



Mitsubishi Industrial Robot

RH-3CH-Sxx/RH-6CH-Sxx

INSTRUCTION MANUAL

ROBOT ARM SETUP & MAINTENANCE



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

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

 DANGER

When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.

 CAUTION

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

 CAUTION

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

 CAUTION

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

 CAUTION

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

 CAUTION

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

 CAUTION

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

 WARNING

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

 WARNING

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

 CAUTION

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

 WARNING

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

 CAUTION

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

 CAUTION

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

 CAUTION

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

 CAUTION

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

WARNING

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

CAUTION

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

CAUTION

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

DANGER

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

DANGER

Do not remove the SSCNET III cable while power is supplied to the controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

DANGER

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

CAUTION

Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

CAUTION

Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

CAUTION

To maintain the safety of the robot system against unauthorized access from external devices via the network, take appropriate measures.
To maintain the safety against unauthorized access via the Internet, take measures such as installing a firewall.

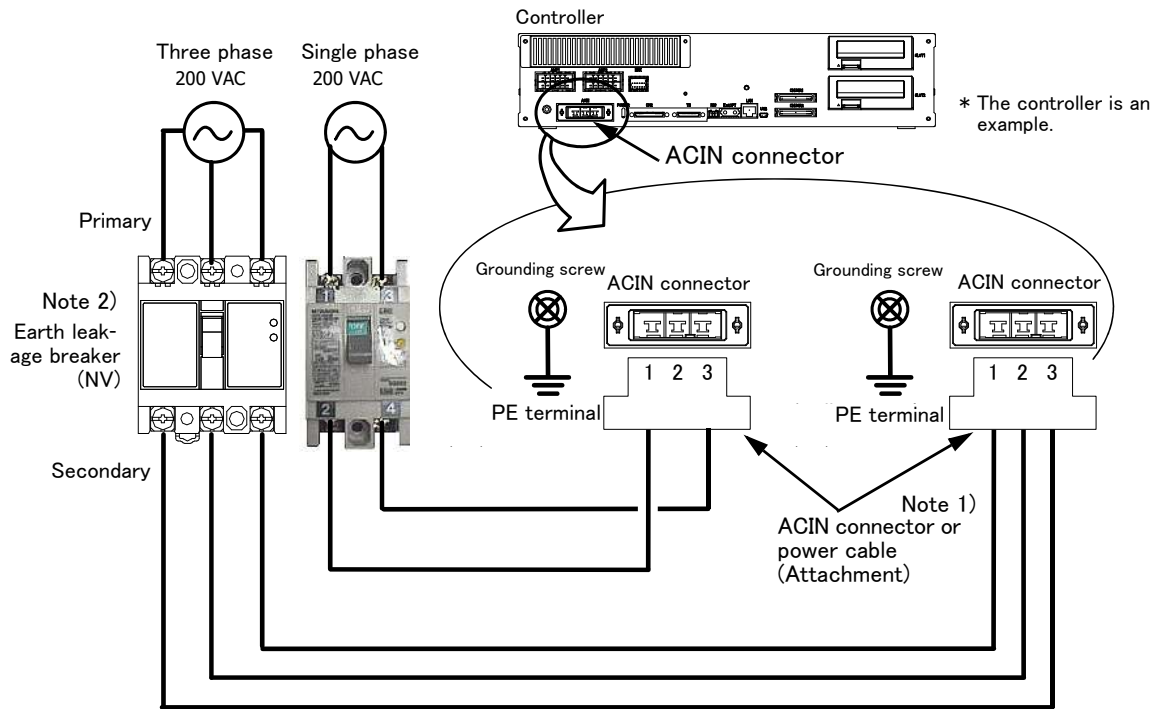
*CR751-D or CR751-Q controller

Notes of the basic component are shown.



CAUTION

Please install the earth leakage breaker in the primary side supply power supply of the controller of CR751-D or CR751-Q because of leakage protection.



Note 1) Crimping swage is recommended for connecting the attachment ACIN connector (soldering is also possible)
Recommendation compression tools: 234171-1(Tyco Electronics)

Note 2) The earth leakage breaker is the customer preparation. Always use the cover below.

Recommendation: For single primary power supply NV30FAU-2P-10A-AC100-240V-30mA, (Cover: TCS-05FA2)
For three primary power supply NV30FAU-3P-10A-AC100-240V-30mA, (Cover: TCS-05FA3)

- 1) Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary power supply (AWG #14 (2mm² or above), cables to ground the primary power supply (AWG #12 (3.5mm² or above).

The secondary power cable (with the ACIN connector) for single phase or three phase power is supplied with the product to match the specifications. When you build a cable suitable for your environment using the ACIN connector and the ACIN terminal supplied, prepare a secondary power cable (AWG #14 (2mm² or above).

- 2) Confirm that the primary power matches the specifications.
- 3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.
- 4) Connect the secondary power cable.

a) When using the supplied power cable with the ACIN connector

Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.

b) When building a power cable using the ACIN connector and the ACIN terminals supplied

Connect the ACIN terminals with the secondary power cable (prepared by customers), and insert the ACIN terminals to the ACIN connector pins with the following numbers. Crimping caulking is recommended to connect the ACIN terminals.

For single phase: 1 and 3

For three phase: 1, 2, and 3

Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.

- 5) Connect this ACIN connector to the ACIN connector on the front of the controller.
- 6) Connect the grounding cable to the PE terminal. (M4 screw)
- 7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.



CAUTION

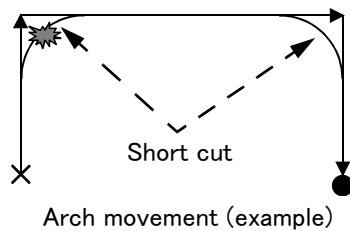
Be careful of interference with peripheral equipment.

Especially don't give a shock to the shaft (J3 axis). When you install the hand, be careful not to knock at the shaft end by the hammer etc. The shaft may be damaged.

Take care also of the following items.

- (1) The robot's locus of movement may change with specified speed.

Especially as for the corner section, short cut distance may change. Therefore, when beginning automatic operation, moves at low speed at first, and you should gather speed slowly with being careful of interference with peripheral equipment.



- (2) It can be confirmed whether the specified position exist in the defined area by using the instruction command "Zone". It can utilize as one of the methods for collision evasion. Refer to the "detailed description of the instructions manual/function, and operation" of the separate volume for the details of the instruction command.

Revision history

Date of Point	Instruction Manual No.	Revision Details
2016-06-20	BFP-A3448	• First print
2016-09-20	BFP-A3448-A	• Added description of special specifications Bellows installation specifications (S23) 5 kg portability specifications for RH-3CH (S51) • Added the replacement procedure for machine cables (replaceable type).
2016-11-02	BFP-A3448-B	• CE marking specification (S15/S24/S52) were added.
2017-07-26	BFP-A3448-C	• S11 specification has been released in Japan. • Contact information of the authorized representative was updated.
2017-09-14	BFP-A3448-D	• "5.4 About Overhaul" was modified.
2018-12-25	BFP-A3448-E	• Description of countermeasures against unauthorized access was added. • Added "Transportation procedure at secondary transportation". • Revised the instructions for replacing machine cables (replaceable type). • Revised "5.3.3 Inspection replacement of timing belt". • Revised the instructions for replacing the backup battery. • Revised the positions of the ABS marks.

*Introduction

Thank you for purchasing the Mitsubishi industrial robot.

This instruction manual explains the method of unpacking, installation and maintenance and inspection of the robot arm.

Always read through this manual before starting use to ensure correct usage of the robot.

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."

This document explains for the following robot type.

- Robot type
- RH-3CH-S11/S15
 - RH-3CH-S23/S24
 - RH-3CH-S51/S52
 - RH-6CH-S11/S15
 - RH-6CH-S23/S24

Note) Only RH-3CH-S11 and RH-6CH-S11 have been released in Japan.

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- 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." or "alarm may occur".
Please contact your nearest dealer if you find any doubtful, wrong or skipped point.
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1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions. Moreover, handling and operation of a teaching pendant (T/B) are described based on R32TB (R33TB) in instruction manuals. If using other T/B, such as R56TB (R57TB), refer to a supplied instruction manual of the T/B.

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.
Special Specifications Manual	Explains the product's specifications, factory-set special specifications, option configuration, 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.
Additional axis function	Explains the specifications, functions and operations of the additional axis control.
Tracking Function Manual	Explains the control function and specifications of conveyor tracking
Extended Function Instruction Manual	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures, about the PLC(CR750-Q/CR751-Q controller) and the GOT(CR750-D/CR751-D controller).

1.1.2 Symbols used in instruction manual

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

Table 1-1: Symbols in instruction manual

Terminology	Item/Symbol	Meaning
Item	iQ Platform	
	Controller	Indicates the controller which controls the robot arm. It consists of the robot CPU system and the drive unit.
	The robot CPU unit or robot CPU	Indicates the CPU unit for the robots which installed to the sequencer base unit (Q3 □ DB) of MELSEC-Q series. It is connected with the drive unit by the dedicated cable.
	The robot CPU system	Multi-CPU system. It consists of MELSEC units, such as the sequencer base unit, the sequencer CPU unit, and the robot CPU unit, etc.
	Drive unit	Indicates the box which mounts the servo amplifier for robot, and the safety circuit, etc.
Item	Stand-alone type	
	Controller	Indicates the box which arranged control parts, such as robot CPU, servo amplifier, and the safety circuit.
Symbol	 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.
	[JOG]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
	[RESET] + [EXE] (A) (B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [RESET] key is pressed while holding down the [EXE] key.
	T/B	This indicates the teaching pendant.
	O/P	Indicates the operating panel on the front of controller or drive unit for the controller which installed the operating panel.

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.

DANGER

When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.

CAUTION

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

CAUTION

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

CAUTION

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

CAUTION

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

CAUTION

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

CAUTION

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

WARNING

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

WARNING

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

CAUTION

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

WARNING

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

CAUTION

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

CAUTION

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

CAUTION

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

CAUTION

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

WARNING

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

 CAUTION

Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

 CAUTION

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

 CAUTION

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

 DANGER

Do not connect the Handy GOT to a programmable controller when using an iQ Platform compatible product with the CR750-Q/CR751-Q/CR760-Q controller. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

 DANGER

Do not remove the SSCNET III cable while power is supplied to the multiple CPU system or the servo amplifier. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables of the Motion CPU or the servo amplifier. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

 DANGER

Do not remove the SSCNET III cable while power is supplied to the controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

 DANGER

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

 CAUTION

Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in failures, such as the emergency stop not being released. In order to prevent from occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed

 CAUTION

Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

 CAUTION

To maintain the safety of the robot system against unauthorized access from external devices via the network, take appropriate measures.
To maintain the safety against unauthorized access via the Internet, take measures such as installing a firewall.

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 "Special Specifications Manual".

Table 2-1 : Standard configuration

No.	Part name	Type	Qty.	Remarks
RH-3CH-S11/S15/S51/S52				
1	Robot arm		1 unit	
2	Installation bolts	M8 × 30	4 pcs.	For robot arm installation
3	Spring washer for installation bolts	For M8	4 pcs.	
4	Plain washer for installation bolts	For M8	4 pcs.	
5	D-sub connector set		2 sets	Connector for fixing the tool wiring
RH-3CH-S23/S24				
1	Robot arm		1 unit	
2	Installation bolts	M8 × 30	4 pcs.	For robot arm installation
3	Spring washer for installation bolts	For M8	4 pcs.	
4	Plain washer for installation bolts	For M8	4 pcs.	
5	D-sub connector set		2 sets	Connector for fixing the tool wiring
6	Fixing device		1 set	For robot arm transportation
RH-6CH-S11/S15				
1	Robot arm		1 unit	
2	Installation bolts	M8 × 30	4 pcs.	For robot arm installation
3	Spring washer for installation bolts	For M8	4 pcs.	
4	Plain washer for installation bolts	For M8	4 pcs.	
5	D-sub connector set		2 sets	Connector for fixing the tool wiring
RH-6CH-S23/S24				
1	Robot arm		1 unit	
2	Installation bolts	M8 × 30	4 pcs.	For robot arm installation
3	Spring washer for installation bolts	For M8	4 pcs.	
4	Plain washer for installation bolts	For M8	4 pcs.	
5	D-sub connector set		2 sets	Connector for fixing the tool wiring
6	Fixing device		1 set	For robot arm transportation

Note) Items No. 2 to 5 are contained in the plastic bag of attachment in the robot arm.

2.2 Installation

2.2.1 Unpacking

(1) RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15

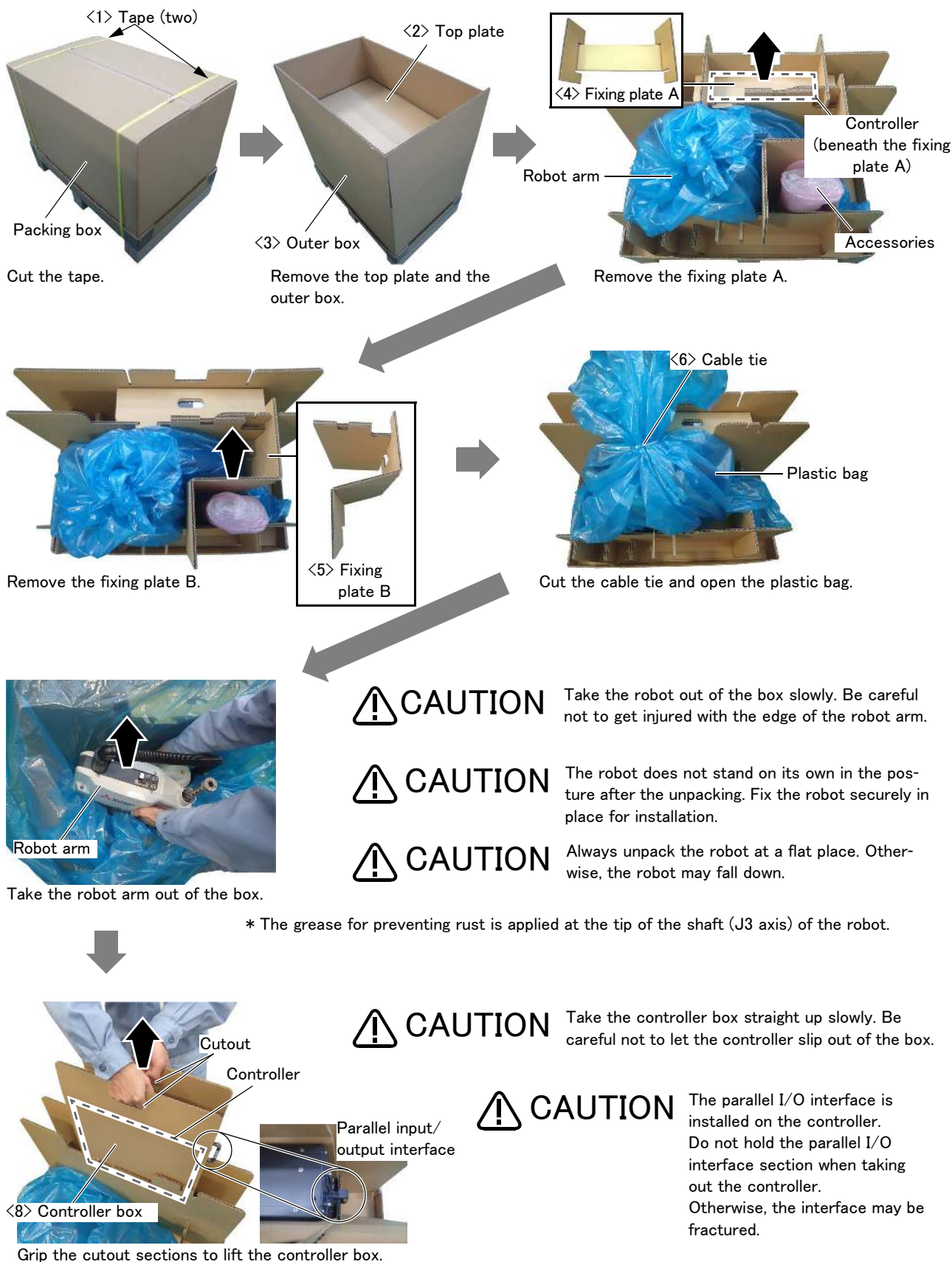


Fig.2-1 : Unpacking of the robot arm (RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15)

The unpacking procedure is shown below.

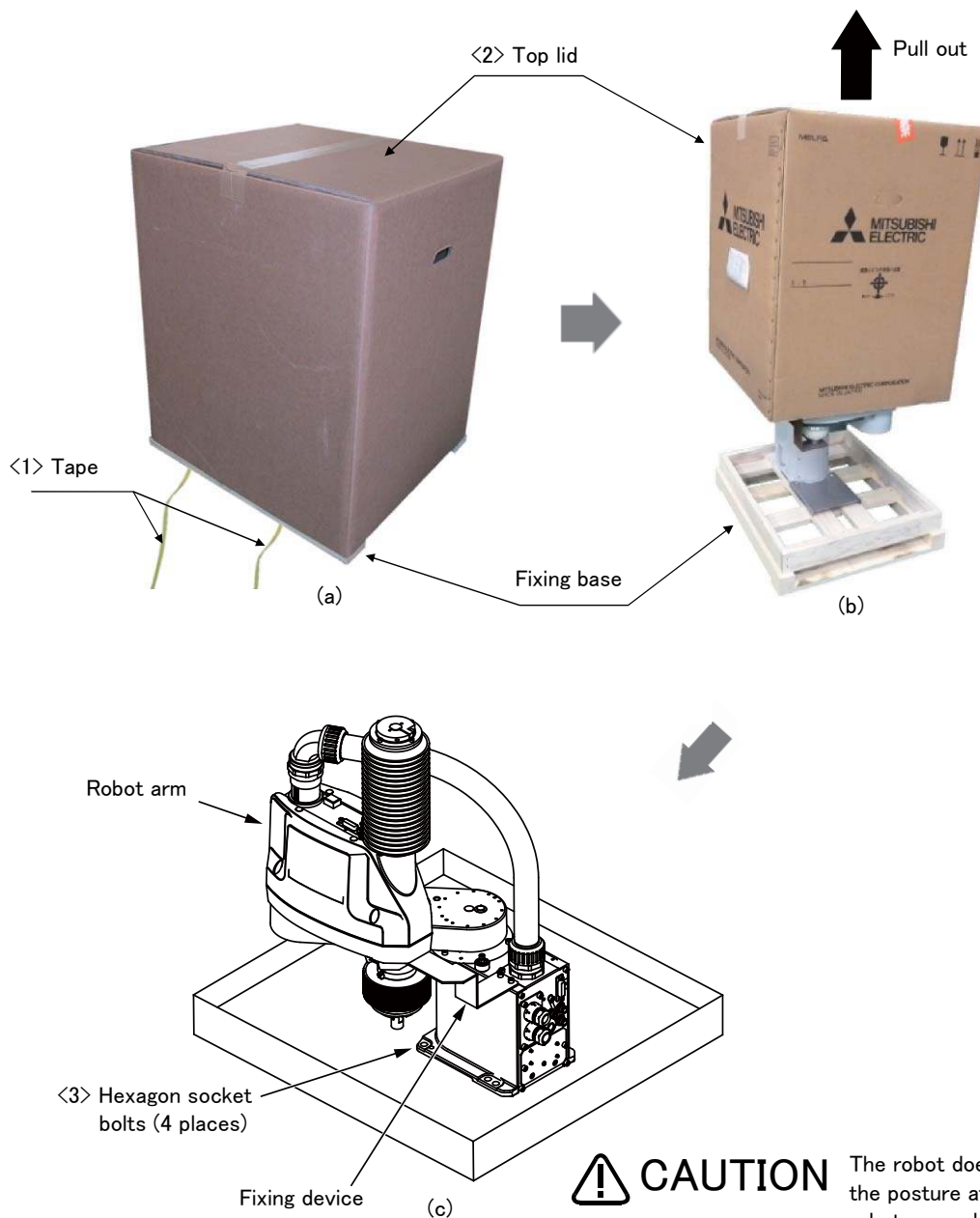
- 1) Cut the tape <1> around the packing box with scissors etc.
- 2) Lift and remove the top plate <2> and the outer box <3>.
- 3) Lift and remove the fixing plate A <4> and the fixing plate B <5> one after another.
- 4) Cut the cable tie <6> with nippers etc. and open the plastic bag.
- 5) Take the robot arm out of the box.

Note that the robot does not stand on its own in the posture after the unpacking.

- 6) Grip the cutout sections of the controller box <8> and take out the controller.

Unpacking is completed.

(2) RH-3CH-S23/S24, RH-6CH-S23/S24



CAUTION

The robot does not stand on its own in the posture after the unpacking. Fix the robot securely in place for installation.

CAUTION

Always unpack the robot at a flat place. Otherwise, the robot may fall down.

* The grease for preventing rust is applied at the tip of the shaft (J3 axis) of the robot.

Fig.2-2 : Unpacking of the robot arm (RH-3CH-S23/S24 and RH-6CH-S23/S24)

The robot is packed in a box consisting of the fixing base and top lid.
Refer to [Fig. 2-2](#) and unpack the product in accordance with "2.2.2 Transportation procedures".

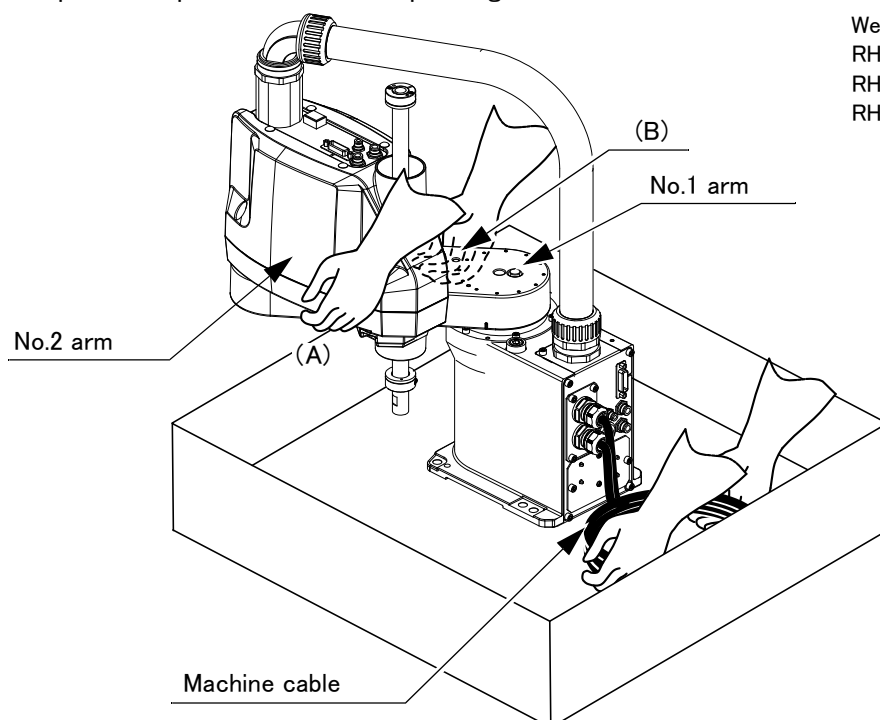
The unpacking procedure is shown below.

- 1) Cut the tape <1> holding the top lid <2> with a cutter. ([Fig. 2-2, \(a\)](#))
- 2) Hold the top lid <2> with both hands, and pull the lid upward. ([Fig. 2-2, \(b\)](#))
- 3) Remove the hexagon socket bolts <3> (4 bolts) fixing the robot. ([Fig. 2-2, \(c\)](#))

Unpacking is completed.

2.2.2 Transportation procedures

(1) Transportation procedure when unpacking



Weight

RH-3CH-Sxx: Approx. 14 kg

RH-6CH6020-Sxx: Approx. 17 kg

RH-6CH7020-Sxx: Approx. 18 kg

Fig.2-3 : Transportation posture and method

- 1) The robot must be transported by two workers. Use a cart or other device for transporting the robot near the installation place. The following instructions for carrying the robot are applicable only when the robot is transferred onto the stand or another cart, or moved for positioning.
- 2) The robot will fall down when the robot is not installed with installation bolts. Support the robot arm with one hand while removing the installation bolts.
- 3) For carrying the robot arm, one person should hold the No.2 arm <A> and No.1 arm and another person should hold the machine cable.
Do not hold the cover of the robot for carrying it. Otherwise, the robot may fall down, the cover may be broken or fall, or other accidents may occur.
Do not apply force to the cover or avoid strong impact on the robot while carrying the robot.
- 4) Transfer the robot slowly. Be careful not to get injured with the edge of the robot arm.
- 5) Transport the robot with fixing it to the packing box at delivery again for secondary transportation such as changing the installation place. If the robot is lifted while it is in the operation posture, its components may be damaged or its gravity position may be inappropriate, resulting in danger at transportation.
If it is difficult to follow the above transportation procedures, refer to [Page 11, "\(2\) Transportation procedure at secondary transportation"](#)

CAUTION

Do not hold the cover of the robot during transportation to prevent accidents.

CAUTION

Do not apply force to the shaft (J3 axis). Otherwise, the shaft may be damaged, resulting in an overload error.

CAUTIONWhen transferring the robot again, adjust the posture of each axis of the robot as specified in [Table 2-2](#).**CAUTION**

Do not place the robot facing sideways. Otherwise, grease leaks or malfunction may occur.

Table 2-2 : Transportation posture

Axis	RH-3CH-S11/S15/S51/S52	RH-3CH-S23/S24	RH-6CH-S11/S15	RH-6CH-S23/S24
J1	0°	50°	0°	30°
J2	145.7°	130°	154.2°	150°
J3	100 mm (not fixed)	90 mm (not fixed)	100 mm (not fixed)	90 mm (not fixed)
J4	Not fixed	Not fixed	Not fixed	Not fixed

(2) Transportation procedure at secondary transportation

If it is difficult to follow the transportation procedure at secondary transportation described in [Page 10, "\(1\) Transportation procedure when unpacking"](#), take countermeasures not to allow the joints of the robot arm freely move by fixing the robot arm in such a way as to take advantage of the screw holes for fixing plates or the like. Do not apply an excessive load to the robot arm while fixing it.

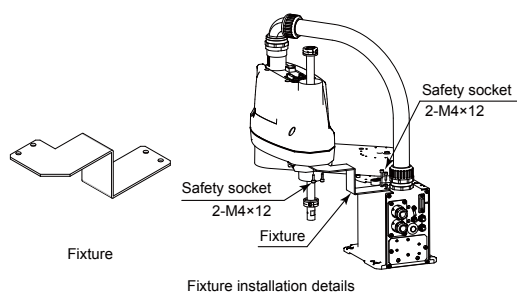
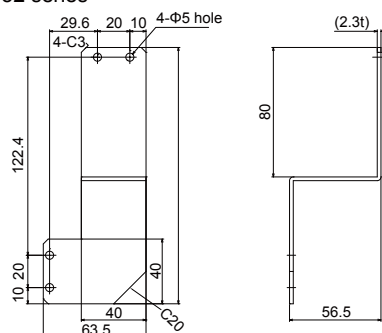
If the robot arm is transported with its joints unfixed, applying an excessive power on the joints by external forces may cause a malfunction.

When fixtures for fixing the joints of the robot arm are required, please consult your local Mitsubishi Electric.

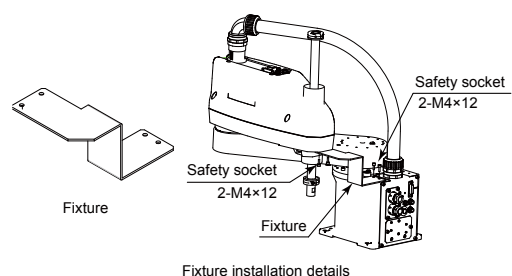
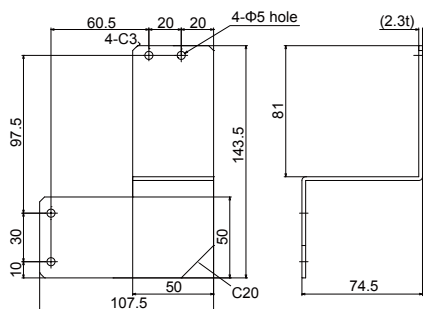
The reference figure of the fixture is shown in [Fig. 2-4](#).

