DENSO ROBOT

Integrated compact type

XR-G SERIES

GENERAL INFORMATION ABOUT ROBOT

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
XR-G series (Integrated compact robot)	XR-43***G

NOTE 1: Model names listed above apply to the models of robot systems. The model names of robot units are followed by M. If the robot system model is XR-43***G, for example, the robot unit model is XR-43***GM.

NOTE 2: Asterisks (***) in model names denote 3 codes meaning the arm length and motion strokes of axes.

IMPORTANT

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

NOTE:

Robots and controllers that will be exported to South Korea after March 1st 2013 need to have KCs mark for each equipment.

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.

Appendix How to Use the Manual Pack CD

Contents

Chapter1 Packing List of the Robot

1.1 Standard Components

The components listed below are contained in the product package.

Standard Components

No.	Item	Qty.
(1)	Robot unit	1
(2)	Robot controller	1
(3)	Power cable (5m)	1
(4)	Motor & encoder cable (Note1) (Option)	1
(5)	Manuals (“Manual Pack CD” and “Safety Precautions”)	1 set
(6)	WINCAPSIII install CD (Trial version)	1
(7)	Spare fuses for robot controller	3
(8)	Pendantless connector (Dummy connector)	1
(9)	Connector set for hand control signals (for CN20 and CN21)	1 set
(10)	Direction indicator label (Note2)	1
(11)	Warning label (Note3)	1
(12)	Spare output IC for robot controller	1
(13)	Eyebolts (for transportation) *Attached to the robot unit when shipped.	2
(14)	Short sockets for robot controller	2

Note1: Choose a motor & encoder cable from the table below to order. The 20-m motor & encoder cable (standard/splash-proof) is not available for controllers equipped with extended-joint options or UL-Listed robot units. The internal cable bending radius shall be at least 200 mm. Excessive bending will result in broken lead wires.

Item		Part No.
Standard cable	4m	410141-4400
Standard cable	4m	410141-3611
Standard cable	6m	410141-3621
Standard cable	12m	410141-3631
Standard cable	20m	410141-4440

Note2: After installation, attach the direction indicator label in a position on the robot unit that can be easily seen.

Note3: 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.

1.2 Optional Components

The table below lists the optional components.

Optional Components (1)

Classification	No.	Item		Remarks		Part No.
I/O cables	1	Standard I/O cable set		(8m) Incl. Nos. 1-1 and 1-2.		410149-0940
				(15m) Incl. Nos. 1-1 and 1-2.		410149-0950
	1-1	I/O cable for Mini I/O (68 pins)		(8m)		410141-2700
				(15m)		410141-2710
	1-2	I/O cable for HAND I/O (20 pins)		(8m)		410141-1740
				(15m)		410141-1750
	2	I/O cable for Parallel I/O board (96 pins)		(8m)		410141-3050
				(15m)		410141-3060
	3	I/O cable for SAFETY I/O (36 pins) (Only for global type)		(8m)		410141-3580
				(15m)		410141-3590
Operation devices	4	Teach pendant		(4m) With cable		410100-1572
				(8m) With cable		410100-1582
				(12m) With cable		410100-1592
	5	Mini-pendant kit (Incl. cable and WINCAPSIII Light)		(4m)	Japanese indication	410109-0392
					English indication	410109-0402
				(8m)	Japanese indication	410109-0412
					English indication	410109-0422
				(12m)	Japanese indication	410109-0432
					English indication	410109-0442
	6	Pendant extension cable		(4m)	For TP, MP	410141-3711
				(8m)	For TP, MP	410141-3721
Programming support tool	7	WINCAPSIII		CD-ROM (common to the languages--Japanese, English, German, Korean, and Chinese)		410090-0980
Optional boards for the robot controller	8	Parallel I/O board	Shipped as installed on the controller	NPN		410010-3320
				PNP		410010-3330
			Shipped as individual boards (supply part)	NPN		410010-3340
				PNP		410010-3350
	9	DeviceNet board	Shipped as installed on the controller	For Slave station		410010-3370
				For Master station		410010-3380
				For Master & slave station		410010-3390
			Shipped as individual boards (supply part)	For Slave station		410010-3400
				For Master station		410010-3410
				For Master & slave station		410010-3480
	10	CC-Link board		Shipped as installed on the controller		410010-3430
				Shipped as individual boards (supply part)		410010-3440
	11	Conveyor tracking board		Shipped as installed on the controller		410010-3460
				Shipped as individual boards (supply part)		410010-3470

Optional Components (2)

Classification	No.	Item	Remarks	Part No.
Optional functions (For own optional board etc.)	12	Optional function for RS232C board Board manufacturer: CONTEC CO., LTD. Model: COM-2P(PCI)H	Shipped after integrated in the controller	410006-0260
			Added when the board is purchased as a spare part	410006-0270
	13	Optional function for S-LINK V board Board manufacturer: SUNX CO., LTD Model: SL-VPCI	Shipped after integrated in the controller	410006-0280
			Added when the board is purchased as a spare part	410006-0290
	14	Optional function for PROFIBUS-DP slave board Board manufacturer: Hilscher GmbH Model: CIF50-DPS\DENSO	Shipped after integrated in the controller	410006-0300
			Added when the board is purchased as a spare part	410006-0310
	15	EtherNet/IP function Board manufacturer: Hilscher GmbH Model: CIFX 50-RE\DENSO	Shipped after integrated in the controller	410006-0800
			Added when the board is purchased as a spare part	410006-0810
	16	Optional function for memory extension	Extension only upon controller shipment (3.25 MB to 5.5 MB)	410006-0320
Optional box	17	Controller protection box		410181-0091
	18	I/O conversion box	For interchangeability with RC5 type controller	410181-0100
CD Manuals	19	Manual Pack CD	Contained in the robot package	410002-2661
Optional manuals (Printed materials, English edition)	20	Instruction manual for XR-G, full set	Incl. C & D	410009-0870
	C	Instruction manual for XR-G, basic set	Incl. C-1 to C-3	410009-0850
	C-1	GENERAL INFORMATION ABOUT ROBOT	For XR-G	410002-3210
	C-2	RC7M CONTROLLER MANUAL	For RC7M controller	410002-2430
	C-3	ERROR CODE TABLES		410002-3370
	D	Instruction manual for XR-G, extension set	Incl. D-1 to D-7	410009-0830
	D-1	INSTALLATION & MAINTENANCE GUIDE	For XR-G	410002-3230
	D-2	STARTUP HANDBOOK		410002-2750
	D-3	SETTING-UP MANUAL		410002-3310
	D-4	PROGRAMMER'S MANUAL (I)		410002-3330
	D-5	PROGRAMMER'S MANUAL (II)		410002-3350
	D-6	Panel Designer USER'S MANUAL		410002-6480
	D-7	OPTIONS MANUAL	For RC7M controller	410002-2650

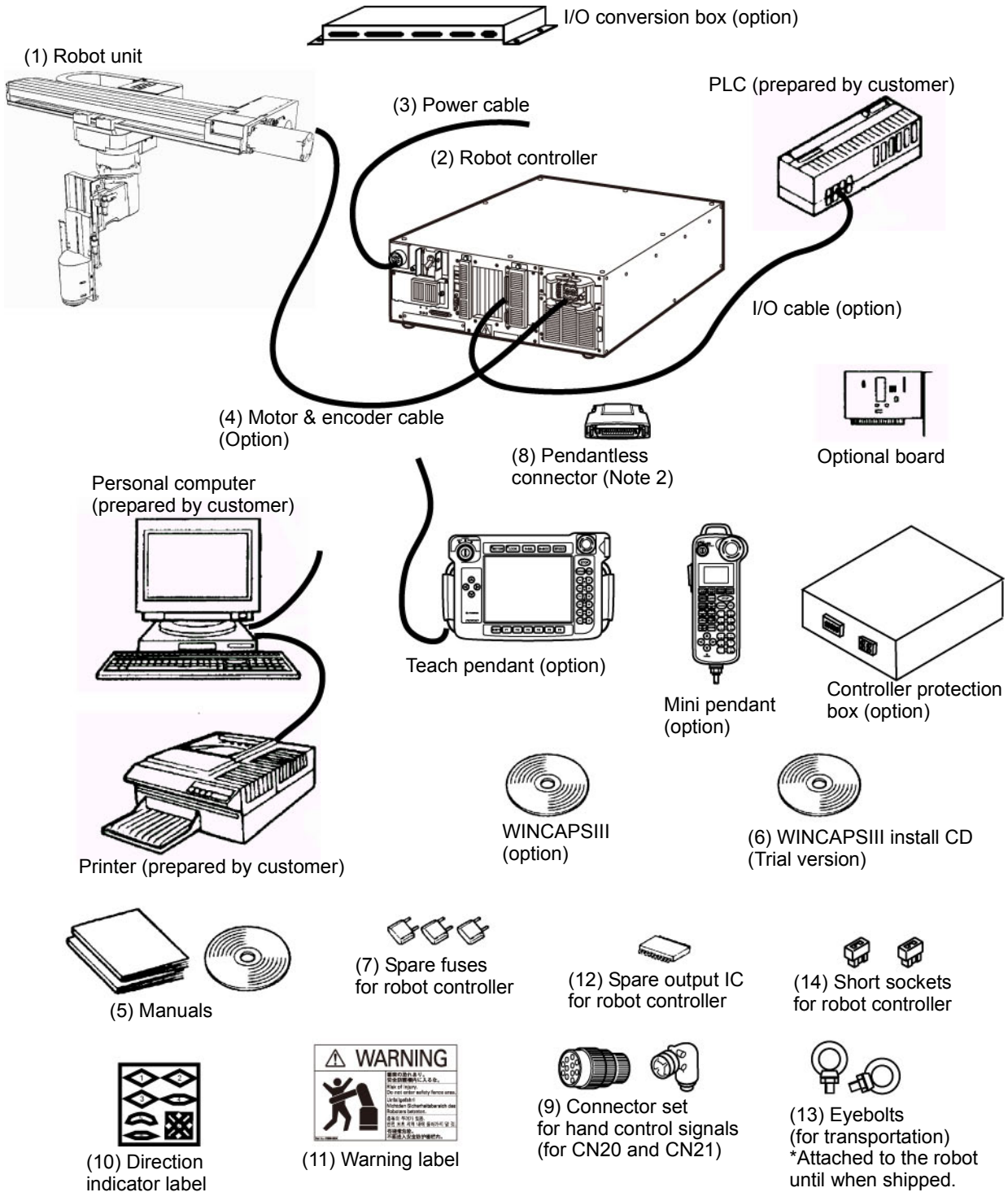
Optional Components (3)

Classification	No.	Item	Remarks	Part No.
Optional cabling /piping kit	21	Valve assembly	Single shipment (supply part) 4-station manifold valve	410640-0230
	22	Valve assembly	Robot mounting shipping 4-station manifold valve	410640-0330
	23	Hand control cabling kit		410879-0470
	24	Hand control cable	2m	410870-3350
Optional stand	25	Full-range stand		411759-0010
	26	Half-range stand		411759-0020

Chapter2 Configuration of the Robot System

2.1 Configurators

The figure below shows configurators of the typical robot system.



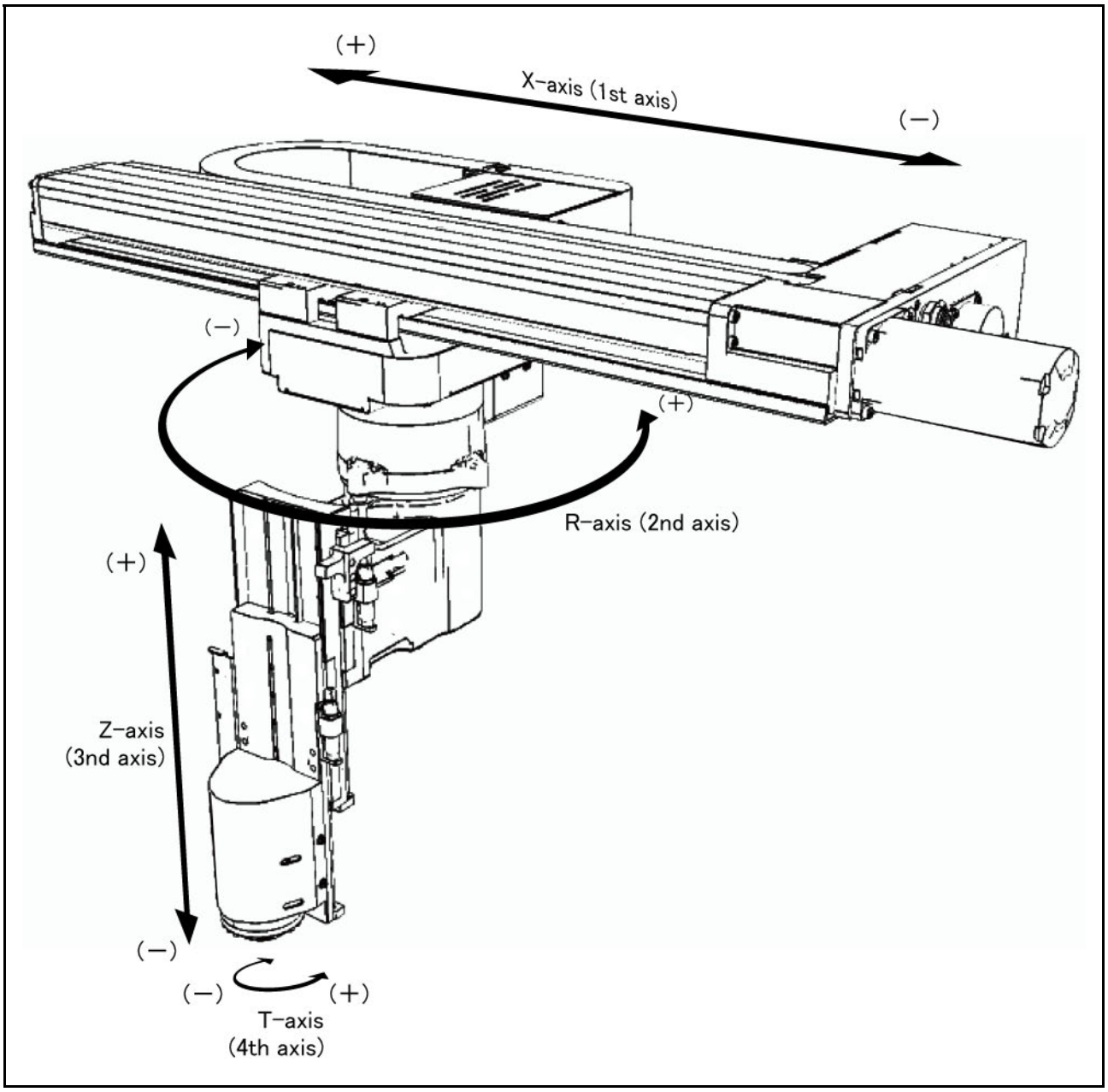
Note1: Components with numbers in () are the standard components contained in the product package listed on page 1.
Note2: The pendantless connector is attached to the robot controller when no teach pendant is connected.

Configurators of the Robot System (XR-G series)

2.2 Names of Robot Unit Components and Motion Direction

2.2.1 Robot Unit Components and Motion Direction

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



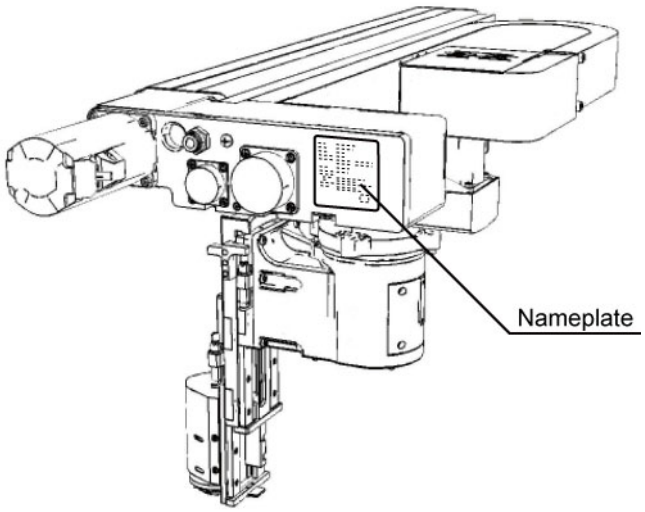
Robot Unit Components and Motion Direction (XR-43***G)

NOTE: The flange and the whole of the 1st axis may be coated with rust preventive oil which does not affect the robot function. If spattering of the oil could be a problem when the robot is in use, wipe it off before use.

