



**BSR/ASHRAE Addendum e to
ANSI/ASHRAE Standard 205-2023**

Public Review Draft

Proposed Addendum e to Standard 205-2023, Representation of Performance Data for HVAC&R and Other Facility Equipment

**First Public Review (December 2024)
(Draft shows Proposed Changes to Current Standard)**

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**Proposed BSR/ASHRAE Addendum e to ANSI/ASHRAE Standard 205-2023,
*Representation of Performance Data for HVAC&R and Other Facility Equipment***

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

Foreword to Addendum e

Standard 205-2023 Addendum e adds coverage of heating performance to RS0004, Air-to-Air Direct Expansion System. This allows representation of direct expansion coil heating in addition to cooling. This addition will allow RS0002 Unitary Cooling Air-Conditioning Equipment to be extended to cover heat pump performance. Addendum e also adds the common enumeration "PerformanceCapabilities", that is used to indicate whether a system is capable of heating and/or cooling (and in the future, other capabilities such as humidification/dehumidification).

Note that Addendum e does not address auxiliary heating typically provided in heat pump systems. Inclusion of auxiliary heating will be provided via future addenda that extend RS0002 (currently Unitary Cooling Air-Conditioning Equipment, will be retitled Unitary Air-Conditioning Equipment) and add representations for resistance- and fuel-based heating equipment.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and strikethrough (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum e to Standard 205-2023

5.6 Required Data Elements. The “Required” data element attribute is used to indicate the conditions where a data element value is required if the containing data group is present in a representation. If the data element is never required, the “Required” data element attribute shall be left blank. The following conditions are allowed.

5.6.1 Unconditional. The data element is unconditionally required. A data element that is unconditionally required shall be denoted with a checkmark “√”.

Informative note: In JSON Schema this is indicated by including the data element name in the list of required properties for the object.

5.6.2 Prerequisite Definition. The data element value shall be required if a specific prerequisite data element is defined in the representation regardless of the value of the prerequisite data element. A data element `dependent`, that is required when the prerequisite data element `prerequisite` is defined, has the requirement stated as `if prerequisite`.

Informative note: In JSON Schema this is indicated through the use of dependencies.

5.6.3 Prerequisite Value. The data element value shall be required if a specific prerequisite data element is defined and is equal to (or not equal to) a specific value in the representation. A data element `option_a`, that is required when the prerequisite data element `option_type` has the value `OPTION_A`, has the requirement stated as `if option_type=OPTION_A`. Similarly, a data element `minimum_speed`, that is required when the prerequisite data element `speed_type` **does not** have the value `SINGLE_SPEED`, has the requirement stated as `if speed_type!=SINGLE_SPEED`.

Informative note: In JSON Schema this is indicated through the use of “if-then” constructs.

5.6.4 Prerequisite Array Value. [The data element value shall be required if a specific prerequisite array data element is defined and contains a specific value in the representation. A data element `option_a`, that is required when the prerequisite data element `option_types` contains the value `OPTION_A`, has the requirement stated as `if option_types contains\(OPTION_A\)`.](#)

Informative note: [In JSON Schema this is indicated through the use of “if-then” and “contains” constructs.](#)

5.6.5 Combining Prerequisite Conditions. When multiple prerequisite conditions are needed to define when a data element is required, these conditions may be combined using `and` and/or `or` and grouped as needed with parentheses. Combined conditions begin with a single `if`.

Informative note: Example: `if (prerequisite and option_type=OPTION_A) or option_type=OPTION_B`.

5.7 Scalable Data Elements. The “Scalable” data element attribute is used to indicate whether a data element value can be scaled by the application software using the information in the Scaling Data Group (see Table 5–16) in the representation’s `performance` data. A data element whose value is scalable shall be denoted with a checkmark “√”. If the data element value shall not be scaled, the “Scalable” data element attribute shall be left blank.

5.8 Common Enumerations. Common enumerations are used in more than one representation specification.

When a representation specification includes data elements of enumerations listed in this section, the specified enumerators shall be used.

