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

Public Review Draft

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

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

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

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Proposed BSR/ASHRAE/IBPSA Addendum *g* 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 g

This Standard 205-2023 Addendum g contains revisions made to replace some material with references to ANSI/ASHRAE/IBPSA Standard 232-2024 (Common Content and Specifications for Building Data Schemas).

During the development of Standard 205, it became clear that many of its basic provisions are useful for representation of many types of building data beyond equipment performance. SPC-232 was formed to extract general sections from Standard 205 to facilitate reference from other standards and to foster development of common software tools.

Addendum g completes this separation by modifying Standard 205 to conform to Standard 232. Addendum g does not alter the fundamental requirements of Standard 205. The changes impact only presentation and terminology. There are thus many small changes throughout the standard and this public review draft includes essentially the entire standard to provide context.

SSPC-205 will develop further addenda as needed to track the evolution of Standard 232 and will contribute to that evolution based on application experience.

[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 *g* to Standard 205-2023

CONTENTS

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

Mechanical equipment uses fuel and/or electricity and emits carbon during operation. Simulation models allow prediction of these impacts given information about how the equipment performs under all conditions. The lack of detailed equipment performance data in readily-usable forms has hampered the application of building simulation models since their invention in the 1960s and 1970s. Data are often not available or published in inconsistent formats, forcing simulation users to resort to default information and/or time consuming (and error-prone) reformatting.

Standard 205 addresses this deficiency by defining common data models and serialization formats for facility equipment performance data, allowing automated exchange among data sources (manufacturers), simulation models, and other engineering applications. The formats and procedures specified by Standard 205 are developed under ASHRAE and ANSI consensus processes with participation of equipment manufacturers, application software developers, and engineering practitioners. The intent is that all data publishers write common-format data files and all application software include procedures to read files using that format. Standard procedures will improve the accuracy and consistency of model results relative to the mix of correlation and application-specific approaches traditionally used.

Standard 205 defines the term representation to mean such a data file. Specifically, a representation is a Concise Binary Object Representation (CBOR) file conforming to a JSON schema defined by a representation specification – a human-readable (text) document that defines data models and formats for an equipment type. Representation specifications are included in Standard 205 appended as an open-ended set. Conceptually, a representation specification has three parts:

- ***Documentation** provides narrative text, schematic(s), references, and other information that explain the equipment and how it is modeled. This material is aimed at human readers to support correct data generation and use. Additional documentation may be available at https://data.ashrae.org/standard205.*
- ***Data model** rigorously specifies the data groups and data elements that identify the performance of the equipment. The ASHRAE 205 JSON schema provides a machine-processable equivalent statement of the data model, allowing automated reading, writing, and validation of data files and is available on-line at https://data.ashrae.org/standard205/schema.html.*
- ***Verification and application rules** set forth logic for identifying data errors and/or using data as intended. Such rules are to be manually implemented in application software.*

The main body of Standard 205 provides rules and definitions used for generating representation specifications. This includes data groups that are common to all representation specifications, requirements for the structure of a representation specification, common definitions such as abbreviations, and informative material. This portion of the main body can be viewed as a meta-standard in that it specifies how to produce a representation specification.

The structure of Standard 205 and how it is applied are shown in Figure 1.

Examples helpful for understanding the form and application of Standard 205 are found in Informative Appendix A and on-line at https://data.ashrae.org/standard205/examples.html.

Standard 205 is intended to support the following use cases –

- ***Data Publication.** Data publishers use representation specifications to guide implementation of data writing and testing software that produces correctly formed representation files.*
- ***Application Development.** Application software developers use representation specifications to guide implementation of software that correctly reads representation data. Such implementations may include verification tests, and developers may use representation specification example data for testing purposes.*
- ***Data Application.** Application software users use representation specifications to understand and check representation data. Data exchange will generally be automated, but the availability of representation specifications facilitates additional data review when needed.*

Standard 205 does not define or restrict distribution schemes for representation files. Data publishers may establish distribution policies that fit their business needs and are free to employ mechanisms such as encryption or digital signatures to control availability. Some organizations may provide publicly accessible representation files. For example, organizations may provide generic representations to support energy code compliance analysis.

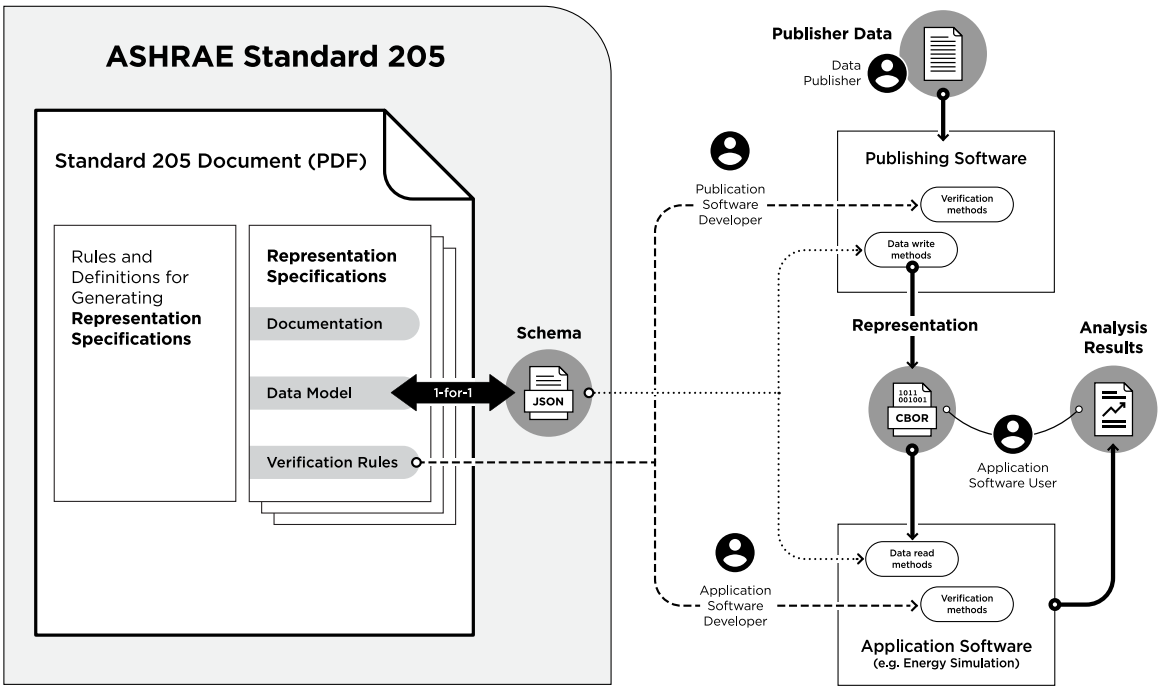

Figure 1 Standard 205 structure and application.

Standard 205 follows use of ASHRAE's SI units practice within representations, an exception to normal ASHRAE dual-units policy. In the context of automated data exchange, requiring or allowing more than one units convention would introduce ambiguity and complicate implementation. Unit conversion can be done as needed for application or display.

Given that all representations have common structures and elements, many software components can be shared by data publishers and application software developers. To this end, an open source project is underway. See https://github.com/open205.

This first version of Standard 205 is the starting point of an ongoing effort to develop efficient and accurate methods for conveying equipment performance data in an industry consensus form. Applying Standard 205 may require substantial investment by both data publishers (manufacturers) and application software developers. Their experiences in applying the standard will inform its future direction.

Standard Project Committee (SPC) 205 will be reconstituted as a Standing Standard Project Committee (SSPC) and anticipates creating addenda, including those that:

- *Include new representation specifications for additional equipment types.*
- *Modify existing representation specifications to make representations more accurate and practical to publish.*

The SSPC encourages input from all stakeholders.

1 PURPOSE

To facilitate automated sharing of equipment performance characteristics by defining data models and data serialization formats.

2 SCOPE

This standard applies to performance data for any HVAC&R or other facility system, equipment, or component.

3 DEFINITIONS

application software: a program or routine that reads and uses representation data.

application software developer: a developer of application software that read and use representation data.

application software user: the end user of application software.

ASHRAE 205 JSON schema: the JSON schema representing all data models defined by the collection of representation specifications in this standard. The official ASHRAE 205 JSON schema is located at https://data.ashrae.org/standard205/schema.html.

CBOR: Concise Binary Object Representation. See CBOR[1].

data element: a named data item with an explicit data type. (Definition from ASHRAE Standard 232[2].)

data group: multiple data elements grouped together under a single, named data structure. (Definition from ASHRAE Standard 232[2].)

data model: a collection of data groups that represent facility equipment characteristics and performance. (Definition from ASHRAE Standard 232[2].)

data publisher: a facility equipment manufacturer or other entity that generates representations. (Definition from ASHRAE Standard 232[2].)

data serialization format: a specification of an implementation for encoding a data model for storage or transmission. Many data serialization formats are possible for a given data model.

~~***data type:*** an attribute that specifies how to interpret that calue of the data (see Section 6.5 for data type definitions).~~

facility equipment: equipment that impacts resource use or conditions related to an element of the built environment.

grid cell: in a performance map, the parameter space defined by adjacent pairs of grid variable values in each dimension. For performance maps with one grid variable, the grid cell is the space between two adjacent points along a line; with two grid variables, the grid cell is a rectangle; with three grid variables, the grid cell is a cuboid; and with four or more grid variables the grid cell is a hyperrectangle of respective dimensionality.

grid variable: a variable describing a single dimension of operating conditions (e.g., ambient drybulb temperature). Grid variable values are represented by an ordered array of discrete values. The collection of all grid variable values defines the overall operating range of the facility equipment. ***Informative note:*** Grid variables are often called "independent variables"; however, the dependence of grid variables and lookup variables can be application specific and thus the term "independent" is intentionally avoided.

JSON: JavaScript Object Notation. A lightweight text-based data-interchange format. See JSON[3].

lookup variable: a variable used for performance characteristics (e.g., capacity or input power). Lookup variable values are defined for each combination of grid variables values. ***Informative note:*** Lookup variables are often called "dependent variables", however, the dependence of grid variables and lookup variables can be application specific and thus the term "dependent" is intentionally avoided.

~~***numerical:*** a data element having data type `Integer` or `Numeric`~~

performance map: a data group consisting of a collection of grid variables and associated lookup variables.

power: electrical power unless explicitly stated otherwise.

representation: a CBOR-format file containing data conforming to a representation specification.

representation specification: a definition of facility equipment performance-related data models, data verification tests, and descriptive information such as text descriptions and equipment schematics. The format of a representation specification is defined by this standard. Representation specifications are appended to the end of this standard.

standard air conditions: air having density of 1.2 kg/m^3 (0.075 lb/ft^3), which approximates dry air at a temperature of 294.25°K (70.0°F) and a barometric pressure of 101.3 kPa (29.92 in. Hg). ***Informative note:*** This is an SI translation of the ASHRAE I-P definition of standard air.

standby operation: the characterization of facility equipment performance when the equipment is idle.

verification rule: a set of one or more computable expressions used to verify consistency and physical reasonableness of a representation.

4 ASHRAE STANDARD 232 CONFORMANCE

The Standard 205 data model and documentation conform with ASHRAE Standard 232[2], and items documented here describe extensions to ASHRAE Standard 232.

5 REPRESENTATION CONTENT

The representation shall be a file conforming to the CBOR data serialization format[1] that (1) is valid according to the ASHRAE 205 JSON schema and (2) passes all verification rules specified in the representation specification.

Representation files shall be named xxxx.a205.cbor, where xxxx is a suitable identifier chosen by the data publisher for the equipment whose performance is represented in the file.

To be valid against the ASHRAE 205 JSON schema, the representation shall be correctly formatted and pass all constraint checks.

6 DATA MODEL CONTENT

6.1 ~~Data Group Composition.~~

6.2 Data Groups. ~~A data group is a collection of data elements as specified in this standard.~~

Standard 205 data groups shall not be extended except via modification of the standard.

Representation files containing data elements or data groups not defined in this standard will not validate against the ASHRAE 205 JSON schema.

6.3 Data Element Attributes. ~~Data elements shall be characterized in data groups using the attributes shown~~ In addition to the data elements attributes defined in ASHRAE Standard 232, the attributes in Table ~~6–1~~6–1 shall be used.

Table 6–1 Data Element Attributes

Attribute	Description	Notes
~~Name~~	~~Public name of data element~~	~~See Section 8.3~~
~~Description~~	~~Text description that defines the meaning of the data element~~	
~~Data Type~~	~~Data type of data element~~	~~See Section 6.5~~
~~Units~~	~~Units of data element~~	~~See Section 6.6~~
~~Constraints~~	~~A list of constraints on the data element value that can be verified against the schema~~	~~See Section 6.8~~
~~Required (abbreviated as Req)~~	~~Indicates whether data element is mandatory when containing data group is present in a representation~~	~~See Section 6.10~~
Scalable	Indicates whether the data element value is scalable within the limits specified in a Scaling data group	See Section 6.11
~~Notes~~	~~Any supplementary information~~	

6.4 Data Type Definitions. All data types used in this standard including fundamental, specific string, derived, enumeration, group, array, and aternative types are defined in ASHRAE Standard 232.

6.5 Data Type Definitions. Each data element shall have one of the data type attributes described in Section 6.5.1 through Section 6.5.3.

6.5.1 Fundamental Data Type Definitions. Standard 205 adopts fundamental data type definitions from JSON Schema.

Table 6–2 Fundamental Data Type Definitions

Data Type	Description	JSON Schema Type	Examples
`Integer`	A positive or negative base-10 whole number (i.e., a number that can be written without a fractional part).	integer	3, 19, -4
`Numeric`	A base-10 number that may include a fractional part with optional leading sign and optional exponent (engineering notation). Numeric values are conveyed in CBOR files in IEEE 754binary64 format without rounding.	number	3.43, 0, -4, 1.03e4
`Boolean`	True or false.	boolean	true, false
`String`	A sequence of characters of any length using any (specified) character set.	string	Indirect evaporative cooler

6.5.2 Specific String Data Type Definitions. The data types in Table 6–3 are defined for the purposes of this standard and are a pre-defined subset of the fundamental`String` data type defined in Table 6–2 conforming to the JSON Schema patterns provided.

Table 6–3 Specific String Data Type Definitions

String Type	Description	JSON Schema Pattern	Examples
`UUID`	An effectively unique character stringconforming to ITU-T X.667.	[0-9, a-f,A-F]{8} -[0-9,a-f,A-F]{4} -[0-9,a-f,A-F]{4} -[0-9,a-f,A-F]{4} -[0-9,a-f,A-F]{12}	123e4567-e89b-12d3-a456-426655440000
`Date`	A calendar date formatted per ISO 86010-9]{4} -[0-9]{2} -[0-9]{2}	2015-04-29	
`Timestamp`	Date with UTC time formatted per ISO 86010-9]{4} -[0-9]{2} -[0-9]{2}T[0-9]{2}:[0-9]{2}Z	2016-06-29T14:35Z	
`Version`	Version identifier in the form major.minor.patch as defined by SemVer(0|[1-9][0-9]*).(0|[1-9][0-9]*).(0|[1-9][0-9]*) (?:-((?:0|[1-9][0-9]*|[0-9]*[a-zA-Z-][0-9a-zA-Z-]*) (?:. (?:0|[1-9][0-9]*|[0-9]*[a-zA-Z-][0-9a-zA-Z-]*))*))? (?:+([0-9a-zA-Z-]+ (?:.[0-9a-zA-Z-]+)*))?	1.1.3, 1.2.0-beta-92	

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String Type	Description	JSON Schema Pattern	Examples
`Pattern`	A regular expression pattern as defined by ECMA-262. Used for characterization (e.g., model numbers).	(Not applicable)	CA225FB.[1-9]

6.5.3 Derived and Composite Data Type Definitions. Some data types are derivedexplicitly for the purposes of this standard. These include specific enumerations, or "choice" data types, and composite data types comprising a collection of data elements of various data types.

