MITSUBISHI ELECTRIC

Mitsubishi Electric Industrial Robot

RH-FRH Series INSTRUCTION MANUAL

ROBOT ARM SETUP & MAINTENANCE

RH-3FRH series
RH-6FRH series
RH-12FRH series
RH-20FRH series
RH-3FRHR series

MELFA

BFP-A3472-B

⚠ 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 connect the Handy GOT to a programmable controller when using an iQ Platform compatible product with the CR800-R/CR800-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 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.

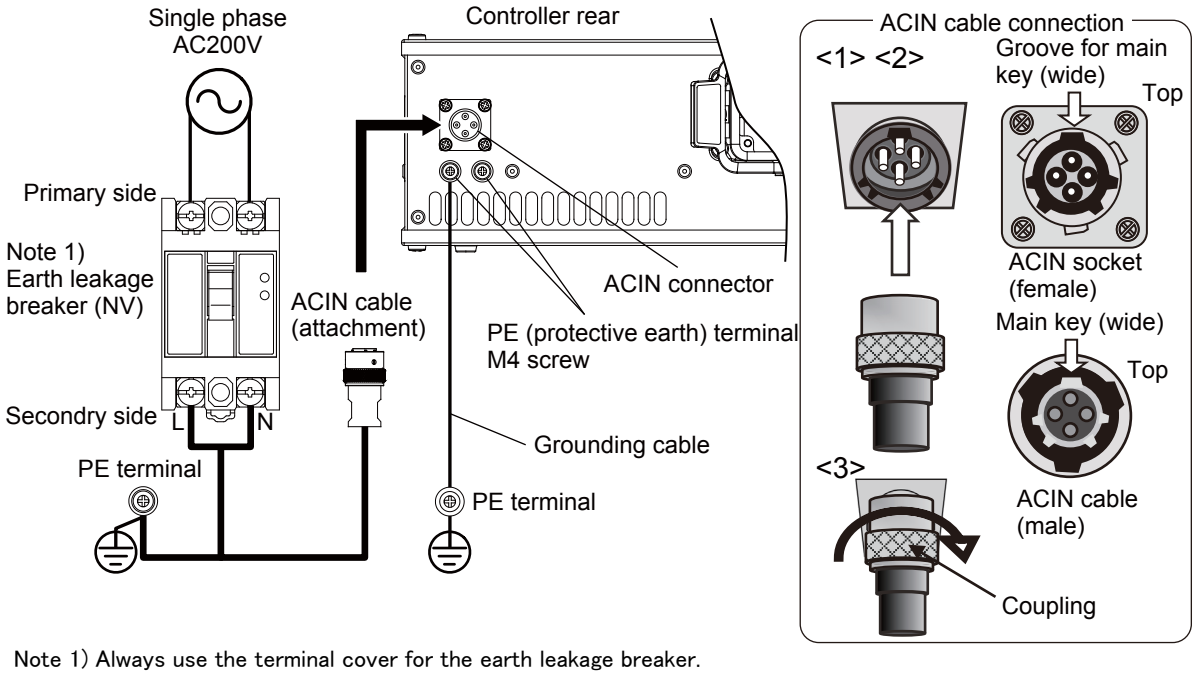
⚠ CAUTION

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.

*CR800 controller

Notes of the basic component are shown.

⚠ CAUTION Please install the earth leakage breaker in the primary side power supply of the controller because of leakage protection.



Note 1) Always use the terminal cover for the earth leakage breaker.

1) Prepare the following items.

Part name	Specifications	Remarks
Earth leakage breaker	The following is recommended product. Single phase: NV30FAU-2P-10A-AC100-240V-30mA (Terminal cover: TCS-05FA2)	Prepared by customer.
Cable for primary power supply	AWG14 ($2mm^2$) or above	Prepared by customer. Tightening torque for terminal fixing screw is 2 ～ 3Nm.
Grounding cable	AWG14 ($2mm^2$) or above	Prepared by customer. Tightening torque for terminal fixing screw is 2 ～ 3Nm.
ACIN cable	Terminal: M5, cable length: 3m	Supplied with the product.

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 ACIN cable to the breaker.
   Connect the power terminals of the ACIN cable to the secondary side terminals of the earth leakage breaker.
   Also, ground the FG terminal of the cable.
5) Connect the ACIN cable to the ACIN connector on the rear of the controller.
   <1> Face the main key on the ACIN cable plug upwards. (Refer to the "ACIN cable connection" illustration.)
   <2> Align the main key of the ACIN cable plug with the grooves on the ACIN connector. Push the plug into the connector as far as it will go.
   The plug may be damaged if it is not correctly aligned with the connector.
   <3> Tighten the coupling on the ACIN cable, turning it to the right until it locks.
6) Connect one end of the grounding cable to the PE (protective earth) terminal on the controller and ground the other end (2-point grounding) in order to comply with the requirements of EN 61800-5-1 for the touch current of 3.5 mA AC or more.
7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

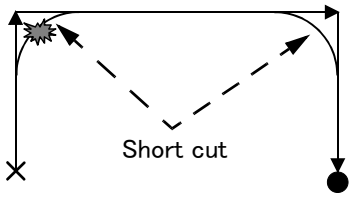
⚠CAUTION Be careful of interference with peripheral equipment.
Especially don't give a shock to the shaft (J3 axis). When you install the hand, be careful not to knock at the shaft end by the hammer etc. The shaft may be damaged.

Collision detection function is valid condition for both of automatic and jog operation at shipping in RH-3FRHR series. However, damage to the ball screw shaft cannot be prevented completely.

Refer to the separate instruction manual "Detailed explanations of functions and operations" for collision detection function.

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.



Arch movement (example)

(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
2017-04-27	BFP-A3472	・First print
2018-03-01	BFP-A3472-A	・Descriptions of CR800-Q controller were added. ・Mechanical stopper position in Fig 3-16 were corrected.
2018-12-25	BFP-A3472-B	・"5.6.3 ABS origin method" was corrected. ・Added further explanation of the ACIN cable.

*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."

And, when maintenance and inspection of the robot, to access the arm and the base section is necessary. Please prepare the environment which can access the robot with the stepladder etc. in RH-3FRHR.

This document explains for the following robot type.

Robot type
On floor type.....*RH-3FRH series
*RH-6FRH series
*RH-12FRH series
*RH-20FRH series
Hanging type .....*RH-3FRHR series

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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 in instruction manuals. If using other T/B, such as R56TB, 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.

Manual name	Description
Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller setup, basic operation, and maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed explanations 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	Explains the control function and specifications of conveyor tracking.
GOT Direct Connection Extended Function	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures about the GOT (standalone type robot).
iQ Platform Supporting Extended Function	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures about the PLC (iQ Platform compatible type robot).
Ethernet Function	Explains the measures to perform communication with personal computers on Ethernet with the TCP/IP protocol.

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 compatible type	
	Controller	Indicates the controller which controls the robot arm.
	The robot CPU unit or robot CPU	Indicates the CPU unit for the robots which installed to the sequencer base unit of MELSEC iQ-R/MELSEC-Q series. It is connected with the controller 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.
	Standalone type	
	Controller	Indicates the controller which controls the robot arm.
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. Descriptions in this manual are based on R32TB.

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 CR800-R/CR800-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 "Standard Specifications".

Table 2-1 : Standard configuration

No.	Part name	Type	Qty.	Remarks
RH-3FRH series				
1	Robot arm		1 unit	
2	Installation bolts	M8 x 40	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	Fixing plates		1 set	For robot arm transportation
6	Fixing plates installation bolt		1 set	
7	Installation bolt for machine-cable	M4 x12	4 pcs.	To fix to the back of robot arm base
RH-6FRH series				
1	Robot arm		1 unit	
2	Installation bolts	M8 x 40	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	Grease nipple	WA-610	1 pc.	
6	Fixing plates		1 set	For robot arm transportation
7	Fixing plates installation bolt		1 set	
RH-12FRH/20FRH series				
1	Robot arm		1 unit	
2	Installation bolts	M12×45	4 pcs	For robot arm installation
3	Spring washer for installation bolts	For M12	4 pcs	
4	Plain washer for installation bolts	For M12	4 pcs	
5	Fixing plates		1 set	For robot arm transportation
6	Fixing plates installation bolt		1 set	
7	Transporting jig		1 set	
8	Transporting jig fixing bolt		1 set	
RH-3FRHR series				
1	Robot arm		1 unit	
2	Installation bolts	M8 × 90	4 pcs.	For robot arm installation
3	Installation bolts (Spare)	M8 × 40	4 pcs.	
4	Installation nut	M8	4 pcs.	
5	Spring washer for installation bolts	For M8	8 pcs.	
6	Plain washer for installation bolts	For M8	8 pcs.	
7	Hanging tools (Eye bolt)		1 set	To hang the robot arm with the crane.
8	Fixing plate		1 set	Fixing plates installation bolt: 5 pcs. Nuts: 4 pcs.
9	Nats for T slot	M5	4 pcs.	For fixing the tool wiring etc.
10	T slot cover	1.5m	1 pc.	For clean/waterproof specification

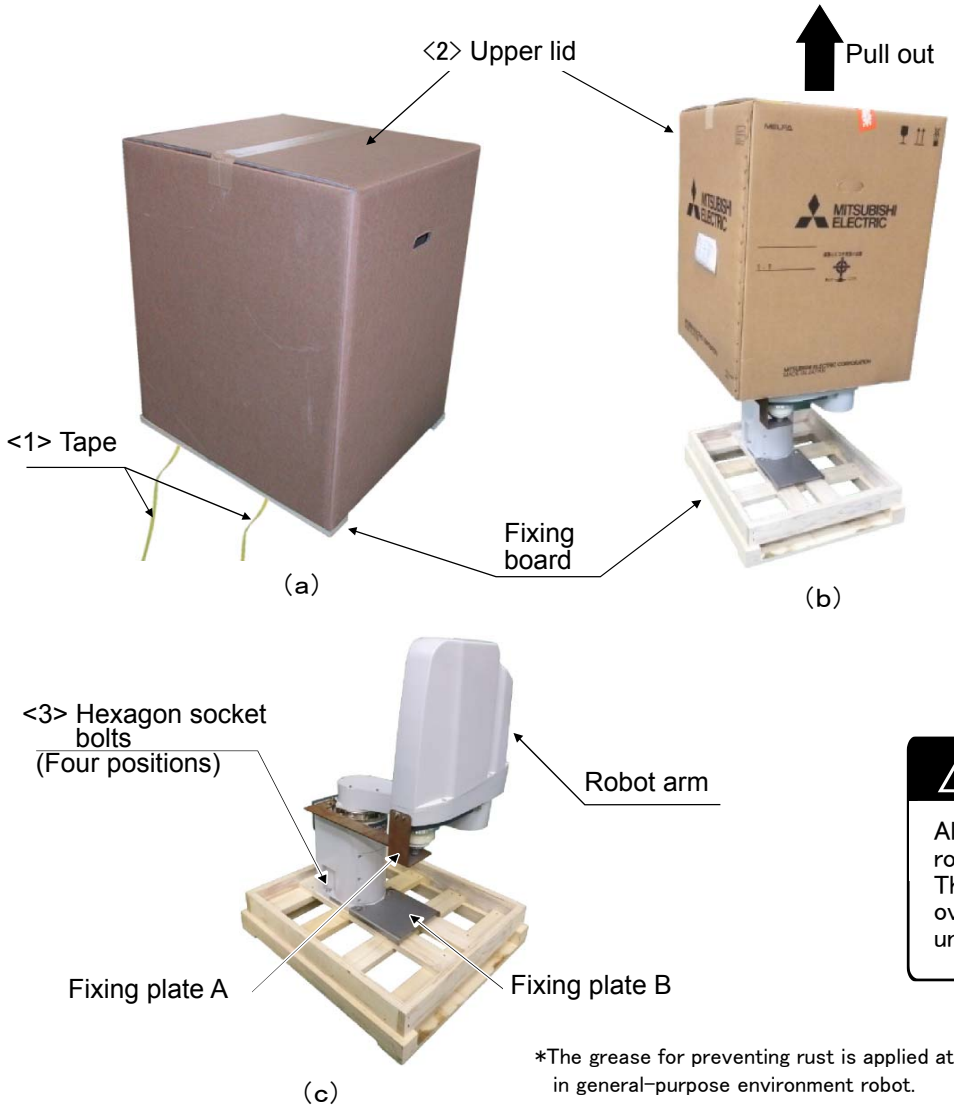
Note1) RH-3FRH/12FRH/20FRH series: Items No. 2 to 4 are contained in the plastic bag of attachment in the robot arm.
RH-6FRH series: Items No. 2 to 5 are contained in the plastic bag of attachment in the robot arm.
RH-3FRHR series: Item No.2 to 6 are contained in the plastic bag of attachment in the robot arm.
No. 7 and 8 are mounted on the robot.
No. 10 is a dustproof cover for T slots in the sides of No.1 arm and No.2 arm of the robot. Please cut and use the T slot cover to a suitable length.

2.2 Installation

⚠DANGER Install the robot with a safety fence or enclosure around it. Otherwise, operators may be injured due to unintended access to the robot.

2.2.1 Unpacking

(1) RH-3FRH/6FRH/12FRH/20FRH series



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

*The grease for preventing rust is applied at the tip of the shaft (J3 axis) in general-purpose environment robot.

Fig.2-1 : Unpacking the robot arm (RH-3FRH/6FRH/12FRH/20FRH series)

The robot is shipped from the factory in cardboard and plywood frame packing. Always refer to Fig. 2-1 and unpack the robot. Handle the robot arm according to "2.2.2Transportation procedures".

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

The unpacking process is shown below.

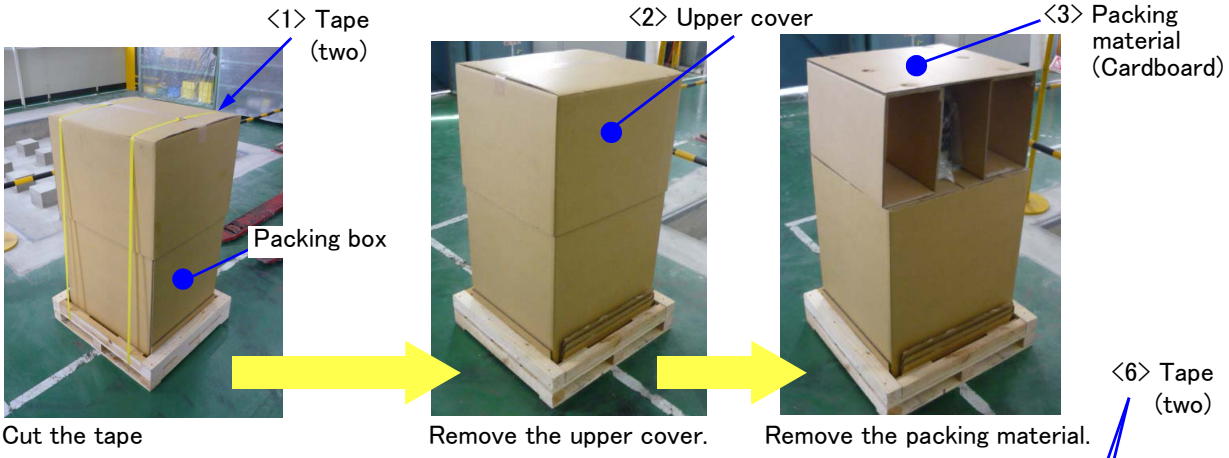
1) Using a knife, etc., slit the tape <1> fixing the upper lid <2> of the cardboard box. (Fig. 2-1 (a))
2) Pull the upper lid <2> of the cardboard box off with both hands. (Fig. 2-1 (b))
3) Remove the hexagon socket bolts <3> (four positions) which fix the robot. (Fig. 2-1 (c))

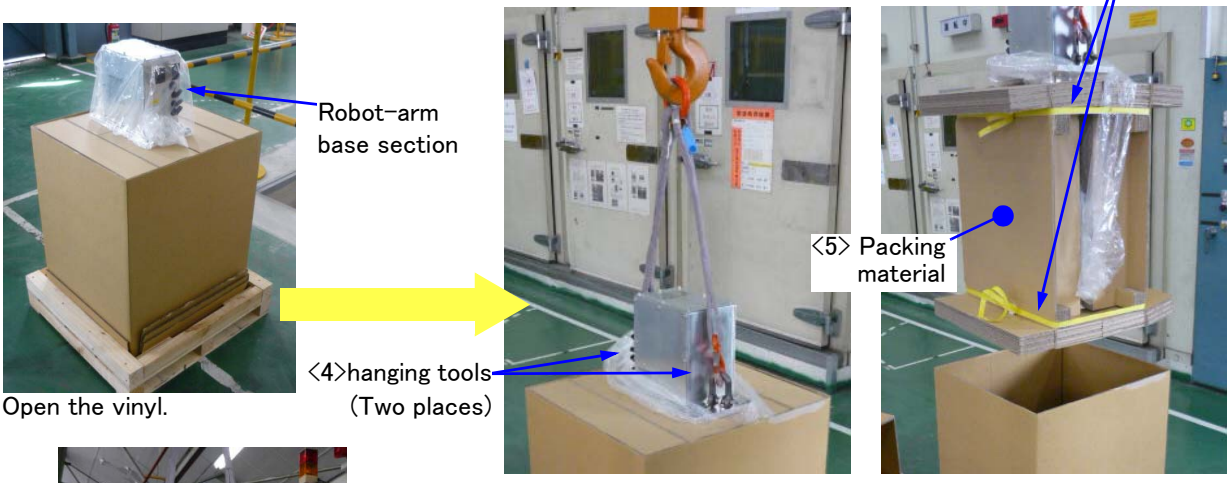
The unpacking is completed.

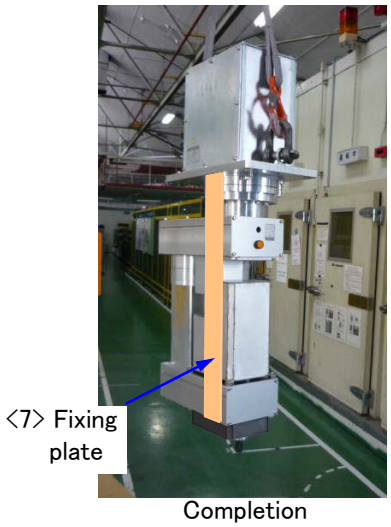
Note) The robot must be transported without removing the fixing plate A and B. Remove after installing.

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

(2) RH-3FRHR series







Unpacking the robot with hoisting.
(Utilize the hanging tools (two places) <4> of the robot arm).
Please unpack near the installation place.

*The grease for preventing rust is applied at the tip of the shaft (J3 axis) in general-purpose environment robot.

CAUTION

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

CAUTION

Don't remove fixing plate <7> till installation is completed. When you pack the robot again, be sure to install the fixing plate <7>.

Fig.2-2 : Unpacking the robot arm (RH-3FRHR series)

The unpacking procedure is shown below.

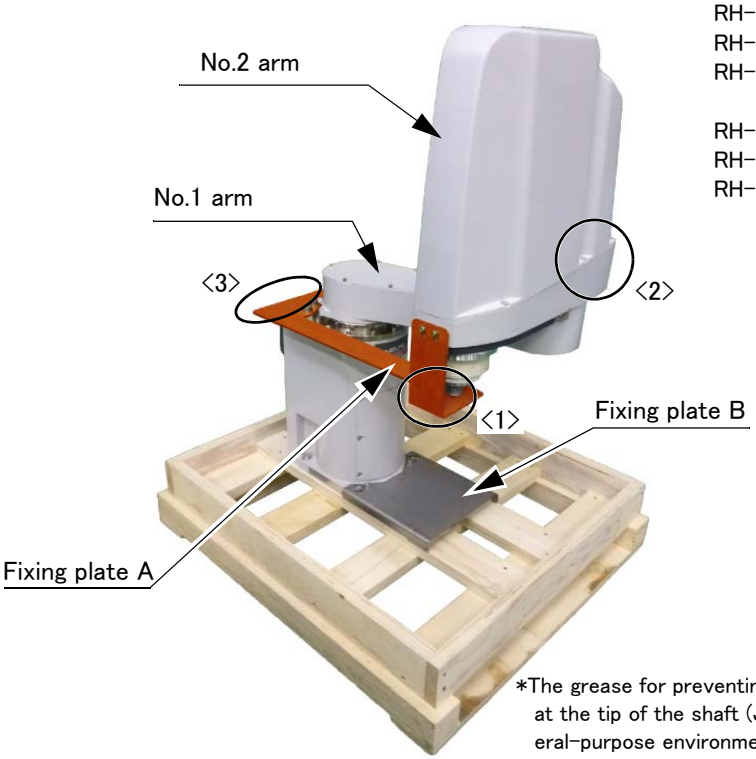
1) Cut with scissors etc. the tape <1> of fixing cardboard.
2) Raise and remove upper cover <2>. Remove packing material (cardboard) <3> in the inside.
3) Open the vinyl and confirm the hanging tools (two places) <4>. Hang the hook of the crane here. (Two places)
4) Hoist with the crane and separate the robot arm together with packing material from the packing box.
5) Cut with scissors etc. tape <6> which fixed packing material <5>, and remove packing material <4>.

Unpacking is completd.

2.2.2 Transportation procedures
(1) RH-3FRH/6FRH series

Mass
RH-3FRH35** series: Approx. 31kg
RH-3FRH45** series: Approx. 32kg
RH-3FRH55** series: Approx. 33kg

RH-6FRH35** series: Approx. 39kg
RH-6FRH45** series: Approx. 40kg
RH-6FRH55** series: Approx. 41kg



*The grease for preventing rust is applied at the tip of the shaft (J3 axis) in general-purpose environment robot.

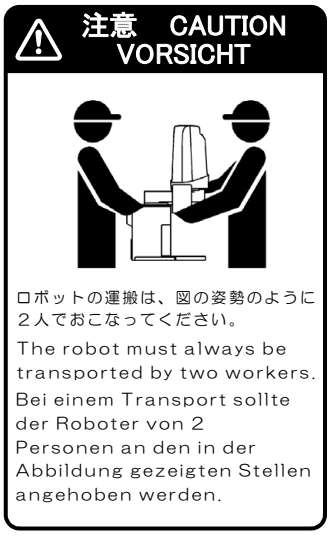


Fig.2-3 : Transportation of robot arm (RH-3FRH/6FRH series)

1) The robot must be transported by two workers with putting the fixing plate A and B. Place the robot on a cart, etc., and move it to near the installation place. Transporting the robot with the following should be limited to placing the robot on the frame or cart, and to positioning.
2) When transporting the robot arm, one person should hold the fixing plate A of No.2 arm <1> and No.2 arm <2> and another person should hold the fixing plate A of base <3>. When transporting the robot, do not apply force to the cover, or apply a strong shock on the robot.
3) Remove the fixtures after installing the robot.
4) Always attach the fixing plate, and follow the above procedures and methods to transport the robot for secondary transportation, such as when changing the installation position.
If the arm is directly holded without using the specified fixing plate, or if it is holded in the work posture, the configuration devices could be damaged, and the transportation workers will be subject to risk due to an inadequate center of gravity position.

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

⚠CAUTION Be careful not to apply force to the shaft section (J3 axis). The shaft may be damaged and the overload error may occur at the time of movement.

⚠CAUTION When installing the fixing tool again, place the robot in the posture where each axis shows the values listed in Table 2-2.

⚠CAUTION The robot should keep vertical. (not be horizontal)
It becomes the cause of the grease leakage or the trouble.

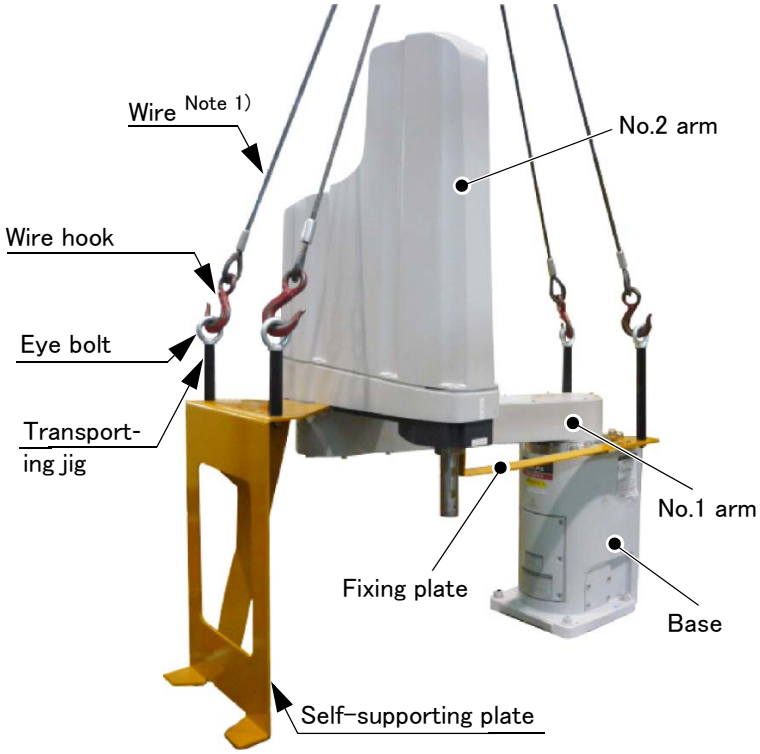
⚠CAUTION The ventilation duct is attached to the clean specification robot's base section rear.
Please handle with care when transporting or installing the robot arm.

⚠CAUTION If it is difficult to follow the transportation procedure shown in this section, 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. Otherwise, applying an excessive power on the joints by external forces may cause a malfunction.
Do not apply an excessive load to the robot arm while fixing it. Otherwise, the robot arm may be damaged.

Table 2-2 : Transportation posture (RH-3FRH/6FRH series)

Axis	RH-3FRH35**	RH-3FRH45**	RH-3FRH55**	RH-6FRH35**	RH-6FRH45**	RH-6FRH55**
J 1	49.5 deg.	25 deg.	17 deg.	57.5 deg.	28 deg.	19 deg.
J 2	-139.5 deg.	-115 deg.	-107 deg.	-147.5 deg.	-118 deg.	-109 deg.
J 3	290.4mm			290.4mm		
J 4	Not fixed			Not fixed		

(2) RH-12FRH/20FRH series



Mass
RH-12FRH55** series: Approx. 65kg
RH-12FRH70** series: Approx. 67kg
RH-12FRH85** series: Approx. 69kg

RH-20FRH85** series: Approx. 75kg
RH-20FRH100** series: Approx. 77kg

Note 1) Use wires that are 1300 mm or more.

*The grease for preventing rust is applied at the tip of the shaft (J3 axis) in general-purpose environment robot.

Fig.2-4 : Transportation of robot arm (RH-12FRH/20FRH series)

1) Hook the wires to each of the four eyebolts attached to the transporting jig. (Make sure the bolts are securely hooked.)
2) Lift with a crane to transport the robot to the designated location.
3) At this time, make sure that the wires, etc., do not interfere with the robot arm or the covers. Always place the cloth, etc., at interfering places.
4) Be careful not to subject the robot to physical shock during transport.
5) After installing the robot (refer to Page 15, "2.2.3 Installation procedures"), remove the wires, the wire hooks (the robot will stand by itself as shown in Fig. 2-4), the self-supporting plate, transporting jig and fixing plate.
6) Always attach the self-supporting plate, fixing plate, and transporting jig, and follow the above procedures and methods to transport the robot for secondary transportation, such as when changing the installation position.
   If the arm is directly suspended without using the specified transporting jig, or if it is suspended in the work posture, the configuration devices could be damaged, and the transportation workers will be subject to risk due to an inadequate center of gravity position.

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

⚠CAUTION To reattach the fixing plate again, set the axes of the robot to the positions according to Table 2-3.

⚠CAUTION The robot should keep vertical. (not be horizontal)
It becomes the cause of the grease leakage or the trouble.

⚠CAUTION The ventilation duct is attached to the clean specification robot's base section rear.
Please handle with care when transporting or installing the robot arm.

⚠CAUTION When the robot is not installed, the self-supporting plate must be attached to the robot.
The robot could tilt over, if the self-supporting plate is not attached to the robot.

⚠CAUTION If it is difficult to follow the transportation procedure shown in this section, 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. Otherwise, applying an excessive power on the joints by external forces may cause a malfunction.
Do not apply an excessive load to the robot arm while fixing it. Otherwise, the robot arm may be damaged.

Table 2-3 : Transportation posture (RH-12FRH/20FRH series)

Axis	RH-12FRH55**	RH-12FRH70**	RH-12FRH85**	RH-20FRH85**	RH-20FRH100**
J1	-37.5°	-21.4°	-15.1°		-21.0°
J2	127.5°	111.4°	105.1°		111.0°
J3[Note1)]	340mm				
J4	Not fixed				

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

(3) RH-3FRHR series

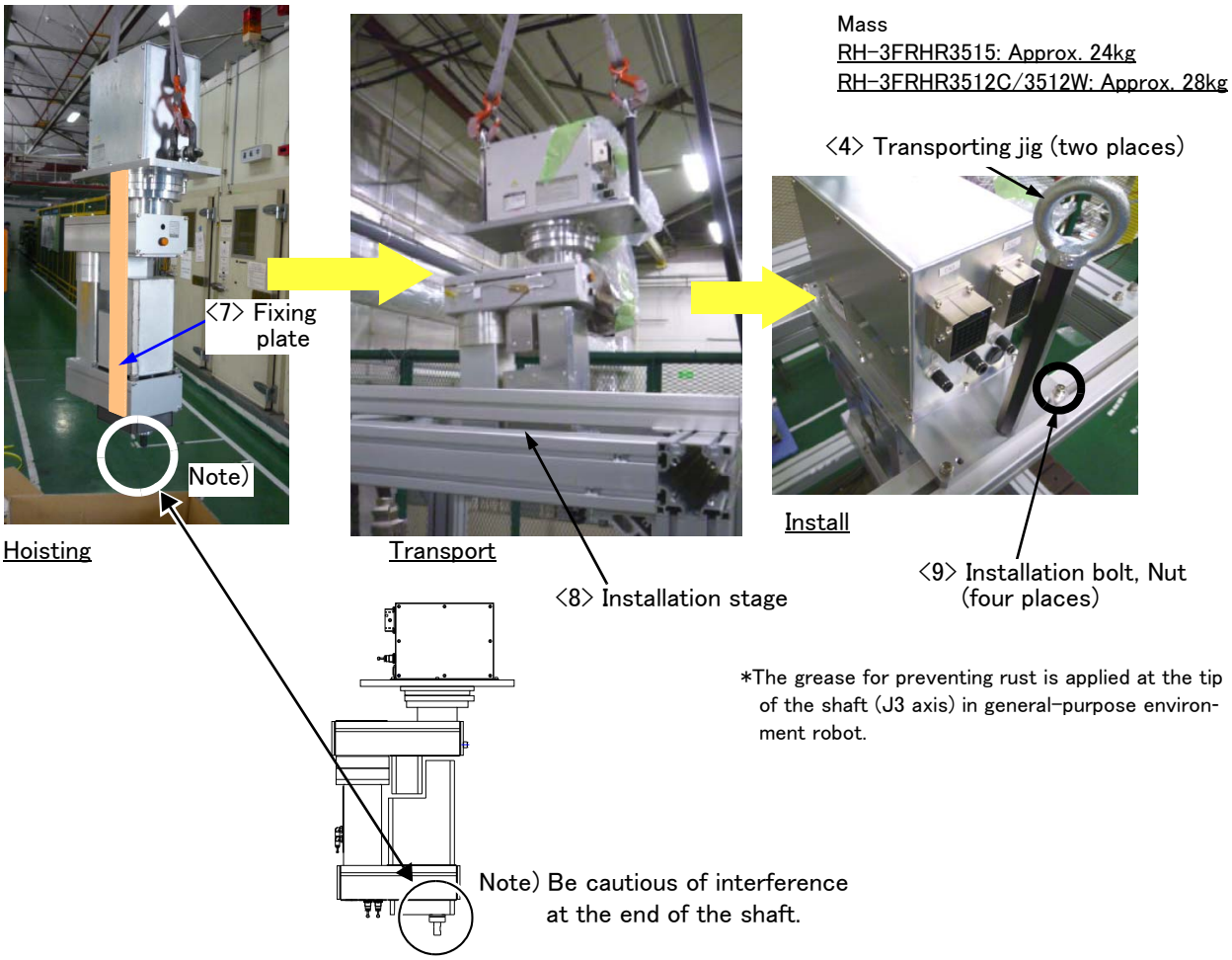


Fig.2-5 : Transportation of robot arm (RH-3FRHR series)

The transportation procedure is shown below. Transport the robot with careful of safety, referring to Fig. 2-5.

⚠CAUTION Transport by using the crane with fixing plate <7> still being installed is necessary. Transport carefully so that the robot may not tilt by using two wires. Take care sufficiently not to give the interference and the shock with the installation stage etc.,

1) Transport the robot by the crane from the condition which unpacking completed to the fixing position of installation stage <8>.
2) Fixing the robot by four installation bolts <9> (attached) certainly to installation stage <8>.
3) Remove transporting jigs (two places) <4> after installation. Loosen the screw (M5 x 4, M4x1) fixing the fixing plate <7>, and remove the fixing plate <7>. Also remove the nut for T slots. Fixing plate <7>, and fixing screws and transporting jigs <4> are needed at secondary transportation. Please keep them with care.
4) Always attach the fixing plate and transporting jig, and follow the above procedures and methods to transport the robot for secondary transportation, such as when changing the installation position.
If the arm is directly suspended without using the specified transporting jig, or if it is suspended in the work posture, the configuration devices could be damaged, and the transportation workers will be subject to risk due to an inadequate center of gravity position.

Transportation is complete above.

⚠CAUTION To reattach the fixing plate again, set the axes of the robot to the positions according to Table 2-4.

⚠CAUTION If it is difficult to follow the transportation procedure shown in this section, 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. Otherwise, applying an excessive power on the joints by external forces may cause a malfunction.
Do not apply an excessive load to the robot arm while fixing it. Otherwise, the robot arm may be damaged.

Table 2-4 : Transportation posture (RH-3FRHR series)

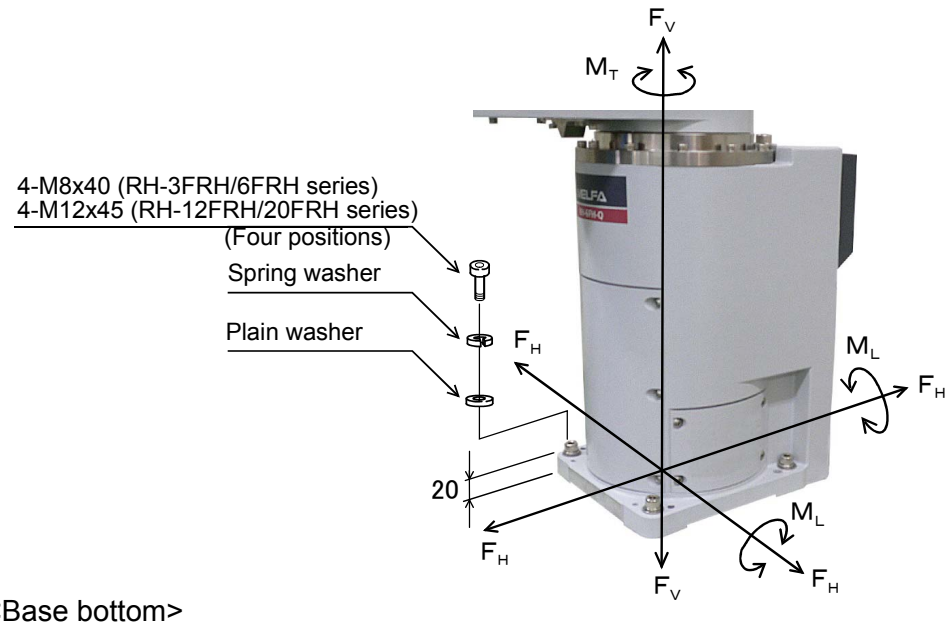
Axis	RH-3FRHR3515	RH-3FRHR3512C/3512W
J1	0 deg.	
J2	0 deg.	
J3 Note1)	-569.5mm (Upper end)	-599.5mm (Upper end)
J4	Not fixed	

Note1) Because if the J3 axis is lowered the shaft juts danger, be sure to specified posture at transport.

2.2.3 Installation procedures

The installation procedure of the robot arm is shown below.

(1) RH-3FRH/6FRH/12FRH/20FRH series



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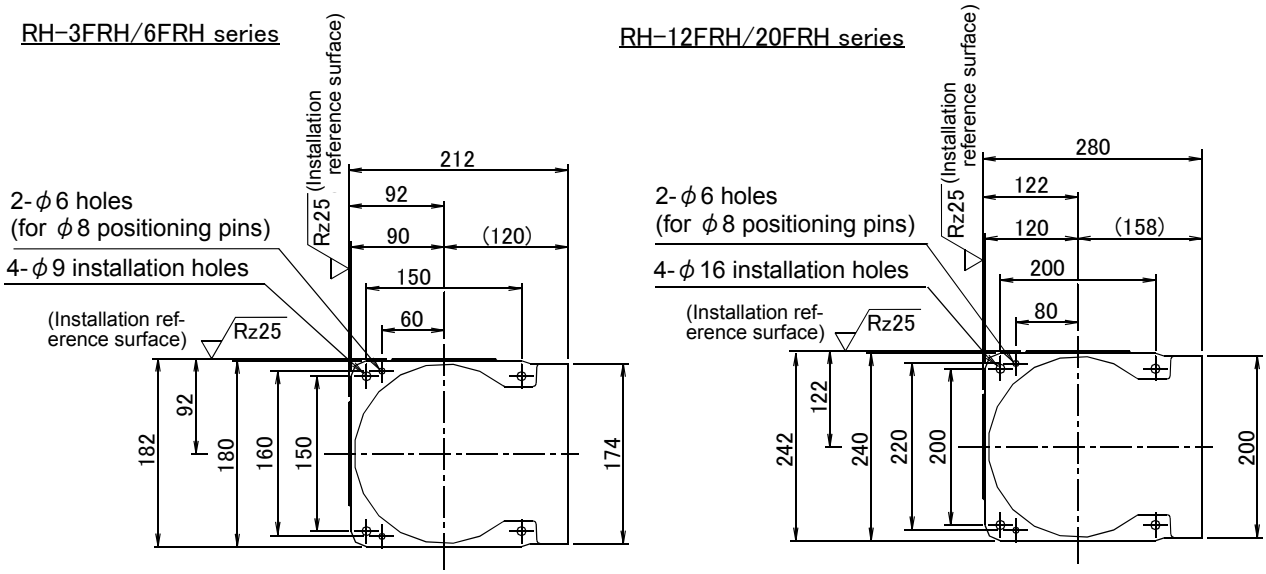


Fig.2-6 : Installation dimensions (RH-3FRH/6FRH/12FRH/20FRH series)

1) The robot installation surface has been machine finished. Use the installation holes (RH-3FRH/6FRH: 4-φ9 holes, RH-12FRH/20FRH: 4-φ16 holes) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (hexagon socket bolts).
2) Install the robot on a level surface.
3) It is recommended that the surface roughness of the table onto which the robot is to be installed by 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) After installing the robot, remove the self-supporting plate, hanging jig, and fixing plate.
7) If you operate the robot at a high speed, reaction forces are applied to the installation stand by the robot's operation. Make sure that the installation stand on which the robot is placed has sufficient strength and

rigidity. Table 2-5 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 2-5 : Magnitude of each reaction force

Item	Unit	Value
RH-3FRH series		
Tilt moment : M_L	N・m	240
Torsional moment : M_T	N・m	255
Horizontal direction translation force : F_H	N	810
Vertical direction translation force : F_V	N	380
RH-6FRH series		
Tilt moment : M_L	N・m	1,640
Torsional moment : M_T	N・m	710
Horizontal direction translation force : F_H	N	1,653
Vertical direction translation force : F_V	N	2,318
RH-12FRH/20FRH series		
Tilt moment : M_L	N・m	3,190
Torsional moment : M_T	N・m	1,840
Horizontal direction translation force : F_H	N	2,240
Vertical direction translation force : F_V	N	2,500

⚠CAUTION When installing the robot, secure enough space for connection of the machine cable and replacement of the backup battery in front of or behind the robot base. And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

(2) RH-3FRHR series

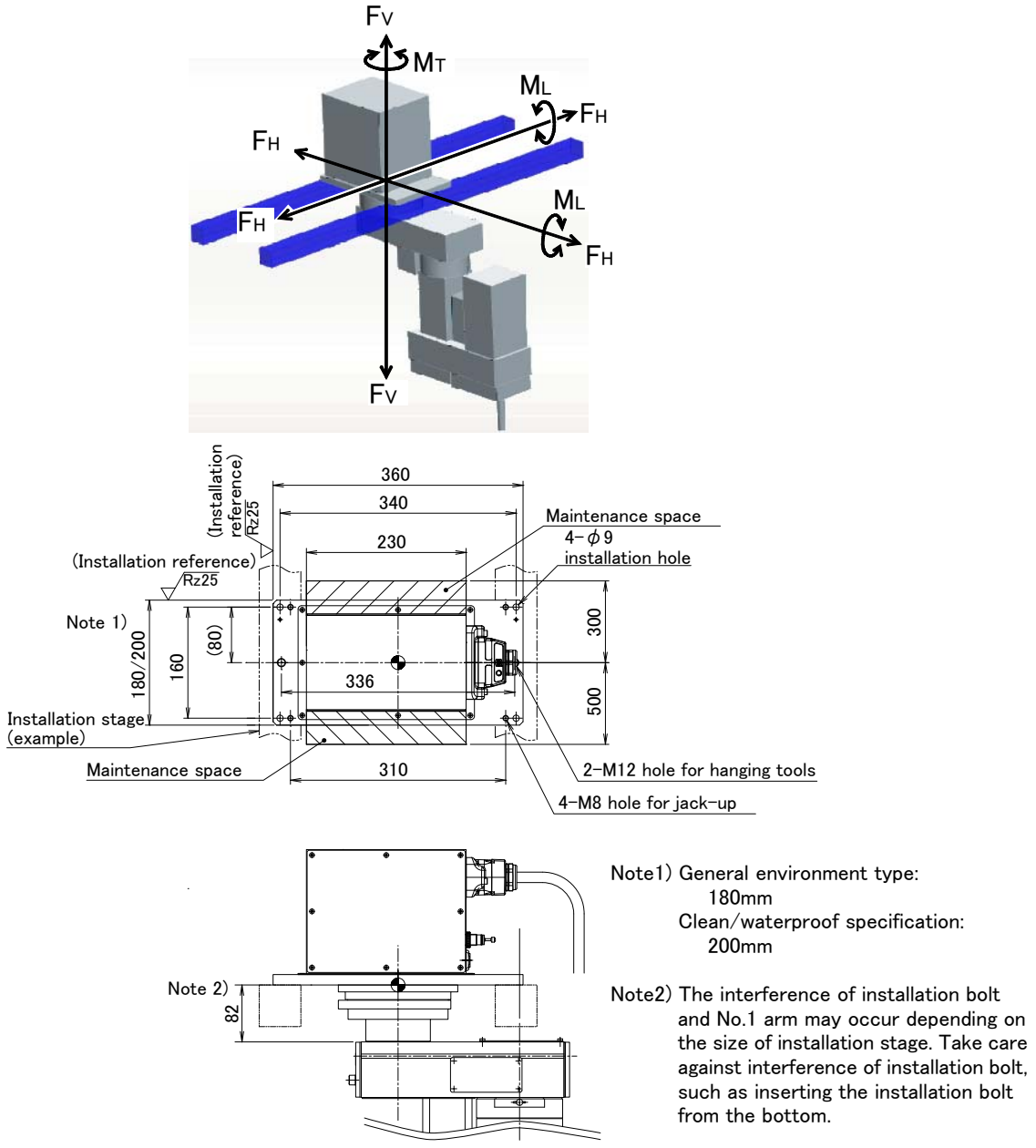


Fig.2-7 : Installation dimensions (RH-3FRHR series)

1) The robot installation surface has been machine finished. Use the installation holes (4-φ9) 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) 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 2-5 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.

7) If you use a clean specification or a waterproof specification robot, always install T-slot cover (attachment) after installing the robot.

Table 2-6 : Magnitude of each reaction force

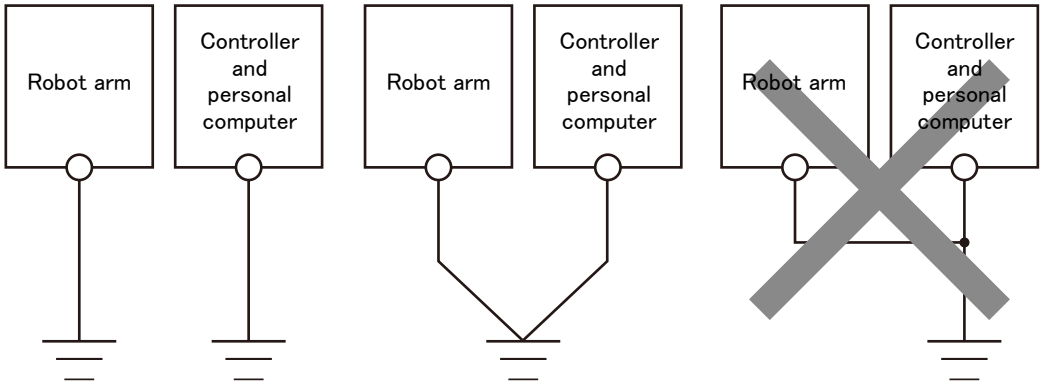
Item	Unit	Value
Tilt moment : M_L	N・m	380
Torsional moment : M_T	N・m	410
Horizontal direction translation force : F_H	N	920
Vertical direction translation force : F_V	N	570

⚠CAUTION Secure the maintenance space necessary at rear for connection of the machine cable and at side for replacement of the backup battery. And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

2.2.4 Grounding procedures

(1) Grounding methods

1) There are three grounding methods as shown in Fig. 2-8, but the dedicated grounding (Fig. 2-8 (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.



(a) Dedicated grounding [Optimum]　(b) Shared grounding [Good]　(c) Common grounding [Not allowed]

Fig.2-8 : Grounding methods

(2) Grounding procedures

1) Prepare the grounding cable (AWG#11(4.2mm^2) or more) and robot side installation screw and washer.
2) If there is rust or paint on the grounding screw section (A), remove it with a file, etc.
3) Connect the grounding cable to the grounding screw section.

<RH-3FRH/6FRH/12FRH/20FRH series>　　<RH-3FRHR series>

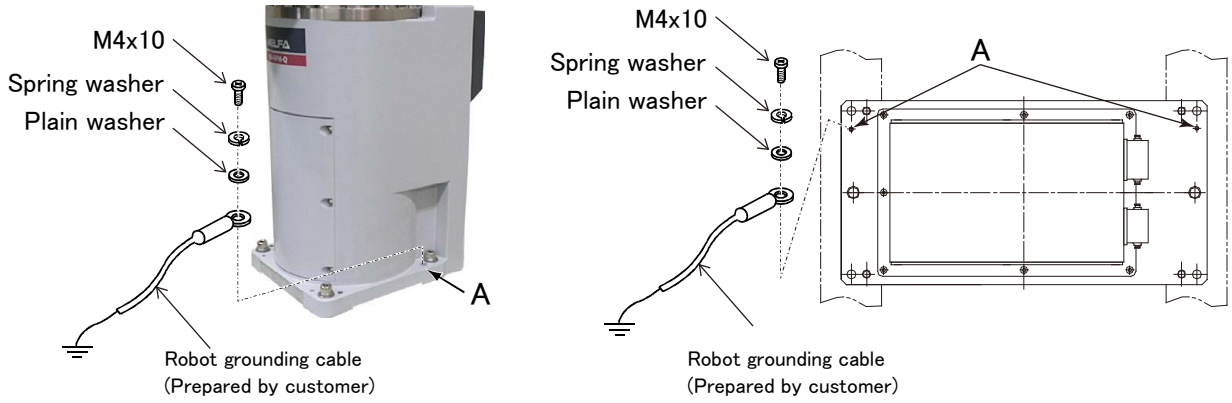


Fig.2-9 : Connecting the grounding cable

2.2.5 Connecting with the controller

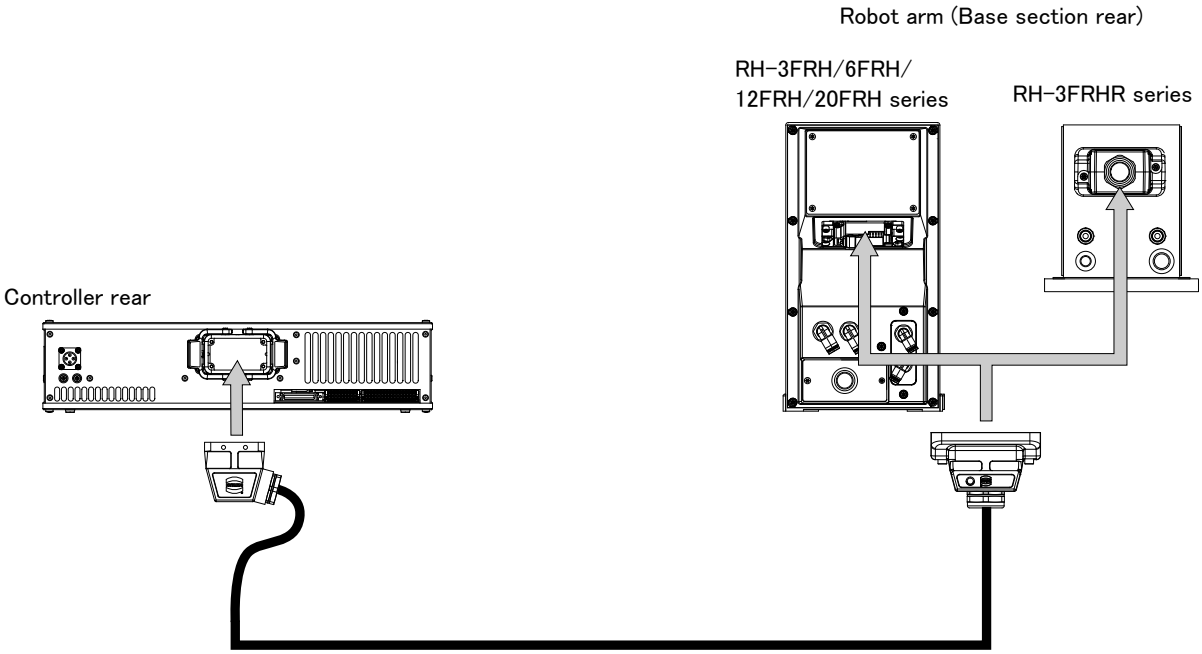
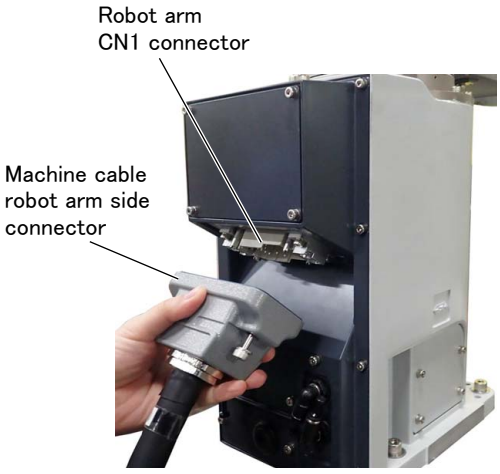


Fig.2-10 : Connecting the machine cables

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

(1) Connection of robot arm and machine cable



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

2) Connect the machine cable to CN1 connector on the robot arm.
Note) RH-6FRH series is shown. The same connection method is also applicable to other models with the same-shaped connector.
Insert the connector until the connector edge is aligned with the CONBOX surface and tighten two bolts.
(Screw fixing torque: 3.6 to 4.4 Nm)

⚠CAUTION Be careful not to get your hand pinched.

Connecting the machine cable is completed.

⚠ CAUTION When installing or removing the connector, to the connector of the other party in parallel, install or remove.
If load strong against one side is applied, the connector pin may be damaged and it may not be connected securely.

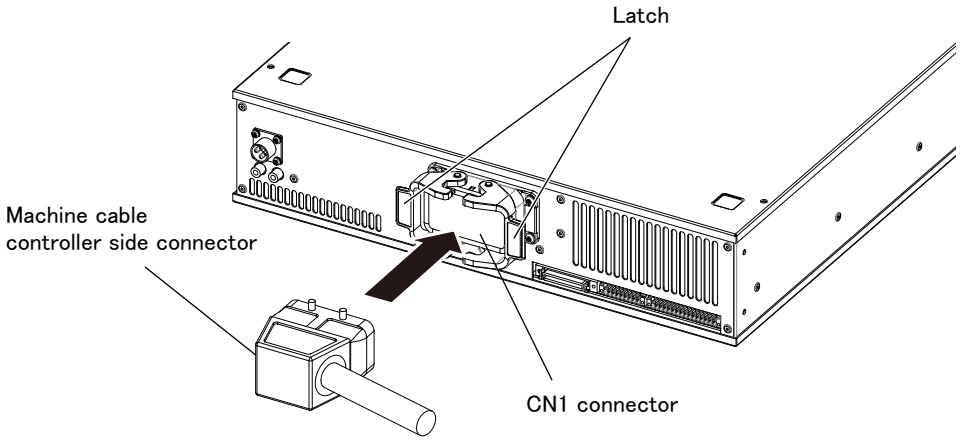
⚠ CAUTION The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠ 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.
Before disconnecting the machine cable, wipe off dust and oil mist around the connector.

⚠ CAUTION Please be careful not to catch the hand at installation and removal.
To disconnect the machine cable, hold the connector part and pull out the cable. Pulling the cable part may cause the cable to come off or break.

(2) Connection of controller and machine cable



1) Make sure that the power of the controller is turned OFF.
2) Connect the controller side connector of the machine cable to CN1 connector on the rear side of the controller.
3) To fix the inserted connector, close the latches of the CN1 connector.

Connecting the machine cable is completed.

⚠ CAUTION When connecting and disconnecting the connector, be careful not to get your hand pinched.

⚠ CAUTION When installing or removing the connector, to the connector of the other party in parallel, install or remove.
If load strong against one side is applied, the connector pin may be damaged and it may not be connected securely.

⚠ CAUTION To disconnect the cable, open the latches, hold the connector part, and pull out the cable. Pulling the cable part may cause the cable to come off or break.

⚠ 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.

2.2.6 Ethernet Cables (RH-3FRH/6FRH/12FRH/20FRH series)

Ethernet cables (4 pairs, totaling 8 lines, of AWG#26 (0.13mm^2) cabtyre cables) are installed within the robot arm from the base unit up to the No. 2 arm, and can be used.
LAN connectors are mounted to both ends of the cables, and can therefore be used to connect to LAN connection devices. Users may also remove the LAN connectors, replace them with their own connectors, and use them as spare wiring by connecting them to user supplied cables.
Further, when passing through the inside of the shaft and using, please use the optional hand internal wiring and piping set in order to prevent the cable disconnection. (Re-cover the connector of the hand input cable that is attached to this option before using)

(1) No.2 arm

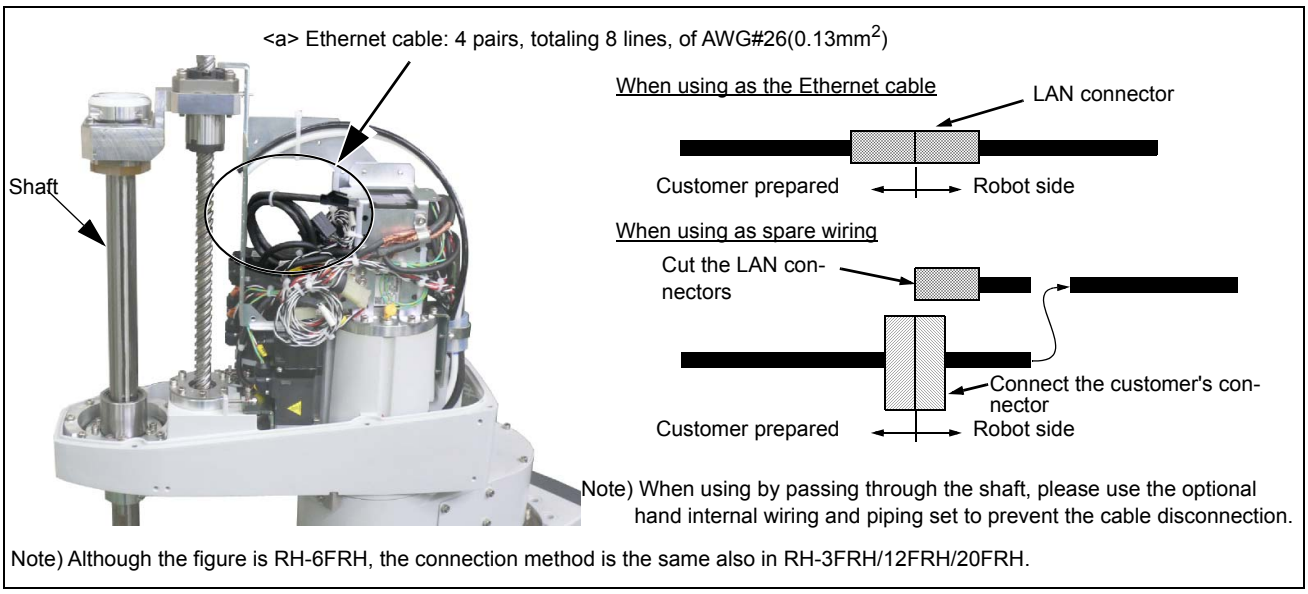


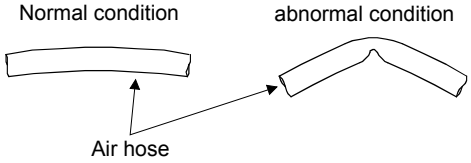
Fig.2-11 : Pulling out the Ethernet cable

How to connect the Ethernet cable is shown below.

1) Remove the screws used to fix the No. 2 arm cover U, and then remove the No. 2 arm cover U.
2) Ethernet cables are located in the positions shown in Fig. 2-11 <a> (coiled and stored).
3) Remove the tying band used to coil the Ethernet cable.
4) Connect the cable on the customer supplied tool.
   (When using as spare wiring please remove the LAN connectors and replace with customer's connector)
5) It is possible to use the optional hand internal wiring and piping set to feed the tool cable through the inside of the shaft.
   Replace the connector of the hand input cable that is attached to the hand wiring and piping set, and then connect. Please reference Page 84, "3.7 Hand internal wiring and piping set (RH-3FRH/6FRH/12FRH/20FRH series)".
6) After the optional hand wiring and piping set has been installed, install the No. 2 arm cover U to its original position. When installing the cover please take care not to damage the spongy sealant material.

Connection of the Ethernet cables on the No. 2 arm is completed.

