



**BSR/ASHRAE/IBPSA Addendum *h* to
ANSI/ASHRAE Standard 205-2023**

Public Review Draft

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

**First Public Review (October 2026)
(Draft shows Proposed Changes to Current Standard)**

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Proposed BSR/ASHRAE/IBPSA Addendum h 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 h

This addendum contains modifications to several aspects of Standard 205-2023 in preparation for anticipated republication of the entire standard in late 2026. The following is an overview of the proposed changes.

Common Verification and Publication Rules

New shared rules that apply across representation specifications, referenced rather than restated in each one:

- **Carnot COP limit:** for refrigerant-cycle equipment, COP shall not exceed the Carnot COP for the corresponding source/sink temperatures, for any combination of grid variable values.
- **Monotonicity:** power input and capacity shall not increase at lower compressor sequence numbers; capacity shall not increase at colder/warmer source or sink temperatures (by mode) unless power input also increases.
- **Air-cooling heat exchanger rule:** sensible cooling capacity shall not increase at lower air flow rates across the heat exchanger.
- *New common Application Rules: disclaimer and expiration_date handling, and standby-operation modeling when an operational limit is exceeded.*
- *RS0001 gains a condenser-type-to-sink-temperature table to apply the Carnot COP rule, and a note that defrost pan heaters are not represented in the data model (application software must characterize their energy use separately).*

Metadata and Product Identification

- *Metadata extended with copyright, license, and expiration_date data elements.*
- *New common ProductIdentifier data group replaces the previous single model_number field, and the id versioning text is updated to reference product_identifiers accordingly.*

Data Group and Data Element Naming

Several families of names historically put the "what it is" word first (e.g., PerformanceMapCooling, RatingAHRI210240), conflicting with the convention used elsewhere in the standard, where the descriptive qualifier comes first (e.g., DesignData, compressor_type). Reordered so the type word is a suffix:

- *Rating data groups: RatingAHRI210240 → AHRI210240Rating (and AHRI 340/360, 550/590, 551/591)*

- *PerformanceMap/GridVariables/LookupVariables data groups and their data elements, across RS0001, RS0003, RS0004 (e.g., PerformanceMapCooling → CoolingPerformanceMap, performance_map_cooling → cooling_performance_map)*
- *RS0001's condenser-type performance maps renamed to match terminology the standard already uses elsewhere (liquid-cooled/air-cooled/evaporatively-cooled condenser): CoolingLiquidPerformanceMap → LiquidCooledPerformanceMap, etc.*
- *RS0001's evaporator/condenser liquid pressure differential data groups reclassified out of the PerformanceMap family (to EvaporatorLiquidPressureDifferential/CondenserLiquidPressureDifferential), since a pressure-vs-flow curve isn't an equipment performance characteristic the way capacity/COP/efficiency are.*
- *§8 (Data Model Naming Conventions) updated to describe the suffix pattern, including its informative regular expressions.*

Data Model Restructuring

- *RS0001 and RS0002's individual AHRI rating data groups nested under a single Ratings data group within Description, instead of appearing as separate siblings of ProductInformation; individual rating element names drop the now-redundant "rating" suffix (ahri_550_590_rating → ahri_550_590). This nesting convention applies to any future representation specification defining rating data.*
- *PerformanceMapTemplate unified with the generic LookupTableTemplate data group template (schema-level) — the two had identical structural requirements.*

Documentation Structure

- *Each representation specification's "Data Group Hierarchy" section marked informative, matching "Version History" and "Schematic."*
- *Two notes relocated out of RS0001's Data Group Hierarchy: a general note on conditionally-required elements of optional data groups generalized into §8 (applies to every representation specification); a note on representing multi-chiller systems moved to RS0001's Publication Rules.*
- *§8 no longer restates ASHRAE Standard 232's own generic naming rules nearly verbatim, per the standard's own stated principle that its text should describe extensions to 232, not restate it.*

Reference Updates

- *CBOR signing/encryption reference updated from RFC 8152 to its successor, RFC 9052.*

[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 h to Standard 205-2023

6.4 Units

6.4.1 General Requirements. Except as specified in Section 6.4.2, all numeric values shall be represented in SI units as specified in ASHRAE SI policy documents⁴. Base units shall be used (e.g., temperature shall be expressed in ~~de-~~~~grees~~ Kelvin and time shall be expressed in seconds). Any unit conversions needed for preparing or using representation data shall be done using conversion factors specified in ASHRAE SI policy. When no appropriate conversion factor is specified in ASHRAE SI policy, it shall be described in the data element descriptive text including conversion factors.

The rules for writing units in documentation and code are defined in ASHRAE Standard 232.

6.4.2 Non-SI Units. Units other than SI are required or permitted in the following situations:

- Ratings. Standard rating values shall be published using the units specified in the rating definition. For example, SEER shall be published in Btu/W·h.
- Descriptive text. Values included in descriptive text or documentation data elements are permitted to be given in any units and the units used shall be stated.

6.9 Common Data Groups. The following data groups shall be referenced in representation specifications where applicable to avoid independent implementations of similar data structures.

6.9.1 Metadata. The `Metadata` data group is the header data group included in ASHRAE Standard 232 and each representation shall include this data group. [Standard 205 extends the `Metadata` data group with the `copyright`, `license`, and `expiration\_date` data elements.](#)

Table 6–9 Metadata

<u>Name</u>	<u>Attributes</u>
<u><code>schema_author</code></u>	Description: Name of the organization that published the schema Type: String Required: True Notes: Identifies the organization that defined the schema
<u><code>schema_name</code></u>	Description: Schema name or identifier Type: String Required: True Notes: Identifies the schema used to define the data content
<u><code>schema_version</code></u>	Description: The version of the schema the data complies with Type: Version Required: True
<u><code>schema_url</code></u>	Description: The Uniform Resource Locator (url) for the schema definition and/or documentation Type: String
<u><code>author</code></u>	Description: Name of the entity creating the serialization Type: String Required: True Notes: Identifies the organization that created the file
<u><code>id</code></u>	Description: Unique data set identifier Type: UUID Notes: Assigned by <i>data publisher</i> to identify this data. <code>id</code> shall remain unchanged for revisions of the same data.
<u><code>description</code></u>	Description: Description of data content (suitable for display) Type: String Required: True

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<u>Name</u>	<u>Attributes</u>
<u>time_of_creation</u>	Description: <u>Timestamp indicating when the serialization was created</u> Type: <u>Timestamp</u> Required: <u>True</u> Notes: <u>Updated anytime any data content is modified</u>
<u>version</u>	Description: <u>Integer version identifier for the data</u> Type: <u>Version</u> Notes: • <u>Used by data publisher to track revisions of the data</u> • <u>Shall be incremented for each data revision</u>
<u>source</u>	Description: <u>Source(s) of the data</u> Type: <u>String</u> Notes: • <u>Used by data publisher to document methods (e.g., software and version) used to generate data</u> • Informative note: <u>source may be different from other data source(s) included elsewhere within the data</u>
<u>disclaimer</u>	Description: <u>Characterization of accuracy, limitations, and applicability of this data</u> Type: <u>String</u>
<u>copyright</u>	Description: <u>Copyright notice for the data</u> Type: <u>String</u> Notes: Informative note: <u>e.g., 'Copyright © 2024 Acme Corporation. All rights reserved.'</u>
<u>license</u>	Description: <u>License governing use, reproduction, and distribution of the data</u> Type: <u>String</u> Notes: Informative note: <u>May be an SPDX identifier (e.g., 'CC-BY-4.0'), a URL to the license terms, or the full license text</u>
<u>expiration_date</u>	Description: <u>Date after which the data is no longer considered valid by the data publisher</u> Type: <u>Date</u>
<u>notes</u>	Description: <u>Additional Information</u> Type: <u>String</u>

6.9.1.1 Representation Versioning. The versioning of a representation is denoted by three individual data elements: `schema_version`, `id`, and `data_version`.

- The `schema_version` indicates the version of the representation specification schema that was used to create the representation.
- The `id` shall uniquely identify the set of equipment covered by the representation. A single `id` represents multiple pieces of equipment when the data in the representation is the same for all the pieces of equipment (e.g., a product line with identical performance but different model numbers). A representation specification shall include a data element for listing the pieces of equipment covered by a representation (e.g., `model+product_number+identifiers`). An `id` shall be assigned when the representation is first created. A new `id` shall be generated if and only if the set of pieces of equipment covered by the representation is altered and
 - Pieces of equipment are added that were previously covered by another representation, or
 - Pieces of equipment are removed and added to another representation.
- The `data_version` shall indicate the version of the data included in the representation. The `data_version` shall be incremented whenever any data in the representation is modified.

6.9.2 Reusable Data Groups. The following data groups are defined here and shall be used in any representation specification where applicable to avoid independent implementations of similar data structures.

Informative note 1: These data groups may be used as many times as necessary, even within a single representation specification.

Informative note 2: Additional reusable data groups will be added as necessary when new representation specifications are defined.

Table 6–10 ProductIdentifier

<u>Name</u>	<u>Attributes</u>
<u>brand</u>	Description: <u>Brand name under which the equipment is sold</u> Type: <u>String</u> Required: <u>True</u>
<u>model_number</u>	Description: <u>Model number of the equipment</u> Type: <u>Pattern</u> Required: <u>True</u> Notes: <u>Pattern shall match all model numbers that can be represented by the representation</u>

Table 6–11 LiquidMixture

<u>Name</u>	<u>Attributes</u>
<u>liquid_components</u>	Description: An array of all liquid components within the liquid mixture Type: <code>Array(Group(LiquidComponent))</code> Required: <code>True</code> Notes: Array may contain a single component

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Name	Attributes
maximum	Description: Maximum scaling factor Type: Numeric Units: - Constraints: • ≥ 1.0 Notes: If not specified, unlimited

Informative note: Each Representation Specification may include a “scaling” data element (of type “{Scaling}”) in its “Performance” data group. If it is not present, scaling is not allowed. If it is present, scaling is allowed within the range it specifies. If it is specified, but neither minimum nor maximum are defined (i.e., the data element is empty), unlimited scaling is allowed.

7 REPRESENTATION SPECIFICATION STRUCTURE

A representation specification shall consist of a single human-readable (e.g., PDF) document organized as specified in ASHRAE Standard 232 and described in this section and appended to this standard as a normative appendix. The ASHRAE 205 JSON schema file(s) associated with each representation specification are deemed equivalent to the data definitions in the representation specification, allowing automated validation and manipulation of representation data.

A representation specification and normative supporting material available at <https://data.ashrae.org/standard205>, along with Standard 205, shall provide all required information for data publishers to prepare conforming representations and for application software developers to implement interface code to access and verify such information.

Informative note: Any number of informative supporting human- or machine- readable files may be provided for a representation specification at <https://data.ashrae.org/standard205>.

7.1 Documentation

7.1.1 Identification. Schema Name. A string code, which uniquely identifies each representation specification. Schema names shall be of the form RSXXXX, where XXXX is 4 decimal digits.

7.1.2 Version History. [This section in each representation specification shall be informative.](#) A table with columns for `schema_version`, “Date”, “Initial Approved Standard”, and “Notes”. Each time a revised representation specification is published, a new row shall be prepended to the top of the table. Entries for “Initial Approved Standard” shall include the year and any relevant addenda. “Notes” shall provide a high level description of relevant changes.

The `schema_version` shall be incremented using semantic versioning⁵ whenever there is a change to the Representation Specification data model.

7.1.3 Use Case. A description of the intended purpose of the representation.

7.1.4 Scope and Description. A narrative section providing information that defines the facility equipment covered by the representation specification. The following sections shall appear in each representation specification.

7.1.4.1 Applicability. A description of the facility equipment covered by the representation specification.

7.1.4.2 Exclusions. A description of related facility equipment explicitly not covered by the representation specification. Representation specifications with no identified exclusions shall indicate this by stating, “None”.

7.1.4.3 Embedded Representations. A list of any representation specifications whose representations are referenced as data elements within the representation specification. The list shall include the schema type, the schema type description, and the fully qualified referencing data element. Representation specifications with no embedded representations shall indicate this by stating, “None”.

7.1.4.4 Referencing Representations. A list of any representation specifications with data elements that reference representations conforming to the pertinent representation specification (and any corresponding text). Representation specifications whose representations are not referenced as data elements shall indicate this by stating, “None”.

7.1.4.5 Schematic. [This section in each representation specification shall be informative.](#) One or more schematics and any associated text shall be included to aid correct generation and application of conforming representations. The schematic shall show conceptual energy and/or fluid flow(s). The schematic shall be annotated to indicate the location of key data elements with their corresponding names.

7.2 Data Model. This section specifies the data groups, data elements, and enumerations that identify the performance of the equipment to be included in a representation.

7.2.1 Data Model Group Hierarchy. [This section in each representation specification shall be informative.](#) Each representation specification shall illustrate the hierarchy of data groups comprising a conforming representation. Data groups shall be nested within each other according to the following hierarchy:

- RSXXXX
 - Metadata
 - Description*
 - ProductInformation*
 - Ratings†*
 - Rating(s)†*
 - Performance
 - PerformanceMap(s)†
 - GridVariables
 - LookUpVariables

where:

- † indicates data groups that are not required to be present in a specific representation specification, and
- * indicates data groups that, when defined in a specific representation specification, are not required to be present in any representation conforming to that representation specification.

[Informative note:](#) [Required data elements of an optional data group are only required when that data group is present in a representation.](#)

7.2.2 Enumerations. Any enumerations specific to the representation specification shall be defined prior to any data group definitions.

7.2.3 Data Groups

7.2.3.1 RSXXXX. Each representation specification shall define a single data group that contains nested data groups specific to the facility equipment's performance and description.

7.2.3.2 Metadata. The first data group in each representation shall be `Metadata`, specified in Section 6.9.1. As a common data group, `Metadata` shall not be repeated in representation specifications.

7.2.3.3 Description. This data group contains descriptive information about the facility equipment. The contents of this data group shall not impact performance results derived using representation data. This data group is not required.

Informative note: Authorities requiring the use of Standard 205 representations could require that this data group or data elements in this data group be present.

7.2.3.4 ProductInformation. This data group describes facility equipment identification information; for example: ~~manufacturer name~~ `brand name(s)`, model number(s), and general characteristics (e.g., compressor type).

7.2.3.5 RatingRatings. If appropriate, a representation specification shall define data groups that ~~includes data elements that~~ represent standard ratings, `nested within a single Ratings data group in Description`. If the equipment is certified according to a rating procedure, the rating data in the representation's description data group shall be consistent with the certified rating.

Informative note: Representation data conveys typical performance at various operating conditions. Rating conditions and operating modes may or may not occur during installed operation. Standard 205 and ratings have different purposes; it is not possible to achieve consistency in all cases.

7.2.3.6 Performance. This data group shall contain the data elements that are needed to characterize the operational performance of the facility equipment by the application software. The performance data group shall contain (1) any number of data elements that represent equipment properties that are constant across all operating conditions, and (2) any number of nested performance map data groups that represent equipment operation over a range of operating conditions.

Informative note: Standard 205 can be thought of as a passive data-conveyance scheme. Application software uses representation data without modification to calculate energy use or other results. This view has the following implications:

- In most situations data publishers should provide values that are expected to occur during normal operation for all operating conditions.
- In some cases, rating procedures specify (or allow) test-only conditions that do not occur in installed operation and/or allow tolerances for test conditions, results reporting, or both. Such provisions should not be applied to performance map data.
- Representations may be created for nontypical situations (for example, reflecting degraded performance for faulty installations or enhanced controls). The data publisher should describe any nontypical characteristics of the representation in its disclaimer data element.

Informative note: Where appropriate, representation specifications may use single data elements (or arrays) to capture equipment performance over a range of operating conditions using regression or curve-fit coefficients. This is generally preferred over the use of performance maps if there is a physical basis for the curve or regression form.

7.2.3.6.1 Operational Limits. Representation specifications shall define operational limits (physical or practical) that define the range of conditions under which the equipment can operate, as applicable. Such limits shall be conveyed using any of the following approaches:

- a. explicitly defined via individual data elements (e.g., `maximum_environmental_temperature`),
- b. implicitly defined by the limits of the grid variable values in performance maps (unless the representation specification explicitly defines extrapolation procedures), or

c. explicitly defined using a lookup variable of type `OperationState` in performance maps.

Informative note: ~~Application software utilizing the representation data should model the equipment in standby operation if any operational limit is exceeded~~[See Section 7.2.6.1.3 for related application rules.](#)

7.2.3.6.2 Standby Operation Performance. Representation specifications for facility equipment that (a) uses fuel and/or electricity, or (b) adds/removes heat from the equipment’s surroundings when the equipment is in standby operation shall define data elements to characterize performance during standby operation. If standby operation performance cannot be characterized by single data elements, it shall be characterized using performance map(s). Standby operation characterized in performance map(s) shall use constant extrapolation to determine performance outside the minimum and maximum values of each grid variable.

Application rules shall define the conditions under which standby operation shall be applied.

7.2.3.7 PerformanceMap. Performance maps are required when the performance over the operational range of the equipment cannot be characterized by single data elements. One or more performance maps are included that convey equipment performance for a range of conditions and operating modes. Performance maps shall consist of data elements representing grid variables and lookup variables that relate the performance of the equipment over a range of operating conditions.

Lookup variable values shall be provided in a rectilinear, but not necessarily uniform, grid (as illustrated in Figure 7–1 for three dimensions) defined by the grid variable values. The lookup variable values shall be provided at the vertex defined by the combination of the grid variable values. This implies that both the outer boundary and each cell are hyperrectangles (n-dimensional rectangles).