6.5.3.1 Enumeration. An enumerationis a data type that takes one of a pre-defined set of string enumerator values. Each enumeration shall be given a unique data type name and shall define the set of string enumerators. Data elements representing enumerations shall be denoted in a data groupby wrapping the name of the enumeration in angle brackets as the data type. Example: `<CompressorType>`.

Informative note: Enumerations are defined in JSON schema as "string" types with pre-defined "enum" values. Enumerators shall be characterized in enumerations by the attributes shown in Table 6–4.

Table 6–4 Enumerator Attributes

Attribute	Description	Notes
Enumerator	Public name of enumerator	See Section 8.4
Description	Text description that defines the meaning of the enumerator	
Display Text	Text used by application for enumerator	
Notes	Any supplementary information	

6.5.3.2 Data Group. Nested data groups shall be denoted by defining a data element whose data type is the name of a defined data group wrapped in curly brackets. Example: `{PerformanceMapCooling}`. The nested data group can be constrained to have a data element with a specific value (See Section 6.9.4).

Informative note: Data groups are defined in JSON schema as "objects".

6.5.3.3 Array. Data elements representing an ordered collection of values of a specific data type (including enumerations, data groups, etc.), shall be denoted by wrapping the data type in square brackets. Examples: `[Numeric]` or `[<CompressorType>]`.

Limitations on arraylengths shall be denoted using a subsequent set of square brackets containing the minimum and maximum lengths of the array separated by two periods. Example: A numeric array that must have at least one value, but no more than four values would appear as `[Numeric][1..4]`.

Arrays with no minimum length (that is, it may have zero values) shall be denoted with no value before the two periods. Example: `[Numeric][..4]`.

Arrays with no maximum length shall be denoted with no value after the two periods. Example: `[Numeric][1..]`.

Arrays with no minimum or maximum length shall be denoted by simply omitting the second set of square brackets altogether. Example `[Numeric]`.

Informative note: Arrays are defined in JSON schema as "array".

6.5.3.4 ~~Alternative.~~ ~~A set of alternative data types where one, and only one corresponding value is provided. Alternatives shall be denoted by wrapping a comma separated list of alternative data types in round brackets. Examples: `({PerformanceMapDiscrete}, {PerformanceMapContinuous})`.~~

~~Informative note:~~ ~~Alternatives are defined in JSON schema using "if-then" (if the selection of an alternative is based on the value of an enumeration data element) or "oneOf".~~

6.6 Units

6.6.1 General Requirements. Except as specified in Section 6.6.2, all numeric values shall be represented in SI units as specified in ASHRAE SI policy documents[4]. Base units shall be used (e.g., temperature shall be expressed in degrees 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.

6.6.2 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.

6.6.3 ~~Units in Representation Specification Documentation.~~

6.7 Constraints. ~~Units of all values in all representation specifications shall be documented using symbols defined below.~~

~~If a numeric data element does not have units, the hyphen "-" character shall be used for its units.~~
~~When combining base units into derived units, the following rules shall apply:~~

- ~~For a symbol raised to a power use the power as an exponent (e.g., m^2).~~
- ~~For the product of two symbols use the interpunct "·" (e.g., N·m).~~
- ~~For the quotient of two symbols use the solidus "/" (e.g., W/(m^2·K))~~
- ~~Use only one solidus symbol per derived unit (e.g., m/s^2, not m/s/s).~~
- ~~Use parentheses for a denominator that is more than a single unit (e.g., W/(m^2·K), not W/m^2·K).~~
- ~~Do not use negative exponents (e.g., W/(m^2·K), not W·m^{-2}·K^{-1}).~~

6.7.1 ~~Units in JSON Schema.~~ ~~Units of all values in JSON schema shall be documented using symbols defined below.~~

~~If a numeric data element does not have units, the hyphen "-" character shall be used for its units.~~
~~When combining base units into derived units, the following rules shall apply:~~

- ~~For a symbol raised to a power use the symbol followed by the power (e.g., m2).~~
- ~~For the product of two symbols use the hyphen "-" (e.g., N-m).~~
- ~~For the quotient of two symbols use the solidus "/" (e.g., W/m2-K)~~
- ~~Use only one solidus symbol per derived unit (e.g., m/s2, not m/s/s).~~
- ~~Do not use parentheses (e.g., W/m2-K, not W/(m2-K)).~~
- ~~Do not use negative exponents (e.g., W/m2-K, not W-m-2-K-1).~~

6.8 ~~Constraints.~~ ~~The following constraints are~~ The constraints used for the "Constraints" data element attribute ~~. When multiple constraints apply to the same data element, the constraints shall be specified as a list.~~ are defined in ASHRAE Standard 232.

6.8.1 ~~Range.~~

6.9 Required Data Elements. ~~The constraint for numerical data elements with valid minimum and/or maximum values shall be expressed as numerical constants using <, <=, >=, or >.~~

~~Informative note:~~ ~~Example: A numerical data element that is required to be greater or equal to zero has the constraint defined as `>=0`.~~

6.9.1 ~~Multiple.~~ ~~The constraint for numerical data elements that must be multiples of a number shall be expressed using %.~~

~~Informative note:~~ ~~Example: A numerical data element that is required to be a multiple of two has the constraint defined as `%2`.~~

6.9.2 ~~Set.~~ ~~The constraint for numerical data elements that must be one of a set of valid values shall be specified by placing the valid values in between square brackets, "`[]`", separated by commas. For string data elements, an enumeration shall be defined instead of using a set constraint.~~

~~Informative note:~~ ~~Example: A numerical data element that is required to be the one of the years 2005, 2008, and 2012 has the constraint defined as `[2005, 2008, 2012]`.~~

6.9.3 ~~String Pattern.~~ ~~The constraint for `String` data elements that must match a specific pattern shall be specified as a regular expression of the pattern.~~

~~Informative note:~~ ~~When a string pattern constraint is to be used on multiple data elements, then a specific string data type should be defined instead.~~

6.9.4 ~~Data Element Value.~~ ~~The constraint for nested data group data elements that must have a data element with a specific value shall be specified by placing the name of the data element followed by the equals sign "=" and the required value.~~

~~Informative note:~~ ~~Example: If a data element `curve_fit` has a nested data group data type `{CurveFit}` having an enumeration data element `type` that has required to have a value of `LINEAR`, then the constraint on `curve_fit` is stated as `type=LINEAR`.~~

6.9.5 ~~Selector.~~ ~~The constraint for alternative data elements where the choice of alternative depends on the value of an enumeration data element shall be specified by placing the corresponding enumerator values in a comma separated list enclosed in parentheses following the enumeration data element name. In this case, the order of the enumerator values shall follow the same order of their corresponding alternative selection.~~

~~Informative note:~~ ~~Example: If an data element, `performance_map` has the alternative data type of `({PerfromanceMapDiscrete}, {PerformanceMapContinuous})` and there is an enumeration data element `performance_map_type` that has enumerators `CONTINUOUS` and `DISCRETE`, then the selector constraint on `performance_map` would be stated as `performance_map_type(CONTINUOUS, DISCRETE)`.~~

6.10 ~~Required Data Elements.~~ ~~The "~~The allowable conditions for the "Required" data element attribute ~~is used to indicate the conditions where a data element value is required if the containing data group is present in a representation. If the data element is never required, the "Required" data element attribute shall be left blank. The following conditions are allowed.~~ are defined in ASHRAE Standard 232.

6.10.1 ~~Unconditional.~~ ~~The data element is unconditionally required. A data element that is unconditionally required shall be denoted with a checkmark "✓".~~

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

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

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

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

~~***Informative note:*** In JSON Schema this is indicated through the use of "if-then" constructs.~~

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

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

6.11 Scalable Data Elements. The "Scalable" data element attribute is used to indicate whether a data element value can be scaled by the application software using the information in the Scaling Data Group (see Table ~~6–15~~6–15) in the representation's `performance` data. A data element whose value is scalable shall be denoted with ~~a checkmark "✓"~~`True`. If the data element value shall not be scaled, the "Scalable" data element attribute shall be left blank.

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

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

Table 6–5 ~~SchemaType~~

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

Table 6–6 CompressorType

Enumerator	Attributes
`RECIPROCATING`	**Description:** Reciprocating compressor
`SCREW`	**Description:** Screw compressor

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Enumerator	Attributes
CENTRIFUGAL	**Description:** Centrifugal compressor
ROTARY	**Description:** Rotary compressor
SCROLL	**Description:** Scroll compressor

Table 6–7 SpeedControlType

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

Table 6–8 CondenserType

Enumerator	Attributes
AIR	**Description:** Air-cooled condenser
LIQUID	**Description:** Liquid-cooled condenser
EVAPORATIVE	**Description:** Evaporative condenser **Notes:** Evaporative condensers include adiabatically-cooled condensers

Table 6–9 LiquidConstituent

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

Table 6–10 ConcentrationType

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

Table 6–11 OperationState

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

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

6.13.1 Metadata. The Metadata data group is the header data group ~~for all representation specifications. Each representation~~ included in ASHRAE Standard 232 and each representation shall include this data group.

6.13.1.1 Representation Versioning .

Table 6–12 ~~Metadata~~

~~Name~~	~~Attributes~~
~~data_model~~	~~**Description:** Data model name~~ ~~**Data Type:** String~~ ~~**Constraints:** "ASHRAE_205"~~ ~~**Req:** ✓~~ ~~**Notes:** Identifies the data model where the schema is defined~~
~~schema~~	~~**Description:** Schema name or identifier~~ ~~**Data Type:** <SchemaType>~~ ~~**Req:** ✓~~ ~~**Notes:** Identifies the schema used to define the data content~~
~~schema_version~~	~~**Description:** The version of the schema the data complies with~~ ~~**Data Type:** Version~~ ~~**Req:** ✓~~
~~id~~	~~**Description:** Unique equipment identifier~~ ~~**Data Type:** UUID~~ ~~**Req:** ✓~~ ~~**Notes:**~~ ~~Assigned by data publisher to identify the contained data~~ ~~id shall remain unchanged for revised data~~
~~description~~	~~**Description:** Description of data (suitable for display)~~ ~~**Data Type:** String~~ ~~**Req:** ✓~~
~~data_timestamp~~	~~**Description:** Date of publication~~ ~~**Data Type:** Timestamp~~ ~~**Req:** ✓~~ ~~**Notes:** Date/time of publication of the data~~

~~*(continued on next page)*~~

(continued from previous page)

Name	Attributes
data_version	**Description:** Integer version identifier for the data in the representation **Data Type:** Integer **Constraints:** ≥1 **Req:** ✓ **Notes:** Used by data publisher to track revisions of the data for a specific representation data_version shall be incremented for each data revision
data_source	**Description:** Source(s) of the data **Data Type:** String **Notes:** Used by data publisher to document methods (e.g., software and version) used to generate data ***Informative note:*** data_source may be different from other data source(s) included elsewhere within the data
disclaimer	**Description:** Characterization of accuracy, limitations, and applicability of this data **Data Type:** String
notes	**Description:** Additional Information **Data Type:** String

6.13.1.2 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_number`). 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.

6.13.2 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 6–13 LiquidMixture

Name	Attributes
`liquid_components`	**Description:** An array of all liquid components within the liquid mixture ~~**Data Type:**~~ **Type:** `[~~+~~Array(Group(LiquidComponent~~+~~]))` ~~**Req:** ✓~~ **Required:** `True` **Notes:** Array may contain a single component
`concentration_type`	**Description:** Defines whether concentration is defined on a volume or mass basis ~~**Data Type:**~~ **Type:** ~~<~~`Enumeration(ConcentrationType~~>~~)` ~~**Req:** ✓~~ **Required:** `True`

Table 6–14 LiquidComponent

Name	Attributes
`liquid_constituent`	**Description:** Substance of this component of the mixture ~~**Data Type:**~~ **Type:** ~~<~~`Enumeration(LiquidConstituent~~>~~)` ~~**Req:** ✓~~ **Required:** `True`
`concentration`	**Description:** Concentration of this component of the mixture ~~**Data Type:**~~ **Type:** `Numeric` **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ • ≤1.0 **Notes:** If omitted, assume equal distribution with any other component with no defined concentration (e.g., can be left blank for the primary component)

Informative note: The `LiquidComponent` is generally only used in the context of a `LiquidMixture`. References to `LiquidMixtures` in representation specifications implies that the representation specification also includes `LiquidComponents`.

Table 6–15 Scaling

Name	Attributes
minimum	**Description:** Minimum scaling factor ~~**Data Type:**~~ **Type:** Numeric **Units:** - **Constraints:** • >0.0~~, ≤1.0~~ • ≤1.0 **Notes:** If not specified, may be scaled down to any value greater than zero
maximum	**Description:** Maximum scaling factor ~~**Data Type:**~~ **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 ~~Identification and History.~~

7.2 Documentation

7.2.1 Identification. ***Schema Name.*** A string code, ~~assigned in Table 6–5,~~ which uniquely identifies each representation specification. Schema names shall be of the form RSXXXX, where XXXX is 4 decimal digits.

~~***Version history.***~~

7.2.2 Version History. 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 versioning[5] whenever there is a change to the Representation Specification data model.

7.3 ~~Scope and Description.~~

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

7.3.2 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.

7.3.3 ~~Applicability.~~

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

7.3.4 ~~Exclusions.~~

7.3.4.1 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".

7.3.5 ~~Embedded Representations.~~

7.3.5.1 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".

7.3.6 ~~Referencing Representations.~~

7.3.6.1 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".

7.3.7 ~~Schematic.~~

7.3.7.1 Schematic. 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.

7.4 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.

7.4.1 ~~Data Group Hierarchy.~~

7.4.2 Data Model Hierarchy. 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*
    - 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.

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

7.4.4 Data Groups

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

7.4.4.2 Metadata. The first data group in each representation shall be `Metadata`, specified in Section 6.13.1. As a common data group, `Metadata` shall not be repeated in representation specifications.

7.4.4.3 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.

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

7.4.4.5 Rating. If appropriate, a representation specification shall define data groups that includes data elements that represent standard ratings. 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.

7.4.4.6 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.

7.4.4.6.1 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.

7.4.4.6.2 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.

7.4.4.7 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.