2.2.2 Name Plate

The name plate is affixed in the base part, which includes serial number of the robot, robot model, and day of manufacturer, etc.

The serial number is the figure which identifies the robot of each customer and it is paired with the figure of the controller.



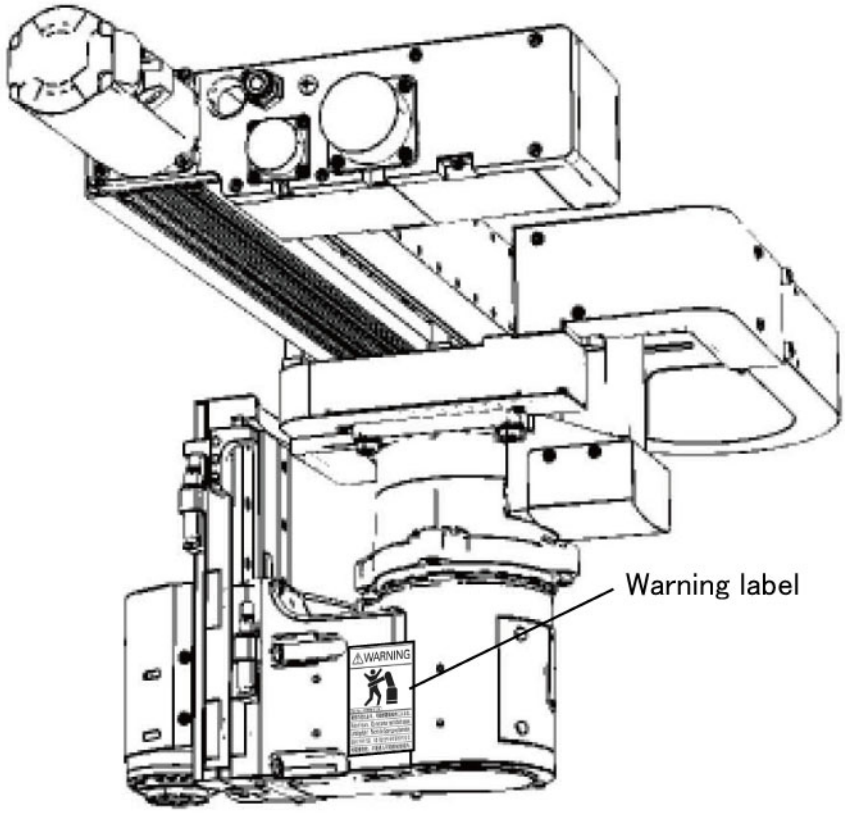
Name Plate Sample (XR-G series)

2.2.3 Warning Label

The robot unit has warning 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 Labels on the Robot Unit

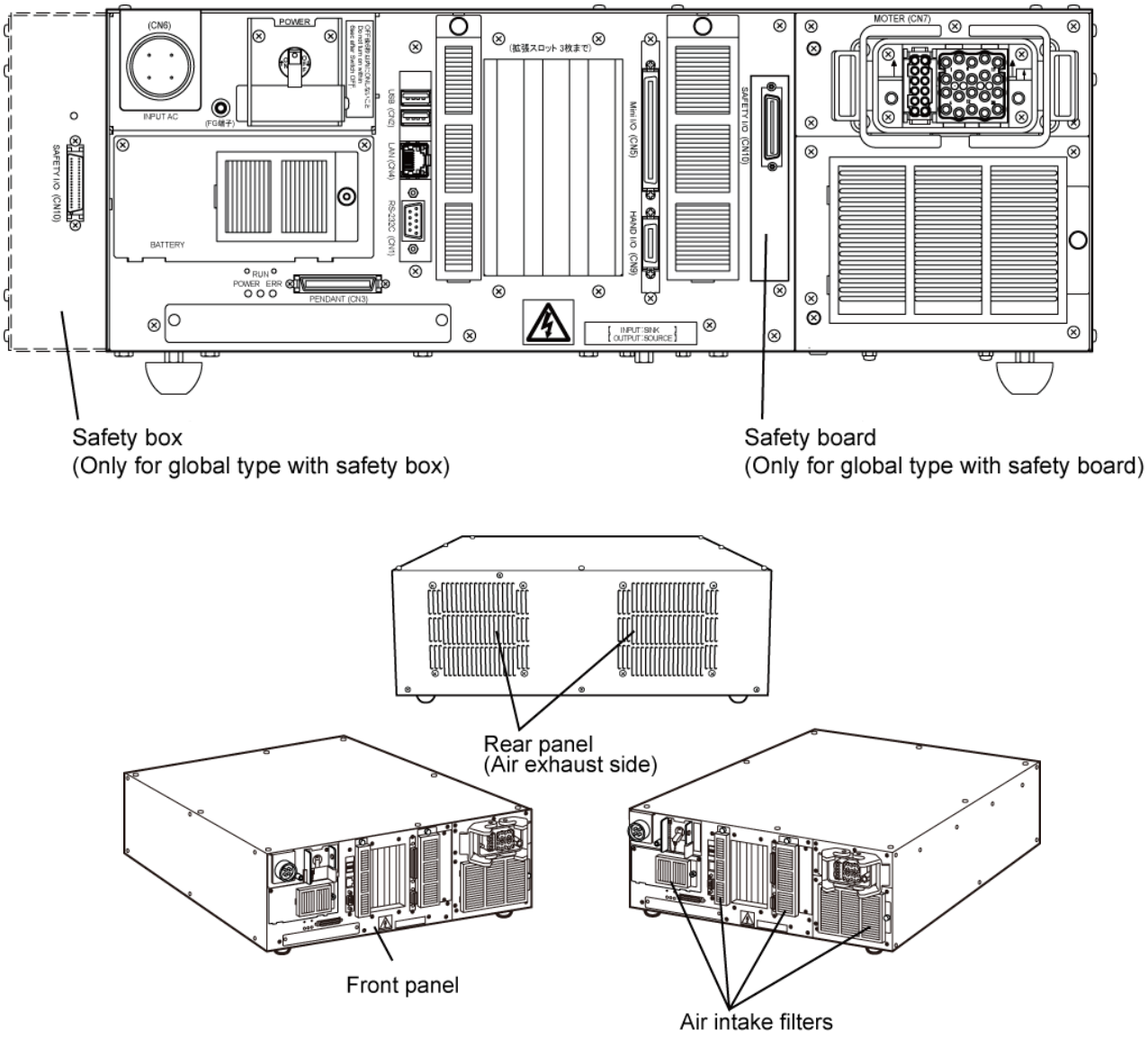
<Location of labels>



Warning Label on the Robot Unit	Additional description
	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.

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.



Connectors for XR-G Series

Connector No.	Marking	Name
CN1	RS-232C	Serial interface connector
CN2	USB	USB connector (2 lines)
CN3	PENDANT	Teach pendant connector
CN4	LAN	Ethernet connector
CN5	Mini I/O	I/O connector
CN6	INPUT AC	Power supply connector
CN7	MOTOR	Motor connector
CN9	HAND I/O	HAND I/O connector
CN10	SAFETY I/O	SAFETY I/O connector (Only for global type)

Chapter3 Specifications of the Robot Unit

3.1 Robot Specifications

The table below lists the specifications of the XR-G series robots.

Robot Unit Specifications of the XR-G Series

Item		Specifications						
Model name of robot system (Note 1)		XR-4341*G	XR-4371*G	XR-4372*G	XR-4373*G	XR-43A1*G	XR-43A2*G	XR-43A3*G
Model name of robot unit		XR-4341*GM	XR-4371*GM	XR-4372*GM	XR-4373*GM	XR-43A1*GM	XR-43A2*GM	XR-43A3*GM
Overall arm length		200mm	200mm	250mm	300mm	200mm	250mm	300mm
Motion range / stroke	1st axis (X-axis)	450mm	760mm			1060mm		
	2nd axis (R-axis)	±168°						
	3rd axis (Z-axis)	*=1:135mm、*=2:200mm						
	4th axis (T-axis)	±360°						
Axis combination		X (1st axis) + R (2nd axis) + Z (3rd axis) + T (4th axis)						
Maximum payload		5kg						
Composite speed	Arm tip (X + R-axis)	3650mm/s	3600mm/s			3240mm/s		
	Z-axis / T-axis	Z:1500mm/s, T:720°/s						
Position repeatability (Note 2)	X + R-axis	±0.015mm						
	Z-axis	±0.010mm						
	T-axis	±0.005°						
Maximum allowable inertia moment		0.05kgm^2						
Position detection		Absolute encoder						
Drive motor and brake		AC servomotors for all axes Z-axis equippedwith brake						
Brake releasing		Enter a brake release command with the teach pendant or mini-pendant.						
User air piping		1 system (φ8) (with optional manifold valve : 4 systems (φ4x8))						
User signal line		10 (for proximity sensor signals, etc)						
Air source	Operating pressure	0.05 to 0.35 MPa						
	Maximum allowable pressure	0.59 Mpa						
Weight (Approx.) (Note 3)		33kg (72lb)	45kg (99lb)	46kg (101lb)	47kg (103lb)	51kg (112lb)	52kg (114lb)	53kg (116lb)

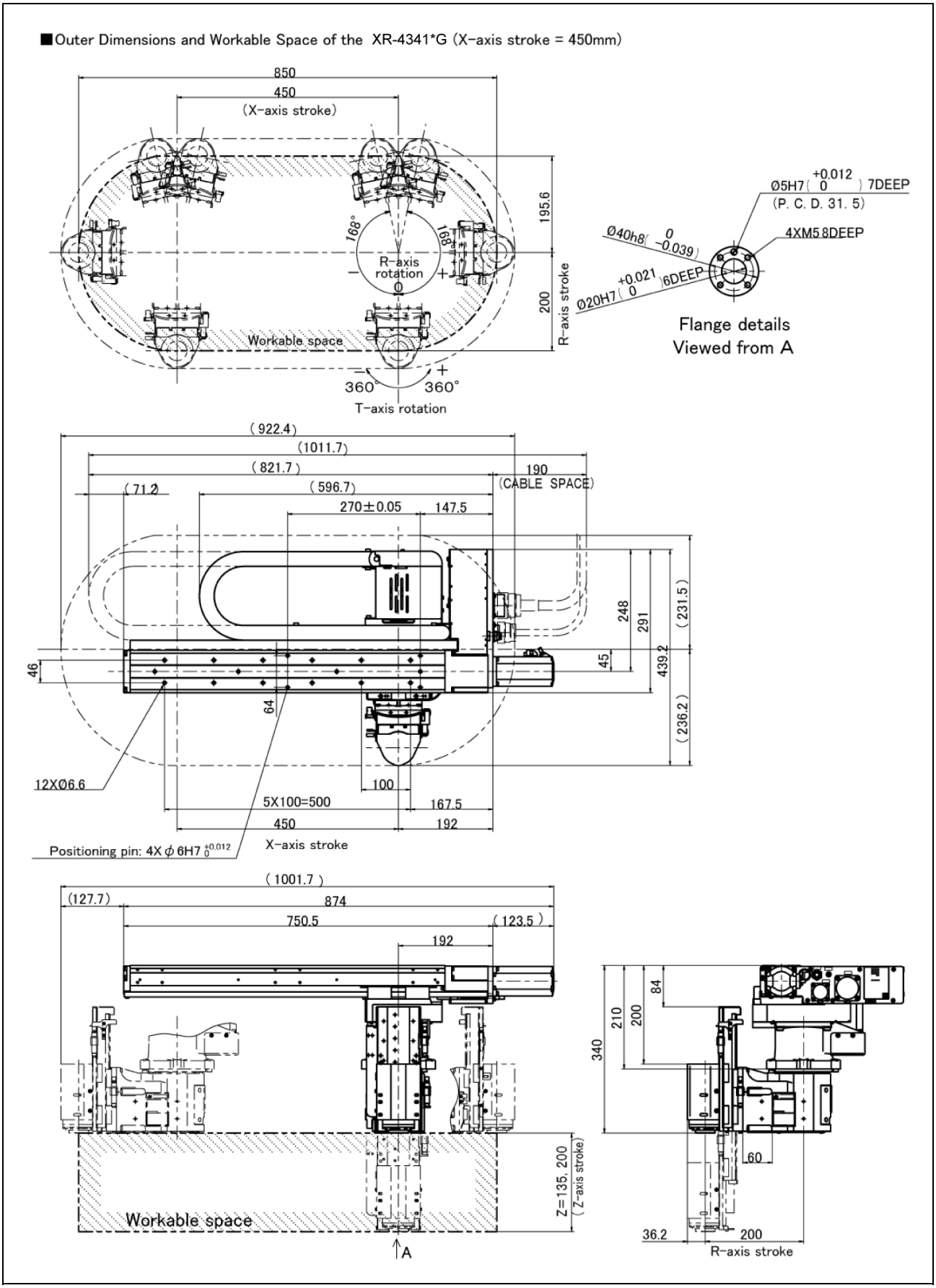
Note 1: The model name of robot system refers to the model of a complete set, including a robot unit and robot controller.

Note 2: Measured at the constant ambient temperature.

Note 3: In the case of the heaviest model (Z=200mm)

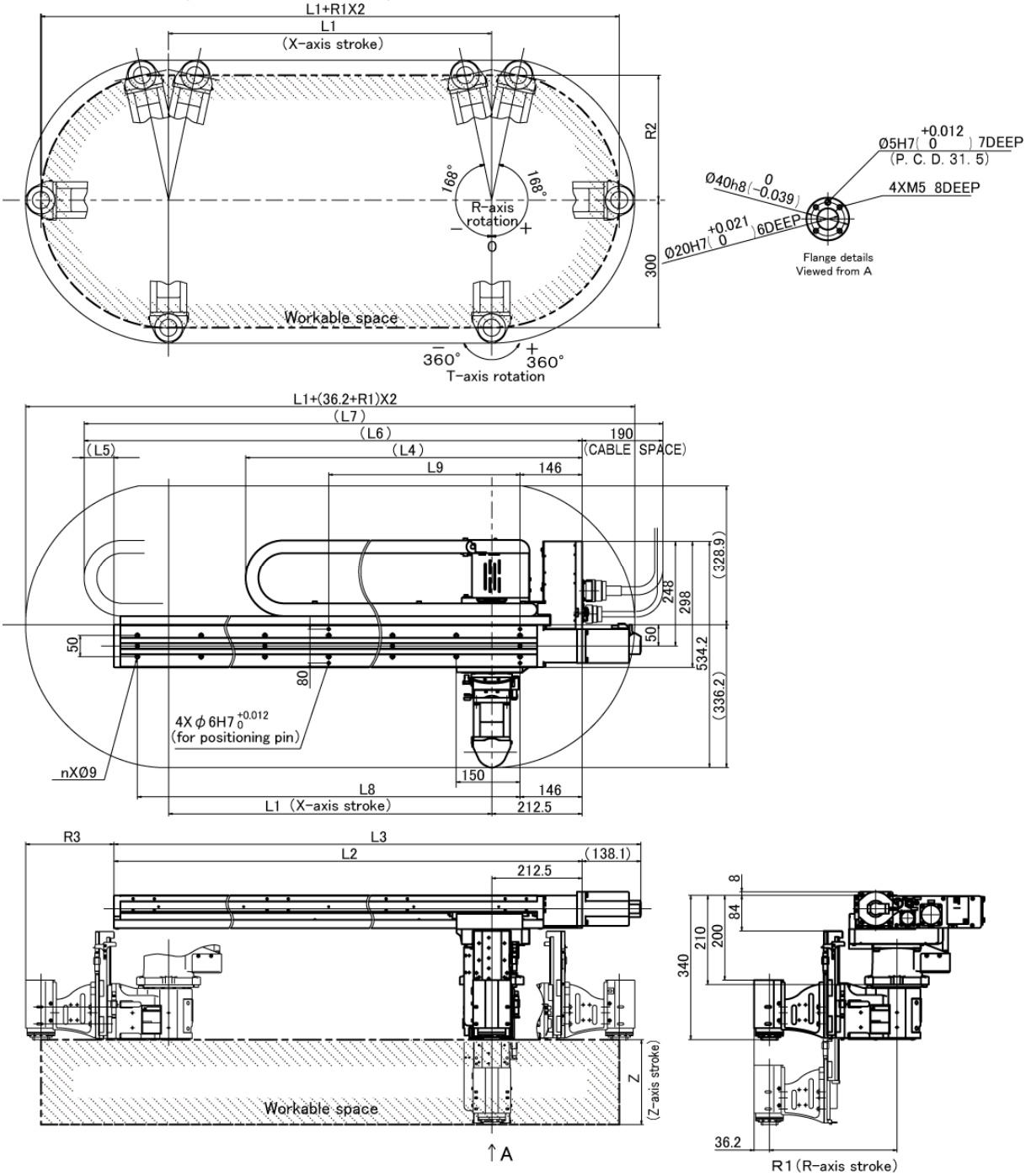
3.2 Outer Dimension and Workable Space of the Robot Unit

The outer dimensions and workable space of the XR-G series are shown on this and the following pages.