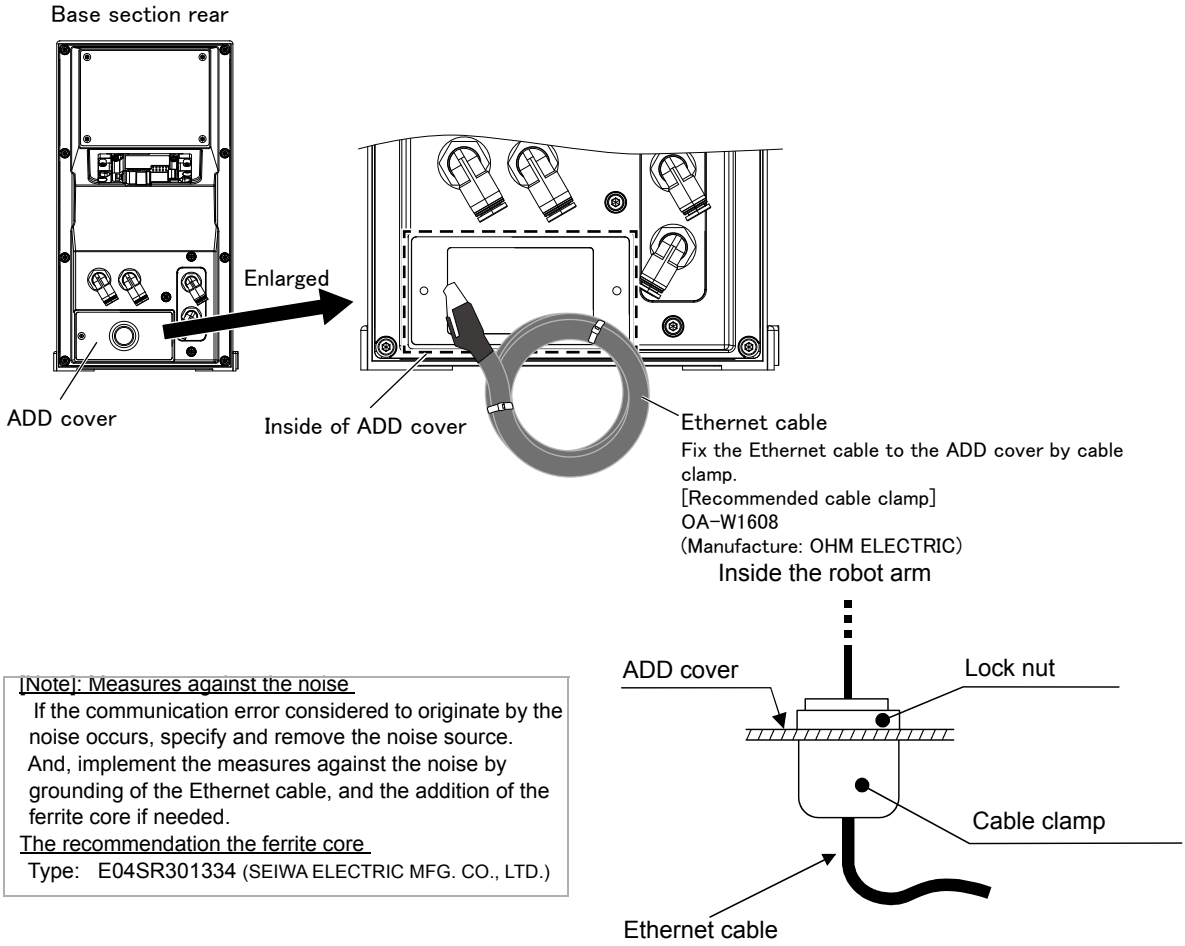
⚠CAUTION When installing the No. 2 arm cover U to its original position please take care not to trap any cables or air hoses. If the cables/hoses are trapped when fixing the cover then cables may be disconnected or hoses punctured, leading to the robot and air driving devices to not operate properly. The sealing property of the packing may also become seriously impaired and there is a risk that the specified level of product protection may not be achievable.



⚠CAUTION When fixing the cable, please keep too much load from being applied to the cables. If too much load is applied, the may break, when the robot moves.

⚠CAUTION When operating the robot, friction may result in dust being generated from the tip of the shaft.
On the clean specification, please be sure to seal the shaft tip with a gasket. If this is not done there is a risk that the level of cleanliness will be reduced.

(2) Base area



[Note]: Measures against the noise
If the communication error considered to originate by the noise occurs, specify and remove the noise source. And, implement the measures against the noise by grounding of the Ethernet cable, and the addition of the ferrite core if needed.
The recommendation the ferrite core
Type: E04SR301334 (SEIWA ELECTRIC MFG. CO., LTD.)

Fig.2-12 : Pull out the Ethernet cable (Base side)

1) Loosen the two screws and remove the ADD cover located at the back of the robot base.
2) Pull out the Ethernet cable that is stored inside the cover (coiled and stored).

3) Remove the cable tie of Ethernet cable.
4) Remove the lock nut attached to the cable clamp (customer prepared) and pass through the Ethernet cable
5) Remove the grommet of ADD cover. After removing the grommet please remove the sealant material that remains in the hole in the plate.
6) Feed the Ethernet cable through the hole that was created by removing the grommet.
7) Feed the end of the Ethernet cable through the cable clamp and securely fasten the ADD cover with the lock nut.
8) Install the ADD cover in its original position. When installing the cover please take care not to damage the spongy sealing material stuck to the hole.

⚠CAUTION Take care against applying big force to the Ethernet cable, other cables, and the air hose.

⚠CAUTION Please confirm not having broken or not having stripped the packing when installing or removing the cover. Contact to the dealer. if packing is broken or has stripped. Failure will be caused if the robot is used under the condition that the packing is broken or stripped, because oil mist etc. will invade in the arm.

⚠CAUTION When ADD cover is installed, please keep too much load from being applied to the cables and the air hoses. If too much load is applied, the cable will be broken and the hose is bent, therefore robot and pneumatic drive equipment cannot operate normally.

⚠CAUTION When ADD cover is installed, catch neither the cable nor the air hose.
If the bolt is tightened while it had been caught, the cable will be broken and the hose is bent, and the robot and pneumatic drive equipment cannot operate normally. Moreover, packing does not stick securely and protection specification cannot be secured.

2.2.7 Ethernet Cables (RH-3FRHR series)

As spare wiring four pairs of cab tire cables (AWG#27(0.1mm^2), Total is eight cores both) are preinstalled between the base section and the No.2 arm rear section. Customer can utilize it. The cable clamp (customer preparation) is necessary to use.

(1) No.2 arm section

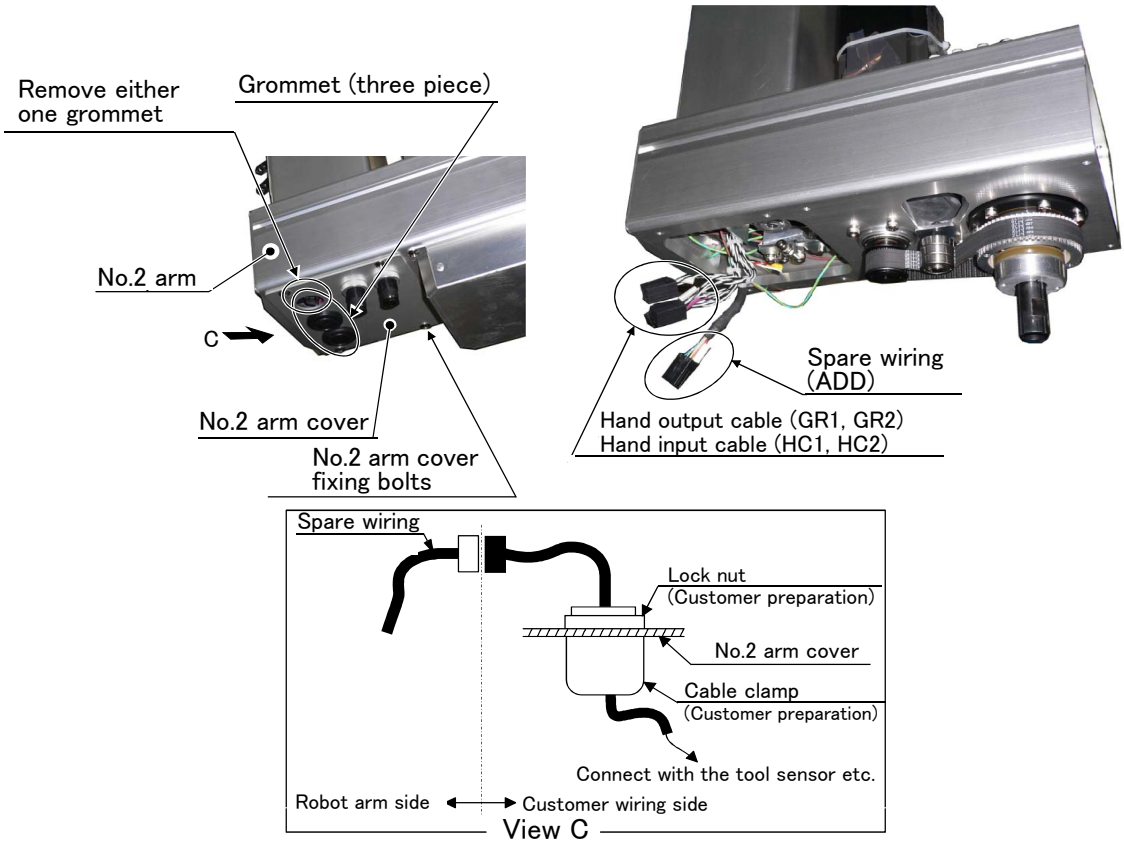


Fig.2-13 : Pull out spare wiring

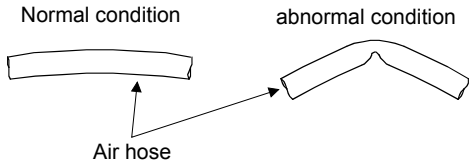
1) The spare wiring (ADD) preinstalled in the robot arm has connector. Please prepare the following of the customer.
   - The cable (calls the "cable for spare wiring connection" below)
   - Connector
   - The cable clamp for fixing the cable for spare wiring connection (OA-W1608 : Product by OHM ELECTRIC CO., LTD)

   (The cable is AWG#27 (0.1mm^2). Refer to the "standard specification document" for detail of the connector.)
2) Remove the low head hexagon socket bolt (four M4 × 8) fixing the No.2 arm cover, and remove the No.2 arm cover.
3) Confirm spare wiring (ADD).
4) Remove either one grommet on the No.2 arm cover.
5) Install the connector after letting the cable for spare wiring connection of customer preparation pass to the cable clamp.
6) Fixing the cable clamp securely to the hole which removed the grommet.
7) Connect the cable for spare wiring connection to the spare wiring.
8) Install the No.2 arm cover as before. Be careful not to catch any the cables.

⚠CAUTION When pulling out spare wiring, keep big power from being added to the cable, the air hose.

⚠CAUTION

When No.2 arm cover is installed, please keep too much load from being applied to the cables inside the robot, and the air hoses.
If too much load is added, the breaking of a wire and the air hose break, and the robot cannot operate normally.



⚠CAUTION

When No.2 arm cover is installed, catch neither the cable nor the air hose.
If the bolt is tightened while it had been caught, the breaking of a wire and the air hose break, and the robot cannot operate normally.

(2) Base area

1) Remove the base cover B (R).

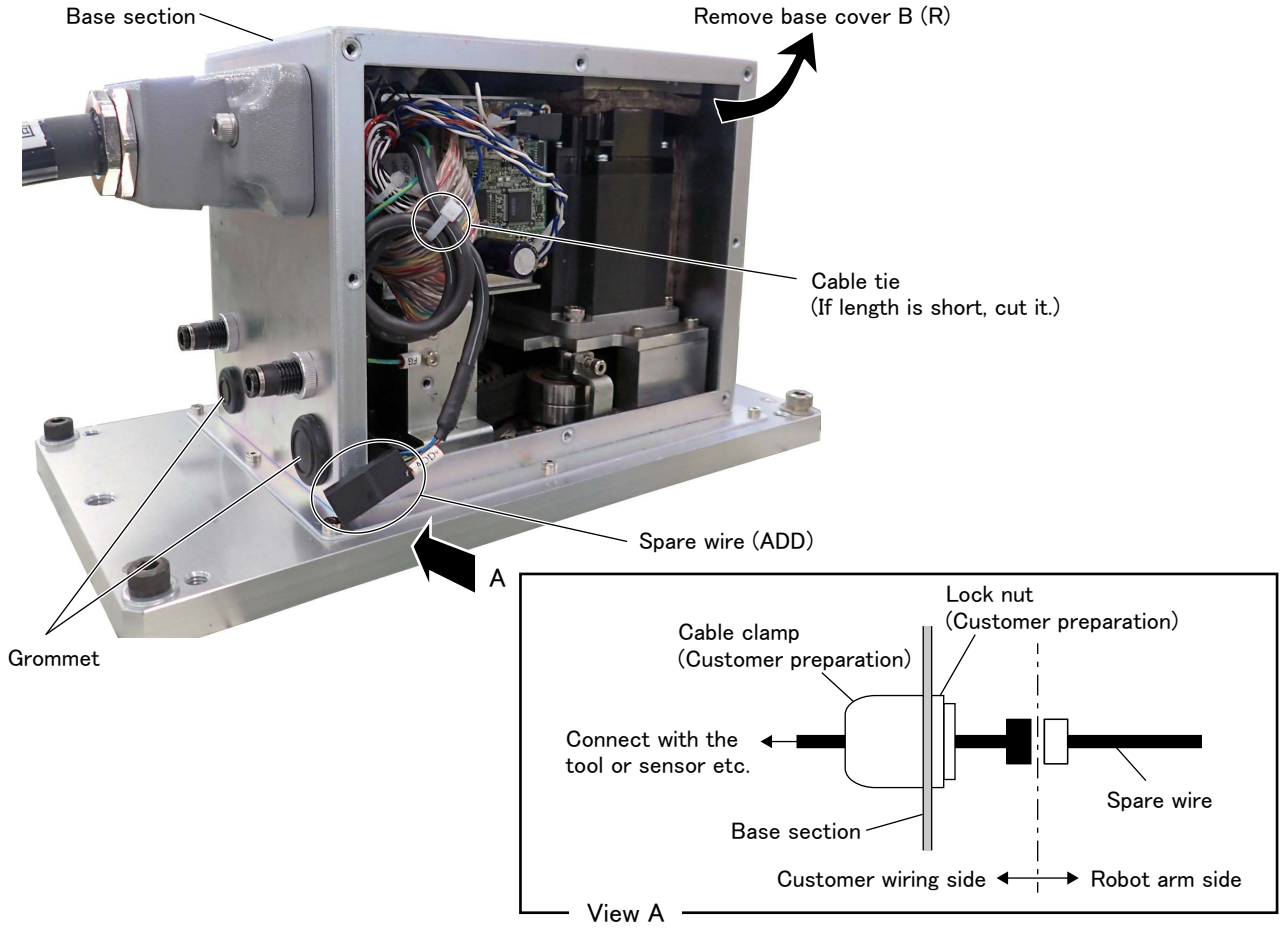


Fig.2-14 : Pull out spare wiring (Base area)

2) The spare wiring (ADD: coiled) preinstalled in the robot arm has connector. The spare wiring (ADD) preinstalled in the robot arm has connector. Please prepare the following of the customer.

- The cable (calls the "cable for spare wiring connection" below)
- Connector
- The cable clamp for fixing the cable for spare wiring connection (OA-W1608 : Product by OHM ELECTRIC CO., LTD)

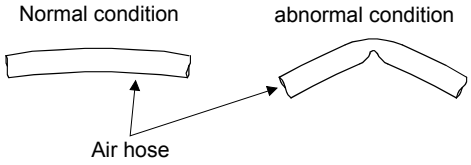
(The cable is AWG#27 (0.1mm^2). Refer to the "standard specification document" for detail of the connector.)

3) Remove the base cover B (L).
4) Confirm spare wiring (ADD). Since spare wiring is bundled in the cable tie, if length is necessary, cut the cable tie.
5) Remove the grommet on the base.
6) Install the connector after letting the cable for spare wiring connection of customer preparation pass to the cable clamp.
7) Fixing the cable clamp securely to the hole which removed the grommet.
8) Connect the cable for spare wiring connection to the spare wiring.
9) Install the base cover B (R) and base cover B (L) as before. Be careful not to catch any the cables.

⚠CAUTION When pulling out spare wiring, keep big power from being added to the cable, the air hose.

⚠CAUTION Check that the packing is not torn or separated while installing or removing the cover. If you find that the packing is torn or separated, contact the dealer. If you keep using the robot with the torn or separated packing, oil mist or the like may get into the robot, resulting in malfunction of the robot.

⚠CAUTION When base cover B (R) is installed, please keep too much load from being applied to the cables inside the robot, and the air hoses.
If too much load is added, the breaking of a wire and the air hose break, and the robot cannot operate normally.



⚠CAUTION When base cover B (R) is installed, catch neither the cable nor the air hose.
If the bolt is tightened while it had been caught, the breaking of a wire and the air hose break, and the robot cannot operate normally. Furthermore, the sealing property of the packing may be significantly impaired, and the protection specifications may not be met.

2.2.8 Passing air hoses and cables through the shaft (RH-3FRH/6FRH/12FRH/20FRH series)

For this robot, customer prepared air hoses and cables can be pulled out from the No. 2 arm by passing through the shaft. For how to pass air hoses and cables through the shaft, refer to the following.

(1) Specifications of internal air hoses and cables

Use the air hoses and the cables, which have flexibility, capability of being repeatedly bent and twisted, and high wear resistance, for the internal use.

Select the air hose and the cable according to the specifications shown in Table 2-7.

Table 2-7 : Specifications of internal air hoses and cables

Model	Shaft inside diameter	Space factor (recommended)	Highest speed of J3 axis	Minimum R of bending	Operating angle of J4 axis
RH-3FRH	φ11mm	50% or less	1,100mm/sec	20mm	±360deg
RH-6FRH	φ18mm	50% or less	2,400mm/sec	25mm	±360deg
RH-12FRH	φ18mm	50% or less	2,800mm/sec	25mm	±360deg
RH-20FRH	φ21mm	50% or less	2,400mm/sec	25mm	±360deg

(2) Customer prepared products

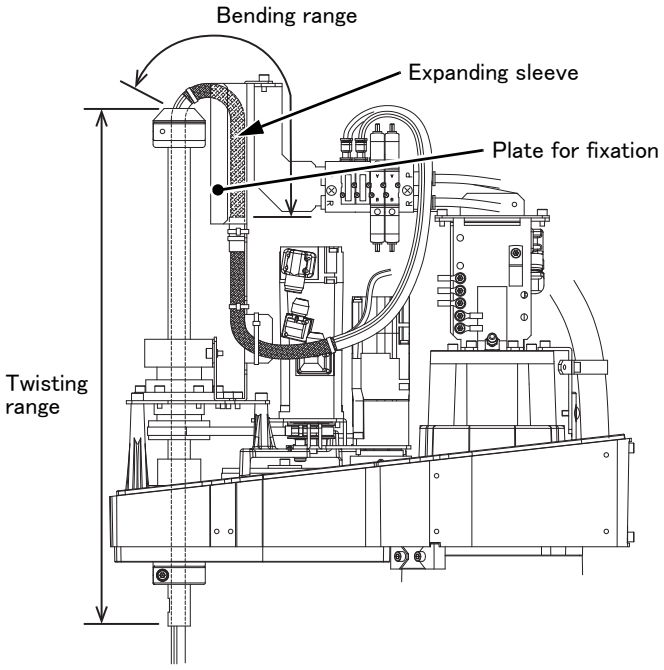
Table 2-8 shows the necessary products for passing air hoses and cables through the shaft. The user needs to prepare the products.

Table 2-8 : Customer prepared products

Name	Qty.	Usage and recommended product
Expanding sleeve	Moderate quantity	Protecting the air hoses and cables, and improving the twisting rigidity Recommended expanding sleeve: EXP-13-PT (manufactured by Kitagawa Industries Co., Ltd.)
Cushion rubber	Moderate quantity	Protecting the bent portion and the fixed portion of the twisted end. Recommended cushion rubber: silicon rubber, thickness of 1mm, dimensions of 30mm × 80mm
Cable tie	Moderate quantity	Fixing the air hoses and the cables
Silicon grease	Moderate amount	Reducing friction and wear when the air hoses and the cables slide Recommended silicon grease: G-501 (manufactured by Shin-Etsu Chemical Co., Ltd.)
Liquid gasket	Moderate amount	Sealing the outlet at the tip of the shaft (for the oil-mist and clean specification models only) Recommended liquid gasket: 1212 (manufactured by Three Bond Co., Ltd.)

【Precautions for implementation of moving part】

1) The internal air hoses and cables are bent and twisted according to the operations of the J3 and J4 axes. Structurally, the twisting occurs inside the shaft, and the bending occurs inside the expanding sleeve. Without the expanding sleeve, the twisted air hoses and cables may run onto the guide portion of the fixing plate, and the air hoses may be bent or broken.
2) Do not place the connector connecting part and the air hose relay part in the binding or twisting range.



(3) Installation procedure

The installation procedure is shown below.
Refer to the installation diagram shown from the next section, and perform the installation correctly.

1) Move the J3 axis to the top end with a jog operation and shut off the controller's power supply. This is necessary for space standard settings when feeding the air hose and hand input cable through the inside of the shaft.
2) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
3) Pass the tool (hand) side of the internal air hoses and cables through the shaft. Make sure that the air hoses and the cables are not twisted or crossed.
4) Fix the air hoses and the cables with a cable tie so as to position the end of the expanding sleeve 10mm away from the opening of the shaft.
5) The highest point of the curved section of the air hoses and cables should be matched up with the top of the fixing plate.

⚠CAUTION If the air hoses and the cables are not long enough or too long, when the robot operates, excessive bending and friction with the shaft upper end or the cover may result in a break or abnormal operations of the tool (hand).

6) In the state of the steps 4) and 5), fix the air hoses and the cables to the (a) and (b) portions of the plate with cable ties. For the (a) portion, wrap the air hoses and the cables with cushion rubber before fixing.
7) When using the hand input signal or the optional solenoid valve, refer to Page 84, "3.7 Hand internal wiring and piping set (RH-3FRH/6FRH/12FRH/20FRH series)".
8) The connected connectors are stored to the (c) portion.

⚠CAUTION Do not remove the cable ties which fixing connectors.
Fix the plate on the No. 2 arm, other cables and air hoses with cable ties. In this way, the internal cables and connectors do not touch the plate edge and others, or break due to the vibration during the robot operation (Refer to Page 91, "3.9 Connector protection when the option devices are installed").

9) Carry out piping and wiring on the tool side.
Fix the air hoses and the cables, which are pulled out from the shaft lower end, to the hand side. Check again that the highest point of the curved section of the air hoses and the cables reaches the height of the fixing plate upper end, and then fix the air hoses and the cables at the outlet of the shaft.
In the case of oil-mist and clean specification models, to avoid mists entering and ensure the cleanliness level, use liquid gasket and others to seal the outlet on the shaft tip where the air hoses and the cables are pulled out.
10) Apply silicon grease to the contact surface between the air hoses of the fixing plate and the cables, the cable sliding portion from the shaft upper end to the fixed portion, and the opening on the shaft upper end.
11) Power on the controller, perform the jog operation for the J3 and J4 axes, and check that the air hoses and the cables do not interfere with other components.

⚠CAUTION Do not power on the controller when the internal cables are connected to the connectors on the robot.
If the end of the cables on the tool side is not processed, troubles such as fuse blown by ground fault or short circuit may occur. Check that the end of the cables has been processed before powering on the controller.

12) Turn off the controller's power supply, then install the No.2 arm cover U securely as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
When installing the cover, check that no air hose or cable is pinched, and no air hose is bent.
Note) The installation surface of a clean and a oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please contact dealer when the sealing material needs to be replaced.

Installing cables and air hoses inside the robot's shaft is completed.

(4) RH-3FRH series

Refer to Page 30, "(3) Installation procedure" and install cables and air hoses correctly. The numbers in Fig. 2-15 are correspond to the same numbers in "(3)Installation procedure".

Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

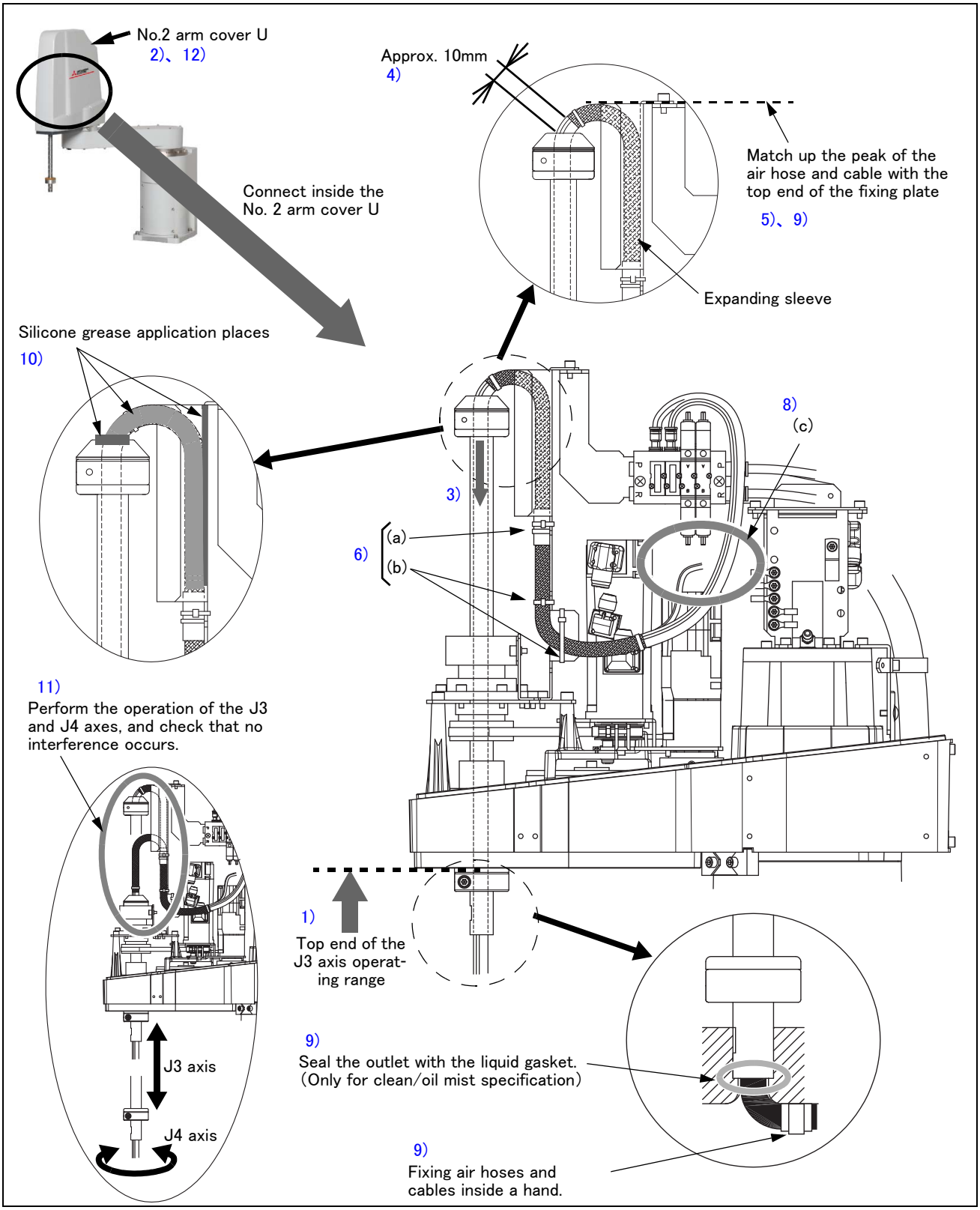


Fig.2-15 : Installation of air hoses and cables inside the robot's shaft (RH-3FRH series)

(5) RH-6FRH series

Refer to Page 30, "(3) Installation procedure" and install cables and air hoses correctly. The numbers in Fig. 2-16 are correspond to the same numbers in "(3)Installation procedure".

Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

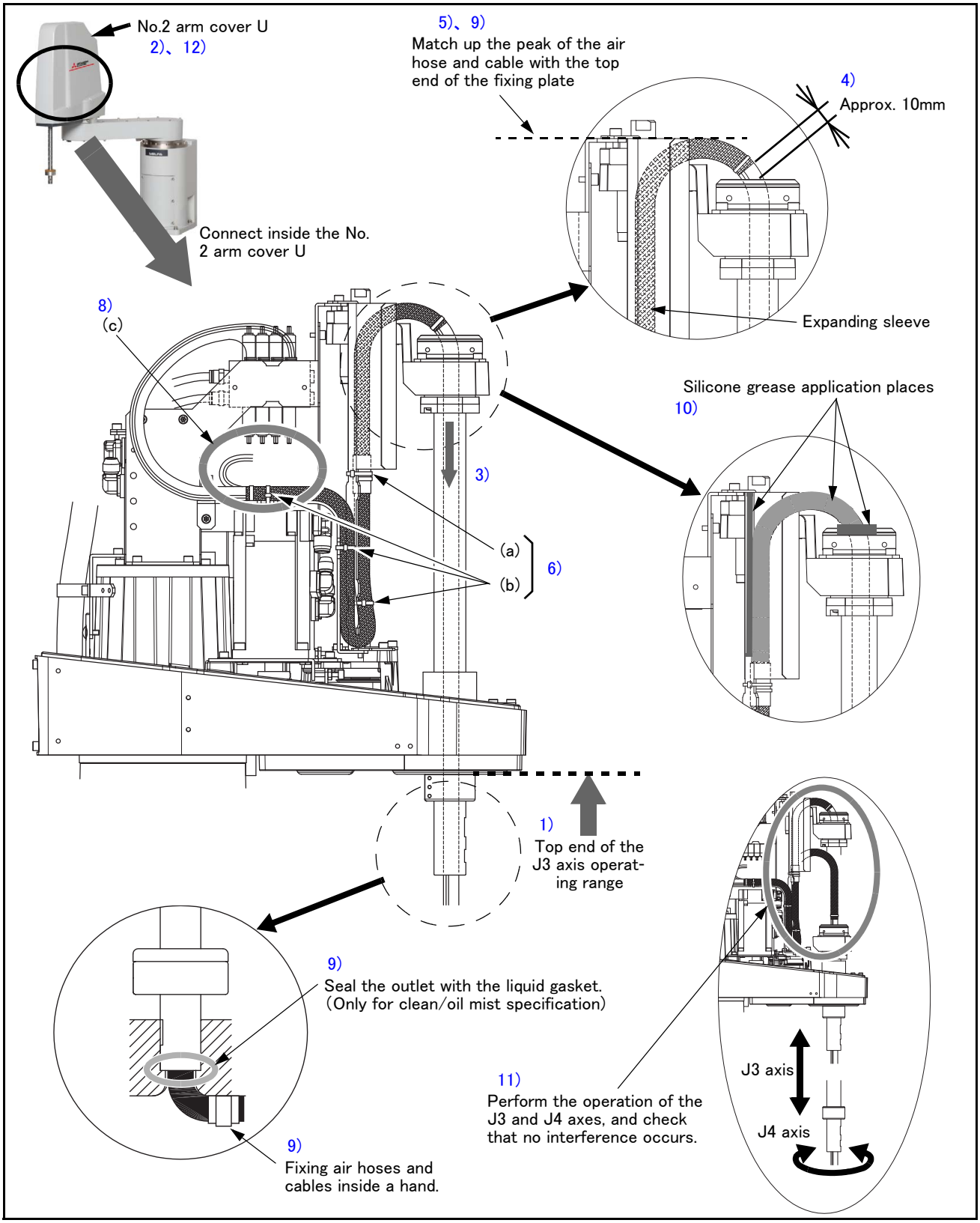


Fig.2-16 : Installation of air hoses and cables inside the robot's shaft (RH-6FRH series)

(6) RH-12FRH/20FRH series

Refer to Page 30, "(3) Installation procedure" and install cables and air hoses correctly. The numbers in Fig. 2-17 are correspond to the same numbers in "(3)Installation procedure".

Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

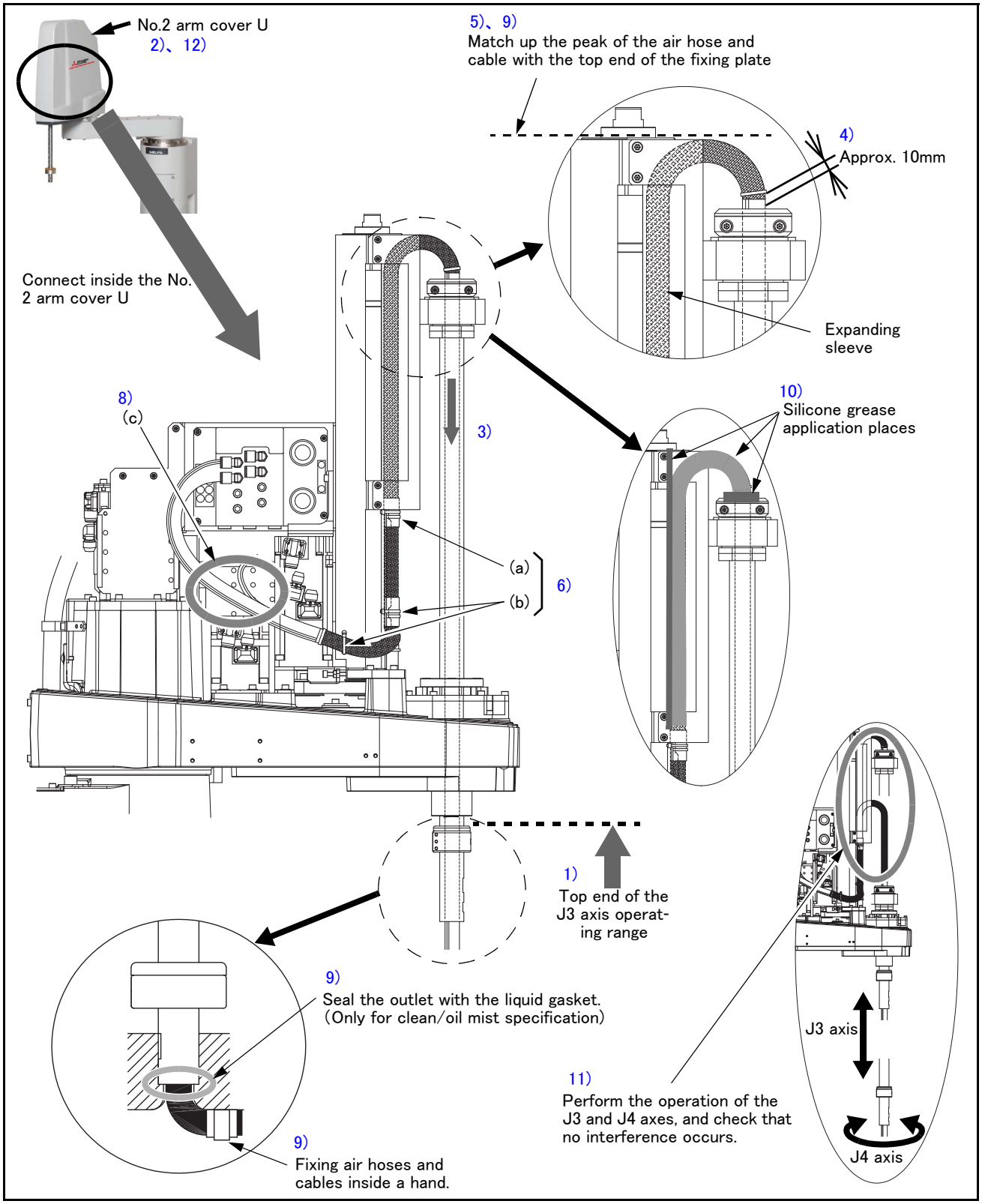


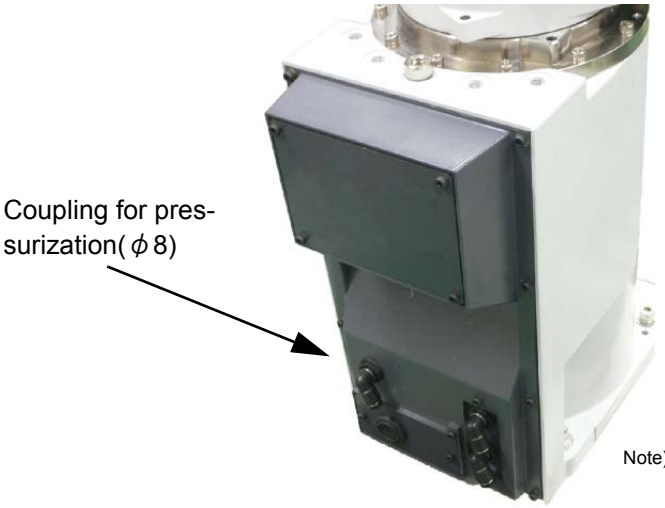
Fig.2-17 : Installation of air hoses and cables inside the robot's shaft (RH-12FRH/20FRH series)

2.2.9 About oil mist specification

(1) Piping for pressurization inside robot arm

In use in oil mist environment, protection performance can be improved by pressurizing the inside of the robot arm. Please connect the φ8 air hose to the joint for pressurization of the robot arm base portion "AIR PURGE", and pressurize the inside of the robot arm.

Refer to the separate "Standard specifications manual" for specification of air purge.



Note) Although the figure is RH-6FRH, the position of the coupling is the same also in RH-3FRH/12FRH/20FRH.

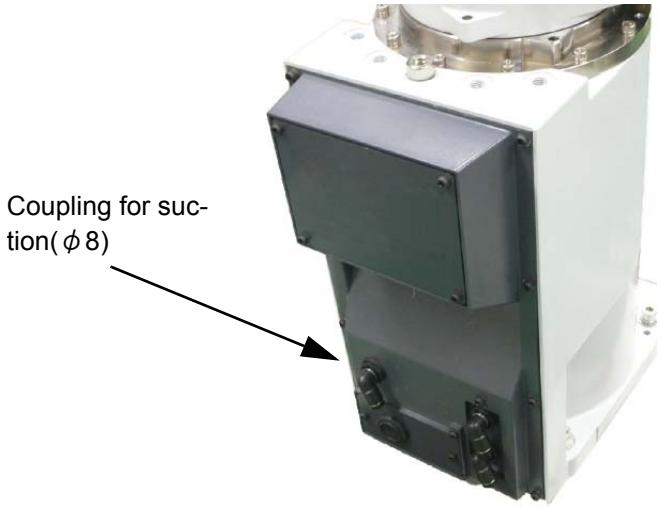
Fig.2-18 : Air purge

2.2.10 About clean specification

(1) Piping for suction inside robot arm

In use of the robot of clean specification, please connect the φ8 air hose to the coupling for suction of the robot body base portion "VACUUM", and suck the inside of the robot arm.

Refer to the separate "Standard specifications manual" for vacuum condition.



Note) Although the figure is RH-6FRH, the position of the coupling is the same also in RH-3FRH series.
RH-12FRH/20FRH series has two couplings.
RH-3FRHR series robot is provided the coupling as in other robots.
Refer to the separate "Standard specifications manual" for details.

Fig.2-19 : Vacuum

(2) Arrangement of the ventilation duct

The ventilation duct is attached to the robot's base section rear (reference Fig. 2-20). As the Z axis moves up and down the volume of the bellows varies, and air is sucked in and released out of the robot's ventilation duct opening. Be sure to locate the ventilation duct's opening in a position that will not affect the robot's cleanliness. Furthermore, whilst it is only a small amount, internal suction results in external air flows into the robot through the ventilation duct's opening, and therefore the following two points should be considered when deciding where to locate the ventilation duct's opening.

- The opening should be facing downwards
- The opening should not be located in the vicinity of dust/dirt or liquids, etc.
  (Recommended cleanliness of surrounding area: less than ISO class 5)

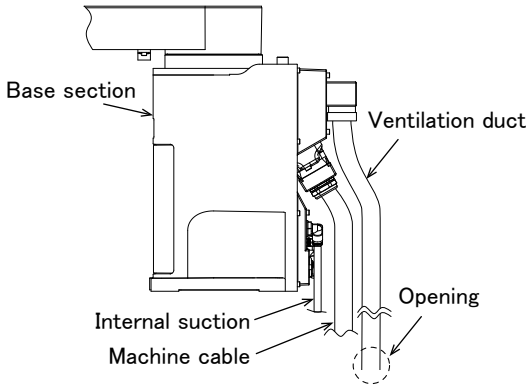


Fig.2-20 : Arrangement of the exhaust duct

Note) When using the optional electromagnetic valve set, we recommend using the primary piping's spare piping (ϕ6 air hose) to release the exhaust fumes.
Please take care as leaking exhaust fumes inside the robot may have an impact on the robot's cleanliness.

2.3 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, the Work jog that moves along the work coordinate system, and the CYLNDER jog that moves along the circular arc.
This operation is carried out while pressing the deadman switch on the back of the T/B.
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 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 142, "5.6 Resetting the origin".

2.3.1 Installing the teaching pendant (T/B)

Installing the T/B, with turning off the controller power.

⚠ 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 so that stress does not start the cable with the connector itself.

Explain the installation method of T/B below.

1) Check that the controller's power supply is OFF.
2) Refer to Fig. 2-21 and connect T/B connector to the robot controller.
   Use as the upper surface the lock lever, and push in until there is sound.
3) Pressing down the lock lever to lock the connector as shown below.

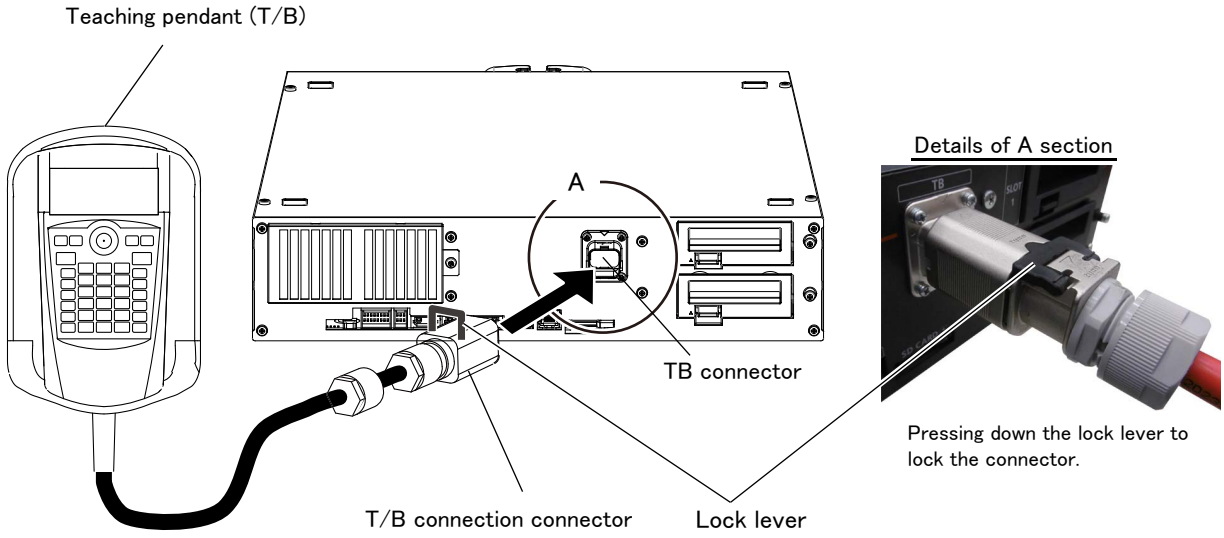


Fig. 2-21 : Installing the T/B

The installation of T/B is finished.

(1) Turning ON the control power

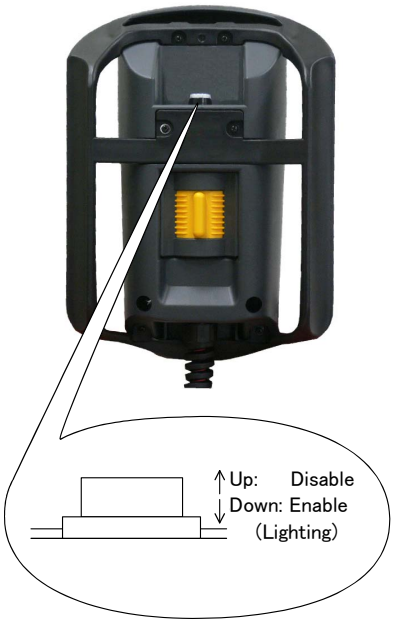
⚠ CAUTION Confirm that there are no operators near the robot before turning the power ON.

1) Turn the controller power switch ON.
   Turns ON the switch of the earth leakage breaker of installation outside.

(2) Preparing the T/B

Next, prepare to use the T/B

1) Set the mode of the controller to "MANUAL".



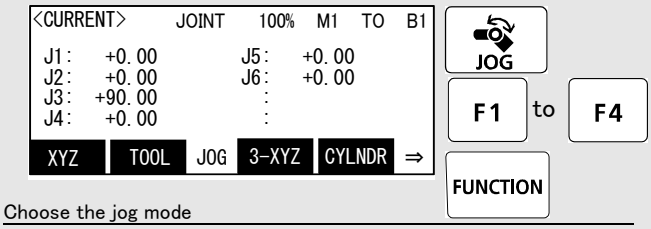
2) Set the T/B [ENABLE] switch to "ENABLE". The menu selection screen will appear.

The following operations are carried out with the T/B.

◇◆◇ Operating from the T/B ◇◆◇

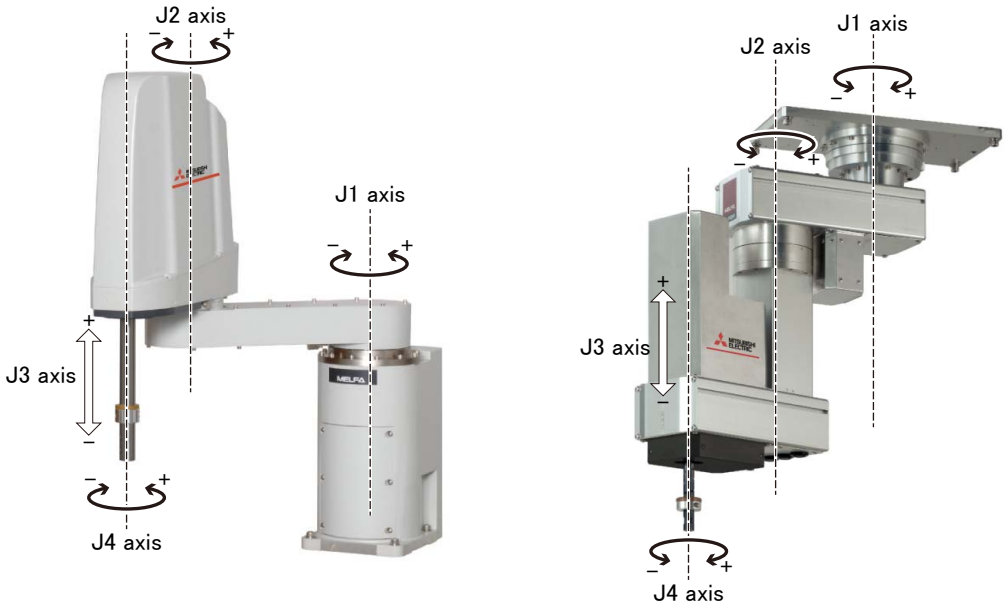
Always set the mode of the controller to "MAMNUAL", and then set the T/B [ENABLE] switch to "ENABLE". When the T/B is valid, only operations from the T/B are possible. Operations from the external signals will not be accepted. The stop-related operations such as an emergency stop can be performed regardless of the valid/ invalid setting.

◇◆◇ How to choose the jog mode ◇◆◇



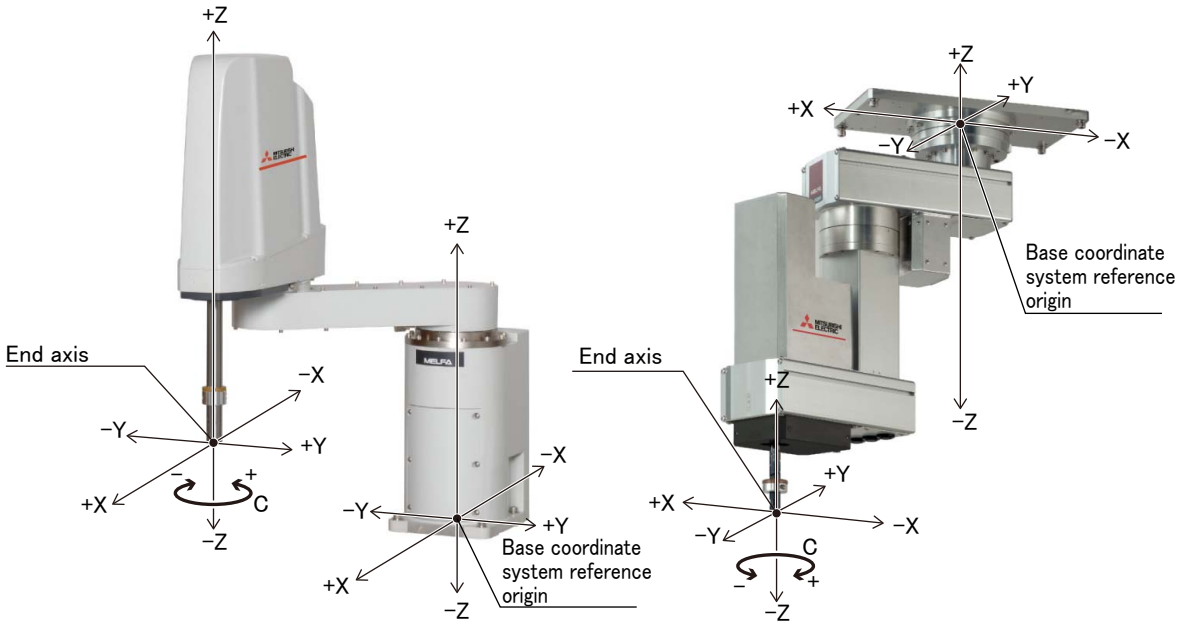
Choose the jog mode

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).



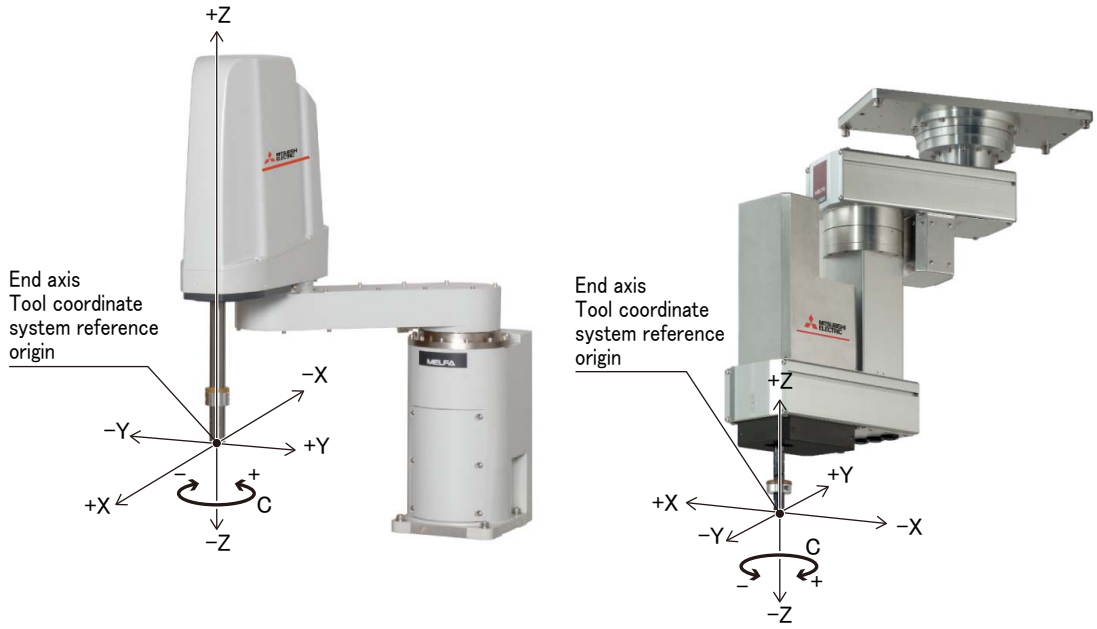
* Each axis moves independently.

Fig.2-22 : JOINT jog operation



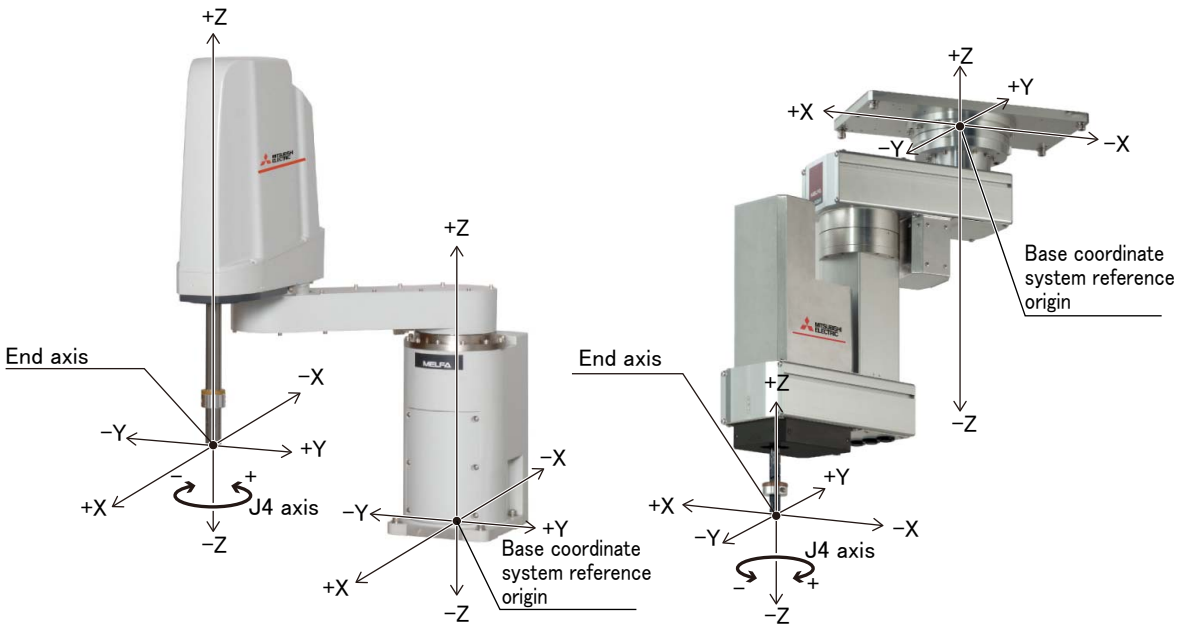
* While maintaining the end axis posture, the axis moves straight along the base coordinate system. Also, while maintaining the end axis position, the end axis posture changes..

Fig.2-23 : XYZ jog operation



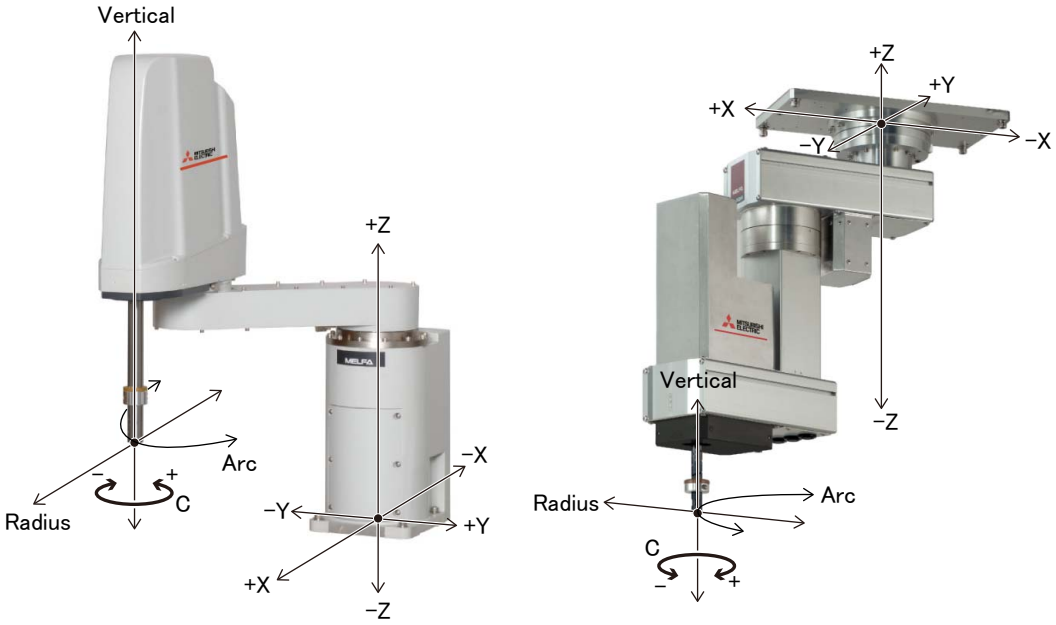
* While maintaining the end axis posture, the axis moves straight along the tool coordinate system. Also, while maintaining the end axis position, the end axis posture changes

Fig.2-24 : TOOL jog operation



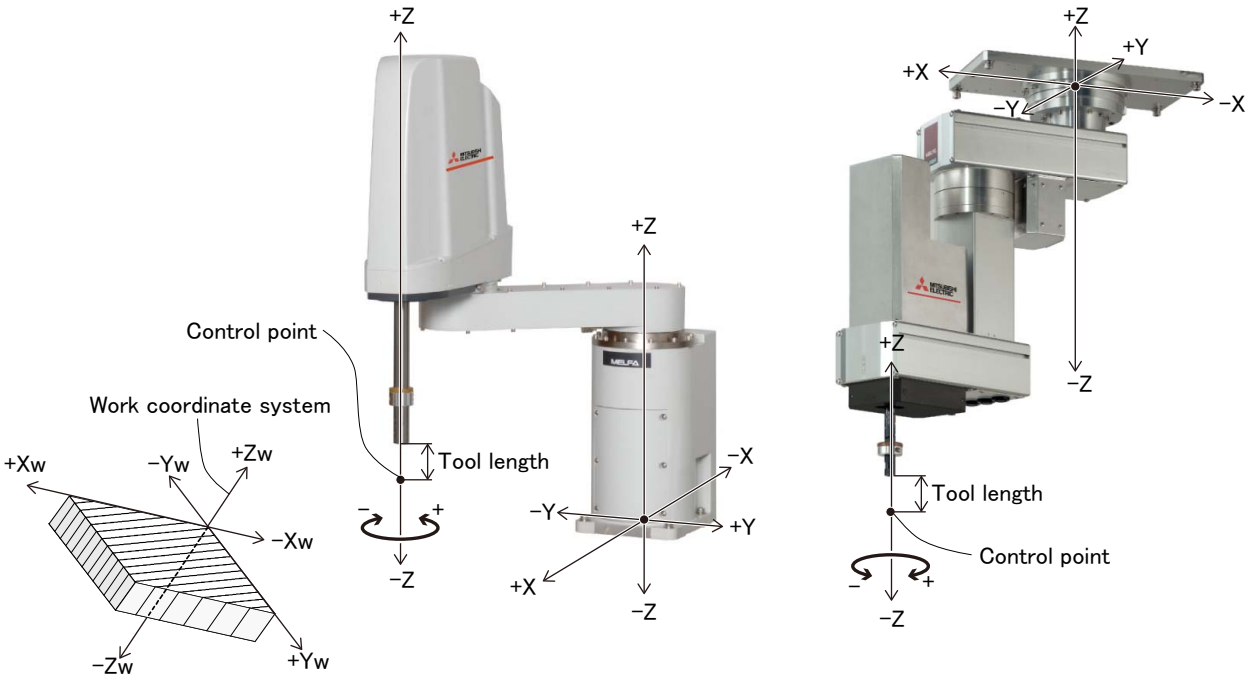
* The axis moves straight along the base coordinate system. At this time, the end axis posture is not maintained. Also, the end axis posture changes.

