2021 WSEC-C - Editorial Comments & Questions
EPAC Proposals being considered for Council Meeting on 9/15/2023
Version: 2023-09-13
By: Eric Vander Mey (ericv@rushingco.com), 206-321-1677

See below for editorial comments for the proposed code language for code change proposals to be reviewed at the Council Committee Meeting on 9/15/2023.

Comments are based on the Com_energy_draft_code_text_091223 file that was posted for the Council Meeting:

EVM Comment:

Per discussion at the MVE Committee meeting on 9/8/2023 EVM was asked by Committee members to look into the possible conflict with EPAC requirements for electrical airsource heatpumps based on the observation that EVM provided in the meeting and public comment ahead of the meeting that not all electric heat pumps are able to do heat pump heating down to 17F.

See below for further research on this topic.

Please note that I am not a lawyer but have provided information in regard to EPAC rules for energy codes. It appears that requiring heat pump heating down to 17F may be in conflict with federal rules for certain types of heat pumps.

PTHP:
See next couple of pages for details on various electric air-to-air heat pumps and AHRI test conditions required by Federal Energy Code ASHRAE 90.1 and EPAC.

Note that certain heat pump types are required to test down to 17F and others are not.

My understanding is that EPAC regulates this and therefore the baseline efficiency for electric heat pumps in the prescriptive code would likely need to be set for based on the operational range of PTHP heat pumps for the C406 credits.

By requiring all air-to-air electric heat pumps to have to operate down to 17F would not all PTHP that are only required to operate down to 25F and test to 47F to be installed.

Restricting a whole category of equipment found in 90.1 & IECC equipment tables that therefore could not be installed in Washington State based on Exception 5.2.

See attached information from EPAC
Federal Register 42 US Code 6297 (f) (3) (B) or (f) (3) (C) that 2021 WSEC Section C403.1.4 Item 2 Exception 5.2 maybe be in conflict.

It appears the PTHP are referred to as a covered product under Federal Register 42 US Code 6295 (4) (A) (ii) as through-the-wall central air conditioning heat pumps.

Additionally per AHRI 310/380 as referenced by 2021 WSEC the PTHP are only required to be tested at 47F for the heat pump heating outdoor air condition.

Possible solutions:
A. Provide an exception in Section Exception 5.2 C403.1.4 for certain types of electric heat pumps.
B. Adjust the baseline starting point for the C406 energy credits to an electrical heat pump that does not operation in heat pump heating all the way down to 17F. Then provide C406 credit for heat pumps that operate in heat pump heating down to 17F.
C. Provide C406 options with negative credits if electric heat pump are selected that do not operate in heat pump heating down to 17F.

WAC 51-11C-40314 Section C403.1.4—HVAC heating equipment.

C403.1.4 Use of electric resistance and fossil fuel-fired HVAC heating equipment.
Commercial buildings shall comply with one of the following:

~~1.~~2. **Heat Pump Space Heating Pathway:** HVAC heating energy shall not be provided by electric resistance or fossil fuel combustion appliances. For the purposes of this section, electric resistance HVAC heating appliances include, but are not limited to, electric baseboard, electric resistance fan coil and VAV electric resistance terminal reheat units and electric resistance boilers. For the purposes of this section, fossil fuel combustion HVAC heating appliances include, but are not limited to, appliances burning natural gas, heating oil, propane, or other fossil fuels.

Exceptions:

5. **Air-to-air heat pumps.** Buildings are permitted to utilize ~~internal electric resistance heaters to~~ supplemental ~~heat pump heating~~ heating sources for air-to-air heat pumps that meet all of the following conditions:
   - 5.1. Internal electric resistance heaters have controls that prevent supplemental heater operation when the heating load can be met by the heat pump alone during both steady-state operation and setback recovery.
   - 5.2. The heat pump controls are configured to use the compressor as the first stage of heating down to an outdoor air temperature of 17°F (-8°C) or lower except when in defrost.
   - 5.3. The heat pump complies with one of the following:
     - 5.3.1. Controlled by a digital or electronic thermostat designed for heat pump use that energizes the supplemental heat only when the heat pump has insufficient capacity to maintain set point or to warm up the space at a sufficient rate.
     - 5.3.2. Controlled by a multistage space thermostat and an outdoor air thermostat wired to energize supplemental heat only on the last stage of the space thermostat and when outdoor air temperature is less than 32°F (0°C) except when in defrost.
     - 5.3.3. The minimum efficiency of the heat pump is regulated by NAECA, its rating meets the requirements shown in Table C403.3.2(2), and its rating includes all usage of internal electric resistance heating.

EVM Comment:
Item 5.2 that requires heat pump heating down to 17F is a potential conflict with ASHRAE 90.1 and EPAC. It excludes usage of code minimum efficiency equipment that is not required to operate in heat pump heating down to 17F.

C403.4.1.1 Heat pump supplementary heat. Unitary air cooled heat pumps shall include microprocessor controls that minimize supplemental heat usage during start-up, set-up, and defrost conditions. These controls shall anticipate need for heat and use compression heating as the first stage of heat. Controls shall indicate when supplemental heating is being used through visual means (e.g., LED indicators). Heat pumps equipped with supplementary heaters shall be installed with controls that prevent supplemental heater operation above 40°F (4.4°C).

