MITSUBISHI ELECTRIC

Mitsubishi Industrial Robot

RV-4F/7F/13F/20F/35F/50F/70F Series INSTRUCTION MANUAL

ROBOT ARM SETUP & MAINTENANCE

MELFA

BFP-A8935-AB

⚠ Safety Precautions

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ DANGER

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

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

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

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ CAUTION

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

⚠ DANGER

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

⚠ DANGER

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

⚠ DANGER

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

⚠ CAUTION

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

⚠ CAUTION

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

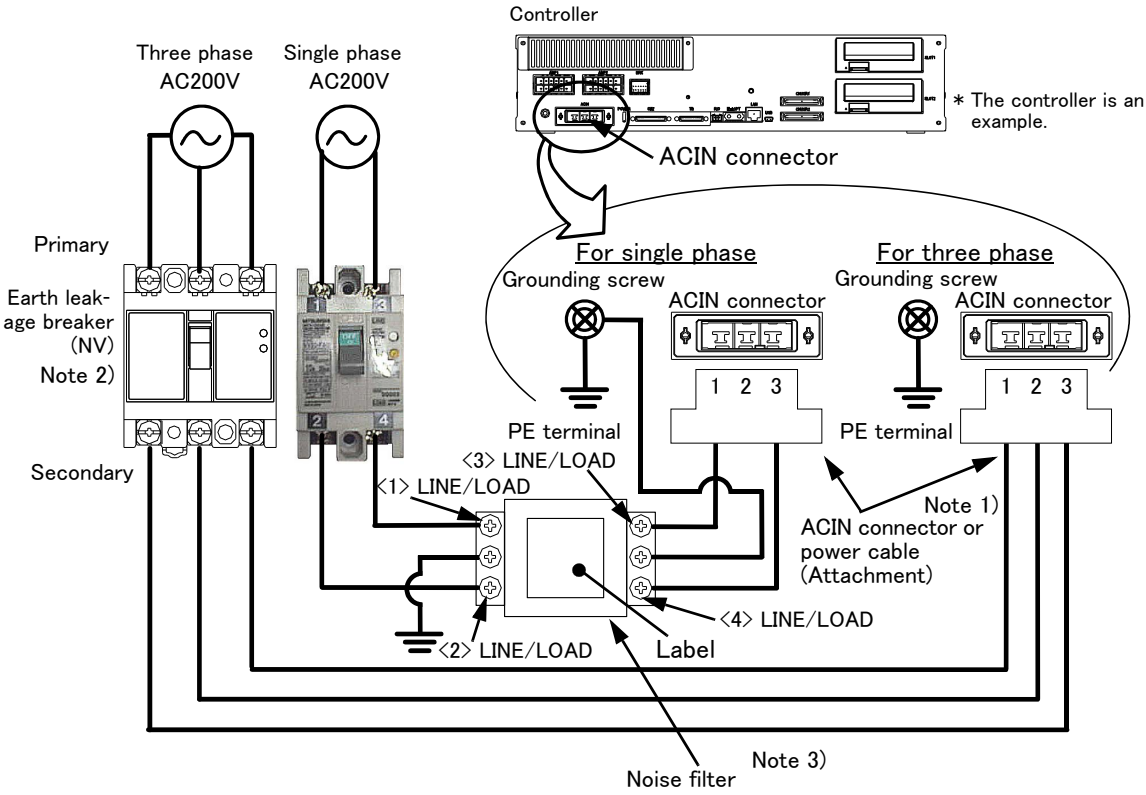
⚠ CAUTION

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

*CR751-D or CR751-Q controller

Notes of the basic component are shown.

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



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

Note 2) The earth leakage breaker is the customer preparation. Always use the cover below.
Recommendation: For single primary power supply ..... NV30FAU-2P-10A-AC100-240V-30mA, (Cover: TCS-05FA2)
For three primary power supply ..... NV30FAU-3P-10A-AC100-240V-30mA, (Cover: TCS-05FA3)

Note 3) If necessary, as shown in the figure, connects the noise filter between ACIN terminal blocks and primary power supply.
(Recommended noise filter: SUP-EL20-ER6 *OKAYA ELECTRIC INDUSTRIES)

1) Please prepare the following: Leakage current breaker (with the terminal cover), cable for connecting the primary power supply (AWG #14 (2mm^2 or above), cables to ground the primary power supply (AWG #12 (3.5mm^2 or above).
The secondary power cable (with the ACIN connector) for single phase or three phase power is supplied with the product to match the specifications. When you build a cable suitable for your environment using the ACIN connector and the ACIN terminal supplied, prepare a secondary power cable (AWG #14 (2mm^2) or above).
2) Confirm that the primary power matches the specifications.
3) Confirm that the primary power is OFF and that the earth leakage breaker power switch is OFF.
4) Connect the secondary power cable.
a) When using the supplied power cable with the ACIN connector
Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.
b) When building a power cable using the ACIN connector and the ACIN terminals supplied
Connect the ACIN terminals with the secondary power cable (prepared by customers), and insert the ACIN terminals to the ACIN connector pins with the following numbers. Crimping caulking is recommended to connect the ACIN terminals.
For single phase: 1 and 3
For three phase: 1, 2, and 3
Refer to the figure above and connect the cable from the secondary side of the earth leakage breaker.
5) Connect this ACIN connector to the ACIN connector on the front of the controller.
6) Connect the grounding cable to the PE terminal. (M4 screw)
7) Connect the primary power cable to the primary side terminal of the earth leakage breaker.

Revision history

Date of Point	Instruction Manual No.	Revision Details
2012-09-27	BFP-A8935	・First print
2012-10-03	BFP-A8935-A	・The notes about installation of the controller and the robot arm were added. (neither direct rays nor the heat of lighting) ・Cross-reference places, in the Inspection, maintenance and replacement of timing belt etc, were corrected. (Error in writing) ・Fixing screws of the Cable clamp box, No.1 arm cover U, CONBOX cover and CONBOX cover R were corrected. (formerly M4x12) ・Seal washers of screws which fixes cable clamp box and CONBOX cover R were corrected to attachment only at protection specification.
2012-11-20	BFP-A8935-B	・The lithium battery type was added to "Table 5-6: Consumable part list". ・The statement about trademark registration was added.
2013-01-09	BFP-A8935-C	・The grease nipple of attachments was corrected. (table of Standard configuration and Lubrication specifications) ・The quantity of screw for suspension fittings was changed. ・J1 axis operating range change (option) was added. ・The precautions to hand input cable installation were added. ・The couplings were added to "Table 2-1: Standard configuration" ・The grounding method to the Base external wiring set was added.
2013-03-21	BFP-A8935-D	・The description of RV-7FLL, RV-13F and RV-20F were added.
2013-04-04	BFP-A8935-E	・The installation method of the optional solenoid valve set (1F-VD0*-03/1F-VD0*E-03) was corrected.
2013-07-18	BFP-A8935-F	・"Table 3-7 : Pin assign of hand input cable" was corrected. ・The values of RV-4F series in "Table 2-2: Strength of the installation side (reference)" were corrected. ・The procedure of installing the optional solenoid valve set for RV-13F series in "3.2 Installing the solenoid valve set" was corrected.
2013-09-17	BFP-A8935-G	・The method to install the solenoid valve set was corrected.
2014-01-07	BFP-A8935-H	・The descriptions of an optional solenoid valve set for RV-4F/7F/7FLL series were added. (Type name of attachment elbow couplings. A note when removing or installing a solenoid valve.) ・The descriptions of RV-4FJL were added. ・The illustration of the dummy connector was corrected. ・The descriptions of default charge amount of lubrication oil was deleted. ・How to choose the origin setting method when an origin resetting is required was added.
2014-03-31	BFP-A8935-J	・Ex-T control function was added. ・The lubrication procedure was supplemented. (Thread sealing tape) ・The caution about the battery cable connector was added.
2014-08-20	BFP-A8935-K	・The cover and corporate logo mark of this manual was changed. ・The explanation of CR751 controller was added. ・"Table 5-3 : Cover fixing screw list" was corrected. ・The method to install the solenoid valve set for RV-4F/7F series robot was corrected.
2014-12-19	BFP-A8935-N	・"(1) Replacing the battery (robot arm)" was changed. ・Packing replacement procedure was added. ・The explanation of the origin setting method were added. The description of the setting range of ABS origin method was added. ・The caution in lubrication was added. ・The corporate logo mark of illustrations in this manual was changed. ・In recommended grease gun, CH-400 was deleted and KH-120 was added.
2015-02-09	BFP-A8935-P	・Belt type of J3 and J4 axis timing belt of RV-4F series was corrected. (error: J3 axis 381-3GT-6、J4 axis 240-3GT-4)
2015-10-29	BFP-A8935-R	・"Fig.5-6 : Inspection, maintenance and replacement of J1 axis timing belt" was modified. (The case where the motor plate is fixed with three screws was added.) ・The explanation of RV-50F series (RV-35F, RV-50F, RV-70F) were added.
2015-11-30	BFP-A8935-S	・The dimension of RV-50F series in "Fig.2-5 : Installation dimensions" was corrected.
2015-04-06	BFP-A8935-T	・"3.2 Installing the solenoid valve set" was modified.

Date of Point	Instruction Manual No.	Revision Details
2016-09-23	BFP-A8935-U	・J2 axis reduction gears for RV-70F was added to "Table 5-8 : Spare parts list". ・Note was added to the explanation of installing the hand input/output cable.
2016-10-18	BFP-A8935-V	・Origin setting tool was added to "Table 5-8: Spare parts list". ・"Table 5-9: Wrist reduction gear unit" was added. ・Series name was modified. (formerly RV-50F series) ・Timing belt type was changed.
2017-05-23	BFP-A8935-W	・Parameter settings when using a solenoid valve was added. ・The descriptions about the timing belt of the RV-7F series robot was modified. Hook pulling force of the J1 axis was changed. Belt type of the J3 axis was changed. Tension adjustment screw of the J4 axis of RV-7F series was deleted. (Error correction) ・Lubrication method of J1 axis of RV-13F series was supplemented. ・Contact information of the authorised representative was updated.
2017-09-25	BFP-A8935-X	・"5.4 About Overhaul" was modified. ・J1 axis timing belt of RV-7F series was changed. ・The position of J1 axis lubrication port of RV-4F/7F series was changed. ・" ■ Replacing the J3 axis timing belt (RV-4FR series)" was modified.
2018-06-01	BFP-A8935-Y	・Description of countermeasures against unauthorized access was added. ・Transportation postures of robot were added. ・"2.2.4 Grounding procedure" was modified.
2018-12-25	BFP-A8935-AA	・"5.6.3 ABS origin method" was corrected.
2020-01-24	BFP-A8935-AB	・Revised the descriptions along with the change in the shape of the transporting jig for the RV-35F/50F/70F series. Changed the length of the screws for attaching the transporting jig. Added the description of plain washers used with the screws for attaching the transporting jig. ・Corrected the explanation of the configuration flags (LEFT/RIGHT) for 5-axis robots. ・Corrected the length of the screw (c) used for installing the RV-4F/7F series cover. (Table 5-3)

*Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual explains the method of unpacking, installation and maintenance and inspection of the robot arm.
Always read through this manual before starting use to ensure correct usage of the robot.
The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed."

This document explains for the following robot type.

Robot type	Series (generic name used in this document for robots listed in each row)
RV-4F, RV-4FL, RV-4FJL	RV-4F series
RV-7F, RV-7FL	RV-7F series
RV-7FLL, RV-13F, RV-13FL, RV-20F	RV-13F series
RV-35F, RV-50F, RV-70F	RV-35F/50F/70F series

CONTENTS

Page

CONTENTS

CONTENTS

Page

1 Before starting use

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

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

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

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.
Additional axis function	Explains the specifications, functions and operations of the additional axis control.
Tracking Function Manual	Explains the control function and specifications of conveyor tracking
Extended Function Instruction Manual	Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures, about the PLC(CR750-Q/CR751-Q controller) and the GOT(CR750-D/CR751-D controller).

1.1.2 Symbols used in instruction manual

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

Table 1-1:Symbols in instruction manual

Terminology	Item/Symbol	Meaning
Item	iQ Platform	
	Controller	Indicates the controller which controls the robot arm. It consists of the robot CPU system and the drive unit.
	The robot CPU unit or robot CPU	Indicates the CPU unit for the robots which installed to the sequencer base unit (Q3 ☐ DB) of MELSEC-Q series. It is connected with the drive unit by the dedicated cable.
	The robot CPU system	Multi-CPU system. It consists of MELSEC units, such as the sequencer base unit, the sequencer CPU unit, and the robot CPU unit, etc.
	Drive unit	Indicates the box which mounts the servo amplifier for robot, and the safety circuit, etc.
Item	Stand-alone type	
	Controller	Indicates the box which arranged control parts, such as robot CPU, servo amplifier, and the safety circuit.
Symbol	⚠ DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
	⚠ CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
	[JOG]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
	[RESET] + [EXE] (A) (B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [RESET] key is pressed while holding down the [EXE] key.
	T/B	This indicates the teaching pendant.
	O/P	Indicates the operating panel on the front of controller or drive unit for the controller which installed the operating panel
	CR751 (Thin type) CR751 (Heavy type)	There are two kinds of CR751 controller; one is "Thin type" (the height is 98mm) and the other is "Heavy type" (the height is 174mm), each of which are different in height. Thin type: CR751-03HD/Q, CR751-06HD/Q, CR751-12HD/Q, CR751-20HD/Q, CR751-03HRD/Q, CR751-02VD/Q, CR751-04VD/Q, CR751-04VJD/Q, CR751-07VD/Q. Heavy type: CR751-13VD/Q, CR751-20VD/Q, CR751-07VLD/Q. * Refer to separate Standard Specifications Manual for the outside dimension of CR751 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

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

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

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

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

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

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

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

1.2.1 Precautions given in the separate Safety Manual

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

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

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

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

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

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

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

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

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

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

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

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

2 Unpacking to Installation

2.1 Confirming the product

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

Table 2-1 : Standard configuration

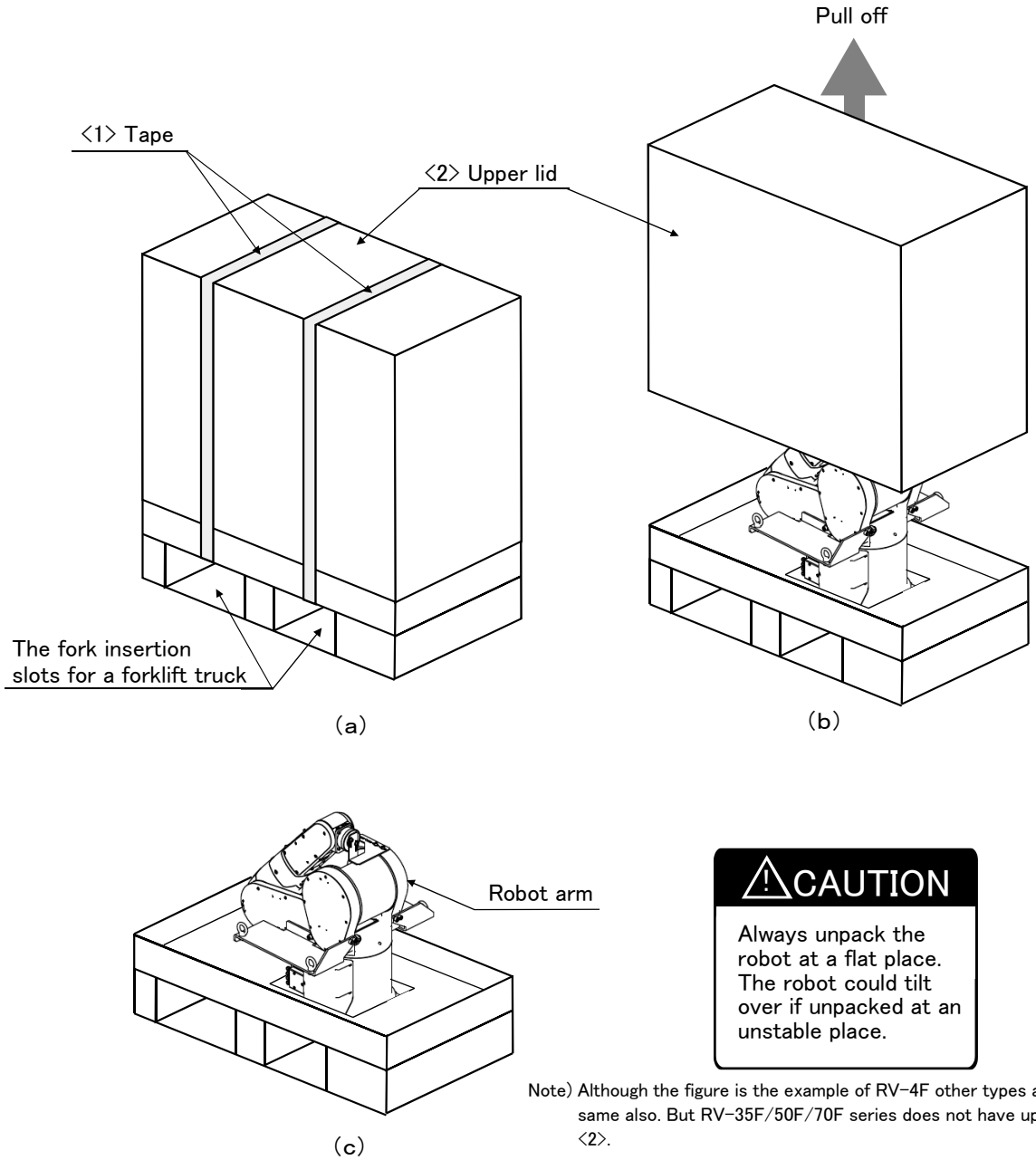
No.	Part name	Type	Qty.	Remarks
RV-4F series				
1	Robot arm	RV-4F/4FL/4FJL	Each 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 x 40	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M8	4 pcs.	
5	Plain washer for installation bolts	For M8	4 pcs.	
6	Grease nipple	WA-610	5 pc.	
7	Coupling front side	ϕ4	4 pcs.	These are attached only to the following Internal wiring and piping type. -SH01
8	Coupling back side	ϕ4	4 pcs.	
9	Air hose	ϕ4	4 pcs.	
10	Coupling front side	ϕ4	2 pcs.	These are attached only to the following Internal wiring and piping types. -SH04, -SH05
11	Coupling back side	ϕ4	2 pcs.	
12	Air hose	ϕ4	2 pcs.	
13	Transporting jig		2 sets	
14	Transporting jig installation bolt	M6 x 20	6 pcs.	
15	Plain washer for suspension fitting installation bolt	For M6	6 pcs.	
16	Eye bolt	M10	4 pcs.	
17	Nut for eye bolt	For M10	4 pcs.	
18	Fixing plate		1 set	
19	Fixing plate installation bolt	M15 x 12	4 pcs.	
20	Plain washer for fixing plate	For M5	4 pcs.	
RV-7F series				
1	Robot arm	RV-7F/7FL	Each 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 x 40	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M8	4 pcs.	
5	Plain washer for installation bolts	For M8	4 pcs.	
6	Grease nipple	WA-610	4 pcs.	
7	Coupling front side	ϕ4	4 pcs.	These are attached only to the following Internal wiring and piping type. -SH01
8	Coupling back side	ϕ4	4 pcs.	
9	Air hose	ϕ4	4 pcs.	
10	Coupling front side	ϕ4	2 pcs.	These are attached only to the following Internal wiring and piping types. -SH04, -SH05
11	Coupling back side	ϕ4	2 pcs.	
12	Air hose	ϕ4	2 pcs.	
13	Transporting jig		2 sets	
14	Transporting jig installation bolt	M8 x 25	4 pcs.	
15	Plain washer for suspension fitting installation bolt	For M8	4 pcs.	
16	Eye bolt	M10	4 pcs.	
17	Nut for eye bolt	For M10	4 pcs.	
18	Fixing plate		1 set	
19	Fixing plate installation bolt	M15 x 12	4 pcs.	
20	Plain washer for fixing plate	For M5	4 pcs.	

No.	Part name	Type	Qty.	Remarks
RV-13F series				
1	Robot arm	RV-7FLL/13F/13FL/20F	Each 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M12 x 55	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M12	4 pcs.	
5	Plain washer for installation bolts	For M12	4 pcs.	
6	Grease nipple	WA-110	3 pcs.	
		WA-610	4 pcs.	
7	Bulkhead coupling	ϕ4	4 pcs.	These are attached only to the following Internal wiring and piping type. -SH01
8	Conversion coupling	ϕ6 to ϕ4	4 pcs.	
9	Air hose for port A	ϕ4 x 50mm	2 pcs.	
10	Air hose for port B	ϕ4 x 85mm	2 pcs.	
11	Bulkhead coupling	ϕ4	2 pcs.	These are attached only to the following Internal wiring and piping types. -SH04, -SH05
12	Conversion coupling	ϕ6 to ϕ4	2 pcs.	
13	Air hose for port A	ϕ4 x 50mm	1 pcs.	
14	Air hose for port B	ϕ4 x 85mm	1 pcs.	
15	Transporting jig		2 sets	
16	Transporting jig installation bolt	M10 x 45	4 pcs.	
17	Plain washer for suspension fitting installation bolt	For M10	4 pcs.	
18	Eye bolt	M12	4 pcs.	
19	Nut for eye bolt	For M12	4 pcs.	
20	Fixing plate		1 set	
21	Fixing plate installation bolt	M6 x 14	4 pcs.	
22	Plain washer for fixing plate	For M6	4 pcs.	
RV-35F/50F/70F series				
1	Robot arm	RV-35F/50F/70F	Each 1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M20 x 65	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M20	4 pcs.	
5	Grease nipple	F-100-N-1/8	1 pcs.	Attached at the shoulder portion of a robot arm.
6	Transporting jig		2 sets	
7	Transporting jig installation bolt	M16 x 40	4 pcs.	
8	Plain washer for transporting jig installation bolt	For M16	4 pcs.	

Note1) RV-4F/7F series: Items No. 3 to 12 are contained in the plastic bag of attachment in the robot arm.
Items No. 13 to 20 are mounted on the robot arm.
RV-13F series: Items No. 3 to 14 are contained in the plastic bag of attachment in the robot arm.
Items No. 15 to 22 are mounted on the robot arm.
RV-35F/50F/70F series: Items No. 3 and 4 are contained in the plastic bag of attachment in the robot arm.
Items No. 5 to 8 are mounted on the robot arm.

2.2 Installation

2.2.1 Unpacking



⚠CAUTION

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

Note) Although the figure is the example of RV-4F other types are the same also. But RV-35F/50F/70F series does not have upper lid <2>.

Fig.2-1 : Unpacking the robot arm

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

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

The unpacking process is shown below.

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

2.2.2 Transportation procedures (Transporting with a crane)

(1) RV-4F/7F/13F series

The transportation procedure is shown in Fig. 2-2 for (RV-4F/7F series) and Fig. 2-3 (RV-13F series).

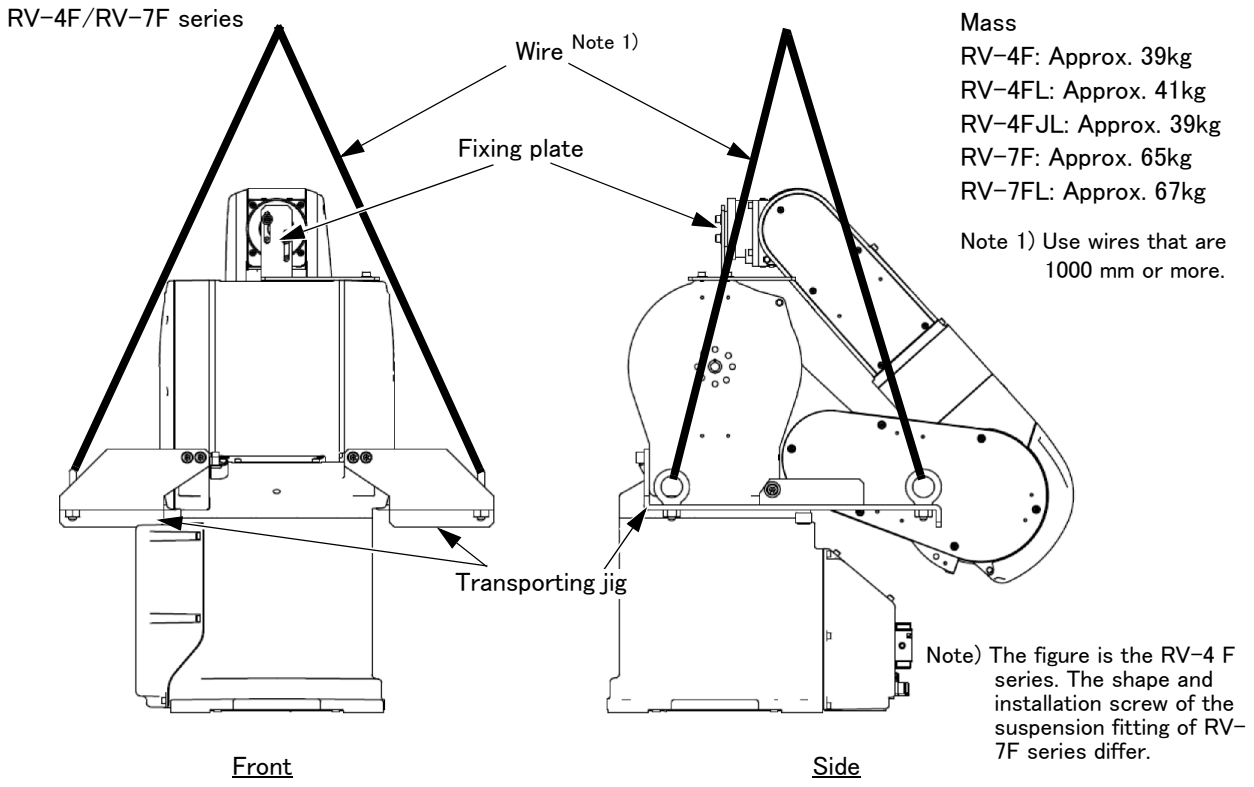


Fig.2-2 : Transportation procedure (transporting with a crane: RV-4F/7F series)

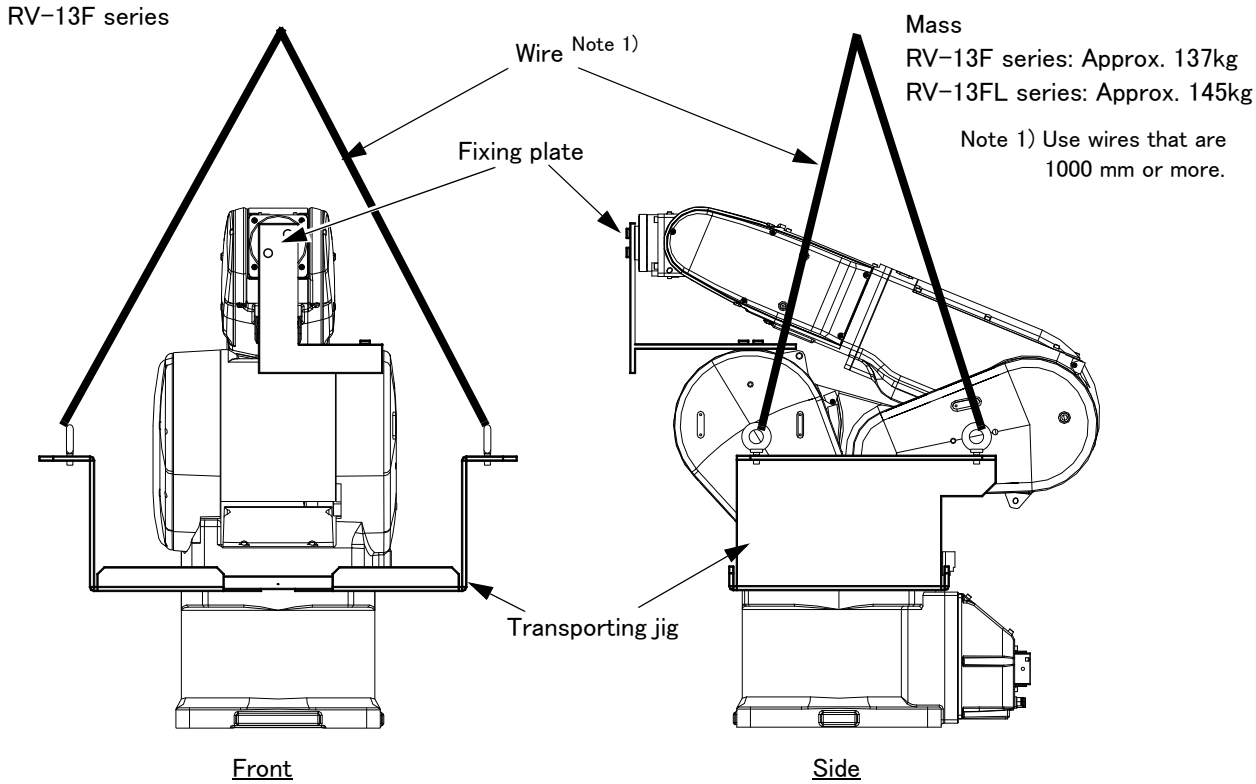


Fig.2-3 : Transportation procedure (transporting with a crane: RV-13F series)

1) Attach the transporting jigs to the left and right sides of the shoulder section, and securely fix with screws and plain washers. (RV-4F series: M6x20, each three screws for the right and left. RV-7F series: M8x25, each two screws for the right and left. RV-13F series: M10x45, each two screws for the right and left.) (The transporting jigs are mounted on robot arm at factory shipping)
2) Catch wires in the eye bolts installed on the transporting jigs, and quietly suspend the arm.
   Note) At this time, make sure that the wires, etc., do not interfere with the robot arm or covers. Always place cloth, etc., at interfering places.
3) When transferring to the installation place, take care not to apply vibration or impact.
4) After installing at the installation place, remove the above transporting jigs.
5) Always attached the fixing plate and transporting jigs, and follow the above procedures and methods to transport the robot for secondary transportation, such as when changing the installation position.
   If the arm is directly suspended without using the specified transporting jigs, or if it is suspended in the work posture, the configuration devices could be damaged, and the transportation workers will be subject to risk due to an inadequate center of gravity position.

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

⚠CAUTION If it is difficult to follow the transportation procedure shown in this section, take countermeasures not to allow the joints of the robot arm freely move by fixing the robot arm in such a way as to take advantage of the screw holes for fixing plates or the like. Otherwise, applying an excessive power on the joints by external forces may cause a malfunction.
Do not apply an excessive load to the robot arm while fixing it. Otherwise, the robot arm may be damaged.

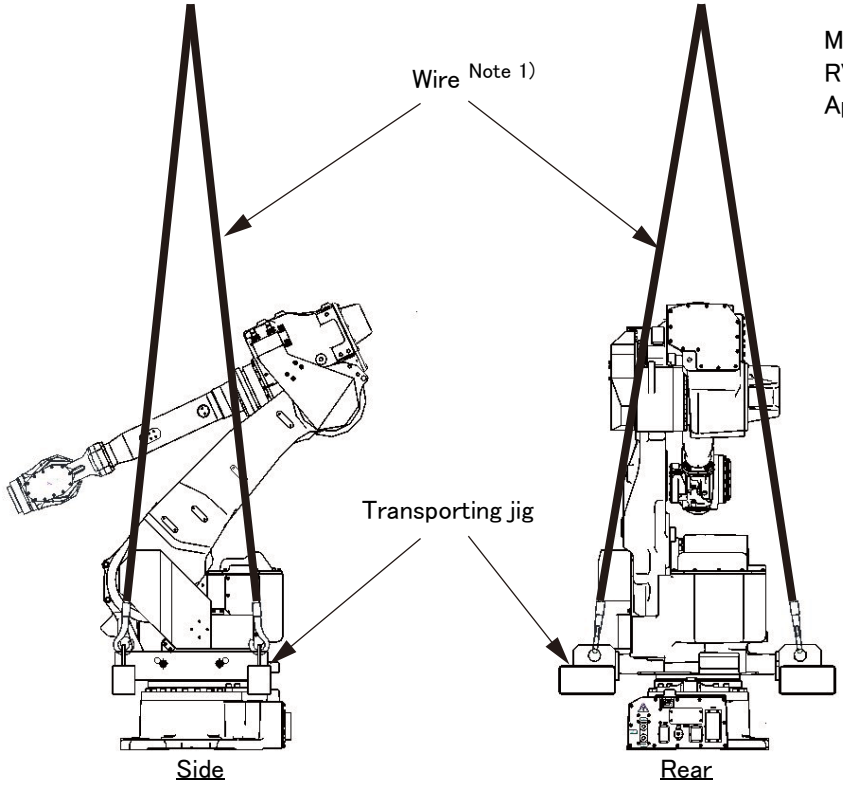
Table 2-2 : Transportation posture (RV-4F/7F/13F series)

Axis	RV-4F		RV-4FL/4FJL		RV-7F		RV-7FL		RV-7FLL RV-13F/13FL RV-20F
	CR750 controller	CR751 controller	CR750 controller	CR751 controller	CR750 controller	CR751 controller	CR750 controller	CR751 controller	
J1	0°	90°	0°	90°	0°	90°	0°	90°	0°
J2 Note1)	-122°		-121°		-116°		-115°		-93°
J3 Note1)	162°		165°		158°		164°		160°
J4	0°		0° Note2)		0°		0°		0°
J5	45°		41°		48°		41°		23°
J6	0°		0°		0°		0°		0°

Note1)The value is a reference value. Release the brake and move the arm until it contact against the mechanical stopper.
Note2)RV-4FJL (5-axis type robot) has no J4 axis.

(2) RV-35F/50F/70F series

The transportation procedure is shown in Fig. 2-4.



Mass
RV-35F/50F/70F series:
Approx. 670kg

Note 1) Use wires that are 3000 mm or more.

Fig.2-4 : Transportation procedure (transporting with a crane: RV-35F/50F/70F series)

1) Attach the transporting jig to the left and right shoulders with hex socket screws (two M16 × 40 screws for each side) and plain washers (two M16 washers for each side).
   (The transporting jigs are mounted on robot arm at factory shipping)
2) Catch wires in the openings of the transporting jigs, and quietly suspend the arm.
   Note) At this time, make sure that the wires, etc., do not interfere with the robot arm or covers. Always place cloth, etc., at interfering places.
3) When transferring to the installation place, take care not to apply vibration or impact.
4) After installing at the installation place, remove the above transporting jigs.
5) Always follow the above procedures and methods to transport the robot for secondary transportation, such as when changing the installation position.
   If the arm is directly suspended without using the specified transporting jigs, or if it is suspended in the work posture, the configuration devices could be damaged, and the transportation workers will be subject to risk due to an inadequate center of gravity position.

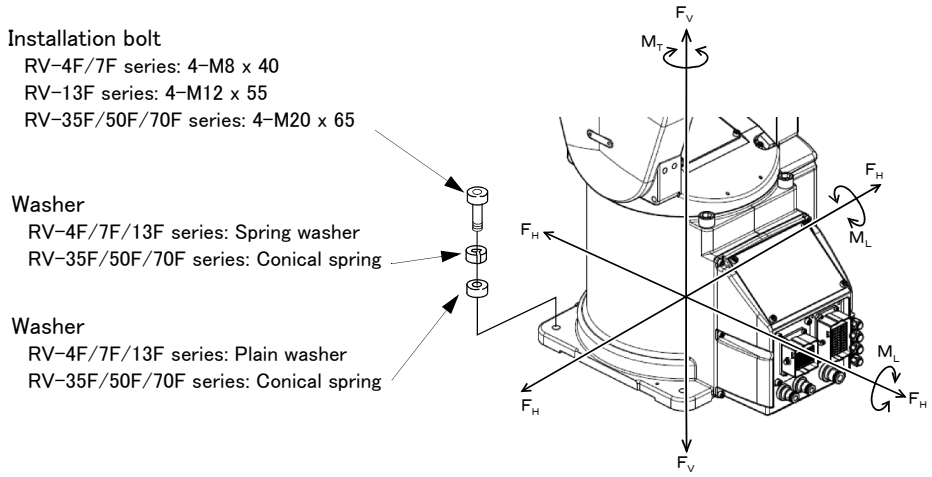
⚠CAUTION When installing the transporting jigs again, place the robot in the posture where each axis shows the values listed in the table below.

Table 2-3 : Transportation posture

	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
RV-35F/50F/70F series	0 deg.	-45 deg.	+160 deg	0 deg.	0 deg.	0 deg.

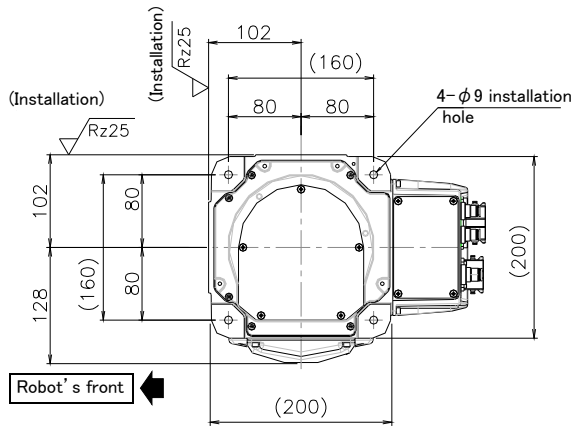
2.2.3 Installation procedures

The installation procedure of the robot arm is shown below.

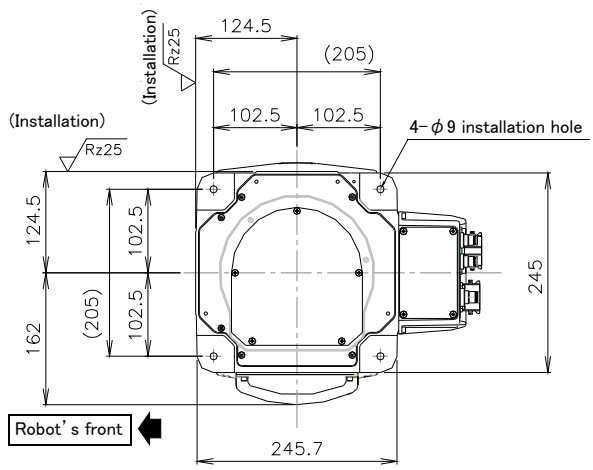


<Bottom view>

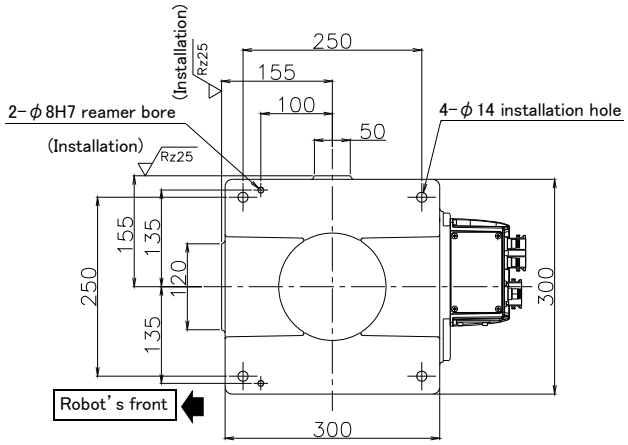
RV-4F series



RV-7F series



RV-13F series



RV-35F/50F/70F series

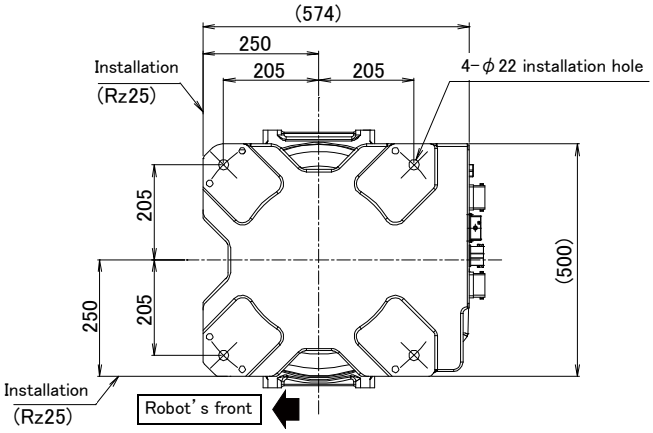


Fig.2-5 : Installation dimensions

1) The robot installation surface has been machine finished. Use the installation holes (RV-4F series and RV-7F series: 4-φ9 holes, RV-13F series: 4-φ14 holes, RV-35F/50F/70F series: 4-φ22 holes) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (RV-4F series and RV-7F series: M8 hexagon socket head cap screws, RV-13F series: M12 hexagon socket head cap screws, RV-35F/50F/70F series: M20 hexagon socket head cap screws).

2) Installation of the robot arm is a very important step for ensuring the optimum functions of the robot. Observe the following points when designing. Install the robot on a level surface.
3) It is recommended that the surface roughness of the table onto which the robot is to be installed by 6.3a or more. If the installation surface is rough, the contact with the table will be poor, and positional deviation could occur when the robot moves.
4) When installing, use a common table to prevent the position of the devices and jigs subject to robot work from deviating.
5) The installation surface must have sufficient strength to withstand the arm reaction during operation, and resistance against deformation and vibration caused by the static (dynamic) load of the robot arm and peripheral devices, etc.
6) Remove the fixing plates and suspension fittings after installing the robot. The plates and fittings are needed in re-transportation. Please keep it carefully.
7) When the robot is installed by hanging from the ceiling or on the wall, the MEGDIR parameter must be changed. For more information about parameters and how to change the parameters, refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations".
8) The installation surface must have sufficient strength to withstand the arm reaction during moving the robot at high speed.

Table 2-4 : Strength of the installation side (reference)

Item	Unit	Value			
		RV-4F series	RV-7F series	RV-7FLL RV-13F series RV-20F	RV-35F RV-50F RV-70F
Falling moment: M_L	N m	410	900	2,060	32,900
Twist moment: M_T	N m	400	900	2,060	28,300
Horizontal translation power: F_H	N	700	1,000	1,750	16,700
Vertical translation power: F_V	N	1,200	1,700	2,900	23,700

⚠CAUTION Please secure the maintenance space required for connection of the machine cable and exchange the backup battery in the rear side, and also space for J1 axis belt in the right side (RV-4F/7F/13F series). And don't install the robot arm in the position where direct rays or the heat of lighting hits. The skin temperature of the robot arm may rise, and the error may occur.

2.2.4 Grounding procedures

Ground the robot arm.

For the RV-4F/7F/13F/20F series, refer to Page 14, "(2) Grounding procedures" for grounding.

For the RV-35F/50F/70F series, the base of the robot arm is installed on the stand to ground it. Therefore, do not coat the installation stand in contact with the robot arm installation surface. After installing the robot arm, ground the installation stand.

(1) Grounding methods

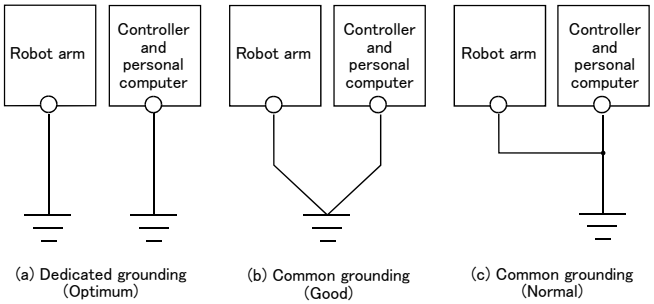
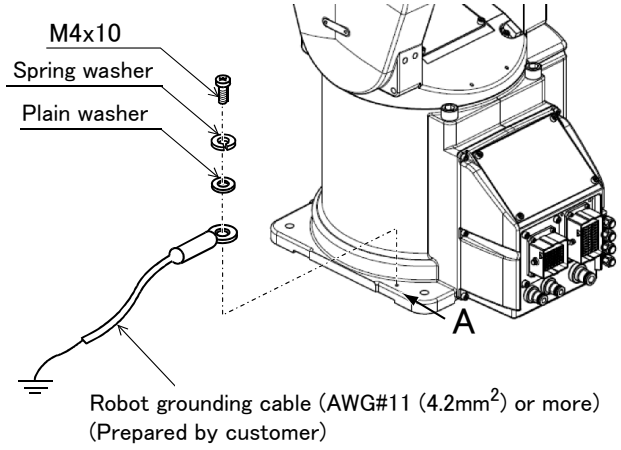


Fig.2-6 : Grounding methods

1) There are three grounding methods as shown in Fig. 2-6, but the dedicated grounding (Fig. 2-6 (a)) should be used for the robot arm and controller when possible. (Refer to the separate " Controller Setup, Basic Operation and Maintenance" for details on the controller grounding.)
2) Use Class D grounding (grounding resistance 100Ω or less).
   Dedicated grounding separated from the other devices should be used.
3) Use a AWG#11(4.2mm^2) or more stranded wire for the grounding wire. The grounding point should be as close to the robot arm and controller as possible, and the length of the grounding wire should be short.

(2) Grounding procedures



Note) Although the figure is the example of RV-4F other types are the same also.

Fig.2-7 : 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
(1) CR750/CR760 controller

<CR750 controller>

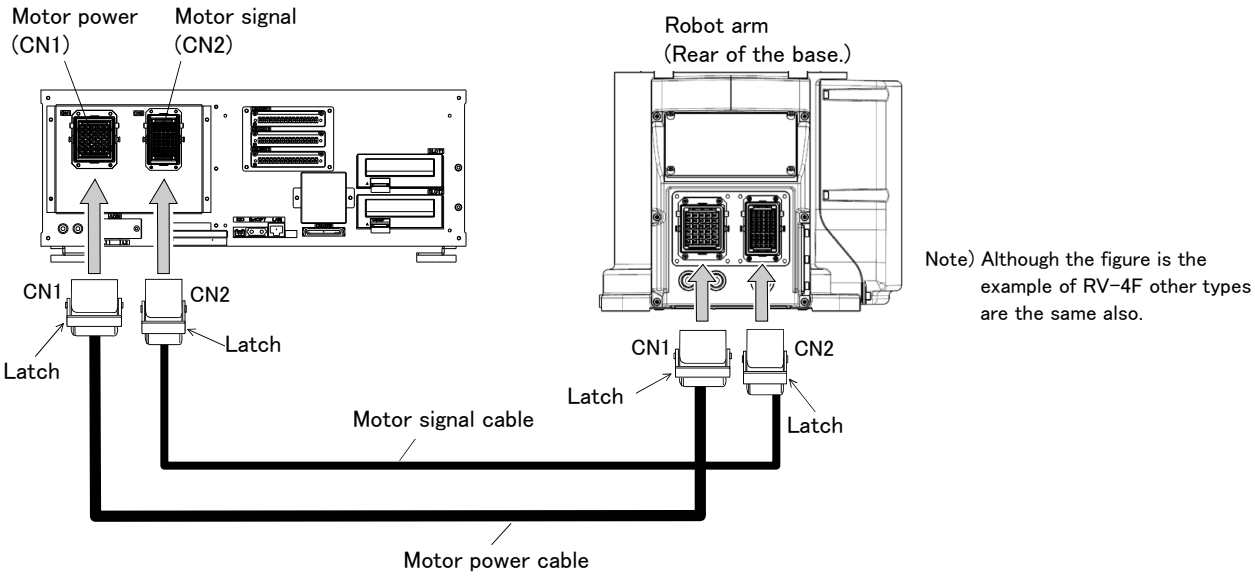


Fig.2-8 : Connecting the machine cables (CR750 controller)

<CR760 controller>

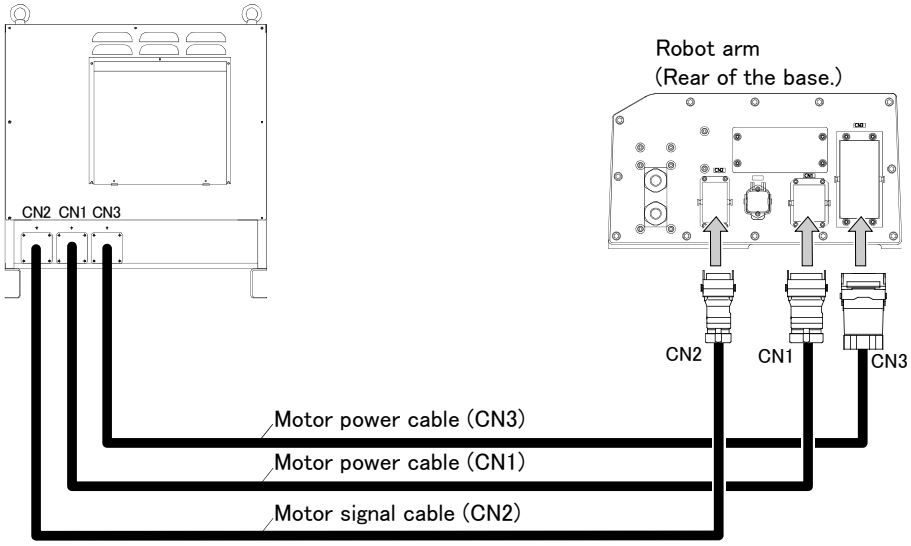
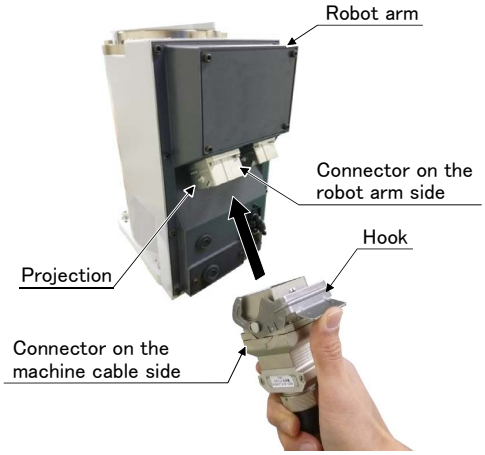


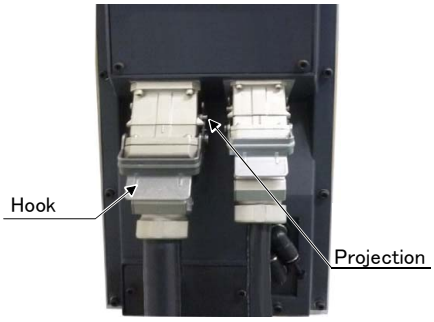
Fig.2-9 : Connecting the machine cables (CR760 controller)

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.



1) Make sure that the power switch on the front of the controller is turned OFF.
   Note) Although the figure is RH-6FH, also in other robots with same connector type, the connection method is the same.

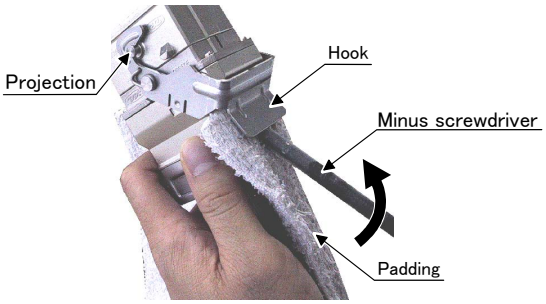
2) Connect the machine cable to its corresponding connector on the robot arm side.
   Note) Although the figure is RH-6FH, also in other robots with same connector type, the connection method is the same.



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.

The connection of machine cables is completed.



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.

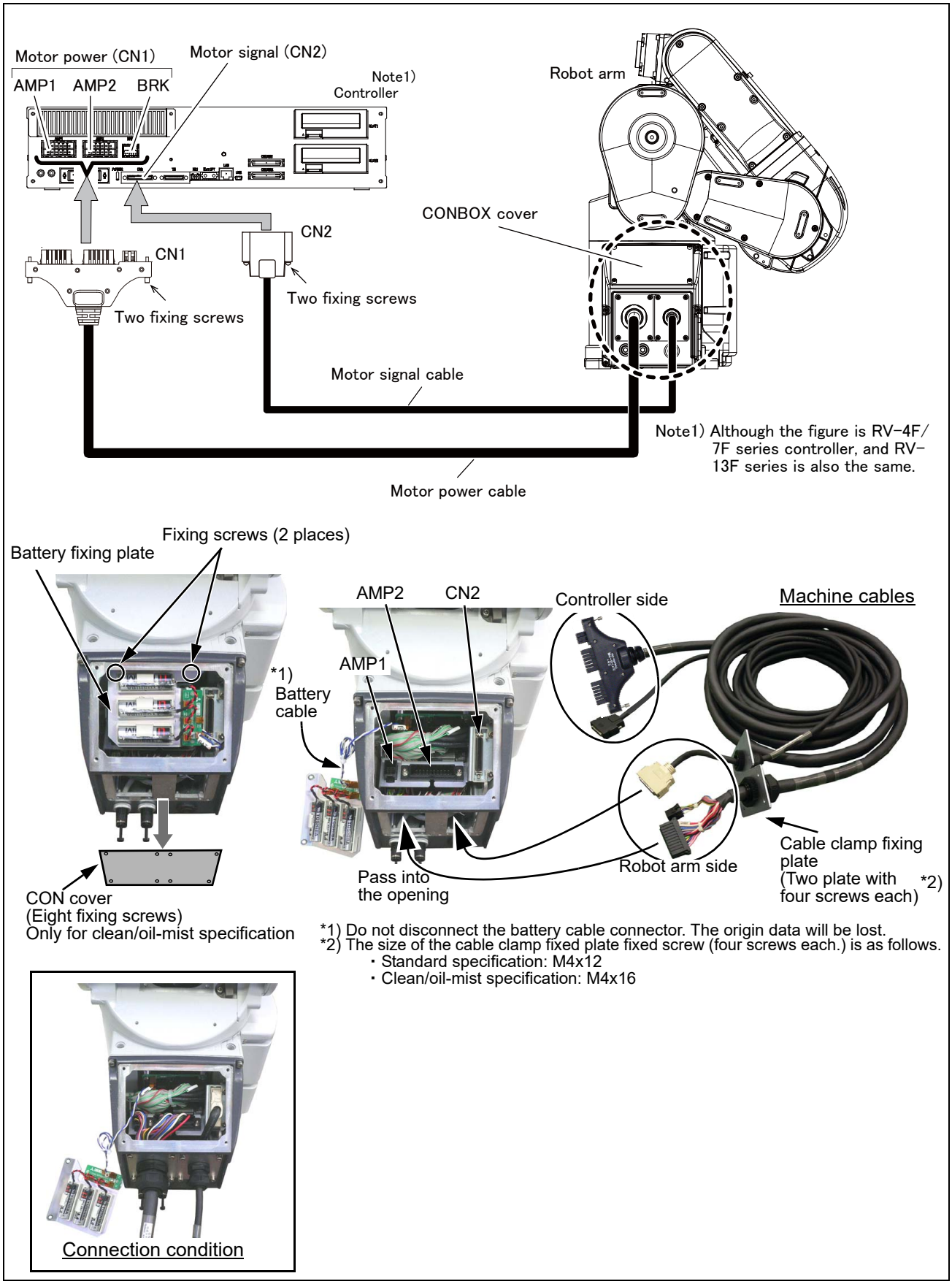
⚠ CAUTION The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠ 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) CR751 controller



*1) Do not disconnect the battery cable connector. The origin data will be lost.
*2) The size of the cable clamp fixed plate fixed screw (four screws each.) is as follows.
- Standard specification: M4x12
- Clean/oil-mist specification: M4x16

Fig.2-10 : Connecting the machine cables (CR751)

Carry out the following procedure after installing the controller and the robot arm referring to the separate "Controller Setup, Basic Operation and Maintenance" and Page 12, "2.2.3 Installation procedures".
And attach a cable fixation plate to the controller referring to the separate "Controller Setup, Basic Operation and Maintenance" manual.
The connection outline is shown in Fig. 2-10.

1) Make sure that the power switch on the front of the controller is turned OFF.
   Note) Although the figure is RV-4F series, also in other robots with same connector type, the connection method is the same.
2) Connect the machine cable connectors to its corresponding connectors on the robot arm side.
   a) Remove the four screws holding the CONBOX cover, and remove the cover. (Refer to Page 92, "5.3.2 Installing/removing the cover" for details.)
   And, the CON cover is installed to clean / oil-mist specification. Removes the eight fixing screws and removes the CON cover. The opening which passes the connector is seen.
   b) The battery fixing plate is inside the CONBOX cover. Remove the two fixing screws and remove the battery fixing plate.
   Note) Do not disconnect the battery cable connector. The origin data will be lost.
   c) Feed the connectors of robot side to the opening on the back of the robot base and connect with the corresponding connector. Connect the connector (AMP1, AMP2, CN2) securely.
   d) Fix the cable clamp fixed plate of the machine cable with the attached fixing screw. Fix both cables securely with the four screws, respectively.
   e) Install the battery fixing plate securely as before. Be careful not to insert the cable.
   f) Install the CONBOX cover securely as before. Be careful not to insert the cable.
3) Connect the machine cable to the corresponding connector of the controller. Connects the connector (CN1(AMP1, AMP2, BRK), CN2) surely. Fix the two fixing screws securely, respectively. Tighten the fixing screw of CN2 by 0.06-0.07 Nm.