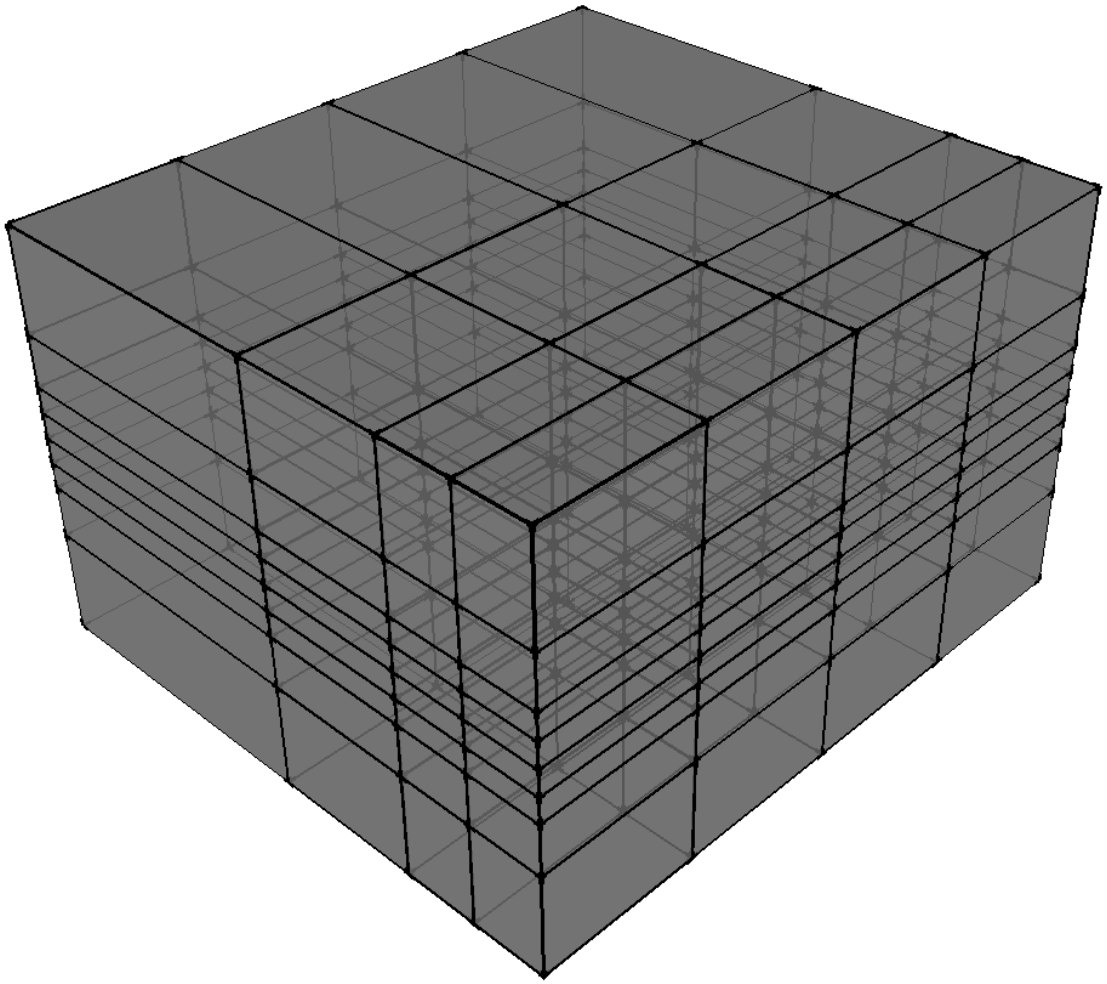

Figure 7–1 Example of a three-dimensional rectilinear grid.

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).

7.4.4.8 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.

7.4.4.9 LookupVariables. Lookup variables values shall be defined as an array corresponding to all combinations of grid variable values. Lookup variables shall appear as an array ordered according to the listed order of grid variables in the data group `GridVariables`, with the value of last corresponding grid variable changing most rapidly. That is, the corresponding array for a lookup variable begins with the value corresponding to the first values of all grid variables, followed by the lookup variable value corresponding to the same grid variable values except using the second value of the last grid variable defined in the `GridVariables` data group. Consecutive lookup variable values correspond to cycling through the values of the last grid variable, followed by the second to last, and so on.

Informative note: See Informative Appendix A for an example.

7.5 ~~Verification Rules.~~

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

Basic data ~~format rules are implicit in data element data types and are enforced via automated checking~~ element data type and value constraints are verified by validating the representation against the ASHRAE 205 JSON schema. ~~Valid constraints shall be included in the Constraints attribute of the data element definitions as defined in Section 6.8. Rules of this type shall~~ 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.

7.5.2 ~~Common Verification Rules.~~

7.5.2.1 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.

7.5.2.2 ~~Schema Type Check.~~

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

7.5.2.3 ~~Schema Version Check.~~

7.5.2.3.1 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.

7.5.2.4 ~~Lookup Variable Count Check.~~

7.5.2.4.1 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.

7.5.2.5 ~~Scalability Consistency Check.~~

7.5.2.5.1 Scalability Consistency Check. A representation and all embedded representations shall have consistent scaling factors in their "scaling" data elements.

7.6 ~~Publishing Rules.~~

7.6.1 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.

7.7 ~~Application Rules.~~

7.7.1 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.

7.7.2 ~~Common Application Rules.~~

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

7.7.2.1 ~~Scalability Rules~~

7.7.2.1.1 Scalability Rules

7.7.2.1.2 . 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.

7.7.2.1.3 . An informative message shall be provided to the user indicating when the performance data from a representation is scaled.

7.8 References. References to external information sources that support this representation specification. For each Ratings data group, a reference to a corresponding ratings procedure document shall be provided.

7.9 Example(s). Representation specifications shall provide one or more examples to illustrate implementation.
Supporting files shall be made available at https://data.ashrae.org/standard205/examples.html

8 DATA MODEL NAMING CONVENTIONS

All names shall be case-sensitive-unique within their scope: 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.

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 with the designated prefixes 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 with the word "Rating" followed by the descriptive name of the corresponding rating standard (e.g., `RatingAHRI210240`).
Informative note: Regular expression pattern: (^Rating[A-Z]*([A-Z]|[a-z]|[0-9])*$)

8.2.2 PerformanceMap, GridVariables, and LookupVariables Data Groups. `PerformanceMap` data group names shall begin with the words "PerformanceMap" followed by the descriptive name of the mode of operation (e.g., `PerformanceMapCooling`, `PerformanceMapHeating`, `PerformanceMapStandby`).
Informative note: Regular expression pattern: (^PerformanceMap[A-Z]*([A-Z]|[a-z]|[0-9])*$)
`GridVariables` and `LookupVariables` data group names shall be suffixed with the same descriptive name of the mode of operation used in the parent `PerformanceMap` (e.g., `GridVariablesCooling`, `LookupVariablesCooling`).
Informative note: Regular expression patterns: (^GridVariables[A-Z]*([A-Z]|[a-z]|[0-9])*$) and (^LookupVariables[A-Z]([A-Z]|[a-z]|[0-9])*$)

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 ASHRAE[6].

8.6 Abbreviations. When appropriate, Table ~~8–16~~ 8–16 abbreviations shall be used in names for all components of the data model. Abbreviations are replacements for groups of words and do not imply definitions of the associated phrases. Some phrases listed in Table ~~8–16~~ 8–16 have multiple context-specific technical definitions. Representation specifications must provide unambiguous definitions for all terms (abbreviated or not).

Table 8–16 Abbreviation Definitions

Abbreviation	Meaning
AFUE	Annual Fuel Utilization Efficiency
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AHU	Air handling unit
COP	Coefficient of performance
DX	Direct expansion
EER	Energy Efficiency Ratio
ID	Identifier
IEER	Integrated Energy Efficiency Ratio
Max, max	Maximum
Min, min	Minimum
PLR	Part load ratio
RS	Representation specification
SEER	Seasonal Energy Efficiency Ratio

8.7 ~~Pre-Existing Names (Informative).~~ ~~Instead of inventing new names, names from existing relevant schemas and data dictionaries should be used when appropriate. Table 8–17 provides a non-exhaustive list of related schemas and data dictionaries. When pre-existing names are adapted for Standard 205 use, they should be modified to conform to naming rules specified in this section.~~

Table 8–17 Sources of Pre-Existing Names

Source	Description	URL
gbXML	Green Building XML	http://www.gbxml.org/
IFC	Industry Foundation Classes	http://www.buildingsmart.org/
DOE-2 BDL	DOE-2 Building Description Language	http://doe2.com/DOE2/
EnergyPlus IDD	EnergyPlus Input Data Dictionary	https://energyplus.net/
ASHRAE Terminology	Assembled by ASHRAE Technical Committee (TC) 1.6, Terminology	https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology
CEC SDD	California Energy Commission Standards Data Dictionary	http://bees.archenergy.com/software.html
COBie	Construction Operations Building Information Exchange	http://www.wbdg.org/resources/cobie.php
COMNET	Commercial Energy Services Network	http://comnet.org/
BEDES	Building Energy Data Exchange Specification	https://bedes.lbl.gov/

8.7 Naming Guidelines (Informative)

- **Readability is more important than length.** Although there is the potential that long names will increase the size of representations, accurate understanding and application of data is the overriding consideration. Unambiguous and expressive names are preferred, for example, `evaporator_pressure_drop` rather than `evap_pres_drp`. It is also anticipated that messaging infrastructure will provide data compression for efficient transfer of representations.

- **Specify dimensions at end of name.** In general, use names such as `entering_temperature`, as opposed to `temperature_entering` (unless the latter form is available as a widely used pre-existing name).

- **Avoid names that include a defined unit of measurement.** For example, do not use names such as `air_cfm` or `pump_gpm`. Instead, consider names such as `air_volumetric_flow_rate` or `pump_volumetric_flow_rate`.

- **Do not include data types in names.** Use `ahri_rated`, not `ahri_rated_boolean`.

- **Avoid abbreviations and acronyms.** The list of exceptions is documented in Section 8.6 of this standard.

- **Avoid using names that conflict with widely used programming languages.** For example, do not use case, switch, default, etc.

- **Avoid names that differ only in case.** Not all programming languages are case-sensitive, so it is best to avoid names differing only in case.

- **Names should not include a repetition of the names of containing structures or data groups.** The container provides adequate context; using its name in component names is redundant and needlessly lengthens component names. For example, the capacity of a chiller should be called simply `capacity` rather than `chiller_capacity`.

- **Consider "Type" at end of enumeration names.** Clear enumeration names often end in "Type". Examples are `CompressorType` and `CondenserType`.

9 PHYSICAL PROPERTIES

9.1 Psychrometric Properties of Moist Air. Psychrometric properties of moist air shall be derived using ideal gas procedures found in the Fundamentals volume of the ASHRAE Handbook[6].

9.2 Liquid Properties. Unless otherwise specified in a representation specification, the properties of water and other heat transfer liquids shall be derived using data found in the ASHRAE Handbook[6]. If a liquid's properties are not defined in the ASHRAE Handbook, an alternative source shall be used and the source shall be described in the notes data element of the `Metadata` data group. Properties shall be assumed to be temperature dependent and pressure independent.

9.3 Refrigerant Properties. The properties of refrigerants shall be derived using data in the ASHRAE Handbook[6] or techniques referenced there.

10 DATA QUALITY, INTEGRITY, ACCESS, AND ACCURACY

10.1 Data Quality. The data publisher shall be responsible for ensuring correctness of published data. Each published representation shall successfully pass all applicable data validity tests included in the ASHRAE 205 JSON schema and the verification rules defined in the associated representation specification.

The application software developer shall be responsible for implementing mechanisms for verifying that derived (e.g., interpolated) performance values do not violate any applicable verification rules or operational limits.

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[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[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[7]. Application software shall support decryption of the CBOR representation file when RFC 8152 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.

10.4 Data Accuracy (Informative). Standard 205 includes no requirements that a representation should reproduce actual equipment performance with any specified accuracy. A data publisher may include information in the `metadata disclaimer` element that characterizes the accuracy of a representation based on the underlying accuracy of data sources such as physical measurements or engineering models.

11 REFERENCES

1. C. Bormann. *CBOR*. 2018. URL: http://cbor.io/.
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(This appendix 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 contains 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.)

INFORMATIVE APPENDIX A: EXAMPLE PERFORMANCE MAP REPRESENTATION

This example shows the data model for a single performance map and illustrates a representation conforming to this data model. This example does not reflect actual performance data of any specific device and is intended for illustrative purposes only.

Table A-1 Example Performance Map Data Group

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariables~~+~~) ~~**Req:** ✓~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariables~~+~~) ~~**Req:** ✓~~ **Required:** True

Table A-2 Example Grid Variable Data Group

Name	Attributes
outdoor_temperature	**Description:** Outdoor Temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ≥0.0 ~~**Req:** ✓~~ • [1..] **Required:** True **Notes:** For example purposes only
indoor_temperature	**Description:** Indoor Temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ≥0.0 ~~**Req:** ✓~~ • [1..] **Required:** True **Notes:** For example purposes only

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Name	Attributes
air_volumetric_flow_rate	**Description:** Air Volumetric Flow Rate ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Notes:** For example purposes only

An example representation of this grid variable data group would be:

```
grid_variables:
  outdoor_temperature: [302.59, 308.15, 313.71]
  indoor_temperature: [295.37, 297.04, 298.71]
  air_volumetric_flow_rate: [0.26, 0.34]
```

Table A-3 Example Lookup Variable Data Group

Name	Attributes
power	**Description:** Power ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Notes:** For example purposes only
capacity	**Description:** Capacity ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Notes:** For example purposes only

An example representation of this lookup variable data group would be:

```
lookup_variables:
  power: [2192.5,2192.5,2192.5,2192.5,2192.5,2192.5,2370,2370,
          2370,2370,2370,2370,2615,2615,2615,2615,2615,2615]
  capacity: [8740,9100,8740,9100,8740,9100,8380,8720,8380,
             8720,8380,8720,8560,8910,8560,8910,8560,8910]
```

An example representation of a performance map ~~data group~~ with the values of the lookup variables expressed explicitly with their corresponding grid variables in table form is shown in Table ~~A-4~~ A-4

Table A-4 Example Performance Map ~~Data Group~~Representation

outdoor_temperature (K)	indoor_temperature (K)	air_volumetric_flow_rate (m^3/s)	power (W)	capacity (W)
302.59	295.37	0.26	2192.5	8740.0
302.59	295.37	0.34	2192.5	9100.0
302.59	297.04	0.26	2192.5	8740.0
302.59	297.04	0.34	2192.5	9100.0
302.59	298.71	0.26	2192.5	8740.0
302.59	298.71	0.34	2192.5	9100.0
308.15	295.37	0.26	2370.0	8380.0
308.15	295.37	0.34	2370.0	8720.0
308.15	297.04	0.26	2370.0	8380.0
308.15	297.04	0.34	2370.0	8720.0
308.15	298.71	0.26	2370.0	8380.0
308.15	298.71	0.34	2370.0	8720.0
313.71	295.37	0.26	2615.0	8560.0
313.71	295.37	0.34	2615.0	8910.0
313.71	297.04	0.26	2615.0	8560.0
313.71	297.04	0.34	2615.0	8910.0
313.71	298.71	0.26	2615.0	8560.0
313.71	298.71	0.34	2615.0	8910.0

Notice the cycling of the corresponding grid variable values. In this case, the `air_volumetric_flow_rate` values are cycling on every row, the `indoor_temperature` cycles every two rows, and the `outdoor_temperature` cycles every six rows. In practice, this defined order allows lookup variables to be conveyed without repetition of grid variable values.

In JSON this example performance map would appear as:

```
{
  "performance_map":{
    "grid_variables":{
      "outdoor_temperature": [302.59, 308.15, 313.71],
      "indoor_temperature": [295.37, 297.04, 298.71],
      "air_volumetric_flow_rate": [0.26, 0.34]
    },
    "lookup_variables":{
      "power": [2192.5,2192.5,2192.5,2192.5,2192.5,2192.5,2370,2370,
                2370,2370,2370,2370,2615,2615,2615,2615,2615,2615],
      "capacity": [8740,9100,8740,9100,8740,9100,8380,8720,8380,
                   8720,8380,8720,8560,8910,8560,8910,8560,8910]
    }
  }
}
```

RS0001 CHILLER

RS0001.1 ~~Identification and History.~~

RS0001.2 Identification. `schema_name`: RS0001

RS0001.3 Version History

`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

RS0001.4 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.

RS0001.5 Scope and Description

RS0001.5.1 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.

RS0001.5.2 Exclusions. Steam turbine driven, combustion engine driven, absorption liquid-chilling and liquid-heating packages, nor chillers with a separate heat recovery liquid stream.

RS0001.5.3 Embedded Representations. None.

RS0001.5.4 Referencing Representations. None.

