MITSUBISHI
Mitsubishi Industrial Robot

RH-5AH/10AH/15AH Series

INSTRUCTION MANUAL
ROBOT ARM SETUP & MAINTENANCE

MELFA

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⚠ 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.

</div>

⚠ **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.

⚠WARNING   For using RH-5AH/10AH/15AH.
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
2001-09-06	BFP-A8175Z	First print.
2001-09-25	BFP-A8175	Formal style.
2001-10-22	BFP-A8175-A	The explanation of the RH-5AH series was added. Error in writing correction.

■ 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.

・ No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
・ The details of this manual are subject to change without notice.
・ The information contained in this document has been written to be accurate as much as possible.
Please interpret that items not described in this document "cannot be performed.".
Please contact your nearest dealer if you find any doubtful, wrong or skipped point.

Contents

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 User's 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.

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⚠ 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.

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-5AH series				
1	Robot arm	RH-5AH35,45,55 series	Either 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 x 40	4 pcs.	
4	Spring washer for installation bolts	For M8	4 pcs.	For robot arm installation
5	Plain washer for installation bolts	For M8	4 pcs.	
6	Arm fixing plates		1 set	For robot arm transportation
7	Arm fixing plate installation bolt		1 set	
RH-10AH/15AH series				
1	Robot arm	RH-10AH55, 70, 85 or RH-15AH85 series	Either 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M12 x 45	4 pcs.	
4	Spring washer for installation bolts	For M12	4 pcs.	For robot arm installation
5	Plain washer for installation bolts	For M12	4 pcs.	
6	Fixing plate		1 set	
7	Fixing plate installation bolts		1 set	For robot arm transportation
8	Suspension fitting		1 set	
9	Suspension fitting installation bolts		1 set	

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

2.2 Installation

2.2.1 Unpacking
（1）RH-5AH series

Pull out vertically.

（a）

（b）

Robot arm

（c）

⚠CAUTION

Always unpack the robot at a flat place. The robot could tilt over if unpacked at an unstable place.

Fixing plate A

Fixing plate B

（d）
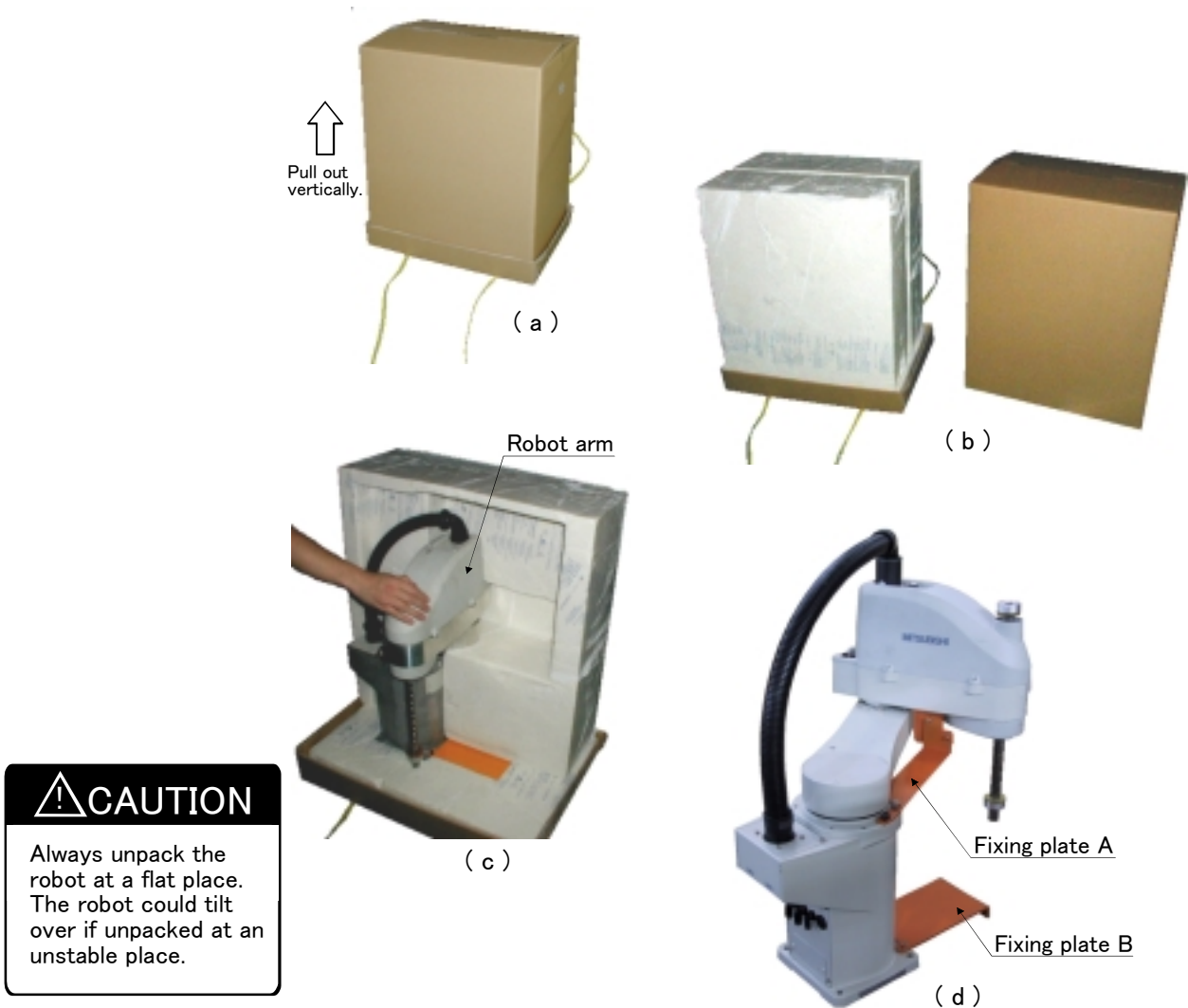
Note) The cushioning material will be required if the robot is transported again , so save it in a safe place.

Fig.2-1 : Unpacking the robot arm (RH-5AH series)

The robot is shipped from the factory in cardboard packing. Always refer to Fig. 2-2 and unpack the robot. Handle the robot arm according to ″2.2.2Transportation procedures″.
The unpacking process is shown below.
    1) Place the cardboard box on a flat floor surface.
    2) Cut the tapes holding the upper and lower cardboard boxes together using a cutter or similar tool. (See (a) of Fig. 2-2.)
    3) Pull out the upper box and place it vertically on the floor surface (see (b) of Fig. 2-2). At this point, be sure to support the robot by hand so that it does not roll.
    4) Remove the cushioning material from the left side (as seen from the front of the robot) (see (c) of Fig. 2-2). Support the robot so that it does not roll.
    5) Remove the robot from the cushioning material (see (d) of Fig. 2-2).

⚠CAUTION   When repackaging the robot in the cardboard box, always use the fixtures.

（2）RH-10AH/15AH series

Wooden frame

Robot arm

⚠CAUTION

Always unpack the
robot at a flat place.
The robot could tilt
over if unpacked at an
unstable place.

Fig.2-2：Unpacking the robot arm

The robot is shipped from the factory in wooden frame packing.
Handle the robot arm according to "2.2.2 Transportation procedures" on page 8.
The unpacking process is shown below.
    1）Place the wooden frame on a level floor surface.
    2）Remove the nails fastening the wooden frame.
    3）Remove the wooden frame and cushioning material.
    4）Remove the four bolts connecting the sleeper and the base unit.

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

2.2.2 Transportation procedures
(1) RH-5AH series (Transportation by people)
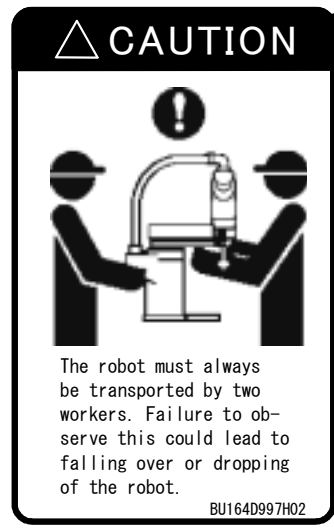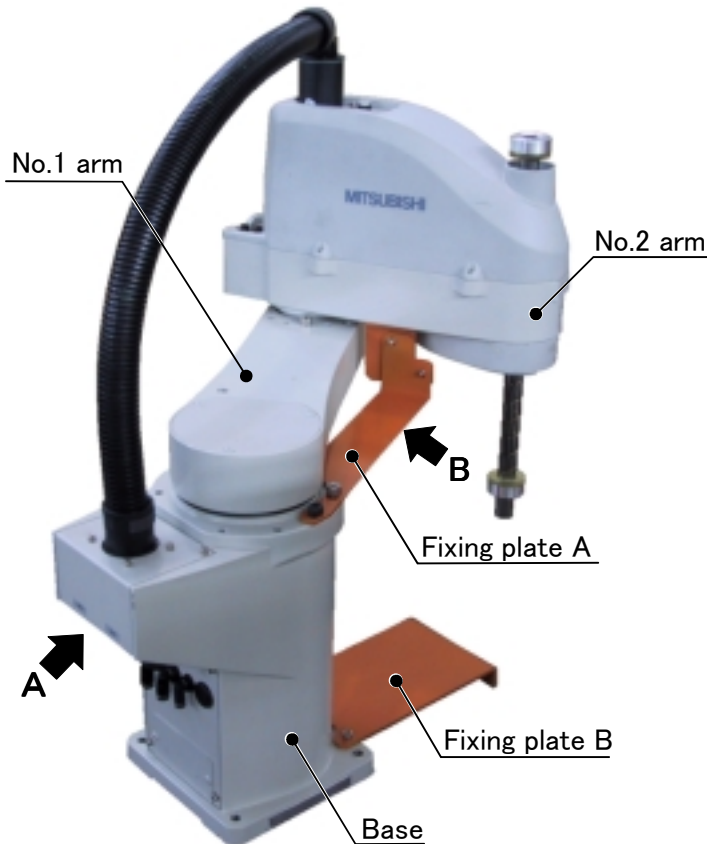
Fig.2-3 : Transportation of robot arm

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.

Axis	RH-5AH35	RH-5AH45	RH-5AH55
J 1	49.5°	25°	17°
J 2	−139.5°	−115°	−107°
J 3	Lower to the upper machine stopper	Lower to the upper machine stopper	Lower to the upper machine stopper
J 4	Not fixed	Not fixed	Not fixed

(2) RH-10AH/15AH series (Transporting with a crane)

〈RH-10AH70/85、RH-15AH85〉

〈RH-10AH55〉
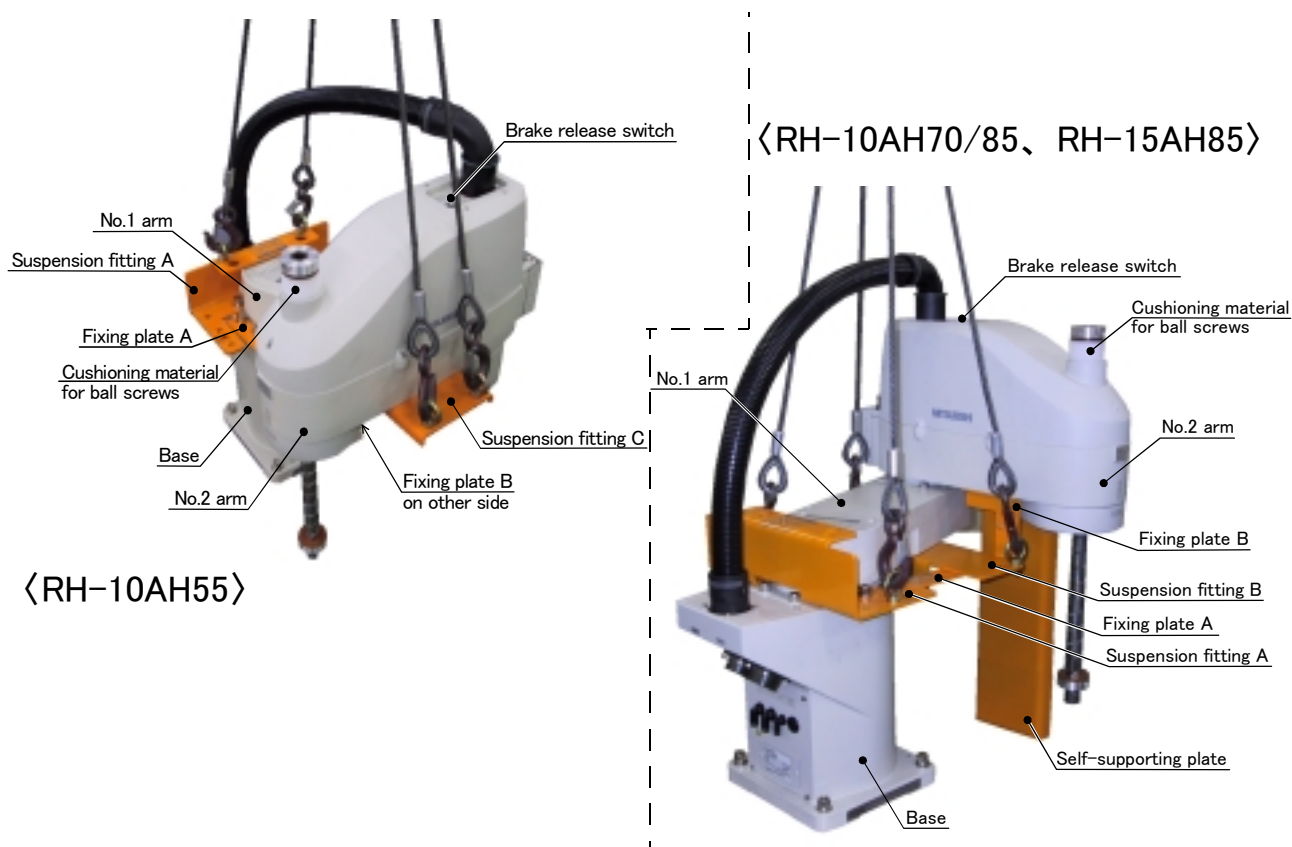
Fig.2-4 : Transportation of robot arm

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) Be careful not to subject the robot to physical shock during transport.
4) After installing the robot (refer to Page 10, "Installation procedures"), remove the wires, the wire hooks (the robot will stand by itself as shown in Fig. 2-4), the self-supporting plate, suspension fitting A and B, and fixing plate A, B and C.

⚠ 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.

Axis	RH-10AH55	RH-10AH70	RH-10AH85/RH-15AH85
J 1	37.5°	21.4°	15.1°
J 2	-127.5°	-111.4°	-105.1°
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.

2.2.3 Installation procedures

<u>RH-5AH series</u>

<2> 4-M8 × 40
Hexagon socket bolts
(Four positions)

Spring washer

Plain washer

20

Installation
reference surface 6.3a

92
180
150

92
180
150

200
(Maintenance space)

<1> 4-φ9
Installation holes

<u>Installation dimension details of X-X</u>

<u>RH-10AH/15AH series</u>

<2> 4-M12 × 45
Hexagon socket bolts
(Four positions)

Spring washer

Plain washer

25

Installation
reference surface 6.3a

122
240
200

122
240
200

240
(Maintenance space)

<1> 4-φ16 (Installation holes)
Installed using M12 x 45 provided

<u>Installation dimension details of X-X</u>

Fig.2-5 : Installation dimensions

1) The robot installation surface has been machine finished. Use the installation holes <1> opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts <2>.

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 (refer to Fig. 2-3 and Fig. 2-4).

⚠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.

2.2.4 Grounding procedures
(1) Grounding methods

Fig.2-6 : Grounding methods

1) There are three grounding methods as shown in Fig. 2-6 (c), but the dedicated grounding (Fig. 2-6 (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 100 Ω or less).
   Dedicated grounding separated from the other devices should be used.
3) Use a A.W.G#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.2-7 : Connecting the grounding cable

1) Prepare the grounding cable (A.W.G#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.

2.2.5 Connecting with the controller
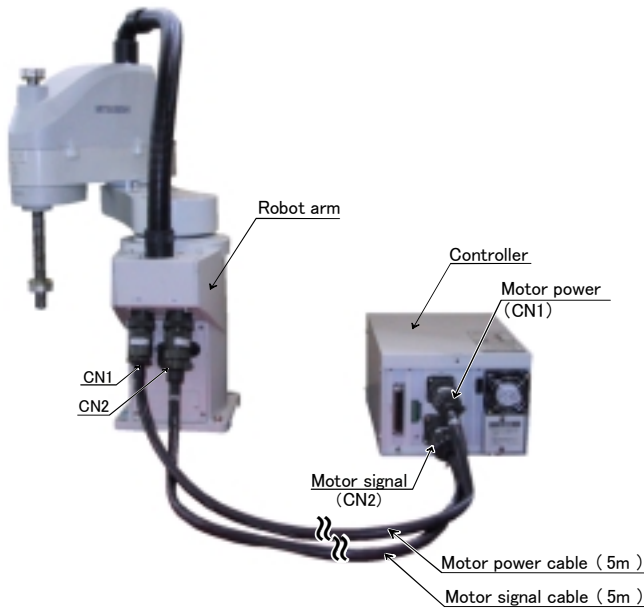
RH-5AH series | RH-10AH/15AH series

Fig.2-8 : 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 the robot arm and the corresponding connector on the controller

⚠ 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.