The connection of machine cables is completed.

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

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

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

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

⚠ CAUTION Please do not disconnect the battery cable connector. If the connector is disconnected, the robot origin data will be lost.
It is necessary to set the origin data again by ABS origin method. Refer to Page 146, "5.6.3 ABS origin method" for details.

2.2.6 About oil mist specification

(1) Piping for pressurization inside robot arm

In RV-4F/7F/13F series robot use in oil mist environment, please connect the φ8 air hose to the coupling for pressurization of the robot arm base portion "AIR PURGE", and pressurize the inside of the robot arm.

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

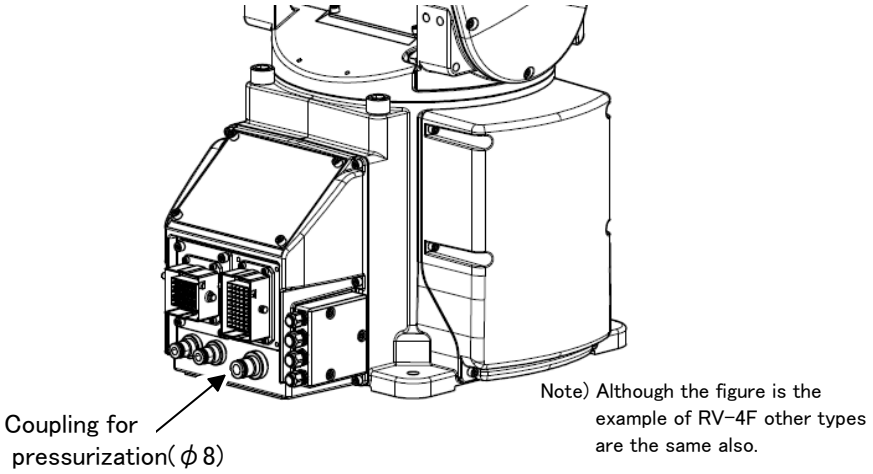


Fig.2-11 : Air purge

2.2.7 About clean specification

(1) Piping for suction inside robot arm

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

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

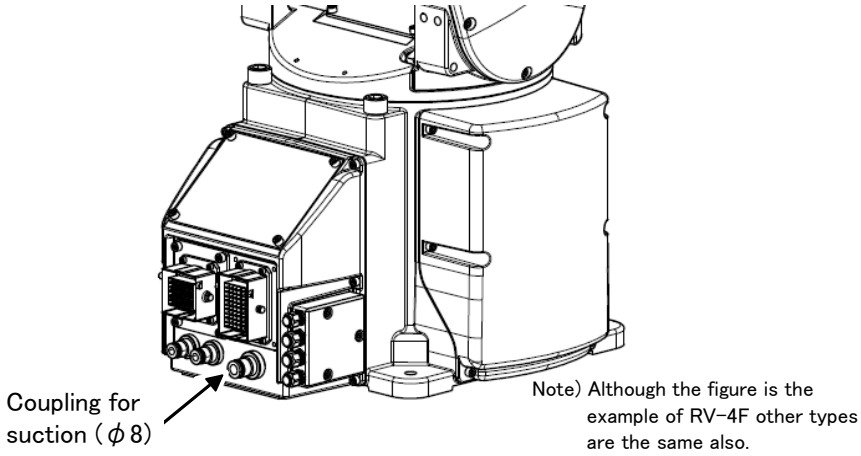


Fig.2-12 : Vacuum

2.3 Setting the origin

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

There are several methods for setting the origin, but the origin data input method will be explained here. Refer to Page 122, "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 122, "5.6 Resetting the origin" and reset the origin using the jig method or ABS method.

2.3.1 Installing the teaching pendant (T/B)

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

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

⚠ CAUTION

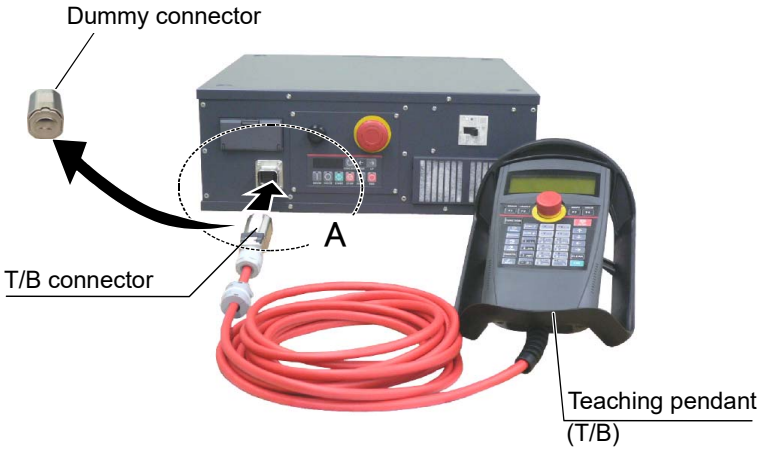
Please do not pull the cable of T/B strongly or do not bend it too much.
It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself.

(1) CR750/CR760 controller

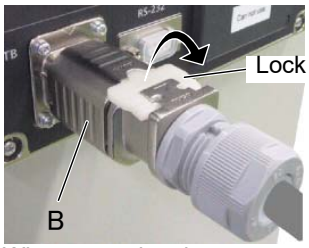
Explain the installation method of T/B below.

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. 2-13, and push in until there is sound.

<CR750 controller>



Details of the A section



When removing the connector for T/B connection, use lock release (state which raised the lock lever to the up side), make the case of the B section slide to the front, and remove and pull up out the latch.

<CR760 controller>

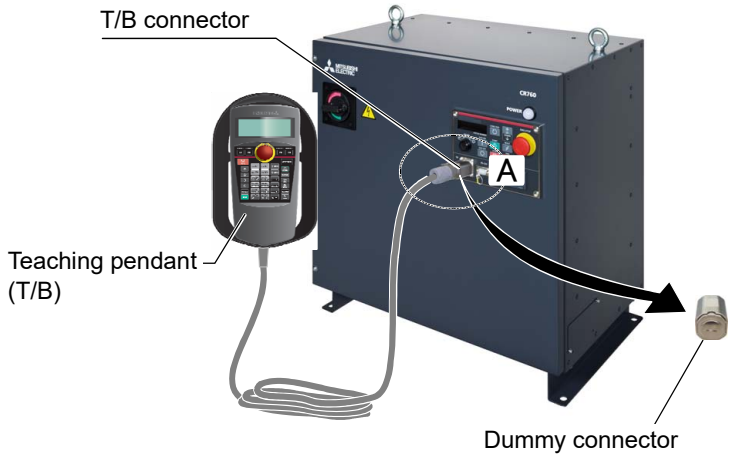


Fig.2-13 : Installing and removing the T/B (CR750/CR760 controller)

The installation of T/B is finished.

◇◆◇ If error C0150 occurs ◇◆◇

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

(2) CR751 controller

Explain the installation method of T/B below.

1) Check that the POWER (power supply) switch of the robot controller is OFF.

2) Connect the T/B connector to the controller's T/B connector. Make sure to fix it securely by fastening the hand locks (in 2 places), as shown in Fig. 2-14.

Note) Although the figure is RV-4F/7F series controller, and RV-13F series is also the same.

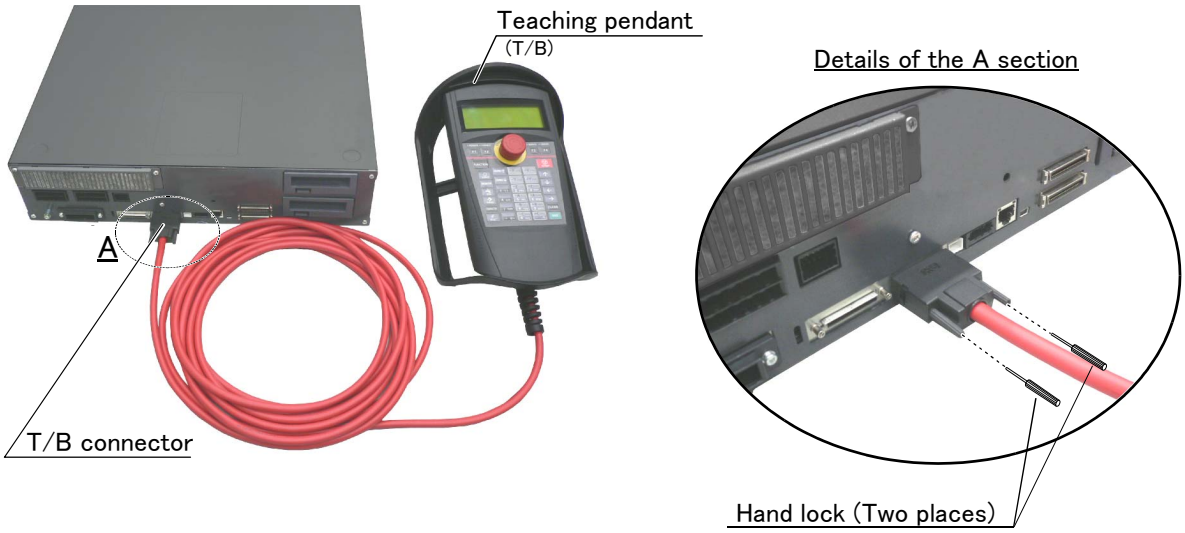


Fig. 2-14 : Installing and removing the T/B (CR751controller)

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.

2.3.2 Setting the origin with the origin data input method

(1) Confirming the origin data

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

Date	Default	. . .	. . .	. . .
D	V!#S29			
J 1	06DTYY			
J 2	2?HL9X			
J 3	1CP55V			
J 4	T6!M$Y			
J 5	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

Fig.2-15 : Origin data label (an example)

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 CON-BOX cover (RV-4F/7F/13F series) or J1 axis motor connector cover (RV-35F/50F/70F series). (Refer to Fig. 2-15).

Referring to Page 92, "5.3.2 Installing/removing the cover", remove the cover above and confirm the value.

The value given in the default setting column is the origin settings set with the calibration jig before shipment.
Note that the 5-axis type robot does not have the J4 axis.

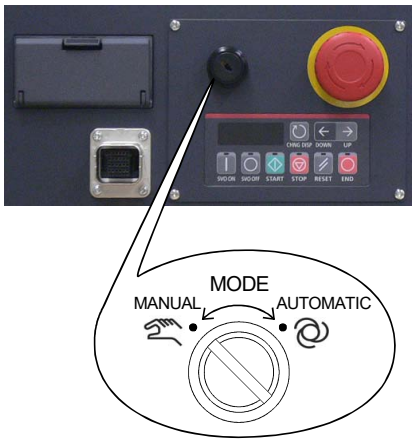
⚠ WARNING Always install/remove the cover with the controller control power turned OFF. Failure to do so could lead to physical damage or personal injury should the robot start moving due to incorrect operations.

(2) Turning ON the control power

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

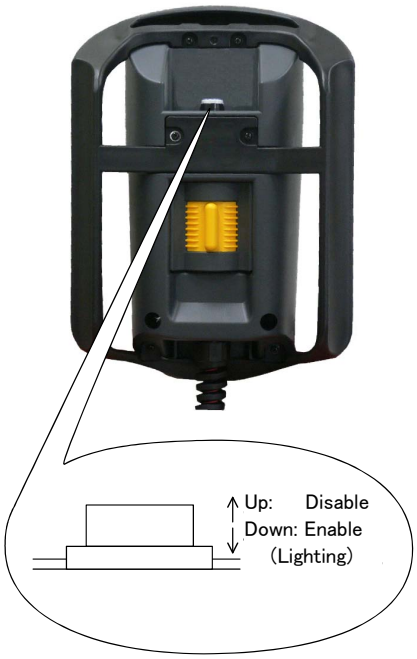
1) Turn the controller [POWER] switch ON.
The CR750/CR760 controller turns ON the front power switch.
The CR751 controller turns ON the switch of the earth leakage breaker of installation outside.

(3) Preparing the T/B



Next, prepare to use the T/B

1) Set the mode of the controller to "MANUAL".
(The figure is example for CR750 controller)

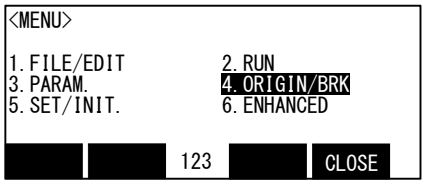


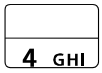
2) Set the T/B [ENABLE] switch to "ENABLE". The menu selection screen will appear.
The following operations are carried out with the T/B.

◇◆◇ Operating from the T/B ◇◆◇

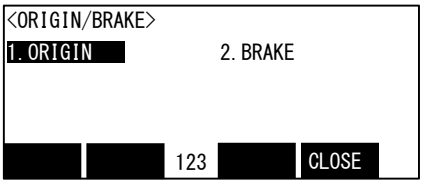
Always set the mode of the controller to "MAMNUAL", and then set the T/B [ENABLE] switch to "ENABLE". When the T/B is valid, only operations from the T/B are possible. Operations from the controller or external signals will not be accepted.

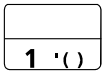
(4) Selecting the origin setting method



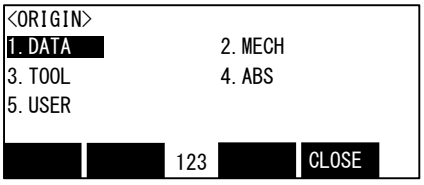


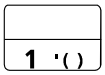
1) Press the [4] key on the menu screen, and display the ORIGIN/BRAKE screen.





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





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

4) Display the origin data input screen

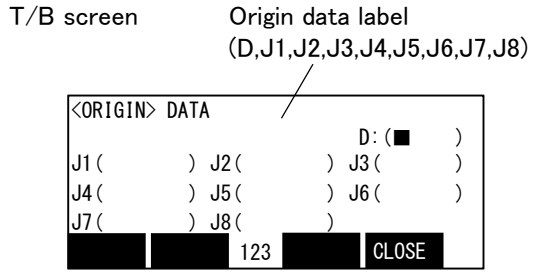
◇◆◇ Selecting a menu ◇◆◇

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

◇◆◇ The input method of numeral ◇◆◇

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

(5) Inputting the origin data

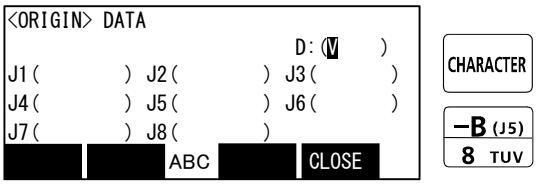


Input the value confirmed in section Page 23, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-16.
(For the 5-axis type robot, the J4 axis is meaningless.)

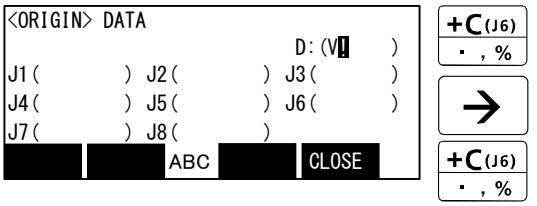
Fig.2-16 : Correspondence of origin data label and axis

The method for inputting the origin data is explained below. The value shown in Fig. 2-15 will be input as an example.

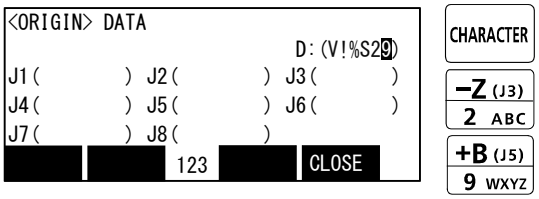
1) Confirm that the cursor is at the "D" position on the T/B display screen.



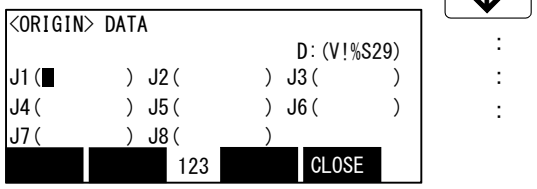
2) Input the D value "V!%S29".
Inputting "V"
Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen)
Press the [TUV] key three times. "V" will be set.



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

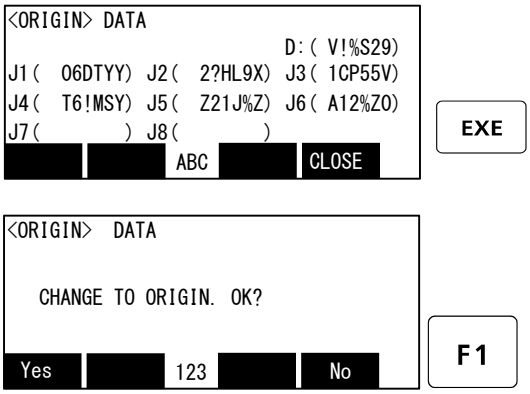


Press the [CHARACTER] key and set to the numeral input mode. (Condition that "123" was displayed under the screen)
Press the [2] key (input "2"), and press the [9] key (input "9").
"V!%S29" will appear at the "D" data on the teaching pendant screen.



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

5) Input the J2, J3, J4, J5 and J6 values in the same manner.
Note that the J4 axis is not required for the 5-axis type.



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

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

◇◆◇ Moving the cursor ◇◆◇

Press the [↑], [↓], [←] and [→] keys.

◇◆◇ Inputting characters ◇◆◇

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

◇◆◇ How to input symbols ◇◆◇

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

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

◇◆◇ Correcting an input ◇◆◇

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

(6) Installing the cover.

Return the cover removed in section Page 23, "(1) Confirming the origin data" to its original position.
(RV-4F/7F/13F series: CONBOX cover, RV-35F/50F/70F series: J1 axis motor connector cover)
This completes the setting of the origin with the origin data input method.

⚠ WARNING

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

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

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

2.4 Confirming the operation

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

⚠ CAUTION

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

⚠ CAUTION

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

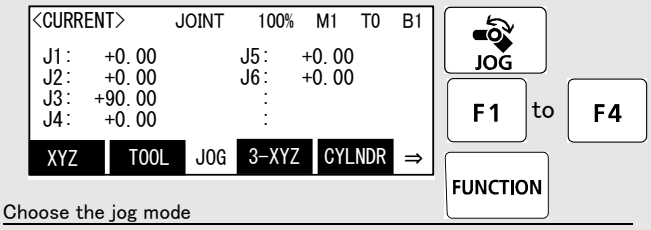
⚠ CAUTION

To check whether the origin of the robot deviates, move the robot arm to the position where the ABS marks align each other, and check the displayed joint coordinates of the position.
For the details of the ABS mark position and the joint coordinates, refer to Page 122, "5.6 Resetting the origin", and Page 146, "5.6.3 ABS origin method".

⚠ WARNING

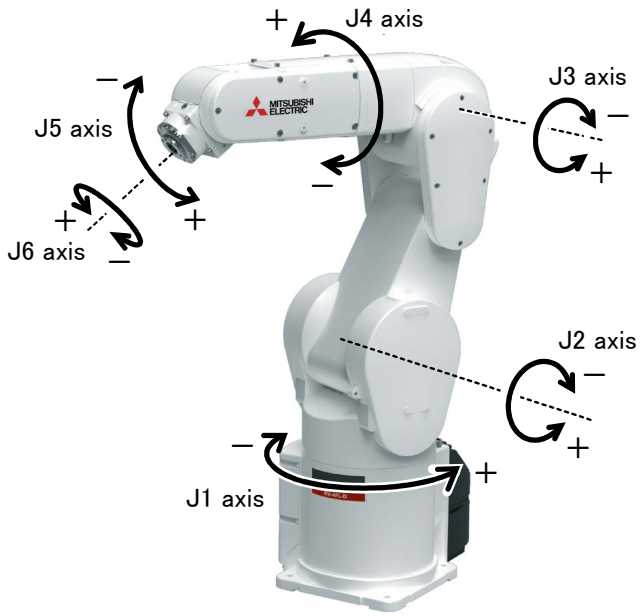
Confirm that the origin has been set. If the origin has not been set, "****" will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.
In such a case, the robot may operate beyond the software-defined operating range, which will cause interference or collisions between the robot mechanical sections.
Refer to Page 20, "2.3 Setting the origin" for details on setting the origin.

◇◆◇ How to choose the jog mode ◇◆◇



Choose the jog mode

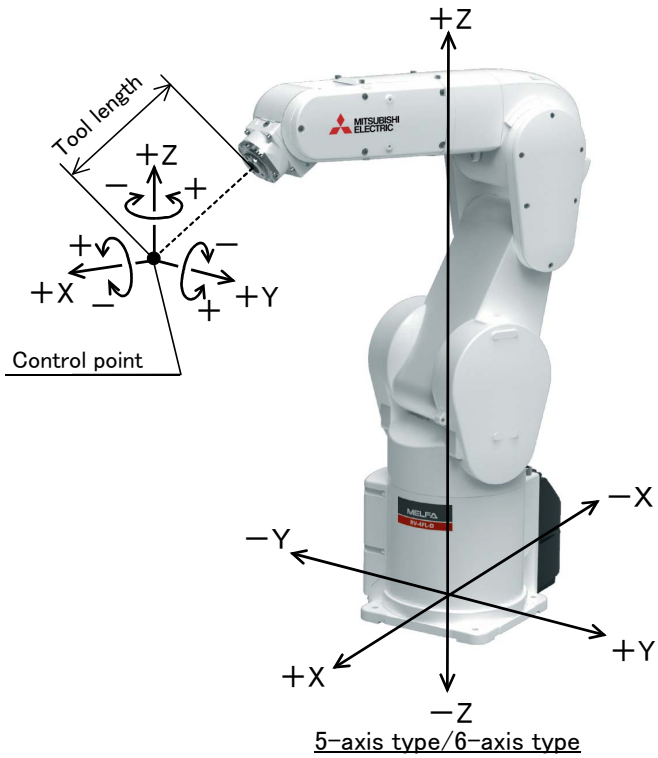
Press the [JOG] key, the jog screen will be displayed, and display the jog mode which can be chosen at the bottom of the screen. Because these correspond to the function key of [F1] – [F4], press the function key corresponding to the jog mode to wish. And, if the [FUNCTION] key is pressed, selection in jog modes other than the present display is possible. The override (100%), the mechanism number (M1), and the tool number (T0), and the base coordinate number (B1) are displayed on the upside of the screen following the present jog mode (JOINT).



5-axis type/6-axis type

* Each axis moves independently. The 5-axis type robot has no J4 axis.

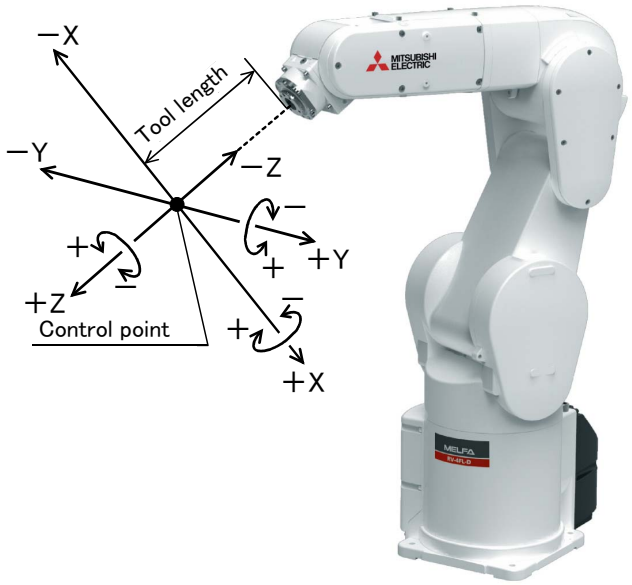
Fig.2-17 : JOINT jog operation



5-axis type/6-axis type

* While maintaining the flange surface posture, the axis moves straight along the base coordinate system.
  The 6-axis type robot maintains the flange surface posture.
  Also, while maintaining the flange surface position, the flange surface posture changes.

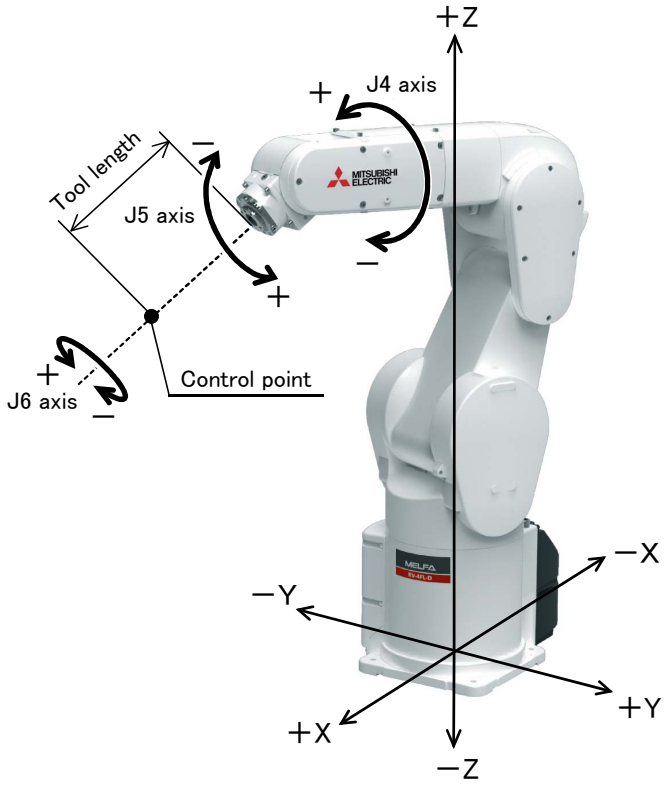
Fig.2-18 : XYZ jog operation



5-axis type/6-axis type

* While maintaining the flange surface posture, the axis moves straight along the tool coordinate system. Also, while maintaining the flange surface position, the flange surface posture changes. For the 5-axis type robot, the axis moves only in the X and Z axis directions of tool coordinate system.

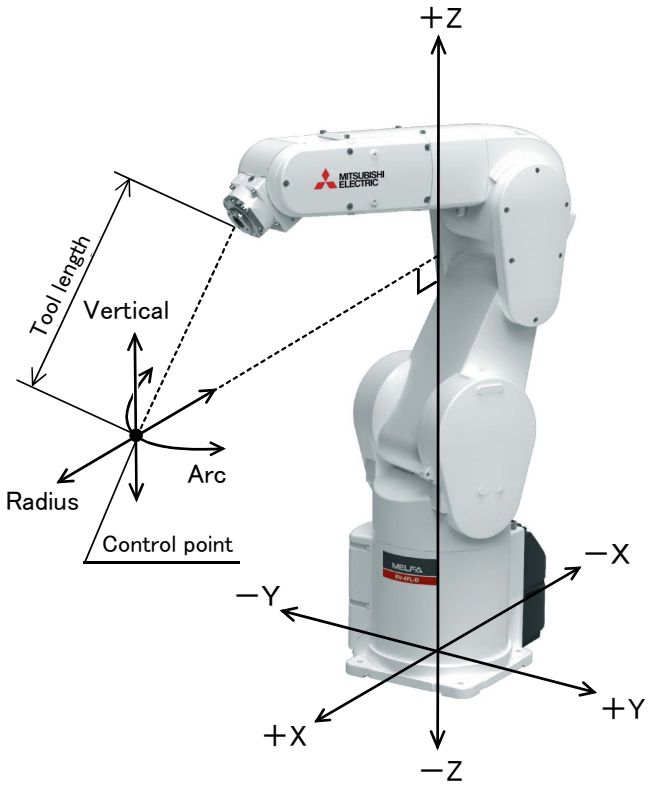
Fig.2-19 : TOOL jog operation



5-axis type/6-axis type

* The axis moves straight along the base coordinate system. At this time, the flange surface posture is not maintained. Also, the flange surface posture changes. The flange surface position does not change at this time. It is effective to change the posture of the wrist, with the position maintained. The 5-axis type robot has no J4 axis.

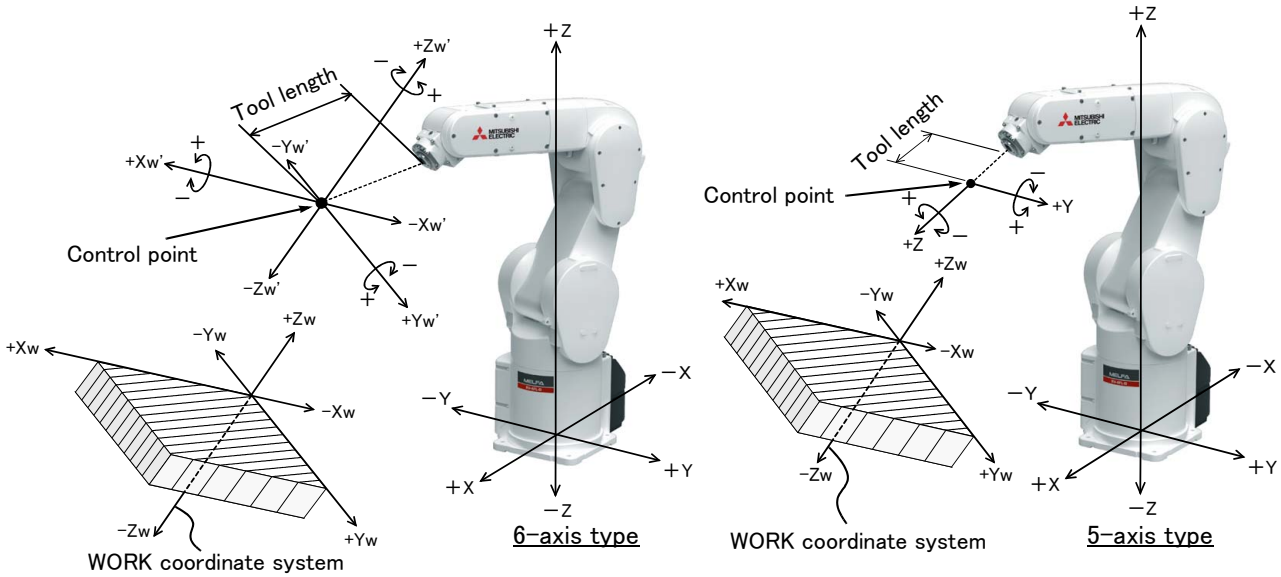
Fig.2-20 : 3-axis XYZ jog operation



5-axis type/6-axis type

* 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 flange surface posture is maintained. Also, while maintaining the flange surface position, the flange surface posture changes.

Fig.2-21 : CYLINDER jog operation

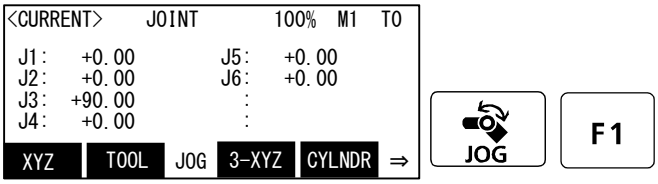


* While maintaining the flange surface posture, the axis moves straight along the work coordinate system. Also, while maintaining the flange surface position, the flange surface posture changes.
* When the controller software version is R5 (F-Q series)/S5 (F-D series) or later, jog operation around the work coordinates system is available for the 6-axis type (EX-T jog). In this jog operation, when the jog operation is performed for the posture elements, the posture rotates on the Xw axis, Yw axis, or Zw axis of the work coordinates system while the control point is changed.

Fig.2-22 : WORK jog operation

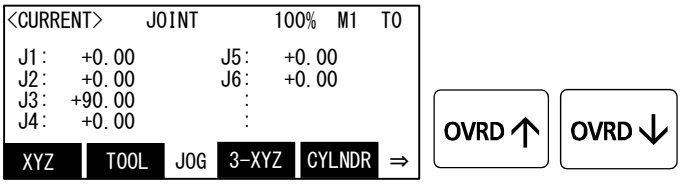
(1) JOINT jog operation

Select joint jog mode



Joint jog mode

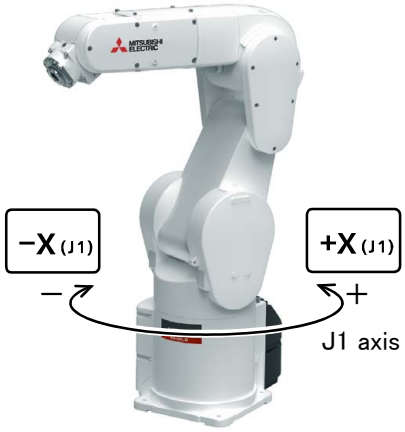
Set jog speed



Setting the speed

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

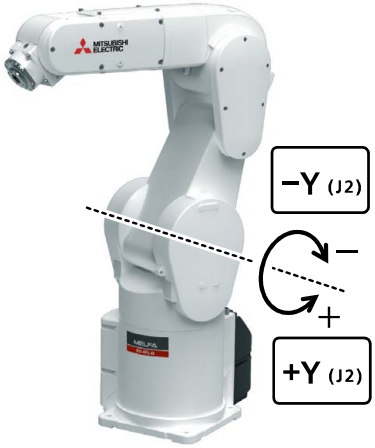
J1 axis jog operation



5-axis type/6-axis type

- 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



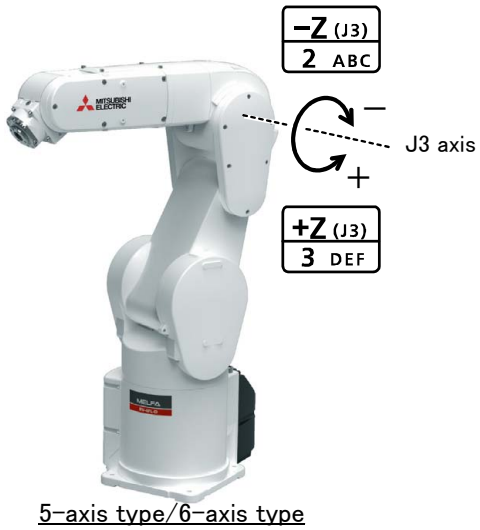
5-axis type/6-axis type

- 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.

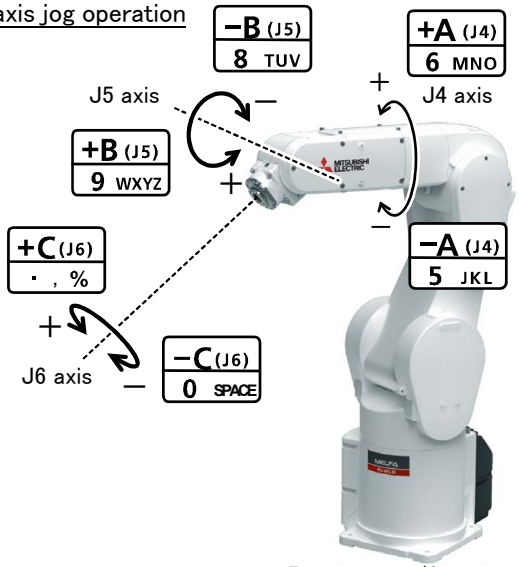
J3 axis jog operation



5-axis type/6-axis type

- 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, J5 and J6 axis jog operation



* The 5-axis type robot has no J4 axis.

5-axis type/6-axis type

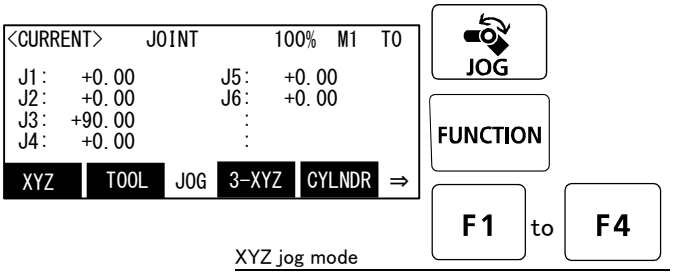
- When the [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction. (6-axis type only)
  When the [−A (J4)] keys are pressed, rotate in the minus direction. (6-axis type only)
- When the [+B (J5)] keys are pressed, the J5 axis will rotate in the plus direction
  When the [−B (J5)] keys are pressed, rotate in the minus direction.
- When the [+C (J6)] keys are pressed, the J6 axis will rotate in the plus direction
  When the [−C (J6)] keys are pressed, rotate in the minus direction.

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

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

(2) XYZ jog operation

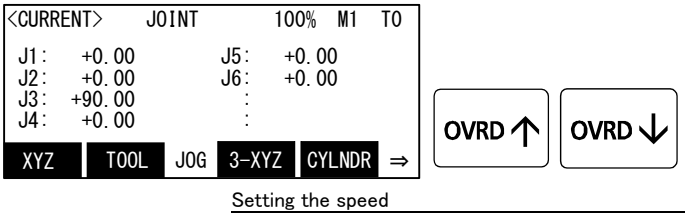
Select XYZ jog mode



XYZ jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "XYZ" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

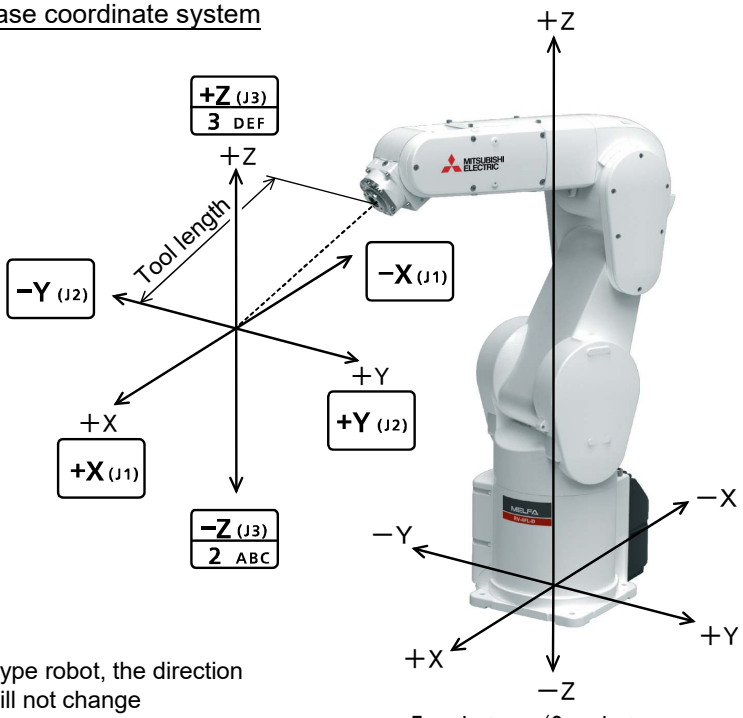
Set jog speed



Setting the speed

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

Moving along the base coordinate system



* For the 6-axis type robot, the direction of the flange will not change

5-axis type/6-axis type

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

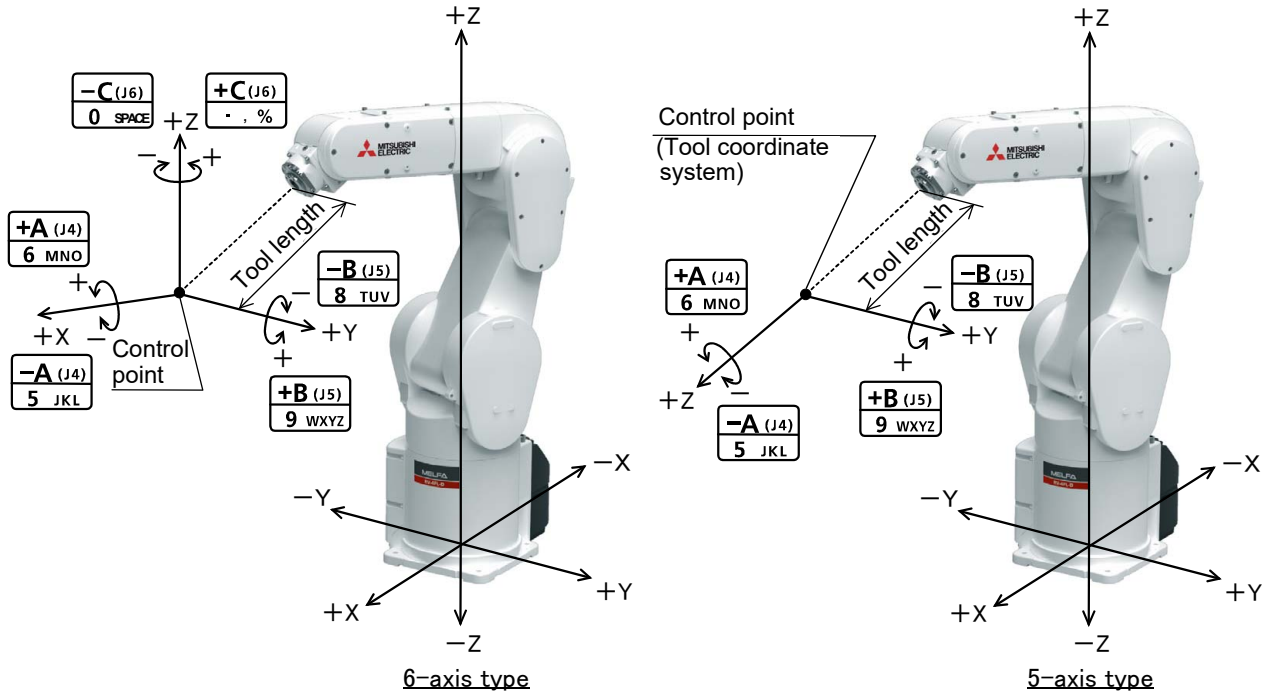
◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 32, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

Changing the flange surface posture



* The control point does not change.

- When the [+A (J4)] keys are pressed,
  6-axis type: the X axis will rotate in the plus direction.
  5-axis type: the Z axis will rotate in the plus direction of the tool coordinate system.
  When the [−A (J4)] keys are pressed, rotate in the minus direction.
- When the [+B (J5)] keys are pressed,
  6-axis type: the Y axis will rotate in the plus direction.
  5-axis type: the Y axis will rotate in the plus direction of the tool coordinate system.
  When the [−B (J5)] keys are pressed, rotate in the minus direction.
- When the [+C (J6)] keys are pressed,
  6-axis type: the Z axis will rotate in the plus direction.
  5-axis type: there is no operation.
  When the [−C (J6)] keys are pressed,
  6-axis type: rotate in the minus direction.
  5-axis type: there is no operation.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

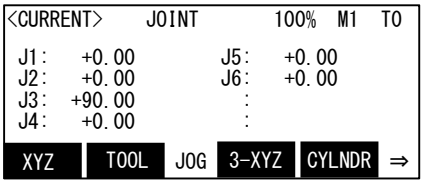
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

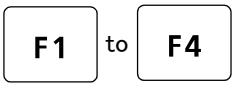
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

Select TOOL jog mode

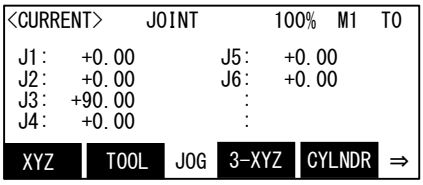


TOOL jog mode

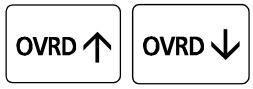


[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "TOOL" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "TOOL." (If the jog mode which he wishes under the screen is not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

Set jog speed

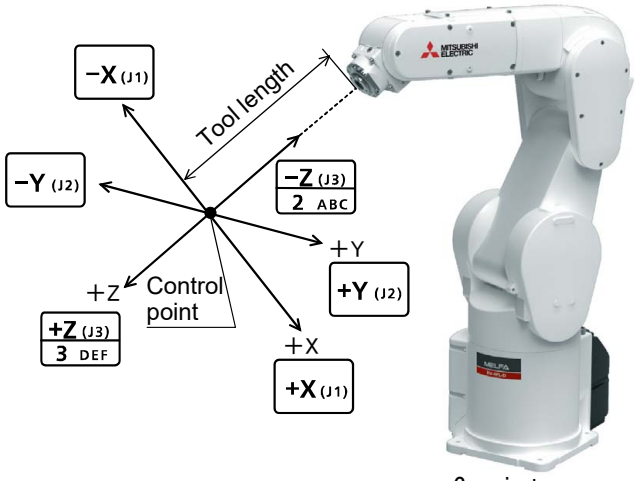


Setting the speed

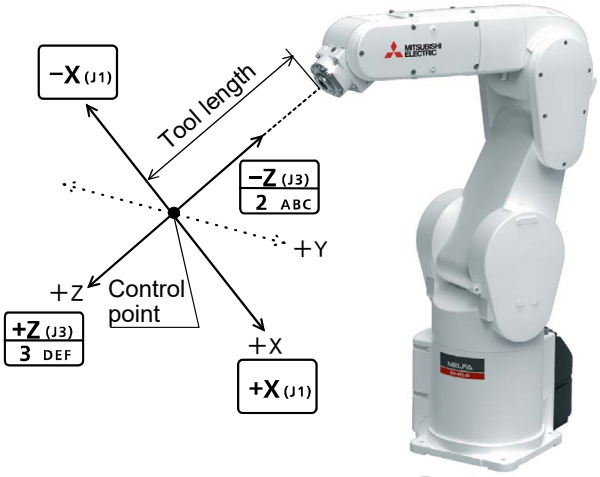


Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work.

Moving along the tool coordinate system



6-axis type



5-axis type

* The direction of the flange will not change

・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. (6-axis type only)
When the [−Y (J2)] keys are pressed, move along the minus direction. (6-axis type only)
・When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
When the [−Z (J3)] keys are pressed, move along the minus direction.

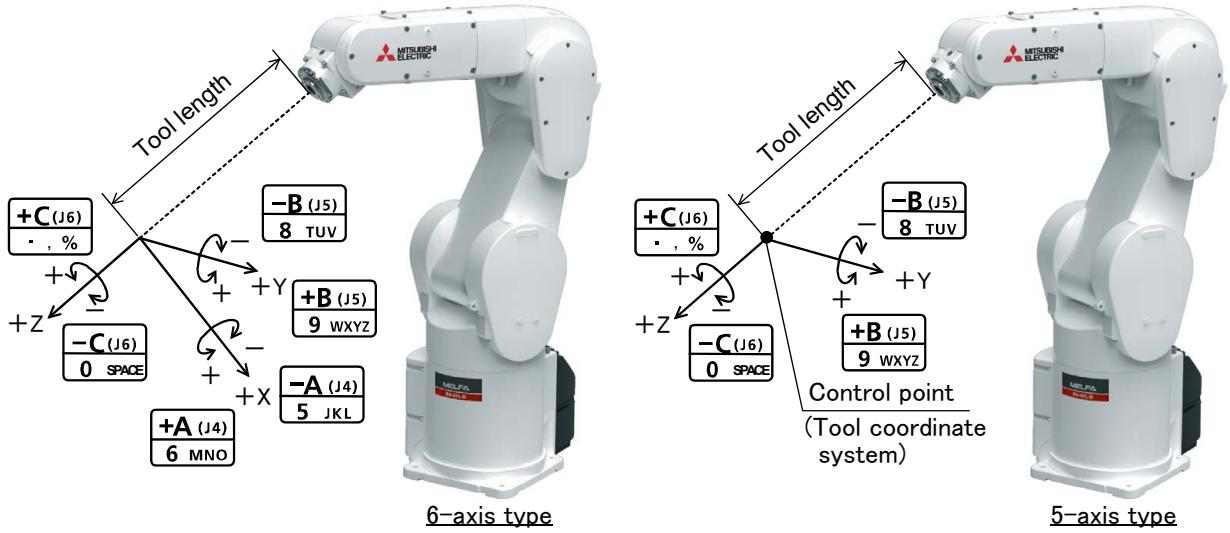
◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 32, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

Changing the flange surface posture



6-axis type　　5-axis type

* The control point does not change.

<6-axis type robot>

- When the[+A (J4)] keys are pressed, the X axis will rotate in the plus direction of the tool coordinate system. When the[−A (J4)] keys are pressed, rotate in the minus direction.
- When the[+B (J5)] keys are pressed, the Y axis will rotate in the plus direction of the tool coordinate system. When the[−B (J5)] keys are pressed, rotate in the minus direction.
- 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.

<5-axis type robot>

- There is no operation by the [+A (J4)] key and [−A (J4)] key.
- When the[+B (J5)] keys are pressed, the J5 axis will rotate in the plus direction. When the[−B (J5)] keys are pressed, rotate in the minus direction.
- When the[+C (J6)] keys are pressed, the J6 axis will rotate in the plus direction. When the[−C (J6)] keys are pressed, rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

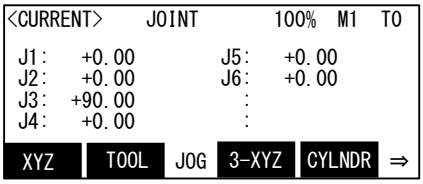
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

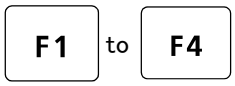
The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(4) 3-axis XYZ jog operation

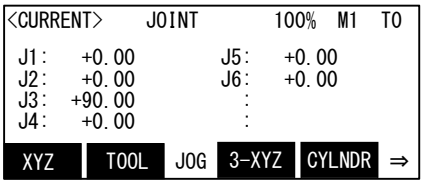
Select XYZ456 jog mode



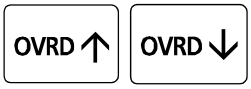
XYZ456 jog mode



Set jog speed

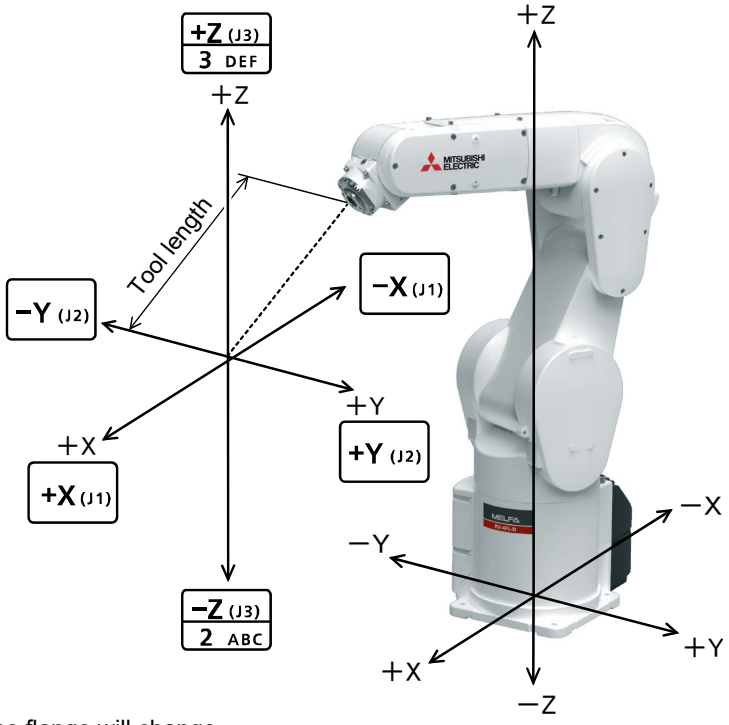


Setting the speed



[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "XYZ456" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ456." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."
Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, 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 flange will change

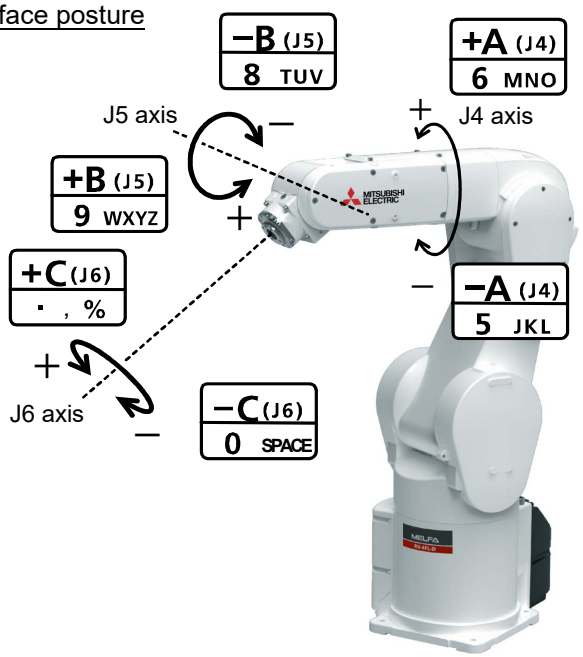
5-axis type/6-axis type

- 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 flange surface posture



* The 5-axis type robot has no J4 axis.

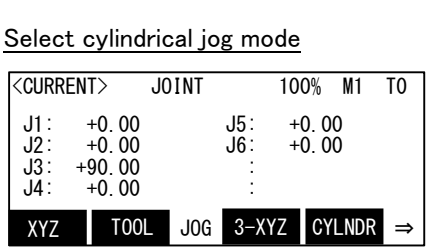
5-axis type/6-axis type

* The wrist pose can be changed maintaining the flange's position.

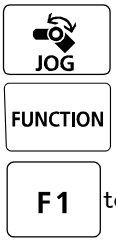
- When the[+A (J4)] keys are pressed, the J4-axis will rotate in the plus direction. (6-axis type)
  At this time, to maintain the flange's position, other axes move simultaneously except J5 and J6.
  When the[−A (J4)] keys are pressed, rotate in the minus direction. (6-axis type)
- When the[+B (J5)] keys are pressed, the J5-axis will rotate in the plus direction.
  At this time, to maintain the flange's position, other axes move simultaneously except J4 and J6.
  When the[−B (J5)] keys are pressed, rotate in the minus direction.
- When the[+C (J6)] keys are pressed, the J6-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

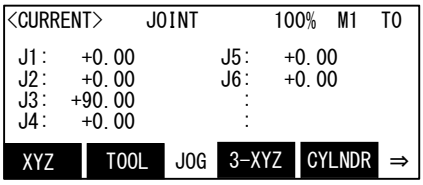


CYLNDER jog mode

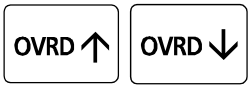


[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "CYLNDER" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "CYLNDER." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Set jog speed

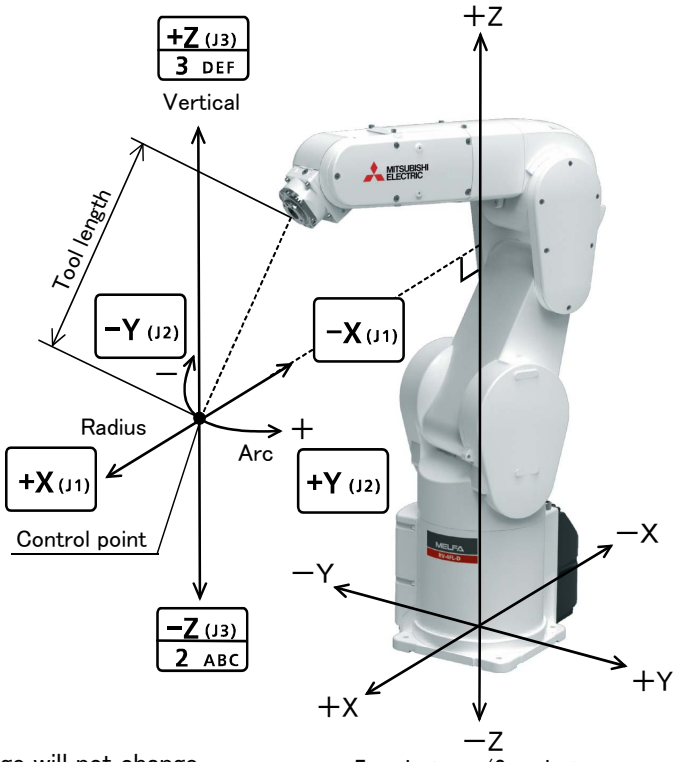


Setting the speed



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

Moving along an arc centering on the Z axis



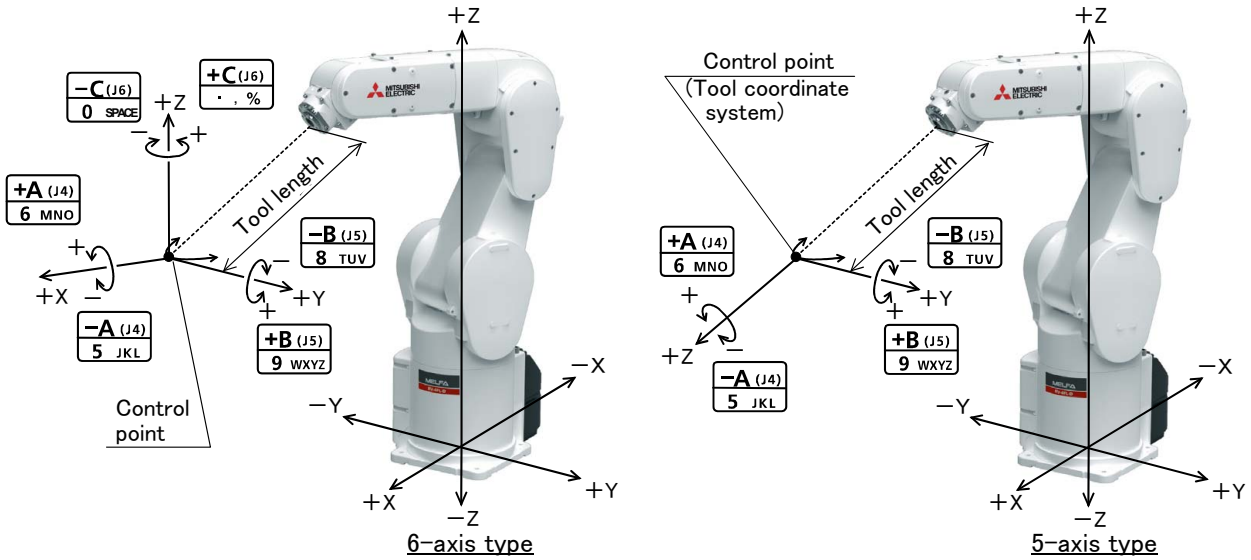
∗ The direction of the frange will not change.

