

What is a ton of refrigeration?

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Commercial refrigeration systems in the US are mostly rated in tons of refrigeration and this term is used widely in other parts of the world. However, outside the US, cooling systems may be normally specified in kW (or MW) or in Btu/h.

The roots for refrigeration are in the ice making industry, and the ice manufacturers wanted an easy way of understanding the size of a refrigeration system in terms of the production of ice. If 288,000 Btu are required to make one ton of ice, divide this by 24 hours to get 12,000 Btu/h required to make one ton of ice in one day. This is the requirement for the phase change from liquid to solid — to convert water at 0°C (+32°F) into ice at 0°C (+32°F). As a practical matter, additional refrigeration is required to take water at room temperature and turn it into ice.

To be specific, one ton of refrigeration capacity can freeze one short ton of water at 0°C (32°F) in 24 hours. So, a ton of refrigeration is 3.517 kW. This is derived as follows:

The latent heat of ice (also the heat of fusion) = 333.55 kJ/kg = 144 Btu/lb

One short ton = 2000 lb

Heat extracted = 2000 x 144/24 hr = 288000 Btu/24 hr = 12000 Btu/hr = 200 Btu/min

1 ton refrigeration = 200 Btu/min = 3.517 kJ/s = 3.517 kW = 4.713 HP

A much less common definition is: 1 tonne of refrigeration is the rate of heat removal required to freeze a metric ton (1000 kg) of water at 0°C in 24 hours. Based on the heat of fusion being 333.55 kJ/kg, 1 tonne of refrigeration = 13,898 kJ/h = 3.861 kW. Thus, 1 tonne of refrigeration is 10% larger than 1 ton of refrigeration.

Another unit of measure is the calorie which is the amount of heat removal required to raise or lower the temperature of one gram of water by one °C. A kilo-calorie is the amount of heat required to raise or lower 1 kg of water by 1°C. One ton of refrigeration is equal to 3024 kilo-calories per hour. This is 12,000 BTU/h divided by 2.204 (pounds per kilogram) divided by 1.8 (°C to °F).

Most residential air conditioning units range in capacity from about 1 to 5 tons of refrigeration or 3.5 kW ~ 17.5 kW, or 12,000 Btu/h ~ 60,000 Btu/h. Large industrial chiller systems range up to 800 tons of refrigeration (2.8 MW or 9.6 million Btu/h).

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