ANSI/AHRI Standard 1230 with Addendum 2

2010 Standard for

Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment

Approved American National Standard
ANSI

Approved by ANSI on 2 August 2010

AHRI Air-Conditioning, Heating, and Refrigeration Institute

2111 Wilson Boulevard, Suite 500
Arlington, VA 22201, USA
www.ahrinet.org

PH 703.524.8800
FX 703.562.1942

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

ANSI/AHRI STANDARD 1230-2010 WITH ADDENDUM 2,

Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment

June 2014

Addendum 2 (dated June 2014) of ANSI/AHRI Standard 1230-2010, changes AHRI Standard 1230-2010 as follows.

Changes have been incorporated (additions are shown by shading and deletions are shown by ~~strikethroughs~~) into the already published version of ANSI/AHRI Standard 1230-2010 with Addendum 1.

The changes are to the inside front cover, scope of the VRF certification program, Sections 2.1, 3.23, 5.1, 5.2, 5.3, 6.1, 6.1.7, 6.6, 6.7, 9.1, and D3.4.

~~Important Note:~~

~~Until AHRI Standard 1230 is approved by DOE,VRF multi-split air-cooled air conditioners and heat pumps, below 65,000 Btu/h [19,000 W] shall be rated in accordance with ARI Standard 210/240-2008.~~

~~Applicability~~

~~Integrated Energy Efficiency Ratio (IEER) is effective beginning January 1, 2010. Integrated Part-Load Value is in effect until January 1, 2010. On January 1, 2010, IEER will supersede IPLV.~~

AHRI CERTIFICATION PROGRAM PROVISIONS

Scope of the Certification Program

The Certification Program includes all Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning, ~~and~~ Heat Pump, and Heat Recovery Equipment rated at AHRI Standard Rating Conditions ~~(Cooling)~~.

Certified Ratings

The following Certification Program ratings are verified by test:

Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment

a. For VRF Multi-Split Air-Conditioners < 65,000 Btu/h [19,000 W]

1. Standard Rating Cooling Capacity, Btu/h [W]

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

2. Seasonal Energy Efficiency Ratio, SEER, Btu/(W·h)
3. Energy Efficiency Ratio, EER, Btu/(W·h)

b. For VRF Multi-Split Air-Conditioners ≥ 65,000 Btu/h [19,000 W]

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Energy Efficiency Ratio, EER, Btu/(W·h)
3. Integrated Energy Efficiency Ratio, IEER ~~(Integrated Part-Load Value, IPLV is Superseded by IEER January 1, 2010)~~

c. For VRF Multi-Split Heat Pumps < 65,000 Btu/h [19,000 W]

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Seasonal Energy Efficiency Ratio, SEER, Btu/(W·h)
3. Energy Efficiency Ratio, EER, Btu/(W·h)
4. High Temperature Heating Standard Rating Capacity, Btu/h [W]
5. Region IV Heating Seasonal Performance Factor, HSPF, Minimum Design Heating Requirement, Btu/(W·h)

d. For VRF Multi-Split Heat Pumps ≥ 65,000 Btu/h [19,000 W]

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Energy Efficiency Ratio, EER, Btu/(W·h)
3. Integrated Energy Efficiency Ratio, IEER ~~(Integrated Part-Load Value, IPLV is Superseded by IEER January 1, 2010)~~
4. High Temperature Heating Standard Rating Capacity, Btu/h [W]
5. High Temperature Coefficient of Performance, COP
6. Low Temperature Heating Standard Rating Capacity, Btu/h [W]
7. Low Temperature Coefficient of Performance, COP

e. For VRF Multi-Split Heat Recovery Heat Pumps

1. Ratings Appropriate in (c) and (d) above
2. Simultaneous Cooling and Heating Efficiency (SCHE) (50% heating/50% cooling).

f. For VRF Multi-Split Heat Pump Systems that Use a Water Source for Heat Rejection

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Energy Efficiency Ratio, EER, Btu/(W·h)
3. Integrated Energy Efficiency Ratio, IEER ~~(Integrated Part-Load Value, IPLV is Superseded by IEER January 1, 2010)~~
4. Heating Standard Rating Capacity, Btu/h [W]
5. Heating Coefficient of Performance, COP
6. Simultaneous Cooling and Heating Efficiency (SCHE) (50% heating/50% cooling) (Heat Recovery models only)

Conformance to the requirements of the Maximum Operating Conditions Test, Voltage Tolerance Test, Low-Temperature Operation Test (Cooling), Insulation Effectiveness Test (Cooling), and Condensate Disposal Test (Cooling), as outlined in Section 8, are also verified by test.

2.1 This standard covers matched variable refrigerant flow Multi-Split Air Conditioners and Multi-Split Heat Pumps using distributed refrigerant technology as defined in Section 3. ~~with cooling and heating capacities for outdoor units from 12,000 Btu/h [3508 W] to 300,000 Btu/h [90,000 W] and indoor units from 5,000 Btu/h [1,000W] to 60,000 Btu/h [20,000 W]. Each indoor unit is designed to condition a single zone.~~

3.23 *Small-duct, High-velocity System.* A heating and/or cooling product that contains a blower and indoor coil combination that is designed for, and produces, at least 1.2 in H_2O [300 Pa] of external static pressure when operated at the certified air volume rate of 220-350 cfm [0.104 – 0.165 m^3/s] per rated ton of cooling. When applied in the field, small-duct

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

products use high-velocity room outlets (i.e., generally greater than 1,000 fpm [5 m/s]) having less than 6.0 in^2 [3,900 mm^2] of free area.

5.1 All Standard Ratings shall be ~~verified by tests conducted in accordance with the test methods and procedures as described in this standard and its appendices.~~ generated either by a) tests conducted per Section 5.2 and in accordance with the test methods and procedures as described in the rest of this standard and its appendices, or b) an Alternative Efficiency Determination Method (AEDM) per Section 5.3.

5.1.1 Air-cooled, water-cooled and evaporative-cooled units shall be tested in accordance with ANSI/ASHRAE Standard 37 and with Appendices C and D.

5.1.2 To set up equipment for test which incorporates inverter-controlled compressors, ~~skilled~~ manufacturer authorized personnel with knowledge of the control software will be required

5.1.3 If the equipment cannot be maintained at steady state conditions by its normal controls, then the manufacturer shall modify or over-ride such controls so that steady state conditions are achieved.

5.1.4 If a manufacturer indicates that its system is designed to recover oil more frequently than every two hours of continuous operation, the oil recovery mode shall be activated during testing. In all other cases, this mode should be disabled during testing.

~~**5.2** *Number of Tests to be Conducted.*~~

~~**5.2.1** Multi-split manufacturers must test two or more combinations of indoor units with each outdoor unit:~~

~~**5.2.1.1** The first system combination shall be tested using only non-ducted indoor units that meet the definition of a Tested Combination. The rating given to any untested multi-split system combination having the same outdoor unit and all non-ducted indoor units shall be set equal to the rating of the tested system having all non-ducted indoor units.~~

~~**5.2.1.2** The second system combination shall be tested using only ducted indoor units that meet the definition of a Tested Combination. The rating given to any untested multi-split system combination having the same outdoor unit and all ducted indoor units shall be set equal to the rating of the tested system having all ducted indoor units. In order to be considered a ducted unit, the indoor unit must be intended to be connected with ductwork and have a rated external static pressure capability greater than zero (0).~~

~~**5.2.2** The rating given to any untested multi-split system combination having the same outdoor unit and a mix of non-ducted and ducted indoor units shall be set equal to the average of the ratings for the two required tested combinations.~~

5.2 *Ratings Determined by Testing.*

5.2.1 For manufacturers that offer either only non-ducted combinations or only ducted combinations, ratings shall be determined by testing at least two complete system samples of the same combination of indoor units.

5.2.1.1 For any system combinations using only non-ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same outdoor unit and all non-ducted indoor units shall be set equal to the rating of the tested system having all non-ducted indoor units.

5.2.1.2 For any system combinations using only ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same outdoor unit and all ducted indoor units shall be set equal to the rating of the tested system having all ducted indoor units. In order to be considered a ducted unit, the indoor unit must be intended to be connected with ductwork and have a rated external static pressure capability greater than zero.

5.2.2 For manufacturers that offer both non-ducted combinations and ducted combinations, ratings must be determined by testing two or more combinations of indoor units with each outdoor unit with one combination consisting of only non-ducted indoor units and the second consisting of only ducted indoor units.

AVA Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

5.2.2.1 For any system combinations using only non-ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same outdoor unit and all non-ducted indoor units shall be set equal to the rating of the tested system having all non-ducted indoor units.

5.2.2.2 For any system combinations using only ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same outdoor unit and all ducted indoor units shall be set equal to the rating of the tested system having all ducted indoor units. In order to be considered a ducted unit, the indoor unit must be intended to be connected with ductwork and have a rated external static pressure capability greater than zero.

5.2.2.3 The rating given to any untested multi-split system combination having the same outdoor unit and a mix of non-ducted and ducted indoor units shall be set equal to the average of the ratings for the two required tested combinations.

5.3 *Ratings Determined by an* Alternative Efficiency Determination Method (AEDM).

5.3.1 A manufacturer may choose to rate its products via an AEDM that is in compliance with DOE requirements specified in 10 CFR 429.70.

6.1 *Standard Ratings.* Standard Ratings shall be established at the Standard Rating Conditions specified in 6.1.3.

Air-cooled Multi-Split Air Conditioner and Heat Pumps <65,000 Btu/h [19,000W] shall be rated at conditions specified in section 6.2, in Tables 5, 6, and 7.

Air-cooled Multi-Split Air Conditioners and Heat Pumps and evaporatively and water-cooled air-conditioning-only systems ≥65,000 Btu/h shall be rated at conditions specified in 6.3 and Table 9.

Multi-Split Heat Pump that use a water-source for heat rejection shall be rated at conditions specified in Section 6.4 and Tables 10 and 11.

If a non-ducted or ducted indoor unit contains an integral condensate pump, the power to operate the pump shall be included in the system total power calculation.

Standard Ratings relating to cooling or heating capacities shall be net values, including the effects of circulating-fan heat, but not including supplementary heat. Power input shall be the sum of power input to the compressor(s) and fan(s), plus controls and other items required as part of the system for normal operation.

Standard Ratings of water-cooled units from 65,000~~ to below 300,000~~ Btu/h [19,000~~ to 88,000~~ W] and above shall include a total allowance for cooling tower fan motor and circulating water pump motor power inputs to be added in the amount of 10.0 W per 1000 Btu/h [34.1 W per 1000 W] cooling capacity.

6.1.1 *Values of Standard Capacity Ratings.* These ratings shall be expressed only in terms of Btu/h [W] as shown:

Table 2. Values of Standard Capacity Ratings

Capacity Ratings, Btu/h [W]	Multiples, Btu/h [W]
< 20,000 [5,900]	100 [30]
≥ 20,000 and < 38,000 [5,900 up to 11,000]	200 [60]
≥ 38,000 and < 65,000 [11,000 up to 19,000]	500 [150]
≥65,000 and < 135,000 [19,000 up to 39,600]	1000 [300]
≥ 135,000 ~~136,000 and < 300,000~~ [39,800~~ up to 88,000~~]	2000 [600]

6.1.7 *Requirements for Separated Assemblies (Applies to all Systems).* All standard ratings for equipment in which the condenser and the evaporator are two separate assemblies, as in Types: MSV-A-CB, MSV-W-CB, HMSV-A-CB, HMSV-W-CB, HMSR-A-CB, (See Table 1 Notes) and HMSR-W-CB, shall be obtained with a minimum 25 ft. [7.6 m] of

AVA Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

interconnecting tubing length (for one indoor unit with additional length requirements for each additional unit). Refer to Table 3 for minimum total refrigerant tube lengths. Refer to Table 4 for Cooling Capacity correction factors that shall be used when the refrigerant line length exceeds the minimum values provided in Table 3. The complete length of tubing furnished as an integral part of the unit (and not recommended for cutting to length) shall be used in the test procedure, or with 25 ft [7.6 m] of refrigerant path, whichever is greater. At least 10 ft [3.0 m] of the system interconnection tubing shall be exposed to the outside conditions. The line diameters, insulation, installation details, evacuation and charging shall follow the manufacturer's published recommendations. The manufacturer will provide a schematic of the tested combination installation (See Figure 1).

Table 4. Refrigerant Line Length Correction Factors

Piping length beyond the requirement (X), ft [m]	Cooling Capacity Correction Factor
3.3 [1] < X ≤ 20 [6.1]	1.01
20 [6.1] < X ≤ 40 [12.2]	1.02
40 [12.2] < X ≤ 60 [18.3]	1.03
60 [18.3] < X ≤ 80 [24.4]	1.04
80 [24.4] < X ≤ 100 [30.5]	1.05
100 [30.5] < X ≤ 120 [36.6]	1.06

Note: Due to the refrigerant line lengths required in the test setup, a correction factor must be applied to normalize the measured cooling capacity

Table 8. Minimum External Static Pressure for Ducted Systems Tested with External Static Pressure > 0 in H2O

Rated Cooling[1] or Heating[2] Capacity		Minimum External Resistance[3,4]			
		Small-duct High-velocity Systems[5]		All Other Systems	
Btu/h	kW	in H_2O	Pa	in H_2O	Pa
Up through 28,800	6.40 to 8.44	1.10	275	0.10	25
29,000 to 42,500	8.5 to 12.4	1.15	388	0.15	37
43,000 thru 60,000	12.6 thru 19.0	1.20	300	0.20	50

Notes:

1) For air conditioners and heat pumps, the value cited by the manufacturer in published literature for the unit's capacity when operated at the A2 Test conditions.
2) For heating-only heat pumps, the value the manufacturer cites in published literature for the unit's capacity when operated at the H12 Test conditions.
3) For ducted units tested without an air filter installed, increase the applicable tabular value by 0.08 in H2O [20 Pa].
4) If the manufacturer's rated external static pressure is less than 0.10 in H2O (25 Pa), then the indoor unit should be tested at that rated external static pressure. (See Section 5.2.1.2)
5) See Definition 1.35 of Appendix C to determine if the equipment qualifies as a Small-duct, High-velocity System.

~~**6.6** *Test Tolerances (Applies to all products covered by this standard).* To comply with this standard, measured test results shall not be less than 95% of Published Ratings for capacities, SEER, HSPF, EER values, and COP values and not less than 90%of Published Ratings for IEER and SCHE values.~~

6.6 *Verification Testing Uncertainty.* When verifying the ratings by testing a sample unit, there are uncertainties that must

AVA Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

be considered. Verification tests, including tests conducted for the AHRI certification program shall be conducted in a laboratory that meets the requirements referenced in this standard and ASHRAE Standard 37 and must demonstrate performance with an allowance for uncertainty. The following make up the uncertainty for products covered by this standard.

6.6.1 *Uncertainty of Measurement*. When testing a unit, there are variations that result from instrumentation and measurements of temperatures, pressure, and flow rates.

6.6.2 *Uncertainty of Test Rooms.* A unit tested in multiple rooms will not yield the same performance due to setup variations.

6.6.3 *Variation due to Manufacturing*. During the manufacturing of units, there are variations due to manufacturing production tolerances that will impact the performance of a unit.

6.6.4 *Uncertainty of Performance Simulation Tools*. Due to the large complexity of options, use of performance prediction tools like an AEDM has some uncertainties.

6.7 To comply with this standard, verification tests shall meet the performance metrics shown in Table 13 with an uncertainty allowance not greater than the following:

Table 13. Uncertainty Allowances

Performance Metric	Uncertainty Allowance	Acceptance Criteria[1]
Cooling Capacity	5%	≥ 95%
SEER[2]	5%	≥ 95%
EER	5%	≥ 95%
IEER[3]	10%	≥ 90%
SCHE[4]	10%	≥ 90%
Heating Capacity[5]	5%	≥ 95%
COP[3,5]	5%	≥ 95%
HSPF[2]	5%	≥ 95%

Notes:
1) Must be ≥ (1 – uncertainty allowance).
2) Applies only to systems < 65,000 Btu/h [19,000 W]
3) Applies only to systems ≥ 65,000 Btu/h [19,000 W]
4)Applies to heat recovery systems only
5) Includes the high temperature and low temperature conditions, and the temperature condition for water-source systems

9.1 *Marking and Nameplate Data.* As a minimum, the nameplate shall display the manufacturer's name, model designation, and electrical characteristics.