Outer Dimensions and Workable Space of the XR-4341*G

■Outer Dimensions and Workable Space of the XR-437**G (X-axis stroke = 760mm)
and XR-43A**G (X-axis stroke = 1060mm)



(mm)

L1(X-axis stroke)	Model	L2	L3	L4	L5	L6	L7	L8	L9	L10
760	XR-437**GM	1101	1239.1	791.2	70.2	1171.2	1361.2	6X150=900	450	14
1060	XR-43A**GM	1401	1539.1	913.7	42.7	1443.7	1633.7	8X150=1200	600	18

R1(R-axis arm length)	Model	R2	R3
200	XR-43*1*GM	195.6	107.7
250	XR-43*2*GM	244.6	157.7
300	XR-43*3*GM	293.4	207.7

Z(Z-axis stroke)	Model
135	XR-43**1GM
200	XR-43**2GM

Outer Dimensions and Workable Space of the XR-437**G and XR-43A**G

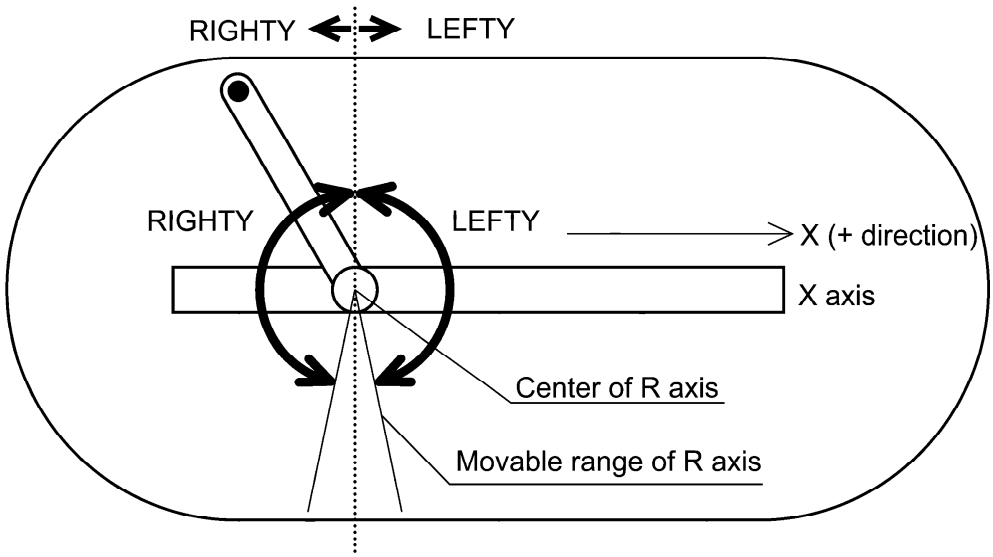
3.3 Figures of XR-G series robot

The XR-G series of robots takes two different shoulder figures--RIGHTY and LEFTY, according to the angle of R axis.

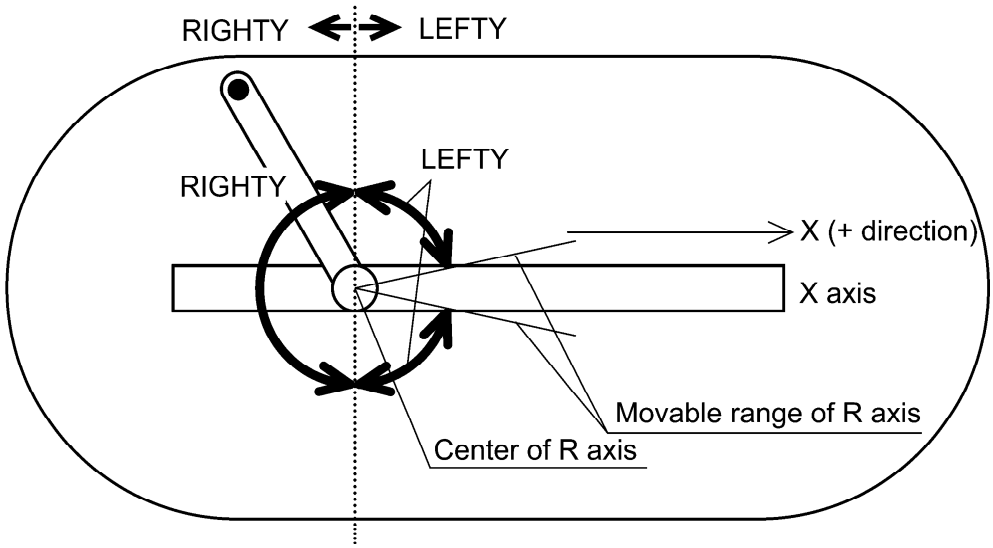
Shoulder Figure

The coverage of the arm is divided into RIGHTY and LEFTY as shown below.

- When the mechanical end is set at 180° (default):



- When the mechanical end is set at 90° :

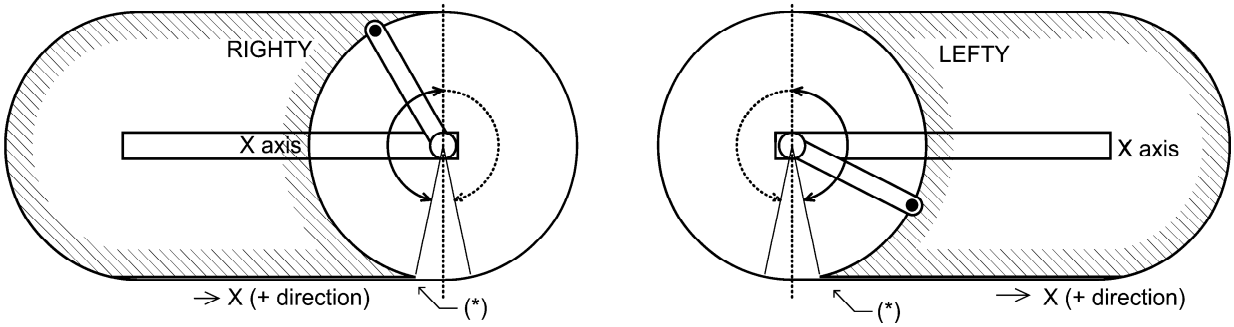


Restricted Space Determined by Mechanical Ends for Each Figure

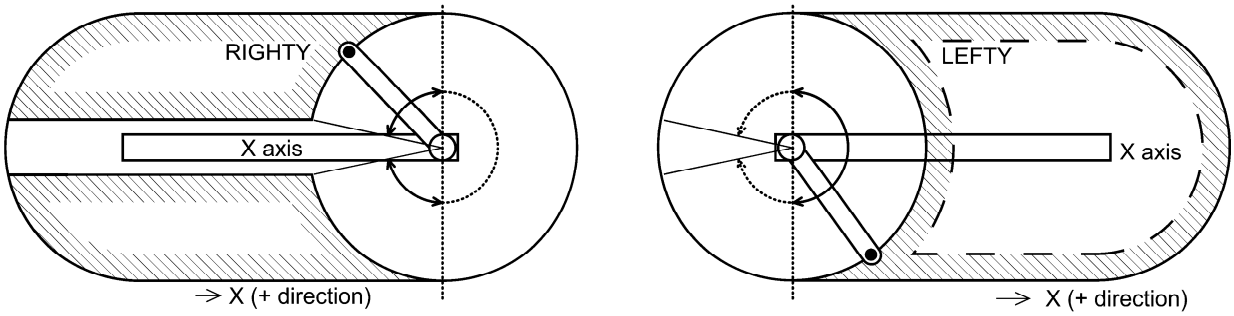
The restricted space of each figure differs depending upon the mechanical end position on the R axis.

The illustrations below are viewed from the top of the XR-G series.

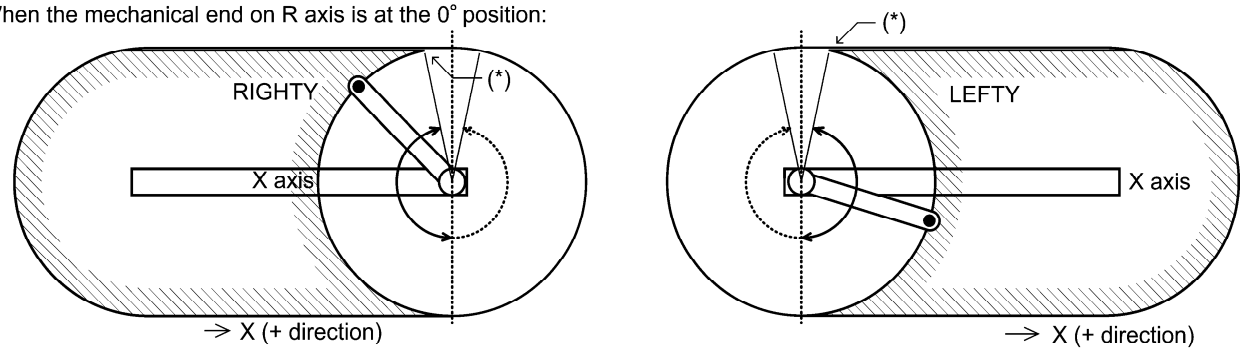
■ When the mechanical end on R axis is at the 180° position (default):



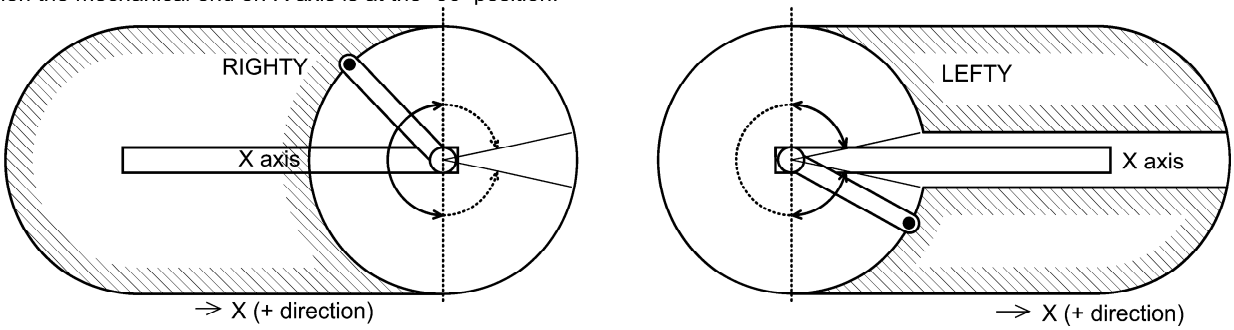
■ When the mechanical end on R axis is at the 90° position:



■ When the mechanical end on R axis is at the 0° position:



■ When the mechanical end on R axis is at the -90° position:



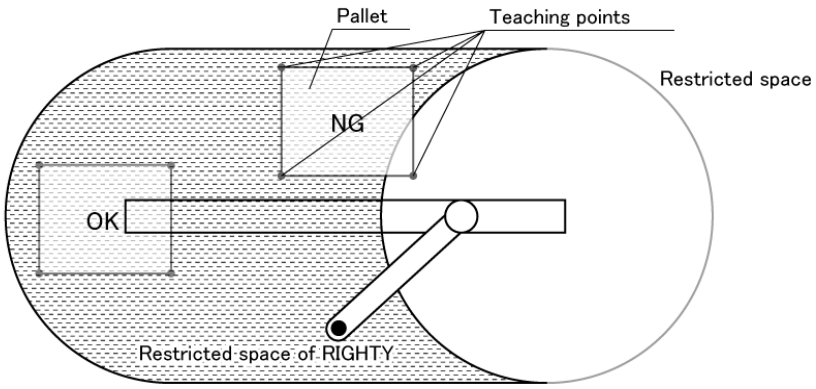
(*) The restricted space narrows by 5 to 7 mm in the direction of Y axis.

Notes on making palletizing programs

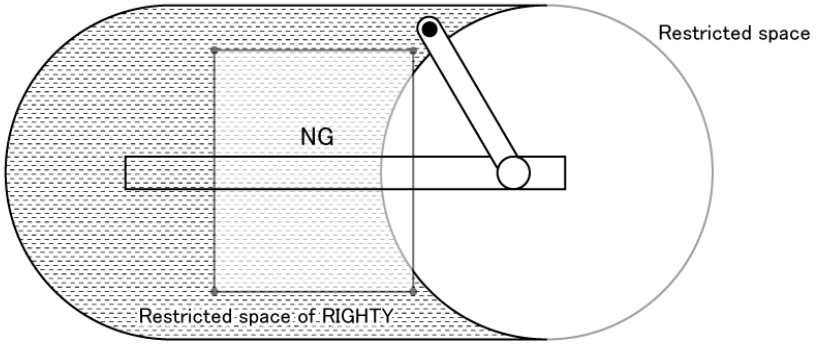
Palletizing programs need to be created so that the whole areas of pallets are within the restricted space of a figure since the XR-G cannot change the figure during palletizing.

In teaching also, be sure to teach the four corners of each pallet in the same figure.

Any pallet out of the restricted space of a figure triggers an error.

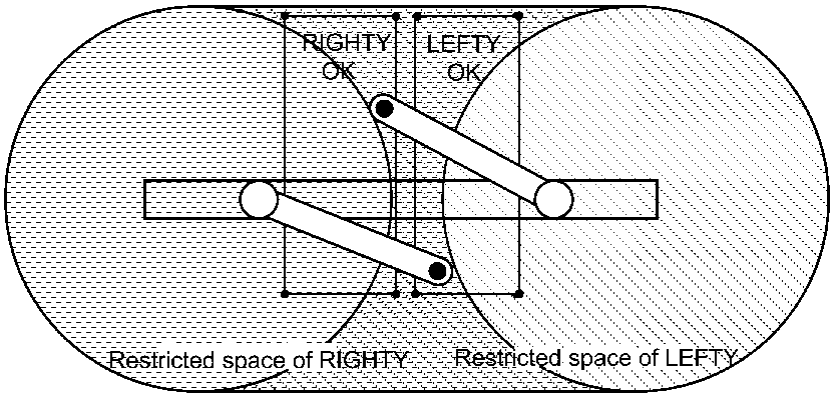


Even if the four teaching points for palletizing are within the restricted space of one figure,
some points within the pallet could be out of the restricted space of a figure, which results an error.



Workaround for pallets that cannot be arranged for one figure

When it is impossible to arrange a pallet for one figure, as a workaround, separate the pallet into two and access each in each figure to avoid an error.



3.4 Robot Positioning Time

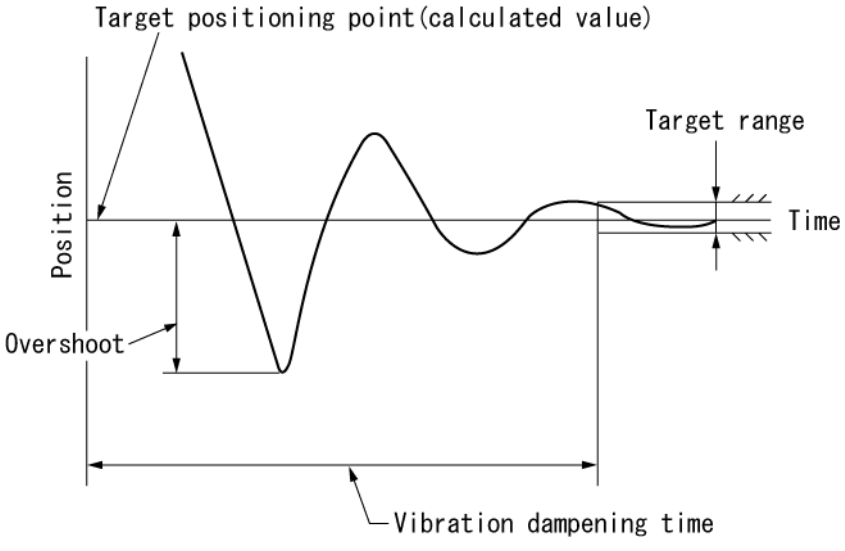
Positioning time for the XR-G series

1. The graphs given on the following pages show the positioning times used to calculate the cycle time. See Chapter 6 Appendix for operating time of each axis.
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.