Fig.2-25 : 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.2-26 : CYLINDER jog operation

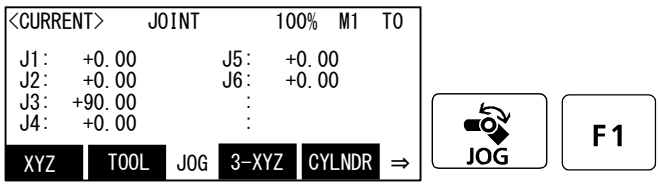


* While maintaining the end axis posture, the axis moves straight along the work coordinate system. Also, while maintaining the end axis position, the end axis posture changes.
* Jog operation around the work coordinates system is available (EX-T jog). In this jog operation, when the jog operation is 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.2-27 : WORK jog operation

(3) JOINT jog operation

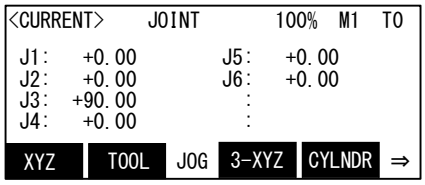
Select joint jog mode



Joint jog mode

[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."

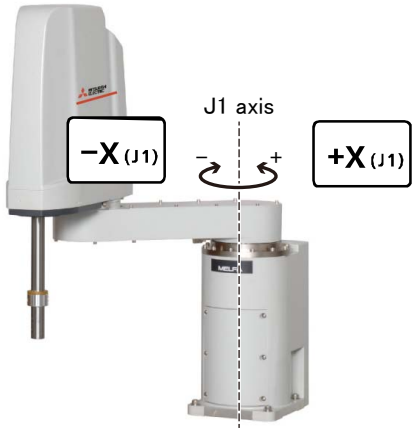
Set jog speed

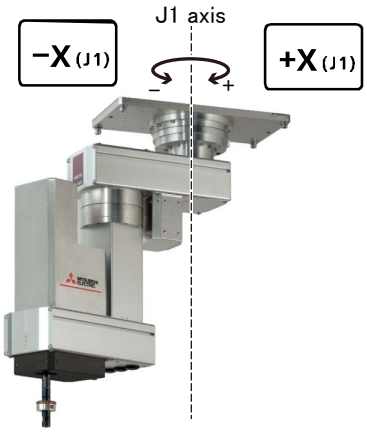


Setting the speed

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. Set the override to 10% here for confirmation work.

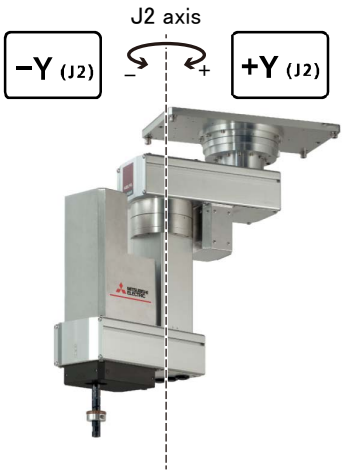
J1 axis jog operation





・ 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.

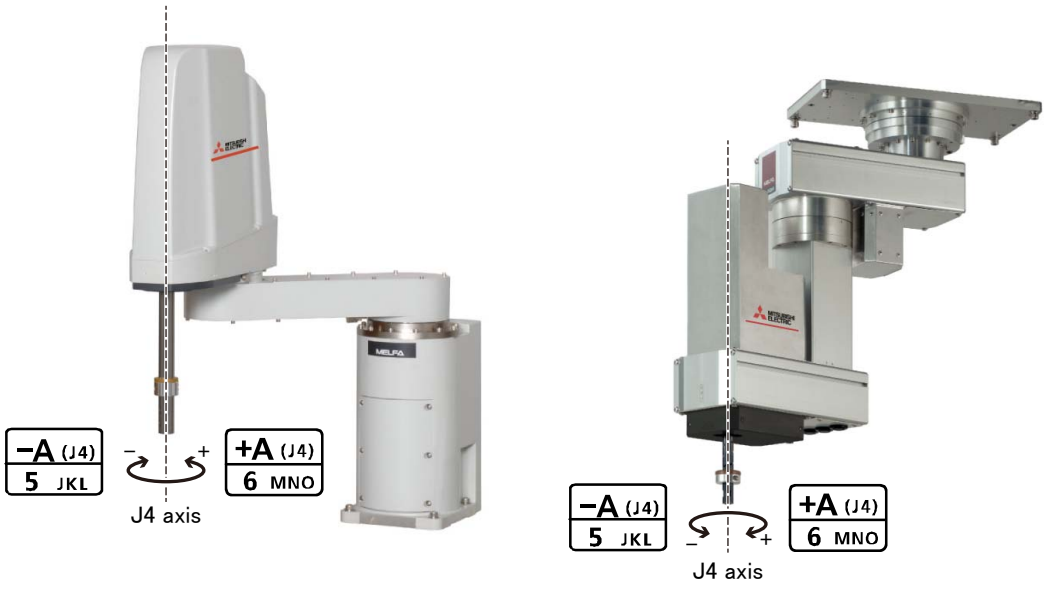
◇◆◇ When the robot is in the transportation posture ◇◆◇

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



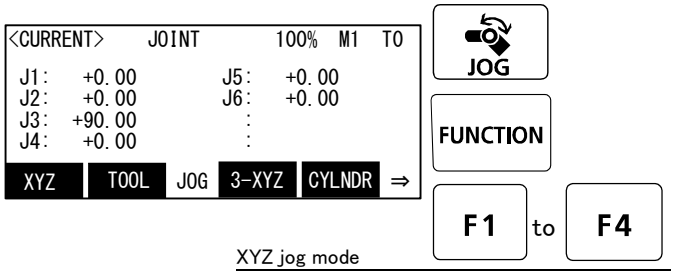
・When the [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
When the [−A (J4)] keys are pressed, rotate in the minus direction.

◇◆◇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.

(4) XYZ jog operation

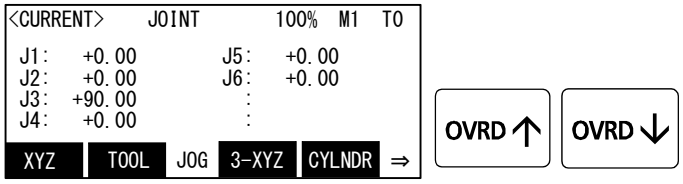
Select XYZ jog mode



XYZ jog mode

[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."

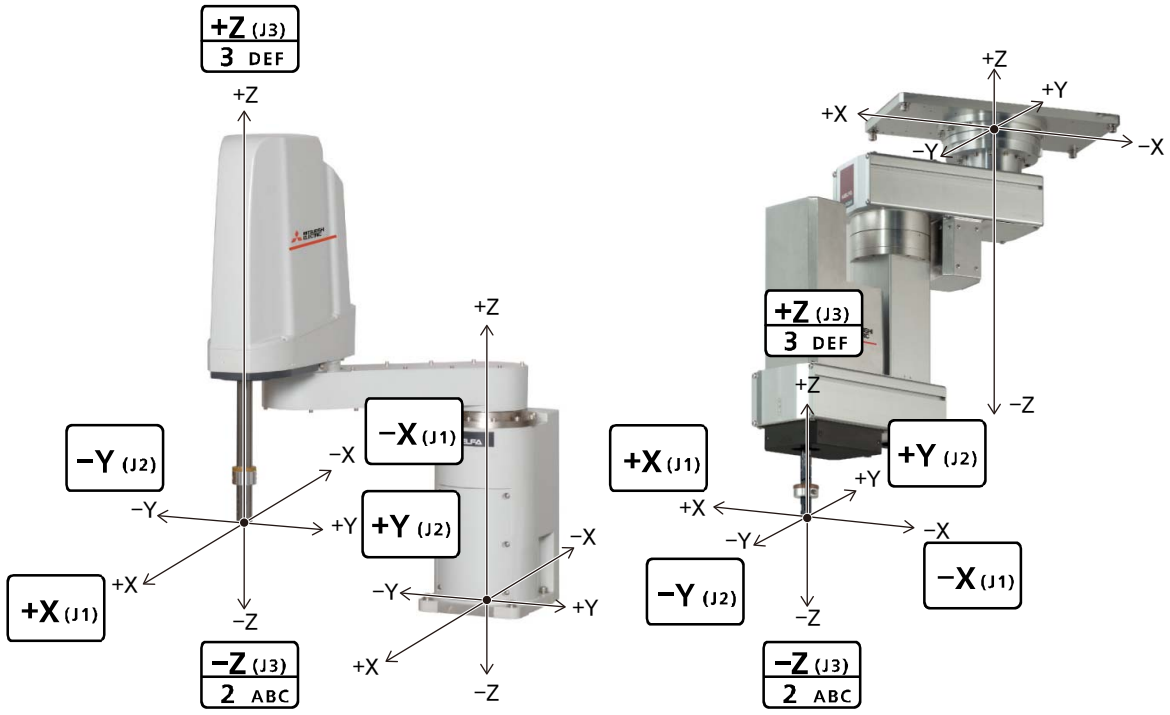
Set jog speed



Setting the speed

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. 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.

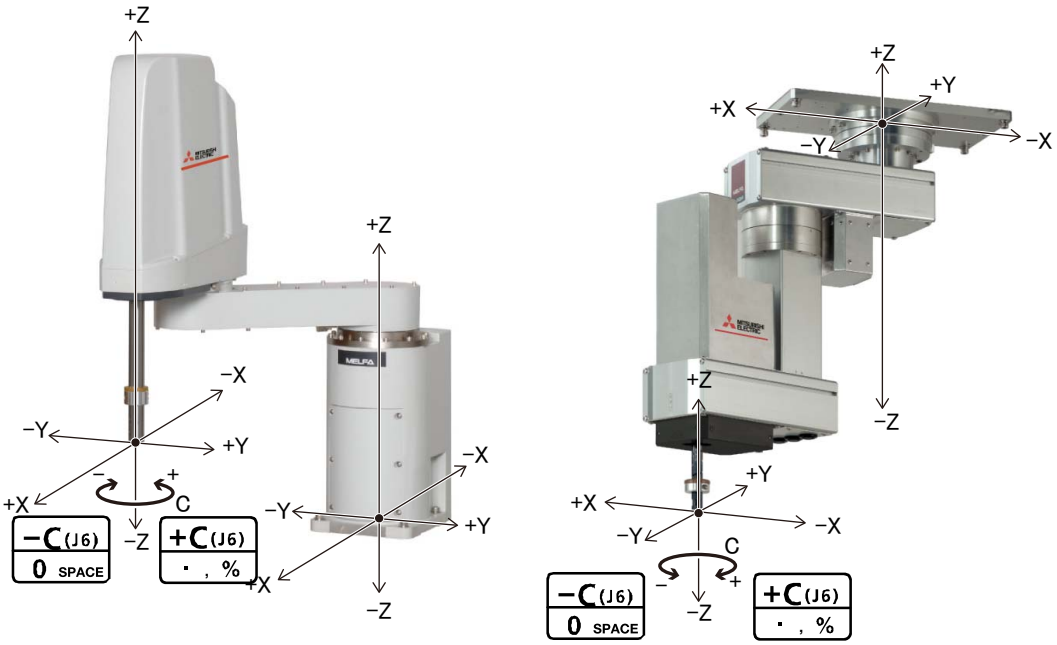
◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 42, "(3) 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 ◇◆◇

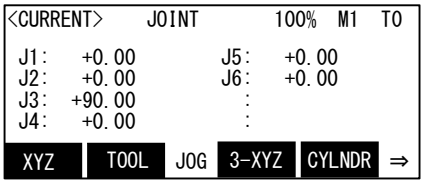
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

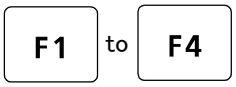
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(5) TOOL jog operation

Select TOOL jog mode

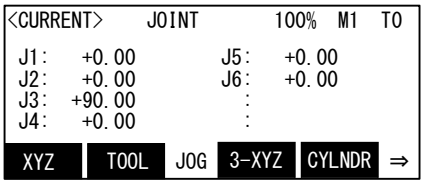


TOOL jog mode

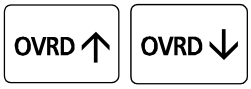


[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "TOOL" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "TOOL." (If the jog mode which he wishes under the screen is not 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."

Set jog speed

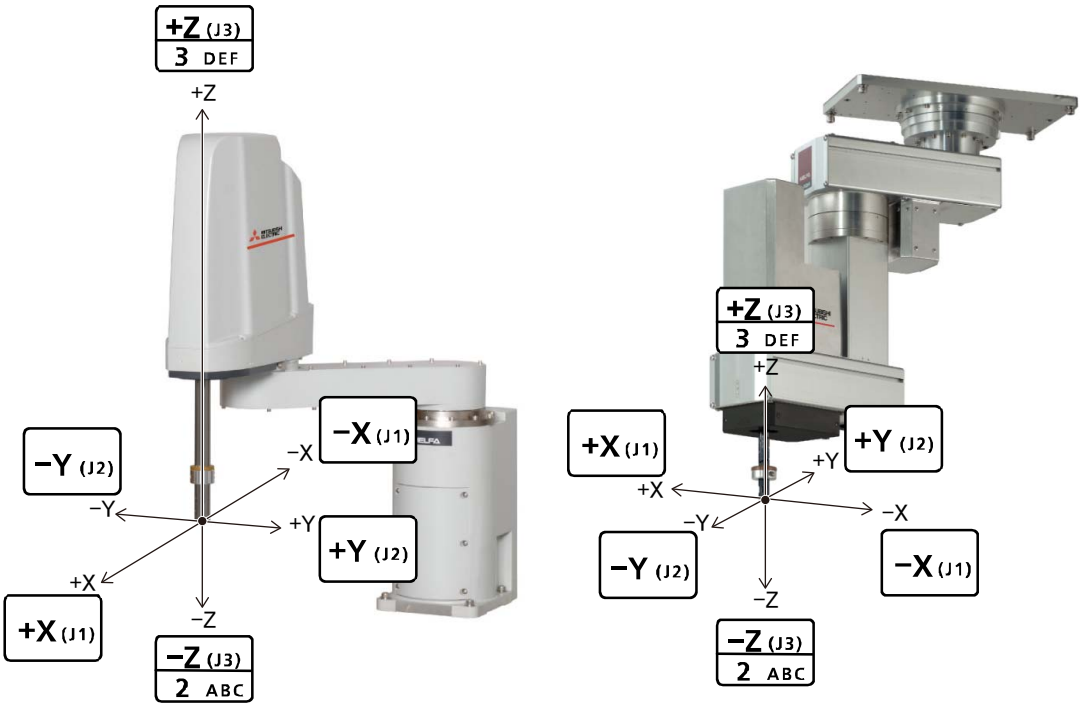


Setting the speed



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. 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.

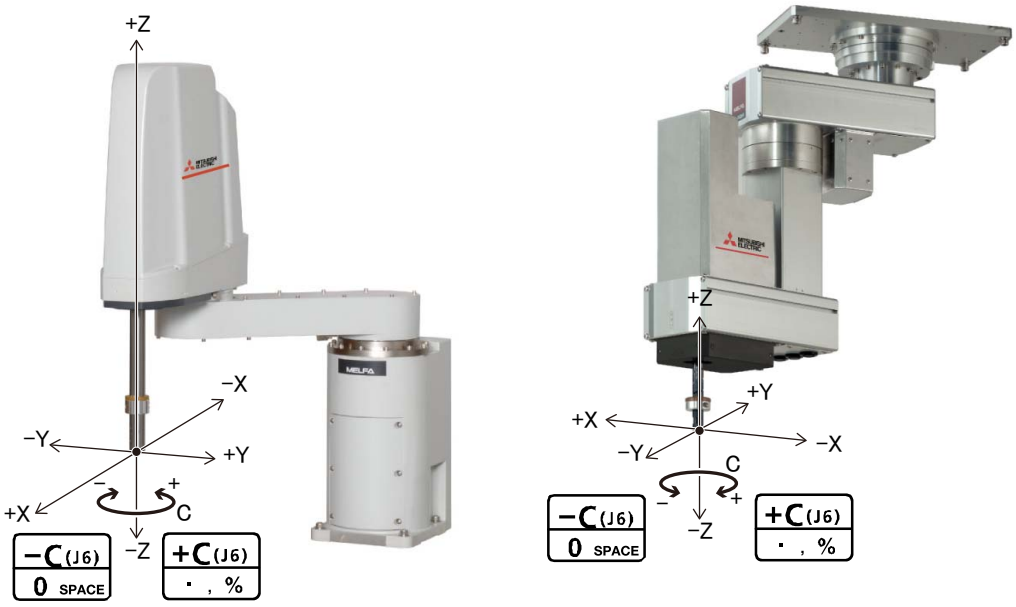
◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 42, "(3) 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 of the tool coordinate system. When the[-C (J6)] keys are pressed, rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

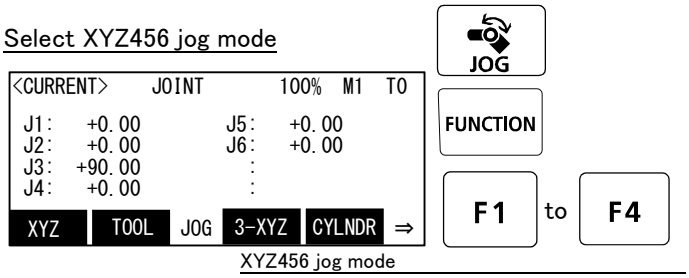
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ 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.

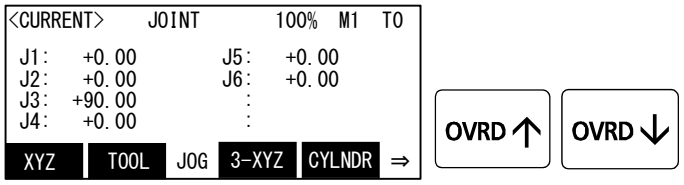
(6) 3-axis XYZ jog operation

Select XYZ456 jog mode



XYZ456 jog mode

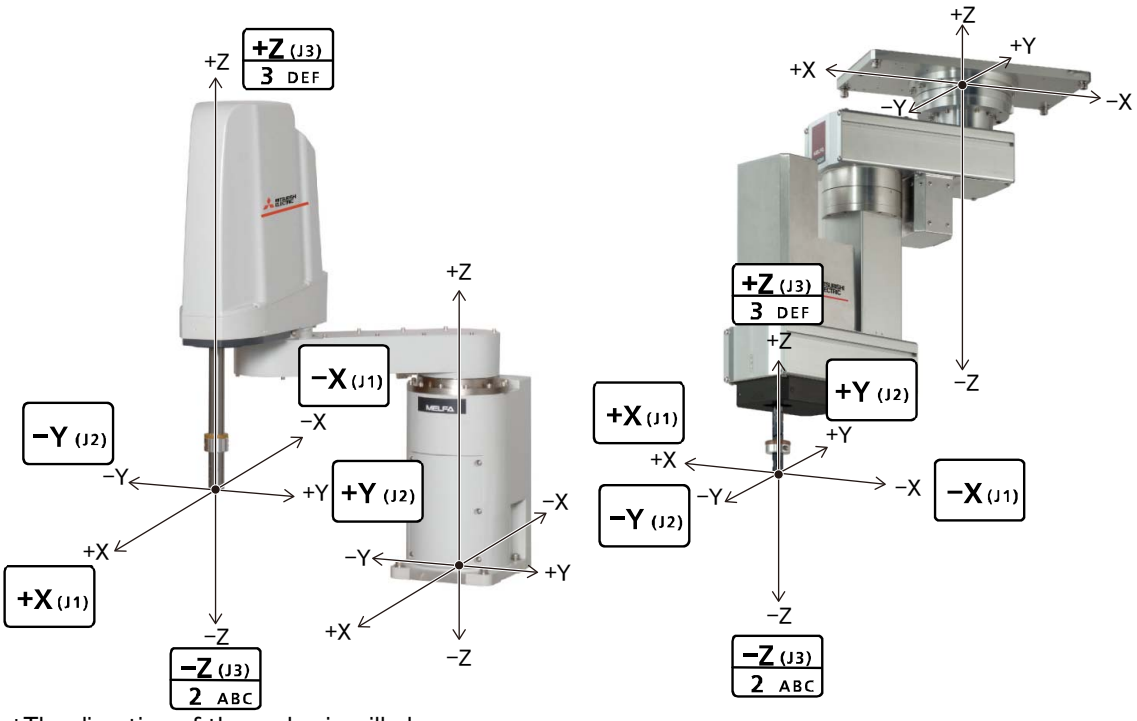
Set jog speed



Setting the speed

[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. Set the override to 10% here for confirmation work.

Moving along the base coordinate system

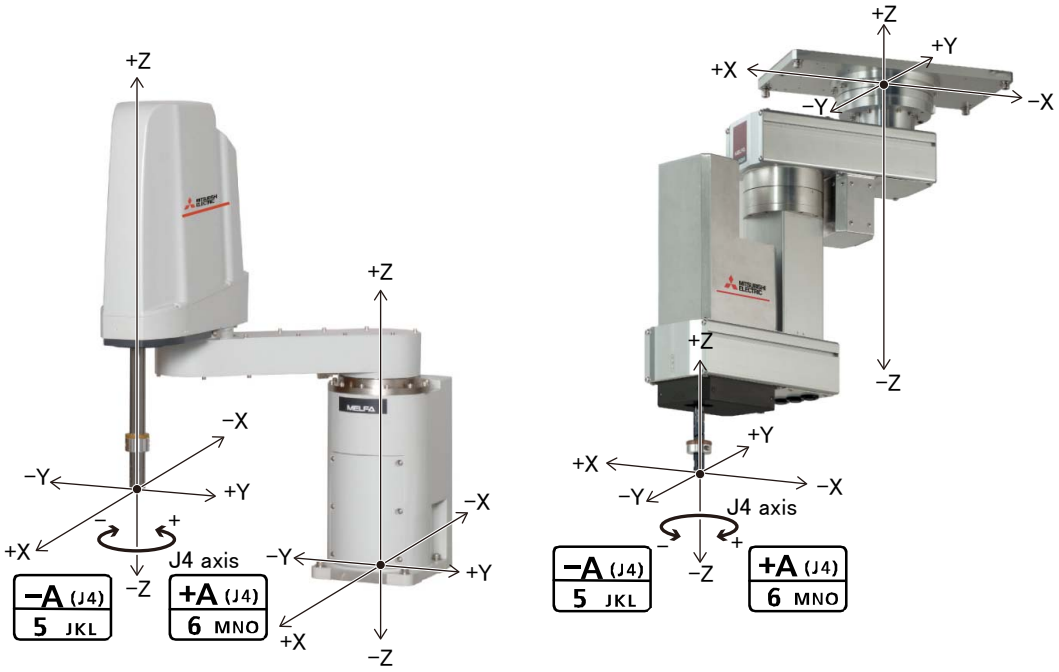


*The direction of the end axis will change.

- 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

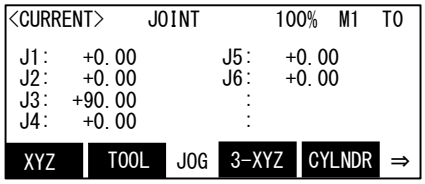


*The Position of the end axis will not change.

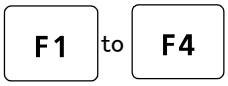
・When the[+C (J6)] keys are pressed, the J4−axis will rotate in the plus direction.
When the[−C (J6)] keys are pressed, rotate in the minus direction.

(7) CYLNDER jog operation

Select cylindrical jog mode

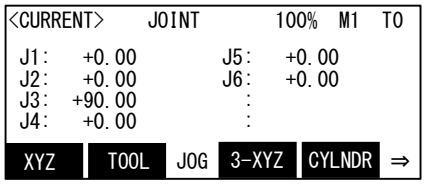


CYLNDER jog mode

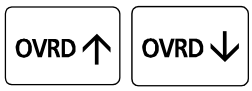


[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "CYLNDER" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "CYLNDER." (If the jog mode which he wishes under the screen 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."

Set jog speed

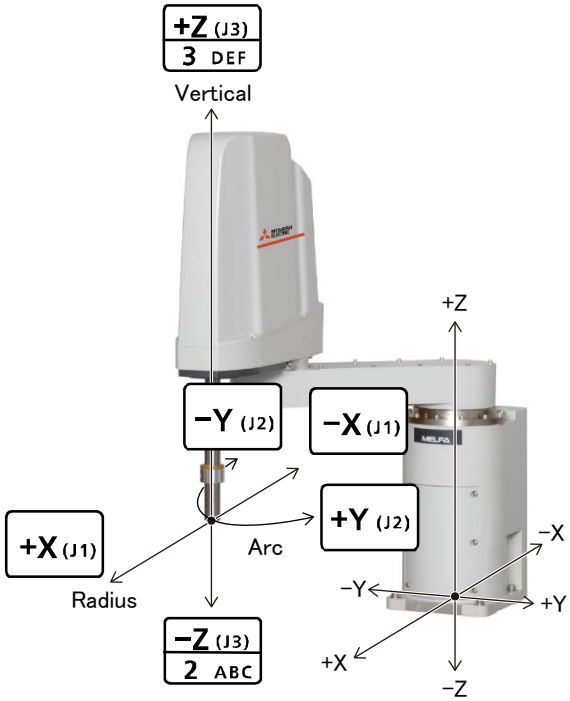


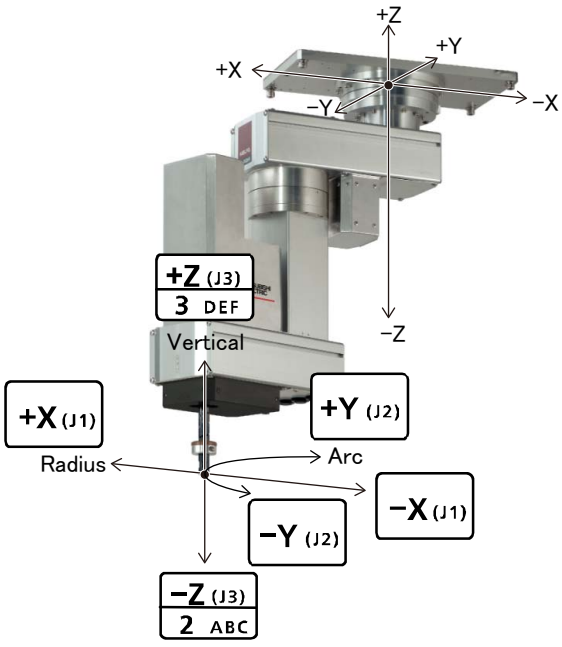
Setting the speed



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. Set the override to 10% here for confirmation work.

Moving along an arc centering on the Z axis

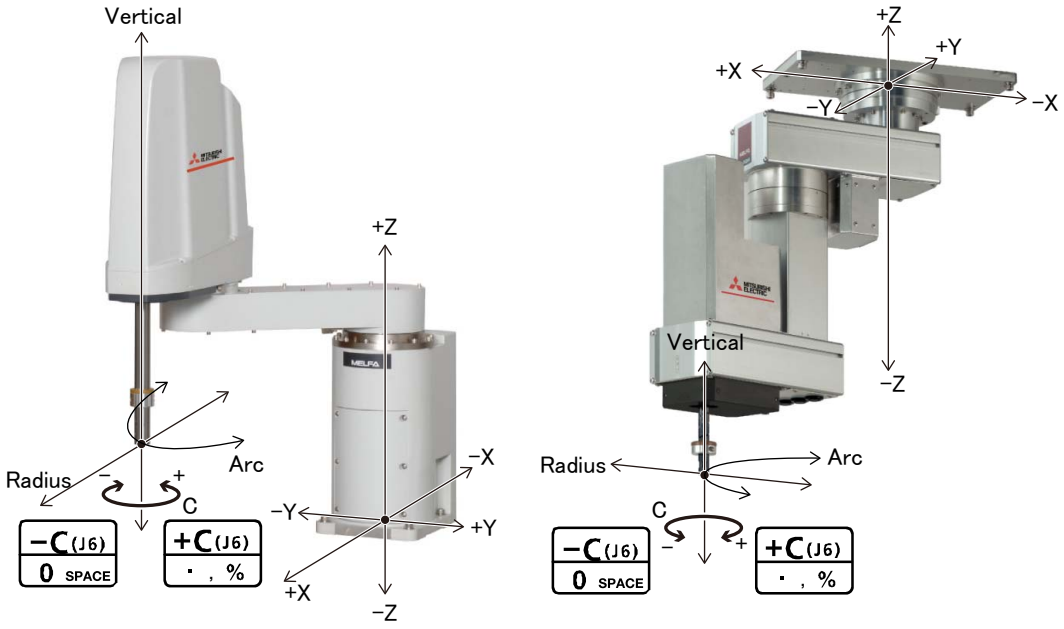




∗ The direction of the frange will not change.

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.



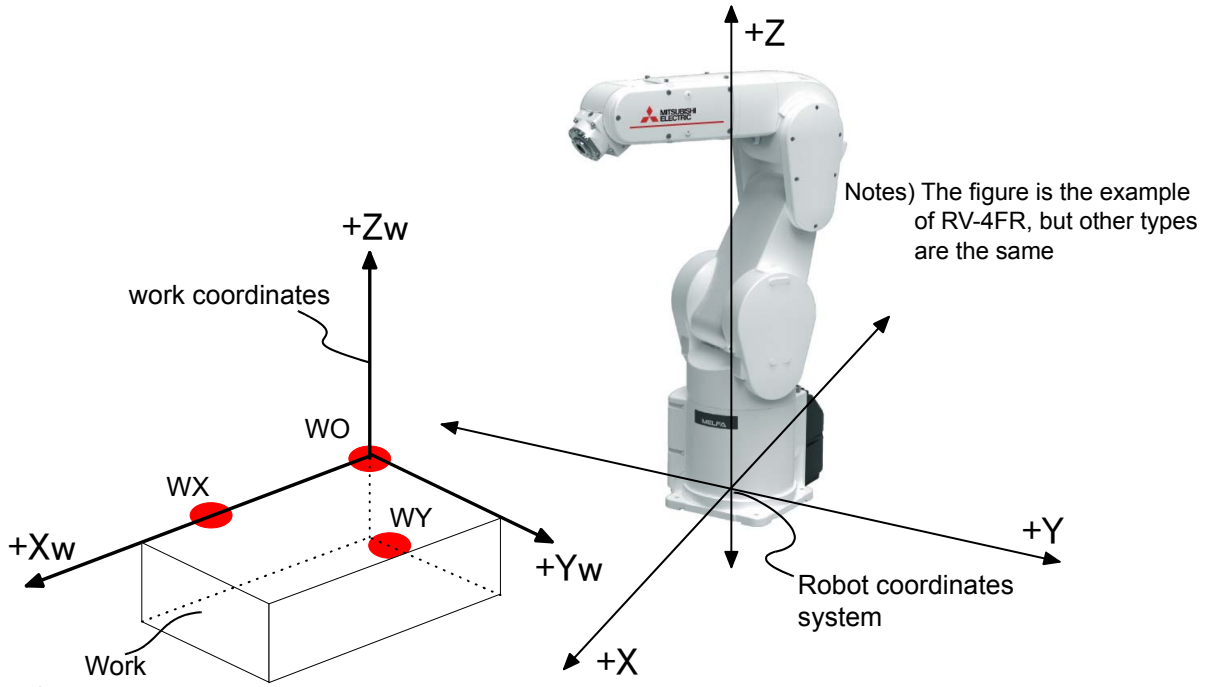
*The position of the end axis will not change.

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

(8) 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 (R32TB) is shown in the following.
(Parameter: Setting the coordinate value to WKnCORD ("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).



The jogging movement based on this work is possible.

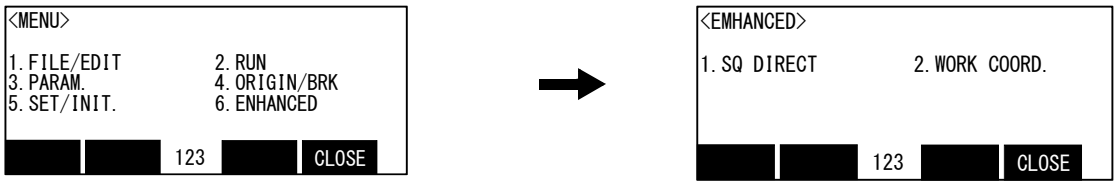
< ● Teaching point>
WO: Work coordinates system origin
WX: Position on the "+X" axis of work coordinates system.
WY: Position at the side of "+Y" axis on the X-Y plane of work coordinates system.

[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)

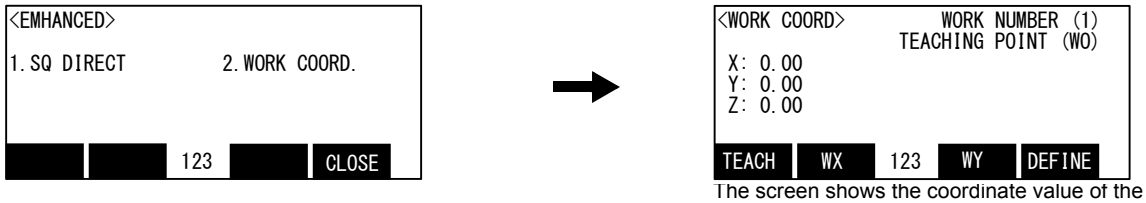
Fig.2-28 : Setting of the work coordinates system (teaching point)

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

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

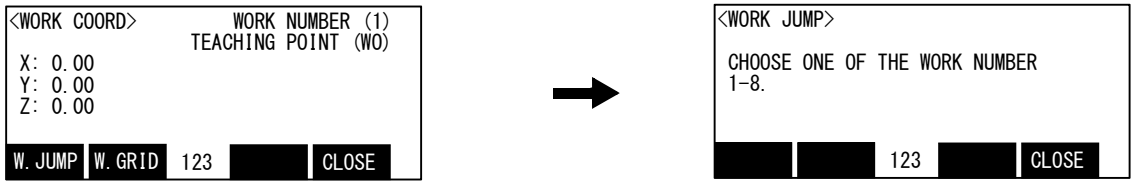


2) Press the [2] keys in the menu screen and select "2. WORK COORD."

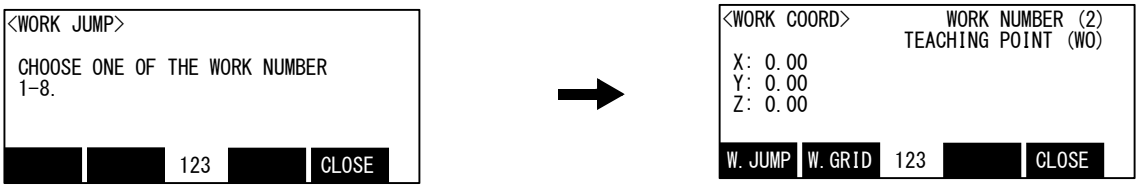


The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

3) Selection of the work coordinates number
Press the [FUNCTION] keys, and display "W: JUMP" function. Press the function key corresponding to "W: JUMP"



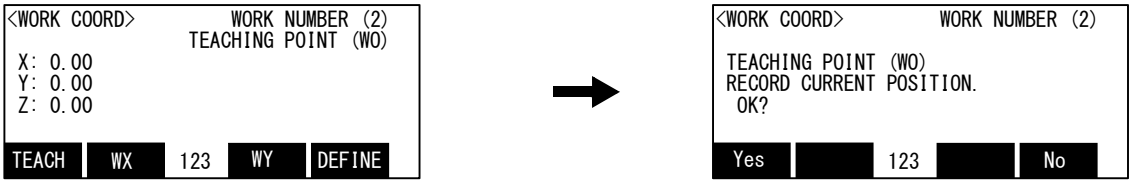
Press numeral key [1] - [8] and specify the work coordinates number. The coordinate value of the specified work coordinates system is displayed.



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

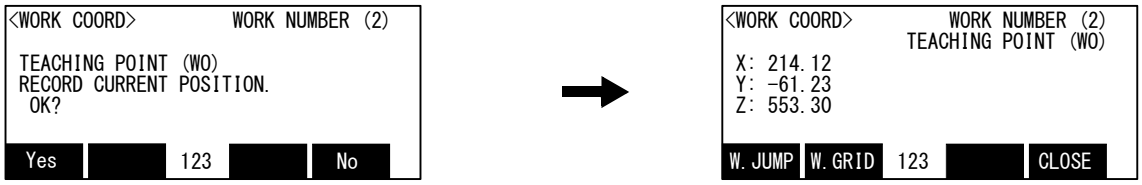
The screen is the example which specified the work coordinates number 2. ("2" at the upper right of the screen)

4) The teaching of the work coordinates system
Teach the three points shown in Fig. 2-28. 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.



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

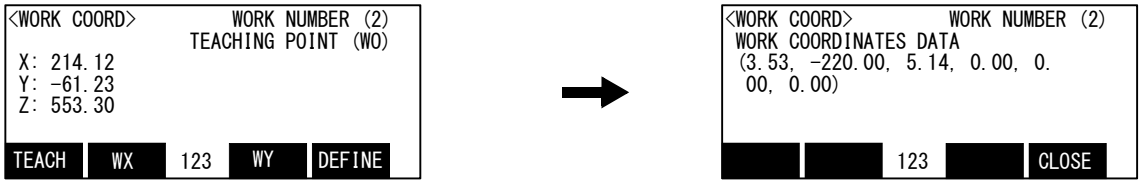


Teach the three points, WO, WX, and WY, by the same operation.
The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)

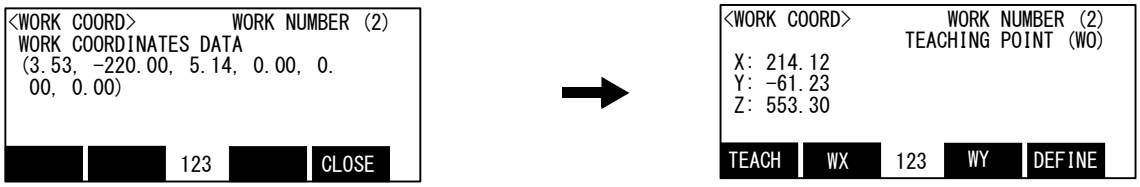
WO= parameter: WKnWO
WX= parameter: WKnWX
WY= parameter: WKnWY

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.

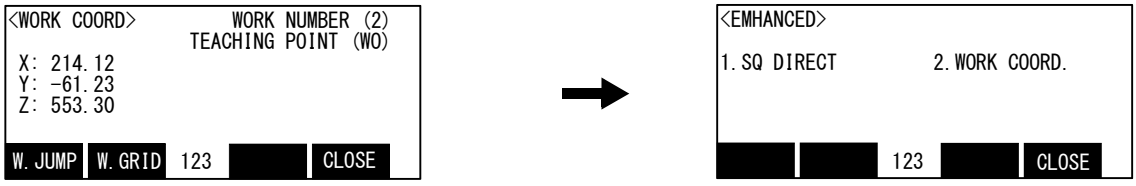


The alarm occurs if the work coordinates system is incalculable. (There are the three points on the straight line, or the two points have overlapped) In this case, reset alarm and re-teach the three points.
This work coordinate data is registered into parameter: WKnCORD. ("n" means the work coordinates numbers 1-8)
If the function key corresponding to "CLOSE" is pressed, it will return to the previous screen.

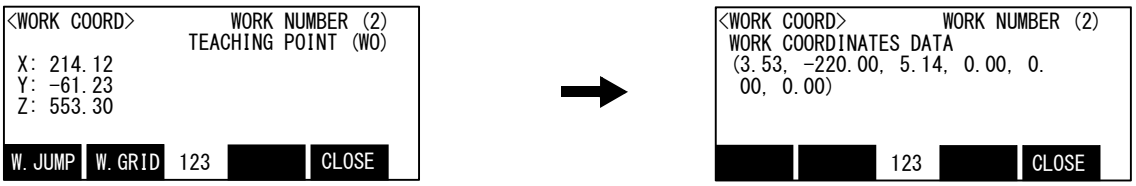


6) Finishing of setting the work coordinates

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



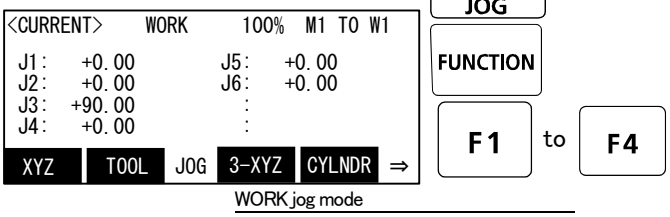
Although setting of work coordinates is finishing above, confirmation of work coordinates can be done by pressing the function key corresponding to "W GRID."([F2])



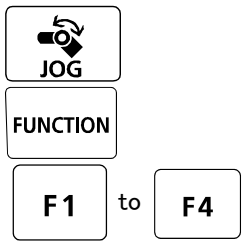
Return to the previous screen by pressing the [CLOSE] ([F4]) key.

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

Select WORK jog mode

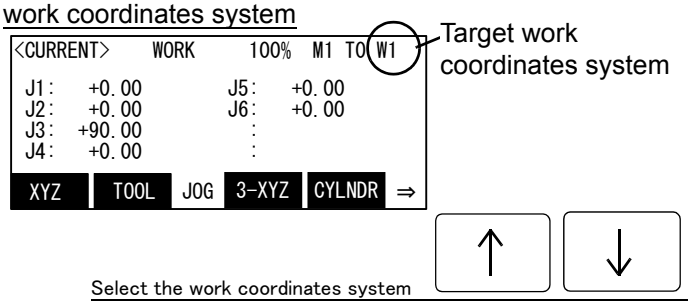


WORK jog mode



[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

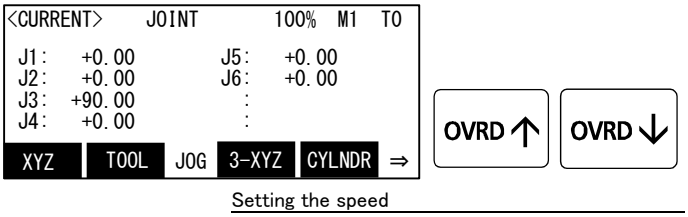


Select the work coordinates system

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



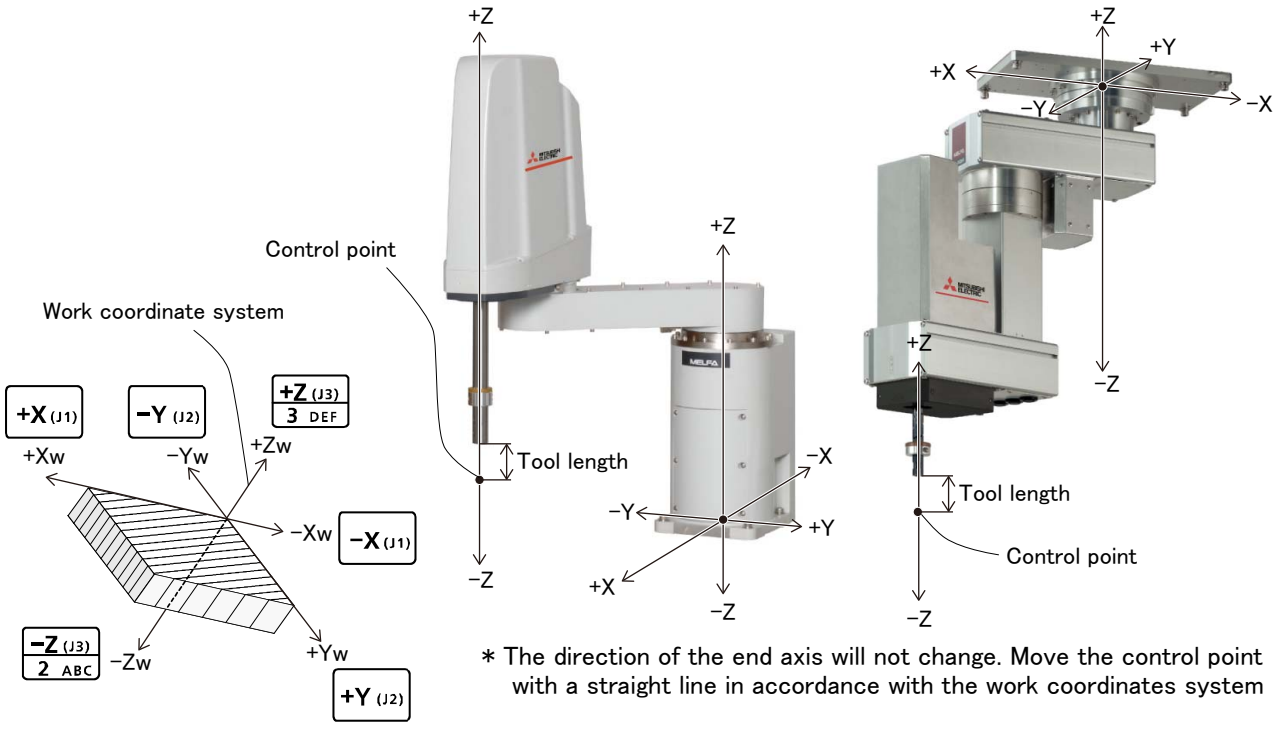
Setting the speed

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.
Set the override to 10% here for confirmation work

The WORK jog operation and the Ex-T jog operation can be switched by setting the parameters WK1-JOGMD to WK8JOGMD of each work coordinates system.
The respective operations are as follows.

WORK jog operation mode	Conventional WORK jog	Ex-T jog
Parameters WKnJOGMD (n is 1 to8) 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 (Zw).
AB key operation	The robot does not move.	The robot does not move.

The jog movement based on work coordinates system



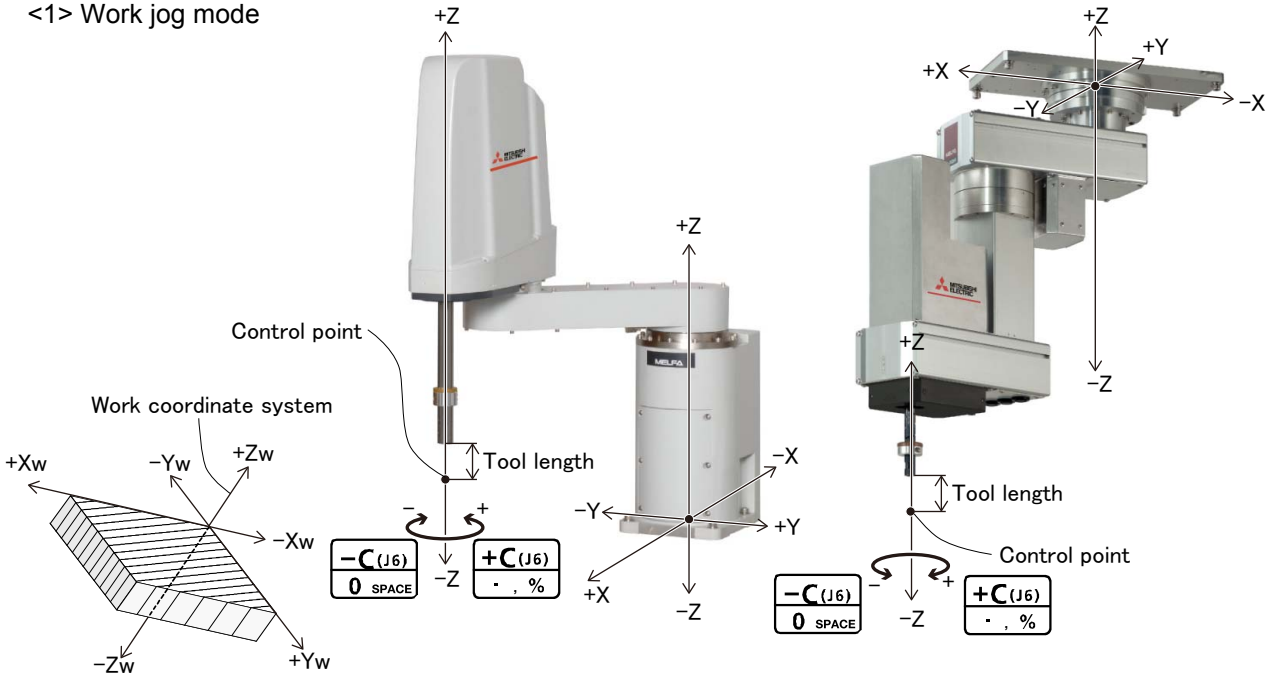
* The direction of the end axis will not change. Move the control point with a straight line in accordance with the work coordinates system

- When the [+X (J1)] keys are pressed, the robot will move along the X axis (Xw) 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 (Yw) 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 (Zw) 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

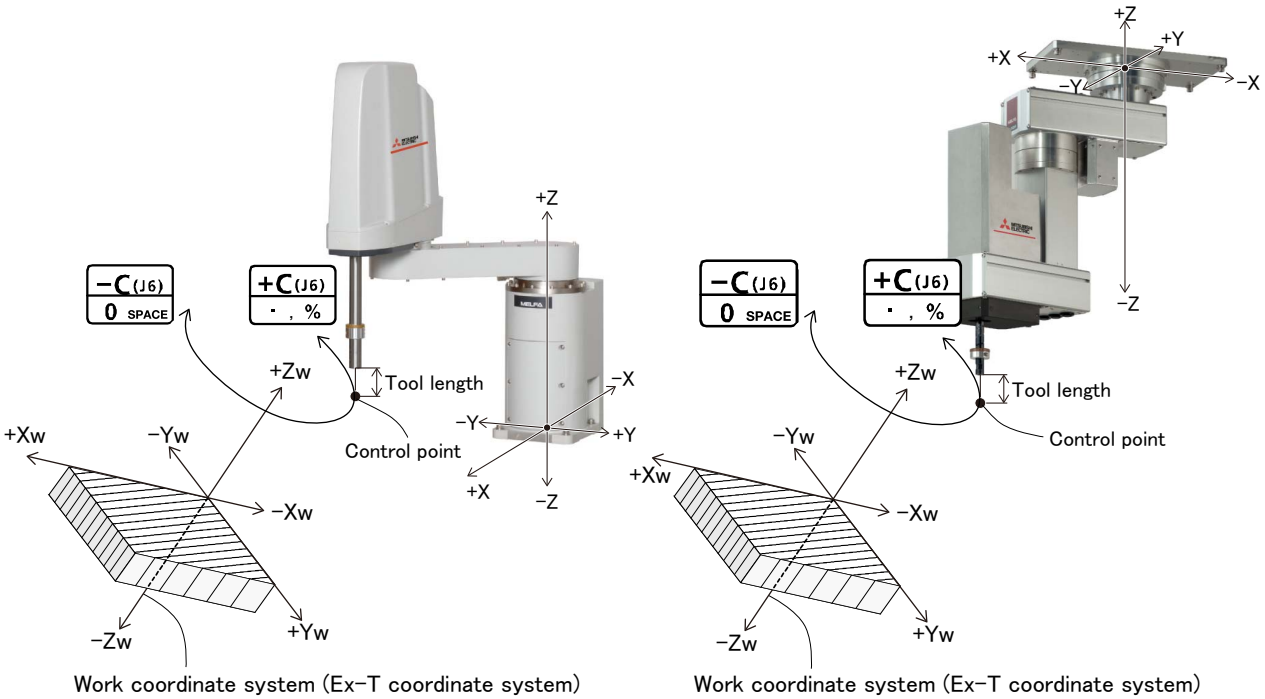
<1> Work jog mode



* The position of the control point does not change.
The end axis is rotated.

・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 section Page 42, "(3) 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.

2.3.2 Setting the hand parameters

Set the parameters to set the hand I/O type and the hand condition according to the robot hand to be used. Refer to the separate volume, "Instruction Manual/Detailed Explanations of Functions and Operations" for how to set parameters.

Table 2-9 : Hand parameter

Parameter	Parameter name	Details explanation	Factory setting
Hand I/O type	HIOTYPE	Set either the sink type or the source type for the solenoid valve and the logic of the hand input signal. -1: Not set 0: Source type 1: Sink type	-1
Hand condition	HNDDAT* * is 0 to 8	Set the initial condition of the hand. (Specify with the tool coordinate system.) (Weight, size X, size Y, size Z, center of gravity X, center of gravity Y, center of gravity Z) Unit: Kg, mm	The setting varies depending on the model.

3 Installing the option devices

3.1 Installing the solenoid valve set (RH-3FRH/6FRH/12FRH/20FRH series)

The installation summary of the solenoid valve is shown below. Remove the No.2 arm cover U, and install the solenoid valve on the No.2 arm. Turn the controller's power OFF before this installing operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.
It is necessary to set the parameters (HIOTYPE, HANDYPE) in accordance with solenoid valve type (sink type/ source type) and output signal before using the solenoid valve set.
Refer to the separate volume, "Instruction Manual/Detailed Explanations of Functions and Operations" for how to set parameters.

(1) RH-3FRH/6FRH series

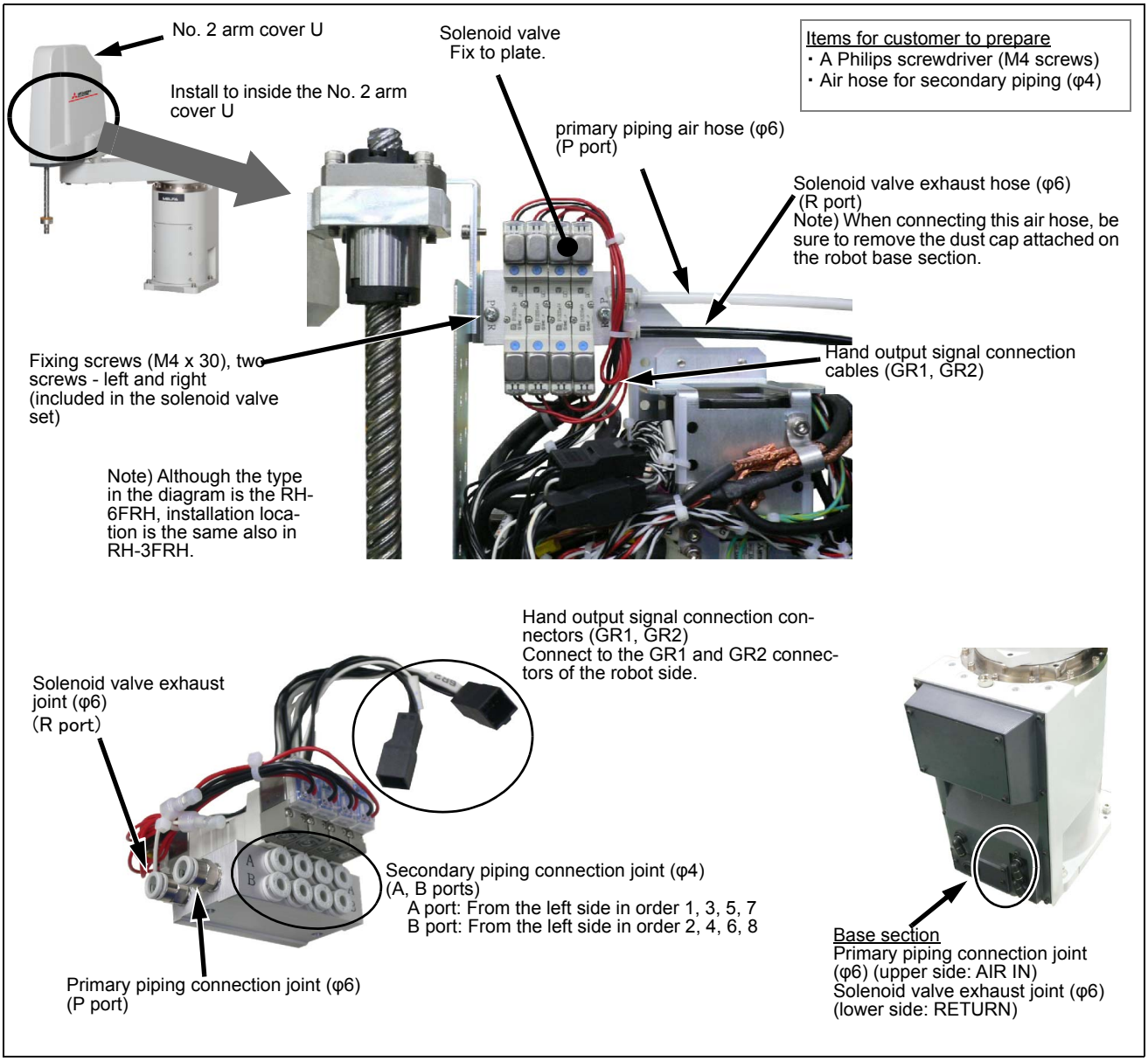


Fig.3-1 : Solenoid valve installation procedures (RH-3FRH/6FRH)

The installation procedure is detailed below.

1) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.

2) Fix the solenoid valve to the plate in the position indicated in Fig. 3-1. Place it so that the solenoid valve's primary piping connection joints (P, R ports) are located on the right hand side, and fix it securely using the M4 screws included (tightening torque: 1.39 to 1.89N・m).
3) Connect the connector (GR1, GR2) of solenoid valve with connector of robot arm side (GR1, GR2). Connect with the same names. The hand output signal cables of the robot arm side are located close to where the solenoid valve is installed and are tied up with cable tie. Pull out and connect them to the connectors. Fix the connectors so that they will not move along with the robot movement. (Refer to Page 91, "3.9 Connector protection when the option devices are installed").
4) Connect the primary piping air hose (φ6). The air hoses are located close to where the solenoid valve is installed and are tied up with cable tie. Cut the cable tie and connect them. Of the two air hoses, connect the one marked "AIR IN" to the solenoid valve's P port, and the one marked "RETURN" to the R port.
   Note) When connecting the RETURN air hose, be sure to remove the dust cap attached at the RETURN joint on the robot base section. If the cap is not removed, exhaust air pressure will increase and the solenoid valve may not operate properly.By connecting the exhaust air hose (φ6: customer preparation) to this RETURN air joint, exhaust air from the solenoid valve is able to escape to the designated point.
5) Connect the secondary piping air hose (φ4).
   The optional hand curl tube, the hand internal wiring and piping set, or the air hose prepared by customer can all be used, however when pulling the tip of the air hose out from the shaft please be sure to use the optional hand internal wiring and piping set.
   Connect the air hoses to solenoid valve port A and port B. Please refer to Table 3-1 and connect to the necessary ports. Covers the unused solenoid valve joints with the plugs included.
   Note) When pulling the tip of the air hose out from the shaft, please be sure to use the optional hand internal wiring and piping set. Silicon grease to apply to friction points is included with the product (please refer to Page 84, "3.7 Hand internal wiring and piping set (RH-3FRH/6FRH/12FRH/20FRH series)"). Further, when using the optional external wiring and piping box, the air hose can be pulled out from the rear of the No. 2 arm (please refer to Page 89, "3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)").
6) If the hand output cable and the air hose have excess length, please tie the excess section by cable tie and fix it to the plate. The plate have some holes for fixing the cable/hose with a cable tie.
   Also, anchor the cables to the plate by a cable tie to prevent the cable connectors from moving freely. Otherwise, the connectors may be damaged due to the impact of hitting devices near the connectors while the robot is under operating condition.
7) Install securely the No.2 arm cover U as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
   Note) The installation surface of the clean and the oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please inform the dealer, if exchange is necessary.

The installing of the solenoid valve set is completed.

⚠CAUTION When installing the solenoid valve set, check that no cables are pinched and no air hoses are bent.
Cable pinching may cause a break in a cable or damage of the solenoid valve cover. Air hose bending may cause a malfunction of the solenoid valve.