Table 5–5 SchemaType

Enumerator	Attributes
RS0001	Description: Liquid-Cooled Chiller
RS0002	Description: Unitary Cooling Air-Conditioning Equipment
RS0003	Description: Fan Assembly
RS0004	Description: Air-to-Air Direct Expansion Refrigerant System
RS0005	Description: Motor
RS0006	Description: Electronic Motor Drive
RS0007	Description: Mechanical Drive

Table 5–6 CompressorType

Enumerator	Attributes
RECIPROCATING	Description: Reciprocating compressor
SCREW	Description: Screw compressor
CENTRIFUGAL	Description: Centrifugal compressor
ROTARY	Description: Rotary compressor
SCROLL	Description: Scroll compressor

Table 5–7 SpeedControlType

Enumerator	Attributes
DISCRETE	Description: Loading is controlled by cycling between one or more discrete stages
CONTINUOUS	Description: Loading is controlled by continuously varying the speed

Table 5–8 CondenserType

Enumerator	Attributes
AIR	Description: Air-cooled condenser
LIQUID	Description: Liquid-cooled condenser
EVAPORATIVE	Description: Evaporative condenser

Table 5–9 LiquidConstituent

Enumerator	Attributes
WATER	Description: Water
PROPYLENE_GLYCOL	Description: Propylene glycol
ETHYLENE_GLYCOL	Description: Ethylene glycol
SODIUM_CHLORIDE	Description: Sodium chloride
CALCIUM_CHLORIDE	Description: Calcium chloride
ETHANOL	Description: Ethanol
METHANOL	Description: Methanol

Table 5–10 ConcentrationType

Enumerator	Attributes
BY_VOLUME	Description: Concentration is defined as a fraction of total liquid mixture volume
BY_MASS	Description: Concentration is defined as a fraction of total liquid mixture mass

Table 5–11 OperationState

Enumerator	Attributes
NORMAL	Description: Indicates that the equipment is in normal operating state
STANDBY	Description: Indicates that the equipment is in standby operating state

Table 5–12 [PerformanceCapabilities](#)

Enumerator	Attributes
COOLING	Description: Indicates that the equipment provides explicitly controlled cooling and the representation contains cooling-related performance data
HEATING	Description: Indicates that the equipment provides explicitly controlled heating and the representation contains heating-related performance data
DEHUMIDIFICATION	Description: Indicates that the equipment provides explicitly controlled dehumidification and the representation contains dehumidification-related performance data
HUMIDIFICATION	Description: Indicates that the equipment provides explicitly controlled humidification and the representation contains humidification-related performance data

RS0004 AIR-TO-AIR DIRECT EXPANSION SYSTEM

RS0004.1 Identification and History. schema: RS0004

schema_version	Date	Initial Approved Standard	Notes
1.0.0	2023	2023	Initial publication
2.0.0	2024	2023 - Addenda a, b, & c	
3.0.0	2024	2023 - Addendum e	Add heating performance

RS0004.2 Scope and Description

RS0004.2.1 Applicability. Direct expansion vapor compression refrigerant systems with two coils (one evaporator and one condenser) both exchanging heat with air streams to provide cooling [and/or heating](#).

RS0004.2.2 Exclusions. Systems with ~~reversing capability to provide heating or systems with heat recovery~~ [hot gas reheat used for dehumidification](#).

RS0004.2.3 Embedded Representations. None.

RS0004.2.4 Referencing Representations

- RS0002: Unitary Cooling Air-Conditioning Equipment

RS0004.2.5 Schematic. Figure RS0004–1 illustrates the ~~components of the refrigerant systems~~ [representation of components within the scope of this appendix during cooling operation](#).