Nameplate voltages for 60 Hz systems shall include one or more of the equipment nameplate voltage ratings shown in Tables 1 and 2 of AHRI Standard 110. Nameplate voltages for 50 Hz systems shall include one or more of the utilization voltages shown in Table 1 of IEC Standard 60038.

D3.4 *Specifications for Measuring Static Pressure for Wall Mounted Indoor Units*.

D3.4.1 Transition duct size shall be based on the length of the discharge opening of the indoor unit. Length (L), Width (W) and Depth (D) should be similar dimensions to form a cube. The length of the unit is the long dimension of the opening. The width of the unit is the short dimension of the opening.

D3.4.2 The duct shall not interfere with the throw angle.

D3.4.2.1 For wall mounted units with a top or bottom discharge:

AVA Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

D3.4.2.1.1 Visually confirm proper setup after making settings/speed changes;
D3.4.2.1.2 Setup duct as shown in Figure D4.
D3.4.2.1.3 Velocity at center of transition duct shall not exceed 250 ft/min [1.27 m/s].

D3.4.3 Transition Duct connection should be installed so that it will not interfere with opening of the indoor unit's outlet.

D3.4.3.1 Space the thermocouples evenly across the unit outlet. When there is free air discharge, thermocouples shall be in the midpoint of the air stream and across the width.

D3.4.3.2 Systems with a single outlet shall have a minimum of three thermocouples connected in parallel, at midpoint and distributed evenly across the outlet to obtain an average temperature leaving.

D3.4.3.3 Systems with more than one outlet, such as cassettes, shall have three thermocouples connected in parallel and distributed evenly across each outlet to obtain an average temperature leaving for each outlet. Cassettes with four outlets require four grids with three thermocouples each.

D3.4.4 Four static pressure taps shall be placed in the center of each duct face.

D3.4.5 Diffuser plates are required on the duct outlet when multiple fan coils are tested. The mixing device shall be placed in the center of the common duct.

D3.4.6 Calculate the duct loss using Equation D1.

$$DL = \Delta t * A * C \quad \text{D1}$$

Where:

DL = Duct loss;
Δt = The differential temperature between inlet and outlet sampler RTDs;
A = Duct loss surface area between the unit outlet and the outlet sampler location;
C = Coefficient representing the insulation heat transfer value, calculated using Equation D2.

$$C = {}^{1}/_{R} \quad \text{D2}$$

Where:

R = Insulation value (minimum shall be greater than or equal to R19).

D3.4.7 The total free air and closed duct balance check shall be verified by comparing total power, within a tolerance of ± 2.0%.

AVA Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

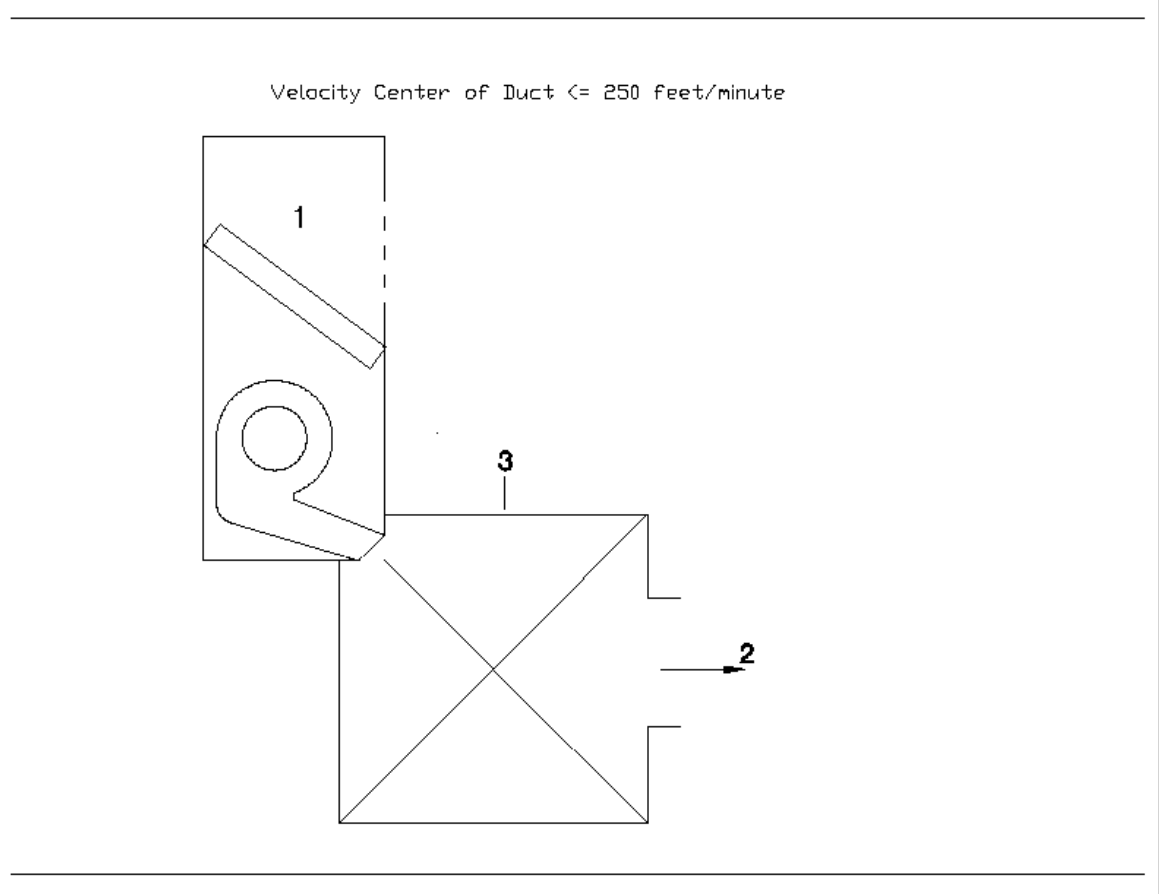


Figure D4. Setup for Wall Mounted Indoor Units
1 – Indoor Unit, 2 – Duct Outlet, 3 – Transition Duct

Note: This addendum is not currently ANSI approved but will be put through the process to become so.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

ANSI/AHRI STANDARD 1230-2010 WITH ADDENDUM 1,

Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment

March 2011

Addendum 1 (dated February 2011) of ANSI/AHRI Standard 1230-2010, changes AHRI Standard 1230-2010 as follows. The proposal is intended to ensure that the definition of Tested Combination in both the standard and the Operations Manual (OM) are the same.

The following changes have been incorporated (additions are shown by shading and deletions are shown by ~~strikethroughs~~) into Paragraph 3.25 of the already published 2010 version of ANSI/AHRI Standard 1230-2010.

The changes include:

3.25 *Tested Combination.* A sample basic model comprised of units that are production units, or are representative of production units, of the basic model being tested. The Tested Combination shall have the following features:

a. The basic model of a variable refrigerant flow system ("VRF system") used as a Tested Combination shall consist of an outdoor unit (an outdoor unit can include multiple outdoor units that have been manifolded into a single refrigeration system, with a specific model number) that is matched with between 2 and ~~5~~ 12 indoor units. ~~(for systems with nominal cooling capacities greater than 150,000 Btu/h [43,846 W], the number of indoor units may be as high as 8 to be able to test non-ducted indoor unit combinations)~~

b. The indoor units shall:

b.1 Represent the highest sales model family as determined by type of indoor unit e.g. ceiling cassette, wall-mounted, ceiling concealed. etc. ~~If 5 are insufficient to reach capacity another model family can be used for testing.~~

Note: This addendum is not currently ANSI approved but will be put through the process to become so.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

IMPORTANT

SAFETY DISCLAIMER

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk.

~~Important Note:~~

~~Until AHRI Standard 1230 is approved by DOE,VRF multi-split air-cooled air-conditioners and heat pumps, below 65,000 Btu/h [19,000 W] shall be rated in accordance with ARI Standard 210/240-2008.~~

~~Applicability~~

~~Integrated Energy Efficiency Ratio (IEER) is effective beginning January 1, 2010. Integrated Part-Load Value is in effect until January 1, 2010. On January 1, 2010, IEER will supersede IPLV.~~

AHRI CERTIFICATION PROGRAM PROVISIONS

Scope of the Certification Program

The Certification Program includes all Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning, ~~and~~ Heat Pump, and Heat Recovery Equipment rated at AHRI Standard Rating Conditions ~~(Cooling)~~.

Certified Ratings

The following Certification Program ratings are verified by test:

Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment

a. For VRF Multi-Split Air-Conditioners < 65,000 Btu/h [19,000 W]

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Seasonal Energy Efficiency Ratio, SEER, Btu/(W·h)
3. Energy Efficiency Ratio, EER, Btu/(W·h)

b. For VRF Multi-Split Air-Conditioners ≥ 65,000 Btu/h [19,000 W]

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Energy Efficiency Ratio, EER, Btu/(W·h)
3. Integrated Energy Efficiency Ratio, IEER ~~(Integrated Part-Load Value, IPLV is Superseded by IEER January 1, 2010)~~

c. For VRF Multi-Split Heat Pumps < 65,000 Btu/h [19,000 W]

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Seasonal Energy Efficiency Ratio, SEER, Btu/(W·h)
3. Energy Efficiency Ratio, EER, Btu/(W·h)
4. High Temperature Heating Standard Rating Capacity, Btu/h [W]
5. Region IV Heating Seasonal Performance Factor, HSPF, Minimum Design Heating Requirement, Btu/(W·h)

d. For VRF Multi-Split Heat Pumps ≥ 65,000 Btu/h [19,000 W]

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Energy Efficiency Ratio, EER, Btu/(W·h)
3. Integrated Energy Efficiency Ratio, ~~IEER (Integrated Part Load Value, IPLV is superseded by IEER January 1, 2010)~~
4. High Temperature Heating Standard Rating Capacity, Btu/h [W]
5. High Temperature Coefficient of Performance, COP
6. Low Temperature Heating Standard Rating Capacity, Btu/h [W]
7. Low Temperature Coefficient of Performance, COP

e. For VRF Multi-Split Heat Recovery Heat Pumps

1. Ratings Appropriate in (c) and (d) above
2. Simultaneous Cooling and Heating Efficiency (SCHE) (50% heating/50% cooling).

f. For VRF Multi-Split Heat Pump Systems that Use a Water Source for Heat Rejection

1. Standard Rating Cooling Capacity, Btu/h [W]
2. Energy Efficiency Ratio, EER, Btu/(W·h)
3. Integrated Energy Efficiency Ratio, IEER ~~(Integrated Part Load Value, IPLV is Superseded by IEER January 1, 2010)~~
4. Heating Standard Rating Capacity, Btu/h [W]
5. Heating Coefficient of Performance, COP
6. Simultaneous Cooling and Heating Efficiency (SCHE) (50% heating/50% cooling)(Heat Recovery models only)

Conformance to the requirements of the Maximum Operating Conditions Test, Voltage Tolerance Test, Low-Temperature Operation Test (Cooling), Insulation Effectiveness Test (Cooling), and Condensate Disposal Test (Cooling), as outlined in Section 8, are also verified by test.

Note:
This is a new standard.

Price $10.00 (M) $20.00 (NM)
Printed in U.S.A.

©Copyright 2010, by Air-Conditioning, Heating and Refrigeration Institute
Registered United States Patent and Trademark Office

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

TABLE OF CONTENTS

SECTION		PAGE
Section 1.	Purpose	1
Section 2.	Scope	1
Section 3.	Definitions	1
Section 4.	Classifications	5
Section 5.	Test Requirements	6
Section 6.	Rating Requirements	7
Section 7.	Minimum Data Requirements for Published Ratings	27
Section 8.	Operating Requirements	28
Section 9.	Marking and Nameplate Data	38
Section 10.	Conformance Conditions	39

LIST OF TABLES

TABLE		PAGE
Table 1	Classification of VRF Multi-Split Systems	5
Table 2	Values of Standard Capacity Ratings	8
Table 3	Piping Requirements for Tested Combinations Installation	13
Table 4	Refrigerant Line Length Correction Factors	13
Table 5	Cooling Mode Test Conditions for Units < 65,000 Btu/h [19,000 W]	15
Table 6	Heating Mode Test Conditions for Units < 65,000 Btu/h [19,000 W]	16
Table 7	Conditions for Operating Requirement Tests for Air-cooled Equipment < 65,000 Btu/h [19,000 W]	17
Table 8	Minimum External Static Pressure for Ducted Systems Tested with External Static Pressure > 0 [in H20]	17

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 9 Operating Conditions for Standard Rating and Performance Operating Tests for Systems ≥ 65,000 Btu/h [19,000W] 19

Table 10 Test Conditions for the Determination of Cooling Capacity for Systems that Use a Water Source for Heat Rejection 21

Table 11 Test Conditions for the Determination of Heating Capacity for Systems that Use a Water Source for Heat Rejection 22

Table 12 IEER Part-Load Rating Conditions 23

Table 13 Uncertainty Allowances 27

Table 14 Maximum Cooling Test Conditions for Systems that Use a Water Source for Heat Rejection 33

Table 15 Maximum Heating Test Conditions for Systems that Use a Water Source for Heat Rejection 34

Table 16 Minimum Cooling Test Conditions for Systems that Use a Water Source for Heat Rejection 34

Table 17 Minimum Heating Test Conditions for Systems that Use a Water Source for Heat Rejection 35

Table 18 Enclosure Sweat and Condensate Test Conditions for Systems that Use a Water Source for Heat Rejection 35

Table 19 Uncertainties of Measurement for Indicated Values 36

Table 20 Variations Allowed in Capacity Test Readings 37

Table 21 Variations Allowed in Performance Test Readings 37

Table 22 Simultaneous Heating and Cooling Test Conditions 38

LIST OF FIGURES

FIGURE PAGE

Figure 1 Test Room Layout 14

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

APPENDICES

APPENDIX		PAGE
Appendix A	References – Normative	40
Appendix B	References – Informative	40
Appendix C	Uniform Test Method for Measuring the Energy Consumption of Central Air Conditioners and Heat Pumps – Normative	41
	Appendix M to Subpart B of Part 430 – Uniform Test Method for Measuring the Energy Consumption of Central Air Conditioners and Heat Pumps	41
Appendix D	Test Requirements – Normative	128
Appendix E	Heat Recovery Test Method – Normative	151
Appendix F	Individual Indoor Unit Capacity Tests – Normative	163
Appendix G	Prescriptive Methodology for the Cyclic Testing Of Ducted Systems – Normative	171
Appendix H	Integrated Part-Load Values (IPLV) – Normative	176

TABLES FOR APPENDICES

TABLE		PAGE
Table D1	Sizes of Calorimeter	134
Table D2	Variations Allowed During Steady State Cooling and Heating Capacity Tests That Only Apply When Using the Indoor Air Enthalpy Method	140
Table D3	Variations Allowed During the Transient Heating Tests That Only Apply When Using The Indoor Air Enthalpy Test Method	140
Table E1	Simultaneous Heating and Cooling Test Conditions	151
Table E2	Variations Allowed During Steady State Cooling And Heating Capacity Tests That Only Apply When Using The Indoor Air Enthalpy Method	153
Table E3	Variations Allowed During The Transient Heating Tests That Only Apply When Using The Indoor Air Enthalpy Test Method	153
Table E4	Data To Be Recorded During The Indoor Air-Enthalpy Capacity Tests	160
Table E5	Data To Be Recorded For Calorimeter Cooling Capacity Tests	160

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table E6 Data To Be Recorded For Calorimeter Heating Capacity Tests 161
Table E7 Cooling Capacity Test Conditions 162
Table F1 Pressure Requirement for Comfort Air Conditioners 164
Table F2 Cooling Capacity Test Conditions 164
Table F3 Voltages for Capacity and Performance Tests 164
Table F4 Variations Allowed In Heating Capacity Tests When Using T Transient ("T") Test Procedure 170
Table H1 Example IPLV Calculation (I-P UNITS) 179