Exception: Packaged terminal heat pumps (PTHPs) of less than 2 tons (24,000 Btu/hr) cooling capacity that have reverse-cycle demand defrost and are configured to operate in heat pump mode whenever the outdoor air temperatures are above 25°F (-3.9°C) and the unit is not in defrost.

EVM Comment:
As noted in 2021 WSEC-C Section C403.4.1.1 PTHP are only required to operate in heat pump heating down to 25F.
This section appears to be in conflict with the 17F outdoor air temperature operation temperature for heat pump heating.
Confirm if C406 credits assume a 17F or 25F lockout temperature for heat pump heating operation.

42 U.S. Code § 6297 - Effect on other law

(f) Exception for certain building code requirements

(1) A regulation or other requirement enacted or prescribed before January 8, 1987, that is contained in a State or local building code for new construction concerning the energy efficiency or energy use of a covered product is not superseded by this part until the effective date of the energy conservation standard established in or prescribed under section 6295 of this title for such covered product.

(2) A regulation or other requirement, or revision thereof, enacted or prescribed on or after January 8, 1987, that is contained in a State or local building code for new construction concerning the energy efficiency or energy use of a covered product is not superseded by this part until the effective date of the energy conservation standard established in or prescribed under section 6295 of this title for such covered product if the code does not require that the energy efficiency of such covered product exceed—

(A) the applicable minimum efficiency requirement in a national voluntary consensus standard; or

(B) the minimum energy efficiency level in a regulation or other requirement of the State meeting the requirements of subsection (b)(1) or (b)(5),

whichever is higher.

(3) Effective on the effective date of an energy conservation standard for a covered product established in or prescribed under section 6295 of this title, a regulation or other requirement contained in a State or local building code for new construction concerning the energy efficiency or energy use of such covered product is not superseded by this part if the code complies with all of the following requirements:

(A) The code permits a builder to meet an energy consumption or conservation objective for a building by selecting items whose combined energy efficiencies meet the objective.

(B) The code does not require that the covered product have an energy efficiency exceeding the applicable energy conservation standard established in or prescribed under section 6295 of this title, except that the required efficiency may exceed such standard up to the level required by a regulation of that State for which the Secretary has issued a rule granting a waiver under subsection (d).

(C) The credit to the energy consumption or conservation objective allowed by the code for installing covered products having energy efficiencies exceeding such energy conservation standard established in or prescribed under section 6295 of this title or the efficiency level required in a State regulation referred to in subparagraph (B) is on a one-for-one equivalent energy use or equivalent cost basis.

(D) If the code uses one or more baseline building designs against which all submitted building designs are to be evaluated and such baseline building designs contain a covered product subject to an energy conservation standard established in or prescribed under section 6295 of this title, the baseline building designs are based on the efficiency level for such covered product which meets but does not exceed such standard or the efficiency level required by a regulation of that State for which the Secretary has issued a rule granting a waiver under subsection (d).

(E) If the code sets forth one or more optional combinations of items which meet the energy consumption or conservation objective, for every combination which includes a covered product the efficiency of which exceeds either standard or level referred to in subparagraph (D), there also shall be at least one combination which includes such covered product the efficiency of which does not exceed such standard or level by more than 5 percent, except that at least one combination shall include such covered product the efficiency of which meets but does not exceed such standard.

(F) The energy consumption or conservation objective is specified in terms of an estimated total consumption of energy (which may be calculated from energy loss- or gain-based codes) utilizing an equivalent amount of energy (which may be specified in units of energy or its equivalent cost).

(G) The estimated energy use of any covered product permitted or required in the code, or used in calculating the objective, is determined using the applicable test procedures prescribed under section 6293 of this title, except that the State may permit the estimated energy use calculation to be adjusted to reflect the conditions of the areas where the code is being applied if such adjustment is based on the use of the applicable test procedures prescribed under section 6293 of this title or other technically accurate documented procedure.

42 U.S. Code § 6295 - Energy conservation standards

(c) Standards for room air conditioners

(1) The energy efficiency ratio of room air conditioners shall be not less than the following for products manufactured on or after January 1, 1990:

Product Class:	Ratio
Without Reverse Cycle and With Louvered Sides:	
Less than 6,000 Btu	8.0
6,000 to 7,999 Btu	8.5
8,000 to 13,999 Btu	9.0
14,000 to 19,999 Btu	8.8
20,000 and more Btu	8.2
Without Reverse Cycle and Without Louvered Sides:	
Less than 6,000 Btu	8.0
6,000 to 7,999 Btu	8.5
8,000 to 13,999 Btu	8.5
14,000 to 19,999 Btu	8.5
20,000 and more Btu	8.2
With Reverse Cycle and With Louvered Sides	8.5
With Reverse Cycle, Without Louvered Sides	8.0

(2)

(A) The Secretary shall publish a final rule no later than January 1, 1992, to determine if the standards established under paragraph (1) should be amended. Such rule shall contain such amendment, if any, and provide that the amendment shall apply to products manufactured on or after January 1, 1995.

