MELFA

Industrial Robots

Instruction Manual
(Robot Arm Setup & Maintenance)

RH-6SH/12SH/18SH Series

Art. no.: 166957
01 08 2005
Version A
BFP-A8417

⚠ Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠CAUTION All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training

⚠CAUTION For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan

⚠WARNING Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch

⚠CAUTION During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress

⚠WARNING Provide a fence or enclosure during operation to prevent contact of the operator and robot.
Installation of safety fence

⚠CAUTION Establish a set signaling method to the related operators for starting work, and follow this method.
Signaling of operation start

⚠CAUTION As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
Indication of maintenance work in progress

⚠CAUTION Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠CAUTION Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

⚠CAUTION Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

⚠CAUTION Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

⚠CAUTION Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

⚠CAUTION Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

⚠CAUTION Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.

⚠WARNING Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

⚠WARNING Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

⚠CAUTION Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

⚠WARNING When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

⚠CAUTION Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

⚠CAUTION After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

⚠CAUTION Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

⚠CAUTION Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.

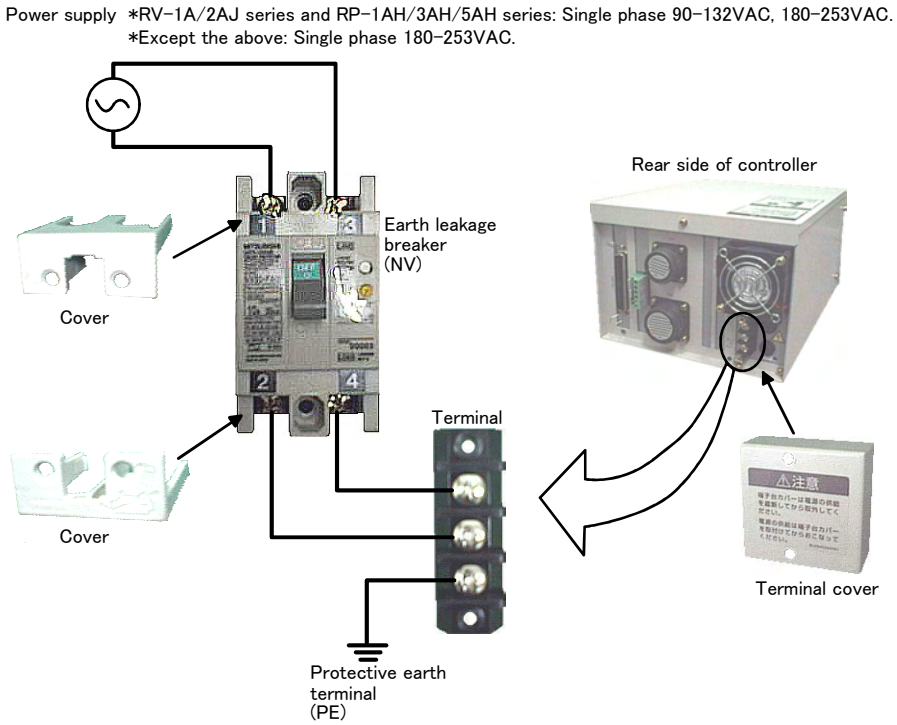
⚠WARNING When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠CAUTION Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

⚠CAUTION Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters.
If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

Precautions for the basic configuration are shown below.(When CR1-571/CR1B-571 is used for the controller.)

⚠CAUTION Provide an earth leakage breaker that packed together on the primary power supply of the controller as protection against electric leakage. Confirm the setting connector of the input power supply voltage of the controller, if the type which more than one power supply voltage can be used. Then connect the power supply.
Failure to do so could lead to electric shock accidents.



⚠WARNING For using RH-5AH/10AH/15AH series or RH-6SH/12SH/18SH series.
While pressing the brake releasing switch on the robot arm, beware of the arm which may drop with its own weight.
Dropping of the hand could lead to a collision with the peripheral equipment or catch the hands or fingers.

Revision history

Date of print	BFP No.	Details of revisions
2005-08-18	BFP-A8417	First print.

■ Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual explains procedures to be taken for unpacking, installing, servicing and inspecting the robot arm.
Always read through this manual before starting use to ensure correct usage of the robot.

The contents of this manual correspond to the following robot types. Refer to the separate manual "Standard Specifications" for details on the robot type.

〈Type〉
- RH-6SH series
- RH-12SH series
- RH-18SH series

Contents

Page

1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.
For special specifications, a separate instruction manual describing the special section may be enclosed.

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.

1.1.2 Symbols used in instruction manual

The symbols and expressions shown in Table 1-1 are used throughout this instruction manual. Learn the meaning of these symbols before reading this instruction manual.

Table 1-1:Symbols in instruction manual

Symbol	Meaning
⚠DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
⚠WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
⚠CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
[JOINT]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
[+/FORWD]+[+X] (A) (B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [+/Forward] key is pressed while holding down the [+X/+Y] key.
[STEP/MOVE]+([COND]-[RPL]) (A) (B) (C)	This indicates to hold down the (A) key, press and release the (B) key, and then press the (C) key. In this example, the [Step/Move] key is held down, the [Condition] key is pressed and released, and the [Replace] key is pressed.
T/B	This indicates the teaching pendant.

1.2 Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠CAUTION All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training

⚠CAUTION For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan

⚠WARNING Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch

⚠CAUTION During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress

⚠ DANGER Provide a fence or enclosure during operation to prevent contact of the operator and robot.
Installation of safety fence

⚠CAUTION Establish a set signaling method to the related operators for starting work, and follow this method.
Signaling of operation start

⚠CAUTION As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
Indication of maintenance work in progress

⚠CAUTION Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
Inspection before starting work

1.2.1 Precautions given in the separate Safety Manual

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
⚠WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
⚠CAUTION	Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
⚠CAUTION	Never carry out modifications based on personal judgments, or use non-designated maintenance parts. Failure to observe this could lead to faults or failures.
⚠WARNING	When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.
⚠CAUTION	Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.
⚠CAUTION	Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters , the internal information of the robot controller may be damaged.

2 Unpacking to Installation

2.1 Confirming the product

The standard configuration of the robot arm, part of the purchased product, is shown in Table 2-1.
Confirm the parts.
Users who have purchased optional products should refer to the separate "Standard Specifications".

Table 2-1 : Standard configuration

No.	Part name	Type	Qty.	Remarks
RH-6SH series				
1	Robot arm		1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 x 40	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M8	4 pcs.	
5	Plain washer for installation bolts	For M8	4 pcs.	
6	Fixing plates		1 set	For robot arm transportation
7	Fixing plates installation bolt		1 set	
8	Grommet		1 pcs.	For hand output cable wiring port
RH-12SH/18SH series				
1	Robot arm		1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M12 x 45	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M12	4 pcs.	
5	Plain washer for installation bolts	For M12	4 pcs.	
6	Fixing plates		1 set	For robot arm transportation
7	Fixing plates installation bolt		1 set	
8	Suspension fitting		1 set	
9	Suspension fitting installation bolts		1 set	
10	Grommet		1 pcs.	For hand output cable wiring port

Note) The number 3, 4 and 5 are in the attached plastic bag in the robot arm.

2.2 Installation

2.2.1 Unpacking

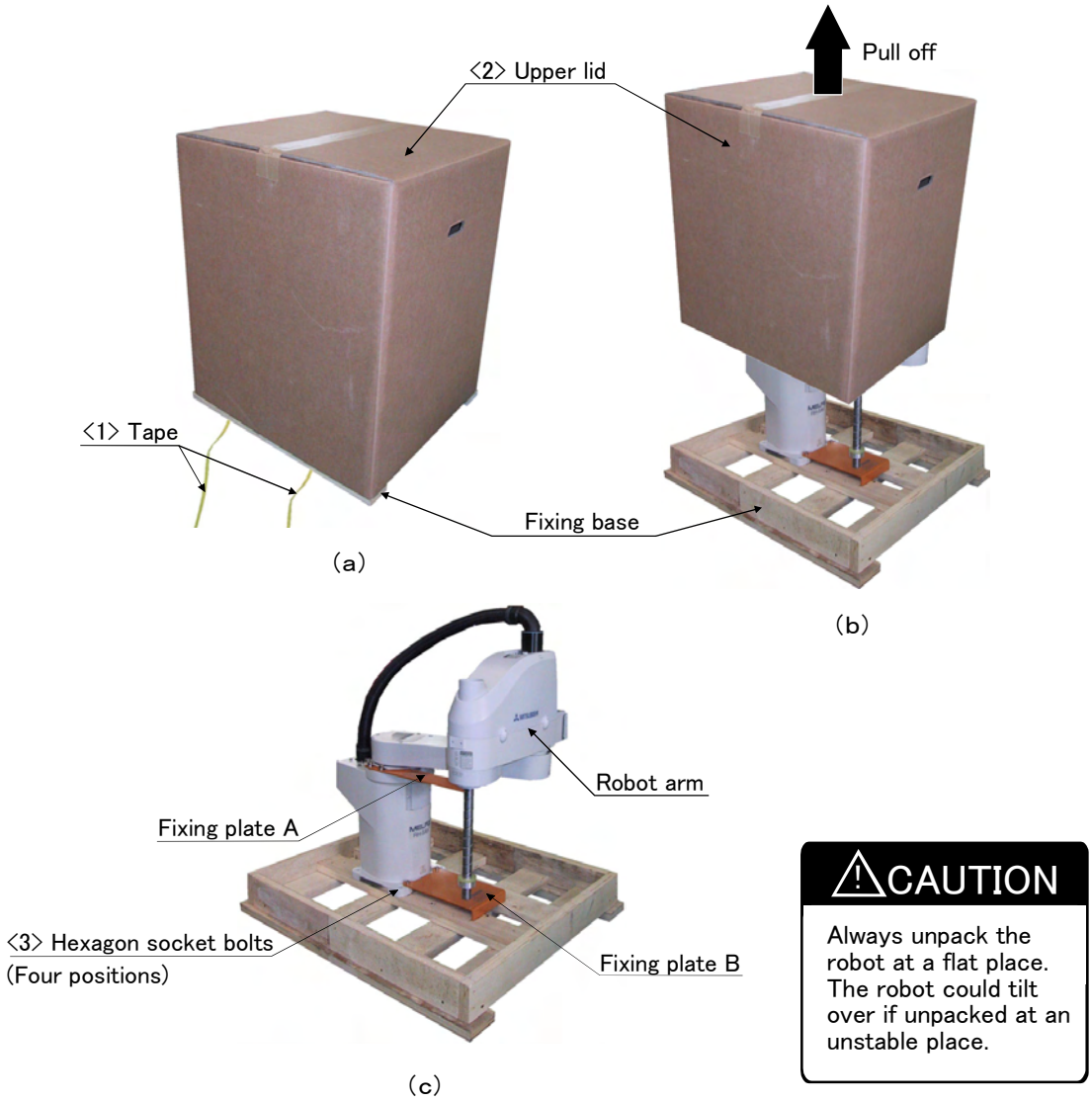


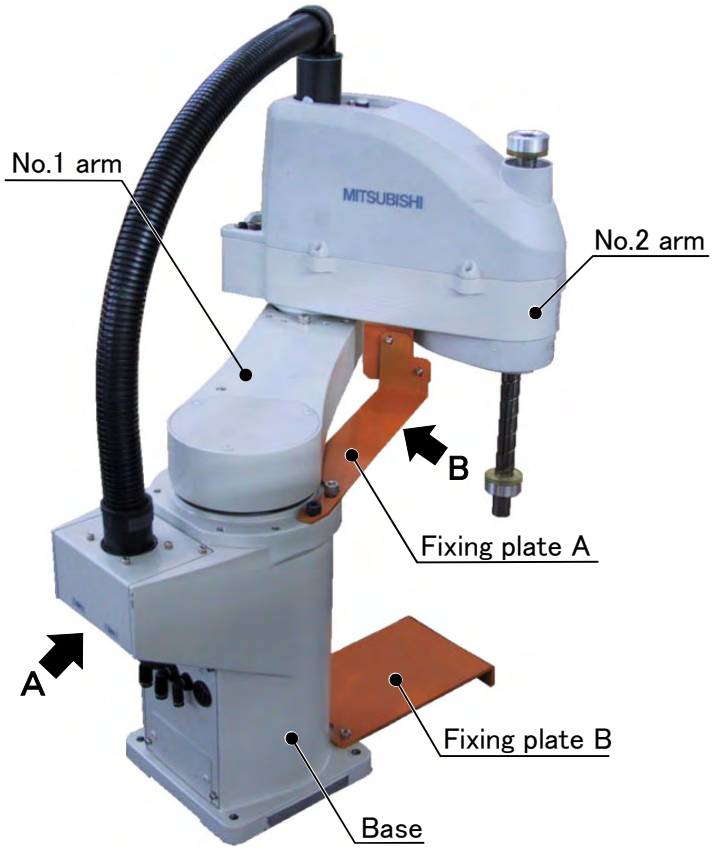
Fig.2-1 : Unpacking the robot arm

The robot is shipped from the factory in cardboard and plywood frame packing. Always refer to Fig. 2-1 and unpack the robot. Be sure to transport the RH-6SH series according to "2.2.2Transportation procedures(Transportation by people: RH-6SH series)", and transport the RH-12SH/18SH series according to "2.2.3Transportation procedures(Transporting with a crane: RH-12SH/18SH series)".

1) HUsing a knife, etc., slit the tape <1> fixing the upper lid <2> of the cardboard box. (Fig. 2-1 (a))
2) Pull the upper lid <2> of the cardboard box off with both hands. (Fig. 2-1 (b))
3) Remove the hexagon socket bolts <3> (four positions) connecting the sleeper and the base unit. (Fig. 2-1 (c))
4) This completes the unpacking.

CAUTION When repackaging the robot in the wooden frame, always use the fixing plate.

2.2.2 Transportation procedures(Transportation by people: RH-6SH series)



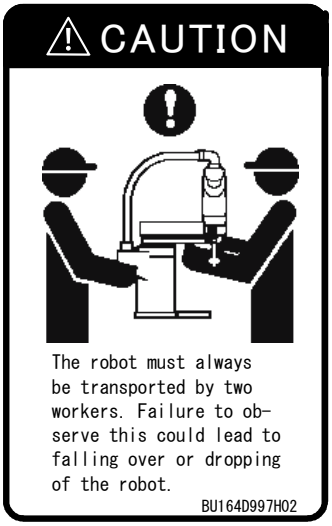


Fig.2-2 : Transportation of robot arm

1) The robot must be transported by two workers with putting the fixing plate A and B. Place the robot on a dolly, etc., and move it to near the installation place. Transporting the robot with the following grips should be limited to placing the robot on the frame or dolly, and to positioning.
2) When transporting the robot arm, one person should hold the rear part of the base area (A) and another person should hold the fixing plate A and No.1 arm (B).
   Never hold the robot from the left/right side or the cover. It may lead to accidents such as the cover dropping off and the robot falling over, causing damage.
3) When transporting the robot, do not apply force on the cover, or apply a strong impact on the robot.
4) Remove the fixtures after installing the robot.

⚠CAUTION To prevent accidents, do not hold the robot from the left/right sides, or hold covers that have no grips .

⚠CAUTION When installing the fixing tool again, place the robot in the posture where each axis shows the values listed in the table below.

Table 2-2 : Transportation posture(RH-6SH series)

Axis	RH-6SH35*	RH-6SH45*	RH-6SH55*
J1	49.5 deg.	25 deg.	17 deg.
J2	-139.5 deg.	-115 deg.	-107 deg.
J3	97mm	97mm	97mm
J4	Not fixed	Not fixed	Not fixed

2.2.3 Transportation procedures(Transporting with a crane: RH-12SH/18SH series)

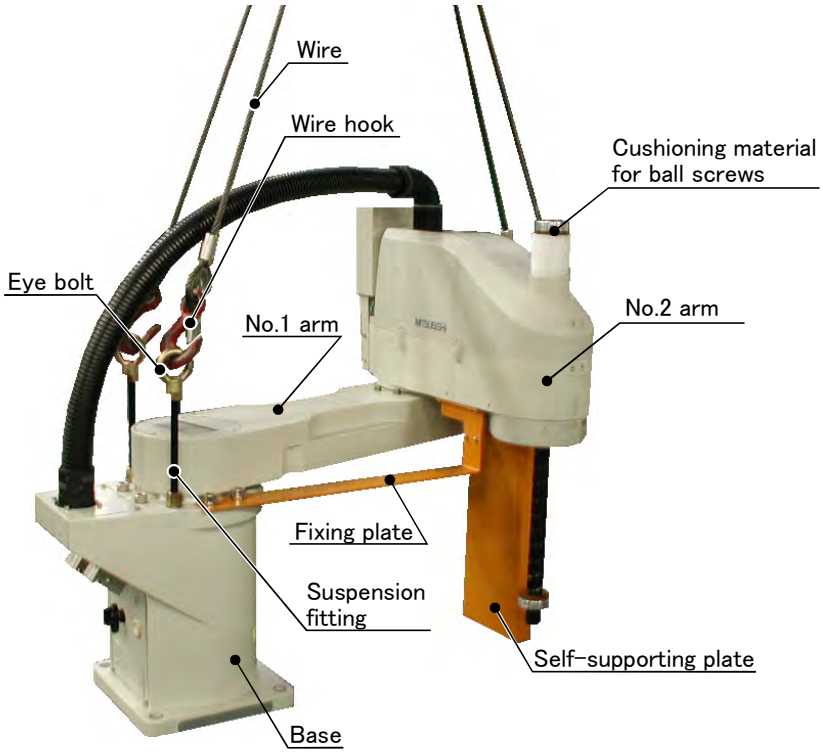


Fig.2-3 : Transportation of robot arm

1) Hook the wires to each of the four eyebolts attached to the suspension fitting. (Make sure the bolts are securely hooked.)
2) Lift with a crane to transport the robot to the designated location.
3) At this time, make sure that the wires, etc., do not interfere with the robot arm or covers. Always place cloth, etc., at interfering places.
4) Be careful not to subject the robot to physical shock during transport.
5) After installing the robot (refer to "2.2.4 Installation procedures" on page 9), remove the wires, the wire hooks (the robot will stand by itself as shown in Fig. 2-3), the self-supporting plate, suspension fitting and fixing plate.
6) Always follow the above procedures and methods to transport the robot for secondary transportation, such as when changing the installation position.
   If the arm is directly suspended without using the specified suspension fittings, or if it is suspended in the work posture, the configuration devices could be damaged, and the transportation workers will be subject to risk due to an inadequate center of gravity position.

⚠CAUTION When transporting a robot, always attach four wires.

⚠CAUTION To reattach the fixing plate again, set the axes of the robot to the positions according to the table below.

Table 2-3 : Transportation posture(RH-12SH/18SH series)

Axis	RH-12SH55*	RH-12SH70*	RH-12SH85*/RH-18SH85*
J 1	37.5 deg.	21.4 deg.	15.1 deg.
J 2	-127.5 deg.	-111.4 deg.	-105.1 deg.
J 3 Note1)	84.5mm	84.5mm	84.5mm
J 4	Not fixed	Not fixed	Not fixed

Note1) The bottom surface of the shaft will interfere with the floor if the J3 axis is lowered down to the upper mechanical stopper. Position the axes as indicated when transporting the robot.

2.2.4 Installation procedures

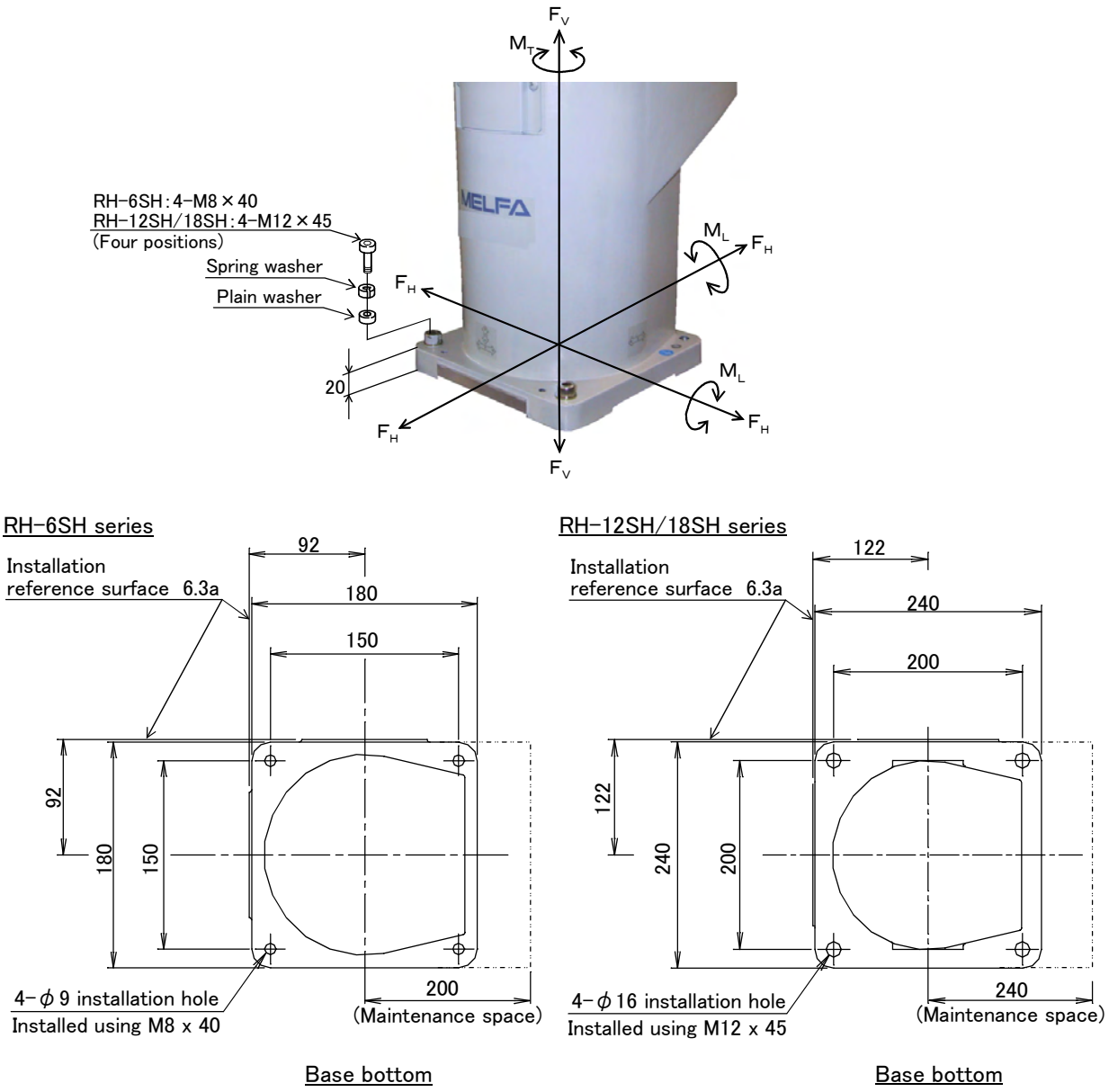


Fig.2-4 : Installation dimensions

1) The robot installation surface has been machine finished. Use the installation holes (RH-6SH series: 4-φ9 holes, RH-12SH/18SH: 4-φ16 holes) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts(hexagon socket bolts).
2) Install the robot on a level surface.
3) It is recommended that the surface roughness of the table onto which the robot is to be installed by 6.3a or more. If the installation surface is rough, the contact with the table will be poor, and positional deviation could occur when the robot moves.
4) When installing, use a common table to prevent the position of the devices and jigs subject to robot work from deviating.
5) The installation surface must have sufficient strength to withstand the arm reaction during operation, and resistance against deformation and vibration caused by the static (dynamic) load of the robot arm and peripheral devices, etc.
6) After installing the robot, remove the self-supporting plate, suspension fitting, and fixing plate.
7) If you operate the robot at a high speed, reaction forces are applied to the installation stand by the robot's operation. Make sure that the installation stand on which the robot is placed has sufficient strength and rigidity. Table 2-4 shows the maximum reaction force (design values) that may be applied to an installation stand. Please use these values as reference when designing the installation stand.

Table 2-4 : Magnitude of each reaction force

	Unit	Value
RH-6SH series		
Tilt moment : M_L	N・m	380
Torsional moment : M_T	N・m	410
Horizontal direction translation force : F_H	N	920
Vertical direction translation force : F_V	N	570
RH-12SH/18SH series		
Tilt moment : M_L	N・m	1,310
Torsional moment : M_T	N・m	1,440
Horizontal direction translation force : F_H	N	1,900
Vertical direction translation force : F_V	N	1,280

⚠CAUTION When installing the robot, secure enough space behind the robot for future maintenance to allow the connection of cables and the replacement of the backup battery.

