, then certified critical parameter values are deemed invalid. As discussed and for the reasons explained in the following sections, DOE is generally adopting the CVP provisions as proposed in the December 2021 VRF TP NOPR.

2. When the CVP Is Conducted

In the December 2021 VRF TP NOPR, DOE proposed to adopt the CVP that is specified in appendix C of AHRI 1230–2021 in the product-specific enforcement provisions for VRF multi-split systems at 10 CFR 429.134(s). 86 FR 70644, 70661 (Dec. 10, 2021). Additionally, DOE proposed to specify at 10 CFR 429.134(s)(3) that DOE would conduct a CVP at each of the four IEER cooling test conditions in the December 2021 VRF TP NOPR. *Id.* DOE also proposed to specify that the CVP would be performed first at the full-load cooling condition to determine maximum critical parameter values, before conducting the CVP at part-load cooling conditions because the maximum critical parameter values are used for calculating normalized deviation for CVPs at part-load conditions. *Id.*

The CA IOUs, Daikin, and AHRI commented that they support DOE's proposal to incorporate the CVP into its product-specific enforcement provisions. (CA IOUs, No. 11 at p. 2; Daikin, No. 13 at p. 4; AHRI, No. 12 at p. 5) The CA IOUs stated that this proposal captured the intent of the VRF TP Term Sheet and that this proposal will capture the benefits of the CVP while limiting test burden primarily to the systems included in enforcement testing. (CA IOUs, No. 11 at p. 2)

NEEA commented that the CVP is an essential process to verify that the system can perform according to its rating. NEEA recommended that the CVP should be required as a part of the test procedure, not only included in enforcement provisions. The commenter stated that, without performing a CVP as part of the test procedure, the manufacturer may not be aware that its equipment is underperforming until DOE selects it for enforcement testing. (NEEA, No. 14 at pp. 2–3)

Joint Advocates and the CA IOUs commented that they support DOE's proposal to conduct a CVP at each of the four load points. The CA IOUs stated that the CVP is important at part-load conditions, where deviation in the VRF system performance is expected to be largest. (CA IOUs, No. 11 at p. 2; Joint Advocates, No. 9 at p. 2) AHRI and Daikin pointed out that DOE's proposal to conduct a CVP at each load point would be more than what is required for AHRI's certification program. (AHRI, No. 12 at p. 10; Daikin, No. 13 at p. 7) Daikin further commented that, due to the relative newness of the CVP, manufacturers would likely perform the same CVP tests that DOE would perform as part of enforcement testing, thereby increasing test burden. (Daikin, No. 13 at p. 7) AHRI further commented that other than conducting the CVP at all load points, the burdens of the NOPR proposals are similar to current industry practice as indicated by AHRI 1230–2021. (AHRI, No. 12 at p. 10)

With regards to NEEA's comment, DOE did consider the potential burden and benefits of including the CVP as part of the Federal test procedure, and this evaluation revealed the following. To start, DOE notes that the CVP is not required for rating models as part of the industry consensus test procedure (AHRI 1230–2021). Per the certification requirements adopted in this final rule (see section III.G.2.b of this document), manufacturers will be required to report

Setpoint Bias—The difference between 80 °F and the nominal thermostat setpoint required for the thermostat to control for 80 °F sensed temperature at the sensed location.

Setpoint Offset—The difference between the temperature indicated by a thermostat's temperature sensor and the actual temperature at the sensor's location.

[17] Figure C.1 in AHRI 1230–2021 displays an example schematic of the indoor dry-bulb temperature in °F, compressor speed in Hz, and the number of thermally active indoor units over the duration of a CVP test.

[18] In response to the December 2021 NOPR, the CA IOUs commented that there were certain incorrect section references in the December 2021 NOPR. They stated that proposed changes to 10 CFR 429.134(s)(3)(ii)(B) state that the RSS points total is defined in Section 3.26 of AHRI 1230–2021, while the definition is actually in section 3.27. (CA IOUs, No. 11 at p. 4). DOE has corrected the section references in this final rule.

[19] In addition to recommending inclusion of a CVP as an appendix to the draft AHRI 1230, the VRF TP Term Sheet also recommended that DOE determine appropriate values for critical parameter tolerances using manufacturer-provided data. DOE subsequently conducted testing and sensitivity analysis of several VRF multi-split systems. The results were used to develop the ''budget method'' for CVP critical parameter verification specified in Section C6 of AHRI 1230–2021.

the critical parameter settings at each of the IEER test conditions as part of their STI. Consequently, DOE expects that manufacturers likely will develop these certified values first through investigative testing of some basic models and then later, as knowledge of VRF control systems improves, through simulations. However, DOE expects that manufacturers may determine that they do not need to conduct the CVP on every basic model in order to understand the behavior of the system controls to develop certified critical parameters. For instance, a manufacturer may conduct a CVP on one or two models within a model line and find that the resulting information provides an adequate basis to develop certified critical parameters for other models in the model line (*e.g.,* similar models of differing capacities). Further, manufacturers likely will have some understanding of the dynamic system controls behavior of their models without conducting the CVP. Requiring conducting the CVP for rating every basic model would not provide manufacturers this discretion, and it could result in unnecessary and costly testing.

Requiring the CVP to be conducted for every basic model would require manufacturers to physically test every basic model of VRF multi-split systems. Per current regulations at 10 CFR 429.43 and 10 CFR 429.70, manufacturers are allowed to rate VRF multi-split systems using AEDMs and are not required to test every basic model. Therefore, requiring the CVP to be conducted for every basic model would substantially increase the number of basic models required to be physically tested. Further, as described in the December 2021 VRF TP NOPR, DOE estimated that the CVP would add approximately eight hours of test time at each of the four IEER load conditions during enforcement testing. 86 FR 70644, 70669 (Dec. 10, 2021). If the CVP were required to be used at each IEER test condition, each basic model would potentially require over 30 hours of testing time for the CVP, beyond the testing time required to measure IEER.

Because manufacturers likely will conduct CVP testing and simulation on a number of their VRF models in order to determine representative certified settings for critical parameters in the STI for all basic models, DOE finds that NEEA's suggestion to include the CVP as part of the test procedure for VRF multi-split systems would not substantially change the critical parameter settings manufacturers would certify, and, thus, would not provide a significant increase in representativeness of the test procedure. Further, NEEA's suggestion would impose significantly more burden on manufacturers than the approach proposed in the December 2021 VRF TP NOPR, because it would require physical testing and conducting the CVP for every basic model, rather than allowing manufacturers to decide the appropriate balance of CVP testing and test burden to develop certified critical parameter settings. Contrary to what NEEA suggests, DOE also finds it unlikely that manufacturers would not take appropriate steps to assess their equipment's performance under the CVP, particularly given the potential business disruptions likely to result were underperformance to be encountered for the first time in the context of DOE enforcement testing. Given that not requiring the CVP for testing is consistent with the VRF TP Term Sheet and the most recent industry consensus test procedure, DOE does not have sufficient evidence to conclude that requiring the CVP for testing would improve the representativeness of the test procedure without being unduly burdensome. Therefore, DOE is adopting the CVP as product-specific enforcement provisions for VRF multi-split systems in 10 CFR 429.134(s) as proposed.

With regard to conducting the CVP at all four IEER load points, DOE found through its investigative testing that there is substantial variability in VRF system behavior observed at different IEER load points, and that the system controls behavior at one IEER point does not necessarily predict behavior at a different load point. Therefore, DOE concludes that separately validating critical parameter behavior at each IEER condition is needed as part of DOE enforcement testing in order to sufficiently ensure representative system controls behavior. In consideration of these factors and comments received, in this final rule, DOE is adopting its proposals at 10 CFR 429.134(v)(3) regarding performing a CVP at full-load cooling conditions first, then at each of the part-load cooling conditions.

Adoption of the CVP in enforcement provisions will not require manufacturers to conduct the CVP on every basic model. As previously discussed, manufacturers likely will choose not to conduct the CVP for every basic model of VRF multi-split systems, as they may find that simulations, similarity between basic models (particularly between models within a model line), and their understanding of the behavior of their system controls provide sufficient basis to develop certified critical parameter settings for some of their model offerings. To the extent that manufacturers conduct CVP testing on their models in order to sufficiently understand systems behavior, DOE acknowledges that its adoption of CVP testing at all four IEER load points for enforcement testing (rather than just at one IEER load point) may result in manufacturers conducting the CVP at more IEER load conditions than they otherwise would have. DOE acknowledges that in certain scenarios, running three more CVPs could take up to 24 hours. However, by performing the CVP at the same time as IEER testing, there would be no additional test burden associated with unit set-up/commissioning. Additionally, a CVP could be completed immediately following a steady-state test run at the corresponding IEER load point, in which case there would be no need to change the test chamber temperatures prior to conducting the CVP. Therefore, DOE concludes that for the basic models for which manufacturers choose to conduct the CVP, conducting the CVP at all four IEER load points would not be unduly burdensome and would increase the representativeness of the test procedure. As discussed, DOE has concluded that conducting the CVP at all four IEER load points is needed to ensure representative system behavior. Therefore, DOE is adopting its proposals at 10 CFR 429.134(v)(3) that as part of assessment or enforcement testing, DOE will perform a CVP at full-load cooling conditions first, then at each of the part-load cooling conditions.

In the December 2021 VRF TP NOPR, DOE also proposed to specify that the CVP would be performed on a single system of the two-system sample during enforcement testing. 86 FR 70644, 70661–70662 (Dec. 10, 2021).

AHRI, Lennox, the CA IOUs, and Daikin commented that performing a CVP on a single system is adequate, provided that the testing laboratory ensures the set-up is correct and that a manufacturer representative is involved. (AHRI, No. 12 at p. 5; Lennox, No. 8 at p. 3; CA IOUs, No. 11 at p. 2; Daikin, No. 13 at p. 4)

For the reasons discussed in the December 2021 VRF TP NOPR and in the preceding paragraphs, DOE adopts its proposal to perform the CVP on a single system during assessment or enforcement testing. DOE is clarifying in this final rule that a CVP would be performed on a single system, regardless of the sample size used for enforcement (see section III.G.7 of this document for further discussion of the enforcement sampling plan). DOE's use of the CVP during assessment and enforcement

testing is illustrated in Figure 1 in section II of this final rule.

3. Critical Parameter Definition

In the December 2021 VRF TP NOPR, DOE proposed not to reference the definition of ''critical parameters'' in Section 3.11 [20] of AHRI 1230–2021 in order to be more explicit that the term ''critical parameters'' refers only to those parameters specified by Section 5.1.2.1 of AHRI 1230–2021. DOE proposed to define critical parameters in section 3 of appendix D1 as specifically referring to the following settings of modulating components of VRF multi-split air conditioners and heat pumps: compressor speed(s), outdoor fan speed(s) and outdoor variable valve position(s). 86 FR 70644, 70659 (Dec. 10, 2021). DOE tentatively concluded that the proposed change to the definition is editorial in nature and would not change or conflict with any testing provisions in AHRI 1230–2021. *Id.* at 86 FR 70659–70660.

AHRI and Daikin commented that the original definition for critical parameters as written in AHRI 1230–2021 should be used in the DOE test procedure. (AHRI, No. 12 at p. 3; Daikin, No. 13 at p. 2) AHRI stated that Section 5.1.2.1 of AHRI 1230–2021 specifies what the critical parameters are for a given system and stated their preference that this be enumerated in the test requirements rather than the definition so as to align with AHRI 1230–2021. (AHRI, No. 12 at p. 3) Daikin argued that the proposed revision to the definition does not add more specificity to which components can be adjusted. (Daikin, No. 13 at p. 2) The CA IOUs commented that they support DOE's proposed definition for ''critical parameters'' and limiting the term to the parameters specified in section 5.1.2.1 of AHRI 1230–2021, and they agreed with DOE that the proposal would not conflict with any testing provisions in AHRI 1230–2021. (CA IOUs, No. 11 at p. 4) Lennox commented that they support DOE's proposal to clarify that critical parameters are limited to compressor speeds, outdoor fan speeds, and outdoor variable valve positions, stating that the proposed definition would provide clarity and consistency when conducting a CVP. (Lennox, No. 8 at p. 3)

[20] The CA IOUs stated that in proposed updates to 10 CFR 431.97, subpart F, appendix D1, DOE states that critical parameter(s) are defined in section 3.10 of AHRI 1230–2021, but the correct reference should be to section 3.11 of that industry standard. (CA IOUs, No. 11 at p. 4) DOE acknowledges this typographical error and has corrected the section references in this final rule.

While section 5.1.2.1 of AHRI 1230–2021 clearly enumerates the three types of components that can be specified for testing and verified by conducting a CVP, the definition of ''critical parameter'' in AHRI 1230–2021 is rather vague, open-ended, and susceptible to a reading that would permit inclusion of components that cannot be overridden during testing (*i.e.,* components other than compressor speed(s), outdoor fan speed(s) and outdoor variable valve position(s)). DOE concludes that specifying the relevant components in the definition will add clarity to the test procedure without conflicting with existing provisions or adding duplicative language into the test procedure. Therefore, for the reasons discussed in the December 2021 VRF TP NOPR and in this paragraph, DOE is adopting its proposed definition for critical parameters that specifically refers to the relevant components: compressor speed(s), outdoor fan speed(s) and outdoor variable valve position(s).

4. Validation of Certified Critical Parameters

As previously discussed, Sections C6.1.2 and C6.1.3 of AHRI 1230–2021 specify validation criteria for the CVP using a budget method that limits the calculated RSS Points Total across all three critical parameters. In the December 2021 VRF TP NOPR, the Department discussed this matter in some detail, and DOE tentatively determined that the language in Sections C6.1.2 and C6.1.3 of AHRI 1230–2021 could be construed and applied in multiple manners, and that this could lead to differing test burdens. 86 FR 70644, 70660 (Dec. 10, 2021). The phrase ''a measurement period of at least three minutes and a minimum of five sample readings'' could be misunderstood to indicate a measurement period with no upper limit, potentially encompassing the entire duration of the CVP. This reading could be misunderstood to require iterative calculations of time periods of varying lengths when validating critical parameters during the CVP (*e.g.,* all three-minute periods, and all four-minute periods, and all five-minute periods). Taken to an extreme, this would result in thousands of calculations. Further, the language ''where the average RSS Points Total is less than or equal to 70 points'' does not indicate the specific procedure for determining the average value of RSS Points Total—*i.e.,* whether ''average'' refers to the average value within the measurement period or the cumulative average value of RSS points at the time of measurement. *Id.*

Accordingly, DOE proposed to clarify these provisions by providing additional instructions for validating critical parameters in 10 CFR 429.134(s)(3)(ii). *Id.* Specifically, DOE proposed to specify that the duration of the time period used for validating critical parameters must be whichever of the following is longer: three minutes or the time period needed to obtain five sample readings while meeting the minimum data collection interval requirements of Table C2 of AHRI 1230–2021. *Id.* DOE also proposed to specify that if at least one measurement period (with the aforementioned duration) exists before the first indoor unit goes thermally inactive that has an average RSS Points Total less than or equal to 70 points, then the certified critical parameter values are validated. *Id.*

a. Validation Time Period

Regarding DOE's proposal to clarify the language about the length of time used for the critical parameter validation period, AHRI commented that DOE should not specify a duration for the measurement period used for validating critical parameters. AHRI argued that it is not necessary to change existing language, as increasing testing duration will not improve the ability of the equipment to conform to testing conditions. (AHRI, No. 12 at pp. 3–4) Daikin commented that while they agree with DOE's interpretation that technically a maximum validation time period is not specified in AHRI 1230–2021, a longer test run would result in a higher RSS point total. Daikin stated that this is detrimental to determining whether the critical parameters are valid and asserted that a manufacturer would likely test using the shortest time period permitted by AHRI 1230–2021 (3 to 4 minutes). (Daikin, No. 13 at p. 3) Despite both AHRI and Daikin indicating that a maximum limit for critical parameter validation is not necessary, they acknowledged that there may be merit in adding a maximum time period and suggested changing this period to twice that proposed (*i.e.,* 8 minutes). Daikin and AHRI provided three reasons to justify their proposals: (1) there may be difficulty achieving all three critical parameter values at the same time; (2) if any one critical parameter achieves its target setpoint before the other critical parameters, the system is penalized for going beyond the target setpoint; and (3) the newness of the CVP results in greater uncertainty. (AHRI, No. 12 at pp. 3–4; Daikin, No. 13 at p. 3)

In response, DOE understands Daikin's comment to reflect a misunderstanding of the calculation of the RSS points total, by suggesting the potential for accumulating more points as more time passes. As specified in Section C6.1.1 of AHRI 1230–2021, RSS points total is calculated at each data collection interval during the R2 period [21] as an instantaneous measurement, and, therefore, it does not accumulate over time. AHRI's comments seemingly contradict each other, as it in one place calls for an 8-minute maximum period while at another place it states that a maximum period would have no effect. With respect to AHRI and Daikin's claims about the timing with which critical parameters achieve their target operating states, DOE is aware of the possibility that system controls may achieve desired setpoints for one critical parameter at a different time during the CVP than other critical parameters. However, the purpose of the CVP is to validate that the measured results of the IEER test procedure are based on critical parameter settings that are representative of critical parameter behavior that would be experienced in the field. Because the measured performance of VRF multi-split systems is dependent on the *simultaneous* interaction of each of the critical parameters, critical parameter variation must be evaluated based on the simultaneous positions of each parameter, not based on the behavior for each parameter at different periods of the CVP. Therefore, DOE concludes that for representative IEER test results, the critical parameter settings used in IEER testing should be representative of a combination of setpoints that would be used simultaneously in real-word applications. If the desired critical parameter setpoints are achieved in the CVP at times far enough apart that the RSS Points Total limit is not met within the maximum length of validation period, then the certified critical parameter settings should be invalidated (*i.e.,* not used for steady-state IEER testing). Daikin and AHRI also did not provide any evidence to support their suggestion for increasing the duration of the validation period beyond the duration in DOE's proposed clarification of Sections C6.1.2 and C6.1.3 of AHRI 1230–2021. Because, as discussed in section III.C.1 of this document, the Working Group unanimously recommended that DOE adopt a test procedure referencing AHRI 1230–2021, DOE understands AHRI 1230–2021 to represent the industry consensus opinion. By extension, DOE understands the critical parameter validation time period between 3–4 minutes specified in AHRI 1230–2021 to reflect consensus on an appropriate validation time interval that provides for sufficient data collection and representative results.