(B) After January 1, 1992, the Secretary shall publish a final rule no later than five years after the date of publication of a previous final rule. The Secretary shall determine in such rule whether to amend the standards in effect for room air conditioners.

(C) Any amendment prescribed under subparagraph (B) shall apply to products manufactured after a date which is five years after—

(i) the effective date of the previous amendment; or

(ii) if the previous final rule did not amend the standards, the earliest date by which a previous amendment could have been effective;

except that in no case may any amended standard apply to products manufactured within three years after publication of the final rule establishing such amended standard.

42 U.S. Code § 6295 - Energy conservation standards

(4) STANDARDS FOR THROUGH-THE-WALL CENTRAL AIR CONDITIONERS, THROUGH-THE-WALL CENTRAL AIR CONDITIONING HEAT PUMPS, AND SMALL DUCT, HIGH VELOCITY SYSTEMS.—

(A) Definitions.—In this paragraph:

(i) Small duct, high velocity system.—The term "small duct, high velocity system" means a heating and cooling product that contains a blower and indoor coil combination that—

(I) is designed for, and produces, at least 1.2 inches of external static pressure when operated at the certified air volume rate of 220–350 CFM per rated ton of cooling; and

(II) when applied in the field, uses high velocity room outlets generally greater than 1,000 fpm that have less than 6.0 square inches of free area.

(ii) Through-the-wall central air conditioner; through-the-wall central air conditioning heat pump.—The terms "through-the-wall central air conditioner" and "through-the-wall central air conditioning heat pump" mean a central air conditioner or heat pump, respectively, that is designed to be installed totally or partially within a fixed-size opening in an exterior wall, and—

(I) is not weatherized;

(II) is clearly and permanently marked for installation only through an exterior wall;

(III) has a rated cooling capacity no greater than 30,000 Btu/hr;

(IV) exchanges all of its outdoor air across a single surface of the equipment cabinet; and

(V) has a combined outdoor air exchange area of less than 800 square inches (split systems) or less than 1,210 square inches (single packaged systems) as measured on the surface area described in subclause (IV).

(iii) Revision.—
The Secretary may revise the definitions contained in this subparagraph through publication of a final rule.

through-the-wall central air conditioning heat pump

(4) Standards for through-the-wall central air conditioners, through-the-wall central air conditioning heat pumps, and small duct, high velocity systems.— (A) Definitions .— In this paragraph: (i) Small duct, high velocity system .— The term "small duct, high velocity system" means a heating and cooling product that contains a blower and indoor coil combination that— (I) is designed for, and produces, at least 1.2 inches of external static pressure when operated at the certified air volume rate of 220–350 CFM per rated ton of cooling; and (II) when applied in the field, uses high velocity room outlets generally greater than 1,000 fpm that have less than 6.0 square inches of free area. (ii) Through-the-wall central air conditioner; through-the-wall central air conditioning heat pump .— The terms "through-the-wall central air conditioner" and "through-the-wall central air conditioning heat pump" mean a central air conditioner or heat pump, respectively, that is designed to be installed totally or partially within a fixed-size opening in an exterior wall, and— (I) is not weatherized; (II) is clearly and permanently marked for installation only through an exterior wall; (III) has a rated cooling capacity no greater than 30,000 Btu/hr; (IV) exchanges all of its outdoor air across a single surface of the equipment cabinet; and (V) has a combined outdoor air exchange area of less than 800 square inches (split systems) or less than 1,210 square inches (single packaged systems) as measured on the surface area described in subclause (IV). (iii) Revision .— The Secretary may revise the definitions contained in this subparagraph through publication of a final rule. (B) Small-duct high-velocity systems.— (i) Seasonal energy efficiency ratio .— The seasonal energy efficiency ratio for small-duct high-velocity systems shall be not less than— (I) 11.00 for products manufactured on or after January 23, 2006 ; and (II) 12.00 for products manufactured on or after January 1, 2015 . (ii) Heating seasonal performance factor .— The heating seasonal performance factor for small-duct high-velocity systems shall be not less than— (I) 6.8 for products manufactured on or after January 23, 2006 ; and (II) 7.2 for products manufactured on or after January 1, 2015 . (C) Subsequent rulemakings .— The Secretary shall conduct subsequent rulemakings for through-the-wall central air conditioners, through-the-wall central air conditioning heat pumps, and small duct, high velocity systems as part of any rulemaking under this section used to review or revise standards for other central air conditioners and heat pumps.

