DENSO ROBOT

Horizontal articulated

HM-G-T SERIES

GENERAL INFORMATION ABOUT ROBOT (T03)

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Preface

Thank you for purchasing this high-speed, high-accuracy assembly robot.

Before operating your robot, read this manual carefully to safely get the maximum benefit from your robot in your assembling operations.

Robot series and/or models covered by this manual

Series	Model	Overall arm length
	Floor-mount	
HM-G-T (Medium-sized, horizontal articulated)	HM-4*60*G-T03 HM-4*70*G-T03 HM-4*85*G-T03 HM-4*A0*G-T03	600 mm 700 mm 850 mm 1000 mm

Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS."

How this book is organized

This book is just one part of the robot documentation set. This book consists of SAFETY PRECAUTIONS, chapters one through five, and appendix.

Chapter 1 Packing List of the Robot
Lists the standard components contained in the product package and optional components.

Chapter 2 Configuration of the Robot System
Illustrates the configuration of the robot system and describes the component names of the robot unit and controller.

Chapter 3 Specifications of the Robot Unit
Describes the specifications, motion space, robot positioning time, air piping and signal wiring, and engineering-design notes for robot hands.

Chapter 4 Specifications of the Robot Controller
Lists the specifications of the robot controller and controller setting table (SETPRM LIST).

Chapter 5 Warranty
Describes the warranty period and coverage.

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Chapter 1 Packing List of the Robot

1.1 Standard Components

The components listed below are contained in the product package.

Standard Components

No.	Item	Q'ty
(1)	Robot unit	1
(2)	Robot controller	1
(3)	Power cable (5 m)	1
(4)	Motor & encoder cable **(Note 1)** (Option)	1
(5)	Manuals (T03) ("Manual Pack CD" and "Safety Precautions")	1 set
(6)	WINCAPSⅢ install CD (T03 Trial version)	1
(7)	Spare fuses for robot controller	3
(8)	Connector set for hand control signals (for CN20 and CN21)	1 set
(9)	Direction indicator label **(Note 2)**	1
(10)	Warning label **(Note 3)**	1
(11)	Spare output IC for robot controller	1
(12)	Dowel pins (internally threaded positioning pin and diamond-shaped pin)	1 set
(13)	Air regulator	1

Note 1: Choose and order a motor & encoder cable from the table below. The internal cable bending radius shall at least be 200 mm. Excessively bending will result in broken lead wires.

Item		Part No.
Splash-proof cable	2 m	410141-4420
Splash-proof cable	4 m	410141-3681
Splash-proof cable	6 m	410141-3691
Splash-proof cable	12 m	410141-3701
Splash-proof cable	20 m	410141-4460

Note 2: After installation, attach the direction indicator label in a position on the robot unit that can be easily seen.

Note 3: Attach the warning label on the robot safety fence or other location where workers will easily notice it. If necessary, prepare a plate for attaching the seal.

NOTE: When placing an order for robot systems, be sure to order the optional teach pendant and operation panel also which are essential in using a robot system.

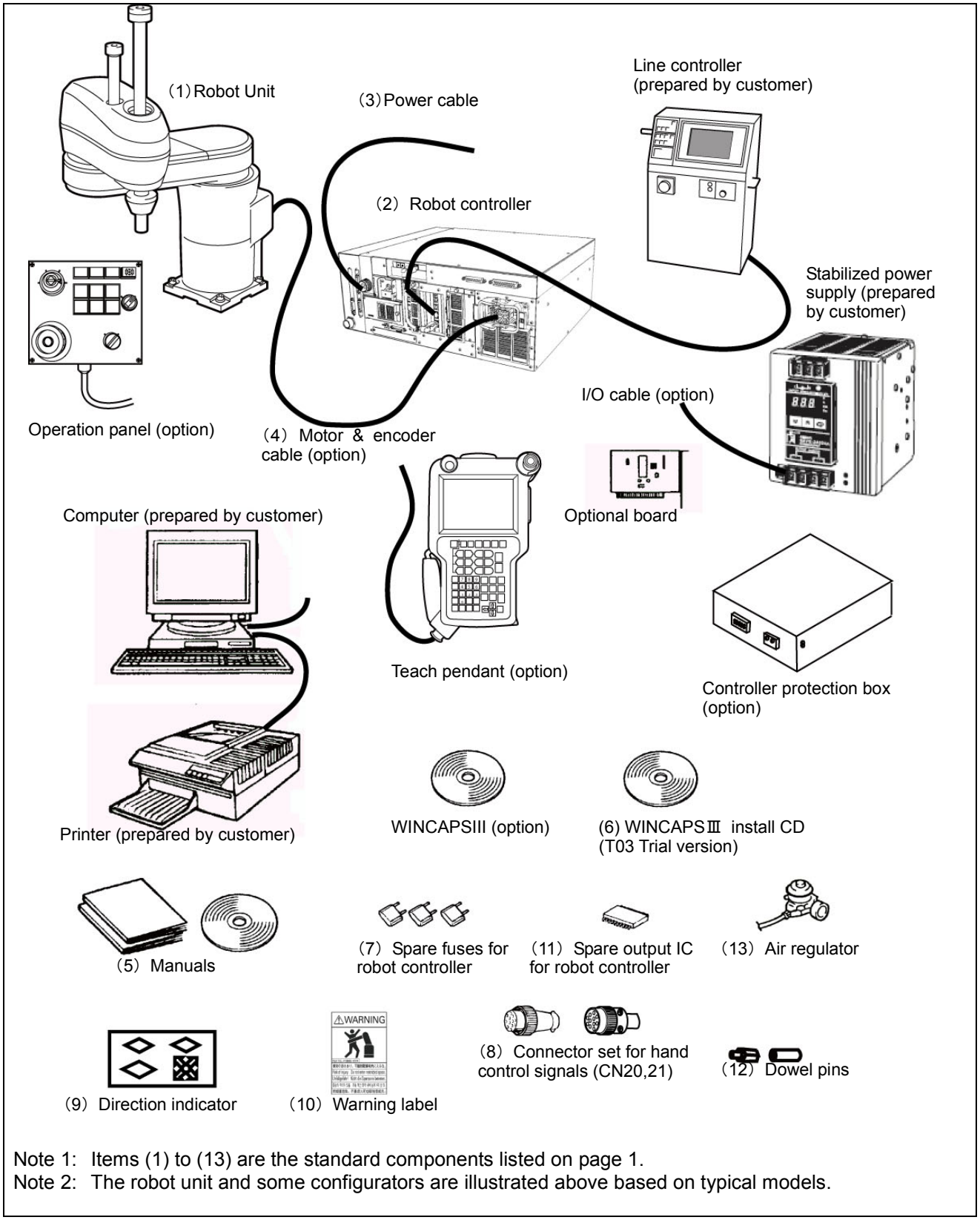
1.2 Optional Components

Please purchase the optional components if necessary referring to OPTIONAL COMPONENTS LISTS (T03) in the Manual Pack CD..

Chapter 2 Configuration of the Robot System

2.1 Configurators

The figure below shows configurators of the typical robot system.



Note 1: Items (1) to (13) are the standard components listed on page 1.
Note 2: The robot unit and some configurators are illustrated above based on typical models.

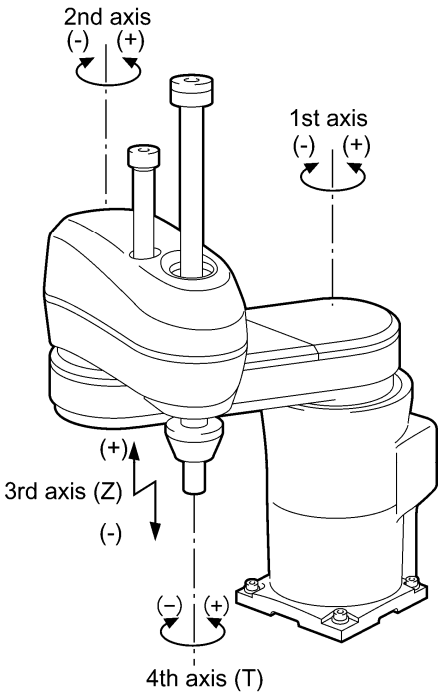
Configurators of the Robot System (HM-G-T series)

2.2 Names of Axes (Joints) of the Robot Unit

2.2.1 Robot Unit Components and Rotation Direction

The figure below shows the names of the components of the robot unit and the rotation direction of each axis.

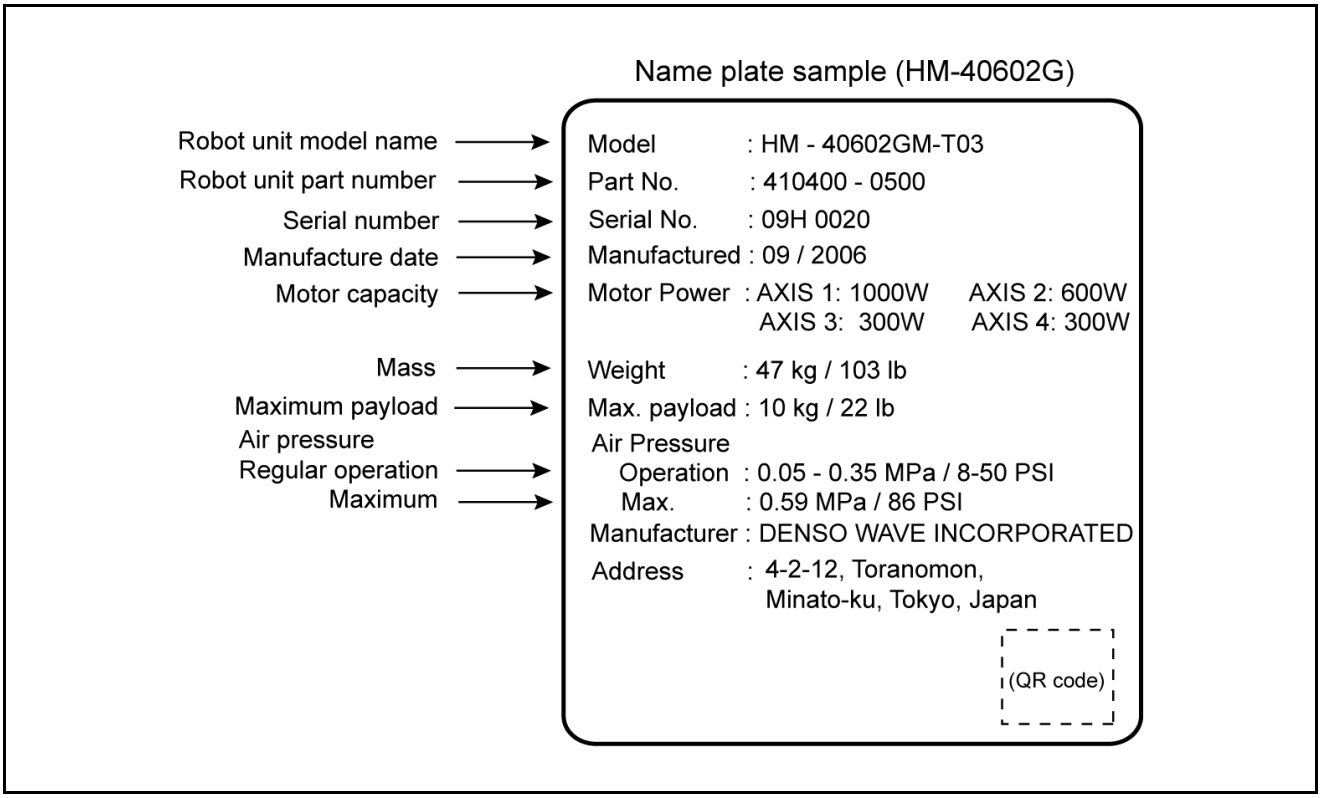
Note: The robot unit has the motor ON lamp on the 2nd arm.



Robot Unit Components and Rotation Direction (HM-G-T series)

2.2.2 Name Plate

The robot unit has a name plate pasted on the base. The serial number printed on the name plate, which is the same as that printed on the controller's name label, identifies an individual robot.



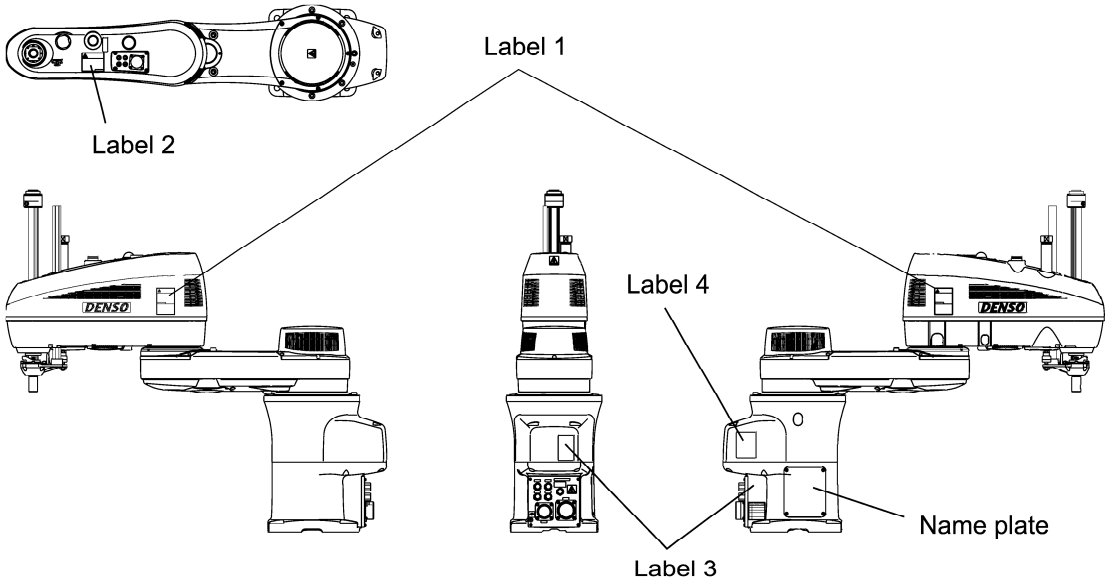
Name Plate Sample (HM-G-T series)

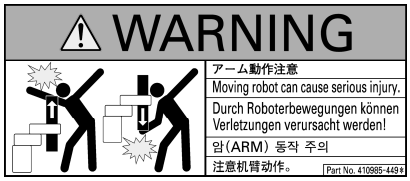
2.2.3 Warning and Caution Labels

The robot unit has warning and caution labels pasted as shown below. They alert the user to the dangers of the areas on which they are pasted. Be sure to observe the instructions printed on those labels.

Warning and Caution Labels on the Robot Unit

Location of labels

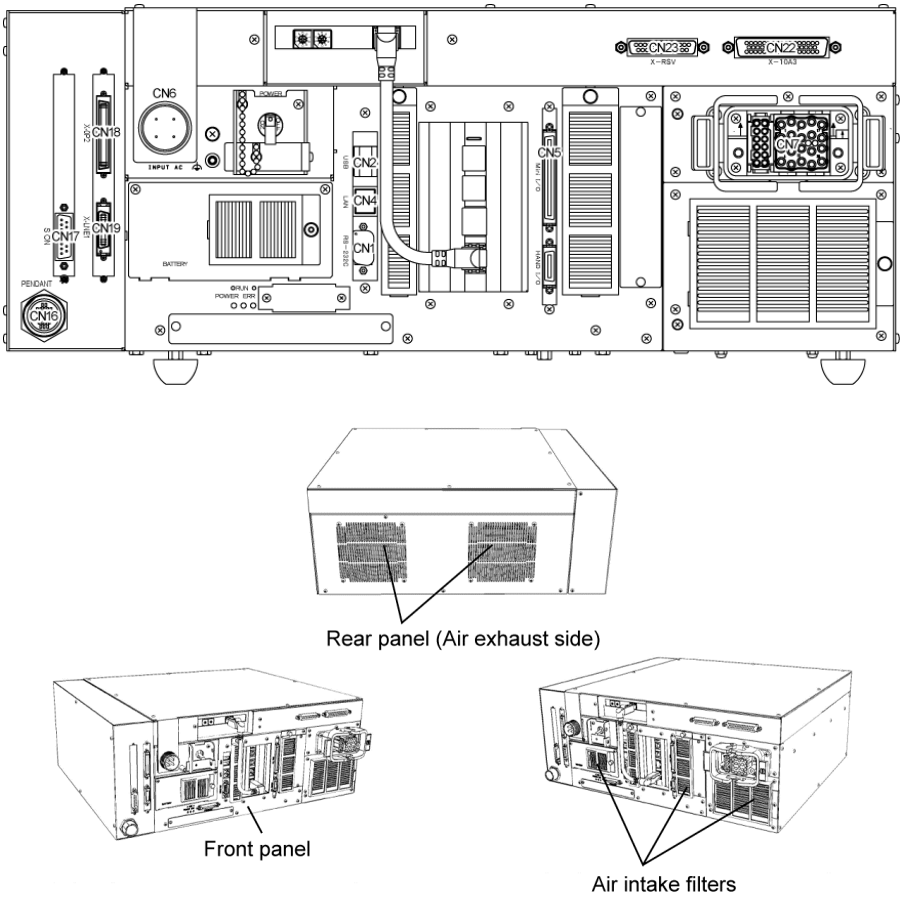


Warning and caution labels on the robot unit	Additional description
Label 1 	Contact with the robot unit which is in motion can cause serious injuries. Observe the following: (1) Never enter the robot's restricted space when the robot is in motion or the motor power is on. (2) When you need to enter the robot's restricted space for recovery from robot failures, be sure to cut the power to the robot motors by activating an emergency stop device or the like.
Label 2 	When the controller power is on, pressing the brake release switch unexpectedly drops or raises the Z-axis. It is DANGEROUS. Observe the following: (1) Never press the brake release switch except in an emergency. (2) Before pressing the brake release switch, be sure to check that there is no danger of injuries or damages on equipment.
Label 3 	There is a high voltage part. This label alerts the user to the dangers of electrical shocks.
Label 4 	Instructions on how to hoist the robot unit.

2.3 Names of the Robot Controller Components

The figure below shows the names of the robot controller components.

Note: For warning and caution labels pasted on the controller, refer to the RC7M CONTROLLER MANUAL (T03).



Connectors for the HM-G-T series (Encoders connected via bus)

Connector No.	Marking	Name
CN1	RS-232C	Serial interface connector
CN2	USB	USB connector (2 lines)
CN4	LAN	Ethernet connector
CN5	Mini I/O	I/O connector
CN6	INPUT AC	Power supply connector
CN7	MOTOR	Motor/encoder connector
CN9	HAND I/O	HAND I/O connector
CN12	—	FL-net connector (X-FL) for line controller
CN13	—	USB connector for PLC
CN14	—	USB connector for PLC
CN16	PENDANT	Teach pendant connector
CN17	S ON	Servo ON output & user power input connector
CN18	X-OP2	Operation panel connector
CN19	X-LNE1	Line controller wiring connector
CN22	X-10A3	User wiring connector for robot unit
CN23	X-RSV	User wiring connector (Reserved.)

Names of Robot Controller Components

Chapter 3 Specifications of the Robot Unit

3.1 Robot Specifications (HM-G-T series)

The table below lists the specifications of the HM-G-T series of robot units.

(1) HM-GM-T03 Series Robot Unit (Floor-mount)

Item		Specifications							
Model name of robot set **(Note 1)**		HM-4060* G-T03	HM-4A60* G-T03	HM-4070* G-T03	HM-4A70* G-T03	HM-4085* G-T03	HM-4A85* G-T03	HM-40A0* G-T03	HM-4AA0* G-T03
Model name of robot unit		HM-4060* GM-T03	HM-4A60* GM-T03	HM-4070* GM-T03	HM-4A70* GM-T03	HM-4085* GM-T03	HM-4A85* GM-T03	HM-40A0* GM-T03	HM-4AA0* GM-T03
Overall arm length		250(J1: 1st arm) + 350 (J2: 2nd arm) = 600 mm		350(J1: 1st arm) + 350 (J2: 2nd arm) = 700 mm		350(J1: 1st arm) + 500 (J2: 2nd arm) = 850 mm		500(J1: 1st arm) + 500 (J2: 2nd arm) = 1000 mm	
Motion angle and stroke	J1 (1st axis)	±165°							
	J2 (2nd axis)	±143°		±147°					
	Z (3rd axis) Vertical stroke	100 mm if * = 1, 150 mm if * = A, 200 mm if * = 2, 300 mm if * = 3, 400 mm if * = 4							
	T (4th axis) Wrist rotation	±360°							
Axis combination		J1 (1st axis) + J2 (2nd axis) + Z (3rd axis) + T (4th axis)							
Maximum payload		10 kg	20 kg	10 kg	20 kg	10 kg	20 kg	10 kg	20 kg
Composite speed	At the center of the hand mounting flange	8,780 mm/s		9,570 mm/s		11,450 mm/s		11,390 mm/s	
	Z	2,760 mm/s							
	T	2220°/s	1540°/s	2220°/s	1540°/s	2220°/s	1540°/s	2220°/s	1540°/s
Position repeatability **(Note 2)**	J1 + J2	±0.02 mm				±0.025 mm			
	Z	±0.01 mm							
	T	±0.005°							
Maximum force-fit		98N (one second or less)							
Maximum allowable moment of inertia around T axis		0.25 kgm^2 (with 10 kg)	0.45 kgm^2 (with 20 kg)	0.25 kgm^2 (with 10 kg)	0.45 kgm^2 (with 20 kg)	0.25 kgm^2 (with 10 kg)	0.45 kgm^2 (with 20 kg)	0.25 kgm^2 (with 10 kg)	0.45 kgm^2 (with 20 kg)
Position detection		Absolute encoder							
Drive motor and brake		AC servomotors for all axes Air balanced cylinder for Z axis (3rd axis) Brakes for J1, J2 and Z axes							
Brake releasing		(1) Press the brake release switch when the controller power is ON. (2) Enter a brake release command with the teach pendant.							
User air piping		4 systems (ϕ6)							
User signal lines		24 (for proximity sensor signals, etc.)							
Air source	Operating pressure	0.05 to 0.35 MPa							
	Maximum allowable pressure	0.59 MPa							
Airborne noise (A-weighted equivalent continuous sound pressure level)		80 dB or less							
Weight		Approx. 54 kg (119 lbs) (See the name plate on each model.)							

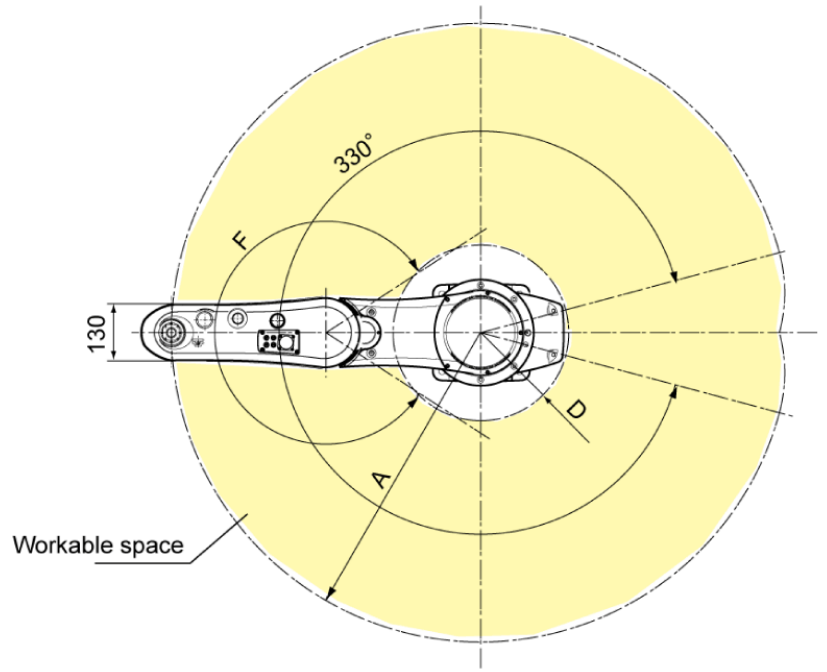
(Note 1) The model name of robot set refers to the model of a complete set including a robot unit and robot controller. An asterisk (*) in model names denotes the Z-axis stroke.

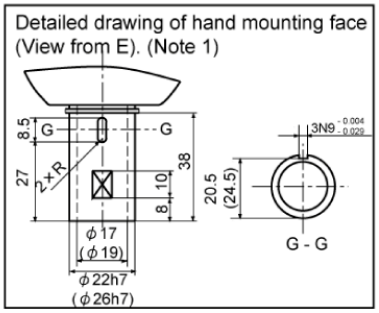
(Note 2) Value at the constant ambient temperature

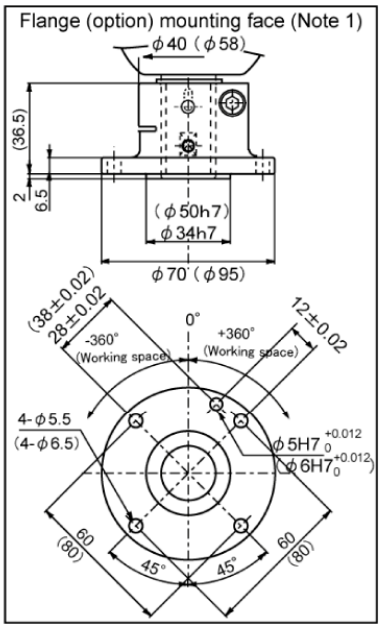
3.2 Outer Dimensions and Workable Space of the Robot Unit (HM-G-T series)

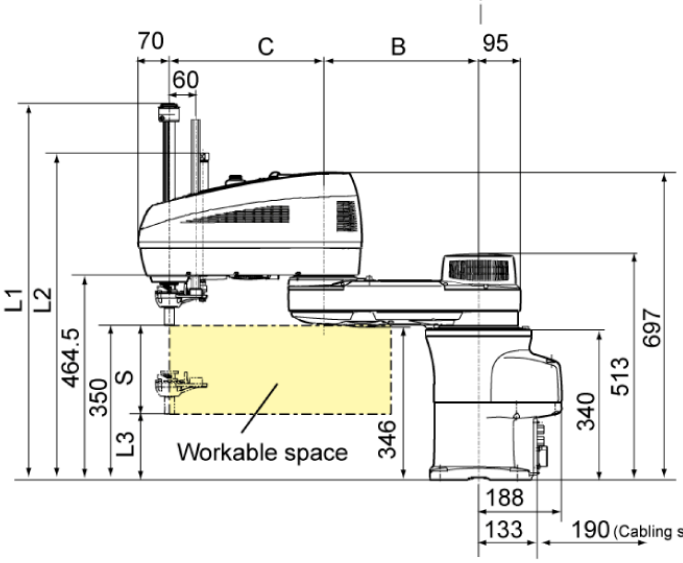
The figure below shows the outer dimensions and workable space of the HM-G-T series.

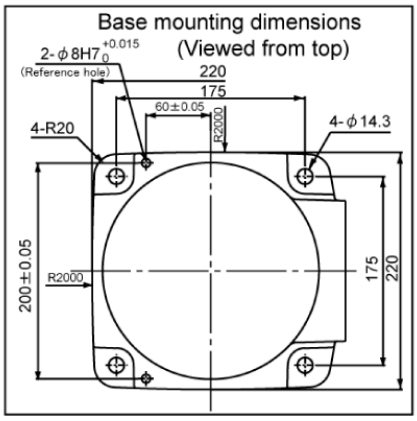
(1) HM-GM-T03 (Floor-mount)











Unit: mm

Type	A	B	C	D	F
HM-4*60*G-UL	600	250	350	213	286°
HM-4*70*G-UL	700	350	350	199	294°
HM-4*85*G-UL	850	350	500	281	294°
HM-4*A0*G-UL	1000	500	500	284	294°

S (Z axis stroke)	L1 10kg	L1 20kg	L2	L3
100	755	749	640	250
150	805	799	690	200
200	855	849	740	150
300	955	949	840	50
400 (Note 2)	1055	1049	940	-50

Note 1: Values denote dimensions for the 10 kg payload type (HM-40***G-T03), and values enclosed in ( ) denote dimensions for the 20 kg payload type (HM-4A***G-T03).
Note 2: In the case of the Z axis 400 mm stroke type, the Z axis in the lowermost position may reach lower than the mounting face.

Outer dimensions and workable space (HM-GM-T03)

3.3 Robot Positioning Time (HM-G-T series)

1. The graphs given on the following pages show the positioning times used to calculate the cycle time.
2. Positioning time refers to the time length required from the start of robot operation to the arrival at the target positioning point.
3. After the robot moves to and passes the target positioning point, vibration will be dampened and the robot will be positioned at the target positioning point as shown in the figure below. This vibration dampening time is not considered in those graphs.

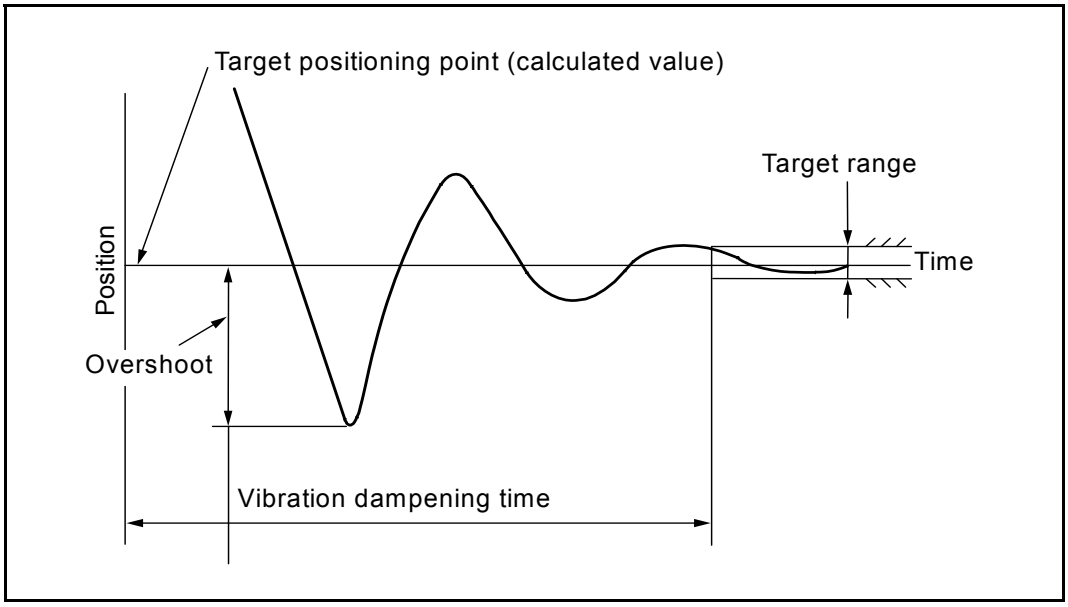
Caution (1) The vibration dampening time depends on factors such as the weight of the hand. If the robot is to be used in such a way that it overshoots or if the vibration damping time is of great concern, then test the robot carefully beforehand.

(2) If acceleration begins before residual vibration of the robot stops, an overcurrent error (code starts from ERROR6120 where the first digit represents the axis number) may be displayed. In this case, take one of the following measures:

- **Lower the deceleration of the preceding operation with a DECEL command to reduce residual vibration.**
- **Keep the robot in stand-by with a DELAY command until residual vibration stops.**
- **Lower acceleration with an ACCEL command.**

(3) Run the robot with the optimum payload setting in accordance with weight of the hand and workpiece. If not, a robot failure may result.

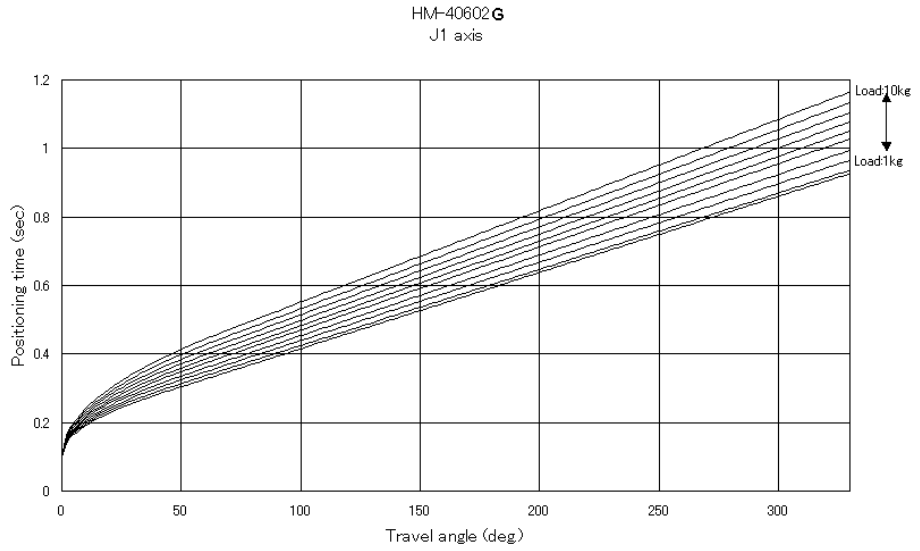
(4) In the positioning time graphs, the Z-axis stroke is represented near the upper end. Near the lower end, the horizontal movement time along the J1/J2 axis increases. (Refer to Section 3.4 "Notes for setting the positioning speed.")



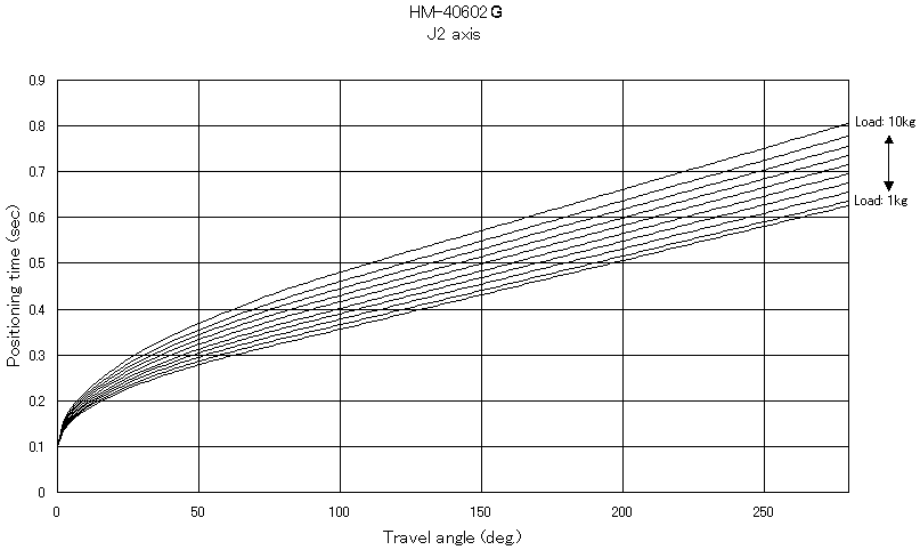
Vibration Dampening Time

(1) HM-40602G

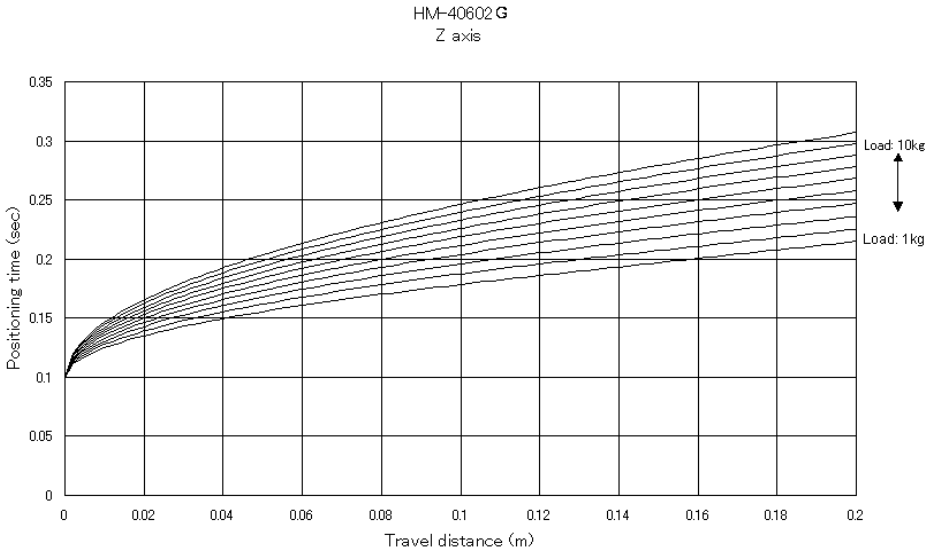
J1 axis (PTP motion)



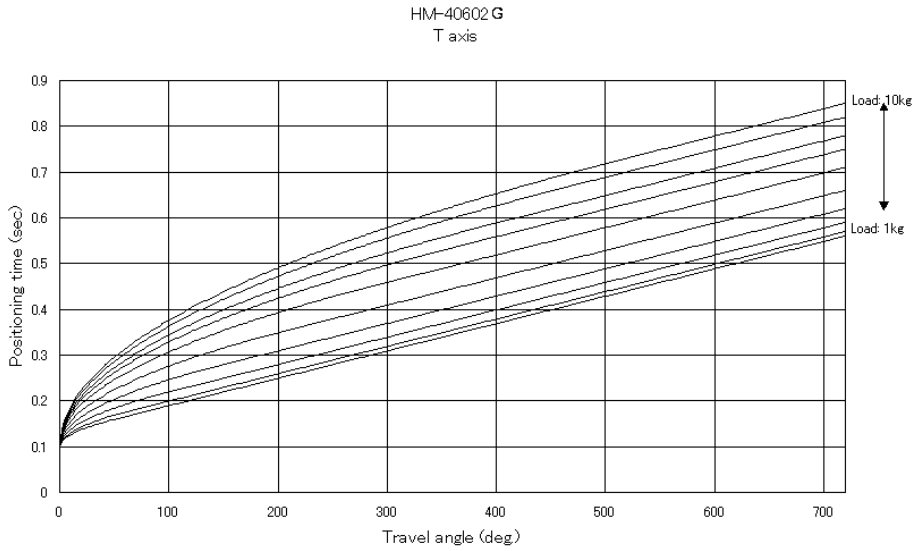
J2 axis (PTP motion)



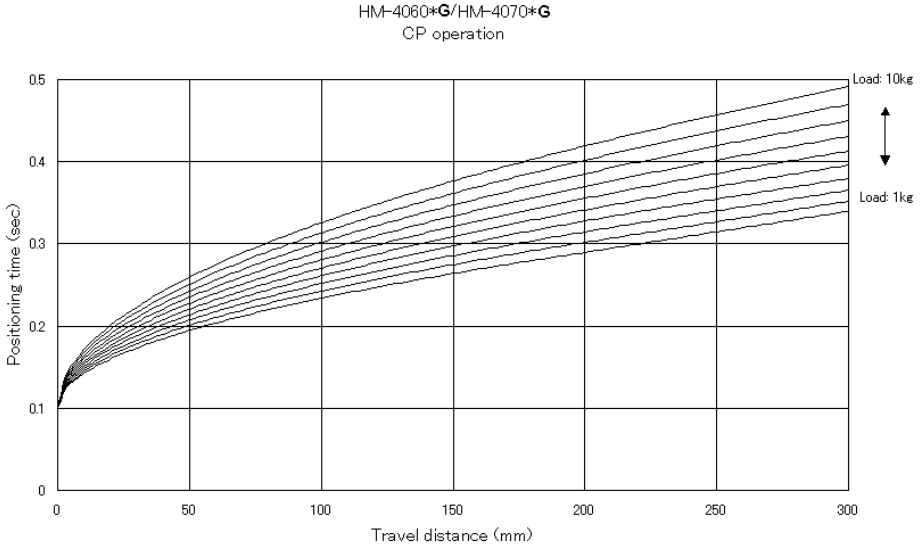
Z axis (PTP motion)



T axis (PTP motion)

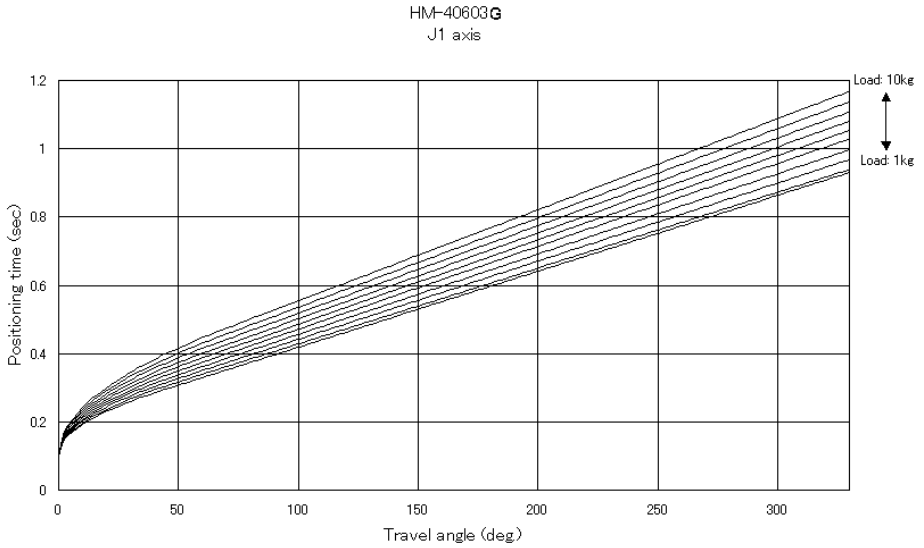


All axes (CP operation)