2.3 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 Page 58, "5.5 Resetting the origin" on page for the other methods.

The teaching pendant is required for this operation.

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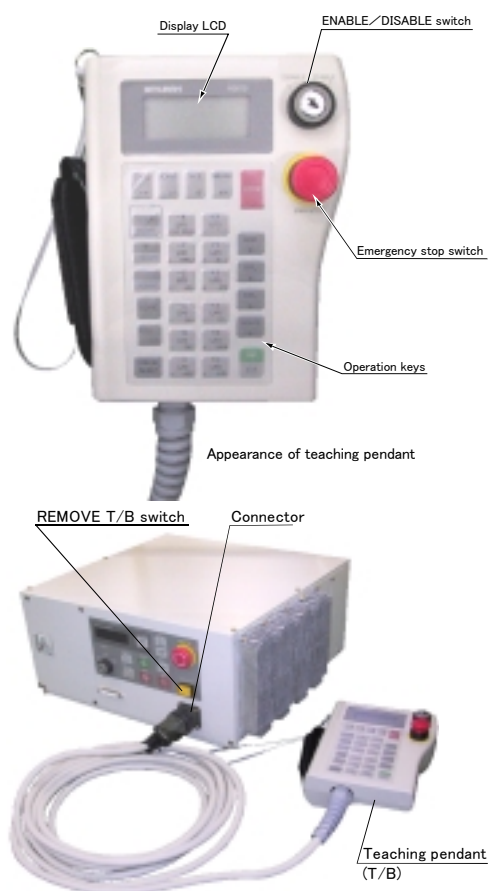
1) Confirm that the controller's power supply switch is OFF.

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".

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

◇◆◇ [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 Page 45, "5.3.2 Installing/removing the cover" on page, 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
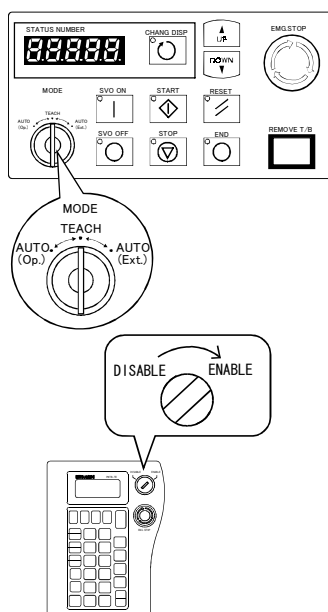
Next, prepare to use the T/B
1) Set the [MODE] switch on the front of the controller to "TEACH".

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".

⑷ Selecting the origin setting method
〈T/B screen〉   [Keys used]

```
<MENU>
1.TEACH 2.RUN
3.FILE    4.MONI
5.MAINT  6.SET
```
[+C (J6) 5 STU]

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

```
<MAINT>
1.PARAM 2.INIT
3.BRAKE  4.ORIGIN
5.POWER
```
[−Y (J2) 4 MNO]

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

```
<ORIGIN>
1.DATA  2.MECH
3.JIG     4.ABS
5.USER
```
[−B (J5) 1 DEF] [INP EXE]

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.

```
<ORIGIN>
SERVO OFF
OK?( )  ■
■ 1:EXECUTE ■
```
[−B (J5) 1 DEF] [INP EXE]

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

```
<DATA>D(000000)
1:000000 000000
3:000000 000000
5:000000 000000
```

◇◆◇ 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

T/B screen   Origin data label (D,J1,J2,J3,J4,J5,J6)

```
<DATA> D(   D   )
1:  J1     J2
3:  J3     J4
5:  J5     J6
```
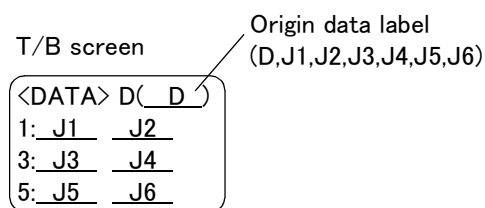
Input the value confirmed in section .
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-11.

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]

```
<DATA>D(000000)
1:000000 000000
3:000000 000000
5:000000 000000
```

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

```
<DATA>D(V00000)
1:000000 000000
3:000000 000000
5:000000 000000
```
[POS CHAR] + [+B (J5) 6 VWX]

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

```
<DATA>D(V!0000)
1:000000 000000
3:000000 000000
5:000000 000000
```
[POS CHAR] + [SPD #%!]

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

```
<DATA>D(V!0000)
1:000000 000000
3:000000 000000
5:000000 000000
```
[POS CHAR] + [SPD #%!]

[POS CHAR] + [+C (J6) 5 STU]

[−A (J4) 2 GHI]   [+Y (J2) 9 &<>]

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.

```
<DATA>D(V!%S29)
1:000000 000000
3:000000 000000
5:000000 000000
```
[RPL ↓]

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.

```
<DATA>D(V!%S29)
1:A@B&8F G#$Y5#
3:H+7%2H B="!1L
5:59A37! K8#&6P
```
[INP EXE]

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

```
<DATA>D(V!%S29)
CHANGES TO ORIGIN
OK?( )
 :EXECUTE
```
[−B (J5) 1 DEF]   [INP EXE]

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.

⑹ Installing the J1 cover
Return the J1 cover, removed in section 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.

⚠ CAUTION   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 Page 13, ″2.3 Setting the origin″ on page for details on setting the origin.
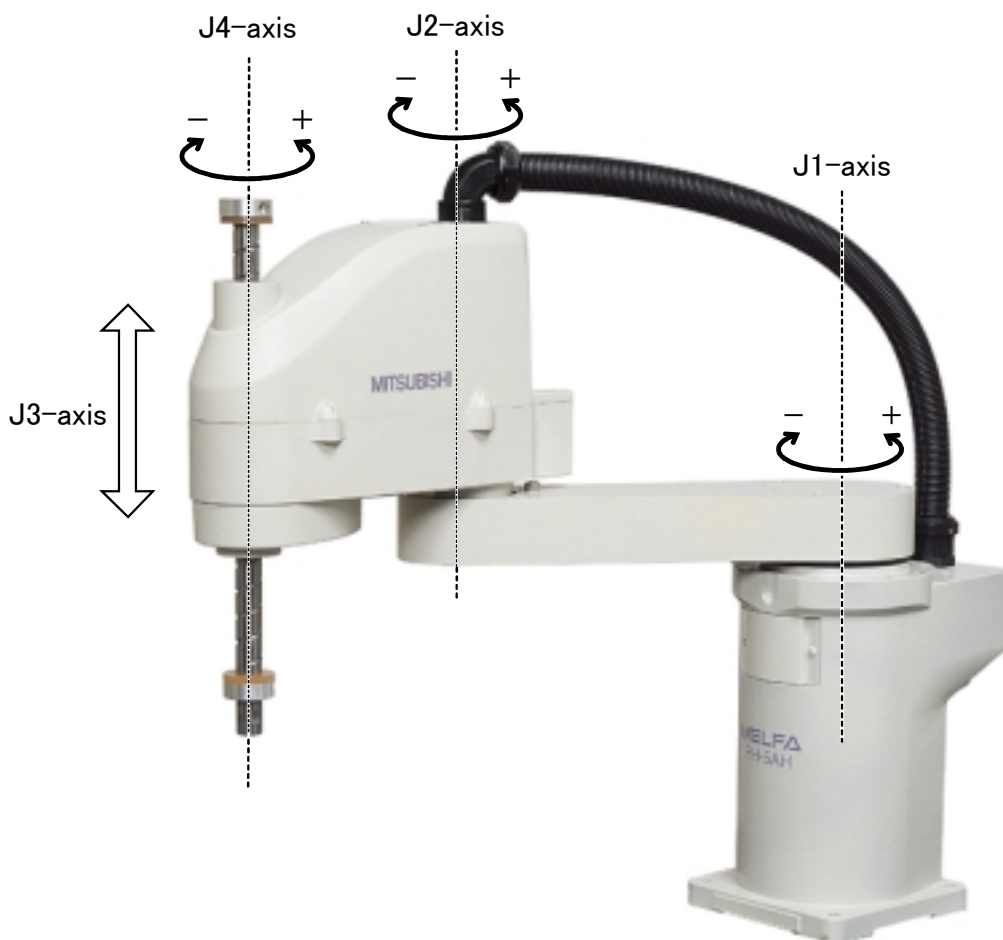
Fig.2-12 : JOINT jog operation
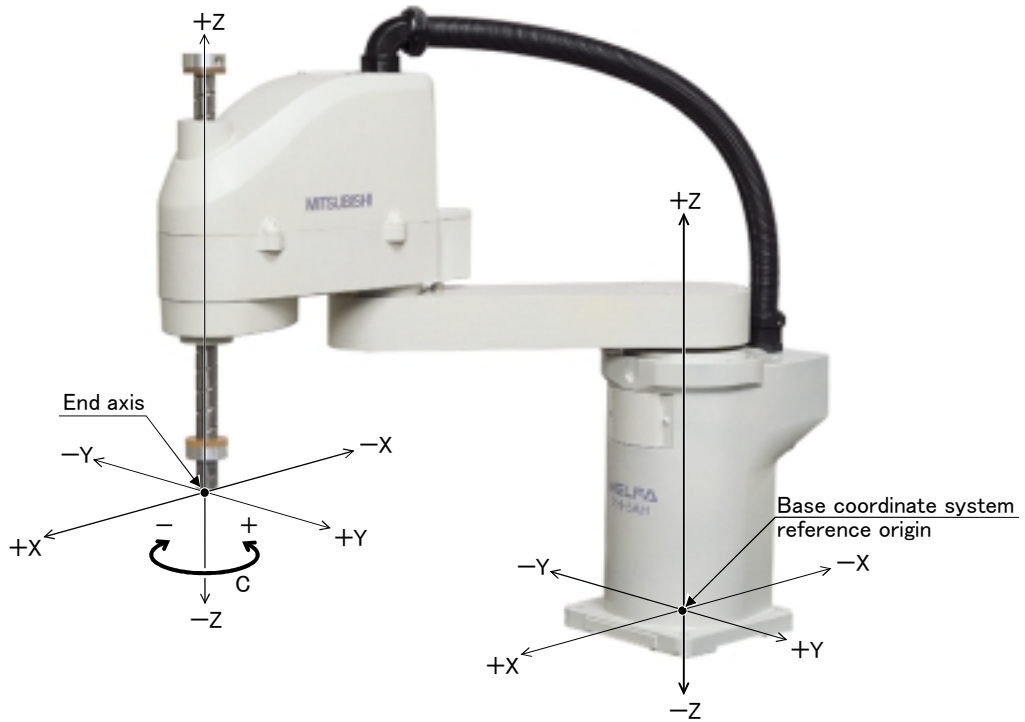
* While maintaining the posture of the end axis, the robot moves straight along the base coordinate system. The end axis rotates.

Fig.2-13 : XYZ jog operation
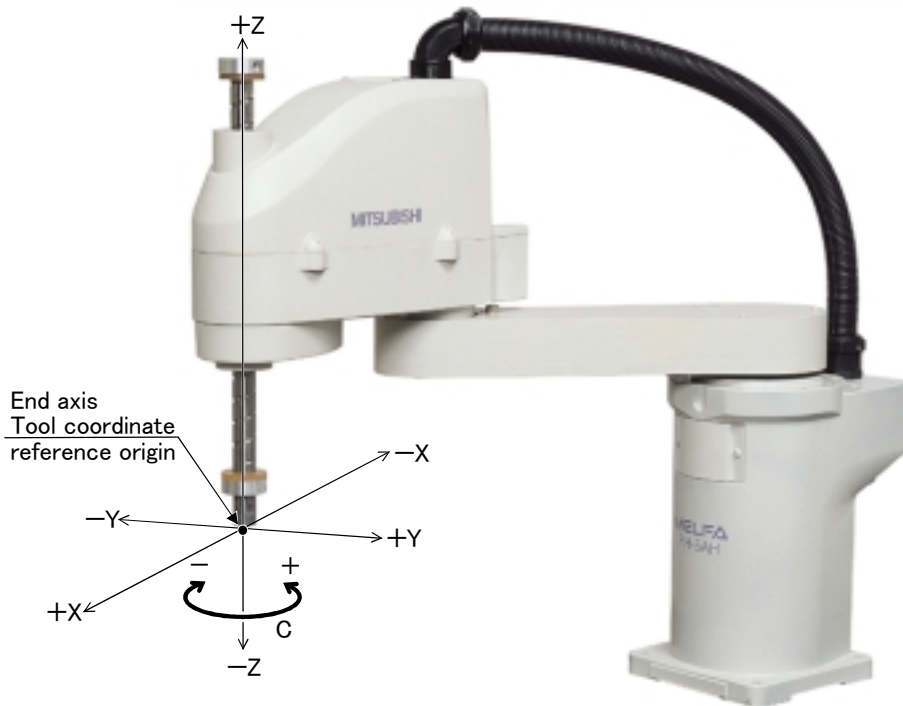
* While maintaining the posture of the end axis, the robot moves straight along the tool coordinate system. The end axis changes directions while maintainingits position.

Fig.2-14 : TOOL jog operation
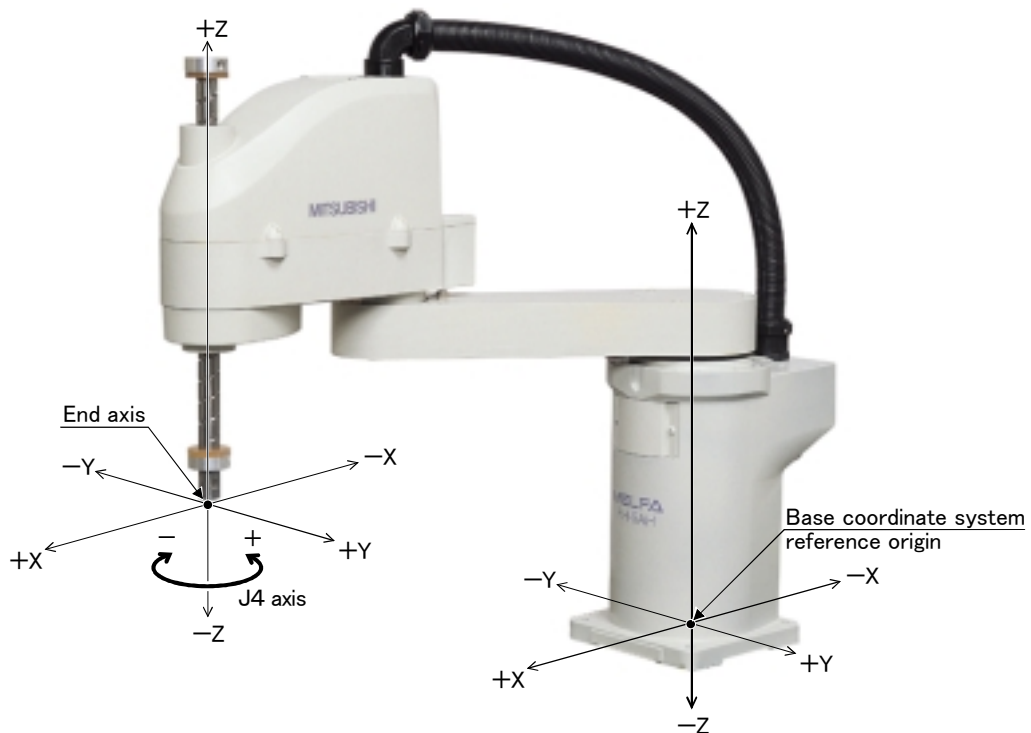
* The robot moves straight along the base coordinate system. The direction of the end axis is not maintained during this type. The direction of the end axis changes. At this time, the end axis position will change.

Fig.2-15 : 3-axis XYZ jog operation
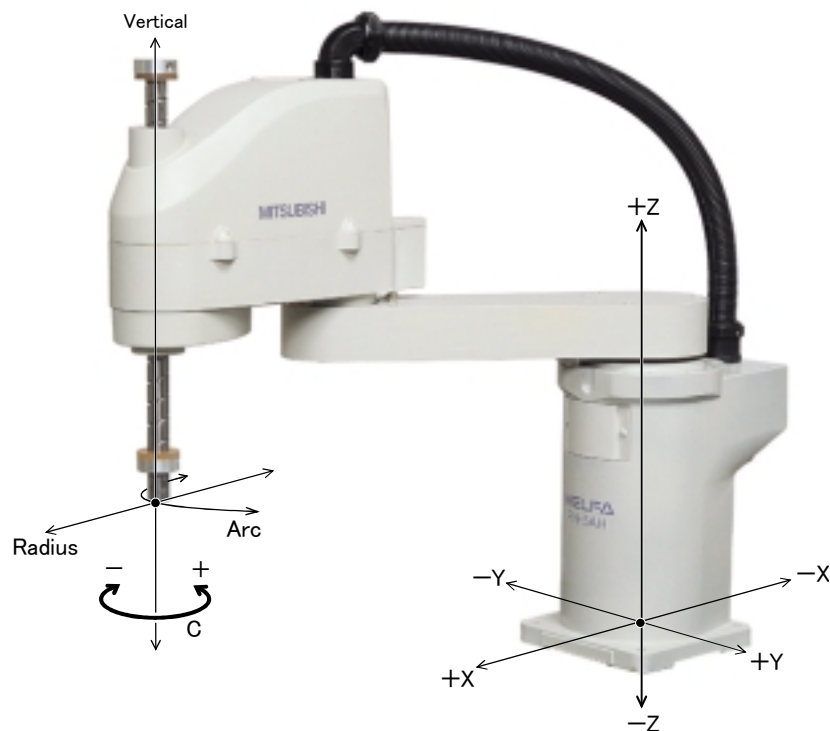
* With an arc using the end axis position as the center of the Z axis, the robot moves over the arc, expands and contracts in the radial direction, and moves vertically. At this time, the posture of the end axis is maintained. The direction is changed while maintaining the end axis position.