TABLE C403.3.2(4)
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE-PACKAGE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS AND ROOM AIR-CONDITIONER HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS[e]

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
PTAC (cooling mode) Standard size	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.9 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		14.0 - (0.300 × Cap/1000) EER[d]	
	> 15,000 Btu/h		9.5 EER	
PTAC (cooling mode) Nonstandard size[a]	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	9.4 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		10.9 - (0.213 × Cap/1000) EER[d]	
	> 15,000 Btu/h		7.7 EER	
PTHP (cooling mode) Standard size	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.9 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		14.0 - (0.300 × Cap/1000) EER[d]	
	> 15,000 Btu/h		9.5 EER	
PTHP (cooling mode) Nonstandard size[b]	< 7,000 Btu/h	95°F db/75°F wb outdoor air[c]	9.3 EER	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		10.8 - (0.213 × Cap/1000) EER[d]	
	> 15,000 Btu/h		7.6 EER	
PTHP (heating mode) Standard size	< 7,000 Btu/h	47°F db/43°F wb outdoor air	3.3 COP_H	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		3.7 - (0.052 × Cap/1000) COP_H[d]	
	> 15,000 Btu/h		2.90 COP_H	
PTHP (heating mode) Nonstandard size[b]	< 7,000 Btu/h	47°F db/43°F wb outdoor air	2.7 COP_H	AHRI 310/380
	≥ 7,000 Btu/h and ≤ 15,000 Btu/h		2.9 - (0.026 × Cap/1000) COP_H[d]	
	> 15,000 Btu/h		2.5 COP_H	
SPVAC (cooling mode)	< 65,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.0 EER	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h		10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h		10.0 EER	
SPVHP (cooling mode)	< 65,000 Btu/h	95°F db/75°F wb outdoor air[c]	11.0 EER	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h		10.0 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h		10.0 EER	
SPVHP (heating mode)	<65,000 Btu/h	47°F db/43°F wb outdoor air	3.3 COP	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h		3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h		3.0 COP	

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EVM Comment:
Note: Heat pump heating testing is at 47F and not 17F for PTHPs under AHRI 310/380

4.2 Standard rating tests

4.2.1 General

Note: *Table 1 indicates the tests and test conditions that are required to determine values of standard capacity ratings and energy efficiency.*

4.2.1.1

Standard cooling ratings shall be verified by tests conducted in accordance with

a) ANSI/ASHRAE 16; or
b) ANSI/ASHRAE 37, except that no secondary capacity check shall be used and no ductwork shall be attached to the condenser.

Instruments used for measuring electricity input shall be accurate to within ± 0.5% of the quantity measured.

4.2.1.2

Standard heating ratings, including reverse-cycle heating, shall be verified by tests conducted in accordance with ANSI/ASHRAE 58.

Units with electrical heating elements shall be tested for heating capacity by measurement of room-side electrical component input.

4.2.1.3

Standard ratings relating to cooling capacity and heating capacity shall be net values, including the effects of circulating fan heat, but not including supplementary heat. Standard input ratings shall be the total power input to the compressor(s) and fans, plus controls and other items included as part of the model number(s).

7.4.2 Temperature conditions

Temperature conditions shall be maintained as specified in Table 1.

PTHP'S

Table 1
Operating conditions for standard rating and performance tests
(See Clauses 4.2.1, 4.5, 7.2.2, 7.3.2, 7.4.2, 7.5.2, 7.6.2, and 10.4.)

	Test	Indoor unit		Outdoor unit		Water	
		Air entering		Air entering			
		Dry-bulb °C (°F)	Wet-bulb °C (°F)	Dry-bulb °C (°F)	Wet-bulb °C (°F)	In °C (°F)	Out °C (°F)
Cooling	Standard rating conditions*	26.7 (80.0)	19.4 (67.0)	35.0 (95.0)	23.9† (75.0)	—	—
	Maximum high-temperature operation	26.7 (80.0)	19.4 (67.0)	46.1 (115.0)	23.9† (75.0)	—	—
	Insulation effectiveness	26.7 (80.0)	23.9 (75.0)	26.7 (80.0)	23.9† (75.0)	—	—
	Condensate disposal	26.7 (80.0)	23.9 (75.0)	26.7 (80.0)	23.9† (75.0)	—	—
	Air infiltration	21.1–26.7 (70.0–80.0)	—	21.1–26.7 (70.0–80.0)	—	—	—
	Part-load conditions	26.7 (80.0)	19.4 (67.0)	27.8 (82.0)	18.3† (65.0)	—	—
Heating	Standard rating (other than heat pump)‡	21.1 (70.0)	—	—	—	93.3 (200.0)	82.2 (180.0)
	Standard rating conditions high-temperature heat pump heating	21.1 (70.0)	15.6 (60.0) max	8.3 (47.0)	6.1 (43.0)	—	—
	Maximum high-temperature operation	26.7 (80.0)	—	23.9 (75.0)	18.3 (65.0)	—	—
	Part-load conditions	21.1 (70.0)	—	16.7 (62.0)	13.6 (56.5)	—	—

* *Not required for heating-only units.*
† *Required when condensate is rejected to the condenser air stream.*
‡ *Where steam is the heating medium, the steam pressure shall be* 13.8 kPa *(2 psig).*

Note: *For all tests except air infiltration, the static pressure difference between the room air-inlet and the outlet of the unit shall be* 0.0 Pa *(0.0 in H_2O). For the air infiltration test, the indoor static pressure shall be* 24.9 Pa *(0.1 in H_2O) below outdoor static pressure.*