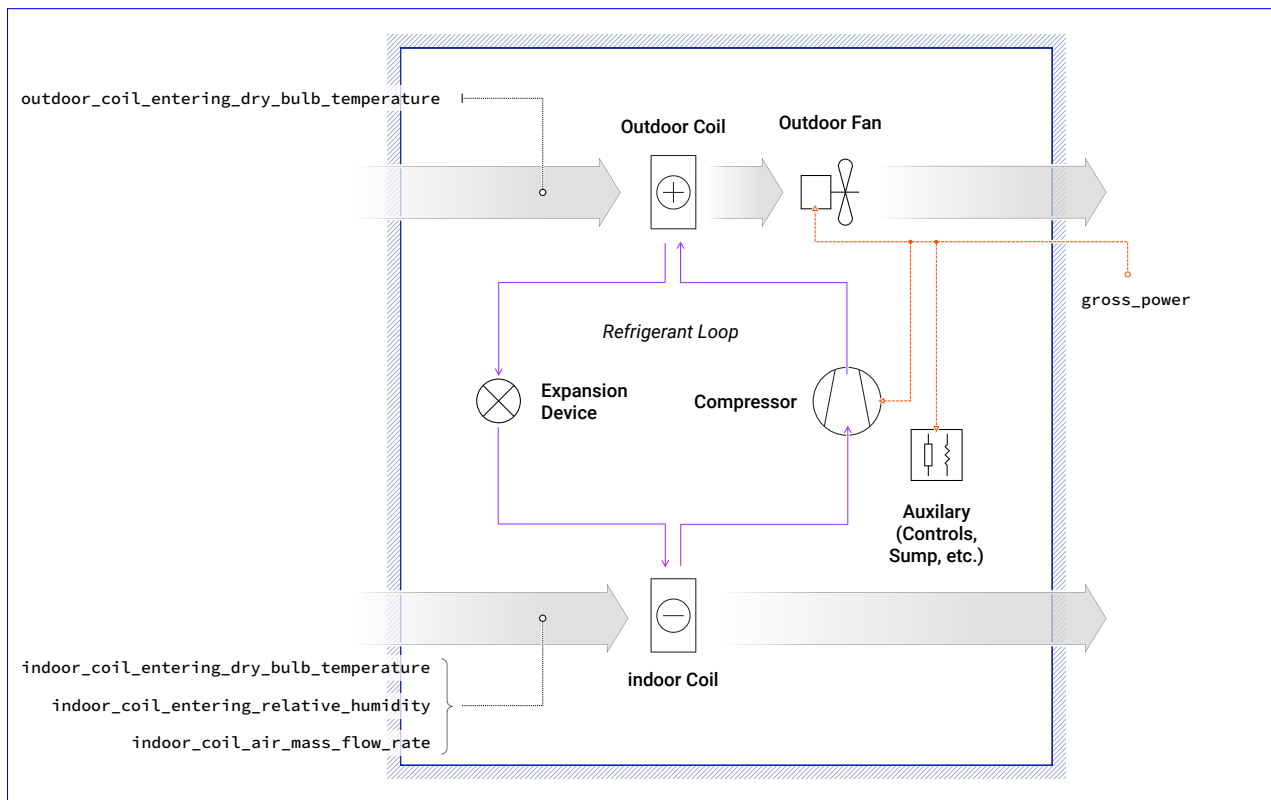


Figure RS0004–1 Air-to-Air direct expansion system during cooling operation.

Figure RS0004–2 illustrates the representation of components within the scope of this appendix during heating operation.