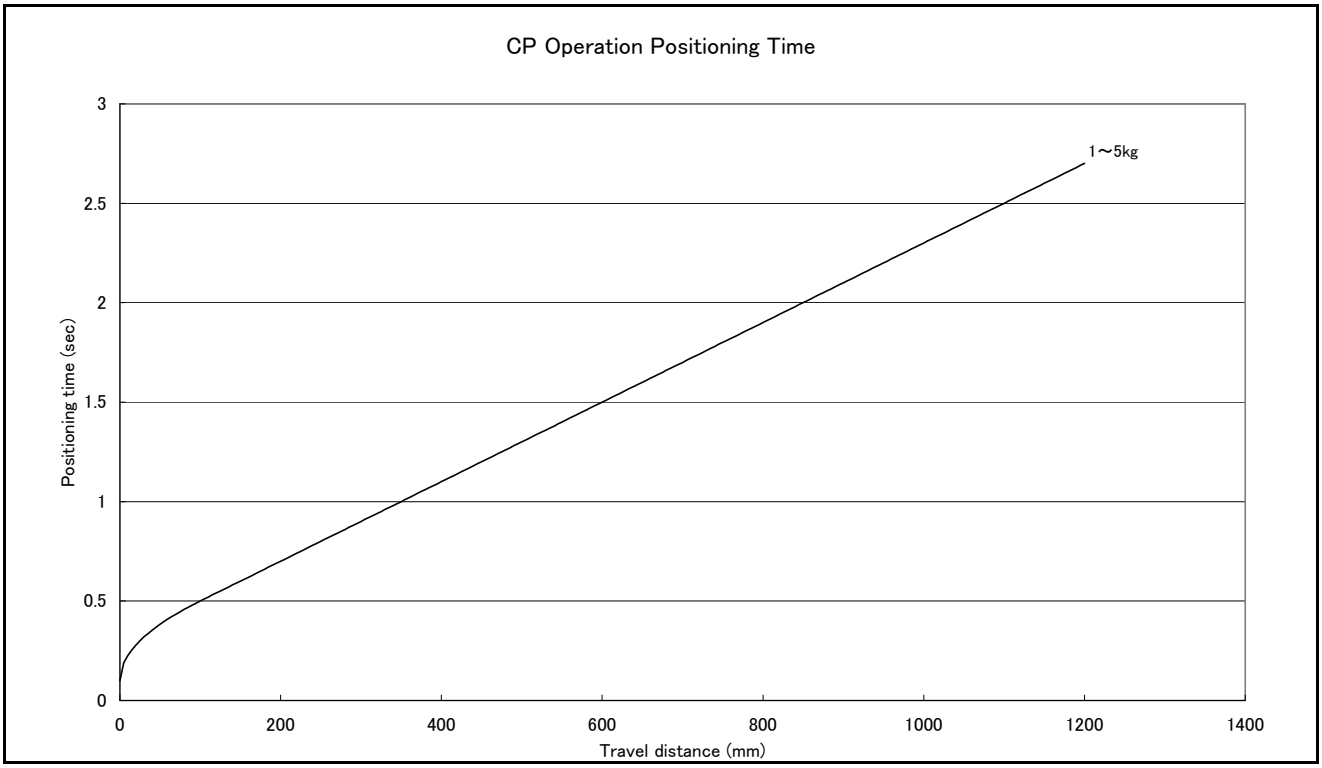
Caution (1) The vibration dampening time depends on factors such as the weight of the hand. If the robot is to be used in such a way that it overshoots or if the vibration damping time is of great concern, test the robot carefully beforehand.

(2) If acceleration begins before residual vibration of the robot stops, an overcurrent error (code starts from ERROR6120; 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 on standby with a DELAY command until residual vibration stops.**
- **Lower acceleration with an ACCEL command.**

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



Vibration Dampening Time



CP Operation Positioning Time

3.5 Electrical Wiring and Air Piping of the Robot Unit

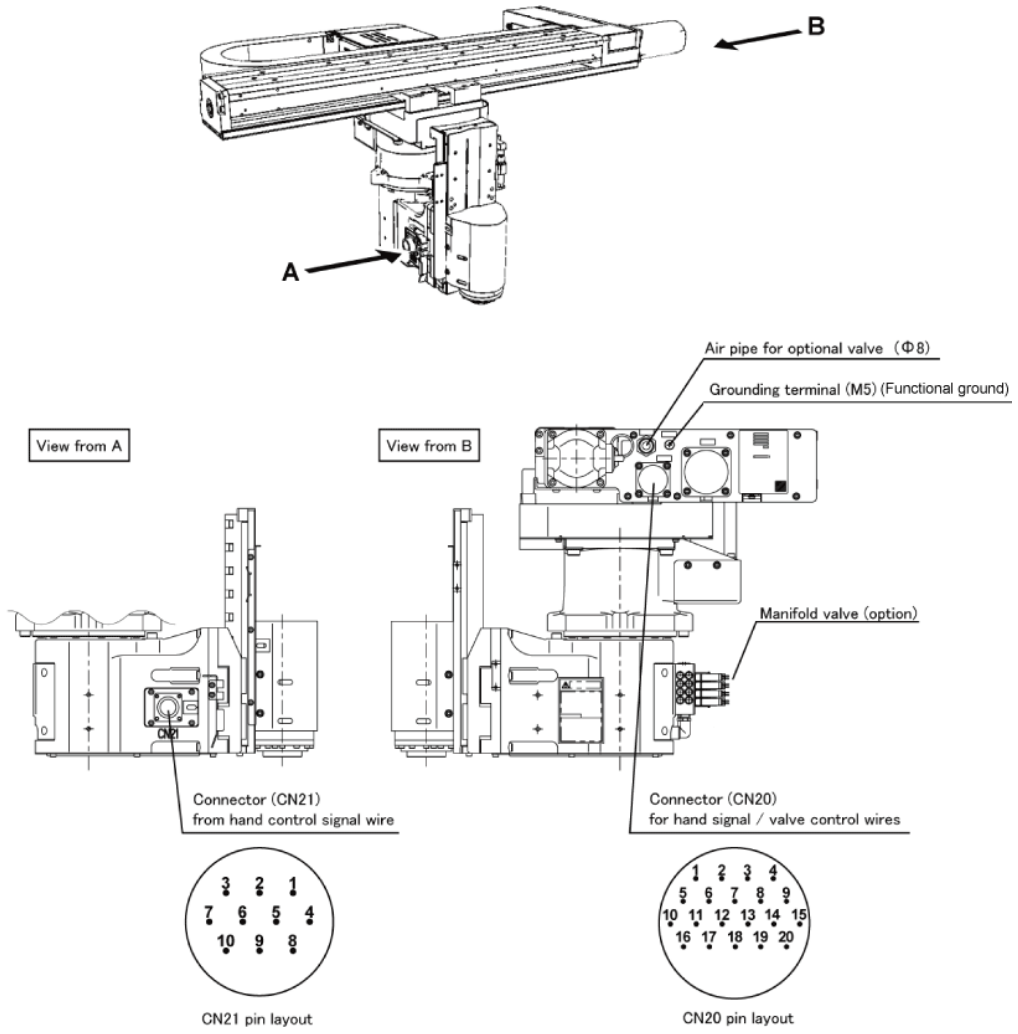
Make electrical wiring and air piping of the hand or tool to be attached to the arm end, referring to the example given below.

Use robot instrumentation cables (manufactured by Daikyo Denshi) or equivalent for electrical wiring.

Caution: - Supply dry air filtered through an air filter (Recommended filtration rating: 5 μm or below).
- Before piping, blow the air tube out with dry air to clean out the inside (flushing); otherwise, any chips, cutting oil, dust or dirt remaining in the air tube may result in a damaged valve.
- Do not pass wires or pipes other than those provided by DENSO through the cable bear of the 1st axis. Doing so may break or damage them.

3.5.1 Air Piping and Signal Wiring

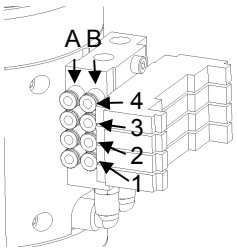
The XR-G series robot is equipped with 10 signal lines and an air pipe (ϕ 8) in it. Manifold valve with 4 systems (ϕ 4x8) is available as option.



Note 1: Pins #1 to #10 on CN21 and those on CN20 are connected with each other. The allowable current per line is 1A.
Note 2: Use the attached connector sets for CN20 and CN21.

Connector set part No.	Part No.	Model and part name	Appearance
410889-0030	410877-0170 (for CN20)	SRCN6A25-24S(round type connector) Japan Aviation Electronics Industry Ltd.	
	410877-0180 (for CN21)	JMLP1610M(L type plug connector) DDK Electronics, Inc.	

Signal Wiring, Air Piping and Connectors of the Robot Unit



CN20 Pin Assignment (for optional valve)

CN20 pin No.	Used for:
12	24V (*1), 0V (*2)
13	Solenoid 1A（solenoid valve 1)
14	Solenoid 1B (solenoid valve 1)
15	Solenoid 2A（solenoid valve 2)
16	Solenoid 2B（solenoid valve 2)
17	Solenoid 3A（solenoid valve 3)
18	Solenoid 3B（solenoid valve 3)
19	Solenoid 4A（solenoid valve 4)
20	Solenoid 4B (solenoid valve 4)

Note 1: NPN (source IN, sink OUT)
Note 2: PNP (sink IN, source OUT)

Manifold Valve (option)
Valve Symbols and Air Intake / Exhaust State

(1A and 1B are piping joint symbols)

Air piping joint		Valve signal		
Air intake	Exhauset	Solenoid valve	Solenoid	
			A	B
1A	1B	1	ON	OFF
1B	1A	1	OFF	ON
2A	2B	2	ON	OFF
2B	2A	2	OFF	ON
3A	3B	3	ON	OFF
3B	3A	3	OFF	ON
4A	4B	4	ON	OFF
4B	4A	4	OFF	ON

Connectors and Pin Assignment for Optional Valve

3.5.2 Specifications of Solenoid Valve (option)

Solenoid Valve Specifications (XR-G series)

	Item	Specifications
Valve	Switching system	2-position double
	Applicable fluid	Air
	Operating system	Pilot type
	Effective cross section (CV value)	1.2mm^2
	Lubrication	Not required
	Operating pressure resistance	0.2 to 0.7 MPa
	Response time	10ms or less (at 0.5 MPa)
	Maximum operating frequency	5Hz
	Ambient temperature	- 10 to 50℃ (No dew condensation allowed.) (When dry air is used)
Solenoid	Operating voltage	24V±10%
	Power consumption (current)	DC 0.35W(15mA)×4
	Surge voltage protection circuit	Zener diode

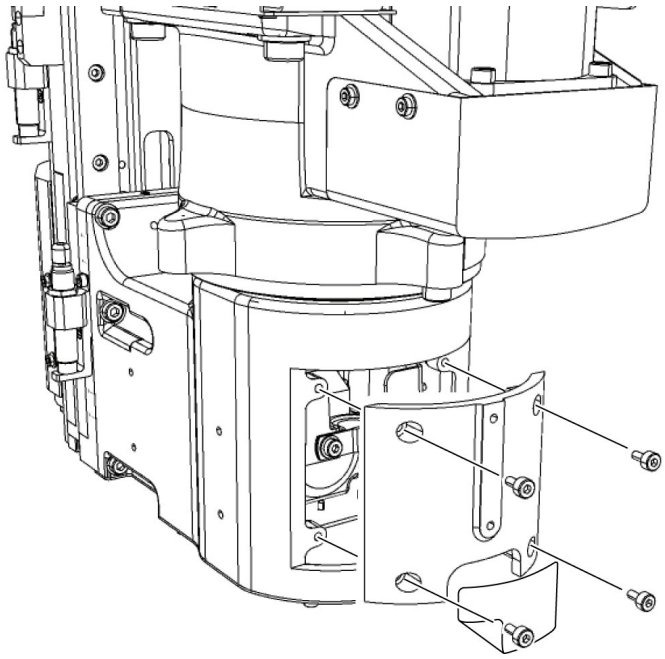
3.5.3 Mounting the Optional Valve

Mount the optional valve using the procedure given below.

> ⚠**Caution:** - Supply dry air filtered through an air filter (Recommended filtration rating: 5 μm or below).
> - Before piping, blow the air tube out with dry air to clean out the inside (flushing); otherwise, any chips, cutting oil, dust or dirt remaining in the air tube may result in a damaged valve.

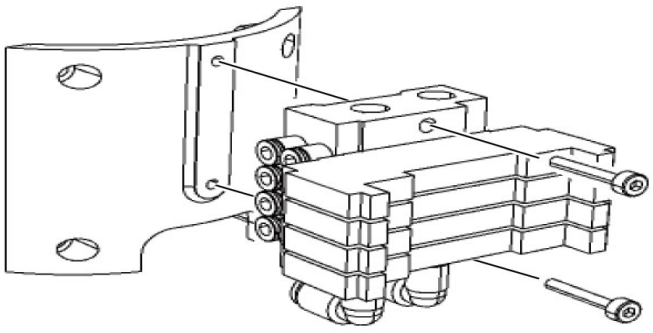
▶ STEP 1

Peel the seal off the cover.
Remove the four hexagonal socket-head bolts (M4) to take off the cover.



▶ STEP 2

Secure the optional valve to the cover with two bolts (M4).
Tightening torque: 3.7 ±0.7 N·m

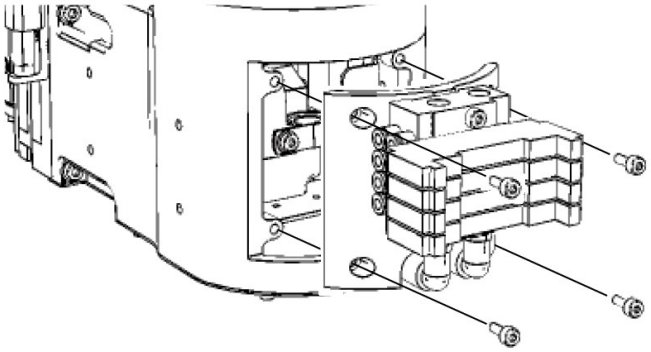


▶ STEP 3

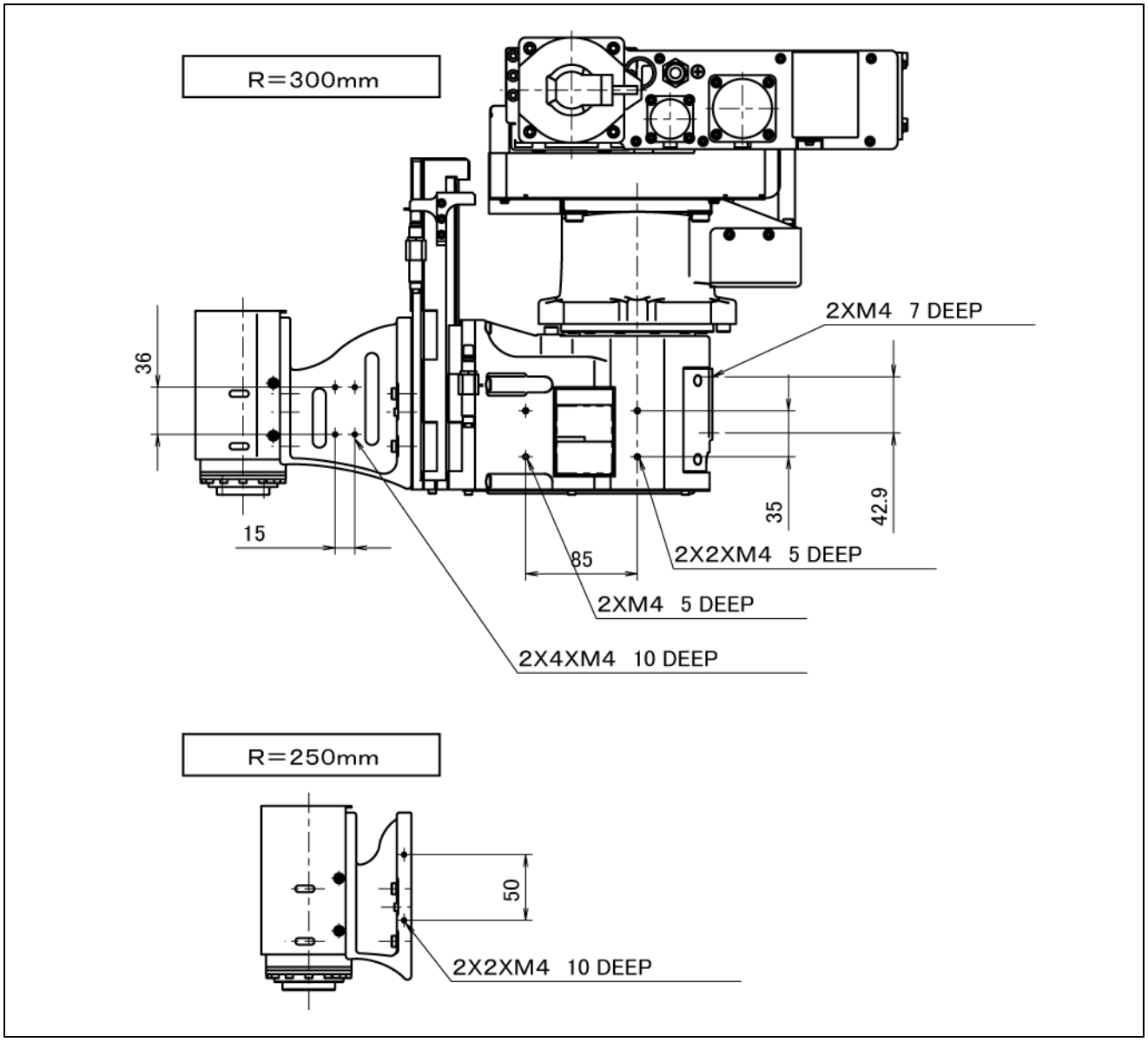
Connect the red and blue connectors and the air tube to the optional valve.