2.2.5 Grounding procedures

(1) Grounding methods

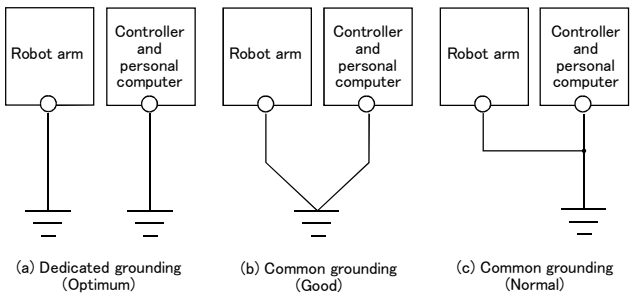


Fig.2-5 : Grounding methods

1) There are three grounding methods as shown in Fig. 2-5 (c), but the dedicated grounding (Fig. 2-5 (a)) should be used for the robot arm and controller when possible. (Refer to the separate " Controller Setup, Basic Operation and Maintenance" for details on the controller grounding.)
2) Use Class D grounding (grounding resistance 100Ω or less).
   Dedicated grounding separated from the other devices should be used.
3) Use a AWG#14(2mm^2) or more stranded wire for the grounding wire. The grounding point should be as close to the robot arm and controller as possible, and the length of the grounding wire should be short.

(2) Grounding procedures

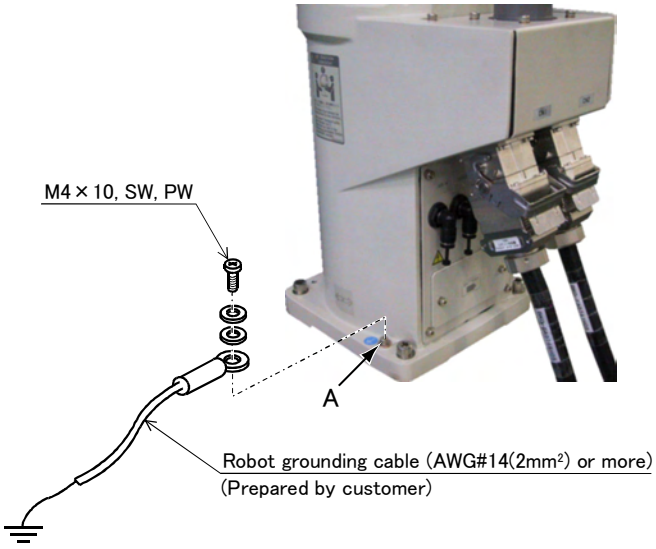


Fig.2-6 : Connecting the grounding cable

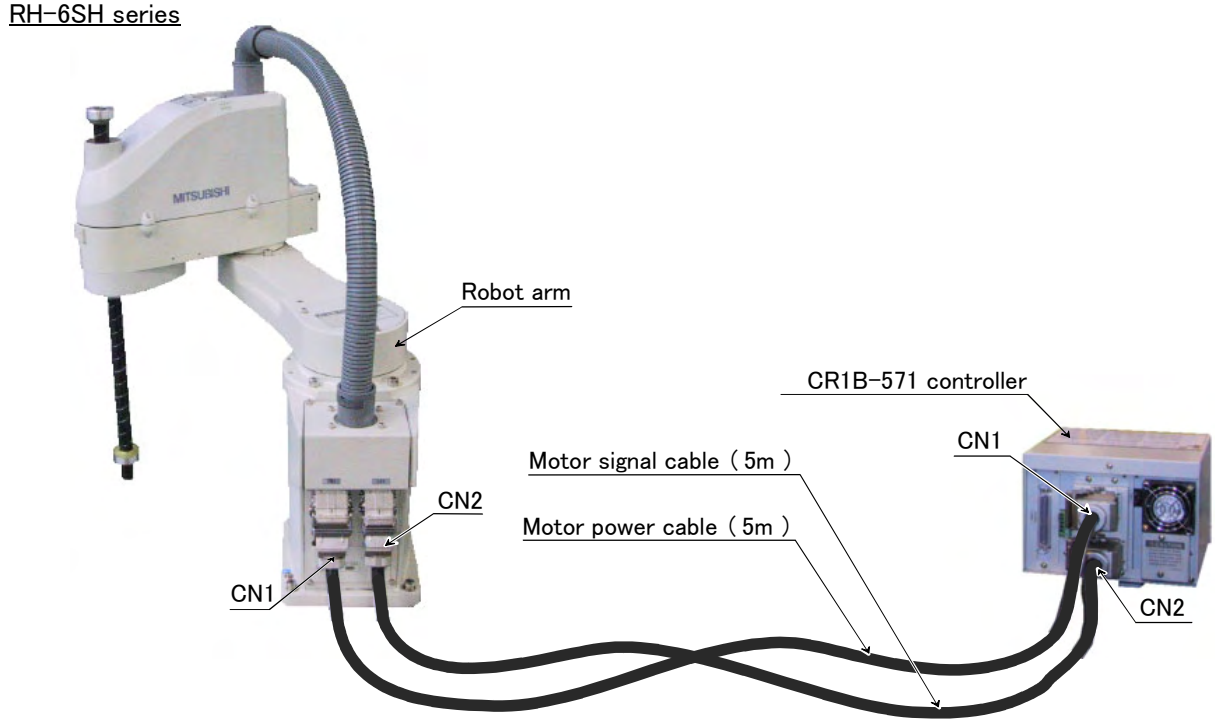
1) Prepare the grounding cable (AWG#14(2mm^2) or more) and robot side installationscrew and washer.

2) If there is rust or paint on the grounding screw section (A), remove it with a file, etc.

3) Connect the grounding cable to the grounding screw section.

2.2.6 Connecting with the controller

RH-6SH series



RH-12SH/18SH series

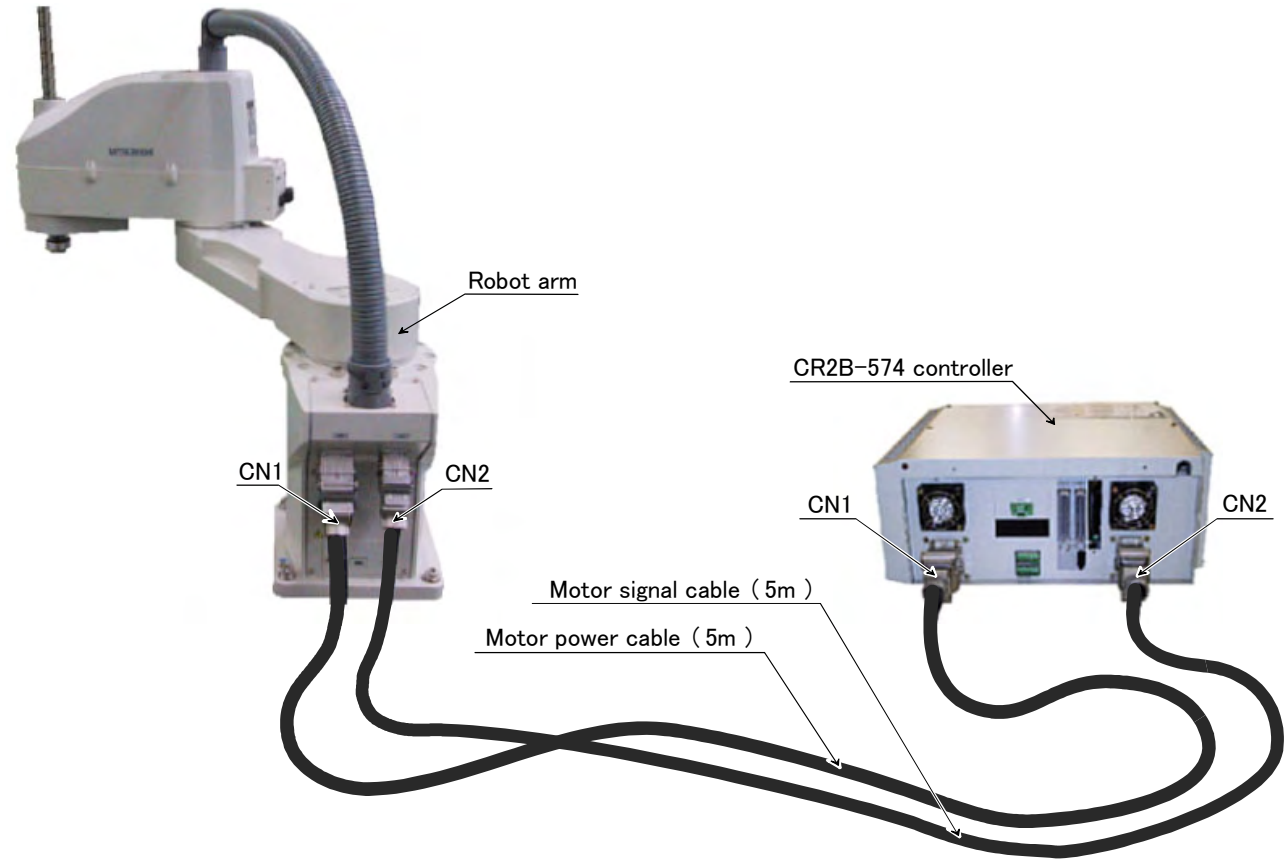
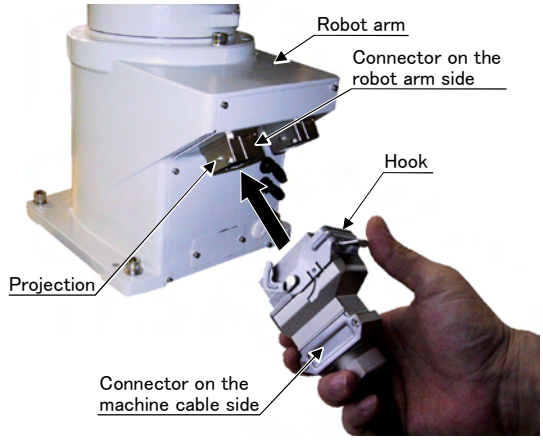


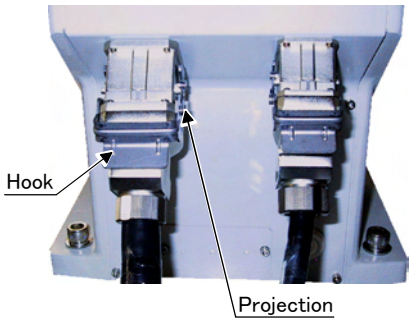
Fig.2-7 : Connecting the machine cables

Carry out the following procedure after installing the controller referring to the separate "Controller Setup, Basic Operation and Maintenance" manual.



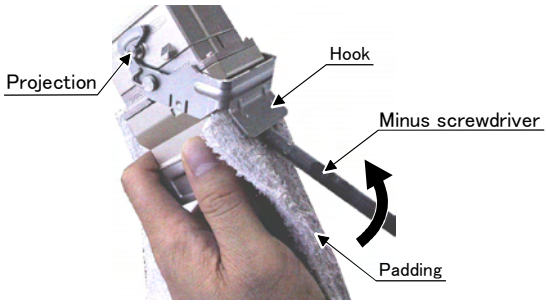
1) Make sure that the power switch on the front of the controller is turned OFF.

2) Connect the machine cable to its corresponding connector on the robot arm side.



3) After connecting the connector, insert the hook attached to the connector on the machine cable side to the rear of the projection of the robot arm connector to fix securely in place.

⚠CAUTION Be careful not to get your hand pinched.



4) To remove the cable, insert a minus screwdriver into the hook while padding with a cloth, and remove the cable by lifting the hook.

⚠CAUTION The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠CAUTION Take special care to the leading of the connection cable. If the cable is pulled with force or bent excessively, wires could break or the connector could be damaged.

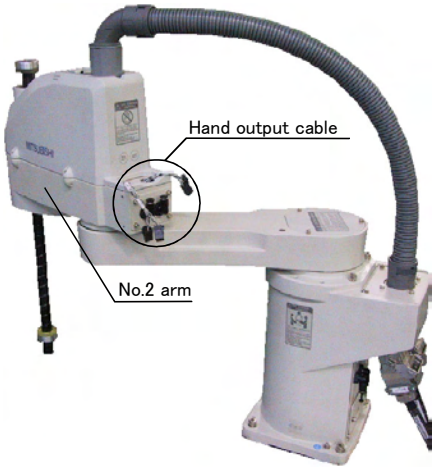
⚠CAUTION Connect cables between devices in a place where there is no risk of contamination from dust and oil mist. Also, be sure to protect the robot arm's connector area from dust and oil mist when cables between devices are disconnected, since contamination will cause failures in the robot.

2.2.7 Procedure for wiring the hand output cables

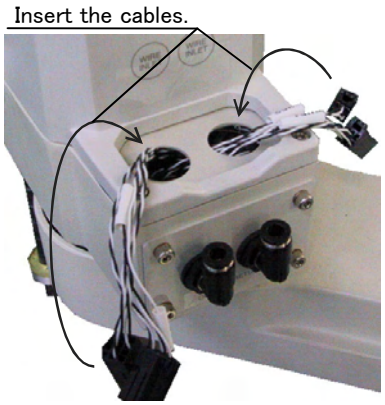
The hand output cables (GR1 and GR2) are coming out from the rear of the No. 2 arm. If these cables are not used, put the cables inside the arm according to the following procedure.

The procedure for using these cables are described in "3 Installing the option devices" on page 34 . Please handle accordingly by referencing this section when installing the solenoid valve.

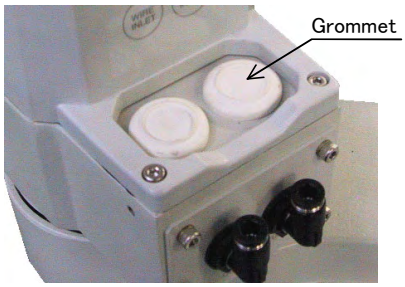
■ Procedure for handling the hand output cables



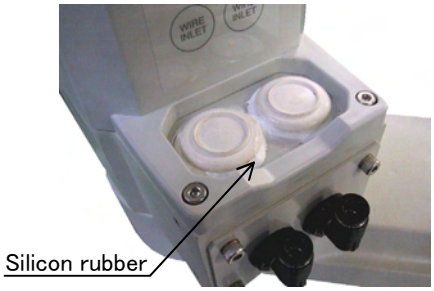
1) When the robot is shipped, the hand output cables are coming out from the rear of the No. 2 arm.



2) Insert the connector into the back of the No. 2 arm.



3) Install the grommets that come with the product to the robot.



4) Fill the surrounding areas of the grommets with silicon rubber.

Fig.2-8 : Procedure for handling the hand output cables

2.3 Setting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. This step must also be carried out if the combination of robot and controller being used is changed.

There are several methods for setting the origin, but the origin data input method will be explained here. Refer to "5.5 Resetting the origin" on page 58 for the other methods.

The teaching pendant is required for this operation.

[Caution] If the origin data at shipment is erased due to out of battery, it is necessary to set the origin again. Refer to "5.5 Resetting the origin" on page 55 and reset the origin using the jig method or mechanical stopper method.

2.3.1 Installing the teaching pendant (T/B)

By using the "REMOVE T/B" switch, the T/B can be installed and removed while the controller's control power is ON. However, in this procedure, the teaching pendant will be installed with the control power OFF.

Refer to the separate "Controller setup, basic operation, and maintenance" for details on installing the teaching pendant with the control power ON.

(1) Installing with the control power OFF

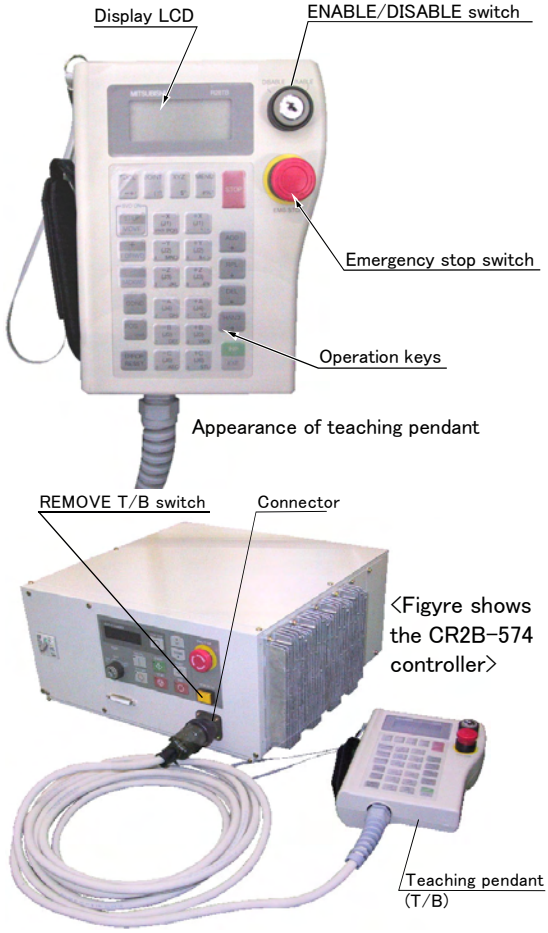


Fig.2-9 : Installing the T/B (control power OFF)

1) Confirm that the controller's power supply switch is OFF.

2) Connect the T/B connector to the RS-422 (T/B) connector on the controller.

3) Do not pull the cable with force or bend it excessively, as the cable could break or the connector could be damaged.

4) Confirm that the [REMOVE T/B] switch on the side of the controller is not depressed (is projected).

5) Set the T/B [ENABLE/DISABLE] switch to "DISABLE".

◇◆◇ [REMOVE T/B] switch ◇◆◇

When using the robot with the T/B, this switch is used to invalidate the emergency stop from the T/B. This is also used to install the T/B with turning the controller's power supply ON.

2.3.2 Setting the origin with the origin data input method

(1) Confirming the origin data

● Origin data history table (Origin Data History) Serial No.ES804008

Date	Default	. . .	. . .	. . .
D	V!#S29			
J 1	06DTYY			
J 2	2?HL9X			
J 3	1CP55V			
J 4	T6!M$Y			
J 5				
J 6				
Method	E	E・N・SP	E・N・SP	E・N・SP

(O: AlphabetO, 0: Zero)

Note) Meanings of symbols in method column

E: Jig method
N: Not used
SP: Not used

The origin data to be input is noted in the origin data sheet enclosed with the arm, or on the origin data history table attached to the back side of the J1 cover . (Refer to Fig. 2-10).

Referring to "5.3.2 Installing/removing the cover" on page 45 , remove the J1 cover, and confirm the value.

The value given in the default setting column is the origin settings set with the calibration jig method before shipment.

Fig.2-10 : Origin data label an example

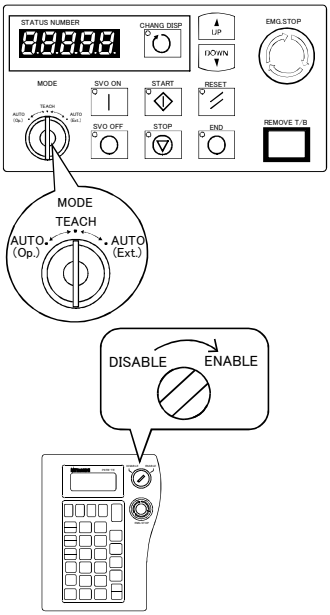
WARNING Always install/remove the cover with the controller control power turned OFF. Failure to do so could lead to physical damage or personal injury should the robot start moving due to incorrect operations.

(2) Turning ON the control power

CAUTION Confirm that there are no operators near the robot before turning the power ON.

1) Turn the controller [POWER] switch ON.
The control power will be turned ON, and " □ . 100" will appear on the STATUS NUMBER display on the front of the controller.

(3) Preparing the T/B



Next, prepare to use the T/B

1) Set the [MODE] switch on the front of the controller to "TEACH".

2) Set the T/B [ENABLE/DISABLE] switch to "ENABLE". The menu selection screen will appear.
The following operations are carried out with the T/B.

◇◆◇ Operating from the T/B ◇◆◇

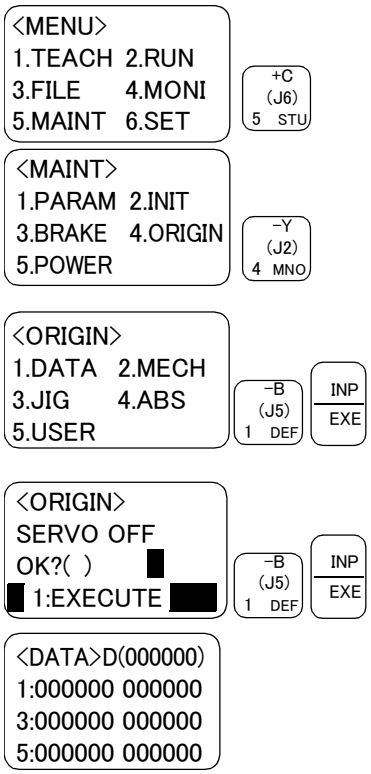
Always set the [MODE] switch (mode selection key switch) on the front of the controller to "TEACH", and then set the T/B [ENABLE/DISABLE] switch to "ENABLE".
When the T/B is valid, only operations from the T/B are possible. Operations from the controller or external signals will not be accepted.

◇◆◇ When T/B operations are mistaken ◇◆◇

The displayed screen will return to the "menu selection screen" when the [MENU] key is pressed. Carry out the operations again from this screen. Operations can also be carried out again by setting the T/B [ENABLE/DISABLE] switch to "DISABLE" once and then setting to "ENABLE".

(4) Selecting the origin setting method

<T/B screen> [Keys used]



1) Press the [5] key on the menu screen, and display the maintenance screen.

2) Press the [4] key on the maintenance screen, and display the origin setting method selection screen.

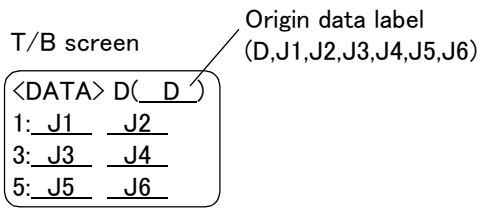
3) Press the [1] key on the origin setting method selection screen, and select the data input method.
The origin data input method will be selected, and the screen for turning OFF the servo power will appear.

4) Press the [1] and [INP] keys to turn OFF the servo power. The screen for inputting the origin data will appear.

◇◆◇ Selecting a menu ◇◆◇

The menu can be selected with one of the following methods.
A: Press the numeral key for the No. of the item to be selected.
B: Using the [↓] and [↑] keys, etc., move the cursor to the item to be selected, and then press the [INP] key.

(5) Inputting the origin data

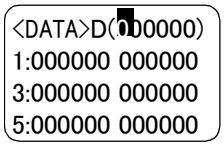


Input the value confirmed in section "(1) Confirming the origin data" on page 16 .
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-11.

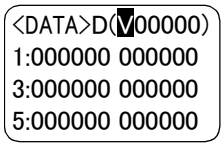
Fig.2-11 : Correspondence of origin data label and axis

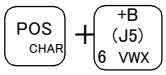
The method for inputting the origin data is explained below. The value shown in Fig. 2-10 will be input as an example.

<T/B screen> [Keys used]



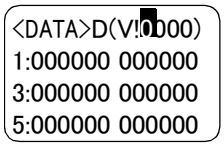
1) Confirm that the cursor is at the "D" position on the T/B display screen.

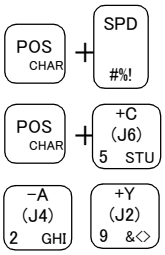




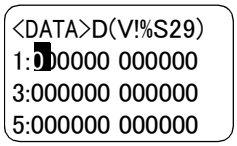
2) Input the D value V!%S29.
Inputting "V"
Press the [VWX] key once while holding down the [CHAR] key. "V" will appear, so release the [CHAR] key. "V" will be set.

Inputting "!"
Press the [#%!] key three times while holding down the [CHAR] key. "!" will appear, so release the [CHAR] key. "!" will be set.



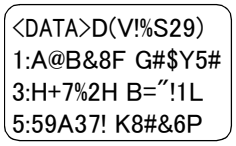


In the same manner, while holding down the [CHAR] key, press the ["%"] key twice, and the [STU] key once (input "S").
Release the [CHAR] key, and press the [2] key (input "2") and then the [9] key (input "9").
V!%S29 will appear at the "D" data on the teaching pendant screen.

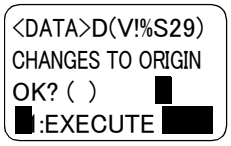


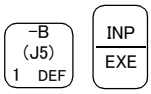
3) Press the [↓] key, and move the cursor to the J1 input position.
4) Input the J1 value in the same manner as above.

5) Input the J2, J3 and J4 values in the same manner.