For the reasons discussed in the December 2021 VRF TP NOPR and in the preceding paragraphs, in this final rule, DOE is adopting its proposal to specify in 10 CFR 429.134(v)(3)(ii) the duration of the time period used for validating critical parameters. The additional instruction results in a validation period lasting a minimum of three minutes and a maximum of four minutes. For tests using the longest allowable data collection interval,[22] the time required to obtain five sample readings would be four minutes (once at the start of the interval plus four successive measurements, once each minute). For tests using shorter data collection intervals, the validation time period would be either the time required to achieve five sample readings or three minutes, whichever is longer.

b. Validation Criteria

Regarding DOE's proposal to validate certified critical parameters based on the presence of a period (with duration discussed in section III.E.4.a of this document) having an average RSS points total less than or equal to 70 points, the CA IOUs commented that they agree that the RSS Point Total budget of 70 points should be large enough to account for any potential source of variability. (CA IOUs, No. 11 at pp. 2–3) In contrast, AHRI and Daikin commented that CVP testing has only been conducted on a limited subset of products, with very few water-source products and no products over 240,000 Btu/h. These commenters further asserted that no lab-to-lab test validation has been conducted, especially between manufacturer laboratories and third-party laboratories. AHRI and Daikin also asserted that manufacturers have observed that changes in the indoor chamber temperature ramp rate impact the unit's ability to meet the average RSS points total and to reach conditions of the CVP. For these reasons, AHRI and Daikin recommended that in the case that a CVP invalidates the certified critical parameter settings during enforcement testing, DOE should require that a second CVP be conducted at an adjusted ramp rate to re-attempt validation. (AHRI, No. 12 at pp. 4–5; Daikin, No. 13 at pp. 3–4)

Regarding AHRI and Daikin's claims about the potential for variation between different CVP test runs, as discussed in section III.E.1 of this final rule, the budget method (adopted at 10 CFR 429.134(v)(3)(ii) in this final rule) allows manufacturers flexibility in critical parameter control strategies while still constraining the overall variation in VRF multi-split system performance. Following Working Group meetings, DOE conducted testing and sensitivity analysis of several VRF multi-split systems, the results of which were incorporated into the development of the budget method for CVP critical parameter verification specified in Section C6 of AHRI 1230–2021. The 70-point threshold was developed as part of AHRI 1230 Technical Committee meetings in which DOE presented anonymized and aggregated test data. As part of those meetings, DOE presented its finding that a minimum point budget of 32 points was required to account for the lab-to-lab and test-to-test variability observed in critical parameter behavior between CVP runs for a single system. (EERE–2018–BT–STD–0003–0063 at p. 23) To account for additional variability (*e.g.,* sample-to-sample variability across the same VRF multi-split system and variability across different types of VRF multi-split systems), DOE recommended a 60-point budget to the Technical Committee. (*Id*) The Technical Committee ultimately agreed to specify a 70-point budget in AHRI 1230–2021. Additionally, in the December 2021 VRF TP NOPR, DOE specifically requested test data demonstrating any issues with repeatability and reproducibility of the CVP that would indicate that the 70-point budget for critical parameter variation included in the industry consensus test procedure AHRI 1230–2021 is insufficient. 86 FR 70644, 70662 (Dec. 10, 2021). DOE did not receive any data in response to this request. For these reasons, DOE concludes that based on all available data, the RSS points total budget of 70 points is appropriately flexible to account for any issues with lab-to-lab and unit-to-unit repeatability when conducting the CVP.

With regard to AHRI and Daikin's proposal to allow a second CVP to be conducted at an alternate ramp rate, DOE does not have sufficient information to support such an addition. As codified in this final rule, manufacturers will be responsible for reporting in their STI specific

[21] Section C4.4.2 of AHRI 1230–2021 defines the ''R2 period'' as beginning when the measured indoor dry-bulb temperature first crosses from above 82 °F to below 82 °F, and as ending when any indoor unit that was designated thermally active at the start of the CVP becomes thermally inactive.

[22] Table C2 of AHRI 1230–2021 specifies the minimum data collection intervals for recording data during the CVP.

instructions for conducting the CVP including ramp rate, starting temperature, and thermally active indoor units. The CVP then includes provisions for ensuring that the test laboratory properly conducts the CVP per manufacturer specifications. Manufacturers also will be required to report certified critical parameter values in their STI, which the manufacturer may develop based on a CVP conducted using the same instructions. These three provisions are all aligned to ensure the CVP is performed consistently and that results are more predictable (*i.e.,* manufacturers can set their own ramp rate and CVP conditions, within bounds of the test procedure, that would provide the most consistent results). Additionally, DOE reiterates that the budget method used for validating critical parameters was designed to give enough flexibility to account for lab-to-lab and test-to-test variation in CVP results. Allowing an additional CVP run to attempt validation of critical parameters would in effect expand the uncertainty allowance beyond that agreed upon by the AHRI 1230 Technical Committee and addressed in AHRI 1230–2021. Therefore, in this final rule DOE is not adopting the suggestion to allow a second CVP to be conducted at an alternate ramp rate.

AHRI further commented that if DOE's proposals regarding CVP validation of certified critical parameters were implemented as enforcement guidance instead of through regulation, then the provisions could be changed or rescinded more easily as industry gains experience with conducting the CVP. (AHRI, No. 12 at p. 5)

As discussed, the CVP provisions (including the RSS points total budget of 70 points) were developed using the data gathered by testing several VRF multi-split systems. These data showed that a 70-point budget would be sufficient to account for lab-to-lab and unit-to-unit test variability. The provisions have also been thoroughly discussed in Working Group and AHRI 1230 Technical Committee meetings prior to inclusion in the most recent industry consensus test procedure AHRI 1230–2021. Therefore, DOE concludes that the CVP provisions are appropriate for inclusion in DOE's regulations. Further, DOE finds that codifying the CVP provisions in regulation provides greater certainty for when and how the CVP would be used and prevents sudden shifts in policy or interpretation.

Based on discussion in the December 2021 VRF TP NOPR and in the preceding paragraphs, DOE is adopting its proposal at 10 CFR 429.134(v)(3)(ii) specifying that if at least one measurement period (with the aforementioned duration) exists before the first indoor unit goes thermally inactive that has an average RSS Points Total less than or equal to 70 points, then the certified critical parameter values are validated.

5. Determination of Alternate Critical Parameters

In the December 2021 VRF TP NOPR, DOE proposed that in cases in which a CVP is not conducted, or if a CVP is conducted and the manufacturer-specified critical parameters are validated, the critical parameter values certified in the STI are to be used as the initial control inputs when conducting the IEER cooling test at the corresponding full- or part-load cooling condition. 86 FR 70644, 70661 (Dec. 10, 2021). In cases in which a CVP fails to validate the certified critical parameter values, DOE proposed at 10 CFR 429.134(s)(3)(iii)(B) that alternate critical parameter values would be determined by averaging the value for each critical parameter from a specified time period of the CVP data, and that these alternate critical parameter values would be used for IEER testing in lieu of the certified critical parameter values. *Id.*

To provide further specification for determining these alternate parameters, DOE proposed to use the same procedure for determination of measurement period length as was proposed for validation of certified critical parameters in 10 CFR 429.134(s)(3)(ii)(A): the longer of three minutes or the time period needed to obtain five sample readings while meeting the minimum data collection interval requirements of Table C2 of AHRI 1230–2021. 86 FR 70644, 70661 (Dec. 10, 2021). DOE also proposed to select the measurement period for determining alternate critical parameter values (with the aforementioned duration) that has the lower average RSS points total over the selected period than over any other period in the CVP having the same duration. *Id.* If multiple such periods exist with the same RSS Points Total, DOE proposed to select the period closest to (but before) the time when the first indoor unit becomes thermally inactive (t_{Off}). *Id.*

Daikin agreed that neither the Working Group nor the AHRI 1230 Technical Committee resolved the question of how to determine alternate critical parameter values in the case where a CVP invalidates the manufacturer's certified values. Daikin concurred with DOE's suggested approach for determining alternate critical parameter settings. (Daikin, No. 13 at p. 3) DOE did not receive any other comments specific to the question of how to determine alternate critical parameters following a CVP that fails to validate the manufacturer-certified critical parameter settings. For the reasons discussed in the December 2021 VRF TP NOPR and in this section, DOE is adopting the provisions for determining alternate critical parameter values in this final rule as proposed.

F. Allowable Critical Parameter Adjustment

1. Adjustment of Certified Critical Parameter Values

Section 6.3.3 of AHRI 1230–2021 provides instructions for adjusting critical parameters during the four specified full- or part-load IEER cooling test conditions in order to meet cooling capacity targets or to adjust SHR to below the allowable limit. In the December 2021 VRF TP NOPR, DOE tentatively determined that amendments to this section of AHRI 1230–2021 are required and proposed to specify allowable critical parameter adjustments in section 5.2 of appendix D1 to subpart F of part 431. 86 FR 70644, 70662 (Dec. 10, 2021). Specifically, DOE proposed (1) instructions for calculating critical parameter variation (in terms of RSS Points Total) for steady-state IEER cooling tests for which the measured capacity is above the target load fraction; (2) clarification that upward adjustments to compressor speed (*i.e.,* when the measured cooling capacity is too low or when the SHR is above the allowable limit) are not constrained by a budget on RSS Points Total; and (3) clarification to the instructions for calculating critical parameter variation in the scenario where a VRF multi-split system contains multiple components corresponding to a single critical parameter (*e.g.,* multiple compressors). *Id.* at 86 FR 70662–70663.

Daikin expressed support for DOE's proposal to calculate normalized critical parameter variation during the adjustment process if tested capacity is above the target capacity and also supported the proposal to adjust critical parameters to meet capacity requirements. (Daikin, No. 13 at p. 4) AHRI supported the clarifications proposed by DOE and commented that the Department should provide example calculations for each case so as to provide additional clarity. Specifically, AHRI mentioned that for systems with multiple modules (*i.e.,* outdoor units), there are two types of critical parameters: (1) those that can be set for each module and (2) those that have one

value for multiple modules. (AHRI, No. 12 at p. 6)

For the reasons discussed in the December 2021 VRF TP NOPR and in the preceding paragraphs, DOE is finalizing its proposals to add clarifying language to the provisions for determining allowable critical parameter adjustments when conducting IEER testing.

Regarding AHRI's request that DOE provide example calculations for ''each case'' describing allowable critical parameter adjustments, the scope of AHRI's suggestion is unclear (*e.g.,* whether AHRI requested example calculations for different equipment classes of VRF multi-split systems or for different permutations of critical parameters). Further, DOE finds that the proposed instructions for critical parameter adjustments are sufficient for testing multi-module VRF multi-split systems, even if parameters are controlled jointly across modules. Section 5.2 of appendix D1 describes critical parameter adjustments and includes provisions that accommodate differential or shared adjustments of multiple instances of the same critical parameter (*e.g.,* two compressors). Because the existing test provisions sufficiently cover the scenario described by AHRI, and because AHRI did not provide any other examples of VRF multi-split system configurations or control schemes for which the proposed testing provisions for critical parameter adjustments are unclear, DOE is not adding example calculations for critical parameter adjustments in this final rule.

In the case that a VRF multi-split system configuration exists that raises questions about how the DOE test procedure should apply, DOE notes that it will receive general inquiries via email at *ApplianceStandardsQuestions@ee.doe.gov.* DOE also maintains a repository of frequently asked questions pertaining to additional guidance issued by DOE.[23] In addition, if it is ultimately determined that a VRF multi-split system configuration exists for which the critical parameter adjustment procedures will result in an inability to test the system or provide materially inaccurate performance results, manufacturers may petition DOE for a test procedure waiver under 10 CFR 431.401.

2. Adjustment of Alternate Critical Parameter Values

As described in section III.E.5 of this document, DOE proposed to clarify how, in the event that a manufacturer's certified critical parameter settings were invalidated through the CVP, alternate critical parameters would be determined and used as control inputs during DOE enforcement testing. 86 FR 70644, 70663 (Dec. 10, 2021). In the December 2021 VRF TP NOPR, DOE elaborated that in such a case, it may still be necessary to adjust the alternate critical parameter values in order to meet capacity tolerances and SHR limits for the IEER test. Accordingly, DOE proposed to include provisions at 10 CFR 429.134(s)(3)(iii)(B)(*3*) specifying that in the case of invalidated critical parameter values in which DOE determines alternate critical parameters, additional adjustments to the alternate critical parameters are allowed in order to comply with capacity and/or SHR requirements. *Id.*

Specifically, DOE proposed to rely on the methods for adjustment of critical parameters in proposed section 5.2 of appendix D1 to subpart F of part 431 with two modifications. *Id.* First, DOE proposed that in such a case, references in section 5.2 of appendix D1 to critical parameter values certified in the STI would be replaced with references to alternate critical parameter values determined under the CVP. Second, DOE proposed to determine the maximum operating state of each critical parameter (referred to as CP_{Max} in AHRI 1230–2021 and the proposed regulatory text) based on the maximum operating state observed during a CVP conducted at 100-percent cooling load conditions, instead of using the information certified to the STI for the 100-percent cooling load point. *Id.*

AHRI commented that it supports DOE's proposal to use alternate critical parameters for IEER adjustments in the case of invalidated STI critical parameters, as this proposal clarifies how a test would be run in this situation. (AHRI, No. 12 at p. 6) Daikin commented that DOE's proposed adjustments to meet capacity requirements, if not provided by the manufacturer in the STI, is acceptable. (Daikin, No. 13 at p. 4) DOE did not receive any additional comments on this topic.

Based on the discussion presented in the December 2021 VRF TP NOPR and in the preceding paragraphs, DOE is adopting its proposals for section 5.2 of appendix D1 to subpart F of part 431 regarding adjustment of alternate critical parameter values.

G. Certification, Compliance, and Enforcement

1. Determination of Represented Values

a. Introduction

VRF multi-split systems are, by definition, split-system commercial package air conditioners and heat pumps that employ an outdoor unit(s) and multiple separate indoor fan coil units connected in a single refrigerant circuit. 10 CFR 431.92. VRF multi-split heat pumps can be configured as heat recovery systems, which allows for recovered energy from the indoor units operating in one mode (*e.g.,* cooling) to be transferred to one or more other indoor units operating in the other mode (*e.g.,* heating). This necessitates a heat recovery box that is installed between the outdoor unit and indoor units. Additionally, VRF multi-split systems are available with different refrigerant options and 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. 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.

In the December 2021 VRF TP NOPR, DOE proposed several items related to configuration of the unit under test and determination of represented values. These proposals included instructions on how to select indoor unit models (via reference of the tested combination requirements specified in section 6.2.1 of AHRI 1230–2021) and provisions specifying the different represented values that must be made for each indoor unit type within a basic model, as well as provisions for determination of represented values for basic models distributed in commerce with specific components, heat recovery components, and multiple refrigerants. 86 FR 70644, 70663–70665 (Dec. 10, 2021). These proposals and related stakeholder comments are discussed in paragraph III.G.1.b of this document.

In this final rule, DOE is providing additional discussion to help clarify the interplay between the previously proposed representation requirements, the proposed indoor unit tested combination requirements, and the proposed approach for specific components. The approach finalized by this rule is substantively the same as the corresponding proposals in the December 2021 VRF TP NOPR. The provisions adopted in this final rule and the justification for adopting these

[23] DOE's website houses frequently asked questions (FAQs) pertaining to the DOE Appliance Standards Program. The FAQ list is available at: *https://www.energy.gov/eere/buildings/appliance-standards-guidance-and-frequently-asked-questions-faqs,* or interested parties may submit a new question at: *https://www.energy.gov/eere/buildings/appliance-standards-guidance-and-frequently-asked-questions.*

provisions are described in greater detail in section III.G.1.c of this document.

b. NOPR Proposals and Comments

i. Tested Combination and Indoor Unit Combinations

In the December 2021 VRF TP NOPR, DOE made two proposals pertaining to represented values for different combinations of VRF indoor unit models. First, DOE proposed to reference the tested combination provisions from section 6.2.1 of AHRI 1230–2021 in the test procedure at appendix D1. 86 FR 70644, 70663 (Dec. 10, 2021). These provisions instruct how to select indoor unit models to comprise a ducted, non-ducted, or small-duct high-velocity tested combination. Section 6.2.1 also specifies an indoor unit selection hierarchy based on indoor unit sub-type and other design characteristics. For example, to compose a non-ducted tested combination, AHRI 1230–2021 specifies compact 4-way ceiling cassettes as the highest-priority selection and further requires that the indoor unit model having the lowest normalized coil volume and lowest-efficiency indoor fan motor within the specified indoor unit type must be selected. Second, DOE proposed that manufacturers must determine separate represented values for each indoor unit tested combination that is distributed in commerce. 86 FR 70644, 70664 (Dec. 10, 2021). Through this approach, each VRF basic model would be required to include separate representations for each of the ducted, non-ducted, and small-duct, high-velocity indoor unit tested combinations (if distributed in commerce in such a combination). DOE also proposed that manufacturers would be allowed to make optional ''mixed'' representations based on the simple average of represented values of any two tested combinations within a basic model. *Id.*

In response, AHRI, Carrier, and Daikin commented that they support DOE's proposals for determining represented values for different indoor unit combinations/mixed combinations. (AHRI, No. 12 at p. 6; Carrier, No. 7 at p. 1; Daikin, No. 13 at p. 5). DOE did not receive any comments specially addressing its proposal to reference the tested combination provisions from section 6.2.1 of AHRI 1230–2021.

ii. Treatment of Specific Components

AHRI 1230–2021 outlines requirements for specific components in Appendix F, ''Unit Configuration for Standard Efficiency Determination—Informative.'' Appendix F provides discussion of components which would not be considered in representations, and provides instructions either to minimize their impact during testing or to determine representations for individual models with such components based on other individual models that do not include them. In the December 2021 VRF TP NOPR, instead of referencing Appendix F of AHRI 1230–2021, DOE tentatively determined that it was necessary to adopt similar instructions in a more comprehensive manner, so the Department proposed provisions in the appendix D1 test procedure, in the representation requirements at 10 CFR 429.43, and in the enforcement provisions at 10 CFR 429.134. 86 FR 70644, 70657 (Dec. 10, 2021).

Specifically, DOE proposed test provisions in section 6 of appendix D1 that instructed how to test a VRF multi-split system equipped with any specific component(s) listed in Table 6.1 [24] of that same section. 86 FR 70644, 70686 (Dec. 10, 2021). These provisions were designed to minimize the impact on measured performance caused by testing with the specific component(s) present. Additionally, DOE proposed representation requirements in 10 CFR 429.43(a)(4) that explicitly allowed representations for individual models with certain components to be based on testing for individual models without those components; the proposal included a table in 10 CFR 429.43(a)(4)(i) listing the two components for which these provisions would apply (air economizers and desiccant dehumidification components). 86 FR 70644, 70657–70658 (Dec. 10, 2021). DOE also proposed corresponding product enforcement provisions in 10 CFR 429.134 indicating that DOE would conduct enforcement testing on VRF multi-split systems having individual indoor unit models that do not include air economizers or dehumidification components, except in certain circumstances. 86 FR 70644, 70658 (Dec. 10, 2021).

DOE also proposed to adopt language more specific to VRF multi-split systems, as compared to the general language contained in section F2.4 of AHRI 1230–2021. Specifically, DOE proposed to use the term ''individual indoor unit models'' to account for potential discrepancies across individual indoor unit models that comprise the VRF multi-split system tested combination. 86 FR 70644, 70657 (Dec. 10, 2021). DOE's proposed approach would allow for the individual consideration of specific components on an indoor unit-by-indoor unit basis to account for scenarios in which individual indoor unit models in the tested combination differ in components.

For two components—coated coils and steam/hydronic heat coils—DOE did not propose to include these components in the list of specific components warranting enforcement relief (*i.e.,* provisions in 10 CFR 429.43(a)), nor did DOE propose any provisions to minimize their impact during testing (*i.e.,* provisions in appendix D1). DOE noted that coated coils and steam/hydronic heat coils were not included in the list of optional features in Section F2.4 of AHRI 1230–2021, and determined the industry consensus to be that coated coils and steam/hydronic heat options should not be treated as optional features for VRF multi-split systems and/or that VRF multi-split systems are not distributed in commerce with these features. 86 FR 70644, 70657 (Dec. 10, 2021).

Finally, DOE stated that, were DOE to adopt the provisions in appendix D1, 10 CFR 429.43, and 10 CFR 429.134 as proposed, DOE would rescind the Commercial HVAC Enforcement Policy to the extent it is applicable to VRF multi-split systems. 86 FR 70644, 70658 (Dec. 10, 2021).