RS0001.5.5 Schematic. 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 RS0001.7.1
- `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 RS0001.7.1
- `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

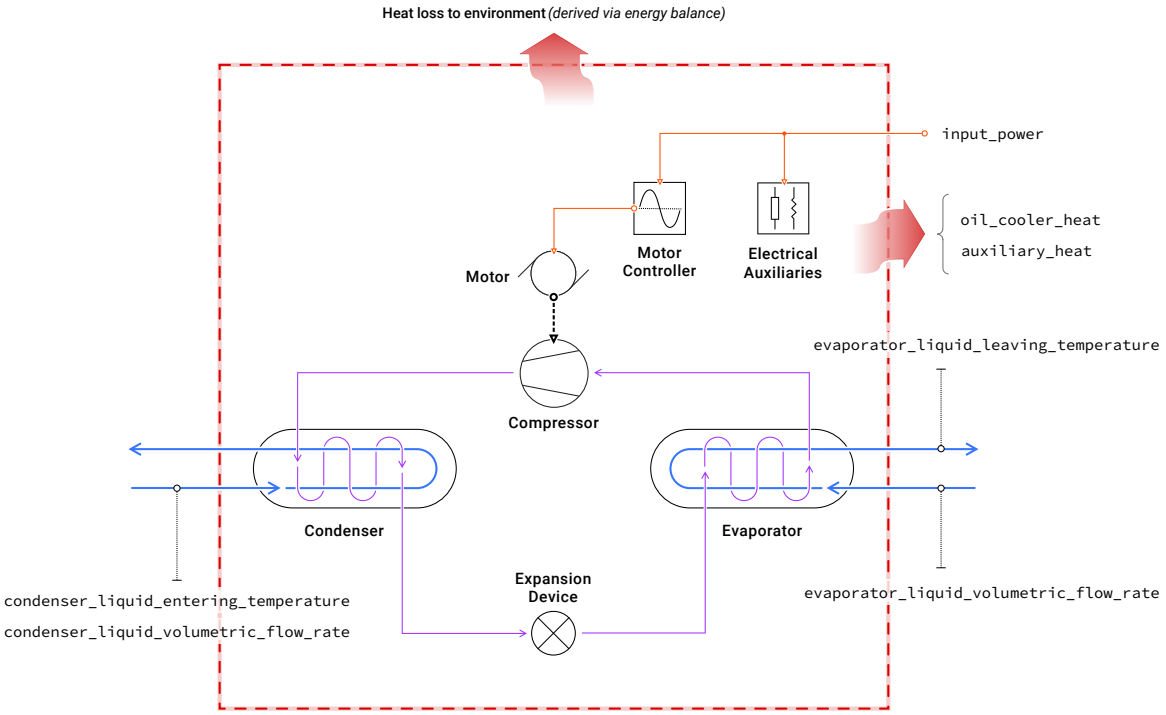

Figure RS0001–1 Liquid-cooled chiller.

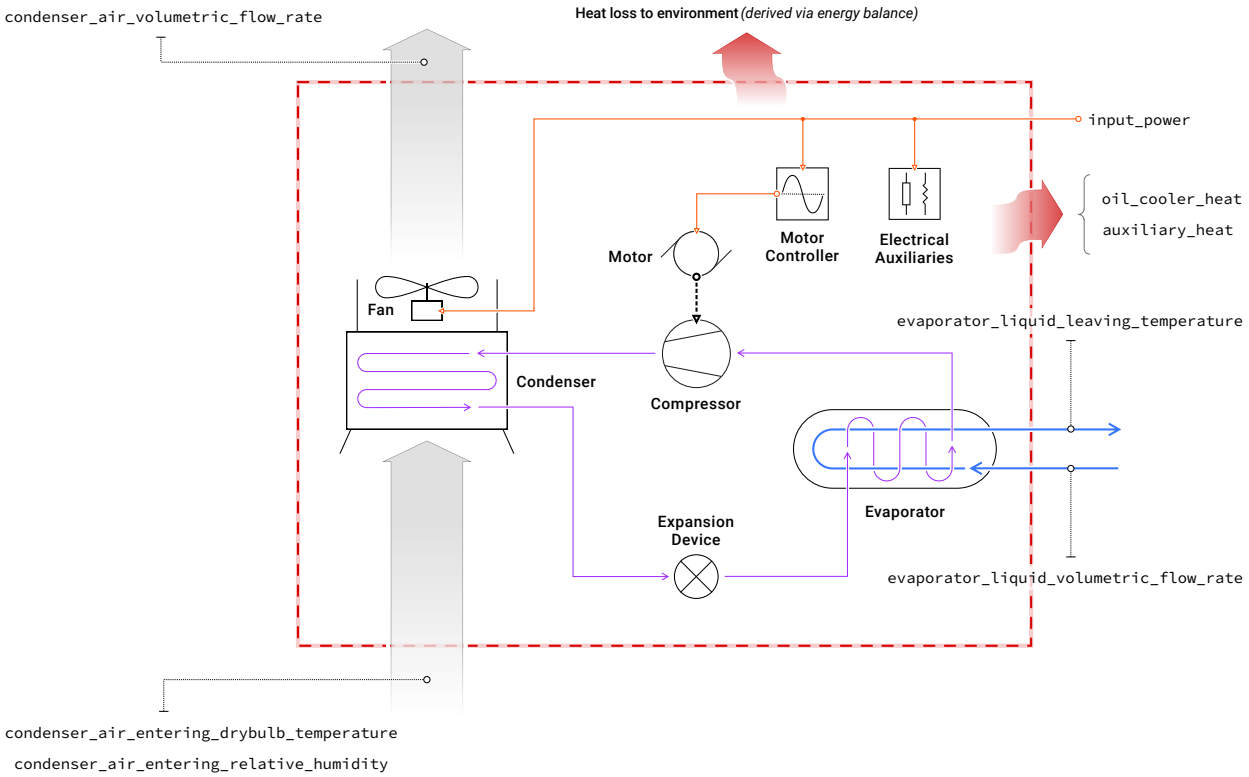

Figure RS0001–2 Air-cooled chiller.

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.

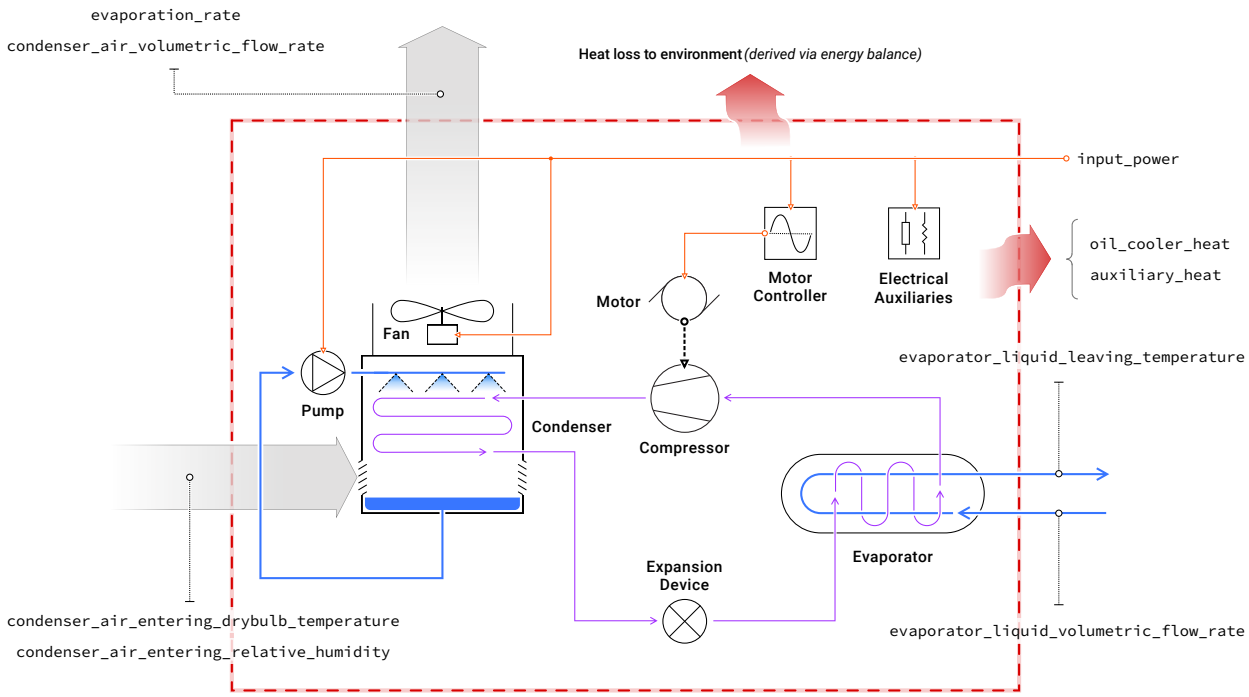

Figure RS0001–3 Evaporatively-cooled chiller.

- 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 RS0001.7.1
- `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.

RS0001.6 Data Model

RS0001.6.1 ~~Data Group Hierarchy.~~

RS0001.6.2 Data Group Hierarchy. A representation implementation conforming to this representation specification shall consist of the following data groups:

```
- RS0001
  - Metadata
  - Description*
    - ProductInformation*
    - RatingAHRI550590*
    - RatingAHRI551591*
  - Performance
    - PerformanceMapCoolingLiquid
      - GridVariablesCoolingLiquid
      - LookupVariablesCoolingLiquid
    - PerformanceMapCoolingAir
      - GridVariablesCoolingAir
      - LookupVariablesCoolingAir
    - PerformanceMapCoolingEvaporative
      - GridVariablesCoolingEvaporative
      - LookupVariablesCoolingEvaporative
    - PerformanceMapStandby
      - GridVariablesStandby
      - LookupVariablesStandby
    - PerformanceMapEvaporatorLiquidPressureDifferential
      - GridVariablesEvaporatorLiquidPressureDifferential
      - LookupVariablesEvaporatorLiquidPressureDifferential
    - PerformanceMapCondenserLiquidPressureDifferential
      - GridVariablesCondenserLiquidPressureDifferential
      - LookupVariablesCondenserLiquidPressureDifferential
```

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 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.

RS0001.6.3 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]

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Enumerator	Attributes
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]
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]

RS0001.6.4 Data Groups

Table RS0001–4 RS0001

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

Table RS0001–5 Description

Name	Attributes
product_information	**Description:** Data group describing product information ~~**Data Type:**~~ **Type:** ~~+~~Group(ProductInformation~~+~~)
rating_ahri_550_590	**Description:** Data group containing information relevant to products rated under AHRI 550/590 ~~**Data Type:**~~ **Type:** ~~+~~Group(RatingAHRI550590~~+~~)

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Name	Attributes
rating_ahri_551_591	**Description:** Data group containing information relevant to products rated under AHRI 551/591 ~~**Data Type:**~~ **Type:** ~~+~~Group(RatingAHRI551591~~+~~)

Table RS0001–6 ProductInformation

Name	Attributes
manufacturer	**Description:** Manufacturer name ~~**Data Type:**~~ **Type:** String
model_number	**Description:** Model number ~~**Data Type:**~~ **Type:** Pattern **Notes:** Pattern shall match all model numbers that can be represented by the representation
nominal_voltage	**Description:** Unit nominal voltage ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** Numeric **Units:** Hz **Constraints:** ≥0.0 **Notes:** Power supply frequency for the intended region of installation
compressor_type	**Description:** Type of compressor ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(CompressorType~~>~~)
liquid_data_source	**Description:** Source of the liquid properties data ~~**Data Type:**~~ **Type:** String **Notes:** Example: 'ASHRAE Handbook Fundamentals 2013 chapter 31'
refrigerant	**Description:** Refrigerant used in the chiller ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** Boolean

Table RS0001–7 RatingAHRI550590

Name	Attributes
certified_reference_number	**Description:** AHRI certified reference number ~~**Data Type:**~~ **Type:** String
test_standard_year	**Description:** Year of the AHRI test standard ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(AHRI550590TestStandardYear~~>~~)
rating_source	**Description:** Source of this rating data ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **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
input_power	**Description:** Combined power input of all components of the unit, including auxiliary power and excluding integral pumps ~~**Data Type:**~~ **Type:** Numeric **Units:** kW **Constraints:** ≥0.0
cop	**Description:** Ratio of the net refrigerating capacity to the total input power at the rating conditions ~~**Data Type:**~~ **Type:** Numeric **Units:** - **Constraints:** >0.0
iplv_ip	**Description:** The Integrated Part-Load Value efficiency of merit calculated at the standard rating conditions ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** Numeric **Units:** -

Table RS0001–8 RatingAHRI551591

Name	Attributes
certified_reference_number	**Description:** AHRI certified reference number ~~**Data Type:**~~ **Type:** String
test_standard_year	**Description:** Year of the AHRI test standard ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(AHRI551591TestStandardYear~~>~~)
rating_source	**Description:** Source of this rating data ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** Numeric **Units:** kW **Constraints:** ≥0.0
cop	**Description:** Ratio of the net refrigerating capacity to the total input power at the rating conditions ~~**Data Type:**~~ **Type:** Numeric **Units:** - **Constraints:** >0.0
iplv_si	**Description:** The Integrated Part-Load Value efficiency of merit calculated at the standard rating conditions ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** Numeric **Units:** -

Table RS0001–9 Performance

Name	Attributes
condenser_type	**Description:** Heat rejection method of the condenser ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(CondenserType~~>~~) ~~**Req:** ✓~~ **Required:** True
evaporator_liquid_type	**Description:** Type of liquid in evaporator ~~**Data Type:**~~ **Type:** ~~+~~Group(LiquidMixture~~+~~) ~~**Req:** ✓~~ **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 ~~**Data Type:**~~ **Type:** ~~+~~Group(LiquidMixture~~+~~) ~~**Req:**~~ **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 ~~**Data Type:**~~ **Type:** Numeric **Units:** $m^2 \cdot K/W$ **Constraints:** ≥0.0 ~~**Req:** ✓~~ **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 ~~**Data Type:**~~ **Type:** Numeric **Units:** $m^2 \cdot K/W$ **Constraints:** ≥0.0 ~~**Req:**~~ **Required:** if condenser_type=LIQUID **Notes:** • Condenser fouling factor at which the performance map was created • May be different from the certification data supplied
compressor_speed_control_type	**Description:** Type of compressor speed control ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(SpeedControlType~~>~~) ~~**Req:** ✓~~ **Required:** True

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Name	Attributes
cycling_degradation_coefficient	**Description:** Cycling degradation coefficient (C_D) as described in AHRI 550/590 or AHRI 551/591 ~~**Data Type:**~~ **Type:** Numeric **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ ~~**Req:** ✓~~ • ≤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 ~~**Data Type:**~~ **Type:** ~~+~~Group(Scaling~~+~~) **Notes:** If not present, scaling of the performance data is not allowed
performance_map_cooling	**Description:** Data group describing cooling performance over a range of conditions ~~**Data Type:**~~ **Type:** Alternative(~~+~~Group(PerformanceMapCoolingLiquid~~+~~), ~~+~~Group(PerformanceMapCoolingAir~~+~~), ~~+~~Group(PerformanceMapCoolingEvaporative~~+~~)) **Constraints:** condenser_type(LIQUID, AIR, EVAPORATIVE) ~~**Req:** ✓~~ **Required:** True
performance_map_standby	**Description:** Data group describing standby performance ~~**Data Type:**~~ **Type:** ~~+~~Group(PerformanceMapStandby~~+~~) ~~**Req:** ✓~~ **Required:** True
performance_map_evaporator_liquid_pressure_differenti	**Description:** Data group describing the liquid pressure differential through the evaporator ~~**Data Type:**~~ **Type:** ~~+~~Group(PerformanceMapEvaporatorLiquidPressureDifferential~~+~~) ~~**Req:** ✓~~ **Required:** True
performance_map_condenser_liquid_pressure_differentia	**Description:** Data group describing the liquid pressure differential through the condenser ~~**Data Type:**~~ **Type:** ~~+~~Group(PerformanceMapCondenserLiquidPressureDifferential~~+~~) ~~**Req:**~~ **Required:** if condenser_type=LIQUID

Table RS0001–10 PerformanceMapCoolingLiquid

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesCoolingLiquid~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariablesCoolingLiquid~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True