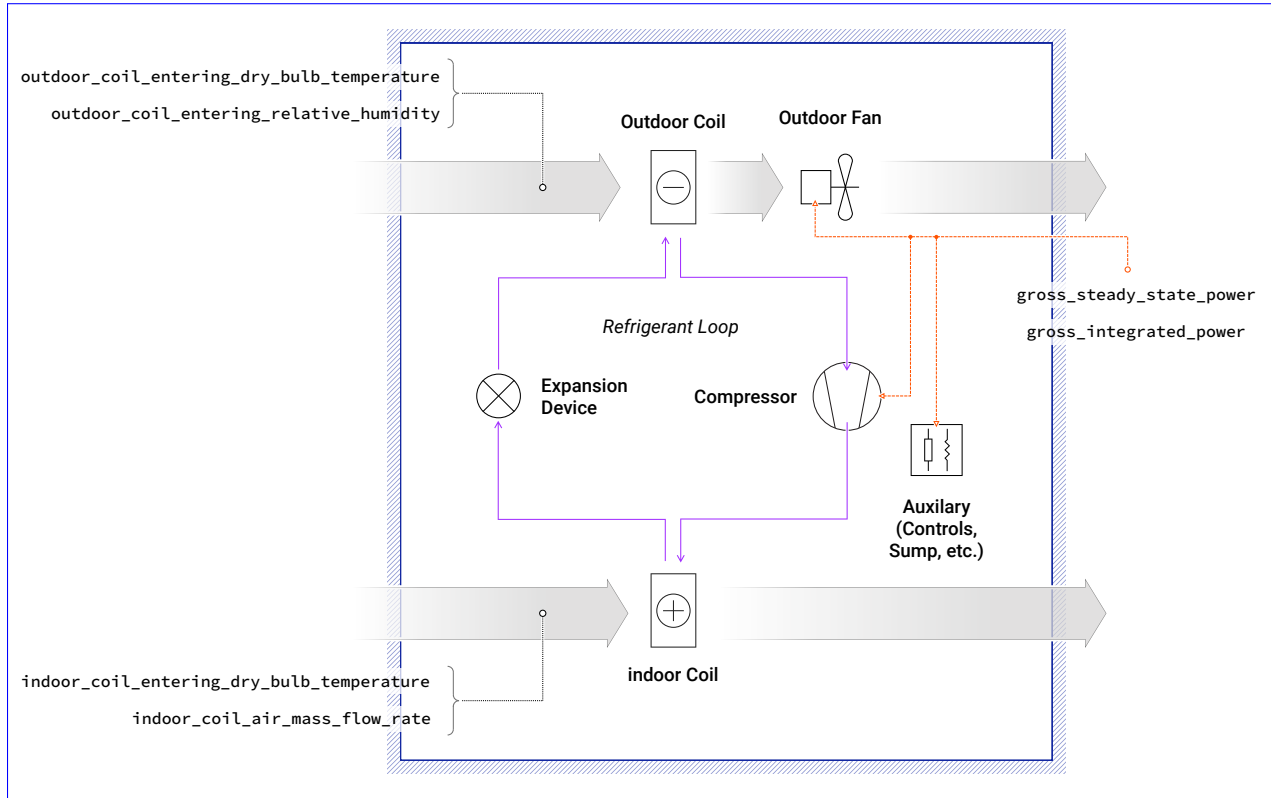


Figure RS0004–2 Air-to-Air direct expansion system during heating operation.

RS0004.3 Data Model

RS0004.3.1 Data Group Hierarchy. A representation implementation conforming to this representation specification shall consist of the following data groups:

- RS0004
 - Metadata
 - Description*
 - ProductInformation*
 - Performance
 - PerformanceMapCooling
 - GridVariablesCooling
 - LookupVariablesCooling
 - PerformanceMapHeating
 - GridVariablesHeating
 - LookupVariablesHeating
 - PerformanceMapStandby
 - GridVariablesStandby
 - LookupVariablesStandby

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification.

RS0004.3.2 Enumerations. None.

RS0004.3.3 Data Groups

Table RS0004–2 RS0004

Name	Attributes
metadata	Description: Metadata data group Data Type: {Metadata} Constraints: schema=RS0004 Req: ✓
description	Description: Data group describing product and rating information Data Type: {Description}
performance	Description: Data group containing performance information Data Type: {Performance} Req: ✓

Table RS0004–3 Description

Name	Attributes
product_information	Description: Data group describing product information Data Type: {ProductInformation}

Table RS0004–4 ProductInformation

Name	Attributes
outdoor_unit_manufacturer	Description: Outdoor unit manufacturer name Data Type: String
outdoor_unit_model_number	Description: Outdoor unit model number Data Type: Pattern Notes: Pattern shall match all model numbers that can be represented by the representation
indoor_unit_manufacturer	Description: Indoor unit manufacturer name Data Type: String Notes: May be omitted for packaged systems with a single manufacturer
indoor_unit_model_number	Description: Indoor unit model number Data Type: Pattern Notes: Pattern shall match all model numbers that can be represented by the representation
refrigerant	Description: Refrigerant used Data Type: String Notes: The string shall start with 'R-' and then include the refrigerant number designation conforming to ANSI/ASHRAE Standard 34 ¹
compressor_type	Description: Type of compressor Data Type: <CompressorType>