FIGURES FOR APPENDICES

FIGURE PAGE

Figure D1 External Static Pressure Measurement 129
Figure D2 External Static Pressure Measurements 130
Figure D3 Air Static Pressure Drop Measurement for a Coil-Onlay Unit 131
Figure D4 Setup for Wall Mounted Indoor Units 133
Figure D5 Typical Calibrated Room-Type Calorimeter 135
Figure D6 Typical Balanced Ambient Room-Type Calorimeter 136
Figure D7 Calorimeter Energy Flows During Cooling Capacity Tests 137
Figure D8 Calorimeter Energy Flows During Heating Capacity Tests 139
Figure D9 Discharge Chamber Requirements When Using the Indoor Air Enthalpy Test Method for Non-Ducted Unit 141
Figure D10 Tunnel Air-Enthalpy Method 143
Figure D11 Loop Air-Enthalpy Test Method Arrangement 144
Figure D12 Calorimeter Air-Enthalpy Test Method Arrangement 145
Figure D13 Airflow Measuring Apparatus 146
Figure D14 Airflow Measuring Nozzle 149
Figure D15 Pressure-Equalizing Device 150

AVA Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Figure E1 Discharge Chamber Requirements When Using the Indoor Air Enthalpy Test Method for Non Ducted Unit 153

Figure E2 Tunnel Air Enthalpy Method 155

Figure E3 Loop Air-Enthalpy Test Method Arrangement 156

Figure E4 Calorimeter Air-Enthalpy Test Method Arrangement 157

Figure F1 Flowchart of Selecting ESP for Rating Ducted Indoor Units 167

Figure G1 Tunnel Air Enthalpy Test Method Arrangement 172

Figure G2 Loop Air Enthalpy Test Method Arrangement 173

Figure G3 Calorimeter Air Enthalpy Test Method Arrangement 174

Figure G4 Room Air Enthalpy Test Method Arrangement 175

Figure H1 Part-Load Factor Example 178

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

PERFORMANCE RATING OF VARIABLE REFRIGERANT FLOW (VRF) MULTI-SPLIT AIR-CONDITIONING AND HEAT PUMP EQUIPMENT

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish for Variable Refrigerant Flow (VRF) Multi-Split Air Conditioners and Heat Pumps: definitions; classifications; test requirements; rating requirements; minimum data requirements for Published Ratings; operating requirements; marking and nameplate data; and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 This standard covers matched variable refrigerant flow Multi-Split Air Conditioners and Multi-Split Heat Pumps using distributed refrigerant technology as defined in Section 3. ~~with cooling and heating capacities for outdoor units from 12,000 Btu/h [3508 W] to 300,000 Btu/h [90,000 W] and indoor units from 5,000 Btu/h [1,000W] to 60,000 Btu/h [20,000 W]. Each indoor unit is designed to condition a single zone.~~

2.2 This standard applies to variable refrigerant flow multi-split systems consisting of the following matched components: a) an outdoor unit with single or multiple compressors or variable capacity compressor or with a variable speed drive; b) indoor unit(s) that have a coil, air movement device intended for single zone air distribution, and a temperature sensing control; and c) a zone temperature control device.

2.3 The multi-split systems covered in this standard are Variable Refrigerant Flow (VRF) Multi-Split Systems and Heat Recovery (VRF) Multi-Split Systems. Included are multi-split, matched system air conditioners and heat pumps irrespective of their type of electric power source, type of refrigeration cycle, or secondary fluid (e.g. air-to-air or water-to-air).

2.4 This standard does not apply to the testing and rating of individual assemblies for separate use. It also does not cover ductless mini-splits (one-to-one split systems) which are covered by AHRI Standard 210/240.

2.5 Energy Source. This standard applies only to electrically operated, vapor compression refrigeration systems.

Note: For the purpose of the remaining clauses, the terms equipment and systems will be used to mean multi-split air-conditioners and/or multi-split heat pumps that are described in Sections 2.1 to 2.5.

Section 3. Definitions

All terms in this document shall follow the standard industry definitions established in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration*, unless otherwise defined in this section.

For the purposes of this Standard, the following definitions apply:

3.1 *Standard Air.* Air weighing 0.075 lb/ft^3 [1.2 kg/m^3] which approximates dry air at 70°F [21°C] and at a barometric pressure of 29.92 in Hg [101.3 kPa].

3.2 *Multi-Split Air-Conditioner.* An encased, factory-made assembly or assemblies designed to be used as permanently installed equipment to provide conditioned air to an enclosed space(s). It includes a prime source of refrigeration for cooling and dehumidification and may optionally include other means for heating, humidifying, circulating and cleaning the air. It

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

normally includes multiple evaporator(s), compressor(s), and condenser(s). Such equipment may be provided in more than one assembly, the separated assemblies of which are intended to be used together.

3.3 *Capacity.*

3.3.1 *Full Capacity*. The capacity of the system when all indoor units and outdoor units are operated in the same mode, at their rated capacity in Btu/h [W].

3.3.2 *Heating Capacity*. The amount of heat the equipment can add to the conditioned space in a defined interval of time in Btu/h [W].

3.3. 3 *Latent Cooling Capacity*. Capacity associated with a change in humidity ratio.

3.3.4 *Sensible Cooling Capacity*. The amount of sensible heat the equipment can remove from the conditioned space in a defined interval of time in Btu/h [W].

3.3.5 *Total Cooling Capacity*. The amount of sensible and latent heat the equipment can remove from the conditioned space in a defined interval of time in Btu/h [W].

3.4 *Coefficient of Performance (COP).* A ratio of the heating capacity in watts [W] to the power input values in watts [W] at any given set of rating conditions expressed in watts/watts [W/W]. For heating *COP*, supplementary resistance heat shall be excluded.

3.5 *Degradation Coefficient (C_D).* The measure of the efficiency loss due to the on/off cycling of the complete system as determined in Appendices C, D and G.

3.6 *Effective Power Input (P_E).* Average electrical power input to the equipment expressed in watts [W] and obtained from:

a) Power input for operation of the compressor
b) Power input to electric heating devices used only for defrosting
c) Power input to all control and safety devices of the equipment
d) Power input to factory installed condensate pumps and
e) Power input for operation of all fans and, if applicable, any water-cooled condenser pump(s).

3.7 *Energy Efficiency Ratio (EER).* A ratio of the Total Cooling Capacity in Btu/h to the power input values in watts [W] at any given set of rating conditions expressed in Btu/W·h.

3.8 *Ground-Water Heat Pump.* Water-to-air heat pump using water pumped from a well, lake, or stream functioning as a heat source/heat sink. The temperature of the water is related to the climatic conditions and may vary from 41º to 77ºF [5° to 25°C] for deep wells.

3.9 *Ground-Loop Heat Pump.* Brine-to-air heat pump using a brine solution circulating through a subsurface piping loop functioning as a heat source/heat sink. The heat exchange loop may be placed in horizontal trenches, vertical bores, or be submerged in a body of surface water. (ANSI/ARI/ASHRAE ISO Standard 13256-1:1998) The temperature of the brine is related to the climatic conditions and may vary from 23º to 104ºF [–5° to 40°C].

3.10 *Multi-Split Heat Pump*. One or more factory-made assemblies designed to be used as permanently installed equipment to take heat from a heat source and deliver it to the conditioned space when heating is desired. It may be constructed to remove heat from the conditioned space and discharge it to a heat sink if cooling and dehumidification are desired from the same equipment. It normally includes multiple indoor conditioning coils, compressor(s), and outdoor coil(s). Such equipment may be provided in more than one assembly, the separated assemblies of which are intended to be used together. The equipment may also provide the functions of cleaning, circulating and humidifying the air.

3.11 *Heating Seasonal Performance Factor (HSPF).* The total heating output of a heat pump, including supplementary electric heat, necessary to achieve building heating requirements during its normal annual usage period for heating divided by the total electric power during the same period, as determined in Appendix C expressed in Btu/[W·h].

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

3.12 *Heating Unit.* A component of a VRF Multi-Split System air conditioner or heat pump that is designed to transfer heat between the refrigerant and the indoor air, and which consists of an indoor coil, a cooling mode expansion device, an air moving device, and a temperature sensing device.

3.13 *Integrated Energy Efficiency Ratio (IEER).* A single number that is a cooling part-load efficiency figure of merit calculated per the method described in Section 6.5.

3.14 *Integrated Part-Load Value (IPLV).* A single number that is a cooling part-load efficiency figure of merit calculated per the method described in Appendix H.

3.15 *Mini-Split Air-Conditioners and Heat Pumps.* Systems that have a single outdoor section and one or more indoor sections. The indoor sections cycle on and off in unison in response to a single indoor thermostat (As defined by DOE, See Appendix C, Paragraph 1.29).

3.16 *Multiple-Split Air-Conditioners and Heat Pumps [a.k.a .Multi-Split Air Conditioners and Heat Pumps]*. Systems that have two or more indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats (As defined by DOE, See Appendix C, Paragraph 1.30).

3.17 *Non-Ducted System*. An air conditioner or heat pump that is designed to be permanently installed equipment and directly heats or cools air within the conditioned space using one or more indoor coils that are mounted on room walls and/or ceilings. The unit may be of a modular design that allows for combining multiple outdoor coils and compressors to create one overall system. Non-ducted systems covered by this test procedure are all split systems.

3.18 *Oil Recovery Mode*. An automatic system operation that returns oil to the compressor crank case when the control system determines oil recovery is needed.

3.19 *Outdoor Unit*. A component of a split-system central air conditioner or heat pump that is designed to transfer heat between refrigerant and air, or refrigerant and water, and which consists of an outdoor coil, compressor(s), an air moving device, and in addition for heat pumps, a heating mode expansion device, reversing valve, and defrost controls.

3.20 *Published Rating.* A statement of the assigned values of those performance characteristics, under stated rating conditions, by which a unit may be chosen to fit its application. These values apply to all systems of like nominal size and type produced by the same manufacturer. As used herein, the term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

3.20.1 *Application Rating.* A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

3.20.2 *Standard Rating.* A rating based on tests performed at Standard Rating Conditions.

3.21 *Seasonal Energy Efficiency Ratio (SEER).* The total cooling of a system covered by this standard with a capacity <65,000 Btu/h [19,000 W] during its normal usage period for cooling (not to exceed 12 months) divided by the total electric energy input during the same period as determined in Appendix C, expressed in Btu/[W·h].

3.22 *"Shall" or "Should"*. "Shall" or "should" shall be interpreted as follows:

3.22.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.22.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.23 *Small-duct, High-velocity System.* A heating and/or cooling product that contains a blower and indoor coil combination that is designed for, and produces, at least 1.2 in H_2O [300 Pa] of external static pressure when operated at the certified air volume rate of 220-350 cfm [0.104 – 0.165 m^3/s] per rated ton of cooling. When applied in the field, small-duct products use high-velocity room outlets (i.e., generally greater than 1,000 fpm [5 m/s]) having less than 6.0 in^2 [3,900 mm^2] of free area.

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

3.24 *Simultaneous Cooling and Heating Efficiency (SCHE).* The ratio of the total capacity of the system (heating and cooling capacity) to the effective power when operating in the heat recovery mode. (Where SCHE is stated without an indication of units, it shall be understood that it is expressed in Btu/[W·h].)

3.25 *System Controls.* The following items characterize system controls:

a. An integral network operations and communications system with sensors to monitor and forecast the status of items such as temperature, pressure, oil, refrigerant levels and fan speed.

b. A micro-processor, algorithm-based control scheme to: (1) communicate with an optimally managed variable capacity compressor, fan speed of indoor units, fan speed of the outdoor unit, solenoids, various accessories; (2) manage metering devices; and (3) concurrently operate various parts of the system.

c. These controls optimize system efficiency and refrigerant flow through an engineered distributed refrigerant system to conduct zoning operations, matching capacity to the load in each of the zones.

3.26 *Tested Combination.* A sample basic model comprised of units that are production units, or are representative of production units, of the basic model being tested. The tested combination shall have the following features:

a. The basic model of a variable refrigerant flow system ("VRF system") used as a Tested Combination shall consist of an outdoor unit (an outdoor unit can include multiple outdoor units that have been manifolded into a single refrigeration system, with a specific model number) that is matched with between 2 and ~~5~~ 12 indoor units. ~~(for systems with nominal cooling capacities greater than 150,000 Btu/h [43,846 W], the number of indoor units may be as high as 8 to be able to test non-ducted indoor unit combinations).~~

b. The indoor units shall:

b.1 Represent the highest sales model family as determined by type of indoor unit e.g. ceiling cassette, wall-mounted, ceiling concealed. etc. ~~If 5 are insufficient to reach capacity another model family can be used for testing.~~

b.2 Together, have a nominal cooling capacity between 95% and 105% of the nominal cooling capacity of the outdoor unit.

b.3 Not, individually, have a nominal cooling capacity greater than 50% of the nominal cooling capacity of the outdoor unit, unless the nominal cooling capacity of the outdoor unit is 24,000 Btu/h [7016 W] or less.

b.4 Have a fan speed that is consistent with the manufacturer's specifications.

b.5 All be subject to the same minimum external static pressure requirement while being configurable to produce the same static pressure at the exit of each outlet plenum when manifolded as per section 2.4.1 of 10 CFR Part 430, Subpart B, Appendix M.

3.27 *Variable Refrigerant Flow (VRF) System.* An engineered direct exchange (DX) multi-split system incorporating at least one variable capacity compressor distributing refrigerant through a piping network to multiple indoor fan coil units each capable of individual zone temperature control, through proprietary zone temperature control devices and common communications network. Variable refrigerant flow implies three or more steps of control on common, inter-connecting piping.

3.28 *VRF Multi-Split System.* 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 alternative compressor combination for varying the capacity of the system by three or more steps, multiple indoor fan coil units, each of which is individually metered and individually controlled by a proprietary control device and common communications network. The system shall be capable of operating either as an air conditioner or a heat pump. Variable refrigerant flow implies three or more steps of control on common, inter-connecting piping.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

3.29 *VRF Heat Recovery Multi-Split System*. 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, multiple indoor fan coil units, each of which is individually metered and individually controlled by a proprietary control device and common communications network. This system is capable of operating as an air-conditioner or as a heat pump. The system is also capable of providing simultaneous heating and cooling operation, where recovered energy from the indoor units operating in one mode can be transferred to one or more other indoor units operating in the other mode. Variable refrigerant flow implies 3 or more steps of control on common, inter-connecting piping.

Note: This may be achieved by a gas/liquid separator or a third line in the refrigeration circuit.

3.30 *Water-To-Air Heat Pump and/or Brine-to-Air Heat Pump.* A heat pump which consists of one or more factory-made assemblies which normally include an indoor conditioning coil with air-moving means, compressor(s), and refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to provide both cooling and heating, cooling-only, or heating-only functions. When such equipment is provided in more than one assembly, the separated assemblies should be designed to be used together. Such equipment may also provide functions of sanitary water heating, air cleaning, dehumidifying, and humidifying.

3.31 *Water Loop Heat Pump.* Water-to-air heat pump using liquid circulating in a common piping loop functioning as a heat source/heat sink. The temperature of the liquid loop is usually mechanically controlled within a temperature range of 59°F [15°C] to 104°F [40.0°C].

Section 4. Classifications

Equipment covered within the scope of this standard shall be classified as shown in Table 1.

Table 1. Classification of VRF Multi-Split Systems

System Identification / Attribute		VRF Multi-Split Air Conditioner or Heat Pump	VRF Heat Recovery Multi-Split
Refrigerant Circuits		One shared with all indoor units	One shared with all indoor units
Compressors		One or more variable speed or alternative method resulting in three or more steps of capacity.	One or more variable speed or alternative method resulting in three or more steps of capacity.
Indoor Units	Qty.	Greater than one indoor unit	
	Operation	Individual Zones/Temp	Individual Zones/Temp
Outdoor Unit(s)	Qty.	One or multiple-manifolded outdoor units with a specific model number.	One or multiple-manifolded outdoor units with a specific model number.
	Steps of Control	Three or More	Three or More
	Mode of Operation	A/C, H/P	A/C, H/P, H/R
	Heat Exchanger	One or more circuits of shared refrigerant flow	One or more circuits of shared refrigerant flow
Classification	Air-Conditioner (air-to-air)	MSV-A-CB	
	Air-Conditioner (water-to-air)	MSV-W-CB	
	Heat Pump (air-to-air)	HMSV-A-CB	HMSR-A-CB
	Heat Pump (water-to-air)	HMSV-W-CB	HMSR-W-CB

Notes:
1)A suffix of "-O" following any of the above classifications indicates equipment not intended for use with field-installed duct systems (6.1.5.1.2).
2) A suffix of "-A" indicates air-cooled condenser and "-W" indicates water-cooled condenser.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

3) For the purposes of the tested combination definition, when two or more outdoor units are connected, they will be considered as one outdoor unit.

