MITSUBISHI

Mitsubishi Industrial Robot

RH-3SDHR3515/3512C/3512W

INSTRUCTION MANUAL
ROBOT ARM SETUP & MAINTENANCE

MELFA

⚠ Safety Precautions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

⚠ 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, RS−232 or LAN. 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.

*S series: RH-6SH/12SH/18SH/20SH series/RH-3SHR series

⚠ CAUTION　Be careful of interference with peripheral equipment.
Especially don't give a shock to the ball screw shaft (J3 axis). The ball screw shaft may be damaged.

　　Collision detection function is valid condition for both of automatic and jog operation at shipping in RH-3SHR 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.

Short cut

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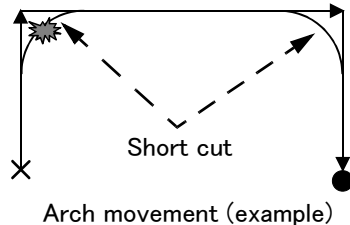
(2)It can be confirmed whether the specified position exist in the defined area by using the instruction command "ZONE". It can utilize as one of the methods for collision evasion. Refer to the "detailed description of the instructions manual/function, and operation" of the separate volume for the details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

⚠ CAUTION　Don't give a shock to the ball screw shaft at the time of hand installation. Especially don't strike the shaft end by hammer etc. The ball screw shaft may be damaged.

Revision history

Date of Point	Instruction Manual No.	Revision Details
2010-11-19	BFP-A8839	・First print
2010-12-02	BFP-A8839-A	・Error in writing was corrected. (Reference figure number in "3.1 Installing the solenoid valve set")
2011-02-02	BFP-A8839-B	・The note of installing the hand input cable was added. ・The precautions about interference of the ball screw shaft and the movement locus were added.
2011-05-09	BFP-A8839-C	・The note of the cover installation screw was added. ・The caution at installing and removing of the machine cable was added.
2012-05-18	BFP-A8839-D	・The clean specification / waterproof specification was added.

■ Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual explains the unpacking methods, installation, basic operation, 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-3SDHR.

The contents of this manual correspond to the following robot types.
　　〈Type〉　　　　　　　　　・RH-3SDHR3515 : General environment
　　　　　　　　　　　　　　　・RH-3SDHR3512C: Clean specification
　　　　　　　　　　　　　　　・RH-3SDHR3512W: Waterproof specification

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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.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.

For special specifications, a separate instruction manual describing the special section may be enclosed.

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

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	The "Robot controller" or the "Controller"	Indicates the controller which controls the robot arm. Indicates the box which arranged control parts, such as robot CPU, servo amplifier, and the safety circuit.
Symbol	⚠ DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
	[JOG]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
	[RESET] + [EXE] (A) (B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [RESET] key is pressed while holding down the [+EXE] key.
	T/B	This indicates the teaching pendant.
	O/P	This indicates the operating panel on the front of the controller.

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

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⚠ 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　If the automatic operation of the robot is operated by two or more control equipment, design the right management of operation of each equipment of 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.
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.

⚠ DANGER

When the SSCNETⅢ cable is removed, install the cap in the connector.
If the cap is not installed, there is a possibility of malfunctioning by adhesion of the dust etc.

⚠ DANGER

Don't remove the SSCNETⅢ cable, when the power supply of the robot controller is turned on. Don't face squarely the light emitted from the tip of the SSCNETⅢ connector or the cable. If light strikes the eyes, there is a possibility of feeling the sense of incongruity for the eyes. (The light source of SSCNETⅢ is equivalent to the class 1 specified to JISC6802 and IEC60825-1.)

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
1	Robot arm	R	1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 × 90	4 pcs.	For robot arm installation
4	Installation bolts（Spare）	M8 × 40	4 pcs.	
5	Installation nut	M8	4 pcs.	
6	Spring washer for installation bolts	For M8	8 pcs.	
7	Plain washer for installation bolts	For M8	8 pcs.	
8	Hanging tools（Eye bolt）		1 set	To hang the robot arm with the crane.
9	Fixing plate		1 set	Fixing plates installation bolt: 5 pcs. Nuts: 4 pcs.
10	Nats for T slot	M5	4 pcs.	For fixing the tool wiring etc.

Note1）The number 3 to 7 is contained in the plastic bag of attachment in the robot arm.
Note2）The numbers 8 and 9 are installed in the robot arm.

2.2 Installation

2.2.1 Unpacking

<1> Tape (two)

Packing box

<2> Upper cover

<3> Packing material (Cardboard)

Cut the tape

Remove the upper cover.

Remove the packing material.

<6> Tape (two)

Robot-arm base section

<4>hanging tools (Two places)

<5> Packing material

Open the vinyl.

Hang the hook of the crane.

Hoist with crane and remove the packing material.

<7> Fixing plate

Completion

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

⚠CAUTION Unpack at the sure flat place. The robot may fall at the 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.2-1 : Unpacking the robot arm

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 complete above.

2.2.2 Transportation procedures(Transporting with a crane)
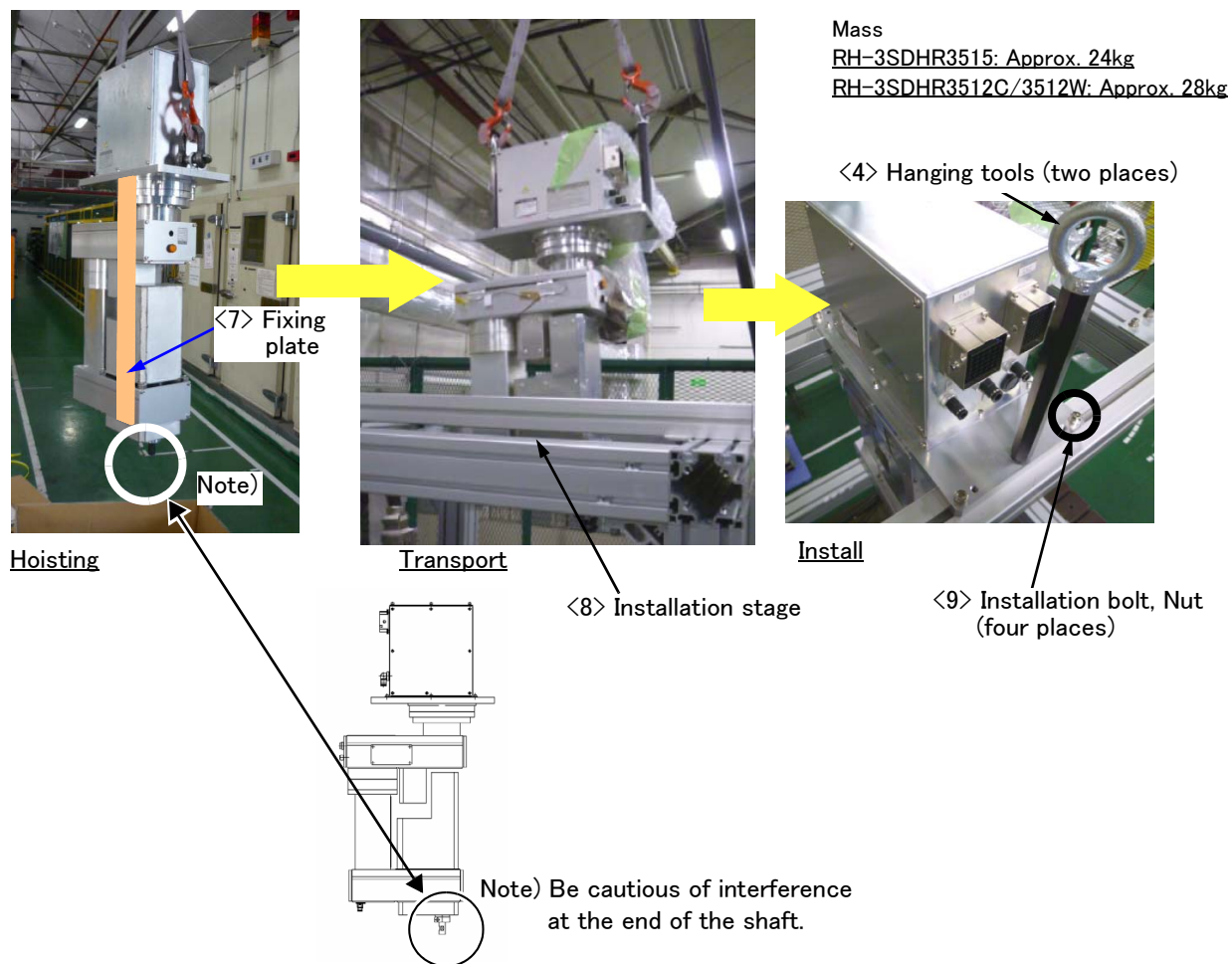
Fig.2−2 : Transportation of robot arm

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

⚠ **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 hanging tools (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 hanging tools <4> are needed at secondary transportation. Please keep them with care.

Transportation is complete above.

The transportation posture is shown in Table 2−2.

Table 2−2 : Transportation posture

Axis	RH−3SDHR3515
J 1	0 deg.
J 2	0 deg.
J 3 Note1)	−569.5mm (Upper end)
J 4	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) General environment type 80mm
Clean/Waterproof type: 200mm
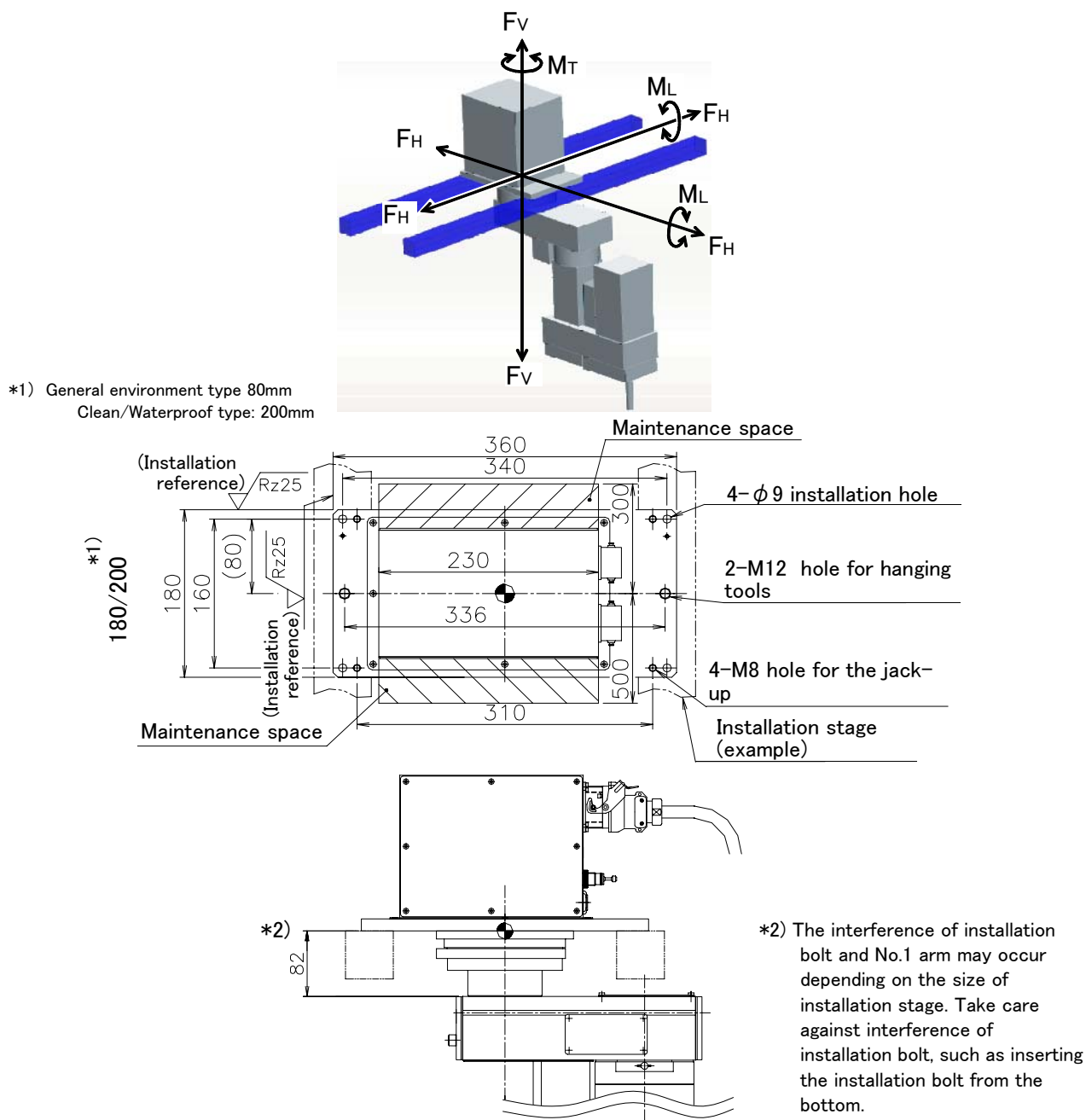
Fig.2-3 : Installation dimensions

*2) The interference of installation bolt and No.1 arm may occur depending on the size of installation stage. Take care against interference of installation bolt, such as inserting the installation bolt from the bottom.

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 2-3 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 2-3 : Magnitude of each reaction force

	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.

2.2.4 Grounding procedures
(1) Grounding methods
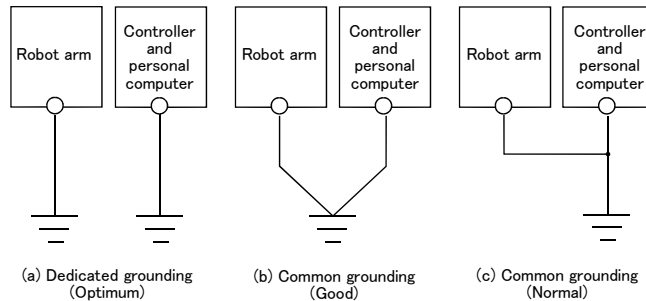
Fig.2-4 : Grounding methods

1) There are three grounding methods as shown in Fig. 2-4, but the dedicated grounding (Fig. 2-4 (a)) should be used for the robot arm and controller when possible. (Refer to the separate " Controller Setup, Basic Operation and Maintenance" for details on the controller grounding.)
2) Use Class D grounding (grounding resistance 100 Ω or less).
   Dedicated grounding separated from the other devices should be used.
3) Use a 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.

(2) Grounding procedures

Robot grounding cable (AWG#11 (4.2mm^2) or more) (Prepared by customer)
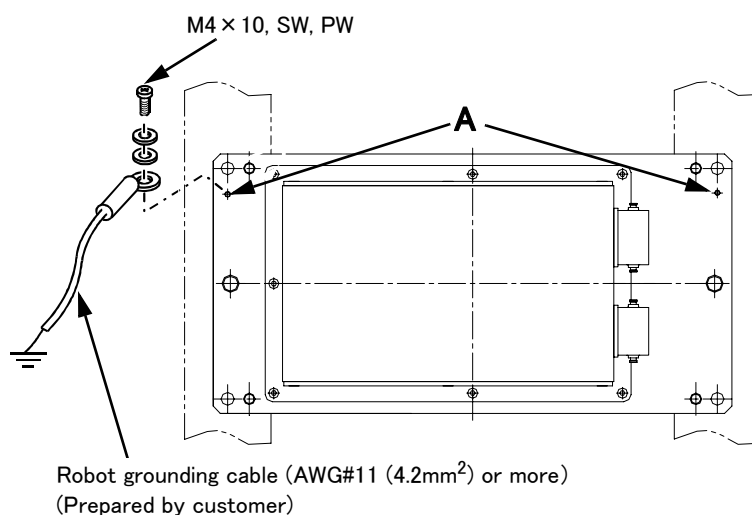
Fig.2-5 : Connecting the grounding cable

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.

2.2.5 Connecting with the controller
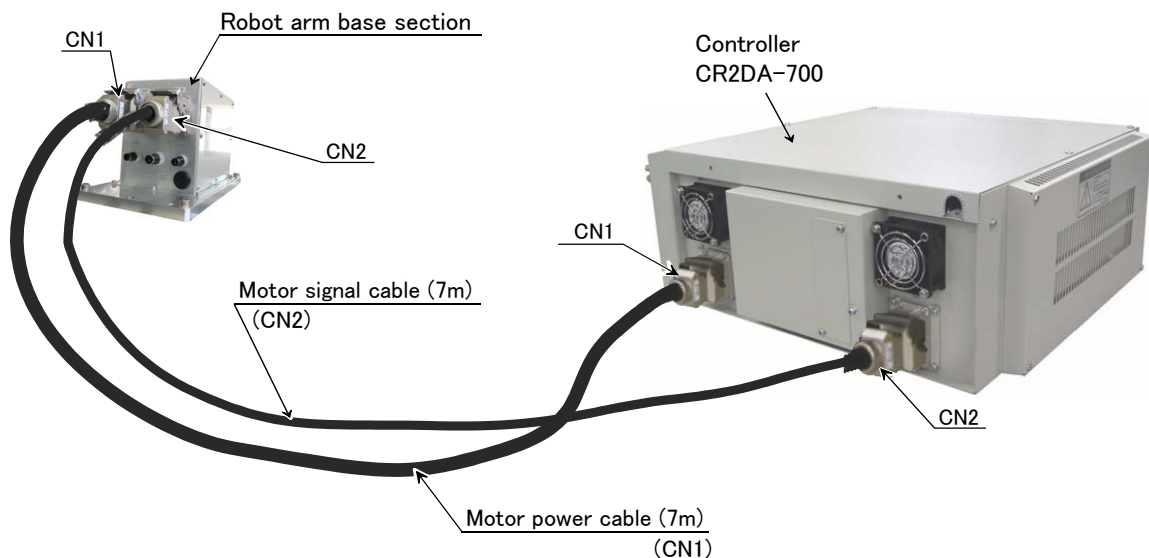
Fig.2-6 : Connecting the machine cables

Carry out the following procedure after installing the controller referring to the separate "Controller Setup, Basic Operation and Maintenance" manual.
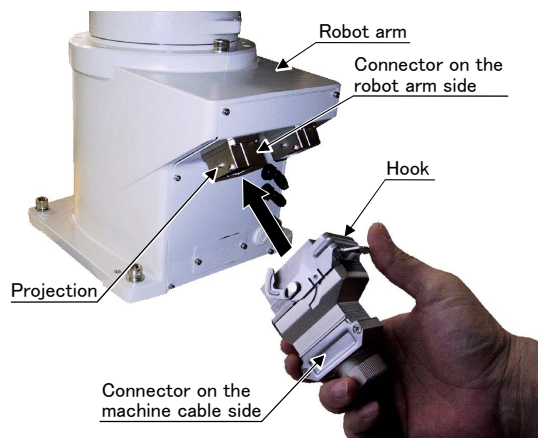
The procedure of connecting the machine cable is shown below. (Although the figure of the robot arm is the example of RV-12SD, it is the same)

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

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

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

⚠ CAUTION Be careful not to get your hand pinched.

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

⚠ CAUTION

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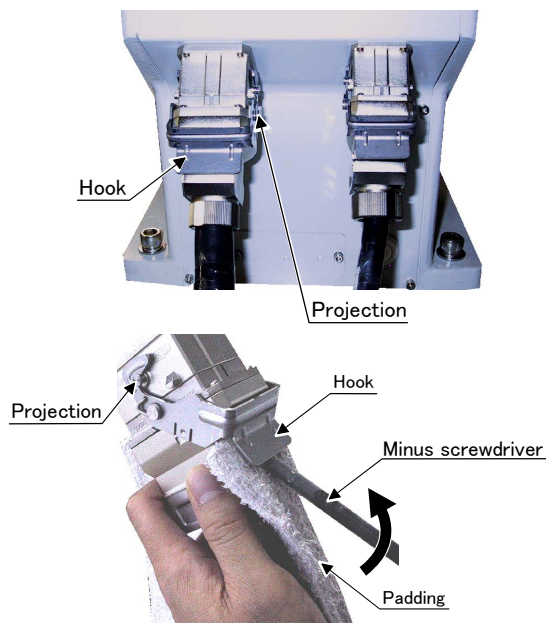
⚠ CAUTION　　The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠ 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.

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

2.3 Spare wiring

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.

2.3.1 No.2 arm section
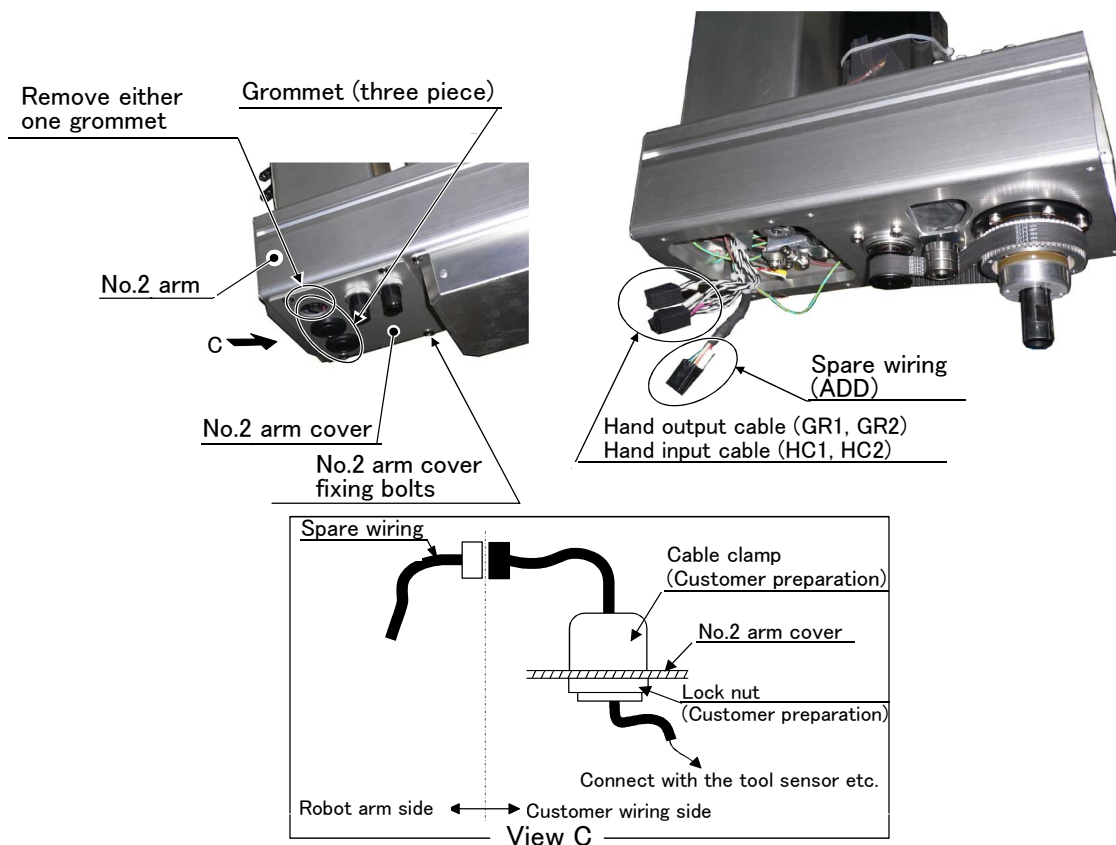
Fig.2-7 : Pull out spare wiring

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.

Normal condition   abnormal condition
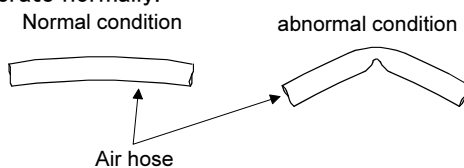
Air hose

⚠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.

2.3.2 Base area

1) Remove the base cover B (R).
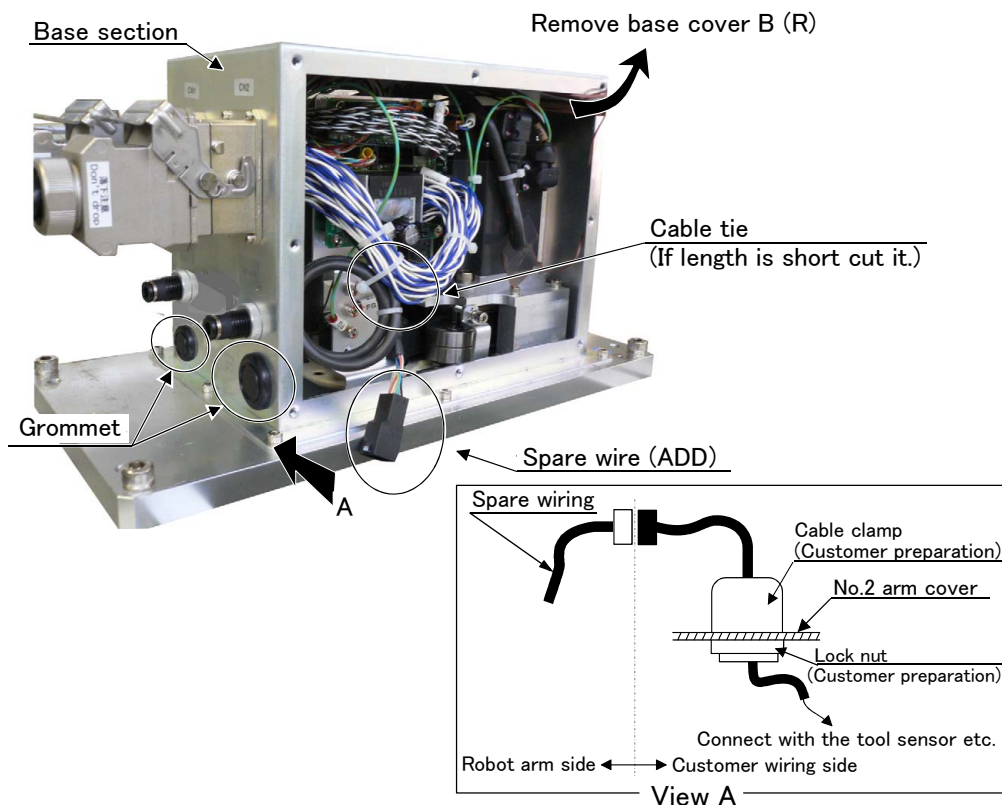
Fig.2-8 : Pull out spare wiring(Base area)

2) The spare wiring (ADD: coiled) preinstalled in the robot arm has connector. The spare wiring (ADD) prein-stalled 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 (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 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.

Normal condition   abnormal condition
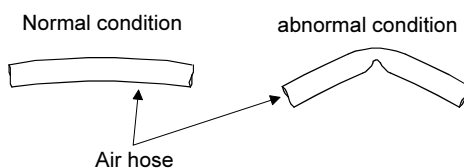
Air hose

⚠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.

2.4 Setting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. This step must also be carried out if the combination of robot and controller being used is changed.
There are several methods for setting the origin, but the origin data input method will be explained here. Refer to Page 81, "5.6 Resetting the origin" for the other methods.
The teaching pendant is required for this operation.
[Caution] If the origin data at shipment is erased due to out of battery, it is necessary to set the origin again.
Refer to Page 81, "5.6 Resetting the origin" and reset the origin using the jig method or ABS method.

