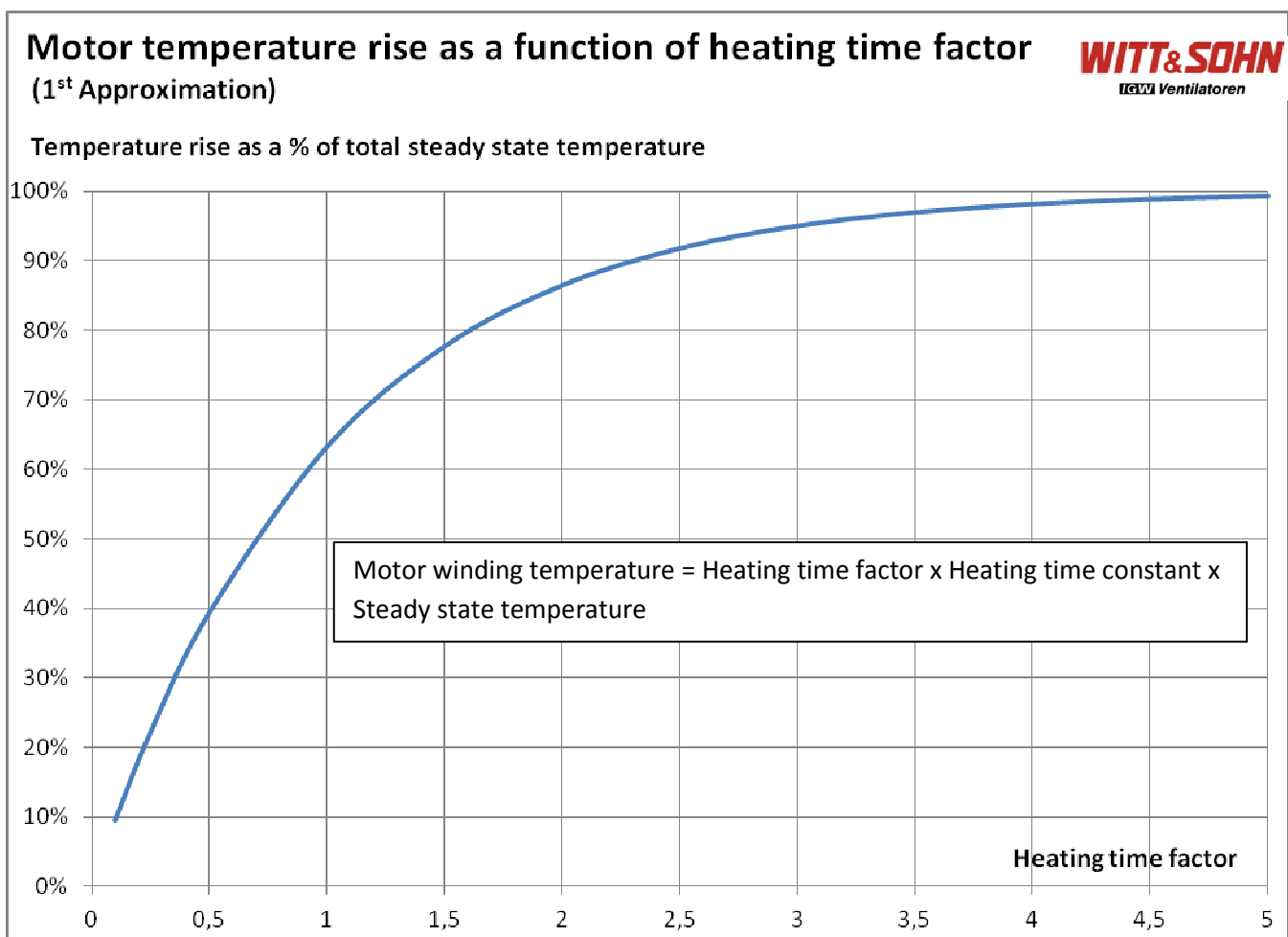# Estimating the temperature rise in electrical motors

We often get asked how long it takes for the windings of an electrical motor to reach their steady state temperature.

There is no easy answer to this question as this depends on very many factors such as ambient temperature, loading of the motor, motor design, cooling method etc. As a first approximation it is often assumed that the temperature rise follows an inverse exponential curve (i.e. $1-1/e^x$).

The time it takes for the winding temperature to reach 63 % (i.e. x = 1) is called the motor heating constant and is normally included in the extended technical information provided by the motor manufacturers. The motor heating constant is typically between 0.5 and 5 hours.

In the graph below is shown the curve which can help to get a quick idea as to how long it approximately will take for a motor to reach its steady state temperature.

Motor temperature rise as a function of heating time factor (1st Approximation)

Temperature rise as a % of total steady state temperature

Motor winding temperature = Heating time factor x Heating time constant x Steady state temperature

Heating time factor

Example:

If heating time constant is 0,5 h, then **63%** is reached after 0,5 hour, **86%** after 1 hour and **99%** after 2.5 hours. If steady state temperature is 145°C, then the winding temperature is ~90°C, ~125°C and 145°C respectively.

If heating time constant is 2.5 h , then **63%** is reached after 2.5 hours, **86 %** after 5 hours and **99%** after 12.5 hours.

If steady state temperature is 150°C, then the winding temperature is ~95°C, ~130°C and 150°C respectively.

The bearing temperature is typically 50 - 75% of the motor winding temperature.