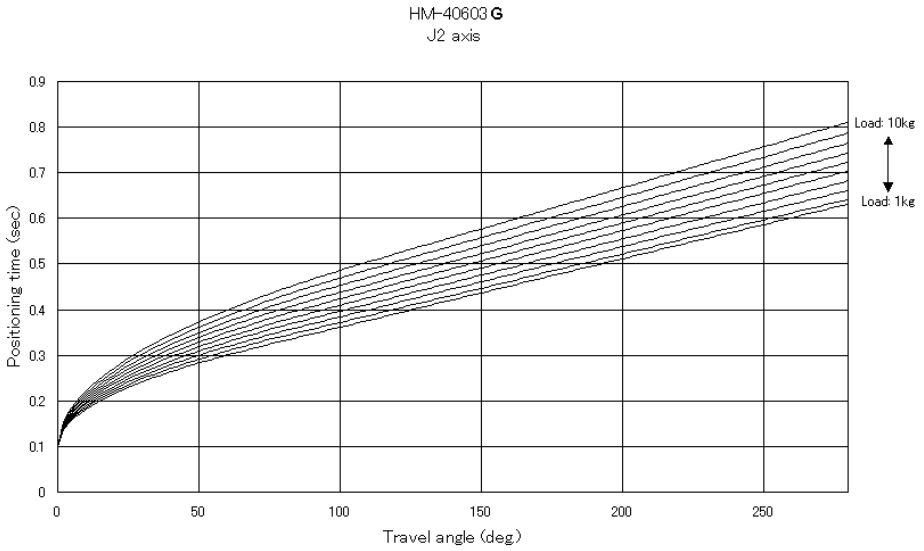


(2) HM-40603G

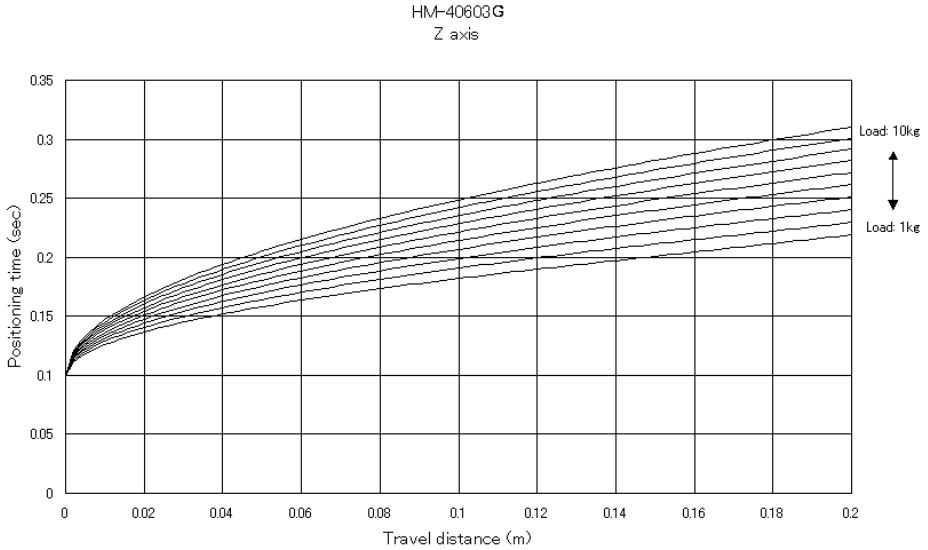
J1 axis (PTP motion)



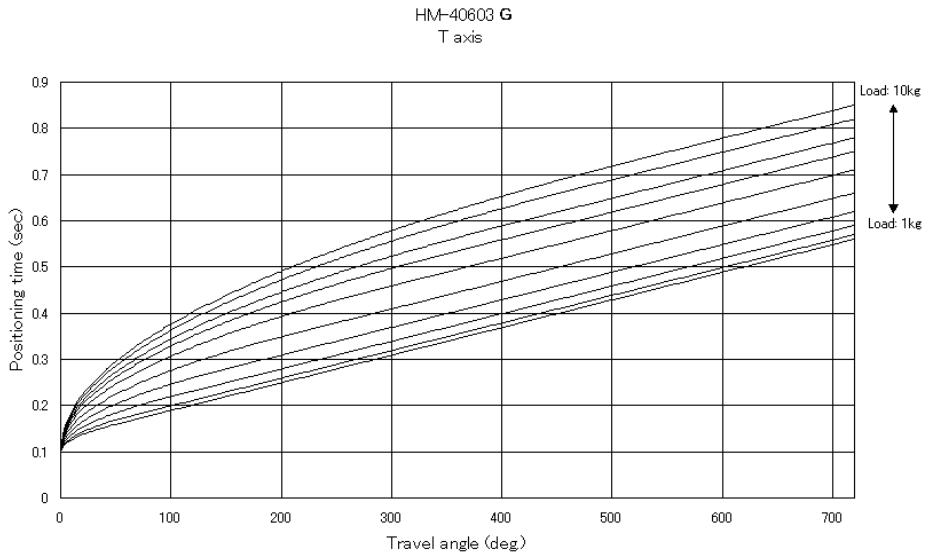
J2 axis (PTP motion)



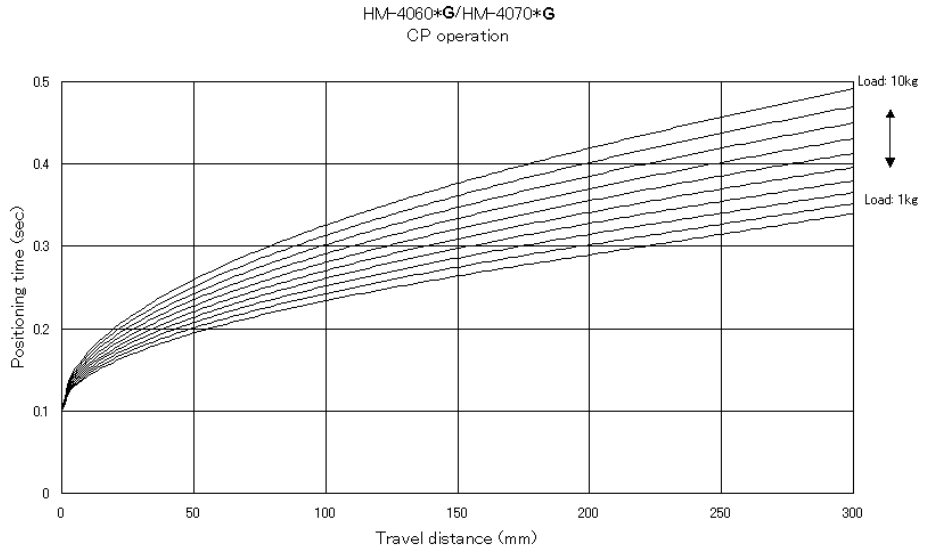
Z axis (PTP motion)



T axis (PTP motion)

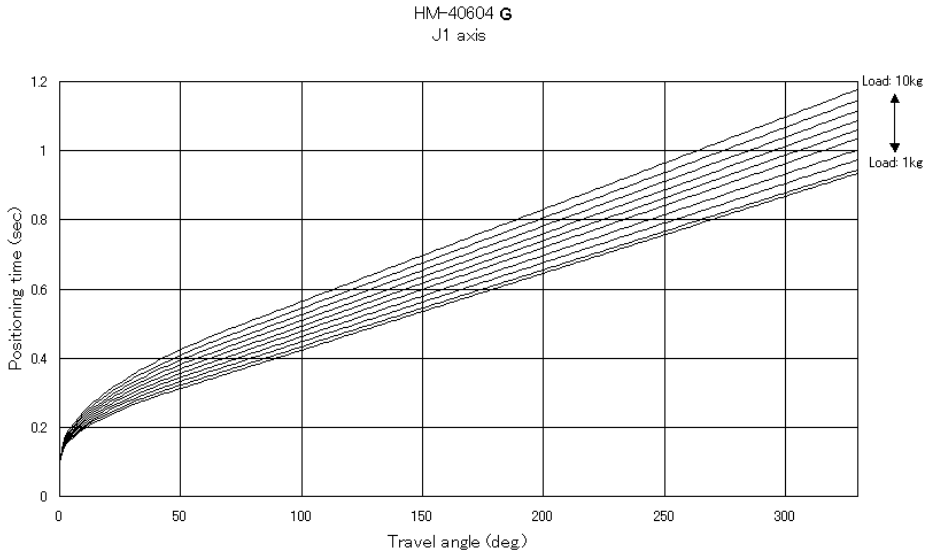


All axes (CP operation)

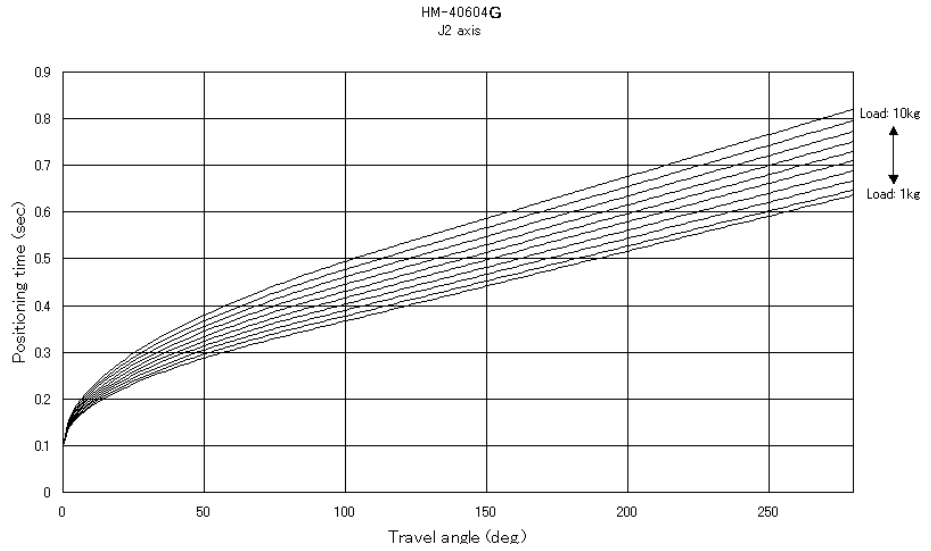


(3) HM-40604G

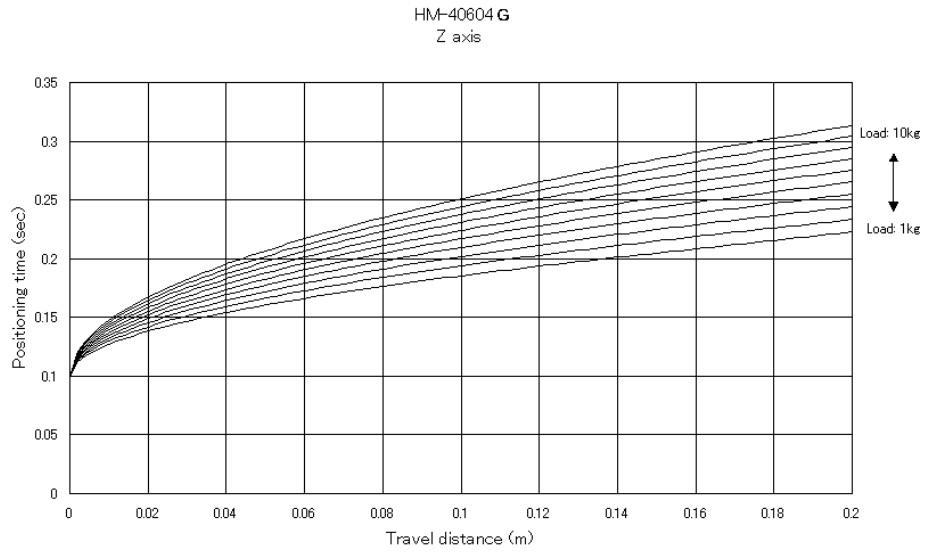
J1 axis (PTP motion)



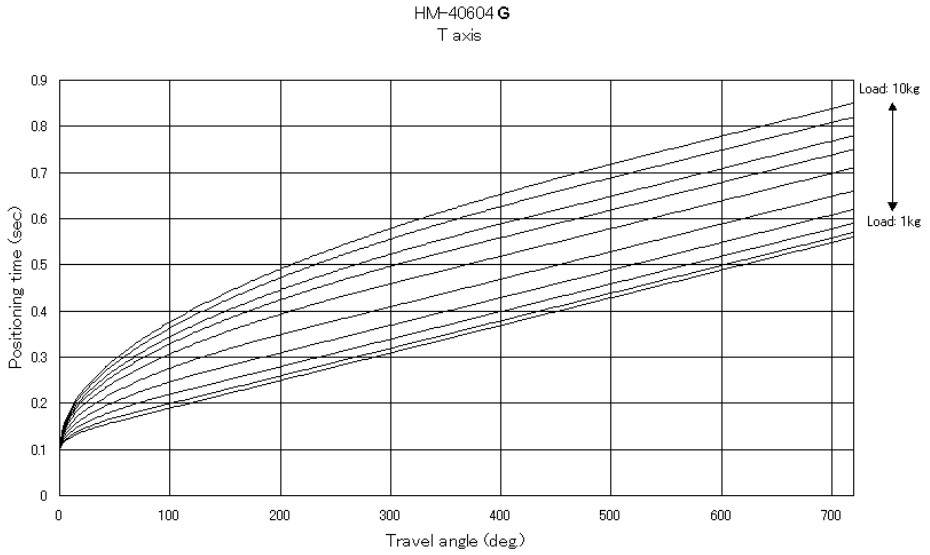
J2 axis (PTP motion)



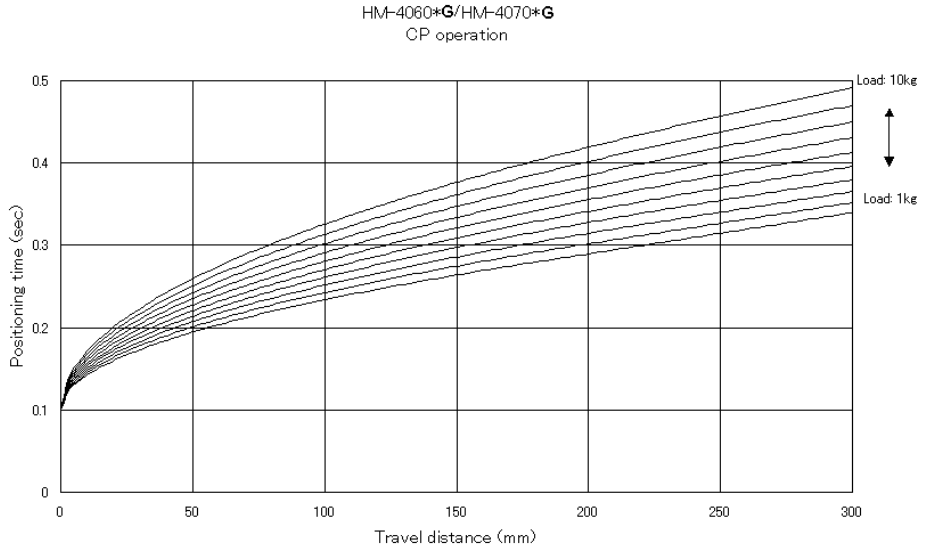
Z axis (PTP motion)



T axis (PTP motion)

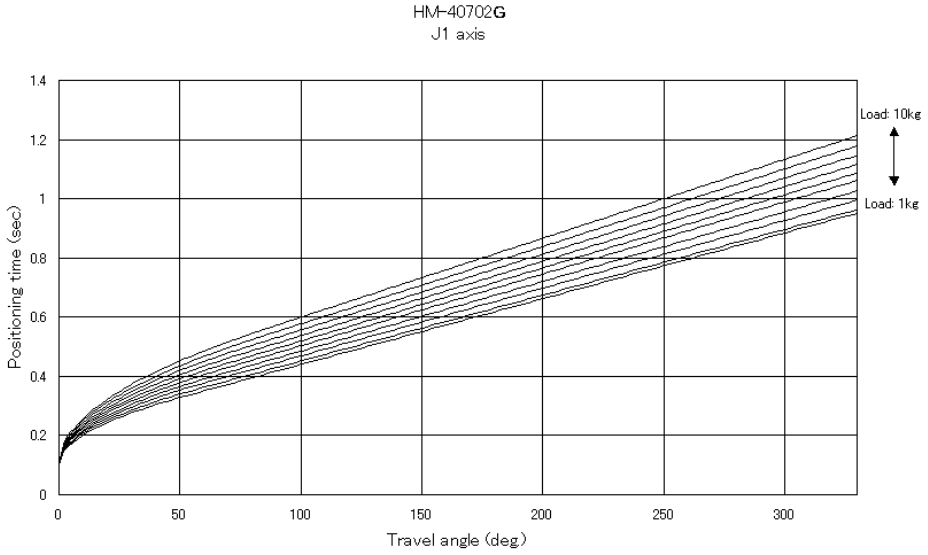


All axes (CP operation)

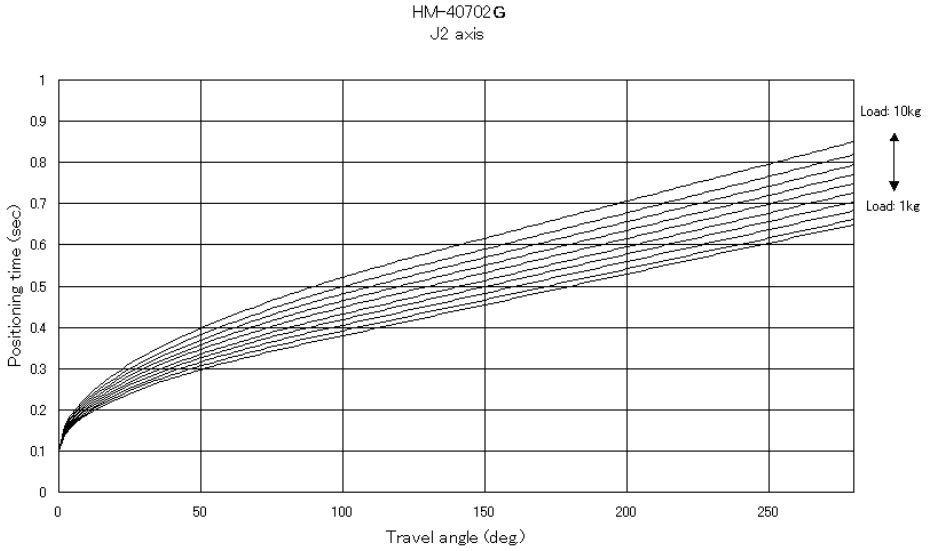


(4) HM-40702G

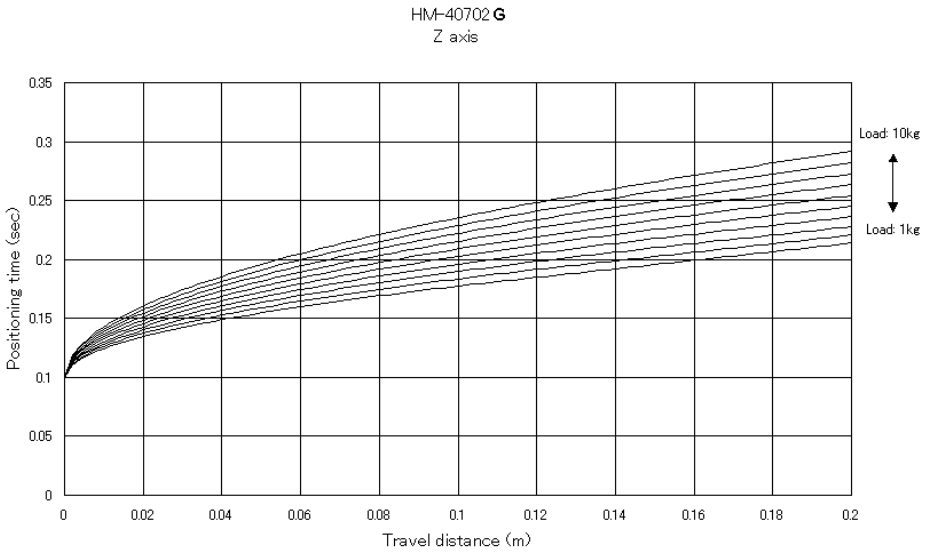
J1 axis (PTP motion)



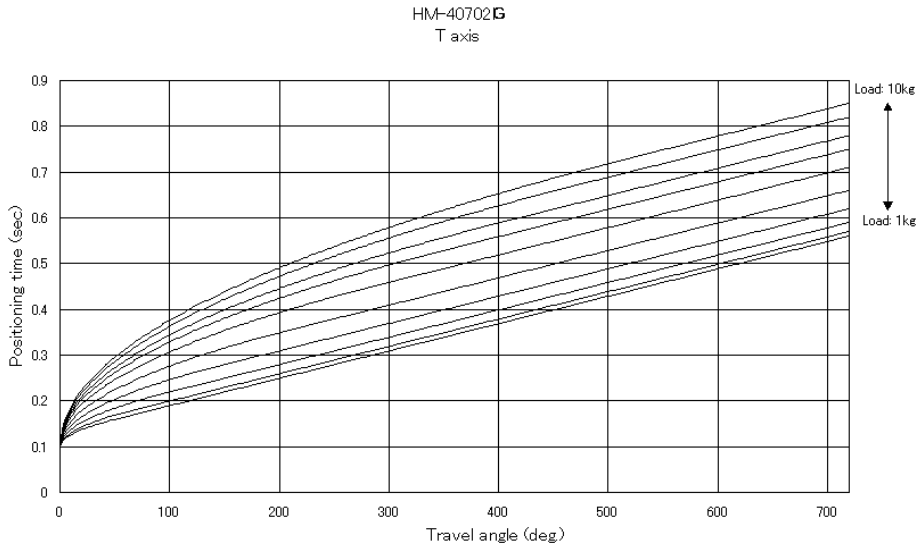
J2 axis (PTP motion)



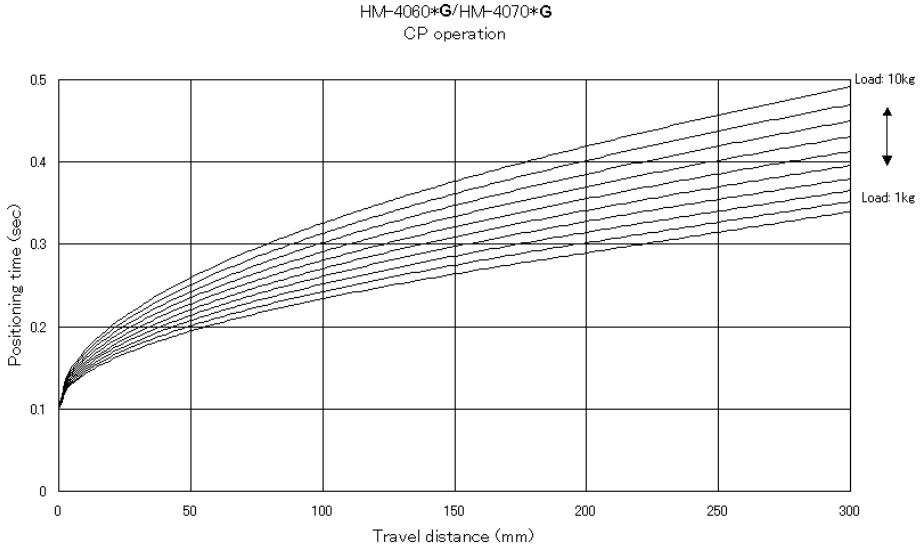
Z axis (PTP motion)



T axis (PTP motion)

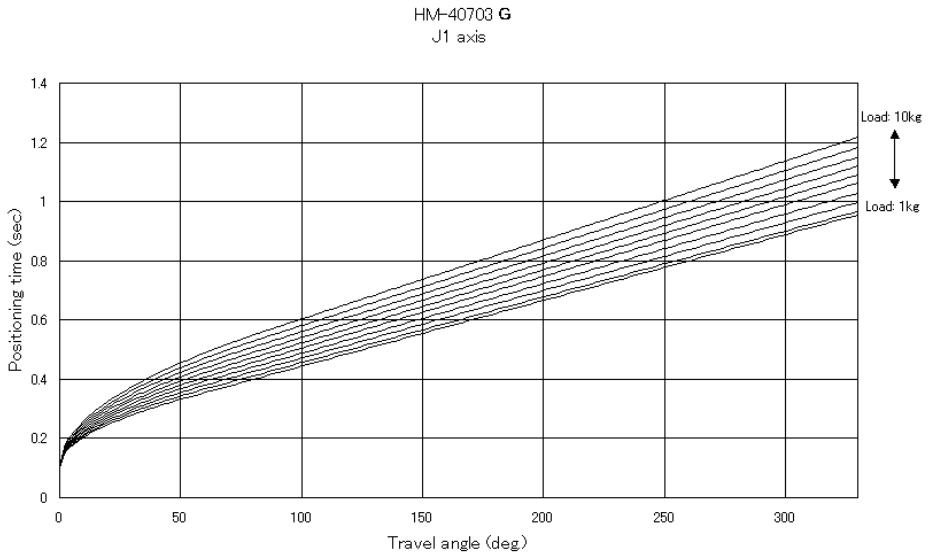


All axes (CP operation)

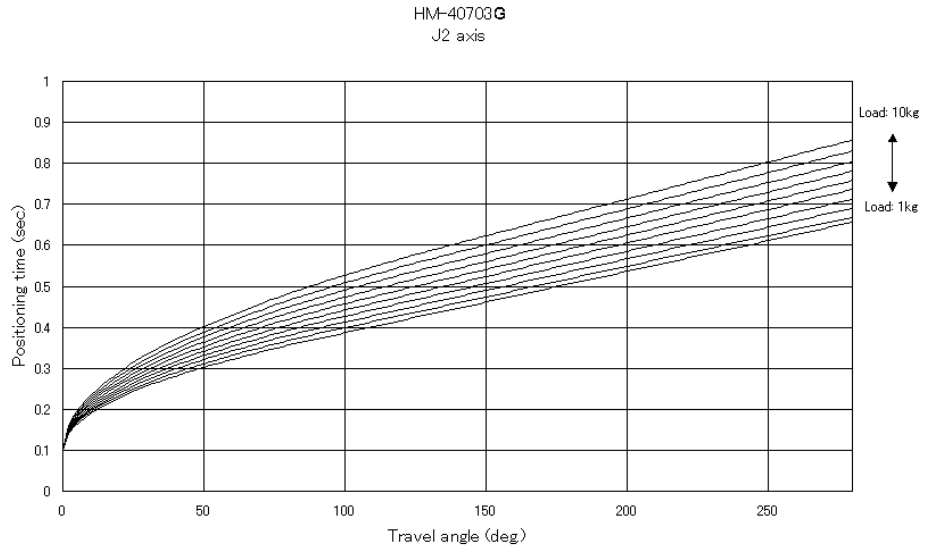


(5) HM-40703G

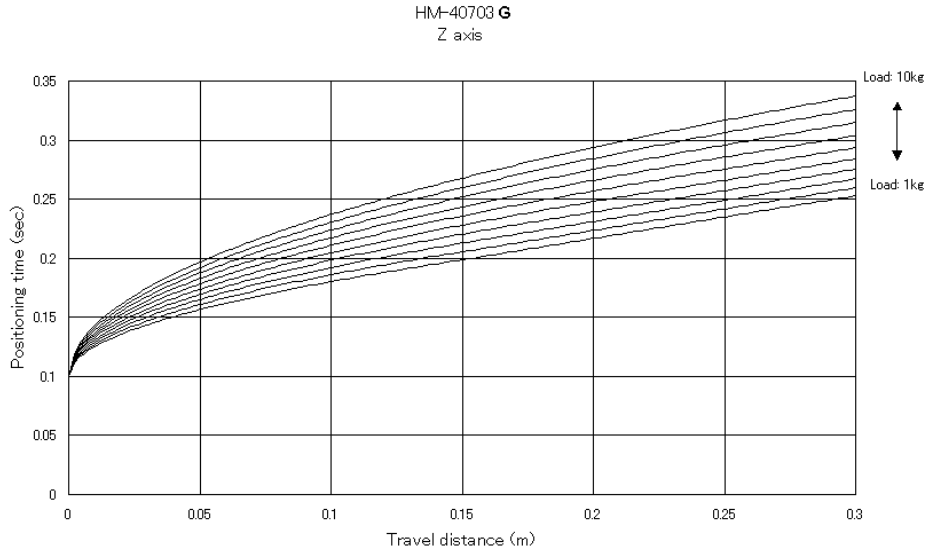
J1 axis (PTP motion)



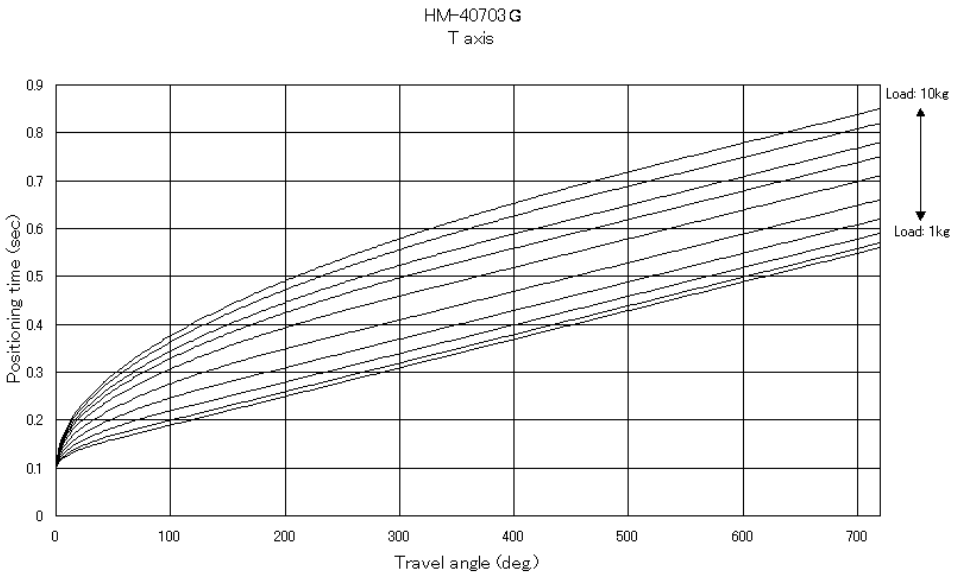
J2 axis (PTP motion)



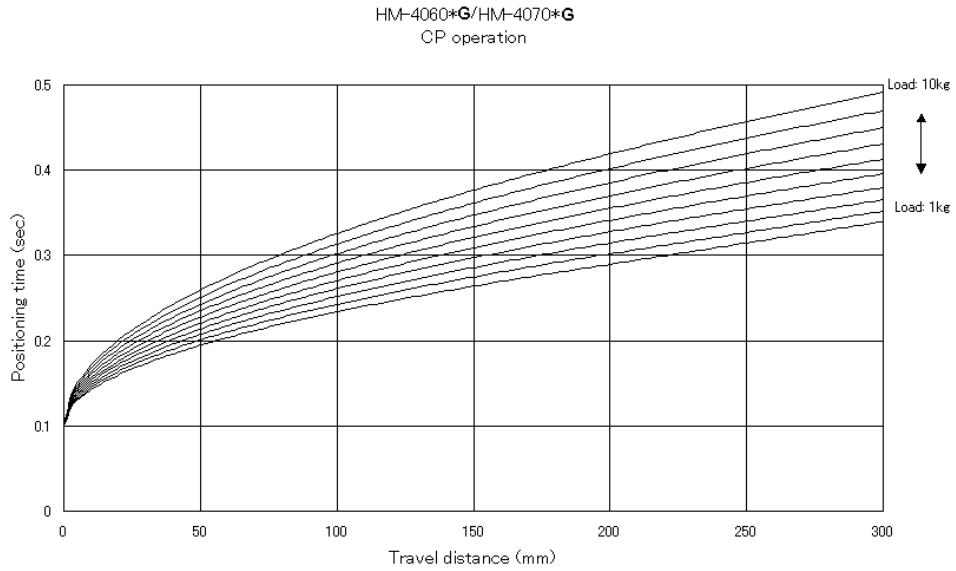
Z axis (PTP motion)



T axis (PTP motion)

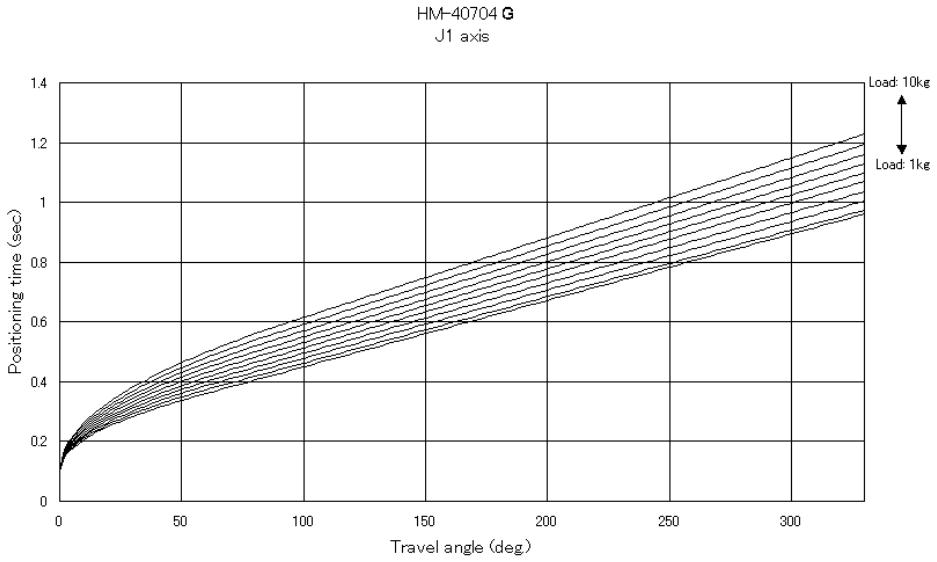


All axes (CP operation)

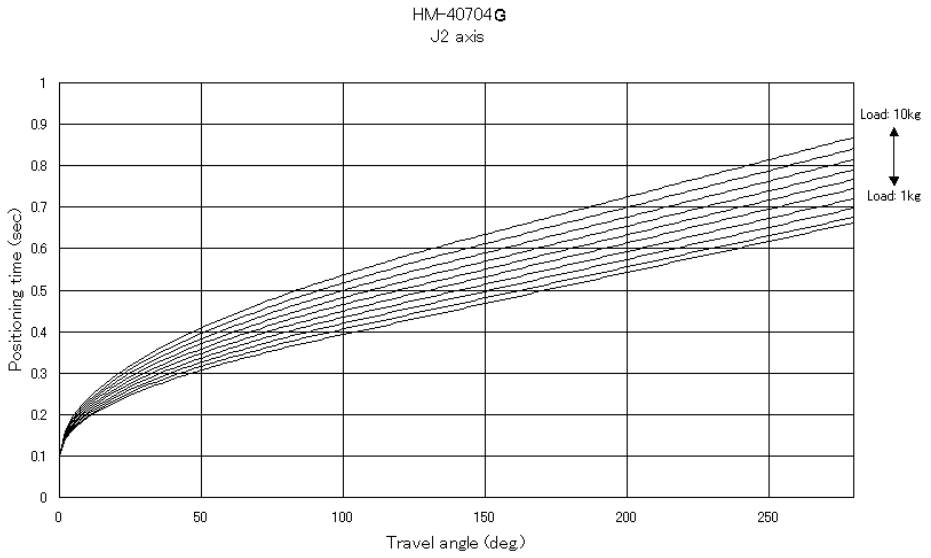


(6) HM-40704G

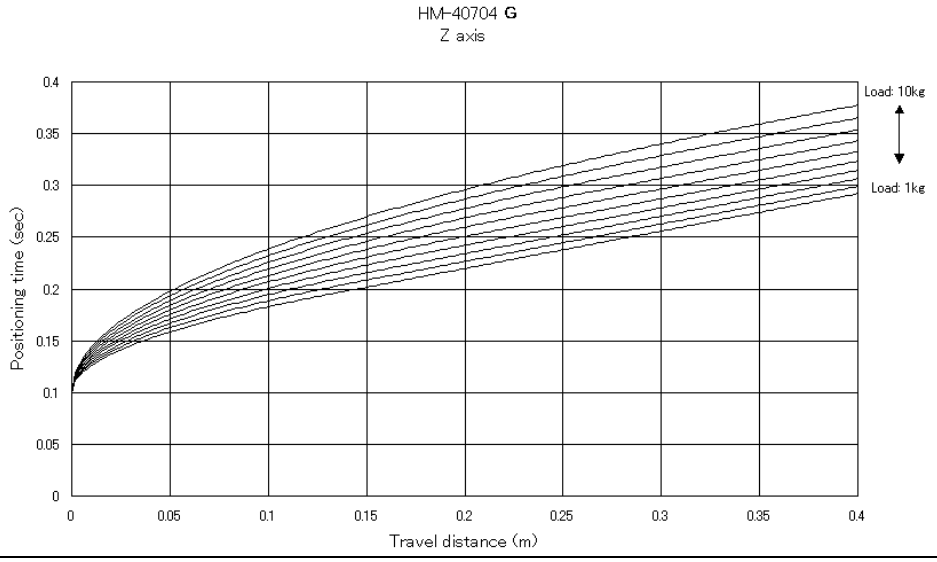
J1 axis (PTP motion)



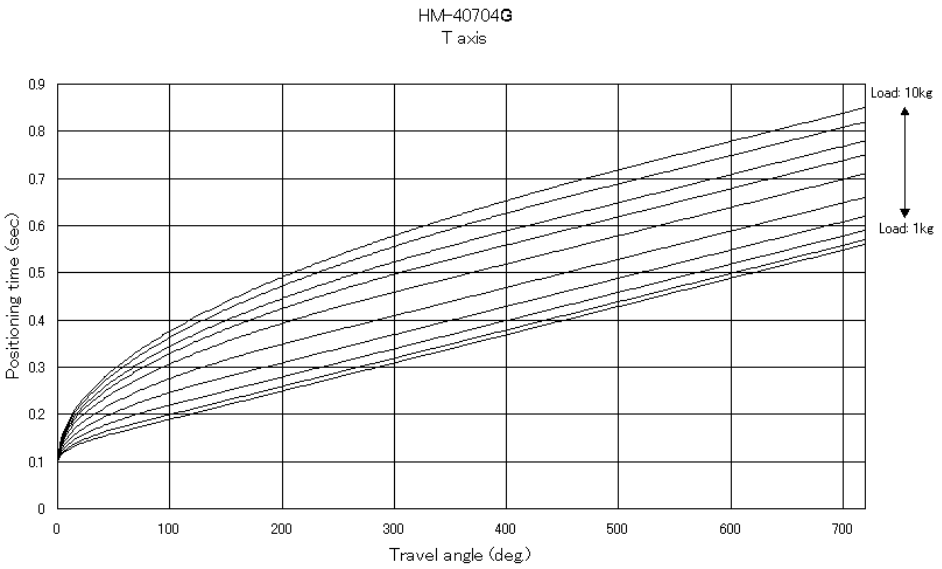
J2 axis (PTP motion)



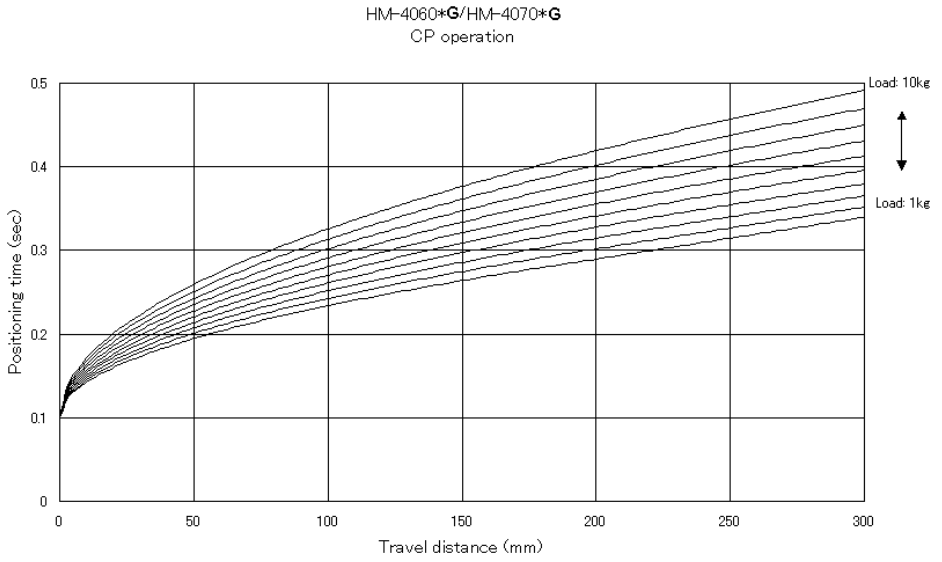
Z axis (PTP motion)



T axis (PTP motion)

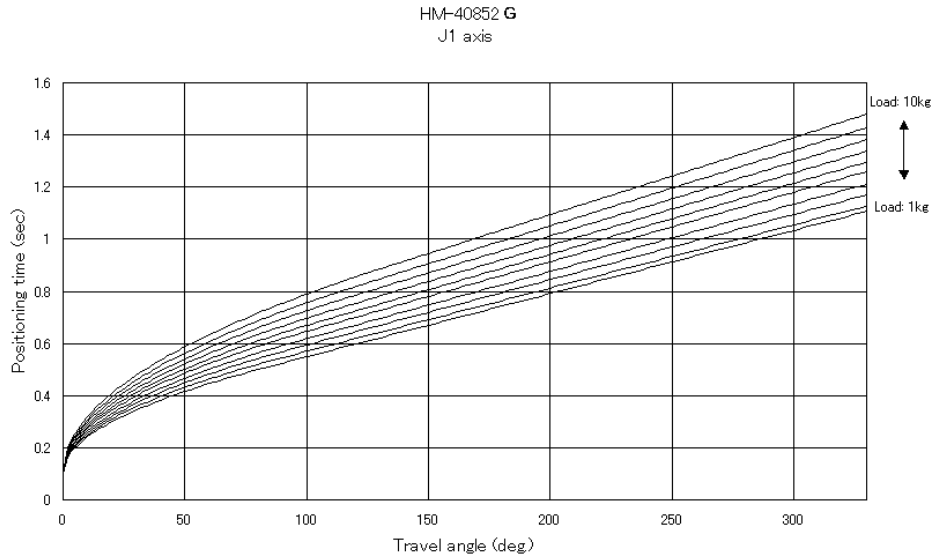


All axes (CP operation)