Use the supplied fixtures for the RH-3CH-S23/S24 and RH-6CH-S23/S24.

<RH-3CH-S11/S15/S51/S52 series>



<RH-6CH6020-S11/S15 series>



<RH-6CH7020-S11/S15 series>

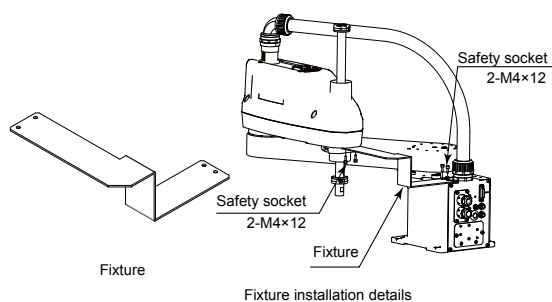
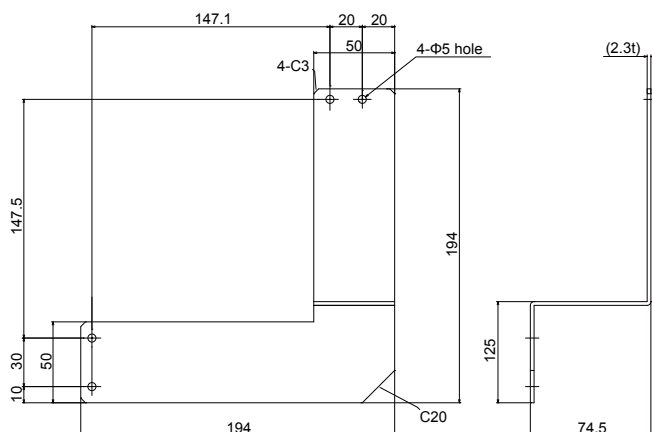


Fig.2-4 : Reference figure of the fixture

Before installing fixtures, adjust the posture of each axis of the robot as specified in [Table 2-3](#).

Table 2-3 : Fixture installation posture

Axis	RH-3CH-S11/ S15/S51/S52	RH-3CH-S23/ S24	RH-6CH6020- S11/S15	RH-6CH7020- S11/S15	RH-6CH6020- S23/S24	RH-6CH7020- S23/S24
J1	50°	50°	30°	30°	30°	30°
J2	130°	130°	150°	150°	150°	150°
J3	90 mm (not fixed)	90 mm (not fixed)	90 mm (not fixed)	90 mm (not fixed)	90 mm (not fixed)	90 mm (not fixed)
J4	Not fixed	Not fixed	Not fixed	Not fixed	Not fixed	Not fixed

2.2.3 Installation procedures

The installation procedure of the robot arm is shown below.

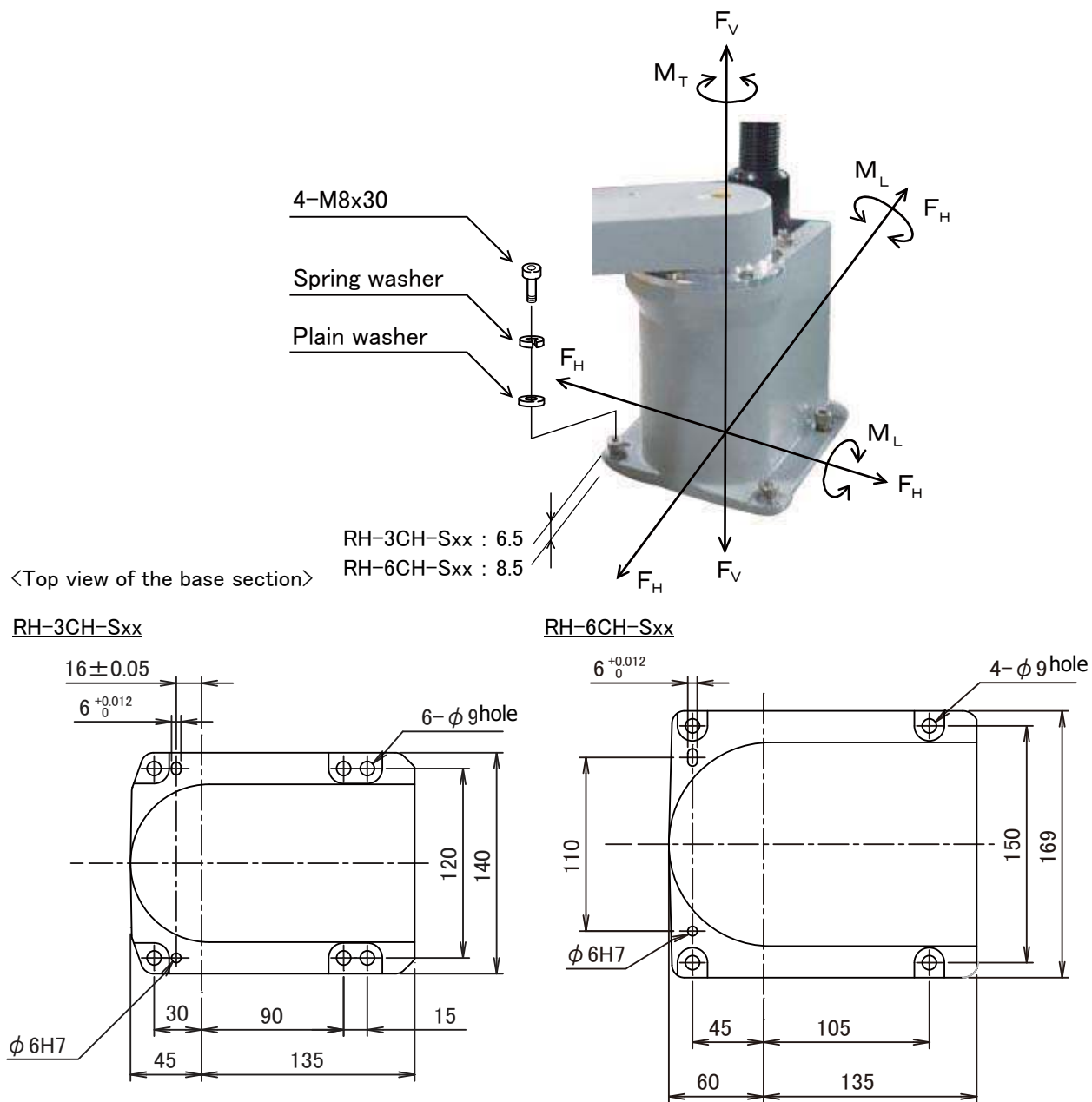


Fig.2-5 : Installation dimensions

- 1) The robot installation surface has been machine finished. Use the installation holes (6-φ9 for RH-3CH-Sxx, 4-φ9 for RH-6CH-Sxx) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (hexagon socket bolts).
- 2) Install the robot on a level surface.
- 3) It is recommended that the surface roughness of the table onto which the robot is to be installed by Rz25 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) For RH-3CH-S23/S24 and RH-6CH-S23/S24, remove the fixing devices after installation.

- 7) If you operate the robot at a high speed, reaction forces are applied to the installation stand by the robot's operation. Make sure that the installation stand on which the robot is placed has sufficient strength and rigidity. Table 2-4 shows the maximum reaction force (design values) that may be applied to an installation stand. Please use these values as reference when designing the installation stand.

Table 2-4 : Magnitude of each reaction force

Item	Unit	Value
RH-3CH-Sxx		
Tilt moment : M_L	N · m	220
Torsional moment : M_T	N · m	180
Horizontal direction translation force : F_H	N	820
Vertical direction translation force : F_V	N	320
RH-6CH6020-Sxx		
Tilt moment : M_L	N · m	410
Torsional moment : M_T	N · m	260
Horizontal direction translation force : F_H	N	800
Vertical direction translation force : F_V	N	640
RH-6CH7020-Sxx		
Tilt moment : M_L	N · m	500
Torsional moment : M_T	N · m	370
Horizontal direction translation force : F_H	N	960
Vertical direction translation force : F_V	N	670

CAUTION

Secure the maintenance space necessary at rear for connection of the machine cable and for replacement of the backup battery. For the dimensions of the maintenance space, refer to "Outside dimensions/Operating range diagram" in the Special Specifications Manual.

CAUTION

Do not install the robot arm in areas where direct sunlight is present or heat is generated from lighting.

The skin temperature of the robot arm may rise, and the error may occur.

2.2.4 Grounding procedures

(1) Grounding methods

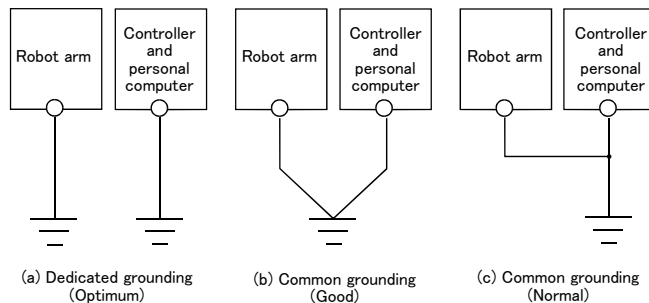


Fig.2-6 : Grounding methods

(2) Grounding procedures

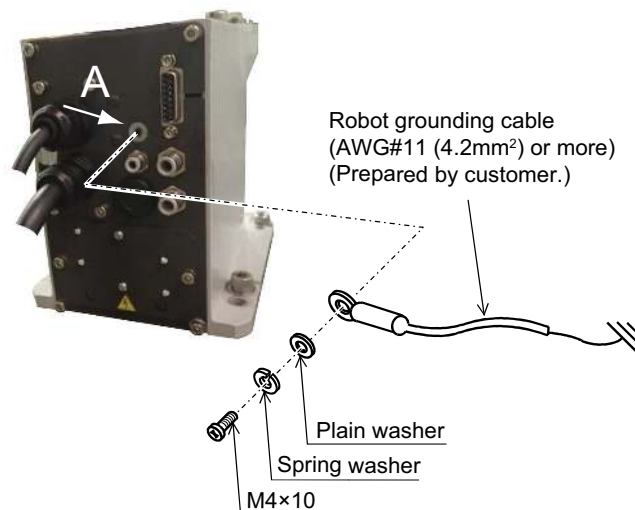


Fig.2-7 : Connecting the grounding cable

- 1) There are three grounding methods as shown in Fig. 2-6, 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 100Ω or less).
Dedicated grounding separated from the other devices should be used.
- 3) Use a AWG#11 (4.2mm^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.

- 1) Prepare a grounding cable (AWG#11 (4.2mm^2) or more) and the installation screw and washer for the robot.
- 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

(1) CR751 controller

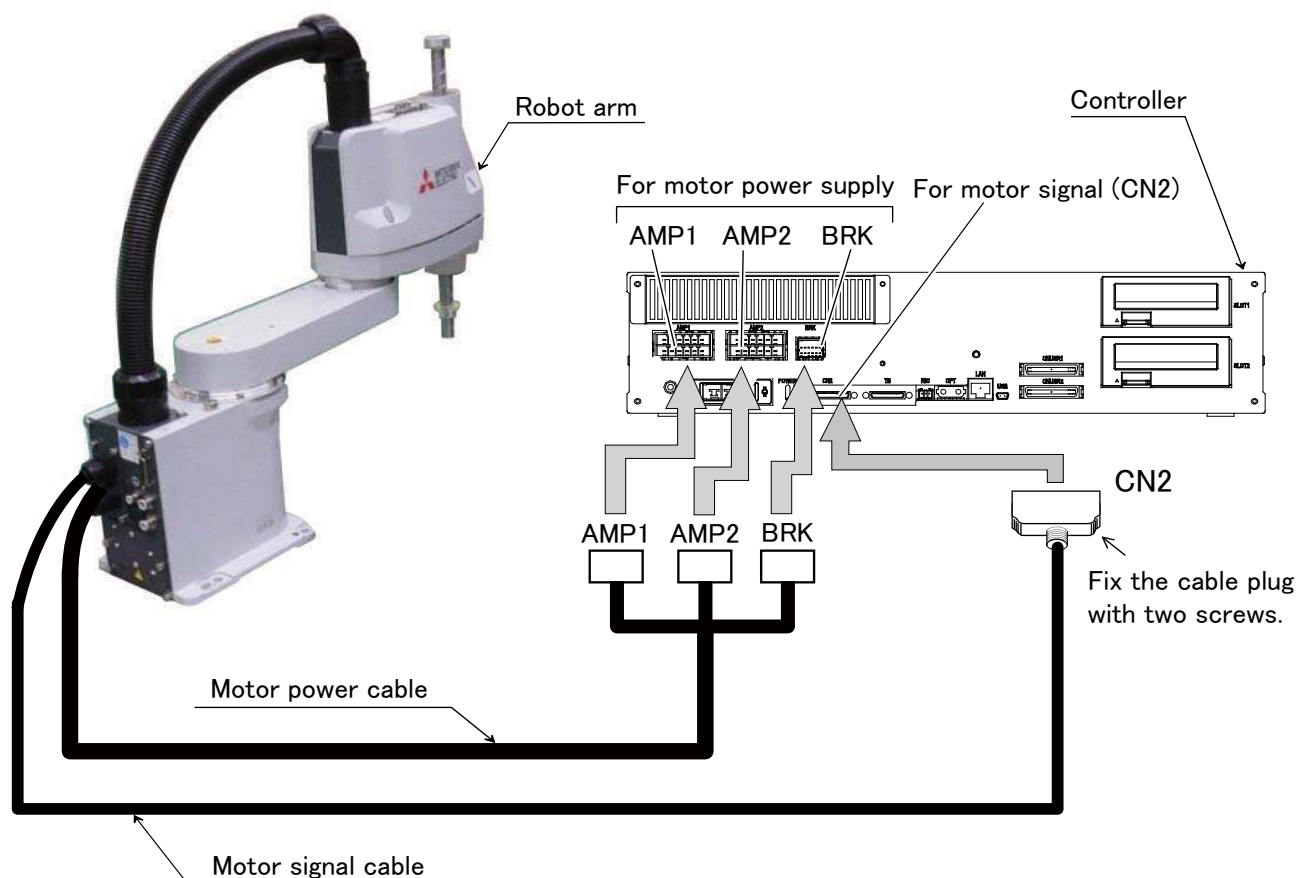


Fig.2-8 : Connecting the machine cables

For details of installation of the controller, refer to the installation procedure in the separate "INSTRUCTION MANUAL Controller setup, basic operation, and maintenance". Refer to the accessories installation procedure and install the cable fixing plate. Then connect the robot arm and the controller as follows. Fig. 2-8 shows the connection diagram.

- 1) Make sure that the power switch on the front of the controller is turned OFF.
- 2) Connect the machine cable to the corresponding connector on the front of the controller. Connect the connectors AMP1, AMP2, BRK, and CN2 securely to the controller. Fix the CN2 connector securely by tightening the 2 connector fixing screws.
Tighten the CN2 fixing screws with a torque of 0.06 to 0.07 N · m.
- 3) The connection method is the same for the optional machine cables (replaceable type). However, refer to the separate "Special Specifications Manual" for information on how to fix a flexible cable.

The connection to the controller is completed.



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 the machine cable at the place without the effect of the dust or oil mist. Please keep the dust and oil mist from being applied to of the robot-arm connector section, in the condition that the machine cable is removed. Since it becomes the cause of failure.



CAUTION

Please be careful not to catch the hand at installation and removal.

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 78, "5.6 Resetting the origin"](#) for the other methods.

The teaching pendant is required for this operation. This manual describes operation using R33TB. When R57TB is used, also refer to the Instruction Manual of R57TB.

[Caution] If the origin data at shipment is erased due to out of battery, it is necessary to set the origin again. Refer to [Page 78, "5.6 Resetting the origin"](#) and reset the origin using the jig method, mechanical stopper method or ABS method.

2.3.1 Installing the teaching pendant (T/B)

When installing and removing the T/B, turn off the controller power supply. If T/B is installed or removed in the state of power supply ON, emergency stop alarm will occur.

If you use the robot wherein T/B is removed, please install the attached dummy connector. With the connector, put the dummy connector or draw it out.



CAUTION

Please do not pull the cable of T/B strongly or do not bend it too much.

It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself.

(1) CR751 controller

Explain the installation method of T/B below.

- 1) Check that the POWER (power supply) switch of the robot controller is OFF.
- 2) Connect the T/B connector to the controller's T/B connector. Make sure to fix it securely by fastening the hand locks (in 2 places), as shown in Fig. 2-9.

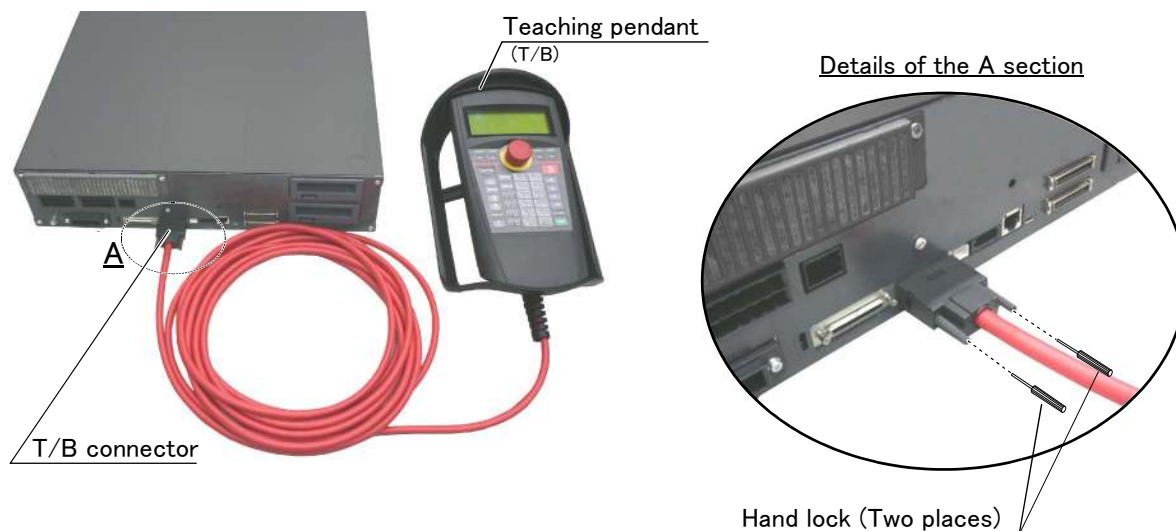


Fig. 2-9 : Installing and removing the T/B (CR751 controller)

The installation of T/B is finished.

◆◆◆ If error C0150 occurs ◆◆◆

At the time of the first power supply injection, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.

Parameter: Please input the serial number of the robot body into RB SERIAL. Refer to "instructions manual / controller setup, and basic operation & maintenance" for the operation method.

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 · S P	E · N · S P	E · N · S P

(O: O(Alphabet), 0: Zero)

Note) Meanings of symbols in method column

E: Jig method

N: Not used

SP: Not used

Fig.2-10 : Origin data label (an example)

The origin data to be input is noted in the origin data history table attached on the side of the base part of the robot arm. (Refer to [Fig. 2-10](#)).

Check the origin data.

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

* The origin data to input is found on also the robot examination report sheet.

**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.

For the CR751 controller, turn ON the switch on the external earth leakage breaker.

(3) Setting up the T/B

Next, prepare to use the T/B

- 1) Set the mode of the controller to "MANUAL".
For information on the mode changeover switch, refer to "Mode changeover switch input" in the Special Specifications Manual.
- 2) Set the T/B [ENABLE] 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 of the controller to "MANUAL", and then set the T/B [ENABLE] 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.

(4) Selecting the origin setting method

<MENU>	
1.FILE/EDIT	2.RUN
3.PARAM.	4.ORIGIN/BRK
5.SET/INIT.	6.ENHANCED
123 CLOSE	

4	GHI
---	-----

1) Press the [4] key on the menu screen, and display the ORIGIN/BRAKE screen.

< ORIGIN/ BRAKE >	
1. ORIGIN	2. BRAKE
123 CLOSE	

1	'()
---	-----

2) Press the [1] key on the ORIGIN/BRAKE screen, and display the origin setting method selection screen.

<ORIGIN>	
1. DATA	2. MECH
3. TOOL	4. ABS
5. USER	
123 CLOSE	

1	'()
---	-----

3) Press the [1] key on the origin setting method selection screen, and select the data input method.

<ORIGIN> DATA		
D: (■)		
J1 ()	J2 ()	J3 ()
J4 ()	J5 ()	J6 ()
J7 ()	J8 ()	
123 CLOSE		

4) Display the origin data input screen

◆◆◆ 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.

◆◆◆ The input method of numeral ◆◆◆

The number can be inputted if the key displayed on the lower left of each key is pressed. Press the

[CHARACTER] key, and in the condition that "123" is displayed on the screen lower side, press the number key.

(5) Inputting the origin data

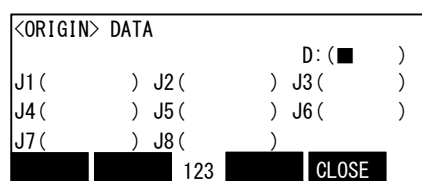


Input the value confirmed in section [Page 19](#), “(1) Confirming the origin data”.

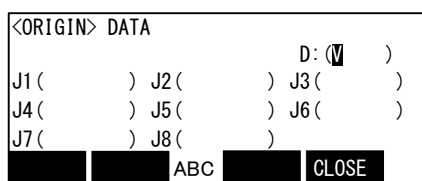
The correspondence of the origin data label value and axis to be input is shown in [Fig. 2-11](#).

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.



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



CHARACTER

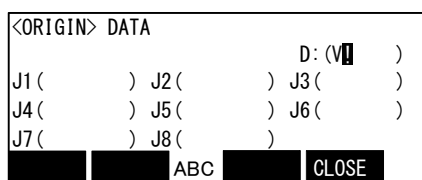
—B (J5)
8 TUV

2) Input the D value “V!%S29”.

Inputting “V”

Press the [CHARACTER] key and set to the character input mode. (Condition that “ABC” was displayed under the screen)

Press the [TUV] key three times. “V” will be set.



+C (J6)
· , %

→

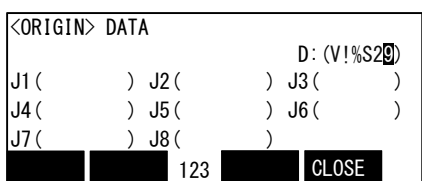
+C (J6)
· , %

Inputting “!”

Press the [, %] key five times. “!” will be set.

Press the [→] key once and advance the cursor.

Press the [, %] key twice (input “%”), and press the [PQRS] key four times (input “S”).



CHARACTER

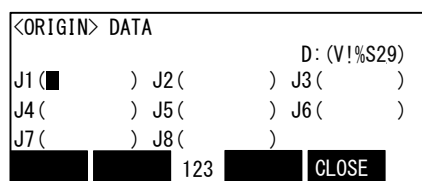
—Z (J3)
2 ABC

+B (J5)
9 WXYZ

Press the [CHARACTER] key and set to the numeral input mode. (Condition that “123” was displayed under the screen)

Press the [2] key (input “2”), and press the [9] key (input “9”).

“V!%S29” will appear at the “D” data on the teaching pendant screen.



↓

3) Press the [↓] key, and move the cursor to the J1 input position.

4) Input the J1 value in the same manner as above.

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

<ORIGIN> DATA			
		D: (V!%S29)	
J1 (06DTYY)	J2 (2?HL9X)	J3 (1CP55V)	
J4 (T6!MSY)	J5 ()	J6 ()	
J7 ()	J8 ()		
ABC		CLOSE	

EXE

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

<ORIGIN> DATA			
CHANGE TO ORIGIN. OK?			
Yes	123	No	

F1

7) Press [F1] (Yes) to end the origin setting

◆◆◆ Moving the cursor ◆◆◆

Press the [↑], [↓], [←] and [→] keys.

◆◆◆ Inputting characters ◆◆◆

Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen). The displayed character is scrolled each time at pressing the key.

◆◆◆ How to input symbols ◆◆◆

The symbol is allocated to [()], [@=], and [,%] key. Please repress each key until the symbol to wish is displayed.

- a) [()] key ' () " ^ : ; ¥ ?
- b) [@ =] key @ = + - * / < >
- c) [, %] key , % # \$! & _ .

◆◆◆ Correcting an input ◆◆◆

After returning one character by pressing the [CLEAR] key, input the character again.

◆◆◆ 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 CYLINDER jog that moves along the circular arc.

This operation is carried out while pressing the deadman switch on the back of the T/B.

Note) The figure of the robot which indicated to the explanation page in each jog mode is an example.



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

To check whether the origin of the robot deviates, move the robot arm to the position where the ABS marks align each other, and check the displayed joint coordinates of the position.

For the details of the ABS mark position and the joint coordinates, refer to [Page 78](#), "5.6 Resetting the origin", and [Page 87](#), "5.6.2 ABS origin method".



WARNING

Confirm that the origin has been set. If the origin has not been set, "****" will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.

In such a case, the robot may operate beyond the software-defined operating range, which will cause interference or collisions between the robot mechanical sections.

Refer to [Page 17](#), "2.3 Setting the origin" for details on setting the origin.

◇◆◇ How to choose the jog mode ◇◆◇

<CURRENT>	JOINT	100%	M1	TO	B1
J1: +0.00	J5: +0.00				
J2: +0.00	J6: +0.00				
J3: +90.00	:				
J4: +0.00	:				
XYZ	TOOL	JOG	3-XYZ	CYLNDR	⇒

Choose the jog mode



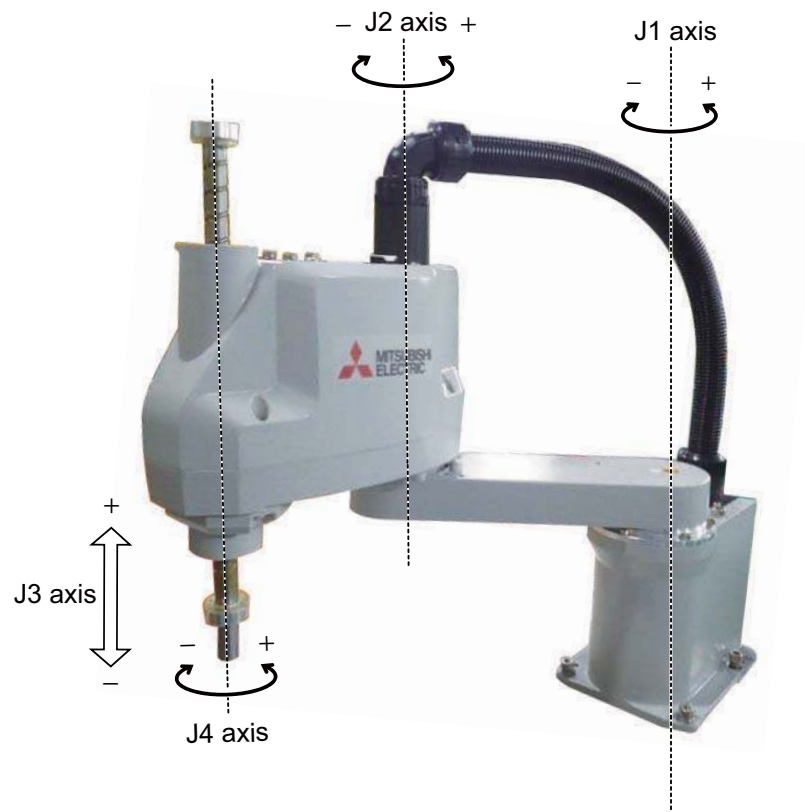
F1

to

F4

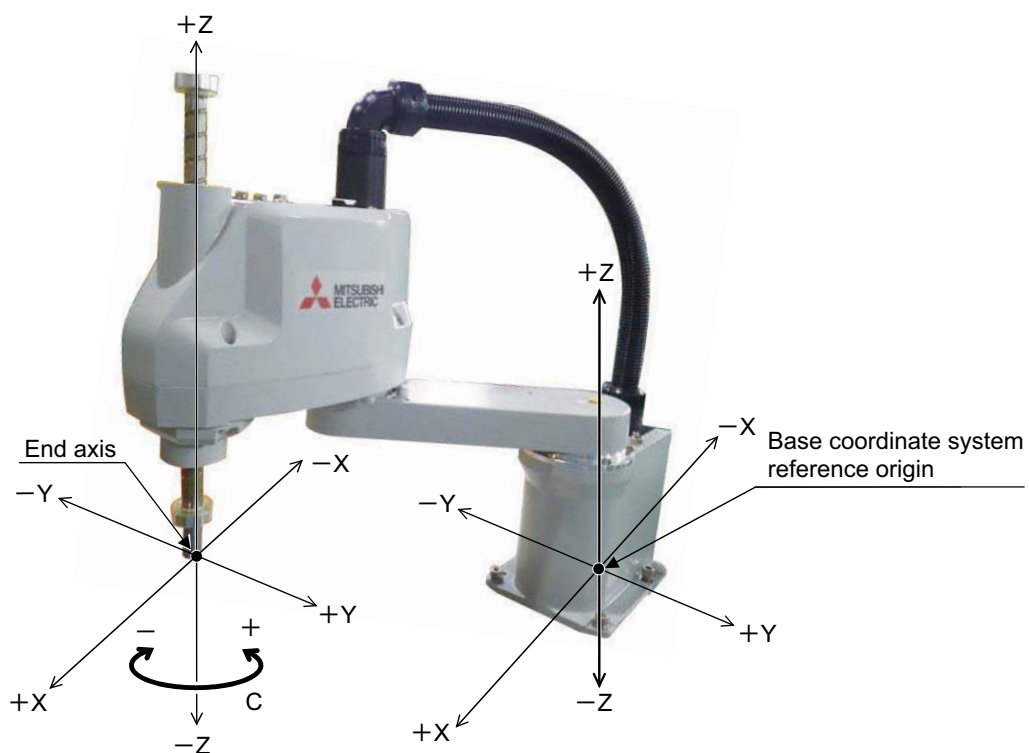
FUNCTION

Press the [JOG] key, the jog screen will be displayed, and display the jog mode which can be chosen at the bottom of the screen. Because these correspond to the function key of [F1] – [F4], press the function key corresponding to the jog mode to wish. And, if the [FUNCTION] key is pressed, selection in jog modes other than the present display is possible. The override (100%), the mechanism number (M1), and the tool number (T1), and the base coordinate number (B1) are displayed on the upside of the screen following the present jog mode (JOINT).



