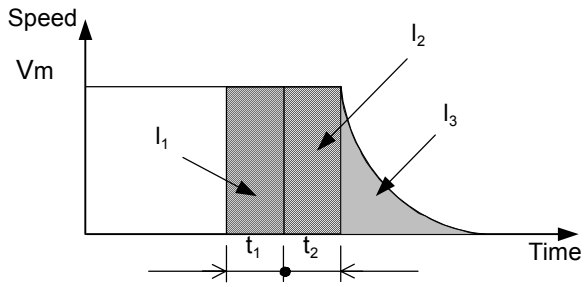
4.2.7 Calculating the Dynamic Brake Stop Distance

The equation for calculating the coasting distance when an abnormality occurs and the machine tool is stopped by dynamic braking with both ends of the motor power line shorted (dynamic brake stop distance) is given below:



Vm : Rapid traverse rate, mm/sec or [deg /sec]
l_1 : Coasting distance due to delay time t_1 of receiver
l_2 : Coasting distance due to deceleration time t_2 of magnetic contactor (MCC)
l_3 : Coasting distance by dynamic braking after magnetic contactor has been operated
(t_1+t_2) is usually about 0.05 [sec].

$$\text{Coasting distance due} = Vm \times (t_2 + t_2) + (J_M + J_L) \times (A \times No + B \times No^3) \times L$$

$[mm]\ or\ [\text{deg}]$

- J_M : Motor inertia [kg·m^2] [kgf·cm·s^2]
- J_L : Load inertia [kg·m^2] [kgf·cm·s^2]
- N_O : Motor speed at rapid traverse [min^{-1}]
- L : Machine movement on one-rotation of motor [mm/rev] or [deg/rev] ($N_O/60 \times L = V_m$)
- A : Coefficient A for calculating the dynamic brake stop distance
- B : Coefficient B for calculating the dynamic brake stop distance

For details of A and B, see the table on the following page.
For J_M, see the data sheet of each motor in the Chapter 6, “SPECIFICATIONS.”

There are two ways of shortening this dynamic brake stop distance: Emergency stop distance shortening function, and emergency stop distance shortening function effective also during power interruptions (additional hardware is required).

[Example of calculation for condition 7] Dynamic brake stop distance

Assume that the desired stop distance is 150 [mm].
Coasting distance =

$(3000/60\times20)[\mathrm{mm/sec}]\times0.05[\mathrm{sec}]+(0.0076[\mathrm{kg\cdot m^2}]+0.01412[\mathrm{kg\cdot m^2}])\times(4.0\times10^{-2}\times3000[\mathrm{min^{-1}}]+3.1\times10^{-9}\times3000^3[\mathrm{min^{-1}}])\times20[\mathrm{mm/rev}]$
$=138\mathrm{mm}$

It has been shown that the machine tool can be stopped within the desired stop distance.
Finally, the αiS 30/4000 which satisfies selection conditions 1 to 6 is selected.

Coefficients for dynamic brake calculation

Model	SI unit		Gravitational system of units	
	A	B	A	B
αiS series (200-V system)				
αiS 2/5000	1.9×10^{-1}	9.0×10^{-8}	1.9×10^{-2}	8.8×10^{-9}
αiS 2/6000	2.9×10^{-1}	1.3×10^{-7}	2.8×10^{-2}	1.3×10^{-8}
αiS 4/5000	7.6×10^{-2}	5.4×10^{-8}	7.4×10^{-3}	5.2×10^{-9}
αiS 8/4000	1.8×10^{-1}	1.1×10^{-8}	1.8×10^{-2}	1.1×10^{-9}
αiS 8/6000	4.2×10^{-1}	4.4×10^{-9}	4.1×10^{-2}	4.3×10^{-10}
αiS 12/4000	1.1×10^{-1}	4.1×10^{-9}	1.1×10^{-2}	4.0×10^{-10}
αiS 22/4000	5.8×10^{-2}	5.2×10^{-9}	5.7×10^{-3}	5.1×10^{-10}
αiS 30/4000	4.0×10^{-2}	3.1×10^{-9}	3.9×10^{-3}	3.0×10^{-10}
αiS 40/4000	2.9×10^{-2}	2.2×10^{-9}	2.8×10^{-3}	2.2×10^{-10}
αiS 50/3000	2.1×10^{-2}	1.4×10^{-9}	2.0×10^{-3}	1.4×10^{-10}
αiS 50/3000 with fan	2.1×10^{-2}	1.4×10^{-9}	2.0×10^{-3}	1.4×10^{-10}
αiS 100/2500	1.1×10^{-2}	2.2×10^{-9}	1.0×10^{-3}	2.2×10^{-10}
αiS 100/2500 with fan	1.1×10^{-2}	2.2×10^{-9}	1.0×10^{-3}	2.2×10^{-10}
αiS 200/2500	5.8×10^{-3}	1.1×10^{-9}	5.7×10^{-4}	1.1×10^{-10}
αiS 200/2500 with fan	5.8×10^{-3}	1.1×10^{-9}	5.7×10^{-4}	1.1×10^{-10}
αiS 300/2000	4.4×10^{-3}	7.9×10^{-10}	4.3×10^{-4}	7.8×10^{-11}
αiS 500/2000	2.3×10^{-3}	5.0×10^{-10}	2.2×10^{-4}	4.9×10^{-11}
αiF series (200-V system)				
αiF 1/5000	5.0×10^{-1}	2.6×10^{-7}	4.9×10^{-2}	2.5×10^{-8}
αiF 2/5000	1.8×10^{-1}	1.6×10^{-7}	1.7×10^{-2}	1.6×10^{-8}
αiF 4/4000	4.5×10^{-1}	2.8×10^{-8}	4.4×10^{-2}	2.8×10^{-9}
αiF 8/3000	1.4×10^{-1}	1.7×10^{-8}	1.4×10^{-2}	1.7×10^{-9}
αiF 12/3000	1.9×10^{-1}	1.7×10^{-8}	1.9×10^{-2}	1.7×10^{-9}
αiF 22/3000	6.0×10^{-2}	9.9×10^{-9}	5.9×10^{-3}	9.7×10^{-10}
αiF 30/3000	5.8×10^{-2}	3.9×10^{-9}	5.7×10^{-3}	3.8×10^{-10}
αiF 40/3000	2.6×10^{-2}	6.0×10^{-9}	2.5×10^{-3}	5.8×10^{-10}
αiF 40/3000 with fan	2.6×10^{-2}	6.0×10^{-9}	2.5×10^{-3}	5.8×10^{-10}