Table RS0001–11 GridVariablesCoolingLiquid

Name	Attributes
evaporator_liquid_volumetric_flow_rate	**Description:** Chilled liquid (evaporator) flow ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • >0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True
evaporator_liquid_leaving_temperature	**Description:** Leaving evaporator liquid temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ~~>~~≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True
condenser_liquid_volumetric_flow_rate	**Description:** Condenser liquid flow ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • >0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True

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Name	Attributes
condenser_liquid_entering_temperature	**Description:** Entering condenser liquid temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ~~>~~≥0.0 ~~Req:~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Integer][~~1..~~]) ~~**Units:** -~~ **Constraints:** • ≥1 ~~Req:~~ ~~✓~~ • [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 RS0001–12 LookupVariablesCoolingLiquid

Name	Attributes
input_power	**Description:** Total power input ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True **Notes:** The capacity of the condenser transferred to the condenser cooling stream using only the sensible heat transfer
oil_cooler_heat	**Description:** Heat transferred to another liquid crossing the control volume boundary from the chiller oil cooler. ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [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). ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True **Notes:** Set as 0 if not present or if heat rejection is met by condenser

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Name	Attributes
operation_state	**Description:** The operation state at the operating conditions ~~**Data Type:**~~ **Type:** [~~<~~Array(Enumeration(OperationState~~>~~)] ~~**Units:** -~~ ~~**Req:** √~~ **Constraints:** [1..] **Required:** True

Table RS0001–13 PerformanceMapCoolingAir

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesCoolingAir~~+~~) ~~**Req:** √~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariablesCoolingAir~~+~~) ~~**Req:** √~~ **Required:** True

Table RS0001–14 GridVariablesCoolingAir

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

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Name	Attributes
condenser_air_entering_drybulb_temperature	**Description:** Entering condenser air drybulb temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ~~>~~≥0.0 ~~**Req:** ✓~~ • [1..] **Required:** True
condenser_air_entering_relative_humidity	**Description:** Entering condenser air relative humidity ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** - **Constraints:** • ≥0.0, ≤1.0 ~~**Req:** ✓~~ • [1..] **Required:** True
ambient_pressure	**Description:** Ambient pressure used to calculate the performance ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** Pa **Constraints:** • >0.0 ~~**Req:** ✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Integer][~~1..~~]) ~~**Units:** -~~ **Constraints:** • ≥1 ~~**Req:** ✓~~ • [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 RS0001–15 LookupVariablesCoolingAir

Name	Attributes
input_power	**Description:** Total power input ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • ~~>~~≥0.0 ~~**Req:**~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True

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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. ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [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). ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [~~<~~Array(Enumeration(OperationState~~>1~~)) ~~**Units:**~~ ~~-~~ ~~**Req:**~~ ~~✓~~ **Constraints:** [1..] **Required:** True

Table RS0001–16 PerformanceMapCoolingEvaporative

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesCoolingEvaporative~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariablesCoolingEvaporative~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True

Table RS0001–17 GridVariablesCoolingEvaporative

Name	Attributes
evaporator_liquid_volumetric_flow_rate	**Description:** Chilled liquid (evaporator) flow ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • >0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True
evaporator_liquid_leaving_temperature	**Description:** Leaving evaporator liquid temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ~~>~~≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True
condenser_air_entering_drybulb_temperature	**Description:** Entering condenser air drybulb temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ~~>~~≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True
condenser_air_entering_relative_humidity	**Description:** Entering condenser air relative humidity ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** - **Constraints:** • ≥0.0, ≤1.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True
ambient_pressure	**Description:** Ambient pressure used to calculate the performance ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** Pa **Constraints:** • >0.0 ~~Req:~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Integer][~~1...~~]) ~~**Units:**~~ - **Constraints:** • ≥1 ~~Req:~~ ~~✓~~ • [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 RS0001–18 LookupVariablesCoolingEvaporative

Name	Attributes
input_power	**Description:** Total power input ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1...~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1...~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True **Notes:** The available cooling capacity of the evaporator to the thermal load calculated using only the sensible heat transfer

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Name	Attributes
net_condenser_capacity	**Description:** Condenser heat rejection ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • ~~>~~≥0.0 ~~**Req:**~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True
evaporation_rate	**Description:** Rate at which water evaporates from the condenser. ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [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. ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:**~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True **Notes:** Set as 0 if not present or if heat rejection is met by condenser

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Name	Attributes
auxiliary_heat	**Description:** Heat transferred to another liquid crossing the control volume boundary from the chiller auxiliaries (motor, motor controller, inverter drive, starter, etc). ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1...~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:** √~~ • [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 ~~**Data Type:**~~ **Type:** [~~<~~Array(Enumeration(OperationState~~>]~~)) ~~**Units:** -~~ ~~**Req:** √~~ **Constraints:** [1..] **Required:** True

Table RS0001–19 PerformanceMapStandby

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for standby performance ~~**Data Type:**~~ **Type:** ~~[~~Group(GridVariablesStandby~~]~~) ~~**Req:** √~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for standby performance ~~**Data Type:**~~ **Type:** ~~[~~Group(LookupVariablesStandby~~]~~) ~~**Req:** √~~ **Required:** True

Table RS0001–20 GridVariablesStandby

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

Table RS0001–21 LookupVariablesStandby

Name	Attributes
input_power	**Description:** Total power consumed in standby operation **~~Data Type:~~** **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [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 RS0001–22 PerformanceMapEvaporatorLiquidPressureDifferential

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for the evaporator liquid pressure differential **~~Data Type:~~** **Type:** ~~+~~Group(GridVariablesEvaporatorLiquidPressureDifferential~~+~~) **~~Req:~~** ~~✓~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for the evaporator liquid pressure differential **~~Data Type:~~** **Type:** ~~+~~Group(LookupVariablesEvaporatorLiquidPressureDifferential~~+~~) **~~Req:~~** ~~✓~~ **Required:** True

Table RS0001–23 GridVariablesEvaporatorLiquidPressureDifferential

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

Table RS0001–24 LookupVariablesEvaporatorLiquidPressureDifferential

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

Table RS0001–25 PerformanceMapCondenserLiquidPressureDifferential

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for the condenser liquid pressure differential ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesCondenserLiquidPressureDifferential~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for the condenser liquid pressure differential ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariablesCondenserLiquidPressureDifferential~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True

Table RS0001–26 GridVariablesCondenserLiquidPressureDifferential

Name	Attributes
condenser_liquid_volumetric_flow_rate	**Description:** Condenser liquid flow ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • >0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True
condenser_liquid_entering_temperature	**Description:** Entering condenser liquid temperature ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ~~>~~≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True

Table RS0001–27 LookupVariablesCondenserLiquidPressureDifferential

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

RS0001.7 Verification Rules

RS0001.7.1 Chiller Heat Balance. Heat balance of a system shall be used to verify conservation of energy. At the highest level, the heat balance is represented by the following equation:

$$\sum \text{Energy}_{\text{In}} = \sum \text{Energy}_{\text{Out}}$$

In the simplest chiller system, this can be represented as:

$$\dot{P}_{\text{in}} + \dot{Q}_{\text{evap}} = \dot{Q}_{\text{cond}}$$

Referring to Figure RS0001-1, this is expanded to:

$$\dot{P}_{\text{in}} + \dot{Q}_{\text{evap}} = \dot{Q}_{\text{cond}} + \dot{Q}_{\text{lossToSpace}} + \dot{Q}_{\text{oilCooler}} + \dot{Q}_{\text{auxiliary}}$$

All these terms are provided in the performance tables except for the losses to the space, which can be calculated as the differences between the other energy flows:

$$\dot{Q}_{\text{lossToSpace}} = (\dot{P}_{\text{in}} + \dot{Q}_{\text{evap}}) - (\dot{Q}_{\text{cond}} + \dot{Q}_{\text{oilCooler}} + \dot{Q}_{\text{auxiliary}})$$

The resulting loss to the space shall not be negative:

$$\dot{Q}_{\text{lossToSpace}} \geq 0$$

Informative note: There may be other losses in the system, such as the pressure effects on the physical state of the liquid flow under high pressure differentials, but for the intended use of the performance data provided in accordance with this standard, those losses have been considered negligible.

RS0001.7.2 Nomenclature

Symbol	Data element	Description
$\dot{P}_{\text{in}}$	`input_power`	Power input to the refrigeration system, W
$\dot{Q}_{\text{evap}}$	`net_evaporator_capacity`	Heat addition rate from the chilled liquid stream to the refrigeration system at the evaporator, W
$\dot{Q}_{\text{cond}}$	`net_condenser_capacity`	Heat rejection rate from the refrigeration system to the cooling liquid stream at the chiller, W
$\dot{Q}_{\text{losstoSpace}}$		Rate of thermal energy generated by the equipment that is lost to the surroundings (the portion of input power that is not transferred as useful work to the refrigeration system), W
$\dot{Q}_{\text{oilCooler}}$	`oil_cooler_heat`	Rate of thermal energy generated by the equipment that is lost through a liquid cooled oil cooler that exits the control volume through a separate liquid stream, W
$\dot{Q}_{\text{auxiliary}}$	`auxiliary_heat`	Rate of thermal energy generated by the equipment that is lost through liquid cooled auxiliaries that exits the control volume through a separate liquid stream, W

RS0001.8 Publishing Rules.

RS0001.9 ~~Publishing Rules.~~ None.

RS0001.10 Application Rules

RS0001.10.1 Cooling Performance. `performance_map_cooling` shall be used to simulate performance when system controls call for cooling.

RS0001.10.2 Standby Performance. `performance_map_standby` shall be used to simulate performance under any of the following conditions:

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

RS0001.10.3 Fluid Types. The fluid type used in the simulation shall be the same as defined in the representation. A warning shall be provided to the software user if the fluid types do not match.

RS0001.10.4 Evaporative Condenser Water Use. The evaporation rate from the condenser is provided in the performance map. The total water usage of the evaporatively-cooled condenser also includes make-up water flow rate based on the cycles of concentration determined by the water chemistry at the installation and any drift losses from the condenser.

RS0001.11 References

1. AHRI. *AHRI 550/590 (I-P) 2015: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2015.
2. AHRI. *AHRI 550/590 (I-P) 2015 with Addendum 1: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2017.
3. AHRI. *AHRI 550/590 (I-P) 2018 with Errata: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2018.
4. AHRI. *AHRI 550/590 (I-P/2020): Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2020.
5. AHRI. *AHRI 550/590 (I-P) 2020 with Addendum 1: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2022.
6. AHRI. *AHRI 550/590 (I-P) 2023: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2023.
7. AHRI. *AHRI 551/591 (SI) 2015: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2015.
8. AHRI. *AHRI 551/591 (SI) 2015 with Addendum 1: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2017.
9. AHRI. *AHRI 551/591 (SI) 2018 with Errata: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2018.
10. AHRI. *AHRI 551/591 (SI/2020): Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2020.
11. AHRI. *AHRI 551/591 (SI) 2020 with Addendum 1: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2022.
12. AHRI. *AHRI 551/591 (SI) 2023: Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle*. Arlington, Virginia: AHRI, 2023.
13. ASHRAE. *Standard 34: Designation and Safety Classification of Refrigerants*. Atlanta, Georgia: ASHRAE, 2022.

RS0001.12 Example (Informative). See https://data.ashrae.org/standard205/examples.html

RS0002 UNITARY COOLING AIR-CONDITIONING EQUIPMENT

RS0002.1 ~~Identification and History.~~

RS0002.2 Identification. `schema_name`: RS0002

RS0002.3 Version History

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

RS0002.4 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.

RS0002.5 Scope and Description

RS0002.5.1 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.

RS0002.5.2 Exclusions. Heating performance, economizers, exhaust fans.

RS0002.5.3 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`

RS0002.5.4 Referencing Representations. None.

RS0002.5.5 Schematic. Figure RS0002–1 illustrates the components of unitary air-conditioning systems within the scope of this appendix.

RS0002.6 Data Model

RS0002.6.1 ~~Data Group Hierarchy.~~

RS0002.6.2 Data Group Hierarchy. A representation implementation conforming to this representation specification shall consist of the following data groups:

```
- RS0002
    - Metadata
    - Description*
        - ProductInformation*
        - RatingAHRI210240*
        - RatingAHRI340360*
    - Performance
        - RS0003
        - RS0004
```

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

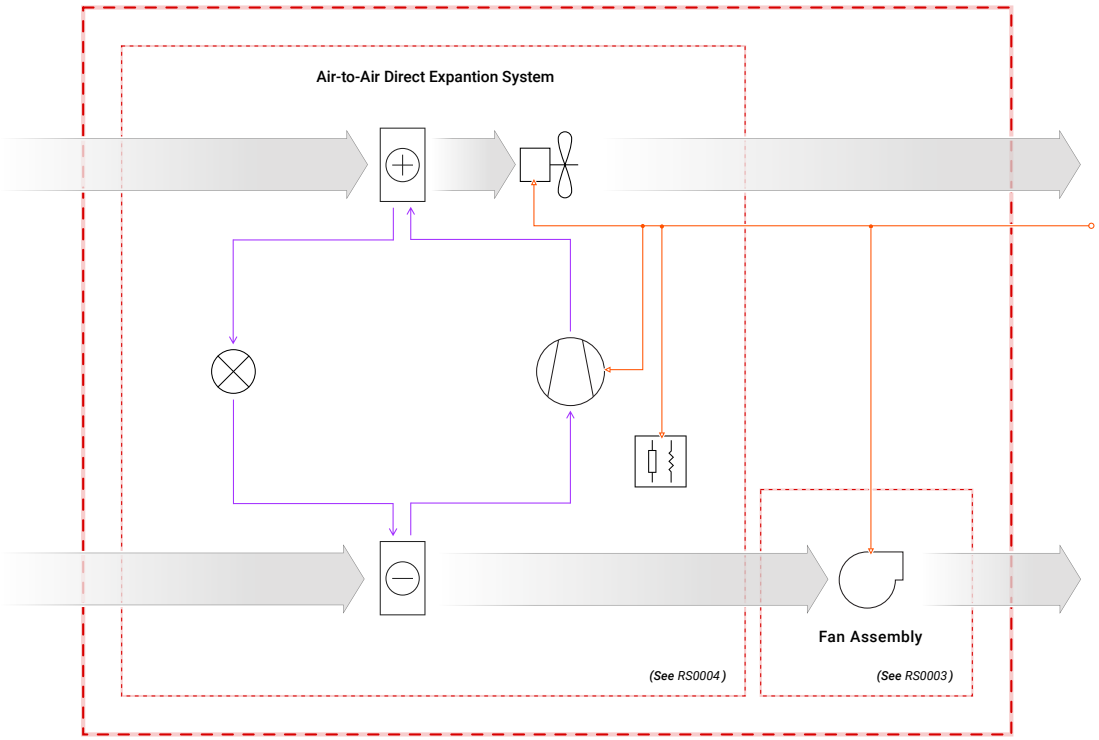

Figure RS0002–1 Unitary air-conditioning system.