6) After inputting all of the values, press the [INP] key. The origin setting confirmation screen will appear.





7) Press [1] (−B/−P) and [INP] key to end the origin setting

◇◆◇ Moving the cursor ◇◆◇
Press the [↑], [↓], [←] and [→] keys.

◇◆◇ Inputting characters ◇◆◇
Hold down the [CHAR] key and press the key with the character to be input on the lower right. Three characters will scroll each time the character key is pressed.

◇◆◇ Correcting an input ◇◆◇
After returning one character by pressing the [DEL] key, input the character again.

(6) Installing the J1 cover

Return the J1 cover, removed in section "(1) Confirming the origin data" on page 16 to its original position.
This completes the setting of the origin with the origin data input method.

⚠ WARNING

Always remove and install the cover with the controller power turned OFF. Failure to do so could lead to the robot moving because of incorrect operations, or to physical damage or personal injury.

◇◆◇ If the origin input data is incorrect ◇◆◇
If the origin input data is incorrect, the alarm No. 1760 (origin setting data illegal) will occur when origin data input. In this case, reconfirm the value input for the origin data.

2.4 Confirming the operation

In this section, the robot will be moved manually using the T/B to confirm that the operation is correct.
Moving the robot manually is called "jog operation". This operation includes the JOINT jog that moves each axis, the XYZ jog that moves along the base coordinate system, the TOOL jog that moves along the tool coordinate system, and the CYLNDER jog that moves along the circular arc.
This operation is carried out while pressing the deadman switch on the back of the T/B.

⚠ CAUTION The robot will move during this operation. Make sure that there are no operators near the robot, and that there are no obstacles, such as tools, in the robot operation range.

⚠ CAUTION To immediately stop the robot, release the deadman switch on the back of the T/B. The servo power will turn OFF, and the robot will stop.
The robot will also stop if the [EMG.STOP] switch (emergency stop switch) on the front of the T/B or the [EMG.STOP] switch (emergency stop) on the front of the controller is pressed.

⚠ WARNING Confirm that the origin has been set. If the origin has not been set, "****" will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.
Refer to "2.3 Setting the origin" on page 15 for details on setting the origin.

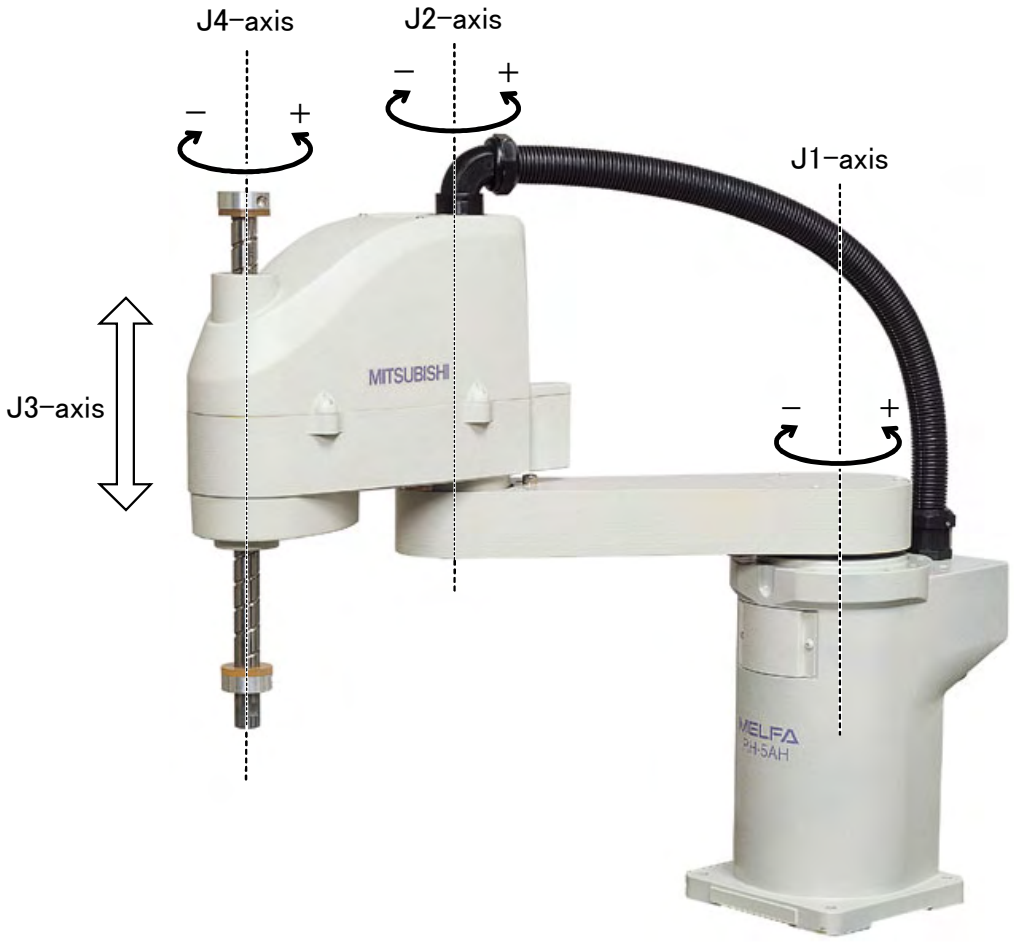
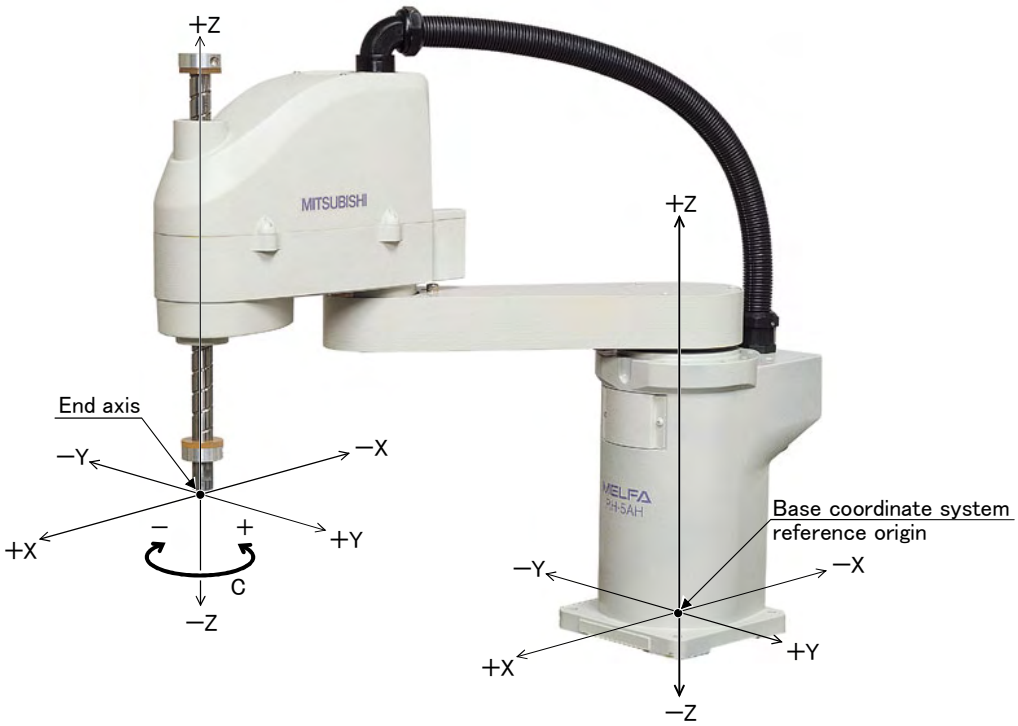
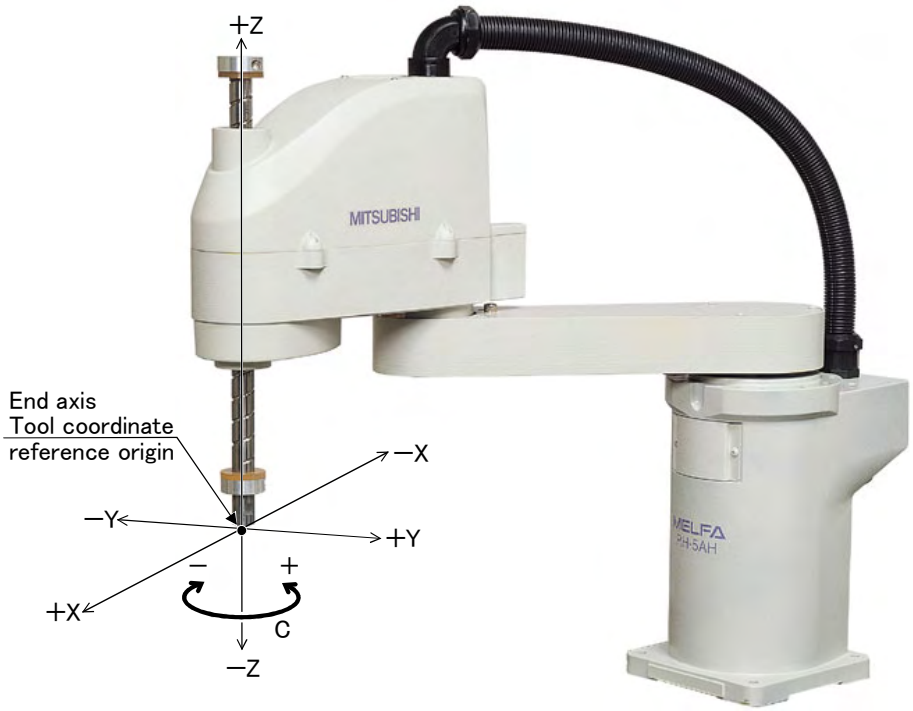


Fig.2-12 : JOINT jog operation



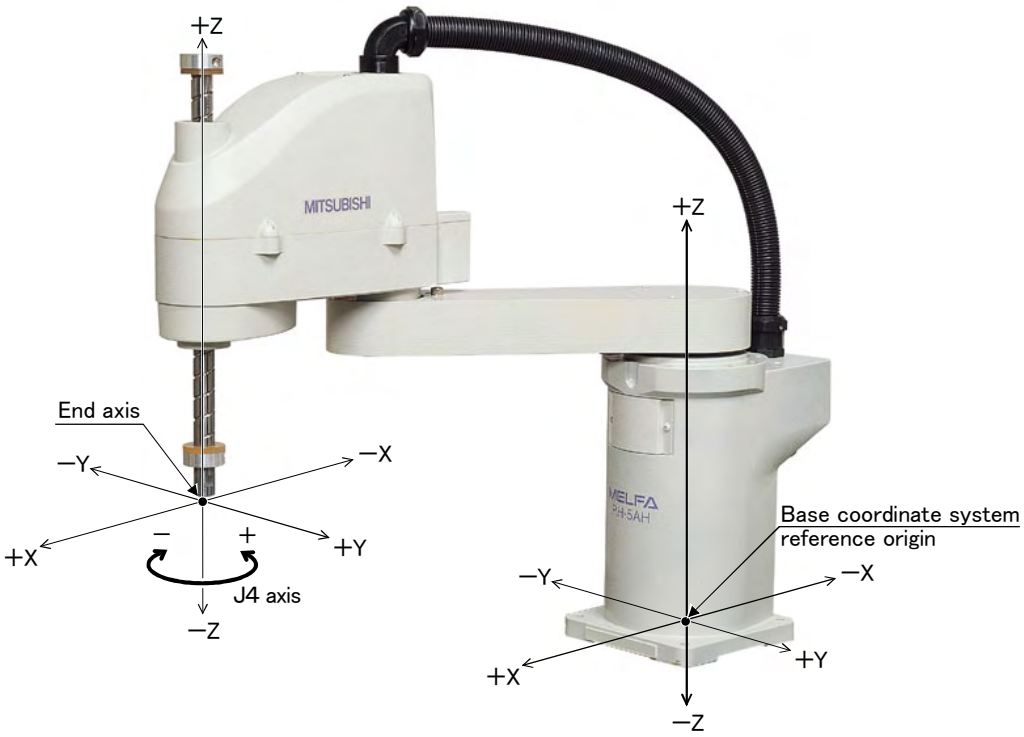
* While maintaining the posture of the end axis, the robot moves straight along the base coordinate system. The end axis rotates.

Fig.2-13 : XYZ jog operation



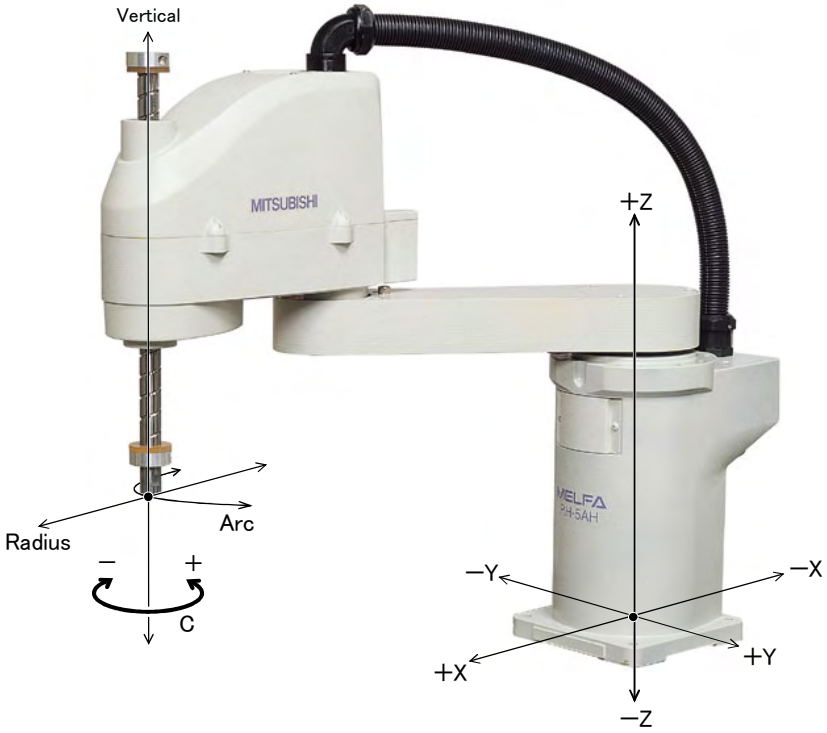
* While maintaining the posture of the end axis, the robot moves straight along the tool coordinate system. The end axis changes directions while maintainingits position.

Fig.2-14 : TOOL jog operation



* The robot moves straight along the base coordinate system. The direction of the end axis is not maintained during this type. The direction of the end axis changes. At this time, the end axis position will change.

Fig.2−15 : 3−axis XYZ jog operation



* With an arc using the end axis position as the center of the Z axis, the robot moves over the arc, expands and contracts in the radial direction, and moves vertically. At this time, the posture of the end axis is maintained. The direction is changed while maintaining the end axis position.

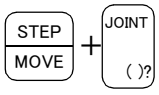
Fig.2−16 : CYLINDER jog operation

(1) JOINT jog operation

Select the JOINT jog mode

JOINT	LOW
J1	+34.50
J2	+20.00
J3	+80.00

JOINT jog mode

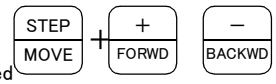


Press the [MOVE] + [JOINT] keys to select the JOINT jog mode. "JOINT" will appear at the upper left of the screen.

Set the jog speed

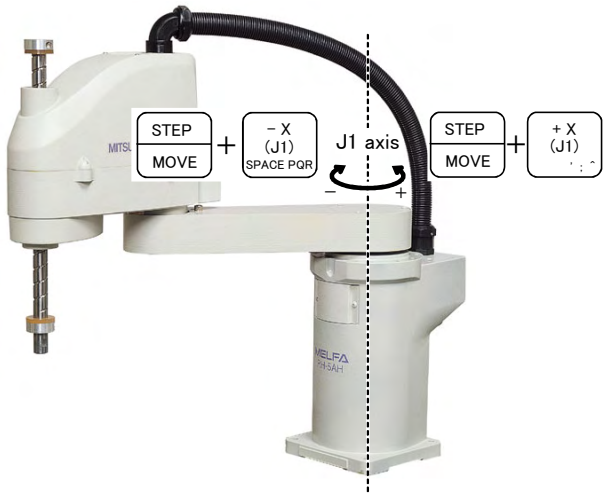
JOINT	LOW
J1	+34.50
J2	+20.00
J3	+80.00

Set the speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%.
When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order.
The currently set speed will appear on the upper right of the screen.
Set the override to 10% here for confirmation work.

J1 axis jog operation



・When the [MOVE] + [+X (J1)] keys are pressed, the J1 axis will rotate in the plus direction.
When the [MOVE] + [−X (J1)] keys are pressed, Rotate in the minus direction.

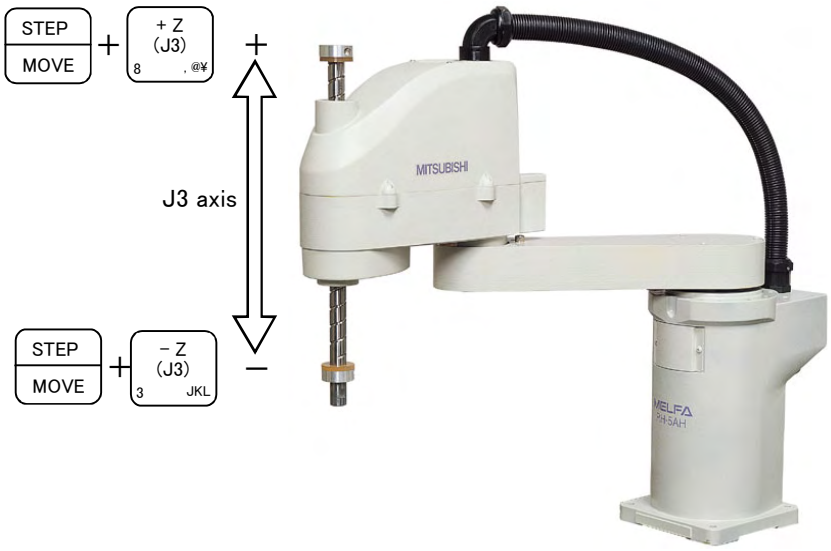
J2 axis jog operation

・When the [MOVE] + [+Y (J2)] keys are pressed, the J2 axis will rotate in the plus direction.
When the [MOVE] + [−Y (J2)] keys are pressed, Rotate in the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

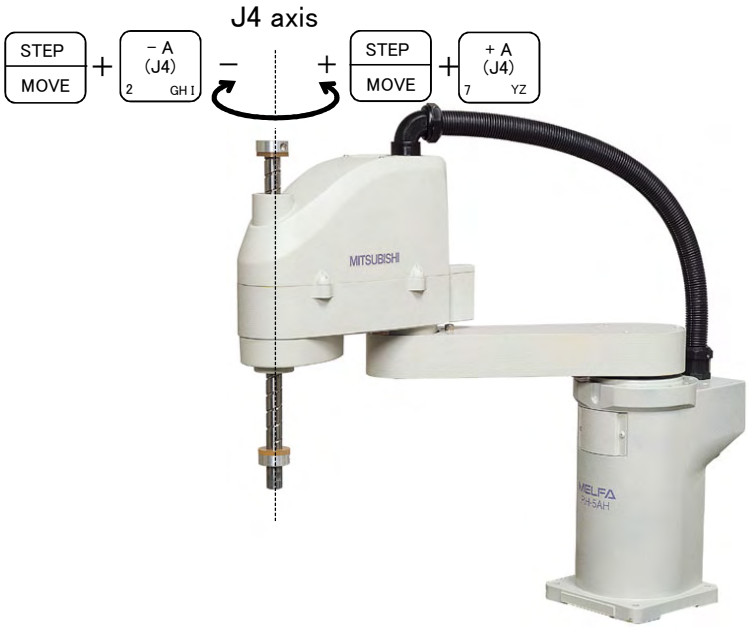
The axes may be outside the movement area. Move these axes toward the inner side of the movement area. If moved outward, an ☒ will appear on the T/B screen, and the robot will not move.

J3 axis jog operation



・When the [MOVE] + [+Z (J3)] keys are pressed, the J3 axis will rotate in the plus direction.
When the [MOVE] + [−Z (J3)] keys are pressed, Rotate in the minus direction.

J4 axis jog operation



・When the [MOVE] + [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
When the [MOVE] + [−A (J4)] keys are pressed, Rotate in the minus direction.

◇◆◇ When an ☒ appears on the T/B screen display ◇◆◇

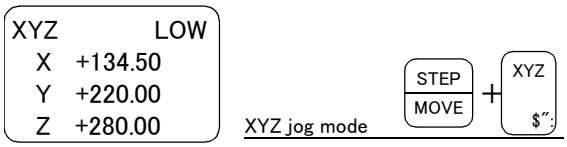
If the robot is moved outside the movement area, an ☒ will appear. In this case, move the axis in the opposite direction.

JOINT	LOW
☒J1	+160.00
J2	+20.00
J3	+80.00

In the example on the left, the J1 axis is at the limit of the plus side movement area.

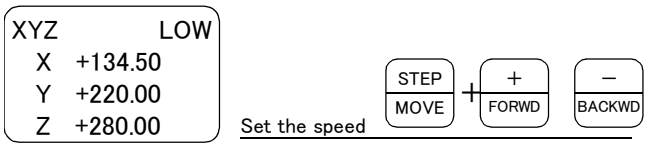
(2) XYZ jog operation

Select the XYZ jog mode



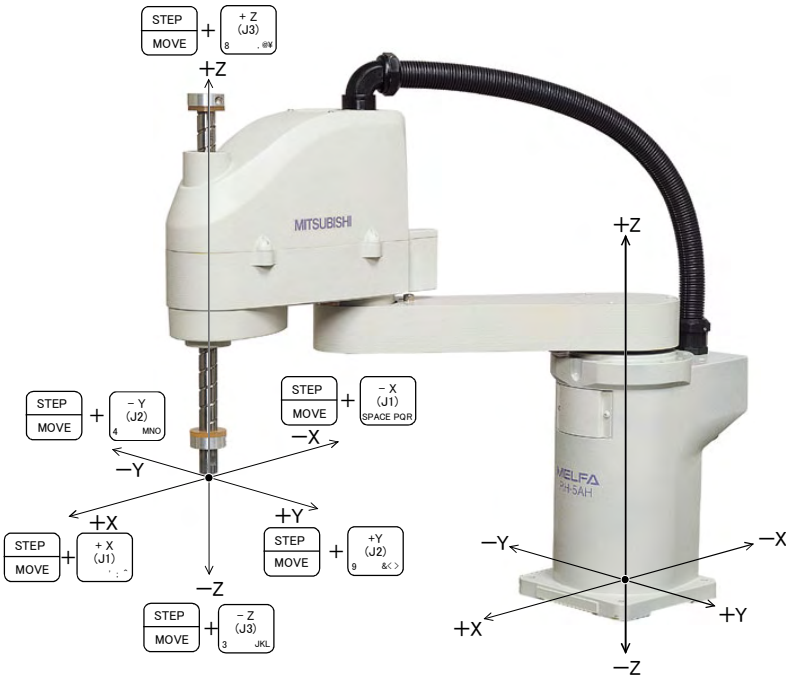
Press the [MOVE] + [XYZ] keys to select the XYZ jog mode. "XYZ" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the base coordinate system



*The direction of the end axis will not change.

・Moving along the X axis
When the [MOVE] + [+X (J 1)] keys are pressed, the robot will move along the X axis plus direction.
When the [MOVE] + [−X (J 1)] keys are pressed, the robot will move along the minus direction.

・Moving along the Y axis
When the [MOVE] + [+Y(J2)] keys are pressed, the robot will move along the Y axis plus direction.
When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move along the minus direction.

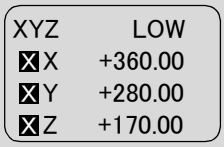
・Moving along the Z axis
When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, an X will appear on the T/B screen, and the robot will not move. Refer to section "(1) JOINT jog operation" on page 24, and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

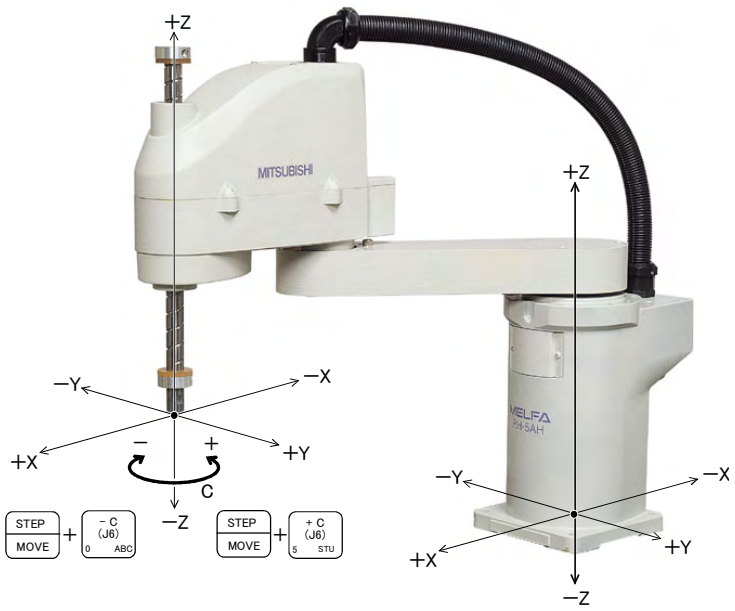
◇◆◇ When an X appears on the T/B screen display ◇◆◇

If the robot is moved outside the movement area with any of the axes, an X will appear. In this case, move the axis in the opposite direction.