In comments on the December 2021 VRF TP NOPR, Lennox, AHRI, and Carrier stated that they support DOE's proposal to include test provisions for specific components, as outlined in Table 6.1 of Appendix D1. (Lennox, No. 8 at p. 2; AHRI, No. 12 at p. 2; Carrier, No. 7 at p. 1) Further, AHRI encouraged DOE to specifically exclude VRF multi-split systems from the Commercial HVAC Enforcement Policy going forward so as to avoid confusion. (AHRI, No. 12 at p. 2) Daikin commented that coated coils, low ambient cooling dampers, and power correction capacitors are a part of the outdoor unit model and asserted that a clarification was needed at 10 CFR 429.43(a)(4) to designate both indoor and outdoor unit models, as opposed to just indoor unit models. (Daikin, No. 13 at p. 2)

With respect to DOE's proposals to exclude coated coils and steam/hydronic heat coils from the testing provisions and from consideration when determining represented values, Lennox, AHRI, and Daikin all commented that DOE should also consider including coated coils and

[24] Table 6.1 includes test provisions for VRF multi-split systems equipped with desiccant dehumidification components, air economizers, fresh air dampers, hail guards, low ambient cooling dampers, power correction capacitors, and/or ventilation energy recovery systems (VERS). 86 FR 70644, 70686–70687 (Dec. 10, 2021).

steam/hydronic heat coils in table 6.1, as contained in the DOE Commercial HVAC Enforcement Policy. (Lennox, No. 8 at p. 2; AHRI, No. 12 at p. 2; Daikin, No. 13 at p. 2) AHRI asserted that coated coils should not be required for testing because units will always be available without them (*i.e.,* represented values should not be required to be based on a VRF multi-split system with coated coils when there would always be an otherwise comparable model available without coated coils). (AHRI, No. 12 at p. 2) Daikin stated that adding steam/hydronic coils to table 6.1 would align regulations for VRF multi-split systems with those for other equipment categories, and that coated coils, low ambient cooling dampers, and power correction capacitors might be included in the outdoor section of VRF multi-split systems. (Daikin, No. 13 at p. 2)

In response, DOE has considered these comments and has determined that clarifications are warranted to the approach proposed in the December 2021 VRF TP NOPR regarding the treatment of certain components for determining represented values. Therefore, DOE is adopting the proposals made in the December 2021 VRF TP NOPR, with clarifications that are discussed in detail in section III.G.1.c of this final rule.

iii. Heat Recovery Components

Section 5.6 of AHRI 1230–2021 specifies that for all VRF heat recovery systems, the heat recovery control unit must be attached during all tests. Similarly, section F2.3 of AHRI 1230–2021 requires that all heat recovery components must be present and installed for testing individual models distributed in commerce with these components. DOE proposed in the December 2021 VRF TP NOPR to reference Section 5.6 of AHRI 1230–2021 in its proposed test procedures for VRF multi-split systems at appendix D1. 86 FR 70644, 70651 (Dec. 10, 2021). Consistent with section F2.3 of AHRI 1230–2021, DOE also proposed to specify in 10 CFR 429.43(a) that for basic models of VRF multi-split systems distributed in commerce with heat recovery components, the manufacturer must determine represented values for the basic model based on performance of an individual model distributed in commerce with heat recovery components. 86 FR 70644, 70656 (Dec. 10, 2021).

DOE did not receive any comments regarding heat recovery components in response to the December 2021 VRF TP NOPR. In this final rule, DOE is finalizing its proposed test provisions in appendix D1 but is removing its proposal to specify in 10 CFR 429.43(a) that VRF multi-split systems distributed in commerce with heat recovery components must determine represented value based on a configuration of the basic model with heat recovery components installed, as discussed in section III.G.1.c.ii of this final rule.

iv. Multiple Refrigerants

DOE proposed in the December 2021 VRF TP NOPR that in cases in which a basic model of VRF multi-split system can be used with multiple refrigerants without requiring different hardware, then a manufacturer must determine the represented values (*e.g.,* IEER, COP, and cooling capacity) for that basic model based on the refrigerant(s)—among all refrigerants listed on the unit's nameplate—that result in the lowest cooling efficiency. 86 FR 70644, 70665 (Dec. 10, 2021). DOE also clarified that, should the use of a different refrigerant require different hardware, this would represent a different basic model and, consequently, separate representations of energy efficiency would be required. *Id.*

The Joint Advocates, Lennox, and the CA IOUs expressed support for DOE's proposal to use the refrigerant listed on the unit's nameplate that results in the lowest cooling efficiency for represented values. (Joint Advocates, No. 9 at p. 1; Lennox, No. 8 at p. 3; CA IOUs, No. 11 at p. 4) The Joint Advocates commented that DOE's proposal would ensure that when manufacturers test a basic model, a refrigerant would not be selected that overstates the efficiency of the equipment as compared to if it were charged with another (less-efficient) refrigerant in the field. (Joint Advocates, No. 9 at p. 1) The Joint Advocates and the CA IOUs recommended allowing manufacturers to make additional representations for a basic model using different (*i.e.,* more-efficient) refrigerants to demonstrate the benefits of using more-efficient refrigerants. (Joint Advocates, No. 9 at p. 1; CA IOUs, No. 11 at p. 4)

DOE has considered these comments and has determined that the multiple refrigerant proposals made in the December 2021 VRF TP NOPR are not needed because the approach for determining represented values adopted in this final rule addresses the issue consistent with the NOPR proposals without need to specifically address multiple refrigerants. This matter is discussed in greater detail in section III.G.1.c of this final rule.

c. Final Rule Approach

i. Summary

As previously introduced, DOE is finalizing an approach for determining represented values that improves the clarity of, but is not substantively different than, the proposals in the December 2021 VRF TP NOPR. In this final rule, DOE is amending language in 10 CFR 429.43(a)(3)(ii) to clarify the interplay between the indoor unit tested combination, the representation requirements pertaining to specific components, and general requirements pertaining to represented values. DOE has structured the provisions at 10 CFR 429.43(a)(3)(ii) to reflect the different considerations when selecting outdoor vs. indoor units, and to highlight that the specific components currently subject to DOE enforcement relief (*i.e.,* desiccant dehumidification components and air economizers) are only applicable at the level of indoor units within a tested combination, not at the basic model level. DOE is specifying that for each indoor unit combination within a basic model (*i.e.,* ducted, non-ducted, or SDHV), the representation must be based on a combination of: (1) the least-efficient outdoor unit model distributed in commerce for that particular basic model which would be based on the least-efficient refrigerant (as discussed in section III.G.1.c.ii of this document); and (2) the combination of indoor units selected in accordance with the criteria described in section III.G.1.c.iii of this document. By taking this approach, DOE is clarifying the interaction between long-standing basic model provisions, tested combination requirements, and the treatment of specific components for VRF multi-split systems.

ii. Outdoor Unit and Heat Recovery

In this final rule DOE is: (1) clarifying that the least-efficient outdoor unit model within a basic model must be used for determining represented values; and (2) clarifying that the test procedure requires that VRF multi-split heat pumps with heat recovery must be tested with heat recovery components present, but without the need for representation requirements as initially proposed. DOE is not adopting any exemptions to the ''least-efficient'' requirement for outdoor unit(s) used to determine represented values because neither of the specific components listed in Table 2 to 10 CFR 429.43(a)(3)(ii)(B) (*i.e.,* air economizers and desiccant dehumidification components—as adopted in this final rule) are applicable for VRF outdoor units.

With respect to comments received regarding multiple refrigerants available for a basic model of VRF multi-split system, because the efficiency of the VRF multi-split system could be impacted by different refrigerant choices, the least-efficient outdoor model requirement necessitates consideration of the least-efficient refrigerant when determining represented values for that basic model. Upon further consideration, DOE has determined that the proposal in the December 2021 VRF TP NOPR regarding multiple refrigerants is already included substantively in the provision adopted at 10 CFR 429.43(a)(3) regarding least-efficient outdoor units, and that additional provisions would be redundant. As such, in this final rule, DOE is not adopting the refrigerant-specific language at 10 CFR 429.43(a)(3) that was proposed in the December 2021 NOPR.

Regarding heat recovery components, as described in section III.G.1.b.iv of this document, DOE proposed related testing provisions in appendix D1 and representation provisions in 10 CFR 429.43(a). In this final rule, DOE is finalizing its proposed test provisions in appendix D1 but is removing its proposal to specify in 10 CFR 429.43(a) that VRF multi-split systems distributed in commerce with heat recovery components must determine represented value based on a configuration of the basic model with heat recovery components installed. Upon further review of the test provisions referencing section 5.6 of AHRI 1230–2021, DOE has determined that all VRF multi-split heat pumps with heat recovery capability would always be required by to be configured with heat recovery components installed. Further, DOE's energy conservation standards for VRF multi-split systems specified at 10 CFR 431.97 classify systems with and without heat recovery to be in different equipment classes, such that a given VRF basic model does not contain systems with and without heat recovery (as such systems are certified under separate equipment classes).[25] The combination of these provisions ensures that represented values for VRF multi-split heat pumps with heat recovery are always determined with heat recovery components installed. Therefore, DOE finds its earlier proposal to be unnecessary, and accordingly, the Department is not adopting represented value provisions related to heat recovery components in this final rule.

iii. Indoor Unit Specification

DOE made several proposals in the December 2021 VRF TP NOPR pertaining to the selection of indoor unit models when determining represented values for the basic model of VRF multi-split system. 86 FR 70644, 70664–70665 (Dec. 10, 2021). As discussed elsewhere in this document, DOE proposed provisions related to different tested combinations of indoor units (see section III.G.1.b.i of this document), certification reporting requirements (see section III.G.2 of this document), and provisions related to treatment of specific components (see section III.G.1.b.ii of this document).

As described in section III.G.1.b.i of this document, DOE received only supportive comments in response to its proposals for determining represented values for different indoor unit tested combinations (*i.e.,* ducted, non-ducted, SDHV, and mixed representations thereof). In light of these comments and the reasoning provided in the December 2021 VRF TP NOPR, DOE is adopting its earlier proposals pertaining to this topic in this final rule.

The adopted provisions provide guidance for determining required represented values of indoor unit combinations (*i.e.,* ducted, non-ducted, SDHV) and provide guidance for determining optional mixed representations that are determined by taking a simple average of any two of the required representations. By adopting these provisions, each VRF outdoor unit may include up to six separate representations within the same basic model number.

Regarding certification requirements, as discussed in greater detail in section III.G.2 of this document, DOE proposed to require that manufacturers publicly report the indoor unit combination (*i.e.,* ducted, non-ducted, SDHV, or mixed) used to determine represented values, as well as all outdoor and indoor unit model numbers used to compose the tested combination. For the reasons discussed in the December 2021 VRF TP NOPR and in section III.G.2.a of this document, DOE is adopting these amended certification requirements as proposed. DOE also proposed to require that manufacturers supply information in their STI regarding whether specific components were present or absent when determining represented values for the basic model. As discussed in section III.G.2.b of this document, DOE is not adopting certification requirements related to specific components in this final rule.

Regarding specific components, DOE is clarifying the provisions at 10 CFR 429.43(a)(3) that cover the determination of represented values for VRF multi-split systems. In the December 2021 VRF TP NOPR, DOE proposed to individually consider specific components on an indoor-unit-by-indoor unit basis when determining represented values. 86 FR 70644, 70657 (Dec. 10, 2021). DOE's approach in this final rule is consistent with the approach in the NOPR in that it requires consideration of specific components for each indoor unit individually, rather than at the basic model level. DOE has also introduced the concept of ''fully-specified'' indoor unit model numbers in order to provide greater clarity about selection of indoor units and to explicitly tie these requirements to the aforementioned certification requirements.

For cases where an indoor unit model number is fully specified in the public certification (*i.e.,* the indoor unit model number includes sufficient information to identify the presence or absence of all components), DOE will require that the indoor unit model number, precisely as it appears as certified, shall be used for determining represented values. For example, for an indoor unit whose certified model number affirmatively designates the presence of dehumidification components, represented values must be determined based on the indoor unit model with dehumidification components installed, regardless of whether otherwise comparable indoor units are distributed in commerce without dehumidification components present. This approach does not conflict with the tested combination requirements in section 6.2 of AHRI 1230–2021, which sets minimum criteria for indoor model specification and does not disallow further specification (including specification of dehumidification components and/or air economizers).

For cases where an indoor unit model number is not fully-specified as part of the certified tested combination (*i.e.,* where the model number is constructed in such a way that does not fully specify

[25] DOE distinguishes certain VRF equipment classes by ''with heat recovery'' and ''without heat recovery'', and other equipment classes with ''no heating or electric resistance heating'' and ''all other types of heating.'' Footnote 1 to Table 13 to 10 CFR 431.97 specifies that VRF systems with heat recovery fall under the category of ''all other types of heating'' unless they also have electric resistance heating. In the March 2022 VRF ECS NOPR, DOE proposed to amend 10 CFR 431.97 to adopt the equipment class structure found in ASHRAE Standard 90.1–2016 for VRF multi-split systems, which, if adopted would create separate equipment classes for VRF heat pumps with and without heat recovery for all capacity ranges and heat rejection media (*i.e.,* replacing any class distinctions based on supplementary heating type). 87 FR 11335, 11346 (March 1, 2022).

the absence or presence of all components), DOE is applying the represented value requirements as proposed in the NOPR. This approach requires that for indoor unit model numbers that are not fully-specified in the certification, a fully-specified indoor unit must be selected to determine represented values for the basic model. This fully-specified indoor model number must be consistent with the certified indoor unit model number (*i.e.,* all specified digits must match), and, among the group of all indoor unit models having a consistent model number, must have the least number (which may include zero) of specific components (*i.e.,* air economizers and desiccant dehumidification components) installed.

Regarding DOE's proposed testing provisions for specific components in 10 CFR 431, subpart F, appendix D1, DOE is adopting the proposals from the December 2021 VRF TP NOPR. Specifically, DOE is finalizing provisions in section 6 to appendix D1 that provide instruction how to test a VRF multi-split system equipped with any specific component(s) listed in Table 6.1 [26] of that same section.

As discussed, DOE received comments suggesting that DOE should consider including coated coils and steam/hydronic heat coils in the list of specific components in table 6.1 to appendix D1. DOE also received similar comments pertaining to coated coils in response to other commercial HVAC equipment test procedure NOPRs, specifically the test procedure supplemental notice of proposed rulemaking (''SNOPR'') published for direct expansion-dedicated outdoor air systems (''DX–DOASes'') [27] (Docket No. EERE–2017–BT–TP–0018, AHRI, No. 34 at p. 4). In response to the DX–DOAS SNOPR, AHRI and Madison Indoor Air Quality (''MIAQ'') asserted that some coated coils impact performance, but that each coating is different (Docket No. EERE–2017–BT–TP–0018, AHRI, No. 34 at p. 4; MIAQ, No. 29 at p. 4).

AHRI and MIAQ's assertion that some coated coils do impact energy use suggests that there are other implementations of coated coils that do not impact energy consumption as measured by the adopted test procedure (*i.e.,* the implementation of coated coils does not necessarily or inherently impact energy use). DOE has no data indicating the range of impacts for those coatings that do affect energy use, or how other characteristics of the coatings, such as durability and cost, correlate with energy use impacts. Absent such data, DOE is unable to determine the specific range of impacts on energy use made by coated coils. Nevertheless, given that comments on the DX–DOAS SNOPR suggest that certain implementations of coated coils do not impact energy use, DOE has determined that for those units for which coated coils do impact energy use, representations should include those impacts, thereby providing full disclosure for commercial customers. Consequently, DOE is not incorporating coated coils into DOE's provisions specified in 10 CFR 429.43(a)(3) which allow for the exclusion of specified components when determining represented values for VRF multi-split systems. This approach is consistent with the one DOE has established in a final rule for the DX–DOAS test procedure. 87 FR 45164, 45186 (July 27, 2022).

Commenters did not indicate whether models are available with steam/hydronic heat, thereby supporting DOE's tentative conclusion in the December 2021 VRF TP NOPR that steam/hydronic heat components are not present in VRF multi-split systems and/or models with these components are not distributed in commerce. 86 FR 70644, 70657 (Dec. 10, 2021). Consequently, DOE is finalizing its proposal to exclude steam/hydronic heat from the specific components list for VRF multi-split systems in 10 CFR 429.43(a)(3).

As proposed in the December 2021 VRF TP NOPR, DOE sought to address VRF multi-split systems that include the specified excluded components both in the requirements for representation (*i.e.,* 10 CFR 429.43) and as part of the equipment specific enforcement provisions for assessing compliance (*i.e.,* 10 CFR 429.143). 86 FR 70644, 70656–70658 (Dec. 10, 2021). Instruction on which units to test for the purpose of representations are addressed in 10 CFR 429.43. DOE has determined that including parallel enforcement provisions in 10 CFR 429.134 would be redundant and potentially cause confusion, because DOE would select for enforcement only those individual models that are the basis for making basic model representations as specified in 10 CFR 429.43. Therefore, in this final rule, DOE is providing the requirements for making representations of VRF multi-split systems that include the specified components in 10 CFR 429.43, and is not including parallel direction in the enforcement provisions of 10 CFR 429.134 established in this final rule. However, DOE is finalizing the provision that allows enforcement testing of alternative individual models with specific components, if DOE cannot obtain for test the individual models without the components that are the basis of the representation.

In regards to the NOPR proposal that DOE shall rescind the commercial HVAC enforcement policy for VRF multi-split systems, DOE has provided substantive guidance for each component included in both the DOE Enforcement Policy and the ''Equipment Features Requiring Test Procedure Action'' from the term sheet agreed upon by an ASRAC working group for certain commercial HVAC equipment (''Commercial HVAC CCE Term Sheet'').[28] (EERE–2013–BT–NOC–0023–0052) Consequently, these documents would no longer be applicable to VRF multi-split systems and could potentially cause confusion. To prevent this confusion, DOE is clarifying in this final rule that the provisions established in this final rule will take precedence over those in the DOE Enforcement Policy and the Commercial HVAC CCE Term Sheet, and that the aforementioned documents will no longer be applicable to VRF multi-split systems. As previously discussed, this change will not take effect until the compliance date of amended energy conservation standards for VRF multi-split systems denominated in terms of IEER, should DOE adopt such standards.

2. Certification Reporting Requirements

a. Certification Requirements

DOE specifies certification reporting requirements for VRF multi-split systems in 10 CFR 429.43(b). Certification reporting requirements for VRF multi-split systems include both public equipment-specific information and STI. As previously described, in the December 2021 VRF TP NOPR DOE proposed to amend the certification reporting requirements for VRF multi-split systems to address the IEER metric but did not propose amendments to the current standards (in terms of EER). 86 FR 70644, 70665 (Dec. 10, 2021). Subsequently, in the March 2022 VRF ECS NOPR DOE proposed to amend

[26] Table 6.1 includes test provisions for VRF multi-split systems equipped with desiccant dehumidification components, air economizers, fresh air dampers, hail guards, low ambient cooling dampers, power correction capacitors, and/or ventilation energy recovery systems (VERS).

[27] *See* 86 FR 72874 (Dec. 23, 2021).

[28] In 2013, members of ASRAC formed the Commercial HVAC Working Group to engage in a negotiated rulemaking effort regarding the certification of certain commercial HVAC equipment, including VRF multi-split systems. The Commercial HVAC Working Group's recommendations are available at *www.regulations.gov* under Docket No. EERE–2013–BT–NOC–0023–0052.

standards for VRF multi-split systems to be in terms of the IEER cooling metric, with a proposed compliance date of January 1, 2024. 87 FR 11335, 11349 (March 1, 2022). Therefore, the amended certification reporting requirement proposals would only apply when certifying to a future IEER standard; existing certification reporting requirements used when certifying to the current EER standards would not change. In the December 2021 VRF TP NOPR, DOE proposed to add the following items to the public certification reporting requirements for VRF multi-split systems:

- IEER values (replacing the current certification requirement for EER values);
- The rated heating capacity, in Btu/h;
- The indoor unit combination used to determine the represented values for an individual combination (*i.e.,* a non-ducted, ducted, SDHV, or mixed indoor unit combination), and all outdoor and indoor unit model numbers used to compose the tested combination; and
- The refrigerant used to determine the represented values for a basic model (*e.g.,* EER, IEER, COP, and cooling capacity).