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
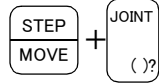
STEP / MOVE + JOINT / ( )?

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

STEP / MOVE + + / FORWD − / BACKWD

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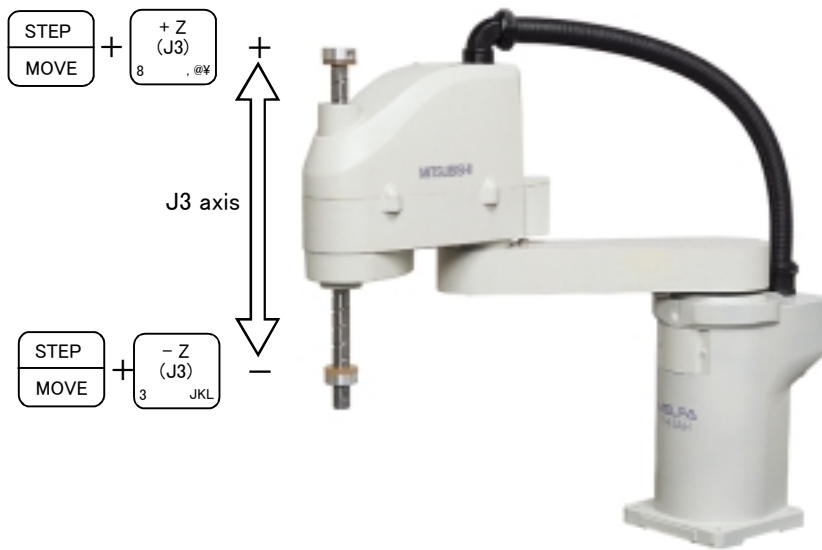
· When the [MOVE] + [+Z (J3)] keys are pressed, the J3 axis will rotate in the plus direction.
  When the [MOVE] + [-Z (J3)] keys are pressed, Rotate in the minus direction.

J4 axis jog operation
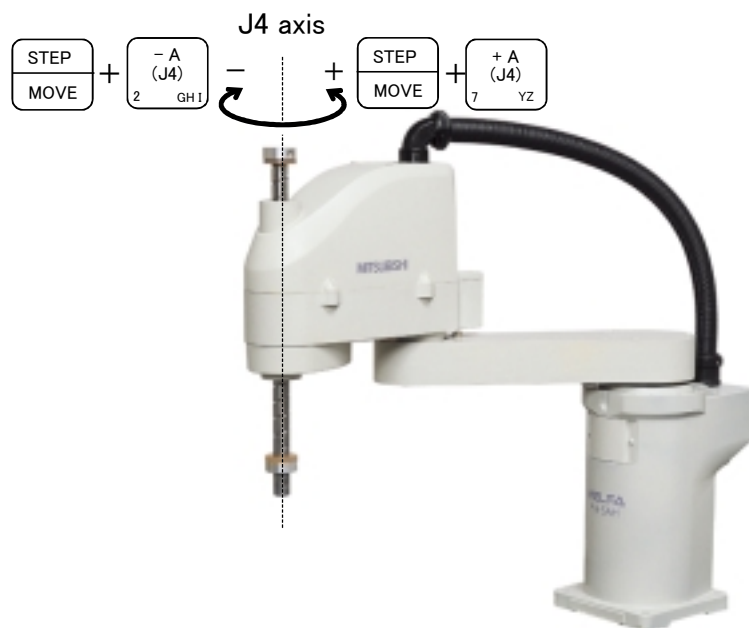
· When the [MOVE] + [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
  When the [MOVE] + [-A (J4)] keys are pressed, Rotate in the minus direction.

◇◆◇ When an �é 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

```
X,Y,Z        LOW
   X  +134.50
   Y  +220.00
   Z  +280.00
```
XYZ jog mode [STEP/MOVE] + [XYZ / $";]

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

```
X,Y,Z        LOW
   X  +134.50
   Y  +220.00
   Z  +280.00
```
Set the speed [STEP/MOVE] + [+ FORWD] [− BACKWD]

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 ☒ will appear on the T/B screen, and the robot will not move. Refer to section Page 22, "(1) JOINT jog operation" on page", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇ When an ☒ appears on the T/B screen display ◇◆◇
   If the robot is moved outside the movement area with any of the axes, an ☒ will appear. In this case, move the axis in the opposite direction.

```
XYZ          LOW
☒X   +360.00
☒Y   +280.00
☒Z   +170.00
```

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

Changing the direction of the end axis

· 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.

*The Position of the end axis will not change.

◇◆◇ 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

```
TOOL      LOW
  X   +134.50
  Y   +220.00
  Z   +280.00
```

TOOL jog mode   [STEP/MOVE] + [TOOL =*/]

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

```
TOOL      LOW
  X   +134.50
  Y   +220.00
  Z   +280.00
```

Set the speed   [STEP/MOVE] + [+ FORWD] [− BACKWD]

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
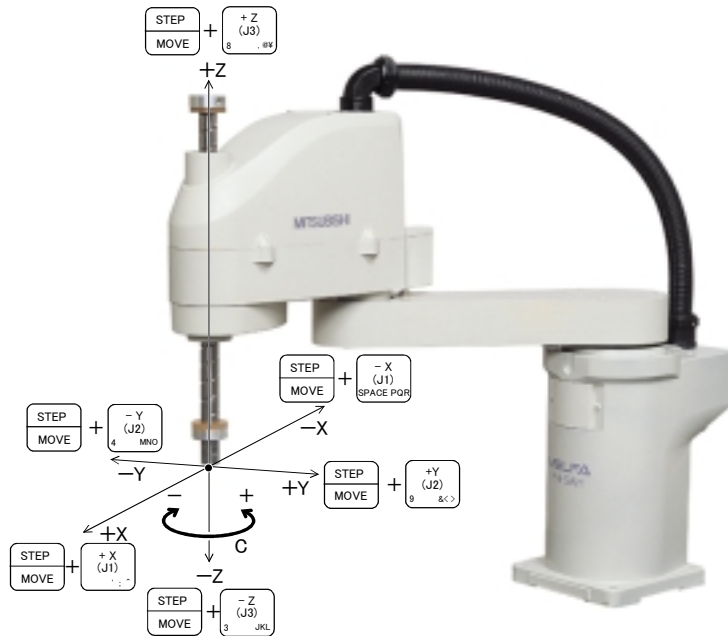
[STEP/MOVE] + [+Z (J3) 8 .@V]   +Z

[STEP/MOVE] + [−X (J1) SPACE PQR]   −X

[STEP/MOVE] + [−Y (J2) 4 MNO]   −Y

[STEP/MOVE] + [+X (J1) :.]   +X

[STEP/MOVE] + [+Y (J2) 9 &<>]   +Y

C

−Z

[STEP/MOVE] + [−Z (J3) 3 JKL]

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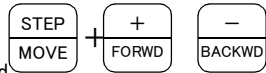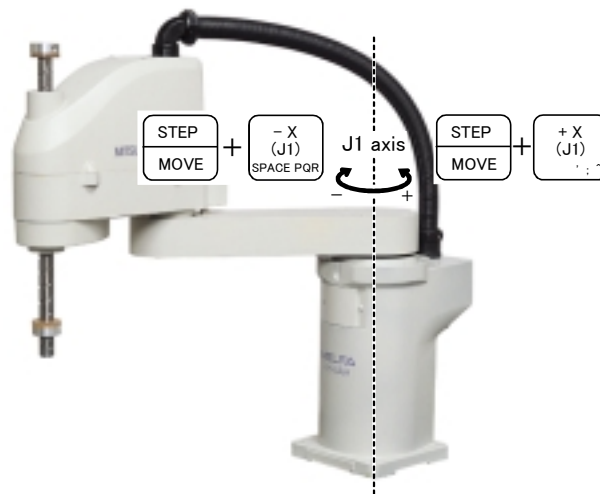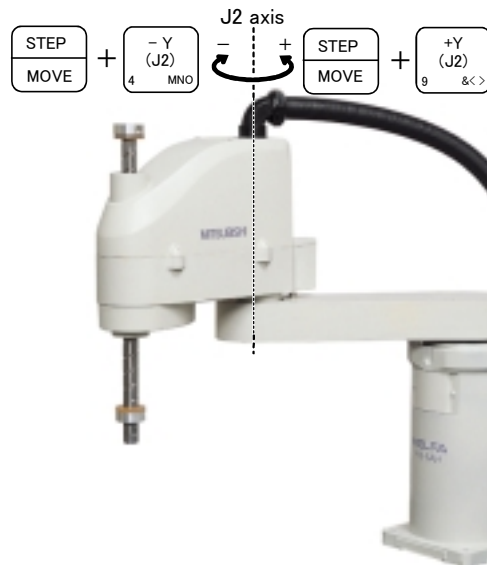When the [MOVE] + [−X (J 1)] keys are pressed, the robot will move along the minus direction.

· 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 ✕ will appear on the T/B screen, and the robot will not move. Refer to section Page 22, "(1) JOINT jog operation" on page, and move the robot to a position where linear movement is possible, and then carry out TOOL

◇◆◇ When an ✕ appears on the T/B screen display ◇◆◇
If the robot is moved outside the movement area with any of the axes, an ✕ will appear. In this case, move the axis in the opposite direction.

```
TOOL        LOW
✕X    +360.00
✕Y    +280.00
✕Z    +170.00
```

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

Rotating the end axis

・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.

*The Position of the end axis will not change.

◇◆◇ 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

```
XYZ456        LOW
   X  +134.50
   Y  +220.00
   Z  +280.00
```
3-axis XYZ jog mode

[STEP/MOVE] + [XYZ $"] [XYZ $"]

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

```
XYZ456        LOW
   X  +134.50
   Y  +220.00
   Z  +280.00
```
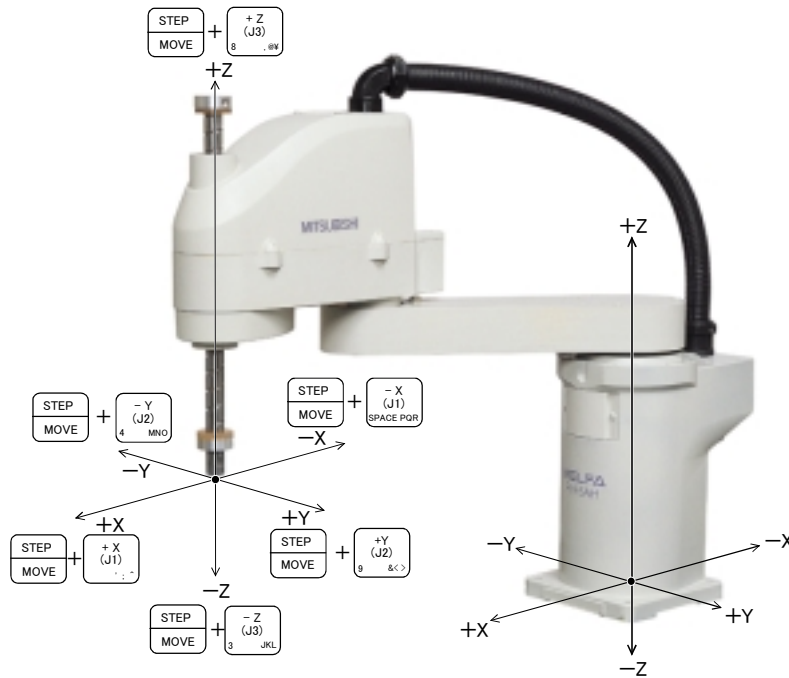Set the soeed

[STEP/MOVE] + [+ FORWD] [− BACKWD]

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.

◇◆◇ Jog mode will change when only [XYZ] key is pressed again ◇◆◇
When the [MOVE] + [XYZ] keys are pressed and then only the [XYZ] key is pressed, the upper left display will change in the order of "XYZ" → "XYZ456" → "CYLNDER". Each jog mode can be selected.

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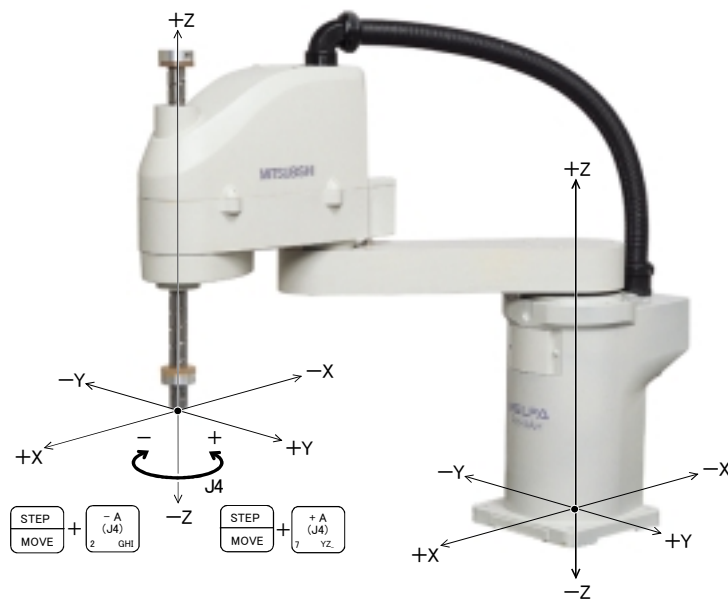
· Rotating around the Z axis
When the [MOVE] + [+C (J4)] keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system. When the [MOVE] + [−C (J4)] keys are pressed, the Z axis will rotate in the minus direction.

＊The Position of the end axis will not change.

(5) CYLNDER jog operation

Select the cylindrical jog mode
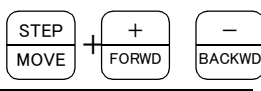
```
CYLNDER   LOW
  R  +134.50
  T  +220.00
  Z  +280.00
```
CYLNDER jog mode [STEP/MOVE] + [XYZ/$":]

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

```
CYLNDER   LOW
  R  +134.50
  T  +220.00
  Z  +280.00
```
Set the speed [STEP/MOVE] + [+/FORWD] [−/BACKWD]

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

[STEP/MOVE] + [+Z (J3) 8 .@¥]
Vertical ↑

[STEP/MOVE] + [−Y (J2) 4 MNO]

[STEP/MOVE] + [−X (J1) SPACE PQR]

Radius

Arc

[STEP/MOVE] + [+Y (J2) 9 &<>]

[STEP/MOVE] + [+X (J1) ; :]

− +
C

[STEP/MOVE] + [−Z (J3) 3 JKL]

+Z

−Y   −X

+X   +Y

−Z
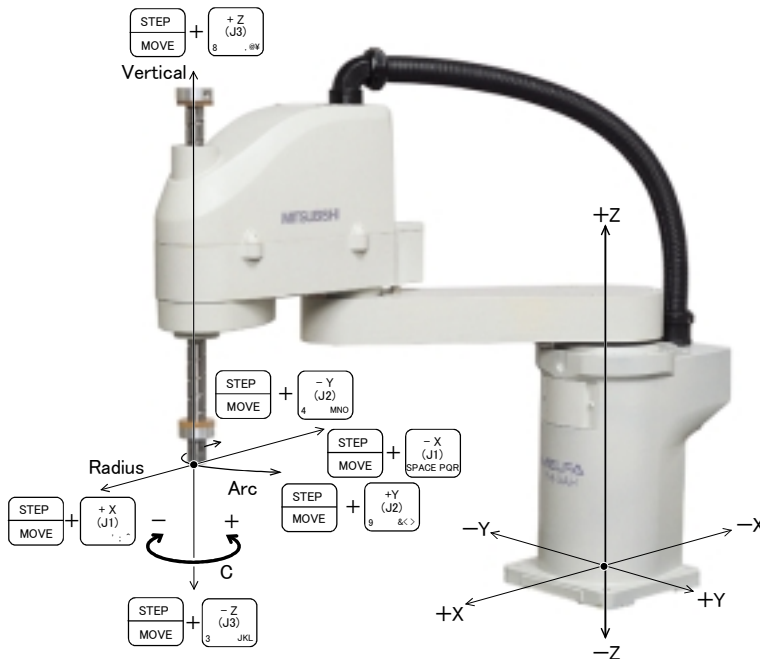
*The direction of the end axis will not change.