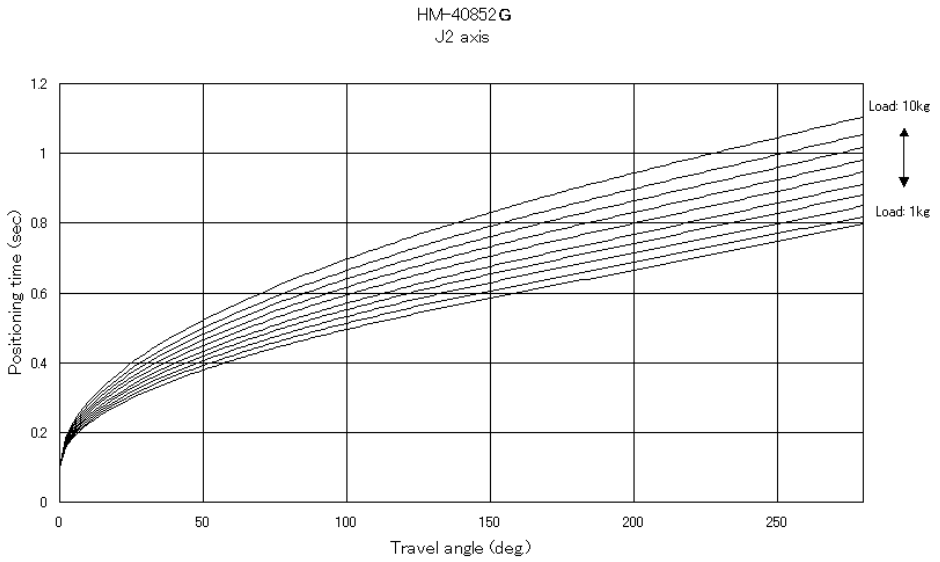


(7) HM-40852G

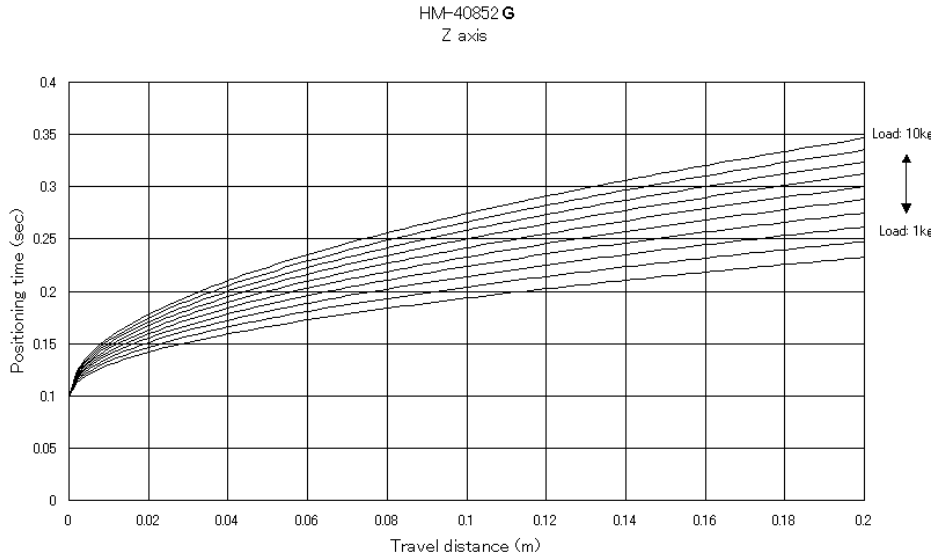
J1 axis (PTP motion)



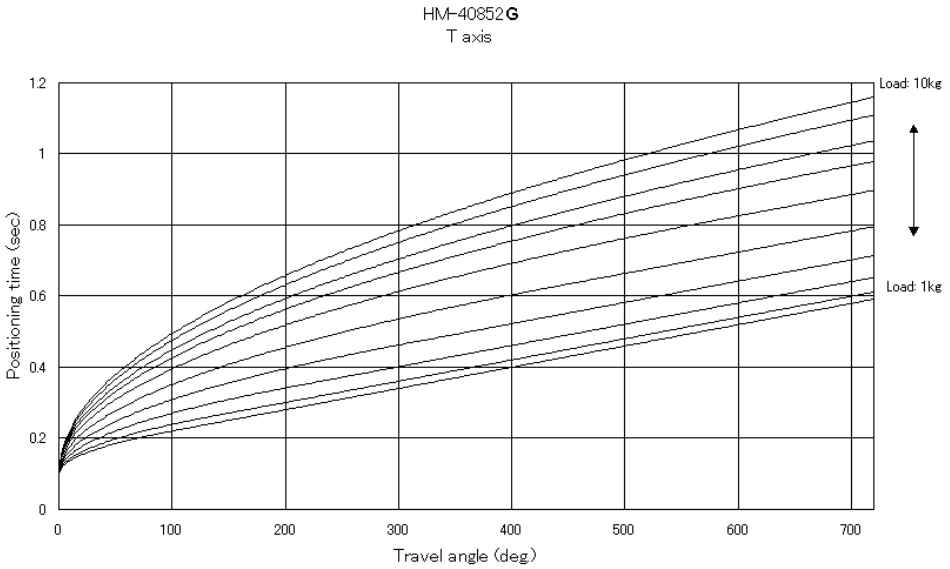
J2 axis (PTP motion)



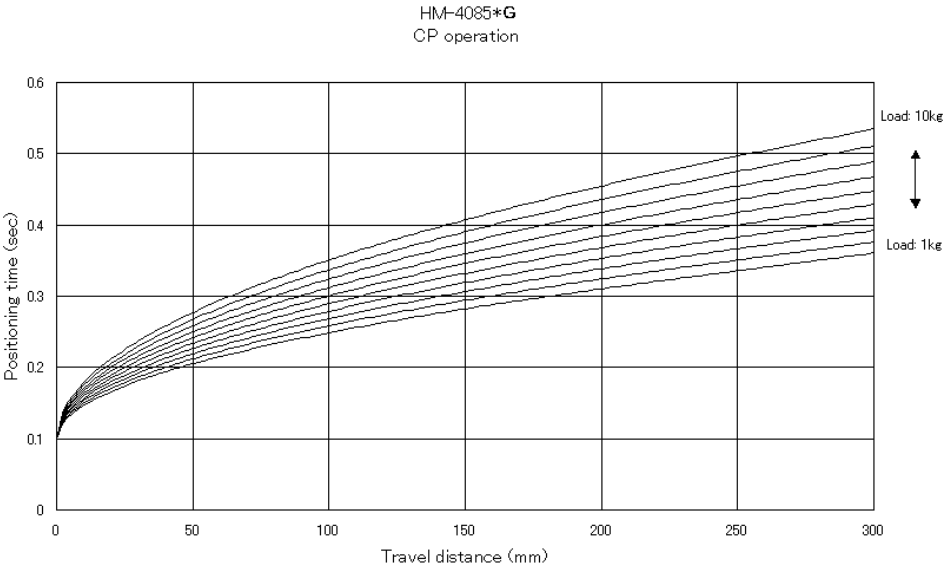
Z axis (PTP motion)



T axis (PTP motion)

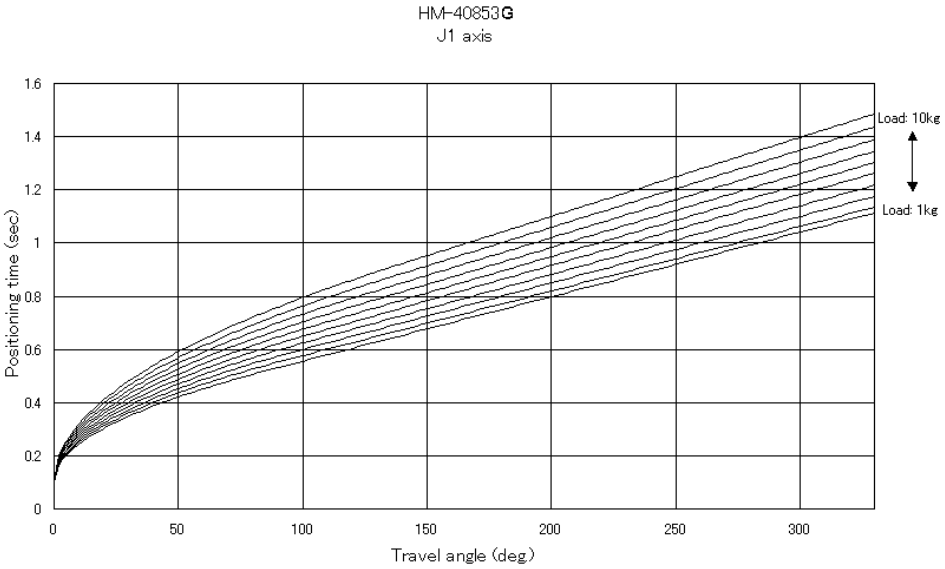


All axes (CP operation)

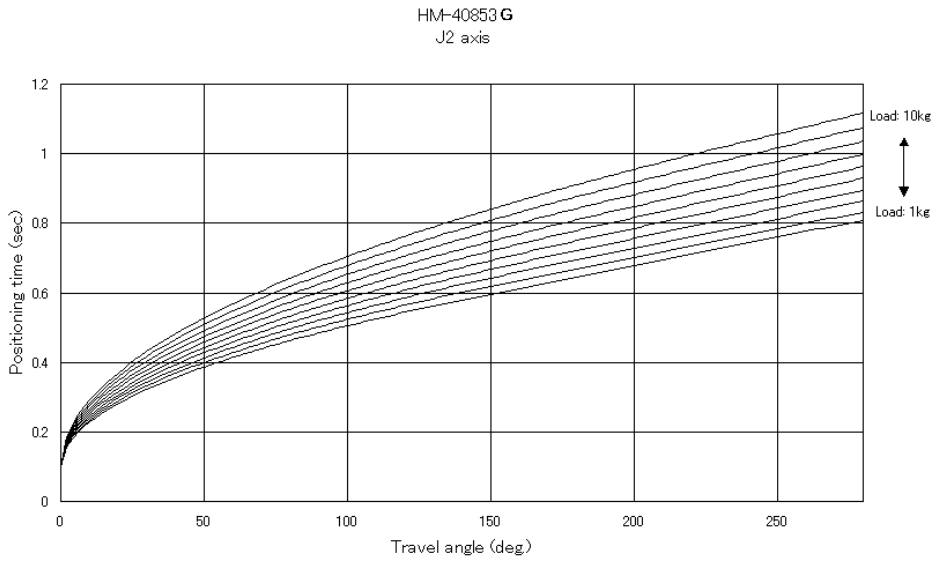


(8) HM-40853G

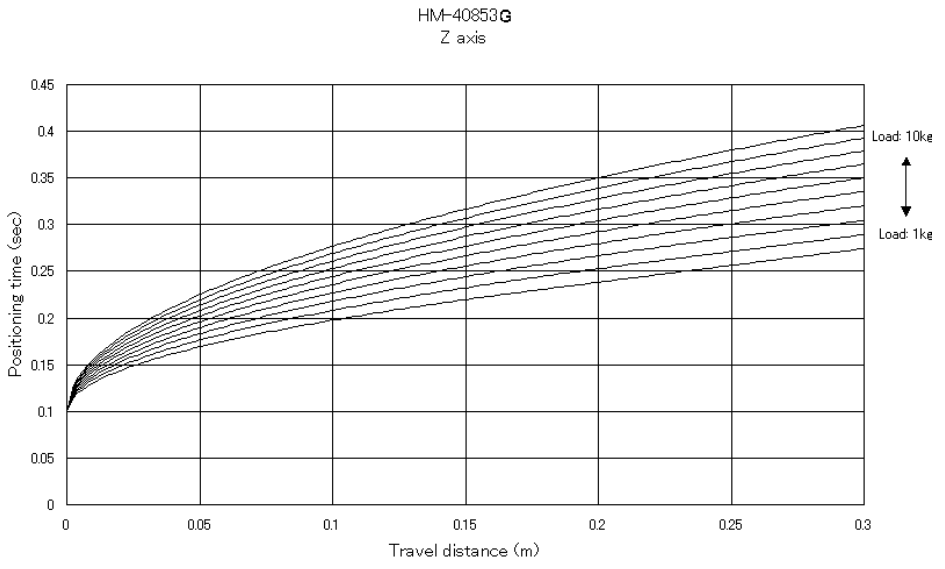
J1 axis (PTP motion)



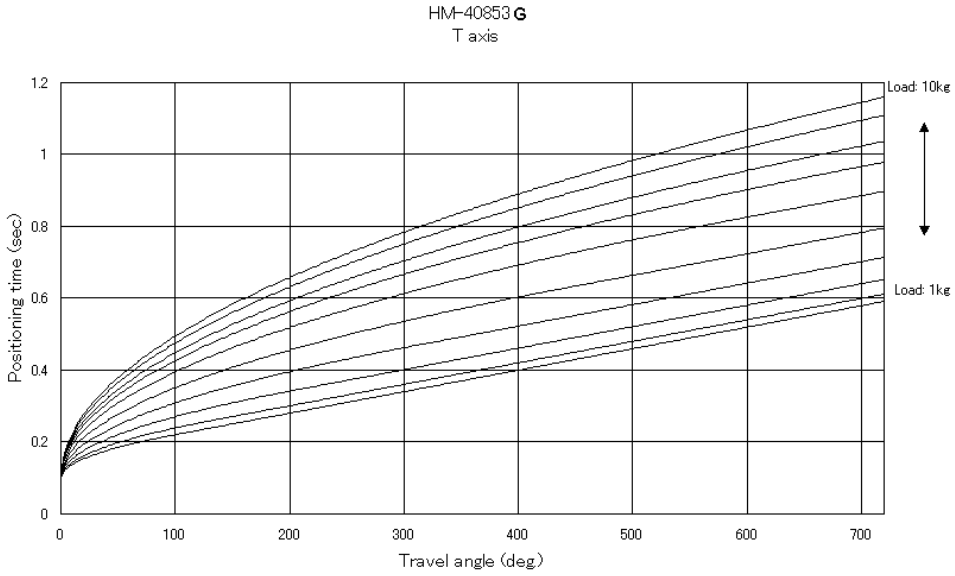
J2 axis (PTP motion)



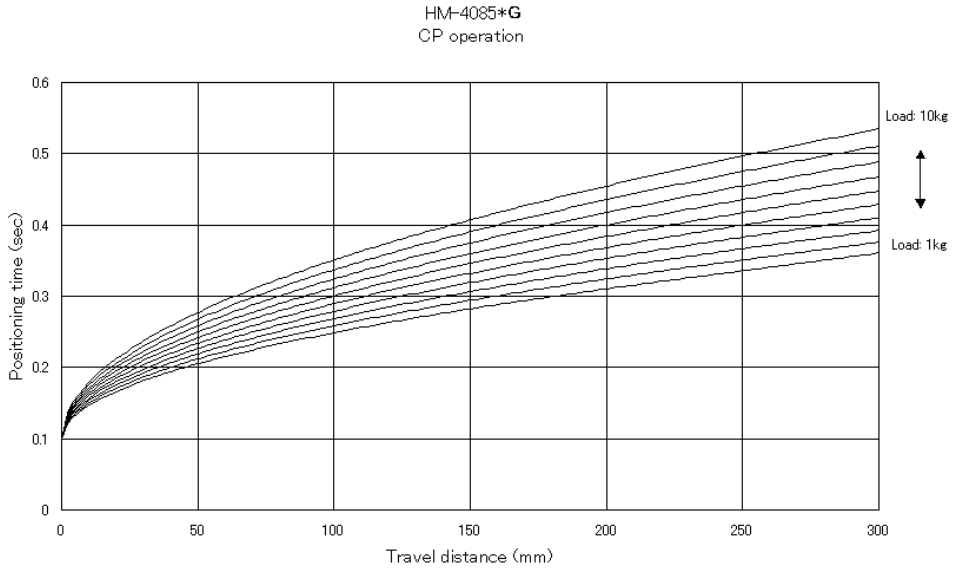
Z axis (PTP motion)



T axis (PTP motion)

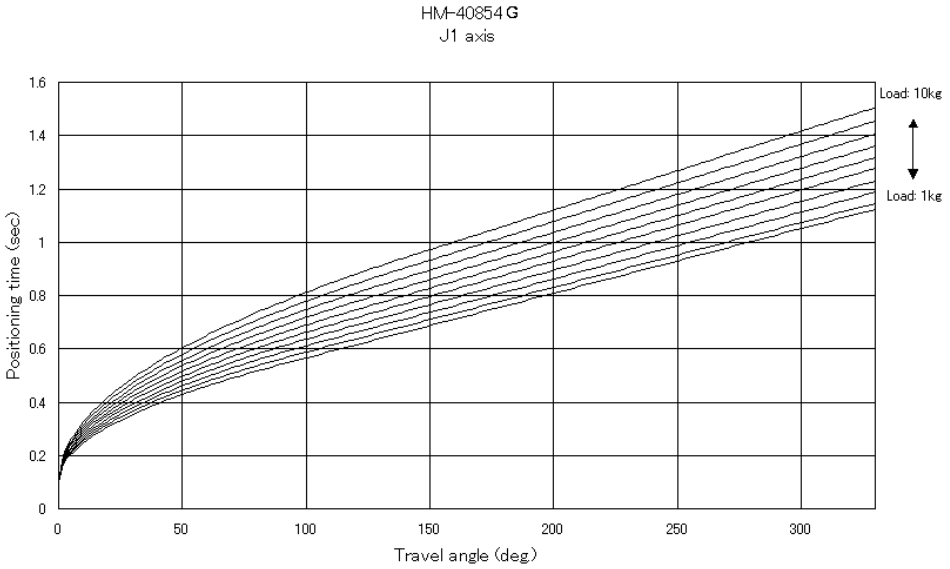


All axes (CP operation)

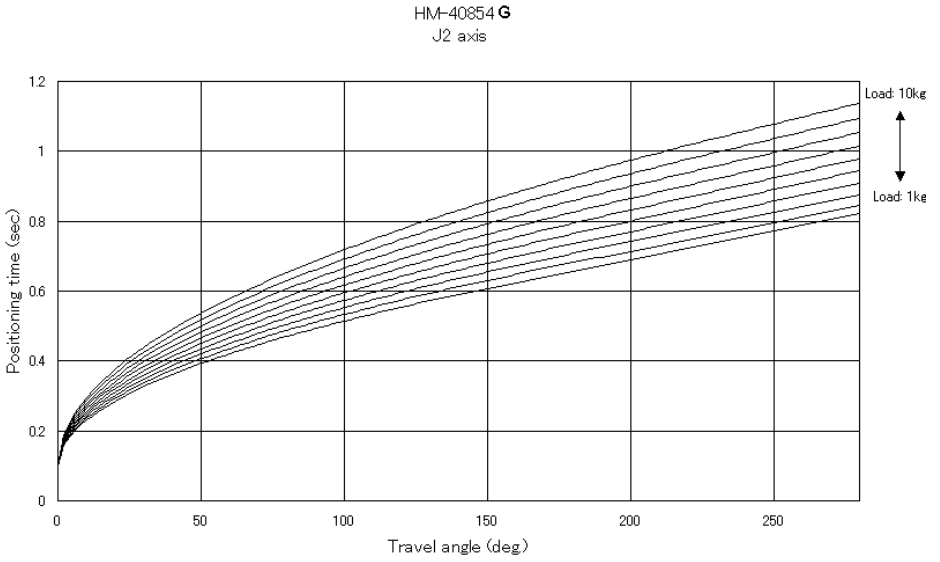


(9) HM-40854G

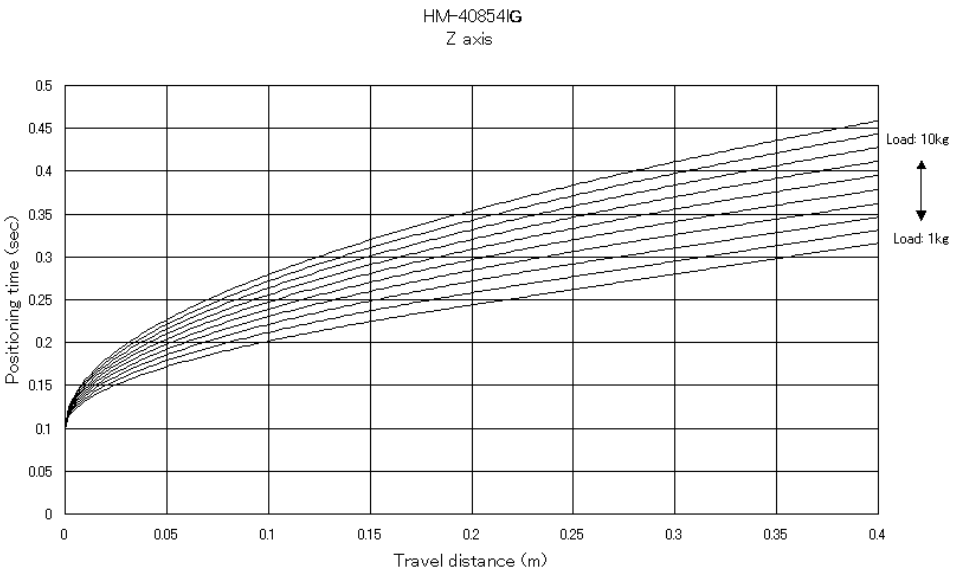
J1 axis (PTP motion)



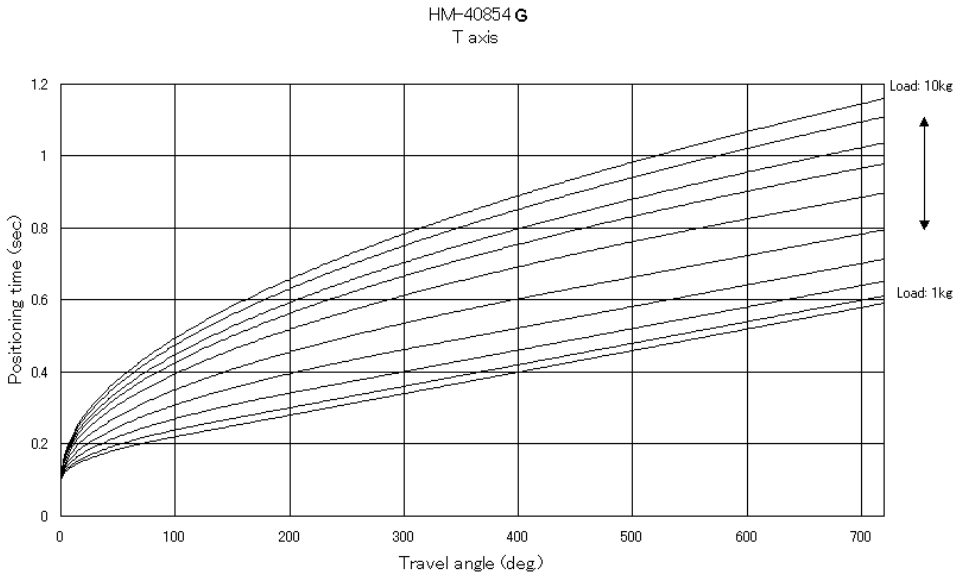
J2 axis (PTP motion)



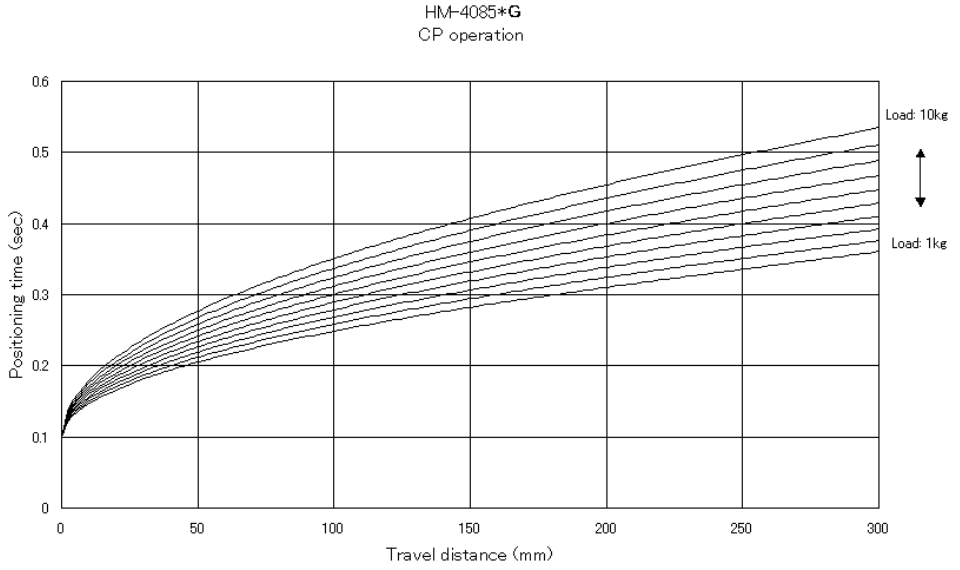
Z axis (PTP motion)



T axis (PTP motion)

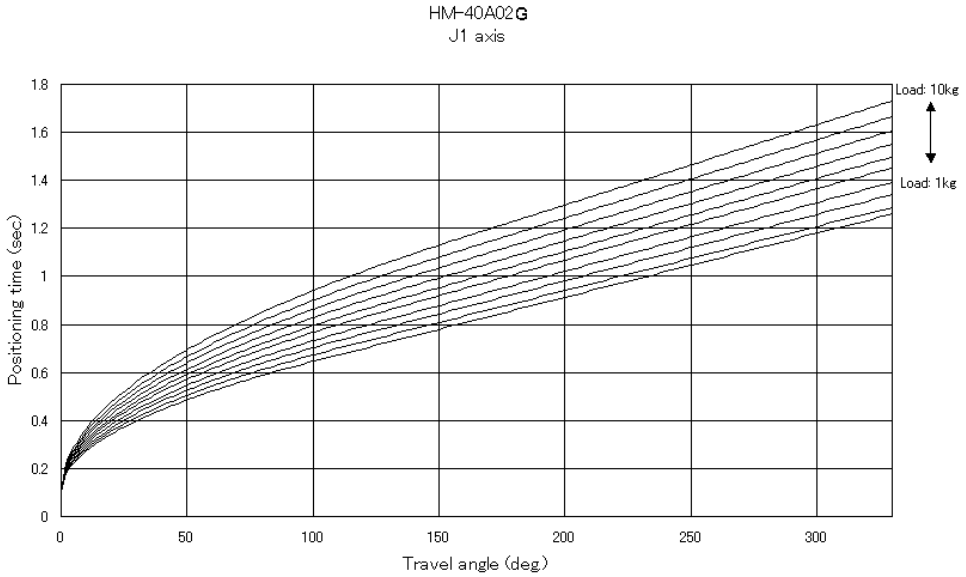


All axes (CP operation)

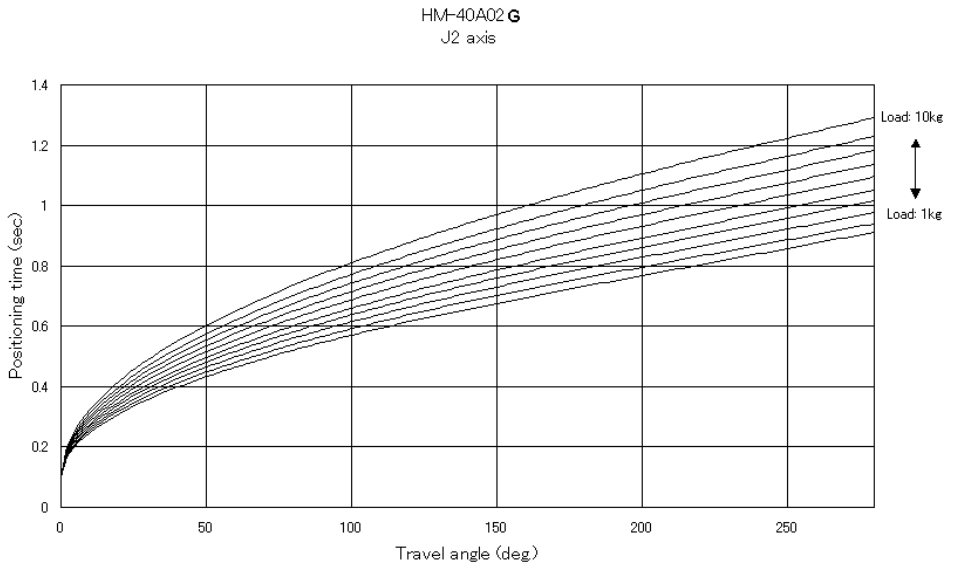


(10) HM-40A02G

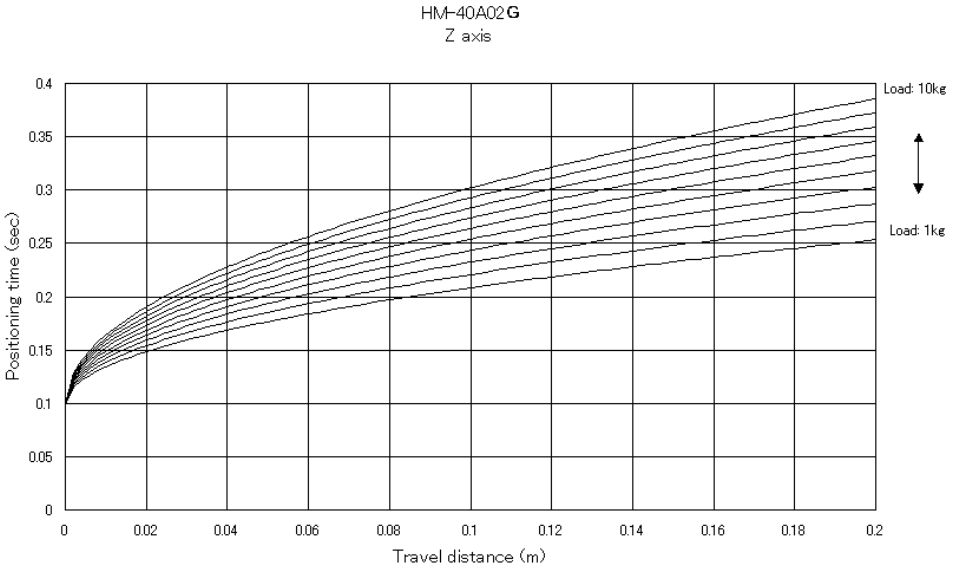
J1 axis (PTP motion)



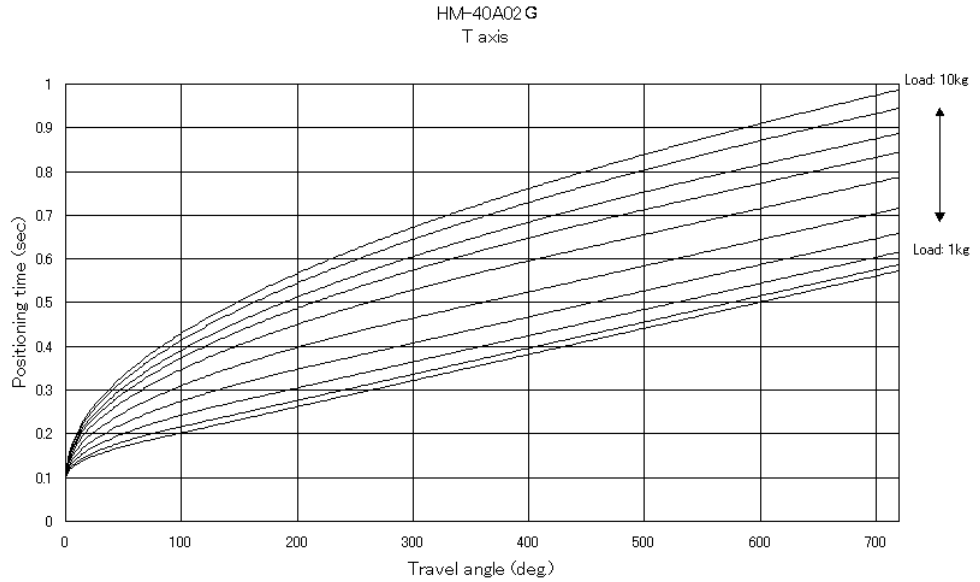
J2 axis (PTP motion)



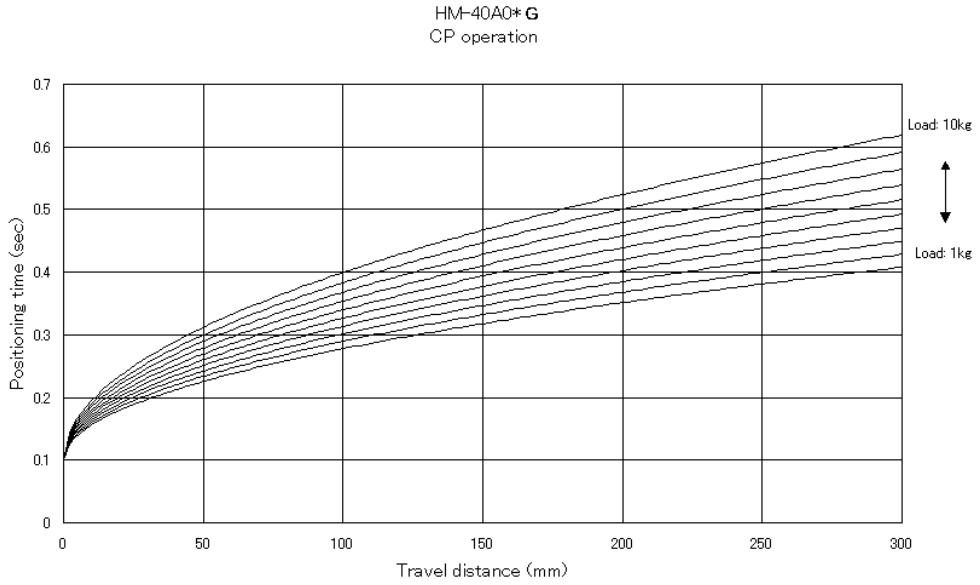
Z axis (PTP motion)



T axis (PTP motion)

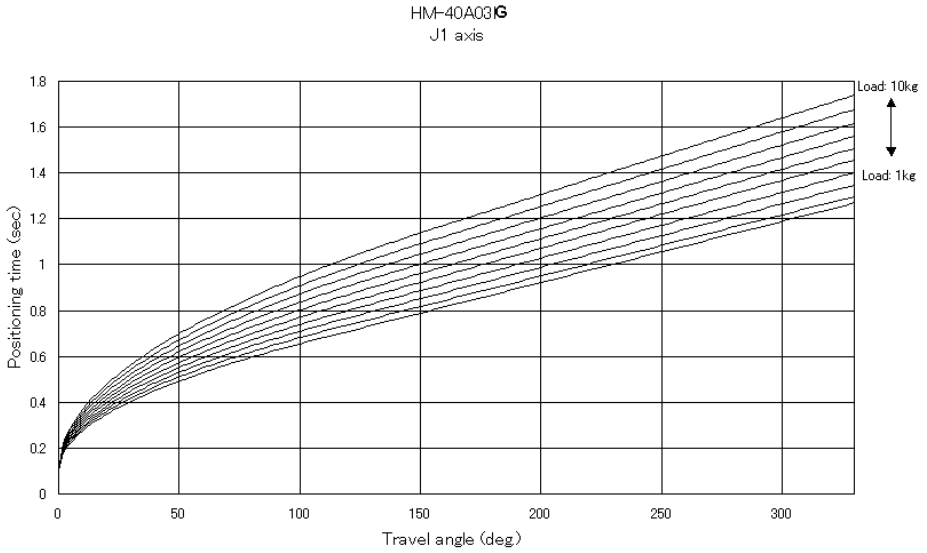


All axes (CP operation)

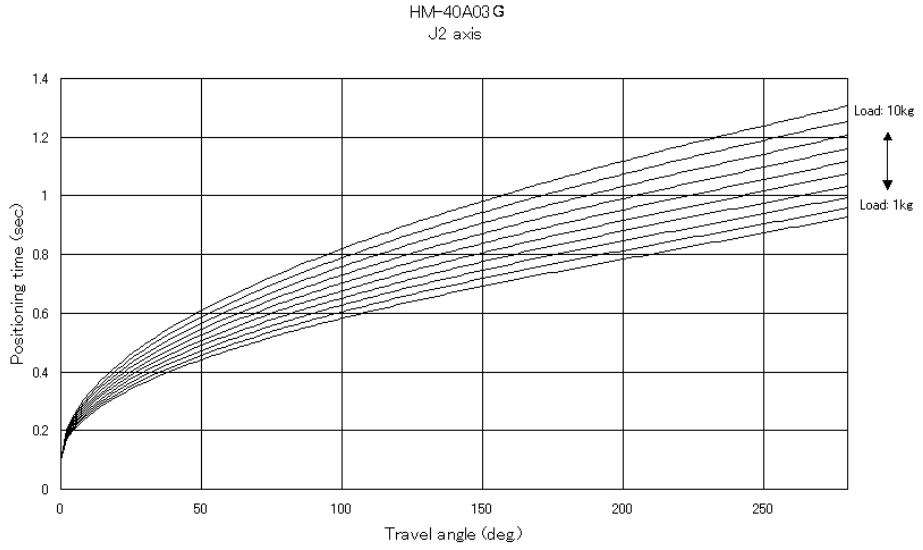


(11) HM-40A03G

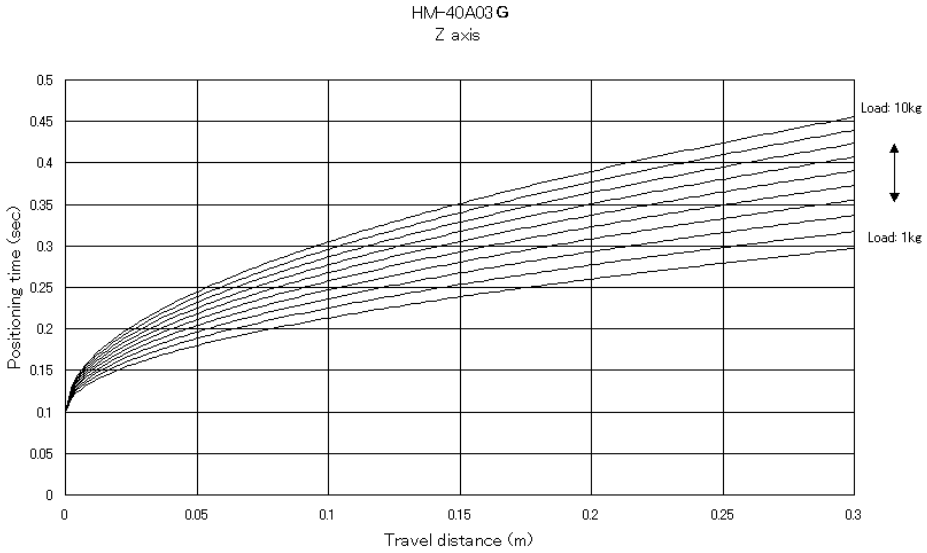
J1 axis (PTP motion)



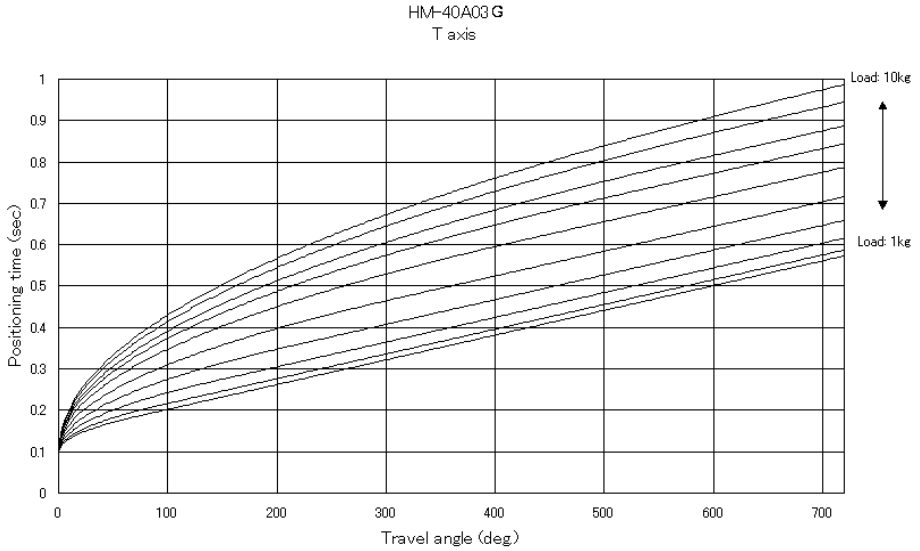
J2 axis (PTP motion)



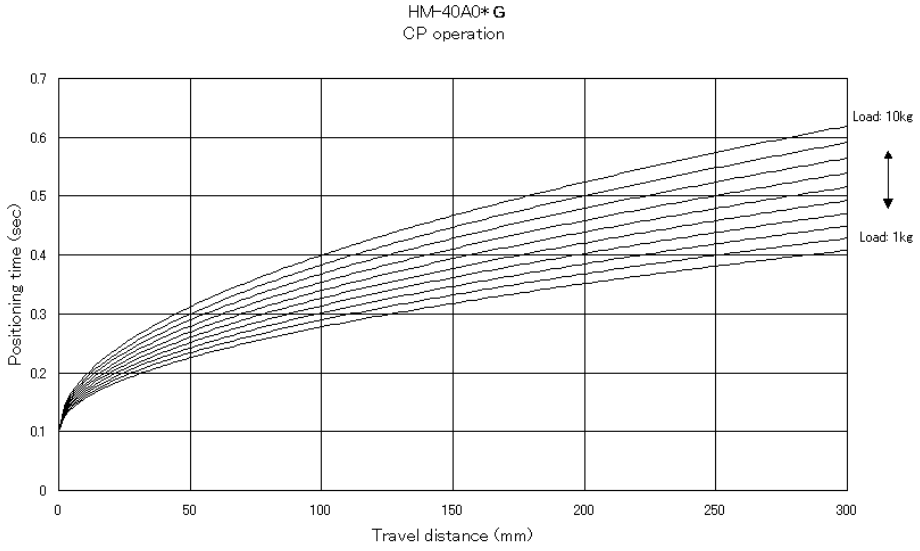
Z axis (PTP motion)