AHRI

Air Conditioning, Heating, and Refrigeration Institute
4100 North Fairfax Drive
Suite 200
Arlington, VA 22203

Standard reference number	Title	Referenced in code section number
ISO/AHRI/ASHRAE 5801-2017	Fans—Performance Testing Using Standardized Airways	C403.8.1.1
ISO/AHRI/ASHRAE 13256-1 (2017)	Water-source Heat Pumps—Testing and Rating for Performance— Part 1: Water-to-air and Brine-to-air Heat Pumps	Table C403.3.2(14)
ISO/AHRI/ASHRAE 13256-2 (2017)	Water-source Heat Pumps—Testing and Rating for Performance— Part 2: Water-to-water and Brine-to-water Heat Pumps	Table C403.3.2(14)
210/240—2017 and 2023	Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment	Table C403.3.2(1), Table C403.3.2(2)
310/380—2017	Standard for Packaged Terminal Air Conditioners and Heat Pumps	Table C403.3.2(4)
340/360—2018	Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment	Table C403.3.2(1), Table C403.3.2(2)
365—09	Commercial and Industrial Unitary Air-conditioning Condensing Units	Table C403.3.2(1)
390—2011	Performance Rating of Single Package Vertical Air Conditioners and Heat Pumps	Table C403.3.2(4)
400—01	Liquid to Liquid Heat Exchangers with Addendum 2	C403.3.2

EVM Comment:
This should be AHRI 390-2003 or 2021. There is no AHRI 390-2011.
ASHRAE 90.1-2019 references AHRI 390-2003
ASHRAE 90.1-202 references AHRI 390-2021

ANSI/AHRI Standard 390-2021 (I-P)

This standard supersedes AHRI 390-2003.

ASHRAE 90.1 Clips

ANSI/AHRI 390-2003	Performance Rating of Single Packaged Vertical Air-Conditioners and Heat Pumps

AHRI 390 (I-P/2021)	Performance Rating of Single Packaged Vertical Air-Conditioners and Heat Pumps	Table 6.8.1-4

Table 3. Conditions for Standard Rating Tests and Operating Requirements

Test		Indoor Side Air Entering Dry-Bulb °F [°C]		Indoor Side Air Entering Wet-Bulb °F [°C]		Outdoor Side Air Entering Dry-Bulb °F [°C]		Outdoor Side Air Entering Wet-Bulb °F [°C]	
COOLING	Standard Rating Conditions, Cooling[1]	80.0	[26.7]	67.0	[19.4]	95.0	[35.0]	75.0[4]	[23.9]
	Low Temperature Operation, Cooling	67.0	[19.4]	57.0	[13.9]	67.0	[19.4]	57.0[4]	[13.9]
	Maximum High Temperature Operation	80.0	[26.7]	67.0	[19.4]	115.0	[46.1]	75.0[4]	[23.9]
	Insulation Effectiveness	80.0	[26.7]	75.0	[23.9]	80.0	[26.7]	75.0 [4]	[23.9]
	Condensate Disposal	80.0	[26.7]	75.0	[23.9]	80.0	[26.7]	75.0 [4]	[23.9]
	Part-Load Conditions[3]	80.0	[26.7]	67.0	[19.4]	80.0	[26.7]	67.0 [4]	[19.4]
HEATING	Standard Rating Conditions, High-Temperature Heat Pump, Heating	70.0	[21.1]	60.0 (max)	[15.6]	47.0	[8.3]	43.0	[6.1]
	Standard Rating Conditions, Low-Temperature Heat Pump, Heating[2]	70.0	[21.1]	60.0 (max)	[15.6]	17.0	[-8.3]	15.0	[-9.4]
	Maximum High-Temperature Operation	80.0	[26.7]	-	-	75.0	[23.9]	65.0	[18.3]
	Part-Load Conditions[3]	70.0	[21.1]	60.0 (max)	[15.6]	62.0	[16.7]	56.5	[13.6]

NOTES:
1 Same conditions used for voltage tolerance tests.
2 Only required if the manufacturer's Published Rating includes low-temperature specification.
3 For multiple compressor units or units with compressor capacity modulation.
4 Required when condensate is rejected to the condenser air stream.

8.4 *Low-Temperature Operation Test (Cooling). SPVAC/SPVHP* equipment shall pass the following low-temperature operation test when operating with initial airflow rates as determined in 5.2.2 and 5.2.3 and with controls, fans, dampers, and grilles 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 3.

8.4.2 *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.

8.4.3 *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 airflow rate 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 shall be caught and removed by the drain provisions.

3.13 *Rating Conditions.* Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.

3.13.1 *Standard Rating Conditions.* Rating Conditions used as the basis of comparison for performance characteristics, as defined in Table 3.