86 FR 70644, 70665 (Dec. 10, 2021). A draft certification template reflecting the proposed changes has been included in the docket.[29]

In response to DOE's certification proposals, the Joint Advocates commented that they support DOE's proposal to publicly report the heating capacity for VRF multi-split systems, stating that this requirement aligns with reporting requirements for the cooling metric and that consumers would be interested in this information. (Joint Advocates, No. 9 at p. 1) The CA IOUs supported DOE's certification proposals but requested that the certification report should clarify that COP is measured per the ''high temperature'' heating test at 47 °F, to prevent confusion with other temperatures at which heating COP tests can be conducted. As introduced in section III.G.1.b.v of this document, the CA IOUs also recommended allowing manufacturers to make additional representations for a basic model using different (*i.e.,* more-efficient) refrigerants. (CA IOUs, No. 11 at p. 3) The CA IOUs suggested a corresponding certification requirement that the global warming potential (GWP) of each refrigerant be listed along with the performance information. (CA IOUs, No. 11 at p. 4)

With respect to the CA IOUs' comment requesting clarification of the COP heating condition in the certification report, as discussed in section III.D.2 of this document, DOE acknowledges the need to clarify that the ratings for heating mode tests of air-cooled VRF multi-split heat pumps used for compliance with standards are those referred to as ''High Temperature Steady-state Test for Heating'' in AHRI 1230–2021 and measured at 47 °F outdoor ambient air temperature. Additionally, DOE acknowledges the need to clarify that the ratings for heating mode tests of water-source VRF multi-split heat pumps used for compliance with standards are those specified for ''Water Loop Heat Pumps'' in AHRI 1230–2021 and measured at 68 °F entering liquid temperature. Consistent with the test procedure provisions adopted in this final rule (as discussed in section III.D.2 of this document) and the CA IOUs' suggestion, DOE is amending the certification template to read ''Coefficient of Performance, measured at 47 °F for air-source VRF multi-split heat pumps or measured at 68 °F Entering Water Temperature for water-source VRF multi-split heat pumps.''

With respect to the CA IOU's comments regarding certification requirements for VRF multi-split systems available with multiple refrigerants, DOE has concluded that because the efficiency of the VRF multi-split system could be impacted by different refrigerant choices, the least-efficient outdoor model requirement necessitates consideration of the least-efficient refrigerant when determining represented values for that basic model (see discussion in III.G.1.c.ii of this document). In this final rule, DOE is also finalizing its proposal to require certification of the refrigerant used to determine the represented values for a basic model. By combining these provisions, a set of represented values will be determined for a given basic model based on the least-efficient outdoor unit (and, therefore, as discussed, the least-efficient refrigerant), and the refrigerant must be certified by the manufacturer. Therefore, DOE is not adopting the CA IOUs' suggestions to allow certification of multiple refrigerants, because it would be inconsistent with the Department's adopted requirement that the represented values for a basic model be based on the least-efficient outdoor unit. Correspondingly, because DOE is not adopting the CA IOU's suggestion to allow certification of multiple refrigerants, DOE has concluded that requiring certification of the associated refrigerant characteristics (*i.e.,* GWP) would provide minimal benefit, as there will not be ratings for different refrigerants within a basic model to compare. Therefore, DOE has concluded that requiring certification of refrigerant GWP would be unnecessarily burdensome.

DOE is adopting all other proposals related to certification reporting requirements, without change. As discussed, these amended certification reporting requirements are not required until the compliance date of amended energy conservation standards for VRF multi-split systems denominated in terms of IEER, should DOE adopt such standards.

b. Supplemental Testing Instructions

The December 2021 VRF TP NOPR included proposals to amend the STI provisions at 10 CFR 429.43(b)(4) to reflect the proposed amendments to the test procedure and the proposed adoption of the IEER metric. 86 FR 70644, 70666 (Dec. 10, 2021). DOE proposed amendments and additions to the STI requirements as follows:

- Identification of the indoor units to be thermally active for each IEER test point;
- The rated indoor airflow for the full-load cooling, full-load heating, and all part-load cooling tests (for each indoor unit), in standard cubic feet per minute (scfm);
- The indoor airflow-control setting to be used in the full-load cooling test and the indoor airflow control setting to be used in the full-load heating test (for each indoor unit);
- For water-cooled units, the rated water flow rate in gallons per minute (gpm);
- System start-up or initialization procedures, including conditions and durations;
- The duration of the compressor break-in period. (Existing requirements in 10 CFR 431.96(c) require manufacturers to include this information in the test data underlying the certified ratings that must be maintained according to 10 CFR 429.71);
- Instructions for adjustment of critical parameters to meet capacity targets and/or SHR limits, including hierarchy for adjusting;
- The layout of the system set-up for testing (previously required upon request) including a piping diagram, set-up instructions for indoor units and outdoor units, charging instructions, a control wiring diagram, and

[29] The draft certification template columns can be found in the docket at: *www.regulations.gov/document/EERE-2021-BT-TP-0019-0001.*

identification of the location of each critical parameter;

• Explicitly providing that the nominal cooling capacity and nominal heating capacity (if applicable) in British thermal units per hour (Btu/h) must be certified for each outdoor unit and indoor unit;

• Requiring testing instructions for conducting testing for all indoor unit combinations with distinct represented values within a basic model, as applicable;

• Removing the current requirement to report compressor frequency setpoints and instead require reporting operational settings for all critical parameters to be manually controlled for each of the four IEER cooling test conditions and for the COP heating test;

• Removing the reporting requirement regarding whether the model will operate at test conditions without manufacturer programming because the VRF enforcement provisions allow for a manufacturer representative to be on site for DOE testing;

• Removing the reporting requirement for rated static pressure, which is unnecessary because AHRI 1230–2021 includes ESP requirements for testing; and

• The frequency of oil-recovery cycles.

Further, in the December 2021 VRF TP NOPR, DOE proposed at 10 CFR 429.43(b)(4) a certification reporting requirement for supplemental test instructions for VRF multi-split systems regarding specific components, corresponding to the proposed representation requirements for specific components at 10 CFR 429.43(a)(4). Specifically, DOE proposed that the manufacturer must certify in the STI for which, if any, specific components (as listed in 10 CFR 429.43(a)(4)(i)) the following provisions are applicable: (1) the indoor unit model(s) in a tested combination within a basic model include both individual indoor unit models distributed in commerce with the specific component and individual indoor unit models distributed in commerce without the specific component; (2) at least one of the individual indoor unit models distributed in commerce without the specific component is otherwise identical to any given individual indoor unit model distributed in commerce with the specific component; and (3) represented values for the tested combination are based on performance of individual indoor unit models distributed in commerce without the specific component. 86 FR 70644, 70666–70667 (Dec. 10, 2021). These proposed provisions would require manufacturers to report whether the represented values for that VRF multi-split system basic model were determined based on the presence or absence of air economizers and/or desiccant dehumidification components.

In commenting on DOE's proposals in this area, AHRI and Carrier stated that STI requirements may need to include provisions that specify which, if any, components were used when calculating efficiency ratings. (AHRI, No. 12 at p. 2; Carrier, No. 7 at p. 1)

In response and as described in section III.G.1.c.iii of this document, DOE is finalizing an approach in this rule requiring that if an indoor unit model number is not fully specified in the public certification, then represented values must be determined from a fully-specified individual indoor unit model distributed in commerce that must be consistent with the certified indoor unit model number (*i.e.,* all specified digits must match). Among the group of all indoor unit models having a consistent model number, that VRF system must have the least number (which may include zero) of specific components installed. Because the representation requirements adopted in this final rule provide clear direction as to how to determine represented values for basic models that include specific components, DOE concludes that a certification requirement for manufacturers to report whether representations are based on model(s) with specific components installed would be duplicative and would impose unnecessary burden on manufacturers. Therefore, DOE is not adopting any certification requirements related to specific components in this final rule.

DOE also proposed to require reporting as part of the STI the following manufacturer-specified input conditions for conducting a CVP at each of the four IEER cooling test conditions:

☐ The required thermostat setpoints to ensure control for 80 °F dry-bulb temperature when accounting for setpoint bias;

☐ The starting indoor dry-bulb temperature; and

☐ The indoor dry-bulb temperature ramp rate.

Id.

The CA IOUs commented that the system controls setting for steady-state tests should be included in the STI requirements. Specifically, the CA IOUs suggested expanding the requirement for the ''required dip switch/control settings for step or variable components'' to instead require ''Dip switch/Control Settings from the manufacturer's installation instructions used for the full-load cooling and full-load heating tests.'' The CA IOUs asserted that this change would reduce the test burden when determining which control setting to use for the CVP as part of enforcement testing. (CA IOUs, No. 11 at p. 4) AHRI commented that some certification reporting requirements, such as compressor speed, critical parameter settings, and system device required for testing, are confidential business information and that they should be designated as such for certification. AHRI elaborated on this point by stating that the information included in the STI is confidential and should be designated as such. (AHRI, No. 12 at pp. 6–7) Similarly, Daikin commented that they support DOE's proposal for certification reporting requirements, provided that all confidential information may be submitted in the STI, because the STI is not available to the public. (Daikin, No. 13 at p. 5)

With respect to the CA IOU's request to amend the language of STI reporting requirements for dip switch/control settings, DOE interprets this suggestion to mean that manufacturers would be required to specify all dip switch/control settings required for conducting the full-load cooling and heating tests. This would include all settings for ''step or variable components'' in addition to any other settings required for testing that are not otherwise dictated by the test procedure but may impact system behavior—for example, ''mode-type'' settings (*e.g.,* eco-mode) or settings related to another function (*e.g.,* noise reduction settings). DOE finds that the CA IOUs' proposal would improve the clarity of existing certification requirements, as it would ensure that the control settings needed for testing are readily identifiable and that they are used in a consistent manner during testing. Further, DOE finds that the CA IOUs' suggestion would not require additional collection of information by manufacturers, because the settings used for conducting testing would be readily available to manufacturers. Therefore, DOE is adopting the STI certification requirements for VRF multi-split systems as proposed in the December 2021 VRF TP NOPR, with the clarification that certification of dip switch/control settings applies more broadly than just step/variable components. As discussed previously, these amended STI certification requirements are not required until the compliance date of amended energy conservation standards denominated in

terms of IEER, should DOE adopt such standards.

With respect to AHRI and Daikin's comments, DOE notes that certification reports routinely include both public and non-public information. Specifically, 10 CFR 429.43(b)(2) specifies requirements for public equipment-specific information, and 10 CFR 429.43(b)(3) and (4) specify requirements for equipment-specific information and supplemental information that are non-public. DOE notes that the treatment of confidential business information is addressed pursuant to the regulations at 10 CFR 1004.11. Any person submitting information that they believe to be confidential and exempt by law from public disclosure should submit via two well-marked copies: one copy of the document marked ''confidential'' including all the information believed to be confidential, and one copy of the document marked ''non-confidential'' with the information believed to be confidential deleted. While DOE is responsible for making the final determination with regard to the disclosure or nondisclosure of information contained in requested documents, DOE will consider the submitter's views in making its determination. 10 CFR 1004.11(a). Accordingly, in light of the existing framework for handling confidential business information, DOE does not find it necessary to adopt the additional measures suggested by AHRI and Daikin. For the reasons stated in the December 2021 VRF TP NOPR and the paragraphs here, DOE is adopting its proposed amendments related to the supplemental testing instructions for VRF multi-split systems along with the previously discussed modifications suggested by the CA IOUs.

3. Models Required for AEDM Validation

In the December 2021 VRF TP NOPR, DOE proposed that the manufacturer must validate an AEDM used to make representations for only a single type of indoor unit combination (*i.e.,* ducted, non-ducted, or SDHV indoor unit combinations) within or across all its basic models by testing at least a single tested combination of that type of indoor unit combination for each of the two selected basic models. 86 FR 70644, 70667 (Dec. 10, 2021). If a manufacturer makes representations for two types of indoor unit combinations (*i.e.,* ducted, non-ducted, and/or SDHV indoor unit combinations) within or across all its basic models to which the AEDM applies, DOE proposed that the manufacturer must test at least: (1) a single tested combination of a selected basic model as the first of those two types of indoor unit combination, and (2) a single tested combination of a different selected basic model as the second of those two types of indoor unit combination. *Id.* If a manufacturer makes representations for all three types of indoor unit combinations (*i.e.,* ducted, non-ducted, and SDHV indoor unit combinations) within or across all its basic models to which the AEDM applies, DOE proposed that the manufacturer must test at least a single tested combination of a selected basic model as a non-ducted tested combination and a single tested combination of a different selected basic model as a ducted tested combination. *Id.*

In response, AHRI and Daikin commented in support of DOE's proposal to amend the applicable requirements for AEDM validation. (AHRI, No. 12 at p. 7; Daikin, No. 13 at p. 5) DOE received no other comments on its AEDM proposals.

Accordingly, DOE is finalizing its proposed AEDM validation requirements for VRF multi-split systems in 10 CFR 429.43(a)(2) and 10 CFR 429.70 to be similar to the sampling plan requirements for tested units, as discussed in section III.G.7 of this final rule. Furthermore, DOE has concluded that these AEDM validation requirements are consistent with AHRI 1230–2021, because they ensure the values developed with an AEDM conform to the results obtained using AHRI 1230–2021.

4. Manufacturer Involvement

a. Role of Manufacturer Representative

In light of the complexity of VRF multi-split systems, the DOE test procedure at 10 CFR 431.96(f) does allow for limited manufacturer involvement, specifying that a manufacturer's representative is allowed to witness assessment and/or enforcement testing, inspect and discuss set-up only with a DOE representative, and adjust only the modulating components in the presence of a DOE representative that are necessary to achieve steady-state operation. In the December 2021 VRF TP NOPR, DOE proposed to establish new provisions for manufacturer involvement as part of the product-specific enforcement provisions at 10 CFR 429.134(s)(2). 86 FR 70644, 70667 (Dec. 10, 2021). The proposals largely align with Sections 5.1.2 and 6.3.3 of AHRI 1230–2021 but prescribe more precisely the actions that a manufacturer's representative may take. Specifically, DOE proposed that a manufacturer's representative is allowed to support commissioning of the VRF multi-split system and to witness DOE assessment or enforcement testing. *Id* at 86 FR 70667–70668. For all cooling and heating tests, DOE proposed that all control settings other than critical parameters must be set by a member of the third-party laboratory, and that a manufacturer's representative may initially set all critical parameters to their certified values. *Id.* at 86 FR 70668. For IEER cooling tests only, DOE proposed to specify that if additional adjustments to critical parameters are required for meeting capacity targets and/or SHR limits, a manufacturer's representative may make such adjustments in accordance with section 5.1 of appendix D1 using a proprietary control tool. *Id.* DOE further proposed that initial setting and any additional critical parameter adjustments performed by a manufacturer's representative during IEER testing must be monitored by third-party laboratory personnel using a service tool. *Id.* For the heating test, DOE proposed that the manufacturer's representative would not be permitted to make any critical parameter adjustments during testing and would only be allowed to initially set critical parameters to their certified values. *Id.*

The CA IOUs, Joint Advocates, and Lennox commented that they support DOE's proposal to specify the parameters of manufacturer involvement during testing. (CA IOUs, No. 11 at p. 3; Joint Advocates, No. 9 at p. 1; Lennox, No. 8 at p. 3) Joint Advocates further asserted that the language in Sections 5.1.2 and 6.3.3 of AHRI 1230–2021 is ambiguous, and that DOE's proposed language clarifies the role of the manufacturer's representative during testing. (Joint Advocates, No. 9 at p. 1) The CA IOUs stated that DOE's proposals strike a reasonable balance between ensuring objective/repeatable ratings and the complexity associated with testing VRF multi-split systems. (CA IOUs, No. 11 at p. 3)

AHRI commented that, due to the need for proprietary software, a manufacturer's representative, if present, should set the control settings, observed by a member of the third-party lab. They elaborated that a member of a third-party laboratory should set the critical parameters in the case where a manufacturer's representative is unable to be physically available or is choosing not to be present. AHRI further commented that they agree with DOE's proposals with respect to manufacturer involvement for cooling tests but argued that the manufacturer's representative should also be allowed to adjust the

critical parameters for heating tests (similar to IEER cooling tests). (AHRI, No. 12 at pp. 7–8) Specifically, AHRI argued that just as critical parameter adjustments are needed for cooling tests to meet capacity targets and/or SHR limits, small adjustments to critical parameters may be needed during heating tests to account for set-up variations between manufacturer and third-party laboratories. Further, AHRI asserted that on this topic, there is a conflict between the language proposed in the preamble and the proposed regulatory text of the December 2021 VRF TP NOPR, so further clarification is needed. The commenter referenced language from the NOPR's preamble (86 FR 70644, 70668 (Dec. 10, 2021)) stating that a manufacturer's representative may not make critical parameter adjustments during heating tests, and would only be allowed to initially set critical parameters to their certified values. AHRI contrasted this with language in the proposed regulatory text at 10 CFR 429.134(s)(2)(ii) that would allow the manufacturer's representative to adjust the critical parameters for heating and IEER cooling tests (86 FR 70644, 70681 (Dec. 10, 2021)). (AHRI, No. 12 at pp. 7–8)

Regarding AHRI's request that a manufacturer's representative should set the control settings rather than a member of the third-party laboratory, DOE interprets this request to refer to control settings other than the critical parameter settings (*e.g.,* airflow control settings) because, as discussed, DOE proposed that the manufacturer's representative would set critical parameter settings to their certified values. DOE finds that requiring a member of the laboratory to set other control settings rather than a manufacturer's representative will improve transparency into testing practices by ensuring that settings used for testing match the settings specified in the manufacturer STI. Also, AHRI's suggestion conflicts with the language present in AHRI 1230–2021 regarding control settings other than critical parameters. Specifically, Section 5.1.2.3 of AHRI 1230–2021 states that ''control settings shall be set by a member of the laboratory. All control settings are to remain unchanged for all load points once system set up has been completed.'' DOE's proposed approach (*i.e.,* requiring that all control settings other than critical parameters be set by a member of the third-party laboratory) is consistent with the language from Section 5.1.2.3 of AHRI 1230–2021, which DOE understands to reflect the industry consensus approach and the intent of the Working Group.

DOE interprets AHRI's concern about ''proprietary software'' to suggest that a member of the third-party laboratory should not be allowed to interact with such software. DOE finds that the use of proprietary software is not a valid reason to preclude involvement of third-party laboratory personnel during testing. Per DOE's proposal, a manufacturer's representative would be allowed to support commissioning of the VRF multi-split system to ensure that any proprietary software is being properly utilized by a member of the third-party laboratory. The amended STI certification requirements (described in section III.G.2.b of this document) ensure that members of the third-party laboratory will be equipped with all necessary information in order to set control settings during testing. If a manufacturer's representative is not available for testing, then testing would proceed with a member of the third-party laboratory using the control tool as provided by the manufacturer (see discussion in section III.G.4.b of this document)—an approach which was similarly suggested by AHRI in their comment. (AHRI, No. 12 at p. 8) Therefore, DOE is finalizing its proposal to require that members of the third-party laboratory set all control settings (other than critical parameters) during testing.

With regard to AHRI's argument for allowing critical parameter adjustments for heating tests, the cooling capacity targets and SHR limits specified in Section 6.3.3 of AHRI 1230–2021 and Section 5.2 of the proposed test procedure in appendix D1 do not apply to heating tests, and neither DOE's proposed test procedure nor AHRI 1230–2021 include any restrictions for heating tests that would warrant critical parameter adjustments. Further, DOE disagrees with AHRI's claim that critical parameter adjustments are needed for heating tests to account for set-up variation between manufacturer and third-party laboratories. DOE concludes that the STI provides manufacturers sufficient opportunity to certify critical parameters, control settings, and any additional testing information needed for the third-party laboratories to consistently test VRF multi-split systems. Therefore, DOE finds that allowing for critical parameter adjustments during heating tests is unnecessary and is inconsistent with the industry consensus test procedure recommended by the Working Group.

Regarding AHRI's claim of contradictory language, the language in 10 CFR 429.134(s)(2)(ii) proposed in the December 2021 VRF TP NOPR states, in relevant part, the following under a heading of ''Manufacturer involvement in heating tests and IEER cooling tests'': ''Critical parameters may be manually controlled by a manufacturer's representative, including initial setting to the certified values and additional adjustments (as described in sections 5.1 and 5.2 of appendix D1 to subpart F of part 431, respectively).'' 86 FR 70644, 70681 (Dec. 10, 2021). Neither section 5.1 nor section 5.2 include any provisions allowing critical parameter adjustments during heating tests. Specifically, section 5.1 of proposed appendix D1 specifies provisions for initially setting control settings applicable for cooling and heating tests, and section 5.2 specifies provisions for allowable critical parameter adjustments that apply only for IEER cooling tests. Because the phrasing in proposed 10 CFR 429.134(s)(2)(ii) allows critical parameter adjustments as described in sections 5.1 and 5.2 of appendix D1, which do not allow for critical parameter adjustments during heating tests, DOE concludes that the proposed regulatory text is consistent with the preamble discussion highlighted by AHRI (86 FR 70644, 70668 (Dec. 10, 2021)). However, DOE recognizes the potential to improve the clarity of the regulatory text regarding the specific adjustments that can be made by a manufacturer representative.