T axis (PTP motion)

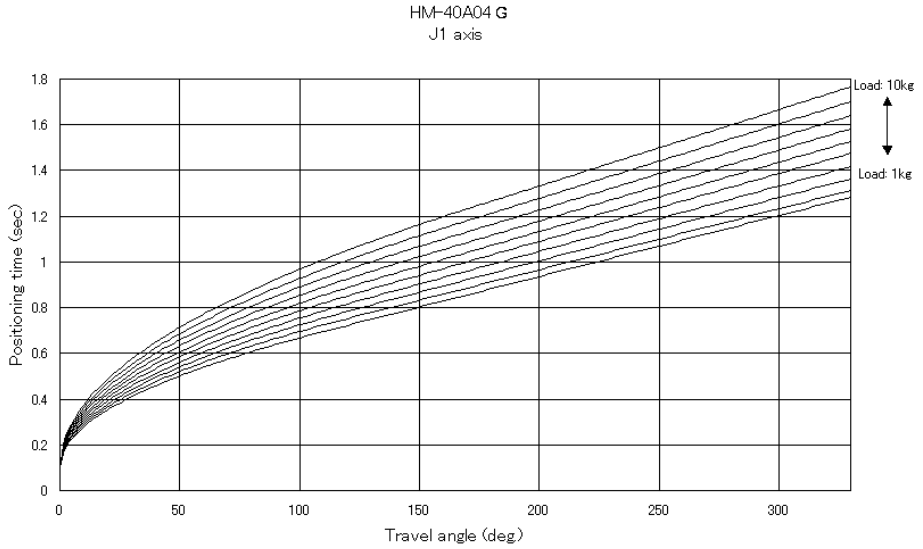


All axes (CP operation)

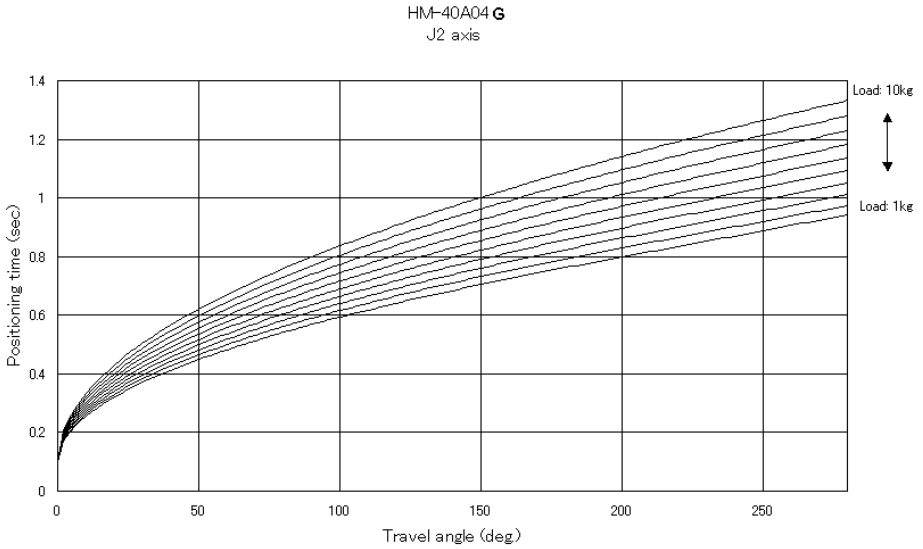


(12) HM-40A04G

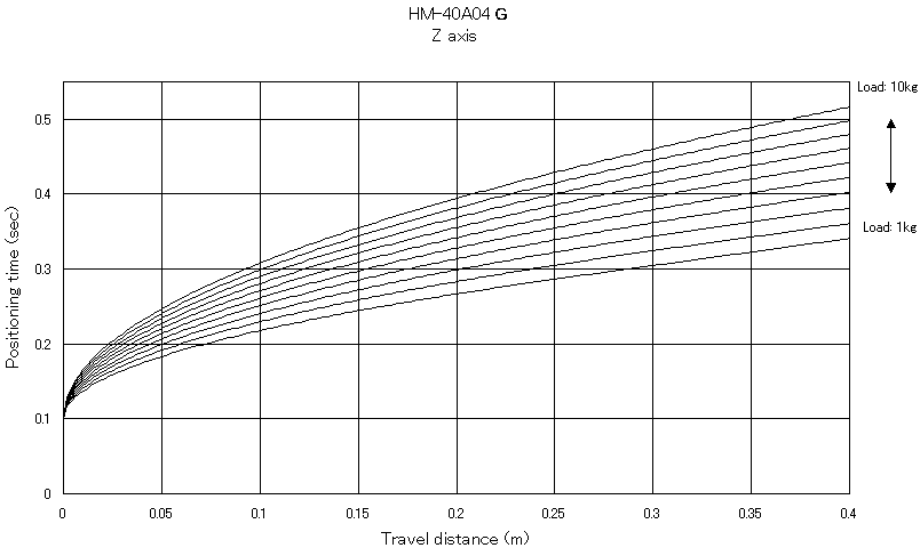
J1 axis (PTP motion)



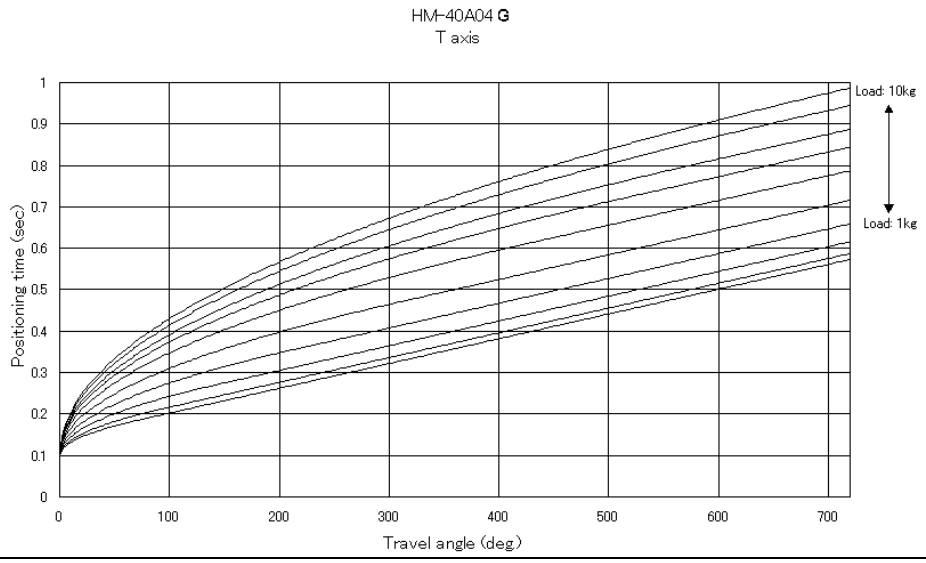
J2 axis (PTP motion)



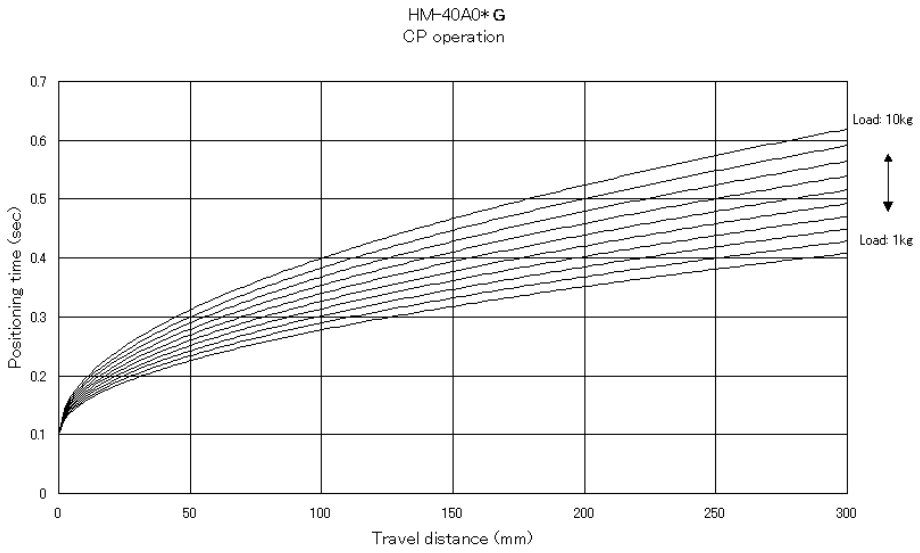
Z axis (PTP motion)



T axis (PTP motion)

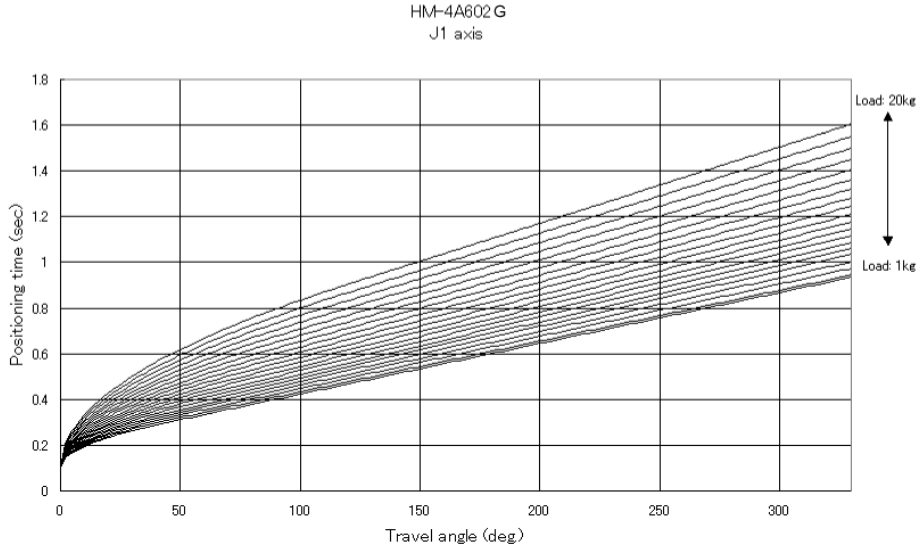


All axes (CP operation)

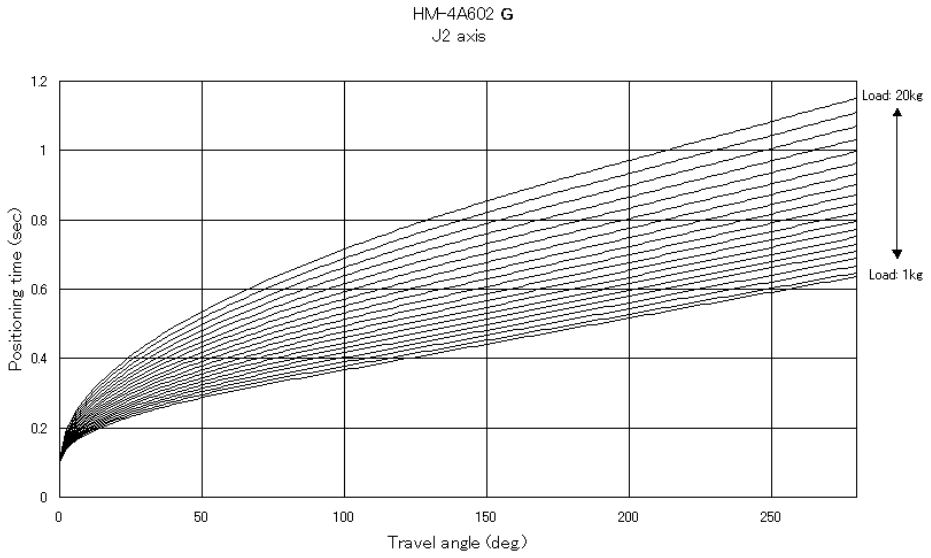


(13) HM-4A602G

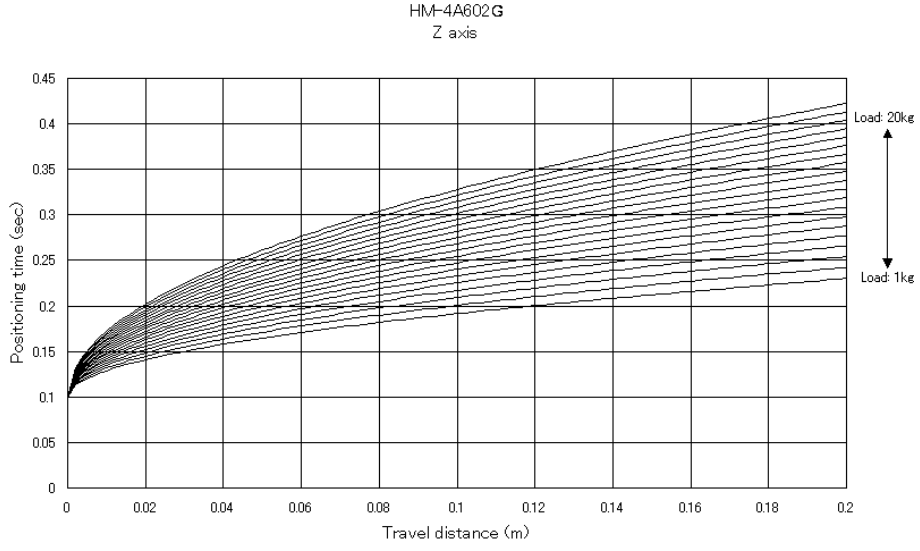
J1 axis (PTP motion)



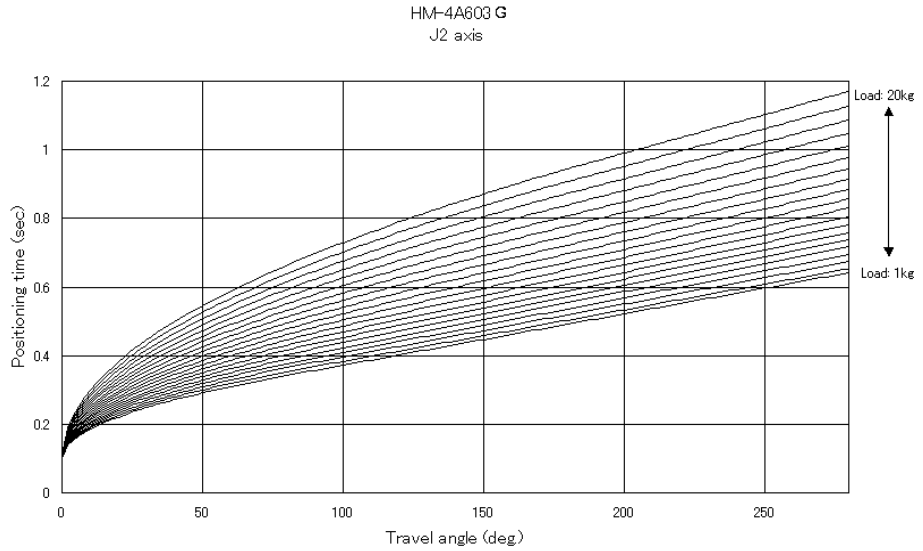
J2 axis (PTP motion)



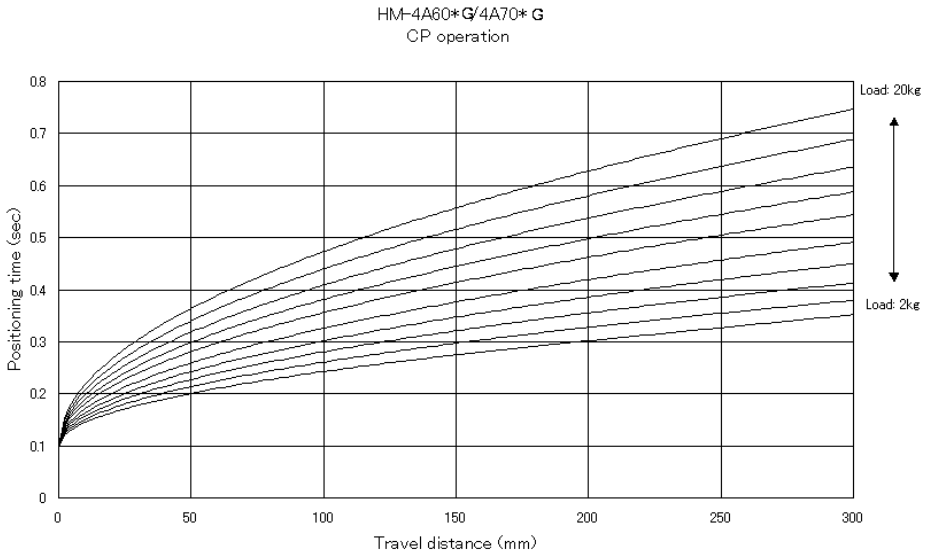
Z axis (PTP motion)



T axis (PTP motion)

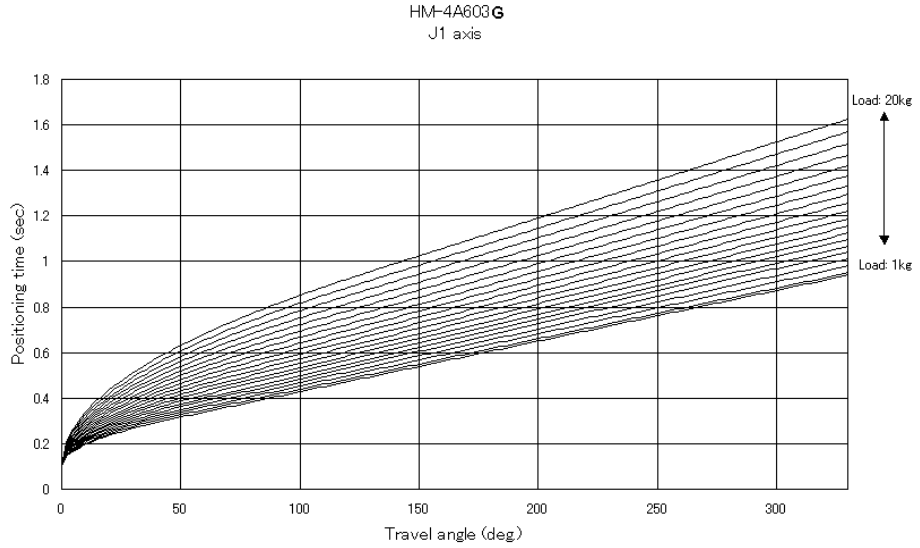


All axes (CP operation)

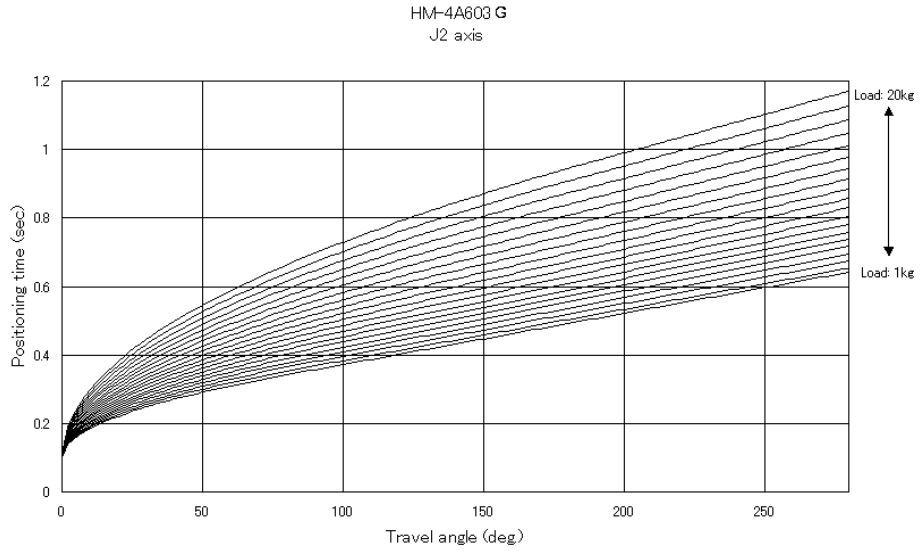


(14) HM-4A603G

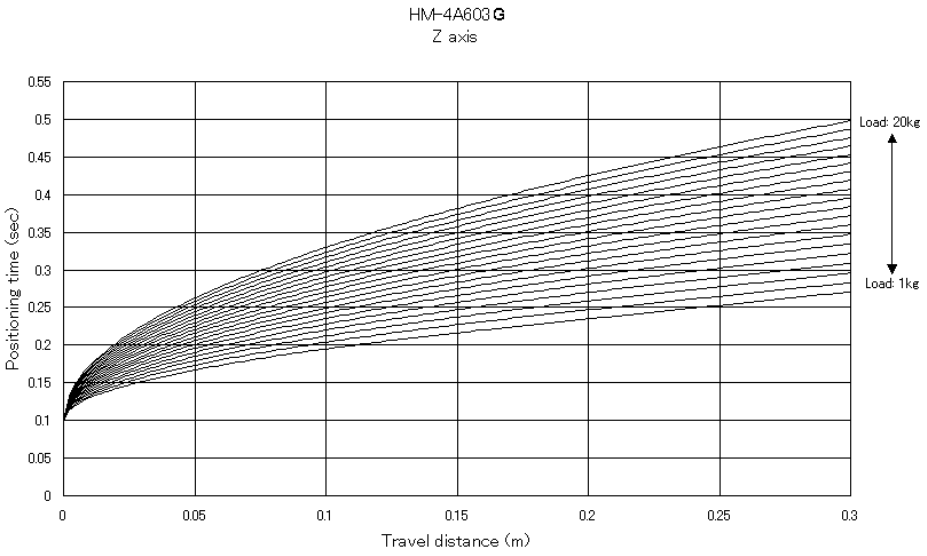
J1 axis (PTP motion)



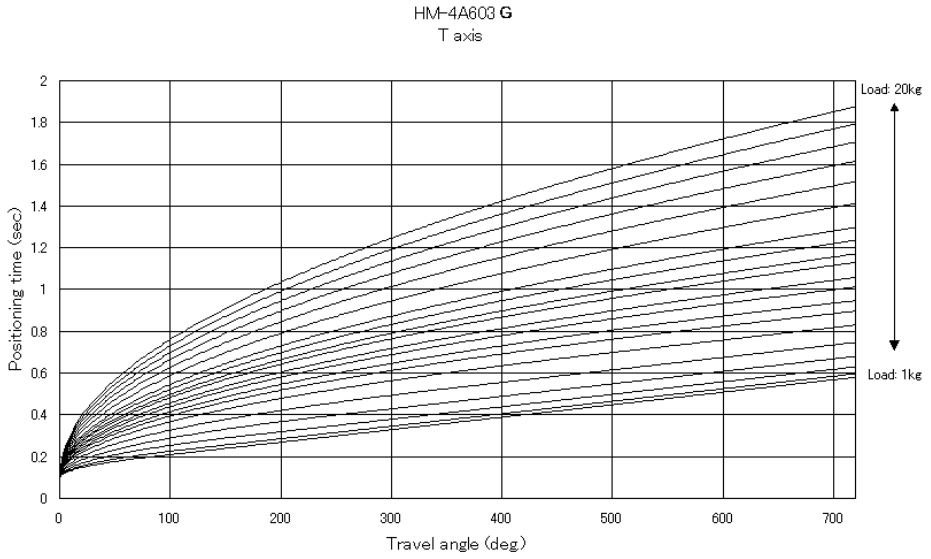
J2 axis (PTP motion)



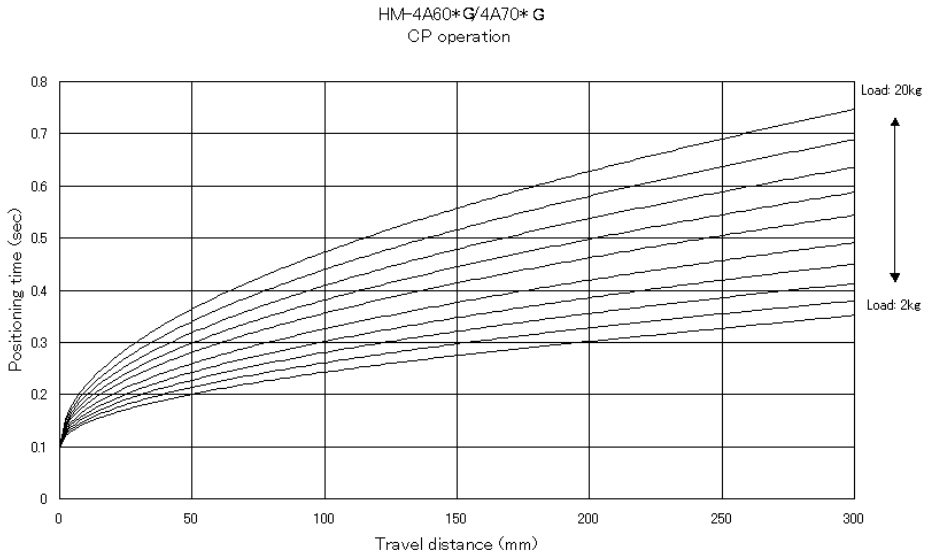
Z axis (PTP motion)



T axis (PTP motion)

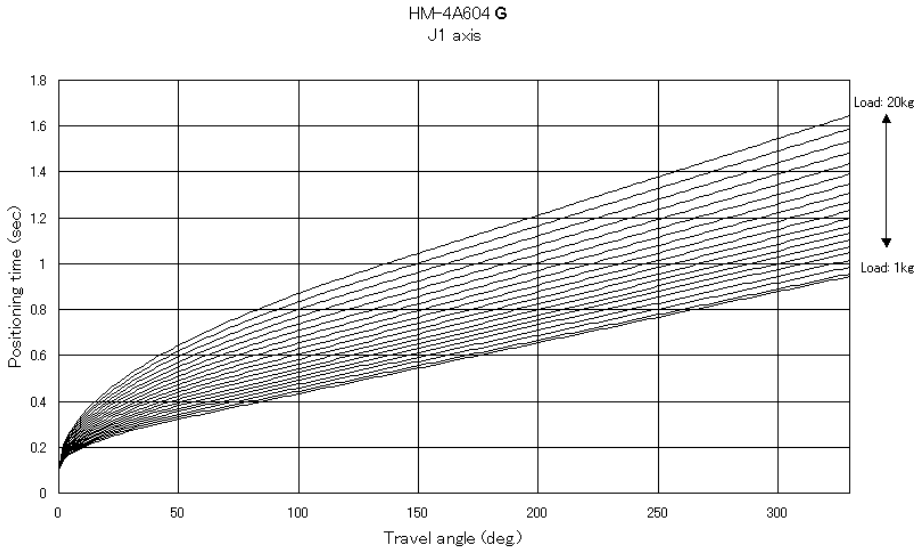


All axes (CP operation)

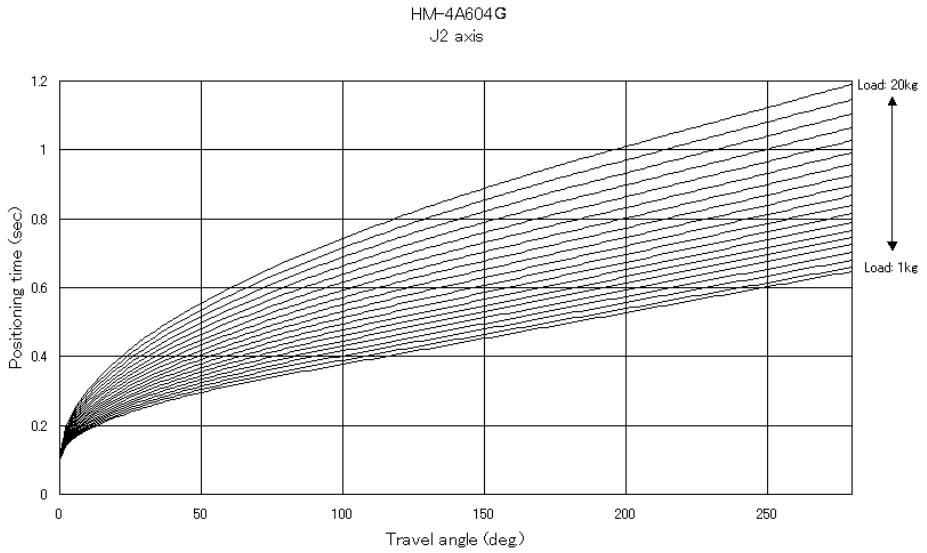


(15) HM-4A604G

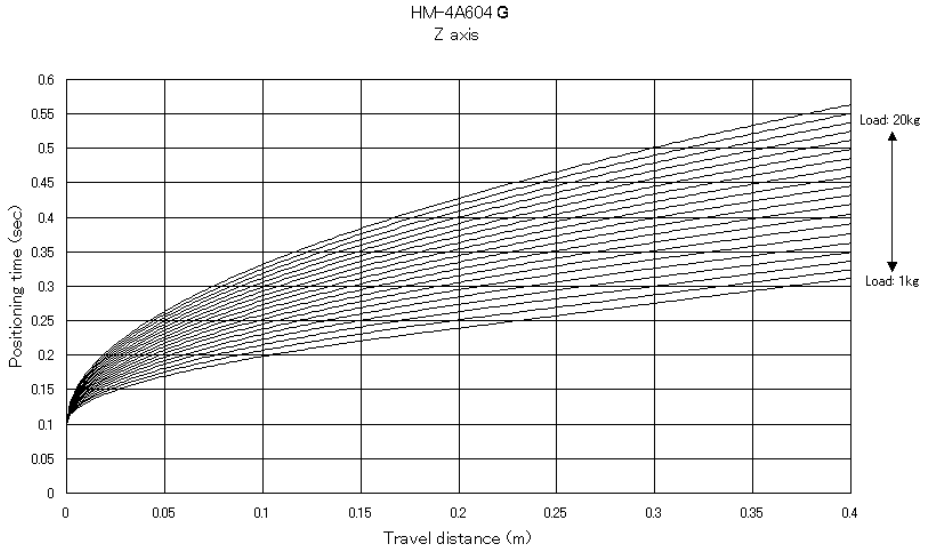
J1 axis (PTP motion)



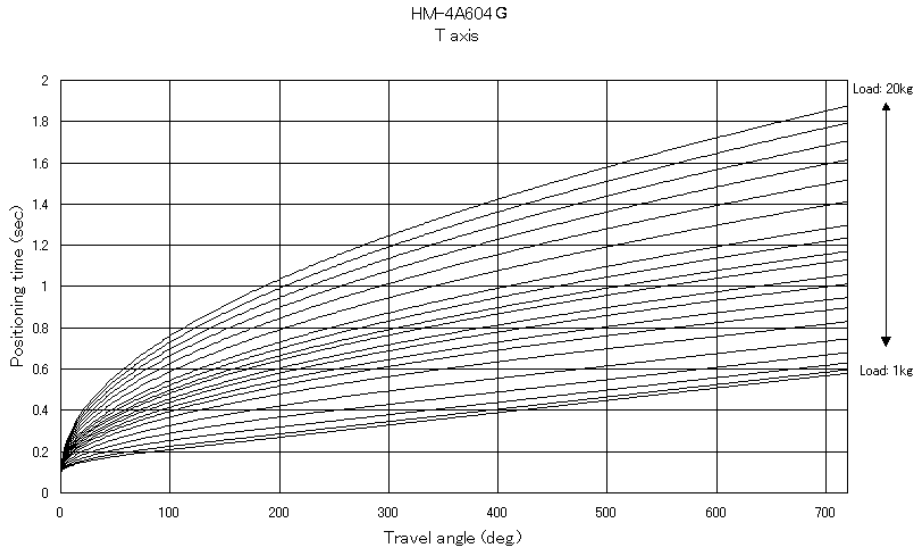
J2 axis (PTP motion)



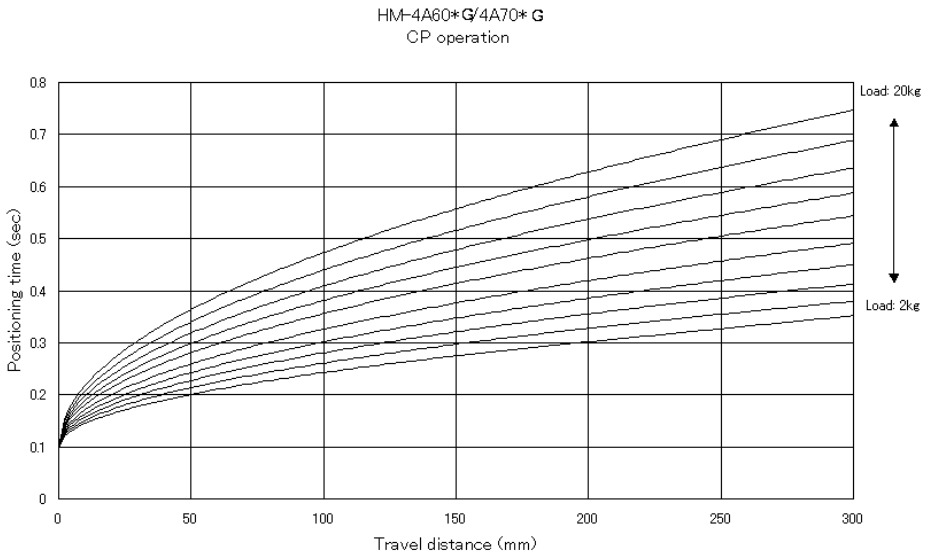
Z axis (PTP motion)



T axis (PTP motion)

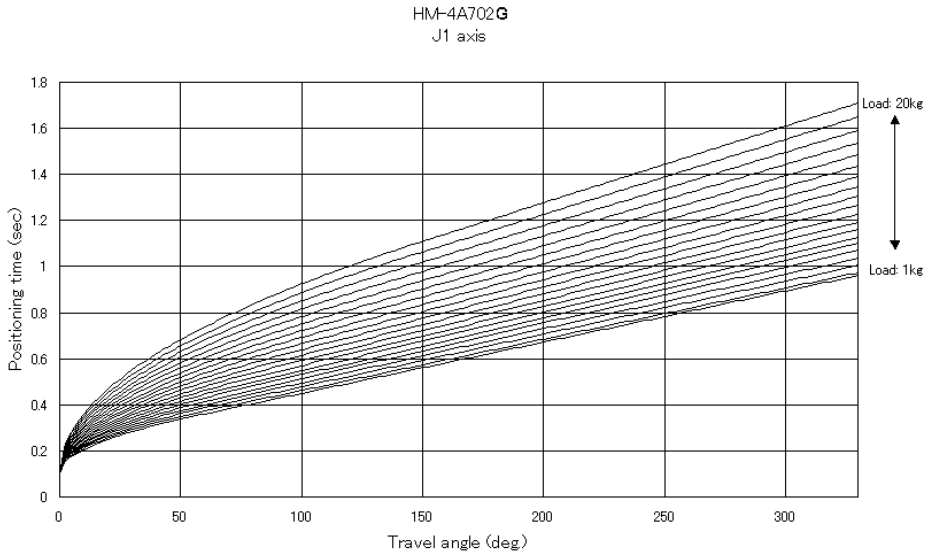


All axes (CP operation)

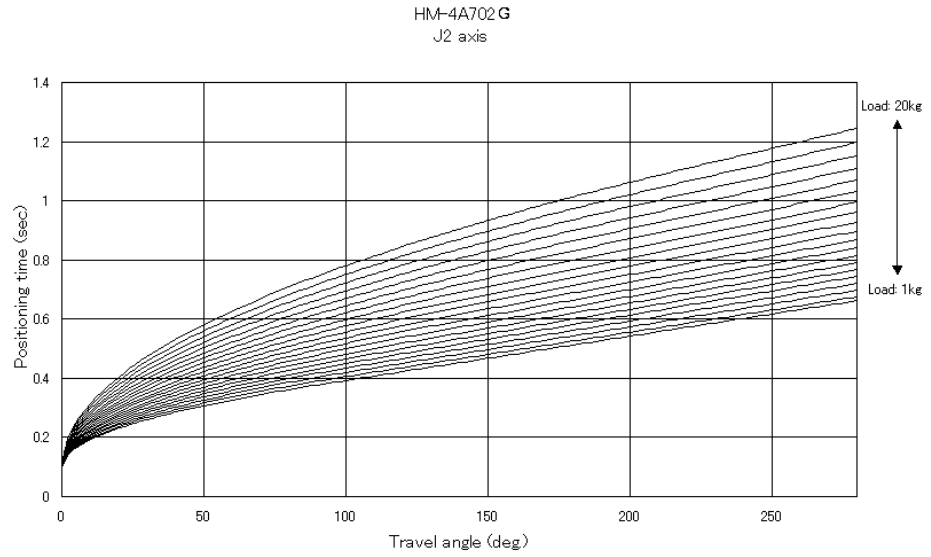


(16) HM-4A702G

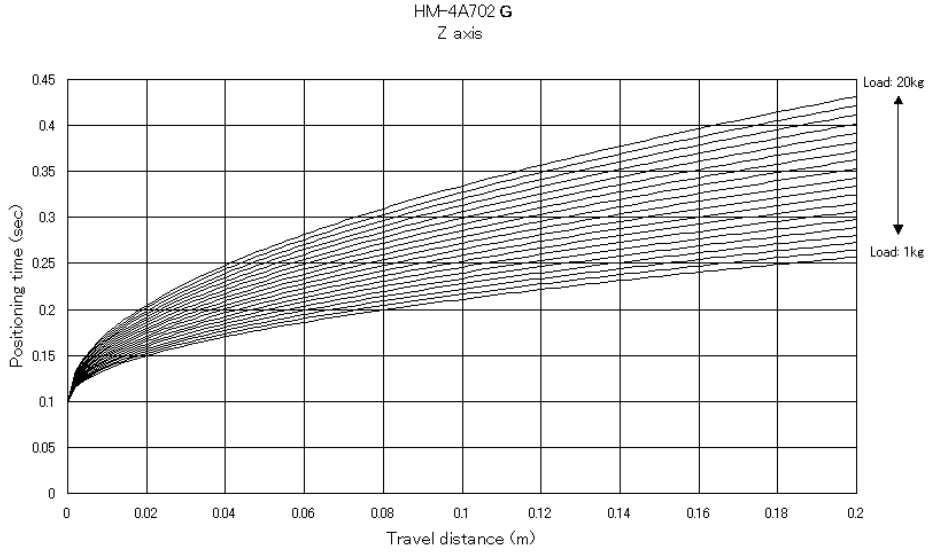
J1 axis (PTP motion)



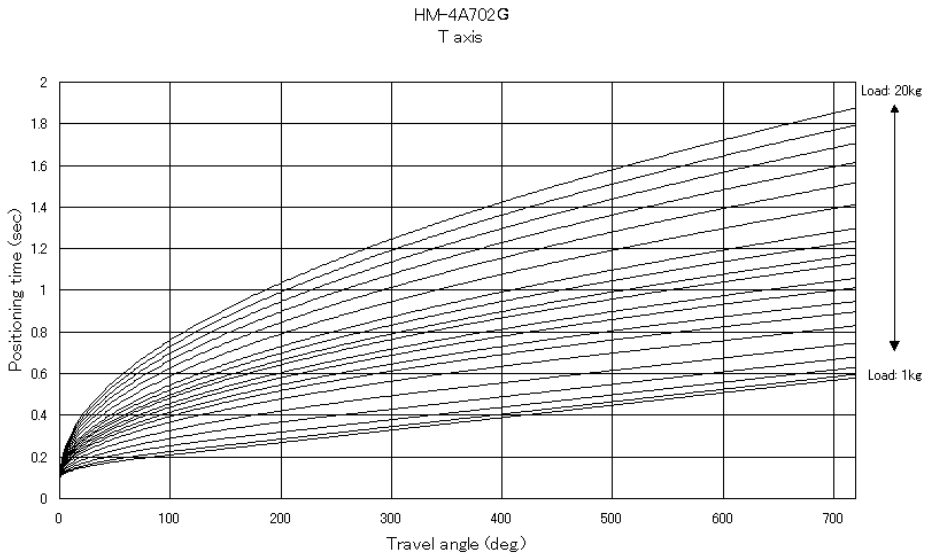
J2 axis (PTP motion)



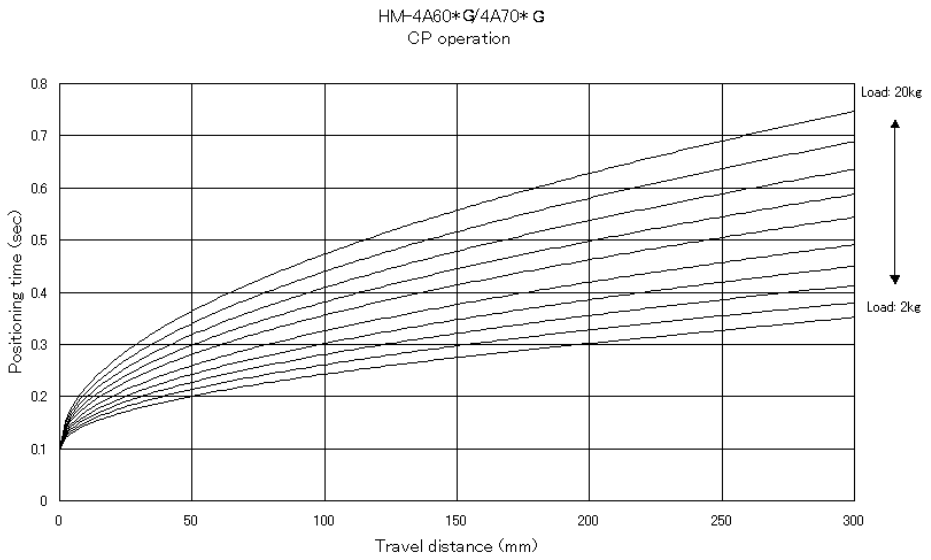
Z axis (PTP motion)