2.4.1 Installing the teaching pendant (T/B)

When installing and removing the T/B, turn off the controller power supply. If T/B is installed or removed in the state of power supply ON, emergency stop alarm will occur.
If you use the robot wherein T/B is removed, please install the attached dummy connector. With the connector, put the dummy connector or draw it out.

⚠ **CAUTION**   Please do not pull the cable of T/B strongly or do not bend it too much.
It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself.

Explain the installation method of T/B below.
1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Connects T/B connector to the robot controller. Use as the upper surface the lock lever shown in Fig. 2-9, and push in until there is sound.
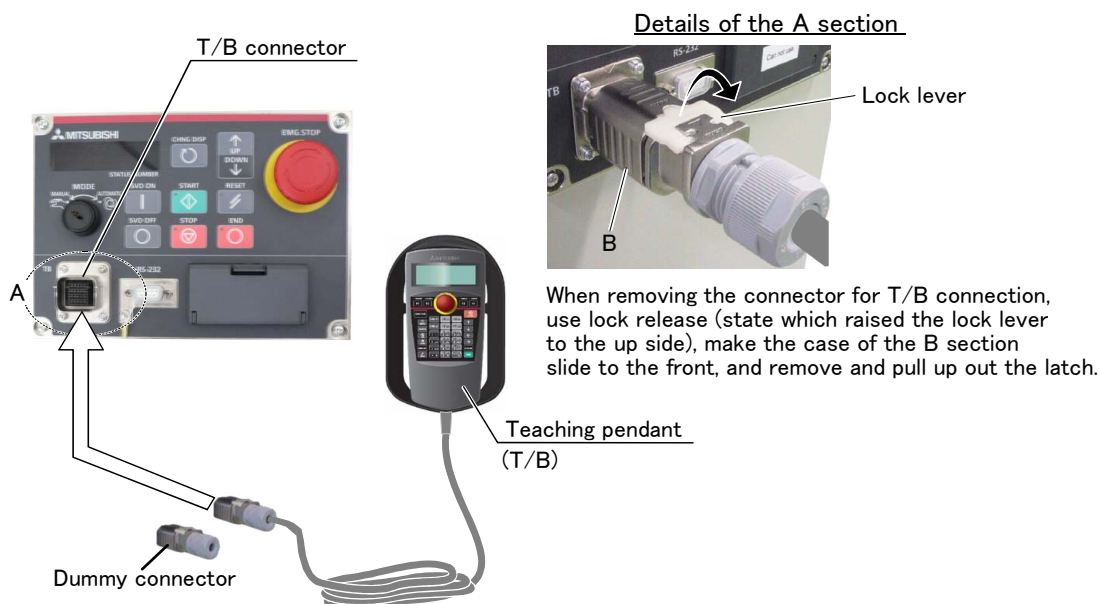
Fig.2-9 : Installing and removing the T/B

The installation of T/B is finished.

◇◆◇ If error C0150 occurs ◇◆◇
At the time of the first power supply injection, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.
Parameter: Please input the serial number of the robot body into RBSERIAL. Refer to "instructions manual / controller setup, and basic operation & maintenance" for the operation method.

2.4.2 Setting the origin with the origin data input method
(1) Confirming the origin data

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

Date	Default	. . .	. . .	. . .
D	V!#S29			
J 1	06DTYY			
J 2	2?HL9X			
J 3	1CP55V			
J 4	T6!M$Y			
J 5	Z2IJ%Z			
J 6	A12%Z0			
Method	E	E・N・SP	E・N・SP	E・N・SP

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

Note) Meanings of symbols in method column
E: Jig method
N: Not used
SP: Not used

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

Referring to Page 66, "5.3.2 Installing/ removing the cover", remove the base cover B(L) and confirm the value.

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

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

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

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

(2) Turning ON the control power

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

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

(3) Preparing the T/B
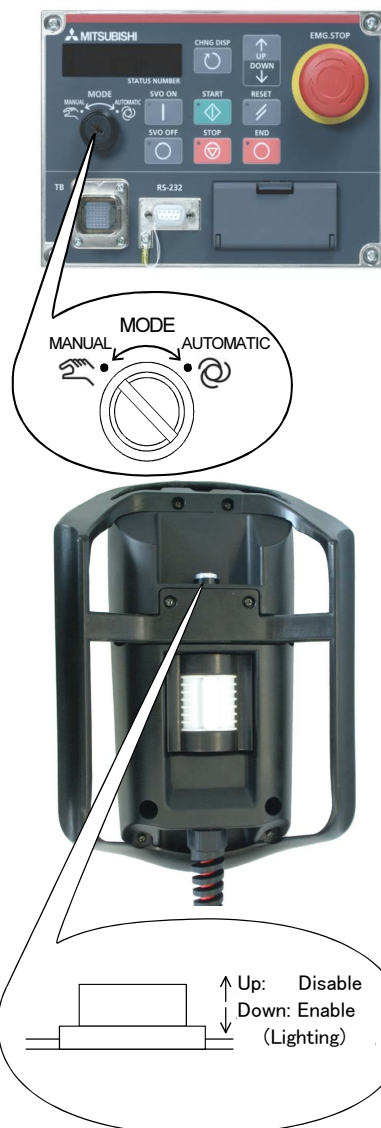
Next, prepare to use the T/B
1) Set the [MODE] switch on the front of the controller to "MANUAL".

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.

↑ Up: Disable
↓ Down: Enable
       (Lighting)

◇◆◇ Operating from the T/B ◇◆◇
Always set the [MODE] switch (mode selection key switch) on the front 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 controller or external signals will not be accepted.

(4) Selecting the origin setting method

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

            123        CLOSE
```

`4  GHI`

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

```
<ORIGIN/BRAKE>
1.ORIGIN         2.BRAKE



            123        CLOSE
```

`1  '()`

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

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

            123        CLOSE
```

`1  '()`

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

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

4) Display the origin data input screen

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

◇◆◇ The input method of numeral ◇◆◇
The number can be inputted if the key displayed on the lower left of each key is pressed. Press the [CHARACTER] key, and in the condition that "123" is displayed on the screen lower side, press the number key.

(5) Inputting the origin data

T/B screen   Origin data label
                    (D,J1,J2,J3,J4,J5,J6,J7,J8)

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

Input the value confirmed in section Page 19, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-11.

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

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

```
<ORIGIN> DATA
                        D:(■    )
J1(      ) J2(      ) J3(        )
J4(      ) J5(      ) J6(        )
J7(      ) J8(        )
                123        CLOSE
```
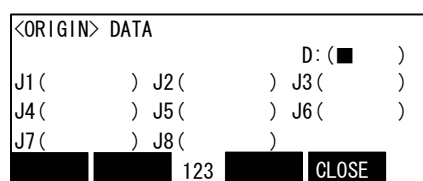
1) Confirm that the cursor is at the "D" position on the T/B display screen.

```
<ORIGIN> DATA
                        D:(V    )
J1(      ) J2(      ) J3(        )
J4(      ) J5(      ) J6(        )
J7(      ) J8(        )
                ABC        CLOSE
```
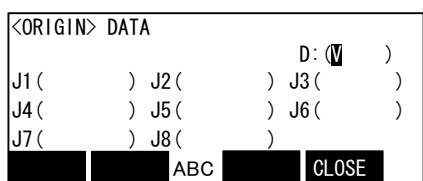
[CHARACTER]

−B (J5)
8 TUV

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

```
<ORIGIN> DATA
                        D:(V■    )
J1(      ) J2(      ) J3(        )
J4(      ) J5(      ) J6(        )
J7(      ) J8(        )
                ABC        CLOSE
```
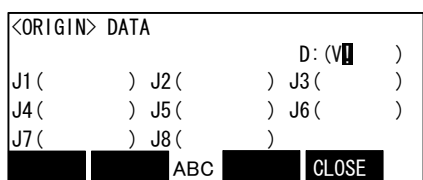
+C (J6)
. , %

→

+C (J6)
. , %

Inputting "!"
Press the [, %] key five times. "!" will be set.
Press the [→] key once and advance the cursor.
Press the [, %] key twice (input "%"), and press the [PQRS] key four times (input "S").

```
<ORIGIN> DATA
                        D:(V!%S29)
J1(      ) J2(      ) J3(        )
J4(      ) J5(      ) J6(        )
J7(      ) J8(        )
                123        CLOSE
```

[CHARACTER]

−Z (J3)
2 ABC

+B (J5)
9 WXYZ

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

↓

:
:
:

```
<ORIGIN> DATA
                        D: (V!%S29)
J1(■      ) J2(      ) J3(        )
J4(      ) J5(      ) J6(        )
J7(      ) J8(        )
                123        CLOSE
```
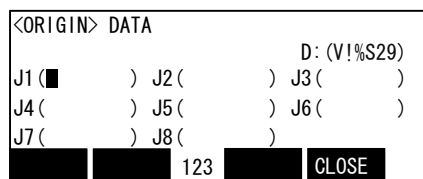
3) Press the [↓] key, and move the cursor to the J1 input position.
4) Input the J1 value in the same manner as above.

Input the J2, J3, J4, J5 and J6 values in the same manner.

```
<ORIGIN> DATA
                          D:( V!%S29)
J1( O6DTYY) J2( 2?HL9X) J3( 1CP55V)
J4( T6!MSY) J5( Z21J%Z) J6( A12%Z0)
J7(       ) J8(       )
              ABC        CLOSE
```

EXE

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

```
<ORIGIN> DATA

   CHANGE TO ORIGIN. OK?


Yes          123          No
```

F1

6) 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.

◇◆◇ Correcting an input ◇◆◇
 After returning one character by pressing the [C L E A R] key, input the character again.

(6) Installing the base cover B(L).
   Return the base cover B(L) removed in section Page 19, "(1) Confirming the origin data" to its original position. This completes the setting of the origin with the origin data input method.

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

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

2.5 Confirming the operation

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

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

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

⚠ WARNING   Confirm that the origin has been set. If the origin has not been set, "****" will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.
Refer to "2.4Setting the origin" on page 18 for details on setting the origin.
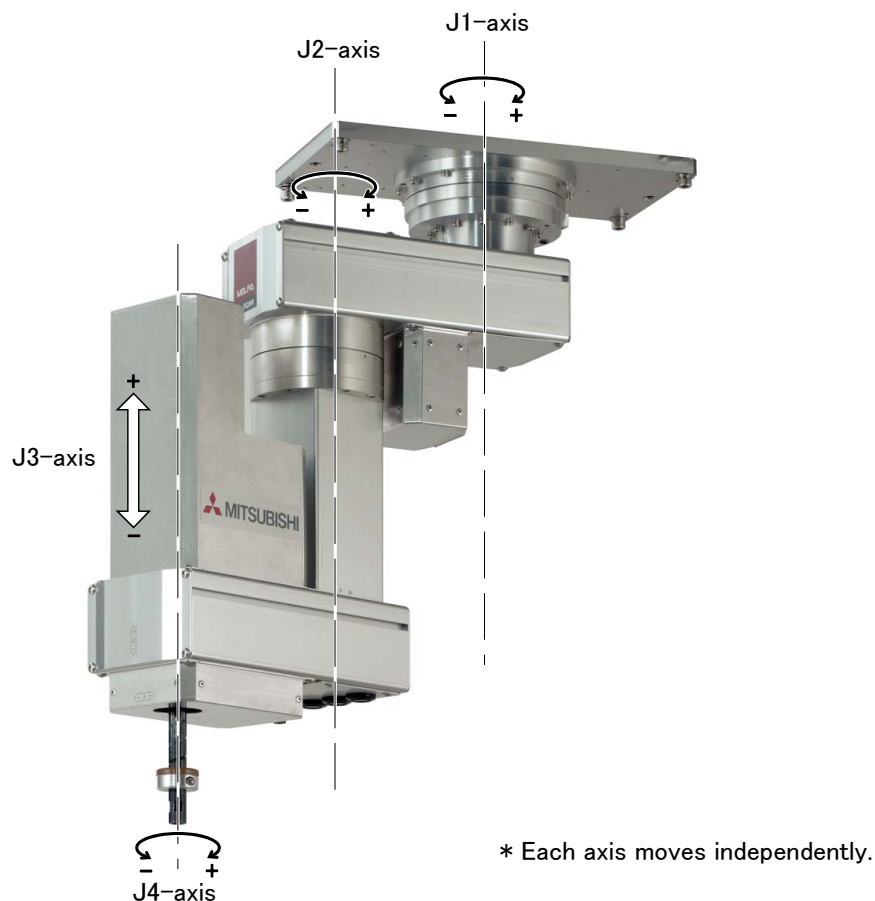
Fig.2-12 : JOINT jog operation
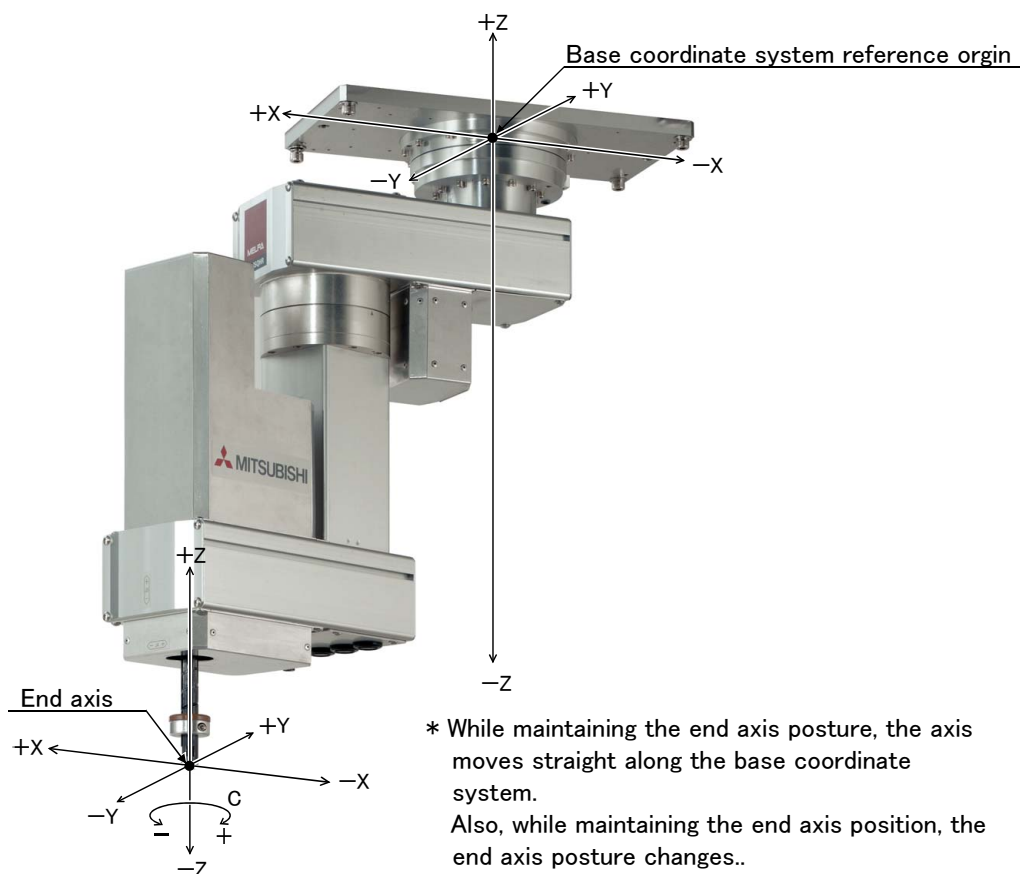
Fig.2-13 : XYZ jog operation

＊ 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..
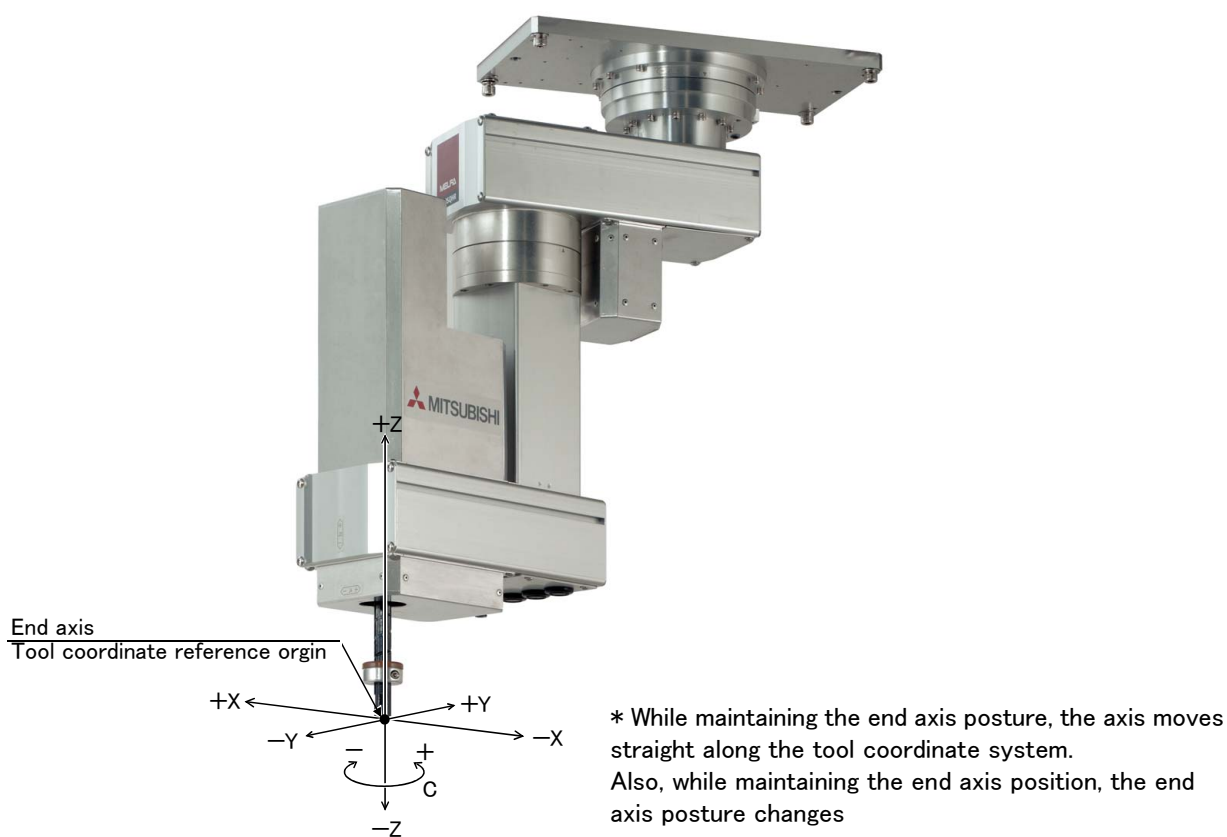
Fig.2-14 : TOOL jog operation

＊ 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

+Z

Base coordinate system reference orgin

+X ← +Y

−Y ← → −X

−Z

+Z

End axis

+X ← → +Y

−Y → −X

−

+

J4軸

−Z

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

Fig.2−15 : 3−axis XYZ jog operation

+Z

+X ← +Y

−Y ← → −X

Vertical

−Z

Radius ← → Arc

C

−

+

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

Fig.2−16 : CYLINDER jog operation
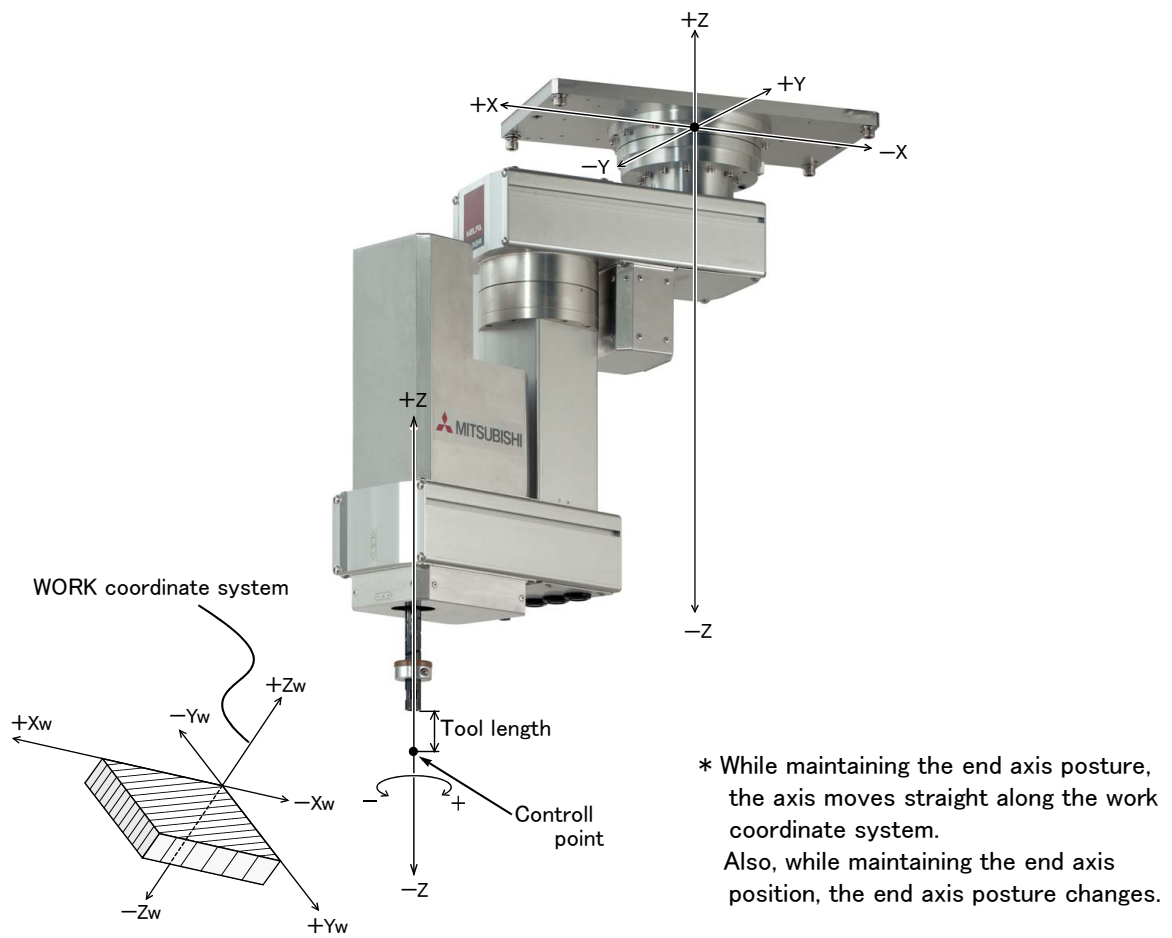
Fig.2-17 : WORK jog operation

＊ 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.

（1）JOINT jog operation

Select joint jog mode
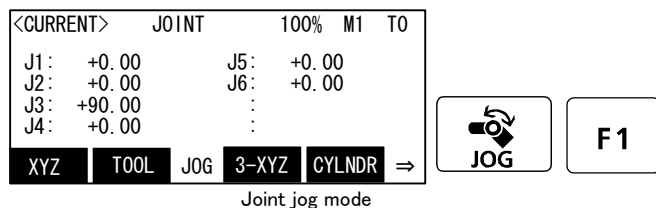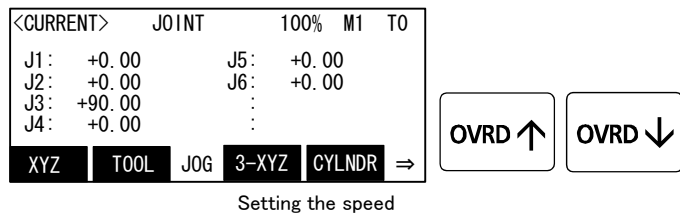
```
<CURRENT>    JOINT      100%  M1  T0

J1:   +0.00     J5:   +0.00
J2:   +0.00     J6:   +0.00
J3:  +90.00            :
J4:   +0.00            :
 XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```

Joint jog mode

Set jog speed

```
<CURRENT>    JOINT      100%  M1  T0

J1:   +0.00     J5:   +0.00
J2:   +0.00     J6:   +0.00
J3:  +90.00            :
J4:   +0.00            :
 XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```

Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "joint" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "joint." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

J1 axis jog operation

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

J2 axis jog operation

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

◇◆◇ When the robot is in the transportation posture ◇◆◇
　The axes may be outside the movement area. Move these axes toward the inner side of the movement area.