▶ STEP 4

Mount the cover combined with the optional valve to the robot unit, taking care not to squeeze the wires or air tube. Make sure that the air tube is not folded.
Tightening torque: 3.7 ±0.7 N·m



3.5.4 Original Thread Holes for Wiring and Piping

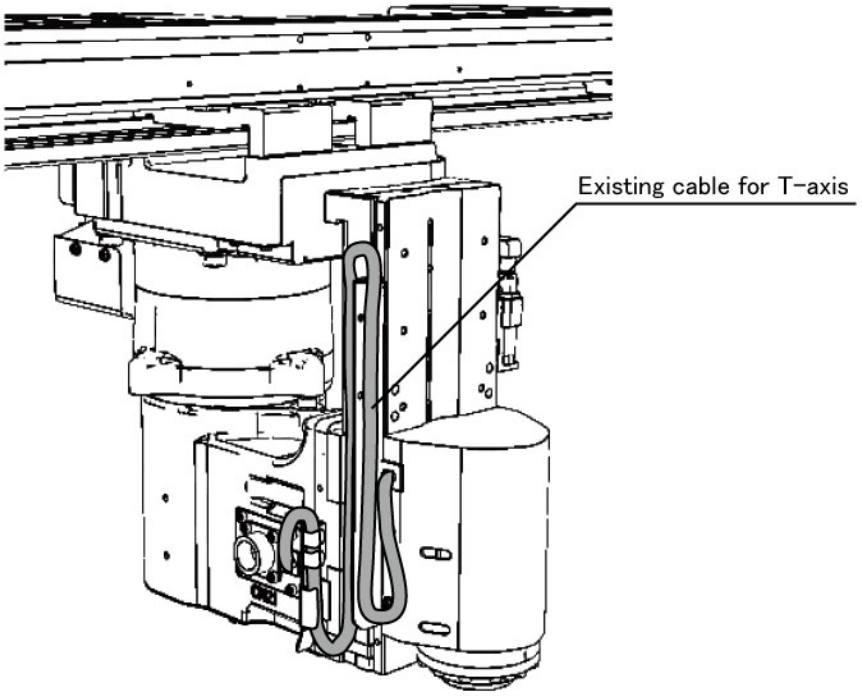


Original Thread Holes for Wiring and Piping (XR-G Series)

3.5.5 Notes for Signal Cabling and Air Piping

Do not fix optional cable or piping together with the existing cable for T-axis. Doing so may break the T-axis cable.

NOTE: Maintenance and inspection of the robot unit sometimes requires removing and installing the covers. Mount the stays for wiring and piping so that they will not interfere with removal/installation of the covers.

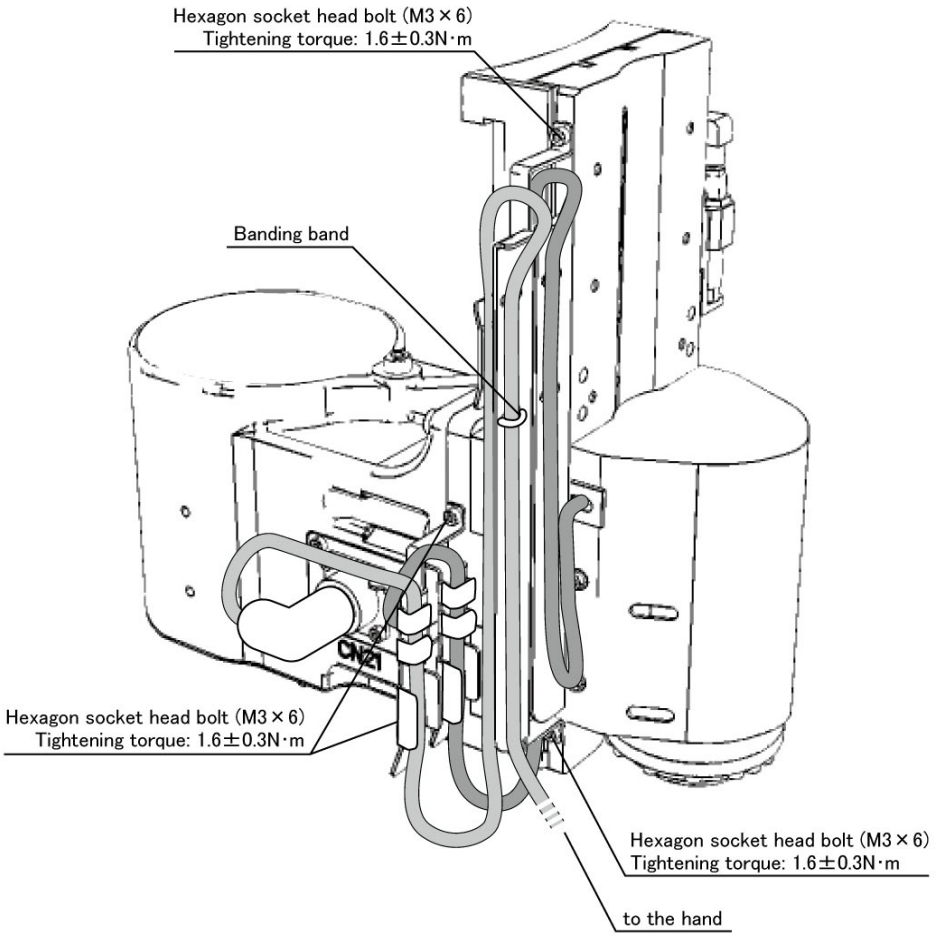


Existing Cable for T-axis

3.5.6 Installing Hand Control Cabling Kit (Optional)

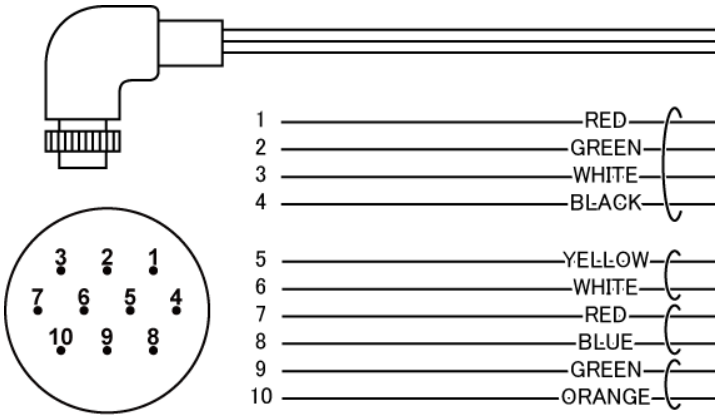
Hand Control Cabling Kit for XR-G series (Part No. 410879-0470) is available.

Install the cable next to the existing cable, referring to the instructions below.



⚠**Note: Fix the cable, taking care not to pull, fold or loosen it.**

Use the hand control cable (Part No. 410870-3350) to replace the cable.



CN21 Hand Control Cable Connection Diagram

Hand Control Cabling Kit Installation Drawing

3.6 Engineering-design Notes for Robot Hands

Design a robot hand so that it will satisfy conditions (1) to (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

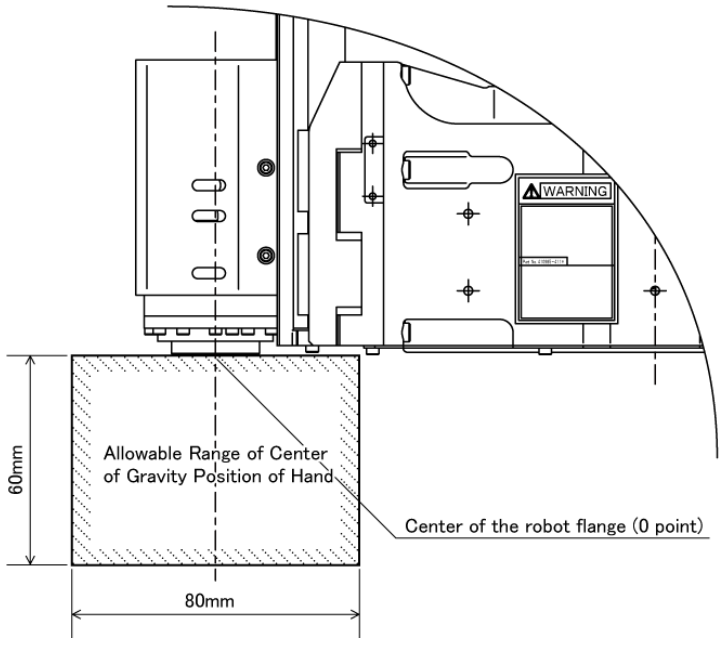
The total mass of a hand (including workpiece) should be less than the maximum allowable payload of the robot. Be sure to include the mass of wiring and piping used for hands.

Total mass of hand ≤ Maximum allowable payload (incl. workpiece)

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

(2) Center of gravity of hand

The center of gravity of a hand (including workpiece) should be located within the range specified in the figure below.



Maximum allowable moment of inertia: 0.05kgm^2

Allowable Range of Center of Gravity Position of Hand

(3) Moment of inertia around the T-axis

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

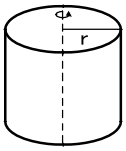
Moment of inertia of hand around the T-axis (incl. workpiece)	≦	Maximum allowable moment of inertia (XR-G series: 0.05kgm^2)

Calculate the moment of inertia around the T-axis, referring to the table on the next page.

Moment-of-inertia Formulas

1. Cylinder (1)

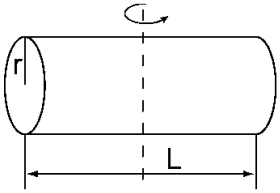
(Axis of rotation = Center axis)



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

2. Cylinder (2)

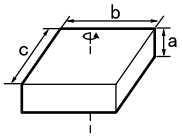
(The axis of rotation passes through the center of gravity.)



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

3. Rectangular parallelepiped

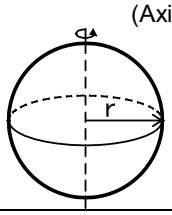
(The axis of rotation passes through the center of gravity.)



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

4. Sphere

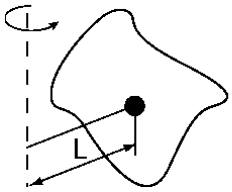
(Axis of rotation = Center axis)



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

5. Center of gravity is not on the axis of ratation.

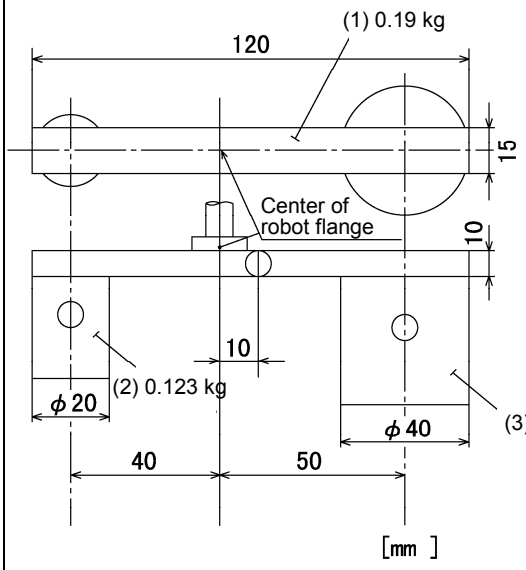
I_g: Moment of inertia around center of gravity [kgm^2]



$$I = I_g + mL^2$$

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)

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

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)

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

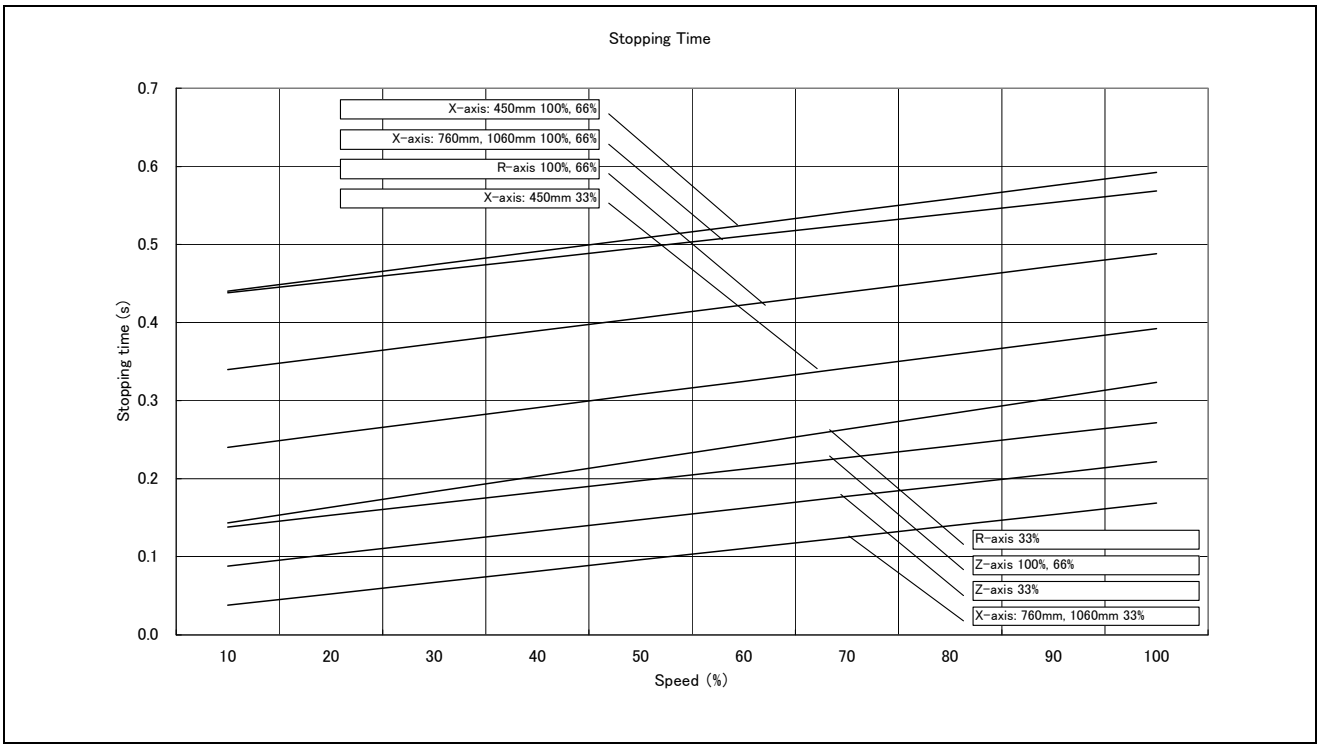
Moment of inertia of entire hand around T-axis: I