* Each axis moves independently.

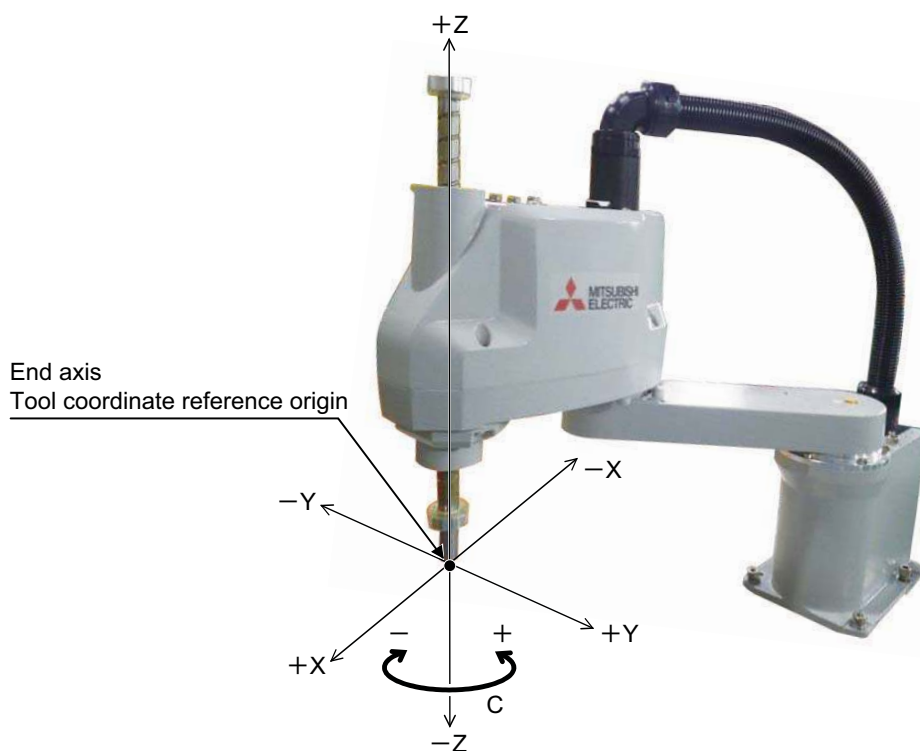
Fig.2-12 : JOINT jog operation



* While maintaining the end axis posture, the axis moves straight along the base coordinate system.

Also, while maintaining the end axis position, the end axis posture changes.

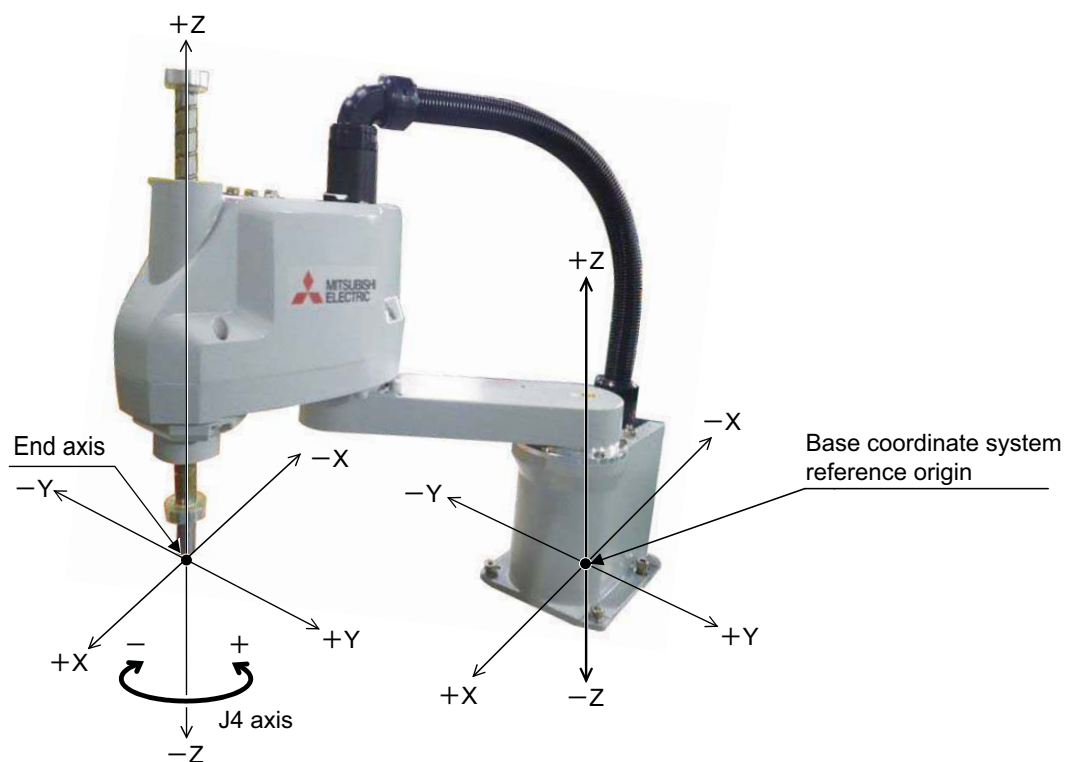
Fig.2-13 : XYZ jog operation



* While maintaining the end axis posture, the axis moves straight along the tool coordinate system.

Also, while maintaining the end axis position, the end axis posture changes

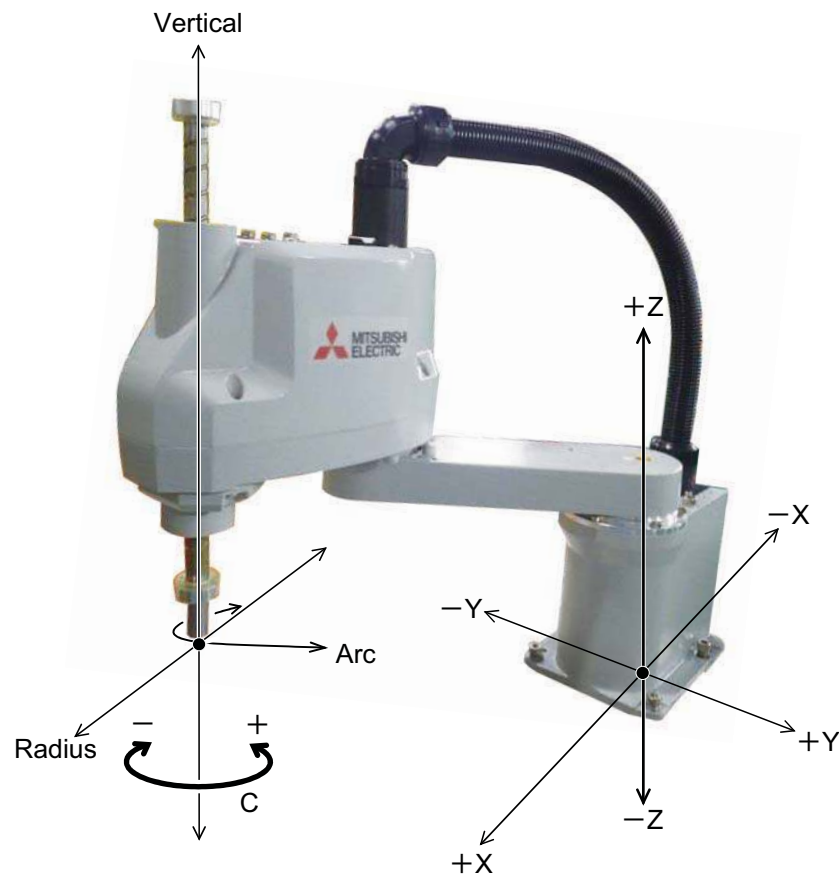
Fig.2-14 : TOOL jog operation



* The axis moves straight along the base coordinate system. At this time, the end axis posture is not maintained.

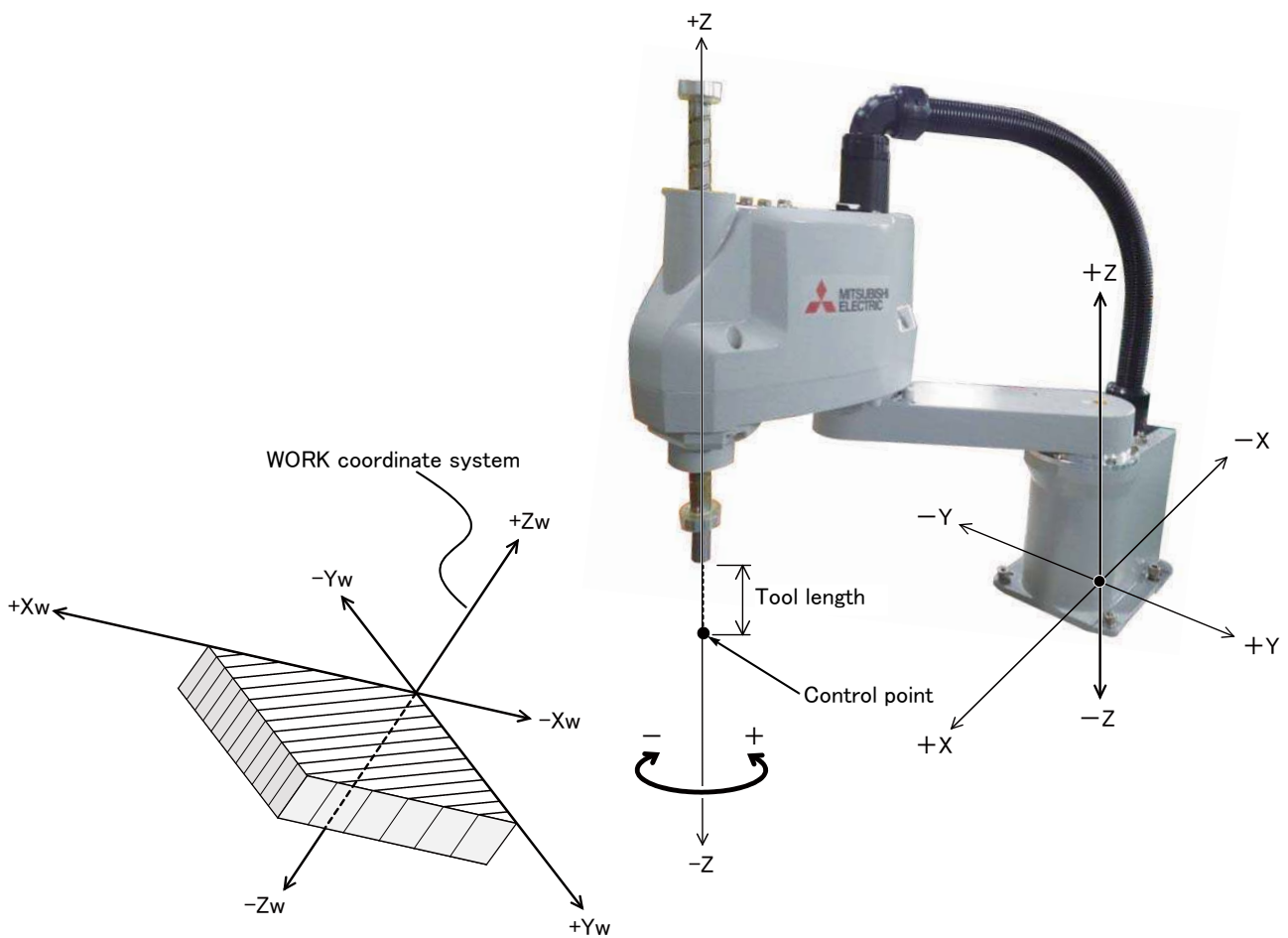
Also, the end axis posture changes.

Fig.2-15 : 3-axis XYZ jog operation



- * The current position is set as the arc centering on the Z axis, and the axis moves along that arc, expands and contracts in the radius direction, and moves vertically. At this time, the end axis posture is maintained. Also, while maintaining the axis posture position, the end axis posture changes.

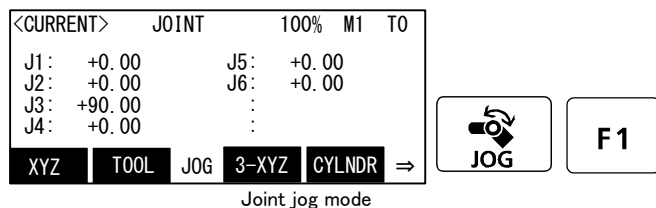
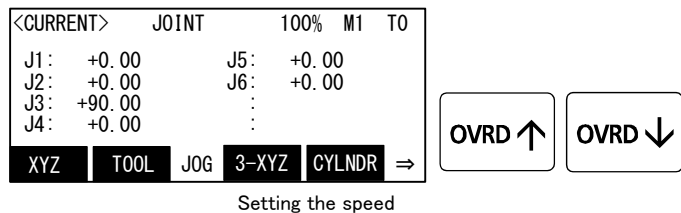
Fig.2-16 : CYLINDER jog operation



- * While maintaining the end axis posture, the axis moves straight along the work coordinate system. Also, while maintaining the end axis position, the end axis posture changes.
- * When the controller software version is R5 or later for the F-Q series or S5 or later for the F-D series, jog operation around the work coordinates system is available (EX-T jog). In this jog operation, when the jog operation is performed for the posture elements, the posture rotates on the Xw axis, Yw axis, or Zw axis of the work coordinates system while the control point is changed.

Fig.2-17 : WORK jog operation

(1) JOINT jog operation

Select joint jog modeSet jog speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

Check that the "joint" in jog mode is displayed on the screen.

If other jog modes are displayed, please press the function key corresponding to the "joint." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)

If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

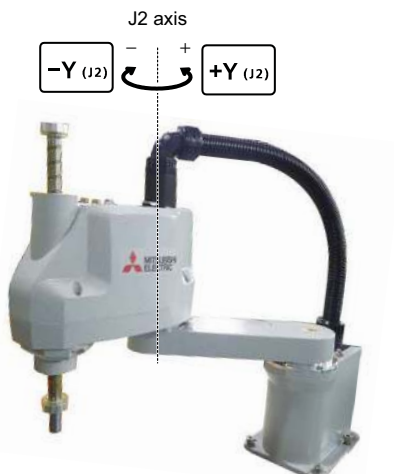
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.

Set the override to 10% here for confirmation work.

J1 axis jog operation

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

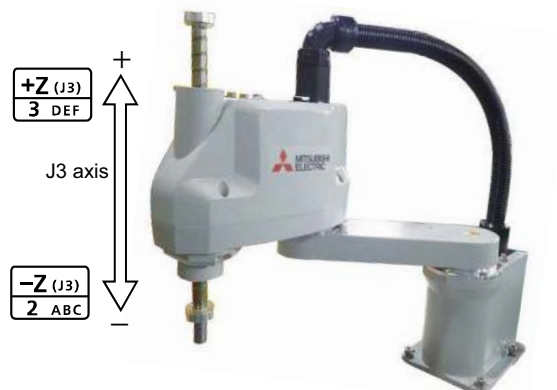
J2 axis jog operation

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

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

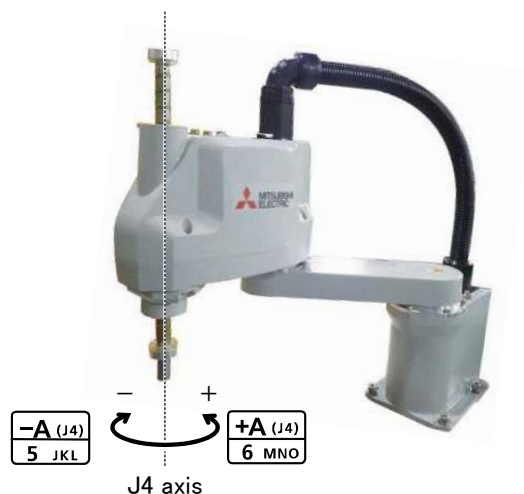
The axes may be outside the movement area. Move these axes toward the inner side of the movement area.

J3 axis jog operation



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

J4 axis jog operation



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

◇◆◇ If the buzzer of T/B sounds and the robot does not move ◇◆◇

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

(2) XYZ jog operation

Select XYZ jog mode

<CURRENT>	XYZ	100%	M1	T0
J1:	+0.00	J5:	+0.00	
J2:	+0.00	J6:	+0.00	
J3:	+90.00	:		
J4:	+0.00	:		

XYZ TOOL JOG 3-XYZ CYLNDR ⇒

XYZ jog mode

Set jog speed

<CURRENT>	XYZ	100%	M1	T0
J1:	+0.00	J5:	+0.00	
J2:	+0.00	J6:	+0.00	
J3:	+90.00	:		
J4:	+0.00	:		

XYZ TOOL JOG 3-XYZ CYLNDR ⇒

Setting the speed



FUNCTION

F1

to F4



[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

Check that the "XYZ" in jog mode is displayed on the screen.

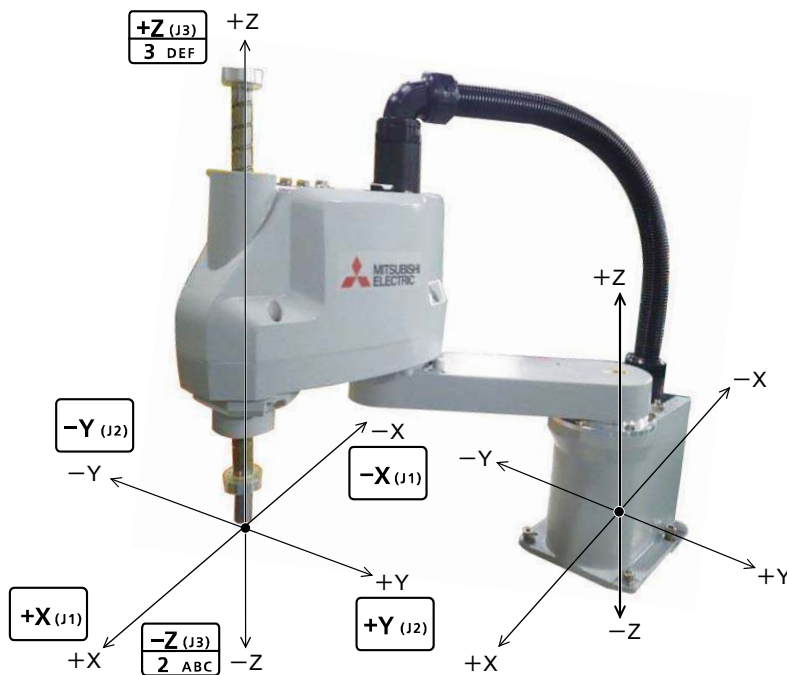
If other jog modes are displayed, please press the function key corresponding to the "XYZ." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)

If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller. Set the override to 10% here for confirmation work.

Moving along the base coordinate system



- When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction.
When the [-X (J1)] keys are pressed, move along the minus direction.
- When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction.
When the [-Y (J2)] keys are pressed, move along the minus direction.
- When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the [-Z (J3)] keys are pressed, move along the minus direction.

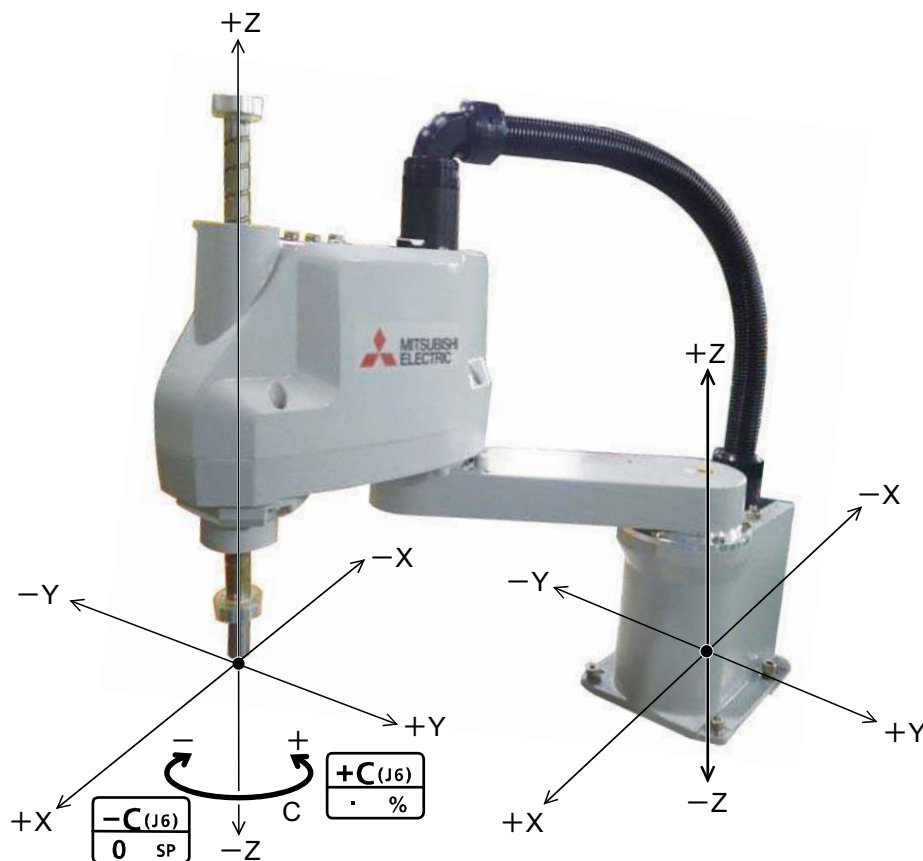
◆◆◆ When the robot is in the transportation posture ◆◆◆

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to [Page 29, "\(1\) JOINT jog operation"](#), and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◆◆◆ If the buzzer of T/B sounds and the robot does not move ◆◆◆

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

Changing the end axis posture



*The Position of the end axis will not change.

- When the [+C (J6)] keys are pressed, the Z axis will rotate in the plus direction.
When the [-C (J6)] keys are pressed, rotate in the minus direction.

◆◆◆ When alarm No. 5150 occurs ◆◆◆

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

◆◆◆ Tool length ◆◆◆

The default tool length is 0mm, and the control point is the center of the end axis.

After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

Select TOOL jog mode

<CURRENT>	JOINT	100%	M1	T0
J1: +0.00	J5: +0.00			
J2: +0.00	J6: +0.00			
J3: +90.00	:			
J4: +0.00	:			

XYZ TOOL JOG 3-XYZ CYLNR =>

TOOL jog mode



FUNCTION

F1

F4

Set jog speed

<CURRENT>	JOINT	100%	M1	T0
J1: +0.00	J5: +0.00			
J2: +0.00	J6: +0.00			
J3: +90.00	:			
J4: +0.00	:			

XYZ TOOL JOG 3-XYZ CYLNR =>

Setting the speed



[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

Check that the "TOOL" in jog mode is displayed on the screen.

If other jog modes are displayed, please press the function key corresponding to the "TOOL." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)

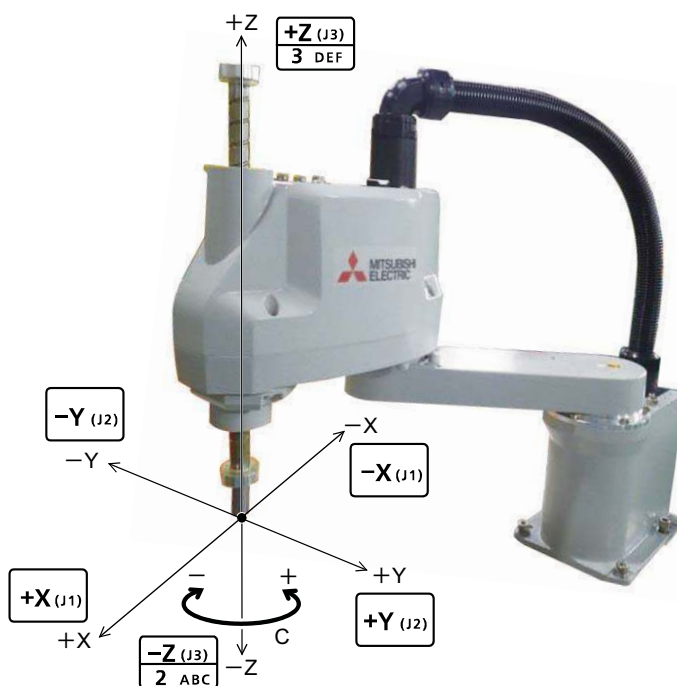
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.

Set the override to 10% here for confirmation work.

Moving along the tool coordinate system



•When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction of the tool coordinate system.

When the [-X (J1)] keys are pressed, move along the minus direction.

•When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction of the tool coordinate system.

When the [-Y (J2)] keys are pressed, move along the minus direction.

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

When the [-Z (J3)] keys are pressed, move along the minus direction.