J3 axis jog operation

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

J4 axis jog

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

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

（2）XYZ jog operation

<u>Select XYZ jog mode</u>
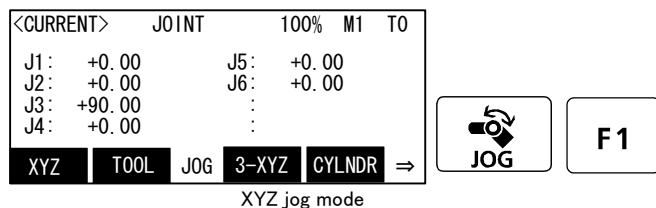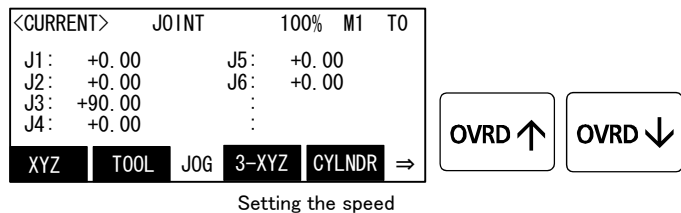
```
<CURRENT>   JOINT      100%  M1  TO

J1:   +0.00     J5:   +0.00
J2:   +0.00     J6:   +0.00
J3:  +90.00              :
J4:   +0.00              :

 XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```

XYZ jog mode

<u>Set jog speed</u>

```
<CURRENT>   JOINT      100%  M1  TO

J1:   +0.00     J5:   +0.00
J2:   +0.00     J6:   +0.00
J3:  +90.00              :
J4:   +0.00              :

 XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```

Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "XYZ" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

<u>Moving along the base coordinate system</u>

- 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 "(1)JOINT jog operation" on page 28", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

Changing the end axis posture

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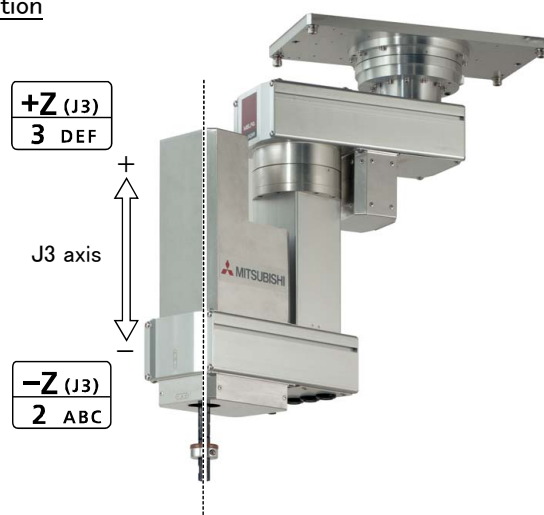When the ［-C (J6)］keys are pressed, Rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

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

◇◆◇ Tool length ◇◆◇

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

(3) TOOL jog operation

Select TOOL jog mode

```
<CURRENT>    JOINT      100%  M1  TO

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00           :
J4:   +0.00           :
 XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
TOOL jog mode

Set jog speed

```
<CURRENT>    JOINT      100%  M1  TO

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00           :
J4:   +0.00           :
 XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "TOOL" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "TOOL." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along the tool coordinate system

・When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction of the tool coordinate system.
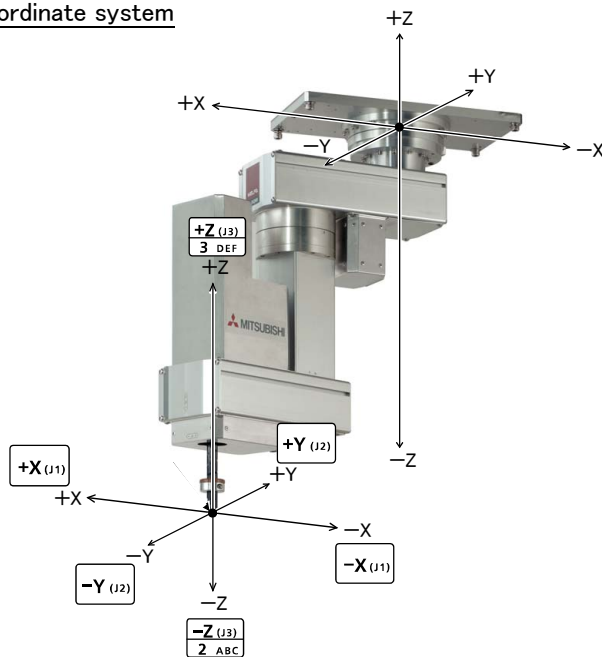 When the [−X (J1)] keys are pressed, Move along the minus direction.
・When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction of the tool coordinate system.
  When the [−Y (J2)] keys are pressed, Move along the minus direction.
・When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
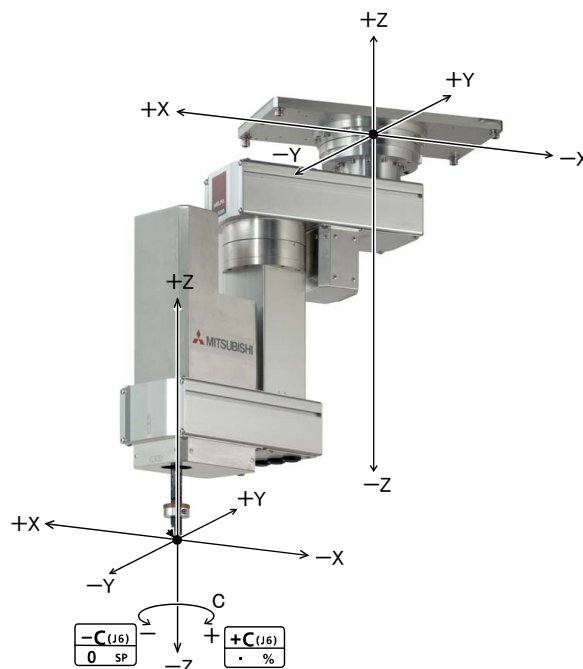 When the [−Z (J3)] keys are pressed, Move along the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇
There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section ″(1)JOINT jog operation″ on page 28″, 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.

(4) 3-axis XYZ jog operation

Select XYZ456 jog mode

```
<CURRENT>    JOINT      100%  M1  T0

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00        :
J4:   +0.00        :

XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
XYZ456 jog mode

Set jog speed

```
<CURRENT>    JOINT      100%  M1  T0

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00        :
J4:   +0.00        :

XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Setting the speed

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
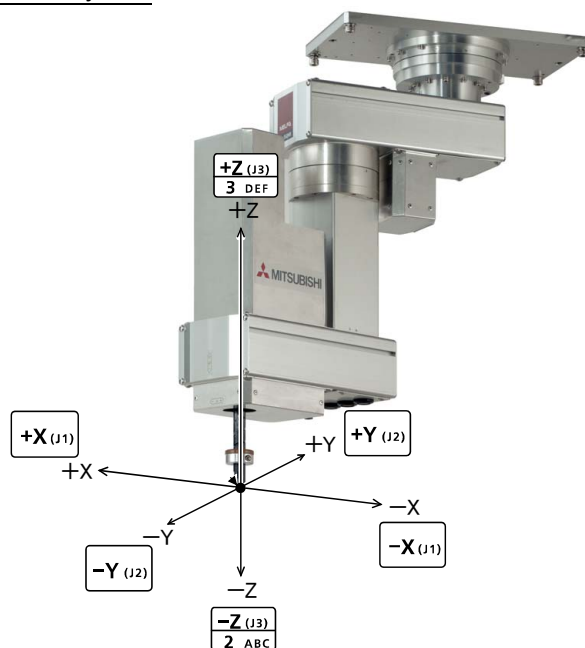Check that the "XYZ456" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ456." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, 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, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along the base coordinate system
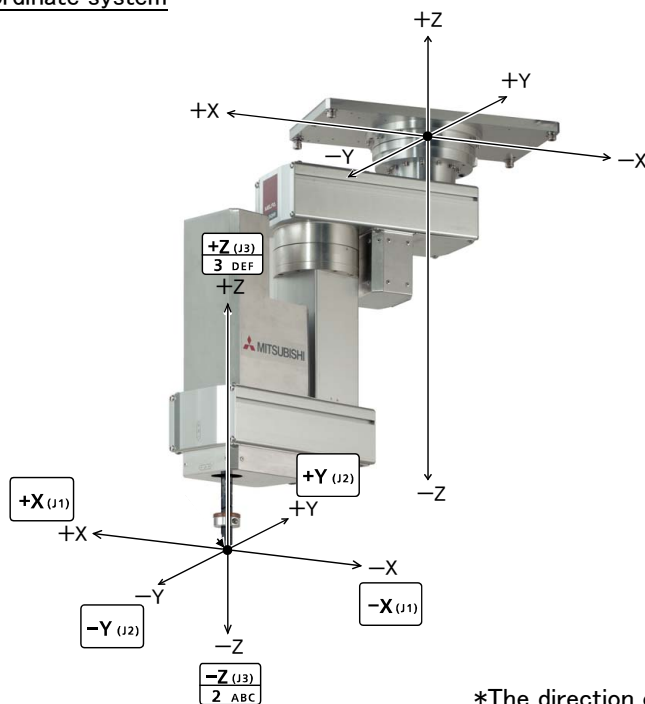
*The direction of the end axis will change.

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

◇◆◇ The flange surface end axis posture cannot be maintained with 3-axis XYZ jog. ◇◆◇
With 3-axis XYZ jog, the flange surface end axis posture (orientation) is not maintained when moving linearly in the X, Y or Z axis direction.
Use XYZ jog to maintain the posture.

Changing the end axis posture
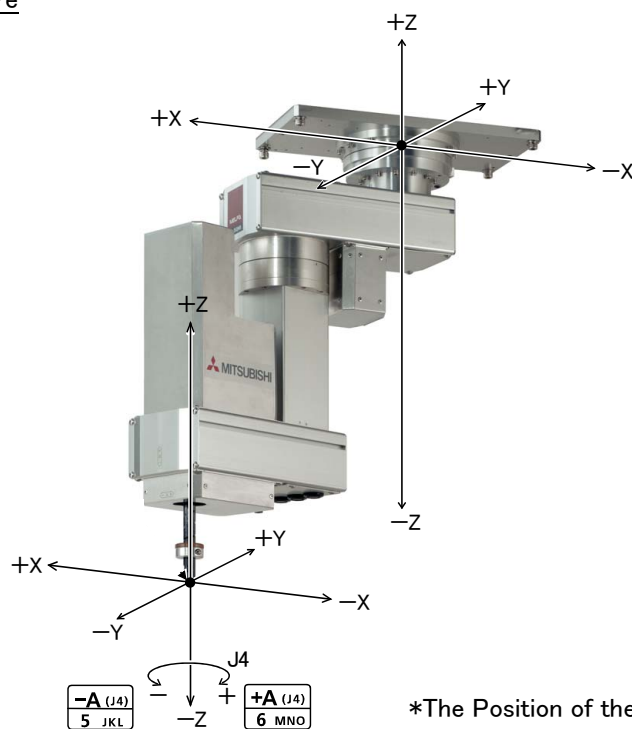
*The Position of the end axis will not change.

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

(5) CYLNDER jog operation

Select cylindrical jog mode

```
<CURRENT>    JOINT        100%  M1  T0

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00       :
J4:   +0.00       :
 XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
CYLNDER jog mode

[JOG]

[FUNCTION]

[F4] ~ [F1]

[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

```
<CURRENT>    JOINT        100%  M1  T0

J1:   +0.00      J5:   +0.00
J2:   +0.00      J6:   +0.00
J3:  +90.00       :
J4:   +0.00       :
 XYZ   TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Setting the speed

[OVRD ↑] [OVRD ↓]

Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along an arc centering on the Z axis
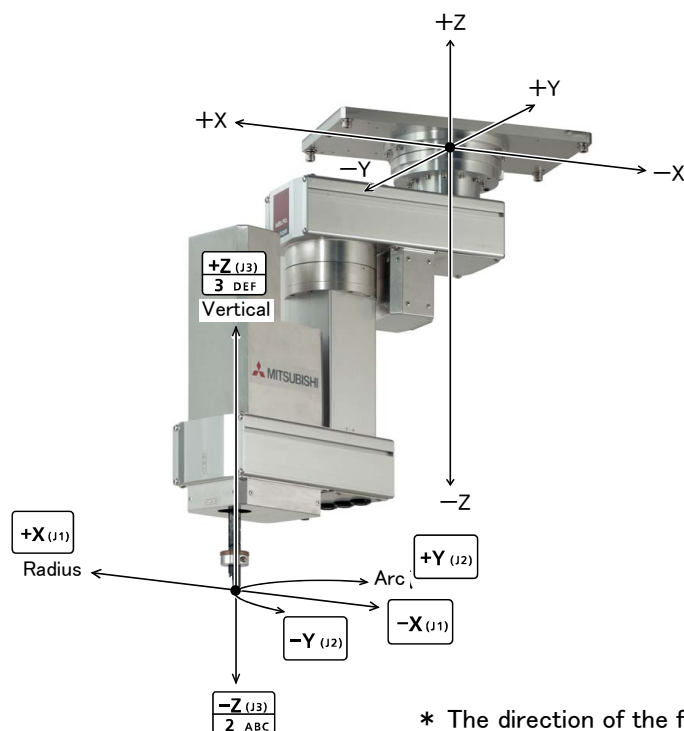
* The direction of the frange will not change.

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.

+Z

+Y

+X

−Y

−X

Vertical

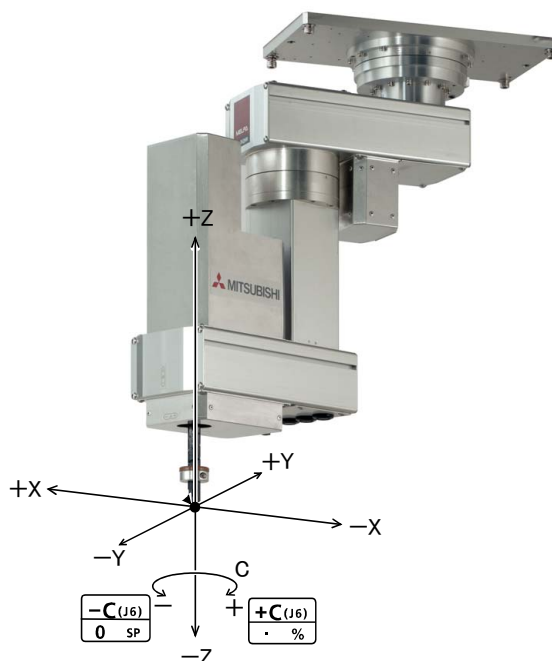MITSUBISHI

−Z

Radius

Arc

C

−C (J6)
0   SP

−   +

+C (J6)
·   %

∗ The position of the end axis will not change.
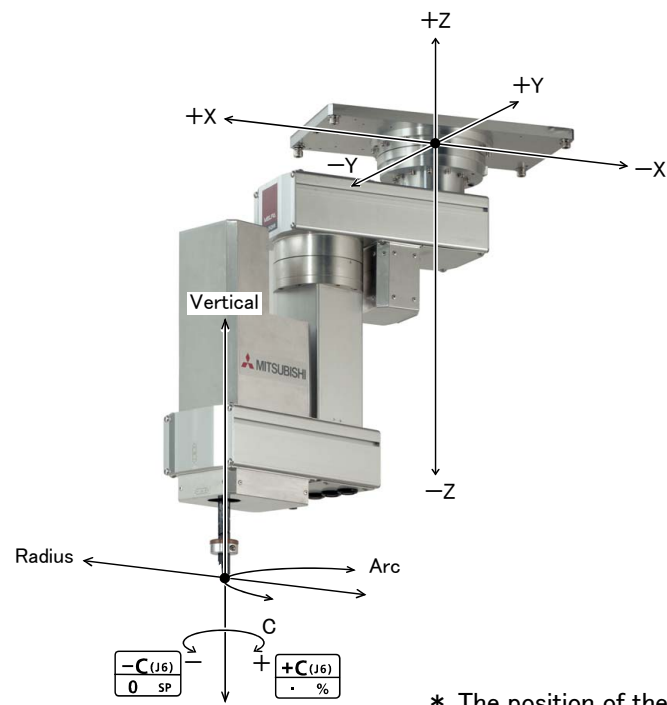
・When the [+C (J6)] keys are pressed, The Z axis will rotate in the plus direction.
　When the [−C (J6)] keys are pressed, Rotates in the minus direction.

(6) Work jog operation

Setting of the work coordinates system is necessary.

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

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

The setting method of the work coordinates system using T/B (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.)

In addition, this jog operation is available at the following software versions. The below-mentioned "6.ENHANCED" menu is not displayed in the other versions.

    T/B   :Ver.1.3 or later
    SQ series: N8 or later
    SD series :P8 or later

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

Notes) The figure is the example of RV-6SD, but other types are the same

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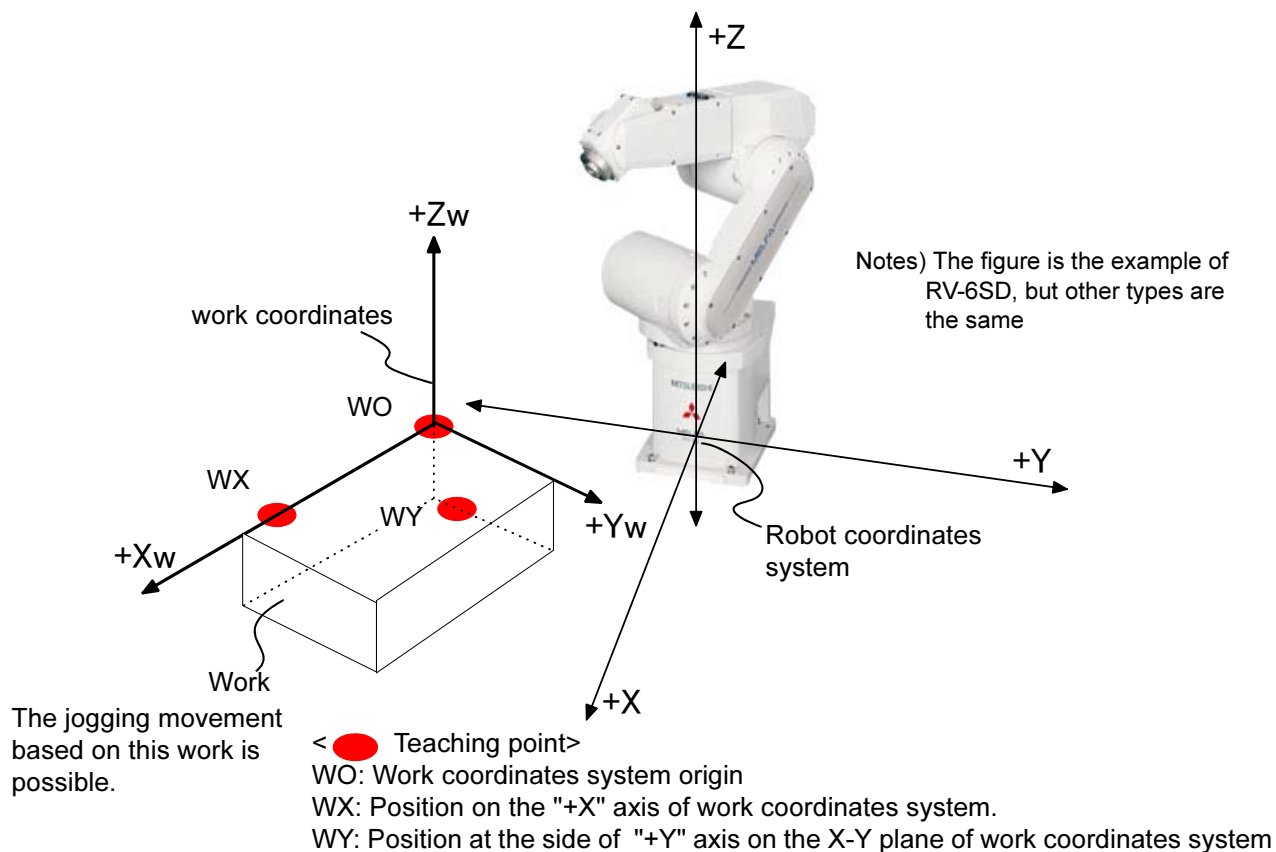
[Supplement] : The coordinate values which use all three teaching points for setting of the work coordinates system are each only X, Y, and the Z-axis. Although the coordinate value of A, B, and C axis is not used, positioning will get easy if the XYZ jog or TOOL jog movement is effected with the same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

Fig.2-18 : 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.

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

              123           CLOSE
```

```
<EMHANCED>
1. SQ DIRECT        2. WORK COORD.



              123           CLOSE
```

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

```
<EMHANCED>
1. SQ DIRECT        2. WORK COORD.



              123           CLOSE
```

```
<WORK COORD>        WORK NUMBER (1)
                    TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

TEACH   WX   123   WY    DEFINE
```
The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

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

```
<WORK COORD>        WORK NUMBER (1)
                    TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

W. JUMP W. GRID 123         CLOSE
```

```
<WORK JUMP>

CHOOSE ONE OF THE WORK NUMBER
1-8.


              123           CLOSE
```

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

```
<WORK JUMP>

CHOOSE ONE OF THE WORK NUMBER
1-8.


              123           CLOSE
```

```
<WORK COORD>        WORK NUMBER (2)
                    TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

W. JUMP W. GRID 123         CLOSE
```

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

```
<WORK COORD>        WORK NUMBER (2)
                    TEACHING POINT (WO)
X: 0.00
Y: 0.00
Z: 0.00

TEACH   WX   123   WY    DEFINE
```
Specify the teaching point [WO],[WX],[WY]
teaching the position [TEACH]

```
<WORK COORD>        WORK NUMBER (2)

TEACHING POINT (WO)
RECORD CURRENT POSITION.
 OK?

Yes           123           No
```

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.

```
<WORK COORD>        WORK NUMBER (2)

TEACHING POINT (WO)
RECORD CURRENT POSITION.
 OK?

  Yes          123          No
```
→
```
<WORK COORD>        WORK NUMBER (2)
                 TEACHING POINT (WO)
 X: 214.12
 Y: -61.23
 Z: 553.30

W.JUMP  W.GRID  123          CLOSE
```
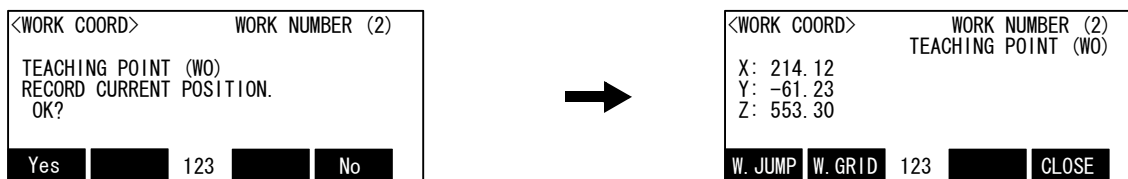
Teach the three points, WO, WX, and WY, by the same operation.
The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)

    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.

```
<WORK COORD>        WORK NUMBER (2)
                 TEACHING POINT (WO)
 X: 214.12
 Y: -61.23
 Z: 553.30

TEACH   WX    123    WY   DEFINE
```
→
```
<WORK COORD>        WORK NUMBER (2)
WORK COORDINATES DATA
(3.53, -220.00, 5.14, 0.00, 0.
 00, 0.00)


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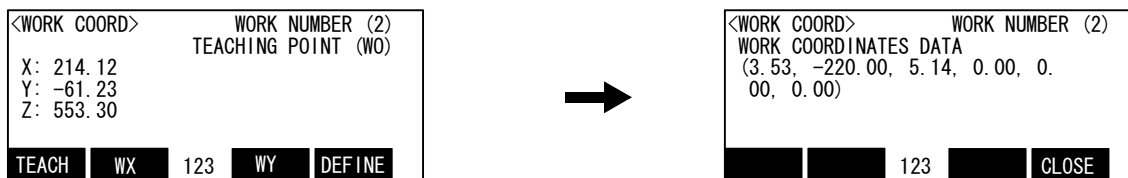
The alarm occurs if the work coordinates system is incalculable. (There are the three points on the straight line, or the two points have overlapped)　In this case, reset alarm and re-teach the three points.
This work coordinate data is registered into parameter: WKnCORD.　("n" means the work coordinates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

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


             123          CLOSE
```
→
```
<WORK COORD>        WORK NUMBER (2)
                 TEACHING POINT (WO)
 X: 214.12
 Y: -61.23
 Z: 553.30

TEACH   WX    123    WY   DEFINE
```
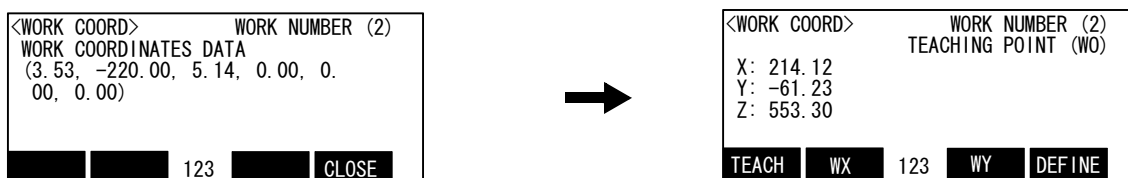
6) Finishing of setting the work coordinates
    Press the [FUNCTION] keys, and display ″CLOSE″ function.　Press the function key corresponding to ″CLOSE″.　Returns to the <MENU> screen.

```
<WORK COORD>        WORK NUMBER (2)
                 TEACHING POINT (WO)
 X: 214.12
 Y: -61.23
 Z: 553.30

W.JUMP  W.GRID  123          CLOSE
```
→
```
<EMHANCED>

1.SQ DIRECT        2.WORK COORD.