Grid variable value combinations at which the equipment is in standby operation shall be represented with corresponding lookup variable of type `OperationState` with a value of `STANDBY`. Standby operation shall be assumed for any conditions falling within a grid cell having a lookup variable of type `OperationState` with a value of `STANDBY` at any vertex.

Informative note: Application software may create temporary virtual operating points in regions of non-operation as a calculation convenience but shall not infer actual operation in non-operating regions.

Application rules shall define the conditions under which each performance map within a representation shall be used.

Lookup variable values shall be provided with sufficient grid variable spacing to capture non-linear performance characteristics (e.g., inflections).

Informative note: A minimum of two values is required to indicate the operational range of the equipment for each grid variable. A single value for a grid variable indicates that operation is limited to that value (unless otherwise noted for the specific grid variable).

The performance map shall be defined in a data group including two data elements called `grid_variables` and `lookup_variables`. The `lookup_variables` data element definition shall include the “Cycling Order” attribute that lists the order that the grid variables are used in row-major order in providing the lookup variables values. Table 7–14 gives an example for two grid variables (“a” and “b”) and a single lookup variable (“V”) with a “Cycling Order” of {a, b}.

Table 7–14 Row-major order for two grid variables

Grid Variable [a]	Grid Variable [b]	Lookup Variable [V]
a1	b1	V _{a1,b1}
a1	b2	V _{a1,b2}
a1	b3	V _{a1,b3}
a2	b1	V _{a2,b1}
a2	b2	V _{a2,b2}
a2	b3	V _{a2,b3}

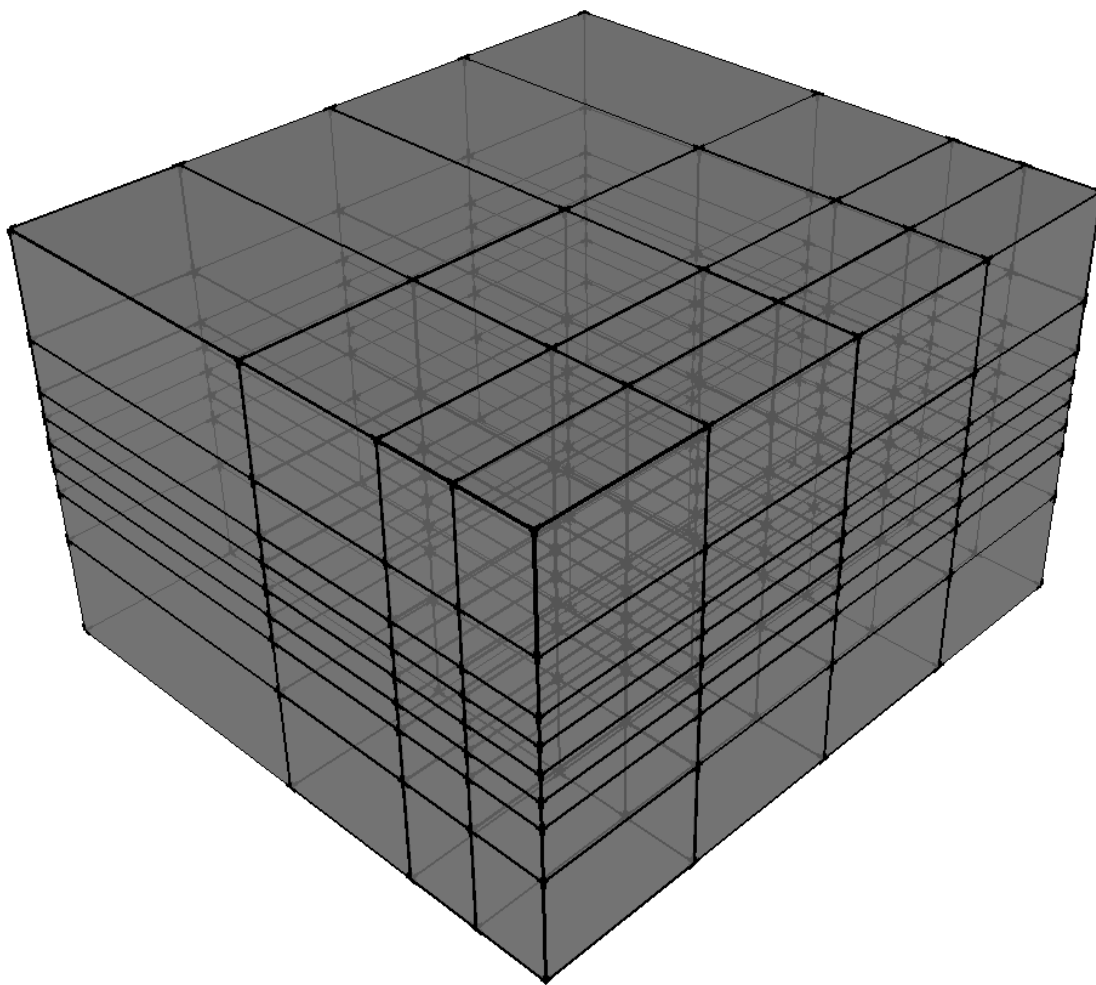


Figure 7–1 Example of a three-dimensional rectilinear grid.

7.2.3.8 GridVariables. Each grid variable within the `GridVariable` data group shall be described as an ordered array of values corresponding to points along an axis. Values shall be defined in ascending numerical order.

7.2.3.9 LookupVariables. Values of the lookup variables shall be defined as an array corresponding to all combinations of grid variable values. Lookup variables shall appear ordered according to the row-major order of the grid variables listed in the “Cycling Order” attribute of the `lookup_variables` data element in the performance map data group.

Informative note: See Informative Appendix A for an example.

7.2.4 Verification Rules. Representation specifications shall include description and documentation of computable rules used to verify minimal data validity and accuracy.

Basic data element data type and value constraints are verified by validating the representation against the ASHRAE 205 JSON schema. Such rules shall not be restated in Verification Rules.

Additional rules shall be included in the Verification Rules section and will depend on the type of facility equipment and data being represented. Typical examples are logical relationships among values and physical constraints such as:

- Cross-element consistency checks.
- Physically-based tests that allow detection of impossible values. For example, air-conditioner latent capacity must not imply that the leaving air has a negative humidity ratio.

The failure of any verification test shall indicate invalid data.

A fully verified representation shall be both validated versus the ASHRAE 205 JSON schema and verified based on the Verification Rules.

Informative note: The set of verification tests in a representation specification may not be sufficient to detect all invalid data.

7.2.4.1 Common Verification Rules. The following verification rules shall be performed on all representations. As common verification rules, the rules listed below shall not be repeated in representation specifications.

7.2.4.1.1 Schema Type Check. The `schema` data element in the `Metadata` data group shall be consistent with the `RSXXXX` data group.

7.2.4.1.2 Schema Version Check. The `schema_version` data element in the `Metadata` data group shall be compatible with the representation specification `schema_version` used to validate the representation. Representations with a major version number inconsistent with the schema major version number shall fail verification. When the major version numbers are identical, representations with minor version numbers greater than the schema minor version number shall fail verification. If both major and minor version numbers are identical, the representation shall pass verification regardless of the patch version number.

7.2.4.1.3 Lookup Variable Count Check. For any performance map, the number of values in a lookup variable array shall be equal to the product of all the lengths of the corresponding grid variable arrays. For example, if a performance map has three grid variables with 3, 3, and 2 values respectively, then every lookup variable array associated with this performance map shall have 18 (= 3 x 3 x 2) values.

7.2.4.1.4 Scalability Consistency Check. A representation and all embedded representations shall have consistent scaling factors in their “scaling” data elements.

7.2.5 Publication Rules. This section shall provide instructions and advice for data publishers to create representations.

Informative note: Any information that makes it easier for the data publisher to understand the data requirements for a representation (e.g., minimum grid spacings) can be included in this section.

7.2.5.1 Common Publication Rules. Common publication rules shall not be repeated in representation specifications; however, each applicable representation specification shall reference the applicable sections.

7.2.5.1.1 Common Refrigerant Cycle Representation Publication Rules. The following publication rules shall apply to representations of equipment that uses a refrigerant cycle, regardless of the fluids on either side of the heat exchange or the mode of operation. Each applicable representation specification shall reference this section and specify which data elements correspond to source and sink temperatures for the purpose of applying these rules.

Informative note: The *source* is the fluid from which heat is extracted by the refrigerant cycle (the evaporator side). The *sink* is the fluid into which heat is rejected by the refrigerant cycle (the condenser side). In cooling operation, the source is the load side and the sink is the heat-rejection side. In heating operation, the source and sink are reversed.

7.2.5.1.1.1 Carnot COP. For any combination of grid variable values in a performance map, the COP shall not exceed the Carnot COP for the corresponding source and sink temperatures. The Carnot COP for cooling operation is:

$$\text{COP}_{\text{Carnot,cooling}} = \frac{T_{\text{source}}}{T_{\text{sink}} - T_{\text{source}}}$$

The Carnot COP for heating operation is:

$$\text{COP}_{\text{Carnot,heating}} = \frac{T_{\text{sink}}}{T_{\text{sink}} - T_{\text{source}}}$$

where T_{source} and T_{sink} are the absolute temperatures of the source and sink fluids as specified in the applicable representation specification.

7.2.5.1.1.2 Monotonicity. For any combination of grid variable values with all other grid variables held constant:

- Power input and capacity shall not increase at lower compressor sequence numbers. Power input and capacity may be equal at adjacent compressor sequence numbers.
- Capacity shall not increase at colder source temperatures when heating or warmer source temperatures when cooling unless power input also increases.
- Capacity shall not increase at warmer sink temperatures when heating or cooler sink temperatures when cooling unless power input also increases.

7.2.5.1.2 Common Air-Cooling Heat Exchanger Representation Publication Rules. The following publication rules shall apply to representations of equipment that includes a heat exchanger that cools air, including but not limited to direct expansion coils, hydronic cooling coils, and air-to-air heat exchangers. Each applicable representation specification shall reference this section.

For any combination of grid variable values with all other grid variables held constant, sensible cooling capacity shall not increase at lower air flow rates across the cooling heat exchanger.

7.2.6 Application Rules. This section shall provide instructions and advice for application developers to use the data included in representations.

Informative note: Any information that makes it easier for the application developer in consuming the data (e.g., modeling assumptions and/or extrapolation methods) can be included in this section.

7.2.6.1 Common Application Rules. The following application rules apply to all representations and shall not be repeated in representation specifications.

7.2.6.1.1 Disclaimer. If the `disclaimer` data element in the `Metadata` data group is present and non-empty, its contents shall be issued to the application software user when the representation is loaded by the software.

7.2.6.1.2 Expiration Date. If the `expiration_date` data element in the `Metadata` data group is present and the date has passed, a message shall be issued to the application software user indicating that the representation data has expired.

7.2.6.1.3 Standby Operation. Unless otherwise specified, when any operational limit is exceeded, application software shall model the equipment in standby operation.

7.2.6.1.4 Out-of-Range Operation. When application software conditions call for normal operation but application software applies standby operation because an operational limit is exceeded, a warning shall be issued to the user. This warning alerts the application software user that the simulated conditions fall outside the equipment's defined operating range, which may indicate that the selected equipment is not suitable for the simulated conditions.

7.2.6.1.5 Scalability Rules

- When scaling is applied by application software, the values of all scalable data elements within a representation must be scaled proportionally using a single scalar.
- An informative message shall be provided to the user indicating when the performance data from a representation is scaled.

8 DATA MODEL NAMING CONVENTIONS

~~All names shall be case-sensitive-unique within their scope.~~ In addition to the requirements of ASHRAE Standard 232, data element names shall be unique within their data group, and data group and enumeration names shall be unique within their representation specification. ~~All matching of names shall be done on a case-sensitive basis (that is, exact character-for-character match).~~

Names shall be assigned according to the following requirements, in addition to those in ASHRAE Standard 232.

8.1 Allowed Characters. All data element, data group, enumeration, and enumerator names shall contain only letters (as defined in the ASCII 7-bit character set, that is “a-z”, “A-Z”), digits “0-9”, and underscore “_”. Spaces and special characters other than underscore (such as punctuation) shall not be used. The first character of each name shall be a letter.

8.2 Data Group Names. ~~Each data group shall be assigned an “Upper Camel Case” (UCC) name. UCC naming results in the capitalization of the first letter of each word of a compound name, including capitalization of the initial letter of the name (e.g., DesignData, LowSpeedRatings).~~ Data groups that do not fall into the specific data group types listed in the following subsections shall not ~~begin-end~~ with the designated ~~prefixes-suffixes~~ for those data group types.

Informative note: Regular expression pattern: $(^?!.*(Rating|PerformanceMap|GridVariables|LookupVariables)\$)[A-Z]([A-Z]([a-z]([0-9]))*)\$)$

8.2.1 Rating Data Groups. Rating data group names shall ~~begin-end~~ with the word “Rating” ~~followed,~~ preceded by the descriptive name of the corresponding rating standard (e.g., ~~RatingAHRI210240~~ AHRI210240Rating).

Informative note: Regular expression pattern: $(^Rating\^[A-Z]*([A-Z]([a-z]([0-9]))*)Rating\$)$

8.2.2 PerformanceMap, GridVariables, and LookupVariables Data Groups. PerformanceMap data group names shall ~~begin-with-the-words-end-with-the-word~~ “PerformanceMap” ~~followed,~~ preceded by the descriptive name of the mode of operation (e.g., ~~PerformanceMapCoolingCoolingPerformanceMap, PerformanceMapHeatingHeatingPerformanceMap, PerformanceMapStandbyStandbyPerformanceMap~~).

Informative note: Regular expression pattern: $(^PerformanceMap\^[A-Z]*([A-Z]([a-z]([0-9]))*)PerformanceMap\$)$

GridVariables and LookupVariables data group names shall be ~~suffixes-suffixes~~ prefixed with the same descriptive name of the mode of operation used in the parent PerformanceMap (e.g., ~~GridVariablesCoolingCoolingGridVariables, LookupVariablesCoolingCoolingLookupVariables~~).

Informative note: Regular expression patterns: $(^GridVariables\^[A-Z]*([A-Z]([a-z]([0-9]))*)GridVariables\$)$ and $(^LookupVariables\^[A-Z]([A-Z]([a-z]([0-9]))*)LookupVariables\$)$

8.3 Data Element Names. ~~Each data element shall be assigned a “Snake Case” name. Snake case (or snake_case) is the practice of writing compound words or phrases in which the elements are lower case and separated with one underscore character “_” and no spaces (e.g., inlet_vane_position, air_mass_flow_rate).~~

Enumeration data elements shall have names that match their enumeration type (e.g., ~~compressor_type~~ should be the name of a data element of the CompressorType enumeration) except where more than one data element of the same enumerated type is used in the same data group. In that situation, distinguishing prefix(es) shall be added to the type name. For example, if a device uses two liquids, data elements could be named ~~condenser_liquid_type~~ and ~~evaporator_liquid_type~~.

Nested representation data elements shall have names suffixed with the word “representation” (e.g., ~~fan_representation~~).

Informative note: Regular expression pattern: $(^([a-z]+)(_([a-z]([0-9]))+)*\$)$

8.4 Enumeration Names. Each enumeration shall be assigned an “Upper Camel Case” (UCC) name. UCC naming results in the capitalization of the first letter of each word of a compound name, including capitalization of the initial letter of the name (e.g., ~~CompressorType, FanPosition~~). Enumeration names shall not begin with designated prefixes for specific data group types.

Informative note: Regular expression pattern: $(^?!.(Rating|PerformanceMap|GridVariables|LookupVariables))[A-Z]([A-Z]([a-z]([0-9]))*)\$)$

8.5 Enumerator Names. Enumerator names shall ~~be strings of any length made up of uppercase letters, numbers, or ‘_’ and beginning with an uppercase letter.~~

Informative note: Regular expression pattern: $(^[A-Z]([A-Z]([0-9]))*)(_([A-Z]([0-9]))+)*\$)$

~~Enumerator names shall~~ use the standard abbreviations specified in Section 8.6. Additional abbreviations used shall be clear and consistent with industry practice. A source of recognized abbreviations is found in ASHRAE⁶.

10.2 Data Integrity. Standard 205 does not require use of schemes that ensure correct data transmission (e.g., digital signatures and message authentication codes).

When such schemes are employed, they shall conform to RFC ~~8152~~[9052](#)⁷, which describes how to create and process signatures, message authentication codes, and encryption using CBOR for serialization.

Application software shall support verification of the integrity of the CBOR representation file when RFC ~~8152~~[9052](#)⁷ has been applied.

10.3 Data Access. Procedures for distributing and transmitting representations are not in the scope of Standard 205. Data publishers may distribute representations according to their individual business practices.

When data publishers encrypt CBOR representation files, the encryption shall comply with RFC ~~8152~~[9052](#)⁷. Application software shall support decryption of the CBOR representation file when RFC ~~8152~~[9052](#) has been applied.

Informative note: Data publishers may restrict access to representations using user-specific licensing. Licensing mechanisms are not within the scope of Standard 205. Data publishers may provide public access or grant other entities permission to provide public access to their representations.

RS0001.2 Version History [\(Informative\)](#)

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	2025	2023 - Addendum d	Add air-cooled and evaporatively-cooled condensers

RS0001.3 Use Case (Informative). Performance data in a representation following this representation specification will be used by building performance software to estimate the thermal performance and energy consumption of liquid, air, and evaporatively cooled liquid chillers.

RS0001.4 Scope and Description

RS0001.4.1 Applicability. Electrically driven vapor compression liquid-chilling packages that include one or more hermetic or open drive compressors (centrifugal, screw, scroll, reciprocating, rotary or other types) and are equipped with a liquid-cooled, air-cooled, or evaporatively-cooled condenser.