(2) RH-12FRH/20FRH series

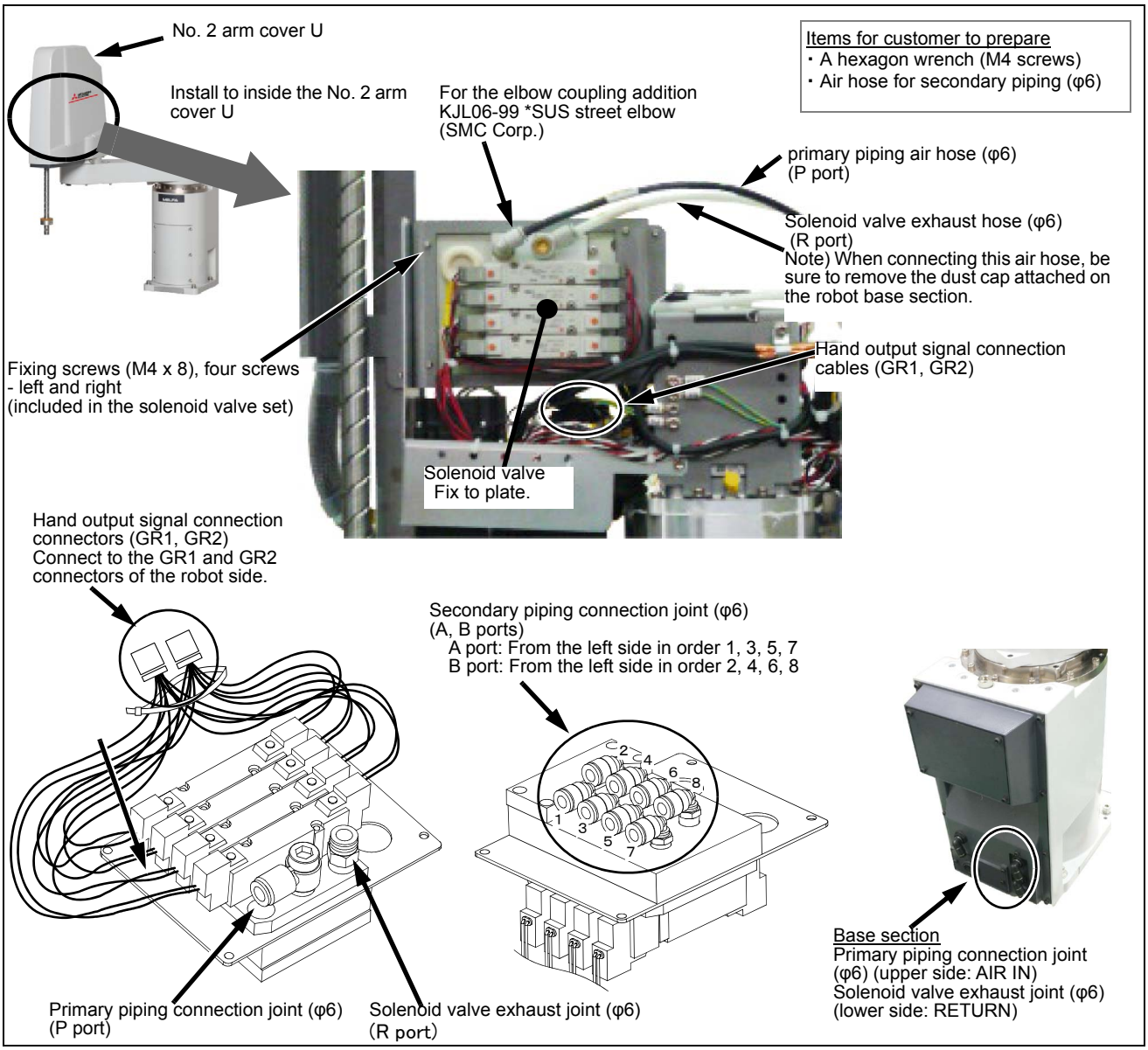


Fig.3-2 : Solenoid valve installation procedures (RH-12FRH/20FRH)

The installation procedure is detailed below.

1) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
2) Fix the solenoid valve to the plate in the position indicated in Fig. 3-2. Place it so that the solenoid valve's primary piping connection joints (P, R ports) are located on the upper side, and fix it securely using the M4 screws included (tightening torque: 1.39 to 1.89N・m).
3) Connect the connector (GR1, GR2) of solenoid valve with connector of robot arm side (GR1, GR2). Connect with the same names. The hand output signal cables of the robot arm side are located close to where the solenoid valve is installed and are tied up with cable tie. Pull out and connect them to the connectors. Fix the connectors so that they will not move along with the robot movement. (Refer to Page 91, "3.9 Connector protection when the option devices are installed").
4) Connect the primary piping air hose (φ6). The air hoses are located close to where the solenoid valve is installed and are tied up with cable tie. Cut the cable tie and connect them. Of the two air hoses, connect the one marked "AIR IN" to the solenoid valve's P port, and the one marked "RETURN" to the R port.
   Note) When connecting the RETURN air hose, be sure to remove the dust cap attached at the RETURN joint on the robot base section. If the cap is not removed, exhaust air pressure will increase and the solenoid valve may not operate properly.By connecting the exhaust air hose (φ6: customer

preparation) to this RETURN air joint, exhaust air from the solenoid valve is able to escape to the designated point.

5) Connect the secondary piping air hose (φ6).
The optional hand curl tube, the hand internal wiring and piping set, or the air hose prepared by customer can all be used, however when pulling the tip of the air hose out from the shaft please be sure to use the optional hand internal wiring and piping set.
Connect the air hoses to solenoid valve port A and port B. Please refer to Table 3-1 and connect to the necessary ports. Covers the unused solenoid valve joints with the plugs included.
Note) When pulling the tip of the air hose out from the shaft, please be sure to use the optional hand internal wiring and piping set. Silicon grease to apply to friction points is included with the product (please refer to Page 84, "3.7 Hand internal wiring and piping set (RH-3FRH/6FRH/12FRH/20FRH series)"). Further, when using the optional external wiring and piping box, the air hose can be pulled out from the rear of the No. 2 arm (please refer to Page 89, "3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)").

6) If the hand output cable and the air hose have excess length, please tie the excess section by cable tie and fix it to the plate. The plate have some holes for fixing the cable/hose with a cable tie.
Also, anchor the cables to the plate by a cable tie to prevent the cable connectors from moving freely. Otherwise, the connectors may be damaged due to the impact of hitting devices near the connectors while the robot is under operating condition.

7) Install securely the No.2 arm cover U as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
Note) The installation surface of the clean and the oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please inform the dealer, if exchange is necessary.

The installing of the solenoid valve set is completed.

⚠CAUTION When installing the solenoid valve set, check that no cables are pinched and no air hoses are bent.
Cable pinching may cause a break in a cable or damage of the solenoid valve cover. Air hose bending may cause a malfunction of the solenoid valve.

(3) Hand number and solenoid valve ports (common to floor installation type robot)

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

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

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

3.2 Installing the solenoid valve set (RH-3FRHR series)

Installation summary of the solenoid valve set of general environment specification (RH-3FRHR3515) is shown in Fig. 3-3 and is shown in Fig. 3-4 about clean/waterproof specification (RH-3FRHR3512C/3512W).

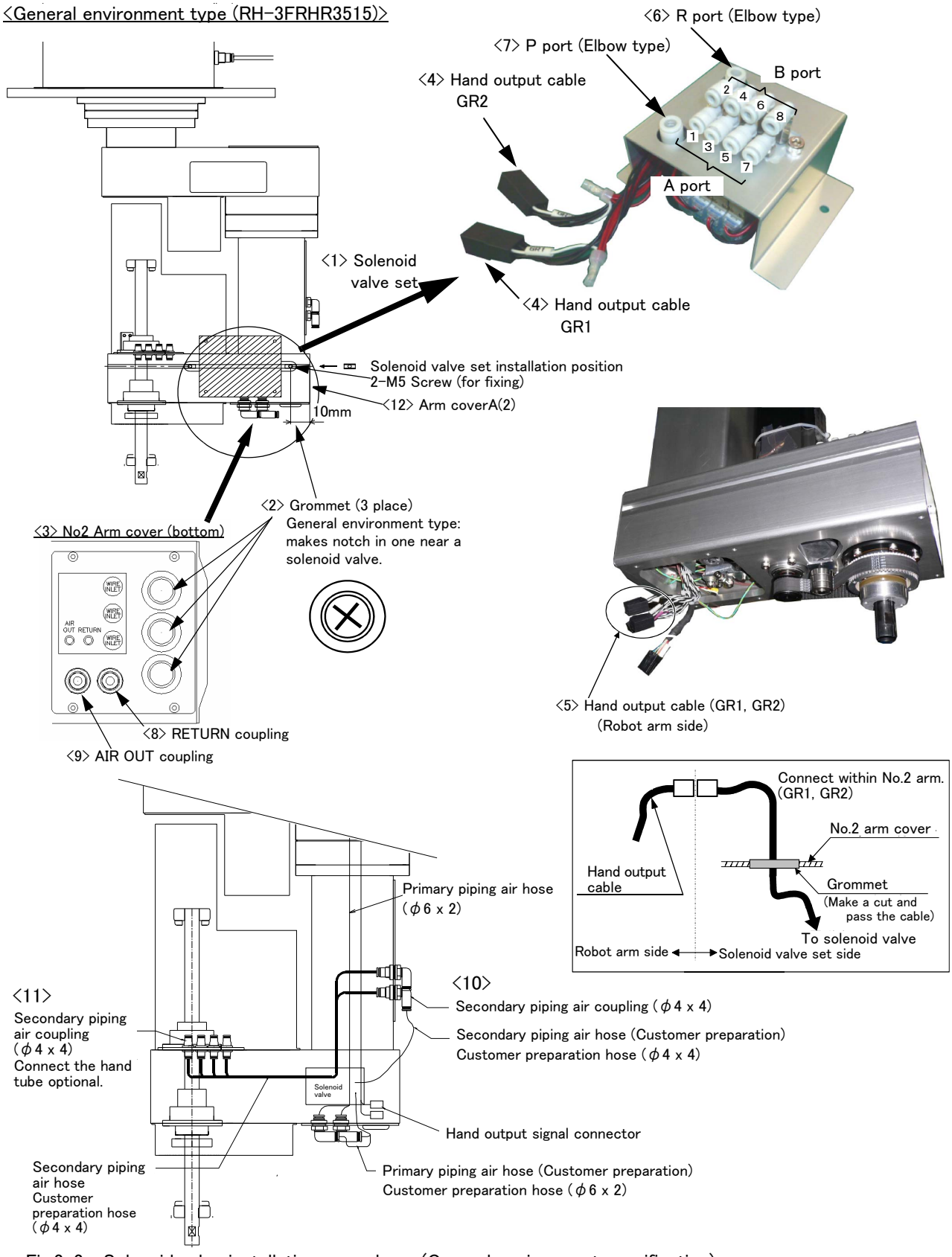


Fig.3-3 : Solenoid valve installation procedures (General environment specification)

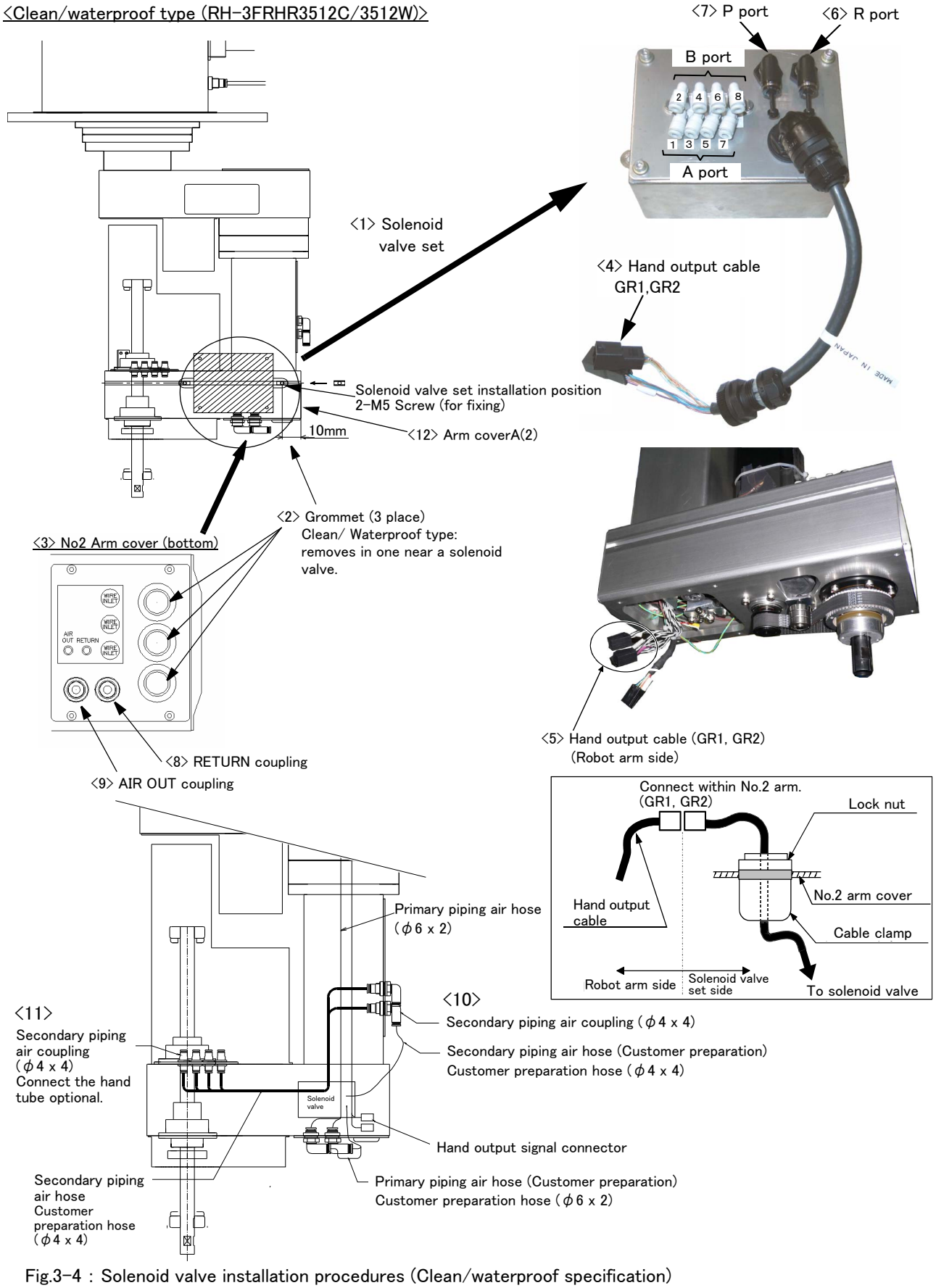


Fig.3-4 : Solenoid valve installation procedures (Clean/waterproof specification)

The installation procedures are as follow. This work must be carried out with the controller power turned OFF.

It is necessary to set the parameters (HIOTYPE, HANDYPE) in accordance with solenoid valve type (sink type/ source type) and output signal before using the solenoid valve set.
Refer to the separate volume, "Instruction Manual/Detailed Explanations of Functions and Operations" for how to set parameters.

1) Install the solenoid valve set <1> on the No.2 arm side. Fixing at the T slot on the No.2 arm side with two fixing screws and two nuts attached for T slots. Install in the position of 10mm from the arm end.
2) Connect the hand output cable within No.2 arm. Makes notch or removes in one of grommet near a solenoid valve. (Following)
   a) General environment: .....makes notch. (draw in a hand output cable from here)
   b) Clean/ Waterproof: .....removes (fixes a hand output cable here by a cable clamp)
3) Loosen the fixing screw and remove the No.2 arm cover <3> and the arm cover A(2) <12>. Since the air tube is connected, No.2 arm cover <3> is completely inseparable.
4) Pass the hand output cable <4> of the solenoid valve set to No.2 arm cover.
   a) General environment: .....pass it to grommet <2> in which the notch was made.
   b) Clean/waterproof: .....fixes it to the hole which removed the grommet by an attached cable clamp. Pass the hand output cable to the attached cable clamp , and pass to the hole of No.2 arm cover, and pass to the lock nut , and fix it to No.2 arm cover by lock nut surely.
5) Connect with hand output cable (GR1, GR2) <5> of the robot arm side in No.2 arm. Connect the same connector names.

Note : Please see the hand output cable from the arm cover A (2) <12> side, and store it outside the bracket. If the cable enters within the bracket, it will rub to the timing belt and will become the cause of breaking down.

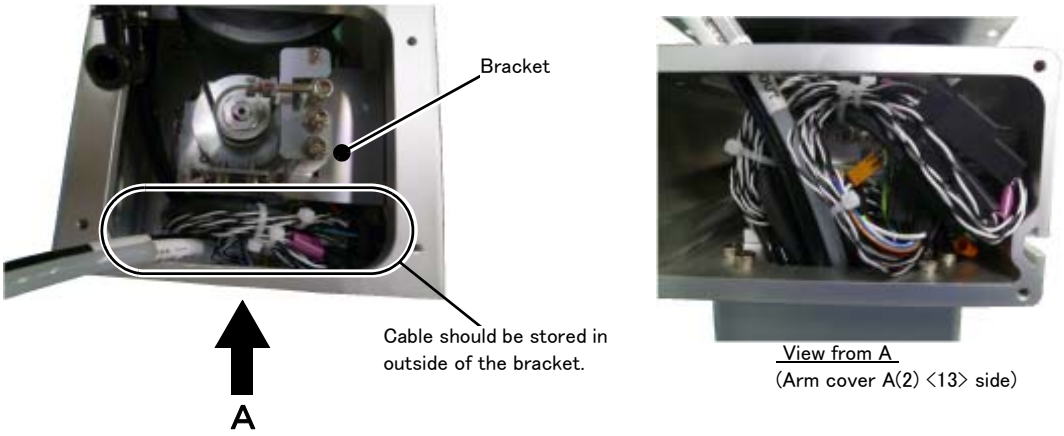
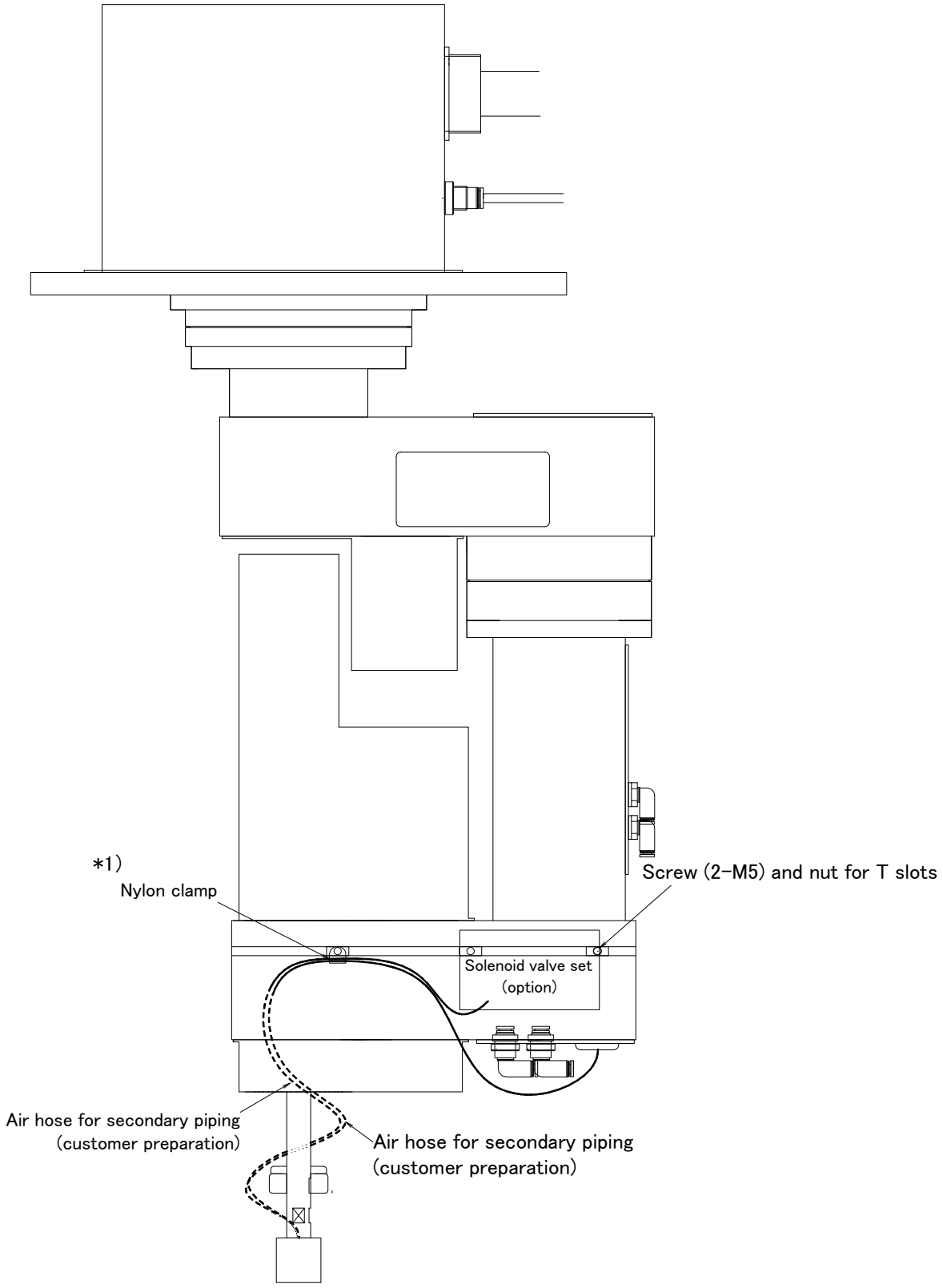


Fig.3-5 : Storing of the hand output cable

6) Install the No.2 arm cover <3> and the arm cover A(2) <12> as before. Be careful not to catch any the cables.
7) Connect primary air piping with the two φ6 air hoses (customer preparation). Connect between the "R" port (6) of the solenoid valve set and the "RETURN"<8> on No.2 arm cover, and between"P" port <7> and "AIROUT"<9>.
8) Connect secondary air piping with the φ4 air hose (customer preparation).
   There are two connection methods as follows.
   a) Connect with the tools of customer preparation direct from the solenoid valve set. The fixing place of the air hose which can be used of the customer is shown in Fig. 3-6.
   b) Connect via the air hose piped in robot arm previously.
      Note: In the robot arm, four φ4 air hoses are piped to the secondary piping air joint in motor cover J3 <11> from the secondary piping air joint of J2 axis upper part <10> previously.
      (If more numbers of piping are necessary, please pipe to the tools directly)
      And, please prepare separately the air hose for connection from the secondary piping air joint <11> to the tools. (The conversion coupling is attached(φ4 to φ3))
      <Reference> : The air hose which can be passed in the shaft is four φ4 hoses maximum. If you utilize the hand tube optional, it can let the optional hand input cable pass further. Refer to the "standard specifications" for detail.



*1) Fixing the air hose (customer preparation) using the T slot by nylon clamp etc.

Fig.3-6 : Fixing place of the air hose (example)

The connection correspondence after installation is as shown in Table 3-2.

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

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

3.3 Installation of hand tube (RH-3FRHR series)

The installation procedure of the hand tube is as follows. In use of solenoid valve set and hand input cable optional, please operate with referring to the Page 63, "3.2 Installing the solenoid valve set (RH-3FRHR series)" and the Page 72, "3.4 Installing the hand input cable" together.
And, operate after turning OFF the power supply of the controller.

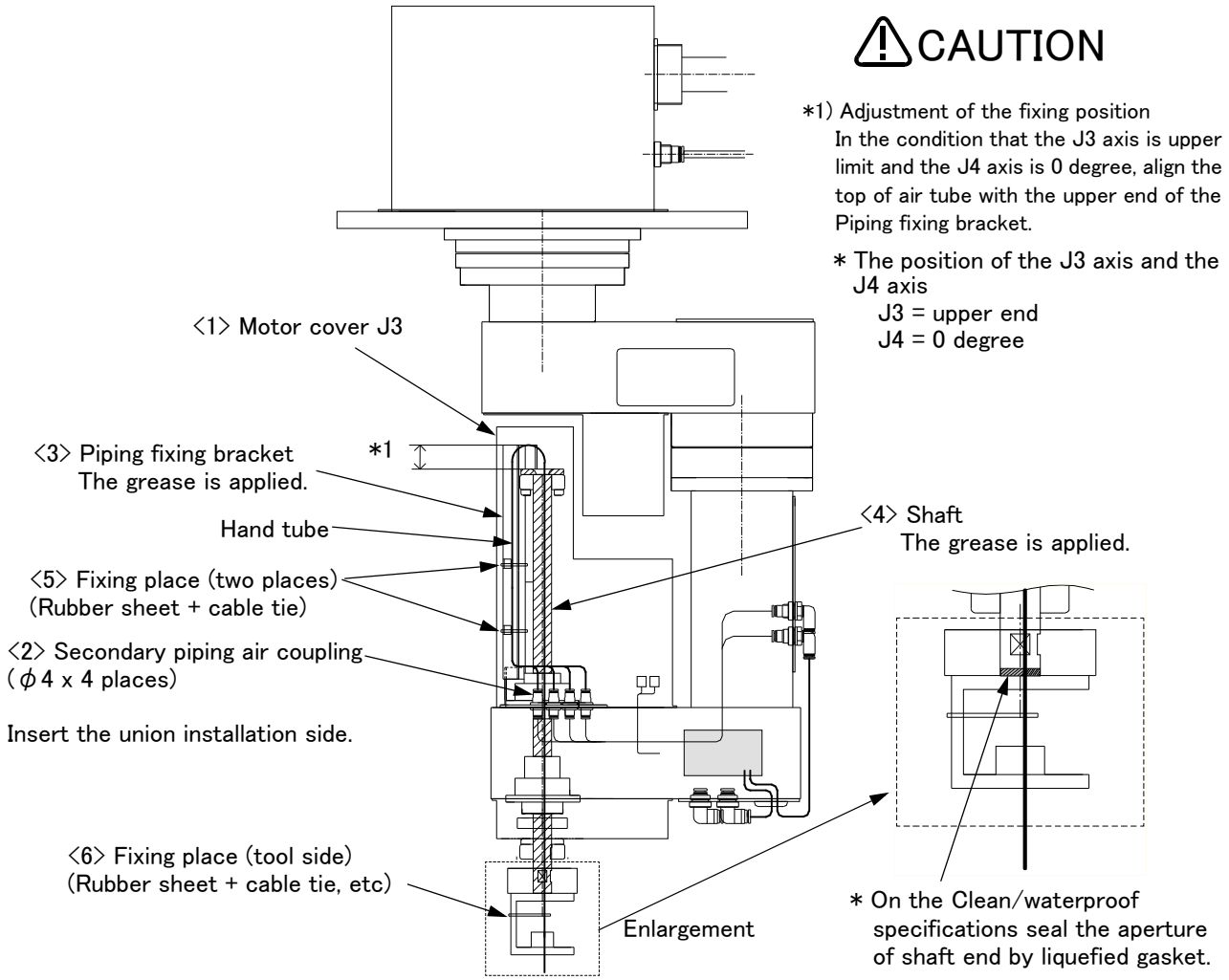
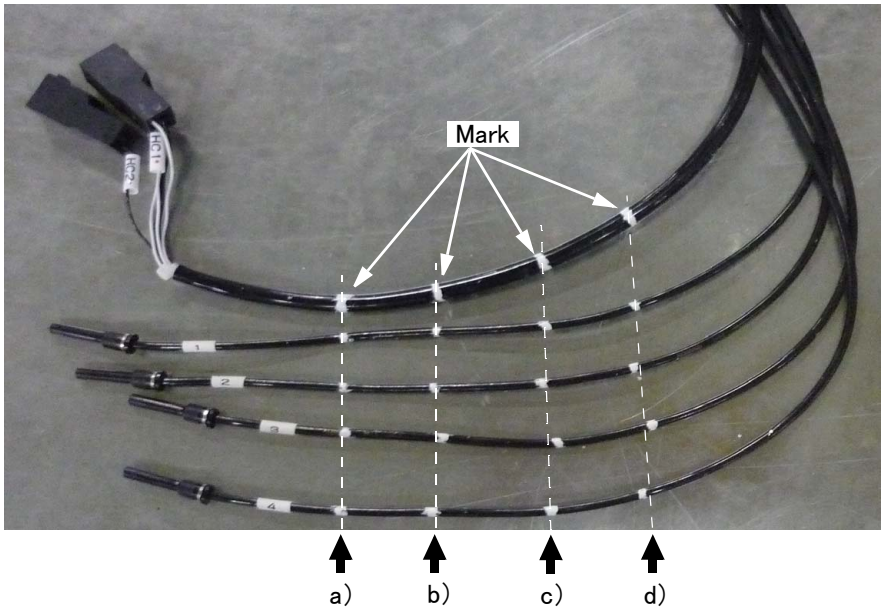


Fig.3-7 : Installation of the hand tube

The procedure is shown below.

1) To protect the fixing place of the hand tube, roll the attached rubber sheet. If using the hand input cable, roll together.

The hand tube and the hand input cable having the mark at the position which rolls the rubber sheet.
The hand tube is the four places, a), b), c), and d) sequentially from the union side.
The hand input cable is the four places, a), b), c), and d) sequentially from the connector side.



Put together each mark and roll the attached rubber sheet.
Roll at two places between a) and b) and between c) and d). And fixing by cable tie (Attachment) each.
This position is the fixing position to the piping fixing bracket <3>.

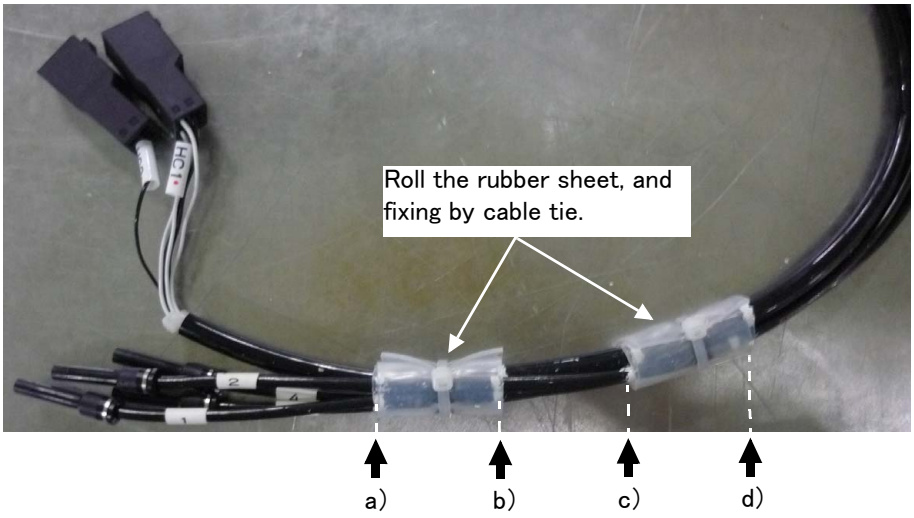


Fig.3-8 : Protection of hand tube and hand input cable

2) Remove motor cover J3 <1> with referring to the Page 101, "5.3.2 Installing/removing the cover".
3) By jog operation, set the J3 axis to the upper end, and set the J4 axis to the 0 degree. This position is adjustment basis for fixing hand tube.

4) Install the union (ϕ 4 to ϕ 3) side of the tube to secondary piping coupling (ϕ 4 x 4 place) <2> on the No.2 arm inside motor cover <1>. The number of 1 to 4 is printed to the marking tube of the hand tube. Connect together with the number of coupling on 2nd arm.

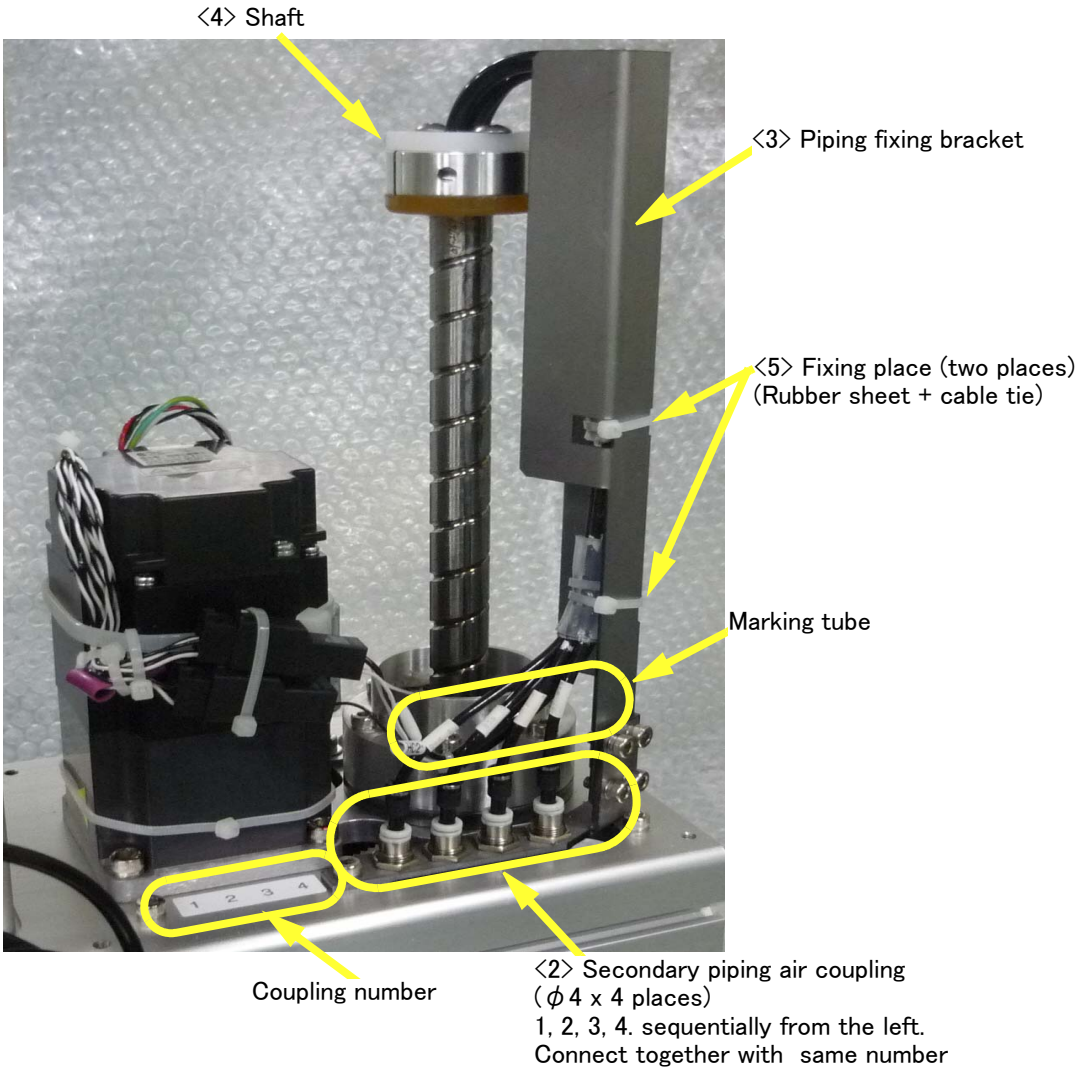


Fig.3-9 : Connection of hand tube

5) Pass the hand tube (tape attachment side) into the shaft <4> along piping fixing bracket <3> one by one.
6) Fixing the hand tube to the piping fixing bracket <3> with cable tie. (two places <5>)
Fixing the tube from top of the rubber sheet that rolled before so that the tube may not slide.
7) Align the top of air tube with the upper end of the piping fixing bracket <3> by the drawer side at the end of the shaft.
8) At the tool side of customer preparation should roll the rubber sheet (attachments) in the same way, and fix it by cable tie etc (attachments) with maintaining this adjustment position. The example of the fixing method is shown in Fig. 3-10.
9) Remove the tape and connect the tool side. Please utilize the attached union (ϕ 4 to ϕ 3) for optional if needed.
Note) The grease is applied to hand tube contact places, such as the inside of the shaft. Please wipe off the grease adhering to the hand tube.
10) Install motor cover J3 <1> securely as before.

The installation of the hand tube is completion above.

⚠CAUTION Fixing the hand tube securely. If fixing is not securely, the tube will slide during robot movement and it will become the cause of tube bend. And since the tube change the shape and the air does not flow if fixing not much strongly, take care.

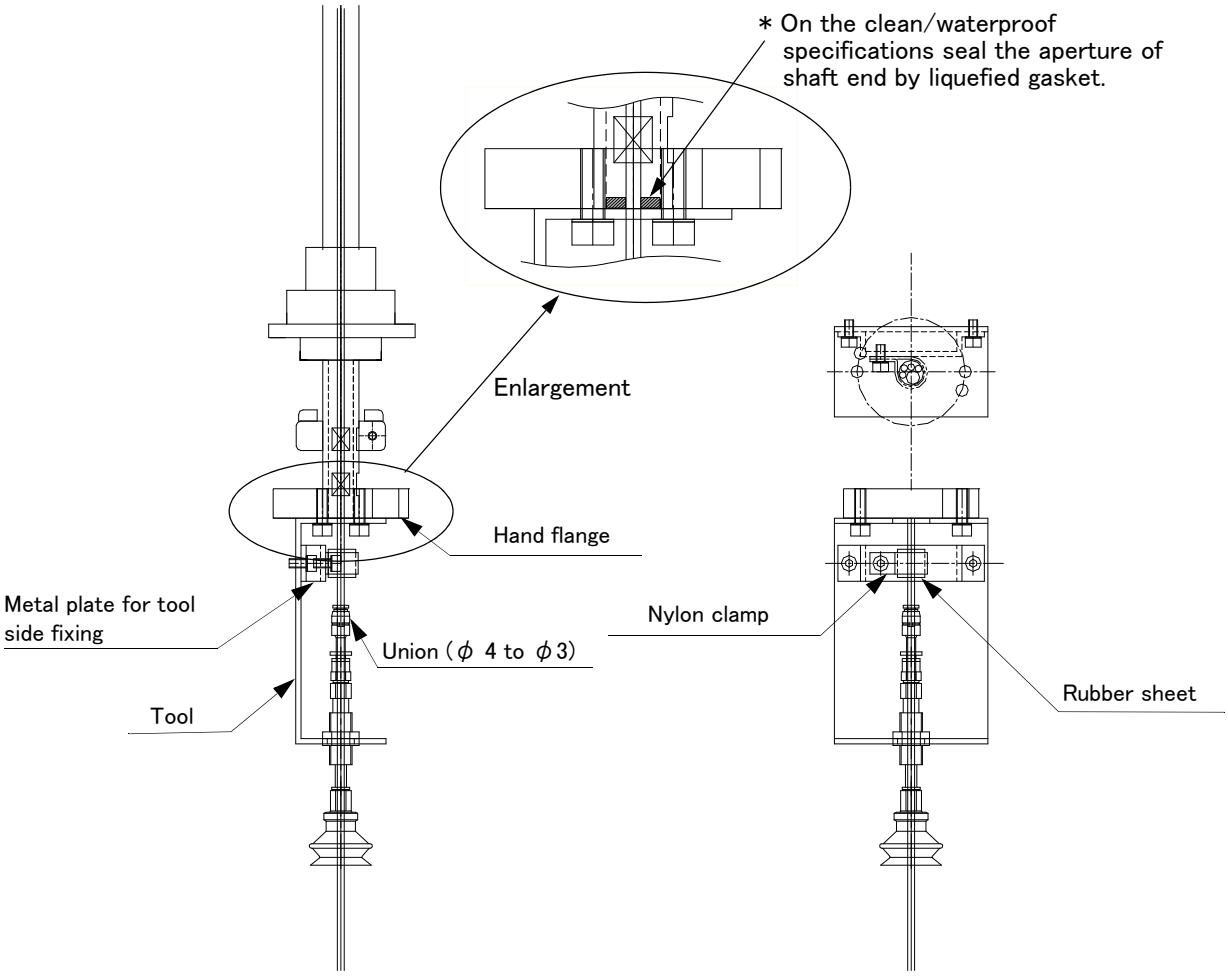


Fig.3-10 : Tool side fixing image of hand tube (example)

3.4 Installing the hand input cable

(1) RH-3FRH/6FRH/12FRH/20FRH series

Fig. 3-11 shows the hand input cable's storage location on the robot.
Please use the optional external wiring and piping box to pull the hand input cable out externally. After connecting the hand input cable connector, reference Page 89, "3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)", and pull it out from the robot arm.
When passing through the inside of the shaft and using it, please use the optional hand internal wiring and piping set.
Remove the No. 2 arm cover U and connect the connector above the No. 2 arm. Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

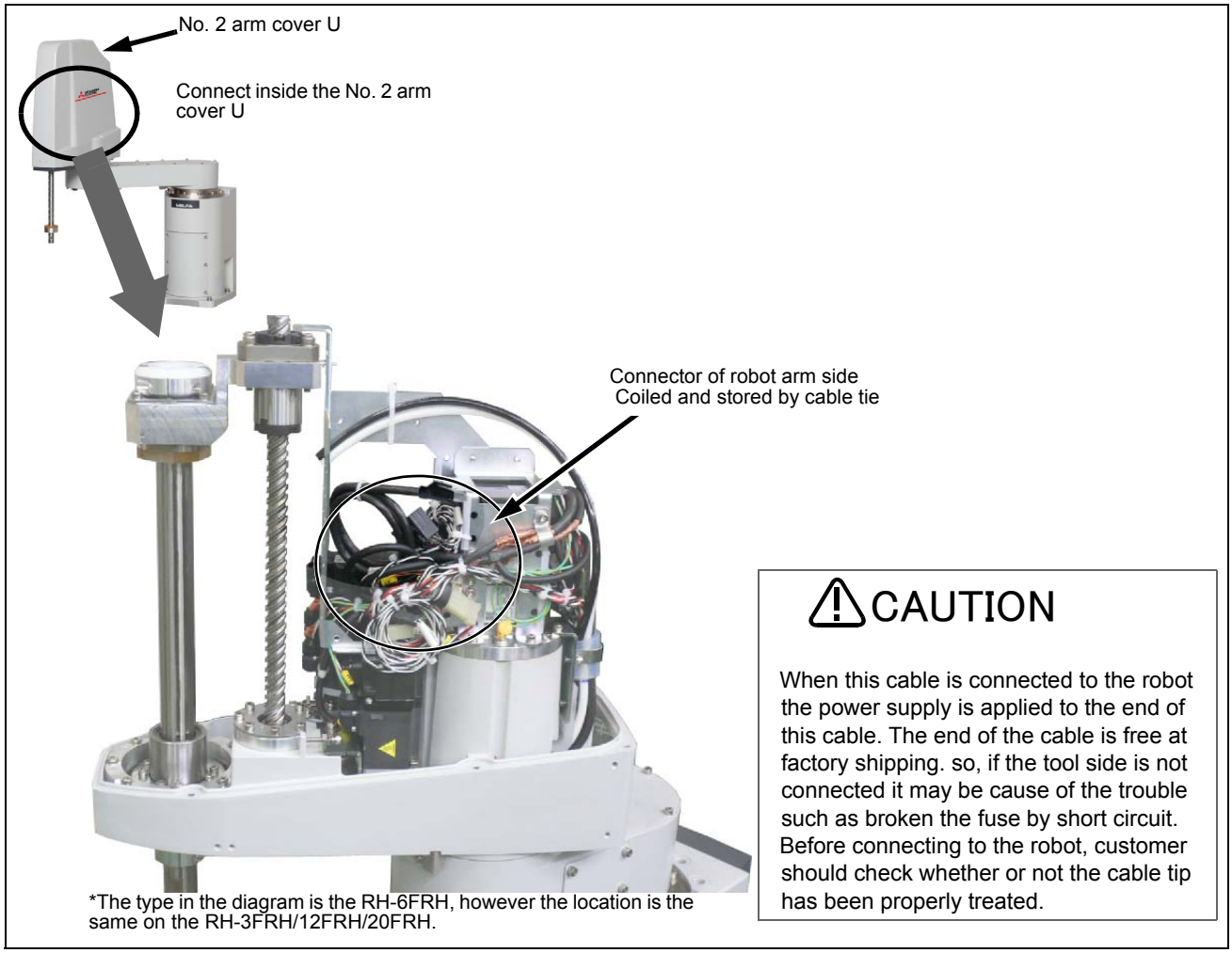


Fig.3-11 : Installing the hand input cable (RH-3FRH/6FRH/12FRH/20FRH series)

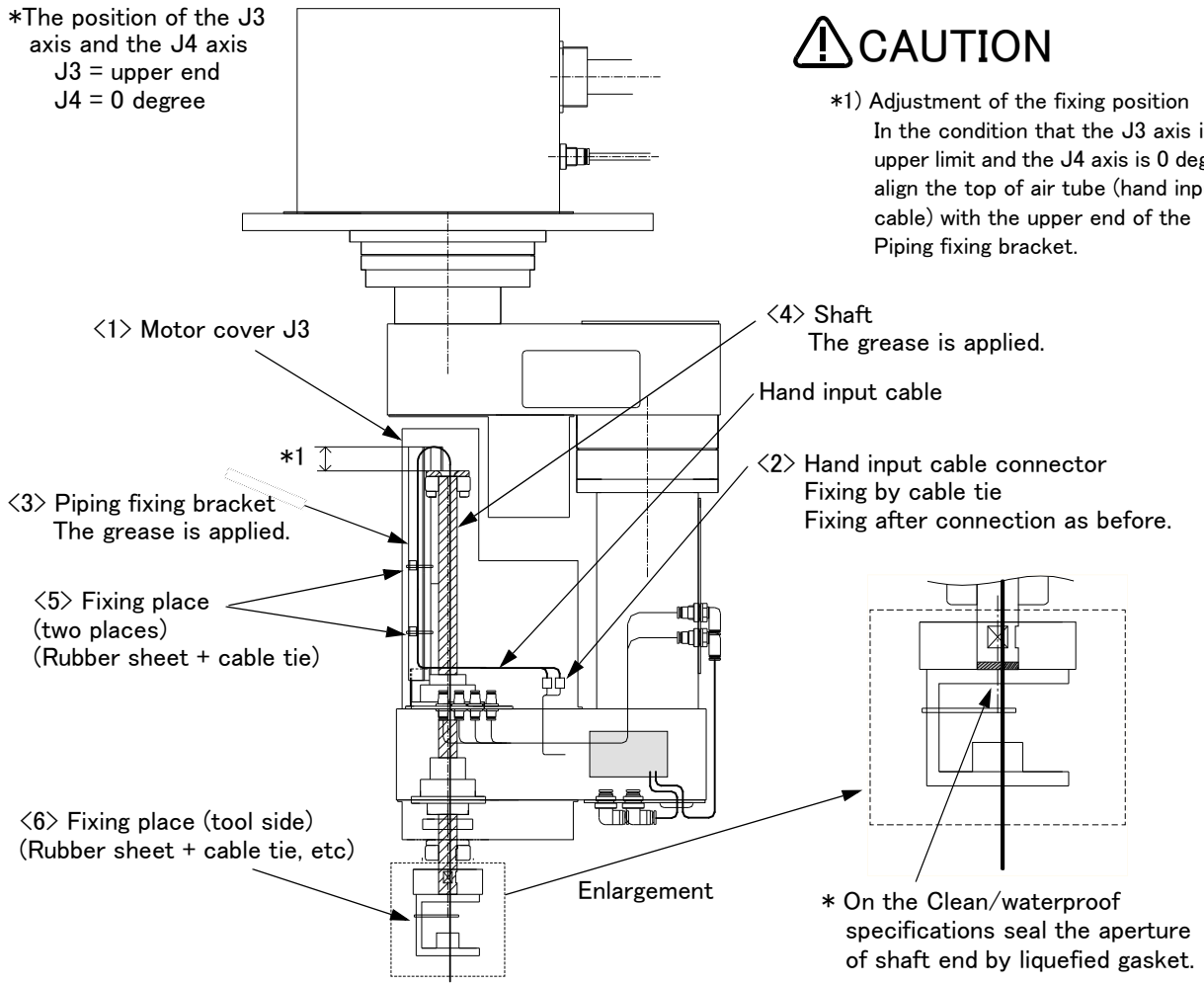
The installation procedure for the hand input cable is shown below

1) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
2) The hand input cable is stored in the location shown in Fig. 3-11. Pull out and check the connectors (HC1, HC2).
3) Connect the connector (HC1,HC2) of optional cable with connector of robot arm side (HC1, HC2). Connect with the same names. Fix the connectors so that they will not move along with the robot movement. (Refer to Page 91, "3.9 Connector protection when the option devices are installed").
4) Pull the hand input cables out of the robot arm. Referencing Page 89, "3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)", pull the cable out.

When installation of the optional external wiring and piping box finished, installing the hand input cable is complete.

(2) RH-3FRHR series

The installation procedure of the hand input cable is as follows. In use of solenoid valve set and hand tube optional, please operate with referring to the Page 63, "3.2 Installing the solenoid valve set (RH-3FRHR series)" and the Page 68, "3.3 Installation of hand tube (RH-3FRHR series)" together.
And, operate after turning OFF the power supply of the controller.



CAUTION If this cable is connected to the robot, the power supply will be applied to the cable terminal. The end of the cable is free at the time of shipment.
Therefore, if it is not still connecting, the trouble may occur by the short circuit. (The fuse breaks etc.)
When you connect to the robot, confirm the cable is disposed properly in the customer in advance.

Fig.3-12 : Installation of the hand input cable (RH-3FRHR series)

1) To protect the fixing place of the hand input cable, roll the attached rubber sheet. Roll the rubber sheet with referring to Page 68, "Fig.3-7 : Installation of the hand tube". If using the hand tube, roll together.
2) Remove motor cover J3 <1> with referring to the Page 101, "5.3.2 Installing/removing the cover".
3) By jog operation, set the J3 axis to the upper end, and set the J4 axis to the 0 degree. This position is adjustment basis for fixing hand input cable.
4) The hand input cable connector <2> is fixed at J4 motor inside the motor cover J3 <1> with cable tie. Once cut the cable tie and connect the hand input cable optional connector. Connect the same connector names.
5) Fixing the connector to the J4 motor by cable tie (attachments) as before.
   Note : Fixing the connector at flat surface on the J4 motor, to make the connector parallel to the motor cover J3 <1>.
6) Pass through the hand input cable into the shaft <4> along the piping fixing bracket <3>.
7) Fixing the hand input cable to the piping fixing bracket <3> with cable tie. (two places <5> attachment) . Fixing the cable from top of the rubber sheet that rolled before so that the cable may not slide.
8) Align the top of hand input cable with the upper end of the piping fixing bracket <3> by the drawer side at the end of the shaft.

9) At the tool side of customer preparation should roll the rubber sheet (attachments) in the same way, and fix it by cable tie etc (attachments) with maintaining this adjustment position. Fixing like the fixing method shown in Fig. 3-10.
10) Install motor cover J3 <1> securely as before. The grease is applied to hand input cable contact places, such as the inside of the shaft. Please wipe off the grease adhering to the hand input cable.

The installation of the hand input cable is completion above.

⚠CAUTION Fixing the hand input cable securely. If fixing is not securely, the cable will bend during robot movement and it will become the cause of breaking down.

3.5 Installing the hand output cable

(1) RH-3FRH/6FRH/12FRH/20FRH series

Fig. 3-13 shows the hand output cable's storage location on the robot.
Please use the optional external wiring and piping box to pull the hand output cable out externally. After connecting the hand output cable connector, reference Page 89, "3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)", and pull it out from the robot arm.
Remove the No. 2 arm cover U and connect the connector above the No. 2 arm. Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

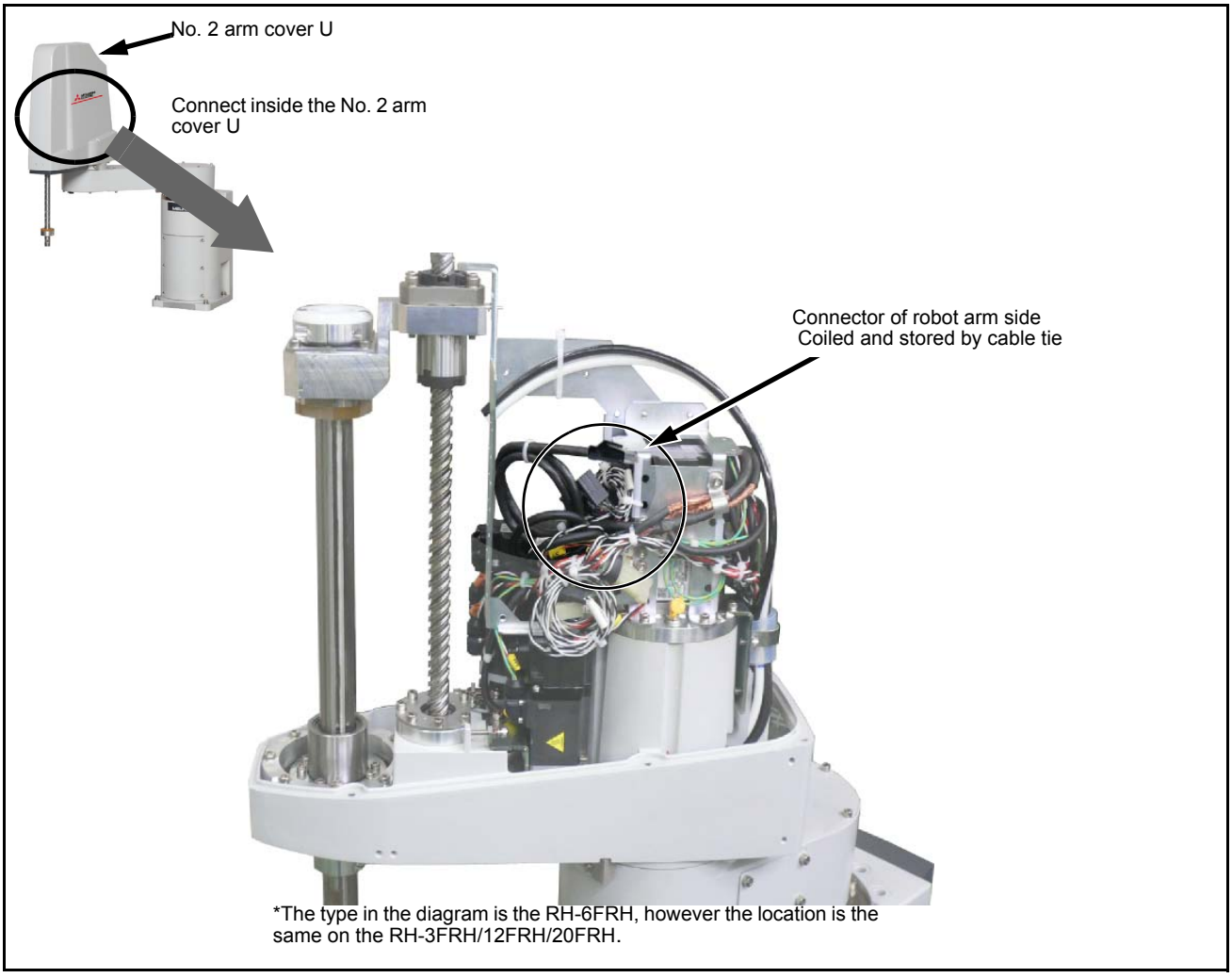


Fig.3-13 : Installing the hand output cable (RH-3FRH/6FRH/12FRH/20FRH series)

The installation procedure for the hand output cable is shown below

1) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
2) The hand output cable is stored in the location shown in Fig. 3-13. Pull out and check the connectors (GR1, GR2).
3) Connect the connector (GR1, GR2) of optional cable with connector of robot arm side (GR1, GR2). Connect with the same names. Fix the connectors so that they will not move along with the robot movement. (Refer to Page 91, "3.9 Connector protection when the option devices are installed").
4) Pull the hand output cables out of the robot arm. Referencing Page 89, "3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)", pull the cable out.

When installation of the optional external wiring and piping box finished, installing the hand output cable is complete.

(2) RH-3FRHR series

The installation procedure of the hand output cable is as follows. Please operate with referring to the Page 59, "3.1 Installing the solenoid valve set (RH-3FRH/6FRH/12FRH/20FRH series)" and the Page 75, "3.5 Installing the hand output cable" together.

And, operate after turning OFF the power supply of the controller.

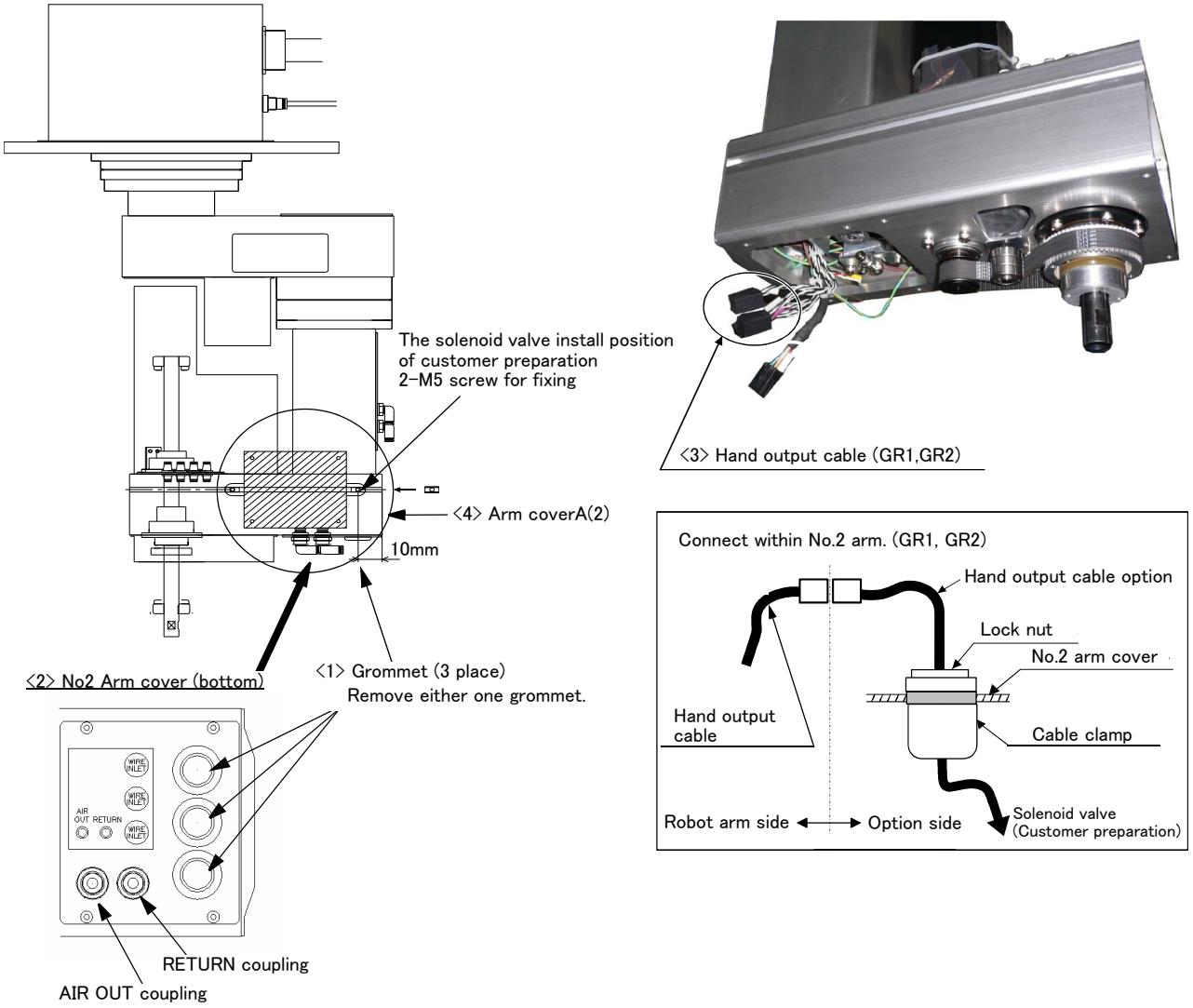


Fig.3-14 : Installing the hand output cable (RH-3FRHR series)

The connection summary of the hand output cable is shown in Fig. 3-14. The connection procedure is as follows. Operate after turning OFF the power supply of the controller.