Table 3. Standard Rating Test Conditions and Operating Requirements

Test	Air Entering Indoor Side, °F		Air Entering Outdoor Side, °F	
	Dry-bulb	Wet-bulb	Dry-bulb	Wet-bulb
Cooling Mode				
Full Load Standard Rating Capacity Test, Cooling[1,2]	80.0	67.0	95.0	75.0[3]
Part-load Standard Rating Conditions	80.0	67.0	Varies with load per Table 7	Varies with load per Table 7[3]
Cooling Mode Operation Tests				
Low Temperature Operation, Cooling	67.0	57.0	67.0	57.0[3]
Maximum High Temperature Operation	80.0	67.0	115.0	75.0[3]
Condensate Disposal	80.0	75.0	80.0	75.0
Insulation Effectiveness	80.0	75.0	80.0	75.0[3]
Heating Mode				
Full Load Standard Rating Capacity Test, Heating[1,2]	70.0	60.0[4]	47.0	43.0
Part-load Capacity Test Heating	70.0	60.0[4]	62.0	56.5
Heating Mode Operation Tests				
Low Temperature Operation, Heating[5]	70.0	60.0[4]	17.0	15.0
Maximum High Temperature Operation	80.0	-	75.0	65.0

Notes:

1. Same Conditions used for voltage tolerance tests.
2. Refer to Appendix D for Standard Rating Conditions for products sold outside the US and Canada.
3. Only required if unit rejects condensate to Outdoor Coil. For units that do not reject condensate to the Outdoor Coil, where all or part of the indoor section of the equipment is located in the outdoor room, maintain an outdoor room dew point temperature of 60.5ºF.
4. Maximum value for all tests. If outdoor air enthalpy method is used for Single Package Heat Pumps, then the wet bulb shall be adjusted to match as close as reasonably possible to the dew point of the outdoor entering air.
5. Only applicable if the manufacturer's Published Rating includes low-temperature specifications.

EVM Comment:
Note: Not all VSTHP's have to test down to 17F only applicable for low-temperature specifications.

8.4 *Low-Temperature Operation Test (Cooling).* SPVAC/SPVHP equipment shall pass the following low-temperature operation test when operating with an indoor-side airflow rate as determined under Section 5.7 and outdoor-side airflow rate as determined under Section 5.8.4 with controls, fans, dampers, and grilles 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. For equipment utilizing variable capacity compressors, the maximum rated compressor speed and corresponding manufacturer-specified airflow shall be used during this test.

8.4.1 *Temperature Conditions.* Temperature conditions shall be maintained as shown in Table 3.

8.4.2 *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.

8.4.3 *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 airflow rate shall not drop more than 25% from that determined under the Standard Rating Full Load test.

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

Note: Certain types of airsource heat pumps are required to have an HSPF rating that require operation per AHRI 210-240-2023 down to 17F

TABLE C403.3.2(2)
ELECTRICALLY OPERATED AIR-COOLED UNITARY HEAT PUMPS—
MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (heating mode)	< 65,000 Btu/h[b]	-	Split System, three phase and applications outside U.S. single phase[b]	7.5 HSPF	AHRI 201/240-2023
		-	Single Package, three phase and applications outside U.S. single phase[b]	6.7 HSPF	

EVM Comment:
Note: Typo should be AHRI 210-240. Typo occurs in multiple locations in 2021 WSEC-C.

Table 7. Required Tests[1]

Test Name				Product Type					
	Former Version			Air-cooled					
New Version	Single	Two	Variable	Single Stage System	Single Stage with VAV/MIB	Two-stage System[9]	Two-stage Northern	Variable Stage System	Triple-capacity Northern
Cooling Mode [2]									
A_{Full}	A	A_2	A_2	R	R	R	R	R	R
A_{Low}	A	A_1	A_1		R				
B_{Full}	B	B_2	B_2	R		R	R	R	R
B_{Low}	-	B_1	B_1		R	R		R	R
C_{Full}	C	C_2	C_2	O [3]		O [3]	O [3]		O [3]
C_{Low}	-	C_1	C_1		O	O [3]			O [3]
D_{Full}	D	D_2	D_2	O [3]		O [3]	O [3]		O [3]
D_{Low}	-	D_1	D_1		O	O [3]			O [3]
E_{Int}	-	-	E_V					R	
F_{Low}	-	F_1	F_1			R		R	R
G_{Low}	-	-	G_1					O [3]	
I_{Low}	-	-	I_1					O [3]	
Cooling Mode Operation Tests [2,4]									
Voltage Tolerance				R	R	R	R	R	R
Low Temperature Cooling				R	R	R	R	R	R
Insulation Efficiency				R	R	R	R	R	R
Condensate Disposal				R	R	R	R	R	R
Maximum Operating Conditions				R	R	R	R	R	R
Heating Mode [5]									
$H0_{Low}$	-	$H0_1$	$H0_1$			R	R	R	R
$H1_{Full}$	H1	$H1_2$	$H1_2$	R	R	R	R	O	R
$H1_{Low}$	-	$H1_1$	$H1_1$		R	R	R	R	R
$H1C_{Full}$	H1C	$H1C_2$	$H1C_2$	O [6]		O [6]	O [6]		O [6]
$H1C_{Low}$	-	$H1C_1$	$H1C_1$		O	O [6]	O [6]	O [6]	O [6]
$H1_{Nom}$	-	-	$H1_N$					R	
$H2_{Boost}$	-	-	-						O
$H2_{Full}$	H2	$H2_2$	$H2_2$	R	R	R	R	O	R
$H2_{Low}$	-	$H2_1$	$H2_1$		O	O [7]	O [7]		R
$H2_{Int}$	-	-	$H2_V$					R	
$H3_{Full}$	H3	$H3_2$	$H3_2$	R	R	R	R	R	R
$H3_{Low}$	-	$H3_1$	$H3_1$		R	R [8]	R [8]		R [8]
$H3_{Boost}$	-	-	-						R
$H3C_{Boost}$	-	-	-						O
$H4_{Full}$	-	-	-	O	O	O	O	O	
$H4_{Boost}$	-	-	-						R
Heating Mode Operation Tests [4]									
Voltage Tolerance				R	R	R	R	R	R
Maximum Operating Conditions				R	R	R	R	R	R