Informative note: When multiple chillers are designed to operate in concert, such as in a series counterflow arrangement, the performance of the chiller system can be represented in a single file. Other designs with multiple chillers operating independently should be represented with multiple files.

RS0001.4.2 Exclusions. Steam turbine driven, combustion engine driven, absorption liquid-chilling and liquid-heating packages, nor chillers with a separate heat recovery liquid stream.

RS0001.4.3 Embedded Representations. None.

RS0001.4.4 Referencing Representations. None.

RS0001.4.5 Schematic [\(Informative\)](#). Figure RS0001–1 shows a schematic of a liquid-cooled vapor compression refrigeration liquid-chilling package with notes below, Figure RS0001–2 shows a schematic of an air-cooled vapor compression refrigeration liquid-chilling package, and Figure RS0001–3 shows a schematic of an evaporatively-cooled vapor compression refrigeration liquid-chilling package.

- Electrical auxiliaries are components such as control system power, block/compressor/crankcase/oil heaters, purge units, or other devices.
- “Heat loss to space” includes any heat that is dissipated to the air where the chiller is located and is determined by applying the energy balance for the chiller as described in Section RS0001.6.1
- `auxiliary_heat` and `oil_cooler_heat` represent liquid cooled heat exchangers providing auxiliary cooling and/or oil cooling not captured in evaporator or condenser performance values. If the heat loss is captured within the chiller and accounted for in the performance data, then no additional heat flows need to be accounted for. These heat flows are represented as the required heat rejection and not the temperature and flow of the liquid streams providing the cooling.
- Electrical auxiliaries are components such as control system power, block/compressor/crankcase/oil heaters, purge units, or other devices.
- “Heat loss to space” includes any heat that is dissipated to the air where the chiller is located and is determined by applying the energy balance for the chiller as described in Section RS0001.6.1
- `auxiliary_heat` and `oil_cooler_heat` represent liquid cooled heat exchangers providing auxiliary cooling and/or oil cooling not captured in evaporator or condenser performance values. If the heat loss is captured within the chiller and accounted for in the performance data, then no additional heat flows need to be accounted for. These heat flows are represented as the required heat rejection and not the temperature and flow of the liquid streams providing the cooling.

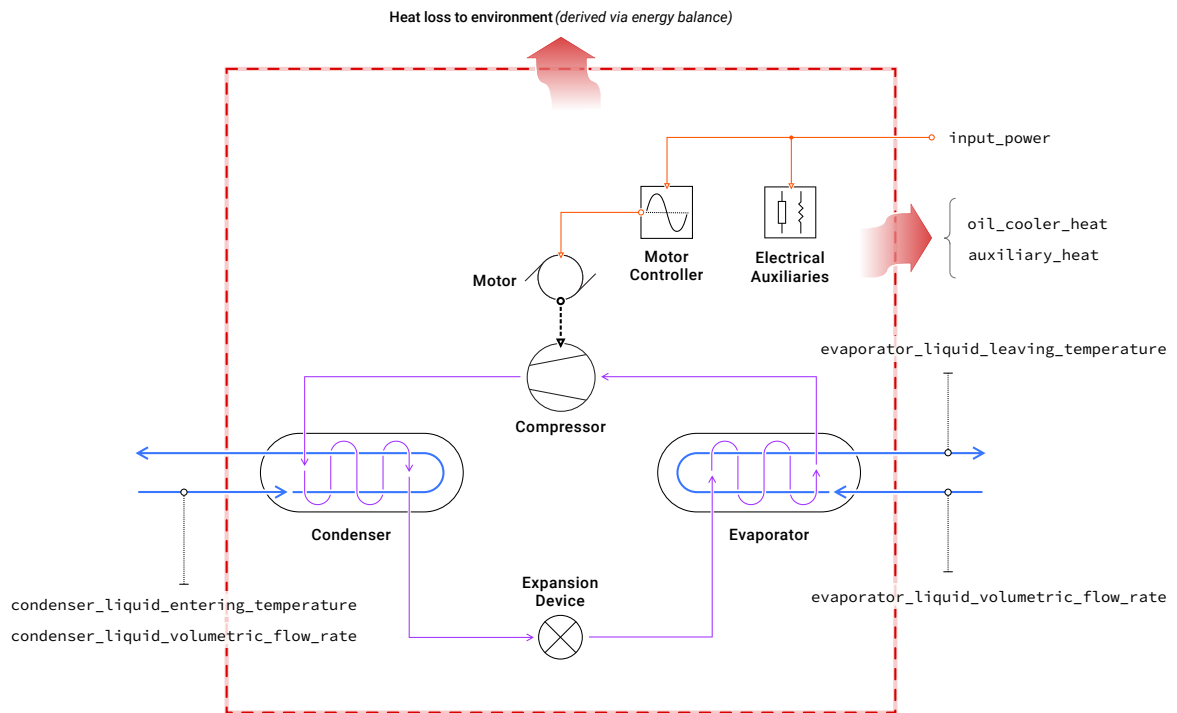


Figure RS0001–1 Liquid-cooled chiller.

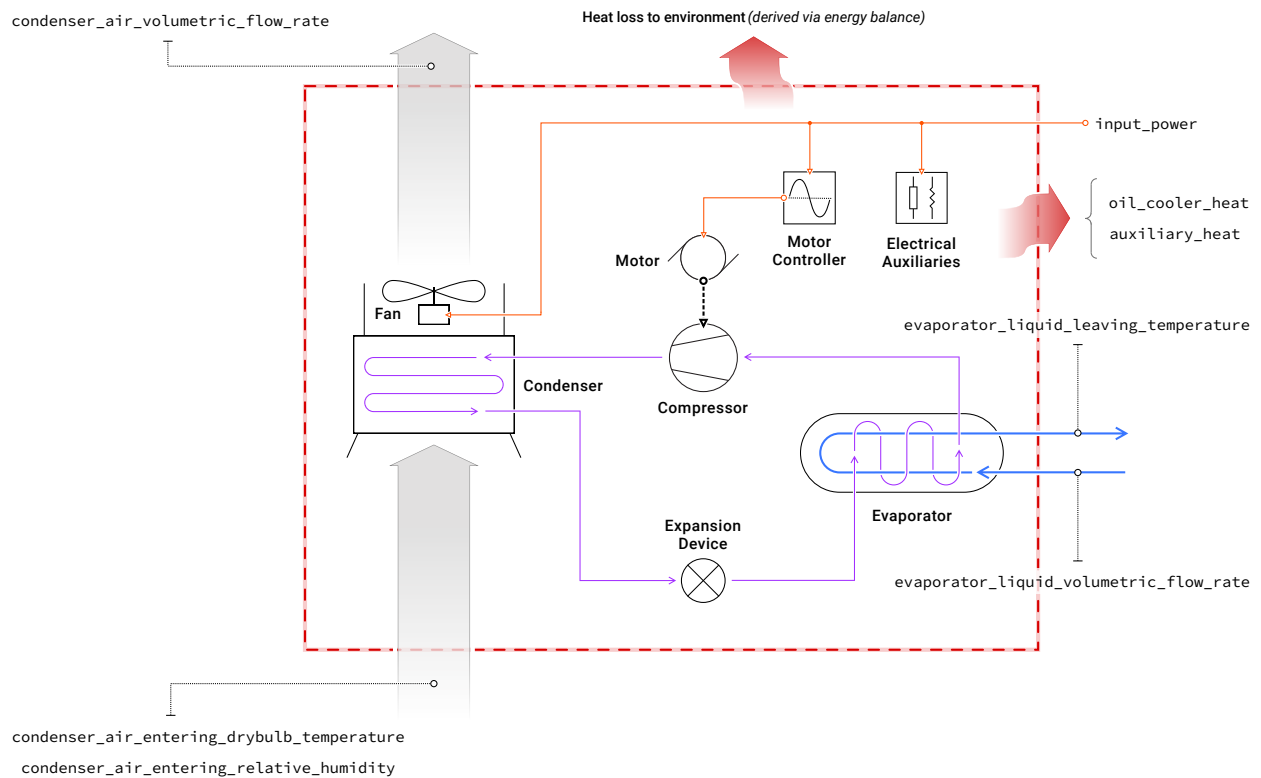


Figure RS0001–2 Air-cooled chiller.

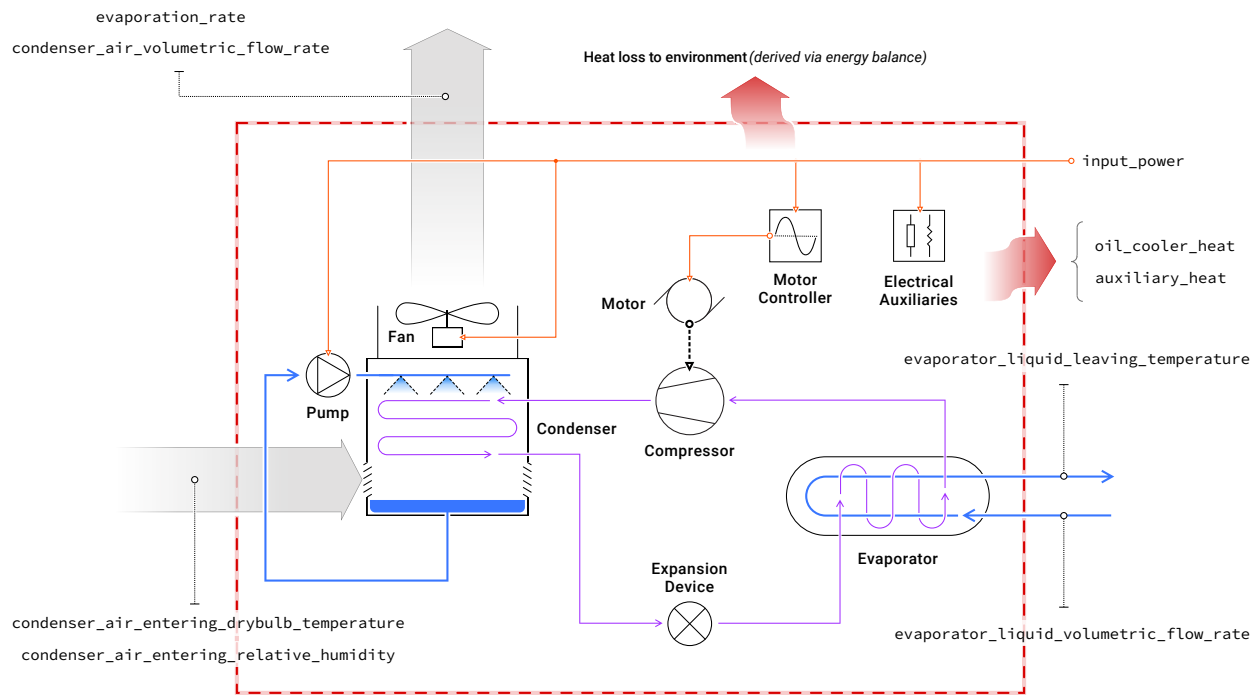


Figure RS0001–3 Evaporatively-cooled chiller.

- Electrical auxiliaries are components such as control system power, block/compressor/crankcase/oil heaters, purge units, or other devices.
- “Heat loss to space” includes any heat that is dissipated to the air where the chiller is located and is determined by applying the energy balance for the chiller as described in Section RS0001.6.1
- `auxiliary_heat` and `oil_cooler_heat` represent liquid cooled heat exchangers providing auxiliary cooling and/or oil cooling not captured in evaporator or condenser performance values. If the heat loss is captured within the chiller and accounted for in the performance data, then no additional heat flows need to be accounted for. These heat flows are represented as the required heat rejection and not the temperature and flow of the liquid streams providing the cooling.

RS0001.5 Data Model

RS0001.5.1 Data Group Hierarchy (Informative). A representation implementation conforming to this representation specification shall consist of the following data groups:

- RS0001
 - Metadata
 - Description*
 - ProductInformation*
 - Ratings*
 - AHRI550590Rating*
 - AHRI551591Rating*
 - Performance
 - LiquidCooledPerformanceMap
 - LiquidCooledGridVariables
 - LiquidCooledLookupVariables

- AirCooledPerformanceMap
 - AirCooledGridVariables
 - AirCooledLookupVariables
- EvaporativelyCooledPerformanceMap
 - EvaporativelyCooledGridVariables
 - EvaporativelyCooledLookupVariables
- StandbyPerformanceMap
 - StandbyGridVariables
 - StandbyLookupVariables
- EvaporatorLiquidPressureDifferential
 - EvaporatorLiquidPressureDifferentialGridVariables
 - EvaporatorLiquidPressureDifferentialLookupVariables
- CondenserLiquidPressureDifferential
 - CondenserLiquidPressureDifferentialGridVariables
 - CondenserLiquidPressureDifferentialLookupVariables

where * indicates data groups that are not required to be present in a representation conforming to this representation specification.

~~Informative note:~~ Required data elements of an optional data group are only required when ~~the data group in that~~ [data group is](#) present in a representation.

~~Informative note:~~ ~~When multiple chillers are designed to operate in concert, such as in a series counterflow arrangement, the performance of the chiller system can be represented in a single file. Other designs with multiple chillers operating independently should be represented with multiple files.~~

RS0001.5.2 Enumerations

Table RS0001–2 AHRI550590TestStandardYear

Enumerator	Attributes
IP_2015	Description: Ratings and design points defined using IP unit version of the standard, 2015 edition ¹
IP_2015_ADDENDUM_1	Description: Ratings and design points defined using IP unit version of the standard, 2015 edition with Addendum 1 ²
IP_2018	Description: Ratings and design points defined using IP unit version of the standard, 2018 edition ³
IP_2020	Description: Ratings and design points defined using IP unit version of the standard, 2020 edition ⁴
IP_2020_ADDENDUM_1	Description: Ratings and design points defined using IP unit version of the standard, 2020 edition with Addendum 1 ⁵
IP_2023	Description: Ratings and design points defined using IP unit version of the standard, 2023 edition ⁶

Table RS0001–3 AHRI551591TestStandardYear

Enumerator	Attributes
SI_2015	Description: Ratings and design points defined using SI unit version of the standard, 2015 edition ⁷
SI_2015_ADDENDUM_1	Description: Ratings and design points defined using SI unit version of the standard, 2015 edition with Addendum 1 ⁸

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Enumerator	Attributes
SI_2018	Description: Ratings and design points defined using SI unit version of the standard, 2018 edition ⁹
SI_2020	Description: Ratings and design points defined using SI unit version of the standard, 2020 edition ¹⁰
SI_2020_ADDENDUM_1	Description: Ratings and design points defined using SI unit version of the standard, 2020 edition with Addendum 1 ¹¹
SI_2023	Description: Ratings and design points defined using SI unit version of the standard, 2023 edition ¹²

RS0001.5.3 Data Groups

Table RS0001–4 RS0001

Name	Attributes
metadata	Description: Metadata data group Type: Group (Metadata) Constraints: schema_name="RS0001" Required: True
description	Description: Data group describing product and rating information Type: Group (Description)
performance	Description: Data group containing performance information Type: Group (Performance) Required: True

Table RS0001–5 Description

Name	Attributes
product_information	Description: Data group describing product information Type: Group (ProductInformation)
~~rating_ahri_550_590~~ ratings	Description: Data group containing ~~information~~ rating information Type: Group (Ratings)

Table RS0001–6 Ratings

Name	Attributes
ahri_550_590	Description: Data group containing information relevant to products rated under AHRI 550/590 Type: Group (~~Rating~~AHRI550590AHRI550590Rating)
~~rating~~ ahri_551_591	Description: Data group containing information relevant to products rated under AHRI 551/591 Type: Group (~~Rating~~AHRI551591AHRI551591Rating)

Table RS0001–7 ProductInformation

Name	Attributes
~~manufacturer~~ product_identifiers	Description: ~~Manufacturer name~~Brand and model number pairs identifying the equipment Type: ~~String~~Array (Group(ProductIdentifier))
~~model_number~~	Description: ~~Model number~~ Type: ~~Pattern~~ Notes: ~~Pattern shall match all model numbers that can be represented by the representation~~
nominal_voltage	Description: Unit nominal voltage Type: Numeric Units: V Constraints: ≥0.0 Notes: If the unit can operate at multiple voltages, the lower of the two shall be stated
nominal_frequency	Description: Unit nominal frequency Type: Numeric Units: Hz Constraints: ≥0.0 Notes: Power supply frequency for the intended region of installation
compressor_type	Description: Type of compressor Type: Enumeration (CompressorType)

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Name	Attributes
liquid_data_source	Description: Source of the liquid properties data Type: String Notes: Example: 'ASHRAE Handbook Fundamentals 2013 chapter 31'
refrigerant	Description: Refrigerant used in the chiller Type: String Notes: The string shall start with 'R-' and then include the refrigerant number designation conforming to ANSI/ASHRAE Standard 34 ¹³
hot_gas_bypass_installed	Description: Indicates if a hot-gas bypass valve is installed on the chiller Type: Boolean

Table RS0001–8 **Rating****AHRI550590****AHRI550590Rating**

Name	Attributes
certified_reference_numbers	Description: AHRI certified reference numbers Type: Array(String) Constraints: "^[0-9]+\$" Notes: One entry per unique AHRI certified reference number applicable to the products covered by the representation
test_standard_year	Description: Year of the AHRI test standard Type: Enumeration (AHRI550590TestStandardYear)
rating_source	Description: Source of this rating data Type: String Notes: Used by data publisher to document methods (e.g., software and version) used to generate rating data
net_refrigerating_capacity	Description: Rated net refrigeration capacity Type: Numeric Units: Btu/h Constraints: ≥ 0.0 Notes: The capacity of the evaporator available for cooling of the thermal load external to the chiller; calculated using only the sensible heat transfer