1) Loosen the fixing screw and remove the No.2 arm cover <2> and the arm cover A(2) <4>. Since the air tube is connected, No.2 arm cover <2> is completely inseparable.
2) Remove one of the three grommets on No.2 arm cover. (Install the cable clamp here)
3) Remove the lock nut of attachment on the hand output cable and let the connector side of hand output cable (with the cable clamp) pass through the hole of No.2 arm cover. Fixing securely with the lock nut removed.
4) Connect the connector of hand output cable optional to the hand output cable connector (GR1, GR2) <3> of robot arm side. Connect the same connector names.

Note : Please see the hand output cable from the arm cover A (2) <4> side, and store it outside the bracket. If the cable enters within the bracket, it will rub to the timing belt and will become the cause of breaking down.

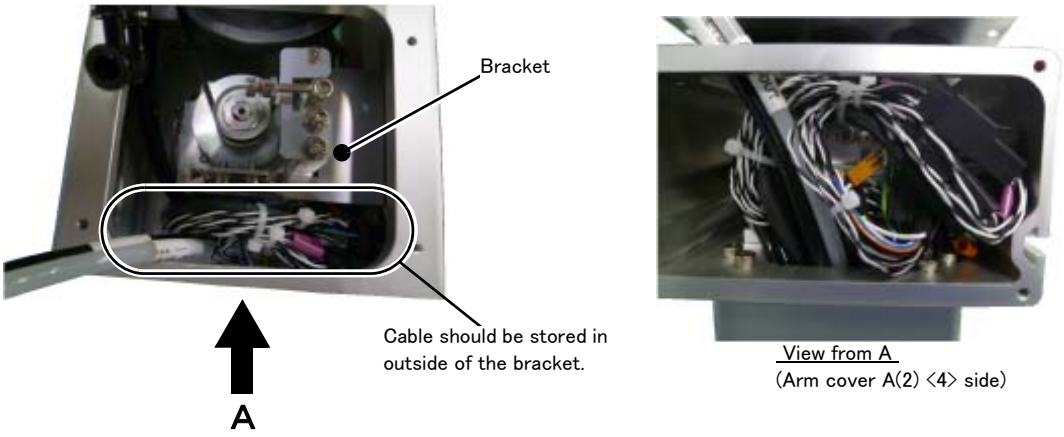


Fig.3-15 : Storing of the hand output cable

5) Install the No.2 arm cover <2> and arm cover A (2) <4> as before. Be careful not to catch any the cables.
6) Connect to the solenoid valve of customer preparation the hand output cable taken out from No.2 arm cover <2>

The installation of the hand output cable is completion above.

3.6 Changing the operating range

(1) RH-3FRH/6FRH/12FRH/20FRH series

The operating ranges of J1 axis can be limited. Change the mechanical stopper and the operating range to be set inside of that area.

If the operating range must be limited to avoid interference with peripheral devices or to ensure safety, set up the operating range as shown below.

(2) Operating range changeable angle

The operating range must be set up at angels indicated by Table 3-3.

Table 3-3 : Operating range changeable angle

	Type Note1)	Direction Note2)	Standard	Change angle Note3) Note4)	
RH-3FRH/6FRH series					
J1	RH-3FRH35*/45*/55* RH-6FRH35*/45*/55*	+ side	+170 deg	+150 deg	+130 deg
		Mechanical stopper angle	+172.3 deg	+152.3 deg	+132.3 deg
		Mechanical stopper position	P10	P11	P12
		- side	-170 deg	-150 deg	-130 deg
		Mechanical stopper angle	-172.3 deg	-152.3 deg	-132.3 deg
		Mechanical stopper position	P10	N11	N12
RH-12FRH/20FRH series					
J1	RH-12FRH55*/70*/85* RH-20FRH85*/100*	+ side	+170 deg	+150 deg	+130 deg
		Mechanical stopper angle	+173.3 deg	+153.3 deg	+133.3 deg
		Mechanical stopper position	P10	P11	P12
		- side	-170 deg	-150 deg	-130 deg
		Mechanical stopper angle	-173.3 deg	-153.3 deg	-133.3 deg
		Mechanical stopper position	P10	N11	N12

Note1)The "*" of the robot type indicates up/down stroke length and environment specification. It is possible to change the movement ranges shown in Table 3-3 for any model.

Note2)Refer to Fig. 3-16 for mechanical stopper position.

Note3)The changeable angle shown in Table 3-3 indicates the operation range by the software. The mechanical stopper angle in the table shows the limit angle by the mechanical stopper. Use caution when layout designing of the robot.

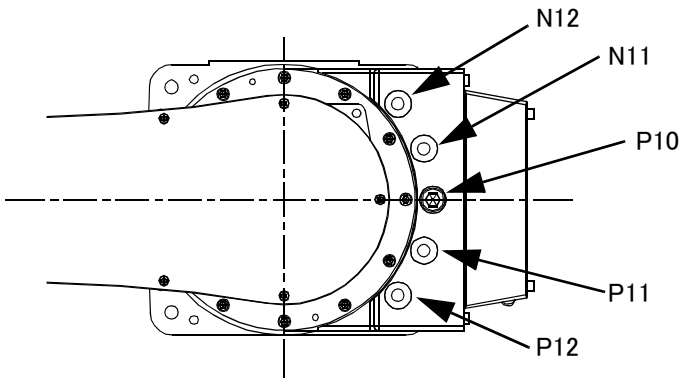
Note4)The changeable angle can be set independently on the + side and - side.

(3) The change method of the operating range

■ Installation of the mechanical stopper

1) Turn off power to the controller.

2) Install the hexagon socket bolt in the screw hole to the angle to set up referring to Table 3-3 and Fig. 3-16. About the mechanical stopper position and the relation of bolt size is shown in Fig. 3-16. When the screw hole is covered by the arm, move the No.1 armslowly by hand.



Installation bolt:
Hexagon socket head cap screw
- RH-3FRH/6FRH series: M10 x 20
- RH-12FRH/20FRH series: M12 x 20

* Changing the operating range is prepared optional.

Fig.3-16 : Mechanical stopper position

■ Change the operating range parameters

Specify the operating range to parameters MEJAR with appropriate values (variable angles given in Table 3-3) by the following steps:

1) Turn on power to the controller.

2) Set up the operating range changed into parameter MEJAR
MEJAR: (J1 minus (-) side, J1 plus (+) side, ☐ , ☐ , ☐ , ...).

■ Change the mechanical stopper origin position parameters

If you have changed operating range on the J1 minus(-) side, change mechanical stopper origin position parameters by the following step:

1) Set MORG parameter to the angle which set mechanical stopper position.
MORG: (J1 mechanical stopper angle, ☐ , ☐ , ☐ , ...).

■ Check the operating range

After changing the parameter, turn off the controller power and turn on again. Then, move the axis changed by joint jog operation to the limit of the operating range.
Confirm that the robot stops by limit over at the changed angle.

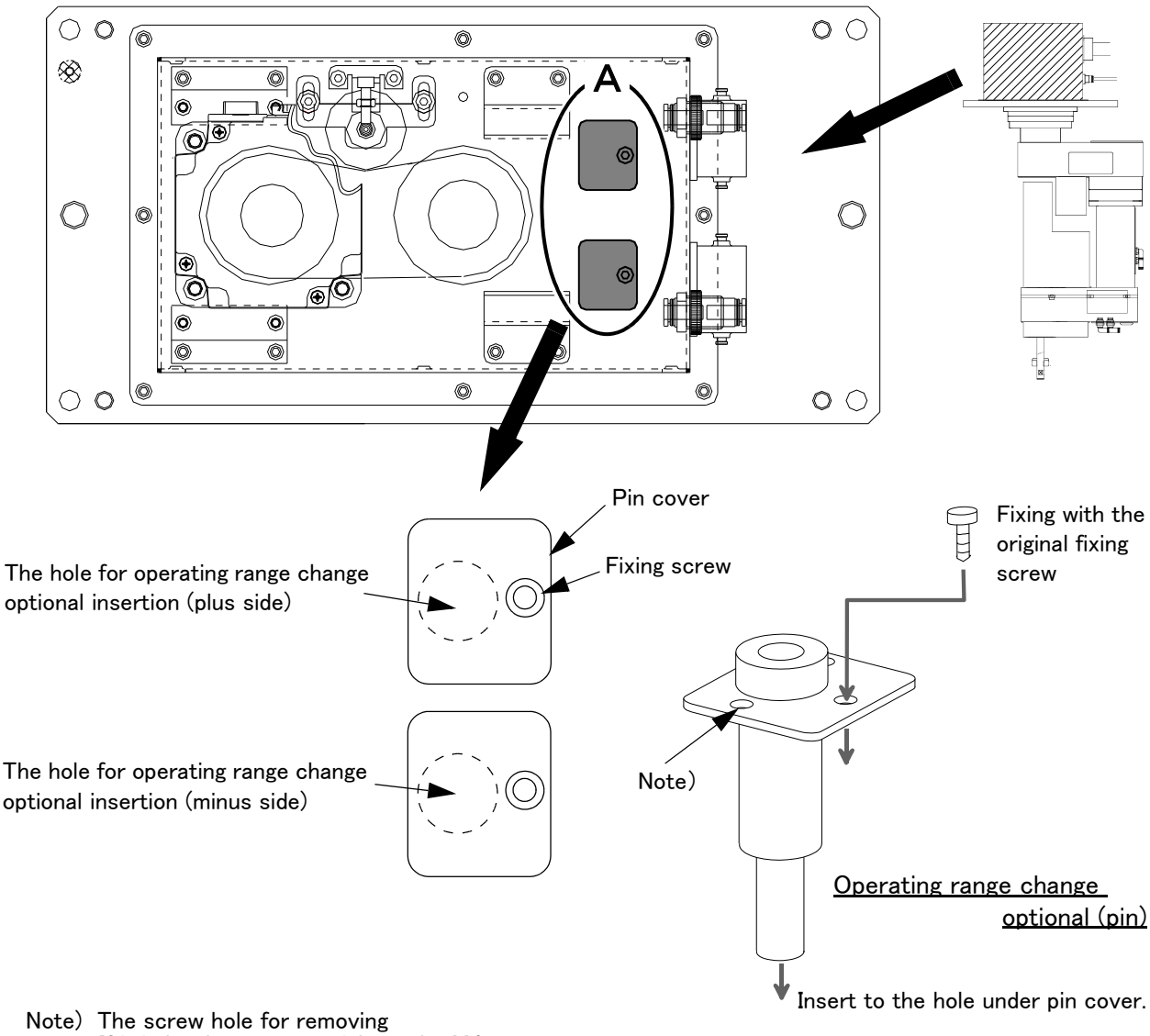
The changing of the operating range is completed.

(4) RH-3FRHR series

The operating range change optional installing method is shown below.
The jog operation is necessary for this option installing. Installing this option after installing the robot and completing origin setting. The procedure is shown below.
Note) Be sure to install the operating range change optional according to the procedure. If the procedure is mistaken, changing the operating range will not be correctly made.

3.6.1 Operating range change of J1 axis

Upper face in base



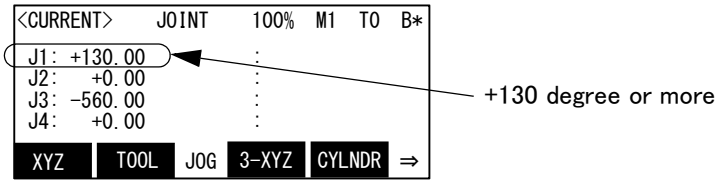
Note) The screw hole for removing
If it is hard to remove, tighten the M4 screw (customer preparation) for easy removal.

Fig.3-17 : Installation of J1 axis operating range change optional

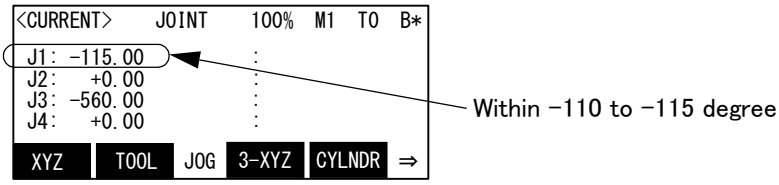
1) Turn OFF the power supply of the controller.
2) Remove base cover B(L) and (R) with referring to the Page 101, "5.3.2 Installing/removing the cover".
3) There is the pin cover at back in the base.("A" of Fig. 3-17. Two places)
Loosen the fixing screw and remove the two pin covers both.(Although the removed pin cover is unnecessary, use the screw for fixing this option later)
4) Move the J1 axis by jog operation. Once turn ON the power supply of the controller. Move the J1 axis 3 times by joint jog operation, confirming the coordinate value of T/B as follows.

Note : This operation is necessary for position adjustment of the mechanism stopper. Although it is not alteration visible especially, performs sure. Because to move correctly, move at 10% or less speed.

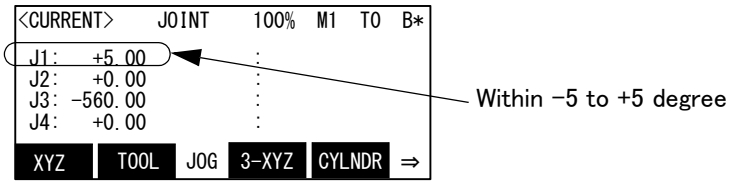
a) First, move to +130 degree or more.



b) Next, move within −110 to −115 degree.



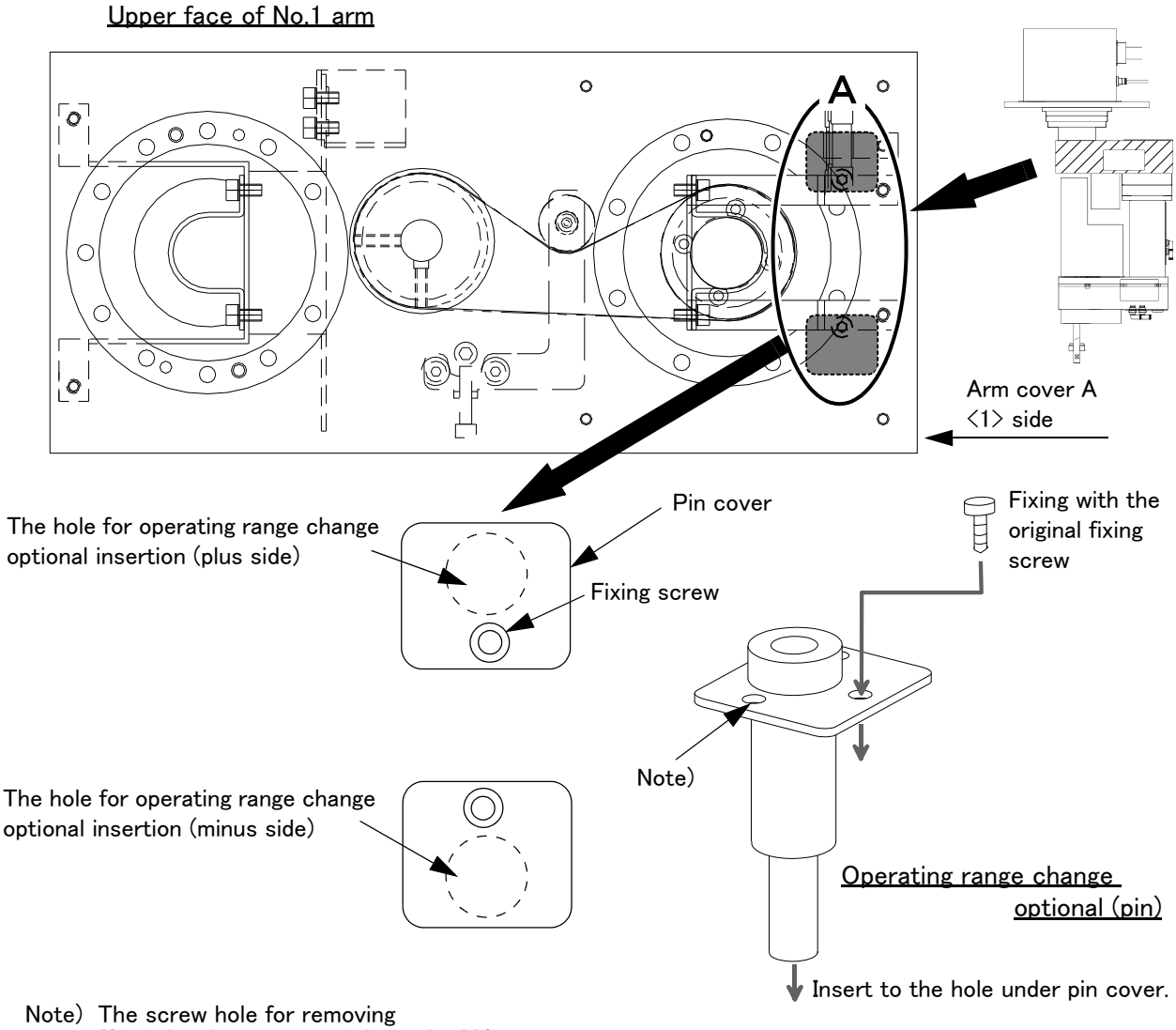
c) Finally stop within −5 to +5 degree.
(Position adjustment of the mechanism stopper is completed now)



5) Turn OFF the power supply of the controller.
6) Install operating range change optional (calls as pin henceforth).
Insert the pin in the holes of plus side and minus side each under the two removed pin covers. (Both of the pin are the same.) Fixing the pin with the fixing screw removed before in the original screw hole securely.
7) Confirm whether the mechanism stopper is installed correctly.
turn on the power supply of the controller.
8) With servo off, move the J1 axis to the mechanism stopper of plus side by hand. (Position at which it stops by the mechanism stopper)
9) Confirm the current coordinate value.
Press the [JOG] key of T/B and display the current coordinate value. (Choose joint jog mode)
If the coordinate value of the J1 axis is nearly +90 degrees, the mechanism stopper is installed correctly.
10) Confirm the minus side in the same way.
If not installed correctly, please reinstall the pin.
11) Install the base cover B(L) and (R) as before.
12) Setting the operation range parameter. Turn on the power supply of the controller.
Parameter: MEJAR..... Set "−90" and "+90" as the 1st element and the 2nd element each.
Parameter: MORG..... Set "+93" as the 1st element.
*Refer to the separate manual "Detailed Explanation of Functions and Operations" (Operation of maintenance screen, Movement parameter) for details of operation
13) Confirm movement. Turn off the controller power supply once.
14) Confirm that the J1 axis does not move the +/− 90 degree or more with joint jog operation.

The operating range change of J1 axis is completion above.

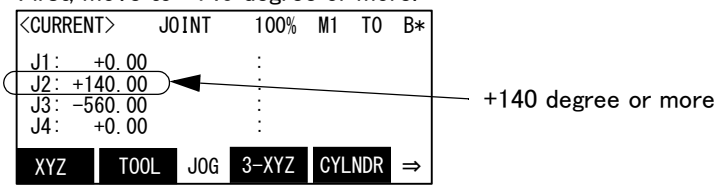
3.6.2 Operating range change of J2 axis



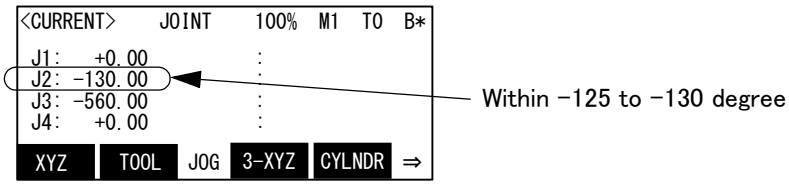
Note) The screw hole for removing
If it is hard to remove, tighten the M4 screw
(customer preparation) for easy removal.

Fig.3-18 : Installation of J2 axis operating range change optional

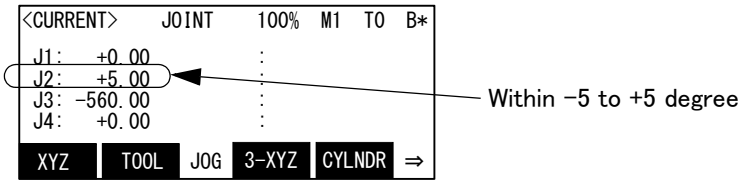
1) Turn OFF the power supply of the controller.
2) Remove arm cover A (1) with referring to the Page 101, "5.3.2 Installing/removing the cover".
3) There is the pin cover in the No.1 arm.("A" of Fig. 3-18. Two places)
   Loosen the fixing screw and remove the two pin covers both.(Although the removed pin cover is unnecessary, use the screw for fixing this option later)
4) Move the J2 axis by jog operation. Once turn ON the power supply of the controller. Move the J2 axis 3 times by joint jog operation, confirming the coordinate value of T/B as follows.
   Note : This operation is necessary for position adjustment of the mechanism stopper. Although it is not alteration visible especially, performs sure. Because to move correctly, move at 10% or less speed.
   a) First, move to +140 degree or more.



b) Next, move within −125 to −130 degree.



c) Finally stop within −5 to +5 degree.
(Position adjustment of the mechanism stopper is completed now)



5) Turn OFF the power supply of the controller.
6) Install operating range change optional (calls as pin henceforth).
Insert the pin in the holes of plus side and minus side each under the two removed pin covers. (Both of the pin are the same.) Fixing the pin with the fixing screw removed before in the original screw hole securely.
7) Confirm whether the mechanism stopper is installed correctly.
turn on the power supply of the controller.
8) With servo off, move the J2 axis to the mechanism stopper of plus side by hand. (Position at which it stops by the mechanism stopper)
9) Confirm the current coordinate value.
Press the [JOG] key of T/B and display the current coordinate value. (Choose joint jog mode)
If the coordinate value of the J2 axis is nearly +60 degrees, the mechanism stopper is installed correctly.
10) Confirm the minus side in the same way.
If not installed correctly, please reinstall the pin.
11) Install the arm cover A (1) as before.
12) Setting the operation range parameter. Turn on the power supply of the controller.
Parameter: MEJAR..... Set "−60" and "+60" as the 3rd element and the 4th element each.
Parameter: MORG..... Set "+63" as the 2nd element.
*Refer to the separate manual "Detailed Explanation of Functions and Operations" (Operation of maintenance screen, Movement parameter) for details of operation
13) Confirm movement. Turn off the controller power supply once.
14) Confirm that the J2 axis does not move the +/− 60 degree or more with joint jog operation.

The operating range change of J2 axis is completion above.

3.7 Hand internal wiring and piping set (RH-3FRH/6FRH/12FRH/20FRH series)

Remove the No. 2 arm cover U and fix this option to the plate on the No. 2 arm.
Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover"for removing/ installing the cover.

(1) Installation procedure

The installation procedure is shown below.
Refer to the installation diagram shown from the next section, and perform the installation correctly. Installation diagram of RH-3FRH series is shown in Fig. 3-19, and RH-6FRH series is shown in Fig. 3-20, RH-12FRH/20FRH series is shown in Fig. 3-21.

1) Move the J3 axis to the top end with a jog operation and shut off the controller's power supply. This is necessary for space standard settings when feeding the air hose and hand input cable through the inside of the shaft.
2) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
3) Pass the tool (hand) side of the secondary piping air hoses and hand input cables through the shaft. Make sure that the air hoses and the cables are not twisted or crossed.
4) Fix the air hoses and the cables with a cable tie so as to position the end of the expanding sleeve 10mm away from the opening of the shaft.
5) The highest point of the curved section of the air hoses and cables should be matched up with the top of the fixing plate.

⚠CAUTION If the air hoses and the cables are not long enough or too long, when the robot operates, excessive bending and friction with the shaft upper end or the cover may result in a break or abnormal operations of the tool (hand).

6) In the state of the steps 4) and 5), fix the air hoses and the cables to the (a) and (b) portions of the plate with cable ties. For the (a) portion, wrap the air hoses and the cables with cushion rubber before fixing.
7) Cut the secondary piping air hoses in appropriate length, and connect the air hoses to the solenoid valve. The diagram shows the connection to the optional solenoid valve as an example. The air hoses can also be pulled out from the rear of the No. 2 arm by using another option: an external wiring and piping box. For the details, refer to Page 89, "3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)".
For the connection to the optional solenoid valve, connect the air hoses to the A and B ports of the solenoid valve.
8) When using the hand input cable connect the connectors (HC1, HC2) of optional hand input cable to connectors (HC1, HC2) of robot side. Connect with the same names. The connectors of robot side and cables are tied up by cable tie at (c) portion. Cut the cable tie and pull them out.
The connected connectors are stored to the (c) portion.
When the hand input cable is not used tie up the connector and fix to the plate by cable tie.

⚠CAUTION Do not remove the cable ties which fixing connectors.
Fix the plate on the No. 2 arm, other cables and air hoses with cable ties. In this way, the internal cables and connectors do not touch the plate edge and others, or break due to the vibration during the robot operation (Refer to Page 91, "3.9 Connector protection when the option devices are installed").

9) Carry out piping and wiring on the tool side.
Fix the air hoses and the cables, which are pulled out from the shaft lower end, to the hand side. Check again that the highest point of the curved section of the air hoses and the cables reaches the height of the fixing plate upper end, and then fix the air hoses and the cables at the outlet of the shaft. In the case of oil-mist and clean specification models, to avoid mists entering and ensure the cleanliness level, use liquid gasket and others to seal the outlet on the shaft tip where the air hoses and the cables are pulled out.
10) Apply silicon grease to the contact surface between the air hoses of the fixing plate and the cables, the cable sliding portion from the shaft upper end to the fixed portion, and the opening on the shaft upper end.
11) Power on the controller, perform the jog operation for the J3 and J4 axes, and check that the air hoses and the cables do not interfere with other components.

⚠CAUTION Do not power on the controller when the internal cables are connected to the connectors on the robot.
If the end of the cables on the tool side is not processed, troubles such as fuse blown by ground fault or short circuit may occur. Check that the end of the cables has been processed before powering on the controller.

12) Turn off the controller's power supply, then install the No.2 arm cover U securely as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
When installing the cover, check that no air hose or cable is pinched, and no air hose is bent.
Note) The installation surface of a clean and a oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please contact dealer when the sealing material needs to be replaced.

The installing of the hand internal wiring and piping set is completed.

(2) RH-3FRH series

Refer to Page 84, "(1) Installation procedure" and install cables and air hoses correctly. The numbers in Fig. 3-19 are correspond to the same numbers in "(1)Installation procedure".

Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

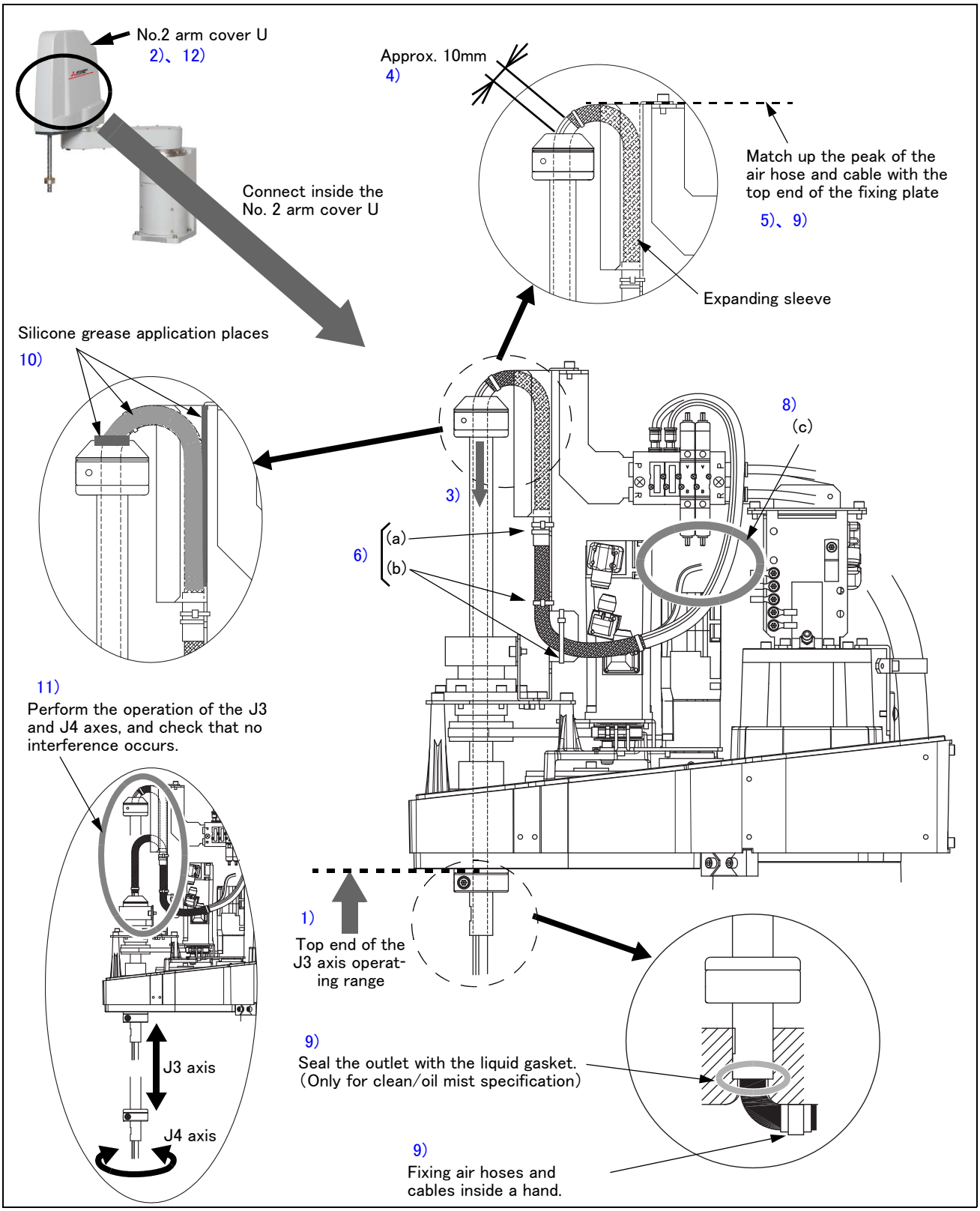


Fig.3-19 : Installing the hand internal wiring and piping set (RH-3FRH series)

(3) RH-6FRH series

Refer to Page 84, "(1) Installation procedure" and install cables and air hoses correctly. The numbers in Fig. 3-20 are correspond to the same numbers in "(1)Installation procedure".

Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

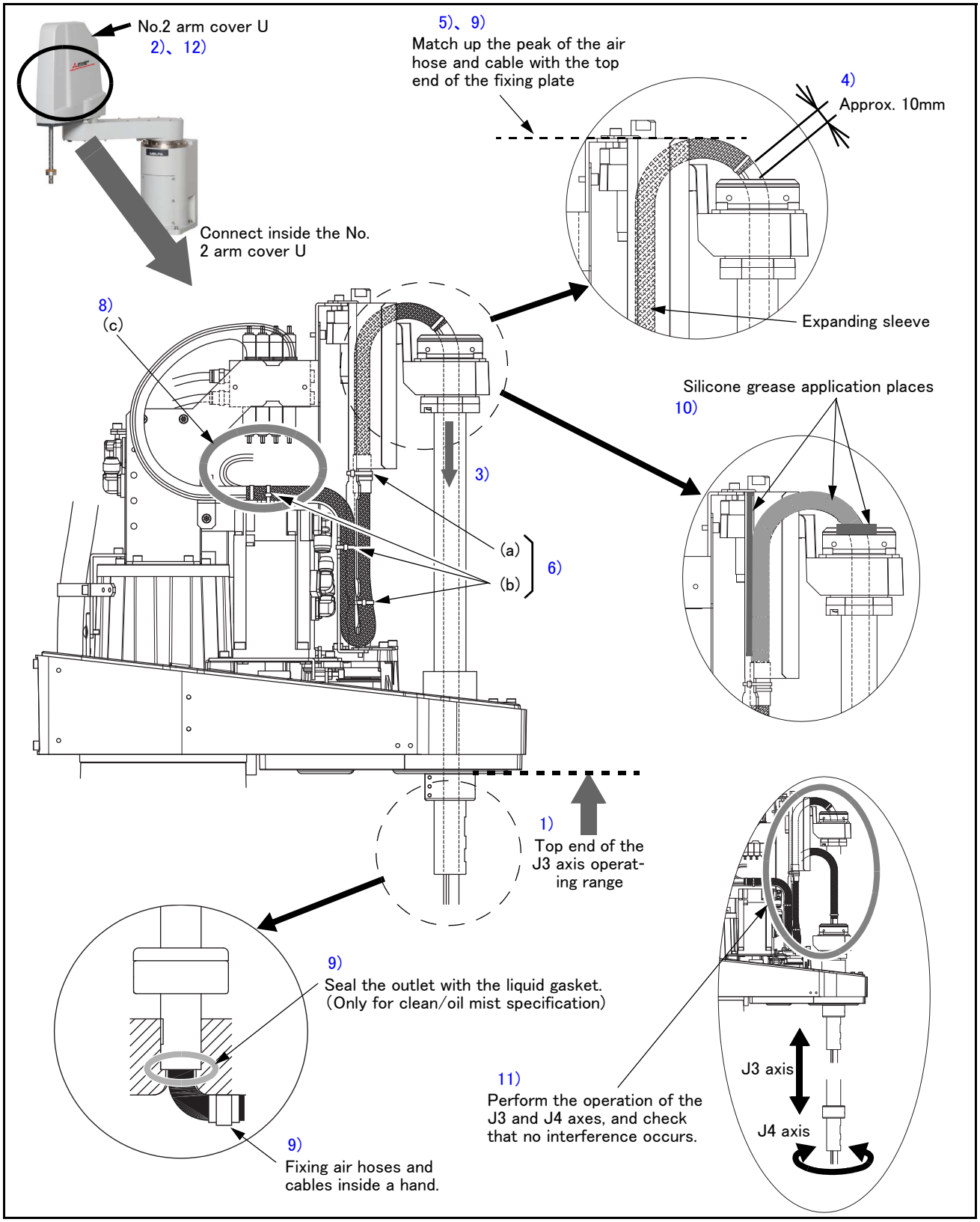


Fig.3-20 : Installing the hand internal wiring and piping set (RH-6FRH series)

(4) RH-12FRH/20FRH series

Refer to Page 84, "(1) Installation procedure" and install cables and air hoses correctly. The numbers in Fig. 3-21 are correspond to the same numbers in "(1)Installation procedure".

Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

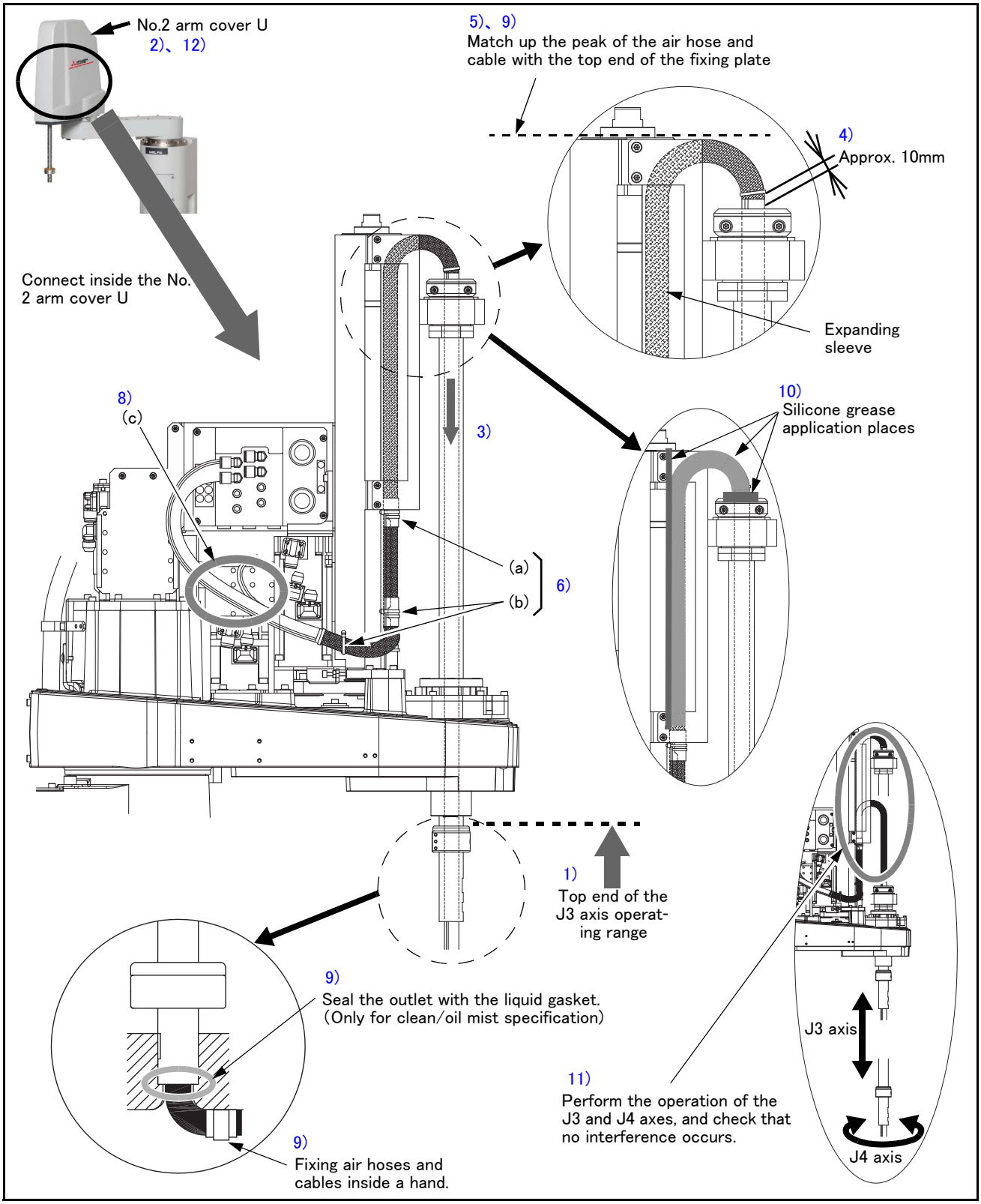


Fig.3-21 : Installing the hand internal wiring and piping set (RH-12FRH/20FRH series)

3.8 External Wiring and Piping Box (RH-3FRH/6FRH/12FRH/20FRH series)

The air hose that is connected inside the robot, the optional hand output cable, the hand input cable, etc., can all be pulled out from the rear of the No. 2 arm.
These can be used to connect a customer supplied solenoid valve to the hand output cable, etc.

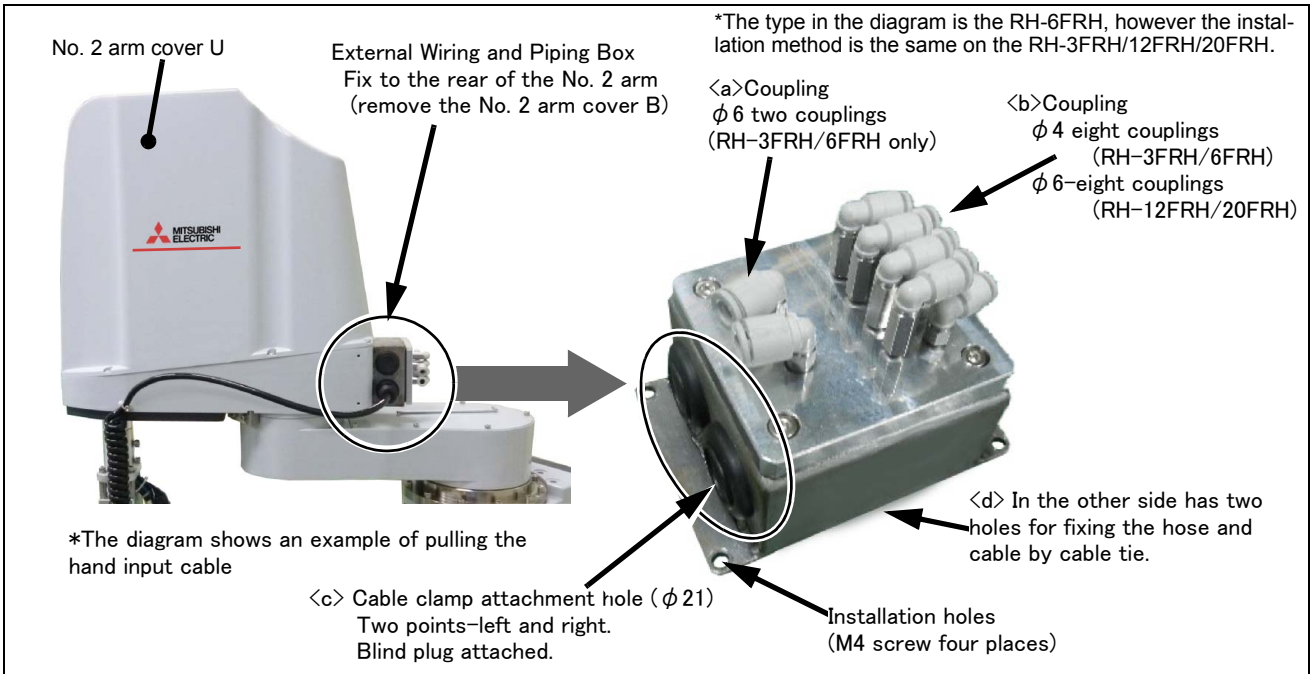


Table 3-4 : Hose and cables which can be pulled out

No	Air hoses/cables	Position to pull out			Example usage
			RH-3FRH/6FRH	RH-12FRH/20FRH	
(1)	Primary piping air hose (φ6-2 hoses) (The primary piping is equipped from rear of base to No. 2 arm)	<a>	Coupling φ6 two couplings	Coupling <b> φ6 two couplings	Primary air supply to externally installed solenoid valve.
(2)	Secondary piping air hose (φ4-8 hoses: RH-3FRH/6FRH, φ6-8 hoses: RH-12FRH/20FRH) (Air hose of the optional hand internal wiring and piping set or prepared by the customer)	<b>	Coupling φ4 eight couplings	Coupling φ6 eight couplings	Taking in the secondary air from externally installed solenoid valve. Pulling out the secondary air from optional solenoid valve.
(3)	Optional hand output cable	<c>	φ21 hole four place	φ21 hole four place	For driving the externally installed solenoid valve.
(4)	Optional hand input cable				Taking in the input signals from tools such as the hand.

Note) Fix all with cable tie (sections <d> and <e> of the diagram)

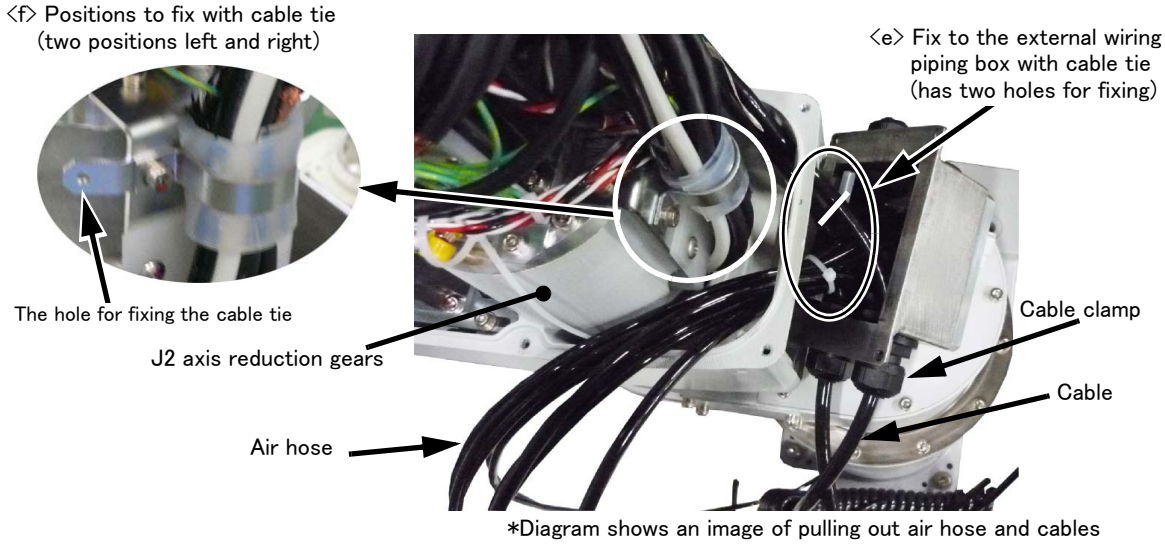


Fig.3-22 : External Wiring and Piping Box

Fig. 3-22 shows the installation procedure for the external wiring and piping box. The procedure is the same in RH-3FRH/6FRH/12FRH/20FRH. Remove the No. 2 arm cover B and install this option using the same screw holes. The installation procedure is shown below.
Turn the controller's power OFF before this operation. Refer to Page 101, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

1) Remove the each fixing screws and remove the No. 2 arm cover U and the No. 2 arm cover B.
2) Pull out the air hoses or cables from the opening which removed the No. 2 arm cover B.
3) Fix (or connect) the air hoses and cables to this option box.
   Previously adjust the air hose and cables to an appropriate length. Make sure that the wiring and piping lines avoid the side of the J2 reducer (because gap is narrow, it interfere with the No. 2 arm cover U).
   Connect the air hoses with the joint inside this option box.
   Remove the blind plug attached to this option box and fix the cable with the cable clamp.

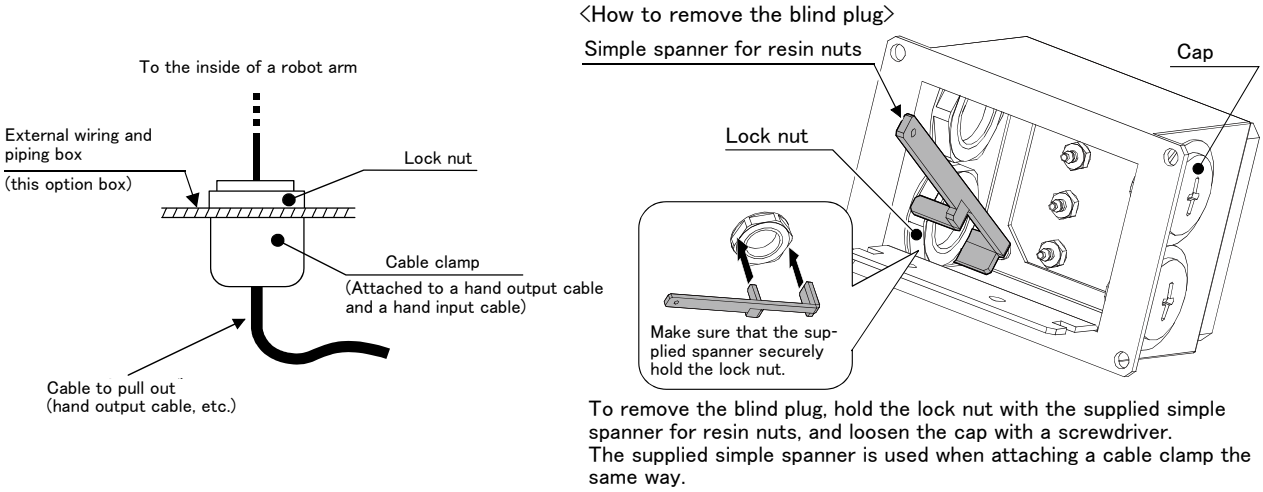


Fig.3-23 : Fixing the Cable

4) Fix the air hoses and cables to the hole inside of this box by using the attached cable tie. (section <e> of Fig. 3-22)
   Note) Be sure to fix the air hoses and cables to prevent the hoses falling out and breaking the cable. Also, fix carefully so that the air hose and cables may not be pulled too much.
5) Install securely the external wiring and piping box to the screw holes that previously installed the No. 2 arm cover B by attached screw. (tightening torque: 1.39 to 1.89Nm).
   When installing pull it little by little from the No. 2 arm side, making sure that the air hose and cables are not bent or trapped.
6) Make sure that the wiring and piping lines on the No.2 arm avoid the side of the J2 reducer (because gap is narrow, it interfere with the No. 2 arm cover U).
   Fix the hoses and cables to the hole shown in section <f> of Fig. 3-22 using cable tie. There are 2 holes, located left and right.
7) If the cables and the air hoses have excess length, please tie the excess section using cable tie.
8) Install securely the No.2 arm cover U as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
   Note) The installation surface of the clean and the oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please contact dealer when the sealing material needs to be replaced.
   In the case of oil-mist and clean specification models, to ensure the cleanliness level, use liquid gasket and others to seal the outlet on the shaft tip where the air hoses and the cables are pulled out.

The installing of the external wiring and piping box is completed.

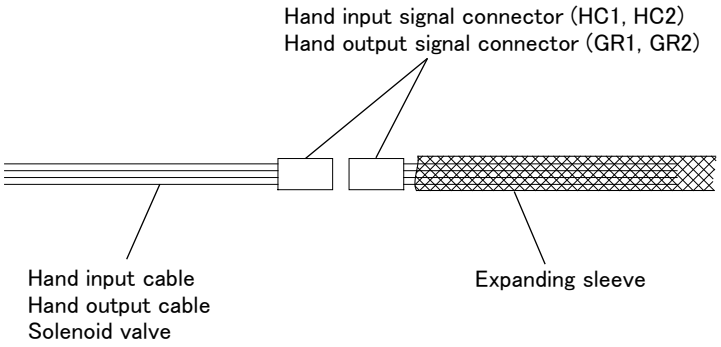
3.9 Connector protection when the option devices are installed

The connectors for the hand input and output cables are stored inside the No. 2 arm so that they do not rub against peripheral parts under the vibrations generated by the robot movement. When an option device is installed, the stored connectors are pulled out for connection to the option device. To avoid interference with peripheral parts, the connectors must be fixed.
Otherwise, the hand input or output cable may break.
The following shows an example of how to fix the connectors.

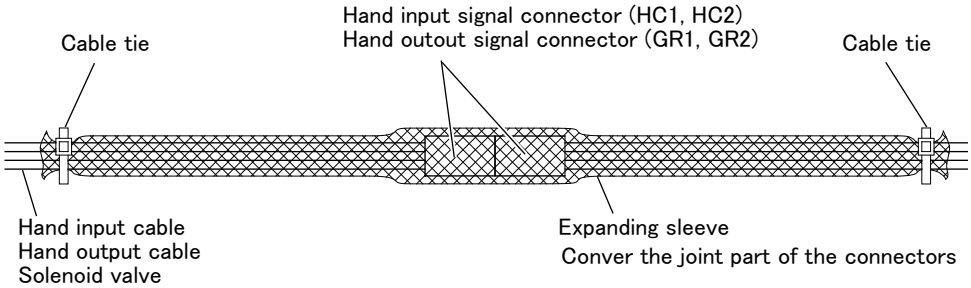
Table 3-5 : Customer prepared products

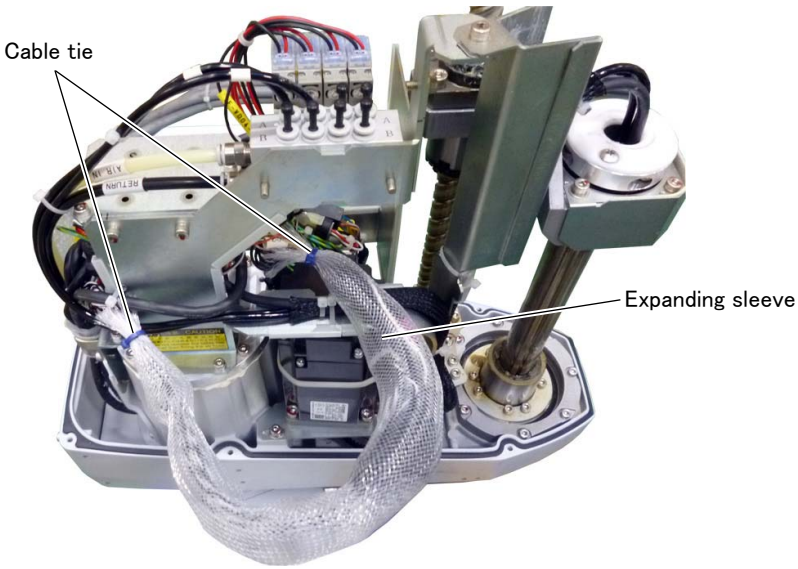
Name	Qty.	Recommended product (Manufacture)
Expanding sleeve	440mm	EXP-13-PT (Kitagawa Industries Co., Ltd.)
Cable tie	5 to 6 pcs.	T18R (HellermannTyton Co., Ltd.)

1) Before connecting the HC1 and HC2 connectors for the hand input signals and the GR1 and GR2 connectors for the hand output signals, insert the cables into the expanding sleeve.

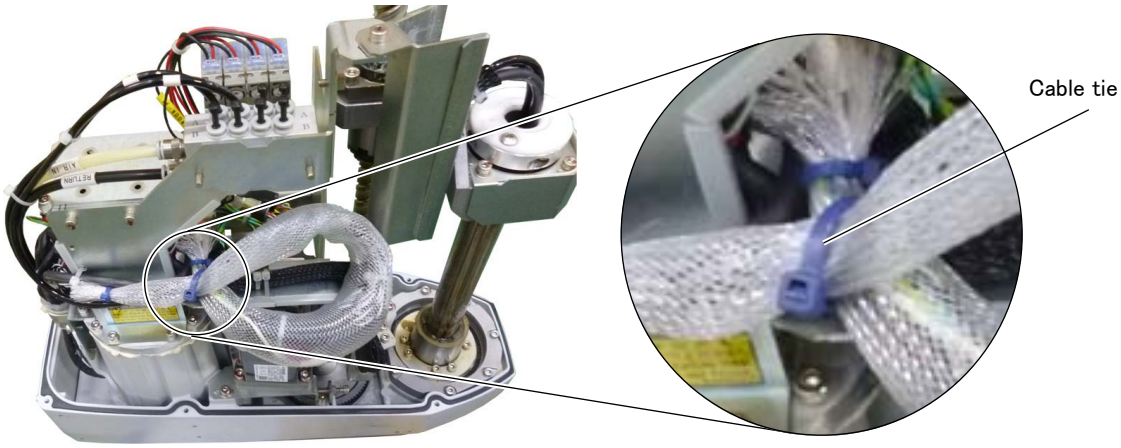


2) Connect the HC1 and HC2 connectors for the hand input signals and the GR1 and GR2 connectors for the hand output signals, and cover the joint part with the expanding sleeve.
Fix the cables with cable ties at the both ends of the expanding sleeve.



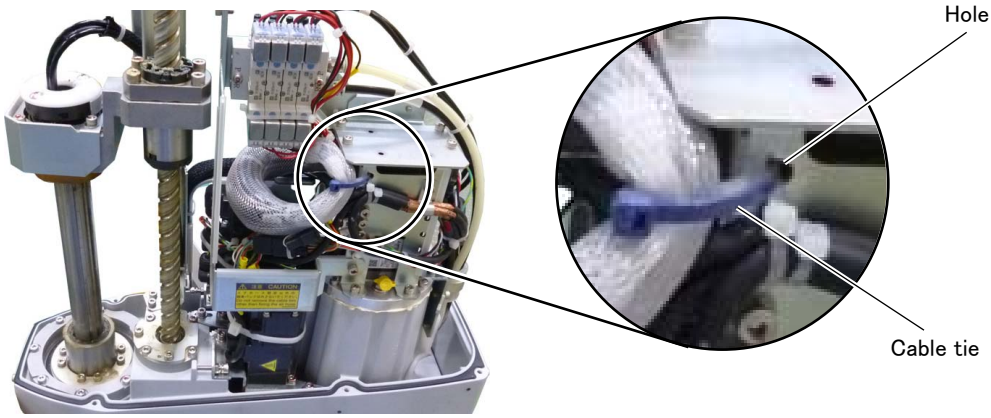


3) Arrange the expanding sleeve in a ring-like shape and fix it with a cable tie.



4) Store the expanding sleeve in the position shown in the figure below.

5) Fix the expanding sleeve with a cable tie using a hole on the metal plate.



Connector protection is completed.

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 Type of inspection and maintenance works

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.
Table 5-1 lists the type of inspection and maintenance works.

Table 5-1 : Type of inspection and maintenance works

No.	Type of inspection and maintenance works		Description	Operating time Note1)
1	Daily inspection		Inspection works to be performed every day before starting operation for the safe use of the robot.	-
2	Periodic inspection	Monthly inspection	Inspection and maintenance works to be performed every month.	Every 300hr
3		6-month inspection	Inspection and maintenance works to be performed every 6 months.	Every 1,800hr
4		2-year inspection	Inspection and maintenance works to be performed every 2 years.	Every 7,200hr
5		Battery replacement	Replacement of the backup battery of the robot. Replace the battery every year regardless of the operating hours.	-
6		Lubrication	Lubrication of each axis (including the shaft) of the robot. Refer to Page 130, "5.3.6 Lubrication" for the lubrication schedule.	-

Note1) The operating hours assume the robot operation of 15 hours per day for 20 days per month.
When the robot operates for 8 hours per day, the operating hours per month become about a half of the one under the above condition. Then, the monthly inspection is required every two months. To check the periodic inspection schedule and calculate the operating hours, refer to Page 97, "(2) 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

Table 5-2 shows the procedure and inspection items. If you notice any abnormal condition, take appropriate measures.

Table 5-2 : 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, foreign contamination or obstacles on the bellows? (For clean/oil mist/waterproof specification) (Visual)	Replace with a new bellows.
After turning the power ON (Turn the power ON while monitoring the robot.)		
1	Is there any abnormal motion or abnormal noise when the power is turned ON?	Follow the troubleshooting section.
During operation (try running with an original program)		
1	Check whether the movement points are deviated? Check the following points if there is any deviation. 1. Are any installation bolts loose? 2. Are any hand installation section bolts loose. 3. Are the positions of the jigs other than the robot deviated? 4. If the positional deviation cannot be corrected, refer to "Troubleshooting", check and remedy.	Follow the troubleshooting section.
2	Is there any abnormal motion or abnormal noise? (Visual)	Follow the troubleshooting section.

5.2.2 Periodic inspection

The inspection items and timings for the robot arm are shown below.

(1) Inspection item

Carry out periodic inspection given in Table 5-3.

Table 5-3 : Periodic inspection items (details)

Inspection item (details)	Remedies
Monthly inspection	
Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.
Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
6-month inspection	
Has the dust accumulated into bellows? (For clean/oil mist/waterproof specification. When environment with much dust)	Remove bellows and clean the inside. (Refer to Page 127, "5.3.5 Replacing the bellows" for how to remove bellows)
2-year inspection[Note1)]	
Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.
Is the timing belt tension value more than the guideline value? Does any position mismatch occur?	When the tension value becomes less than the guideline value, the timing belt must be replaced.
Battery replacemenet	
Replace the backup battery in the robot arm. Replace the battery every year regardless of the operating hours.	Replace it referring to Page 136, "5.3.7 Replacing the backup battery".
Lubrication	
Check the lubrication schedule for each axis, and perform lubrication. The lubrication schedule differs according to the model.	Lubricate it referring to Page 130, "5.3.6 Lubrication".
Is enough grease applied on the shaft? (Greasing is required approximately every 2000 km.)	

Note1) When the robot is operated 24 hours a day or with a heavy load, it is recommended to be inspected every 6 months (1,800hr).

(2) Schedule

The following shows the schedule for the periodic inspection works. Perform the periodic inspection works as appropriate according to the following table.