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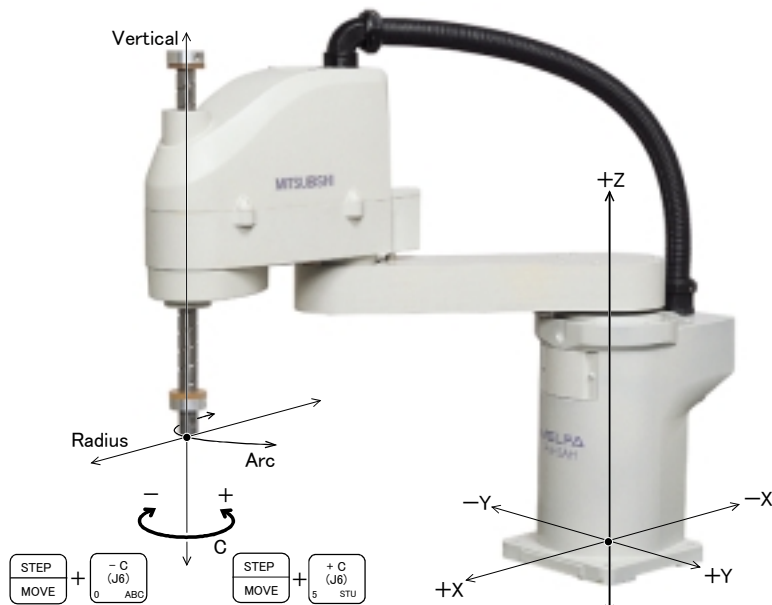
· Rotating around the Z axis
When the [MOVE] + [+C (J4)] keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system.
When the [MOVE] + [−C (J4)] keys are pressed, the Z axis will rotate in the minus direction.

*The Position of the end axis will not change.

3 Installing the option devices

3.1 Installing the solenoid valve set (general enveronment specifications)
(1) RH-5AH (1E-VD01/VD01E/VD02/VD02E/VD03/VD03E/VD04/VD04E)
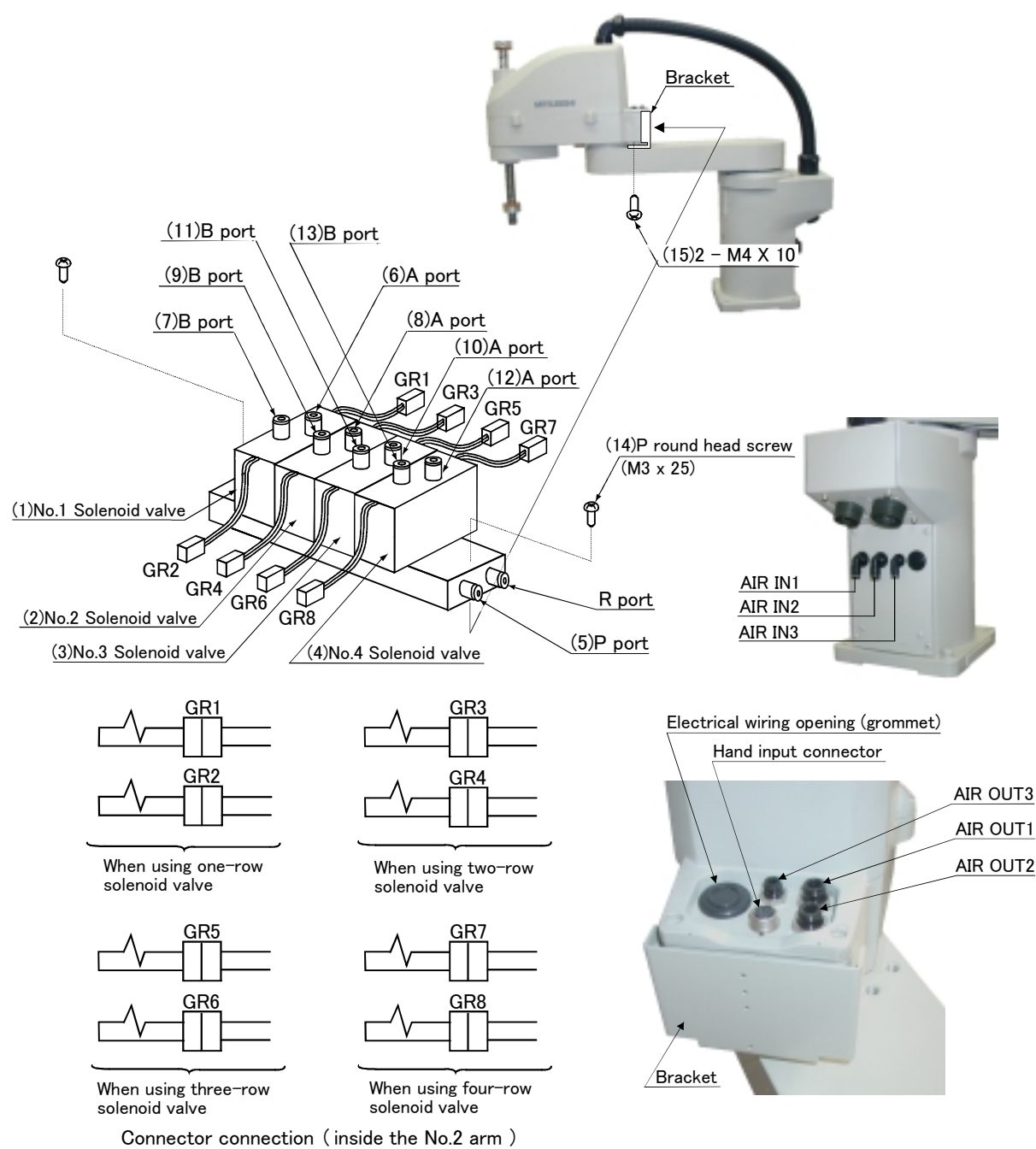
Fig.3-1 : Solenoid valve installation procedures (RH-5AH)

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.

1) Attach the bracket with the two screws (15) provided (M4 x 10) to the hole at the back of the No. 2 arm of the robot. Attach the solenoid valve to the bracket with the two screws (14) provided (M3 x 25).

2) Connect the quick coupling (port P) (5) for the solenoid valve and either AIR OUT1 or AIR OUT2 of the rear end of the No. 2 arm with the air hose on the primary air-supply side (φ 6, provided by the customer).

3) Connect the air hose on the primary air-supply side (φ 6, provided by the customer) to either AIR IN1 or AIR IN2 of the rear section of the base unit.

4) Connect the secondary piping couplings (6) to (13) and the hand (provided by the customer) to the secondary-piping air hose (provided by the customer) at about the 800 mm position.

5) Connect the GR1 plug coming from the No. 1 solenoid valve (1) to the GR1 connector in the No. 2 arm of the robot.
The cover U of the No. 2 arm must be removed before performing connections. Pierce through the center area of the electrical wiring opening grommet with a knife to let the connector on the solenoid valve side feed through. (Repeat when necessary.)
Connect the GR2 plug coming from the No. 1 solenoid valve (1) to the GR2 connector in the No. 2 arm of the robot.

In the case of a two sets valve (1E-VD02/1E-VD02E),
 also connect the GR3 plug coming from the No. 2 solenoid valve (2) to the GR3 connector in the No. 2 arm of the robot.
Then, connect the GR4 plug coming from the No. 2 solenoid valve (2) to the GR4 connector in the No. 2 arm of the robot.

In the case of a three sets valve (1E-VD03/1E-VD03E),
 also connect the GR5 plug coming from the No. 3 solenoid valve (3) to the GR5 connector in the No. 2 arm of the robot.
Then, connect the GR6 plug coming from the No. 3 solenoid valve (3) to the GR6 connector in the No. 2 arm of the robot.

In the case of a four sets valve (1E-VD04/1E-VD04E),
 also connect the GR7 plug coming from the No. 4 solenoid valve (4) to the GR7 connector in the No. 2 arm of the robot.
Then, connect the GR8 plug coming from the No. 4 solenoid valve (4) to the GR8 connector in the No. 2 arm of the robot.

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	A	1 st row
	CLOSE	B	
Hand 2	OPEN	A	2 nd row
	CLOSE	B	
Hand 3	OPEN	A	3 rd row
	CLOSE	B	
Hand 4	OPEN	A	4 th row
	CLOSE	B	

(2) RH−10AH/15AH（1N−VD01/VD01E/VD02/VD02E/VD03/VD03E/VD04/VD04E）
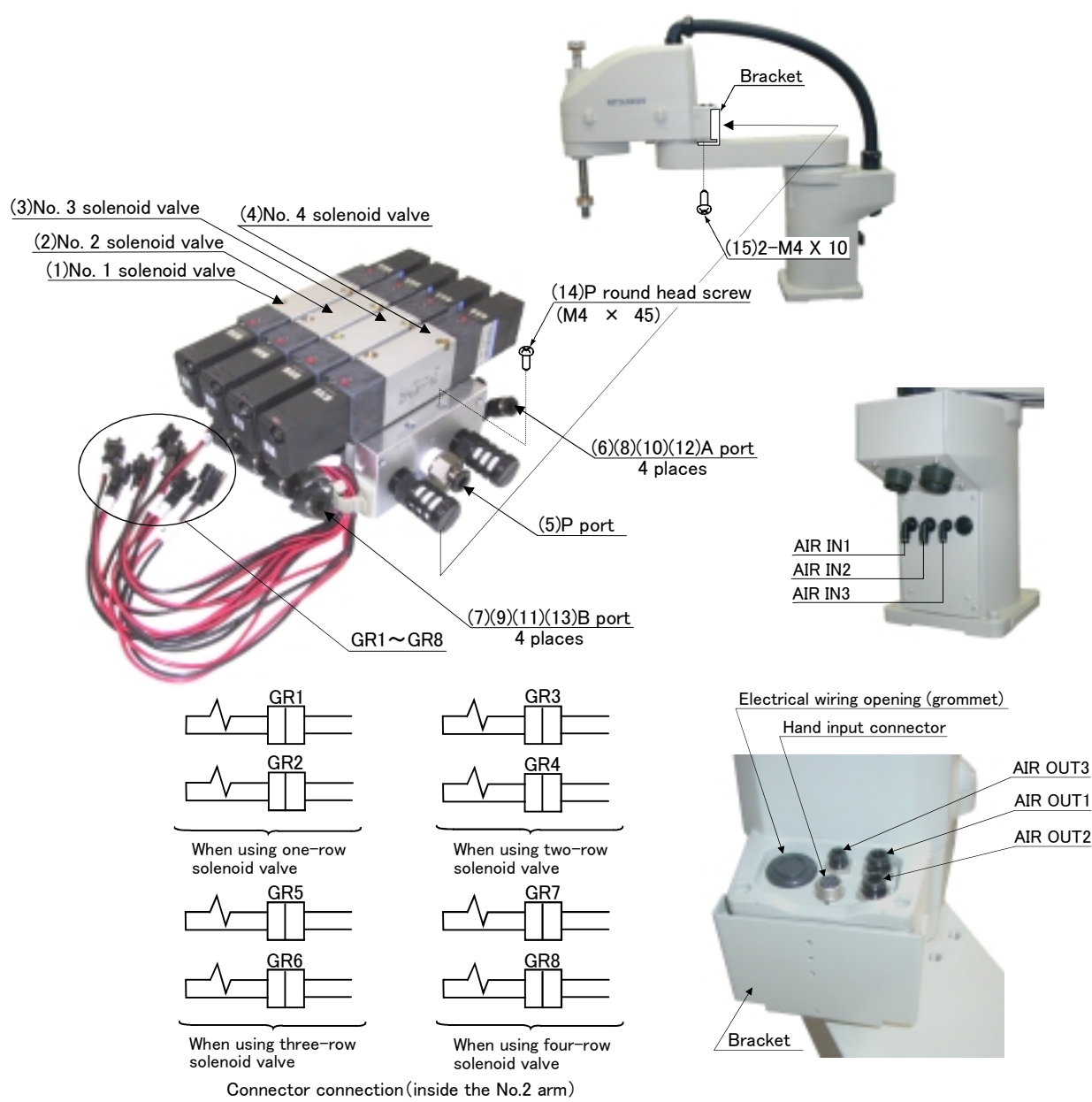
Fig.3−2 : Solenoid valve installation procedures (RH−10AH/15AH)

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.

1) Attach the bracket with the two screws (15) provided (M4 x 10) to the hole at the back of the No. 2 arm of the robot. Attach the solenoid valve to the bracket with the four screws (14) provided (M4 x 45).

2) Connect the quick coupling (port P) (5) for the solenoid valve and either AIR OUT1 or AIR OUT2 of the rear end of the No. 2 arm with the air hose on the primary air−supply side (φ 6, provided by the customer).

3) Connect the air hose on the primary air−supply side (φ 6, provided by the customer) to either AIR IN1 or AIR IN2 of the rear section of the base unit.

4) Connect the secondary piping couplings (6) to (13) and the hand (provided by the customer) to the secondary−piping air hose (provided by the customer) at about the 1,200 mm position.

5) Connect the GR1 plug coming from the No. 1 solenoid valve (1) to the GR1 connector in the No. 2 arm of the robot.
   The cover U of the No. 2 arm must be removed before performing connections. Pierce through the center area of the electrical wiring opening grommet with a knife to let the connector on the solenoid valve side feed through. (Repeat when necessary.)

Connect the GR2 plug coming from the No. 1 solenoid valve (1) to the GR2 connector in the No. 2 arm of the robot.

In the case of a two sets valve (1N-VD02/1N-VD02E),
 also connect the GR3 plug coming from the No. 2 solenoid valve (2) to the GR3 connector in the No. 2 arm of the robot.
Then, connect the GR4 plug coming from the No. 2 solenoid valve (2) to the GR4 connector in the No. 2 arm of the robot.

In the case of a three sets valve (1N-VD03/1N-VD03E),
 also connect the GR5 plug coming from the No. 3 solenoid valve (3) to the GR5 connector in the No. 2 arm of the robot.
Then, connect the GR6 plug coming from the No. 3 solenoid valve (3) to the GR6 connector in the No. 2 arm of the robot.

In the case of a four sets valve (1N-VD04/1N-VD04E),
 also connect the GR7 plug coming from the No. 4 solenoid valve (4) to the GR7 connector in the No. 2 arm of the robot.
Then, connect the GR8 plug coming from the No. 4 solenoid valve (4) to the GR8 connector in the No. 2 arm of the robot.

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

Table 3-2 : Solenoid valve ports and hoses: Correspondence of couplings and hand ports

Hand	Hand port	Solenoid valve port	Solenoid valve used
Hand 1	OPEN	A	1 st row
	CLOSE	B	
Hand 2	OPEN	A	2 nd row
	CLOSE	B	
Hand 3	OPEN	A	3 rd row
	CLOSE	B	
Hand 4	OPEN	A	4 th row
	CLOSE	B	

3.2 Installing the solenoid valve set (protection env150enment specifications)

RH-5AH series
1A-VD01M-01/VD01ME-01/VD02M-01/VD02ME-01/VD03M-01/VD03ME-01/VD04M-01/VD04ME-01
RH-10AH/15AH series
1A-VD01M-02/VD01ME-02/VD02M-02/VD02ME-02/VD03M-02/VD03ME-02/VD04M-02/VD04ME-02
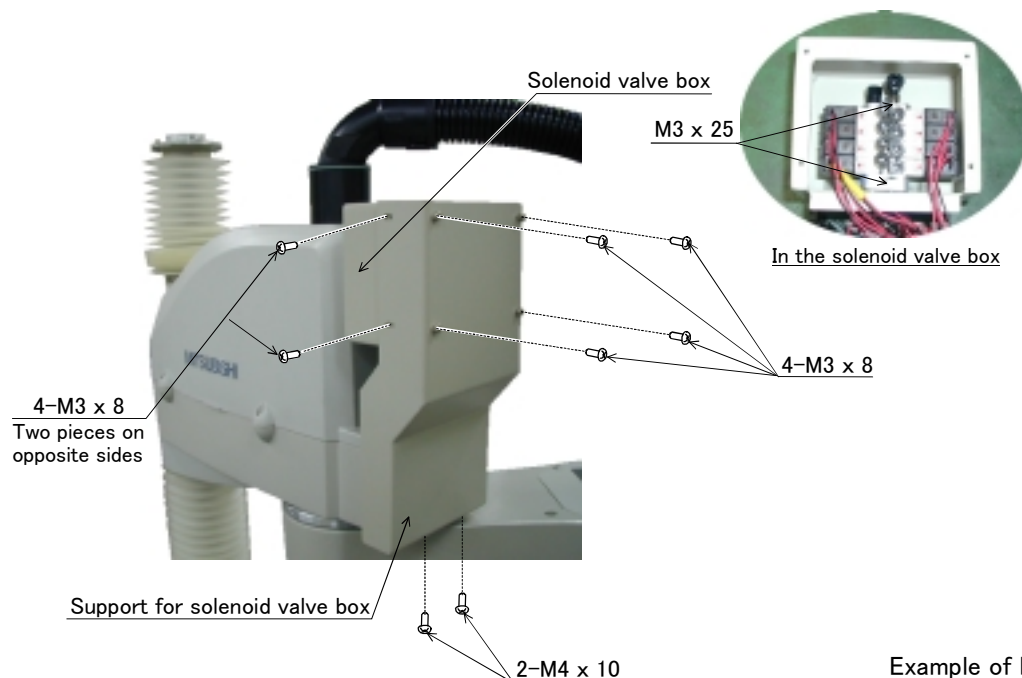
Fig.3-3 : Solenoid valve installation procedures

Fig. 3-3 shows how to install the solenoid valve set and how to connect the solenoid valve connector. The solenoid valve must be installed in the solenoid valve box. Turn the power supply to the controller off when performing this operation. Turn off the power supply when performing this operation.

