Studying the Driving Motor

When selecting a driving motor required to rotate the Ball Screw, normally take into account the rotational speed, rotational torque and minimum feed amount.

When Using a Servomotor

[Rotational Speed]

The rotation speed required for the motor is obtained using the equation (52) based on the feed speed, Ball Screw lead and reduction ratio.

$$N_M = \frac{V \times 1000 \times 60}{Ph} \times \frac{1}{A} \quad \cdots\cdots\cdots (52)$$

N_M : Required rotation speed of the motor (min^{-1})
V : Feeding speed (m/s)
Ph : Ball Screw lead (mm)
A : Reduction ratio

The rated rotational speed of the motor must be equal to or above the calculated value (N_M) above.

$N_M \leqq N_R$

N_R : The rated rotation speed of the motor (min^{-1})

[Required Resolution]

Resolutions required for the encoder and the driver are obtained using the equation (53) based on the minimum feed amount, Ball Screw lead and reduction ratio.

$$B = \frac{Ph \cdot A}{S} \quad \cdots\cdots\cdots (53)$$

B : Resolution required for the encoder and the driver (p/rev)
Ph : Ball Screw lead (mm)
A : Reduction ratio
S : Minimum feed amount (mm)

[Motor Torque]

The torque required for the motor differs between uniform motion, acceleration and deceleration. To calculate the rotational torque, see "Studying the Rotational Torque" on A15-61.

a. Maximum torque

The maximum torque required for the motor must be equal to or below the maximum peak torque of the motor.

$T_{max} \leqq Tp_{max}$

T_{max} : Maximum torque acting on the motor

Tp_{max} : Maximum peak torque of the motor

b. Effective torque value

The effective value of the torque required for the motor must be calculated. The effective value of the torque is obtained using the equation (54).

$$T_{rms} = \sqrt{\frac{T_1^2 \times t_1 + T_2^2 \times t_2 + T_3^2 \times t_3}{t}} \quad \cdots\cdots\cdots(54)$$

T_{rms} : Effective torque value (N·mm)

T_n : Fluctuating torque (N·mm)

t_n : Time during which the torque T_n is applied (s)

t : Cycle time (s)

($t=t_1+t_2+t_3$)

The calculated effective value of the torque must be equal to or below the rated torque of the motor.

$T_{rms} \leqq T_R$

T_R : Rated torque of the motor (N·mm)

[Inertial Moment]

The inertial moment required for the motor is obtained using the equation (55).

$$J_M = \frac{J}{C} \quad \cdots\cdots\cdots(55)$$

J_M : Inertial moment required for the motor ($kg \cdot m^2$)

C : Factor determined by the motor and the driver

(It is normally between 3 to 10. However, it varies depending on the motor and the driver. Check the specific value in the catalog by the motor manufacturer.)

The inertial moment of the motor must be equal to or above the calculated J_M value.

Ball Screw

When Using a Stepping Motor (Pulse Motor)

[Minimal Feed Amount(per Step)]

The step angle required for the motor and the driver is obtained using the equation (56) based on the minimum feed amount, Ball Screw lead and reduction ratio.

$$E = \frac{360S}{Ph \cdot A} \quad \cdots\cdots\cdots (56)$$

E : Step angle required for the motor and the driver (°)
S : Minimum feed amount (per step) (mm)
Ph : Ball Screw lead (mm)
A : Reduction ratio

[Pulse Speed and Motor Torque]

a. Pulse speed

The pulse speed is obtained using the equation (57) based on the feed speed and the minimum feed amount.

$$f = \frac{V \times 1000}{S} \quad \cdots\cdots\cdots (57)$$

f : Pulse speed (Hz)
V : Feeding speed (m/s)
S : Minimum feed amount (mm)

b. Torque required for the motor

The torque required for the motor differs between the uniform motion, the acceleration and the deceleration. To calculate the rotational torque, see "Studying the Rotational Torque" on A**15-61**.

Thus, the pulse speed required for the motor and the required torque can be calculated in the manner described above.
Although the torque varies depending on the motors, normally the calculated torque should be doubled to ensure safety. Check if the torque can be used in the motor's speed-torque curve.