Operating time Note1)	Inspection schedule		Type of periodic inspection works Note2)				
	15 hours per day	8 hours per day	Monthly inspection	6-month inspection	2-year inspection	Battery replacement	Lubrication
300hr	1 month	2 months	○			Every year Note3)	As appropriate Note4)
600hr	2 months	4 months	○				
900hr	3 months	6 months	○				
1,200hr	4 months	8 months	○				
1,500hr	5 months	10 months	○				
1,800hr	6 months	12 months	○	○			
:	:		:				
3,600hr	12 months	24 months	○	○			
:	:		:				
7,200hr	24 months	48 months	○	○	○		
:	:		:				
10,800hr	36 months	72 months	○	○			

Note1)The following shows examples of calculation of the operating hours.

- Operating hours when the robot operates 15 hours per day for 20 days per month for three months:
  15 hr/day ×20 days/month ×3 months = 900hr
- Operating hours when the robot operates 8 hours per day for 20 days per month for three months:
  8 hr/day× 20 days/month × 3 months = 480hr … Approx. 500 hr

Note2)The item marked with the circle (○) is to be performed. According to the guideline of the operating hours, perform the inspection to check the items described in Table 5-3.

Note3)Replace the battery every year regardless of the operating hours.

Note4)Check the lubrication interval described in Page 130, "5.3.6 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 140, "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 is shown below.

(1) RH-3FRH series

1) The J1 axis is rotated by the J1 axis motor <1> and the reduction gears <2> in the base. Brakes are not mounted in the J1 axis motor <1>.
2) The J2 axis is rotated by the J2 axis motor <3> and the reduction gears <4> in the No. 2 arm. Brakes are not mounted in the J2 axis motor <3>.
3) The rotation of the J3 axis motor <8> arranged in the No.2 arm is conveyed to the ball screw spline via the timing belt <9> to move the J3 axis as up and down. Non-excitation magnetic brakes are mounted in the J3 axis motor <8>.
4) The rotation of the J4 axis motor <5> arranged in the No.2 arm is conveyed to the ball screw spline via the timing belt 1 <6> and the timing belt 2 <7> to rotate the J4 axis. Brakes are not mounted in the J4 axis motor.

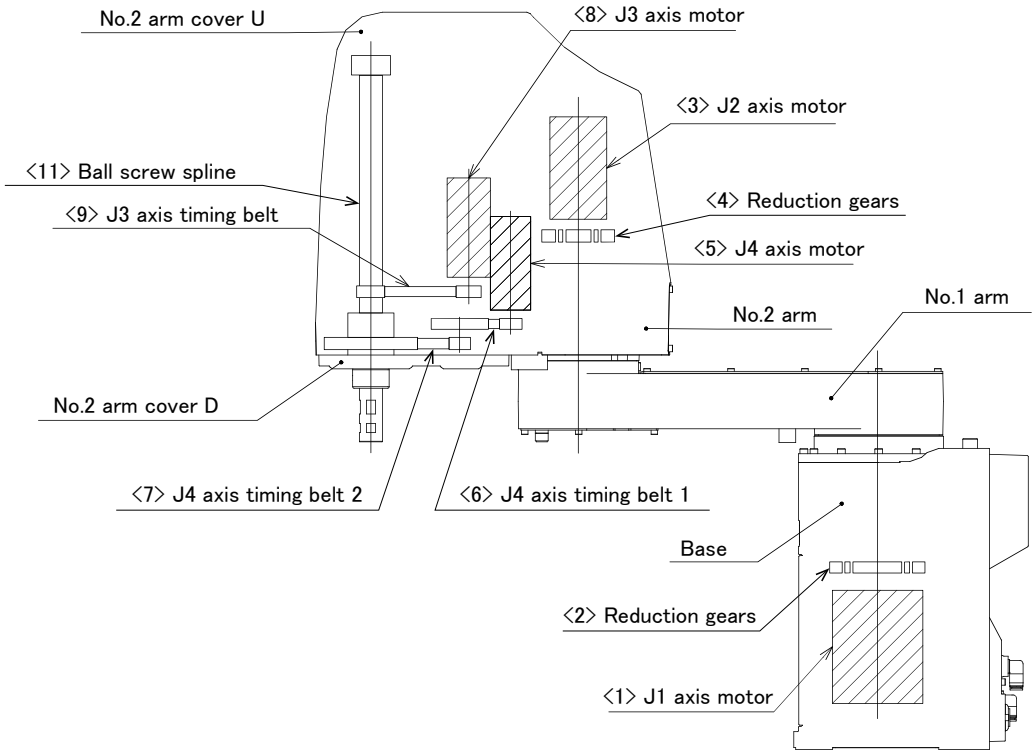


Fig.5-1 : Outline structure drawing of robot arm (RH-3FRH)

(2) RH-6FRH/12FRH/20FRH series

1) The J1 axis is rotated by the J1 axis motor <1> and the reduction gears <2> in the base. Brakes are not mounted in the J1 axis motor <1>.
2) The J2 axis is rotated by the J2 axis motor <3> and the reduction gears <4> in the No. 2 arm. Brakes are not mounted in the J2 axis motor <3>.
3) The rotation of the J3 axis motor <8> arranged in the No.2 arm is conveyed to the ball screw via the timing belt <9> to move the J3 axis as up and down. Non-excitation magnetic brakes are mounted in the J3 axis motor <8>.
4) The rotation of the J4 axis motor <5> arranged in the No.2 arm is conveyed to the ball spline via the timing belt 1 <6> and the timing belt 2 <7> to rotate the J4 axis. Brakes are not mounted in the J4 axis motor.

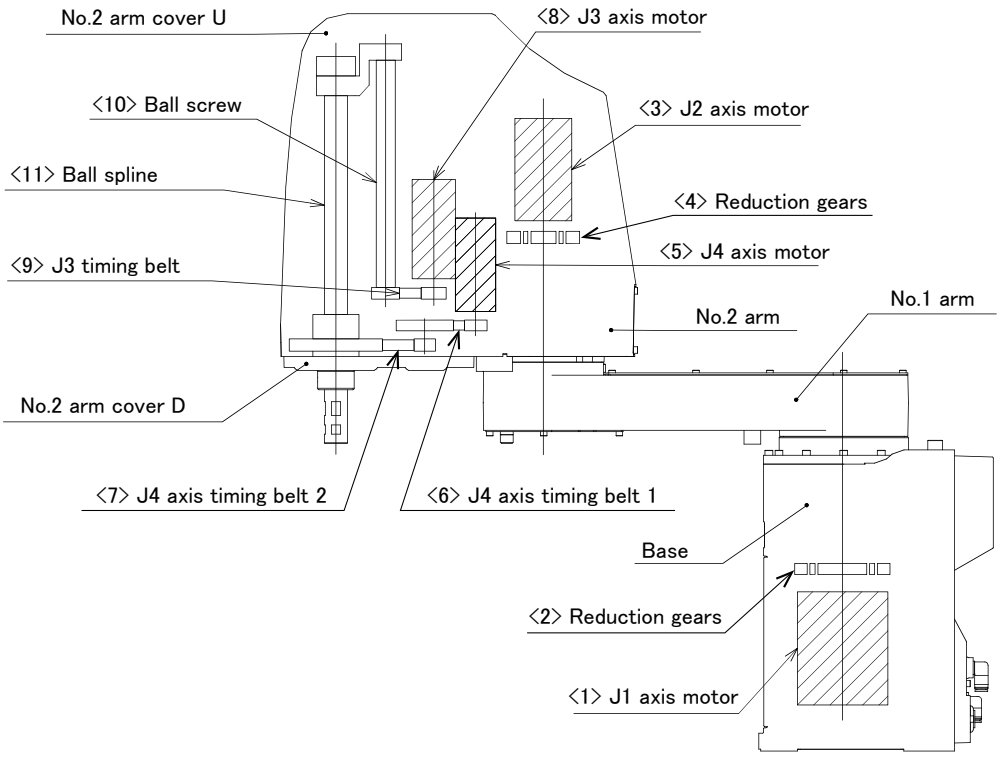


Fig.5-2 : Outline structure drawing of robot arm (RH-6FRH/12FRH/20FRH series)

(3) RH-3FRHR series

1) The rotation of the J1 axis motor <1> arranged in the base is conveyed to the reduction gears <3> via the timing belt <2> to rotate the J1 axis.
   Brakes are not mounted in the J1 axis motor.
2) The rotation of the J2 axis motor <4> arranged in the No.1 arm is conveyed to the reduction gears <6> via the timing belt <5> to rotate the J2 axis.
   Brakes are not mounted in the J2 axis motor.
3) The rotation of the J3 axis motor <7> arranged in the No.2 arm is conveyed to the shaft via the timing belt <8> to move the J3 axis as up and down.
   Non-excitation magnetic brakes are mounted in the J3 axis motor.
4) The rotation of the J4 axis motor <9> arranged in the No.2 arm is conveyed to the shaft via the timing belt (motor side) <10> and the timing belt (shaft side) <11> to rotate the J4 axis.
   Brakes are not mounted in the J4 axis motor.

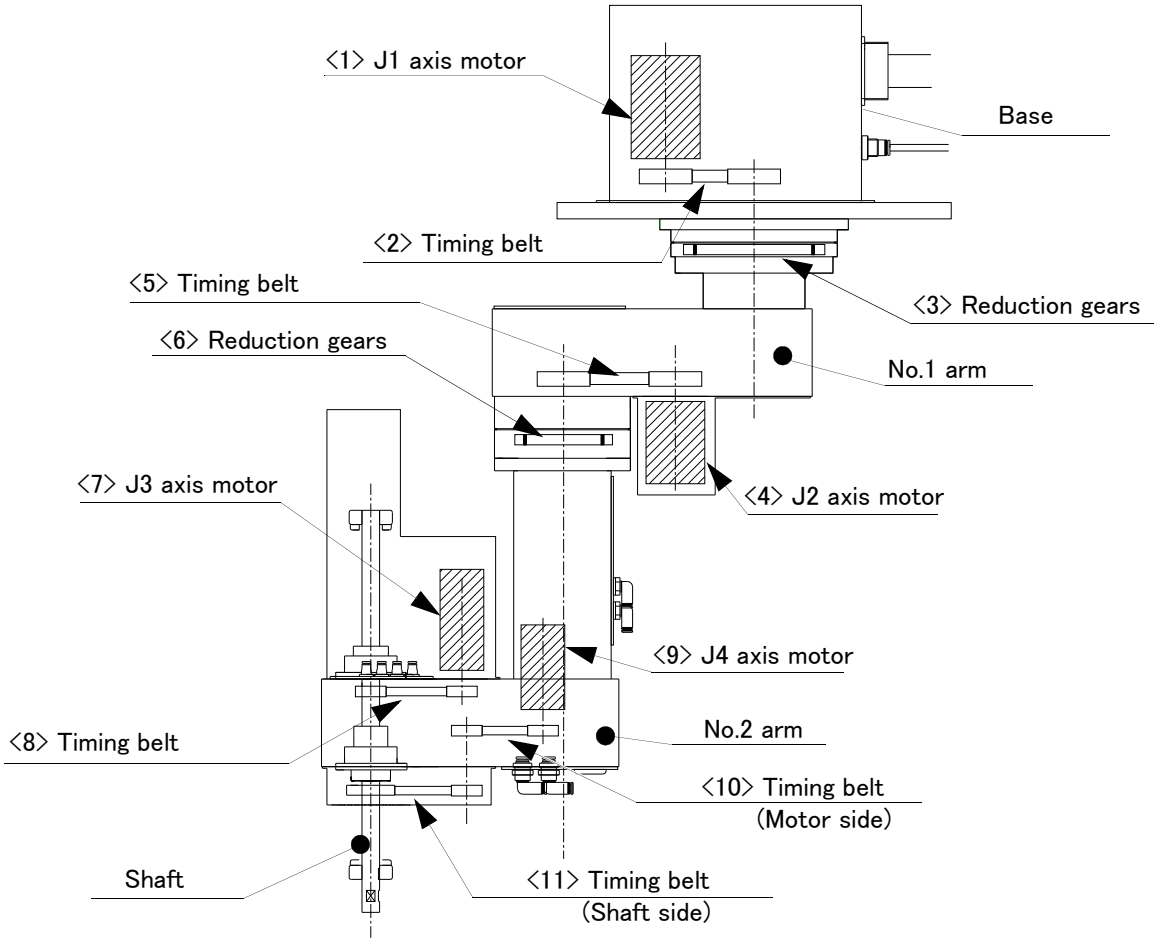


Fig.5-3 : Outline structure drawing of robot arm (RH-3FRHR series)

5.3.2 Installing/removing the cover
(1) RH-3FRH/6FRH/12FRH/20FRH series

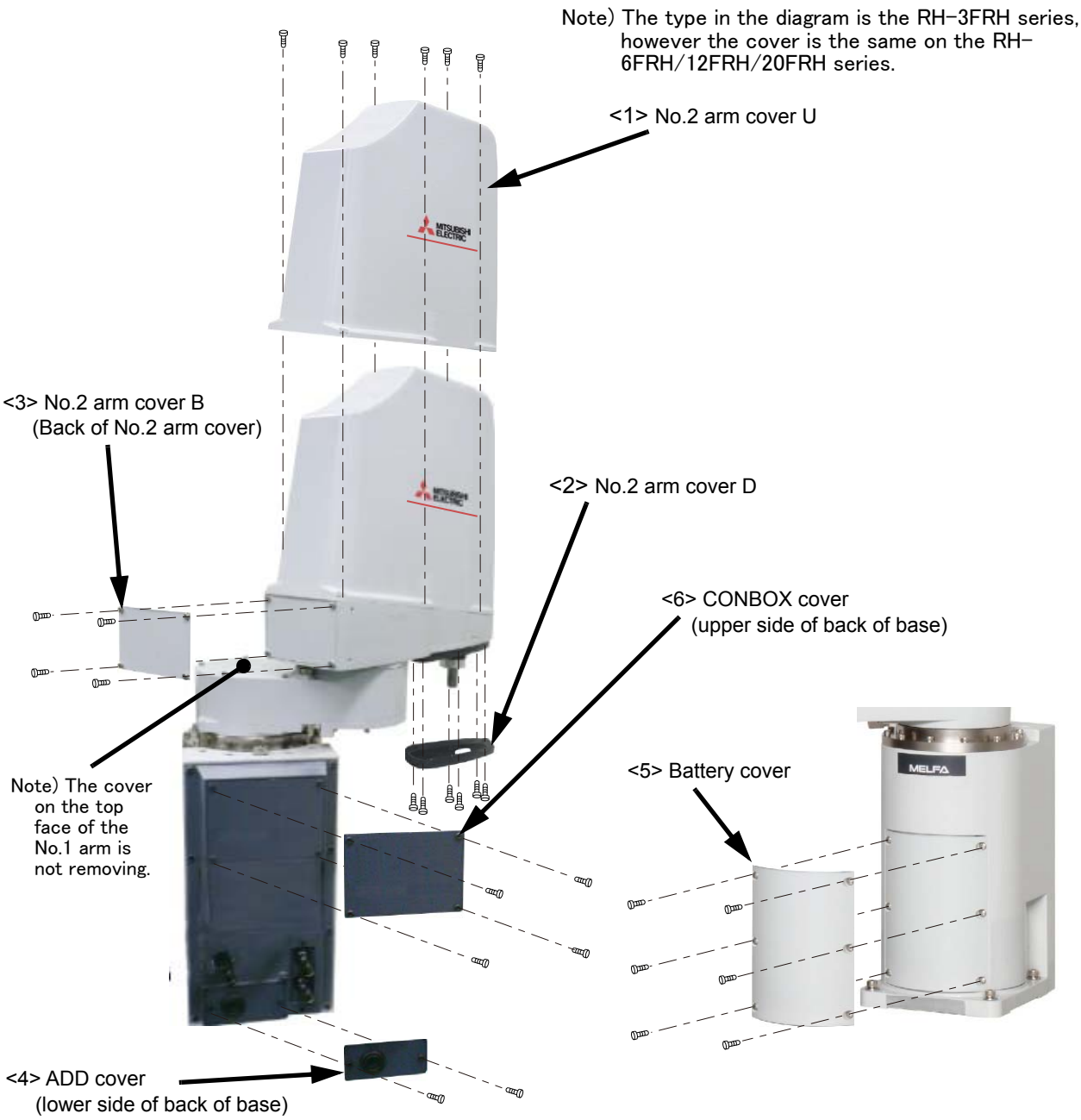


Fig.5-4 : Installing/removing the cover (RH-3FRH/6FRH/12FRH/20FRH series)

⚠ CAUTION

Check that the packing is not torn or separated while installing or removing the cover. If you find that the packing is torn or separated, contact the dealer. If you keep using the robot with the torn or separated packing, oil mist or the like may get into the robot, resulting in malfunction of the robot.

Table 5-4 : Cover name and installation screw list (RH-3FRH/6FRH/12FRH/20FRH series)

No.	Cover name	Installation screw name Note1)	Qty.	Remarks
<1>	No.2 arm cover U	Truss head screw, M4 x 10	6	RH-3FRH/6FRH series
		Truss head screw, M4 x 10	8	RH-12FRH series, RH-20FRH85** series
		Truss head screw, M4 x 10	10	RH-20FRH100** series
<2>	No.2 arm cover D	Truss head screw, M4 x 10	6	
<3>	No.2 arm cover B	Hexagon socket screw, M4 x 8	4	
<4>	ADD cover	Hexagon socket screw, M4 x 8	2	
<5>	Battery cover	Truss head screw, M4 x 10	6	
<6>	CONBOX cover	Hexagon socket screw, M4 x 8	4	

Note1)The fixing torque for each screw are 1.39-1.89Nm.

(1) Refer to Fig. 5-4, and remove the covers.
(2) The names of the cover and installation screw are given in Table 5-4. The number in Table 5-4 correspond to Fig. 5-4.
(3) When reattaching the covers after a maintenance inspection, proceed in the reverse order of their removal. Tightening the screw with the torque shown in Table 5-4.

[Note] Sealant is applied to the installation surface of cover in the oil mist and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape. Moreover, in the case of oil mist and clean specification models, it is necessary to remove the bellows.

(2) RH-3FRHR series

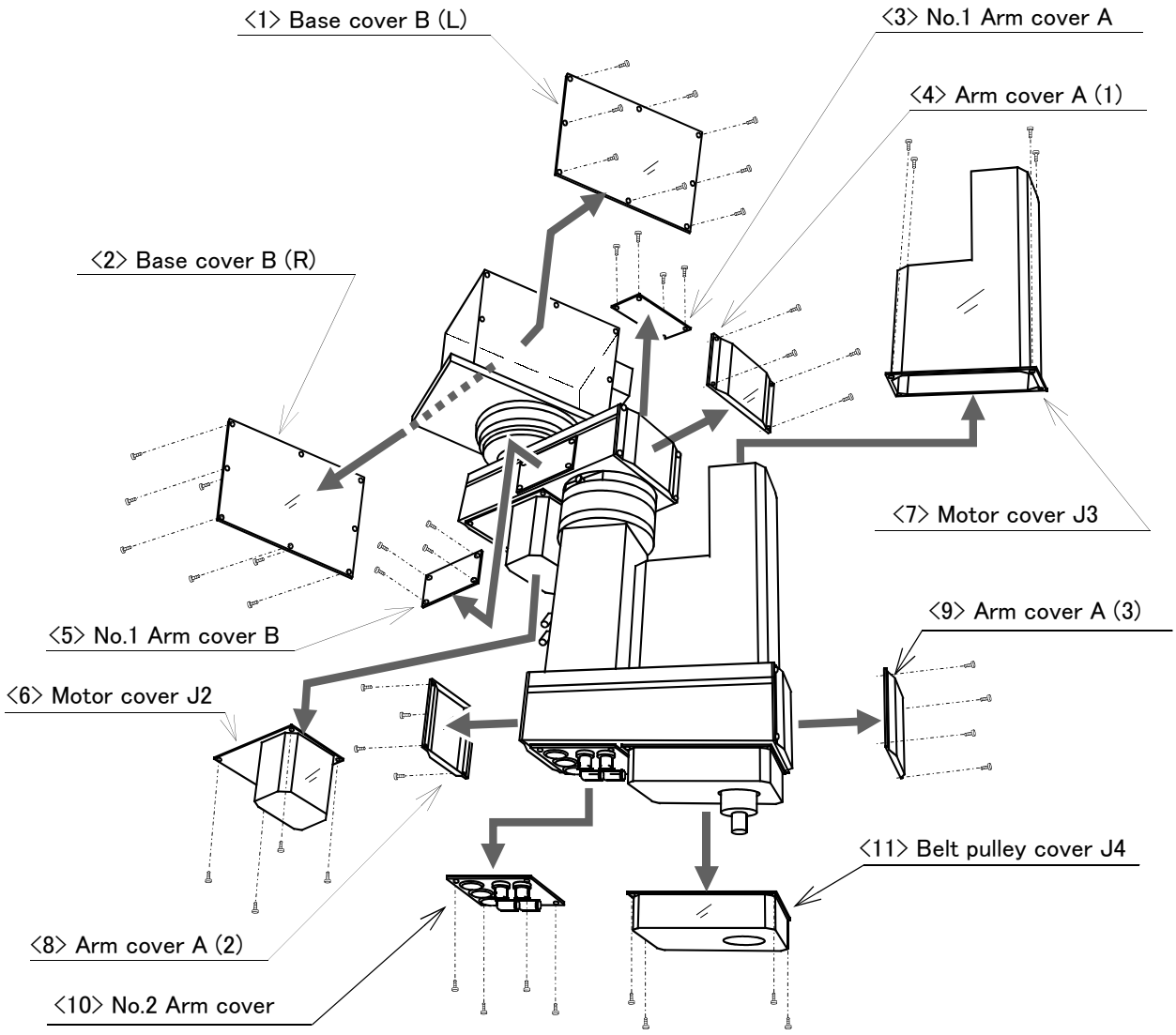


Fig.5-5 : Installing/removing the cover (RH-3FRHR series)

Table 5-5 : Cover name and installation screw list (RH-3FRHR series)

No.	Cover name	Installation screw name Note1)	Qty.	Remarks
General environment specification				
<1>	Base cover B (L)	Low head hexagon socket screw, M4 x 8	8	
<2>	Base cover B (R)	Low head hexagon socket screw, M4 x 8	8	
<3>	No.1 Arm cover A	Low head hexagon socket screw, M4 x 8	4	
<4>	Arm cover A (1)	Low head hexagon socket screw, M4 x 8	4	
<5>	No.1 Arm cover B	Low head hexagon socket screw, M4 x 8	4	
<6>	Motor cover J2	Low head hexagon socket screw, M4 x 8	4	
<7>	Motor cover J3	Low head hexagon socket screw, M4 x 8	4	
<8>	Arm cover A (2)	Low head hexagon socket screw, M4 x 8	4	
<9>	Arm cover A (3)	Low head hexagon socket screw, M4 x 8	4	
<10>	No.2 Arm cover	Low head hexagon socket screw, M4 x 8	4	
<11>	Belt pulley cover J4	Low head hexagon socket screw, M4 x 8	4	

No.	Cover name	Installation screw name Note1)	Qty.	Remarks
Clean/Waterproof specification				
<1>	Base cover B (L)	SUS hexagon socket screw, M4×10	8	With seal washer.
<2>	Base cover B (R)	SUS hexagon socket screw, M4×10	8	With seal washer.
<3>	No.1 Arm cover A	SUS hexagon socket screw, M4×10	8	With seal washer.
<4>	Arm cover A (1)	SUS hexagon socket screw, M4×8	8	With seal washer.
<5>	No.1 Arm cover B	SUS hexagon socket screw, M4×10	8	With seal washer.
<6>	Motor cover J2	SUS hexagon socket screw, M4×10	8	With seal washer.
<7>	Motor cover J3	SUS hexagon socket screw, M4×10	8	With seal washer.
<8>	Arm cover A (2)	SUS hexagon socket screw, M4×8	8	
<9>	Arm cover A (3)	SUS hexagon socket screw, M4×8	8	
<10>	No.2 Arm cover	SUS hexagon socket screw, M4×10	8	With seal washer.
<11>	Belt pulley cover J4	SUS hexagon socket screw, M4×10	8	With seal washer.

Note1)Bolting torque of each fixing screw is 1.39 to 1.89N・m.

[Caution]
When you remove the cover, don't remove other than the screw shown in Fig. 5-5 and Table 5-5.

(1) Refer to Fig. 5-5, and remove the covers.
(2) The names of the cover and installation screw are given in Table 5-5. The number in Table 5-5 correspond to Fig. 5-5.
(3) Depending on the robot's posture, some covers are hard to be removed. In such a case, change the robot's posture by performing jog operation to remove the covers.
(4) When reattaching the covers after a maintenance inspection, proceed in the reverse order of their removal. Tightening the screw with the torque shown in Table 5-5.

Note) Please wipe off the grease which splashed from the ball screw spline at the time of maintenance inspection.

5.3.3 Packing Replacement Procedure

The packing gets deteriorated with the passage of time and must be replaced as required. Table 5-6 provides guidelines for replacing the packing. Replace the packing in accordance with the instructions given below. If the packing is not replaced in a timely manner, water or oil will be allowed to intrude the robot, possibly making it inoperative.

Table 5-6 : Packing replacement guideline

Service environment	Whether or not robot is pressurized	When packing must be replaced
General environment	Not pressurized Note1)	When signs of cracking or peeling are noted in the packing.
Clean room	Not pressurized Note1)	
Waterproof environment	Not pressurized	
Oil mist	Pressurized	
	Not pressurized	When the cover mounted on the robot is removed/put back in place

Note1) When used in the "general" or "clean room" environment, robot can do away with pressurization.

(1) Packing Replacement Instructions

Stick again new packing as before.

1) Remove the old packing, and clean and degrease the surface on which it has been placed.
2) The sticking surface of packing is double-coated adhesive tape. Referring to "Fig.5-6 : Example of sticking packing (good example)" and "Fig.5-8 : Sticking the cord-like packing", and stick the packing in line with form . Be careful for the packing not to slide. The example of unsuitable packing slid is shown in "Fig.5-7 : Example of sticking packing (bad example)".
3) Extra length is included for each packing piece used on the cover where two or more pieces are attached to one place. Stick packing in the following procedures. For more information, see "Fig.5-9 : Examples of packing overlaps". Examples of improperly treated cut edge are shown, as well.
   a) Stick packing in line with form of the sticking surface. Finally, cut packing so that adjoining pieces have a 1mm overlap at the end.
   b) Apply liquid gasket to the cut edges. (Designated liquid gasket: 1212 (Maker: Three Bond))
   c) Stick so that the gap may not be made to each other's packing.

⚠ CAUTION Do not install the cover immediately after sticking packing. Install the cover, after the 6 hours pass after sticking packing for gasket hardening.

4) Confirm that packing is stuck correctly and install the cover. When tightening the bolts fixing the cover, avoid tightening them to a specified torque at a time. Tighten the bolt in the order shown as much as possible in the "Fig. 5-10 Example of order which tighten bolts" The torque which tightens the fixing bolt of each cover is shown in "Table 5-4 : Cover name and installation screw list (RH-3FRH/6FRH/12FRH/20FRH series)" or "Table 5-5 : Cover name and installation screw list (RH-3FRHR series)".

⚠ CAUTION Stick the packing securely, pressing down with the finger. If sticking is insufficient, when the cover is installed, packing slides by the pressure, and there is a possibility that it may become impossible to secure protection performance.

The packing replacement is completed.

Fig.5-6 : Example of sticking packing (good example)

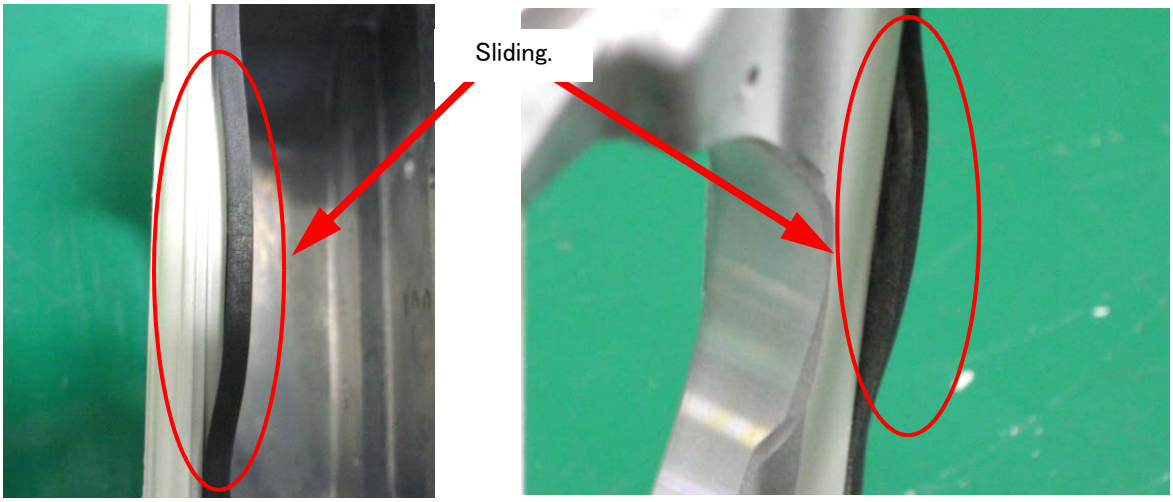


Fig.5-7 : Example of sticking packing (bad example)

Some of the packings to be used are cord-like.
Stick such packings by bending in line with the form.

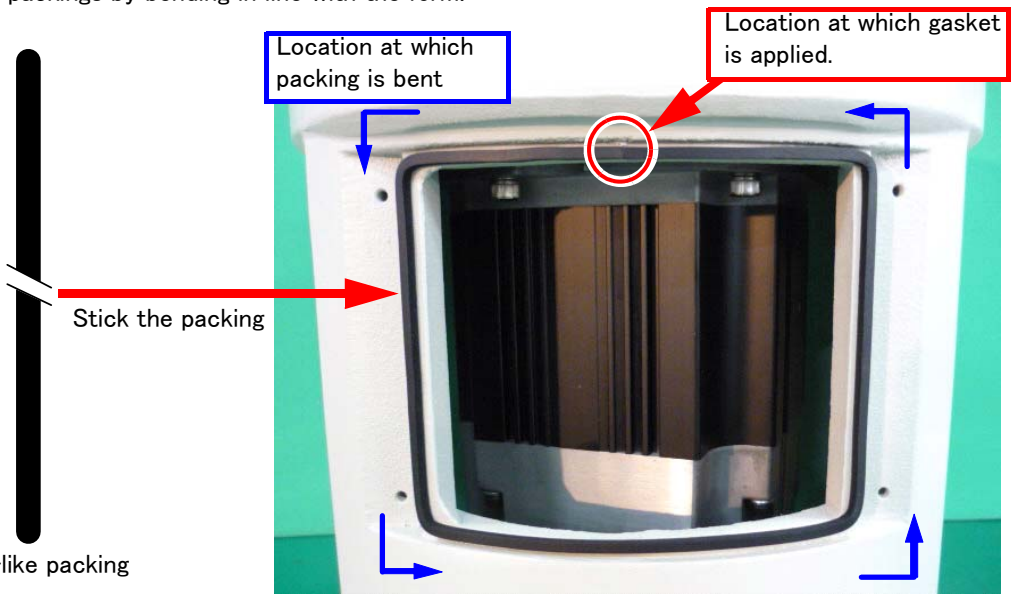
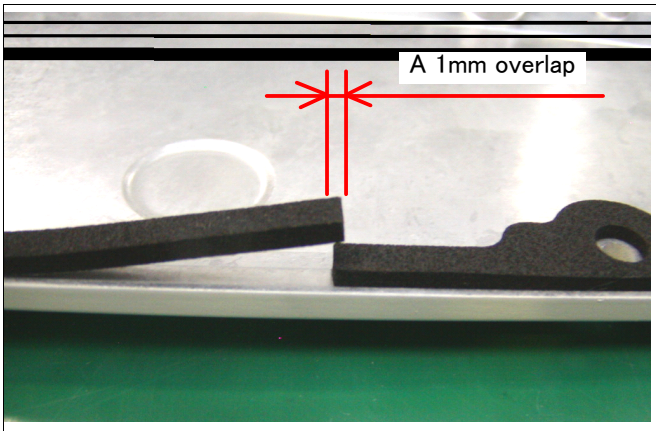
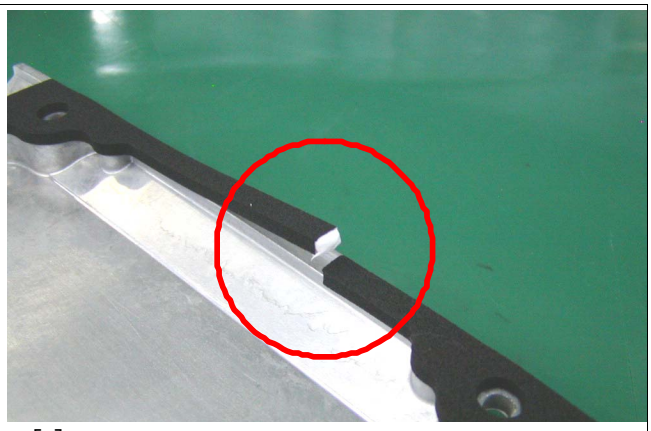


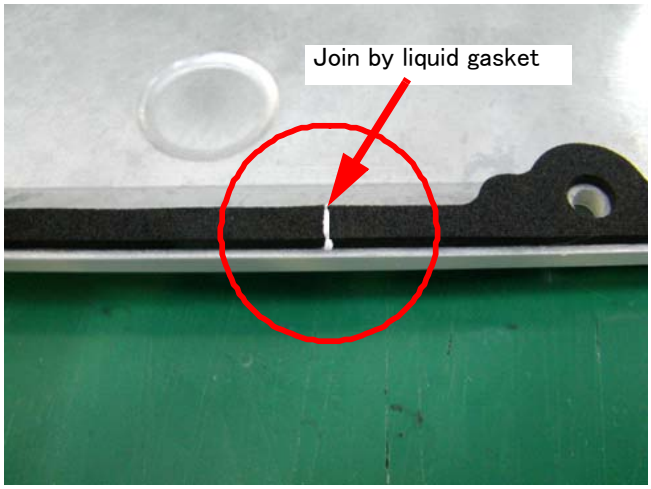
Fig.5-8 : Sticking the cord-like packing



[1] Cut the packing so that there is a 1mm overlap at the end.



[2] Apply liquid gasket to the cut edges.



[3] Stick the packing so that there is no gap between the adjacent pieces.

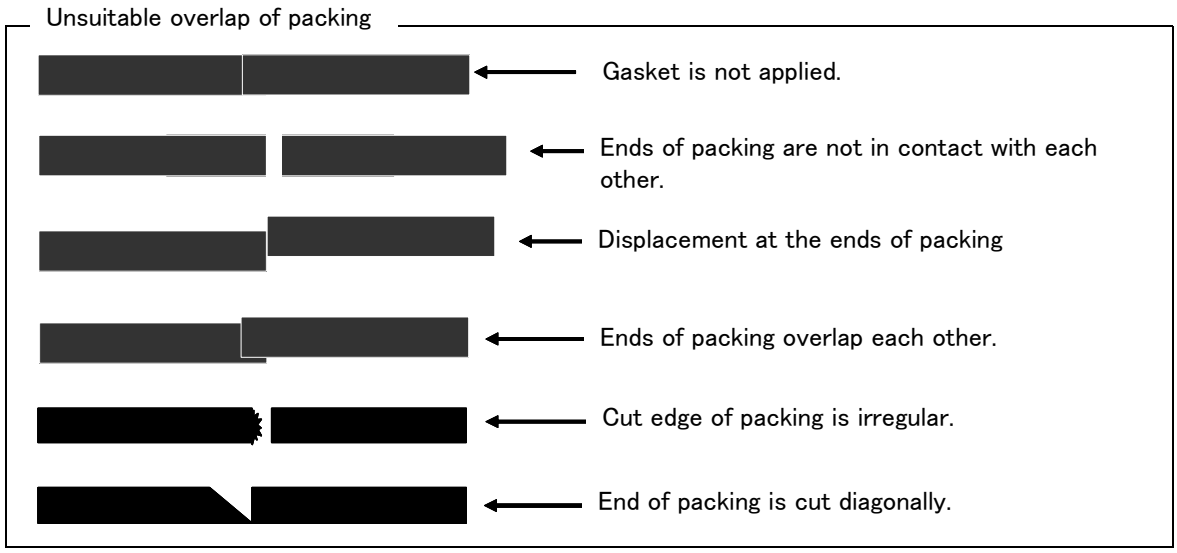


Fig.5-9 : Examples of packing overlaps

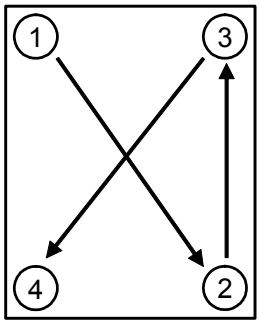


Fig.5-10 : Example of order which tighten bolts

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 125, "(12) 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.5-11 : Tension adjustment method of timing belt

⚠ CAUTION

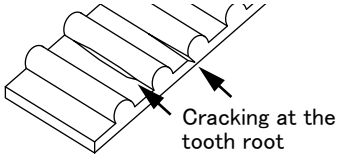
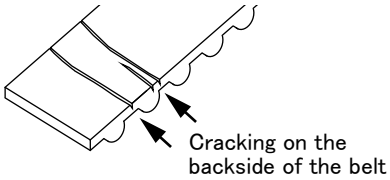
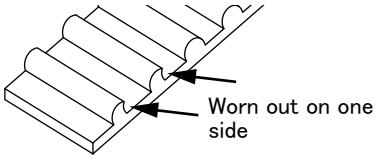
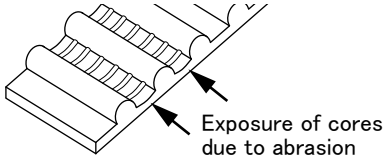
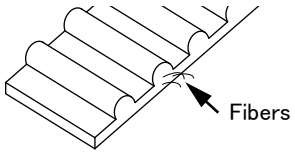
When the timing belt has to be removed for repair or some other reason, measure the tension before removing the belt.
When the belt is reinstalled, the tension must be the same as the one measured before removal. Otherwise, the life of the belt and the relevant parts may be shortened.

(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 5-7.

Table 5-7 : Typical damage conditions of the timing belt

Damage condition	Appearance	Cause
Gear tooth crack		Overload
Backside crack		Deterioration of rubber due heat to or ozone
Worn teeth		Overload Excessive or insufficient tension
Tooth bottom abrasion and exposure of cores		Excessive tension
The following is not a belt damage.		
Fibers coming out of the side face of the belt		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.

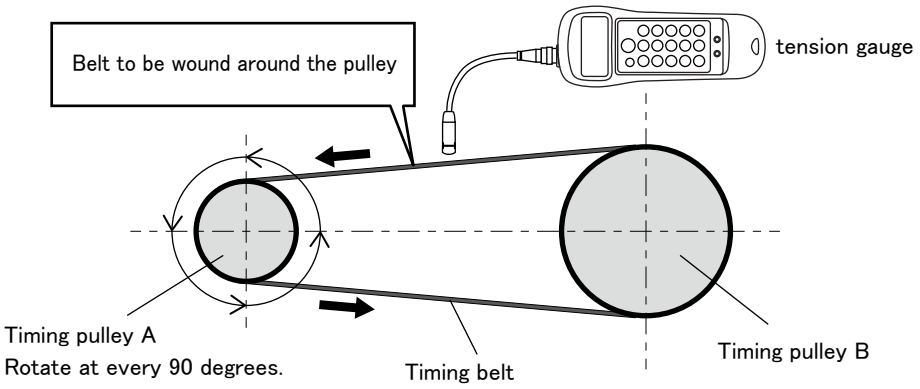


Fig.5-12 : Timing belt tension measurement

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 126, "(13) 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 125, "(12) Timing belt tension". When the belt tension value becomes less than the guideline value, the belt must be replaced immediately.

(3) RH-3FRH series: Inspecting the J3 axis timing belt

The section related to J3 axis timing belt of RH-3FRH series is shown in Fig. 5-13. The picture is the image which removed the No.2 arm cover.

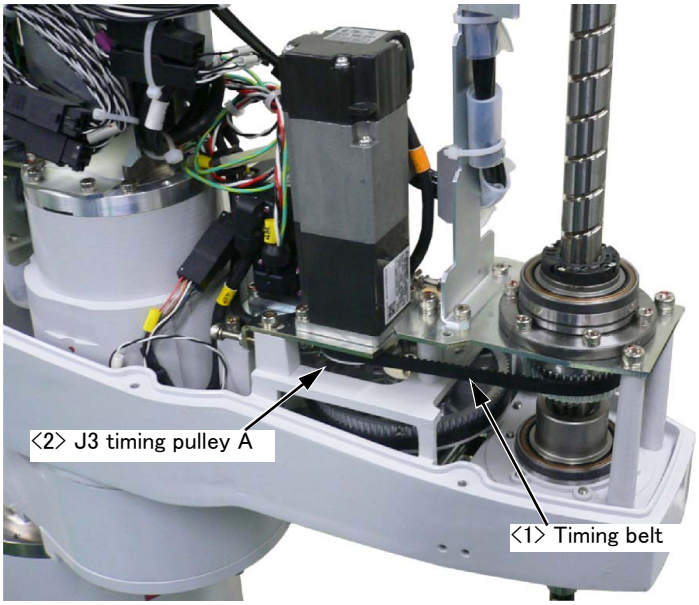


Fig.5-13 : Inspecting the J3 axis timing belt(RH-3FRH)

Inspection procedure of the timing belt of J3 axis are shown below.

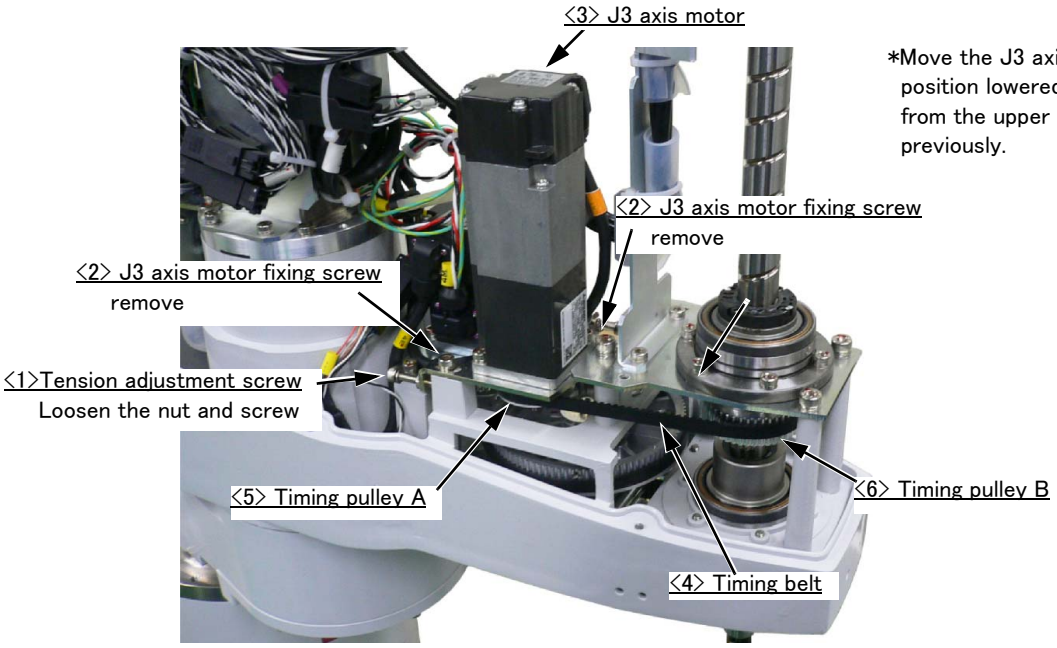
1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U.
2) Visually confirm that the symptoms indicated inPage 110, "(1) Timing belt replacement period" have not occurred with the <1> timing belt.
3) Refer to Page 111, "(2) Timing belt tension measurement", and confirm the belt tension.
4) Install the No.2 arm cover U securely as before and finish inspection.

(4) RH-3FRH series: Replacing the J3 axis timing belt

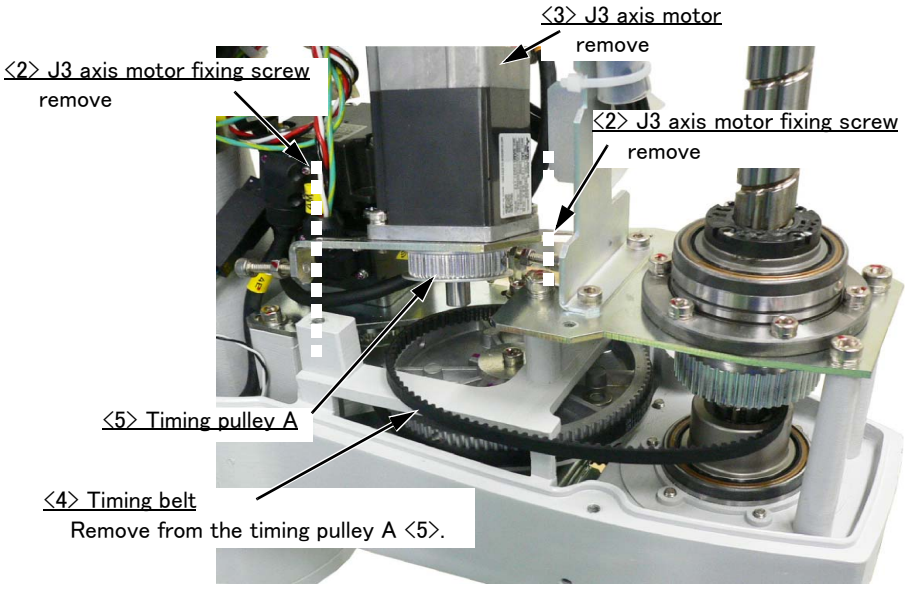
⚠ CAUTION It is possible for the customer to replace the timing belt, but precise adjustment is needed to prevent malfunction of the relevant parts. To ask for replacement of the timing belt, contact the dealer.

The procedure for replacing the J3 axis timing belt of the RH-3FRH series is shown below. The diagram shows an image of the removed No. 2 arm cover U.
After replacing the J3 axis timing belt the resetting the origin of J3 and J4 axis is necessary.

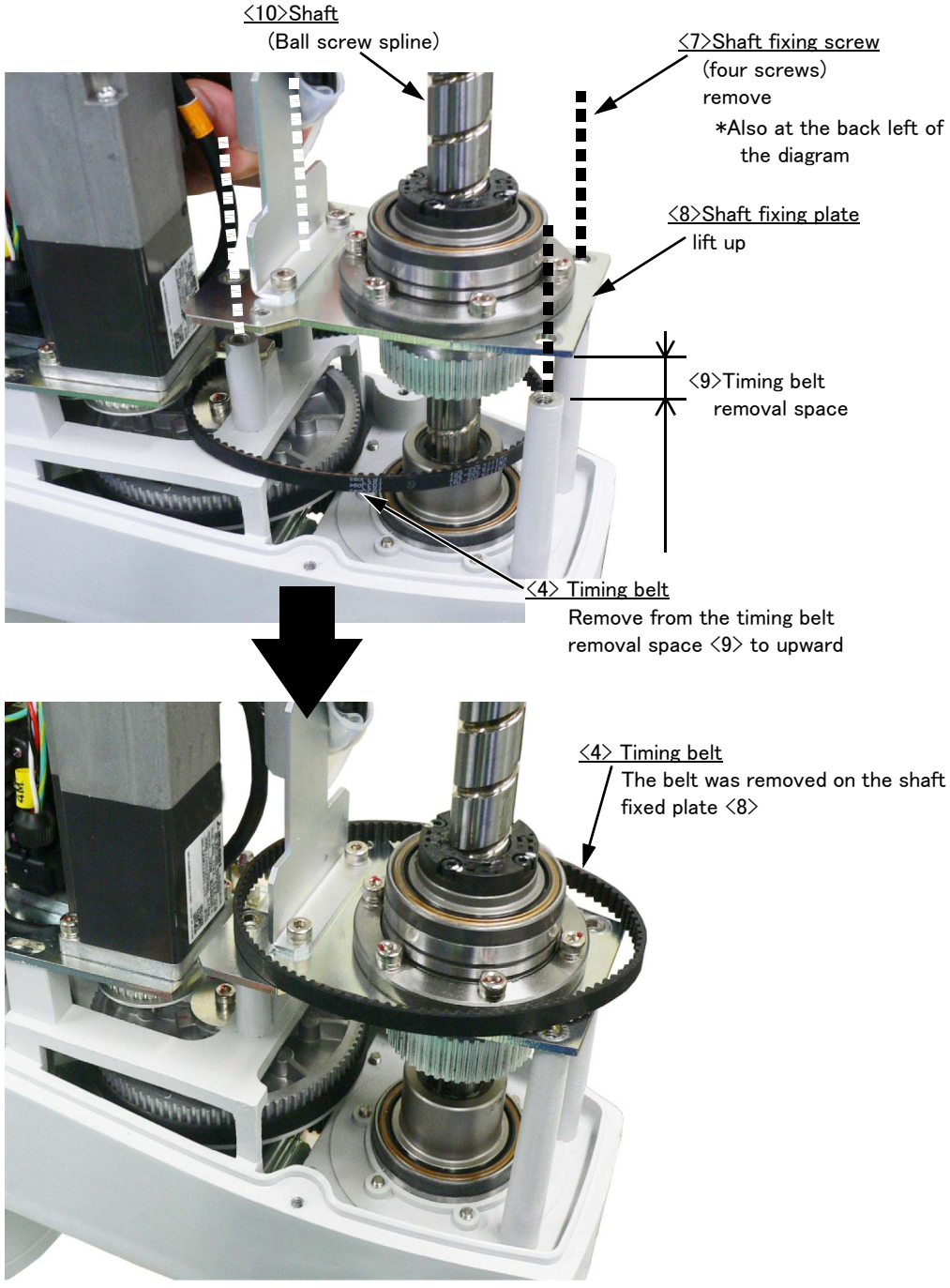
1) Move the J3 axis to the position lowered about 30mm from the upper limit by jog operation. This position makes the space for removing the belt.
   After moving the J3 axis turn the controller's power supply OFF.
2) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U.
3) Loosen the nut of tension adjustment screw <1>, and loosen the tension adjustment screw <1>.



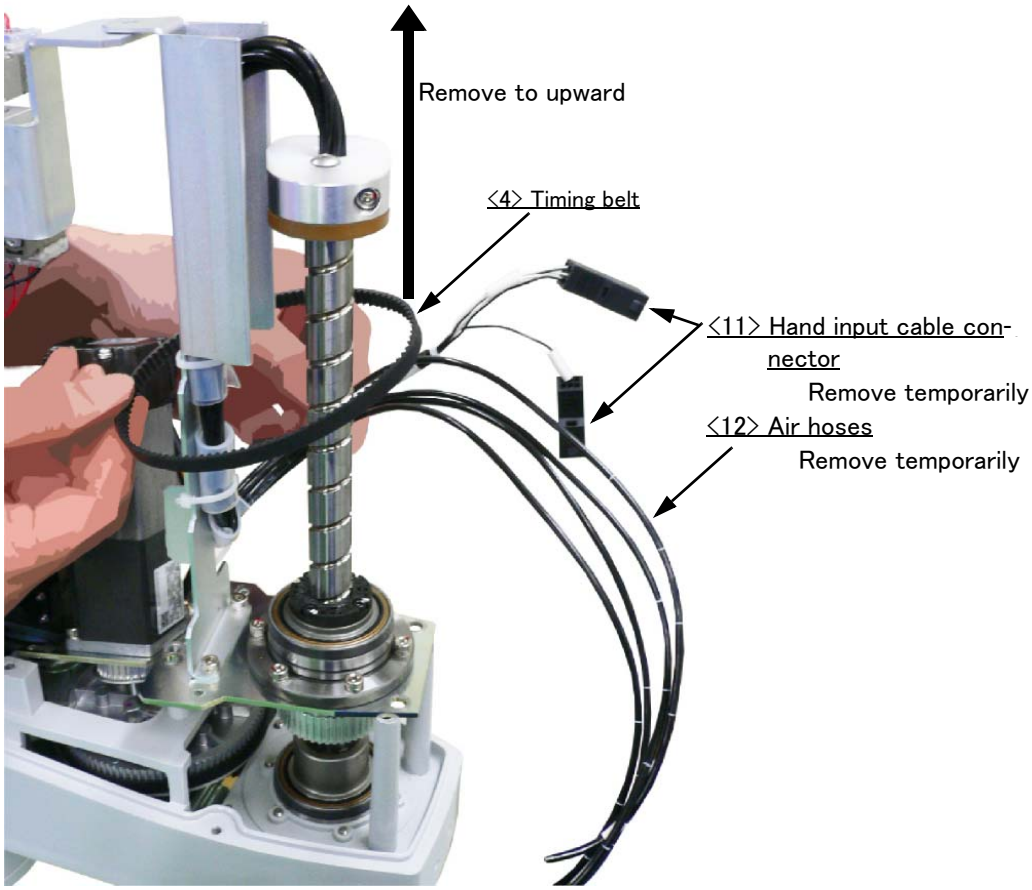
4) Remove two fixing screws <2>, remove the J3 axis motor <3>, remove the timing belt <4> from the timing pulley A <5>.



5) Remove the timing belt <4> from the shaft to upward.
Remove the fixing screw <7> of shaft fixing plates and lift up the shaft fixing plate <8>.
When using the optional hand internal wiring and piping set remove the fixing screws fixed to the top.
Remove the timing belt <4> from the timing belt removal space <9> created under the shaft fixing plate <8> by lift up.



6) Remove the timing belt <4> from the top of the shaft
If using the optional hand internal wiring and piping set, temporarily remove the hand input cable connector <11> and air hoses <12> of solenoid valve side. And remove the timing belt to upward.



7) Install the new timing belt in reverse procedure of removal.
Install the new belt to the timing pulley (on the motor) <5> and timing pulley B <6> securely.
Fix the shaft fixing plate <8> by fastening the original fixing screws securely.
If using the hand input cables <11> and air hoses <12>, connect them as before.
8) Install the J3 axis motor <3> by tightening lightly the J3 axis motor fixing screw <2> (two screws)
9) The nut which is fixing tension adjustment screw <1> is loosened, turn tension adjustment screw <1>, and adjust the tension of timing belt <4>.
When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
Adjust the belt tension slack to within the range as shown in Page 125, "(12) Timing belt tension".
Before the tension measurement, rotate the timing pulley at least three times in each direction so that the timing belt fits in the pulley. Check the tension measurement method in Page 111, "(2) Timing belt tension measurement".
If the belt is loosened too much when adjusting the tension causing it to come off the timing pulley A <5> and the timing pulley B <6>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
10) Fasten the two J3 axis motor fixing screws <2> certainly (M4 screw: tightening torque is 4.51 Nm). Moreover, also fasten the nut of tension adjustment screw <1> certainly. Improper tightening can cause the belt to loosen with vibration.
11) Install the No.2 arm cover U securely as before.
12) Reset the origin of J3 and J4 axis with referring to the Page 142, "5.6 Resetting the origin"
13) When the maintenance forecast function is valid, reset the accumulation data about the belt. Reset by the dedicated screen or parameter MFBRST of RT ToolBox3. Refer to "RT ToolBox3/RT ToolBox3 mini User's Manual" for operation of RT3 and refer to "Instruction Manual/Detailed Explanation of Functions and Operations" for the parameter.

Replacement of the J3 axis timing belt is completed.

(5) RH-6FRH/12FRH/20FRH series: Inspecting the J3 axis timing belt

The section related to J3 axis timing belt of RH-6FRH/12FRH/20FRH is shown in Fig. 5-14. The picture is the image which removed the No.2 arm cover.

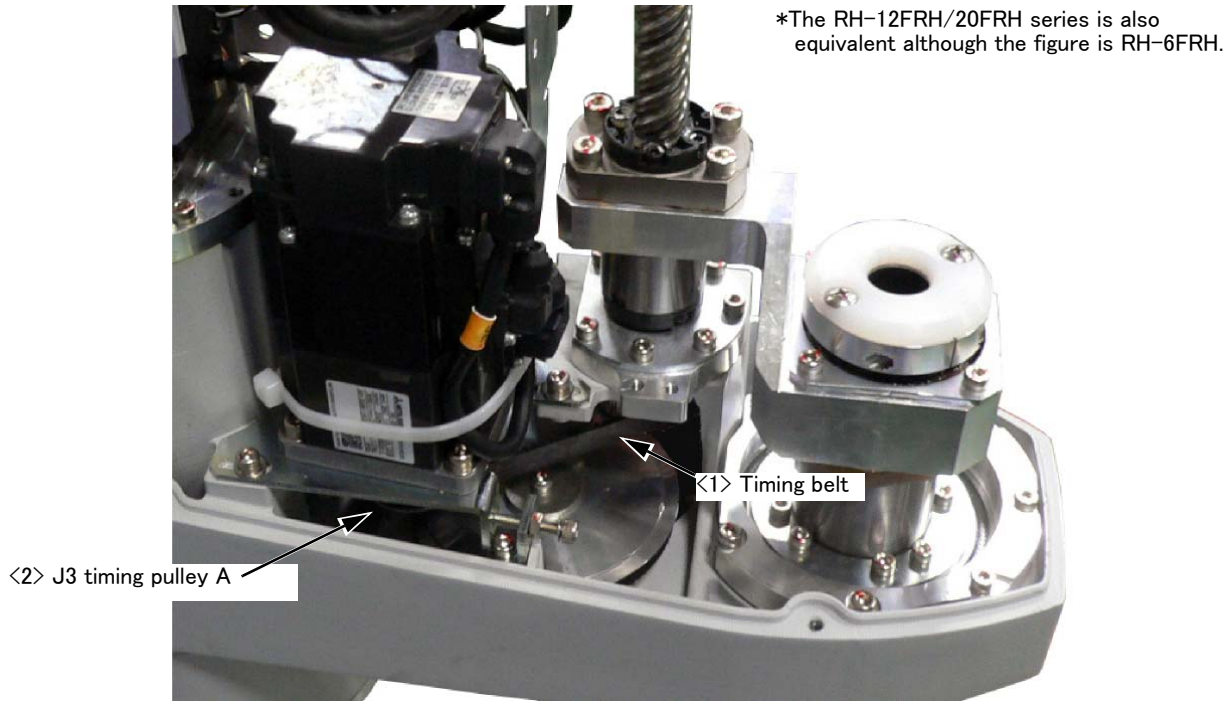


Fig.5-14 : Inspecting the J3 axis timing belt (RH-6FRH/12FRH/20FRH)

Inspection procedure of the timing belt of J3 axis are shown below.