5-axis type/6-axis type

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.

Changing the flange surface posture



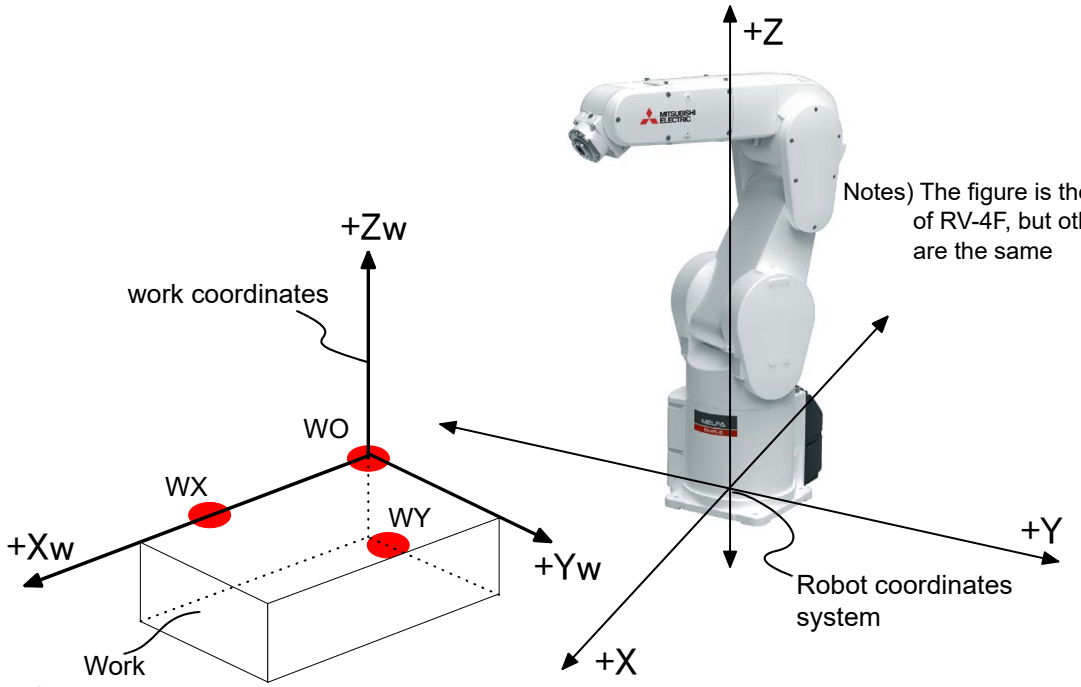
* The flange position does not change.
  This is the same as the A, B and C axis XYZ jog operation.

- When the [+A (J4)] keys are pressed,
  6−axis type: the X axis will rotate in the plus direction.
  5−axis type: the Z axis will rotate in the plus direction of the tool coordinate system.
  When the [−A (J4)] keys are pressed, rotate in the minus direction.
- When the [+B (J5)] keys are pressed,
  6−axis type: the Y axis will rotate in the plus direction.
  5−axis type: the Y axis will rotate in the plus direction of the tool coordinate system.
  When the [−B (J5)] keys are pressed, rotate in the minus direction.
- When the [+C (J6)] keys are pressed,
  6−axis type: the Z axis will rotate in the plus direction.
  5−axis type: There is no operation.
  When the [−C (J6)] keys are pressed,
  6−axis type: rotates in the minus direction.
  5−axis type: There is no operation.

(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.)

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



The jogging movement based on this work is possible.

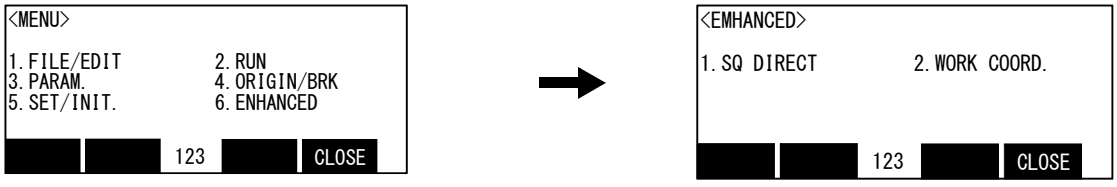
< ● Teaching point>
WO: Work coordinates system origin
WX: Position on the "+X" axis of work coordinates system.
WY: Position at the side of "+Y" axis on the X-Y plane of work coordinates system.

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

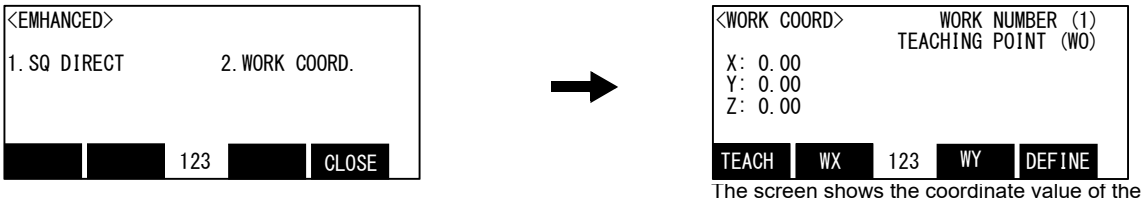
Fig.2-23 : Setting of the work coordinates system (teaching point)

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

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



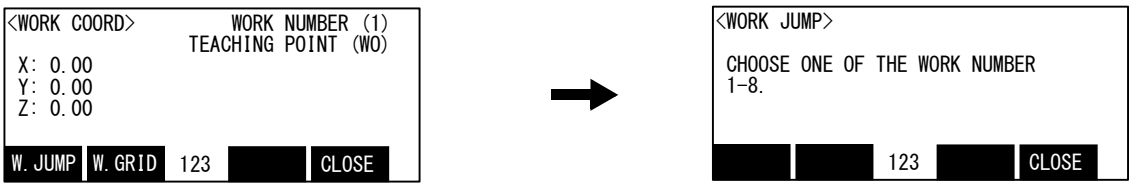
2) Press the [2] keys in the menu screen and select "2. WORK COORD."



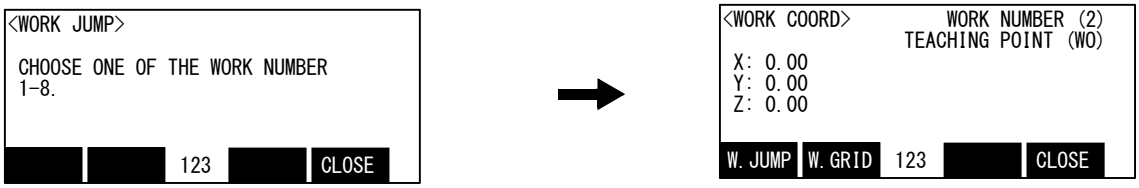
The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

3) Selection of the work coordinates number

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



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

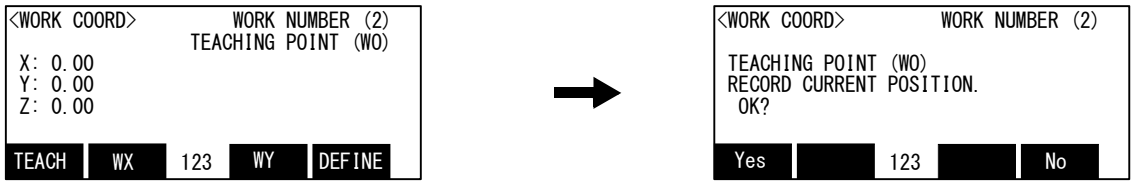


Operation will be canceled if the [CLOSE] key is pressed.

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

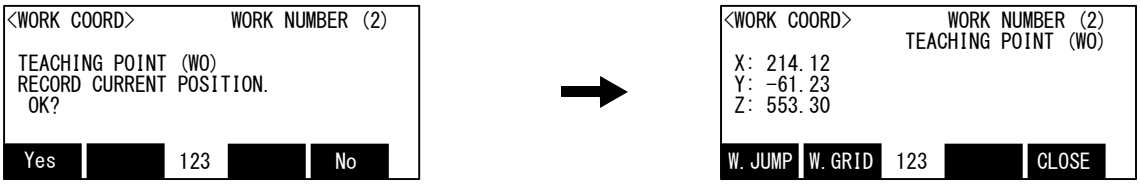
4) The teaching of the work coordinates system

Teach the three points shown in Fig. 2-23. Confirm the name currently displayed on the "TEACHING POINT" at the upper right of the screen. If it differs, press the function key corresponding to each point(WO, WX, WY) to teach. Move the robot's arm by jog operation (other jogging movement), and press the function key corresponding to "TEACH."([F1]) The confirmation screen is displayed.



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

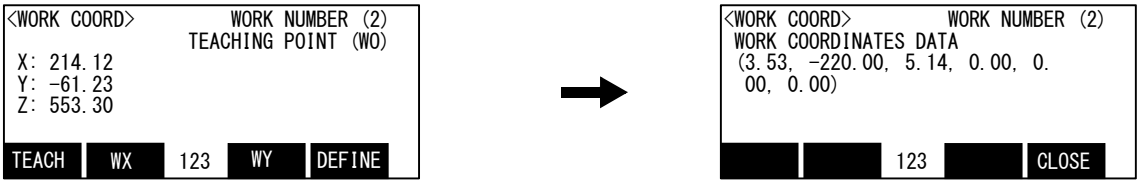
Presses the function key corresponding to"Yes", the robot's current position is registered, and the registered coordinates value is displaye. Operation will be canceled if the [CLOSE] key is pressed.



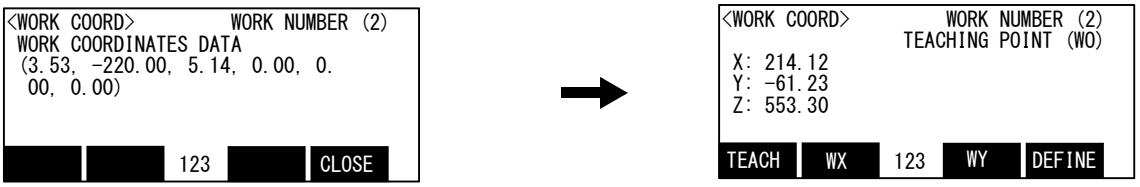
Teach the three points, WO, WX, and WY, by the same operation.
The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)

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

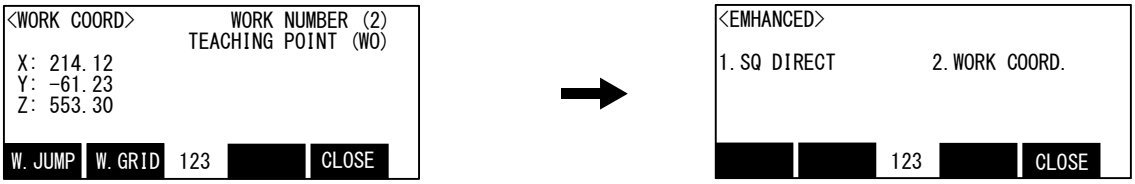
5) Setting of work coordinates (definition)
If the function key corresponding to "DEFINE" ([F1]) is pressed, the work coordinates system will be calculated using the three points, and the result will be displayed.



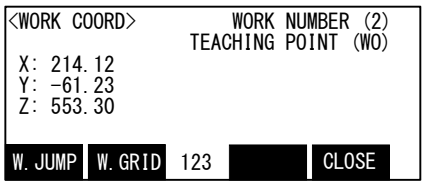
The alarm occurs if the work coordinates system is incalculable. (There are the three points on the straight line, or the two points have overlapped) In this case, reset alarm and re-teach the three points.
This work coordinate data is registered into parameter: WKnCORD. ("n" means the work coordinates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

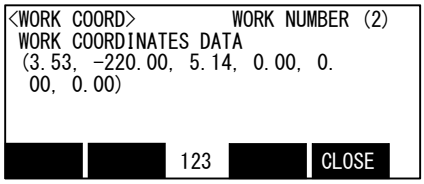


6) Finishing of setting the work coordinates
Press the [FUNCTION] keys, and display "CLOSE" function. Press the function key corresponding to "CLOSE". Returns to the <MENU> screen.



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

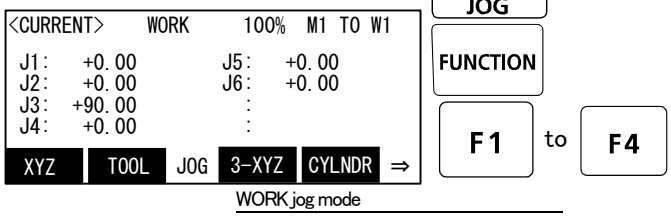




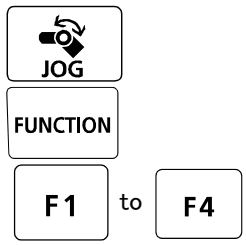
Return to the previous screen by pressing the [CLOSE] ([F4]) key.

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

Select WORK jog mode

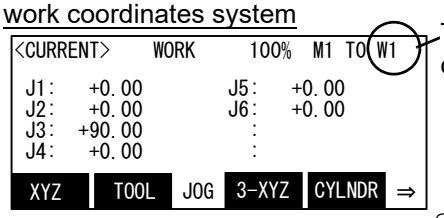


WORK jog mode

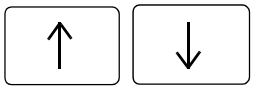


[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "WORK" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "WORK." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Confirmation and selection of the work coordinates system



Target work coordinates system



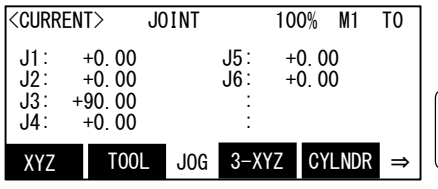
Select the work coordinates system

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

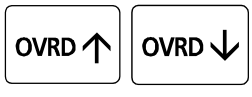
⚠ CAUTION

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

Set jog speed



Setting the speed



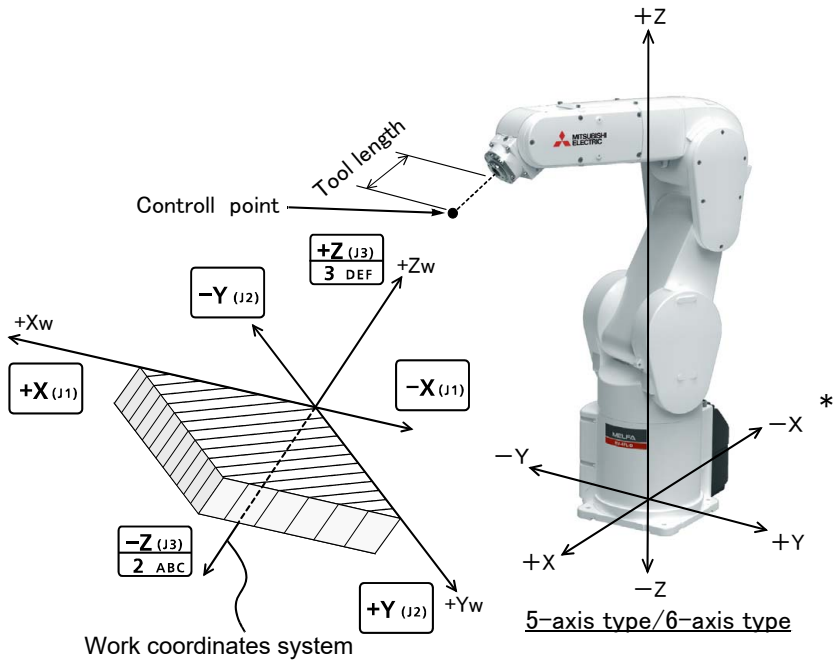
Whenever it presses the key of [OVRD(Upper arrow)], the override goes up. Conversely, if the [OVRD(Lower arrow)] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

When the software version is R5 (F-Q series)/S5 (F-D series) or later, the additional WORK jog operation, Ex-T jog, is available. The conventional WORK jog operation and the Ex-T jog operation can be switched by setting the parameters WK1JOGMD to WK8JOGMD of each work coordinates system.
The respective operations are as follows.

WORK jog operation mode	Conventional WORK jog	Ex-T jog
Parameters WKnJOGMD (n is 1 to8) setting	0 (initial value)	1
XYZ key operation	Moves along each axis of the work coordinates system	Same as the conventional WORK jog
ABC key operation	With the control point position maintained, the direction changes along the work coordinates system.	While the control point position is changed, the direction changes on each axis of the work coordinates system.

* The Ex-T jog cannot be used for the 5-axis type. Even when "1" is set in the parameter WKnJOGMD, the operation is the same as the conventional WORK jog operation.

The jog movement based on work coordinates system



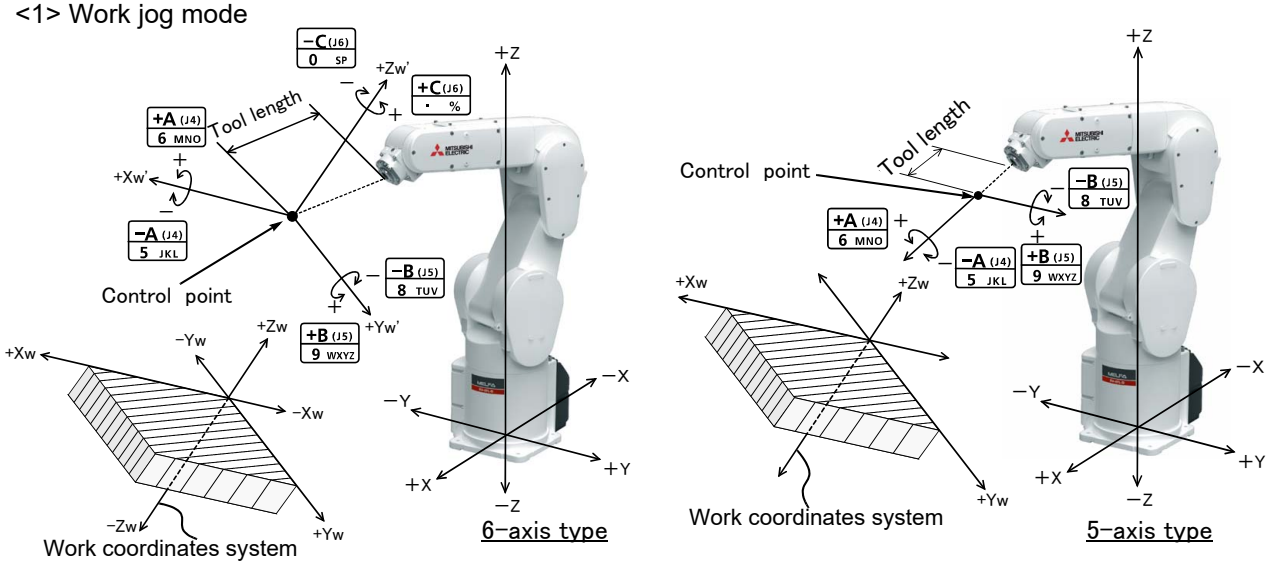
* The direction of the flange will not change. (6−axis type)
Move the control point with a straight line in accordance with the work coordinates system

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

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

Changing the flange surface posture

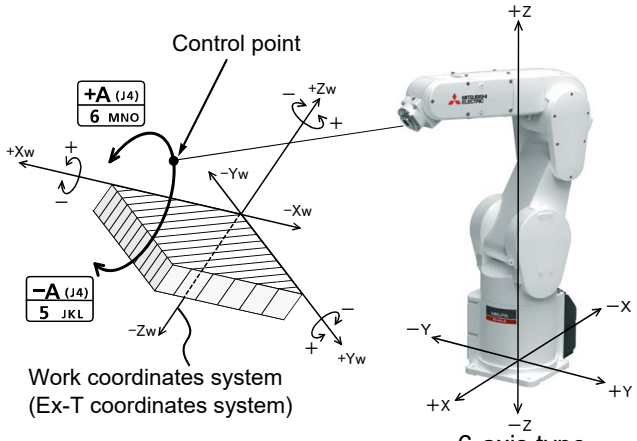
<1> Work jog mode



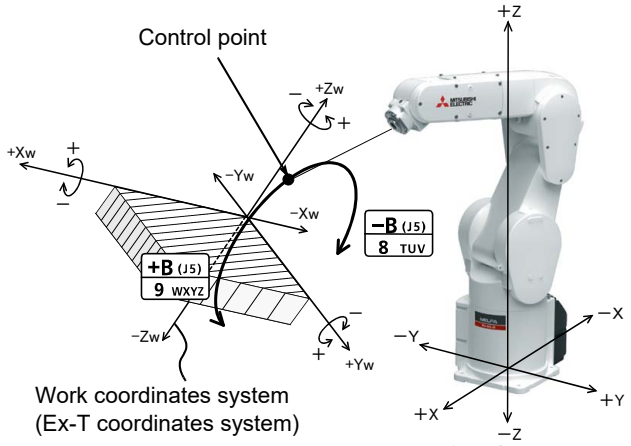
* The position of the control point does not change.
Change the direction of the flange in accordance with the work coordinates system.

- When the [+A (J4)] keys are pressed,
  6−axis type: the X axis will rotate in the plus direction of the work coordinate system.
  5−axis type: the Z axis will rotate in the plus direction of the tool coordinate system.
  When the [−A (J4)] keys are pressed, rotate in the minus direction.
- When the[+B (J5)] keys are pressed,
  6−axis type: the Y axis will rotate in the plus direction of the work coordinate system.
  5−axis type: the Y axis will rotate in the plus direction of the tool coordinate system.
  When the [−B (J5)] keys are pressed, rotate in the minus direction.
- When the [+C (J6)] keys are pressed,
  6−axis type: the Z axis will rotate in the plus direction of the work coordinate system.
  5−axis type: There is no operation.
  When the [−C (J6)] keys are pressed,
  6−axis type: rotate in the minus direction.
  5−axis type: There is no operation.

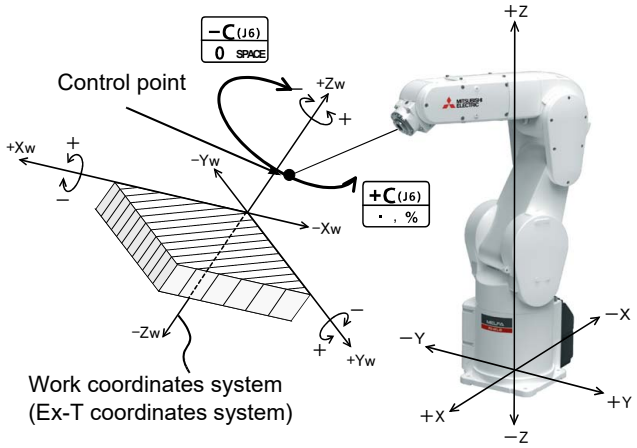
<2> Ex-T jog mode



6-axis type



6-axis type



6-axis type

* The control point rotates around each axes of work coordinates system (Ex-T coordinates system). When the [+A (J4)] or the [-A (J4)] key is pressed, the control point rotates around the Xw axis. When the [+B (J5)] or the [-B (J5)] key is pressed, the control point rotates around the Yw axis. When the [+C (J6)] or the [-C (J6)] key is pressed, the control point rotates around the Zw axis.
* The Ex-T jog cannot be used for the 5-axis type.

・When the [+A (J4)] keys are pressed, the control point will rotate in the plus direction around the X axis (Xw) of work coordinates system (Ex−T coordinates system).
When the [−A (J4)] keys are pressed, the control point will rotate in the minus direction.
・ When the [+B (J5)] keys are pressed, the control point will rotate in the plus direction around the Y axis (Yw) of work coordinates system. (Ex−T coordinates system).
When the [−B (J5)] keys are pressed, the control point will rotate in the minus direction.
・ When the [+C (J6)] keys are pressed, the control point will rotate in the plus direction around the Z axis (Zw) of work coordinates system. (Ex−T coordinates system).
When the [−C (J6)] keys are pressed, the control point will rotate in the minus direction.

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

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section Page 32, "(1) JOINT jog operation"", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

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

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

◇◆◇ Tool length ◇◆◇

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

3 Installing the option devices

3.1 Installing the J1 axis operating range change

The configuration, changeable angle and installation outline of J1 axis operating range change are shown below.

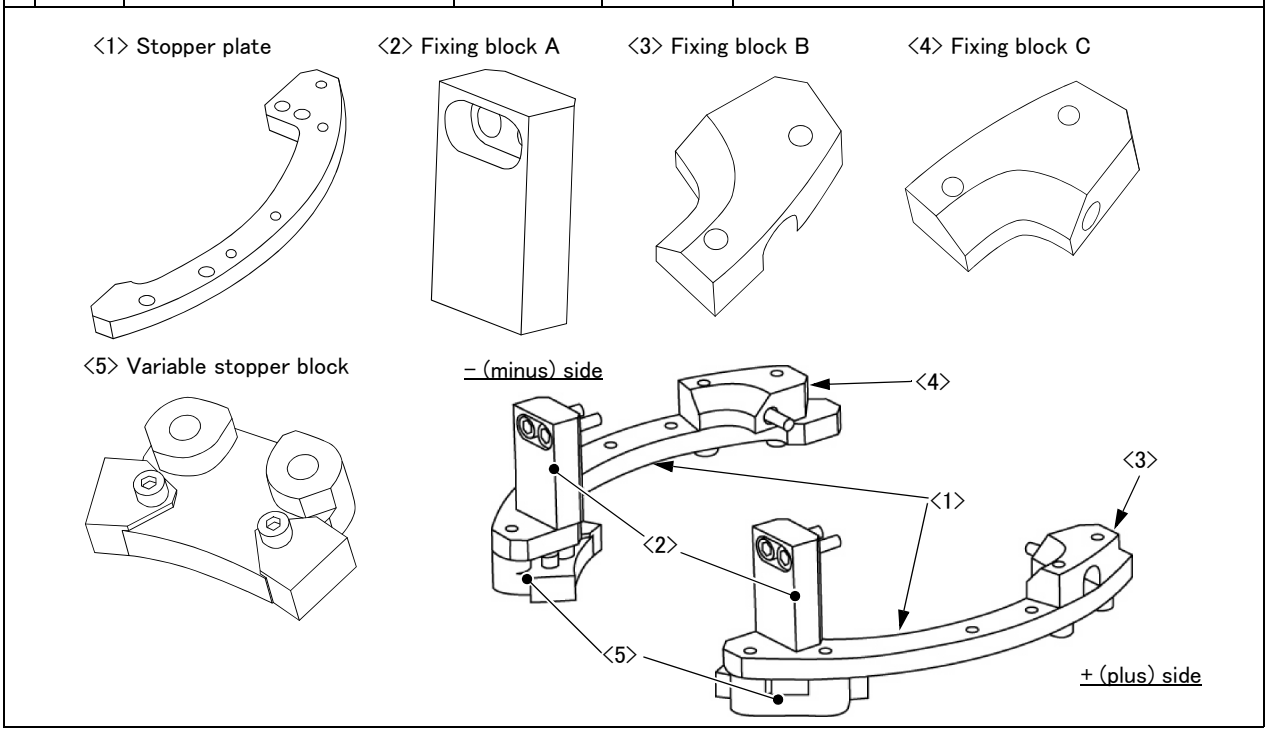
3.1.1 RV-4F/7F series

(1) Configuration

The configuration parts of this option are shown in Table 3-1. Please confirm.
The option for RV-4F series is 1F-DH-03, and RV-7F series is 1F-DH-04.

Table 3-1 : Configuration devices

No.	Part name	Qty.	Mass (kg)	Remarks
RV-4F series				
<1>	Stopper plate	2	1.1	One piece each for + side/- side
<2>	Fixing block A	2		One piece each for + side/- side
<3>	Fixing block B	1		+ side
<4>	Fixing block C	1		- side
<5>	Variable stopper block	2		One piece each for + side/- side
<6>	Screw (M10x20)	2		Use for mechanical stopper screw A and B
<7>	Screw (M6x25)	2		For fixing
<8>	Screw (M6x20)	16		For fixing
RV-7F series				
<1>	Stopper plate	2	1.1	One piece each for + side/- side
<2>	Fixing block A	2		One piece each for + side/- side
<3>	Fixing block B	1		+ side
<4>	Fixing block C	1		- side
<5>	Variable stopper block	2		One piece each for + side/- side
<6>	Screw (M12x25)	2		Use for mechanical stopper screw A and B
<7>	Screw (M8x25)	14		For fixing
<8>	Screw (M8x20)	4		For fixing



(2) Changeable angle

The changeable angle of RV-4F series is shown in Table 3-2, and of RV-7F series is shown in Table 3-3. Use as reference for the installation position of Variable stopper block to the wished angle and use/disuse of the Mechanical stopper screw A/B and the parameter setup value.

Table 3-2 : Changeable angle (RV-4F series)

Item	Standard	Changeable angle (combination of + side/- side) (Unit: Degree)			
+ (plus) side	+240	+30	+73	+103	+146
Variable stopper block angle	-	+33	+76	+106	+149
Variable stopper block position Note1)	-	(a)	(b)	(a)	(b)
Mechanical stopper screw A Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	+240	+30	+73	+103	+146
+ (minus) side	-240	-30	-73	-103	-146
Variable stopper block angle	-	-33	-76	-106	-149
Variable stopper block position Note1)	-	(d)	(c)	(d)	(c)
Mechanical stopper screw B Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	-240	-30	-73	-103	-146

Note1)Symbol: "(a)" - "(d)" in Table 3-2 is related with the symbol of "Fig. 3-1: Installation image of J1axis operating range change option".

Note2)In the table, it means that "Disuse" does not install the screw, and "Use" does install the screw.

Note3)Mechanical stopper screw which is either one of the two is always necessary. For this reason, the combination enclosed by the thick line of the square in the table (both of + (plus) side and - (minus) side are 103 or 146) cannot be used. Example) Setting + 146 degree and -103 degree simultaneously cannot be used. The other combination can be set up.

Table 3-3 : Changeable angle (RV-7F series)

Item	Standard	Changeable angle (combination of + side/- side) (Unit: Degree)			
+ (plus) side	+240	+35	+77	+99	+141
Variable stopper block angle	-	+38	+80	+102	+144
Variable stopper block position Note1)	-	(a)	(b)	(a)	(b)
Mechanical stopper screw A Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	+240	+35	+77	+99	+141
+ (minus) side	-240	-35	-77	-99	-141
Variable stopper block angle	-	-38	-80	-102	-144
Variable stopper block position Note1)	-	(d)	(c)	(d)	(c)
Mechanical stopper screw B Note2)	-	Use		Disuse Note3)	
Parameter (MEJAR) setting value	-240	-35	-77	-99	-141

Note1)Symbol: "(a)" - "(d)" in Table 3-3 is related with the symbol of "Fig. 3-1: Installation image of J1axis operating range change option".

Note2)In the table, it means that "Disuse" does not install the screw, and "Use" does install the screw.

Note3)Mechanical stopper screw which is either one of the two is always necessary. For this reason, the combination enclosed by the thick line of the square in the table (both of + (plus) side and - (minus) side are 99 or 141) cannot be used. Example) Setting + 141 degree and -99 degree simultaneously cannot be used. The other combination can be set up.

The installation procedure of the J1 axis operating range change is shown below.

When installing this option to the minus side, should move the J1 axis to the +70 degrees using jog operation previously, and do this work.

[Note] When installing this option for safety, you should cut off the power supply of the controller.
Surely fix the screw of M6 by 15.7Nm, and the screw of M10 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot. Although the following shows the procedure installed to +(plus) side, −(minus) side is the same also.

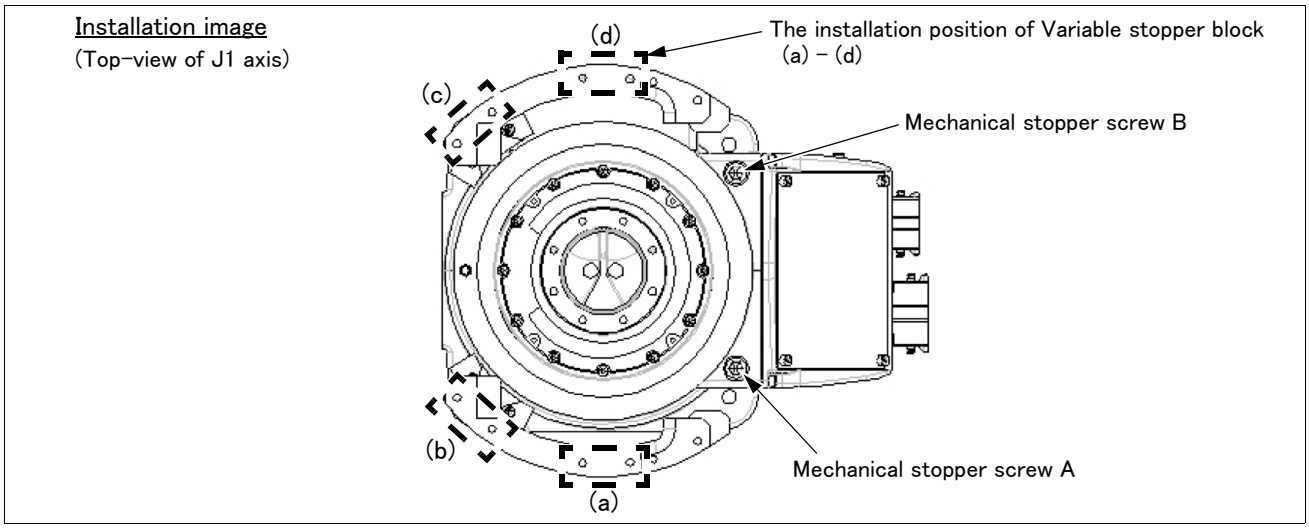


Fig.3-1 : Installation image of J1axis operating range change option

[Example] In the RV-7F series, when limiting the +side to +35 degree, and the −side to −141 degree, install as following.
Variable stopper block: Installs in the position of (a), and the position of (c).
Mechanical stopper screw A: Install.
Mechanical stopper screw B: Do not install.

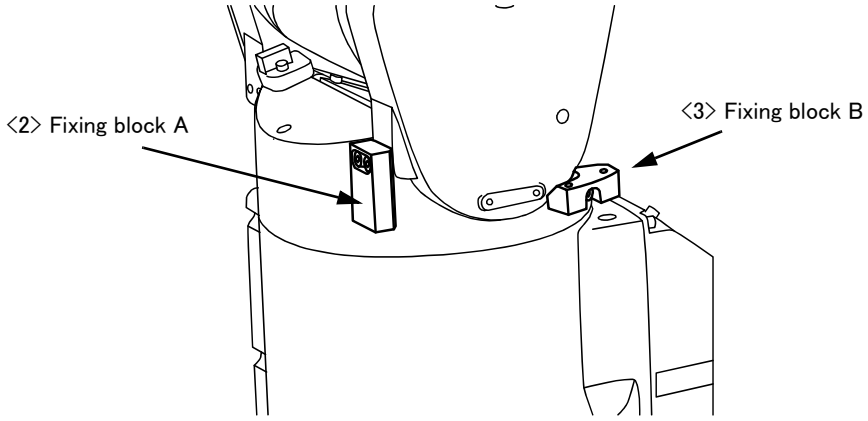
(3) Installation procedure

The installation procedure of the J1 axis operating range change is shown below.

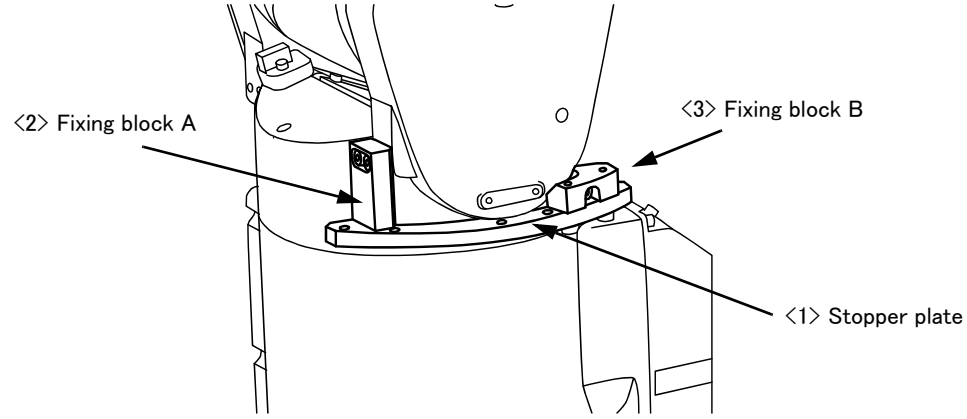
When installing this option to the minus side, should move the J1 axis to the +70 degrees using jog operation previously, and do this work.

⚠CAUTION When installing this option for safety, you should cut off the power supply of the controller.
Surely fix the screw of M6 by 15.7Nm, and the screw of M10 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot.
Although the following shows the procedure installed to +(plus) side, −(minus) side is the same also.

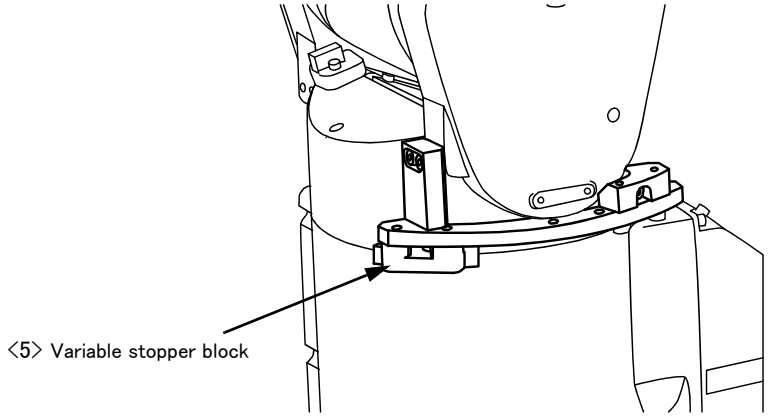
1) Fix the Fixing block A <2> and the Fixing block B <3> to the robot arm as temporary.
Fix the Fixing block A <2> by using the two screws <8>, and fix the Fixing block B <3> by using a screw <7>.



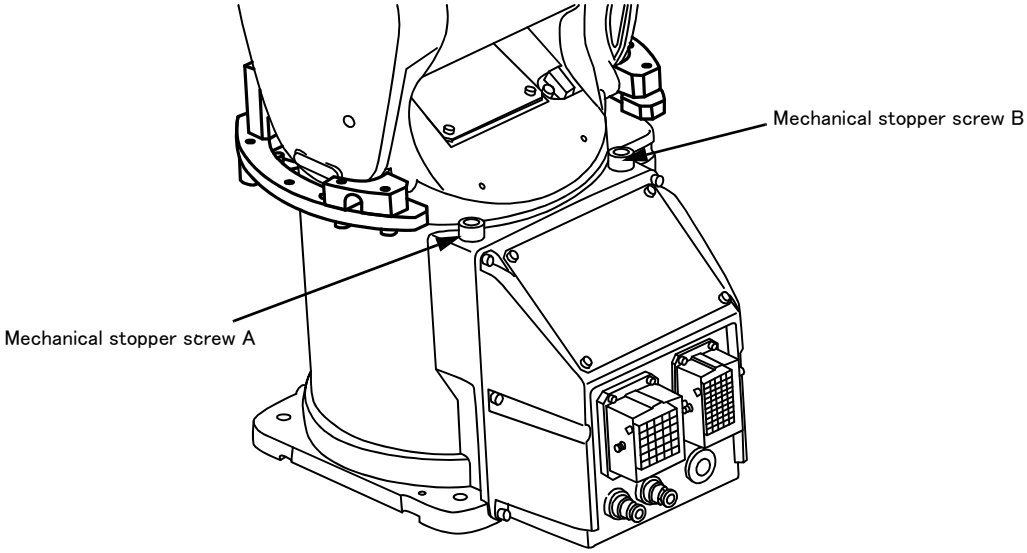
2) Install the Stopper plate <1>. Install by using each two screws (RV−4F: screw <8>, RV−7F: screw <7>), adjusting the combination position of the Fixing block A <2> and the Fixing block B <3>. Finally fix <1>,<2>,<3> securely.



3) Install the Variable stopper block <5> by using two screws (RV-4F: screw <8>, RV-7F: screw <7>). There are two installation positions in the +/- side respectively. Install to the position of the angle which limits the operating range with referring to Table 3-2 and Table 3-3.
Install the minus side in the same way. Move the J1 axis to the +70 degrees using jog operation previously, and install. (Turn on the power supply and move the J1 axis by jog operation) After installation, turn on the power supply and move the J1 axis to the 0 degree by jog operation.



4) Install the Mechanical stopper screw A or B. Install the necessary screw with referring to Table 3-2 and Table 3-3.



(4) Setting the parameter

Specify the operating range to parameters MEJAR with appropriate values (variable angles given in Table 3-2 or Table 3-3) by the following steps.

1) Turn on the power supply.
2) Set up the operating range changed into parameter MEJAR.
MEJAR: (J1 minus (-) side, J1 plus (+) side, ***, ***, ***, ...).

Note) Refer to the separate "Instruction manual/Detailed Explanation of Functions and Operations" for the details of the setting method.

(5) Check the operating range

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

The changing of the operating range is completed.

3.1.2 RV-13F series

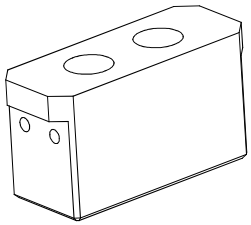
(1) Configuration

The configuration parts of this option (1F-DH-05J1) are shown in Table 3-1. Please confirm.

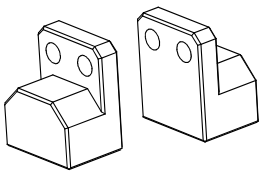
Table 3-4 : Configuration devices

No.	Part name	Qty.	Mass (kg)	Remarks
<1>	Stopper Block J1	1	0.3	
<2>	Resin Stopper B	2		One piece each for + side/− side
<3>	Screw (M12×20)	2		Mechanical Stopper screw
<4>	Screw (M10×40)	2		For Stopper Block J1 fixing
<5>	Screw (M4×12)	4		For Resin Stopper B fixing

<1>Stopper Block J1



<2>Resin Stopper B



(2) Changeable

The changeable angle of RV-13F series is shown in Table 3-5. Use as reference for the installation position of Mechanical Stopper screw and the parameter setup value.

Table 3-5 : Changeable angle (RV-13F series)

Item		Standard	Changeable angle	
+ (plus) side		+190	+30	+120
	Mechanical Stopper screw position Note1)	–	(A)	(B)
	Mechanical Stopper position	+193	+32.5	+122.5
	Parameter (MEJAR) setting value	+190	+30	+120
+ (minus) side		-190	-30	-120
	Mechanical Stopper screw position Note1)	–	(D)	(C)
	Mechanical Stopper position	-193	-32.5	-122.5
	Parameter (MEJAR) setting value	-190	-30	-120

Note1)Symbol: "(A)" – "(D)" in the Table 3-5 is related with the symbol of "Fig. 3-2: Installation image of J1axis operating range change option (RV-13F series)".

The installation procedure of the J1 axis operating range change is shown below.

[Note] When installing this option for safety, you should cut off the power supply of the controller. Surely fix the screw of M4 by 15.7Nm, and the screw of M10 by 26.5Nm, and the screw of M12 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot.

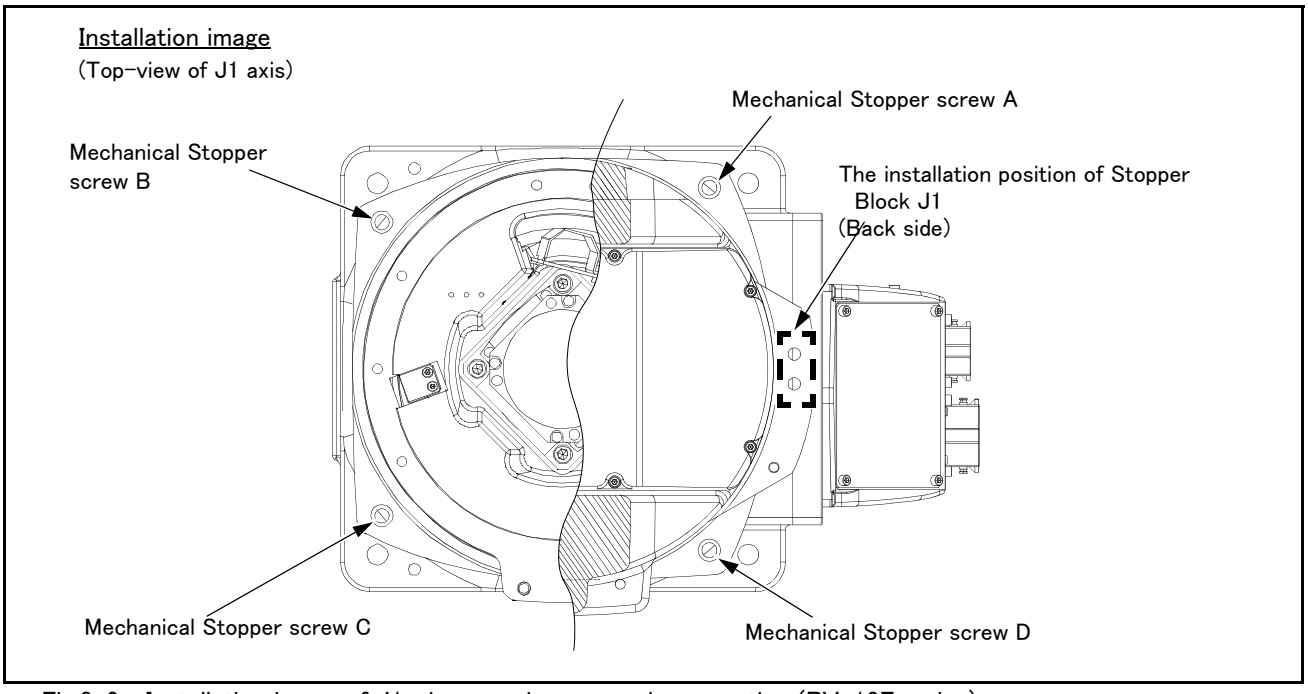


Fig.3-2 : Installation image of J1axis operating range change option (RV-13F series)

[Example] In the RV-13F series, when limiting + side to +32.5 degree and – side to -122.5 degree, install the Mechanical Stopper screw in the position of (A) and (C).

(3) Installation procedure

The installation procedure of the J1 axis operating range change is shown below.

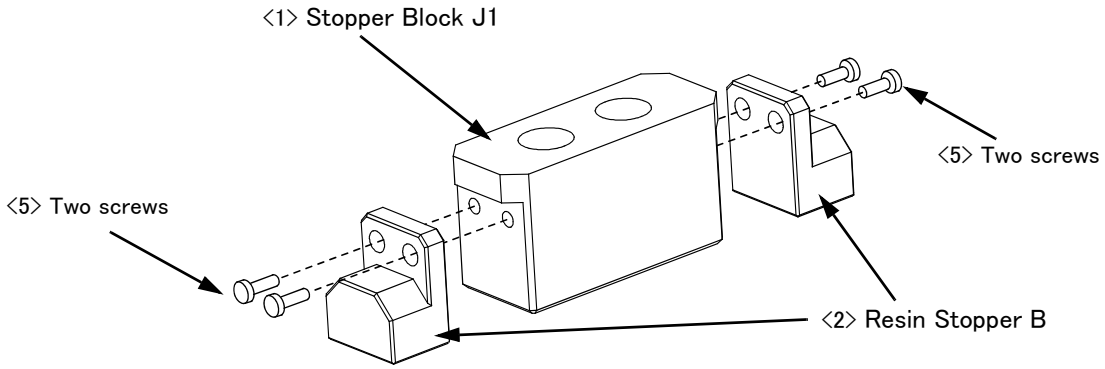
[Note] Previously, move the J1 axis to the position of the +90 degrees or the −90 degrees by jog operation.

⚠CAUTION When installing this option for safety, you should cut off the power supply of the controller.

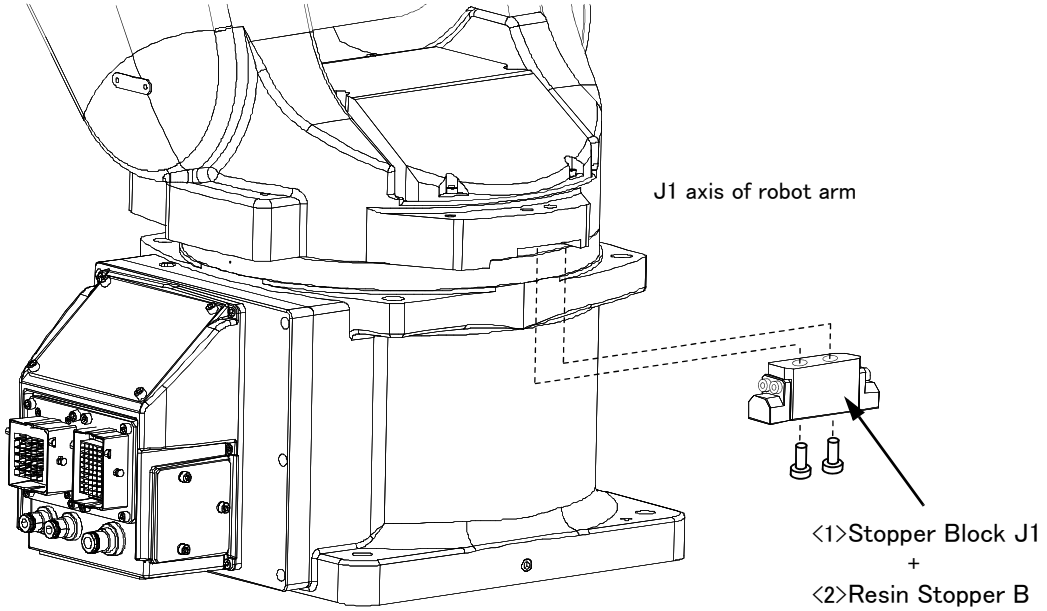
Surely fix the screw of M4 by 15.7Nm, and the screw of M10 by 26.5Nm, and the screw of M12 by 26.5Nm. Please confirm having surely fixed by correct torque before moving the robot.

Although the following shows the procedure installed to +(plus) side, −(minus) side is the same also.

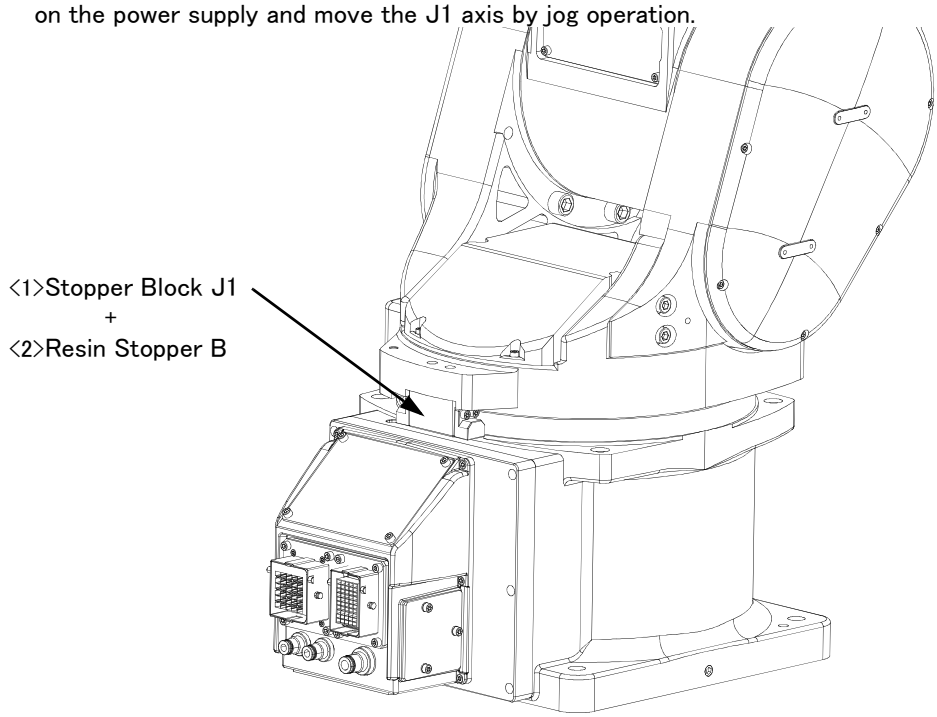
1) Install <2> Resin Stopper B (two pieces) to the both sides of <1> Stopper Block J1 in with the two attached <5> screws, and fix securely.



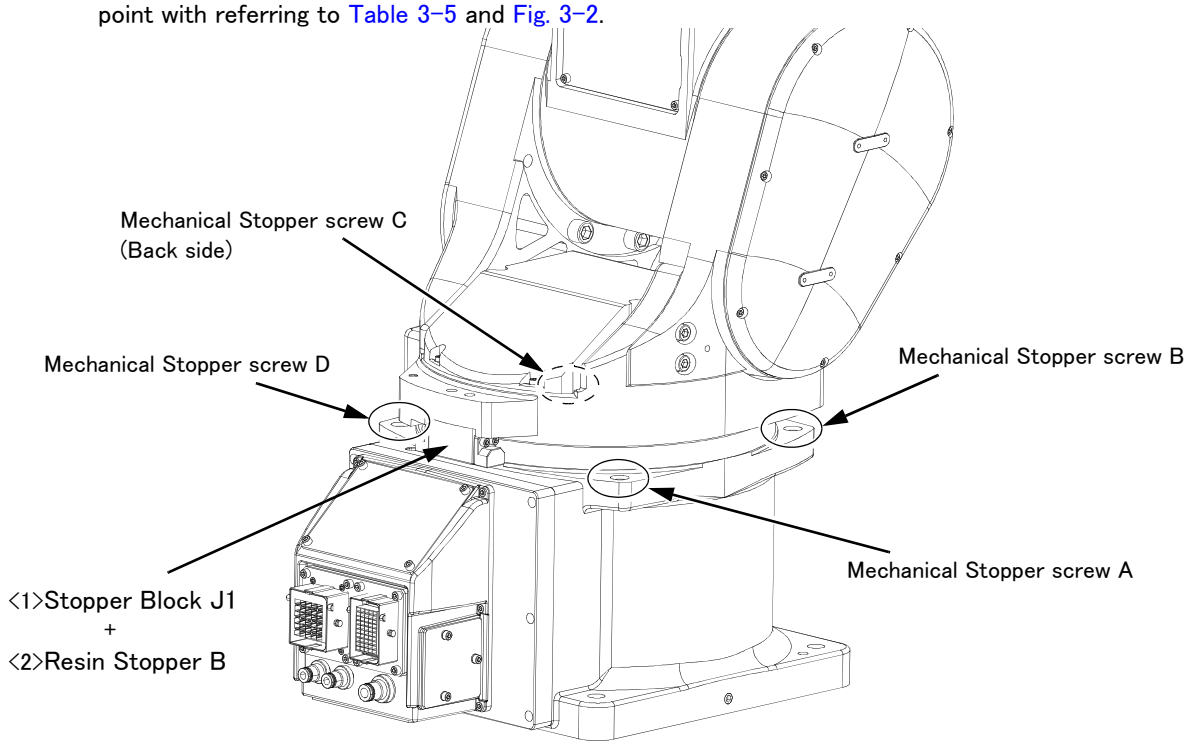
2) Install <1> Stopper Block J1 which combined with <2> Resin Stopper B to behind the J1 axis of robot arm by <4> two attached screws.