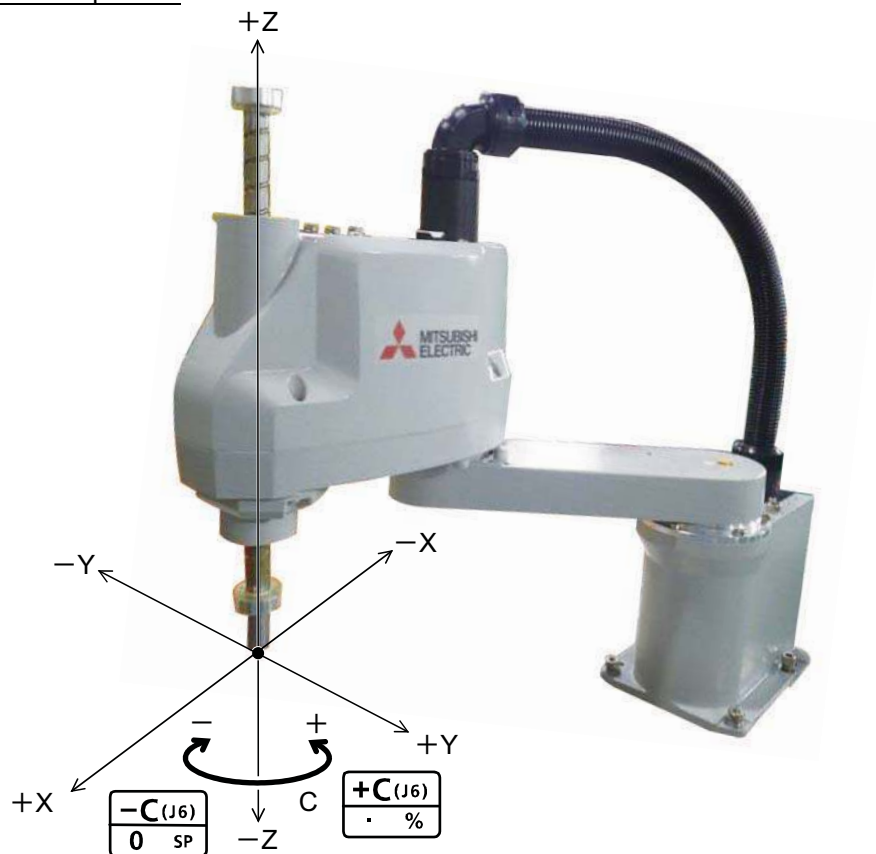
◆◆◆ When the robot is in the transportation posture ◆◆◆

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to [Page 29, "\(1\) JOINT jog operation"](#), and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◆◆◆ If the buzzer of T/B sounds and the robot does not move ◆◆◆

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

Changing the end axis posture



- When the $[+C(J6)]$ keys are pressed, the Z axis will rotate in the plus direction of the tool coordinate system. When the $[-C(J6)]$ keys are pressed, rotate in the minus direction.

◆◆◆ When alarm No. 5150 occurs ◆◆◆

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

◆◆◆ Tool length ◆◆◆

The default tool length is 0mm, and the control point is the center of the end axis.

After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(4) 3-axis XYZ jog operation

Select XYZ456 jog mode

<CURRENT>	JOINT	100%	M1	T0
J1: +0.00	J5: +0.00			
J2: +0.00	J6: +0.00			
J3: +90.00	:			
J4: +0.00	:			

XYZ TOOL JOG 3-XYZ CYLNR =>

XYZ456 jog mode



FUNCTION

F1

F4

Set jog speed

<CURRENT>	JOINT	100%	M1	T0
J1: +0.00	J5: +0.00			
J2: +0.00	J6: +0.00			
J3: +90.00	:			
J4: +0.00	:			

XYZ TOOL JOG 3-XYZ CYLNR =>

Setting the speed

OVRD ↑

OVRD ↓

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

Check that the "XYZ456" in jog mode is displayed on the screen.

If other jog modes are displayed, please press the function key corresponding to the "XYZ456." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)

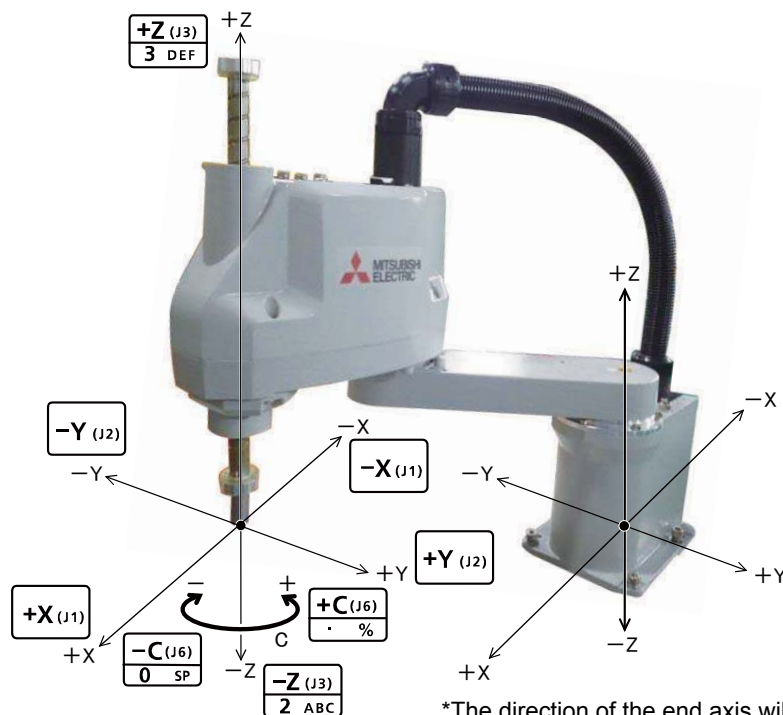
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.

Set the override to 10% here for confirmation work.

Moving along the base coordinate system



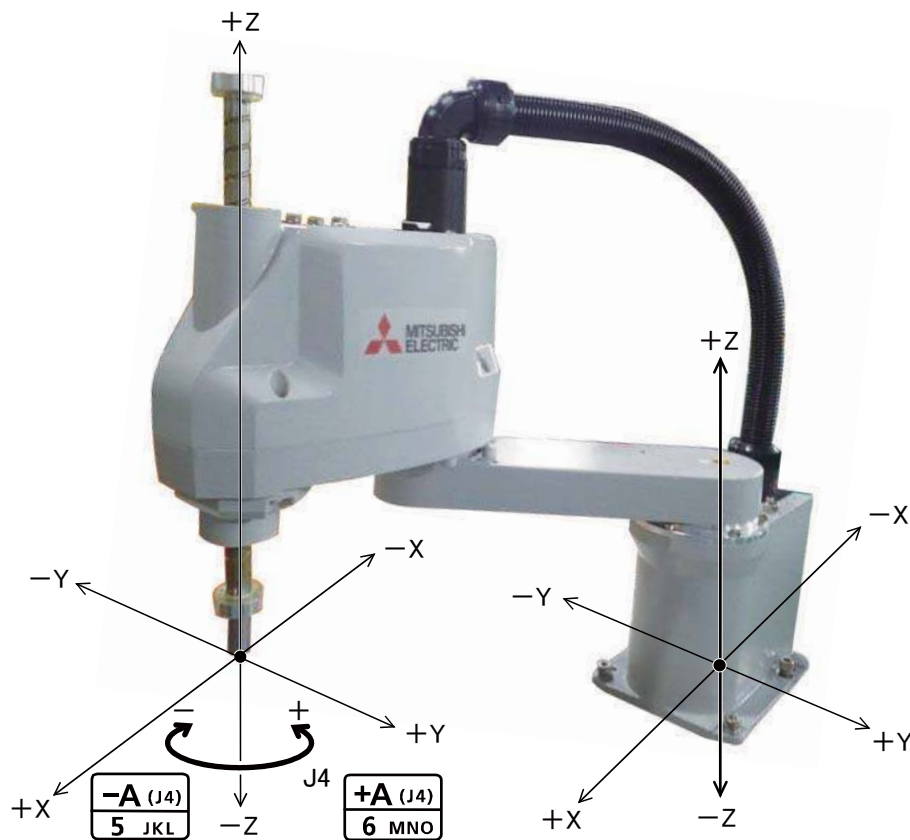
*The direction of the end axis will change.

- When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction.
When the [-X (J1)] keys are pressed, move along the minus direction.
- When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction.
When the [-Y (J2)] keys are pressed, move along the minus direction.
- When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the [-Z (J3)] keys are pressed, move along the minus direction.

◆◆◆ The flange surface end axis posture cannot be maintained with 3-axis XYZ jog. ◆◆◆

With 3-axis XYZ jog, the flange surface 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 end axis posture

*The Position of the end axis will not change.

- When the [+C (J6)] keys are pressed, the J4-axis will rotate in the plus direction.
When the [-C (J6)] keys are pressed, rotate in the minus direction.

(5) CYLINDER jog operation

Select cylindrical jog mode

<CURRENT>	JOINT	100%	M1	T0
J1: +0.00	J5: +0.00			
J2: +0.00	J6: +0.00			
J3: +90.00	:			
J4: +0.00	:			

XYZ TOOL JOG 3-XYZ CYLNR =>

CYLINDER jog mode



FUNCTION

F1

to

F4

Set jog speed

<CURRENT>	JOINT	100%	M1	T0
J1: +0.00	J5: +0.00			
J2: +0.00	J6: +0.00			
J3: +90.00	:			
J4: +0.00	:			

XYZ TOOL JOG 3-XYZ CYLNR =>

Setting the speed

OVRD ↑

OVRD ↓

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

Check that the "CYLINDER" in jog mode is displayed on the screen.

If other jog modes are displayed, please press the function key corresponding to the "CYLINDER." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)

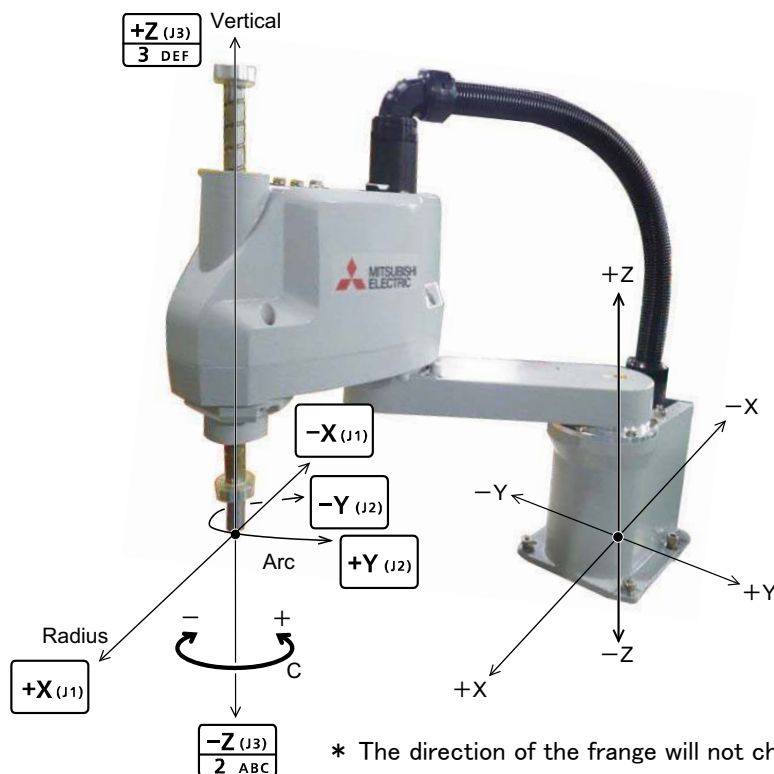
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.

Set the override to 10% here for confirmation work.

Moving along an arc centering on the Z axis



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

- When the [+X (J1)] keys are pressed, the robot will expand in the radial direction.
When the [-X (J1)] keys are pressed, contract in the radial direction.
- When the [+Y (J2)] keys are pressed, the robot will move along the arc in the plus direction.
When the [-Y (J2)] keys are pressed, move in the minus direction.
- When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
When the [-Z (J3)] keys are pressed, move along the minus direction.

(6) Work jog operation

Setting of the work coordinates system is necessary.

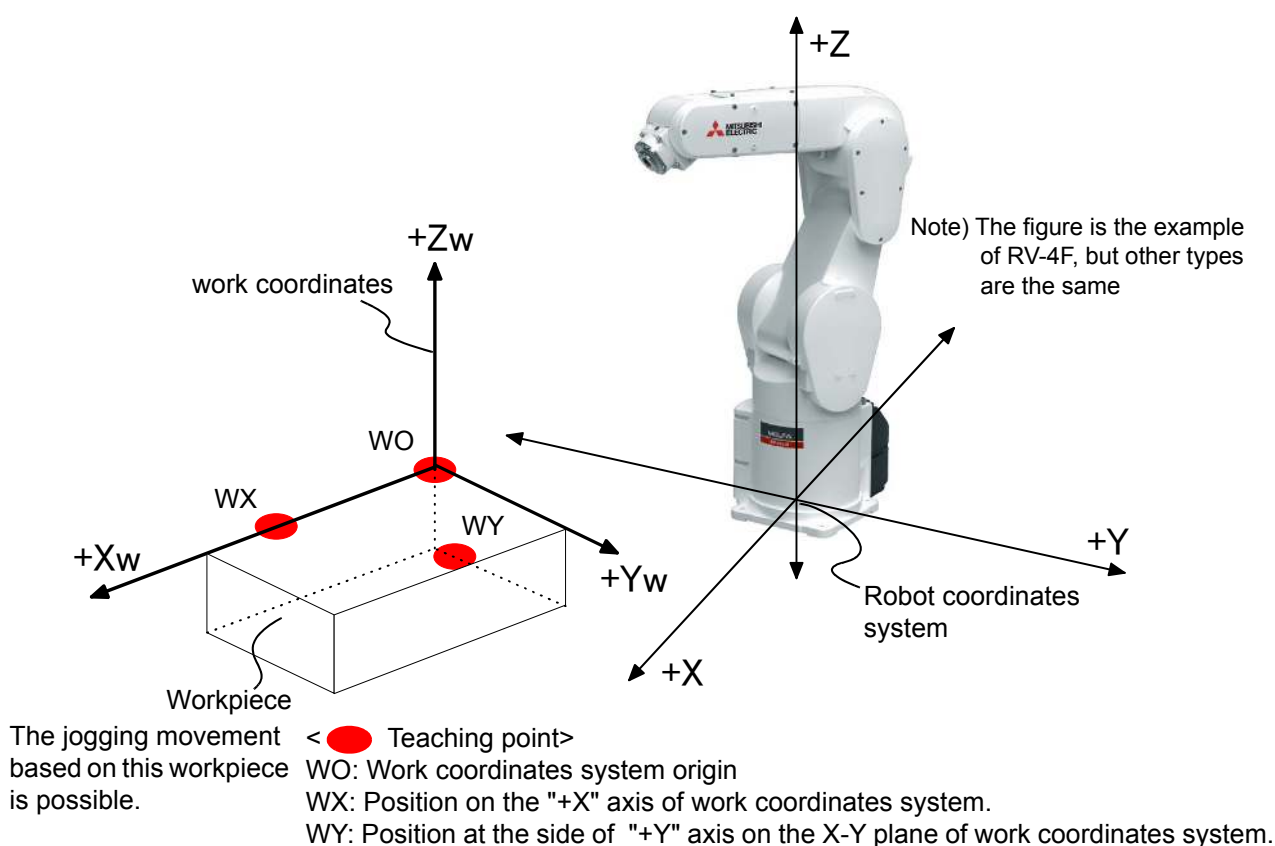
By this jog operation, robot can be move along with the direction of work (or working table etc.), so teaching operations get easier.

When jog operation, select by which work coordinates the robot moves

The setting method of the work coordinates system using T/B (R33TB) is shown in the following.

(Parameter: Setting the coordinate value to WK n CORD ("n" is meaning the number (1-8) of work coordinates) can also set up the work coordinates system. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details of parameter.)

The work coordinates system teaches and sets up the three points (WO, WX, WY).



[Supplement] : The coordinate values which use all three teaching points for setting of the work coordinates system are each only X, Y, and the Z-axis. Although the coordinate value of A, B, and C axis is not used, positioning will get easy if the XYZ jog or TOOL jog movement is effected with the same value. (The direction of the hand is the same)

Fig.2-18 : Setting of the work coordinates system (teaching point)

The setting (definition) method of the work coordinates system is shown as following.

1) Select "6.ENHANCED" screen on the <MENU> screen.

<MENU>	
1. FILE/EDIT	2. RUN
3. PARAM.	4. ORIGIN/BRK
5. SET/INIT.	6. ENHANCED
123 CLOSE	



<EMHANCED>	
1. SQ DIRECT	2. WORK COORD.
123 CLOSE	

2) Press the [2] keys in the menu screen and select "2. WORK COORD."

<EMHANCED>	
1. SQ DIRECT	2. WORK COORD.
123 CLOSE	



<WORK COORD>	
WORK NUMBER (1)	
TEACHING POINT (WO)	
X: 0.00	
Y: 0.00	
Z: 0.00	
TEACH WX 123 WY DEFINE	

The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

3) Selection of the work coordinates number

Press the [FUNCTION] keys, and display "W: JUMP" function. Press the function key corresponding to "W: JUMP"

<WORK COORD>	
WORK NUMBER (1)	
TEACHING POINT (WO)	
X: 0.00	
Y: 0.00	
Z: 0.00	
W. JUMP W. GRID 123 CLOSE	



<WORK JUMP>	
CHOOSE ONE OF THE WORK NUMBER	
1-8.	
123 CLOSE	

Press numeral key [1] - [8] and specify the work coordinates number. The coordinate value of the specified work coordinates system is displayed.

<WORK JUMP>	
CHOOSE ONE OF THE WORK NUMBER	
1-8.	
123 CLOSE	



<WORK COORD>	
WORK NUMBER (2)	
TEACHING POINT (WO)	
X: 0.00	
Y: 0.00	
Z: 0.00	
W. JUMP W. GRID 123 CLOSE	

The screen is the example which specified the work coordinates number 2. ("2" at the upper right of the screen)

Operation will be canceled if the [CLOSE] key is pressed.

4) The teaching of the work coordinates system

Teach the three points shown in Fig. 2-18. Confirm the name currently displayed on the "TEACHING POINT" at the upper right of the screen. If it differs, press the function key corresponding to each point(WO, WX, WY) to teach. Move the robot's arm by jog operation (other jogging movement), and press the function key corresponding to "TEACH."([F1]) The confirmation screen is displayed.

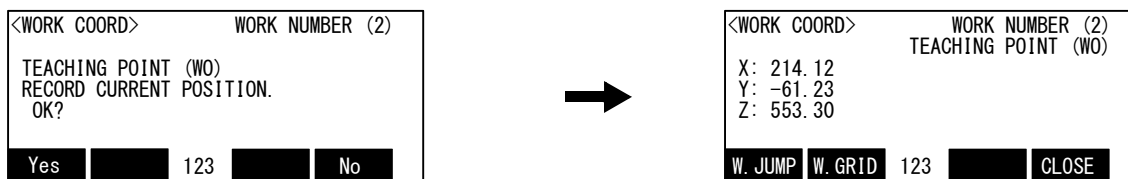
<WORK COORD>	
WORK NUMBER (2)	
TEACHING POINT (WO)	
X: 0.00	
Y: 0.00	
Z: 0.00	
TEACH WX 123 WY DEFINE	



<WORK COORD>	
WORK NUMBER (2)	
TEACHING POINT (WO)	
RECORD CURRENT POSITION.	
OK?	
Yes 123 No	

Specify the teaching point [WO],[WX],[WY]
teaching the position [TEACH]

Presses the function key corresponding to "Yes", the robot's current position is registered, and the registered coordinates value is displayed. Operation will be canceled if the [CLOSE] key is pressed.



Teach the three points, WO, WX, and WY, by the same operation.

The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)

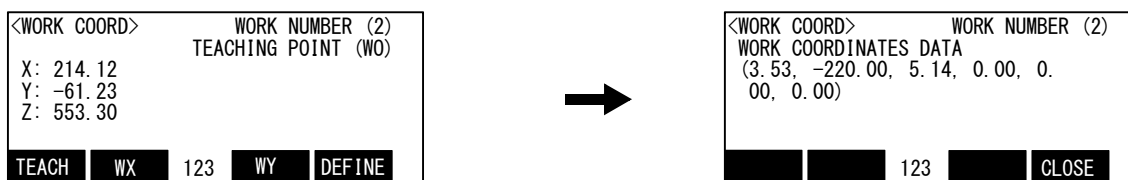
WO= parameter: WKnWO

WX= parameter: WKnWX

WY= parameter: WKnWY

5) Setting of work coordinates (definition)

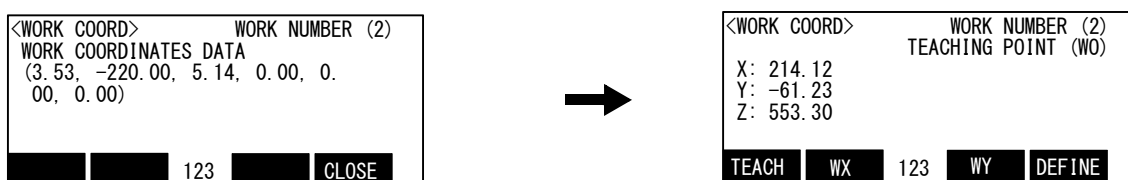
If the function key corresponding to "DEFINE" ([F1]) is pressed, the work coordinates system will be calculated using the three points, and the result will be displayed.



The alarm occurs if the work coordinates system is incalculable. (There are the three points on the straight line, or the two points have overlapped) In this case, reset alarm and re-teach the three points.

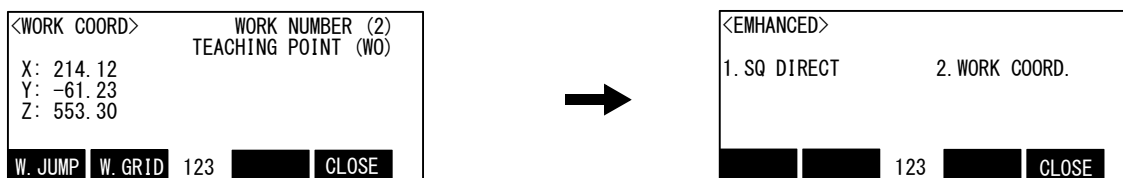
This work coordinate data is registered into parameter: WKnCORD. ("n" means the work coordinates numbers 1-8)

If the function key corresponding to "CLOSE" is pressed, it will return to the previous screen.



6) Finishing of setting the work coordinates

Press the [FUNCTION] keys, and display "CLOSE" function. Press the function key corresponding to "CLOSE". Returns to the <MENU> screen.



Although setting of work coordinates is finishing above, confirmation of work coordinates can be done by pressing the function key corresponding to "W GRID."([F2])

<WORK COORD>		WORK NUMBER (2)	
X: 214.12		TEACHING POINT (WO)	
Y: -61.23			
Z: 553.30			
W. JUMP	W. GRID	123	CLOSE



<WORK COORD>		WORK NUMBER (2)	
WORK COORDINATES DATA			
(3.53, -220.00, 5.14, 0.00, 0.			
00, 0.00)			
		123	CLOSE

Return to the previous screen by pressing the [CLOSE] ([F4]) key.

Then, the operation method of the work jog is shown.
Change to the work jog after nearing the work.

Select WORK jog mode

<CURRENT>		WORK		100% M1 TO W1	
J1:	+0.00	J5:	+0.00		
J2:	+0.00	J6:	+0.00		
J3:	+90.00	:	:		
J4:	+0.00	:	:		
XYZ	TOOL	JOG	3-XYZ	CYLNR	⇒

WORK jog mode

JOG

FUNCTION

F1 ~ F4

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)

Check that the "WORK" in jog mode is displayed on the screen.

If other jog modes are displayed, please press the function key corresponding to the "WORK." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)

If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Confirmation and selection of the work coordinates system

<CURRENT>		WORK		100% M1 TO W1	
J1:	+0.00	J5:	+0.00		
J2:	+0.00	J6:	+0.00		
J3:	+90.00	:	:		
J4:	+0.00	:	:		
XYZ	TOOL	JOG	3-XYZ	CYLNR	⇒

Select the work coordinates system

↑

↓

Target work coordinates system

Confirm the target work coordinates system.

The current target number is displayed on the screen upper right. (W1 - W8)

The number of work coordinates can be changed by the arrow key [Upper arrow], [Lower arrow]

Push the key [Upper arrow], the number will increase. (W1, W2, W8) Conversely, push the key [Lower arrow], the number will decrease



CAUTION

Always confirm that the number of the target work coordinates system is displayed correctly (Display of W1-W8 at the upper right of the screen)

If mistaken, the robot will move in the direction which is not meant and will cause the damage and the personal injuries.

Set jog speed

<CURRENT>		JOINT		100% M1 TO	
J1:	+0.00	J5:	+0.00		
J2:	+0.00	J6:	+0.00		
J3:	+90.00	:	:		
J4:	+0.00	:	:		
XYZ	TOOL	JOG	3-XYZ	CYLNR	⇒

Setting the speed

OVRD ↑

OVRD ↓

Whenever it presses the key of [OVRD(Upper arrow)], the override goes up. Conversely, if the [OVRD(Lower arrow)] key is pressed, it will go down.

The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.

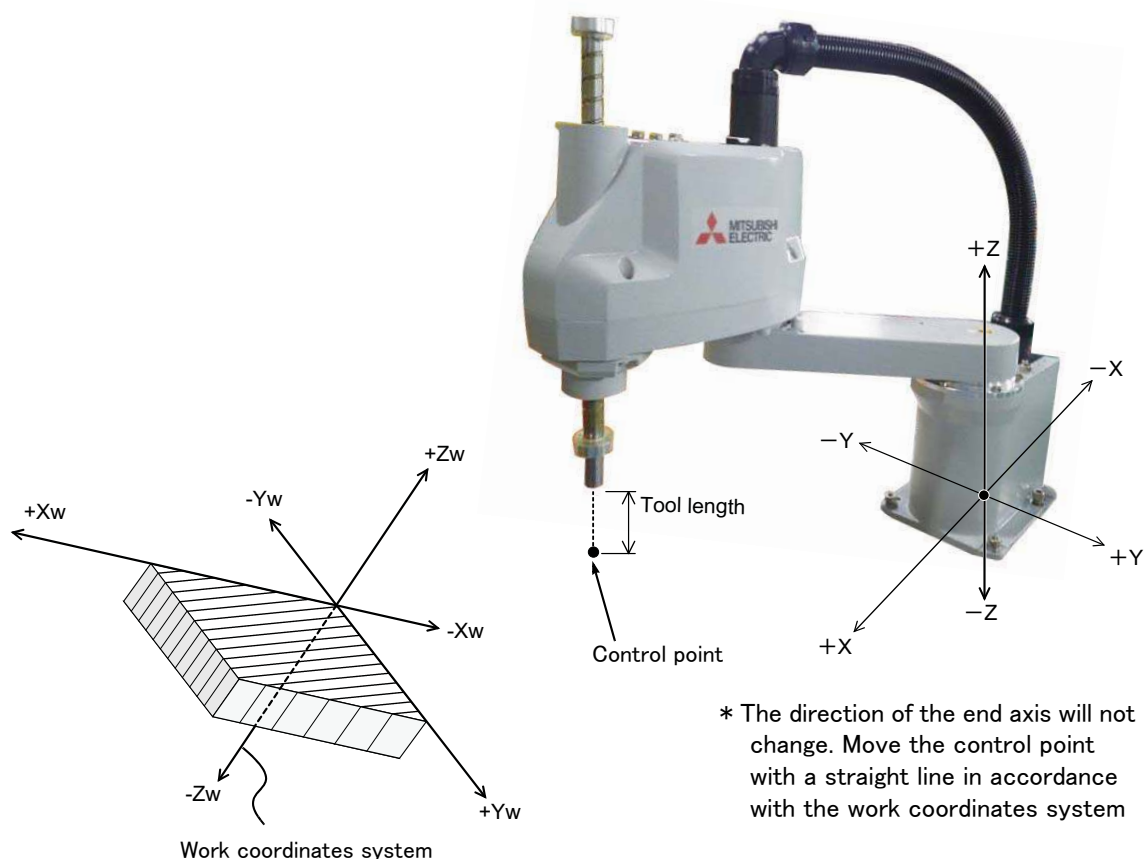
Set the override to 10% here for confirmation work

When the software version is S5 or later for the F-Q series or S5 or later for the F-D series, the additional WORK jog operation, Ex-T jog, is available. The conventional WORK jog operation and the Ex-T jog operation can be switched by setting the parameters WK1JOGMD to WK8JOGMD of each work coordinates system.

The respective operations are as follows.

WORK jog operation mode	Conventional WORK jog	Ex-T jog
Parameters WK n JOGMD (n is 1 to 8) setting	0 (initial value)	1
XYZ key operation	Moves along each axis of the work coordinates system	Same as the conventional WORK jog
C key operation	With the control point position maintained, the direction changes along the work coordinates system.	While the control point position is changed, the direction changes on the Z axis of the work coordinates system (Z w).
AB key operation	The robot does not move.	The robot does not move.