1) Install the solenoid valve in the solenoid valve box using the two M3 x 25 screws provided.
2) Perform the wiring and piping using the same installation procedure as described in steps 2) to 5) of Section "(1) RH-5AH (1E-VD01/VD01E/VD02/VD02E/VD03/VD03E/VD04/VD04E)" on page 33.
3) Install the solenoid valve box and support for the solenoid valve box using eight M3 x 8 screws. At this point, pull out the wiring and piping of the solenoid valve from the bottom of the box so that they do not overlap. Confirm that the wiring and piping are clamped with sealant.
4) Return the plugs GR1 to 8 inside the wiring port at the rear of robot's No. 2 arm.
After placing the connector inside No. 2 arm, surround the grommet with silicon rubber.
5) Install the solenoid valve box with the two M4 x 10 screws provided using the screw holes at the rear of robot's No. 2 arm.

[Caution] The hand output cable is located outside the solenoid valve box at the time of shipping. Even if this hand output cable will not be used, place the GR1 to GR8 plugs inside the wiring port, attach the supplied grommet, and then fill the fringe of the grommet with silicon rubber.

3.3 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.

3.4 Hand output cable (1N-GR35S)

This hand output cable is used by the user to connect to the handle output connector on the rear of the robot arm.

Refer to section Page 33, "(1) RH-5AH (1E-VD01/VD01E/VD02/VD02E/VD03/VD03E/VD04/VD04E)" on page, Table 3-1 for the connection methods.

In the case of clean specification or protrction specification models, after connecting the plugs GR1 to 8 inside the wiring port at the rear of robot's No. 2 arm, make a cut in the center of the wiring-port grommet using a cutter or similar tool, and let the lead through to the outside. Seal the grommet area with liquid sealant or similar material.

3.5 Installing the hand input cable (1A-HC35C) and hand curl tube (1E-ST040*C)

The hand input cable and hand curl tube are used to connect to the hand and sensor manufactured by the customer.

This option is not used for clean specification models. There is a risk that dust will be generated by friction between the cables. Examine the location of the cable clamp in order to reduce the friction as much as possible.

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).

0 Hr			
	Monthly inspection		
	Monthly inspection		
500 Hr	Monthly inspection	3-month inspection	
	Monthly inspection		
	Monthly inspection		
1000 Hr	Monthly inspection	3-month inspection	6-month inspection
	Monthly inspection		
	Monthly inspection		
1500 Hr	Monthly inspection	3-month inspection	
	Monthly inspection		
	Monthly inspection		
2000 Hr	Monthly inspection	3-month inspection	6-month inspection	Yearly inspection

(Daily inspection column spans the full vertical range)

Operating time

\<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. Note) Grease component may leak out in RH-5AHC**-SA as well. In this case, wipe away the grease (there is no need to 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 protrction 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 protrction specification).	Exchange it referring to Page 52, "5.3.4 Replacing Bellows"

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.
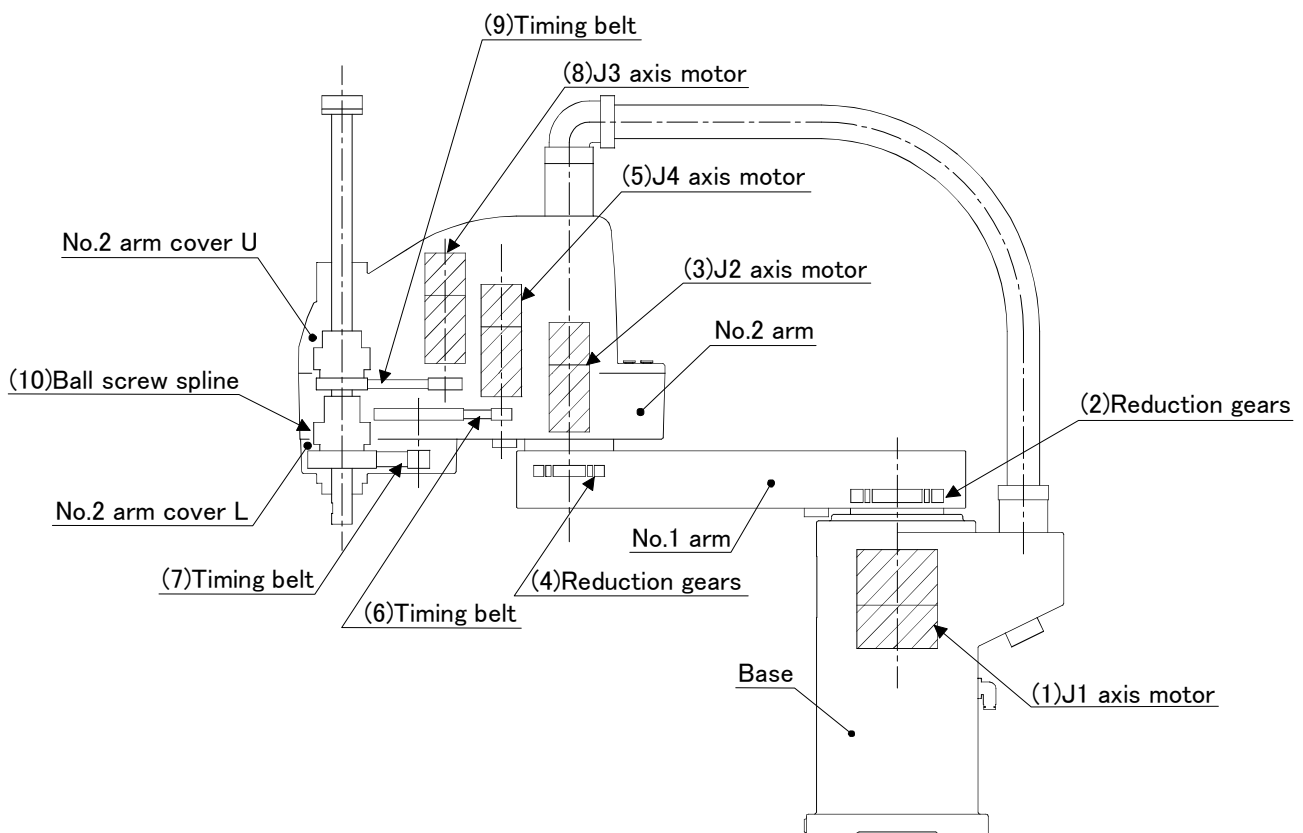
Fig.5-2 : Outline structure drawing of robot arm (Common to all type)

5.3.2 Installing/removing the cover
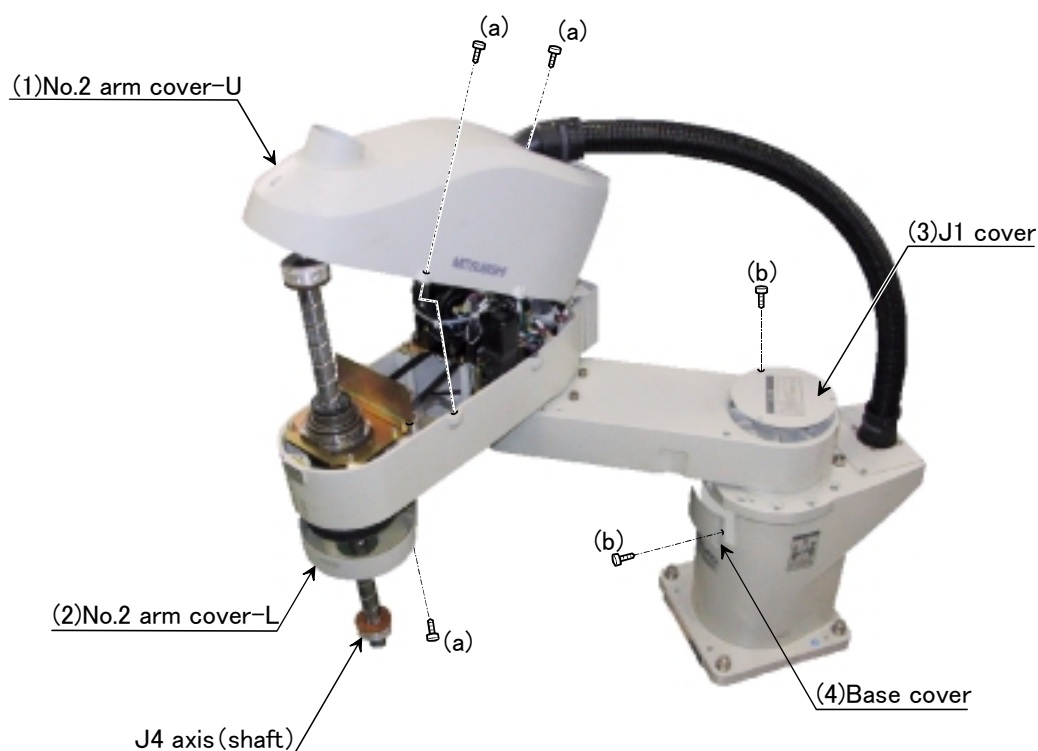
Fig.5-3 : Installing/removing the cover

Table 5-3 : Cover names

No.	Cover name	Q'ty	Installation bolt name	Remarks
(1)	No.2 arm cover-U	1	(a) Hexagonal socket-head cap screws, 10-M4 x 10 (RH-5AH series), , 11-M4 × 10 (RH-10AH/15AH series)	
(2)	No.2 arm cover-L	1	(a) Hexagonal socket-head cap screws, 3-M4 × 10	
(3)	J1 cover	1	(b) Truss-head screws, 3-M4 × 8	
(4)	Base cover	1	(b) Truss-head screws, 2-M4 × 8	

(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 protrction 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 protrction 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.

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

(7)Shaft
(6)Shaft inatallation screw
(3)J3 motor
(1)J3 motor inatallation screw
(4)Timing pulley
(Bottom of the J3 motor)
(2)Timing belt
(5)Timing pulley
(Bottom of the shaft)
(7)Shaft
(2)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 "(4) Timing belt tension" on page 51. Lightly press the center of the belt, and confirm that the value of belt slack is in following.
    RH-5AH........................... Force to press the belt: apprpx. 2N /Flexure: approx. 2.5mm
    RH-10AH/15AH........... 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 two J3 motor installation screws (1) for RH-5AH or three J3 motor installation screws (1) for RH-10AH/15AH(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-5AH........................... Force to press the belt : approx. 2N / Flexure: 2.5mm
    RH-10AH/15AH........... 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 according to steps 3) to 6) in " ■ Adjusting the J3 axis timing belt" and "(4) Timing belt tension" on page 51.
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) For more accurate tension adjustment, the use of the method as shown in Fig. 5-5 is recommended. Loosen the J3 motor installation screws (1), and then push the J3 motor (3) with a force of 65N for RH-5AH or 90N for RH-10AH/15AH using the push-pull gauge (8).

    12) 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.

(8)Push-pull gauge

(1)J3 motor inatallation screw

Remove the bracket attached vertically on the shaft fastening area.

Fig.5-5 : J3 axis timing belt tension

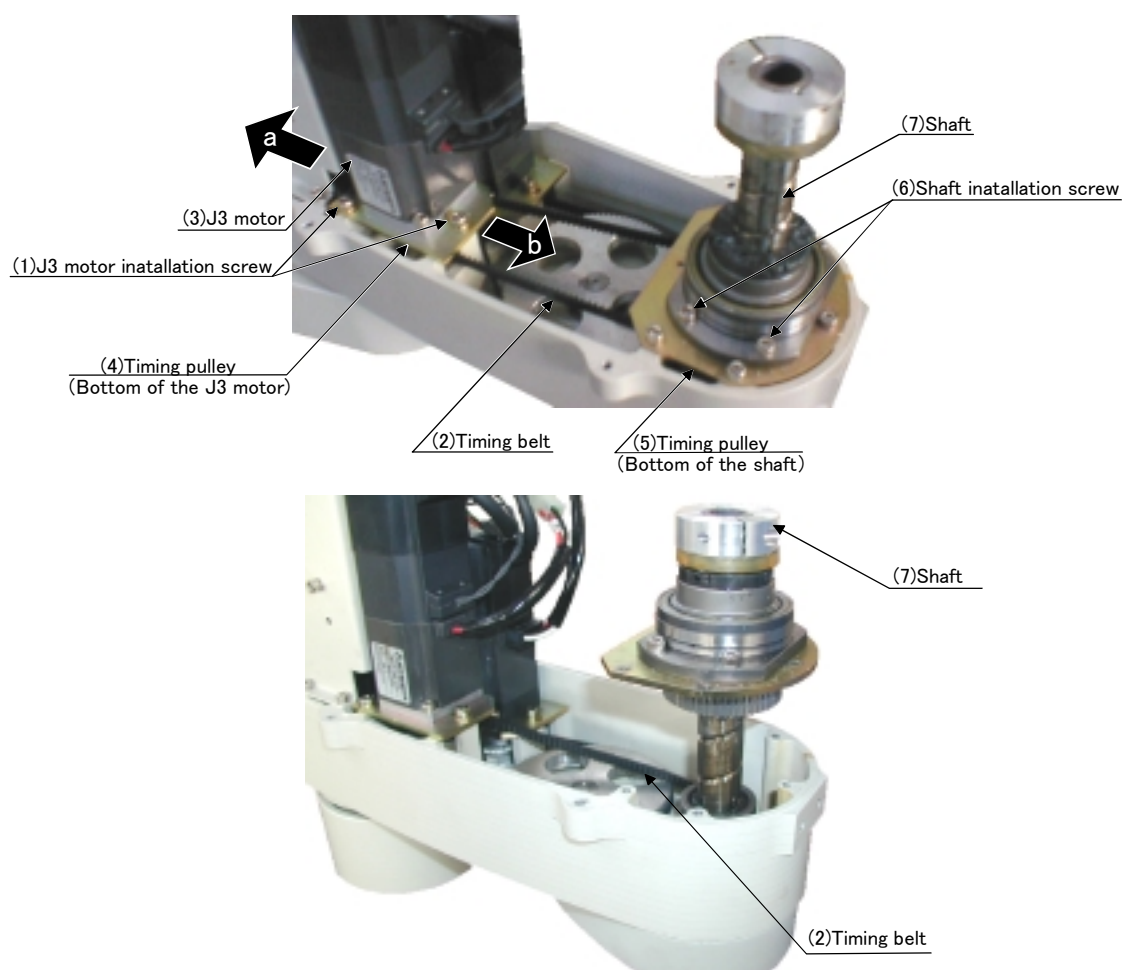(3) Inspection, maintenance and replacement of J4-axis timing belt
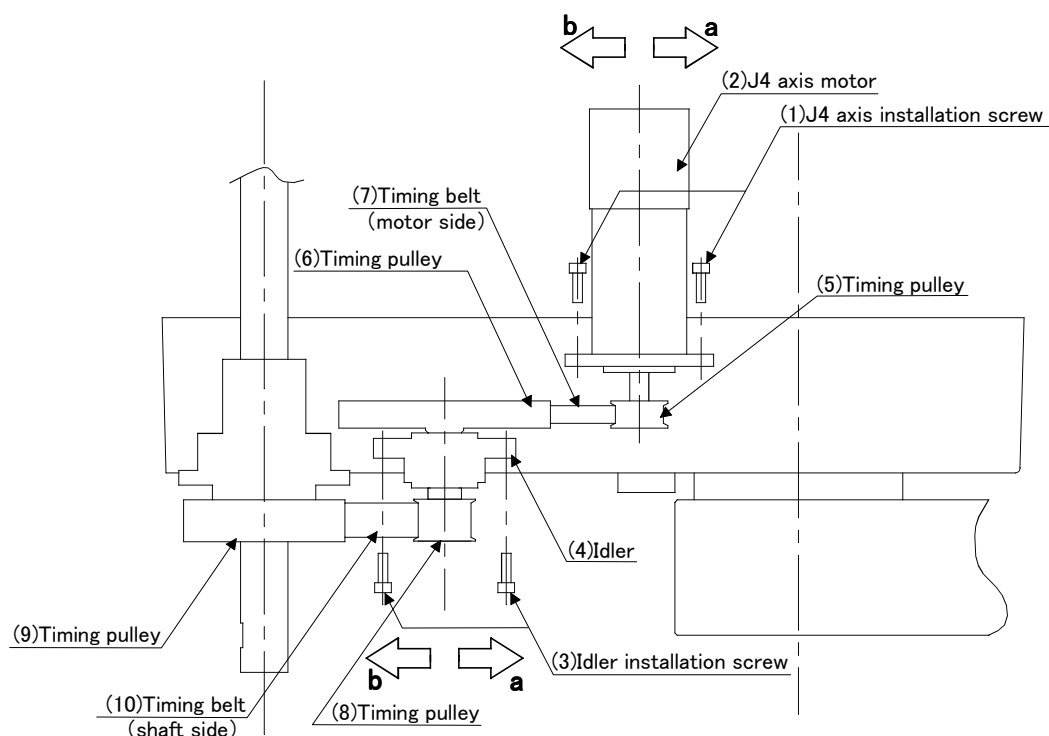
Fig.5-6 : Inspection, maintenance and replacement of J4-axis timing belt