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Name	Attributes
input_power	Description: Combined power input of all components of the unit, including auxiliary power and excluding integral pumps Type: Numeric Units: kW Constraints: ≥ 0.0
cop	Description: Ratio of the net refrigerating capacity to the total input power at the rating conditions Type: Numeric Units: - Constraints: > 0.0
iplv_ip	Description: The Integrated Part-Load Value efficiency of merit calculated at the standard rating conditions Type: Numeric Units: -
nplv_ip	Description: The Non-Standard Part-Load Value efficiency of merit calculated at the conditions other than the IPLV.IP conditions Type: Numeric Units: -

Table RS0001–9 **Rating**~~AHRI551591~~**AHRI551591Rating**

Name	Attributes
certified_reference_numbers <u>s</u>	Description: AHRI certified reference numbers <u>s</u> Type: Array (String) Constraints: "^[0-9]+\$" Notes: One entry per unique AHRI certified reference number applicable to the products covered by the representation
test_standard_year	Description: Year of the AHRI test standard Type: Enumeration(AHRI551591TestStandardYear)
rating_source	Description: Source of this rating data Type: String Notes: Used by data publisher to document methods (e.g., software and version) used to generate rating data

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Name	Attributes
net_refrigerating_capacity	Description: Rated net refrigeration capacity Type: Numeric Units: kW Constraints: ≥ 0.0 Notes: The capacity of the evaporator available for cooling of the thermal load external to the chiller; calculated using only the sensible heat transfer
input_power	Description: Combined power input of all components of the unit, including auxiliary power and excluding integral pumps Type: Numeric Units: kW Constraints: ≥ 0.0
cop	Description: Ratio of the net refrigerating capacity to the total input power at the rating conditions Type: Numeric Units: - Constraints: > 0.0
iplv_si	Description: The Integrated Part-Load Value efficiency of merit calculated at the standard rating conditions Type: Numeric Units: -
nplv_si	Description: The Non-Standard Part-Load Value efficiency of merit calculated at the conditions other than the IPLV.SI conditions Type: Numeric Units: -

Table RS0001–10 Performance

Name	Attributes
condenser_type	Description: Heat rejection method of the condenser Type: Enumeration(CondenserType) Required: True

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Name	Attributes
evaporator_liquid_type	Description: Type of liquid in evaporator Type: Group (LiquidMixture) Required: True Notes: • LiquidMixture specifies liquid constituents and their concentrations • Density shall be evaluated at the evaporator inlet liquid temperature
condenser_liquid_type	Description: Type of liquid in condenser Type: Group (LiquidMixture) Required: if condenser_type=LIQUID Notes: • LiquidMixture specifies liquid constituents and their concentrations • Density shall be evaluated at the condenser inlet liquid temperature
evaporator_fouling_factor	Description: Factor of heat transfer inhibition due to heat exchanger fouling layer Type: Numeric Units: $\text{m}^2 \cdot \text{K/W}$ Constraints: ≥ 0.0 Required: True Notes: • Evaporator fouling factor at which the performance map was created • May be different from the certification data supplied
condenser_fouling_factor	Description: Factor of heat transfer inhibition due to heat exchanger fouling layer Type: Numeric Units: $\text{m}^2 \cdot \text{K/W}$ Constraints: ≥ 0.0 Required: if condenser_type=LIQUID Notes: • Condenser fouling factor at which the performance map was created • May be different from the certification data supplied

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Name	Attributes
compressor_speed_control_type	Description: Type of compressor speed control Type: Enumeration(SpeedControlType) Required: True
cycling_degradation_coefficient	Description: Cycling degradation coefficient (C_D) as described in AHRI 550/590 or AHRI 551/591 Type: Numeric Units: - Constraints: • ≥ 0.0 • ≤ 1.0 Required: True Notes: Used when the unit cycles to meet a setpoint
scaling	Description: Specifies the range the performance data can be scaled to represent different capacity equipment Type: Group(Scaling) Notes: If not present, scaling of the performance data is not allowed
~~cooling~~ _performance_map= ~~cooling~~	Description: Data group describing cooling performance over a range of conditions Type: Alternative(Group(~~PerformanceMapCoolingLiquidLiquidCooledPerformanceMap~~), Group(~~PerformanceMapCoolingAirAirCooledPerformanceMap~~), Group(~~PerformanceMapCoolingEvaporativeEvaporativelyCooledPerformanceMap~~)) Constraints: condenser_type(LIQUID, AIR, EVAPORATIVE) Required: True
~~standby~~ _performance_map= ~~standby~~	Description: Data group describing standby performance Type: Group(~~PerformanceMapStandbyStandbyPerformanceMap~~) Required: True
~~performance_map~~ _evaporator_liquid_pressure_differential	Description: Data group describing the liquid pressure differential through the evaporator Type: Group(~~PerformanceMapEvaporatorLiquidPressureDifferential~~) Required: True

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Name	Attributes
~~performance_map~~ condenser_liquid_pressure_differential	Description: Data group describing the liquid pressure differential through the condenser Type: Group(~~PerformanceMap~~ CondenserLiquidPressureDifferential) Required: if condenser_type=LIQUID

Table RS0001-11 ~~PerformanceMapCoolingLiquid~~LiquidCooledPerformanceMap

Name	Attributes
grid_variables	Description: Data group defining the grid variables for cooling performance Type: Group(~~GridVariablesCoolingLiquid~~ LiquidCooledGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for cooling performance Type: Group(~~LookupVariablesCoolingLiquid~~ LiquidCooledLookupVariables) Required: True Cycling Order: [evaporator_liquid_volumetric_flow_rate, evaporator_liquid_leaving_temperature, condenser_liquid_volumetric_flow_rate, condenser_liquid_entering_temperature, compressor_sequence_number]

Table RS0001-12 ~~GridVariablesCoolingLiquid~~LiquidCooledGridVariables

Name	Attributes
evaporator_liquid_volumetric_flow_rate	Description: Chilled liquid (evaporator) flow Type: Array (Numeric) Units: m ³ /s Constraints: >0.0 [1..] Required: True Scalable: True

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Name	Attributes
evaporator_liquid_leaving_temperature	Description: Leaving evaporator liquid temperature Type: Array (Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True
condenser_liquid_volumetric_flow_rate	Description: Condenser liquid flow Type: Array (Numeric) Units: m³/s Constraints: • > 0.0 • [1..] Required: True Scalable: True
condenser_liquid_entering_temperature	Description: Entering condenser liquid temperature Type: Array (Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True
compressor_sequence_number	Description: Index indicating the relative capacity order of the compressor speed/stage expressed in order from lowest capacity (starting at 1) to highest capacity Type: Array (Integer) Constraints: • ≥ 1 • [1..] Required: True Notes: • If <code>compressor_speed_control_type</code> is DISCRETE, sequence numbers shall be provided for each discrete stage of the compressor(s) • If <code>compressor_speed_control_type</code> is CONTINUOUS, sufficient sequence numbers shall be provided to capture the continuous operation of the compressor(s)

Table RS0001–13 **LookupVariablesCoolingLiquidLiquidCooledLookupVariables**

Name	Attributes
input_power	Description: Total power input Type: Array (Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: All power consumed by the chiller, including controls, motors, variable speed drives, purge units, sump heaters, fans, etc.
net_evaporator_capacity	Description: Refrigeration capacity Type: Array (Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: The available cooling capacity of the evaporator to the thermal load calculated using only the sensible heat transfer
net_condenser_capacity	Description: Condenser heat rejection Type: Array (Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: The capacity of the condenser transferred to the condenser cooling stream using only the sensible heat transfer

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Name	Attributes
oil_cooler_heat	Description: Heat transferred to another liquid crossing the control volume boundary from the chiller oil cooler. Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: Set as 0 if not present or if heat rejection is met by condenser
auxiliary_heat	Description: Heat transferred to another liquid crossing the control volume boundary from the chiller auxiliaries (motor, motor controller, inverter drive, starter, etc). Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: Set as 0 if not present or if heat rejection is met by condenser
operation_state	Description: The operation state at the operating conditions Type: Array(Enumeration(OperationState)) Constraints: [1..] Required: True

Table RS0001–14 **PerformanceMapCoolingAirAirCooledPerformanceMap**

Name	Attributes
grid_variables	Description: Data group defining the grid variables for cooling performance Type: Group(GridVariablesCoolingAirAirCooledGridVariables) Required: True

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Name	Attributes
lookup_variables	Description: Data group defining the lookup variables for cooling performance Type: Group (LookupVariablesCoolingAirAirCooledLookupVariables) Required: True Cycling Order: [evaporator_liquid_volumetric_flow_rate, evaporator_liquid_leaving_temperature, condenser_air_entering_drybulb_temperature, condenser_air_entering_relative_humidity, ambient_pressure, compressor_sequence_number]

Table RS0001–15 [GridVariablesCoolingAir](#)[AirCooledGridVariables](#)

Name	Attributes
evaporator_liquid_volumetric_flow_rate	Description: Chilled liquid (evaporator) flow Type: Array (Numeric) Units: m³/s Constraints: • >0.0 • [1..] Required: True Scalable: True
evaporator_liquid_leaving_temperature	Description: Leaving evaporator liquid temperature Type: Array (Numeric) Units: K Constraints: • ≥0.0 • [1..] Required: True
condenser_air_entering_drybulb_temperature	Description: Entering condenser air drybulb temperature Type: Array (Numeric) Units: K Constraints: • ≥0.0 • [1..] Required: True

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Name	Attributes
condenser_air_entering_relative_humidity	Description: Entering condenser air relative humidity Type: Array (Numeric) Units: - Constraints: • ≥ 0.0, ≤ 1.0 • [1..] Required: True
ambient_pressure	Description: Ambient pressure used to calculate the performance Type: Array (Numeric) Units: Pa Constraints: • > 0.0 • [1..] Required: True Notes: Informative Note: the intent of the ambient pressure is to capture the pressure at the installation and not changes in the ambient pressure due to weather effects
compressor_sequence_number	Description: Index indicating the relative capacity order of the compressor speed/stage expressed in order from lowest capacity (starting at 1) to highest capacity Type: Array (Integer) Constraints: • ≥ 1 • [1..] Required: True Notes: • If <code>compressor_speed_control_type</code> is DISCRETE, sequence numbers shall be provided for each discrete stage of the compressor(s) • If <code>compressor_speed_control_type</code> is CONTINUOUS, sufficient sequence numbers shall be provided to capture the continuous operation of the compressor(s)

Table RS0001–16 [LookupVariablesCoolingAirAirCooledLookupVariables](#)

Name	Attributes
input_power	Description: Total power input Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: All power consumed by the chiller, including controls, motors, variable speed drives, purge units, sump heaters, fans, etc.
net_evaporator_capacity	Description: Refrigeration capacity Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: The available cooling capacity of the evaporator to the thermal load calculated using only the sensible heat transfer
net_condenser_capacity	Description: Condenser heat rejection Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: The capacity of the condenser transferred to the condenser cooling stream using only the sensible heat transfer

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Name	Attributes
condenser_air_volumetric_flow_rate	Description: Condenser air flow Type: Array(Numeric) Units: m³/s Constraints: • ≥0.0 • [1..] Required: True Scalable: True
oil_cooler_heat	Description: Heat transferred to another liquid crossing the control volume boundary from the chiller oil cooler. Type: Array(Numeric) Units: W Constraints: • ≥0.0 • [1..] Required: True Scalable: True Notes: Set as 0 if not present or if heat rejection is met by condenser
auxiliary_heat	Description: Heat transferred to another liquid crossing the control volume boundary from the chiller auxiliaries (motor, motor controller, inverter drive, starter, etc). Type: Array(Numeric) Units: W Constraints: • ≥0.0 • [1..] Required: True Scalable: True Notes: Set as 0 if not present or if heat rejection is met by condenser
operation_state	Description: The operation state at the operating conditions Type: Array(Enumeration(OperationState)) Constraints: [1..] Required: True

Table RS0001–17 [PerformanceMapCoolingEvaporativeEvaporativelyCooledPerformanceMap](#)

Name	Attributes
grid_variables	Description: Data group defining the grid variables for cooling performance Type: Group(GridVariablesCoolingEvaporativeEvaporativelyCooledGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for cooling performance Type: Group(LookupVariablesCoolingEvaporativeEvaporativelyCooledLookupVariables) Required: True Cycling Order: [evaporator_liquid_volumetric_flow_rate, evaporator_liquid_leaving_temperature, condenser_air_entering_drybulb_temperature, condenser_air_entering_relative_humidity, ambient_pressure, compressor_sequence_number]

Table RS0001–18 [GridVariablesCoolingEvaporativeEvaporativelyCooledGridVariables](#)

Name	Attributes
evaporator_liquid_volumetric_flow_rate	Description: Chilled liquid (evaporator) flow Type: Array (Numeric) Units: m³/s Constraints: • >0.0 • [1..] Required: True Scalable: True
evaporator_liquid_leaving_temperature	Description: Leaving evaporator liquid temperature Type: Array (Numeric) Units: K Constraints: • ≥0.0 • [1..] Required: True

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Name	Attributes
condenser_air_entering_drybulb_temperature	Description: Entering condenser air drybulb temperature Type: Array (Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True
condenser_air_entering_relative_humidity	Description: Entering condenser air relative humidity Type: Array (Numeric) Units: - Constraints: • $\geq 0.0, \leq 1.0$ • [1..] Required: True
ambient_pressure	Description: Ambient pressure used to calculate the performance Type: Array (Numeric) Units: Pa Constraints: • > 0.0 • [1..] Required: True Notes: Informative Note: the intent of the ambient pressure is to capture the pressure at the installation and not changes in the ambient pressure due to weather effects

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Name	Attributes
compressor_sequence_number	Description: Index indicating the relative capacity order of the compressor speed/stage expressed in order from lowest capacity (starting at 1) to highest capacity Type: Array(Integer) Constraints: • ≥ 1 • [1..] Required: True Notes: • 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)

Table RS0001–19 [LookupVariablesCoolingEvaporativeEvaporativelyCooledLookupVariables](#)

Name	Attributes
input_power	Description: Total power input Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: All power consumed by the chiller, including controls, motors, variable speed drives, purge units, sump heaters, fans, etc.

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Name	Attributes
net_evaporator_capacity	Description: Refrigeration capacity Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: The available cooling capacity of the evaporator to the thermal load calculated using only the sensible heat transfer
net_condenser_capacity	Description: Condenser heat rejection Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: The capacity of the condenser transferred to the condenser cooling stream using only the sensible heat transfer
condenser_air_volumetric_flow_rate	Description: Condenser air flow Type: Array(Numeric) Units: m³/s Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True

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Name	Attributes
evaporation_rate	Description: Rate at which water evaporates from the condenser. Type: Array(Numeric) Units: m³/s Constraints: • ≥0.0 • [1..] Required: True Scalable: True Notes: Does not include blow down or drift losses.
oil_cooler_heat	Description: Heat transferred to another liquid crossing the control volume boundary from the chiller oil cooler. Type: Array(Numeric) Units: W Constraints: • ≥0.0 • [1..] Required: True Scalable: True Notes: Set as 0 if not present or if heat rejection is met by condenser
auxiliary_heat	Description: Heat transferred to another liquid crossing the control volume boundary from the chiller auxiliaries (motor, motor controller, inverter drive, starter, etc). Type: Array(Numeric) Units: W Constraints: • ≥0.0 • [1..] Required: True Scalable: True Notes: Set as 0 if not present or if heat rejection is met by condenser
operation_state	Description: The operation state at the operating conditions Type: Array(Enumeration(OperationState)) Constraints: [1..] Required: True

Table RS0001–20 **PerformanceMapStandbyStandbyPerformanceMap**

Name	Attributes
grid_variables	Description: Data group defining the grid variables for standby performance Type: Group(GridVariablesStandbyStandbyGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for standby performance Type: Group(LookupVariablesStandbyStandbyLookupVariables) Required: True Cycling Order: [environment_dry_bulb_temperature]

Table RS0001–21 **GridVariablesStandbyStandbyGridVariables**

Name	Attributes
environment_dry_bulb_temperature	Description: Dry bulb temperature of the air in the environment of the chiller Type: Array (Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True

Table RS0001–22 ~~LookupVariablesStandbyStandby~~[LookupVariables](#)

Name	Attributes
input_power	Description: Total power consumed in standby operation Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: • Includes devices that cycle on and off (e.g., purge units and sump units) and devices that draw continuous power (e.g., fans and controls) • Expressed as a time averaged power consumption

Table RS0001–23 ~~PerformanceMapEvaporatorLiquidPressureDifferentialEvaporatorLiquidPressureDifferential~~

Name	Attributes
grid_variables	Description: Data group defining the grid variables for the evaporator liquid pressure differential Type: Group(~~GridVariablesEvaporatorLiquidPressureDifferential~~EvaporatorLiquidPressureDifferentialGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for the evaporator liquid pressure differential Type: Group(~~LookupVariablesEvaporatorLiquidPressureDifferential~~EvaporatorLiquidPressureDifferentialLookupVariables) Required: True Cycling Order: [evaporator_liquid_volumetric_flow_rate, evaporator_liquid_leaving_temperature]

Table RS0001–24 [GridVariablesEvaporatorLiquidPressureDifferentialEvaporatorLiquidPressureDifferentialGridVariables](#)

Name	Attributes
evaporator_liquid_volumetric_flow_rate	Description: Chilled liquid (evaporator) flow Type: Array (Numeric) Units: m ³ /s Constraints: • >0.0 • [1..] Required: True
evaporator_liquid_leaving_temperature	Description: Leaving evaporator liquid temperature Type: Array (Numeric) Units: K Constraints: • ≥0.0 • [1..] Required: True

Table RS0001–25 [LookupVariablesEvaporatorLiquidPressureDifferentialEvaporatorLiquidPressureDifferentialLookupVariables](#)

Name	Attributes
evaporator_liquid_differential_pressure	Description: Pressure difference across the evaporator Type: Array (Numeric) Units: Pa Constraints: • ≥0.0 • [1..] Required: True

Table RS0001-26 ~~PerformanceMapCondenserLiquidPressureDifferential~~[CondenserLiquidPressureDifferential](#)

Name	Attributes
grid_variables	Description: Data group defining the grid variables for the condenser liquid pressure differential Type: Group(~~GridVariablesCondenserLiquidPressureDifferential~~CondenserLiquidPressureDifferentialGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for the condenser liquid pressure differential Type: Group(~~LookupVariablesCondenserLiquidPressureDifferential~~CondenserLiquidPressureDifferentialLookupVariables) Required: True Cycling Order: [condenser_liquid_volumetric_flow_rate, condenser_liquid_entering_temperature]

Table RS0001-27 ~~GridVariablesCondenserLiquidPressureDifferential~~[CondenserLiquidPressureDifferentialGridVariables](#)

Name	Attributes
condenser_liquid_volumetric_flow_rate	Description: Condenser liquid flow Type: Array(Numeric) Units: m³/s Constraints: • >0.0 • [1..] Required: True
condenser_liquid_entering_temperature	Description: Entering condenser liquid temperature Type: Array(Numeric) Units: K Constraints: • ≥0.0 • [1..] Required: True

Table RS0001–28 [LookupVariablesCondenserLiquidPressureDifferentialCondenserLiquidPressureDifferentialLookupVariables](#)

Name	Attributes
condenser_liquid_differential_pressure	Description: Pressure difference across the condenser Type: Array (Numeric) Units: Pa Constraints: • ≥ 0.0 • [1..] Required: True

RS0001.7 ~~Publishing~~Publication Rules. ~~None.~~ Representations conforming to this representation specification shall comply with the common refrigerant cycle representation publication rules in Section 7.2.5.1.1. For the purpose of applying these rules:

- The source temperature shall be taken as the leaving evaporator liquid temperature (evaporator_liquid_leaving_temperature).
- The COP shall be taken as the ratio of net_evaporator_capacity to input_power.
- The sink temperature shall be taken according to condenser type as specified in Table RS0001–30.