Section 5. Test Requirements

5.1 All Standard Ratings shall be ~~verified by tests conducted in accordance with the test methods and procedures as described in this standard and its appendices.~~ generated either by a) tests conducted per Section 5.2 and in accordance with the test methods and procedures as described in the rest of this standard and its appendices, or b) an Alternative Efficiency Determination Method (AEDM) per Section 5.3.

5.1.1 Air-cooled, water-cooled and evaporative-cooled units shall be tested in accordance with ANSI/ASHRAE Standard 37 and with Appendices C and D.

5.1.2 To set up equipment for test which incorporates inverter-controlled compressors, ~~skilled~~ manufacturer authorized personnel with knowledge of the control software will be required

5.1.3 If the equipment cannot be maintained at steady state conditions by its normal controls, then the manufacturer shall modify or over-ride such controls so that steady state conditions are achieved.

5.1.4 If a manufacturer indicates that its system is designed to recover oil more frequently than every two hours of continuous operation, the Oil Recovery Mode shall be activated during testing. In all other cases, this mode should be disabled during testing.

~~**5.2** *Number of Tests to be Conducted.*~~

~~**5.2.1** Multi-split manufacturers must test two or more combinations of indoor units with each outdoor unit:~~

~~**5.2.1.1** The first system combination shall be tested using only non-ducted indoor units that meet the definition of a Tested Combination. The rating given to any untested multi-split system combination having the same outdoor unit and all non-ducted indoor units shall be set equal to the rating of the tested system having all non-ducted indoor units.~~

~~**5.2.1.2** The second system combination shall be tested using only ducted indoor units that meet the definition of a Tested Combination. The rating given to any untested multi-split system combination having the same outdoor unit and all ducted indoor units shall be set equal to the rating of the tested system having all ducted indoor units. In order to be considered a ducted unit, the indoor unit must be intended to be connected with ductwork and have a rated external static pressure capability greater than zero (0).~~

~~**5.2.2** The rating given to any untested multi-split system combination having the same outdoor unit and a mix of non-ducted and ducted indoor units shall be set equal to the average of the ratings for the two required tested combinations.~~

5.2 *Ratings Determined by Testing*.

5.2.1 For manufacturers that offer either only non-ducted combinations or only ducted combinations, ratings shall be determined by testing at least two complete system samples of the same combination of indoor units.

5.2.1.1 For any system combinations using only non-ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same Outdoor Unit and all non-ducted indoor units shall be set equal to the rating of the tested system having all non-ducted indoor units.

5.2.1.2 For any system combinations using only ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same Outdoor Unit and all ducted indoor units shall be set equal to the rating of the tested system having all ducted indoor units. In order to be considered a ducted unit, the indoor unit must be intended to be connected with ductwork and have a rated external static pressure capability greater than zero.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

5.2.2 For manufacturers that offer both non-ducted combinations and ducted combinations, ratings must be determined by testing two or more combinations of indoor units with each outdoor unit with one combination consisting of only non-ducted indoor units and the second consisting of only ducted indoor units.

5.2.2.1 For any system combinations using only non-ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same Outdoor Unit and all non-ducted indoor units shall be set equal to the rating of the tested system having all non-ducted indoor units.

5.2.2.2 For any system combinations using only ducted indoor units that meet the definition of a Tested Combination, the rating given to any untested multi-split system combination having the same Outdoor Unit and all ducted indoor units shall be set equal to the rating of the tested system having all ducted indoor units. In order to be considered a ducted unit, the indoor unit must be intended to be connected with ductwork and have a rated external static pressure capability greater than zero.

5.2.2.3 The rating given to any untested multi-split system combination having the same Outdoor Unit and a mix of non-ducted and ducted indoor units shall be set equal to the average of the ratings for the two required tested combinations.

5.3 *Ratings Determined by an* Alternative Efficiency Determination Method (AEDM).

5.3.1 A manufacturer may choose to rate its products via an AEDM that is in compliance with DOE requirements specified in 10 CFR 429.70.

Section 6. Rating Requirements

6.1 *Standard Ratings.* Standard Ratings shall be established at the Standard Rating Conditions specified in 6.1.3.

Air-cooled Multi-Split Air Conditioner and Heat Pumps <65,000 Btu/h [19,000W] shall be rated at conditions specified in Section 6.2, in Tables 5, 6, and 7.

Air-cooled Multi-Split Air Conditioners and Heat Pumps and evaporatively and water-cooled air-conditioning-only systems ≥65,000 Btu/h shall be rated at conditions specified in 6.3 and Table 9.

Multi-Split Heat Pump that use a water-source for heat rejection shall be rated at conditions specified in Section 6.4 and Tables 10 and 11.

If a non-ducted or ducted indoor unit contains an integral condensate pump, the power to operate the pump shall be included in the system total power calculation.

Standard Ratings relating to cooling or heating capacities shall be net values, including the effects of circulating-fan heat, but not including supplementary heat. Power input shall be the sum of power input to the compressor(s) and fan(s), plus controls and other items required as part of the system for normal operation.

Standard Ratings of water-cooled units from 65,000~~ to below 300,000~~ Btu/h [19,000~~ to 88,000~~ W] and above shall include a total allowance for cooling tower fan motor and circulating water pump motor power inputs to be added in the amount of 10.0 W per 1000 Btu/h [34.1 W per 1000 W] Cooling Capacity.

6.1.1 *Values of Standard Capacity Ratings.* These ratings shall be expressed only in terms of Btu/h [W] as shown:

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 2. Values of Standard Capacity Ratings	
Capacity Ratings, Btu/h [W]	Multiples, Btu/h [W]
< 20,000 [5,900]	100 [30]
≥ 20,000 and < 38,000 [5,900 up to 11,000]	200 [60]
≥ 38,000 and < 65,000 [11,000 up to 19,000]	500 [150]
≥65,000 and < 135,000 [19,000 up to 39,600]	1000 [300]
≥ 135,000 ~~136,000 and < 300,000~~ [39,800 ~~up to 88,000~~]	2000 [600]

6.1.2 *Values of Energy Efficiency.*

6.1.2.1 *For Systems < 65,000 Btu/h [19,000W]; Values of Measures of Energy Efficiency.* Standard measures of energy efficiency, whenever published, shall be expressed in multiples of the nearest 0.05 Btu/(W·h) for EER, SEER and HSPF.

6.1.2.2 *For Systems ≥ 65,000 Btu/h [19,000W]; Values of Measures of Energy Efficiency.* Energy Efficiency Ratios (EER), and Integrated Energy Efficiency Ratios (IEER) [Integrated Part-Load Values (IPLV)] for cooling, whenever published shall be expressed in multiples of the nearest 0.1 Btu/W·h [0.03 W/W]. Coefficients of Performance (COP) shall be expressed in multiples of the nearest 0.01.

6.1.3 *Standard Rating Tests.* Tables 5 - 11 indicate the test and test conditions which are required to determine values of Standard Capacity ratings and measures of energy efficiency.

6.1.3.1 *For Systems < 65,000 Btu/h [19,000W]; Assigned Degradation Factor.* In lieu of conducting the heating or cooling cycling test, an assigned value of 0.25 may be used for either the cooling or heating Degradation Coefficient, C_D, or both.

6.1.3.2 *Electrical Conditions.* Standard rating tests shall be performed at the nameplate rated frequency. For equipment which is rated with 208/230 V dual nameplate voltages, standard rating tests shall be performed at 230 V. For all other dual nameplate voltage equipment covered by this standard, the standard rating tests shall be performed at both voltages or at the lower of the two voltages if only a single Standard Rating is to be published.

6.1.4 *Control of System and Indoor Units.* The manufacturer must provide a schematic and sequence of operation for providing control of the system during testing.

6.1.5 *Airflow Requirements for Systems with Capacities <65,000 Btu/h [19,000 W]*. Air volume rate is equivalent to air flow rates, volumetric air flow rate and may be used interchangeably.

6.1.5.1 *Cooling Full-Load Air Volume Rate.*

6.1.5.1.1. *Cooling Full-Load Air Volume Rate for Ducted Units*. The manufacturer must specify the cooling air volume rate. Use this value as long as the following two requirements are satisfied. First, when conducting the A_2 test (exclusively), the measured air volume rate, when divided by the measured indoor air-side total Cooling Capacity, must not exceed 37.5 scfm per 1,000 Btu/h [0.06 m^3/s per 1,000 W]. If this ratio is exceeded, reduce the air volume rate until this ratio is equaled. Use this reduced air volume rate for all tests that call for using the Cooling Full-load Air Volume Rate. The second requirement is as follows:

a. For all ducted units tested with an indoor fan installed, except those having a variable-speed, constant-air-volume-rate indoor fan. The second requirement applies exclusively to the A_2 test and is met as follows.

1. Achieve the cooling full-load air volume rate, determined in accordance with the previous paragraph;

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

2. Measure the external static pressure;

3. If this pressure is equal to or greater than the applicable minimum external static pressure cited in Table 8, this second requirement is satisfied. Use the current air volume rate for all tests that require the Cooling Full-load Air Volume Rate.

4. If the Table 8 minimum is not equaled or exceeded,

   4a. reduce the air volume rate until the applicable Table 8 minimum is equaled, or

   4b. until the measured air volume rate equals 95 percent of the air volume rate from step 1, whichever occurs first.

5. If the conditions of step 4a occur first, this second requirement is satisfied. Use the step 4a reduced air volume rate for all tests that require the cooling full-load air volume rate.

6. If the conditions of step 4b occur first, make an incremental change to the set-up of the indoor fan (e.g., next highest fan motor pin setting, next highest fan motor speed) and repeat the evaluation process beginning at above step 1. If the indoor fan set-up cannot be further changed, reduce the air volume rate until the applicable Table 8 minimum is equaled. Use this reduced air volume rate for all tests that require the cooling full-load air volume rate.

b. For ducted units that are tested with a variable-speed, constant-air-volume-rate indoor fan installed. For all tests that specify the cooling full-load air volume rate, obtain an external static pressure as close to (but not less than) the applicable Table 8 value that does not cause instability or an automatic shutdown of the indoor blower.

6.1.5.1.2 *Cooling Full-load Air Volume Rate for Non-ducted Units*. For non-ducted units, the Cooling Full-load Air Volume Rate is the air volume rate that results during each test when the unit is operated at an external static pressure of zero in H_2O [zero Pa].

6.1.5.2 *Cooling Minimum Air Volume Rate.*

a. For ducted units that regulate the speed (as opposed to the cfm) of the indoor fan,

$$\text{Cooling Minimum Air Vol. Rate} = \text{Cooling Full-load Air Vol. Rate} \times \frac{\text{Cooling Minimum Fan Speed}}{\text{A}_2 \text{ Test Fan Speed}} \qquad (1)$$

Where "cooling minimum fan speed" corresponds to the fan speed used when operating at the minimum compressor speed. For such systems, obtain the Cooling Minimum Air Volume Rate regardless of the external static pressure.

b. For ducted units that regulate the air volume rate provided by the indoor fan, the manufacturer must specify the cooling minimum air volume rate. For such systems, conduct all tests that specify the cooling minimum air volume rate — (i.e., the B_1, F_1, and G_1 tests) — at an external static pressure that does not cause instability or an automatic shutdown of the indoor blower while being as close to, but not less than,

$$B_1,\ F_1, \text{ and } G_1 \text{ Test } \Delta P_{st} = {}_{st,A_2} \times \left[\frac{\text{Cooling Minimum Air Volume Rate}}{\text{Cooling Full-load Air Volume Rate}}\right]^2 \qquad (2)$$

where $\Delta P_{st,A_2}$ is the applicable Table 8 minimum external static pressure that was targeted during the A_2 (and B_2) test.

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

c. For non-ducted units, the Cooling Minimum Air Volume Rate is the air volume rate that results during each test when the unit operates at an external static pressure of zero in H_2O [zero Pa] and at the indoor fan setting used at minimum compressor speed.

6.1.5.3 *Cooling Intermediate Air Volume Rate.*

a. For ducted units that regulate the speed of the indoor fan,

$$\text{Cooling Intermediate Air Volume Rate} = \text{Cooling Full} - \text{load Air Volume Rate} \times \frac{E_V \text{ Test Fan Speed}}{A_2 \text{ Test Fan Speed}} \quad (3)$$

For such units, obtain the Cooling Intermediate Air Volume Rate regardless of the external static pressure.

b. For ducted units that regulate the air volume rate provided by the indoor fan, the manufacturer must specify the cooling intermediate air volume rate. For such systems, conduct the E_V test at an external static pressure that does not cause instability or an automatic shutdown of the indoor blower while being as close to, but not less than,

$$E_V \text{ Test } \Delta P_{st,A_2} \times \left[\frac{\text{Cooling Intermediate Air Volume Rate}}{\text{Cooling Full} - \text{load Air Volume Rate}} \right]^2 \quad (4)$$

where $\Delta P_{st,A_2}$ is the applicable Table 8 minimum external static pressure that was targeted during the A_2 (and B_2) test.

c. For non-ducted units, the Cooling Intermediate Air Volume Rate is the air volume rate that results when the unit operates at an external static pressure of zero in H_2O [zero Pa] and at the fan speed selected by the controls of the unit for the E_V test conditions.

6.1.5.4 *Heating Full-load Air Volume Rate.*

6.1.5.4.1 *Ducted Heat Pumps where the Heating and Cooling Full-load Air Volume Rates are the Same.*

a. Use the Cooling Full-load Air Volume Rate as the Heating Full-load Air Volume Rate for:

1. Ducted heat pumps that operate at the same indoor fan speed during both the A_2 and the $H1_2$ tests;

2. Ducted heat pumps that regulate fan speed to deliver the same constant air volume rate during both the A_2 and the $H1_2$ tests; and

3. The airflow of all of the individual ducted indoor units must be added together to arrive at the full-load air volume rate

b. For heat pumps that meet the above criteria "1" and "3," no minimum requirements apply to the measured external static pressure. For heat pumps that meet the above criterion "2," test at an external static pressure that does not cause instability or an automatic shutdown of the indoor blower while being as close to, but not less than, the same Table 8 minimum external static pressure as was specified for the A_2 cooling mode test.

6.1.5.4.2 *Ducted Heat Pumps where the Heating and Cooling Full-load Air Volume Rates are Different due to Indoor Fan Operation.*

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

a. For ducted heat pumps that regulate the speed (as opposed to the cfm) of the indoor fan,

$$\text{Heating Full}-\text{load Air Volume Rate} = \text{Cooling Full}-\text{load Air Volume Rate} \times \frac{\text{H1 or H1}_2\text{ Test Fan Speed}}{\text{A or A}_2\text{ Test Fan Speed}} \quad (5)$$

For such heat pumps, obtain the Heating Full-load Air Volume Rate without regard to the external static pressure.

b. For ducted heat pumps that regulate the air volume rate delivered by the indoor fan, the manufacturer must specify the Heating Full-load Air Volume Rate. For such heat pumps, conduct all tests that specify the Heating Full-load Air Volume Rate at an external static pressure that does not cause instability or an automatic shutdown of the indoor blower while being as close to, but not less than,

$$\text{Heating Full}-\text{load } \Delta P_{st} = \text{Cooling Full Load } \Delta P_{st} \left[\frac{\text{Heating Air Volume Rate}}{\text{Cooling Air Volume Rate}}\right]^2 \quad (6)$$

Where the cooling ΔP_{st}, $H1_2$ is the applicable Table 8 minimum external static pressure that was specified for the A_2 test.

6.1.5.4.3 *Non-ducted Heat Pumps, Including Non-ducted Heating-only Heat Pumps.* For non-ducted heat pumps, the Heating Full-load Air Volume Rate is the air volume rate that results during each test when the unit operates at an external static pressure of zero in H_2O [zero Pa].

