# GBES Heat Pump Terminology

## SEER, EER, HSPF, & COP

Heat Pumps are basically Air Conditioners that operate in a cooling and heating mode using a refrigerant in a compression cycle to move heat into and out of a building enclosure. The terminology about unit efficiencies can become confusing when you are talking about A/C efficiency, Heating efficiency or combined efficiency of either Residential or Commercial units.

**SEER** & **EER** are related to the cooling side of a heat pump and **HSPF** & **COP** are related to the heating side of a heat pump. The values for SEER & HSPF are averages for an entire season, while EER & COP values are instantaneous values at a given outdoor temperature.

**SEER (Seasonal Energy Efficiency Ratio)** is the measurement of how efficient a residential central cooling system (air conditioner or heat pump in the cooling mode) will operate over a typical cooling season. A higher rating means a more efficient system. Each 1-point increase in the SEER rating is a 10% increase in efficiency. SEER ratings are a maximum efficiency rating, like a car having 28 MPG on the highway, but if there's traffic, that number can be lower. SEER ratings can be determined by the number of BTUs in the cooling season by the number of watt-hours used in that same cooling season. This formula is represented as:

$$SEER = \frac{BTUs\ of\ cooling\ season}{Watt - hours\ of\ cooling\ season}$$

**EER (Energy Efficiency Ratio)** is the measurement of how efficient a cooling system will operate at 80°F at 50% relative humidity indoors and 95°F outdoors. The higher the EER means a more efficient system. The difference between EER and SEER is that EER is calculated at one temperature as opposed to being calculated across an entire season. The formula is represented as:

$$EER = \frac{\frac{BTU}{hr}\ of\ cooling\ at\ 95°}{Watts\ used\ at\ 95°}$$

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**HSPF (Heating Seasonal Performance Factor)** is the measurement of how efficient all residential and some commercial heat pumps will operate in their heating mode over an entire normal heating season. A higher HSPF means a more efficient system. HSPF is determined by dividing the total number of BTUs of heat produced over the heating season by the total number of watt-hours of electricity that is required to produce that heat. The formula is represented as:

$$HSPF = \frac{BTUs\ of\ heat\ produced\ over\ the\ heating\ season}{Total\ number\ of\ Watt-hours\ of\ electricity\ used\ over\ the\ heating\ season}$$

**COP (Coefficient of Performance)** is the measurement of how efficient a heating or cooling system will operate at a single outdoor temperature condition. A higher COP means a more efficient system. COP can be calculated by two methods. One, the BTU of heat produced by the heat pump divided by the BTU equivalent of electricity that is required to produce that heat. The formula is shown as:

$$COP = \frac{BTUs\ of\ heat\ produced\ at\ 47°F}{BTUs\ worth\ of\ electricity\ used\ at\ 47°F}$$

The second method determines the chiller efficiency. Divide 3.516 by the number of kilowatts per ton used by the system. This formula is shown as:

$$COP = \frac{3.516\ (1\frac{ton}{kW})}{number\ of\ kW\ per\ ton\ used\ by\ the\ system}$$