3) Because to install the Mechanical Stopper screw, once move the J1 axis to the position of 0 degree. Turn on the power supply and move the J1 axis by jog operation.



4) Install the <3> Mechanical Stopper screw. Install the <3> attached Mechanical Stopper screw to the needed point with referring to Table 3-5 and Fig. 3-2.



(4) Setting the parameter

Specify the operating range to parameters MEJAR with appropriate values (variable angles given in Table 3-5) by the following steps.

1) Turn on the power supply.
2) Set up the operating range changed into parameter MEJAR.
   MEJAR: (J1 minus (−) side, J1 plus (+) side, ***, ***, ***, ...).

Note) Refer to the separate "Instruction manual/Detailed Explanation of Functions and Operations"" for the details of the setting method.

(5) Check the operating range

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

The changing of the operating range is completed.

3.2 Installing the solenoid valve set

As shown in Fig. 3-3, install the solenoid valve set on the forearm.

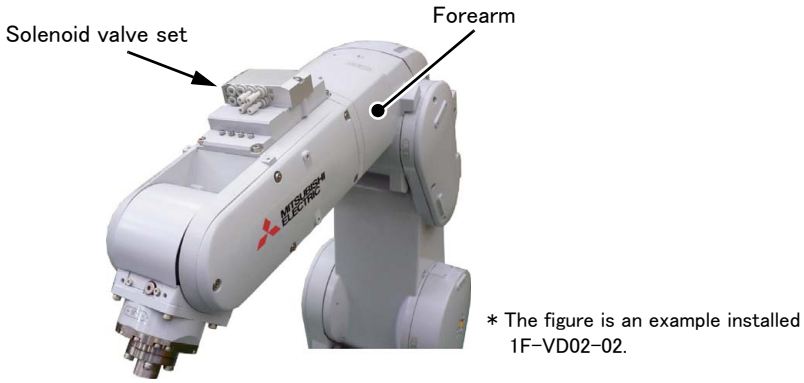


Fig.3-3 : The installation image of the optional solenoid valve set (RV-4F series)

The installation procedure of solenoid valve set depends on robot series and specifications. Refer to the explanation section corresponding to the robot which uses and install the solenoid valve set properly.

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

<Explanation section for each type of robot >

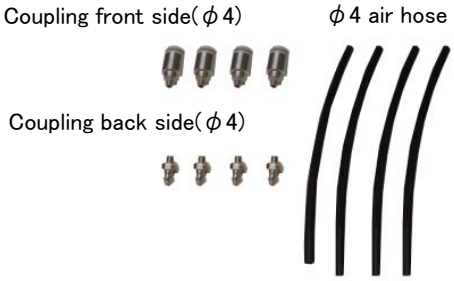
- RV-4F/7F series and RV-7FLL robots: Refer to Page 61, "(1) RV-4F/7F series, RV-7FLL".
- RV-13F/13FL and RV-20F robots: Refer to Page 70, "(2) RV-13F/13FL series, RV-20F".

(1) RV-4F/7F series, RV-7FLL

This paragraph explains how to install the solenoid valve set to RV-4F/7F series and RV-7FLL robots. (The solenoid valve set of 1F-VD04-02 is used as an example.)
Turn the controller's power OFF before this installing operation.
In addition, an instruction is described based on internal wiring and piping specification. Refer only to the required section for standard specification. Moreover, please prepare the following furnished accessory.

Robot arm accessory (only internal wiring and piping specification)

* The numbers of attached couplings and air hoses depends on the robot specifications. In the shown example, four sets of couplings and four hoses are used.



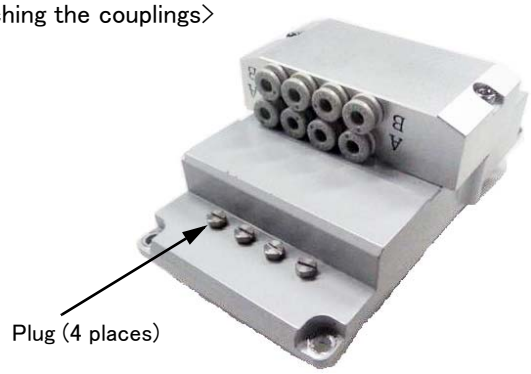
Solenoid-valve set attachments

* Three elbow couplings are attached.

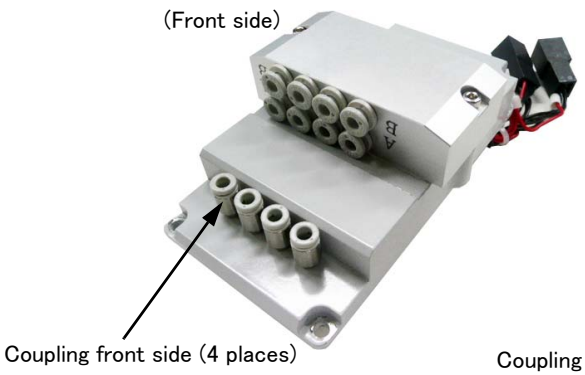
<Type name of elbow coupling>
Maker: SMC Corporation
Name: Plug-in elbow
Model: KQ2L06-99A

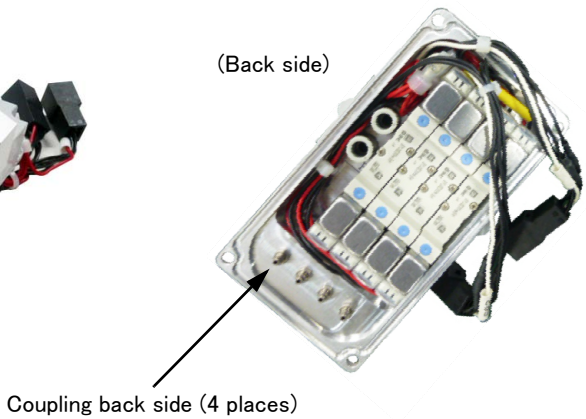
1) Removes the plug on the solenoid valve and installs the coupling. (only internal wiring and piping specification)
Remove the plug of the position to use as shown in the figure.
Install the attached coupling for front side (φ4 front side) in the screw hole which removed the plug. Turn the solenoid valve set over and install the back side coupling in the same way.

<Before attaching the couplings>



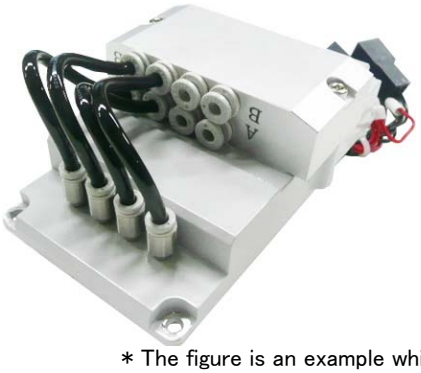
<After attaching the couplings>





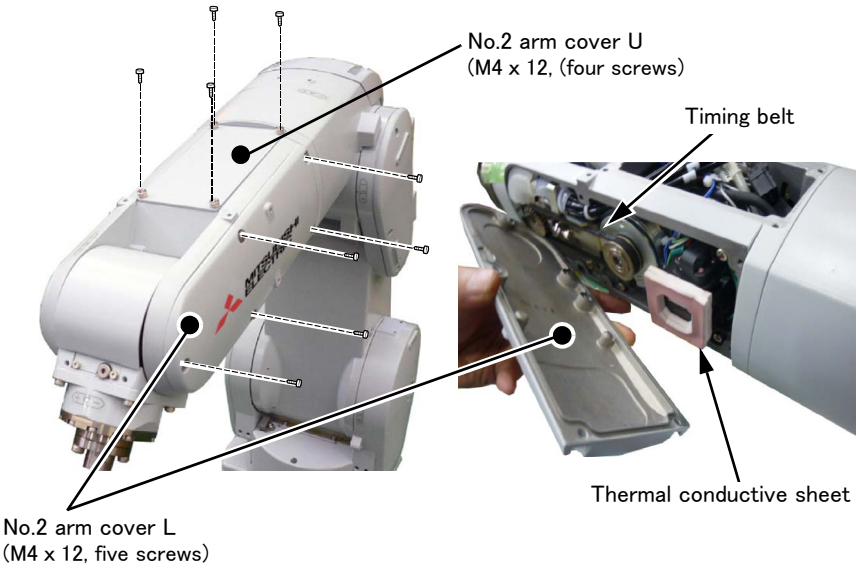
* The figure is an example which connected the first and second solenoid valve.

2) Installs the air hose. (only internal wiring and piping specification)
Connects the port A/B of solenoid valve to use and the coupling on the front side installed by above-mentioned "1)" with air hoses (φ4).



* The figure is an example which connected the first and second solenoid valve.

3) Loosen the fixing screws (M4x12) and detach the No.2 arm cover U (forearm upside) and the No.2 arm cover L (forearm side face). (standard/internal wiring and piping specification common)
The connectors (GR1, GR2), φ4 secondary piping air hoses (4), and the AIR IN (φ6, white) and RETURN (φ6, black) primary piping air hoses are set inside the forearm.

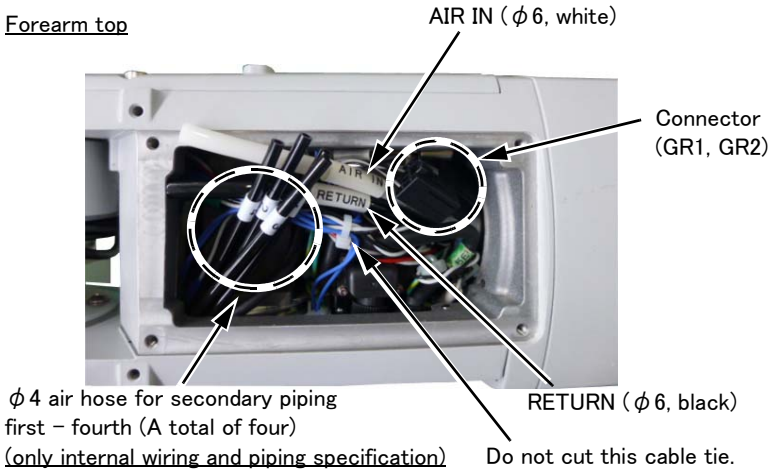


CAUTION

The thermal conductive sheet is adhered closely to the No.2 arm cover L. To prevent the thermal conductive sheet from coming off, detach the cover slowly and firmly. When the sheet comes off, reattach it to the original position.

CAUTION

After the cover is removed, take care not to damage the thermal conductive sheet or timing belt.



CAUTION

Take sufficient care to prevent foreign matters (cut chips of air hoses, etc.) from entering the robot.

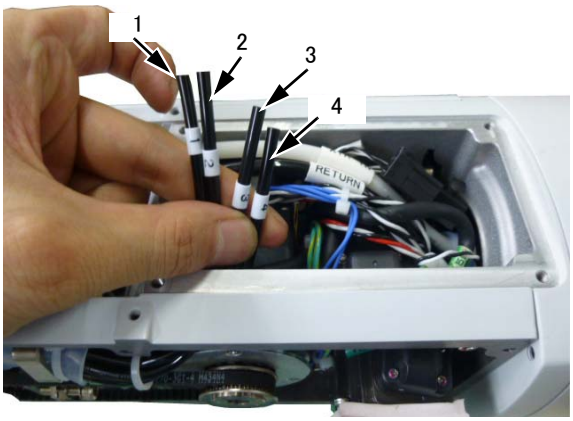
CAUTION

Do not cut the cable tie that bundles the cables inside the arm.
Doing so may loosen the fixed cables, resulting in interference with the timing belt.

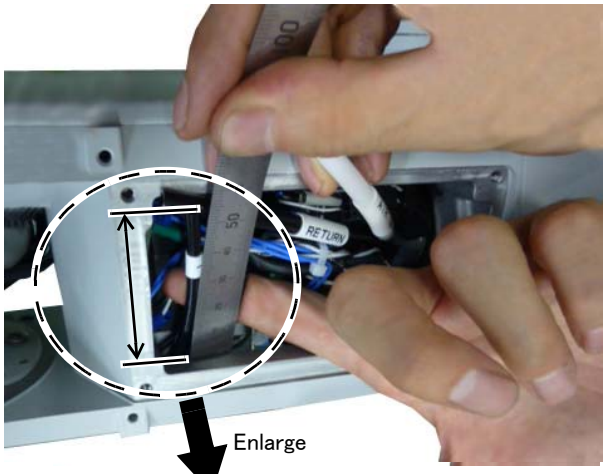
4) Cut the ϕ4 secondary piping air hoses. (only internal wiring and piping specification)
Cutting the ϕ4 secondary piping air hoses facilitates connection to the solenoid valve.

⚠CAUTION Securely cut and connect the air hose to a surely suitable length.
Failure to observe this could lead to the air hose breaks within an arm, and a solenoid valve becomes the cause of not operating to a normality.

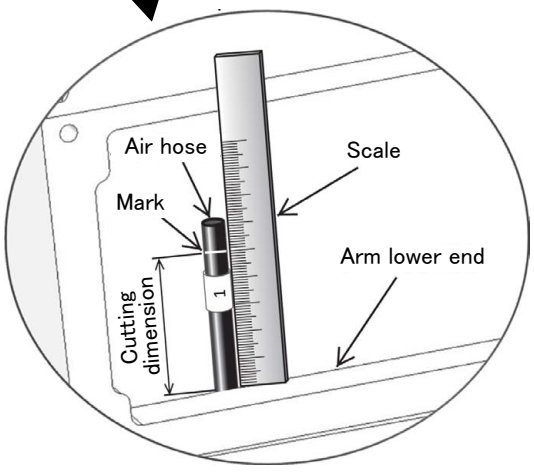
- Align the ϕ4 secondary piping air hoses from No.1 to No.4 on the No.2 arm cover side as shown in the figure.



- Apply the scale to the arm lower end on the No.2 arm cover L side, and measure the length, then mark and cut the hose.
- Cut the air hose vertically in the lengthwise direction of the air hose with a dedicated cutter. If the cut end is not vertical, it causes air leakage.



Enlarge



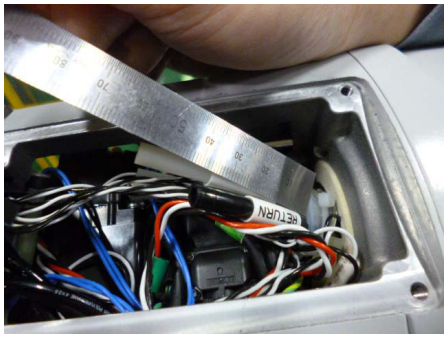
<Cutting dimension guide>

1: 50–55mm
2: 45–50mm
3: 40–45mm
4: 35–40mm

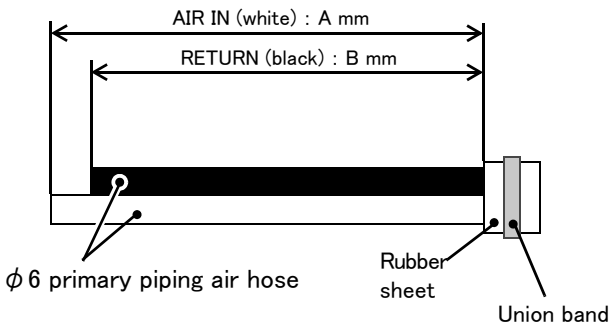
⚠CAUTION

Take sufficient care to prevent foreign matters (cut chips of air hoses, etc.) from entering the robot.

5) Cut the φ6 primary piping air hoses. (standard/internal wiring and piping specification common)
To facilitate connection to the solenoid valve, measure the length of φ6 primary piping air hoses (AIR IN and RETURN) from the end of rubber sheet at the base of the air hoses before cutting



<Cutting dimension guide >



⚠CAUTION

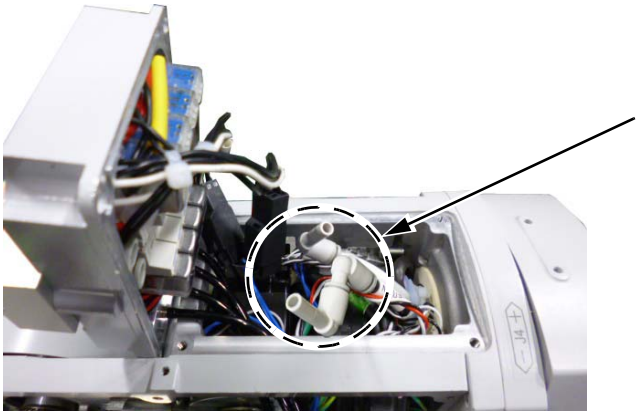
Take sufficient care to prevent foreign matters (cut chips of air hoses, etc.) from entering the robot.

Cutting dimension guide A, B (Unit: mm)

Robot	Dimension A (AIR IN)	Dimension B (RETURN)
RV-4F	60	35
RV-4FL/4FJL/7F/7FL/7FLL series	70	45

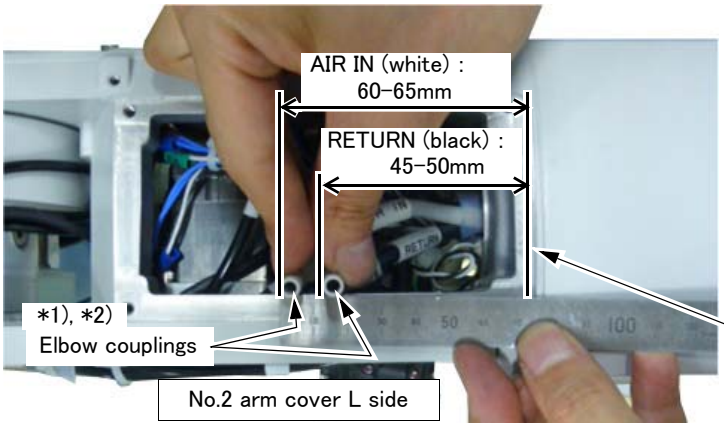
6) Attach the elbow coupling and check the positions for connection. (standard/internal wiring and piping specification common)

a) Attach the elbow couplings which attached the solenoid valve set to the φ6 primary piping air hoses (one for AIR IN, two for RETURN).



Attach the elbow couplings to the AIR IN (white) and RETURN (black) air hoses. Two elbow couplings are made to connect with the air hose of RETURN (black) to a series.

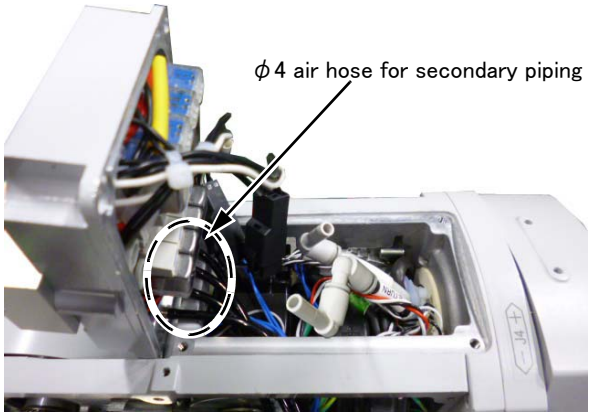
b) Check the position for connecting the couplings.
Measure the dimensions from the end of machined surface which install the solenoid valve to the end of elbow coupling.
If the Length of an air hose is unsuitable, please cut again and adjust.



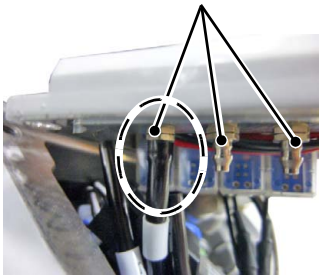
*1) To facilitate connection to the solenoid valve, attach the elbow couplings to face upward.

*2) Before measuring the dimensions, press the elbow couplings against the No.2 arm cover L side end face. Also, check that the air hoses are not bent in the area specified in the figure.

7) Connect the φ4 secondary piping air hoses. (only internal wiring and piping specification)
Connect the φ4 secondary piping air hoses to the couplings on the back side of the solenoid valve.
Connect the air hoses sequentially from No.1.



<Enlarged view of the φ4 air hose connection area>

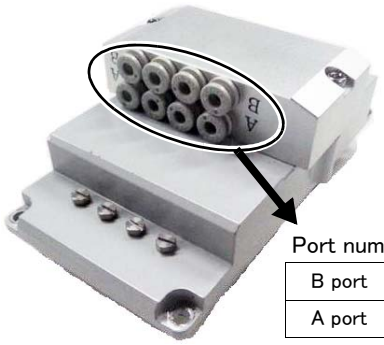


Push the φ4 secondary piping air hoses firmly to the base of couplings as shown in the figure.

The numbers (No.1 to No.4) indicated on the φ4 secondary piping air hoses are consistent with the numbers of piping pulled out of the mechanical interface. Refer to the numbers for piping to the tool.
As an example of the tools, Table 3-6 shows the relation between hand condition and coupling port number.

Table 3-6 : Solenoid valve ports and hand number

Hand	Hand condition	Port number	The solenoid valve set in use
Hand 1	OPEN	1	One set
	CLOSE	2	
Hand 2	OPEN	3	Two sets
	CLOSE	4	
Hand 3	OPEN	5	Three sets
	CLOSE	6	
Hand 4	OPEN	7	Four sets
	CLOSE	8	

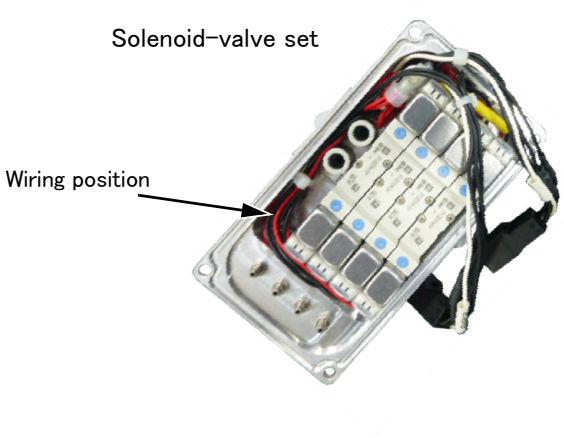


Port number

B port	2	4	6	8
A port	1	3	5	7

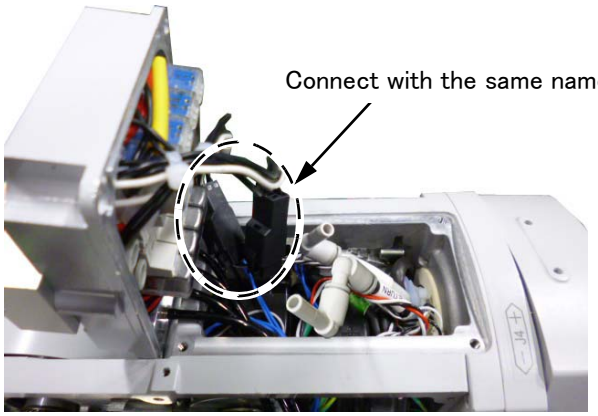
8) Connect the connector. (standard/internal wiring and piping specification common)

a) To prevent the lead wire from being put, checks that the lead wire which has come out of the solenoid valve is stored inside a solenoid-valve set as shown in a figure. If that is not right, store as shown in a figure.

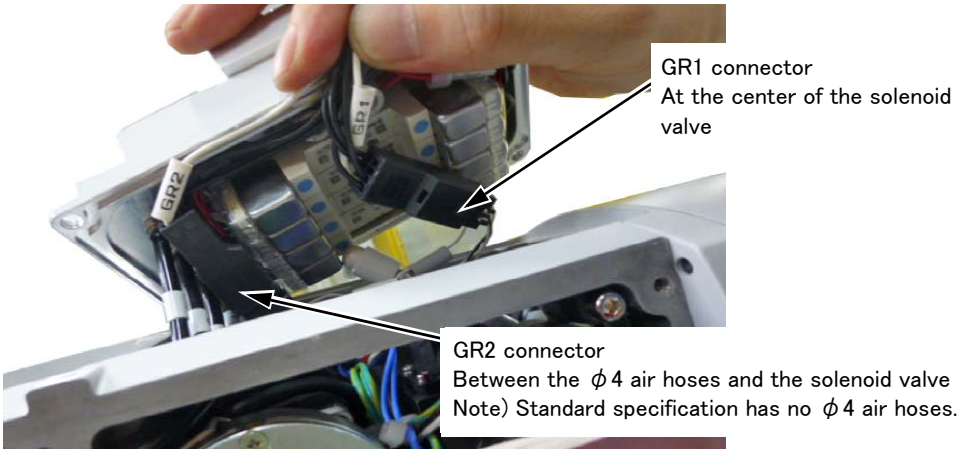


b) Connects the hand output cable inside the forearm (GR1 and GR2) to the connectors of the solenoid-valve set.

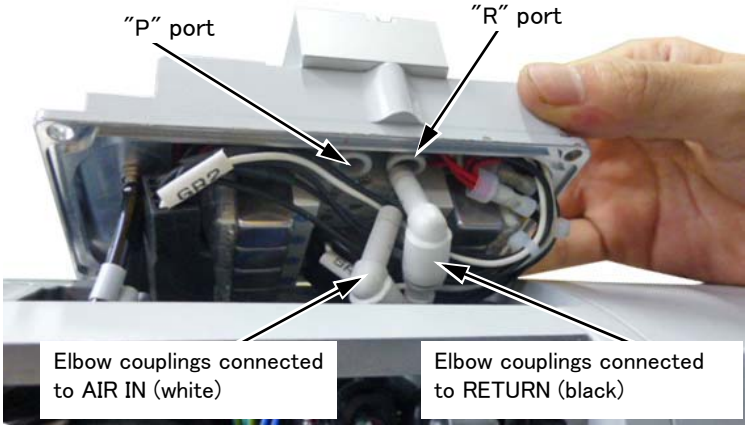
Note) In the solenoid-valve set of one set or two sets, connects only connector GR1.



c) Store the connected connectors in the positions shown in the figure below.

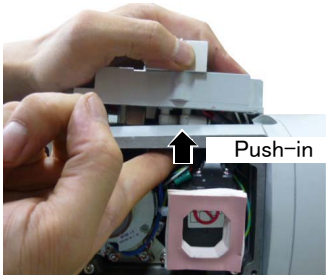


9) Connect the elbow couplings to the solenoid valve set. (standard/internal wiring and piping specification common)
First, connect the elbow couplings for AIR IN (white) to the "P" port, and then connect the elbow couplings for RETURN (black) to the "R" port.

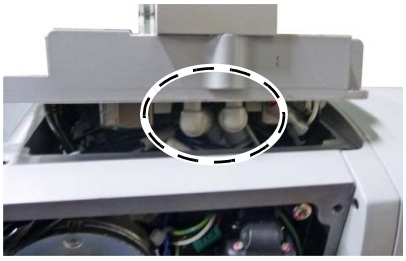


Note) The lead wire should be wired inside elbow couplings to prevent inserting the cable as shown in a figure

<Connection and adjustment of the elbow couplings>

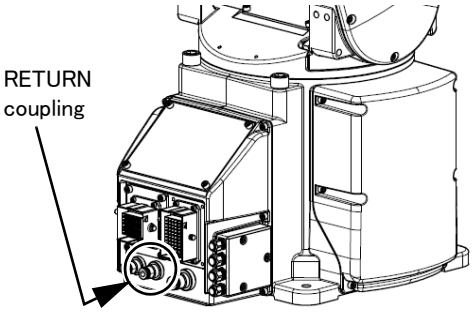


As shown in the above figure, push in the elbow couplings from the No.2 arm cover L side to improve workability.



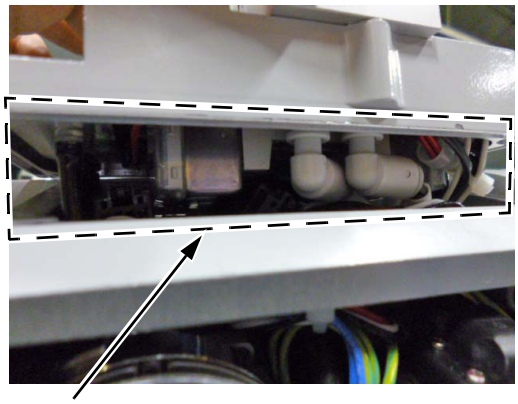
As shown in the above figure, adjust the direction of elbow couplings connected to AIR IN (white) and RETURN (black) as cross the solenoid valve to improve workability.

⚠CAUTION When connecting the RETURN air hose, be sure to remove the dust cap attached at the RETURN coupling on the robot base section. If the cap is not removed, exhaust air pressure will increase and the solenoid valve may not operate properly. By connecting the exhaust air hose (ϕ6: customer preparation) to this RETURN air coupling, exhaust air from the solenoid valve is able to escape to the designated point.



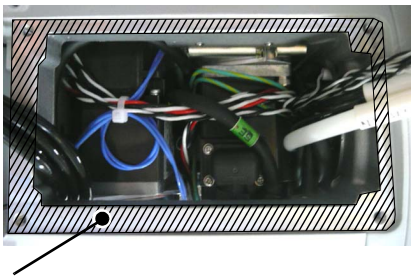
⚠CAUTION When removing the solenoid valve set, remove it slowly with care.
Strong pulling may cause damage of the joint or the piping air hose connected to the solenoid valve.

10) Install the solenoid valve set to the forearm. (standard/internal wiring and piping specification common)
Install the solenoid valve set to the forearm and match their positions. Take care not to put air hoses or cables between them.



Visually check that the cables and air hoses are not pinched, and the air hoses are not bent.

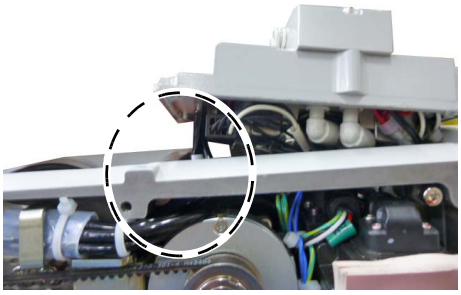
Forearm top



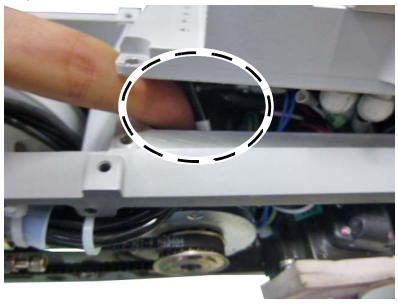
The solenoid valve is installed to the shaded area.
To prevent cables from being pinched, push the cables into the forearm and avoid placing any cable on the shaded area.

<Adjustment of piping layout of φ4 secondary piping air hoses> (only internal wiring and piping specification)

Side of robot

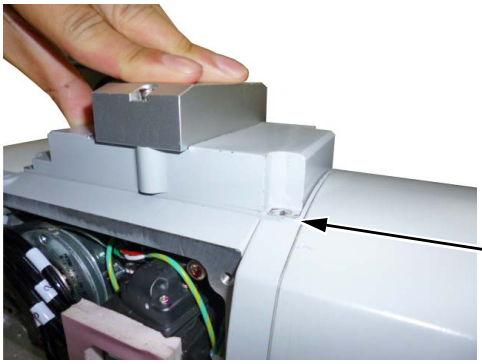


Top of robot



Push in the φ4 secondary piping air hose (No.4) with a finger from the No.2 arm cover L side or No.2 arm cover U side. Draw the hose around the motor upper surface to prevent it from being bent.

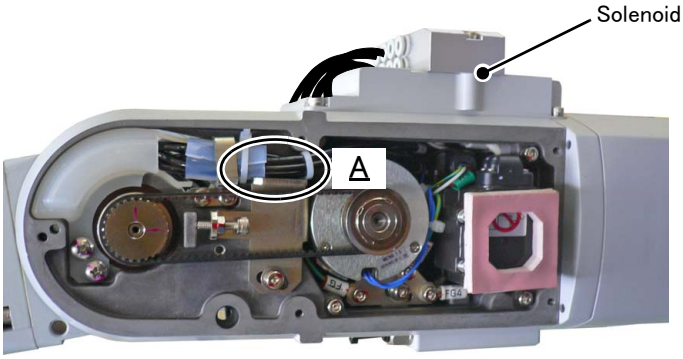
<Confirmation method of cable storage condition>
Check that the solenoid-valve set is pressed down by hand and there is no gap in the installation surface.
If there is a gap the cable may not be correctly stored, please check again.



Check that there is no gap.。

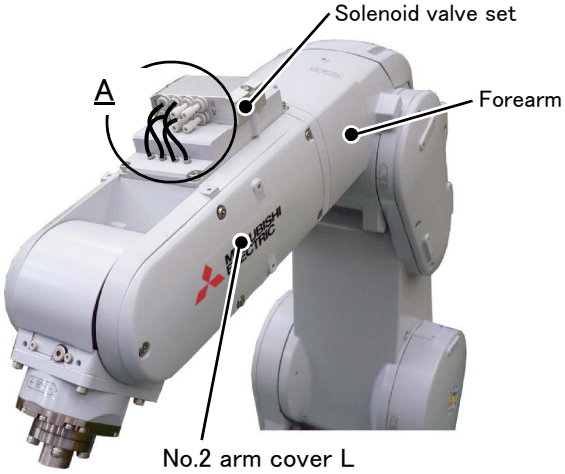
⚠CAUTION When you install the solenoid valve set, be careful to not put the cable and air hose between the cover and arm and do not break the air hose.
If the cable is inserted, it will become the cause that the cable or solenoid valve cover be broken. And, if the air hose is put or it breaks, it becomes the cause that the solenoid valve operation is abnormal.

11) Installs the solenoid valve set on the forearm upside. (standard/internal wiring and piping specification common)
Firmly fix the solenoid valve set using the original fixing screws of the No.2 arm cover U. (Tightening torque: 1.39–1.89N・m).
Then, from the No.2 arm cover L side, check that the air hoses in the forearm are not bent.

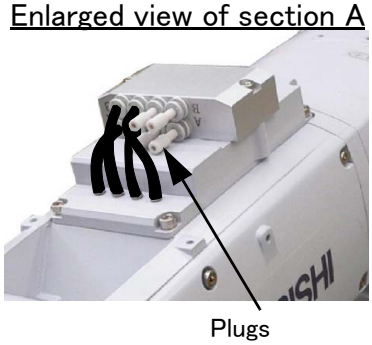


⚠CAUTION Keep the air hoses from interfering with the moving parts of timing belt and its pulley. (See the area A.)
Otherwise, air leakage may occur.

12) Install the No.2 arm cover L to the forearm. (standard/internal wiring and piping specification common)
Install attached plugs to the port A/B couplings that are not used for the solenoid valve set.



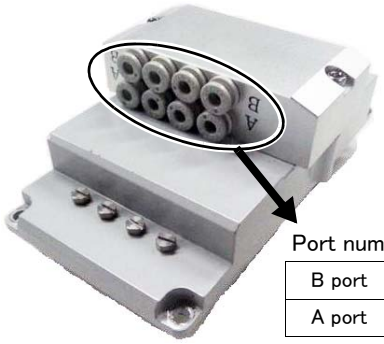
Enlarged view of section A



13) Connect the tool prepared by the customer with solenoid valve port A and B. (standard/internal wiring and piping specification common)
When you use the standard specification robot, please prepare the air hoses for connection.
Table 3-6 shows the relation between hand condition and port number.

Table 3-7 : Solenoid valve ports and hand number

Hand	Hand condition	Port number	The solenoid valve set in use
Hand 1	OPEN	1	One set
	CLOSE	2	
Hand 2	OPEN	3	Two sets
	CLOSE	4	
Hand 3	OPEN	5	Three sets
	CLOSE	6	
Hand 4	OPEN	7	Four sets
	CLOSE	8	



Port number

B port	2	4	6	8
A port	1	3	5	7

The installing of the solenoid valve set is completed.

(2) RV-13F/13FL series, RV-20F

This paragraph explains how to install the solenoid valve set to RV-13F/13FL series and RV-20F robots. (The solenoid valve set of 1F-VD04-03 is used as an example.)

Turn the controller's power OFF before this installing operation.

In addition, an instruction is described based on internal wiring and piping specification. Refer only to the Required section for standard specification

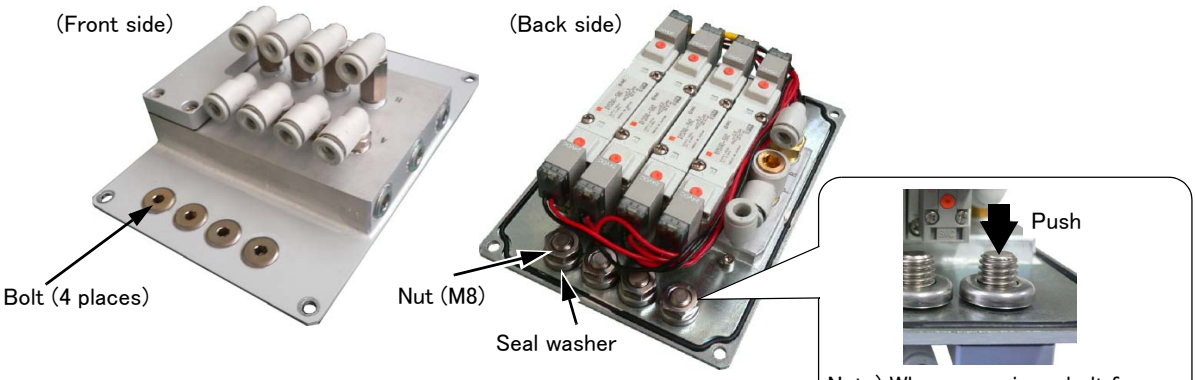
1) Removes a bolt and installs the coupling. (only internal wiring and piping specification)

a) Remove bolts, nuts and seal washers that were fixed on the optional solenoid valve set. To do this, remove the bolts attached the position to use as shown in the figure.

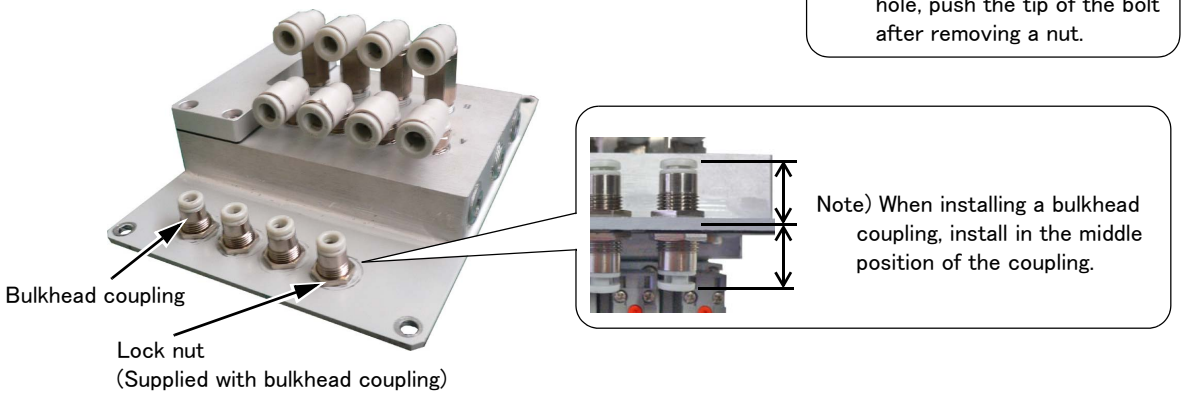
b) Attach a bulkhead coupling to the hole. The bulkhead couplings are one of the attachments of robot arm. Remove one of lock nuts, width across flats: 11mm, from a bulkhead coupling, and attach the bulkhead coupling to the hole.

c) Fasten firmly with the removed lock nut.

<Before attaching the couplings>



<After attaching the couplings>

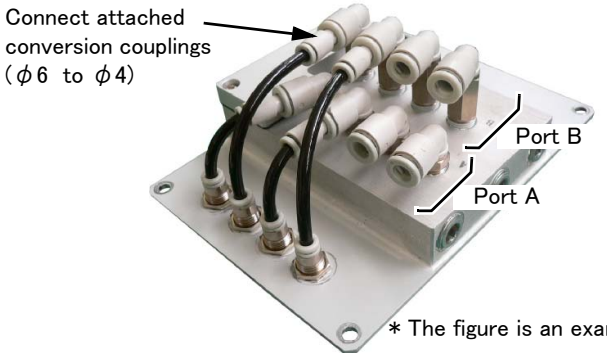


* The figure is an example which connected the first and second solenoid valve.

2) Installs the air hose. (only internal wiring and piping specification)

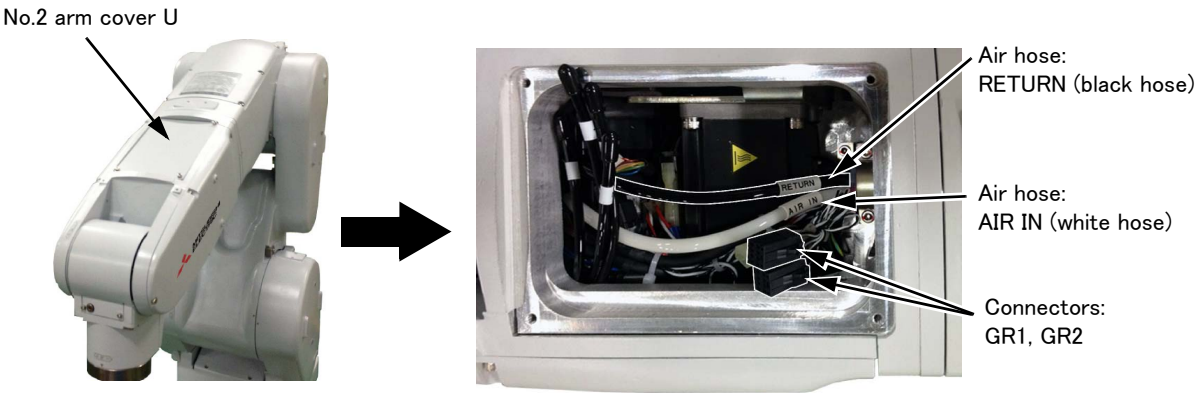
Install attached conversion couplings (φ6 to φ4) to the port A/B on the solenoid valve.

Then, connects the port A/B of solenoid valve to use and the coupling on the front side installed by above-mentioned "1)" with air hoses (φ4).



* The figure is an example which connected the first and second solenoid valve.

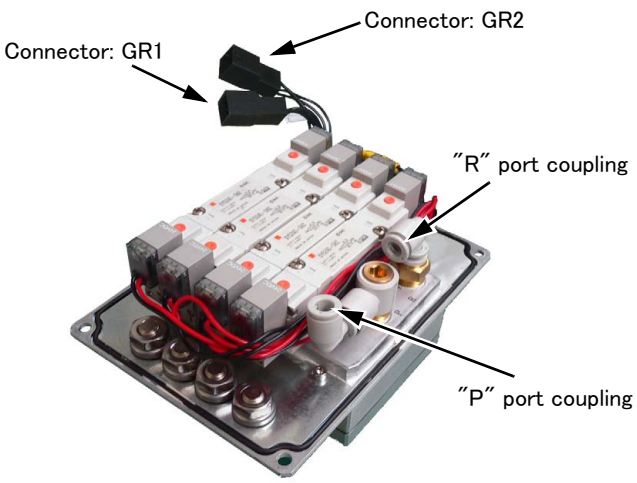
3) Loosen the four fixing screws of No.2 arm cover U (forearm upside) and remove the cover.
(standard/internal wiring and piping specification common)
(Mounts the solenoid-valve set instead of the removed cover) The connectors (GR1, GR2) and air hoses (AIR IN, RETURN) connected to the solenoid-valve set inside the cover.

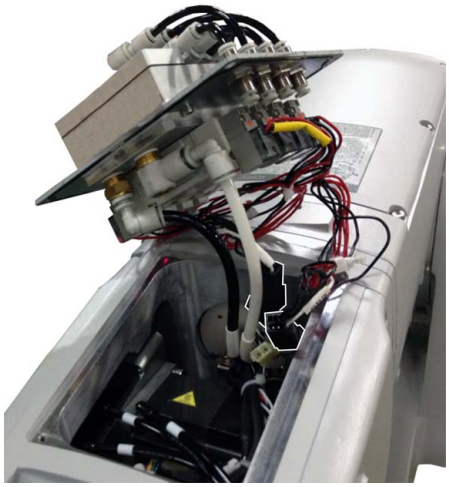


4) Connects the air hoses and the connectors. (standard/internal wiring and piping specification common)
a) Connects the hand output cable inside the forearm (GR1 and GR2) to the connectors of the solenoid-valve set. Connect with the same names.
Note) In the solenoid-valve set of one set or two sets, connects only connector GR1.
b) The two air hoses equipped inside the forearm, connects AIR IN (white) to "P" port coupling of the solenoid-valve set, and connects RETURN (black) to "R" port coupling of the solenoid-valve set. The AIR IN (white) air hose is connected with the AIR IN coupling of the robot arm base rear, and the RETURN (black) air hose is connected with the RETURN coupling.

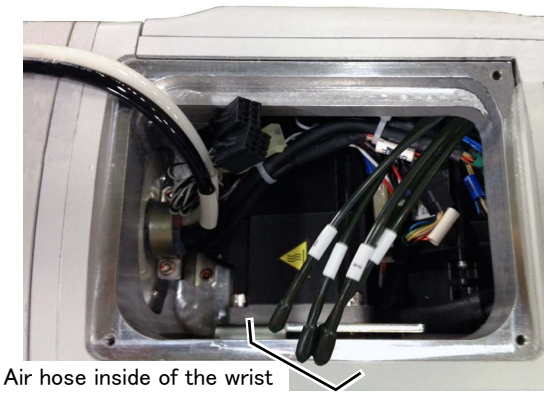
⚠CAUTION Because the long length air hoses are equipped, please cut and connect it to the suitable length. If that is not right, the air hose breaks within the arm and it becomes the cause that the solenoid valve operation is abnormal.

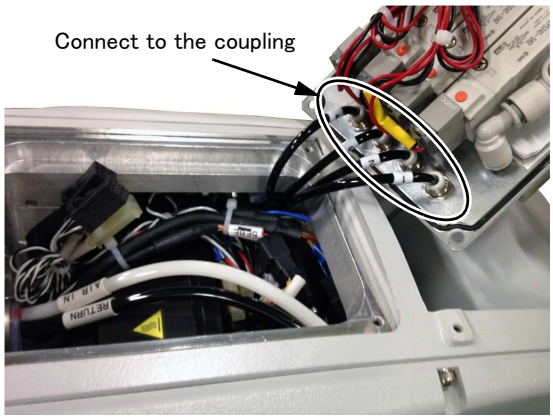
⚠CAUTION When connecting the RETURN air hose, be sure to remove the dust cap attached at the RETURN coupling on the robot base section. If the cap is not removed, exhaust air pressure will increase and the solenoid valve may not operate properly. By connecting the exhaust air hose (ϕ6: customer preparation) to this RETURN air coupling, exhaust air from the solenoid valve is able to escape to the designated point.





c) Cconnect the piping inside the wrist. (only internal wiring and piping specification)
Cuts the air hose inside of the wrist to suitable length, and connect to the coupling on the back side of solenoid valve set. The number indicated on the air hoses inside of the wrist is same as the air hoses pulled out of the mechanical interface, so make it the reference at the piping to the tool. Table 3-8 shows the relation between hand condition and port number.

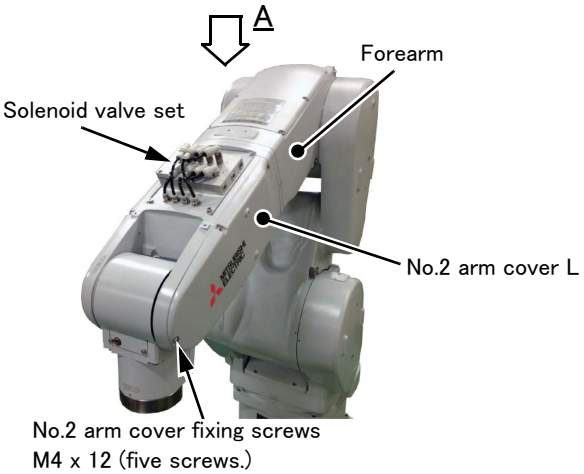


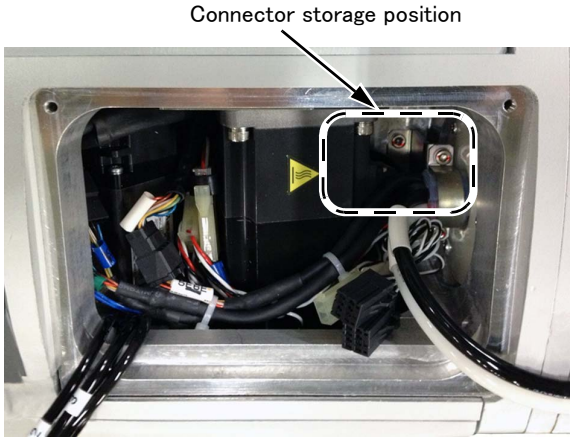


5) Installs the solenoid valve set on the forearm upside. (standard/internal wiring and piping specification common)
Installs the solenoid valve set instead of the No.2 arm cover U removed above.

⚠CAUTION When you install the solenoid valve set, be careful to not put the cable and air hose between the cover and arm and do not break the air hose.
If the cable is inserted, it will become the cause that the cable be broken. And, if the air hose is put or it breaks, it becomes the cause that the solenoid valve operation is abnormal.

Confirms having inserted neither the cable nor the air hose and that the air hose has not broken, and fix the No.2 arm cover U securely by the original fixing screws (Tightening torque: 1.39-1.89N・m). Confirms that the air hose has not broken by removing the No.2 arm cover L.



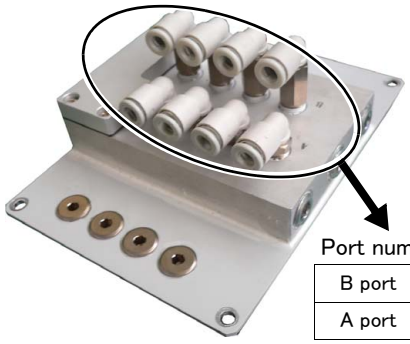


View A

6) Connect the tool prepared by the customer with solenoid valve port A and B. (standard/internal wiring and piping specification common)
Install plugs to the port A/B couplings that are not used for the solenoid valve set. Please prepare the air hoses and plugs to use by customer.
Table 3-8 shows the relation between hand condition and port number.

Table 3-8 : Solenoid valve ports and hand number

Hand	Hand condition	Port number	The solenoid valve set in use
Hand 1	OPEN	1	One set
	CLOSE	2	
Hand 2	OPEN	3	Two sets
	CLOSE	4	
Hand 3	OPEN	5	Three sets
	CLOSE	6	
Hand 4	OPEN	7	Four sets
	CLOSE	8	



Port number

B port	2	4	6	8
A port	1	3	5	7

The installing of the solenoid valve set is completed.

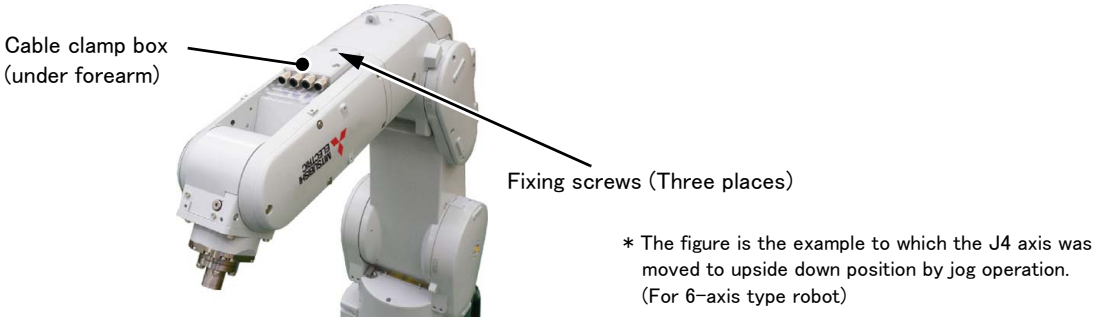
3.3 Installing the hand input cable

(1) RV-4F/7F/13F series

The installation procedure of the hand input cable is shown below. Turn the controller's power OFF before this installing operation.

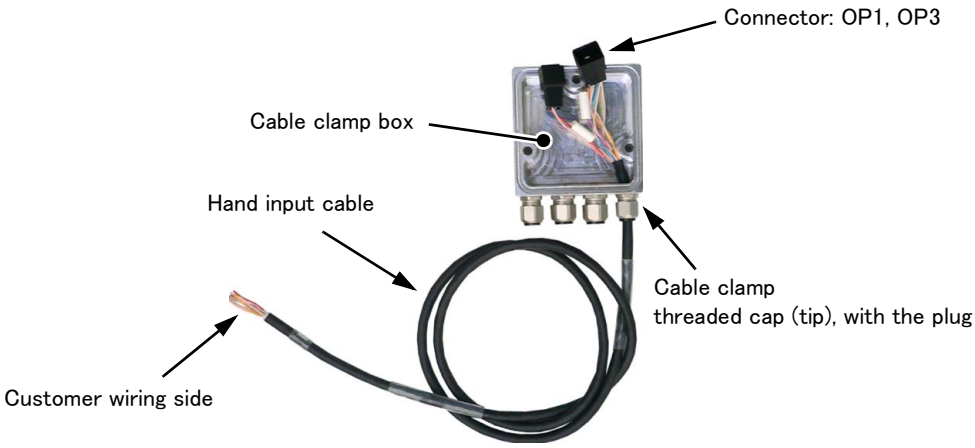
Note) Although the robot's figure described to each page is RV-4F series, the method is the same on other robot series.

1) Loosen the fixing screws (three M4x16 screws) of cable clamp box (under forearm) and remove the cover. For the 6-axis type robot, move the J4 axis in advance to the upside down position by jog operation to facilitate installation of the cable.

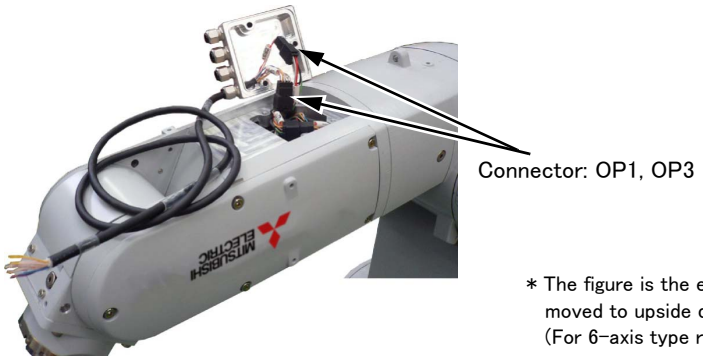


* The figure is the example to which the J4 axis was moved to upside down position by jog operation. (For 6-axis type robot)

2) Feed and fix the optional hand input cable through the inside of cable clamp mounted on the cable clamp box. Uses either one in the cable clamp of both ends.
   a) Loosens the threaded cap of the cable clamp and removes the plug. Use either one place of both ends.
   b) Pass the customer wiring side of cable from inner side. Pass the cable with little by little, and fix the cable securely by tightening the threaded cap as shown in the following figure.

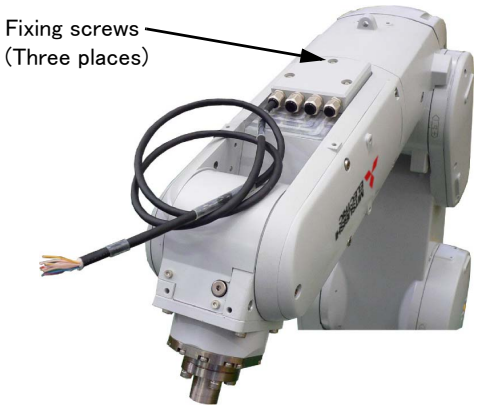


3) Connects the connector inside the forearm (OP1 and OP3) to the connector of the hand input cable. Connect with the same names.