6.1.5.4.4 *Heating Minimum Air Volume Rate.*

a. For ducted heat pumps that regulate the speed (as opposed to the cfm) of the indoor fan,

$$\text{Heating Minimum Air Volume Rate} = \text{Heating Full}-\text{load Air Volume Rate} \times \left[\frac{\text{Heating Minimum Fan Speed}}{\text{H1}_2\text{ Test Fan Speed}}\right] \quad (7)$$

Where "heating minimum fan speed" corresponds to the lowest fan speed used at any time when operating at the minimum compressor speed (variable-speed system). For such heat pumps, obtain the Heating Minimum Air Volume Rate without regard to the external static pressure.

b. For ducted heat pumps that regulate the air volume rate delivered by the indoor fan, the manufacturer must specify the Heating Minimum Air Volume Rate. For such heat pumps, conduct all tests that specify the heating minimum air volume rate — (i.e., the $H0_1$, $H0C_1$, and $H1_1$ tests) — at an external static pressure that does not cause instability or an automatic shutdown of the indoor blower while being as close to, but not less than,

$$H0_1, H1_1, H2_1, H0C_1 \; \Delta P_{st,H1_2} \times \left[\frac{\text{Heating Minimum Air Volume Rate}}{\text{Heating Full}-\text{load Air Volume Rate}}\right]^2 \quad (8)$$

Where $\Delta P_{st,H1_2}$ is the minimum external static pressure that was targeted during the $H1_2$ test.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

c. For non-ducted heat pumps, the Heating Minimum Air Volume Rate is the air volume rate that results during each test when the unit operates at an external static pressure of zero in H_2O [zero Pa] and at the indoor fan setting used at minimum compressor speed.

6.1.5.4.5 *Heating Intermediate Air Volume Rate.*

a. For ducted heat pumps that regulate the speed of the indoor fan,

$$\text{Heating Intermediate Air Volume Rate} = \text{Heating } \textit{Full-load} \text{ Air Volume Rate} \times \frac{H2_V \text{ Test Fan Speed}}{H1_2 \text{ Test Fan Speed}} \quad (9)$$

For such heat pumps, obtain the Heating Intermediate Air Volume Rate without regard to the external static pressure.

b. For ducted heat pumps that regulate the air volume rate delivered by the indoor fan, the manufacturer must specify the Heating Intermediate Air Volume Rate. For such heat pumps, conduct the $H2_V$ test at an external static pressure that does not cause instability or an automatic shutdown of the indoor blower while being as close to, but not less than,

$$H2_V \text{ Test } \Delta P_{st,H1_2} = \left[\frac{\text{Heating Intermediate Air Volume Rate}}{\text{Heating } \textit{Full-load} \text{ Air Volume Rate}}\right]^2 \quad (10)$$

Where $\Delta P_{st,H1_2}$ is the minimum external static pressure that was specified for the $H1_2$ test.

c. For non-ducted heat pumps, the Heating Intermediate Air Volume Rate is the air volume rate that results when the heat pump operates at an external static pressure of zero in H_2O [zero Pa] and at the fan speed selected by the controls of the unit for the $H2_V$ test conditions.

6.1.5.4.6 *Heating Nominal Air Volume Rate*. Except for the noted changes, determine the Heating Nominal Air Volume Rate using the approach described in section 6.1.5.4.5. Required changes include substituting "$H1_N$ test" for "$H2_V$ test" within the first section 6.1.5.4.5 equation, substituting "$H1_N$ test ΔP_{st}" for "$H2_V$ test ΔP_{st}" in the second section 6.1.5.4.5 equation, substituting "$H1_N$ test" for each "$H2_V$ test", and substituting "Heating Nominal Air Volume Rate" for each "Heating Intermediate Air Volume Rate."

$$\text{Heating Intermediate Air Volume Rate} = \text{Heating } \textit{Full-load} \text{ Air Volume Rate} \times \frac{H2_V \text{ Test Fan Speed}}{H1_2 \text{ Test Fan Speed}} \quad (11)$$

$$H1_N \text{ Test } \Delta P_{st} = \Delta P_{st,H1_2} \left[\frac{\text{Heating Nominal Air Volume Rate}}{\text{Heating } \textit{Full-load} \text{ Air Volume Rate}}\right]^2 \quad (12)$$

6.1.6 *Outdoor-Coil Airflow Rate (Applies to all Air-to-Air Systems).* All Standard Ratings shall be determined at the outdoor-coil airflow rate specified by the manufacturer where the fan drive is adjustable. Where the fan drive is non-adjustable, ratings shall be determined at the outdoor-coil airflow rate inherent in the equipment when operated with all of the resistance elements associated with inlets, louvers, and any ductwork and attachments considered by the manufacturer as normal installation practice. Once established, the outdoor coil air circuit of the equipment shall remain unchanged throughout all tests prescribed herein.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

6.1.7 *Requirements for Separated Assemblies (Applies to all Systems).* All standard ratings for equipment in which the condenser and the evaporator are two separate assemblies, as in Types: MSV-A-CB, MSV-W-CB, HMSV-A-CB, HMSV-W-CB, HMSR-A-CB, (See Table 1 Notes) and HMSR-W-CB, shall be obtained with a minimum 25 ft. [7.6 m] of interconnecting tubing length (for one indoor unit with additional length requirements for each additional unit). Refer to Table 3 for minimum total refrigerant tube lengths. Refer to Table 4 for Cooling Capacity correction factors that shall be used when the refrigerant line length exceeds the minimum values provided in Table 3. The complete length of tubing furnished as an integral part of the unit (and not recommended for cutting to length) shall be used in the test procedure, or with 25 ft [7.6 m] of refrigerant path, whichever is greater. At least 10 ft [3.0 m] of the system interconnection tubing shall be exposed to the outside conditions. The line diameters, insulation, installation details, evacuation and charging shall follow the manufacturer's published recommendations. The manufacturer will provide a schematic of the tested combination installation (See Figure 1).

Table 3. Piping Requirements for Tested Combinations
(Piping length from outdoor unit to each indoor unit)

System Capacity	Systems with Non-ducted Indoor Units	Systems with Ducted Indoor Units
0 to <65,000 Btu (0 to <10,950 W)	25' (7.6 m)	25' (7.6 m)
≥65,000 Btu to <105,000 Btu (≥10,950 W to <30,800 W)	50' (15.5 m)	25' (7.6 m)
≥106,000 Btu to <134,000 Btu (≥31,100 W to <39,300 W)	75' (23 m)	25' (7.6 m)
≥135,000 Btu to <350,000 Btu (≥40,000 W to <102,550 W)	100' (30.5 m)	50' (15.5 m)
>350,000 Btu (>102,550 W)	150' (45.7 m)	75' (23 m)

Table 4. Refrigerant Line Length Correction Factors

Piping length beyond the requirement (X), ft [m]	Cooling Capacity Correction Factor
3.3 [1] < X ≤ 20 [6.1]	1.01
20 [6.1] < X ≤ 40 [12.2]	1.02
40 [12.2] < X ≤ 60 [18.3]	1.03
60 [18.3] < X ≤ 80 [24.4]	1.04
80 [24.4] < X ≤ 100 [30.5]	1.05
100 [30.5] < X ≤ 120 [36.6]	1.06

Note: Due to the refrigerant line lengths required in the test setup, a correction factor must be applied to normalize the measured cooling capacity

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

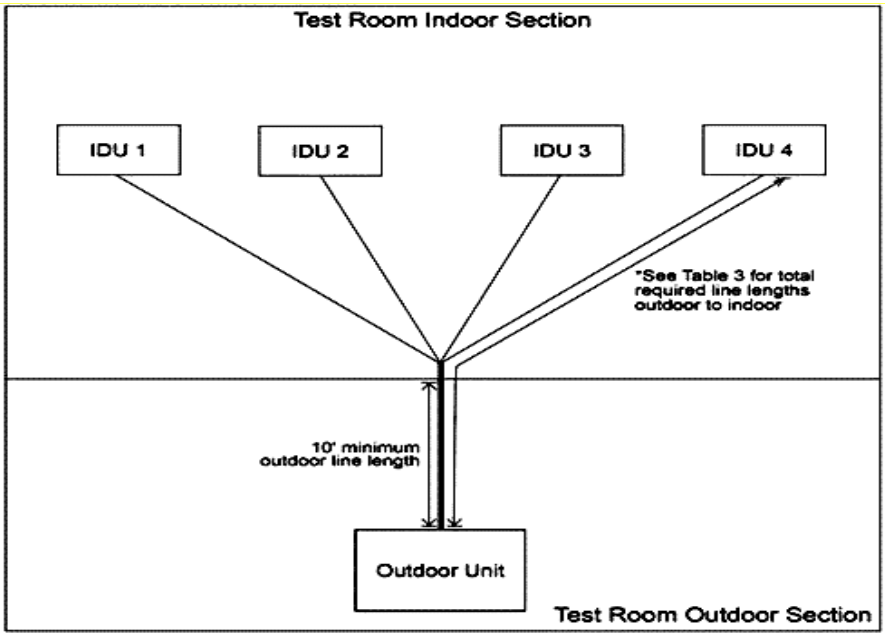


Figure 1. Test Room Layout

6.2 *Conditions for Standard Rating Test for Air-cooled Systems < 65,000 Btu/h [19,000W].*

6.2.1 *Instructions for Multiple Indoor Unit Testing.*

a. At least one indoor unit must be turned off for tests conducted at minimum compressor speed. In addition, the manufacturer may elect to have one or more indoor units turned off for tests conducted at the intermediate compressor speed. In all cases, the manufacturer specifies the particular indoor unit(s) that is turned off.

6.2.2 *Compressor Speed.* The speed at which the compressor runs to deliver the capacity of the tested combination.

6.2.2.1 *Maximum Compressor Speed.* Manufacturers shall designate the maximum compressor speed. The maximum compressor speed for cooling mode tests is a fixed value. The maximum compressor speed for heating mode tests is also a fixed value that may be the same or different from the cooling mode value.

6.2.2.2 *Intermediate Compressor Speed.* For each test manufactures will designate the intermediate compressor speed that falls within ¼ and ¾ of the difference between the minimum and maximum speeds for both cooling and heating.

6.2.2.3 *Minimum Compressor Speed.* Manufacturers shall designate the minimum compressor speed at a steady-state level below which the system would rarely operate. The minimum compressor speed for cooling mode tests is a fixed value. The minimum compressor speed for heating mode tests is also a fixed value that may be the same or different from the cooling mode value.

6.2.3 *Cooling Tests for a Unit Having a Variable-speed Compressor.*

a. Conduct five steady-state wet coil tests: the A_2, E_V, B_2, B_1, and F_1 tests. Use the two optional dry-coil tests, the steady-state G_1 test and the cyclic I_1 test, to determine the cooling mode cyclic degradation coefficient, C_D^c. If the two optional tests are not conducted, assign C_D^c the default value of 0.25.

Table 5 specifies test conditions for these seven tests.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 5. Cooling Mode Test Conditions for Units < 65,000 Btu/h [19,000 W]

Test Description	Air Entering Indoor Unit Temperature		Air Entering Outdoor Unit Temperature		Compressor Speed	Cooling Air Volume Rate
	Dry-Bulb °F [°C]	Wet-Bulb °F [°C]	Dry-Bulb °F [°C]	Wet-Bulb °F [°C]		
A_2 Test - required (steady, wet coil)	80.0 [26.7]	67.0 [19.4]	95.0 [35.0]	75.0[1] [23.9[1]]	Maximum[7]	Cooling Full-load Air Volume Rate[2]
B_2 Test - required (steady, wet coil)	80.0 [26.7]	67.0 [19.4]	82.0 [27.8]	65.0[1] [18.3[1]]	Maximum[7]	Cooling Full-load Air Volume Rate[2]
E_V Test - required (steady, wet coil)	80.0 [26.7]	67.0 [19.4]	87.0 [30.6]	69.0[1] [20.6[1]]	Intermediate[8]	Cooling Intermediate[3]
B_1 Test - required (steady, wet coil)	80.0 [26.7]	67.0 [19.4]	82.0 [27.8]	65.0[1] [18.3[1]]	Minimum[9]	Cooling Minimum[4]
F_1 Test - required (steady, wet coil)	80.0 [26.7]	67.0 [19.4]	67.0 [19.4]	53.5[1] [11.9[1]]	Minimum[9]	Cooling Minimum[4]
G_1 Test[5] - optional (steady, dry coil)	80.0 [26.7]	[6]	67.0 [19.4]	NA	Minimum[9]	Cooling Minimum[4]
I_1 Test[5] - optional (cyclic, dry coil)	80.0 [26.7]	[6]	67.0 [19.4]	NA	Minimum[9]	[6]

Notes:
1) The specified test condition only applies if the unit rejects condensate to the outdoor coil.
2) Defined in Section 6.1.5.1
3) Defined in Section 6.1.5.3
4) Defined in Section 6.1.5.2
5) The entering air must have a low enough moisture content so no condensate forms on the indoor coil. (It is recommended that an indoor wet-bulb temperature of 57.0 °F [13.9 °C] or less be used.)
6) Maintain the airflow nozzles static pressure difference or velocity pressure during the ON period at the same pressure difference or velocity pressure as measured during the G1 Test.
7) Maximum compressor speed is defined in Section 6.2.2.1.
8) Intermediate compressor speed is defined in Section 6.2.2.2.
9) Minimum compressor speed is defined in Section 6.2.2.3.

6.2.4 *Heating Mode Tests for a Heat Pump Having a Variable-speed Compressor.*

a. Conduct one maximum temperature test ($H0_1$), two high temperature tests ($H1_2$ and $H1_1$), one frost accumulation test ($H2_V$), and one low temperature test ($H3_2$). Conducting one or both of the following tests is optional: an additional high temperature test ($H1_N$) and an additional frost accumulation test ($H2_2$). Conduct the optional maximum temperature cyclic ($H0C_1$) test to determine the heating mode cyclic degradation coefficient, C_D^h. If this optional test is not conducted, assign C_D^h the default value of 0.25. Table 6 specifies test conditions for these eight tests.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 6. Heating Mode Test Conditions for Units < 65,000 Btu/h [19,000 W]

Test Description	Air Entering Indoor Unit Temperature		Air Entering Outdoor Unit Temperature		Compressor Speed	Heating Air Volume Rate
	Dry-Bulb °F [°C]	Wet-Bulb (max) °F [°C]	Dry-Bulb °F [°C]	Wet-Bulb °F [°C]		
$H0_1$ Test (required, steady)	70.0 [21.1]	60.0 [15.6]	62.0 [16.7]	56.5 [13.6]	Minimum[6]	Heating Minimum[1]
$H0C_1$ Test (optional, cyclic)	70.0 [21.1]	60.0 [15.6]	62.0 [16.7]	56.5 [13.6]	Minimum[6]	[2]
$H1_2$ Test (required, steady)	70.0 [21.1]	60.0 [15.6]	47.0 [8.3]	43.0 [6.1]	Maximum[8]	Heating Full-load Air Volume Rate[3]
$H1_1$ Test (required, steady)	70.0 [21.1]	60.0 [15.6]	47.0 [8.3]	43.0 [6.1]	Minimum[6]	Heating Minimum[1]
$H1_N$ Test (optional, steady)	70.0 [21.1]	60.0 [15.6]	47.0 [8.3]	43.0 [6.1]	Cooling Mode Maximum[7]	Heating Nominal[4]
$H2_2$ Test (optional)	70.0 [21.1]	60.0 [15.6]	35.0 [1.7]	33.0 [0.6]	Maximum[8]	Heating Full-load Air Volume Rate[3]
$H2_V$ Test (required)	70.0 [21.1]	60.0 [15.6]	35.0 [1.7]	33.0 [0.6]	Intermediate[7]	Heating Intermediate[5]
$H3_2$ Test (required, steady)	70.0 [21.1]	60.0 [15.6]	17.0 [-8.3]	15.0 [-9.4]	Maximum[8]	Heating Full-load Air Volume Rate[3]

NOTES:
1) Defined in Section 6.1.5.4.4
2) Maintain the airflow nozzles static pressure difference or velocity pressure during the ON period at the same pressure difference or velocity pressure as measured during the H01 Test.
3) Defined in Section 6.1.5.4.
4) Defined in Section 6.1.5.4.6.
5) Defined in Section 6.1.5.4.5.
6) Minimum compressor speed is defined in Section 6.2.2.1.
7) Intermediate compressor speed is defined in Section 6.2.2.3.
8) Maximum compressor speed is defined in Section 6.2.2.3.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 7. Conditions for Operating Requirement Tests for Air-Cooled Equipment < 65,000 Btu/h [19,000 W]

Test		Indoor Unit Air Entering Temperature Dry-Bulb °F [°C]	Indoor Unit Air Entering Temperature Wet-Bulb °F [°C]	Outdoor Unit Air Entering Temperature Dry-Bulb °F [°C]	Outdoor Unit Air Entering Temperature Wet-Bulb °F [°C]
Cooling	Voltage Tolerance	80.0 [26.7]	67.0 [19.4]	95.0 [35.0]	75.0[1] [23.9]
	Low Temperature Operation Cooling	67.0 [19.4]	57.0 [13.9]	67.0 [19.4]	57.0[1] [13.9]
	Insulation Efficiency	80.0 [26.7]	75.0 [23.9]	80.0 [26.7]	75.0[1] [23.9]
	Condensate Disposal	80.0 [26.7]	75.0 [23.9]	80.0 [26.7]	75.0[1] [23.9]
	Maximum Operating Conditions	80.0 [26.7]	67.0 [19.4]	115.0 [46.1]	75.0[1] [23.9]
Heating	Voltage Tolerance (Heating-only units)	70.0 [21.1]	60.0 [15.6] (max)	47.0 [8.3]	43.0 [6.1]
	Maximum Operating Conditions	80.0 [26.7]	NA NA	75.0 [23.9]	65.0 [18.3]

Note:

1) The wet-bulb temperature condition is not required when testing air-cooled condensers which do not evaporate condensate.