■ 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 "(4) Timing belt tension" on page 51. Lightly press the center of the belt, and confirm that the value of belt slack is in following.
      RH-5AH 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-10AH/15AH 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 (shaft side) (10), move the idler (4) in the directions of the arrows indicated in the figure above. Lightly press down the center section of the belt (with a force of about 4N for RH-5AH or about 5N for RH-10AH/15AH), and then move the idler (4) so that the flexure of the timing belt (10) reaches about 1.2 mm for RH-5AH or about 1.7 mm for RH-10AH/15AH.
   4) While checking the tension of the timing belt (motor side) (7), move the J4 axis motor (2) in the directions of the arrows indicated in the figure above. Lightly press down the center section of the belt (with a force of about 2N), and then move the J4 axis motor (2) so that the flexure of the timing belt (7) reaches about 1.2 mm for RH-5AH or about 2.1 mm for RH-10AH/15AH.
   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 bolts (3) and J4 motor installation bolt (2). 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 "(4) Timing belt tension" on page 51. 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).
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.
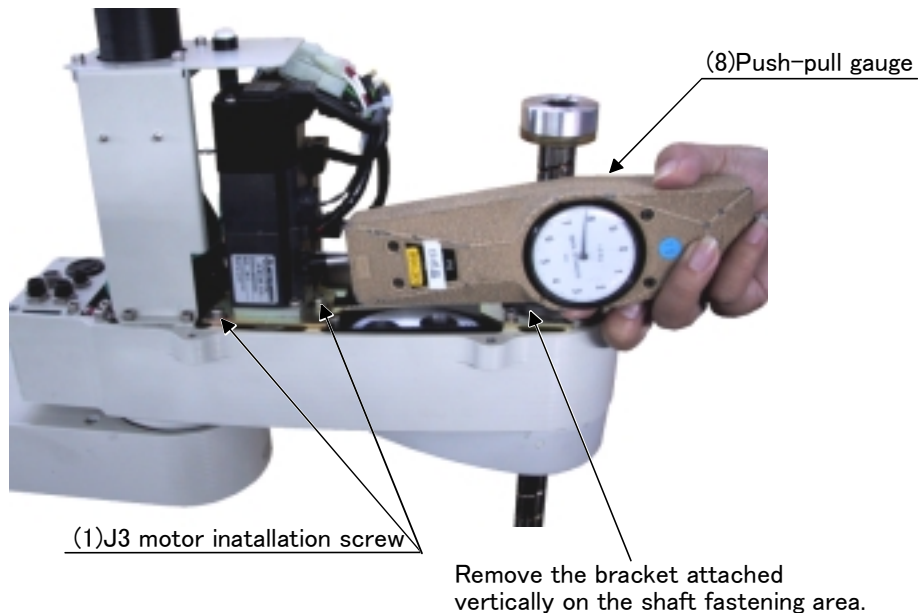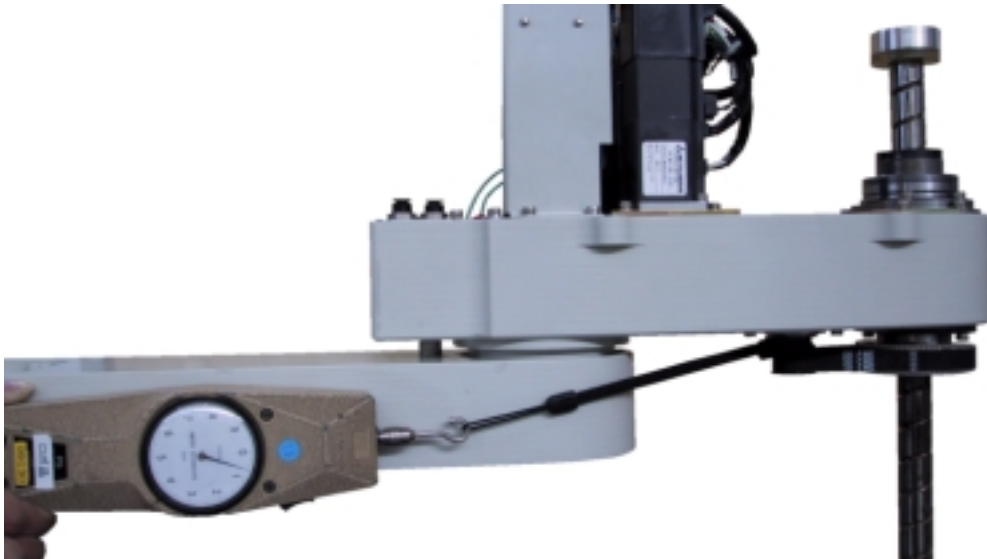

Fig.5-7 : J4 axis timing belt tension (1)
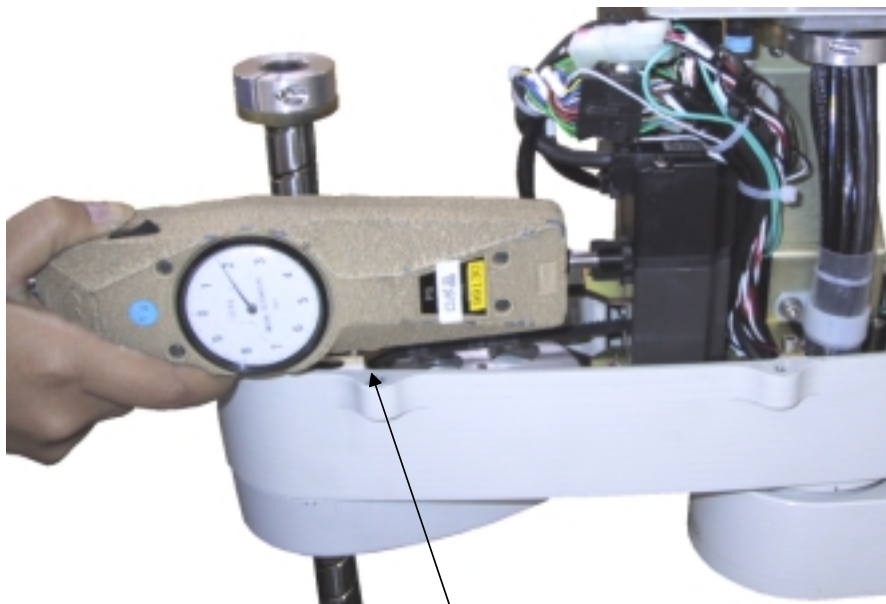
Remove the bracket attached vertically on the shaft fastening area.

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

(4) Timing belt tension

RH-5AH series

f : Pressing force
s : Span
d : Slack

Axis	Belt type	Span : s (mm)	Slack : d (mm)	Pressing force : f (N)
J3	351-3GT-6	159	2.5	2
J4 (Motor side)	453-3GT-6	79	1.2	2
J4(Shaft side)	303-3GT-12	75	1.2	4

Fig.5-9 : Belt tension(RH-5AH series)

RH-10AH/15AH series

f : Pressing force
s : Span
d : Slack

Axis	Belt type	Span : s (mm)	Slack : d (mm)	Pressing force : f (N)	Remarks
J3	666-3GT-12	239	3.7	4	RH-10AH55/70/85
	681-3GT-12	238	3.7	4	RH-15AH85
J4 (Motor side)	540-3GT-6	134	2.1	2	
J4(Shaft side)	471-3GT-15	107	1.7	5	
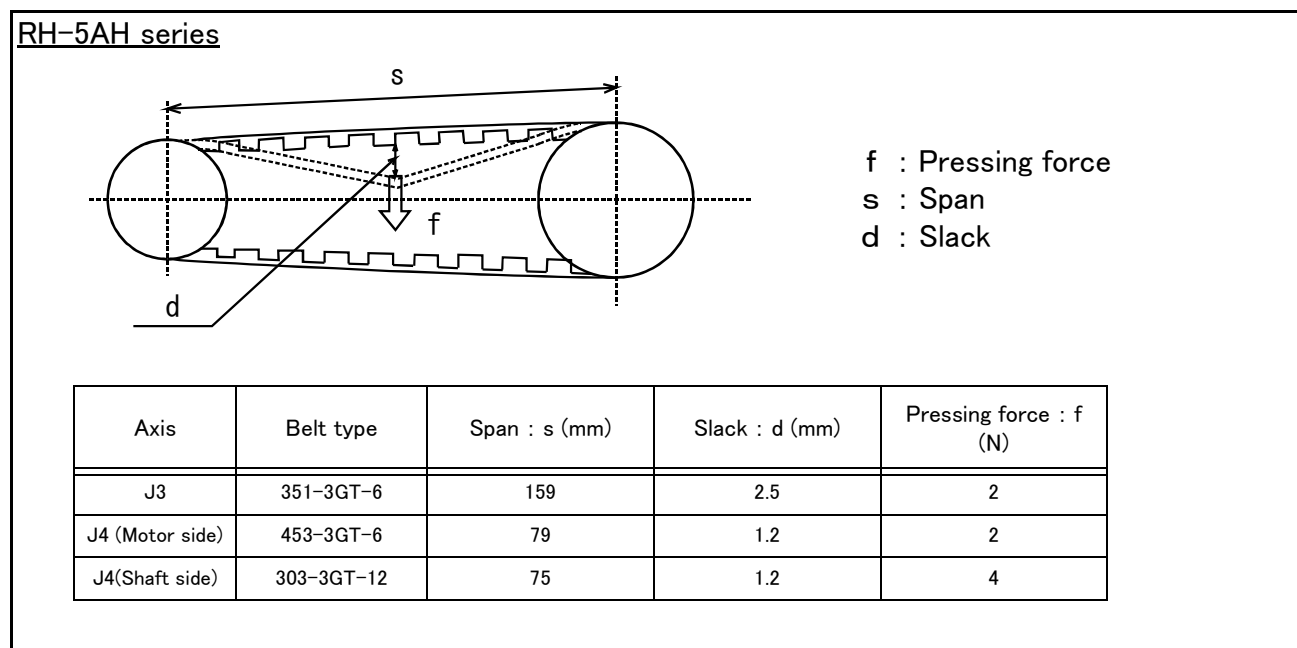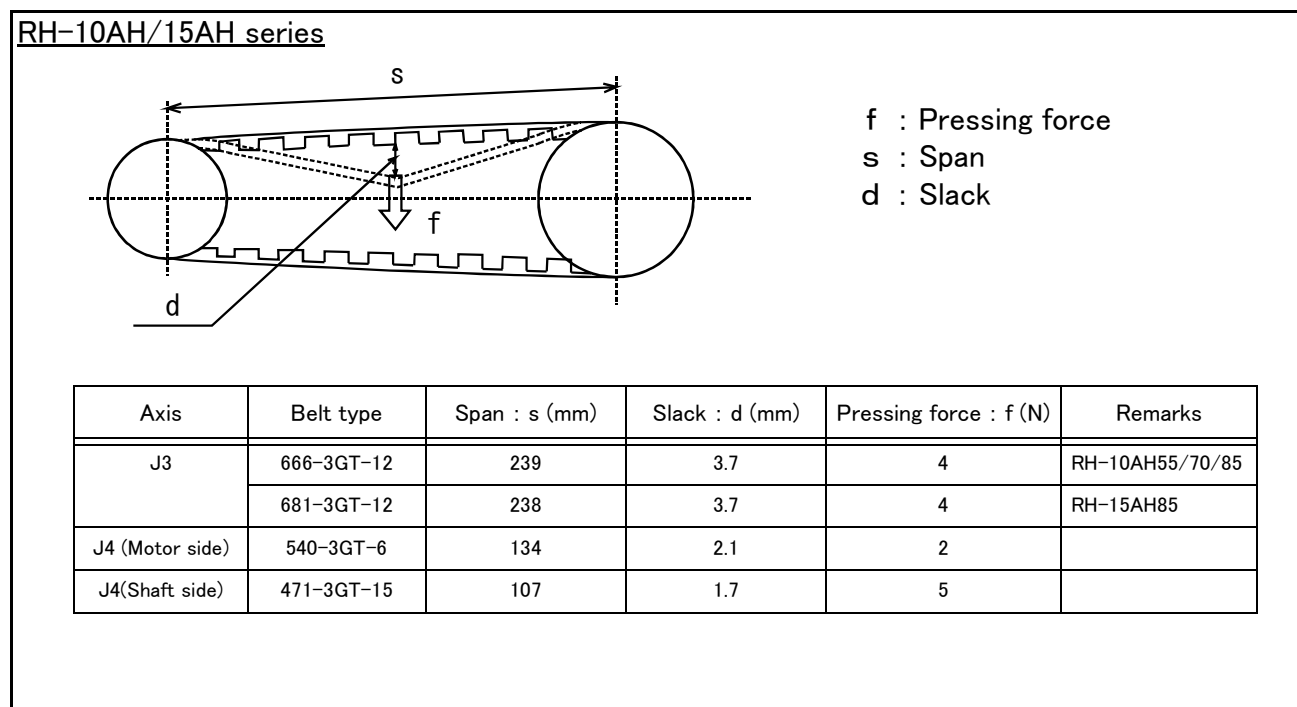
Fig.5-10 : Belt tension(RH-10AH/15AH series)

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 and Fig. 5-10.
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. 5-11 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.5-11 : 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.

(2) How to Replace the Bottom Bellows
　　　　Refer to Fig. 5-12 and replace the bottom 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.

図 5-12 : Replace the bottom 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

RH-5AH series
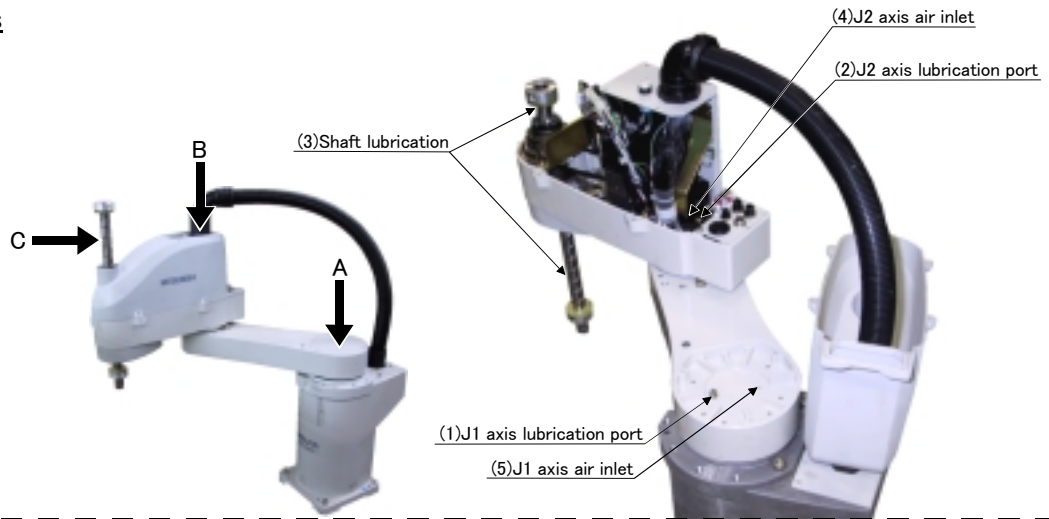
RH-10AH/15AH series
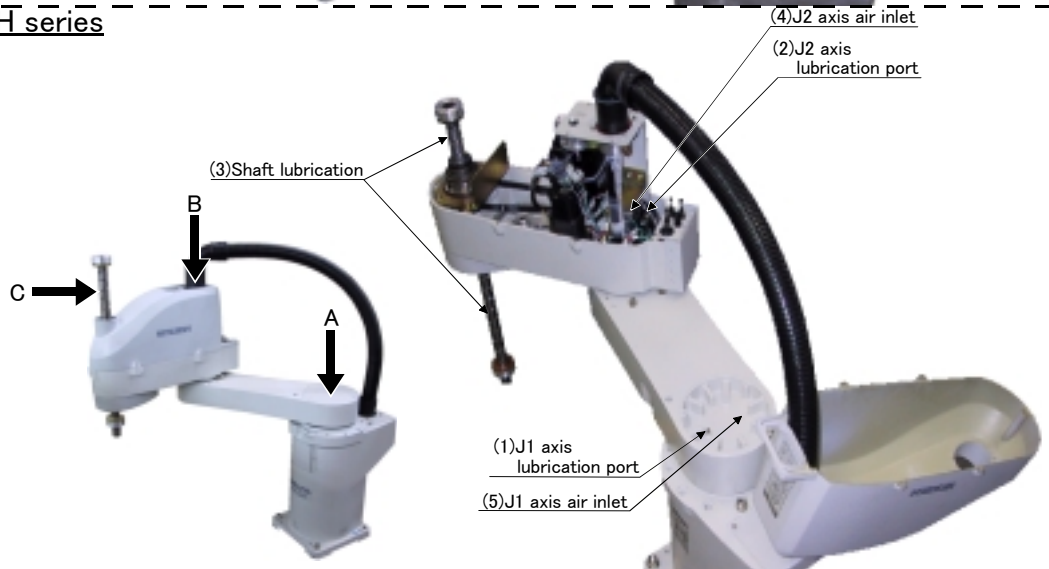
Fig.5-13 : Lubrication positions

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
RH-5AH series					
(1)	J1 axis reduc-tion gears	Grease nipple WC-610(Only addition)	Grease Harmonic grease SK-1A (Japan Harmonic Systems)	6,000Hr 3g	J1 cover
(2)	J2 axis reduc-tion gears			6,000Hr 2g	No. 2 arm cover-U
(3)	Shaft	Wipe the old grease, and paint	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 100km movement 1g	
RH-10AH/15AH series					
(1)	J1 axis reduction gears	Grease nipple WA-610(Only addition)	Grease Harmonic grease SK-1A (Japan Harmonic Systems)	6,000Hr 3g	J1 cover
(2)	J2 axis reduction gears			6,000Hr 2g	No. 2 arm cover-U
(3)	Shaft	Wipe the old grease, and paint	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 100km movement. 1g	

The grease nipple position is shown in Fig. 5-13. 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 sus-
    pended, 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 Table 5-4 correspond to the supply positions in Fig. 5-13.