In the example on the left, further linear movement in the same direction is not possible.

Changing the direction of the end axis



*The Position of the end axis will not change.

・Rotating around the Z axis
When the [MOVE] + [+C (J4)] keys are pressed, the Z axis will rotate in the plus direction.
When the [MOVE] + [−C (J4)] keys are pressed, the Z axis will rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

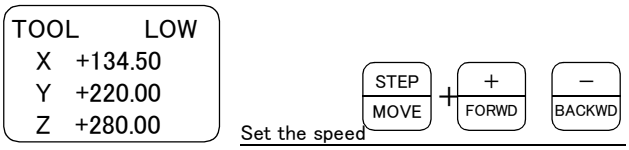
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

Select the TOOL jog mode

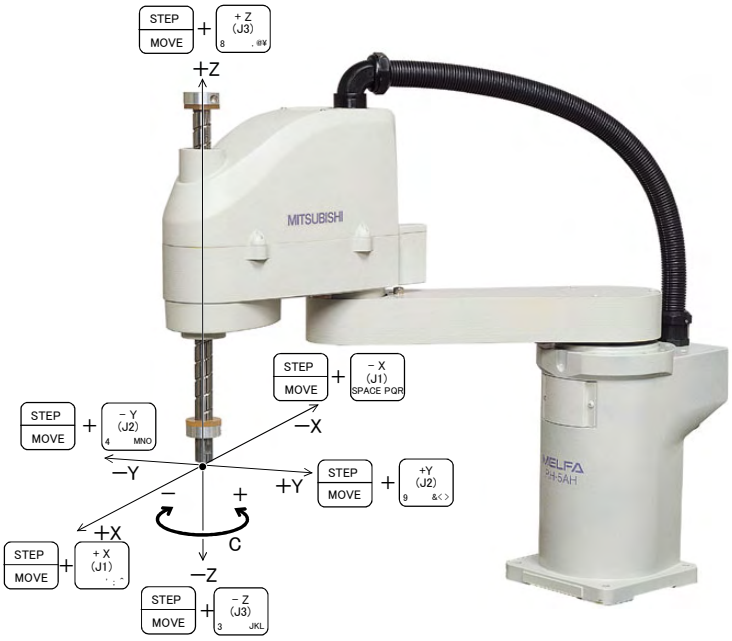
Press the [MOVE] + [TOOL] keys to select the TOOL jog mode. "TOOL" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the tool coordinate system



*The direction of the end axis will not change.

・Moving along the X axis
When the [MOVE] + [+X (J 1)] keys are pressed, the robot will move along the X axis plus direction of the tool coordiate system.
When the [MOVE] + [−X (J 1)] keys are pressed, the robot will move along the minus direction.

・Moving along the Y axis
When the [MOVE] + [+Y(J2)] keys are pressed, the robot will move along the Y axis plus direction of the tool coordnate system.
When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move along the minus direction.

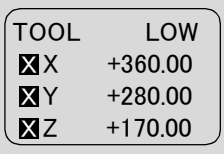
・Moving along the Z axis
When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, an X will appear on the T/B screen, and the robot will not move. Refer to section "(1) JOINT jog operation" on page 24 , and move the robot to a position where linear movement is possible, and then carry out TOOL jog.

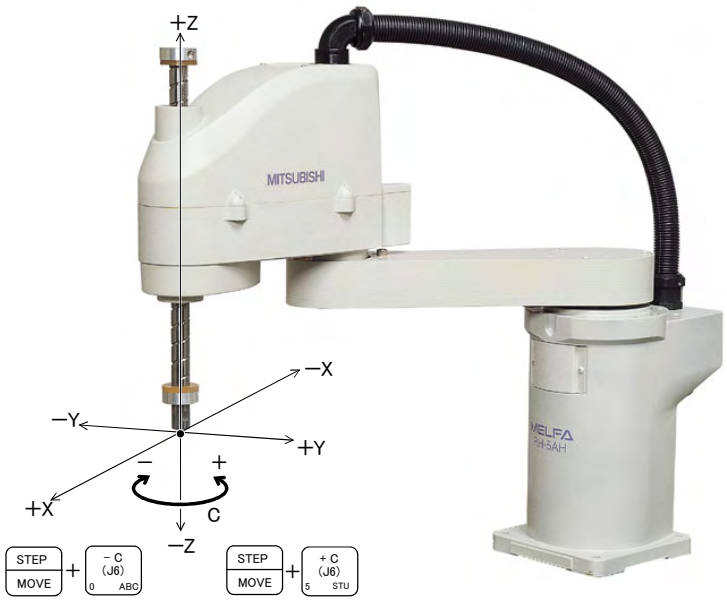
◇◆◇ When an X appears on the T/B screen display ◇◆◇

If the robot is moved outside the movement area with any of the axes, an X will appear. In this case, move the axis in the opposite direction.



In the example on the left, further linear movement in the same direction is not possible.

Rotating the end axis



*The Position of the end axis will not change.

・Rotating around the Z axis
When the [MOVE] + [+C (J4)] keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [−C (J4)] keys are pressed, the Z axis will rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

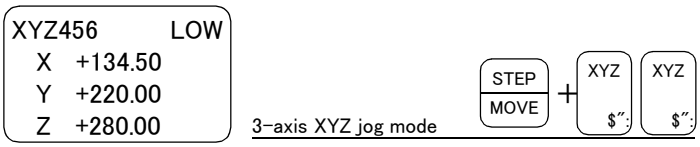
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

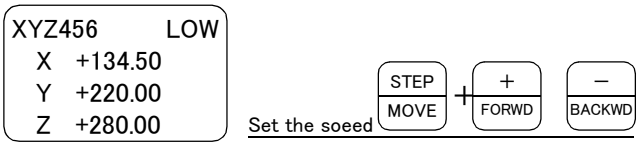
(4) 3-axis XYZ jog operation

Select the 3-axis XYZ jog mode



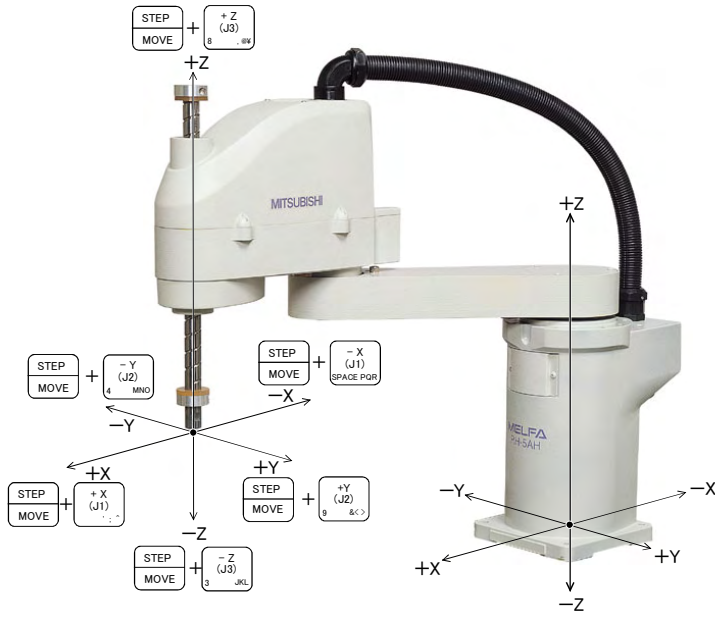
Press the [MOVE] + [XYZ] keys, and then press only the [XYZ] key. "XYZ456" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along the base coordinate system



The direction of the end axis will not change.

・Moving along the X axis
When the [MOVE] + [+X (J 1)] keys are pressed, the robot will move along the X axis plus direction.
When the [MOVE] + [−X (J 1)] keys are pressed, the robot will move along the minus direction.

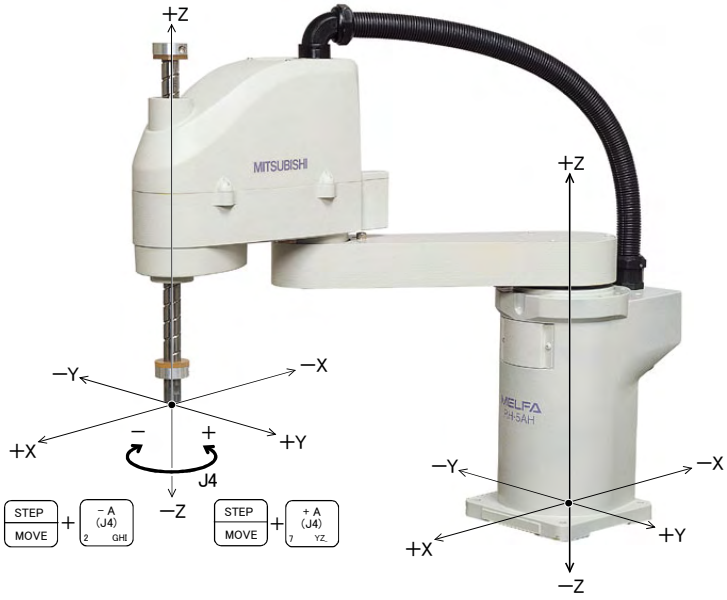
・Moving along the Y axis
When the [MOVE] + [+Y(J2)] keys are pressed, the robot will move along the Y axis plus direction.
When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move along the minus direction.

・Moving along the Z axis
When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.

◇◆◇ The end axis posture cannot be maintained with 3-axis XYZ jog ◇◆◇

With 3-axis XYZ jog, the end axis posture (orientation) is not maintained when moving linearly in the X, Y or Z axis direction. Use XYZ jog to maintain the posture.

Changing the direction of the end axis

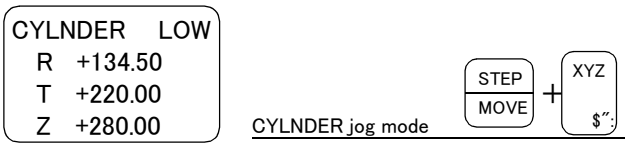


*The Position of the end axis will not change.

・Rotating around the Z axis
When the [MOVE] + [+C (J4)] keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [−C (J4)] keys are pressed, the Z axis will rotate in the minus direction.

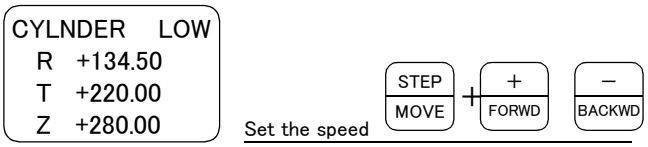
(5) CYLNDER jog operation

Select the cylindrical jog mode



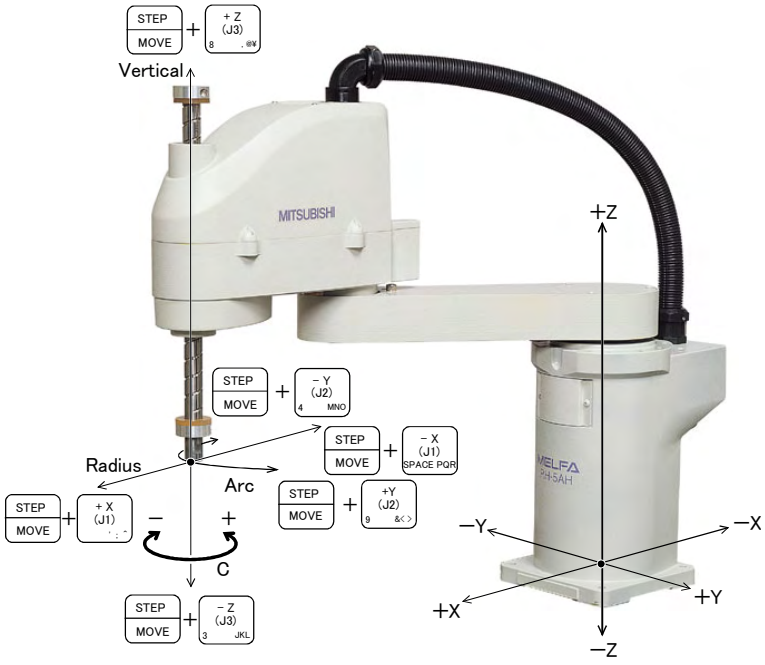
Press the [MOVE] + [XYZ] keys, and then press only the [XYZ] key. "CYLNDER" will appear at the upper left of the screen.

Set the jog speed



Each time the [MOVE] + [+] keys are pressed, the override will increase in the order of LOW → HIGH → 3 → 5 → 10 → 30 → 50 → 70 → 100%. When the [MOVE] + [−] keys are pressed, the override will decrease in the reverse order. The currently set speed will appear on the upper right of the screen. Set the override to 10% here for confirmation work.

Moving along an arc centering on the Z axis



*The direction of the end axis will not change.

・Moving along an arc

Assuming that the current position is on an arc centering on the Z axis, the robot moves along that arc.

When the [MOVE] + [+Y (J2)] keys are pressed, the robot will move along the arc in the plus direction.

When the [MOVE] + [−Y (J2)] keys are pressed, the robot will move in the minus direction.

・Moving in the radial direction

Assuming that the current position is on an arc centering on the Z axis, the robot will expand and contract in the radial direction

When the [MOVE] + [+X (J 1)] keys are pressed, the robot will expand in the radial direction

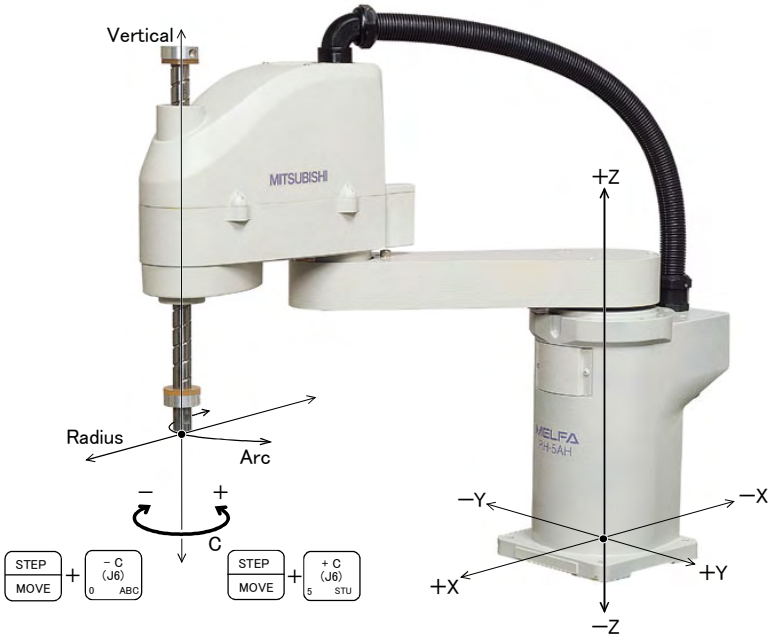
When the [MOVE] + [+X (J 1)] keys are pressed, the robot will contract in the radial direction

・Moving along the Z axis

When the [MOVE] + [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.

When the [MOVE] + [−Z (J3)] keys are pressed, the robot will move along the minus direction.

Changing the direction of the end axis

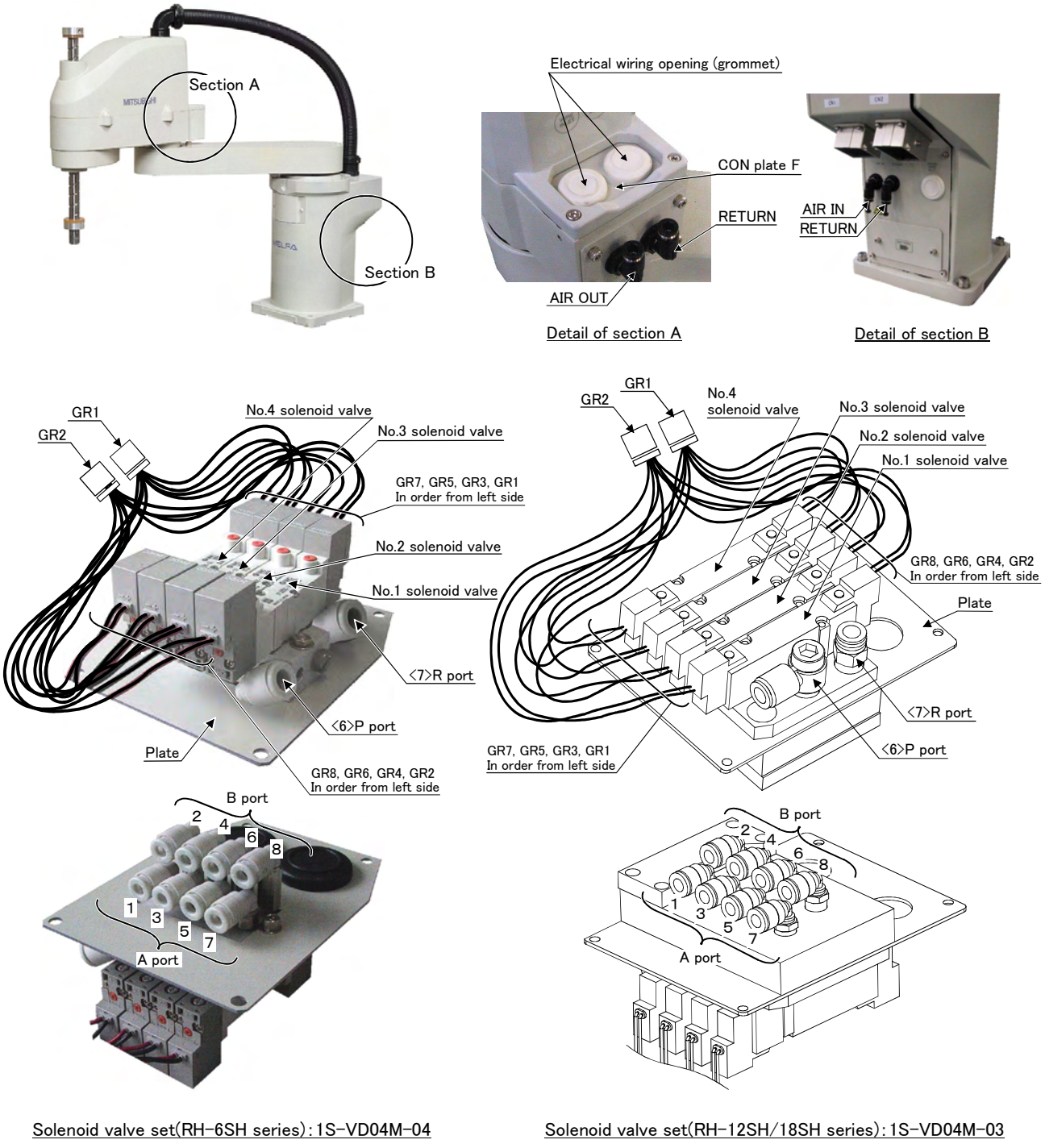


*The Position of the end axis will not change.

・Rotating around the Z axis
When the [MOVE] + [+C (J4)] keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [–C (J4)] keys are pressed, the Z axis will rotate in the minus direction.

3 Installing the option devices

3.1 Installing the solenoid valve set

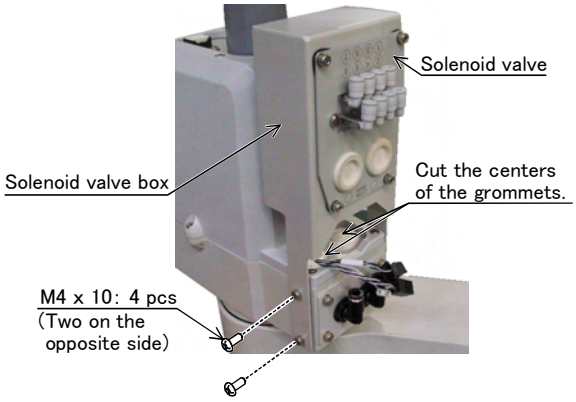


Solenoid valve set(RH-6SH series):1S-VD04M-04

Solenoid valve set(RH-12SH/18SH series):1S-VD04M-03

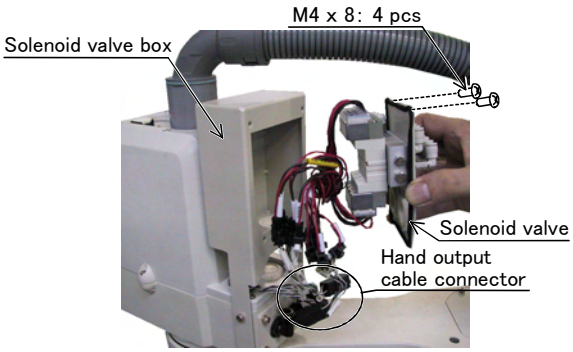
Fig.3-1 : Solenoid valve installation procedures

Fig. 3-1 shows the solenoid valve installation procedures and the solenoid valve connector connection procedures. The installation procedures are as follow. This work must be carried out with the controller power turned OFF. If the hand input cables (1S-HC35C-02) or the hand output cables (1S-GR35S-02) are used, be sure to install them in advance.
(Refer to "3.2 Installing the hand input cable" on page 37 and "3.3 Installing the hand output cable" on page 38 .)
Please note that neither the hand input cables nor the hand output cables can be installed once the solenoid valve set is installed.



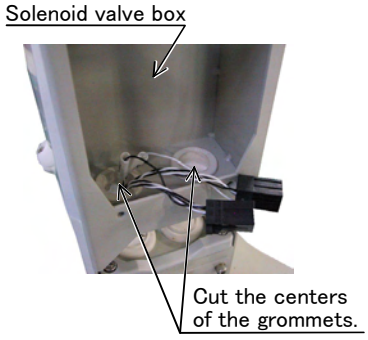
1) Using a cutter knife, cut the centers of the grommets that come with the robot arm. Install the grommets through the connectors coming out of the rear of the No. 2 arm.

2) Using the screw holes on the rear of the No. 2 arm, firmly install the solenoid valve box with the mounting screws (M4 x 10: 4 pcs) that come with the product. Be sure to securely tighten the screws so that they do not interfere with the robot arm.



3) Loosen the mounting screws (M4 x 8: 4 pcs) of the solenoid valve from the solenoid valve box, and remove the solenoid valve.

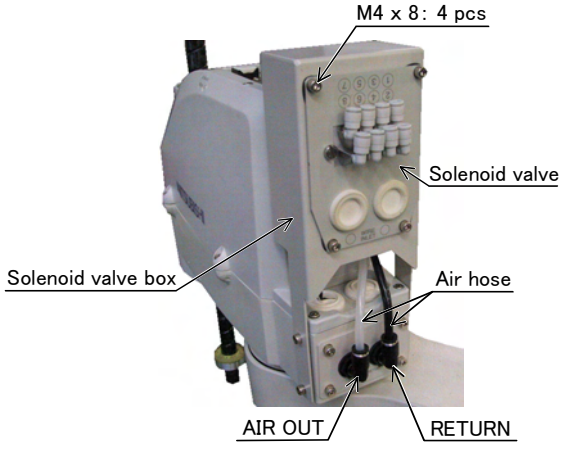
4) Using a cutter knife, cut the centers of the grommets located on the bottom of the solenoid valve box. Feed the connectors (GR1 and GR2) coming out of the rear of the No. 2 arm through the grommets, and connect them with the hand output cable connectors (GR1 and GR2) coming out of the solenoid valve.



5) Pull out the air hose (ϕ6, provided by the customer) coming out of the port P of the solenoid valve from a grommet located on the bottom of the solenoid valve box. If air ventilation is required to satisfy the clean specification, connect an air hose (ϕ6, provided by the customer) to the port R of the solenoid valve, and pull it out from a grommet in the same manner.

6) Install the solenoid valve back in the original position, and securely tighten it with its screws. Be careful not to pinch cables while in this installation operation. Also, be sure that no gap is created between the solenoid valve box and the solenoid valve by the sponge sealant applied onto the solenoid valve. If there is a gap, the protection specification may degrade.

