TYPE 692: PERFORMANCE MAP FLUID COOLER

General Description

Type692 models a simple fluid cooling device. The model relies on an external, user-supplied data file that contains device capacity and COP as a function of the inlet fluid temperature and a sink temperature.

Nomenclature

$\dot{m}$	[kg/hr]	The mass flow rate of fluid entering the cooling device
$\dot{Q}_{need}$	[kJ/hr]	The amount of energy required to bring the fluid from its inlet temperature to the set point temperature.
$\dot{Q}_{fluid}$	[kJ/hr]	The amount of energy that is removed from the fluid stream
$\dot{Q}_{rej}$	[kJ/hr]	The amount of energy rejected to the device temperature sink.
Cp	[kJ/kg.K]	The specific heat of fluid in the cooling device
T_{in}	[ºC]	The temperature of fluid entering the cooling device
T_{set}	[ºC]	The set point temperature of the cooling device.
T_{out}	[ºC]	The outlet temperature of the cooling device.
Cap	[kJ/hr]	The capacity of the cooling device.
$\dot{P}$	[kJ/hr]	The power drawn b the cooling device.
COP	[-]	The cooling device coefficient of performance.

Detailed Description

No Flow Condition

If fluid is not flowing through the cooling device or if the temperature of fluid entering the device is already lower than the device set point temperature, Type692 sets the outlet fluid temperature to the inlet temperature and sets the device capacity, COP, energy rejected, energy removed from the fluid and power drawn by the device to zero.

Flow Condition

If fluid is flowing through the cooling device and the entering fluid temperature is greater than the set point temperature, Type692 calls the TRNSYS Data routine to determine the basis of the device performance. The performance data for the device must therefore be provided in an external data file that contains two lines of independent variable values. The first line must contain at least one value of entering fluid temperature (specified in ºC) and the second line must contain at least one value of the device sink temperature (also specified in ºC). The subsequent lines of the data file must each contain two values: device capacity (in kJ/hr) and device COP. Based on the user specified inlet and sink temperatures, Type692 calls the TRNSYS Data routine, which returns the current device capacity and COP. As with all queries to the Data routine, Data is able to linearly interpolate in multiple dimensions between the values present in the data file. It is not, however, able to extrapolate beyond the data range

specified in the file. If a value above or below a given range is sent to the Data routine, Data will return the corresponding value at the end of its range and will print a warning to the list file and simulation log file. For more information on the TRNSYS Data routine please refer to the TRNSYS Main Manual.

Upon returning from the Data query, Type692 calculates the amount of energy that must be removed from the fluid stream in order to bring it from its inlet temperature to the set point temperature using equation 692.1

$$\dot{Q}_{need} = \dot{m}\, Cp\left(T_{in} - T_{set}\right) \quad \text{(Eq. 692.1)}$$

A check is next made to determine whether or not the necessary energy exceeds the device capacity. The energy that is able to be removed from the fluid is then

$$\dot{Q}_{fluid} = MIN\left(Cap, \dot{Q}_{need}\right) \quad \text{(Eq. 692.2)}$$

If the energy required does not exceed the device capacity, fluid exits the device at the set point temperature. If, on the other hand, the required energy does exceed device capacity. The fluid outlet temperature is given by equation 692.3

$$T_{out} = T_{in} - \frac{Cap}{\dot{m}\, Cp} \quad \text{(Eq. 692.3)}$$

The power drawn by the device when operating is given by equation 692.4.

$$\dot{P} = \frac{\dot{Q}_{fluid}}{COP} \quad \text{(Eq. 692.4)}$$

The energy that must be rejected to the temperature sink by the device is given by equation 692.5. It is assumed that the Type692 temperature sink is infinite. Therefore the energy rejected to the sink does not affect the sink temperature in any way.

$$\dot{Q}_{rej} = \dot{Q}_{fluid} + \dot{P} \quad \text{(Eq. 692.5)}$$