The values of A and B are calculated by assuming that the resistance of the power line is 0.05Ω per phase. The values will vary slightly according to the resistance value of the power line.

The coefficient above values are applicable when the αiSV series servo amplifier is being used. The coefficient may change, depending on the type of the servo amplifier. Contact FANUC when using the βiSV series servo amplifier.

Model	SI unit		Gravitational system of units	
	A	B	A	B
αiS series (400-V system)				
αiS 2/5000HV	3.9×10^{-1}	4.4×10^{-8}	3.8×10^{-2}	4.4×10^{-10}
αiS 2/6000HV	5.9×10^{-1}	6.7×10^{-8}	5.8×10^{-2}	6.8×10^{-10}
αiS 4/5000HV	2.6×10^{-1}	1.6×10^{-8}	2.5×10^{-2}	1.5×10^{-9}
αiS 8/4000HV	1.4×10^{-1}	1.4×10^{-8}	1.4×10^{-2}	1.4×10^{-9}
αiS 8/6000HV	3.2×10^{-1}	5.8×10^{-9}	3.1×10^{-2}	5.6×10^{-10}
αiS 12/4000HV	8.4×10^{-2}	5.3×10^{-9}	8.2×10^{-3}	5.2×10^{-10}
αiS 22/4000HV	1.2×10^{-1}	2.5×10^{-9}	1.2×10^{-2}	2.5×10^{-10}
αiS 30/4000HV	6.7×10^{-2}	1.8×10^{-9}	6.6×10^{-3}	1.8×10^{-10}
αiS 40/4000HV	4.9×10^{-2}	1.3×10^{-9}	4.8×10^{-3}	1.3×10^{-10}
αiS 50/3000HV	6.3×10^{-3}	4.5×10^{-9}	6.2×10^{-4}	4.4×10^{-10}
αiS 50/3000HV with fan	6.3×10^{-3}	4.5×10^{-9}	6.2×10^{-4}	4.4×10^{-10}
αiS 100/2500HV	3.0×10^{-3}	8.1×10^{-9}	2.9×10^{-4}	7.9×10^{-10}
αiS 100/2500HV with fan	3.0×10^{-3}	8.1×10^{-9}	2.9×10^{-4}	7.9×10^{-10}
αiS 200/2500HV	1.6×10^{-3}	4.1×10^{-9}	1.6×10^{-4}	4.0×10^{-10}
αiS 200/2500HV with fan	1.6×10^{-3}	4.1×10^{-9}	1.6×10^{-4}	4.0×10^{-10}
αiS 300/2000HV	2.1×10^{-3}	1.7×10^{-9}	2.0×10^{-4}	1.7×10^{-10}
αiS 500/2000HV	1.1×10^{-3}	1.0×10^{-9}	1.1×10^{-4}	1.0×10^{-10}
αiS 1000/2000HV	6.3×10^{-4}	5.9×10^{-10}	6.2×10^{-5}	5.8×10^{-11}
αiS 2000/2000HV	3.3×10^{-4}	1.3×10^{-10}	3.2×10^{-5}	1.3×10^{-11}
αiS 3000/2000HV	1.7×10^{-4}	7.4×10^{-11}	1.6×10^{-5}	7.3×10^{-12}
αiF series (400-V system)				
αiF 4/4000HV	3.9×10^{-1}	3.3×10^{-8}	3.8×10^{-2}	3.2×10^{-9}
αiF 8/3000HV	1.1×10^{-1}	2.2×10^{-8}	1.1×10^{-2}	2.2×10^{-9}
αiF 12/3000HV	1.5×10^{-1}	2.3×10^{-8}	1.4×10^{-2}	2.2×10^{-9}
αiF 22/3000HV	4.5×10^{-2}	1.3×10^{-8}	4.4v10 $^{-3}$	1.3×10^{-9}

The values of A and B are calculated by assuming that the resistance of the power line is 0.05Ω per phase. The values will vary slightly according to the resistance value of the power line.

The coefficient above values are applicable when the αiSV series servo amplifier is being used. The coefficient may change, depending on the type of the servo amplifier. Contact FANUC when using the βiSV series servo amplifier.

4.3 HOW TO FILL IN THE SERVO MOTOR SELECTION DATA TABLE

Select a suitable motor according to load conditions, rapid traverse rate, increment system and other factors. To aid in selecting the correct motor, we recommend filling in the "Servo Motor Selection Data Table" on the following page.
This section describes the items to fill in the Servo Motor Selection Data Table.

4.3.1 Servo Motor Selection Data Table

The Servo Motor Selection Data Table for the SI system of units and that for the gravitational system of units are given on the following pages.