* The figure is the example to which the J4 axis was moved to upside down position by jog operation. (For 6-axis type robot)

4) Fixes the cable clamp box securely by the fixing screws as before. Installs carefully so that the cable may not be inserted.



* The figure is the example to which the J4 axis was moved to upside down position by jog operation. (For 6-axis type robot)

CAUTION When you install the cable clamp box, be careful to not put the cable between the cable clamp box and arm. If the cable is inserted, it will become the cause that the cable be broken.

CAUTION When this cable is connected to the robot the power supply is applied to the end of this cable. The end of the cable is free at factory shipping. so, if the tool side is not connected it may be cause of the trouble such as broken the fuse by short circuit. Before connecting to the robot, customer should check whether or not the cable tip has been properly treated.

The installing of the cable clamp box is completed. Pin assign of the hand input cable is shown in Table 3-9.

Table 3-9 : Pin assign of hand input cable

Color	Connector Note1)	Pin number: names	Color	Connector Note1)	Pin number: names
Purple	OP1	A1: HC1	Yellow	OP3	A1: +24V
Brown		A2: HC2	Green		A2: +24G (RG)
Blue		A3: HC3	-		Reserved
Black		A4: HC4	-		Reserved
Red		B1: HC5			
White		B2: HC6			
Gray		B3: HC7			
Pink		B4: HC8			

Note1)The connector shows the connector name connected to the robot-arm side.

(2) RV-35F/50F/70F series

Pass the hand input cable through the drilled hole in the elbow cover, and connect it to the circuit board. The installation procedure of the hand input cable is shown below. Turn the controller's power OFF before this installing operation.

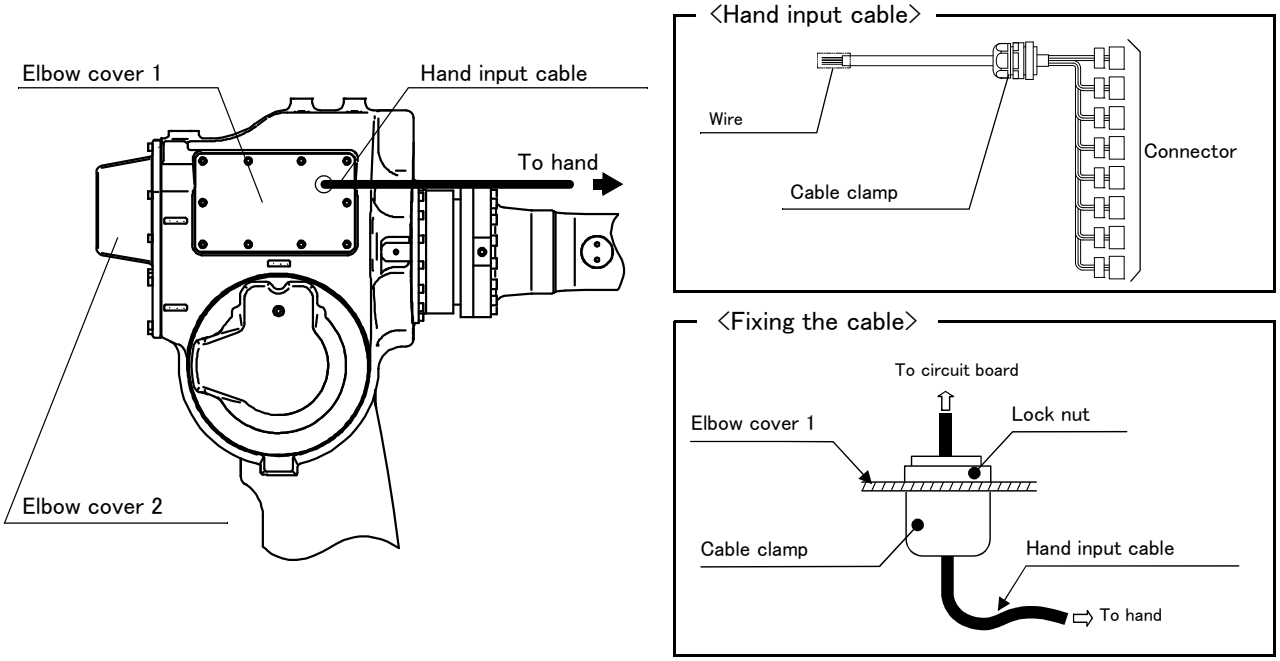
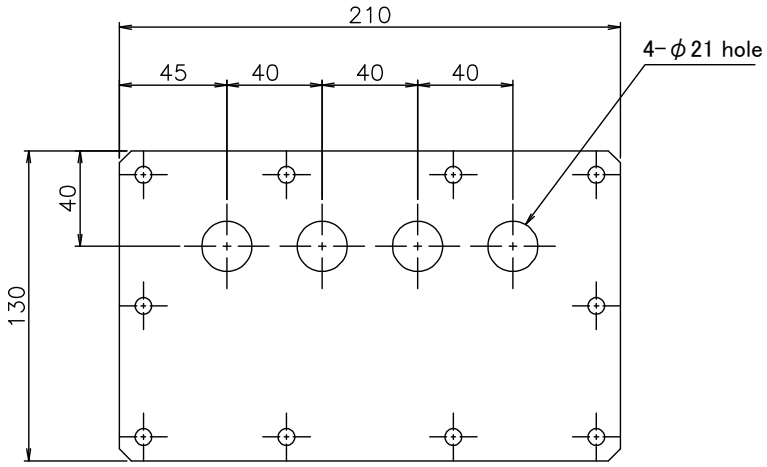


図 3-4 : Installing the hand input cable (RV-35F/50F/70F series)

1) Refer to Page 92, "5.3.2 Installing/removing the cover" and remove the elbow cover 1.
2) Drill the required number of φ21 holes in the elbow cover 1. Reference drawing is shown below.



3) Pass the connector of the hand input cable through the hole in the elbow cover 1 and fix the cable with the cable clamp's lock nut.
4) Refer to Page 92, "5.3.2 Installing/removing the cover" and remove the elbow cover 2. And connect the hand input cable connector to the corresponding connector of the circuit board inside the robot.
   Note) Circuit board is mounted to the back side of the elbow cover 2. The circuit board and robot are connected by a cable, so that the elbow cover 2 cannot be completely removed. Please be careful not to pull the cover strongly when you remove it. If you pull the cover strongly, it may disconnect the cable.
5) Install the elbow cover 2.
6) Install the elbow cover 1 carefully so that the hand input cable may not be inserted.

The installing of the hand input cable is completed.

3.4 Installing the hand output cable

(1) RV-4F/7F/13F series

As shown in Fig. 3-5, connects with connector GR1 and GR2 inside the forearm, and pulls out the hand output cable from the cable clamp box at the forearm lower part.

Note) ・When installing the hand output cable for the safety, turn OFF the power supply of the controller.
The cable clamp box in Fig. 3-5 shows the example of four-clamps type.
・Although the robot's figure described to each page is RV-4F series, the method is the same on other robot series.

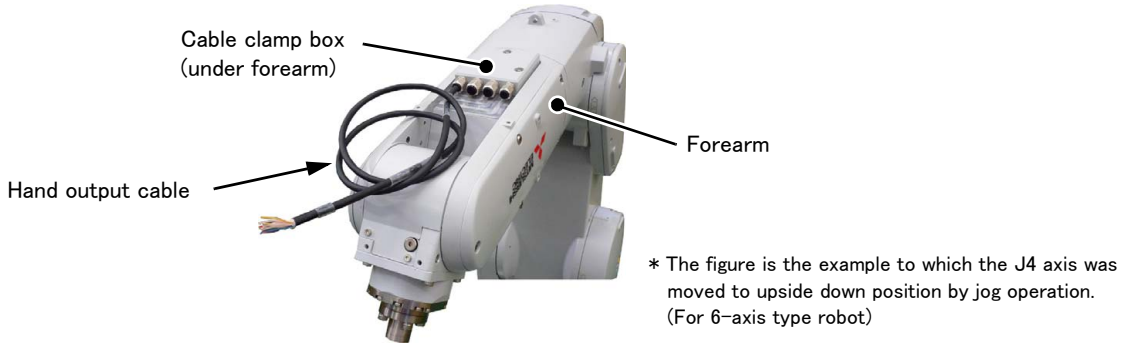
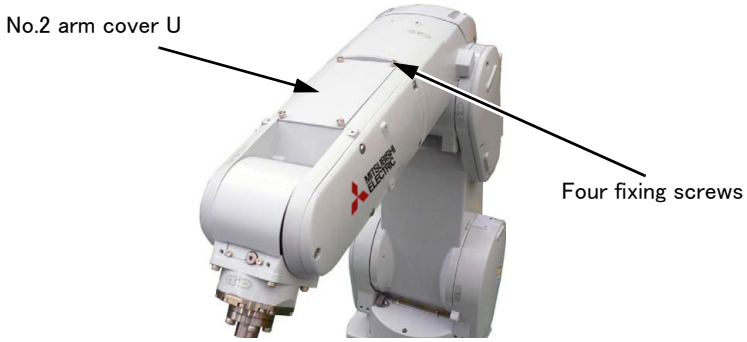


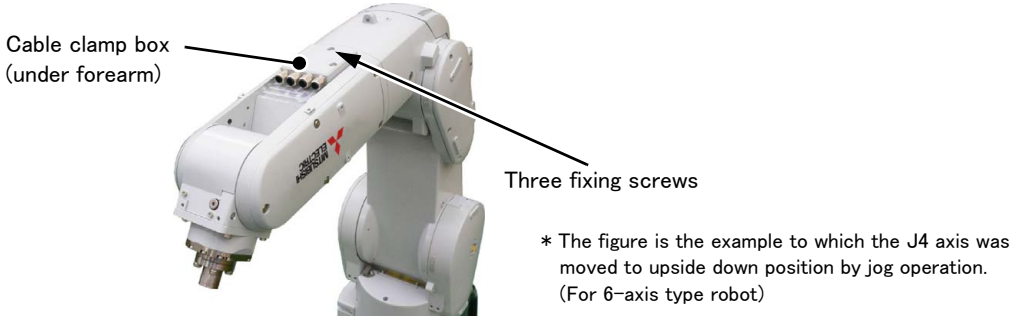
Fig.3-5 : Image which pulled out hand output cable

The installation procedure of the hand output cable is shown below. Turn the controller's power OFF before this installing operation.

1) Loosen the fixing screws (four M4x12 screws) of No.2 arm cover U and remove the cover.



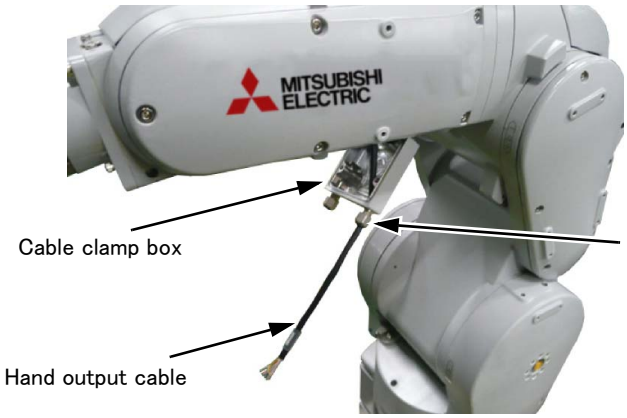
2) Loosen the fixing screws (three M4x16 screws) of cable clamp box (under forearm) and remove it.
For the 6-axis type robot, move the J4 axis in advance to the upside down position by jog operation to facilitate installation of the cable.



3) Feed the hand output cable through to the cable clamp box side from No.2 arm cover U side inside the arm. When the cable inside the No.2 arm cover U is pulled out, it will become easy. Feed the hand output cable through between the motors. (ellipse position of following figure)

4) Connects the connector inside the forearm (GR1 and GR2) to the connector of the hand output cable. Connect with the same names.

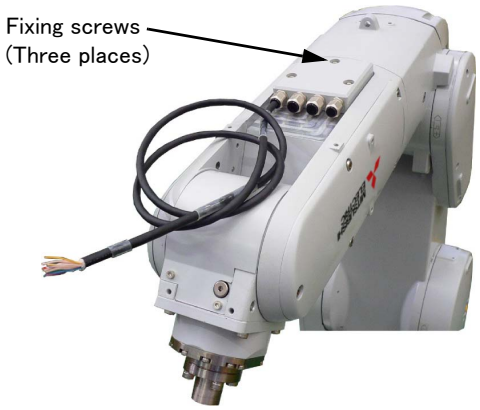
5) Feed the hand output cable through the cable clamp box.
Loosens the threaded cap of the cable clamp and removes the plug of the cable clamp box. (Tip) Pass the cable with little by little, and pulls out the needed length, and fix the cable securely by tightening the threaded cap.



・Tightening torque

Threaded cap	Lock nut (Reference)
0.2N・m	0.5N・m

6) Fixes the cable clamp box securely by the fixing screws as before. Installs carefully so that the cable may not be inserted.

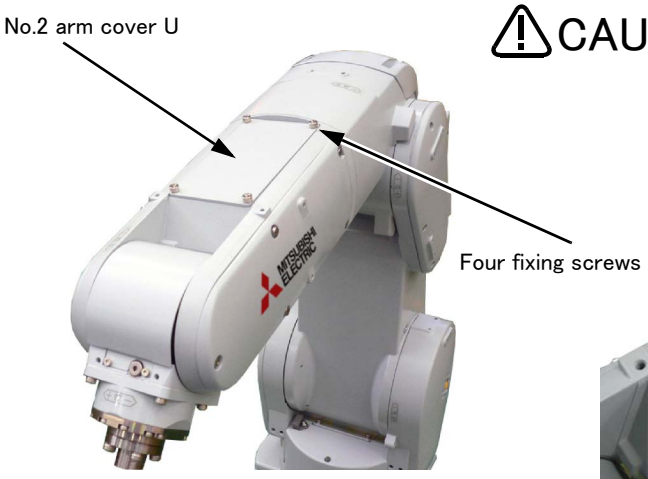


* The figure is the example to which the J4 axis was moved to upside down position by jog operation. (For 6-axis type robot)

⚠CAUTION

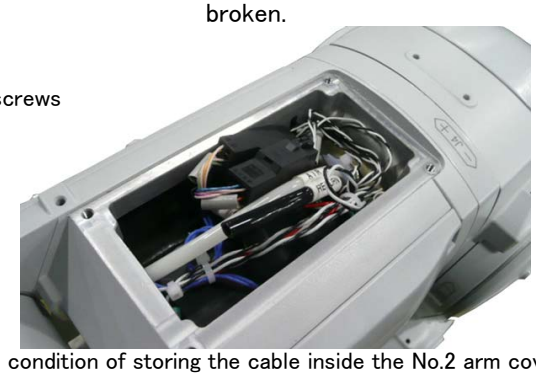
When you install the cable clamp box, be careful to not put the cable between the cable clamp box and arm. If the cable is inserted, it will become the cause that the cable be broken.

7) Fixes the No.2 arm cover U securely by the fixing screws as before. Installs carefully so that the cable may not be inserted.



⚠CAUTION

When you install the No.2 arm cover U, be careful to not put the cable between the cable clamp box and arm. If the cable is inserted, it will become the cause that the cable be broken.



The condition of storing the cable inside the No.2 arm cover U

The installing of the cable clamp box is completed. Pin assign of the hand output cable is shown in Table 3-10.

Table 3-10 : Pin assign of hand output cable

Color	Connector	Pin number: names	Color	Connector	Pin number: names
Yellow	GR1	A1: +24V	Green	GR2	A1: +24V
–		A2: Reserved	–		A2: Reserved
Purple		A3: GR1 (Hand output 1)	Red		A3: GR5 (Hand output 5)
Brown		A4: GR2 (Hand output 2)	White		A4: GR6 (Hand output 6)
Blue		B1: GR3 (Hand output 3)	Gray		B1: GR7 (Hand output 7)
Black		B2: GR4 (Hand output 4)	Pink		B2: GR8 (Hand output 8)
–		B3: Reserved	–		B3: Reserved
–		B4: Reserved	–		B4: Reserved

(2) RV-35F/50F/70F series

Pass the hand output cable through the drilled hole in the elbow cover, and connect it to the circuit board. The installation procedure of the hand output cable is shown below. Turn the controller's power OFF before this installing operation.

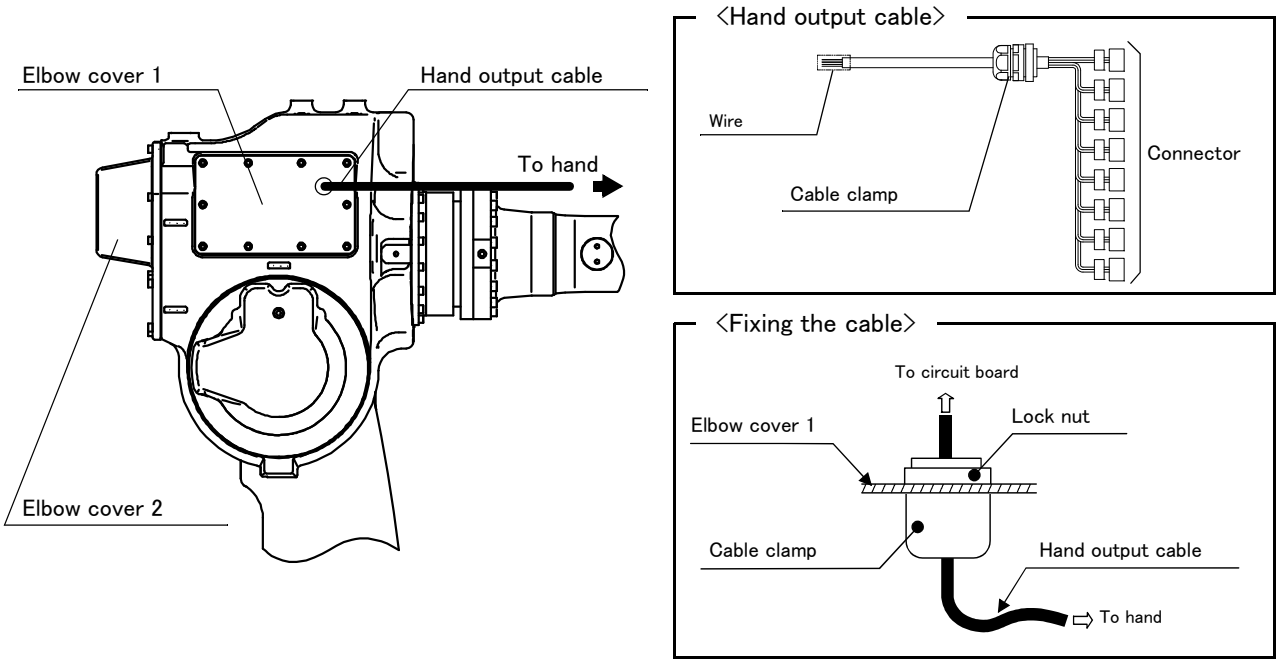
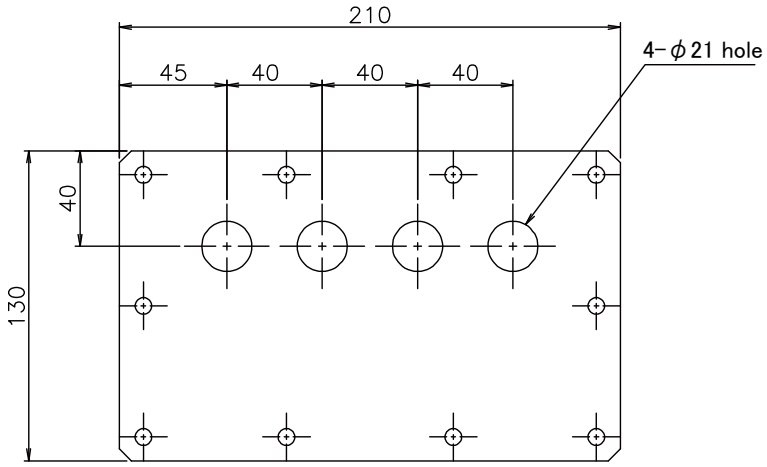


図 3-6 : Installing the hand output cable (RV-35F/50F/70F series)

1) Refer to Page 92, "5.3.2 Installing/removing the cover" and remove the elbow cover 1.
2) Drill the required number of ϕ21 holes in the elbow cover 1. Reference drawing is shown below.



3) Pass the connector of the hand output cable through the hole in the elbow cover 1 and fix the cable with the cable clamp's lock nut.
4) Refer to Page 92, "5.3.2 Installing/removing the cover" and remove the elbow cover 2. And connect the hand output cable connector to the corresponding connector of the circuit board inside the robot.
   Note) Circuit board is mounted to the back side of the elbow cover 2. The circuit board and robot are connected by a cable, so that the elbow cover 2 cannot be completely removed. Please be careful not to pull the cover strongly when you remove it. If you pull the cover strongly, it may disconnect the cable.
5) Install the elbow cover 2.
6) Install the elbow cover 1 carefully so that the hand output cable may not be inserted.

The installing of the hand output cable is completed.

3.5 Installing the Forearm external wiring set/ Base external wiring set

The installation procedure of Forearm external wiring set/ Base external wiring set is shown below. To pull out the cable of the same purpose as the forearm side and the base side, you should use this option in pair. Turn the controller's power OFF before this installing operation. Refer to Page 92, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

Note) Although the robot's figure described to each page is RV-4F series, the method is the same on other robot series.

(1) Installing the Forearm external wiring set

The installation summary of the Forearm external wiring set is shown in Fig. 3-7. Mounts this option instead of the removed cable clamp box. For the 6-axis type robot, move the J4 axis in advance to the upside down position by jog operation to facilitate installation of the cable.

1) Loosen the fixing screws (three M4x16 screws) of cable clamp box (under forearm) and remove the box.
2) Connects the connector of robot arm side inside the forearm to the connector of Forearm external wiring set. Connect with the same names, and keep it into the forearm. The connector to connect is shown in Table 3-11.

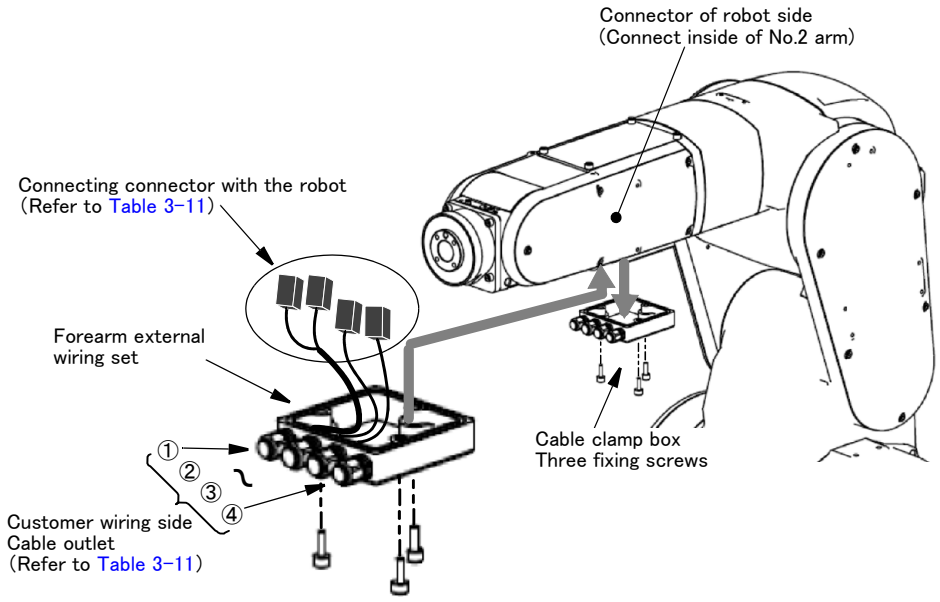


Fig.3-7 : Installing the Forearm external wiring set

Table 3-11 : Cable to pull out and robot side connection connector

Forearm external wiring set	Cable to pull out			Robot side connection connector
	Outlet	Name	Purpose of use	
1F-HB01S-01	①	HC	Hand input cable Note1)	OP1, OP3
	②	LAN	Vision sensor controller	LAN
	③	Reserved		
	④	E・F1	Force sensor	OP4, OP2
1F-HB02S-01	①	Reserved		
	②	LAN	Vision sensor controller	LAN
	③	E・F1	Reserved	OP1, OP3
	④	E・F2	Force sensor	OP4, OP2

Note1) Although the connector is attached to the customer wiring side of the hand input cable, it can use by cutting. Pin assign of the hand input cable is shown in Table 3-12.

3) Install Forearm external wiring set on the position where cable clamp box was being installed, by using original three fixing screws. Installs carefully so that the cable etc may not be inserted.
4) Connects the cable pulled out to the tool or sensor etc which customer will use. The Outlet and cable names of each cables are shown in Table 3-11. You can fix the cable by using the screw holes on the robot arm. (refer to separate "Standard Specifications Manual")
Note) Although the connector is attached to the customer wiring side of the hand input cable, it can use by cutting. Pin assign of the hand input cable is shown in Table 3-12.

Table 3-12 : Pin assign of hand input cable

Color	Signal name	Connector (HC) Note1)	Color	Signal name	Connector (HC) Note1)
Purple	HC1	A1	Red	HC5	B1
Brown	HC2	A2	White	HC6	B2
Blue	HC3	A3	Gray	HC7	B3
Black	HC4	A4	Pink	HC8	B4
Yellow	+24V	A6	Green	+24G(RG)	B6

Note1) Shows the pin number of the connector previously attached to the customer wiring side.
Connector type: 1-1827864-6, Pin type: 1827570-2, Maker: Tyco Electronics Japan G.K.

5) Confirms after the connection that the cable interferes with neither the robot arm nor the peripheral device and the not having receive stress. And, confirms that the tool, the sensor, etc. operate correctly.

The installing of the forearm external wiring set is completed.

(2) Installing the Base external wiring set

The installation summary of the Base external wiring set is shown in Fig. 3-8. Mounts this option instead of the CONBOX cover R.

1) Loosen the fixing screws (three M4x16 screws) of CONBOX cover R and remove the box.
2) The connector: LAN, CNOP1 is in CONBOX cover R. The connector is previously attached to the connector LAN. Removes this connector.
3) Connects the connector of Base external wiring set to the connector of robot arm side. Connect with the same name.

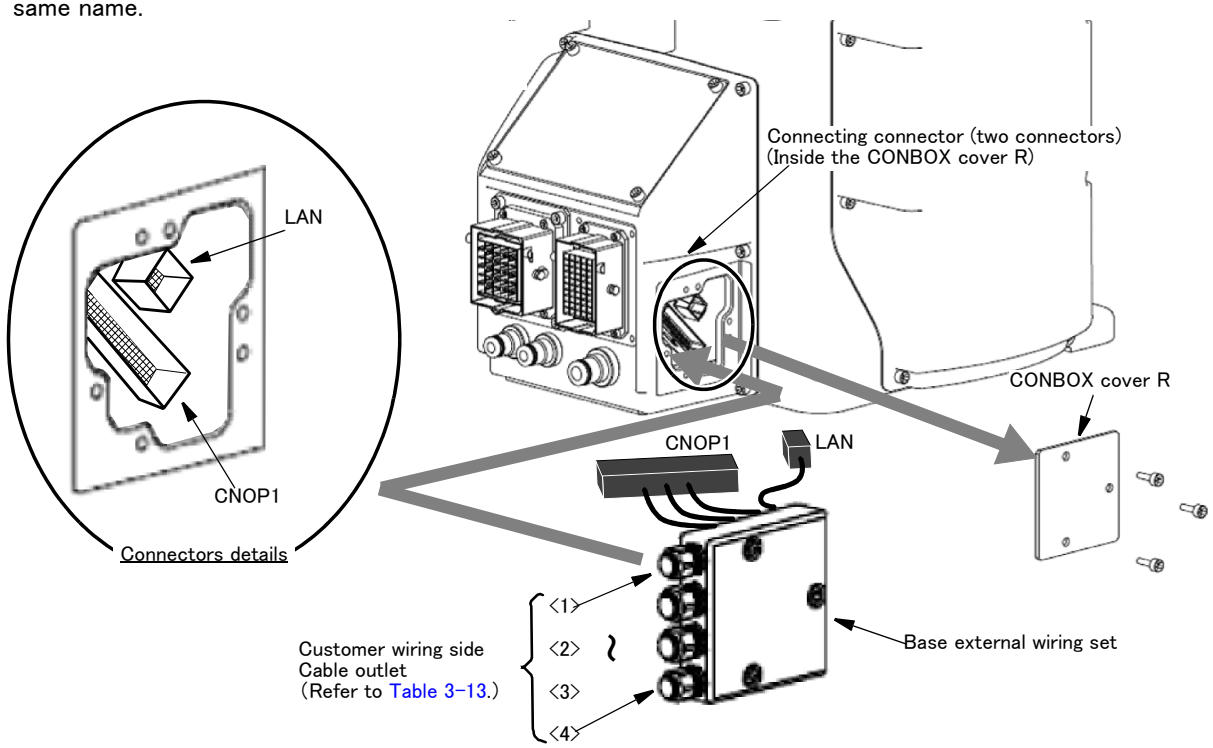


Fig.3-8 : Installing the Base external wiring set

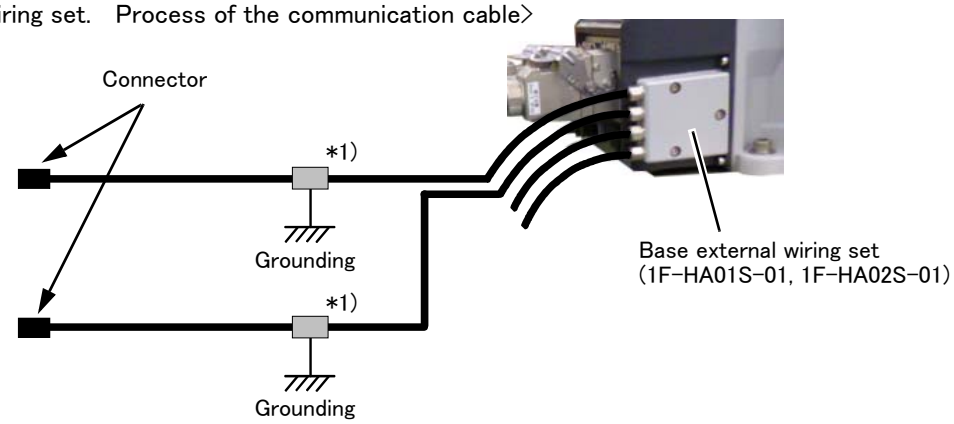
4) Install Base external wiring set on the position where CONBOX cover R was being installed, by using original three fixing screws. Installs carefully so that the cable etc may not be inserted.
5) Connects the cable of Base external wiring set to the force sensor interface etc which customer will use. The Outlet and cable names of each cables are shown in Table 3-13.

Table 3-13 : Cable to pull out and outlet

Base external wiring set	Cable to pull out			Robot side connection connector	Grounding process
	Outlet	Name	Purpose of use		
1F-HA01S-01	<1>	E・F1	Force sensor interface	CNOP1	Require
	<2>	Reserved			
	<3>	LAN	Vision sensor controller	LAN	Not require
	<4>	RIO	Reserved	CNOP1	Require
1F-HA02S-01	<1>	E・F2	Force sensor interface	CNOP1	Not require
	<2>	E・F1	Reserved	CNOP1	Require
	<3>	LAN	Vision sensor controller	LAN	Not require
	<4>	RIO	Reserved	CNOP1	Require

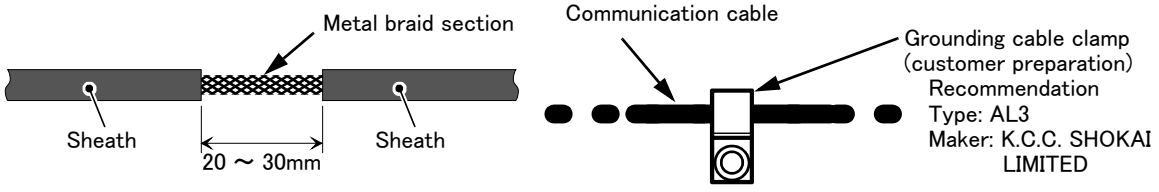
6) The cable which connects the force sensor interface needs grounding.
The method is shown below.

<Base external wiring set. Process of the communication cable>



*1) Grounding process

Skins the sheath and grounds the metal braid section to the grounding terminal of customer preparation.
Note) Don't damage the shield line



The installing of the base external wiring set is completed.

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

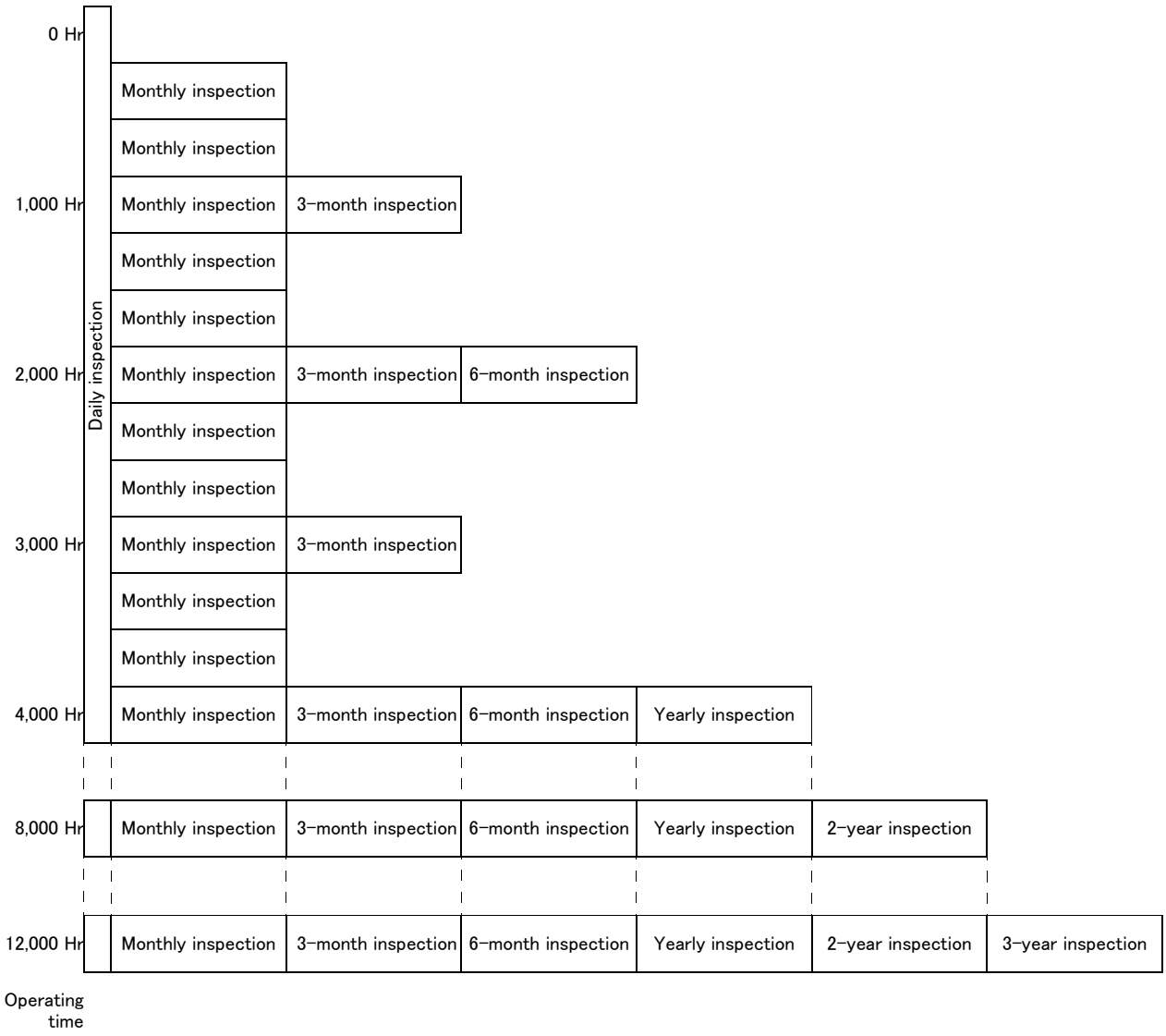
The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

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 1,000 Hr operation hours).



<Guideline for inspection period>

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

For two shifts..... 15 Hr/day ×20 days/month ×3 months = approx. 1,000 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 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 (3-month, 6-month) 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.
Yearly inspection items		
1	Replace the backup battery in the robot arm.	Exchange it referring to Page 116, "5.3.5 Replacing the backup battery".
2-year 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	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.

Note) Supply the grease to each axis with referring to Page 108, "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 120, "5.5 Maintenance parts" of this manual. Always contact your dealer when parts are needed.

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

5.3.1 Robot arm structure

An outline structure drawing is shown below. Each part is as shown below. Non-excitation magnetic brakes are mounted in all axis motor.

(1) RV-4F/7F series

1) The rotation of the J1 axis motor <1> arranged in the base is conveyed to the reduction gears <3> via the timing belt <2> to rotate the J1 axis.

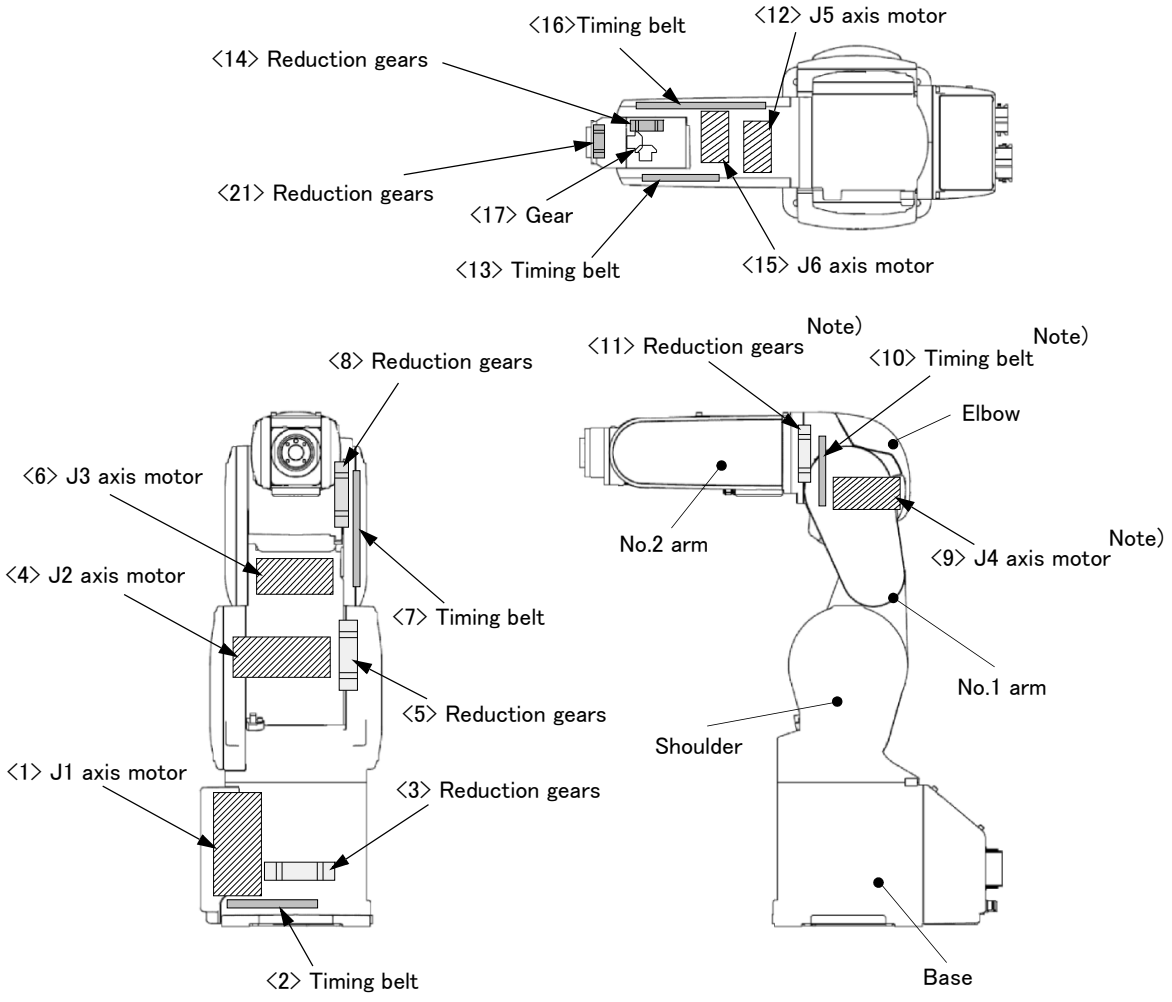
2) The J2 axis rotation is driven by the J2 axis motor <4> and reduction gears <5>.

3) The rotation of the J3 axis motor <7> arranged in the No.1 arm is conveyed to the reduction gears <9> via the timing belt <8> to rotate the J3 axis.

4) The rotation of the J4 axis motor <10> arranged in the elbow is conveyed to the reduction gears <12> via the timing belt <11> to rotate the J4 axis.
Since RV-4FJL is 5-axis type robot, they have no J4 axis.

5) The rotation of the J5 axis motor <13> arranged in the No.2 arm is conveyed to the reduction gears <16> via the timing belt <14> to rotate the J5 axis.

6) The rotation of the J6 axis motor <18> arranged in the No.2 arm is conveyed to the reduction gears <21> via the timing belt <19> and gear <20> to rotate the J6 axis.



Note) Not provided for RV-4FJL.

Fig 5-2 : Outline structure of robot arm (RV-4F/7F series)

(2) RV-13F series

1) The J1 axis rotation is driven by the J1 axis motor <1> and reduction gears <2>.

2) The J2 axis rotation is driven by the J2 axis motor <3> and reduction gears <4>.

3) The J3 axis rotation is driven by the J3 axis motor <5> and reduction gears <6>.

4) The rotation of the J4 axis motor <7> arranged in the elbow is conveyed to the reduction gears <9> via the timing belt <8> to rotate the J4 axis.

5) The rotation of the J5 axis motor <10> arranged in the No.2 arm is conveyed to the reduction gears <12> via the timing belt <11> to rotate the J5 axis.

6) The rotation of the J6 axis motor <13> arranged in the No.2 arm is conveyed to the reduction gears <16> via the timing belt <14> and gear <15> to rotate the J6 axis.

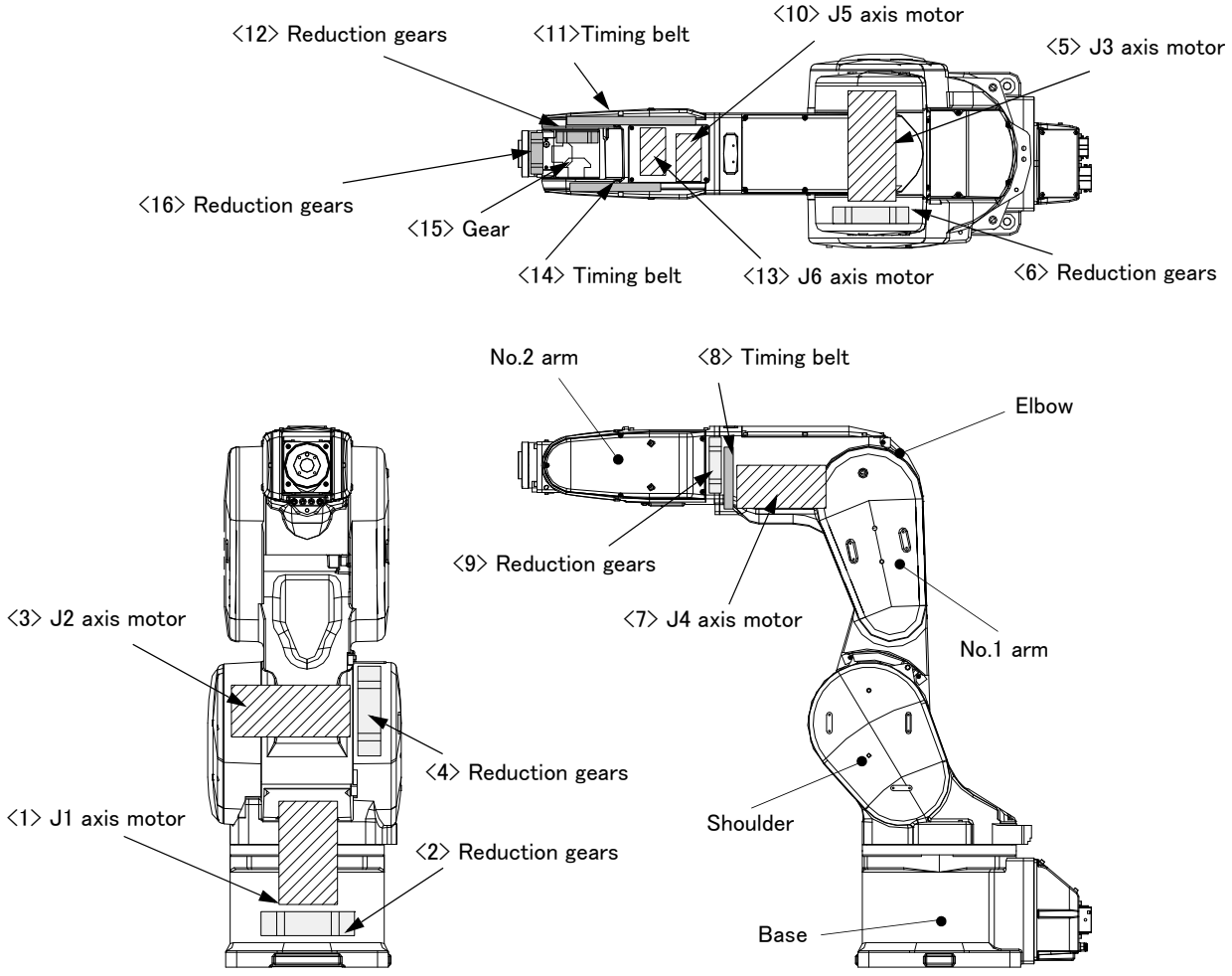


Fig 5-3 : Outline structure of robot arm (RV-13F series)

(3) RV-35F/50F/70F series

1) The rotation of the J1 axis motor <1> arranged in the shoulder portion is conveyed to the J1 axis reduction gears <3> via the J1 axis gear <2> to rotate the J1 axis.

2) The J2 axis rotation is driven by the J2 axis motor <4> arranged in the shoulder portion and J2 axis reduction gears <5>.

3) The J3 axis rotation is driven by the J3 axis motor <6> arranged in the elbow portion and J3 axis reduction gears <7>.

4) The rotation of the J4 axis motor <8> arranged in the elbow portion is conveyed to the J4 axis reduction gears <10> via the J4 axis gear <9> to rotate the J4 axis.

5) The rotation of the J5 axis motor <11> arranged in the elbow portion is conveyed to the J5 axis reduction gears <15> via the J5 axis gear <12>, J5 axis shaft <13>, and J5 axis gear <14> to rotate the J5 axis.

6) The rotation of the J6 axis motor <16> arranged in the elbow portion is conveyed to the J6 axis reduction gears <22> via the J6 axis gear <17>, J6 axis shaft <18>, J6 axis gear <19>, J6 axis gear <20>, and J6 axis gear <21> to rotate the J6 axis.

7) The wrist reduction gear unit consists of J5 axis gear <14>, J5 axis reduction gears <15>, J6 axis gear <19>, J6 axis gear <20>, J6 axis gear <21>, and J6 axis reduction gear <22>.

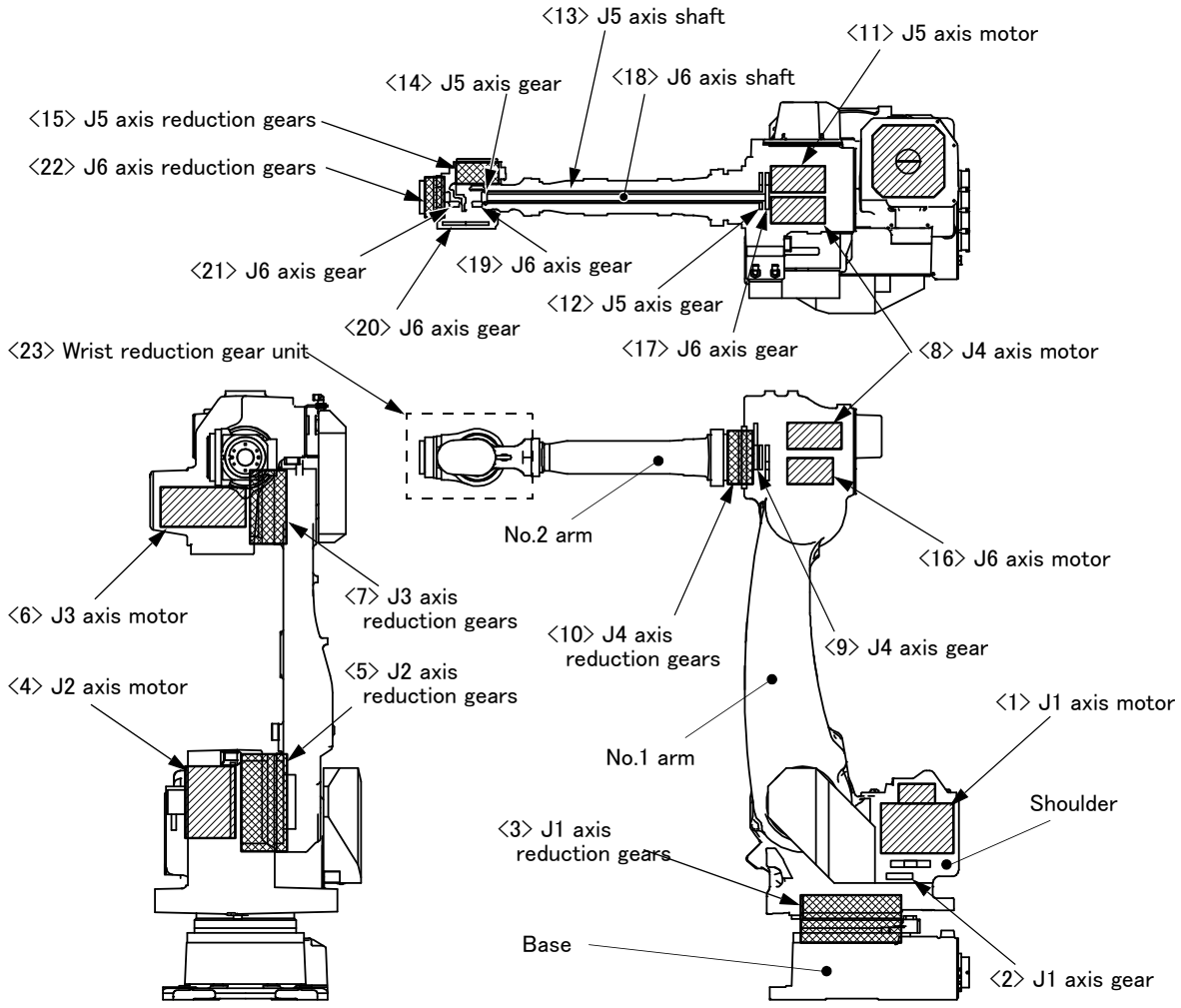


Fig 5-4 : Outline structure of robot arm (RV-35F/50F/70F series)

5.3.2 Installing/removing the cover

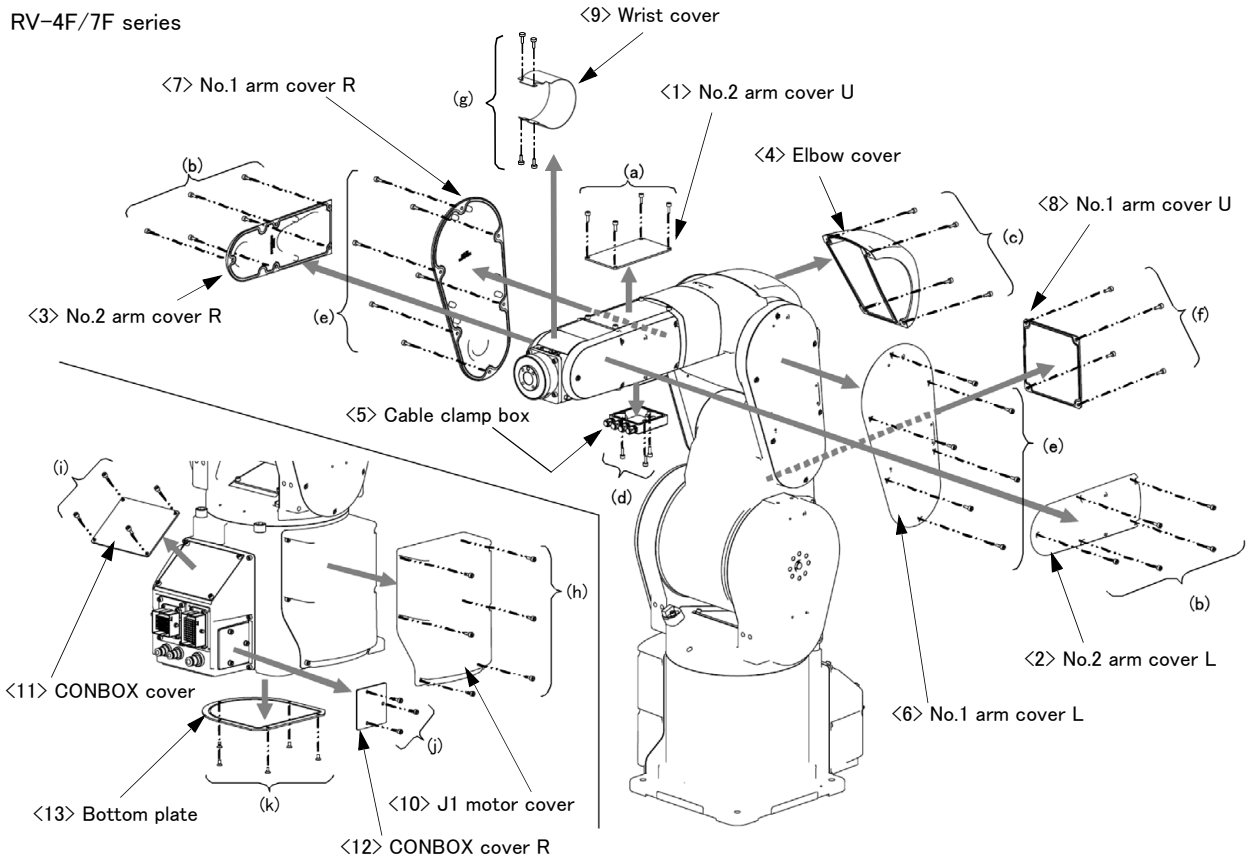


Fig.5-5 : Installing/removing the cover (RV-4F/7F series)

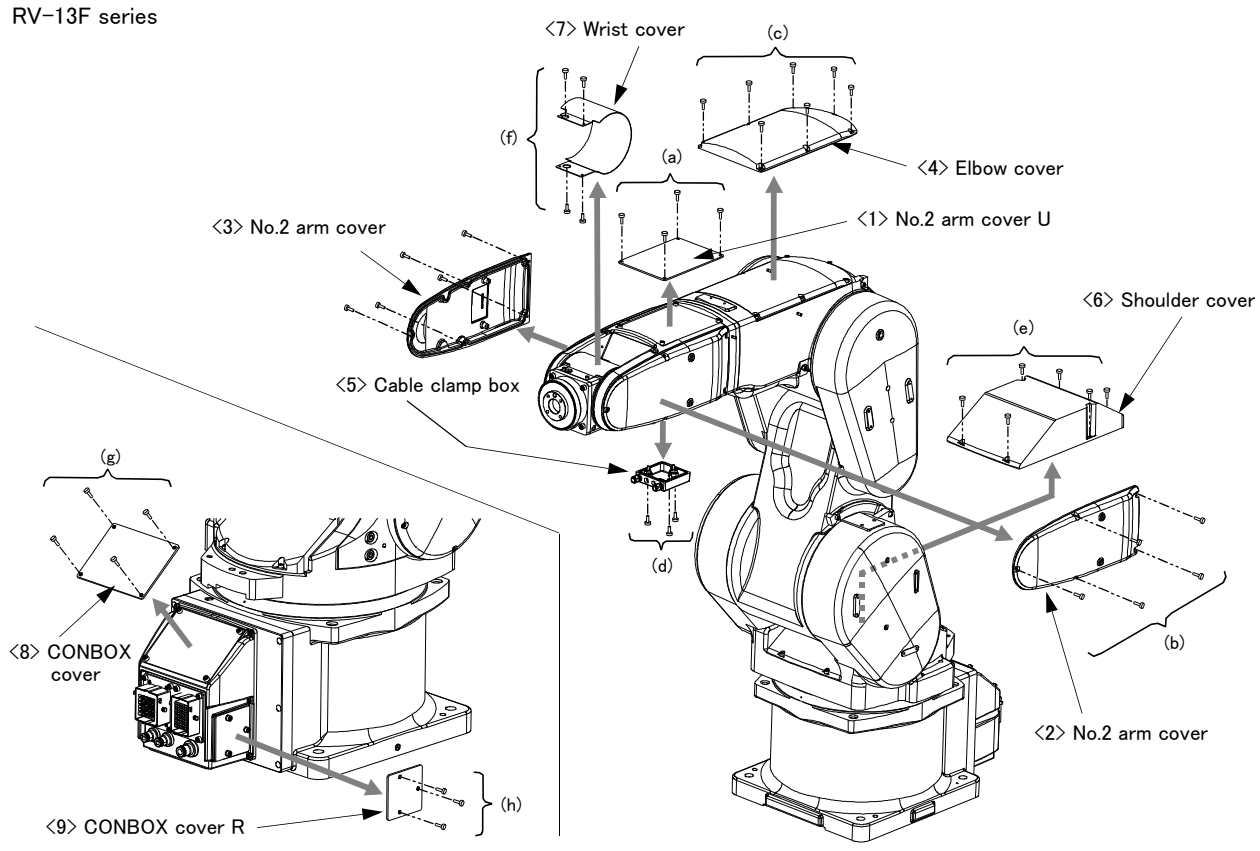


Fig.5-6 : Installing/removing the cover (RV-13F series)

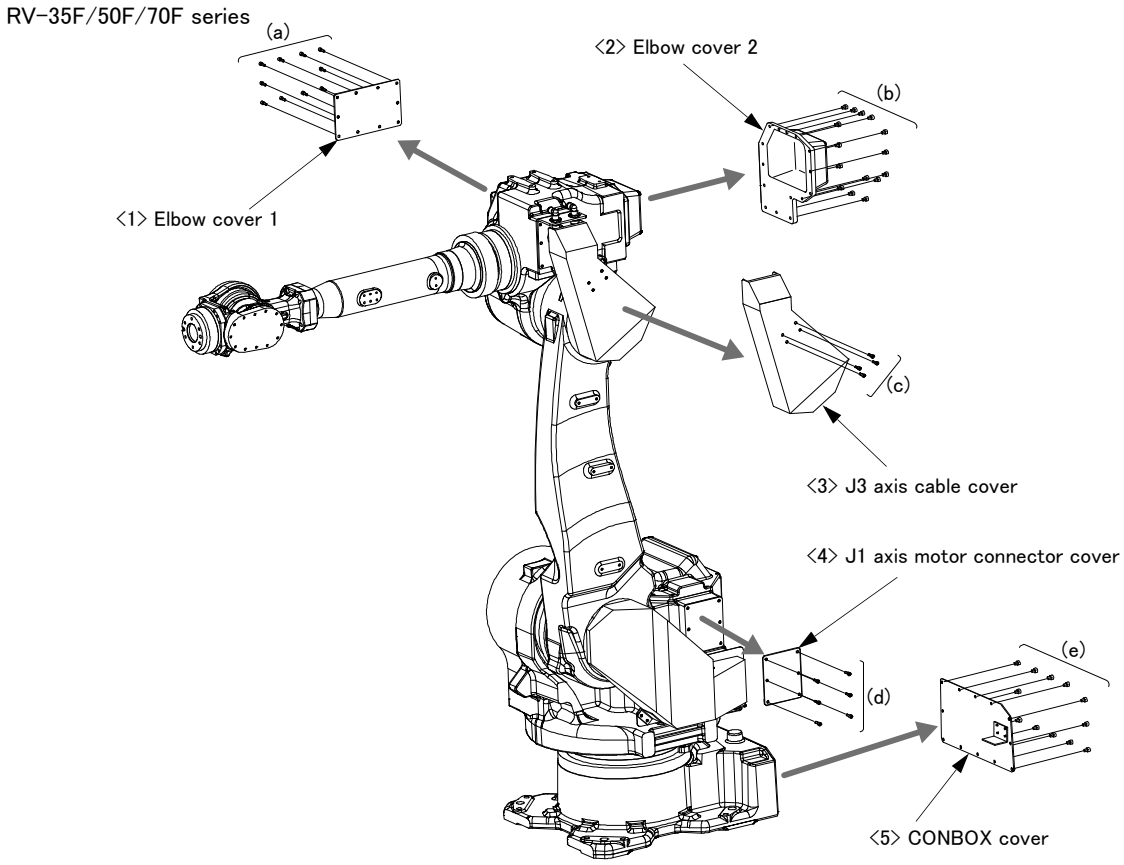


Fig.5-7 : Installing/removing the cover (RV-35F/50F/70F series)

Table 5-3 : Cover fixing screw list

Symbols	Installation screws Note1)	Qty	Remarks
RV-4F/7F series			
(a)	Hexagon socket head cap screw, M4 x 12	4	
(b)	Hexagon socket head cap screw, M4 x 12	5/one side	Fix five screws on one side.
(c)	Hexagon socket head cap screw, M4 x 16	4	
(d)	Hexagon socket head cap screw, M4 x 20	3	Only protection specification has seal washer M4
(e)	Hexagon socket head cap screw, M4 x 12	5/one side	For RV-4F/7F series. Fix five screws on one side.
		6/one side	For RV-4FL/4FJL/7FL series. Fix six screws on one side.
(f)	Hexagon socket head cap screw, M4 x 8	4	For RV-4F/7F series
		6	For RV-4FL/4FJL/7FL series
(g)	Low head cap screw, M3 x 8	4	
(h)	Hexagon socket head cap screw, M4 x 12	6	
(i)	Hexagon socket head cap screw, M4 x 8	4	
(j)	Hexagon socket head cap screw, M4 x 20	3	Only protection specification has seal washer M4
(k)	Flat head screw, M4 x 8	5	
RV-13F series			
(a)	Hexagon socket head cap screw, M4 x 12	4	
(b)	Hexagon socket head cap screw, M4 x 12	5/one side	Fix five screws on one side.
(c)	Hexagon socket head cap screw, M4 x 12	7	
(d)	Hexagon socket head cap screw, M4 x 16	3	Only protection specification has seal washer M4
(e)	Hexagon socket head cap screw, M4 x 12	6	
(f)	Low head cap screw, M3 x 8	4	For RV-7FLL
	Hexagon socket head cap screw, M3 x 8	4	For RV-13F/13FL/20F
(g)	Hexagon socket head cap screw, M4 x 8	4	

Symbols	Installation screws Note1)	Qty	Remarks
(h)	Hexagon socket head cap screw, M4 x 20	4	Only protection specification has seal washer M4
RV-35F/50F/70F series			
(a)	Hexagon socket head cap screw, M6 x 10	10	
(b)	Hexagon socket head cap screw, M6 x 20	14	
(c)	Hexagon socket head cap screw, M6 x 10	4	
(d)	Hexagon socket head cap screw, M6 x 10	6	
(e)	Hexagon socket head cap screw, M6 x 10	12	

Note1) The tightening torque of each screws are shown below.
M3 screw: 0.608 – 0.824 N·m
M4 screw: 1.39 – 1.89 N·m
M6 screw: 8.8 N·m

(1) Refer to Fig. 5-5 (RV-4F/7F series), Fig. 5-6 (RV-13F series), or Fig. 5-7 (RV-35F/50F/70F series), and remove the covers.
(2) Table 5-3 lists the names of the covers and the cover fixing screws.
(3) Depending on the robot's posture, some covers are hard to be removed. In such a case, change the robot's posture by performing jog operation to remove the covers.
(4) When removing the wrist cover, move the J5 axis to the position of +90 degrees by jog operation.
(5) When attaching the cover after maintenance and inspection, use the detaching procedure in reverse.

The part Nos. and symbols in Table 5-3 correspond to Fig. 5-5 (RV-4F/7F series), Fig. 5-6 (RV-13F series), or Fig. 5-7 (RV-35F/50F/70F series).

5.3.3 Inspection, maintenance and replacement of timing belt

RV-4F/7F/13F series 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 replacement is necessary if the timing belt is in the condition which showed in "(1)Timing belt replacement period". The inspection and adjustment and replacement method of the timing belt of each axis is shown below. Please check, and adjust and replace if necessary.

Prepare 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 106, "(8) 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, maintenance and replacement of J1-axis timing belt (RV-4F/7F series only)

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-8.

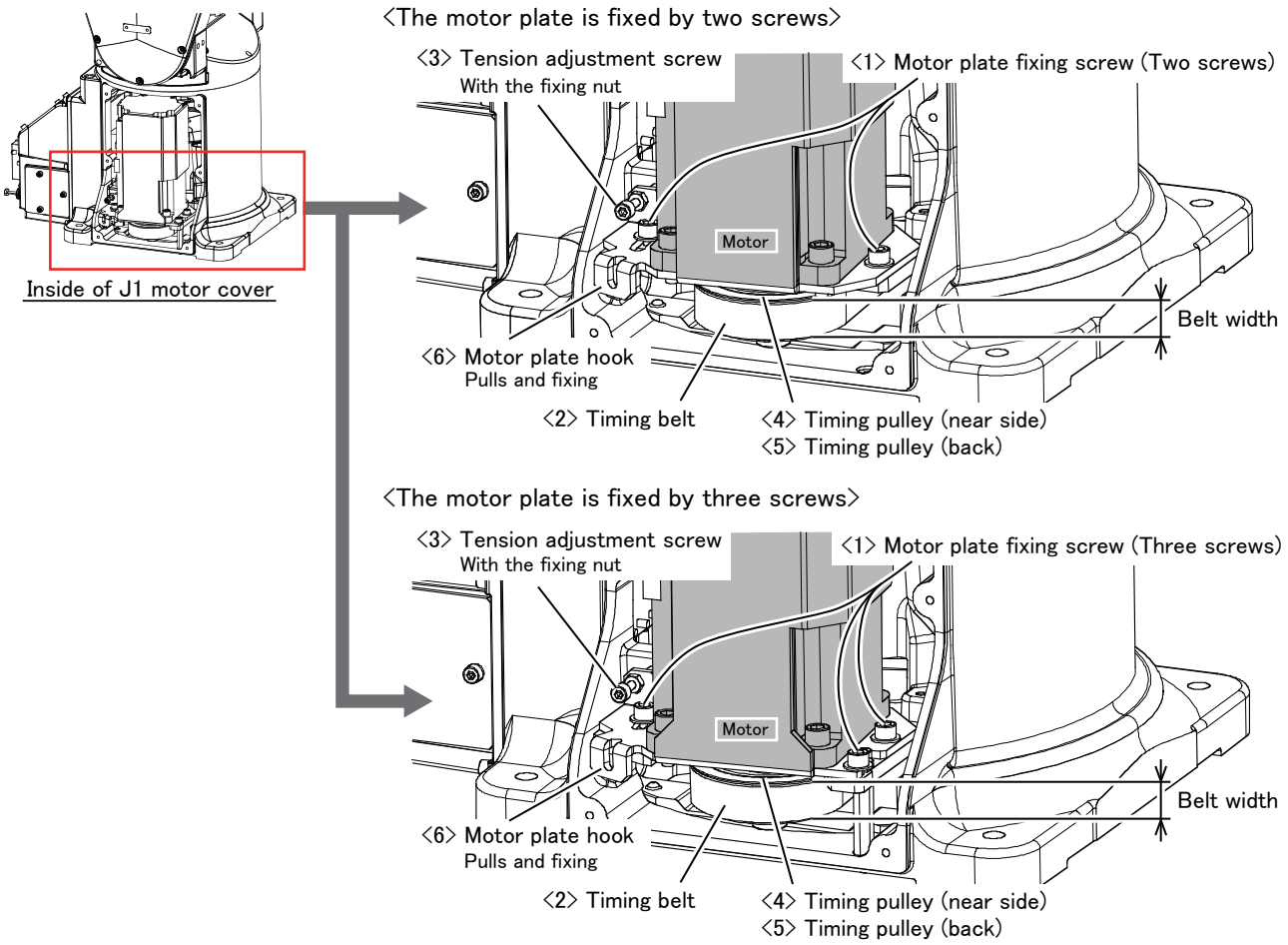


Fig.5-8 : Inspection, maintenance and replacement of J1 axis timing belt

■ Inspecting the J1 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the J1 motor cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Adjust the belt with reference to following " ■ Adjusting the J1 axis timing belt".

■ 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 motor plate fixing screw <1>. (Do not loosen too much.)
3) Loosen the nut fixing tension adjustment screw <3>. And lightly loosen tension adjustment screw <3>.
4) In the condition that hook <6> of the motor plate is pulled by the force shown below, fix the motor plate fixing screws <1> tight.

Force which pulls the hook <6>

Robot type		Used belt [N]	New belt [N]
RV-4F series		53 to 65	80 to 98
RV-7F series Note1)	Timing belt width: 15mm	65 to 79	107 to 131
	Timing belt width: 20mm	67 to 78	91 to 112

Note1)In RV-7F series, the timing belt of J1 axis differs according to manufacturing date. Please check the width of the belt and install with an appropriate tension in accordance with the belt width.

The tension of J1 axis timing belt is adjusted with this method. Certainly fix the motor plate fixing screws <1>. Improper tightening can cause the belt to loosen with vibration.

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.

5) After adjustment, fixes the fixing nut and certainly fix tension adjustment screw <3>.

■ Replacing the J1 axis timing belt

Note) Make sure that the pulleys do not move while replacing the belt. If the pulley <4> and <5> position relation deviates, the position could deviate.

1) Loosen the nut of the tension adjustment screw <3>, and loosen the tension adjustment screw <3>.
2) Remove the motor plate fixing screw <1>, and remove the timing belt <2> from the timing pulley (this side) <4>.
3) Remove the J1 axis motor, and remove the timing belt <2>.
4) Install the new timing belt to the timing pulley (back) <5> and timing pulley (this side) <4>, and install the J1 axis motor to the original position by motor plate fixing screw <1>.
5) Refer to "■ Adjusting the J1 axis timing belt" and "(8)Timing belt tension" to adjust the tension.
6) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 122, "5.6 Resetting the origin", and reset the origin position.

(3) Inspection, maintenance and replacement of J3-axis timing belt (RV-4F/7F series only)
The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-9.

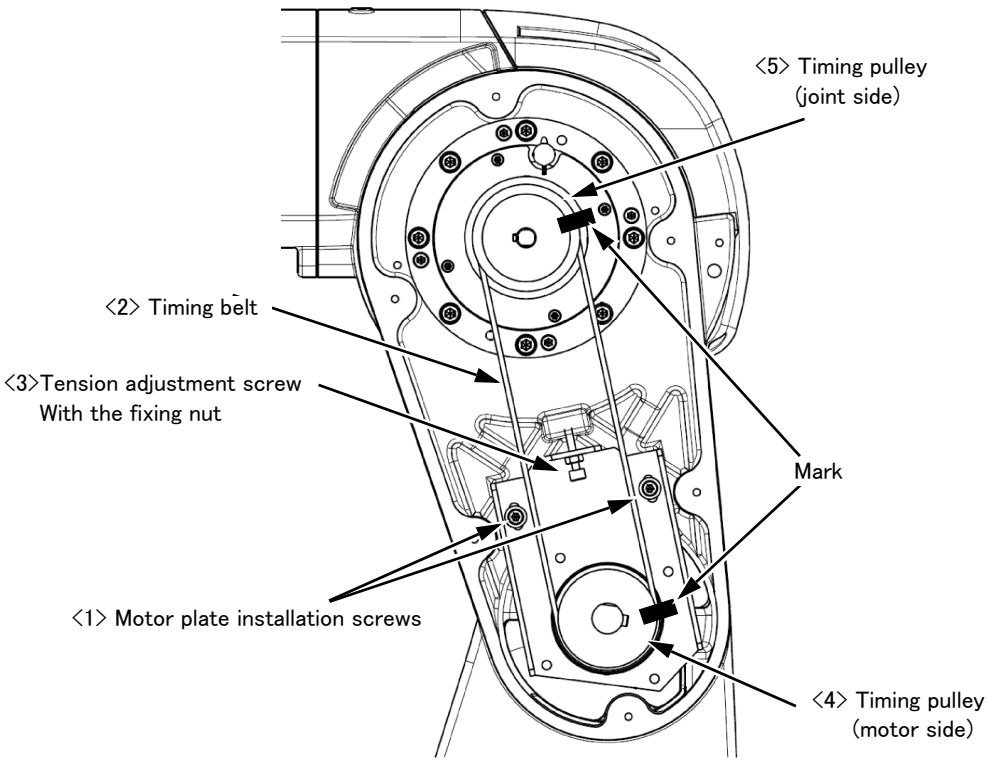


Fig.5-9 : Inspection, maintenance and replacement of J3 axis timing belt

■ Inspecting the J3 axis timing belt
1) Confirm that the robot controller power is OFF.
2) Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the No. 1 arm cover L.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt <2>.
4) Confirm that the belt tension is adjusted to slacken as shown in "Fig.5-17 : Belt tension".

■ 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 motor plate installation screws <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.
Adjust the belt tension slack to within the range as shown in "Fig.5-17 : Belt tension".
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 motor plate installation screws <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J3 axis timing belt (RV-4F series)

⚠ CAUTION If the timing belt of the J3 axis is removed, the forearm will drop by the self-weight. And, if the positional relation between the timing pulley (4) and (5) deviated, it will become the cause of the position deviation. For the safety before replacing the timing belts, hit the J3 axis against mechanical stopper with releasing brake.

1) Carry out steps "1)" and "2)" indicated in " ■ Inspecting the J3 axis timing belt" above.
2) Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the No.1 arm cover U.

3) Remove the heat conduction sheet A stuck on the J3 axis motor (see Fig. 5-10). Be careful not to get any dust, etc. on the adhesive side.
4) Make sure that the pulleys do not move while replacing the belt. If the timing pulley <4> and <5> position relation deviates, the position could deviate.
Be careful not to shift the heat conduction sheet B (see Fig. 5-10).
5) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-9 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
6) Lightly loosen the two motor plate installation screws <1>. (Do not loosen too much.)
7) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.
8) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
9) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
10) Refer to "■ Adjusting the J3 axis timing belt" and "(8)Timing belt tension" to adjust the tension.
11) Stick the adhesive side of heat conduction sheet A to the J3 axis motor. If the heat conduction sheet A is damaged, please replace it.
12) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 122, "5.6 Resetting the origin", and reset the origin position.

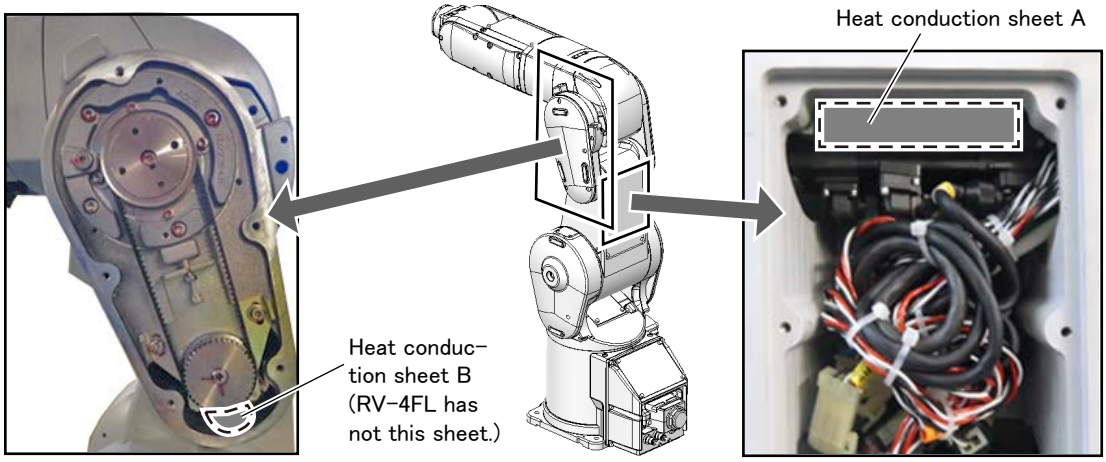


Fig.5-10 : Heat conduction sheet position

■ Replacing the J3 axis timing belt(RV-7F series)

⚠ CAUTION If the timing belt of the J3 axis is removed, the forearm will drop by the self-weight. And, if the positional relation between the timing pulley (4) and (5) deviated, it will become the cause of the position deviation. For the safety before replacing the timing belts, hit the J3 axis against mechanical stopper with releasing brake.

1) Carry out steps "1)" and "2)" indicated in "■ Inspecting the J3 axis timing belt" above.
2) Make sure that the pulleys do not move while replacing the belt. If the timing pulley <4> and <5> position relation deviates, the position could deviate.
3) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-9 so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
4) Lightly loosen the two motor plate installation screws <1>. (Do not loosen too much.)
5) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.
6) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
7) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
8) Refer to "■ Adjusting the J3 axis timing belt" and "(8)Timing belt tension" to adjust the tension.
9) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 122, "5.6 Resetting the origin", and reset the origin position.

(4) Inspection, maintenance and replacement of J4-axis timing belt (6-axis type robot of RV-4F/7F series)

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-11.

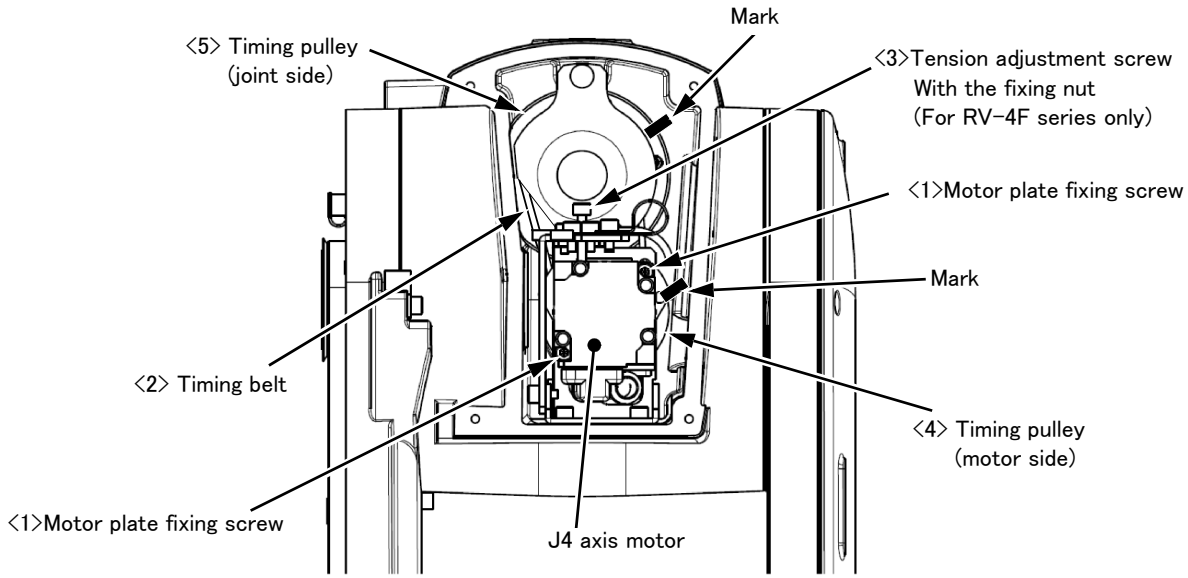


Fig.5-11 : Inspection, maintenance and replacement of J4 axis timing belt (RV-4F/7F series)

■ Inspecting the J4 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the elbow cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken as shown in "Fig.5-17 : Belt tension".

■ 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 motor plate fixing screws <1>. (Do not loosen too much.)
3) In RV-4F series, the nut which is fixing tension adjustment screw <3> is loosened, turn the 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.
   The tension adjustment screw <3> is not provided in RV-7F series. Push the J4 axis motor directly to adjust the tension of timing belt <2>.
   Adjust the belt tension slack to within the range as shown in "Fig.5-17 : Belt tension".
   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> (RV-4F series only). Moreover, also fasten motor plate fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J4 axis timing belt

Carries out the replacement of the timing belt of the J4 axis by our service provider. Please contact our service provider after confirming the robot arm and the serial number of the controller.

(5) Inspection, maintenance and replacement of J4-axis timing belt (For RV-13F series)

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-12.

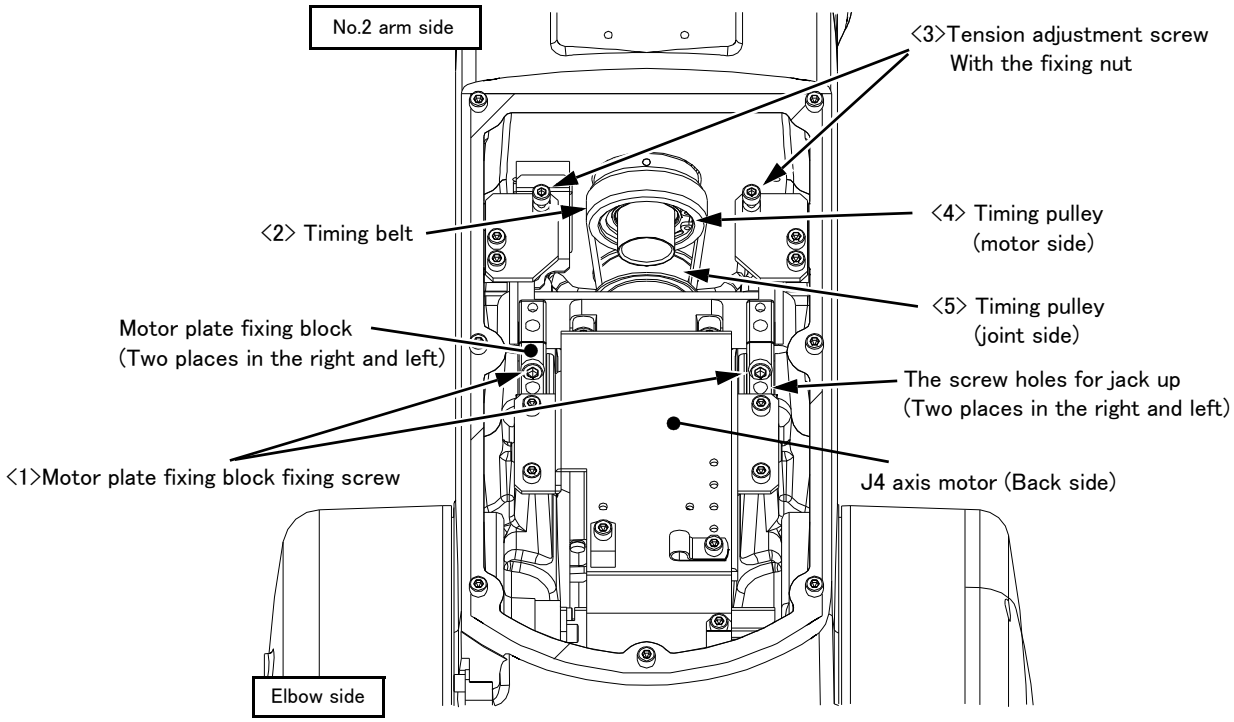


Fig.5-12 : Inspection, maintenance and replacement of J4 axis timing belt (RV-13F series)

■ Inspecting the J4 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the elbow cover.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken as shown in "Fig.5-17 : Belt tension".

■ 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 tension adjustment screws <3>.
3) Loosens the motor plate fixing block. (Two right and left)
   Remove fixing-screw <1> of the motor plate fixing block, tighten it to the screw hole for the jack ups, and loosen the motor plate fixing block. Loosen both the right and left in the same way.
4) Turn the 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.
   Adjust the belt tension slack to within the range as shown in "Fig.5-17 : Belt tension".
   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.
5) After adjustment fastens the fixing nut of tension adjustment screw <3>, and certainly fixes tension adjustment screw <3>. Moreover, also fasten motor plate fixing block fixing screw <1> certainly. (two pc.)
   Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J4 axis timing belt

Carries out the replacement of the timing belt of the J4 axis by our service provider. Please contact our service provider after confirming the robot arm and the serial number of the controller.

(6) Inspection, maintenance and replacement of J5 axis timing belt

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-13 (RV-4F/7F series, RV-7FLL) or Fig. 5-14 (RV-13F/20F).

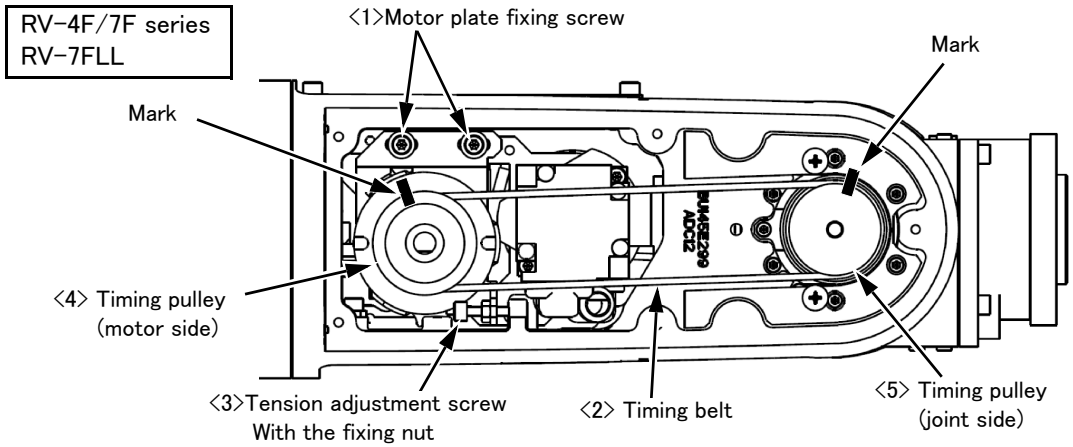


Fig.5-13 : Inspection, maintenance and replacement of J5 axis timing belt (RV-4F/7F series, RV-7FLL)

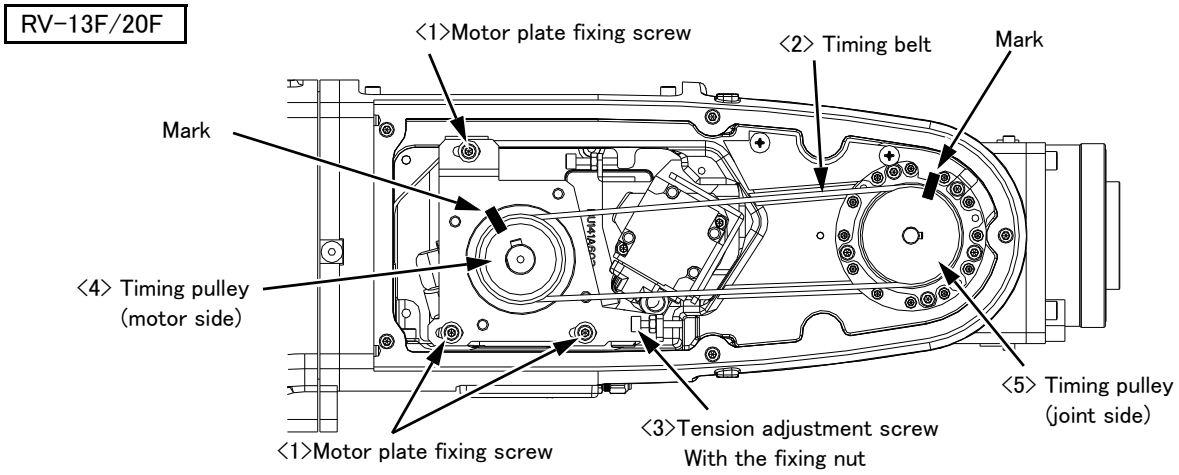


Fig.5-14 : Inspection, maintenance and replacement of J5 axis timing belt (RV-13F/20F)

■ Inspecting the J5 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the No. 2 arm cover L.
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken as shown in "Fig.5-17 : Belt tension".

■ Adjusting the J5 axis timing belt

1) Carry out steps 1) and 2) indicated in " ■ Inspecting the J5 axis timing belt" above.
2) Lightly loosen the two (R-4F/7F series, RV-7FLL) or three (RV-13F/RV-20F) motor plate fixing screws <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.
   Adjust the belt tension slack to within the range as shown in "Fig.5-17 : Belt tension".
   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 motor plate fixing screw <1> certainly. (RV-4F/7F series and RV-7FLL: two pc. RV-13F/20F: three pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J5 axis timing belt

⚠ CAUTION If the timing belt of the J5 axis is removed, the forearm will drop by the self-weight. (faces in the downward) And, if the positional relation between the timing pulley (4) and (5) deviated, it will become the cause of the position deviation. For the safety before replacing the timing belt, move the J3 axis so that it may face in the downward by jog operation.

1) Carry out steps 1) and 2) indicated in "■ Inspecting the J5 axis timing belt" above.
2) Make sure that the pulleys do not move while replacing the belt. If the timing pulley <4> and <5> position relation deviates, the position could deviate.
3) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-13 (RV-4F/7F series, RV-7FLL) or Fig. 5-14 (RV-13F/20F), so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
4) Lightly loosen the three motor plate fixing screws <1> (RV-4F/7F series: two pc. RV-13F series: three pc.).
5) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.
6) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
7) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
8) Refer to "■ Adjusting the J5 axis timing belt" and "(8)Timing belt tension" to adjust the tension.
9) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 122, "5.6 Resetting the origin", and reset the origin position.

(7) Inspection, maintenance and replacement of J6-axis timing belt

The reference figure at inspection, adjustment, and replacement of the timing belt is shown in Fig. 5-15 (RV-4F/7F series, RV-7FLL) or Fig. 5-16 (RV-13F/20F).

RV-4F/7F series
RV-7FLL

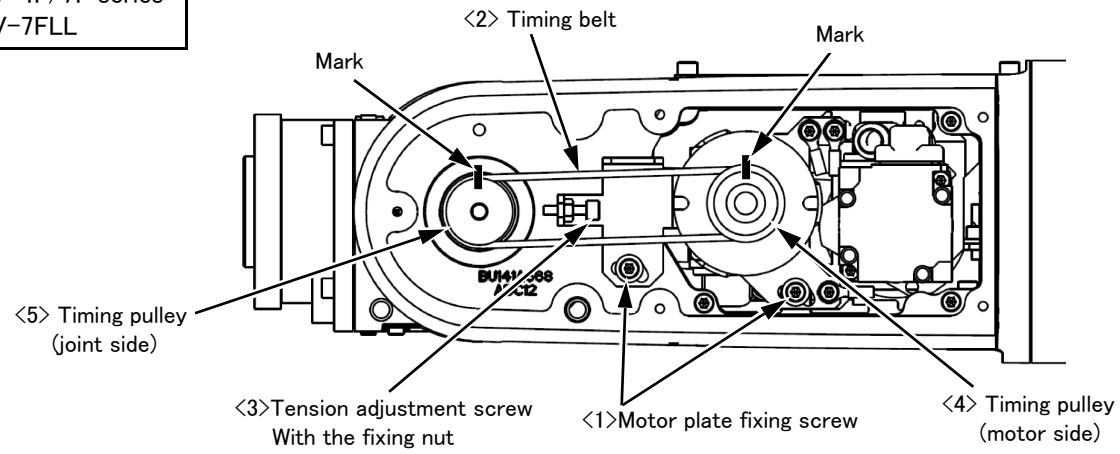


Fig.5-15 : Inspection, maintenance and replacement of J6 axis timing belt (RV-4F/7F series, RV-7FLL)

RV-13F/20F

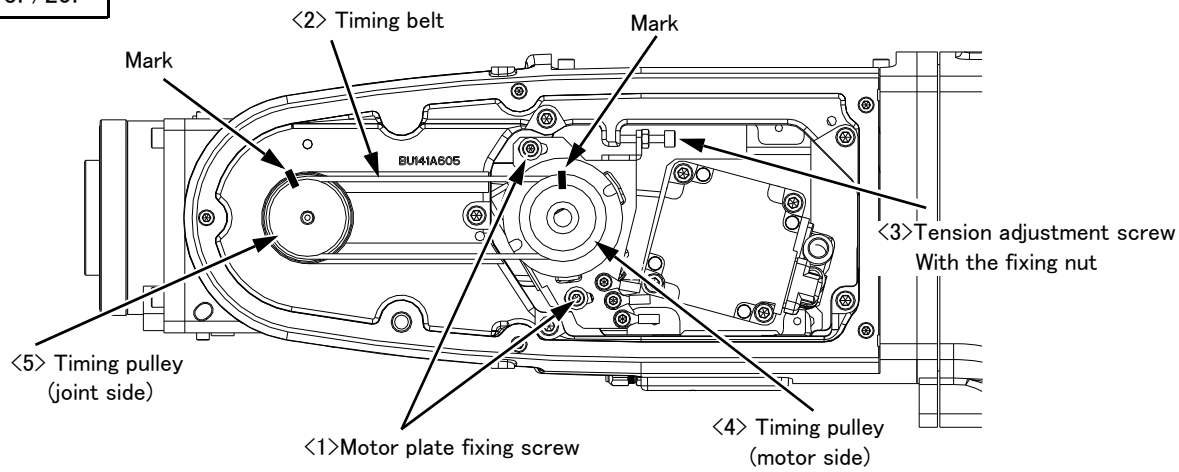


Fig.5-16 : Inspection, maintenance and replacement of J6 axis timing belt (RV-13F/20F)

■ Inspecting the J6 axis timing belt

1) Confirm that the robot controller power is OFF.
2) Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the No. 2 arm cover R
3) Visually confirm that the symptoms indicated in "(1)Timing belt replacement period" have not occurred with the timing belt.
4) Confirm that the belt tension is adjusted to slacken as shown in "Fig.5-17 : Belt tension".

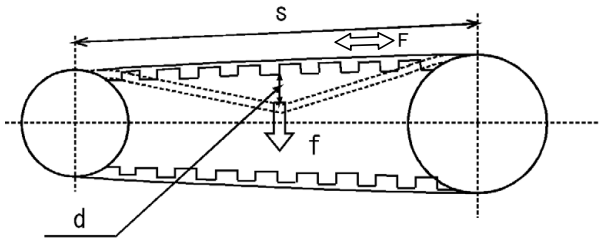
■ Adjusting the J6 axis timing belt

1) Carry out steps 1) and 2) indicated in " ■ Inspecting the J6 axis timing belt" above.
2) Lightly loosen the two motor plate fixing screws <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.
   Adjust the belt tension slack to within the range as shown in "Fig.5-17 : Belt tension".
   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 motor plate fixing screw <1> certainly. (two pc.) Improper tightening can cause the belt to loosen with vibration.

■ Replacing the J6 axis timing belt

1) Carry out steps 1) and 2) indicated in "■ Inspecting the J6 axis timing belt" above.
2) Make sure that the pulleys do not move while replacing the belt. If the pulley <4> and <5> position relation deviates, the position could deviate.
3) Make marks on the timing belt <2> and timing pulleys <4> and <5> with a felt-tip pen as shown in Fig. 5-15 (RV-4F/7F series, RV-7FLL) or Fig. 5-16 (RV-13F/20F), so that the engagement of the timing belt <2> and timing pulleys <4> and <5> does not deviate.
4) Lightly loosen the two pc. motor plate fixing screws <1>. (Do not loosen too much.)
5) Loosen the nut fixing tension adjustment screw <3>. Loosen the tension adjustment screw <3>, and remove the old belt.
6) Copy the marks onto the new timing belt. Make sure that both belts are tense when making the marks.
7) Align the new timing belt with the marks on the timing pulleys <4> and <5>, and install.
8) Refer to "■ Adjusting the J6 axis timing belt" and "(8)Timing belt tension" to adjust the tension.
9) The position could deviate after the belt is replaced. Confirm that the position has not deviated. If deviated, refer to Page 122, "5.6 Resetting the origin", and reset the origin position.

(8) Timing belt tension



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

■ RV-4F series

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

Axis	Belt type	Preset value			Standard tension (N)[Note1]	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J1	315-EV3GT-12	2.5	12	85.5	79.7 – 97.4 (80 – 98)	53.1 – 64.9 (53 – 65)
J3	369-EV3GT-6	2.5	6	118.4	39.2 – 47.9	26.1 – 31.9
J4 [Note2]	240-EV3GT-6	2.5	6	56.4		
J5	393-EV3GT-4	2.5	4	149.8	27.0 – 33.0	18.0 – 22.0
J6	270-EV3GT-4	2.5	4	96.0		

Note1) The value inside the parenthesis shown in the column of tension of the J1 axis shows the force which pulls the motor plate hook at belt adjustment.
Note2) Since RV-4FJL is 5-axis type robot, they have no J4 axis.

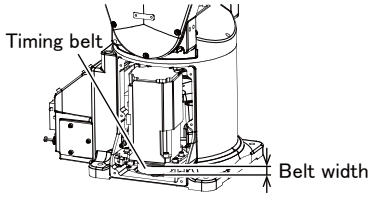
■ RV-7F series

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

Axis	Belt type	Preset value			Standard tension (N)[Note1]	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J1[Note2]	405-5GT-15 (Belt width: 15mm)	4.0	15	108	113 ～ 139 (107 ～ 131)	68 ～ 83 (65 ～ 79)
	405-EV5GT-20 (Belt width: 20mm)	4.0	20	108	96 ～ 118 (91 ～ 112)	70 ～ 82 (67 ～ 78)
J3	501-3GT-9	2.5	9	178.5	59.4 – 72.6	39.6 – 48.4
J4	237-EV3GT-6	2.5	6	54.9	39.2 – 47.9	26.1 – 31.9
J5	408-EV3GT-6	2.5	6	150.0		
J6	270-EV3GT-4	2.5	4	96.0	27.0 – 33.0	18.0 – 22.0

Note1) The value inside the parenthesis shown in the column of tension of the J1 axis shows the force which pulls the motor plate hook at belt adjustment.
Note2) The type of J1 axis timing belt differs depending on manufacturing date of the robot. It is necessary to install the belt by an appropriate tension corresponding to the belt width. The manufacturing date of the robot arm is shown on the DATA field of the rated nameplate on the base section of the robot arm.

- 15-mm width belt .. The products manufactured in October, 2017 or before. The special specification products with S15 in the end of robot's type name manufactured in May, 2017 or before.
- 20-mm width belt .. Other than the above.



■ RV-7FLL

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

Axis	Belt type	Preset value			Standard tension (N)	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J4	252-EV3GT-9	2.5	9	60.0	59.4- 72.6	39.6 – 48.4
J5	408-EV3GT-6	2.5	6	150.0	39.2 – 47.9	26.1 – 31.9
J6	270-EV3GT-4	2.5	4	96.0	27.0 – 33.0	18.0 – 22.0

■ RV-13F/20F

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

Axis	Belt type	Preset value			Standard tension (N)	
		M(g/m)	W(mm/R)	S(mm)	New belt	Used belt
J4	252-EV3GT-9	2.5	9	60.0	59.4- 72.6	39.6 – 48.4
J5	495-EV3GT-9	2.5	9	181.0		
J6	330-EV3GT-6	2.5	6	111.0	39.2 – 47.9	26.1 – 31.9

Fig.5-17 : 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 loose. 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. 5-17.
Check and adjust with the belt pressing force f and the slack amount d between spans.

5.3.4 Lubrication

(1) RV-4F/7F/13F series

■ Lubrication position and specifications

The grease nipple position is shown in Fig. 5-18 (RV-4F/7F series) or Fig. 5-19 (RV-13F series). The lubrication specifications for each place are shown in Table 5-4. Refer to the Page 92, "5.3.2 Installing/removing the cover" for the method of removing and installing the cover.

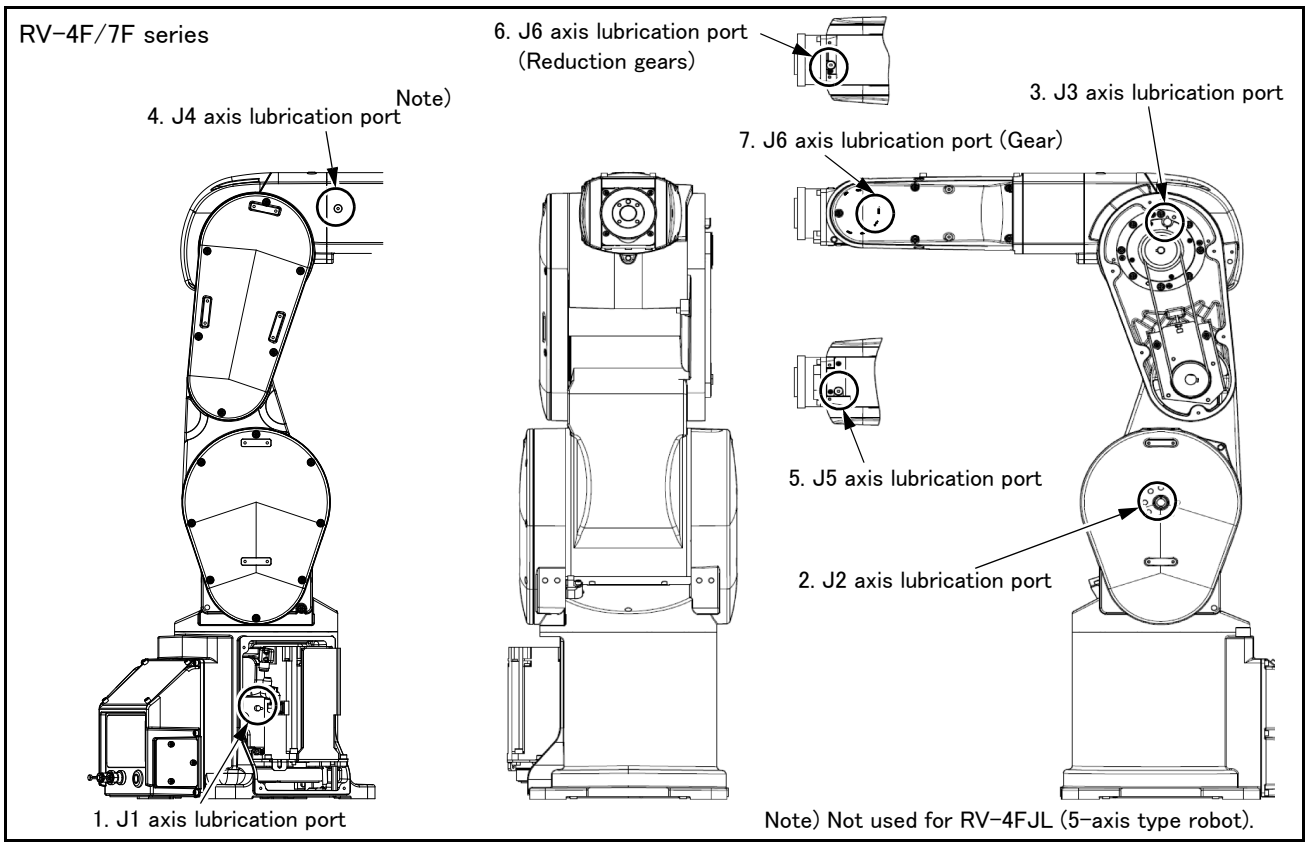


Fig.5-18 : Lubrication positions (RV-4F/7F series)

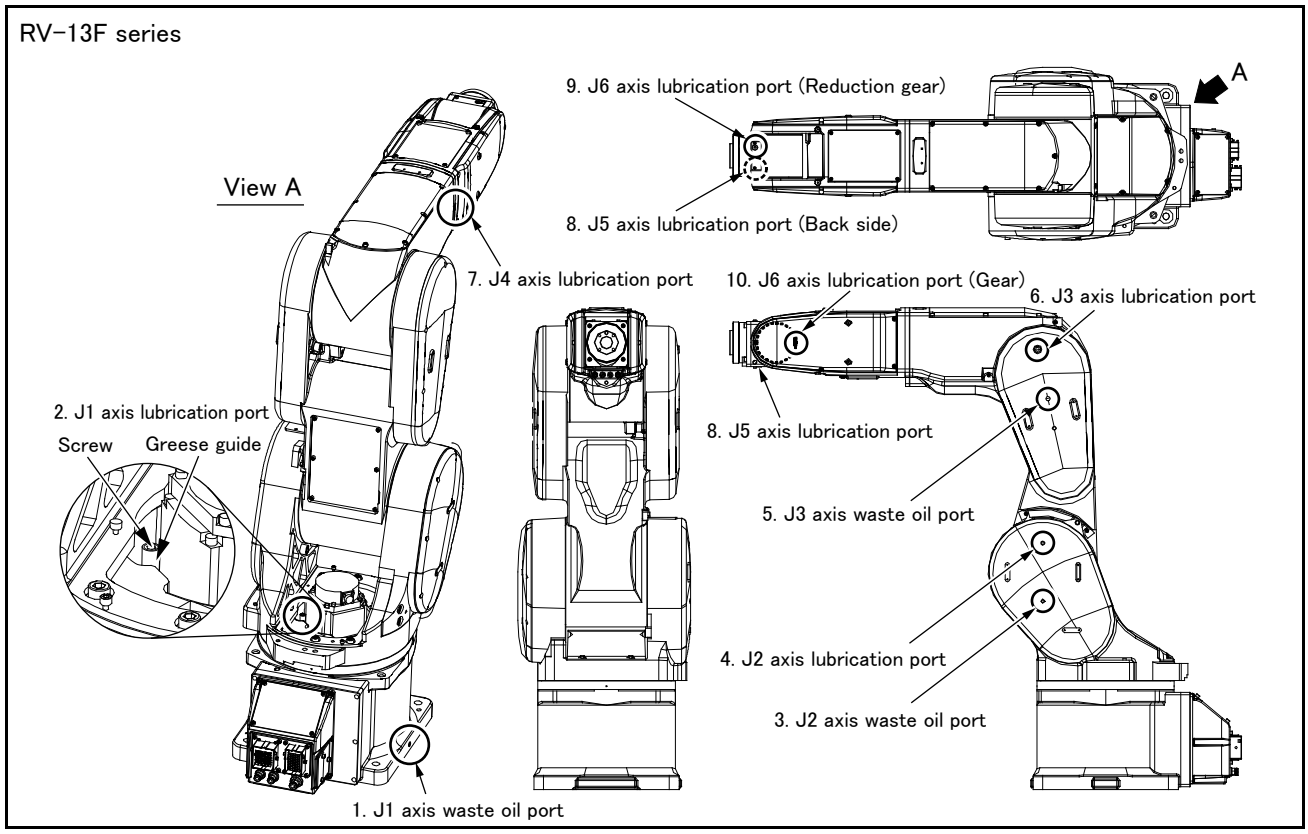


Fig.5-19 : Lubrication positions (RV-13F series)

Table 5-4 : Lubrication specifications

No.	Parts to be lubricated Note1)	Oiling method	Lubrication oil (maker)	Lubrication interval	Lubrication amount	Cover to remove
RV-4F series						
1	J1 axis reduction gears	Grease nipple WA-610	4B No.2 (Harmonic Drive Systems Inc.)	24,000Hr	8g	J1 motor cover
2	J2 axis reduction gears				8g	
3	J3 axis reduction gears				4g	No.1 arm cover L
4	J4 axis reduction gears Note2)				4g	
5	J5 axis reduction gears				2g	
6	J6 axis reduction gears				2g	
7	J6 axis gears				1.3g	Wrist cover
RV-7F series						
1	J1 axis reduction gears	Grease nipple WA-610	4B No.2 (Harmonic Drive Systems Inc.)	24,000Hr	12g	J1 motor cover
2	J2 axis reduction gears				12g	
3	J3 axis reduction gears				8g	No.1 arm cover L
4	J4 axis reduction gears				4g	
5	J5 axis reduction gears				2g	
6	J6 axis reduction gears				2g	
7	J6 axis gears				1.3g	Wrist cover
RV-7FLL						
2	J1 axis reduction gears	Grease nipple WA-110	VIGO GREASE (Nabtesco Co., Ltd.)	20,000Hr	255g	Shoulder cover
4	J2 axis reduction gears				251g	
6	J3 axis reduction gears				150g	

No.	Parts to be lubricated Note1)	Oiling method	Lubrication oil (maker)	Lubrication interval	Lubrication amount	Cover to remove
7	J4 axis reduction gears	Grease nipple WA-610	4B No.2 (Harmonic Drive Systems Inc.)	24,000Hr	7g	
8	J5 axis reduction gears				2g	
9	J6 axis reduction gears				2g	
10	J6 axis gears				1.3g	Wrist cover
RV-13F/20F						
2	J1 axis reduction gears	Grease nipple WA-110	VIGO GREASE (Nabtesco Co., Ltd.)	20,000Hr	255g	Shoulder cover
4	J2 axis reduction gears				251g	
6	J3 axis reduction gears				150g	
7	J4 axis reduction gears	Grease nipple WA-610	4B No.2 (Harmonic Drive Systems Inc.)	24,000Hr	7g	
8	J5 axis reduction gears				3g	
9	J6 axis reduction gears				2g	
10	J6 axis gears				1.5g	Wrist cover

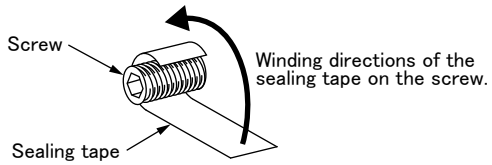
Note1) When the screw is installed in the illustrated lubrication point, install the attached grease nipple and supply the grease.
Note2) Since RV-4FJL is 5-axis type robot, they have no J4 axis reduction gears.

[Caution]
- The brand name of the grease shown in the Table 5-4 is the grease put in at shipping.
- The lubrication time is a cumulative value of the operation at the maximum speed. If the operation has been suspended, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
- Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
- By the maintenance forecast function of RT ToolBox2 (option) computes the guide of the lubrication hours put together with the customer's operation status.
- The numbers in theTable 5-4 correspond to the supply positions in Fig. 5-18 (RV-4F/7F series) or Fig. 5-19 (RV-13F series).
- When the specified time limit (24,000 Hr) is due, the overhaul work to replace internal grease is required. The maintenance after it needs the overhaul work which replaces internal grease. Please ask dealer for more details about overhaul.

■ Lubrication method

1) Set the robot to the posture shown in Fig. 5-18 (RV-4F/7F series) or Fig. 5-19 (RV-13F series).
2) Refer to the Page 92, "5.3.2 Installing/removing the cover" and remove the covers.
3) Please protect the timing belt with the cloth etc. so that the grease does not take for the timing belt at the time of oil supply.
4) - RV-4F series
   Remove the following screws, and install the attached grease nipples.
   J3 axis lubrication port <3>, J4 axis lubrication port <4>, J5 axis lubrication port <5>, J6 axis lubrication port <6> (reduction gears) and J6 axis lubrication port <7> (gear).
   * RV-4FJL does not use the J4 axis lubrication port <4>. Securely tighten the grease nipple by 4.7 N·m to 6.3 N·m
   - RV-7F series
   Remove the following screws, and install the attached grease nipples.
   J4 axis lubrication port <4>, J5 axis lubrication port <5>, J6 axis lubrication port <6> (reduction gears) and J6 axis lubrication port <7> (gear). Securely tighten the grease nipple by 4.7 N·m to 6.3 N·m
   - RV-13F series
   Removes J1 axis waste oil screw <1>, the J2 axis waste oil screw <3>, and the J3 axis waste oil screw <5>. Because the oil appears from the screw hole, please wipe off with the rag etc.
   Remove the screw of from J1 axis lubrication port <2> to the J6 axis lubrication port (gear) <7>, and install the attached grease nipple. Securely tighten the grease nipple by 4.7 N·m to 6.3 N·m
5) Insert the grease shown in Table 5-4 using a grease gun from the lubrication grease nipple.

6) In the RV-13F series, wind thread sealing tape two or three times around the thread of the screws removed from waste oil portion (1), (3), and (5) (refer to the image below). Then tighten the screws by 7.1 N·m to 8.5 N·m. (Recommended sealing tape: NITOFLON Pipe Seal No.95 (JIS), manufacture: NITTO DENKO)



⚠ CAUTION If the screw is tightened with lower/higher torque or not winded a sealing tape, it may cause grease to leak.

7) Remove the grease nipples installed above and install the original screws.
   - RV-4F/7F series
     Tighten the screws by 4.7N·m – 6.3N·m.
   - RV-13F series
     In lubrication portion of from (7) to (10), tighten the screw by 4.7N·m – 6.3N·m.
     In lubrication portion (2), (4), and (6), wind thread sealing tape two or three times around the thread of the screws (see 6)). (Recommended sealing tape: NITOFLON Pipe Seal No.95 (JIS), manufacture: NITTO DENKO)
     Tighten the screw of lubrication portion (2) to the end surface of grease guide.
     Tighten the screw of lubrication portion (4) and (6) by 7.1 N·m to 8.5 N·m.

⚠ CAUTION If the screw is tightened with lower/higher torque or not winded a sealing tape, it may cause grease to leak.

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

⚠ CAUTION Use manual grease gun, and inject grease with pressure 0.03Mpa or less. Do not use the grease gun, which derived by the factory air presser to avoid injecting by too high pressure.
A grease gun that fits the grease nipple is required.
Recommended grease gun: KH-120 (amount: 140ml) or KH-32 (amount: 200ml)
(manufacture: Yamada Corporation Inc.,)
The grease guns come with a short nozzle (HSP-1) as standard. If this short nozzle does not reach the desired areas, depending on the robot model and installation location, it may be useful to use a long nozzle (HSP-2).

(2) RV-35F/50F/70F series

■ Lubrication position and specifications

The grease nipple position is shown in Fig. 5-20 and Fig. 5-21. The lubrication specifications for each place are shown in Table 5-5. Refer to the Page 92, "5.3.2 Installing/removing the cover" for the method of removing and installing the cover.

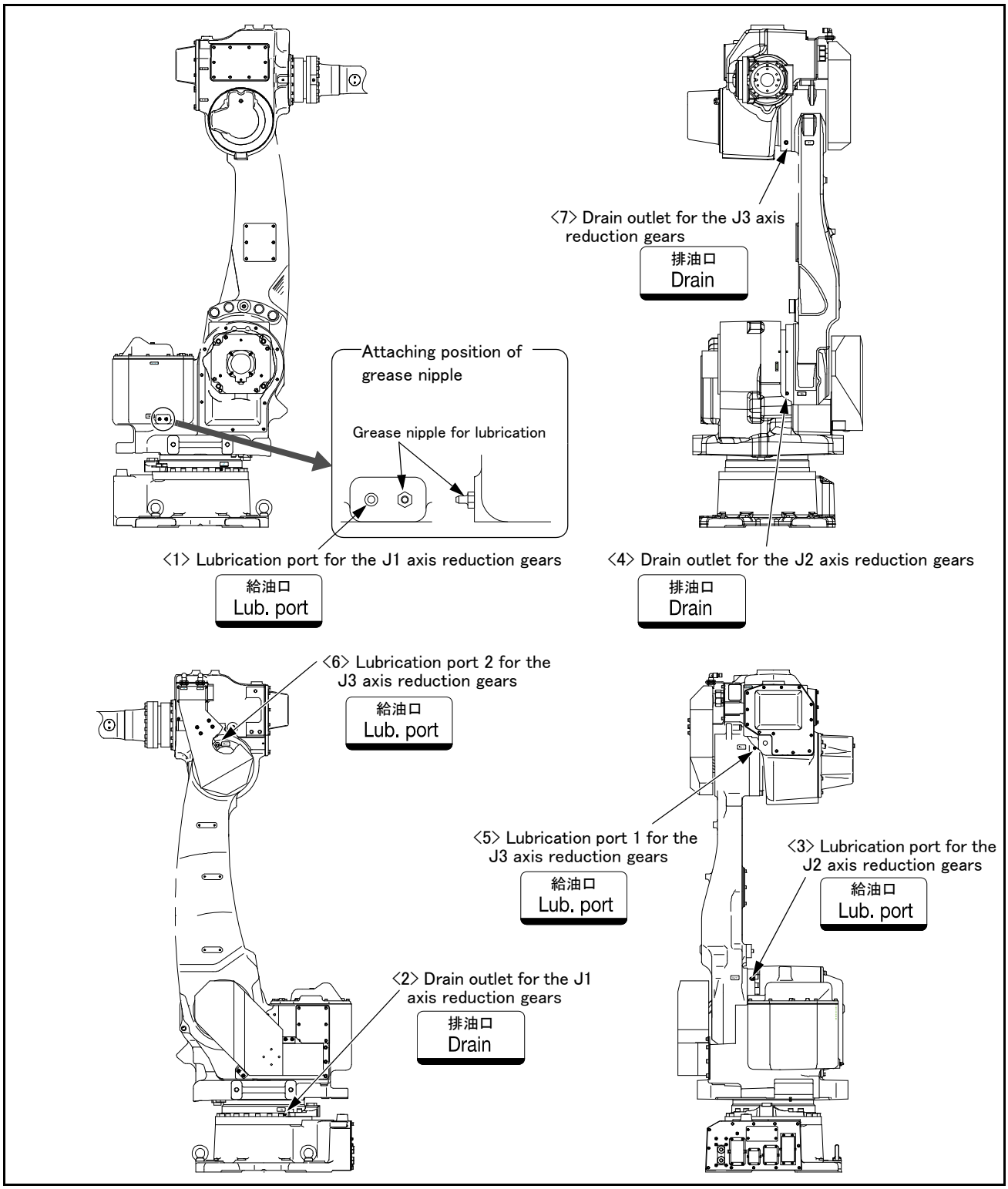


Fig.5-20 : Lubrication positions (RV-35F/50F/70F series: J1, J2, and J3 axis)

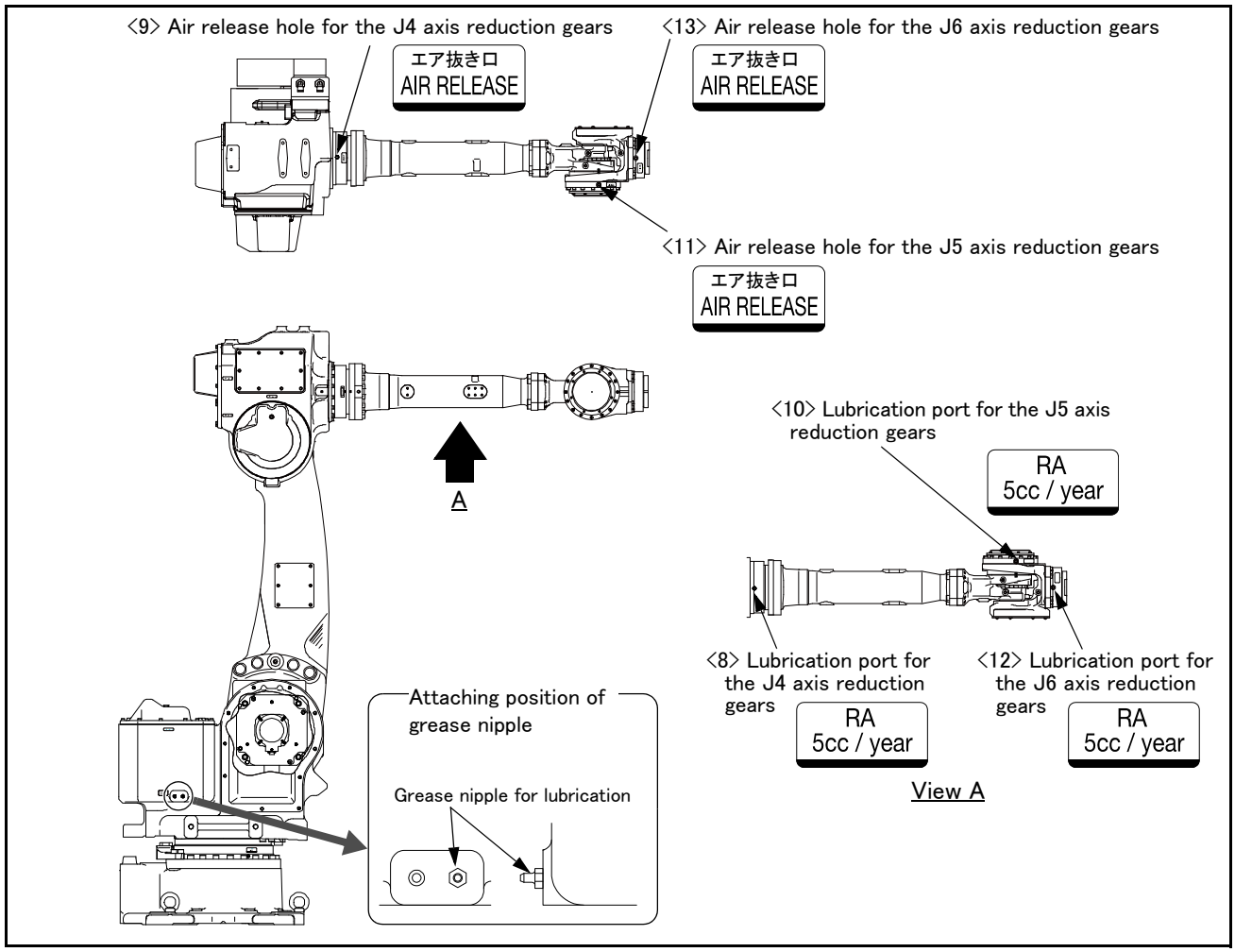


Fig.5-21 : Lubrication positions (RV-35F/50F/70F series: J4, J5, and J6 axis)

Table 5-5 : Lubrication specifications

No.	Parts to be lubricated	Oiling method	Lubrication oil (maker)	Lubrication interval	Lubrication amount [Requirements for lubrication]
<1>	J1 axis reduction gears	Grease nipple (attachment) F-100-N-1/8	Molywhite RE No.00 (Nabtesco Corporation)	10,000Hr	3150g (Approx. 3600cc) [6000g (Approx. 6900cc)]
<3>	J2 axis reduction gears				1250g (Approx. 1430cc) [1650g (Approx. 1900cc)]
<5> <6>	J3 axis reduction gears				490g (Approx. 565cc) [985g (Approx. 1130cc)]
<8>	J4 axis reduction gears		Alvania RA-J (Showa Shell Sekiyu K.K.)	6,000Hr	4.5g (5cc)
<10>	J5 axis reduction gears				4.5g (5cc)
<12>	J6 axis reduction gears				4.5g (5cc)

[Caution]

- The brand name of the grease shown in the Table 5-5 is the grease put in at shipping.
- The lubrication time is a cumulative value of the operation at the maximum speed. If the operation has been suspended, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
- Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
- By the maintenance forecast function of RT ToolBox2 (option) computes the guide of the lubrication hours put together with the customer's operation status.
- The numbers in theTable 5-5 correspond to the supply positions in Fig. 5-20 and Fig. 5-21.

・When the specified time limit (20,000 Hr) is due, the overhaul work to replace internal grease is required. The maintenance after it needs the overhaul work which replaces internal grease. Please ask dealer for more details about overhaul.

■ Lubrication method for the J1 axis

1) Place a grease receiving pan under the drain outlet <2> for the J1 axis reduction gears.
2) Remove the hexagon plug from the drain outlet <2> for the J1 axis reduction gears.
3) Remove the hexagon plug from the lubrication port <1> for the J1 axis reduction gears.
4) Remove the grease nipple from the robot arm and attach it to the lubrication port <1> for the J1 axis reduction gears.
5) Inject grease into the inlet with the lubrication grease nipple using a grease gun until the drain outlet <2> for the J1 axis reduction gears drains clean grease only. (About 6900 cc (6000 g) of grease is required.) Measure the amounts of injected and collected grease. For grease injection, hold right pressure less than 0.2 MPa.
6) Remove the grease nipple of the lubrication port <1> for the J1 axis reduction gears to connect air piping. (Prepare the Rc-1/8 joint.)
7) Supply air to drain any excess of inside grease injected on step-5) so that the reduction gears retain 3600 to 3650 cc (about 3150 g) of grease. For air supply, hold 0.03 MPa pressure or less.
If any grease is drained, operate the robot slowly in the direction of J1 axis by jog operation to emit an excess of grease.
8) After the excess of grease is drained, wind thread sealing tape around and replace the hexagon plug on each thread of screws of the lubrication port <1> for the J1 axis reduction gears and the drain outlet <2> for the J1 axis reduction gears. The tightening torques are shown below.
Lubrication port <1> for the J1 axis reduction gears: 12.7N・m
Drain outlet <2> for the J1 axis reduction gears: 29.4N・m
9) Return the grease nipple to its original place.

■ Lubrication method for J2 axis

1) Place a grease receiving pan under the drain outlet <4> for the J2 axis reduction gears.
2) Remove the hexagon plug from the drain outlet <4> for the J2 axis reduction gears.
3) Remove the hexagon plug from the lubrication port <3> for the J2 axis reduction gears.
4) Remove the grease nipple from the robot arm and attach it to the lubrication port <3> for the J2 axis reduction gears.
5) Inject grease into the inlet with the lubrication grease nipple using a grease gun until the drain outlet <4> for the J2 axis reduction gears drains clean grease only. (About 1900 cc (1650 g) of grease is required.) Measure the amounts of injected and collected grease. For grease injection, hold right pressure less than 0.2 MPa.
6) Remove the grease nipple of the lubrication port <3> for the J2 axis reduction gears to connect air piping. (Prepare the Rc-1/8 joint.)
7) Supply air to drain any excess of inside grease injected on step-5) so that the reduction gears retain 1400 to 1450 cc (about 1250 g) of grease. For air supply, hold 0.03 MPa pressure or less.
If any grease is drained, operate the robot slowly in the direction of J2 axis by jog operation to emit an excess of grease.
8) After the excess of grease is drained, wind thread sealing tape around and replace the hexagon plug on each thread of screws of the lubrication port <3> for the J2 axis reduction gears and the drain outlet <4> for the J2 axis reduction gears. The tightening torque is 12.7N・m.
9) Return the grease nipple to its original place.

■ Lubrication method for J3 axis

1) Place a grease receiving pan under the drain outlet <7> for the J3 axis reduction gears.
2) Remove the hexagon plug from the drain outlet <7> for the J3 axis reduction gears.
3) Remove the hexagon plug from the lubrication port 1 <5> for the J3 axis reduction gears.
4) Remove the grease nipple from the robot arm and attach it to the lubrication port 1 <5> for the J3 axis reduction gears.
5) Inject grease into the inlet with the lubrication grease nipple using a grease gun until the drain outlet <7> for the J3 axis reduction gears drains clean grease only. (About 350 cc (305 g) of grease is required.) Measure the amounts of injected and collected grease. For grease injection, hold right pressure less than 0.2 MPa.
6) Remove the hexagon plug from the lubrication port 2 <6> for the J3 axis reduction gears.
7) Remove the grease nipple from the lubrication port 1 <5> for the J3 axis reduction gears and attach the grease nipple to the lubrication port 2 <6> for the J3 axis reduction gears.

Wind thread sealing tape around and replace the hexagon plug on the thread of screws of the lubrication port 1 <5> for the J3 axis reduction gears. The tightening torque is 12.7N・m.

8) Inject grease into the inlet with the lubrication grease nipple using a grease gun until the drain outlet <7> for the J3 axis reduction gears drains clean grease only. (About 780 cc (680 g) of grease is required.) Measure the amounts of injected and collected grease. For grease injection, hold right pressure less than 0.2 MPa.
9) Remove the grease nipple of the lubrication port 2 <6> for the J3 axis reduction gears to connect air piping. (Prepare the Rc-1/8 joint.)
10) Supply air to drain any excess of inside grease injected on step-5) and 8) so that the reduction gears retain 550 to 580 cc (about 495 g) of grease. For air supply, hold 0.03 MPa pressure or less.
If any grease is drained, operate the robot slowly in the direction of J3 axis by jog operation to emit an excess of grease.
11) After the excess of grease is drained, wind thread sealing tape around and replace the hexagon plug on each thread of screws of the lubrication port 2 <6> for the J3 axis reduction gears and the drain outlet <7> for the J3 axis reduction gears. The tightening torque is 12.7N・m.
12) Return the grease nipple to its original place.

■ Lubrication method for J4, J5, and J6 axis

1) Remove the hexagon plug from the lubrication port and air release hole.
2) Remove the grease nipple from the robot arm and attach it to the lubrication port.
3) Inject 5 cc (4.5 g) of grease into each of the inlet with the lubrication grease nipple using a grease gun. For grease injection, hold right pressure less than 0.03MPa.
4) Wind thread sealing tape around and replace the hexagon plug on each thread of screws. The tightening torque is 12.7 N・m.
5) Return the grease nipple to its original place.
6) If the maintenance forecast function is enable, please reset the accumulated data about grease. Carries out the resetting operation by RT ToolBox or parameter (MFGRST). Refer to separate "RT ToolBox2 / RT ToolBox2 mini User's Manual" for the operation method of RT ToolBox, and refer to separate "Instruction Manual/ Detailed Explanation of Functions and Operations" for details of parameter (MFGRST).

⚠ CAUTION

Use manual grease gun. Do not use the grease gun, which derived by the factory air presser to avoid injecting by too high pressure.
A grease gun that fits the grease nipple is required.
Recommended grease gun: KH-120 (amount: 140ml) or KH-32 (amount: 200ml)
(manufacture: Yamada Corporation Inc.,)
The grease guns come with a short nozzle (HSP-1) as standard. If this short nozzle does not reach the desired areas, depending on the robot model and installation location, it may be useful to use a long nozzle (HSP-2).

5.3.5 Replacing the backup battery

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

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state. There exists the kinds of the errors about the battery shown in Table 5-6. If error 7500 occurs, please exchange the battery of the robot arm and the controller simultaneously.

Table 5-6 : The error about the battery

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

Note1) "n" indicates the axis number

The method of replacing the battery of robot arm is shown below.
refer to the separate "Instruction manual/Controller setup, basic operation, and maintenance" about controller's battery.
About the purchase of the battery, refers to Page 120, "5.5 Maintenance parts".

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

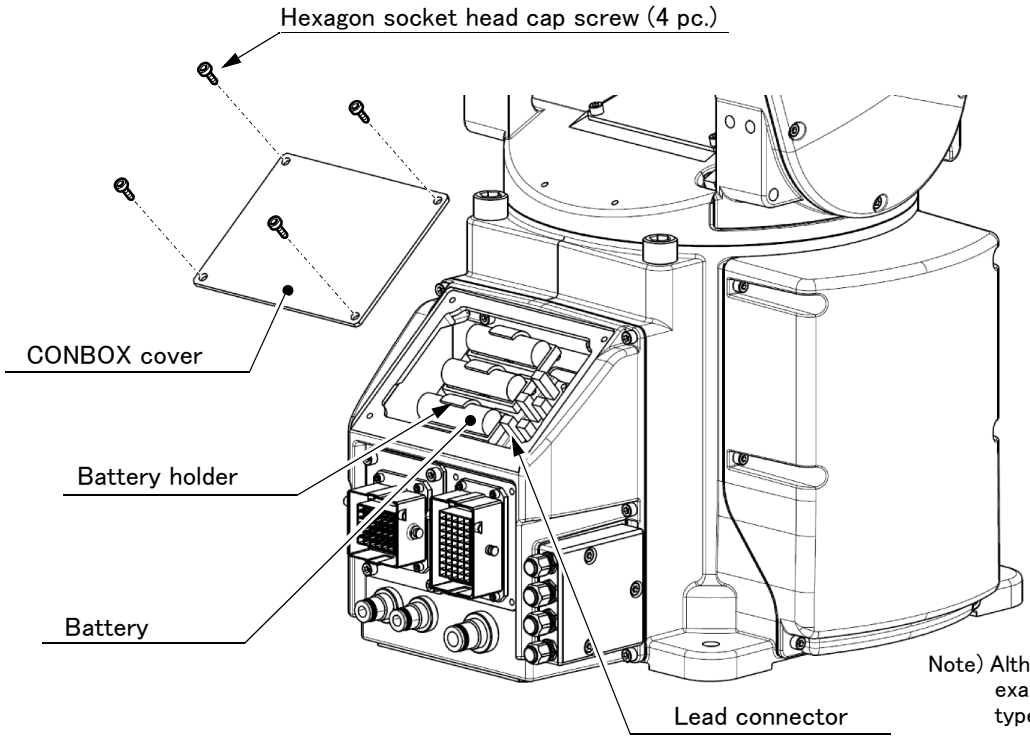
(1) Replacing the battery (robot arm)

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

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

The battery installation position is shown in Fig. 5-22 (RV-4F/7F/13F series) or Fig. 5-22 (RV-35F/50F/70F series). Refers to the figure and replaces the batteries in the following procedures.

■ RV-4F/7F/13F series



Note) Although the figure is the example of RV-4F other types are the same also.

Fig.5-22 : Replacing the battery (RV-4F/7F/13F series)

1) Turn the controller control power OFF.
2) Remove CONBOX cover, referring to Page 92, "5.3.2 Installing/removing the cover".
3) Replaces the backup battery one by one. The battery holder is located inside the CONBOX cover. Remove the old battery from the holder, and disconnect the lead connector.
4) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
5) All the batteries should be checked that it has been exchanged newly. If the old battery is contained, generating heat and damaging may occur.
6) Install the CONBOX cover as before. Be careful so that the cable may not be inserted.
7) Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again. Refer to Page 122, "5.6 Resetting the origin" and reset the origin using the ABS origin method.

■ RV-35F/50F/70F series

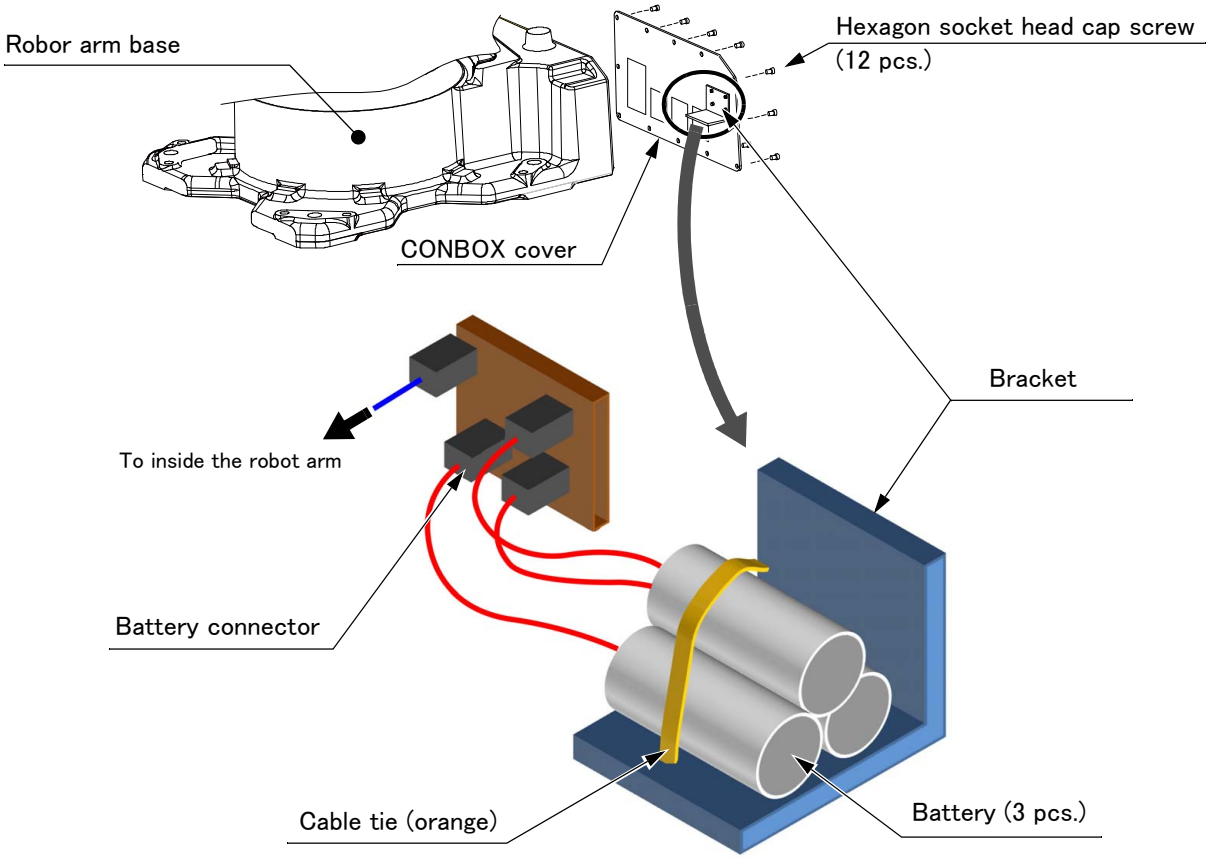


Fig.5-23 : Replacing the battery (RV-35F/50F/70F series)

1) Turn the controller control power OFF.
2) Remove CONBOX cover, referring to Page 92, "5.3.2 Installing/removing the cover".
   The CONBOX cover is not separated completely from the robot base section since some internal cables are connected between the cover and the base section.
3) Removes the battery from the bracket.
   Cable tie (orange) can be reused. Do not cut it off.
4) Replaces the backup battery one by one. Remove the old battery from the bracket, and disconnect the battery connector.
   Insert the new battery into the bracket, and connect the battery connector. Replace all batteries with new ones at the same time.
5) All the batteries should be checked that it has been exchanged newly. If the old battery is contained, generating heat and damaging may occur.
6) Tie up the batteries with the cable tie removed in 3) and fix it as shown in Fig. 5-23.
7) Install the CONBOX cover as before. Be careful so that the cable may not be inserted.
   The tightening torque of the hexagon socket head cap screw is 8.8N/m.
8) Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again.
Refer to Page 122, "5.6 Resetting the origin" and reset the origin using the 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. As a rule of thumb, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the specified time (24,000 hours for the RV-4F/7F/13F series robot arm, 20,000 hours for the RV-35F/50F/70F series robot arm, and 36,000 hours for the controller) (See Fig. 5-24.). However, the degree of the equipment's wear and deterioration presumably varies depending on their operating conditions. Especially for operation with high load and frequency, the maintenance cycle may be shorter. For details on the part selection for replacement and the timing of overhaul, contact your dealer.

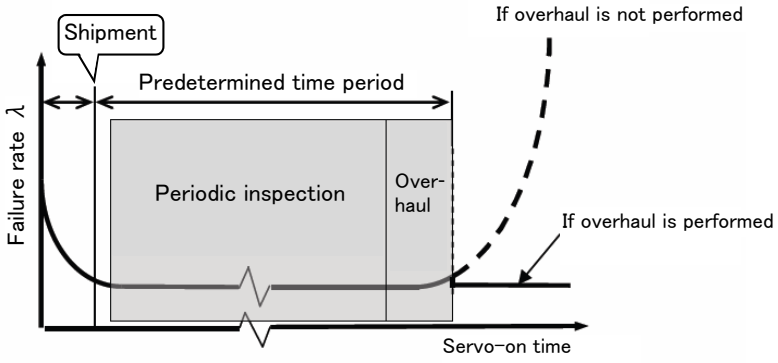


Fig.5-24 : Periodic inspection/overhaul periods

5.5 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-7, and spare parts that may be required during repairs are shown in Table 5-8. Purchase these parts from the dealer when required.
The wrist reduction gear unit is shown in Table 5-9. At the time of wrist reduction gear unit failure, it requires exchange by unit.
The wrist reduction gear unit is estimated individually. If you need the wrist reduction gear unit, please contact dealer.
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 5-7 : Consumable part list

No.	Part name	Type	Usage place	Q'ty	Supplier
1	Timing belt		J1 axis	1	Mitsubishi Electric
2			J3 axis	1	
3			J4 axis	1	
4			J5 axis	1	
5			J6 axis	1	
6	Grease		Reduction gears of each axis	A small amount	
7	Lithium battery	ER6	Inside the CONBOX cover	3	

Table 5-8 : Spare parts list

No.	Names	Usage place	Q'ty	Supplier
RV-4F series (common)				
1	AC servo motor	J1, J2 axis	2	Mitsubishi Electric
2		J3 axis	1	
3		J4, J5 axis	2	
4		J6 axis	1	
RV-4F (Standard arm type)				
5	Reduction gears	J1, J2 axis	2	Mitsubishi Electric
6		J3 axis	1	
7		J4 axis	1	
8		J5 axis	1	
9		J6 axis	1	
RV-4FL (Long arm type)				
10	Reduction gears	J1 axis	1	Mitsubishi Electric
11		J2, J3 axis	2	
12		J4 axis	1	
13		J5 axis	1	
14		J6 axis	1	
RV-4FJL (Long arm type)				
15	Reduction gears	J1 axis	1	Mitsubishi Electric
16		J2, J3 axis	2	
17		J5 axis	1	
18		J6 axis	1	
RV-7F series (common)				
19	AC servo motor	J1, J2 axis	2	Mitsubishi Electric
20		J3 axis	1	
21		J4, J5 axis	2	
22		J6 axis	1	
RV-7F (Standard arm type)				
23	Reduction gears	J1, J2 axis	2	Mitsubishi Electric
24		J3 axis	1	
25		J4 axis	1	
26		J5 axis	1	
27		J6 axis	1	
RV-7FL (Long arm type)				
28	Reduction gears	J1 axis	1	Mitsubishi Electric
29		J2, J3 axis	2	
30		J4 axis	1	
31		J5 axis	1	
32		J6 axis	1	

No.	Names	Usage place	Q'ty	Supplier
RV-7FLL (Long arm type)				
33	AC servo motor	J1, J2 axis	2	
34		J3 axis	1	
35		J4 axis	1	
36		J5 axis	1	
37		J6 axis	1	
38	Reduction gears	J1 axis	1	Mitsubishi Electric
39		J2 axis	1	
40		J3 axis	1	
41		J4 axis	1	
42		J5 axis	1	
43		J6 axis	1	
RV-13F/20F (common)				
44	AC servo motor	J1, J2 axis	2	
45		J3 axis	1	
46		J4 axis	1	Mitsubishi Electric
47		J5 axis	1	
48		J6 axis	1	
RV-13F/RV-20F (Standard arm type)				
49	Reduction gears	J1 axis	1	
50		J2 axis	1	
51		J3 axis	1	
52		J4 axis	1	Mitsubishi Electric
53		J5 axis	1	
54		J6 axis	1	
RV-13FL (Long arm type)				
55	Reduction gears	J1 axis	1	
56		J2 axis	1	
57		J3 axis	1	
58		J4 axis	1	Mitsubishi Electric
59		J5 axis	1	
60		J6 axis	1	
RV-35F/50F/70F (common)				
61	AC servo motor	J1, J2 axis	2	
62		J3 axis	1	
63		J4 axis	1	
64		J5 axis	1	Mitsubishi Electric
65		J6 axis	1	
66	Reduction gears	J1 axis	1	
67		J3 axis	1	
RV-35F/50F/70F (common)				
68	Origin setting tool		1	Mitsubishi Electric
RV-35F/50F (common)				
69	Reduction gears	J2 axis	1	Mitsubishi Electric
RV-70F				
70	Reduction gears	J2 axis	1	Mitsubishi Electric
RV-35F				
71	Reduction gears	J4 axis	1	Mitsubishi Electric
RV-50F/70F (common)				
72	Reduction gears	J4 axis	1	Mitsubishi Electric

Table 5-9 : Wrist reduction gear unit

No.	Names	Usage place	Q'ty	Supplier
RV-35F				
1	Wrist reduction gear unit	J5 and J6 axis	1	Mitsubishi Electric
RV-50F/70F (common)				
2	Wrist reduction gear unit	J5 and J6 axis	1	Mitsubishi Electric

5.6 Resetting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. The origin must be reset if the combination of robot and controller being used is changed or if the motor is changed causing an encoder area. The origin setting methods and when each origin setting method is required are shown in Table 5-10.

Table 5-10 : Origin setting method

No	Method	Explanation	Cases when setting the origin is required	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B. Use this method at the initial startup.	・At the initial startup ・When the controller is replaced ・When the data is lost due to flat battery of the robot controller (when C7500 occurs)	The setting method is explained in Page 20, "2.3 Setting the origin" .
2	Jig method	The origin posture is set with the calibration jig installed.	・When a structural part of the robot (motor, reduction gear, timing belt, etc.) is replaced ・When deviation occurred by a collision.	The setting method is explained in Page 123, "5.6.1 Jig method (RV-4F/7F/13F series)" or Page 137, "5.6.2 Jig method (RV-35F/50F/70F series)".
3	ABS origin method	This method is used when the encoder backup data lost in the cause such as battery cutting.	・When the encoder data is lost due to flat battery of the robot arm (when H112n occurs)	Before using this method, the origin must be set with the other method with same encoder. The setting method is explained in Page 146, "5.6.3 ABS origin method".
4	User origin method	A randomly designated position is set as the origin posture.	・When an arbitrary position is set as the origin	Before using this method, the origin must be set with the other method. The setting method is explained in Page 152, "5.6.4 User origin method".

[Caution]

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

[Remarks]

- The ABS origin method cannot be used when the robot arm mechanically deviates (for example caused by replacement of the reduction gear, motor, or timing belt).
- After the origin setting is completed, move the robot arm to the position where the ABS marks align each other, and check that the displayed joint coordinates of the position are correct.
  For the details of the ABS mark position and the joint coordinates, refer to Page 146, "5.6.3 ABS origin method".

5.6.1 Jig method (RV-4F/7F/13F series)

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. 5-25.

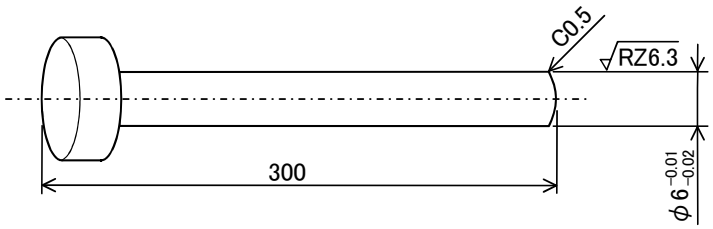


Fig.5-25 : Reference dimension of origin setting tool

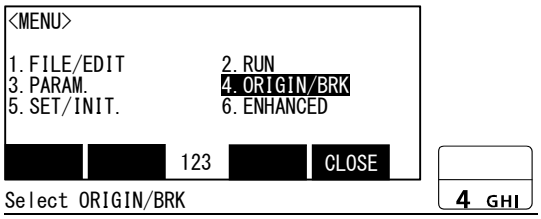
The procedure of setting the origin with the origin setting tool is shown below.

This operation is carried out with the teaching pendant. Set the mode of the controller to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The origin setting can be performed for the target axis only instead of for all axes. Go to steps for the target axis to set the origin.
Do the following operations, pressing down the enabling switch of T/B lightly.

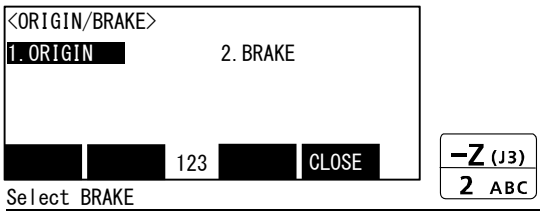
⚠ CAUTION

In the following procedure, the J3 axis brake is released to move its shaft with both hands.
To ensure safety, the brake-release procedure should always be done by two persons.

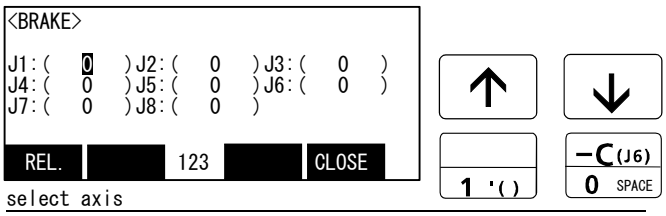
(1) J1 axis origin setting



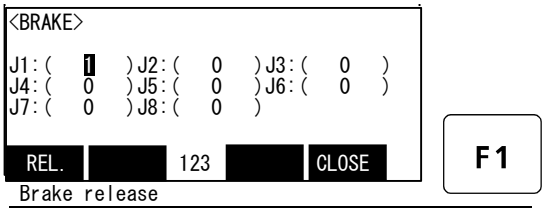
1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.



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



3) Release the brake of the J1 axis.
Input "1" into the J1 axis. Set "0" to other axes.



4) Confirm the axis for which the brakes are to be released.
5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.

RV-4F/7F series

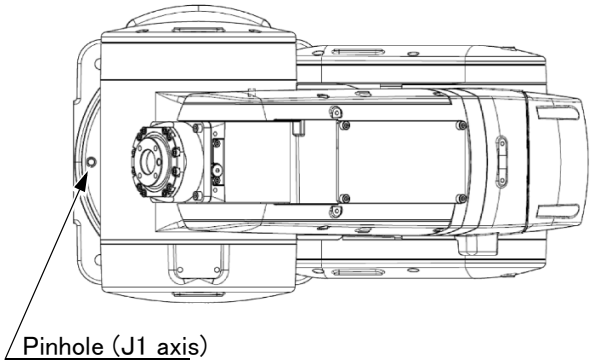


Diagram of the robot viewed from the top

6) Move the J1 axis slowly toward the front using both hands. Align the pinhole of the lower part of the shoulder and the pinhole at the base section, feed through the origin jig (ϕ6) into the pinholes and fasten.

RV-13F series

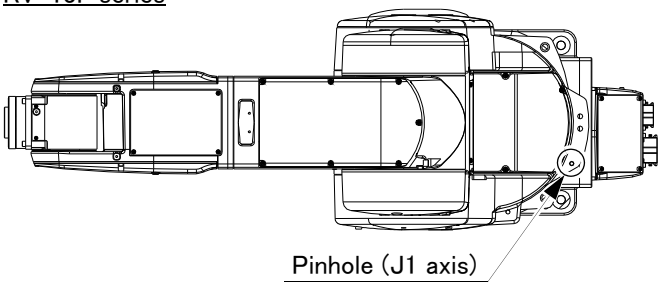
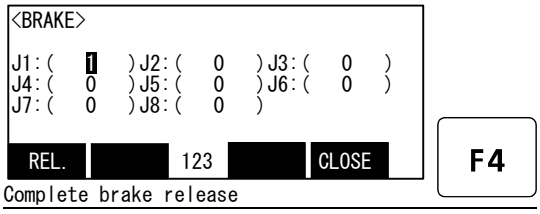
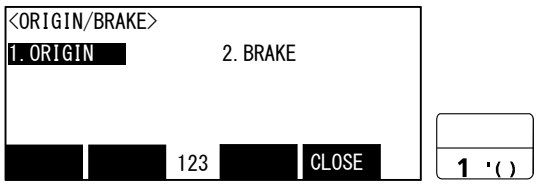


Diagram of the robot viewed from the top



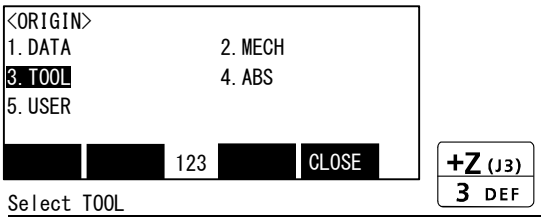
F4

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



1 '( )

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



+Z (J3)
3 DEF

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

↑

↓

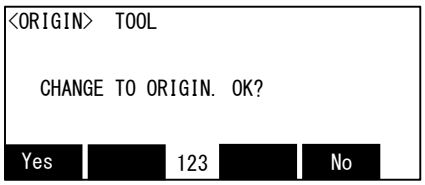
1 '( )

−C (J6)
0 SPACE

EXE

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

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



F1

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

13) Setting of the origin is completed.

14) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

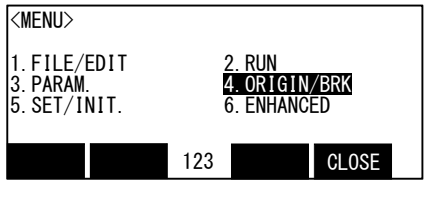
◇◆◇ Release the brake ◇◆◇

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 ◇◆◇

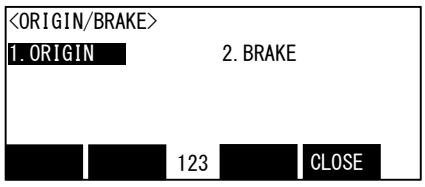
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(2) J2 axis origin setting



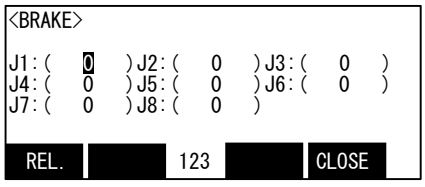
4 GHI

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



−Z (J3)
2 ABC

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



1 '( )

−C (J6)
0 SPACE

3) Release the brake of the J2 axis.
Input "1" into the J2 axis. Set "0" to other axes.

F1

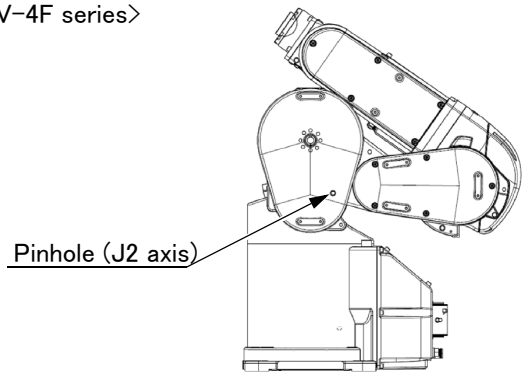
4) Confirm the axis for which the brakes are to be released.

5) One worker must securely support the upper arm with both hands.

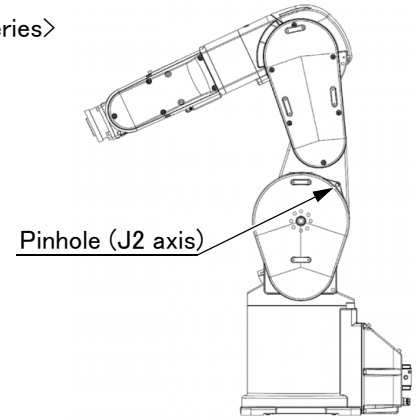
6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
Note) In the RV-13F series, brake is released in an off-and-on way, because to drop J2 axis slowly.

7) With both hands, slowly move the J2 axis to − (minus)107 degree direction (RV-4F series), to 0 degree direction (RV-7F/13F series). Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig (ϕ6) into the pinholes and fasten.

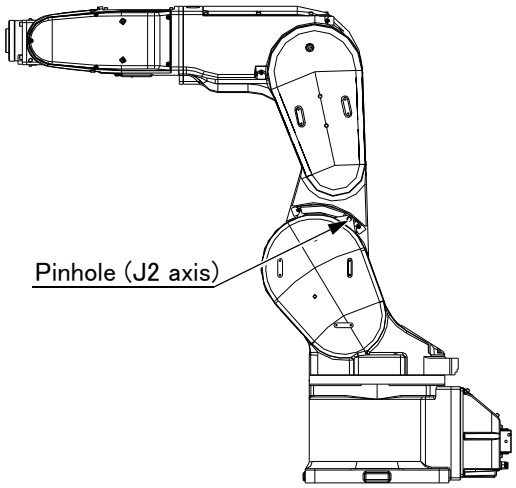
<RV-4F series>



<RV-7F series>

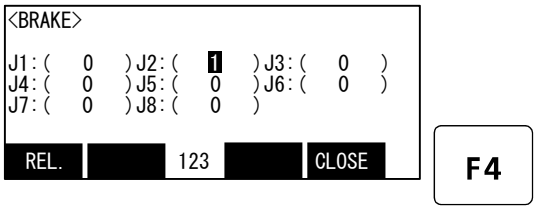


<RV-13F series>

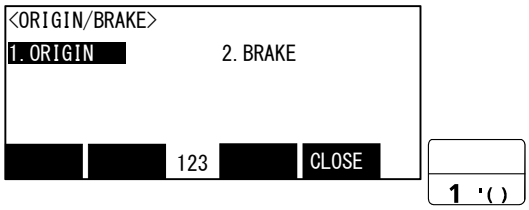


⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.

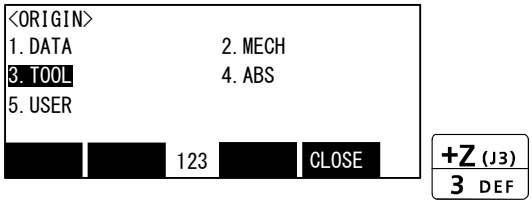
⚠ CAUTION If [F1] key or enable switch of T/B is released, the brakes will be work immediately.



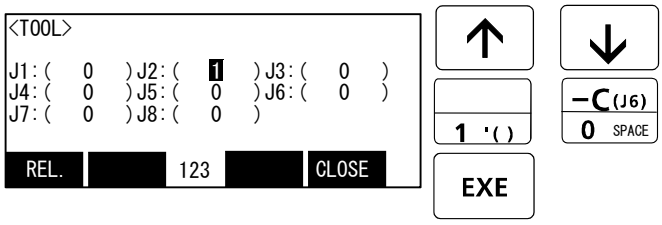
8) Detach the [F1] key and work the brake. Press the [F4] key and return to the origin / brake screen.



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

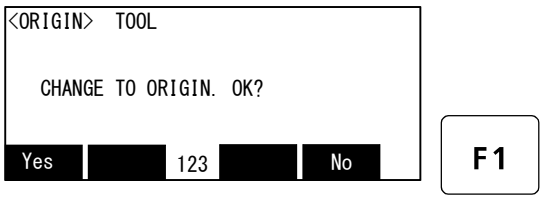


10) Press the [3] key, and display the Tool selection screen.

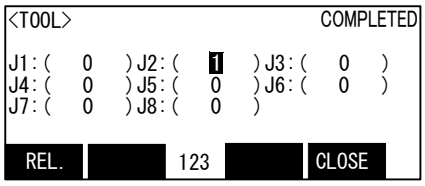


11) Input "1" into the J2 axis. Set "0" to other axes.

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



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



14) Setting of the origin is completed.

15) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

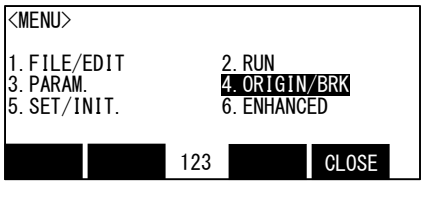
◇◆◇ Release the brake ◇◆◇

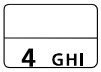
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

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

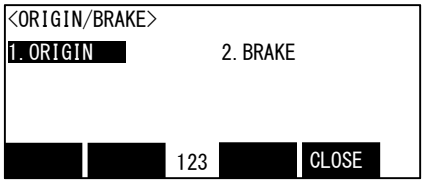
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

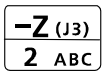
(3) J3 axis origin setting



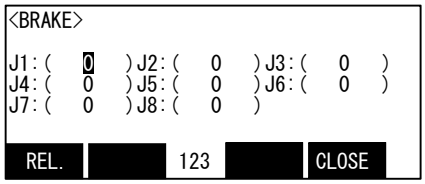


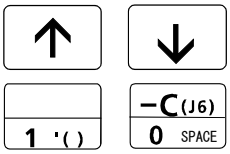
1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.





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





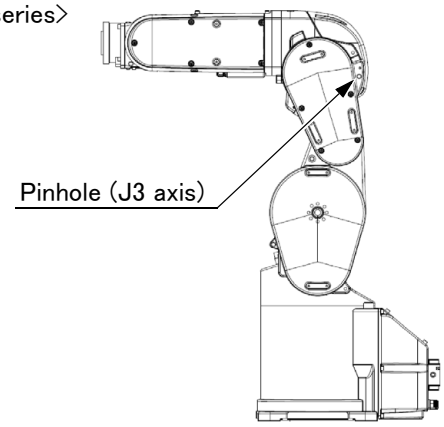
3) Release the brake of the J3 axis.
Input "1" into the J3 axis. Set "0" to other axes.

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

5) One worker must securely support the upper arm with both hands.

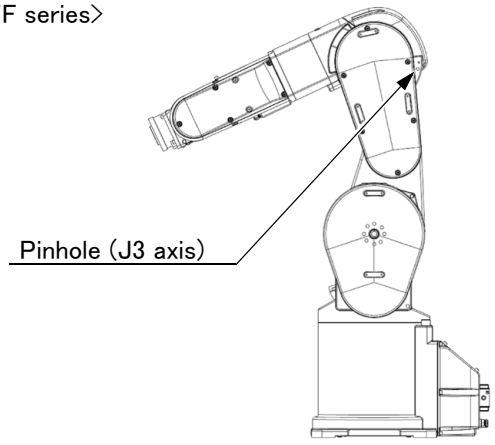
6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
Note) In the RV-13F series, brake is released in an off-and-on way, because to drop J2 axis slowly.

<RV-4F series>

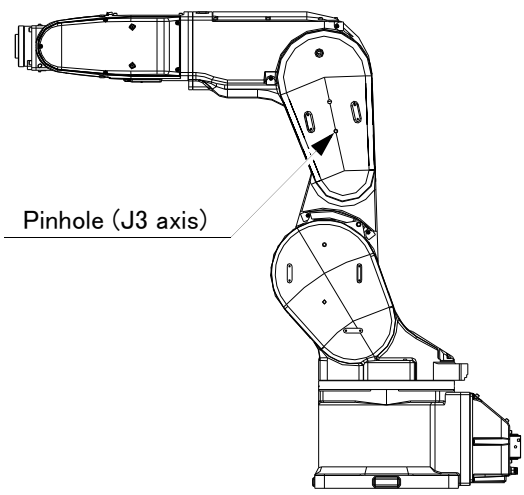


7) With both hands, slowly move the J3 axis to + (plus) 90 degree direction (RV-4F series), to + (plus) 115 degree direction (RV-7F/13F series). Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig (ϕ6) into the pinholes and fasten.

<RV-7F series>



<RV-13F series>

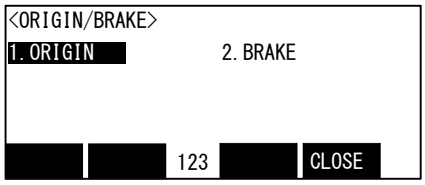


CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the arm. When the brakes are released, the robot arm could drop by its own weight depending on the posture.

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

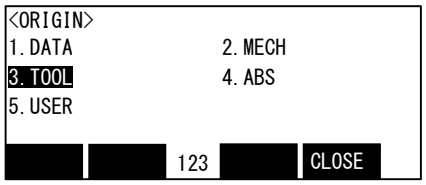
F4

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



1 '()

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



+Z (J3)
3 DEF

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

↑

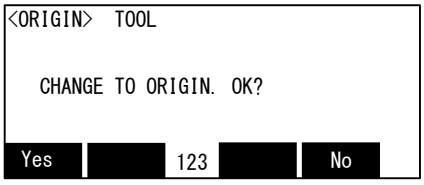
1 '()

EXE

↓

−C (J6)
0 SPACE

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



F1

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

14) Setting of the origin is completed.

15) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

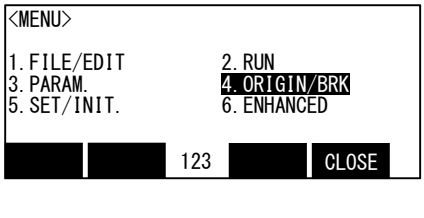
◇◆◇ Release the brake ◇◆◇

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 ◇◆◇

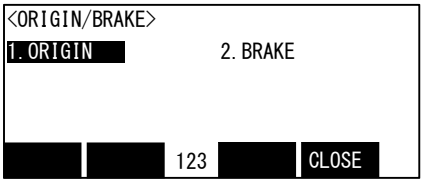
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(4) J4 axis origin setting (6-axis type robot only)



4 GHI

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



−Z (J3)
2 ABC

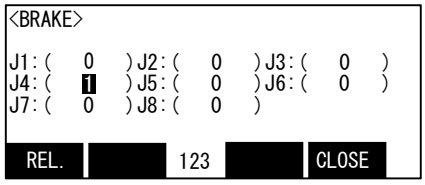
2) Press the [2] key, and display the Brake release selection screen.

↑ ↓

1 '( )

−C (J6)
0 SPACE

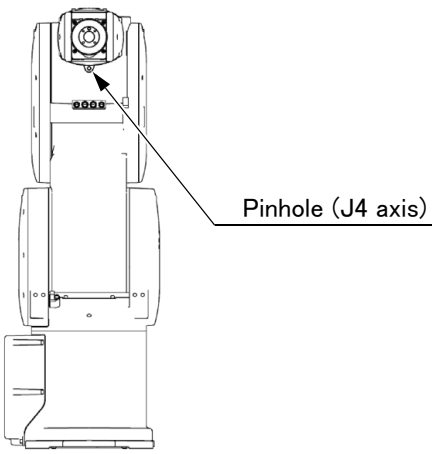
3) Release the brake of the J4 axis.
Input "1" into the J4 axis. Set "0" to other axes.



F1

4) Confirm the axis for which the brakes are to be released.
5) One worker must securely support the upper arm with both hands.

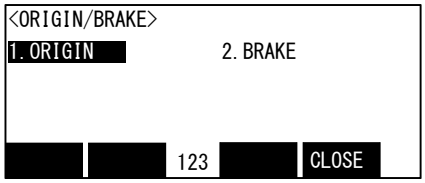
6) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.



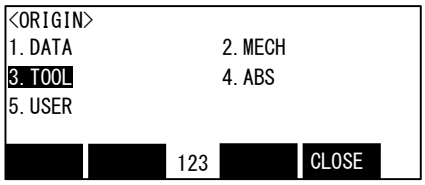
7) With both hands, slowly move the J4 axis to 0 degree direction, and align the pinholes of the No. 2 arm, feed through the origin jig (ϕ6) into the pinholes and fasten.

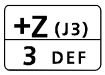
F4

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

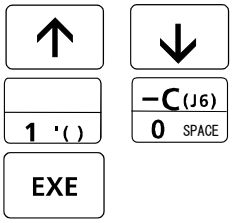


9) Press the [1] key, and display the Origin setting selection screen.

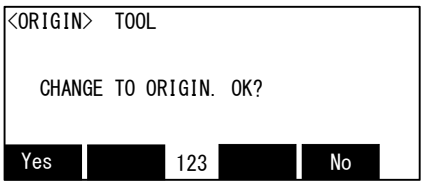




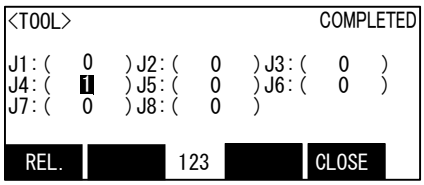
10) Press the [3] key, and display the Tool selection screen.



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



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



14) Setting of the origin is completed.

15) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇

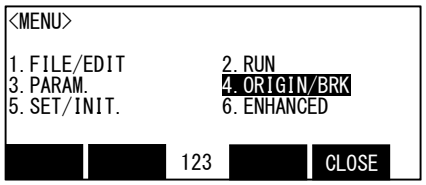
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

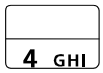
◇◆◇ Select the axis of origin setting ◇◆◇

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

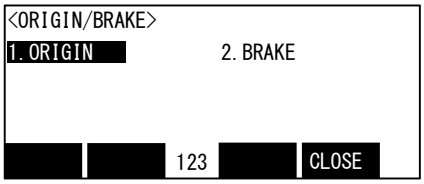
(5) Origin setting of J5 axis and J6 axis (jig)

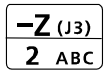
Always perform origin setting of the J5 axis and the J6 axis simultaneously. First, set the J5 axis posture.



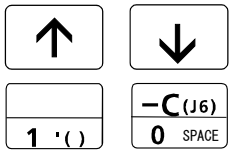


1) Remove the No.2 arm cover L. The pin hole is inside the cover.
2) Press the [4] key on the menu screen, and display the Origin/BRK selection screen.

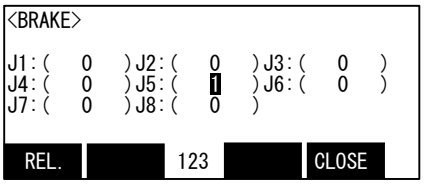




3) Press the [2] key , and display the Brake release selection screen.



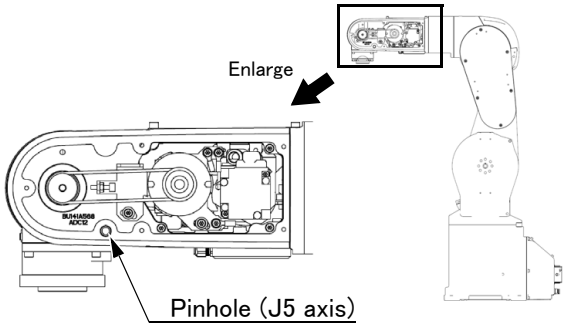
4) Brake release of the J5 axis
Press the [Arrow] key, move the cursor to the J5 axis and press the [1] key. Set [0] to other axes.



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

6) The one person needs to support the list part securely with both hands.

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



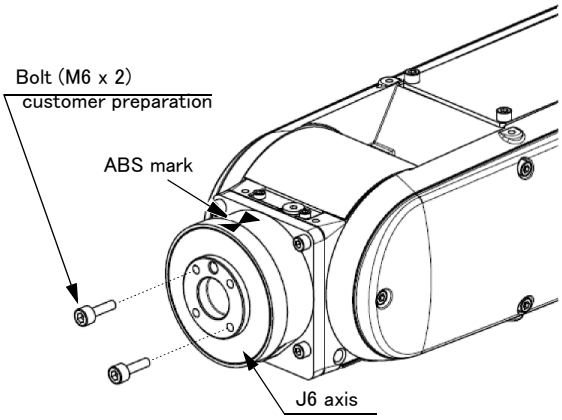
8) Slowly rotate the J5 axis in the direction of plus 90 degree with both hands. Align the pinholes of the No. 2 arm and wrist , feed through the origin jig (ϕ 6) into the pinholes and fasten.

⚠ CAUTION To ensure safety, the brake-release procedure described below should always be done by two persons.
Be careful that the robot arm will fall by the self-weight depending on the posture if the brake is released.

⚠ CAUTION If the [F1] key or the enabling switch of T/B is detached, the brake will work immediately.

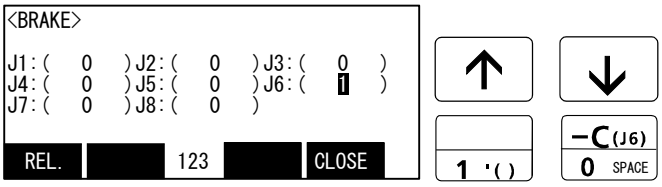
9) Detach the [F1] key and work the brake.

Next, set the J6 axis posture.



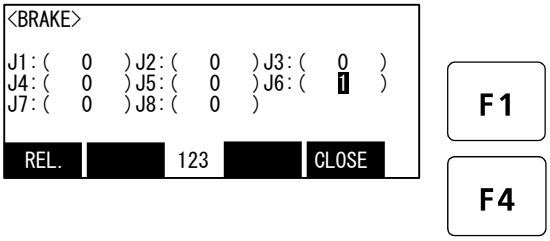
10) Install the bolt (M6: 2, customer preparation) in the diagonal position at the J6 axis.
Hold the bolts with hands, rotate them slowly and align the ABS mark of the J6 axis with the ABS mark of the wrist area.
[Press the [Arrow] key, move the cursor to the J6 axis and press the [1] key. Set [0] to other axes.

CAUTION The J6 axis of internal wiring and piping specification type have mechanical stopper, but the standard specification type is without mechanical stopper. Please do not move to the position exceeding the operating range (+/−360 degree)



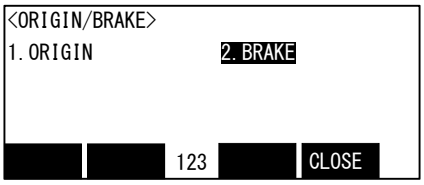
11) Confirm the axis for which the brakes are to be released.

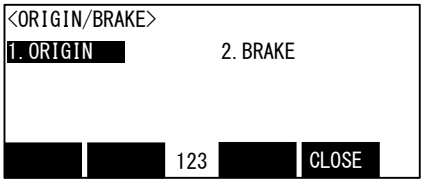
12) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.

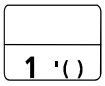


13) Hold the bolts with hands, rotate them slowly and align the ABS mark of the J6 axis with the ABS mark of the wrist area.

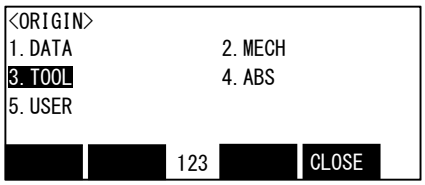
14) If the ABS mark is aligned detach the [F1] key and work the brake.
15) Press the [F4] key and return to the origin / brake screen.

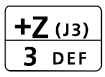




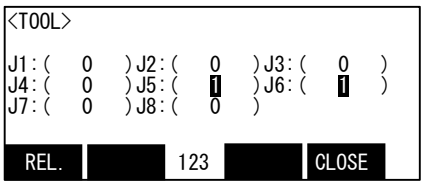


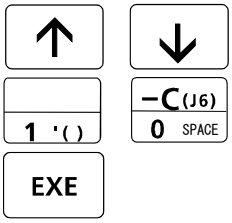
16) Press the [1] key , and display the Origin setting selection screen.





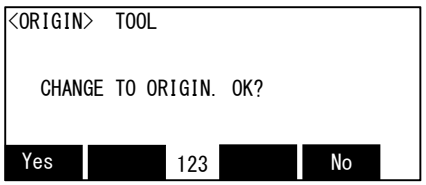
17) Press the [3] key , and display the Tool selection screen.





18) Press the [Arrow] key, move the cursor, and set "1" to the J5 axis and J6 axis. Set [0] to other axes.

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



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

21) Setting of the origin is completed.

22) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

The origin settings are completed by the jig method.

◇◆◇ Release the brake ◇◆◇

Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

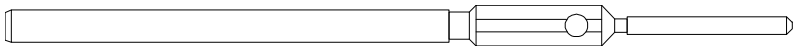
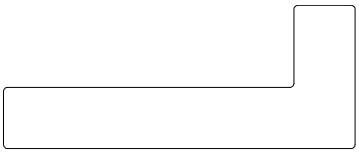
◇◆◇ Select the axis of origin setting ◇◆◇

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

5.6.2 Jig method (RV-35F/50F/70F series)

This method is using the origin setting tool. RV-35F/50F/70F series robot requires the dedicated tool, please ask nearby dealer. The reference figure of the origin setting tool is shown in Table 5-11.

Table 5-11 : Figure of origin setting tool

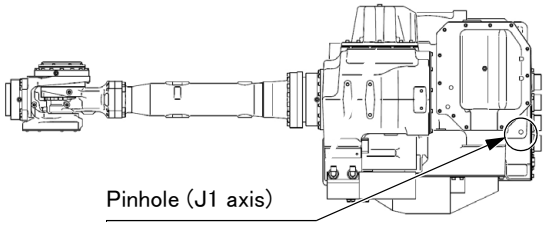
No.	Name	Schematic diagram
1	Origin setting pin for J1 to J4 axes	
2	Origin setting block for J4 axis	
3	Origin setting block for J5 and J6 axes	

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

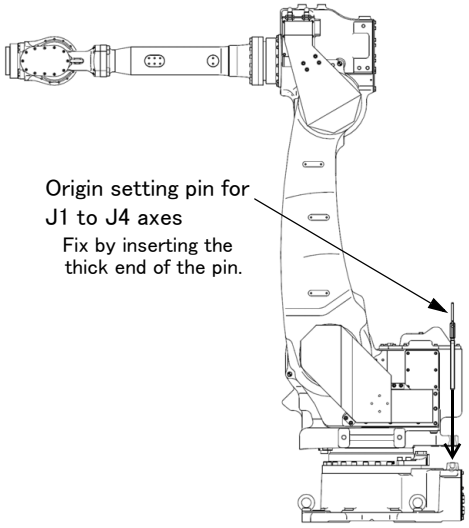
This operation is carried out with the teaching pendant. Set the mode of the controller to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The origin setting can be performed for the target axis only instead of for all axes. Go to steps for the target axis to set the origin.
Do the following operations, pressing down the enabling switch of T/B lightly.

(1) J1 axis origin setting

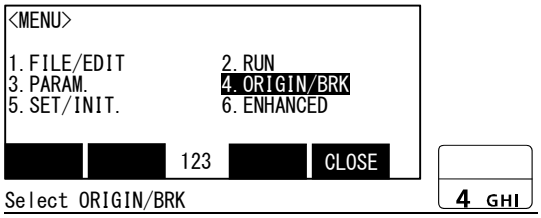
1) Remove the cap from the pinhole.
2) Operate the robot by jog operation to align the J1 axis pinholes for inserting the thick end of the origin setting pin for J1 to J4 axes into the pinholes. Refer to Page 28, "2.4 Confirming the operation" for jog operation.



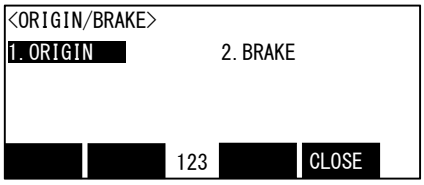
Top view



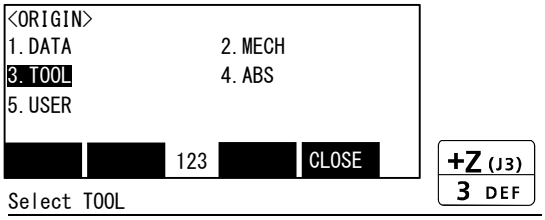
Side view



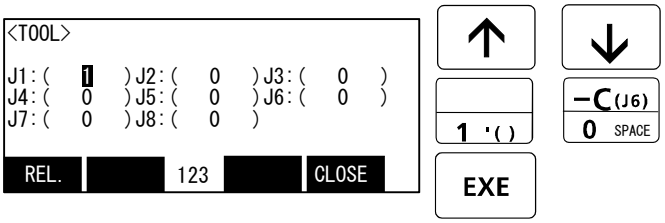
3) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.



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

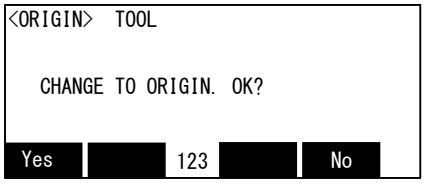


5) Press the [3] key, and display the Tool selection screen.



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

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



F1

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

9) Setting of the origin is completed.

10) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇

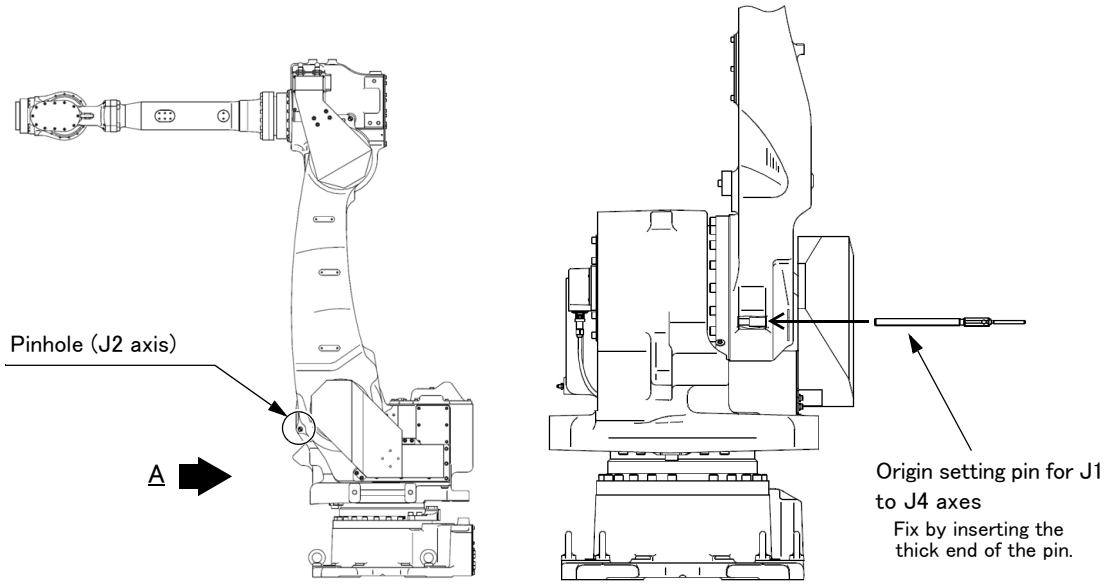
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is 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".

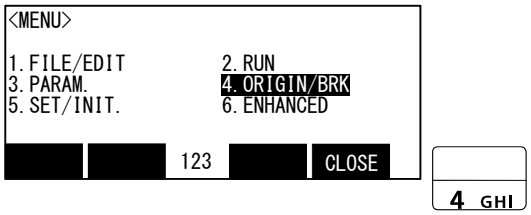
(2) J2 axis origin setting

1) Remove the cap from the pinhole.
2) Operate the robot by jog operation to align the J2 axis pinholes for inserting the thick end of the origin setting pin for J1 to J4 axes into the pinholes. Refer to Page 28, "2.4 Confirming the operation" for jog operation.

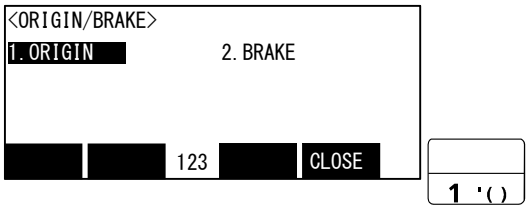


Side view

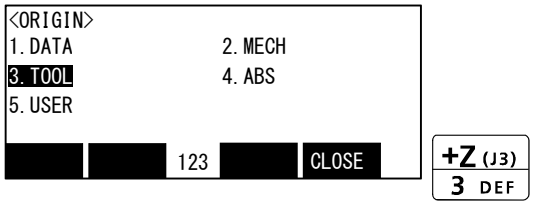
View A



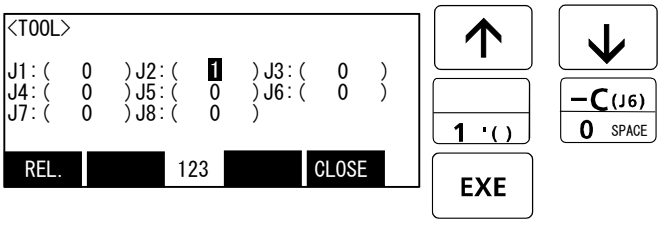
3) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.



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

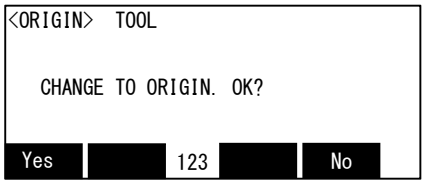


5) Press the [3] key, and display the Tool selection screen.



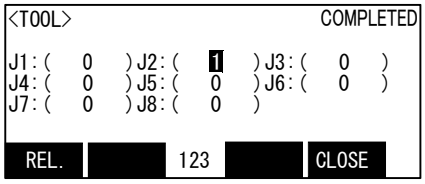
6) Input "1" into the J2 axis. Set "0" to other axes.

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



F1

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



9) Setting of the origin is completed.

10) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇

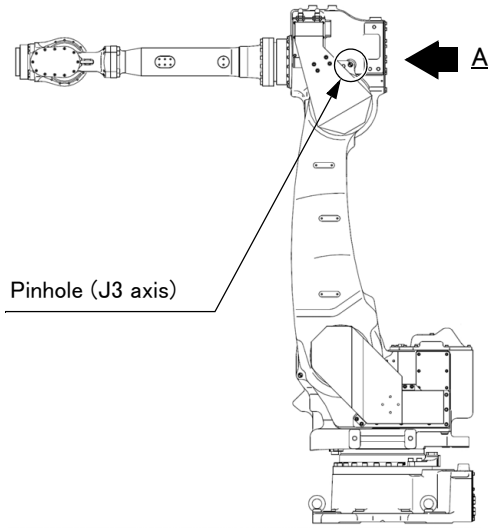
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

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

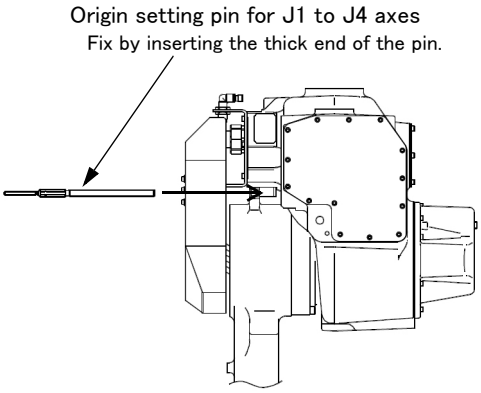
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(3) J3 axis origin setting

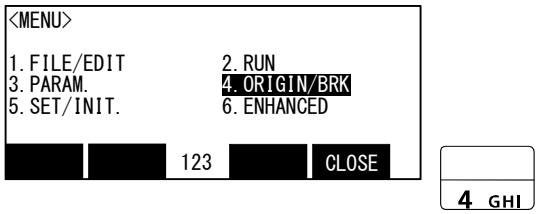
1) Remove the cap from the pinhole.
2) Operate the robot by jog operation to align the J3 axis pinholes for inserting the thick end of the origin setting pin for J1 to J4 axes into the pinholes. Refer to Page 28, "2.4 Confirming the operation" for jog operation.



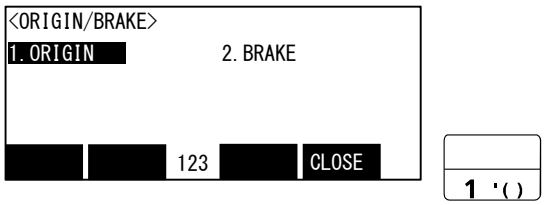
Side view



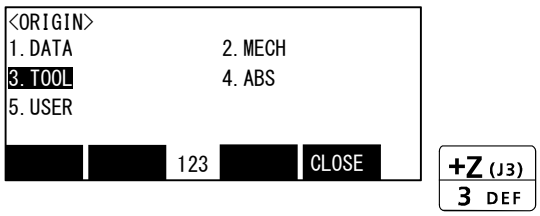
View A



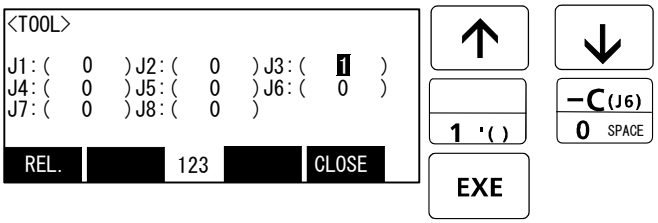
3) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.



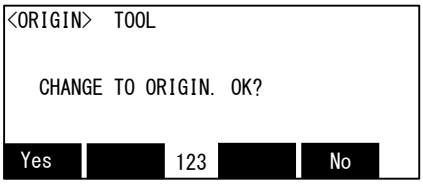
4) Press the [1] key, and display the Origin setting selection screen.



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



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



F1

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

9) Setting of the origin is completed.

10) Refer to Page 154, "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.

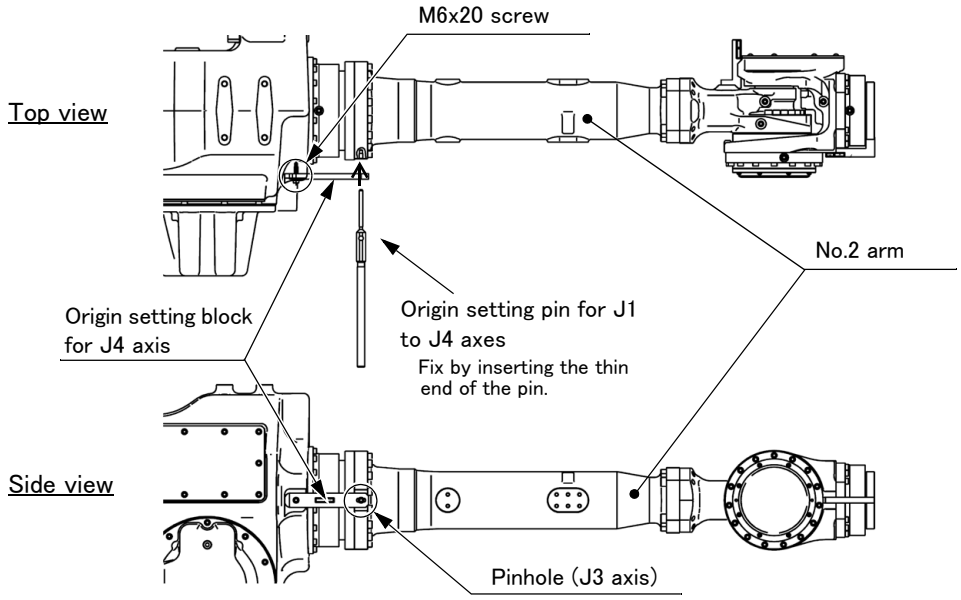
◇◆◇ Select the axis of origin setting ◇◆◇

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".

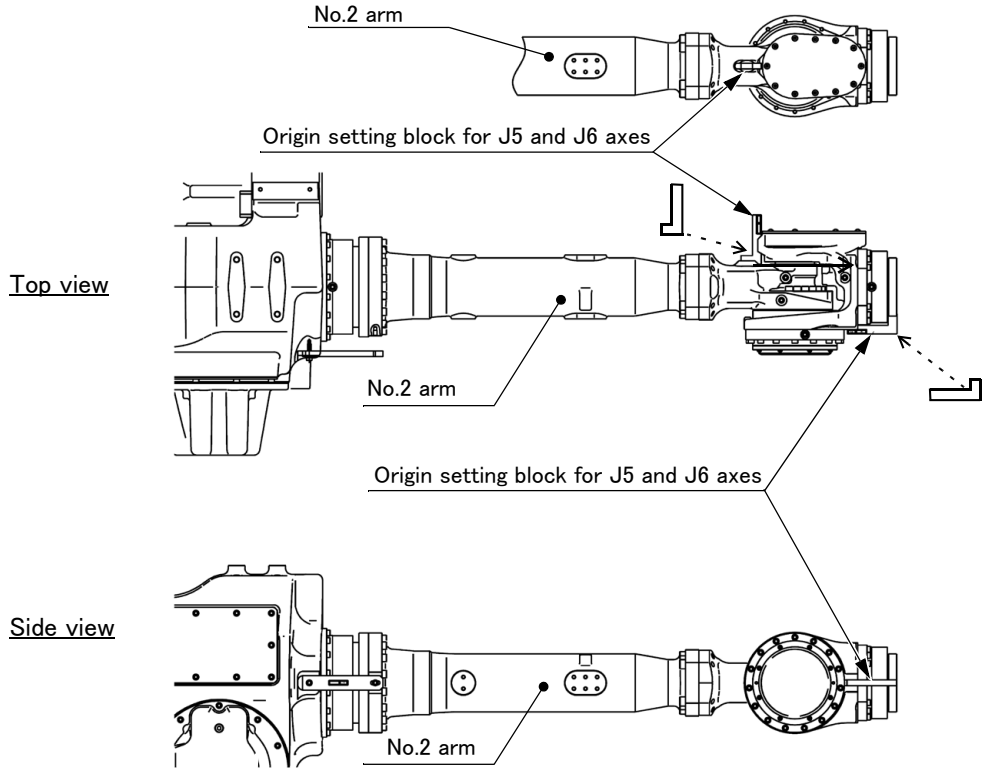
(4) Origin setting of J5 axis and J6 axis

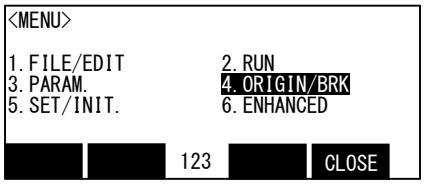
Always perform origin setting of the J4, J5, and J6 axis simultaneously.

1) Remove the cap from the pinhole on the No.2 arm side.
2) Fix the origin setting block for J4 axis on the robot arm by M6x20 screw. (The tightening torque: 13.8 N・m)
3) Operate the robot by jog operation to align the oval-shaped pinhole on the origin setting block for J4 axis and the pinhole on the side of the No.2 arm for inserting the thin end of the origin setting pin for J1 to J4 axes into the pinholes. Refer to Page 28, "2.4 Confirming the operation" for jog operation.



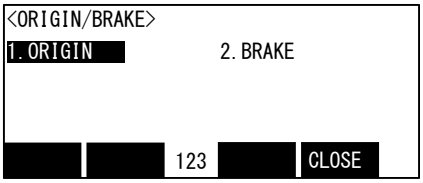
4) Operate the robot by jog operation to align the slits for J5 and J6 axes for inserting the origin setting block for J5 and J6 axes into the slits. Refer to Page 28, "2.4 Confirming the operation" for jog operation.





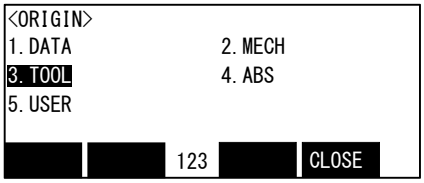
4 GHI

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



1 '( )

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



+Z (J3)
3 DEF

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

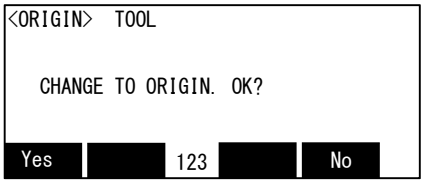
1 '( )

−C (J6)
0 SPACE

EXE

8) Press the [Arrow] key, move the cursor, and set "1" to the J4 axis, J5 axis, and J6 axis. Set [0] to other axes.

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



F1

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

11) Setting of the origin is completed.

12) Refer to Page 154, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

The origin settings are completed by the jig method.

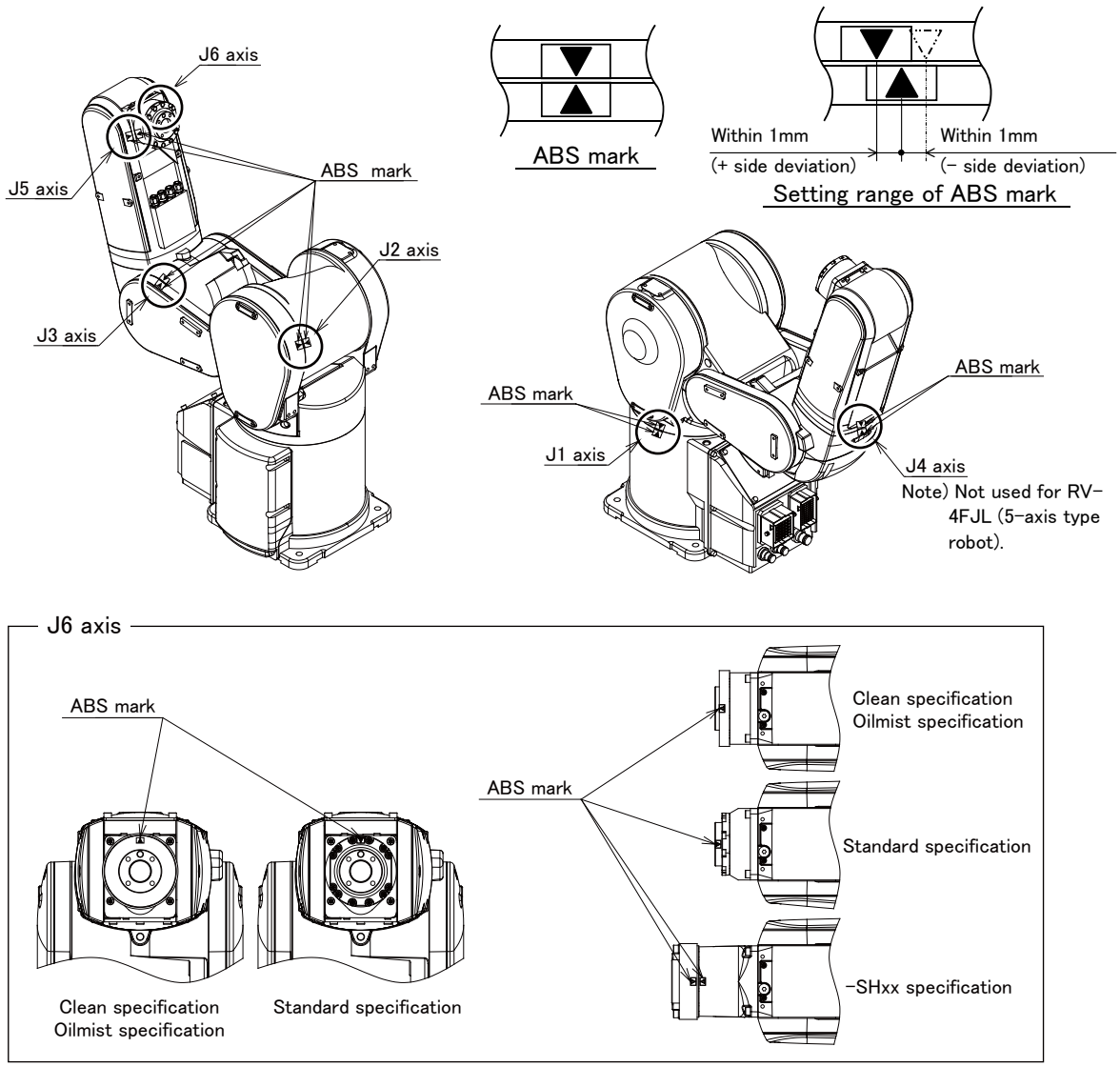
◇◆◇ Select the axis of origin setting ◇◆◇

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

5.6.3 ABS origin method

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

This operation is carried out with the teaching pendant. Set the controller mode to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
First, set to the ABS mark arrow of the axis for which the origin is to be set with jog operation. This can be set for all axes simultaneously or each axis independently.
To align the ABS marks, view the robot from the front. The deviation between the end points of the two triangular marks must be 1 mm or less.
The positions where the ABS mark is attached are shown in below. Refer to Page 28, "2.4 Confirming the operation" for details on the jog operation.

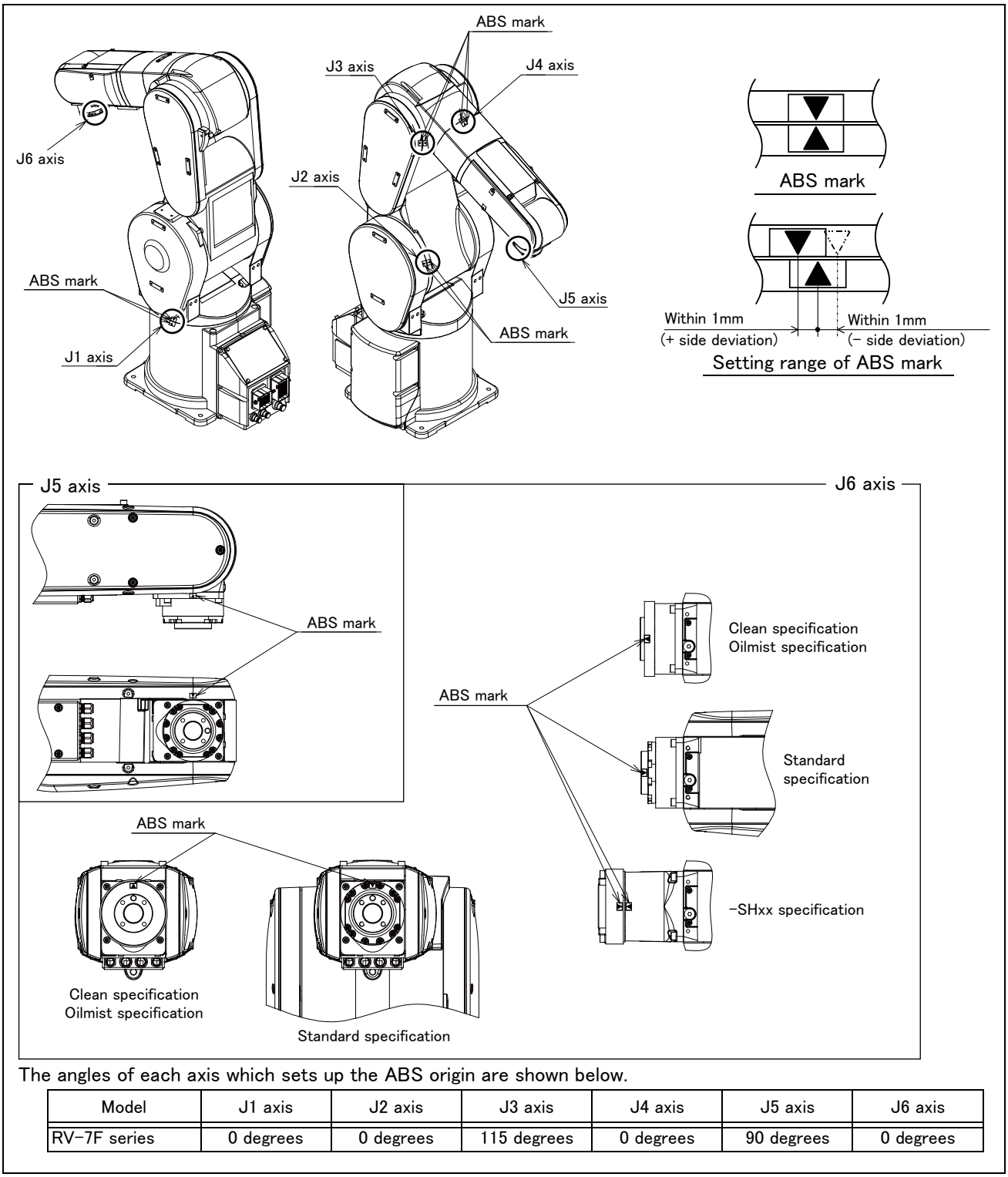


The angles of each axis which sets up the ABS origin are shown below.

Model	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
RV-4F series	0 degrees	-107 degrees	90 degrees	0 degrees Note1)	90 degrees	0 degrees

Note1)RV-4FJL (5-axis type robot) does not have the J4 axis.

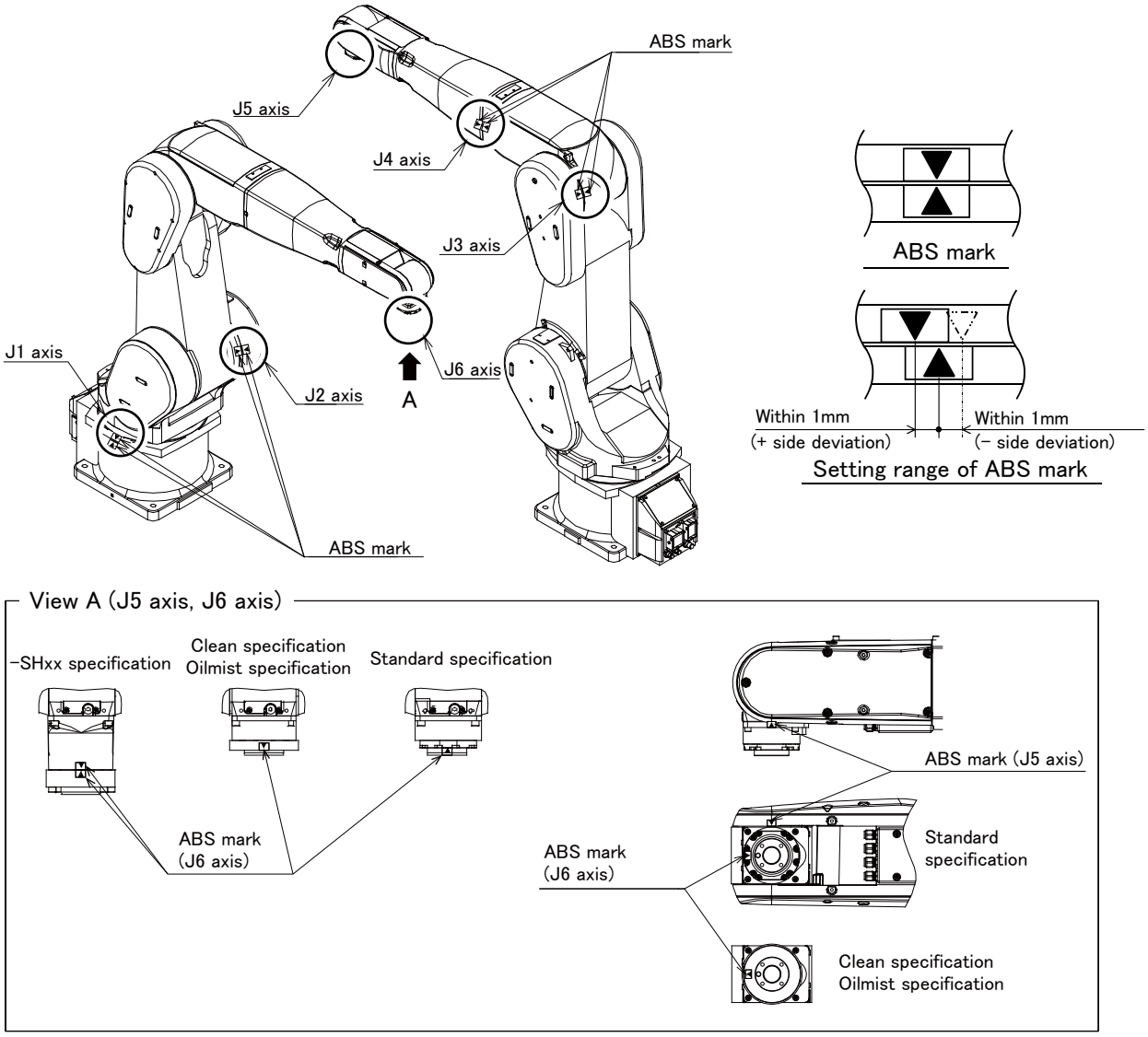
Fig.5-26 : ABS mark attachment positions (RV-4F series)



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

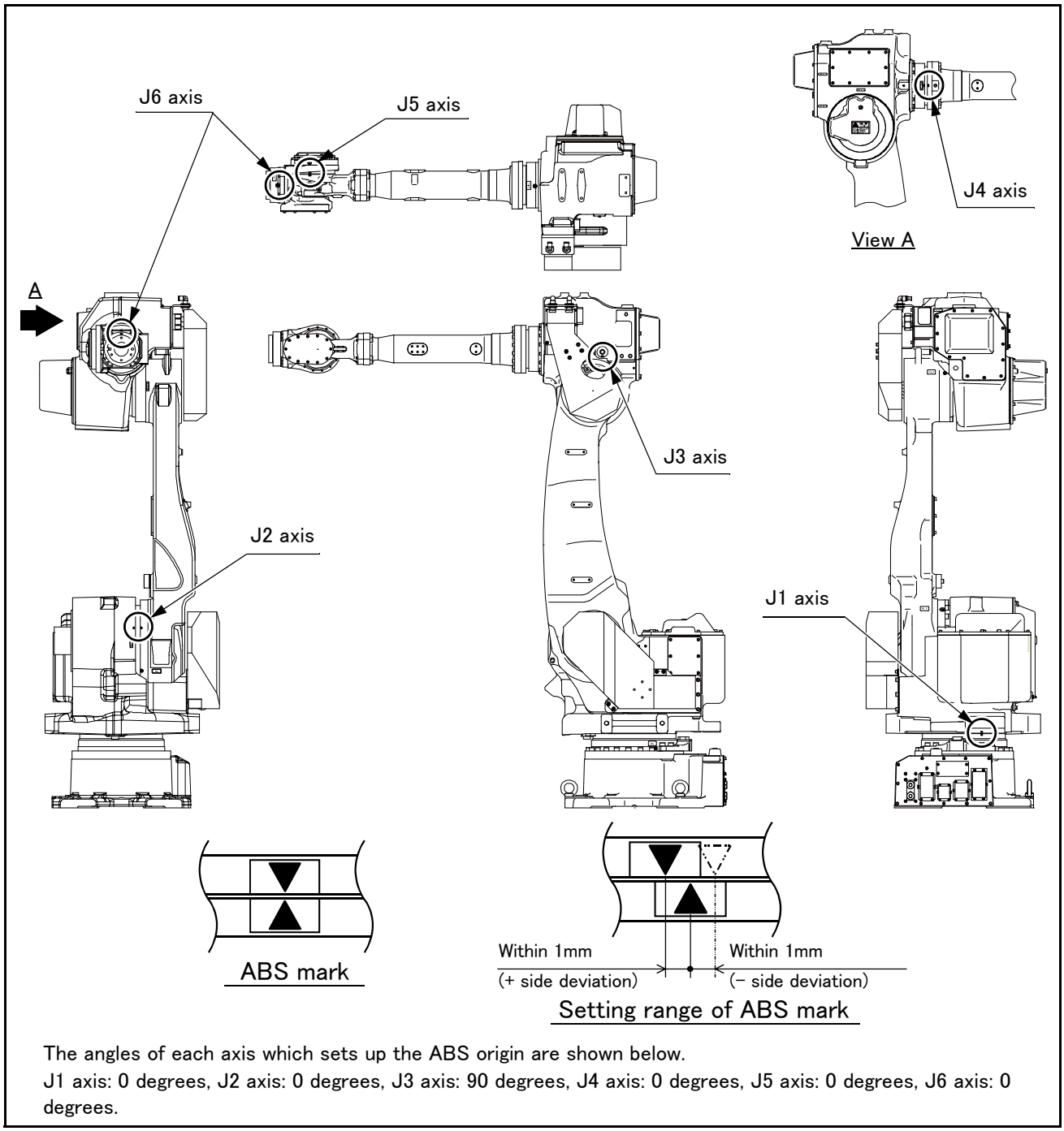
Model	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
RV−7F series	0 degrees	0 degrees	115 degrees	0 degrees	90 degrees	0 degrees

Fig.5−27 : ABS mark attachment positions (RV−7F series)



The angles of each axis which sets up the ABS origin are shown below.
J1 axis: 0 degrees, J2 axis: 0 degrees, J3 axis: 90 degrees, J4 axis: 0 degrees, J5 axis: 90 degrees, J6 axis: 0 degrees.

Fig.5-28 : ABS mark attachment positions (RV-13F series)



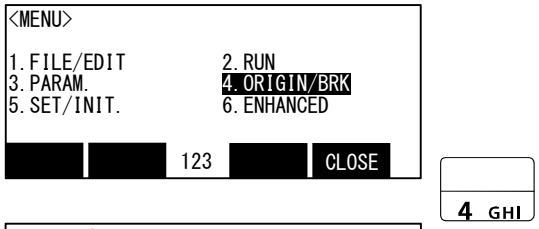
The angles of each axis which sets up the ABS origin are shown below.
J1 axis: 0 degrees, J2 axis: 0 degrees, J3 axis: 90 degrees, J4 axis: 0 degrees, J5 axis: 0 degrees, J6 axis: 0 degrees.

Fig.5-29 : ABS mark attachment positions (RV-35F/50F/70F series)

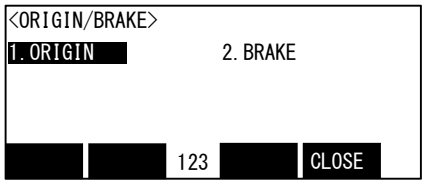
The procedures for setting the origin with the ABS method are explained below.

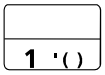
(1) Select the T/B

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

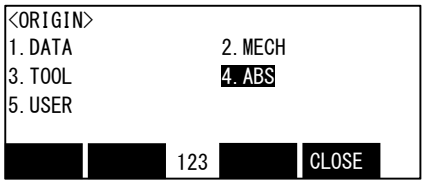


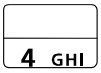
1) Press the [4] key on the menu screen, and display the Origin/Brake selection screen.



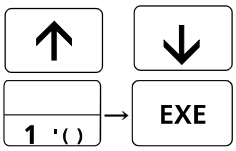


2) Press the [1] key, and display the Origin setting selection screen.

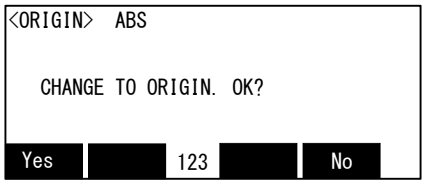




3) Press the [4] key, and display the ABS selection screen.



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



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

The origin settings are completed by the ABS method.

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

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

5.6.4 User origin method

CAUTION Before using this method, the origin must be set with the other method.
The setting method is explained in Page 122, "Table 5-10 : Origin setting method".

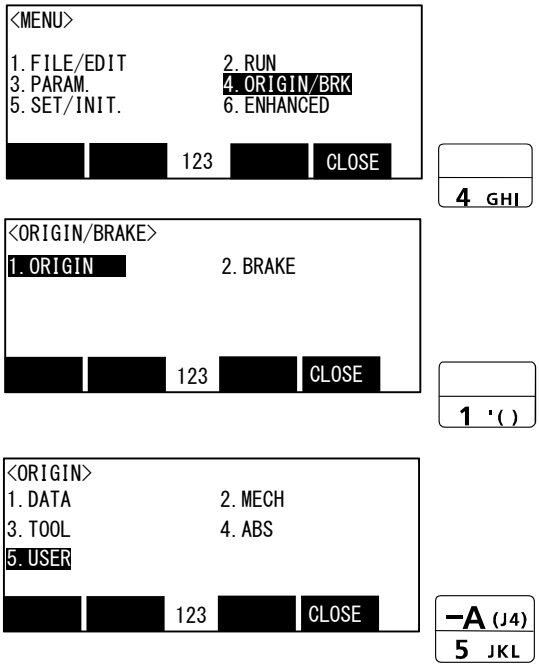
The procedure for setting the origin with the user origin method is explained below.
This operation is carried out with the teaching pendant. Set the controller mode to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown 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 28, "2.4 Confirming the operation" for details on the jog operation.

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

2) Enter the JOINT jog mode, and display the joint coordinates on the teaching pendant screen. Record the value of the axis for which the origin is to be set.
3) Input the value recorded in the "user designated origin parameter (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.

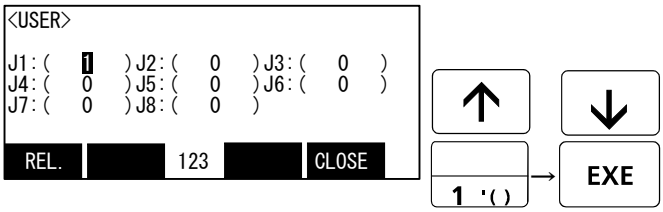


4) Next, set the origin.
Display the menu screen.

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

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

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



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

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

The origin settings are completed by the user origin method.

5.6.5 Recording the origin data

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 CONBOX cover (RV-4F/7F/13F series) or J1 axis motor connector cover (RV-35F/50F/70F series).
The teaching pendant operation method and the cover removal method for confirming the origin data is the same as the methods for setting the origin with the origin data input method. Refer to Page 23, "2.3.2 Setting the origin with the origin data input method", and write the origin data displayed on the teaching pendant onto the origin label.

(1) Confirming the origin data label
Remove the CONBOX cover (RV-4F/7F/13F series) or J1 axis motor connector cover (RV-35F/50F/70F series). Refer to Page 92, "5.3.2 Installing/removing the cover", and remove the cover.

(2) Confirming the origin data
Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to Page 23, "2.3.2 Setting the origin with the origin data input method", "(5)Inputting the origin data", and display the Origin Data Input screen on the teaching pendant display screen.

(3) Recording the origin data
Write the origin data displayed on the teaching pendant to the origin data label attached to the back of the CONBOX cover (RV-4F/7F/13F series) or J1 axis motor connector cover (RV-35F/50F/70F series). Refer to Page 23, "Fig.2-15 : Origin data label (an example)", and Page 26, "Fig.2-16 : Correspondence of origin data label and axis" for details on the origin data label.

(4) Installing the cover
Install the CONBOX cover (RV-4F/7F/13F series) or J1 axis motor connector cover (RV-35F/50F/70F series) removed in step "(1)Confirming the origin data label" above.
Refer to Page 92, "5.3.2 Installing/removing the cover", and replace the cover.

The recording of the origin data is completed.

6 Appendix

Appendix 1 : Configuration flag

The configuration flag indicates the robot posture.

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

The types of configuration flags are shown below.

(1) RIGHT/LEFT

The figure of the 5-axis robot shows the position of control point R in relation to the vertical plane that runs through the center of rotation of the J1 axis.

P is center of J5 axis rotation in comparison with the plane through the J1 axis vertical to the ground. (6-axis type robot)

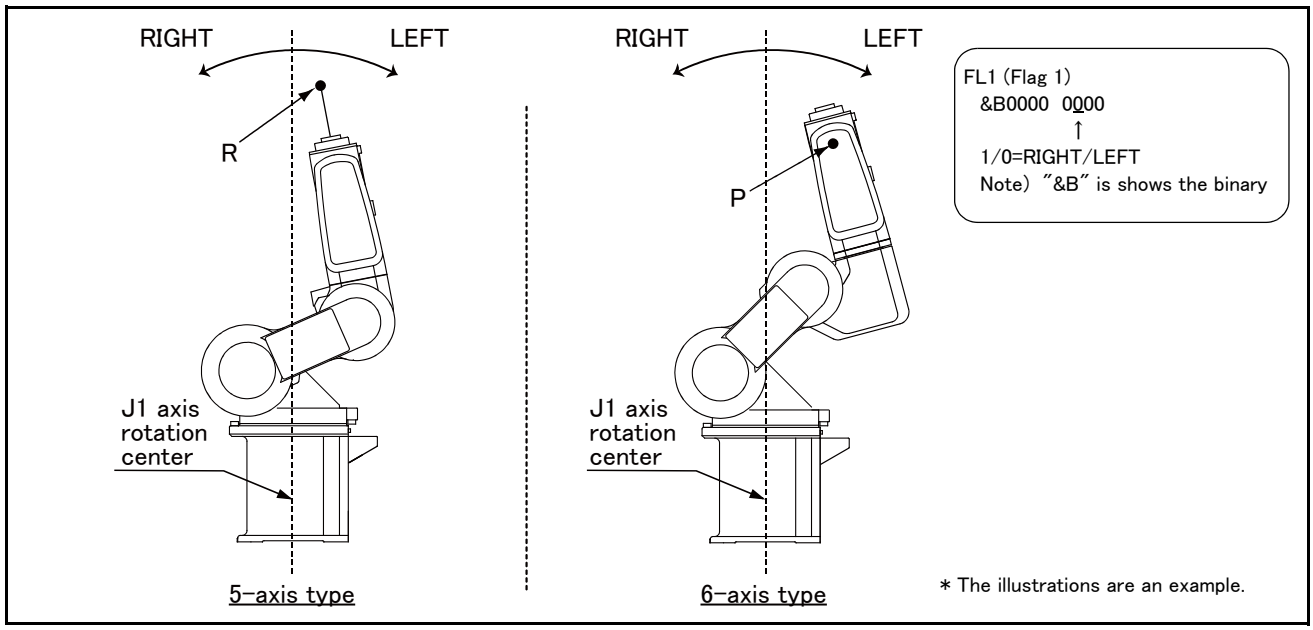


Fig.6-1 : Configuration flag (RIGHT/LEFT)

(2) ABOVE/BELOW

P is center of J5 axis rotation in comparison with the plane through both the J3 and the J2 axis.

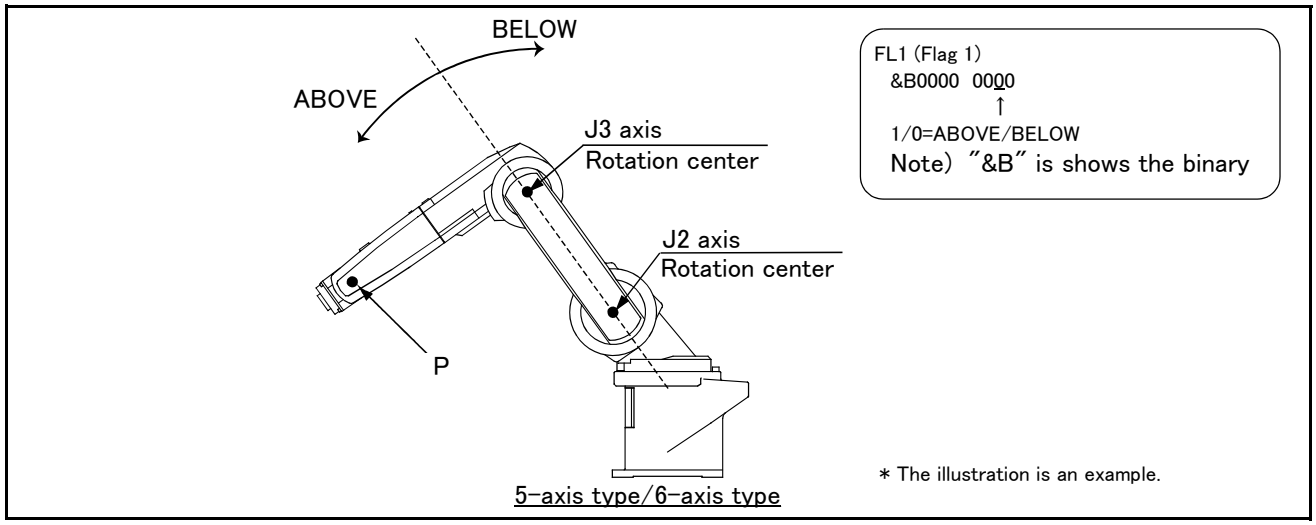


Fig.6-2 : Configuration flag (ABOVE/BELOW)

(3) NONFLIP/FLIP (6-axis type robot only)

This means in which side the J6 axis is in comparison with the plane through both the J4 and the J5 axis.

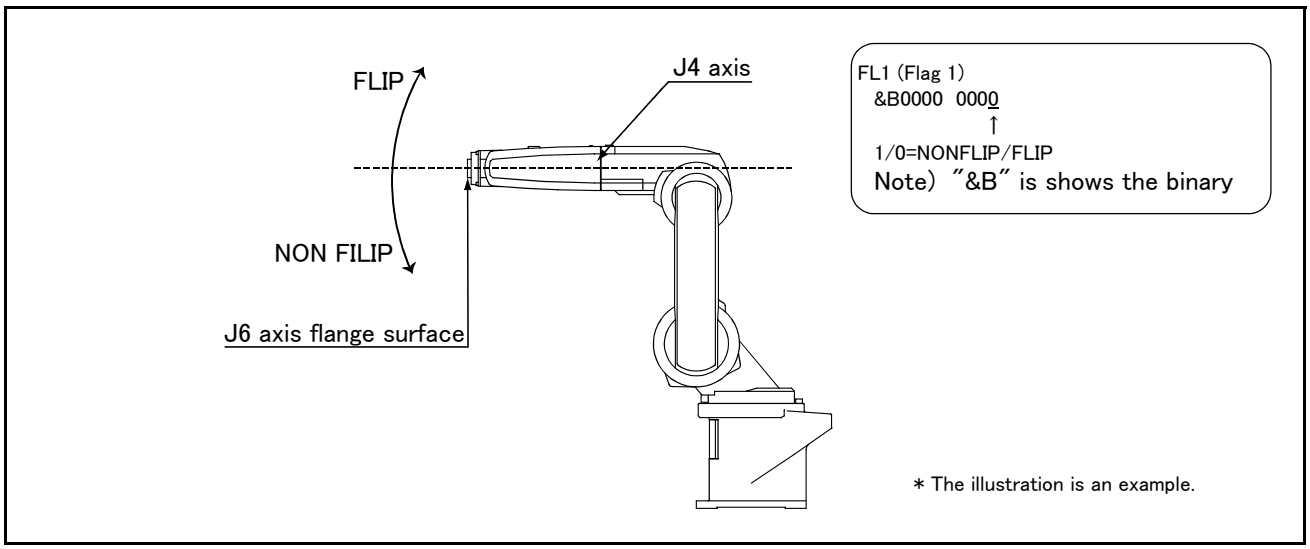


Fig.6-3 : Configuration flag (NONFLIP/FLIP)

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 5-1-14, YADA-MINAMI, HIGASHI-KU NAGOYA 461-8670, JAPAN
Authorised representative:
Mitsubishi Electric Europe B.V. FA - European Business Group
Mitsubishi-Electric-Platz 1, D-40882 Ratingen, Germany
Tel: +49(0)2102-4860

Jan. 2020 MEE Printed in Japan on recycled paper.