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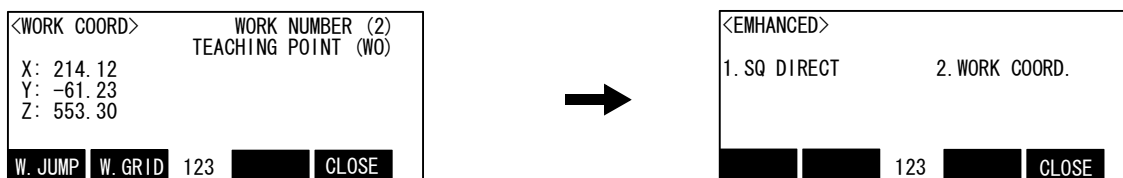
Although setting of work coordinates is finishing above, confirmation of work coordinates can be done by pressing the function key corresponding to "W GRID."([F2])

```
<WORK COORD>       WORK NUMBER (2)
                   TEACHING POINT (W0)
 X: 214.12
 Y: -61.23
 Z: 553.30

 W. JUMP  W. GRID  123        CLOSE
```

➡️

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



          123        CLOSE
```

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

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

Select WORK jog mode

```
<CURRENT>   WORK    100%  M1 TO W1

 J1:  +0.00     J5:  +0.00
 J2:  +0.00     J6:  +0.00
 J3: +90.00          :
 J4:  +0.00          :
 XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
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

```
<CURRENT>   WORK    100%  M1 TO W1

 J1:  +0.00     J5:  +0.00
 J2:  +0.00     J6:  +0.00
 J3: +90.00          :
 J4:  +0.00          :
 XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
Select the work coordinates system

— Target work coordinates system

Confirm the target work coordinates system.
The current target number is displayed on the screen upper right. (W1 - W8)
The number of work coordinates can be changed by the arrow key [Upper arrow], [Lower arrow]
Push the key [Upper arrow], the number will increase. (W1, W2, ... W8) Conversely, push the key [Lower arrow], the number will decrease

⚠️ **CAUTION** Always confirm that the number of the target work coordinates system is displayed correctly (Display of W1-W8 at the upper right of the screen)
If mistaken, the robot will move in the direction which is not meant and will cause the damage and the personal injuries.

Set jog speed

```
<CURRENT>   JOINT   100%  M1  TO

 J1:  +0.00     J5:  +0.00
 J2:  +0.00     J6:  +0.00
 J3: +90.00          :
 J4:  +0.00          :
 XYZ    TOOL   JOG  3-XYZ  CYLNDR  ⇒
```
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, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

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 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 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 plus direction on the work coordinates system.
 When the[−Z (J3)] keys are pressed, Move along the minus direction.

Changing the end axis posture

* The position of the control point does not change. The end axis is rotated.
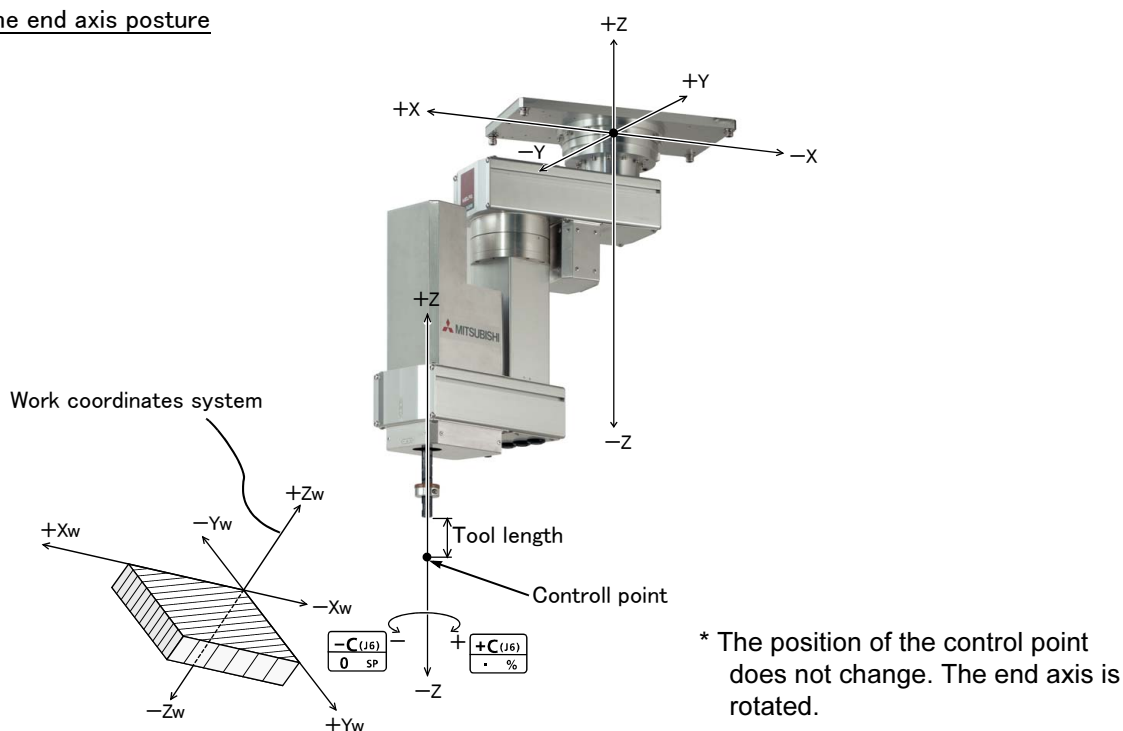
・When the[+C (J6)] keys are pressed, The Z axis will rotate in the plus direction of the XYZ coordinate system. When the[−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ 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 ″(1)JOINT jog operation″ on page 28″, and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

3 Installing the option devices

3.1 Installing the solenoid valve set

Installation outline of the solenoid valve set of general environment specification is shown in Fig. 3-1 and is shown in Fig. 3-2 about clean / waterproof specification.

〈General environment type (RH-3SDHR3515)〉

〈7〉 P port (Elbow type)
〈6〉 R port (Elbow type)
B port
〈4〉 Hand output cable GR2
2 4 6 8
1 3 5 7
A port
〈1〉 Solenoid valve set
〈4〉 Hand output cable GR1

Solenoid valve set installation position 2-M5 Screw (for fixing)
〈13〉 Arm coverA(2)
10mm

〈3〉 No2 Arm cover (bottom)
〈2〉 Grommet (3 place)
General environment specification : makes notch in one near a solenoid valve..

WIRE INLET
WIRE INLET
AIR OUT RETURN
WIRE INLET

〈8〉 RETURN coupling
〈9〉 AIR OUT coupling

〈5〉 Hand output cable (Robot arm side)

Primary piping air hose (φ6 x 2)

Connect within No.2 arm. (GR1, GR2)
No.2 arm cover
Hand output cable
Grommet (Make a cut and pass the cable)
To solenoid valve
Robot arm side ← → Solenoid valv set side

〈11〉 Secondary piping air coupling (φ4 x 4) Connect the hand tube optional.

〈10〉 Secondary piping air coupling (φ4 x 4)
Secondary piping air hose (Customer preparation)
Customer preparation hose (φ4 x 4)
電磁弁

Hand output signal connector

Secondary piping air hose Customer preparation hose (φ4 x 4)

Primary piping air hose (Customer preparation)
Customer preparation hose (φ6 x 2)

Fig.3-1 : Solenoid valve installation procedures (general environment type)

<Clean/ Waterproof type（RH-3SDHR3512C/3512W）>

<7> P port   <6> R port

B port

2 4 6 8

1 3 5 7

A port

<1> Solenoid valve set

Solenoid valve set installation position
2-M5 Screw (for fixing)
<13> Arm coverA(2)

10mm

<4> Hand output cable
GR1,GR2

MADE IN JAPAN

<3> No2 Arm cover (bottom)

WIRE INLET

AIR OUT RETURN

WIRE INLET

WIRE INLET

<2> Grommet (3 place)
Clean/ Waterproof specification :
removes in one near a solenoid
valve.

<8> RETURN coupling

<9> AIR OUT coupling

<5> Hand output cable
(Robot arm side)

Primary piping air hose
(φ6 x 2)

<11>
Secondary piping
air coupling
(φ4 x 4)
Connect the hand
tube optional.

電磁弁

<10>
Secondary piping air coupling (φ4 x 4)

Secondary piping air hose (Customer preparation)
Customer preparation hose (φ4 x 4)

Hand output signal connector

Primary piping air hose (Customer preparation)
Customer preparation hose (φ6 x 2)

Secondary piping
air hose
Customer
preparation hose
(φ4 x 4)

Connect within No.2 arm.
(GR1, GR2)

Cable clamp

No.2 arm cover

Hand output
cable

Lock nut

To solenoid valve

Robot arm side | Solenoid valve
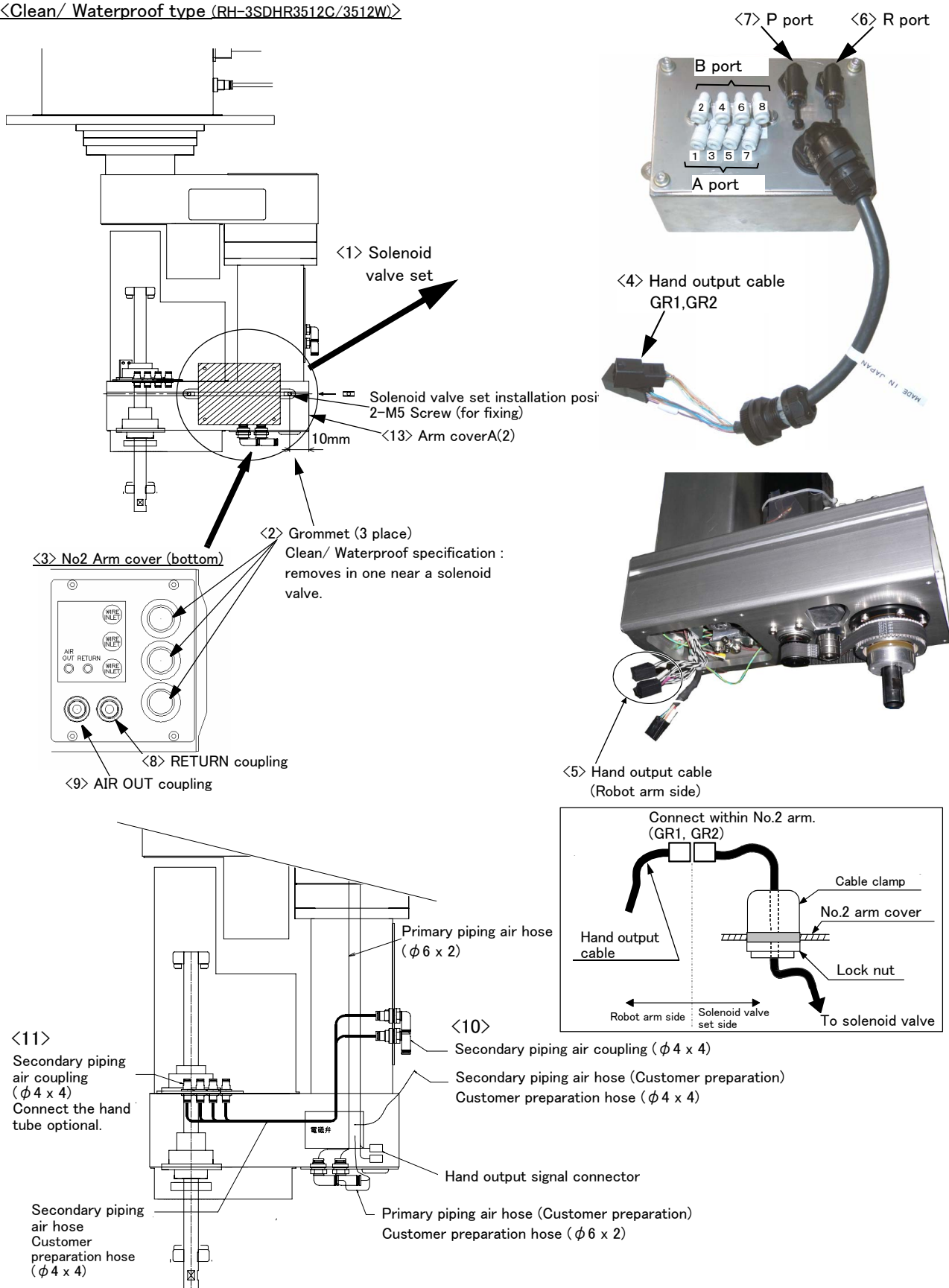set side

Fig.3-2 : Solenoid valve installation procedures (<u>clean/ waterproof type</u>)

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

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) <13>. 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) <13> 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.
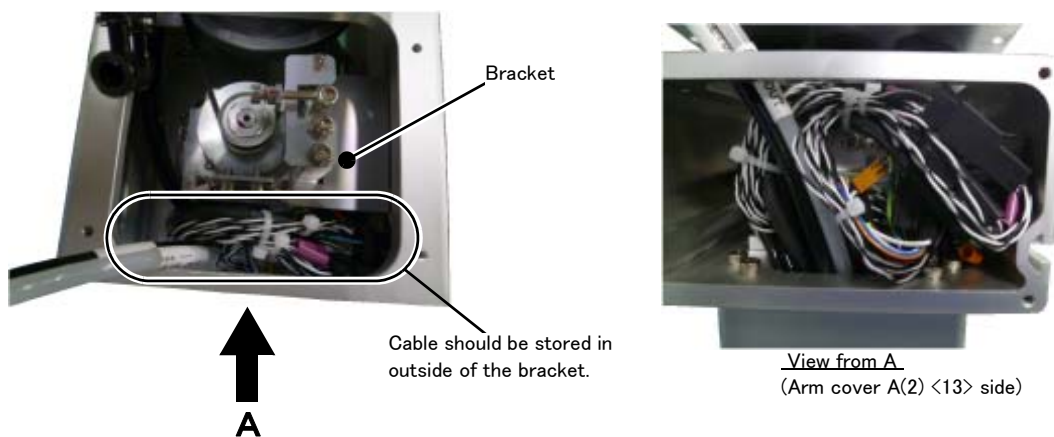
Fig.3-3 : Storing of the hand output cable

6) Install the No.2 arm cover <3> and the arm cover A(2) <13> 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. 3-4.
      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) Nylon clamp

Screw (2-M5) and nut for T slots

Solenoid valve set
(option)

Air hose for secondary piping
(customer preparation)

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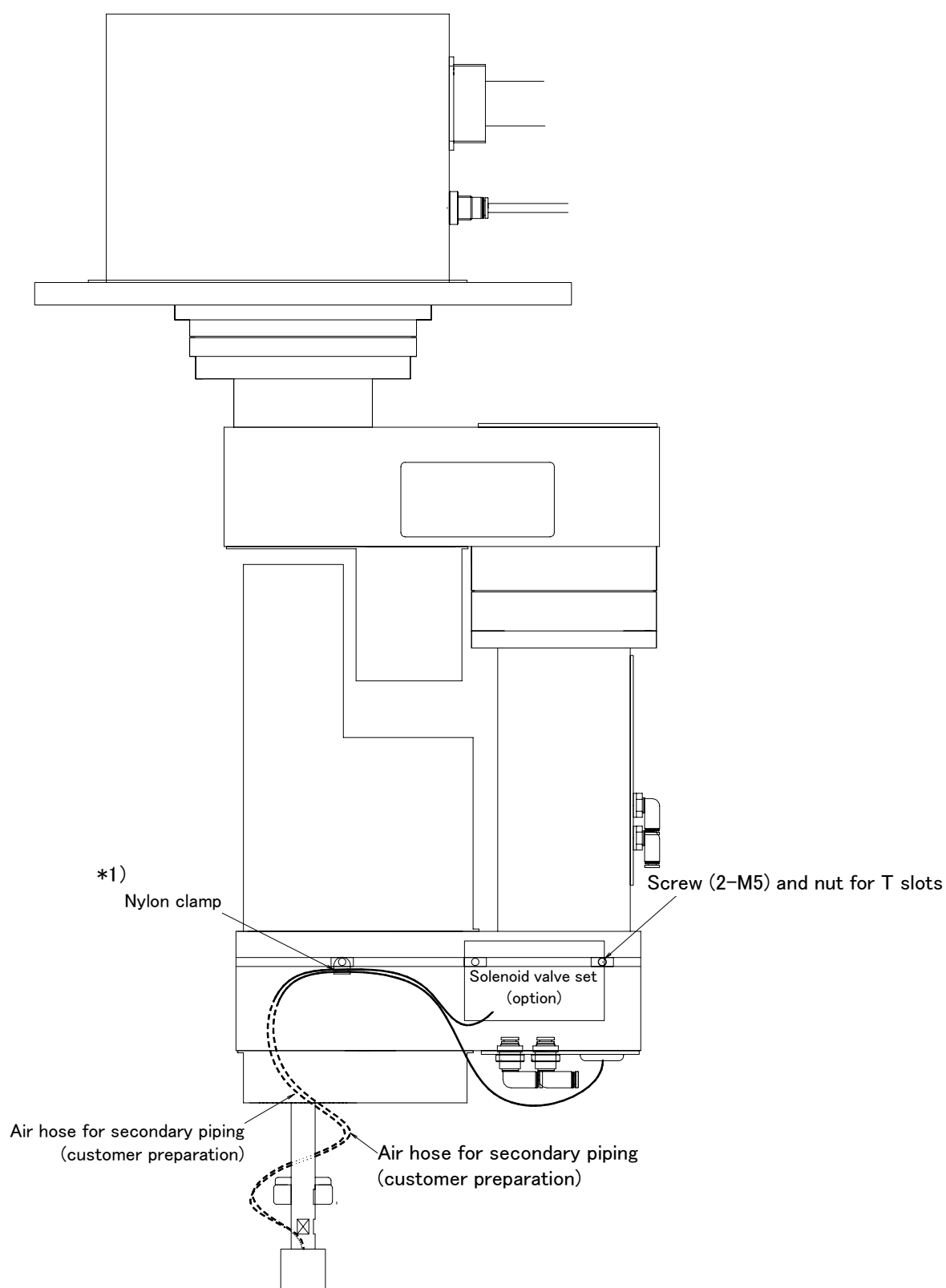
*1) Fixing the air hose (customer preparation) using the T slot by nylon clamp etc.

Fig.3-4 : Fixing place of the air hose (example)

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

3.2 Installation of hand tube

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 44, "3.1 Installing the solenoid valve set" and the Page 53, "3.3 Installing the hand input cable" together.

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

⚠️ CAUTION

*1) Adjustment of the fixing position
In the condition that the J3 axis is upper limit and the J4 axis is 0 degree, align the top of air tube with the upper end of the Piping fixing bracket.

＊The position of the J3 axis and the J4 axis
J3 = upper end
J4 = 0 degree

<1> Motor cover J3

<3> Piping fixing bracket
The grease is applied.

*1

Hand tube

<4> Shaft
The grease is applied.

<5> Fixing place (two places)
(Rubber sheet + cable tie)

<2> Secondary piping air coupling
(φ4 x 4 places)

Insert the union installation side.

<6> Fixing place (tool side)
(Rubber sheet + cable tie, etc)

Enlargement

＊On the Clean/ Waterproof specifications seal the aperture of shaft end by liquefied gasket.

Fig.3-5 : 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.
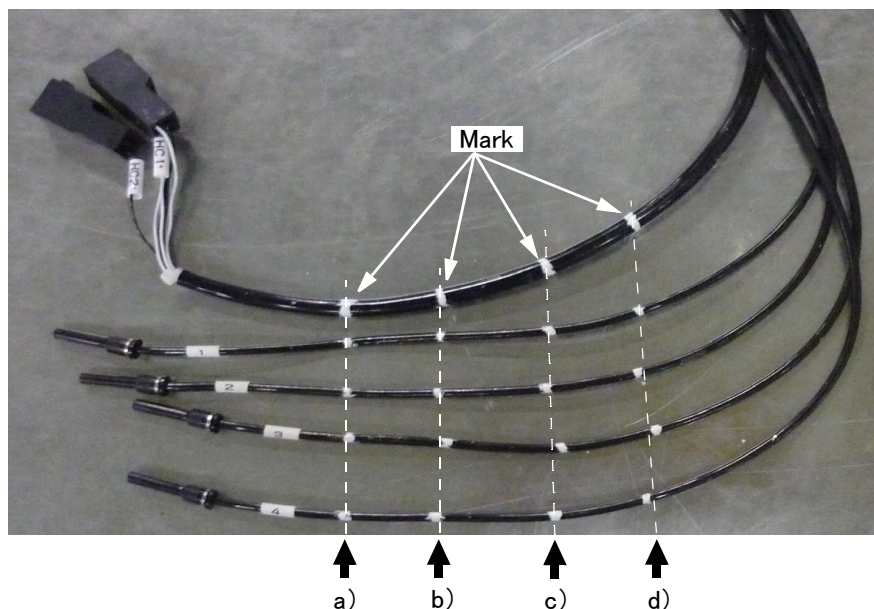
Put together each mark and roll the attached rubber sheet.
Roll at two places between a) and b) and between c) and d). And fixing by cable tie (Attachment) each.
This position is the fixing position to the piping fixing bracket <3>.
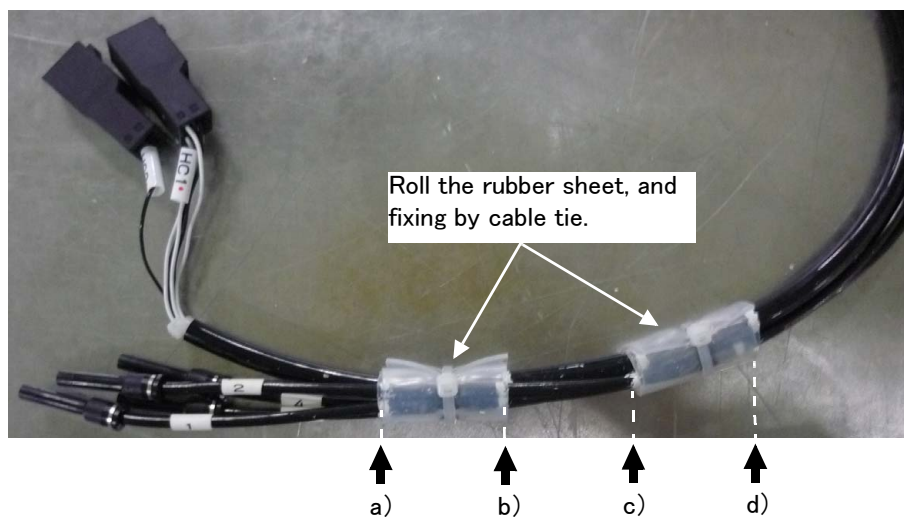
Fig.3-6 : Protection of hand tube and hand input cable

2) Remove motor cover J3 <1> with referring to the Page 66, "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 φ3) side of the tube to secondary piping coupling (φ4 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.

<4> Shaft

<3> Piping fixing bracket

<5> Fixing place (two places)
(Rubber sheet + cable tie)

Marking tube

Coupling number

<2> Secondary piping air coupling
(φ4 x 4 places)
1, 2, 3, 4. sequentially from the left.
Connect together with same number
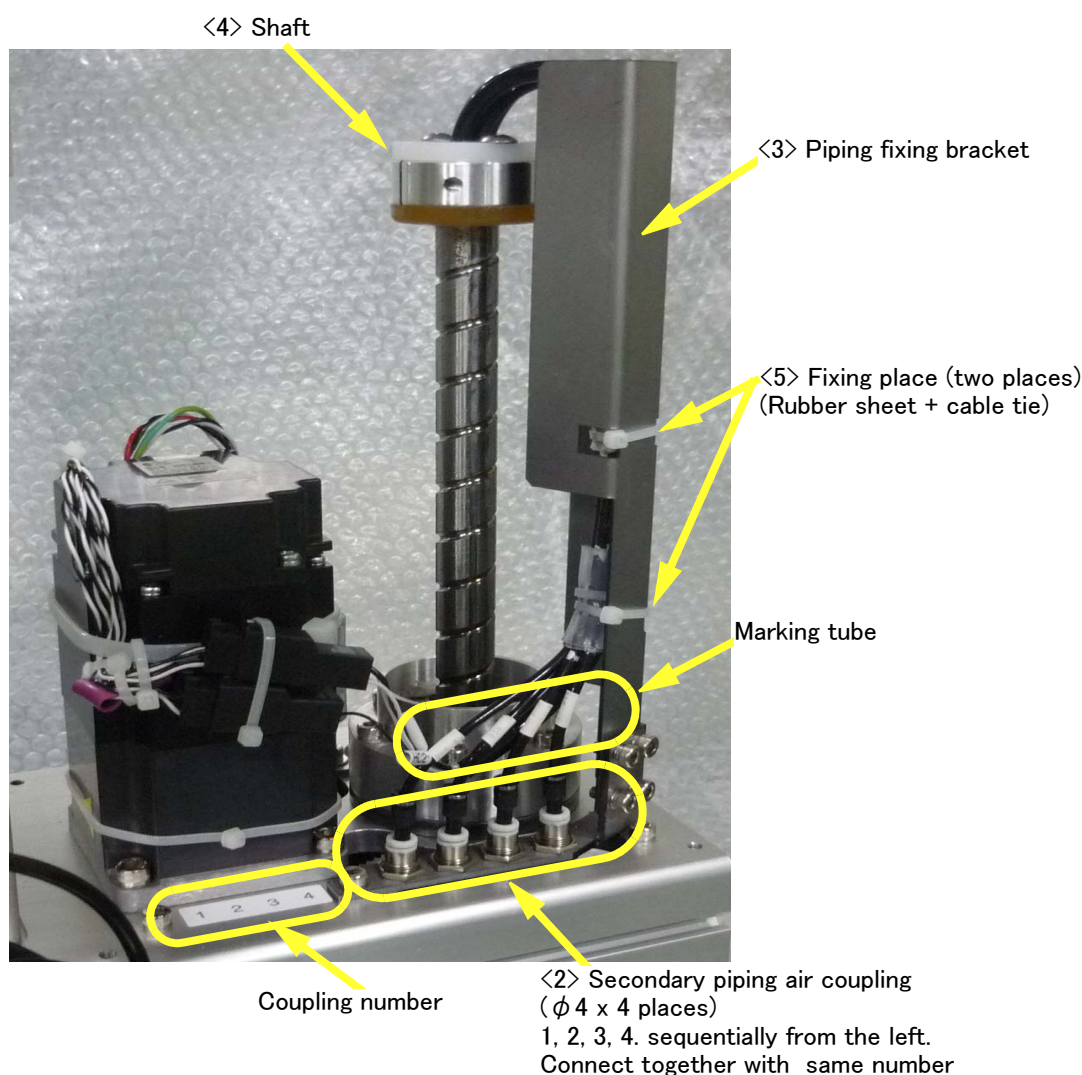
Fig.3-7 : Connection of hand tube

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. 3-8.
9) Remove the tape and connect the tool side. Please utilize the attached union (φ 4 to φ3) 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.

*On the Clean/ Waterproof specifica-
tions seal the aperture of shaft end
by liquefied gasket.

Enlargement

Hand flange

Metal plate for tool
side fixing

Union (φ4 to φ3)

Tool

Nylon clamp

Rubber sheet

Fig.3-8 : Tool side fixing image of hand tube (example)

3.3 Installing the hand input cable

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 44, "3.1 Installing the solenoid valve set" and the Page 49, "3.2 Installation of hand tube" together.
And, operate after turning OFF the power supply of the controller.
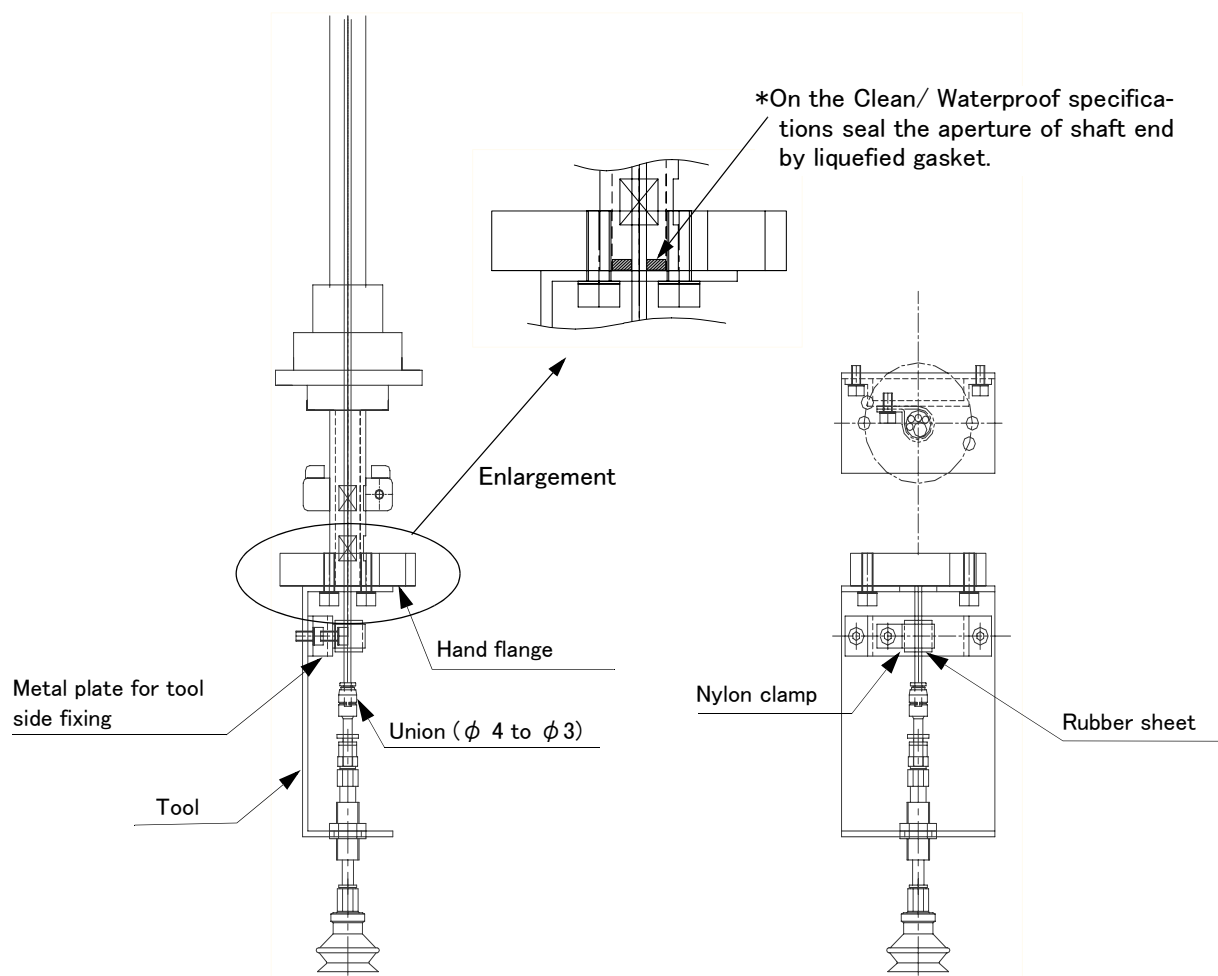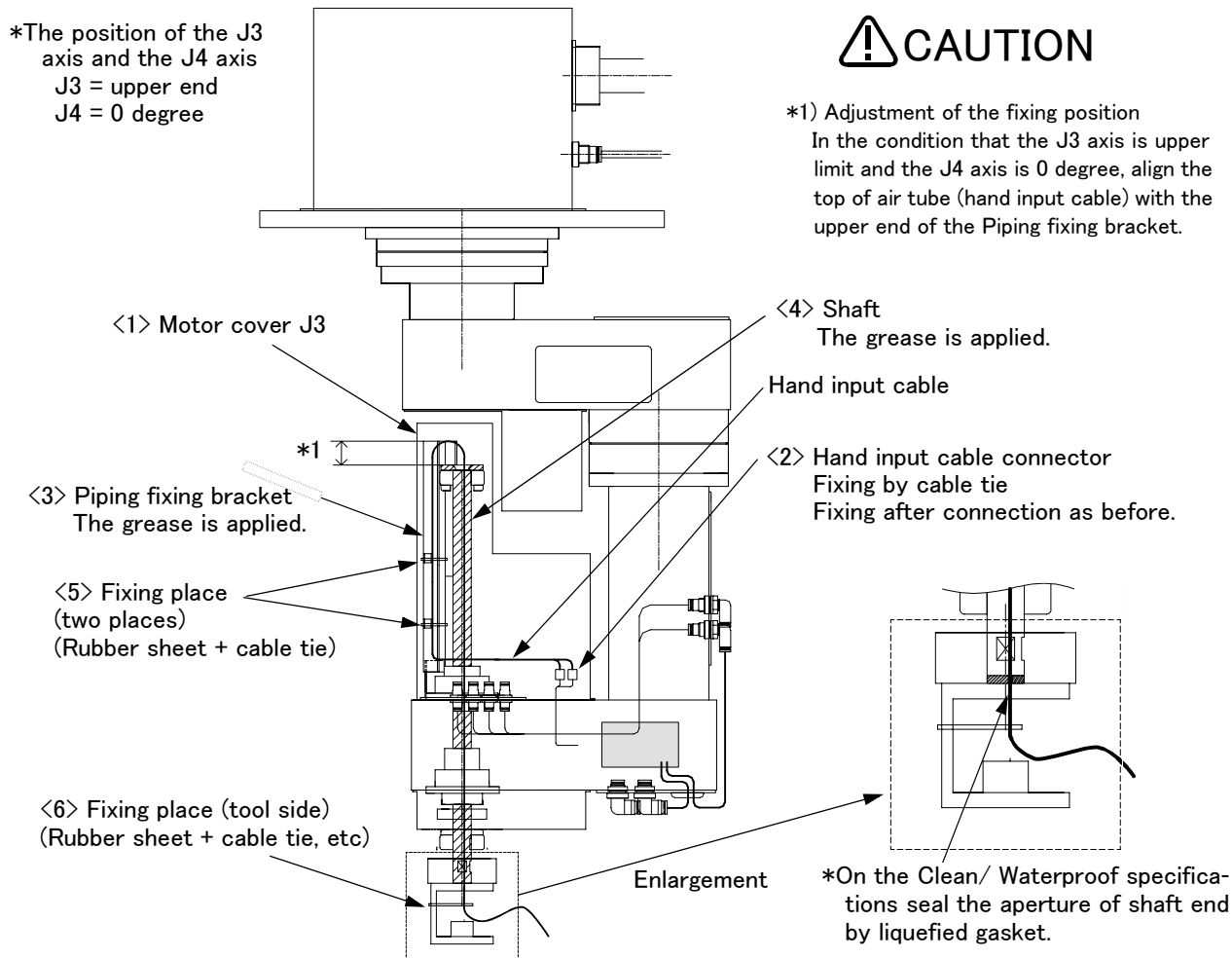
*The position of the J3 axis and the J4 axis
J3 = upper end
J4 = 0 degree

⚠ CAUTION

*1) Adjustment of the fixing position
In the condition that the J3 axis is upper limit and the J4 axis is 0 degree, align the top of air tube (hand input cable) with the upper end of the Piping fixing bracket.

<1> Motor cover J3

<4> Shaft
The grease is applied.

Hand input cable

*1

<3> Piping fixing bracket
The grease is applied.

<2> Hand input cable connector
Fixing by cable tie
Fixing after connection as before.

<5> Fixing place
(two places)
(Rubber sheet + cable tie)

<6> Fixing place (tool side)
(Rubber sheet + cable tie, etc)

Enlargement

*On the Clean/ Waterproof specifications seal the aperture of shaft end by liquefied gasket.

⚠ 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.3-9 : Installation of the hand input cable

1) To protect the fixing place of the hand input cable, roll the attached rubber sheet. Roll the rubber sheet with referring to Page 50, "Fig.3-6 : Protection of hand tube and hand input cable". If using the hand tube, roll together.
2) Remove motor cover J3 <1> with referring to the Page 66, "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. 3-8.

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.

3.4 Installing the hand output cable

The installation procedure of the hand output cable is as follows. Please operate with referring to the Page 44, "3.1 Installing the solenoid valve set" and the Page 55, "3.4 Installing the hand output cable" together.
And, operate after turning OFF the power supply of the controller.

The solenoid valve install position
of customer preparation
2-M5 screw for fixing

⟨3⟩ Hand output cable (GR1,GR2)

⟨13⟩ Arm coverA(2)

10mm

⟨2⟩ No2 Arm cover (bottom)

⟨1⟩ Grommet (3 place)
Make a cut either one grommet.

Connect within No.2 arm.
(GR1, GR2)

Hand output cable option

Cable clamp

No.2 arm cover

Lock nut

Hand output
cable

Robot arm side   Option side

Solenoid valve
(Customer preparation)

RETURN coupling

AIR OUT coupling
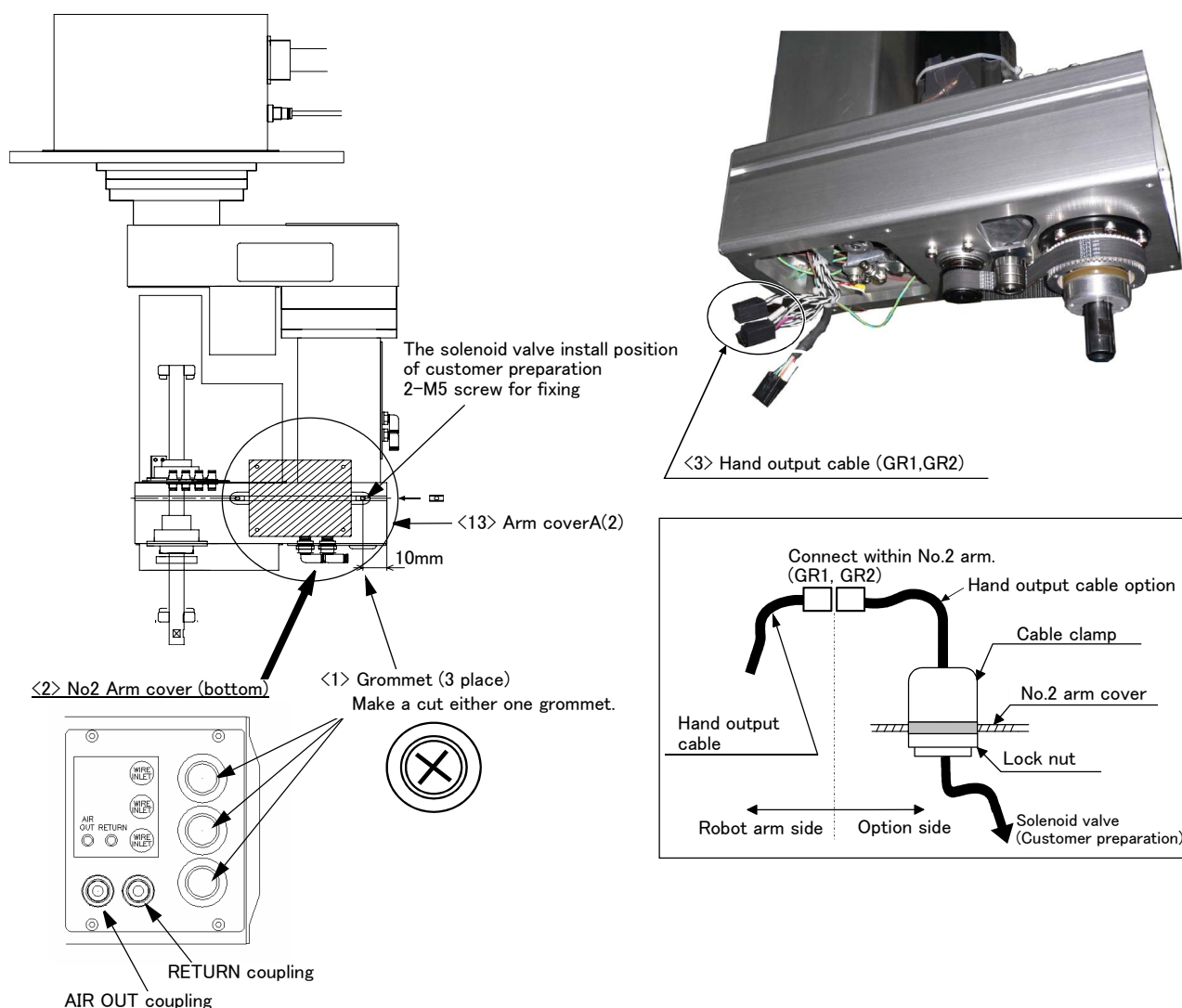
Fig.3-10 : Installing the hand output cable

The connection summary of the hand output cable is shown in Fig. 3-10. 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 ⟨3⟩ and the arm cover A(2) ⟨4⟩. Since the air tube is connected, No.2 arm cover ⟨3⟩ 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.

Bracket

Cable should be stored in outside of the bracket.
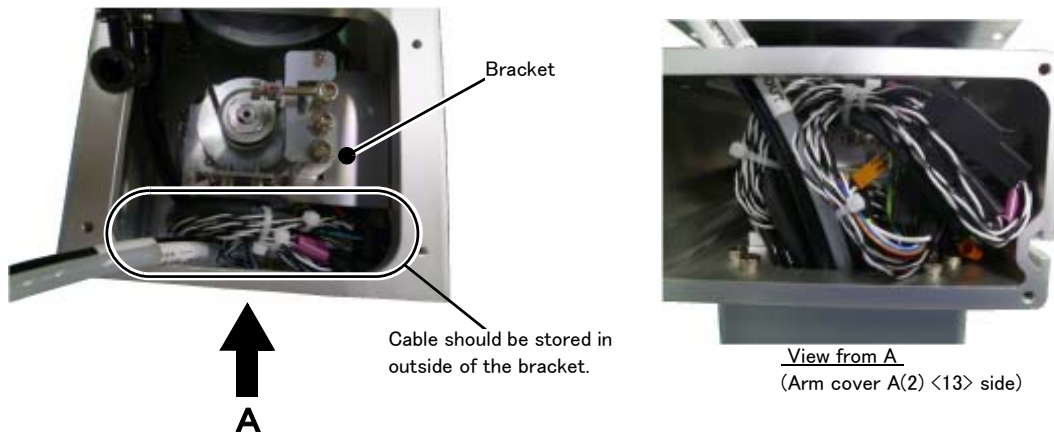
A

View from A
(Arm cover A(2) <13> side)

Fig.3-11 : Storing of the hand output cable

5) Install the No.2 arm cover <3> 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.
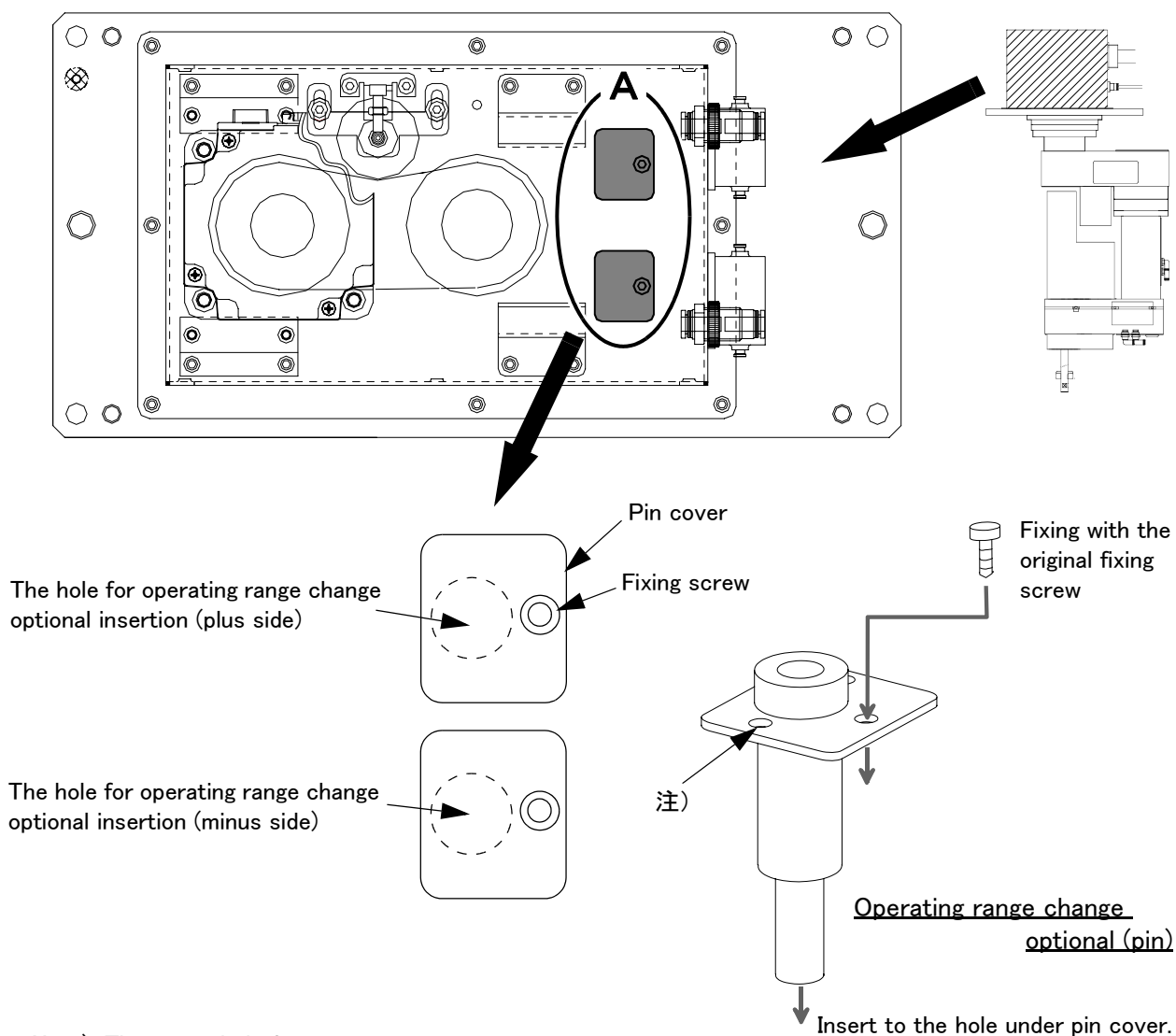
3.5 Changing the operating range

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.

3.5.1 Operating range change of J1 axis

Upper face in base

The hole for operating range change optional insertion (plus side)

Pin cover

Fixing screw

Fixing with the original fixing screw

The hole for operating range change optional insertion (minus side)

注)

Operating range change optional (pin)

Insert to the hole under pin cover.

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

Fig.3-12 : 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 66, "5.3.2 Installing/removing the cover".
3) There is the pin cover at back in the base.("A" of Fig. 3-12. 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.