Informative note: The leaving evaporator liquid temperature is used as the source temperature because it is a grid variable directly available at each point in the performance map. This yields a slightly more conservative Carnot COP limit than the entering temperature, but real chiller performance operates well below either bound.

Table RS0001–30 Sink temperature data elements by condenser type

<u>Condenser Type</u>	<u>Sink Temperature</u>
<u>Liquid-cooled</u>	<u>condenser_liquid_entering_temperature</u>
<u>Air-cooled</u>	<u>condenser_air_entering_drybulb_temperature</u>
<u>Evaporatively-cooled</u>	<u>Wet-bulb temperature calculated from condenser_air_entering_drybulb_temperature and condenser_air_entering_relative_humidity</u>

RS0001.8 Application Rules

RS0001.8.1 Cooling Performance. cooling_performance_map~~_cooling~~ shall be used to simulate performance when system controls call for cooling.

RS0001.8.2 Standby Performance. standby_performance_map~~_standby~~ shall be used to simulate performance under any of the following conditions:

- a. system controls are not calling for cooling, or
- b. system controls are calling for cooling, but either:
 1. the current simulated conditions are outside the range of grid variables in cooling_performance_map~~_cooling~~, or
 2. the corresponding lookup variable operation_state in cooling_performance_map~~_cooling~~ has a value of STANDBY at the current simulated conditions.

RS0002.2 Version History [\(Informative\)](#)

schema_version	Date	Initial Approved Standard	Notes
1.0.0	2023	2023	Initial publication
2.0.0	2024	2023 - Addenda a, b, & c	

RS0002.3 Use Case (Informative). Performance data in a representation following this representation specification will be used by building performance software to estimate the thermal performance and energy consumption of air cooled direct expansion cooling air conditioners.

RS0002.4 Scope and Description

RS0002.4.1 Applicability. Air cooled direct expansion cooling air conditioners, including those with single speed, staged, or variable speed compressor(s). This representation specification applies to both unitary and packaged systems.

RS0002.4.2 Exclusions. Heating performance, economizers, exhaust fans.

RS0002.4.3 Embedded Representations

Schema Type	Schema Type Description	Data Element
RS0003	Fan Assembly	performance.indoor_fan_representation
RS0004	Air-to-Air Direct Expansion System	performance.dx_system_representation

RS0002.4.4 Referencing Representations. None.

RS0002.4.5 Schematic [\(Informative\)](#). Figure RS0002–1 illustrates the components of unitary air-conditioning systems within the scope of this appendix.

RS0002.5 Data Model

RS0002.5.1 Data Group Hierarchy [\(Informative\)](#). A representation implementation conforming to this representation specification shall consist of the following data groups:

- RS0002
 - Metadata
 - Description*
 - ProductInformation*
 - Ratings*
 - AHRI210240Rating*
 - AHRI340360Rating*
 - Performance
 - RS0003
 - RS0004

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification. [Required data elements of an optional data group are only required when that data group is present in a representation.](#)

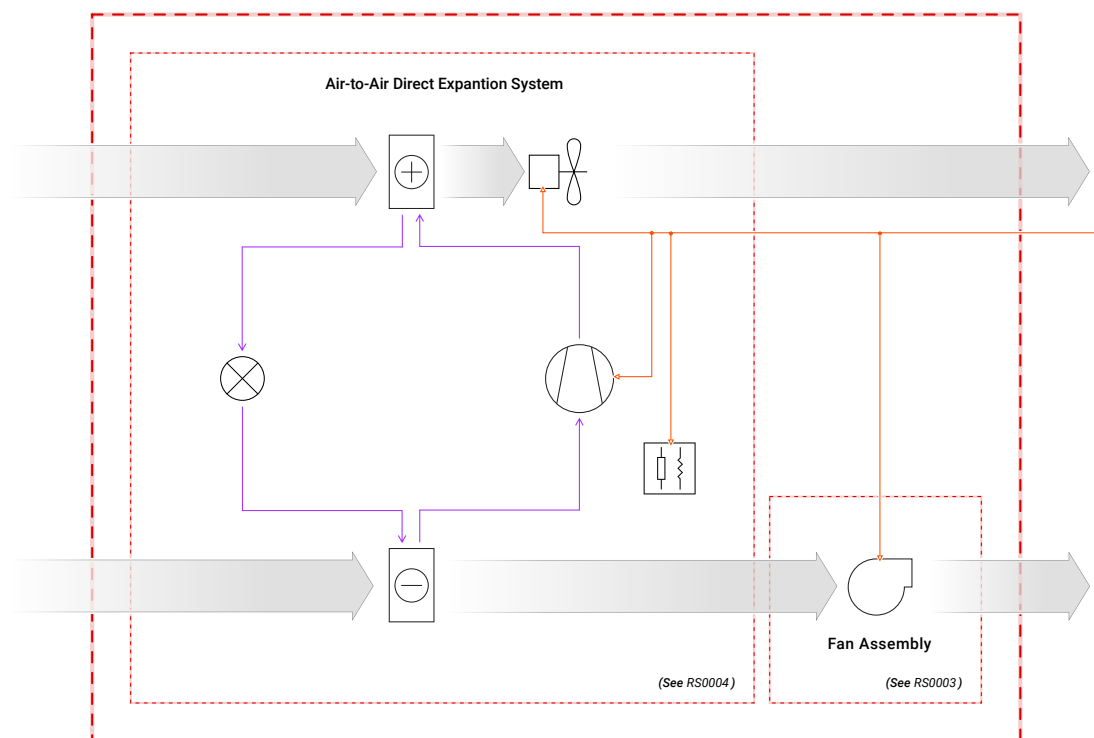


Figure RS0002–1 Unitary air-conditioning system.

RS0002.5.2 Enumerations

Table RS0002–3 FanPosition

Enumerator	Attributes
BLOW_THROUGH	Description: Fan is placed upstream of the indoor coil
DRAW_THROUGH	Description: Fan is placed downstream of the indoor coil

Table RS0002–4 AHRI210240TestStandardYear

Enumerator	Attributes
IP_2008	Description: Ratings defined using IP unit version of the standard, 2008 edition. ¹
IP_2017	Description: Ratings defined using IP unit version of the standard, 2017 edition. ²
IP_2023	Description: Ratings defined using IP unit version of the standard, 2023 edition. ³

Table RS0002–5 AHRI210240CompressorStagingType

Enumerator	Attributes
SINGLE_STAGE	Description: Single, fixed capacity compressor
TWO_STAGE	Description: Compressor or group of compressors operating with only two stages of capacity
VARIABLE_STAGE	Description: Variable speed compressor or compressor or group of compressors with three or more stages of capacity

Table RS0002–6 AHRI340360TestStandardYear

Enumerator	Attributes
IP_2007	Description: Ratings defined using IP unit version of the standard, 2007 edition. ⁴
IP_2015	Description: Ratings defined using IP unit version of the standard, 2015 edition. ⁵
IP_2019	Description: Ratings defined using IP unit version of the standard, 2019 edition. ⁶
IP_2022	Description: Ratings defined using IP unit version of the standard, 2022 edition. ⁷

Table RS0002–7 AHRI340360CapacityControlType

Enumerator	Attributes
FIXED_CAPACITY	Description: Limited to a single stage of refrigeration capacity
STAGED_CAPACITY	Description: Limited to multiple fixed or discrete stages of refrigeration capacity
PROPORTIONAL_CAPACITY	Description: Compressor capacity can be modulated continuously or in steps not more than 5% of the rated capacity

RS0002.5.3 Data Groups

Table RS0002–8 RS0002

Name	Attributes
metadata	Description: Metadata data group Type: Group (Metadata) Constraints: schema_name="RS0002" Required: True
description	Description: Data group describing product and rating information Type: Group (Description)

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Name	Attributes
performance	Description: Data group containing performance information Type: Group(Performance) Required: True

Table RS0002–9 Description

Name	Attributes
product_information	Description: Data group describing product information Type: Group(ProductInformation)
~~rating_ahri_210_240~~ <u>ratings</u>	Description: Data group containing ~~information~~ <u>rating information</u> Type: <u>Group(Ratings)</u>

Table RS0002–10 Ratings

<u>Name</u>	<u>Attributes</u>
<u>ahri_210_240</u>	Description: <u>Data group containing information</u> relevant to products rated under AHRI 210/240 Type: Group (~~Rating~~ <u>AHRI210240</u> <u>AHRI210240Rating</u>)
~~rating_ahri_340_360~~	Description: Data group containing information relevant to products rated under AHRI 340/360 Type: Group (~~Rating~~ <u>AHRI340360</u> <u>AHRI340360Rating</u>)

Table RS0002–11 ProductInformation

Name	Attributes
~~manufacturer~~ <u>product_identifiers</u>	Description: ~~Package manufacturer name~~ <u>Brand and model number pairs identifying the equipment</u> Type: ~~StringPattern~~ <u>Array</u> (<u>Group(ProductIdentifier)</u>) Notes: Pattern shall match all model numbers that can be represented by the representation

Table RS0002–12 **Rating**~~AHRI210240~~**AHRI210240Rating**

Name	Attributes
<code>certified_reference_numbers</code>	Description: AHRI certified reference numbers Type: <code>Array(String)</code> Constraints: <code>"^[0-9]+\$"</code> Notes: <u>One entry per unique AHRI certified reference number applicable to the products covered by the representation</u>
<code>test_standard_year</code>	Description: Year of the AHRI test standard Type: <code>Enumeration(AHRI210240TestStandardYear)</code>
<code>rating_source</code>	Description: Source of this rating data Type: <code>String</code> Notes: Used by data publisher to document methods (e.g., software and version) used to generate rating data
<code>staging_type</code>	Description: Type of compressor staging Type: <code>Enumeration(AHRI210240CompressorStagingType)</code>
<code>seer</code>	Description: Seasonal Energy Efficiency Ratio Type: <code>Numeric</code> Units: Btu/W·h Constraints: <code>>0.0</code> Notes: Used for versions of the test standard up through 2017
<code>seer2</code>	Description: Seasonal Energy Efficiency Ratio Type: <code>Numeric</code> Units: Btu/W·h Constraints: <code>>0.0</code> Notes: Used for versions of the test standard from 2023
<code>eer</code>	Description: Full stage Energy Efficiency Ratio (at 'A' operating conditions) Type: <code>Numeric</code> Units: Btu/W·h Constraints: <code>>0.0</code> Notes: Used for versions of the test standard up through 2017

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Name	Attributes
eer2	Description: Full stage Energy Efficiency Ratio (at 'A' operating conditions) Type: Numeric Units: Btu/W·h Constraints: >0.0 Notes: Used for versions of the test standard from 2023
cooling_capacity	Description: Full stage net total cooling capacity (at 'A' operating conditions) Type: Numeric Units: Btu/h Constraints: ≥0.0 Notes: At high stage for multi-stage equipment

Table RS0002–13 **Rating**AHRI340360AHRI340360Rating

Name	Attributes
certified_reference_numbers	Description: AHRI Certified Reference Numbers Type: Array(String) Constraints: "^[0-9]+\$" Notes: One entry per unique AHRI certified reference number applicable to the products covered by the representation
test_standard_year	Description: Name and version of the AHRI test standard Type: Enumeration(AHRI340360TestStandardYear)
rating_source	Description: Source of this rating data Type: String Notes: Used by data publisher to document methods (e.g., software and version) used to generate rating data
capacity_control_type	Description: Type of capacity control Type: Enumeration(AHRI340360CapacityControlType)
ieer	Description: Integrated Energy Efficiency Ratio Type: Numeric Units: Btu/W·h Constraints: >0.0

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RS0002.7 ~~Publishing~~Publication Rules. None.

RS0003.2 Version History [\(Informative\)](#)

schema_version	Date	Initial Approved Standard	Notes
1.0.0	2023	2023	Initial publication
2.0.0	2024	2023 - Addenda a, b, & c	

RS0003.3 Use Case (Informative). Performance data in a representation following this representation specification will be used by building performance software to estimate the performance and energy consumption of fans within a packaged assembly.

RS0003.4 Scope and Description

RS0003.4.1 Applicability. Fans within a packaged assembly. An “assembly” describes the context of static pressure values provided in a conforming representation. An assembly shall include any number of components in addition to the fan that are accounted for in the representation’s static pressure values. An assembly shall contain no additional components if no other components are accounted for in the representation’s static pressure values.

Informative note: For some fans, air flow data are only available in the context of static pressure across an assembly. Non-fan components are solely included in an assembly to provide the context for the static pressure values within the representation. For example, a representation of a fan assembly that includes a cooling coil shall not be applied to fans in contexts without a cooling coil because the effect of the cooling coil on the pressure drop across the assembly is inherent in the representation. This representation specification does not describe the performance data of non-fan components within the assembly. For example, the effect of a cooling coil on the air temperature is not described in a fan assembly representation.

RS0003.4.2 Exclusions

- Fans using inlet guide vanes to modulate flow rate
- Variable pitch axial fans

RS0003.4.3 Embedded Representations

Schema Type	Schema Type Description	Data Element
RS0005	Motor	performance.motor_representation
RS0007	Mechanical Drive	performance.mechanical_drive_representation

RS0003.4.4 Referencing Representations

- RS0002: Unitary Cooling Air-Conditioning Equipment

RS0003.4.5 Schematic (Informative). Figure RS0003–1 illustrates an example of a fan assembly within the scope of this representation (quantity and types of components will vary based on context).

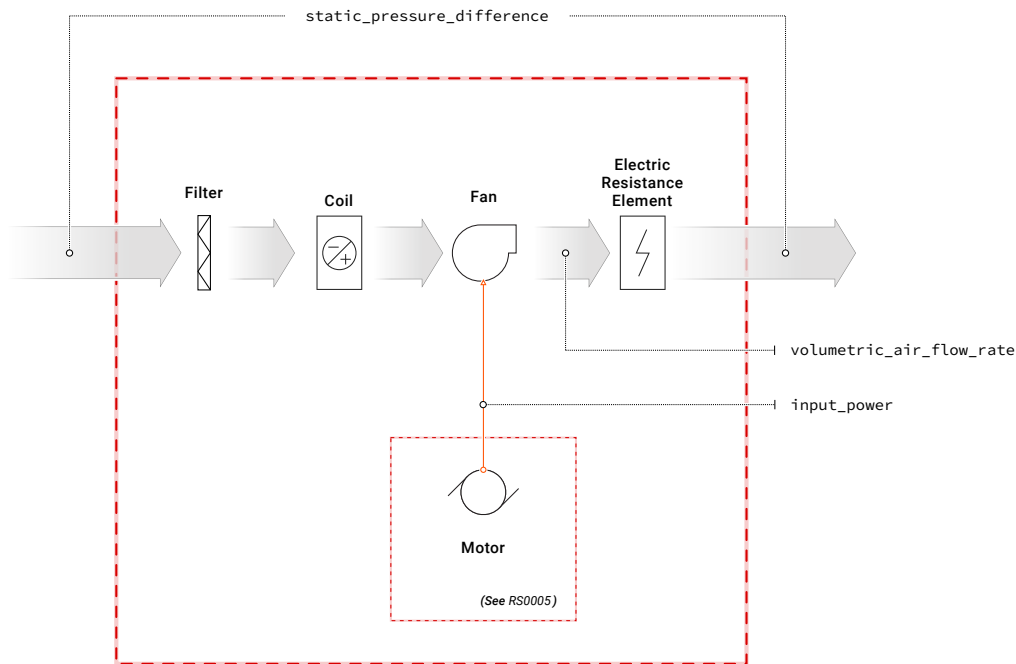


Figure RS0003–1 Example Fan Assembly for a Packaged System (Does Not Illustrate All Possible Combinations of Components).