Table RS0004–5 Performance

Name	Attributes
performance_capabilities	<p>Description: An array of unique operating modes that indicate the capabilities of the equipment</p> <p>Data Type: [PerformanceCapabilities]</p> <p>Req: ✓</p>
compressor_speed_control_type	<p>Description: Method used to control different speeds of the compressor</p> <p>Data Type: <SpeedControlType></p> <p>Req: ✓</p>
cooling_cycling_degradation_coefficient	<p>Description: Cycling Cooling cycling degradation coefficient (C_D^c) as described in AHRI 210/240</p> <p>Data Type: Numeric</p> <p>Units: -</p> <p>Constraints: ≥ 0.0, < 1.0</p> <p>Req: ✓ if performance_capabilities contains(COOLING)</p> <p>Notes:</p> <ul style="list-style-type: none"> Used for the lowest stage when the unit cycles to meet load Informative note: 340/360 specifies a fixed cycling degradation coefficient of approximately 0.12
heating_cycling_degradation_coefficient	<p>Description: Heating cycling degradation coefficient (C_D^h) as described in AHRI 210/240</p> <p>Data Type: Numeric</p> <p>Units: -</p> <p>Constraints: ≥ 0.0, < 1.0</p> <p>Req: if performance_capabilities contains(HEATING)</p> <p>Notes:</p> <ul style="list-style-type: none"> Used for the lowest stage when the unit cycles to meet load Informative note: 340/360 specifies a fixed cycling degradation coefficient of approximately 0.12
scaling	<p>Description: Specifies the range the performance data can be scaled to represent different capacity equipment</p> <p>Data Type: {Scaling}</p> <p>Notes: If not present, scaling of the performance data is not allowed</p>
performance_map_cooling	<p>Description: Data group describing cooling performance over a range of conditions</p> <p>Data Type: {PerformanceMapCooling}</p> <p>Req: ✓ if performance_capabilities contains(COOLING)</p>
performance_map_heating	<p>Description: Data group describing heating performance over a range of conditions</p> <p>Data Type: PerformanceMapHeating</p> <p>Req: if performance_capabilities contains(HEATING)</p>
performance_map_standby	<p>Description: Data group describing standby performance</p> <p>Data Type: {PerformanceMapStandby}</p> <p>Req: ✓</p>

Table RS0004–6 PerformanceMapCooling

Name	Attributes
grid_variables	Description: Data group defining the grid variables for cooling performance Data Type: {GridVariablesCooling} Req: ✓
lookup_variables	Description: Data group defining the lookup variables for cooling performance Data Type: {LookupVariablesCooling} Req: ✓

Table RS0004–7 GridVariablesCooling

Name	Attributes
outdoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the outdoor coil Data Type: [Numeric][1..] Units: K Constraints: ≥ 0.0 Req: ✓
indoor_coil_entering_relative_humidity	Description: Relative humidity of the air entering the indoor coil Data Type: [Numeric][1..] Units: - Constraints: $\geq 0.0, \leq 1.0$ Req: ✓ Notes: As measured immediately before entering the coil (i.e., after the fan in a blow-through configuration)
indoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the indoor coil Data Type: [Numeric][1..] Units: K Constraints: ≥ 0.0 Req: ✓ Notes: As measured immediately before entering the coil (i.e., after the fan in a blow-through configuration)
indoor_coil_air_mass_flow_rate	Description: Mass flow rate of air entering the indoor coil Data Type: [Numeric][1..] Units: kg/s Constraints: > 0.0 Req: ✓ Scalable: ✓

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Name	Attributes
compressor_sequence_number	<p>Description: Index indicating the relative capacity order of the compressor speed/stage expressed in order from lowest capacity (starting at 1) to highest capacity</p> <p>Data Type: [Integer] [1..]</p> <p>Units: -</p> <p>Constraints: ≥1</p> <p>Req: ✓</p> <p>Notes:</p> <ul style="list-style-type: none"> • If compressor_speed_control_type is DISCRETE, sequence numbers shall be provided for each discrete stage of the compressor(s) • If compressor_speed_control_type is CONTINUOUS, sufficient sequence numbers shall be provided to capture the continuous operation of the compressor(s)
ambient_absolute_air_pressure	<p>Description: Ambient absolute air pressure</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: Pa</p> <p>Constraints: ≥0.0</p> <p>Req: ✓</p>