Accordingly, in this final rule DOE is adopting the proposed provisions for manufacturer involvement as part of product-specific enforcement provisions at 10 CFR 429.134(v)(2). However, in light of the confusion reflected in AHRI's comment, DOE is adopting language in 10 CFR 429.134(v)(2) that clarifies that critical parameter adjustments apply only to IEER cooling tests, not to heating tests.

b. Control Tool

In the case that a manufacturer is not present for assessment or enforcement testing, third-party laboratory personnel may need a manufacturer's control tool to set critical parameters to the initial settings or make additional adjustments required by the test procedure. In the December 2021 VRF TP NOPR, DOE proposed to amend its enforcement test notice requirements for VRF multi-split systems at 10 CFR 429.110(b)(1)(iv) to require manufacturers to include a means of control to set and adjust critical parameters with all systems provided for enforcement testing. 86 FR 70644, 70668 (Dec. 10, 2021). Correspondingly, DOE proposed provisions for VRF multi-split systems at 10 CFR 429.104(b) that would require

manufacturers to provide a means of control for assessment testing, although manufacturers would not be required to provide the VRF multi-split system for assessment testing. *Id.* This proposal would enable the laboratory staff to perform IEER and heating tests in the event that a manufacturer's representative is not available for assessment and/or enforcement testing. *Id.* DOE also proposed that, if a manufacturer's representative is not present for testing, a member of the third-party laboratory shall set and adjust critical parameter values in accordance with section 5.1 of appendix D1 using the means of control provided by the manufacturer in response to the test notice. *Id.*

AHRI commented that the means of control of the unit could not be shipped ''from a retailer or distributor'' because it is not sold with the unit and, therefore, not sold by a distributor. They further commented that the means of control would need to be provided by the manufacturer, and preferably by the manufacturer's representative due to confidentiality. They suggested the following language: ''If a manufacturer's representative is not present for testing, a member of the third-party laboratory must set and adjust critical parameters using the provided means of control described in § 429.110(b)(1)(iv) for enforcement testing.'' (AHRI, No. 12 at pp. 7–8)

Daikin commented that DOE's proposal regarding manufacturer involvement during assessment and enforcement testing is acceptable, provided that, should testing be scheduled and then delayed due to unforeseen circumstances (*e.g.,* travel issues, positive COVID–19 tests), the provision stating ''If a manufacturer's representative is not present for testing, a member of the third-party laboratory must set and adjust critical parameters . . .'' would not be invoked, but rather the testing would be rescheduled. Daikin further commented that a means of control for running the CVP would not be sold by retailers or distributors, as it contains confidential company intellectual property. Daikin suggested regulatory text that would require the manufacturer to ship any means of control necessary for conducting testing, if requested by DOE. Daikin also suggested language specifying that the means of control may be provided separately from the system(s) selected for testing, stating that it is not appropriate to ship the controls tool (usually a laptop) along with the VRF equipment via less than truckload (LTL) freight shipping. (Daikin, No. 13 at pp. 5–6)

With regard to the logistics around sending manufacturer control tools, DOE acknowledges the comments from AHRI and Daikin indicating that means of control are not typically provided with a VRF multi-split system and would, therefore, not come from a retailer or distributor, but directly from the manufacturer, and potentially separate from the VRF equipment itself. Consequently, DOE is adopting the proposed provisions at 10 CFR 429.104(b) and 10 CFR 429.110(b)(1)(iv) with modifications to specify that, while manufacturers must provide a means of control for assessment testing, the means of control (necessary for testing conducted in accordance with appendix D1) may be shipped directly from the manufacturer, and separately from the system(s) selected for testing. These revisions are consistent with the language proposed by Daikin in their comment.

With regard to Daikin's suggestion that enforcement testing be rescheduled if the manufacturer is unable to attend due to ''unforeseen circumstances,'' DOE will consider such circumstances as they arise on a case-by-case basis, and the Department will balance between providing reasonable flexibility and maintaining the integrity of the enforcement program. With regard to AHRI's suggestion that if a manufacturer's representative is not present for testing, a member of the third-party laboratory must set and adjust critical parameters using the provided means of control. DOE finds that this suggestion is already consistent with the proposed provisions covering manufacturer involvement and with the discussion in this section. In consideration of all input received on this topic, DOE is adopting its proposed provisions at 10 CFR 429.104, 10 CFR 429.110, and 10 CFR 429.134 as proposed, with the additional clarifications previously discussed in this section.

5. Break-In Period

The current Federal test procedure for VRF multi-split systems specifies at 10 CFR 431.96(c) that manufacturers may optionally specify a ''break-in'' period, not to exceed 20 hours, to operate the equipment under test prior to conducting the test method specified in by AHRI 1230–2010. In the December 2021 VRF TP NOPR, DOE proposed to include similar provisions for VRF multi-split systems, but as part of the STI certification requirements rather than the proposed test procedure. 86 FR 70644, 70666 (Dec. 10, 2021). DOE did not receive any comments in response to this proposal.

However, DOE inadvertently omitted the 20-hour maximum time period from the proposed STI certification requirements. A 20-hour maximum time period prevents DOE testing from being unduly burdensome and is consistent with the current Federal test procedures for VRF multi-split systems as well as numerous other categories of air conditioners and heat pumps, including three-phase CUAC/HPs with cooling capacity less than 65,000 Btu/h, single package vertical units, computer room air conditioners, and central air conditioners and heat pumps. Therefore, DOE concludes that a 20-hour limit on the specified break-in period should also apply to testing VRF multi-split systems according to Appendix D1.

As such, for the reasons previously stated, DOE is specifying in 10 CFR 429.43(b)(4) that a manufacturer may certify a compressor break-in period duration of 20 hours or less in its STI. Further, DOE is adding a clarifying provision at 10 CFR 429.134(v)(4) stating that, during assessment and enforcement testing, DOE will perform a break-in period on VRF multi-split systems using a duration specified by the manufacturer only if a break-in period duration is specified in the STI.

6. Certified Critical Parameter Operational Settings

DOE proposed in the December 2021 VRF TP NOPR to add a certification reporting provision specific to VRF multi-split systems in 10 CFR 429.43(b)(5) stating that if a manufacturer becomes aware that any of the certified operational settings for the critical parameters are determined to be invalid according to the results of a CVP, whether that CVP be performed by the manufacturer or another party, the manufacturer would be required to re-certify the operational settings of those critical parameters for all affected basic models, as well as re-rate and re-certify the affected basic models. 86 FR 70644, 70668 (Dec. 10, 2021). DOE also proposed to amend the enforcement testing requirements at 10 CFR 429.110(a) to state that DOE may initiate enforcement testing for VRF multi-split systems if DOE has reason to believe that the model is not in compliance, has invalid certified operational settings for critical parameter values, or has an otherwise invalid certified rating. *Id.* at 86 FR 70669.

Joint Advocates commented that DOE should provide additional clarification in the case when a manufacturer becomes aware that their certified critical parameter values have been invalidated, and these commenters

specifically suggested that DOE should specify a timeline between becoming aware of the invalid parameters and recertifying the impacted models. (Joint Advocates, No. 9 at p. 2) The CA IOUs commented that they support DOE's proposal for evaluating compliance of a system whose STI-reported critical parameters have been invalidated. (CA IOUs, No. 11 at p. 2) AHRI commented that in the context of a ''another party'' (*i.e.,* other than DOE) conducting a CVP that results in invalidated operational settings for critical parameters for a basic model, DOE should clarify that ''another party'' should not be a competitor, university, or party other than DOE. They commented that only DOE, a third-party lab contracted by DOE, or AHRI should have access to the STI. Further, they commented that if ''another party'' becomes aware of a potential issue, an investigation should take place rather than enforcement action. (AHRI, No. 12 at p. 8)

In response, regarding the comments received from the Joint Advocates and AHRI about DOE's procedures for recertification and for initiating enforcement testing, DOE notes that these procedures pertain to DOE enforcement testing policy more generally, not just to VRF multi-split systems. Under 10 CFR 429.102(a)(8), it is a prohibited act for a manufacturer or private labeler to knowingly misrepresent the efficiency rating of any covered product or covered equipment distributed in commerce in a manner that is not supported by test data (*e.g.,* a manufacturer determines IEER rating based on certified critical parameter values which are later invalidated via a CVP). For any other regulated product types, DOE does not specify in regulations a required timeline for recertification or any constraints on the information sources that DOE may consider as part of an enforcement case. For other categories of regulated air conditioners and heat pumps for which similar proprietary information may be included in STI or non-public sections of certification reports, the treatment of any proprietary aspects of the certification materials has been adequately addressed under the existing enforcement regulations without any product-specific restrictions. Therefore, while DOE acknowledges AHRI's concern that the critical parameter settings necessary for testing contain sensitive information, DOE has concluded that VRF multi-split systems do not warrant additional product-specific restrictions to the existing enforcement regulations. Therefore, DOE is not adopting a timeline regarding re-certification or defining which entities are able to submit information that may instigate potential enforcement action for VRF multi-split systems in this final rule. DOE will consider any appropriately submitted information in its assessment of compliance on a case-by-case basis. Based on the discussion presented in the December 2021 VRF TP NOPR and in the preceding paragraphs, DOE is adopting the provisions as proposed in the NOPR regarding the CCE process in the event that certified critical parameter operational settings have been invalidated by a CVP. This process is visually represented in Figure 1 in section II of this document.

7. Enforcement Sampling Plan

The enforcement sampling plan for VRF multi-split systems was last amended in a final rule published in the **Federal Register** on March 7, 2011, which addressed certification, compliance, and enforcement for consumer products and commercial and industrial equipment. 76 FR 12422 (''March 2011 CCE Final Rule''). In the March 2011 CCE Final Rule, DOE specified flexible sampling provisions for certain covered products and equipment for which there is a lower market volume and/or manufacturing tends to be more customized. 76 FR 12422, 12436 (March 7, 2011). DOE included among such covered equipment commercial heating, air-conditioning, and ventilation equipment, which includes VRF multi-split systems. *Id.* As established by the March 2011 CCE Final Rule, 10 CFR 429.110(e)(2) states that for commercial air conditioners and heat pumps (which includes VRF multi-split systems), DOE will use an initial sample size of not more than four units when determining a basic model's compliance with applicable energy conservation standards.

In the December 2021 VRF TP NOPR, DOE proposed to amend its enforcement sampling plan requirements specific to VRF multi-split systems to require a sample size of two VRF multi-split systems. DOE proposed a reduced sample size to reflect what the Department considers to be an adequate sample size for assessment and enforcement testing but that also recognizes of the involved nature of testing VRF multi-split systems. DOE did not propose to amend the process for determining compliance with energy conservation standards (*i.e.,* the compliance determination would be made for VRF multi-split systems using the sampling plan found in appendix B to subpart C of part 429 with a first sample size of $n_1 = 2$). 86 FR 70644, 70669 (Dec. 10, 2021).

The Joint Advocates commented that they support DOE's proposed sampling plan, due to the complexity of the test procedure commissioning for VRF equipment. (Joint Advocates, No. 9 at p. 2). Daikin agreed that the cost burden of testing VRF multi-split systems is high, including the equipment itself, copper piping, refrigerant, and laboratory testing. (Daikin, No. 13 at p. 6)

However, Daikin expressed concern with using a sample size of two combined with the sampling plan found in appendix B to subpart C of part 429. Specifically, Daikin worried that the sample size of only two units would be unlikely to produce a sample mean and standard deviation that match the population mean and standard deviation. Daikin provided examples illustrating that a two-unit sample with lower and more varied test results could be determined compliant with the standard (*e.g.,* first sample testing at 16.1 and the second sample testing at 15.5 would be considered to meet a 17 IEER standard), while a different two-unit sample with higher and less varied test results could be determined non-compliant (*e.g.,* first sample testing at 16.1 and the second sample testing at 16.2 would be considered to fail to meet a 17 IEER standard). Daikin concluded by asserting that it is not impractical, due to inherent statistics, to test four samples for enforcement. (Daikin, No. 13 at p. 6) AHRI commented that while costs associated with procurement of VRF multi-split systems may be high, there is not sufficient technical justification to deviate from the four-unit sample used for enforcement testing. AHRI stated that using a statistical sample to develop testing is an important feature of DOE's enforcement program. (AHRI, No. 12 at p. 9)

DOE recognizes the concerns from AHRI and Daikin regarding the proposed reduced enforcement sampling plan for VRF multi-split systems. In particular, DOE acknowledges Daikin's comments that modifying the regulations to specify a two-system enforcement sample with the existing sampling plan at appendix B to subpart C of part 429 could result in further variation between the sample standard deviation and the population standard deviation. Therefore, DOE is not amending the enforcement sampling plan for VRF multi-split systems at 10 CFR 429.110(e)(2) as proposed, which would have reduced the required sample size from four units to two units. Figure 1 in section II of this document reflects this determination.

Although DOE is not amending the enforcement sampling plan for VRF multi-split systems in this final rule, DOE notes that stakeholder comments agreed with DOE's position in the December 2021 VRF TP NOPR that the burden associated with testing VRF multi-split systems is significantly higher than for other types of commercial HVAC equipment. In the March 2011 CCE Final Rule, DOE established an initial sample size of four units for this equipment and included provisions that provides for testing of fewer than four units if they are unavailable at the time that the test notice is received. 10 CFR 429.110(e)(3). The enforcement provisions also include a general provision applicable to all covered products and equipment that states if testing of the available or subsequently available units of a basic model would be impractical, as for example when a basic model has unusual testing requirements or has limited production, DOE may in its discretion decide to base the determination of compliance on the testing of fewer than the otherwise required number of units. 10 CFR 429.110(e)(7). DOE explained in the March 2011 CCE Final Rule that it would, in its evaluation of testing availability, take into consideration the units themselves as well as availability of third-party testing facilities to run the DOE test procedure. 76 FR 12422, 12436 (March 7, 2011).

8. Certified vs. Tested Performance

In the December 2021 VRF TP NOPR, DOE proposed a process for assessment and enforcement testing for VRF multi-split systems to incorporate the CVP, which was illustrated via a flowchart in Figure 1 of that NOPR (repeated here as Figure 2). 86 FR 70644, 70662 (Dec. 10, 2021). One of the paths in the diagram showed that if a system was tested for IEER and was determined to be in compliance with the Federal standards, but did not meet the certified IEER value, then it would constitute an improper certification and manufacturers would be required to re-rate and recertify that model.

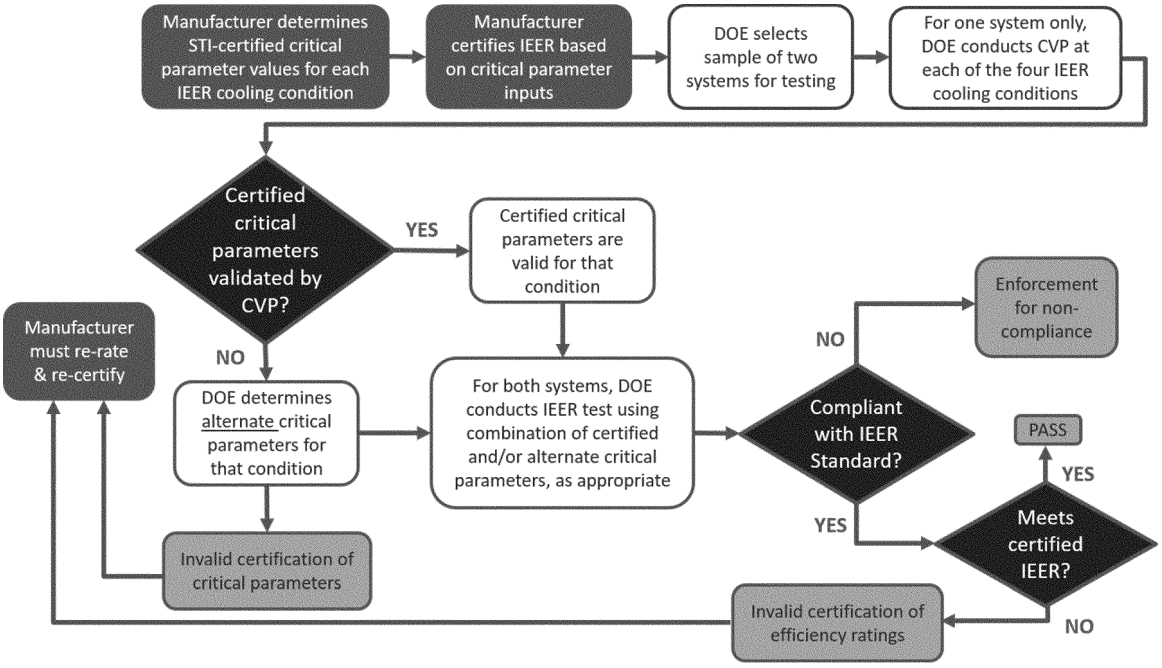

Figure III-1: DOE's Proposed Enforcement Process from the December 2021 VRF TP NOPR

Daikin commented that this figure illustrates that regardless of whether a CVP is performed, the basic model must be re-rated if the IEER testing results are deemed invalid. Daikin asserted that the proposed regulatory text did not indicate that if critical parameters are validated but the IEER is not validated then a re-rate is required, as indicated in the figure. (Daikin, No. 13 at p. 7)

AHRI asserted that DOE's proposal would introduce a tolerance on the certified IEER and claimed that DOE's proposal for certified IEER to be within any tolerance of the rated IEER would create a more stringent requirement for VRF equipment than for other Federally-regulated products. AHRI further asserted that verification of published ratings is the purpose of the AHRI certification program, and that DOE's enforcement authority is to ensure compliance with energy conservation standards. However, AHRI acknowledged DOE's enforcement authority under 10 CFR 429.102(a)(8), 10 CFR 429.102(b), and 10 CFR 429.106(a), and further recognized that 10 CFR 429.114(b) provides that DOE may issue a notice of noncompliance determination in the event that the Department determines a manufacturer has failed to comply with an applicable certification requirement with respect to a particular basic model. However, AHRI argued that besides DOE's

regulations for application of an AEDM at 10 CFR 429.70,[30] there are no other references to or requirements surrounding the accuracy of certified ratings in subpart B—Certification. (AHRI, No. 12 at p. 9)

In response, DOE clarifies that it did not propose and is not adopting amendments to the enforcement process as it pertains to validating certified performance with test results. DOE did not propose any percentage agreement between certified and tested performance, and is not making any such amendment to its regulations in this final rule. As acknowledged by AHRI in their comment, in the event that DOE determines a manufacturer has failed to comply with an applicable certification requirement with respect to a particular basic model, DOE may issue a notice of noncompliance determination to the manufacturer or private labeler. 10 CFR 429.114(b). This notice of noncompliance determination will notify the manufacturer or private labeler of its obligations including the obligation to immediately comply with the applicable certification requirement. 10 CFR 429.114(b)(2). To avoid further confusion, DOE has clarified these mechanisms in a revised CCE process diagram for this final rule (see Figure 1 at section II of this document).

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H. Effective and Compliance Dates

The effective date for the adopted test procedure amendment will be 30 days after publication of this final rule in the **Federal Register**. EPCA prescribes that 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 the final rule in the **Federal Register**. (42 U.S.C. 6314(d)(1)) To the extent the modified test procedure adopted in this final rule is required only for the evaluation and issuance of updated efficiency standards (*e.g.,* standards using the IEER metric), compliance with the amended test procedure does not require use of such modified test procedure provisions until the compliance date of updated standards.