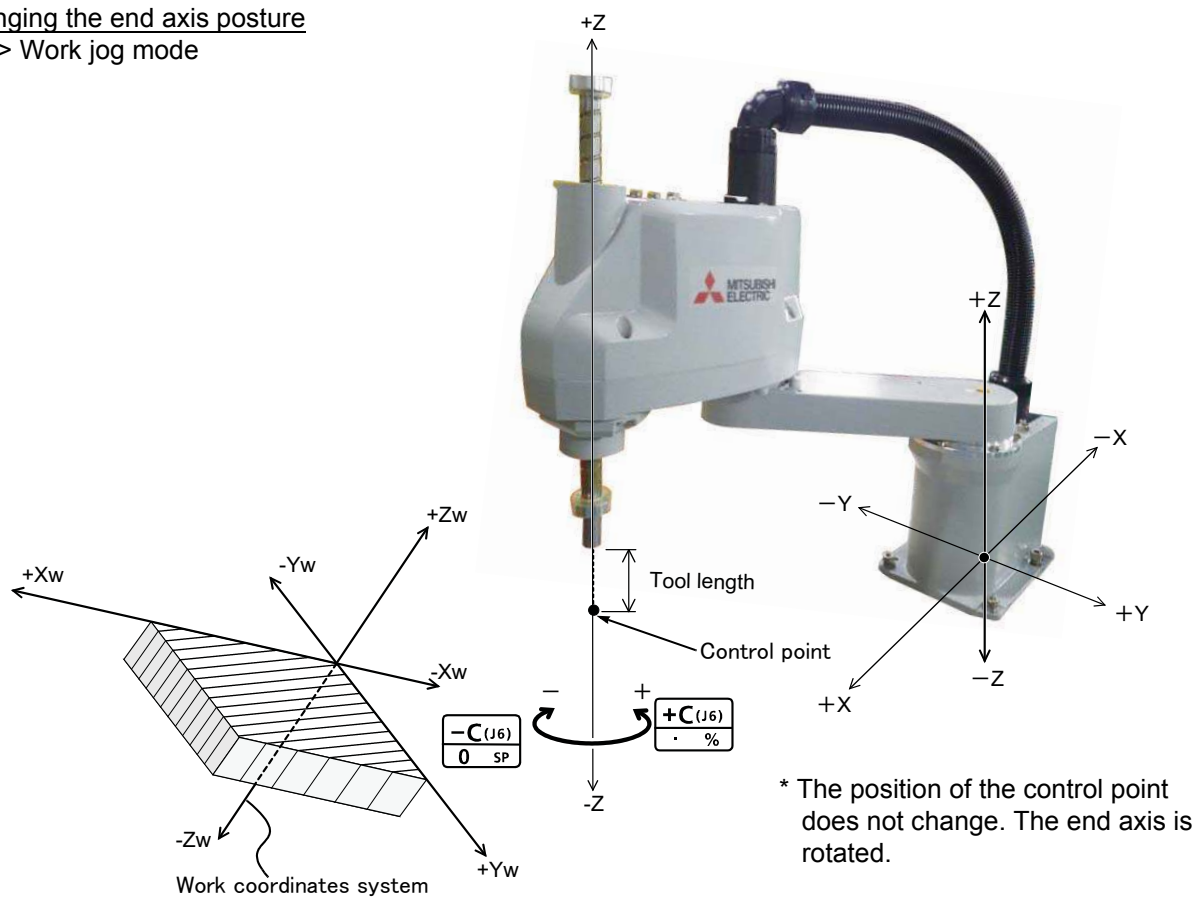
The jog movement based on work coordinates system



- When the [+X (J1)] keys are pressed, the robot will move along the X axis (X w) plus direction on the work coordinates system.
When the [-X (J1)] keys are pressed, Move along the minus direction.
- When the [+Y (J2)] keys are pressed, the robot will move along the Y axis (Y w) plus direction on the work coordinates system.
When the [-Y (J2)] keys are pressed, Move along the minus direction.
- When the [+Z (J3)] keys are pressed, the robot will move along the Z axis (Z w) plus direction on the work coordinates system.
When the [-Z (J3)] keys are pressed, Move along the minus direction.

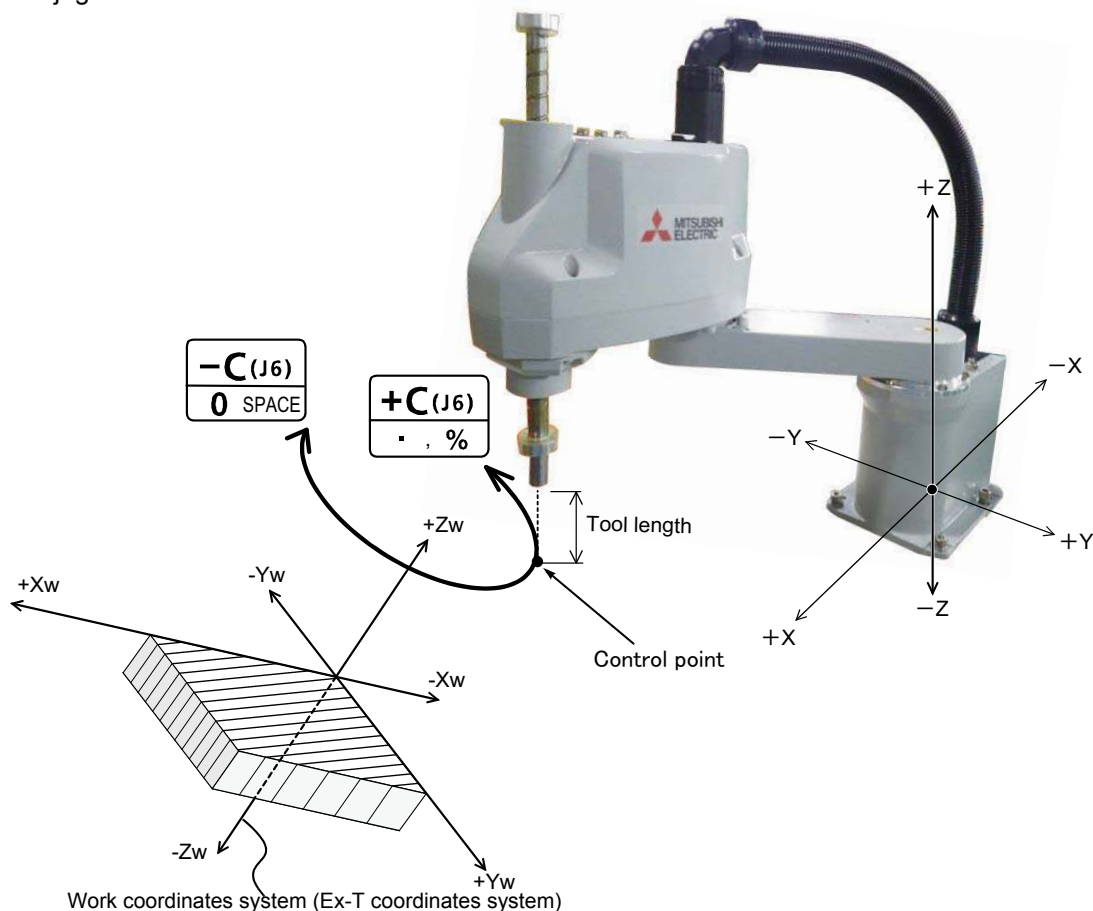
When the X, Y, or Z keys are used, the operation is the same in the WORK jog and the Ex-T jog modes.

Changing the end axis posture <1> Work jog mode



- When the $[+C (J6)]$ keys are pressed, the Z axis will rotate in the plus direction of the XYZ coordinate system. When the $[-C (J6)]$ keys are pressed, rotate in the minus direction.

<2> Ex-T jog mode



- When the [+C (J6)] keys are pressed, the control point will rotate in the plus direction around the Z axis (Zw) of work coordinates system (Ex-T coordinates system).
When the [-C (J6)] keys are pressed, the control point will rotate in 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, the robot will not move. Refer to [Page 29, "\(1\) JOINT jog operation"](#), and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◆◆◆ If the buzzer of T/B sounds and the robot does not move ◆◆◆

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

◆◆◆ 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 Installation of optional equipment

3.1 Operation range change

The operation range of the J1 axis can be limited. Change the mechanical stopper settings and the operation range inside the region between the mechanical stoppers.

When there is possibility of interference with peripheral devices or it is necessary to limit the operation range, set the range as follows.

(1) Angle setting for changing the operation range

The operation range can be set with the angles shown in Table 3-1.

Table 3-1 : Angle setting for changing the operation range

Model	Axis	Direction ^{Note 1)}	Standard	Angle setting for changing the operation range ^{Note 2) Note 3)}	
					Customer-prepared items
RH-3CH-Sxx	J1 axis	Positive	+132°	+110°	—
		Mechanical stopper angle	+133.5°	+111.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P11	
		Negative	-132°	-110°	—
		Mechanical stopper angle	-133.5°	-111.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P12	
	J2 axis	Positive	+141°	+125°	—
		Mechanical stopper angle	+145.7°	+127.7°	Move the bolt at P13.
		Mechanical stopper position	P13	P14	
		Negative	-141°	-125°	—
		Mechanical stopper angle	-145.7°	-127.7°	Move the bolt at P15.
		Mechanical stopper position	P15	P16	
RH-6CH6020-Sxx	J1 axis	Positive	+132°	+115°	—
		Mechanical stopper angle	+133.8°	+117.7°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P11	
		Negative	-132°	-115°	—
		Mechanical stopper angle	-133.8°	-117.7°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P12	
	J2 axis	Positive	+150°	+125°	—
		Mechanical stopper angle	+154.2°	+130.2°	Move the bolt at P13.
		Mechanical stopper position	P13	P14	
		Negative	-150°	-125°	—
		Mechanical stopper angle	-154.2°	-130.2°	Move the bolt at P15.
		Mechanical stopper position	P15	P16	
RH-6CH7020-Sxx	J1 axis	Positive	+132°	+115°	—
		Mechanical stopper angle	+133°	+116.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P11	
		Negative	-132°	-115°	—
		Mechanical stopper angle	-133°	-116.9°	Hexagon socket bolt M8 (length: 16)
		Mechanical stopper position	P10	P12	
	J2 axis	Positive	+150°	+125°	—
		Mechanical stopper angle	+154.2°	+130.2°	Move the bolt at P13.
		Mechanical stopper position	P13	P14	
		Negative	-150°	-125°	—
		Mechanical stopper angle	-154.2°	-130.2°	Move the bolt at P15.
		Mechanical stopper position	P15	P16	

Note 1) Refer to Fig. 3-1 for the mechanical stopper position.

Note 2) The angles in Table 3-1 for the axes show the movable range set by software.

The mechanical stopper angles in the table show the angles limited by the mechanical stoppers. Care should be needed in designing the layout.

Note 3) The positive and negative angles can be set separately.

(2) Operation range change method

■ Installing the mechanical stoppers

- 1) Turn off the controller's power supply.
- 2) Refer to [Table 3-1](#) and [Fig. 3-1](#), and install the stoppers in the screw holes at the angles to be set. [Fig. 3-1](#) shows the mechanical stopper positions. When the screw holes are hidden under the arm, slowly move the No.1 arm by hand.

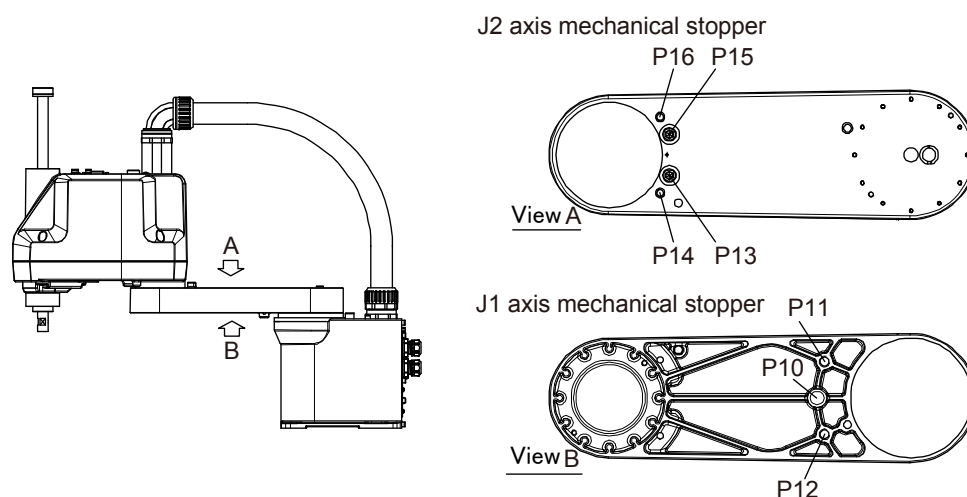


Fig.3-1 : Mechanical stopper position

■ Changing the operation range parameter

Set the operation range (angle setting in [Table 3-1](#)) in the joint operation range parameter MEJAR.

- 1) Turn on the controller's power supply.
- 2) Set the operation range after the change in the parameter MEJAR.

MEJAR: (J1 negative direction operation range, J1 positive direction operation range, □, □, ...)

■ Checking the operation range

Turn off and on the controller's power supply after changing the setting of this parameter. Then, move the axis by joint jog operation to the limit of the operation range to check that the robot stops at the angle after the change.

The operation range change is completed.

3.2 Replacement procedure for machine cables (replaceable type)

The replacement method for optional machine cables (replaceable type) is explained.

The robot arm comes with standard accessory machine cables installed before shipment.

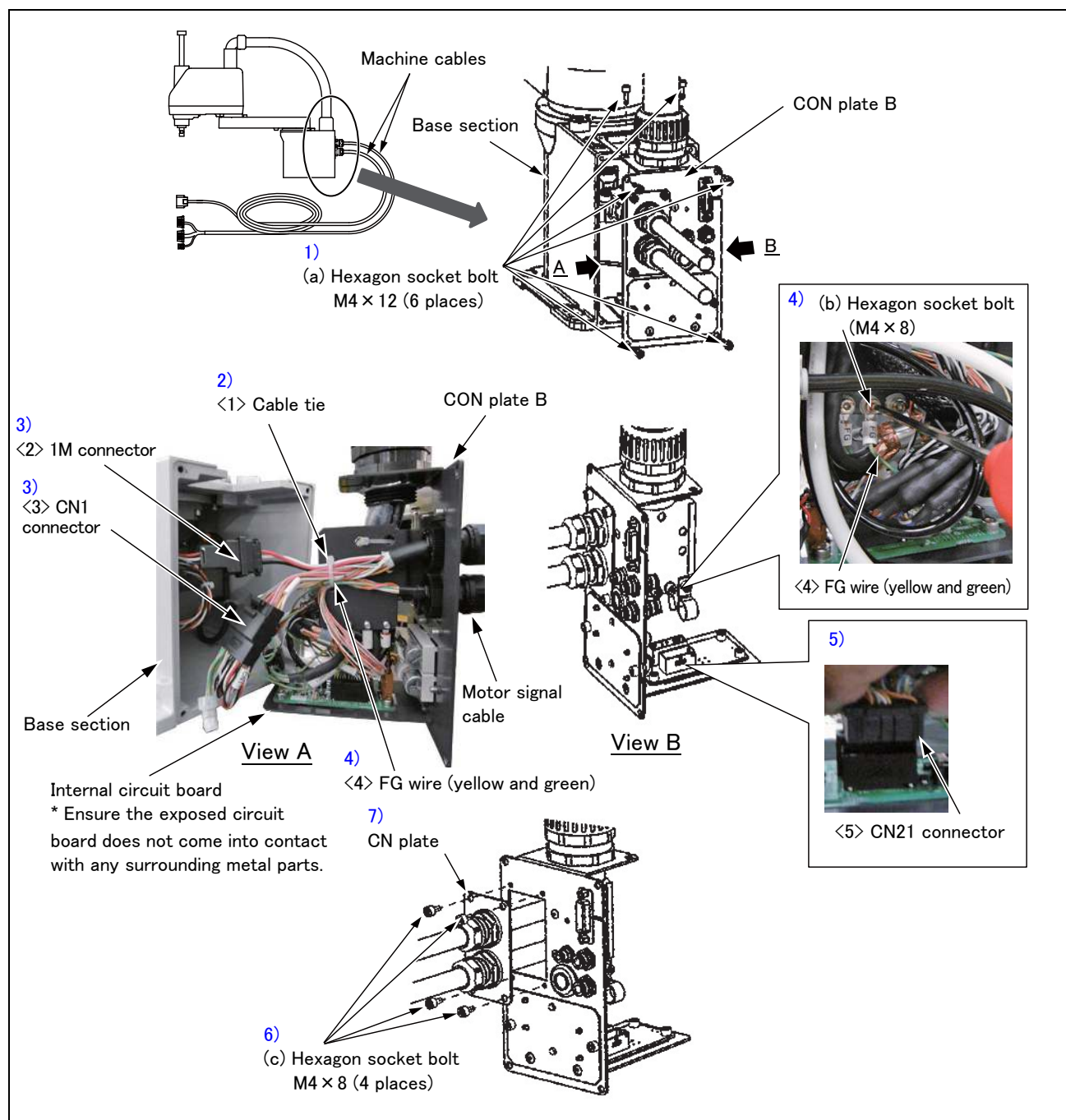


Fig.3-2 : Replacement method for machine cables (replaceable type)

- 1) Remove the installation screws (a) from CON plate B on the back of the base, and pull CON plate B forward.



CAUTION

When pulling out CON plate B, ensure the exposed circuit board does not come into contact with any surrounding metal parts.

- 2) Cut the cable tie <1> with nippers, and remove the cables from the plate. The cables use the two holes on the plate and are fixed with cable ties.



CAUTION

Do not cut cable ties other than the cable tie <1>.
Also, be careful not to cut the cables when cutting the cable tie.

- 3) Remove the 1M connector <2> and CN1 connector <3>.
- 4) Remove the FG wire <4> of the motor signal cable. Remove the installation screw (b) used to fix the FG wire terminal.
- 5) Remove the CN21 connector <5>.



CAUTION

The origin data will be erased if you remove a connector other than the CN21 connector <5>.

Refer to [Page 78, "5.6 Resetting the origin"](#) and set the origin again.

- 6) Remove the installation screws (c) from the CN plate.
- 7) Confirm that <1> to <5> are all removed, and pull the connector out from the rectangular hole on CON plate B, and remove the machine cables together with the CN plate.

Follow the removal procedure from 1) to 7) in reverse to install the optional machine cables (replaceable type).
When installing the CON plate B and the CN plate, use a bolting torque of 1.39 to 1.89 N · m for the installation screws.



CAUTION

When installing CON plate B and the CN plate, ensure that the cables are not pinched by the plates.

This completes replacement of the machine cables (replaceable type).

4 Basic operations

The basic operations from creating the program to automatic operation are explained in section "4. Basic operations" in the "Controller setup, basic operation, and maintenance" manual. Refer that manual as necessary.

5 Maintenance and Inspection

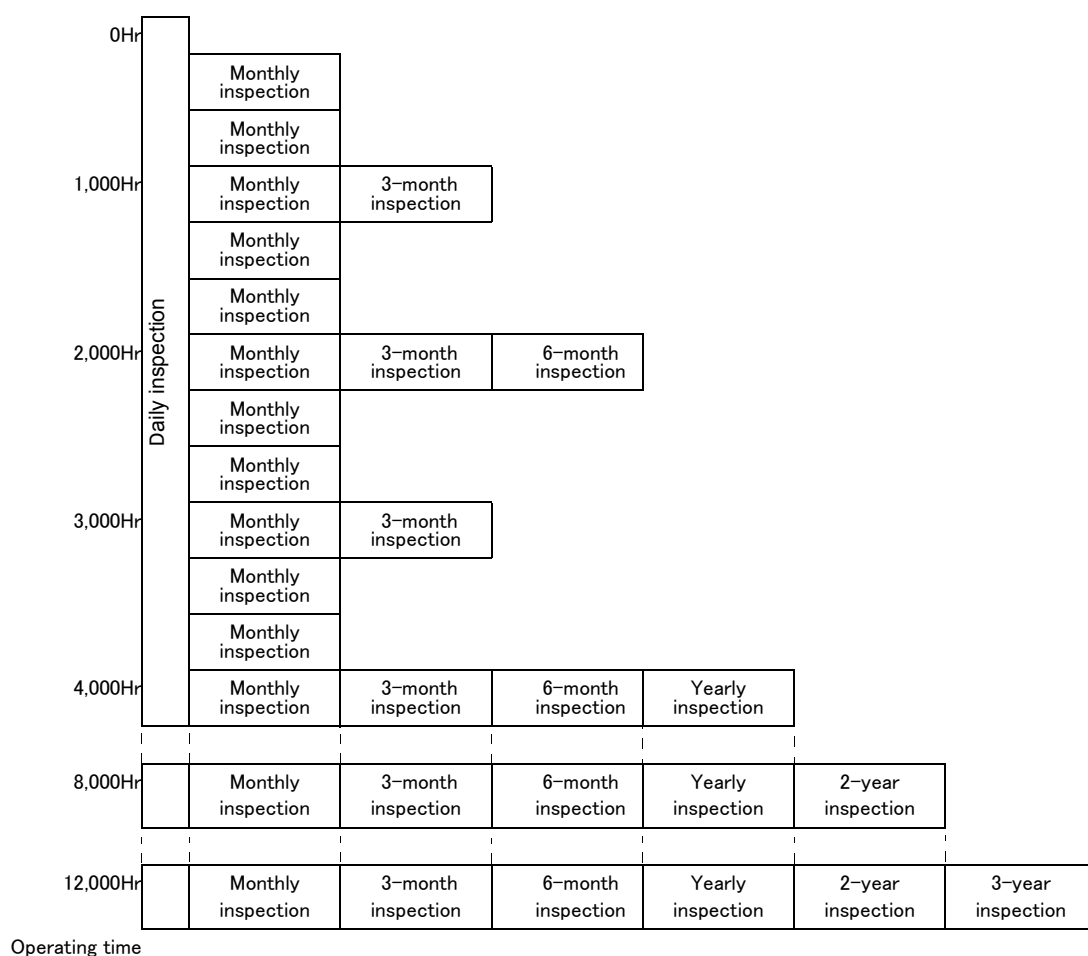
The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

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 1,000 Hr operation hours)



<Guideline for inspection period>

For one shift

$$10 \text{ Hr/day} \times 20 \text{ days/month} \times 3 \text{ months} = \text{approx. 600 Hr}$$

For two shifts

$$15 \text{ Hr/day} \times 20 \text{ days/month} \times 3 \text{ months} = \text{approx. 1000 Hr}$$

[Caution] For one shift operation, determine the inspection period based on the inspection schedule for two shift operation.

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 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 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).
8	Are there any cracks or foreign contamination on the bellows? (For RH-3CH-S23/S24 and RH-6CH-S23/S24 only)	Replace with 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 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-month inspection items		
1	Is there any grease of the shaft section still?	Wipe off the old grease and supply the new grease.
2	Is the oil leaking from the felt attached to the ball screw/spline section? If the leaked oil is adhered to the cover, the cover may be deteriorated and cracked.	Exchange it referring to Page 75, "5.3.7 Felt replacement" .
Yearly inspection items		
1	Replace the backup battery in the robot arm.	Exchange it referring to Page 73, "5.3.6 Replacing the backup battery" .
2-year inspection items		
1	Is there any timing belt tooth wear?	If you find that the tooth is lost or significantly worn, replace the timing belt.
2	Is the timing belt tension abnormal? Does any subsequent position mismatch occur?	If the timing belt is loose or too tense, adjust it.
3-year inspection items		
1	Lubricate the grease at the harmonic reduction gears to J1 axis and J2 axis.	Lubricate it referring to Page 68, "5.3.5 Lubrication"

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 customer to carry out maintenance and inspection are described in Page 77, "5.5 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 of the robot arm is shown below.

<RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15>

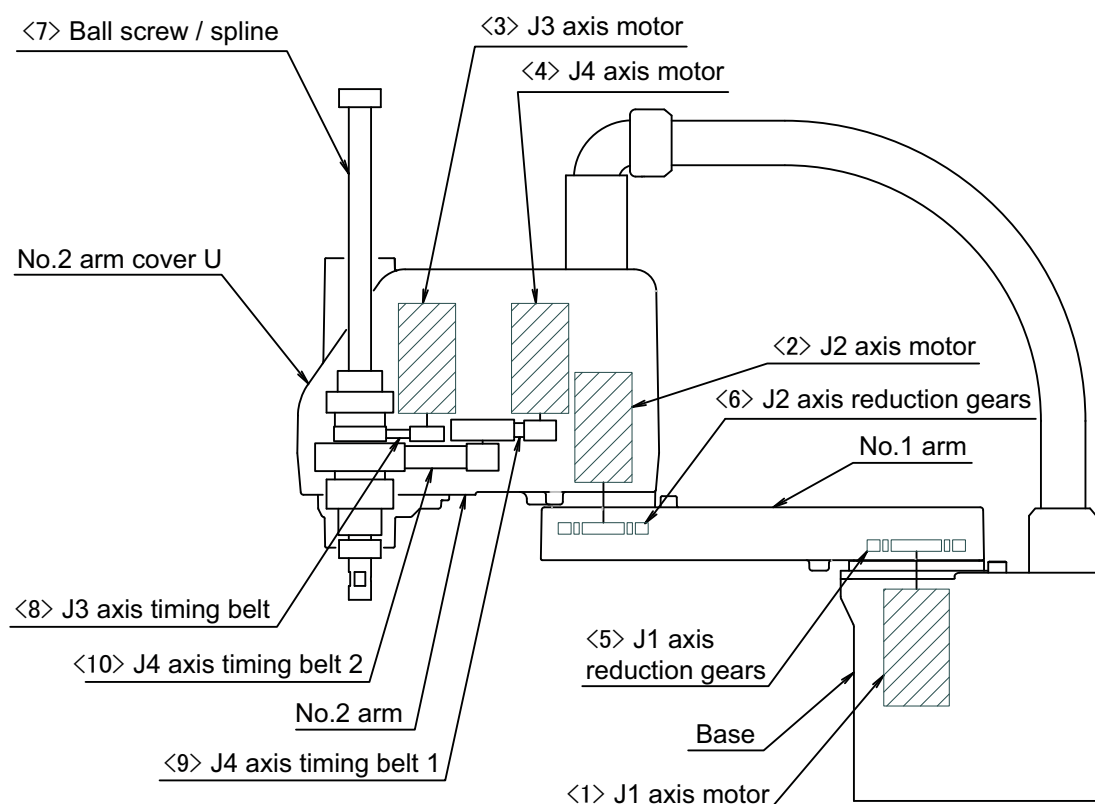


Fig.5-2 : Outline structure drawing of robot arm (RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15)

