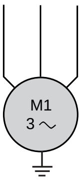
Lexium 05 motion control

BSH servo motors

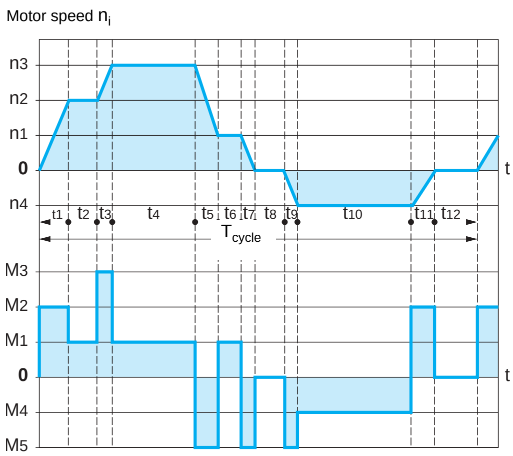


Sizing the servo motor

The "**Lexium Sizer**" sizing tool is available on the www.telemecanique.com website to help you size your servo motor.

These 2 pages are provided to help you understand the calculation method used.

To be able to size the servo motor you need to know the equivalent thermal torque and the average speed required by the mechanism to be used with the servo motor. Both values are calculated using the motor cycle timing diagram and should be compared with the torque/speed curves given for each servo motor (see BSH servo motor curves, on pages 43742/2 to 43742/24).



Motor cycle timing diagram

The motor cycle is made up of several sub-cycles, the duration of which is known. Each sub-cycle is divided into phases which correspond to the periods of time during which the motor torque is constant (1 to 3 phases maximum per sub-cycle).
This division into phases can be used to calculate the following for each phase:

- Duration (tj)
- Speed (n_i)
- Required torque value (M_i)

The curves on the left show the four types of phase:

- Constant acceleration during times t_1, t_3 and t_9
- At work during times t_2, t_4, t_6 and t_{10}
- Constant deceleration during times t_5, t_7 and t_{11}
- Motor stopped during times t_8 and t_{12}

The total duration of the cycle is:

$T_{cycle} = t_1 + t_2 + t_3 + t_4 + t_5 + t_6 + t_7 + t_8 + t_9 + t_{10} + t_{11} + t_{12}$

Calculating the average speed n_{avg}

The average speed is calculated using the formula: $n_{avg} = \dfrac{\sum |ni| \cdot t_j}{\sum t_j}$

- n_i corresponds to the different work speeds
- $\dfrac{ni}{2}$ corresponds to the average speeds during the acceleration phases constant and constant deceleration

In the above example:

Duration tj	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}	t_{11}	t_{12}
Speed |ni|	$\frac{\lvert n2\rvert}{2}$	$\lvert n2\rvert$	$\frac{\lvert n3\rvert + \lvert n2\rvert}{2}$	$\lvert n3\rvert$	$\frac{\lvert n3\rvert + \lvert n1\rvert}{2}$	$\lvert n1\rvert$	$\frac{\lvert n1\rvert}{2}$	0	$\frac{\lvert n4\rvert}{2}$	$\lvert n4\rvert$	$\frac{\lvert n4\rvert}{2}$	0

The average speed is calculated as follows:

$$n_{avg} = \frac{\frac{n2}{2} \cdot t1 + n2 \cdot t2 + \frac{n3 + n2}{2} \cdot t3 + n3 \cdot t4 + \frac{n3 + n1}{2} \cdot t5 + n1 \cdot t6 + \frac{n1}{2} \cdot t7 + \frac{n4}{2} \cdot t9 + n4 \cdot t10 + \frac{n4}{2} \cdot t11}{Tcycle}$$

Calculating the equivalent thermal torque M_{eq}

The equivalent thermal torque is calculated using the formula:

$$M_{eq} = \sqrt{\frac{\sum Mi^2 \cdot t_j}{Tcycle}}$$

In the above example, this formula gives the following calculation:

$$M_{eq} = \sqrt{\frac{M2^2 \cdot t1 + M1^2 \cdot t2 + M3^2 \cdot t3 + M1^2 \cdot t4 + M5^2 \cdot t5 + M1^2 \cdot t6 + M5^2 \cdot t7 + M5^2 \cdot t9 + M4^2 \cdot t10 + M2^2 \cdot t11}{Tcycle}}$$

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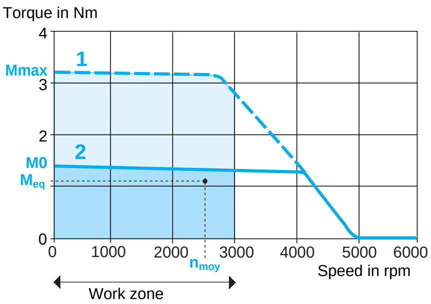

Sizing the servo motor (continued)

Determining the size of the servo motor

The point defined by the two preceding calculations (average speed and equivalent thermal torque) where the:
■ horizontal axis represents the average speed n_{avg}
■ vertical axis represents the thermal torque M_{eq}
must be within the area bounded by curve 2 and the work zone.

The motor cycle timing diagram should also be used to ensure that all torques M_i required for the different speeds n_i during the various cycle phases are within the area bounded by curve 1 and the work zone.

1 Peak torque
2 Continuous torque