```
┌────────────────────────────────────┐
│ <CURRENT>    JOINT    100%  M1  TO  B* │
│ ┌────────────┐                       │
│ │ J1: +130.00 │◀────          :       │
│ └────────────┘                       │           +130 degree or more
│   J2:    +0.00               :       │
│   J3:  -560.00               :       │
│   J4:    +0.00               :       │
│ ┌─────┬──────┬─────┬───────┬────────┐ │
│ │ XYZ │ TOOL │ JOG │ 3-XYZ │ CYLNDR │⇒│
│ └─────┴──────┴─────┴───────┴────────┘ │
└────────────────────────────────────┘
```
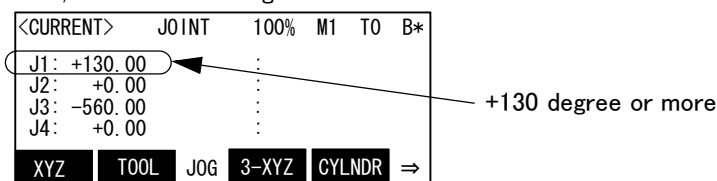
    b) Next, move within −110 to −115 degree.
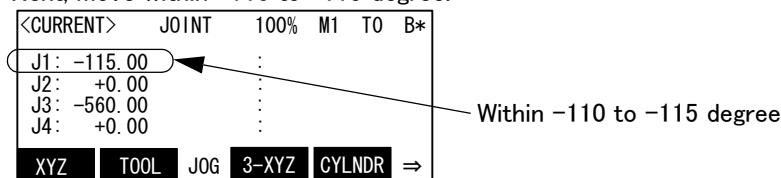
```
┌────────────────────────────────────┐
│ <CURRENT>    JOINT    100%  M1  TO  B* │
│ ┌────────────┐                       │
│ │ J1: -115.00 │◀────          :       │
│ └────────────┘                       │           Within -110 to -115 degree
│   J2:    +0.00               :       │
│   J3:  -560.00               :       │
│   J4:    +0.00               :       │
│ ┌─────┬──────┬─────┬───────┬────────┐ │
│ │ XYZ │ TOOL │ JOG │ 3-XYZ │ CYLNDR │⇒│
│ └─────┴──────┴─────┴───────┴────────┘ │
└────────────────────────────────────┘
```

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

```
┌────────────────────────────────────┐
│ <CURRENT>    JOINT    100%  M1  TO  B* │
│ ┌────────────┐                       │
│ │ J1:    +5.00 │◀────          :       │
│ └────────────┘                       │           Within -5 to +5 degree
│   J2:    +0.00               :       │
│   J3:  -560.00               :       │
│   J4:    +0.00               :       │
│ ┌─────┬──────┬─────┬───────┬────────┐ │
│ │ XYZ │ TOOL │ JOG │ 3-XYZ │ CYLNDR │⇒│
│ └─────┴──────┴─────┴───────┴────────┘ │
└────────────────────────────────────┘
```

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.

3.5.2 Operating range change of J2 axis

Upper face of No.1 arm
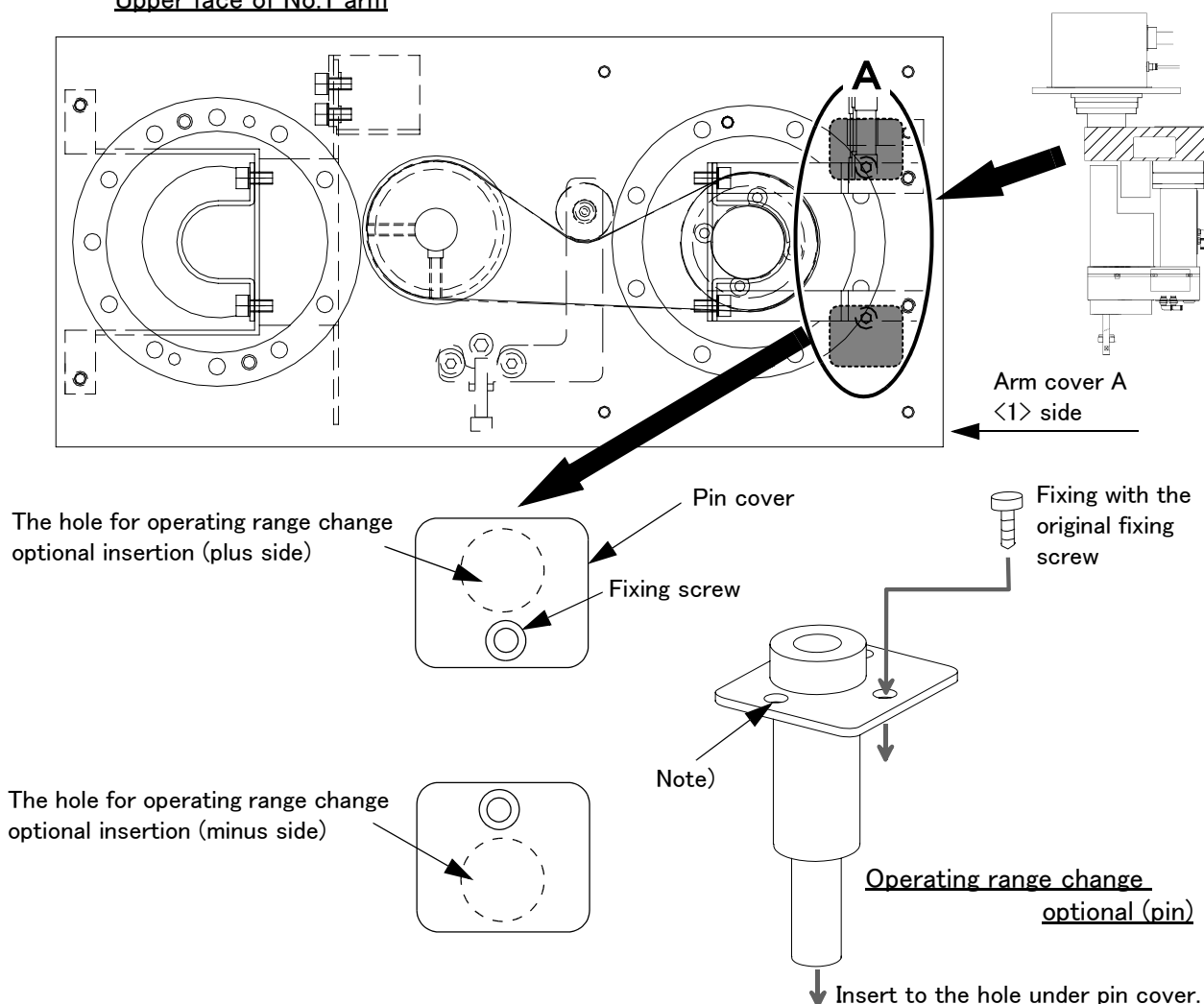
A

Arm cover A
<1> side

The hole for operating range change optional insertion (plus side)

Pin cover

Fixing screw

Fixing with the original fixing screw

The hole for operating range change optional insertion (minus side)
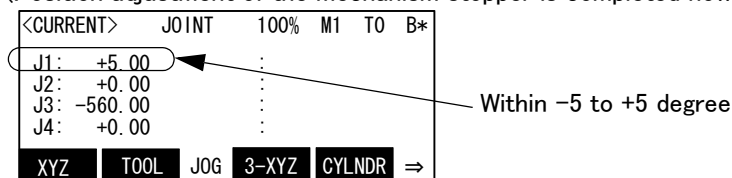
Note)

Operating range change optional (pin)

Insert to the hole under pin cover.

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

Fig.3-13 : 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 66, "5.3.2 Installing/removing the cover".
3) There is the pin cover in the No.1 arm.("A" of Fig. 3-13. 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.