Table 8. Minimum External Static Pressure for Ducted Systems Tested with External Static Pressure > 0 in H2O

Rated Cooling[1] or Heating[2] Capacity		Minimum External Resistance[3,4] Small-duct High-velocity Systems[5]		All Other Systems	
Btu/h	kW	in H_2O	Pa	in H_2O	Pa
Up through 28,800	6.40 to 8.44	1.10	275	0.10	25
29,000 to 42,500	8.5 to 12.4	1.15	388	0.15	37
43,000 thru 60,000	12.6 thru 19.0	1.20	300	0.20	50

Notes:

1) For air conditioners and heat pumps, the value cited by the manufacturer in published literature for the unit's Capacity when operated at the A2 Test conditions.
2) For heating-only heat pumps, the value the manufacturer cites in published literature for the unit's Capacity when operated at the H12 Test conditions.
3) For ducted units tested without an air filter installed, increase the applicable tabular value by 0.08 in H2O [20 Pa].
4) If the manufacturer's rated external static pressure is less than 0.10 in H2O (25 Pa), then the indoor unit should be tested at that rated external static pressure. (See Section 5.2.1.2)
5) See Definition 1.35 of Appendix C to determine if the equipment qualifies as a Small-duct, High-velocity System.

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

6.3 *Conditions for Standard Rating Test for Air-cooled Air Conditioner and Heat Pump Systems and Water-cooled Air Conditioning Systems ≥ 65,000 Btu/h [19,000W].*

6.3.1 *Indoor-Coil Airflow Rate.* All Standard Ratings shall be determined at an indoor-coil airflow rate as outlined below. All airflow rates shall be expressed in terms of Standard Air.

a. Equipment with indoor fans intended for use with field installed duct systems shall be rated at the manufacturer specified airflow rate (not to exceed 37.5 SCFM per 1000 Btu/h [0.06 m^3/s per 1000 W] of rated capacity) while meeting or exceeding the minimum external resistance specified in Table 6.

b. Equipment with indoor fans not intended for use with field installed duct systems (free discharge) shall be rated at the indoor-side air quantity delivered when operating at zero in H_2O [zero Pa] external pressure.

c. 100% recirculated air shall be used.

d. Equipment which does not incorporate an indoor fan is not covered in this standard.

e. Indoor-coil airflow rates and pressures as referred to herein apply to the airflow rate experienced when the unit is cooling and dehumidifying under the conditions specified in this section. This airflow rate, except as noted in 6.3.1b and 8.8 shall be employed in all other tests prescribed herein without regard to resultant external static pressure.

6.3.2 *External Resistances.* Commercial and Industrial Unitary Air-Conditioners and Heat Pumps shall be tested at the minimum external resistances in Table 8 when delivering the rated capacity and airflow rate specified in Section 6.3.1.

Indoor air-moving equipment not intended for use with field installed duct systems (free discharge) shall be tested at zero in H_20 [zero Pa] external pressure.

6.3.3 *Rating Conditions for Air Conditioning Equipment with Optional Outdoor Air Cooling Coil.* Commercial and Industrial Unitary Air Conditioners which incorporate an outdoor air cooling coil shall use the Standard Rating Conditions (Table 9) for rating except for the following changes:

a. Unit shall be adjusted to take in 20% outdoor air at conditions specified in Table 9.

b. Return air temperature conditions shall be 80.0ºF [27.0ºC] dry-bulb, 67.0ºF [19.0ºC] wet-bulb.

6.3.4 *Outdoor-Coil Airflow Rate (Applies to All Air-to-air Systems).* All Standard Ratings shall be determined at the outdoor-coil airflow rate specified by the manufacturer where the fan drive is adjustable. Where the fan drive is non-adjustable, they shall be determined at the outdoor-coil airflow rate inherent in the equipment when operated with all of the resistance elements associated with inlets, louvers, and any ductwork and attachments considered by the manufacturer as normal installation practice. Once established, the outdoor-side air circuit of the equipment shall remain unchanged throughout all tests prescribed herein unless automatic adjustment of outdoor airflow rates by system function is made.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 9. Operating Conditions for Standard Rating and Performance Operating Tests for Systems ≥ 65,000 Btu/h [19,000 W]

	TEST	Indoor Section		Outdoor Section					
		Air Entering		Air Entering				Water[5]	
				Air Cooled		Evaporative			
		Dry-Bulb °F [°C]	Wet-Bulb °F [°C]	Dry-Bulb °F [°C]	Wet-Bulb °F [°C]	Dry-Bulb °F [°C]	Wet-Bulb °F [°C]	IN °F [°C]	OUT °F [°C]
COOLING	Standard Rating Conditions Cooling[3]	80.0 [26.7]	67.0 [19.4]	95.0 [35.0]	75.0[1] [23.9]	95.0 [35.0]	75.0 [23.9]	85.0 [29.4]	95.0 [35.0]
	Low Temperature Operating Cooling[3]	67.0 [19.4]	57.0 [13.9]	67.0 [19.4]	57.0[1] [13.9]	67.0 [19.4]	57.0 [13.9]	NA	70.0[2] [21.1]
	Maximum Operating Conditions[3]	80.0 [26.7]	67.0 [19.4]	115 [46.1]	75.0[1] [23.9]	100 [37.8]	80.0[4] [26.7]	90.0[2] [32.2]	NA
	Part-Load Conditions (IEER)[3]	80.0 [26.7]	67.0 [19.4]	Varies with load per Table 12	[1]Varies with load per Table 12	Varies with load per Table 12	Varies with load per Table 12	[2]Varies with load per Table 12	Varies with load per Table 12
	Part-Load Conditions (IPLV)[3]	80.0 [26.7]	67.0 [19.4]	80.0 [26.7]	67.0[1] [19.4]	80.0 [26.7]	67.0 [26.7]	75.0[2] [23.9]	NA
	Insulation Efficiency[3]	80.0 [26.7]	75.0 [23.9]	80.0 [26.7]	75.0[1] [23.9]	80.0 [26.7]	75.0 [23.9]	NA	80.0 [26.7]
	Condensate Disposal[3]	80.0 [26.7]	75.0 [23.9]	80.0 [26.7]	75.0[1] [23.9]	80.0 [26.7]	75.0 [23.9]	NA	80.0 [26.7]
HEATING	Standard Rating Conditions (High Temperature Steady State Heating)	70.0 [21.1]	60.0 [15.6] (max)	47.0 [8.3]	43.0 [6.1]	NA	NA	NA	NA
	Standard Rating Conditions (Low Temperature Steady State Heating)	70.0 [21.1]	60.0 [15.6] (max)	17.0 [-8.3]	15.0 [-9.4]	NA	NA	NA	NA
	Maximum Operating Conditions	80.0 [26.7]	NA	75.0 [23.9]	65.0 [18.3]	NA	NA	NA	NA

Notes:

1) The wet-bulb temperature condition is not required when testing air cooled condensers which do not evaporate condensate except for units with optional outdoor cooling coil.
2) Water flow rate as determined from Standard Rating Conditions Test.
3) Cooling rating and operating tests are not required for heating only heat pumps.
4) Make-up water temperature shall be 90.0°F [32.0°C].
5) The ratings for water-cooled outdoor sections in this table apply only to air conditioning-only systems.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

6.4 *Conditions for Standard Rating Tests for Heat Pump Systems that use Water-source for Heat Rejection.*

6.4.1 *Standard Ratings.* Standard ratings shall be established at the standard rating conditions specified in 6.4.8 and Tables 10 and 11. Standard ratings relating to cooling and heating capacities shall be net values, including the effects of circulating- fan heat, but not including supplementary heat. Standard efficiency ratings shall be based on the effective power input as defined in 3.6.

6.4.2 *Power Input of Liquid Pumps.*

6.4.2.1 If no liquid pump is provided with the heat pump, a pump power adjustment is to be included in the effective power consumed by the heat pump, using the following formula:

$$\varphi_{pa} = q \times \Delta p / \eta \quad (13)$$

Where:

φ_{pa} = Pump power adjustment, in watts;
η = 1.59 (gpm)(ft H_2O)(1/W) [0.3×10^3 Liter/s*Pa*(1/W)] by convention;
Δp = Measured internal static pressure difference, (feet H_2O)[pascals];
q Nominal fluid flow rate, in gallons per minute [liters per second].

6.4.2.2 If a liquid pump is an integral part of the heat pump, only the portion of the pump power required to overcome the internal resistance shall be included in the effective power input to the heat pump. The fraction which is to be excluded from the total power consumed by the pump shall be calculated using the following formula:

$$\varphi_{pa} = q \times \Delta p / \eta \quad (14)$$

Where:

φ_{pa} Pump power adjustment, in watts;
η = 1.59 (gpm)(ft H_2O)(1/W) [0.3×10^3] Liter/s*Pa*(1/W)] by convention; See note below.
Δp = The measured external static pressure difference, (feet H_2O)[pascals];
q = Nominal fluid flow rate, in gallons per minute [liters per second].

Note: 0.3×10^3 (L/s)(Pa)(1/W)
= 0.3×10^3 (L/s)(Pa)(1/W)(15.850323 gpm/ (L/s)) (.000334552 ft H_2O/ Pa)
= 1.59 (gpm)(ft H_2O)(1/W)

6.4.3 *Liquid Flow Rates.*

6.4.3.1 All standard ratings shall be determined at a liquid flow rate described below, expressed as gallons per minute (liters per second).

6.4.4 Heat pumps with integral liquid pumps shall be tested at the liquid flow rates specified by the manufacturer or those obtained at zero external static pressure difference, whichever provides the lower liquid flow rate.

6.4.5 Heat pumps without integral liquid pumps shall be tested at the flow rates specified by the manufacturer.

6.4.6 The manufacturer shall specify a single liquid flow rate for all of the tests required in 6.4 unless automatic adjustment of the liquid flow rate is provided by the equipment. A separate control signal output for each step of liquid flow rate will be considered as an automatic adjustment.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

6.4.7 *Test Liquids.*

6.4.7.1 The test liquid for water-loop heat pumps and ground-water heat pumps shall be water.

6.4.7.2 The test liquid for ground-loop heat pumps shall be a 15% solution by mass of sodium chloride in water.

6.4.7.3 The test liquid shall be sufficiently free of gas to ensure that the measured result is not influenced by the presence of gas.

6.4.8 *Standard Rating and Part-load Rating Test Conditions.*

6.4.8.1 The test conditions for the determination of standard and part-load cooling ratings are specified in Table 10.

6.4.8.2 The test conditions for determination of standard and part-load heating ratings are specified in Table 11.

6.4.8.3 Heat pumps intended for a specific application shall be rated at the conditions specified for that application, for example, water-loop, ground-water, or ground-loop, and shall be identified as such (i.e., water-loop heat pump, groundwater heat pump, or ground-loop heat pump). Heat pumps intended for two or three applications shall be rated at the conditions specified for each of these applications and shall be so identified (see 7.3 of ANSI/ARI/ASHRAE ISO Standard 13256-1:1998)

6.4.8.4 For each test, the equipment shall be operated continuously until equilibrium conditions are attained, but for not less than one hour before capacity test data are recorded. The data shall then be recorded for 30 minutes at 5-minutes intervals until seven consecutive sets of readings have been attained within the tolerances specified in 8.13.5. The averages of these data shall be used for the calculation of the test results.

Table 10. Test Conditions for The Determination of Cooling Capacity for Systems that use a Water Source for Heat Rejection

	Water-loop Heat Pumps	Ground-water Heat Pumps	Ground-loop Heat Pumps
Air entering indoor side — dry bulb, °F [°C] — wet bulb, °F [°C]	 80.6 [27.0] 66.2 [19.0]	 80.6 [27.0] 66.2 [19.0]	 80.6 [27.0] 66.2 [19.0]
Air surrounding unit — dry bulb, °F [°C]	 80.6 [27.0]	 80.6 [27.0]	 80.6 [27.0]
Standard Rating Test Liquid entering heat exchanger, °F [°C]	86.0 [30.0]	59.0 [15.0]	77.0 [25.0]
Part Load Rating Test Liquid entering heat exchanger, °F [°C]	86.0 [30.0]	59.0 [15.0]	68.0 [20.0]
Frequency[1]	Rated	Rated	Rated
Voltage[2]	Rated	Rated	Rated

Notes:

1) Equipment with dual-rated frequencies shall be tested at each frequency.
2) Equipment with dual-rated voltages shall be tested at both voltages, or at the lower if the two voltages if only a single rating is published.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 11. Test Conditions for the Determination of Heating Capacity for Systems that use a Water Source for Heat Rejection			
	Water-loop Heat Pumps	Ground-water Heat Pumps	Ground-loop Heat Pumps
Air entering indoor side[1] — dry bulb, °F [°C] — maximum wet bulb, °F [°C]	 68.0 [20.0] 59.0 [15.0]	 68.0 [20.0] 59.0 [15.0]	 68.0 [20.0] 59.0 [15.0]
Air surrounding unit — dry bulb, °F [°C]	 68.0 [20.0]	 68.0 [20.0]	 68.0 [20.0]
Standard Rating Test Liquid entering heat exchanger, °F [°C]	68.0 [20.0]	50.0 [10.0]	32.0 [0]
Part Load Rating Test Liquid entering heat exchanger, °F [°C]	68.0 [20.0]	50.0 [10.0]	41.0 [5.0]
Frequency[1]	Rated	Rated	Rated
Voltage[2]	Rated	Rated	Rated
Notes: 1) Equipment with dual-rated frequencies shall be tested at each frequency. 2) Equipment with dual-rated voltages shall be tested at both voltages, or at the lower if the two voltages if only a single rating is published.			

6.5 *Part-Load Rating.* Integrated Part-Load Value (IPLV) is in effect until January 1, 2010. See Appendix H for the method and calculation of IPLV. Effective January 1, 2010, all units ≥ 65000 Btu/h [19,000W] rated in accordance with this standard shall include an Integrated Energy Efficiency Ratio (IEER).

6.5.1 *Part-load Rating Conditions.* Test conditions for part-load ratings shall be per Table 9. Any water flow required for system function shall be at water flow rates established at (full load) Standard Rating Conditions. Capacity reduction means may be adjusted to obtain the specified step of unloading. No manual adjustment of indoor and outdoor airflow rates from those of the Standard Rating Conditions shall be made. However, automatic adjustment of airflow rates by system function is permissible.

6.5.2 *General.* The IEER is intended to be a measure of merit for the part-load performance of the unit. Each building may have different part-load performance due to local occupancy schedules, building construction, building location and ventilation requirements. For specific building energy analysis an hour-by-hour analysis program should be used.

