

# Efficient HVAC Systems

Conversion Factors for units and separators



# Conversion factors for units, prefixes and separators for decimals and thousands

## Conventions for separators in this course

- Separators for decimals: '.' (point)  
*Example: 32.6 means thirty-two point 6*
- Separators for thousands: thin space or no space  
*Example: both 32600 and 32 600 mean thirty-two thousand six hundred*

## SI Prefixes

Factor	Name	Symbol
$10^{15}$	peta	P
$10^{12}$	tera	T
$10^9$	giga	G
$10^6$	mega	M
$10^3$	kilo	k
$10^{-3}$	milli	m
$10^{-6}$	micro	$\mu$
$10^{-9}$	nano	n

## Units

Units: See for instance

- [https://www.engineeringtoolbox.com/unit-converter-d\\_185.html](https://www.engineeringtoolbox.com/unit-converter-d_185.html)

- [Unit conversion factors](#) (pdf) by E.J. Roschke and F.E.C. Culick, California Institute of Technology, 2001

(SI units: in bold underlines below)

## Temperature:

Celsius [ $^{\circ}\text{C}$ ], fahrenheit [ $^{\circ}\text{F}$ ], **kelvin [K]**

- $T_K = T_{^{\circ}\text{C}} + 273.15$
- $T_{^{\circ}\text{C}} = T_K - 273.15$
- $T_{^{\circ}\text{C}} = (T_{^{\circ}\text{F}} - 32)/1.8$
- $T_{^{\circ}\text{F}} = T_{^{\circ}\text{C}} * 1.8 + 32$
- $T_{^{\circ}\text{F}} = (T_K - 273.15) * 1.8 + 32$

Temperature difference:

- $\Delta T_{^{\circ}\text{C}} = \Delta T_K = 1.8 * \Delta T_{^{\circ}\text{F}}$
- $\Delta T_{^{\circ}\text{F}} = \Delta T_{^{\circ}\text{C}} / 1.8 = \Delta T_K / 1.8$
- $\Delta T_K = \Delta T_{^{\circ}\text{C}} = 1.8 * \Delta T_{^{\circ}\text{F}}$

In formula's, K must be used for actual temperatures and K or  $^{\circ}\text{C}$  is used for temperature differences (they are equal).

## Length

foot [ft], inch [in], mile [mile] **metre [m]**

- $1 \text{ m} = 3.28083 \text{ ft} = 39.3701 \text{ in} = 6.2137 \times 10^{-4} \text{ mile}$
- $1 \text{ ft} = 0.3048 \text{ m} = 12 \text{ in} = 1.894 \times 10^{-4} \text{ mile}$
- $1 \text{ in} = 0.0254 \text{ m} = 0.08333 \text{ ft} = 1.578 \times 10^{-5} \text{ mile}$
- $1 \text{ mile} = 1609.3 \text{ m} = 63346 \text{ in} = 5280 \text{ ft}$

## Mass

ounce [oz], pound [lb], **kilogram [kg]**

- $1 \text{ kg} = 2.2046 \text{ lb} = 35.27 \text{ oz}$
- $1 \text{ lb} = 16 \text{ oz} = 0.4536 \text{ kg}$
- $1 \text{ oz} = 28.35 \times 10^{-3} \text{ kg} = 0.0625 \text{ lb}$

## Energy

british thermal unit [Btu] = [BTU], calorie [cal], kiloton oil equivalent [ktoe], **watt hour [Wh], joule [J]**

- $1 \text{ Wh} = 3.6 \times 10^3 \text{ J} = 3600 \text{ J} = 859.9 \text{ cal} = 3.412 \text{ Btu} = 8.598 \times 10^{-5} \text{ ktoe}$
- $1 \text{ J} = 2.778 \times 10^{-4} \text{ Wh} = 0.2390 \times 10^{-4} \text{ cal} = 9.478 \times 10^{-4} \text{ Btu} = 2.388 \times 10^{-17} \text{ ktoe}$
- $1 \text{ Btu} = 251.996 \text{ cal} = 0.29307 \text{ Wh} = 1055.06 \text{ J} = 2.52 \times 10^{-11} \text{ ktoe}$
- $1 \text{ cal} = 4.1868 \text{ J} = 1.163 \times 10^{-3} \text{ Wh} = 3.968 \times 10^{-3} \text{ Btu} = 10^{-13} \text{ cal}$
- $1 \text{ ktoe} = 11.63 \times 10^9 \text{ Wh} = 41.868 \times 10^{12} \text{ J} = 10^{13} \text{ cal} = 39 \text{ 683. 2} \times 10^6 \text{ Btu}$

### Energy flow rate

british thermal unit/hour [Btu/h], british thermal unit/second [Btu/s], calorie/hour [cal/h], **watt [W], joule/second [J]**

$$1 \text{ W} = 1 \text{ J/s} = 859.8 \text{ cal/h} = 3.412 \text{ Btu/h} = 0.948 \text{ Btu/s}$$

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$$1 \text{ cal/h} = 1.163 \times 10^{-3} \text{ W} = 1.163 \times 10^{-3} \text{ J/s} = 3.968 \times 10^{-3} \text{ Btu/h} = 1.102 \times 10^{-3} \text{ Btu/s}$$

$$1 \text{ Btu/s} = 1055.1 \text{ W} = 1055.1 \text{ J/s} = 3600 \text{ Btu/h} = 0.07 \text{ cal/h}$$

$$1 \text{ Btu/h} = 0.2931 \text{ W} = 0.2931 \text{ J/s} = 252 \text{ cal/h} = 2.778 \times 10^{-4} \text{ Btu/s}$$