* In the case of the oil mist or clean specification, fill the surrounding areas of the grommets as well as the outlets of the cables and air hoses with silicon rubber.



7) Connect the air hose (port P) pulled out of the solenoid valve box to the coupling (AIR OUT) on the robot arm side. Also, if the port R of the solenoid valve is used, connect that air hose to the coupling (RETURN) on the robot arm side. In this case, remove the dustproof cap attached to the RETURN air coupling (ϕ6) in the rear of the robot's base section. If the robot is operated with this cap on, the exhaust air pressure increases and the solenoid valve may not function normally. Additionally, the exhaust air from the solenoid value can be relieved to the designated location by connecting an exhaust hose to the RETURN air coupling (ϕ6, provided by the customer).

8) Connect the air hose on the primary air-supply side (ϕ6, provided by the customer) to AIR IN of the rear section of robot arm's base unit.

The connection correspondence after installation is as shown in Table 3-1.

Table 3-1 : Solenoid valve ports and hoses: Correspondence of couplings and hand ports

Hand	Hand port	Solenoid valve port	Solenoid valve used
Hand 1	OPEN	1	1 st row
	CLOSE	2	
Hand 2	OPEN	3	2 nd row
	CLOSE	4	
Hand 3	OPEN	5	3 rd row
	CLOSE	6	
Hand 4	OPEN	7	4 th row
	CLOSE	8	

3.2 Installing the hand input cable

The procedure for installing the hand input cable is as follows. Conduct work by referring to Page 34 "Fig. 3-1: Solenoid valve installation procedures" and Page 37 "Fig. 3-2: Installing the hand input cable" below.
This work must be carried out with the controller power turned OFF.

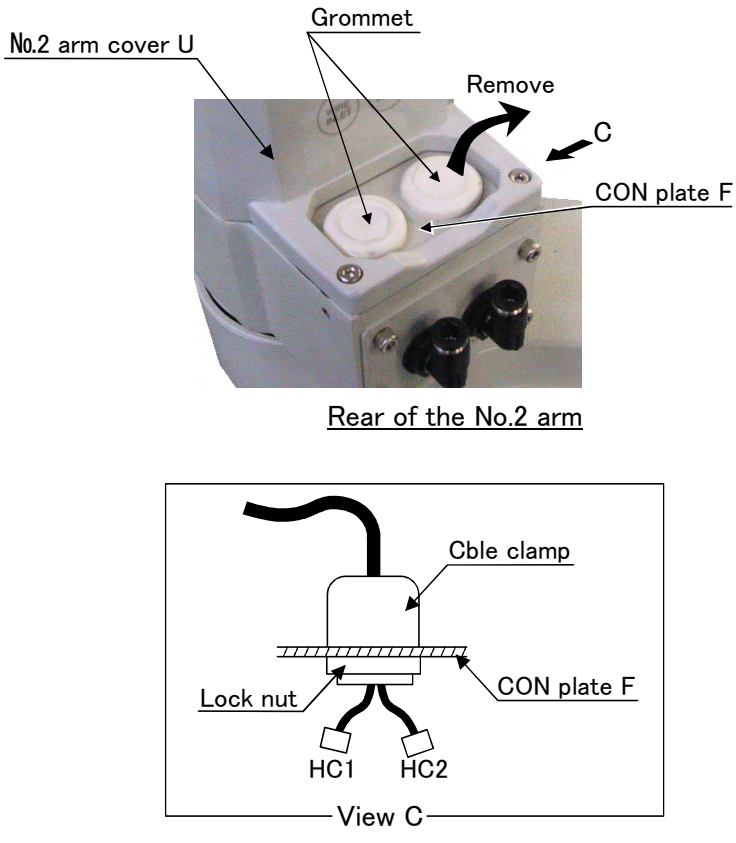
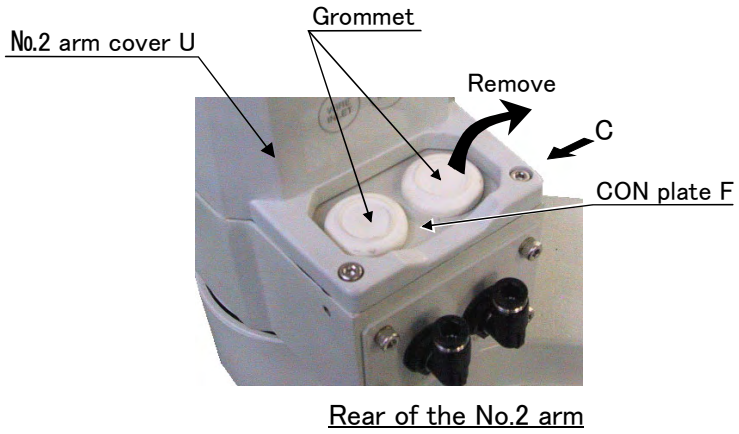


Fig.3-2 : Installing the hand input cable

1) Remove the hexagon socket bolts (ten M4 x 10: 10 pcs (RH-6SH series), M4 x 10: 11 pcs (RH-12SH/18SH series)) that hold the No. 2 arm cover U, and then remove both the No. 2 arm cover U.
2) Remove the bolts (M4 x 10: 2 pcs) fastening the CON plate F at the rear of the No. 2 arm, and remove the CON plate F.
3) Remove one of the two grommets of the CON plate F. After removing the grommet, peal off the sealant left on the hole section on of the CON plate F.
4) After removing the lock nut attached to the hand input cable, feed the connector side of the hand input cable (with a cable clamp) through the hole on the CON plate F. Replace the removed lock nut in position and fasten it securely.
5) Connect the connectors of "HC1" and "HC2" stored in section A shown in Fig. 3-1 to "HC1" and "HC2" of the hand input cable.
6) Install the CON plate F to the rear of the No. 2 arm., and be careful not to entangle the cables when you do so.
7) When you have completed the installation, reinstall the No.2 arm cover U to its original position. When installing, be careful not to damage the sponge sealant applied.

3.3 Installing the hand output cable

The procedure for installing the hand output cable is as follows. Conduct work by referring to Page 34 "Fig. 3-1: Solenoid valve installation procedures" and Page 38 "Fig. 3-3: Installing the hand output cable" below.
This work must be carried out with the controller power turned OFF.



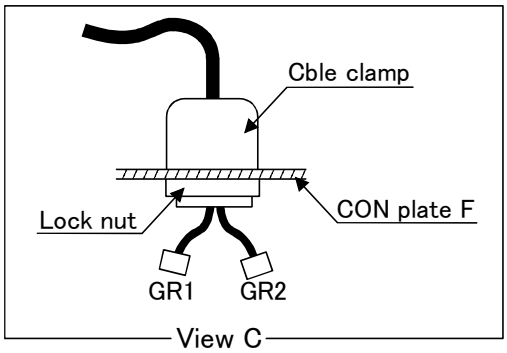


Fig.3-3 : Installing the hand output cable

1) Remove the hexagon socket bolts (ten M4 x 10: 10 pcs (RH-6SH series), M4 x 10: 11 pcs (RH-12SH/18SH series)) that hold the No. 2 arm cover U, and then remove both the No. 2 arm cover U.
2) Remove the bolts (M4 x 10: 2 pcs) fastening the CON plate F at the rear of the No. 2 arm, and remove the CON plate F.
3) Remove one of the two grommets of the CON plate F. After removing the grommet, peal off the sealant left on the hole section on of the CON plate F.
4) After removing the lock nut attached to the hand output cable, feed the connector side of the hand output cable (with a cable clamp) through the hole on theCON plate F. Replace the removed lock nut in position and fasten it securely.
5) Connect the connectors of "GR1" and "GR2" stored in section A shown in Fig. 3-1 to "GR1" and "GR2" of the hand output cable.
6) Install the CON plate F to the rear of the No. 2 arm., and be careful not to entangle the cables when you do so.
7) When you have completed the installation, reinstall the No.2 arm cover U to its original position. When installing, be careful not to damage the sponge sealant applied.

3.4 Installing the pneumatic hand interface

Refer to the separate "Instruction Manual/Controller setup, basic operation, and maintenance", and install the pneumatic hand interface on the controller.

The pneumatic hand interface is mounted on the RZ-326 or RZ-327 card in the controller.

4 Basic operations

The basic operations from creating the program to automatic operation are explained in section ″4. Basic operations″ in the ″From Controller Setup to Maintenance″ manual. Refer that manual as necessary.

5 Maintenance and Inspection

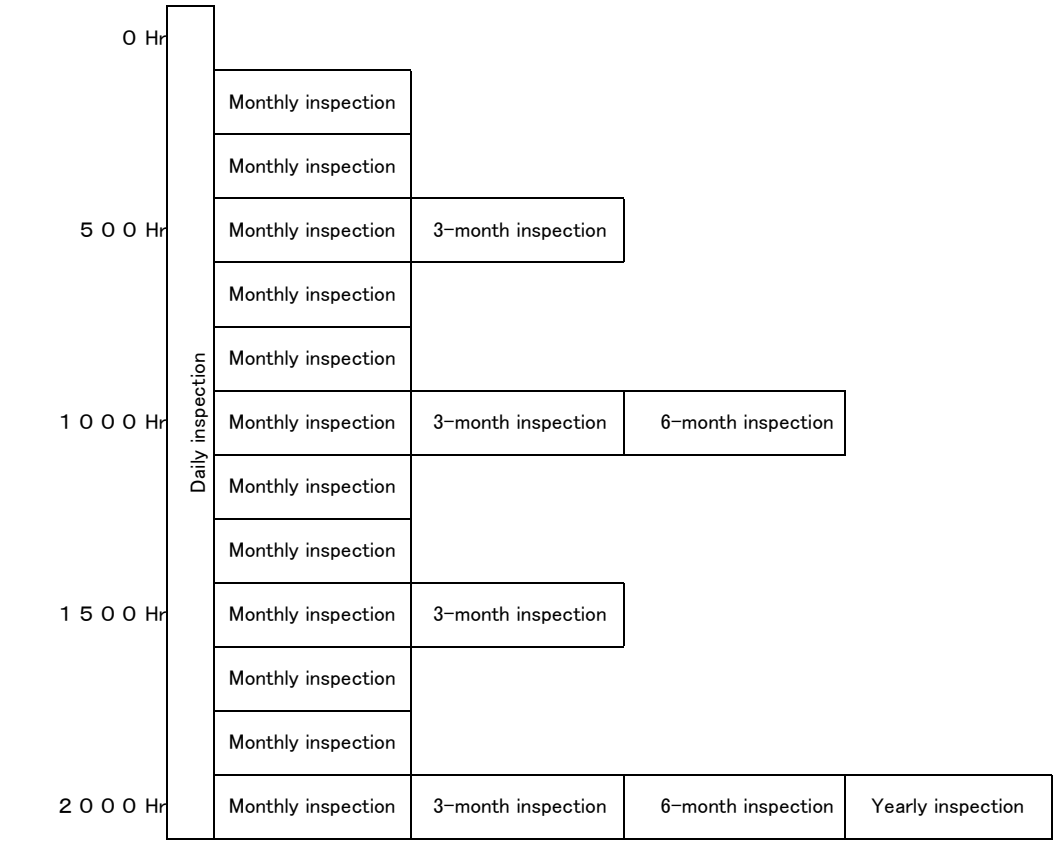
The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

5.1 Maintenance and inspection interval

Maintenance and inspection are divided into the inspections carried out daily, and the periodic inspections carry out at set intervals. Always carry these out to prevent unforeseen trouble, to maintain the product for a long time, and to secure safety.

(1) Inspection schedule

In addition to the monthly inspection, add the following inspection items every three months (estimated at 500 Hr operation hours).



<Guideline for inspection period>

For one shift

8 Hr/day × 20 days/month × 3 months = approx. 500 Hr

10 Hr/day × 20 days/month × 3 months = approx. 600 Hr

For two shifts

15 Hr/day × 20 days/month × 3 months = approx. 1000 Hr

[Caution] When using two lines, the 3-month inspection, 6-month inspection and yearly inspection must be carried out when half the time has passed.

Fig.5-1 : Inspection schedule

5.2 Inspection items

The inspection items for the robot arm are shown below.
Also refer to section "5. Maintenance and inspection" in the "Controller setup, basic operation, and maintenance" manual, and inspect the controller.

5.2.1 Daily inspection items

Carry out the daily inspections with the procedures given in Table 5-1.

Table 5-1 : Daily inspection items (details)

Procedure	Inspection item (details)	Remedies
Before turning power ON (Check the following items before turning the power ON.)		
1	Are any of the robot installation bolts loose? (Visual)	Securely tighten the bolts.
2	Are any of the cover tightening screws loose? (Visual)	Securely tighten the screws.
3	Are any of the hand installation bolts loose? (Visual)	Securely tighten the bolts
4	Is the power supply cable securely connected? (Visual)	Securely connect.
5	Is the machine cable between the robot arm and controller securely connected? (Visual)	Securely connect.
6	Are there any cracks, foreign contamination or obstacles on the robot and controller cover?	Replace with a new part, or take remedial measures.
7	Is any grease leaking from the robot arm? (Visual)	After cleaning, replenish the grease.
8	Is there any abnormality in the pneumatic system? Are there any air leaks, drain clogging or hose damage? Is the air source normal? (Visual)	Drain the drainage, and remedy the air leaks (replace the part).
9	Are there any cracks or foreign particles on the bellows? (only for clean and oil mist specification) (Visual)	Replace with a new bellows.
After turning the power ON (Turn the power ON while monitoring the robot.)		
1	Is there any abnormal motion or abnormal noise when the power is turned ON?	Follow the troubleshooting section.
During operation (try running with an original program)		
1	Check whether the movement points are deviated? Check the following points if there is any deviation. 1. Are any installation bolts loose? 2. Are any hand installation section bolts loose? 3. Are the positions of the jigs other than the robot deviated? 4. If the positional deviation cannot be corrected, refer to "Troubleshooting", check and remedy.	Follow the troubleshooting section.
2	Is there any abnormal motion or abnormal noise? (Visual)	Follow the troubleshooting section.

5.2.2 Periodic inspection

Carry out periodic inspection with the procedures given in Table 5-2.

Table 5-2 : Periodic inspection items (details)

Procedure	Inspection item (details)	Remedies
Monthly (160 hr) inspection items		
1	Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.
2	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
3	Remove the cover at each section, and check the cables for wear damage and adherence of foreign matter.	Check and eliminate the cause. If the cables are severely damaged, contact the Mitsubishi Service Department.
3-month (500 hr) inspection items		
1	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.
2	It runs out of grease on the shaft.	Wipe the old grease off, and lubricate.
6-month (1,000 hr) inspection items		
1	Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.
Yearly (2,000 hr) inspection items		
1	Replace the backup battery in the robot arm.	Exchange it referring to Page 56, "5.3.6 Replacing the backup battery"
3-year (6,000 hr) inspection items		
1	Lubricate the grease at the harmonic reduction gears for J1 and J2 axis.	Lublicate it referring to Page 54, "5.3.5 Lubrication".
2	Replace the bellows (J3 axis) (only for clean and oil mist specification)	Exchange it referring to Page 56, "5.3.6 Replacing the backup battery"

5.3 Maintenance and inspection procedures

The procedures for carrying out the periodic maintenance and inspection are described in this section. Thoroughly read the contents, and follow the instructions. This work can be commissioned to the Mitsubishi Service Department for a fee. (Never disassemble, etc., the parts not described in this manual.)

The maintenance parts, etc., required for the user to carry out maintenance and inspection are described in Page 57, "5.4 Maintenance parts" of this manual. Always contact your dealer when parts are needed.

⚠CAUTION The origin of the machine system could deviate when this work is carried out. "Review of the position data" and "re-teaching" will be required.

5.3.1 Robot arm structure

An outline structure drawing is shown in Fig. 5-2. Each part is as shown below.

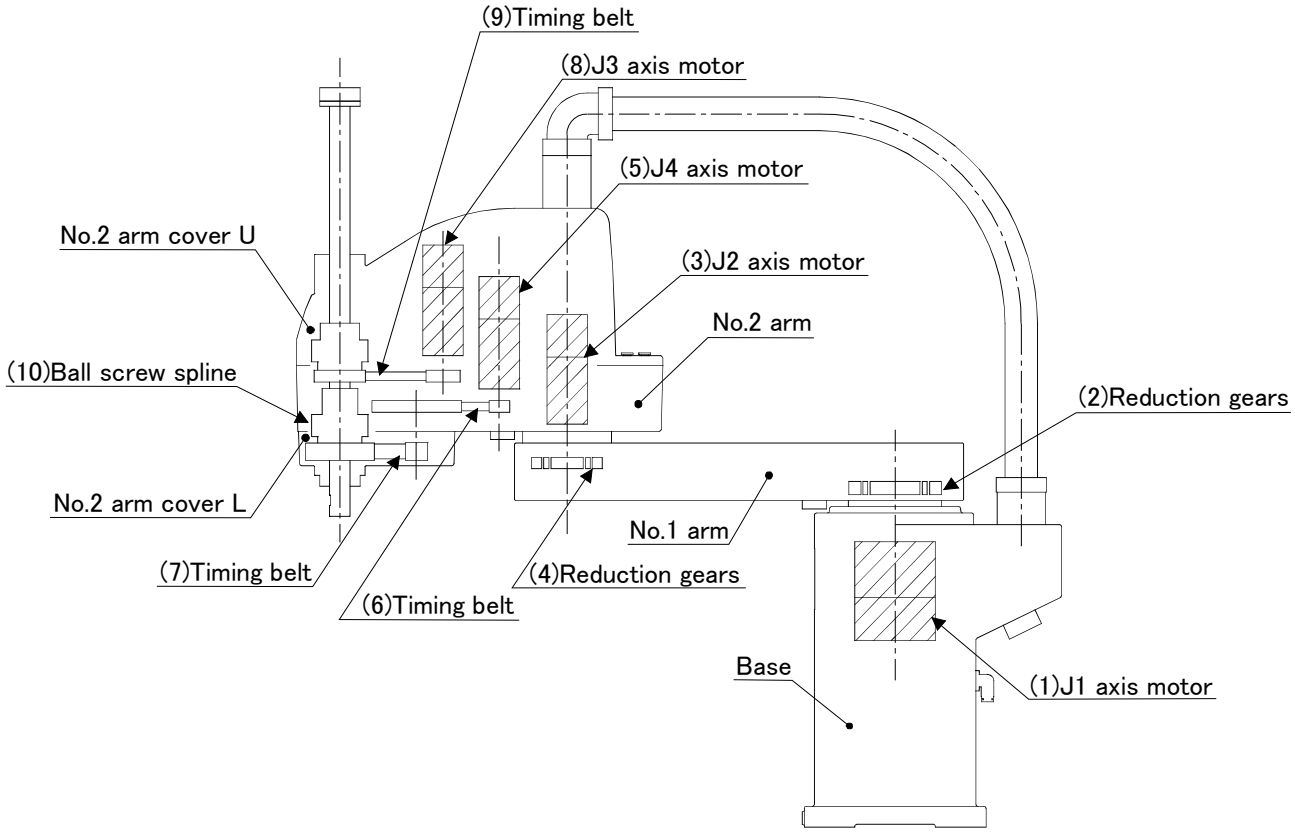


Fig.5-2 : Outline structure drawing of robot arm

5.3.2 Installing/removing the cover

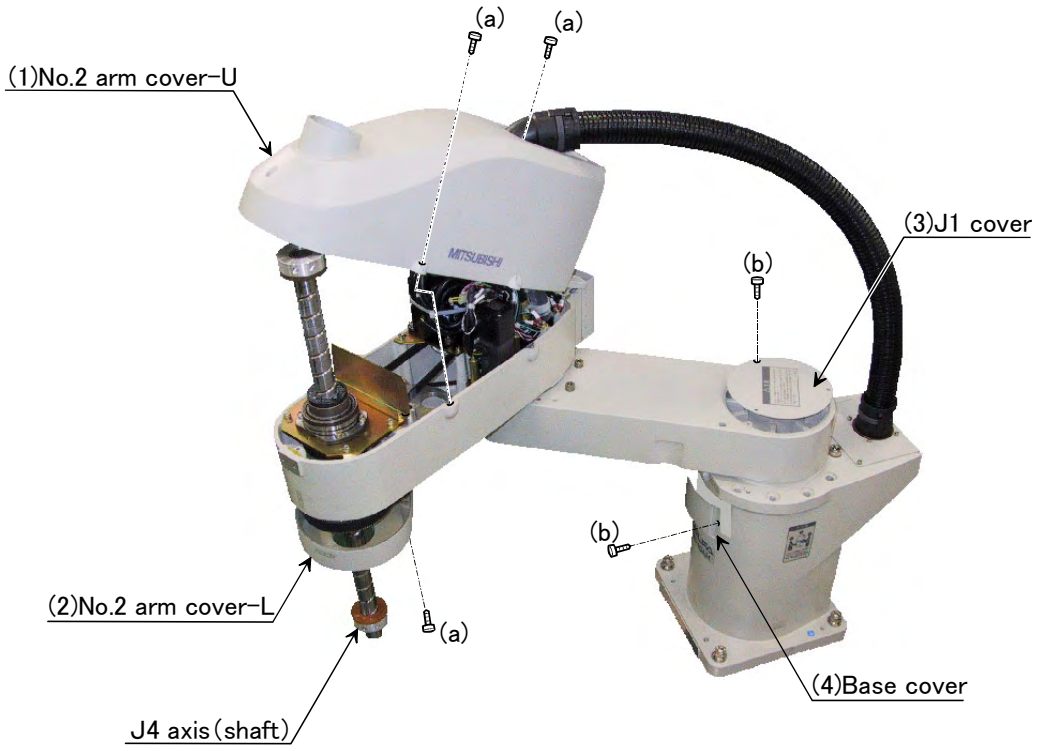


Fig.5-3 : Installing/removing the cover

Table 5-3 : Cover names

No.	Cover name	Q'ty	Installation bolt name	Remarks
(1)	No.2 arm cover-U	1	Hexagon socket bolts, 10-M4 x 10 (RH-6SH series)	
			Hexagon socket bolts, 11-M4 x 10 (RH-12SH/18SH series)	
(2)	No.2 arm cover-L	1	Hexagon socket bolts, 3-M4 x 10	
(3)	J1 cover	1	Hexagon socket bolts, 3-M4 x 10	
(4)	Base cover	1	Hexagon socket bolts, 2-M4 x 10	

(1) Referring to Fig. 5-3, remove the covers.
(2) Table 5-3 lists the names of the covers and installation screws.
(3) Lower the J4 axis (shaft) using jog operations before removing the No.2 arm cover-U.
(4) When reattaching the covers after a maintenance inspection, proceed in the reverse order of their removal.

[Note] Sealant is applied to the cover joint surface of the oil mist specification and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape. (Use liquid gasket and packing in Page 57, "Table 5-6 : Spare parts list".)
Moreover, in the case of oil mist specification and clean specification models, it is necessary to remove the top and bottom bellows. Refer to Page 52, "5.3.4 Replacing Bellows" for details on how to remove them.

5.3.3 Inspection, maintenance and replacement of timing belt

This robot uses a timing belt for the drive conveyance system of the pitch axis. Compared to gears and chains, the timing belt does not require lubrication and has a low noise. However, if the belt usage method and tension adjustment are inadequate, the life could drop and noise could be generated. Sufficient aging to remove the initial elongation of the belt, and adjustment of the belt tension have been carried out before shipment from the factory. However, depending on the robot working conditions, elongation will occur gradually over a long time. The tension must be confirmed during the periodic inspection. The timing belt must be replaced in the following cases.

(1) Timing belt replacement period

The timing belt life is greatly affected by the robot working conditions, so a set time cannot be given. However, if the following symptoms occur, replace the belt.

1) When cracks from at the base or back of the belt teeth.
2) When the belt expands due to adherence of oil, etc.
3) When the belt teeth wear (to approx. half of the tooth width).
4) When the belt teeth jump due to belt teeth wear.
5) When the belt snaps.

⚠ CAUTION Due to the manufacturing of the timing belt, initial wear will occur. Wear chips may accumulate in the cover after approx. 300 Hr of operating the robot, but this is not a fault. If the wear chips appear soon after wiping them off, replace the belt.

⚠ CAUTION When the belt is replaced, the machine system origin may deviate. In this case, the position data must be reviewed.