Notes:
1. "R" means Required, "O" means Optional, and a blank cell indicates test is not applicable for the given product type.
2. Required for any unit that has a cooling mode function.
3. Refer to Section 6.1.3.1.
4. See AHRI Unitary Small Equipment Operation Manual for details.
5. Required for any unit that has a heating mode function.
6. Refer to Section 6.1.3.2.
7. Not necessary if low-capacity compressor heat pump performance at outdoor temperatures less than 37.0°F is not needed to calculate the HSPF2 per Section 11. Also, instead of testing, the $H2_{Low}$ capacity and electrical power may be approximated based on $H1_{Low}$ and $H3_{Low}$ tests per Section 6.1.3.4.

Table 8. Test Conditions for Air-cooled Products				
Test Name	Air Entering Outdoor Unit [2] (ºF)	Air Entering Indoor Unit [2] (ºF)	Compressor Speed [3]	Indoor Airflow [4]
Cooling Mode				
A_{Full}	95.0 / 75.0 [5,6]	80.0 / 67.0	$Full_C$ [12]	$Full_C$ [12]
A_{Low}	95.0 / 75.0 [5,6]	80.0 / 67.0	$Full_C$ [12,16]	Low_C
B_{Full}	82.0 / 65.0 [5,6]	80.0 / 67.0	$Full_C$	$Full_C$
B_{Low}	82.0 / 65.0 [5,6]	80.0 / 67.0	Low_C [16]	Low_C
C_{Full}	82.0 / 58.0 [5,6]	80.0 / 57.0 [7]	$Full_C$	$Full_C$
C_{Low}	82.0 / 58.0 [5,6]	80.0 / 57.0 [7]	Low_C [16]	Low_C
D_{Full}	82.0 / 58.0 [5,6]	80.0 / 57.0 [7]	$Full_C$	$Full_C$ [8]
D_{Low}	82.0 / 58.0 [5,6]	80.0 / 57.0 [7]	Low_C [16]	Low_C [8]
E_{Int}	87.0 / 69.0 [5,6]	80.0 / 67.0	Int_C	Int_C
F_{Low}	67.0 / 53.5 [5,6]	80.0 / 67.0	Low_C [16]	Low_C
G_{Low}	67.0 / 58.0 [5,6]	80.0 / 57.0 [7]	Low_C [16]	Low_C
I_{Low}	67.0 / 58.0 [5,6]	80.0 / 57.0 [7]	Low_C [16]	Low_C [8]
Cooling Mode Operation Tests				
Voltage Tolerance	95.0 / 75.0 [5]	80.0 / 67.0	$Full_C$	$Full_C$
Low Temperature	67.0 / 57.0	67.0 / 57.0	$Full_C$	$Full_C$
Insulation Efficiency	80.0 / 75.0	80.0 / 75.0	$Full_C$	$Full_C$
Condensate Disposal	80.0 / 75.0	80.0 / 75.0	$Full_C$	$Full_C$
Maximum Operation	115.0 / --	80.0 / 67.0	$Full_C$	$Full_C$
Extra High Maximum Operation (Optional)	125.6 / --	80.0 / 67.0	$Full_C$	$Full_C$
Heating Mode				
$H0_{Low}$	62.0 / 56.5	70.0 / 60.0 [9]	Low_H [16]	Low_H
$H0C_{Low}$	62.0 / 56.5	70.0 / 60.0 [9]	Low_H [16]	Low_H
$H1_{Full}$	47.0 / 43.0	70.0 / 60.0 [9]	$Full_H$ [17]	$Full_H$
$H1_{Low}$	47.0 / 43.0	70.0 / 60.0 [9]	Low_H [16]	Low_H
$H1C_{Full}$	47.0 / 43.0	70.0 / 60.0 [9]	$Full_H$	$Full_H$ [8]
$H1C_{Low}$	47.0 / 43.0	70.0 / 60.0 [9]	Low_H [16]	Low_H [8]
$H1_{Nom}$	47.0 / 43.0	70.0 / 60.0 [9]	Nom_H [15]	Nom_H [10]
$H2_{Boost}$	35.0 / 33.0	70.0 / 60.0 [9]	$Boost_H$	$Full_H$
$H2_{Full}$	35.0 / 33.0	70.0 / 60.0 [9]	$Full_H$ [17]	$Full_H$
$H2_{Low}$	35.0 / 33.0	70.0 / 60.0 [9]	Low_H [16]	Low_H
$H2_{Int}$	35.0 / 33.0	70.0 / 60.0 [9]	Int_H	Int_H
$H3_{Full}$	17.0 / 15.0	70.0 / 60.0 [9]	$Full_H$ [17]	$Full_H$
$H3_{Low}$	17.0 / 15.0	70.0 / 60.0 [9]	Low_H [16]	Low_H
$H3_{Boost}$	17.0 / 15.0	70.0 / 60.0 [9]	$Boost_H$	$Full_H$
$H3C_{Boost}$	17.0 / 15.0	70.0 / 60.0 [9]	$Boost_H$	$Full_H$
$H4_{Full}$	5.0 / 3.0 [11]	70.0 / 60.0 [9]	$Full_H$ [18]	$Full_H$
$H4_{Boost}$	5.0 / 3.0 [11]	70.0 / 60.0 [9]	$Boost_H$	$Full_H$
Heating Mode Operation Tests				
Voltage Tolerance	47.0 / 43.0	70.0 / 60.0 [9]	$Full_H$	$Full_H$
Maximum Operation	75.0 / 65.0	80.0 / --	$Full_H$	$Full_H$