(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 protrction 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 protrction 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 protrction specification and clean specification models, it is necessary to remove the top and bot-
    tom bellows. See Section Page 52, "5.3.4 Replacing Bellows" for details on how to remove them.
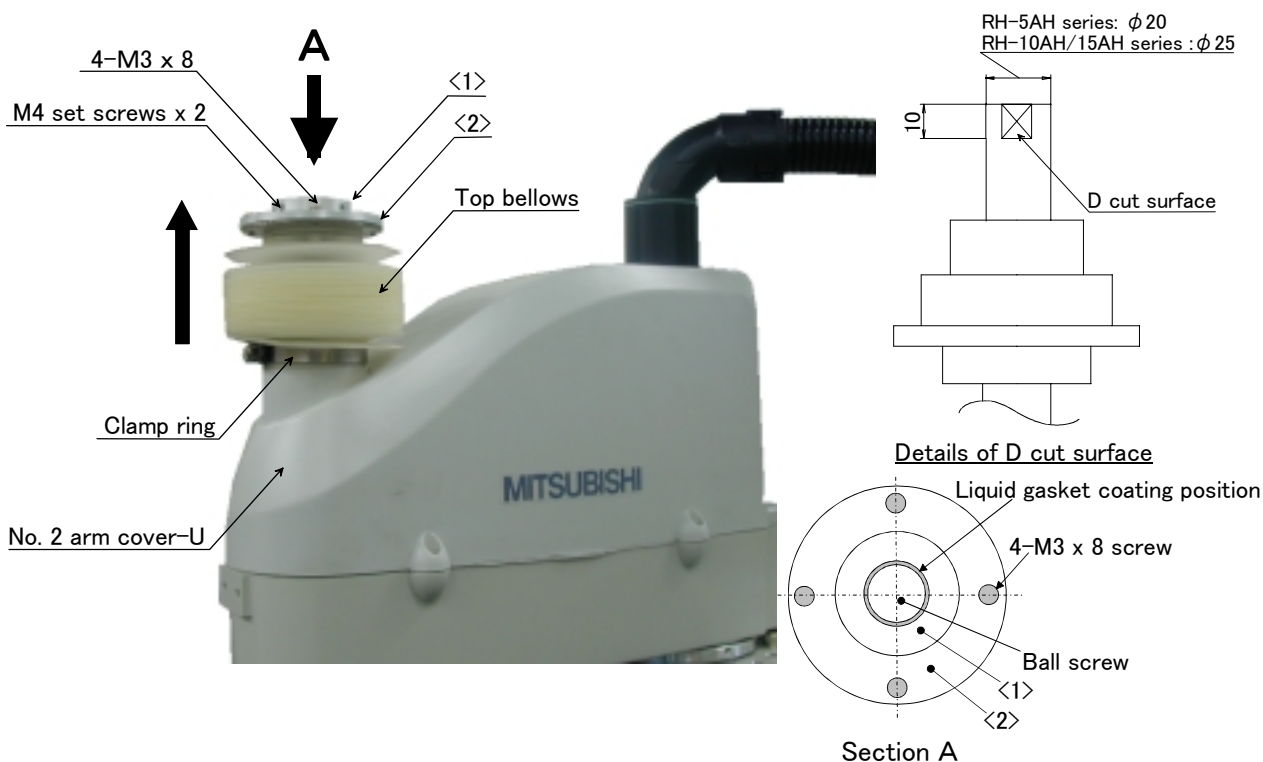
⚠ CAUTION   Replace the bellows in a place where there is no risk of contamination by dust and
            oil mist. If it must be replaced in a dust-filled area, be sure to remove as much
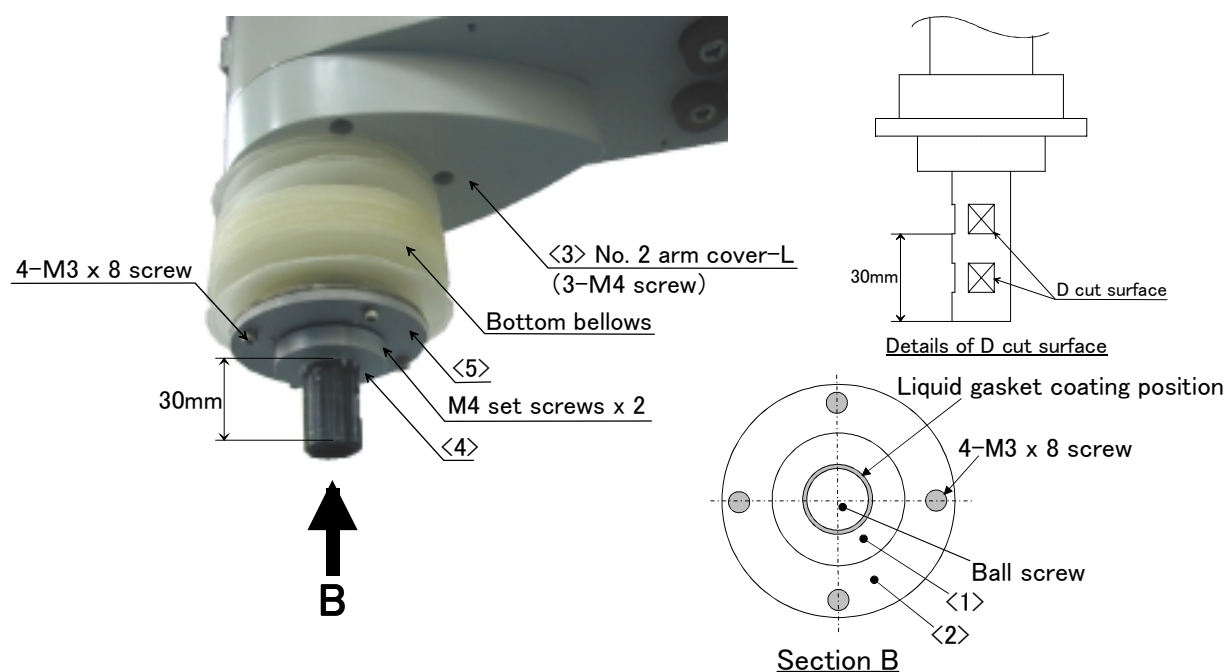   dust as possible in advance before replacing it.

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 user.

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.

(1)Installation screw x 2

(2)Battery cover
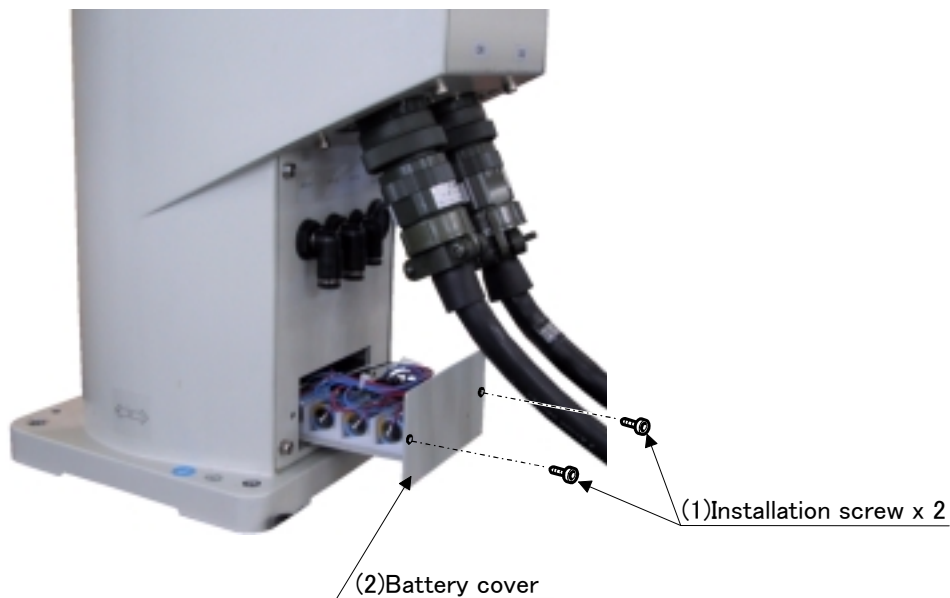
Fig.5-14 : Replacing the battery

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.

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	SK−1A	Reduction gears of each axis	An needed	Mitsubishi Electric
2	Lithium battery	A6BAT	In base	4	

Table 5–6 : Spare parts list

No.	Part name	Type	Usage place	Q'ty	Supplier
RH−5AH series					
1	Timing belt	453−3GT−6	J3 axis	1	Mitsubishi Electric
2		357−3GT−6	J4 axis motor side	1	
3		303−3GT−12	J4 axis shaft side	1	
4	AC servo motor	BU160B365G51	J1 axis	1	
5		BU160C366G52	J2 axis	1	
6		BU149C707G63	J3 axis	1	
7		BU160C366G54	J4 axis	1	
8	Reduction gears	BKO−FA0530H12	J1 axis	1	
9		BKO−FA0530H11	J2 axis	1	
10	Top bellows	BU223C263G51	J3 axis (clean and protrction specification)	1	
11	Bottom bellows	BU160C561G51	J3 axis (clean and protrction specification)	1	
12	Liquid gasket	#1212	Bellows (clean and protrction specification)	An needed	
13	Norseal	V714 (3.2t x 5mm)	Installation area of each cover (clean and protrction specification)	An needed	
RH−10AH/15AH series					
1	Timing belt	666−3GT−12	J3 axis （RH−10AH55/70/85）	1	Mitsubishi Electric
2		681−3GT−12	J3 axis （RH−15AH85）	1	
3		540−3GT−6	J4 axis motor side	1	
4		471−3GT−15	J4 axis shaft side	1	
5	AC servo motor	BU160B378G51	J1 axis	1	
6		BU160B365G52	J2 axis	1	
7		BU160C379G51	J3 axis	1	
8		BU160C366G54	J4 axis （RH−10AH55/70/85）	1	
9		BU160C422G54	J4 axis （RH−15AH85）	1	
10	Reduction gears	BKO−FA0530H13	J1 axis （RH−10AH55/70）	1	
11		BKO−FA0530H14	J1 axis （RH−10AH85/15AH85）	1	
12		BKO−FA0530H12	J2 axis	1	
10	Top bellows	BU223C265G51	J3 axis (protrction specification)	1	
11	Bottom bellows	BU160C562G51	J3 axis (protrction specification)	1	
12	Liquid gasket	#1212	Bellows (protrction specification)	An needed	
13	Norseal	V714 (3.2t x 5mm)	Installation area of each cover (protrction specification)	An needed	

Note) Confirm the robot arm serial No., and contact the dealer 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.

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 13, "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 58, "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 64, "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 69, "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

```
<MENU>
1.TEACH  2.RUN
3.FILE   4.MONI
5.MAINT  6.SET
```
Display the maintenance screen
+C (J6) 5 STU

```
<MAINT>
1.PARAM 2.INIT
3.BRAKE 4.ORIGIN
5.POWER
```

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

```
<MAINT>
1.PARAM 2.INIT
3.BRAKE 4.ORIGIN
5.POWER
```
Display the method selection screen
−Y (J2) 4 MNO

```
<ORIGIN>
1.DATA    2.MECH
3.JIG     4.ABS
5.USER
```

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

```
<ORIGIN>
1.DATA    2.MECH
3.JIG     4.ABS
5.USER
```
Select the jig method
−A (J4) 2 GHI → −B (J5) 1 DEF → INP EXE

```
<MECHA>
SERVO OFF
OK ? (1)
  1:EXECUTE
```

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
```

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

J1
(−)

```
RPL
 ↓
```
Move the cursor

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        -C        INP
(J5)  ·   (J6)   →
1  DEF    0  ABC      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        INP
(J5)   →
1  DEF     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 (10000000)
ORIGIN :COMPLETED
```

6) Refer to Page 70, "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        │
└─────────────────────────┘
```
```
┌──────┐
│ −B   │
│ (J5) │
│ 1 DEF│
└──────┘
```

Designate the origin setting axis

J2
(+)

```
┌──────┐
│ RPL  │
│  ↓   │
└──────┘
```

Move the cursor

```
┌─────────────────────────┐
│ <MECHA> 12345678        │
│ BRAKE    (00000000)     │
│ SET AXIS (01000000)     │
│ ORIGIN  :NOT DEF        │
└─────────────────────────┘
```

Designate the origin setting axis

```
┌──────┐   ┌──────┐      ┌──────┐
│ −B   │ · │ −C   │  →   │ INP  │
│ (J5) │   │ (J6) │      │ EXE  │
│ 1 DEF│   │0 ABC │      └──────┘
└──────┘   └──────┘
```

```
┌─────────────────────────┐
│ <MECHA>                 │
│ SET ORIGIN              │
│ OK?(1)                  │
│ 1:EXECUTE               │
└─────────────────────────┘
```

Set the origin

```
┌──────┐      ┌──────┐
│ −B   │  →   │ INP  │
│ (J5) │      │ EXE  │
│ 1 DEF│      └──────┘
└──────┘
```

```
┌─────────────────────────┐
│ <MECHA> 12345678        │
│ BRAKE    (00000000)     │
│ SET AXIS (01000000)     │
│ ORIGIN :COMPLETED       │
└─────────────────────────┘
```

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

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 2 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 70, "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.

```
<MECHA>  12345678
BRAKE    (00000000)
SET AXIS (11110000)
ORIGIN   :NOT DEF
```
```
-B
(J5)
1   DEF
```

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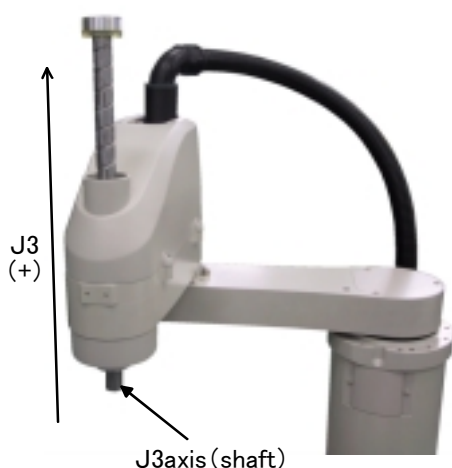
1) Press the [0] key twice and then press the [1] key. "1" will display at the 3 position to set the brake release.
2) Confirm the axis for which the brakes are to be released.

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.

J3
(+)

J3axis（shaft）

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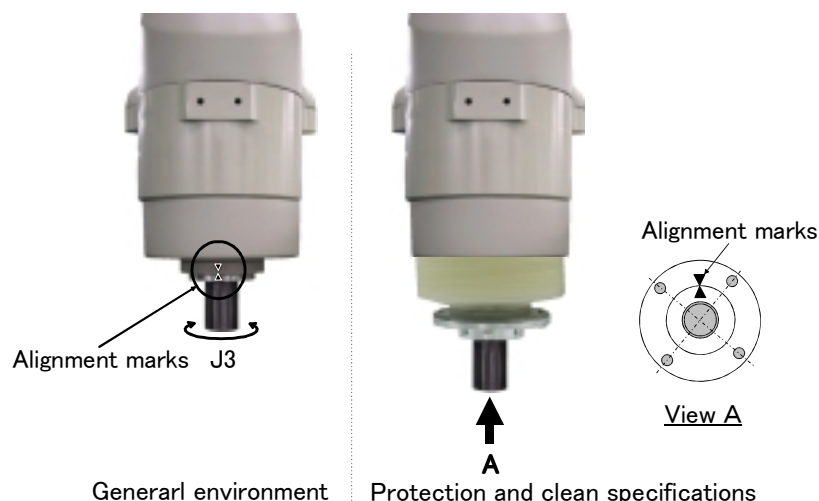
6) Hold the J4 axis with your hand and rotate it slowly to match the alignment marks.

Alignment marks

Alignment marks   J3

View A

Generarl environment

A

Protection and clean specifications

◇◆◇ 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.

Move the cursor
```
RPL
 ↓
```

```
<MECHA> 12345678
BRAKE    (00000000)
SET AXIS (00110000)
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 (00110000)
ORIGIN   :COMPLETED
```

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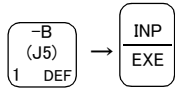
9) Press the [1] and [INP] keys.
   The origin posture will be set.

10) Setting of the origin is completed.

11) Refer to Page 70, "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

1) Perform origin settings for the J1, J2, J3 and J4 axes, by refer to Page 59, ″(2) J1 axis origin setting″, Page 60, ″(3) J2 axis origin setting″,Page 61, ″(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.

Move the cursor

```
 RPL
  ↓
```

```
<MECHA> 12345678
BRAKE    (00000000)
SET AXIS (11110000)
ORIGIN  :NOT DEF
```
Designate the origin setting axis

```
 -B      -C      INP
(J5)  ·  (J6)  →  EXE
1  DEF   0  ABC
```

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.

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

```
 -B      INP
(J5)  →  EXE
1  DEF
```
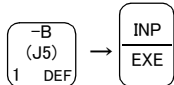
5) Press the [1] and [INP] keys.
The origin posture will be set.

6) Setting of the origin is completed.