T axis (PTP motion)

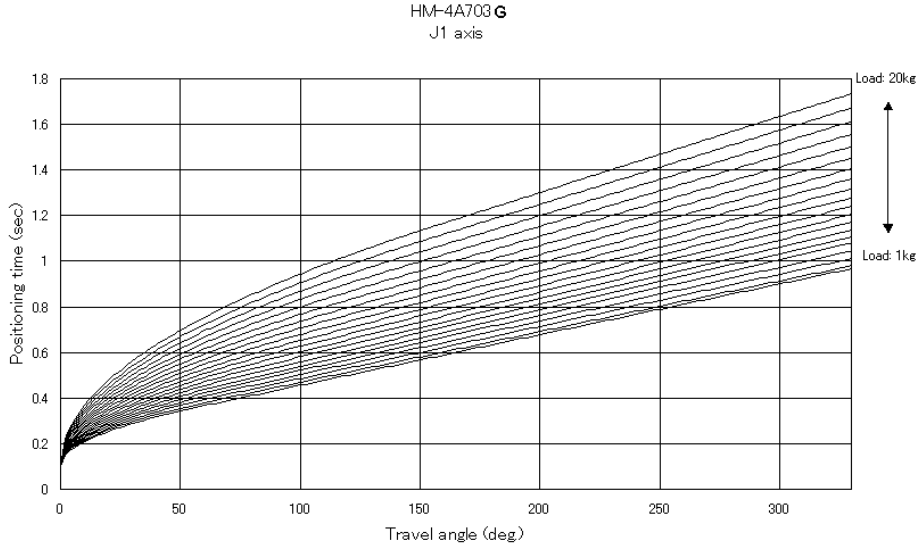


All axes (CP operation)

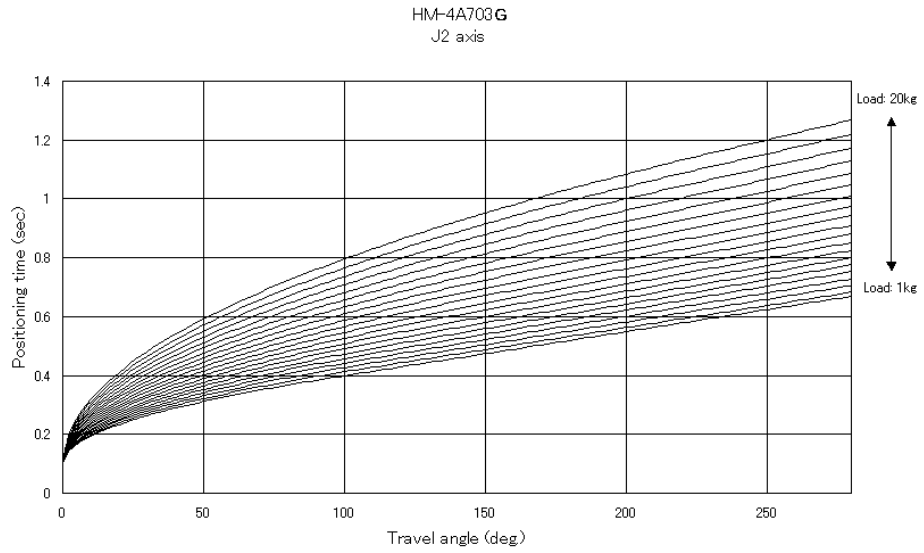


(17) HM-4A703G

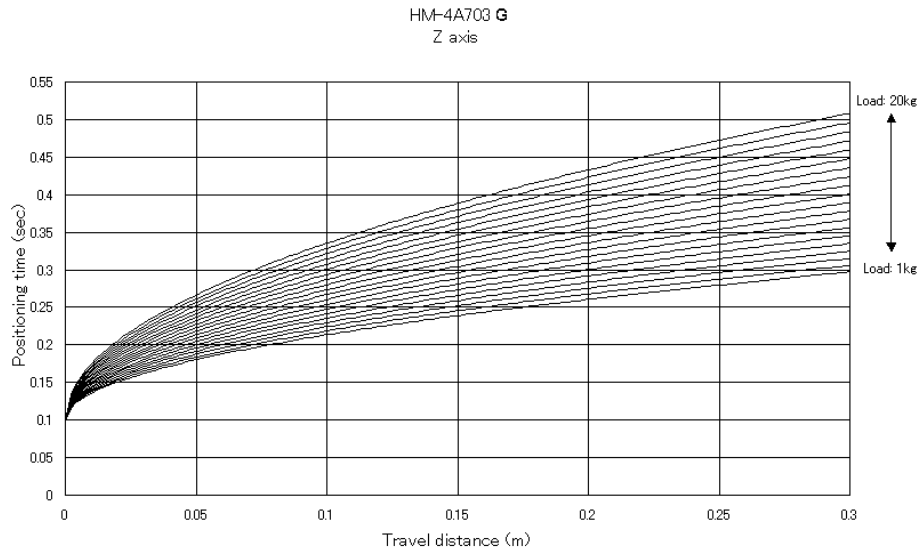
J1 axis (PTP motion)



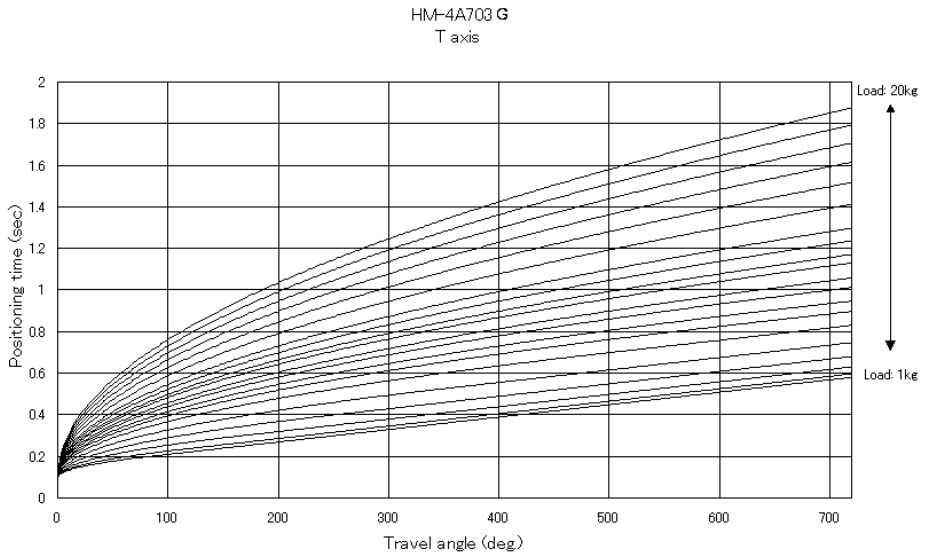
J2 axis (PTP motion)



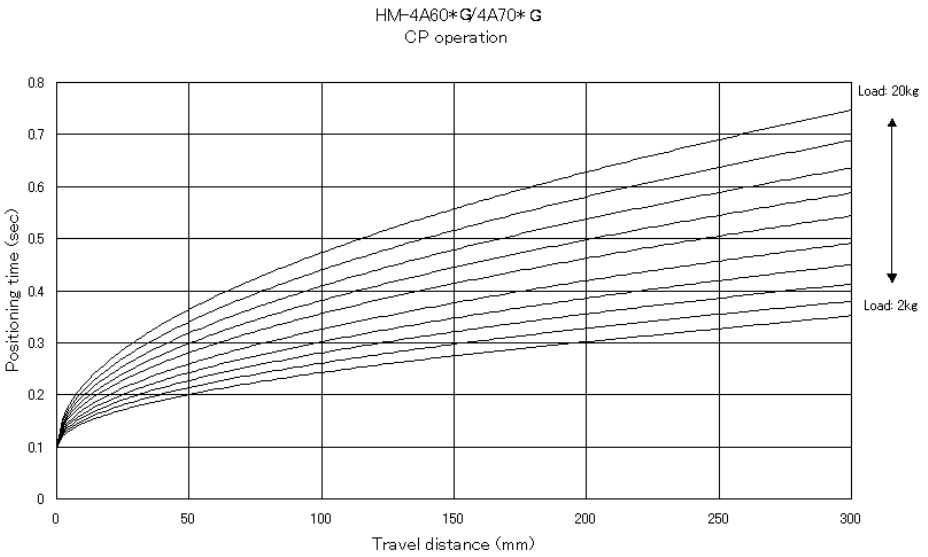
Z axis (PTP motion)



T axis (PTP motion)

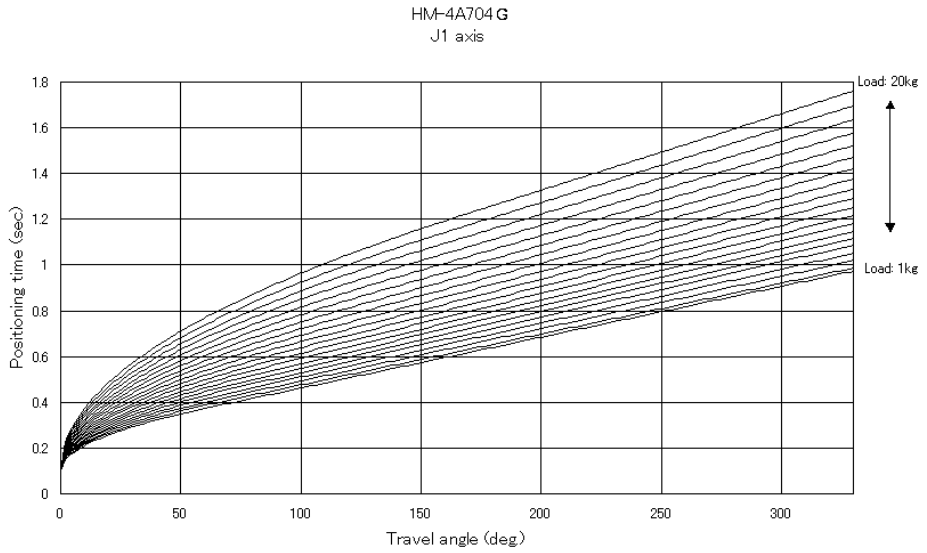


All axes (CP operation)

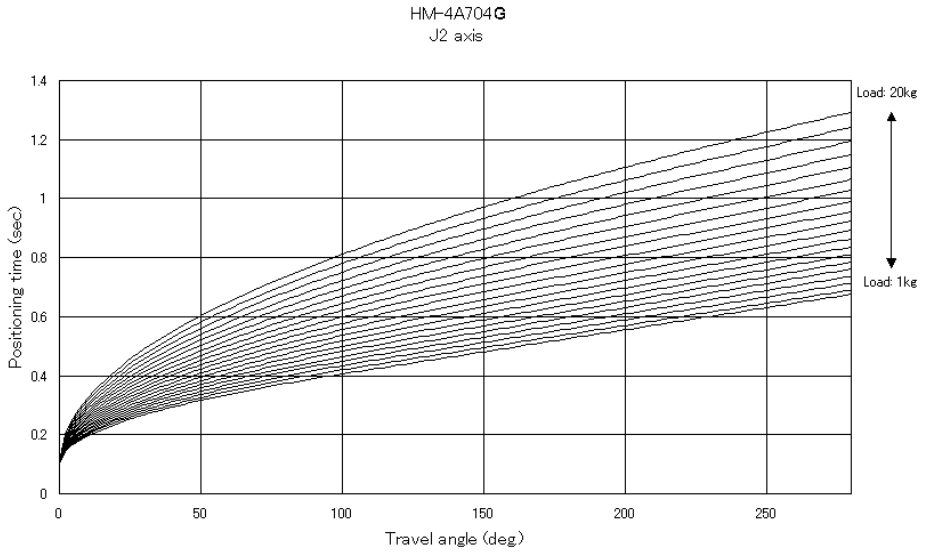


(18) HM-4A704G

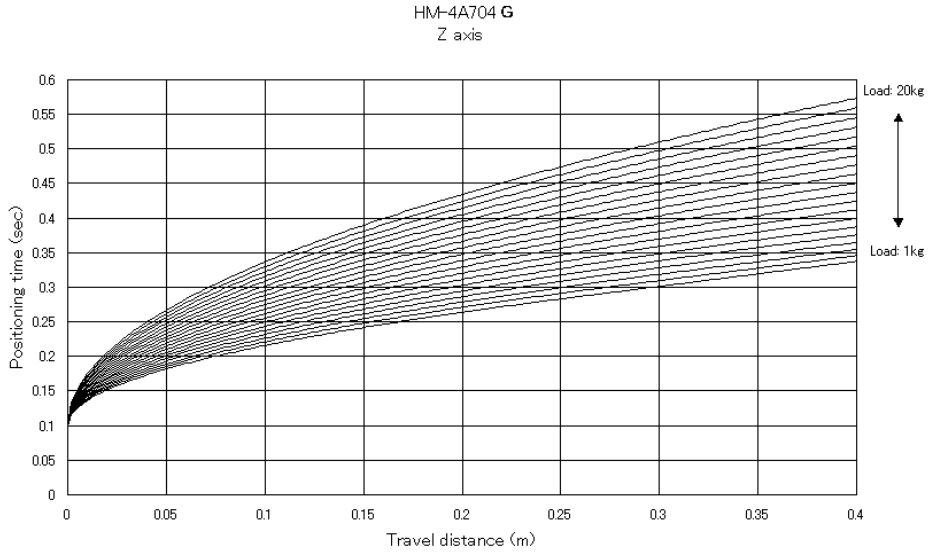
J1 axis (PTP motion)



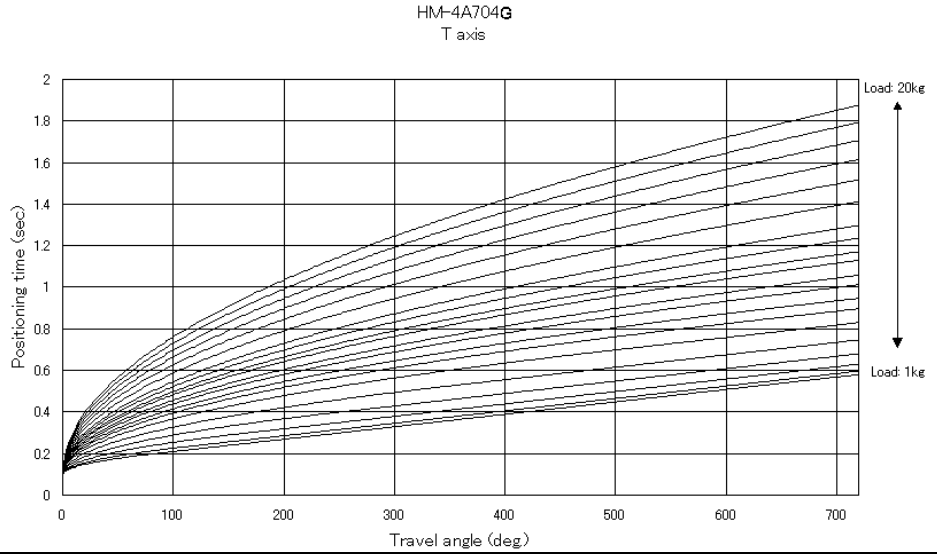
J2 axis (PTP motion)



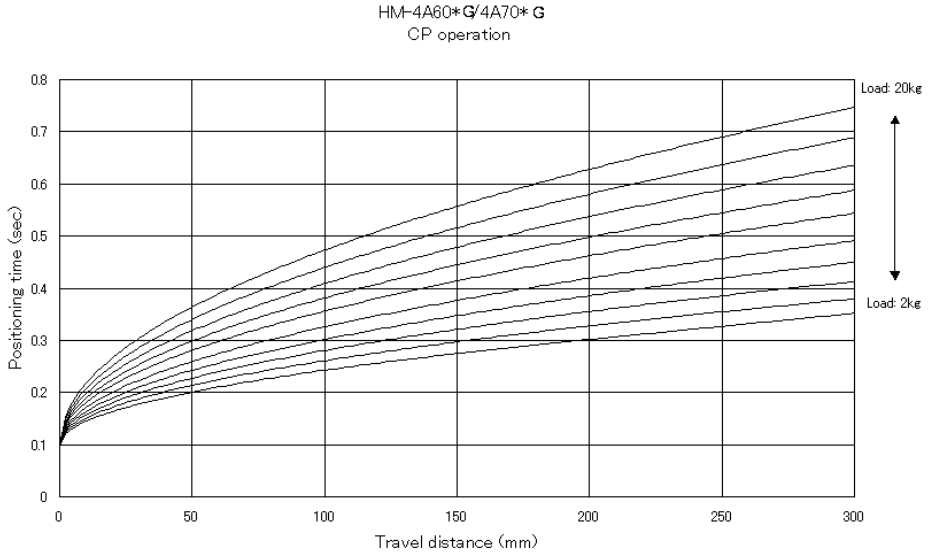
Z axis (PTP motion)



T axis (PTP motion)

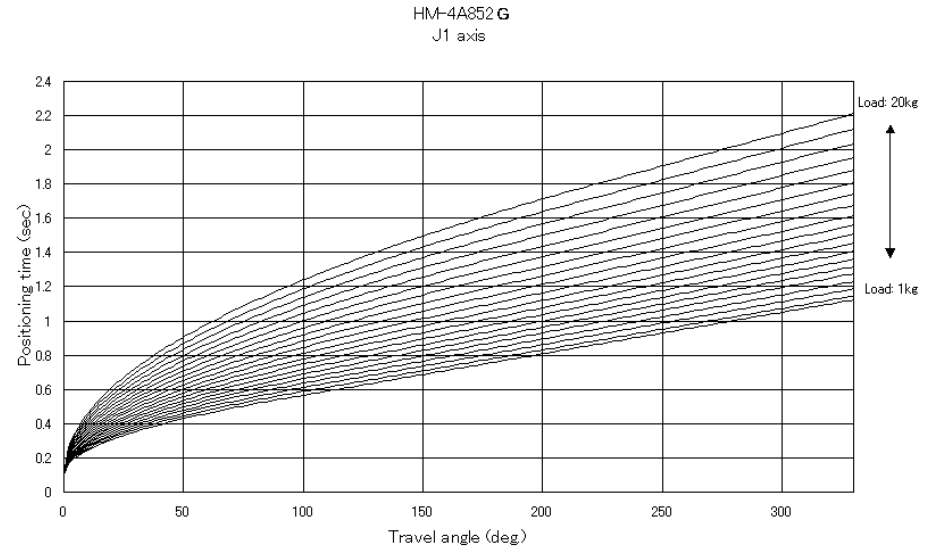


All axes (CP operation)

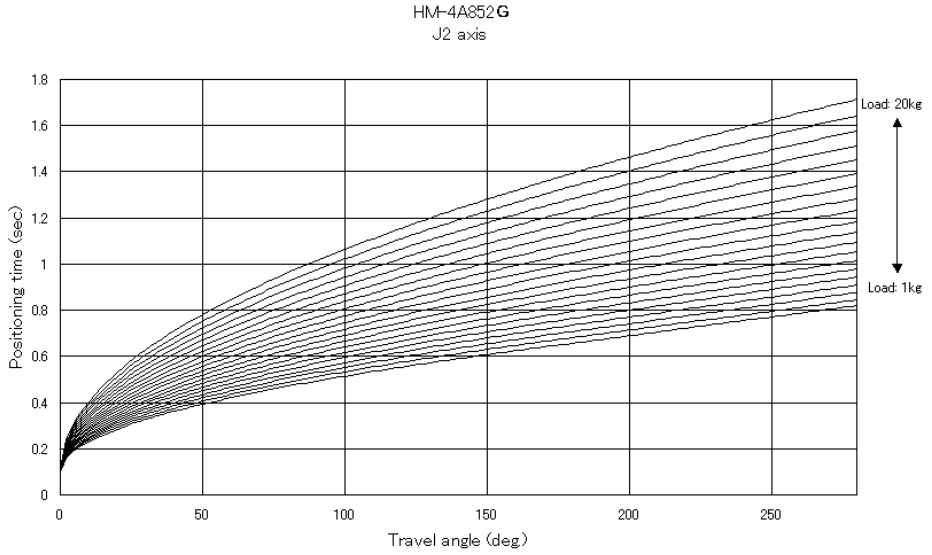


(19) HM-4A852G

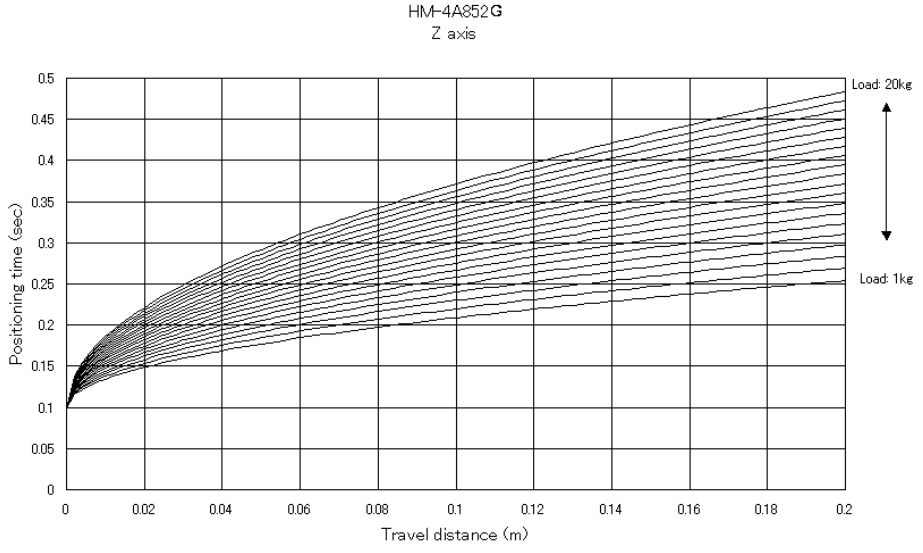
J1 axis (PTP motion)



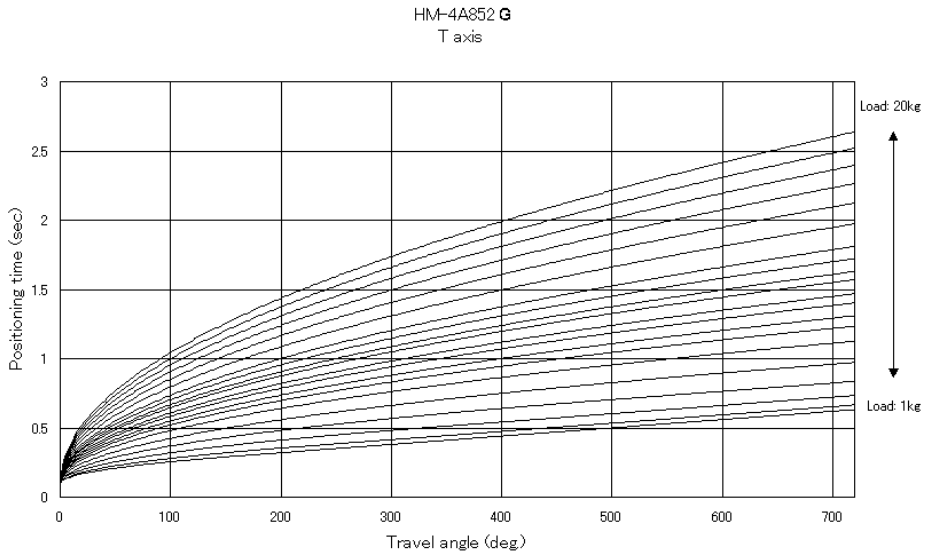
J2 axis (PTP motion)



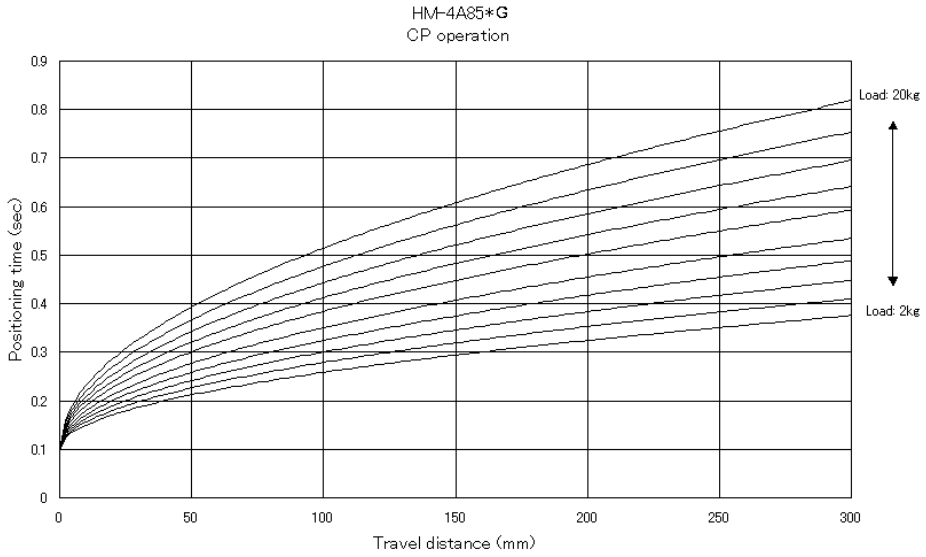
Z axis (PTP motion)



T axis (PTP motion)

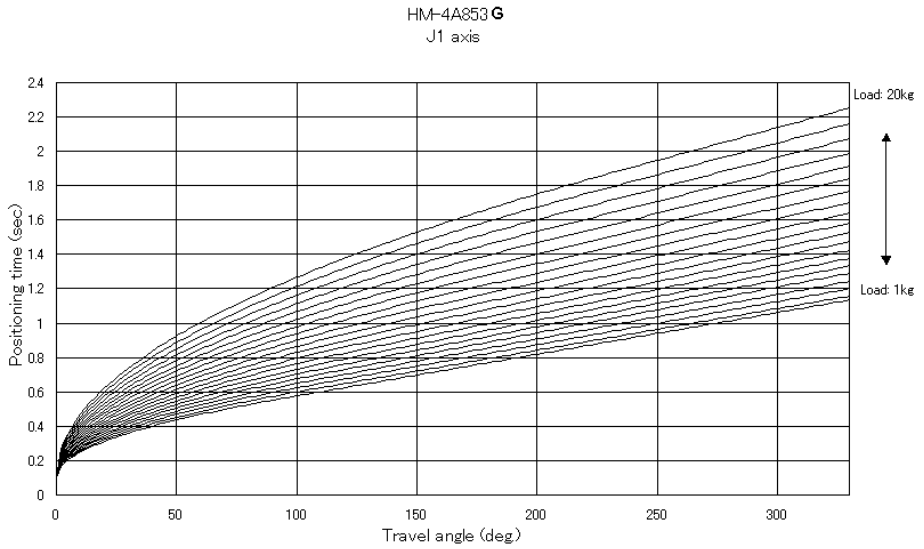


All axes (CP operation)

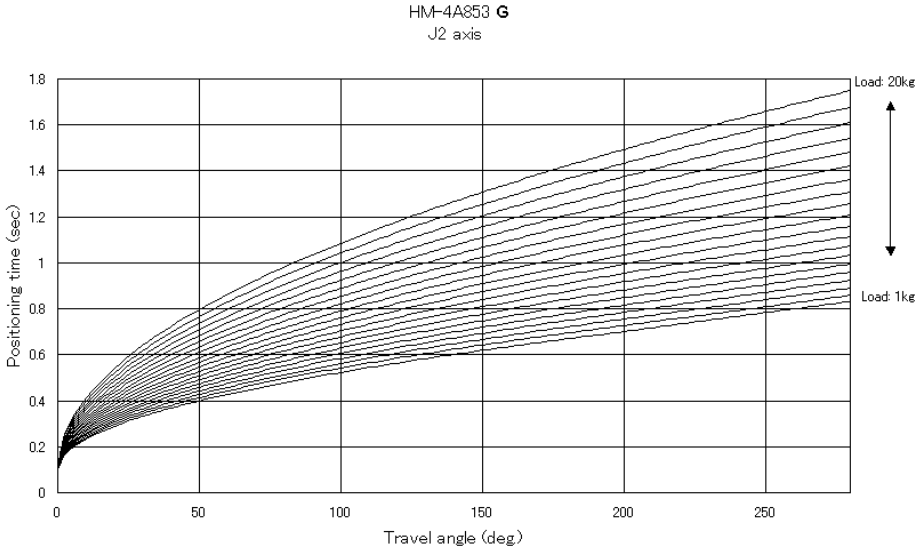


(20) HM-4A853G

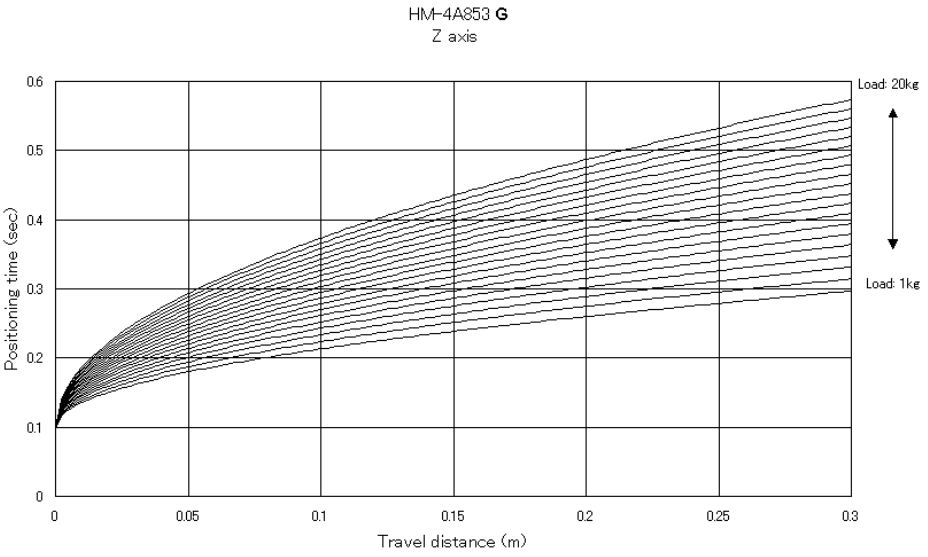
J1 axis (PTP motion)



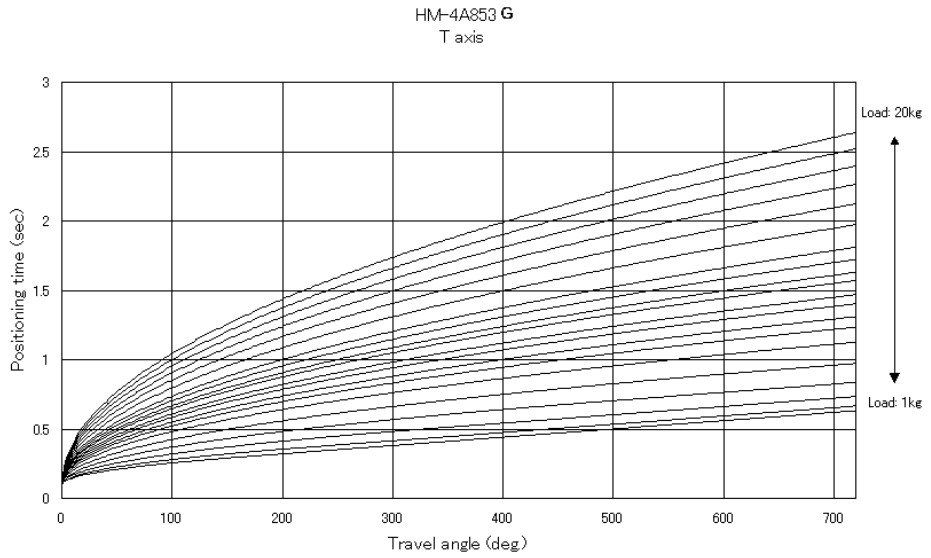
J2 axis (PTP motion)



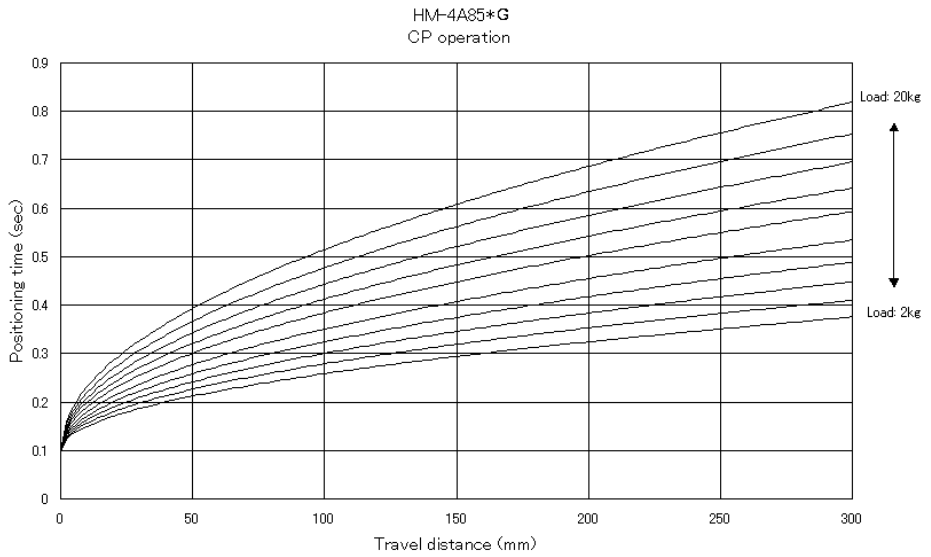
Z axis (PTP motion)



T axis (PTP motion)

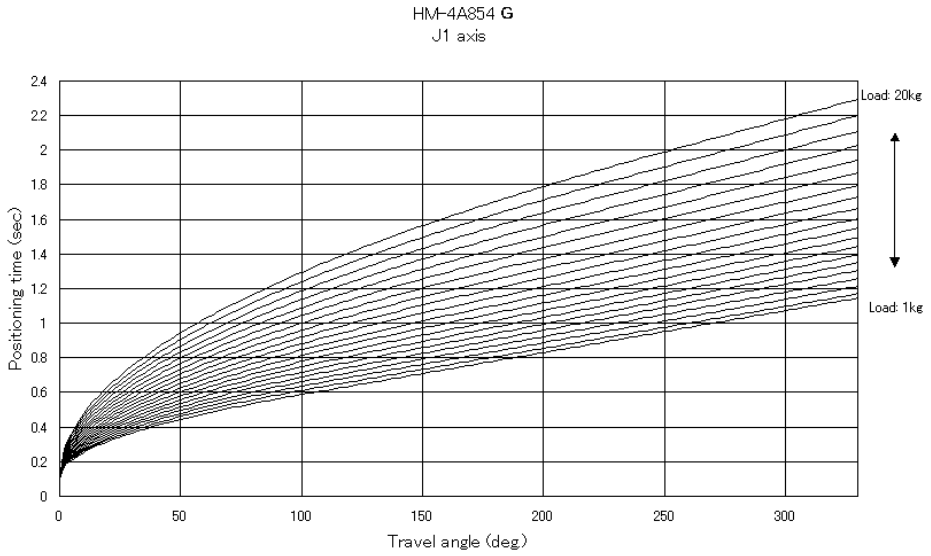


All axes (CP operation)

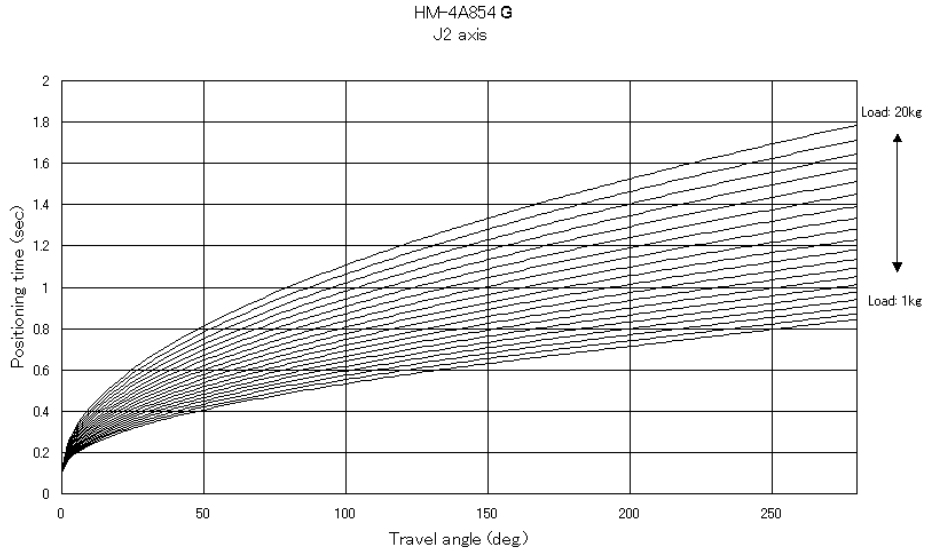


(21) HM-4A854G

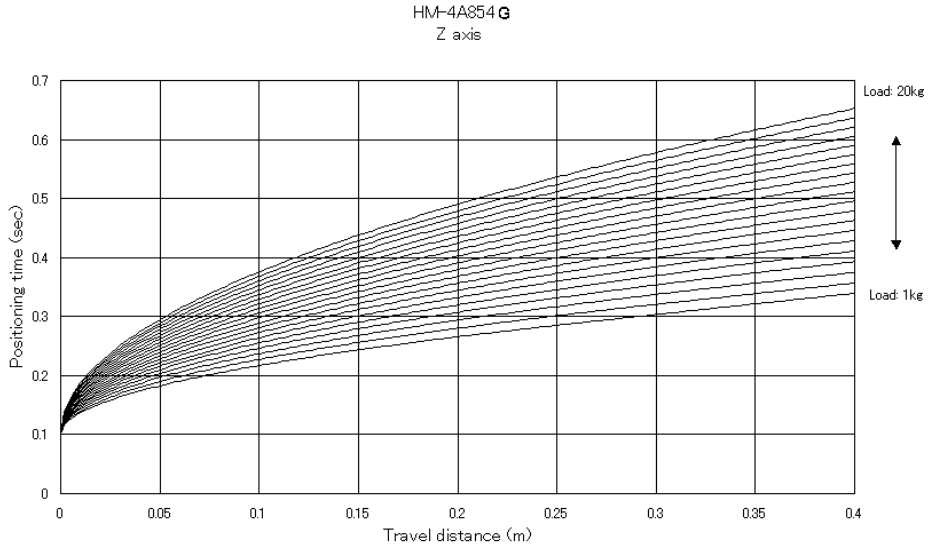
J1 axis (PTP motion)



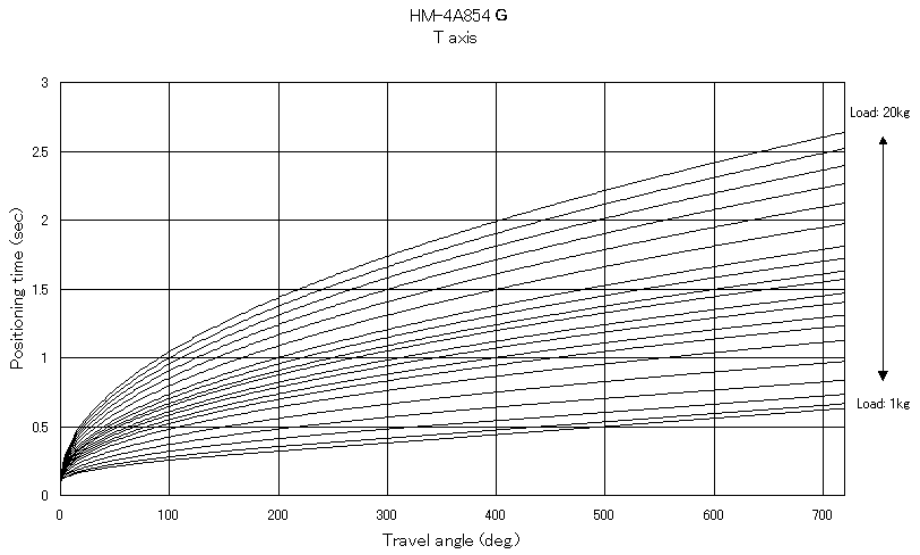
J2 axis (PTP motion)



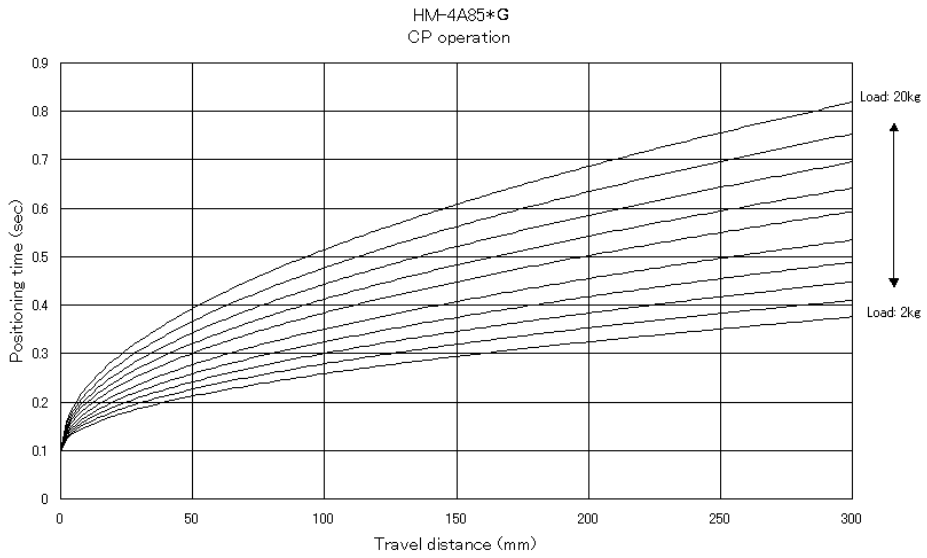
Z axis (PTP motion)



T axis (PTP motion)