Notes:

1. Test condition tolerances are defined within ASHRAE Standard 37, ASHRAE Standard 116 Table 3b for cyclic, and Section 8.7 of this standard.
2. Values listed are dry-bulb temperature / wet-bulb temperature, °F.
3. Refer to Section 3 for definition of “Full”, “Low”, “Int” and “Boost” for each compressor type.

TABLE C403.3.2(2) (Continued)
ELECTRICALLY OPERATED AIR-COOLED UNITARY HEAT PUMPS

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (heating mode)	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	-	47ºF db/43ºF wb Outdoor Air	3.40 COP_H	AHRI 340/360
			17ºF db/15ºF wb Outdoor Air	2.25 COP_H	
	≥ 135,000 Btu/h and < 240,000 Btu/h (cooling capacity)	-	47ºF db/43ºF wb Outdoor Air	3.30 COP_H	
			17ºF db/15ºF wb Outdoor Air	2.05 COP_H	
	≥ 240,000 Btu/h (cooling capacity)		47ºF db/43ºF wb Outdoor Air	3.20 COP_H	
			17ºF db/15ºF wb Outdoor Air	2.05 COP_H	

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Table 6. Conditions for Standard Rating and Operating Tests

Test		Indoor Section[4]		Outdoor Section[6]						
		Air Entering		Test Conditions based on Condenser Type						
				Air Cooled		Evaporative			Water Cooled	
		Dry-bulb, ºF	Wet-bulb, ºF	Dry-bulb, ºF	Wet-bulb, ºF	Dry-bulb, ºF	Wet-bulb, ºF	Makeup Water, ºF	Inlet, ºF	Outlet, ºF
Cooling	Standard Rating Conditions Cooling[3, 5]	80.0	67.0	95.0	75.0[1,7]	95.0	75.0	85.0	85.0	95.0
	Low Temperature Operating Cooling[3, 5]	67.0	57.0	67.0	57.0	67.0	57.0	67.0	--	70.0[2]
	Maximum Operating Conditions[3, 5]	80.0	67.0	115	--	100	80.0[4]	90.0	90.0[2]	--
	Standard Rating Part-Load Conditions (IEER)[3, 5]	80.0	67.0	Varies with load per Table 9	Varies with load per Table 9[1,7]	Varies with load per Table 9	Varies with load per Table 9	77.0	Varies with load per Table 9[2]	Varies with load per Table 9
	Insulation Efficiency[3, 5]	80.0	75.0	80.0	75.0	80.0	75.0	85.0	--	80.0
	Condensate Disposal[3, 5]	80.0	75.0	80.0	75.0	80.0	75.0	85.0	--	80.0
Heating	Standard Rating Conditions (High Temperature Steady State Heating)[5]	70.0	60.0 (max)	47.0	43.0	--	--	--	--	--
	Standard Rating Conditions (Low Temperature Steady State Heating)[5]	70.0	60.0 (max)	17.0	15.0	--	--	--	--	--
	Maximum Operating Conditions[5]	80.0	--	75.0	65.0	--	--	--	--	--

Footnotes:

1. Only required if unit rejects condensate to Outdoor 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. Indoor fan system external static pressure shall be set per Table 7.
5. Tests are only valid when the atmospheric pressure is greater than 13.700 psia.
6. For some product classifications, the outdoor section can be located indoors per section 5.9.
7. For Single Package Units that do not reject condensate to the Outdoor Coil, where all or part of the indoor section of the equipment is located in the outdoor room, maintain an outdoor room dew point temperature of 60.5ºF for 100, 75, and 50 Percent Load tests and 58.7ºF for 25 Percent Load tests.