RS0002.6.3 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

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Enumerator	Attributes
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

RS0002.6.4 Data Groups

Table RS0002–8 RS0002

Name	Attributes
metadata	**Description:** Metadata data group ~~**Data Type:**~~ **Type:** ~~+~~Group(Metadata~~+~~) **Constraints:** schema_name="RS0002" ~~**Req:** ✓~~ **Required:** True
description	**Description:** Data group describing product and rating information ~~**Data Type:**~~ **Type:** ~~+~~Group(Description~~+~~)
performance	**Description:** Data group containing performance information ~~**Data Type:**~~ **Type:** ~~+~~Group(Performance~~+~~) ~~**Req:** ✓~~ **Required:** True

Table RS0002–9 Description

Name	Attributes
product_information	**Description:** Data group describing product information ~~**Data Type:**~~ **Type:** ~~+~~Group(ProductInformation~~+~~)
rating_ahri_210_240	**Description:** Data group containing information relevant to products rated under AHRI 210/240 ~~**Data Type:**~~ **Type:** ~~+~~Group(RatingAHRI210240~~+~~)
rating_ahri_340_360	**Description:** Data group containing information relevant to products rated under AHRI 340/360 ~~**Data Type:**~~ **Type:** ~~+~~Group(RatingAHRI340360~~+~~)

Table RS0002–10 ProductInformation

Name	Attributes
manufacturer	**Description:** Package manufacturer name ~~**Data Type:**~~ **Type:** String
model_number	**Description:** Package model number ~~**Data Type:**~~ **Type:** Pattern **Notes:** Pattern shall match all model numbers that can be represented by the representation

Table RS0002–11 RatingAHRI210240

Name	Attributes
certified_reference_number	**Description:** AHRI certified reference number ~~**Data Type:**~~ **Type:** String
test_standard_year	**Description:** Year of the AHRI test standard ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(AHRI210240TestStandardYear~~>~~)
rating_source	**Description:** Source of this rating data ~~**Data Type:**~~ **Type:** String **Notes:** Used by data publisher to document methods (e.g., software and version) used to generate rating data
staging_type	**Description:** Type of compressor staging ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(AHRI210240CompressorStagingType~~>~~)

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Name	Attributes
`seer`	**Description:** Seasonal Energy Efficiency Ratio ~~**Data Type:**~~ **Type:** `Numeric` **Units:** Btu/W·h **Constraints:** `>0.0` **Notes:** Used for versions of the test standard up through 2017
`seer2`	**Description:** Seasonal Energy Efficiency Ratio ~~**Data Type:**~~ **Type:** `Numeric` **Units:** Btu/W·h **Constraints:** `>0.0` **Notes:** Used for versions of the test standard from 2023
`eer`	**Description:** Full stage Energy Efficiency Ratio (at 'A' operating conditions) ~~**Data Type:**~~ **Type:** `Numeric` **Units:** Btu/W·h **Constraints:** `>0.0` **Notes:** Used for versions of the test standard up through 2017
`eer2`	**Description:** Full stage Energy Efficiency Ratio (at 'A' operating conditions) ~~**Data Type:**~~ **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) ~~**Data Type:**~~ **Type:** `Numeric` **Units:** Btu/h **Constraints:** `≥0.0` **Notes:** At high stage for multi-stage equipment

Table RS0002–12 RatingAHRI340360

Name	Attributes
`certified_reference_number`	**Description:** AHRI Certified Reference Number ~~**Data Type:**~~ **Type:** `String`
`test_standard_year`	**Description:** Name and version of the AHRI test standard ~~**Data Type:**~~ **Type:** ~~`<`~~`Enumeration(AHRI340360TestStandardYear`~~`>`~~`)`

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Name	Attributes
rating_source	**Description:** Source of this rating data ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** ~~Enumeration(~~AHRI340360CapacityControlType~~)~~
ieer	**Description:** Integrated Energy Efficiency Ratio ~~**Data Type:**~~ **Type:** Numeric **Units:** Btu/W·h **Constraints:** >0.0
eer	**Description:** Energy Efficiency Ratio at Standard Rating Conditions ~~**Data Type:**~~ **Type:** Numeric **Units:** Btu/W·h **Constraints:** >0.0
cooling_capacity	**Description:** Net total cooling capacity at Standard Rating Conditions ~~**Data Type:**~~ **Type:** Numeric **Units:** Btu/h **Constraints:** ≥0.0

Table RS0002–13 Performance

Name	Attributes
standby_power	**Description:** Continuous unit power draw regardless of fan or DX system operation ~~**Data Type:**~~ **Type:** Numeric **Units:** W **Constraints:** ≥0.0 ~~**Req:** √~~ **Required:** True **Scalable:** ~~√~~True **Notes:** Includes on-board controls and other power not included in the fan or dx system representations
indoor_fan_representation	**Description:** The corresponding Standard 205 fan assembly representation ~~**Data Type:**~~ **Type:** ~~Group(~~RS0003~~)~~ **Notes:** Required if the indoor fan is packaged with the unitary equipment
fan_position	**Description:** Position of the fan relative to the cooling coil ~~**Data Type:**~~ **Type:** ~~Enumeration(~~FanPosition~~)~~ ~~**Req:**~~ **Required:** if indoor_fan_representation

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Name	Attributes
`dx_system_representation`	**Description:** The corresponding Standard 205 direct expansion system representation ~~**Data Type:**~~ **Type:** ~~+~~`Group(RS0004~~+~~)` ~~**Req:** ✓~~ **Required:** `True`
`scaling`	**Description:** Specifies the range the performance data can be scaled to represent different capacity equipment ~~**Data Type:**~~ **Type:** ~~+~~`Group(Scaling~~+~~)` **Notes:** If not present, scaling of the performance data is not allowed

RS0002.7 Verification Rules. None.

RS0002.8 ~~Publishing Rules.~~

RS0002.9 Publishing Rules. None.

RS0002.10 Application Rules

RS0002.10.1 Standby Performance. `standby_power` shall be used to simulate performance under all conditions regardless of fan or DX system operation.

RS0002.11 References

1. AHRI. *AHRI 210/240 (2008) with Addenda 1 and 2: Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment*. Arlington, Virginia: AHRI, 2008.
2. AHRI. *AHRI 210/240 (2017) with Addendum 1: Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment*. Arlington, Virginia: AHRI, 2017.
3. AHRI. *AHRI 210/240-2023 (2020): Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment*. Arlington, Virginia: AHRI, 2020.
4. AHRI. *AHRI 340/360 (2007) with Addenda 1 and 2: Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment*. Arlington, Virginia: AHRI, 2007.
5. AHRI. *AHRI 340/360 (2015): Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment*. Arlington, Virginia: AHRI, 2015.
6. AHRI. *AHRI 340/360 (I-P/2019): Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment*. Arlington, Virginia: AHRI, 2019.
7. AHRI. *AHRI 340/360 (I-P/2022): Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment*. Arlington, Virginia: AHRI, 2022.

RS0002.12 Example (Informative). See https://data.ashrae.org/Standard205/examples.html

RS0003 FAN ASSEMBLY

RS0003.1 ~~Identification and History.~~

RS0003.2 Identification. `schema_name`: RS0003

RS0003.3 Version History

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

RS0003.4 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.

RS0003.5 Scope and Description

RS0003.5.1 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.

RS0003.5.2 Exclusions

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

RS0003.5.3 Embedded Representations

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

RS0003.5.4 Referencing Representations

- RS0002: Unitary Cooling Air-Conditioning Equipment

RS0003.5.5 Schematic. 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).

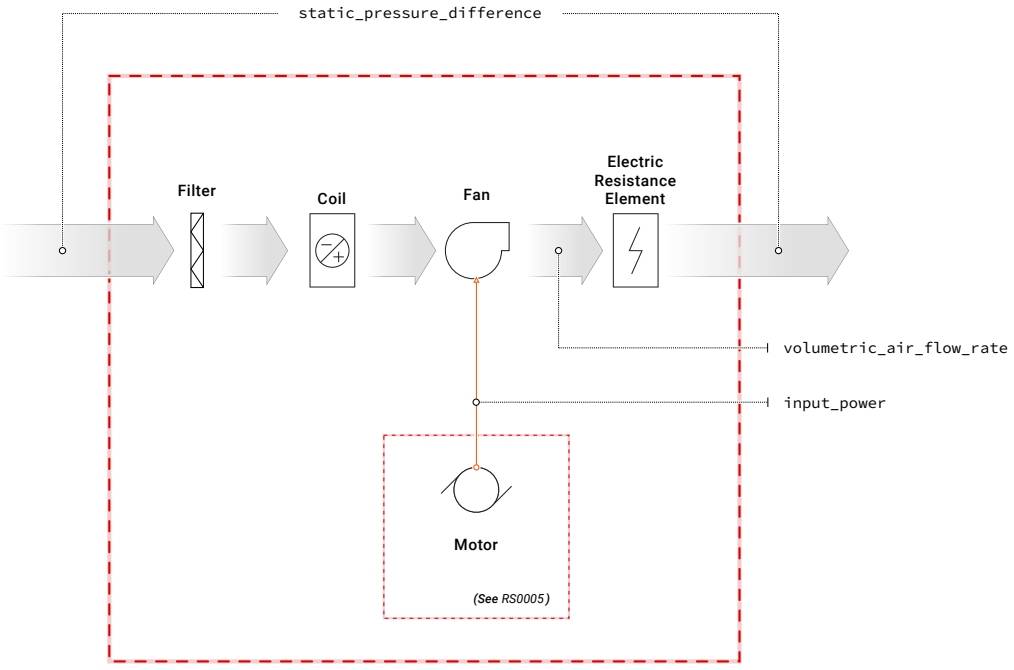

Figure RS0003–1 Example Fan Assembly for a Packaged System (Does Not Illustrate All Possible Combinations of Components).

RS0003.6 Data Model

RS0003.6.1 ~~Data Group Hierarchy.~~

RS0003.6.2 Data Group Hierarchy. A representation implementation conforming to this representation specification shall consist of the following data groups

- RS0003
  - Metadata
  - Description*
    - ProductInformation*
    - AssemblyComponent*
  - Performance
    - PerformanceMapContinuous
      - GridVariablesContinuous
      - LookupVariablesContinuous
    - PerformanceMapDiscrete
      - GridVariablesDiscrete
      - LookupVariablesDiscrete

where asterisks (*) indicate data groups that are not required to be present in a representation conforming to this representation specification. Either `PerformanceMapContinuous` or `PerformanceMapDiscrete` is required, but not both.

RS0003.6.3 Enumerations

Table RS0003–3 InstallationSpeedControlType

Enumerator	Attributes
`FIXED`	**Description:** Fan speed does not change after installation **Notes:** ***Informative note:*** 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

RS0003.6.4 Data Groups

Table RS0003–6 RS0003

Name	Attributes
`metadata`	**Description:** Metadata data group ~~**Data Type:**~~ **Type:** ~~`+`~~`Group(Metadata`~~`+`~~`)` **Constraints:** `schema_name="RS0003"` ~~**Req:** ✓~~ **Required:** `True`

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Name	Attributes
description	**Description:** Data group describing product and rating information ~~**Data Type:**~~ **Type:** ~~+~~Group(Description~~+~~)
performance	**Description:** Data group containing performance information ~~**Data Type:**~~ **Type:** ~~+~~Group(Performance~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True

Table RS0003–7 Description

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

Table RS0003–8 ProductInformation

Name	Attributes
manufacturer	**Description:** Assembly/unit manufacturer name ~~**Data Type:**~~ **Type:** String
model_number	**Description:** Assembly/unit model number ~~**Data Type:**~~ **Type:** Pattern **Notes:** Pattern shall match all model numbers that can be represented by the representation
impeller_type	**Description:** Type of impeller in fan assembly ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(ImpellerType~~>~~)
number_of_impellers	**Description:** Number of impellers included in the fan assembly ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** Numeric **Units:** m^3/s **Constraints:** ≥0.0 ~~**Req:** ✓~~ **Required:** True **Scalable:** ~~✓~~True **Notes:** Used for calculating component wet pressure difference
is_enclosed	**Description:** Fan assembly is enclosed ~~**Data Type:**~~ **Type:** Boolean ~~**Req:** ✓~~ **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 ~~**Data Type:**~~ **Type:** [~~+~~Array(Group(AssemblyComponent~~+~~])) ~~**Req:**~~ **Required:** if is_enclosed=True
heat_loss_fraction	**Description:** Fraction of efficiency losses transferred into the air stream ~~**Data Type:**~~ **Type:** Numeric **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ ~~Req:~~ ~~✓~~ • ≤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 ~~**Data Type:**~~ **Type:** Numeric **Units:** rev/s **Constraints:** ≥0.0 ~~**Req:** ✓~~ **Required:** True

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Name	Attributes
minimum_impeller_rotational_speed	**Description:** Minimum impeller rotational speed ~~**Data Type:**~~ **Type:** Numeric **Units:** rev/s **Constraints:** ≥0.0 ~~**Req:** ✓~~ **Required:** True **Notes:** If no minimum, use zero
stability_curve	**Description:** The system curve defining the stability area for system selection ~~**Data Type:**~~ **Type:** ~~+~~Group(SystemCurve~~+~~) **Notes:** ***Informative note:*** 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 ~~**Data Type:**~~ **Type:** ~~+~~Enumeration(SpeedControlType~~+~~) ~~**Req:** ✓~~ **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
installation_speed_control_type	**Description:** Type of fan impeller speed control ~~**Data Type:**~~ **Type:** ~~+~~Enumeration(InstallationSpeedControlType~~+~~) ~~**Req:** ✓~~ **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 ~~**Data Type:**~~ **Type:** ~~+~~Group(RS0005~~+~~) **Notes:** If the fan assembly is packaged with a motor, a motor representation shall be provided

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Name	Attributes
mechanical_drive_representation	**Description:** The corresponding Standard 205 mechanical drive representation ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** ~~+~~Group(Scaling~~+~~) **Notes:** If not present, scaling of the performance data is not allowed
performance_map	**Description:** Data group describing fan assembly performance when operating ~~**Data Type:**~~ **Type:** Alternative(~~+~~Group(PerformanceMapContinuous~~+~~), ~~+~~Group(PerformanceMapDiscrete~~+~~)) **Constraints:** operation_speed_control_type(CONTINUOUS, DISCRETE) ~~**Req:** √~~ **Required:** True

Table RS0003–10 AssemblyComponent

Name	Attributes
component_type	**Description:** Type of component ~~**Data Type:**~~ **Type:** ~~+~~Enumeration(ComponentType~~+~~) ~~**Req:** √~~ **Required:** True
component_description	**Description:** Informative description of the component ~~**Data Type:**~~ **Type:** String
component_id	**Description:** Identifier of the corresponding Standard 205 representation ~~**Data Type:**~~ **Type:** UUID **Notes:** Optionally provided if the component has a Standard 205 representation

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Name	Attributes
wet_pressure_difference	**Description:** Additional static pressure difference if the component is wet (e.g., because of condensate collection or wetting evaporative media) ~~**Data Type:**~~ **Type:** Numeric **Units:** Pa **Constraints:** ≥0.0 ~~**Req:** √~~ **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
standard_air_volumetric_flow_rate	**Description:** Volumetric air flow rate through an air distribution system at standard air conditions ~~**Data Type:**~~ **Type:** [Array(Numeric][~~2...~~]) **Units:** m^3/s **Constraints:** • ≥0.0 ~~Req:~~ ~~√~~ • [2..] **Required:** True **Scalable:** ~~√~~True
static_pressure_difference	**Description:** Static pressure difference of an air distribution system ~~**Data Type:**~~ **Type:** [Array(Numeric][~~2...~~]) **Units:** Pa **Constraints:** • ≥0.0 ~~Req:~~ ~~√~~ • [2..] **Required:** True **Scalable:** ~~√~~True

Table RS0003–12 PerformanceMapContinuous

Name	Attributes
grid_variables	**Description:** Data group describing grid variables for continuous fan performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesContinuous~~+~~) ~~**Req:** √~~ **Required:** True

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Name	Attributes
`lookup_variables`	**Description:** Data group describing lookup variables for continuous fan performance ~~**Data Type:**~~ **Type:** ~~+~~`Group(LookupVariablesContinuous~~+~~)` ~~**Req:** √~~ **Required:** `True`