Table RS0004–8 LookupVariablesCooling

Name	Attributes
gross_total_capacity	<p>Description: Total heat removed by the indoor coil</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: W</p> <p>Constraints: ≥0.0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes: Shall not include fan heat</p>
gross_sensible_capacity	<p>Description: Sensible heat removed by the indoor coil</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: W</p> <p>Constraints: ≥0.0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes: Shall not include fan heat</p>
gross_power	<p>Description: Gross power draw (of the outdoor unit)</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: W</p> <p>Constraints: >0.0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes:</p> <ul style="list-style-type: none"> • Includes compressor, outdoor fan, and any auxiliary power used by the unit’s controls and any sump heater • Shall not include power drawn by the indoor fan

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Name	Attributes
operation_state	Description: The operation state at the operating conditions Data Type: [<OperationState>] Units: - Req: ✓

Table RS0004–9 [PerformanceMapHeating](#)

Name	Attributes
grid_variables	Description: Data group defining the grid variables for heating performance Data Type: {GridVariablesHeating} Req: ✓
lookup_variables	Description: Data group defining the lookup variables for heating performance Data Type: {LookupVariablesHeating} Req: ✓

Table RS0004–10 [GridVariablesHeating](#)

Name	Attributes
outdoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the outdoor coil Data Type: [Numeric] [1..] Units: K Constraints: ≥0 Req: ✓
outdoor_coil_entering_relative_humidity	Description: Relative humidity of the air entering the outdoor coil Data Type: [Numeric] [1..] Units: - Constraints: ≥0, ≤1.0 Req: ✓
indoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the indoor coil Data Type: [Numeric] [1..] Units: K Constraints: ≥0 Req: ✓ Notes: As measured immediately before entering the coil (i.e., after the fan in a blow-through configuration)
indoor_coil_air_mass_flow_rate	Description: Mass flow rate of air entering the indoor coil Data Type: [Numeric] [1..] Units: kg/s Constraints: >0 Req: ✓ Scalable: ✓

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<u>Name</u>	<u>Attributes</u>
compressor_sequence_number	<p>Description: Index indicating the relative order of the compressor speed/stage</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: -</p> <p>Constraints: ≥0</p> <p>Req: ✓</p> <p>Notes: Expressed in order from initial stage/speed to final stage/speed</p>

Table RS0004-11 [LookupVariablesHeating](#)

<u>Name</u>	<u>Attributes</u>
gross_steady_state_capacity	<p>Description: Total heat added by the indoor coil under steady-state conditions (i.e., does not include the impact of frost accumulation or defrost operation)</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: W</p> <p>Constraints: >0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes:</p> <ul style="list-style-type: none"> Sometimes also referred to as “instantaneous” capacity Does not account for heat added by the fan
gross_integrated_capacity	<p>Description: Total heat added by the indoor coil integrated over the time between defrost terminations</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: W</p> <p>Constraints: >0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes:</p> <ul style="list-style-type: none"> Sometimes referred to as “frost accumulation” capacity Does not account for heat added by the fan
gross_steady_state_power	<p>Description: Gross power draw of the outdoor unit under steady-state conditions (i.e., does not include the impact of frost accumulation or defrost operation)</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: W</p> <p>Constraints: >0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes:</p> <ul style="list-style-type: none"> Sometimes also referred to as “instantaneous” power Does not include power drawn by the indoor fan Includes compressor, outdoor fan, and any auxiliary power used by the unit’s controls and any sump heater

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Name	Attributes
gross_integrated_power	<p>Description: Gross power draw of the outdoor unit integrated over the time between defrost terminations</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: W</p> <p>Constraints: >0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes:</p> <ul style="list-style-type: none"> • Sometimes referred to as “frost accumulation” power • Does not include power drawn by the indoor fan • Includes compressor, outdoor fan, and any auxiliary power used by the unit’s defrost process, controls, and any sump heater
defrost_cycle_frequency	<p>Description: Frequency of defrost terminations under the current operating conditions</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: Hz</p> <p>Req: ✓</p> <p>Notes: This is the inverse of the duration between defrost terminations, a value of zero implies defrost is not occurring</p>
defrost_time_fraction	<p>Description: Fraction of time between defrost terminations that the defrost process is engaged</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: -</p> <p>Constraints: ≥0, ≤1.0</p> <p>Req: ✓</p>