(2) Inspection, maintenance and replacement of J3-axis timing belt

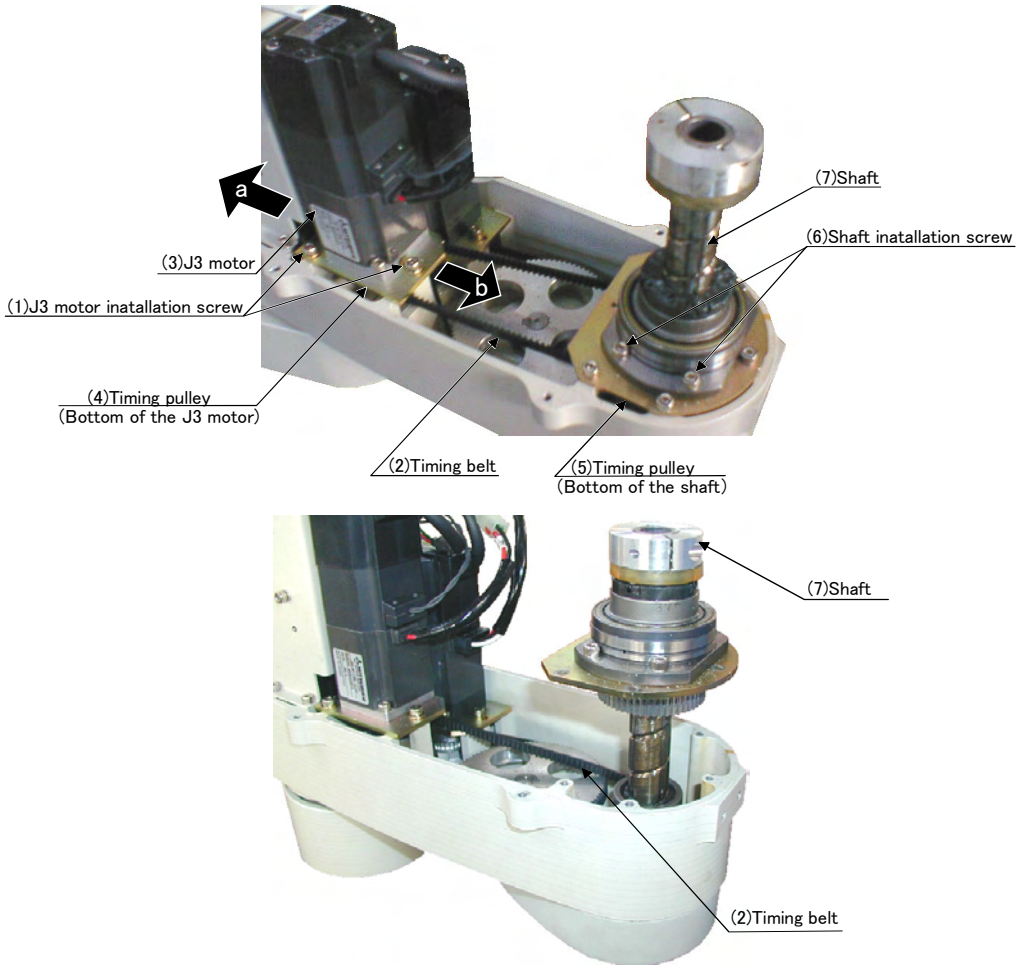


Fig.5-4 : Inspection, maintenance and replacement of J3-axis timing belt

■ Inspecting the J3 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Fig. 5-3, and remove the No.2 arm cover-U.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Check the belt tension as shown in Page 51, "(4) Timing belt tension". Lightly press the center of the belt, and confirm that the value of belt slack is in following.
   RH-6SH series..... Force to press the belt: apprpx. 2N /Flexure: approx. 2.5mm
   RH-12SH/18SH series..... Force to press the belt: apprpx. 4N / Flexure: approx. 3.7mm

■ Adjusting the J3 axis timing belt

1) Carry out steps 1) and 2) indicated in " ■ Inspecting the J3 axis timing belt" above.
2) Lightly loosen J3 motor installation screws (1) (Be careful not to overly loosen the screws.).
3) While checking the tension of the timing belt (2), move the J3 motor (3) in the directions of the arrows indicated in the figure above. Lightly press the center of the belt, and confirm that the value of belt slack is in following.
   RH-6SH series..... Force to press the belt : approx. 2N / Flexure: 2.5mm
   RH-12SH/18SH series..... Force to press the belt: approx. 4N / Flexure: 3.7mm
4) The belt tension will increase when moved in the direction of arrow a, and will decrease when moved in the direction of arrow b.
5) If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys (4) and (5), or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
6) After adjusting, securely tighten the J3 motor installation screws (1). Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J3 axis timing belt

1) Fig. 5-4 shows the methods for inspecting, adjusting and replacing the timing belt.
2) Move the robot posture with the teaching pendant so that the J3 axis contacts the mechanical stopper of upside. The J3 axis brakes must be released.
3) Turn off the controller power.
4) Be careful not to let the timing pulley (4) on the J3 axis motor move while the belt is being changed.
5) If the pulley (4) and (5) position relation deviates, the position could deviate.
6) Loosen the J3 motor installation screws (1) to lift the J3 motor (3) upward and remove the timing belt (2) from the timing pulley (4).
7) Loosen the shaft installation screws (6) to lift the shaft upward and remove the timing belt (2) by lifting it from the bottom spline section. (Refer to Fig. 5-4.)
8) Install a new timing belt on the timing pulleys (4) and (5) in the reverse order of the procedure described in steps 6) and 7) above.
9) With the J3 axis touching the upper mechanical stopper, hook the timing belt (2) around the timing pulleys (4) and (5).
10) Perform tension adjustment referring to steps 3) to 6) in "■ Adjusting the J3 axis timing belt" and Page 51, "(4) Timing belt tension".
For more accurate tension adjustment, pull out the idler (4) with a force of 135N for RH-5AH or 115N for RH-10AH/15AH using the push-pull gauge, and then tighten the idler installation screws (3) as shown in Fig. 5-7. The use of the method as shown in Fig. 5-8 is recommended. Push the J4 axis motor (2) with a force of 65N for RH-5AH or 45N for RH-10AH/15AH using the push-pull gauge, and tighten the J4 axis motor installation screws (1).
11) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 58, "5.5 Resetting the origin", and reset the origin position.

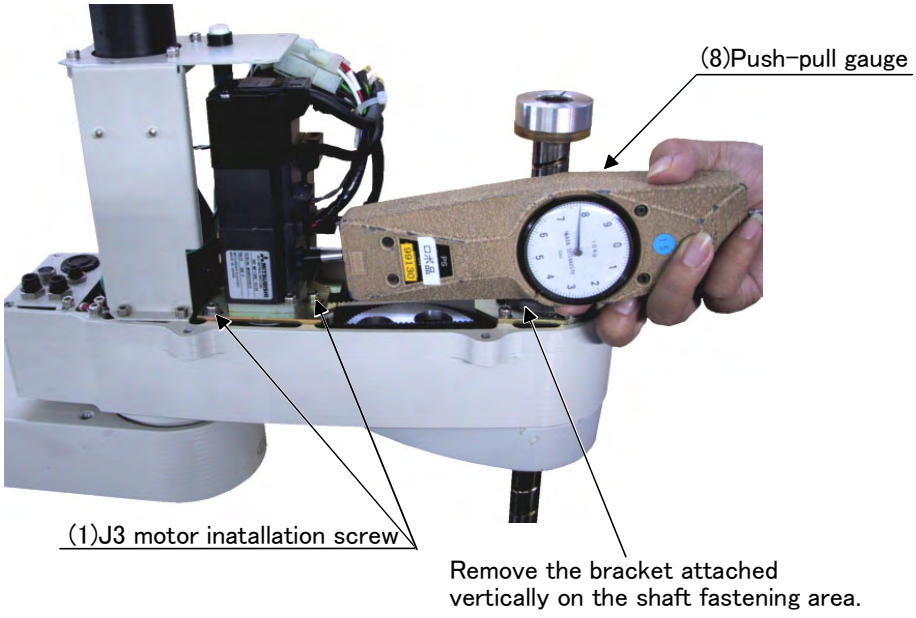


Fig.5-5 : J3 axis timing belt tension

(3) Inspection, maintenance and replacement of J4-axis timing belt

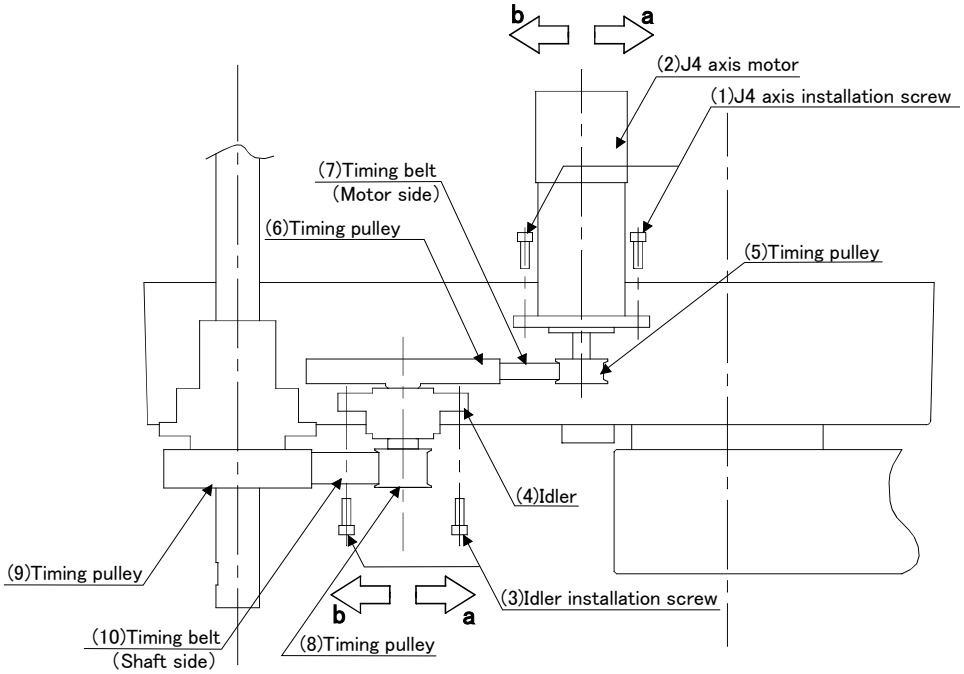


Fig.5-6 : Inspection, maintenance and replacement of J4-axis timing belt

■ Inspecting the J4 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Fig. 5-3, and remove the No.2 arm cover-U and No.2 arm cover-L.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt. (At two locations, one at the first row and another at the second row)
4) Check the belt tension as shown in Page 51, "(4) Timing belt tension". Lightly press the center of the belt, and confirm that the value of belt slack is in following.
   RH-6SH series
   (Motor side) Force to press the belt: apprpx. 2N / Flexure: 1.2mm.
   (Shaft side) Force to press the belt: apprpx. 4N / Flexure: 1.2mm.
   RH-12SH/18SH series
   (Motor side) Force to press the belt: approx. 2N / Flexure: 2.1mm.
   (Shaft side) Force to press the belt: approx. 5N /Flexure: 1.7mm.

■ Adjusting the J4 axis timing belt

1) Carry out steps 1) and 2) indicated in " ■ Inspecting the J4 axis timing belt" above.
2) Slightly loosen the two J4 motor installation screws (1) and the three idler installation screws (3). (Be careful not to overly loosen the screws.)
3) While checking the tension of the timing belt (10), move the idler (4) in the directions of the arrows indicated in the figure above. Lightly press the center of the belt, and confirm that the value of belt slack is in following.
   RH-6SH series..... Force to press the belt : approx. 4N / Flexure: 1.2mm
   RH-12SH/18SH series..... Force to press the belt: approx. 5N / Flexure: 1.7mm
4) While checking the tension of the timing belt (7), move the J4 motor (2) in the directions of the arrows indicated in the figure above. Lightly press the center of the belt, and confirm that the value of belt slack is in following.
   RH-6SH series..... Force to press the belt : approx. 2N / Flexure: 1.2mm
   RH-12SH/18SH series..... Force to press the belt: approx. 2N / Flexure: 2.1mm
5) The belt tension will increase when moved in the direction of arrow a, and will decrease when moved in the direction of arrow b.
6) If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys (5), (6), (8) and (9), or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
7) After adjusting, securely tighten the idler installation screws (3) and J4 motor installation screws (1). Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J4 axis timing belt

1) Fig. 5-6 shows the methods for inspecting, adjusting and replacing the timing belt.
2) Turn off the controller power.
3) To reduce dislocation, try to keep the relative positions of the timing pulleys (5), (6), (8) and (9) as much as possible.
4) Loosen the three idler installation screws (3) and the two J4 axis motor installation screws (1) to remove the timing belts (7) and (10). If the hand prevents the belts from being removed, remove the hand when changing the belts.
5) Perform tension adjustment according to steps 3) to 6) in ″ ■ Adjusting the J4 axis timing belt″ and Page 51, ″(4) Timing belt tension″. For more accurate tension adjustment, tighten the idler (4) with the idler installation screws (3) as shown in Fig. 5-7, while pulling the RH-6SH series with a force of 135 N and the RH-12SH/18SH series with a force of 115 N using a push-pull gauge. As shown in Fig. 5-8, it is recommended to tighten the J4 axis motor installation screws (1) while pushing the J4 axis motor (2) with a force of 65 N for the RH-6SH series and 45 N for the RH-12SH/18SH series using a push-pull gauge.
6) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 58, ″5.5 Resetting the origin″, and reset the origin position.

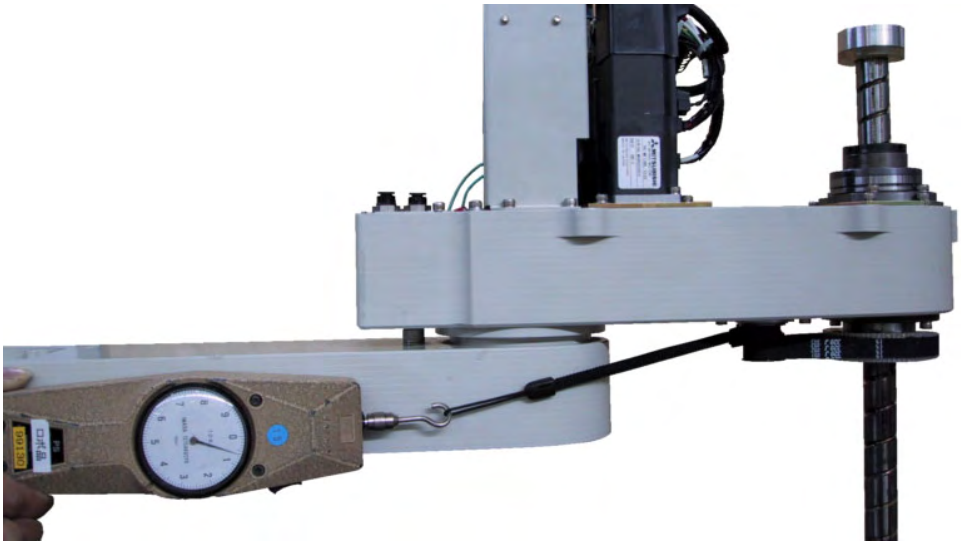


Fig.5-7 : J4 axis timing belt tension (1)

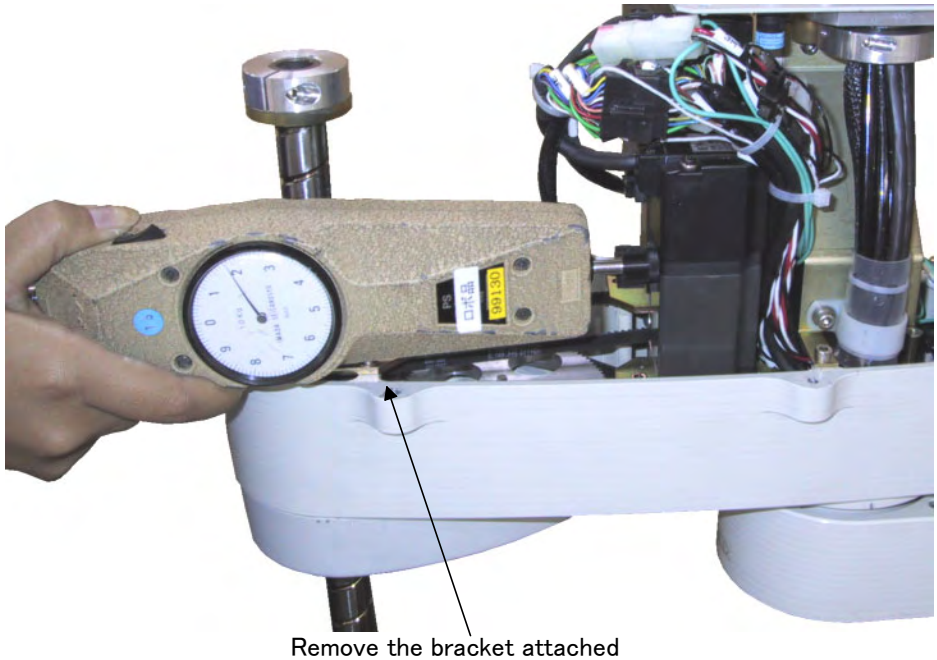
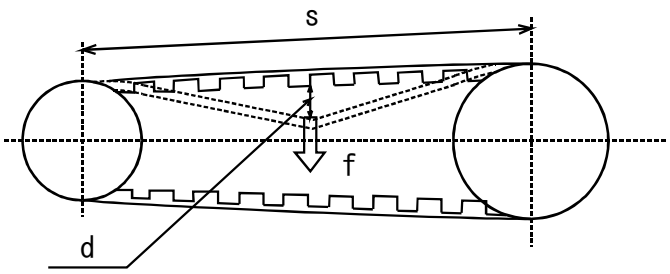


Fig.5-8 : J4 axis timing belt tension (2)

(4) Timing belt tension



f : Pressing force
s : Span
d : Slack

Axis	Belt type	Span : s (mm)	Slack : d (mm)	Pressing force : f (N)	Remarks
RH-6SH series					
J3	453-3GT-6	159	2.5	2	J3
J4(Motor side)	357-3GT-6	79	1.2	2	J4(Motor side)
J4(Shaft side)	303-3GT-12	75	1.2	4	J4(Shaft side)
RH-12SH series					
J3	666-3GT-12	239	3.7	4	RH-12SH series
	681-3GT-12	238	3.7	4	RH-18SH series
J4(Motor side)	540-3GT-6	134	2.1	2	
J4(Shaft side)	471-3GT-15	107	1.7	5	

Fig.5-9 : Belt tension

The timing belt can satisfactorily convey the drive and keep a durable force only when it has an adequate tension. The belt tension should not be too tight or too lose. Instead, it should be adjusted to a degree that elasticity is felt when the belt is pressed with the thumb. If the belt tension is too weak, the belt loosening side will vibrate. On the other hand, if the belt tension is too strong, a sharp sound will be heard and the belt tension side will vibrate.
The detailed adjustment (tension) is shown in Fig. 5-9.
Check and adjust with the belt pressing force f and the slack amount d between span s.

5.3.4 Replacing Bellows

(1) How to Replace the Top Bellows

Refer to Fig. 5-10 and replace the top bellows.

1) Move the J3 axis to the position where the clamp ring becomes visible.
2) Turn off the robot controller's power supply.
3) Remove the clamp ring.
4) Loosen the M4 set screws (two pieces) next to part <1> installed at the top of the ball screw, and remove the top bellows from the No. 2 arm cover-U.
5) Remove the screws (four M3 x 8 screws) of installation part <2> of the bellows, and remove the bellows.
6) Install the new bellows (four M3 x 8 screws、Tightening torque 0.8Nm)
7) Align part <1> on the ball screw, and tighten the M4 set screws (two pieces) adjusting to the D cut surface.
8) Install the bellows on the No.2 arm cover-U with clamp ring.
9) Fill the clearance between part <1> and the ball screw with the liquid gasket described in Page 57, "Table 5-6 : Spare parts list". or similar material.

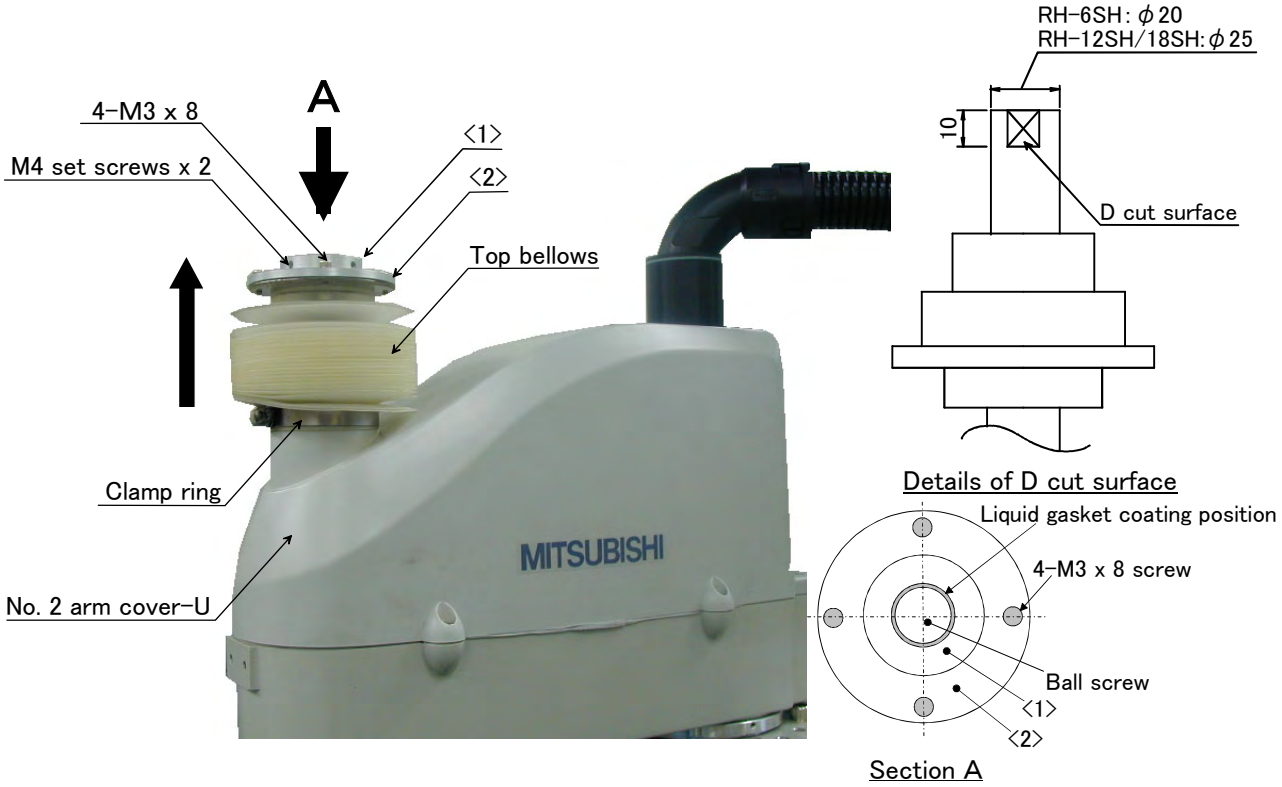


Fig.5-10 : Replace the top bellows

⚠ CAUTION

Replace the bellows in a place where there is no risk of contamination by dust and oil mist. If it must be replaced in a dust-filled area, be sure to remove as much dust as possible in advance before replacing it.

(2) How to Replace the Bottom Bellows

Refer to Fig. 5-11 and replace the top bellows.

1) Turn off the robot controller's power supply.
2) Remove the installation screws (three M4 screws) of the No. 2 arm cover-L <3>.
3) Loosen the two M4 set screws installed beside the part <4>, 30 mm above from the bottom edge of the ball screw, and remove the bottom bellows from the No. 2 arm cover-L.
4) Remove the screws (four M3 x 8 screws) of installation part <5> of the bellows, and remove the bellows.
5) Install the new bellows (four M3 x 8 screws、Tightening torque 0.8Nm)
6) Align part <4> to 30 mm above the bottom edge of the ball screw, and tighten the M4 set screws (two pieces) adjusting to the D cut surface.
7) Install the No. 2 arm cover-L <3> with the M4 screws (three pieces).
8) Fill the clearance between part <4> and the ball screw with the liquid gasket described in Page 57, "Table 5-6 : Spare parts list". or similar material.

[Note] Check the condition of the sealant when installing the No. 2 arm cover-L onto No. 2 arm. Be sure to replace the sealant if it is dislocated and bent or crushed and does not return to its original shape. Page 57, "Table 5-6 : Spare parts list" provides a list of names of Norseal types.