Table RS0003–13 GridVariablesContinuous

Name	Attributes
`standard_air_volumetric_flow_rate`	**Description:** Volumetric air flow rate through fan assembly at standard air conditions ~~**Data Type:**~~ **Type:** `[Array(Numeric][~~1..~~])` **Units:** m^3/s **Constraints:** • `≥0.0` ~~**Req:** √~~ • `[1..]` **Required:** `True` **Scalable:** ~~√~~`True`
`static_pressure_difference`	**Description:** External static pressure across fan assembly at dry coil conditions ~~**Data Type:**~~ **Type:** `[Array(Numeric][~~1..~~])` **Units:** Pa **Constraints:** • `≥0.0` ~~**Req:** √~~ • `[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 RS0003–14 LookupVariablesContinuous

Name	Attributes
`impeller_rotational_speed`	**Description:** Rotational speed of fan impeller ~~**Data Type:**~~ **Type:** `[Array(Numeric][~~1..~~])` **Units:** rev/s **Constraints:** • `≥0.0` ~~**Req:** √~~ • `[1..]` **Required:** `True`

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Name	Attributes
shaft_power	**Description:** Mechanical shaft power input to fan assembly ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~**Req:** √~~ • [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 ~~**Data Type:**~~ **Type:** [~~<~~Array(Enumeration(OperationState~~>~~]) ~~**Units:** -~~ ~~**Req:** √~~ **Constraints:** [1..] **Required:** True

Table RS0003–15 PerformanceMapDiscrete

Name	Attributes
grid_variables	**Description:** Data group describing grid variables for discrete fan performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesDiscrete~~+~~) ~~**Req:** √~~ **Required:** True
lookup_variables	**Description:** Data group describing lookup variables for discrete fan performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariablesDiscrete~~+~~) ~~**Req:** √~~ **Required:** True

Table RS0003–16 GridVariablesDiscrete

Name	Attributes
speed_number	**Description:** Number indicating discrete speed of fan impeller in rank order (with 1 being the lowest speed) ~~**Data Type:**~~ **Type:** [Array(Integer][~~1..~~]) ~~**Units:**~~ - **Constraints:** • ≥0 ~~Req:~~ ~~✓~~ • [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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** Pa **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [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 RS0003–17 LookupVariablesDiscrete

Name	Attributes
standard_air_volumetric_flow_rate	**Description:** Volumetric air flow rate through fan assembly at standard air conditions ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** m^3/s **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True
shaft_power	**Description:** Mechanical shaft power input to fan assembly ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [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

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Name	Attributes
impeller_rotational_speed	**Description:** Rotational speed of fan impeller ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1...~~]) **Units:** rev/s **Constraints:** • ≥0.0 ~~**Req:** ✓~~ • [1..] **Required:** True
operation_state	**Description:** The operation state at the operating conditions ~~**Data Type:**~~ **Type:** [~~<~~Array(Enumeration(OperationState~~>~~)) ~~**Units:** -~~ ~~**Req:** ✓~~ **Constraints:** [1..] **Required:** True

RS0003.7 Verification Rules. Performance data supplied must satisfy the following verification tests.

RS0003.7.1 Fan Efficiency. The resulting energy content of the air flow, which is a product of unit static pressure (ΔP) and flow rate ($\dot{V}$), must be less than the fan assembly power input ($\dot{P}_f$). That is, the fan efficiency (ε_f) must be less than unity.

$$\varepsilon_f = \frac{\dot{V} \cdot \Delta P}{\dot{P}_f} < 1$$

Informative note: All losses are assumed to be added to the air stream and/or the surroundings depending on the value of heat_loss_fraction.

RS0003.7.2 Nomenclature

Symbol	Description
$\dot{V}$	Volumetric flow rate, m^3/s
ΔP	Static pressure difference across assembly, Pa
$\dot{P}_f$	Input power to fan assembly, W
ε_f	Fan efficiency, -

RS0003.8 Publishing Rules.

RS0003.9 ~~Publishing Rules.~~ None.

RS0003.10 Application Rules. Corrections to different operating conditions shall use fan laws from the ASHRAE SI Handbook of HVAC Systems and Equipment-2020[1], Chapter 21, based on the assumption that the fan assembly is a constant volume device. For instance, the fan power and static pressure values at standard air conditions would be modified according to the fan laws at different temperatures and atmospheric pressures by using density correction factors.

RS0003.11 References

1. ASHRAE. *ASHRAE Handbook—HVAC Systems and Equipment*. Atlanta, Georgia: ASHRAE, 2020.

RS0003.12 Example (Informative). See https://data.ashrae.org/Standard205/examples.html.

RS0004 AIR-TO-AIR DIRECT EXPANSION SYSTEM

RS0004.1 ~~Identification and History.~~

RS0004.2 Identification. `schema_name`: RS0004

RS0004.3 Version History

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

RS0004.4 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.

RS0004.5 Scope and Description

RS0004.5.1 Applicability. Direct expansion vapor compression refrigerant systems with two coils (one evaporator and one condenser) both exchanging heat with air streams to provide cooling.

RS0004.5.2 Exclusions. Systems with reversing capability to provide heating or systems with heat recovery.

RS0004.5.3 Embedded Representations. None.

RS0004.5.4 Referencing Representations

- RS0002: Unitary Cooling Air-Conditioning Equipment

RS0004.5.5 Schematic. Figure RS0004–1 illustrates the components of the refrigerant systems within the scope of this appendix.

RS0004.6 Data Model

RS0004.6.1 ~~Data Group Hierarchy.~~

RS0004.6.2 Data Group Hierarchy. A representation implementation conforming to this representation specification shall consist of the following data groups:

```
- RS0004
    - Metadata
    - Description*
        - ProductInformation*
    - Performance
        - PerformanceMapCooling
            - GridVariablesCooling
            - LookupVariablesCooling
        - PerformanceMapStandby
            - GridVariablesStandby
            - LookupVariablesStandby
```

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

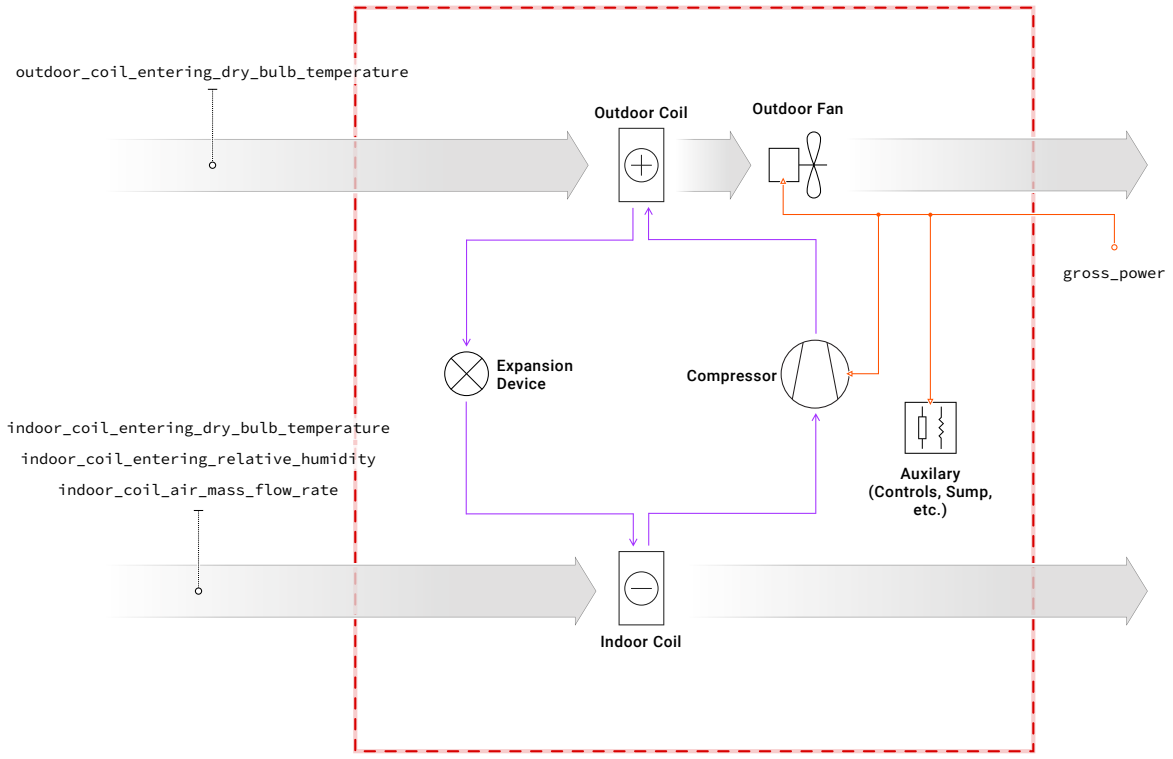

Figure RS0004–1 Air-to-Air direct expansion refrigerant system.

RS0004.6.3 Enumerations. None.

RS0004.6.4 Data Groups

Table RS0004–2 RS0004

Name	Attributes
metadata	**Description:** Metadata data group ~~**Data Type:**~~ **Type:** ~~+~~Group(Metadata~~+~~) **Constraints:** schema_name="RS0004" ~~**Req:** ✓~~ **Required:** True
description	**Description:** Data group describing product and rating information ~~**Data Type:**~~ **Type:** ~~+~~Group(Description~~+~~)
performance	**Description:** Data group containing performance information ~~**Data Type:**~~ **Type:** ~~+~~Group(Performance~~+~~) ~~**Req:** ✓~~ **Required:** True

Table RS0004–3 Description

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

Table RS0004–4 ProductInformation

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

Table RS0004–5 Performance

Name	Attributes
compressor_speed_control_type	**Description:** Method used to control different speeds of the compressor ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(SpeedControlType~~>~~) ~~**Req:** ✓~~ **Required:** True

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Name	Attributes
cycling_degradation_coefficient	**Description:** Cycling degradation coefficient (C_D) as described in AHRI 210/240 ~~**Data Type:**~~ **Type:** Numeric **Units:** - **Constraints:** • ≥0.0~~, <1.0~~ ~~**Req:** ✓~~ • <1.0 **Required:** True **Notes:** • Used for the lowest stage when the unit cycles to meet load • ***Informative note:*** 340/360 specifies a fixed cycling degradation coefficient of approximately 0.12
scaling	**Description:** Specifies the range the performance data can be scaled to represent different capacity equipment ~~**Data Type:**~~ **Type:** ~~+~~Group(Scaling~~+~~) **Notes:** If not present, scaling of the performance data is not allowed
performance_map_cooling	**Description:** Data group describing cooling performance over a range of conditions ~~**Data Type:**~~ **Type:** ~~+~~Group(PerformanceMapCooling~~+~~) ~~**Req:** ✓~~ **Required:** True
performance_map_standby	**Description:** Data group describing standby performance ~~**Data Type:**~~ **Type:** ~~+~~Group(PerformanceMapStandby~~+~~) ~~**Req:** ✓~~ **Required:** True

Table RS0004–6 PerformanceMapCooling

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesCooling~~+~~) ~~**Req:** ✓~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for cooling performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariablesCooling~~+~~) ~~**Req:** ✓~~ **Required:** True

Table RS0004–7 GridVariablesCooling

Name	Attributes
outdoor_coil_entering_dry_bulb_temperature	**Description:** Dry bulb temperature of the air entering the outdoor coil ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True
indoor_coil_entering_relative_humidity	**Description:** Relative humidity of the air entering the indoor coil ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ ~~Req:~~ ~~✓~~ • ≤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 ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** K **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Notes:** As measured immediately before entering the coil (i.e., after the fan in a blow-through configuration)
indoor_coil_air_mass_flow_rate	**Description:** Mass flow rate of air entering the indoor coil ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** kg/s **Constraints:** • >0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~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 ~~**Data Type:**~~ **Type:** [Array(Integer][~~1..~~]) ~~**Units:** -~~ **Constraints:** • ≥1 ~~Req:~~ ~~✓~~ • [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)
ambient_absolute_air_pressure	**Description:** Ambient absolute air pressure ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** Pa **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True

Table RS0004–8 LookupVariablesCooling

Name	Attributes
gross_total_capacity	**Description:** Total heat removed by the indoor coil ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True **Notes:** Shall not include fan heat

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

Table RS0004–9 PerformanceMapStandby

Name	Attributes
grid_variables	**Description:** Data group defining the grid variables for standby performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariablesStandby~~+~~) ~~**Req:** ✓~~ **Required:** True
lookup_variables	**Description:** Data group defining the lookup variables for standby performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariablesStandby~~+~~) ~~**Req:** ✓~~ **Required:** True

Table RS0004–10 GridVariablesStandby

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

Table RS0004–11 LookupVariablesStandby

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

RS0004.7 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 1[2].

RS0004.7.1 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:

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

and

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

.

RS0004.7.2 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:

$$\omega_l \leq \omega_e$$

RS0004.7.3 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

RS0004.8 Publishing Rules.

RS0004.9 ~~Publishing Rules.~~ None.

RS0004.10 Application Rules

RS0004.10.1 Cooling Performance. `performance_map_cooling` shall be used to simulate performance when system controls call for cooling.

RS0004.10.2 Standby Performance. `performance_map_standby` shall be used to simulate performance under any of the following conditions:

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

RS0004.11 References

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

RS0004.12 Example (Informative). See https://data.ashrae.org/Standard205/examples.html.

RS0005 MOTOR

RS0005.1 ~~Identification and History.~~

RS0005.2 Identification. `schema_name`: RS0005

RS0005.3 Version History

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

RS0005.4 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.

RS0005.5 Scope and Description

RS0005.5.1 Applicability. Electric motors.

RS0005.5.2 Exclusions. None.

RS0005.5.3 Embedded Representations

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

RS0005.5.4 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.

RS0005.5.5 Schematic. Figure RS0005–1 illustrates an example of a motor within the scope of this representation.

RS0005.6 Data Model

RS0005.6.1 ~~Data Group Hierarchy.~~

RS0005.6.2 Data Group Hierarchy. 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.

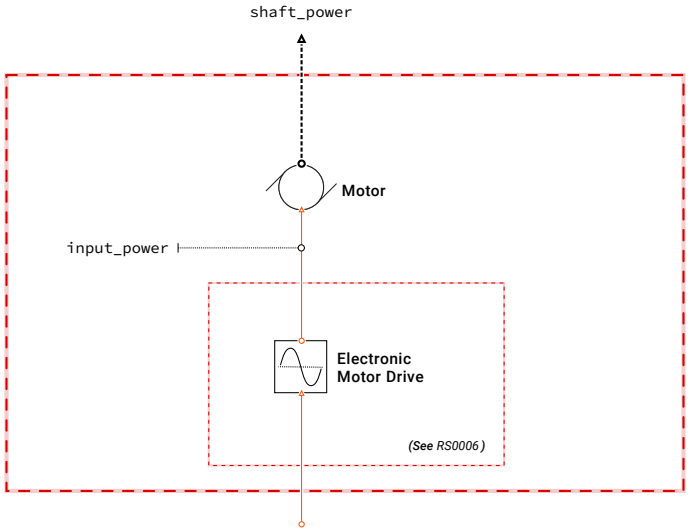

Figure RS0005–1 Motor.

RS0005.6.3 Enumerations. None.