```
<MECHA> 12345678
BRAKE    (00000000)
SET AXIS (11110000)
ORIGIN :COMPLETED
```

7) Refer to Page 70, ″5.5.4 Recording the origin data″ in this manual, and record the origin data on the origin data seal.

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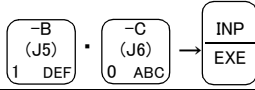To release the brakes, move the cursor to the ″BRAKE″ axis No. with the [←] or [→] key.
The brakes can be released only for the axis for which a ″1″ is displayed on the screen. If the brakes are not to be released, press the [0] key and display a ″0″.
If the [+X] key on the teaching pendant or the deadman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

```
<MENU>                    <MAINT>
1.TEACH  2.RUN            1.PARAM 2.INIT
3.FILE    4.MONI          3.BRAKE 4.ORIGIN
5.MAINT  6.SET            5.POWER
```

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

```
+C
(J6)
5    STU
```
Display the maintenance screen

```
<MAINT>                   <ORIGIN>
1.PARAM 2.INIT            1.DATA    2.MECH
3.BRAKE 4.ORIGIN          3.JIG     4.ABS
5.POWER                   5.USER
```

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

```
-Y
(J2)
4    MNO
```
Display the method selection screen

```
<ORIGIN>                  <MECHA>
1.DATA    2.MECH          SERVO OFF
3.JIG     4.ABS           OK ? (1)
5.USER                       1:EXECUTE
```

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.

```
-Z          -B          INP
(J3)   →    (J5)   →   ___
3   JKL     1   DEF      EXE
```
Select the jig method

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

```
−B
(J5)
1    DEF
```

RH−5AH series


```
Origin jig
Pinhole
No.1 arm
```

RH−10AH/15AH series


```
Origin jig
Pinhole
No.1 arm
```

```
RPL
↓
```
Move the cursor

```
<MECHA>  12345678
BRAKE    (00000000)
SET AXIS (10000000)
ORIGIN   :NOT DEF
```
Designate the origin setting axis

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

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

```
−B          INP
(J5)    →
1    DEF    EXE
```

```
<MECHA>  12345678
BRAKE    (00000000)
SET AXIS (10000000)
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 70, "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.
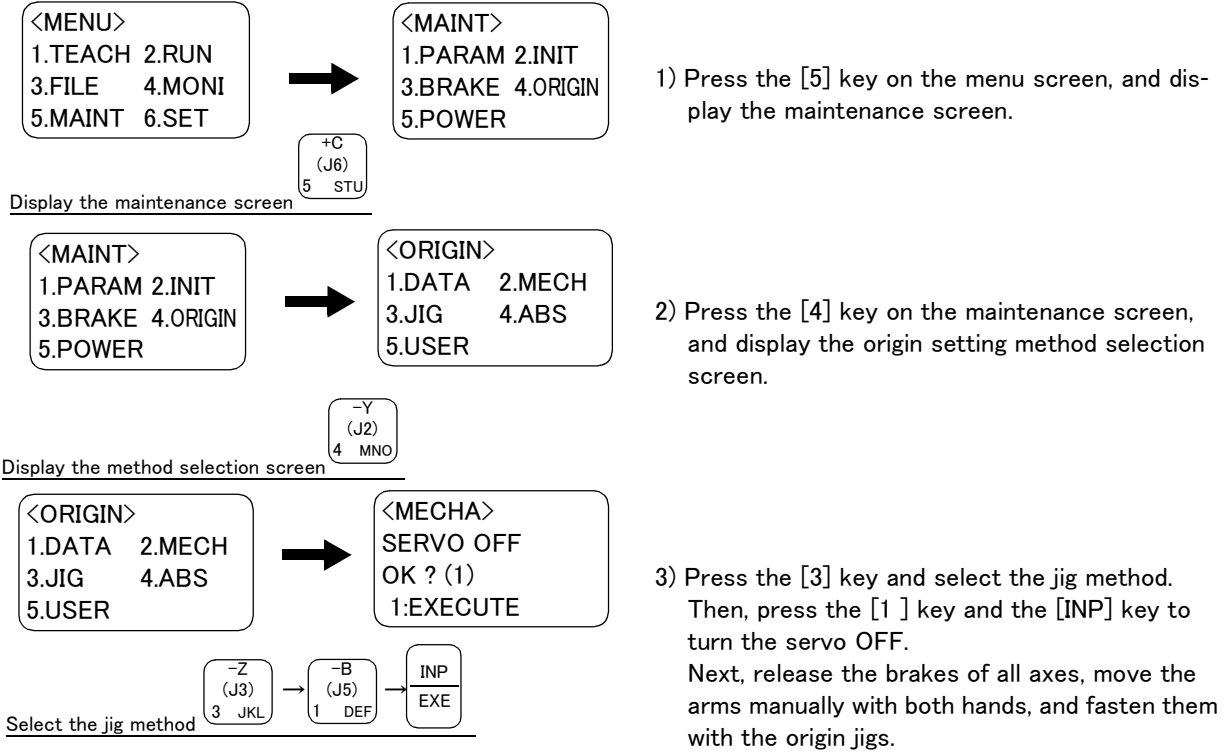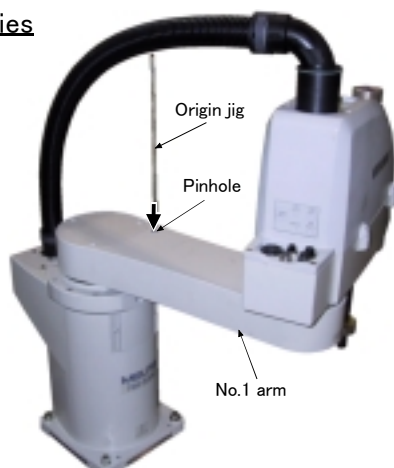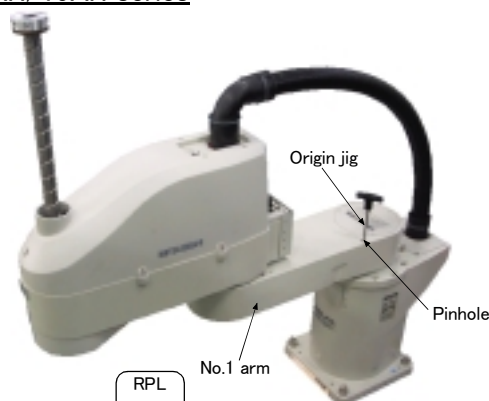   The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(2) J2 axis origin setting

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

Designate the origin setting axis

```
 -B
(J5)
1    DEF
```

RH-5AH series

No.2 arm

No.1 arm

Pinhole

Origin jig

RH-10AH/15AH series

No.2 arm

No.1 arm

Pinhole

Origin jig

```
RPL
 ↓
```

Move the cursor

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

Designate the origin setting axis

```
 -B        -C         INP
(J5)   ·  (J6)   →   EXE
1   DEF   0   ABC
```

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

Set the origin

```
 -B        INP
(J5)   →  EXE
1   DEF
```

```
<MECHA>  12345678
BRAKE    (00000000)
SET AXIS (01000000)
ORIGIN :COMPLETED
```

1) Slowly rotate the J2 axis to 90 deg. clockwise with both hands, if RH-5AH series.
   Slowly rotate the J2 axis to 0 deg. with both hands, if RH-10AH/15AH series.
   Align the pinholes of the No. 1 and No. 2 arms, 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 2 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 70, "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".
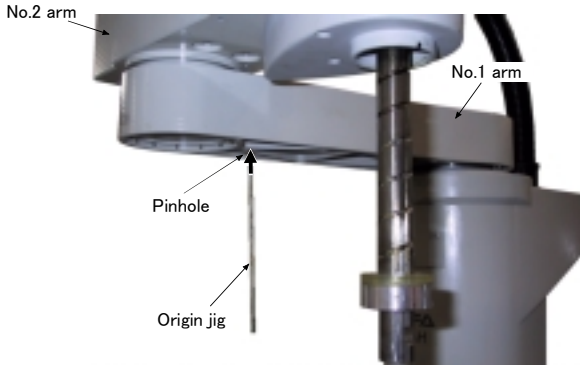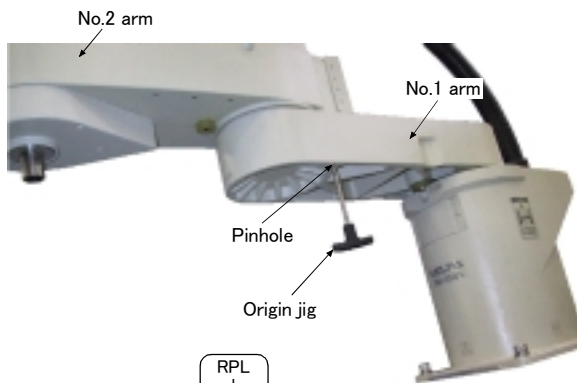
（3）J3 and J4 axis origin setting

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 61, "(4) J3 and J4 axis origin setting", perform the required origin setting operations.

(4) All axis origin setting

<u>RH-5AH series</u>

1) Perform origin settings for the J1, J2, J3 and J4 axes, by refer to Page 59, ″(2) J1 axis origin setting″, Page 66, ″(2) J2 axis origin setting″,Page 67, ″(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.

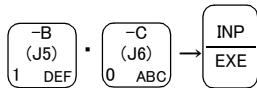2) The robot should look like the diagram at left, once all procedures are complete.
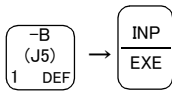
<u>RH-10AH/15AH series</u>

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.

```
RPL
↓
```
Move the cursor

```
<MECHA>  12345678
BRAKE    (00000000)
SET AXIS (11110000)
ORIGIN  :NOT DEF
```
Designate the origin setting axis

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

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

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

```
−B              INP
(J5)      →
1  DEF          EXE
```

6) Setting of the origin is completed.

```
<MECHA>  12345678
BRAKE    (00000000)
SET AXIS (11110000)
ORIGIN :COMPLETED
```

7) Refer to Page 70, ″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 for details on the jog operation.
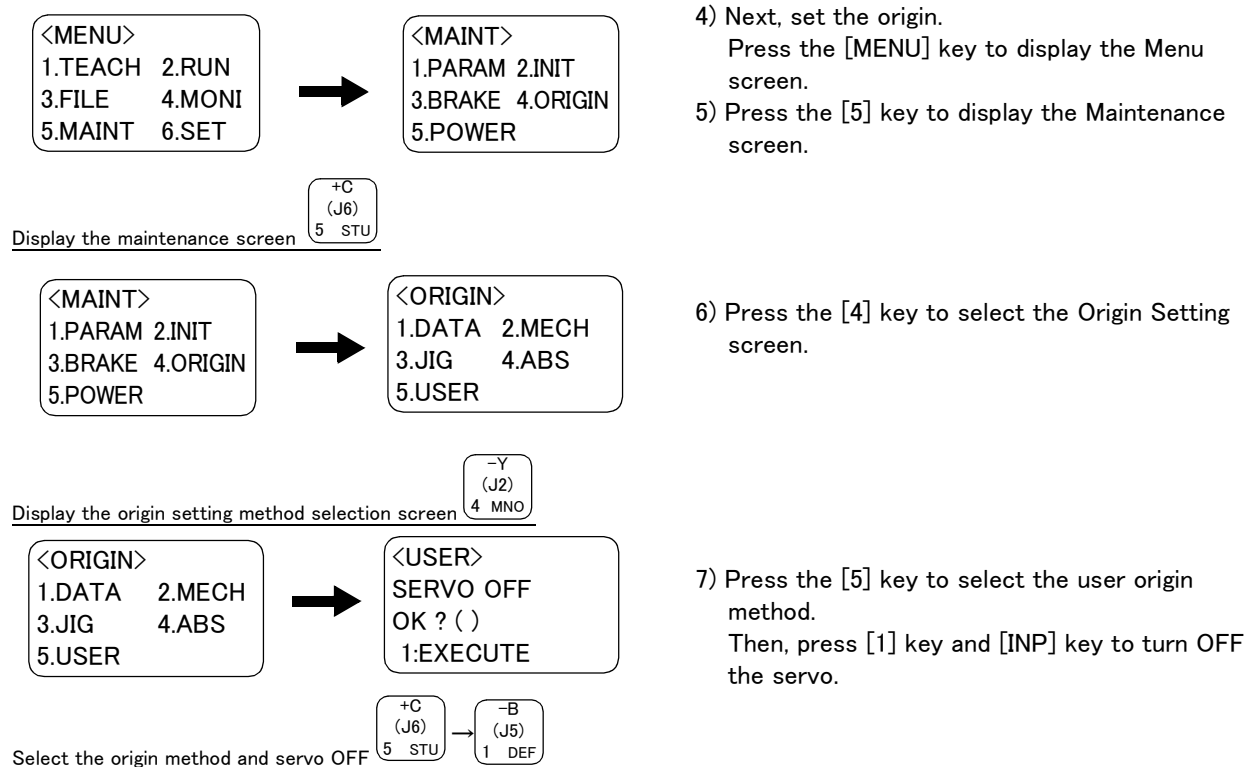
⚠ CAUTION This position is left as a guideline to position all axes with jog operation when setting the origin again with this method.

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.

```
<MENU>
1.TEACH  2.RUN
3.FILE    4.MONI
5.MAINT   6.SET
```
➡
```
<MAINT>
1.PARAM 2.INIT
3.BRAKE 4.ORIGIN
5.POWER
```

Display the maintenance screen [+C (J6) 5 STU]

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

```
<MAINT>
1.PARAM 2.INIT
3.BRAKE 4.ORIGIN
5.POWER
```
➡
```
<ORIGIN>
1.DATA   2.MECH
3.JIG    4.ABS
5.USER
```

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

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

```
<ORIGIN>
1.DATA   2.MECH
3.JIG    4.ABS
5.USER
```
➡
```
<USER>
SERVO OFF
OK ? ( )
  1:EXECUTE
```

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

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

```
┌─────────────────────┐          ┌─────────────────────┐
│ <USER>   12345678   │          │ <USER>              │
│ BRAKE   (00000000)  │   ──▶    │ CHANGES TO ORIGIN   │
│ SET AXIS(11110000)  │          │ OK?( )              │
│ ORIGIN:NOT DEF      │          │   1:EXECUTE         │
└─────────────────────┘          └─────────────────────┘
```

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.
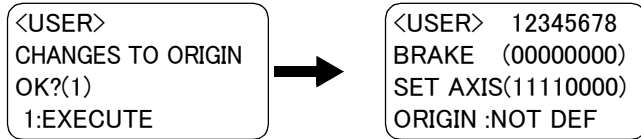
Designate the origin setting axis

```
┌─────┐     ┌─────┐     ┌─────┐
│ RPL │     │ −B  │     │ INP │
│  ↓  │ ──▶ │(J5) │ ──▶ │ EXE │
│     │     │1 DEF│     │     │
└─────┘     └─────┘     └─────┘
```

```
┌─────────────────────┐          ┌─────────────────────┐
│ <USER>              │          │ <USER>   12345678   │
│ CHANGES TO ORIGIN   │   ──▶    │ BRAKE   (00000000)  │
│ OK?(1)              │          │ SET AXIS(11110000)  │
│   1:EXECUTE         │          │ ORIGIN :NOT DEF     │
└─────────────────────┘          └─────────────────────┘
```
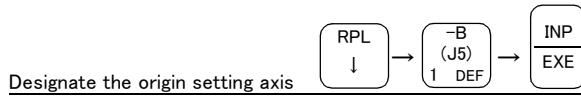
9) Press the [1] key and then the [INP] key. The origin will be set

Set the origin

```
┌─────┐     ┌─────┐
│ −B  │     │ INP │
│(J5) │ ──▶ │ EXE │
│1 DEF│     │     │
└─────┘     └─────┘
```

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 14, "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 14, "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 14 "Fig. 2-10Origin data label an example", and Page 17 "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 J1cover.

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
                        ↑
1/0 = RIGHT/LEFT

Note) ″&B″ is shows the binary

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