```
<CURRENT>    JOINT    100%  M1  T0  B*

J1:    +0.00           :
J2:  +140.00           :           ←————— +140 degree or more
J3:  -560.00           :
J4:    +0.00           :

 XYZ   TOOL  JOG  3-XYZ CYLNDR ⇒
```

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

```
<CURRENT>    JOINT     100%   M1   TO   B*

 J1:    +0.00        :
 J2:  -130.00        :          ← Within -125 to -130 degree
 J3:  -560.00        :
 J4:    +0.00        :

  XYZ  │  TOOL  │ JOG │ 3-XYZ │ CYLNDR │ ⇒
```

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

```
<CURRENT>    JOINT     100%   M1   TO   B*

 J1:    +0.00        :
 J2:    +5.00        :          ← Within -5 to +5 degree
 J3:  -560.00        :
 J4:    +0.00        :

  XYZ  │  TOOL  │ JOG │ 3-XYZ │ CYLNDR │ ⇒
```

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.

4 Basic operations

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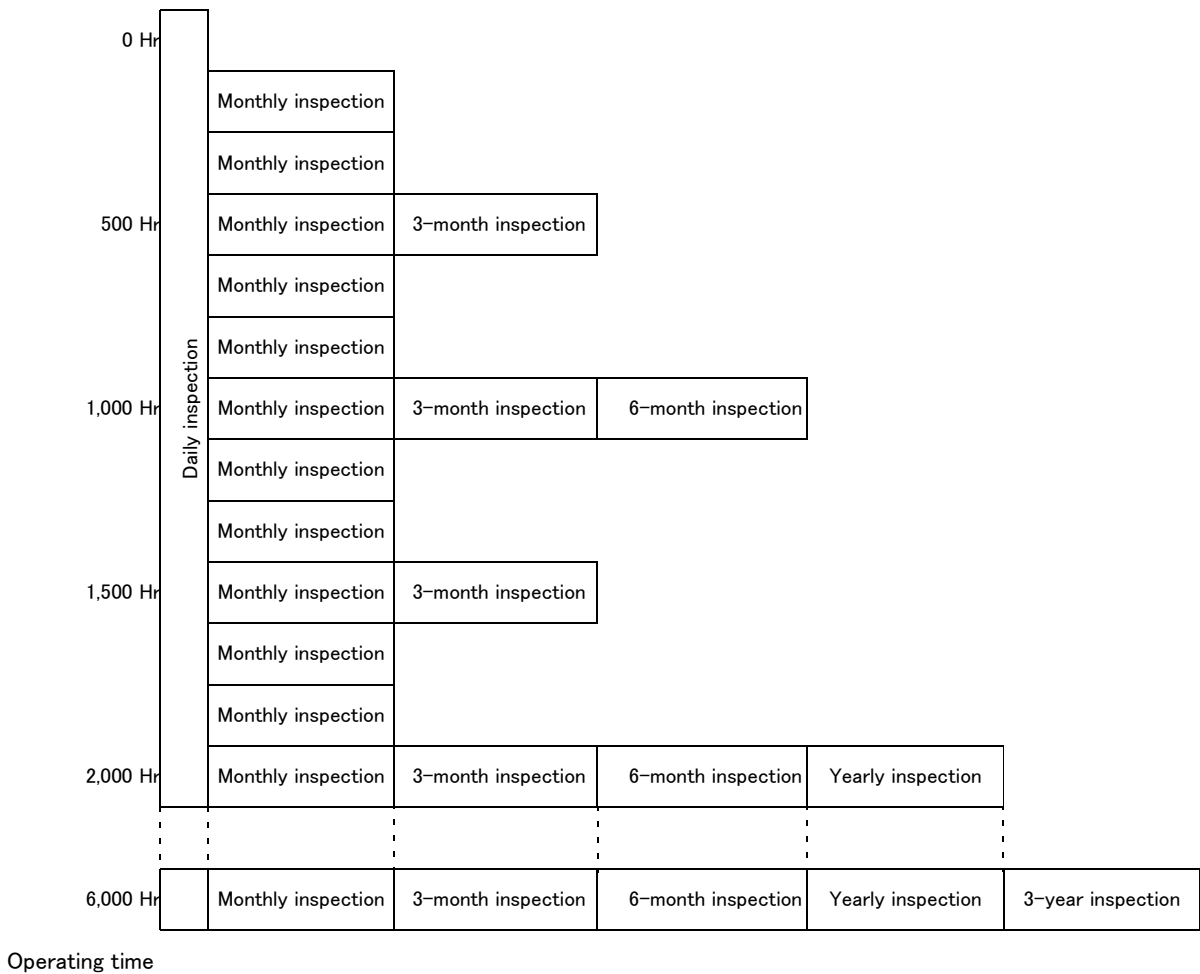
5 Maintenance and Inspection

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

5.1 Maintenance and inspection interval

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

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

Operating time	Daily inspection	Monthly inspection	3-month inspection	6-month inspection	Yearly inspection	3-year inspection
0 Hr						
		Monthly inspection				
		Monthly inspection				
500 Hr		Monthly inspection	3-month inspection			
		Monthly inspection				
		Monthly inspection				
1,000 Hr		Monthly inspection	3-month inspection	6-month inspection		
		Monthly inspection				
		Monthly inspection				
1,500 Hr		Monthly inspection	3-month inspection			
		Monthly inspection				
		Monthly inspection				
2,000 Hr		Monthly inspection	3-month inspection	6-month inspection	Yearly inspection	
6,000 Hr		Monthly inspection	3-month inspection	6-month inspection	Yearly inspection	3-year inspection

〈Guideline for inspection period〉
For one shift
8 Hr/day × 20 days/month × 3 months = approx. 500 Hr
10 Hr/day × 20 days/month × 3 months = approx. 600 Hr
For two shifts
15 Hr/day × 20 days/month × 3 months = approx. 1000 Hr

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

Fig.5-1 : Inspection schedule

5.2 Inspection items

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

5.2.1 Daily inspection items

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

Table 5-1 : Daily inspection items (details)

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

5.2.2 Periodic inspection

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

Table 5-2 : Periodic inspection items (details)

Procedure	Inspection item (details)	Remedies
Monthly inspection items		
1	Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.
2	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
3	Remove the cover at each section, and check the cables for wear damage and adherence of foreign matter.	Check and eliminate the cause. If the cables are severely damaged, contact the Mitsubishi Service Department.
3-month inspection items		
1	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.
2	Is there any grease of the shaft section still?	Wipe off the old grease and supply the new grease.
6-month inspection items		
1	Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.
2	Confirm that there is no rubbing or crack etc at the hand tube and hand input cable.	If there is rubbing or crack etc replace.
Yearly inspection items		
1	Replace the backup battery in the robot arm.	Exchange it referring to Page 77, "5.3.5 Replacing the backup battery".
3-year inspection items		
1	Lubricate the grease at the harmonic reduction gears to J1 axis and J2 axis.	Lublicate it referring to Page 75, "5.3.4 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 80, "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 in Fig. 5-2. Each part is as shown below.

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.
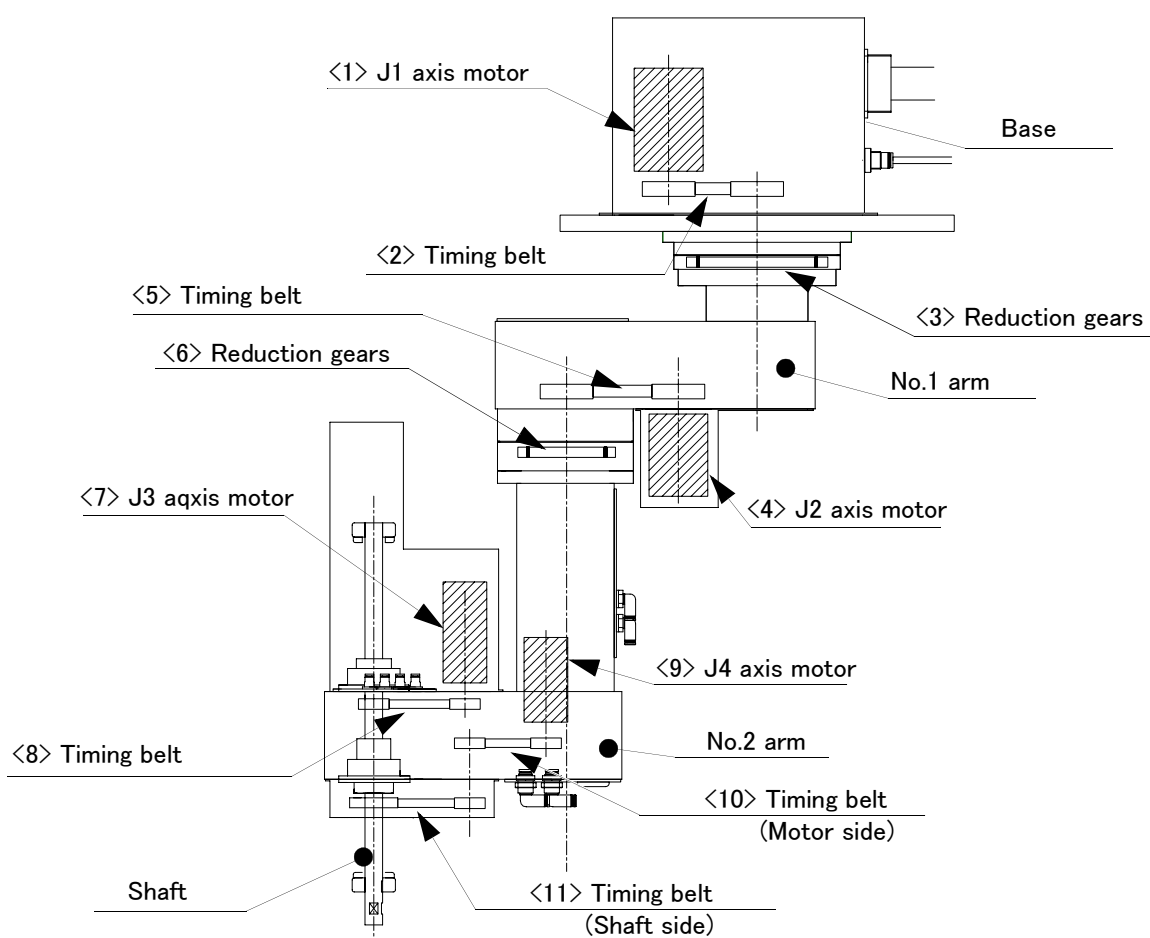Brakes are not mounted in the J4 axis motor.

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

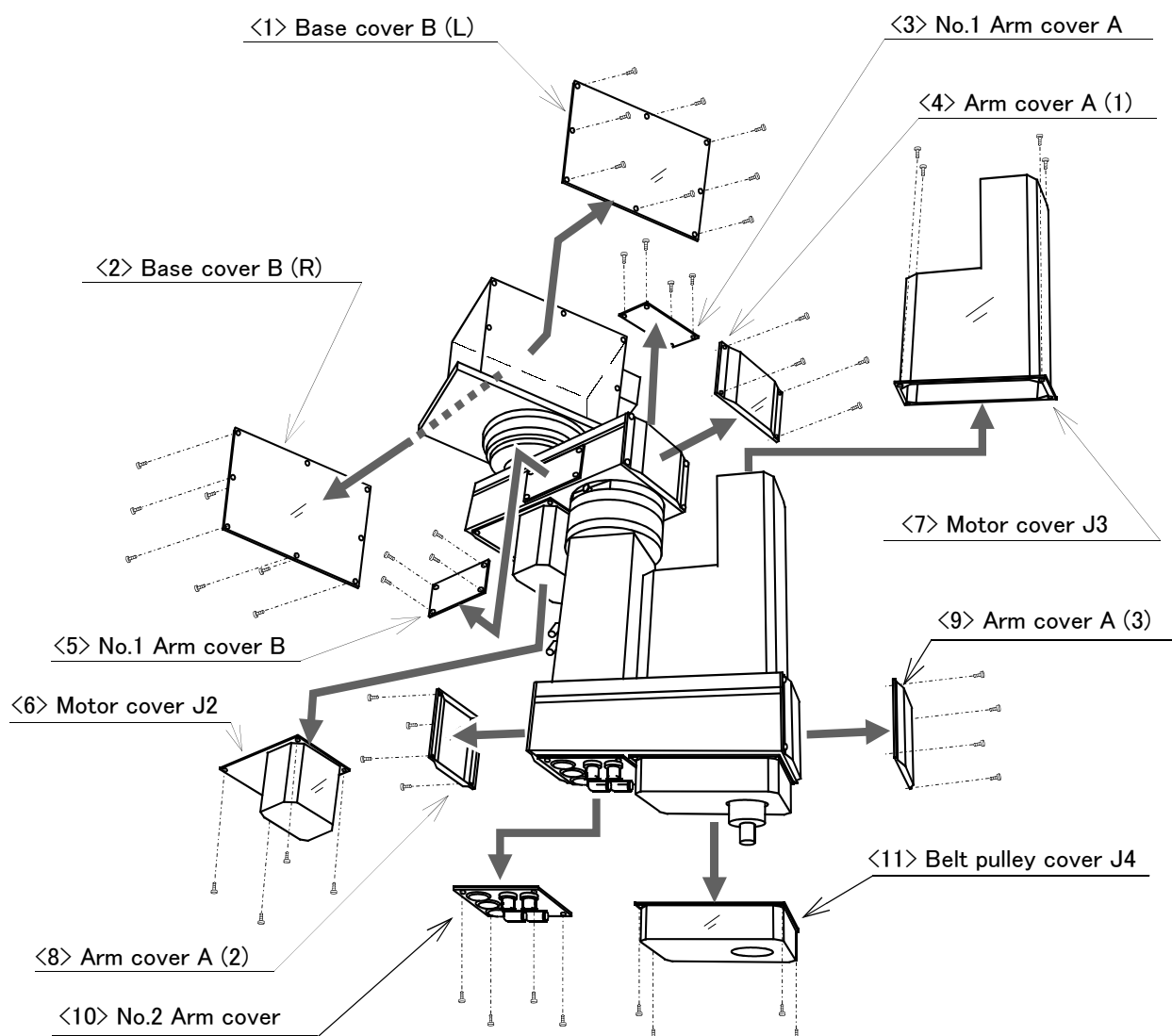## 5.3.2 Installing/removing the cover

Fig.5-3 : Installing/removing the cover

Table 5-3 : Cover fixing screw list

No.	Cover name	Installation screw name: Qty. [Note1)]	
		General environment type	Clean/Waterproof type
<1>	Base cover B (L)	Low head hexagon socket bolt, M4 x 8-eight bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]
<2>	Base cover B (R)	Low head hexagon socket bolt, M4 x 8-eight bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]
<3>	No.1 Arm cover A	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]
<4>	Arm cover A (1)	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 8-eight bolts [Note2)]
<5>	No.1 Arm cover B	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]
<6>	Motor cover J2	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]
<7>	Motor cover J3	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]
<8>	Arm cover A (2)	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 8-eight bolts
<9>	Arm cover A (3)	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 8-eight bolts
<10>	No.2 Arm cover	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]
<11>	Belt pulley cover J4	Low head hexagon socket bolt, M4 x 8-four bolts	SUS hexagon socket bolt, M4 × 10-eight bolts [Note2)]

Note1)Bolting torque of each fixing screw is 1.39 to 1.89N・m.
Note2)With seal washer.

[Caution]
When you remove the cover, don't remove other than the screw shown in Fig. 5-3 and Table 5-3.

（1）Referring to Fig. 5-3, remove the covers.
（2）The names of the covers are given in Table 5-3, and a list of the cover installation screws is given in Table 5-3.
（3）When installing the cover after maintenance and inspection, use the procedure of removal in reverse.
　　　Bolt the installation screw with the torque shown in Table 5-3.

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

5.3.3 Inspection, maintenance and replacement of timing belt

This robot uses a timing belt for the drive conveyance system of the J5 axis. Compared to gears and chains, the timing belt does not require lubrication and has a low noise. However, if the belt usage method and tension adjustment are inadequate, the life could drop and noise could be generated. Sufficient aging to remove the initial elongation of the belt, and adjustment of the belt tension have been carried out before shipment from the factory. However, depending on the robot working conditions, elongation will occur gradually over a long time. The tension must be confirmed during the periodic inspection. The timing belt must be replaced in the following cases.
In addition, it is serviceable if there is the sound wave type belt tension gauge in inspection and adjustment of the timing belt. The recommendation gauge is shown below. Please prepare by customer. Refer to the Page 74, "(6) Timing belt tension" for the tension adjustment value of the timing belt.

     Maker:Gates Unitta Asia Company,
     Type:U-505

(1) Timing belt replacement period

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

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

⚠ **CAUTION** Due to the manufacturing of the timing belt, initial wear will occur. Wear chips may accumulate in the cover after approx. 300 Hr of operating the robot, but this is not a fault. If the wear chips appear soon after wiping them off, replace the belt.
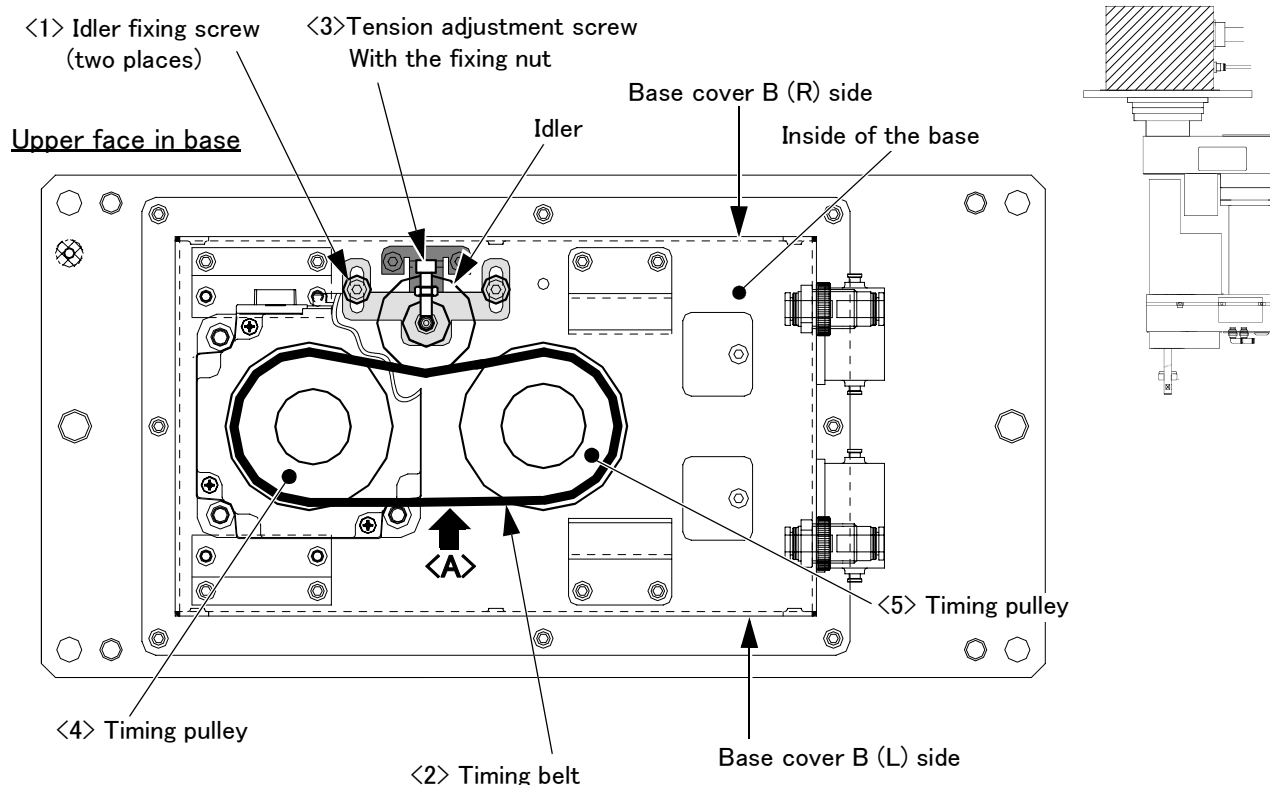
⚠ **CAUTION** When the belt is replaced, the machine system origin may deviate. In this case, the position data must be reviewed.

(2) Inspection and maintenance of J1 axis timing belt

The reference figure at inspection and adjustment of the timing belt is shown in Fig. 5-4.

Fig.5-4 : Inspection, maintenance and cleaning of J1 axis timing belt
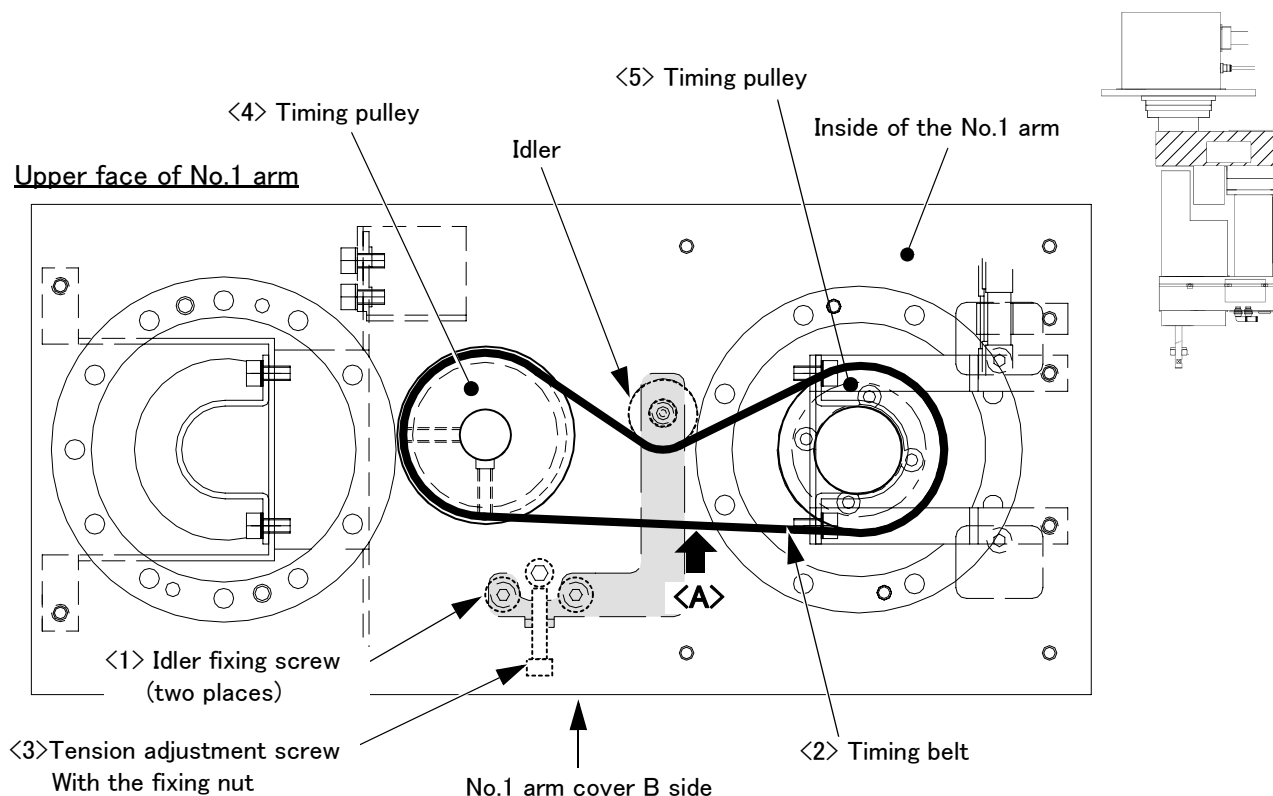
■ Inspecting the J1 axis timing belt
1) Confirm that the robot controller power is OFF.
2) Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the base cover B (R) and (L).
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Check the belt tension as shown in "Fig.5-8 : Belt tension" . Lightly press the center of the belt <A>, and confirm that the value of belt slack is in following.
RH-3SDHR3515 : Force to press the belt: apprpx.10N・m, Flexure: approx.1.3mm

■ Adjusting the J1 axis timing belt
1) Carry out steps "1)" and "2)" indicated in "■ Inspecting the J1 axis timing belt" above.
2) Lightly loosen the two idler installation bolts <1>. (Do not loosen too much.)
3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and adjust the tension of timing belt <2>. When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
Lightly press the center of the belt <A>, and confirm that the value of belt slack is in following.
RH-3SDHR3515 : Force to press the belt: apprpx.10N・m, Flexure: approx.1.3mm
If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate
4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten idler fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

(3) Inspection and maintenance of J2 axis timing belt
The reference figure at inspection and adjustment of the timing belt is shown in Fig. 5-5.

Fig.5-5 : Inspection, maintenance and cleaning of J2 axis timing belt

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

■ Inspecting the J2 axis timing belt
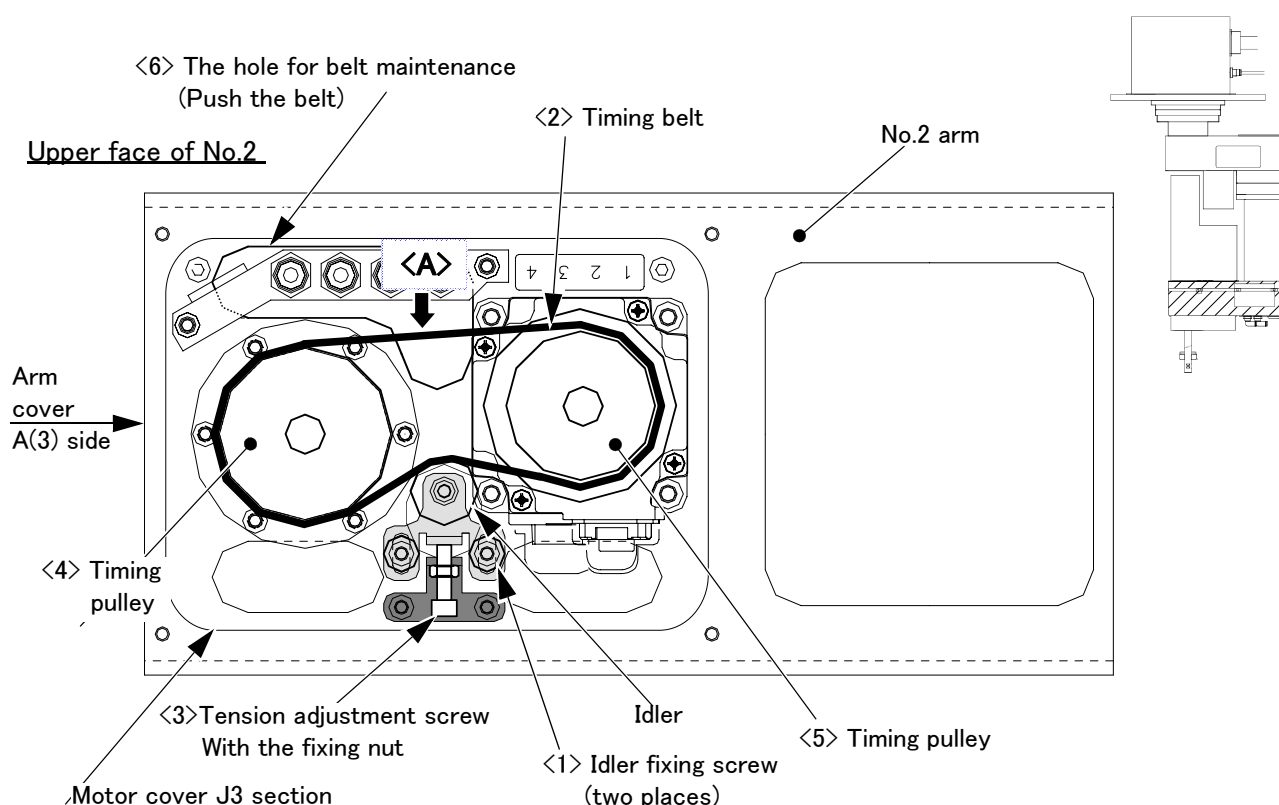1) Confirm that the robot controller power is OFF.
2) Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the No.1 arm cover B.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt <2>.
4) Check the belt tension as shown in "Fig.5-8 : Belt tension" . Lightly press the center of the belt <A>, and confirm that the value of belt slack is in following.
RH-3SDHR3515 : Force to press the belt: apprpx.4N・m, Flexure: approx.1.6mm

■ Adjusting the J2 axis timing belt
1) Carry out steps "1)" and "2)" indicated in " ■ Inspecting the J2 axis timing belt" above.
2) Lightly loosen the two idler installation bolts <1>. (Do not loosen too much.)
3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and adjust the tension of timing belt <2>. When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
Lightly press the center of the belt <A>, and confirm that the value of belt slack is in following.
RH-3SDHR3515 : Force to press the belt: apprpx.4N・m, Flexure: approx.1.6mm
If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate
4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten idler fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

(4) Inspection and maintenance of J3 axis timing belt
    The reference figure at inspection and adjustment of the timing belt is shown in Fig. 5-6.

<6> The hole for belt maintenance
(Push the belt)

Upper face of No.2

<2> Timing belt

No.2 arm

<A>

Arm
cover
A(3) side

<4> Timing
    pulley

<3>Tension adjustment screw
With the fixing nut

Idler

<5> Timing pulley

Motor cover J3 section

<1> Idler fixing screw
(two places)

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).
      The belt can be pushed and adjusted from hole for belt maintenance <6>.
      The idler fixing section and the tension adjustment screw section are in the No.2 arm.

    Fig.5-6 : Inspection, maintenance and cleaning of J3 axis timing belt

■ Inspecting the J3 axis timing belt
    1) Confirm that the robot controller power is OFF.
    2) Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the motor cover J3 and arm cover A(3).
    3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with
       the timing belt <2>.
    4) Check the belt tension as shown in "Fig.5-8 : Belt tension" . Lightly press the center of the belt <A>, and
       confirm that the value of belt slack is in following.
   RH-3SDHR3515 : Force to press the belt: apprpx.3N・m, Flexure: approx.1.2mm

■ Adjusting the J3 axis timing belt
    1) Carry out steps "1)" and "2)" indicated in " ■ Inspecting the J3 axis timing belt" above.
    2) Lightly loosen the two idler installation bolts <1>. (Do not loosen too much.)
    3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and