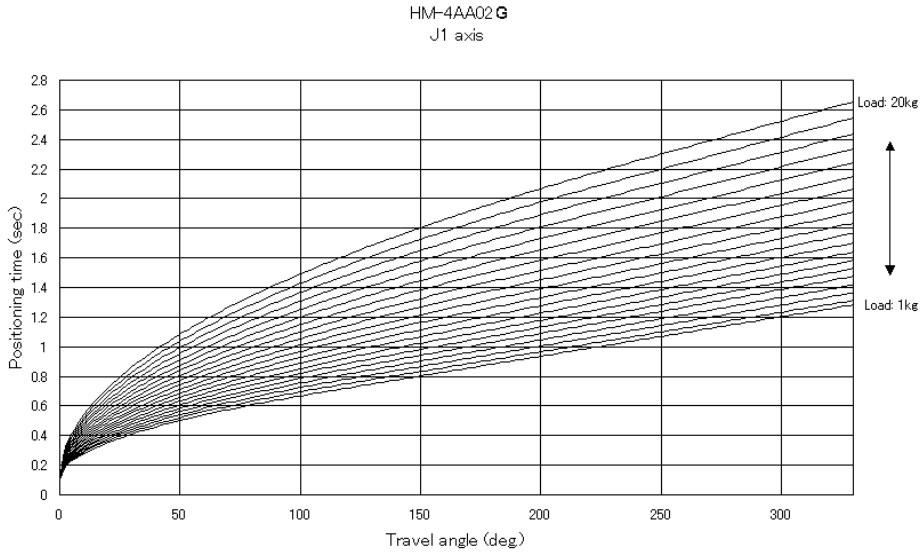


All axes (CP operation)

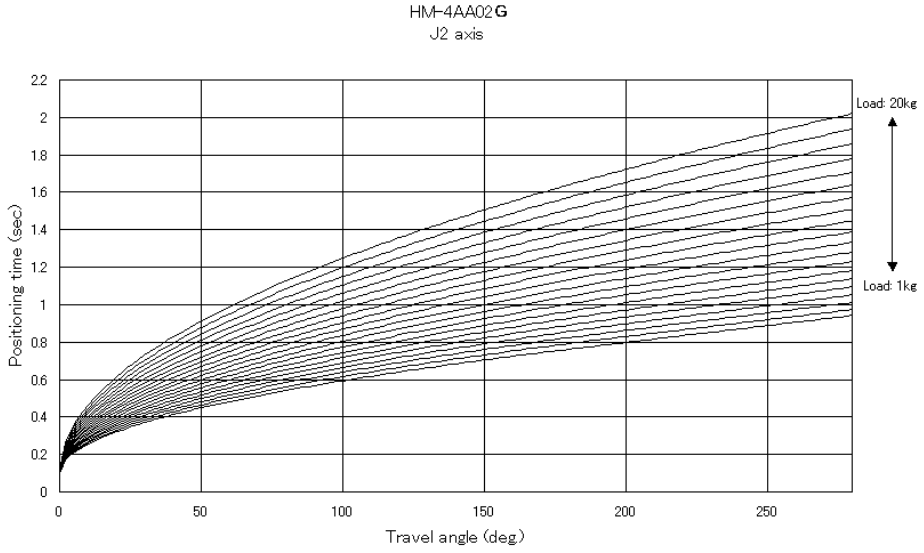


(22) HM-4AA02G

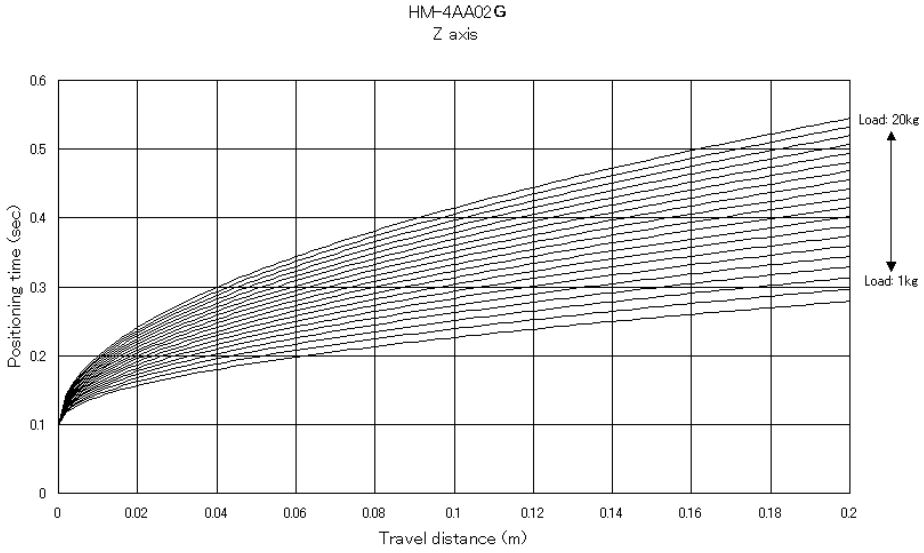
J1 axis (PTP motion)



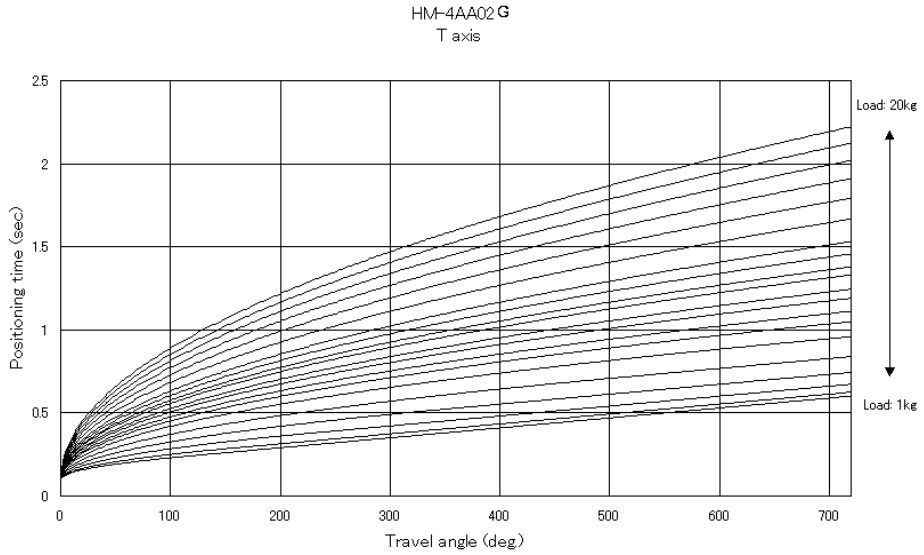
J2 axis (PTP motion)



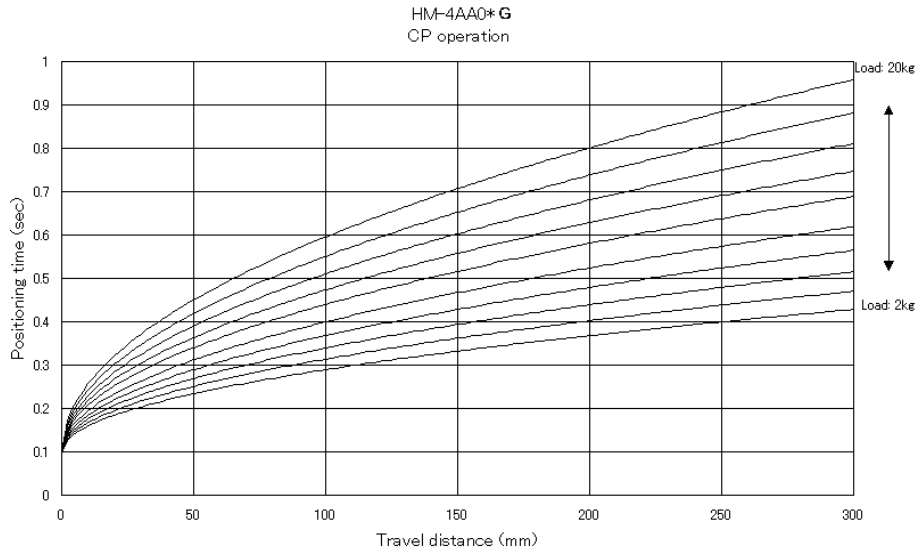
Z axis (PTP motion)



T axis (PTP motion)

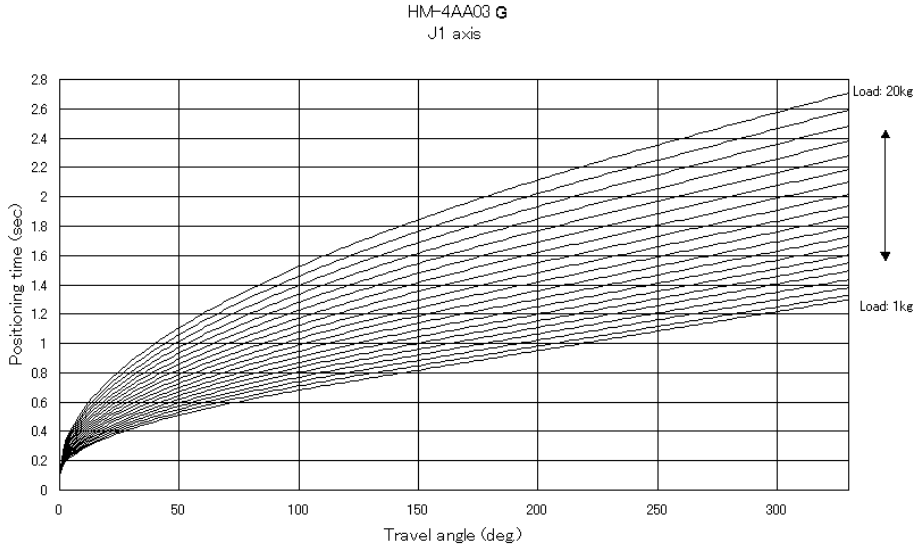


All axes (CP operation)

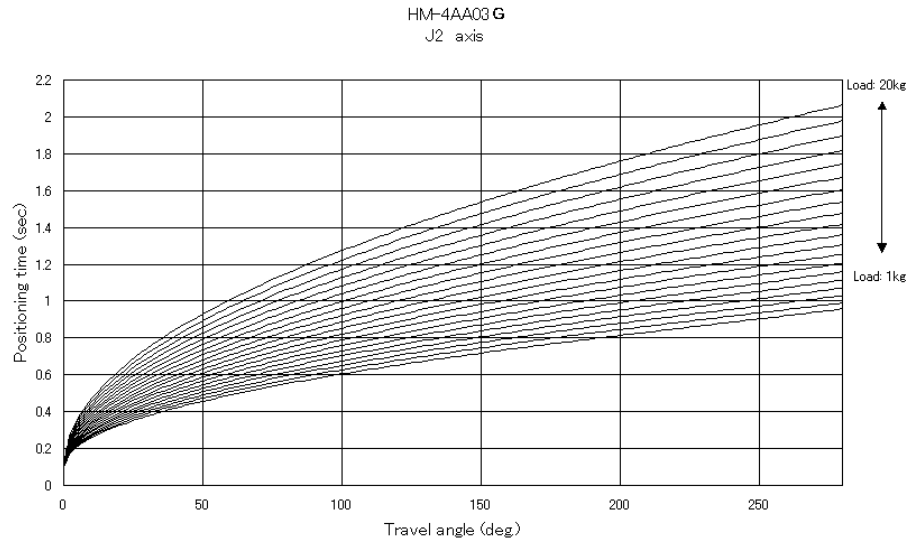


(23) HM-4AA03G

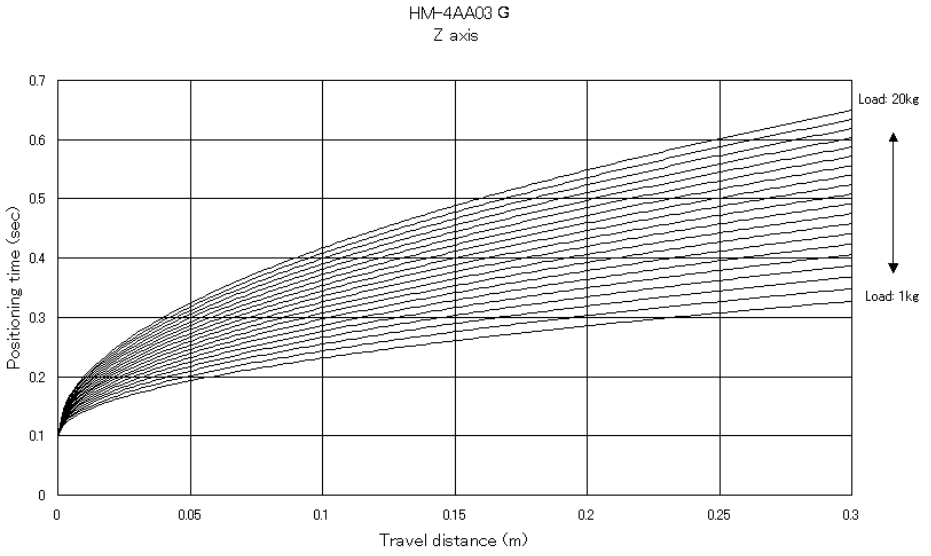
J1 axis (PTP motion)



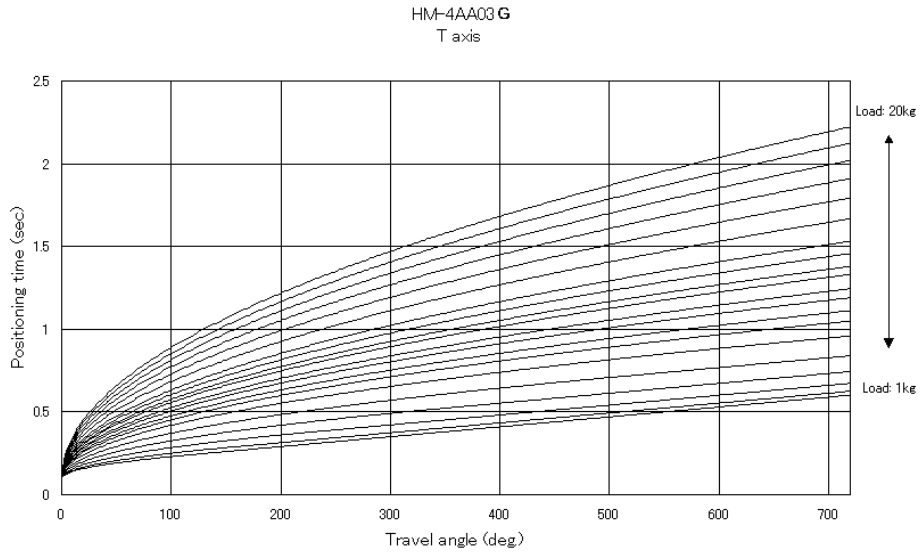
J2 axis (PTP motion)



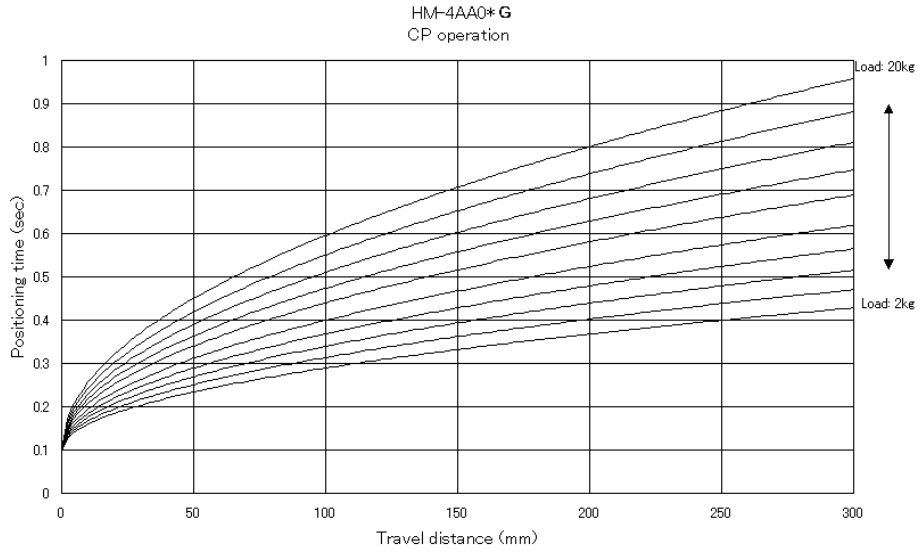
Z axis (PTP motion)



T axis (PTP motion)

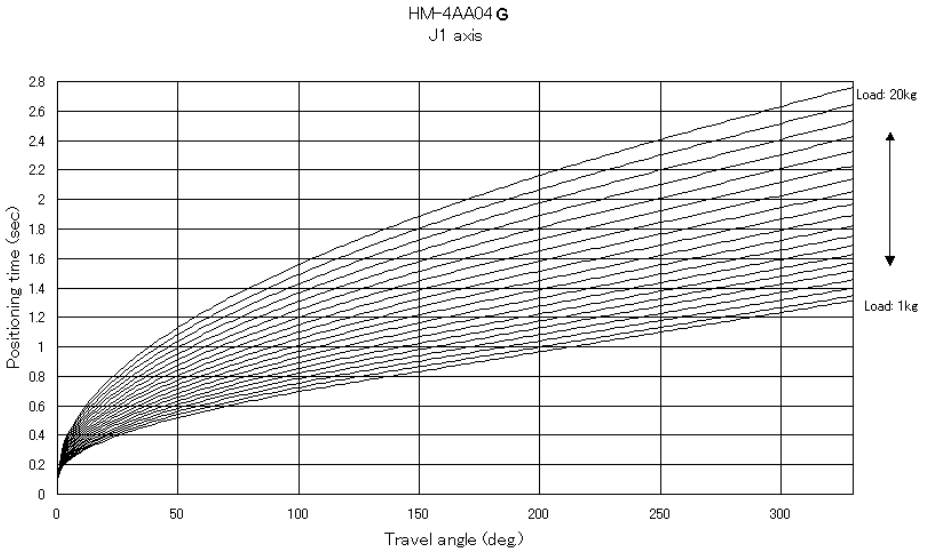


All axes (CP operation)

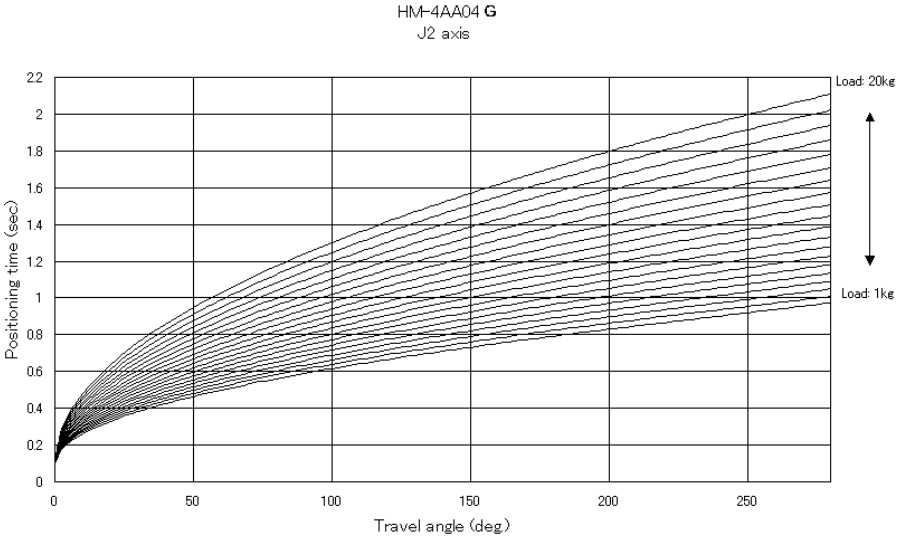


(24) HM-4AA04G

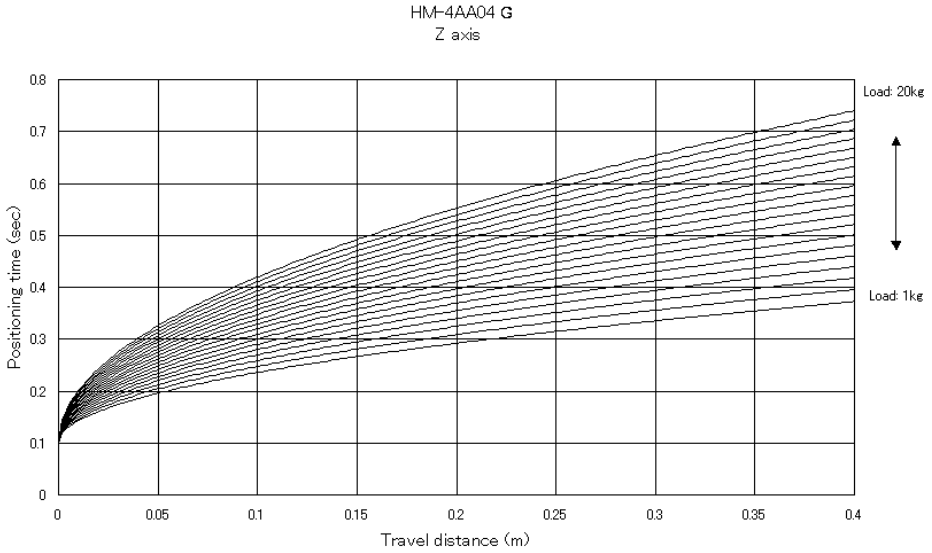
J1 axis (PTP motion)



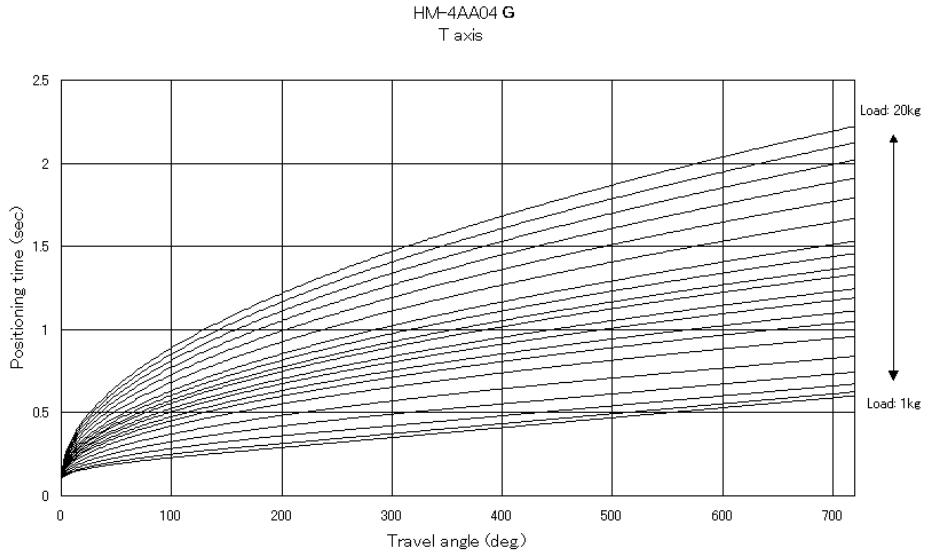
J2 axis (PTP motion)



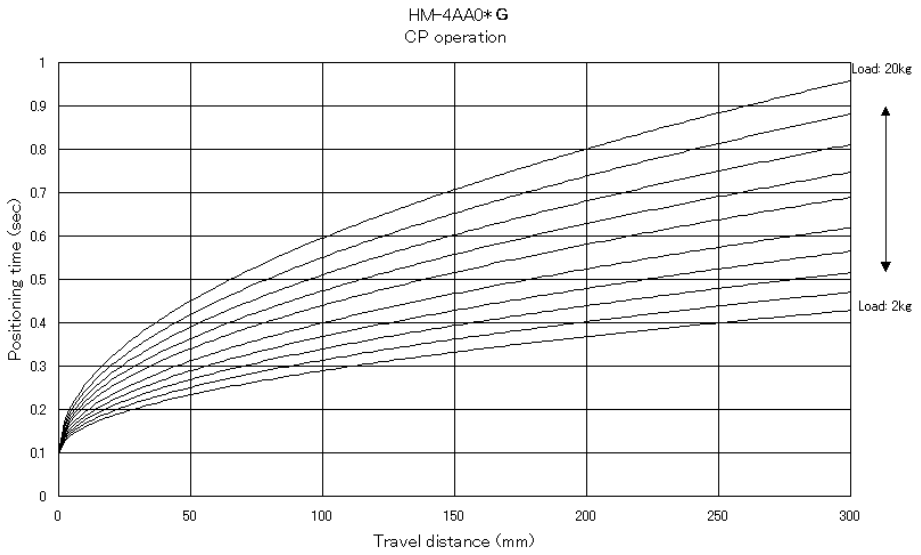
Z axis (PTP motion)



T axis (PTP motion)



All axes (CP operation)



3.4 Notes for Setting the Positioning Speed (HM-G-T series)

■ To be applied to all models of the HM-G-T series (Floor-mount type)

(1) To horizontally traverse the robot arm at high speeds, teach the robot so that Z axis comes to be as close as possible to its upper end.

(2) To stabilize positioning of Z axis near its lower end, the following maximum speed limiting control is automatically provided for J1 and J2 axes depending on the Z-axis coordinate value, only when the robot is moved under PTP control (MV, MVP, DRV, APR).

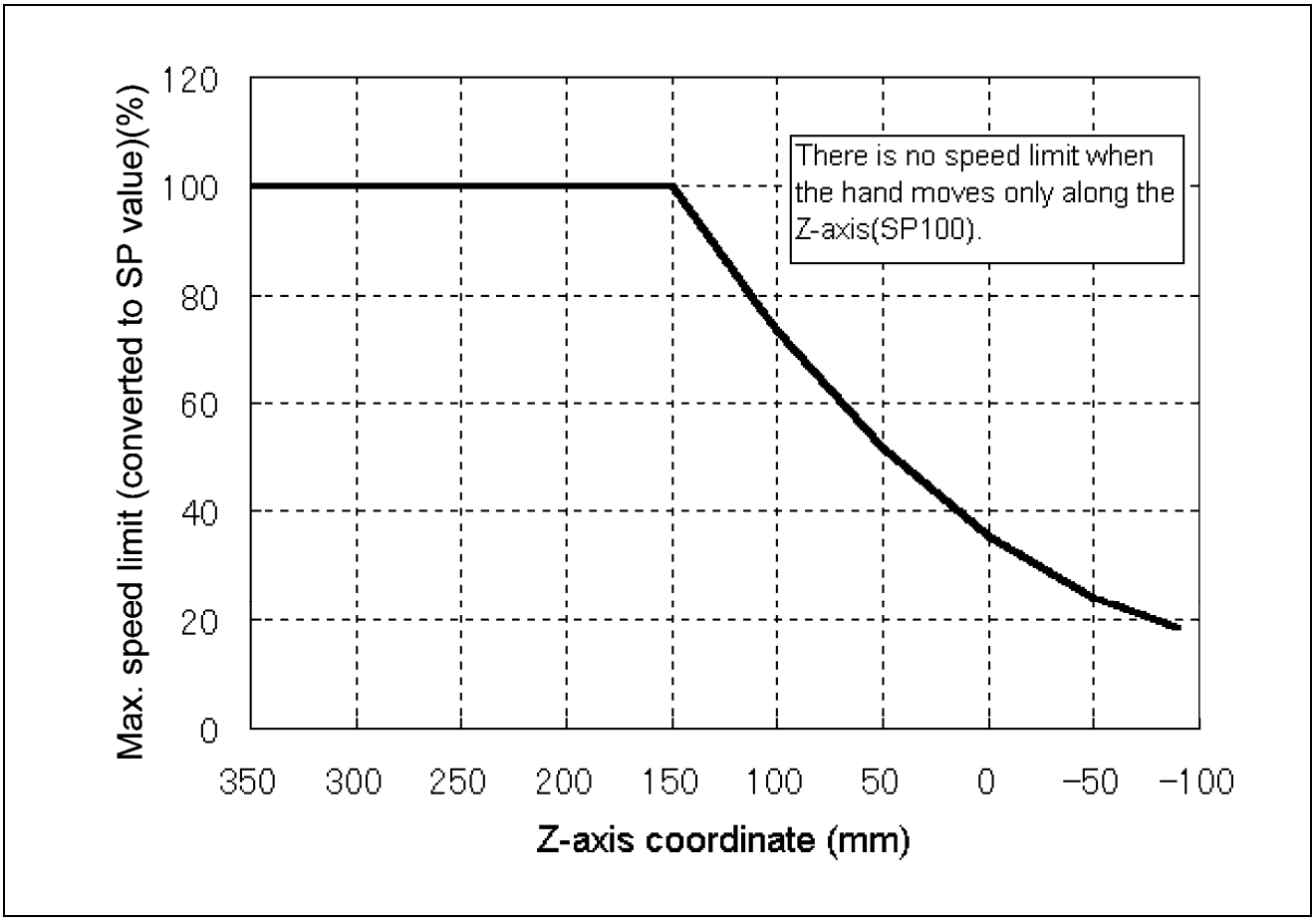
The positioning time of J1 and J2 axes becomes longer according to the maximum speed limit shown below.

$$\frac{\text{[Movement time in J1/J2 positioning time graphs (sec.)]}}{\text{Max. speed limit}} \times 100 \text{ (sec.)}$$

For example, when the robot arm moves by SP100 from the start point (Z-axis coordinate 100 mm) to the target point (Z-axis coordinated 0 mm), the maximum speed limits are as follows:

75 when Z-axis coordinate is 100 mm
35 when Z-axis coordinate is 0 mm

At this time, the maximum speed is the smaller value (at the lowest end) of 35.

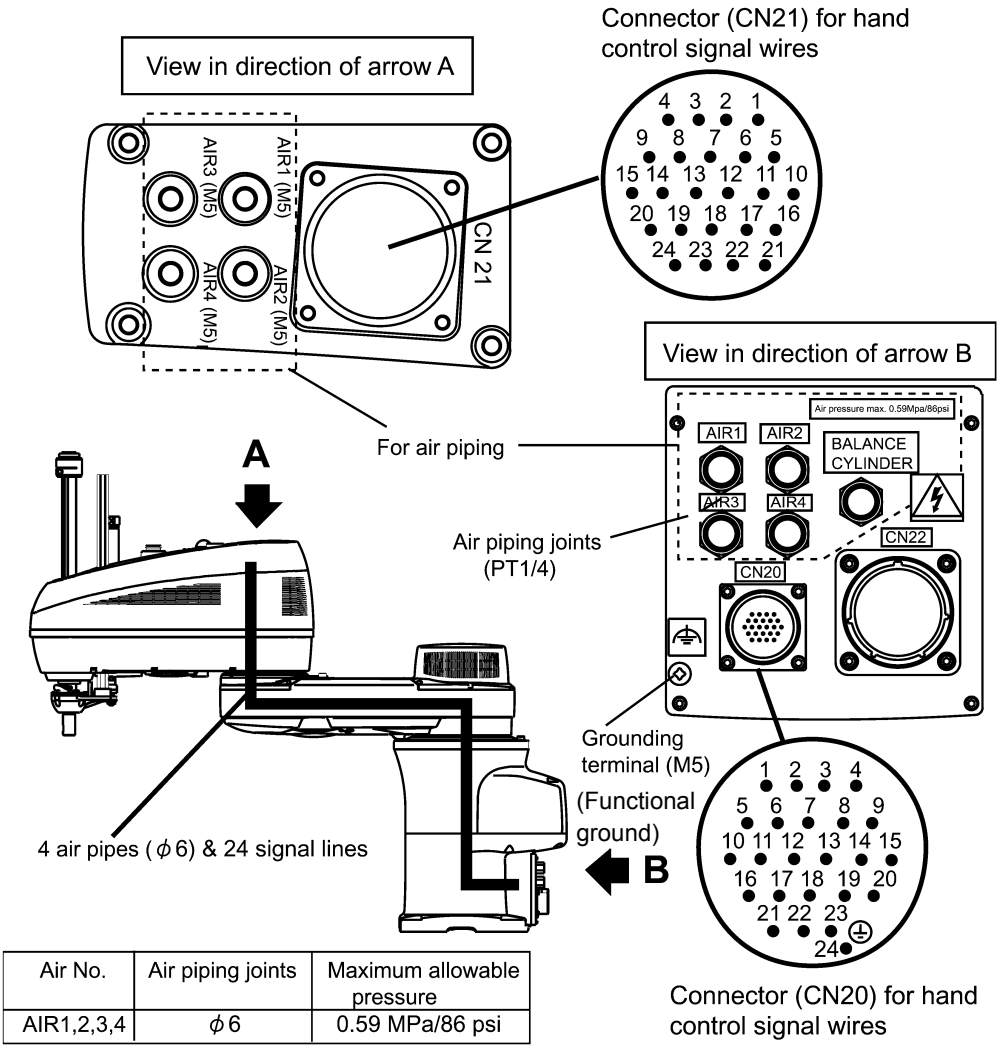


HM-G-T Series: Maximum Speed Limit on the J1 and J2 (PTP control)

3.5 Air Piping and Signal Wiring (HM-G-T series)

The HM-G-T series is equipped with 4 air pipes (ϕ6) for air chuck and 24 signal lines in the robot unit.

(1) HM-GM-T03



Air No.	Air piping joints	Maximum allowable pressure
AIR1,2,3,4	ϕ6	0.59 MPa/86 psi

Note 1: Pins #1 to #24 on CN21 and those on CN20 are connected with each other.
The maximum rated current per line is 1A.

Note 2: Use the attached connector set for CN20 and CN21.

Connector set part No.	Part No.	Model and name	Remarks
410889-0120	410877-0640 (for CN20)	CE01-6A24-28SC(D69) (Straight plug) (DDK Electronics, Inc.)	
	410877-0650 (for CN20)	CE01-24BS-DS (Straight plug) (DDK Electronics, Inc.)	
	410877-0660 (for CN20)	CE3057-16A-1-D (Cable clamp) (DDK Electronics, Inc.)	Applicable wire diameter: ϕ15 to 19.1
	410877-0670 (for CN20)	CE3057-16A-4-D (Cable clamp) (DDK Electronics, Inc.)	Applicable wire diameter: ϕ19.1 to 21
	410877-0450 (for CN21)	JMSP2524M (Straight plug) (DDK Electronics, Inc.)	

Air piping and Signal Wiring (HM-GM-T03)

3.5.1 Instructions for Using Splash-proof Connector Sets

The splash-proof connector sets for CN20 and CN21 assure the splash-proofness as long as they are properly assembled and connected.

When using those connector sets, be sure to observe the following notes.

(1) The degree of protection of the splash-proof robot unit, which is specified in Section 3.1 "Robot Specifications," is assured as long as the splash-proof connectors are joined with connectors CN20 and CN21 on the robot unit. If there is no connection on CN20 and CN21, the splash-proof rating is not assured.

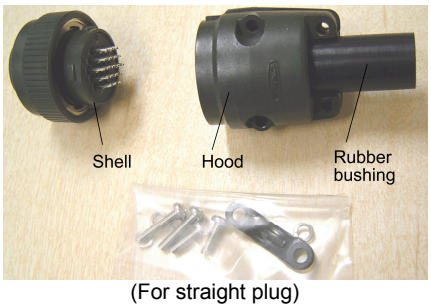
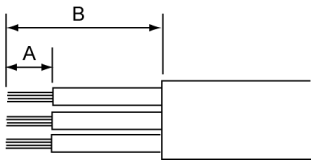
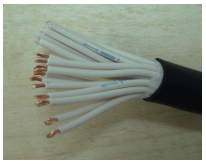
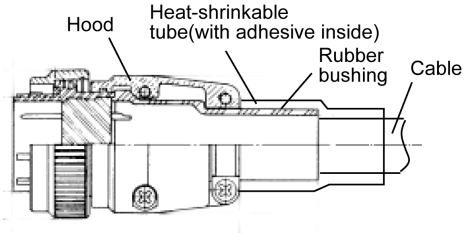
(2) Use a sheathed cable for a splash-proof connector. Using an unsheathed cable cannot assure the splash-proof rating.

(3) Each connector set contains two types of cord clamps for CN20. Use the one that matches the cable diameter.

(4) Each connector set should be assembled according to the instructions specified by the connector manufacturer.

The table below shows an assembly procedure example of a connector set for CN21. The actual assembly procedure should be in accordance with the instructions specified by the connector manufacturer.

Overview of assembly procedure example of connector set for CN21

Components of connector set for CN21	Assembly procedure example
 (For straight plug)	(1) Treatment of wire ends: Strip the wire ends of the cable (prepared by the customer). The cable diameter and the lengths "A" and "B" should be in accordance with the instructions given by the connector manufacturer.   (2) Tinning: Tin both the core wires and the connector contacts. (3) Pass the cable through the heat-shrinkable tube for splash-proof purpose (with adhesive inside, prepared by the customer) and the rubber bushing. (4) Solder the core wires onto the connector contacts to connect them each other. (5) Press the rubber bushing against the shell to fit the hood. Then cover the rubber bushing with the heat-shrinkable tube and apply heat to shrink the tube. 

3.6 Engineering-design Notes for Robot Hands (HM-G-T series)

Design a hand (end-effector) so that it will satisfy conditions (1) and (3) described below.

⚠**Caution**: Strictly observe these engineering-design notes. Otherwise, the clamped sections of the robot unit will become loose, rattle or be out of position. In the worst case, the mechanical parts of the robot unit and the robot controller may be damaged.

(1) Mass of hand

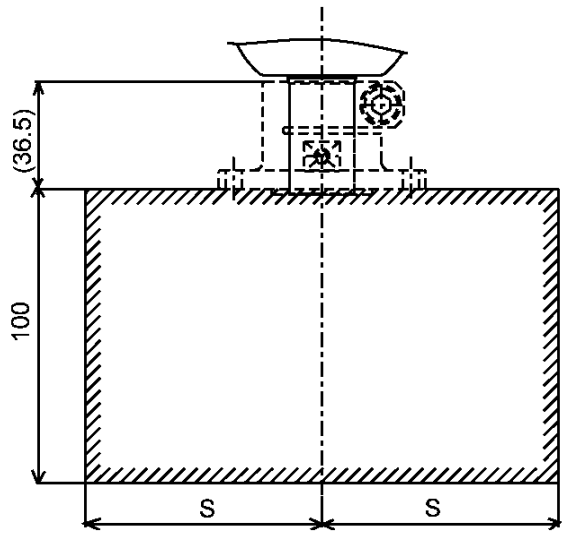
The total mass of a hand or tool (including workpiece) should be less than the maximum allowable payload of the robot. Be sure to include the mass of wirings and piping used for a hand or tool.

Total mass of hand or tool (incl. workpiece) ≤ Max. allowable payload

NOTE: The maximum allowable payload refers to a mass of payload that you have preset.

(2) Hand center of gravity

The center of gravity of a hand or tool (including work-piece) should be located within the range specified in the figure below.



Robot model	S
HM-40***G(10kg payload)	80mm
HM-4A***G(20kg payload)	60mm

(Unit: mm)

Hand center of gravity (HM-G-T series)

(3) Moment of inertia around the T axis

The moment of inertia of a hand or tool (including work-piece) around the T axis should be less than the maximum allowable moment of inertia around the T axis of the robot.

Hand's moment of inertia (incl. Work-piece) around the T axis ≤ Max. allowable moment of inertia

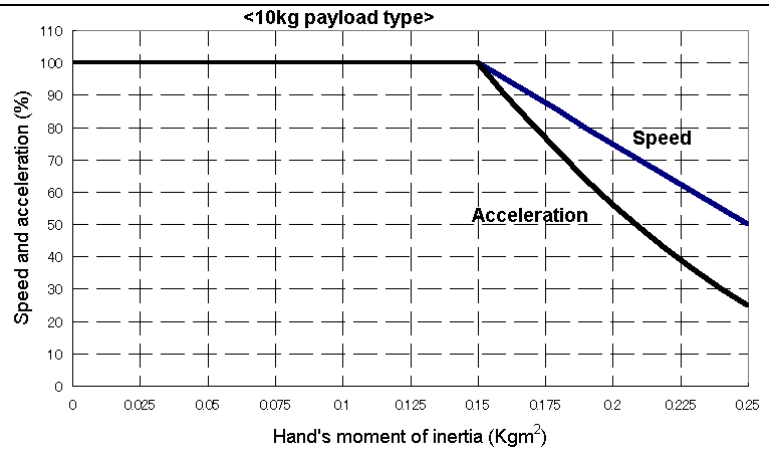
Calculate the moment of inertia around the T axis according to the graph given below.

NOTE: You may program the reduced ratio of the speed and acceleration individually within the range specified below. If you set the reduced ratio of the programmed speed only, the controller automatically calculates that of the acceleration according to the formula below.

$$\text{Acceleration (\%)} = (\text{Speed}/100)^2 \times 100$$

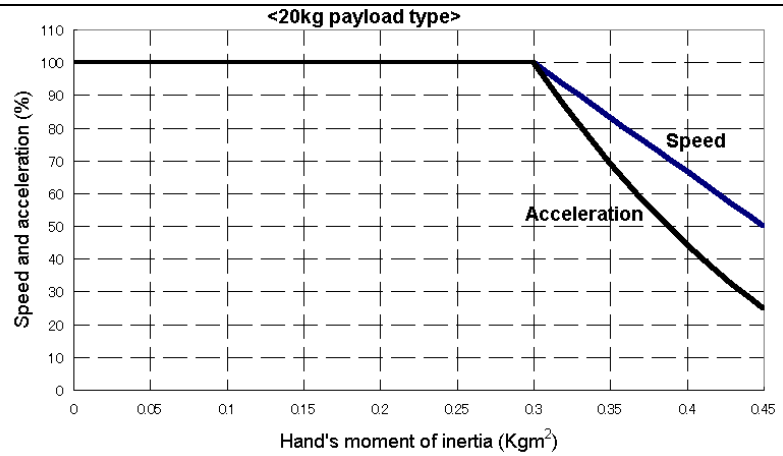
Application sample of hand's moment of inertia: HM-G-T series, 10 kg payload type

- To run the robot at 100% of the programmed speed and acceleration: The moment of inertia around the T axis should be 0.15 kgm^2 or less.
- If the moment of inertia around the T axis is 0.17 kgm^2: Run the robot at 90% or less of the programmed speed and at 81% or less of the programmed acceleration.



