Rating

There are limits of operation in terms of temperature rise to assure the motor performance. Rating is divided into continuous rating and short-time rating.
This defines not only the running limit against the output, but also limiting conditions such as voltage, frequency and rotational speed. These conditions are called as rated voltage, rated frequency and rated speed.

Continuous rating and short-time rating

A time rating is used to express the time during which the motor can normally output the rated power. Continuous rating indicates that the motor can provide the rated power during this period. The short-time rating indicates that the motor will reliably operate to produce the rated output for the relatively short time specified.

Output

Output represents a work which the motor can carry out in a unit time. This is determined by the rotational speed and the torque of the motor. The rated output of the motor, P0 is described in wattage

P0 (W) as;

- **SI units**

  P0 = 0.1047 x T x N

  T : Torque **(N·m)**

  N : Rotational speed **(min^{-1})**

- **Gravitational system of units**

  P0 = 1.027 x T x N

  T : Torque **(kgf·m)**

  N : Rotational speed **(min^{-1})**

Rated output

An optimum output performance which the motor can generate at the rated voltage and frequency. A rotational speed and torque with which the rated output is generated is called the rated speed and torque. In general, an output is referred to as the rated output.

Starting torque (see (1) in the figure)

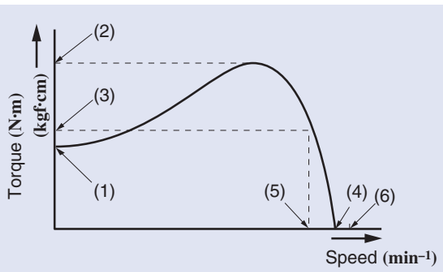
A torque which the motor generates at starting. The motor will not start if a larger load than this starting torque is applied to the motor.

Stalling torque (see (2) in the figure)

A maximum torque which the motor can generate at constant voltage and frequency. The motor will stall if a larger load than this torque is applied to the motor.

Rated toque (see (3) in the figure)

A torque of the motor generates the rated output continuously at rated voltage and frequency. This is usually referred to as a torque at the rated speed.



- Speed-torque characteristics
  (1) Starting torque
  (2) Stalling torque
  (3) Rated torque
  (4) No load speed
  (5) Rated speed
  (6) Synchronous speed

No load speed (see (4) in the figure)

Motor speed with no load applied. In the case of induction and reversible motor, this speed becomes a few percent lower (approx. 20 to 60 min-1) than a synchronous speed.

Rated rotational speed (see (5) in the figure)

Motor speed at which the motor generates the rated output. This is the most optimum speed.

Synchronous speed (see (6) in the figure)

An inherent speed determined by the number of poles of the motor and frequency of the power source.
This is described in the following formula.

$$Ns = \frac{120}{P} f \ (min^{-1})$$

where, **Ns** : Synchronous speed **(min^{-1})**
f : Frequency **(Hz)**
P : Number of poles **(min^{-1})**
120 : Constant

For example of 4-pole motor and power source frequency is 50 Hz, then,

$$Ns = \frac{120 \times 50}{4} = 1500 \ (min^{-1})$$

Slippage

Slippage can be described in the following formula as one of the rotational speed.

$$S = \frac{Ns - N}{Ns} \quad or \quad N = Ns\,(1 - S)$$

where, **Ns** : Synchronous speed **(min^{-1})**
N : Discretionary no load speed **(min^{-1})**

when an induction motor with 4-pole, 50 Hz runs with a slippage, S = 0.1, then,

$$N = Ns\,(1 - S) = 1500\,(1 - 0.1) = 1350 \ (min^{-1})$$

Overrun

Revolutions that the motor makes from when the power source is turned off till the motor stops, and is described in the number of revolutions.

Fit tolerance

Fit tolerance symbol (JIS) is applied to dimensions of motor “Faucet face” and “Gear head” output shaft. The value of tolerance depends on the basic dimension. See the table right.

Classification of standard dimension		Shaft tolerance (unit: mm)
Over	Equal to or below	Shaft tolerance class: h7
–	3	0
		–0.01
3	6	0
		–0.012
6	10	0
		–0.015
10	18	0
		–0.018
18	30	0
		–0.021
30	50	0
		–0.025
50	80	0
		–0.03
80	120	0
		–0.035