       adjust the tension of timing belt <2>. When the screw is turned to the right, the belt will be stretched, and
       when turned to the left, will loosen.
       Lightly press the center of the belt <A>, and confirm that the value of belt slack is in following.
       RH-3SDHR3515 : Force to press the belt: apprpx.3N・m, Flexure: approx.1.2mm
       If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and
       <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate
    4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension
       adjustment screw <3>. Moreover, also fasten idler fixing screw <1> certainly. (two pc.) Improper tightening can
       cause the belt to loosen with vibration.

（5）Inspection and maintenance of J4 axis timing belt

The reference figure at inspection and adjustment of the timing belt is shown in Fig. 5-7.

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

Motor side（Inside figure of No.2 arm）
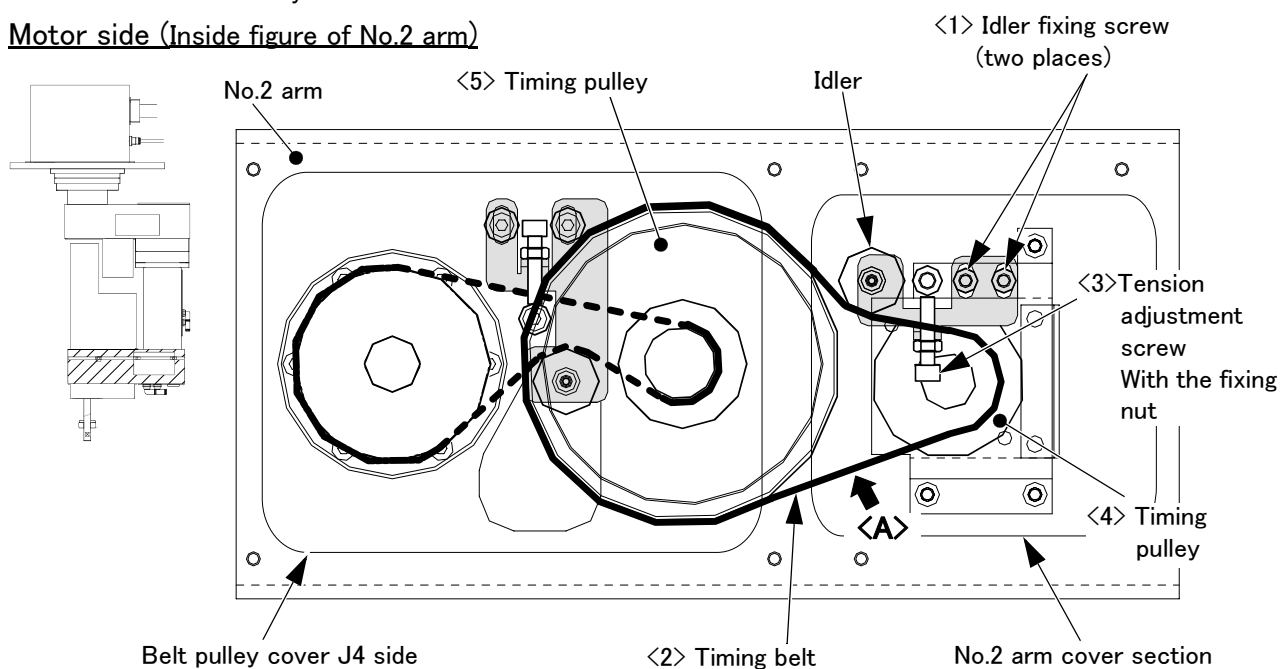
Note）The figure shows the timing belt structure section (motor side) inside the No.2 arm.
Remove and confirm the No.2 arm cover and the belt pulley cover J4.
The belt can be pushed and adjusted by removing the No.2 arm cover.

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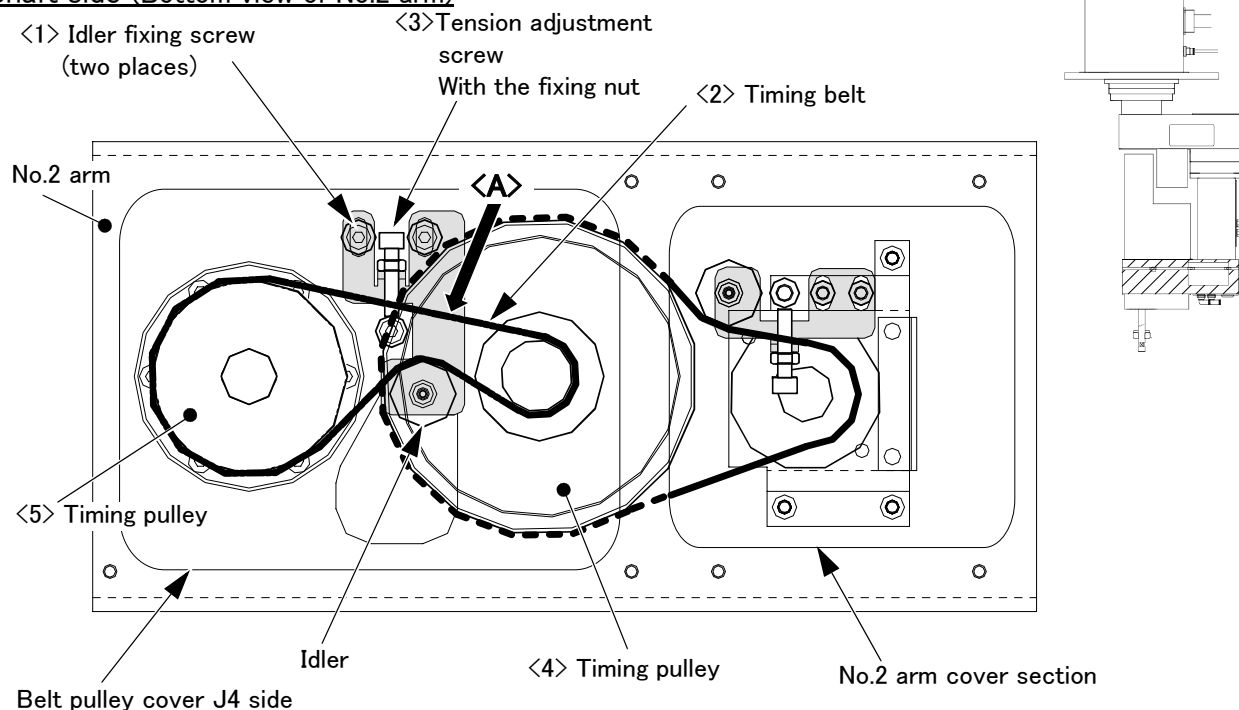
Note）The figure shows the timing belt structure section (shaft side) inside the No.2 arm.
Remove and confirm the No.2 arm cover and the belt pulley cover J4.

Fig.5-7 : Inspection, maintenance and cleaning of J4 axis timing belt

■ Inspecting the J4 axis timing belt
    1) Confirm that the robot controller power is OFF.
    2) Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover and the belt pulley cover J4.
    3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt <2>.
    4) Check the belt tension as shown in "Fig.5-8 : Belt tension" . Lightly press the center of the belt <A>, and confirm that the value of belt slack is in following.
    RH-3SDHR3515
        Motor side: Force to press the belt: apprpx.2N・m, Flexure: approx.1.1mm
        Shaft side: Force to press the belt: apprpx.4N・m, Flexure: approx.1.3mm

■ Adjusting the J4 axis timing belt
    1) Carry out steps "1)" and "2)" indicated in "■ Inspecting the J4 axis timing belt" above.
    2) Lightly loosen the two idler installation bolts <1>. (Do not loosen too much.)
    3) The nut which is fixing tension adjustment screw <3> is loosened, turn tension adjustment screw <3>, and adjust the tension of timing belt <2>. When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
    Lightly press the center of the belt <A>, and confirm that the value of belt slack is in following.
    RH-3SDHR3515
        Motor side: Force to press the belt: apprpx.2N・m, Flexure: approx.1.1mm
        Shaft side: Force to press the belt: apprpx.4N・m, Flexure: approx.1.3mm
    If the belt is loosened too much when adjusting the tension causing it to come off the timing pulleys <4> and <5>, or if the belt and pulley teeth engagement is deviated, the machine system's origin will deviate
    4) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten idler fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.
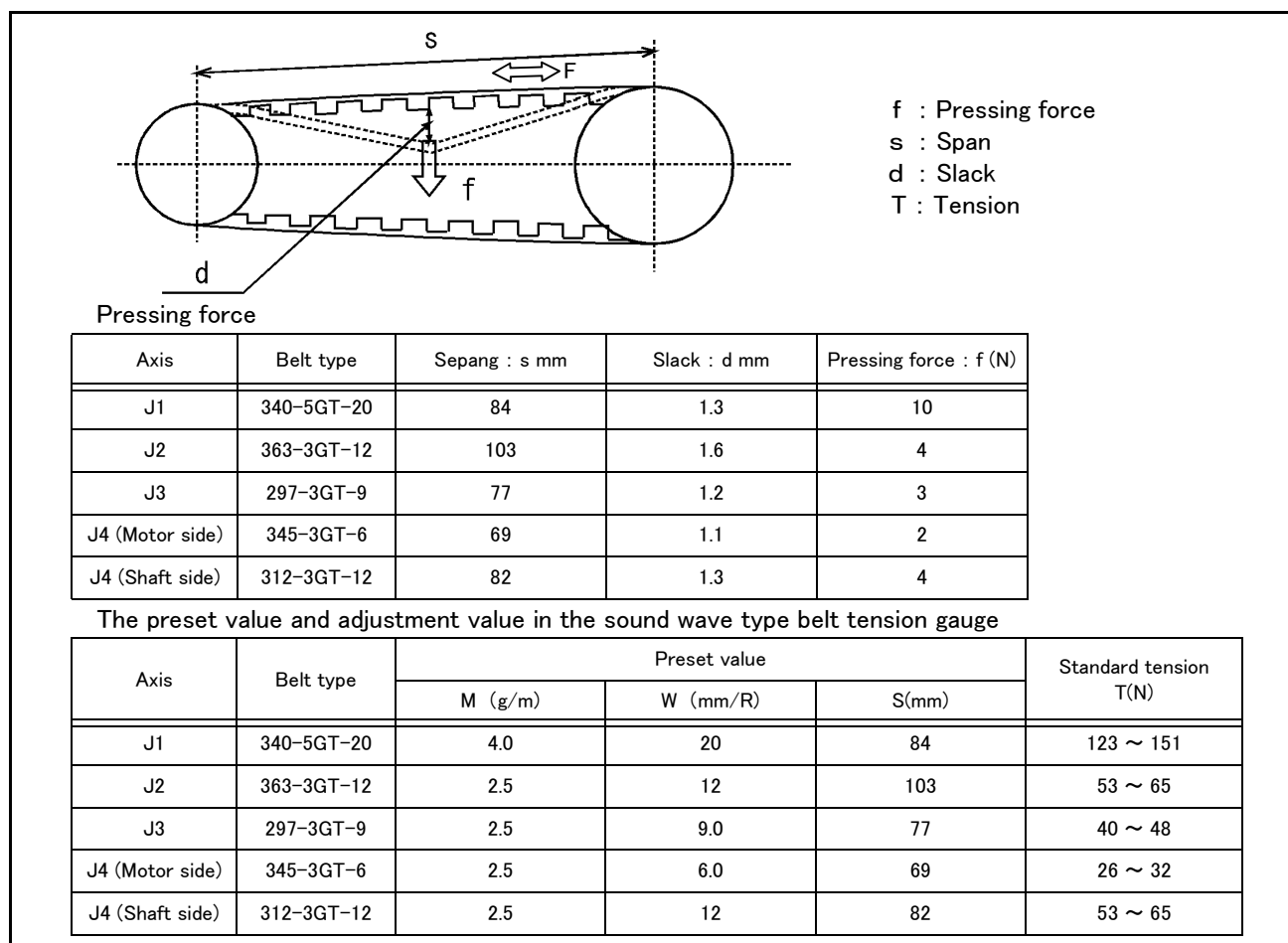
(6) Timing belt tension

f : Pressing force
s : Span
d : Slack
T : Tension

Pressing force

Axis	Belt type	Sepang : s mm	Slack : d mm	Pressing force : f (N)
J1	340–5GT–20	84	1.3	10
J2	363–3GT–12	103	1.6	4
J3	297–3GT–9	77	1.2	3
J4 (Motor side)	345–3GT–6	69	1.1	2
J4 (Shaft side)	312–3GT–12	82	1.3	4

The preset value and adjustment value in the sound wave type belt tension gauge

Axis	Belt type	Preset value			Standard tension T(N)
		M (g/m)	W (mm/R)	S(mm)	
J1	340–5GT–20	4.0	20	84	123 ～ 151
J2	363–3GT–12	2.5	12	103	53 ～ 65
J3	297–3GT–9	2.5	9.0	77	40 ～ 48
J4 (Motor side)	345–3GT–6	2.5	6.0	69	26 ～ 32
J4 (Shaft side)	312–3GT–12	2.5	12	82	53 ～ 65

Fig.5–8 : Belt tension

The timing belt can satisfactorily convey the drive and keep a durable force only when it has an adequate tension. The belt tension should not be too tight or too lose. Instead, it should be adjusted to a degree that elasticity is felt when the belt is pressed with the thumb. If the belt tension is too weak, the belt loosening side will vibrate. On the other hand, if the belt tension is too strong, a sharp sound will be heard and the belt tension side will vibrate. The detailed adjustment (tension) is shown in Fig. 5–8.
Check and adjust with the belt pressing force f and the slack amount d between span s.

5.3.4 Lubrication
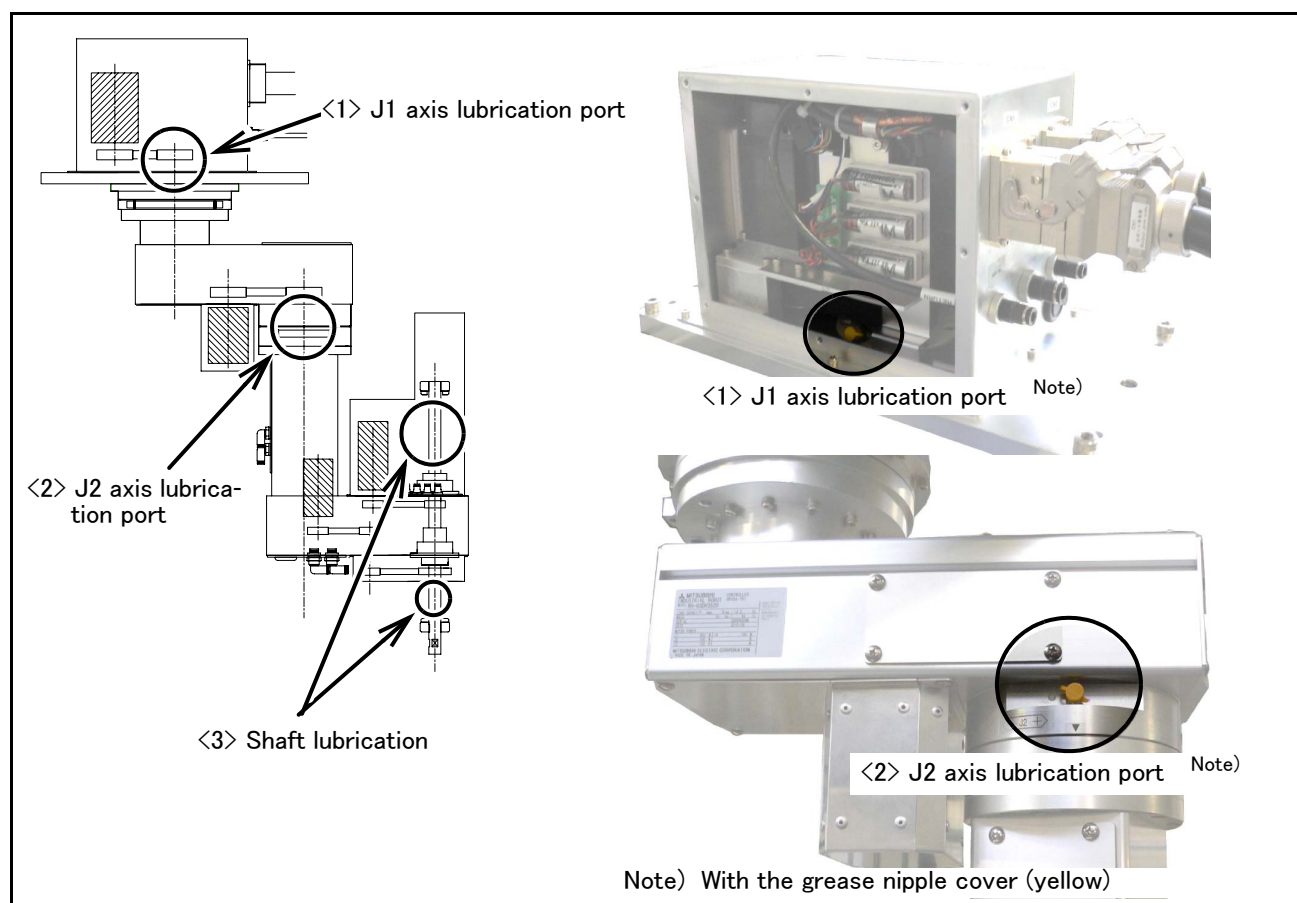（1）Lubrication position and specifications

Note） With the grease nipple cover (yellow)

Fig.5−9 : Lubrication positions

Table 5−4 : Lubrication specifications

No.	Parts to be lubricated	Oiling method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
＜1＞	J1 axis reduction gears	Grease nipple WC−610(Only addition)	Grease Harmonic grease SK−1A （Japan Harmonic Systems）	6,000 Hr	4.1 g	Base cover B （L）
＜2＞	J2 axis reduction gears			6,000 Hr	1.8 g	−
＜3＞	Shaft	Wipe the old grease, and paint	Marutenpu PS No.2 （KYODO YUSHI CO.,LTD. ）	Every 2000km movement	1 g	Motor cover J3

The grease nipple position is shown in Fig. 5−9. The lubrication specifications for each place are shown in Table 5−4. When lubricating, remove the covers that need to be taken off by refer to "Fig.5−3 : Installing/removing the cover".

［Caution］
・ The name of each grease of Table 5−4 is the enclosed at shipping.
・The lubrication time is a cumulative value of the operation at the maximum speed. If the operation has been suspended, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
・ Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
・ With the maintenance forecast function of the personal computer support software（option）, the guidance of lubrication time is calculated according to the operating environment of the customer.
・ The numbers in the Table 5−4 correspond to the supply positions in Fig. 5−9.
・ Avoid excessive lubrication since it may lead to grease leak. Also, the number of lubrications is limited to 3 times. The maintenance exceeding 3 times needs the overhaul operations which replace internal grease. Please consult dealer.

(2) Lubrication method

1) The positions of lubrication ports are shown in the Fig. 5-9. Move the robot to the posture in which it can supply the grease easy.
2) Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the covers necessary.
3) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple.
4) Install the covers with the removal procedure in reverse.

⚠ **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.

(3) Lubrication method to the J1, J2 axis

1) Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the covers necessary.
2) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple. Add only the specified amount of grease. Adding excess grease may cause grease to leak.
3) The J1 axis has the grease nipple and the timing belt in the near position. Although the timing belt is using the oil-resistant belt, if the grease adheres, please wipe it off.
4) Install the covers with the removal procedure in reverse.

(4) Lubrication method to the shaft

1) Refer to Page 66, "5.3.2 Installing/removing the cover"," 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.

5.3.5 Replacing the backup battery

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

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state.

Error No. 7520 :Battery consumption time is over
Error No. 133n :Encoder battery voltage low. (n indicates the axis number.)
        (The encoder battery voltage of the robot arm is low.)
Error No. 7510 :Battery voltage low (R/C)
        (The battery voltage of the controller is low.)
Error No. 7500 :No battery voltage
        (The battery of the controller is depleted.)

⚠ **CAUTION**

If error No. 7500 occurs, the program data and other data in the controller is lost and it becomes necessary to load the data again.

If any of the battery-related errors above occur and the robot continues to be used, the data integrity of the memory cannot be guaranteed. If an error occurs, replace the batteries of both the robot arm and controller promptly.

It is also recommended to save programs and position data on the personal computer side via the personal computer support software and so forth in advance.

（1）Replacing the robot arm battery

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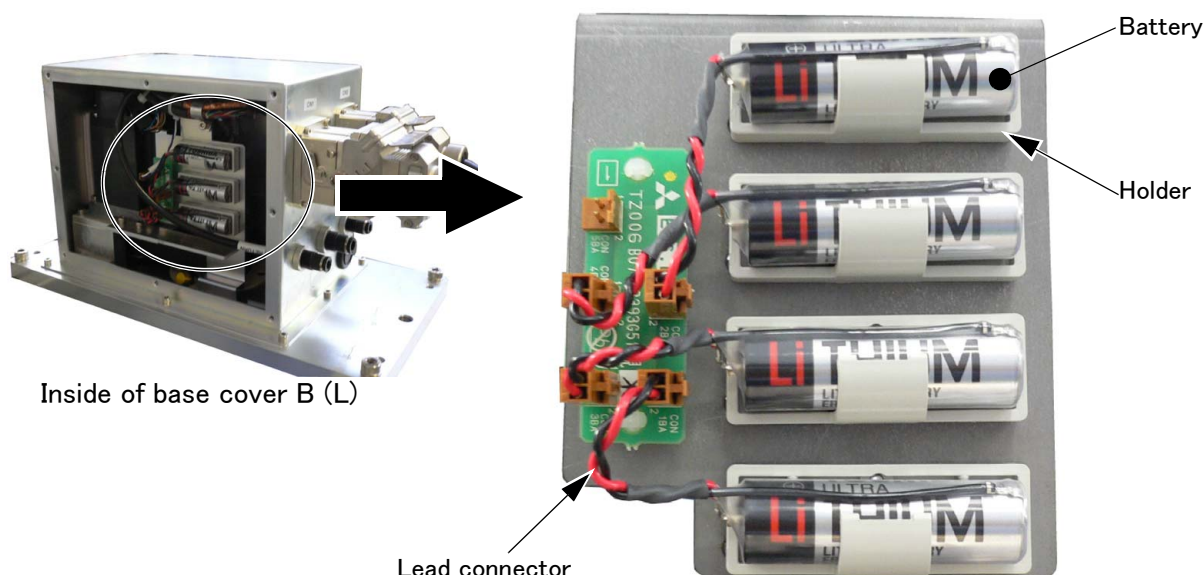

Inside of base cover B（L）

Battery

Holder

Lead connector

Fig.5-10 : Replacing the battery

1) Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the covers necessary.
2) Replacement of the battery should be performed one by one. Extract the old battery from holder and remove the lead connector.
3) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
4) Install the base cover B(L) as before. Be careful not to catch any the cables.
5) Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

[Note]
If it is replaced by exhausting the battery, Refer to Page 81, "5.6 Resetting the origin" and reset the origin using the jig method or mechanical stopper method or ABS origin method.

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. Overhaul interval for robots presumably varies with their operating conditions and thus with the degree of the equipment's wear and loss of performance. As a rule of thumb, however, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the predetermined levels (24,000 hours for the robot body and 36,000 hours for the controller). (See Fig. 5-11.) For specific information about parts to be replaced and timing of overhaul, contact your local service representative.
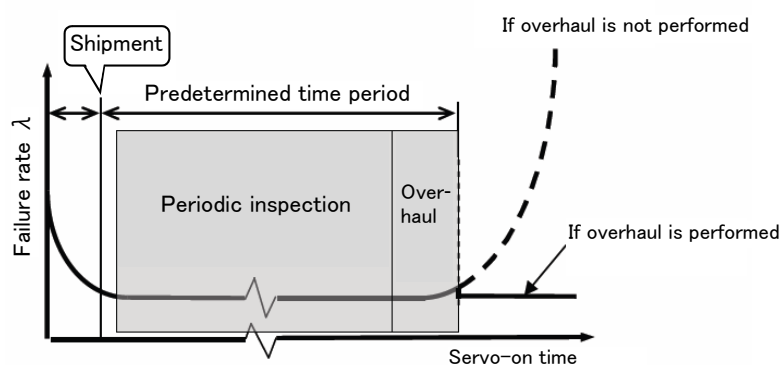

Fig.5-11 : Periodic inspection/overhaul periods

5.5 Maintenance parts

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

Table 5-5 : Consumable part list

No.	Part name	Type Note1)	Usage place	Q'ty	Supplier
1	Timing belt		J1 axis	1	
			J2 axis	1	
			J3 axis	1	
			J4 axis motor side	1	Mitsubishi Electric
			J4 axis shaft side	1	
2	Grease		Reduction gears of each axis	An needed	
3	Lithium battery		In base cover B(L)	4	

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

Table 5-6 : Spare parts list

No.	Names	Usage place	Q'ty	Supplier
1	AC servo motor	J1 axis	1	
2		J2 axis	1	
3		J3 axis	1	
4		J4 axis	1	Mitsubishi Electric
5	Reduction gears	J1 axis	1	
6		J2 axis	1	
7	Ball screw spline	J3 axis (General environment)	1	

5.6 Resetting the origin

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

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

.

Table 5-7 : Origin setting method

No	Method	Explanation	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B.	The setting method is explained in Page 18, "2.4 Setting the origin" .
2	Mechanical stopper method	This origin posture is set by contacting each axis against the mechanical stopper.	The setting method is explained in Page 82, "5.6.1 Mechanical stopper method" .
3	Jig method	The origin posture is set with the calibration jig installed.	The setting method is explained in Page 90, "5.6.2 Jig method" .
4	User origin method	A randomly designated position is set as the origin posture.	The setting method is explained in Page 98, "5.6.4 User origin method".
5	ABS origin method	This method is used when the encoder backup data lost in the cause such as battery cutting.	Before using this method, the origin must be set with the other method with same encoder. The setting method is explained in Page 96, "5.6.3 ABS origin method".

5.6.1 Mechanical stopper method

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

This operation is carried out with the T/B. Set the [MODE] switch on the front of the controller to "MANUAL", and set the T/B [ENABLE] switch to "ENABLE" to validate the T/B.

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

(1) J1 axis origin setting(mechanical stopper)

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

            123        CLOSE
```