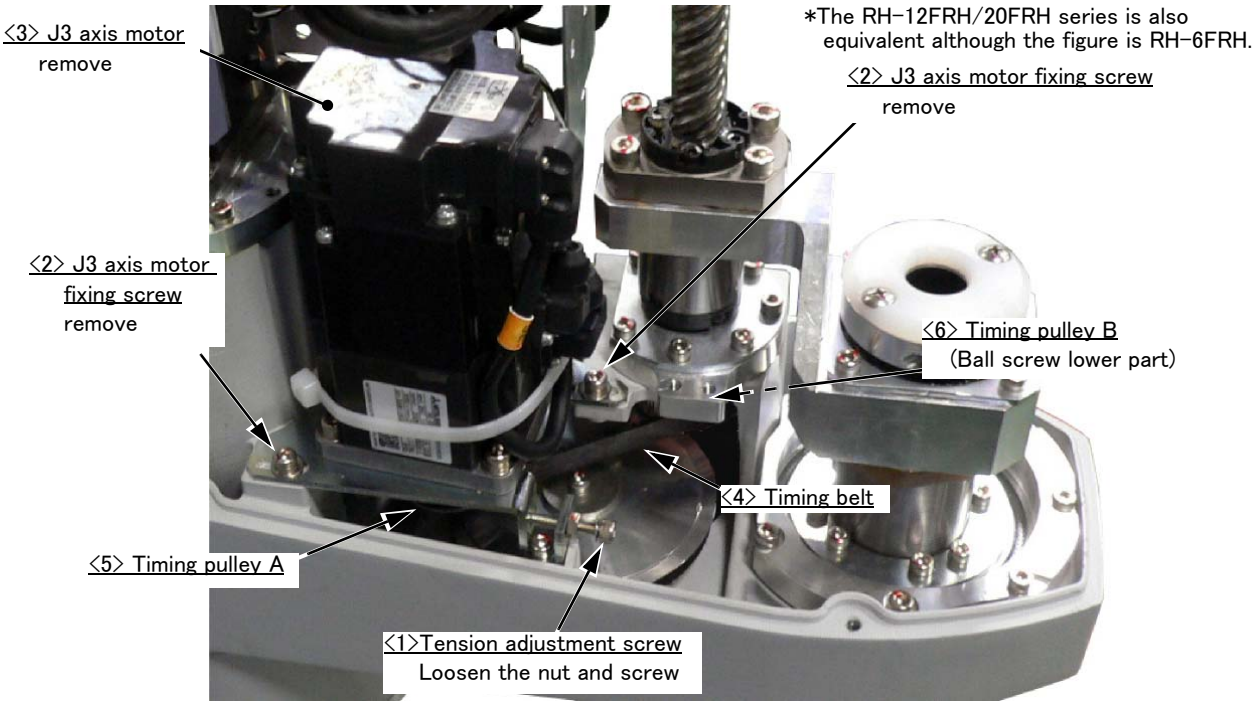
1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U.
2) Visually confirm that the symptoms indicated in Page 110, "(1) Timing belt replacement period" have not occurred with the <1> timing belt.
3) Refer to Page 111, "(2) Timing belt tension measurement", and confirm the belt tension.
4) Install the No.2 arm cover U securely as before and finish inspection.

(6) RH-6FRH/12FRH/20FRH series: Replacing the J3 axis timing belt

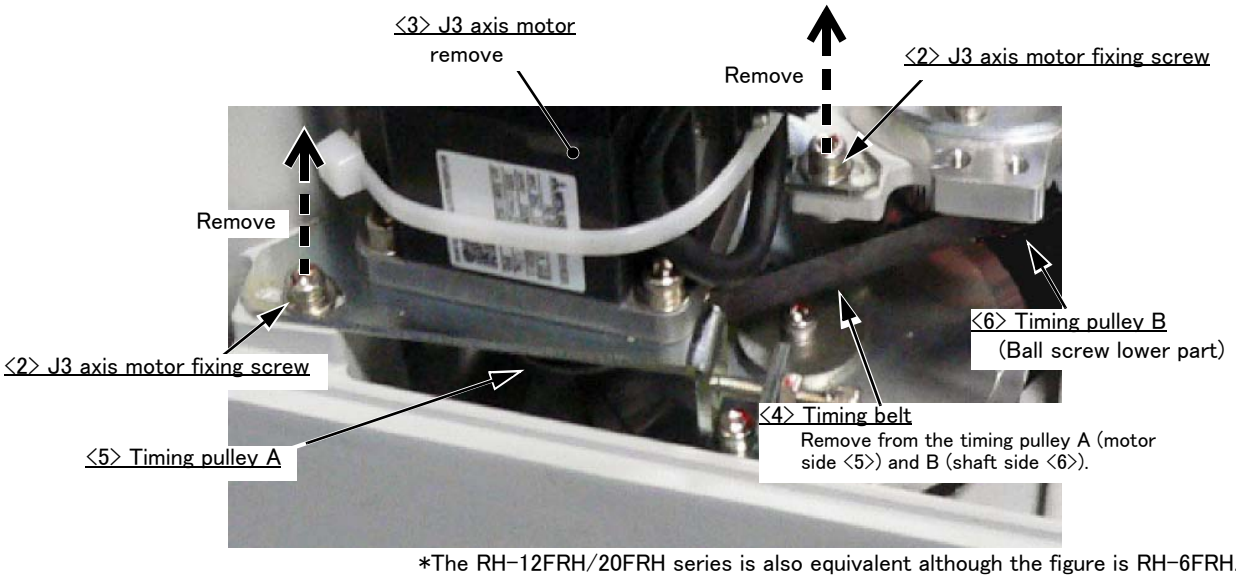
⚠ CAUTION It is possible for the customer to replace the timing belt, but precise adjustment is needed to prevent malfunction of the relevant parts. To ask for replacement of the timing belt, contact the dealer.

The procedure for replacing the J3 axis timing belt of the RH-6FRH/12FRH/20FRH series is shown below. The diagram shows an image of the removed No. 2 arm cover U.
After replacing the J3 axis timing belt the resetting the origin of J3 and J4 axis is necessary.

1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U.
2) Loosen the nut of tension adjustment screw <1>, and loosen the tension adjustment screw <1>.



3) Remove two fixing screws <2>, and remove the J3 axis motor <3>.



*The RH-12FRH/20FRH series is also equivalent although the figure is RH-6FRH.

4) Remove the timing belt <4> from the timing pulley A <5> and B <6>.

5) Install surely the new belt to the timing pulley A <5> and timing pulley B <6>, and fix the J3 axis motor <3> with J3 axis motor fixing screw <2>.
   Confirms having related the timing belt <4> to the timing pulley A <5> and the timing pulley B <6> securely.
6) Lightly loosen J3 motor installation screws <2> (Be careful not to overly loosen the screws.).
7) The nut which is fixing tension adjustment screw <1> is loosened, turn tension adjustment screw <1>, and adjust the tension of timing belt <4>.
   When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
   Adjust the belt tension slack to within the range as shown in Page 125, "(12) Timing belt tension".
   Before the tension measurement, rotate the timing pulley at least three times in each direction so that the timing belt fits in the pulley. Check the tension measurement method in Page 111, "(2) Timing belt tension measurement".
   If the belt is loosened too much when adjusting the tension causing it to come off the timing pulley A <5> and the timing pulley B <6>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate.
8) Fasten the two J3 axis motor fixing screws <2> certainly with the following torque.

Model	Screw size: tightening torque
RH-3FRH series	M4: 4.51Nm
RH-6FRH/12FRH/20FRH series	M5: 9.31Nm

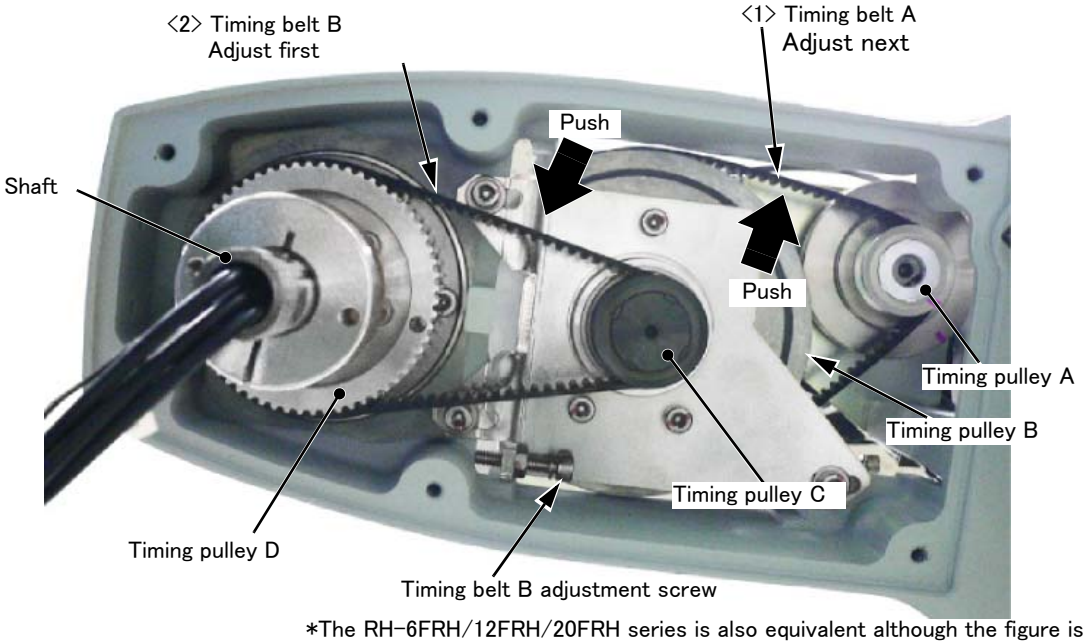
   Moreover, also fasten the nut of tension adjustment screw <1> certainly. Improper tightening can cause the belt to loosen with vibration.
9) Install No.2 arm cover U securely as before.
10) Reset the origin of J3 and J4 axis with referring to the Page 142, "5.6 Resetting the origin"
11) When the maintenance forecast function is valid, reset the accumulation data about the belt. Reset by the dedicated screen or parameter MFBRST of RT ToolBox3. Refer to "RT ToolBox3/RT ToolBox3 mini User's Manual" for operation of RT3 and refer to "Instruction Manual/Detailed Explanation of Functions and Operations" for the parameter.

Replacement of the J3 axis timing belt is completed.

(7) RH-3FRH/6FRH/12FRH/20FRH series: Inspecting the J4 axis timing belt

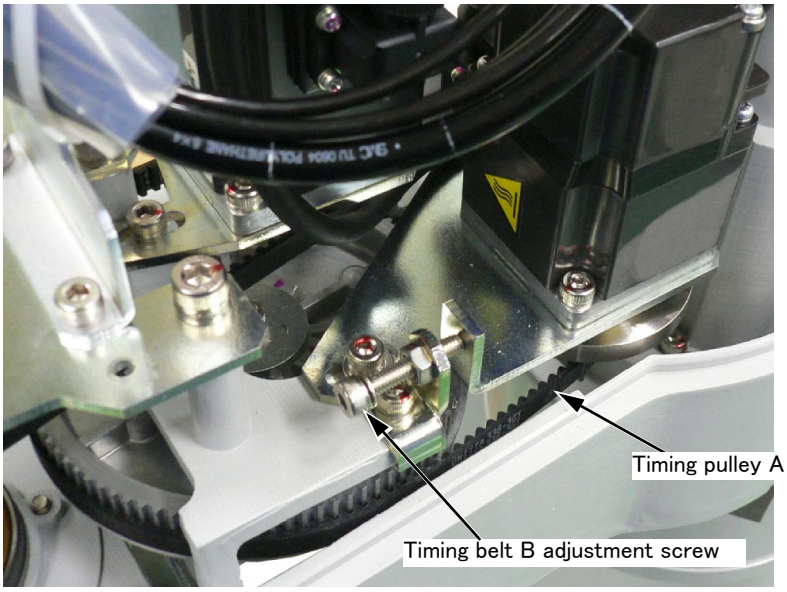
As shown in Fig. 5-15, the J4 axis timing belt consists of two timing belts: timing belt A <1> and timing belt B <2>. When adjusting the timing belts, first adjust timing belt B <2> and then proceed to adjust timing belt A <1>.

<The No.2 arm bottom view (Inside of the No.2 arm cover D)>



*The RH-6FRH/12FRH/20FRH series is also equivalent although the figure is RH-3FRH.

<The No.2 arm upper view (Inside of the No.2 arm cover U)>



*The RH-6FRH/12FRH/20FRH series is also equivalent although the figure is RH-3FRH.

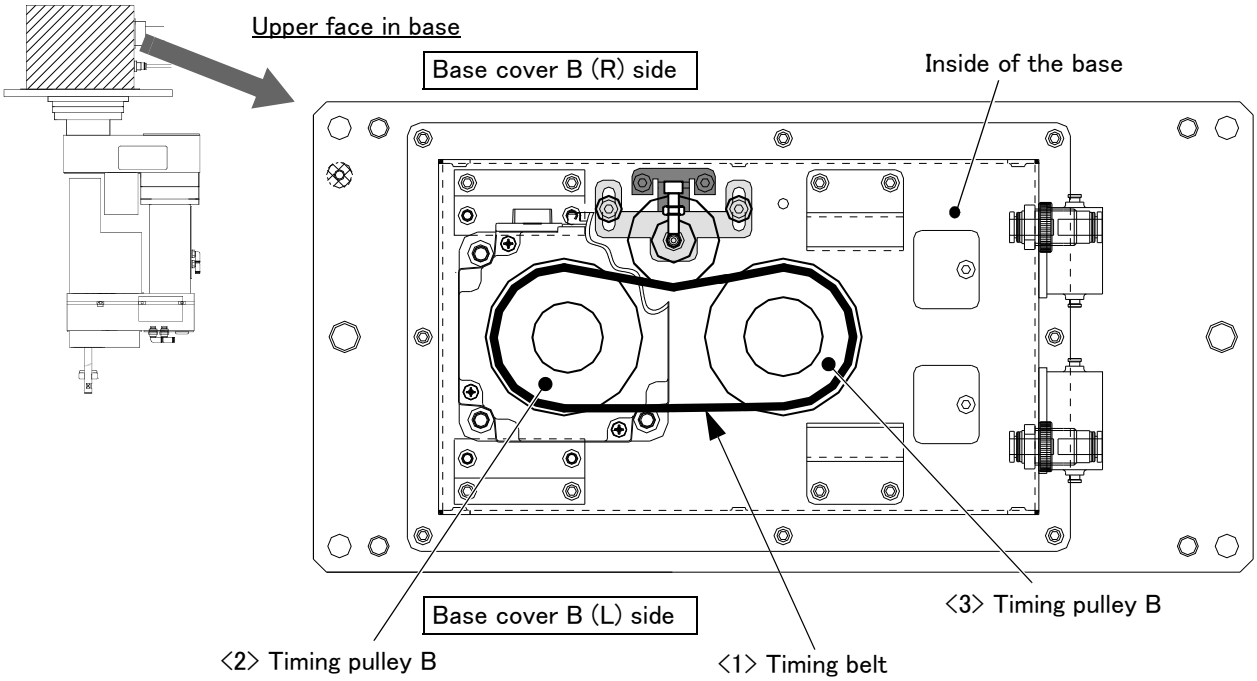
Fig.5-15 : Inspecting the J4 axis timing belt(RH-3FRH/6FRH/12FRH/20FRH)

Inspection procedure of the timing belt of J4 axis are shown below.

1) Refer to Page 101 "Fig. 5.3.2: Installing/removing the cover", and remove the No.2 arm cover U and No.2 cover D.
2) Visually confirm that the symptoms indicated in Page 110, "(1) Timing belt replacement period" have not occurred with the timing belt.
3) Refer to Page 111, "(2) Timing belt tension measurement", and confirm the belt tension.
   For replacement of the timing belt, check the serial numbers of the robot arm and the controller and contact the dealer.
4) Install the No.2 arm cover U and No.2 arm cover D securely as before and finish inspection.

(8) RH-3FRHR series: Inspection of J1 axis timing belt

The reference figure at inspection of the timing belt is shown in Fig. 5-16.



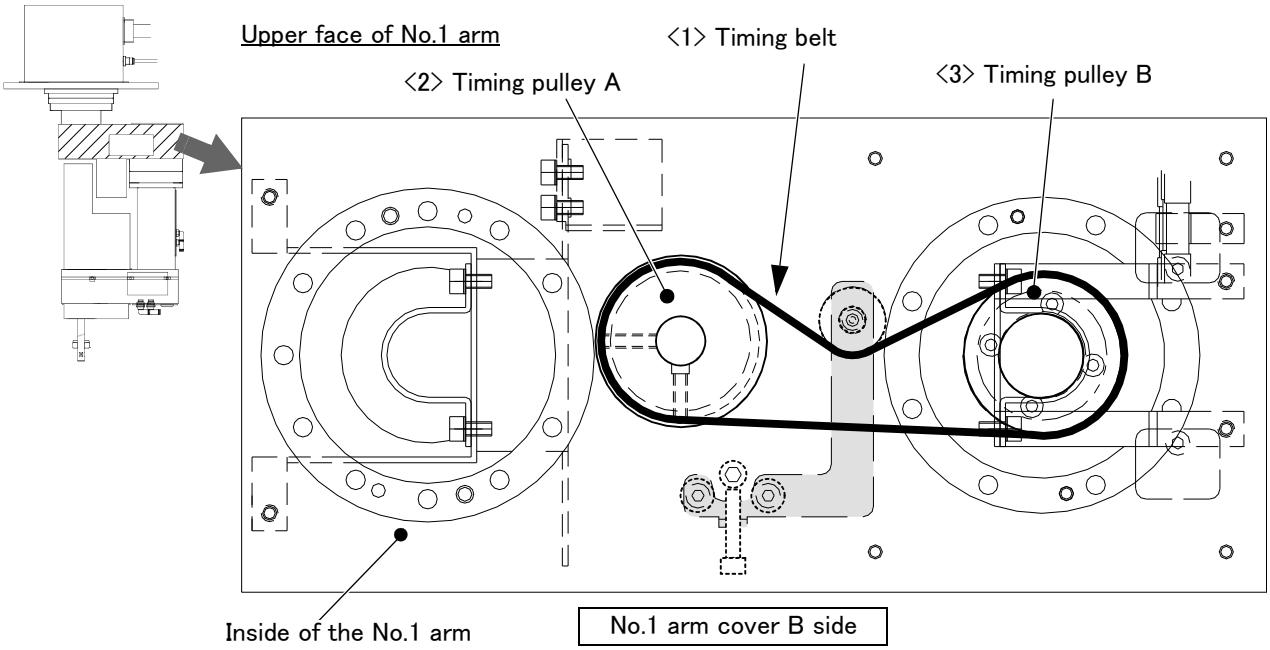
Note) The figure shows the timing belt structure section in the base portion.
Remove and confirm both base cover B (L) and (R).

Fig.5-16 : Inspection of J1 axis timing belt

1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the base cover B (R) and (L).
2) Visually confirm that the symptoms indicated in Page 110, "(1) Timing belt replacement period" have not occurred with the timing belt.
3) Refer to Page 111, "(2) Timing belt tension measurement", and confirm the belt tension.
For replacement of the timing belt, check the serial numbers of the robot arm and the controller and contact the dealer.
4) Install the base cover B (R) and (L) securely as before and finish inspection.

(9) RH-3FRHR series: Inspection of J2 axis timing belt

The reference figure at inspection of the timing belt is shown in Fig. 5-17.



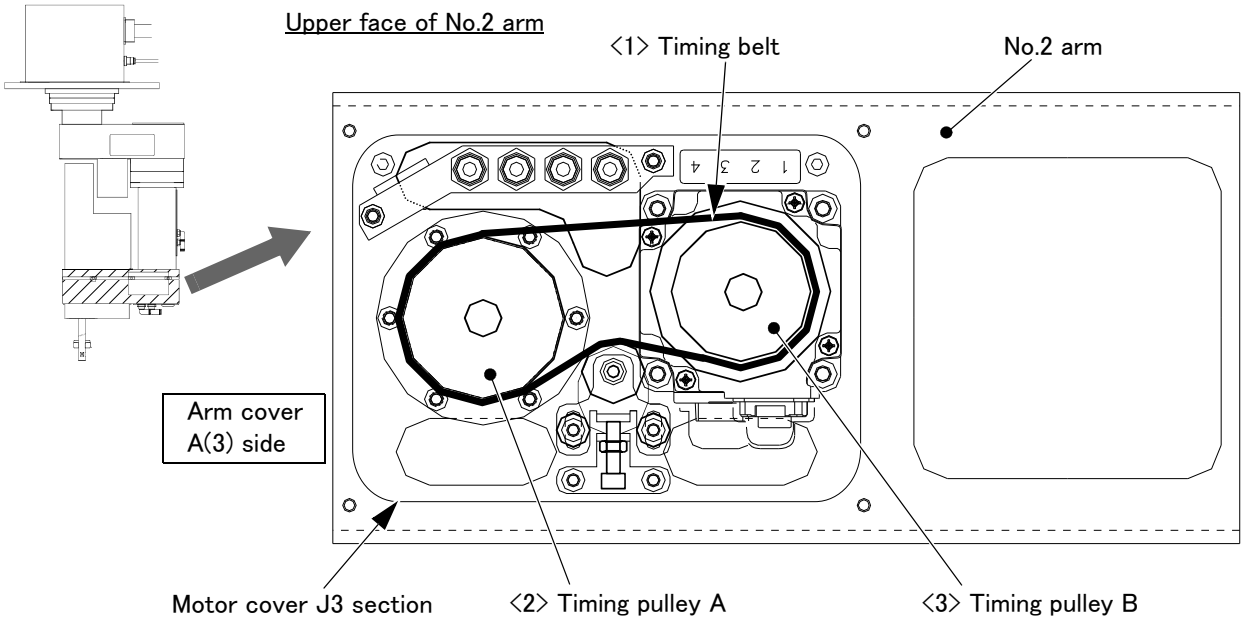
Note) The figure shows the timing belt structure section in the No.1 arm portion.
Remove and confirm both No.1 arm cover B.

Fig.5-17 : Inspection of J2 axis timing belt

1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the No.1 arm cover B.
2) Visually confirm that the symptoms indicated in Page 110, "(1) Timing belt replacement period" have not occurred with the timing belt <2>.
3) Refer to Page 111, "(2) Timing belt tension measurement", and confirm the belt tension.
   For replacement of the timing belt, check the serial numbers of the robot arm and the controller and contact the dealer.
4) Install the No.1 arm cover B securely as before and finish inspection.

(10) RH-3FRHR series: Inspection of J3 axis timing belt

The reference figure at inspection of the timing belt is shown in Fig. 5-18.



Note) The figure shows the timing belt structure section inside the No.2 arm.
Remove and confirm the motor cover J3 and the arm cover A(3).

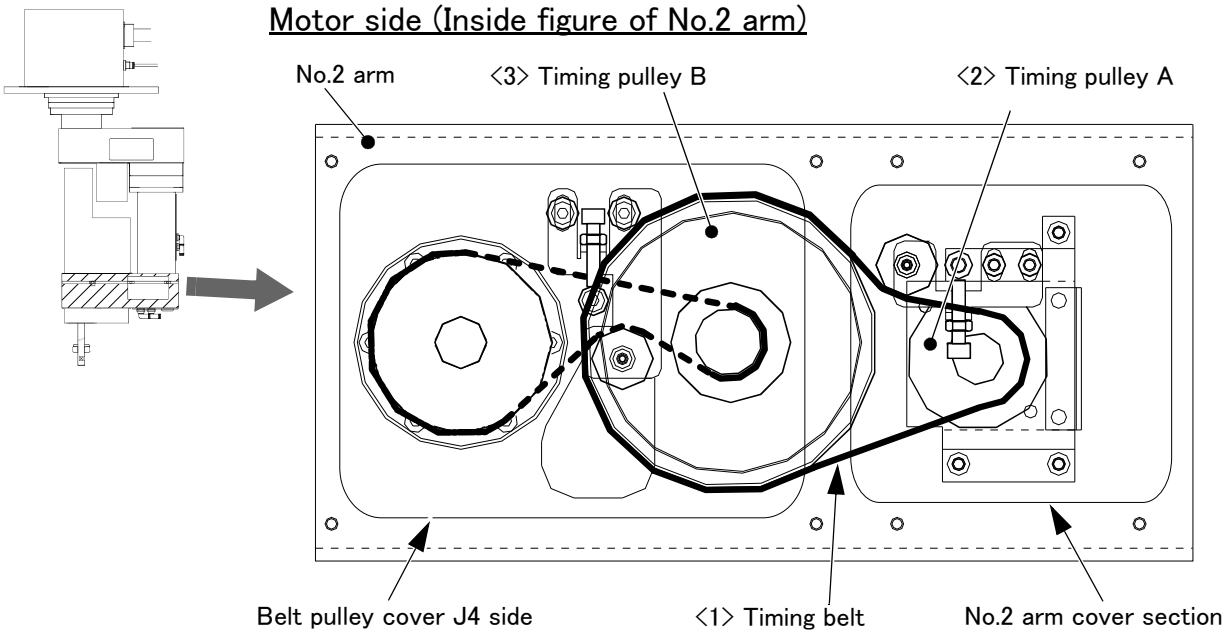
Fig.5-18 : Inspection of J3 axis timing belt

1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the motor cover J3 and arm cover A(3).
2) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt <2>.
3) Refer to Page 111, "(2) Timing belt tension measurement", and confirm the belt tension.
   For replacement of the timing belt, check the serial numbers of the robot arm and the controller and contact the dealer.
4) Install the motor cover J3 and arm cover A(3) securely as before and finish inspection.

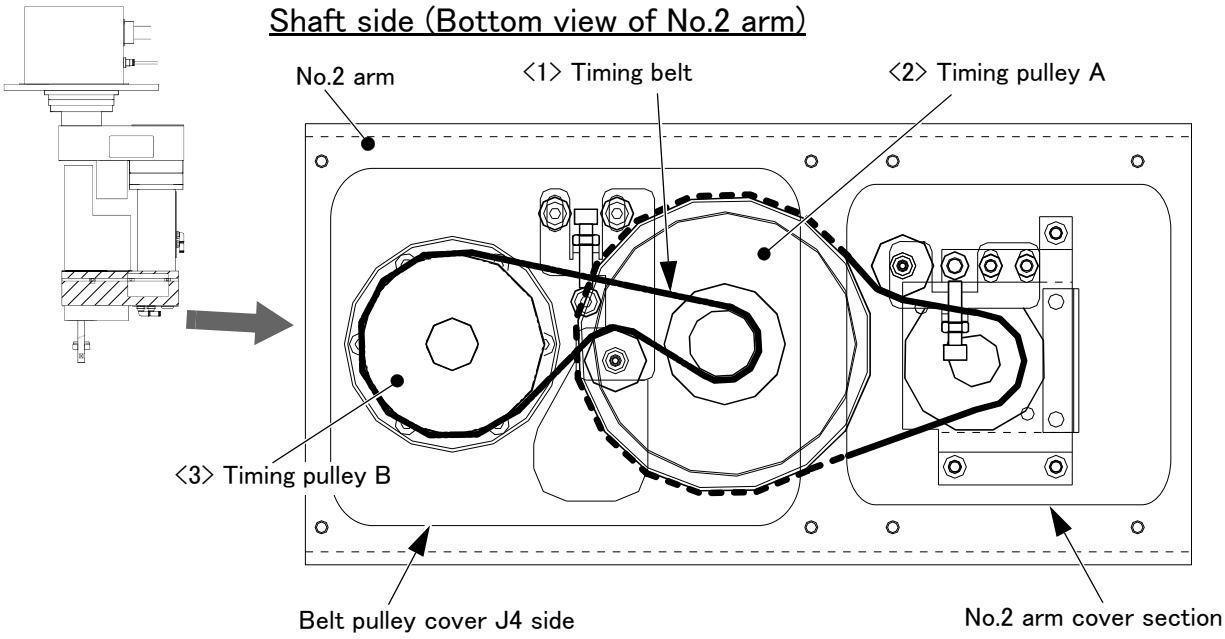
(11) RH-3FRHR series: Inspection of J4 axis timing belt

The reference figure at inspection of the timing belt is shown in Fig. 5-19.

There are the two belts of the motor side and the shaft side, in the J4 axis. Perform inspection of two belts simultaneously.



Note) The figure shows the timing belt structure section (motor side) inside the No.2 arm.
Remove and confirm the No.2 arm cover and the belt pulley cover J4.



Note) The figure shows the timing belt structure section (shaft side) inside the No.2 arm.
Remove and confirm the No.2 arm cover and the belt pulley cover J4.

Fig.5-19 : Inspection of J4 axis timing belt

1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover and the belt pulley cover J4.
2) Visually confirm that the symptoms indicated in Page 110, "(1) Timing belt replacement period" have not occurred with the timing belt <2>.

3) Refer to Page 111, "(2) Timing belt tension measurement", and confirm the belt tension.
   For replacement of the timing belt, check the serial numbers of the robot arm and the controller and contact the dealer.
4) Install the No.2 arm cover and the belt pulley cover J4 securely as before and finish inspection.

(12) 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 5-8 : 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-3FRH series						
J3	309-EV3GT-6	2.5	6	96	39 to 48	15
J4 (motor side)	336-EV3GT-6	2.5	6	64	39 to 48	15
J4 (shaft side)	282-EV3GT-12	2.5	12	74	80 to 97	30
RH-6FRH series						
J3	264-EV3GT-9	2.5	9	82	59 to 79	22
J4 (motor side)	315-EV3GT-6	2.5	6	64	39 to 48	15
J4 (shaft side)	363-EV3GT-12	2.5	12	95	80 to 97	30
RH-12FRH series						
J3	288-EV3GT-12	2.5	12	71	83 to 101	30
J4 (motor side)	417-EV3GT-9	2.5	9	99	60 to 73	22
J4 (shaft side)	456-EV3GT-20	2.5	20	121	138 to 151	49
RH-20FRH series						
J3	303-EV3GT-12	2.5	12	71	83 to 101	30
J4 (motor side)	417-EV3GT-9	2.5	9	99	60 to 73	22
J4 (shaft side)	456-EV3GT-20	2.5	20	121	138 to 151	49
RH-3FRHR series						
J1	340-5GT-20	4.0	20	84	171 to 209	69
J2	363-3GT-12	2.5	12	103	80 to 97	30
J3	297-3GT-9	2.5	9.0	77	31.1 to 38	22
J4 (motor side)	345-3GT-6	2.5	6.0	69	39.8 to 45.4	15
J4 (shaft side)	312-3GT-12	2.5	12	82	43.6 to 52.8	30

(13) 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 5-9.

Table 5-9 : Amount of movement of each axis during the tension measurement

Model	Amount of movement				
	J1 axis	J2 axis	J3 axis	J4 axis (Timing belt A)	J4 axis (Timing belt B)
RH-3FRH series	-	-	4mm	8.4°	36.0°
RH-6FRH series	-	-	6.3mm	6.2°	24.1°
RH-12FRH/20FRH series	-	-	6mm	6.0°	25.5°
RH-3FRHR series	1.8°	1.8°	4mm	8.4°	36.0°

5.3.5 Replacing the bellows

The following shows how to replace the bellows of the clean, oil mist, or waterproof specification robot. To replace the bellows, refer to the relevant page for each specification.

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

(1) RH-3FRH/6FRH/12FRH/20FRH series

■ Clean specification

1) Turn off the controller's power supply.
2) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U and the No.2 arm cover D.
3) Loosen the two fixing (M4) screws of bellows, and remove the bellows to downward together with No.2 arm cover D.
4) Remove the four fixing screws which fix the bellows to the No.2 arm cover D, and removes the ring, then the bellows can be removed from No.2 arm cover D.
5) Fix the new bellows to the No. 2 arm cover D in the same way (screw tightening torque: 0.8Nm). Fill the gap between the No. 2 arm cover D and the bellows with a seal such as a liquid gasket.
6) Install the No. 2 arm cover D as before.
7) Fix the bellows to shaft with adjusting the position of the bellows's bottom to 30mm from end of shaft. Align two set screws (M4) to the D cut surface and fix them securely.
8) Fill the gap between the bellows fixing section and the shaft with a seal, such as a liquid gasket.
9) Sticks the attached ABS mark on the lower part of bellows. Makes the J4 axis into the position of 0 degree by jog operation etc., and match the ABS mark sticker with ABS mark on the shaft, and stick it.

[Caution] When installing the No. 2 arm cover D to the No. 2 arm, please check the condition of the sealing. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please inform the dealer, if exchange is necessary.

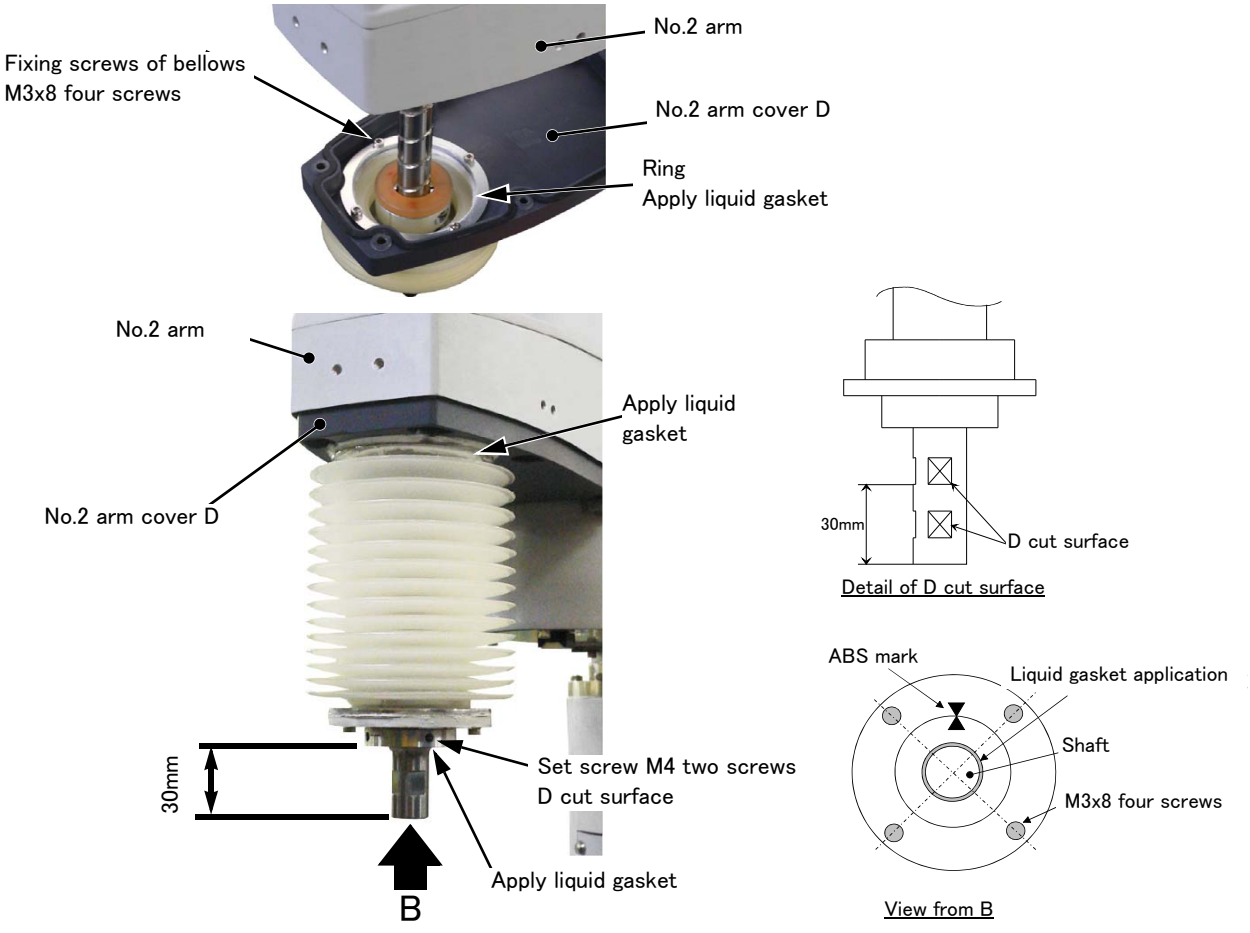


Fig.5-20 : Replace the bellows (clean specification)

■ Oil mist specification

1) Previously, move the J3 axis to upper end position by jog operation.
   This position is necessary to set the ABS mark (marking-off line) of J4 axis after.
2) Turn off the controller's power supply.
3) Remove the four screws (M3x8) which fix the lower part of bellows to the frange.
4) Lift the bellows, and loosen the two set screws of the frange, and remove the frange.
5) Loosens the fixing screw of the bellows stop ring which is fixing the upper part of bellows, and remove bellows.
6) Installs new bellows.
7) Installs the frange in the position of 30 mm from the shaft lower end as before. Align two set screws (M4) to the D cut surface and fix them securely.
8) Fixes the bellows lower part to the frange as before. Fixes the four bellows fixing screws (M3x8) securely.
9) Makes the J4 axis into the position of 0 degree by jog operation etc., and match the ABS mark (marking-off line) with ABS mark (marking-off line) on the shaft.
   In the condition that each other's ABS mark has matched, fixes the bellows upper part.
10) Fixes the fixing screw of the bellows stop ring as before, and fixes the upper part of bellows securely.

⚠ CAUTION The fixing screw should fix the bellows stop ring in the position used as the inner side. (refer to figure) If that is not right, the fixing screw may interfere with the No.1 arm. And, you should confirm that the stop ring has covered the perimeter of bellows surely. If the fixation is not enough, the protection performance may drop.

Replacing bellows is completed.

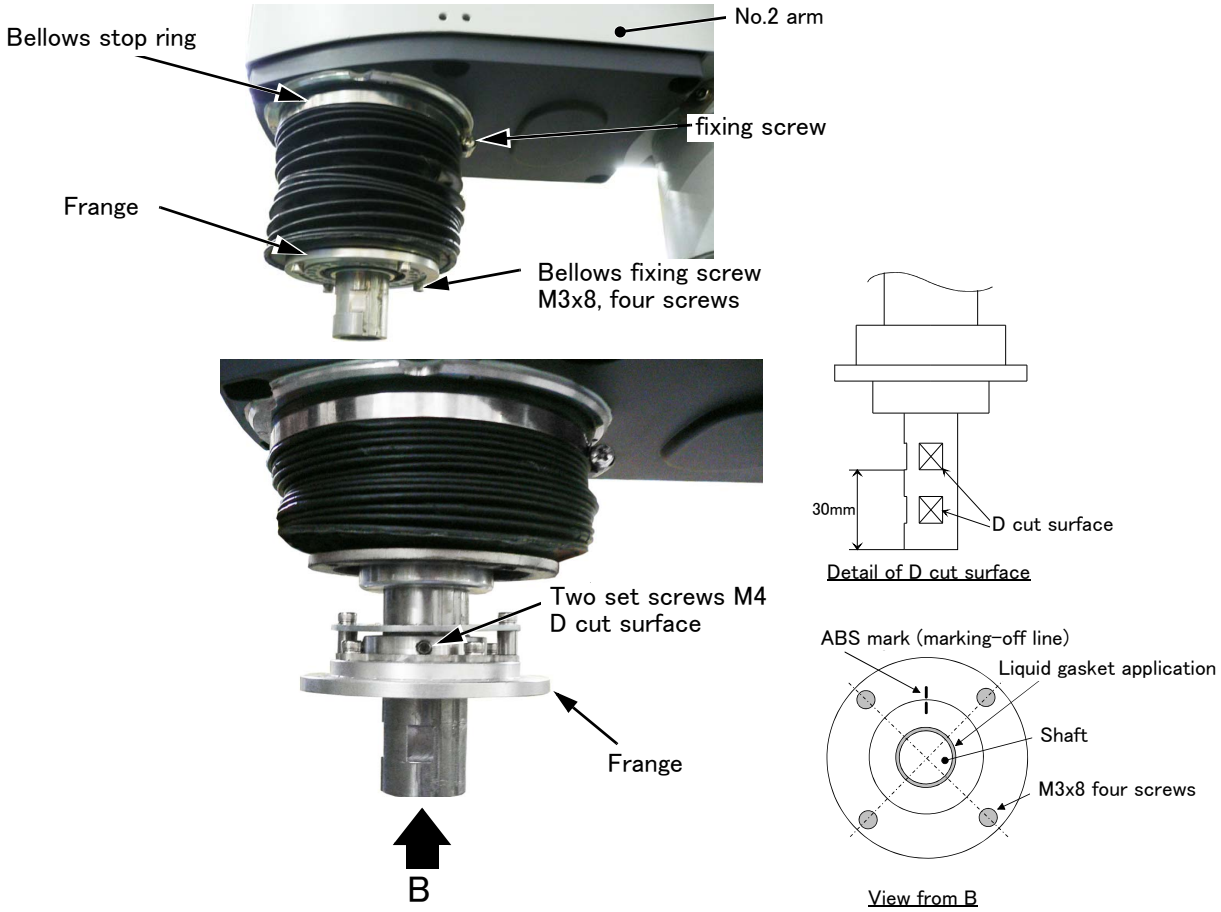


Fig.5-21 : Replace the bellows (oil mist specification)

(2) RH-3FRHR series

■ Clean/waterproof specification

1) Turn off the controller's power supply.
2) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the belt pulley cover J4.
3) Loosen the two fixing (M4) screws of bellows, and remove the bellows to downward together with belt pulley cover J4.
4) Remove the four fixing screws which fix the bellows to the belt pulley cover J4, and removes the ring, then the bellows can be removed from belt pulley cover J4.
5) Fix the new bellows to the belt pulley cover J4 in the same way (screw tightening torque: 0.8Nm). Fill the gap between the belt pulley cover J4 and the bellows with a seal such as a liquid gasket.
6) Install the belt pulley cover J4 as before.
7) Fix the bellows to shaft with adjusting the position of the bellows's bottom to 30mm from end of shaft. Align two set screws (M4) to the D cut surface and fix them securely.
8) Fill the gap between the bellows fixing section and the shaft with a seal, such as a liquid gasket.
9) Sticks the attached ABS mark on the lower part of bellows. Makes the J4 axis into the position of 0 degree by jog operation etc., and match the ABS mark sticker with ABS mark on the shaft, and stick it.

[Caution] When installing the belt pulley cover J4 to the No. 2 arm, please check the condition of the sealing. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please inform the dealer, if exchange is necessary.

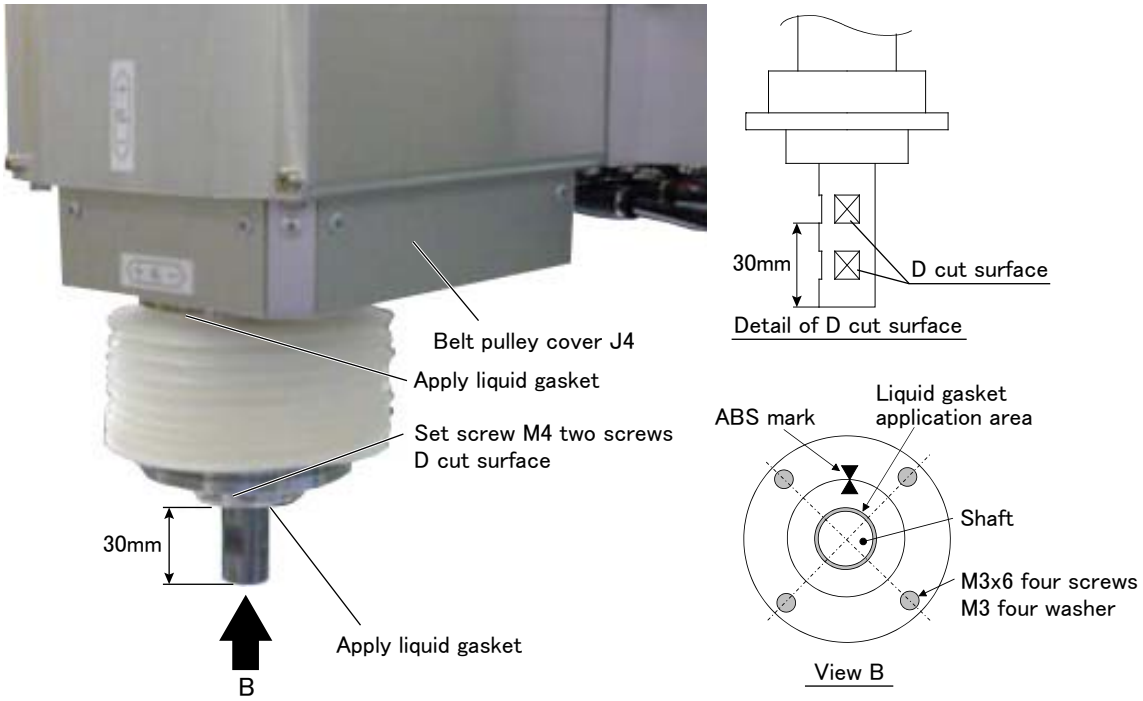


Fig.5-22 : Replace the bellows

5.3.6 Lubrication

(1) RH-3FRH/6FRH/12FRH/20FRH series

■ Lubrication position and specifications

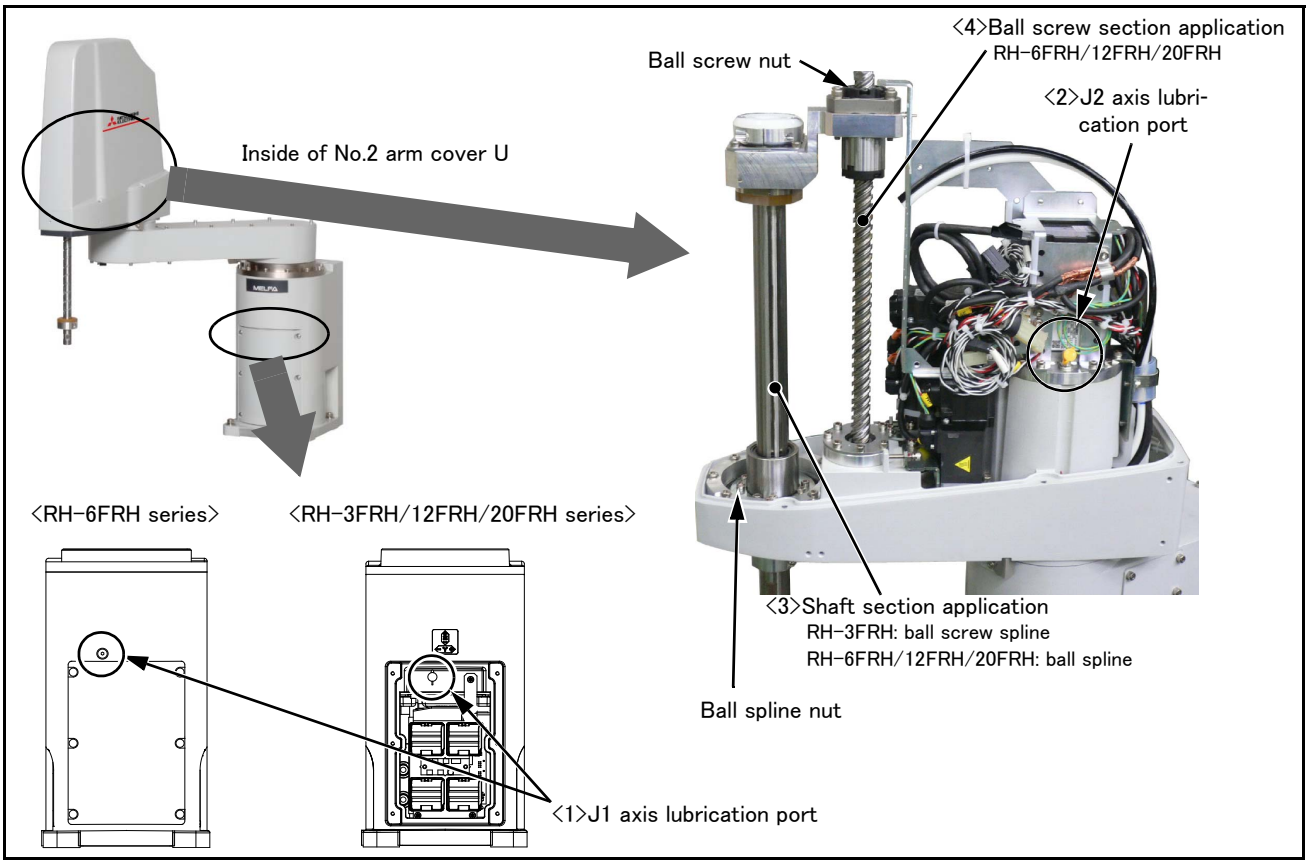


Fig.5-23 : Lubrication positions (RH-3FRH/6FRH/12FRH/20FRH series)

Table 5-10 : Lubrication specifications

No.	Parts to be lubricated	Lubrication method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
RH-3FRH series						
<1>	J1 axis reduction gears	Grease nipple WA-610(Only addition)	4B No.2 (Harmonic Drive Systems Inc.)	24,000 Hr	12 g	Battery cover
<2>	J2 axis reduction gears	Grease nipple WB-610(Only addition)		24,000 Hr	8 g	No.2 arm cover U
<3>	Shaft (ball screw spline)	Wipe the old grease, and applies	Multemp PS2 (KYODO YUSHI CO., LTD.)	Every 2,000km movement	1 g	
RH-6FRH series						
<1>	J1 axis reduction gears[Note1)]	Grease nipple WA-610(Only addition)	4B No.2 (Harmonic Drive Systems Inc.)	24,000 Hr	12 g	
<2>	J2 axis reduction gears	Grease nipple WB-610(Only addition)		24,000 Hr	8 g	No.2 arm cover U
<3>	Shaft (ball spline)	Wipe the old grease, and applies	Multemp PS2 (KYODO YUSHI CO., LTD.)	Every 2,000km movement	1 g	
<4>	Shaft (ball screw)				1 g	

No.	Parts to be lubricated	Lubrication method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
RH-12FRH/20FRH series						
<1>	J1 axis reduction gears	Grease nipple WA-610(Only addition)	4B No.2 (Harmonic Drive Systems Inc.)	24,000 Hr	16 g	Battery cover
<2>	J2 axis reduction gears	Grease nipple WB-610(Only addition)		24,000 Hr	12 g	No.2 arm cover U
<3>	Shaft (ball spline)	Wipe the old grease, and applies	Multemp PS2 (KYODO YUSHI CO., LTD.)	Every 2,000km movement	1 g	
<4>	Shaft (ball screw)				1 g	

Note1)Remove the screw from lubrication point and install the supplied grease nipple for supplying grease.

[Caution]

- The brand name of the grease shown in the Table 5-10 is the grease put in at shipping.
- The lubrication interval 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 interval 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 5-10 when the operation is repeated with a short stroke.
- By the maintenance forecast function of RT ToolBox3 (option) computes the guide of the lubrication hours put together with the customer's operation status.
- The numbers in theTable 5-10 correspond to the supply positions in Fig. 5-23.
- When the specified time limit (24,000 Hr) is due, the overhaul work to replace internal grease is required. For the J1/J2 axis reduction gears, if the overhaul cannot be conducted at the specified timing, lubricate them at the lubrication interval in Table 5-10.
  For the overhaul, contact the dealer.

■ Lubrication method to the J1, J2 axis

1) Turn off the controller's power supply.
2) Refer to the "5.3.2Installing/removing the cover" and remove the covers.
3) In RH-6FRH series, remove the screw from the J1 axis lubrication port, and install the attached grease nipple. Securely tighten the grease nipple by 4.7 N·m to 6.3 N·m.
4) Insert the grease shown in Table 5-10 using a grease gun from the lubrication grease nipple. Add only the specified amount of grease. Adding excess grease may cause grease to leak.

⚠ 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 (amount: 140ml) or KH-32 (amount: 200ml)
(manufacture: Yamada Corporation Inc.,)
The grease guns come 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).

5) In RH-6FRH series, removes the grease nipple installed above and installs the original screw. Securely tighten the screw by 4.7 N·m to 6.3 N·m.
6) Install the removed cover as before.
   Note) Sealant is applied to the installation surface of the cover in the oil mist and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape. If the sealant is required to be replaced, contact the dealer.
7) If the maintenance forecast function is enable, please reset the accumulated data about grease. Carries out the resetting operation by RT ToolBox3 (option) or parameter MFGRST. Refer to separate "RT ToolBox3/RT ToolBox3 mini User's Manual" for the operation method of RT ToolBox3, and refer to separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details of parameter MFGRST.

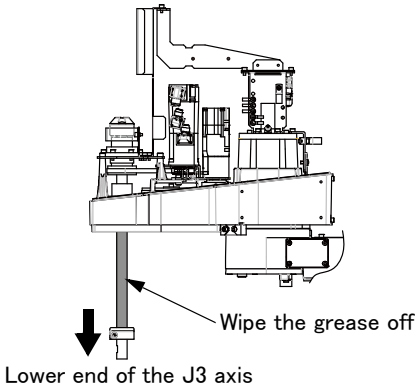
The lubricating to J1 and J2 axes is completed.

■ Lubrication method to the shaft

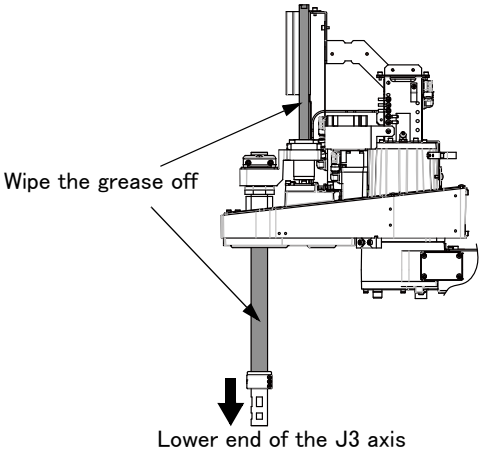
1) Move the J3 axis to the bottom end with a jog operation and shut off the controller's power supply.
2) Refer to Page 101 "Fig. 5.3.2: Installing/removing the cover", remove the No. 2 arm cover U. The bellows must be removed in the case of the oil mist and clean specifications. Reference Page 127, "5.3.5 Replacing the bellows"and remove the bellows.

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

3) Wipe the old grease off the shaft. Wipe off the grease inside the No. 2 arm cover-U and the bracket attached vertically to the shaft fixing area.

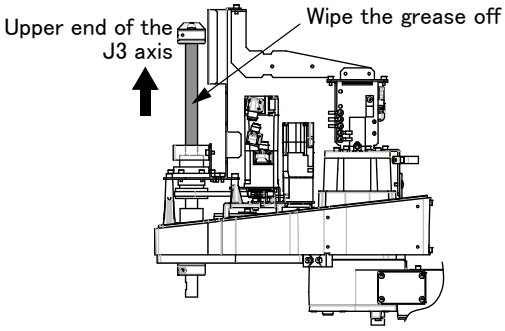


RH-3FRH series

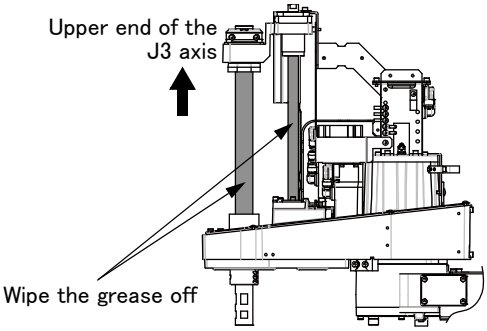


RH-6FRH/12FRH/20FRH series

4) Power on the controller and move the J3 axis to the top end with a jog operation. Then shut off the controller's power supply again.
5) Wipe off the old grease beneath the ball spline nut and the ball screw nut on the shaft.

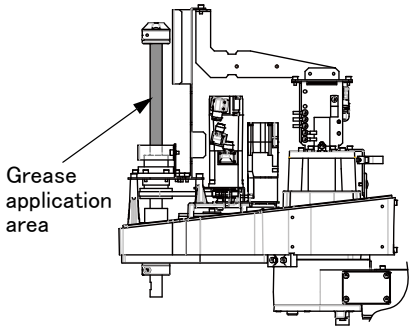


RH-3FRH series

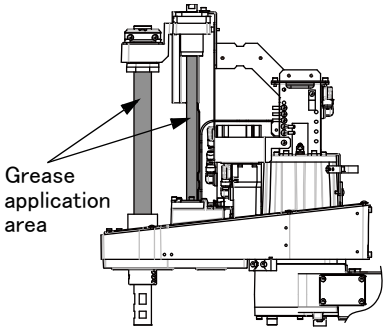


RH-6FRH/12FRH/20FRH series

6) 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.

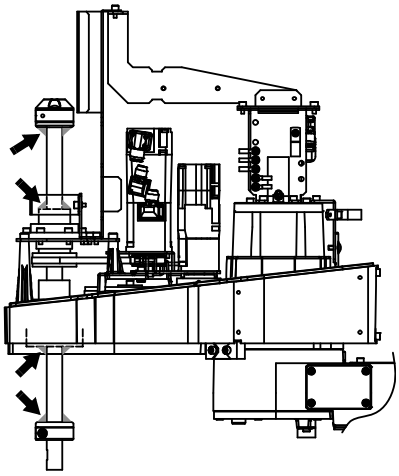


RH-3FRH series

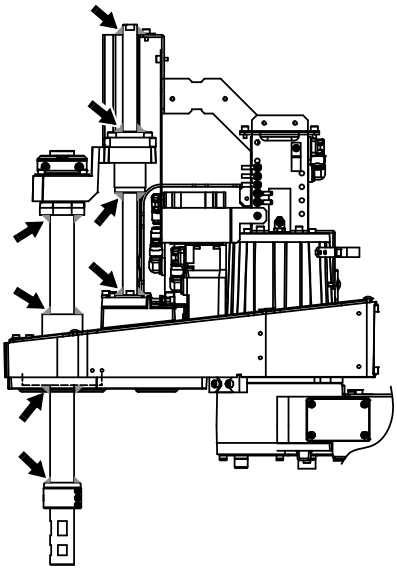


RH-6FRH/12FRH/20FRH series

7) 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.
8) 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.
9) Wipe off the grease adhering around the shaft ends or the nuts of the ball spline and the ball screw (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-3FRH series



RH-6FRH/12FRH/20FRH series

10) Install the No.2 arm cover U as before. Install the bellows as before in the oil mist and clean specification
Note) Sealant is applied to the installation surface of cover in the oil mist and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape. If the sealant is required to be replaced, contact the dealer.

Applying grease to shaft is completed.