<RH-3CH-S23/S24, RH-6CH-S23/S24>

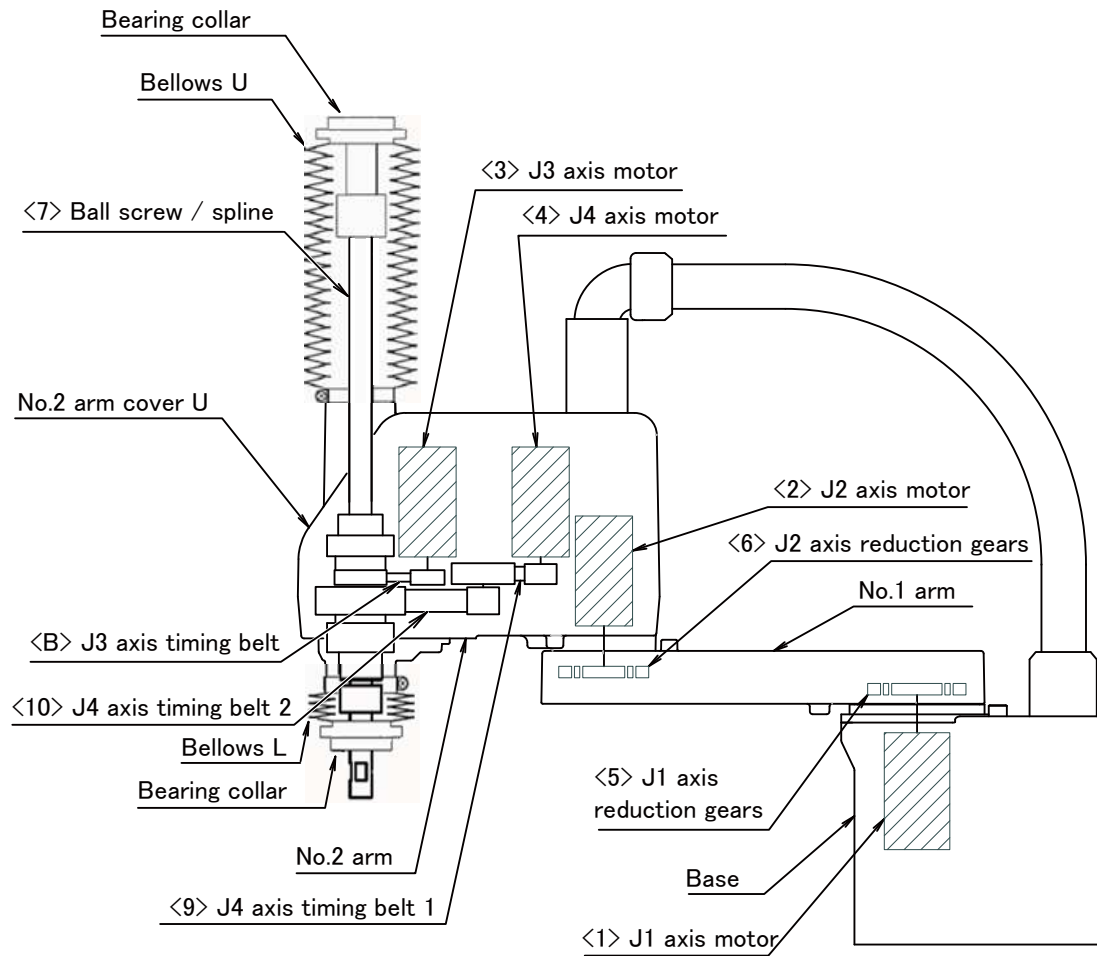


Fig.5-3 : Outline structure drawing of robot arm (RH-3CH-S23/S24, RH-6CH-S23/S24)

5.3.2 Installing/removing the cover

<RH-3CH-S11/S15/S51/S52, RH6CH-S11/S15>

<1> No.2 arm cover U

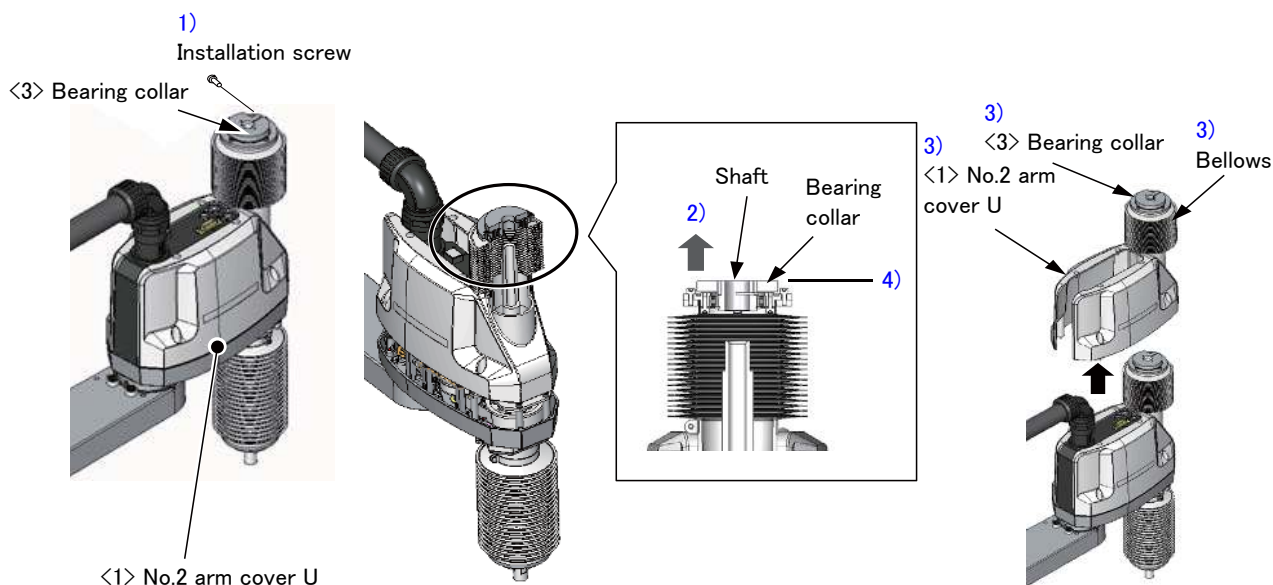
Note) RH-3CH-S11/S15 is shown. The same method is applicable to RH-3CH-S51/S52 and RH-6CH-S11/S15.

<2> Battery cover



Fig.5-4 : Installing/removing the cover (RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15)

<RH-3CH-S23/S24、RH-6CH-S23/S24>



Note) RH-3CH-S23/S24 is shown. The same is applicable to RH-6CH-S23/S24.

Note) For the battery cover <2> in the base section, refer to Fig. 5-4.

Fig.5-5 : Installing/removing the cover (RH-3CH-S23/S24 and RH-6CH-S23/S24)

- 1) Remove the installation screws from the No.2 arm cover U <1>, and loosen the installation screw of the bearing collar.
The locations of the installation screws of No.2 arm cover U are the same as that of RH-3CH-S11/S15/S51/S52 and RH-6CH-S11/S15. Refer to Fig. 5-4.
- 2) Pull the bearing collar straight upward to remove it out of the shaft.
- 3) Remove the No.2 arm cover U <1>, bearing collar <3>, and bellows by lifting them together.
- 4) Follow the removal procedure in reverse when installing the cover.
However, when mounting the bearing collar on the shaft in 3) during installation, push the bearing collar in until the end face of the shaft is aligned with the top face of the bearing collar.

Table 5-3 : Cover fixing screw list

No.	Cover name	Installation screw name: Qty. Note 1), Note 2)	Remarks
Common for RH-3CH-S11/S15/S51/S52 and RH-6CH-S11/S15			
<1>	No.2 arm cover U	Truss screw M4 × 10: 8	
<2>	Battery cover	Hexagon socket bolt, M4 × 8: 2	
Common for RH-3CH-S23/S24 and RH-6CH-S23/S24			
<1>	No.2 arm cover U	Truss screw M4 × 10: 8	
<2>	Battery cover	Hexagon socket bolt, M4 × 8: 2	
<3>	Bearing collar	Hexagon socket bolt, M4 × 16: 1	

Note 1) Use a bolting torque of 1.39 to 1.89 N · m for the installation screws <1> and <2>.

Note 2) Use a bolting torque of 4.02 to 5.00 N · m for the installation screw <3>.

- (1) Refer to [Fig. 5-4](#) and [Fig. 5-3](#) to remove the covers.
- (2) The names of the covers are given in [Table 5-3](#).
- (3) When installing the cover after maintenance and inspection, use the procedure of removal in reverse.
Bolt the installation screw with the torque shown in [Table 5-3](#).

5.3.3 Replacement of bellows

(1) Installation/removal of bellows U

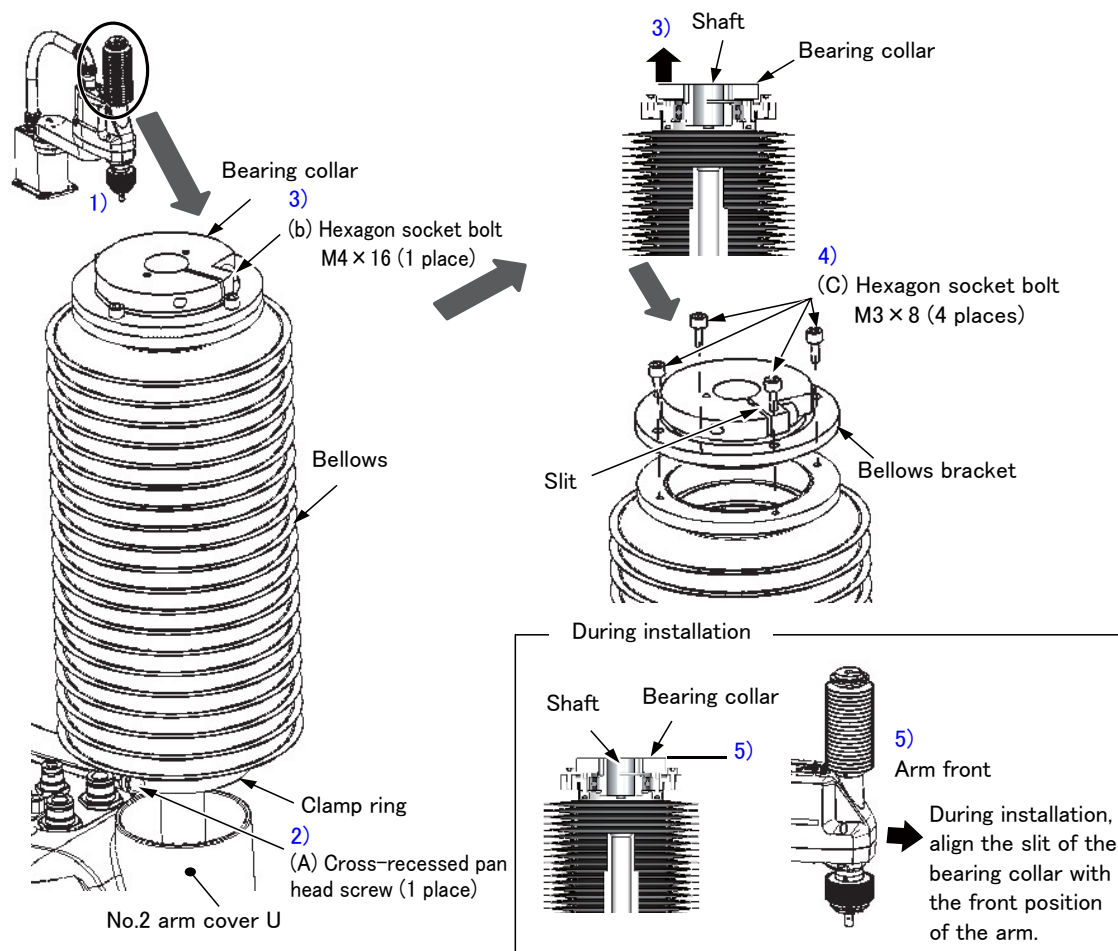


Fig.5-6 : Installation/removal of bellows U

- 1) Move the J4 axis to 0 degrees, and then turn OFF the controller's power supply.
 - 2) Loosen the installation screw (A) of the clamp ring used to fix the bellows, and remove the bellows from the No.2 arm cover U.
 - 3) Loosen the installation screw (B) of the bearing collar, and pull it along with the bellows straight upward to remove them out of the shaft.
 - 4) Remove the installation screws (C) from the bellows bracket, and remove the bellows.
 - 5) Follow the removal procedure in reverse when installing the bellows.
- However, observe the following for step 3) during installation.
- When mounting the bearing collar on the shaft during installation, push the bearing collar in until the end face of the shaft is aligned with the top face of the bearing collar.
 - When fixing the bearing collar, ensure that the slit of the bearing collar is aligned with the front position of the arm when the J4 axis is at 0 degrees.

Tighten each installation screw with the bolting torque shown in the table below.

Table 5-4 : Bellows installation screws and bolting torques list

No.	Installation screw name: Qty.	Bolting torque	Remarks
(A)	Cross-recessed pan head screw: 1 screw	1.39 to 1.89 N · m	
(B)	Hexagon socket bolt, M4 × 16: 1 bolt	4.02 to 5.00 N · m	
(C)	Hexagon socket bolt, M3 × 8: 4 bolts	1.76 to 2.16 N · m	

(2) Installation/removal of bellows L

Follow the below procedure to remove the bellows.

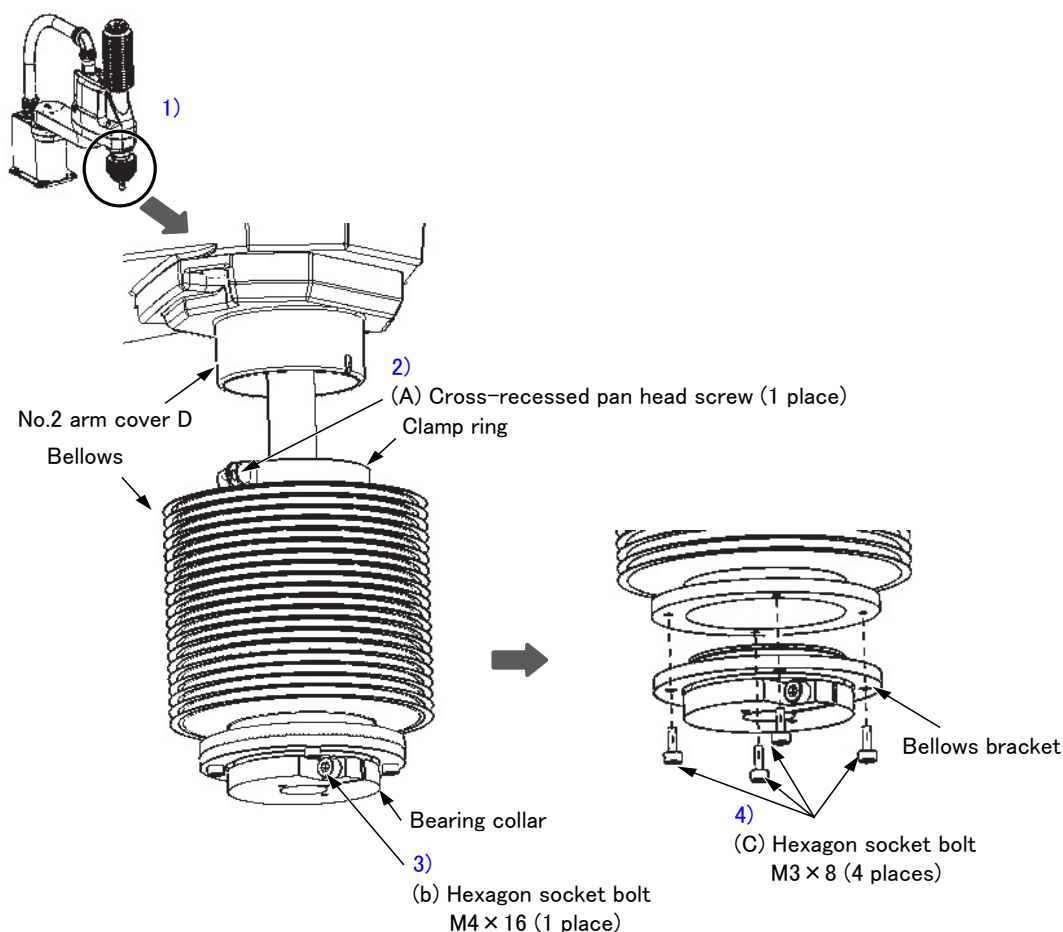


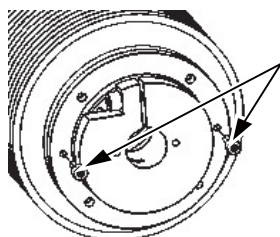
Fig.5-7 : Removing bellows L

- 1) Move the J4 axis to 0 degrees and the J3 axis to the +50 mm position, and then turn OFF the controller's power supply.
- 2) Loosen the screw (A) of the clamp ring used to fix the bellows, and remove the bellows from the No.2 arm cover D.
- 3) Loosen the installation screw (B) of the bearing collar, and pull it along with the bellows straight downward to remove them out of the shaft.
- 4) Remove the installation screws (C) from the bellows bracket, and remove the bellows.



CAUTION

If the bellows cannot be removed in 4), push the removed installation screws (C) into the two opposite screw holes of the bellows bracket until the bellows bracket comes out, and then remove the bellows.



Push the installation screws (C) into two opposite screw holes of the bellows bracket.

For the bolting torque of each screw, refer to [Table 5-4](#).

Follow the below procedure to install the bellows.

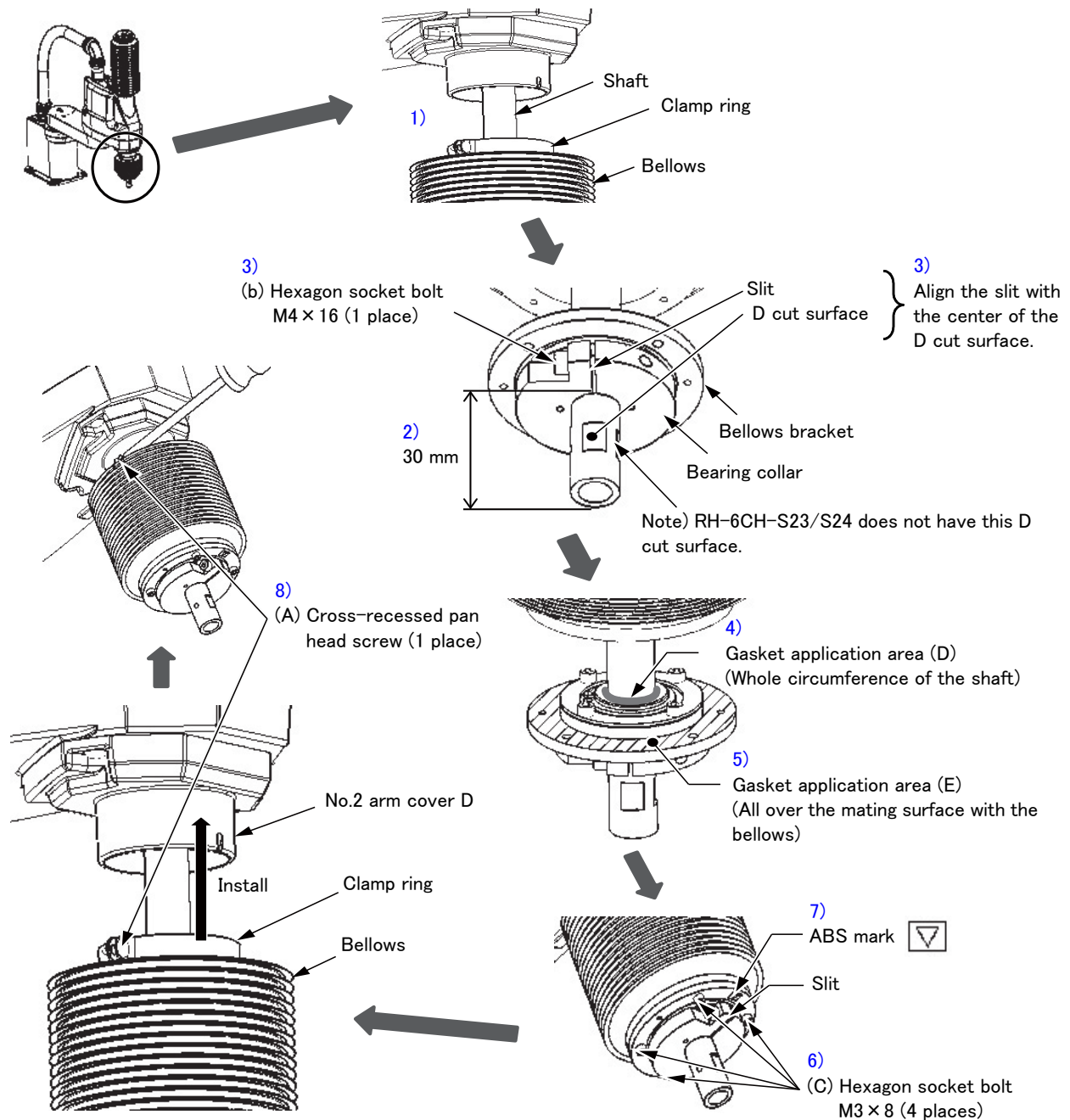


Fig.5-8 : Installation/removal of bellows L

- 1) Pass the clamp ring and bellows over the shaft.
- 2) Align the bearing collar and bellows bracket at a distance of 30 mm from the lower end of the shaft.
- 3) Align the slit of the bearing collar with the center of the D cut surface of the shaft, and firmly fix with the installation screw (B).



CAUTION

The ABS origin cannot be set correctly unless you align the slit with the D cut surface of the shaft. This can cause a positional deviation to occur.

- 4) Apply the liquid gasket to the gasket application area (D) between the bearing collar and the shaft.
Apply the liquid gasket in such a way to fill the gap between the bearing collar and the shaft.
Recommended liquid gasket: 1212 (manufacturer: ThreeBond Co., Ltd.)
- 5) Apply the liquid gasket to the gasket application position (E) of the bellows bracket.
Apply a thin layer of liquid gasket all over the gasket application area (E).

- 6) Install the bellows bracket with the installation screws (C).
- 7) Adjust the position of the bellows by turning it so that the ABS mark of the bellows bracket is aligned with the slit of the bearing collar.
- 8) Install the bellows on the No.2 arm cover D, and fix it with the clamp ring by tightening the installation screw (A).

For the bolting torque of each screw, refer to [Table 5-4](#).

5.3.4 Inspection replacement of timing belt

This robot uses a timing belt for the drive conveyance system. 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 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.

Please prepare the sound wave type belt tension gauge in inspection of the timing belt. Refer to the [Page 67, "\(4\) Timing belt tension"](#) for the tension of the timing belt.

The recommendation gauge is shown below.

Manufacture: Gates Unitta Asia Company

Type: U-508



Fig.5-9 : Tension adjustment method of timing belt

CAUTION

When the timing belt has to be removed for repair or some other reason, measure the tension before removing the belt.

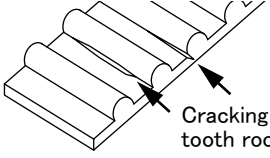
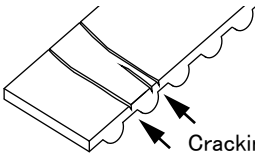
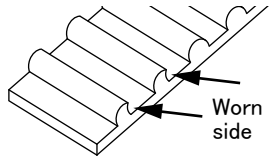
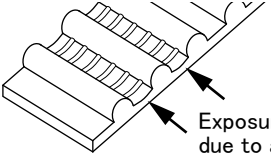
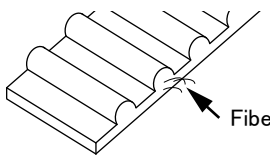
When the belt is reinstalled, the tension must be the same as the one measured before removal. Otherwise, the life of the belt and the relevant parts may be shortened.

(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) The belt tension value becomes less than the guideline value.
- 2) A position mismatch or gear teeth skipping occurs.
- 3) The belt is damaged as shown in [Table 5-5](#).

Table 5-5 : Typical damage conditions of the timing belt

Damage condition	Appearance	Cause
Gear tooth crack	 Cracking at the tooth root	Overload
Backside crack	 Cracking on the backside of the belt	Deterioration of rubber due heat to or ozone
Worn teeth	 Worn out on one side	Overload Excessive or insufficient tension
Tooth bottom abrasion and exposure of cores	 Exposure of cores due to abrasion	Excessive tension
The following is not a belt damage.		
Fibers coming out of the side face of the belt	 Fibers	Manufacturing related factor. This is not a belt damage.

**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.

**CAUTION**

When the belt is replaced, the machine system origin may deviate. After the replacement, ensure to reset the origin.

(2) Timing belt tension measurement

Rotate the timing pulley A to one direction while visually checking its position, and measure the belt tension at every 90 degrees, four times in total. The average of the four measurements is used as the timing belt tension value.

The timing belt must be pulled tight before the tension is measured. For this purpose, rotate the timing pulley A 90 degrees before measurement. Measure the tension of the belt to be pulled by the movement of the timing pulley A. When the temperature of the robot arm is high, the timing belt tension is increased. To ensure reliability of the measurement, take measurements at least 30 minutes after the robot stops its movement.

Low ambient temperature may make accurate measurements using a tension gauge impossible. In this case, perform the automatic operation or jog operation at measuring target axis for a few minutes, then measure the tension of the belt.

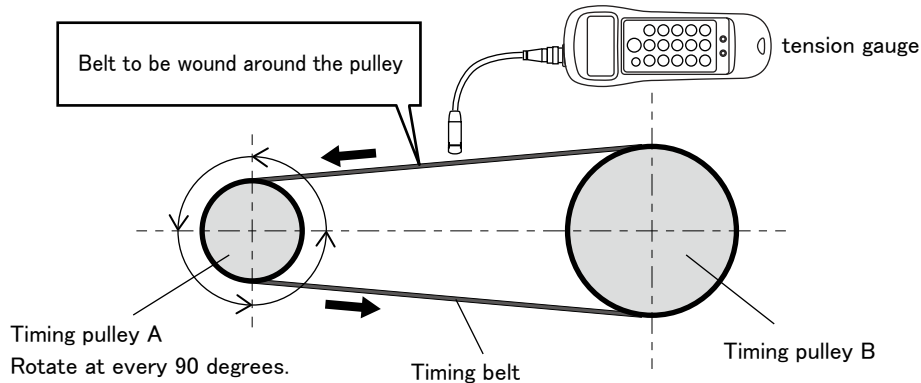


Fig.5-10 : Timing belt tension measurement

The procedure is shown below.

- 1) Turn on the controller's power supply.
- 2) Rotate the timing pulley A to one direction in jog operation while visually checking its position, and measure the belt tension at every 90 degrees, four times in total (for one turn of the timing pulley A).
The amount of movement of each axis when the timing pulley A is rotated 90 degrees are shown in [Page 67, "\(5\) Amount of movement of each axis during the timing belt tension measurement"](#).
- 3) Take an average of the four measurements to determine the timing belt tension value.
During inspection of the timing belt, check that the belt tension exceeds the replacement guideline value in [Page 67, "\(4\) Timing belt tension"](#). When the belt tension value becomes less than the guideline value, the belt must be replaced immediately.

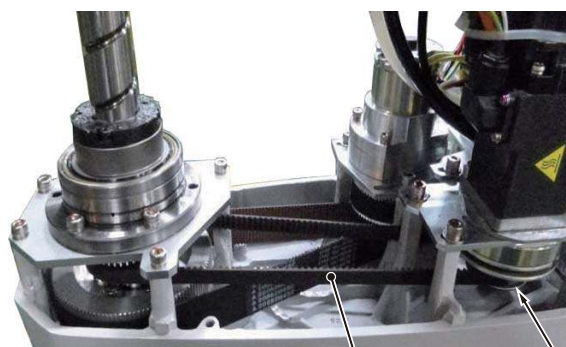
(3) Inspection of timing belt

The parts related to the inspection of the timing belt are shown in Fig. 5-11. The picture is the image which removed the No.2 arm cover.

Replacement of the timing belt will be performed by Mitsubishi Electric.

Check the serial numbers of the robot arm and the controller, and contact Mitsubishi Electric.

<J3 axis>



Timing belt

Timing pulley A

Note) This figure shows the RH-3CH series. The same configuration is applied to the RH-6CH series.

<J4 axis>



Timing pulley A

Timing belt A

Timing belt B

Fig.5-11 : Inspecting the timing belt

The procedure for inspecting the timing belt is shown below.

- 1) Refer to [Page 56, "5.3.2 Installing/removing the cover"](#), and remove the No.2 arm cover U.
- 2) Visually confirm that the symptoms indicated in [Page 64, "\(1\) Timing belt replacement period"](#) have not occurred with the timing belt.
- 3) Refer to [Page 65, "\(2\) Timing belt tension measurement"](#), and confirm the belt tension.
- 4) Install the No.2 arm cover U securely as before and finish inspection.

(4) Timing belt tension

The following table shows the preset values of the sonic belt tension gauge, the tension value for new belt installation, and the tension value as the replacement guideline.

Table 5-6 : Belt tension

Axis	Belt type	Preset value			Tension for new belt installation (N)	Replacement guideline tension (N)
		M(g/m)	W(mm/R)	S(mm)		
RH-3CH series						
J3	60 MTS3M 309 G	2.0	6	103	31 to 38	12
J4 (motor side)	226-2GT-10	1.3	10	61	40 to 45	15
J4 (shaft side)	160 S2M 272 GB	1.3	16	65	44 to 52	16
RH-6CH series						
J3	90 MTS3M 489 G	2.0	6	187	31 to 38	12
J4 (motor side)	226-2GT-10	1.3	10	61	40 to 45	15
J4 (shaft side)	452-2GT-20	1.3	20	144	84 to 95	30

(5) Amount of movement of each axis during the timing belt tension measurement

The amount of movement of each axis when the timing pulley A is rotated 90 degrees are shown in [Table 5-7](#).