RS0003.5 Data Model

RS0003.5.1 Data Group Hierarchy (Informative). A representation implementation conforming to this representation specification shall consist of the following data groups

- RS0003
 - Metadata
 - Description*
 - ProductInformation*
 - AssemblyComponent*
 - Performance
 - ContinuousPerformanceMap
 - ContinuousGridVariables
 - ContinuousLookupVariables
 - DiscretePerformanceMap
 - DiscreteGridVariables
 - DiscreteLookupVariables

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification. ~~Either Required data elements of an optional data group are only required when that data group is present in a representation. Either PerformanceMapContinuousContinuousPerformanceMap or PerformanceMapDiscreteDiscretePerformanceMap is required, but not both.~~

RS0003.5.2 Enumerations

Table RS0003–3 InstallationSpeedControlType

Enumerator	Attributes
FIXED	Description: Fan speed does not change after installation Notes: <i>Informative note:</i> Examples include dip-switch/tap selection and pulley adjustments
VARIABLE	Description: Fan speed can change depending on operation after installation

Table RS0003–4 ImpellerType

Enumerator	Attributes
CENTRIFUGAL_FORWARD_CURVED	Description: Forward curved fan impeller
CENTRIFUGAL_BACKWARD_CURVED	Description: Backward curved or inclined fan impeller
CENTRIFUGAL_AIR_FOIL	Description: Air foil impeller with shaped blades
AXIAL	Description: Fan impeller with shaft parallel to air flow stream for high static applications
PROPELLER	Description: Fan impeller with shaft parallel to air flow stream for low static pressure applications

Table RS0003–5 ComponentType

Enumerator	Attributes
COIL	Description: Finned coil in cross-flow arrangement
FURNACE	Description: Fuel-fired heating section
FILTER	Description: Air filters
HEAT_EXCHANGER	Description: Heat exchanger Notes: e.g., air-to-air heat exchanger
ELECTRIC_RESISTANCE_ELEMENT	Description: Electric resistance heater elements
DIRECT_EVAPORATIVE	Description: Wetted evaporative cooling media
OTHER	Description: Additional components in air stream

RS0003.5.3 Data Groups

Table RS0003–6 RS0003

Name	Attributes
metadata	Description: Metadata data group Type: Group(Metadata) Constraints: schema_name="RS0003" Required: True
description	Description: Data group describing product and rating information Type: Group(Description)
performance	Description: Data group containing performance information Type: Group(Performance) Required: True

Table RS0003–7 Description

Name	Attributes
product_information	Description: Data group describing product information Type: Group(ProductInformation)

Table RS0003–8 ProductInformation

Name	Attributes
~~manufacturer~~ product_identifiers	Description: ~~Assembly/unit manufacturer name~~ Brand and model number pairs identifying the equipment Type: ~~StringPattern~~ Array(Group(ProductIdentifier)) Notes: Pattern shall match all model numbers that can be represented by the representation
impeller_type	Description: Type of impeller in fan assembly Type: Enumeration(ImpellerType)
number_of_impellers	Description: Number of impellers included in the fan assembly Type: Integer

Table RS0003–9 Performance

Name	Attributes
nominal_standard_air_volumetric_flow_rate	Description: Nominal or rated air flow rate at standard air conditions Type: Numeric Units: m³/s Constraints: ≥0.0 Required: True Scalable: True Notes: Used for calculating component wet pressure difference
is_enclosed	Description: Fan assembly is enclosed Type: Boolean Required: True Notes: True if the performance data reflects the static pressure difference across the enclosure
assembly_components	Description: An array of components included in the fan assembly air stream, not including any fans Type: Array(Group(AssemblyComponent)) Required: if is_enclosed=True
heat_loss_fraction	Description: Fraction of efficiency losses transferred into the air stream Type: Numeric Units: - Constraints: • ≥0.0 • ≤1.0 Required: True Notes: Used to determine amount of heat from the motor added to the air stream
maximum_impeller_rotational_speed	Description: Maximum impeller rotational speed Type: Numeric Units: rev/s Constraints: ≥0.0 Required: True

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Name	Attributes
minimum_impeller_rotational_speed	Description: Minimum impeller rotational speed Type: Numeric Units: rev/s Constraints: ≥ 0.0 Required: True Notes: If no minimum, use zero
stability_curve	Description: The system curve defining the stability area for system selection Type: Group(SystemCurve) Notes: <i>Informative note:</i> Application software may use this curve to indicate to application software users when a selected fan is operating in an unstable region where surging or stalling is likely to occur
operation_speed_control_type	Description: Type of performance map Type: Enumeration(SpeedControlType) Required: True Notes: • Determines which performance map data group is used for performance_map • If operation_speed_control_type is DISCRETE performance map data is provided at individual impeller speeds • If operation_speed_control_type is CONTINUOUS performance map data is provided over a range of impeller speeds

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Name	Attributes
installation_speed_control_type	Description: Type of fan impeller speed control Type: Enumeration(InstallationSpeedControlType) Required: True Notes: • If operation_speed_control_type is DISCRETE and installation_speed_control_type is FIXED, impeller speed shall be restricted to a single discrete speed • If operation_speed_control_type is DISCRETE and installation_speed_control_type is VARIABLE, impeller speed shall be restricted to a set of two or more discrete speeds • If operation_speed_control_type is CONTINUOUS and installation_speed_control_type is FIXED, impeller speed shall be restricted to a single speed (which may be interpolated from impeller_speed values provided in the performance map) • If operation_speed_control_type is CONTINUOUS and installation_speed_control_type is VARIABLE, impeller speed shall be unrestricted within operational limits
motor_representation	Description: The corresponding Standard 205 motor representation Type: Group(RS0005) Notes: If the fan assembly is packaged with a motor, a motor representation shall be provided
mechanical_drive_representation	Description: The corresponding Standard 205 mechanical drive representation Type: Group(RS0007) Notes: If the fan assembly is packaged with a mechanical drive, a mechanical drive representation shall be provided
scaling	Description: Specifies the range the performance data can be scaled to represent different capacity equipment Type: Group(Scaling) Notes: If not present, scaling of the performance data is not allowed

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Name	Attributes
performance_map	Description: Data group describing fan assembly performance when operating Type: Alternative (Group (~~PerformanceMapContinuous~~ContinuousPerformanceMap), Group (~~PerformanceMapDiscrete~~DiscretePerformanceMap)) Constraints: operation_speed_control_type (CONTINUOUS, DISCRETE) Required: True

Table RS0003–10 AssemblyComponent

Name	Attributes
component_type	Description: Type of component Type: Enumeration (ComponentType) Required: True
component_description	Description: Informative description of the component Type: String
component_id	Description: Identifier of the corresponding Standard 205 representation Type: UUID Notes: Optionally provided if the component has a Standard 205 representation
wet_pressure_difference	Description: Additional static pressure difference if the component is wet (e.g., because of condensate collection or wetting evaporative media) Type: Numeric Units: Pa Constraints: ≥ 0.0 Required: True Scalable: True Notes: - Corresponds to additional pressure difference at nominal_standard_air_volumetric_flow_rate - If unknown, a value of 75 Pa shall be used

Table RS0003–11 SystemCurve

Name	Attributes
grid_variables	Description: Data group defining the grid variables for the system curve Type: Group(SystemCurveGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for the system curve Type: Group(SystemCurveLookupVariables) Required: True Cycling Order: [standard_air_volumetric_flow_rate]

Table RS0003–12 [SystemCurveGridVariables](#)

Name	Attributes
standard_air_volumetric_flow_rate	Description: Volumetric air flow rate through an air distribution system at standard air conditions Type: Array(Numeric) Units: m^3/s Constraints: • ≥ 0.0 • [2..] Required: True Scalable: True

Table RS0003–13 [SystemCurveLookupVariables](#)

Name	Attributes
static_pressure_difference	Description: Static pressure difference of an air distribution system Type: Array(Numeric) Units: Pa Constraints: • ≥ 0.0 • [2,-1..] Required: True Scalable: True

Table RS0003–14 [PerformanceMapContinuousContinuousPerformanceMap](#)

Name	Attributes
grid_variables	Description: Data group describing grid variables for continuous fan performance Type: Group(GridVariablesContinuousContinuousGridVariables) Required: True
lookup_variables	Description: Data group describing lookup variables for continuous fan performance Type: Group(LookupVariablesContinuousContinuousLookupVariables) Required: True Cycling Order: [standard_air_volumetric_flow_rate, static_pressure_difference]

Table RS0003–15 [GridVariablesContinuousContinuousGridVariables](#)

Name	Attributes
standard_air_volumetric_flow_rate	Description: Volumetric air flow rate through fan assembly at standard air conditions Type: Array(Numeric) Units: m ³ /s Constraints: • ≥0.0 • [1..] Required: True Scalable: True
static_pressure_difference	Description: External static pressure across fan assembly at dry coil conditions Type: Array(Numeric) Units: Pa Constraints: • ≥0.0 • [1..] Required: True Notes: Any static pressure deduction (or addition) for wet coil is specified by wet_pressure_difference in ‘assembly_components’ data group

Table RS0003–16 ~~LookupVariablesContinuous~~[ContinuousLookupVariables](#)

Name	Attributes
impeller_rotational_speed	Description: Rotational speed of fan impeller Type: Array(Numeric) Units: rev/s Constraints: • ≥ 0.0 • [1..] Required: True
shaft_power	Description: Mechanical shaft power input to fan assembly Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: Does not include the mechanical efficiency of any mechanical drive used to modify rotational speed between the motor and impeller
operation_state	Description: The operation state at the operating conditions Type: Array(Enumeration(OperationState)) Constraints: [1..] Required: True

Table RS0003–17 ~~PerformanceMapDiscrete~~[DiscretePerformanceMap](#)

Name	Attributes
grid_variables	Description: Data group describing grid variables for discrete fan performance Type: Group(~~GridVariablesDiscrete~~ DiscreteGridVariables) Required: True
lookup_variables	Description: Data group describing lookup variables for discrete fan performance Type: Group(~~LookupVariablesDiscrete~~ DiscreteLookupVariables) Required: True Cycling Order: [speed_number, static_pressure_difference]

Table RS0003–18 [GridVariablesDiscreteDiscreteGridVariables](#)

Name	Attributes
speed_number	Description: Number indicating discrete speed of fan impeller in rank order (with 1 being the lowest speed) Type: Array(Integer) Constraints: • ≥ 0 • [1..] Required: True Notes: Data shall be provided for all allowable discrete speeds or settings
static_pressure_difference	Description: External static pressure across fan assembly at dry coil conditions Type: Array(Numeric) Units: Pa Constraints: • ≥ 0.0 • [1..] Required: True Notes: Any static pressure deduction (or addition) for wet coil is specified by wet_pressure_difference in ‘assembly_components’ data group

Table RS0003–19 [LookupVariablesDiscreteDiscreteLookupVariables](#)

Name	Attributes
standard_air_volumetric_flow_rate	Description: Volumetric air flow rate through fan assembly at standard air conditions Type: Array(Numeric) Units: m³/s Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True

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Name	Attributes
shaft_power	Description: Mechanical shaft power input to fan assembly Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: Does not include the mechanical efficiency of any mechanical drive used to modify rotational speed between the motor and impeller
impeller_rotational_speed	Description: Rotational speed of fan impeller Type: Array(Numeric) Units: rev/s Constraints: • ≥ 0.0 • [1..] Required: True
operation_state	Description: The operation state at the operating conditions Type: Array(Enumeration(OperationState)) Constraints: [1..] Required: True

RS0003.7 ~~Publishing~~Publication Rules. None.

RS0004.2 Version History [\(Informative\)](#)

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

RS0004.3 Use Case (Informative). Performance data in a representation following this representation specification will be used by building performance software to estimate the thermal performance of direct expansion vapor compression refrigerant systems with two coils.

RS0004.4 Scope and Description

RS0004.4.1 Applicability. Direct expansion vapor compression refrigerant systems with two coils (one evaporator and one condenser) both exchanging heat with air streams to provide cooling, heating, or both.

RS0004.4.2 Exclusions

- Systems with hot gas reheat used for dehumidification
- Systems with evaporative condenser type

RS0004.4.3 Embedded Representations. None.

RS0004.4.4 Referencing Representations

- RS0002: Unitary Cooling Air-Conditioning Equipment

RS0004.4.5 Schematic [\(Informative\)](#). Figure RS0004–1 illustrates the representation of components within the scope of this appendix during cooling operation.

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

RS0004.5 Data Model

RS0004.5.1 Data Group Hierarchy [\(Informative\)](#). A representation implementation conforming to this representation specification shall consist of the following data groups:

- RS0004
 - Metadata
 - Description*
 - ProductInformation*
 - Performance
 - CoolingPerformanceMap
 - CoolingGridVariables
 - CoolingLookupVariables
 - HeatingPerformanceMap
 - HeatingGridVariables
 - HeatingLookupVariables
 - DefrostCorrectionPerformanceMap
 - DefrostCorrectionGridVariables
 - DefrostCorrectionLookupVariables
 - StandbyPerformanceMap
 - StandbyGridVariables
 - StandbyLookupVariables

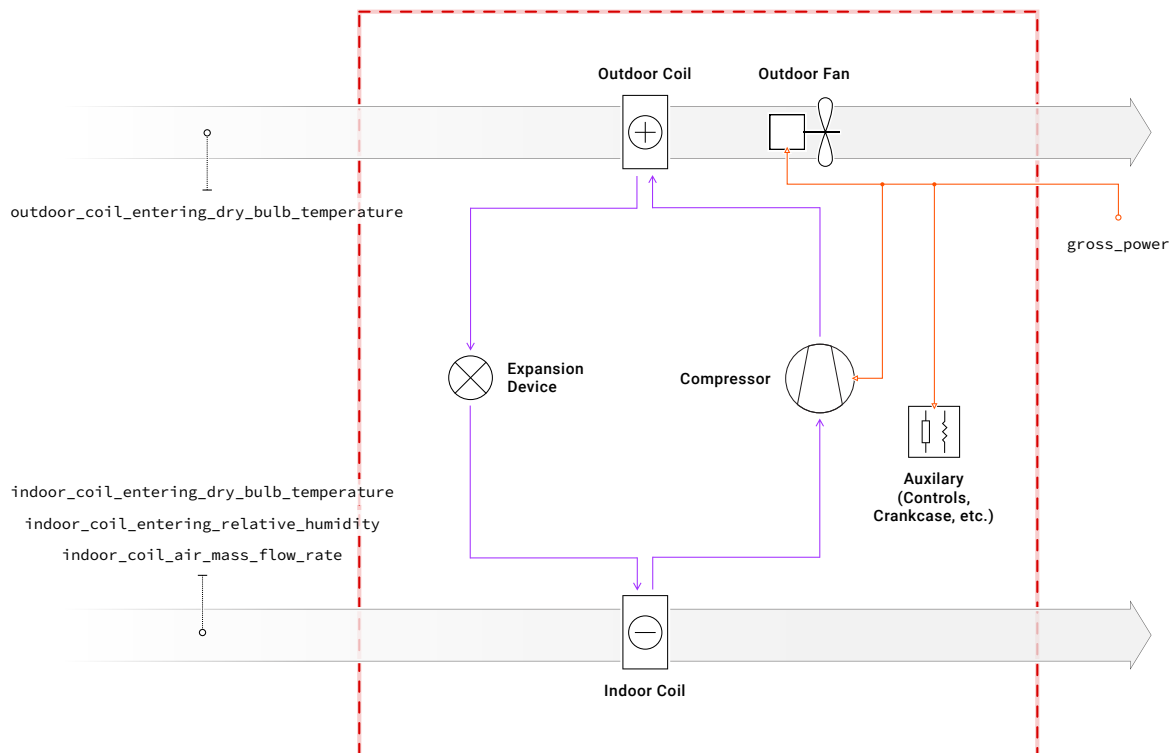


Figure RS0004–1 Air-to-Air direct expansion system during cooling operation.

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification. [Required data elements of an optional data group are only required when that data group is present in a representation.](#)

RS0004.5.2 Enumerations. None.