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

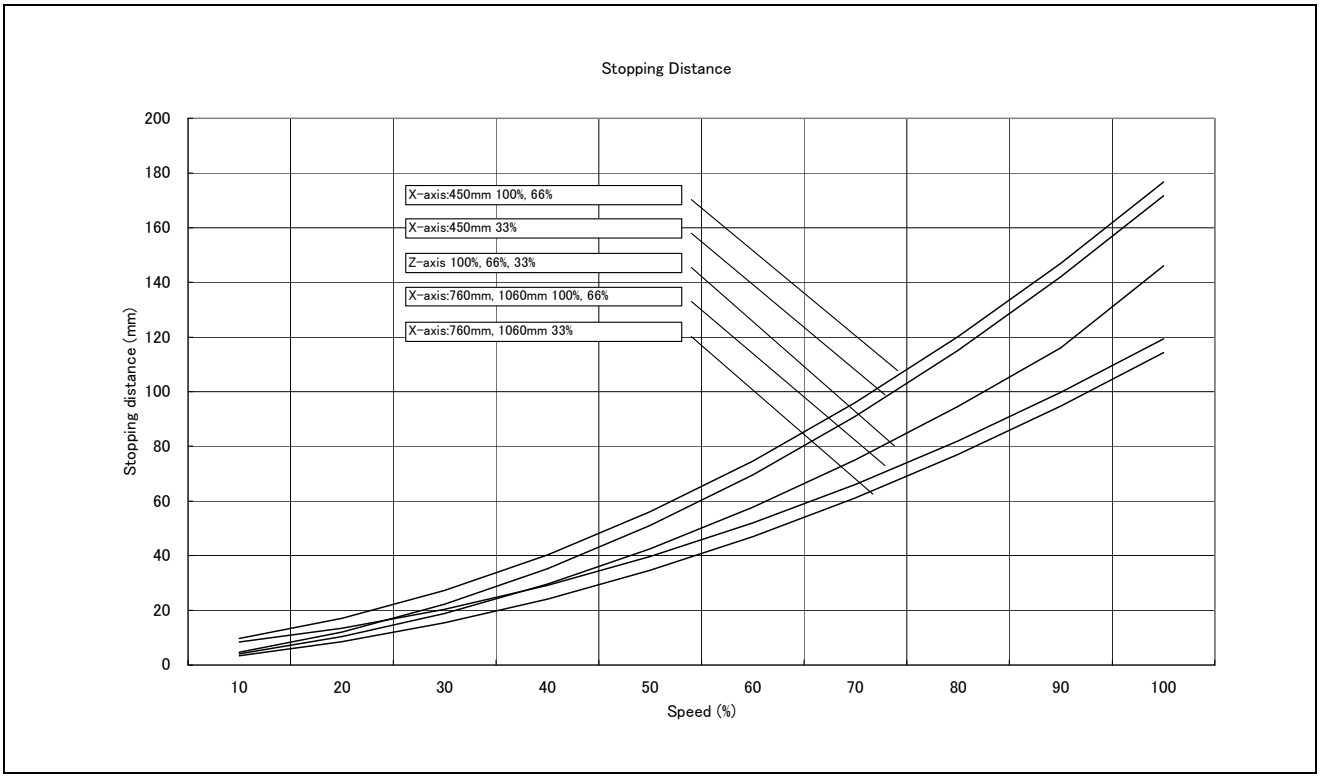
Calculation Example of Moment of Inertia of Hand around the T-axis

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

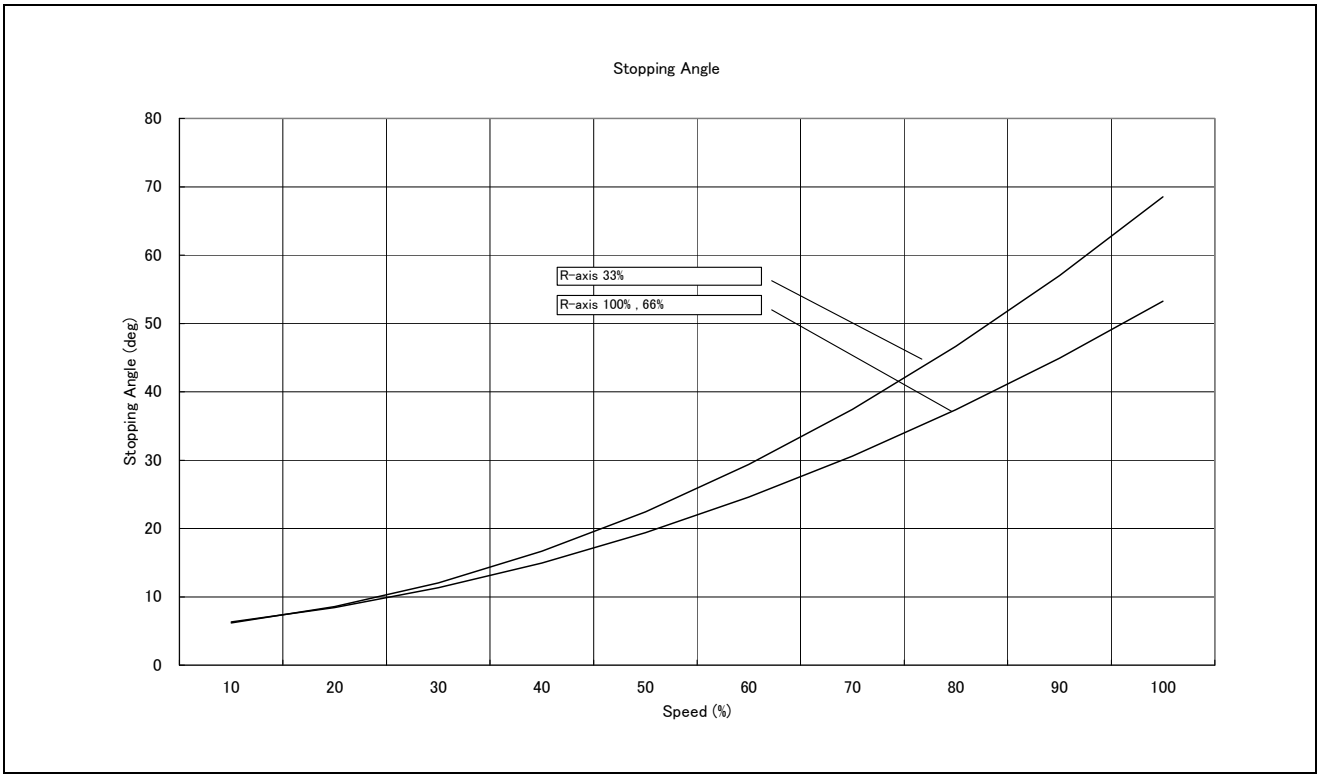
Pressing the emergency stop button when the robot is in motion stops the robot. The stopping time required from activation of a stop signal and the distance (angle) for major three joints vary with the robot speed as shown in the graphs below. The measuring conditions are: Robot arm extended, 33%, 66%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



X, R, Z Stopping Time vs. Speed at an Emergency Stop (XR-G Series)



X, Z Stopping Distance vs. Speed at an Emergency Stop (XR-G Series)



R-axis Stopping Angle vs. Speed at an Emergency Stop (XR-G Series)

Chapter4 Robot Controller Specifications

4.1 Specifications

The table below lists the specifications of the robot controllers for XR-G series.

RC7M Controller Specifications (XR-G Series) (1)

Item			Specifications
Applicable robot			Integrated compact type (XR-G)
Model			RC7M-XRG4BA-**
Control system			PTP, CP 3-dimensional linear, 3-dimensional circular
No. of controllable axes			Up to four axes simultaneously
Drive system			All axes: all digital AC servo
Language used			DENSO robot language (conforming to SLIM)
Memory capacity			3.25MB (equivalent to 10,000 steps, or 30,000 points)
Teaching system			1) Remote teaching 2) Numerical input (MDI)
External signals (I/O)	Standard I/O	Mini I/O	Input signals: 8 user open points + 11 fixed system points Output signals: 8 user open points + 14 fixed system points (Note: In global type, some fixed system points are not used.)
		HAND I/O	Input signals: 8 user open points Output signals: 8 user open points
	SAFETY I/O (Only for Global type)		Input signals: 6 fixed system points Output signals: 5 fixed system points
	Parallel I/O board (option)	2 boards	Input signals: Additional 80 user open points Output signals: Additional 96 user open points
		1 board	Input signals: Additional 40 user open points Output signals: Additional 48 user open points
	DeviceNet board (option)	Master & slave	Input signals: 1024 points (Master) + 256 points (Slave) Output signals: 1024 points (Master) + 256 points (Slave)
		Master	Input signals: 1024 points Output signals: 1024 points
		Slave	Input signals: 256 points Output signals: 256 points
	CC- Link (option)	Slave	Input signals: 384 points Output signals: 384 points(including remote registers RWw and RWr)
External communication			RS-232C: 1 line Ethernet: 1 line USB: 2 lines (flash memory drive available)
Extension slot			3 (For an optional board)
Self-diagnosis function			Overrun, servo error, memory error, input error, etc.
Timer function			0.02 to 10sec. (in units of 1/60 sec.)
Error display			Error codes will be issued to the external I/O. Error messages will be displayed in English on the teach pendant (option) Error codes will be displayed on the mini pendant (option)

RC7M Controller Specifications (XR-G Series) (2)

Item		Specification
Cables	Motor & encoder cable (option)	2m, 4m, 6m, 12m, 20m (Standard type)
	I/O cable (option)	8m, 15m (For Mini I/O, HAND I/O, Optional board for parallel I/O and SAFETY I/O)
	Power cable	5m
Environmental conditions (in operation)		Temperature: 0 to 40℃ Humidity: 90% RH or less (no condensation allowed)
Power source		3-phase: 200VAC-15% to 230VAC+10%, 50/60Hz, 1.8KVA Single-phase: 230VAC-10% to 230VAC+10%, 50/60Hz, 1.8KVA
Degree of protection		IP20
Weight		Standard type: approx. 17 kg Global type with safety board: approx. 18kg Global type with safety box: approx. 21kg

Cautions for Use of the Robot Controller

⚠WARNING

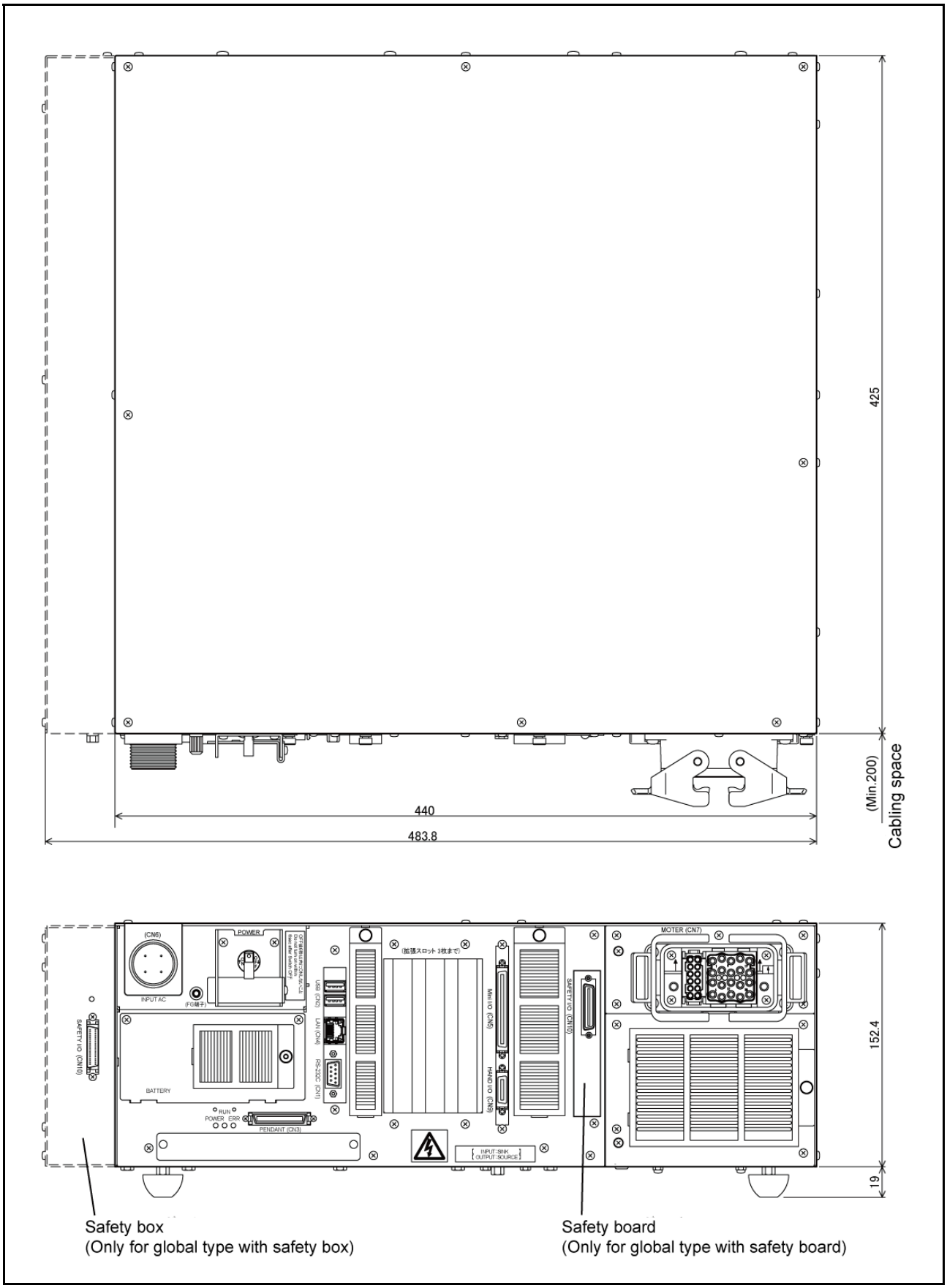
- DO NOT touch fins. Their hot surfaces may cause severe burns.
- DO NOT insert fingers or foreign objects into openings. Doing so may cause bodily injury.
- Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect 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 when the power is applied. Doing so may cause electric shock or controller failure.

⚠CAUTION IN INSTALLATION

- This controller does not meet dust-proof, splash-proof or explosion-proof specifications.
- Read the user's manuals before installation.
- Do not place anything on the controller or apply impact.

4.2 Outer Dimensions

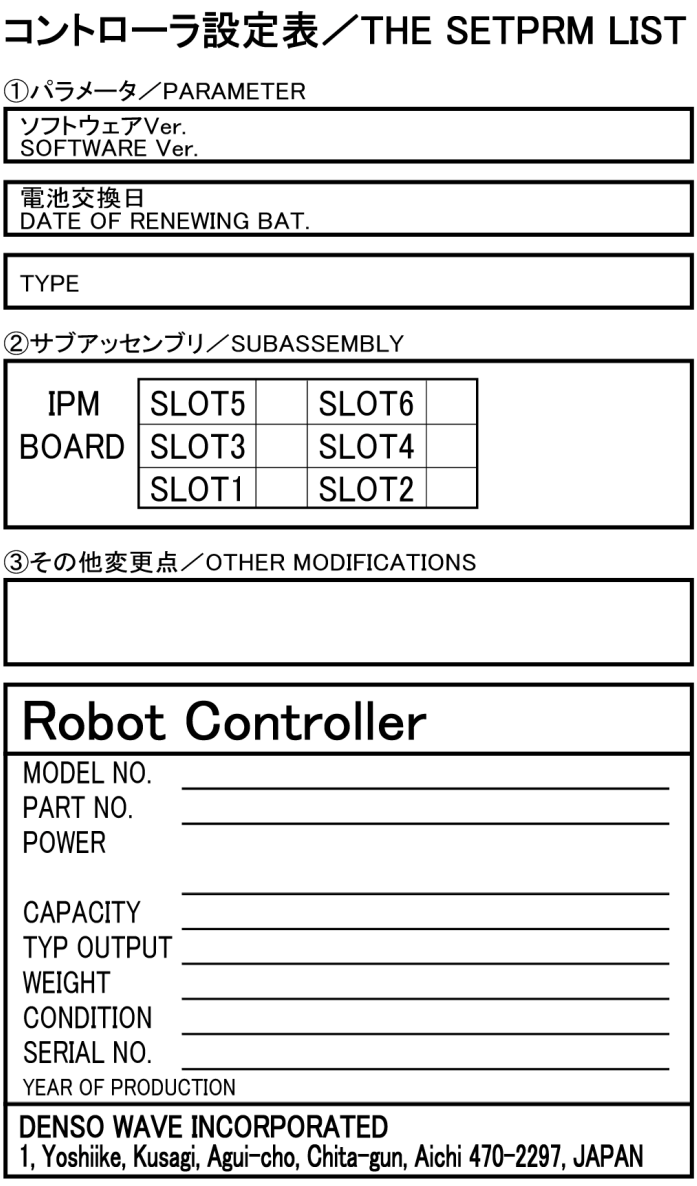
Figure below shows the outer dimensions of the robot controller.