Table 5-7 : Amount of movement of each axis during the tension measurement

Model	Amount of movement		
	J3 axis	J4 axis (Timing belt A)	J4 axis (Timing belt B)
RH-3CH series	2.8mm	8.0°	22.1°
RH-6CH series	3mm	6.5°	18.0°

5.3.5 Lubrication

(1) Lubrication position and specifications

The grease nipple position is shown in Fig. 5-12. The lubrication specifications for each place are shown in Table 5-8. Refer to the Page 56, "5.3.2 Installing/removing the cover" for the method of removing and installing the cover.

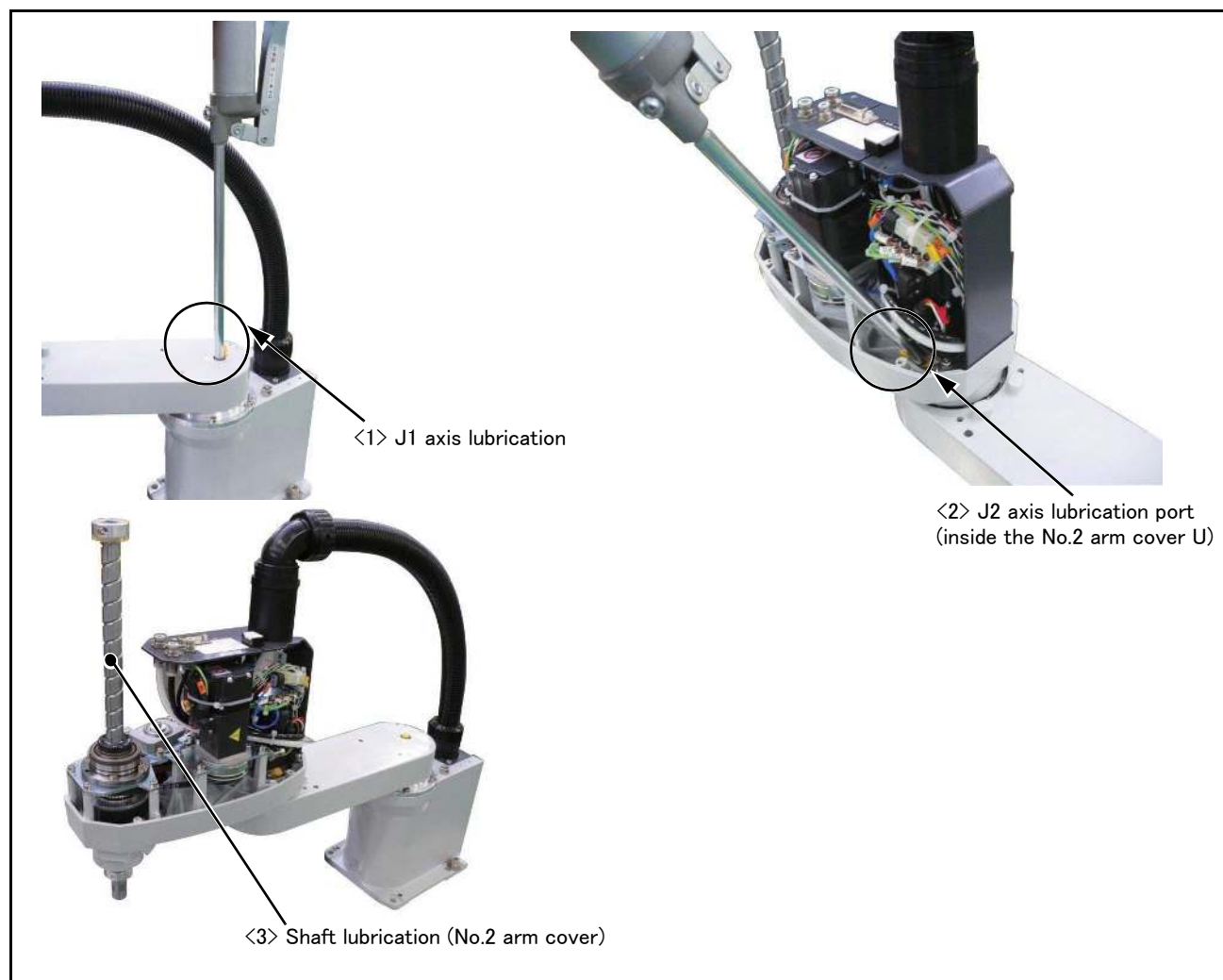


Fig.5-12 : Lubrication positions

Table 5-8 : Lubrication specifications

No.	Parts to be lubricated	Oiling method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
RH-3CH-Sxx						
<1>	J1 axis reduction gears	Grease nipple WA-610	SK-1A (Harmonic Drive Systems Inc.)	6,000 Hr	8 g	No.2 arm cover U
<2>	J2 axis reduction gears	Grease nipple WA-610		6,000 Hr	5 g	
<3>	Shaft (Ball screw/spline)	Wipe the old grease, and paint	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 2000km movement	1 g	
RH-6CH-Sxx						
<1>	J1 axis reduction gears	Grease nipple WA-610	SK-1A (Harmonic Drive Systems Inc.)	6,000 Hr	12 g	No.2 arm cover U
<2>	J2 axis reduction gears	Grease nipple WA-610		6,000 Hr	8 g	
<3>	Shaft (Ball screw/spline)	Wipe the old grease, and paint	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 2000km movement	1 g	

[Caution]

- The brand name of the grease shown in the [Table 5-8](#) is the grease put in at shipping.
- The lubrication time is a cumulative value of the operation at the maximum speed. If the operation has been suspended, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
- Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
For the shaft, the lubrication interval should be shorter than one in [Table 5-8](#) when the operation is repeated with a short stroke.
- By the maintenance forecast function of RT ToolBox2 (option) computes the guide of the lubrication hours put together with the customer's operation status.
- The numbers in the [Table 5-8](#) correspond to the supply positions in [Fig. 5-12](#).

(2) Lubrication method to the J1, J2 axis

- 1) Then, turn off the controller's power supply.
- 2) Refer to [Page 56, "5.3.2 Installing/removing the cover"](#), and remove the covers necessary.
- 3) Insert the grease shown in [Table 5-8](#) using a grease gun from the lubrication grease nipple. Apply the specified amount of grease. Too much lubrication causes grease leakage.

**CAUTION**

Use manual grease gun, and inject grease with pressure 0.03Mpa or less. Do not use the grease gun, which derived by the factory air presser to avoid injecting by too high pressure.

A grease gun that fits the grease nipple is required.

Recommended grease gun: KH-120 (capacity: 140 ml) or KH-32 (capacity: 200 ml)
(manufacturer: Yamada Corporation)

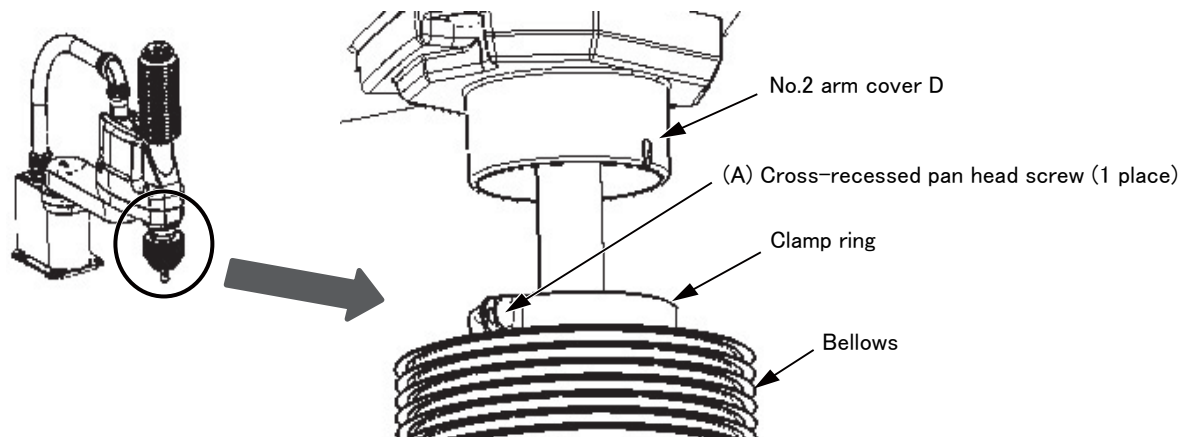
The above-mentioned grease gun comes with a short nozzle (HSP-1) as standard. If this short nozzle does not reach the desired areas, depending on the robot model and installation location, it may be useful to use a long nozzle (HSP-2).

- 4) Install the covers with the removal procedure in reverse.
- 5) If the maintenance forecast function is enable, please reset the accumulated data about grease. Carries out the resetting operation by RT ToolBox or parameter (MFGRST). Refer to separate "RT ToolBox2 / RT ToolBox2 mini User's Manual" for the operation method of RT ToolBox, and refer to separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details of parameter (MFGRST).

The lubricating to J1 and J2 axes is completed.

(3) Lubrication method to the shaft

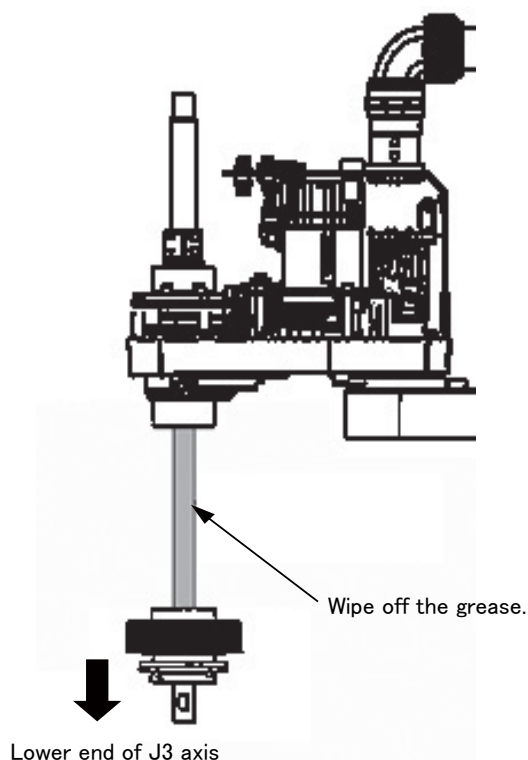
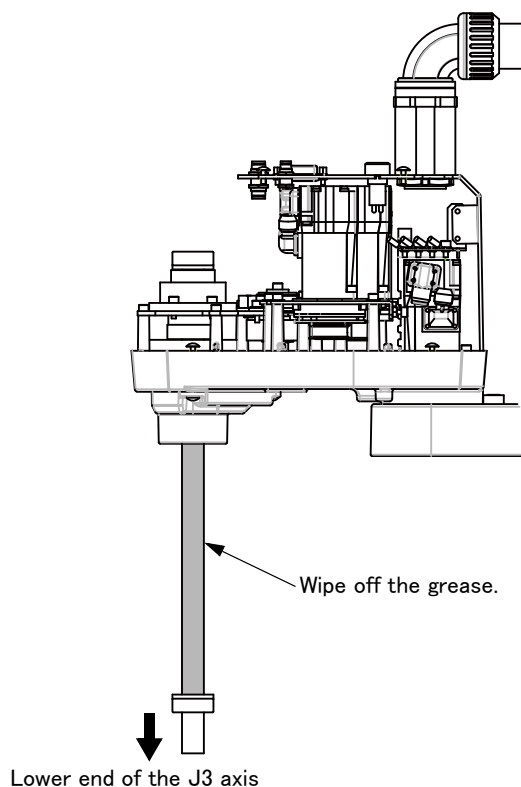
- 1) Move the J3 axis to the lower end limit by jog operation. Then, turn off the controller's power supply.
- 2) Remove a part of bellows L. (for the model with bellows (S23/S24 model) only)
 - a) Loosen the installation screw (A) of the clamp ring used to fix the bellows, and remove the bellows from the No.2 arm cover D.
 - b) Push the bellows so that it does not interfere with the lubrication work.



- 3) Refer to [Page 56, "5.3.2 Installing/removing the cover"](#), and remove the No.2 arm cover U.
- 4) Wipe off the old grease on the shaft. Also, wipe off the grease scattered inside the No.2 arm cover U.

<RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15>

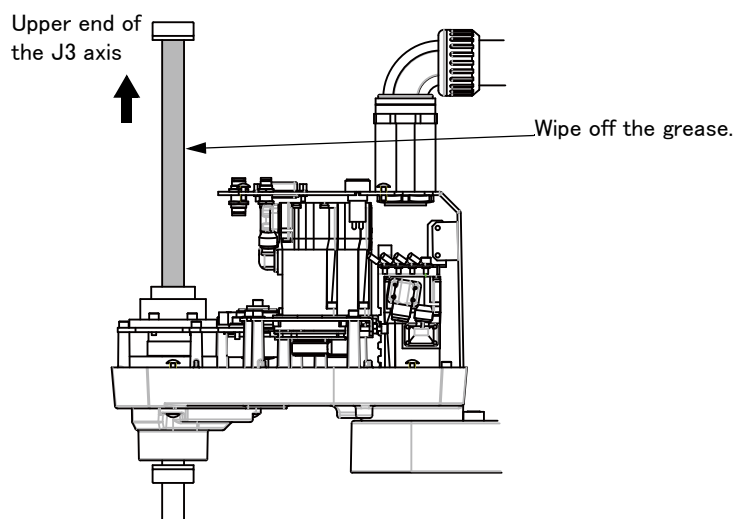
<RH-3CH-S23/S24, RH-6CH-S23/S24>



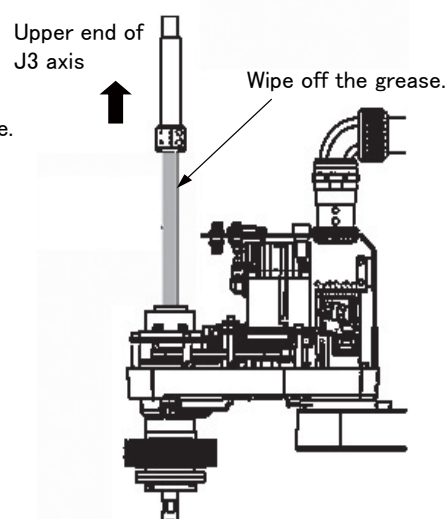
- 5) Turn on the controller's power supply, and move the J3 axis to the upper end limit by jog operation. Then, turn off the controller's power supply again.

- 6) Wipe off the old grease on the shaft, which was hidden beneath the ball screw spline nut.

<RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15>

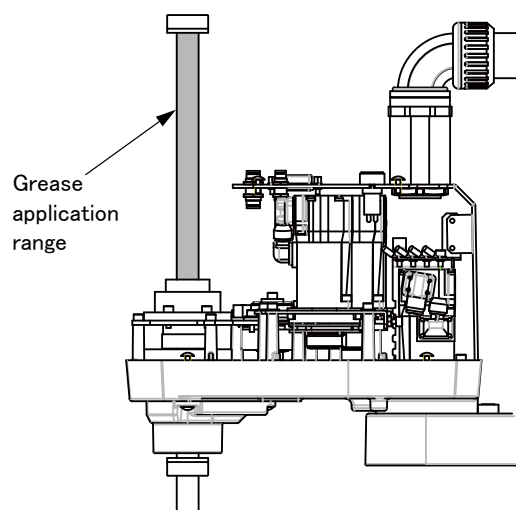


<RH-3CH-S23/S24, RH-6CH-S23/S24>

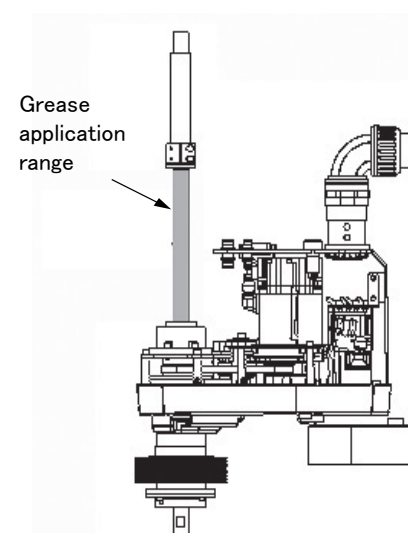


- 7) Apply the specified amount of grease to the shaft. Fill the shaft grooves with the grease. Also, apply the grease lightly to the areas other than the grooves on the shaft surface to prevent rusting.

<RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15>



<RH-3CH-S23/S24, RH-6CH-S23/S24>

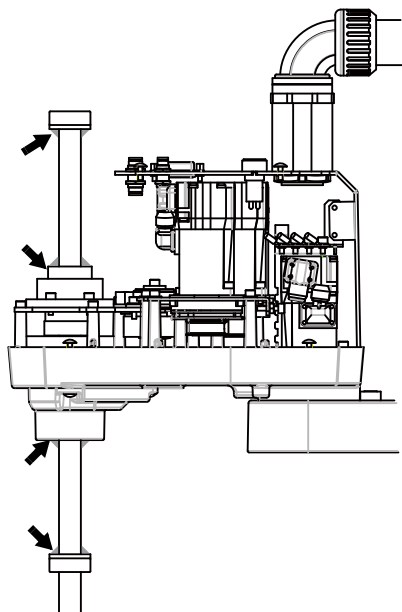


- 8) Turn on the controller's power supply. Move the J3 axis up and down for several times using the jog operation to distribute the grease inside the ball spline nut and the ball screw nut.
- 9) Move the J3 axis to a position around the center of the stroke using the jog operation. Then, turn off the controller's power supply.

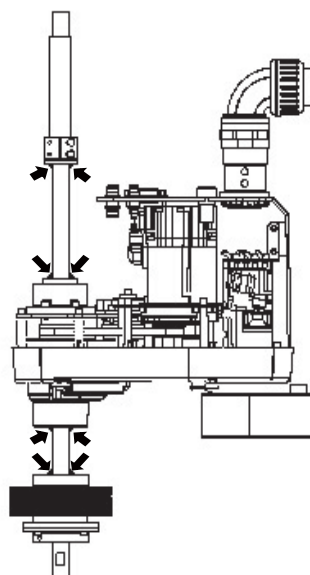
- 10) Wipe off the grease adhering around the shaft ends or the nuts of the ball screw spline (indicated with the arrows below).

When the ball spline and the ball screw are moved with extra grease on them, a large amount of grease is scattered inside the arm. The grease may reach the timing belt inside the No.2 arm, causing the timing belt to deteriorate early.

<RH-3CH-S11/S15/S51/S52, RH-6CH-S11/S15>

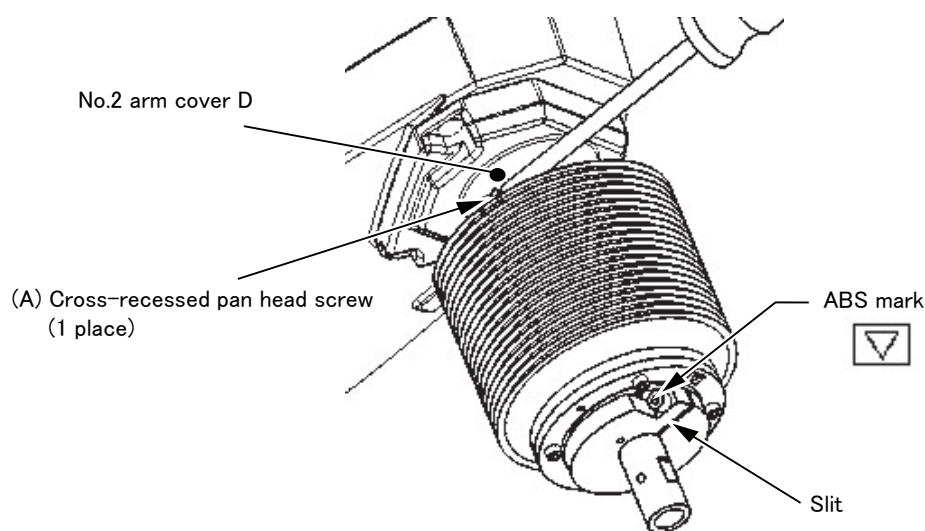


<RH-3CH-S23/S24, RH-6CH-S23/S24>



- 11) Push the bellows L back to the original position. (for the model with bellows (S23/S24 model) only)

- Adjust the position of the bellows by turning it so that the ABS mark of the bellows bracket is aligned with the slit of the bearing collar.
- Install the bellows on the No.2 arm cover D, and fix it with the clamp ring by tightening the installation screw (A).



- 12) Reinstall the No.2 arm cover U.

Lubrication to the shaft is completed.



CAUTION

When applying grease to the shaft, prevent the grease from adhering to the No.2 arm cover U. If the grease is adhered to the cover, wipe it off. If the grease is adhered around the screw installation section for a long time, the cover may be deteriorated and cracked.

5.3.6 Replacing the backup battery

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

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state. There exists the kinds of the errors about the battery shown in [Table 5-9](#). If error 7500 occurs, please exchange the battery of the robot arm and the controller simultaneously.

Table 5-9 : The error about the battery

Item	Error number	Description	Measure
Controller	7520	The battery consumption time was exceeded	Replace the battery
	7510	Battery voltage low	
	7500	No battery voltage	The backup data cannot be guaranteed if this error occurs.
Robot arm	7520	The battery consumption time was exceeded	Replace the battery
	133n ^{Note1)}	Encoder battery voltage low.	
	112n	Encoder ABS position data lost	The backup data cannot be guaranteed if this error occurs.

Note1) "n" indicates the axis number

The method of replacing the battery of robot arm is shown below.

refer to the separate "Instruction manual/Controller setup, basic operation, and maintenance" about controller's battery.

About the purchase of the battery, refer to [Page 77](#), "5.5 Maintenance parts".



CAUTION

If error 7500 or 112n occurs, the program data and other data in the controller is lost and it becomes necessary to load the data such as program and origin data again.

(1) Replacing the battery (robot arm)

CAUTION

The power supply for the encoder is supplied by cable connected with battery board. The cable must be connected while replacing the battery or operating usually. Thus, if the cable connection is incomplete, the encoder position data will be lost, and resetting the origin is necessary.

CAUTION

Replace the battery one by one . If all battery's are removed the encoder data will be lost, and resetting the origin is necessary.

The battery installation position is shown in [Fig. 5-13](#). Refer to the figure and replaces the batteries in the following procedures.

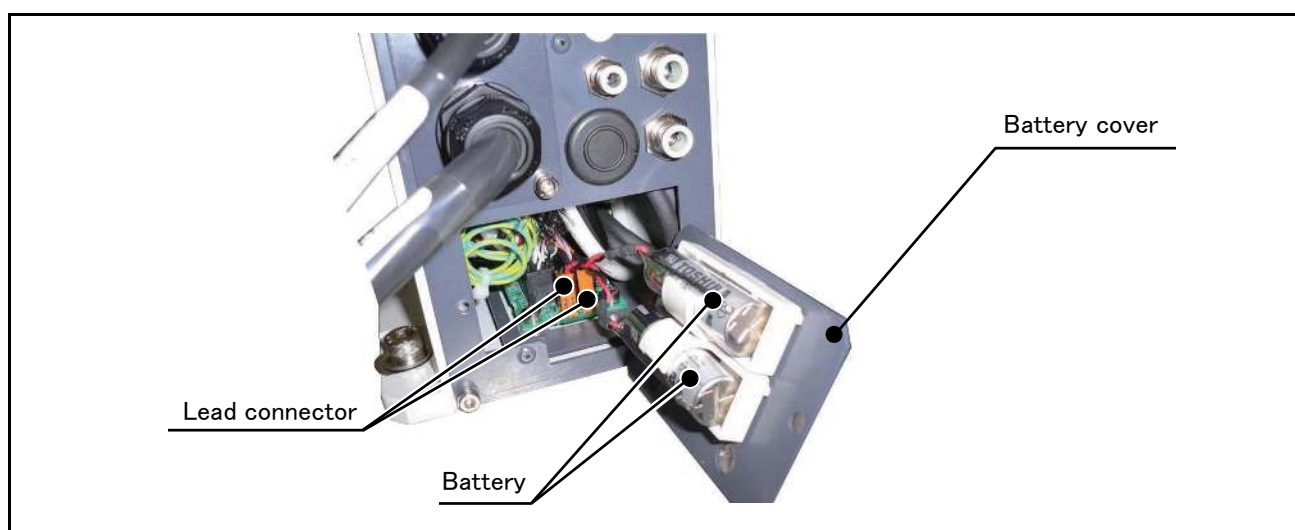


Fig.5-13 : Replacing the battery

- 1) Turn the controller control power OFF.
- 2) Remove the two battery cover installation screws to detach the battery cover.
- 3) Replaces the backup battery one by one. The battery holder is located on the back side of the battery cover. Remove the old battery from the holder, and disconnect the lead connector.
To remove the lead connector, squeeze the retaining latch while pulling on the connector.
- 4) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
- 5) All the batteries should be checked that it has been exchanged newly. If the old battery is contained, generating heat and damaging may occur.
- 6) Reinstall the battery cover. Be careful so that the cable may not be inserted.
- 7) Initialize the battery consumption time.

Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again. Refer to [Page 78](#), "5.6 Resetting the origin" and reset the origin using the ABS origin method.

5.3.7 Felt replacement

If the felt attached to the ball screw/spline section is saturated with the grease oil, replace the felt. If the oil is leaking from the felt and adheres to the cover, the cover may be deteriorated and cracked.

(1) Replacing the felt

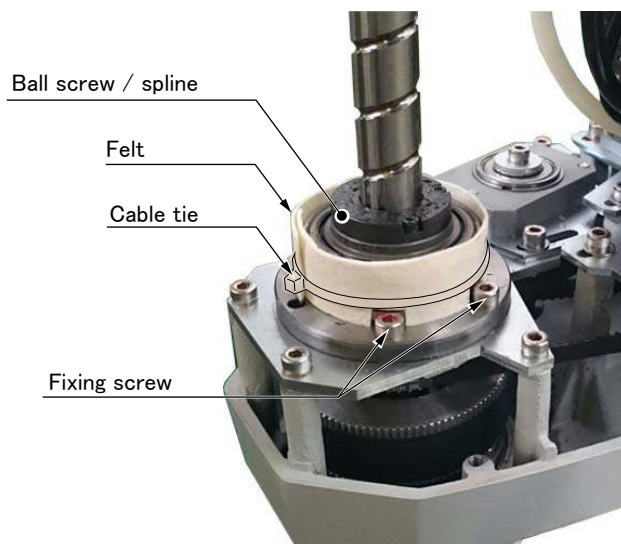


Fig.5-14 : Replacing the felt

- 1) Remove the No.2 arm cover U.
- 2) Remove the cable tie securing the old felt and remove the felt.
- 3) Wrap the new felt around the ball screw/spline and secure it with a cable tie. At this time, align the cutout parts of the felt with the position of the ball screw/spline fixing screws.
- 4) Install the No.2 arm cover U.

The felt replacement is complete.

5.4 About Overhaul

Robots which have been in operation for an extended period of time can suffer from wear and other forms of deterioration. In regard to such robots, we define overhaul as an operation to replace parts running out of specified service life or other parts which have been damaged, so that the robots may be put back in shape for continued use. As a rule of thumb, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the specified time (24,000 hours for the robot arm and 36,000 hours for the controller) (see Fig. 5-15.). However, the degree of the equipment's wear and deterioration presumably varies depending on their operating conditions. Especially for operation with high load and frequency, the maintenance cycle may be shorter. For details on the part selection for replacement and the timing of overhaul, contact your dealer.