RS0004.5.3 Data Groups

Table RS0004–2 RS0004

Name	Attributes
metadata	Description: Metadata data group Type: Group(Metadata) Constraints: schema_name="RS0004" Required: True
description	Description: Data group describing product and rating information Type: Group(Description)

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Name	Attributes
performance	Description: Data group containing performance information Type: Group(Performance) Required: True

Table RS0004–3 Description

Name	Attributes
product_information	Description: Data group describing product information Type: Group(ProductInformation)

Table RS0004–4 ProductInformation

Name	Attributes
~~outdoor_unit_manufacturer~~ <u>product_identifiers</u>	Description: ~~Outdoor unit manufacturer name~~ <u>Brand and model number pairs identifying the outdoor unit</u> Type: ~~String~~ <u>Array(Group(ProductIdentifier))</u>
~~outdoor_unit_model_number~~ <u>indoor_unit_model_product_number_identifiers</u>	Description: ~~Outdoor unit model number~~ <u>Brand and model number pairs identifying the indoor unit</u> Type: ~~PatternString~~ <u>Array(Group(ProductIdentifier))</u> Notes: May be omitted for packaged systems ~~with a single manufacturer~~
~~indoor_unit_model_number~~	Description: ~~Indoor unit model number~~ Type: ~~Pattern~~ Notes: ~~Pattern shall match all model numbers that can be represented by the representation~~
refrigerant	Description: Refrigerant used 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 Type: Enumeration(CompressorType)

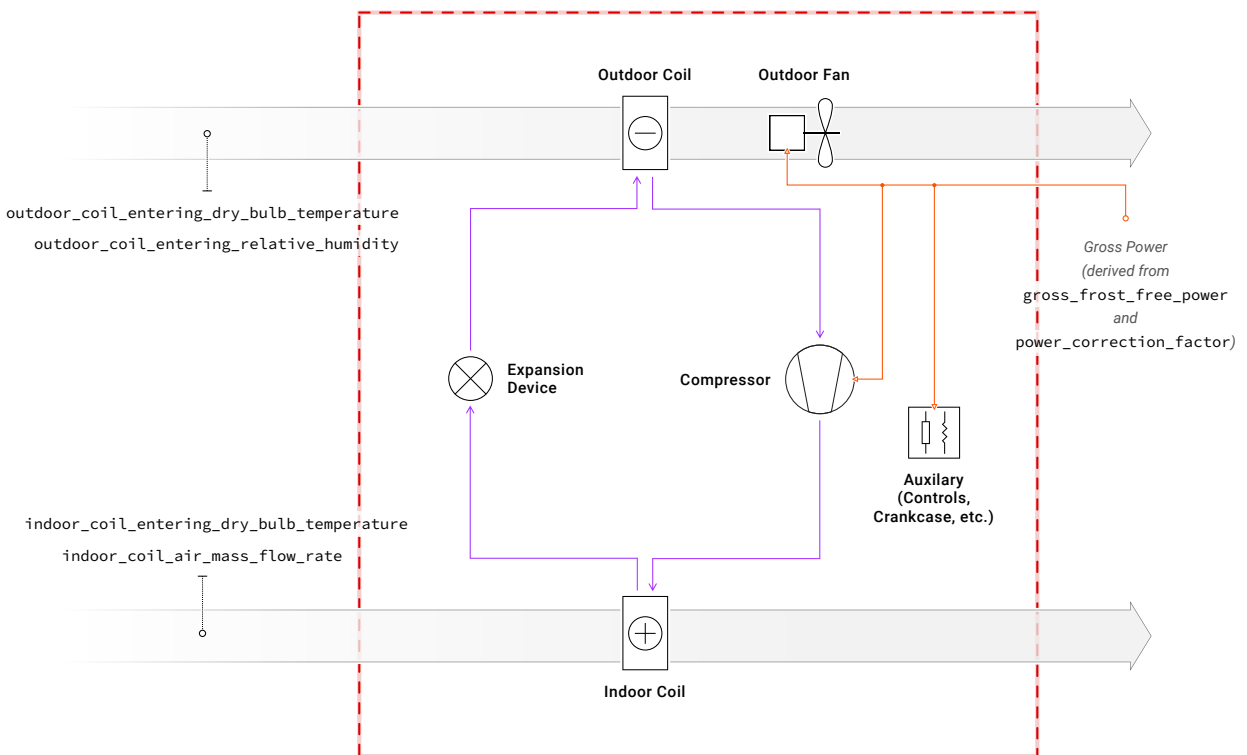


Figure RS0004–2 Air-to-Air direct expansion system during heating operation. Features unrelated to data elements may be omitted, such as the refrigerant reversing valve.

Table RS0004–5 Performance

Name	Attributes
performance_capabilities	Description: An array of unique operating modes that indicate the capabilities of the equipment Type: Array (Enumeration (PerformanceCapabilities)) Required: True
compressor_speed_control_type	Description: Method used to control different speeds of the compressor Type: Enumeration (SpeedControlType) Required: True
cooling_cycling_degradation_coefficient	Description: Cooling cycling degradation coefficient (C_D^c) Type: Numeric Units: - Constraints: • ≥ 0.0 • < 1.0 Required: if performance_capabilities contains (COOLING) Notes: • Used for the lowest stage when the unit cycles to meet load
heating_cycling_degradation_coefficient	Description: Heating cycling degradation coefficient (C_D^h) Type: Numeric Units: - Constraints: • ≥ 0.0 • < 1.0 Required: if performance_capabilities contains (HEATING) Notes: • Used for the lowest stage when the unit cycles to meet load
scaling	Description: Specifies the range the performance data can be scaled to represent different capacity equipment Type: Group (Scaling) Notes: If not present, scaling of the performance data is not allowed
<u>cooling</u> _performance_map ~~eeeling~~	Description: Data group describing cooling performance over a range of conditions Type: Group (PerformanceMapCoolingCoolingPerformanceMap) Required: if performance_capabilities contains (COOLING)

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Name	Attributes
heating_performance_map ~~heating~~	Description: Data group describing heating performance over a range of conditions Type: Group (~~PerformanceMapHeating~~ HeatingPerformanceMap) Required: if performance_capabilities contains (HEATING)
~~performance_map~~ ~~defrost_correction_performance~~	Description: Data group describing the impact on heating performance due to frost formation, defrost operation, or both Type: Group (~~PerformanceMapDefrostCorrection~~ DefrostCorrectionPerformanceMap) Required: if performance_capabilities contains (HEATING)
standby_performance_map ~~standby~~	Description: Data group describing standby performance Type: Group (~~PerformanceMapStandby~~ StandbyPerformanceMap) Required: True

Table RS0004–6 ~~PerformanceMapCooling~~[CoolingPerformanceMap](#)

Name	Attributes
grid_variables	Description: Data group defining the grid variables for cooling performance Type: Group (~~GridVariablesCooling~~ CoolingGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for cooling performance Type: Group (~~LookupVariablesCooling~~ CoolingLookupVariables) Required: True Cycling Order: [outdoor_coil_entering_dry_bulb_temperature, indoor_coil_entering_relative_humidity, indoor_coil_entering_dry_bulb_temperature, indoor_coil_air_mass_flow_rate, compressor_sequence_number, ambient_absolute_air_pressure]

Table RS0004–7 **GridVariablesCoolingCoolingGridVariables**

Name	Attributes
outdoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the outdoor coil Type: Array (Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True
indoor_coil_entering_relative_humidity	Description: Relative humidity of the air entering the indoor coil Type: Array (Numeric) Units: - Constraints: • ≥ 0.0 • ≤ 1.0 • [1..] Required: True 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 Type: Array (Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True Notes: As measured immediately before entering the coil (i.e., after the fan in a blow-through configuration)

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Name	Attributes
indoor_coil_air_mass_flow_rate	Description: Mass flow rate of air entering the indoor coil Type: Array (Numeric) Units: kg/s Constraints: • >0.0 • [1..] Required: True Scalable: True
compressor_sequence_number	Description: Index indicating the relative capacity order of the compressor speed/stage expressed in order from lowest capacity (starting at 1) to highest capacity Type: Array (Integer) Constraints: • ≥1 • [1..] Required: True Notes: • If <code>compressor_speed_control_type</code> is DISCRETE, sequence numbers shall be provided for each discrete stage of the compressor(s) • If <code>compressor_speed_control_type</code> is CONTINUOUS, sufficient sequence numbers shall be provided to capture the continuous operation of the compressor(s)
ambient_absolute_air_pressure	Description: Ambient absolute air pressure Type: Array (Numeric) Units: Pa Constraints: • ≥0.0 • [1..] Required: True

Table RS0004–8 [LookupVariablesCoolingCoolingLookupVariables](#)

Name	Attributes
gross_total_capacity	Description: Total heat removed by the indoor coil Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: Shall not include fan heat
gross_sensible_capacity	Description: Sensible heat removed by the indoor coil Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: Shall not include fan heat
gross_power	Description: Gross power draw (of the outdoor unit) Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: • Includes compressor, outdoor fan, and any auxiliary power used by the unit's controls and any crankcase heater • Shall not include power drawn by the indoor fan
operation_state	Description: The operation state at the operating conditions Type: Array(Enumeration(OperationState)) Constraints: [1..] Required: True

Table RS0004–9 **PerformanceMapHeatingHeatingPerformanceMap**

Name	Attributes
grid_variables	Description: Data group defining the grid variables for heating performance Type: Group(~~GridVariablesHeating~~ HeatingGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for heating performance Type: Group(~~LookupVariablesHeating~~ HeatingLookupVariables) Required: True

Table RS0004–10 **GridVariablesHeatingHeatingGridVariables**

Name	Attributes
outdoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the outdoor coil Type: Array(Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True
indoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the indoor coil Type: Array(Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True Notes: As measured immediately before entering the coil (i.e., after the fan in a blow-through configuration)

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Name	Attributes
indoor_coil_air_mass_flow_rate	Description: Mass flow rate of air entering the indoor coil Type: Array (Numeric) Units: kg/s Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True
compressor_sequence_number	Description: Index indicating the relative capacity order of the compressor speed/stage expressed in order from lowest capacity (starting at 1) to highest capacity Type: Array (Integer) Constraints: • ≥ 1 • [1..] Required: True Notes: • If <code>compressor_speed_control_type</code> is DISCRETE, sequence numbers shall be provided for each discrete stage of the compressor(s) • If <code>compressor_speed_control_type</code> is CONTINUOUS, sufficient sequence numbers shall be provided to capture the continuous operation of the compressor(s)

Table RS0004–11 **LookupVariablesHeatingHeatingLookupVariables**

Name	Attributes
gross_frost_free_capacity	Description: Rate of heat added by the indoor coil under steady state conditions with no frost present on the outdoor coil Type: Array (Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: • Informative note: Sometimes also referred to as “instantaneous” or “steady state” capacity • Does not account for heat added by the fan
gross_frost_free_power	Description: Gross power draw of the outdoor unit under steady state conditions with no frost present on the outdoor coil Type: Array (Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: • Informative note: Sometimes also referred to as “instantaneous” or “steady state” 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 crankcase heater
operation_state	Description: The operation state at the operating conditions Type: Array (Enumeration (OperationState)) Required: True

Table RS0004–12 [PerformanceMapDefrostCorrection](#)[DefrostCorrectionPerformanceMap](#)

Name	Attributes
grid_variables	Description: Data group defining the grid variables for the impact on heating performance due to the effects of frost formation, defrost operation, or both Type: Group(GridVariablesDefrostCorrectionDefrostCorrectionGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for the impact on heating performance due to the effects of frost formation, defrost operation, or both Type: Group(LookupVariablesDefrostCorrectionDefrostCorrectionLookupVariables) Required: True

Table RS0004–13 [GridVariablesDefrostCorrection](#)[DefrostCorrectionGridVariables](#)

Name	Attributes
outdoor_coil_entering_dry_bulb_temperature	Description: Dry bulb temperature of the air entering the outdoor coil Type: Array(Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True
outdoor_coil_entering_relative_humidity	Description: Relative humidity of the air entering the outdoor coil Type: Array(Numeric) Units: - Constraints: • ≥ 0.0 • ≤ 1.0 • [1..] Required: True

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Name	Attributes
compressor_sequence_number	Description: Index indicating the relative capacity order of the compressor speed/stage expressed in order from lowest capacity (starting at 1) to highest capacity Type: Array(Integer) Constraints: • ≥ 1 • [1..] Required: True Notes: Shall be consistent with the values of compressor_sequence_number in GridVariablesHeatingHeatingGridVariables

Table RS0004–14 [LookupVariablesDefrostCorrectionDefrostCorrectionLookupVariables](#)

Name	Attributes
capacity_correction_factor	Description: Factor representing the correction to the gross frost-free heating capacity to account for impacts of frost formation, defrost operation, or both over the integrated time period Type: Array(Numeric) Units: - Constraints: • ≥ 0.0 • ≤ 1.0 • [1..] Required: True Notes: A value of 1.0 indicates no frost formation or defrost operation
power_correction_factor	Description: Factor representing the correction to the gross frost-free power to account for impacts of frost formation, defrost operation, or both over the integrated time period Type: Array(Numeric) Units: - Constraints: • ≥ 0.0 • [1..] Required: True Notes: A factor greater than 1.0 indicates electric resistance strip heat might be applied to defrost the outdoor coil

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Name	Attributes
defrost_time_fraction	Description: Fraction of integrated time period when defrost operation is active Type: Array (Numeric) Units: - Constraints: • ≥ 0.0 • ≤ 1.0 • [1..] Required: True Notes: <i>Informative note:</i> This value is used to inform application software when it may need to control supplemental heating during defrost

Table RS0004–15 [PerformanceMapStandbyStandbyPerformanceMap](#)

Name	Attributes
grid_variables	Description: Data group defining the grid variables for standby performance Type: Group (GridVariablesStandbyStandbyGridVariables) Required: True
lookup_variables	Description: Data group defining the lookup variables for standby performance Type: Group (LookupVariablesStandbyStandbyLookupVariables) Required: True Cycling Order: [outdoor_coil_environment_dry_bulb_temperature]

Table RS0004–16 [GridVariablesStandbyStandbyGridVariables](#)

Name	Attributes
outdoor_coil_environment_dry_bulb_temperature	Description: Dry bulb temperature of the air in the environment of the outdoor coil Type: Array (Numeric) Units: K Constraints: • ≥ 0.0 • [1..] Required: True

Table RS0004–17 **LookupVariablesStandbyStandbyLookupVariables**

Name	Attributes
gross_power	Description: Gross power draw (of the outdoor unit) Type: Array(Numeric) Units: W Constraints: • ≥ 0.0 • [1..] Required: True Scalable: True Notes: Includes any auxiliary power used by the unit's controls and any crankcase heater

RS0004.6 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.

RS0004.6.1 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

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

RS0004.6.2 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:

$$\omega_l \leq \omega_e$$

RS0004.6.3 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

RS0004.6 **Publishing Rules**

RS0004.7 Publication Rules. Representations conforming to this representation specification shall comply with the common refrigerant cycle representation publication rules in Section 7.2.5.1.1 and the common air-cooling heat exchanger representation publication rules in Section 7.2.5.1.2. For the purpose of applying these rules:

- In cooling operation, the source temperature shall be taken as the indoor coil entering dry-bulb temperature (indoor_coil_entering_dry_bulb_temperature) and the sink temperature shall be taken as the outdoor coil entering dry-bulb temperature (outdoor_coil_entering_dry_bulb_temperature). The gross COP shall be taken as the ratio of gross_total_capacity to gross_power.
- In heating operation, the source temperature shall be taken as the outdoor coil entering dry-bulb temperature (outdoor_coil_entering_dry_bulb_temperature) and the sink temperature shall be taken as the indoor coil entering dry-bulb temperature (indoor_coil_entering_dry_bulb_temperature). The gross COP shall be taken as the ratio of gross_frost_free_capacity to gross_frost_free_power.
- The air flow rate across the cooling heat exchanger shall be taken as indoor_coil_air_mass_flow_rate and the sensible cooling capacity shall be taken as gross_sensible_capacity.

RS0004.7.1 Heating Performance. `performance_map_defrost_correction_performance_map` approximates the impact on heating performance due to frost formation, defrost operation, or both over the integrated time period. Figure RS0004–3 and Figure RS0004–4 illustrate the modeling simplification used to represent capacity and power.

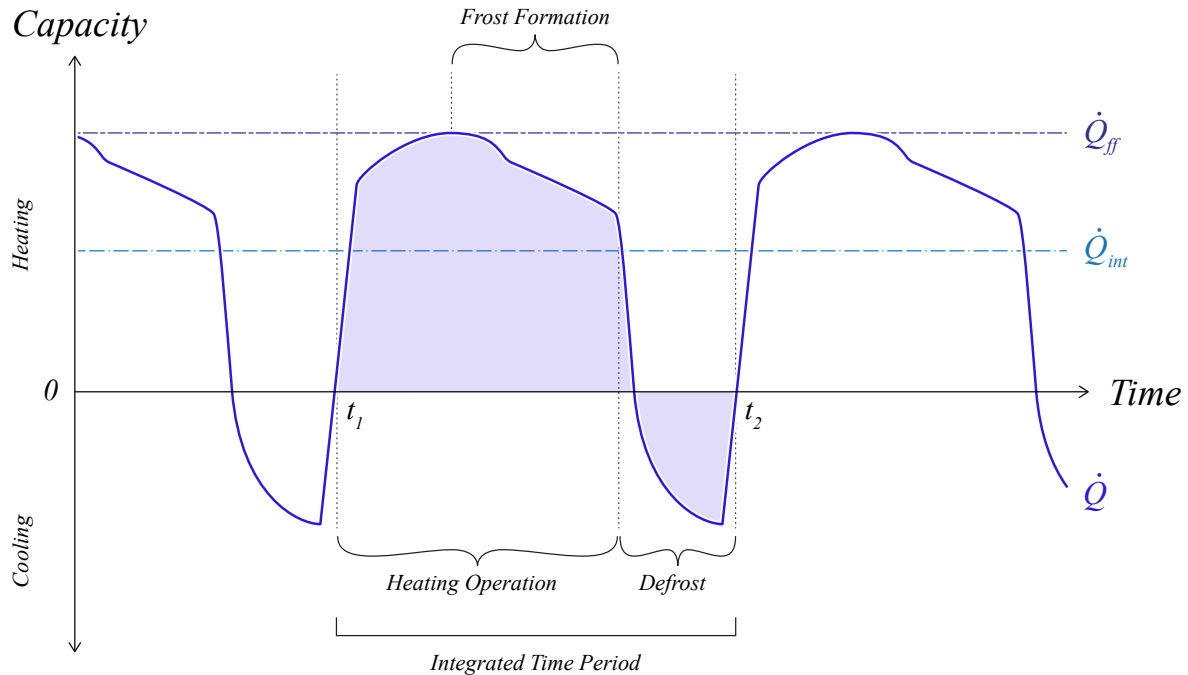


Figure RS0004–3 Reverse-cycle heat pump capacity performance during heating.