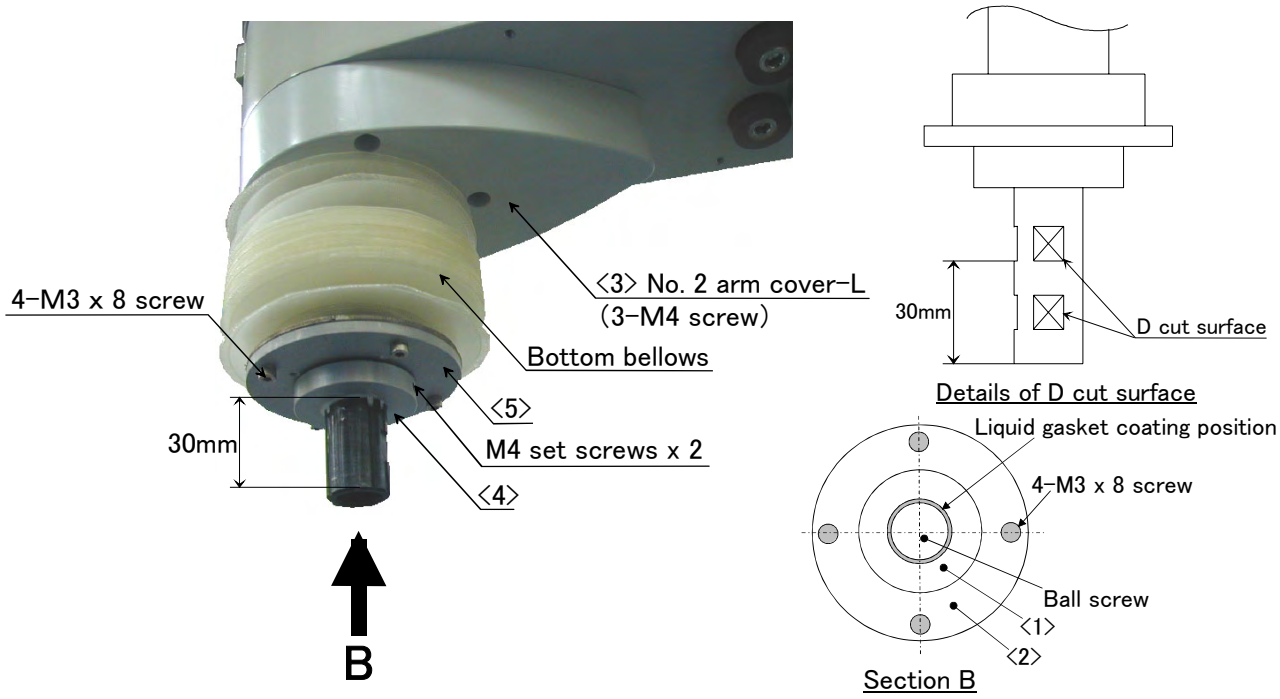


Fig.5-11 : Replace the top bellows

⚠ CAUTION

Replace the bellows in a place where there is no risk of contamination by dust and oil mist. If it must be replaced in a dust-filled area, be sure to remove as much dust as possible in advance before replacing it.

5.3.5 Lubrication

(1) Lubrication position and specifications

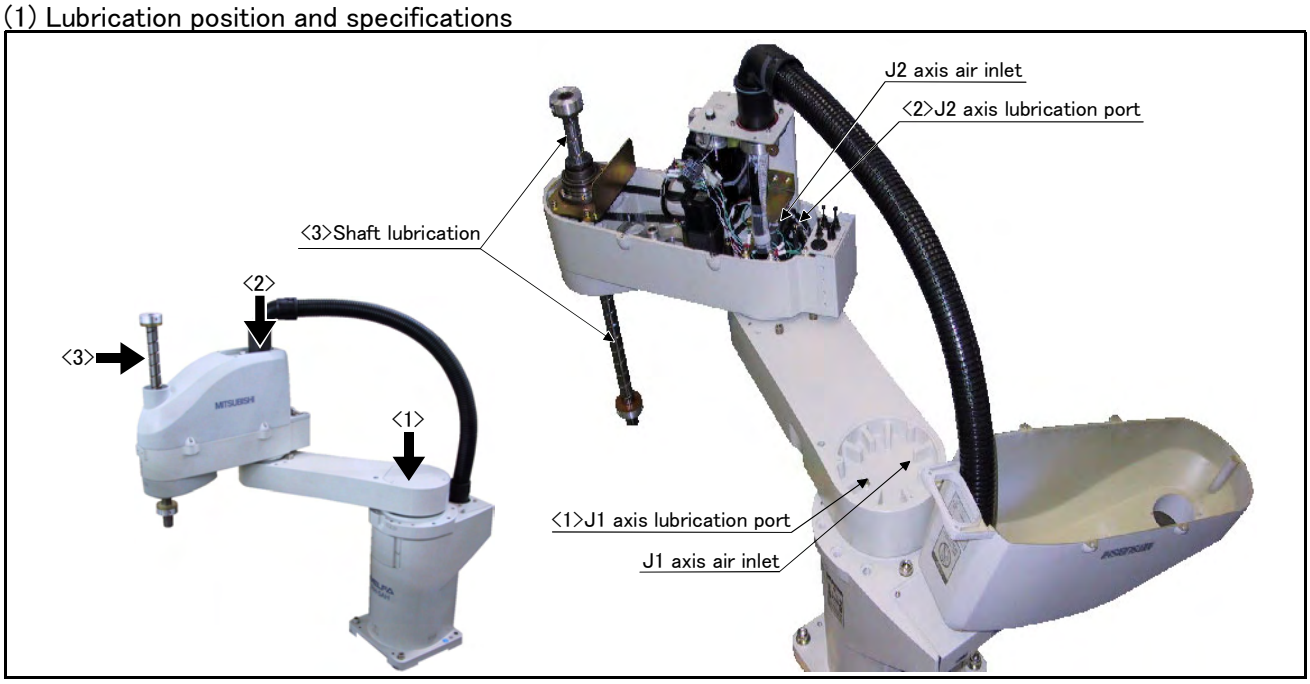


Fig.5-12 : Lubrication positions

Table 5-4 : Lubrication specifications

No.	Parts to be lubricated	Oiling method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
<1>	J1 axis reduction gears	Grease nipple WC-610(Only addition)	Grease Harmonic grease SK-1A (Japan Harmonic Systems)	6,000 Hr	3 g	J1 cover
<2>	J2 axis reduction gears			6,000 Hr	2 g	No. 2 arm cover-U
<3>	Shaft	Wipe the old grease, and paint	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 2000km movement	1g	

The grease nipple position is shown in Fig. 5-12. The lubrication specifications for each place are shown in Table 5-4. When lubricating, remove the covers that need to be taken off by refer to "Fig.5-3 : Installing/removing the cover".

[Caution]

- The brands of grease given in Table 5-4 are those filled when the robot is shipped.
- The lubrication time is a cumulative value of the operation at the maximum speed. If the operation has been suspended, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
- Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
- The numbers in the correspond to the supply positions in Fig. 5-12.

(2) Lubrication method to the J1, J2 axis

1) Refer to the Page 45 "Fig. 5-3Installing/removing the cover" and remove the covers.
2) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple.Add only the specified amount of grease. Adding excess grease may cause grease to leak.
3) Replace the covers with the removal procedure in reverse.

[Note] Sealant is applied to the cover joint surface of the oil mist specification and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape.
(Use liquid gasket and Norseal in Page 57, "Table 5-6 : Spare parts list".)
Moreover, in the case of oil mist specification and clean specification models, it is necessary to remove the top and bottom bellows. See Section Page 52, "5.3.4 Replacing Bellows" for details on how to remove them.

(3) Lubrication method to the shaft

1) Refer to Page 45 "Fig. 5-3Installing/removing the cover"," remove the No. 2 arm cover-U.
2) Wipe the old grease off the shaft. At this time, wipe off the grease that has been scattered inside the No. 2 arm cover-U and the bracket attached vertically to the shaft fastening area.
3) Apply the specified amount of grease to the shaft. If too much grease is applied, grease may get scattered all over inside of the No. 2 arm. If the grease reaches the timing belt inside the No. 2 arm, the timing belt may deteriorate prematurely.
4) Attach the covers in the reverse order of their removal.

*In the case of oil mist specification and clean specification models, it is necessary to remove the top and bottom bellows. See Section Page 52, "5.3.4 Replacing Bellows" for details on how to remove them.

⚠ CAUTION

Replace the bellows in a place where there is no risk of contamination by dust and oil mist. If it must be replaced in a dust-filled area, be sure to remove as much dust as possible in advance before replacing it.

5.3.6 Replacing the backup battery

An absolute encoder is used for the position detector, so the position must be saved with the backup battery when the power is turned OFF. The controller also uses a backup battery to save the program, etc. These batteries are installed when the robot is shipped from the factory, but as these are consumable parts, they must be replaced periodically by the customer.

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state. When the battery life nears, the "Battery cumulative time over alarm (Alarm No. 7520)" will occur. Once the alarm occurs, replace all batteries in the robot arm and controller as soon as possible. Lithium batteries (type: A6BAT and ER6) are used in both the controller and robot arm. The battery replacement procedures are as follow.

(1) Replacing the robot arm battery

⚠ CAUTION

Don't disconnect connector, etc. While replacing the battery, the encoder position data is saved by the power supplied from the controller. Thus, if the cable connection is incomplete, the encoder position data will be lost when the controller power is turned OFF. Several batteries are used in the robot arm, but replace all old batteries with new batteries at the same time.

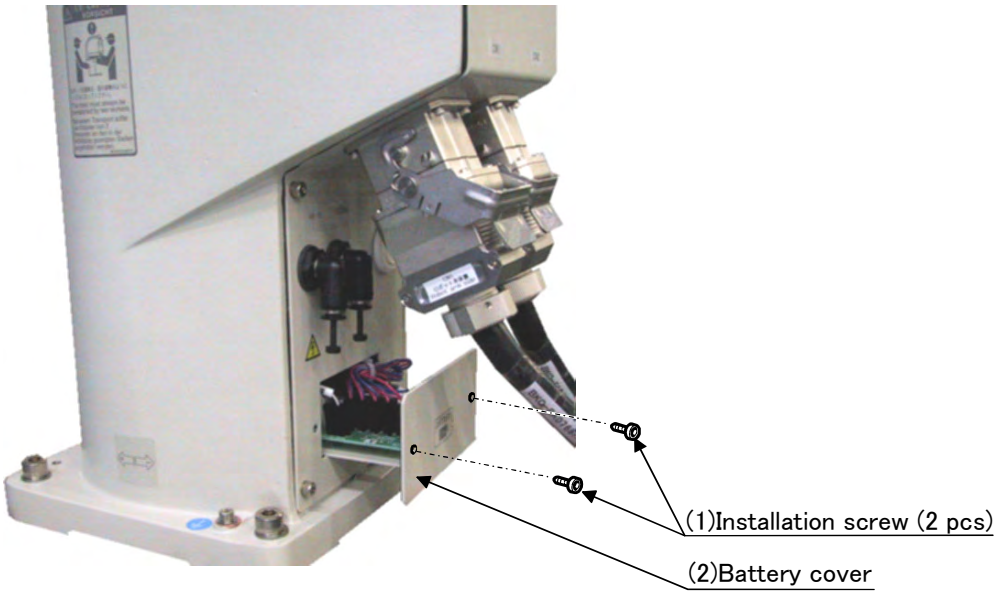


Fig.5-13 : Replacing the battery

1) Confirm that the robot arm and controller are connected with a cable.
2) Turn the controller control power ON.
   The position data is retained by the power supplied from the controller while replacing the battery. Thus, if the cable is not connected correctly, or if the controller power is OFF, the position data will be lost.
3) Press the emergency stop button to set the robot in the emergency stop state. This is a measure for safety, and must always be carried out.
4) Remove the two installation screws (1), and remove the battery cover (2).
5) Remove the old battery from the holder, and disconnect the lead connector.
6) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
7) Carry out steps 4) to 6) in reverse to install the parts.
8) Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again. Refer to Page 58, "5.5 Resetting the origin" and reset the origin using the jig method or mechanical stopper method.

5.4 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-5, and spare parts that may be required during repairs are shown in Table 5-6. Purchase these parts from the dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 5-5 : Consumable part list

No.	Part name	Type	Usage place	Q'ty	Supplier
1	Grease		Reduction gears of each axis	An needed	Mitsubishi Electric System & Service;Co.,Ltd.
2	Lithium battery		In base	5	
RH-6SH series					
3	Timing belt		J3 axis	1	Mitsubishi Electric System & Service;Co.,Ltd.
4			J4 axis motor side	1	
5			J4 axis shaft side	1	
RH-12SH/18SH series					
6	Timing belt		J3 axis	1	Mitsubishi Electric System & Service;Co.,Ltd.
7			J4 axis motor side	1	
8			J4 axis shaft side	1	

Table 5-6 : Spare parts list

No.	Part name	Type Note1)	Usage place	Q'ty	Supplier
RH-6SH series					
1	AC servo motor		J1 axis	1	Mitsubishi Electric System & Service;Co.,Ltd.
2			J2 axis	1	
3			J3 axis	1	
4			J4 axis	1	
5	Reduction gears		J1 axis	1	
6			J2 axis	1	
7	Ball screw spline		J3 axis (General environment and oil mist specification)	1	
8			J3 axis (clean specification)	1	
9	Top bellows		J3 axis (clean and oil mist specification)	1	
10	Bottom bellows		J3 axis (clean and oil mist specification)	1	
11	Liquid gasket		Bellows (clean and oil mist specification)	An needed	
12	Packing		Installation area of each cover (clean and oil mist specification)	An needed	
RH-12SH/18SH series					
13	AC servo motor		J1 axis	1	Mitsubishi Electric System & Service;Co.,Ltd.
14			J2 axis	1	
15			J3 axis	1	
16			J4 axis	1	
17	Reduction gears		J1 axis (RH-12SH55*, RH-12SH75*)	1	
18			J1 axis (RH-12SH85*, RH-18SH series)	1	
19			J2 axis	1	
20	Ball screw spline		J3 axis (General environment and oil mist specification)	1	
21			J3 axis (clean specification)	1	
22	Top bellows		J3 axis (clean and oil mist specification)	1	
23	Bottom bellows		J3 axis (clean and oil mist specification)	1	
24	Liquid gasket		Bellows (clean and oil mist specification)	An needed	
25	Norseal		Installation area of each cover (clean and oil mist specification)	An needed	

Note1) Confirm the robot arm serial No., and contact the dealer or service branch of Mitsubishi Electric Co., for the type.

5.5 Resetting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. The origin must be reset if the combination of robot and controller being used is changed or if the motor is changed causing an encoder area. The types of origin setting methods are shown in Table 5-7.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again.Reset the origin using the jig method or mechanical stopper method.

Table 5-7 : Origin setting method

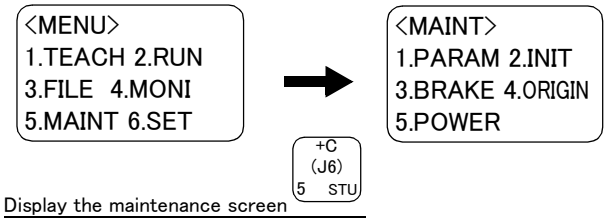
No	Method	Explanation	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B.	The setting method is explained in Page 15, "2.3 Setting the origin" .
2	Mechanical stopper method	This origin posture is set by contacting each axis against the mechanical stopper.	The setting method is explained in Page 59, "5.5.1 Mechanical stopper method"
3	Jig method	The origin posture is set with the calibration jig installed.	The setting method is explained in Page 65, "5.5.2 Jig method"
4	User origin method	A randomly designated position is set as the origin posture.	Before using this method, the origin must be set with the origin data input method or Mechanical stopper method or jig method. The setting method is explained in Page 70, "5.5.3 User origin method".

5.5.1 Mechanical stopper method

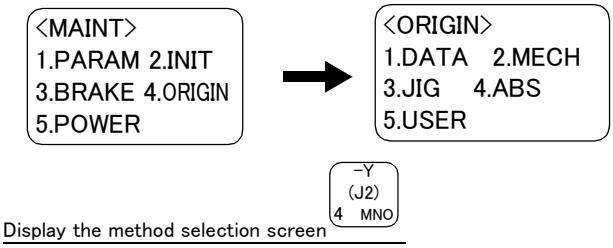
The method for setting the origin with the transportation jig is explained below.

This operation is carried out with the T/B. Set the [MODE] switch on the front of the controller to "TEACH", and set the T/B [ENABLE/DISABLE] switch to "ENABLE" to validate the T/B. Move the J4 axis to the upper end with jog operation beforehand.

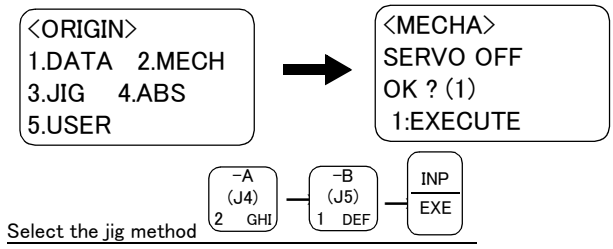
(1) Select the T/B



1) Press the [5] key on the menu screen, and display the maintenance screen.



2) Press the [4] key on the maintenance screen, and display the origin setting method selection screen.



3) Press the [2] key and select the jig method. Then, press the [1] key and the [INP] key to turn the servo OFF.
Securely fix the transportation jig A to the base with the fixing bolts (M4 × 12, 2 bolts) in this state

When setting the origin, all axes can be set, or only random axes can be set.
The methods corresponding to the axes to be set are described below, so select the corresponding explanation and set the origin.

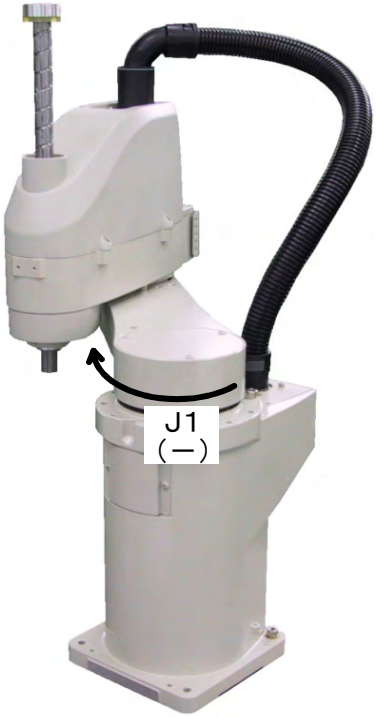
⚠ CAUTION The brakes are released here, and the J3 axis (shaft) is moved with both hands. For safety purposes, the brakes must be released by two workers.

(2) J1 axis origin setting

<MECHA> 12345678
BRAKE (00000000)
SET AXIS (11110000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF



RPL ↓

Move the cursor

1) With both hands, slowly move the J1 axis in − (minus) direction , and contact the mechanical stopper.

2) Press the [↓] key. The cursor will move to "SET AXIS".

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(10000000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF ▪ −C (J6) 0 ABC → INP EXE

3) Designate the axis for which the origin is to be set.
Set "1" for the 1 axis, and set "0" for the other axes. Then, press [INP] key. Next, a confirmation screen will appear.

<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE

Set the origin

−B (J5) 1 DEF → INP EXE

4) Press the [1] and [INP] keys.
The origin posture will be set.

5) Setting of the origin is completed.

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(00000000)
ORIGIN :COMPLETED

6) Refer to Page 71, "5.5.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(3) J2 axis origin setting

<MECHA> 12345678
BRAKE (00000000)
SET AXIS (11110000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF

1) With both hands, slowly move the J2 axis in + (plus) direction , and contact the mechanical stopper.

RPL ↓

Move the cursor

2) Press the [↓] key. The cursor will move to "SET AXIS".

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(01000000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF ▪ −C (J6) 0 ABC — INP EXE

3) Designate the axis for which the origin is to be set.
Set "1" for the 2 axis, and set "0" for the other axes. Then, press [INP] key. Next, a confirmation screen will appear.

<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE

Set the origin

−B (J5) 1 DEF → INP EXE

4) Press the [1] and [INP] keys.
The origin posture will be set.

5) Setting of the origin is completed.

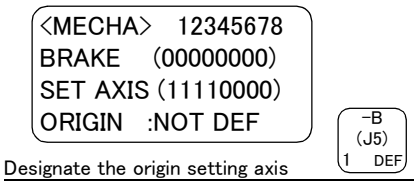
<MECHA> 12345678
BRAKE (00000000)
SET AXIS(00000000)
ORIGIN :COMPLETED

6) Refer to Page 71, "5.5.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

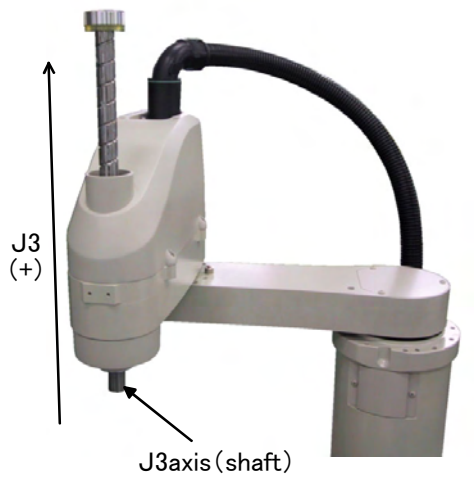
◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(4) J3 and J4 axis origin setting
Origin settings for the J3 and J4 axes must be performed at the same time.



1) Press the [0] key twice and then press the [1] key. "1" will display at the 3 position to set the brake release.
2) Confirm the axis for which the brakes are to be released.

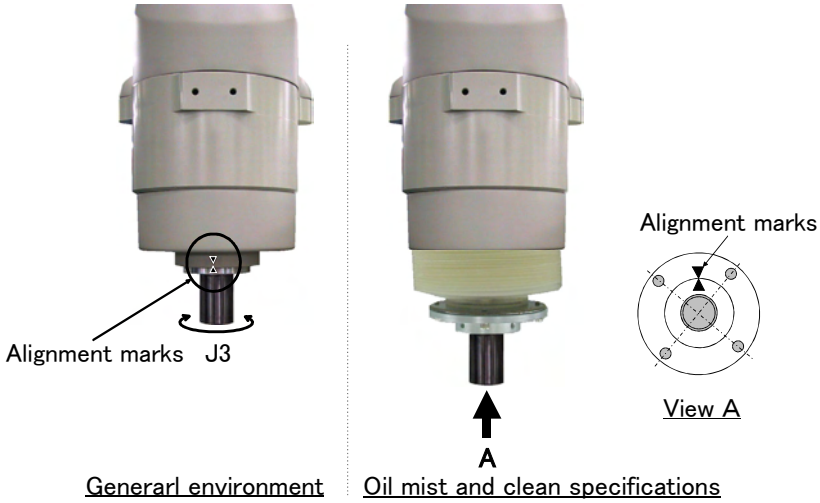


3) One worker must securely support the J3 axis (shaft) with both hands.
4) While holding down the deadman switch, hold down the [MOVE] + [+X] keys. The brakes will be released while the keys are held down.

5) With both hands, slowly move the J3 axis in Upward direction (plus), and contact the mechanical stopper.

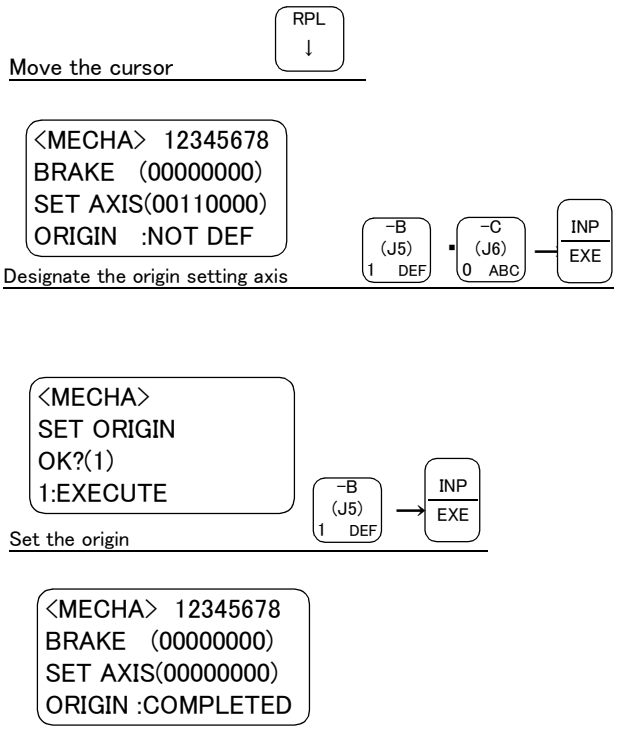
⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the J3 axis (shaft).
Be careful when releasing the brakes, since the J3 axis may fall off by its dead load depending on the weight of the tool.

⚠ CAUTION If the T/B [+X] key or the deadman switch is released, the brakes will be applied immediately.