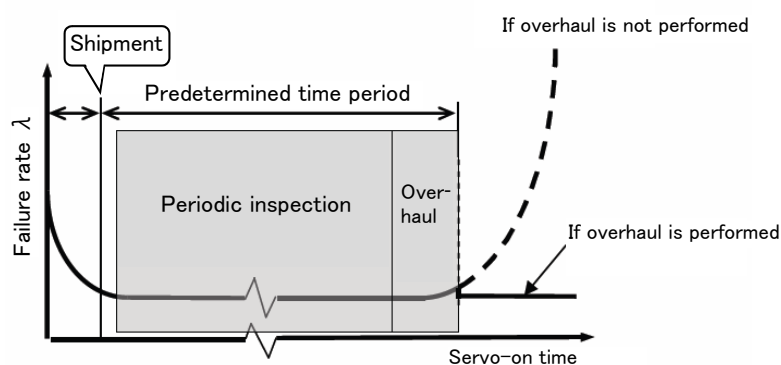


Fig.5-15 : Periodic inspection/overhaul periods

5.5 Maintenance parts

The consumable parts that must be replaced periodically are shown in [Table 5-10](#), and spare parts that may be required during repairs are shown in [Table 5-11](#). 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 5-10 : Consumable part list

No.	Part name	Usage place	Q'ty	Refer to section	Supplier
1	Grease	Reduction gears of each axis	A small amount	"5.3.5Lubrication"	Mitsubishi Electric
2		shaft	A small amount		
3	Lithium battery (battery : ER6)	Inside the battery cover	2	"5.3.6Replacing the backup battery"	
RH-3CH-Sxx					
4	Timing belt	J3 axis	1	"5.3.4Inspection replacement of timing belt"	Mitsubishi Electric
5		J4 axis motor side	1		
6		J4 axis shaft side	1		
7	Felt	Ball screw / spline	1	"5.3.7Felt replacement"	
RH-6CH-Sxx					
8	Timing belt	J3 axis	1	"5.3.4Inspection replacement of timing belt"	Mitsubishi Electric
9		J4 axis motor side	1		
10		J4 axis shaft side	1		
11	Felt	Ball screw / spline	1	"5.3.7Felt replacement"	

Table 5-11 : Spare parts list

No.	Names	Usage place	Q'ty	Supplier
Common for RH-3CH-Sxx				
1	AC servo motor	J1 axis	1	Mitsubishi Electric
2		J2 axis	1	
3		J3 axis	1	
4		J4 axis	1	
5	Reduction gears	J1 axis	1	
6		J2 axis	1	
7	Ball screw spline	J3 axis	1	
RH-3CH-S23/S24				
8	Bellows	J3 axis (for models with bellows)	2	Mitsubishi Electric
9	Liquid gasket	Bellows (for models with bellows)	A small amount	
RH-6CH-Sxx				
1	AC servo motor	J1 axis	1	Mitsubishi Electric
2		J2 axis	1	
3		J3 axis	1	
4		J4 axis	1	
5	Reduction gears	J1 axis	1	
6		J2 axis	1	
7	Ball screw spline	J3 axis	1	
RH-6CH-S23/S24				
8	Bellows	J3 axis (for models with bellows)	2	Mitsubishi Electric
9	Liquid gasket	Bellows (for models with bellows)	A small amount	

5.6 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 origin setting methods and when each origin setting method is required are shown in [Table 5-12](#).

Table 5-12 : Origin setting method

No	Method	Explanation	Cases when setting the origin is required	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B. Use this method at the initial startup.	- At the initial startup - When the controller is replaced - When the data is lost due to flat battery of the robot controller (when C7500 occurs)	The setting method is explained in Page 17, "2.3 Setting the origin" .
2	Jig method	The origin posture is set with the calibration jig installed.	- When a structural part of the robot (motor, reduction gear, timing belt, etc.) is replaced - When deviation occurred by a collision.	The setting method is explained in Page 79, "5.6.1 Jig method" .
3	ABS origin method	This method is used when the encoder backup data lost in the cause such as battery cutting.	When the encoder data is lost due to flat battery of the robot arm (when H112n occurs)	Before using this method, the origin must be set with the other method with same encoder. The setting method is explained in Page 87, "5.6.2 ABS origin method" .
4	User origin method	A randomly designated position is set as the origin posture.	When an arbitrary position is set as the origin	Before using this method, the origin must be set with the other method. The setting method is explained in Page 89, "5.6.3 User origin method" .

[Caution]

- The origin is set using the jig method (No.2) at factory default.
- The value set with the jig method is encoded and used as the origin data to be input at the initial startup after shipment. When the robot arm does not mechanically deviate (for example caused by replacement of the reduction gear, motor, or timing belt) or does not lose the encoder data, the origin data input method at shipment can be used to set the origin.
- The origin data is inherent to the serial number of each robot arm.
- The ABS origin method is used to restore the previous data by aligning the triangular marks to each other for each axis to set the lost origin data.
(Although the setting position is confirmed visually, deviations within a half rotation of the motor can be compensated.)

[Remarks]

- The ABS origin method cannot be used when the robot arm mechanically deviates (for example caused by replacement of the reduction gear, motor, or timing belt).
- After the origin setting is completed, move the robot arm to the position where the ABS marks align each other, and check that the displayed joint coordinates of the position are correct.
For the details of the ABS mark position and the joint coordinates, refer to [Page 87, "5.6.2 ABS origin method"](#).

5.6.1 Jig method

This method is using the origin setting tool. If the origin setting tool is required, please ask nearby dealer. The reference figure of the origin setting tool is shown in Fig. 5-16.

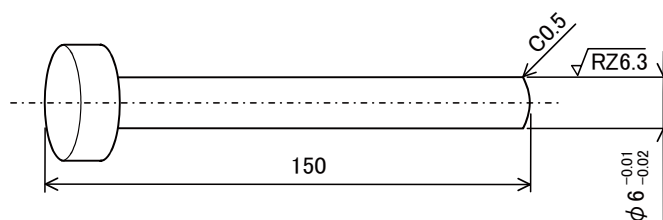


Fig.5-16 : Reference dimension of origin setting tool

The procedure of setting the origin with the origin setting tool is shown below.

This operation is carried out with the teaching pendant. Set the mode of the controller to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.

The origin setting can be performed for the target axis only instead of for all axes. Go to steps for the target axis to set the origin.

Do the following operations, pressing down the enabling switch of T/B lightly.

⚠ CAUTION

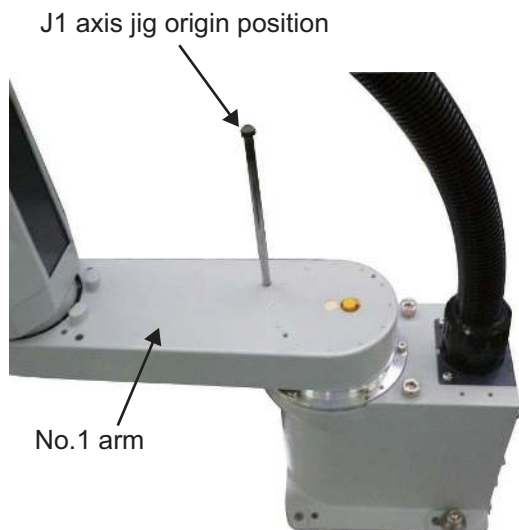
In the following procedure, the J3 axis brake is released to move its shaft with both hands.

To ensure safety, the brake-release procedure should always be done by two persons.

(1) J1 axis origin setting

<MENU>	
1. FILE/EDIT	2. RUN
3. PARAM.	4. ORIGIN/BRK
5. SET/INIT.	6. ENHANCED
123	CLOSE
Select ORIGIN/BRK	
4	GHI

1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



2) 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.

< ORIGIN / BRAKE >	
1. ORIGIN	2. BRAKE
123	CLOSE
1	' ()

3) Press the [1] key, and display the Origin setting selection screen.

<ORIGIN>	
1. DATA	2. MECH
3. TOOL	4. ABS
5. USER	
123	CLOSE
Select TOOL	
+Z (J3)	3 DEF

4) Press the [3] key, and display the Tool selection screen.

<ORIGIN> TOOL		COMPLETED
J1: (1)	J2: ()	J3: ()
J4: ()	J5: ()	J6: ()
J7: ()	J8: ()	
123	CLOSE	
↑ to →		
1	' ()	-C (J6)
EXE		0 SPACE

5) Input "1" into the J1 axis. Set "0" to other axes.

6) Press the [EXE] key, and display Confirmation screen.

```

<ORIGIN> TOOL

CHANGE TO ORIGIN. OK?

Yes 123 No
    
```

F1

7) Press the [F1] key, and the origin position is set up.

```

<ORIGIN> TOOL COMPLETED

J1:( 1 ) J2:( ) J3:( )
J4:( ) J5:( ) J6:( )
J7:( ) J8:( )

123 CLOSE
    
```

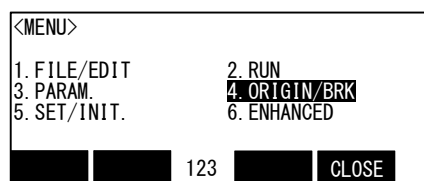
8) Setting of the origin is completed.

9) Refer to [Page 91, "5.6.4 Recording the origin data"](#) in this manual, and record the origin data on the origin data seal.

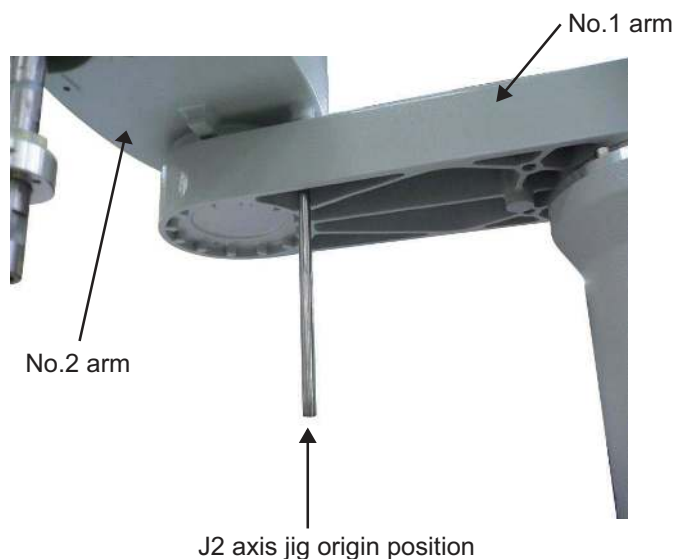
◆◆◆ Select the axis of origin setting ◆◆◆

Do cursor movement into the parenthesis of each axis by the arrow 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".

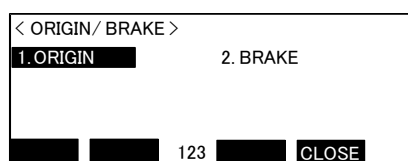
(2) J2 axis origin setting



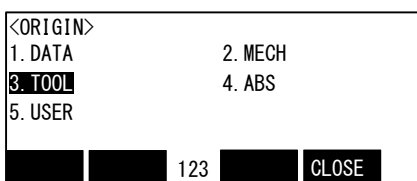
- 1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



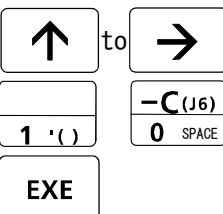
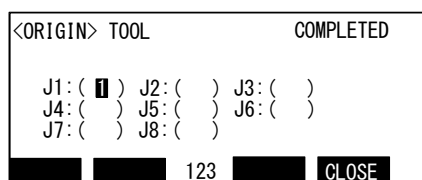
- 2) Move the J2 axis slowly using both hands. Align the pinholes of the No. 1 and No. 2 arms, feed through the origin jig into the pinholes and fasten.
The posture angle is +89 degrees for RH-3CH-S11/S15, and +110 degrees for RH-6CH-S11/S15.



- 3) Press the [1] key, and display the Origin setting selection screen.



- 4) Press the [3] key, and display the Tool selection screen.



- 5) Input "1" into the J2 axis. Set "0" to other axes.

- 6) Press the [EXE] key, and display Confirmation screen.

<ORIGIN> TOOL			
CHANGE TO ORIGIN. OK?			
Yes	123	No	

F1

7) Press the [F1] key, and the origin position is set up.

<ORIGIN> TOOL		COMPLETED	
J1:()	J2:(1)	J3:()	
J4:()	J5:()	J6:()	
J7:()	J8:()		
	123	CLOSE	

8) Setting of the origin is completed.

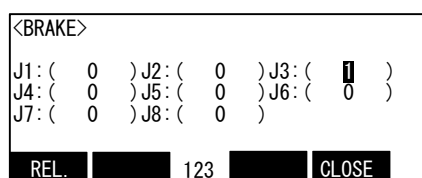
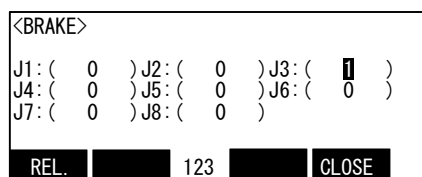
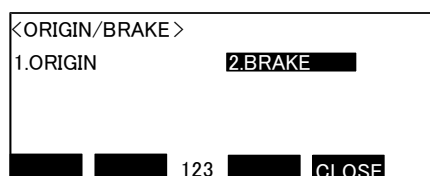
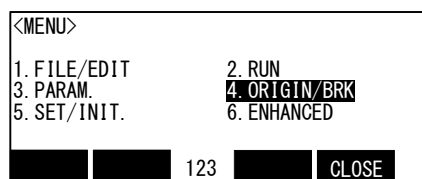
9) Refer to [Page 91, "5.6.4 Recording the origin data"](#) in this manual, and record the origin data on the origin data seal.

◆◆◆ Select the axis of origin setting ◆◆◆

Do cursor movement into the parenthesis of each axis by the arrow 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

Always perform origin setting of the J3 axis and the J4 axis simultaneously.



1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

2) Press the [2] key, and display the Break release selection screen.

3) Release the brake of the J3 axis for RH-3CH-S11/S15.

Input "1" into the J3 axis. Set "0" to other axes.

Release the brake of the J3 axis and J4 axis for RH-6CH-S11/S15.

4) Confirm the axis for which the brakes are to be released.



5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.

Note) To prevent sudden fall of the J3 axis, release and lock the brake of the following axis repeatedly at intervals of about 200 ms. (Intermittent releasing of the brake)

6) With both hands, slowly move the J3 axis in + (plus) direction, and contact the axis against the mechanical stopper.

CAUTION

For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the J3 axis (shaft). When the brake is released, the J3 axis could drop with its own weight.

CAUTION

If [F1] key or enable switch of T/B is released, the brakes will be work immediately.



- 7) Hold the J4 axis with your hand and rotate it slowly to align the slit with the ABS mark.
*Move the J4 axis with maintaining the condition that the releasing brake of the J3 axis and the J3 axis contact to the mechanical stopper.

<BRAKE>

J1:(0) J2:(0) J3:(1)
J4:(0) J5:(0) J6:(0)
J7:(0) J8:(0)

REL. 123 CLOSE

F4

- 8) Detach the [F1] key and work the brake.
Press the [F4] key and return to the origin / brake screen.

< ORIGIN / BRAKE >

1. ORIGIN 2. BRAKE

123 CLOSE

1 '()

- 9) Press the [1] key, and display the Origin setting selection screen.

< ORIGIN >

1. DATA 2. MECH
3. TOOL 4. ABS
5. USER

123 CLOSE

+Z (J3)
3 DEF

- 10) Press the [3] key, and display the Tool selection selection screen.

< ORIGIN > TOOL

J1() J2() J3(1)
J4(1) J5() J6()
J7() J8()

123 CLOSE

↑ to →

1 '()

EXE

-C (J6)
0 SPACE

- 11) Input "1" into the J3 and J4 axis. Set "0" to other axes.
12) Press the [EXE] key, and display Confirmation screen.

<ORIGIN> MECH			
CHANGE TO ORIGIN. OK?			
Yes	123	No	

F1

13) Press the [F1] key, and the origin position is set up.

14) Setting of the origin is completed.

15) Refer to [Page 91, "5.6.4 Recording the origin data"](#) in this manual, and record the origin data on the origin data seal.

◆◆◆ Release the brake ◆◆◆

Do cursor movement into the parenthesis of each axis by the arrow 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 [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

◆◆◆ Select the axis of origin setting ◆◆◆

Do cursor movement into the parenthesis of each axis by the arrow 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".

5.6.2 ABS origin method

When the origin setting of the robot is performed for the first time, this product records the angular position of the origin within one rotation of the encoder as the offset value. If the origin setting is performed according to the ABS origin method, this value is used to suppress variations in the origin setting operations and to reproduce the initial origin position accurately.

This operation is carried out with the teaching pendant. Set the mode of the controller to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.

First, set to the ABS mark arrow of the axis for which the origin is to be set with jog operation. This can be set for all axes simultaneously or each axis independently.

To align the ABS marks, view the robot from the front. The deviation between the end points of the two triangular marks must be 1 mm or less.

The positions where the ABS mark is attached are shown in below. Refer to [Page 24, "2.4 Confirming the operation"](#) for details on the jog operation.

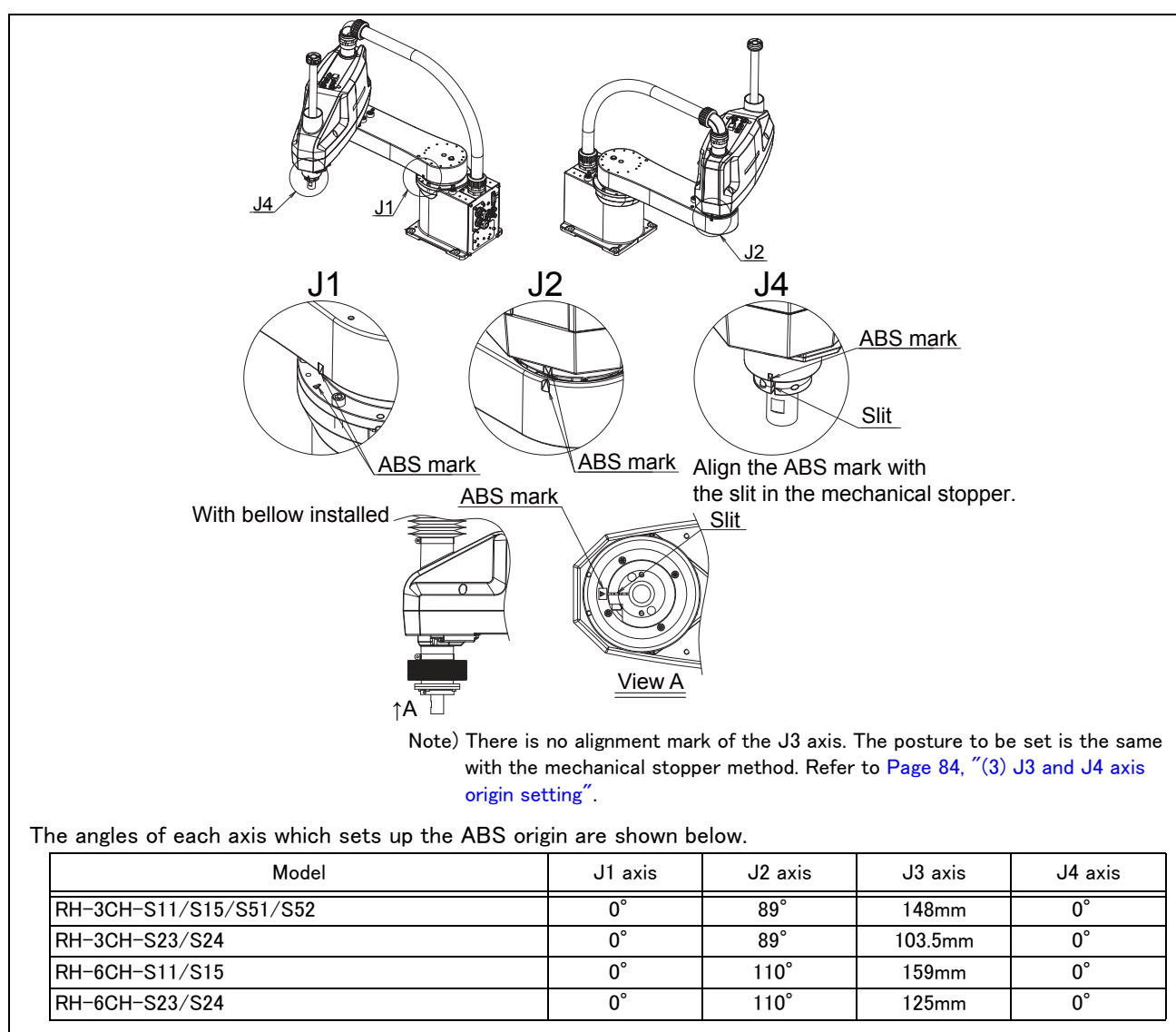


Fig.5-17 : ABS mark attachment positions

The procedures for setting the origin with the ABS method are explained below.

(1) Select the T/B

```

<MENU>
1. FILE/EDIT      2. RUN
3. PARAM.         4. ORIGIN/BRK
5. SET/INIT.      6. ENHANCED
REL. 123 CLOSE
  
```

```

4 GHI
  
```

1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

```

< ORIGIN/ BRAKE >
1. ORIGIN      2. BRAKE
REL. 123 CLOSE
  
```

```

1 '()
  
```

2) Press the [1] key, and display the Origin setting selection screen.

```

<ORIGIN>
1. DATA      2. MECH
3. TOOL       4. ABS
5. USER
REL. 123 CLOSE
  
```

```

4 GHI
  
```

3) Press the [4] key, and display the ABS selection screen.

```

<ABS>
J1: ( 1 ) J2: ( 0 ) J3: ( 0 )
J4: ( 0 ) J5: ( 0 ) J6: ( 0 )
J7: ( 0 ) J8: ( 0 )
REL. 123 CLOSE
  
```

```

↑ to →
1 '() → EXE
  
```

4) Input "1" into the axis to origin setting. Press the [EXE] key, and display Confirmation screen.

```

<ORIGIN> ABS
CHANGE TO ORIGIN. OK?
Yes 123 No
  
```

```

F1
  
```

5) Press the [F1] key, and the origin position is set up.

```

<ABS>
J1: ( 1 ) J2: ( 0 ) J3: ( 0 )
J4: ( 0 ) J5: ( 0 ) J6: ( 0 )
J7: ( 0 ) J8: ( 0 )
REL. 123 CLOSE
  
```

The origin settings are completed by the ABS method.



CAUTION

After setting the origin, when the joint coordinates of the ABS mark position deviate from the coordinates of the ABS origin by 1.5° or more, align the end points of the ABS marks and set the origin using the ABS origin method again.

5.6.3 User origin method

 **CAUTION**

Before using this method, the origin must be set with the other method.
The setting method is explained in [Page 78, "Table 5-12 : Origin setting 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 of the controller to "MAMNUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown below.

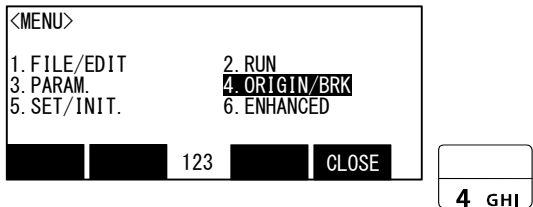
When setting the origin for the first time using this method, carry out the operations in order from step 1). For the second and following time, move the robot arm to the user origin position with jog operation, and accurately position all axis. Then start the procedure from step 4).

- 1) Determine the user origin position
- Move the robot to the position to be set as the origin with jog operation. Refer to [Page 24, "2.4 Confirming the operation"](#) for details on the jog operation.

 **CAUTION**

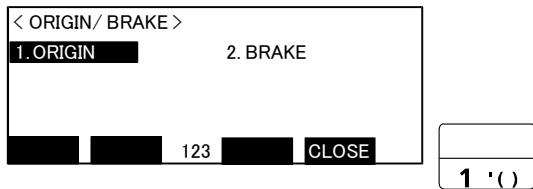
Choose the user origin position as the position where it doesn't move by the gravity.
This position is left as a guideline to position all axes with jog operation when setting the origin again with this method.

- 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.

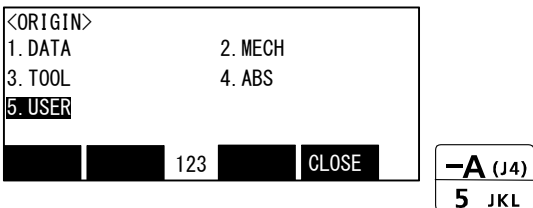


- 4) Next, set the origin.
- Display the menu screen.

- 5) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

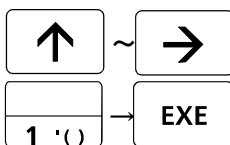


- 6) Press the [1] key, and display the Origin setting selection screen.



- 7) Press the [5] key, and display the User selection screen.

<USER>			
J1: (	1	)J2: (	0
J4: (	0	)J5: (	0
J7: (	0	)J8: (	0
REL.		123	CLOSE



8) Input "1" into the axis to origin setting. Press the [EXE] key, and display Confirmation screen.

<ORIGIN> USER	
CHANGE TO ORIGIN. OK?	
Yes	No



9) Press the [F1] key, and the origin position is set up.

The origin settings are completed by the User origin method.

5.6.4 Recording the origin data

When the origin has been set with the 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 attached on the side of the base part of the robot arm.

The teaching pendant operation method and the battery cover 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 19, "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

Confirm the value displayed on the teaching pendant's Origin Data Input screen.

Refer to [Page 19, "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.

(2) Recording the origin data

Write the origin data displayed on the teaching pendant to the origin data label mentioned above. Refer to [Page 19, "Fig.2-10 : Origin data label \(an example\)"](#), and [Page 22, "Fig.2-11 : Correspondence of origin data label and axis"](#) for details on the origin data label.

The recording of the origin data is completed.

6 Appendix

Appendix 1 : Configuration flag

The configuration flag indicates the robot posture.

For the 6-axis type robot, 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 end axis position relative to the line that passes through both the rotational center of the J1 axis and the rotational center of the J2 axis.

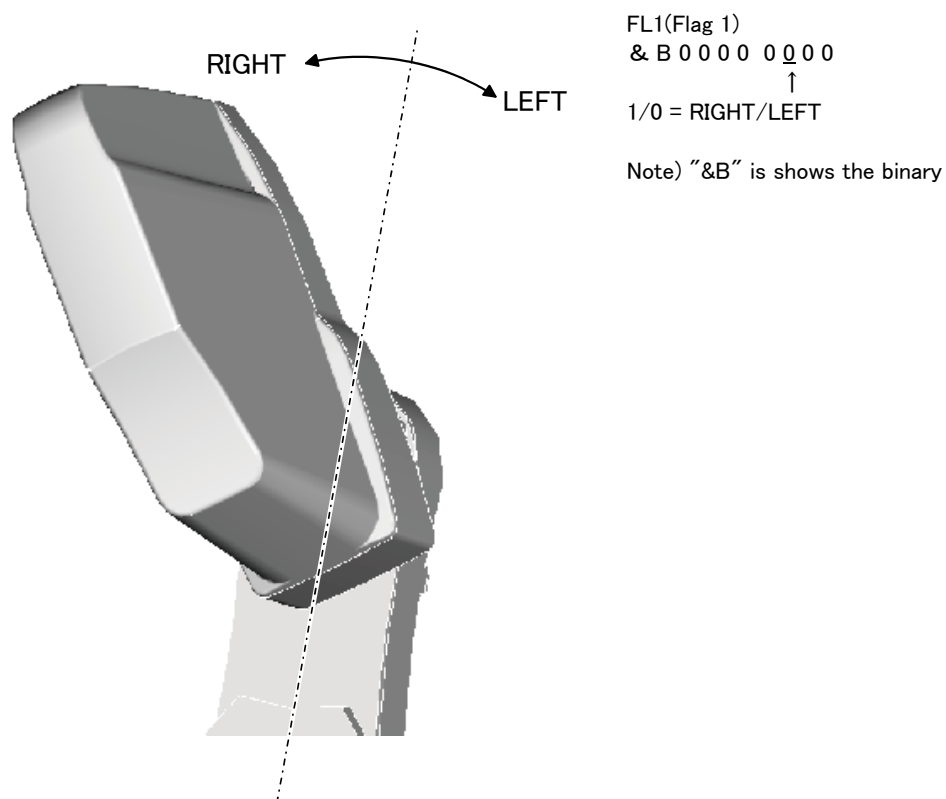


Fig.6-1 : Configuration flag (RIGHT/LEFT)

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