I. Test Procedure Costs

In this final rule, DOE amends the current test procedure for VRF multi-split systems at 10 CFR 431.96 by: (1) incorporating by reference AHRI 1230–2021 and ANSI/ASHRAE 37–2009; and (2) establishing provisions for determining IEER for VRF multi-split systems. DOE also amends its CCE provisions for VRF multi-split systems to provide information that is necessary for testing VRF multi-split systems consistent with the updated industry test procedure AHRI 1230–2021. Most significantly, these changes include the incorporation of the CVP from AHRI 1230–2021 into DOE's product-specific enforcement provisions at 10 CFR 429.134, as well as accompanying certification requirements at 10 CFR 429.43.

DOE has determined that these amended test procedures will be more representative of an average use cycle and will not be unduly burdensome for manufacturers to conduct. The amended appendix D, measuring EER and COP per ANSI/AHRI 1230–2010, is simply a relocation of and does not contain any changes to the current Federal test procedure, and, therefore, it will not require retesting solely as a result of DOE's adoption of this amendment to the test procedure. The test procedure in appendix D1, measuring IEER and COP per AHRI 1230–2021, will lead to an increase in cost from appendix D testing. DOE estimates that the cost for third-party laboratory testing according to appendix D1 for measuring IEER and COP to be $7,500—$27,000 per VRF multi-split heat pump system, depending on size and configuration.

As discussed in section III.D.1 of this document, the test procedure provisions regarding IEER will not be mandatory unless DOE amends the energy conservation standards for VRF multi-split systems based on IEER. In the event testing is required pursuant to appendix D1, DOE has determined that the new test procedure would not be expected to increase the testing burden on VRF multi-split system manufacturers. All VRF multi-split system manufacturers are AHRI members; DOE is adopting the relevant provisions of the prevailing industry test procedure that was established for use in AHRI's certification program (which DOE presumes will be updated to include IEER in terms of the latest industry test procedure AHRI 1230–2021). Therefore, DOE expects that manufacturers will begin testing using the test methods in AHRI 1230–2021, and the testing burden will already be incurred by AHRI members participating in AHRI's certification program. Additionally, DOE has determined that the test procedure amendments will not require manufacturers to redesign any of the covered equipment, will not require

[30] AHRI acknowledged that10 CFR 429.70 requires that for covered products with an energy efficiency metric, the predicted efficiency of each model calculated by applying the AEDM may not be more than five percent greater than the efficiency determined from the corresponding test of the model.

[31] AHRI acknowledged that 10 CFR 429.70 requires that for covered products with an energy efficiency metric, the predicted efficiency of each model calculated by applying the AEDM may not be more than five percent greater than the efficiency determined from the corresponding test of the model.

changes to how the equipment is manufactured, and will not impact the utility of the equipment.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Executive Order (''E.O.'') 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review, 76 FR 3821 (Jan. 21, 2011), requires agencies, to the extent permitted by law, to: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget (''OMB'') has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this 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 (5 U.S.C. 601 *et seq.*) requires preparation of a final regulatory flexibility analysis (FRFA) for any final rule where the agency was first required by law to publish a proposed rule for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website: *www.energy.gov/gc/office-general-counsel.* DOE reviewed this final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003.

DOE reviewed this rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. DOE certifies that the rule will not have a significant economic impact on a substantial number of small entities. The factual basis of this certification is set forth in the following paragraphs.

DOE is amending the test procedures for VRF multi-split systems to satisfy its statutory requirements under EPCA to remain consistent with updates to the applicable industry test procedure and to re-evaluate its test procedures at least once every 7 years. (42 U.S.C. 6314(a)(4)(A) and (B); 42 U.S.C. 6314(a)(1)(A))

DOE is updating 10 CFR 431.96, ''Uniform test method for the measurement of energy efficiency of commercial air conditioners and heat pumps,'' as follows: (1) incorporate by reference AHRI 1230–2021 and ANSI/ASHRAE 37–2009, as corrected by the Errata Sheet issued March 27, 2019; and (2) establish provisions for determining IEER for VRF multi-split systems. DOE is adding new appendices D and D1 to subpart F of part 431, both titled ''Uniform test method for measuring the energy consumption of variable refrigerant flow multi-split air conditioners and heat pumps (other than air-cooled with rated cooling capacity less than 65,000 Btu/h),'' (''appendix D'' and ''appendix D1'', respectively). The current DOE test procedure for VRF multi-split systems is being relocated to appendix D without change, and the new test procedure adopting AHRI 1230–2021 is being established in appendix D1 for determining IEER. Compliance with appendix D1 is not required until the compliance date of amended energy conservation standards for VRF multi-split systems that rely on IEER, should DOE adopt such standards.

DOE is also updating its certification, compliance, and enforcement (''CCE'') provisions for VRF multi-split systems to provide information that is necessary for testing VRF multi-split systems consistent with the updated industry test procedure AHRI 1230–2021. Most significantly, these changes include the incorporation of the controls verification procedure (''CVP'') from AHRI 1230–2021 into DOE's product-specific enforcement provisions at 10 CFR 429.134, as well as accompanying certification requirements at 10 CFR 429.43.

For manufacturers of VRF multi-split systems, the Small Business Administration (''SBA'') has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. 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. The equipment covered by this rule is classified under North American Industry Classification System (''NAICS'') code 333415,[32] ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.'' DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. DOE identified manufacturers using DOE's Compliance Certification Database [33] and the AHRI database.[34] DOE identified ten original equipment manufacturers (''OEMs'') of the covered equipment.

In reviewing the ten OEMs for the December 2021 VRF TP NOPR, DOE did not identify any companies that met the SBA criteria for a small entity because all identified OEMs surpassed the SBA's employee threshold. 86 FR 70644,

[32] 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 7, 2022).

[33] DOE's Compliance Certification Database is available at: *www.regulations.doe.gov/ccms* (Last accessed April 22, 2022).

[34] The AHRI Database is available at: *www.ahridirectory.org/* (Last accessed April 22, 2022).

70671 (Dec. 10, 2021). DOE tentatively concluded that the proposed rule would not have a significant economic impact on a substantial number of small entities. DOE requested comment regarding this assessment in the December 2021 VRF TP NOPR. *Id.* Because no comments were received in response to this request and having subsequently found no additional information to the contrary, DOE finalizes its conclusion that this final rule will not have a significant economic impact on a substantial number of small entities.

Therefore, in the absence of small business manufacturers, DOE concludes that the cost effects accruing from this test procedure final rule will 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 VRF multi-split systems 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 VRF multi-split systems. (*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.

Under EPCA, DOE's energy conservation program consists essentially of four parts: (1) Testing; (2) labeling; (3) Federal energy conservation standards, and (4) certification and enforcement procedures. For covered equipment, relevant provisions of the Act include definitions (42 U.S.C. 6311), energy conservation standards (42 U.S.C. 6313), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), and the authority to require information and reports from manufacturers (42 U.S.C. 6316).

DOE's certification and compliance activities ensure accurate and comprehensive information about the energy and water use characteristics of covered products and covered equipment sold in the United States. Manufacturers of all covered products and covered equipment must submit a certification report before a basic model is distributed in commerce, annually thereafter, and if the basic model is redesigned in such a manner to increase the consumption or decrease the efficiency of the basic model such that the certified rating is no longer supported by the test data. Additionally, manufacturers must report when production of a basic model has ceased and is no longer offered for sale as part of the next annual certification report following such cessation. DOE requires the manufacturer of any covered product or covered equipment to establish, maintain, and retain the records of certification reports, of the underlying test data for all certification testing, and of any other testing conducted to satisfy the requirements of 10 CFR part 429 and 10 CFR part 431. Certification reports provide DOE and consumers with comprehensive, up-to date efficiency information and support effective enforcement.

DOE requires manufacturers or their party representatives to prepare and submit certification reports and compliance statements using DOE's electronic web-based tool, the CCMS, which is the primary mechanism for submitting certification reports to DOE. CCMS currently has product-specific and equipment-specific templates which manufacturers are required to use when submitting certification data to DOE. DOE believes the availability of electronic filing through the CCMS system reduces reporting burdens, streamlines the process, and provides DOE with needed information in a standardized, more accessible form. This electronic filing system also ensures that records are recorded in a permanent, systematic way.

In this final rule, DOE is amending the reporting requirements for VRF multi-split systems as discussed in section III.G.2 of this document. DOE sent a revised information collection approval to OMB under the existing Control Number 1910–1400, which reflected the changes in this rulemaking as an amendment to the existing information collection. More specifically, in this final rule, DOE is adding IEER, rated heating capacity, indoor unit combination, and the refrigerant used to determine the represented values for a basic model to the certification reporting requirements for VRF multi-split systems. These amended certification requirements enable the use of the industry test procedure, AHRI 1230–2021 (which, as described in III.C.1 of this document, DOE has concluded is more representative for measuring VRF performance). AHRI supported DOE's proposal to adopt IEER as determined under AHRI 1230–2021 in the federal test procedure for VRF multi-split systems. (AHRI, No. 12 at p. 2) DOE infers from AHRI's supportive comments that AHRI also plans to use AHRI 1230–2021 as the test procedure for its certification program for VRF multi-split systems. Therefore, DOE expects that manufacturers will already have the required certification information in order to test according to the amended industry test procedure. Additionally, AHRI 1230–2021 includes an informative appendix D, which specifies rated heating capacity and indoor unit combination as fields to include in the OEM's certified supplemental testing instructions. Therefore, DOE concludes that adopting the certification requirements in this final rule will not constitute additional burden, as compared to expected industry practice.

DOE is requiring in this final rule that respondents must submit electronic forms using DOE's online CCMS. DOE's CCMS is accessible at: *www.regulations.doe.gov/ccms,* and includes instructions for users, registration forms, and the product-specific reporting templates required for use when submitting information to CCMS. DOE also concludes that manufacturers will rely on existing record keeping systems to maintain the additional information reported.

OMB has approved this revised information collection under existing OMB Control Number 1910–1400. 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 amends the test procedure for VRF multi-split systems, amendments which it expects will be used to develop and implement future energy conservation standards for such

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

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 10, 1999), imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism 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. 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. Pub. L. 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 *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 Federal test procedure for VRF multi-split systems adopted in this final rule incorporates testing methods contained in certain sections of the following applicable commercial test standards: AHRI 1230–2021 and ANSI/ASHRAE 37–2009. DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (*i.e.,* whether they were developed in a manner that fully provides for public participation, comment, and review). DOE 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 final 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:

(1) AHRI 1230–2021 is an industry-accepted test procedure for measuring the performance of VRF multi-split systems. AHRI 1230–2021 is available on AHRI's website at *www.ahrinet.org/search-standards.aspx.*

(2) ANSI/AHRI 1230–2010 is an industry-accepted test procedure for measuring the performance of VRF multi-split systems. ANSI/AHRI 1230–2010 is available on AHRI's website at *www.ahrinet.org/search-standards.aspx.*

(3) ANSI/ASHRAE Standard 37–2009. ANSI/ASHRAE Standard 37–2009 is an industry-accepted test procedure that provides a method of test for many categories of air conditioning and heating equipment. ANSI/ASHRAE Standard 37–2009 is available on ANSI's website at *webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2FASHRAE+Standard+37–2009.*

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

The following standards were previously approved for incorporation by reference in the section where they appear and no change is made: AHRI 210/240–2008, AHRI 340/360–2007, AHRI 390–2003, ASHRAE 127–2007, and ISO Standard 13256–1.

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, Incorporation by reference, Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on October 6, 2022, by Francisco Alejandro Moreno, Acting 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 October 12, 2022.

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. Revising paragraph (a); and

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

The revision and addition read as follows.

§ 429.4 Materials incorporated by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in

this section, the U.S. Department of Energy (DOE) must publish a document in the **Federal Register** and the material must be available to the public. All approved incorporation by reference (IBR) material is available for inspection at DOE and at the National Archives and Records Administration (NARA). Contact DOE at: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, Sixth Floor, 950 L'Enfant Plaza SW, Washington, DC 20024, (202) 586–9127, *Buildings@ee.doe.gov, www.energy.gov/eere/buildings/building-technologies-office.* For information on the availability of this material at NARA, email: *fr.inspection@nara.gov,* or go to:*www.archives.gov/federal-register/cfr/ibr-locations.html.* The material may be obtained from the sources in the following paragraphs of this section.

* * * * *

(c) * * *

(2) AHRI Standard 1230(I–P) (''AHRI 1230–2021''), *2021 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment,* copyright 2021; IBR approved for §§ 429.43; 429.134.

* * * * *

■ 3. Amend § 429.43 by:

■ a. Revising paragraphs (a) introductory text, (a)(1)(ii)(A) introductory text, and (a)(1)(ii)(B) introductory text;

■ b. Redesignating table 1 to paragraph (a)(3) as table 1 to paragraph (a)(3)(i)(A);

■ c. In paragraph (a)(3)(i), removing the text ''Table 1 to paragraph (a)(3)'', wherever it appears, and adding in its place the text ''table 1 to paragraph (a)(3)(i)(A)'' and removing the text ''Table 1'', wherever is appears, and adding in its place the text ''table 1'';

■ d. Adding reserved paragraph (a)(3)(i)(B);

■ e. Adding paragraph (a)(3)(ii);

■ f. Revising paragraphs (b)(2)(xi) and (xii);

■ g. Removing paragraph (b)(2)(xiii);

■ h. Redesignating paragraphs (b)(2)(xiv) and (xv) as (b)(2)(xiii) and (xiv), respectively;

■ i. Revising paragraphs (b)(4)(vii) and (viii);

■ j. Removing paragraph (b)(4)(ix);

■ k. Redesignating paragraphs (b)(4)(x) through (b)(4)(xiv) as (b)(4)(ix) through (b)(4)(xiii), respectively; and

■ l. Adding paragraph (b)(5).

The revisions and additions read as follows.

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

(a) Determination of represented values. Manufacturers must determine the represented values, which include the certified ratings, for each basic model of commercial HVAC equipment either by testing, in conjunction with the applicable sampling provisions, or by applying an AEDM.

(1) * * *

(ii) * * *

(A) Any represented value of energy consumption or other measure of energy use of a basic model, or of a tested combination for variable refrigerant flow multi-split air conditioners and heat pumps certified to standards in terms of IEER as provided at paragraph (a)(3)(ii)(C) of this section, for which consumers would favor lower values shall be greater than or equal to the higher of:

* * * * *

(B) Any represented value of energy efficiency or other measure of energy consumption of a basic model, or of a tested combination for variable refrigerant flow multi-split air conditioners and heat pumps certified to standards in terms of IEER as provided at paragraph (a)(3)(ii)(C) of this section, for which consumers would favor higher values shall be less than or equal to the lower of:

* * * * *

(3) * * *

(i) * * *

(B) [Reserved]

(ii) Variable refrigerant flow multi-split air conditioners and heat pumps (other than air-cooled with cooling capacity less than 65,000 btu/h). When certifying to standards in terms of IEER, the following provisions apply.

(A) *Outdoor Unit Model Selection.* All representations for basic models of VRF multi-split systems must be based on the least-efficient outdoor unit model(s) distributed in commerce within the basic model.

(B) *Indoor Unit Model Selection.* A manufacturer must determine represented values for basic models of VRF multi-split systems based on the following provisions regarding selection of indoor units:

(*1*) The combination of indoor unit models shall be selected per the certified tested combination in the STI, subject to the provisions in paragraph (a)(3)(ii)(B)(*2*) of this section.

(*2*) For each indoor unit model identified in the tested combination for which the model number certified in the STI does not fully specify the presence or absence of all components, a fully-specified indoor unit model shall be selected that meets the following qualifications:

(*i*) Is distributed in commerce; and

(*ii*) Has a model number consistent with the certified indoor unit model number (*i.e.,* shares all digits of the model number that are specified in the certified indoor unit model number); and

(*iii*) Among the group of all indoor models meeting the criteria from paragraphs (a)(3)(ii)(B)(*2*)(*i*) and (*ii*) of this section, has the least number (which could be zero) of components listed in Table 2 to paragraph (a)(3)(ii)(B)(*2*) of this section.

TABLE 2 TO PARAGRAPH (a)(3)(ii)(B)(*2*)—SPECIFIC COMPONENTS FOR VARIABLE REFRIGERANT FLOW MULTI-SPLIT SYSTEMS

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

(C) *Represented Values for Different Indoor Unit Combinations.* (*1*) If a basic model includes only one type of indoor unit combination (*i.e.,* ducted, non-ducted, or SDHV), a manufacturer must determine the represented values for the basic model in accordance with the sampling plan set forth in § 429.11 and paragraph (a)(1) of this section if the represented values are determined through testing, or in accordance with the provisions for applying an AEDM set forth in paragraph (a)(2) of this section and § 429.70. Indoor unit models must be selected in accordance

with paragraph (a)(3)(ii)(B) of this section.

(*2*) If a basic model includes more than one type of indoor unit combination (*i.e.,* ducted, non-ducted, and/or SDHV):

(*i*) A manufacturer must determine separate represented values for each type of indoor unit combination. If the represented values are determined through testing, a manufacturer must test, at a minimum, a single tested combination that represents each type of indoor unit combination included in that basic model. A manufacturer may alternatively determine separate represented values through application of an AEDM as set forth in paragraph (a)(2) of this section and § 429.70. Indoor unit models within the indoor unit combination must be selected in accordance with paragraph (a)(3)(ii)(B) of this section.

(*ii*) A manufacturer may also determine optional ''mixed'' representations by calculating the mean value across any two required representations described in the paragraph (a)(3)(ii)(C)(*2*)(*i*) of this section (*i.e.,* a representation for ''mixed ducted/non-ducted'' would be determined by averaging the ducted representation and the non-ducted representation; a representation for ''mixed ducted/SDHV'' would be determined by averaging the ducted representation and the SDHV representation, and a representation for ''mixed non-ducted/SDHV'' would be determined by averaging the non-ducted representation and the SDHV representation).

(b) * * *

(2) * * *

(xi) Variable refrigerant flow multi-split air-cooled air conditioners (other than air-cooled with rated cooling capacity less than 65,000 btu/h):

(A) When certifying compliance with an EER standard: The energy efficiency ratio (EER in British thermal units per Watt-hour (Btu/Wh)), rated cooling capacity in British thermal units per hour (Btu/h), and the type(s) of heating used by the basic model (*e.g.,* electric, gas, hydronic, none).

(B) When certifying compliance with an IEER standard, the following must be certified for each tested combination as required under paragraph (a)(3)(ii)(C) of this section: The integrated energy efficiency ratio (IEER) in British thermal units per Watt-hour (Btu/Wh)); the rated cooling capacity in British thermal units per hour (Btu/h); whether the represented values are for a non-ducted, ducted, or SDHV tested combination, or for a mixed representation of any two of the tested combinations; and the outdoor unit(s) and indoor units identified in the tested combination. The following must be certified for each basic model: the type(s) of heating used (*i.e.,* electric, gas, hydronic, none); and the refrigerant used to determine the represented values.

(xii) Variable refrigerant flow multi-split heat pumps (other than air-cooled with rated cooling capacity less than 65,000 btu/h):

(A) When certifying compliance with an EER standard: The energy efficiency ratio (EER in British thermal units per Watt-hour (Btu/Wh)), the coefficient of performance (COP), rated cooling capacity in British thermal units per hour (Btu/h), and the type(s) of heating used by the basic model (*e.g.,* electric, gas, hydronic, none).

(B) When certifying compliance with an IEER standard, the following must be certified for each tested combination as required under paragraph (a)(3)(ii)(C) of this section: The integrated energy efficiency ratio (IEER) in British thermal units per Watt-hour (Btu/Wh); the coefficient of performance (COP); the rated cooling capacity in British thermal units per hour (Btu/h); the rated heating capacity (Btu/h); whether the represented values are for a non-ducted, ducted, or SDHV tested combination, or for a mixed representation of any two of the tested combinations; and the outdoor unit(s) and indoor units identified in the tested combination. The following must be certified for each basic model: the type(s) of heating used (*i.e.,* electric, gas, hydronic, none); and the refrigerant used to determine the represented values.