Application sample of hand's moment of inertia: HM-G-T series, 20 kg payload type

- To run the robot at 100% of the programmed speed and acceleration: The moment of inertia around the T axis should be 0.3 kgm^2 or less.
- If the moment of inertia around the T axis is 0.33 kgm^2: Run the robot at 90% or less of the programmed speed and at 81% or less of the programmed acceleration.

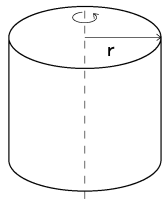


When calculating the hand's or tool's moment of inertia around the T axis, refer to the moment-of-inertia formulas on the next page.

Moment-of-inertia Formulas

1. Cylinder (1)

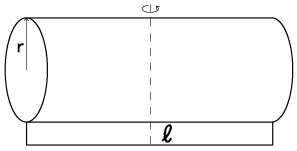
(Axis of rotation = Center axis)



$$I = \frac{mr^2}{2}$$

2. Cylinder (2)

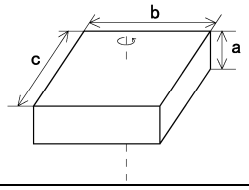
(The axis of rotation passes through the center of gravity.)



$$I = \frac{m}{4}\left(r^2 + \frac{\ell^2}{3}\right)$$

3. Rectangular parallelepiped

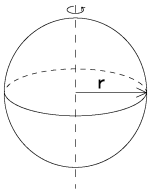
(The axis of rotation passes through the center of gravity.)



$$I = \frac{m}{12}\left(b^2 + c^2\right)$$

4. Sphere

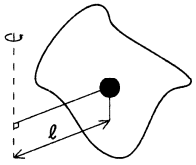
(Axis of rotation = Center axis)



$$I = \frac{2mr^2}{5}$$

5. Center of gravity not on the axis of rotation.

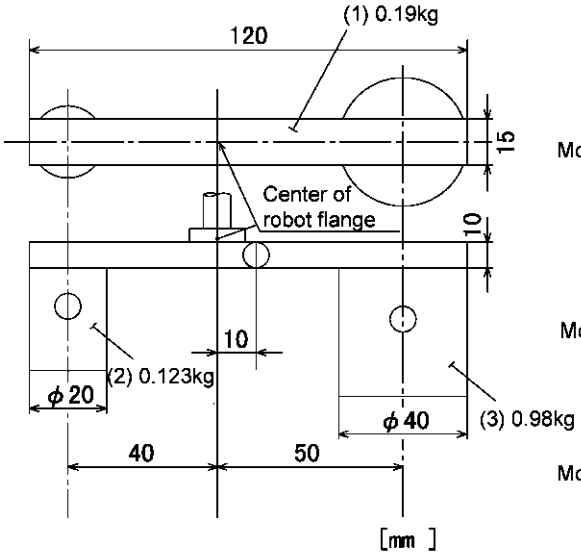
Ig: Moment of inertia around center of gravity



$$I = I_g + m\ell^2 \quad [kgm^2]$$

I:	Moment of inertia	[kgm^2]
m:	Mass	[kg]
r:	Radius	[m]
a, b, c, ℓ:	Length	[m]

Calculation example : When calculating the moment of inertia of a complicated shape, divide it into simple parts as much as possible for easier calculations.
As shown in the figure below, divide the hand into three parts ((1), (2), (3)).



Moment of inertia around T-axis of (1): I_1 (from 3 and 5 in the above table)

$$I_1 = \frac{0.19}{12}\left(0.12^2 + 0.015^2\right) + 0.19 \times 0.01^2 = 2.51 \times 10^{-4} \quad [kgm^2]$$

Moment of inertia around T-axis of (2): I_2 (from 1 and 5 in the above table)

$$I_2 = \frac{0.123 \times 0.01^2}{2} + 0.123 \times 0.04^2 = 2.03 \times 10^{-4} \quad [kgm^2]$$

Moment of inertia around T-axis of (3): I_3 (from 1 and 5 in the above table)

$$I_3 = \frac{0.98 \times 0.02^2}{2} + 0.98 \times 0.05^2 = 2.65 \times 10^{-3} \quad [kgm^2]$$

Moment of inertia around T-axis of entire hand: I

$$I = I_1 + I_2 + I_3 = 0.003 \quad [kgm^2]$$

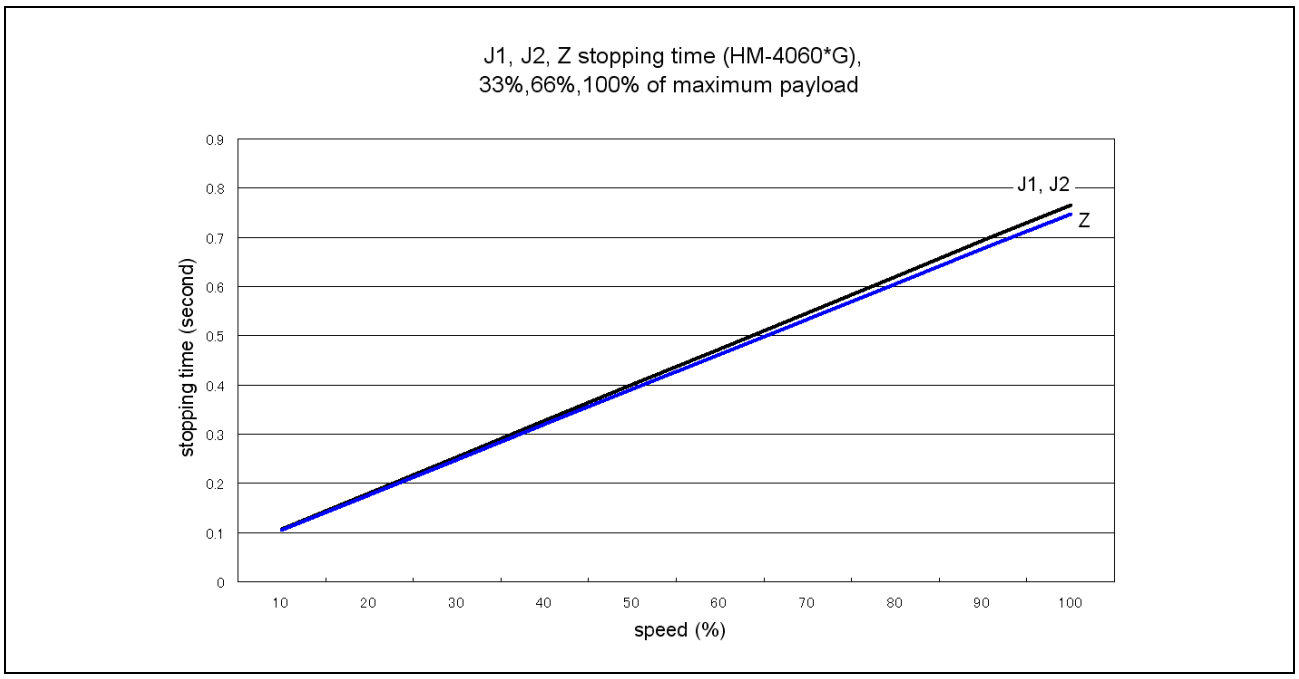
Calculation Example of Hand's Moment of Inertia Around the T Axis

3.7 Stopping Time and Distance (Angle) at an Emergency Stop

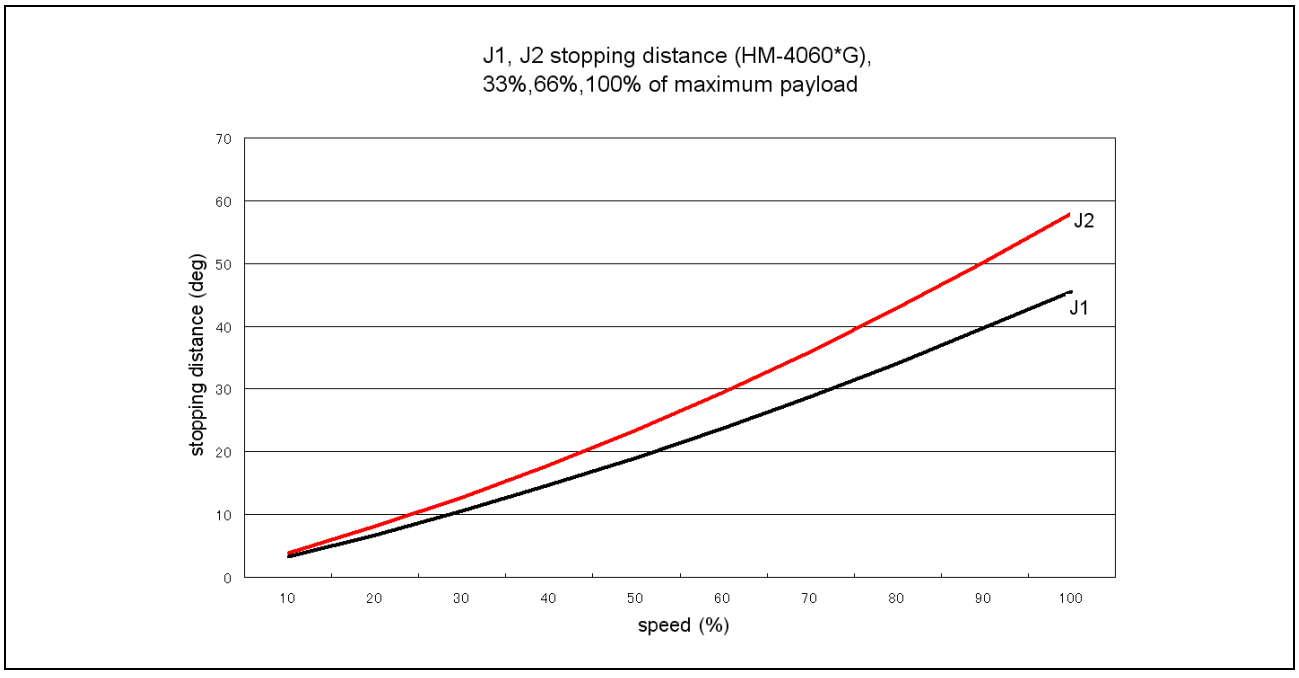
Pressing the emergency stop button when the robot is in motion stops the robot. The stopping time required from activation of a stop signal and the distance (angle) for major three joints vary with the robot speed as shown in the graphs below. The measuring conditions are: Robot arm extended, 33%, 66% and 100% of the maximum payload.

3.7.1 Maximum Payload 10 kg Type

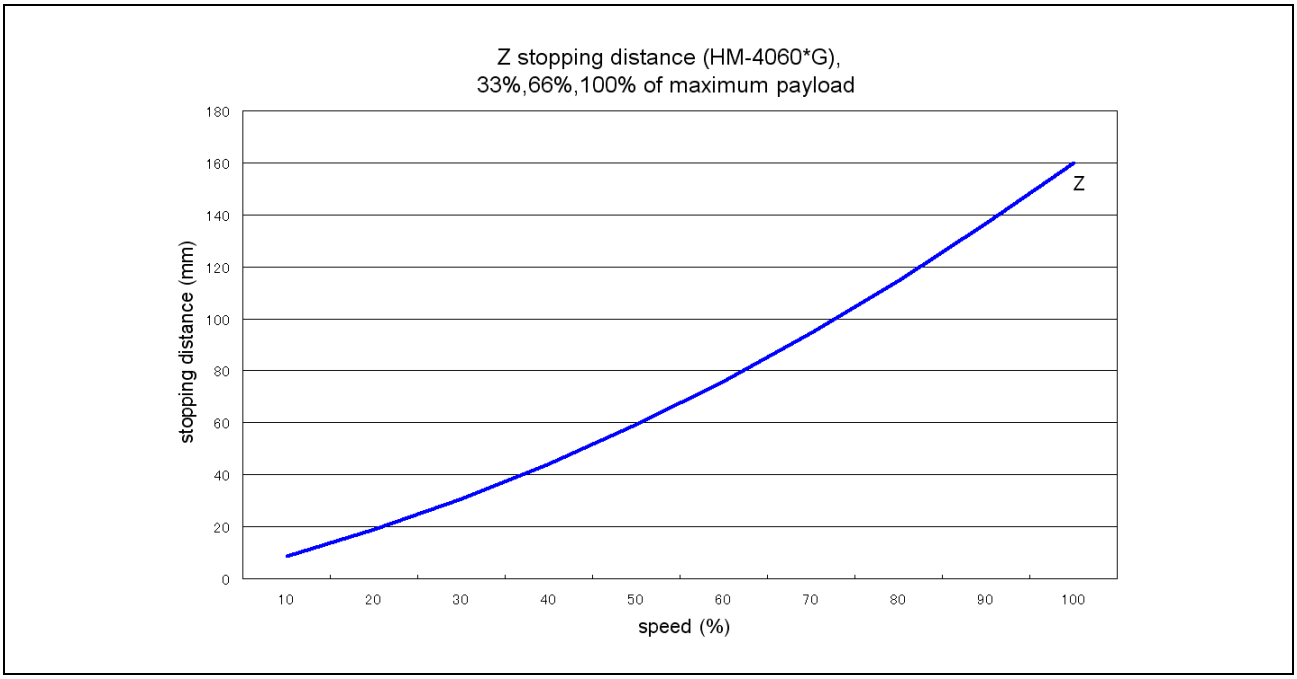
(1) HM-4060*G-T series



J1, J2, Z stopping time vs. speed at an emergency stop (HM-4060*G)

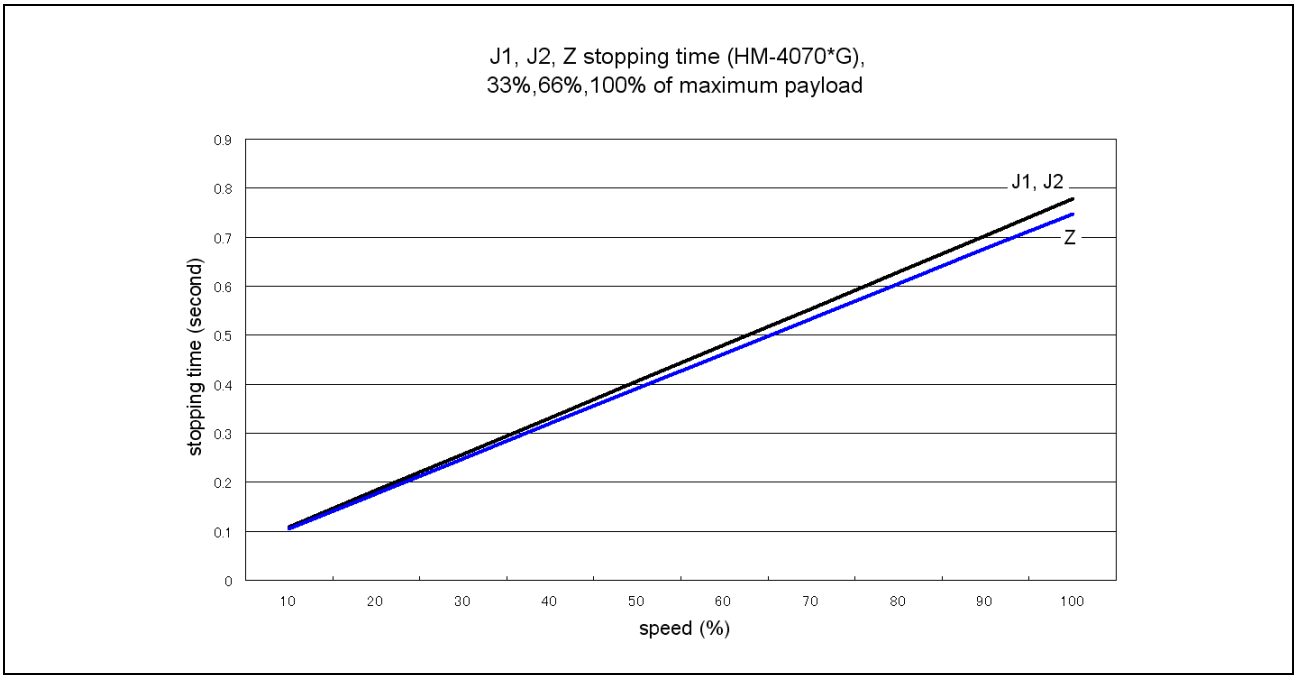


J1, J2 stopping distance vs. speed at an emergency stop (HM-4060*G)

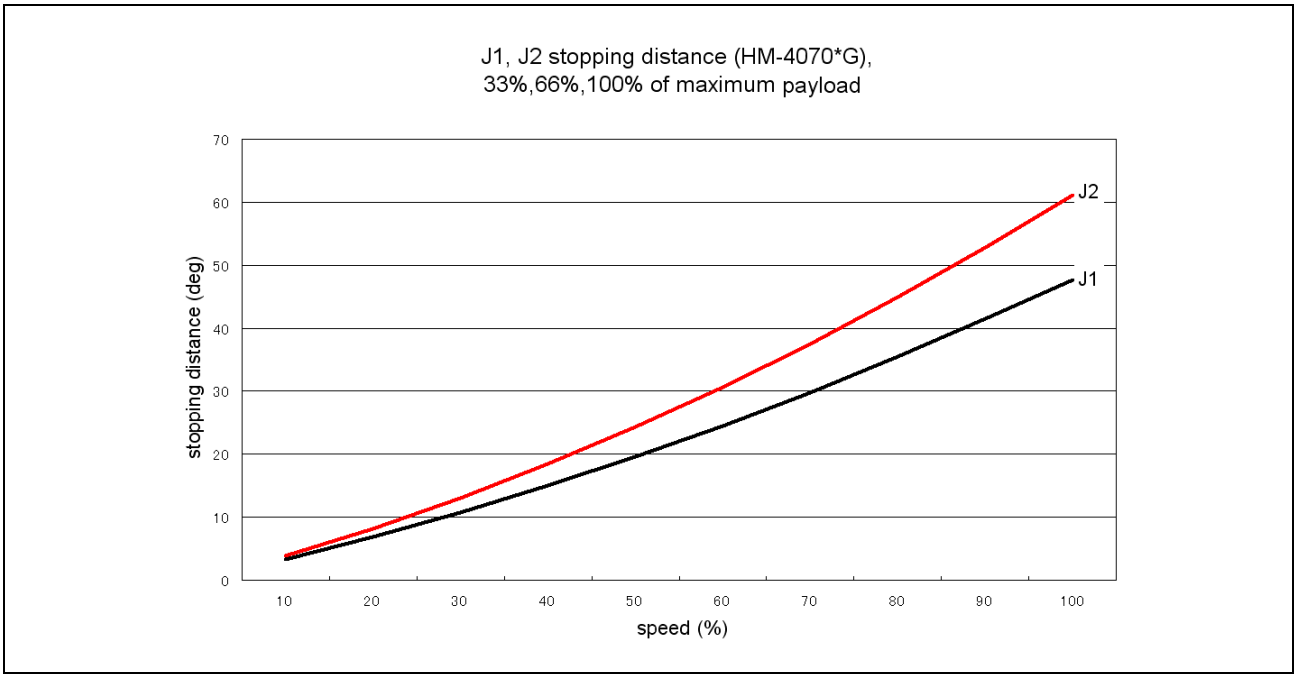


Z stopping distance vs. speed at an emergency stop (HM-4060*G)

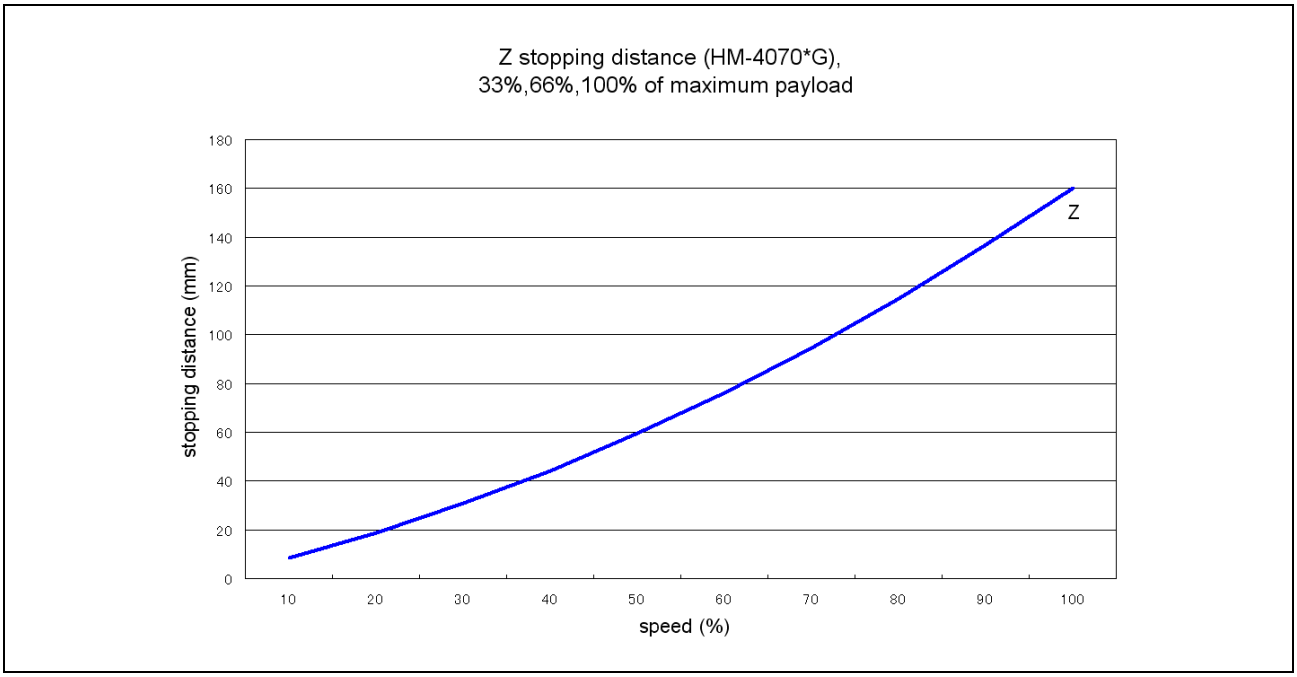
(2) HM-4070*G-T series



J1, J2, Z stopping time vs. speed at an emergency stop (HM-4070*G)

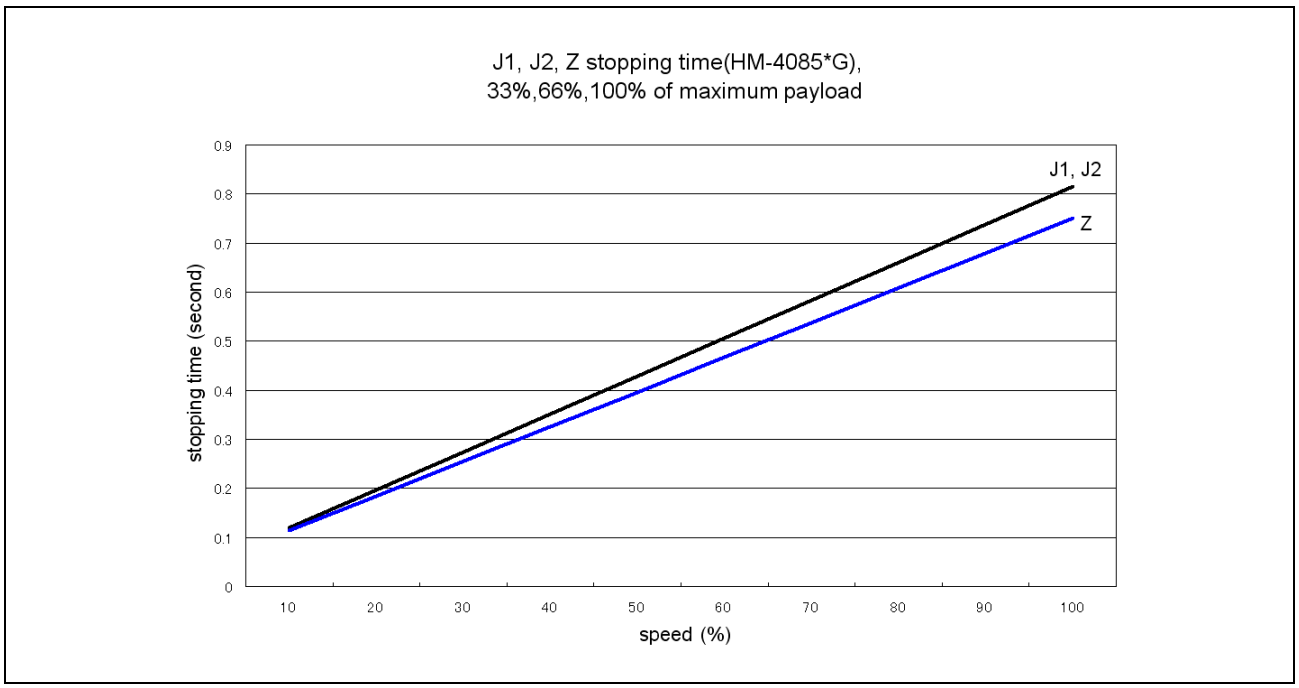


J1, J2 stopping distance vs. speed at an emergency stop (HM-4070*G)

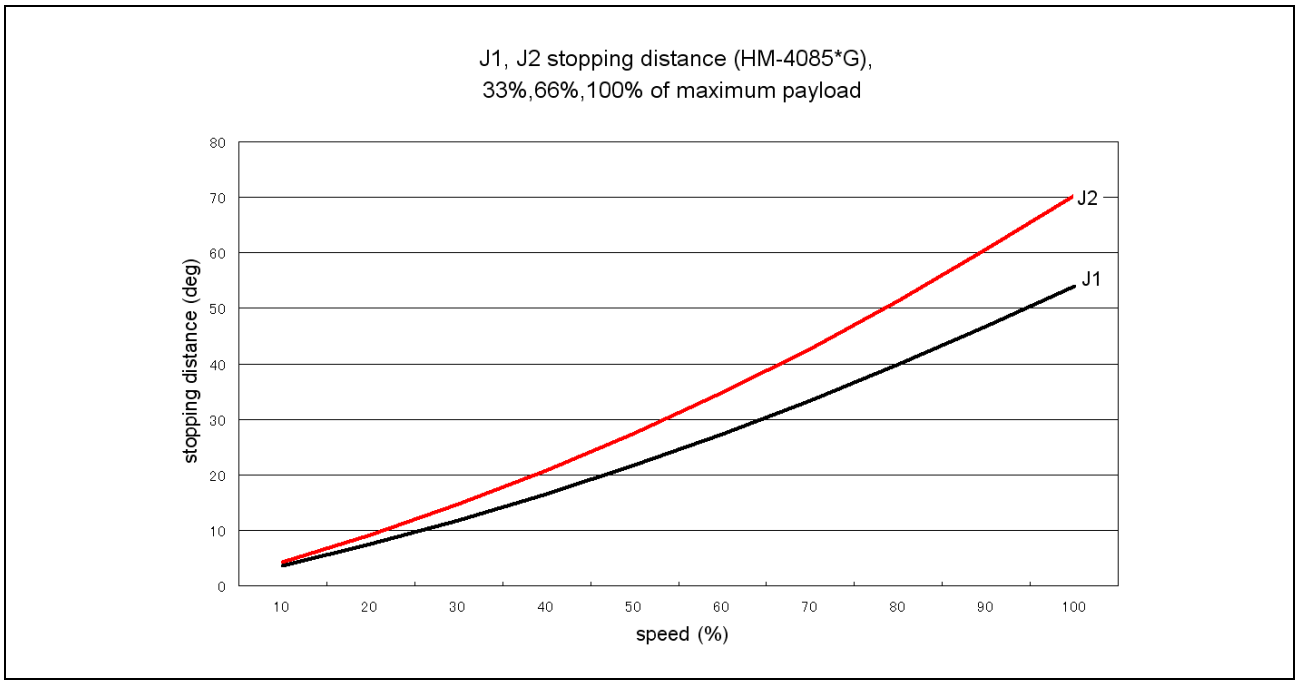


Z stopping distance vs. speed at an emergency stop (HM-4070*G)

(3) HM-4085*G-T series



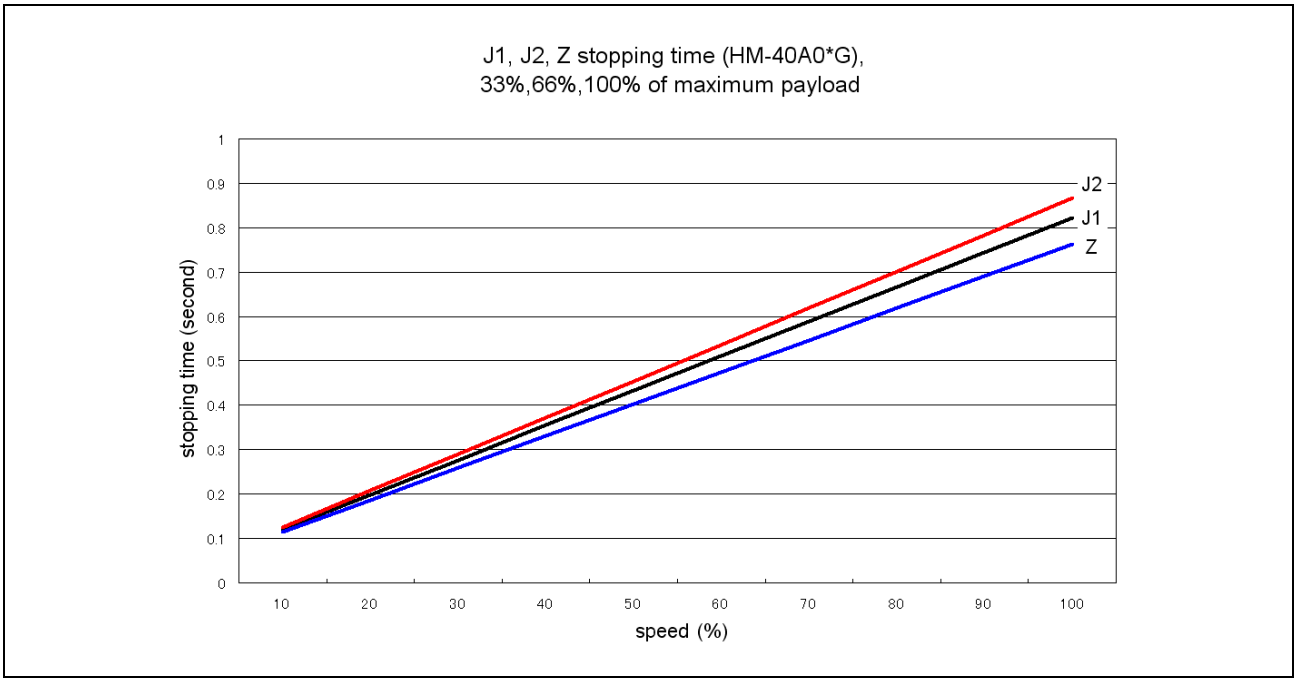
J1, J2, Z stopping time vs. speed at an emergency stop (HM-4085*G)



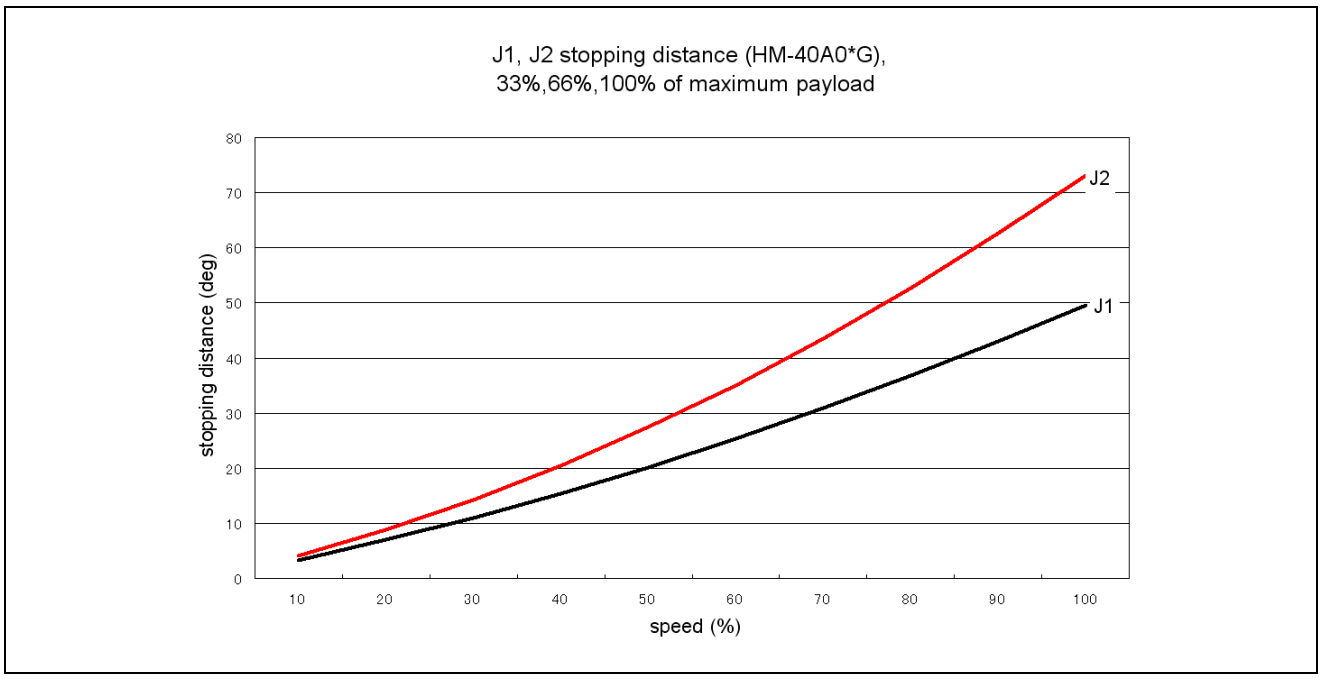
J1, J2 stopping distance vs. speed at an emergency stop (HM-4085*G)

Z stopping distance vs. speed at an emergency stop (HM-4085∗G)

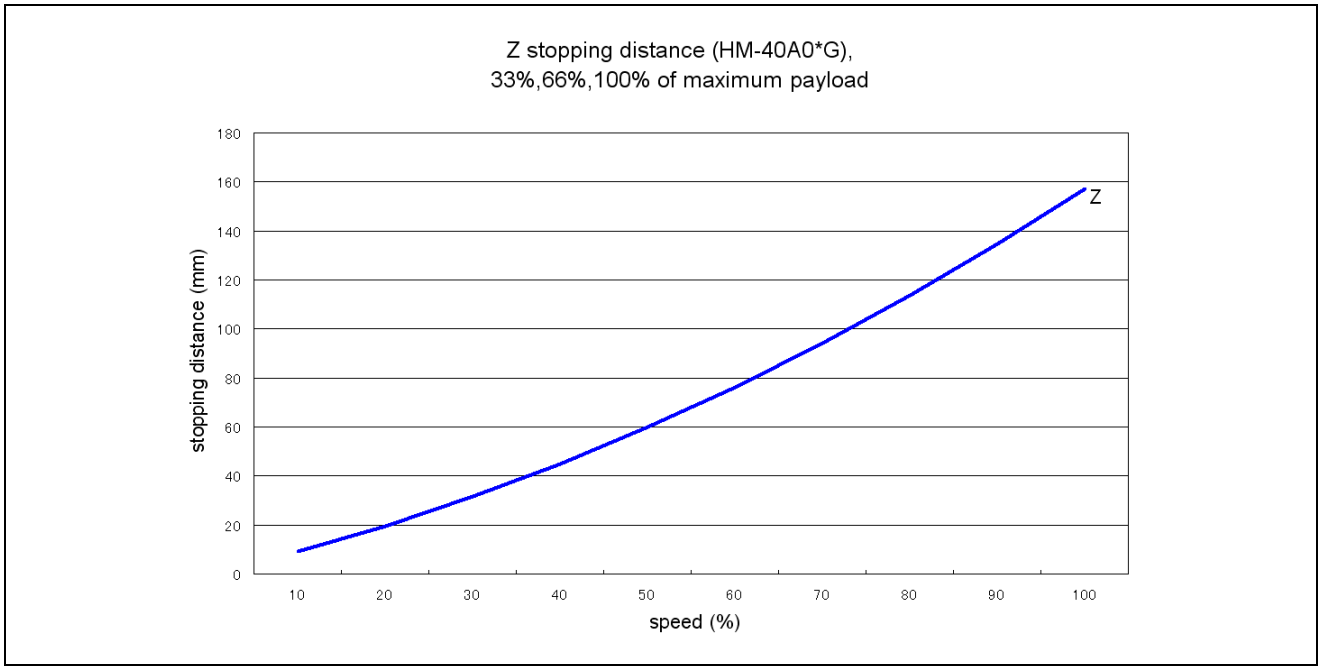
(4) HM-40A0∗G-T series



J1, J2, Z stopping time vs. speed at an emergency stop (HM-40A0∗G)



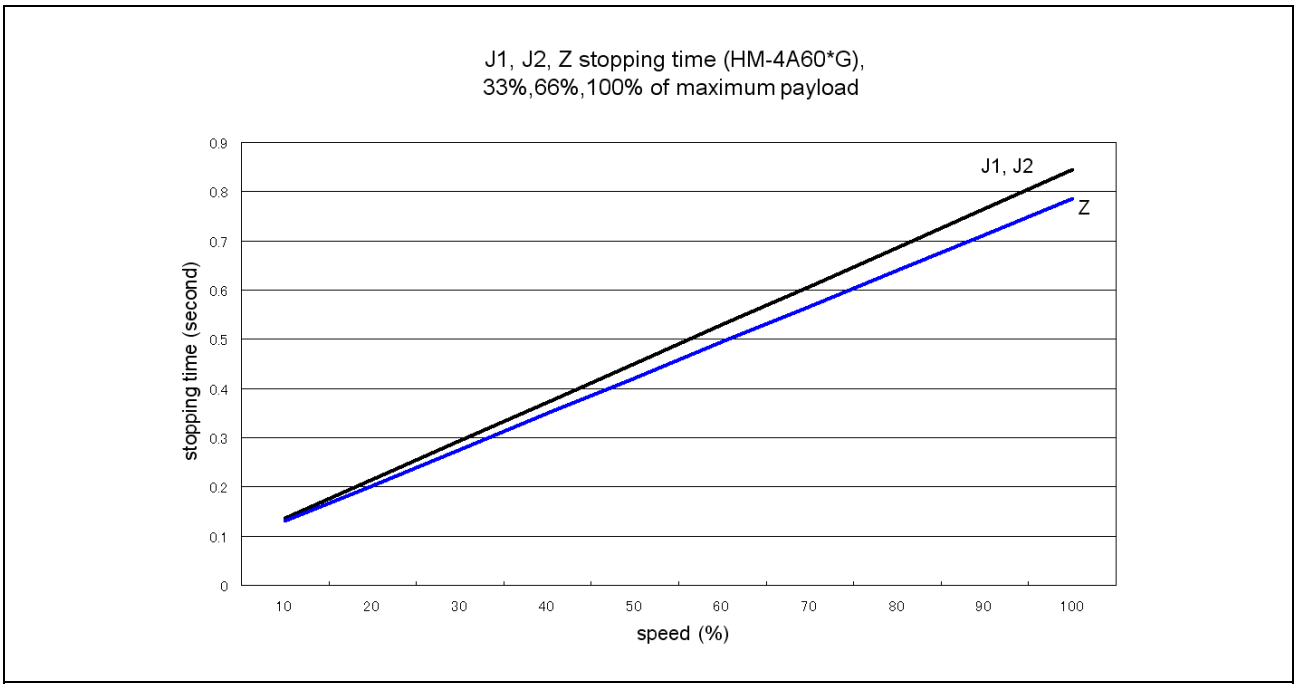
J1, J2 stopping distance vs. speed at an emergency stop (HM-40A0*G)



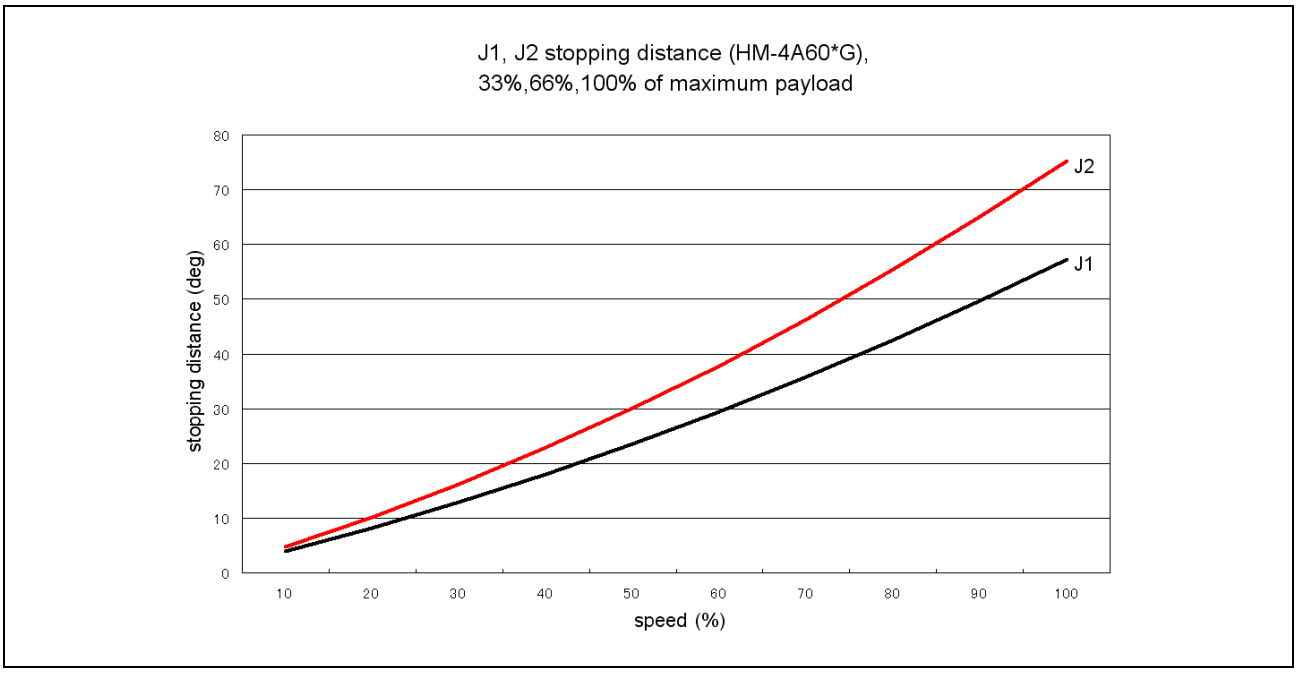
Z stopping distance vs. speed at an emergency stop (HM-40A0*G)