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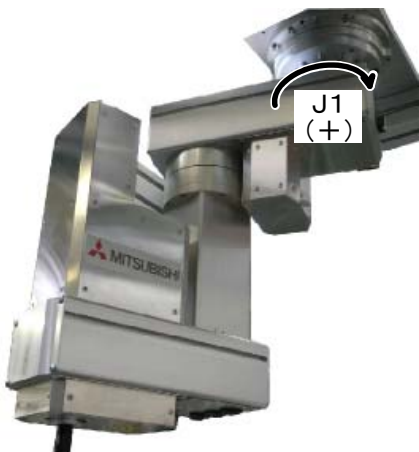
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

2) With both hands, slowly move the J1 axis in + (plus) direction , and contact the axis against the mechanical stopper.

```
<ORIGIN/BRAKE>
1. ORIGIN        2. BRAKE



            123        CLOSE
```

```
1  '()
```

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

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

            123        CLOSE
```

```
−Z (J3)
2  ABC
```

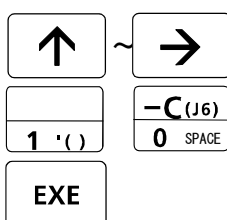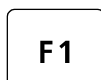4) Press the [2] key, and display the Mechanical stopper selection screen.

```
<ORIGIN> MECH

J1 ( 1 )    J2 (     )    J3 (     )
J4 (     )   J5 (     )    J6 (     )
J7 (     )   J8 (     )
                   123              CLOSE
```

↑ ~ →

1 '()   -C (J6)
         0 SPACE

EXE

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

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

```
<ORIGIN>  MECH

   CHANGE TO ORIGIN.  OK?

 Yes           123              No
```

F 1

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

```
<ORIGIN> MECH              COMPLETED

J1 ( 1 )    J2 (     )    J3 (     )
J4 (     )   J5 (     )    J6 (     )
J7 (     )   J8 (     )
                   123              CLOSE
```

8) Setting of the origin is completed.

9) Refer to Page 100, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.
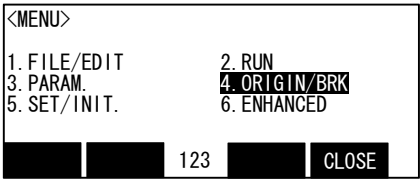
◇◆◇ Release the brake ◇◆◇
　Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant 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".
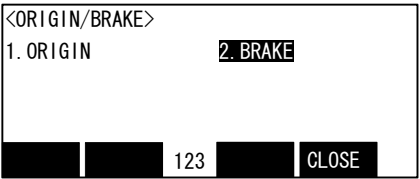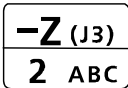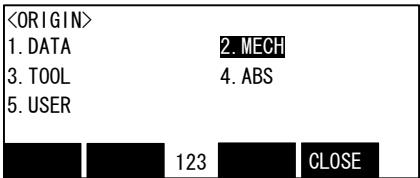
(2) J2 axis origin setting(mechanical stopper)

<MENU>

1. FILE/EDIT   2. RUN
3. PARAM.   4. ORIGIN/BRK
5. SET/INIT.   6. ENHANCED

123   CLOSE

4 GHI

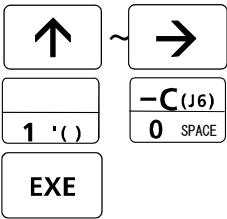1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

J2
(+)

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

<ORIGIN/BRAKE>

1. ORIGIN   2. BRAKE

123   CLOSE

1 '()

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

<ORIGIN>

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

123   CLOSE

−Z (J3)
2 ABC

4) Press the [2] key, and display the Mechanical stopper selection screen.

<ORIGIN> MECH

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

123   CLOSE

↑ ~ →

1 '()

−C (J6)
0 SPACE

EXE

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

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

```
<ORIGIN>  MECH


   CHANGE TO ORIGIN. OK?



 Yes            123           No
```

F1

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

```
<ORIGIN> MECH              COMPLETED

 J1(      )   J2( 1 )   J3(      )
 J4(      )   J5(      )   J6(      )
 J7(      )   J8(      )
                123           CLOSE
```

8) Setting of the origin is completed.

9) Refer to Page 100, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

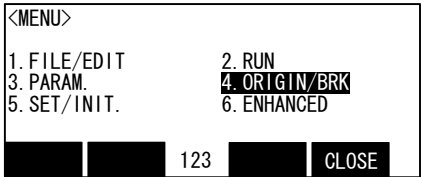◇◆◇ Release the brake ◇◆◇

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.
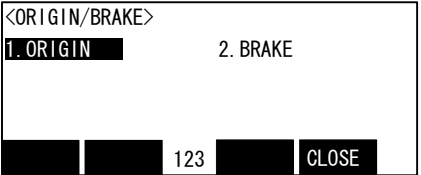
◇◆◇ Select the axis of origin setting ◇◆◇

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".
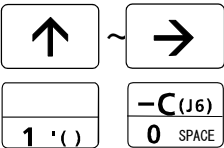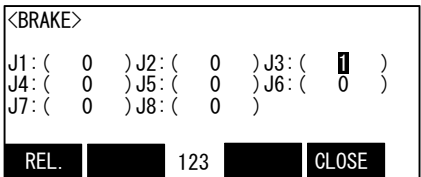
**(3) J3 and J4 axis origin setting (mechanical stopper)**

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

              123          CLOSE
```

```
4  GHI
```

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

```
<ORIGIN/BRAKE>
1.ORIGIN          2.BRAKE



              123          CLOSE
```

```
−Z (J3)
2  ABC
```

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

```
<BRAKE>
J1:(   0   )J2:(   0   )J3:(   1   )
J4:(   0   )J5:(   0   )J6:(   0   )
J7:(   0   )J8:(   0   )

REL.          123          CLOSE
```

```
↑  ~  →
```

```
1 '()      −C (J6)
           0  SPACE
```
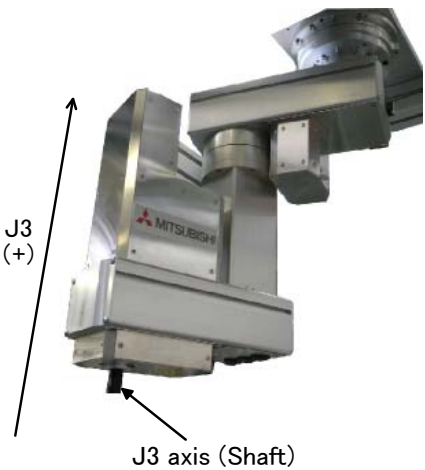
3) Release the brake of the J3 axis.
   Input "1" into the J3 axis. Set "0" to other axes.
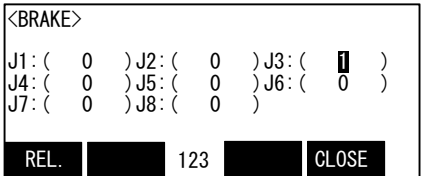
4) Confirm the axis for which the brakes are to be released.

```
<BRAKE>
J1:(   0   )J2:(   0   )J3:(   1   )
J4:(   0   )J5:(   0   )J6:(   0   )
J7:(   0   )J8:(   0   )

REL.          123          CLOSE
```

```
F1
```

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

J3 (+)

J3 axis (Shaft)

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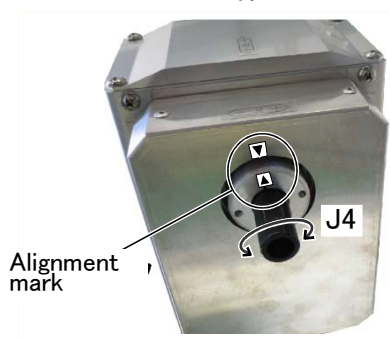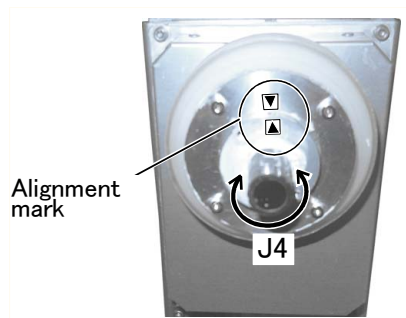   Match the alignment mark of J4 axis in this condition next.

   Go to the following procedure continuously.

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

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

General environment type

Alignment mark

J4

Clean/Waterproof type

Alignment mark

J4

```
<BRAKE>

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

 REL.          123          CLOSE
```

F4

7) 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.

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

```
<ORIGIN/BRAKE>
1.ORIGIN          2. BRAKE



           123        CLOSE
```

```
┌─────┐
│ 1 '()│
└─────┘
```

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

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

           123        CLOSE
```

```
┌──────────┐
│ −Z (J3)  │
│ 2  ABC   │
└──────────┘
```

10) Press the [2] key , and display the Mechanical stopper selection screen.

```
<ORIGIN> MECH

J1(    )   J2(    )   J3( 1 )
J4( 1 )   J5(    )   J6(    )
J7(    )   J8(    )
           123        CLOSE
```

```
┌─────┐      ┌─────┐
│  ↑  │  ~   │  →  │
└─────┘      └─────┘
┌─────┐      ┌──────────┐
│ 1 '()│      │ −C (J6)  │
└─────┘      │ 0  SPACE │
┌─────┐      └──────────┘
│ EXE │
└─────┘
```

11) Input ″1″ into the J3 and J4 axis. Set ″0″ to other axes.

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

```
<ORIGIN>  MECH

   CHANGE TO ORIGIN. OK?


Yes        123         No
```

```
┌─────┐
│ F 1 │
└─────┘
```

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

14) Setting of the origin is completed.

```
<ORIGIN> MECH           COMPLETED

J1(    )   J2(    )   J3( 1 )
J4( 1 )   J5(    )   J6(    )
J7(    )   J8(    )
           123        CLOSE
```

15) Refer to Page 100, ″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″.

(4) All axis origin setting

1) Refer to the paragraphs from Page 82, ″(1) J1 axis origin setting(mechanical stopper)″ to Page 86, ″(3) J3 and J4 axis origin setting (mechanical stopper)″ above for the description of how to adjust the origins of the J1 to J4 axes. Line up the ABS marks for the J4 axis and move the other axes into contact with the mechanical stoppers. At this point, the robot will have the posture shown below

<ORIGIN/BRAKE>
1.ORIGIN   2.BRAKE

                  123   CLOSE

1 '( )

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

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

                  123   CLOSE

+Z (J3)
3 DEF

3) Press the [2] key, and display the Mechanical stopper selection screen.

<ORIGIN> MECH

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

                  123   CLOSE

↑   →

1 '( )   **−C (J6)**
                0 SPACE

EXE

4) Input ″1″ into the J1 to J4 axis. Set ″0″ to other axes.

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

<ORIGIN> MECH

  CHANGE TO ORIGIN. OK?

Yes   123   No

F 1

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

<ORIGIN> MECH   COMPLETED

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

                  123   CLOSE

7) Setting of the origin is completed.

8) Refer to Page 100, ″5.6.5 Recording the origin data″ in this manual, and record the origin data on the origin data seal.

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. 5-12.
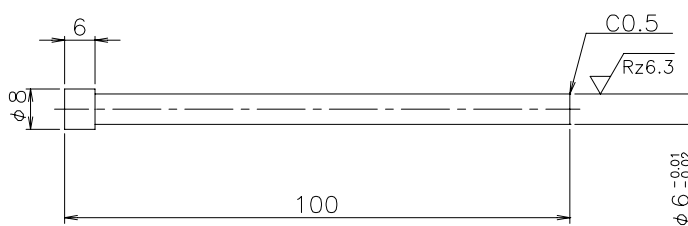

Fig.5-12 : Reference dimension of origin setting tool

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

Carry out this method for each axis.
First, set each axis by the origin position. There are the method of releasing the brake and adjusting with the origin position manually and the method of adjusting with the origin position by jog feed. Here, explain operation by brake release.
Then, do origin setting operation and set up the origin.

⚠ **CAUTION**   To ensure safety, the brake-release procedure described below should always be done by two persons.

This operation is carried out with the teaching pendant. Set the [MODE] switch on the front 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

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

              123         CLOSE
Select ORIGIN/BRK
```
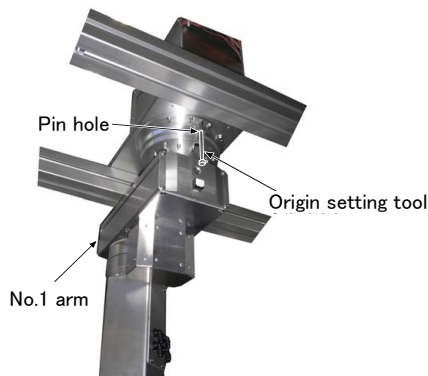**4 GHI**

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

Pin hole

Origin setting tool

No.1 arm

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.
The origin setting tool should be inserted 35mm.

```
<ORIGIN/BRAKE>
1. ORIGIN          2. BRAKE

              123         CLOSE
```

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

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

              123         CLOSE
Select TOOL
```
+Z (J3)
3 DEF

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

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

↑ ~ →

1 '( )   **−C (J6)**
           0 SPACE

EXE

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

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

```
<ORIGIN>  TOOL

   CHANGE TO ORIGIN. OK?

Yes          123         No
```
F1

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

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

8) Setting of the origin is completed.

9) Refer to Page 100, ″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.
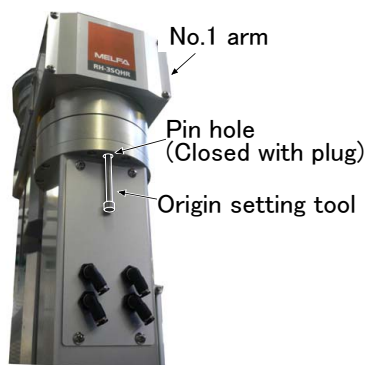
◇◆◇ Select the axis of origin setting ◇◆◇

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".

(2) J2 axis origin setting

```
<MENU>

1.FILE/EDIT      2.RUN
3.PARAM.         4.ORIGIN/BRK
5.SET/INIT.      6.ENHANCED

              123            CLOSE
```

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

No.1 arm

Pin hole
(Closed with plug)

Origin setting tool

2) Slowly rotate the J2 axis 0 degree with both hands. Remove the plug installed in the pin hole by hexagon wrench. Align the pinholes of the No. 1 and No. 2 arms, feed through the origin jig into the pinholes and fasten.
   The origin setting tool should be inserted 65mm.
   Note) If the stick cannot insert 65mm move the J2 axis to mechanical stopper once.

```
<ORIGIN/BRAKE>

1.ORIGIN         2.BRAKE



              123            CLOSE
```

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

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

```
<TOOL>

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

REL.          123            CLOSE
```

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

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

```
<ORIGIN> TOOL

   CHANGE TO ORIGIN. OK?


Yes           123            No
```

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

```
<TOOL>

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

REL.          123            CLOSE
```

8) Setting of the origin is completed.

9) Refer to Page 100, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

   *After origin setting should always install the plug in pin hole as before. Roll the seal tape onto the plug and install.

◇◆◇ 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".

(3) J3 and J4 axis origin setting

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

The method of origin setting is the same as the mechanical stopper method. Refer to Page 86, "(3) J3 and J4 axis origin setting (mechanical stopper)", perform the required origin setting operations.

(4) All axis origin setting

    1) Refer to the paragraphs from Page 91, ″(1) J1 axis origin setting″ to Page 94, ″(3) J3 and J4 axis origin setting″ above for the description of how to adjust the origins of the J1 to J4 axes. At this point, the robot will have the posture shown below.


```
<ORIGIN/BRAKE>
1.ORIGIN          2. BRAKE



             123        CLOSE
```

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

```
1 '( )
```

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

3) Press the [3] key, and display the Mechanical stopper selection screen.

```
+Z (J3)
3 DEF
```

```
<ORIGIN> TOOL

  J1( 1 )   J2( 1 )   J3( 1 )
  J4( 1 )   J5(  )   J6(  )
  J7(  )   J8(  )
             123        CLOSE
```

4) Input ″1″ into the J1 to J4 axis. Set ″0″ to other axes.

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

```
<ORIGIN>  TOOL

  CHANGE TO ORIGIN.  OK?

Yes          123          No
```

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

```
F1
```

```
<ORIGIN> TOOL

  J1( 1 )   J2( 1 )   J3( 1 )
  J4( 1 )   J5(  )   J6(  )
  J7(  )   J8(  )
             123        CLOSE
```

7) Setting of the origin is completed.

8) Refer to Page 100, ″5.6.5 Recording the origin data″ in this manual, and record the origin data on the origin data seal.

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] switch on the front 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.
When setting the ABS mark, always view the operations from the mark, and set at the end of the triangular mark. The positions where the ABS mark is attached are shown in below. Refer to Page 24, "2.5 Confirming the operation" for details on the jog operation.

Note that if the ABS marks are peeled off, the positions can be matched using the following alternative methods. *Match the ruling lines of the ABS mark mounting position surfaces.
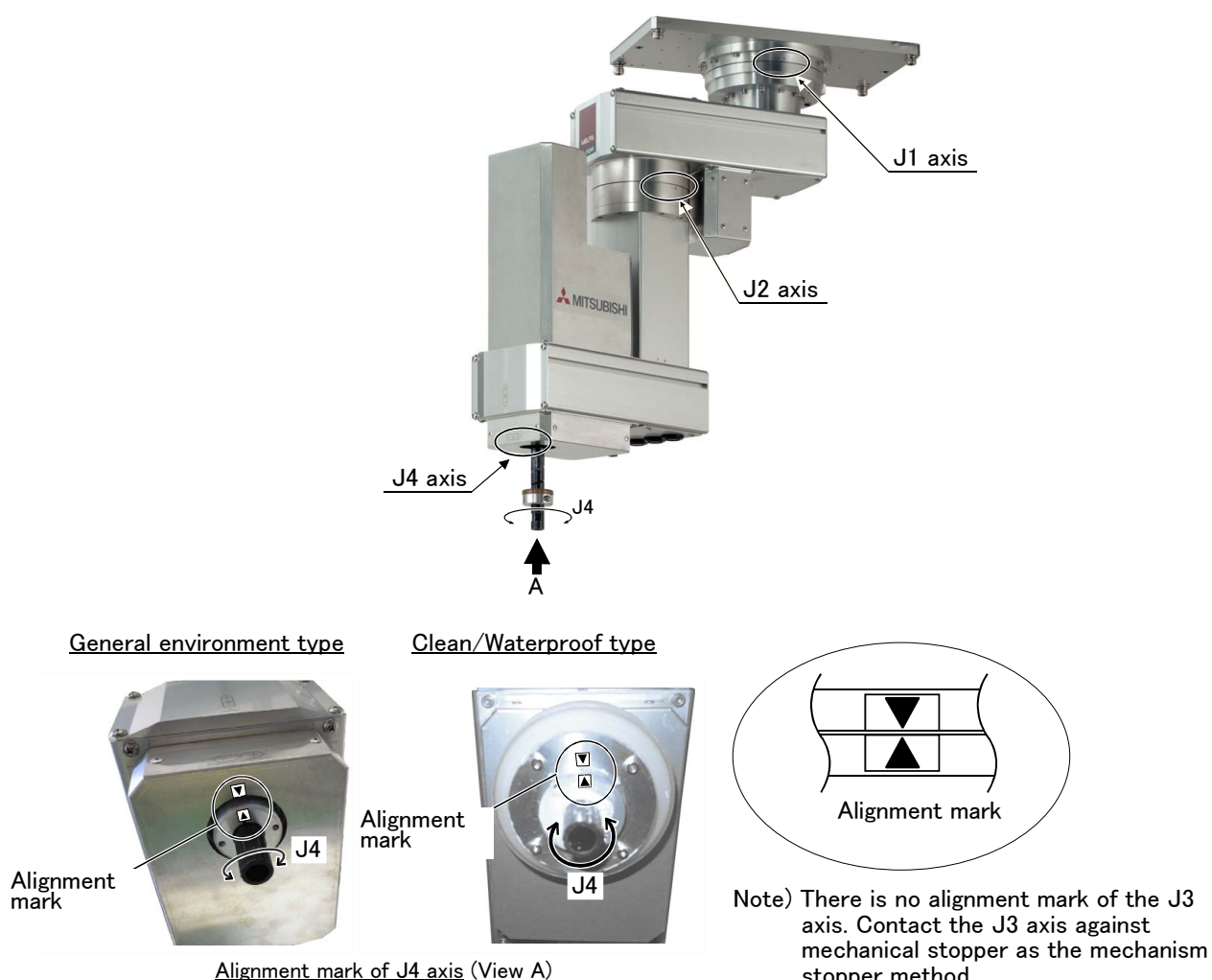

General environment type   Clean/Waterproof type

Alignment mark of J4 axis (View A)

Note) There is no alignment mark of the J3 axis. Contact the J3 axis against mechanical stopper as the mechanism stopper method.

Fig.5-13 : ABS mark attachment positions

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

（1）Select the T/B

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

           123        CLOSE
```

```
4  GHI
```

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

```
<ORIGIN/BRAKE>
1. ORIGIN          2. BRAKE



           123        CLOSE
```

```
1  '()
```

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

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

           123        CLOSE
```

```
4  GHI
```

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

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

```
↑  ~  →
1 '()  →  EXE
```

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

```
<ORIGIN>  ABS

   CHANGE TO ORIGIN. OK?


Yes        123         No
```

```
F1
```

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

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

This completes the setting of the origin with the ABS 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 81, "Table 5-7 : Origin setting method".

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

When setting the origin for the first time using this method, carry out the operations in order from step 1). For the second and following time, move the robot arm to the user origin position with jog operation, and accurately position all 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 24, "2.5 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 (USRORG)".
   The parameter details and input methods are described in the separate "Instruction Manual/Detailed Explanation of Functions and Operations". Refer to that manual and input the user designated origin position.

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

            123        CLOSE
```

[4 GHI]

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

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

```
<ORIGIN/BRAKE>
1.ORIGIN         2.BRAKE

            123        CLOSE
```

[1 '()]

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

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

            123        CLOSE
```

[-A (J4)]
[5 JKL]

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

```
<USER>
J1:(   1   )J2:(   0   )J3:(   0   )
J4:(   0   )J5:(   0   )J6:(   0   )
J7:(   0   )J8:(   0   )

REL.            123          CLOSE
```

↑ ~ →

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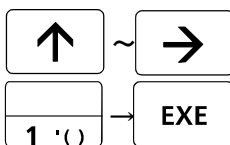
8) Input ″1″ into the axis to origin setting. Press the [EXE] key, and display Confirmation screen.

```
<ORIGIN>  USER

   CHANGE  TO  ORIGIN.  OK?

Yes             123           No
```

F1

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

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

5.6.5 Recording the origin data

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

Confirm the origin data on the teaching pendant screen (origin data input screen). The origin data label is enclosed with the arm or attached on the back of the .
The teaching pendant operation method and removal method for confirming the origin data is the same as the methods for setting the origin with the origin data input method. Refer to Page 19, "2.4.2 Setting the origin with the origin data input method", and write the origin data displayed on the teaching pendant onto the origin label.

（1）Confirming the origin data label
Remove the .
Refer to Page 66, "5.3.2 Installing/removing the cover", and remove the .

（2）Confirming the origin data
Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to Page 19, "2.4.2 Setting the origin with the origin data input method", "(5)Inputting the origin data" and display the Origin Data Input screen on the teaching pendant display screen.

（3）Recording the origin data
Write the origin data displayed on the teaching pendant to the origin data label attached to the back of the .
Refer to Page 19, "Fig.2-10 : Origin data label (an example)", and Page 22, "Fig.2-11 : Correspondence of origin data label and axis" for details on the origin data label.

（4）Installing the cover
Install the removed in step "(1)Confirming the origin data label" above.
Refer to Page 66, "5.3.2 Installing/removing the cover", and replace the .

This completes the recording of the origin data.

6 Appendix

Appendix 1 : Configuration flag

The configuration flag indicates the robot posture.
For the 6-axis type robot, the robot hand end is saved with the position data configured of X, Y, Z, A, B and C. However, even with the same position data, there are several postures that the robot can change to. The posture is expressed by this configuration flag, and the posture is saved with FL1 in the position constant (X, Y, Z, A, B, C) (FL1, FL2).
The types of configuration flags are shown below.

(1) RIGHT/LEFT
Indicates the location of the end axis relative to the line that passes through both the rotational center of the J1 axis and the rotational center of the J2 axis.
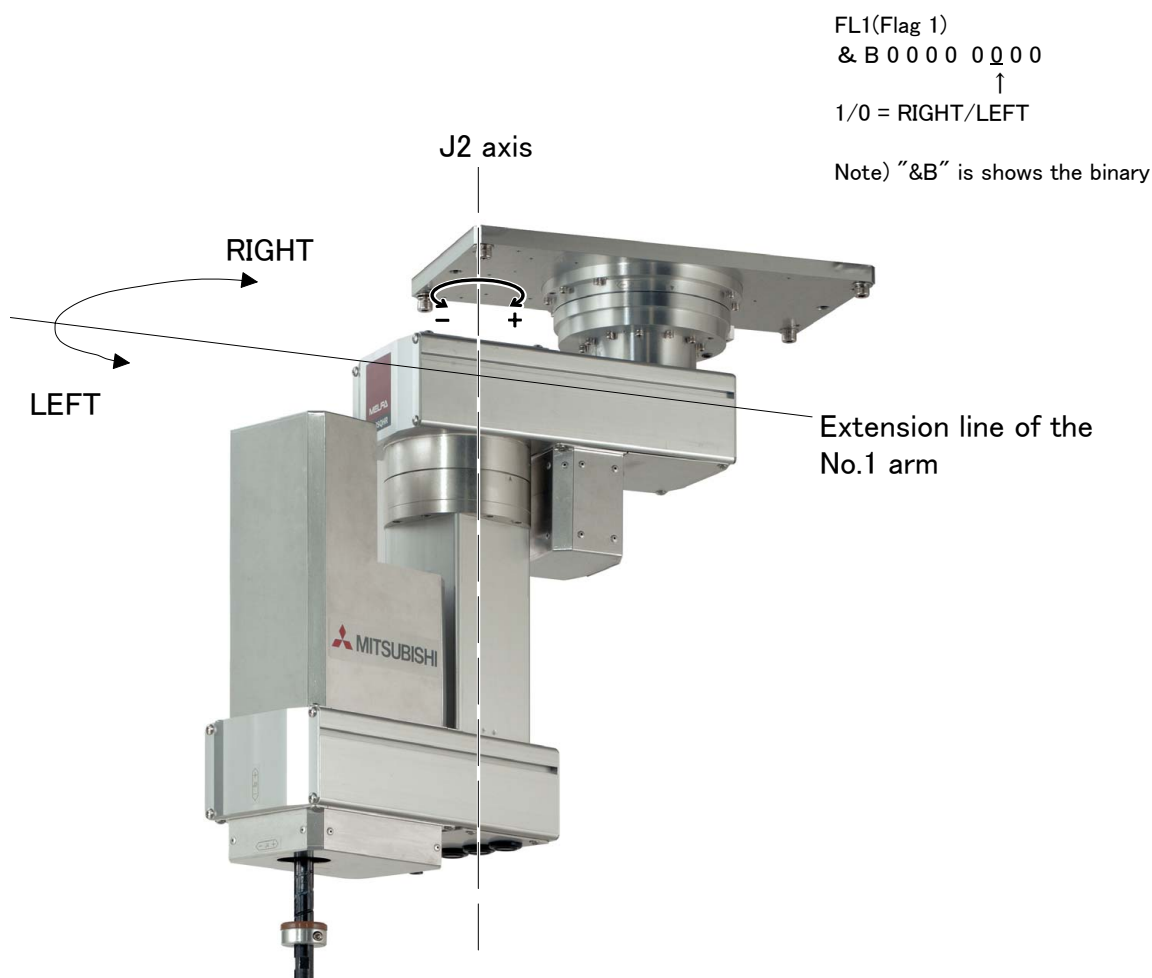

FL1(Flag 1)
＆B 0 0 0 0　0 0 0 0
　　　　　　　　　　↑
1/0 = RIGHT/LEFT

Note) "&B" is shows the binary

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

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