RS0005.6.4 Data Groups

Table RS0005–3 RS0005

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

Table RS0005–4 Description

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

Table RS0005–5 ProductInformation

Name	Attributes
manufacturer	**Description:** Manufacturer name ~~**Data Type:**~~ **Type:** String
model_number	**Description:** Model number ~~**Data Type:**~~ **Type:** Pattern **Notes:** Pattern shall match all model numbers that can be represented by the representation
nominal_voltage	**Description:** Nominal voltage ~~**Data Type:**~~ **Type:** Numeric **Units:** V **Constraints:** ≥0.0
nominal_frequency	**Description:** Nominal frequency ~~**Data Type:**~~ **Type:** Numeric **Units:** Hz **Constraints:** ≥0.0

Table RS0005–6 Performance

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

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Name	Attributes
standby_power	**Description:** Power draw when motor is not operating ~~**Data Type:**~~ **Type:** Numeric **Units:** W **Constraints:** ≥0.0 ~~**Req:** ✓~~ **Required:** True **Scalable:** ~~✓~~True
number_of_poles	**Description:** Number of poles ~~**Data Type:**~~ **Type:** Integer **Constraints:** • >0~~, %2~~ ~~Req: ✓~~ • %2 **Required:** True
drive_representation	**Description:** The corresponding Standard 205 drive representation ~~**Data Type:**~~ **Type:** ~~+~~Group(RS0006~~+~~)
scaling	**Description:** Specifies the range the performance data can be scaled to represent different capacity equipment ~~**Data Type:**~~ **Type:** ~~+~~Group(Scaling~~+~~) **Notes:** If not present, scaling of the performance data is not allowed
performance_map	**Description:** Data group describing motor performance when operating ~~**Data Type:**~~ **Type:** ~~+~~Group(PerformanceMap~~+~~) **Notes:** • If no performance map is defined, the motor shall be assumed to transfer all electric power directly to mechanical shaft power • ***Informative note:*** This field may be omitted for motor-driven equipment where motor efficiencies are incorporated into their performance data

Table RS0005–7 PerformanceMap

Name	Attributes
grid_variables	**Description:** Data group describing grid variables for motor performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariables~~+~~) ~~**Req:** ✓~~ **Required:** True
lookup_variables	**Description:** Data group describing lookup variables for motor performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariables~~+~~) ~~**Req:** ✓~~ **Required:** True

Table RS0005–8 GridVariables

Name	Attributes
shaft_power	**Description:** Delivered rotational shaft power ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True
shaft_rotational_speed	**Description:** Rotational speed of shaft ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** rev/s **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True

Table RS0005–9 LookupVariables

Name	Attributes
efficiency	**Description:** Efficiency of motor ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ ~~Req:~~ ~~✓~~ • ≤1.0 • [1..] **Required:** True **Notes:** Defined as the ratio of mechanical shaft power to electrical input power of the motor
power_factor	**Description:** Power factor of the motor ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ ~~Req:~~ ~~✓~~ • ≤1.0 • [1..] **Required:** True

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Name	Attributes
`operation_state`	**Description:** The operation state at the operating conditions ~~**Data Type:**~~ **Type:** [~~<~~`Array(Enumeration(OperationState~~>~~))` ~~**Units:** -~~ ~~**Req:** ✓~~ **Constraints:** `[1..]` **Required:** `True`

RS0005.7 Verification Rules. Performance data supplied must satisfy the following verification tests.

RS0005.7.1 Motor Efficiency. The resulting mechanical shaft power ($\dot{P}_s$) must be less than or equal to the electrical input power to the motor ($\dot{P}_m$). That is, the motor efficiency (ε_m) must be less than or equal to unity.

$$\varepsilon_m = \frac{\dot{P}_s}{\dot{P}_m} \leq 1$$

Informative note: All losses are assumed to be added as heat to the surroundings or to a fluid stream as indicated by a referencing representation.

RS0005.7.2 Nomenclature

Symbol	Description
$\dot{P}_s$	Mechanical shaft power, W
$\dot{P}_m$	Input power to motor, W
ε_m	Motor efficiency, -

RS0005.8 Publishing Rules.

RS0005.9 ~~Publishing Rules.~~ None.

RS0005.10 Application Rules

RS0005.10.1 Standby Performance. `standby_power` shall be used to simulate performance under the following conditions:

a. when system controls are not calling for shaft rotation, or
b. system controls are calling for shaft rotation, but the corresponding lookup variable `operation_state` in `performance_map` has a value of STANDBY at the current simulated conditions.

RS0005.11 References. None.

RS0005.12 Example (Informative). See https://data.ashrae.org/Standard205/examples.html.

RS0006 ELECTRONIC MOTOR DRIVE

RS0006.1 ~~Identification and History.~~

RS0006.2 Identification. `schema_name`: RS0006

RS0006.3 Version History

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

RS0006.4 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.

RS0006.5 Scope and Description

RS0006.5.1 Applicability. Electronic motor drives.

RS0006.5.2 Exclusions. None.

RS0006.5.3 Embedded Representations. None.

RS0006.5.4 Referencing Representations

- RS0005: Motor

RS0006.5.5 Schematic. Figure RS0006–1 illustrates an example of an electronic motor drive within the scope of this representation.

RS0006.6 Data Model

RS0006.6.1 ~~Data Group Hierarchy.~~

RS0006.6.2 Data Group Hierarchy. 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.

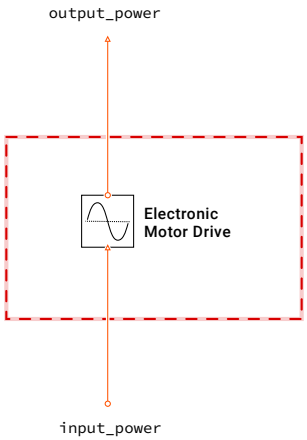

Figure RS0006–1 Electronic motor drive.

RS0006.6.3 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

RS0006.6.4 Data Groups

Table RS0006–3 RS0006

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

Table RS0006–4 Description

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

Table RS0006–5 ProductInformation

Name	Attributes
manufacturer	**Description:** Manufacturer name ~~**Data Type:**~~ **Type:** String
model_number	**Description:** Model number ~~**Data Type:**~~ **Type:** Pattern **Notes:** Pattern shall match all model numbers that can be represented by the representation

Table RS0006–6 Performance

Name	Attributes
maximum_power	**Description:** Maximum power draw of the drive ~~**Data Type:**~~ **Type:** Numeric **Units:** W **Constraints:** ≥0.0 ~~**Req:** √~~ **Required:** True **Scalable:** ~~√~~True
standby_power	**Description:** Power draw when the motor is not operating ~~**Data Type:**~~ **Type:** Numeric **Units:** W **Constraints:** ≥0.0 ~~**Req:** √~~ **Required:** True **Scalable:** ~~√~~True
cooling_method	**Description:** Method used to cool the drive ~~**Data Type:**~~ **Type:** ~~<~~Enumeration(CoolingMethod~~>~~) ~~**Req:** √~~ **Required:** True
scaling	**Description:** Specifies the range the performance data can be scaled to represent different capacity equipment ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** ~~+~~Group(PerformanceMap~~+~~) ~~**Req:** √~~ **Required:** True

Table RS0006–7 PerformanceMap

Name	Attributes
grid_variables	**Description:** Data group describing grid variables for drive performance ~~**Data Type:**~~ **Type:** ~~+~~Group(GridVariables~~+~~) ~~**Req:** √~~ **Required:** True

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Name	Attributes
lookup_variables	**Description:** Data group describing lookup variables for drive performance ~~**Data Type:**~~ **Type:** ~~+~~Group(LookupVariables~~+~~) ~~**Req:**~~ ~~✓~~ **Required:** True

Table RS0006–8 GridVariables

Name	Attributes
output_power	**Description:** Power delivered to the motor ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** W **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True **Scalable:** ~~✓~~True
output_frequency	**Description:** Frequency delivered to the motor ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** Hz **Constraints:** • ≥0.0 ~~Req:~~ ~~✓~~ • [1..] **Required:** True

Table RS0006–9 LookupVariables

Name	Attributes
efficiency	**Description:** Efficiency of drive ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ ~~Req:~~ ~~✓~~ • ≤1.0 • [1..] **Required:** True **Notes:** • Defined as the ratio of electrical output power (to the motor) to electrical input power (to the drive) • Input power shall include any power required to provide active air cooling for the drive

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Name	Attributes
`operation_state`	**Description:** The operation state at the operating conditions ~~**Data Type:**~~ **Type:** [~~<~~`Array(Enumeration(OperationState~~>~~)`~~)~~] ~~**Units:** -~~ ~~**Req:** ✓~~ **Constraints:** [`1..`] **Required:** `True`

RS0006.7 Verification Rules. Performance data supplied must satisfy the following verification tests.

RS0006.7.1 Drive Efficiency. The output power delivered to the motor ($\dot{P}_m$) must be less than or equal to the input electrical power to the drive ($\dot{P}_d$). That is, the drive efficiency (ε_d) must be less than or equal to unity.

$$\varepsilon_d = \frac{\dot{P}_m}{\dot{P}_d} \leq 1$$

Informative note: All losses are assumed to be added as heat according to the cooling_method defined in the representation.

RS0006.7.2 Nomenclature

Symbol	Description
$\dot{P}_m$	Output power to motor, W
$\dot{P}_d$	Input power to drive, W
ε_d	Drive efficiency, -

RS0006.8 Publishing Rules.

RS0006.9 ~~Publishing Rules.~~ None.

RS0006.10 Application Rules. `standby_power` shall be used to simulate performance under the following conditions:

a. when system controls are not calling for drive output, or
b. system controls are calling for drive output, but the corresponding lookup variable `operation_state` in `performance_map` has a value of STANDBY at the current simulated conditions.

RS0006.11 References. None.

RS0006.12 Example (Informative). See https://data.ashrae.org/Standard205/examples.html.

RS0007 MECHANICAL DRIVE

RS0007.1 ~~Identification and History.~~

RS0007.2 Identification. `schema_name`: RS0007

RS0007.3 Version History

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

RS0007.4 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.

RS0007.5 Scope and Description

RS0007.5.1 Applicability. Mechanical drives used to transmit mechanical power from one shaft to another through belts, gears, or chains.

RS0007.5.2 Exclusions. None.

RS0007.5.3 Embedded Representations. None.

RS0007.5.4 Referencing Representations

- RS0003: Fan Assembly

RS0007.5.5 Schematic. Figure RS0007–1 illustrates an example of a mechanical drive within the scope of this representation.

RS0007.6 Data Model

RS0007.6.1 ~~Data Group Hierarchy.~~

RS0007.6.2 Data Group Hierarchy. 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.

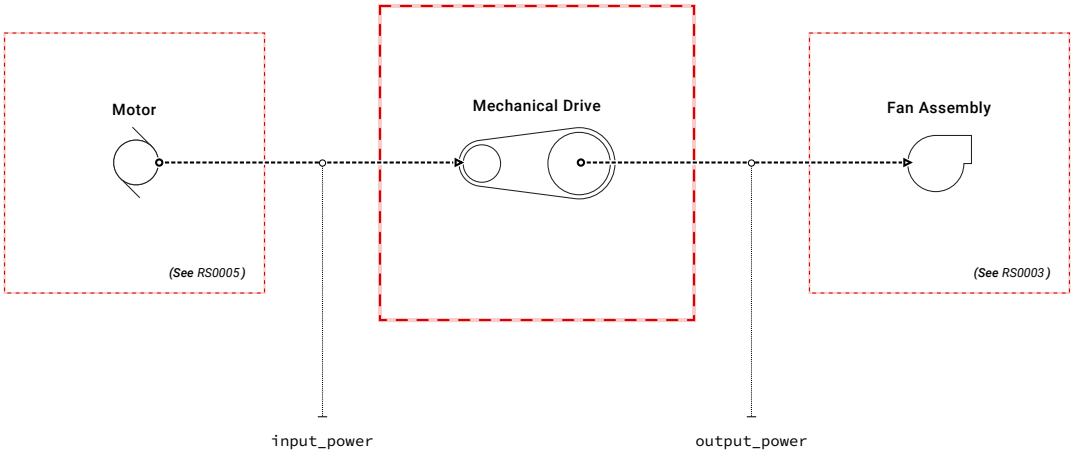

Figure RS0007–1 Mechanical drive.

RS0007.6.3 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

RS0007.6.4 Data Groups

Table RS0007–3 RS0007

Name	Attributes
metadata	**Description:** Metadata data group ~~**Data Type:**~~ **Type:** ~~+~~Group(Metadata~~+~~) **Constraints:** schema_name="RS0007" ~~**Req:** ✓~~ **Required:** True

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Name	Attributes
`description`	**Description:** Data group describing product and rating information ~~**Data Type:**~~ **Type:** ~~+~~`Group(Description~~+~~)`
`performance`	**Description:** Data group containing performance information ~~**Data Type:**~~ **Type:** ~~+~~`Group(Performance~~+~~)` ~~**Req:**~~ ~~✓~~ **Required:** `True`

Table RS0007–4 Description

Name	Attributes
`product_information`	**Description:** Data group describing product information ~~**Data Type:**~~ **Type:** ~~+~~`Group(ProductInformation~~+~~)`

Table RS0007–5 ProductInformation

Name	Attributes
`manufacturer`	**Description:** Manufacturer name ~~**Data Type:**~~ **Type:** `String`
`model_number`	**Description:** Model number ~~**Data Type:**~~ **Type:** `Pattern` **Notes:** Pattern shall match all model numbers that can be represented by the representation
`drive_type`	**Description:** Type of mechanical drive ~~**Data Type:**~~ **Type:** ~~+~~`Enumeration(DriveType~~+~~)`

Table RS0007–6 Performance

Name	Attributes
`speed_ratio`	**Description:** Ratio of input shaft speed to output shaft speed ~~**Data Type:**~~ **Type:** `Numeric` **Units:** - **Constraints:** `>0.0` ~~**Req:**~~ ~~✓~~ **Required:** `True`

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Name	Attributes
`scaling`	**Description:** Specifies the range the performance data can be scaled to represent different capacity equipment ~~**Data Type:**~~ **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 ~~**Data Type:**~~ **Type:** ~~+~~`Group(PerformanceMap~~+~~)` ~~**Req:** ✓~~ **Required:** `True`

Table RS0007–7 PerformanceMap

Name	Attributes
`grid_variables`	**Description:** Data group describing grid variables for drive performance ~~**Data Type:**~~ **Type:** ~~+~~`Group(GridVariables~~+~~)` ~~**Req:** ✓~~ **Required:** `True`
`lookup_variables`	**Description:** Data group describing lookup variables for drive performance ~~**Data Type:**~~ **Type:** ~~+~~`Group(LookupVariables~~+~~)` ~~**Req:** ✓~~ **Required:** `True`

Table RS0007–8 GridVariables

Name	Attributes
`output_power`	**Description:** Output shaft power ~~**Data Type:**~~ **Type:** `[Array(Numeric][~~1..~~])` **Units:** W **Constraints:** • `≥0.0` ~~**Req:** ✓~~ • `[1..]` **Required:** `True` **Scalable:** ~~✓~~`True`

Table RS0007–9 LookupVariables

Name	Attributes
efficiency	**Description:** Efficiency of drive ~~**Data Type:**~~ **Type:** [Array(Numeric][~~1..~~]) **Units:** - **Constraints:** • ≥0.0~~, ≤1.0~~ ~~Req:~~ ~~✓~~ • ≤1.0 • [1..] **Required:** True **Notes:** Defined as the ratio of output shaft power to input shaft power
operation_state	**Description:** The operation state at the operating conditions ~~**Data Type:**~~ **Type:** [~~<~~Array(Enumeration(OperationState~~>~~]) ~~**Units:** -~~ ~~**Req:** ✓~~ **Constraints:** [1..] **Required:** True

RS0007.7 Verification Rules. Performance data supplied must satisfy the following verification tests.

RS0007.7.1 Drive Efficiency. The output shaft power ($\dot{P}_o$) must be less than or equal to the input shaft power ($\dot{P}_i$). That is, the drive efficiency (ε_d) must be less than or equal to unity.

$$\varepsilon_d = \frac{\dot{P}_o}{\dot{P}_i} \leq 1$$

RS0007.7.2 Nomenclature

Symbol	Description
$\dot{P}_o$	Output shaft power, W
$\dot{P}_i$	Input shaft power, W
ε_d	Drive efficiency, -

RS0007.8 ~~Publishing Rules.~~

RS0007.9 Publishing Rules. None.

RS0007.10 Application Rules. None.

RS0007.11 References. None.

RS0007.12 Example (Informative). See https://data.ashrae.org/Standard205/examples.html.