6) Hold the J4 axis with your hand and rotate it slowly to match the alignment marks.

◇◆◇ Releasing the brakes ◇◆◇
To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] key.
The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0".
If the [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.



7) Press the [↓] key. The cursor will move to "SET AXIS".

8) Designate the axis for which the origin is to be set.
Set "1" for the 3 and 4 axes, and set "0" for the other axes. Then, press [INP] key. Next, a confirmation screen will appear.

9) Press the [1] and [INP] keys.
The origin posture will be set.

10) Setting of the origin is completed.

11) Refer to Page 71, "5.5.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(5) All axis origin setting

RPL
↓

Move the cursor

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(11110000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF ▪ −C (J6) 0 ABC → INP EXE

<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE

Set the origin

−B (J5) 1 DEF → INP EXE

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(00000000)
ORIGIN :COMPLETED

1) Perform origin settings for the J1, J2, J3 and J4 axes, by refer to Page 66, "(1) J1 axis origin setting", Page 61, "(3) J2 axis origin setting",Page 62, "(4) J3 and J4 axis origin setting". Origin setting operations will be performed with other axes later. At this point you only need to release the brakes to make each axis touch the mechanical stopper or to align the marks.

2) The robot should look like the diagram at left, once all procedures are complete.

3) Press the [(] key to move the cursor to "SET AXIS".

4) Select the axis whose origin is to be set.
Set 1 to 4 of "SET AXIS" to 1 and then press the [INP] key. A confirmation screen will be displayed.

5) Press the [1] and [INP] keys.
The origin posture will be set.

6) Setting of the origin is completed.

7) Refer to Page 71, "5.5.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] key.
The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0".
If the [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

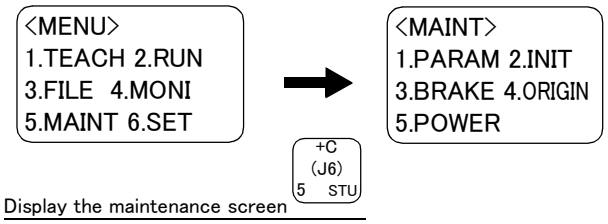
◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

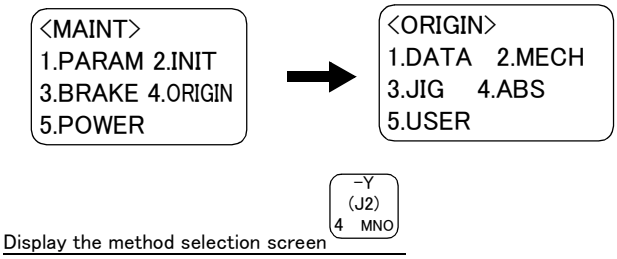
5.5.2 Jig method

The method for setting the origin with the transportation jig is explained below.
This operation is carried out with the T/B. Set the [MODE] switch on the front of the controller to "TEACH", and set the T/B [ENABLE/DISABLE] switch to "ENABLE" to validate the T/B.

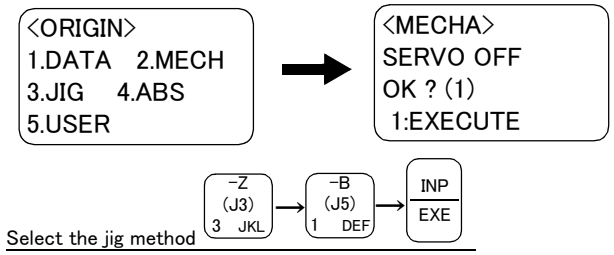
The following operation is carried out while lightly pressing the T/B deadman switch.



1) Press the [5] key on the menu screen, and display the maintenance screen.



2) Press the [4] key on the maintenance screen, and display the origin setting method selection screen.



3) Press the [3] key and select the jig method. Then, press the [1] key and the [INP] key to turn the servo OFF.
Next, release the brakes of all axes, move the arms manually with both hands, and fasten them with the origin jigs.

Origin setting can be performed only for the axes you wish to set instead of setting the origin for all axes. Go to the appropriate section that describes the origin setting and perform the necessary origin setting.

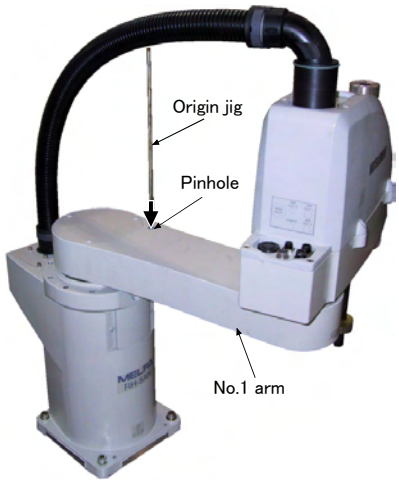
⚠ CAUTION At this point release the brakes and move the J3 axis (shaft) with both hands. To ensure safety, the brake-release procedure described below should always be done by two persons.

(1) J1 axis origin setting

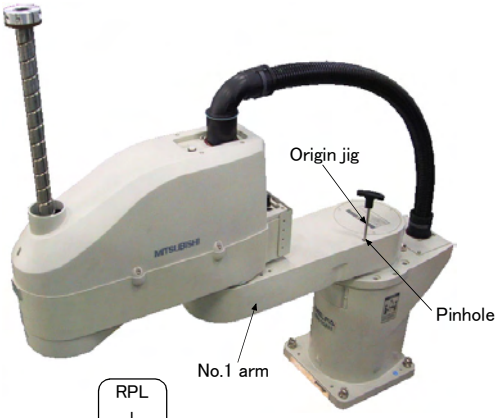
```
<MECHA>  12345678
BRAKE   (00000000)
SET AXIS (11110000)
ORIGIN   :NOT DEF
```

Designate the origin setting axis

RH-6SH series



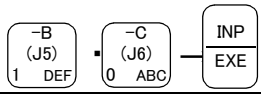
RH-12SH/18SH series



Move the cursor

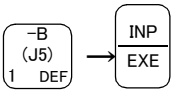

```
<MECHA>  12345678
BRAKE   (00000000)
SET AXIS(10000000)
ORIGIN   :NOT DEF
```

Designate the origin setting axis




```
<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE
```

Set the origin




```
<MECHA>  12345678
BRAKE   (00000000)
SET AXIS(00000000)
ORIGIN :COMPLETED
```

1) Move the J1 axis slowly toward the front using both hands. Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig into the pinholes and fasten.

2) Press the [↓] key. The cursor will move to "SET AXIS".

3) Designate the axis for which the origin is to be set.
Set "1" for the 1 axis, and set "0" for the other axes. Then, press [INP] key. Next, a confirmation screen will appear.

4) Press the [1] and [INP] keys.
The origin posture will be set.

5) Setting of the origin is completed.

6) Refer to Page 71, "5.5.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(2) J2 axis origin setting

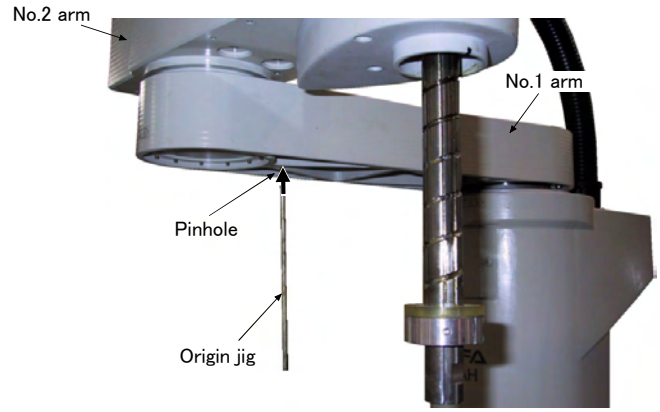
<MECHA> 12345678
BRAKE (00000000)
SET AXIS (11110000)
ORIGIN :NOT DEF

Designate the origin setting axis

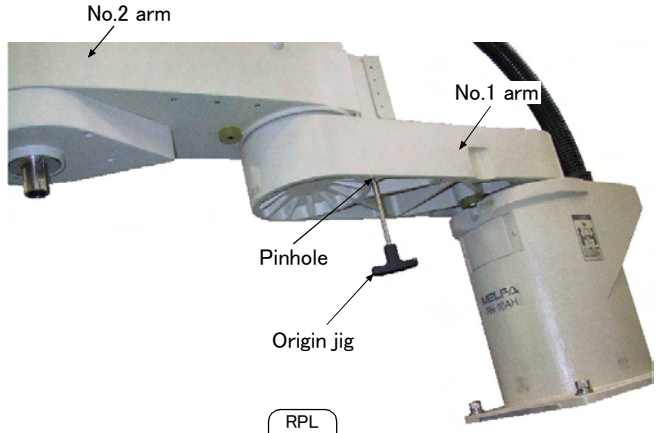
−B (J5) 1 DEF

1) Slowly rotate the J2 axis 90° clockwise with both hands. Align the pinholes of the No. 1 and No. 2 arms, feed through the origin jig into the pinholes and fasten.

RH-6SH series



RH-12SH/18SH series



2) Press the [↓] key. The cursor will move to "SET AXIS".

RPL ↓

Move the cursor

3) Designate the axis for which the origin is to be set.
Set "1" for the 2 axis, and set "0" for the other axes. Then, press [INP] key. Next, a confirmation screen will appear.

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(01000000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF ▪ −C (J6) 0 ABC → INP EXE

4) Press the [1] and [INP] keys.
The origin posture will be set.

<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE

Set the origin

−B (J5) 1 DEF → INP EXE

5) Setting of the origin is completed.

<MECHA> 12345678
BRAKE (00000000)
SET AXIS (00000000)
ORIGIN :COMPLETED

6) Refer to Page 71, "5.5.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(3) J3 and J4 axis origin setting

Origin settings for the J3 and J4 axes must be performed at the same time.

The method of origin setting is the same as the mechanical stopper method. Refer to Page 62, "(4) J3 and J4 axis origin setting", perform the required origin setting operations.

(4) All axis origin setting

RH-6SH series

1) Perform origin settings for the J1, J2, J3 and J4 axes, by refer to Page 66, "(1) J1 axis origin setting", Page 67, "(2) J2 axis origin setting",Page 68, "(3) J3 and J4 axis origin setting". Origin setting operations will be performed with other axes later. At this point you only need to release the brakes to make each axis touch the mechanical stopper or to align the marks.

2) The robot should look like the diagram at left, once all procedures are complete.

RH-12SH/18SH series

3) Press the [(] key to move the cursor to "SET AXIS".

Move the cursor

RPL
↓

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(11110000)
ORIGIN :NOT DEF

Designate the origin setting axis

−B (J5) 1 DEF
−C (J6) 0 ABC
INP EXE

4) Select the axis whose origin is to be set.
Set 1 to 4 of "SET AXIS" to 1 and then press the [INP] key. A confirmation screen will be displayed.

<MECHA>
SET ORIGIN
OK?(1)
1:EXECUTE

Set the origin

−B (J5) 1 DEF
INP EXE

5) Press the [1] and [INP] keys.
The origin posture will be set.

<MECHA> 12345678
BRAKE (00000000)
SET AXIS(00000000)
ORIGIN :COMPLETED

6) Setting of the origin is completed.

7) Refer to Page 71, "5.5.4 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Releasing the brakes ◇◆◇

To release the brakes, move the cursor to the "BRAKE" axis No. with the [←] or [→] key.
The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0".
If the [+X] key on the teaching pendant or the deadman switch is pressed while the brakes are released, the brakes will be applied immediately.

◇◆◇ Origin setting axis designation ◇◆◇

Move the cursor to the "SET AXIS" axis No. in the origin setting with the [←] or [→] key.
The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

5.5.3 User origin method

CAUTION Before using this method, the origin must be set with the origin data input method, jig method, or mechanical stopper method.

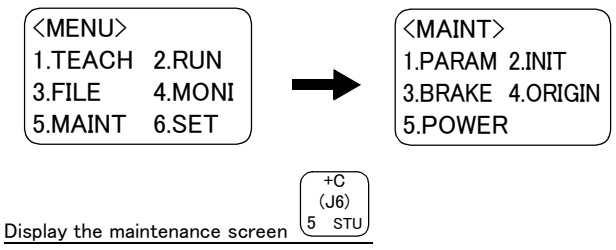
The procedure for setting the origin with the user origin method is explained below.
This operation is carried out with the teaching pendant. Set the [MODE] switch on the front of the controller to "TEACH", and set the [ENABLE/DISABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown below.

When setting the origin for the first time using this method, carry out the operations in order from step 1). For the second and following time, move the robot arm to the user origin position with jog operation, and accurately position all axes. Then start the procedure from step 4).

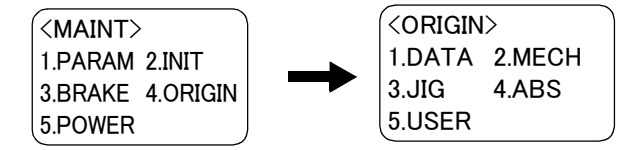
1) Determine the user origin position
   Move the robot to the position to be set as the origin with jog operation. Refer to Page 21, "2.4 Confirming the operation" for details on the jog operation.

CAUTION This position is left as a guideline to position all axes with jog operation when setting the origin again with this method.

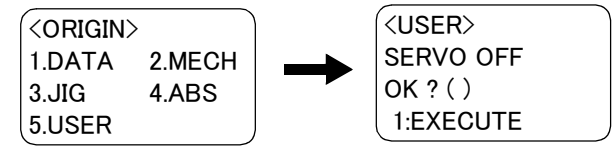
2) Enter the JOINT jog mode, and display the joint coordinates on the teaching pendant screen. Record the value of the axis for which the origin is to be set.
3) Input the value recorded in the "user designated origin parameter (USERORG)".
   The parameter details and input methods are described in the separate "Instruction Manual/Detailed Explanation of Functions and Operations". Refer to that manual and input the user designated origin position.



Display the maintenance screen +C (J6) 5 STU



Display the origin setting method selection screen −Y (J2) 4 MNO

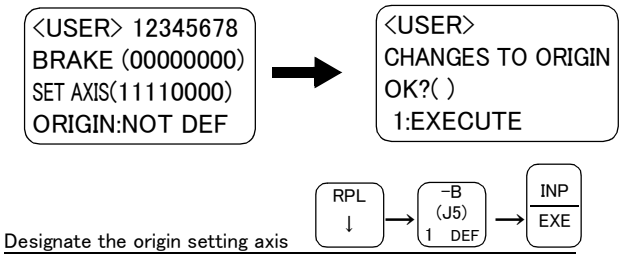


Select the origin method and servo OFF +C (J6) 5 STU → −B (J5) 1 DEF

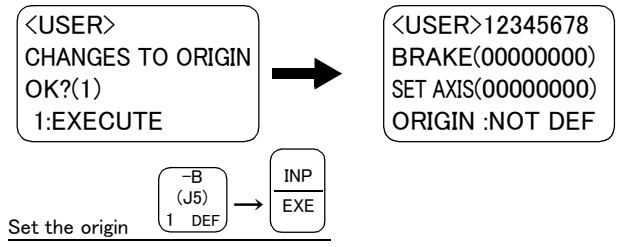
4) Next, set the origin.
   Press the [MENU] key to display the Menu screen.
5) Press the [5] key to display the Maintenance screen.

6) Press the [4] key to select the Origin Setting screen.

7) Press the [5] key to select the user origin method.
   Then, press [1] key and [INP] key to turn OFF the servo.



8) Press the [↓] key, and input "1" for the axis for which the origin is to be set. Press the [INP] key to display the Confirmation screen.



9) Press the [1] key and then the [INP] key. The origin will be set

This completes the setting of the origin with the user origin method.

5.5.4 Recording the origin data

When the origin has been set with the mechanical stopper method or jig method, record that origin data on the origin data label. With this, the origin can be set with the origin data input method the next time.

Confirm the origin data on the teaching pendant screen (origin data input screen). The origin data label is enclosed with the arm or attached on the back of the J1cover.
The teaching pendant operation method and J1cover removal method for confirming the origin data is the same as the methods for setting the origin with the origin data input method. Refer to Page 16, "2.3.2 Setting the origin with the origin data input method", and write the origin data displayed on the teaching pendant onto the origin label.

(1) Confirming the origin data label
Remove the J1cover.
Refer to Page 45, "5.3.2 Installing/removing the cover", and remove the J1cover.

(2) Confirming the origin data
Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to Page 16, "2.3.2 Setting the origin with the origin data input method""(5)Inputting the origin data" , and display the Origin Data Input screen on the teaching pendant display screen.

(3) Recording the origin data
Write the origin data displayed on the teaching pendant to the origin data label attached to the back of the J1cover Refer to Page 16 "Fig. 2-10Origin data label an example", and Page 19 "Fig. 2-11Correspondence of origin data label and axis" for details on the origin data label

(4) Installing the J1 cover
Install the J1cover removed in step "(1)Confirming the origin data label" above.
Refer to Page 45, "5.3.2 Installing/removing the cover", and replace the Battery coverJ1cover.

This completes the recording of the origin data.

6 Appendix

Appendix 1 : Configuration flag

The configuration flag indicates the robot posture.
The robot hand end is saved with the position data configured of X, Y, Z, A, B and C. However, even with the same position data, there are several postures that the robot can change to. The posture is expressed by this configuration flag, and the posture is saved with FL1 in the position constant (X, Y, Z, A, B, C) (FL1, FL2).
The types of configuration flags are shown below.

(1) RIGHT/LEFT

Indicates the location of the end axis relative to the line that passes through both the rotational center of the J1 axis and the rotational center of the J2 axis.

FL1(Flag 1)
& B 0 0 0 0 0 0 0 0 0
↑
1/0 = RIGHT/LEFT

Note) "&B" is shows the binary

HEADQUARTERS

MITSUBISHI ELECTRIC EUROPE B.V. **EUROPE**
German Branch
Gothaer Straße 8
D-40880 Ratingen
Phone: +49 (0)2102 / 486-0
Fax: +49 (0)2102 / 486-1120

MITSUBISHI ELECTRIC EUROPE B.V. **FRANCE**
French Branch
25, Boulevard des Bouvets
F-92741 Nanterre Cedex
Phone: +33 (0)1 / 55 68 55 68
Fax: +33 (0)1 / 55 68 57 57

MITSUBISHI ELECTRIC EUROPE B.V. **IRELAND**
Irish Branch
Westgate Business Park, Ballymount
IRL-Dublin 24
Phone: +353 (0)1 4198800
Fax: +353 (0)1 4198890

MITSUBISHI ELECTRIC EUROPE B.V. **ITALY**
Italian Branch
Viale Colleoni 7
I-20041 Agrate Brianza (MI)
Phone: +39 039 / 60 53 1
Fax: +39 039 / 60 53 312

MITSUBISHI ELECTRIC CORPORATION **JAPAN**
Office Tower "Z" 14 F
8-12,1 chome, Harumi Chuo-Ku
Tokyo 104-6212
Phone: +81 3 622 160 60
Fax: +81 3 622 160 75

MITSUBISHI ELECTRIC EUROPE B.V. **UK**
UK Branch
Travellers Lane
UK-Hatfield, Herts. AL10 8XB
Phone: +44 (0)1707 / 27 61 00
Fax: +44 (0)1707 / 27 86 95

MITSUBISHI ELECTRIC EUROPE B.V. **SPAIN**
Spanish Branch
Carretera de Rubí 76-80
E-08190 Sant Cugat del Vallés (Barcelona)
Phone: +34 93 / 565 3131
Fax: +34 93 / 589 1579

MITSUBISHI ELECTRIC AUTOMATION **USA**
500 Corporate Woods Parkway
Vernon Hills, IL 60061
Phone: +1 847 478 21 00
Fax: +1 847 478 22 83

EUROPEAN REPRESENTATIVES

GEVA **AUSTRIA**
Wiener Straße 89
AT-2500 Baden
Phone: +43 (0)2252 / 85 55 20
Fax: +43 (0)2252 / 488 60

Koning & Hartman B.V. **BELGIUM**
Industrial Solutions
Woluwelaan 31
BE-1800 Vilvoorde
Phone: +32 (0)2 / 257 02 40
Fax: +32 (0)2 / 257 02 49

AutoCont Control Systems, s.r.o. **CZECH REPUBLIC**
Jelinkova 59/3
CZ-721 00 Ostrava Svinov
Phone: +420 (0)59 / 5691 150
Fax: +420 (0)59 / 5691 199

AutoCont Control Systems, s.r.o. **CZECH REPUBLIC**
Technologická 374/6
CZ-708 00 Ostrava-Pustkovec
Phone: +420 595 691 150
Fax: +420 595 691 199

B:TECH, a.s. **CZECH REPUBLIC**
Na Ostrove 84
CZ-58001 Havlickuv Brod
Phone: +420 (0)569 / 408 841
Fax: +420 (0)569 / 408 889

B:TECH, a.s. **CZECH REPUBLIC**
Headoffice
U Borové 69
CZ-580 01 Havlickuv Brod
Phone: +420 569 777 777
Fax: +420 569 777 778

Beijer Electronics A/S **DENMARK**
Lautruphoj 1-3
DK-2750 Ballerup
Phone: +45 (0)70 / 26 46 46
Fax: +45 (0)70 / 26 48 48

Beijer Electronics OY **FINLAND**
Jaakonkatu 2
FIN-01620 Vantaa
Phone: +358 (0)207 / 463 500
Fax: +358 (0)207 / 463 501

KOUVALIAS ROBOT + VISION SYSTEMS **GREECE**
25, El.Venizelou Ave
GR-17671 Kallithea
Phone: +30 22950 / 42902/3/4
Fax: +30 22950 / 42690

AXICONT AUTOMATIKA KFT. **HUNGARY**
Reitter F. U. 132
HU-1131 Budapest
Phone: +36 (0)1 / 412-0882
Fax: +36 (0)1 / 412-0883

EUROPEAN REPRESENTATIVES

Koning & Hartman B.V. **NETHERLANDS**
Haarlerbergweg 21-23
NL-1101 CH Amsterdam
Phone: +31 (0)20 / 587 76 00
Fax: +31 (0)20 / 587 76 05

Beijer Electronics AS **NORWAY**
Postboks 487
NO-3002 Drammen
Phone: +47 (0)32 / 24 30 00
Fax: +47 (0)32 / 84 85 77

MPL Technology Sp. z o.o. **POLAND**
Ul. Krakowska 50
PL-32-083 Balice
Phone: +48 (0)12 / 630 47 00
Fax: +48 (0)12 / 630 47 01

INEA SR d.o.o. **SERBIA**
Karadjordjeva 12/260
SER-113000 Smederevo
Phone: +381 (0)26 / 617 163
Fax: +381 (0)26 / 617 163

CS MTrade Slovensko, s.r.o. **SLOVAKIA**
Vajanskeho 58
SK-92101 Piestany
Phone: +421 (0)33 / 7742 760
Fax: +421 (0)33 / 7735 144

INEA d.o.o. **SLOVENIA**
Stegne 11
SI-1000 Ljubljana
Phone: +386 (0)1 / 513 8100
Fax: +386 (0)1 / 513 8170

Beijer Electronics Automation AB **SWEDEN**
Box 426
SE-20124 Malmö
Phone: +46 (0)40 / 35 86 00
Fax: +46 (0)40 / 35 86 02

ECONOTEC AG **SWITZERLAND**
Hinterdorfstr. 12
CH-8309 Nürensdorf
Phone: +41 (0)44 / 838 48 11
Fax: +41 (0)44 / 838 48 12

GTS **TURKEY**
Darulaceze Cad. No. 43 KAT. 2
TR-34384 Okmeydani-Istanbul
Phone: +90 (0)212 / 320 1640
Fax: +90 (0)212 / 320 1649

EURASIAN REPRESENTATIVES

CONSYS **RUSSIA**
Promyshlennaya st. 42
RU-198099 St. Petersburg
Phone: +7 812 / 325 36 53
Fax: +7 812 / 325 36 53

ICOS **RUSSIA**
Industrial Computer Systems ZAO
Ryazanskij Prospekt, 8A, Office 100
RU-109428 Moscow
Phone: +7 495 / 232 0207
Fax: +7 495 / 232 0327

MIDDLE EAST REPRESENTATIVES

ILAN & GAVISH Ltd. **ISRAEL**
Automation Service
24 Shenkar St., Kiryat Arie
IL-49001 Petah-Tiqva
Phone: +972 (0)3 / 922 18 24
Fax: +972 (0)3 / 924 0761

AFRICAN REPRESENTATIVE

CBI Ltd. **SOUTH AFRICA**
Private Bag 2016
ZA-1600 Isando
Phone: + 27 (0)11 / 928 2000
Fax: + 27 (0)11 / 392 2354