TYPE 756: RESIDENTIAL COOLING COIL (AIR CONDITIONER) WITH UNIFIED DATA FORMAT

General Description

Type756 models a residential cooling coil, more commonly known as a residential air conditioner. It relies on catalog data provided in an external text file to determine coil performance. An example data file and information on data file format are provided. This component is functionally identical to the Type651 residential cooling coil except that Type651 requires a different data file format. Depending upon the source of data, this component or Type651 may be the more appropriate version.

Nomenclature

$T_{evap,in}$	[ºC]	Temperature of air entering the evaporator side of the coil
$h_{evap,in}$	[kJ/kg]	Enthalpy of air exiting the evaporator side of the coil
$\omega_{evap,in}$	[kgH_2O/kgAir]	Humidity ratio of air entering the evaporator side of the coil
$P_{evap,in}$	[atm]	Pressure of air entering the evaporator side of the coil
$T_{evap,out}$	[ºC]	Temperature of air exiting the evaporator side of the coil
$h_{evap,out}$	[kJ/kg]	Enthalpy of air entering the evaporator side of the coil
$\omega_{evap,out}$	[kgH_2O/kgAir]	Humidity ratio of air exiting the evaporator side of the coil
$P_{evap,out}$	[atm]	Pressure of air exiting the evaporator side of the coil
$\dot{Q}_{total}$	[kJ/hr]	Rate of total energy transferred by the coil
$\dot{Q}_{sensible}$	[kJ/hr]	Rate of sensible energy transferred by the coil
$\dot{Q}_{rejected}$	[kJ/hr]	Rate of energy rejected by the coil to ambient
$\dot{m}_{evap}$	[kg/hr]	Flow rate of air on the evaporator side of the coil
$\dot{m}_{condensate}$	[kg/hr]	Mass flow rate of condensate exiting the coil
Cp_{air}	[kJ/kg.K]	Specific heat of dry air
ΔP_{evap}	[atm]	Pressure drop across the evaporator side of the coil
COP	[-]	Coil Coefficient of Performance
Pwr_{total}	[kJ/hr]	Total power draw by the air conditioner (residential cooling coil)
EER	[-]	Energy Efficiency Rating of the coil

Detailed Description

Type756 relies on a catalog data lookup method to predict the performance of residential air conditioning devices. The user must provide a single text based data files in the standard TRNSYS data file format. The file must provide the air conditioner's total cooling capacity (in kW), sensible cooling capacity (in kW) and power draw (in W) for varying values of evaporator air flow rates (in liters per second), for varying indoor air wet bulb temperatures (in ºC) for varying condenser temperatures (in ºC). and for varying values of indoor dry bulb temperature (in ºC).

Type756 first performs a call to the TRNSYS Psychrometrics routine in order to obtain the remaining air properties that are not specified by the user among the component's inputs. If indoor dry bulb temperature and humidity ratio are inputs to the model and a humidity ratio higher than the saturation humidity ratio for that dry bulb temperature is specified, the psychrometrics routine will reset the humidity ratio to its saturated condition and print a warning in the TRNSYS list file. Having fully defined the entering indoor air state, Type756 next determines the volumetric flow rate of evaporator air using the mass flow rate specified by the user and the dry air density returned by the psychrometrics routine. It then calls the TRNSYS Data Reading routine, which reads the data file and returns total cooling capacity, sensible cooling capacity, and total power draw. The TRNSYS Data Reading routine is able to interpolate the three dependent variables (power draw, total and sensible cooling capacity) in all four dimensions of the independent variables (evaporator inlet dry and wet bulb temperatures, condenser inlet dry bulb temperature, and evaporator volumetric flow rate). It cannot, however extrapolate beyond the range of data given in the data file. If a independent variable value outside the data file range is specified, the Data Reading routine will return the corresponding maximum or minimum dependent variable values and will print a warning to the TRNSYS list and simulation log files.

The outlet conditions of the evaporator side air stream are calculated using Equations 756.1a, 756.1b, and 756.1c,

$$h_{evap,out} = h_{evap,in} - \frac{\dot{Q}_{total}}{\dot{m}_{evap}} \quad \text{(Eq. 756.1a)}$$

$$T_{evap,out} = T_{evap,in} - \frac{\dot{Q}_{sensible}}{\dot{m}_{evap} Cp_{air}} \quad \text{(Eq. 756.1b)}$$

$$P_{evap,out} = P_{evap,in} - \Delta P_{evap} \quad \text{(Eq. 756.1c)}$$

The total power draw of the air conditioner, as specified in the data file is assumed to include controller power draw, blower power draw and compressor power draw. Both controller and blower power draw are requested as inputs to the model; the compressor power is simply the difference between the power read from the data file and the combined blower and controller power. The heat rejection of the device (the rate at which heat is rejected from the device to the ambient is calculated using Equation 756.2

$$\dot{Q}_{rejected} = \dot{Q}_{total} + Pwr_{total} \quad \text{(Eq. 756.2)}$$

The COP (coefficient of performance) and EER (energy efficiency rating) are therefore:

$$COP = \frac{\dot{Q}_{total}}{Pwr_{total}} \quad \text{(Eq. 756.3)}$$

$$EER = COP * 3.413 \quad \text{(Eq. 756.4)}$$

The amount of moisture removed from the evaporator air stream leaves the device via a condensate stream whose fluid temperature is that of the air exiting the evaporator and whose flow rate is given by Equations 756.5.

$$\dot{m}_{condensate} = \dot{m}_{evap}\left(\omega_{evap,in} - \omega_{evap,out}\right) \quad \text{(Eq. 756.5)}$$

Example data files are provided in the following directory:

\trnsys16\Tess Models\SampleCatalogData\UnitaryAirConditioner\UnifiedFileFormat\.

The format of the data files is shown below for reference.

Example of a **PARTIAL** Cooling Capacity Data File

```
378    472                                          !evaporator flow rates [l/s]
29.44  35.00  40.56  46.11  51.67                   !condenser inlet dry bulb temperature [C]
13.89  16.67  19.44  22.22                          !evaporator inlet wet bulb temperature [C]
20.00  21.67  23.33  25.00  26.67  28.33  30.00     !evaporator inlet dry bulb temperature [C]
7.09    4.37   1.96     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/13.89/20.00
7.09    5.04   1.96     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/13.89/21.67
7.09    5.74   1.96     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/13.89/23.33
7.09    6.42   1.96     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/13.89/25.00
7.09    7.09   1.96     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/13.89/26.67
7.09    7.09   1.96     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/13.89/28.33
7.09    7.09   1.96     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/13.89/30.00
7.21    3.81   1.98     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/16.67/20.00
7.21    4.48   1.98     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/16.67/21.67
7.21    5.19   1.98     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/16.67/23.33
7.21    5.86   1.98     !tot. cap. [kW], sens. cap. [kW] and power draw [W] at 378/29.44/16.67/25.00
7.21    6.54   1.98     !etc.
7.21    7.21   1.98
7.21    7.21   1.98
7.82    2.55   1.98
7.82    3.22   1.98
7.82    3.93   1.98
7.82    4.60   1.98
7.82    5.28   1.98
7.82    5.98   1.98
7.82    6.65   1.98
8.41    0.00   2.23
...
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