6.5.3 *Integrated Energy Efficiency Ratio (IEER).* For equipment covered by this standard, the IEER shall be calculated using test derived data and the following formula.

$$IEER = (0.020 \cdot A) + (0.617 \cdot B) + (0.238 \cdot C) + (0.125 \cdot D)$$

Where:

A = EER at 100% net capacity at AHRI standard rating conditions
B = EER at 75% net capacity and reduced ambient (see Table 12)
C = EER at 50% net capacity and reduced ambient (see Table 12)
D = EER at 25% net capacity and reduced ambient (see Table 12)

The IEER rating requires that the unit efficiency be determined at 100%, 75%, 50% and 25% load (net capacity) at the conditions specified in Table 12. If the unit, due to its capacity control logic cannot be operated at the 75%, 50%, or 25% load points, then the 75%, 50%, or 25% EER is determined by plotting the tested EER vs. the percent load and using straight line segments to connect the actual performance points. Linear interpolation is used to determine the EER at 75%, 50% and 25% net capacity. For the interpolation, an actual capacity point equal to or less than the required rating point must be used to plot the curves. Extrapolation of the data is not allowed.

If the unit has a variable indoor airflow rate, the external static pressure shall remain constant at the full load rating point as defined in Table 12, but the airflow rate should be adjusted to maintain the unit leaving dry bulb air

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

temperature measured at the full load rating point.

If the unit cannot be unloaded to the 75%, 50%, or 25% load then the unit should be run at the minimum step of unloading at the condenser conditions defined for each of the rating load points and then the efficiency should be adjusted for cyclic performance using the following equation.

$$EER = \frac{LF \cdot \text{Net Capacity}}{LF \cdot [C_D \cdot (P_C + P_{CF})] + P_{IF} + P_{CT}} \quad (15)$$

Where:

Net Capacity = Measured net capacity at the lowest machine unloading point operating at the desired part load rating condition, indoor measured capacity minus fan heat, Btu/h

P_C = Compressor power at the lowest machine unloading point operating at the desired part load rating condition, watts

P_{CF} = Condenser fan power, if applicable at the minimum step of unloading at the desired part load rating condition, watts

P_{IF} = Indoor fan motor power at the fan speed for the minimum step of capacity, watts

P_{CT} = Control circuit power and any auxiliary loads, watts

C_D = Degradation coefficient to account for cycling of the compressor for capacity less than the minimum step of capacity. C_D should be determined using the following equation.

$$C_D = (-0.13 \cdot LF) + 1.13 \quad (16)$$

Where:

LF = Fractional "on" time for last stage at the desired load point.

$$LF = \frac{\left(\frac{\%Load}{100}\right) \cdot (\text{Full Load Unit Net Capacity})}{\text{Part Load Unit Net Capacity}} \quad (17)$$

%Load = The standard rating point i.e. 75%, 50%, 25%.

Table 12. IEER Part-Load Rating Conditions

Conditions	°F	°C
Indoor Air		
Return Air Dry-Bulb Temperature	80.0	26.7
Return Air Wet-Bulb Temperature	67.0	19.4
Indoor Airflow Rate	Note 1	Note 1
Condenser (Air Cooled)		
Entering Dry-Bulb Temperature Outside Air Temperature (OAT)	For % Load > 44.4%, OAT = 0.54 · % Load + 41 For % Load ≤ 44.4%, OAT = 65.0	For % Load > 44.4%, OAT = 0.30 · % Load + 5.0 For % Load ≤ 44.4%, OAT = 18.3
Condenser Airflow Rate (cfm)	Note 2	Note 2
Condenser (Water Cooled)		
Condenser Entering Water Temperature (EWT)	For % Load > 34.8%, EWT = 0.460 · % LOAD + 39 For % Load ≤ 34.8%, EWT = 55.0	For % Load > 34.8% , EWT = 0.256 · % LOAD + 3.8 For % Load ≤ 34.8%, EWT = 12.8
Condenser Water Flow Rate (gpm)	full load flow	full load flow
Condenser (Evaporatively Cooled)		
Entering Wet-Bulb Temperature (EWB)	For % Load > 36.6%, EWB = 0.35 · % Load + 40 For % Load ≤ 36.6%, EWB = 52.8	For % Load > 36.6%, EWB = 0.19 · % Load + 4.4 For % Load ≤36.6%, EWB = 11.6

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Table 12. IEER Part-Load Rating Conditions

Notes:
1 For fixed speed indoor fans the airflow rate should be held constant at the full load airflow rate. For units using discrete step fan control, the fan speed should be adjusted as specified by the controls.
2 Condenser airflow should be adjusted as required by the unit controls for head pressure control.

6.5.4 *Example Calculations.*

Example 1 - Unit with proportional capacity control and can be run at the 75%, 50%, and 25% rating points and has a fixed speed indoor fan.

Assume that the unit has the following measured capacity:

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W
4	95.0	100	114,730	8,707	650	1,050	100	10.92
3	81.5	75	86,047	5,928	650	1,050	100	11.13
2	68.0	50	57,365	3,740	650	1,050	100	10.35
1	65.0	25	28,682	2,080	650	1,050	100	7.39

Using the measured performance you can then calculate the IEER as follows:

$$IEER = (0.020 \cdot 10.92) + (0.617 \cdot 11.13) + (0.238 \cdot 10.35) + (0.125 \cdot 7.39) = 10.48$$

Example 2 – Unit has a single compressor with a fixed speed indoor fan.

Assume the unit has the following measured capacity:

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER
	(°F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W
1	95.0	100	114,730	8,707	650	1,050	100	10.92
1	81.5	104.8	120,264	7,623	650	1,050	100	12.76
1	68.0	108.6	124,614	6,653	650	1,050	100	14.74
1	65.0	109.1	125,214	6,450	650	1,050	100	15.18

The unit cannot unload to the 75%, 50% or 25% points so tests were run with the compressor on at the ambient temperatures specified for 75%, 50%, and 25%

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER	C_D	LF
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W		
1	95.0	100.0	114,730	8,707	650	1,050	100	10.92		
1	81.5	104.8	120,264	7,623	650	1,050	100	12.76		
		75.0			Adjusted for Cyclic Performance			11.81	1.037	0.715
1	68.0	108.6	124,614	6,653	650	1,050	100	14.74		
		50.0			Adjusted for Cyclic Performance			12.08	1.070	0.460
1	65.0	109.1	125,214	6,450	650	1,050	100	15.18		
		25.0						9.76	1.100	0.229

Calculate the Load Factor (LF) and the C_D factors and then calculate the adjusted performance for the 75%, 50%, and 25% points and then calculate the IEER.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

The following is an example of the C_D calculation for the 50% point:

$$LF = \frac{\left(\frac{50}{100}\right) \cdot 114,730}{124,614} = .460$$

$$C_D = (-0.13 \cdot .460) + 1.13 = 1.070$$

$$EER_{50\%} = \frac{.460 \times 124,614}{.460 \cdot (1.070 \cdot (6,653 + 650)) + 1,050 + 100} = 12.08$$

$$IEER = (0.020 \cdot 10.92) + (0.617 \cdot 11.81) + (0.238 \cdot 12.08) + (0.125 \cdot 9.76) = 11.60$$

Example 3 – Unit has two refrigeration circuits with one compressor in each circuit and two stages of capacity with a fixed speed indoor fan.

Assume the unit has the following measured performance.

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W
2	95.0	100	114,730	8,707	650	1,050	100	10.92
1	71.0	55.5	63,700	3,450	325	1,050	100	12.93
1	68.0	55.9	64,100	3,425	325	1,050	100	13.08
1	65.0	56.1	64,400	3,250	325	1,050	100	13.63

The unit can unload to get to the 75% point, but cannot unload to get to the 50% and 25% points so additional tests are run at the 50% and 25% load ambients with the stage 1 loading.

Calculate the 50% and 25% load factors and C_D factors as shown below.

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER	C_D	LF
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W		
2	95.0	100.0	114,730	8,707	650	1,050	100	10.92		
1	71.0	55.5	63,700	3,450	325	1,050	100	12.93		
		75.0				interpolation		12.05		
1	68.0	55.9	64,100	3,425	325	1,050	100	13.08		
		50.0			Adjusted for Cyclic Performance			12.60	1.014	0.895
1	65.0	56.1	64,400	3,250	325	1,050	100	13.63		
		25.0						10.04	1.072	0.445

Calculate the Load Factor (LF) and the C_D factors and then calculate the adjusted performance for the 75%, 50%, and 25% points and then calculate the IEER:

$$IEER = (0.020 \cdot 10.92) + (0.617 \cdot 12.05) + (0.238 \cdot 12.60) + (0.125 \cdot 10.04) = 11.91$$

Example 4 – Unit has three refrigeration circuits with one compressor in each circuit and three stages of capacity with a fixed speed indoor fan.

Assume the unit has the following measured performance.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W
3	95.0	100.0	114,730	8,707	650	1,050	100	10.92
2	79.5	71.3	81,841	5,125	433	1,050	100	12.20
1	65.0	38.3	43,980	2,250	217	1,050	100	12.16

The stage 1 operates at 38.3% capacity which is above the minimum 25% load point, but because the ambient condition was 65 °F, another test at the 25% load ambient condition is not required as it would be the same test point.

Calculate the IEER which requires interpolation for the 75% and 50% point and the use of the degradation factor for the 25% point.

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER	C_D	LF
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W	NA	NA
3	95.0	100.0	114,730	17,414	1,300	1,050	100	10.92	NA	NA
2	79.5	71.3	81,841	4,950	433	1,050	100	12.53	NA	NA
		75.0				interpolation		12.32	NA	NA
2	79.5	71.3	81,841	4,950	433	1,050	100	12.53	NA	NA
1	65.0	38.3	43,980	2,250	217	1,050	100	12.16	NA	NA
		50.0				interpolation		12.57	NA	NA
1	65.0	38.3	43,980	2,250	217	1,050	100	12.16	NA	NA
		25.0			Adjusted for Cyclic Performance			10.13	1.045	0.652

$$IEER = (0.02 \cdot 10.92) + (0.617 \cdot 12.32) + (0.238 \cdot 12.57) + (0.125 \cdot 10.13) = 12.08$$

Example 5 – Unit is a VAV unit and has 5 stages of capacity and a variable speed indoor.

Assume the unit has the following measured performance.

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W
5	95.0	100.0	229,459	17,414	1,300	2,100	200	10.92
4	85.1	81.7	187,459	11,444	1,300	1,229	150	13.27
3	74.0	61.0	140,064	6,350	1,300	575	150	16.72
2	69.6	52.9	121,366	6,762	650	374	150	15.29
1	65.0	30.6	70,214	2,139	650	85	150	23.2

This unit can unload down to 30.6% so a degradation calculation will be required but because the stage 1 was already run at the lowest ambient and the ambient for the 25% load point no additional tests are required.

Using this data you can then calculate the standard load points.

Stage	Ambient	Actual % Load	Net Cap	Cmpr (P_C)	Cond (P_{CF})	Indoor (P_{IF})	Control (P_{CT})	EER	C_D	LF
	(F)	(Net Cap)	Btu/h	W	W	W	W	Btu/W		
5	95.0	100.0	229,459	17,414	1,300	2,100	200	10.92		
4	85.1	81.7	187,459	11,444	1,300	1,229	150	13.27		
3	74.0	61.0	140,064	6,350	1,300	575	150	16.72		
		75.0					interpolation	14.39		
2	69.6	52.9	121,366	6,762	650	374	150	15.29		
1	65.0	30.6	70,214	2,139	650	85	150	23.22		
		50.0					interpolation	16.32		
		25.0			Adjusted for Cyclic Performance			22.34	1.024	0.817

Note: Blank space equals NA.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

With this you can then calculate the IEER:

$$IEER = (0.02 \cdot 10.92) + (0.617 \cdot 14.39) + (0.238 \cdot 16.32) + (0.125 \cdot 22.34) = 15.78$$

~~**6.6** *Test Tolerances (Applies to all products covered by this standard).* To comply with this standard, measured test results shall not be less than 95% of Published Ratings for capacities, SEER, HSPF, EER values, and COP values and not less than 90%of Published Ratings for IEER and SCHE values.~~

6.6 *Verification Testing Uncertainty.* When verifying the ratings by testing a sample unit, there are uncertainties that must be considered. Verification tests, including tests conducted for the AHRI certification program shall be conducted in a laboratory that meets the requirements referenced in this standard and ASHRAE Standard 37 and must demonstrate performance with an allowance for uncertainty. The following make up the uncertainty for products covered by this standard.

6.6.1 *Uncertainty of Measurement*. When testing a unit, there are variations that result from instrumentation and measurements of temperatures, pressure, and flow rates.

6.6.2 *Uncertainty of Test Rooms.* A unit tested in multiple rooms will not yield the same performance due to setup variations.

6.6.3 *Variation due to Manufacturing*. During the manufacturing of units, there are variations due to manufacturing production tolerances that will impact the performance of a unit.

6.6.4 *Uncertainty of Performance Simulation Tools*. Due to the large complexity of options, use of performance prediction tools like an AEDM has some uncertainties.

6.7 To comply with this standard, verification tests shall meet the performance metrics shown in Table 13 with an uncertainty allowance not greater than the following:

Table 13. Uncertainty Allowances

Performance Metric	Uncertainty Allowance	Acceptance Criteria[1]
Cooling Capacity	5%	≥ 95%
SEER[2]	5%	≥ 95%
EER	5%	≥ 95%
IEER[3]	10%	≥ 90%
SCHE[4]	10%	≥ 90%
Heating Capacity[5]	5%	≥ 95%
COP[3,5]	5%	≥ 95%
HSPF[2]	5%	≥ 95%

Notes:
1) Must be ≥ (1 – uncertainty allowance).
2) Applies only to systems < 65,000 Btu/h [19,000 W]
3) Applies only to systems ≥ 65,000 Btu/h [19,000 W]
4)Applies to heat recovery systems only
5) Includes the high temperature and low temperature conditions, and the temperature condition for water-source systems

Section 7. Minimum Data Requirements for Published Ratings

7.1 *Minimum Data Requirements for Published Ratings.* As a minimum, Published Ratings shall consist of the following information:

a. For VRF Multi-Split Air-Conditioners <65,000 Btu/h [19,000 W]

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

1. Standard Rating Cooling Capacity Btu/h [W]
2. Seasonal Energy Efficiency Ratio, SEER Btu/(W·h)

b. For VRF Multi-Split Air-Conditioners ≥ 65,000 Btu/h [19,000 W]
   1. Standard Rating Cooling Capacity Btu/h [W]
   2. Energy Efficiency Ratio, EER Btu/(W·h)
   3. Integrated Energy Efficiency Ratio, IEER (Integrated Part-Load Value, IPLV is Superseded by IEER January 1, 2010)

c. For all VRF Multi-Split Heat Pumps <65,000 Btu/h [19,000 W]
   1. Standard Rating Cooling Capacity Btu/h [W]
   2. Seasonal Energy Efficiency Ratio, SEER Btu/(W·h)
   3. High Temperature Heating Standard Rating Capacity Btu/(W·h) [W]
   4. Region IV Heating Seasonal Performance Factor, HSPF, minimum design heating requirement (W·h)

d. For VRF Multi-Split Heat Pumps ≥ 65,000 Btu/h [19,000 W]
   1. Standard Rating Cooling Capacity Btu/h [W]
   2. Energy Efficiency Ratio, EER Btu/(W·h)
   3. Integrated Energy Efficiency Ratio, IEER (Integrated Part-Load Value, IPLV is Superseded by IEER January 1, 2010)
   4. High Temperature Heating Standard Rating Capacity Btu/h [W]
   5. High Temperature Coefficient of Performance
   6. Low Temperature Heating Standard Rating Capacity Btu/h [W]
   7. Low Temperature Coefficient of Performance

e. For VRF Multi-Split Heat Recovery Heat Pumps
   1. Ratings Appropriate in 7 (c) (d) above
   2. Simultaneous Cooling and Heating Efficiency (SCHE) (50% heating/50% cooling)

f. For VRF Multi-Split Heat Pumps Systems that Use a Water Source for Heat Rejection
   1. Standard Rating Cooling Capacity Btu/h [W]
   2. Energy Efficiency Ratio, EER Btu/(W·h)
   3. Integrated Energy Efficiency Ratio, IEER (Integrated Part-Load Value, IPLV is Superseded by IEER January 1, 2010)
   4. Heating Standard Rating Capacity Btu/h [W]
   5. Heating Coefficient of Performance
   6. Simultaneous Cooling and Heating Efficiency (SCHE) (50% heating/50% cooling)/ (Heat Recovery models only)

7.2 *Latent Cooling Capacity Designation.* The moisture removal designation shall be published in the manufacturer's specifications and literature. The value shall be expressed consistently in either gross or net in one or more of the following forms:

a. Sensible cooling capacity/total cooling capacity ratio (sensible heat ratio) and total capacity, Btu/h [W]
b. Latent cooling capacity and total cooling capacity, Btu/h [W]
c. Sensible cooling capacity and total cooling capacity, Btu/h [W]

7.3 *Rating Claims.* All claims to ratings within the scope of this standard shall include the statement "Rated in accordance with AHRI Standard 1230". All claims to ratings outside the scope of this standard shall include the statement: "Outside the scope of AHRI Standard 1230". Wherever Application Ratings are published or printed, they shall include a statement of the conditions at which the ratings apply.