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

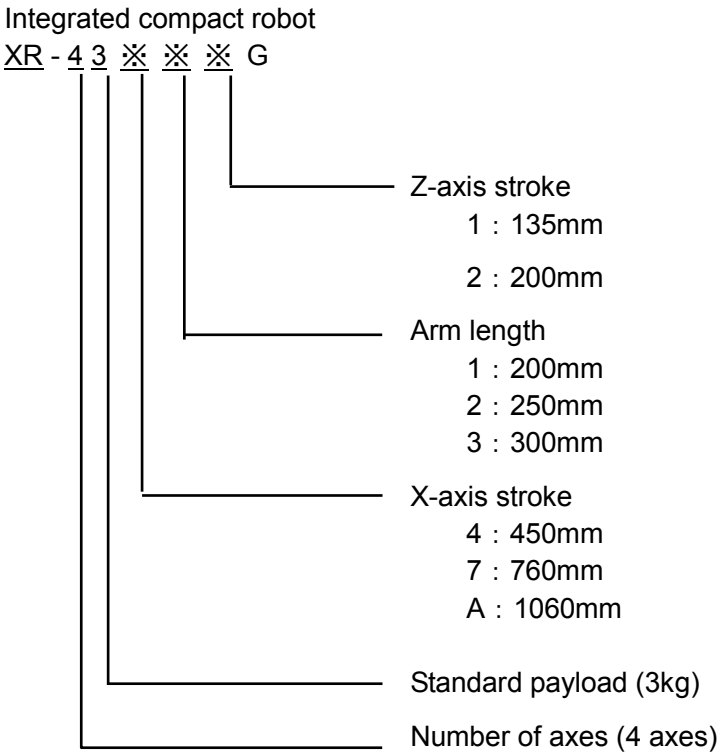
MODEL NO. _____
PART NO. _____
POWER
_____
CAPACITY _____
TYP OUTPUT _____
WEIGHT _____
CONDITION _____
SERIAL NO. _____
YEAR OF PRODUCTION

DENSO WAVE INCORPORATED
1, Yoshiike, Kusagi, Agui-cho, Chita-gun, Aichi 470-2297, 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 model name of the robot system is coded as shown on the next page.
SUBASSEMBLY	The type and position of the controller IPM board are described.

■Coding of the Model Name of Robot System



Chapter5 Warranty

DENSO manufactures robots under strict quality control. In case of failure, we warrant the robot under the following conditions:

Warranty Period

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

Warranty Coverage

DENSO 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 by DENSO;

(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 by DENSO, such as dust and water ingress;

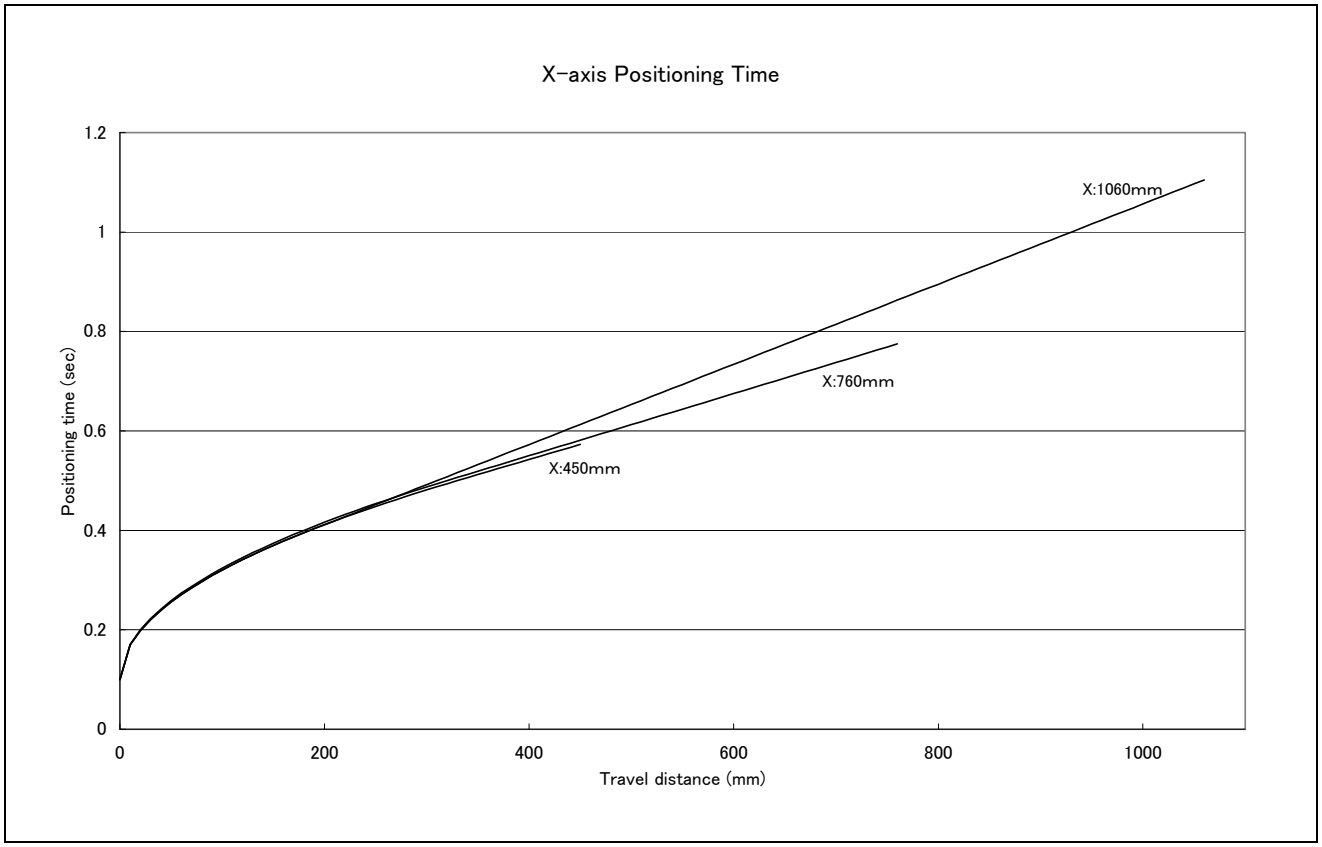
(5) Failures caused by a worn-out consumable, such as a fan filter;

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

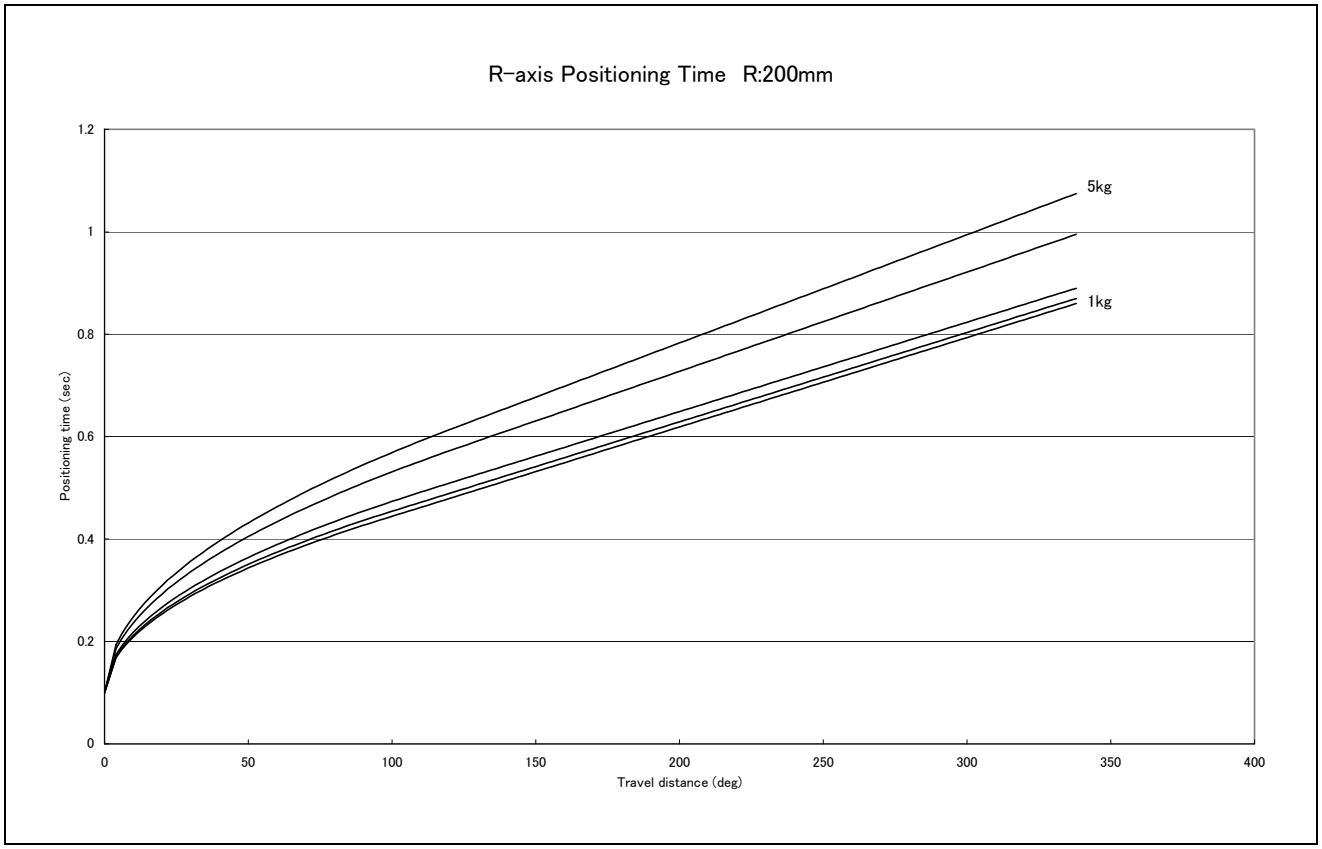
(7) Damages other than the robot repair costs.