The time integrated average capacity shall be calculated with the following equation:

$$\dot{Q}_{int} = \frac{\int_{t_1}^{t_2} \dot{Q} dt}{t_2 - t_1}$$

The time integrated average power shall be calculated with the following equation:

$$\dot{P}_{int} = \frac{\int_{t_1}^{t_2} \dot{P} dt}{t_2 - t_1}$$

The `capacity_correction_factor` shall be calculated with the following equation:

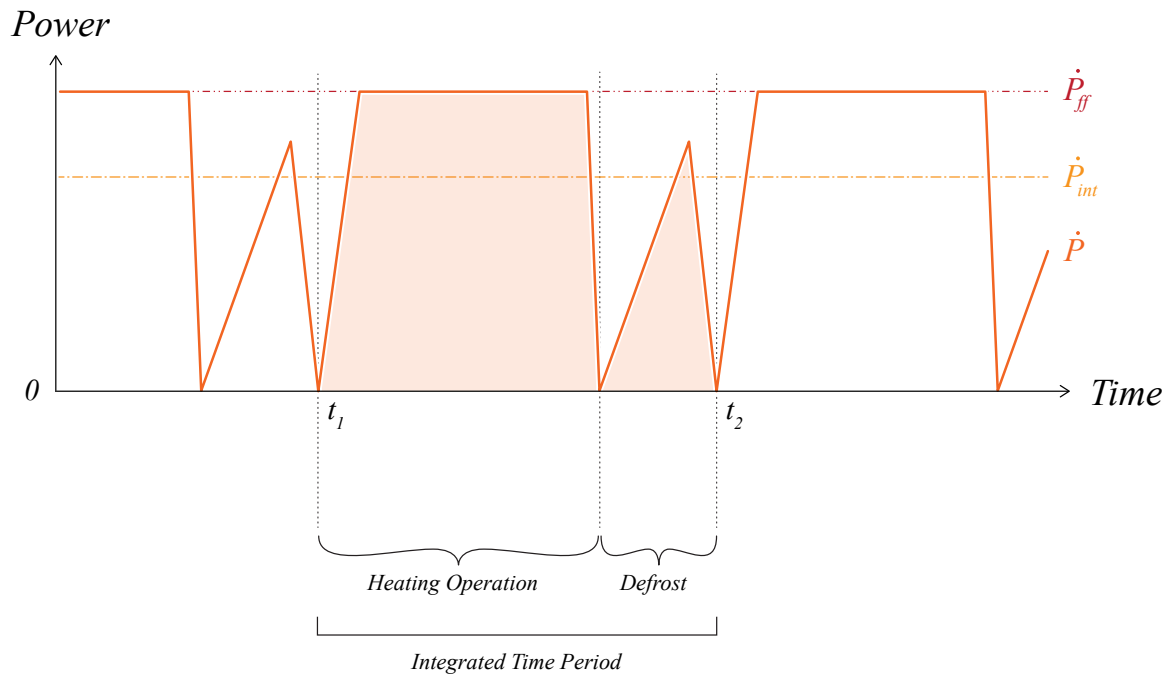


Figure RS0004-4 Reverse-cycle heat pump power during heating.

$$f_{\dot{Q}} = \frac{\dot{Q}_{int}}{\dot{Q}_{ff}}$$

The `power_correction_factor` shall be calculated with the following equation:

$$f_{\dot{P}} = \frac{\dot{P}_{int}}{\dot{P}_{ff}}$$

RS0004.7.2 Nomenclature

Symbol	Data element	Description
$\dot{Q}_{int}$		Time integrated average gross capacity over the integrated time period, W
$\dot{Q}_{ff}$	<code>gross_frost_free_capacity</code>	Rate of heat added by the indoor coil under steady state conditions with no frost present on the outdoor coil, W
$\dot{Q}$		Rate of heat added by the indoor coil, W
$f_{\dot{Q}}$	<code>capacity_correction_factor</code>	Factor representing the average correction to the gross frost-free capacity over the integrated time period
$\dot{P}_{int}$		Time integrated average gross power over the integrated time period, W
$\dot{P}_{ff}$	<code>gross_frost_free_power</code>	Gross power draw of the outdoor unit under steady state conditions with no frost present on the outdoor coil, W
$\dot{P}$		Gross power, W

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Symbol	Data element	Description
f_P	power_correction_factor	Factor representing the average correction to the gross frost-free power over the integrated time period
t_1		Time at the initial defrost termination, s
t_2		Time at the successive defrost termination, s

RS0004.8 Application Rules

RS0004.8.1 Cooling Performance. [cooling_performance_map_cooling](#) shall be used to simulate performance when system controls call for cooling.

RS0004.8.2 Heating Performance. [heating_performance_map_heating](#) and [performance_map_defrost_correction_performance](#) shall be used to simulate performance under the following conditions:

- when system controls call for heating, and
- the corresponding lookup variable `operation_state` in [heating_performance_map_heating](#) has a value of NORMAL at the current simulated conditions

The simulated capacity shall be modeled with the following equation:

$$\dot{Q}_{int} = \dot{Q}_{ff} \cdot f_{\dot{Q}}$$

The simulated power shall be modeled with the following equation:

$$\dot{P}_{int} = \dot{P}_{ff} \cdot f_P$$

RS0004.8.3 Standby Performance. [standby_performance_map_standby](#) shall be used to simulate performance under any of the following conditions:

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

[Defrost pan heaters are not represented in this data model. Application software shall separately characterize the energy use of defrost pan heaters.](#)

RS0004.8.4 Cycling Degradation. The cycling degradation coefficients, `cooling_cycling_degradation_coefficient` and `heating_cycling_degradation_coefficient`, shall be used to adjust the gross power when the system is cycling between the lowest `compressor_sequence_number` of the respective performance map and standby operation.

The time integrated average gross power during heating or cooling operation while cycling shall be calculated as:

$$\bar{P}_{cyc} = f_{cyc} \cdot \frac{\dot{P}_{low}}{1 - C_D \cdot (1 - f_{cyc})}$$

The average power during standby operation while cycling shall be calculated as:

$$\bar{P}_{sb} = (1 - f_{cyc}) \cdot \dot{P}_{sb}$$

RS0005.2 Version History [\(Informative\)](#)

schema_version	Date	Initial Approved Standard	Notes
1.0.0	2023	2023	Initial publication
2.0.0	2024	2023 - Addenda a, b, & c	

RS0005.3 Use Case (Informative). Performance data in a representation following this representation specification will be used by building performance software to estimate the performance of electric motors.

RS0005.4 Scope and Description

RS0005.4.1 Applicability. Electric motors.

RS0005.4.2 Exclusions. None.

RS0005.4.3 Embedded Representations

Schema Type	Schema Type Description	Data Element
RS0006	Electronic Motor Drive	performance.drive_representation

RS0005.4.4 Referencing Representations

- RS0003: Fan Assembly

When representations of motor-driven equipment incorporate motor efficiency implicitly in their data (i.e., input power represents electrical power and not mechanical shaft power), the referenced motor representation shall omit the motor's performance map to imply that the input power of the referencing representation serves as electrical input power (instead of mechanical shaft power). Referencing representations shall also indicate what fraction of motor efficiency losses are added as heat to a fluid stream if the motor is used to move fluids.

RS0005.4.5 Schematic [\(Informative\)](#). Figure RS0005–1 illustrates an example of a motor within the scope of this representation.

RS0005.5 Data Model

RS0005.5.1 Data Group Hierarchy [\(Informative\)](#). A representation implementation conforming to this representation specification shall consist of the following data groups

- RS0005
 - Metadata
 - Description*
 - ProductInformation*
 - Performance
 - PerformanceMap
 - GridVariables
 - LookupVariables

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification. [Required data elements of an optional data group are only required when that data group is present in a representation.](#)

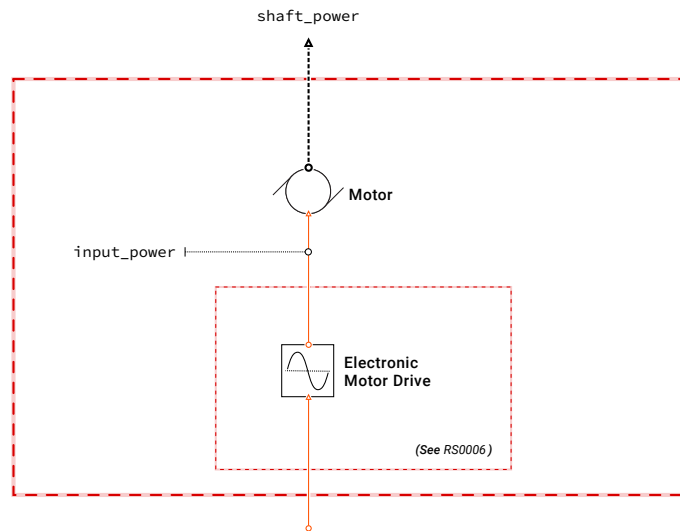


Figure RS0005–1 Motor.

RS0005.5.2 Enumerations. None.

RS0005.5.3 Data Groups

Table RS0005–3 RS0005

Name	Attributes
metadata	Description: Metadata data group Type: Group(Metadata) Constraints: schema_name="RS0005" Required: True
description	Description: Data group describing product and rating information Type: Group(Description)
performance	Description: Data group containing performance information Type: Group(Performance) Required: True

Table RS0005–4 Description

Name	Attributes
product_information	Description: Data group describing product information Type: Group(ProductInformation)

Table RS0005–5 ProductInformation

Name	Attributes
~~manufacturer~~ product_identifiers	Description: ~~Manufacturer name~~ Brand and model number pairs identifying the equipment Type: ~~StringPattern~~ Array(Group(ProductIdentifier)) Notes: Pattern shall match all model numbers that can be represented by the representation
nominal_voltage	Description: Nominal voltage Type: Numeric Units: V Constraints: ≥ 0.0
nominal_frequency	Description: Nominal frequency Type: Numeric Units: Hz Constraints: ≥ 0.0

Table RS0005–6 Performance

Name	Attributes
maximum_power	Description: Maximum operational input power to the motor Type: Numeric Units: W Constraints: ≥ 0.0 Required: True Scalable: True Notes: Operational limit set to prevent overheating or overcurrent, not the rated name plate power

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RS0005.7 ~~Publishing~~Publication Rules. None.

RS0006.2 Version History [\(Informative\)](#)

schema_version	Date	Initial Approved Standard	Notes
1.0.0	2023	2023	Initial publication
2.0.0	2024	2023 - Addenda a, b, & c	

RS0006.3 Use Case (Informative). Performance data in a representation following this representation specification will be used by building performance software to estimate the performance of electrical motor drives.

RS0006.4 Scope and Description

RS0006.4.1 Applicability. Electronic motor drives.

RS0006.4.2 Exclusions. None.

RS0006.4.3 Embedded Representations. None.

RS0006.4.4 Referencing Representations

- RS0005: Motor

RS0006.4.5 Schematic [\(Informative\)](#). Figure RS0006–1 illustrates an example of an electronic motor drive within the scope of this representation.

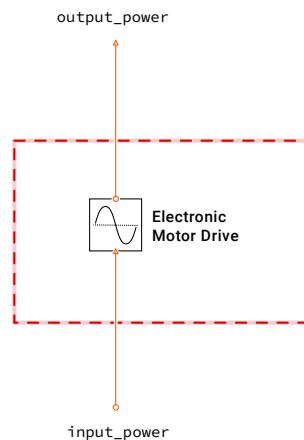


Figure RS0006–1 Electronic motor drive.

RS0006.5 Data Model

RS0006.5.1 Data Group Hierarchy (Informative). A representation implementation conforming to this representation specification shall consist of the following data groups

- RS0006
 - Metadata
 - Description*
 - ProductInformation*
 - Performance
 - PerformanceMap
 - GridVariables
 - LookupVariables

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification. [Required data elements of an optional data group are only required when that data group is present in a representation.](#)

RS0006.5.2 Enumerations

Table RS0006–2 CoolingMethod

Enumerator	Attributes
PASSIVE_COOLED	Description: Drive is cooled using natural air convection within the surrounding environment Notes: All drive efficiency losses are assumed to be added as heat to the surrounding environment
ACTIVE_AIR_COOLED	Description: Drive is cooled using forced air convection within the surrounding environment Notes: • Electrical power required for the active cooling system shall be included in the efficiency of the drive • All drive efficiency losses are assumed to be added as heat to the surrounding environment
ACTIVE_LIQUID_COOLED	Description: Drive is cooled using forced liquid convection, transferring heat to the liquid Notes: • Any liquid pumping power shall be modeled external to the drive by the application software • All drive efficiency losses are assumed to be added as heat to the liquid stream

RS0006.5.3 Data Groups

Table RS0006–3 RS0006

Name	Attributes
metadata	Description: Metadata data group Type: Group(Metadata) Constraints: schema_name="RS0006" Required: True
description	Description: Data group describing product and rating information Type: Group(Description)
performance	Description: Data group containing performance information Type: Group(Performance) Required: True

Table RS0006–4 Description

Name	Attributes
product_information	Description: Data group describing product information Type: Group(ProductInformation)

Table RS0006–5 ProductInformation

Name	Attributes
~~manufacturer~~ product_identifiers	Description: ~~Manufacturer name~~ Brand and model number pairs identifying the equipment Type: ~~StringPattern~~ Array(Group(ProductIdentifier)) Notes: Pattern shall match all model numbers that can be represented by the representation

RS0006.7 ~~Publishing~~Publication Rules. None.

RS0007.2 Version History [\(Informative\)](#)

schema_version	Date	Initial Approved Standard	Notes
1.0.0	2023	2023	Initial publication
2.0.0	2024	2023 - Addenda a, b, & c	

RS0007.3 Use Case (Informative). Performance data in a representation following this representation specification will be used by building performance software to estimate the performance of mechanical drives.

RS0007.4 Scope and Description

RS0007.4.1 Applicability. Mechanical drives used to transmit mechanical power from one shaft to another through belts, gears, or chains.

RS0007.4.2 Exclusions. None.

RS0007.4.3 Embedded Representations. None.

RS0007.4.4 Referencing Representations

- RS0003: Fan Assembly

RS0007.4.5 Schematic [\(Informative\)](#). Figure RS0007–1 illustrates an example of a mechanical drive within the scope of this representation.

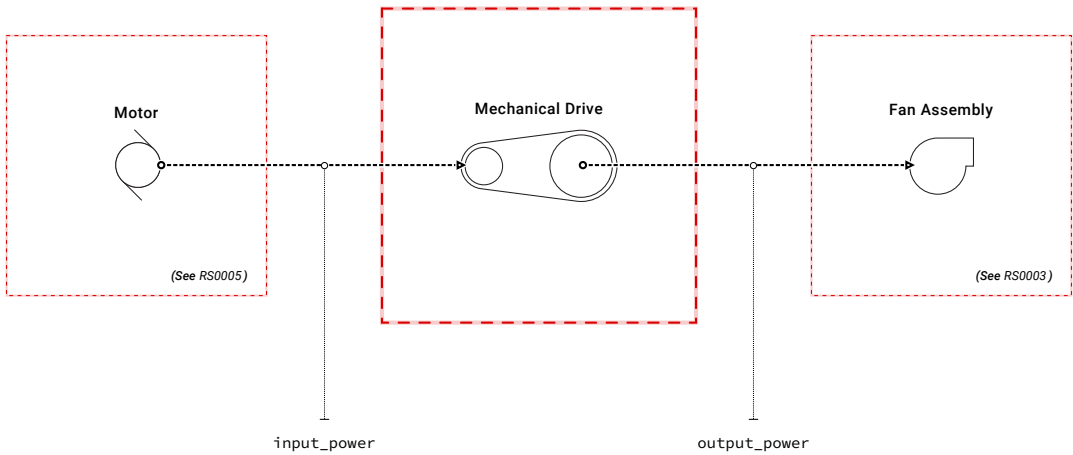


Figure RS0007–1 Mechanical drive.

RS0007.5 Data Model

RS0007.5.1 Data Group Hierarchy (Informative). A representation implementation conforming to this representation specification shall consist of the following data groups

- RS0007
 - Metadata
 - Description*
 - ProductInformation*
 - Performance
 - PerformanceMap
 - GridVariables
 - LookupVariables

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification. [Required data elements of an optional data group are only required when that data group is present in a representation.](#)

RS0007.5.2 Enumerations

Table RS0007–2 DriveType

Enumerator	Attributes
V_BELT	Description: V-Belt
COGGED_BELT	Description: Cogged Belt
SYNCHRONOUS_BELT	Description: Synchronous Belt
GEAR	Description: Gear
CHAIN	Description: Chain

RS0007.5.3 Data Groups

Table RS0007–3 RS0007

Name	Attributes
metadata	Description: Metadata data group Type: Group(Metadata) Constraints: schema_name="RS0007" Required: True
description	Description: Data group describing product and rating information Type: Group(Description)
performance	Description: Data group containing performance information Type: Group(Performance) Required: True

Table RS0007–4 Description

Name	Attributes
product_information	Description: Data group describing product information Type: Group(ProductInformation)

Table RS0007–5 ProductInformation

Name	Attributes
~~manufac-~~ ~~turer~~ product_identifiers	Description: ~~Manufacturer name~~ Brand and model number pairs identifying the equipment Type: ~~StringPattern~~ Array(Group(ProductIdentifier)) Notes: Pattern shall match all model numbers that can be represented by the representation
drive_type	Description: Type of mechanical drive Type: Enumeration(DriveType)

Table RS0007–6 Performance

Name	Attributes
speed_ratio	Description: Ratio of input shaft speed to output shaft speed Type: Numeric Units: - Constraints: >0.0 Required: True
scaling	Description: Specifies the range the performance data can be scaled to represent different capacity equipment Type: Group(Scaling) Notes: If not present, scaling of the performance data is not allowed
performance_map	Description: Data group describing drive performance when operating Type: Group(PerformanceMap) Required: True

RS0007.7 ~~Publishing~~Publication Rules. None.