Table RS0004–12 PerformanceMapStandby

Name	Attributes
grid_variables	<p>Description: Data group defining the grid variables for standby performance</p> <p>Data Type: {GridVariablesStandby}</p> <p>Req: ✓</p>
lookup_variables	<p>Description: Data group defining the lookup variables for standby performance</p> <p>Data Type: {LookupVariablesStandby}</p> <p>Req: ✓</p>

Table RS0004–13 GridVariablesStandby

Name	Attributes
outdoor_coil_environment_dry_bulb_temperature	<p>Description: Dry bulb temperature of the air in the environment of the outdoor coil</p> <p>Data Type: [Numeric] [1..]</p> <p>Units: K</p> <p>Constraints: ≥0.0</p> <p>Req: ✓</p>

Table RS0004-14 LookupVariablesStandby

Name	Attributes
gross_power	<p>Description: Gross power draw (of the outdoor unit)</p> <p>Data Type: [Numeric][1..]</p> <p>Units: W</p> <p>Constraints: >0.0</p> <p>Req: ✓</p> <p>Scalable: ✓</p> <p>Notes: Includes any auxiliary power used by the unit's controls and any sump heater</p>

RS0004.4 Verification Rules. Performance data supplied must satisfy the following verification tests. The psychrometric functions used below shall follow the definitions provided by the ASHRAE Handbook of Fundamentals-2021, Chapter 1².

RS0004.4.1 Apparatus Dew Point. An apparatus dew point for the indoor coil must be determinable from the given combination of entering air conditions, total cooling capacity, and sensible heat ratio. That is, a line drawn on a psychrometric chart between the inlet and outlet conditions must intersect the saturation curve when extended beyond the outlet conditions:

There exists $T_{db,ADP}$ and ω_{ADP} such that:

$$\frac{\omega_e - \omega_l}{T_{db,e} - T_{db,l}} = \frac{\omega_e - \omega_{ADP}}{T_{db,e} - T_{db,ADP}}$$

and

$$\phi(T_{db,ADP}, \omega_{ADP}, P) = 1.0$$

RS0004.4.2 Moisture Conservation. The resulting humidity ratio of the air leaving the indoor coil shall not exceed the humidity ratio of the air entering the indoor coil:

$$\omega_l \leq \omega_e$$

RS0004.4.3 Nomenclature

Symbol	Description
ϕ	Relative humidity
ω	Humidity ratio, kg _{water} / kg~dry air~
T_{db}	Dry-bulb temperature, K
P	Absolute pressure, Pa
e	Subscript indicating entering coil conditions
l	Subscript indicating leaving coil conditions
ADP	Subscript indicating Apparatus Dew Point (ADP) conditions

RS0004.5 Publishing Rules. None.

RS0004.6 Application Rules

RS0004.6.1 Cooling Performance. `performance_map_cooling` shall be used to simulate performance when system controls call for cooling.

RS0004.6.2 Heating Performance. [performance_map_heating](#) shall be used to simulate performance when system controls call for heating.

RS0004.6.3 Standby Performance. `performance_map_standby` shall be used to simulate performance under any of the following conditions:

- a. system controls are not calling for cooling [or heating](#), or
- b. system controls are calling for cooling [or heating](#), but either:
 1. the current simulated conditions are outside the range of grid variables in [performance_map_cooling](#) [the respective performance map](#), or
 2. the corresponding lookup variable `operation_state` in [performance_map_cooling](#) [the respective performance map](#) has a value of STANDBY at the current simulated conditions.

RS0004.7 References

1. ASHRAE. *Standard 34: Designation and Safety Classification of Refrigerants*. Atlanta, Georgia: ASHRAE, 2022.
2. ASHRAE. *ASHRAE Handbook—Fundamentals*. Atlanta, Georgia: ASHRAE, 2021.

RS0004.8 Example (Informative). See <https://data.ashrae.org/Standard205/examples.html>.