Chapter6 Appendix

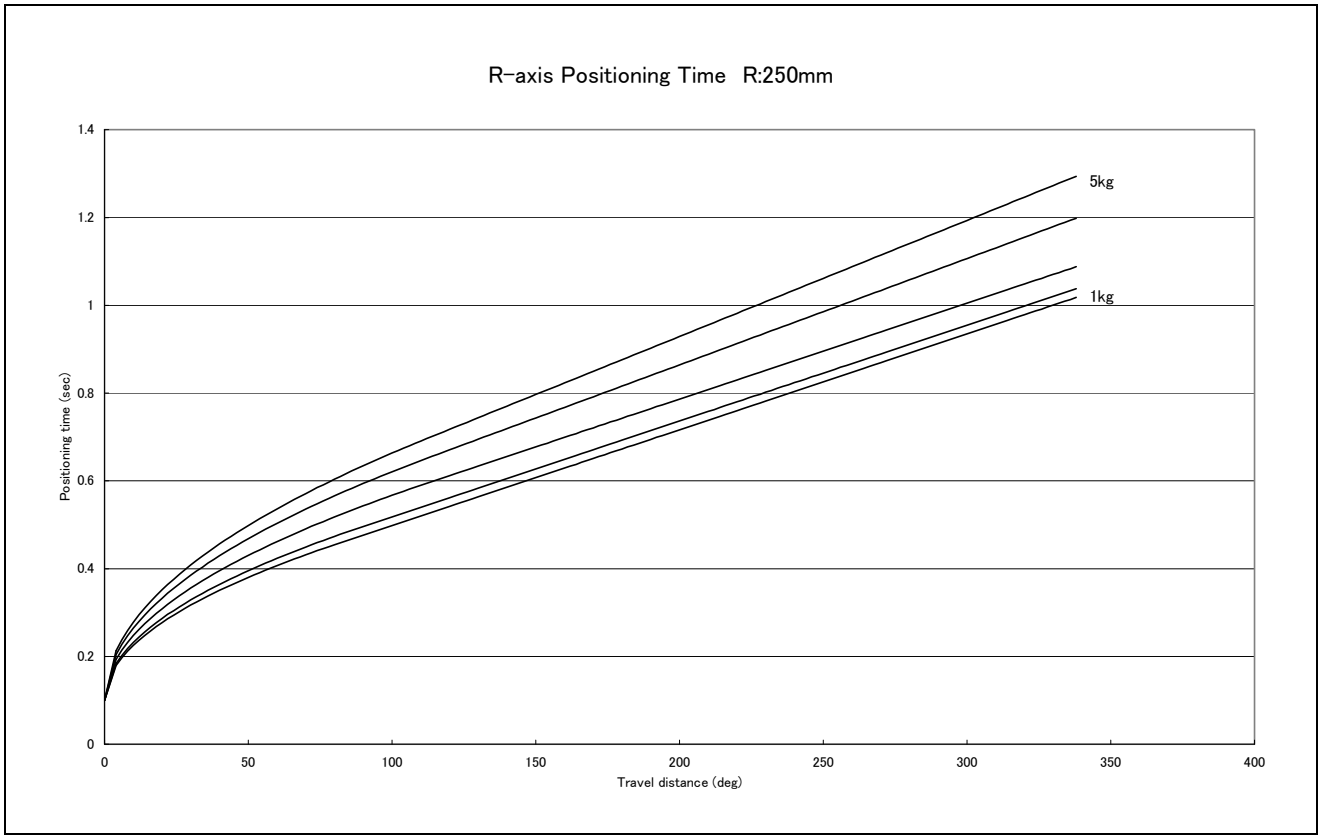
6.1 Operating time of each axis



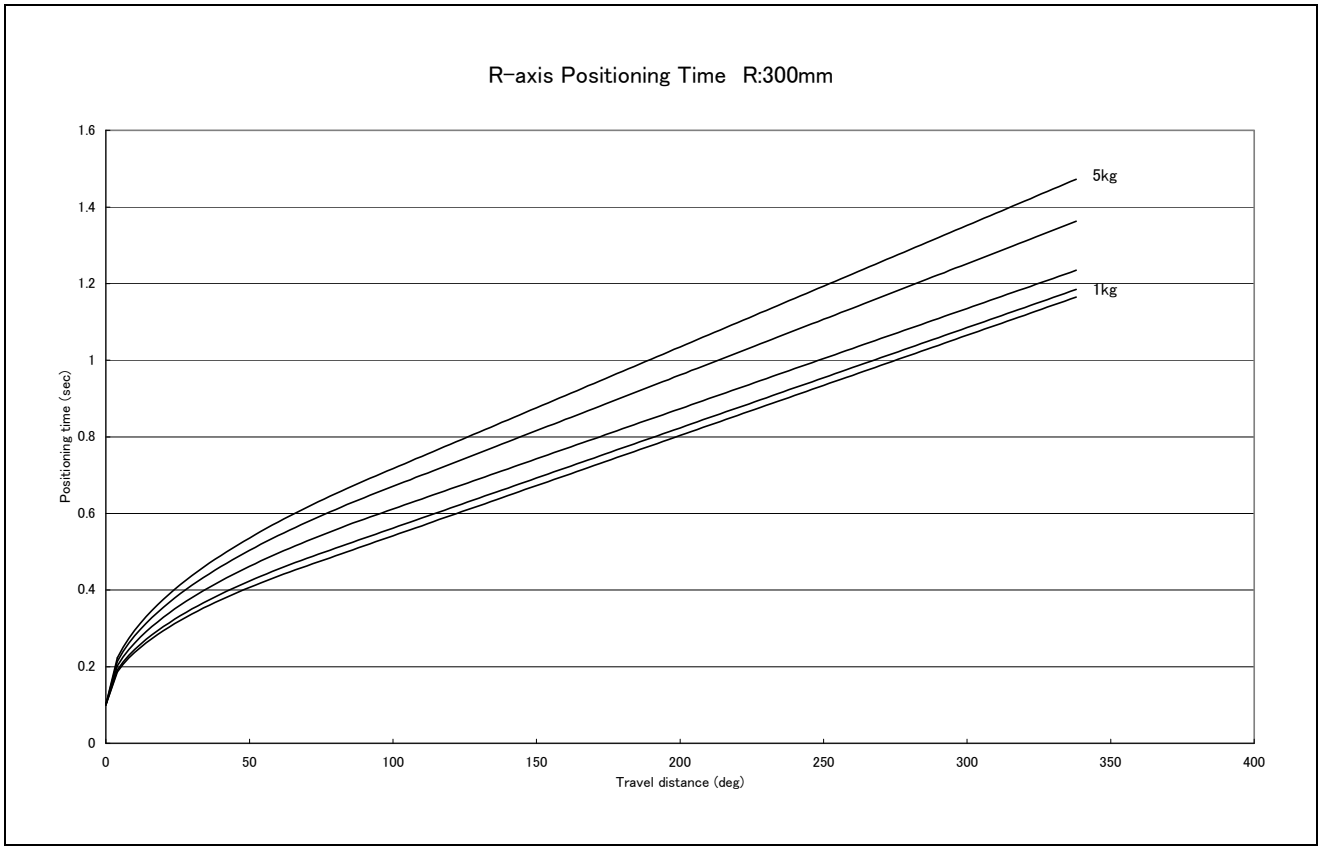
X-axis Positioning Time



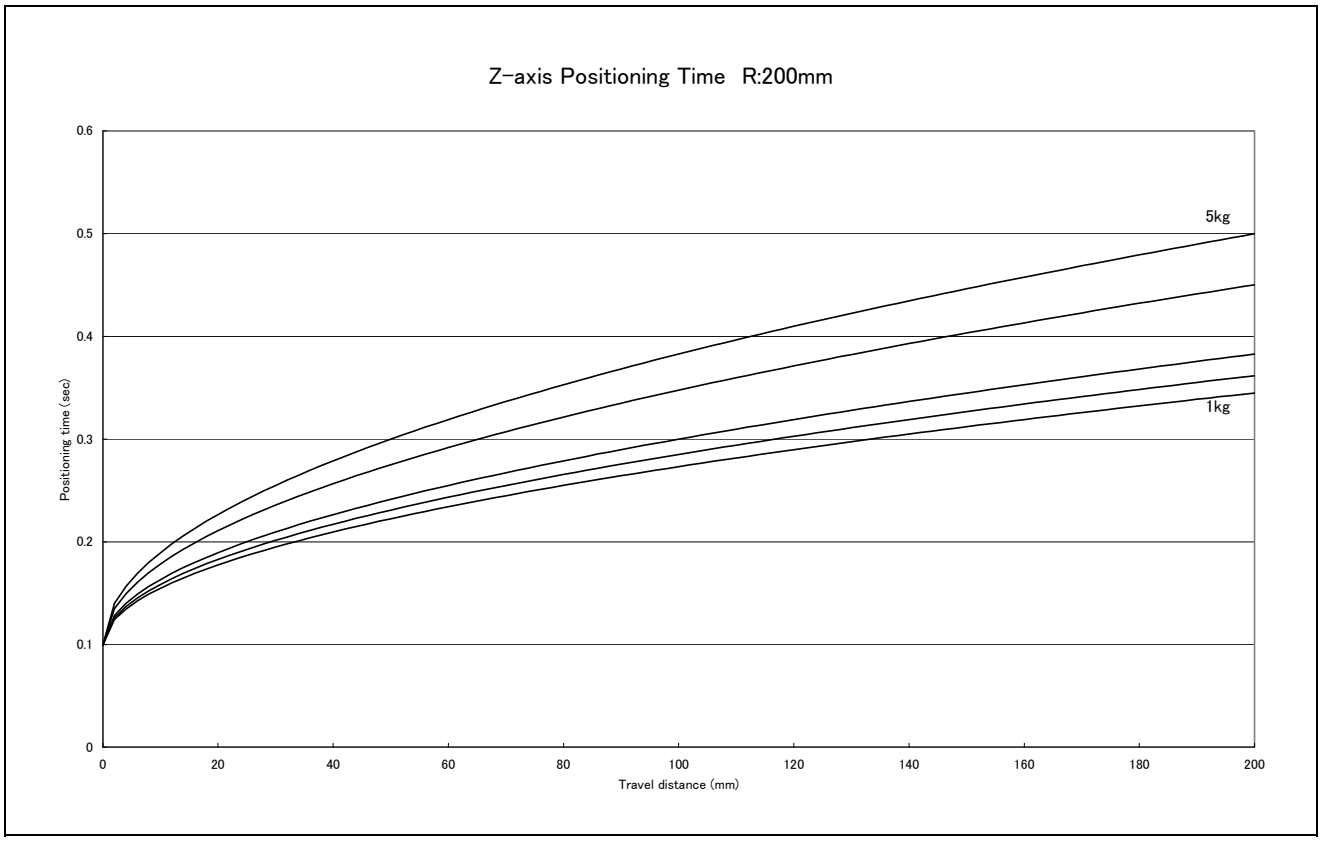
R-axis Positioning Time R:200mm



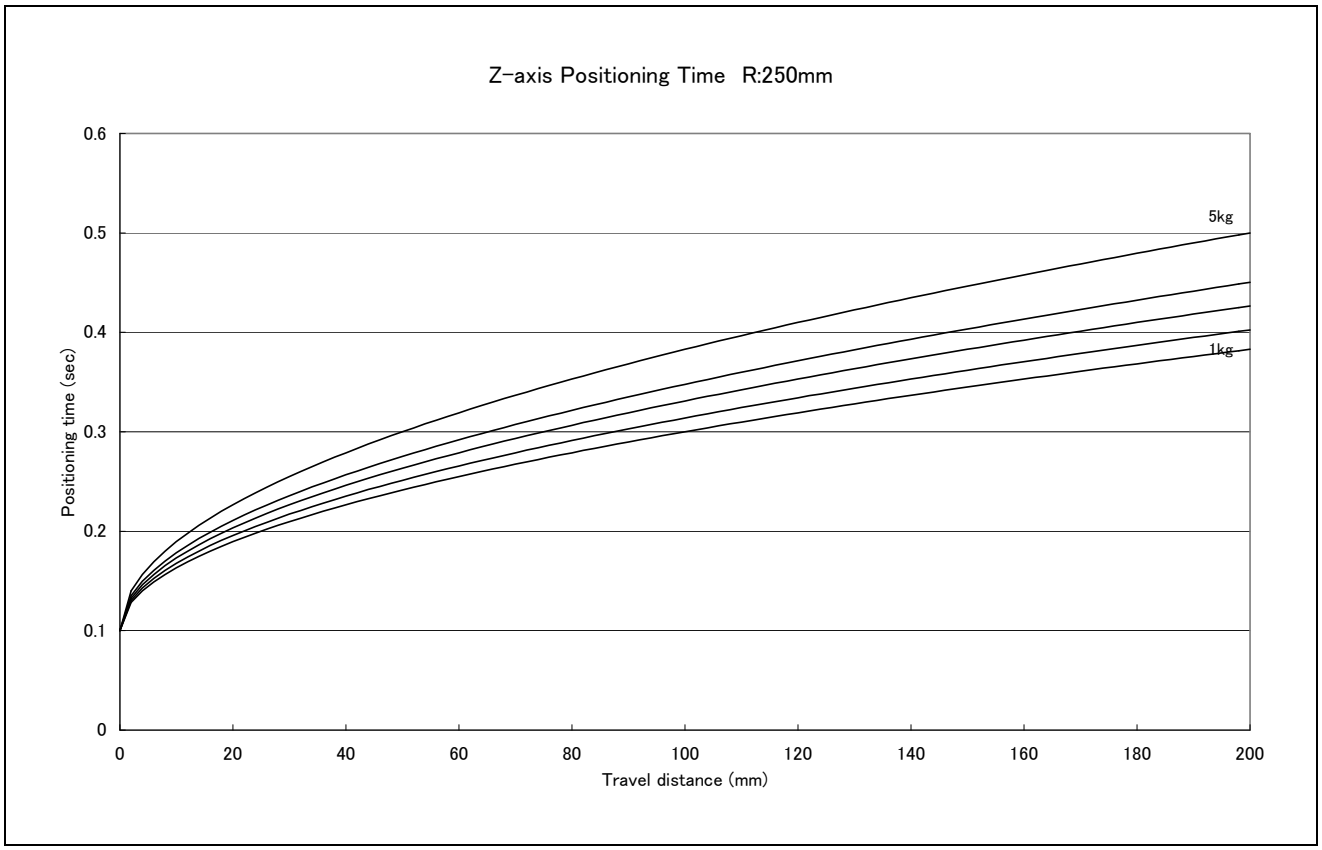
R-axis Positioning Time R:250mm



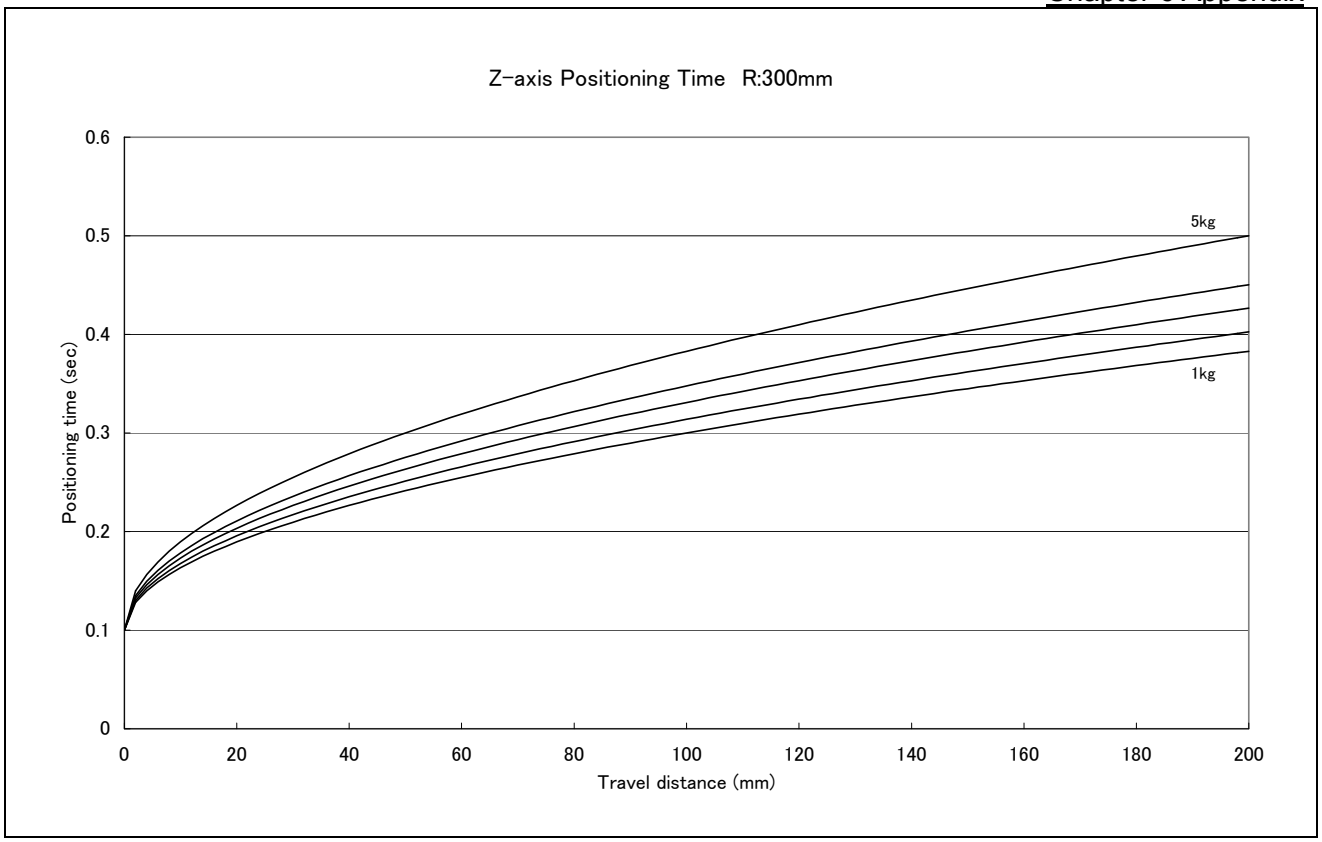
R-axis Positioning Time R:300mm



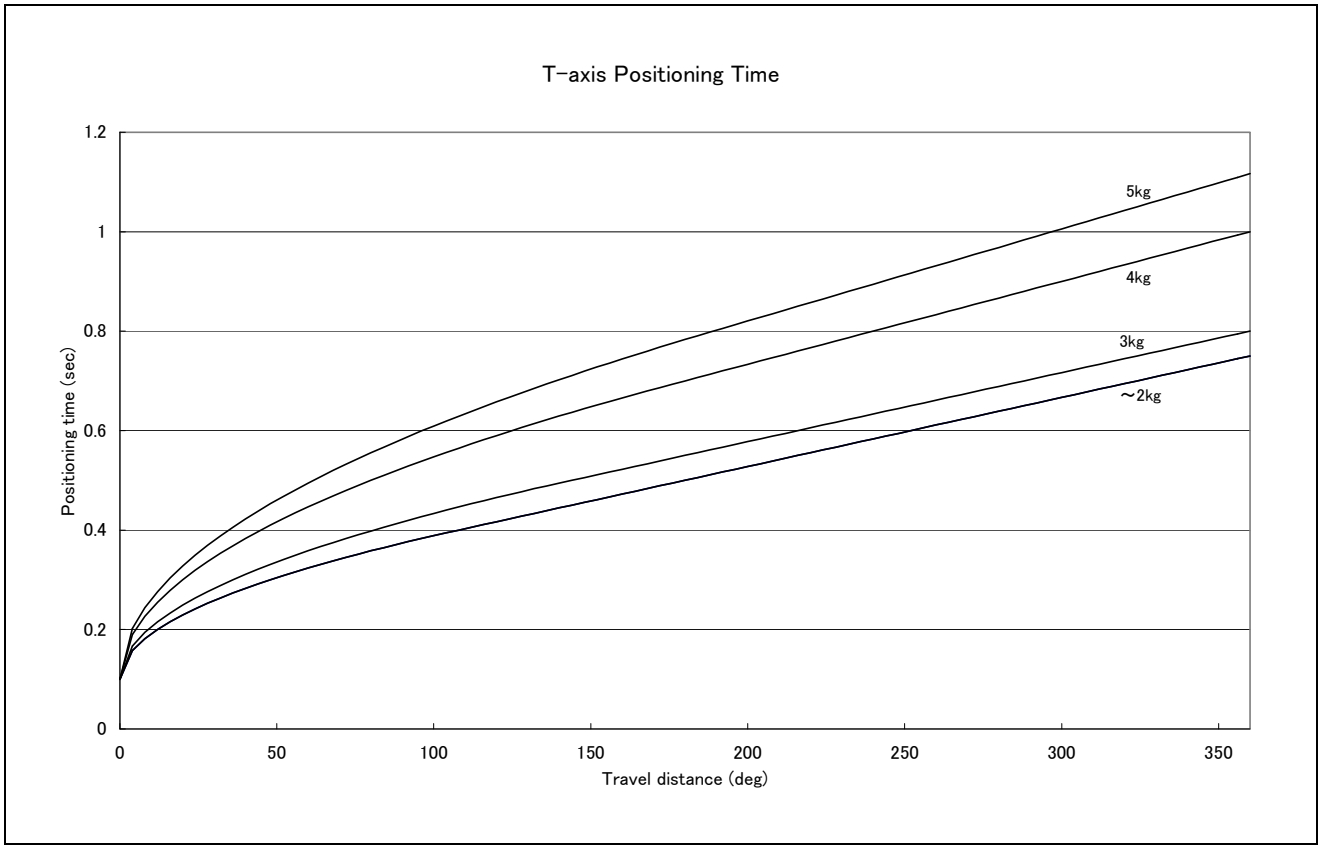
Z-axis Positioning Time R:200mm



Z-axis Positioning Time R:250mm



Z-axis Positioning Time R:300mm



T-axis Positioning Time

6.2 Conformity with Standards by Robot Model

For information on conformity with standards, refer to "Conformity with Standards by Robot Model" in the Additional Information section of the RC7M controller manual pack CD SUPPLEMENT.

Integrated compact robot

XR-G SERIES

GENERAL INFORMATION ABOUT ROBOT

First Edition March 2008
Seventh Edition October 2011
Eighth Edition February 2013

DENSO WAVE INCORPORATED

2Q**C

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.