* * * * *

(4) * * *

(vii) Variable refrigerant flow multi-split air-cooled air conditioners (other than air-cooled with rated cooling capacity less than 65,000 btu/h):

(A) When certifying compliance with an EER standard: The nominal cooling capacity in British thermal units per hour (Btu/h); outdoor unit(s) and indoor units identified in the tested combination; components needed for heat recovery, if applicable; rated airflow in standard cubic feet per minute (scfm) for each indoor unit; rated static pressure in inches of water; compressor frequency setpoints; required dip switch/control settings for step or variable components; a statement whether the model will operate at test conditions without manufacturer programming; any additional testing instructions if applicable; if a variety of motors/drive kits are offered for sale as options in the basic model to account for varying installation requirements, the model number and specifications of the motor (to include efficiency, horsepower, open/closed, and number of poles) and the drive kit, including settings, associated with that specific motor that were used to determine the certified rating; and which, if any, special features were included in rating the basic model. Additionally, upon DOE request, the manufacturer must provide a layout of the system set-up for testing including charging instructions consistent with the installation manual.

(B) When certifying compliance with an IEER standard (for requirements in this list pertaining to or affected by indoor units, the requirements must be certified for each tested combination as required under paragraph (a)(3)(ii)(C) of this section): The nominal cooling capacity in British thermal units per hour (Btu/h) for each indoor and outdoor unit; identification of the indoor units to be thermally active for each IEER test point; the rated indoor airflow for the full-load cooling and all part-load cooling tests (for each indoor unit) in standard cubic feet per minute (scfm); the indoor airflow-control setting to be used in the full-load cooling test (for each indoor unit); system start-up or initialization procedures, including conditions and duration; compressor break-in period duration of 20 hours or less; the frequency of oil recovery cycles; operational settings for all critical parameters to be controlled at each of the four IEER cooling test conditions; all dip switch/control settings used for the full-load cooling test; identification of any system control device required for testing; a hierarchy of instructions for adjustment of critical parameters to reduce cooling capacity during IEER cooling tests (to be used if, using initial critical parameter settings, the measured cooling capacity is more than 3 percent above the target cooling capacity); any additional testing instructions if applicable; and if a variety of motors/drive kits are offered for sale as options in the basic model to account for varying installation requirements, the model number and specifications of the motor (to include efficiency, horsepower, open/closed, and number of poles) and the drive kit, including settings, associated with that specific motor that were used to determine the certified rating. Instructions for conducting a controls verification procedure (as described in Appendix C of AHRI 1230–2021, (incorporated by reference, *see* § 429.4) at each of the four IEER cooling test conditions must also be provided, including: the required thermostat

setpoints to ensure control for 80 °F dry-bulb temperature when accounting for setpoint bias, the starting indoor dry-bulb temperature, and the indoor dry-bulb temperature ramp rate (R2). Additionally, the manufacturer must provide a layout of the system set-up for testing (including a piping diagram, a power wiring diagram, a control wiring diagram, and identification of the location of the component(s) corresponding to each critical parameter to be controlled), set-up instructions for indoor units and outdoor units, and charging instructions consistent with the installation manual.

(viii) Variable refrigerant flow multi-split heat pumps (other than air-cooled with rated cooling capacity less than 65,000 btu/h):

(A) When certifying compliance with an EER standard: The nominal cooling capacity in British thermal units per hour (Btu/h); rated heating capacity in British thermal units per hour (Btu/h); outdoor unit(s) and indoor units identified in the tested combination; components needed for heat recovery, if applicable; rated airflow in standard cubic feet per minute (scfm) for each indoor unit; water flow rate in gallons per minute (gpm) for water-cooled units only; rated static pressure in inches of water; compressor frequency setpoints; required dip switch/control settings for step or variable components; a statement whether the model will operate at test conditions without manufacturer programming; any additional testing instructions if applicable; if a variety of motors/drive kits are offered for sale as options in the basic model to account for varying installation requirements, the model number and specifications of the motor (to include efficiency, horsepower, open/closed, and number of poles) and the drive kit, including settings, associated with that specific motor that were used to determine the certified rating; and which, if any, special features were included in rating the basic model. Additionally, upon DOE request, the manufacturer must provide a layout of the system set-up for testing including charging instructions consistent with the installation manual.

(B) When certifying compliance with an IEER standard (for requirements in this list pertaining to or affected by indoor units, the requirements must be certified for each tested combination as required under paragraph (a)(3)(ii)(C) of this section): The nominal cooling capacity in British thermal units per hour (Btu/h) for each indoor and outdoor unit; the nominal heating capacity (Btu/h) for each indoor and outdoor unit; components needed for heat recovery, if applicable; identification of the indoor units to be thermally active for each IEER test point; the rated indoor airflow for the full-load cooling, full-load heating, and all part-load cooling tests (for each indoor unit) in standard cubic feet per minute (scfm); the indoor airflow-control setting to be used in the full-load cooling test (for each indoor unit); the airflow-control setting to be used in the full-load heating test (for each indoor unit); for water-cooled units—the rated water flow rate in gallons per minute (gpm); system start-up or initialization procedures, including conditions and duration; compressor break-in period duration of 20 hours or less; the frequency of oil-recovery cycles; operational settings for all critical parameters to be controlled at each of the four IEER cooling test conditions; operational settings for all critical parameters to be controlled for the heating test; all dip switch/control settings used for the full-load cooling and full-load heating tests; identification of any system control device required for testing; a hierarchy of instructions for adjustment of critical parameters to reduce cooling capacity during IEER cooling tests (to be used if, using initial critical parameter settings, the measured cooling capacity is more than 3 percent above the target cooling capacity); any additional testing instructions if applicable; and if a variety of motors/drive kits are offered for sale as options in the basic model to account for varying installation requirements, the model number and specifications of the motor (to include efficiency, horsepower, open/closed, and number of poles) and the drive kit, including settings, associated with that specific motor that were used to determine the certified rating. Instructions for conducting a controls verification procedure (as described in Appendix C of AHRI 1230–2021) at each of the four IEER cooling test conditions must also be provided, including the required thermostat setpoints to ensure control for 80 °F dry-bulb temperature when accounting for setpoint bias, the starting indoor dry-bulb temperature, and the indoor dry-bulb temperature ramp rate (R2). Additionally, the manufacturer must provide a layout of the system set-up for testing (including a piping diagram, a power wiring diagram, a control wiring diagram, and identification of the location of the component(s) corresponding to each critical parameter to be adjusted), set-up instructions for indoor units and outdoor units, and charging instructions consistent with the installation manual.

* * * * *

(5) 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), if a manufacturer has knowledge that any of its certified operational settings for critical parameters to be controlled during IEER tests (per paragraph (b)(4)(vii)(B) or (b)(4)(viii)(B) of this section) are invalid according to the results of a controls verification procedure conducted according to § 429.134(v)(3), then the manufacturer must re-rate and re-certify using valid operational settings for critical parameters for all affected basic models.

* * * * *

■ 4. Amend § 429.70 by revising paragraph (c)(2)(i) to read as follows:

§ 429.70 Alternative methods for determining energy efficiency and energy use.

* * * * *

(c) * * *

(2) * * *

(i) The manufacturer must select at least the minimum number of basic models for each validation class specified in paragraph (c)(2)(iv) of this section to which the particular AEDM applies. Using the AEDM, calculate the energy use or efficiency for each of the selected basic models.

(A) Except 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) when certifying to standards in terms of IEER, test a single unit of each selected basic model in accordance with paragraph (c)(2)(iii) of this section. Compare the results from the single unit test and the AEDM energy use or efficiency output according to paragraph (c)(2)(ii) of this section. The manufacturer is responsible for ensuring the accuracy and reliability of the AEDM.

(B) 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) when certifying to standards in terms of IEER, the following provisions apply.

(*1*) If a manufacturer makes representations for a single type of indoor unit combination (*i.e.,* only ducted, non-ducted, or SDHV indoor unit combinations) across all the basic models for which an AEDM applies, the manufacturer must test at least a single tested combination of that type of indoor unit combination for each selected basic model in accordance with paragraph (c)(2)(iii) of this section.

(*2*) If a manufacturer makes representations for two types of indoor unit combinations (*i.e.,* ducted, non-ducted, and/or SDHV) within or across all the basic models for which the AEDM applies, the manufacturer must test at least a single tested combination of a selected basic model for one of those two types of indoor unit combination, and at least a single tested combination of a different selected basic model for the other of those two types of indoor unit combination, each tested in accordance with paragraph (c)(2)(iii) of this section.

(*3*) If a manufacturer makes representations for all three types of indoor unit combinations (*i.e.,* ducted, non-ducted, and SDHV) within or across basic models for which the AEDM applies, the manufacturer must test at least a single tested combination of a selected basic model as a non-ducted tested combination and a single tested combination of a different selected basic model as a ducted tested combination, each in accordance with paragraph (c)(2)(iii) of this section.

(*4*) In all cases, compare the results from each tested basic model and the AEDM energy use or efficiency output according to paragraph (c)(2)(ii) of this section. The manufacturer is responsible for ensuring the accuracy and reliability of the AEDM.

* * * * *

■ 5. Section 429.104 is revised to read as follows:

§ 429.104 Assessment testing.

(a) DOE may, at any time, test a basic model to assess whether the basic model is in compliance with the applicable energy conservation standard(s).

(b) 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), when DOE may require that the manufacturer of a basic model ship at its expense any means of control for the basic model necessary for conducting testing in accordance with Appendix D1 to subpart F of 10 CFR part 431 of this subchapter.

■ 6. Amend § 429.110 by:

■ a. Redesignating paragraphs (a)(2) and (3) as paragraphs (a)(3) and (4), respectively;

■ b. Adding new paragraph (a)(2); and

■ c. Revising paragraph (b)(1)(iv).

The addition and revision read as follows.

§ 429.110 Enforcement testing.

(a) * * *

(2) 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), when determining compliance with an energy conservation standard based on IEER, DOE may test for enforcement if DOE has reason to believe that a basic model is not in compliance, has invalid certified operational settings for critical parameter values, or has an otherwise invalid certified rating.

* * * * *

(b) * * *

(1) * * *

(iv) DOE may require in the test notice that the manufacturer of a basic model ship or cause to be shipped from a retailer or distributor at its expense the requested number of units of a basic model specified in such test notice to the testing laboratory specified in the test notice. The manufacturer shall ship the specified initial test unit(s) of the basic model to the testing laboratory within 5 working days from the time unit(s) are selected. 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) the manufacturer shall also ship any means of control necessary for conducting testing in accordance with appendix D1 to subpart F of 10 CFR part 431 of this subchapter. The manufacturer may ship the means of control separately from the system(s) selected for testing.

* * * * *

■ 7. Amend § 429.134 by:

■ a. In paragraph (s)(1), removing the text ''Table 1 of § 429.43(a)(3)'' and adding in its place the text ''table 1 to § 429.43(a)(3)(i)(A)''; and

■ b. Adding paragraph (v) to read as follows:

§ 429.134 Product-specific enforcement provisions.

* * * * *

(v) *Variable refrigerant flow multi-split air conditioners and heat pumps (other than air-cooled with rated cooling capacity less than 65,000 btu/h).* The following provisions apply for assessment and enforcement testing of models subject to standards in terms of IEER:

(1) *Specific components.* For each indoor unit model identified in the tested combination for which the model number certified in the STI does not fully specify the presence or absence of components listed at table 2 to 10 CFR 429.43(a)(3)(ii)(B), the following provision applies. If DOE is not able to obtain an individual model with the least number of those components, then DOE may test a system that includes any individual indoor unit model that has a model number consistent with the certified indoor unit model number.

(2) *Manufacturer involvement in assessment or enforcement testing.* A manufacturer's representative will be allowed to support commissioning and witness assessment and/or enforcement testing for variable refrigerant flow multi-split air conditioners and heat pumps, including during the controls verification procedures (CVPs) specified in paragraph (v)(3) of this section, with allowance for additional involvement as described in the following provisions.

(i) *Manufacturer involvement in CVP.* Control settings must be set by a member of the third-party laboratory consistent with the provisions in section 5.1 of appendix D1 to subpart F of 10 CFR part 431. Critical parameters must operate automatically from the system controls and must not be manually controlled or adjusted at any point by any party during the CVP.

(ii) *Manufacturer involvement in heating tests and IEER cooling tests.* All control settings other than critical parameters must be set by a member of the third-party laboratory consistent with the provisions of section 5.1 of appendix D1 to subpart F of 10 CFR part 431. In heating tests and IEER cooling tests, critical parameters may be manually controlled by a manufacturer's representative and initially set to their certified values as described in section 5.1 of appendix D1 to subpart F of 10 CFR part 431. During IEER cooling mode tests only, a manufacturer's representative may also make additional adjustments to the critical parameters as described in section 5.2 of appendix D1 to subpart F of 10 CFR part 431. Setting and adjustment of critical parameters by a manufacturer's representative must be monitored by third-party laboratory personnel using a service tool. Other than critical parameter adjustments made in accordance with section 5.3 of appendix D1 to subpart F of 10 CFR part 431, the manufacturer's representative must not make any other adjustments to the VRF multi-split system under test. If a manufacturer's representative is not present for testing, a member of the third-party laboratory must set and adjust critical parameters using the means of control provided by the manufacturer, as described in § 429.110(b)(1)(iv) for enforcement testing and § 429.104 for assessment testing.

(3) *Controls Verification Procedure (CVP).* This procedure validates the certified values of critical parameters for which positions may be manually set during the full- and part-load IEER cooling test conditions specified at appendix D1 to subpart F of 10 CFR part

431. The CVP will only be conducted for a single system.

(i) *Conducting the CVP*—The CVP will be conducted at all of the four IEER cooling test conditions as specified in appendix D1 to subpart F of 10 CFR part 431; the CVP is not conducted at any heating test conditions. The CVP will first be performed at the full-load cooling condition before being conducted at part-load cooling conditions and must be conducted per Appendix C of AHRI 1230–2021 (incorporated by reference, see § 429.4).

(ii) *Validating critical parameters*—At each load point, certified critical parameter values will be validated or invalidated according to Section C6 of AHRI 1230–2021 with the following amendments:

(A) The duration of the period used for validating certified critical parameter values must be whichever of the following is longer: three minutes, or the time period needed to obtain five sample readings while meeting the minimum data collection interval requirements of Table C2 of AHRI 1230–2021.

(B) If at least one measurement period with duration identified in paragraph (v)(3)(ii)(A) of this section exists before t_{OFF} that has an average root-sum-square (''RSS'') points total (as defined in Section 3.27 of AHRI 1230–2021) over the measurement period that is less than or equal to 70 points, the certified critical parameter values are valid.

(C) If no measurement period with duration identified in paragraph (v)(3)(ii)(A) of this section exists before t_{OFF} that has an average RSS points total over the measurement period that is less than or equal to 70 points, the certified critical parameter values are invalid.

(iii) *Determining critical parameters for use in steady-state IEER cooling tests.* If, following a CVP, IEER testing is conducted per appendix D1 to subpart F of 10 CFR part 431, the following provisions apply:

(A) *Validated critical parameter settings.* At each load point, if certified critical parameter values are found to be valid according to the results of the CVP, initially set critical parameters to their certified values for the IEER test at the corresponding full- or part-load cooling condition. Perform additional adjustments to critical parameters as described in section 5.2 of appendix D1 to subpart F of 10 CFR part 431.

(B) *Invalidated critical parameter settings.* At each load point, if certified critical parameter values identified pursuant to paragraph (v)(3) of this section are found to be invalid according to the results of the CVP, determine alternate critical parameter values for use in the corresponding IEER test (as specified in appendix D1 to subpart F of 10 CFR part 431) as follows:

(*1*) Select the CVP measurement period—this period must have duration determined per paragraph (v)(3)(ii)(A) of this section and must be the period where the RSS points total has a lower average value over the measurement period than over any other time period in the CVP of the same duration. If multiple periods exist with the same RSS points total, select the measurement period closest to but before the time that the first indoor unit switches to thermally inactive (denoted as ''t_{off}'' in AHRI 1230–2021).

(*2*) Determine alternate critical parameters—calculate the average position for each critical parameter during the measurement period selected in paragraph (v)(3)(iii)(B)(*1*) of this section. When initially setting critical parameters per section 5.1 of appendix D1 to subpart F of 10 CFR part 431, instead of using the certified critical parameter values, use the alternate critical parameter values as control inputs. The same initial alternate critical parameter values must be used for all systems in the assessment/enforcement sample (though critical parameter adjustments as needed to achieve target capacity or sensible heat ratio (SHR) limits are made independently for each tested system, per paragraph (v)(3)(iii)(B)(*3*) of this section.

(*3*) For each system, determine whether critical parameter adjustments are needed to achieve the target capacity or SHR limit for an IEER cooling test. Perform critical parameter adjustments independently on each system as described in section 5.2 of appendix D1 to subpart F of 10 CFR part 431, with the following exceptions:

(*i*) Replace all references to ''certified critical parameter values'' with ''alternate critical parameter values'' as determined in paragraph (v)(3)(iii)(B) of this section.

(*ii*) Determine CP_{Max} from a CVP conducted at full-load cooling conditions as the maximum value observed during the R2 period as described in Section C.4.4.2.3 of AHRI 1230–2021. If multiple components corresponding to a single parameter are present, determine CP_{Max} at the point during the R2 period at which the average value across all components corresponding to that critical parameter is maximized.

(4) *Break-in period.* DOE will perform a compressor break-in period during assessment or enforcement testing using a duration specified by the manufacturer only if a break-in period duration is provided in the supplemental testing instructions.

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

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

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

■ 9. Section 431.92 is amended by revising the definition of ''Integrated energy efficiency ratio, or IEER'' to read as follows:

§ 431.92 Definitions concerning commercial air conditioners and heat pumps.

* * * * *

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 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 and measured 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).

* * * * *

■ 10. Amend § 431.95 by:
■ a. Revising paragraph (b)(7);
■ b. Adding paragraph (b)(8);
■ c. Revising paragraph (c)(2);
■ d. Redesignating paragraphs (c)(3) through (7) as (c)(4) through (8); and
■ e. Adding new paragraph (c)(3).

The revisions and addition read as follows:

§ 431.95 Materials incorporated by reference.

* * * * *

(b) * * *

(7) ANSI/AHRI Standard 1230–2010, (''ANSI/AHRI 1230–2010''), ''2010 Standard for *Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment,*'' approved August 2, 2010 and updated by addendum 1 in March 2011; IBR approved for § 431.96 and appendix D to this subpart.

(8) AHRI Standard 1230 (I–P), (''AHRI 1230–2021'), ''*2021 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment*'', copyright in 2021; IBR approved for appendix D1 to this subpart.

(c) * * *

(2) ANSI/ASHRAE Standard 37–2009, (''ANSI/ASHRAE 37–2009''), ''Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment,'' ASHRAE approved June 24, 2009; IBR approved for § 431.96 and appendices A, B, and D1 to this subpart.

(3) 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; IBR approved for appendix D1 to this subpart.

* * * * *

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

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

* * * * *

(b) * * *

(1) Determine the energy efficiency of each type of covered equipment by conducting the test procedure(s) listed in table 1 to this paragraph (b) along with any additional testing provisions set forth in paragraphs (c) through (g) of this section and appendices A through D1 of this subpart, that apply to the energy efficiency descriptor for that equipment, category, and cooling capacity. The omitted sections of the test procedures listed in table 1 to this paragraph (b) must not be used. For equipment with multiple appendices listed in table 1 to this paragraph (b), consult the notes at the beginning of those appendices to determine the applicable appendix to use for testing.