(2) RH-3FRHR series

■ Lubrication position and specifications

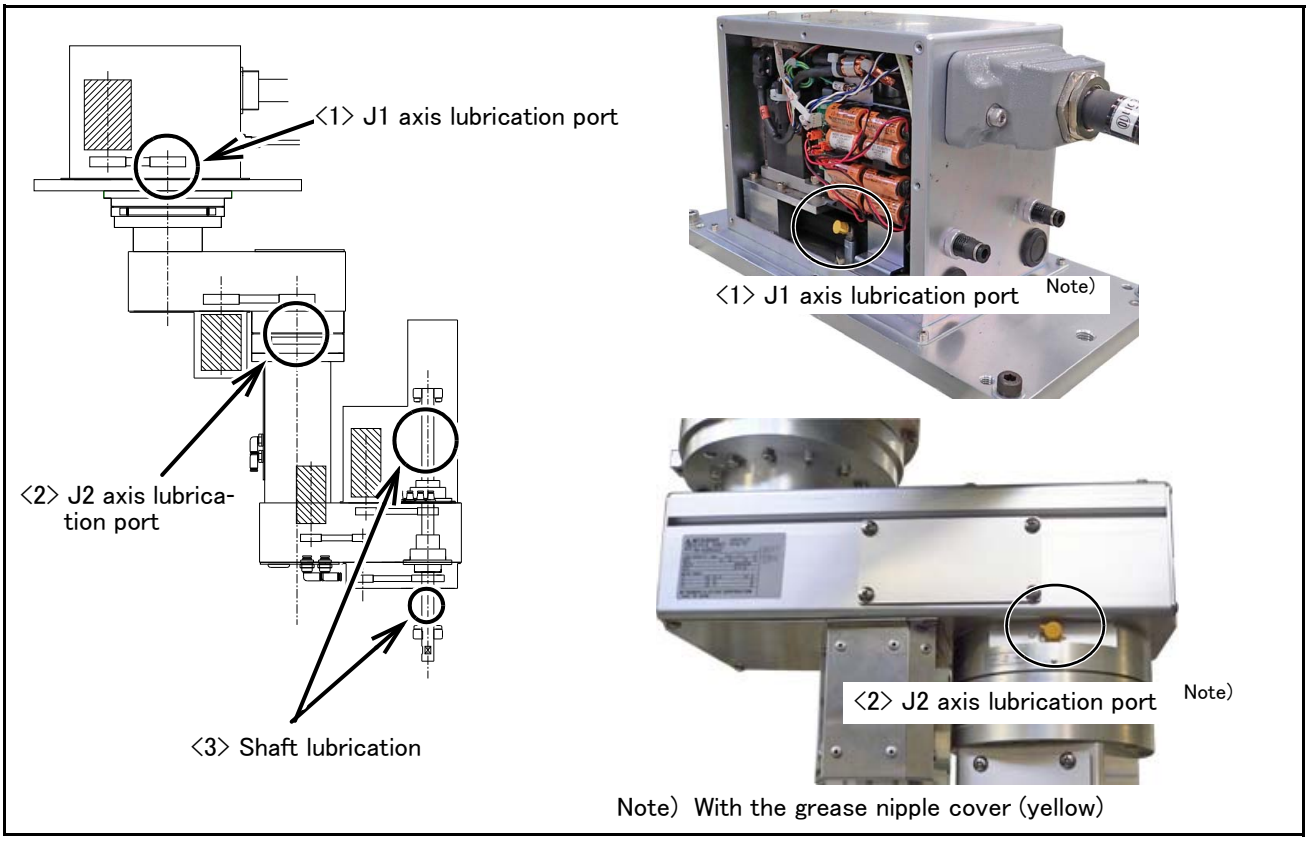


Fig.5-24 : Lubrication positions (RH-3FRHR series)

Table 5-11 : Lubrication specifications

No.	Parts to be lubricated	Oiling method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
<1>	J1 axis reduction gears	Grease nipple WC-610(Only addition)	Grease Harmonic grease SK-1A (Harmonic Drive Systems Inc.)	6,000 Hr	4.1 g	Base cover B (L)
<2>	J2 axis reduction gears			6,000 Hr	1.8 g	-
<3>	Shaft (General environment/ Clean specification)	Wipe the old grease, and apply new grease	Marutenpu PS No.2 (KYODO YUSHI CO.,LTD.)	Every 2000km movement	1 g	Motor cover J3
<4>	Shaft (Waterproof specification)		NOK Klubersynth UH1 14-222 (NOK CORPORATION)			

[Caution]

- The brand name of the grease shown in the Table 5-11 is the grease put in at shipping.
- The lubrication interval 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 interval will fluctuate, so determine the time according to the state so that the grease does not run out.
- By the maintenance forecast function of RT ToolBox3 (option) computes the guide of the lubrication hours put together with the customer's operation status.
- The numbers in theTable 5-11 correspond to the supply positions in Fig. 5-24.
- Because excessive lubrication leads to the grease leak, avoid it. And the number of times of lubrication limits to 3 times. The maintenance after it needs the overhaul work which replaces internal grease. Contact the dealer.

■ Lubrication method to the J1, J2 axis

1) The positions of lubrication ports are shown in the Fig. 5-24. Move the robot to the posture in which it can supply the grease easy.
2) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the covers necessary.
3) Insert the grease shown in Table 5-11 using a grease gun from the lubrication grease nipple. Add only the specified amount of grease. Adding excess grease may cause grease to leak. The J1 axis grease lubrication port is positioned near the timing belt. If the grease is adhered to the belt, wipe it off, although the belt is resistant to grease.

⚠ 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: CH-400 (manufacture: Yamada Corporation Inc.,)
The CH-400 gun is a cartridge-type grease gun. Contact your dealer and use commercially available grease cartridges.
When a grease can is used, hand grease gun KH-32 (manufacture: Yamada Corporation) is recommended. The KH-32 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). CH-400 has a long nozzle as standard equipment.

4) Install the removed cover as before.
5) If the maintenance forecast function is enable, please reset the accumulated data about grease. Carries out the resetting operation by RT ToolBox3 (option) or parameter MFGRST. Refer to separate "RT ToolBox3/RT ToolBox3 mini User's Manual" for the operation method of RT ToolBox3, 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.

■ Lubrication method to the shaft

1) Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the motor cover J3.
2) Wipe the old grease off the shaft. At this time, wipe off the grease that has been scattered inside the motor cover J3 and the bracket attached vertically to the shaft fastening area.
3) Apply the specified amount of grease to the shaft. If too much grease is applied, grease may get scattered all over inside of the No. 2 arm. If the grease reaches the timing belt inside the No. 2 arm, the timing belt may deteriorate prematurely.
4) Install the covers with the removal procedure in reverse.

The applying grease to shaft is completed.

5.3.7 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 CR800-Q controller uses a backup battery to save the program, etc. These batteries are installed when the robot is shipped from the factory, but as these are consumable parts, they must be replaced periodically by the customer.

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state. There exists the kinds of the errors about the battery shown in Table 5-12. If error occurs, please exchange the battery of the robot arm and robot CPU unit (CR800-Q controller only).

Table 5-12 : The error about the battery

Error number	Description	Measure
7510	Encoder battery voltage low	Replace the battery as soon as possible.
7500	No encoder battery voltage	
112n[Note1)]	Encoder ABS position data lost	The backup data cannot be guaranteed if this error occurs.
7451[Note2)]	Robot CPU unit battery voltage low	Replace the battery as soon as possible.
7450[Note2)]	No robot CPU unit battery voltage	The backup data cannot be guaranteed if this error occurs.

Note1) "n" indicates the axis number
Note2)This error occurs in CR800-Q controller only.

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, refers to Page 140, "5.5 Maintenance parts".

⚠ CAUTION If error 7500 or 112n (n indicates the axis number) 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.

⚠ CAUTION If error 7450 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 of the robot arm

⚠ CAUTION The battery circuit board connection cable is used to supply power from the backup battery to the encoder. 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 Before replacing the backup battery, check that the capacitor is fully charged.
If the robot has been used for over 36,000 hours, the battery life is gradually shortened due to deterioration of the capacitor.

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

The battery installation position is shown below. Refers to the figure and replaces the batteries in the following procedures.

■ RH-3FRH/6FRH/12FRH/20FRH series

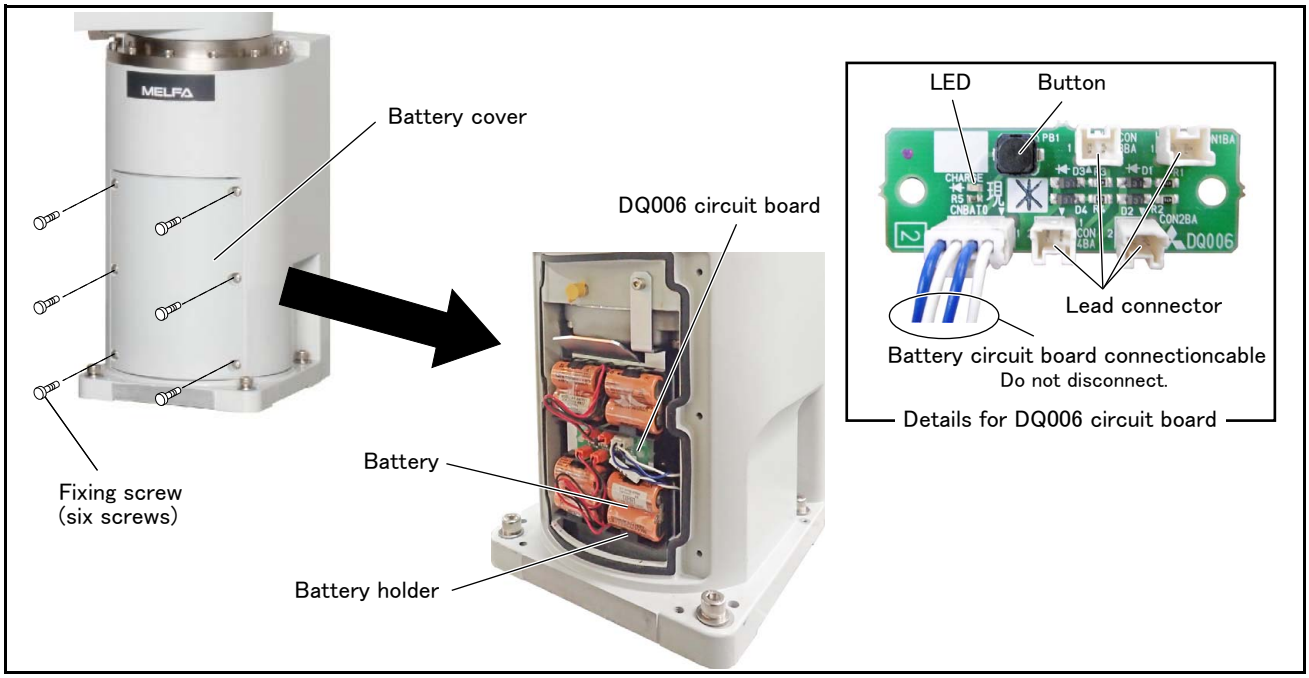


Fig.5-25 : Replacing the battery (RH-3FRH/6FRH/12FRH/20FRH series)

1) Turn the controller control power OFF.
2) Remove the battery cover, referring to Page 101, "5.3.2 Installing/removing the cover".
3) Check that the capacitor is fully charged. Press the button on the DQ006 circuit board and check that the LED on the same circuit board turns on.
   Replace the battery within 15 minutes after checking that the LED turns on.
   If the LED does not turn on when the button is pressed, the capacitor needs to be charged. Turn on the controller and charge the capacitor for approximately 30 minutes.
4) Replaces the backup battery one by one. The battery holder is located inside the battery cover. Remove the old battery from the holder, and disconnect the lead connector.
5) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
6) All the batteries should be checked that it has been exchanged newly. If the old battery is contained, generating heat and damaging may occur.
7) Install the battery cover as before. Be careful so that the cable may not be inserted.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again.

Refer to Page 142, "5.6 Resetting the origin" and reset the origin using the ABS origin method.
The CR800-D controller requires time setup. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

■ RH-3FRHR series

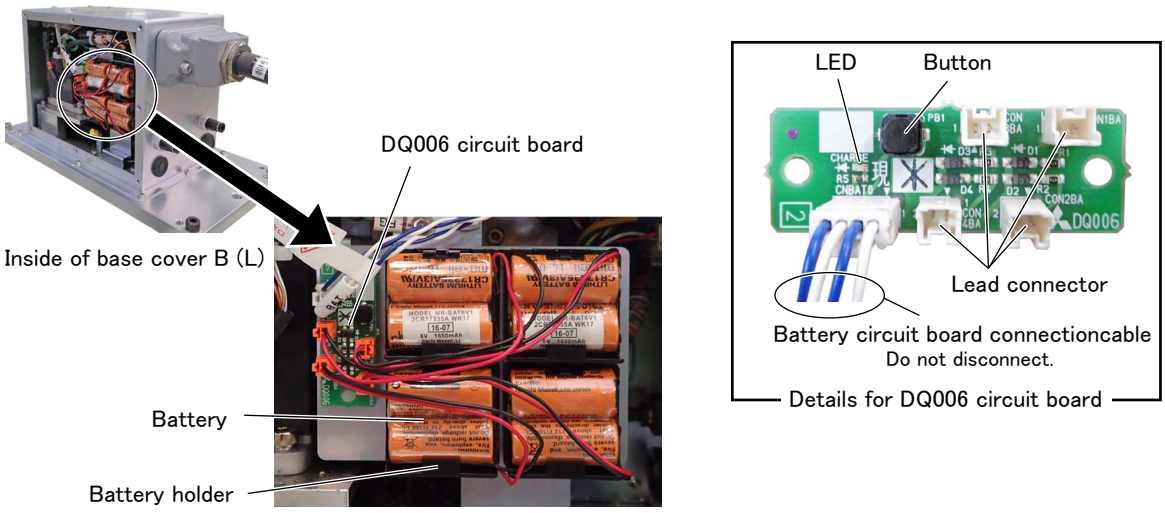


Fig.5-26 : Replacing the battery (RH-3FRHR series)

1) Turn the controller control power OFF.
2) Remove the base cover B (L), referring to Page 101, "5.3.2 Installing/removing the cover".
3) Check that the capacitor is fully charged. Press the button on the DQ006 circuit board and check that the LED on the same circuit board turns on.
   Replace the battery within 15 minutes after checking that the LED turns on.
   If the LED does not turn on when the button is pressed, the capacitor needs to be charged. Turn on the controller and charge the capacitor for approximately 30 minutes.
4) Replaces the backup battery one by one. The battery holder is located inside the base cover B (L). Remove the old battery from the holder, and disconnect the lead connector.
5) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
6) All the batteries should be checked that it has been exchanged newly. If the old battery is contained, generating heat and damaging may occur.
7) Install the base cover B (L) as before. Be careful so that the cable may not be inserted.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again.
Refer to Page 142, "5.6 Resetting the origin" and reset the origin using the ABS origin method.
The CR800-D controller requires time setup. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

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. 5-27.) 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.

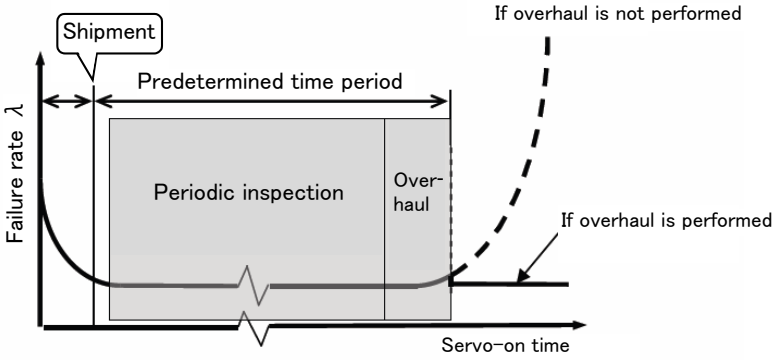


Fig.5-27 : Periodic inspection/overhaul periods

5.5 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-13, and spare parts that may be required during repairs are shown in Table 5-14. Purchase these parts from the dealer when required.
[Note] 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 5-13 : Consumable part list

No.	Part name	Usage place	Q'ty	Description	Supplier
RH-3FRH/6FRH/12FRH/20FRH series common					
1	Grease	Reduction gears of each axis	A small amount	"5.3.6Lubrication"	Mitsubishi Electric
2		Shaft	A small amount		
3	Lithium battery (MR-BAT6V1)	Base section	4	"5.3.7Replacing the backup battery"	
4	Liquefied gasket	Packing Note1)	A small amount	"5.3.3Packing Replacement Procedure"	
RH-3FRH series					
5	Timing belt	J3 axis	1	"5.3.4Inspection replacement of timing belt"	Mitsubishi Electric
6		J4 axis motor side	1		
7		J4 axis shaft side	1		
RH-6FRH series					
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		
RH-12FRH series					
11	Timing belt	J3 axis	1	"5.3.4Inspection replacement of timing belt"	Mitsubishi Electric
12		J4 axis motor side	1		
13		J4 axis shaft side	1		
RH-20FRH series					
14	Timing belt	J3 axis	1	"5.3.4Inspection replacement of timing belt"	Mitsubishi Electric
15		J4 axis motor side	1		
16		J4 axis shaft side	1		
RH-3FRHR series					
17	Timing belt	J1 axis	1	"5.3.4Inspection replacement of timing belt"	Mitsubishi Electric
18		J2 axis	1		
19		J3 axis	1		
20		J4 axis motor side	1		
21		J4 axis shaft side	1		
22	Grease	Reduction gears of each axis	A small amount	"5.3.6Lubrication"	
23	Lithium battery (MR-BAT6V1)	Base section	4	"5.3.7Replacing the backup battery"	

Note1)The liquefied gasket is necessary for the place which uses two or more packings to connect.

Table 5-14 : Spare parts list

No.	Names	Usage place	Q'ty	Supplier
RH-3FRH series				
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 (general environment and oil mist specification)	1	
8		J3 axis (clean specification)	1	
9	Bellows	J3 axis (oil mist specification)	1	
10		J3 axis (clean specification)	1	
11	Liquid gasket	Bellows (clean specification)	A small amount	

No.	Names	Usage place	Q'ty	Supplier
RH-6FRH series				
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 spline	J3 axis (general environment specification)	1	
8		J3 axis (clean/oil mist specification)	1	
9	Ball screw	J3 axis (general environment/clean/oil mist specification)	1	
10	Bellows	J3 axis (oil mist specification)	1	
11		J3 axis (clean specification)	1	
12	Liquid gasket	Bellows (clean specification)	A small amount	
RH-12FRH series				
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 spline	J3 axis (general environment specification)	1	
8		J3 axis (clean/oil mist specification)	1	
9	Ball screw	J3 axis (general environment/clean/oil mist specification)	1	
10	Bellows	J3 axis (oil mist specification)	1	
11		J3 axis (clean specification)	1	
12	Liquid gasket	Bellows (clean specification)	A small amount	
RH-20FRH series				
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 spline	J3 axis (general environment specification)	1	
8		J3 axis (clean/oil mist specification)	1	
9	Ball screw	J3 axis (general environment/clean/oil mist specification)	1	
10	Bellows	J3 axis (oil mist specification)	1	
11		J3 axis (clean specification)	1	
12	Liquid gasket	Bellows (clean specification)	A small amount	
RH-3FRHR series				
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 (general environment specification)	1	
8		J3 axis (clean specification)	1	
9		J3 axis (waterproof specification)	1	
10	Bellows	J3 axis (clean/waterproof specification)	1	

5.6 Resetting the origin

The origin is set so that the robot can be used with a high accuracy. The origin is set so that the robot can be used with a high accuracy. Setting is required if the motor is replaced or an encoder error occurs.
The origin setting methods and when each origin setting method is required are shown in Table 5-15.

Table 5-15 : 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.	・When the data is lost due to flat battery of the robot controller (when C7500 occurs)	The setting method is explained in Page 143, "5.6.1 Setting the origin with the origin data input method" .
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 147, "5.6.2 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 156, "5.6.3 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 160, "5.6.4 User origin method".

[Caution]
- The origin is set using the jig method (No.2) at factory default.
- 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 156, "5.6.3 ABS origin method".

5.6.1 Setting the origin with the origin data input method

(1) Confirming the origin data

The origin data to be input is noted in the origin data sheet. (See Fig. 5-28.)

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

Date	Default	. . .	. . .	. . .
D	V!#S29			
J1	06DTYY			
J2	2?HL9X			
J3	1CP55V			
J4	T6!M$Y			
J5				
J6				
Method	J	J・A・U	J・A・U	J・A・U

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

Note) Meanings of symbols in method column
J: Jig method
A: ABS origin method
U: User origin method

Fig.5-28 : Origin data label (an example)

The origin data history table is attached on the back of the following covers.

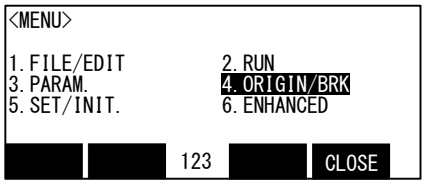
Model	Cover
RH-3FRH/6FRH/12FRH/20FRH series	Battery cover
RH-3FRHR series	Base cover B (L)

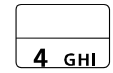
Referring to Page 101, "5.3.2 Installing/removing the cover", remove the cover above and confirm the value.
The value given in the default setting column is the origin settings set with the jig method before shipment.

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

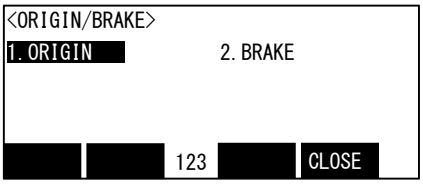
⚠ WARNING Always install/remove the cover with the controller control power turned OFF. Failure to do so could lead to physical damage or personal injury should the robot start moving due to incorrect operations.

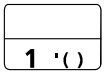
(2) Selecting the origin setting method



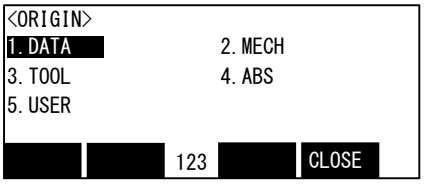


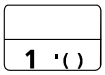
1) Press the [4] key on the menu screen, and display the ORIGIN/BRAKE screen.





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





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

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.

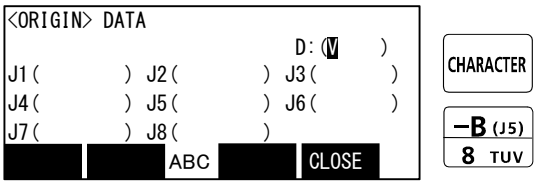
(3) Inputting the origin data

Input the value confirmed in section Page 143, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 5-29.

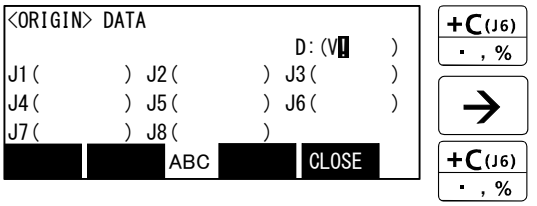
Fig.5-29 : Correspondence of origin data label and axis

The method for inputting the origin data is explained below. The value shown in Fig. 5-28 will be input as an example.

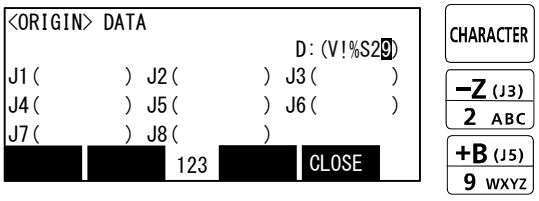
1) Confirm that the cursor is at the "D" position on the T/B display screen.



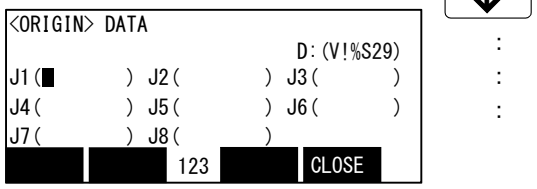
2) Input the D value "V!%S29".
Inputting "V"
Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen)
Press the [TUV] key three times. "V" will be set.



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").

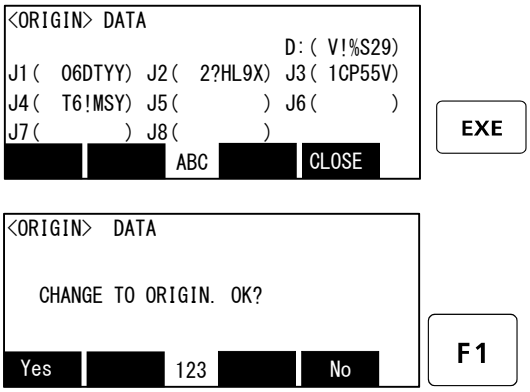


Press the [CHARACTER] key and set to the numeral input mode. (Condition that "123" was displayed under the screen)
Press the [2] key (input "2"), and press the [9] key (input "9").
"V!%S29" will appear at the "D" data on the teaching pendant screen.



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.



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

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.

(4) Installing the cover

Return the cover removed in section Page 143, "(1) Confirming the origin data" to its original position.
The setting of the origin with the origin data input method is completed.

⚠ WARNING

Removing and installing the cover by always turning off the controller power.
Failure to do so could lead to the robot moving because of incorrect operations, or to physical damage or personal injury.

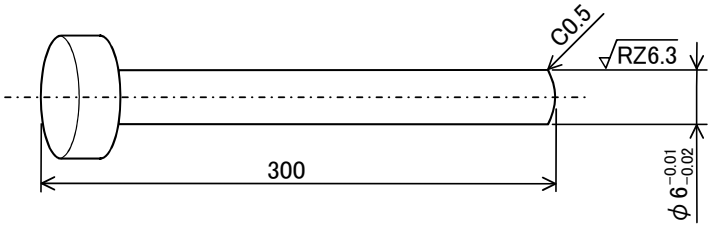
◇◆◇ If the origin input data is incorrect ◇◆◇

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

5.6.2 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. 5-30.

<RH-3FRH/6FRH/12FRH/20FRH series>



<RH-3FRHR series>

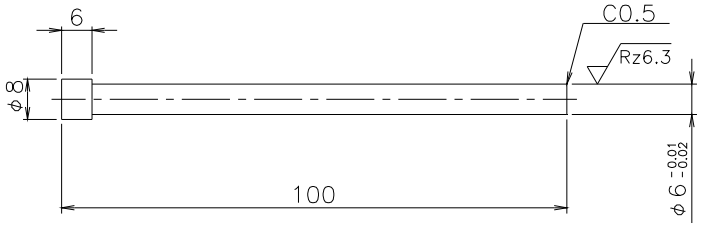


Fig.5-30 : Reference dimension of origin setting tool

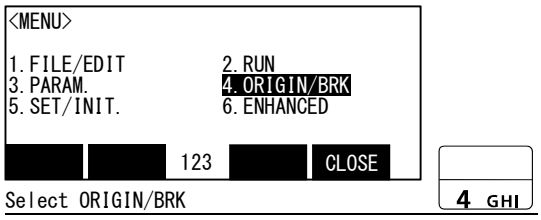
The procedure of setting the origin with the origin setting tool is shown below.
The origin setting can be performed for the target axis only instead of for all axes. Go to steps for the target axis to set the origin.

⚠ CAUTION

In the following procedure, the J3 axis brake is released to move its shaft with both hands.
When the brake is released, the J3 axis falls by its own weight.
To ensure safety, take appropriate measures such as supporting the axis to avoid the free fall.

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

(1) J1 axis origin setting

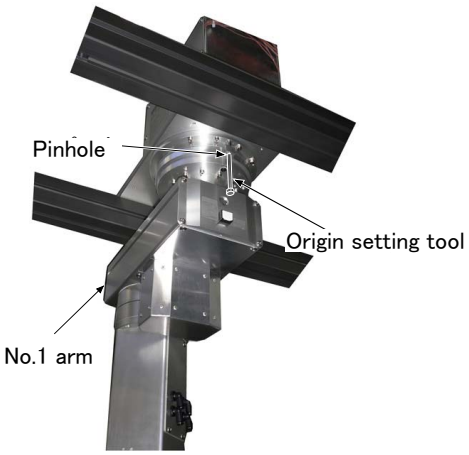


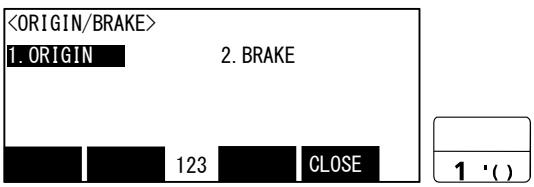
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

<RH-3FRH/6FRH/12FRH/20FRH series>

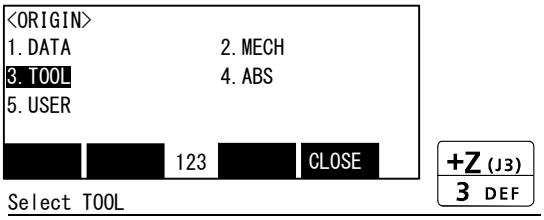
2) Move the J1 axis slowly toward the front using both hands. Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig into the pinholes and fasten.
In RH-3FRHR series, the origin setting tool should be inserted 35mm.

<RH-3FRHR series>

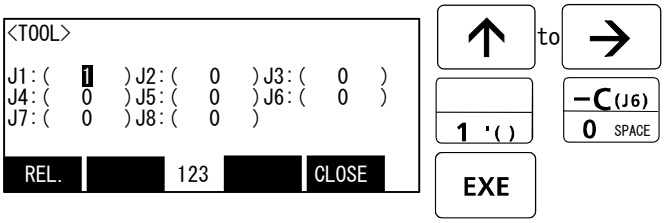




3) Press the [1] key, and display the Origin setting selection screen.

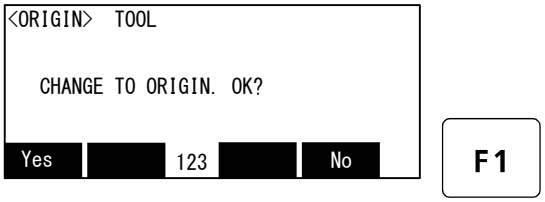


4) Press the [3] key, and display the Tool selection screen.



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

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



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

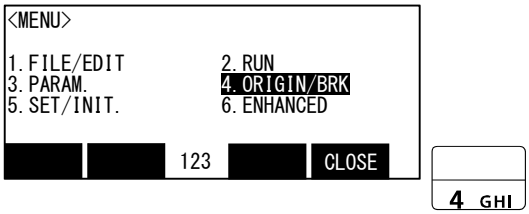
8) Setting of the origin is completed.

9) Refer to Page 162, "5.6.5 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



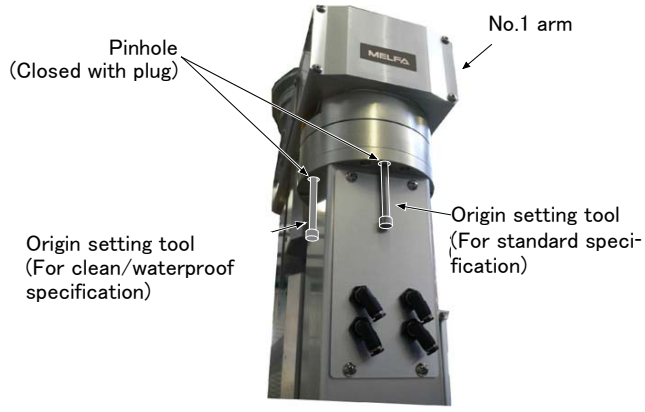
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

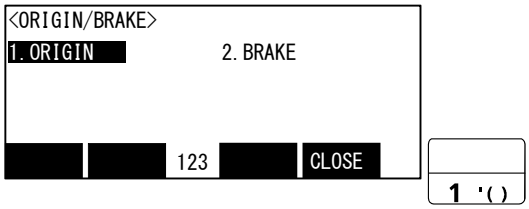
<RH-3FRH/6FRH/12FRH/20FRH series>

2) Move the J2 axis slowly with both hands to the position around ±0° . And align the pinholes of the No. 1 and No. 2 arms, feed through the origin jig into the pinholes and fasten.
Note) RH-3FRH/6FRH series robot which have 350mm arm length have to be rotated in the direction of +90 degrees.

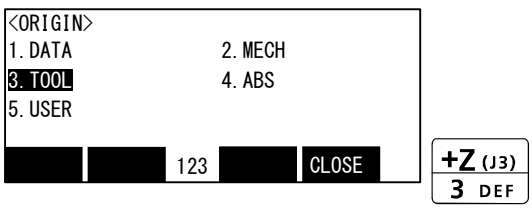
For the RH-3FRHR series, set the origin after removing the plug from the pinhole with a hexagon wrench. The origin setting tool should be inserted 65 mm.
The origin setting tool should be inserted 65mm.
Note) If the stick cannot insert 65mm move the J2 axis to mechanical stopper once.

<RH-3FRHR series>

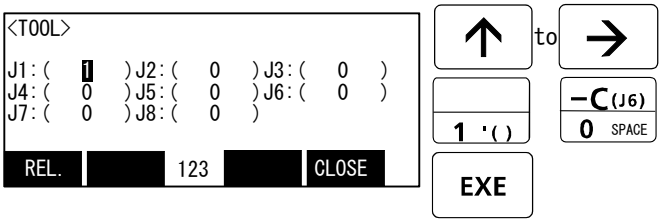




3) Press the [1] key, and display the Origin setting selection screen.

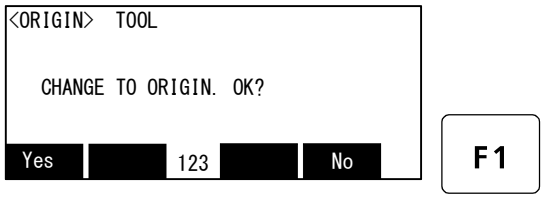


4) Press the [3] key, and display the Tool selection screen.



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

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



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

8) Setting of the origin is completed.

9) Refer to Page 162, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

* For the RH-3FRHR series, reinstall the plug into the pinhole after the origin setting. Wrap the sealing tape around the plug to fix it securely.

◇◆◇ 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".

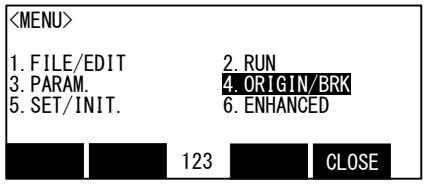
(3) J3 and J4 axis origin setting

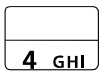
Always perform origin setting of the J3 axis and the J4 axis simultaneously.

In the RH-3FRH series, if the wiring and piping is passed in the shaft, remove the No.2 arm cover U and operate the origin setting.

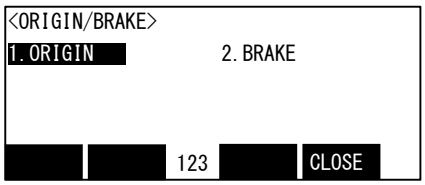
Note) If origin setting is carried out with the No.2 arm cover U installed, the origin may not be set up correctly because the wiring and the piping interfere with the No.2 arm cover U.

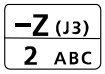
1) In the RH-3FH series, if the wiring and piping is passed in the shaft, removes the No.2 arm cover U referring the Page 101, "5.3.2 Installing/removing the cover". It is not necessary to remove the cover if wiring and piping is not passed, or if using the other robot.



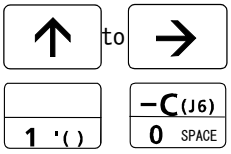


2) Press the [4] key on the menu screen, and display the Origin/Break selection screen.





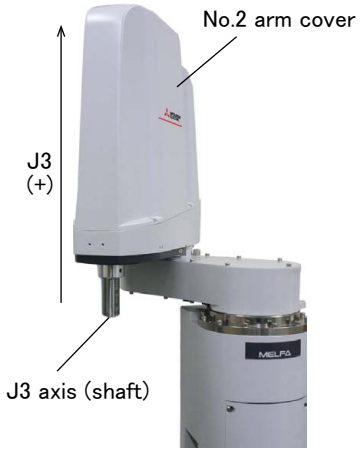
3) Press the [2] key, and display the Break release selection screen.



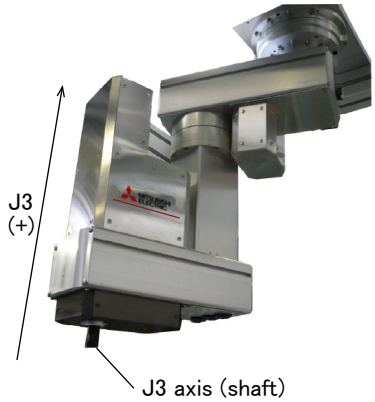
4) Release the brake of the J3 axis.
Input "1" into the J3 axis. Set "0" to other axes.

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

<RH-3FRH/6FRH/12FRH/20FRH series>



<RH-3FRHR series>



6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
Note) In RH-3FRH/6FRH/12FRH/20FRH series, the brake of the axis shown below repeats release/lock at the interval in each about 200ms for dropping the J3 axis slowly.

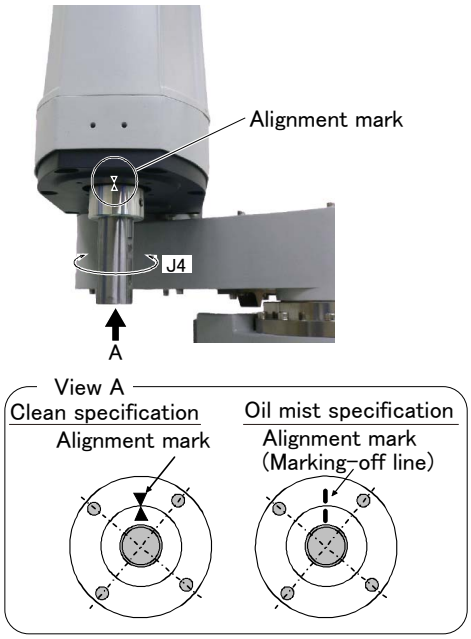
7) With both hands, slowly move the J3 axis in + (plus) direction , and contact the axis against the mechanical stopper.
Match the alignment mark of J4 axis in this condition next.

Go to the following procedure continuously.

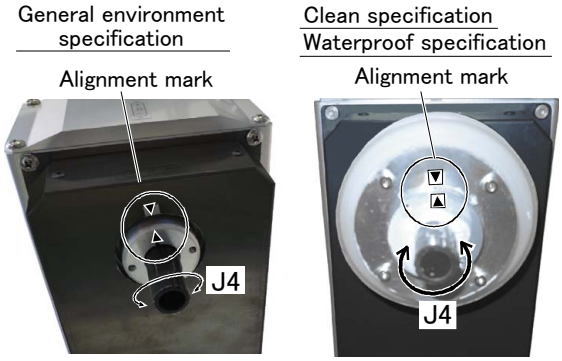
⚠ CAUTION When the brake is released, the J3 axis falls by its own weight.
To ensure safety, take appropriate measures such as supporting the axis to avoid the free fall.

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

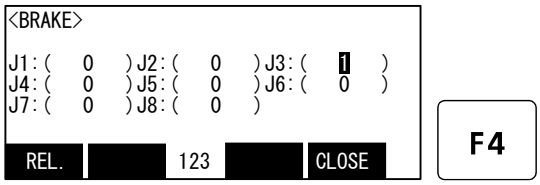
<RH-3FRH/6FRH/12FRH/20FRH series>



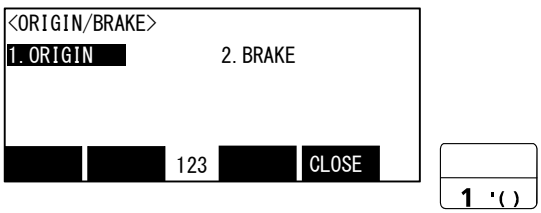
<RH-3FRHR series>



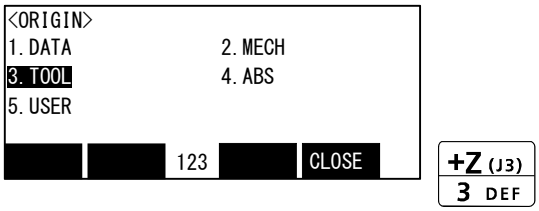
8) Hold the J4 axis with your hand and rotate it slowly to match the alignment marks.
Move the J4 axis with maintaining the condition that the releasing brake of the J3 axis and the J3 axis contact to the mechanical stopper.
Note) If the J3 axis has slid, move the J3 axis against the mechanical stopper, and contact again.



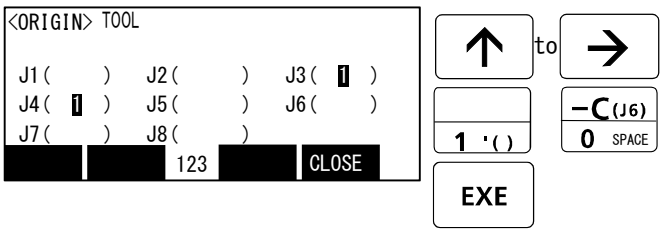
9) Detach the [F1] key and work the brake.
Press the [F4] key and return to the origin / brake screen.



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

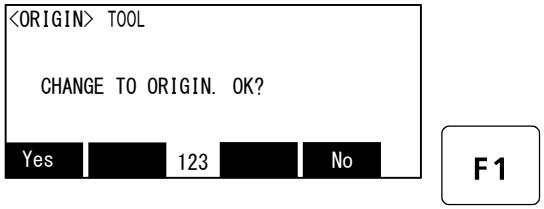


11) Press the [3] key, and display the Tool selection screen.



12) Input "1" into the J3 and J4 axis. Set "0" to other axes.

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



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

15) When No.2 arm cover U was removed, installs as before.

16) Setting of the origin is completed.

17) Refer to Page 162, "5.6.5 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 ◇◆◇

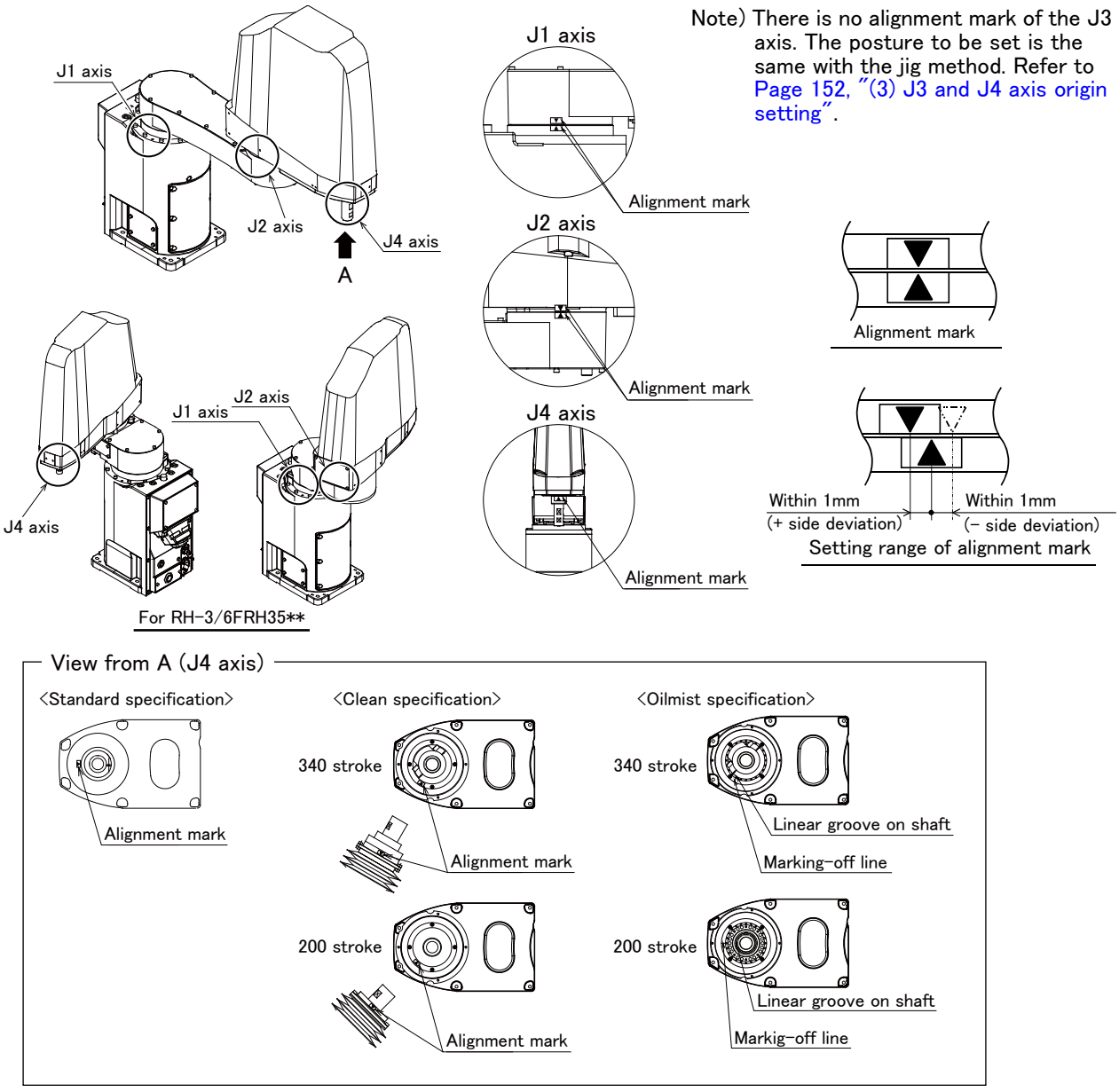
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

5.6.3 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 36, "2.3 Confirming the operation" for details on the jog operation.

(1) RH-3FRH/6FRH/12FRH/20FRH series

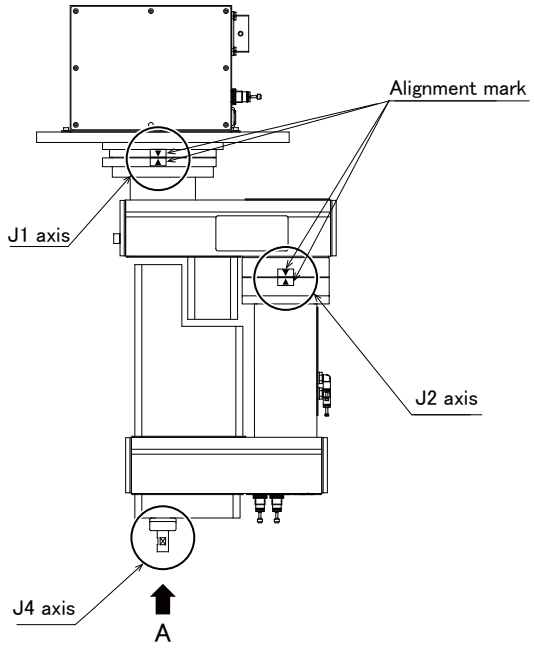


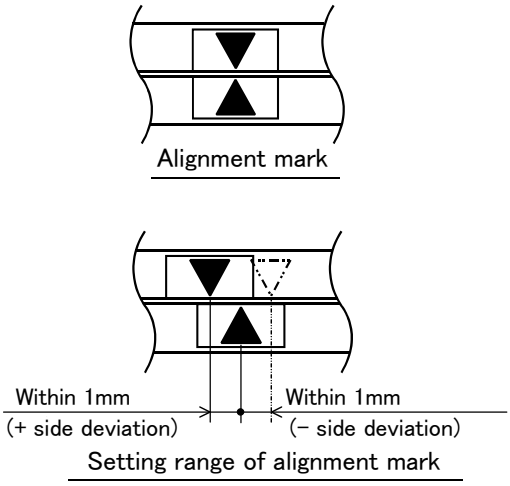
The angles of each axis which sets up the ABS origin are shown below.

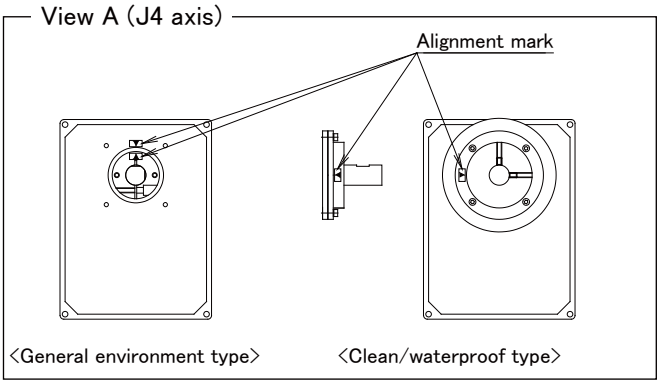
Model	J1 axis	J2 axis	J3 axis	J4 axis
RH-3FRH3515	0 degree	103.5 degrees	383.4mm	0 degree
RH-3FRH3512C	0 degree	103.5 degrees	341.9mm	0 degree
RH-3FRH4515/5515	0 degree	0 degree	383.4mm	0 degree
RH-3FRH4512C/5512C	0 degree	0 degree	341.9mm	0 degree
RH-6FRH35** (Excluded RH-6FRH3534C/M)	0 degree	103.5 degrees	336mm	0 degree
RH-6FRH3534C/M	0 degree	103.5 degrees	300mm	0 degree
RH-6FRH45**/55** (Excluded RH-6FRH4534C/M、RH-6FRH5534C/M)	0 degree	0 degree	336mm	0 degree
RH-6FRH4534C/M、RH-6FRH5534C/M	0 degree	0 degree	300mm	0 degree
RH-12FRH55**/70**/80**(C/M)	0 degree	0 degree	350.5mm	0 degree
RH-20FRH85**/100**(C/M)	0 degree	0 degree	342.5mm	0 degree

Fig.5-31 : ABS mark attachment positions (RH-3FRH/6FRH/12FRH/20FRH series)

(2) RH-3FRHR series







Note) There is no alignment mark of the J3 axis. The posture to be set is the same with the jig method. Refer to Page 152, "(3) J3 and J4 axis origin setting".

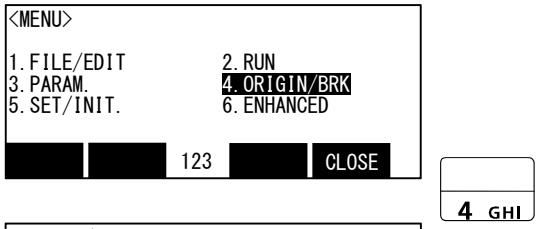
The angles of each axis which sets up the ABS origin are shown below.

Model	J1 axis	J2 axis	J3 axis	J4 axis
RH-3FRHR3515	0 degree	0 degree	−569.5mm	0 degree
RH-3FRHR3512C/W	0 degree	0 degree	−609mm	0 degree

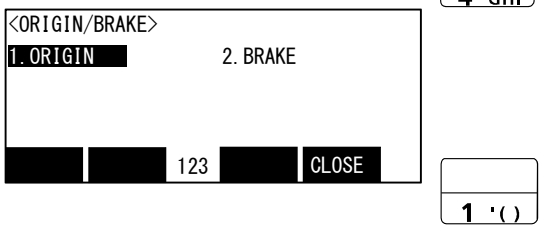
Fig.5-32 : ABS mark attachment positions (RH-3FRHR series)

(3) Origin setting procedure

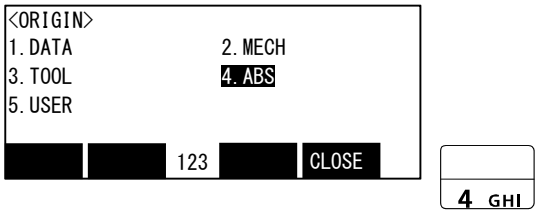
Do the following operations with pressing the enabling switch of T/B lightly.



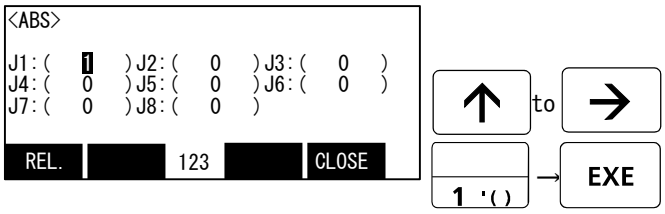
1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.



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

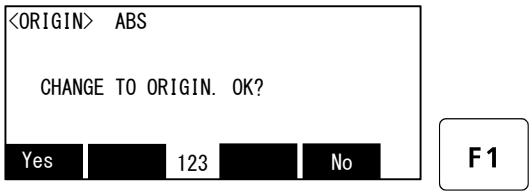


3) Press the [4] key, and display the ABS selection screen.



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

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



The origin settings are completed.

⚠ 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.

⚠ CAUTION When the ABS mark label of the axis other than the J6 axis is peeled off, align the pinholes used to set the origin with the jig method. The joint coordinates are the same between the ABS origin method and the jig method.

5.6.4 User origin method

CAUTION Before using this method, the origin must be set with the other method.
The setting method is explained in Page 142, "Table 5-15 : Origin setting method".

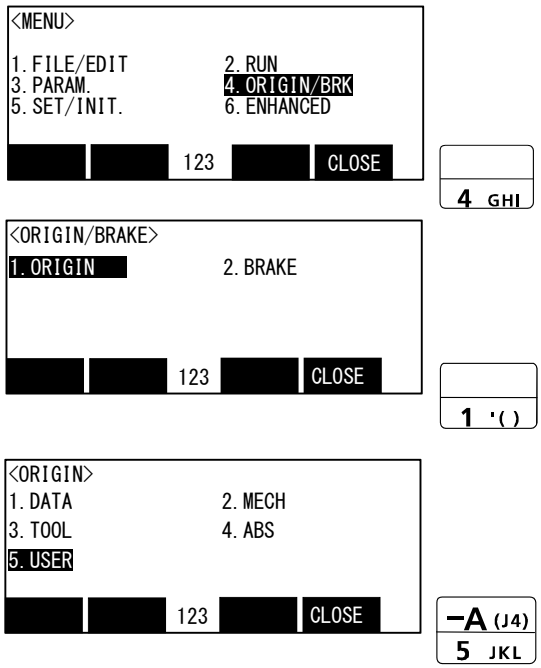
The procedure for setting the origin with the user origin method is explained below.
This operation is carried out with the teaching pendant. Set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown below.

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 axes. Then start the procedure from step "4)".

1) Determine the user origin position
Move the robot to the position to be set as the origin with jog operation. Refer to Page 36, "2.3 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.

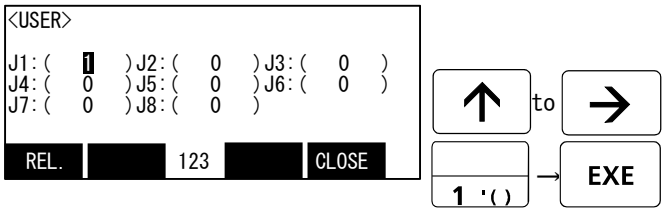


4) Next, set the origin.
Display the menu screen.

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



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

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

The origin settings are completed by the user origin method.

5.6.5 Recording the origin data

Confirm the origin data on the teaching pendant screen (origin data input screen). The origin data label is enclosed with the following cover.

Robot model	Cover
RH-3FRH/6FRH/12FRH/20FRH series	Battery cover
RH-3FRHR series	Base cover B (L)

The teaching pendant operation method and the 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 143, "5.6.1 Setting the origin with the origin data input method", and write the origin data displayed on the teaching pendant onto the origin label.

(1) Confirming the origin data label
Remove the cover.
Refer to Page 101, "5.3.2 Installing/removing the cover", and remove the cover.

(2) Confirming the origin data
Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to Page 143, "5.6.1 Setting the origin with the origin data input method", "(3)Inputting the origin data", and display the Origin Data Input screen on the teaching pendant display screen.

(3) Recording the origin data
Write the origin data displayed on the teaching pendant to the origin data label.
Refer to Page 143, "Fig.5-28 : Origin data label (an example)"for details on the origin data label.

(4) Installing the cover
Install the cover removed in step "(1)Confirming the origin data label" above.
Refer to Page 101, "5.3.2 Installing/removing the cover", and replace the cover.

The recording of the origin data is completed.

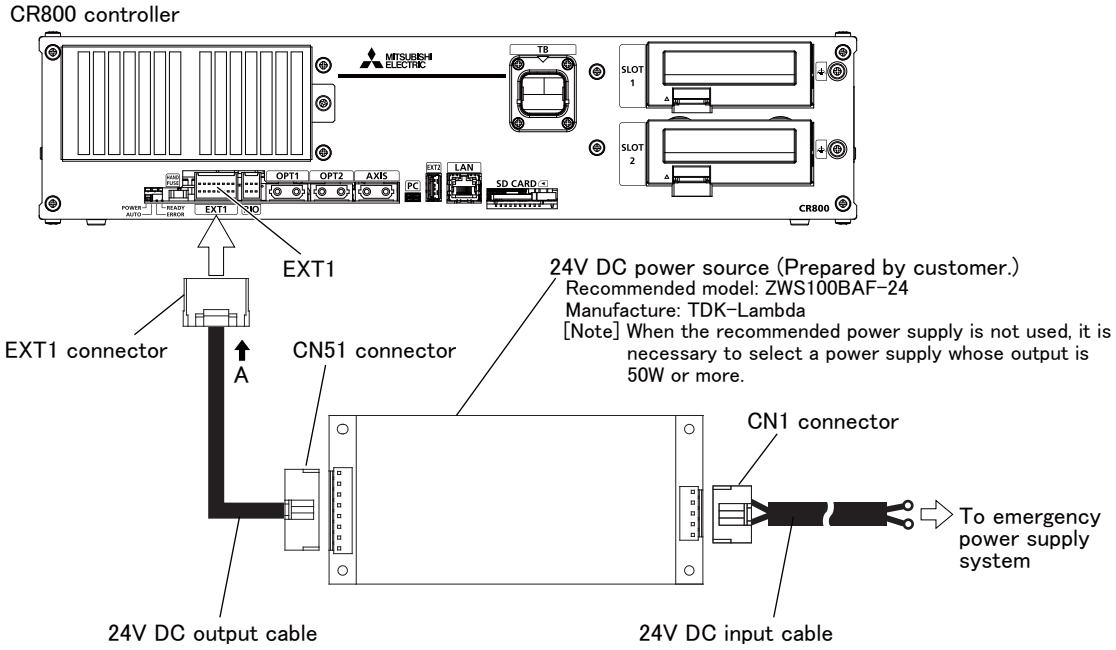
5.7 How to release the brake in an emergency

The following describes how to release the brake using the emergency power supply in an emergency. Using an emergency power supply system separated from the primary power supply of the robot prevents the robot from moving accidentally during the brake release operation, which contributes to enhancing customer safety.

An emergency here means an emergency stop of robot operation, which requires the brake release operation to set the robot in an evacuation posture temporarily.

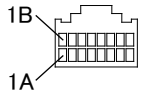
[Note] Do not connect an emergency power supply to multiple robots and release their brakes at the same time.

1) Connect the teaching pendant to the robot controller.
2) Connect the 24V DC power supply to EXT1 of the controller as shown in the figure below.
   To prevent accidental power supply from the primary power supply of the robot, prepare an emergency power supply system separated from the primary power supply of the robot to supply AC power to the 24V DC power supply.
   [Note] For using the CR800-R/Q controller, it is necessary to turn on the primary power supply of the robot CPU system (PLC). But, do not turn on the primary power supply of the CR800-R/Q controller.



The following shows the connector specifications.

EXT1 connector
Connector: J21DF-16V-KX
Contact: SJ2F-01GF-P1.0
Manufacture: JST



Pin assignment

Pin number	Signal name
8A	24V
8B	
3B	
7A	GND
7B	
3A	

CN51 connector (recommended)
Connector: VHR-8N
Contact: SVH-41T-P1.1
Manufacture: JST

Pin assignment

Pin number	Signal name
1	GND
2	
3	
4	
5	24V
6	
7	
8	

CN1 connector (recommended)
Connector: VHR-5N
Contact: SVH-41T-P1.1
Manufacture: JST

Pin assignment

Pin number	Signal name
1	L
3	N
5	FG

3) When the 24V DC power supply is turned on, the controller starts and then errors (H0712, H0090, H0212) will occur.
[Note] For using the R800-R/Q controller, turn ON the 24V DC power supply, then the robot CPU system power on.

4) Release the brake using the teaching pendant.
For the brake release operation using the teaching pendant, refer to "Explanation of operation methods" in the separate volume, "Instruction Manual/Detailed Explanations of Functions and Operations".

6 Appendix

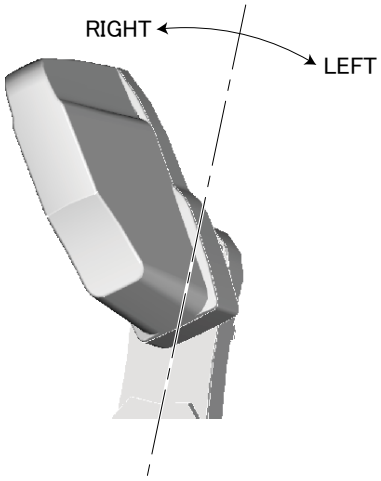
Appendix 1 : Configuration flag

The configuration flag indicates the robot posture.
For the 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.

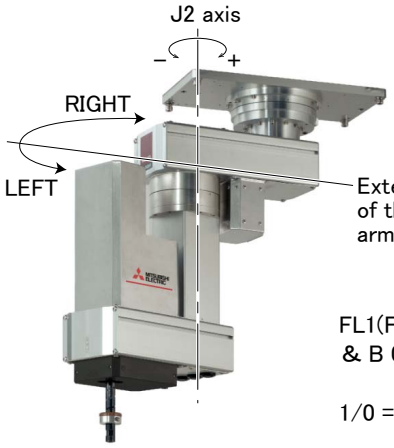
(1) RIGHT/LEFT

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

<RH-3FRH/6FRH/12FRH/20FRH series>



<RH-3FRHR series>



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

Note) "&B" is shows the binary

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