Section 8. Operating Requirements

8.1 *Operating Requirements.* Unitary equipment shall comply with the provisions of this section such that any production unit will meet the requirements detailed herein.

Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

8.2 *Operating Requirements for Systems < 65,000 Btu/h [19,000 W]*.

8.2.1 *Maximum Operating Conditions Test for Systems < 65,000 Btu/h [19,000 W]*. Unitary equipment shall pass the following maximum operating conditions test with an indoor-coil airflow rate as determined under 6.1.5.1.

8.2.1.1 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 7.

8.2.2 *Voltages.* The test shall be run at the Range A minimum utilization voltage from AHRI Standard 110, Table 1, based upon the unit's nameplate rated voltage(s). This voltage shall be supplied at the unit's service connection and at rated frequency.

8.2.3 *Procedure.* The equipment shall be operated for one hour at the temperature conditions and voltage specified.

8.2.4 *Requirements.* The equipment shall operate continuously without interruption for any reason for one hour.

8.2.4.1 Units with water-cooled condensers shall be capable of operation under these maximum conditions at a water pressure drop not to exceed 413.5 in H_2O [103 kPa], measured across the unit.

8.3 *Voltage Tolerance Test for Systems < 65,000 Btu/h [19,000 W]*. Unitary equipment shall pass the following voltage tolerance test with a cooling coil airflow rate as determined under 6.1.5.1.

8.3.1 *Temperature Conditions.* Temperature conditions shall be maintained at the standard cooling (and/or standard heating, as required) steady state conditions as shown in Table 7.

8.3.2 *Voltages.*

8.3.2.1 Tests shall be run at the Range B minimum and maximum utilization voltages from ARI Standard 110, Table 1, based upon the unit's nameplate rated voltage(s). These voltages shall be supplied at the unit's service connection and at rated frequency. A lower minimum or a higher maximum voltage shall be used, if listed on the nameplate.

8.3.2.2 The power supplied to single phase equipment shall be adjusted just prior to the shut-down period (8.3.3.2) so that the resulting voltage at the unit's service connection is 86% of nameplate rated voltage when the compressor motor is on locked-rotor. (For 200V or 208V nameplate rated equipment the restart voltage shall be set at 180V when the compressor motor is on locked rotor). Open circuit voltage for three-phase equipment shall not be greater than 90% of nameplate rated voltage.

8.3.2.3 Within one minute after the equipment has resumed continuous operation (8.3.4.3), the voltage shall be restored to the values specified in 8.3.2.1.

8.3.3 *Procedure*.

8.3.3.1 The equipment shall be operated for one hour at the temperature conditions and voltage(s) specified.

8.3.3.2 All power to the equipment shall be interrupted for a period sufficient to cause the compressor to stop (not to exceed five seconds) and then restored.

8.3.4 *Requirements.*

8.3.4.1 During both tests, the equipment shall operate without failure of any of its parts.

8.3.4.2 The equipment shall operate continuously without interruption for any reason for the one hour period preceding the power interruption.

8.3.4.3 The unit shall resume continuous operation within two hours of restoration of power and shall then operate continuously for one-half hour. Operation and resetting of safety devices prior to establishment of continuous operation is permitted.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

8.4 *Low-Temperature Operation Test for Systems < 65,000 Btu/h [19,000 W] (Cooling).* Unitary equipment shall pass the following low-temperature operation test when operating with initial airflow rates as determined in 6.1.5.1 and 6.1.6 and with controls and dampers set to produce the maximum tendency to frost or ice the evaporator, provided such settings are not contrary to the manufacturer's instructions to the user.

8.4.1 *Temperature Conditions.* Temperature Conditions shall be maintained as shown in Table 7.

8.4.2 *Procedure.* The test shall be continuous with the unit on the cooling cycle, for not less than four hours after establishment of the specified temperature conditions. The unit will be permitted to start and stop under control of an automatic limit device, if provided.

8.4.3 *Requirements.*

8.4.3.1 During the entire test, the equipment shall operate without damage or failure of any of its parts.

8.4.3.2 During the entire test, the air quantity shall not drop more than 25% from that determined under the Standard Rating test.

8.4.3.3 During the test and during the defrosting period after the completion of the test, all ice or meltage must be caught and removed by the drain provisions.

8.5 *Insulation Effectiveness Test (Cooling). Test for Systems < 65,000 Btu/h [19,000 W].* Unitary equipment shall pass the following insulation effectiveness (aka insulation efficiency test) when operating with airflow rates as determined in 6.1.5.1 and 6.1.6 with controls, fans, dampers, and grilles set to produce the maximum tendency to sweat, provided such settings are not contrary to the manufacturer's instructions to the user.

8.5.1 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 7.

8.5.2 *Procedure.* After establishment of the specified temperature conditions, the unit shall be operated continuously for a period of four hours.

8.5.3 *Requirements.* During the test, no condensed water shall drop, run, or blow off from the unit casing.

8.6 *Condensate Disposal Test (Cooling). Test for Systems < 65,000 Btu/h [19,000 W].* Unitary equipment which rejects condensate to the condenser air shall pass the following condensate disposal test when operating with airflow rates as determined in 6.1.5.1 and 6.1.6 and with controls and dampers set to produce condensate at the maximum rate, provided such settings are not contrary to the manufacturer's instructions to the user. (This test may be run concurrently with the Insulation Effectiveness Test (8.5)).

8.6.1 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 7.

8.6.2 *Procedure.* After establishment of the specified temperature conditions, the equipment shall be started with its condensate collection pan filled to the overflowing point and shall be operated continuously for four hours after the condensate level has reached equilibrium.

8.6.3 *Requirements.* During the test, there shall be no dripping, running-off, or blowing-off of moisture from the unit casing.

8.7 *Test Tolerance for Systems <65,000 Btu/h [19,000 W].* The conditions for the tests outlined in Section 8 are average values subject to tolerances of ± 1.0°F [± 0.6°C] for air wet-bulb and dry-bulb temperatures and ± 1.0% of the reading for voltages.

8.8 *Operating Requirements for Systems ≥ 65,000 Btu/h [19,000 W].*

8.8.1 *Maximum Operating Conditions Test (Cooling and Heating) Systems ≥ 65,000 Btu/h [19,000 W].* Multi-Split Air-Conditioners and Heat Pumps shall pass the following maximum cooling and heating operating conditions test with an indoor coil airflow rate as determined under 6.3.1 (refer to test for equipment with optional air cooling coils in Section 6.3.3).

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

8.8.2 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 9.

8.8.3 *Voltages*. Tests shall be run at the minimum and maximum utilization voltages of Voltage Range B as shown in Table 1 of AHRI Standard 110, at the unit's service connection and at rated frequency.

8.8.4 *Procedure.*

8.8.4.1 Multi-split Air-Conditioners and Heat Pumps shall be operated continuously for one hour at the temperature conditions and voltage(s) specified.

8.8.4.2 All power to the unitary equipment shall be interrupted for a period sufficient to cause the compressor to stop (not to exceed five seconds) and then be restored.

8.8.5 *Requirements.*

8.8.5.1 During both tests, the unitary equipment shall operate without failure of any of its parts.

8.8.5.2 The unit shall resume continuous operation within one hour of restoration of power and shall then operate continuously for one hour. Operation and resetting of safety devices prior to establishment of continuous operation is permitted.

8.8.5.3 Units with water-cooled condensers shall be capable of operation under these maximum conditions at a water-pressure drop not to exceed 413.5 in H_2O [103 kPa] measured across the unit.

8.8.6 *Maximum Operating Conditions Test for Equipment with Optional Outdoor Cooling Coil.* Multi-split Air Conditioners and Heat Pumps which incorporate an outdoor air cooling coil shall use the conditions, voltages, and procedure (Sections 8.8.1 through 8.8.4) and meet the requirements of 8.8.5 except for the following changes.

a. Outdoor air set as in Section 6.3.1

b. Return air temperature conditions shall be 80.0ºF [26.7ºC] dry-bulb, 67.0ºF [19.4ºC] wet-bulb

c. Outdoor air entering outdoor air cooling coil shall be 115ºF [46.1ºC] dry-bulb and 75.0ºF [23.9ºC] wet-bulb

8.9 *Cooling Low Temperature Operation Test for Systems ≥ 65,000 Btu/h [19,000 W].* Multi-split Air-Conditioners and Heat Pumps shall pass the following low-temperature operation test when operating with initial airflow rates as determined in Sections 6.3.1, 6.3.4, and with controls and dampers set to produce the maximum tendency to frost or ice the indoor coil, provided such settings are not contrary to the manufacturer's instructions to the user.

8.9.1 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 9.

8.9.2 *Voltage and Frequency*. The test shall be performed at nameplate rated voltage and frequency.

For air-conditioners and heat pumps with dual nameplate voltage ratings, tests shall be performed at the lower of the two voltages.

8.9.3 *Procedure.* The test shall be continuous with the unit in the cooling cycle for not less than four hours after establishment of the specified temperature conditions. The unit will be permitted to start and stop under control of an automatic limit device, if provided.

8.9.4 *Requirements.*

8.9.4.1 During the entire test, the unitary equipment shall operate without damage to the equipment.

8.9.4.2 During the entire test, the indoor airflow rate shall not drop more than 25% from that specified for the Standard Rating test.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

8.9.4.3 During all phases of the test and during the defrosting period after the completion of the test, all ice or meltage must be caught and removed by the drain provisions.

8.10 *Insulation Efficiency Test (Cooling) for Systems ≥ 65,000 Btu/h [19,000 W].* Multi-Split Air-Conditioners and Heat Pumps shall pass the following Insulation Efficiency Test when operating with airflow rates as determined in 6.3.1, 6.3.4, and with controls, fans, dampers, and grilles set to produce the maximum tendency to sweat, provided such settings are not contrary to the manufacturer's instructions to the user.

8.10.1 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 9.

8.10.2 *Procedure.* After establishment of the specified temperature conditions, the unit shall be operated continuously for a period of four hours.

8.10.3 *Requirements.* During the test, no condensed water shall drop, run, or blow off from the unit casing.

8.11 *Condensate Disposal Test (Cooling) for Systems ≥ 65,000 Btu/h [19,000 W].* Multi-Split Air-Conditioners and Heat Pumps which reject condensate to the condenser air shall pass the following condensate disposal test when operating with airflow rates as determined in Sections 6.3.1, 6.3.4, and with controls and dampers set to produce condensate at the maximum rate, provided such settings are not contrary to the manufacturer's instructions to the user (This test may be run concurrently with the insulation efficiency test (Section 8.10)).

8.11.1 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 9.

8.11.2 *Procedure.* After establishment of the specified temperature conditions, the equipment shall be started with its condensate collection pan filled to the overflowing point and shall be operated continuously for four hours after the condensate level has reached equilibrium.

8.11.3 *Requirements.* During the test, there shall be no dripping, running-off, or blowing-off of moisture from the unit casing.

8.12 *Tolerances for Systems ≥ 65,000 Btu/h [19,000 W].* The conditions for the tests outlined in Sections 8.2 and 8.3 are average values subject to tolerances of ±1.0ºF [±0.6ºC] for air wet-bulb and dry-bulb temperatures, ±0.5ºF [±0.3ºC] for water temperatures, and ±1.0% of the readings for specified voltage.

8.13 *Performance Requirements for Systems using a Water Source for Heat Rejection.*

8.13.1 *Capacity Requirements.*

8.13.1.1 To be consistent with ISO 13256-1-2, water-to-air and brine-to-air heat pumps shall be designed and produced such that any production unit will meet the applicable requirements of this standard.

8.13.1.2 For heat pumps with capacity control, the performance requirements tests shall be conducted at maximum capacity.

8.13.2 *Maximum Operating Conditions Test.*

8.13.2.1 *Test conditions.* The maximum operating conditions tests shall be conducted for cooling and heating at the test conditions established for the specific applications specified in Tables 14 and 15. Heat pumps intended for use in two or more applications shall be tested at the most stringent set of conditions specified in Tables 14 and 15.

8.13.2.2 *Test Procedures.*

8.13.2.2.1 The equipment shall be operated continuously for one hour after the specified temperatures have been established at each specified voltage level.

8.13.2.2.2 The 110% voltage test shall be conducted prior to the 90% voltage test.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...

8.13.2.2.3 All power to the equipment shall be interrupted for three minutes at the conclusion of the one hour test at the 90% voltage level and then restored for one hour.

8.13.2.3 *Test Requirements.* Heat pumps shall meet the following requirements when operating at the conditions specified in Tables 14 and 15.

8.13.2.3.1 During the entire test, the equipment shall operate without any indication of damage.

8.13.2.3.2 During the test period specified in Section 8.13.2.2.1, the equipment shall operate continuously without tripping any motor overload or other protective devices.

8.13.2.3.3 During the test period specified in Section 8.13.2.2.3, the motor overload protective device may trip only during the first five minutes of operation after the shutdown period of three minutes. During the remainder of the test period, no motor overload protective device shall trip. For those models so designed that resumption of operation does not occur within the first five minutes after the initial trip, the equipment may remain out of operation for no longer than 30 minutes. It shall then operate continuously for the remainder of the test period.

8.13.3 *Minimum Operating Conditions Test.* Heat pumps shall be tested at the minimum operating test conditions for cooling and heating at the test conditions established for the specific applications specified in Tables 16 and 17. Heat pumps intended for use in two or more applications shall be tested at the most stringent set of conditions specified in Tables 16 and 17.

8.13.3.1 *Test Procedures.* For the minimum operating cooling test, the heat pump shall be operated continuously for a period of no less than 30 minutes after the specified temperature conditions have been established. For the minimum operating heating test, the heat pump shall soak for 10 minutes with liquid at the specified temperature circulating through the coil. The equipment shall then be started and operated continuously for 30 minutes.

8.13.3.2 *Test Requirements.* No protective device shall trip during these tests and no damage shall occur to the equipment.

Table 14. Maximum Cooling Test Conditions for Systems that use a Water Source for Heat Rejection

	Water-loop Heat Pumps		Ground-water Heat Pumps		Ground-loop Heat Pumps	
Air entering indoor side[1]	°F	°C	°F	°C	°F	°C
— dry bulb	89.6	32.0	89.6	32.0	89.6	32.0
— wet bulb	73.4	23.0	73.4	23.0	73.4	23.0
Air surrounding unit — dry bulb	89.6	32.0	89.6	32.0	89.6	32.0
Liquid entering heat exchanger[1]	104	40.0	77.0	25.0	104	40.0
Frequency[2]	Rated		Rated		Rated	
Voltage	1) 90% and 110% of rated voltage for equipment with a single nameplate rating. 2) 90% of minimum voltage and 110% of maximum voltage for equipment with dual nameplate voltage.		1) 90% and 110% of rated voltage for equipment with a single nameplate rating. 2) 90% of minimum voltage and 110% of maximum voltage for equipment with dual nameplate voltage.		1) 90% and 110% of rated voltage for equipment with a single nameplate rating. 2) 90% of minimum voltage and 110% of maximum voltage for equipment with dual nameplate voltage.	

Notes:
1) Air and liquid flow rates shall be as established in Sections 6.1.5 and 6.4.3.
2) Equipment with dual-rated frequencies shall be tested at each frequency.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1230-2010 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipm...