

# Data Types

Data Type	Description	JSON Schema Type	Examples
Integer	A positive or negative whole number (i.e., a number that can be written without a fractional part).	integer	3, 19, -4
Numeric	A number that may include a fractional part with optional leading sign and optional exponent (engineering notation).	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
ID	A referencable identification for a data group and sequence of characters of any length using any (specified) character set.	string	AHU-01
Null	Indicator that no value is provided. Only used in combination with other data types, e.g., 'Number/Null'.	null	null

# ConditioningType

Enumerator	Description	Notes
HEATED_AND_COOLED	Heated and cooled	
HEATED_ONLY	Heated only	
SEMIHEATED	Semiheated	
UNCONDITIONED	Unconditioned	

# SpaceFunctionType

Enumerator	Description	Notes
LABORATORY	Laboratory	
KITCHEN	Kitchen	
OTHER	Other	

# InfiltrationMethodType

Enumerator	Description	Notes
WEATHER_DRIVEN	Weather Driven. The amount of air leakage is determined by a correlation usually involving windspeed, height, and the difference between indoor and outdoor temperature.	
PRESSURE_BASED	Pressure Based. The amount of air leakage is determined by induced airflows from pressure differences between zones, air distribution system components, the outside due to wind speed and direction.	
CONSTANT	Constant. The amount of air leakage is fixed.	

# SurfaceClassificationType

Enumerator	Description	Notes
WALL	Vertical or nearly vertical wall	
FLOOR	Floor	
CEILING	Ceiling	

# SurfaceAdjacentTo

Enumerator	Description	Notes
EXTERIOR	Exterior wall or roof which is adjacent to the exterior environment.	
GROUND	Slab-on-grad or below grade surface if adjacent to ground.	
INTERIOR	Interior surface if adjacent to another space which is explicitly modeled.	
IDENTICAL	Surface adjacent to a environment identical to the space. Sometimes this is described as adiabatic surface since no heat is transferred. The space on the other side of the surface is not explicitly modeled.	
UNDEFINED	The surface adjacency cannot be determined by the software.	

# SurfaceConstructionInputOptions

Enumerator	Description	Notes
LAYERS	Construction is entered layer-by-layer.	
SIMPLIFIED	Construction is entered by R-value only.	

## SubsurfaceClassificationType

Enumerator	Description	Notes
WINDOW	Window	
SKYLIGHT	Skylight	
DOOR	Door	
OTHER	Other types of subsurfaces including glass block	

## LightingDaylightingControlType

Enumerator	Description	Notes
STEPPED	Stepped	
CONTINUOUS_DIMMING	Continuous Dimming	
OTHER	Other types of daylighting control	
NONE	None	No daylighting is used.

## LightingOccupancyControlType

Enumerator	Description	Notes
FULL_AUTO_ON	Full auto on	
PARTIAL_AUTO_ON	Parial auto on	
MANUAL_ON	Manual on	
OTHER	Other types of occupancy control	
NONE	None	No occupancy controls is used.

## MiscellaneousEquipmentType

Enumerator	Description	Notes
PLUG	Plug	
PROCESS	Process	
OTHER	Other	

## TransformerType

Enumerator	Description	Notes
DRY_TYPE	Dry Type	
FLUID_FILLED	Fluid Filled	
OTHER	Other	

## ElectricalPhase

Enumerator	Description	Notes
SINGLE_PHASE	Single Phase	
THREE_PHASE	Three Phase	

## ScheduleSequenceTypeOptions

Enumerator	Description	Notes
HOURLY	Hourly	
EVENT	Event	

## ScheduleTypeOptions

Enumerator	Description	Notes
MULTIPLIER_DIMENSIONLESS	Multiplier dimensionless	
TEMPERATURE	Temperature	
POWER	Power	
FLOW_RATE	Flow rate	

## DayOfWeek

Enumerator	Description	Notes
SUNDAY	Sunday	
MONDAY	Monday	
TUESDAY	Tuesday	
WEDNESDAY	Wednesday	
THURSDAY	Thursday	
FRIDAY	Friday	
SATURDAY	Saturday	

## CoolingDesignDayTypeOptions

Enumerator	Description	Notes
COOLING_0_4	Cooling design day 0.4% annual cumulative frequency of occurrence	
COOLING_1_0	Cooling design day 1.0% annual cumulative frequency of occurrence	
COOLING_2_0	Cooling design day 2.0% annual cumulative frequency of occurrence	

## HeatingDesignDayTypeOptions

Enumerator	Description	Notes
HEATING_99_6	Heating design day 99.6% annual cumulative frequency of occurrence	
HEATING_99_0	Heating design day 99.0% annual cumulative frequency of occurrence	

## HeatingSystemType

Enumerator	Description	Notes
HEAT_PUMP	Heat Pump	
FURNACE	Furnace	
ELECTRIC_RESISTANCE	Electric resistance	
FLUID_LOOP	Fluid loop	
BASEBOARD	Baseboard	
NONE	None	
OTHER	Other	

## CoolingSystemType

Enumerator	Description	Notes
DIRECT_EXPANSION	Direct expansion	
FLUID_LOOP	Fluid loop	
NON_MECHANICAL	Non-mechanical	
NONE	None	
OTHER	Other	

## DehumidificationType

Enumerator	Description	Notes
MECHANICAL_COOLING	Mechanical cooling	
DESICCANT	Desiccant	
SERIES_HEAT_RECOVERY	Series heat recovery	
NONE	None	
OTHER	Other	

## HumidificationType

Enumerator	Description	Notes
ADIABATIC	Adiabatic	
NONE	None	
OTHER	Other	

# HeatpumpAuxilliaryHeatType

Enumerator	Description	Notes
ELECTRIC_RESISTANCE	Electric resistance	
NONE	None	
OTHER	Other	

# FanSystemPurposeType

Enumerator	Description	Notes
SUPPLY	Supply	
RETURN	Return	
EXHAUST	Exhaust	
RELIEF	Relief	
OTHER	Other	

# FanSystemTemperatureControlType

Enumerator	Description	Notes
CONSTANT	Constant	
OUTDOOR_AIR_RESET	Outdoor air reset	
ZONE_RESET	Zone reset	
SCHEDULED	Scheduled	
OTHER	Other	

# FanSystemSupplyFanControlType

Enumerator	Description	Notes
CONSTANT	Constant	
VARIABLE_SPEED_DRIVE	Variable speed drive	
CYCLING	Cycling	
INLET_VANE	Inlet vane	
DISCHARGE_DAMPER	Discharge damper	
OTHER	Other	

# AirEconomizerType

Enumerator	Description	Notes
FIXED_FRACTION	Fixed Fraction	
TEMPERATURE	Dry-bulb temperature	
ENTHALPY	Enthalpy	
DIFFERENTIAL_TEMPERATURE	Differential dry-bulb temperature	
DIFFERENTIAL_ENTHALPY	Differential enthalpy	
OTHER	Other	
NONE	None	

# EnergyRecoveryType

Enumerator	Description	Notes
SENSIBLE_HEAT_EXCHANGE	Sensible heat exchange	
ENTHALPY_HEAT_EXCHANGE	Enthalpy heat exchange	
SENSIBLE_HEAT_WHEEL	Sensible heat wheel	
ENTHALPY_HEAT_WHEEL	Enthalpy heat wheel	
HEAT_PIPE	Heat pipe	
OTHER	Other	
NONE	None	

# EnergyRecoveryOperation

Enumerator	Description	Notes
WHEN_FANS_ON	When fans on	
WHEN_MINIMUM_OUTSIDE_AIR	When minimum outside air	
SCHEDULED	Scheduled	
OTHER	Other	
NONE	None	

# EnergyRecoverySupplyAirTemperatureControl



Enumerator	Description	Notes
FIXED_SETPOINT	Fixed setpoint	
MIXED_AIR_RESET	Mixed air reset	
OTHER	Other	
NONE	None	

## DemandControlVentilationControlType

Enumerator	Description	Notes
CO2_RETURN_AIR	CO2 return air	
CO2_ZONE	CO2 zone	
OTHER	Other	
NONE	None	

## AirTerminalType

Enumerator	Description	Notes
VARIABLE_AIR_VOLUME_BOX	Variable air volume box	
PARALLEL_FAN_POWERED_BOX	Parallel fan powered box	
SERIES_FAN_POWERED_BOX	Parallel fan powered box	
OTHER	Other	

## ReheatSourceType

Enumerator	Description	Notes
ELECTRIC	Electric	
HOT_WATER	Hot water	
NONE	None	
OTHER	Other	

## FluidLoopFlowControlOptions

Enumerator	Description	Notes
<code>FIXED_FLOW</code>	Fixed flow	
<code>VARIABLE_FLOW</code>	Variable flow	

## FluidLoopTypeOptions

Enumerator	Description	Notes
<code>HEATING</code>	Heating	
<code>COOLING</code>	Cooling	
<code>HEATING_AND_COOLING</code>	Heating and cooling	
<code>CONDENSER</code>	Condenser	
<code>OTHER</code>	Other	

## TemperatureResetTypeOptions

Enumerator	Description	Notes
<code>NO_RESET</code>	No Reset	
<code>CONSTANT</code>	Constant	
<code>OUTSIDE_AIR_RESET</code>	Outside air reset	
<code>LOAD_RESET</code>	Load Reset	
<code>OTHER</code>	Other	

## FluidLoopOperationOptions

Enumerator	Description	Notes
<code>CONTINUOUS</code>	Continuous	
<code>INTERMITTENT</code>	Intermittent	

## PumpSpeedControlOptions

Enumerator	Description	Notes
<code>FIXED_SPEED</code>	Fixed speed	
<code>VARIABLE_SPEED</code>	Variable speed	

## PumpSpecificationMethodOptions

Enumerator	Description	Notes
<code>SIMPLE</code>	Simple	Specify the electric power input of pump
<code>DETAILED</code>	Detailed	Specify the motor nameplate power, design head, impellor efficiency, motor efficiency

## BoilerCombustionOptions

Enumerator	Description	Notes
<code>NATURAL</code>	Natural	
<code>FORCED</code>	Forced	

## BoilerEfficiencyMetricTypeOptions

Enumerator	Description	Notes
<code>ANNUAL_FUEL_UTILIZATION</code>	Annual fuel utilization efficiency	
<code>THERMAL</code>	Thermal efficiency	
<code>COMBUSTION</code>	Combustion efficiency	

## ChillerPartLoadEfficiencyMetricTypeOptions

Enumerator	Description	Notes
<code>INTEGRATED_PART_LOAD_VALUE</code>	Integrated part load value efficiency expressed as a coefficient of performance (COP)	
<code>NONSTANDARD_PART_LOAD_VALUE</code>	Nonstandard part load value efficiency expressed as a coefficient of performance (COP)	
<code>OTHER</code>	Other part load efficiency metric	

## ChillerCompressorTypeOptions

Enumerator	Description	Notes
SCREW	Screw	
CENTRIFUGAL	Centrifugal	
RECIPROCATING	Reciprocating	
SCROLL	Scroll	
POSITIVE_DISPLACEMENT	Positive displacement	
SINGLE_EFFECT_INDIRECT_FIRED_ABSORPTION	Single-effect indirect-fired absorption	
DOUBLE_EFFECT_INDIRECT_FIRED_ABSORPTION	Double-effect indirect-fired absorption	
SINGLE_EFFECT_DIRECT_FIRED_ABSORPTION	Single-effect direct-fired absorption	
DOUBLE_EFFECT_DIRECT_FIRED_ABSORPTION	Double-effect direct-fired absorption	
OTHER	Other	

## HeatRejectionTypeOptions

Enumerator	Description	Notes
OPEN_CIRCUIT_COOLING_TOWER	Open-circuit cooling tower	
CLOSED_CIRCUIT_COOLING_TOWER	Closed-circuit cooling tower or fluid cooler	
DRY_COOLER	Dry-cooler or air-cooled fluid cooler	
EVAPORATIVE_CONDENSER	Evaporative condenser	
AIR_COOLED_CONDENSER	Air cooled condenser	
OTHER	Other	

## HeatRejectionFanTypeOptions

Enumerator	Description	Notes
AXIAL	Axial or Propellor	
CENTRIFUGAL	Centrifugal	
OTHER	Other	

## HeatRejectionFluidOptions

Enumerator	Description	Notes
WATER	Water	
REFRIGERANT	Refrigerant	Including R-448A
AMMONIA	Ammonia	
OTHER	Other	

## HeatRejectionResetOptions

Enumerator	Description	Notes
CONSTANT	Constant	
LOAD_RESET	Load reset	
OTHER	Other	

## HeatRejectionFanSpeedControlOptions

Enumerator	Description	Notes
CONSTANT	Constant	
TWO_SPEED	Two Speed	
VARIABLE_SPEED	Variable Speed	
OTHER	Other	

## ExternalFluidSourceTypeOptions

Enumerator	Description	Notes
CHILLED_WATER	Chilled water	
HOT_WATER	Hot water	
STEAM	Steam	

## ServiceWaterHeatingEnteringWaterTemperatureInputOptions

Enumerator	Description	Notes
ANNUAL_MAIN	Annual main entering water temperature option	
MONTHLY_MAIN	Monthly main entering water temperature option	
ANNUAL_GROUND	Annual ground entering water temperature option	
MONTHLY_GROUND	Monthly ground entering water temperature option	

# EnergySourceTypeOptions

Enumerator	Description	Notes
ELECTRICITY	Electricity	
NATURAL_GAS	Natural gas	
OTHER	Other	

# ASHRAE229

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group.	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
transformers	Electrical transformers at the building site	[[Transformer]]				Contains a list of transformers that convert electricity from a higher voltage to one used by the building, exterior lighting, and other services at the site.
buildings	Buildings on the site	[[Building]]				Contains a list of buildings on the site (often just one).
calendar	Information on the calendar used with the simulation.	{Calendar}				
schedules	Schedules for internal loads, thermostats, equipment operation and control, and any other need.	[[Schedule]]				Contains a list of schedules used in model.
weather	Information on the local weather conditions used with the simulation.	{Weather}				
infiltration_pressure_difference	Differential pressure difference assumed for infiltration values.	Numeric	Pa	≥0		Often 50 Pa or 75 Pa and used as rating conditions for air leakage for a building.
overall_simulation_outputs	Outputs from the simulation summed for all buildings in the simulation.	{OverallSimulationOutputs}				
category	Indicates which category the current model represents for rulesets with multiple simulation models	<CategoryType2019ASHRAE90I>				
compliance_path	Indicates the chosen compliance path if the ruleset has multiple compliance paths such as 90.1 Appendix G has code compliance and beyond code	<CompliancePathType2019ASHRAE90I>				
building_rotation_angles	A list of angles that building simulations are performed and results are provided.	[Numeric]	degrees			List of angles that the building has been rotated.
fluid_loops	Fluid loops on the site	[[FluidLoop]]				Contains a list of fluid loops on the site.
conditioning_components	Links to all conditioning components used on the site	[[Pump],[Boiler],[Chiller], {HeatRejection}, {DistrictFluidMeter}]				Contains a list of all components related to conditioning.

# Building

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
building_segments	Large portions of a building that share a building area type	[{BuildingSegment}]				Contains a list of building segments in the building.
is_all_new	Indicates whether building is completely new construction (true) or existing (false).	Boolean				Projects that include additions should be False. Projects with additional instead may be modeled as two buildings - one new and one existing, as curtain rules such as baseline fenestration area will apply differently to each portion.
elevators	Elevators	[{Elevator}]				Contains a list of elevators in the building.
exterior_lighting	Exterior lighting systems	[{ExteriorLighting}]				Contains a list of exterior lighting systems for the building.
refrigeration_components	Refrigeration	[{Refrigeration}]				Contains a list of refrigeration components in the building.
building_open_schedule	Reference to the schedule containing indicating when the building is open	\$ID			✓	One represent when the building is open and zero when closed.

## BuildingSegment



Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
number_of_floors_above_grade	Number of floors above grade	Numeric		≥0		JG to verify if used in test case description.
number_of_floors_below_grade	Number of floors below grade	Numeric		≥0		JG to verify if used in test case description.
thermal_blocks	Thermal blocks in the building	[{ThermalBlock}]				Contains a list of thermal blocks in the building.
heating_ventilation_air_conditioning_systems	HVAC systems in the building	[{HeatingVentilationAirConditioningSystem}]				Contains a list of HVAC systems in the building.
service_water_heating_systems	Service water heating systems in the building	[{ServiceWaterHeatingSystem}]				Contains a list of service water heating systems in the building.
area_type_vertical_fenestration	Building area classification used for vertical fenestration	<VerticalFenestrationBuildingAreaType2019ASHRAE901>				The enumeration is based on the standard used.
lighting_building_area_type	Building area lighting area type	<LightingSpaceType2019ASHRAE901T951TG38>				
area_type_heating_ventilation_air_conditioning_system	Classification used for HVAC	<HeatingVentilationAirConditioningBuildingAreaType2019ASHRAE901>				The enumeration is based on the standard used. JG to verify if used in test case description.

# ThermalBlock

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
zones	Zones in the building	[{Zone}]				Contains a list of zones in the building.
thermostat_cooling_setpoint	Setpoint temperature for cooling during occupied hours	Numeric	C			JG to verify if used in test case description.
thermostat_heating_setpoint	Setpoint temperature for heating during occupied hours	Numeric	C			JG to verify if used in test case description.
served_by_heating_ventilation_air_conditioning_systems	HVAC systems serving the thermal block	[String]				Contains a list of IDs of the HVAC systems serving the thermal block - from Unique Identification Number in HeatingVentilationAirConditioningSystem.
served_by_service_water_heating_system	A service water heating system serving the thermal block	String				Contains a single ID of the service water heating system serving the thermal block - from Unique Identification Number in ServiceWaterHeatingSystem.
transfer_airflow_rate	Transfer airflow rate	Numeric	L/s	≥0		JG to verify if used in test case description.
exhaust_airflow_rate	Number of occupants in the space	Numeric	L/s	≥0		JG to verify if used in test case description.
non_mechanical_cooling_fan_power	Non-mechanical cooling fan power	Numeric	W	≥0		JG to verify if used in test case description.
non_mechanical_cooling_fan_airflow	Non-mechanical cooling fan power	Numeric	L/s	≥0		JG to verify if used in test case description.
air_distribution_effectiveness	Air distribution effectiveness	Numeric		≥0		JG to verify if used in test case description.

# Zone

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
spaces	Spaces in the building	[{Space}]				Contains a list of spaces in the building.
volume	Volume of the space	Numeric	m3	≥0		
surfaces	Surfaces surrounding the zone	[{Surface}]				Contains a list of surfaces that define the zone.
conditioning_type	Space conditioning category	<ConditioningType>				
infiltration	Airleakage into the zone.	{Infiltration}				References a single infiltration data group.

# Space

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
interior_lighting	Internal lighting that produce internal gains for a space.	{{InteriorLighting}}				
miscellaneous_equipment	Miscellaneous equipment loads that produce internal gains for a space.	{{MiscellaneousEquipment}}				
floor_area	The floor area of the space.	Numeric	m2	≥0		The floor area of a space within the building, including basements, mezzanine and intermediate-floored tiers, and penthouses with a headroom height of 7.5 ft or greater. It is measured from the exterior faces of walls or from the center-line of walls separating buildings, but excluding covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features. This is the floor area that is modeled.
number_of_occupants	Number of occupants in the space	Numeric		≥0		
occupant_multiplier_schedule	Reference to the schedule containing the multiplier for the number of occupants	\$ID			✓	
occupant_sensible_heat_gain	Sensible heat gain of each occupant.	Numeric	W	≥0		JG to verify if used in test case description.
status_type	Choice of new, existing, addition, or alteration.	<SpaceStatusType2019ASHRAE901>				
space_function	Generic function for the space.	<SpaceFunctionType>				The enumeration is based on the standard used.
lighting_space_type	Lighting space type classification	<LightingSpaceType2019ASHRAE901TG37>				The enumeration is based on the standard used.
ventilations_space_type	Ventilation space type classification	<VentilationSpaceType2019ASHRAE901>				The enumeration is based on the standard used.

Name	Description	Data Type	Units	Range	Req	Notes
service_water_heating_space_type	Service water heating space type classification	<ServiceWaterHeatingSpaceType2019ASHRAE901>				The enumeration is based on the standard used.

# Infiltration

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
modeling_method	The software methodology chosen for modeling infiltration	<InfiltrationMethodType>				
air_leakage_rate	Air leakage rate from infiltration of outside air	Numeric	m3/s	≥0		Based on the pressure described in ASHRAE229.infiltration_pressure_difference.
multiplier_schedule	Referenced to the schedule containing the multiplier for the infiltration	\$ID				

# Surface

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
subsurfaces	Subsurfaces that are on the surface	[{Subsurface}]				Contains a list of surfaces that define the space.
classification	Classification for the surface.	<SurfaceClassificationType>				Options for surface being interior or exterior wall, floor, or ceiling.
area	area of the surface	Numeric	m2	≥0		Measured from interior face area. It is the gross area of the wall and includes the area of all subsurfaces.
tilt	Angle between vertical and the surface outward normal	Numeric	degrees			Example value would be 0 = roof, 90 = wall, 180 = downward facing surface (exterior floor)
azimuth	Clockwise angle between North and the horizontal projection of the wall's outward normal.	Numeric	degrees	≥0		Example values would be 0 = north, 90 = East, 180 = South, 270 = West
adjacent_to	Used to classify the conditions on the surface.	<SurfaceAdjacentTo>, <AdditionalSurfaceAdjacentToRESNET>, <AdditionalSurfaceAdjacentTo2019ASHRAE901>				Determines whether the other side of the surface is modeled and if not what assumptions should be used.
adjacent_zone	ID of the adjacent zone for interior surface. Only required when adjacent zone is explicitly modeled when adjacent_to is set to INTERIOR.	\$ID				
does_cast_shade	Determines whether the surface is modeled as casting shade on other exterior surfaces	Boolean				
construction	Construction description of surface.	{Construction}				
surface_optical_properties	Optical properties of the surface.	{SurfaceOpticalProperties}				

## Construction

Name	Description	Data Type	Units	Range	Req	Notes
<code>id</code>	Scope-unique reference identifier for instances of this data group	<code>ID</code>			✓	
<code>reporting_name</code>	Descriptive name used in RCT reports if id is not already a descriptive name	<code>String</code>				
<code>notes</code>	Supplementary information to provide context to the model reviewer	<code>String</code>				
<code>surface_construction_input_option</code>	Identifies whether construction is entered layer-by-layer or simplified (R-value)	<code>&lt;SurfaceConstructionInputOptions&gt;</code>				
<code>fraction_framing</code>	Fraction of the construction that is framing.	<code>Numeric</code>		$\geq 0, \leq 1$		Fraction of the construction using <code>framing_layers</code> , the remaining portion uses the <code>primary_layers</code> . If blank, assume zero framing.
<code>primary_layers</code>	List of names of layer descriptions starting from the outside surface for primary heat path	<code>[[Material]]</code>				For constructions with framing and cavity heat transfer paths, use this for the cavity. For homogeneous constructions, use this element only. Air films should not be included in the list of layers.
<code>framing_layers</code>	List of names of layer descriptions starting from the outside surface for the framing heat path	<code>[[Material]]</code>				For constructions with framing and cavity heat transfer paths, use this for the framing. For homogeneous constructions, do not use this element. Air films should not be included in the list of layers.
<code>insulation_location</code>	The location of the insulation related to the surface	<code>String</code>				
<code>u_factor</code>	surface U-factor	<code>Numeric</code>	W/m2-K	$\geq 0$		Includes interior and exterior air films as specified by the referenced standard.
<code>c_factor</code>	surface C-factor	<code>Numeric</code>	W/m2-K	$\geq 0$		
<code>f_factor</code>	surface F-factor	<code>Numeric</code>	W/m-K	$\geq 0$		
<code>r_value</code>	r-value of the insulation for the surface	<code>Numeric</code>	K-m2/W	$\geq 0$		
<code>has_radiant_heating</code>	Includes embedded radiant heating elements	<code>Boolean</code>				
<code>has_radiant_cooling</code>	Includes embedded radiant cooling elements	<code>Boolean</code>				

# Material

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
thickness	The thickness of the material layer	Numeric	m	>0		
thermal_conductivity	The thermal conductivity of the material layer	Numeric	W/m-K	≥0		When thermal_conductivity is specified, r_value should not be provided.
density	The density of the material layer	Numeric	kg/m3	≥0		
specific_heat	The specific heat of the material layer	Numeric	J/kg-K	≥0		
r_value	r-value of the insulation for the material layer	Numeric	K-m2/W	≥0		When r_value is specified, thermal_conductivity should not be provided. Typically used for insulation or air gaps.

## SurfaceOpticalProperties

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
absorptance_thermal_exterior	Thermal absorptance of long wavelength radiation on the exterior surface.	Numeric		$\geq 0$		
absorptance_solar_exterior	Thermal absorptance of short wavelength radiation on the exterior surface.	Numeric		$\geq 0$		
absorptance_visible_exterior	Thermal absorptance of visible radiation on the exterior surface.	Numeric		$\geq 0$		
absorptance_thermal_interior	Thermal absorptance of long wavelength radiation on the interior surface.	Numeric		$\geq 0$		
absorptance_solar_interior	Thermal absorptance of short wavelength radiation on the interior surface.	Numeric		$\geq 0$		
absorptance_visible_interior	Thermal absorptance of visible radiation on the interior surface.	Numeric		$\geq 0$		

## Subsurface

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Name	Description	Data Type	Units	Range	Req	Notes
<code>id</code>	Scope-unique reference identifier for instances of this data group	<code>ID</code>			✓	
<code>reporting_name</code>	Descriptive name used in RCT reports if id is not already a descriptive name	<code>String</code>				
<code>notes</code>	Supplementary information to provide context to the model reviewer	<code>String</code>				
<code>classification</code>	Classification for the subsurface being window, skylight, door.	<code>&lt;SubsurfaceClassificationType&gt;</code>				
<code>subclassification</code>	Standard specific subclassification for subsurfaces	<code>&lt;SubsurfaceSubclassificationType2019ASHRAE901&gt;</code>				
<code>is_operable</code>	Identifies whether window subsurface can be opened and closed including by pivoting or sliding.	<code>Boolean</code>				This applies to windows and skylights but not to doors.
<code>has_open_sensor</code>	Has sensor and reports to building control system when the window or door is open.	<code>Boolean</code>				
<code>framing_type</code>	The material of the framing.	<code>&lt;SubsurfaceFrameType2019ASHRAE901&gt;</code>				This applies to windows and skylights but not to doors.
<code>glazed_area</code>	Area of subsurface including glass and transparent surfaces	<code>Numeric</code>	m2	≥0		
<code>opaque_area</code>	Area of subsurface framing for a window or skylight or opaque portion for a door.	<code>Numeric</code>	m2	≥0		
<code>u_factor</code>	Overall Subsurface U-factor	<code>Numeric</code>	W/m2-K	≥0		Includes interior and exterior air films as specified by the referenced standard.
<code>is_dynamic_glazing</code>	Identifies whether the window subsurface can change it's performance properties	<code>Boolean</code>				
<code>solar_heat_gain_coefficient</code>	Subsurface SHGC	<code>Numeric</code>		≥0		For dynamic glazing represents the minimum SHGC
<code>maximum_solar_heat_gain_coefficient</code>	Maximum Subsurface SHGC for Dynamic Glazing	<code>Numeric</code>		≥0		Only used for dynamic glazing
<code>visible_transmittance</code>	Subsurface VT	<code>Numeric</code>		≥0		For dynamic glazing represents the maximum visible transmittance
<code>minimum_visible_transmittance</code>	Minimum Subsurface VT for Dynamic Glazing	<code>Numeric</code>		≥0		Only used for dynamic glazing
<code>depth_of_overhang</code>	Distance from the edge of the overhang to the subsurface.	<code>Numeric</code>	m	≥0		

Name	Description	Data Type	Units	Range	Req	Notes
has_shading_overhang	Identifies whether subsurface has overhangs	Boolean				
has_shading_sidefins	Identifies whether subsurface has sidefins	Boolean				
has_manual_interior_shades	Are there manually-operated interior shading such as blinds, curtains or shades	Boolean				
solar_transmittance_multiplier_summer	Solar transmittance multiplier for summer	Numeric		≥0		Often used to account for interior shading such as drapes.
solar_transmittance_multiplier_winter	Solar transmittance multiplier for summer	Numeric		≥0		Often used to account for interior shading such as drapes.
has_automatic_shades	Are there automatic interior shading such as blinds, curtains or shades	Boolean				

# InteriorLighting

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Name	Description	Data Type	Units	Range	Req	Notes
<code>id</code>	Scope-unique reference identifier for instances of this data group	<code>ID</code>			✓	
<code>reporting_name</code>	Descriptive name used in RCT reports if id is not already a descriptive name	<code>String</code>				
<code>notes</code>	Supplementary information to provide context to the model reviewer	<code>String</code>				
<code>purpose_type</code>	Lighting space type classification	<code>&lt;LightingPurposeType2019ASHRAE901&gt;</code>				The enumeration is based on the standard used.
<code>power_per_area</code>	Total power for lights divided by the area of the space.	<code>Numeric</code>	W/m2			When computing the power per area use the area of the entire space.
<code>lighting_multiplier_schedule</code>	Reference to the schedule containing the multiplier for lighting	<code>\$ID</code>			✓	
<code>occupancy_control_type</code>	Indicates the type of occupancy controls	<code>&lt;LightingOccupancyControlType&gt;</code>				
<code>daylighting_control_type</code>	Indicates the type of daylighting controls	<code>&lt;LightingDaylightingControlType&gt;</code>				
<code>are_schedules_used_for_modeling_occupancy_control</code>	Indicates that schedule values are used for modeling the impacts of occupancy controls on lighting.	<code>Boolean</code>				
<code>are_schedules_used_for_modeling_daylighting_control</code>	Indicates that schedule values are used for modeling the impacts of daylighting controls on lighting.	<code>Boolean</code>				For simulations that are modeling daylighting by computing the illuminance this should be false.

## MiscellaneousEquipment

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
energy_type	Source of energy for the miscellaneous equipment in the space	<EnergySourceTypeOptions>				
peak_usage	Peak energy usage per hour by the miscellaneous equipment in the space.	Numeric	W			
multiplier_schedule	Referenced to the schedule containing the multiplier for the miscellaneous equipment	\$ID			✓	
sensible_fraction	Fraction of energy that is a sensible load on the space.	Numeric		≥0, ≤1		Sensible plus latent do not necessarily add up to 1.0.
latent_fraction	Fraction of energy that is a latent load on the space.	Numeric		≥0, ≤1		Sensible plus latent do not necessarily add up to 1.0.
miscellaneous_equipment_type	Type of miscellaneous equipment	<MiscellaneousEquipmentType>				
has_automatic_control	Indicates that the receptacles have automatic controls	Boolean				

# Transformer

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
type	The type of transformer	<TransformerType>				
phase	The number of electrical phases	<ElectricalPhase>				
efficiency	Transformer efficiency	Numeric		≥0, ≤1		Expresses the efficiency of the transformer as a fraction from 0 to 1, where 1 would represent 100% efficiency.
capacity	Rated Capacity of the Transformer	Numeric	V-A	≥0		
peak_load	Annual Peak electric load on the transformer	Numeric	W	≥0		Peak electric load on the transformer based on an annual simulation with typical weather file.

## Schedule

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Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
purpose	The purpose of schedule	String				Describe the purpose of the schedule and how it can be used. Not an enumerations. The purpose assigned by BEM tool should match across RMRs. Examples include thermostat, multiplier for lighting, availability for equipment.
schedule_sequence_type	Schedule sequence type	<ScheduleSequenceTypeOptions>				
hourly_values	Hourly Values of Schedule	[Numeric] [8760]				Used when schedule_sequence_type is HOURLY. Can also use functions like EFLH(), MAX(), MIN() to determine overall characteristics for the list of schedule values.
event_times	Event times when the schedule changes	[Numeric]	s			Used when schedule_sequence_type is EVENT to describe the time of the year in seconds that the schedule changes value.
event_values	Event value at corresponding event time.	[Numeric]				Used when schedule_sequence_type is EVENT. New values starting at corresponding to the event time until following event time minus one second. Can also use functions like EFLH(), MAX(), MIN() to determine overall characteristics for the list of schedule values.
type	The type of schedule	<ScheduleTypeOptions>				Primarily indicates if the values may be represented by units such as C for temperature or W for power or m3/s for flow rate or are dimensionless multipliers.
prescribed_schedule	True if any schedule values have changed from what appears in the schedule library	<PrescribedSchedules2019ASHRAE901>				
is_schedule_modified_for_workaround	True if any schedule has been modified for a workaround	Boolean				

# Calendar

Name	Description	Data Type	Units	Range	Req	Notes
notes	Supplementary information to provide context to the model reviewer	String				
day_of_week_for_january_1	Day of the week for January 1	<DayOfWeek>				
is_leap_year	The schedules assume it is a leap year	Boolean				
has_daylight_saving_time	The schedules adjust for Daylight Saving Time	Boolean				

## Weather

Name	Description	Data Type	Units	Range	Req	Notes
notes	Supplementary information to provide context to the model reviewer	String				
monthly_ground_temperature	Modeled monthly ground temperatures	[Numeric][1..12]	C			For annual ground temperatures provide 12 equal numbers
weather_file_name	The file name for the weather file including extension.	String				The file name for the annual weather file such as from TMY, TRY, CWEC, CTZ, WYEC or other sources.
climate_zone	The designation of the climate zone where the building is located	<ClimateZone2019ASHRAE901>			✓	The enumeration is based on the standard used.
cooling_design_day_type	The frequency of occurrence type for cooling design day	<CoolingDesignDayTypeOptions>				
heating_design_day_type	The frequency of occurrence type for heating design day	<HeatingDesignDayTypeOptions>				

## Elevator

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
motor_power	Elevator peak motor power	Numeric	W			The motor power can be provided either together with or, instead of, the detailed elements used to calculate it.
cab_counterweight	Elevator car counterweight	Numeric	kg			
cab_weight	Weight of elevator car	Numeric	kg			
design_elevator_load	Elevator load at which to operate	Numeric	kg			
speed	Design speed of the elevator	Numeric	m/s			
cab_area	Floor area of elevator cab	Numeric	m2			
cab_lighting_power	Lighting power of cab	Numeric	W			
cab_ventilation_fan_power	Ventilation fan power of cab	Numeric	W			
cab_ventilation_fan_flow	Airflow of cab ventfan	Numeric	L/s			
cab_motor_multiplier_schedule	Elevator motor operation multiplier schedule name	\$ID				
cab_ventilation_fan_multiplier_schedule	Elevator ventilation fan operation multiplier schedule name	\$ID				
cab_lighting_multiplier_schedule	Elevator lighting multiplier schedule name	\$ID				

# HeatingVentilationAirConditioningSystem



Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
zones_served	List of the zones served by the HVAC system	[{Zone}]				
fan_systems	List of fan systems	[{FanSystem}]				JG to verify if used in test case description.
air_terminals	List of air terminals	[{AirTerminal}]				JG to verify if used in test case description.
heating_system_type	Heating system type	<HeatingSystemType>				JG to verify if used in test case description.
hot_water_loop	Referenced to the hot water fluid loop	\$ID				
heating_coil_setpoint	Setpoint of the air leaving the heating coil	Numeric	C			JG to verify if used in test case description.
heating_package	Furnace or heating portion of the heat pump	{HeatingPackage}				JG to verify if used in test case description.
cooling_system_type	Cooling system type	<CoolingSystemType>				JG to verify if used in test case description.
chilled_water_loop	Referenced to the Chilled water fluid loop	\$ID				
condenser_water_loop	Referenced to the Condenser water fluid loop	\$ID				
cooling_direct_expansion	Direct expansion cooling or cooling portion of the heat pump	{CoolingDirectExpansion}				JG to verify if used in test case description.
preheat_loop	Referenced to the Preheat fluid loop	\$ID				
reheat_loop	Referenced to the reheat fluid loop	\$ID				
peak_cooling_load	Peak cooling load	Numeric	W	≥0		JG to verify if used in test case description.
peak_heating_load	Peak cooling load	Numeric	W	≥0		JG to verify if used in test case description.
total_cool_capacity	Total cooling capacity	[Numeric]	W/m2	≥0		JG to verify if used in test case description.
sensible_cool_capacity	Sensible cooling capacity	[Numeric]	W/m2	≥0		May be design value or result from the simulation. If multiple values are provided, they correspond to rotated building orientations

Name	Description	Data Type	Units	Range	Req	Notes
heat_capacity	Heating capacity	[Numeric]	W/m2	≥0		May be design value or result from the simulation. If multiple values are provided, they correspond to rotated building orientations
dehumidification_type	Dehumidification type	<DehumidificationType>				JG to verify if used in test case description.
humidification_type	Humidification type	<HumidificationType>				JG to verify if used in test case description.
cooling_turndown_ratio	Cooling turndown ratio	Numeric				Cooling capacity turndown before simultaneous heating and cooling occurs. JG to verify if used in test case description.
does_serve_computer_room	Determines whether a computer room is served by the system	Boolean				JG to verify if used in test case description.
does_serve_zone_with_refrigerator_cases	Determines whether a zone with refrigeration cases is served by the system	Boolean				JG to verify if used in test case description.

## HeatingPackage

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
full_load_efficiency	Full Low Efficiency expressed as a coefficient of performance or thermal efficiency	Numeric	W/W			JG to verify if used in test case description.
part_load_efficiency	Efficiency value based on the selected part_load_efficiency_metric	Numeric		≥0, ≤1		JG to verify if used in test case description.
heatpump_auxilliary_heat_type	Heatpump auxilliary heat type	<HeatpumpAuxilliaryHeatType>				JG to verify if used in test case description.
heatpump_auxilliary_heat_high_temperature_shutoff	Heatpump auxilliary heat high temperature shutoff	Numeric	C			JG to verify if used in test case description.
heatpump_low_temperature_shutoff	Heatpump low temperature shutoff	Numeric	C			JG to verify if used in test case description.

## CoolingPackage

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
full_load_efficiency	Full Low Efficiency expressed as a coefficient of performance (COP)	Numeric	W/W			JG to verify if used in test case description.
part_load_efficiency	Efficiency value based on the selected part_load_efficiency_metric	Numeric		≥0, ≤1		JG to verify if used in test case description.

# FanSystem

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Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
purpose_type	Purpose of the fan system	<FanSystemPurposeType>				JG to verify if used in test case description.
is_multi_zone	If the fan system serves multiple zones	Boolean				JG to verify if used in test case description.
is_variable_air_volume	If the fan system is variable air volume.	Boolean				JG to verify if used in test case description.
temperature_control	Supply air temperature control type	<FanSystemTemperatureControlType>				JG to verify if used in test case description.
supply_air_temperature_setpoint	Supply air temperature setpoint temperarue	Numeric	C			JG to verify if used in test case description.
reset_differential_temperature	Supply air temperature reset differential temperature at minimum cooling load	Numeric	C			JG to verify if used in test case description.
supply_air_temperature_reset_schedule	Supply air temperature reset schedule	\$ID				JG to verify if used in test case description.
operating_schedule	Operating schedule name	\$ID				Zero when fan is off. JG to verify if used in test case description.
airflow	Design supply airflow	Numeric	L/s			JG to verify if used in test case description.
power	Design supply fan power	Numeric	W			JG to verify if used in test case description.
fan_power_adjustment_factor	Fan power adjustment factor	Numeric				JG to verify if used in test case description.
motor_efficiency	Fan motor efficiency	Numeric	W			JG to verify if used in test case description.
fan_control	Supply fan control type	<FanSystemSupplyFanControlType>				JG to verify if used in test case description.
minimum_airflow	Minimum volume airflow	Numeric	L/s			JG to verify if used in test case description.
minimum_outdoor_airflow	Minimum outdoor air volume airflow	Numeric	L/s			JG to verify if used in test case description.
maximum_outdoor_airflow	Maximum outdoor air volume airflow	Numeric	L/s			JG to verify if used in test case description.
air_economizer_type	Air economizer type	<AirEconomizerType>				JG to verify if used in test case description.

Name	Description	Data Type	Units	Range	Req	Notes
economizer_high_limit_temperature_shutoff	Economizer high limit temperature shutoff	Numeric	C			JG to verify if used in test case description.
has_gas_phase_air_cleaning	True if the fan system includes gas phase air cleaning	Boolean				JG to verify if used in test case description.
energy_recovery_type	Energy recovery type	<EnergyRecoveryType>				JG to verify if used in test case description.
enthalpy_recovery_ratio	Enthalpy recovery ratio	Numeric				JG to verify if used in test case description.
energy_recovery_operation	Energy recovery operation	<EnergyRecoveryOperation>				JG to verify if used in test case description.
energy_recovery_supply_air_temperature_control	Energy recovery supply air temperature control	<EnergyRecoverySupplyAirTemperatureControl>				JG to verify if used in test case description.
economizer_design_sensible_effectiveness	Economizer design sensible effectiveness	Numeric				JG to verify if used in test case description.
economizer_design_latent_effectiveness	Economizer design latent effectiveness	Numeric				JG to verify if used in test case description.
demand_control_ventilation_control_type	Demand control ventilation control type	<DemandControlVentilationControlType>				JG to verify if used in test case description.
supply_air_to_room_air_humidity_ratio	Supply air to room air humidity ratio	Numeric				JG to verify if used in test case description.

# AirTerminal

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
type	Type of air terminal	<AirTerminalType>				JG to verify if used in test case description.
reheat_source	Source of reheat	<ReheatSourceType>				JG to verify if used in test case description.
fan_power	Fan powered box fan power	Numeric	W			JG to verify if used in test case description.
primary_airflow	Zone terminal primary airflow	Numeric	L/s			JG to verify if used in test case description.
secondary_airflow	Zone terminal secondary airflow	Numeric	L/s			JG to verify if used in test case description.
supply_temperature_setpoint	Zone terminal supply temperature setpoint	Numeric	C			JG to verify if used in test case description.
minimum_airflow	Zone terminal minimum volume airflow	Numeric	L/s			JG to verify if used in test case description.
minimum_outdoor_airflow	Zone terminal minimum outdoor air volume airflow	Numeric	L/s			JG to verify if used in test case description.
minimum_outdoor_airflow_multiplier_schedule	Zone terminal minimum outdoor air volume airflow multiplier schedule name	\$ID				JG to verify if used in test case description.

# FluidLoop

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Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
type	Type of loop	<FluidLoopTypeOptions>				
pump_power_per_flow_rate	Total design pump power divided by the loop design flow rate	Numeric	W/s-L			This is the pump power per flow rate for the entire pumping system on the current FluidLoop. The power and flow rate should be for the current FluidLoop only and does not include power and flow rate in any child loops.
child_loops	Other fluid loops connected to this one as children.	[{FluidLoop}]				Secondary loops should be described as child loops.
cooling_or_condensing_design_and_control		{FluidLoopDesignAndControl}				
heating_design_and_control		{FluidLoopDesignAndControl}				

# FluidLoopDesignAndControl

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
design_supply_temperature	Design Supply Temperature	Numeric	C			
design_return_temperature	Design Return Temperature	Numeric	C			
is_sized_using_coincident_load	True if the loop is sized based on coincident load	Boolean				
minimum_flow_fraction	Minimum fraction of full flow allowed	Numeric				
operation	Type of operation used by loop	<FluidLoopOperationOptions>				
flow_control	Flow control options	<FluidLoopFlowControlOptions>				
temperature_reset_type	Type of temperature reset used by loop	<TemperatureResetTypeOptions>				
outdoor_high_for_loop_supply_temperature_reset	Outdoor high for loop supply temp reset	Numeric	C			
outdoor_low_for_loop_supply_temperature_reset	Outdoor low for loop supply temp reset	Numeric	C			
loop_supply_temperature_at_outdoor_high	Loop supply temperature at outdoor high temperature	Numeric	C			
loop_supply_temperature_at_outdoor_low	Loop supply temperature at outdoor low temperature	Numeric	C			

# Pump

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
loop	Referenced to the fluid loop	\$ID			✓	
specification_method	Options for how the pump is specified	<PumpSpecificationMethodOptions>				
design_electric_power	Pump design electric power	Numeric	W			Pump electric power at design conditions. Only used when specification_method is set to Simple
motor_nameplate_power	Pump motor nameplate power	Numeric	W			Only used when specification_method is set to Detailed
design_head	Head of the pump at design flow conditions	Numeric	m			Only used when specification_method is set to Detailed
impeller_efficiency	Full load efficiency of the impeller	Numeric		≥0, ≤1		Only used when specification_method is set to Detailed
motor_efficiency	Full load efficiency of the pump motor	Numeric		≥0, ≤1		Only used when specification_method is set to Detailed
speed_control	Options for pump speed control	<PumpSpeedControlOptions>				
design_flow	Design Pump Flowrate	Numeric	L/s			
is_flow_autosized	True if the design_flow is autosized	Boolean				
is_variable_speed	True if variable speed drive such a VFD	Boolean				

# Boiler



Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
loop	Referenced to the fluid loop	\$ID			✓	
design_capacity	Heating capacity	Numeric	W			
rated_capacity	Heating capacity	Numeric	W			At rating conditions.
minimum_load_ratio	Minimum fraction of full load allowed	Numeric				
draft_type	Combustion option	<BoilerCombustionOptions>				
energy_source_type	Source of energy for the boiler	<EnergySourceTypeOptions>				
efficiency_metric	The type of efficiency metric used	<BoilerEfficiencyMetricTypeOptions>				
efficiency	Efficiency value based on the selected efficiency_metric	Numeric		≥0, ≤1		
output_validation_points	Energy validation points	[[BoilerOutputValidationPoint]]				Load is input to each validation point and energy output is the result. A minimum number of four points is recommended.
auxiliary_power	Auxiliary power	Numeric	W			Power for boiler pump, combustion fan, or other auxiliary that operates when boiler operates.
operation_lower_limit	Heating load range operation, lower limit	Numeric	W			
operation_upper_limit	Heating load range operation, upper limit	Numeric	W			

## BoilerOutputValidationPoint

Name	Description	Data Type	Units	Range	Req	Notes
load	Load	Numeric	W			No name and id is needed since typically used as one of a series.
result	Result	Numeric	W			

## Chiller

Name	Description	Data Type	Units	Range	Req	Notes
<code>id</code>	Scope-unique reference identifier for instances of this data group	<code>ID</code>			✓	
<code>reporting_name</code>	Descriptive name used in RCT reports if id is not already a descriptive name	<code>String</code>				
<code>notes</code>	Supplementary information to provide context to the model reviewer	<code>String</code>				
<code>cooling_loop</code>	Referenced to the cooling fluid loop	<code>\$ID</code>			✓	
<code>condensing_loop</code>	Referenced to the condensing fluid loop	<code>\$ID</code>				No condensing loop name implies air-cooled chiller.
<code>compressor_type</code>	Compressor Type	<code>&lt;ChillerCompressorTypeOptions&gt;</code>				
<code>energy_source_type</code>	Source of energy for the chiller	<code>&lt;EnergySourceTypeOptions&gt;</code>				
<code>design_capacity</code>	Chiller Design Cooling Capacity	<code>Numeric</code>	W			
<code>rated_capacity</code>	Chiller Design Cooling Capacity	<code>Numeric</code>	W			At rating conditions.
<code>minimum_load_ratio</code>	Minimum fraction of full load allowed	<code>Numeric</code>				
<code>design_flow_evaporator</code>	Chiller evaporator design flow	<code>Numeric</code>	L/s			
<code>design_flow_condenser</code>	Chiller condenser design flow	<code>Numeric</code>	L/s			
<code>full_load_efficiency</code>	Full Low Efficiency expressed as a coefficient of performance (COP)	<code>Numeric</code>	W/W			
<code>part_load_efficiency</code>	Efficiency value based on the selected <code>part_load_efficiency_metric</code>	<code>Numeric</code>		≥0, ≤1		
<code>part_load_efficiency_metric</code>	The type of part load efficiency metric used	<code>&lt;ChillerPartLoadEfficiencyMetricTypeOptions&gt;</code>				
<code>capacity_validation_points</code>	Capacity validation points	<code>[[ChillerCapacityValidationPoint]]</code>				
<code>power_validation_points</code>	Energy validation points	<code>[[ChillerPowerValidationPoint]]</code>				

## ChillerCapacityValidationPoint

Name	Description	Data Type	Units	Range	Req	Notes
<code>chilled_water_supply_temperature</code>	Chilled water supply temperature	<code>Numeric</code>	C			No name and id is needed since used as one of a series. The temperature is leaving the chiller.
<code>condenser_temperature</code>	Second temperature	<code>Numeric</code>	C			Outside air dry-bulb temperature for air cooled chillers and condenser water temperature for water cooled chillers. For water cooled chillers, this is the temperature as the water enters the chiller. For air cooled chillers this the temperature of the ambient air.
<code>result</code>	Result	<code>Numeric</code>	W			

## ChillerPowerValidationPoint

Name	Description	Data Type	Units	Range	Req	Notes
chilled_water_supply_temperature	Chilled water supply temperature	Numeric	C			No name and id is needed since used as one of a series. The temperature is leaving the chiller.
condenser_temperature	Second temperature	Numeric	C			Outside air dry-bulb temperature for air cooled chillers and condenser water temperature for water cooled chillers. For water cooled chillers, this is the temperature as the water enters the chiller. For air cooled chillers this the temperature of the ambient air.
load	Load	Numeric	W			
result	Result	Numeric	W			

## HeatRejection

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
loop	Referenced to the fluid loop	\$ID			✓	
type	Heat Rejection Type	<HeatRejectionTypeOptions>				
fan_type	Heat Rejection Fan Type	<HeatRejectionFanTypeOptions>				
fluid	Fluid Cooled by Heat Rejection	<HeatRejectionFluidOptions>				
range	Heat rejection Range	Numeric	C			
approach	Heat rejection Approach	Numeric	C			
reset_type	Leaving Temperature reset strategy	<HeatRejectionResetOptions>				
minimum_reset_temperature	Minimum leaving temperature setpoint	Numeric	C			
fan_power	Fan Power	Numeric	W			
fan_speed_control	Fan Speed Control Type	<HeatRejectionFanSpeedControlOptions>				
design_supply_temperature	Design leaving water temperature	Numeric	C			
design_wetbulb_temperature	Design wetbulb temperature	Numeric	C			0.4% ASHRAE MCWB
design_water_flowrate	Design condenser water flow rate	Numeric	L/s			
rated_water_flowrate	Rated condenser water flow rate	Numeric	L/s			At rating conditions.

## ExternalFluidSource

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
loop	Referenced to the fluid loop	\$ID			✓	
type	Type of external fluid source	<ExternalFluidSourceTypeOptions>				
energy_source_type	Source of energy for the external fluid source	<EnergySourceTypeOptions>				

# ServiceWaterHeatingSystem

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Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
area_type	Service Water Heating Loop Area Type	<ServiceWaterHeatingSpaceType2019ASHRAE901>				The enumeration is based on the standard used.
design_flow	Design Flowrate of service water heating loop	Numeric	L/s			
supply_temperature	Design supply temperature setpoint of service water heating loop	Numeric	C			
flow_multiplier_schedule	service water heating Loop flow multiplier schedule name	\$ID				
annual_entering_water_temperature	Annual service main or annual ground temperature used for service water heating calculations entering water temperature degrees	Numeric	C			
monthly_entering_water_temperature	Monthly service main or ground temperatures used for service water heating entering water temperature degrees	[Numeric][1..12]	C			Arrayed variable with 12 values for monthly entering water temperature
entering_water_temperature_type	Method of determining service water heating entering water temperature	<ServiceWaterHeatingEnteringWaterTemperatureInputOptions>				
heater	Referenced to the service water heater	\$ID			✓	
heater_fuel_type	Service water heating heater fuel type	<EnergySourceTypeOptions>				
heater_efficiency	Service water heating heater efficiency	Numeric		≥0		

# ExteriorLighting

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
type	The type of exterior lighting fixture none	<ExteriorLightingAreas2019ASHRAE901TableG36>				
area	Area of the exterior functional space.	Numeric	m2	>0		
nominal_wattage	Nominal capacity of exterior lighting fixtures	Numeric	W	>0		
fixture_height	Installation height of exterior fixture	Numeric	m	>0		
trade_light_power	Exterior Lighting power for tradable surface	Numeric	W	≥0		Note that the sum of trade_light_power and non_trade_light_power should be the total exterior lighting power.
non_trade_light_power	Exterior Lighting power for non-tradable surface	Numeric	W	≥0		Note that the sum of trade_light_power and non_trade_light_power should be the total exterior lighting power.
site_zone_type	Site zone type for Sec 9.4.2	<ExteriorLightingZones2019ASHRAE901>				
parking_area	Area of exterior parking space	Numeric	m2	≥0		
tradable_surface_type	Type of tradable surfaces for exterior lighting	<ExteriorLightingAreas2019ASHRAE901TableG36>				
tradable_surface_area	Area of tradable surface	Numeric	m2	≥0		
tradable_surface_linear	Linear length of tradable surface	Numeric	m	≥0		
has_walkway	If the building has an exterior walkway	Boolean				
tradable_walkway_width	Width of the exterior walkway	Numeric	m	≥0		
tradable_opening_width	Width of an exterior opening	Numeric	m	≥0		
multiplier	Multiplier for exterior lighting specifications	Numeric		>0		

# Refrigeration

Name	Description	Data Type	Units	Range	Req	Notes
id	Scope-unique reference identifier for instances of this data group	ID			✓	
reporting_name	Descriptive name used in RCT reports if id is not already a descriptive name	String				
notes	Supplementary information to provide context to the model reviewer	String				
type	Refrigeration equipment type	<RefrigerationType2019ASHRAE901>				
equipment_class	Equipment Class from referenced standard	<RefrigerationClass2019ASHRAE901>				
energy_per_day	Rated electrical energy use per day	Numeric	kWh			
case_volume	volume of a refrigerated case in cubic meters	Numeric	m3			
total_display_area	display area of a refrigerated case in square meters	Numeric	m2			

## OverallSimulationOutputs

Name	Description	Data Type	Units	Range	Req	Notes
<code>id</code>	Scope-unique reference identifier for instances of this data group	<code>ID</code>			✓	
<code>reporting_name</code>	Descriptive name used in RCT reports if id is not already a descriptive name	<code>String</code>				
<code>notes</code>	Supplementary information to provide context to the model reviewer	<code>String</code>				
<code>refrigeration_energy_enduse</code>	Annual refrigeration energy end use from simulation output	<code>Numeric</code>	kWh			
<code>service_water_heating_annual_enduse_electricity</code>	Annual electricity energy end_use for SWH loops	<code>Numeric</code>	kWh	≥0		
<code>service_water_heating_annual_enduse_fossilfuel</code>	Annual fossil fuel energy end_use for SWH loops	<code>Numeric</code>	J	≥0		
<code>unmet_heating_load_hours</code>	total hours any HVAC Zone heating temperature setpoint not met	<code>Numeric</code>	J	≥0		JG to verify if used in test case description.
<code>unmet_cooling_load_hours</code>	total hours any HVAC Zone cooling temperature setpoint not met	<code>Numeric</code>	J	≥0		JG to verify if used in test case description.