* * * * *

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

Equipment type	Category	Cooling capacity or moisture removal capacity [2]	Energy efficiency descriptor	Use tests, conditions, and procedures [1] in	Additional test procedure provisions as indicated in the listed paragraphs of this section
Small Commercial Package Air-Conditioning and Heating Equipment.	Air-Cooled, 3-Phase, AC and HP.	<65,000 Btu/h	SEER and HSPF	AHRI 210/240–2008 (omit section 6.5).	Paragraphs (c) and (e).
	Air-Cooled AC and HP	≥65,000 Btu/h and <135,000 Btu/h.	EER, IEER, and COP	Appendix A to this subpart.	None.
	Water-Cooled and Evaporatively-Cooled AC.	<65,000 Btu/h	EER	AHRI 210/240–2008 (omit section 6.5).	Paragraphs (c) and (e).
		≥65,000 Btu/h and <135,000 Btu/h.	EER	AHRI 340/360–2007 (omit section 6.3).	Paragraphs (c) and (e).
	Water-Source HP	<135,000 Btu/h	EER and COP	ISO Standard 13256–1	Paragraph (e).
Large Commercial Package Air-Conditioning and Heating Equipment.	Air-Cooled AC and HP	≥135,000 Btu/h and <240,000 Btu/h.	EER, IEER and COP	Appendix A to this subpart.	None.
	Water-Cooled and Evaporatively-Cooled AC.	≥135,000 Btu/h and <240,000 Btu/h.	EER	AHRI 340/360–2007 (omit section 6.3).	Paragraphs (c) and (e).
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 (omit section 6.3).	Paragraphs (c) and (e).
Packaged Terminal Air Conditioners and Heat Pumps.	AC and HP	<760,000 Btu/h	EER and COP	Paragraph (g) of this section.	Paragraphs (c), (e), and (g).
Computer Room Air Conditioners.	AC	<65,000 Btu/h	SCOP	ASHRAE 127–2007 (omit section 5.11).	Paragraphs (c) and (e).
		≥65,000 Btu/h and <760,000 Btu/h.	SCOP	ASHRAE 127–2007 (omit section 5.11).	Paragraphs (c) and (e).
Variable Refrigerant Flow Multi-split Systems.	AC	<65,000 Btu/h (3-phase)	SEER	ANSI/AHRI 1230–2010 (omit sections 5.1.2 and 6.6).	Paragraphs (c), (d), (e), and (f).
Variable Refrigerant Flow Multi-split Systems, Air-cooled.	HP	<65,000 Btu/h (3-phase)	SEER and HSPF	ANSI/AHRI 1230–2010 (omit sections 5.1.2 and 6.6).	Paragraphs (c), (d), (e), and (f).
Variable Refrigerant Flow Multi-split Systems, Air-cooled.	AC and HP	≥65,000 Btu/h and <760,000 Btu/h.	EER and COP	Appendix D to this subpart [3].	None.
		≥65,000 Btu/h and <760,000 Btu/h.	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.
		<760,000 Btu/h	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	AHRI 390–2003 (omit section 6.4).	Paragraphs (c) and (e).
Direct Expansion-Dedicated Outdoor Air Systems.	All	<324 lbs. of moisture removal/hr.	ISMRE2 and ISCOP2	Appendix B to this subpart.	None.

[1] Incorporated by reference; see § 431.95.
[2] Moisture removal capacity 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.

* * * * *

Appendix C to Subpart F of Part 431 [Reserved]

■ 12. Add reserved appendix C to subpart F of part 431.

■ 13. Add appendix D to subpart F of part 431 to read as follows:

Appendix D to Subpart F of Part 431—Uniform Test Method for Measuring the Energy Consumption of Variable Refrigerant Flow Multi-Split Air Conditioners and Heat Pumps (Other Than Air-Cooled With Rated Cooling Capacity Less Than 65,000 Btu/h)

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

For any amended standards for variable refrigerant flow multi-split air conditioners and heat pumps that rely on integrated energy efficiency ratio (IEER) published after January 1, 2022, manufacturers must use the results of testing under appendix D1 of this subpart to determine compliance. Representations related to energy consumption must be made in accordance with the appropriate appendix that applies (*i.e.,* appendix D or appendix D1) when determining compliance with the relevant standard.

1. Incorporation by Reference

DOE incorporated by reference in § 431.95, the entire standard for ANSI/AHRI 1230–2010. However, enumerated provisions of ANSI/AHRI 1230–2010, as listed in this section 1, are excluded. 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 ANSI/AHRI 1230–2010:

(a) Section 5.1.2—Manufacturer involvement.

(b) Section 6.6—Verification testing and uncertainty is inapplicable as specified in section 2.2 of this appendix.

1.2 [Reserved.]

2. *General.* Determine the energy efficiency ratio (EER) and coefficient of performance (COP) (as applicable) in accordance with ANSI/AHRI 1230–2010.

Note: Sections 3 through 6 of this appendix provide additional instructions for determining EER and COP.

3. *Optional break-in period.* Manufacturers may optionally specify a ''break-in'' period, not to exceed 20 hours, to operate the equipment under test prior to conducting the test method specified in this appendix. A manufacturer who elects to use an optional compressor break-in period in its certification testing should record this period's duration as part of the information in the supplemental testing instructions under 10 CFR 429.43.

4. *Refrigerant line length corrections.* For test set-ups where it is physically impossible for the laboratory to use the required line length listed in Table 3 of the ANSI/AHRI 1230–2010, then the actual refrigerant line length used by the laboratory may exceed the required length and the following cooling capacity correction factors are applied:

Piping length beyond minimum, X (ft)	Piping length beyond minimum, Y (m)	Cooling capacity correction (%)
0> X ≤20	0> Y ≤6.1	1
20> X ≤40	6.1> Y ≤12.2	2
40> X ≤60	12.2> Y ≤18.3	3
60> X ≤80	18.3> Y ≤24.4	4
80> X ≤100	24.4> Y ≤30.5	5
100> X ≤120	30.5>Y ≤36.6	6

5. *Additional provisions for equipment set-up.* The only additional specifications that may be used in setting up the basic model for test 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 5.1 through 5.3 of this appendix provide specifications for addressing key information typically found in the installation and operation manuals.

5.1. 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.

5.2. The airflow rate used for testing must be that set forth in the installation and operation manual 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.

5.3. The test set-up and the fixed compressor speeds (*i.e.,* the maximum, minimum, and any intermediate speeds used for testing) should be recorded and maintained as part of the test data underlying the certified ratings that is required to be maintained under 10 CFR 429.71.

6. *Manufacturer involvement in assessment or enforcement testing.* A manufacturer's representative will be allowed to witness assessment and/or enforcement testing for variable refrigerant flow multi-split air conditioners and heat pumps. The manufacturer's representative will be allowed to inspect and discuss set-up only with a DOE representative. During testing, the manufacturer's representative may adjust only the modulating components that are necessary to achieve steady-state operation in the presence of a DOE representative. Only previously documented specifications for set-up as specified under sections 4 and 5 of this appendix will be used.

■ 14. Add appendix D1 to subpart F of part 431 to read as follows:

Appendix D1 to Subpart F of Part 431—Uniform Test Method for Measuring the Energy Consumption of Variable Refrigerant Flow Multi-Split Air Conditioners and Heat Pumps (Other Than Air-Cooled With Rated Cooling Capacity Less Than 65,000 Btu/h)

Note: Manufacturers must use the results of testing under this appendix to determine compliance with any amended standards for variable refrigerant flow multi-split air conditioners and heat pumps provided in § 431.97 that are published after January 1, 2022, and that rely on integrated energy efficiency ratio (IEER). Representations related to energy consumption must be made in accordance with the appropriate appendix that applies (*i.e.,* appendix D or appendix D1) when determining compliance with the relevant standard.

1. Incorporation by Reference

DOE incorporated by reference in § 431.95, the entire standard for AHRI 1230–2021 and ANSI/ASHRAE 37–2009, as corrected by the Errata sheet for ANSI/ASHRAE 37–2009 issued on March 27, 2019 (''ANSI/ASHRAE 37–2009 (as corrected)''). However, only

enumerated provisions of AHRI 1230–2021 and ANSI/ASHRAE 37–2009 are required or excluded, as listed in this section 1. 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 Provisions Required

1.1.1 AHRI 1230–2021

(a) Section 3—Definitions, except section 3.11, as specified in section 2 of this appendix,

(b) Section 5—Test Requirements, except section 5.1.2, as specified in sections 2 and 5.1 of this appendix,

(c) Section 6—Rating Requirements, except sections 6.3.3 and 6.5, as specified in sections 2, 4.1, 4.1.1, 4.2, 4.2.1, and 5.1 of this appendix,

(d) Section 11—Calculations is applicable as specified in sections 2, 5.2.1.2, and 5.2.2 of this appendix,

(e) Section 12—Symbols, Subscripts, and Superscripts as specified in section 2 of this appendix,

(f) Appendix E—ANSI/ASHRAE Standard 37–2009 Clarifications/Exceptions—Normative as specified in section 2 of this appendix.

1.1.2 [Reserved]

1.2 Provisions Excluded

1.2.1 ANSI/ASHRAE 37–2009 (as Corrected)

(a) Section 1—Purpose,

(b) Section 2—Scope, and

(c) Section 4—Classification.

2. *General.* Determine IEER and coefficient of performance (COP) (as applicable) in accordance with AHRI 1230–2021 and ANSI/ASHRAE 37–2009 (as corrected). Sections 3 through 5 of this appendix provide additional instructions for determining IEER and COP. In cases where there is a conflict, the language of this appendix takes highest precedence, followed by AHRI 1230–2021, followed by ANSI/ASHRAE 37–2009 (as corrected).

Note: The controls verification procedure specified in Appendix C of AHRI 1230–2021 is referenced as part of DOE's certification provisions at § 429.43(b) and product-specific enforcement provisions located at § 429.134(v)(3).

3. Definitions

3.1. *Critical Parameter(s)* are the following settings of modulating components of variable refrigerant flow multi-split air conditioners and heat pumps: compressor speed(s), outdoor fan speed(s), and outdoor variable valve position(s).

4. Test Conditions

4.1 *Test Conditions for Air-Cooled VRF Multi-split Systems with Rated Cooling Capacity Greater Than 65,000 Btu/h.* When testing to certify to the energy conservation standards in § 431.97, test using the ''Standard Rating Conditions, Cooling'' and ''Standard Rating Part-Load Conditions (IEER)'' conditions for cooling mode tests and ''Standard Rating Conditions (High Temperature Steady-state Test for Heating)'' conditions for heat pump heating mode tests, as specified in Table 9 in Section 6 of AHRI 1230–2021.

4.1.1 Representations of COP for air-cooled VRF multi-split systems with rated cooling capacity greater than 65,000 Btu/h made using the ''Low Temperature Operation, Heating'' condition specified in Table 9 in Section 6 of AHRI 1230–2021 are optional.

4.2 *Test Conditions for Water-source VRF Multi-split Systems.* When testing to certify to the energy conservation standards in § 431.97, test using the ''Part-load Conditions (IEER)'' conditions specified for ''Water Loop Heat Pumps'' in Table 10 of AHRI 1230–2021 for cooling mode tests and the ''Standard Rating Test'' conditions specified for ''Water Loop Heat Pumps'' in Table 11 in Section 6 of AHRI 1230–2021 for heat pump heating mode tests.

4.2.1 For water-source VRF multi-split systems, representations of EER made using the ''Standard Rating Test'' conditions specified for ''Ground-loop Heat pumps'' in Table 10 of Section 6 of AHRI 1230–2021 and representations of COP made using the ''Standard Rating Test'' conditions specified for ''Ground-loop Heat Pumps'' in Table 11 of Section 6 of AHRI 1230–2021 are optional.

5. Test Procedure

5.1 *Control Settings.* Control settings must be set in accordance with Sections 5.1.3, 5.1.4, 5.1.5, and 5.2 of AHRI 1230–2021. For systems equipped with head pressure controls, the head pressure controls must be set per manufacturer installation instructions or per factory settings if no instructions are provided. Indoor airflow-control settings must be set in accordance with Section 6.3.1 of AHRI 1230–2021. At each load point, critical parameters must be set to the values certified in the supplemental testing instructions (STI) provided by the manufacturer pursuant to § 429.43(b)(4) of this chapter. In cases in which a certified critical parameter value is not in the STI, the system must operate per commands from the system controls for that parameter. Once set, control settings must remain unchanged for the remainder of the test (except for allowable adjustment of critical parameters as described in section 5.2 of this appendix).

5.2 *Allowable Critical Parameter Adjustments for IEER Cooling Tests.* The following sections describe allowable adjustments to critical parameters after the initial system set-up (during which all control settings, including certified critical parameters, are set). Adjust critical parameters in order to achieve full- and part-load cooling capacity targets and sensible heat ratio (SHR) limits.

5.2.1 *Critical Parameter Adjustments for Meeting Cooling Capacity Targets.* Once critical parameters have been set to the values certified in the STI, if the unit cannot operate within 3% of the target cooling capacity (*i.e.,* within 3% of the load fraction for a given part-load cooling test (75%, 50%, or 25% load) or within 3% of the certified cooling capacity for a 100% full-load cooling test), manually-controlled critical parameters must be adjusted according to the following provisions:

5.2.1.1. *Cooling Capacity is Below Lower Tolerance.* If, for any test, the cooling capacity operates below the lower tolerance for the target cooling capacity, increase the compressor speed(s) beyond the STI-certified value(s) until the cooling capacity operates within 3% of the target cooling capacity. If multiple compressors are present in the system, increase compressor speed by the same absolute increment in RPM or Hz for each compressor for which the following conditions apply:

(a) The STI specifies a non-zero compressor speed for the compressor for that test and

(b) The compressor has not yet reached its maximum capable operating speed. The compressor speed(s) must not be less than the STI-certified value(s) at any point during the test. Upward adjustments to compressor speed are not constrained by a budget on RSS Points Total (See section 5.2.1.2.1 of this appendix).

5.2.1.2 *Cooling Capacity is Above Upper Tolerance.* If, for any test, the cooling capacity operates above the upper tolerance for the target cooling capacity, adjust any manually-controlled critical parameters per the STI. If the STI does not include a hierarchy of instructions for adjustment of critical parameters to reduce cooling capacity during IEER cooling tests, then reduce only the compressor speed(s) to reduce cooling capacity. If multiple compressors are present in the system, decrease compressor speed by the same absolute increment for each compressor for which the following conditions apply:

(a) The STI specifies a non-zero compressor speed for the compressor for that test and

(b) The compressor has not yet reached minimum speed. Continue reducing cooling capacity in this manner until one of the following occurs:

(1) The unit operates within 3% of the target cooling capacity; or

(2) The RSS point total reaches a budget of 70 points (see section 5.2.1.2.1 of this appendix). For the 75%, 50%, and 25% part-load cooling test points, if the RSS point total reaches 70 during critical parameter adjustments before the capacity operates within 3% of the target cooling capacity, stop adjustment and follow cyclic degradation procedures in accordance with Section 11.2.2.1 of AHRI 1230–2021.

5.2.1.2.1 *Measuring Critical Parameter Variation During Adjustment Period.* When adjusting critical parameters to reduce cooling capacity, critical parameter variation must be calculated each time the critical parameters are adjusted, using the following equations:

(a) First, use equation 5.2–1 to calculate the absolute parameter percent difference () between each adjusted critical parameter and the value for that parameter certified in the STI.

Equation 5.2-1 $$PPD_i = \left|\frac{CP_{i,Adj} - CP_{i,STI}}{CP_{Max}}\right| \times 100$$

Where:

''i'' identifies the critical parameter—either compressors speed(s), outdoor fan speed(s), or outdoor variable valve position(s)

$CP_{i,Adj}$ = The adjusted position of critical parameter ''i'' recorded at each measurement interval. If multiple components corresponding to a single parameter are present (*e.g.,* multiple compressors), calculate the average position across all components corresponding to that parameter at each measurement interval when determining $CP_{i,Adj}$.

$CP_{i,STI}$ = The position of critical parameter ''i'' as certified in the STI. If multiple components corresponding to a single parameter are present, calculate the average position across all components corresponding to that parameter at each measurement interval when determining $CP_{i,STI}$.

CP_{Max} = The maximum operating position for Critical Parameter ''i'' as certified in the STI for the 100% load condition. If multiple components corresponding to a single parameter are present, calculate as the average value across all components corresponding to that critical parameter certified in the STI for the 100% load condition.

(b) Next, use equation 5.2–2 to this section to determine the accrued points for each critical parameter:

Equation 5.2-2 $$Points_i = PPD_i \times NPV_i$$

Where:

''i'' identifies the critical parameter—either compressors speed(s), outdoor fan speed(s), or outdoor variable valve position(s)

NPV_i = the nominal point value for critical parameter ''i'' as follows:

TABLE 5.1—CRITICAL PARAMETER NOMINAL POINT VALUES

Critical parameter	Nominal point value
Compressor Speed(s)	13
Outdoor Fan Speed(s)	7
Outdoor Variable Valve Position(s)	1

(c) Finally, use equation 5.2–3 to this section to calculate the root-sum-squared (RSS) Points Total across all critical parameters.

Equation 5.2-3 $$RSS\ Points = \sqrt{\left(Points_{Compressors}\right)^2 + (Points_{Fans})^2 + (Points_{Valves})^2}$$

5.2.2 *Critical Parameter Adjustments for Meeting SHR Limits.* The SHR for the 100% load test point and the 75% part-load test point must not be higher than 0.82 and 0.85, respectively (measured to the nearest hundredth). If the SHR is above the allowable limit, increase the compressor speed(s) until either the SHR is less than or equal to the allowable limit or the cooling capacity reaches 3% greater than the target cooling capacity for that test, whichever happens first. If multiple compressors are present in the system, increase compressor speed by the same absolute increment for each compressor for which the following conditions apply:

(a) The STI specifies a non-zero compressor speed for the compressor for that test and

(b) The compressor has not yet reached maximum speed. Upwards adjustments to compressor speed are not constrained by a budget on RSS Points Total. Should the SHR remain above the maximum limit when the cooling capacity reaches its upper 3% tolerance, no further compressor adjustments shall be made, and the calculation procedures specified in Section 11.2.2.2 of AHRI 1230–2021 must be applied using the adjusted SHR value obtained after increasing the compressor speed(s).

6. *Set-Up and Test Provisions for Specific Components.* When testing a VRF multi-split system that includes any of the specific components listed in table 6.1 to this appendix, test in accordance with the set-up and test provisions specified in table 6.1.

TABLE 6.1—TEST PROVISIONS FOR SPECIFIC COMPONENTS

Component	Description	Test provisions
Desiccant Dehumidification Components.	An assembly that reduces the moisture content of the supply air through moisture transfer with solid or liquid desiccants.	Disable desiccant dehumidification components for testing.
Air Economizers	An automatic system that enables a cooling system to supply outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather.	For any air economizer that is factory-installed, place the economizer in the 100% return position and close and seal the outside air dampers for testing. For any modular air economizer shipped with the unit but not factory-installed, do not install the economizer for testing.
Fresh Air Dampers	An assembly with dampers and means to set the damper position in a closed and one open position to allow air to be drawn into the equipment when the indoor fan is operating.	For any fresh air dampers that are factory-installed, close and seal the dampers for testing. For any modular fresh air dampers shipped with the unit but not factory-installed, do not install the dampers for testing.
Hail Guards	A grille or similar structure mounted to the outside of the unit covering the outdoor coil to protect the coil from hail, flying debris, and damage from large objects.	Remove hail guards for testing.

TABLE 6.1—TEST PROVISIONS FOR SPECIFIC COMPONENTS—Continued

Component	Description	Test provisions
Low Ambient Cooling Dampers.	An assembly with dampers and means to set the dampers in a position to recirculate the warmer condenser discharge air to allow for reliable operation at low outdoor ambient conditions.	Remove low ambient cooling dampers for testing.
Power Correction Capacitors	A capacitor that increases the power factor measured at the line connection to the equipment. These devices are a requirement of the power distribution system supplying the unit.	Remove power correction capacitors for testing.
Ventilation Energy Recovery Systems (VERS).	An assembly that preconditions outdoor air entering the equipment through direct or indirect thermal and/or moisture exchange with the exhaust air, which is defined as the building air being exhausted to the outside from the equipment.	For any VERS that is factory-installed, place the VERS in the 100% return position and close and seal the outside air dampers and exhaust air dampers for testing, and do not energize any VERS subcomponents (*e.g.,* energy recovery wheel motors). For any VERS module shipped with the unit but not factory-installed, do not install the VERS for testing.

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