3.7.2 Maximum Payload 20 kg Type

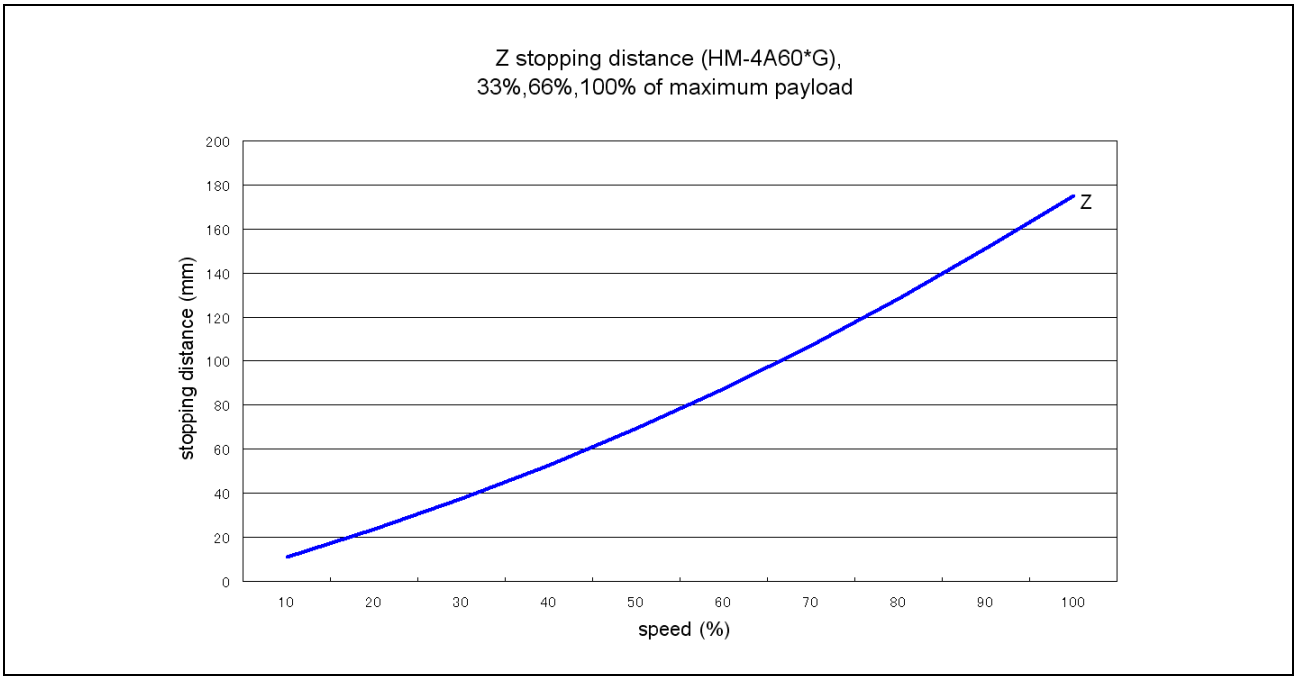
(1) HM-4A60∗G-T series



J1, J2, Z stopping time vs. speed at an emergency stop (HM-4A60∗G)

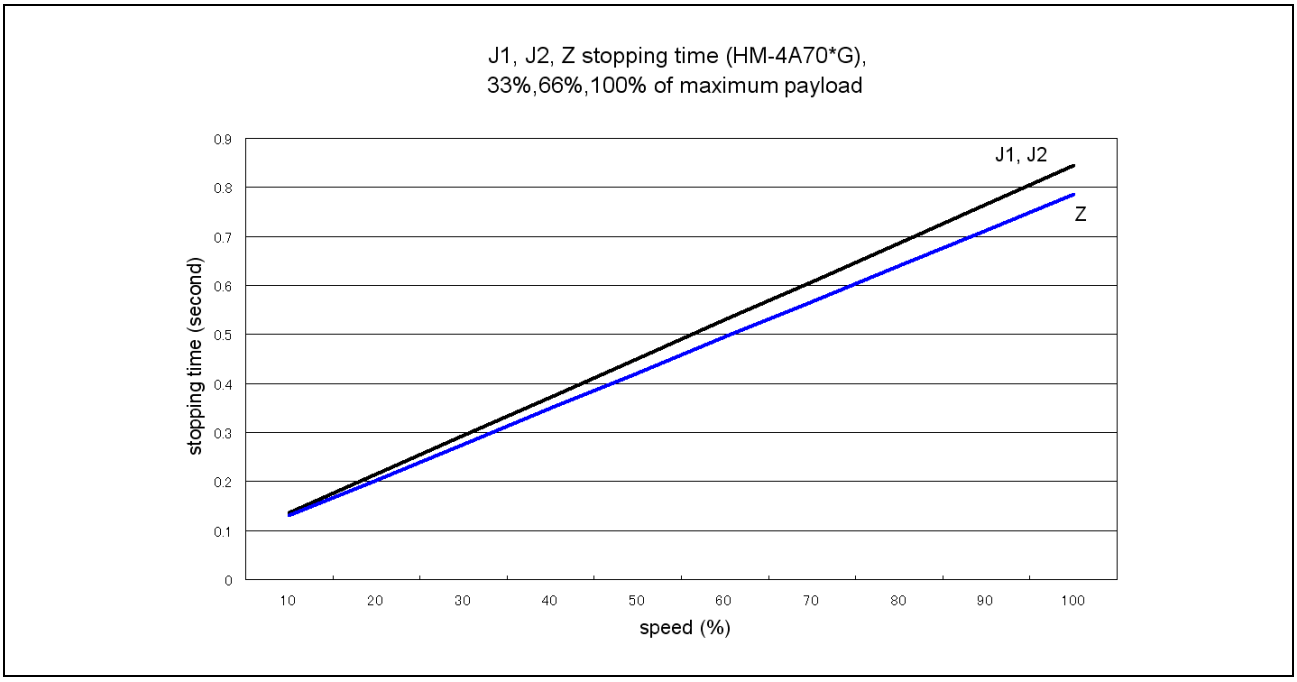


J1, J2 stopping distance vs. speed at an emergency stop (HM-4A60∗G)

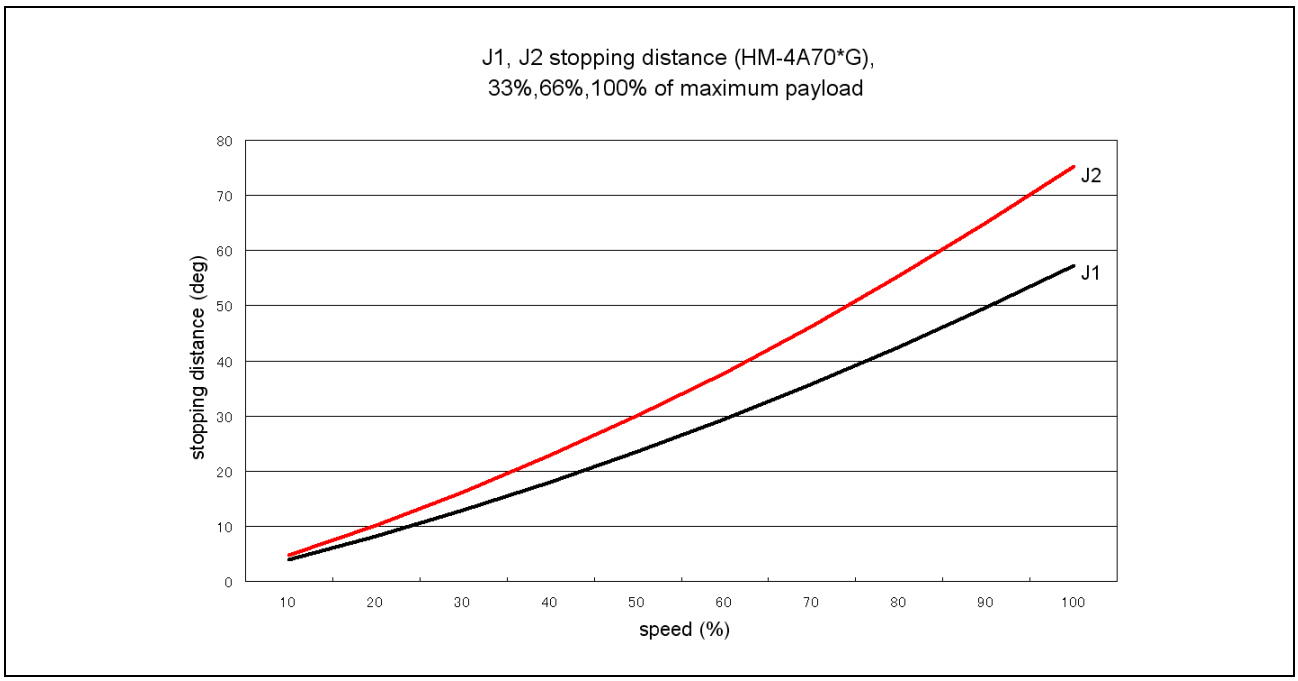


Z stopping distance vs. speed at an emergency stop (HM-4A60∗G)

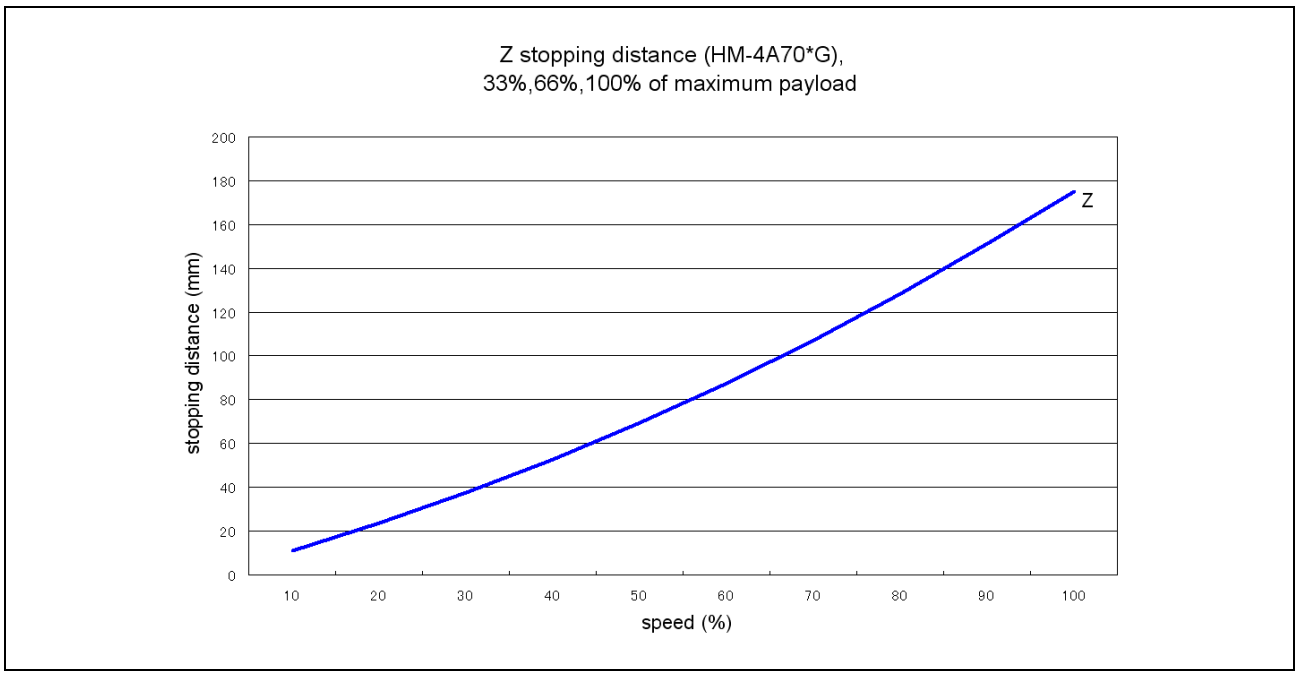
(2) HM-4A70∗G-T series



J1, J2, Z stopping time vs. speed at an emergency stop (HM-4A70∗G)

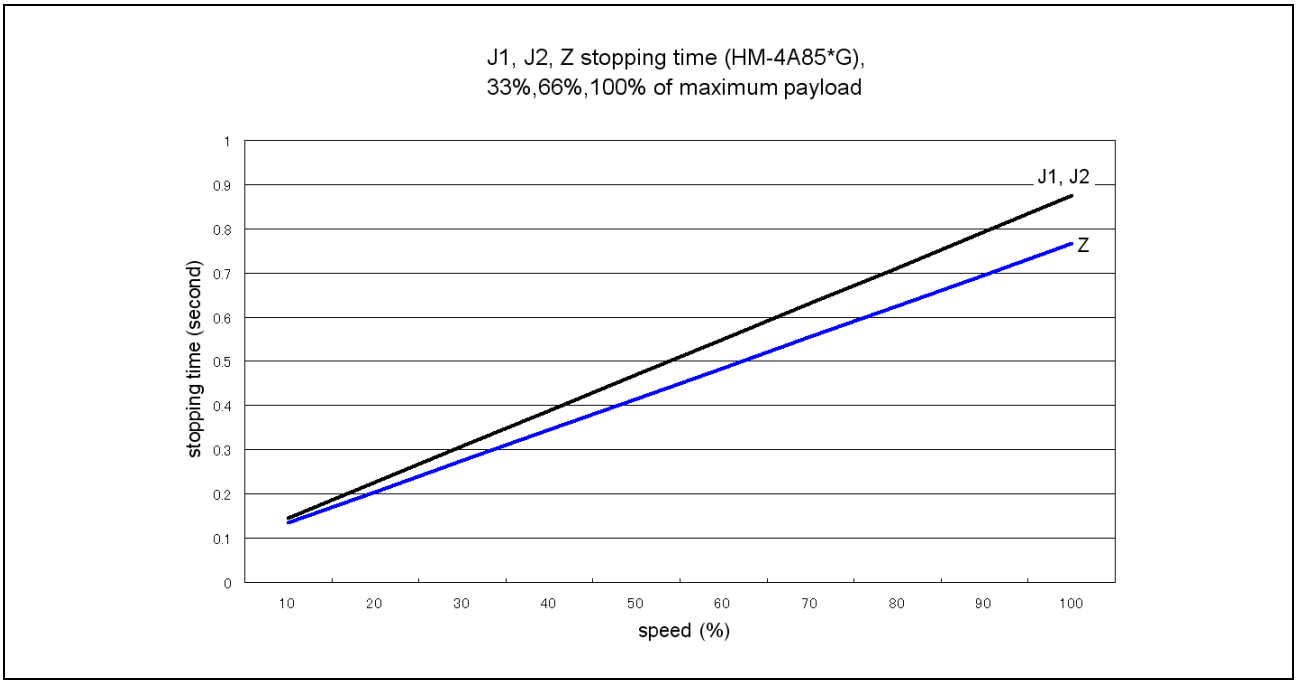


J1, J2 stopping distance vs. speed at an emergency stop (HM-4A70*G)

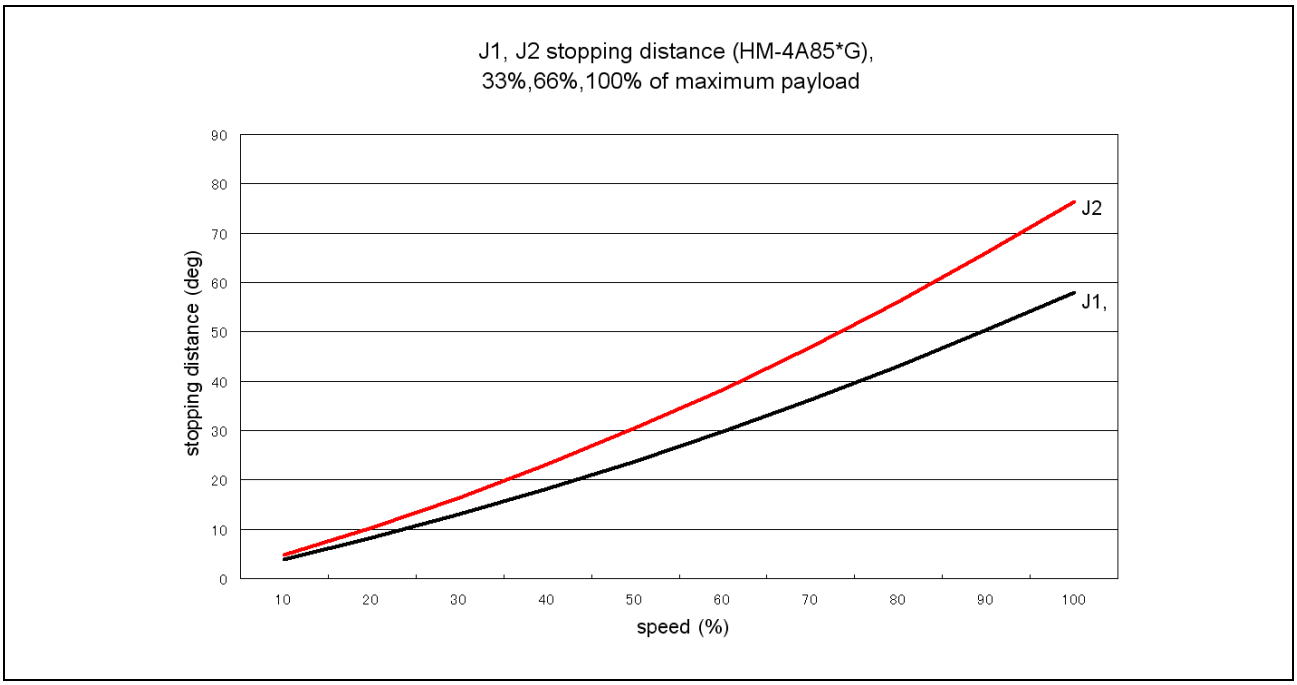


Z stopping distance vs. speed at an emergency stop (HM-4A70*G)

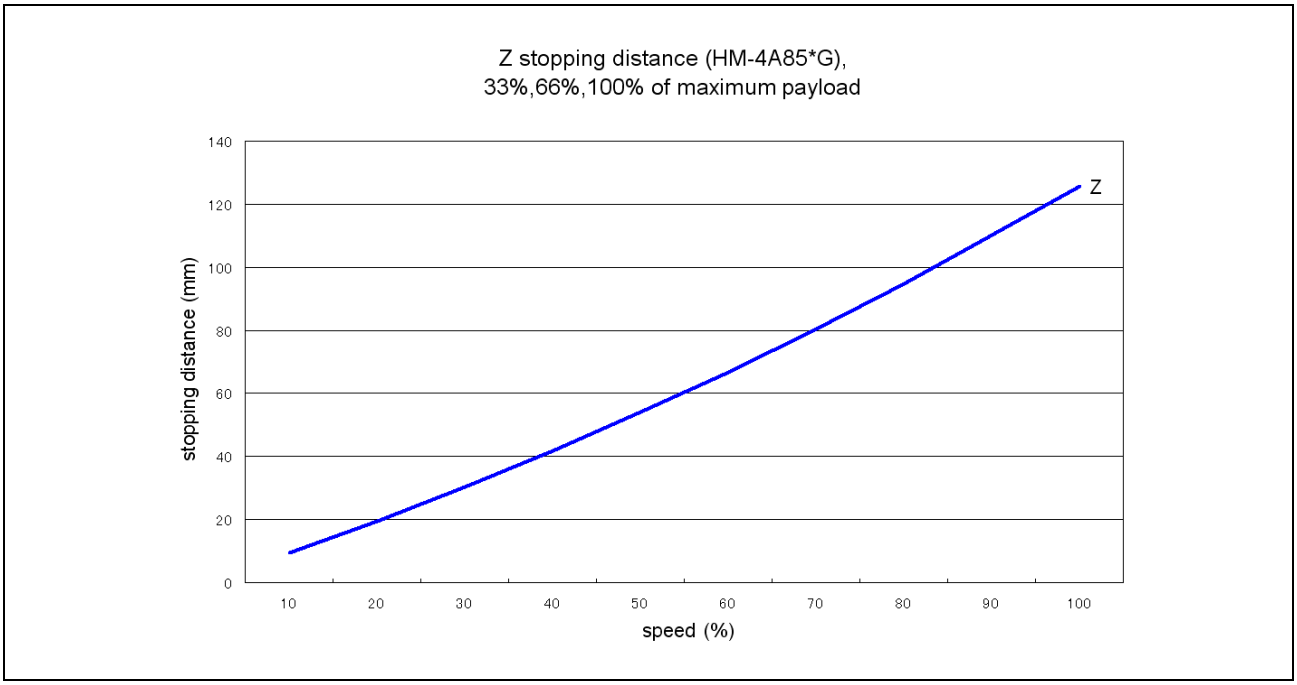
(3) HM-4A85*G-T series



J1, J2, Z stopping time vs. speed at an emergency stop (HM-4A85*G)

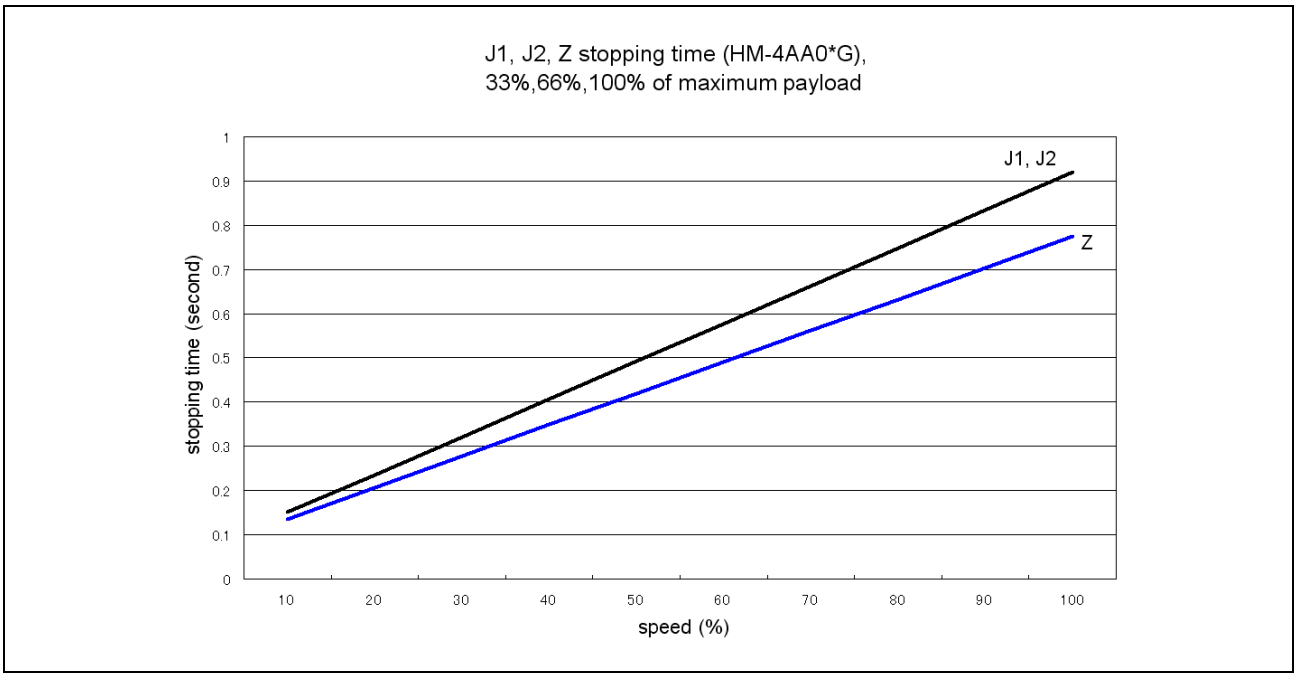


J1, J2 stopping distance vs. speed at an emergency stop (HM-4A85*G)

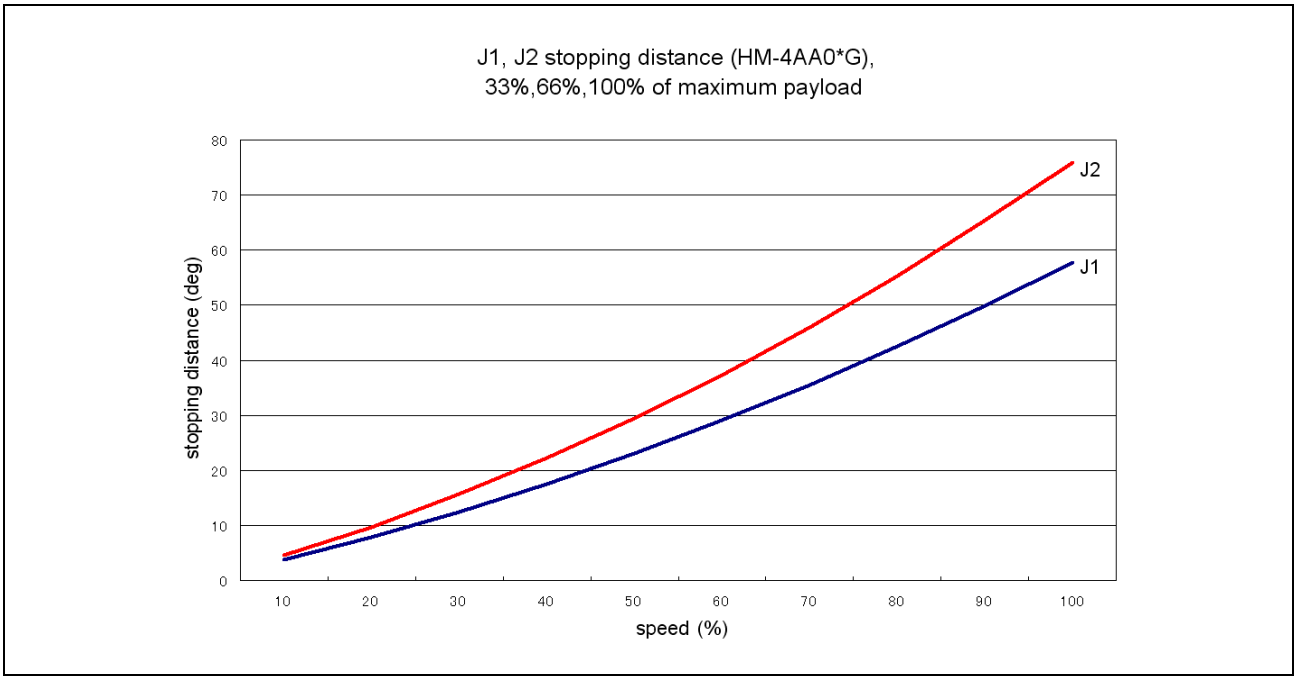


Z stopping distance vs. speed at an emergency stop (HM-4A85∗G)

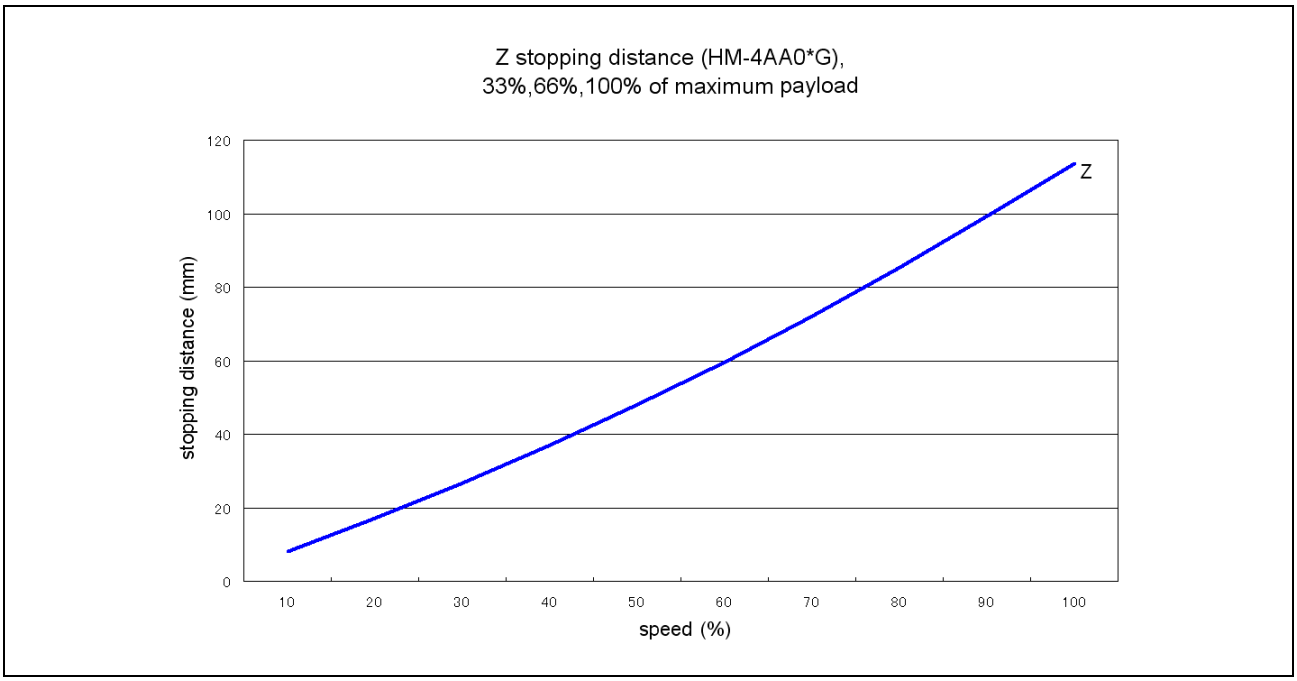
(4) HM-4AA0∗G-T series



J1, J2, Z stopping time vs. speed at an emergency stop (HM-4AA0∗G)



J1, J2 stopping distance vs. speed at an emergency stop (HM-4AA0*G)



Z stopping distance vs. speed at an emergency stop (HM-4AA0*G)

Chapter 4
Specifications of the Robot Controller

4.1 Specifications

Table below lists the robot controller specifications.

RC7M Controller Specifications (HM-G-T series)

Item			Specifications
Applicable robot			Medium-sized, horizontal articulated type (HM-G-T series)
Model			RC7M-HMG4BA-FP-3AD
Control system			PTP, CP 3-dimensional linear, 3-dimensional circular
No. of controllable axes			Four axes
Drive system			All axes: Full-digital AC servo
Language used			TOYOTA robot language DENSO robot language PAC (conforming to SLIM)
Memory capacity			3.25 MB (equivalent to 10,000 steps, 30,000 points)
Teaching system			1) Direct teaching 2) Remote teaching 3) Numerical input (MDI)
External signals (I/O)	Standard I/O	Mini I/O	Input signals: 8 user open points (PNP) Output signals: 8 user open points (PNP)
		HAND I/O	Input signals: 8 user open points (PNP) Output signals: 8 user open points (PNP)
	PLC	PLC I/O	Available with FL remote I/O
		DLNK-M2	Available with extension unit
		FL-net	Built in TOYOPUC PC10P
		CMP-LNK	Available with extension unit
External communication			RS-232C: 1 line Ethernet: 1 line USB: 2 lines
Extension slot			1 (Two out of three extension slots have been occupied)
Safety circuit			Safety controller in safety category 4
Self-diagnosis function			Overrun, servo error, memory error, input error, etc.
Timer function			0.02 to 10 sec. (in units of 1/60 sec.)
Error display			Error codes will be outputted on the external I/O. Error messages will be displayed in English on the teach pendant.
Cables	Motor & encoder cable (option)		2 m, 4 m, 6 m, 12 m, 20 m (Splash-proof)
	I/O cable (option)		8 m, 15 m (For Mini I/O, HAND I/O, X-LNE1, S ON and X-10A3)
	Power cable		5 m
Environmental conditions (in operation)			Temperature: 0 to 40°C Humidity: 90% RH or less (no condensation allowed)
Power source			Three-phase, 200 VAC-10% to 230 VAC+10%, 50/60 Hz, 2.5 kVA Single-phase, 230 VAC-10% to 230 VAC+10%, 50/60 Hz, 2.5 kVA
I/O power source	External power source to be used		Supply 24 DVC ±10% power externally
Degree of protection			IP20
Weight			Approx. 25 kg (55 lbs)

⚠WARNING

- **DO NOT touch fins. Their hot surfaces may cause severe burns.**
- **DO NOT insert fingers or foreign objects into openings. Doing so may cause bodily injury.**
- **Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect the power cable, and wait 3 minutes or more. This is for protecting you from electric shock.**
- **DO NOT connect or disconnect connector to/from the controller while the power switch is on. Doing so may cause electric shock or controller failure.**

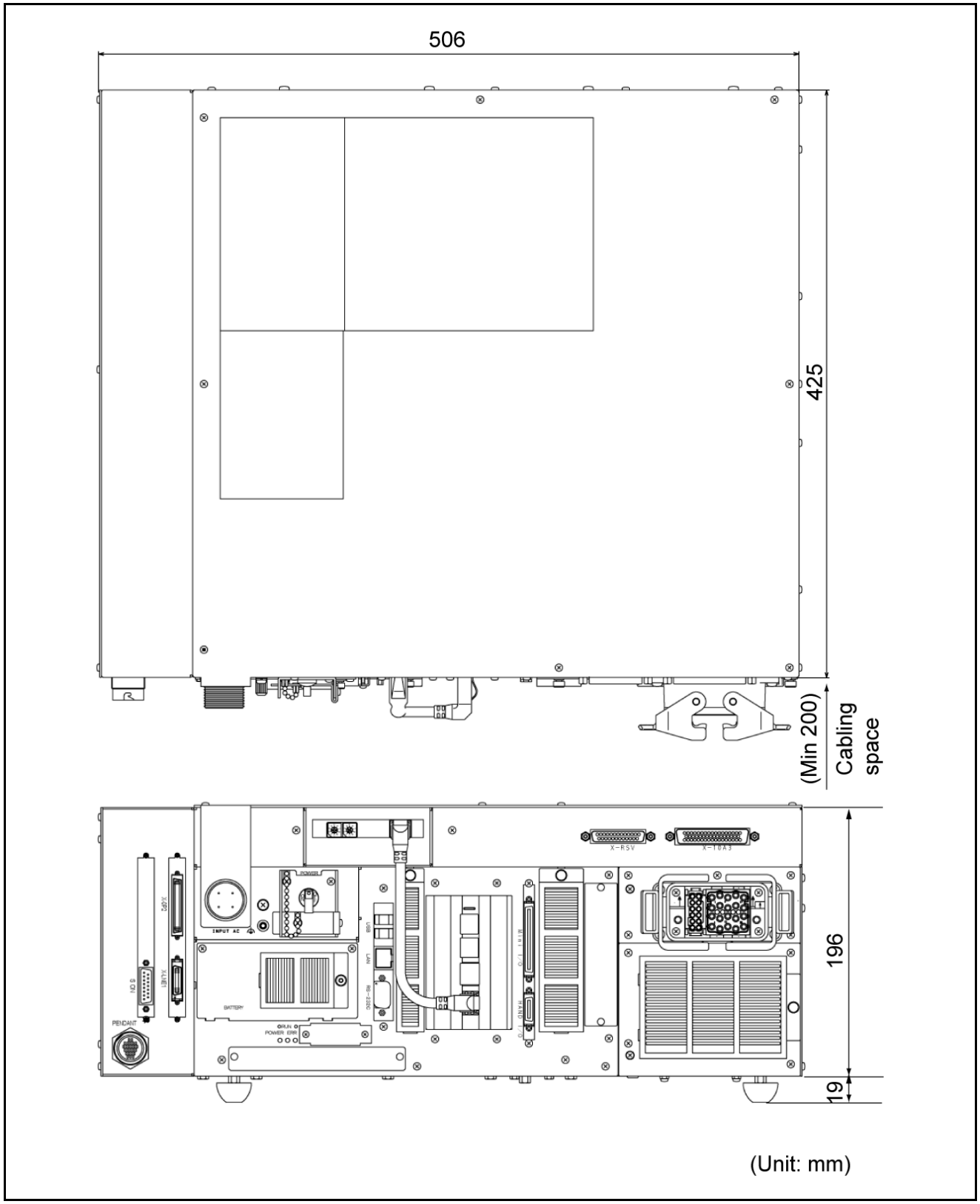
⚠ CAUTION IN INSTALLATION

- **This controller is not designed to be dust-proof, splash-proof, or explosion-proof.**
- **Read operation-manuals before installation.**
- **Do not place anything on the controller.**

4.2 Outer Dimensions

Figure below shows the outer dimensions of the robot controller.

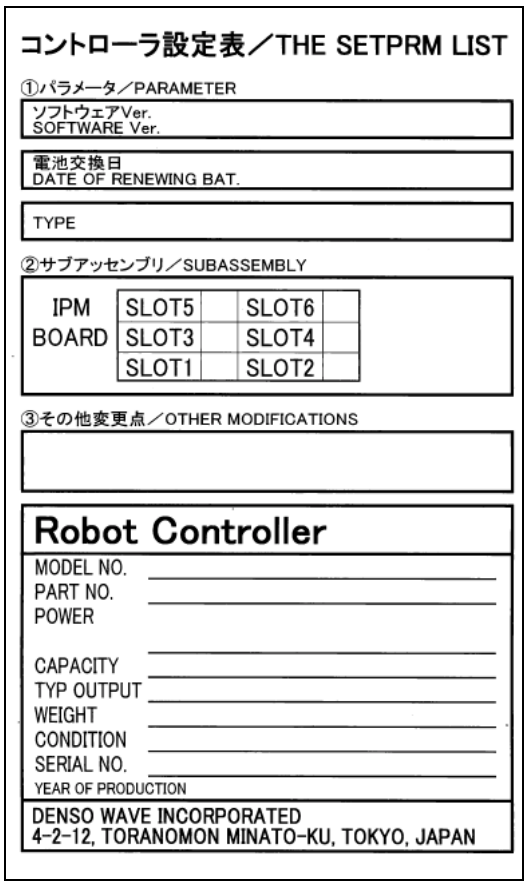
Outer Dimensions of Robot Controller (HM-G-T series)



Outer Dimensions of RC7M Robot Controller

4.3 Controller Setting Table

The controller setting table given in Figure below is attached to the controller. It shows the software version, the next replacement dates of the memory backup battery and encoder backup battery, etc.


コントローラ設定表／THE SETPRM LIST

①パラメータ／PARAMETER

ソフトウェアVer.
SOFTWARE Ver.

電池交換日
DATE OF RENEWING BAT.

TYPE

②サブアッセンブリ／SUBASSEMBLY

IPM BOARD	SLOT5		SLOT6	
	SLOT3		SLOT4	
	SLOT1		SLOT2	

③その他変更点／OTHER MODIFICATIONS

Robot Controller

MODEL NO.
PART NO.
POWER
CAPACITY
TYP OUTPUT
WEIGHT
CONDITION
SERIAL NO.
YEAR OF PRODUCTION

DENSO WAVE INCORPORATED
4-2-12, TORANOMON MINATO-KU, TOKYO, JAPAN

<Content THE SETPRM LIST>

SOFTWARE Ver.	The version of the main software for the controller is entered.
DATE OF RENEWING BAT.	The next replacement dates of the memory backup battery and encoder backup battery are entered.
TYPE	The model of the robot system is entered. The coding of the set model is described below:
SUBASSEMBLY	The type and position of the controller IPM board are described.

The coding of the set model (HM-G-T series)

HM – 4 0 85 2 G – T03

- Z-axis stroke
  1: 100 mm, A: 150 mm, 2: 200 mm, 3: 300 mm, 4: 400 mm
- Arm length
  60: 600 mm, 70: 700 mm, 85: 850 mm, A0: 1000 mm
- Maximum payload
  0: 10 kg, A: 20 kg
- Number of axes (4 axes)
- Horizontal articulated robot, medium-sized
  HM: Floor-mount type

Chapter 5 Warranty

DENSO robots are manufactured under strict quality control. In case of failure, we warranty the robot under the following conditions:

Warranty Period

The warranty shall be effective for one year from the date of purchase.

Warranty Coverage

DENSO WAVE shall repair the robot free of charge when a failure occurs and is attributable to the design, manufacture or material of the robot within the warranty period in spite of proper use.

Items Not Covered

Failures, which arise from one of the following, shall not be covered by the warranty even if the robot is under warranty:

(1) Failures caused by improper repair, modification, transfer or handling by you or a third party;

(2) Failures caused by the use of a part or oil/fat other than those specified in the related manuals;

(3) Failures caused by a fire, salt damage, earthquake, storm/flood or other acts of God;

(4) Failures caused by the use of the robot in an environment other than the environment specified in the related manuals, such as dust and water ingress;

(5) Failures caused by a worn-out consumable, such as a fan filter;

(6) Failures caused by improper performance or non-performance of lubrication, maintenance or inspections stated in this owner's manual; and

(7) Damages other than the robot repair costs.

Horizontal Articulated Robot
HM-G-T SERIES

GENERAL INFORMATION ABOUT ROBOT (T03)

First Edition May 2007
Third Edition September 2010
Fourth Edition August 2011

DENSO WAVE INCORPORATED

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The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.