EPSON
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Industrial Robot: 6-Axis Robots

N series

MAINTENANCE MANUAL

Rev.4

ENM231R5661F

Original instructions

Industrial Robot: 6-Axis Robots

N series Maintenance Manual

Rev. 4

FOREWORD

Thank you for purchasing our robot products.
This manual contains the information necessary for the correct use of the manipulator.
Please carefully read this manual and other related manuals before installing the robot system.
Keep this manual handy for easy access at all times.

The robot system and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with our high performance standards. Please note that the basic performance of the product will not be exhibited if our robot system is used outside of the usage conditions and product specifications described in the manuals.

This manual describes possible dangers and consequences that we can foresee. Be sure to comply with safety precautions on this manual to use our robot system safety and correctly.

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The contents of this manual are subject to change without notice.
Please notify us if you should find any errors in this manual or if you have any comments regarding its contents.

MANUFACTURER

SEIKO EPSON CORPORATION

CONTACT INFORMATION

Contact information is described in “SUPPLIERS” in the first pages of the following manual:

Robot System Safety Manual Read this manual first

DISPOSAL

When disposing this product, dispose in accordance with the laws and regulations of each country.

Regarding battery disposal

The battery removal/replacement procedure is described in the following manuals:
Maintenance Manual

For European Union customers only

The crossed out wheeled bin label that can be found on your product indicates that this product and incorporated batteries should not be disposed of via the normal household waste stream. To prevent possible harm to the environment or human health please separate this product and its batteries from other waste streams to ensure that it can be recycled in an environmentally sound manner. For more details on available collection facilities please contact your local government office or the retailer where you purchased this product. Use of the chemical symbols Pb, Cd or Hg indicates if these metals are used in the battery.

This information only applies to customers in the European Union, according to DIRECTIVE 2006/66/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC and legislation transposing and implementing it into the various national legal systems.
For other countries, please contact your local government to investigate the possibility of recycling your product.

For Users in Taiwan region

Please separate used batteries from other waste streams to ensure that it can be recycled in an environmentally sound manner. For more details on available collection facilities please contact your local government office or the retailer where you purchased this product.

Before Reading This Manual

This section describes what you should know before reading this manual.

Structure of Control System

N2 series Manipulators can be used with the following combinations of Controllers and software.

Controller : RC700-A

Software : EPSON RC+ 7.0 Ver.7.2.0 or later

N6 series Manipulators can be used with the following combinations of Controllers and software.

Controller : RC700-A

Software : EPSON RC+ 7.0 Ver.7.3.4 or later

Setting by Software

This manual contains setup procedures using the software.
Those sections are indicated by the symbol on the left.

Turning ON/OFF Controller

When you see the instruction “Turn ON/OFF the Controller” in this manual, be sure to turn ON/OFF all the hardware components.

Photos and Illustrations Used in This Manual

The appearance of some parts may differ from those on an actual product depending on when it was shipped or the specifications. The procedures themselves, however, are accurate.

The Manuals of This Product

The following are typical manual types for this product and an outline of the descriptions.

Safety Manual (book, PDF)

This manual contains safety information for all people who handle this product. The manual also describes the process from unpacking to operation and the manual you should look at next.

Read this manual first.

- Safety precautions regarding robot system and residual risk
- Declaration of conformity
- Training
- Flow from unpacking to operation

RC700 series Manual (PDF)

This manual explains the installation of the entire robot system and the specifications and functions of the controller. The manual is primarily intended for people who design robot systems.

- The installation procedure of the robot system (specific details from unpacking to operation)
- Daily inspection of the controller
- Controller specifications and basic functions

N series Manual (PDF)

This manual describes the specifications and functions of the Manipulator. The manual is primarily intended for people who design robot systems.

- Technical information, functions, specifications, etc. required for the Manipulator installation and design
- Daily inspection of the Manipulator

Status Code/Error Code List (PDF)

This manual contains a list of code numbers displayed on the controller and messages displayed in the software message area. The manual is primarily intended for people who design robot systems or do programming.

RC700 series Maintenance Manual (PDF)
N series Maintenance Manual (PDF) (xx: Manipulator series name)

This manual describes the details of maintenance etc. The manual is intended for people who perform maintenance.

- Daily inspection
- Replacement and repair of maintenance parts
- The method of firmware update and controller setting backup etc.

EPSON RC+ 7.0 User's Guide (PDF)

This manual describes general information about program development software.

EPSON RC+ 7.0 SPEL+ Language Reference (PDF)

This manual describes the robot programming language “SPEL+”.

Other Manual (PDF)

Manuals for each option are available.

N2 series Maintenance

N6 series Maintenance

N2 Maintenance

This volume contains maintenance procedures with safety precautions for the N2 series Manipulators.

1. Safety Maintenance

Please read this chapter, this manual, and other relevant manuals carefully to understand safe maintenance procedures before performing any maintenance.

Only the personnel who have taken maintenance training held by us or suppliers should be allowed to maintain the robot system.

 WARNING	■ Do not remove any parts unless otherwise instructed by this manual. Follow the maintenance procedure strictly as described. Improper removal of parts or improper maintenance may cause not only malfunction of the robot system but serious safety problems. ■ If you have not received training, keep away from the Manipulator while the power is ON. Do not enter the operating area while the power is ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even it seems to be stopped. ■ When you check the operation of the Manipulator after replacing parts, be sure to check it while you are outside of the safeguarded area. Checking the operation of the Manipulator while you are inside of the safeguarded area may cause serious safety problems as the Manipulator may move unexpectedly. ■ Before operating the robot system, make sure that both the Emergency Stop switches and safeguard switch function properly. Operating the robot system when the switches do not function properly is extremely hazardous and may result in serious bodily injury and/or serious damage to the robot system as the switches cannot fulfill their intended functions in an emergency.

 WARNING	■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ When connecting / replacing the brake release unit or the external short connector, turn OFF the power to the Controller and the brake release unit. Inserting and removing the connector while the power is ON may result in electrical shock.

CAUTION	■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ If the Manipulator is operated without connecting the brake release unit or the external short connector, the brakes cannot be released and it may cause damage on them. After using the brake release unit, be sure to connect the external short connector to the Manipulator, or check connection of the connector for the brake release unit. ■ The Manipulator arms may become hot after the Manipulator operation due to heat generation of the motors. Be careful when performing maintenance. ■ When operating maintenance of manipulator, secure about 50 cm of empty space around the manipulator.

2. General Maintenance

This chapter describes maintenance inspection procedures. Performing maintenance inspection properly is essential to prevent trouble and ensure safety.
Be sure to perform the maintenance inspections in accordance with the schedule.

2.1 Maintenance Inspection

2.1.1 Schedule for Maintenance Inspection

Inspection points are divided into five stages: daily, monthly, quarterly, biannual, and annual. The inspection points are added every stage.
If the Manipulator is operated for 250 hours or longer per month, the inspection points must be added every 250 hours, 750 hours, 1500 hours, and 3000 hours operation.

	Inspection Point					
	Daily inspection	Monthly inspection	Quarterly inspection	Biannual inspection	Annual inspection	Overhaul*
1 month (250 h)	Inspect every day	√				
2 months (500 h)		√				
3 months (750 h)		√	√			
4 months (1000 h)		√				
5 months (1250 h)		√				
6 months (1500 h)		√	√	√		
7 months (1750 h)		√				
8 months (2000 h)		√				
9 months (2250 h)		√	√			
10 months (2500 h)		√				
11 months (2750 h)		√				
12 months (3000 h)		√	√	√	√	
13 months (3250 h)		√				
⋮	⋮	⋮	⋮	⋮	⋮	⋮
20000 h						√

h = hour

*Overhaul (parts replacement)

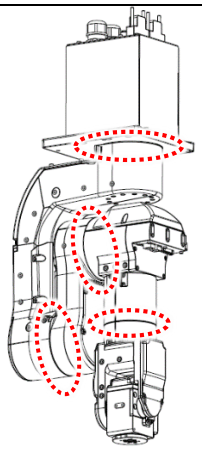
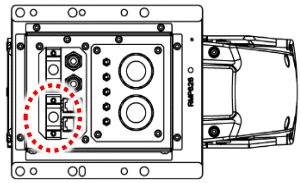
2.1.2 Inspection Point

Inspection Item

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check looseness or backlash of bolts/screws.	End effector mounting bolts	√	√	√	√	√
	Manipulator mounting bolts	√	√	√	√	√
Check looseness of connectors.	External connectors on Manipulator (on the connector plates etc.)	√	√	√	√	√
Visually check for external defects. Clean up if necessary.	External appearance of Manipulator	√	√	√	√	√
	External cables		√	√	√	√
Check for bends or improper location. Repair or place it properly if necessary.	Safeguard etc.	√	√	√	√	√
Check the brake operation.	Brake for Arm #2 to #6	√	√	√	√	√
Check whether unusual sound or vibration occurs.	Whole	√	√	√	√	√
Check the leak of grease for cables.	Grease for Arm #1 to #4	√	√			
Check either the external short connector or the brake release unit connector is connected.	The external short connector on the back side of the Manipulator, or the brake release unit connector.	√	√	√	√	√

Inspection Method

Inspection Point	Inspection Method
Check looseness or backlash of bolts/screws.	Use a hexagonal wrench to check that the end effector mounting bolts and the Manipulator mounting bolts are not loose. When the bolts are loose, refer to "*2.4 Tightening Hexagon Socket Head Bolts*" and tighten them to the proper torque.
Check looseness of connectors.	Check that connectors are not loose. When the connectors are loose, reattach it not to come off.
Visually check for external defects. Clean up if necessary.	Check the appearance of the Manipulator and clean up if necessary. Check the appearance of the cable, and if it is scratched, check that there is no cable disconnection.
Check for bends or improper location. Repair or place it properly if necessary.	Check that the safeguard, etc. are located properly. If the location is improper, place it properly.
Check the brake operation.	Check that the arm does not fall when in MOTOR OFF. If the arm falls when in MOTOR OFF and the brake is not released, contact the supplier.
Check whether unusual sound or vibration occurs.	Check that there is no unusual sound or vibration when operating. If there is something wrong, contact the supplier.

Inspection Point	Inspection Method
Check the leak of grease for cables.	When the grease for cables is leaked from the gap of the Arm #1 to #4, wipe off the leaked grease. 
Check either the external short connector or the brake release unit connector is connected.	Check that either the external short connector or the brake release unit connector is connected. When it is not connected, connect it. 

2.2 Overhaul (Parts Replacement)

CAUTION	■ If you do not overhaul properly, it may have a serious impact on safety. ■ Overhaul timing is based on an assumption that all joints are operated for equal distance. If a particular joint has a high duty or high load, it is recommended to overhaul all joints (as many as possible) before exceeding 20,000 operation hours with the joint as a basis.

The parts for the Manipulator joints may cause accuracy decline or malfunction due to deterioration of the Manipulator resulting from long term use. In order to use the Manipulator for a long term, it is recommended to overhaul the parts (parts replacement).

The time between overhauls is 20,000 operation hours of the Manipulator as a rough indication.

However, it may vary depending on ambient temperature, usage condition and degree of the load (such as when operated with the maximum motion speed and maximum acceleration / deceleration in continuous operation) applied on the Manipulator.

NOTE

For the EPSON RC+ 7.0 Ver. 7.2.x or later (firmware Ver.7.2.x.x or later), the recommended replacement time for the parts subject to maintenance (motors, reduction gear units, and timing belts) can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.
For details, refer to the following manual.
RC700 series Maintenance Manual 6. Alarm

Note:
The recommended replacement time for the maintenance parts is when it reaches the L10 life (time until 10% failure probability). In the [Maintenance] dialog box, the L10 life is displayed as 100%.

The Manipulator operation hours can be checked in [Controller Status Viewer] dialog box - [Motor On Hours].

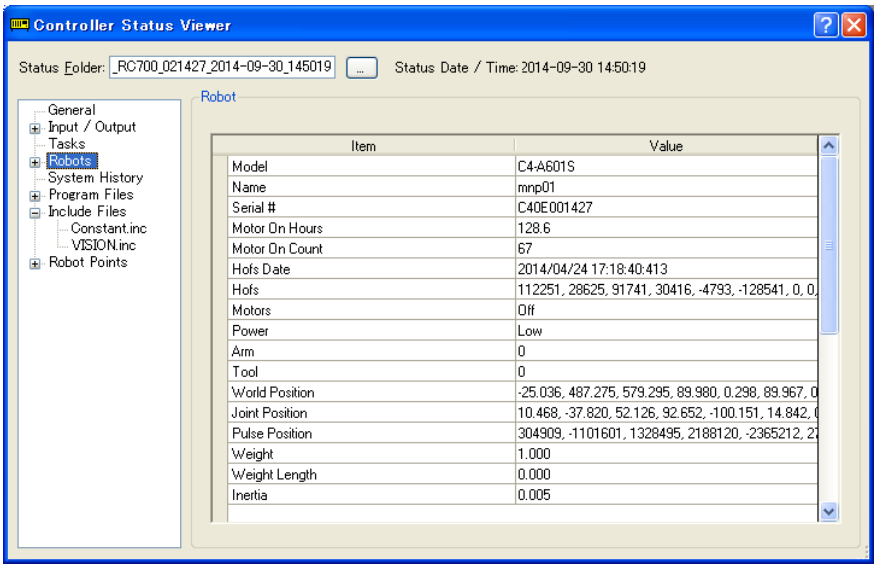
(1) Select EPSON RC+ menu-[Tools]-[Controller] to open the [Controller Tools] dialog box.

(2) Click the <View Controller Status> button to open the [Browse For Folder] dialog box.

(3) Select the folder where the information is stored.

(4) Click <OK> to view the [Controller Status Viewer] dialog box.

(5) Select [Robot] from the tree menu on the left side.



For the parts subject to overhaul, refer to *9. N2 Maintenance Parts List.*

For details of replacement of each part, refer to each section.

Please contact the supplier of your region for further information.

2.3 Greasing

The actuator units and reduction gear units need greasing regularly. Only use the grease specified in the following table.

For the greasing procedure, please contact the supplier of your region.

 WARNING	■ Before greasing, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

 CAUTION	■ Keep enough grease in the Manipulator. Operating the Manipulator with insufficient grease will cause the noise or damage sliding parts and/or result in insufficient function of the Manipulator. Once the parts are damaged, a lot of time and money will be required for the repairs. ■ If grease gets into your eyes, mouth, or on your skin, follow the instructions below. If grease gets into your eyes: Flush them thoroughly with clean water, and then see a doctor immediately. If grease gets into your mouth: If swallowed, do not induce vomiting. See a doctor immediately. If grease just gets into your mouth, wash out your mouth with water thoroughly. If grease gets on your skin: Wash the area thoroughly with soap and water.

	Part	Interval	Grease
Joint #1, 2, 3	Actuator unit, Reduction gear unit	Overhaul timing	SK-1A
Joint #4, 5, 6			SK-2

As a rough indication, perform greasing at the same timing as overhaul.
However, it may vary depending on ambient temperature, usage condition and degree of the load (such as when operated with the maximum motion speed and maximum acceleration / deceleration in continuous operation) applied on the Manipulator.

2.4 Tightening Hexagon Socket Head Bolts

Hexagon socket head cap bolts (hereinafter, “bolts”) are used in places where mechanical strength is required. These bolts are fastened with the tightening torque shown in the following tables.

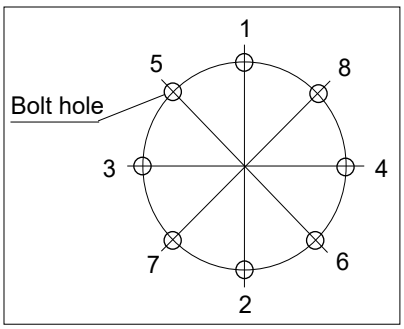
When it is required to refasten the bolts in some procedures in this manual (except special cases as noted), use a torque wrench so that the bolts are fastened with appropriate tightening torque as shown below.

Bolt	Tightening Torque
M2.5	1.4 ± 0.1 N·m (14± 1 kgf·cm)
M3	2.0 ± 0.1 N·m (21 ± 1 kgf·cm)
M4	4.0 ± 0.2 N·m (41 ± 2 kgf·cm)
M5	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)
M6	13.0 ± 0.6 N·m (133 ± 6 kgf·cm)
M8	32.0 ± 1.6 N·m (326 ± 16 kgf·cm)
M10	58.0 ± 2.9 N·m (590 ± 30 kgf·cm)
M12	100.0 ± 5.0 N·m (1,020 ± 51 kgf·cm)

See below for the set screw.

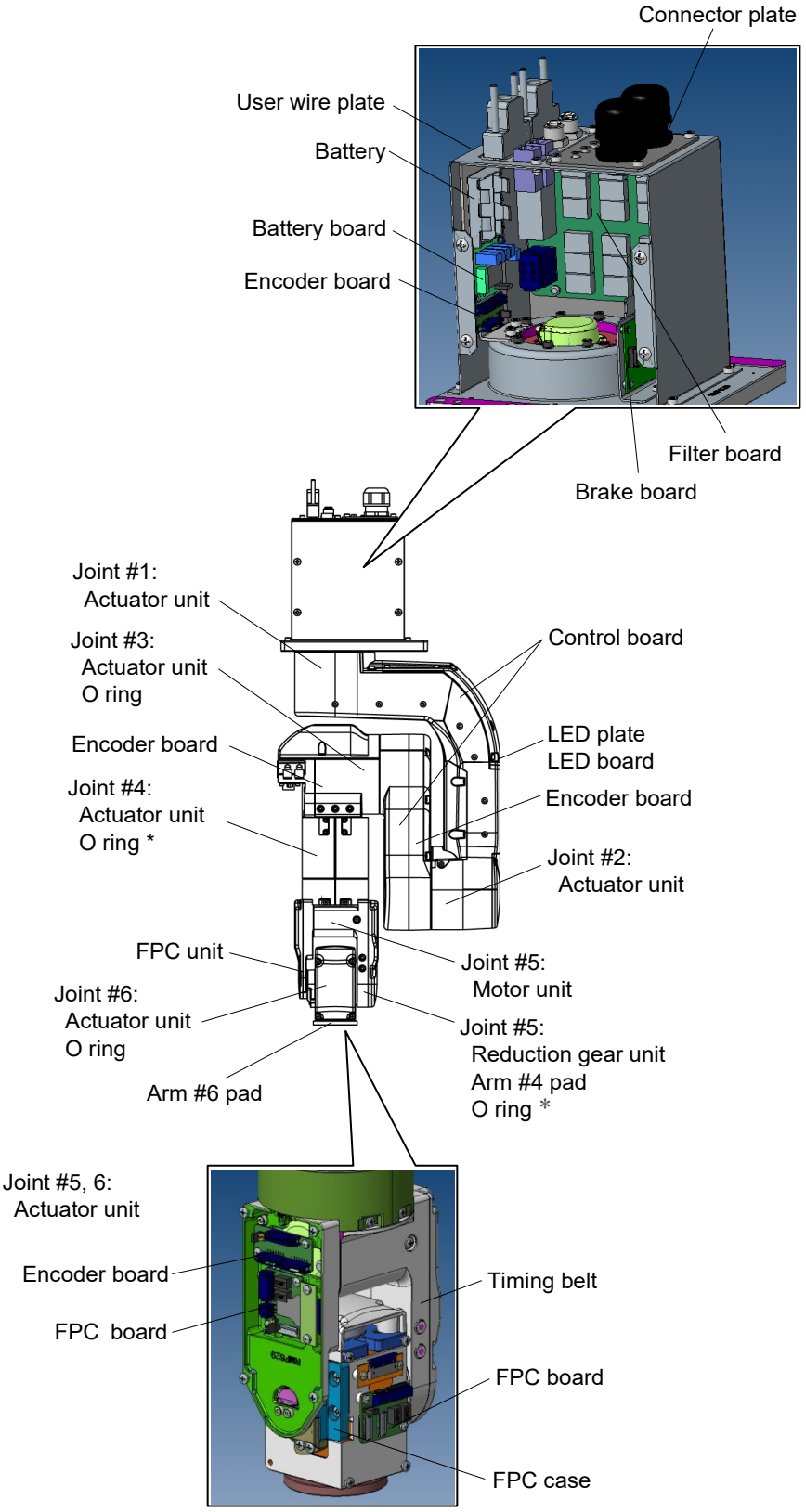
Set Screw	Tightening Torque
M3	0.9 ± 0.1 N·m (9 ± 1 kgf·cm)
M4	2.4 ± 0.1 N·m (26 ± 1 kgf·cm)
M5	3.9 ± 0.2 N·m (40 ± 2 kgf·cm)
M6	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)

It is recommended to fasten the bolts aligned on a circumference in a crisscross pattern as shown in the figure below.



Do not fasten all bolts securely at one time. Divide the number of times to fasten the bolts into two or three and fasten the bolts securely with a hexagonal wrench. Then, use a torque wrench to fasten the bolts with tightening torques shown in the table above.

2.5 Layout of Maintenance Parts

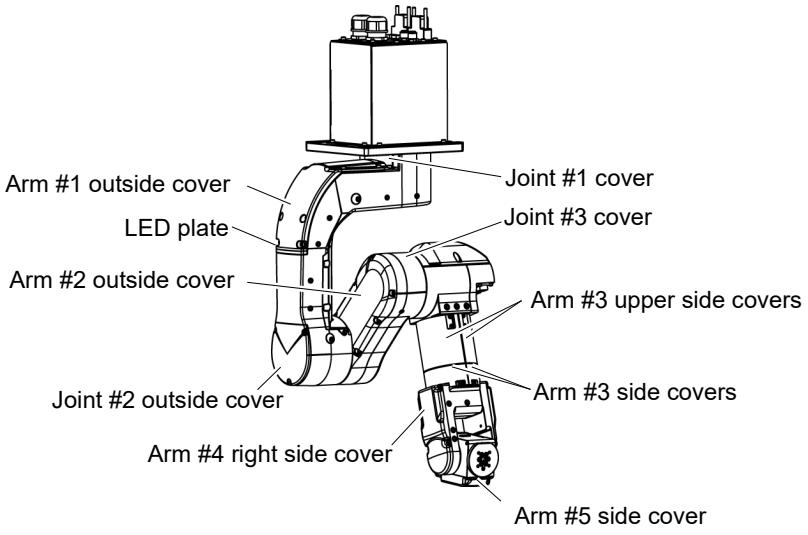


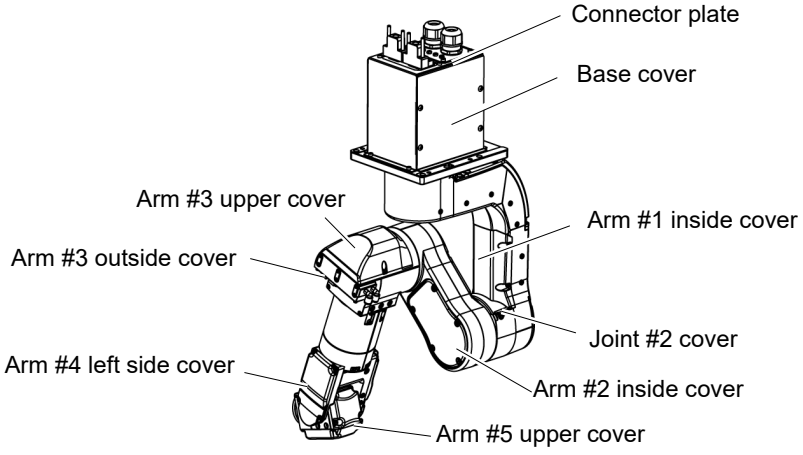
* : Joint #4 and #5 O rings are common.

3. Covers

This chapter describes removal and installation steps of the covers necessary for maintenance.

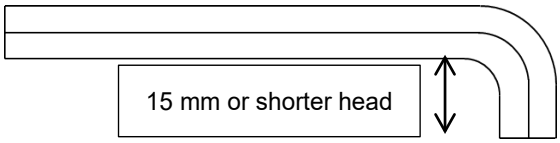
WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.





	Name			Qty.	Note
Maintenance parts	Cover	Arm #1	Joint #1 cover	1	1685530
			Joint #2 cover	1	1685531
			Arm #1 inside cover	1	1696705
			Joint #2 outside cover	1	1685538
			LED plate	1	1685535
		Arm #2	Arm #2 inside cover	1	1685539
			Arm #2 outside cover	1	1696706
			Joint #3 cover	1	1685540
		Arm #3	Arm #3 upper cover	1	1696707
			Arm #3 side cove	2	1696708
		Arm #4	Arm #4 right side cover	1	1685545
			Arm #4 left side cover	1	1696709
		Arm #5	Arm #5 side cover	1	1696710
			Arm #5 upper cover	1	1685547
Tools	Hexagonal wrench		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
			width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)			1	For cross recessed screws

* To remove the Arm #1 outside cover and the Joint #1 cover, a short head hexagonal wrench as shown below is necessary.



3.1 Arm #1 Outside Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

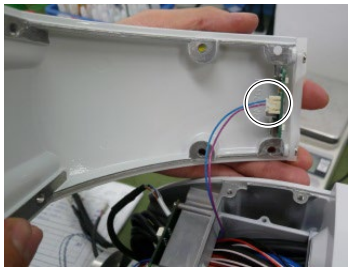
Removal

(1) Remove the bolts and then remove the Arm #1 outside cover.

Hexagon socket head cap bolts with captive washer:
4-M4×12 (upper)
4-M4×12 (side)

NOTE Use a short head hexagonal wrench when removing the bolts with the base plate installed.

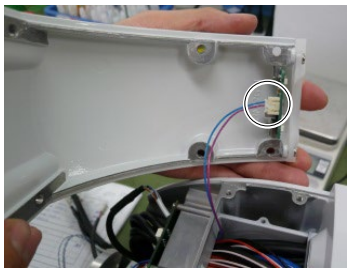
(2) Remove the LED board connector.



NOTE The cable is connected to the inside of the Arm #1 outside cover.
When removing the cover, be careful not to pull the cable forcibly.

Installation

(1) Connect the connector to the LED board.



(2) Install the Arm #1 outside cover.

Hexagon socket head cap bolts with captive washer: 8-M4×12

Tightening torque: 4 ± 0.2 N·m

NOTE

Be careful not to get the cables caught in the cover.

Use a short head hexagonal wrench when fixing the bolts with the base plate installed.

3.2 Joint #1 Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

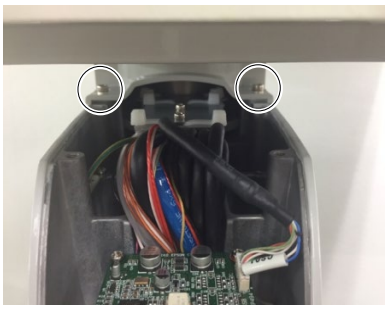
Removal

(1) Remove the Arm #1 outside cover.

For details, refer to *3.1 Arm #1 Outside Cover*.

(2) Remove the bolts, and then remove the Joint #1 cover.

NOTE Use a short head hexagonal wrench when removing the bolts with the base plate installed.



Hexagon socket head cap bolts with captive washer: 2-M4×12

Installation

(1) Install the Joint #1 cover to the Manipulator.

Tightening torque: 0.6 ± 0.05 N·m

NOTE The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

Use a short head hexagonal wrench when fixing the bolts with the base plate installed.

(2) Install the Arm #1 outside cover.

For details, refer to *3.1 Arm #1 Outside Cover*.

3.3 Arm #1 Inside Cover, Joint #2 Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #2 brake.

EPSON RC+ Command

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> brake off, 2
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(3) Turn the Arm #2 about 90 degrees so that the screws of the Arm #1 inside cover can be seen from above.

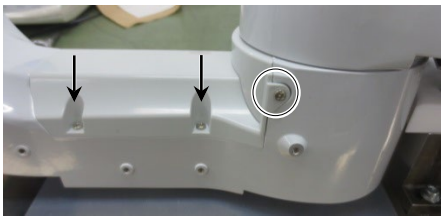
(4) Turn off the Controller.

Removal

Remove all screws of the Arm #1 inside cover and the Joint #2 cover.

Remove the Joint #2 cover and the Arm #1 inside cover, in that order.

Joint #2 cover



Cross recessed binding head machine screw: 2-M3×6

Arm #1 inside cover

Cross recessed binding head machine screw: 4-M3×6

Installation

Attach the Arm #1 inside cover and the Joint #2 cover in that order to the Manipulator, and then fix them with the screws.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.4 Joint #2 Outside Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

Remove the screws, and then remove the Joint #2 outside cover.

Installation

Install the Joint #2 outside cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

Cross recessed binding head machine screw: 3-M3×6

3.5 Arm #2 Outside Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #2 brake.

EPSON RC+ Command

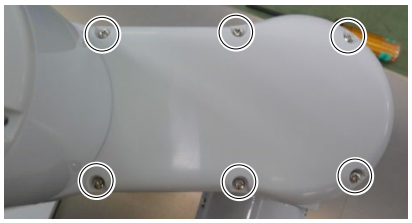
```
> brake off, 2
```

(3) Turn the Arm #2 about 90 degrees so that the screws of the Arm #2 outside cover can be seen from above.

(4) Turn off the Controller.

Removal

Remove the screws, and then remove the Arm #2 outside cover.



Cross recessed binding head machine screw: 6-M3×6

Installation

Install the Arm #2 outside cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.6 Joint #3 Cover

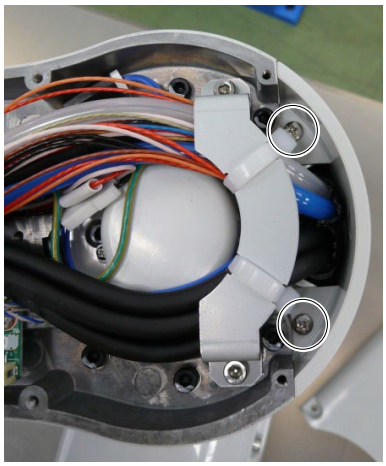
CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

(1) Remove the Arm #2 outside cover.

For details, refer to *3.5 Arm #2 Outside Cover*.

(2) Remove the screws, and then remove the Joint #3 cover.



Cross recessed binding head machine screw: 2-M3×12

Installation

(1) Install the Joint #3 cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

Be careful not to get the cables caught in the cover.

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

(2) Install the Arm #2 outside cover.

For details, refer to *3.5 Arm #2 Outside Cover*.

3.7 Arm #2 Inside Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #3 brake.

EPSON RC+ Command

```
> brake off, 3
```

(3) Turn the Arm #3 about 90 degrees so that the screws of the Arm #2 inside cover can be seen from above.

(4) Turn off the Controller.

Removal

Remove the screws, and then remove the Arm #2 inside cover.

Cross recessed binding head machine screw: 5-M3×6

Installation

Install the Arm #2 inside cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.8 Arm #3 Upper Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #2 brake.

EPSON RC+ Command

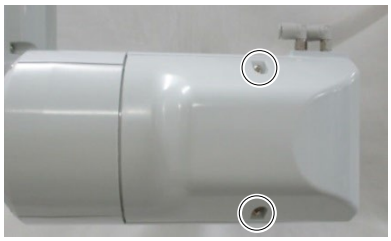
```
> brake off, 2
```

(3) Turn the Arm #2 about 90 degrees so that the screws of the Arm #3 upper cover can be seen from above.

(4) Turn off the Controller.

Removal

Remove the screws, and then remove the Arm #3 upper cover.



Cross recessed binding head machine screw: 2-M3×6

Installation

Install the Arm #3 upper cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

Be careful not to get the cables caught in the cover.

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.9 Arm #3 Outside Cover

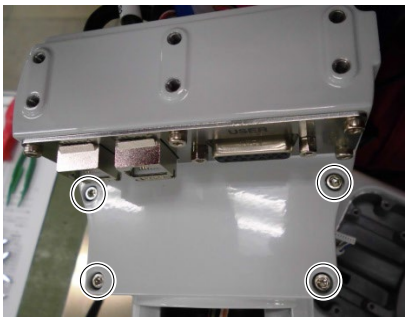
CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

(1) Remove the Arm #3 upper cover.

For details, refer to *3.8 Arm #3 Upper Cover*.

(2) Remove the screws, and then remove the Arm #3 outside cover.



Hexagon socket head cap bolt:
4-M3×15

NOTE
The cable is connected to the inside of the Arm #3 outside cover.
When removing the cover, be careful not to pull the cable forcibly.

Installation

(1) Install the Arm #3 outside cover to the Manipulator.

Tightening torque: 2 ± 0.1 N·m

NOTE
Be careful not to get the cables caught in the cover.

(2) Install the Arm #3 upper cover.

For details, refer to *3.8 Arm #3 Upper Cover*.

3.10 Arm #3 Side Cover, Arm #3 Upper Side Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #3 brake.

EPSON RC+ Command

```
> brake off, 3
```

(3) Turn the Arm #3 about 90 degrees so that the screws of the Arm #3 side covers can be seen from every angle.

(4) Turn off the Controller.

Removal

(1) Remove the following covers.

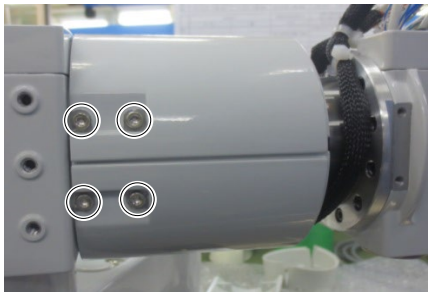
Arm #4 right side cover Arm #4 left side cover.

For details, refer to *3.11 Arm #4 Right Side Cover*, and *3.12 Arm #4 Left Side Cover*.

(2) Remove the screws, and then remove the Arm #3 side covers (2 covers).

Cross recessed binding head machine screw: 2-M3×6 (×2)

(3) Remove the screws, and then remove the Arm #3 upper side covers (2 covers).

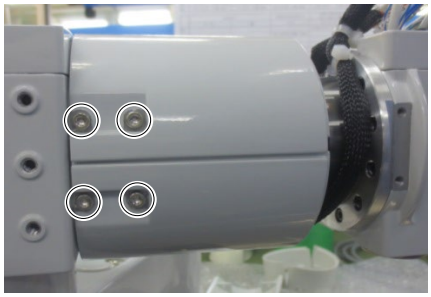


Hexagon socket head cap bolt: 4-M3×8 (×2)

Installation

(1) Install the Arm #3 upper side covers (2 covers) to the Manipulator.

Tightening torque: 2 ± 0.1 N·m



Hexagon socket head cap bolt:
4-M3×8 (×2)

(2) Install the Arm #3 side covers (2 covers) to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

Cross recessed binding head machine screw: 2-M3×6 (×2)

NOTE
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

(3) Install the following covers.

Arm #4 right side cover

Arm #4 left side cover.

For details, refer to
3.11 Arm #4 Right Side Cover
3.12 Arm #4 Left Side Cover.

3.11 Arm #4 Right Side Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

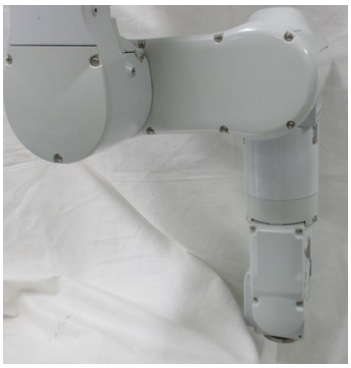
(2) Release the Joint #3 brake.

EPSON RC+ Command

```
> brake off, 3
```

(3) Turn the Arm #3 about 90 degrees so that the screws of the Arm #4 right side cover can be seen from above.

(4) Turn off the Controller.



Removal

Remove the screws, and then remove the Arm #4 right side cover.

Cross recessed binding head machine screw: 4-M3×6

Installation

Install the Arm #4 right side cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.12 Arm #4 Left Side Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If the Arm #4 left side cover is overlapped by another arm, or if it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #3 brake.

EPSON RC+ Command

```
> brake off, 3
```

(3) Turn the Arm #3 about 90 degrees so that the screws of the Arm #4 left side cover can be seen from above.

(4) Turn off the Controller.

Removal

Remove the screws, and then remove the Arm #4 left side cover.

Cross recessed binding head machine screw: 4-M3×6

Installation

Install the Arm #4 left side cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

Be careful not to get the cables caught in the cover.
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.13 Arm #5 Side Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If the Arm #5 side cover is facing inside the Arm #4, or if it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #5 brake.

EPSON RC+ Command

```
> brake off, 5
```

(3) Turn the Arm #3 so that the screws of the Arm #5 side cover can be seen from above.

(4) Turn off the Controller.

Removal

Remove the screws, and then remove the Arm #5 side cover.

Cross recessed binding head sems screw: 4-M3×6

Installation

Install the Arm #5 side cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.14 Arm #5 Upper Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

If it is difficult to remove the cover, change the Manipulator posture by following the steps below.

(1) Turn on the Controller.

(2) Release the Joint #5 brake.

EPSON RC+ Command

```
> brake off, 5
```

(3) Turn the Arm #5 about 90 degrees so that the screws of the Arm #5 upper cover can be seen from above.

(4) Turn off the Controller.

Removal

Remove the screws, and then remove the Arm #5 upper cover.

Cross recessed binding head machine screw: 4-M3×6

Installation

Install the Arm #5 upper cover to the Manipulator.

Tightening torque: 0.45 ± 0.05 N·m

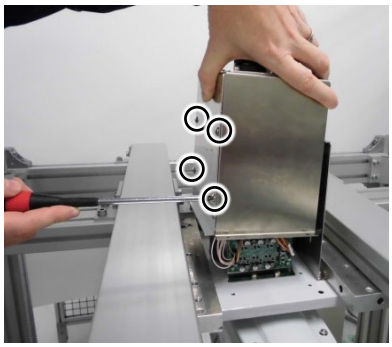
NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

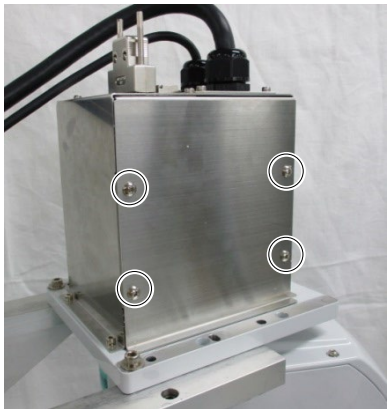
3.15 Base Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

NOTE When the tool cannot reach the screws fixing the base cover while the Manipulator is installed on the table, remove the cover by removing the base from the base plate.



Removal Remove the screws, and then remove the base cover.



Installation Install the base cover to the Manipulator.

Tightening torque: 0.9 ± 0.1 N·m

Cross recessed truss head small screws: 5-M4×5

3.16 Connector Plate

CAUTION	■ Do not remove the connector plate forcibly. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the connector plate, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the connector plate. Be sure to place the cables back to their original locations.

Removal Remove the bolts, and then remove the connector plate.

Installation Install the connector plate to the Manipulator.

Tightening torque: 4.0 ± 0.2 N·m

NOTE

Be careful not to get the cables caught in the plate.

Hexagon socket head cap bolts:
4-M4×8

4. Cable Unit and FPC Unit

4.1 Replacing the Cable Unit

 WARNING	■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

 CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to the *4.5 Connector Pin Assignment.*

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

	Name		Quantity	Note
Maintenance Parts	Cable unit (HP_CABLE_A_UNIT)		1	2186101
	Wire tie	AB150	-	1675754, 1 bag (100 ties: white)
		AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts, short head
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a wire tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

Removal: Cable Unit

Removal

(1) Remove the following covers.

Arm #4 left side cover
Arm #3 side cover
Arm #3 upper side cover
Arm #3 upper cover
Arm #2 inside cover
Arm #3 outside cover
Joint #2 cover
Joint #2 outside cover
Arm #1 inside cover

For details, refer to *3. Covers*.

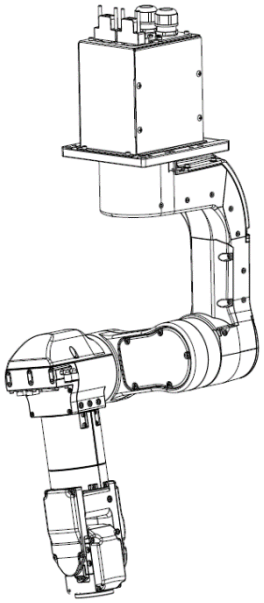
(2) Turn ON the Controller.

(3) Release the Joint #2 and #3 brakes.

EPSON RC+ Command

```
>brake off, 2
>brake off, 3
```

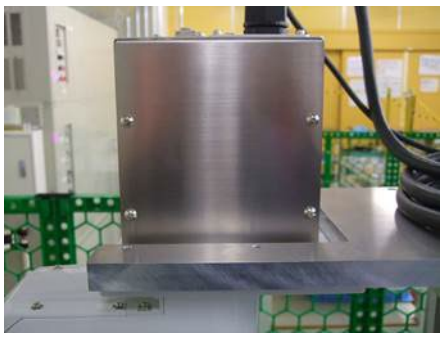
(4) Move the Manipulator to be as shown on the right.



(5) Turn OFF the Controller.

(6) Remove the base cover.

Cross recessed truss screw: 4-M4×5



(7) Remove the M/C cable.

For details, refer to *4.4 Replacing the M/C Cable*.

(8) Remove the brake release connector.

(9) Remove the base.

Hexagon socket head cap bolt: 9-M4×8

(10) Remove the following connectors on the board inside the base and the two tubes.

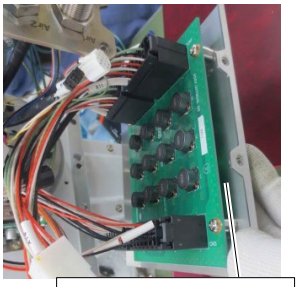
Connectors:
USER1-B, USER2-B, BAT_CN3, BAT_CN6, EB01_CN1, EB0x_CN2, EB01_CN3, FIL_CN3, FIL_CN4, PW1, BRK_CN1, BRK_CN2, BR_CN3

NOTE Be careful that the jumper pins on the board do not come off.

(11) Remove the filter board unit.

Hexagon socket head cap bolt: 2-M4×8

NOTE Do not remove the board.



(12) Remove the D-sub connector indicated as "USER".

(13) Remove the ground wires.

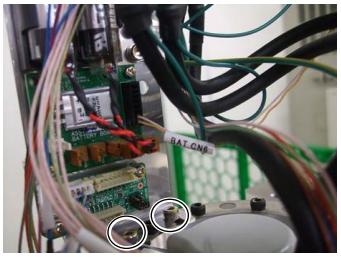
Hexagon socket head cap bolt: 6-M4×5

(14) Remove the user wire plate.

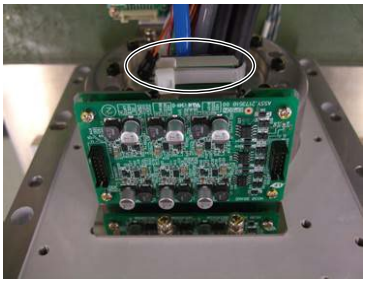
Hexagon socket head cap bolt: 2-M4×8

NOTE

Do not remove the board and the battery.

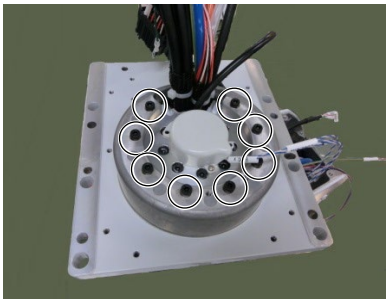


(15) Cut off the wire tie.



(16) Remove the base plate.

Hexagon socket head cap bolt: 8-M4×20



(17) Remove the following covers.

Arm #1 outside cover

Joint #1 cover

For details, refer to *3. Covers*.

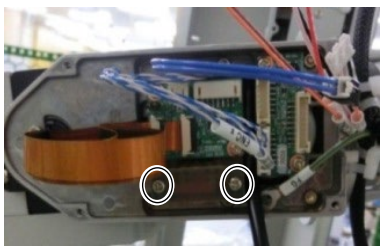
(18) Loosen the FPC Power Connector mounting screws and remove the following connectors. .

Connector:

PW5, J6P-01, BR5, FL_CN2, EB05_CN1

NOTE

Be careful that the jumper pins on the board do not come off.



(19) Remove the ground wire (FG).

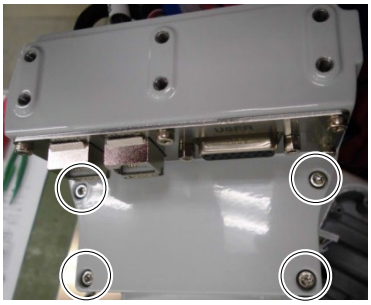
Cross recessed screw: M4×6

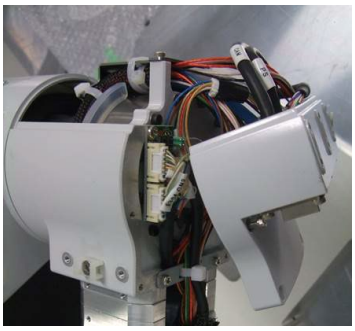
(20) Cut off the four wire ties fixed to the Arm #4.

(21) Remove the Arm #3 outside cover.

Hexagon socket head cap bolt: 4-M3×15

For details, refer to *3. Covers*.

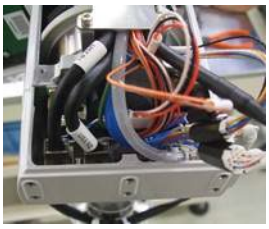




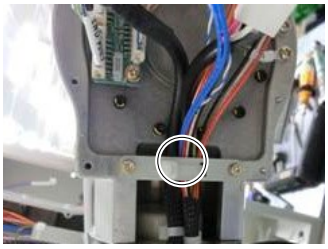
(22) Remove the following connectors.

Connector: USER1, USER2, X71, X72

(23) Remove the two air tubes.

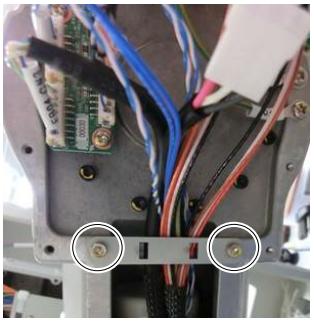


(24) Cut off wire tie of the cable fixing plate.



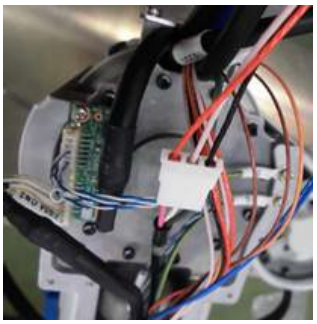
(25) Remove the cable fixing plate and pull out the cables.

Hexagon socket head cap bolt: 2-M3×6



(26) Remove the following connectors.

Connector:
PW4, BR4, EB04_CN3, EB04_CN1



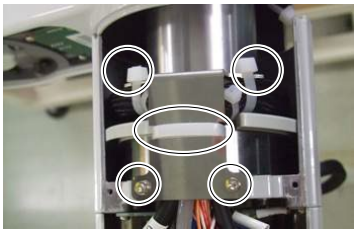
NOTE ☞ When the connector EB04_CN3 is removed, a bundle of cables will be removed.

NOTE ☞ Be careful that the jumper pins on the board do not come off.

(27) Remove the two ground wires (FG).

Cross recessed screw: 2-M4×6

(28) Cut off the wire ties (3 ties) fixing the cables to the plate.

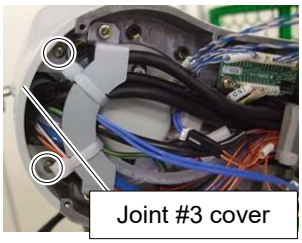


(29) Remove the cable fixing plate.

Hexagon socket head cap bolt: 2-M3×6

(30) Remove the Joint #3 cover.

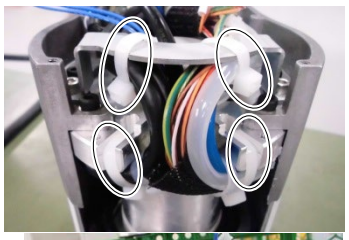
Cross recessed screw: 2-M3×12



(31) Cut off the wire tie.

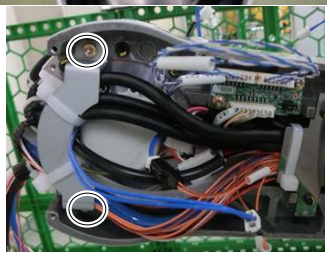
For plate: 2 ties

For flange: 2 ties



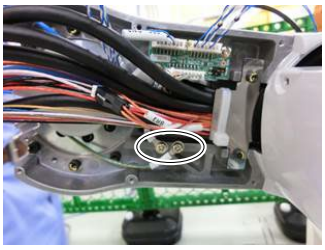
(32) Remove the cable fixing plate.

Hexagon socket head cap bolt: 2- M4×6



(33) Remove the connectors.

Connector:
PW2, PW3, BR2, BR3, EB02_CN1,
EB0x_CN3 (comes from the Joint #2 side.)



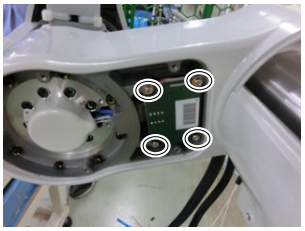
NOTE Be careful that the jumper pins on the board do not come off.

(34) Remove the ground wires (FG, 2 wires).

Cross recessed screw: 2-M4×6

(35) Remove the control board 2.

Cross recessed screw: 4-M3×6



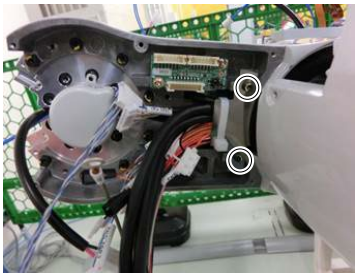
NOTE Keep the control board 2 not to lose it.

(36) Remove the connector.

Connector: GS02

(37) Remove the screws fixing the cable fixing plate.

Hexagon socket head cap bolt: 2-M3×6

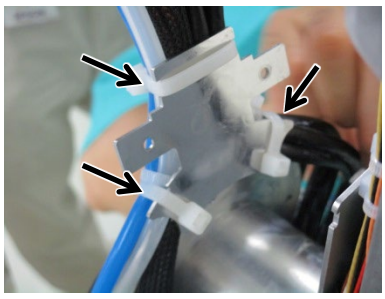


(38) Remove the Arm #2.

Hexagon socket head cap bolt: 8-M4×20

NOTE When removing the Arm #2, check if the cables are caught.

(39) Cut off the wire ties (3 ties) fixing the plate and the cables.



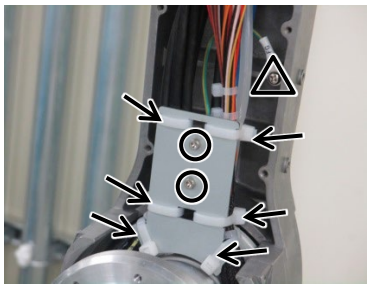
NOTE One of the fixing plates comes off.
Be careful not to lose it.

(40) Remove the cable fixing plate.

Hexagon socket head cap bolt: 2-M3×6
(indicated with circles)

Remove the ground wire (FG).

Cross recessed screw: M4×6
(indicated with triangles)



Cut off the wire ties (6 ties: indicated with arrows) fixing the plate and the cable unit.

NOTE The fixing plates come off.
Be careful not to lose them.

(41) Remove the following connector.

Connector: GS01

Cross recessed screw: 4-M3×6

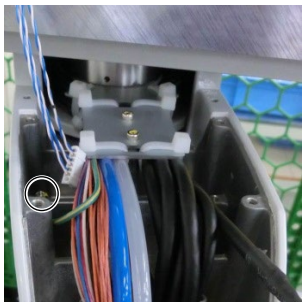
(42) Remove the control board 1.

NOTE Keep the board not to lose it.

(43) Pull the cables to the upper side of the Arm #1.

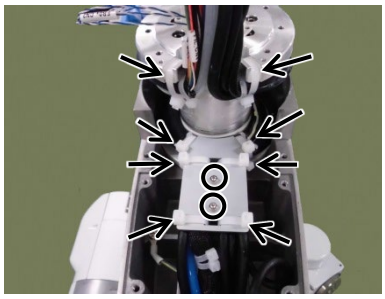
(44) Remove the ground wire.

Hexagon socket head cap bolt: M4×6



(45) Cut off the wire ties (indicated with arrows) fixing the cables.

For plate: 6 ties
For flange: 2 ties



(46) Remove the cable fixing plate.

Hexagon socket head cap bolt: 2-M3×6
(indicated with circles)

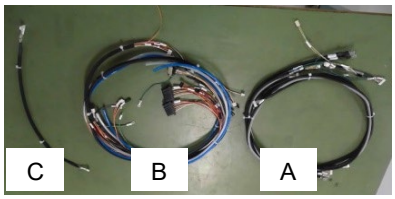
NOTE The fixing plate comes off. Be careful not to lose it.

(47) Remove the cables.

Installation: Cable Unit

Installation

(1) Check if you have the cable units A, B, and C shown in the photo.



NOTE Be careful of the following:
When the wire ties are accidently cut off or moved, the cable units cannot be installed properly.

- Do not cut off the wire ties binding the cables.
- Do not move the wire ties on the cables.

(2) Apply the grease.

Grease
Krytox: 4 g in total (approximate)

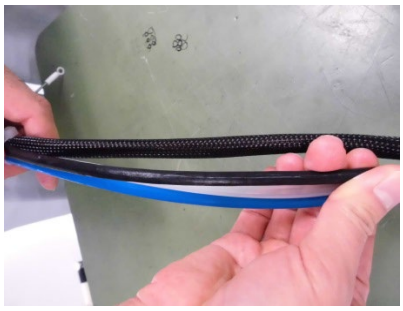
NOTE Excessive grease increases the possibility of grease leakage from the Manipulator.

Grease amount and application point
Cable unit A: 1.5 g
Between the first and second wire ties from the base.

Cable unit A

Cable unit B: 1.5 g
Between the first and second wire ties from the base.

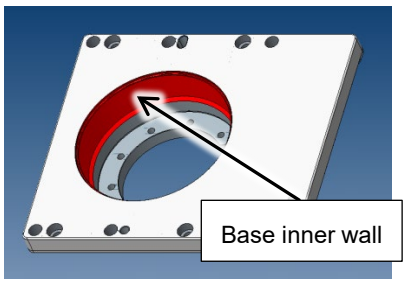
Apply half of the grease to the inner and outer sides of the braided tube for each.

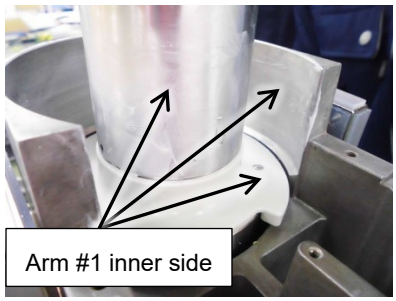


Cable unit B

NOTE Apply the grease to each cable evenly.

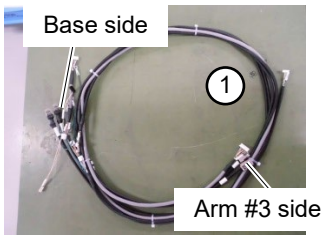
Base plate (inner wall of the base): 0.5 g
Joint #1 of Arm #1 (inner side): 0.5 g
If you wiped off the grease applied before replacing the cables, apply new grease only to the part where the cables touch.



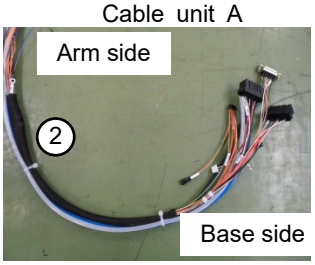


(3) Fix the cable units A and B to the cable fixing plate.

Wire tie (AB200): 6 ties
Tightening strength: 85 ± 5 N



Cable unit A



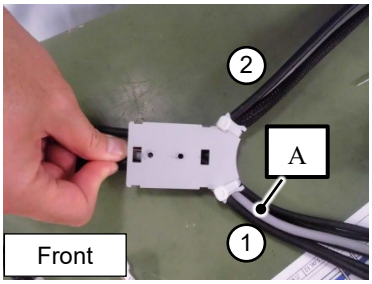
Cable unit B

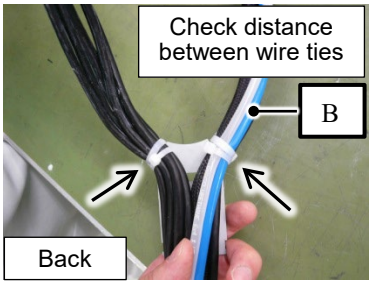
Be careful of installation positions of the cable units A and B.
Details are given below.

First, fix the cable unit while aligning to the fixing plate. (2 places)

Wire tie (AB200): 2 ties

- Align positions of the second wire ties from the base (1, 2) on the cable units A and B.
- Face the cable units to the following directions:
  Gray colored cable of the cable unit A
  : Face to the fixing plate
  Air tubes of the cable unit B
  : Face to the opposite side of fixing plate



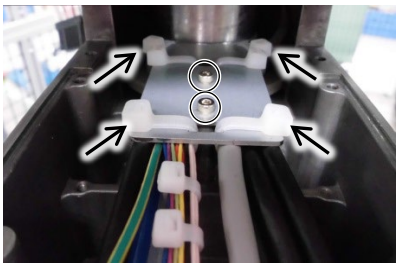


NOTE ☞ Be careful of fixing positions of the wire ties (indicated with arrows).

NOTE ☞ The wire ties fixing the cable units to the plate (1, 2) should be as close to the ones binding the cables as possible.
The life of the cables may be shorter when the wire ties are separated.

(4) Install the cable fixing plate to the Arm #1.

Hexagon socket head cap bolt: 2-M3×6
Tightening torque: 2.4 ± 0.1 N·m



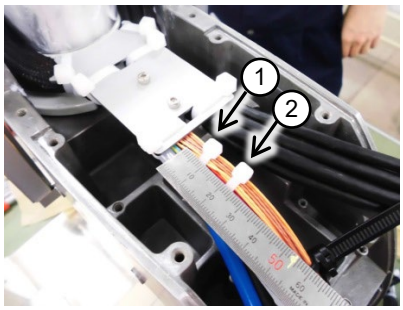
NOTE ☞ Be careful not to tighten the screws with the cables get caught in the plate.

Then, fix the cable units to the fixing plate.

Wire tie (AB200): 4 ties
Tightening strength: 85 ± 5 N

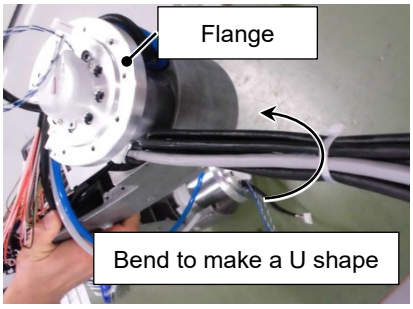
NOTE ☞ Be careful of positions of the wire ties (indicated with arrows).

(5) Bind the discrete cables of the cable unit B.
Wire tie (AB150) : 2 ties
Tightening strength: 85 ± 5 N



Wire tie 1:
10 mm from the cable fixing plate.
Wire tie 2:
Leave 10 mm from the wire tie 1.

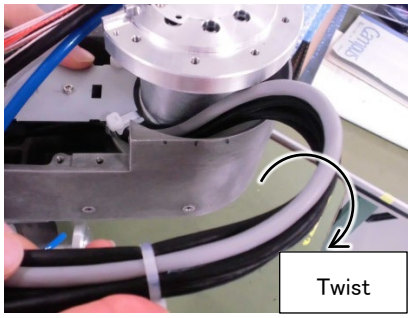
(6) Pass the cable unit A through the Joint #1 and fix it to the flange with the wire tie.
Wire tie (AB200): 1 tie
Tightening strength: 85 ± 5 N



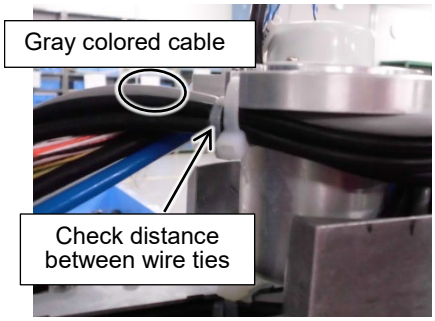
First, insert the cable unit A to the inside of the Manipulator while bending it to make a U shape.

Then, twist the cable unit A 180 degrees to the direction of the arrow.

Twist can be checked by the position of the gray colored cable of the cable unit.

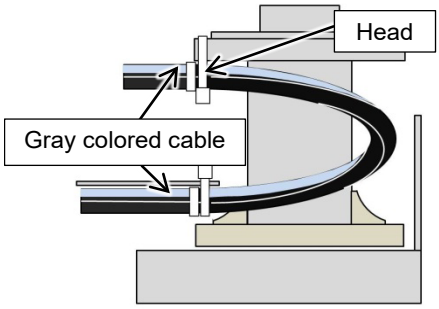


Fix the cable unit A with the wire tie (AB200) so that the gray colored cable faces the flange. At this point, tighten the wire tie to be adjacent to the one fixing the cable unit A.
(See the photo on the right)

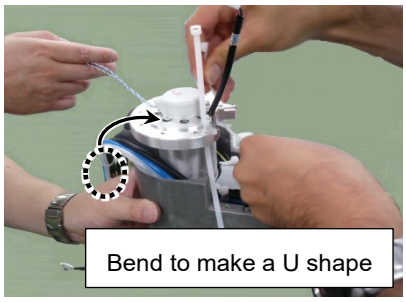


NOTE
The wire ties fixing the cable units to the flange should be as close to the ones binding the cables as possible.
The life of the cables may be shorter when the wire ties are separated.

Refer to the figure for positions of the wire tie heads.



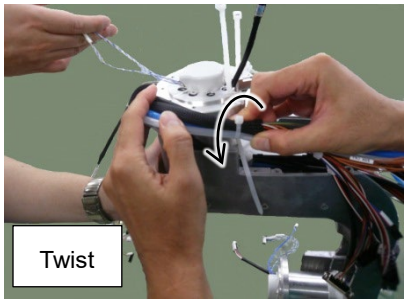
(7) Pass the cable unit B through the Joint #1 and fix it to the flange with the wire tie.
Wire tie (AB200) : 1 tie
Tightening strength: 85 ± 5 N



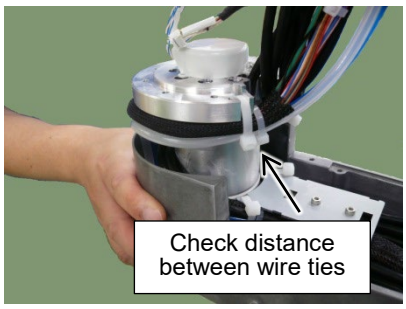
Insert the cable unit B to the inside of the Manipulator while bending it to make a U shape in the same manner as the cable unit A.

Twist the cable unit B 180 degrees to the direction of the arrow.

At this point, two air tubes of the cable unit B are at the opposite side of the flange.

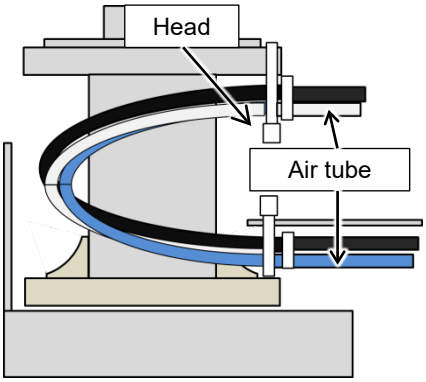


Fix the cable unit B with the wire tie (AB200) so that the air tubes are at the opposite side of the flange.
At this point, tighten the wire tie to be adjacent to the one fixing the cable unit.
(See the figure)



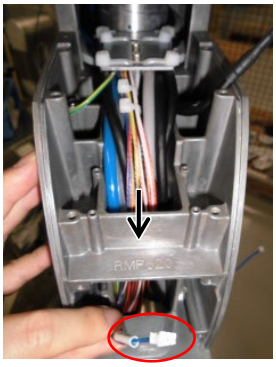
NOTE
The wire ties fixing the cable units to the flange should be as close to the ones binding them as possible.
The life of the cables may be shorter when the wire ties are separated.

Refer to the figure for positions of the wire tie heads.



(8) Pass the cable unit through the Arm #1.

NOTE
Inserting the cable unit forcibly while the connectors get caught may result in breakage of the cables and connectors. Be careful when inserting the unit.



Do not pass the following connector through the hole.

Connector: GS01

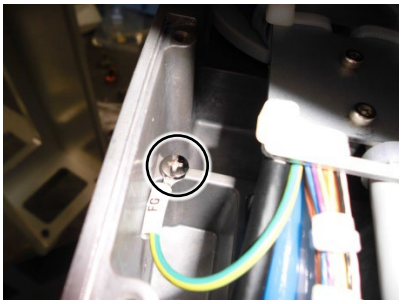
Disconnect the following connector from hole.

Connector: LED (red circle on the right photo)

(9) Connect the ground wire.

Cross recessed screw: M4×6

Tightening torque: 0.6 ± 0.05 N·m

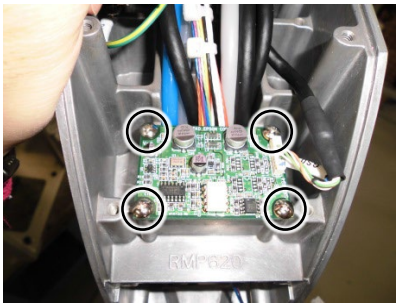


(10) Install the control board 1 and connect the connector.

Connector: GS01

Cross recessed screw: 4-M3×6

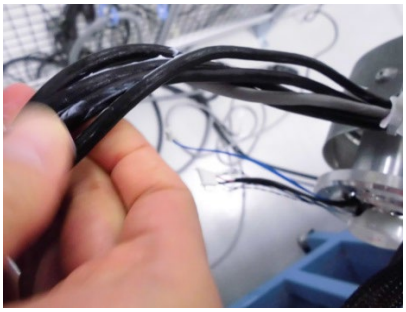
Tightening torque: 0.45 ± 0.05 N·m



(11) Apply the grease.

Grease

Krytox: 4 g in total (approximate)



NOTE Excessive grease increases the possibility of grease leakage from the Manipulator.

Grease amount and application point

Cable unit A: 1.5 g

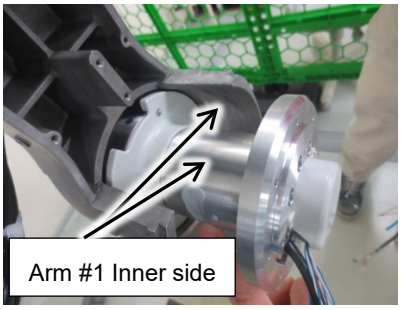
Between the third and fourth wire ties from the base.

Cable unit B: 1.5 g

Between the third and fourth wire ties from the base.

Apply half of the grease to the inner and outer sides of the braided tube for each.

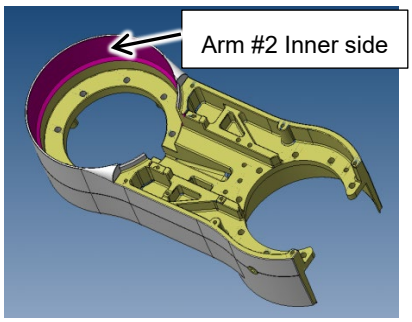
Apply the grease to each cable evenly.



Arm #1 Joint #2 (Arm #1 inner side): 0.5 g

Arm #2 Joint #2 (Arm #2 inner side): 0.5 g

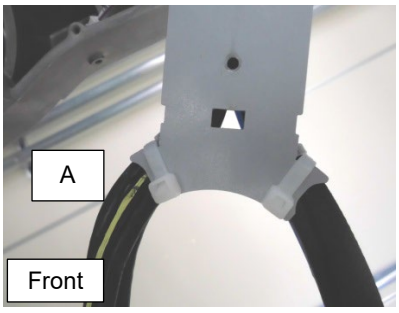
If you wiped off the grease applied before replacing the cables, apply new grease only to the part where the cables touch.

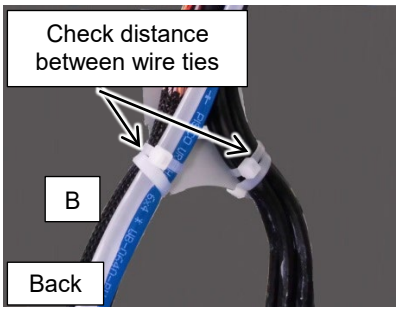


(12) Fix the cable units A and B to the cable fixing plate.

Wire tie (AB200): 2 ties
Tightening strength: 85 ± 5N

- Face the cable units to the following directions:
  Gray colored cable of the cable unit A
  : Face to the fixing plate
  Air tubes of the cable unit B
  : Face to the opposite side of fixing plate
- Fix the cable units at as close to the wire ties binding the cables as possible.





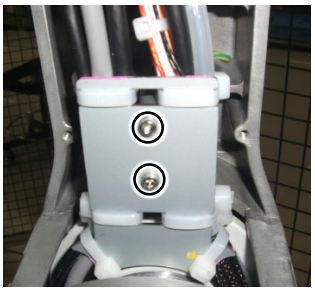
NOTE ☞ The wire ties fixing the cable units to the plate should be as close to the ones binding the cables as possible.
The life of the cables may be shorter when the wire ties are separated.

Refer to the figure for positions of the wire tie heads.

(13) Install the cable fixing plate to the Arm #1.

Hexagon socket head cap bolt: 2-M3×6

Tightening torque: 2.4 ± 0.1 N·m



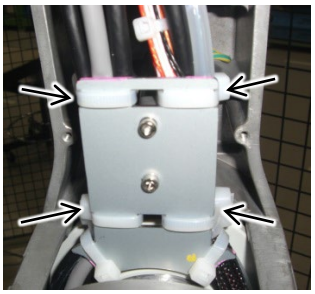
NOTE ☞ Be careful not to tighten the screws with the cables get caught in the plate.

(14) Fix the cable units A and B to the cable fixing plate.

Wire tie (AB200) :4 ties
Tightening strength: 85 ± 5N

Use four wire ties (AB200) to fix the cable units and the plate.

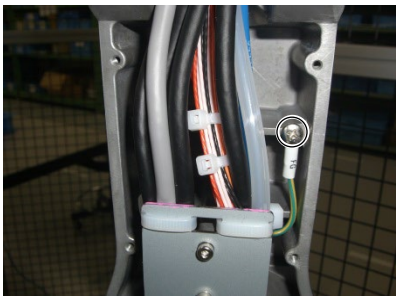
Refer to the figure for positions of the wire tie heads.



(15) Install the ground wire.

Cross recessed head screw: M4×6

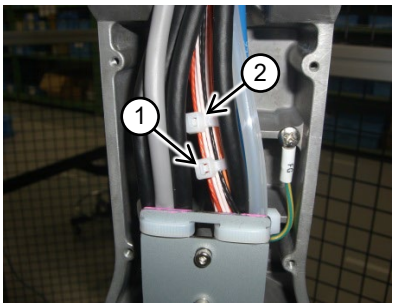
Tightening torque: 0.6 ± 0.05 N·m



(16) Bind the discrete wires of the cable unit B.

Wire tie (AB150): 2 ties

Tightening strength: 85 ± 5 N



Wire tie 1:

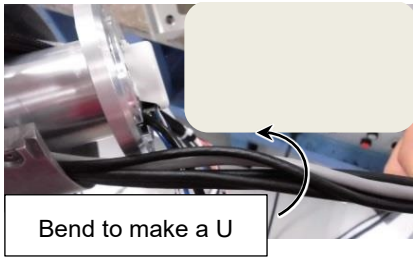
10 mm from the cable fixing plate.

Wire tie 2:

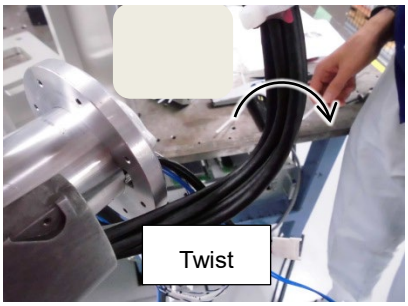
Leave 10 mm from the wire tie 1.

(17) Pass the cable unit A through the Joint #2.

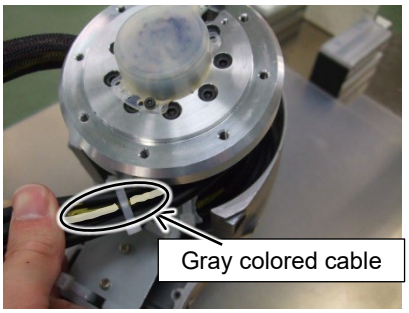
Insert the cable unit A to the inside of the Manipulator while bending it to make a U shape.



Twist the cable unit A 180 degrees to the direction of the arrow.



Check that the gray colored cable of the cable unit is at the flange side.

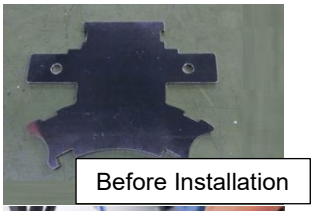


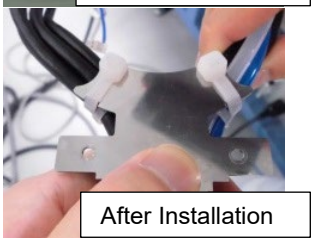
(18) Fix the cable unit A to the cable fixing plate with the wire ties.

Wire tie (AB200): 1 tie

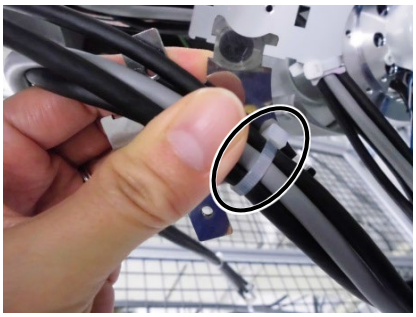
Tightening strength: 85 ± 5N

Use the plate shown in the photo.





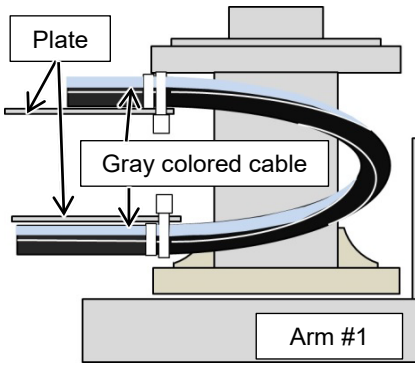
Fix the cable unit A with the wire tie so that the gray colored cable on the unit is at the opposite side of the plate.
In addition, tighten the wire tie to be adjacent to the one fixing the cable unit A.
(See the figure on the right)



NOTE

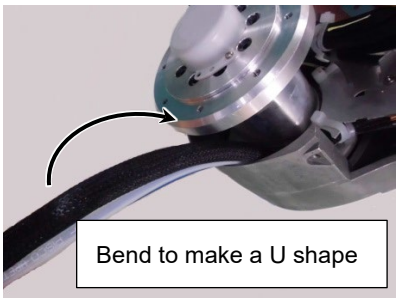
The wire ties fixing the cable unit to the plate should be as close to the ones binding the cables as possible.
The life of the cables may be shorter when the wire ties are separated.

Be careful of positions of the wire tie heads.



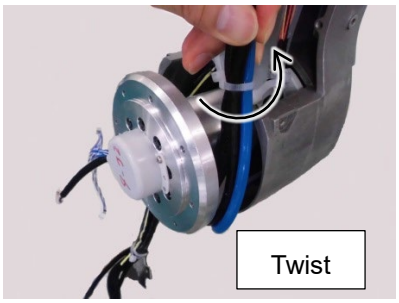
(19) Pass the cable unit B to the Joint #2.

Insert the cable unit B to the inside of the Manipulator while bending it to make a U shape in the same manner as the cable unit A.



Twist the cable unit B 180 degrees to the direction of the arrow.

At this point, two air tubes of the cable unit B are at the opposite side of the flange.

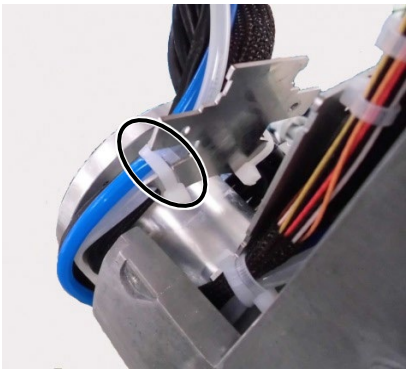


(20) Fix the cable unit B to the cable fixing plate with the wire ties.

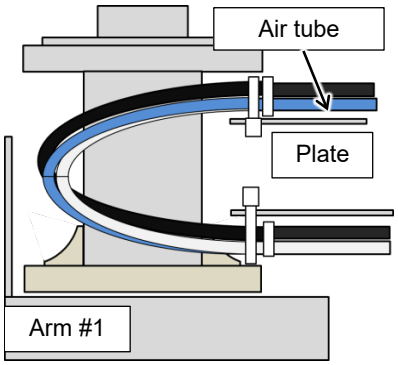
Wire tie (AB200): 1 tie

Tightening strength: 85 ± 5N

Fix the cable unit B with the wire tie (AB200) so that the air tubes of the unit are at the side of the plate.



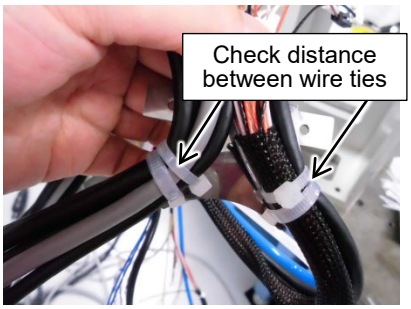
In addition, tighten the wire tie to be adjacent to the one fixing the cable unit B.
(See the figure on the right)



NOTE

The wire ties fixing the cable unit to the plate should be as close to the ones binding the cables as possible.
The life of the cables may be shorter when the wire ties are separated.

Be careful of positions of the wire tie heads.

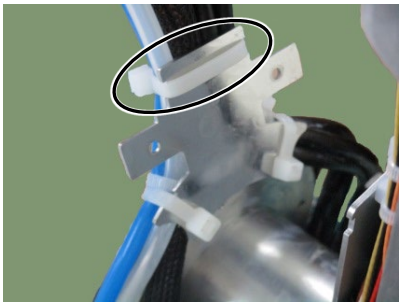


(21) Fix the cable units A and B to the cable fixing plate with the wire tie.

Wire tie (AB200) :1 tie

Tightening strength: 85 ± 5N

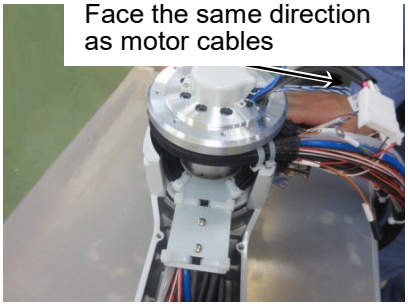
Be careful of position of the wire tie head.



(22) Fix the Arm #2 to the Joint #2 while aligning the cable unit to the direction of the cables coming from the Joint #2.

Hexagon socket head cap bolt: 8-M4×20

Tightening torque: 5.5 ± 0.25 N·m



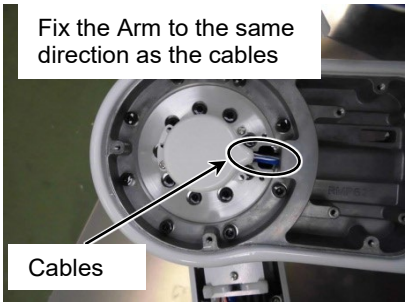
NOTE

Be careful of the direction of the Arm #2.

The photos on the right are examples for the cable unit removal step (3). If you removed the Arm #2 with a different arm orientation, the direction of the motor cables is different.

Be careful not to get the cables coming from the Joint #2 caught.

Have at least two people to perform this step.

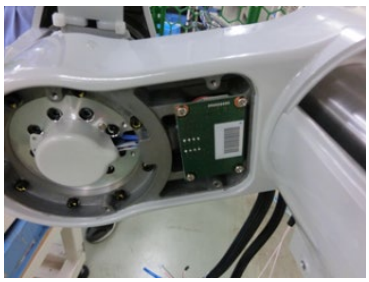


(23) Pass the connector GS02 to the hole as shown in the photo.

(24) Connect the connector GS02 to the control board 2, and then install the control board 2 to the Arm #2.

Cross recessed head screw: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m



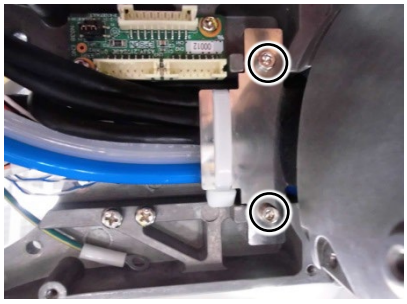
NOTE

Be careful not to get the cables caught.
It may result in cable breakage.

(25) Install the cable fixing plate.

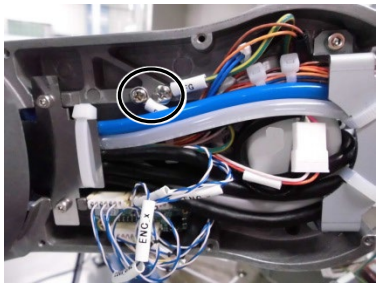
Hexagon socket head cap bolt: 2-M3×6

Tightening torque: 2.0± 0.1 N·m



(26) Connect the following connectors.

Connector:
PW2, PW3, BR2, BR3, EB02_CN1,
EB0x_CN3 (comes from the Joint #2 side)



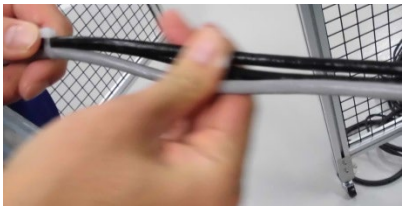
NOTE Be careful that the jumper pins on the board do not come off.

(27) Fix the ground wire.

Cross recessed head screw: 2-M4×6

Tightening torque: 0.6 ± 0.05 N·m

(28) Apply the grease.



Grease
Krytox: 4 g in total (approximate)

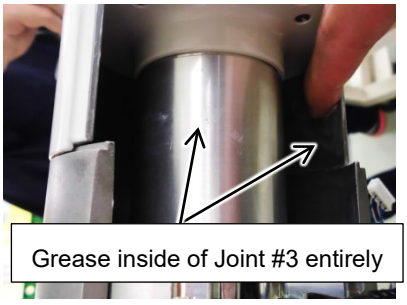
NOTE Excessive grease increases the possibility of grease leakage from the Manipulator.

Grease amount and application point

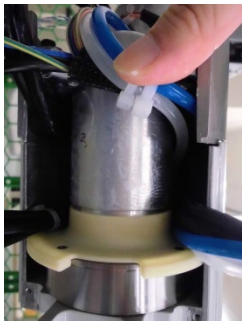
Cable unit A: 1.5 g
Between the fifth and sixth wire ties from the base.

Cable unit B: 1.5 g
Between the fifth and sixth wire ties from the base.
Apply the grease to each cable evenly.

Joint #3 of Arm #2 and #3: 0.5 g
If you wiped off the grease applied before replacing the cables, apply new grease only to the part where the cables touch.



(29) Pass the cable unit through the Joint #3.

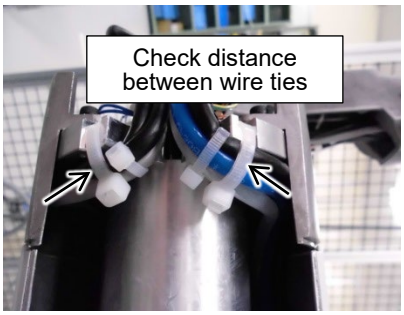


Be careful of the following:

- The cable unit should be passed though the Joint #3 in U-shape like Joint #1 and #2.
- Ensure that the gray colored cable on the cable units can be seen.

(30) Fix the cable units A and B to the cable fixing plate.

Wire tie (AB200): 2 ties
Tightening strength: 85 ± 5 N

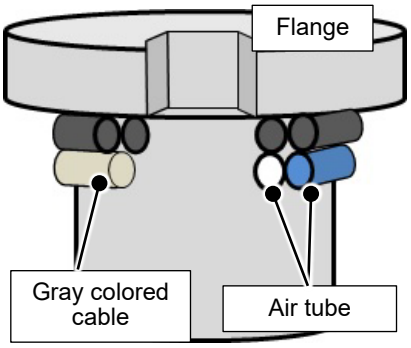


Cable unit A:

Fix the cable unit with the wire tie (AB200) so that the gray colored cable on the cable faces the opposite side of the flange.

Cable unit B:

Fix the cable unit with the wire tie (AB200) so that the air tubes are at the opposite side of the flange.

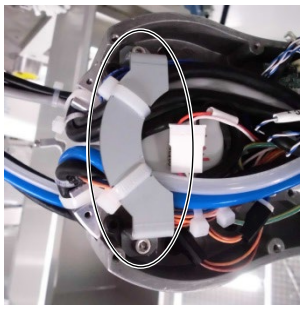


Fix the cable units so that the wire ties are adjacent to the ones binding the cable units A and B.

NOTE ☞ The wire ties fixing the cable units to the flange should be as close to the ones binding the cables as possible.
The life of the cables may be shorter when the wire ties are separated.

Be careful of positions of the wire tie heads.

(31) Install the cable fixing plate to the Arm #2.

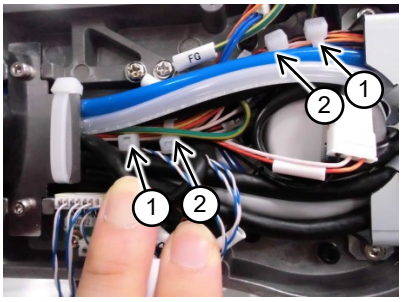


Fix the cable unit to the cable fixing plate with the wire ties.

Hexagon socket head cap bolt: 2-M4×6
Tightening torque: 2.0 ± 0.1 N·m

Wire tie (AB200): 2 ties
Tightening strength: 85 ± 5N

(32) Bind the discrete cables of the cable unit B.
Wire tie (AB150) : 4 wires
Tightening strength : 85 ± 5 N



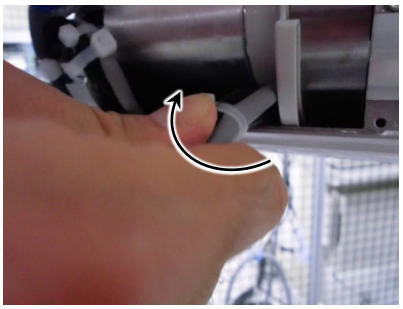
Wire tie 1:
10 mm from the cable fixing plate.
Wire tie 2:
Leave 10 mm from the wire tie 1.

(33) Fix the cable units A and B to the cable fixing plate.

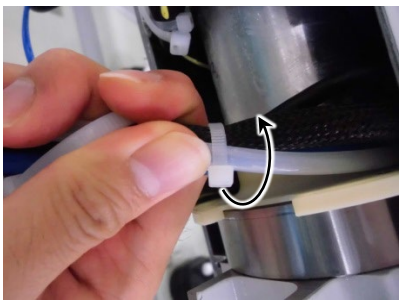
Wire tie (AB200): 3 ties
Tightening strength: 85 ± 5N

Use the plate shown in the photo.

Twist the cable unit A 180 degrees in the direction indicated with the arrow so that the gray colored cable faces the Arm #3. (See the photo)



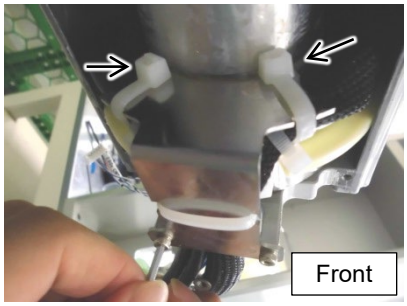
Twist the cable unit B 180 degrees in the direction of the arrow so that the two air tubes face the Arm #3. (See the photo)

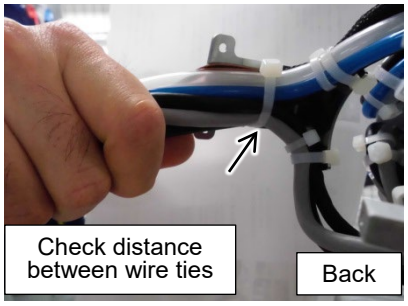


Fix the cable unit A and B to the plate with the wire tie (AB200).
At this point, fix the cable units so that the wire ties are adjacent to the ones binding the cable units A and B. (See the photo)

The wire ties fixing the cable units to the plate should be as close to the ones binding the cables as possible.
The life of the cables may be shorter when the wire ties are separated.

Be careful of positions (indicated with the arrow) of the wire tie heads.

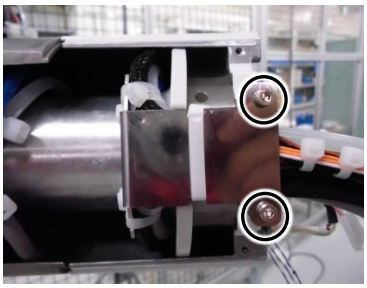




(34) Install the cable fixing plate.

Hexagon socket head cap bolt: 2-M3×6

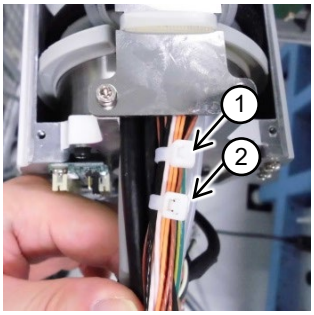
Tightening torque: 2.0 ± 0.1 N·m



(35) Bind the discrete cables of the cable unit B.

Wire tie (AB150): 2 ties
Tightening strength: 85 ± 5 N

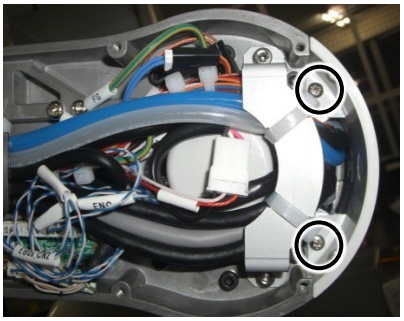
Wire tie 1:
10 mm from the cable fixing plate.
Wire tie 2:
Leave 10 mm from the wire tie 1.



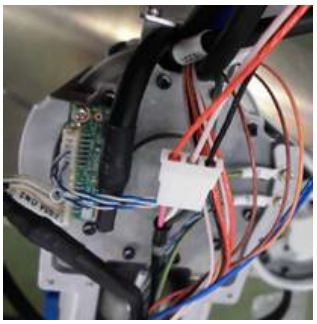
(36) Install the Joint #3 cover.

Cross recessed head screw: 2-M3×12

Tightening torque: 0.45 ± 0.05 N·m



(37) Connect the connectors.



Connector:
PW4, BR4, EB04_CN3, EB04_CN1

EB04_CN3 is the connector for the cable unit “C” in the step (1).

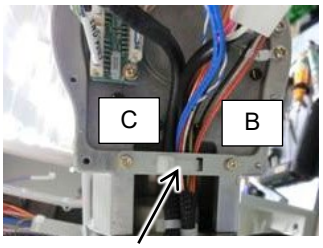
NOTE ☞ Be careful that the jumper pins on the board do not come off.

(38) Fix the ground wire. (2 wires)

Cross recessed head screw: 2-M4×6

Tightening torque: 0.6 ± 0.05 N·m

(39) Fix the cable unit B and C to cable fixing plate with the wire tie.



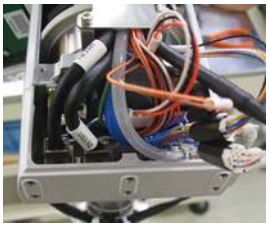
Wire Tie

Wire tie (AB150) : 1 tie
Tightening strength: 85 ± 5 N

Then, fix the plate using screws.

Hexagon socket head cap bolt: 2-M3×6
Tightening torque: 2.0±0.1 N·m

(40) Install the following connectors and the two air tubes.



Connector: USER1, USER2, X71, X72

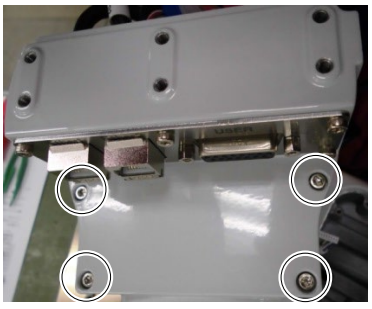
Connection point
USER1→ Ether1

USER2 →Ether2

Air tube (white) → Valve 1

Air tube (blue) → Valve 2

(41) Install the Arm #3 outside cover.



Be careful not to get the cables caught in the cover.

(42) Fix the cable units with the wire ties (4 ties).

Wire tie (AB200) : 2 ties (Arm #3 side)
Wire tie (AB150) : 2 ties (Arm #4 side)

Wire tie fixing strength: 85 ± 5N

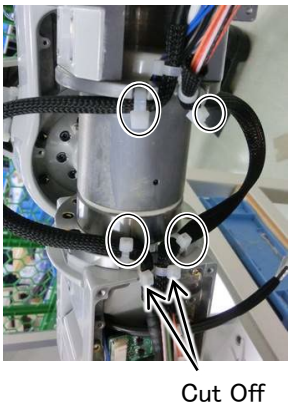
Use wire tie binding the cable unit B and C as a mark for fix position.

Wire tie using as a mark and wire tie fixing on the flange should be as close as possible.

The life of the cables may be shorter when the wire ties are separated.

Be careful of positions of the wire tie heads.

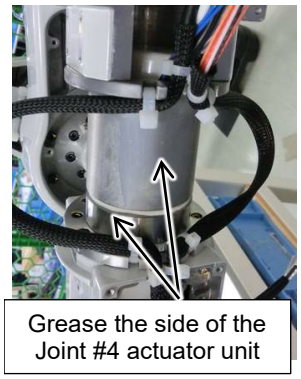
Cut off the wire ties using as a mark after fixing cables on the flange.



(43) Wipe off the grease which was applied before replacing the cables from the Joint #4 actuator unit.
Apply new grease.

Grease
Krytox : 1 g in total (approximate)

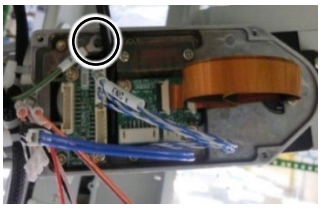
NOTE Excessive grease increases the possibility of grease leakage from the Manipulator.



(44) Fix the ground wire.

Cross recessed head screw: M4×6

Tightening torque: 0.6 ± 0.05 N·m



(45) Connect the connectors.

Connector:
PW5, J6P-01, BR5, FL_CN2, EB05_CN1

NOTE Be careful that the jumper pins on the board do not come off.

(46) Install the following covers.

Arm #1 outside cover

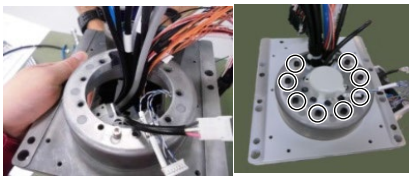
Joint #1 cover

For details, refer to *4.4 Replacing the M/C Cable*.

(47) Pass the cable to the base plate hole and install the base plate.

Hexagon socket head cap bolt: 8-M4×20

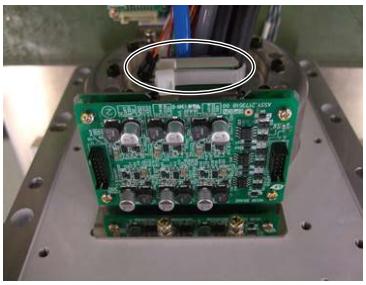
Tightening torque: 5.5 ± 0.25 N·m



(48) Fix the cables coming from the Arm #1 to the fixing plate.

Wire tie (AB200): 1 tie

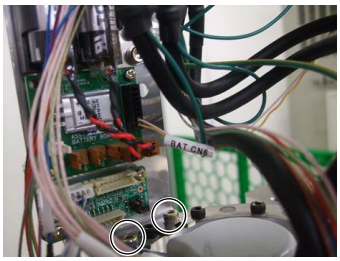
Tightening strength: 85 N ± 5N



(49) Fix the user wire plate.

Hexagon socket head cap bolt: 2-M4×8

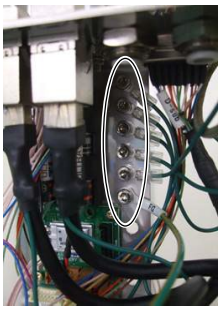
Tightening torque: 4.0 ± 0.2 N·m



(50) Install the ground wire terminals.

Hexagon socket head cap bolt: 6-M4×5

Tightening torque: 4.0 ± 0.2 N·m

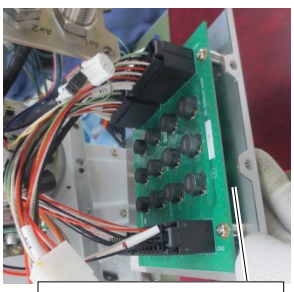


(51) Install the D-sub connector to the connector indicated as “USER”.

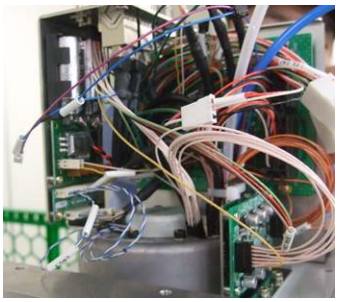
(52) Install the filter board unit.

Hexagon socket head cap bolt: 2-M4×8

Tightening torque: 4.0 ± 0.2 N·m



(53) Install the following connectors and two air tubes.



Connector:

USER1-B, USER2-B, BAT_CN3, BAT_CN6, EB01_CN1, EB0x_CN2, EB01_CN3, FIL_CN3, FIL_CN4, PW1, BRK_CN1, BRK_CN2, BR_CN3

Connection point

USER1-B→ Ether1

USER2 -B→Ether2

Air tube (white) → Valve 1

Air tube (blue) → Valve 2

NOTE Be careful that the jumper pins on the board do not come off.

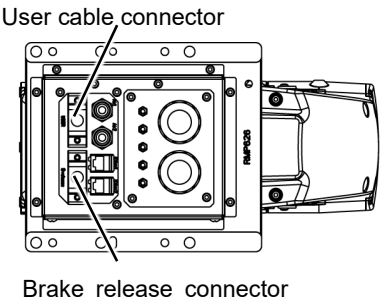
(54) Install the base.

Hexagon socket head cap bolt: 9-M4×8

Tightening torque: 4.0 ± 0.2 N·m

(55) Connect the brake release connector.

NOTE The connector of the connection cable and the adjacent user cable connector have the same shape. Be careful not to connect the wrong connector.



(56) Install the M/C cable.

For details refer to *4.4 Replacing the M/C Cable*.

(57) Install the base cover.

Cross recessed truss screw: 4-M4×5

Tightening torque: 0.9 ± 0.1 N·m

(58) Install the following covers.

Arm #4 left side cover	
Arm #3 side cover	Arm #3 upper side cover
Arm #3 upper cover	
Arm #2 inside cover	Arm #2 outside cover
Joint #2 cover	Joint #2 outside cover
Arm #1 inside cover	

For details, refer to *3. Covers*.

(59) Preform the calibration.

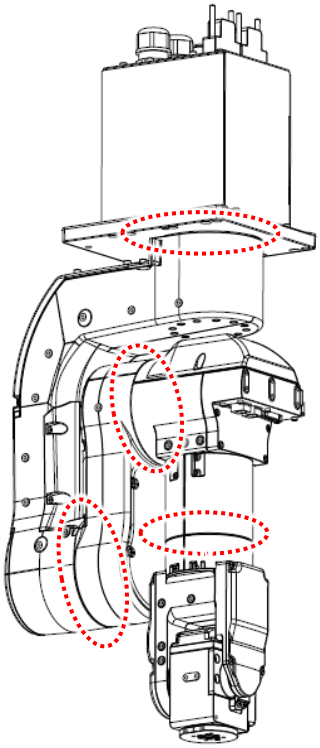
For details, refer to *8. Calibration*.

(60) During initial operation, excess grease for cables may leak from the space between the Joint #1, #2, #3, and #4 (see the figure below).
In that situation, please wipe off the leaked grease.

It is not necessary to apply the additional grease.

NOTE

When wiping off the grease, turn OFF the Controller.



4.2 Replacing the Relay Cables

WARNING

- Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.
- Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
- When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
  When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

CAUTION

- When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions.
  Improper connection of the connectors may result in improper function of the robot system.
  For details on the connections, refer to the *4.5 Connector Pin Assignment.*

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

The relay cables (HP_Harness_A_01 to 07) are reusable.

Replace them when the cables or the connector latches are damaged during replacement of the cable unit.

	Name		Quantity	Note
Maintenance Parts	Relay cable	HP_Harness_A_01	1	2176213
		HP_Harness_A_02	1	2176214
		HP_Harness_A_03	1	2176215
		HP_Harness_A_04	1	2176216
		HP_Harness_A_05	1	2176217
		HP_Harness_A_06	1	2176218
		HP_Harness_A_07	1	2176220
	Wire tie	AB150	-	1675754 1 bag (100 ties: white)
		AB200	-	1684328 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts, short head
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a wire tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

4.2.1 HP_Harness_A_01

HP_Harness_A_01

Removal

(1) Remove the Arm #4 left side cover.

For details, refer to *3. Covers*.

(2) Remove the following connectors.

Connector: EB05_CN3, FL01_CN1

Installation

(1) Check if you have HP_Harness_A_01.

(2) Install the following connectors.

Connector: EB05_CN3, FL01_CN1

(3) Install the following connectors.

For details, refer to *3. Covers*.

(4) Calibrate the Joint #6.

For details, refer to *8. Calibration*.

4.2.2 HP_Harness_A_02

HP_Harness_A_02

Removal

(1) HP_Harness_A_02 is connected to the actuator unit of each axis.
Follow the steps according to the unit you are going to replace.

When replacing the Joint #1 actuator unit:
Remove the parts by following the instructions below so that the encoder cover of the Joint #1 actuator unit can be seen.
Reference: *5.1 Replacing the Joint #1 Actuator Unit*

When replacing the Joint #2 actuator unit:
Remove the Joint #2 actuator unit.
Reference: *5.2 Replacing the Joint #2 Actuator Unit*

When replacing the Joint #3 actuator unit:
Remove the Arm #2 outside cover.
Reference: *3. Covers*.
Remove the parts so that the encoder cover of the Joint #3 actuator unit can be seen.
Remove the connector ENCB0x_CN2 which comes from the Joint #3 actuator unit side.

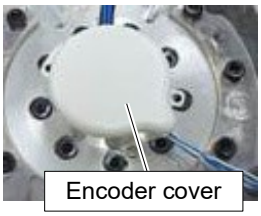
When replacing the Joint #4 actuator unit:
Remove the Joint #4 actuator unit.
Reference: *5.4 Replacing the Joint #4 Actuator Unit*

When replacing the Joint #5, #6 actuator unit:
Remove the Arm #4 side arm.
Reference: *4.3. Replacing the FPC Unit*

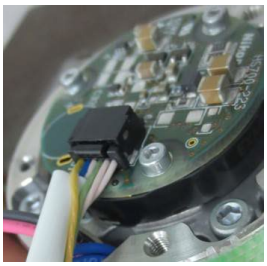
When replacing the Joint #6 actuator unit:
Remove the Arm #5 upper cover and the Arm #5 side cover.
Reference: *3. Covers*.
Remove the connector (ENCB0x_CN2).

(2) Remove the encoder cover. (common to all joints)

Cross recessed head screw: 2-M2.5×6



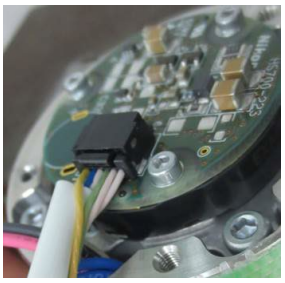
(3) Remove the connector ENC_x. (common to all joints)



Installation

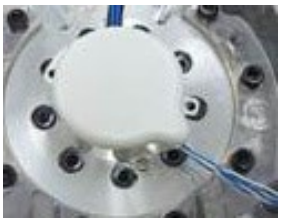
(1) Check if you have HP_Harness_A_02.

(2) Connect the connector ENC_x to the encoder.
(common to all joints)



(3) Install the encoder cover (common to all joints)

Cross recessed head screw: 2-M2.5×6



(4) HP_Harness_A_02 is connected to the actuator unit of each axis.
Follow the steps according to the unit you are going to replace.

When replacing the Joint #1 actuator unit:
Install the base cover.
Reference: *5.1 Replacing the Joint #1 Actuator Unit*

When replacing the Joint #2 actuator unit:
Install he Joint #2 actuator unit.
Reference: *5.2 Replacing the Joint #2 Actuator Unit*

When replacing the Joint #3 actuator unit:
Connect the connector coming from the Joint #3 actuator unit (ENCB0x_CN2) to the encoder board 2.
Install the Arm #2 outside cover.
Reference: *3. Covers*

When replacing the Joint #4 actuator unit:
Install the Joint #4 actuator unit.
Reference: *5.4 Replacing the Joint #4 Actuator Unit*

When replacing the Joint #5, #6 actuator unit:
Install the Arm #4 side arm.
Reference: *4.3 Replacing the FPC Unit*

When replacing the Joint #5, #6 actuator unit:
Install the Arm #4 side arm.
Reference: *4.3 Replacing the FPC Unit*

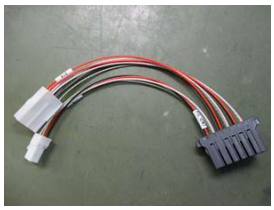
When replacing the Joint #6 actuator unit:
Connect the connector (ENCB0x_CN2) to the FPC board 2.
Install the Arm #5 upper cover and the Arm #5 side cover.
Reference: *3. Covers*.

(5) Calibrate the joints whose cables were replaced.

For details, refer to *8. Calibration*.

4.2.3 HP_Harness_A_03

HP_Harness_A_03



Removal

(1) Remove the filter board unit.

Hexagon socket head cap bolt: 4-M4×8

NOTE ☞ The cable is connected to the filter board unit. When removing the cover, be careful not to pull the cable forcibly.

(2) Remove the following connectors.

Connector: X11, X12, FIL_CN1

Installation

(1) Check if you have HP_Harness_A_03.

(2) Connect the following connectors.

Conenctor: X11, X12, FIL_CN1

(3) Install the filter board unit.

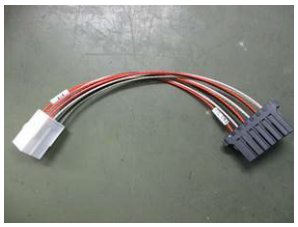
Hexagon socket head cap bolt: 4-M4×8

Tightening torque: 4.0± 0.2 N·m

NOTE ☞ Be careful not to get the cables caught in the cover.

4.2.4 HP_Harness_A_04

HP_Harness_A_04



Removal

(1) Remove the filter board unit.

Hexagon socket head cap bolt: 4-M4×8

NOTE ☞ The cable is connected to the filter board unit. When removing the cover, be careful not to pull the cable forcibly.

(2) Remove the following connectors.

Connector: X14, FIL_CN2

Installation

(1) Check if you have HP_Harness_A_04.

(2) Connect the following connectors.

Connector: X14, FIL_CN2

(3) Install the filter board unit.

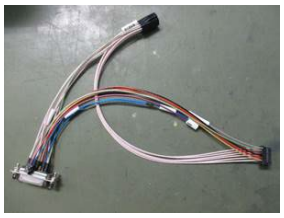
Hexagon socket head cap bolt: 4-M4×8

Tightening torque: 4.0± 0.2 N·m

NOTE ☞ Be careful not to get the cables caught in the cover.

4.2.5 HP_Harness_A_05

HP_Harness_A_05



Removal

(1) Remove the base cover.

For details, refer to *3. Covers*.

(2) Remove the D-sub connector on the B-release side.

(3) Remove the following connectors.

Connector: LED, BR010, BR_CN3, BRK_CN1

Installation

(1) Check if you have HP_Harness_A_05.

(2) Install the D-sub connector to the B-release side.

(3) Install the following connectors.

Connector: LED, BR010, BR_CN3, BRK_CN1

(4) Install the base cover.

For details, refer to *3. Covers*.

4.2.6 HP_Harness_A_06

HP_Harness_A_05

Removal

(1) Remove the Arm #5 side cover.

For details, refer to *3. Covers*.

(2) Remove the following connectors.

Connector: BR6, FL_CN2

Installation

(1) Check if you have HP_Harness_A_06.

(2) Install the following connectors.

Connector: BR6, FL_CN2

(3) Install the Arm #5 side cover.

For details, refer to *3. Covers*.

4.2.7 HP_Harness_A_07

HP_Harness_A_05

Removal

(1) Remove the Arm #3 outside cover.

For details, refer to *3. Covers*.

(2) Remove the following connectors.

Connector: X71, X72

(3) Remove the D-sub connector.

NOTE After removing the D-sub connector, keep the D-sub fixing plate not to lose it.

Installation

(1) Check if you have HP_Harness_A_07.

(2) Install the D-sub connector.

NOTE The attached nut and washer are not used. Please dispose of them.
Use the D-sub fixing plate.

(3) Connect the following connectors.

Connector: X71, X72

(4) Install the Arm #3 outside cover.

For details, refer to *3. Covers*.

4.3 Replacing the FPC Unit

 WARNING	■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

 CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to the *4.5 Connector Pin Assignment.*

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

	Name	Quantity	Note
Maintenance Parts	FPC unit	1	1696704
Tools	Hexagonal wrench (width across flats: 2.5 mm)	1	For M3 hexagon socket head cap bolts
	Long nose pliers	1	For removing air tubes
	Cross-point screwdriver (#2)	1	For cross recessed head screws
	Torque wrench	1	For tightening torque control

Removal

(1) Turn OFF the Controller.

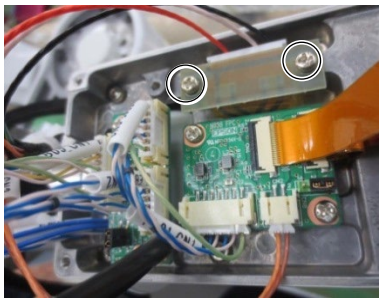
(2) Remove the following covers.

Arm #5 side cover
Arm #4 left side cover
Arm #3 side cover

For details, refer to *3. Covers*.

(3) Remove the following connectors.

Connector:
PW5 (Joint #5 power cable)
J6P_01 (FPC power connector)
BR5 (Joint #5 brake)
EB05_CN1 (encoder board)
FL_CN2 (FPC board)
FL01_CN1 (FPC board)
EB05_CN3 (encoder board)
EB0x_CN2 (Joint #5 encoder)



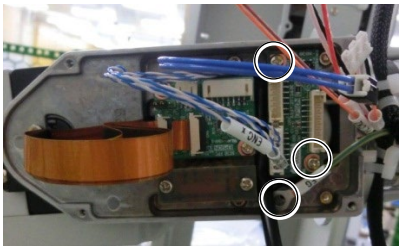
Loosen the screws.
Cross recessed screw: 2-M3×6

NOTE

Be careful that the jumper pins on the board do not come off.

(4) Remove the encoder board.

Cross recessed screw: 2-M3×6

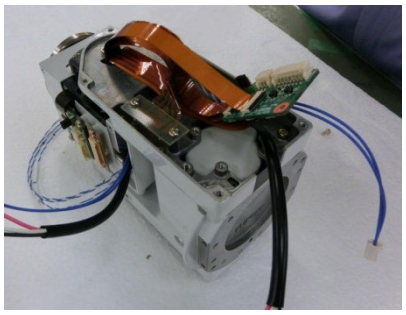


(5) Remove the ground wire.

Cross recessed screw: M4×6

(6) Remove the FPC board.

Cross recessed screw: 2-M3×6

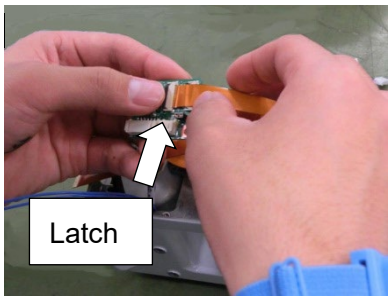


(7) Remove the FPC power connector.

Cross recessed screw: 2-M3×6

(8) Remove all FPC connecters to the FPC board.

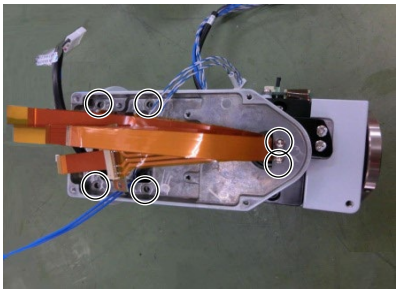
Lift up the black latch to remove the connector easily.



NOTE Do not pull the FPC forcibly.
It may cause damage on the FPC and the board, and may result in electric shock and/or malfunction of the robot system.

(9) Remove the bolts fixing the Arm #4 side arm.

Hexagon socket head cap bolt: 4-M3×8

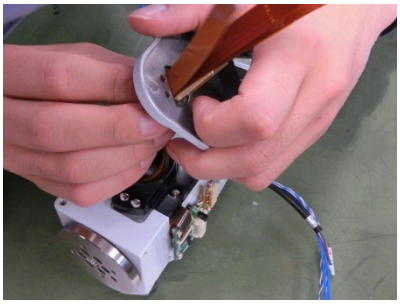


(10) Remove the bolts fixing the support for FPC.

Hexagon socket head cap bolt: 2-M3×6

(11) Remove the FPC from the Arm #4 side arm.

Fold the FPC power connector in order to pass through the hole.

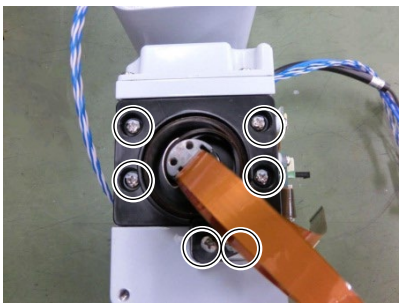


(12) Remove the FPC guide.

Cross recessed screw: 2-M3×12

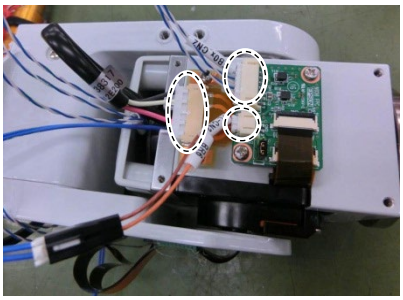
(13) Remove the FPC case.

Cross recessed screw: 4-M3×6



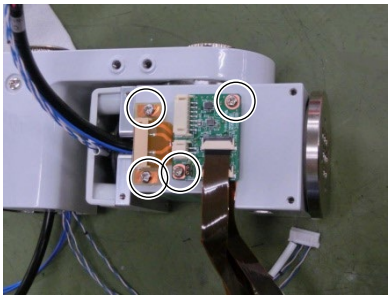
(14) Remove the connectors connected to the FPC board and the FPC power connector of the Arm #5.

FPC power connector
EB0x_CN2 (Joint #6 encoder)
FL_CN2 (Joint #6 brake)



(15) Remove the FPC board from the Arm #5.

Cross recessed screw: 2-M3×6

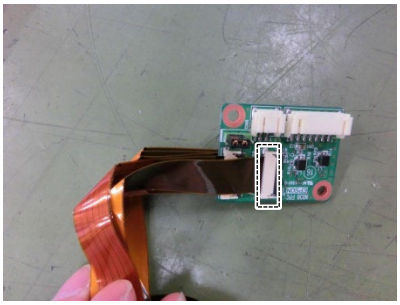


(16) Remove the FPC power cable from the Arm #5.

Cross recessed screw: 2-M3×6

(17) Remove all FPC (5 pcs) connected to the FPC board.

Lift up the black latch to remove the connector easily.



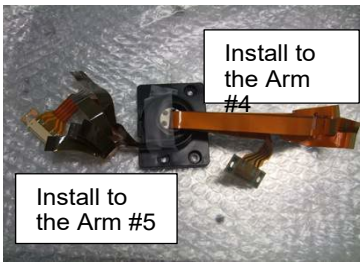
NOTE ☞ Do not pull the FPC forcibly.
It may cause damage on the FPC and the board, and may result in electric shock and/or malfunction of the robot system.

Installation

(1) Turn OFF the Controller.

(2) Check the installation direction of the FPC unit.

The FPC coming from the upper part of the FPC case is for the Arm #4, and the one coming from the side of the FPC case is for the Arm #5.

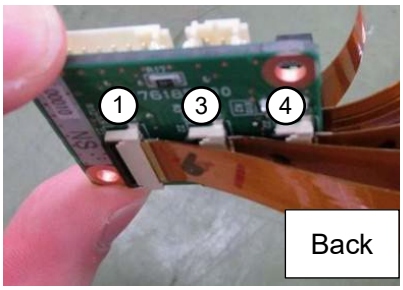


NOTE The FPC unit is fixed by tape with FPC stored in the FPC case. Do not remove the tape until the Arm #4 side arm is installed to keep FPC stored in the case.

(3) Install the FPC to the FPC board of the Arm #5.

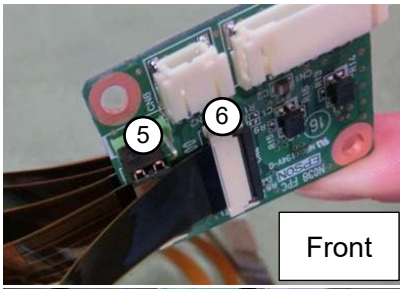
Layer the FPC on top of one another so that the black parts come to the back side of the board (where two connectors are located). See the photo for the installation order of FPC.

Insert the FPC with the black latch lifted up, and then lower the latch to fix it.



NOTE Connect the FPC correctly.
Operating the Manipulator with incorrect connection may cause malfunction.

Insert the FPC connectors firmly to the end.

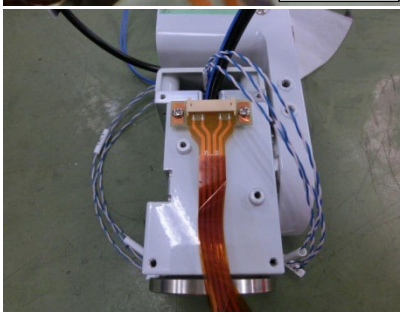


(4) Install the FPC power connector to the Arm #5.

Cross recessed screw 2-M3×6

Tightening torque: 0.3±0.05 N·m

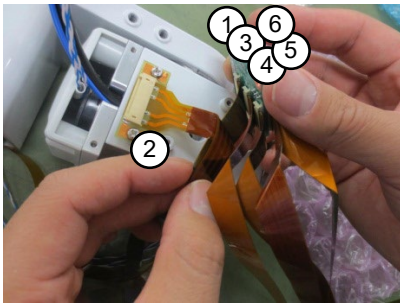
Make sure that the orange part of FPC is facing the front side.



(5) Install the FPC board with the FPC to the Arm #5.

Cross recessed screw: 2-M3×6

Tightening torque: 0.45±0.05N·m

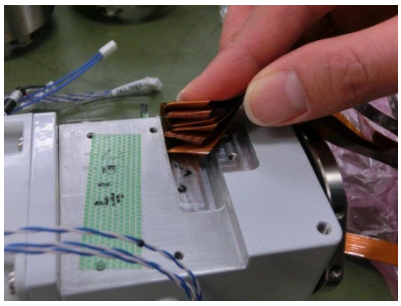


NOTE Layer the FPC on top of one another so that the one with the FPC power connector indicated as “2” in the photo comes to the second from the back. If the installation order is incorrect, the FPC will get twisted.

(6) Fold the FPC one by one, and then put them in layers.

Fold the FPC along the crease one by one. Then, layer the folded FPC along the grove.

NOTE ☞ If the FPC are folded at once, they may get twisted or it may cause wrong wiring.



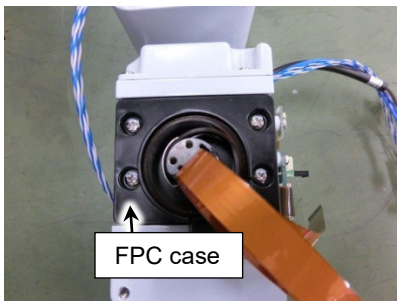
(7) Align the FPC case to the Arm #5.

While holding the FPC with the FPC case, set the FPC coming from the side of the FPC case along the grove on the case.

Fix the FPC case to the Arm #5.

Cross recessed screw: 4-M3×6

Tightening torque: 0.45 ± 0.05N·m



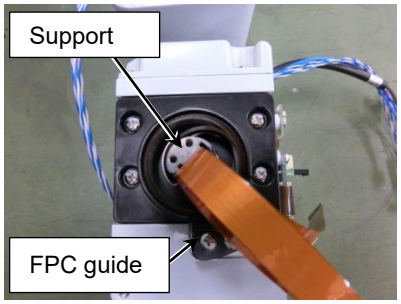
(8) Install the FPC guide.　Make sure that the FPC inside the case do not have deflection.

Cross recessed screw: 2-M3×12

Tightening torque: 0.45 ± 0.05N·m

Remove the tape fixing the FPC and the case, and then turn the support fixing the FPC at the center of the case to check if the folded FPC have deflection.

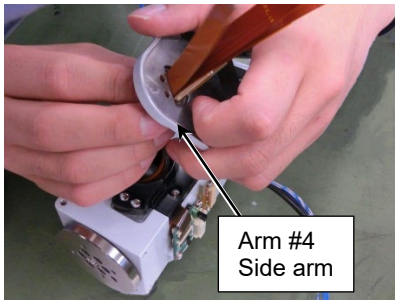
If deflection was found, please contact the supplier of your region.



(9) Pass the FPC to the semicircular hole on the Arm #4 side arm.

Pass the FPC while not applying excessive force to it, and aligning the hole on the support and the installation hole on the Arm #4 side arm.

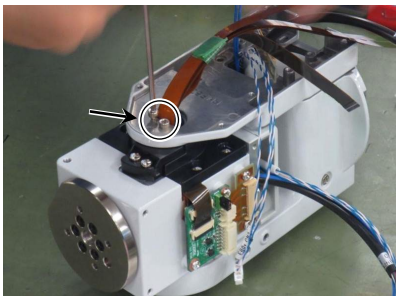
Pass the FPC which has the power connector so that it has deflection.



(10) Pass the three cables coming from the Joint #5 motor unit to the Arm #4 side arm.
Fix the FPC support to the Arm #4 side arm.

Hexagon socket head cap bolt: 2-M3×6

Tightening torque: 2 ± 0.1N·m

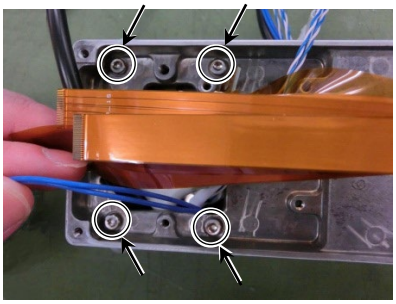


(11) Install the Arm #4 side arm to the Arm #4.

Hexagon socket head cap bolt: 4-M3×8

Tightening torque: 2 ± 0.1N·m

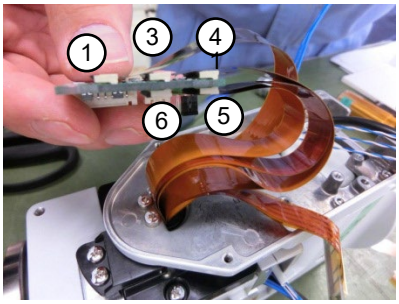
When installing, be careful not to get the cables caught.



(12) Connect the FPC to the FPC board of the Arm #4.

Layer the FPC on top of one another neatly so that the orange parts come to the front side of the board (where two connectors are located). See the photo for the installation order of FPC.
(1, 3, and 4 are at the back side of the board)

Insert the FPC with the black latch lifted up, and then lower the latch to fix it.



NOTE

Connect the FPC correctly.
Operating the Manipulator with incorrect connection may cause malfunction.

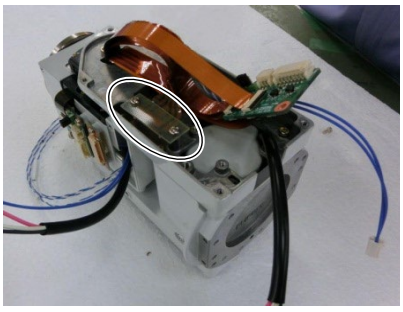
Insert the FPC connectors firmly to the end.

(13) Install the FPC power connector.

Install so that the pattern surface of the power connector is facing down and the FPC with the power connector is at the second from the bottom.

Cross recessed screw: 2-M3×6

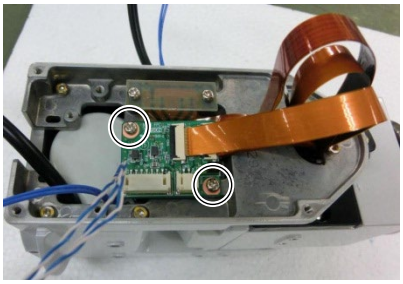
Tightening torque: 0.45 ± 0.05N·m



(14) Install the FPC board.

Cross recessed screw: 2-M3×6

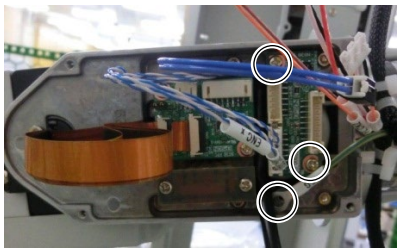
Tightening torque: 0.45 ± 0.05N·m



(15) Install the ground wire.

Cross recessed screw: M4×6

Tightening torque: 0.9 ± 0.1N·m

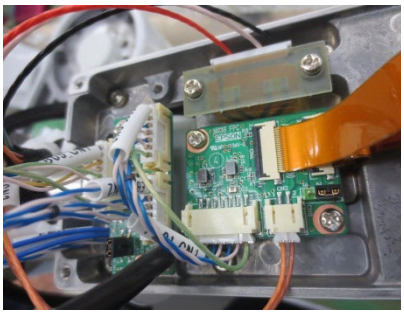


(16) Install the encoder board.

Cross recessed screw: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

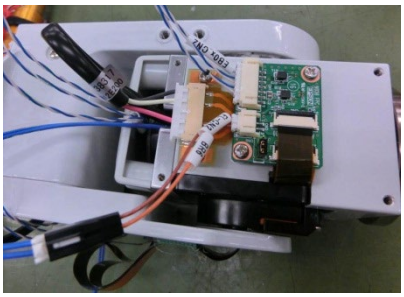
(17) Connect the following connectors inside the Arm #4.



Connector:
- PW5 (Joint #5 power cable)
- J6P_01 (FPC power connector)
- BR5 (Joint #5 brake)
- EB05_CN1 (encoder board)
- FL_CN2 (FPC board)
- FL01_CN1 (FPC board)
- EB05_CN3 (encoder board)
- EB0x_CN2 (Joint #5 encoder)

NOTE Be careful that the jumper pins on the board do not come off.

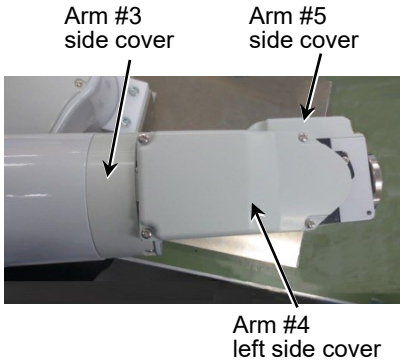
(18) Connect the following connectors inside the Arm #5.



Connector:
- FPC power connector
- EB0x CN2 (Joint #6 encoder)
- FL-CN2 (Joint #6 brake)

(19) Installing the following covers.

Arm #5 side cover
Arm #4 left side cover
Arm #3 side cover



For details, refer to *3. Covers*.

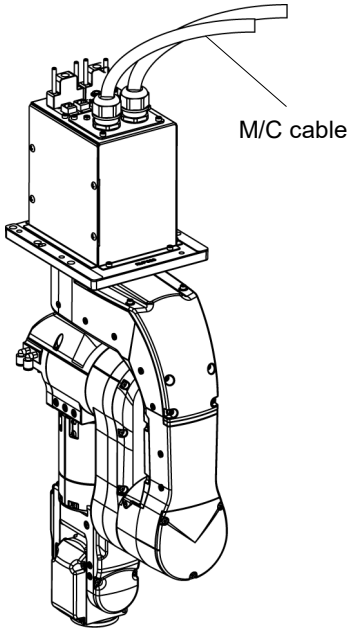
NOTE When installing the covers, be careful not to get the cables caught in the covers.

4.4 Replacing the M/C Cable

WARNING

- Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.
- Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
- When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
  When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to *4.5 Connector Pin Assignment*. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations after removing the cover. Be sure to place the cables back to their original locations.



	Name			Quantity	Note
Maintenance Parts	M/C cable	3 m	Straight	1	1696711
			L-shaped	1	1696714
		5 m	Straight	1	1696712
			L-shaped	1	1696715
		10 m	Straight	1	1696713
			L-shaped	1	1696716
		15 m	Straight	1	1745266
			L-shaped	1	1745268
		20 m	Straight	1	1745267
			L-shaped	1	1745269
Tools	Hexagonal wrench (width across flats: 3 mm)			1	For M4 hexagon socket head cap bolts

Removal

(1) Turn OFF the Controller power.

(2) Disconnect the following connectors from the Controller.

Power cable connector

Signal cable connector

(3) Remove the base cover from the base.

For details, refer to*: 3. Covers*.

(4) Remove the connectors.

Connector: X11, X12, X14, BR010, X010, X020, X040, LED, GS01

NOTE

Each connector is numbered and has a different shape.

Do not disconnect the battery connectors (BAT_CN3, BAT_CN6). Otherwise, calibration will be required.

For details, refer to*: 8. Calibration*.

(5) Remove the connector sub plate.

For details, refer to*: 3. Covers*.

NOTE

Do not remove the M/C cable from the connector plate.

Installation

(1) Install the connector plate to the base.

For details, refer to*: 3. Covers*.

(2) Connect the connectors of the new M/C cable to these of the cable unit.

Connector: X11, X12, X14, BR010, X010, X020, X040, LED, GS01

(3) Install the base cover to the base.

For details, refer to*: 3. Covers*.

(4) Connect the following connectors to the Controller.

Power cable connector

Signal cable connector

(5) Turn ON the Controller power.

(6) Check operation to see if the Manipulator's position and posture are out of position. Move the Manipulator to two or three points (poses) of the registered points.

(7) If the battery connectors (BAT_CN3, BAT_CN6) were disconnected, calibrate all the Joints.

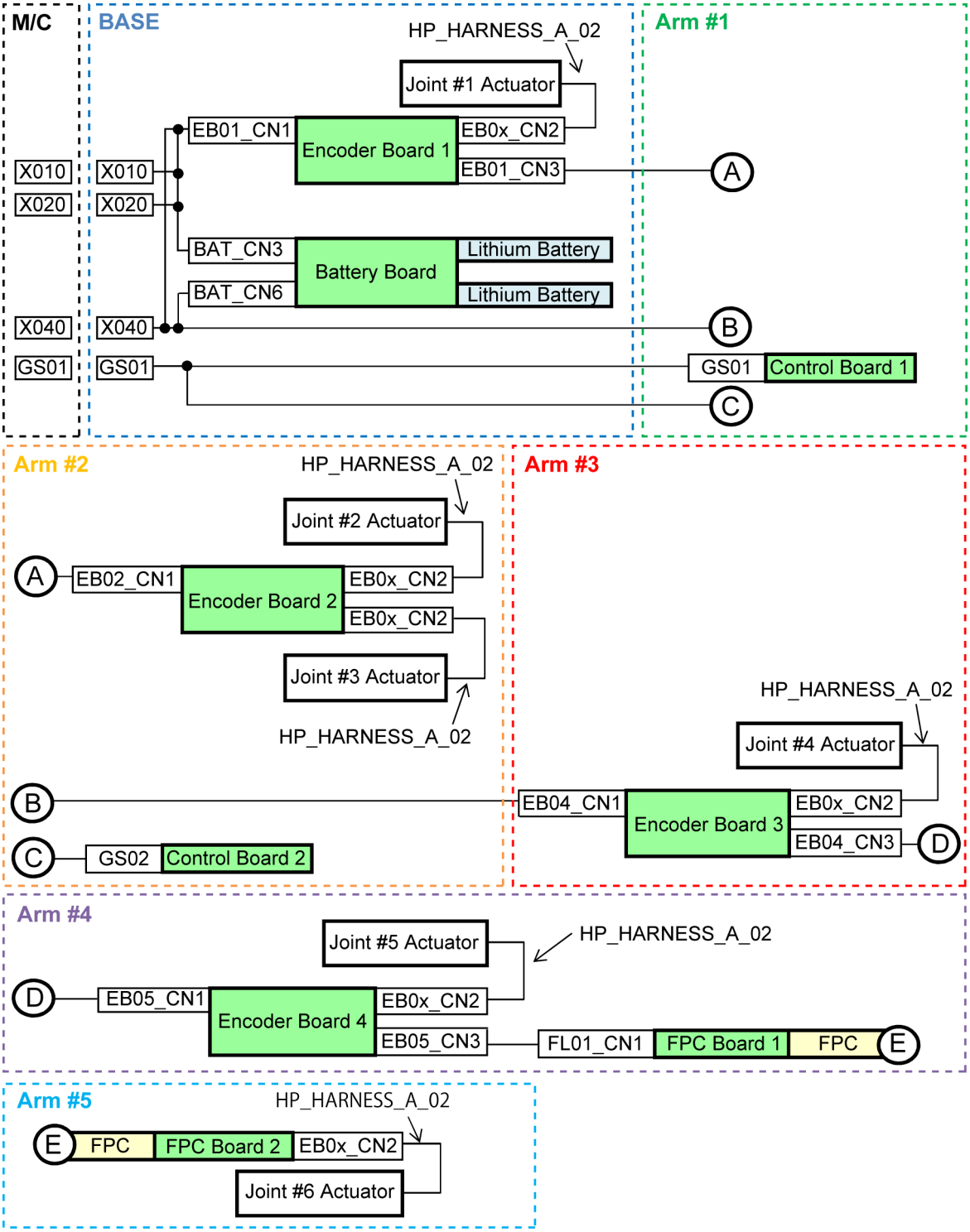
For details, refer to*: 8. Calibration*.

(8) If the Manipulator is off position, calibrate all the joints.

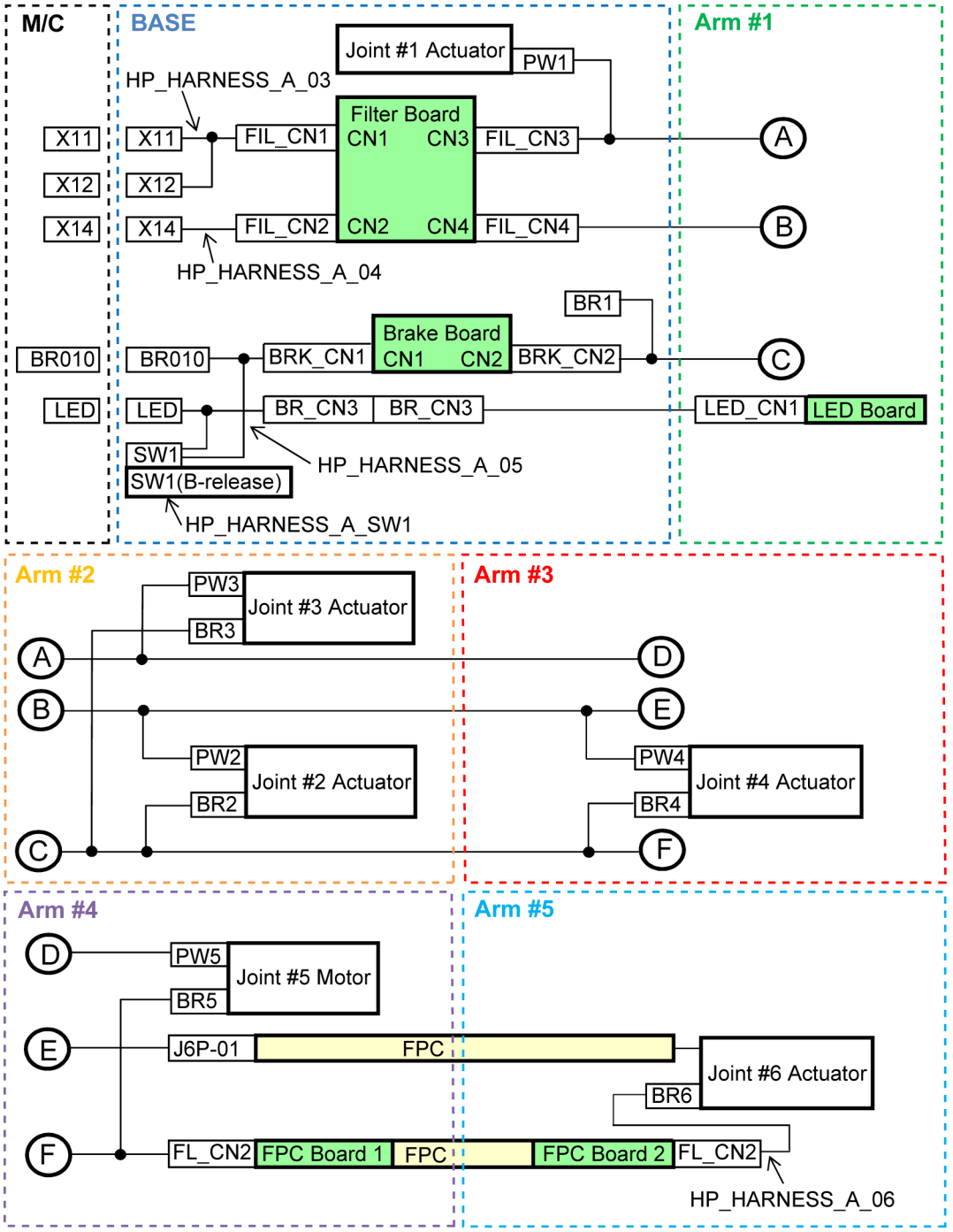
For details, refer to*: 8. Calibration*.

4.5 Connector Pin Assignment

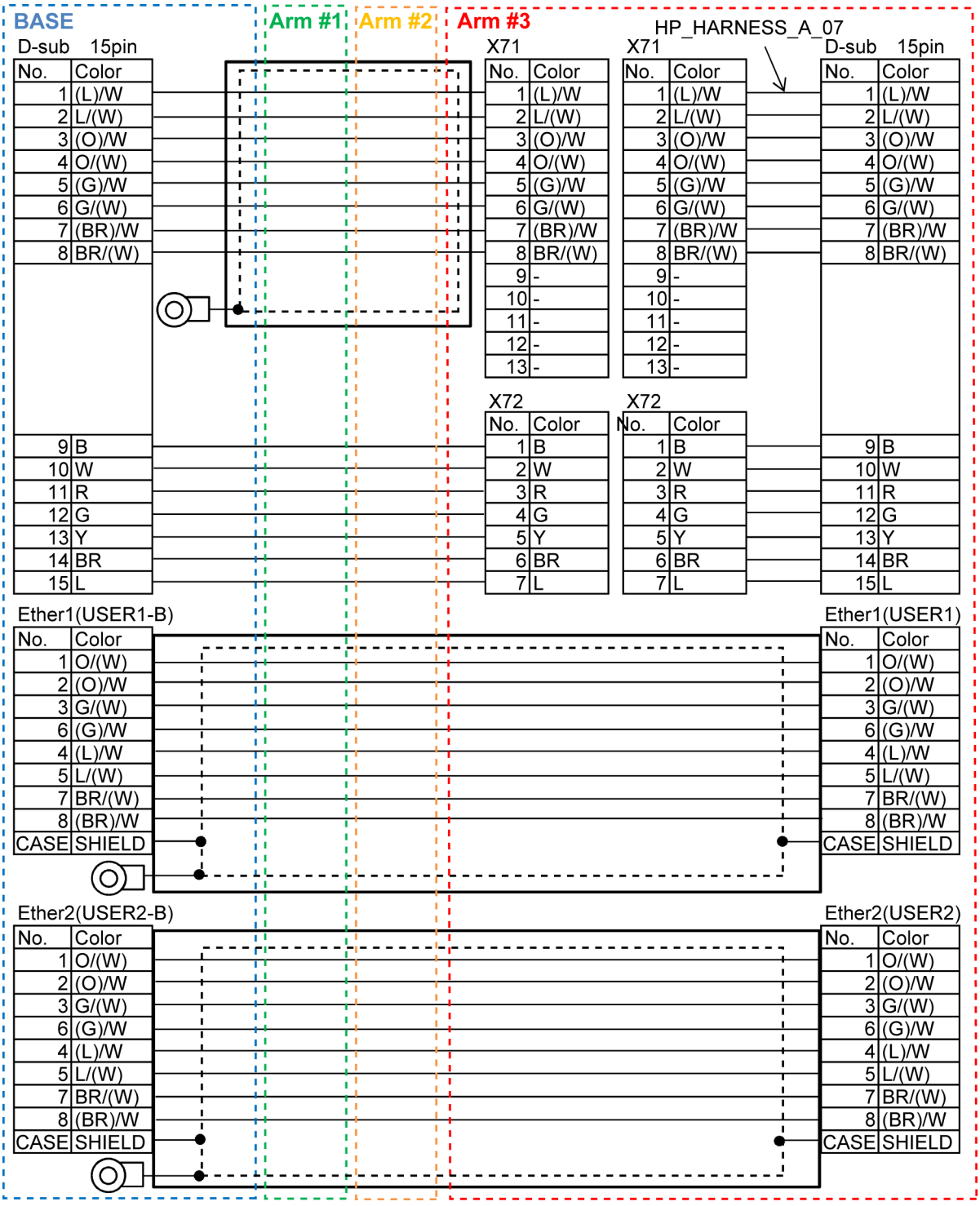
4.5.1 Signal Cable



4.5.2 Power Cable



4.5.3 User Cable



4.5.4 Color of Cables

The following table shows the codes and cable colors indicated in the pin assignments.

4.5.1 Signal Cable

4.5.2 Power Cable

4.5.3 User Cable

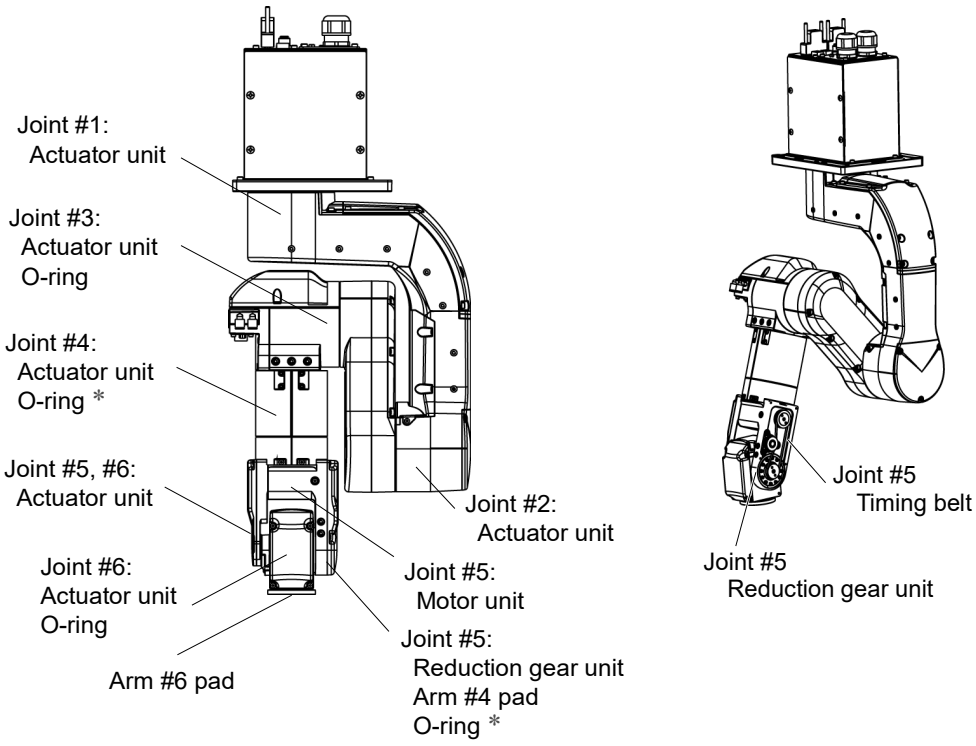
Code	Cable color
B	Black
W	White
R	Red
G	Green
Y	Yellow
BR	Brown
L	Blue
V	Violet
A	Azure
O	Orange
GL	Gray
P	Pink

5. Actuator Units

 WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

 CAUTION	■ Be careful not to apply excessive shock to the actuator units and motor shaft during replacement procedures. The shock may shorten the life of the actuator units and motor and/or damage them. ■ Never disassemble the parts (units). Disassembled the parts will cause a positional gap and cannot be used again.

After parts (units) have been replaced, the Manipulator cannot perform positioning properly because a gap exists between the origin stored in the parts and its corresponding origin stored in the Controller.
After replacing the parts, it is necessary to match these origins.
The process of aligning the two origins is called “Calibration”.
Refer to “*8. Calibration*” and follow the steps to perform calibration.



* : Joint #4 and #5 O rings are common.

NOTE

The Joint #5 is not equipped with the actuator unit. Replace the following parts for each.
Motor unit, reduction gear unit, timing belt

5.1 Replacing the Joint #1 Actuator Unit

⚠ CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ Before removing the Joint #1 actuator unit, move the Arm #2 about 90 degrees from the origin position. If the Arm #2 is not tilted, the actuator unit cannot be replaced. ■ When removing the Arm #1, there must be two or more people to work on it so that at least one of them can support the arm while the others are removing the bolts. Removing the bolts without supporting the arm may result in the arm falling, bodily injury, and/or malfunction of the robot system.

	Name		Quantity	Note
Maintenance Parts	Joint #1 actuator unit		1	1696678
	Wire tie (AB200)		-	1684328 : 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting the wire ties
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

The Joint #1 is not equipped with the brake. When performing maintenance, be careful not to exceed the motion range of the Joint #1.

Before removing the Joint #1 actuator unit, move the Arm #2 about 90 degrees from the origin position.

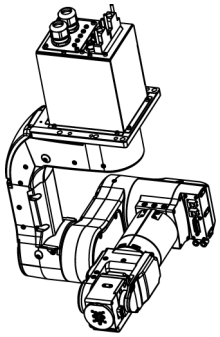
Joint #1 Actuator Unit

Removal: Joint #1 Actuator Unit

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when operating the Manipulator.

Removal:

(1) Turn ON the Controller.



(2) Release the Joint #3 brake.

EPSON RC+ Command

```
> brake off, 3
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(3) Tilt the angle of the Arm #2 about 90 degrees from the origin posture.

(4) Turn OFF the Controller.

(5) Remove the base cover.

For details, refer to "*3. Covers*".

(6) Remove the M/C cable.

For details, refer to "*4.4 Removing the M/C Cable*".

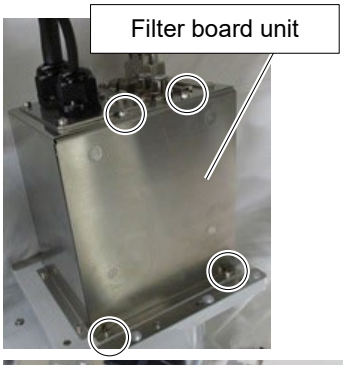
(7) Remove the following connectors and two air tubes.

Connector:
USER1-B, USER2-B, BAT_CN3, BAT_CN6, EB01_CN1, EB0x_CN2, EB01_CN3, FIL_CN3, FIL_CN4, PW1, BR_CN3

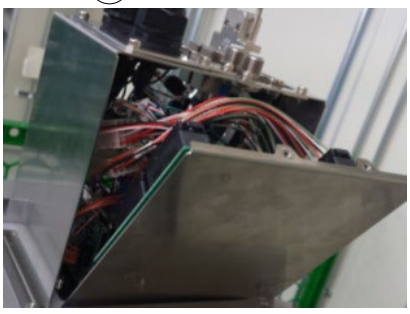
NOTE Be careful that the jumper pins on the board do not come off.

(8) Remove the filter board unit.

Hexagon socket head cap bolt: 4-M4×8



NOTE The cables are connected to the filter board unit. When removing the board, be careful not to pull the cables forcibly.



(9) Remove the connectors connected to the filter board unit.

Connector: FIL_CN3, FIL_CN4

(10) Remove the filter board unit.

(11) Remove the D-sub connectors on the cover.

Brake release connector

(12) Remove the D-sub connector from “USER” connector.

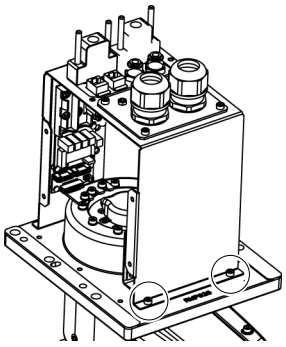
User cable connector

(13) Remove the ground wire terminals.

Hexagon socket head cap bolt: 6-M4×5

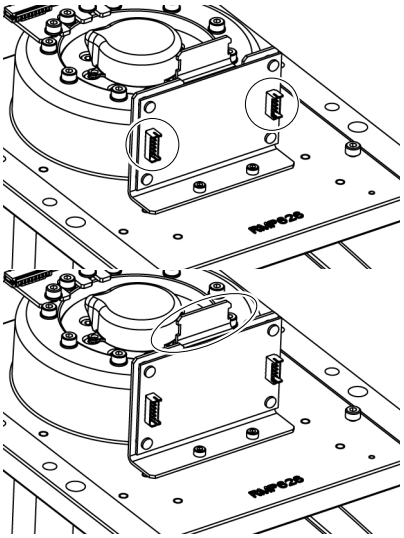
(14) Remove the base.

Hexagon socket head cap bolt: 4-M4×8



(15) Remove the connectors on the brake board.

Connector: BRK_CN1, BRK_CN2



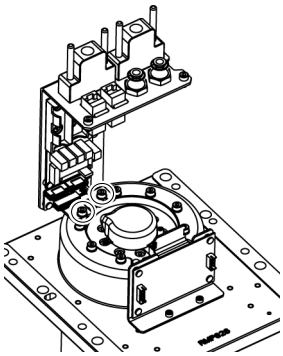
(16) Cut off the wire tie on the brake board plate

NOTE When cutting off the wire tie, be careful not to damage the cables.

Do not cut off of the wire ties other than the one bundling the cables.

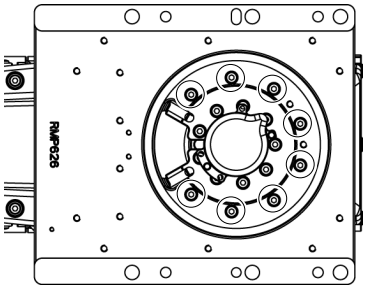
(17) Remove the user wire plate.

Hexagon socket head cap bolt: 2-M4×8

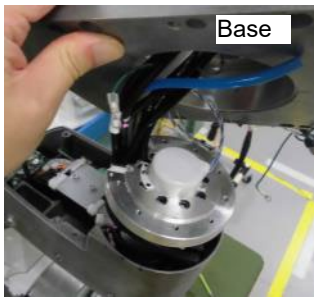


(18) Remove the base from the Joint #1 actuator unit.

Hexagon socket head cap bolt:
8-M4×20 (with plain washer)



Pull up the base and pass the cable from the base hole to remove.



(19) Remove the following covers.

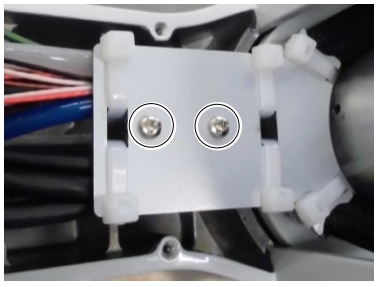
Arm #1 outside cover

Joint #1 cover

For details, refer to "*3. Covers*".

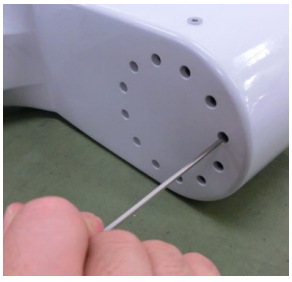
(20) Remove the cable fixing plate from the Arm #1.

Hexagon socket head cap bolt: 2-M3×6

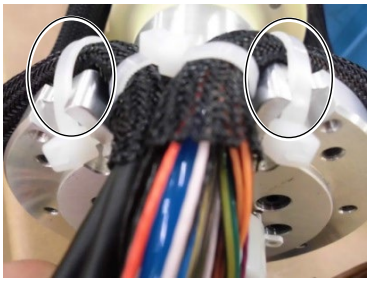


(21) Remove the Joint #1 actuator unit from the Arm #1.

Hexagon socket head cap bolt:
12-M3×15 (with plain washer)



(22) Cut off the wire ties on the flange of the Joint #1 actuator unit to remove the cables.



NOTE

Be careful that the jumper pins on the board do not come off.

When cutting off the wire ties, be careful not to damage the cables.

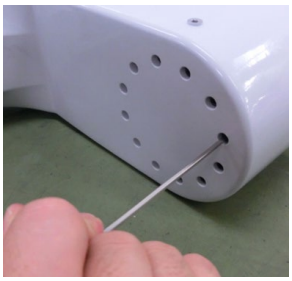
Installation: Joint #1 Actuator Unit

Installation

(1) Install the Joint #1 actuator unit to the Arm #1.

Hexagon socket head cap bolt:
12-M3×15 (with plain washer)

Tightening torque: 2.4 ± 0.1 N·m



NOTE

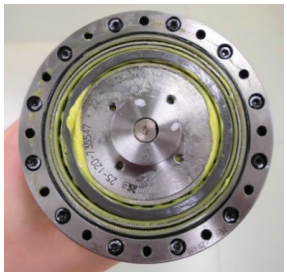
Apply the grease to the cable contacting part on the actuator unit.

If you wiped off the grease on the base plate and Joint #1, apply the grease to the cable contacting part.

For details, refer to "*4.1. Replacing the Cable Unit: Installation (2)*".

Insert the attached O-ring to the groove on the reduction gear unit's circular spline, and then fix the actuator.

Apply a thin coat of grease (SK-1A) to the O-ring.

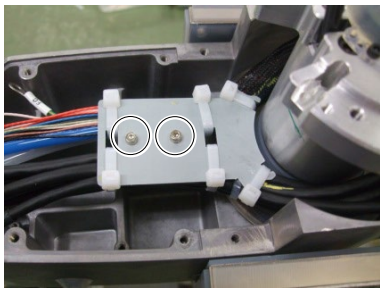


Fix the actuator unit so that the cutout on the white cover of the Joint #1 actuator unit faces the cable fixing plate.

(2) Install the cable fixing plate to the Arm #1.

Hexagon socket head cap bolt:
2-M3×6 (with plain washer)

Tightening torque: 2.0 ± 0.1 N·m



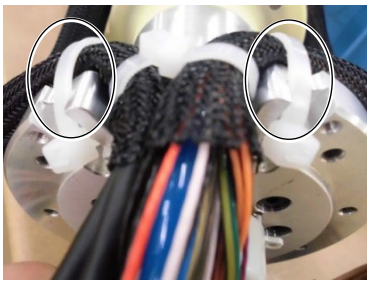
NOTE

Install the cables around the Joint #1 actuator unit in U shape.

(3) Install the cables bundled with the wire ties to the Joint #1 actuator unit.

Wire tie: AB200 2ties

Tightening strength: 85 ± 5 N



NOTE Install the wire ties according to the marks put in the removal step (22).

The cables need to be twisted 180 degrees.

For details, refer to "*4.1 Replacing the Cable Unit: Installation (6), (7)*".

(4) Install the following covers.

Arm #1 outside cover

Joint #1 cover

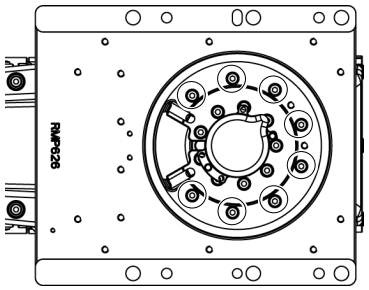
For details, refer to "*3. Covers*".

(5) Install the base to the Joint #1 actuator unit.

Hexagon socket head cap bolt:
8-M4×20 (with plain washer)

Tightening torque: 5.5 ± 0.25 N·m

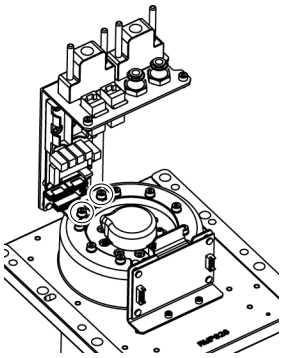
Mount the base on the Joint #1 actuator unit after passing the cable to the base hole.



(6) Install the user wire plate to the base.

Hexagon socket head cap bolt: 2-M4×8

Tightening torque: 4.0 ± 0.2 N·m



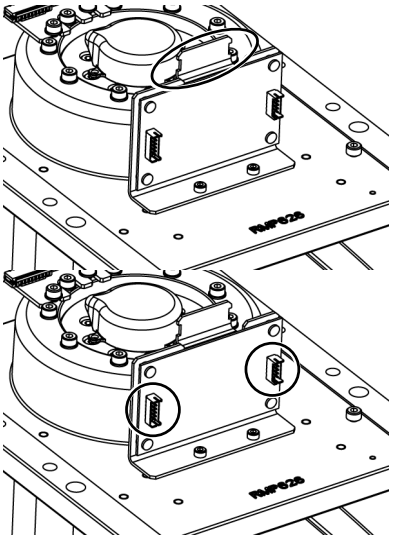
(7) Bundle the cables coming from the Arm #1 and fix them to the brake board plate with a wire tie.

Wire tie (AB200) 1 tie

Tightening strength: 85 ± 5 N

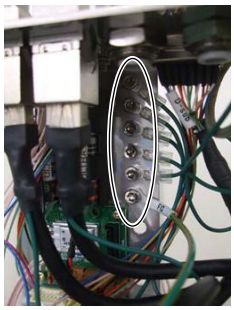
(8) Connect the following connectors to the brake board.

Connector: BRK_CN1, BRK_CN2



(9) Install the ground wire terminals.

Hexagon socket head cap bolt: 6-M4×5

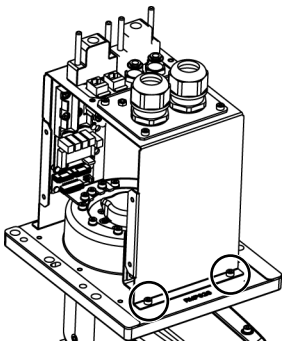


(10) Connect the D-sub connector to “USER”.

(11) Install the base.

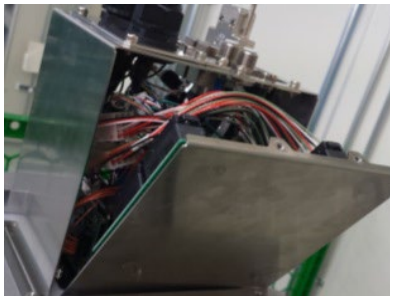
Hexagon socket head cap bolt: 4-M4×8

Tightening torque: 4.0 ± 0.2 N·m



(12) Connect the following connectors to the filter board unit.

Connector: FIL_CN3, FIL_CN4



(13) Install the filter board unit.

Hexagon socket head cap bolt: 4-M4×8

Tightening torque: 4.0 ± 0.2 N·m

(14) Connect the following connectors and two air tubes to the base cover from the cover side.

Connector:
USER1-B, USER2-B, BAT_CN3, BAT_CN6, EB01_CN1, EB0x_CN2, EB01_CN3, PW1,BR_CN3

NOTE

Be careful that the jumper pins on the board do not come off.

(15) Install the M/C cable.

For details, refer to “*4.4 Replacing the M/C Cable*”.

(16) Install the base cover.

For details, refer to "*3. Covers*".

(17) Connect the following D-sub connectors to the base.

User cable connector

Brake release connector

NOTE ☞ The connector of the connection cable and the adjacent user cable connector have the same shape. Be careful not to connect the wrong connector.

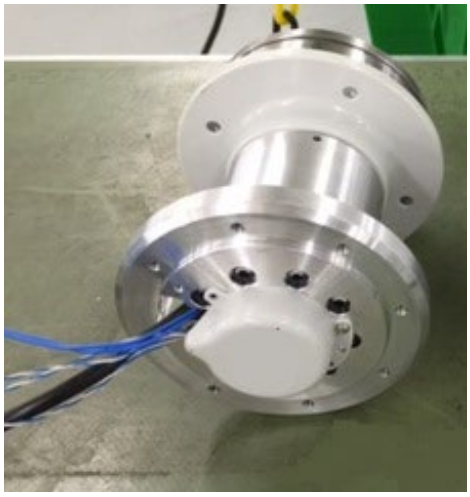
5.2 Replacing the Joint #2 Actuator Unit

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ Before removing the Joint #2 actuator unit, move the Arms #2 and #3 about 90 degrees from the origin position. If the Arms are not tilted, the actuator unit cannot be replaced.

	Name		Quantity	Note
Maintenance Parts	Joint #2 actuator unit		1	1696697
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket set screws
		width across flats: 3 mm	1	For M4 hexagon socket set screws
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Before removing the Joint #2 actuator unit, move the Arms #2 and #3 about 90 degrees from the origin position.



Joint #2 Actuator Unit

Removal: Joint #2 Actuator Unit

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when operating the Manipulator.

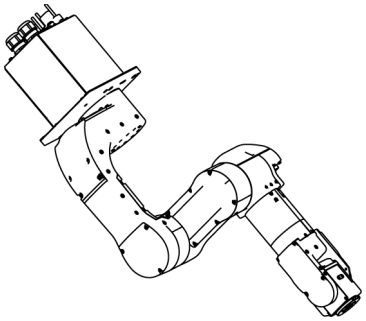
Removal

(1) Turn ON the Controller.

(2) Release the Joint #2 and #3 brakes.

EPSON RC+ Command

```
> brake off, 2
> brake off, 3
```



(3) Tilt the angle of the Arms #2 and #3 about 90 degrees from the origin posture.

(4) Turn OFF the Controller.

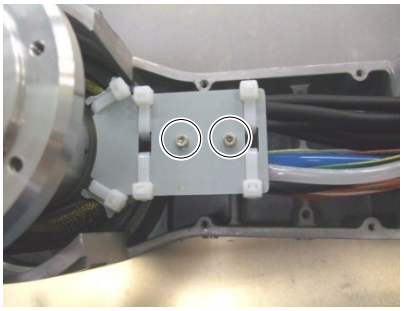
(5) Remove the following covers.

Arm #1 inside cover.
Joint #2 cover Joint #2 outside cover
Arm #2 outside cover Arm #2 inside cover

For details, refer to "*3. Covers*".

(6) Remove the cable fixing plate from the Arm #1.

Hexagon socket head cap bolt: 2-M3×6

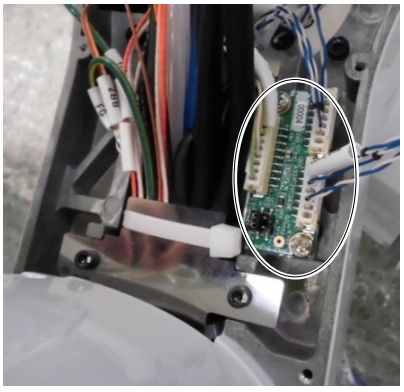


(7) Remove the ground wire inside the Arm #1.

Ground wire (green/yellow): 1 wire
Cross recessed head screws: M4×6

(8) Remove the following connectors from the Arm #2.

Connector:
EB0C_CN2 (2 connectors),
EB02_CN1 (on the encoder board),
PW2, BR2



NOTE Be careful not to remove the connectors for the Joint #3 actuator unit.

NOTE Be careful that the jumper pins on the board do not come off.

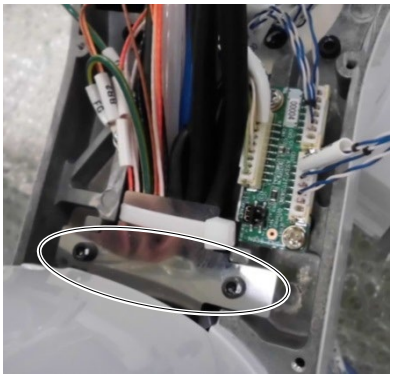
(9) Remove the ground wires inside the Arm #2.

Ground wire (green/yellow): 2 wire

Cross recessed head screw: 2-M4×6

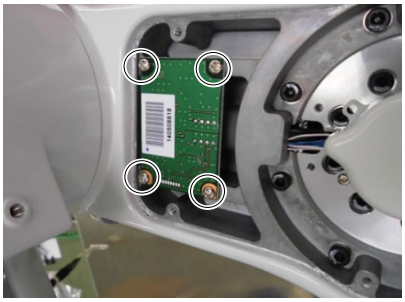
(10) Remove the cable fixing plate from the Arm #2.

Hexagon socket head cap bolt: 2-M3×6



(11) Remove the control board inside the Arm #2.

Cross recessed head screw: 4-M3×6

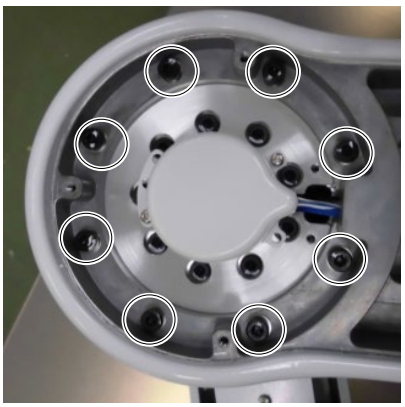


NOTE The connector (GS02) is connected to the back side of the board. Remove the board slowly, and then remove the connector (GS02).

For details, refer to "*7. Boards*".

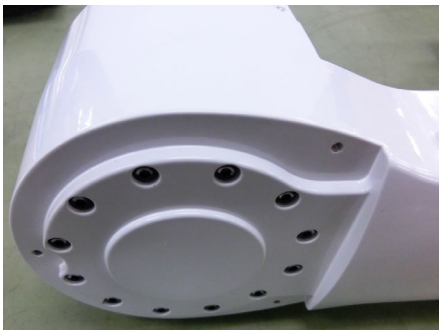
(12) Remove the Joint #2 actuator unit from the Arm #2.

Hexagon socket head cap bolt:
8-M4×20 (with plain washer)



(13) Remove the Joint #2 actuator unit from the Arm #1.

Hexagon socket head cap bolt:
12-M3×15



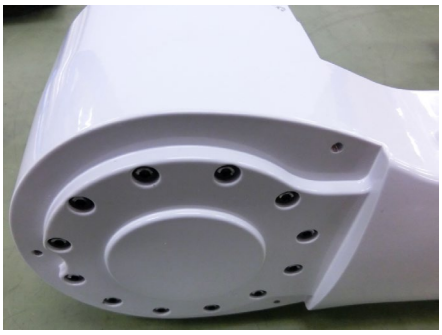
Installation: Joint #2 actuator unit

Installation

(1) Install the Joint #2 actuator unit to the Arm #2.

Hexagon socket set screw: 12-M3×15

Tightening torque: 2.4 ± 0.1 N·m



Apply the grease to the cable contacting part on the actuator unit.

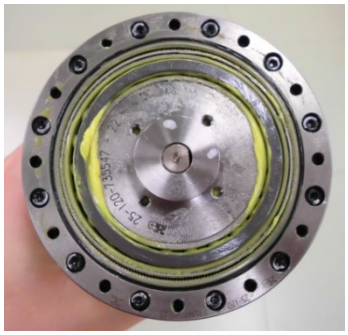
If you wiped off the grease on the base plate and Joint #1, apply the grease to the cable contacting parts.

For details, refer to "*4.1. Replacing the Cable Unit: Installation (11)*".

NOTE Install the cables around the Joint #2 actuator unit in U shape.

NOTE Insert the attached O-ring to the groove on the reduction gear unit's circular spline, and then fix the actuator.

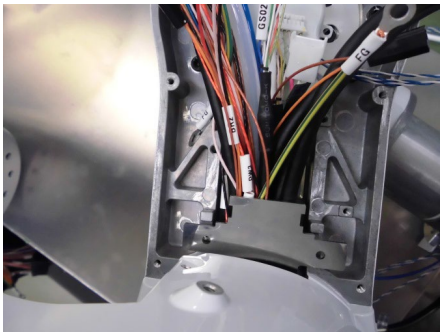
NOTE Apply a thin coat of grease (SK-1A) to the O-ring.



Turn the cutout on the white cover of the Joint #1 actuator unit to face the cable fixing plate and fix the actuator unit.

NOTE Set the cable fixing plate to the groove on the installation part, and then install the Arm #2 over the Joint #2 actuator unit while holding the plate by hand.

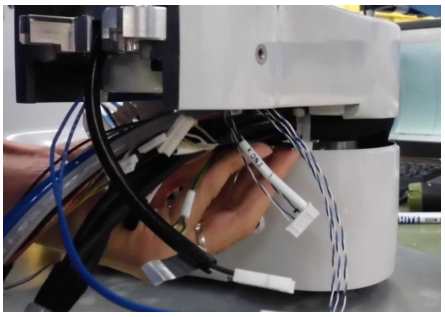
For details, refer to "*4.1. Replacing the Cable Unit: Installation (22) to (24)*".



NOTE

Be careful not to get the cables caught between the Arm #1 and #2.

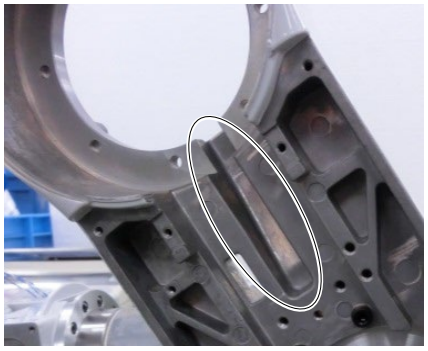
For details, refer to "*4.1. Replacing the Cable Unit: Installation (22) to (24)*".



NOTE

Fix the Arm #2 to the Joint #2 actuator unit, while installing the cables coming from the Joint #2 actuator unit along the groove on the Arm #2. (See the photo)

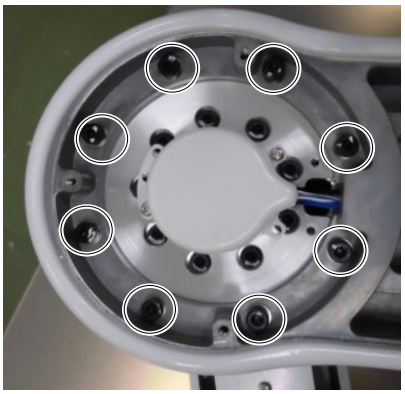
For details, refer to "*4.1. Replacing the Cable Unit: Installation (22) to (24)*".



(2) Install the Joint #2 actuator unit to the Arm #2.

Hexagon socket head cap bolt:
8-M4×20 (with plain washer)

Tightening torque: 5.5 ± 0.25 N·m

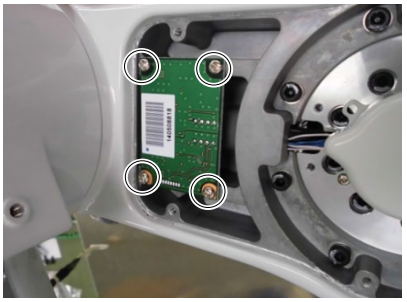


(3) Mount the control board on the Arm #2.

Cross recessed head screw: 4-M3×6

(4) Connect next connector on the back side of the board.

Connector: GS02

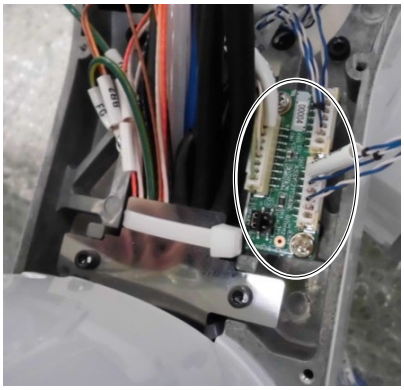


(5) Install the cable fixing plate to the Arm #2.

Hexagon socket head cap bolt: 2-M3×6

Tightening torque: 2.0 ± 0.1 N·m

(6) Connect the following connectors inside the Arm #2.

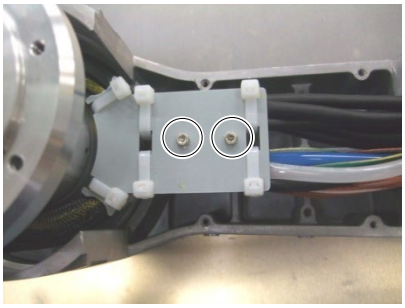


Connector:
EB0C_CN2 (2 connectors),
EB02_CN1 (on the encoder board),
PW2, BR2

NOTE EB0C_CN2 can be connected to either connector.

NOTE Be careful that the jumper pins on the board do not come off.

(7) Install the cable fixing plate to the Arm #2.



Hexagon socket head cap bolt: 2-M3×6

Tightening torque: 2.0 ± 0.1 N·m

(8) Install the ground wire inside the Arm #2.

Ground wire (green/yellow) 2 wire

Cross recessed head screw: 2-M4×6

Tightening torque: 0.9 ± 0.1 N·m

(9) Install the ground wire inside the Arm #2.

Ground wire (green/yellow) 1 wire

Cross recessed head screw: 1-M4×6

Tightening torque: 0.9 ± 0.1 N·m

(10) Install the following covers to the Arm #1 and #2.

Arm #1 inside cover.

Joint #2 cover Joint #2 outside cover

Arm #2 outside cover Arm #2 inside cover

For details, refer to "*3. Covers*".

NOTE When fixing the covers, be careful not to get the cables caught between them.

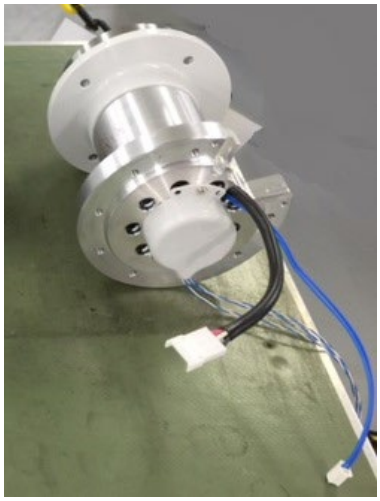
5.3 Replacing the Joint #3 Actuator Unit

⚠ CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ Before removing the Joint #3 actuator unit, move the Arm #2 about 90 degrees from the origin position. If the Arm #2 is not tilted, the actuator unit cannot be replaced.

	Name		Quantity	Note
Maintenance Parts	Joint #3 actuator unit		1	1696698
	Wire tie (AB200)		-	1684328 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket set screws
		width across flats: 3 mm	1	For M4 hexagon socket set screws
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting the wire ties
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Before removing the Joint #3 actuator unit, move the Arm #2 about 90 degrees from the origin position.



Joint #3 Actuator Unit

Removal: Joint #3 actuator unit

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when operating the Manipulator.

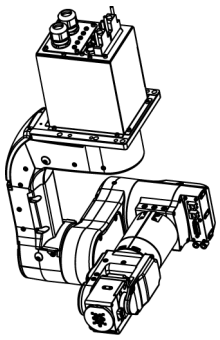
Removal

(1) Turn ON the Controller.

(2) Release the Joint #3 brake.

EPSON RC+ Command

```
> brake off, 3
```



(3) Tilt the angle of the Arm #2 about 90 degrees from the origin posture.

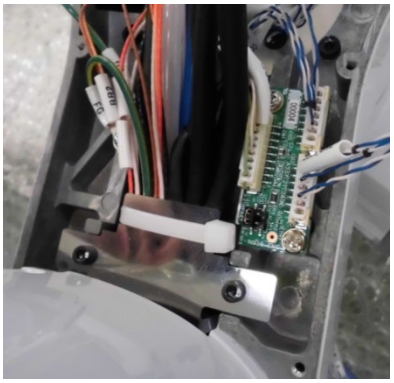
(4) Turn OFF the Controller.

(5) Remove the Arm #2 outside cover.

For details, refer to "*3. Covers*".

(6) Remove the following connectors from the Arm #2.

Connector:
EB0C_CN2 (2 connectors),
EB02_CN1 (on the encoder board),
PW3, BR3

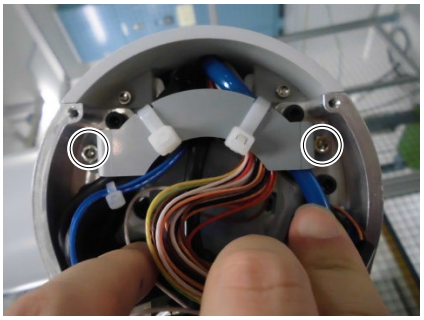


NOTE Be careful not to remove the connectors for the Joint #2 actuator unit.

NOTE Be careful that the jumper pins on the board do not come off.

(7) Remove the cable fixing plate.

Hexagon socket head cap bolt: 2-M4×6



(8) Remove the following covers.

Joint #3 cover

Arm #3 upper cover.

For details, refer to "*3. Covers*".

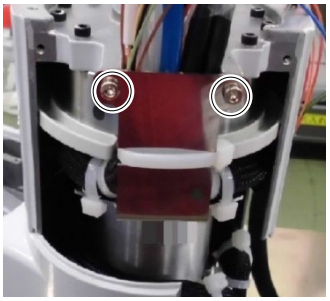
(9) Before cutting off the wire ties, put a mark on the surface of cables with a permanent marker so that the fixed positions can be checked later.

Cut off the wire ties on the flange of the Joint #3 actuator unit, and then remove the cables.

NOTE When cutting off the wire tie, be careful not to damage the cables.

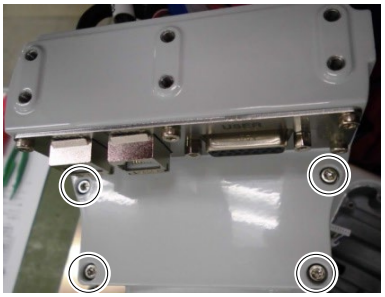
(10) Remove the cable fixing plate from the Arm #3.

Hexagon socket head cap bolt: 2-M3×6



(11) Remove the Arm #3 outside cover.

Hexagon socket head cap bolt: 4-M3×15



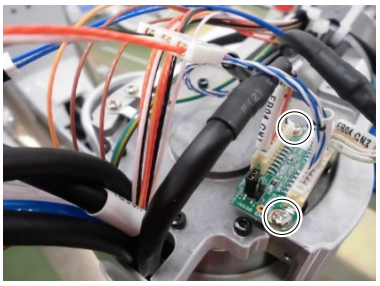
(12) Remove the connectors and two air tubes from the cover.

Connectors: USER1, USER2, X71, X72

(13) Remove the encoder board and the ground wires connected to the Arm #3.

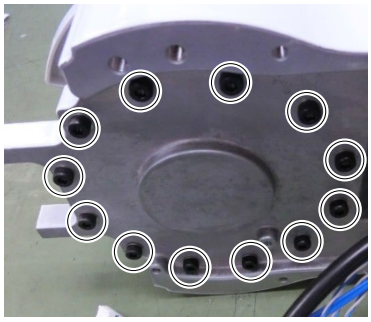
Encoder board:
Cross recessed head screw: 2-M3×6

Ground wire (green/yellow) 2 wires
Cross recessed screw: 2-M3×6



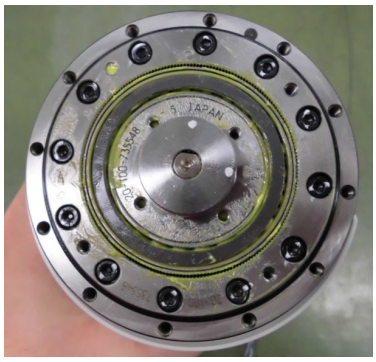
(14) Remove the Joint #3 actuator unit from the Arm #3.

Hexagon socket head cap bolt: 12-M3×15 (with plain washer)



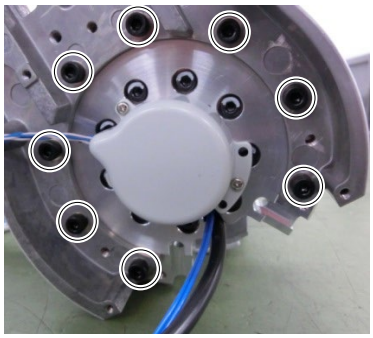
NOTE There is an O-ring between the Arm #3 and the Joint #3 actuator unit.
Remove the O-ring together with the actuator unit.

O-ring: Inner diameter ø 69.57 mm
Wire diameter ø 1.78 mm



(15) Remove the Joint #3 actuator unit from the Arm #2.

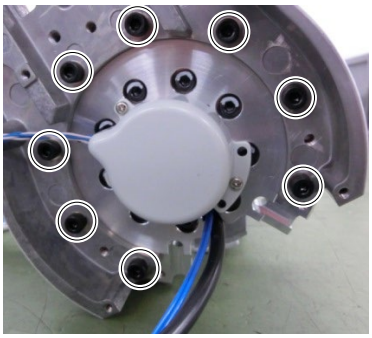
Hexagon socket head cap bolt: 8-M4×18 (with plain washer)



Installation: Joint #3 actuator unit

Installation

(1) Install the Joint #3 actuator unit to the Arm #2.



Hexagon socket head cap bolt:
8-M4×18 (with plain washer)

Tightening torque: 5.5 ± 0.25 N·m

NOTE

Be careful of the assembly direction of the Joint #3 actuator unit.
Install the actuator unit so that the cutout on the actuator flange matches the direction of the cutout on the Arm #2.

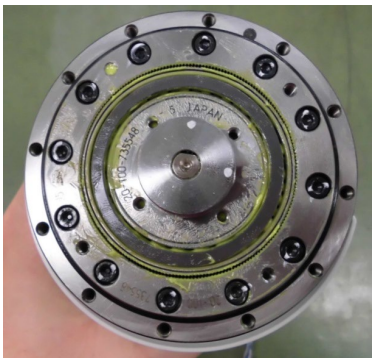
NOTE

Apply the grease to the cable contacting part on the actuator unit.

If you wiped off the grease on the Joint #2 and #3, apply the grease to the cable contacting parts.

For details, refer to "*4.1. Replacing the Cable Unit*".

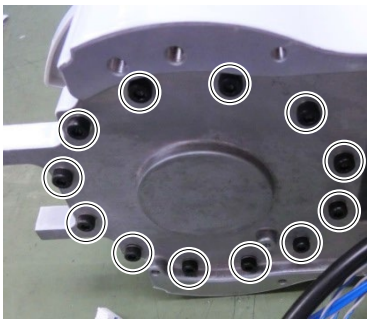
(2) Install the O-ring to the Joint #3 actuator unit.
Install the actuator unit to the Arm #3.



O-ring: Inner diameter ø 69.57 mm
Wire diameter ø 1.78 mm

NOTE

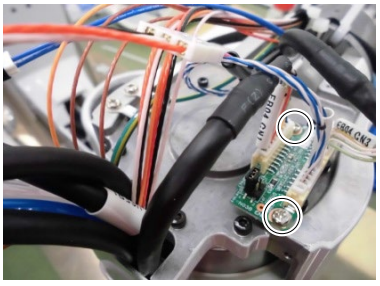
Apply a thin coat of grease (SK-1A) to the O-ring.



Hexagon socket set screw:
12-M3×15 (with plain washer)

Tightening torque: 2.4 ± 0.1 N·m

(3) Install the encoder board and the ground wires to the Arm #3.



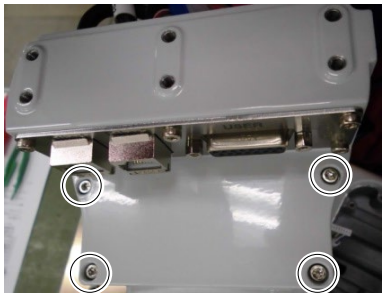
Encoder board
Cross recessed screw: 2-M3×6

Ground wire (green/yellow) 2 wires
Cross recessed screw: 2-M3×6

(4) Install the Arm #3 outside cover.

Hexagon socket head cap bolt: 4-M3×15

Tightening torque: 2.0 ± 0.1 N·m



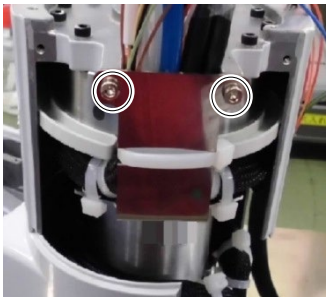
(5) Mount the connectors and two air tubes on the cover.

Connectors: USER1, USER2, X71, X72

(6) Install the cable fixing plate to the Arm #3.
Pass the cables between the protruding parts.

Hexagon socket head cap bolt: 2-M3×6

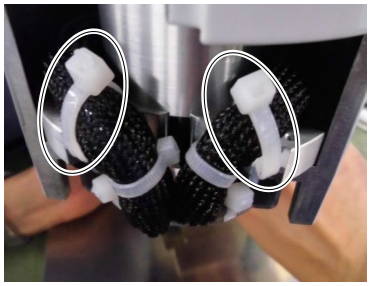
Tightening torque: 2.0 ± 0.1 N·m



(7) Fix the cables to the flange of the Joint #3 actuator unit with the wire ties.
Install the cables so that the head parts of the wire ties face the cable fixing plate side on the Arm #3.

Wire tie (AB200) 2 tie

Tightening strength: 85 ± 5 N



NOTE ☞ Install the wire ties according to the marks put in the removal step (8).
Set the cables around the Joint #3 actuator unit in U shape.
The cables need to be twisted 180 degrees.

For details, refer to "*4.1. Replacing the Cable Unit: Installation (29), (30)*".

(8) Install the cable fixing plate to the Arm #2.

Hexagon socket head cap bolt: 2-M4×6

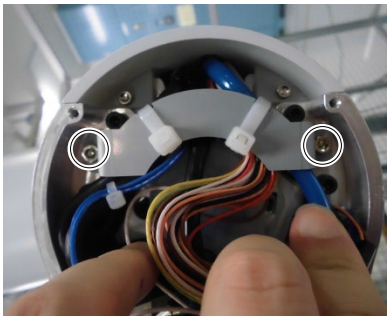
Tightening torque: 4.0 ± 0.2 N·m

(9) Install the following covers.

Joint #3 cover

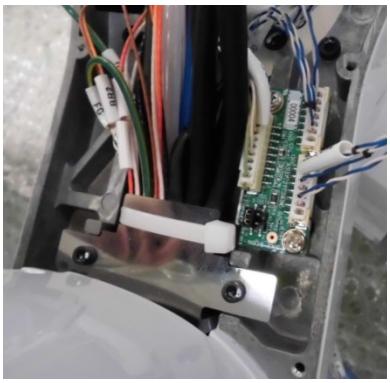
Arm #3 upper cover.

For details, refer to "*3. Covers*".



NOTE ☞ Be careful not to twist the cables or get them caught in the Arm.

(10) Install the following connectors.



Connector:
EB0C_CN2 (2 connectors),
EB02_CN1 (on the encoder board),
PW3, BR3

NOTE Be careful that the jumper pins on the board do not come off.

(11) Install the Arm #2 outside cover.

For details, refer to "*3. Covers*".

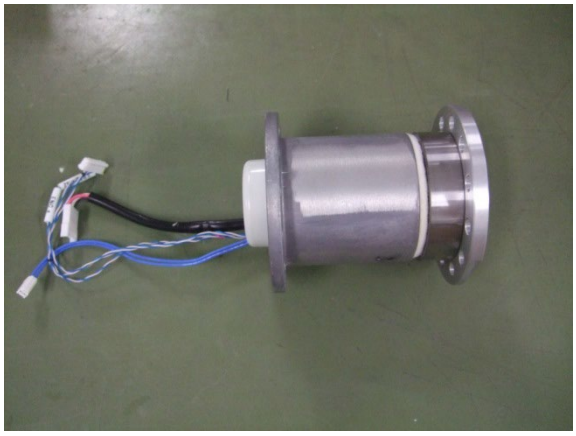
5.4 Replacing the Joint #4 Actuator Unit

⚠ CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ Before removing the Joint #4 actuator unit, move the Arm #3 about 90 degrees from the origin position. If the Arm is not tilted, the actuator unit cannot be replaced.

	Name		Quantity	Note
Maintenance Parts	Joint #4 actuator unit		1	1696699
	Wire tie (AB200)		-	1684328 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2 mm	1	For M2.5 hexagon socket head cap bolts
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Nippers		1	For cutting the wire ties
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the
Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Before removing the Joint #4 actuator unit, move the Arm #3 about 90 degrees from the origin position.



Joint #4 Actuator Unit

Removal: Joint #4 Actuator Unit

Removal

(1) Turn ON the Controller.

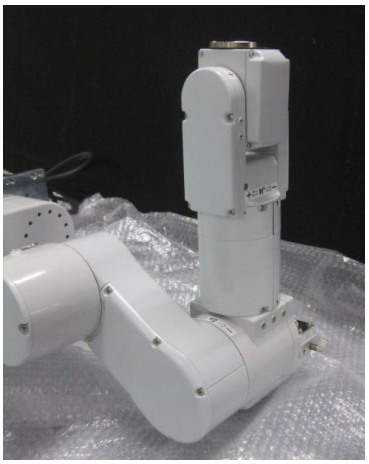
(2) Release the Joint #3 brake.

EPSON RC+ Command

```
> brake off, 3
```

(3) Tilt the angle of the Arm #3 about 90 degrees from the origin posture.

(4) Turn OFF the Controller.



(5) Remove the following covers.

Arm #4 left side cover

Arm #4 right side cover

Arm #3 side cover (2 covers)

Arm #3 upper side cover (2 covers)

For details, refer to "*3. Covers*".

(6) Remove the Arm #3 upper side covers.

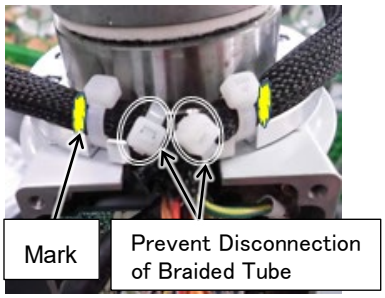
NOTE

Be careful not to cut off the cables.

For details, refer to "*3. Covers*".

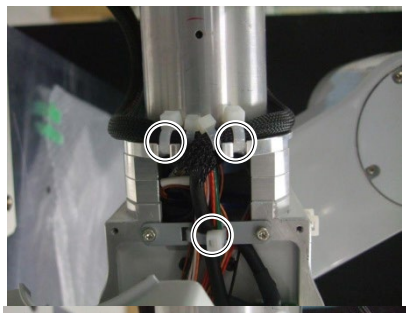
(7) Before cutting off the wire ties, put a mark on the surface of the cables near the wire tie with a permanent marker.
Also, fix the braided tube with wire ties to prevent disconnection.

Cut off the wire ties bundling the cables.



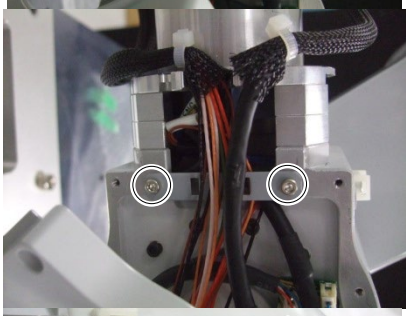
NOTE
When cutting of the wire ties, be careful not to damage the cables.

Do not cut off of the wire ties other than the ones bundling the cables.



(8) Remove the cable fixing plate.

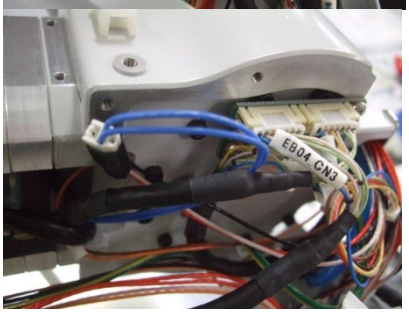
Hexagon socket head cap bolt: 2-M3×6



(9) Remove the following connectors connected to the Joint #4 actuator unit.

Connector: EB0x_CN2, PW4, BR4
(Push the latch and pull to remove.)

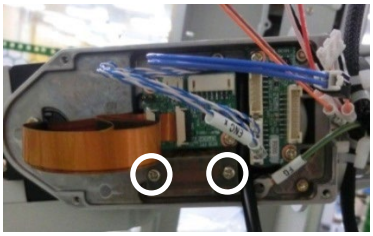
NOTE
Be careful that the jumper pins on the board do not come off.



(10) Loosen the FPC Power Connector mounting screws.
Remove the connector and ground wire from the Arm #4.

Connector:
PW5, J6P-01, BR5, FL_CN2, EB05_CN1

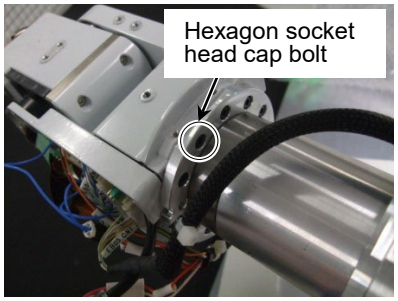
Ground wire (green/yellow) :
Cross recessed screw: M4×6



NOTE
Be careful that the jumper pins on the board do not come off.

(11) Remove the Arm #4.

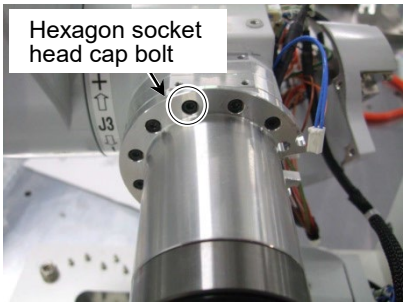
Hexagon socket head cap bolt:
10-M3×8 (with plain washer)



(12) Remove the Joint #4 actuator unit from the Arm #3.

Hexagon socket head cap bolt:
10-M3×10 (with plain washer)

There is a positioning pin (2-ø3×8) between the Arm #3 and the Joint #4 actuator unit.
Be careful not to lose it.



Installation: Joint #4 Actuator Unit

Installation

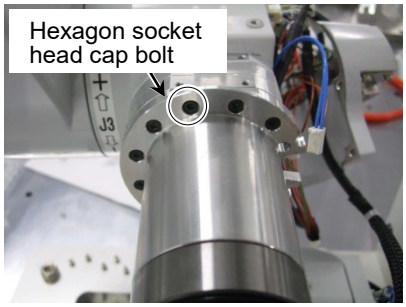
(1) Insert the positioning pin to the Arm #3.

Install the Joint #4 actuator unit to the Arm #3.

Positioning pin: 2-ø3×8

Hexagon socket head cap bolt:
10-M3×10 (with plain washer)

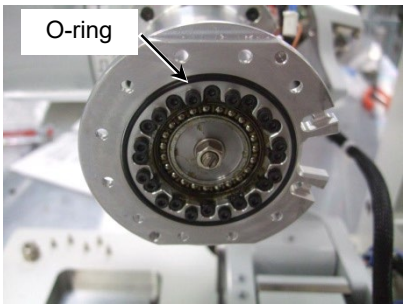
Tightening torque: 2.4 ± 0.1 N·m



(2) Check if there is an O-ring on the Joint #4 actuator unit.

O-ring: Inner diameter ø 51.0 mm
Wire diameter ø 1.5 mm

NOTE Apply a thin coat of grease (SK-2) to the O-ring.

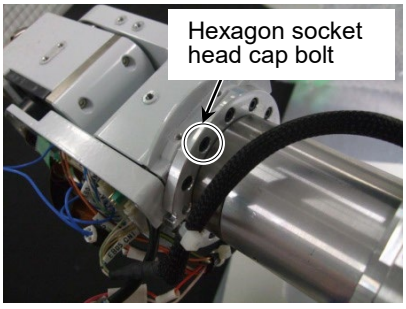


(3) Install the Arm #4.

Align the positions of the cables coming from the Arm #4 and the groove on the flange.

Hexagon socket head cap bolt:
10-M3×8 (with plain washer)

Tightening torque: 2.4 ± 0.1 N·m



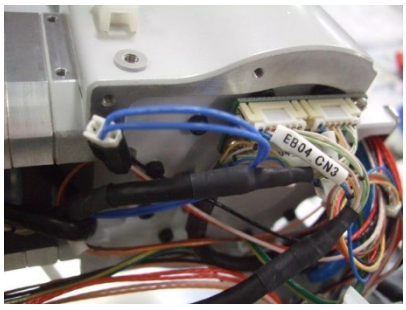
NOTE Apply the grease to the cable contacting part on the actuator unit.

For details, refer to "*4.1. Replacing the Cable Unit*".

(4) Connect the following connectors.

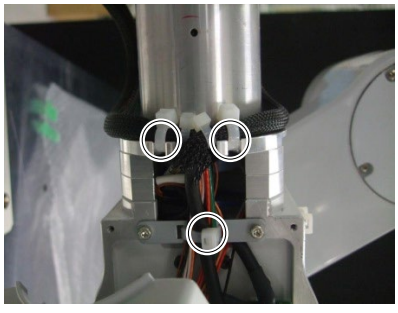
Connector: EB0x_CN2, PW4, BR4

NOTE Be careful that the jumper pins on the board do not come off.

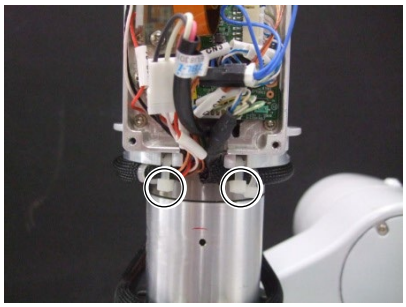


(5) Temporarily fix the cables to the cable fixing plate with the wire ties, and then fix the plate to the Arm #3.

Hexagon socket head cap bolt: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m



(6) Fix the cables with the wire ties according to the marks put in the removal step (7).



Wire tie (AB200) : 3 ties

Wire tie (AB150) : 2 ties

Tightening strength: 85 ± 5N

Position:

Joint #4 actuator unit:

Arm #3 side flange: 2 ties (AB200)

Arm #4 side flange: 2 ties (AB150)

Cable fixing plate: 1 tie (AB200)

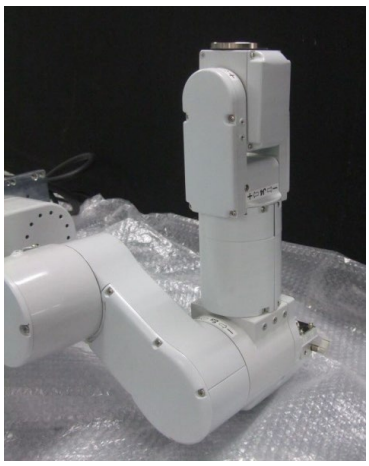
For details, refer to "*4.1. Replacing the Cable Unit: Installation (42)*".

(7) Mount connector and ground wire on the Arm#4.

Connectors: PW5, J6P-01, BR5, FL_CN2, EB05_CN1

Ground wire (green/yellow): Cross recessed screw: 2-M3×6

(8) Install the following covers in that order.



Arm #3 outside cover

Arm #3 upper cover

Arm #3 upper side cover (2 covers)

Arm #3 side cover (2 covers)

Arm #4 right side cover

Arm #4 left side cover

For details, refer to "*3. Covers*".

(9) Calibrate the Joint #4.

For details, refer to "*8. Calibration*".

5.5 Joint #5

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance.

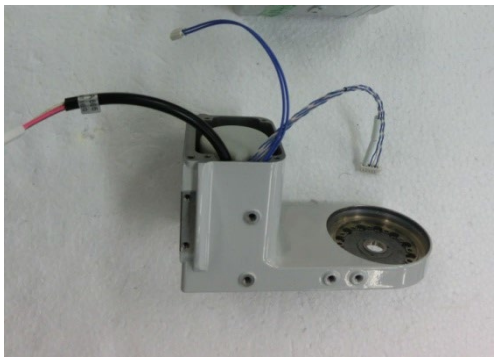
NOTE The Joint #5 is not equipped with the actuator unit. Replace the following parts for each.
Motor unit, reduction gear unit, timing belt

5.5.1 Replacing the Motor Unit

	Name		Quantity	Note
Maintenance Parts	Joint #5 motor unit		1	1696700
	Belt tensile jig*		1	1696718
	Wire tie (AB150)		-	1675754 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 1.5 mm	1	For M3 hexagon socket set screws
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting the wire ties
	Belt tension meter		1	Refer: Unitta U-505
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

* The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

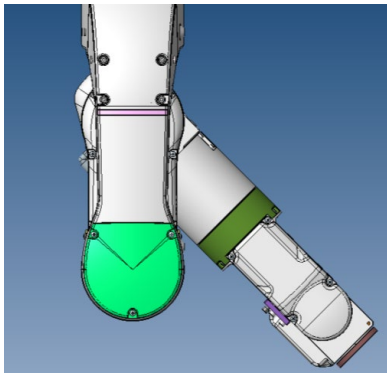
The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.



Joint #5 Motor Unit

Removal: Joint #5 motor unit

Removal



(1) Turn ON the Controller.

(2) Release the Joint #2 and #3 brakes.

EPSON RC+ Command

```
> brake off, 2
> brake off, 3
```

(3) Tilt the angle between the Arms #2 and #3 about 45 degrees.

(4) Turn OFF the Controller.

(5) Remove the following covers.

Arm #4 right side cover

Arm #4 left side cover

Arm #3 side cover

For details, refer to "*3. Covers*".

(6) Remove the Joint #5 timing belt.

For details, refer to "*5.5.3 Replacing the Timing Belt*".

(7) Remove the boards on the Arm #4.

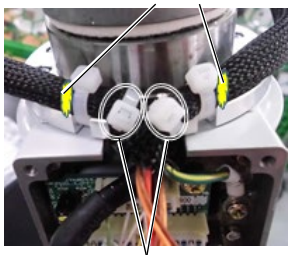
Board: Encoder board 4
FPC board 1

For details, refer to "*7. Boards*".

(8) Before cutting off the wire ties, put a mark on the both side of wire tie fixed part with a permanent marker. Also, fix the braided tube with wire ties to prevent disconnection.

Cut off the wire ties from the flange on the Joint #4 actuator unit.

When cutting off the wire ties, be careful not to damage the cables.



(9) Remove the wire ties on the Joint #4 actuator unit. (2 ties on the Arm #4 side flange)

When cutting off the wire ties, be careful not to damage the cables.

NOTE

Do not cut off of the wire ties other than the ones bundling the cables.

(10) Separate the Joint #4 actuator unit from the Arm #4.

Hexagon socket head cap bolt:
10-M3×8 (with plain washer)

(11) Remove the FPC unit from the Joint #6 actuator unit.

For details, refer to "*4.3. Replacing the FPC Unit*".

(12) Remove the timing belt from the Joint #5, #6 actuator unit.

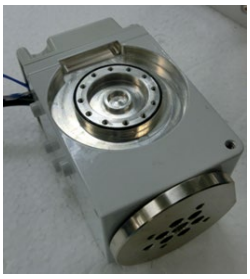
For details, refer to "*5.5.3 Replacing the Timing Belt: Removal*".

(13) Remove the two pulleys from the Joint #5, #6 actuator unit.

Hexagon socket set screw: 4-M3×8

(14) Remove the Joint #5 reduction gear unit.

For details, refer to "*5.5.2 Replacing the Reduction Gear Unit*".



Installation: Joint #5 motor unit

NOTE For details of tightening the hexagon socket head screws, refer to "*2.4 Tightening Hexagon Socket Head Bolts*".

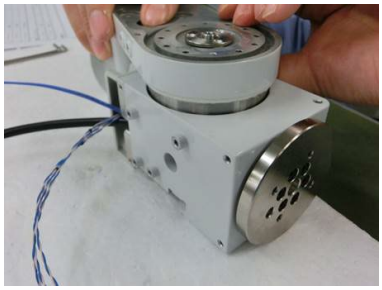
Installation

(1) Install the Joint #5 reduction gear unit to the Joint #6 actuator unit.

For details, refer to "*5.5.2 Replacing the Reduction Gear Unit, installation steps*".

(2) Install the Joint #5 reduction gear unit to the Joint #5 motor unit.

For details, refer to "*5.5.2 Replacing the Reduction Gear Unit, installation steps*".



(3) Install the two pulleys to the Joint #5, #6 actuator unit.

Hexagon socket set screw: 4-M3×8

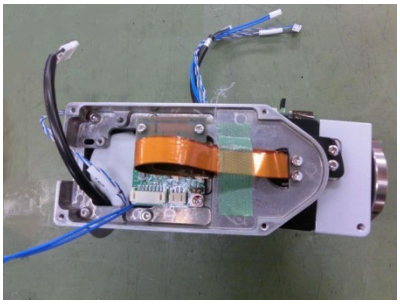
NOTE Be careful of the installation direction of the pulleys.
Install the non-flanged pulley to the shaft on the Joint #5 reduction gear unit side.

Install both pulleys to the shaft with set screws while pressing the protruding parts on the surface to the bearing. Rotate the pulleys so that the set screws touch the D-cut surface on the shaft.

Fix the pulleys while aligning the end face of the shaft and that of the pulley.

(4) Install the FPC unit to the Joint #6 actuator unit.

For details, refer to "*4.3. Replacing the FPC Unit*".



(5) Install the timing belt to the Joint #5, #6 actuator unit.

For details, refer to "*5.5.3 Replacing the Timing Belt*".

(6) Install the Joint #5 motor to the Joint #4 actuator unit.

Hexagon socket head cap bolt:
10-M3×8 (with plain washer)

Tightening torque: 2.4 ± 0.1 N·m

(7) Fix the cables to the flange of the Joint #4 actuator unit with the wire ties according to the marks put in the removal step (8).

Wire tie (AB150): 2 ties

Tightening strength: 85 N ± 5N

Cut off the wire ties attached for preventing disconnection of braided tube.

(8) Install the board unit to the Arm #4.

Board: Encoder board 4
FPC board 1

For details, refer to "*7. Boards*".

(9) Install the following covers.

Arm #4 right side cover

Arm #4 left side cover

Arm #3 side cover

For details, refer to "*3. Covers*".

(10) Perform the calibration.

For details, refer to "*8. Calibration*".

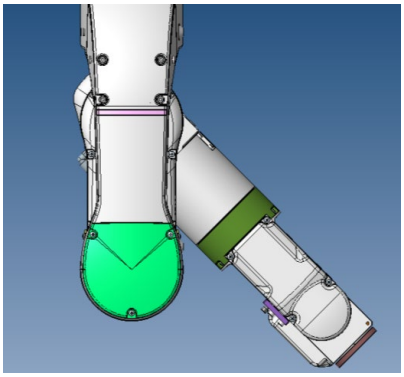
5.5.2 Replacing the Reduction Gear Unit

	Name		Quantity	Note
Maintenance Parts	Joint #5 reduction gear unit		1	1696702
	Belt tensile jig*		1	1696718
	Wire tie (AB150)		-	1675754 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 1.5 mm	1	For M3 hexagon socket set screws
		width across flats: 2.0 mm	1	For M2.5 hexagon socket head cap bolts
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Belt tension meter		1	Refer: Unitta U-505
	Nippers		1	For cutting the wire ties
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Removal: Joint #5 reduction gear unit

Removal:



(1) Turn ON the Controller.

(2) Release the Joint #2 and #3 brakes.

EPSON RC+ Command

```
> brake off, 2
> brake off, 3
```

(3) Tilt the angle between the Arms #2 and #3 about 45 degrees.

(4) Turn OFF the Controller.

(5) Remove the following covers.

Arm #4 right side cover
Arm #4 left side cover
Arm #3 side cover

For details, refer to "*3. Covers*".

(6) Remove the timing belt.

For details, refer to "*5.5.3 Replacing the Timing Belt*".

(7) Remove the boards on the Arm #4.

Board: Encoder board 4
FPC board 1

For details, refer to "*7. Boards*".

(8) Cut off the wire ties on the Joint #4 actuator unit. (Flange of the Arm #4 side)

For details, refer to "*5.5.1 Replacing the Motor Unit: Removal (8)*".

When cutting off the wire ties, be careful not to damage the cables.

(9) Separate the Joint #4 actuator unit from the Arm #5.

Hexagon socket set screw: 10-M3×8 (with plain washer)

(10) Remove the FPC unit.

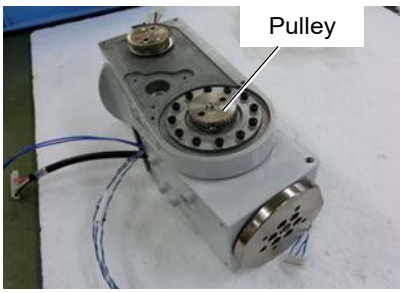
For details, refer to "*4.3. Replacing the FPC Unit*".

(11) Remove the timing belt.

For details, refer to "*5.5.3 Replacing the Timing Belt*".

(12) Remove the non-flanged pulley shown in the photo.

Hexagon socket set screw: 2-M3×8



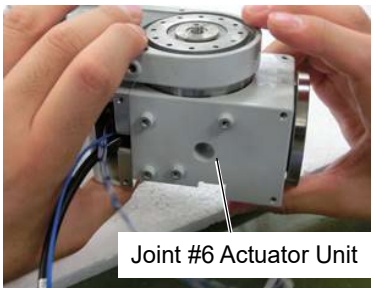
(13) Remove the bolts fixing the Joint #5, #6 actuator unit.

Hexagon socket head cap bolt:
12-M2.5×8 (with plain washer)

(14) Pull the Joint #6 actuator unit by hand, and pull out the shaft from the bearing.

NOTE ☞ The shaft and the wave generator of the reduction gear unit are integrated. The wave generator may come off.

The O-ring (inner diameter ø24 mm, wire diameter ø1.5 mm) will come off when the Joint #6 actuator unit is removed.



(15) Remove the bearing holder.

Cross recessed flat head machine screw:
3-M2×5

(16) Remove the wave generator from the reduction gear unit.

NOTE ☞ Hold the shaft by hand to pull.

(17) Remove the circular spline.

Hexagon socket head cap bolt: 12-M2.5×6

(18) Remove the flexspline.

Hexagon socket head cap bolt: 9-M3×8

(19) Remove the cross roller bearing.

Hexagon socket head cap bolt: 12-M2.5×6

NOTE ☞ The following parts will also be removed when the cross roller bearing is removed.

Wave washer
Bearing (695)
O-ring (inner diameter ø36 mm, wire diameter ø1 mm)

Installation: Joint #5 reduction gear unit

Installation

(1) Assemble the bearing to the cross roller bearing. After assembling the bearing, set the wave washer on it.

Bearing: 695

Wave washer: Inner diameter ø 10 mm
Outside diameter ø 20 mm

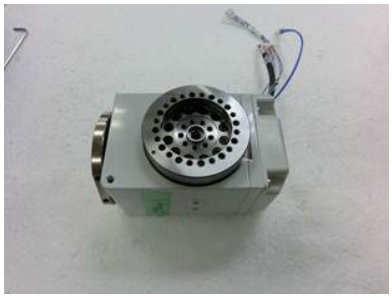
(2) Install the O-ring to the Joint #6 actuator unit. Install the cross roller bearing.

O-ring: Inner diameter ø 36 mm
Wire diameter ø 1 mm

Apply a thin coat of grease (SK-2) to the O-ring.

NOTE

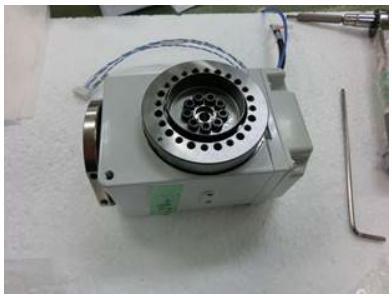
Prevent the following parts from being detached.
Wave washer
Bearing (695)
Cross roller



(3) Install the flexspline to the cross roller bearing.

Hexagon socket head cap bolt: 9-M3×8

Tightening torque: 2.4 ± 0.1 N·m



(4) Apply grease to the flexspline.

Grease: SK-2

Grease amount: 2.9 g

(5) Install the circular spline to the Joint #6 actuator unit.

Hexagon socket head cap bolt: 12-M2.5×6

Tightening torque: 1.4 ± 0.1 N·m

(6) Apply grease to the circular spline.

Grease: SK-2

Grease amount: 0.1 g

(7) Install the wave generator to the reduction gear unit.

NOTE

Install the pulley to the D-cut side of the shaft. Install the wave generator so that the screw hole side can be seen.

(8) Apply grease to the wave generator.

Grease: SK-2

Grease amount: 0.5 g

(9) Install the O-ring to the Arm #4.

O-ring: Inner diameter ø 24mm
Wire diameter ø 1.5mm

Apply a thin coat of grease (SK-2) to the O-ring.

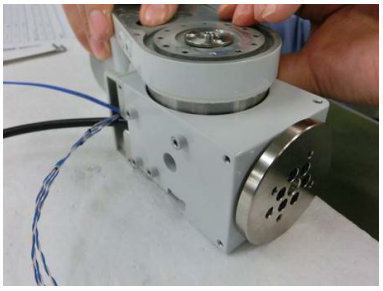
(10) Assemble the bearing to the shaft, and then fix the bearing holder.

Bearing: 2F-WBC6-12

Cross recessed flat head machine screw:
3-M2×5

Tightening torque: 0.3 ± 0.05 N·m

(11) Fix the Joint #5 reduction gear unit to the Arm #4.



Hexagon socket set screw:
12-M2.5×8 (with plain washer)

Tightening torque: 1.4 ± 0.1 N·m

(12) Install the non-flanged pulley to the shaft of the Joint #5 reduction gear unit.

Hexagon socket set screw: 2-M3×8

Tightening torque: 0.9 ± 0.1 N·m

NOTE Fix the set screws while pressing the protruding parts on the pulley to the bearing. Rotate the pulleys so that the set screws touch the D-cut surface on the shaft.

Fix the pulley where the end face of the shaft and that of the pulley match.

(13) Install the FPC unit.

For details, refer to "*4.3. Replacing the FPC Unit*".

(14) Install the Joint #5 motor to the Joint #4 actuator unit.

Hexagon socket set screw: 10-M3×8 (with washer)

Tightening torque: 2.4 ± 0.1 N·m

(15) Install the following board units to the Arm #4.

Board: Encoder board 4, FPC board 1

For details, refer to "*7. Boards*".

(16) Install the timing belt to the Arm #4.

For details, refer to "*5.5.3 Replacing the Timing Belt*".

(17) Fix the cables to the flange of the Joint #4 actuator unit with the wire ties.

For details, refer to "*5.5.1 Replacing the Motor Unit: Removal (7)*".

Wire tie (AB150) : 2 ties

Tightening strength: 85 N ± 5N

(18) Install the following covers.

Arm #4 right side cover
Arm #4 left side cover
Arm #3 side cover

For details, refer to "*3. Covers*".

(19) Perform the calibration.

For details, refer to "*8. Calibration*".

5.5.3 Replacing the Timing Belt

	Name		Quantity	Note
Maintenance Parts	Joint #5 timing belt (260 mm)		1	1698992
	Belt tensile jig*		1	1696718
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Belt tension meter		1	Refer: Unitta U-505

* The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Removal: Joint #5 timing belt

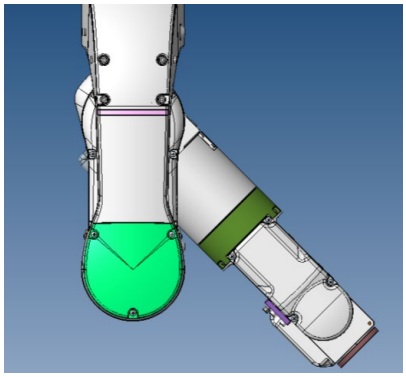
Removal:

(1) Turn ON the Controller.

(2) Release the Joint #2 and #3 brakes.

EPSON RC+ Command

```
> brake off, 2
> brake off, 3
```



(3) Tilt the angle between the Arms #2 and #3 about 45 degrees.

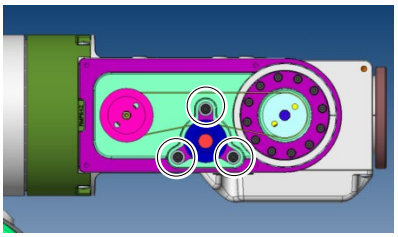
(4) Turn OFF the Controller.

(5) Remove the Arm #4 side cover.

For details, refer to "*3. Covers*".

(6) Remove the idler.

Hexagon socket head cap bolt:
3-M3×8 (with plain washer)



(7) Remove the Joint #5 timing belt.

Installation: Joint #5 Timing Belt

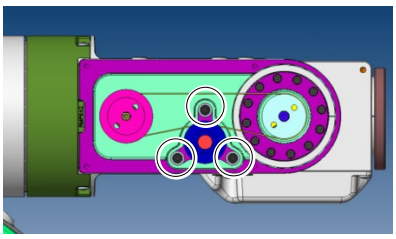
NOTE For details of tightening the hexagon socket head screws, refer to "*2.4 Tightening Hexagon Socket Head Bolts*".

Installation

(1) Set the Joint #5 timing belt around the pulleys.
Check that the teeth of the timing belt engage with these of the pulleys.

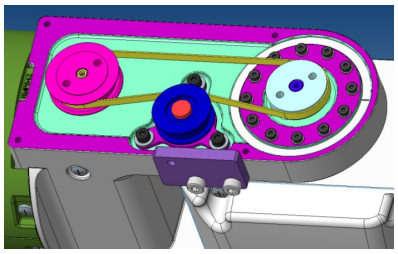
(2) Temporarily fix the idler.

Hexagon socket head cap bolt:
3-M3×8 (with plain washer)



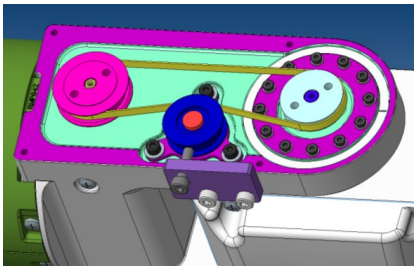
(3) Install the belt tensile jig.

Hexagon socket head cap bolt: 2-M4×12



(4) Install the bolt for pushing the idler to the belt tensile jig.

Hexagon socket head cap bolt:
M4×15 (with polyacetal)



NOTE Push the idler gradually using a rubber sheet as an intermediary so as not to damage the idler.

(5) Use the belt tension meter to apply appropriate tension to the Joint #5 timing belt, and then fix the idler.

Joint #5 timing belt tension: 9.5 ± 2N

Belt tension meter setting value

Weight: 1.3 g/mm width × m span, Width: 4 mm, Span: 89 mm

Hexagon socket head cap bolt: 3-M3×8 (with plain washer)

Tightening torque: 2.4 ± 0.1 N·m

NOTE Regarding belt tension:

- Jumping (position gap) may occur if the value is below the lower limit.
- Vibration (abnormal noise) or reduction of life of the parts may occur if the value exceeds the upper limit.
- A new belt has low tension. Check the tension of the belt after 48 hours of the operation.

(6) Remove the belt tensile jig.

Hexagon socket head cap bolt: 2-M4×12

(7) Install the Arm #4 right side cover.

For details, refer to "*3. Covers*".

5.6 Replacing the Joint #5, #6 Actuator Unit

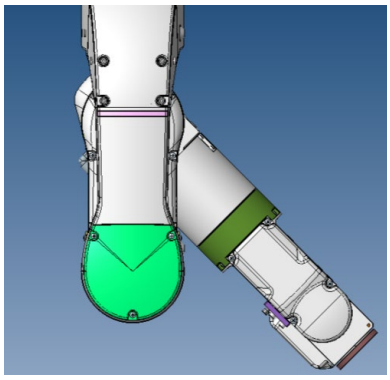
CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance.

	Name	Quantity	Maintenance parts code, remarks
Maintenance Parts	#5, #6 actuator unit	1	1696703
	Wire tie (AB150)	-	1675754 1 bag (100 ties: white)
Tools	Hexagonal wrench (width across flats: 2.5 mm)	1	For M3 hexagon socket head cap bolts
	Cross-point screwdriver (#2)	1	For cross recessed head screws
	Torque wrench	1	For tightening torque control
	Nippers	1	For cutting the wire ties
	Cable tie gun	1	Refer: HellermannTyton MK8
	Cable tie gun tester	1	Refer: HellermannTyton DGT500-MK8

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Removal: Joint #5, #6 actuator unit

Removal:



(1) Turn ON the Controller.

(2) Release the Joint #2 and #3 brakes.

EPSON RC+ Command
> brake off, 2
> brake off, 3

(3) Tilt the angle between the Arms #2 and #3 about 45 degrees.

(4) Turn OFF the Controller.

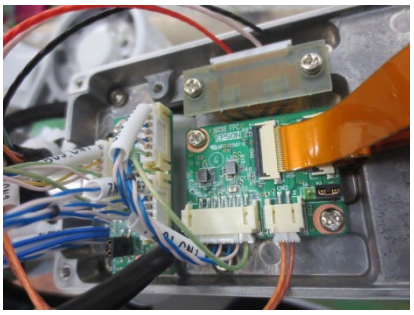
(5) Remove the following covers.

Arm #4 right side cover

Arm #4 left side cover

Arm #3 side cover

For details, refer to "*3. Covers*".



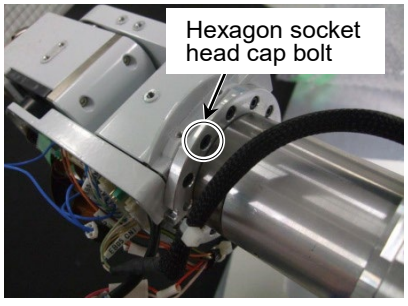
(6) Remove the following connectors.

Connector:
PW5, J6P_01, BR5, EB05_CN1, FL_CN2, FL01_CN1, EB05_CN3, EB0x_CN2

NOTE Be careful that the jumper pins on the board do not come off.

(7) Remove the wire ties (2 ties) from the flange of the Joint #4 actuator unit.

For details, refer to "*5.5.1 Replacing the Motor Unit: Removal (8)*".



(8) Separate the Joint #4 actuator unit from the Arm #5.

Hexagon socket head cap bolt:
10-M3×8 (with plain washer)

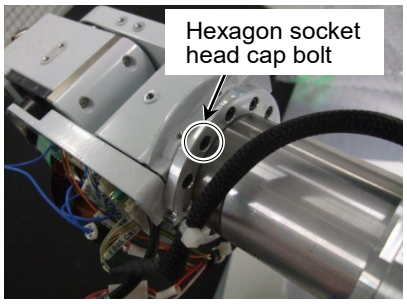
Installation: Joint #5, #6 actuator unit

Installation

(1) Check if there is the O-ring on the Joint #4 actuator unit.

O-ring: Inner diameter ø 51.0 mm
Wire diameter ø 1.5 mm

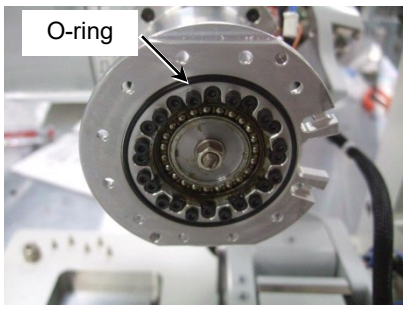
Apply a thin coat of grease (SK-2) to the O-ring.



(2) Install the Joint #5, #6 actuator unit to the Joint #4 actuator unit.

Hexagon socket head cap bolt:
10-M3×8 (with plain washer)

Tightening torque: 2.4 ± 0.1 N·m



(3) Fix the cables to the flange of the Joint #4 actuator unit with the wire ties (2 ties).

Wire tie (AB200) 2 tie

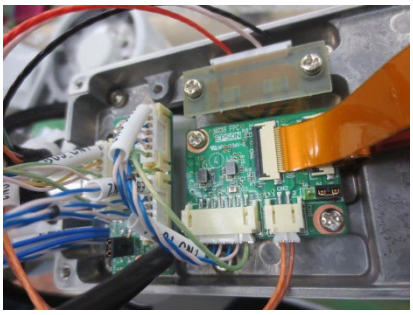
Wire tie tightening strength: 85 ± 5N

For details, refer to "*5.5.1 Replacing the Motor Unit: Removal (7)*".

(4) Connect the following connectors.

Connector:
PW5, J6P_01, BR5, EB05_CN1, FL_CN2, FL01_CN1, EB05_CN3, EB0x_CN2

NOTE Be careful that the jumper pins on the board do not come off.



(5) Install the following covers.

Arm #4 left side cover

Arm #4 right side cover

Arm #3 side cover

For details, refer to "*3. Covers*".

(6) Perform the calibration.

For details, refer to "*8. Calibration*".

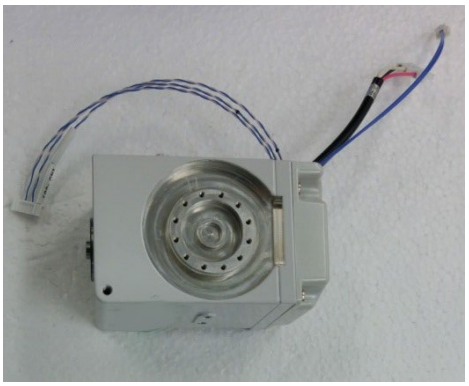
5.7 Replacing the Joint #6 Actuator Unit

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance.

	Name		Quantity	Note
Maintenance Parts	Joint #6 actuator unit		1	1696701
	Belt tensile jig*		1	1696718
Tools	Hexagonal wrench	width across flats: 1.5 mm	1	For M3 hexagon socket set screws
		width across flats: 2.0 mm	1	For M2.5 hexagon socket set screws
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Belt tension meter		1	Refer: Unitta U-505

* The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the
Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.



Joint #6 Actuator Unit

Removal: Joint #6 actuator unit

Removal

(1) Remove the Joint #5 reduction gear unit.

For details, refer to "*5.5.2 Replacing the Reduction Gear Unit*".

(2) Remove the flange.

Hexagon socket head cap bolt: 6-M3×5

Installation: Joint #6 Actuator Unit

NOTE For details of tightening the hexagon socket head screws, refer to "*2.4 Tightening Hexagon Socket Head Bolts*".

Installation

(1) Install the flange to the Joint #6 actuator unit.

Hexagon socket head cap bolt: 6-M3×5

Tightening torque: 2.4 ± 0.1 N·m

(2) Install the Joint #5 reduction gear unit.

For details, refer to "*5.5.2 Replacing the Reduction Gear Unit*".

(3) Install the non-flanged pulley to the shaft of the Joint #5 reduction gear unit.

Hexagon socket set screw: 2-M3×8

Tightening torque: 0.9 ± 0.1 N·m

NOTE Fix the set screws while pressing the protruding parts on the pulley to the bearing. Rotate the pulleys so that the set screws touch the D-cut surface on the shaft.

Fix the pulley while aligning the end face of the shaft and that of the pulley.

(4) Install the FPC unit.

For details, refer to "*4.3. Replacing the FPC Unit*".

(5) Install the board unit to the Arm #4.

Board: Encoder board 4
FPC board 1

For details, refer to "*7. Boards*".

(6) Install the timing belt to the Arm #4.

For details, refer to "*5.5.3 Replacing the Timing Belt*".

(7) Install the following covers.

Arm #4 right side cover

Arm #4 left side cover

For details, refer to "*3. Covers*".

(8) Perform the calibration.

For details, refer to "*8. Calibration*".

6. Battery

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

WARNING	■ Take meticulous care when handling the lithium metal battery. Improper handling of the battery as mentioned below is extremely hazardous and may result in heat generation, leakage, explosion, or inflammation. It also may cause serious safety problems. <Improper Handling> Attempting to charge / Deforming by pressure Disassembling / Short-circuit (Polarity; Positive/Negative) Connecting batteries improperly / Heating (85 °C or more) Exposing to fire / Soldering the terminal of the lithium battery directly Forcing discharge ■ When disposing the battery, consult with the professional disposal services or comply with the local regulation. Make sure that the battery terminal is insulated, even for a used buttery. If the terminal contacts with the other metals, it may short and result in heat generation, leakage, explosion, or inflammation.

In case of the low battery (lithium metal battery) power, the error to warn the voltage reduction occurs at the Controller startup (the software startup). All position data will be lost and you will need to calibrate all joints.

The life span of the lithium metal battery varies depending on the energizing hours and installation environment of the Controller. It is about 3 years as a rough guide (when the Controller is connected to power for 8 hours a day). When the Controller is not connected to power, the battery consumption will significantly increase compared to when the Controller is energized. If warnings of voltage reduction occur, replace the lithium metal battery even if it has not reached the above product life.

NOTE

For the EPSON RC+ 7.0 Ver. 7.2.x or later (firmware Ver.7.2.x.x or later), the recommended replacement time for the battery can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.

For details, refer to the following manual.

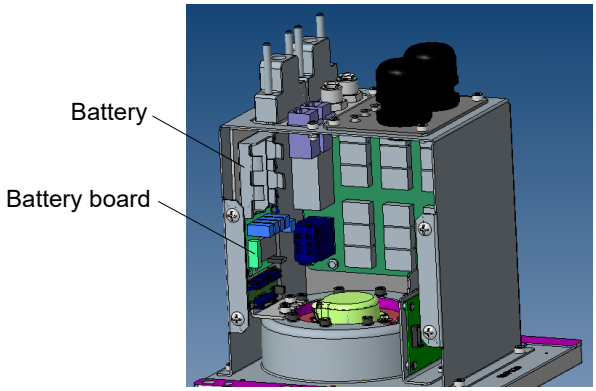
RC700 series Maintenance Manual 6. Alarm

The battery may run out if it passes the recommended replacement time.

If no warnings of voltage reduction occur, the calibration for all joints is not necessary. You need to perform calibration if the position moves from the originals after replaced the battery.

Always use the lithium metal battery and battery board designated by us.

Be careful of the battery polarity to connect it correctly.

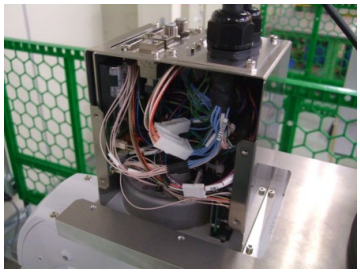


	Name	Quantity	Note
Maintenance Parts	Battery	1	2172925 (2 lithium metal batteries for replacement)
	Battery board	1	2173216
Tools	Cross-point screwdriver (#2)	1	For cross recessed head screws
	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts

6.1 Replacing the Battery Unit (Lithium Metal Battery)

(1) Turn OFF the Controller.

(2) Remove the base cover.



See the following section if the base cover cannot be removed due to a fixing pillar in the installation place.

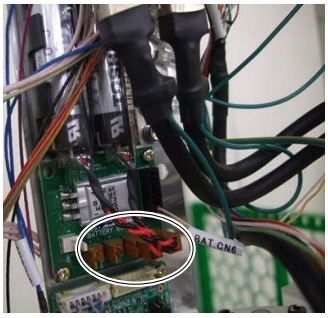
For details, refer to "*3. Covers*".

(3) Remove the battery from the battery box.

NOTE ☞ Do not remove the connector.
If you removed all the batteries before connecting the new ones, the calibration data will be deleted and you will need to perform calibration.
Follow the steps below to remove the lithium metal batteries.

(4) Connect the two new batteries to the connectors of the battery board which are not connected to anything.

(5) Remove the old batteries.
Hold the board by hand and pull the battery cable upward to remove the connector.



(6) Install the battery to the battery box.

(7) Install the base cover.

For details, refer to "*3. Covers*".

(8) Turn ON the Controller.

(9) Check operation to see if the Manipulator's position and posture are out of position.
Move the Manipulator to two or three points (poses) of the registered points.

(10) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

6.2 Replacing the Battery Board

After parts (actuator units, timing belts, etc.) or the battery board have been replaced, the Manipulator cannot perform positioning properly because a gap exists between the origin stored in each actuator unit and its corresponding origin stored in the Controller.
After replacing the parts, it is necessary to match these origins.
The process of aligning the two origins is called “Calibration”.

Refer to “*8. Calibration*” and follow the steps to perform calibration.

Removal

(1) Turn OFF the Controller.

(2) Remove the base cover.

For details, refer to “*3. Covers*”.

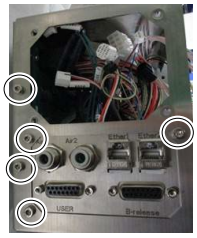
(3) Remove the M/C cable.

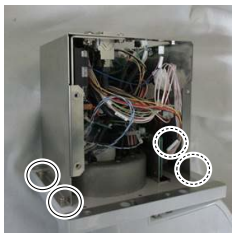
For details, refer to “*4.4 Replacing the M/C Cable*”.

(4) Remove the brake release connector.

(5) Remove the base.

Hexagon socket head cap bolt:
9-M4×8





(6) Remove the batteries from the battery box.

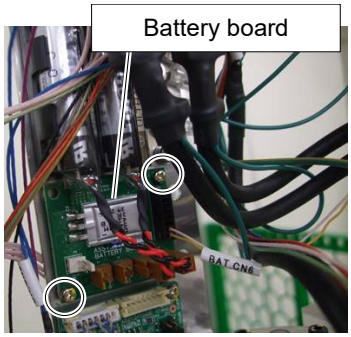
(7) Remove the battery connectors.

NOTE

Hold the board by hand and pull the battery cable upward to remove the connector.

(8) Remove the connectors from the battery board.

Connector: BAT_CN3,
BAT_CN6



(9) Remove the battery board fixed to the fixing plate.

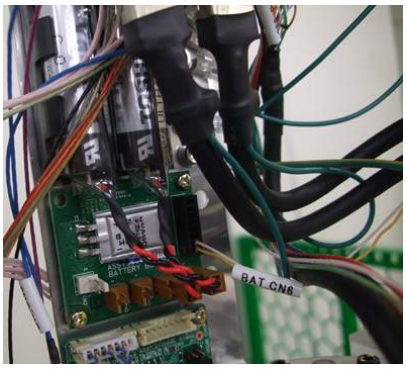
Cross recessed head screw: 2-M3×6

Installation

(1) Install the battery board to the fixing plate.

Cross recessed head screw: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m



(2) Connect the connectors to the battery board.

Connector: BAT_CN3,
BAT_CN6

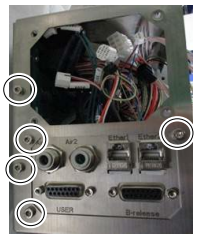
(3) Connect the battery connectors.

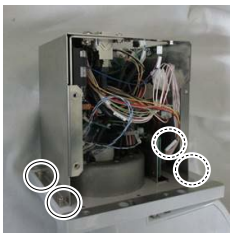
(4) Install the batteries to the battery box.

(5) Install the base.

Hexagon socket head cap bolt: 9-M4×8

Tightening torque: 4.0 ± 0.2 N·m





NOTE Be careful not to get the cables caught in the base.

(6) Install the brake release connector.

NOTE The user cable connector and the brake release connector have the same shape. Be careful not to connect the wrong connector.

(7) Install the M/C cable.

For details, refer to "*4.4 Replacing the M/C Cable*".

(8) Install the base cover.

For details, refer to "*3. Covers*".

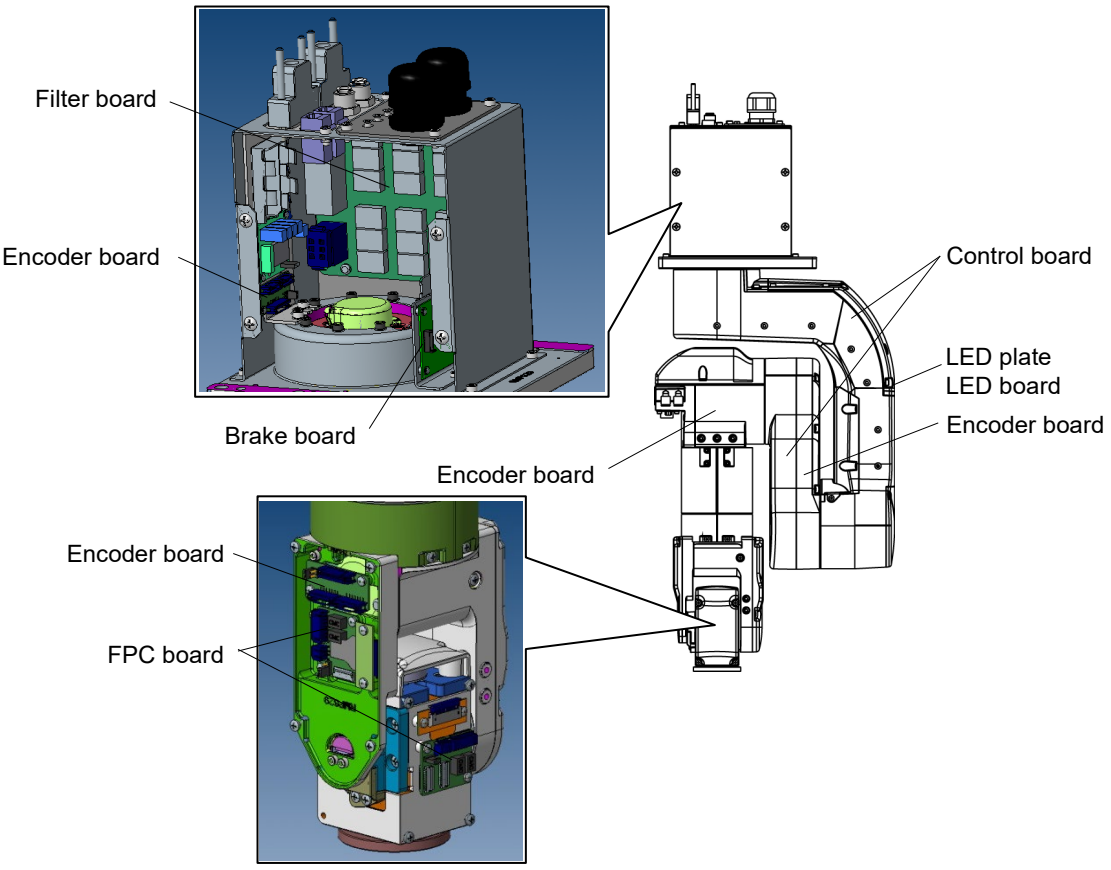
(9) Perform calibration.

For details, refer to "*8. Calibration*".

7. Boards

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

Always use the boards designated by us.



	Name	Quantity	Note
Maintenance Parts	Control board (1, 2)	1	2138032
	Encoder board (1, 2, 3, 4)	1	2179137
	Filter board	1	2178380
	Brake board	1	2178379
	FPC board (1, 2)	1	2179138
	LED board	1	2178376
Tools	Short head hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)	1	For cross recessed head screws

7.1 Replacing the Control Board 1

Removal

(1) Turn OFF the Controller.

(2) Remove the Arm #1 outside cover.

For details, refer to "*3. Covers*".

NOTE ☞ The cables are connected to the Arm #1 outside cover.
When removing the cover, be careful not to pull the cables forcibly.

(3) Remove the connector connected to the LED board.

Connector: LED_CN1

(4) Remove the connector connected to the control board 1.

Connector: GS

(5) Remove the control board fixed to the Arm #1.

Cross recessed head screw: 4-M3×6

NOTE ☞ Be careful not to drop the screws inside the Manipulator while removing them.

Installation

(1) Install the control board 1 to the Arm #1.

Cross recessed head screw: 4-M3×6

Tightening torque: 0.45 ± 0.05 N·m

NOTE ☞ Be careful not to drop the screws inside the Manipulator while installing them.

(2) Connect the connector to the control board 1.

Connector: GS01

(3) Connect the connector to the LED board 1.

Connector: LED_CN1

(4) Install the Arm #1 outside cover.

For details, refer to "*3. Covers*".

NOTE ☞ Be careful not to get the cables caught in the cover.

(5) Turn ON the Controller.

(6) Check operation to see if the Manipulator's position and posture are out of position.
Move the Manipulator to two or three points (poses) of the registered points.

(7) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

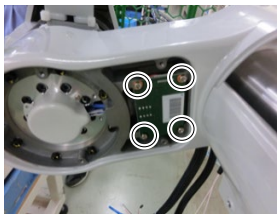
7.2 Replacing the Control Board 2

Removal

(1) Remove the Arm #2 inside cover.

For details, refer to "*3. Covers*".

(2) Remove the control board 2.



Cross recessed head screw: 4-M3×6

NOTE ☞ The cables are connected to the control board 2. When removing the board, be careful not to pull the cables forcibly.

(3) Remove the connector connected to the control board 2.

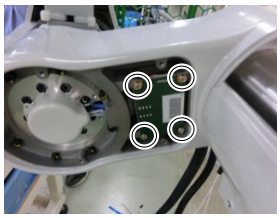
Connector: GS02

Installation

(1) Connect the connector to the control board 2.

Connector: GS02

(2) Install the control board 2 to the Arm #2.



Cross recessed head screw: 4-M3×6

Tightening torque: 0.45 ± 0.05 N·m

(3) Install the Arm #2 inside cover.

For details, refer to "*3. Covers*".

(4) Turn ON the Controller.

(5) Check operation to see if the Manipulator's position and posture are out of position. Move the Manipulator to two or three points (poses) of the registered points.

(6) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

7.3 Replacing the Encoder Board 1

Removal

(1) Turn ON the Controller.

(2) Remove the base cover.

For details, refer to "*3. Covers*".

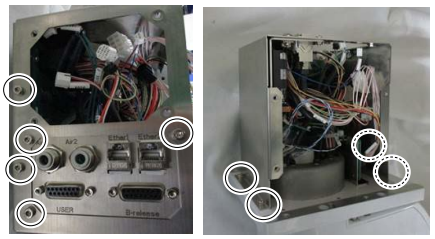
(3) Remove the M/C cable.

For details, refer to "*4.4 Replacing the M/C Cable*".

(4) Remove the brake release connector.

(5) Remove the base.

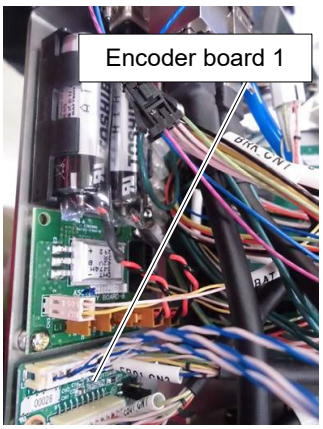
Hexagon socket head cap bolt: 9-M4×8



(6) Remove the connectors connected to the encoder board 1.

Connector:
EB01_CN1, EB01_CN3, EB0x_CN2

NOTE ☞ Be careful that the jumper pins on the board do not come off.



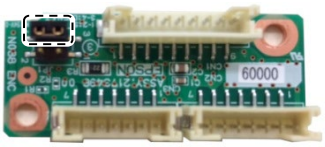
(7) Remove the encoder board 1.

Cross recessed head screw: 4-M3×6

CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

Installation

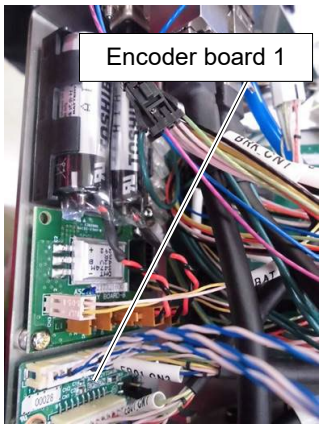
(1) Check that the jumper pin of the encoder board 1 is at “3-4 short”.



(2) Install the encoder board 1 to the user wire plate.

Cross recessed head screw: 4-M3×6

Tightening torque: 0.45 ± 0.05 N·m



(3) Connect the connectors to the encoder board 1.

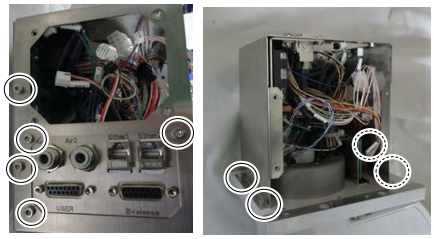
Connector:
EB01_CN1, EB01_CN3, EB0x_CN2

NOTE Be careful that the jumper pins on the board do not come off.

(4) Install the base.

Hexagon socket head cap bolt: 9-M4×8

Tightening torque: 4.0± 0.2 N·m



NOTE Be careful not to get the cables caught in the base.

(5) Install the brake release connector.

NOTE The user cable connector and the brake release connector have the same shape. Be careful not to connect the wrong connector.

(6) Install the M/C cable.

For details, refer to “*4.4 Replacing the M/C Cable*”.

(7) Install the base cover.

For details, refer to "*3. Covers*".

(8) Turn ON the Controller.

(9) Calibrate all the Joints.

For details, refer to "*8. Calibration*".

7.4 Replacing the Encoder Board 2

Removal

(1) Remove the Arm #2 outside cover.

For details, refer to "*3. Covers*".

Remove the connectors connected to the encoder board 2.

Connector: EB02_CN1
EB0x_CN2 (Joint #2 side)
EB0x_CN2 (Joint #3 side)

NOTE Be careful that the jumper pins on the board do not come off.

(2) Remove the encoder board 2.

Cross recessed head screw: 2-M3×6

NOTE Be careful not to drop the screws inside the Manipulator while removing them.

CAUTION

■ Improper jumper pin settings may result in occurrence of the errors such as below.
Example:
5042: Position error overflow in high power state.
Check the power cable connection, the robot, the driver and the motor.
When replacing the boards, be careful not to configure them incorrectly.

Installation

(1) Change the position of the jumper pin on the encoder board 2 to "1-2 short".

(2) Install the encoder board 2 to the Arm #2.

Cross recessed head screw: 4-M3×6

Tightening torque: 0.45 ± 0.05 N·m

NOTE Be careful not to drop the screws inside the Manipulator while removing them.

(3) Connect the connectors to the encoder board 2.

Connector: EB02_CN1
EB0x_CN2 (Joint #2 side)
EB0x_CN2 (Joint #3 side)

NOTE Be careful that the jumper pins on the board do not come off.

(4) Install the Arm #2 outside cover.

For details, refer to "*3. Covers*".

(5) Turn ON the Controller.

(6) Calibrate the Joints #2 and #3.
For details, refer to "*8. Calibration*".

7.5 Replacing the Encoder Board 3

Removal

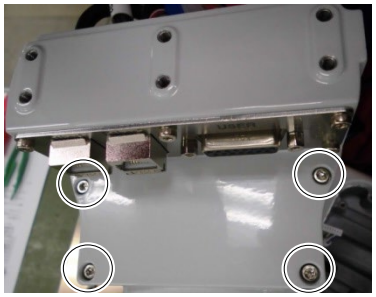
(1) Remove the Arm #3 upper cover.

For details, refer to "*3. Covers*".

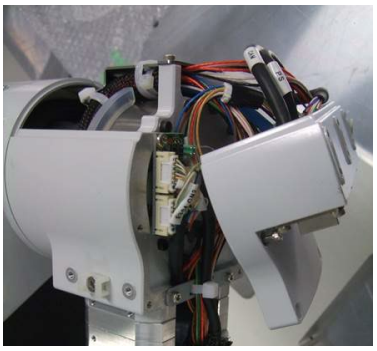
(2) Remove the Arm #3 outside cover.

Hexagon socket head cap bolt: 4-M3×15

For details, refer to "*3. Covers*".

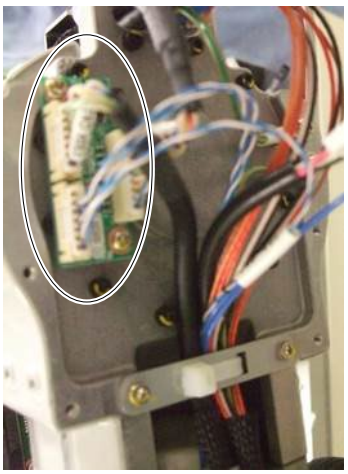


NOTE ☞ The cables are connected to the Arm #3 outside cover. When removing the cover, be careful not to pull the cables forcibly.



(3) Remove the connectors connected to the encoder board 3.

Connector: EB04_CN1, EB04_CN3,
EB0x_CN2



NOTE ☞ Be careful that the jumper pins on the board do not come off.

(4) Remove the encoder board 3.

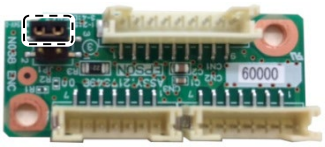
Cross recessed head screw: 2-M3×6

NOTE ☞ Be careful not to drop the screws inside the Manipulator while removing them.

CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

Installation

(1) Check that the jumper pin of the encoder board 3 is at “3-4 short”.

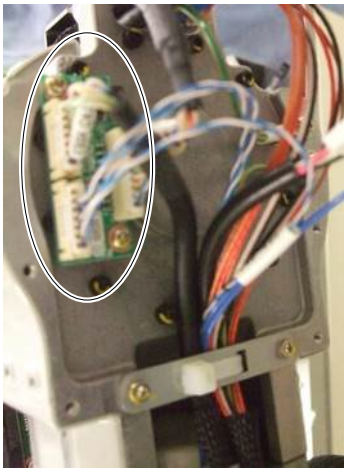


(2) Install the encoder board 3 to the Arm #2.

Cross recessed head screw: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

NOTE Be careful not to drop the screws inside the Manipulator while removing them.



(3) Connect the connectors to the encoder board 3.

Connector: EB04_CN1, EB04_CN3, EB0x_CN2

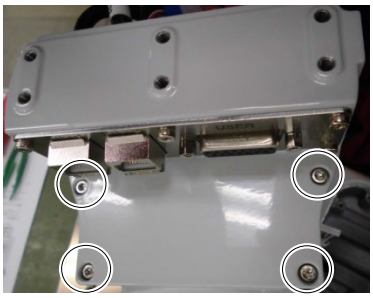
NOTE Be careful that the jumper pins on the board do not come off.

(4) Install the Arm #3 outside cover.

Hexagon socket head cap bolt: 4- M3×15

Tightening torque: 2.0 ± 0.1 N·m

For details, refer to “*3. Covers*”.



NOTE Be careful not to get the cables caught in the base.

(5) Install the Arm #3 upper covers.

For details, refer to “*3. Covers*”.

(6) Turn ON the Controller.

(7) Calibrate the Joints #4, #5, and #6.

For details, refer to “*8. Calibration*”.

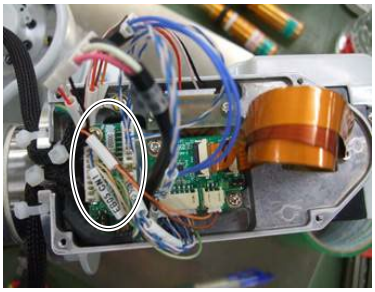
7.6 Replacing the Encoder Board 4

Removal

(1) Remove the Arm #4 left side cover.

For details, refer to "*3. Covers*".

(2) Remove the connectors connected to the encoder board 4.



Connector: EB05_CN1, EB05_CN3,
EB0x_CN2

NOTE Be careful that the jumper pins on the board do not come off.

(3) Remove the encoder board 4.

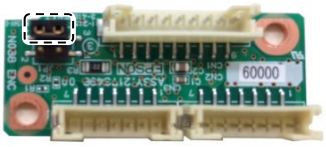
Cross recessed head screw: 2-M3×6

NOTE Be careful not to drop the screws inside the Manipulator while removing them.

CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

Installation

(1) Check that the jumper pin of the encoder board 4 is at "3-4 short".



(2) Install the encoder board 4 to the Arm #4.

Cross recessed head screw: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

NOTE Be careful not to drop the screws inside the Manipulator while installing them.

(3) Connect the connectors to the encoder board 4.

Connector: EB05_CN1, EB05_CN3, EB0x_CN2

NOTE Be careful that the jumper pins on the board do not come off.

(4) Install the Arm #4 left side cover.

For details, refer to "*3. Covers*".

(5) Turn ON the Controller.

(6) Calibrate the Joints #5 and #6.

For details, refer to "*8.Caribration*".

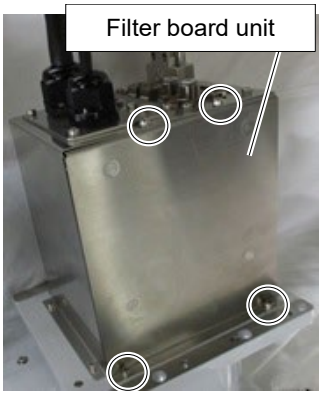
7.7 Replacing the Filter Board

Removal

(1) Turn OFF the Controller.

(2) Remove the filter board unit.

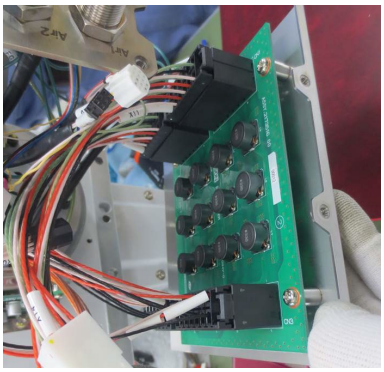
Hexagon socket head cap bolt: 4-M4×8



NOTE The cables are connected to the filter board unit. When removing the board, be careful not to pull the cables forcibly.

(3) Remove the connectors connected to the filter board.

Connector:
FIL_CN1, FIL_CN2, FIL_CN3, FIL_CN4



(4) Remove the filter board.

Cross recessed head screw: 4-M4×8

Installation

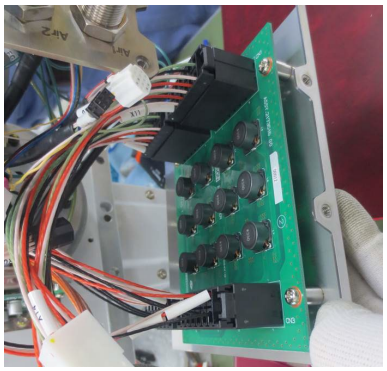
(1) Install the filter board to the base of the filter board unit.

Cross recessed head screw: 4-M4×8

Tightening torque: 0.6 ± 0.1 N·m

(2) Connect the connectors to the filter board.

Connector:
FIL_CN1, FIL_CN2, FIL_CN3, FIL_CN4



(3) Install the filter board unit to the base.

Hexagon socket head cap bolt: 4-M4×8

Tightening torque: 4.0 ± 0.2 N·m

NOTE

Be careful not to get the cables caught in the base.

(4) Turn ON the Controller.

(5) Check operation to see if the Manipulator's position and posture are out of position. Move the Manipulator to two or three points (poses) of the registered points.

(6) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

7.8 Replacing the Brake Board

Removal

(1) Turn OFF the Controller.

(2) Remove the base cover.

For details, refer to "*3. Covers*".

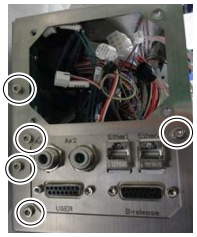
(3) Remove the M/C cable.

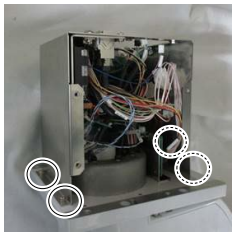
For details, refer to "*4.4 Replacing the M/C Cable*".

(4) Remove the brake release connector.

(5) Remove the base.

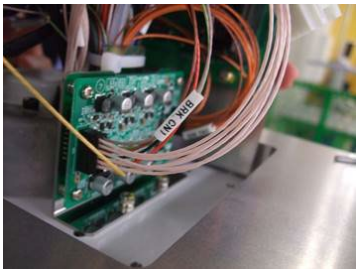
Hexagon socket head cap bolt: 9-M4×8





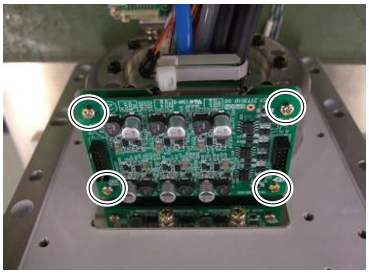
(6) Remove the connectors connected to the brake board.

Connector: BRK_CN1, BRK_CN2



(7) Remove the brake board.

Cross recessed head screw: 4-M3×6

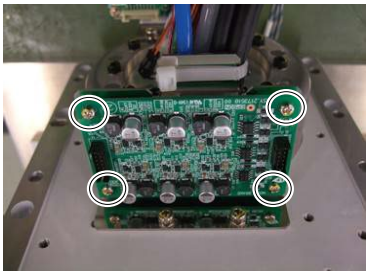


Installation

(1) Install the brake board to the plate inside the base.

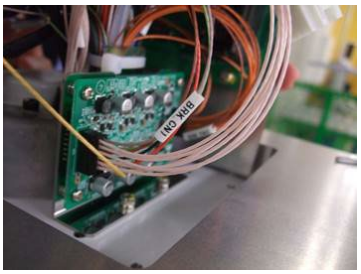
Cross recessed head screw: 4-M3×6

Tightening torque: 0.45 ± 0.05 N·m



(2) Connect the connectors to the brake board.

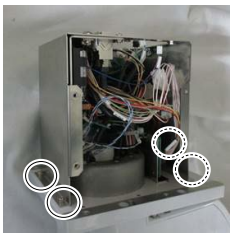
Connector: BRK_CN1, BRK_CN2



(3) Install the base.

Hexagon socket head cap bolt: 9-M4×8

Tightening torque: 4.0 ± 0.2 N·m



NOTE ☞ Be careful not to get the cables caught in the base.

(4) Install the brake release connector.

NOTE ☞ The user cable connector and the brake release connector have the same shape. Be careful not to connect the wrong connector.

(5) Install the M/C cable.

For details, refer to "*4.4. Replacing the M/C Cable*".

(6) Install the base cover.

For details, refer to " *3. Covers*".

(7) Turn ON the Controller.

7.9 Replacing the FPC board 1

NOTE
Be careful that the jumper pins on the board do not come off.

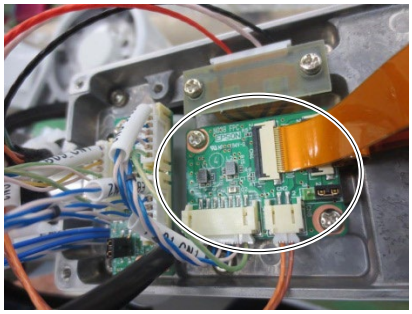
Removal

(1) Remove the Arm #4 left side cover.

For details, refer to "*3. Covers*".

(2) Remove the connectors connected to the FPC board 1.

Connector: FL01_CN1, FL_CN2



(3) Remove the FPC board 1.

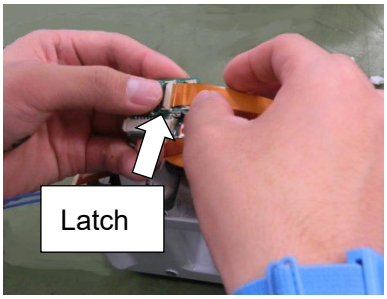
Cross recessed head screw: 2-M3×6

NOTE
Be careful not to drop the screws inside the Manipulator while removing them.

NOTE
The FPC are connected to the board.
When removing them, be careful not to pull forcibly.

(4) Remove the FPC from the FPC board 1.

NOTE
Lift up the black latch on the board side connectors to remove the connectors.
If the connectors are removed while the latch is not lifted up, the FPC may get damaged.

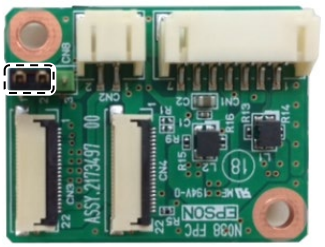


CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

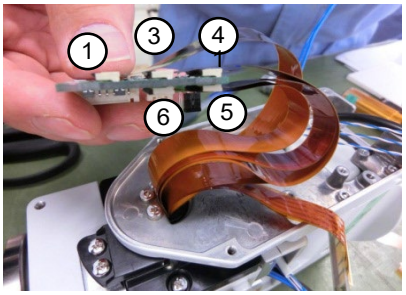
NOTE
Be careful that the jumper pins on the board do not come off.

Installation

(1) Check that the jumper pin of the FPC board 1 is at "1-2 short".



(2) Connect the FPC to the FPC board 1.



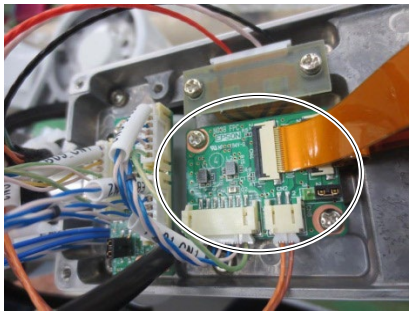
NOTE
Layer the FPC on top of one another neatly so that the orange parts come to the front side of the board (where two connectors are located). See the photo for the installation order of FPC. (1, 3, and 4 are at the back side of the board)

Insert the FPC with the black latch lifted up, and then lower the latch to fix it.

Connect the FPC correctly.
Operating the Manipulator with incorrect connection may cause malfunction.

Insert the FPC connectors firmly to the end.

(3) Install the FPC board 1 to the Arm #4.



Cross recessed head screw: 2-M3×6

Tightening torque: 0.45 ± 0.05 Nm

NOTE
Be careful not to drop the screws inside the Manipulator while removing them.

(4) Connect the connectors to the FPC board 1.

Connector: FL01_CN1, FL_CN2

(5) Install the Arm #4 left side cover.

For details, refer to "*3. Covers*".

(6) Calibrate the Joints #5 and #6.

For details, refer to "*8. Calibration*".

7.10 Replacing the FPC Board 2

NOTE
Be careful that the jumper pins on the board do not come off.

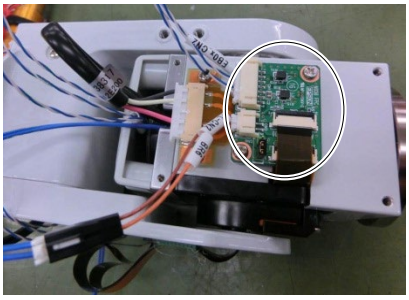
Removal

(1) Remove the Arm #5 outside cover.

For details, refer to "*3. Covers*".

(2) Remove the connectors connected to the FPC board 2.

Connector: EB0x_CN2, FL_CN2



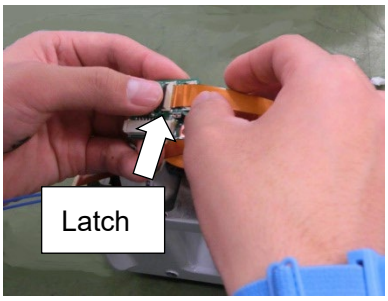
(3) Remove the FPC board 2.

Cross recessed head screw: 2-M3×6

NOTE
Be careful not to drop the screws inside the Manipulator while removing them.

NOTE
The FPC are connected to the board.
When removing them, be careful not to pull forcibly.

(4) Remove the FPC from the FPC board 2.



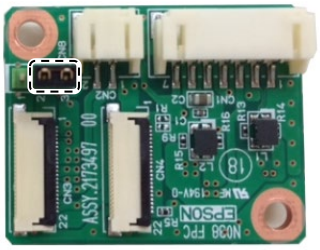
NOTE
Lift up the black latch on the board side connectors to remove the connectors.
If the connectors are removed while the latch is not lifted up, the FPC may get damaged.

CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

NOTE Be careful that the jumper pins on the board do not come off.

Installation

(1) Change the position of the jumper pin on the FPC board 2 to “2-3 short”.



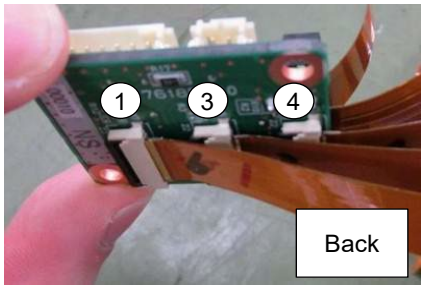
(2) Connect the FPC to the FPC board 2.

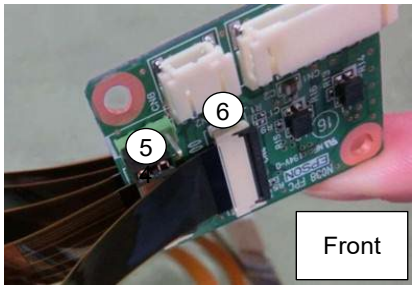
NOTE Layer the FPC on top of one another so that the black parts come to the back side of the board (where two connectors are located).
See the photo for the installation order of FPC.

Insert the FPC with the black latch lifted up, and then lower the latch to fix it.

Connect the FPC correctly.
Operating the Manipulator with incorrect connection may cause malfunction.

Insert the FPC connectors firmly to the end.

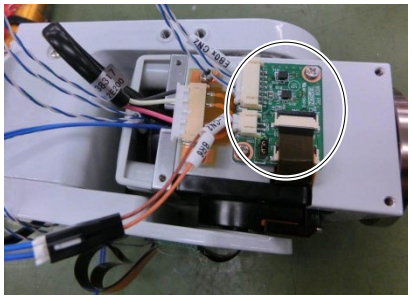




(3) Install the FPC board 2 to the Arm #5.

Cross recessed head screw: 2-M3×6

Tightening torque: 0.45 ± 0.05 Nm



NOTE Be careful not to drop the screws inside the Manipulator while removing them.

(4) Connect the connectors to the FPC board 2.

Connector: EB0x_CN2, FL_CN2

(5) Install the Arm #5 side cover.

For details, refer to “*3. Covers*”.

(6) Calibrate the Joints #5 and #6.

For details, refer to “*8. Calibration*”.

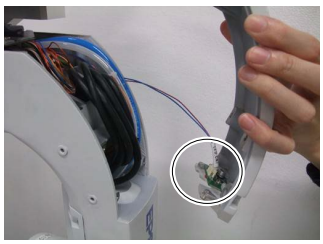
7.11 Replacing the LED Board

Removal

(1) Turn OFF the Controller.

(2) Remove the Arm #1 outside cover.

For details, refer to "*3. Covers*".



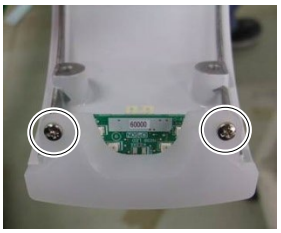
NOTE ☞ The cables are connected to the Arm #1 outside cover. When removing the cover, be careful not to pull the cables forcibly.

(3) Remove the connector connected to the LED board.

Connector: LED_CN1

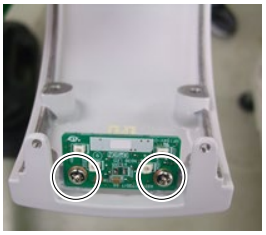
(4) Remove the LED plate.

Cross recessed head screw: 2-M3×6



(5) Remove the LED board.

Cross recessed head screw: 2-M3×6

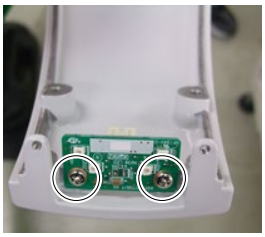


Installation

(1) Install the LED board to the Arm #1 outside cover.

Cross recessed head screw: 2-M3×6

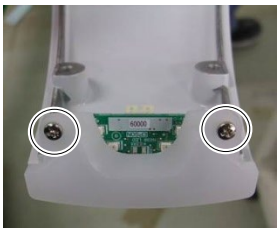
Tightening torque: 0.45 ± 0.1 N·m



(2) Install the LED plate to the Arm #1 outside cover.

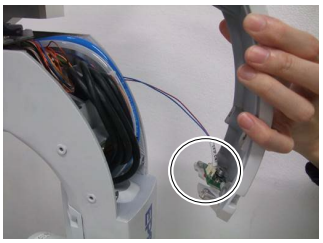
Cross recessed head screw: 2-M3×6

Tightening torque: 0.45 ± 0.1 N·m



(3) Connect the connector to the LED board 1.

Connector: LED_CN1



(4) Install the Arm #1 outside cover.

For details, refer to "*3. Covers*".

NOTE

Be careful not to get the cables caught in the base.

8. Calibration

8.1. Overview

After parts (actuator units, timing belts, etc.) or the battery board have been replaced, the Manipulator cannot perform positioning properly because a gap exists between the origin stored in each actuator unit and its corresponding origin stored in the Controller.
After replacing the parts, it is necessary to match these origins.
The process of aligning the two origins is called “Calibration”.
Note that calibration is not the same as teaching*

* “Teaching” means to teach the Controller coordinate points (including poses) anywhere in the operating area of the Manipulator.

WARNING	■ To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the *Installation and Design Precautions* in the *Safety* chapter of the *EPSON RC+ User’s Guide*. ■ Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted (low speeds and low power) status to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly.

There are two methods to move the Manipulator during calibration.

- Releasing the Solenoid brake and moving the arms manually.
  For details, refer to N series Manual “*N2 Manipulator*”-“*1.6 How to Move Arms with the Solenoid brake*”.
- Moving the Manipulator using Jog & Teach.
  For details of Jog & Teach, refer to the following manual.
  EPSON RC+ User's Guide 5.12.1 [Robot Manager] Command (Tools Menu)-[Jog and Teach]

Moving the Manipulator while releasing the Solenoid brake involves risk as described below.

CAUTION	■ Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may cause hands and fingers to be caught and/or equipment damage to or malfunction of the Manipulator as the arms of the Manipulator may move in unexpected directions. ■ Be careful of the arm falling when releasing the brake. While the brake is being released, the Manipulator’s arm falls by its own weight. The arm falling may cause hands and fingers to be caught and/or may cause equipment damage to or malfunction of the Manipulator.

Also, pay attention to the following points at the encoder initialization.

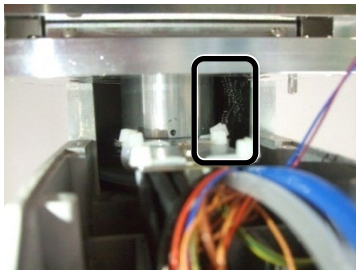
CAUTION	■ The Joint #1 and Joint #4 have no mechanical stops and they may be rotated more than 360 degrees. If the encoder initialization is performed with improper posture, the Manipulator moves outside the operation range. If the Manipulator was moved outside the operation range, the internal wiring may be damaged by being twisted or pinched and it may result in Manipulator malfunction.

NOTE

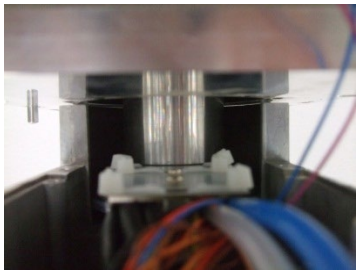
When the origin positions of the Joint #1 and #4 are uncertain, check torsion of the internal cables. The origin positions are where the Manipulator has the internal cables not twisted at the basic orientation described in *N series Manual "N2 Manipulator"- "3.8 Checking the Basic Orientation*".
Torsion of the internal cables can be checked by removing the following covers.

Joint #1 : Joint #1 cover, Arm #1 cover

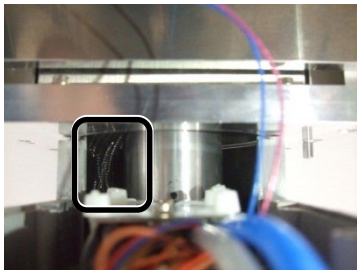
Joint #4 : Arm #3 side covers, Arm #3 upper side covers



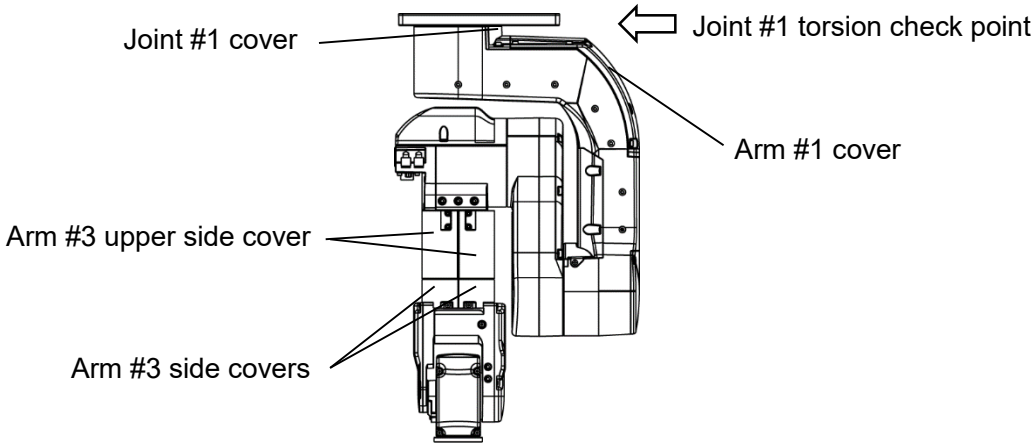
When J1: +180°
Black cable is on
the right side



When J1: 0°
Black cable
cannot be seen



When J1: -180°
Black cable is on
the left side



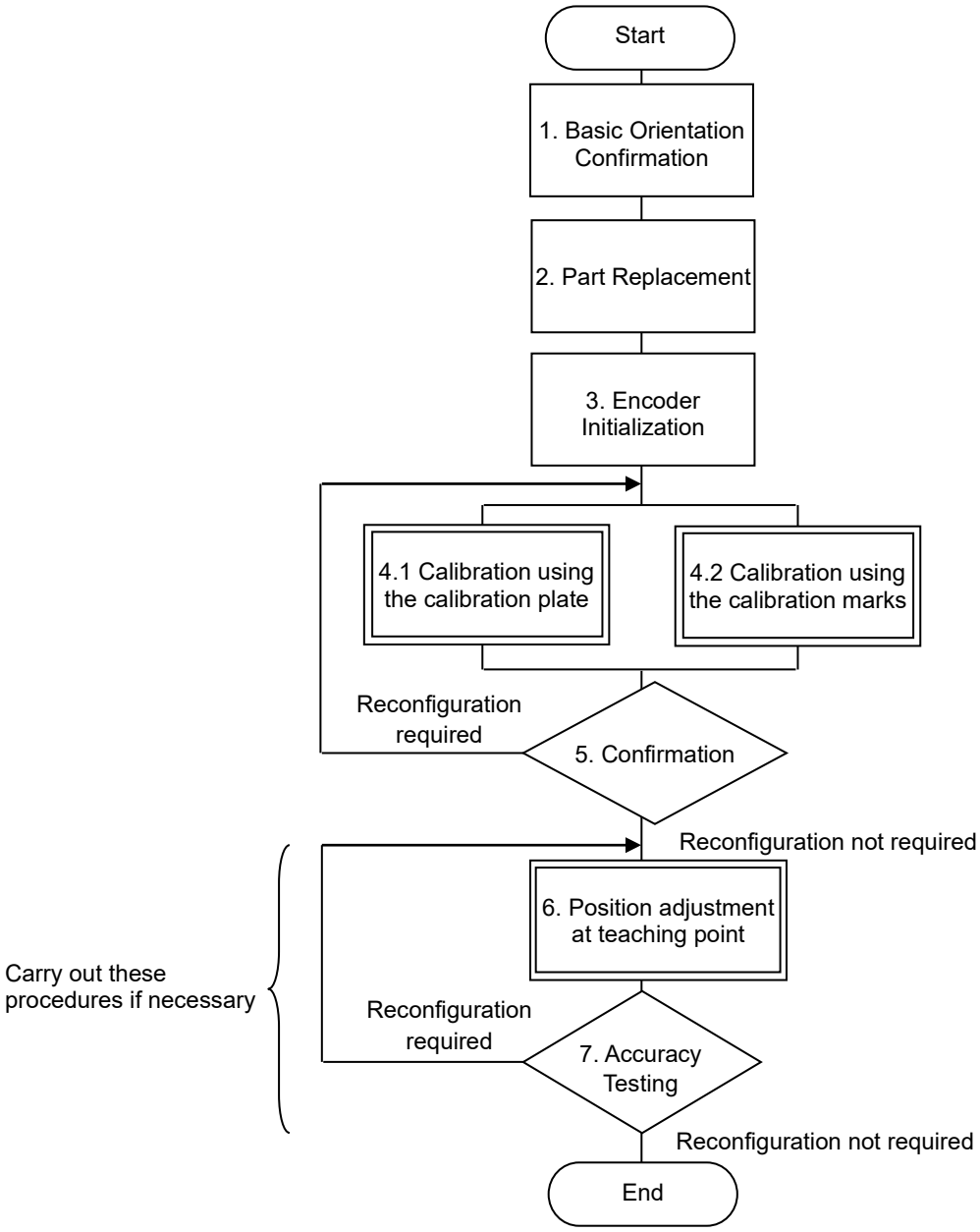
When J4: +180°

When J4: 0°

When J4: -180°

NOTE
- For details about the basic orientation, refer to *N series Manual "N2 Manipulator"* - "*3.8 Checking the Basic Orientation*".

Calibration Flowchart



8.2. Calibration Procedure

Calibration methods

There are two methods to perform calibration.

Calibration using the calibration plates:
By aligning the Manipulator to the calibration plate, all the axes can be calibrated at once.

Calibration using the calibration marks:
By performing calibration at the points where the calibration marks match each other, the axes can be calibrated individually. When the Manipulator cannot have the basic orientation, calibration by this method is available by defining the reference orientation and putting the “match marks”.

Command Input

Command execution is required in some calibration procedures.
Select the EPSON RC+ menu-[Tools]-[Command Window].

This step is omitted in the calibration procedures.

Jog Motion

Setting of the jog motion is required in some calibration procedures.
Select EPSON RC+ menu-[Tools]-[Robot Manager] and select the [Jog & Teach] page.

The panel, window, and page above are indicated as [Jog & Teach] in the calibration procedures.

Follow the steps 1 to 5 to calibrate the Manipulator.

1. Basic Orientation Confirmation

The calibration is performed with the basic orientation of the Manipulator.
For details about the basic orientation, refer to *N series Manual "N2 Manipulator"*-"*3.8 Checking the Basic Orientation*".

When the Manipulator cannot have the basic orientation, define the reference orientation in advance, and record the point data. Also, put the "match marks" to indicate the orientation.

The coordinate points including the Arm orientation are referred to as "points", and the data of the points are called "point data" in the EPSON RC+.

Follow the steps 1 through 3, and then choose either method at the step 4.

Calibration at Basic Orientation:
Step 4-1. Calibration using the calibration plate

Calibration using the calibration marks:
Step 4-2. Calibration using the calibration marks

2. Part Replacement

Replace the parts as instructed in this manual.
Be careful not to injure yourself or damage parts during part replacement.

3. Encoder Initialization:

Connect the cables and turn ON the Controller while all joints are in the motion range.

The error message "Encoder alarm has occurred. Check robot battery. EPSON RC+ must be restarted." will be displayed on the EPSON RC+ window.

Initialize the encoder at the current Manipulator position and reset the error.

Initialize the encoder using one of the following procedures.

Execute the following command in the [Command Window] to initialize the encoder.

EPSON RC+

`>Encreset` [The joint number (1 to 6) of the encoder to be reset]

Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

4. Calibration

4-1. Calibration using the calibration plate

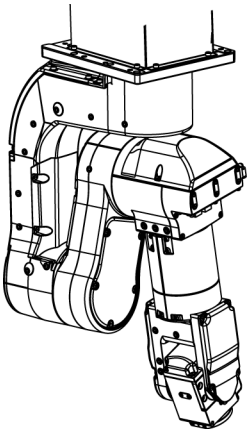
Prepare the following parts to perform calibration using the calibration plate.

Parts	Quantity
Calibration plate	1
Arm #4 offset jig	1
Arm #6 offset jig	1
Hexagon socket head cap bolts (M4×15)	8
Hexagon socket head cap bolts (M4×20)	4
J1 origin point pin	1
Hexagon socket head cap bolts (M2.5×20)	1
Plain washer for M4 (small washer)	8

4-1-1 Move the Manipulator to the basic orientation.

EPSON RC+

Set the jog mode to “Joint” in the [Jog & Teach] panel, and then move the Manipulator in Jog motion so that each axis has the basic orientation (0 pulse position).
At this moment, move the Manipulator to have the posture as shown in the photo on the right in order to install the calibration plate easily.

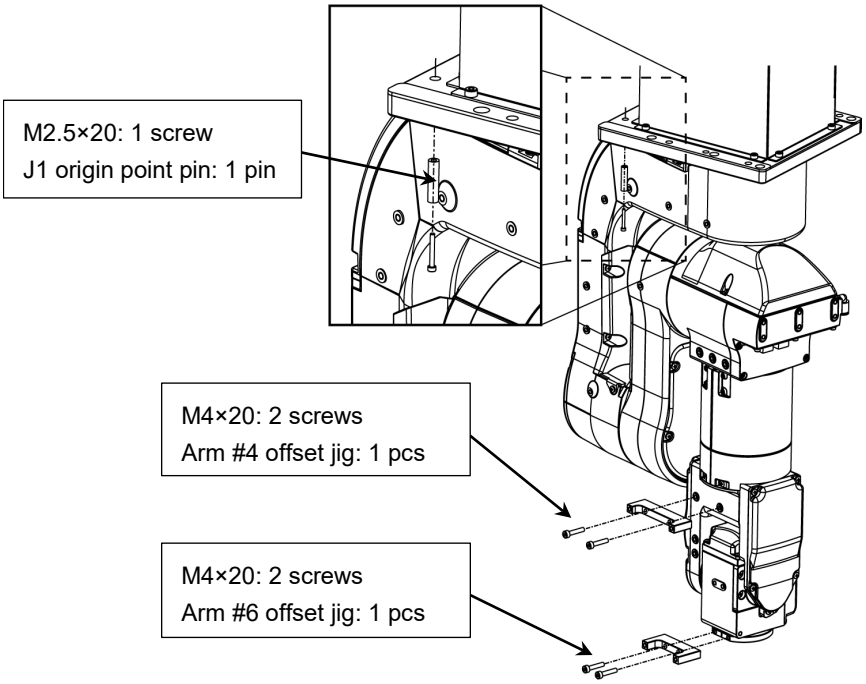


4-1-2 Use the calibration plate to align each joint to the origin posture.

NOTE

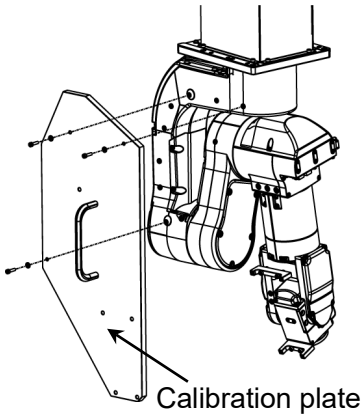
Be careful not to get injured by getting hands and fingers caught or due to the fall of the calibration plate.
Be careful of the arm falling or rotating when releasing the brake.

Turn OFF the motors, set the calibration pin to the base plate, and set the offset jigs to the Arms #4 and #6.



Rotate the Arm #1 so that the J1 origin point pin comes inside the calibration plate, and fix the calibration plate to the Arm #1 with the three screws.

M4×15: 3 screws
M4 washer: 3 washers



Release the Joint #2 brake.

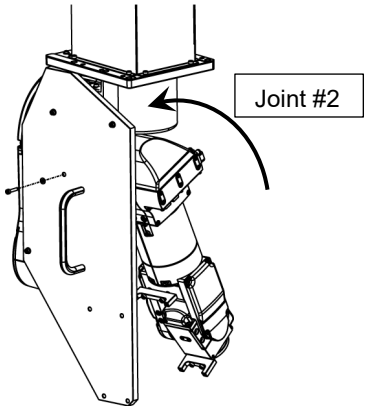
EPSON RC+

Brake release command

```
>Brake Off, 2
```

Rotate the Arm #2 by hand to align it to the calibration plate, and then tighten the screws where the Arm touches the calibration plate.

M4×15: 1 screws
M4 washer: 1 washer



Release the Joint #3 and #4 brakes.

EPSON RC+

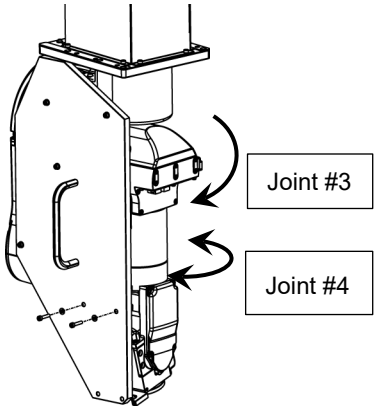
Brake release command

```
>Brake Off, 3,4
```

Rotate the attachment installed on the Arm #4 by hand to align the arm to the calibration plate, and then tighten the screws where the Arm touches the calibration plate.

Align the Manipulator so that the surface of the attachment fits that of the calibration plate as much as possible.

M4×15: 2 screws
M4 washer: 2 washers



Release the Joint #5 and #6 brakes.

EPSON RC+

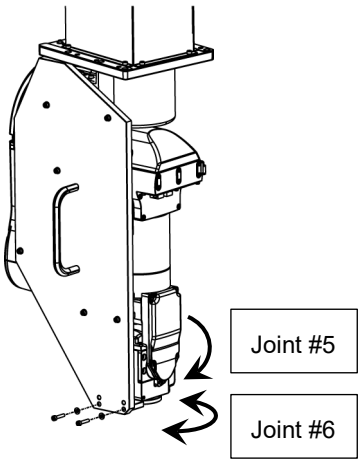
Brake release command

```
>Brake Off, 5,6
```

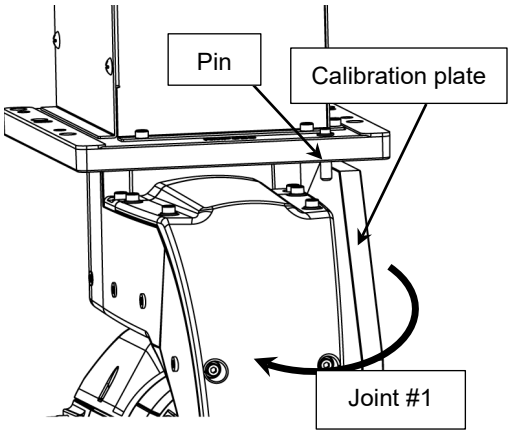
Rotate the attachment installed on the Arm #6 by hand to align the arm to the calibration plate, and then tighten the screws where the Arm touches the calibration plate.

Align the Manipulator so that the surface of the attachment fits that of the calibration plate as much as possible.

M4×15: 2 screws
M4 washer: 2 washers



Rotate the Arm #1 to one direction by hand until the pin installed on the base plate touches the calibration plate.



4-1-3 Initialize the Encoder.

EPSON RC+

Execute the command in the [Command Window] according to the joint to initialize the encoder as follows.

```
Joint #1 >Encreset 1
Joint #2 >Encreset 2
Joint #3 >Encreset 3
Joint #4 >Encreset 4
Joint #5 >Encreset 5
Joint #6 >Encreset 6
```

Restart the Controller.

Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

4-1-4 Execute the origin point setting.

EPSON RC+

Execute the following command in the [Command Window] to specify the pulse values to be set as the origin point.

```
>calpls 0,0,0,0,0,0
```

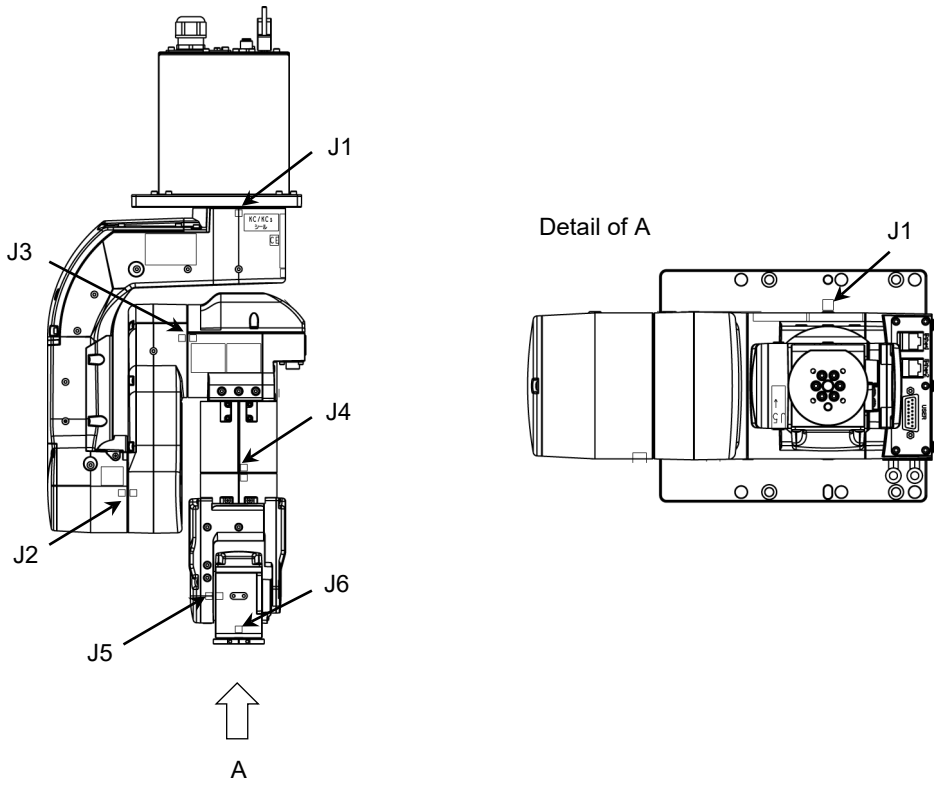
* Manipulator will not move.

Then, execute the following command in the [Command Window] to set the specified pulse values to the encoder according to the joint to set the origin point.

```
Joint #1 >Calib 1
Joint #2 >Calib 2
Joint #3 >Calib 3
Joint #4 >Calib 4
Joint #5 >Calib 5
Joint #6 >Calib 6
```

Remove the calibration plate.
When removing it, be careful of the fall of the calibration plate.

Calibration marks of each joint



4-2. Calibration using the calibration marks

EPSON RC+

4-2-1 Align the calibration marks of the target joint

Set the jog mode to “Joint” in the [Jog & Teach] panel, and then move the Manipulator in Jog motion so that the calibration marks on the target joint match as much as possible.

See the above figure for location of the calibration marks.

When the Manipulator cannot have the basic orientation, move it to the predetermined reference position by aligning the “match marks”.

4-2-2 Initialize the Encoder.

EPSON RC+

Execute the command in the [Command Window] according to the joint to adjust as follows.

```
Joint #1 >Encreset 1
Joint #2 >Encreset 2
Joint #3 >Encreset 3
Joint #4 >Encreset 4
Joint #5 >Encreset 5
Joint #6 >Encreset 6
```

Restart the Controller.

Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

4-2-3 Execute the origin point setting.

EPSON RC+

Execute the following command in the [Command Window] to specify the pulse values to be set as the origin point.

```
>calpls J1 pulse, J2 pulse, J3 pulse, J4 pulse, J5 pulse, J6 pulse
```

* Manipulator will not move.

Specify the pulse values that are “0” when the Manipulator is aligned to the calibration marks, or the values recorded at the predetermined reference orientation (where the match marks are aligned) to the command parameters.
If the point data for the reference orientation is “P1”, the command parameters can be specified as follows

```
>calpls ppls(P1,1), ppls(P1,2), ppls(P1,3),
ppls(P1,4), ppls(P1,5), ppls(P1,6)
```

Then, execute the following command in the [Command Window] to set the specified pulse values to the encoder according to the joint to set the origin point.

Joint #1 `>Calib 1`
Joint #2 `>Calib 2`
Joint #3 `>Calib 3`
Joint #4 `>Calib 4`
Joint #5 `>Calib 5`
Joint #6 `>Calib 6`

5. Confirmation

Move the arm to several points to check if the arm moves to the original positions properly.

Teach points if fine adjustment is necessary.

Position adjustment by teaching point (perform if necessary)

EPSON RC+

After the calibration, move the Manipulator to the selected point data by jogging in [Jog & Teach].

When the selected point data is “P1”,
Execute “Motor On” in [Control Panel] and execute “Go P1” in [Jog & Teach].

EPSON RC+

Adjust the calibrated joints accurately by jog command so that the end effector is aligned to the selected point data position.
*When the Joint #5 is calibrated, adjust the Joint #5 and #6.

Select the “Joint” jog mode from [Jog & Teach] to change and adjust the angle of the target joint in the jog motion.

Set the pulse values again at the adjusted point.

Execute the following command in the [Command Window] to specify the pulse values to set.

```
>calpls J1 pulse, J2 pulse, J3 pulse, J4 pulse, J5 pulse, J6 pulse
```

* Manipulator will not move.

Specify the pulse values of the selected point data to the command parameters.
If the point data for the reference orientation is “P1”, the command parameters can be specified as follows

```
>calpls ppls(P1,1), ppls(P1,2), ppls(P1,3),
ppls(P1,4), ppls(P1,5), ppls(P1,6)
```

* Manipulator will not move.

Then, execute the following command in the [Command Window] to set the specified pulse values to the encoder according to the joint to set the origin point.

Joint #1 >`Calib 1`
Joint #2 >`Calib 2`
Joint #3 >`Calib 3`
Joint #4 >`Calib 4`
Joint #5 >`Calib 5`
Joint #6 >`Calib 6`

7. Accuracy Testing

Move the Manipulator to a different pose (point) to verify whether it moves back to the original position. If accuracy is inadequate, it is necessary to re-calibrate the origin using a different pose (point). You must set the pose (point) again if the Manipulator does not move back to the original position after re-calibration.

9. N2 Maintenance Parts List

Name		Code	Note	Reference	Overhaul **
Actuator unit	Joint #1	1696678	100 W, unit	5.1	✓
	Joint #2	1696697	100 W, unit	5.2	✓
	Joint #3	1696698	100 W, unit	5.3	✓
	Joint #4	1696699	30 W, unit	5.4	✓
	Joint #6	1696701	15 W, unit	5.7	✓
	Joint #5, 6	1696703	30 W/15 W, unit	5.6	✓
Motor unit	Joint #5	1696700	30 W, unit	5.5.1	✓
Reduction gear unit*		1696702	Unit	5.5.2	✓
Timing belt		1698992		5.5.3	✓
Belt tensile jig		1696718	Assembly jig	4.1, 4.2, 5.5, 5.5.2, 5.5.3, 5.7	
Battery set		2172925	(2 lithium metal batteries for replacement)	6.1	
Battery board		2173216		6.2	

* Reduction Gear Unit: A reduction gear unit consists of the following three parts.
Replace the following parts for each.

Waveform generator

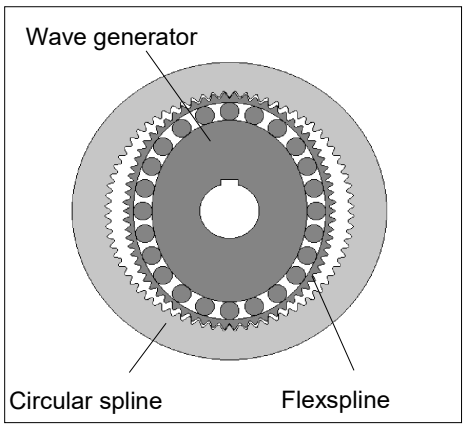
The waveform generator consists of an ellipsoidal cam and ball bearings on outer circumference.
The inner ring of the bearings is secured to the cam, while the outer ring is capable of flexible deformation through the ball bearings.

Flexspline

A thin, elastic, cup-shaped metal body with gear teeth around the outer circumference of the opening.

Circular spline

A rigid, ring-shaped body with gear teeth on the inner circumference.
The circular spline has two more teeth than the flexspline does.



The splines are greased. Be sure to keep the grease from being attaching to the clothes.

** Overhaul

As a rough indication, perform overhaul (parts replacement) before reaching 20,000 operation hours of the Manipulator.
The operation hours can be checked in [Controller Status Viewer] dialog box - [Motor On Hours].
For details, refer to "*2.2 Overhaul (Parts Replacement)*".

Name		Code	Note	Reference
Grease ***	Joint #1, 2, 3: SK-1A	-	For purchasing the grease, please contact the supplier of your region.	2.1.2, 2.3
	Joint #4, 5, 6: SK-2	-		
	Cable: GPL-224	-		4, 5

*** Due to the chemicals regulations of individual countries (the UN GHS), we are requesting our customers to purchase grease required for maintenance from the manufacturers listed in the table below as of April 2015.
Regarding purchase of the grease and other materials, please contact the following manufacturers.
If there is anything unclear, please contact the supplier of your region.

Product name	Manufacturer	URL
Harmonic Grease SK-1A Harmonic Grease SK-2	Harmonic Drive Systems Inc.	https://www.harmonicdrive.net/
Krytox®GPL-224	Chemours	https://www.chemours.com/en/brands-and-products

Name			Code	Note	Reference
Control Board			2138032		7.1, 7.2
FPC unit			1696704		4.3
FPC case			1685554		4.3
FPC board			2179138		7.9, 7.10
LED plate			1685535		7.11
LED board			2178376		
Encoder board			2179137		7.3, 7.4, 7.5, 7.6
Brake board			2178379		7.8
Filter board			2178380		7.7
O-ring	Joint #1, 2		1706460	Wire diameter ø 0.9mm, Inner diameter ø 67.0mm	5.1,5.2
	Joint #3		1686826	Wire diameter ø 1.78 mm Inner diameter ø 69.57 mm	5.3
	Joint #4, 5		1686825	Wire diameter ø 1.5mm Inner diameter ø 51.0mm	5.4, 5.5, 5.6
	Joint #6		1686862	Wire diameter ø 1.0mm Inner diameter ø 36.0mm	5.7
M/C cable	3 m	Straight	1696711		4.4
		L-shaped	1696714		
	5 m	Straight	1696712		
		L-shaped	1696715		
	10 m	Straight	1696713		
		L-shaped	1696716		
	15 m	Straight	1745266		
		L-shaped	1745268		
	20 m	Straight	1745267		
		L-shaped	1745269		
Cable unit	HP_CABLE_A_UNIT		2186101		4.1

Name			Code	Note	Reference
Relay cable		HP_Harness_A_01	2176213		4.2
		HP_Harness_A_02	2176214		
		HP_Harness_A_03	2176215		
		HP_Harness_A_04	2176216		
		HP_Harness_A_05	2176217		
		HP_Harness_A_06	2176218		
		HP_Harness_A_07	2176220		
Brake release connector		HP_Harness_A_SW1	2176222		4.1, 4.2
Wire tie		AB150	1675754	1 bag (100 ties: white)	
		AB200	1684328	1 bag (100 ties: white)	
Cover	Arm #1	Joint #1 cover	1685530	Plastic cover *	3
		Joint #2 cover	1685531		
		Arm #1 inside cover.	1696705		
		Joint #2 outside cover	1685538		
		LED plate	1685535		
	Arm #2	Arm #2 inside cover.	1685539		
		Joint #3 cover	1685540		
		Arm #2 outside cover	1696706		
	Arm #3	Arm #3 upper cover.	1696707		
		Arm #3 side cover	1696708		
	Arm #4	Arm #4 left side cover	1696709		
		Arm #4 right side cover	1685545		
	Arm #5	Arm #5 upper cover.	1685547		
		Arm #5 side cover	1696710		
Pad	Arm #4 pad		1686754		5.4, 5.5
	Arm #6 pad		1686773		5.7
Calibration mark			1692799		8
Air fittings		Elbow	1644177	KQ2L06-M5N	
		Straight	1636156	KQ2H06-M5N	

* Covers of metal are not the maintenance parts.

10. N2 Option Parts List

Name		Code	Note	Reference*
Brake release unit (with M/C short connector)		R12NZ900N4	For Europe	6.1
		R12NZ900N5	For U.S. & Japan	
MC short connector		R12NZ900N7	For brake release unit	
Camera plate unit		R12B031922	Common to C3 and C4 (R12NZ9003F)	6.2
Tool adapter (ISO flange)		R12NZ900PZ		6.3
Standard user connector kit	D-sub	R12NZ900LX		6.4
Calibration plate		R12NZ900Q1		6.7
Table top mount bracket		R12NZ900Q2		6.6
Wiring guide		R12NZ900Q3		6.5

* : Refer to each Manipulator section of N series Manual

N6 Maintenance

This volume contains maintenance procedures with safety precautions for the N6 series Manipulators.

1. Safety Maintenance

Please read this chapter, this manual, and other relevant manuals carefully to understand safe maintenance procedures before performing any maintenance.

Only the personnel who have taken maintenance training held by us or suppliers should be allowed to maintain the robot system.

 WARNING	■ Do not remove any parts unless otherwise instructed by this manual. Follow the maintenance procedure strictly as described. Improper removal of parts or improper maintenance may cause not only malfunction of the robot system but serious safety problems. ■ If you have not received training, keep away from the Manipulator while the power is ON. Do not enter the operating area while the power is ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even it seems to be stopped. ■ When you check the operation of the Manipulator after replacing parts, be sure to check it while you are outside of the safeguarded area. Checking the operation of the Manipulator while you are inside of the safeguarded area may cause serious safety problems as the Manipulator may move unexpectedly. ■ Before operating the robot system, make sure that both the Emergency Stop switches and safeguard switch function properly. Operating the robot system when the switches do not function properly is extremely hazardous and may result in serious bodily injury and/or serious damage to the robot system as the switches cannot fulfill their intended functions in an emergency.

 WARNING	■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ When connecting / replacing the brake release unit or the external short connector, turn OFF the power to the Controller and the brake release unit. Inserting and removing the connector while the power is ON may result in electrical shock.

CAUTION	■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ If the Manipulator is operated without connecting the brake release unit or the external short connector, the brakes cannot be released and it may cause damage on them. After using the brake release unit, be sure to connect the external short connector to the Manipulator, or check connection of the connector for the brake release unit. ■ The Manipulator arms may become hot after the Manipulator operation due to heat generation of the motors. Be careful when performing maintenance. ■ When operating maintenance of manipulator, secure about 50 cm of empty space around the manipulator.

2. General Maintenance

This chapter describes maintenance inspection procedures. Performing maintenance inspection properly is essential to prevent trouble and ensure safety.
Be sure to perform the maintenance inspections in accordance with the schedule.

2.1 Maintenance Inspection

2.1.1 Schedule for Maintenance Inspection

Inspection points are divided into five stages: daily, monthly, quarterly, biannual, and annual. The inspection points are added every stage.
If the Manipulator is operated for 250 hours or longer per month, the inspection points must be added every 250 hours, 750 hours, 1500 hours, and 3000 hours operation.

	Inspection Point					
	Daily inspection	Monthly inspection	Quarterly inspection	Biannual inspection	Annual inspection	Overhaul*
1 month (250 h)	Inspect every day	√				
2 months (500 h)		√				
3 months (750 h)		√	√			
4 months (1000 h)		√				
5 months (1250 h)		√				
6 months (1500 h)		√	√	√		
7 months (1750 h)		√				
8 months (2000 h)		√				
9 months (2250 h)		√	√			
10 months (2500 h)		√				
11 months (2750 h)		√				
12 months (3000 h)		√	√	√	√	
13 months (3250 h)		√				
⋮	⋮	⋮	⋮	⋮	⋮	⋮
20000 h						√

h = hour

*Overhaul (parts replacement)

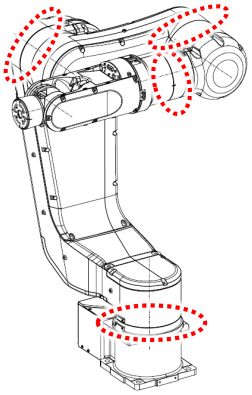
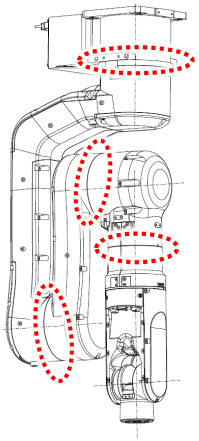
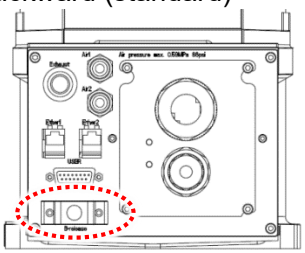
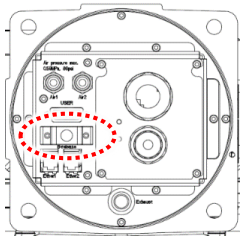
2.1.2 Inspection Point

Inspection Item

Inspection Point	Inspection Place	Daily	Monthly	Quarterly	Biannual	Annual
Check looseness or backlash of bolts/screws.	End effector mounting bolts	√	√	√	√	√
	Manipulator mounting bolts	√	√	√	√	√
Check looseness of connectors.	External connectors on Manipulator (on the connector plates etc.)	√	√	√	√	√
Visually check for external defects. Clean up if necessary.	External appearance of Manipulator	√	√	√	√	√
	External cables		√	√	√	√
Check for bends or improper location. Repair or place it properly if necessary.	Safeguard etc.	√	√	√	√	√
Check the brake operation.	Brake for Arm #2 to #6	√	√	√	√	√
Check whether unusual sound or vibration occurs.	Whole	√	√	√	√	√
Check the leak of grease for cables.	Grease for Arm #1 to #4	√	√			
Check either the external short connector or the brake release unit connector is connected.	The external short connector on the back side of the Manipulator, or the brake release unit connector.	√	√	√	√	√

Inspection Method

Inspection Point	Inspection Method
Check looseness or backlash of bolts/screws.	Use a hexagonal wrench to check that the end effector mounting bolts and the Manipulator mounting bolts are not loose. When the bolts are loose, refer to "*2.4 Tightening Hexagon Socket Head Bolts*" and tighten them to the proper torque.
Check looseness of connectors.	Check that connectors are not loose. When the connectors are loose, reattach it not to come off.
Visually check for external defects. Clean up if necessary.	Check the appearance of the Manipulator and clean up if necessary. Check the appearance of the cable, and if it is scratched, check that there is no cable disconnection.
Check for bends or improper location. Repair or place it properly if necessary.	Check that the safeguard, etc. are located properly. If the location is improper, place it properly.
Check the brake operation.	Check that the arm does not fall when in MOTOR OFF. If the arm falls when in MOTOR OFF and the brake is not released, contact the supplier.
Check whether unusual sound or vibration occurs.	Check that there is no unusual sound or vibration when operating. If there is something wrong, contact the supplier.

<table>
<tr><th>Inspection Point</th><th>Inspection Method</th></tr>
<tr><td rowspan="2">Check the leak of grease for cables.</td><td>When the grease for cables is leaked from the gap of the Arm #1 to #4, wipe off the leaked grease.</td></tr>
<tr><td>N6-A1000**
 
N6-A850**
  </td></tr>
<tr><td rowspan="2">Check either the external short connector or the brake release unit connector is connected.</td><td>Check that either the external short connector or the brake release unit connector is connected.
When it is not connected, connect it.</td></tr>
<tr><td>M/C cable direction:
Backward (standard)
 
M/C cable direction:
Upward and Downward
  </td></tr>
</table>

2.2 Overhaul (Parts Replacement)

CAUTION	■ If you do not overhaul properly, it may have a serious impact on safety. ■ Overhaul timing is based on an assumption that all joints are operated for equal distance. If a particular joint has a high duty or high load, it is recommended to overhaul all joints (as many as possible) before exceeding 20,000 operation hours with the joint as a basis.

The parts for the Manipulator joints may cause accuracy decline or malfunction due to deterioration of the Manipulator resulting from long term use. In order to use the Manipulator for a long term, it is recommended to overhaul the parts (parts replacement).

The time between overhauls is 20,000 operation hours of the Manipulator as a rough indication.

However, it may vary depending on ambient temperature, usage condition and degree of the load (such as when operated with the maximum motion speed and maximum acceleration / deceleration in continuous operation) applied on the Manipulator.

NOTE

For the EPSON RC+ 7.0 Ver. 7.2.x or later (firmware Ver.7.2.x.x or later), the recommended replacement time for the parts subject to maintenance (motors, reduction gear units, and timing belts) can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.
For details, refer to the following manual.
RC700 series Maintenance Manual 6. Alarm
Note:
The recommended replacement time for the maintenance parts is when it reaches the L10 life (time until 10% failure probability). In the [Maintenance] dialog box, the L10 life is displayed as 100%.

The Manipulator operation hours can be checked in [Controller Status Viewer] dialog box-[Motor On Hours].

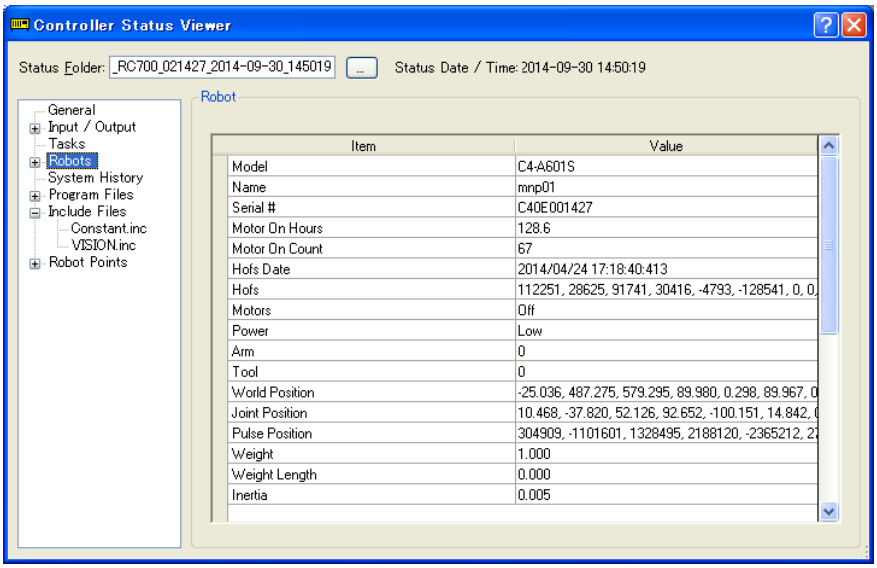
(1) Select EPSON RC+ menu-[Tools]-[Controller] to open the [Controller Tools] dialog box.

(2) Click the <View Controller Status> button to open the [Browse For Folder] dialog box.

(3) Select the folder where the information is stored.

(4) Click <OK> to view the [Controller Status Viewer] dialog box.

(5) Select [Robot] from the tree menu on the left side.



For the parts subject to overhaul, refer to "*9. N6 Maintenance Parts List*".

For details of replacement of each part, refer to each section.

Please contact the supplier of your region for further information.

2.3 Greasing

The actuator units and reduction gear units need greasing regularly. Only use the grease specified in the following table.

For the greasing procedure, please contact the supplier of your region.

WARNING	■ Before greasing, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

CAUTION	■ Keep enough grease in the Manipulator. Operating the Manipulator with insufficient grease will cause the noise or damage sliding parts and/or result in insufficient function of the Manipulator. Once the parts are damaged, a lot of time and money will be required for the repairs. ■ If grease gets into your eyes, mouth, or on your skin, follow the instructions below. If grease gets into your eyes: Flush them thoroughly with clean water, and then see a doctor immediately. If grease gets into your mouth: If swallowed, do not induce vomiting. See a doctor immediately. If grease just gets into your mouth, wash out your mouth with water thoroughly. If grease gets on your skin: Wash the area thoroughly with soap and water.

	Greasing part	Greasing Interval	Grease
Joint #1, #2, 3, #4, and #5	Reduction gear unit	Overhaul timing	SK-1A
Joint #6			SK-2
Joint #6	Bevel gear		SK-2

Joint #1, 2, 3, 4, 5, 6 reduction gear units

As a rough indication, perform greasing in 10,000 hours or 2 years, whichever comes first.

However, it may vary depending on ambient temperature, usage condition and degree of the load (such as when operated with the maximum motion speed and maximum acceleration / deceleration in continuous operation) applied on the Manipulator.

	Name	Quantity	Note
Maintenance parts	Grease up kit	1	1674592 (A set of grease gun, nipple, and extension jig)
	Grease plug	1	1656158
	O-ring for grease inlet	1	1657289
Tools	Hexagonal wrench (width across flats: 2.5 mm)	1	For M3 hexagon socket head cap bolts
	Cross-point screwdriver (#2)	1	For cross-recessed head screws
	Flat head screwdriver	1	For grease plug

NOTE ☞ Before greasing, move the Manipulator so that the grease inlet is not directed down.
Do not remove the grease plug while the grease inlet is directed down. Otherwise the oil content separated from the grease may leak out.

NOTE ☞ Do not use any tool to install and remove the grease nipple and grease line extension jig.
Always handle them directly by your hand.
If the grease nipple or grease line extension jig is installed or removed with a tool such as wrench, they will get damage.

2.3.1 Joint #1 Reduction Gear Unit

NOTE

If the Manipulator is mounted on the ceiling, the grease inlet is directed down. Note that the oil content separated from the grease will leak out if removing the grease plug of the Joint #1 grease inlet while it is directed down.

Greasing

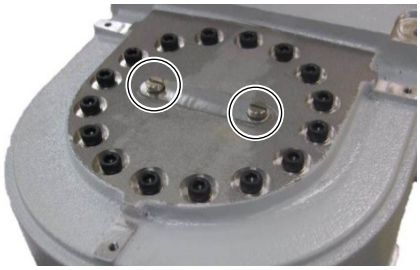
(1) Remove the Joint #1 inside cover.

For details, refer to "*3. Covers*".

(2) Remove the two grease plug from the Joint #1 grease inlet located inside the Arm #1.

(3) Attach the grease nipple to one side of the Joint #1 grease inlet.

N6-A1000**



N6-A850**R

(4) Inject grease from the grease nipple using a grease gun

Grease: SK-1A

Grease amount: 8g

N6-A1000**

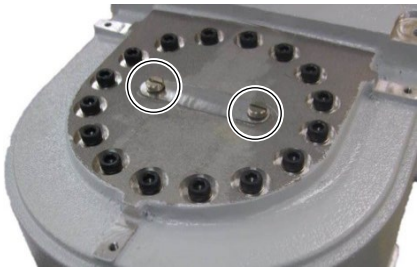
N6-A850**R

(5) Remove the grease nipple from the Joint #1 grease inlet.

(6) Attach the grease plug to the Joint #1 grease inlet.

If the grease plug is damaged or deteriorated, replace it with a new one.

N6-A1000**



N6-A850**R

(7) Install the Joint #1 inside cover.

For details, refer to "*3. Covers*".

2.3.2 Joint #2 Reduction Gear Unit

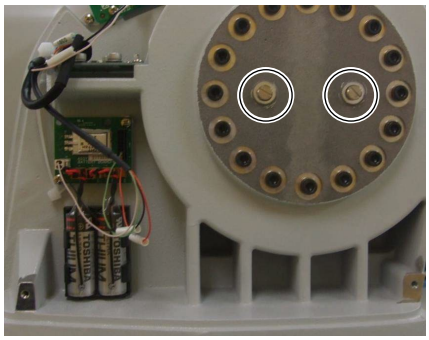
Greasing

(1) Remove the Joint #2 outside cover.

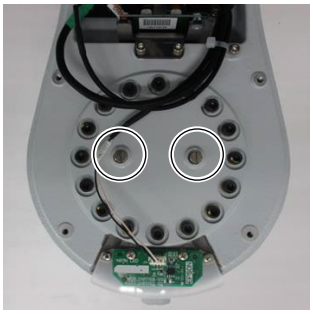
For details, refer to "*3. Covers*".

(2) Remove the two grease plug from the Joint #2 grease inlet located inside the Arm #2.

N6-A1000**



N6-A850**R



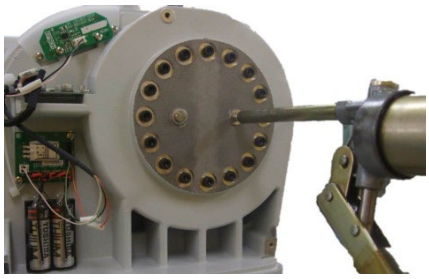
(3) Attach the grease nipple to one side of the Joint #2 grease inlet.

(4) Inject grease from the grease nipple using a grease gun.

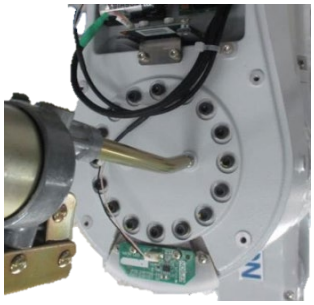
Grease: SK-1A

Grease amount: 7g

N6-A1000**



N6-A850**R

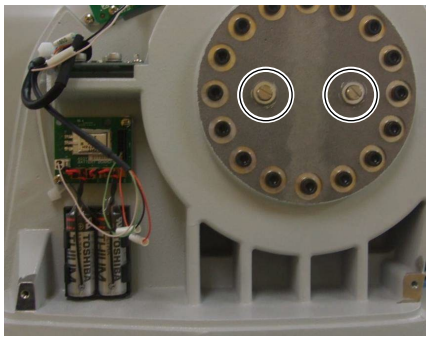


(5) Remove the grease nipple from the Joint #2 grease inlet.

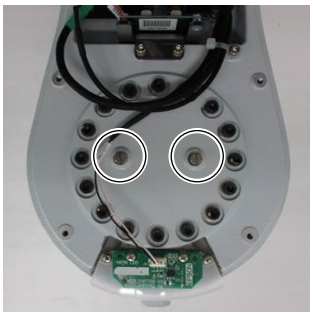
(6) Attach the grease plug to the Joint #2 grease inlet.

If the grease plug is damaged or deteriorated, replace it with a new one.

N6-A1000**



N6-A850**R



(7) Install the Joint #2 outside cover.

For details, refer to "*3. Covers*".

2.3.3 Joint #3 Reduction Gear Unit

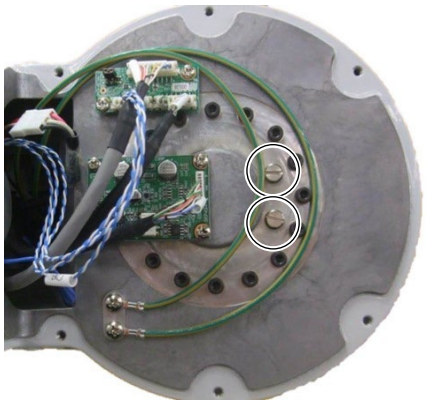
Greasing

(1) Remove the Arm #3 cover.

For details, refer to "*3. Covers*".

(2) Remove the two grease plug from the Joint #3 grease inlet located inside the Arm #3.

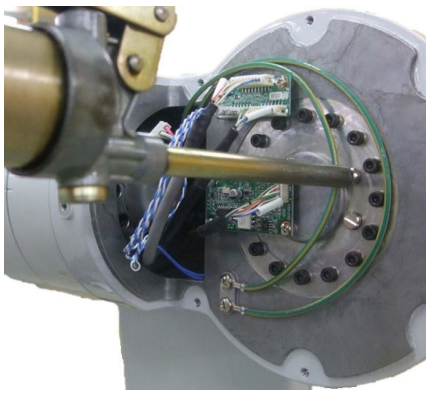
(3) Attach the grease nipple to one side of the Joint #3 grease inlet.



(4) Inject grease from the grease nipple using a grease gun.

Grease: SK-1A

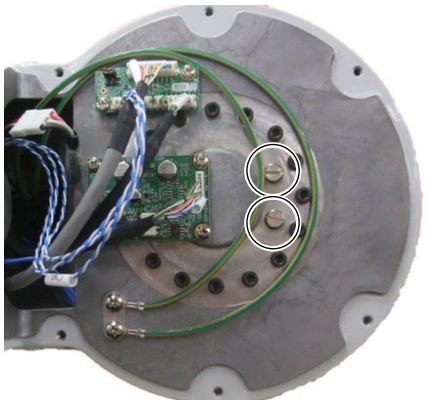
Grease amount: 4g



(5) Remove the grease nipple from the Joint #3 grease inlet.

(6) Attach the grease plug to the Joint #3 grease inlet.

If the grease plug is damaged or deteriorated, replace it with a new one.



(7) Install the Arm #3 cover.

For details, refer to "*3. Covers*".

2.3.4 Joint #4 Reduction Gear Unit

Greasing

(1) Remove the two grease plug from the Joint #4 grease inlet of the Arm #4.

(2) Attach the grease nipple to one side of the Joint #4 grease inlet.

(3) Inject grease from the grease nipple using a grease gun.

Grease: SK-1A

Grease amount: 2g

(4) Remove the grease nipple from the Joint #4 grease inlet.

(5) Attach the grease plug to the Joint #4 grease inlet.

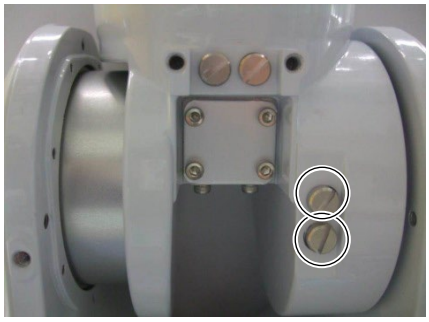
If the grease plug is damaged or deteriorated, replace it with a new one.

2.3.5 Joint #5 Reduction Gear Unit

Greasing

(1) Remove the grease plug from the two Joint #5 grease inlet of the Arm #5.

(2) Attach the grease nipple to one side of the Joint #5 grease inlet.



NOTE

Be careful not to confuse it with the Joint #6 grease inlet.

(3) Inject grease from the grease nipple using a grease gun.

Grease: SK-1A

Grease amount: 1g

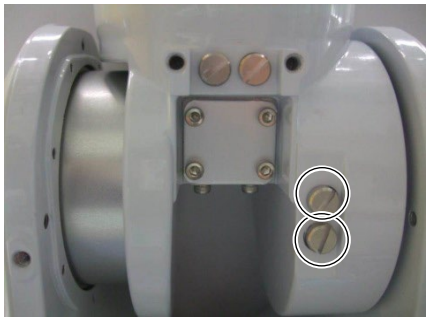
NOTE

Be careful not to mix with the grease used in the Joint #6 (SK-2).

(4) Remove the grease nipple from the Joint #5 grease inlet.

(5) Attach the grease plug to the Joint #5 grease inlet.

If the grease plug is damaged or deteriorated, replace it with a new one.

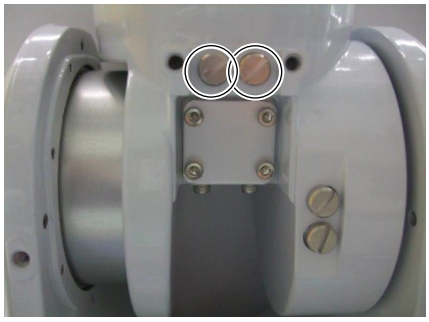


2.3.6 Joint #6 Reduction Gear Unit

Greasing

(1) Remove the grease plug from the two Joint #6 grease inlet of the Arm #5.

(2) Attach the grease nipple to one side of the Joint #6 grease inlet.



NOTE Be careful not to confuse it with the Joint #5 grease inlet.

(3) Inject grease from the grease nipple using a grease gun.

Grease: SK-2

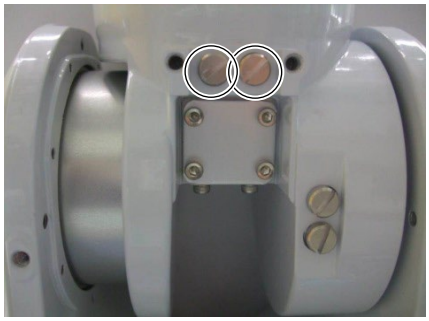
Grease amount: 0.7g

NOTE Be careful not to mix with the grease used in the Joint #5 (SK-1A).

(4) Remove the grease nipple from the Joint #6 grease inlet.

(5) Attach the grease plug to the Joint #6 grease inlet.

If the grease plug is damaged or deteriorated, replace it with a new one.

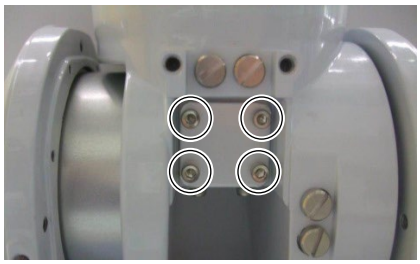


2.3.7 Joint #6 Bevel Gear

Greasing

(1) Remove the Arm #5 grease inlet cover.

Hexagon socket head cap bolts: 4-M3×6



(2) Remove the O-ring located in the base groove.

(3) Apply grease to the mating surface of the bevel gear inside the Arm #5.

Grease: SK-2

Grease amount: 3g

(4) Apply a thin coat of grease to the O-ring. Fit the O-ring into the base groove.

Grease: SK-2

NOTE

Do not allow the O-ring to come out of the groove.

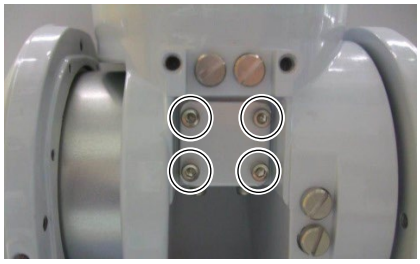
NOTE

If the O-ring is swollen, damaged, or deteriorated, replace it with a new one.

(5) Install the Arm #5 grease inlet cover.

Hexagon socket head cap bolts: 4-M3×6

Tightening torque: 2.0 ± 0.1 N·m



2.4 Tightening Hexagon Socket Head Bolts

Hexagon socket head cap bolts (hereinafter, “bolts”) are used in places where mechanical strength is required. These bolts are fastened with the tightening torque shown in the following tables.

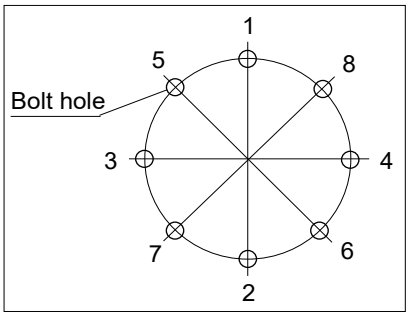
When it is required to refasten the bolts in some procedures in this manual (except special cases as noted), use a torque wrench so that the bolts are fastened with appropriate tightening torque as shown below.

Bolt	Tightening Torque
M2.5	1.4 ± 0.1 N·m (14± 1 kgf·cm)
M3	2.0 ± 0.1 N·m (21 ± 1 kgf·cm)
M4	4.0 ± 0.2 N·m (41 ± 2 kgf·cm)
M5	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)
M6	13.0 ± 0.6 N·m (133 ± 6 kgf·cm)
M8	32.0 ± 1.6 N·m (326 ± 16 kgf·cm)
M10	58.0 ± 2.9 N·m (590 ± 30 kgf·cm)
M12	100.0 ± 5.0 N·m (1,020 ± 51 kgf·cm)

See below for the set screw.

Set Screw	Tightening Torque
M3	0.9 ± 0.1 N·m (9 ± 1 kgf·cm)
M4	2.4 ± 0.1 N·m (26 ± 1 kgf·cm)
M5	3.9 ± 0.2 N·m (40 ± 2 kgf·cm)
M6	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)

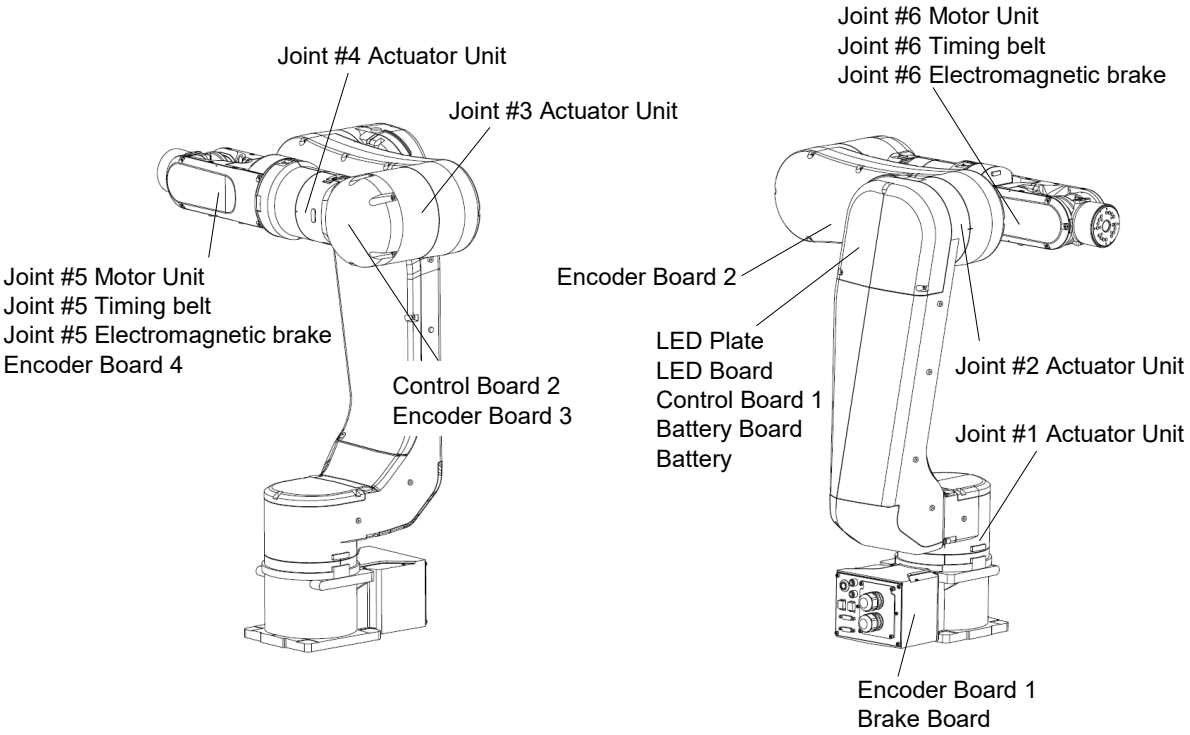
It is recommended to fasten the bolts aligned on a circumference in a crisscross pattern as shown in the figure below.



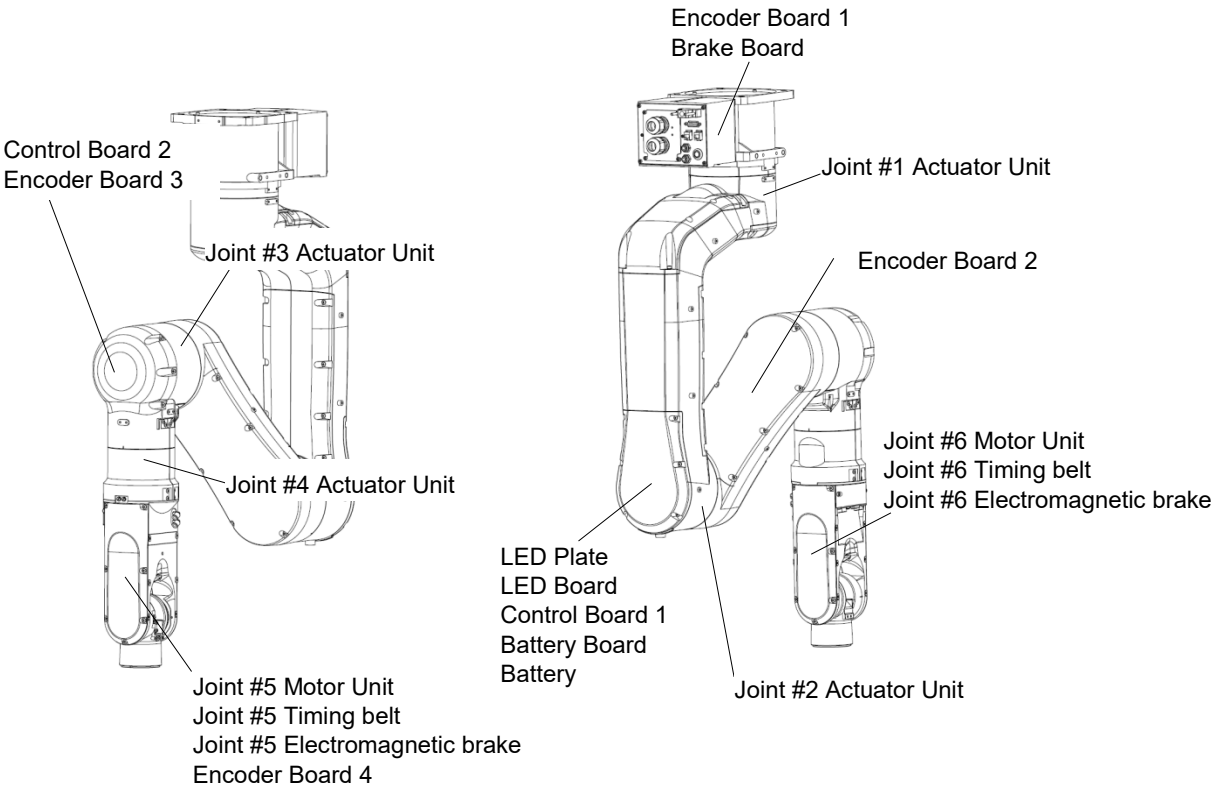
Do not fasten all bolts securely at one time. Divide the number of times to fasten the bolts into two or three and fasten the bolts securely with a hexagonal wrench. Then, use a torque wrench to fasten the bolts with tightening torques shown in the table above.

2.5 Layout of Maintenance Parts

N6-A1000**



N6-A850**R

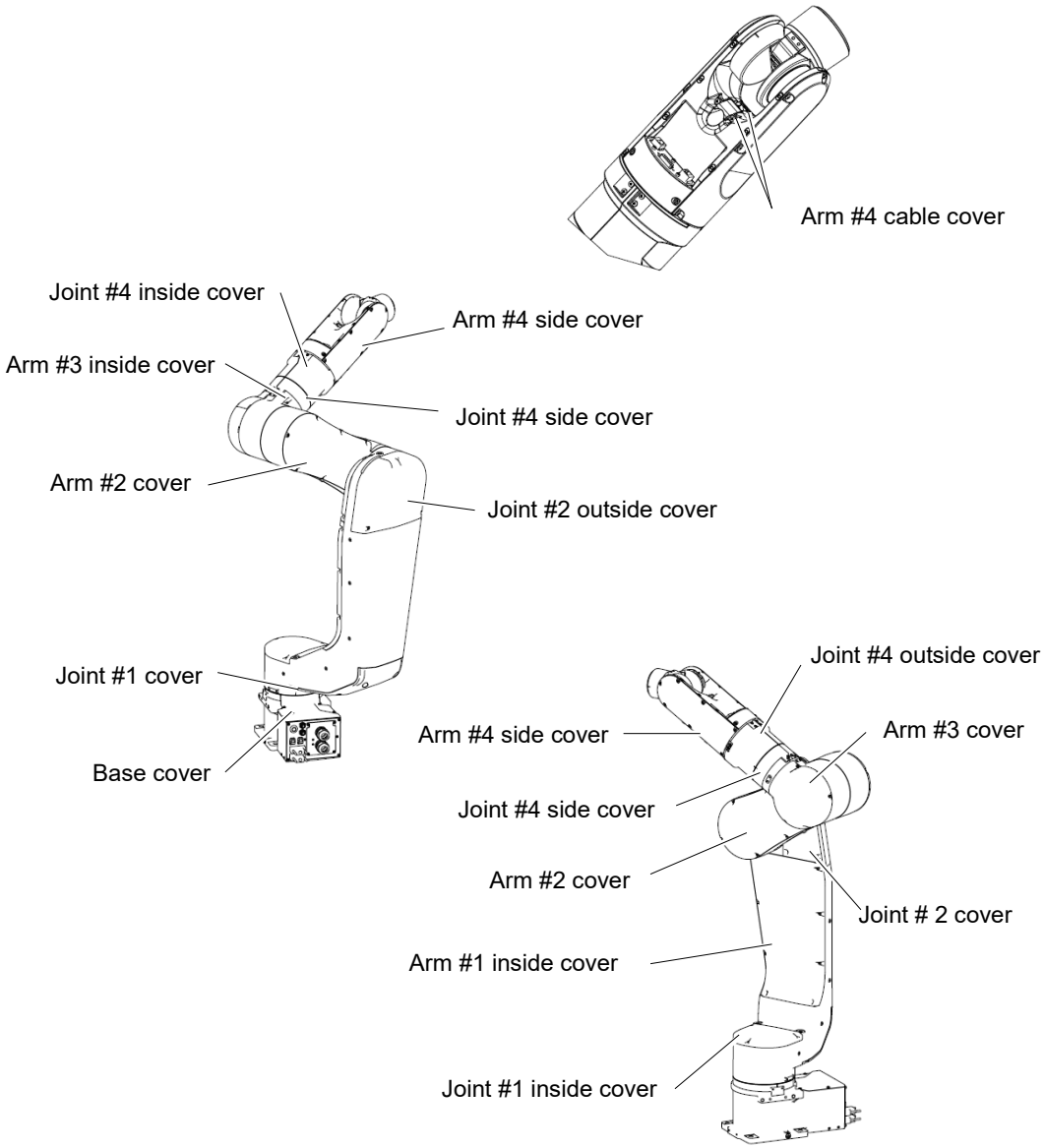


3. Covers

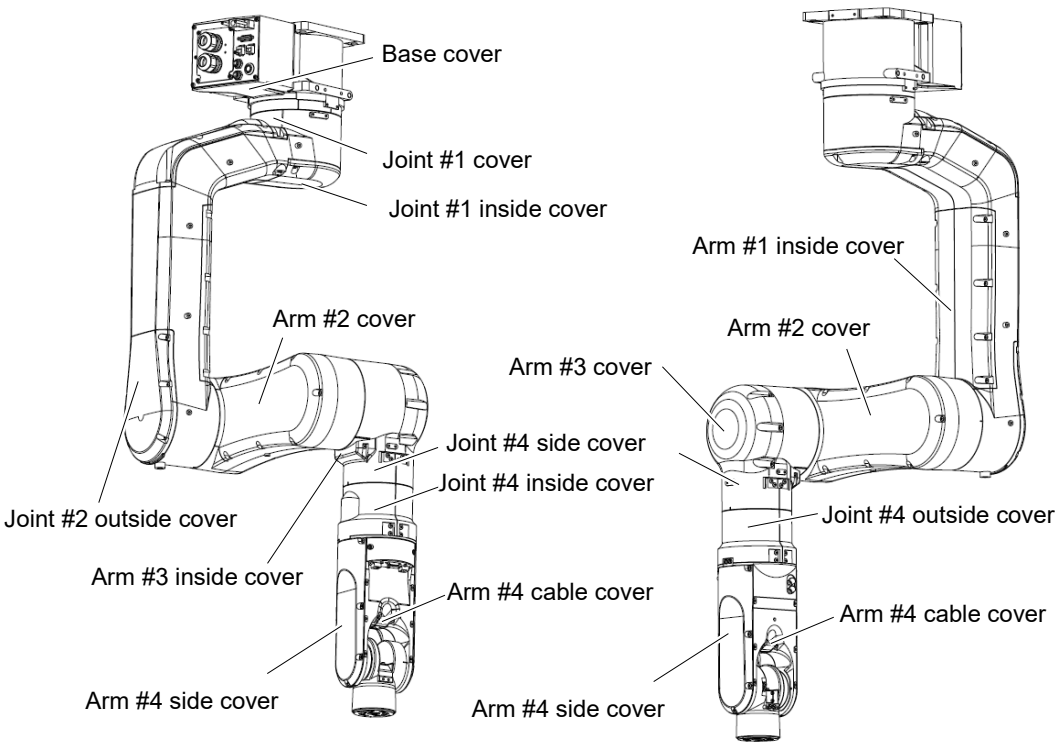
This chapter describes removal and installation steps of the covers necessary for maintenance.

 WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

N6-A1000**


Arm #4 cable cover
Joint #4 inside cover
Arm #4 side cover
Arm #3 inside cover
Joint #4 side cover
Arm #2 cover
Joint #2 outside cover
Joint #1 cover
Base cover
Joint #4 outside cover
Arm #4 side cover
Arm #3 cover
Joint #4 side cover
Arm #2 cover
Joint # 2 cover
Arm #1 inside cover
Joint #1 inside cover

N6-A850**R


Base cover
Joint #1 cover
Joint #1 inside cover
Arm #2 cover
Joint #2 outside cover
Arm #3 inside cover
Joint #4 side cover
Joint #4 inside cover
Arm #4 cable cover
Arm #4 side cover
Arm #1 inside cover
Arm #2 cover
Arm #3 cover
Joint #4 outside cover
Arm #4 cable cover
Arm #4 side cover

Standard-Model (N6-A1000S*, N6-A850S*R)

	Name			Qty.	Code, Note
Maintenance part	Cover (Standard model)	Base	Base cover	1	1749181
		Arm #1 (N6-A1000)	Joint # 1 cover	1	1739213
			Joint # 1 inside cover	1	1739211
			Arm # 1 inside cover	1	1739215
			Joint # 2 outside cover	1	1739214
			Joint # 2 cover	1	1739212
		Arm #1 (N6-A850)	Joint # 1 cover	1	1755217
			Joint # 1 inside cover	1	1755218
			Arm # 1 inside cover	1	1755220
			Joint # 2 outside cover	1	1755219
		Arm #2	Arm # 2 cover	2	1749176
		Arm #3	Arm # 3 inside cover	1	1739218
			Arm # 3 cover	1	1749177
			Joint # 4 side cover	2	1749178
		Arm #4	Joint # 4 inside cover	1	1739223
			Joint # 4 outside cover	1	1749180
			Arm # 4 side cover	2	1749179
			Arm # 4 cable cover	2	1739221
Tool	Cross-point screwdriver (#2)			1	For cross recessed screws

Cleanroom-Model (N6-A1000C*, N6-A850C*R)

	Name			Qty.	Code, Note
Maintenance part	Cover (Cleanroom model)	Base	Base cover	1	1761617
		Arm #1 (N6-A1000)	Joint # 1 cover	1	1755506
			Joint # 1 inside cover	1	1755504
			Arm # 1 inside cover	1	1755508
			Joint # 2 outside cover	1	1755507
			Joint # 2 cover	1	1755505
		Arm #1 (N6-A850)	Joint # 1 cover	1	1757779
			Joint # 1 inside cover	1	1757780
			Arm # 1 inside cover	1	1757782
			Joint # 2 outside cover	1	1757781
		Arm #2	Arm # 2 cover	2	1761612
		Arm #3	Arm # 3 inside cover	1	1755511
			Arm # 3 cover	1	1761613
			Joint # 4 side cover	2	1761614
		Arm #4	Joint # 4 inside cover	1	1755514
			Joint # 4 outside cover	1	1761616
			Arm # 4 side cover	2	1761615
			Arm # 4 cable cover	2	1739221
Tool	Cross-point screwdriver (#2)			1	For cross recessed screws

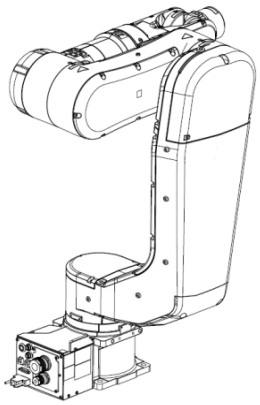
3.1 Base Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

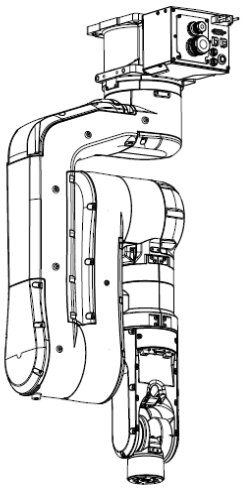
Removal

(1) Move the Arm #1 to a position where you can remove the the base cover.

N6-A1000**



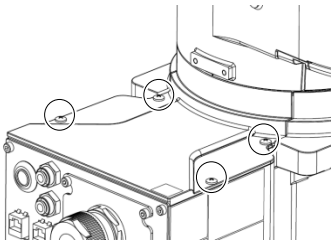
N6-A850**R



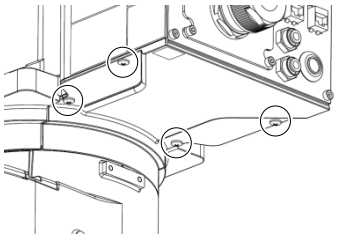
(2) Remove the screws, and then remove the base cover.

Cross recessed binding head machine screw: 4-M4×8

N6-A1000**



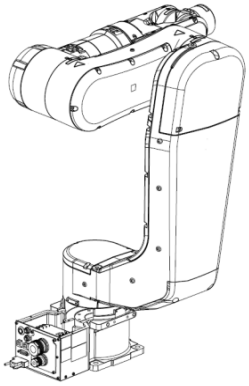
N6-A850**R



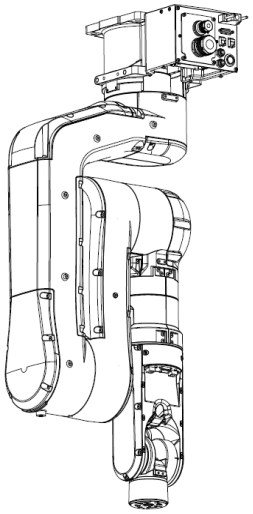
Installation

(1) Move the Arm #1 to a position where you can install the base cover.

N6-A1000**



N6-A850**R

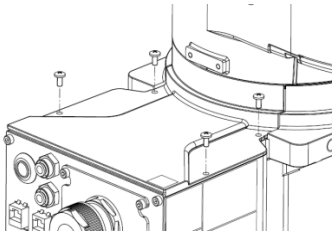


(2) Install the base cover.

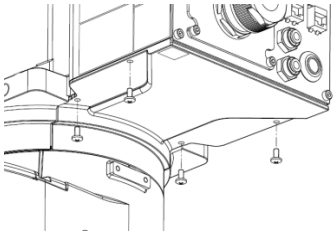
Cross recessed binding head machine screw: 4-M4×8

Tightening torque: 0.45 ± 0.05 N·m

N6-A1000**



N6-A850**R



NOTE

Be careful not to get the cables caught in the cover.

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.2 Joint #1 Cover

3.2.1 N6-A1000** (Joint #1 Cover)

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

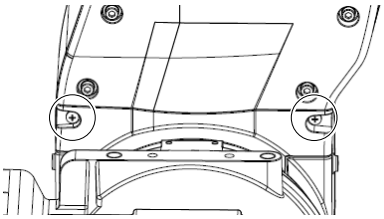
Removal

(1) Remove the base cover.

For more details, refer to "*3.1 Base Cover*".

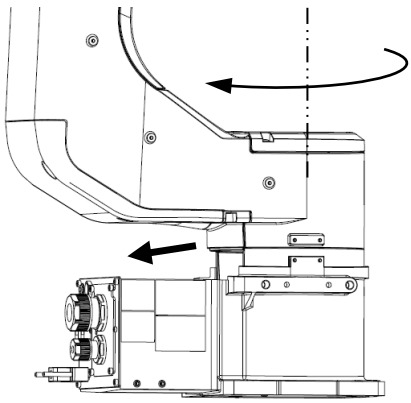
(2) Remove the screws of the Joint #1 cover.

Cross recessed binding head machine screw:
2-M4×8



(3) Move the Arm #1 to the origin position while holding the Joint #1 cover by hand so as not to fall.

(4) Remove the Joint #1 cover.



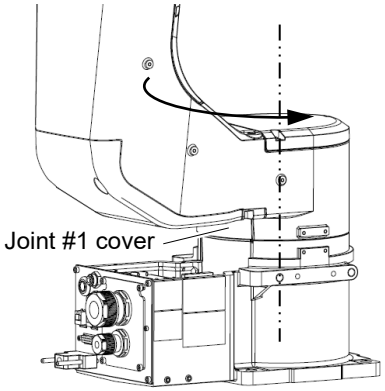
NOTE

Do not remove forcibly when the cover is got caught on the Manipulator.
The cover may get broken.

Installation

(1) Make sure that the base cover is removed and the Arm #1 is at the origin position.
For procedures to remove the base cover, refer to "*3.1 Base Cover*".

(2) Set the Joint #1 cover to the installation position and move the Arm #1 to a position where you can install the cover easily.

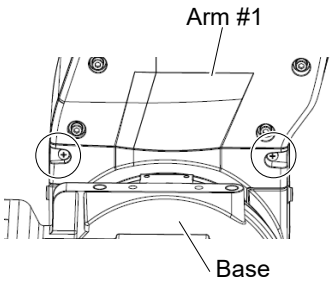


NOTE

When moving the arm, be careful not to get the cover caught on the Manipulator.
If you move the cover while the cover is got caught on the Manipulator, the cover may get broken.

(3) Fix the Joint #1 cover with the screws.

Cross recessed binding head machine screw:
2-M4×8
Tightening torque: 0.45 ± 0.05 N·m



NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

(4) Install the base cover.

For more details, refer to "*3.1 Base Cover*".

3.2.2 N6-A850**R (Joint #1 Cover)

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

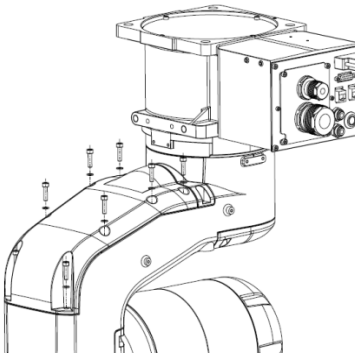
Removal

(1) Remove the base cover.

For more details, refer to "*3.1 Base Cover*".

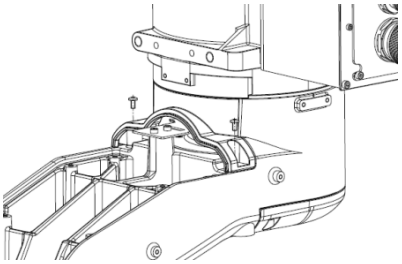
(2) Remove the Arm #1 outside cover.

Hexagon socket head cap bolts:
8-M5×20 (with plain washer)



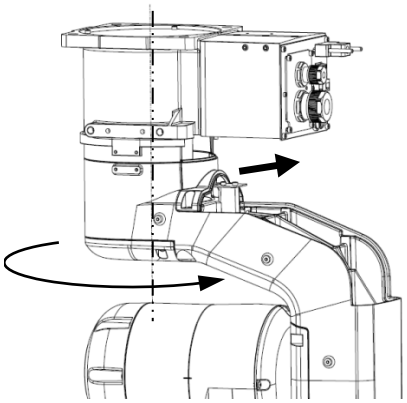
(2) Remove the screws of the Joint #1 cover.

Cross recessed binding head machine screw:
2-M4×8



(3) Hold the Joint #1 cover by hand so as not to fall, and move the Arm #1 to the origin position.

(4) Remove the Joint #1 cover.

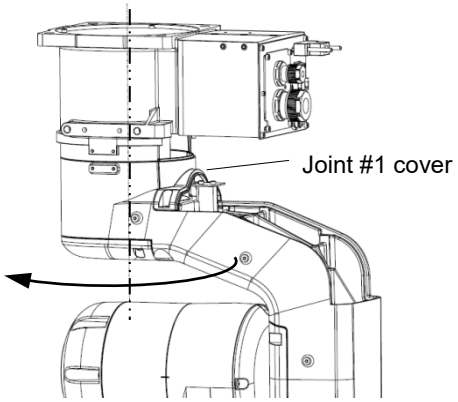


NOTE
Do not remove forcibly when the cover is got caught on the Manipulator.
The cover may get broken.

Installation

(1) Make sure that the base cover is removed and the Arm #1 is at the origin position.
For procedures to remove the base cover, refer to "*3.1 Base Cover*".

(2) Set the Joint #1 cover to the installation position and move the Arm #1 to a position where you can install the cover easily.



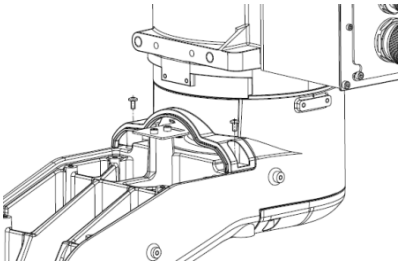
NOTE

When moving the arm, be careful not to get the cover caught on the Manipulator.
If you move the cover while the cover is got caught on the Manipulator, the cover may get broken.

(3) Fix the Joint #1 cover with the screws.

Cross recessed binding head machine screw: 2-M4×8

Tightening torque: 0.45 ± 0.05 N·m



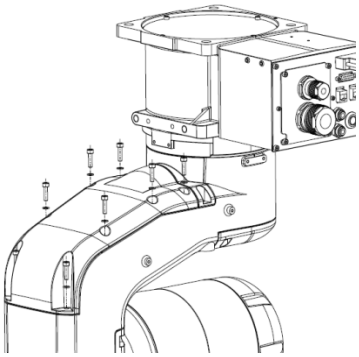
NOTE

The cover may get broken if it is fastened too tight. Be careful not to exceed the above tightening torque.

(4) Install the Arm #1 outside cover.

Hexagon socket head cap bolts: 8-M5×20 (with plain washer)

Tightening torque: 8.0 ± 0.4 N·m



(5) Install the base cover.

For more details, refer to "*3.1 Base Cover*".

3.3 Joint #1 Inside Cover

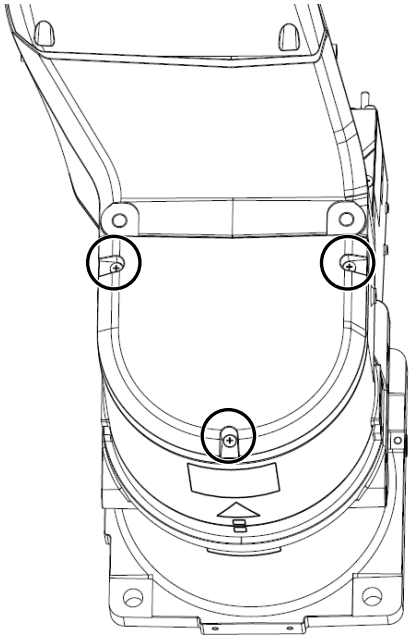
3.3.1 N6-A1000** (Joint #1 Inside Cover)

Removal

Remove the screws, and then remove the Joint #1 inside cover.

Cross recessed binding head machine screw:

3-M4×8



Installation

Set the Joint #1 inside cover to the Manipulator and fix it with the screws.

Cross recessed binding head machine screw:

3-M4×8

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.3.2 N6-A850**R (Joint #1 Inside Cover)

Removal

(1) Turn ON the Controller.

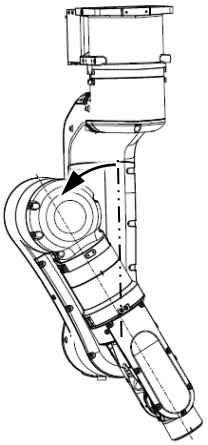
(2) Release the brake on the Joint #2.

EPSON RC+ Command

```
> brake off, 2
```

NOTE

When releasing the brake, be careful of the arm falling due to its own weight.



(3) Move the Arm #2 about 30 degrees.

(4) Operate the brake of the Joint #2.

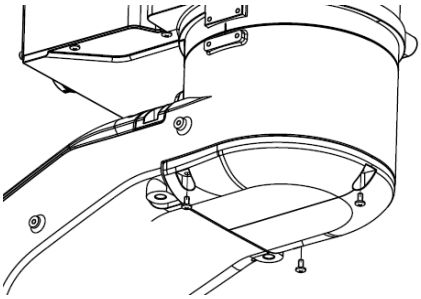
EPSON RC+ Command

```
> brake on, 2
```

(5) Turn OFF the Controller.

(6) Remove the screws, and then remove the Joint #1 inside cover.

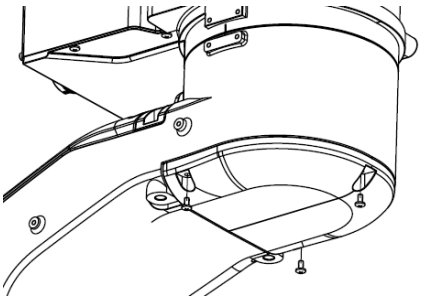
Cross recessed binding head machine screw:
3-M4×8



Installation

(1) Set the Joint #1 inside cover to the Manipulator and fix it with the screws.

Cross recessed binding head machine screw:
3-M4×8
Tightening torque: 0.45 ± 0.05 N·m



NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.4 Arm #1 Inside Cover

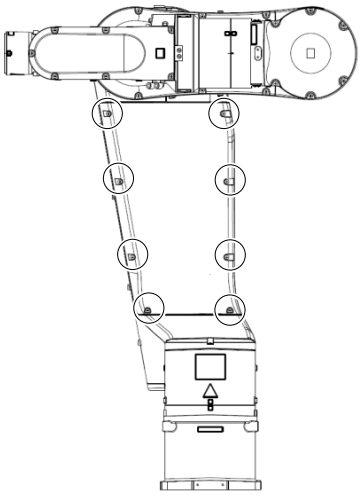
3.4.1 N6-A1000** (Arm #1 Inside Cover)

⚠ CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

Remove the screws, and then remove the Arm #1 inside cover.

Cross recessed binding head machine screw: 8-M4×8



Installation

Install the Arm #1 inside cover to the Manipulator and fix it with the screws.

Cross recessed binding head machine screw: 8-M4×8
Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.4.2 N6-A850**R (Arm #1 Inside Cover)

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

(1) Turn ON the Controller.

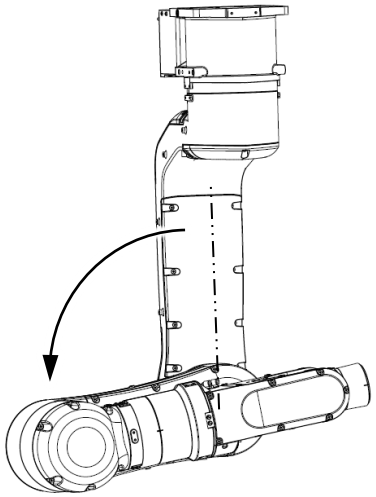
(2) Release the brake on the Joint #2.

EPSON RC+ Command

```
> brake off, 2
```

NOTE

When releasing the brake, be careful of the arm falling due to its own weight.



(3) Move the Arm #2 about 100 degrees.

(4) Operate the brake of the Joint #2.

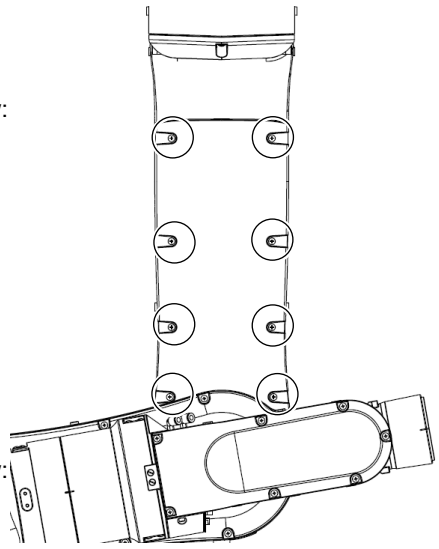
EPSON RC+ Command

```
> brake on, 2
```

(5) Turn OFF the Controller.

(6) Remove the screws, and then remove the Joint #1 inside cover.

Cross recessed binding head machine screw:
3-M4×8



Installation

(1) Install the Arm #1 inside cover.

Cross recessed binding head machine screw:
8-M4×8
Tightening torque: 0.45 ± 0.05 N·m

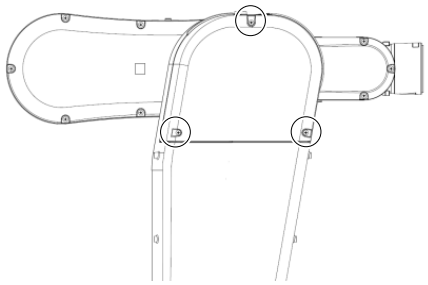
3.5 Joint #2 Outside Cover

⚠ CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

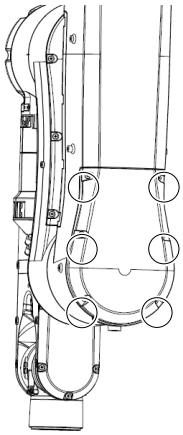
Remove the screws, and then remove the Joint #2 outside cover.

N6-A1000**



Cross recessed binding head machine screw: 3-M4×8

N6-A850**R

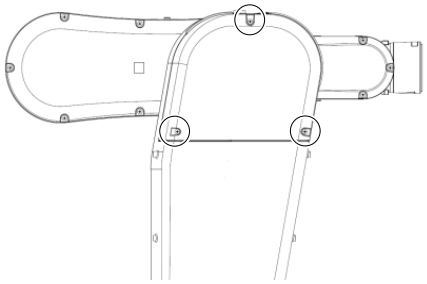


Cross recessed binding head machine screw: 6-M4×8

Installation

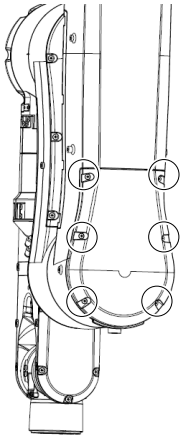
Install the Joint #2 outside cover to the Manipulator and fix it with the screws.

N6-A1000**



Cross recessed binding head machine screw: 3-M4×8
Tightening torque: 0.45 ± 0.05 N·m

N6-A850**R



Cross recessed binding head machine screw: 6-M4×8
Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.6 Joint #2 Cover

3.6.1 N6-A1000** (Joint #2 Cover)

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

(1) Turn ON the Controller.

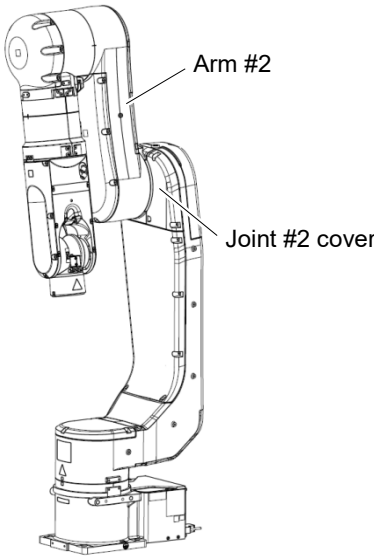
(2) Release the Joint #2 brake.

EPSON RC+ Command

```
> brake off, 2
```

NOTE When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the Arm #2 about 100 degrees to a position where you can remove the screws of the Joint #2 cover.



(4) Operate the brake of the Joint #2.

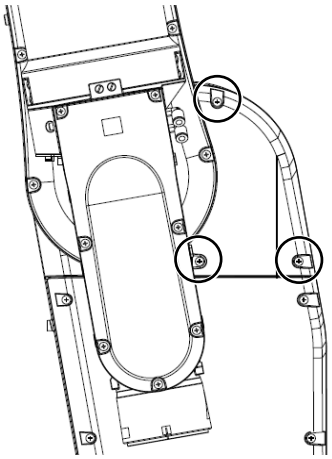
EPSON RC+ Command

```
> brake on, 2
```

(5) Turn OFF the Controller.

(6) Remove the screws, and then remove the Joint #2 cover.

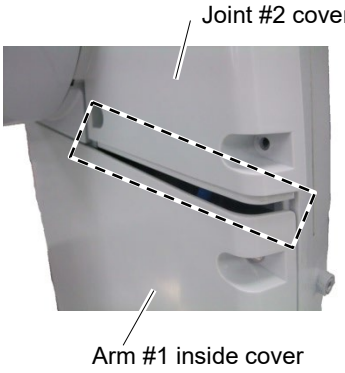
Cross recessed binding head machine screw:
3-M4×8



Installation

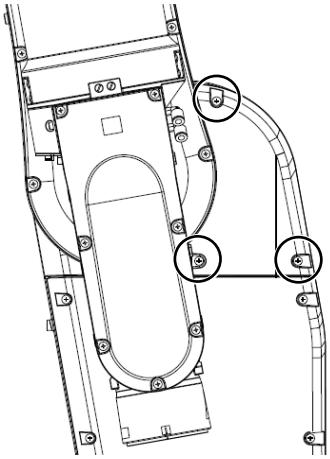
(1) Set the Joint #2 cover to the Manipulator.

Install the Joint #2 cover into the Arm #1 inside cover.



(2) Fix the Joint #2 cover with the screws.

Cross recessed binding head machine screw:
3-M4×8
Tightening torque: 0.45 ± 0.05 N·m



NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.7 Arm #2 Cover (Arm #1 side)

3.7.1 N6-A1000** (Arm #2 Cover, Arm #1 Side)

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

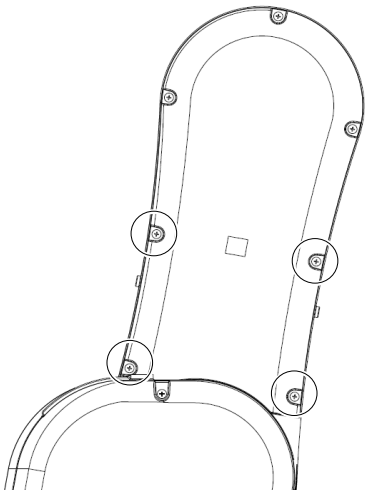
Removal

(1) Remove the Joint #2 cover.

For more details, refer to "*3.6.1 N6-A1000** (Joint #2 Cover)*".

(2) Remove the screws shown in the right figure of the screws that fix the Arm #2 cover (Arm #1 side).

Cross recessed binding head machine screw: 4-M4×8



(3) Turn ON the Controller.

(4) Release the Joint #2 brake.

EPSON RC+

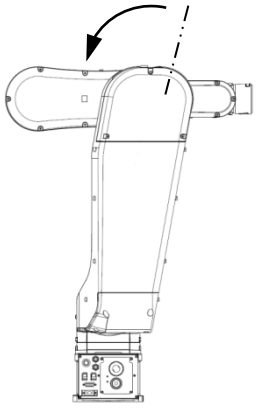
Command

```
> brake off, 2
```

NOTE

When releasing the brake, be careful of the arm falling due to its own weight.

(5) Move the Arm #2 to the origin position.



(6) Activate the Joint #2 brake.

EPSON RC+

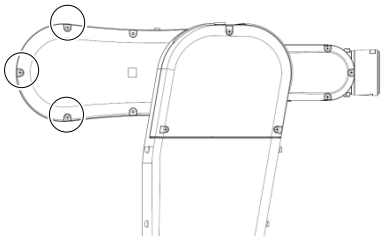
Command

```
> brake on, 2
```

(7) Turn OFF the Controller.

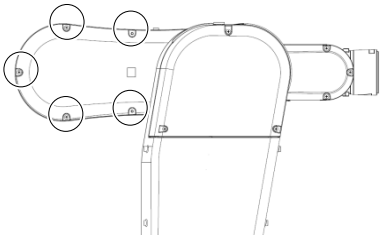
(8) Remove the rest of the screws that fix the Arm #2 cover (Arm #1 side), and remove the Arm #2 cover.

Cross recessed binding head machine screw: 3-M4×8



Installation

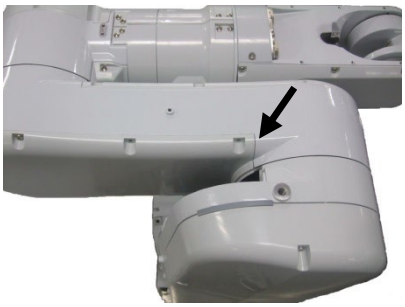
(1) When the Arm #2 is at the origin position, set the Arm #2 cover to the Manipulator and temporarily fix with the screws.

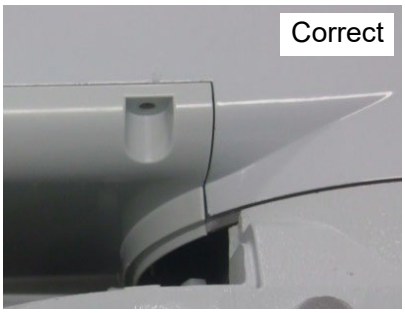


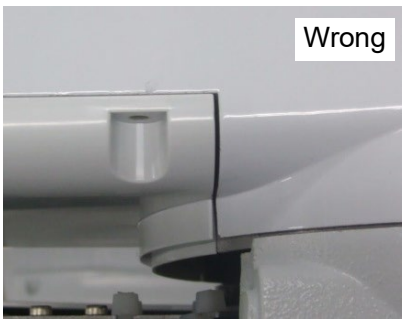
Cross recessed binding head machine screw:
5-M4×8
Tightening torque: 0.45 ± 0.05 N·m

NOTE
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

NOTE
Make sure that there is no space between the Arm #2 cover and Arm #2, and then fix it.







(2) Turn ON the Controller.

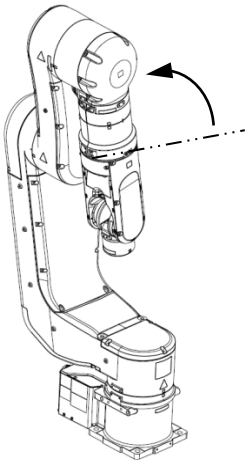
(3) Release the Joint #2 brake.

EPSON RC+

Command
```
> brake off, 2
```

NOTE
When releasing the brake, be careful of the arm falling due to its own weight.

(4) Move the Arm #2 about 100 degrees.



(5) Activate the Joint #2 brake.

EPSON RC+

Command

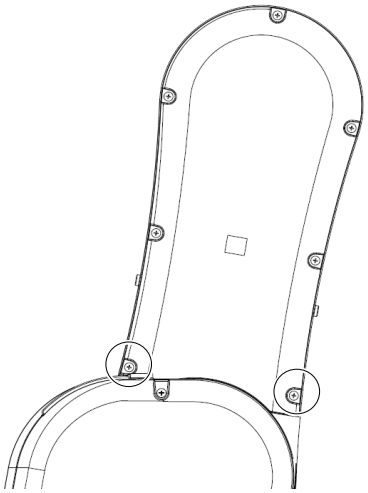
```
> brake on, 2
```

(6) Turn OFF the Controller.

(7) Fix the Arm #2 cover (Arm #1 side) with the screws.

Cross recessed binding head machine screw
: 2-M4×8

Tightening torque: 0.45 ± 0.05 N·m



(8) Install the Joint #2 cover,
For more details, refer to "*3.6.1 N6-A1000** (Joint #2 Cover)*".

3.7.2 N6- A850**R (Arm #2 Cover, Arm #1 Side)

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

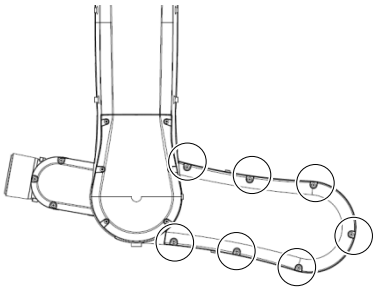
Removal

(1) Remove the Arm #1 inside cover.

For more details, refer to "*3.4.2 N6-A850**R (Arm #1 Inside Cover)*".

(2) Remove the screws shown in the right figure of the screws that fix the Arm #2 cover (Arm #1 side).

Cross recessed binding head machine screw: 7-M4×8



(3) Turn ON the Controller.

(4) Release the Joint #2 brake.

EPSON RC+

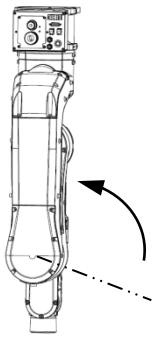
Command

```
> brake off, 2
```

NOTE

When releasing the brake, be careful of the arm falling due to its own weight.

(5) Move the Arm #2 to the origin position while holding the Arm #2 cover (Arm #1 side).



(6) Activate the Joint #2 brake.

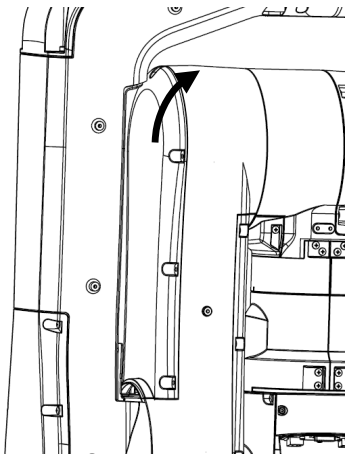
EPSON RC+

Command

```
> brake on, 2
```

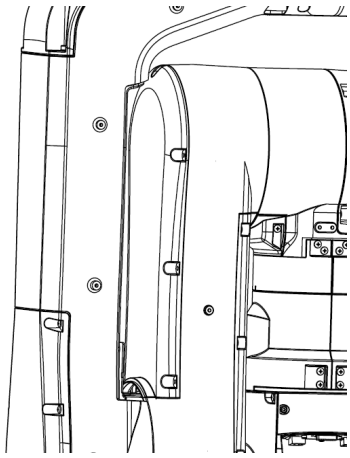
(7) Turn OFF the Controller.

(8) Remove the Arm #2 cover.



Installation

(1) When the Arm #2 is at the origin position, set the Arm #2 cover to the Manipulator.



(2) Turn ON the Controller.

(3) Release the Joint #2 brake.

EPSON RC+

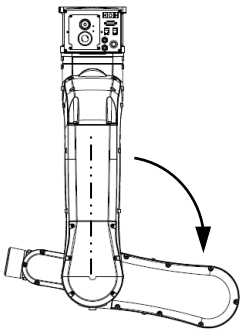
Command

```
> brake off, 2
```

NOTE

When releasing the brake, be careful of the arm falling due to its own weight.

(4) Move the Arm #2 about 100 degrees while holding the Arm #2 cover (Arm #1 side).



(5) Activate the Joint #2 brake.

EPSON RC+

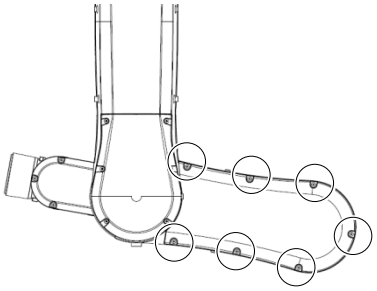
Command

```
> brake on, 2
```

(6) Turn OFF the Controller.

(7) Fix the Arm #2 cover (Arm #1 side) with the screws.

Cross recessed binding head machine screw:
7-M4×8
Tightening torque:0.45 ± 0.05 N·m



(8) Install the Arm #1 inside cover.

For more details, refer to "*3.4.2 N6-A850**R (Arm #1 Inside Cover)*".

3.8 Arm #2 Cover (Arm #3 side)

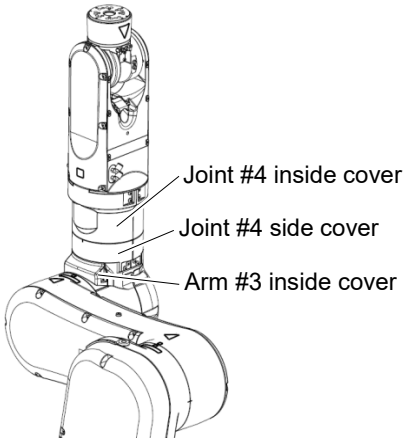
⚠ CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal (1) Remove the following covers in order.

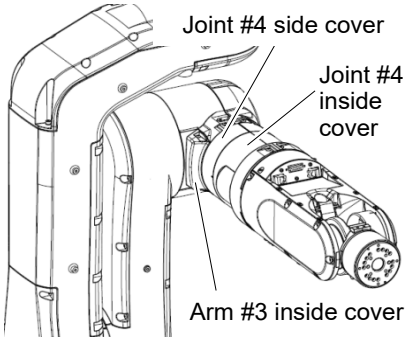
Joint #4 inside cover
Joint #4 side cover (Arm #2 side)
Arm #3 inside cover

Details are described in the following sections:
3.12 Joint #4 Inside Cover
3.11 Joint #4 Side Cover
3.9 Arm #3 Inside Cover

N6-A1000**



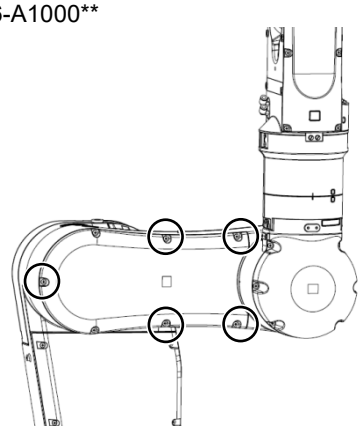
N6-850**R



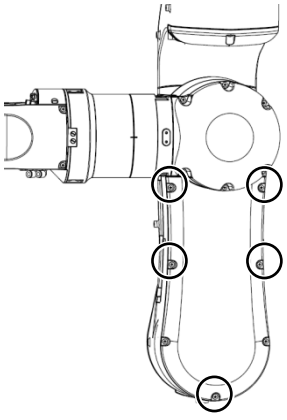
(2) Remove the screws shown below of the screws that fix the Arm #2 cover (Arm #3 side).

Cross recessed binding head machine screw: 5-M4×8

N6-A1000**



N6-850**R



(3) Turn ON the Controller.

(4) Release the Joint #3 brake.

EPSON RC+ Command

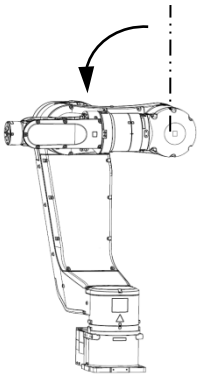
```
> brake off, 3
```

NOTE

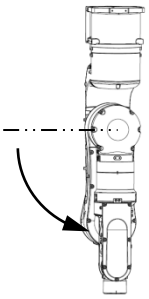
When releasing the brake, be careful of the arm falling due to its own weight.

(5) Move the Arm #3 to the origin position.

N6-A1000**



N6-850**R



(6) Activate the Joint #3 brake.

EPSON RC+ Command

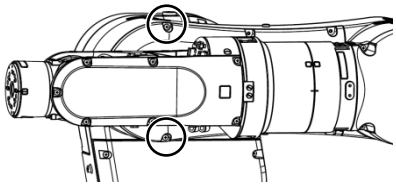
```
> brake on, 3
```

(7) Turn OFF the Controller.

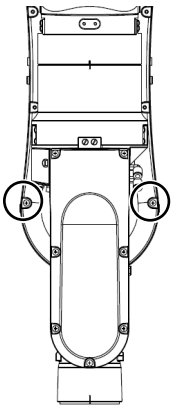
(8) Remove the rest of screws that fix the Arm #2 cover, and remove the Arm #2 cover.

Cross recessed binding head machine screw: 2-M4×8

N6-A1000**



N6-850**R

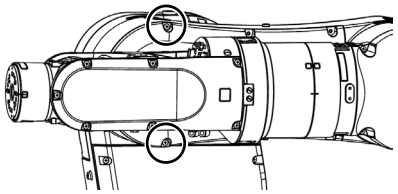


Installation

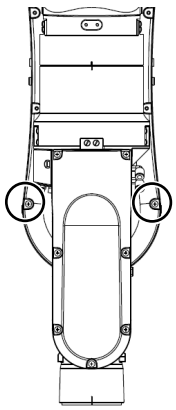
(1) When the Arm #3 is at the origin position, set the Arm #2 cover to the Manipulator and temporarily fix with the screws.

Cross recessed binding head machine screw: 2-M4×8
Tightening torque: 0.45 ± 0.05 N·m

N6-A1000**

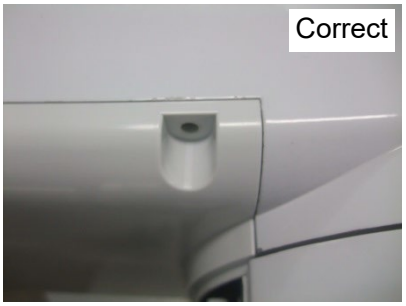


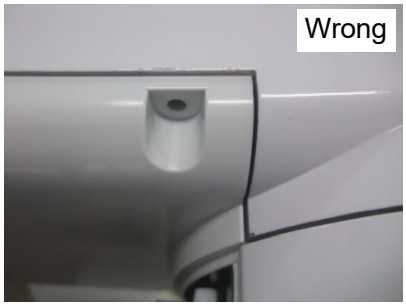
N6-850**R



NOTE
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

NOTE
Make sure that there is no space between the Arm #2 cover and Arm #2, and then fix it.





(2) Turn ON the Controller.

(3) Release the Joint #3 brake.

EPSON RC+

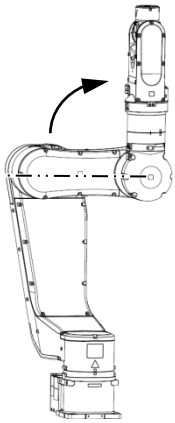
Command

```
> brake off, 3
```

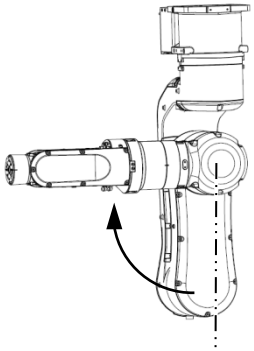
NOTE
When releasing the brake, be careful of the arm falling due to its own weight.

(4) Move the Arm #3 about 90 degrees as shown below.

N6-A1000**



N6-850**R



(5) Activate the Joint #3 brake.

EPSON RC+

Command

```
> brake on, 3
```

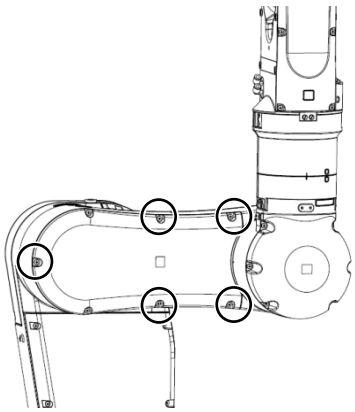
(6) Turn OFF the Controller.

(7) Fix the Arm #2 cover with the screws.

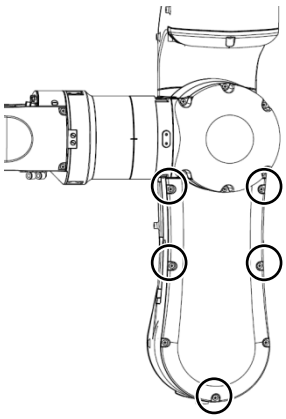
Cross recessed binding head machine screw: 5-M4×8

Tightening torque: 0.45 ± 0.05 N·m

N6-A1000**



N6-850**R



NOTE

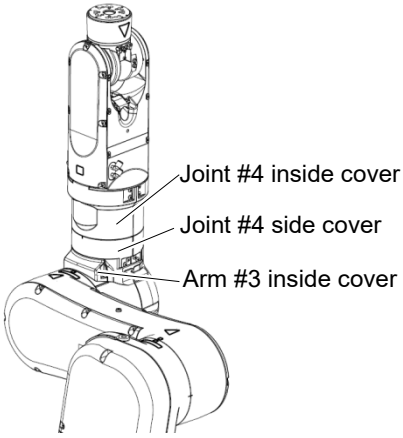
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

(8) Install the following covers.

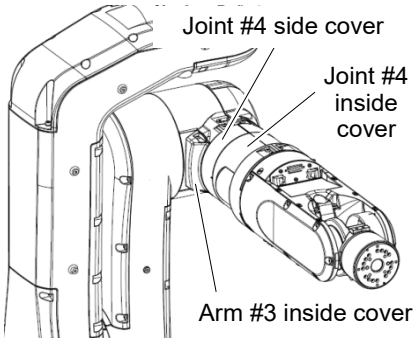
Arm #3 inside cover
Joint #4 side cover (Arm #2 side)
Joint #4 inside cover

Details are described in the following sections:
3.9 Arm #3 Inside Cover
3.11 Joint #4 Side Cover
3.12 Joint #4 Inside Cover

N6-A1000**



N6-850**R



3.9 Arm #3 Inside Cover

⚠ CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

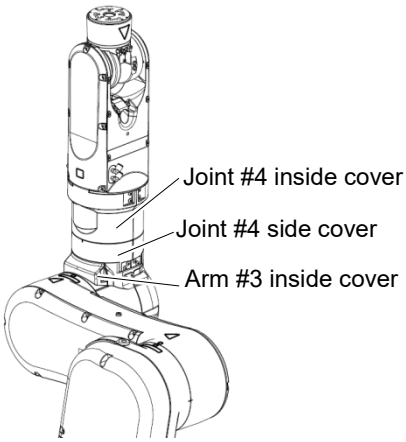
Removal

(1) Remove the following covers in order.

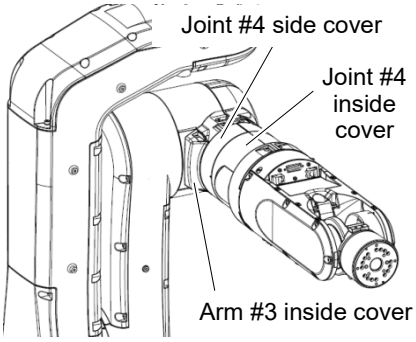
Joint #4 inside cover
Joint #4 side cover (Arm #2 side)

Details are described in the following sections:
3.11 Joint #4 Side Cover
3.12 Joint #4 Inside Cover

N6-A1000**



N6-850**R



(2) Remove the screws that fix the Arm #3 inside cover, and then remove the cover.

Cross recessed binding head machine screw:
2-M4×8

Installation

(1) Set the Arm #3 inside cover to the Manipulator and fix it with the screws.

Cross recessed binding head machine screw:
2-M4×8
Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight. Be careful not to exceed the above tightening torque.

(2) Install the following covers.

Joint #4 side cover (Arm #2)
Joint #4 inside cover

Details are described in the following sections:
3.11 Joint #4 Side Cover
3.12 Joint #4 Inside Cover

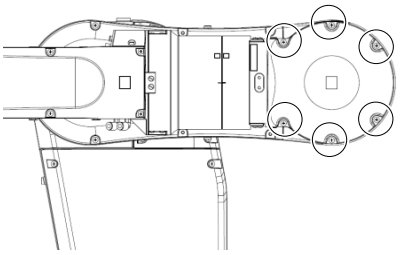
3.10 Arm #3 Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

Remove the screws, and then remove the Arm #3 cover.

Cross recessed binding head machine screw:
6-M4×8



Installation

Set the Arm #3 cover to the Manipulator and fix it with the screws.

Cross recessed binding head machine screw:
6-M4×8

Tightening torque: 0.45 ± 0.05 N·m

NOTE
Be careful not to get the cables caught in the arm.

NOTE
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

3.11 Joint #4 Side Cover

⚠ CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

(1) Remove the following covers.

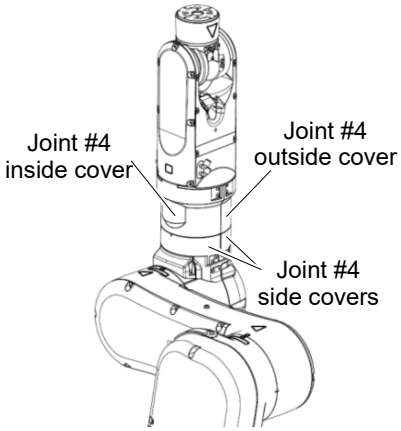
Joint #4 inside cover, Joint #4 outside cover

Details are described in the following sections:

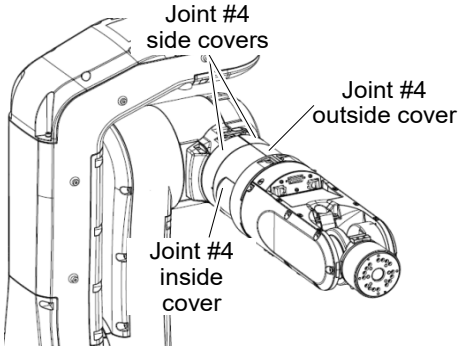
3.12 Joint #4 Inside Cover

3.13 Joint #4 Outside Cover

N6-A1000**



N6-850**R



(2) Remove the screws, and then remove the Joint #4 side covers (2 covers).

Cross recessed binding head machine screw: 8-M4×8

Installation

(1) Match the two Joint #4 side covers and set to the Manipulator, then fix them with the screws.

Cross recessed binding head machine screw: 8-M4×8

Tightening torque: 0.45 ± 0.05 N·m

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

NOTE

Do not tighten the screws when the covers are not matched properly.
The covers may get broken.

NOTE

Be sure to install the cover while pressing it to the Manipulator.
If the cover is installed away from the Manipulator, it may rub the other covers during the operation.

(2) Install the following covers:

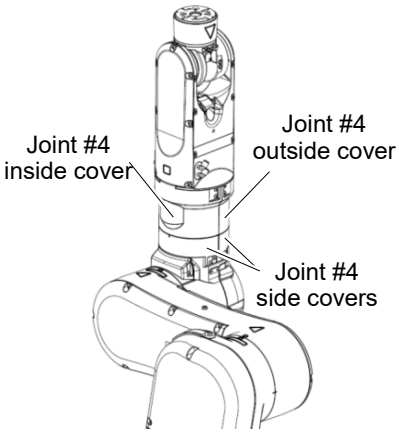
Joint #4 inside cover, Joint #4 outside cover

Details are described in the following sections:

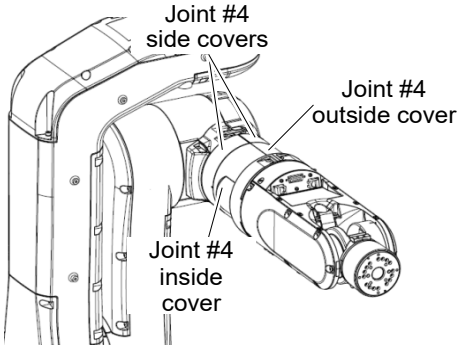
3.12 Joint #4 Inside Cover

3.13 Joint #4 Outside Cover

N6-A1000**



N6-850**R



3.12 Joint #4 Inside Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

(1) Turn ON the Controller.

(2) Release the Joint #3 brake.

EPSON RC+

Command

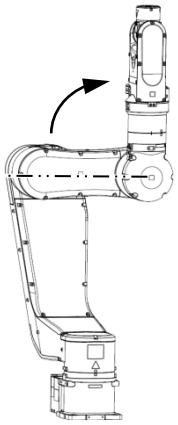
```
> brake off, 3
```

NOTE

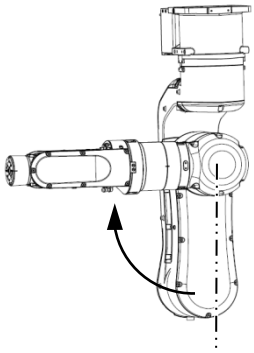
When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the Arm #3 about 90 degrees as shown below.

N6-A1000**



N6-850**R



(4) Activate the Joint #3 brake.

EPSON RC+

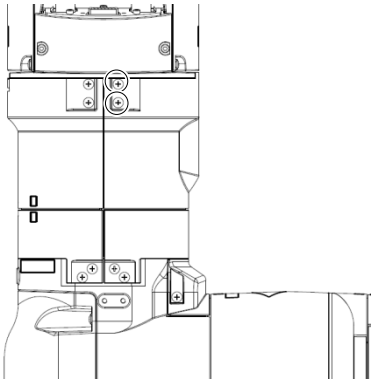
Command

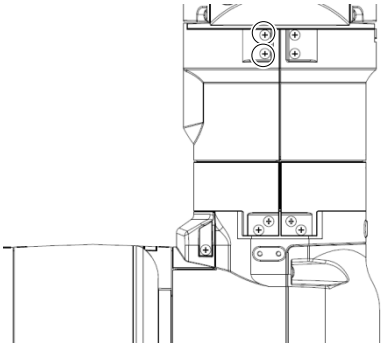
```
> brake on, 3
```

(5) Turn OFF the Controller.

(6) Remove the screws, and then remove the Arm #3 cover.

Cross recessed binding head machine screw: 4-M4×8



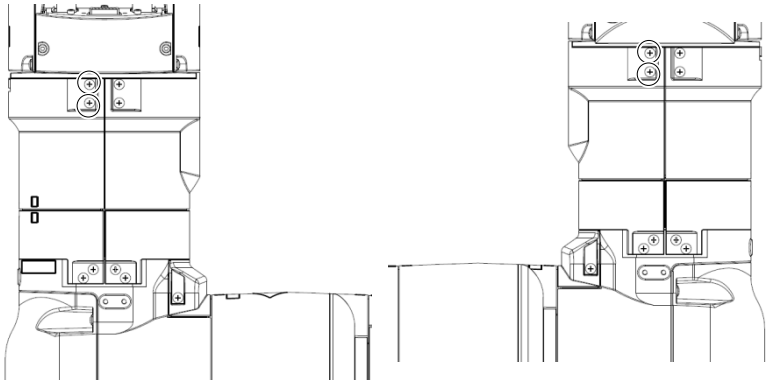


Installation

Match the Joint #4 inside cover and the Joint #4 outside cover, and set them to the Manipulator. Then, fix them with the screws.

Cross recessed binding head machine screw: 4-M4×8

Tightening torque: 0.45 ± 0.05 N·m



NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

NOTE

Do not tighten the screws when the covers are not matched properly.
The covers may get broken.

NOTE

Be careful not to get the cables caught in the cover.

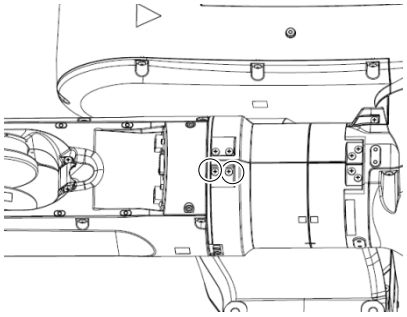
3.13 Joint #4 Outside Cover

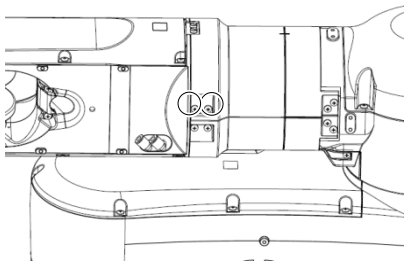
⚠ CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

Remove the screws, and then remove the Joint #4 outside cover.

Cross recessed binding head machine screw:
4-M4×8





Installation

Match the Joint #4 inside cover and the Joint #4 outside cover, and set them to the Manipulator. Then, fix them with the screws.

Cross recessed binding head machine screw: 4-M4×8
Tightening torque: 0.45 ± 0.05 N·m

NOTE
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

NOTE
Do not tighten the screws when the covers are not matched properly.
The covers may get broken.

NOTE
Be careful not to get the cables caught in the cover.

3.14 Arm #4 Side Cover

CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

(1) Turn ON the Controller.

(2) Release the Joint #3 brake.

EPSON RC+

Command

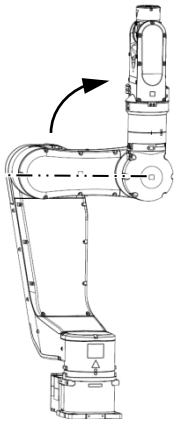
```
> brake off, 3
```

NOTE

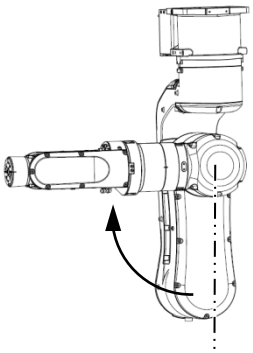
When releasing the brakes, be careful of the arm falling due to its own weight.

(3) Move the Arm #3 about 90 degrees as shown below.

N6-A1000**



N6-850**R



(4) Activate the Joint #3 brake.

EPSON RC+

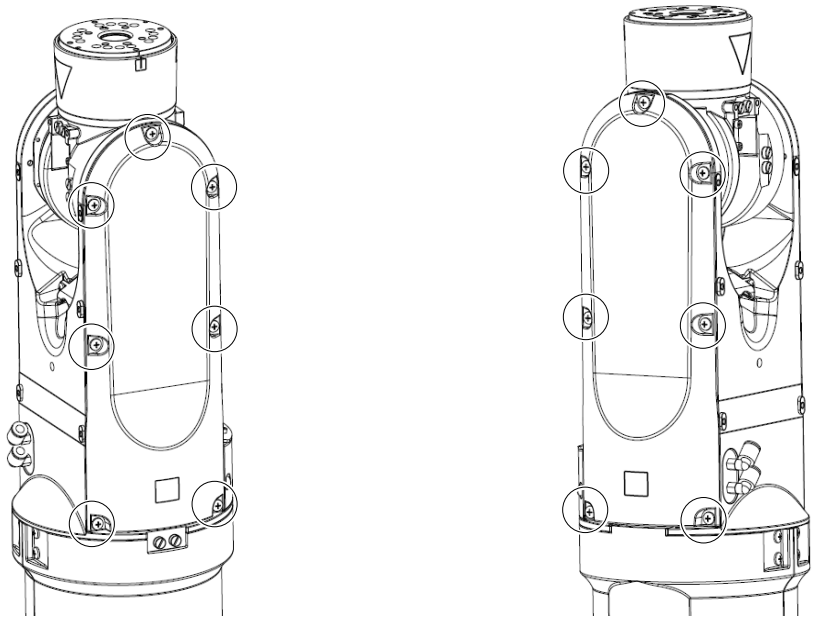
Command

```
> brake on, 3
```

(5) Turn OFF the Controller.

(6) Remove the screws, and then remove the Arm #4 side covers (2 covers).

Cross recessed binding head machine screw: 14-M4×8

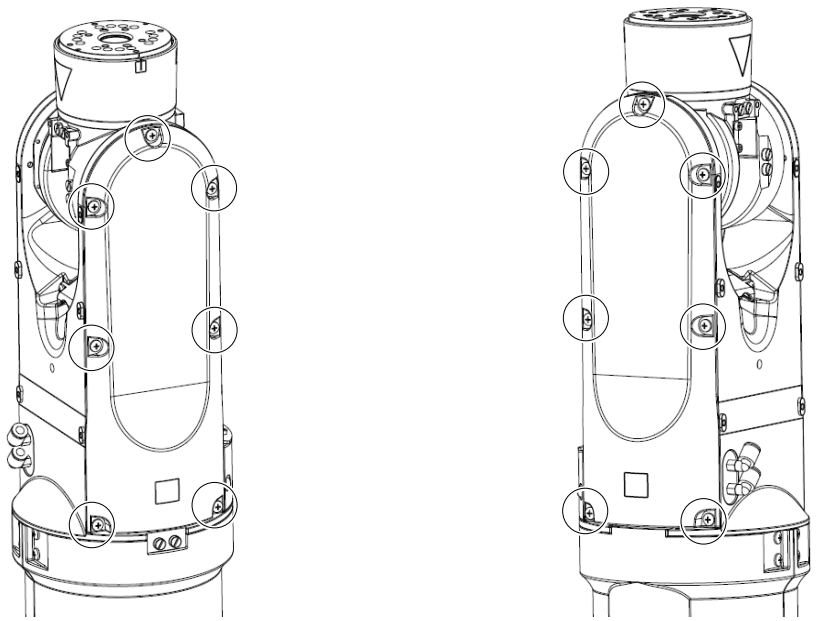


Installation

Set the Arm #4 side covers (2 covers) to the Manipulator and fix with the screws.

Cross recessed binding head machine screw: 14-M4×8

Tightening torque: 0.45 ± 0.05 N·m



NOTE

Be careful not to get the cables caught in the cover.

NOTE

The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

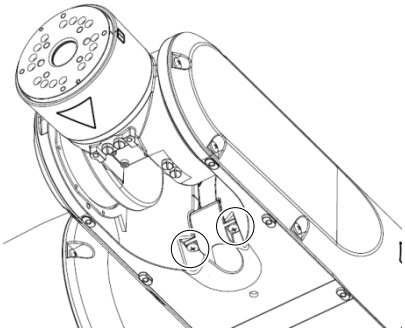
3.15 Arm #4 Cable Cover

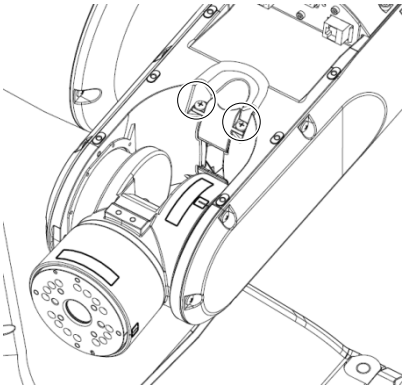
CAUTION	■ When installing the cover, be careful not to get the cables caught in it or bend them forcibly to push into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, check the cable locations at removing the cover. Be sure to place the cables back to their original locations.

Removal

Remove the screws, and then remove the Arm #4 cable covers (2 covers).

Cross recessed binding head machine screw:
4-M4×8





Installation

Set the Arm #4 cable covers (2 covers) and fix them with the screws.

Cross recessed binding head machine screw: 4-M4×8
Tightening torque: 0.45 ± 0.05 N·m

NOTE
The cover may get broken if it is fastened too tight.
Be careful not to exceed the above tightening torque.

NOTE
When passing cables, be careful not to get the cables caught in the covers.

4. Cable

4.1 Replacing the Cable Unit (N6-A1000*): Cable Direction: Standard (backward)

WARNING

- Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system.
- Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
- When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system.
  When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

CAUTION

- When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions.
  Improper connection of the connectors may result in improper function of the robot system.
  For details on the connections, refer to "*4.7 Connector Pin Assignment*".

	Name		Qty	Code, Note
Maintenance Parts	Cable unit		1	2187251 (Standard)
				2194258 (Cleanroom)
	Cable tie	AB150	-	1675754, 1 bag (100 ties: white)
		AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

NOTE
The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

Removal

Cable Unit

Cable direction
Standard
(backward)

(1) Remove the following covers:

Arm #4 side cover (2 covers)		
Joint #4 inside cover	Joint #4 outside cover	Joint #4 side covers (2 covers)
Arm #3 cover	Arm #3 inside cover	Arm #2 cover (2 covers)
Joint #2 cover	Joint #2 outside cover	
Arm #1 inside cover	Joint #1 cover	Base cover

For details, refer to "*3. Covers*".

(2) Turn ON the Controller.

(3) Release the brakes of each joint and move the Manipulator to the orientation as shown below.

EPSON RC+

Command
`>Brake off,` [the number (from 2 to 6) corresponding to the arm whose brake will be turned OFF]

Joint #1 +90°
Joint #2 +90°
Joint #3 –90°
Joint #4 0°
Joint #5 0°
Joint #6 0°

NOTE
When releasing the brake, the arm may rotate by its own weight.

NOTE
Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may cause hands and fingers to be caught and/or equipment damage to or malfunction of the Manipulator as the arms of the Manipulator may move in unexpected directions.

(4) Brake each joint.

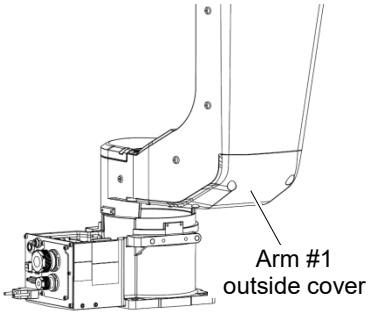
EPSON RC+

Command
`>Brake On,`[The number (from 2 to 6) corresponding to the arm whose brake will be turned ON]

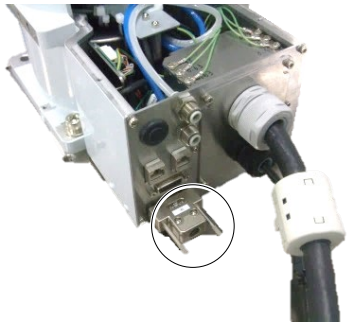
(5) Turn OFF the Controller.

(6) Remove the Arm #1 outside cover.

Hexagon socket head cap bolts:
8-M5×20 (with plain washer)



(7) Disconnect the external short connector.

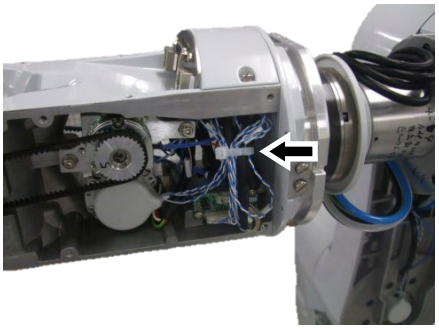


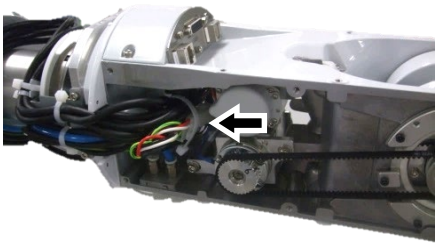
(8) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(9) Cut off the cable tie of the cables.

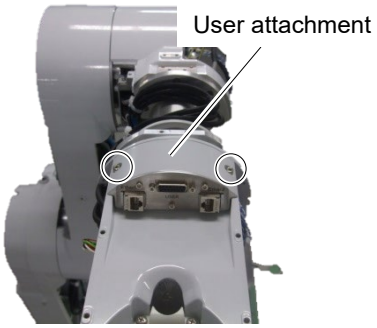
NOTE
Be careful not to cut the cables.





(10) Remove the user attachment of the Arm #4.

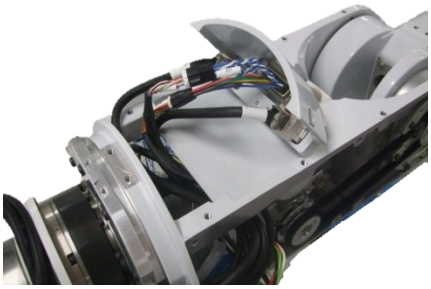
Hexagon socket head cap bolts: 2-M4×8



NOTE
Cables are connected to the user attachment. When you disconnect the cables, make sure not to pull the user attachment forcibly.

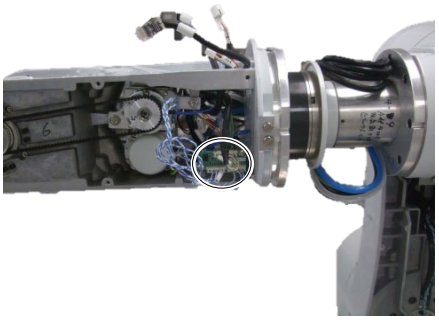
(11) Disconnect the connectors from the user attachment.

Connectors: Ether1, Ether2, X71, X72



(12) Disconnect the connector connected to the encoder board 4.

Connector: EB05_CN1

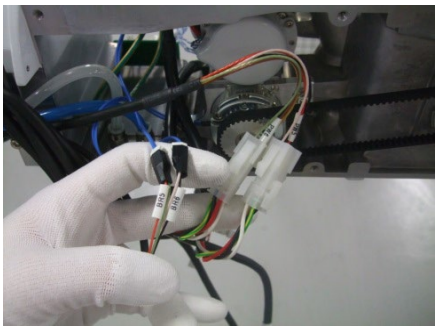


NOTE

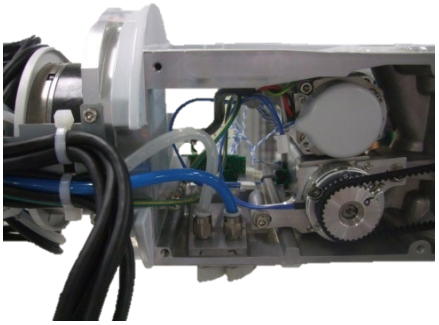
Be careful that the jumper pins on the board do not come off.

(13) Remove the connectors.

Connectors: PW5, PW6, BR5, BR6

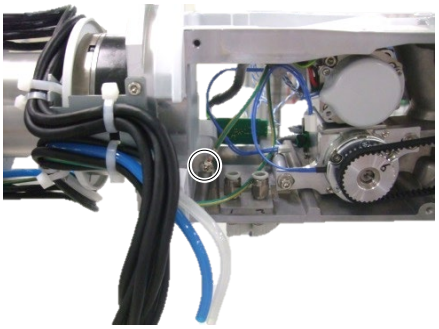


(14) Remove the two air tubes.

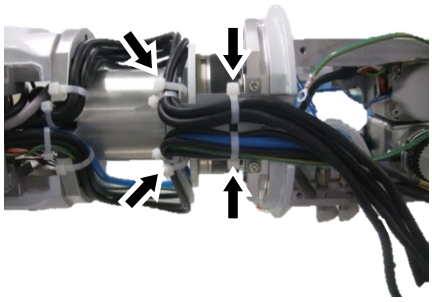


(15) Remove the ground wire terminals.

Cross recessed binding head machine screw: M4×8

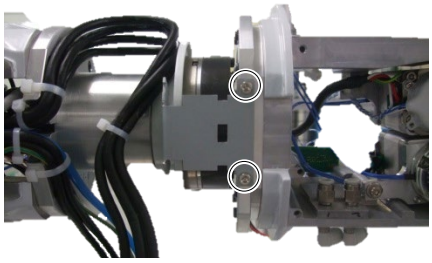


(16) Cut off the cable tie that fixes the cable unit to the plate.



(17) Remove the cable fixing plate.

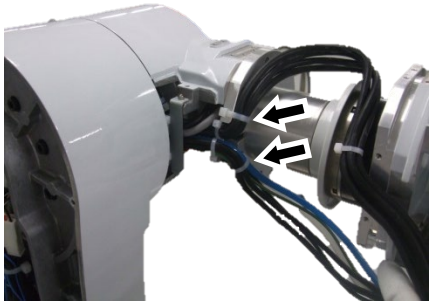
Hexagon socket head cap bolts: 2-M4×8



NOTE

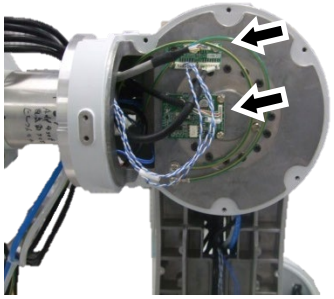
Be careful not to lose the removed cable fixing plate.

(18) Cut off the cable tie of the flange on the Joint #4 actuator unit.



(19) Disconnect the connectors connected to the encoder board 3 and the control board 2.

Connectors: EB04_CN1, EB04_CN3, EB0x_CN2, GS02

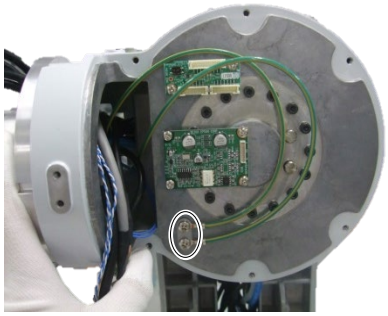


NOTE

Be careful that the jumper pins on the board do not come off.

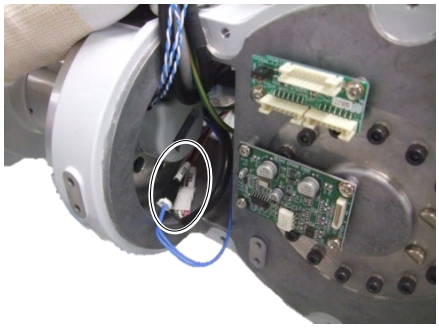
(20) Remove the two ground wire terminals.

Cross recessed binding head machine screws: 2-M4×8



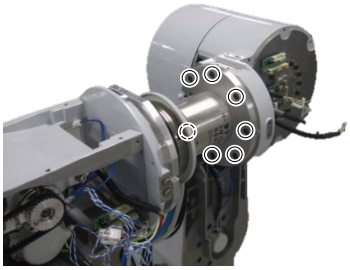
(21) Disconnect the connectors connected to the Joint #4 actuator unit.

Connectors: PW4, BR4



(22) Remove the Joint #4 actuator unit from the Arm #3.

Hexagon socket head cap bolts:
7-M4×15 (with plain washer)



NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

When removing it, make sure not to lose the positioning pin.

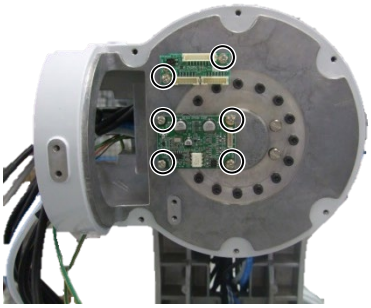
Also, be careful not to catch the cables on the Joint #4 actuator unit.

(23) Remove the J3 cable fixing plate fixed on the Arm #3.

Hexagon socket head cap bolts: 2-M3×6

(24) Remove the encoder board 3 and the control board 2.

Cross recessed binding head machine screws: 6-M3×6



NOTE

Be careful not to lose the removed board

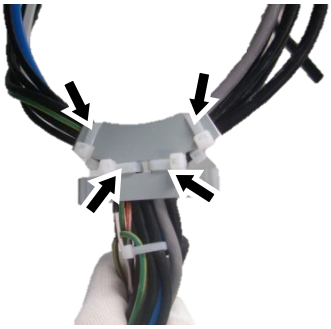
(25) Remove the Arm #3.

Hexagon socket head cap bolts:
16-M4×30 (with plain washer)

NOTE

After removing the Arm #3, confirm that the O-ring is installed to the reduction gear unit. If the O-ring is installed on the Arm #3, re-install it on the reduction gear unit.

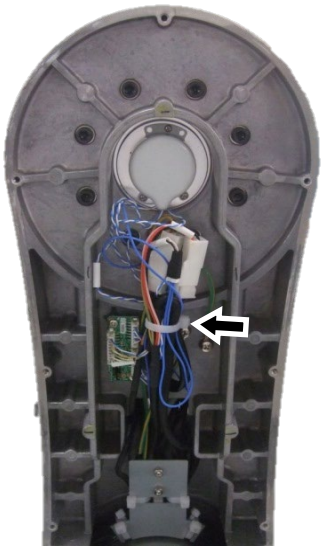
(26) Cut off the cable tie of the removed J3 cable fixing plate.



NOTE

Be careful not to lose the removed cable fixing plate.

(27) Cut off the cable tie of the cables.



(28) Disconnect the connectors connected to the Joint #2 actuator unit.

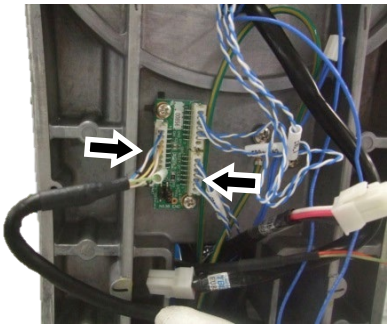
Connectors: PW2, BR2

(29) Disconnect the connectors connected to the Joint #3 actuator unit.

Connectors: PW3, BR3

(30) Disconnect the connectors connected to the encoder board 2.

Connectors:
EB02_CN1
EB0x_CN2 (Joint #2 side)



NOTE
Be careful that the jumper pins on the board do not come off.

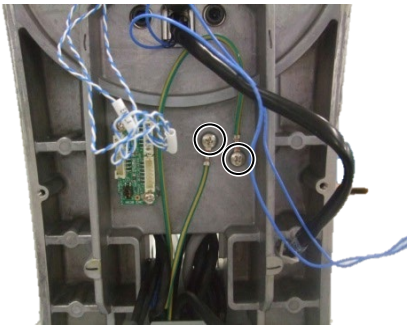
(31) Pull the cables from the Joint #2 actuator unit to the Arm #3 side.

Cables (connectors):
PW2, BR2, EB0x_CN2

NOTE
Do not pull the cables forcibly while the connectors get caught. Doing so may result in disconnection of the cables or breakage of the connectors.

(32) Remove the two ground wire terminals.

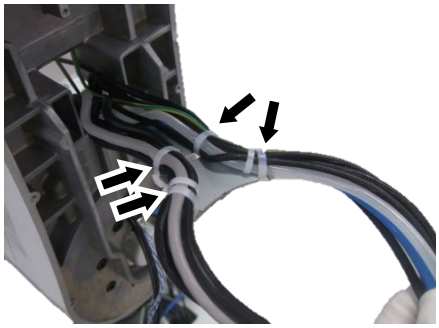
Cross recessed binding head machine screw: 2-M4×8



(33) Remove the J3 cable fixing plate fixed on the Arm #2.

Hexagon socket head cap bolts: 2-M4×8

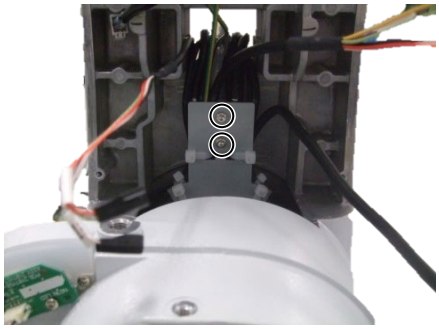
(34) Cut off the cable tie of the removed J3 cable fixing plate.



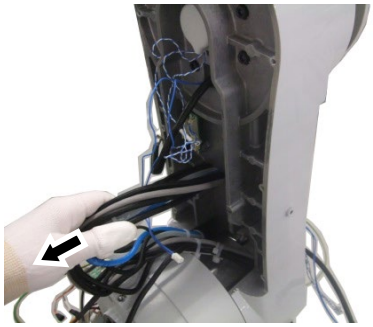
NOTE Be careful not to lose the removed cable fixing plate.

(35) Remove the J2 cable fixing plate fixed on the Arm #2.

Hexagon socket head cap bolts: 2-M4×8



(36) Pull out the cable unit passing through the Arm #2.



NOTE Be careful not to catch the cables coming from the Joint #2 actuator unit to the cable unit.

(37) Remove the Arm #2.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)

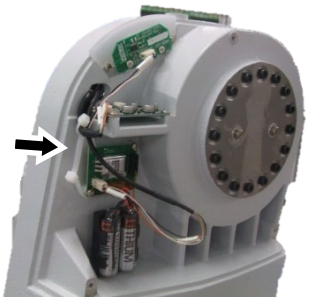
NOTE Be sure to have at least 2 people to perform the operation since the parts being heavy.

NOTE Be careful not to catch the cables on the Joint #2 actuator unit or Arm #2.

(38) Cut off the cable tie of the removed J2 cable fixing plate.

NOTE Be careful not to lose the removed cable fixing plate.

(39) Cut off the cable tie of the cables.

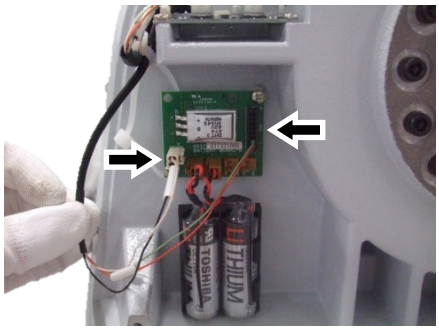


(40) Disconnect the connectors connected to the battery board.

Connectors: BAT_CN3, BAT_CN6

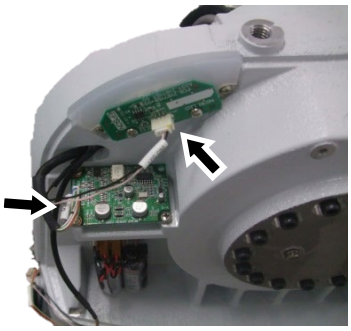
NOTE

You do not need to disconnect the connectors of the batteries.



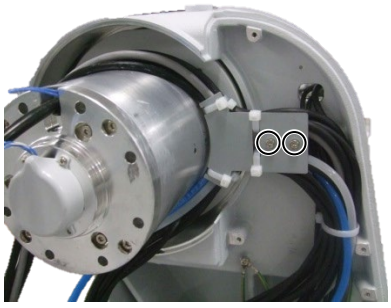
(41) Disconnect the connectors connected to the control board 1 and the LED board.

Connectors: GS01, LED_CN1



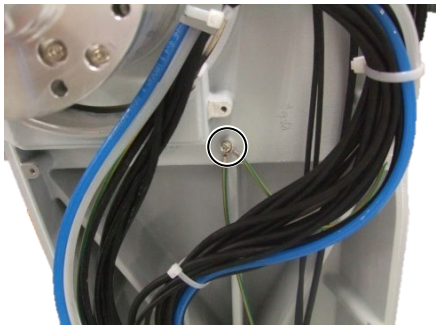
(42) Remove the J2 cable fixing plate fixed on the Arm #1.

Hexagon socket head cap bolts: 2-M4×8



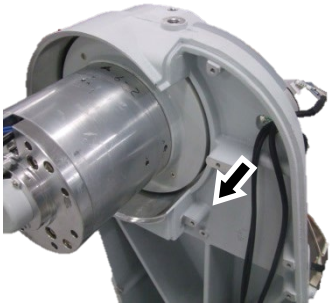
(43) Remove the ground wire terminals.

Cross recessed binding head machine screw: M4×8



(44) Pull the following cables (connectors) to the inside of the Arm #1.

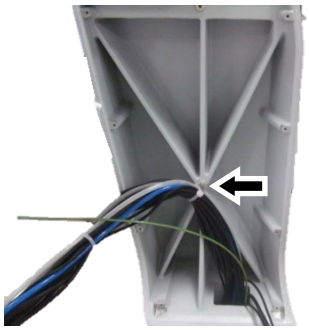
Cables (connectors):
BAT_CN3, BAT_CN6, GS01,
LED_CN



(45) Cut off the cable tie of the removed J2 cable fixing plate.

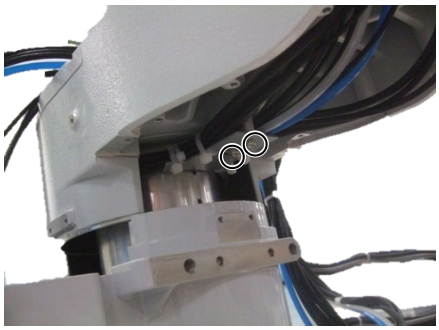
NOTE
Be careful not to lose the removed cable fixing plate.

(46) Cut off the cable tie that fixes the cable unit.



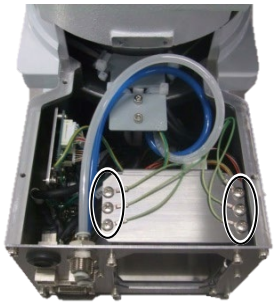
(47) Remove the J1 cable fixing plate fixed on the Arm #1.

Hexagon socket head cap bolts: 2-M4×8



(48) Remove the six ground wire terminals.

Cross recessed binding head machine screw: M4×8



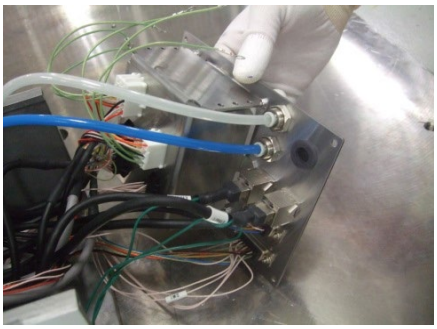
(49) Remove the base side plate.

Hexagon socket head cap bolts: 4-M4×8

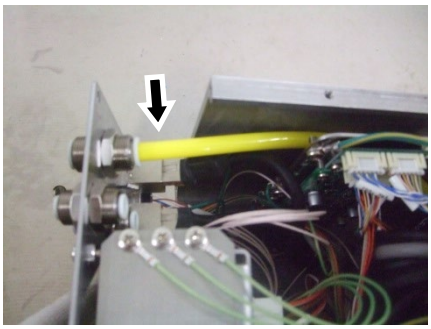
(50) Disconnect the connectors and two air tubes (for cleanroom model: three air tubes) from the removed base side plate.

Connectors: X11, X12, X010, BR010, Ether1, Ether2, D-sub, SW1

Standard model

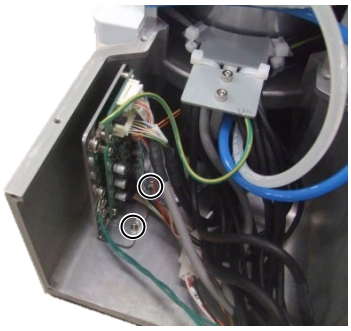


Cleanroom model



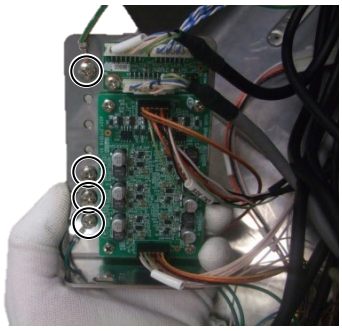
(51) Remove the board fixing plate.

Hexagon socket head cap bolts: 2-M3×6



(52) Disconnect the connectors connected to the encoder board 1 and the brake board.

Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2



NOTE

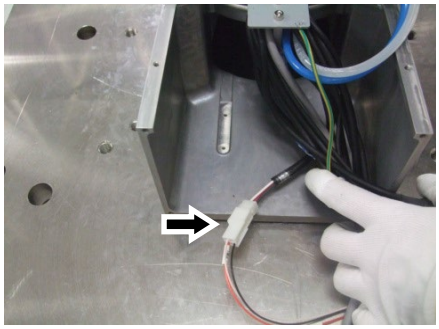
Be careful that the jumper pins on the board do not come off.

(53) Remove the four ground wire terminals fixed on the board fixing plate.

Cross recessed binding head machine screws: 4-M4×8

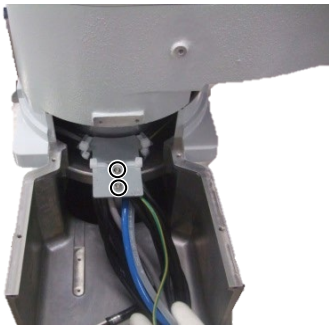
(54) Disconnect the connector connected to the Joint #1 actuator unit.

Connector: PW1



(55) Remove the J1 cable fixing plate fixed on the base.

Hexagon socket head cap bolts: 2-M4×8



(56) Rotate the Arm #1 to the origin position.

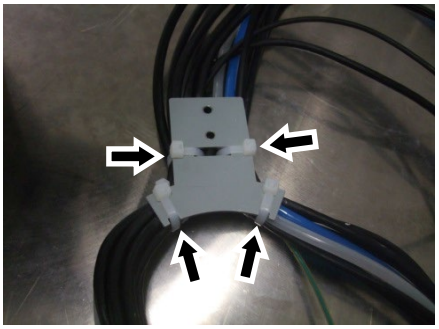
(57) Pull out the cable unit from the Arm #1.

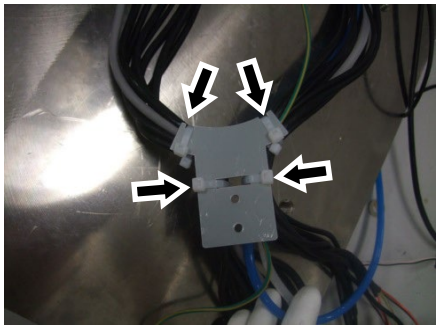
(58) Remove the cable unit from the Joint #1.

(59) Cut off the cable tie of the removed J1 cable fixing plate.

NOTE

Be careful not to lose the removed cable fixing plate.





NOTE

The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

Installation

Cable Unit

Cable direction: Standard (backward)

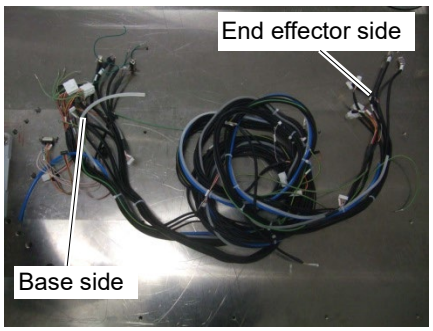
(1) Check the cable unit.

The cable unit consists of the cable A and the cable B.

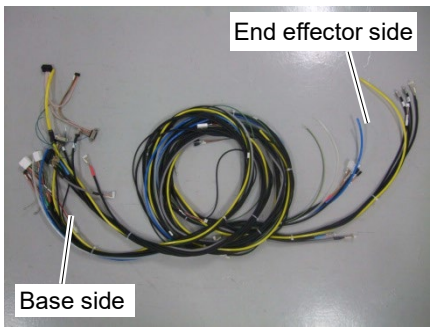
A: Include the gray colored cable.
B: Include the ground wire (green).

The cable A and the cable B are bundled by eight cable ties.

Standard model



Cleanroom model



Hereinafter referred to as below in order from the base side.
A1, A2, …, A8 (cable A)
B1, B2, …, B8 (cable B)

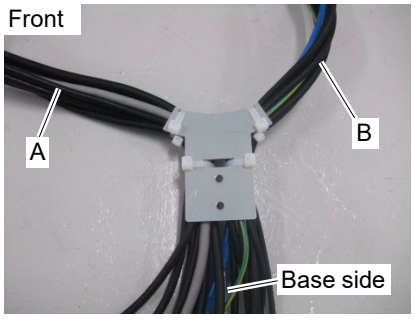
NOTE

Do not cut off or move the position of the cable tie. The cable unit will not be able to install properly.

(2) Fix the cable unit to the cable fixing plate.

Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

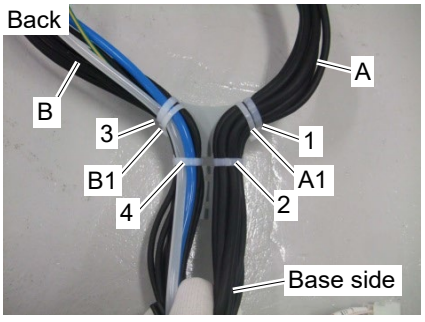


Cable A

Set the A1 of the cable tie to the cable fixing plate and fix it by using the cable ties 1 and 2. Make sure that the gray colored cable is on the plate side.

Cable B

Set the B1 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure that the two air tubes (blue and white) are on the opposite side of the plate.



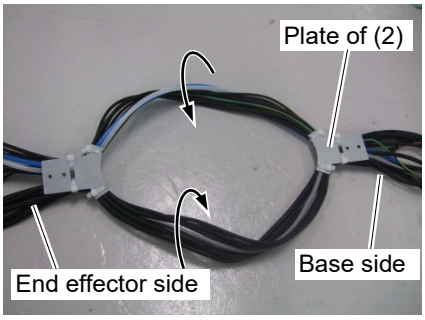
NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A1 and B1 to set positions.

Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A1, and 3 and B1 should be as close as possible.

Improper order or position of the cable tie may shorten the life cycle of the cables.

(3) Fix the cable unit to the cable fixing plate with twisting 180 degrees.

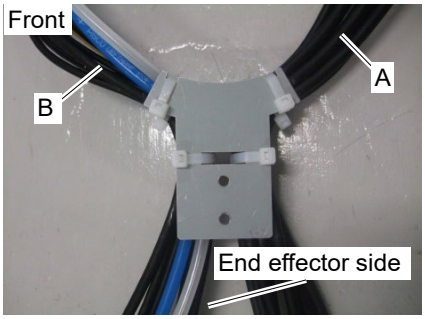


Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

Cable A

Set the A2 of the cable tie to the cable fixing plate and fix it with by using the cable ties 1 and 2. Make sure to twist 180 degrees and fix the cable A so that the gray colored cable is on the opposite side of the plate.

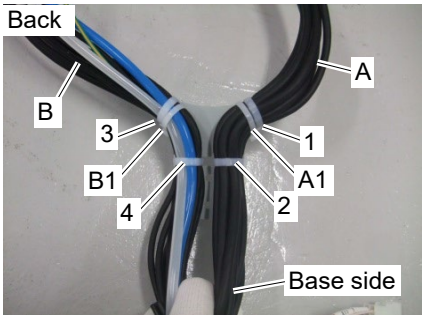


Cable B

Set the B2 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure to twist 180 degrees and fix the cable B so that the two air tubes (blue and white) are on the plate side.

NOTE

Refer to the figure for positions of the cable tie heads.

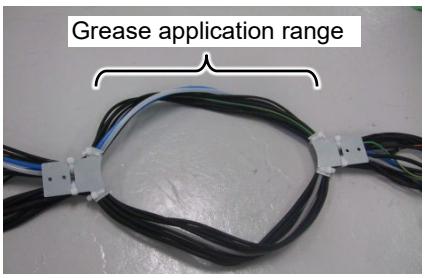


Rotate the heads of the cable ties A2 and B2 to set positions.

Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A2, and 3 and B2 should be as close as possible.

Improper order or position of the cable tie may shorten the life cycle of the cables.

(4) Apply the grease to the cables between the two cable fixing plates.



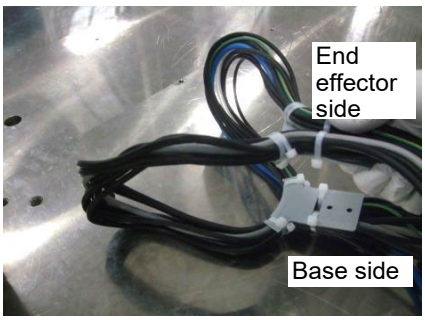
Grease:
Krytox: Cable A and B
Standard model: 1g for each
Cleanroom model: 1.5g for each

NOTE

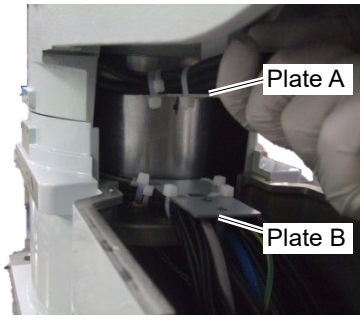
Apply the grease to each cable evenly.

(5) To face the two cable fixing plates, bend the cable unit and pass it through the Joint #1.

End effector side : Plate A
Base side : Plate B



NOTE
When operating the Manipulator, make sure not to apply excessive force to the cables.



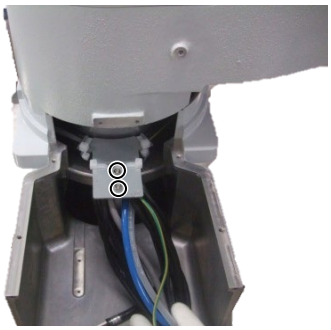
(6) Move the Arm #1 approx. 90 degrees.

NOTE
Be careful not to get the cables caught in the Arm #1.

(7) Install the cable fixing plate B to the base.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE
Be careful not to tighten the screws with the cables get caught on the plate.



(8) Install the cable fixing plate A to Arm #1.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE
Be careful not to tighten the screws with the cables get caught on the plate.

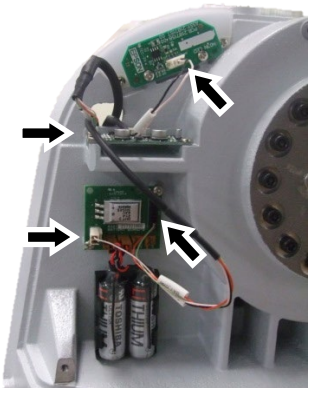
(9) Pass the cable unit to the Arm #1.

NOTE

Do not pass the cables forcibly while the connectors get caught. Doing so may result in disconnection of the cables or breakage of the connectors.

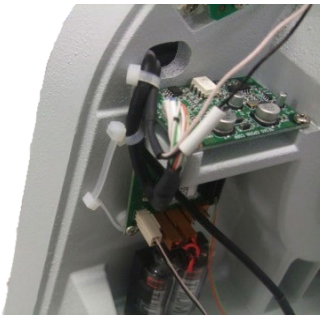
(10) Pass the cables (connectors) through the hole on the end of the Arm #1

Cables (connectors):
BAT_CN3, BAT_CN6
GS01,
LED_CN1



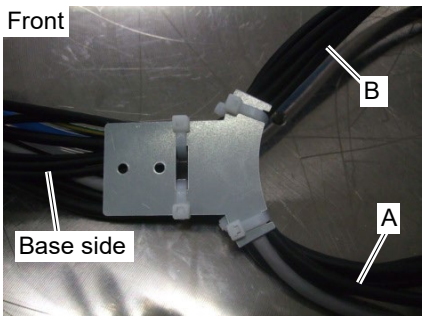
(11) Fix the cables on the Arm #1.

Cable ties (AB150) × 4



(12) Fix the cable unit to the cable fixing plate. Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

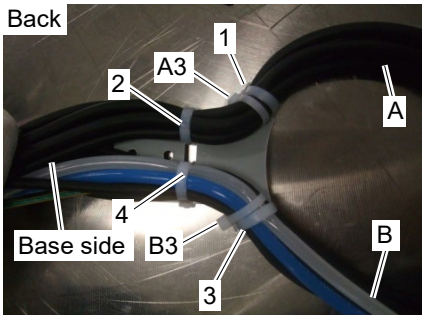


Cable A

Set the A3 of the cable tie to the cable fixing plate and fix it by using the cable ties 1 and 2. Make sure that the gray colored cable is on the plate side.

Cable B

Set the B3 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure that the two air tubes (blue and white) are on the opposite side of the plate.

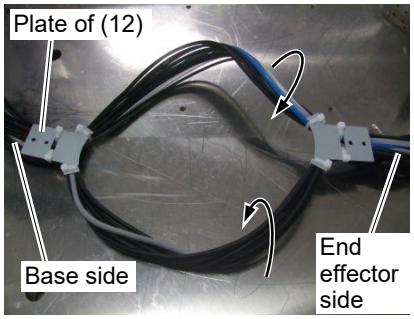


NOTE Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A3 and B3 to set positions.

NOTE Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A3, and 3 and B3 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

(13) Fix the cable unit to the cable fixing plate with twisting 180 degrees.
Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

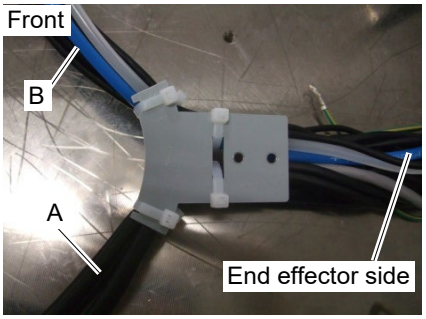


Cable A

Set the A4 of the cable tie to the cable fixing plate and fix it with by using the cable ties 1 and 2. Make sure to twist 180 degrees and fix the cable A so that the gray colored cable is on the opposite side of the plate.

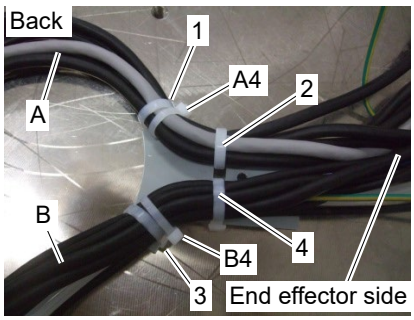
Cable B

Set the B4 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure to twist 180 degrees and fix the cable B so that the two air tubes (blue and white) are on the plate side.



NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A4 and B4 to set positions.



Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A4, and 3 and B4 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

(14) Apply the grease to the cables between the two cable fixing plates.

Grease:
Krytox: Cable A and B
Standard model : 1g for each
Cleanroom model : 1.5g for each

NOTE

Apply the grease to each cable evenly.

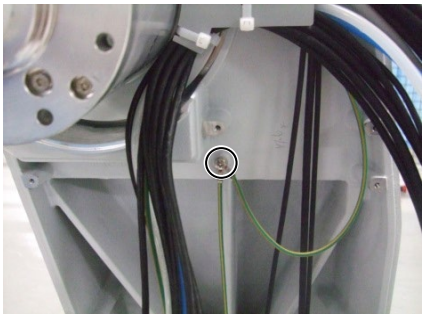
(15) Install the cable fixing plates to Arm #1.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Be careful not to tighten the screws with the cables get caught on the plate.

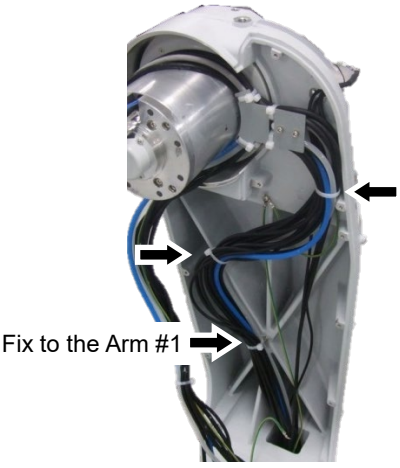
(16) Install the two ground wire terminals.



Cross recessed binding head machine screw: M4×8
Tightening torque: 0.9 ± 0.1 N·m

(17) Bundle (three positions) the cable unit.

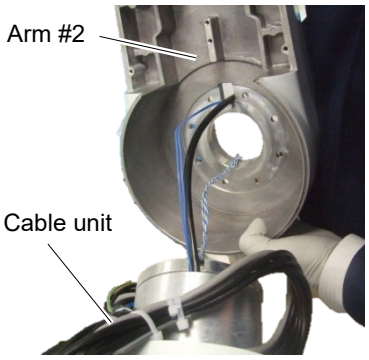
Cable ties (AB200)



(18) To face the two cable fixing plates, bend the cable unit and pass it through the Joint #2.

(19) Install the Arm #2 while aligning the cable unit to the direction of the cables coming from the Joint #2 actuator.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)
Tightening torque: 18 ± 0.9 N·m



NOTE

Refer to the picture for installing direction.
When installing it, pass the cables from the Joint #2 actuator unit through the hole of the Arm #2.

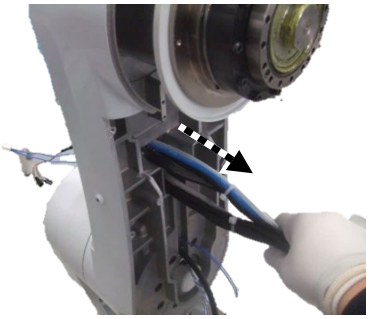
Be careful not to get the cables caught.

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

(20) Pass the cable unit except the following cables (connectors) to Arm #2.

Cables (connectors):
PW2, PW3, BR2, BR3,
EB02_CN1, ground wire

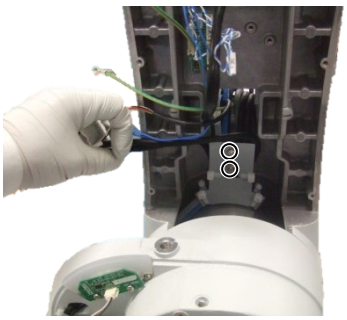


NOTE

Do not pass the cables forcibly while the connectors get caught.
Doing so may result in disconnection of the cables or breakage of the connectors.

(21) Install the cable fixing plates to Arm #2.

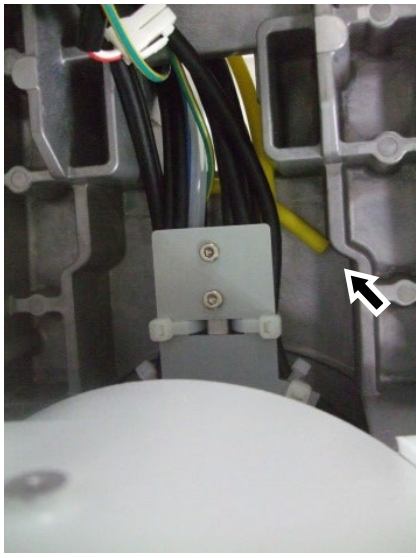
Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m



NOTE

Be careful not to tighten the screws with the cables get caught on the plate.

For cleanroom model, face one yellow air tube to Joint #2 side.

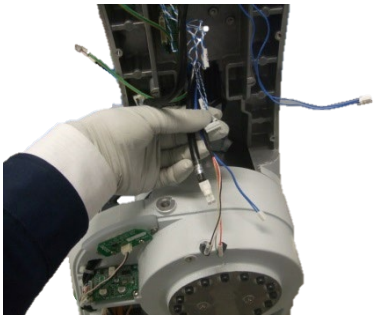


NOTE

Be careful not to bend or collapse the air tubes.

(22) Pass the cables from the Joint #2 actuator unit through the hole of the Arm 2, and pull them to the Arm #1 side.

Cables (connectors):
PW2, BR2, EB0x_CN2

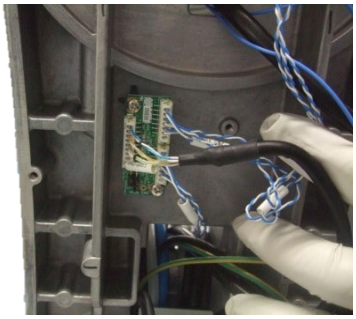


NOTE

Do not pull the cables forcibly while the connectors get caught. Doing so may result in disconnection of the cables or breakage of the connectors.

(23) Connect the connectors to the encoder board 2.

Connectors:
EB02_CN1, EB0x_CN2 (J2 side)

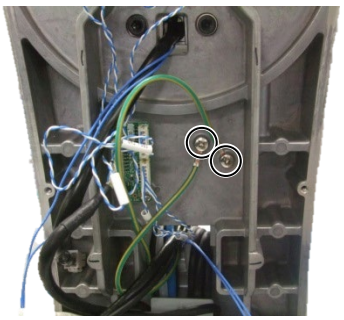


NOTE

Be careful that the jumper pins on the board do not come off.

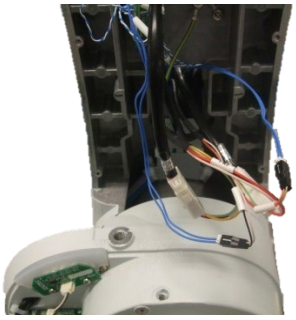
(24) Install the two ground wire terminals.

Cross recessed binding head machine screws:
2-M4×8
Tightening torque: 0.9 ± 0.1 N·m



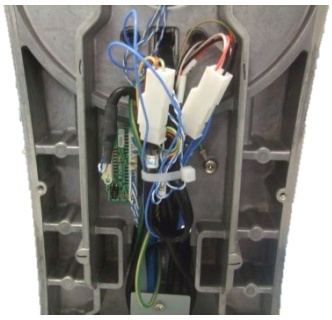
(25) Connect the connectors.

Connectors: PW2, BR2, PW3, BR3



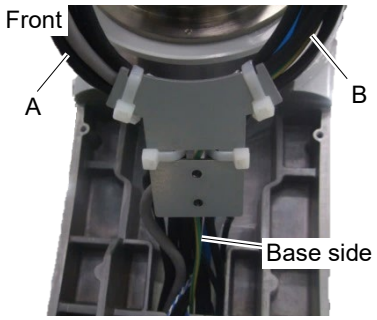
(26) Bundle the cables.

Cable ties (AB200) × 1



(27) Fix the cable unit to the cable fixing plate.
Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

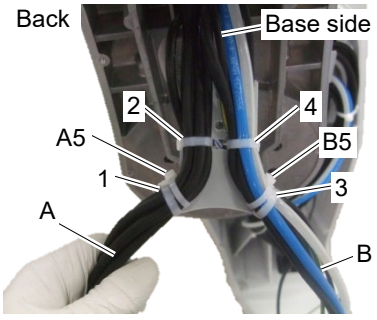


Cable A

Set the A5 of the cable tie to the cable fixing plate and fix it by using the cable ties 1 and 2. Make sure that the gray colored cable is on the plate side.

Cable B

Set the B5 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure that the two air tubes (blue and white) are on the opposite side of the plate.



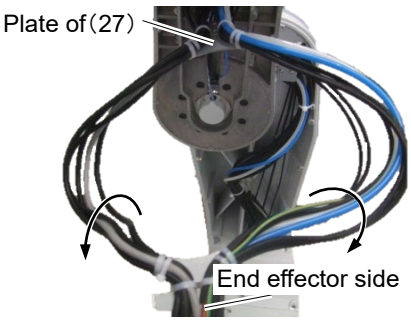
NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A5 and B5 to set positions.

Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A5, and 3 and B5 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

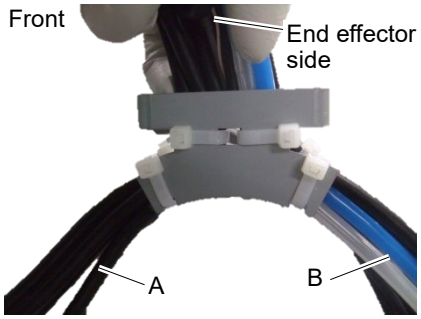
(28) Fix the cable unit to the cable fixing plate with twisting 180 degrees. Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N



Cable A

Set the A6 of the cable tie to the cable fixing plate and fix it with by using the cable ties 1 and 2. Make sure to twist 180 degrees and fix the cable A so that the gray colored cable is on the opposite side of the plate.

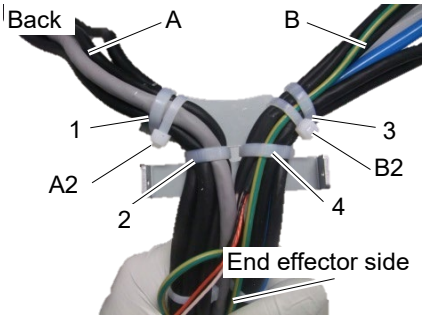


Cable B

Set the B6 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure to twist 180 degrees and fix the cable B so that the two air tubes (blue and white) are on the plate side.

NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A6 and B6 to set positions.



Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A6, and 3 and B6 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

(29) Apply the grease to the cables between the two cable fixing plates.

Grease:
Krytox: Cable A and B
Standard model : 1g for each
Cleanroom model: 1.5g for each

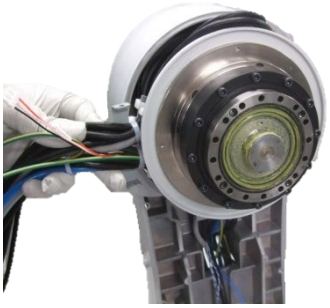
NOTE
Apply the grease to each cable evenly.

(30) Install the cable fixing plates to Arm #2.

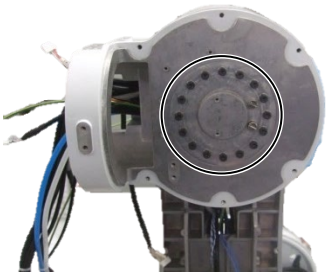
Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE
Be careful not to tighten the screws with the cables get caught on the plate.

(31) To face the two cable fixing plates, bend the cable unit and pass it through the Joint #3.



(32) Install the Arm #3 with approx. - 90 degrees while inserting the cable unit to the Arm #3.



Hexagon socket head cap bolts:
16-M4×30 (with plain washer)
Tightening torque: 5.5 ± 0.25 N·m

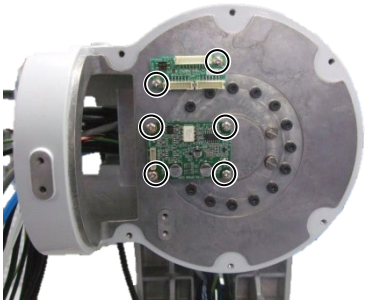
NOTE
Be sure to have at least 2 people to perform the operation since the parts being heavy. Be careful not to catch the cables.

Make sure that the O-ring will not be out of the groove.

Do not apply excessive shock to the parts.

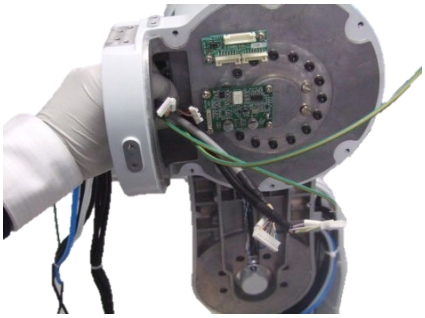
(33) Install the encoder board 3 and the control board 2.

Cross recessed binding head machine screws:
6-M3×6
Tightening torque: 0.45 ± 0.05 N·m



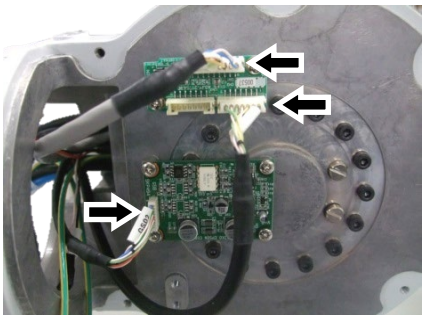
(34) Pull the cables (connectors) to the outside of the Arm #3.

Cables (connectors):
PW4, BR4, EB04_CN1, GS02,
EB04_CN3, two ground wires



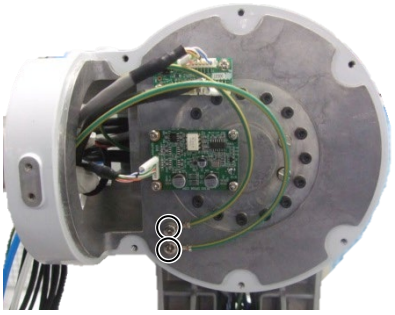
(35) Connect the connectors to the encoder board 3 and the control board 2.

Connectors:
EB04_CN1, EB04_CN3
GS02



(36) Install the two ground wire terminals.

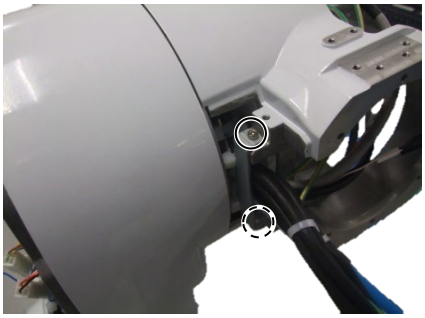
Cross recessed binding head machine screws:
2-M4×8
Tightening torque: 0.9 ± 0.1 N·m



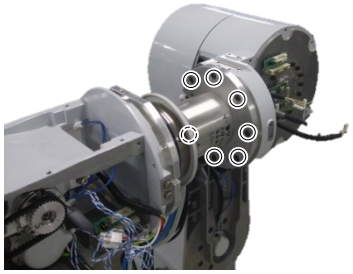
(37) Install the cable fixing plates to Arm #3.

Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m

NOTE Be careful not to tighten the screws with the cables get caught on the plate.



(38) Install the Joint #4 actuator unit to the Arm #3.



Hexagon socket head cap bolts:
7-M4×15 (with plain washer)
Tightening torque: 5.5 ± 0.25 N·m

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

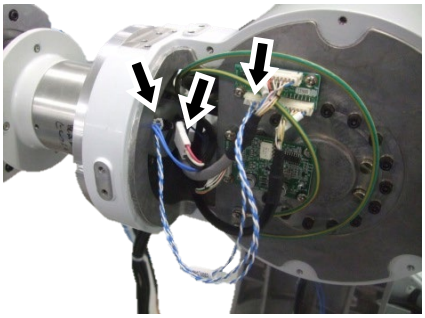
Make sure to take out the cables from the Joint #4 actuator unit to outside of the Arm #3.

Confirm that the positioning pins are installed on the Arm #3. Then, install the Joint #4 actuator unit to match with the pins.

Be careful not to get the cables caught.

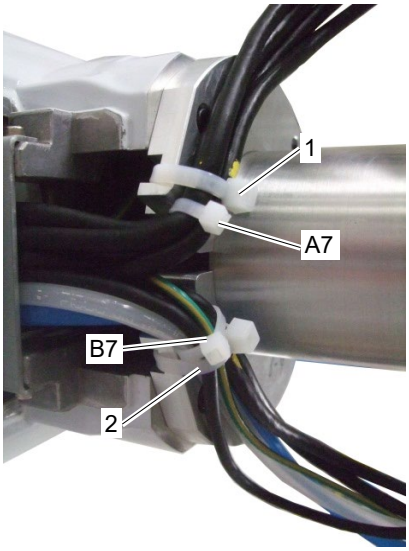
(39) Connect the connectors.

Connectors: PW4, BR4, EB0x_CN2



(40) Fix the cable unit to the flange of the Joint #4 actuator unit with the cable ties.

Cable ties (AB200) × 2 (1 and 2)
Tightening strength: 85 ± 5 N



NOTE

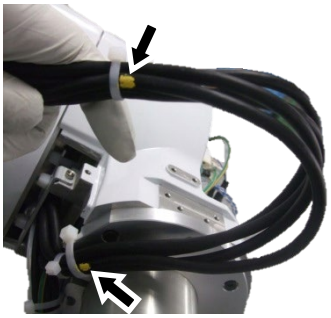
Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A7 and B7 to set positions.

Distance between the cable tie 1 and A7, and 3 and B7 should be as close as possible. (Do not pull the cables forcibly to get close the cable ties.)

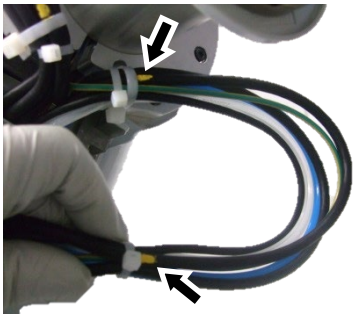
Be careful not to bend the air tubes.

Improper order or position of the cable tie may shorten the life cycle of the cables.

(41) Place marks on the cable of cable A (near the cable ties A7 and A8) on the opposite side of the flange.

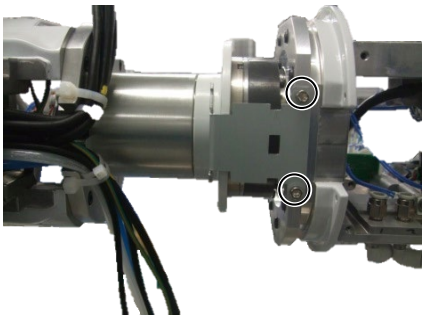


(42) As with the above, place marks on the cable or the air tube of cable B (near the cable ties B7 and B8) on the opposite side of the flange.



(43) Install the cable fixing plates to the flange of the Arm #4.

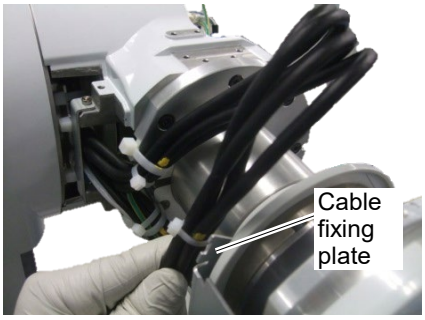
Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m



(44) Fix the cable unit on the cable fixing plate. Follow the steps below:

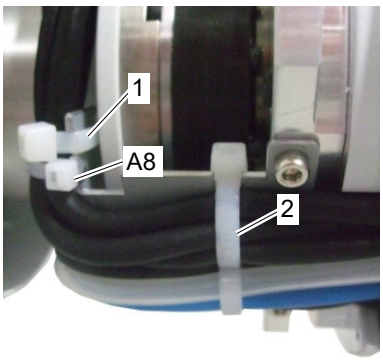
Cable A

Bend the cable so that the mark near the cable tie A8 will be on the cable fixing plate side.



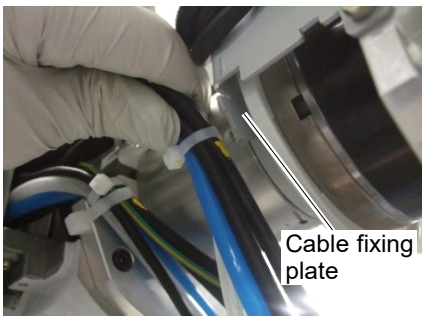
As shown on the right, set the position of the cable tie A8 to the cable fixing plate and fix it by using cable ties 1 and 2.

Cable ties (AB200) × 2 (1 and 2)
Tightening strength: 85 ± 5 N



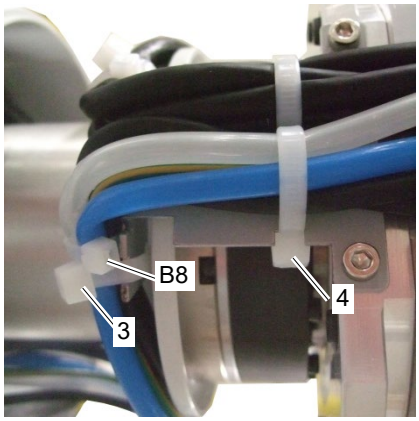
Cable B

Bend the cable so that the mark near the cable tie B8 will be on the cable fixing plate side.



As shown on the right, set the position of the cable tie B8 to the cable fixing plate and fix it by using cable ties 3 and 4.

Cable ties (AB200) × 2 (3 and 4)
Tightening strength: 85 ± 5 N



NOTE

Be careful not to bend the air tubes.

NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A8 and B8 to set positions.

Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A8, and 3 and B8 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

(45) Apply the grease to the cables between the cable tie A7 and A8, and B7 and B8.

Grease:
Krytox: Cable A and B
Standard model : 0.5g for each
Cleanroom model : 0.8g for each

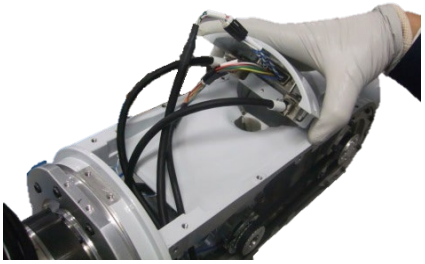
NOTE

Apply the grease to each cable evenly.

(46) Pass the cables (connectors) through the Arm #4 and connect them to the user attachment.

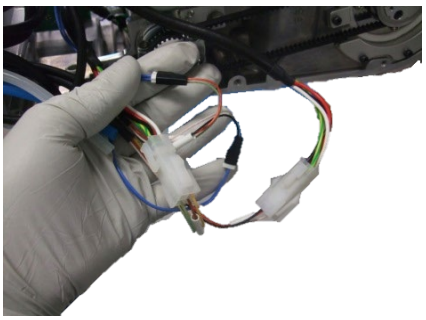
Cables (connectors):
Ether1, Ether2, X71, X72

Connect the Ether1 and Ether2 depending on the user attachment display.



(47) Connect the connectors.

Connectors: PW5, PW6, BR5, BR6

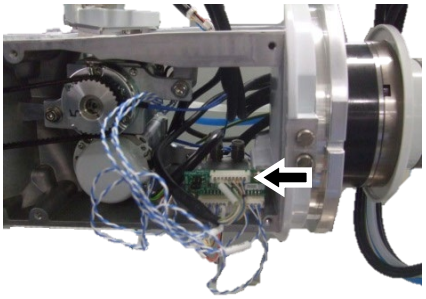


(48) Connect the connector to the encoder board 4.

Connector: EB05_CN1

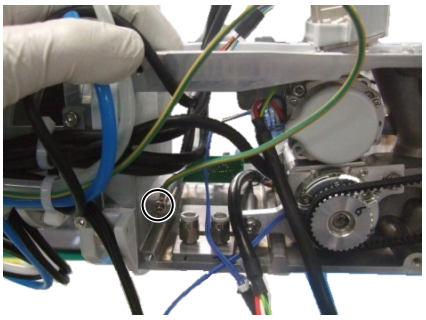
NOTE

Be careful that the jumper pins on the board do not come off.



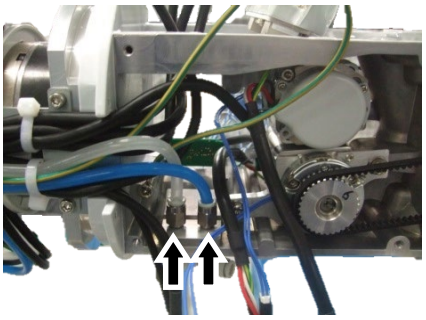
(49) Install the ground wire terminals.

Cross recessed binding head machine screw:
M4×8
Tightening torque: 0.9 ± 0.1 N·m

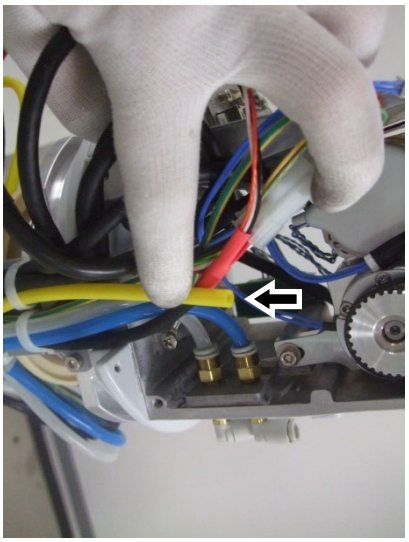


(50) Cut the two air tubes with proper length and connect them to fittings.

Air1: White
Air2: Blue



For cleanroom model, cut the yellow air tube with the length as shown in the picture.



NOTE

Make sure that the air tube does not interfere with the pulley or belt.

(51) Install the user attachment on the Arm #4.

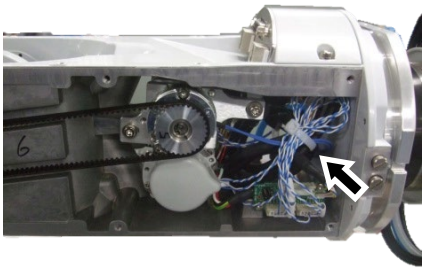
Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

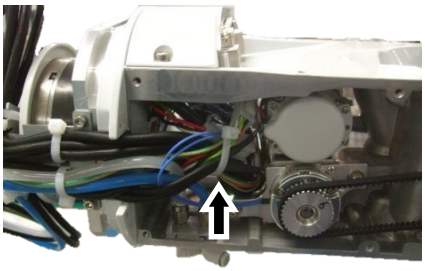
NOTE

Be careful not to get the cables caught.

(52) Bundle the cables with the cable tie to prevent the cables from interfering with the pulley or belt.

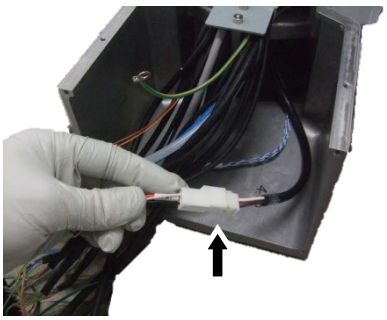
Cable ties (AB200) × 2





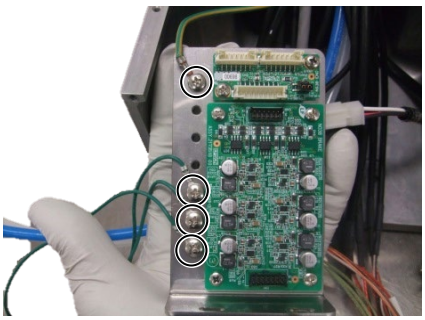
(53) Connect the connector.

Connector: PW1



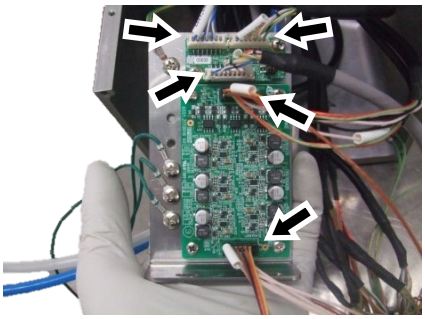
(54) Install the four ground wire terminals except the connector X11, X12 to the board fixing plate.

Cross recessed binding head machine screws:
4-M4×8
Tightening torque: 0.9 ± 0.1 N·m



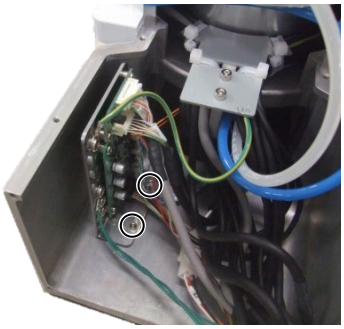
(55) Connect the connectors to the encoder board 1 and the brake board.

Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2



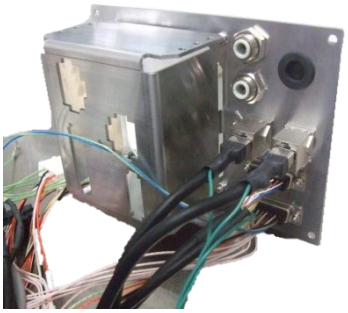
(56) Install the board fixing plate in the back of the base.

Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m



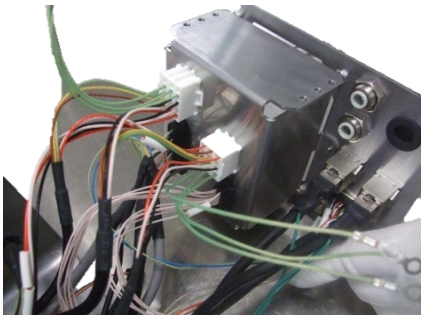
(57) Connect the connectors to the base side plate.

Connectors: Ether1, Ether2, D-sub, SW1

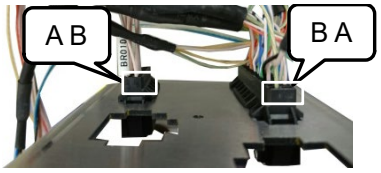


(58) Connect the connectors to the box-shaped plate.

Connectors: X11, X12, X010, BR010

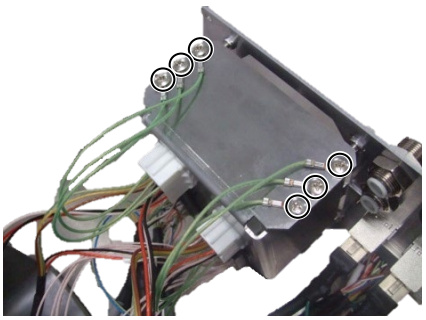


Refer to the right picture for installation direction of black colored connectors (X010, BR010).



(59) Install the six ground wire terminals from the connector X11, X12 to the box-shaped plate.

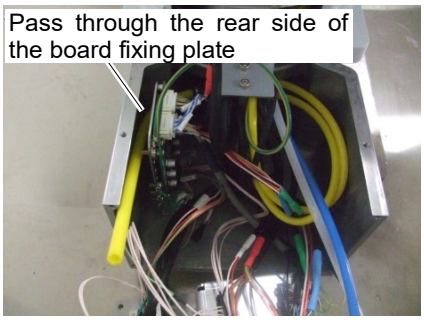
Cross recessed binding head machine screws:
6-M4×8
Tightening torque: 0.9 ± 0.1 N·m

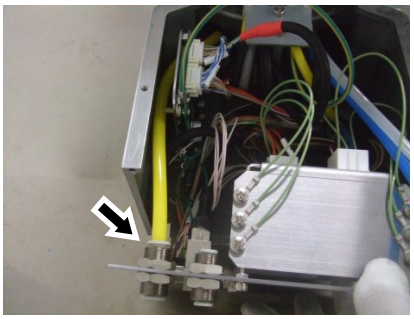


For cleanroom model, install the yellow air tube as shown in the following pictures. Pass the air tube through the rear side of the board fixing plate, then connect to the fittings.

NOTE

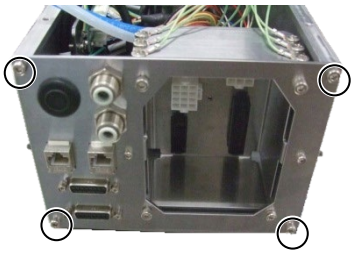
Be careful not to bend or collapse the air tubes.





(60) Install the base side plate.

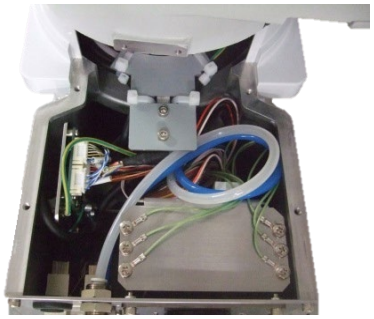
Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m



As shown on the right, make sure that the cable of Ether1 passes through the rear side of the board fixing plate.

(61) Install the two air tubes as shown on the right, and connect them to fittings.

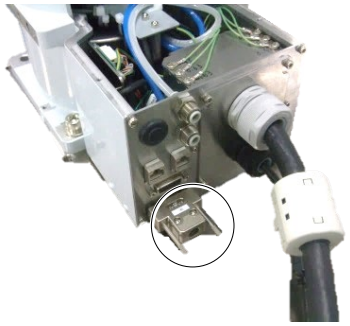
Air1: White
Air2: Blue



(62) Connect the M/C cable.

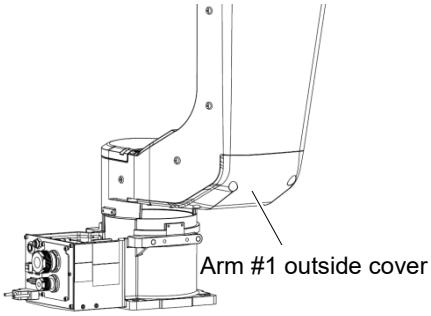
For details, refer to "*4.6. M/C Cable*".

(63) Connect the external short connector.



(64) Install the Arm #1 outside cover.

Hexagon socket head cap bolts:
8-M5×20 (with plain washer)
Tightening torque: 8.0 ± 0.4 N·m



(65) Install the following covers:

Arm #4 side cover (2 covers)

Joint #4 inside cover	Joint #4 outside cover	Joint #4 side covers (2 covers)
Arm #3 cover	Arm #3 inside cover	
Arm #2 cover (2 covers)	Joint #2 cover	Joint #2 outside cover
Arm #1 inside cover	Joint #1 cover	
	Base cover	

For details, refer to "*3. Covers*".

(66) Perform calibration.

For details, refer to "*8. Calibration*".

4.2 Replacing the Cable Unit (N6-A1000*B): Cable Direction: Upward and Downward

WARNING	■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to "*4.7 Connector Pin Assignment*".

	Name		Qty	Code, Note
Maintenance Parts	Cable unit		1	2187251 (Standard) 2194258 (Cleanroom)
	Cable tie	AB150	-	1675754, 1 bag (100 ties: white)
		AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

NOTE

The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

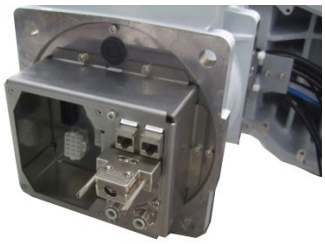
Removal

Cable Unit

(Cable direction: Upward and Downward)

(1) Perform the Removal steps (1) through (6), (8) in "*4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

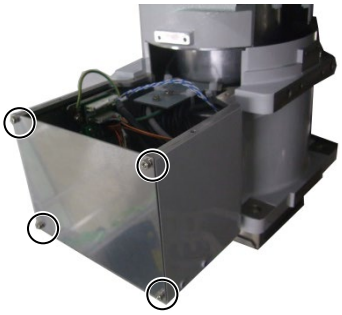
(2) Disconnect the external short connector.



(3) Perform the Removal steps (9) through (47) in "*4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

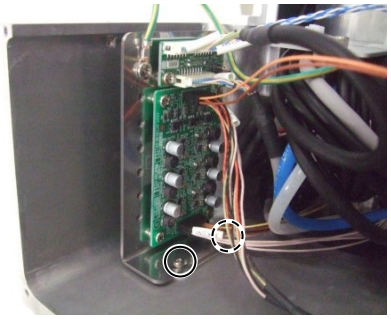
(4) Remove the base side plate.

Hexagon socket head cap bolts: 4-M4×8



(5) Remove the board fixing plate.

Hexagon socket head cap bolts: 2-M3×6



(6) Disconnect the connectors connected to the encoder board 1 and the brake board.

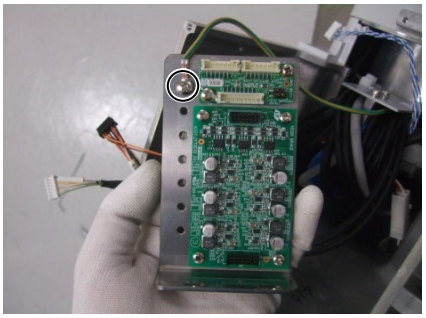
Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2

NOTE

Be careful that the jumper pins on the encoder board do not come off.

(7) Remove the ground wire terminals fixed on the board fixing plate.

Cross recessed binding head machine screw: M4×8



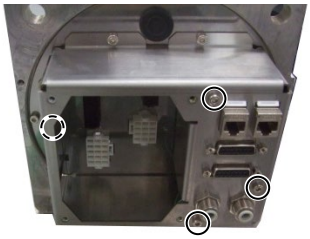
(8) Perform the Removal steps (54) through (59) in "*4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(9) Lay down the Manipulator.

NOTE Be sure to have at least 2 people to lay down the Manipulator.

(10) Remove the plate part 1 from the base bottom.

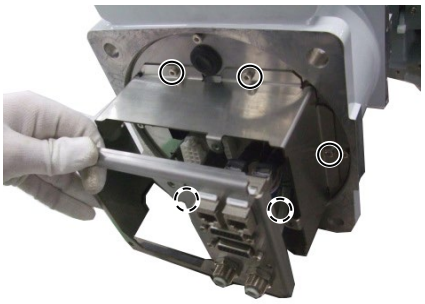
Hexagon socket head cap bolts: 4-M4×8



NOTE Do not pull the part after removing it.
Doing so may result in disconnection of the cables since the cables are connected.

(11) Remove the plate part 2 from the base bottom.

Hexagon socket head cap bolts: 5-M4×8

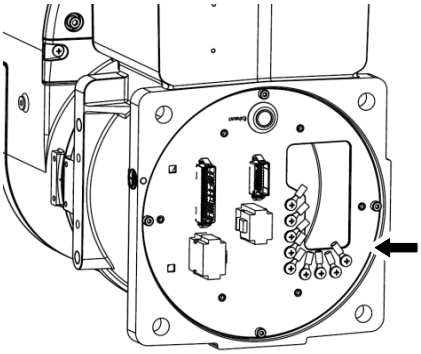


(12) Remove the two air tubes and connectors from the plate part 1.

Connectors: Ether1, Ether2, D-sub, SW1

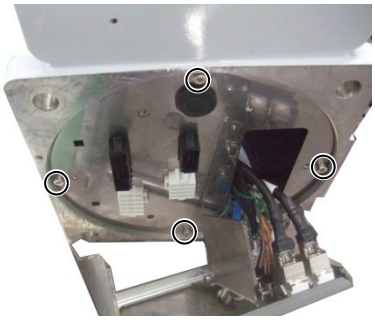
(13) Remove the nine ground wire terminals fixed on the plate part 3.

Cross recessed binding head machine screws: 9-M4×8



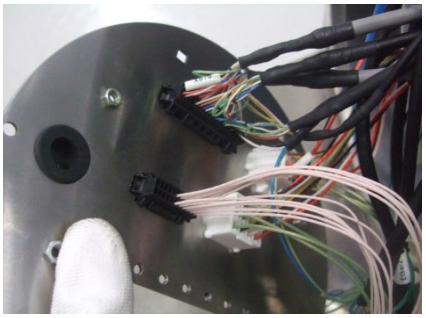
(14) Remove the plate part 3.

Hexagon socket head cap bolts: 4-M4×8

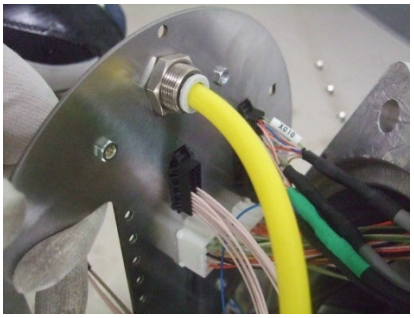


(15) Disconnect the connectors from the plate part 3.

Connectors: X11, X12, X010, BR010



For cleanroom model, disconnect the yellow air tube as well.



NOTE

The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

Installation

Cable Unit (Cable direction: Upward and Downward)

(1) Perform the Installation steps (1) through (8) in "*4.1 Replacing the Cable Unit: Cable direction Standard (backward)*".

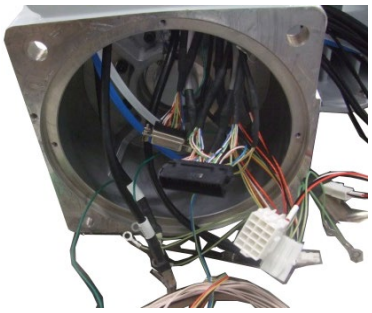
(2) Lay down the Manipulator.

NOTE

Manipulator is heavy. Be sure to have at least 2 people to perform the operation.

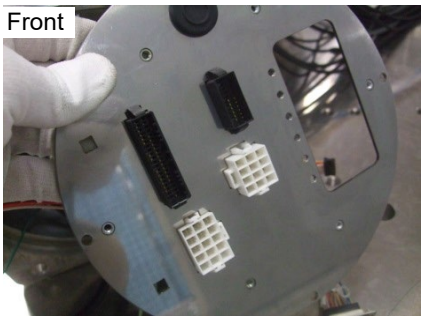
(3) Pull out the cable unit except the following cables.

Cables (connectors):
BRK_CN2, EB01_CN3, ground wire



(4) Connect the connectors to the plate part 3

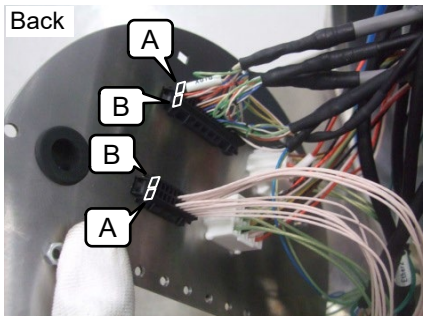
Connectors: X11, X12, X010, BR010



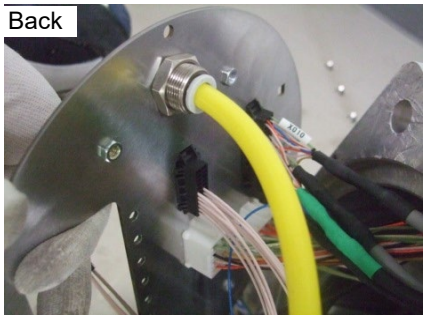
NOTE

There are the front side and the back side on the plate part 3. Be careful for the directions.

Refer to the right picture for installation direction of black colored connectors (X010, BR010).



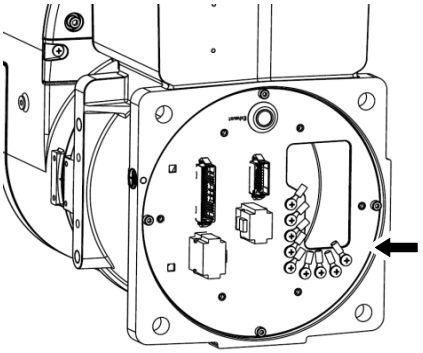
For cleanroom model, connect the yellow air tube to the fittings.



(5) Install the nine ground wire terminals from the following connectors to the front side of the plate part 3.

Connectors:
X11, X12, D-sub, Ether1, Ether2

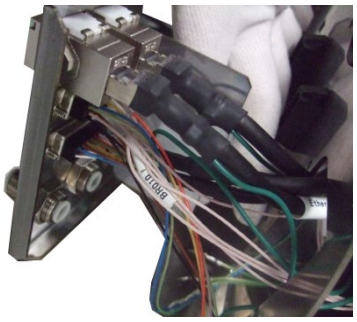
Cross recessed binding head machine screw:
9-M4×8
Tightening torque: 0.9 ± 0.1 N·m



NOTE Refer to the right figure for the installation position.

(6) Pass the connectors through the hole of the plate part 3, and install on the the plate part 1.

Connectors: Ether1, Ether2, D-sub, SW1

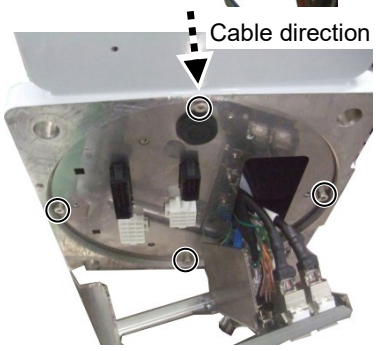


(7) Connect the two air tubes to fittings.

Air1: White
Air2: Blue

(8) Install the plate part 3 to the base.

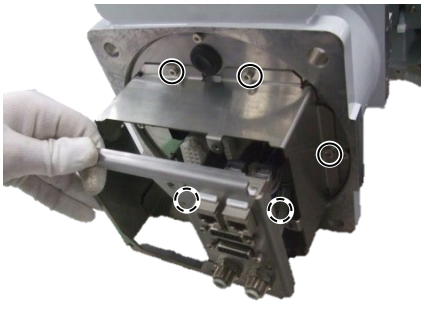
Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m



NOTE Refer to the right figure for the installation position.

(9) Install the plate part 2.

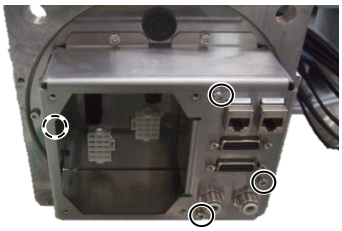
Hexagon socket head cap bolts: 5-M4×8
Tightening torque: 4.0 ± 0.2 N·m



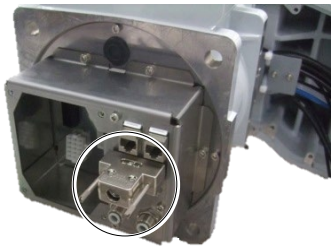
NOTE Be careful not to get the cables caught.

(10) Install the plate part 1.

Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m



(11) Connect the external short connector.



(12) Connect the M/C cable.

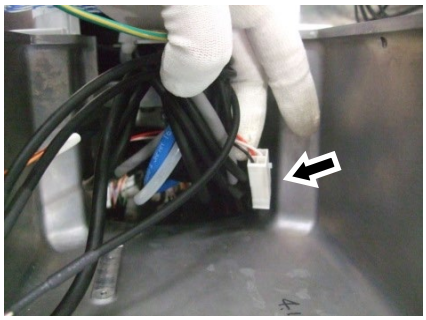
For details, refer to "*4.6. M/C Cable*".

(13) Mount the Manipulator on the base table.

NOTE
Be sure to have at least 2 people to mount the Manipulator.

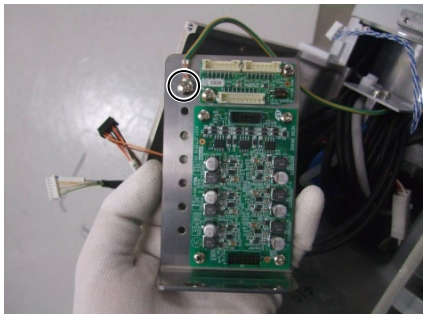
(14) Connect the connectors.

Connector: PW1



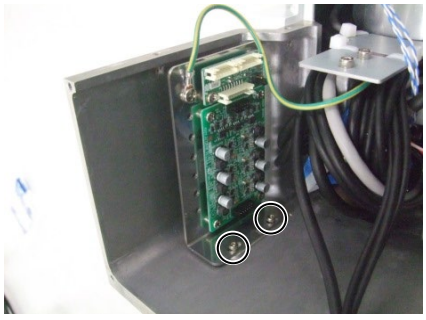
(15) Install the ground wire terminal on the board fixing plate.

Cross recessed binding head machine screw: M4×8
Tightening torque: 0.9 ± 0.1 N·m



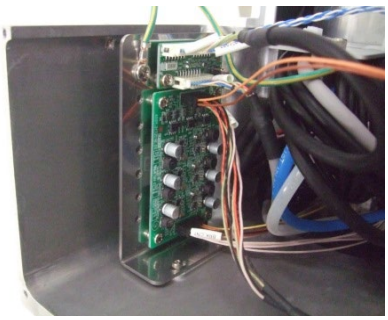
(16) Install the board fixing plate in the back of the base.

Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m



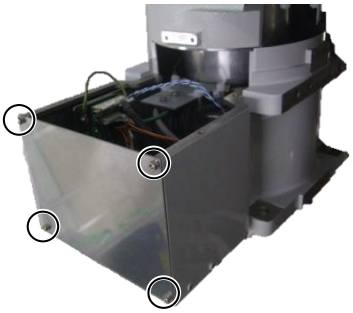
(17) Connect the connectors to the encoder board 1 and the brake board.

Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2



(18) Install the base side plate.

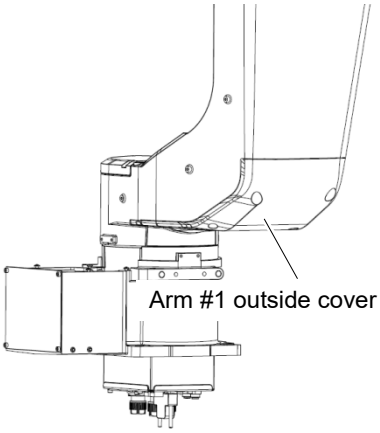
Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m



(19) Perform the Installation steps (9) through (52) in "*4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(20) Install the Arm #1 outside cover.

Hexagon socket head cap bolts:
8-M5×20 (with plain washer)
Tightening torque: 8.0 ± 0.4 N·m



(21) Install the following covers:

Arm #4 side cover (2 covers)

Joint #4 inside cover	Joint #4 outside cover	Joint #4 side covers (2 covers)
Arm #3 cover	Arm #3 inside cover	
Arm #2 cover (2 covers)	Joint #2 cover	Joint #2 outside cover
Arm #1 inside cover	Joint #1 cover	
Base cover		

For details, refer to "*3. Covers*".

(22) Perform calibration.

For details, refer to "*8. Calibration*".

4.3 Replacing the Cable Unit (N6-A850*R): Cable Direction: Standard (backward)

 WARNING	■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

 CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to "*4.7 Connector Pin Assignment*".

	Name		Qty	Code, Note
Maintenance Parts	Cable unit		1	2187251 (Standard)
				2194258 (Cleanroom)
	Cable tie	AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

NOTE
The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

Removal

Cable Unit

Cable direction (N6-A850*R) Standard (backward)

(1) Mount the ceiling mounted robot to the table top.

NOTE
Be sure to have at least 2 people to perform the operation since the Manipulator is heavy.

(2) Remove the following covers:

Arm #4 side cover (2 covers)		
Joint #4 inside cover	Joint #4 outside cover	Joint #4 side covers (2 covers)
Arm #3 cover	Arm #3 inside cover	Arm #2 cover (2 covers)
Joint #2 outside cover	Arm #1 inside cover	
Arm #1 outside cover	Joint #1 cover	Base cover

For details, refer to "*3. Covers*".

* Remove the Arm #1 outside cover simultaneously with the Joint #1 cover.

(3) Turn ON the Controller.

(4) Release the brakes of each joint and move the Manipulator to the orientation as shown below.

EPSON RC+

Command
`>Brake off,` [the number (from 2 to 6) corresponding to the arm whose brake will be turned OFF]

Joint #1	+90°
Joint #2	+90°
Joint #3	–90°
Joint #4	0°
Joint #5	0°
Joint #6	0°

NOTE
When releasing the brake, the arm may rotate by its own weight.

NOTE
Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may cause hands and fingers to be caught and/or equipment damage to or malfunction of the Manipulator as the arms of the Manipulator may move in unexpected directions.

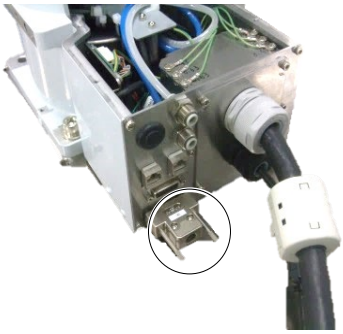
(5) Brake each joint.

EPSON RC+

Command
`>Brake On,`[The number (from 2 to 6) corresponding to the arm whose brake will be turned ON]

(6) Turn OFF the Controller.

(7) Disconnect the external short connector.



(8) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(9) Cut off the cable tie of the cables.

NOTE

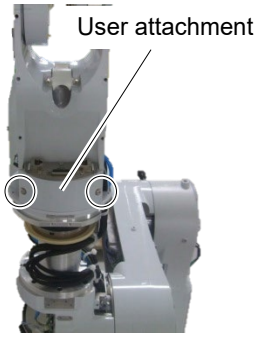
Be careful not to cut the cables.

(10) Remove the user attachment of the Arm #4.

Hexagon socket head cap bolts: 2-M4×8

NOTE

Cables are connected to the user attachment. When you disconnect the cables, make sure not to pull the user attachment forcibly.



(11) Disconnect the connectors from the user attachment.

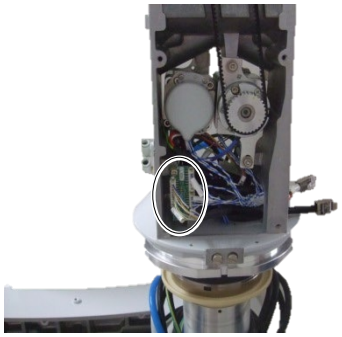
Connectors: Ether1, Ether2, X71, X72

(12) Disconnect the connector connected to the encoder board 4.

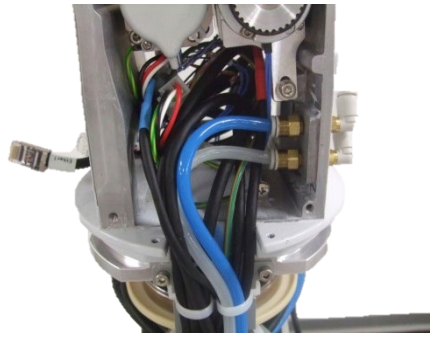
Connector: EB05_CN1

NOTE

Be careful that the jumper pins on the board do not come off.

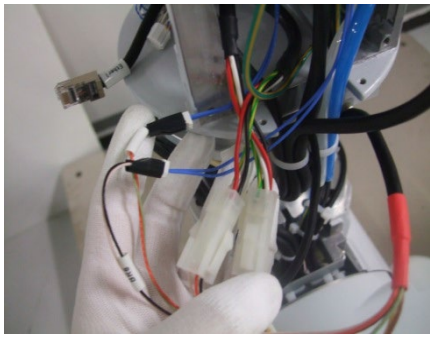


(13) Remove the two air tubes.



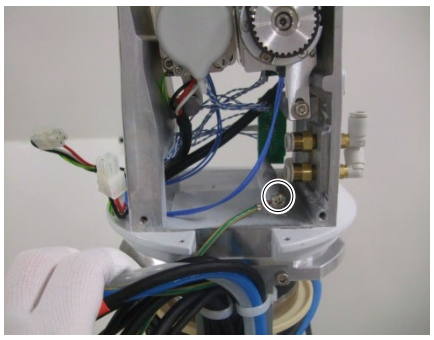
(14) Remove the connectors.

Connectors: PW5, PW6, BR5, BR6



(15) Remove the ground wire terminals.

Cross recessed binding head machine screw: M4×8



(16) Cut off the cable tie that fixes the cable unit to the plate.

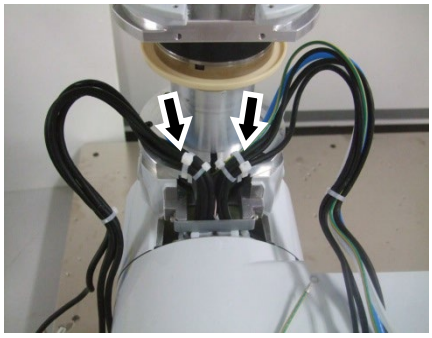
(17) Remove the cable fixing plate.

Hexagon socket head cap bolts: 2-M4×8

NOTE

Be careful not to lose the removed cable fixing plate.

(18) Cut off the cable tie of the flange on the Joint #4 actuator unit.

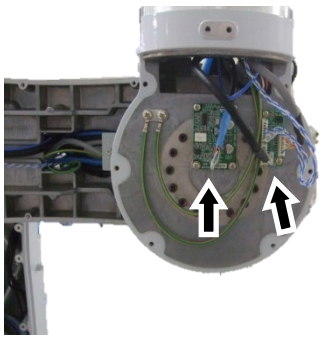


(19) Disconnect the connectors connected to the encoder board 3 and the control board 2.

Connectors: EB04_CN1, EB04_CN3,
EB0x_CN2, GS02

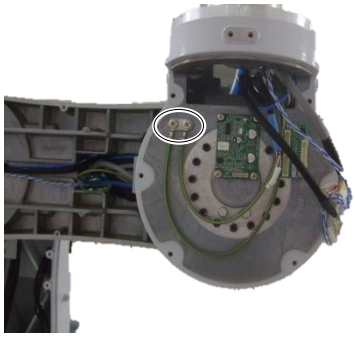
NOTE

Be careful that the jumper pins on the board do not come off.



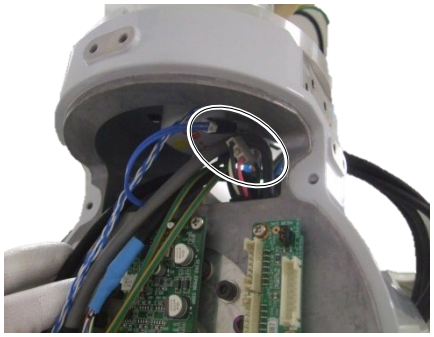
(20) Remove the two ground wire terminals.

Cross recessed binding head machine screws: 2-M4×8



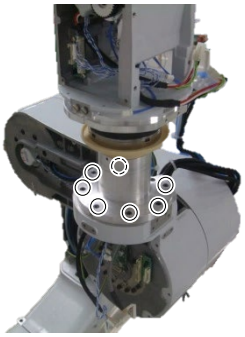
(21) Disconnect the connectors connected to the Joint #4 actuator unit.

Connectors: PW4, BR4



(22) Remove the Joint #4 actuator unit from the Arm #3.

Hexagon socket head cap bolts:
7-M4×15 (with plain washer)



NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

When removing it, make sure not to lose the positioning pin.

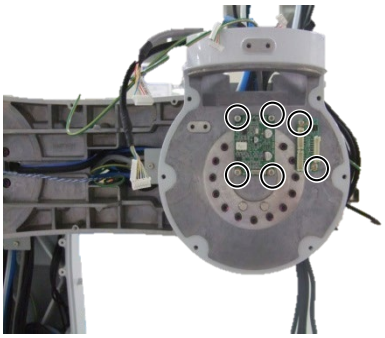
Also, be careful not to catch the cables on the Joint #4 actuator unit.

(23) Remove the J3 cable fixing plate fixed on the Arm #3.

Hexagon socket head cap bolts: 2-M3×6

(24) Remove the encoder board 3 and the control board 2.

Cross recessed binding head machine screws: 6-M3×6

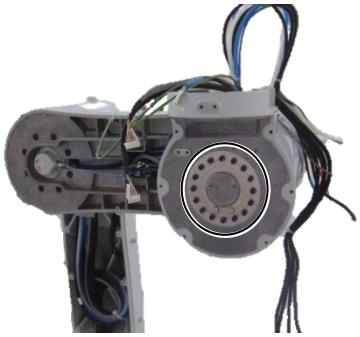


NOTE

Be careful not to lose the removed board

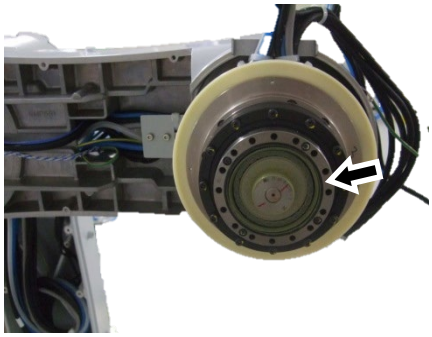
(25) Remove the Arm #3.

Hexagon socket head cap bolts:
16-M4×30 (with plain washer)



NOTE

After removing the Arm #3, confirm that the O-ring is installed to the reduction gear unit. If the O-ring is installed on the Arm #3, re-install it on the reduction gear unit.

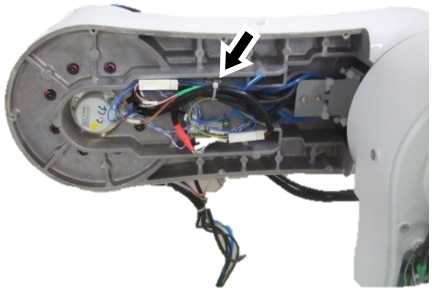


(26) Cut off the cable tie of the removed J3 cable fixing plate.

NOTE

Be careful not to lose the removed cable fixing plate.

(27) Cut off the cable tie of the cables.

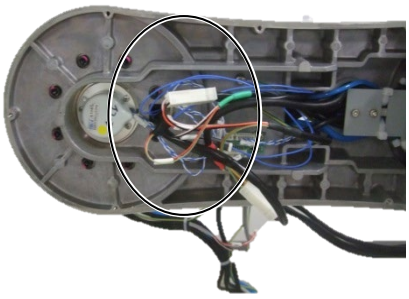


(28) Disconnect the connectors connected to the Joint #2 actuator unit.

Connectors: PW2, BR2

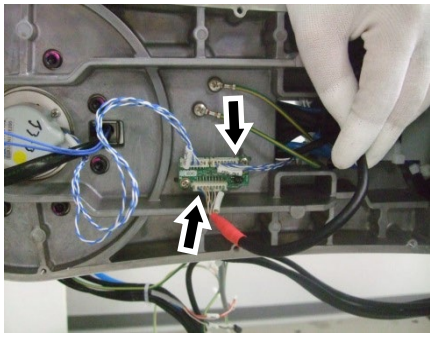
(29) Disconnect the connectors connected to the Joint #3 actuator unit.

Connectors: PW3, BR3



(30) Disconnect the connectors connected to the encoder board 2.

Connectors:
EB02_CN1
EB0x_CN2 (Joint #2 side)



NOTE
Be careful that the jumper pins on the board do not come off.

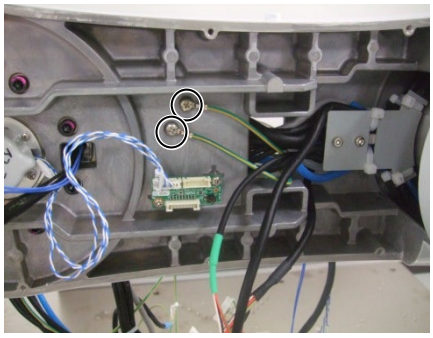
(31) Pull the cables from the Joint #2 actuator unit to the Arm #3 side.

Cables (connectors):
PW2, BR2, EB0x_CN2

NOTE
Do not pull the cables forcibly while the connectors get caught. Doing so may result in disconnection of the cables or breakage of the connectors.

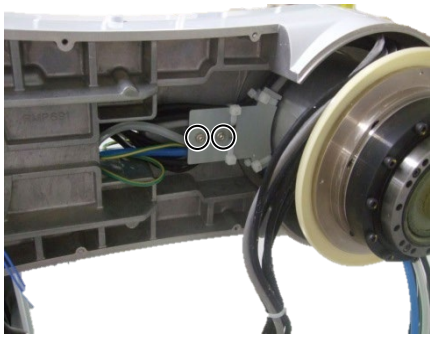
(32) Remove the two ground wire terminals.

Cross recessed binding head machine screw: 2-M4×8

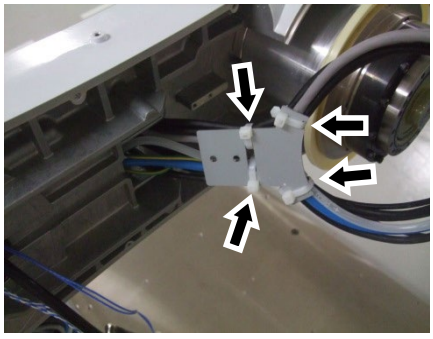


(33) Remove the J3 cable fixing plate fixed on the Arm #2.

Hexagon socket head cap bolts: 2-M4×8



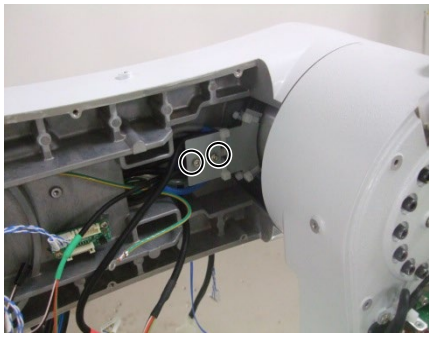
(34) Cut off the cable tie of the removed J3 cable fixing plate.



NOTE
Be careful not to lose the removed cable fixing plate.

(35) Remove the J2 cable fixing plate fixed on the Arm #2.

Hexagon socket head cap bolts: 2-M4×8



(36) Pull out the cable unit passing through the Arm #2.

NOTE

Be careful not to catch the cables coming from the Joint #2 actuator unit to the cable unit.

(37) Remove the Arm #2.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

NOTE

Be careful not to catch the cables on the Joint #2 actuator unit or Arm #2.

(38) Cut off the cable tie of the removed J2 cable fixing plate.

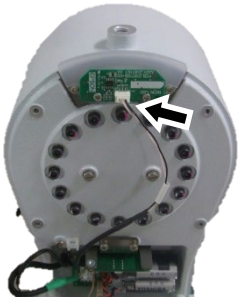
NOTE

Be careful not to lose the removed cable fixing plate.

(39) Cut off the cable tie of the cables.

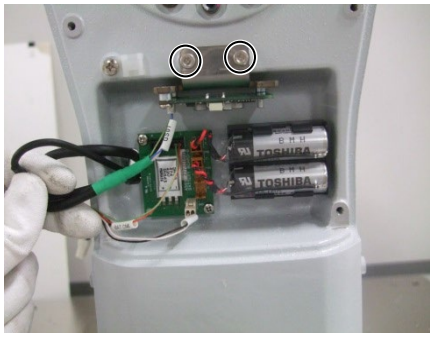
(40) Disconnect the connectors connected to the LED board.

Connector: LED_CN1



(41) Remove the plate which the control board 1 is fixed.

Hexagon socket head cap bolts: 2-M4×8

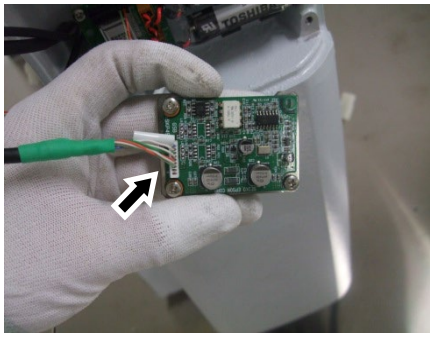


(42) Disconnect the connectors connected to the control board 1.

Connector: GS01

NOTE

Be careful not to lose the removed plate and board.

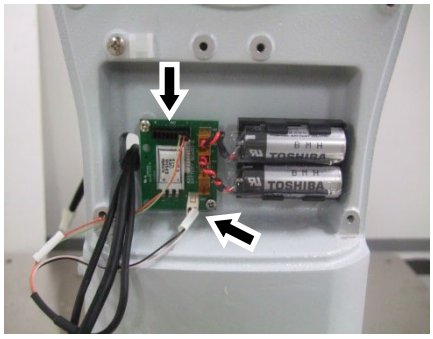


(43) Disconnect the connectors connected to the battery board.

Connectors: BAT_CN3, BAT_CN6

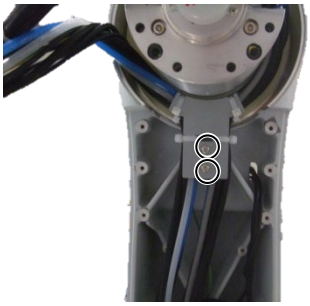
NOTE

You do not need to disconnect the connectors of the batteries.



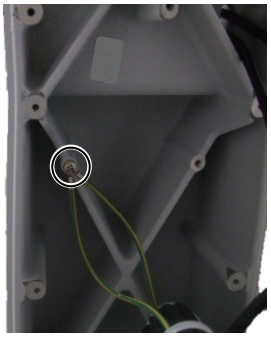
(44) Remove the J2 cable fixing plate fixed on the Arm #1.

Hexagon socket head cap bolts: 2-M4×8



(45) Remove the ground wire terminals.

Cross recessed binding head machine screw: M4×8



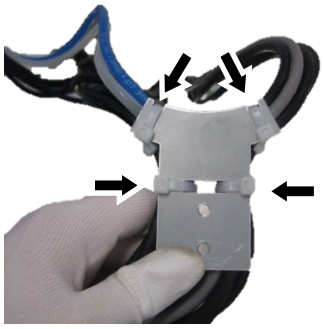
(46) Pull the following cables (connectors) to the inside of the Arm #1.

Cables (connectors):
BAT_CN3, BAT_CN6, GS01, LED_CN1

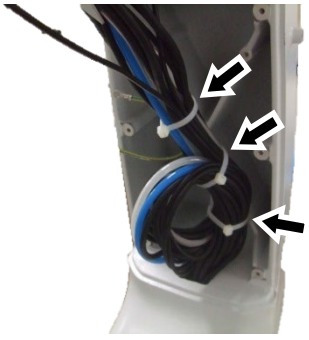
(47) Cut off the cable tie of the removed J2 cable fixing plate.

NOTE

Be careful not to lose the removed cable fixing plate.



(48) Cut off the cable tie that fixes the cable unit.

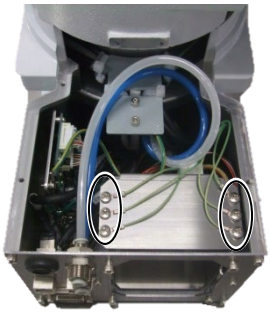


(49) Remove the J1 cable fixing plate fixed on the Arm #1.

Hexagon socket head cap bolts: 2-M4×8

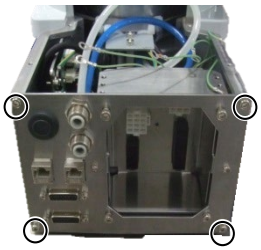
(50) Remove the six ground wire terminals.

Cross recessed binding head machine screw: 6-M4×8



(51) Remove the base side plate.

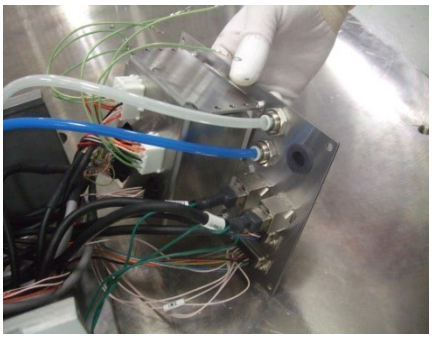
Hexagon socket head cap bolts: 4-M4×8



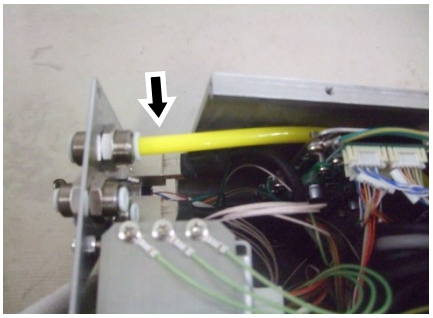
(52) Disconnect the connectors and two air tubes (for cleanroom model: three air tubes) from the removed base side plate.

Connectors: X11, X12, X010, BR010, Ether1, Ether2, D-sub, SW1

Standard model

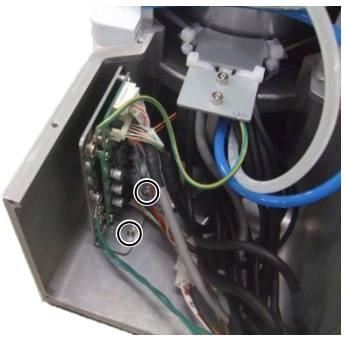


Cleanroom model



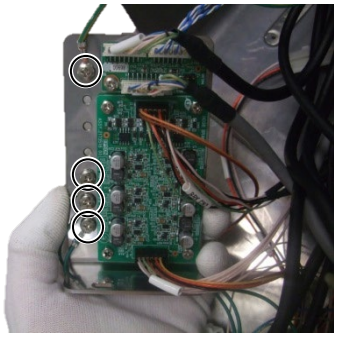
(53) Remove the board fixing plate.

Hexagon socket head cap bolts: 2-M3×6



(54) Disconnect the connectors connected to the encoder board 1 and the brake board.

Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2



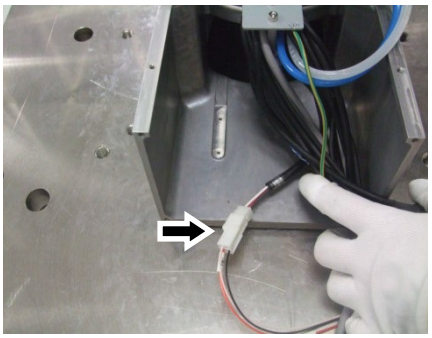
NOTE
Be careful that the jumper pins on the board do not come off.

(55) Remove the four ground wire terminals fixed on the board fixing plate.

Cross recessed binding head machine screws: 4-M4×8

(56) Disconnect the connector connected to the Joint #1 actuator unit.

Connector: PW1



(57) Remove the J1 cable fixing plate fixed on the base.

Hexagon socket head cap bolts: 2-M4×8

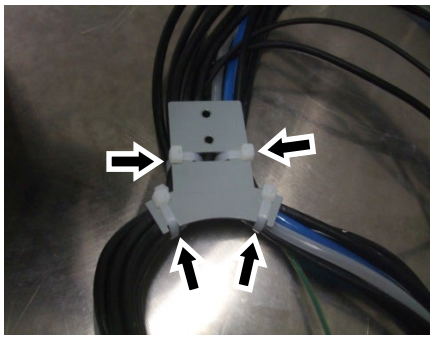
(58) Rotate the Arm #1 to the origin position.

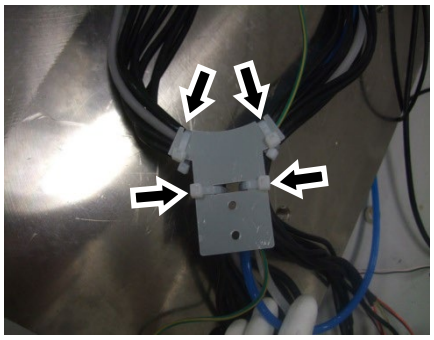
(59) Pull out the cable unit from the Arm #1.

(60) Remove the cable unit from the Joint #1.

(61) Cut off the cable tie of the removed J1 cable fixing plate.

NOTE Be careful not to lose the removed cable fixing plate.





NOTE

The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

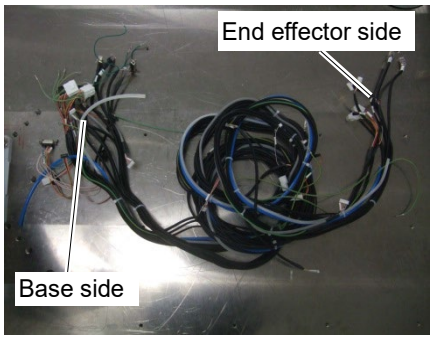
Installation

Cable Unit
(N6-A850*R)
Cable direction:
Standard
(backward)

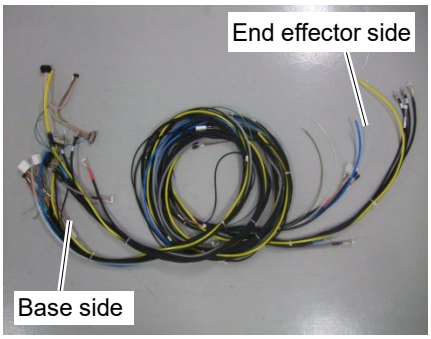
(1) Check the cable unit.
The cable unit consists of the cable A and the cable B.
A: Include the gray colored cable.
B: Include the ground wire (green).

The cable A and the cable B are bundled by eight cable ties.

Standard model



Cleanroom model



Hereinafter referred to as below in order from the base side.
A1, A2, …, A8 (cable A)
B1, B2, …, B8 (cable B)

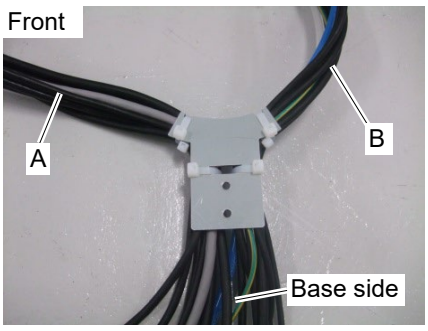
NOTE

Do not cut off or move the position of the cable tie. The cable unit will not be able to install properly.

(2) Fix the cable unit to the cable fixing plate.

Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

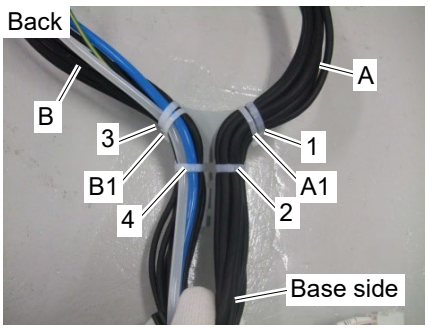


Cable A

Set the A1 of the cable tie to the cable fixing plate and fix it by using the cable ties 1 and 2. Make sure that the gray colored cable is on the plate side.

Cable B

Set the B1 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure that the two air tubes (blue and white) are on the opposite side of the plate.

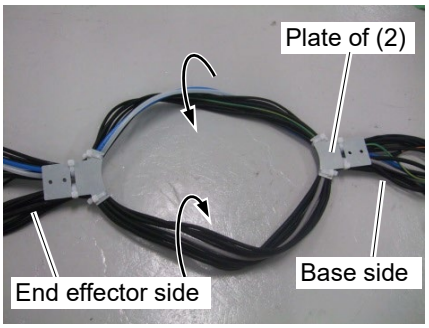


NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A1 and B1 to set positions.
Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A1, and 3 and B1 should be as close as possible.

Improper order or position of the cable tie may shorten the life cycle of the cables.

(3) Fix the cable unit to the cable fixing plate with twisting 180 degrees.

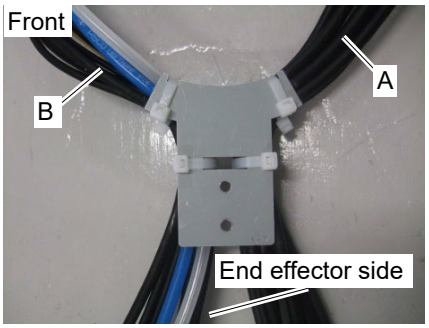


Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

Cable A

Set the A2 of the cable tie to the cable fixing plate and fix it with by using the cable ties 1 and 2. Make sure to twist 180 degrees and fix the cable A so that the gray colored cable is on the opposite side of the plate.



Cable B

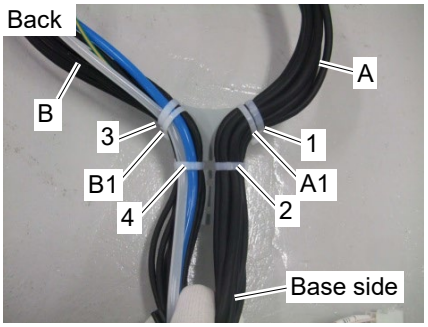
Set the B2 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure to twist 180 degrees and fix the cable B so that the two air tubes (blue and white) are on the plate side.

NOTE

Refer to the figure for positions of the cable tie heads.

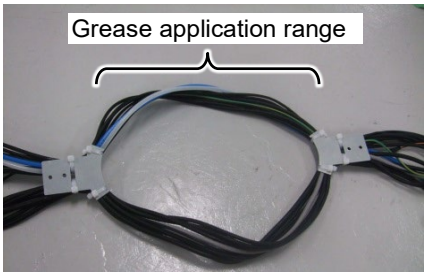
Rotate the heads of the cable ties A2 and B2 to set positions.

Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A2, and 3 and B2 should be as close as possible.



Improper order or position of the cable tie may shorten the life cycle of the cables.

(4) Apply the grease to the cables between the two cable fixing plates.



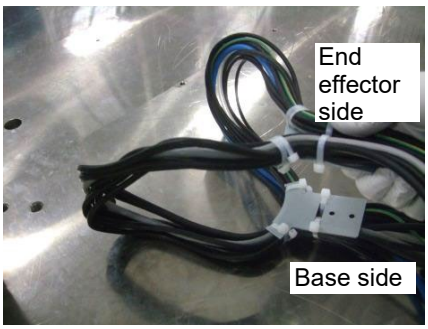
Grease:
Krytox: Cable A and B
Standard model: 1g for each
Cleanroom model: 1.5g for each

NOTE

Apply the grease to each cable evenly.

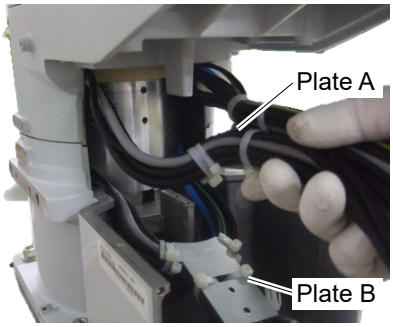
(5) To face the two cable fixing plates, bend the cable unit and pass it through the Joint #1.

End effector side : Plate A
Base side : Plate B



NOTE

When operating the Manipulator, make sure not to apply excessive force to the cables.



(6) Move the Arm #1 approx. 90 degrees.

NOTE

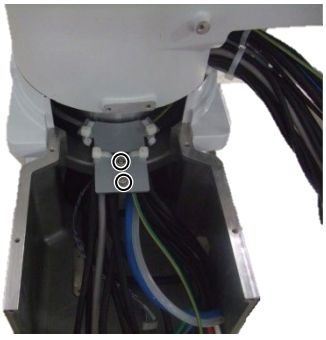
Be careful not to get the cables caught in the Arm #1.

(7) Install the cable fixing plate B to the base.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Be careful not to tighten the screws with the cables get caught on the plate.



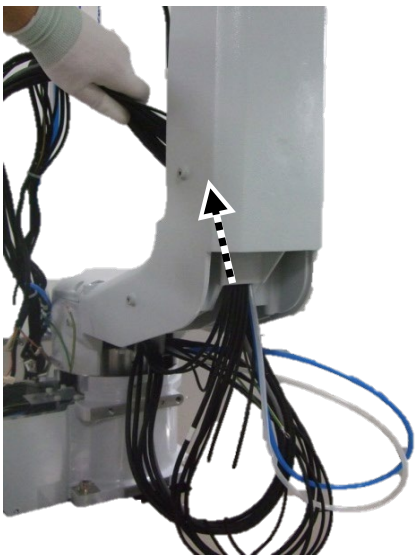
(8) Install the cable fixing plate A to Arm #1.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Be careful not to tighten the screws with the cables get caught on the plate.

(9) Pass the cable unit to the Arm #1.

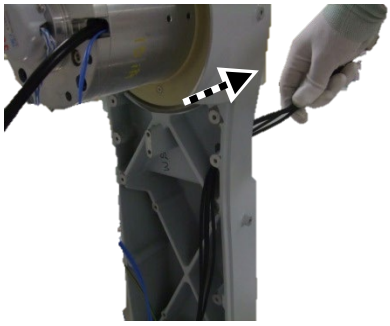


NOTE

Do not pass the cables forcibly while the connectors get caught. Doing so may result in disconnection of the cables or breakage of the connectors.

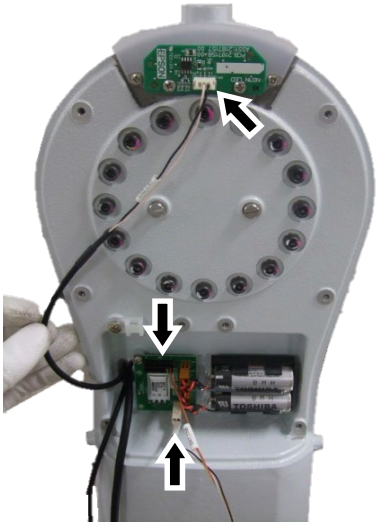
(10) Pass the cables (connectors) through the hole on the end of the Arm #1

Cables (connectors):
BAT_CN3, BAT_CN6
GS01,
LED_CN1



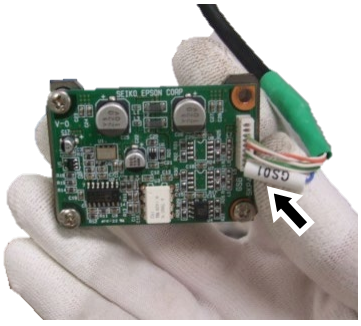
(11) Connect the connectors to the board.

Cables (connectors):
BAT_CN3, BAT_CN6
LED_CN1



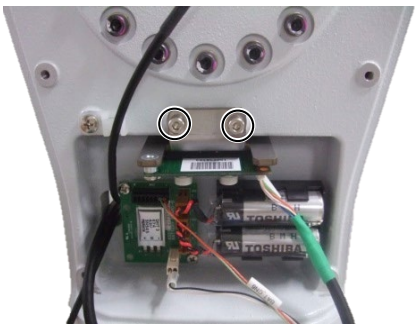
(12) Connect the connectors to the control board 1.

Cable (connector): GS01



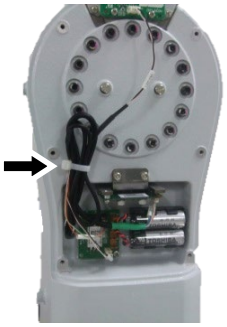
(13) Install the control board 1 to the Arm #1.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m



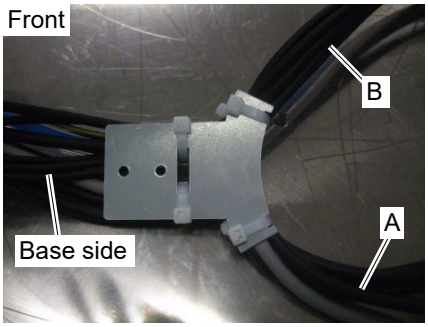
(14) Fix the cables on the Arm #1.

Cable tie (AB200): 1



(15) Fix the cable unit to the cable fixing plate. Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

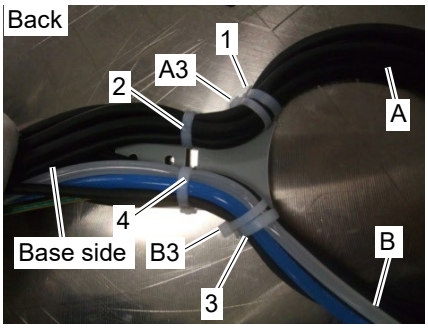


Cable A

Set the A3 of the cable tie to the cable fixing plate and fix it by using the cable ties 1 and 2. Make sure that the gray colored cable is on the plate side.

Cable B

Set the B3 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure that the two air tubes (blue and white) are on the opposite side of the plate.

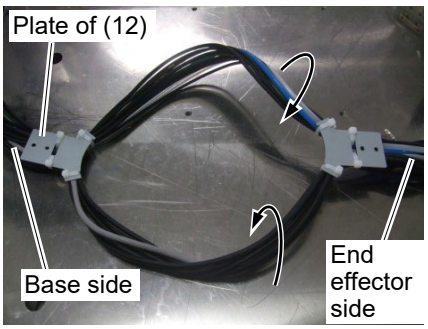


NOTE
Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A3 and B3 to set positions.

NOTE
Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A3, and 3 and B3 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

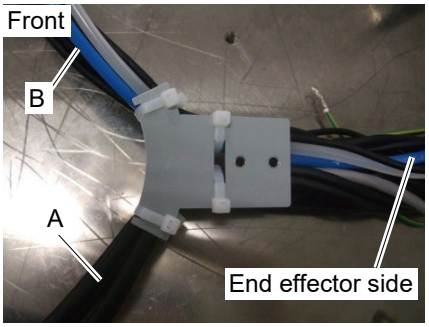
(16) Fix the cable unit to the cable fixing plate with twisting 180 degrees.
Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N



Cable A

Set the A4 of the cable tie to the cable fixing plate and fix it with by using the cable ties 1 and 2. Make sure to twist 180 degrees and fix the cable A so that the gray colored cable is on the opposite side of the plate.



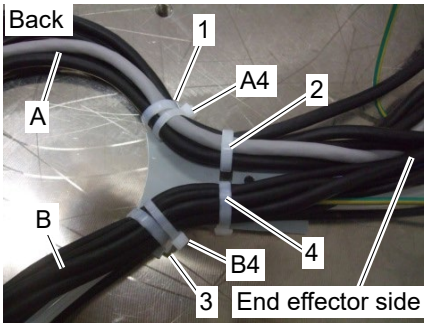
Cable B

Set the B4 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure to twist 180 degrees and fix the cable B so that the two air tubes (blue and white) are on the plate side.

Refer to the figure for positions of the cable tie heads.

NOTE

Rotate the heads of the cable ties A4 and B4 to set positions.



Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A4, and 3 and B4 should be as close as possible.

Improper order or position of the cable tie may shorten the life cycle of the cables.

(17) Apply the grease to the cables between the two cable fixing plates.

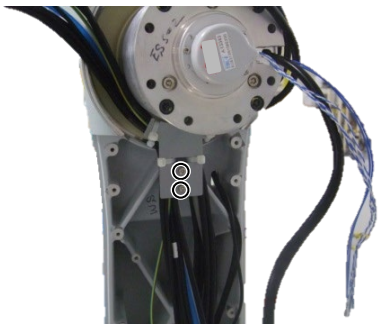
Grease:
Krytox: Cable A and B
Standard model : 1g for each
Cleanroom model : 1.5g for each

NOTE

Apply the grease to each cable evenly.

(18) Install the cable fixing plates to Arm #1.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m



NOTE

Be careful not to tighten the screws with the cables get caught on the plate.

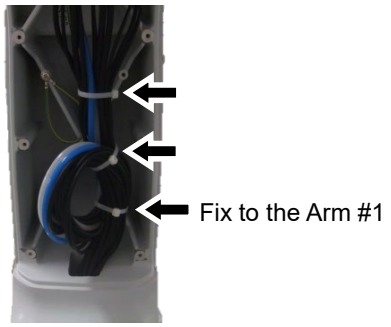
(19) Install the two ground wire terminals.

Cross recessed binding head machine screw: M4×8
Tightening torque: 0.9 ± 0.1 N·m

(20) Install the cable unit as shown on the right, and then bundle three positions with the cable ties.

Fix one position to the Arm #1.

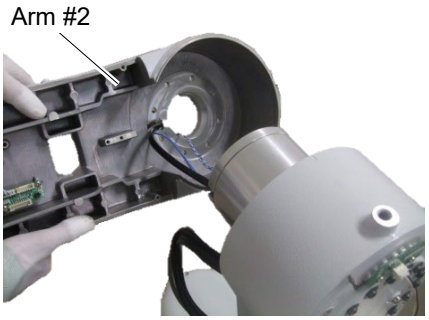
Cable ties (AB200)



(21) To face the two cable fixing plates, bend the cable unit and pass it through the Joint #2.

(22) Install the Arm #2 while aligning the cable unit to the direction of the cables coming from the Joint #2 actuator.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)
Tightening torque: 18 ± 0.9 N·m



NOTE

Refer to the picture for installing direction.
When installing it, pass the cables from the Joint #2 actuator unit through the hole of the Arm #2.

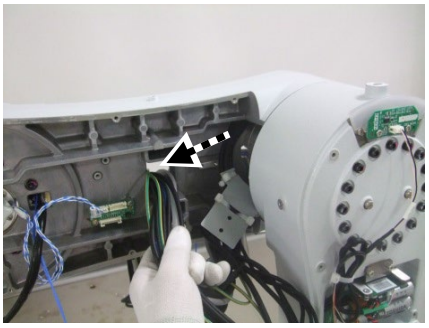
Be careful not to get the cables caught.

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

(23) Pass the cable unit except the following cables (connectors) to Arm #2.

Cables (connectors):
PW2, PW3, BR2, BR3,
EB02_CN1, ground wire



NOTE

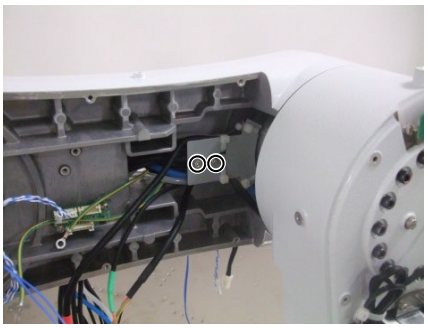
Do not pass the cables forcibly while the connectors get caught.
Doing so may result in disconnection of the cables or breakage of the connectors.

(24) Install the cable fixing plates to Arm #2.

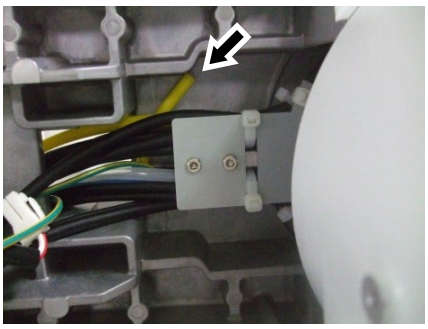
Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Be careful not to tighten the screws with the cables get caught on the plate.



For cleanroom model, face one yellow air tube to Joint #2 side.



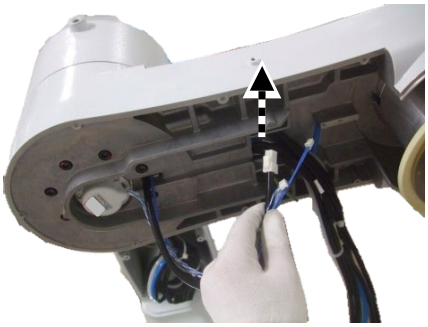
NOTE

Be careful not to bend or collapse the air tubes.

(25) Pass the cables from the Joint #2 actuator unit through the hole of the Arm 2, and pull them to the Arm #1 side.

Cables (connectors):

PW2, BR2, EB0x_CN2



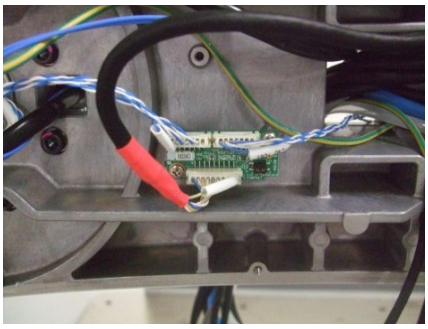
NOTE

Do not pull the cables forcibly while the connectors get caught. Doing so may result in disconnection of the cables or breakage of the connectors.

(26) Connect the connectors to the encoder board 2.

Connectors:

EB02_CN1, EB0x_CN2 (J2 side)



NOTE

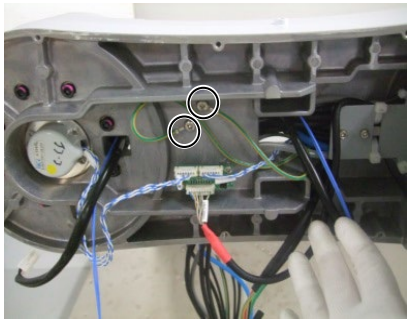
Be careful that the jumper pins on the board do not come off.

(27) Install the two ground wire terminals.

Cross recessed binding head machine screws:

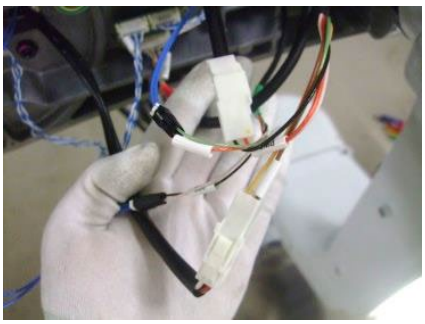
2-M4×8

Tightening torque: 0.9 ± 0.1 N·m



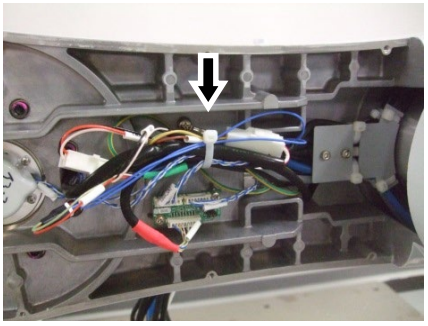
(28) Connect the connectors.

Connectors: PW2, BR2, PW3, BR3



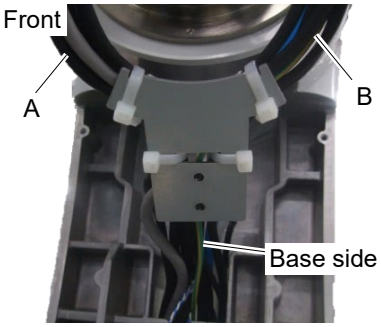
(29) Bundle the cables.

Cable tie (AB200) × 1



(30) Fix the cable unit to the cable fixing plate. Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N

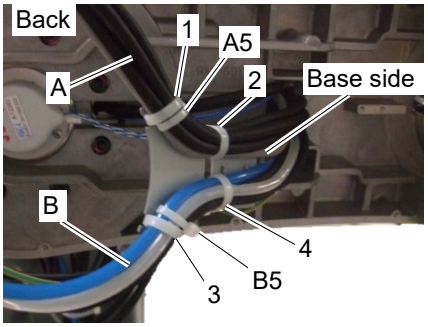


Cable A

Set the A5 of the cable tie to the cable fixing plate and fix it by using the cable ties 1 and 2. Make sure that the gray colored cable is on the plate side.

Cable B

Set the B5 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure that the two air tubes (blue and white) are on the opposite side of the plate.



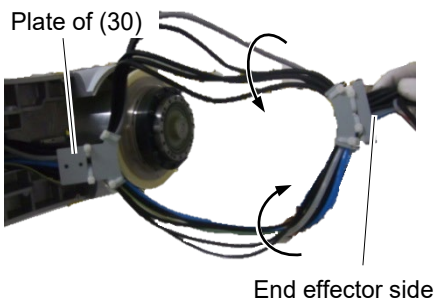
NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A5 and B5 to set positions.

Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A5, and 3 and B5 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

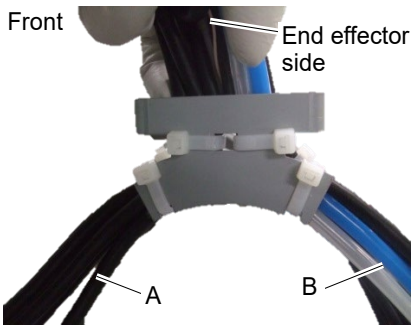
(31) Fix the cable unit to the cable fixing plate with twisting 180 degrees. Be careful for the following:

Cable ties (AB200) × 4 (1 to 4)
Tightening strength: 85 ± 5 N



Cable A

Set the A6 of the cable tie to the cable fixing plate and fix it with by using the cable ties 1 and 2. Make sure to twist 180 degrees and fix the cable A so that the gray colored cable is on the opposite side of the plate.

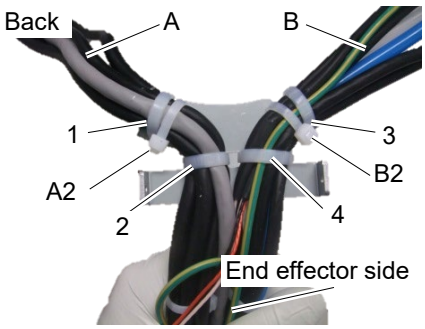


Cable B

Set the B6 of the cable tie to the cable fixing plate and fix it by using the cable ties 3 and 4. Make sure to twist 180 degrees and fix the cable B so that the two air tubes (blue and white) are on the plate side.

NOTE

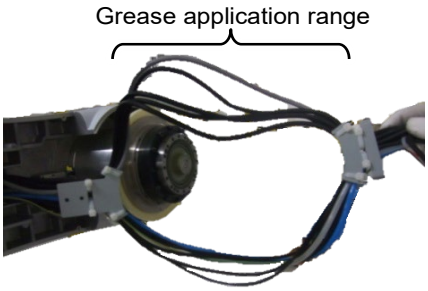
Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A6 and B6 to set positions.



Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A6, and 3 and B6 should be as close as possible.

Improper order or position of the cable tie may shorten the life cycle of the cables.

(32) Apply the grease to the cables between the two cable fixing plates.



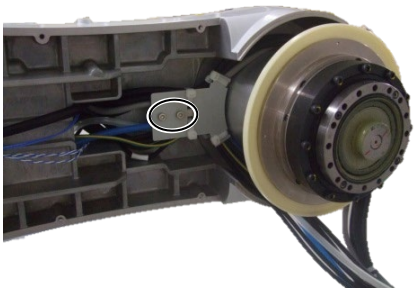
Grease:
Krytox: Cable A and B
Standard model : 1g for each
Cleanroom model: 1.5g for each

NOTE

Apply the grease to each cable evenly.

(33) Install the cable fixing plates to Arm #2.

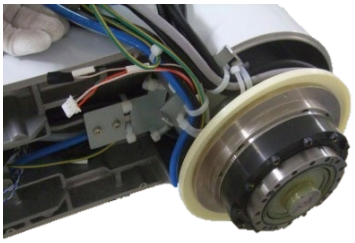
Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m



NOTE

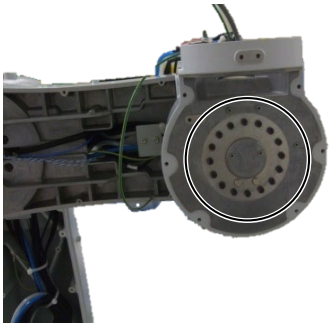
Be careful not to tighten the screws with the cables get caught on the plate.

(34) To face the two cable fixing plates, bend the cable unit and pass it through the Joint #3.



(35) Install the Arm #3 with approx. - 90 degrees while inserting the cable unit to the Arm #3.

Hexagon socket head cap bolts:
16-M4×30 (with plain washer)
Tightening torque: 5.5 ± 0.25 N·m



NOTE

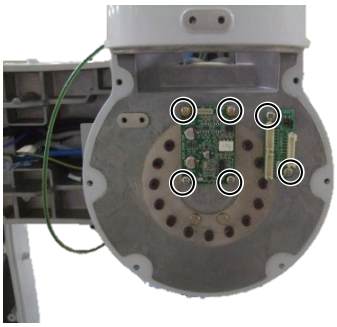
Be sure to have at least 2 people to perform the operation since the parts being heavy. Be careful not to catch the cables.

Make sure that the O-ring will not be out of the groove.

Do not apply excessive shock to the parts.

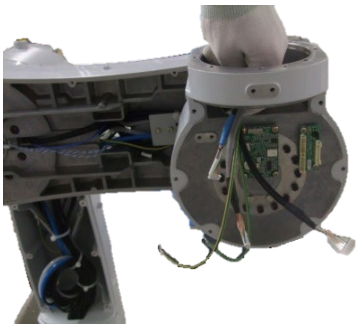
(36) Install the encoder board 3 and the control board 2.

Cross recessed binding head machine screws:
6-M3×6
Tightening torque: 0.45 ± 0.05 N·m



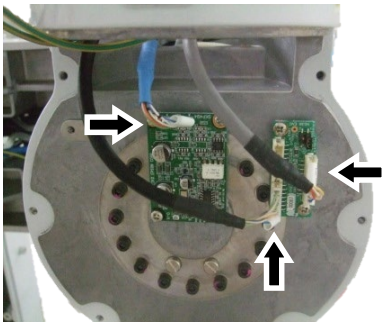
(37) Pull the cables (connectors) to the outside of the Arm #3.

Cables (connectors):
PW4, BR4, EB04_CN1, GS02,
EB04_CN3, two ground wires



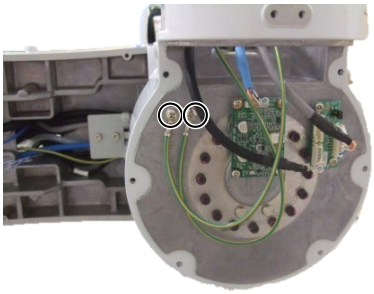
(38) Connect the connectors to the encoder board 3 and the control board 2.

Connectors:
EB04_CN1, EB04_CN3
GS02



(39) Install the two ground wire terminals.

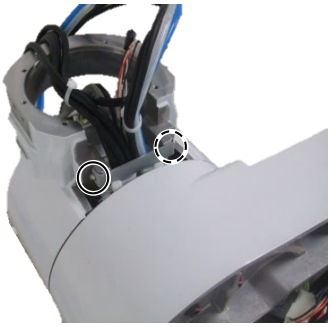
Cross recessed binding head machine screws:
2-M4×8
Tightening torque: 0.9 ± 0.1 N·m



(40) Install the cable fixing plates to Arm #3.

Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m

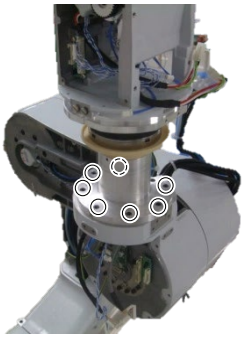
NOTE
Be careful not to tighten the screws with the cables get caught on the plate.



(41) Install the Joint #4 actuator unit to the Arm #3.

Hexagon socket head cap bolts:
7-M4×15 (with plain washer)
Tightening torque: 5.5 ± 0.25 N·m

NOTE
Be sure to have at least 2 people to perform the operation since the parts being heavy.



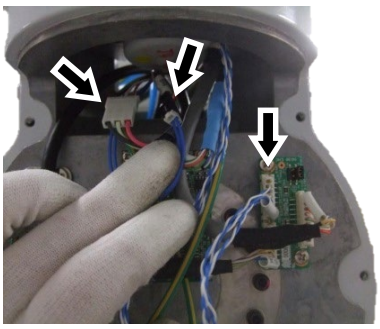
Make sure to take out the cables from the Joint #4 actuator unit to outside of the Arm #3.

Confirm that the positioning pins are installed on the Arm #3. Then, install the Joint #4 actuator unit to match with the pins.

Be careful not to get the cables caught.

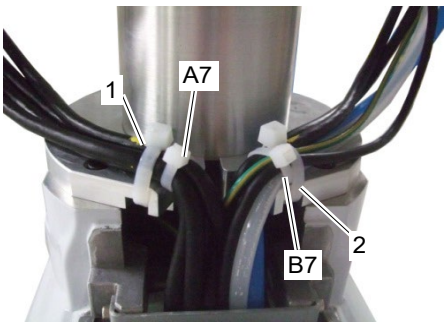
(42) Connect the connectors.

Connectors: PW4, BR4, EB0x_CN2



(43) Fix the cable unit to the flange of the Joint #4 actuator unit with the cable ties.

Cable ties (AB200) × 2 (1 and 2)
Tightening strength: 85 ± 5 N



NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A7 and B7 to set positions.

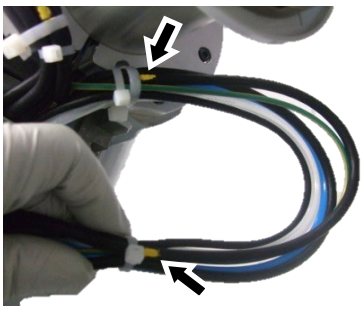
Distance between the cable tie 1 and A7, and 3 and B7 should be as close as possible. (Do not pull the cables forcibly to get close the cable ties.)

Be careful not to bend the air tubes.

Improper order or position of the cable tie may shorten the life cycle of the cables.

(44) Place marks on the cable of cable A (near the cable ties A7 and A8) on the opposite side of the flange.

(45) As with the above, place marks on the cable or the air tube of cable B (near the cable ties B7 and B8) on the opposite side of the flange.



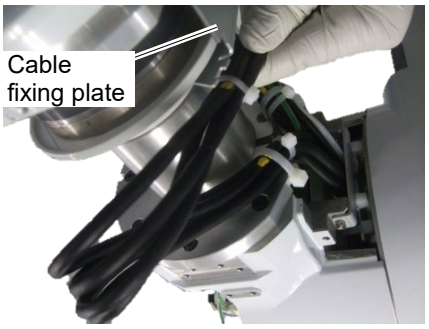
(46) Install the cable fixing plates to the flange of the Arm #4.

Hexagon socket head cap bolts: 2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

(47) Fix the cable unit on the cable fixing plate.
Follow the steps below:

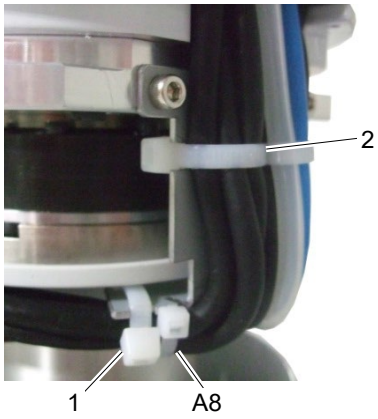
Cable A

Bend the cable so that the mark near the cable tie A8 will be on the cable fixing plate side.



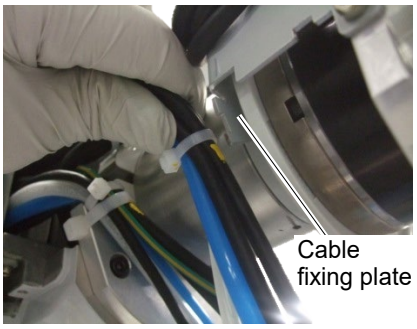
As shown on the right, set the position of the cable tie A8 to the cable fixing plate and fix it by using cable ties 1 and 2.

Cable ties (AB200) × 2 (1 and 2)
Tightening strength: 85 ± 5 N



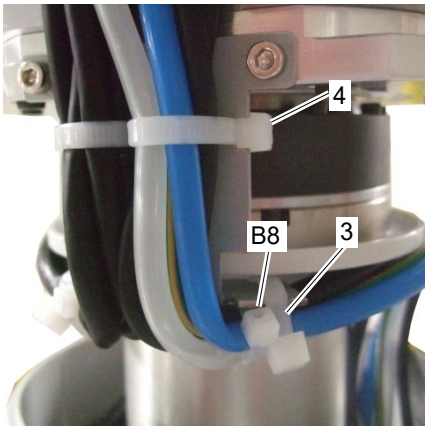
Cable B

Bend the cable so that the mark near the cable tie B8 will be on the cable fixing plate side.



As shown on the right, set the position of the cable tie B8 to the cable fixing plate and fix it by using cable ties 3 and 4.

Cable ties (AB200) × 2 (3 and 4)
Tightening strength: 85 ± 5 N



NOTE

Be careful not to bend the air tubes.

NOTE

Refer to the figure for positions of the cable tie heads.
Rotate the heads of the cable ties A8 and B8 to set positions.

Be careful for the orders and the positions of the cable ties.
Distance between the cable tie 1 and A8, and 3 and B8 should be as close as possible.
Improper order or position of the cable tie may shorten the life cycle of the cables.

(48) Apply the grease to the cables between the cable tie A7 and A8, and B7 and B8.

Grease:
Krytox: Cable A and B
Standard model : 0.5g for each
Cleanroom model : 0.8g for each

NOTE
Apply the grease to each cable evenly.

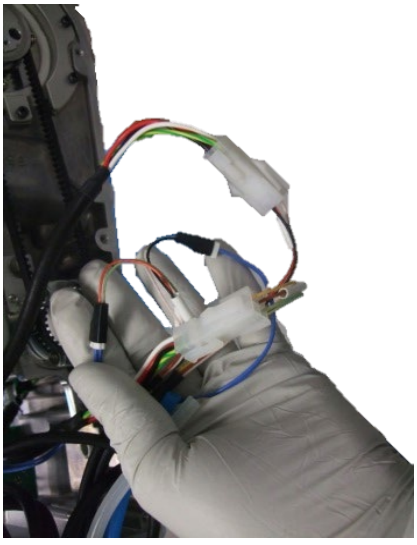
(49) Pass the cables (connectors) through the Arm #4 and connect them to the user attachment.

Cables (connectors):
Ether1, Ether2, X71, X72

Connect the Ether1 and Ether2 depending on the user attachment display.

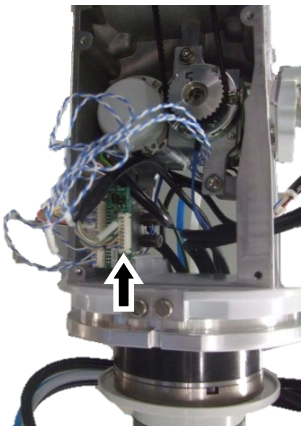
(50) Connect the connectors.

Connectors: PW5, PW6, BR5, BR6



(51) Connect the connector to the encoder board 4.

Connector: EB05_CN1

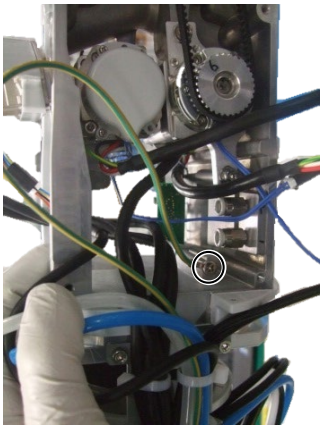


NOTE

Be careful that the jumper pins on the board do not come off.

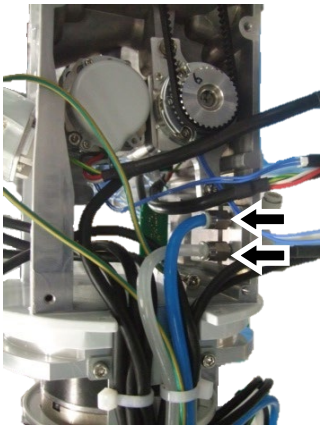
(52) Install the ground wire terminals.

Cross recessed binding head machine screw:
M4×8
Tightening torque: 0.9 ± 0.1 N·m

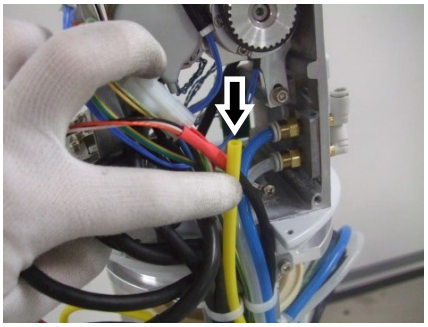


(53) Cut the two air tubes with proper length and connect them to fittings.

Air1: White
Air2: Blue



For cleanroom model, cut the yellow air tube with the length as shown in the picture.



NOTE

Make sure that the air tube does not interfere with the pulley or belt.

(54) Install the user attachment on the Arm #4.

Hexagon socket head cap bolts: 2-M4×8

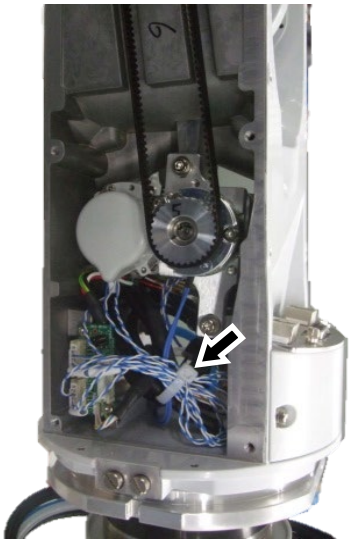
Tightening torque: 4.0 ± 0.2 N·m

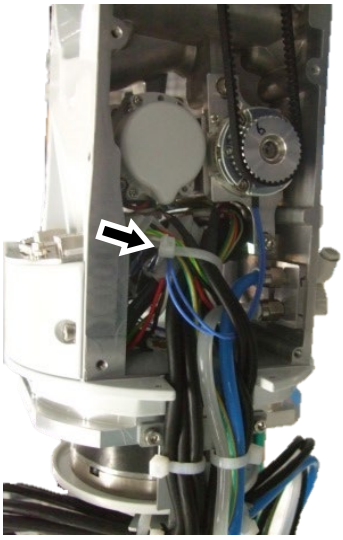
NOTE

Be careful not to get the cables caught.

(55) Bundle the cables with the cable tie to prevent the cables from interfering with the pulley or belt.

Cable ties (AB200) × 2





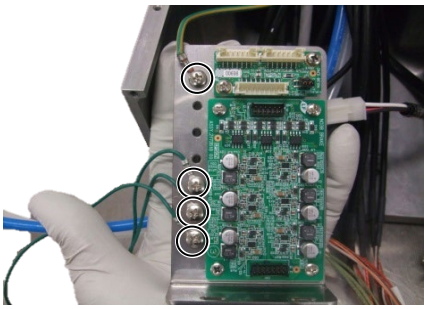
(56) Connect the connector.

Connector: PW1

(57) Install the four ground wire terminals except the connector X11, X12 to the board fixing plate.

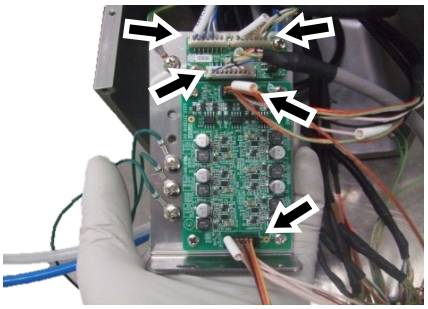
Cross recessed binding head machine screws: 4-M4×8

Tightening torque: 0.9 ± 0.1 N·m



(58) Connect the connectors to the encoder board 1 and the brake board.

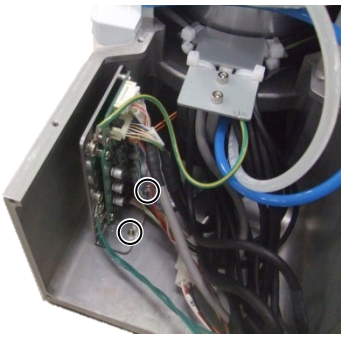
Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2



(59) Install the board fixing plate in the back of the base.

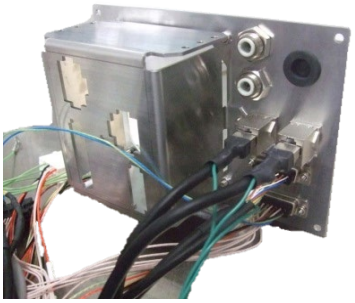
Hexagon socket head cap bolts: 2-M3×6

Tightening torque: 2.0 ± 0.1 N·m



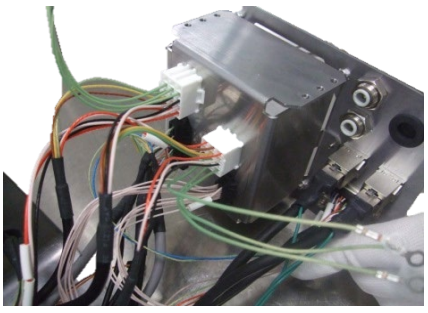
(60) Connect the connectors to the base side plate.

Connectors: Ether1, Ether2, D-sub, SW1

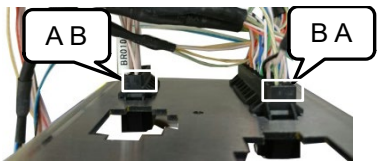


(61) Connect the connectors to the box-shaped plate.

Connectors: X11, X12, X010, BR010

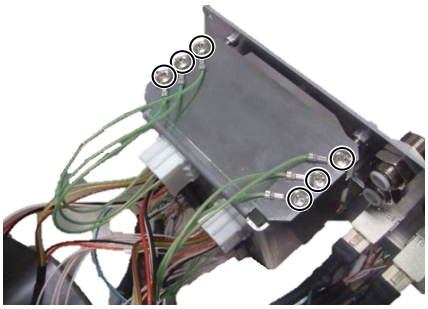


Refer to the right picture for installation direction of black colored connectors (X010, BR010).



(62) Install the six ground wire terminals from the connector X11, X12 to the box-shaped plate.

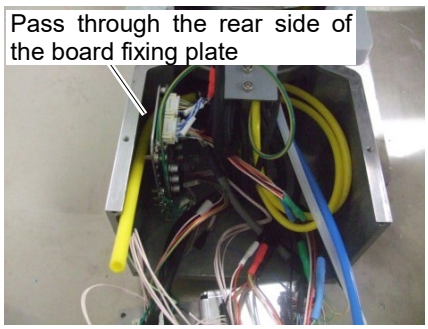
Cross recessed binding head machine screws:
6-M4×8
Tightening torque: 0.9 ± 0.1 N·m

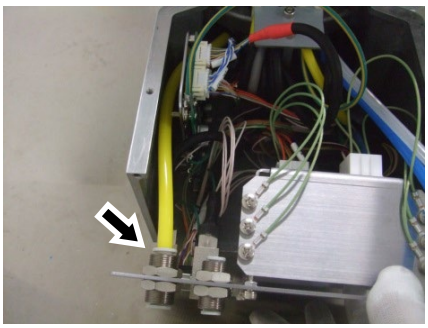


For cleanroom model, install the yellow air tube as shown in the following pictures. Pass the air tube through the rear side of the board fixing plate, and then connect to the fittings.

NOTE

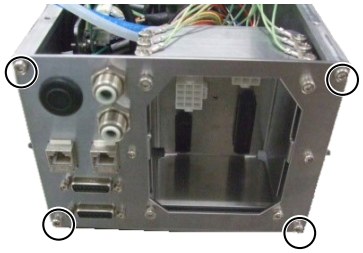
Be careful not to bend or collapse the air tubes





(63) Install the base side plate.

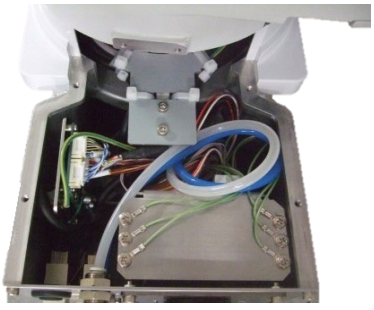
Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m



As shown on the right, make sure that the cable of Ether1 passes through the rear side of the board fixing plate.

(64) Install the two air tubes as shown on the right, and connect them to fittings.

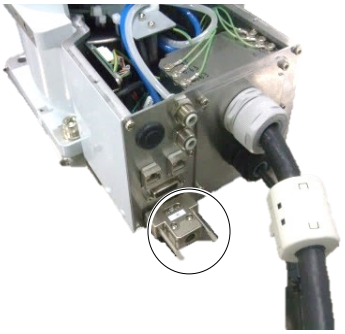
Air1: White
Air2: Blue



(65) Connect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(66) Connect the external short connector.



(67) Install the following covers:

Arm #4 side cover (2 covers)		
Joint #4 inside cover	Joint #4 outside cover	Joint #4 side covers (2 covers)
Arm #3 cover	Arm #3 inside cover	Arm #2 cover (2 covers)
Joint #2 outside cover	Arm #1 inside cover	
Arm #2 outside cover *	Joint #1 cover	Base cover

For details, refer to "*3. Covers*".

* Install the Arm #1 outside cover simultaneously with the Joint #1 cover.

(68) Perform calibration.

For details, refer to "*8. Calibration*".

4.4 Replacing the Cable Unit (N6-A850*BR):Cable Direction: Upward

WARNING	■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to "*4.7 Connector Pin Assignment*".

	Name		Qty	Code, Note
Maintenance Parts	Cable unit		1	2187251 (Standard) 2194258 (Cleanroom)
	Cable tie	AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

NOTE

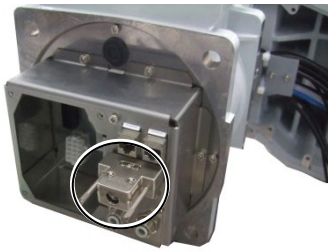
The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

Removal

Cable Unit (N6-A850*BR) Cable direction: Upward

(1) Perform the Removal steps (2) through (6), (8) in "*4.3 Replacing Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

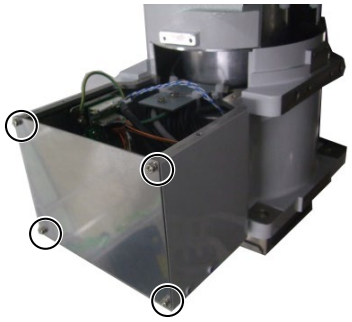
(2) Disconnect the external short connector.



(3) Perform the Removal steps (9) through (49) in "*4.3 Replacing Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(4) Remove the base side plate.

Hexagon socket head cap bolts: 4-M4×8

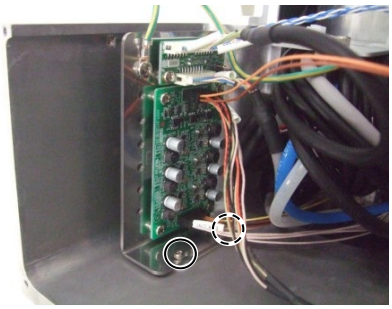


(5) Remove the board fixing plate.

Hexagon socket head cap bolts: 2-M3×6

(6) Disconnect the connectors connected to the encoder board 1 and the brake board.

Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2

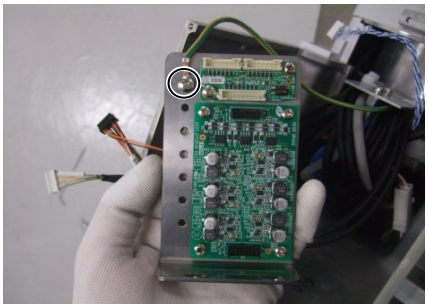


NOTE

Be careful that the jumper pins on the encoder board do not come off.

(7) Remove the ground wire terminals fixed on the board fixing plate.

Cross recessed binding head machine screw: M4×8



(8) Perform the Removal steps (56) through (61) in "*4.3 Replacing Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

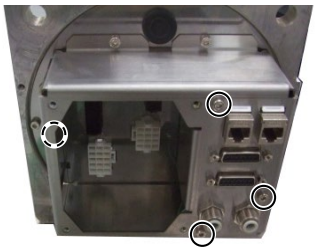
(9) Lay down the Manipulator.

NOTE

Be sure to have at least 2 people to lay down the Manipulator.

(10) Remove the plate part 1 from the base bottom.

Hexagon socket head cap bolts: 4-M4×8

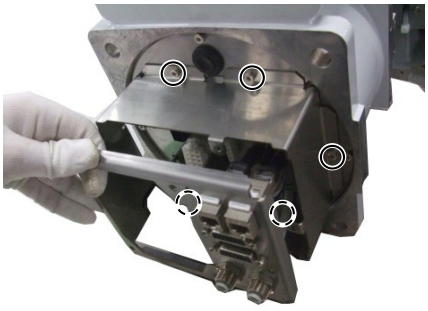


NOTE

Do not pull the part after removing it.
Doing so may result in disconnection of the cables since the cables are connected.

(11) Remove the plate part 2 from the base bottom.

Hexagon socket head cap bolts: 5-M4×8

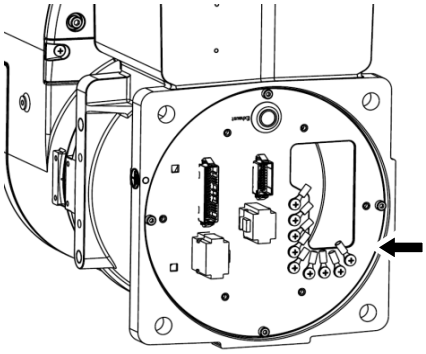


(12) Remove the two air tubes and connectors from the plate part 1.

Connectors: Ether1, Ether2, D-sub, SW1

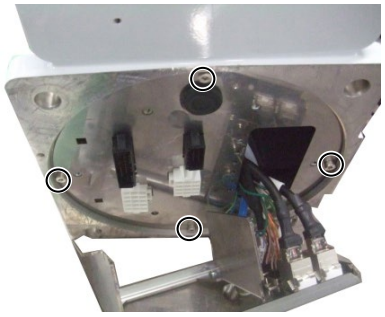
(13) Remove the nine ground wire terminals fixed on the plate part 3.

Cross recessed binding head machine screws: 9-M4×8



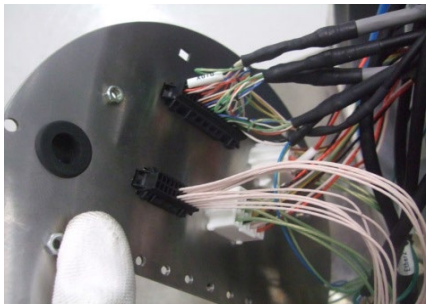
(14) Remove the plate part 3.

Hexagon socket head cap bolts: 4-M4×8

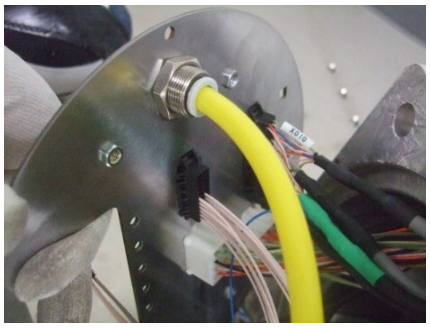


(15) Disconnect the connectors from the plate part 3.

Connectors: X11, X12, X010, BR010



For cleanroom model, disconnect the yellow air tube as well.



NOTE

The subsequent steps are described with the standard model's cable unit.
For cleanroom model, a yellow air tube is included in the cable unit.

Installation

Cable Unit
(N6-A850*BR)
Cable direction:
Upward

(1) Perform the Installation steps (1) through (8) in "*4.3 Replacing Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

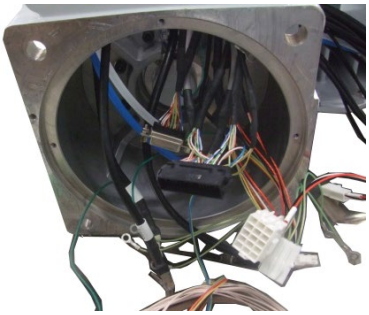
(2) Lay down the Manipulator.

NOTE

Manipulator is heavy. Be sure to have at least 2 people to perform the operation.

(3) Pull out the cable unit except the following cables.

Cables (connectors):
BRK_CN2, EB01_CN3, ground wire

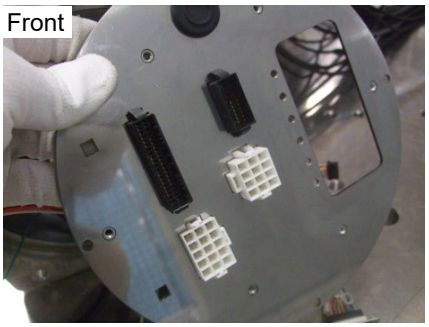


(4) Connect the connectors to the plate part 3

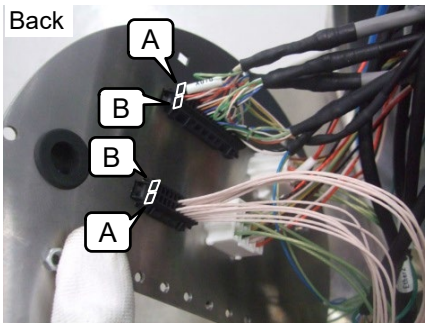
Connectors: X11, X12, X010, BR010

NOTE

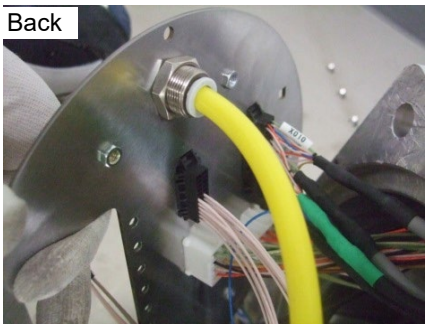
There are the front side and the back side on the plate part 3. Be careful for the directions.



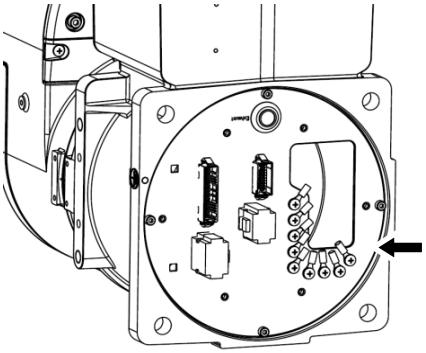
Refer to the right picture for installation direction of black colored connectors (X010, BR010).



For cleanroom model, connect the yellow air tube to the fittings.



(5) Install the nine ground wire terminals from the following connectors to the front side of the plate part 3.

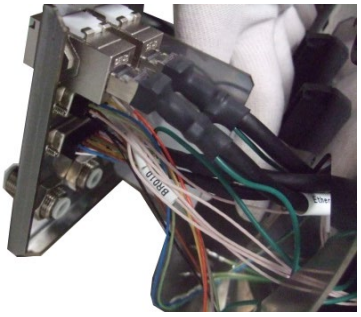


Connectors:
X11, X12, D-sub, Ether1, Ether2

Cross recessed binding head machine screw:
9-M4×8
Tightening torque: 0.9 ± 0.1 N·m

NOTE
Refer to the right figure for the installation position.

(6) Pass the connectors through the hole of the plate part 3, and install on the the plate part 1.

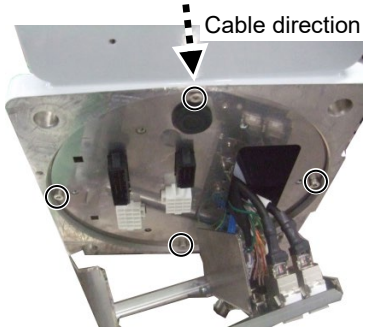


Connectors: Ether1, Ether2, D-sub, SW1

(7) Connect the two air tubes to fittings.

Air1: White
Air2: Blue

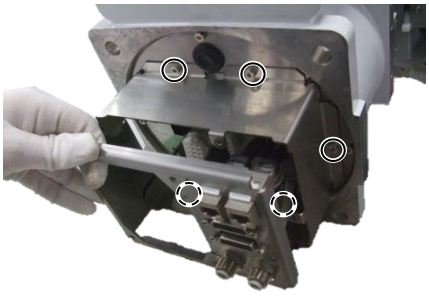
(8) Install the plate part 3 to the base.



Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE
Refer to the right figure for the installation position.

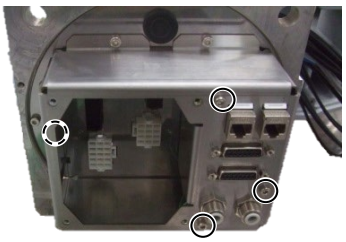
(9) Install the plate part 2.



Hexagon socket head cap bolts: 5-M4×8
Tightening torque: 4.0 ± 0.2 N·m

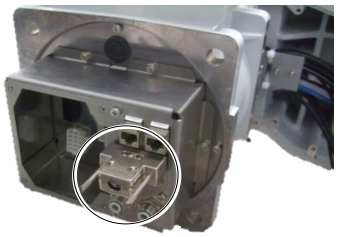
NOTE
Be careful not to get the cables caught.

(10) Install the plate part 1.



Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m

(11) Connect the external short connector.



(12) Connect the M/C cable.

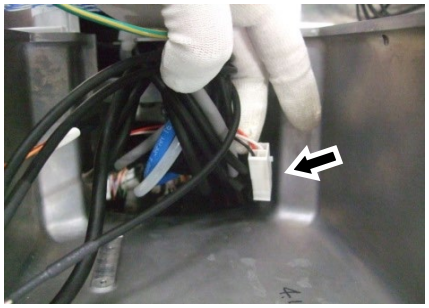
For details, refer to "*4.6. M/C Cable*".

(13) Mount the Manipulator on the base table.

NOTE
Be sure to have at least 2 people to mount the Manipulator.

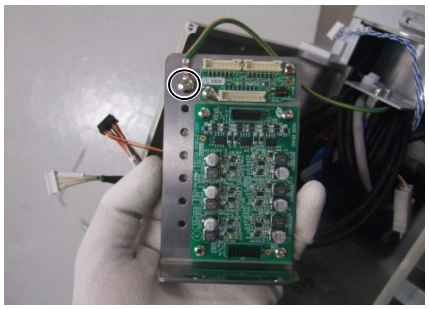
(14) Connect the connectors.

Connector: PW1



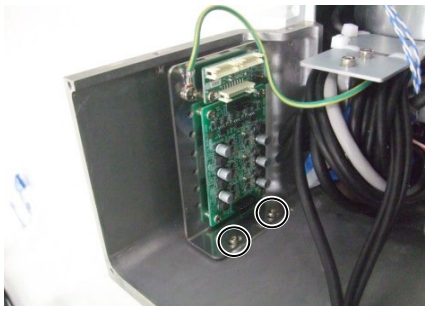
(15) Install the ground wire terminal on the board fixing plate.

Cross recessed binding head machine screw: M4×8
Tightening torque: 0.9 ± 0.1 N·m

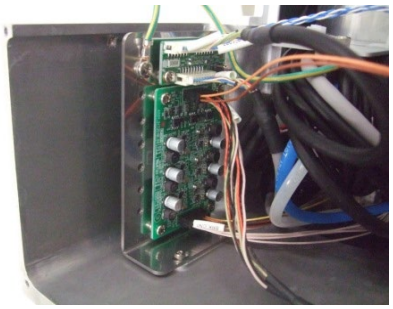


(16) Install the board fixing plate in the back of the base.

Hexagon socket head cap bolts: 2-M3×6
Tightening torque: 2.0 ± 0.1 N·m

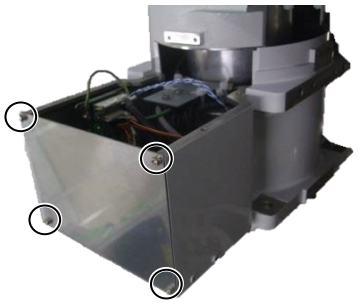


(17) Connect the connectors to the encoder board 1 and the brake board.



Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2
BRK_CN1, BRK_CN2

(18) Install the base side plate.



Hexagon socket head cap bolts: 4-M4×8
Tightening torque: 4.0 ± 0.2 N·m

(19) Perform the Installation steps (9) through (55) in "*4.3 Replacing Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(20) Install the following covers:

Arm #4 side cover (2 covers)

Joint #4 inside cover	Joint #4 outside cover	Joint #4 side covers (2 covers)
Arm #3 cover	Arm #3 inside cover	Arm #2 cover (2 covers)
Joint #2 outside cover	Arm #1 inside cover	
Arm #1 outside cover	Joint #1 cover	Base cover

For details, refer to "*3. Covers*".

* Install the Arm #1 outside cover simultaneously with the Joint #1 cover.

(21) Perform calibration.

For details, refer to "*8. Calibration*".

4.5 Relay Cable

WARNING	■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to "*4.7 Connector Pin Assignment*".

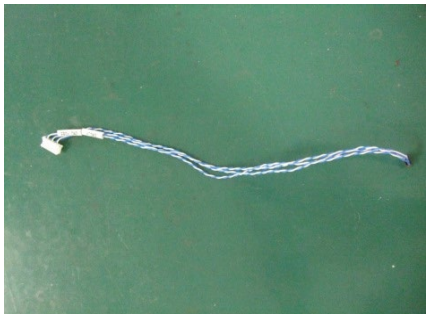
The relay cables are reusable.

Replace them when the cables or the connector clips are damaged during replacement of the cable unit.

	Name		Qty	Code, Note
Maintenance Parts	Relay cable 1		1	2187252
	Relay cable 2		1	2176220
	Cable tie	AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#1)		1	For cross recessed head screws
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

4.5.1 Relay Cable 1

Relay Cable 1



Removal

The relay cable 1 is connected to the actuator unit and the motor unit on each joint. Refer to the following steps depending on the positions to replace.

Joint #1 Actuator Unit

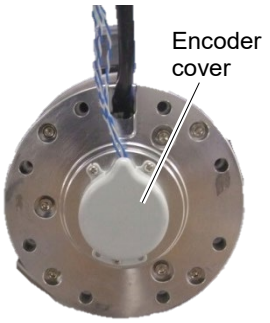
Relay Cable 1

(1) Remove the Joint #1 actuator unit.

For details, refer to "*5.1 Replacing the Joint #1 Actuator Unit*".

(2) Remove the encoder cover.

Cross recessed head screws: 3-M2.5×6



(3) Disconnect the connector.

Connector: ENC_x

Removal

Joint #2 Actuator Unit

Relay Cable 1

(1) Remove the Arm #2 cover (2 covers).

For details, refer to the following sections:

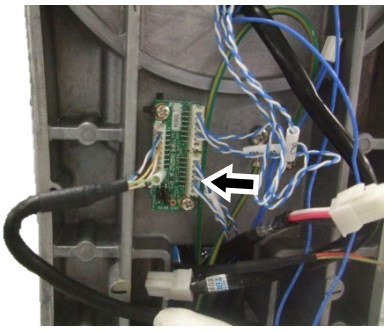
*3.7.1 N6-A1000** (Arm #2 Cover, Arm #1 Side)*

*3.7.2 N6- A850**R (Arm #2 Cover, Arm #1 Side)*

3.8 Arm #2 Cover (Arm #3 side)

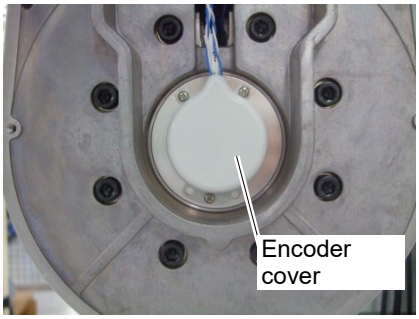
(2) Remove the connector from the encoder board 2.

Connector: EB0x_CN2 (Joint #2 side)



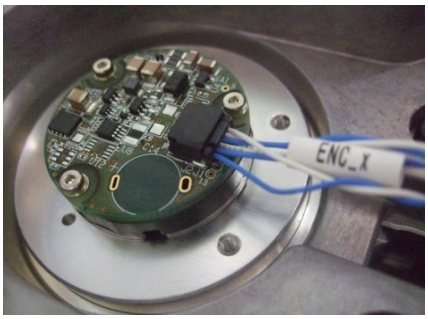
(3) Remove the encoder cover.

Cross recessed head screws: 3-M2.5×6



(4) Disconnect the connector.

Connector: ENC_x



Removal

Joint #3 Actuator Unit

Relay Cable 1

(1) Remove the Arm #2 cover.

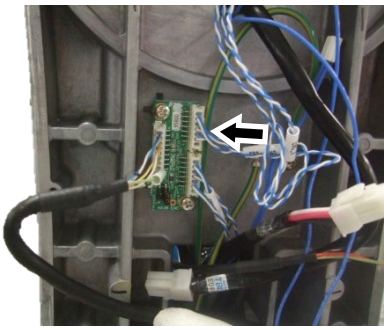
For details, refer to the following sections:

*3.7.1 N6-A1000** (Arm #2 Cover, Arm #1 Side)*

*3.7.2 N6- A850**R (Arm #2 Cover, Arm #1 Side)*

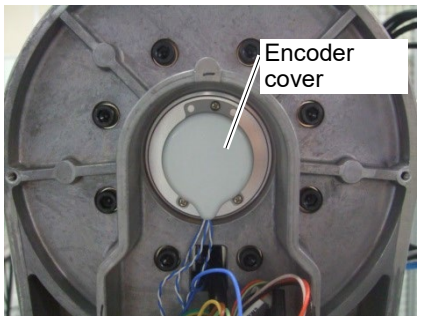
(2) Remove the connector from the encoder board 2.

Connector: EB0x_CN2 (Joint #3 side)



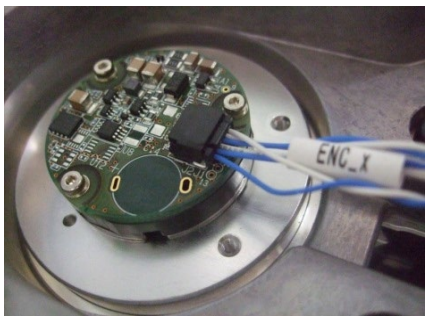
(3) Remove the encoder cover.

Cross recessed head screws: 3-M2.5×6



(4) Disconnect the connector.

Connector: ENC_x



Removal

Joint #4 Actuator Unit

Relay Cable 1

(1) Remove the covers.

Arm #4 side covers (2 covers)
Joint #4 outside cover
Arm #3 cover
Joint #4 inside cover
Joint #4 side covers (2 covers)

For details, refer to "*3. Covers*".

(2) Remove the Joint #4 actuator unit from the Arm #3.

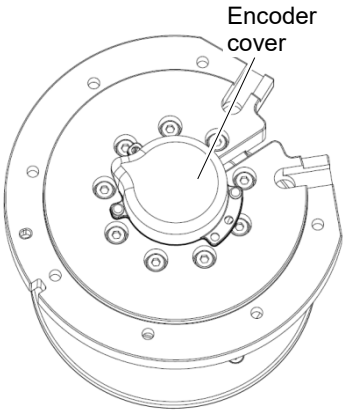
For details, refer to the following section:

Removal steps (9) through (22) in *4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward).*

Removal steps (9) through (22) in *4.3 Replacing the Cable Unit (N6-A850*R): Cable direction Standard (backward).*

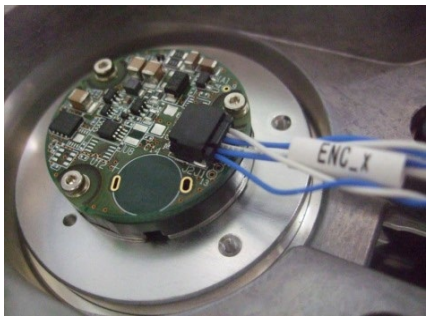
(3) Remove the encoder cover.

Cross recessed head screws: 2-M2.5×6



(4) Disconnect the connector.

Connector: ENC_x



Removal

Joint #5 Motor Unit

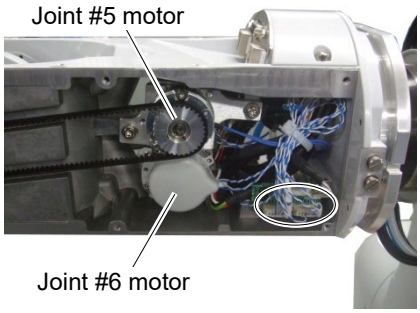
Relay Cable 1

(1) Remove the Arm #4 side cover (2 covers).

For details, refer to "*3.14 Arm #4 Side Cover*".

(2) Cut off the cable tie that bundles the cables, then disconnect the connector from the encoder board #4.

Connector:
EB0x_CN2 (Joint #5 motor connection)

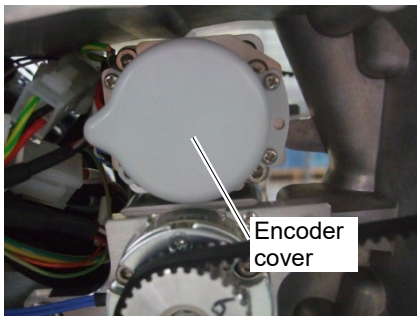


NOTE

You do not need to disconnect the connector connected to the Joint #6 motor.

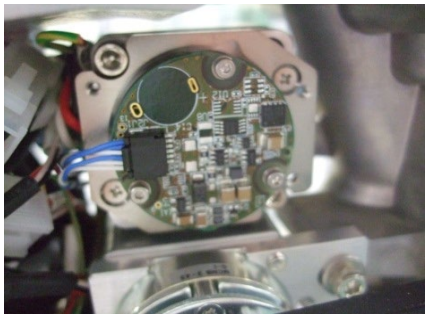
(3) Remove the encoder cover.

Cross recessed head screws: 3-M2.5×6



(4) Disconnect the connector.

Connector: ENC_x



Removal

Joint #6 Motor Unit

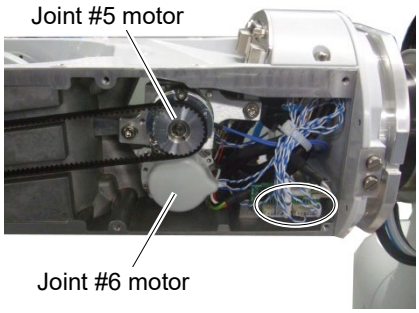
Relay Cable 1

(1) Remove the Arm #4 side cover (2 covers).

For details, refer to "*3.14 Arm #4 Side Cover*".

(2) Cut off the cable tie that bundles the cables, then disconnect the following connector from the encoder board #4.

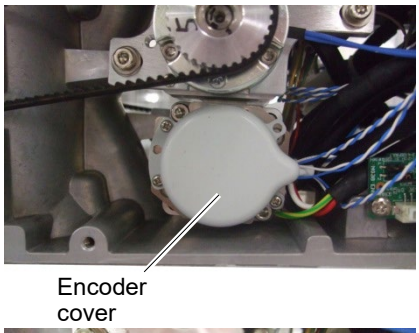
Connector:
EB0x_CN2 (Joint #6 motor connection)



NOTE You do not need to disconnect the connector connected to the Joint #5 motor.

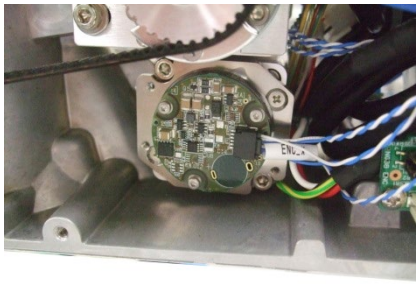
(3) Remove the encoder cover.

Cross recessed head screws: 3-M2.5×6



(4) Disconnect the connector.

Connector: ENC_x



Installation

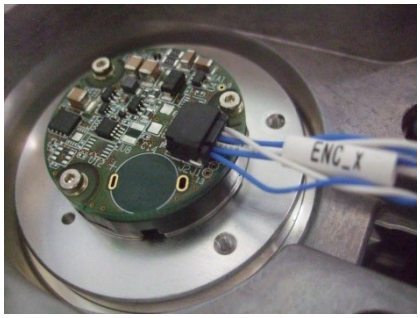
Joint #1 Actuator Unit

Relay Cable 1

The relay cable 1 is connected to the actuator unit and the motor unit on each joint. Refer to the following steps depending on the positions to replace.

(1) Connect the connector of the relay cable 1 to the encoder.

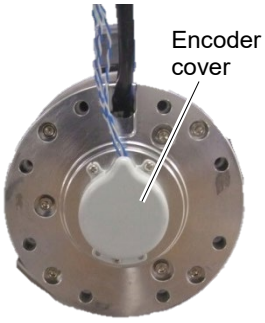
Connector: ENC_x



(2) Install the encoder cover.

Cross recessed head screws: 3-M2.5×6

Tightening torque: 0.2 ± 0.1 N·m



(3) Install the Joint #1 actuator unit.

For details, refer to "*5.1 Replacing the Joint #1 Actuator Unit*".

(4) Perform calibration for the Joint #1.

For details, refer to "*8. Calibration*".

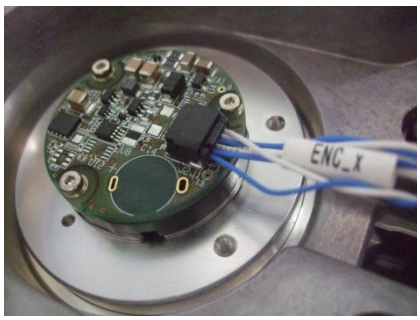
Installation

Joint #2 Actuator Unit

Relay Cable 1

(1) Connect the connector of the relay cable 1 to the encoder.

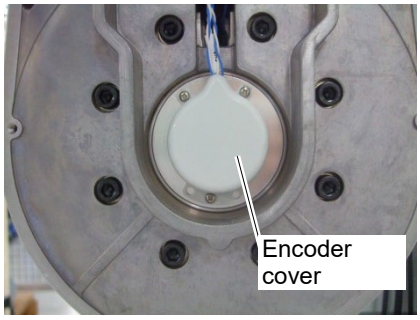
Connector: ENC_x



(2) Install the encoder cover.

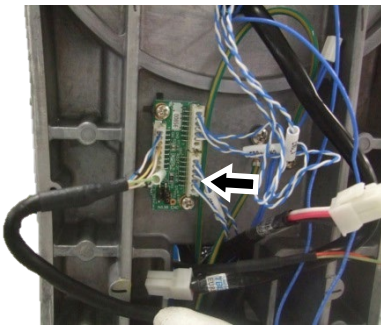
Cross recessed head screws: 3-M2.5×6

Tightening torque: 0.2 ± 0.1 N·m



(3) Connect the connector to the encoder board 2.

Connector: EB0x_CN2



(4) Install the Arm #2 cover (2 covers).

For details, refer to the following sections:

*3.7.1 N6-A1000** (Arm #2 Cover, Arm #1 Side)*

*3.7.2 N6- A850**R (Arm #2 Cover, Arm #1 Side)*

3.8 Arm #2 Cover (Arm #3 side)

(5) Connect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(6) Perform calibration for the Joint #2.

For details, refer to "*8. Calibration*".

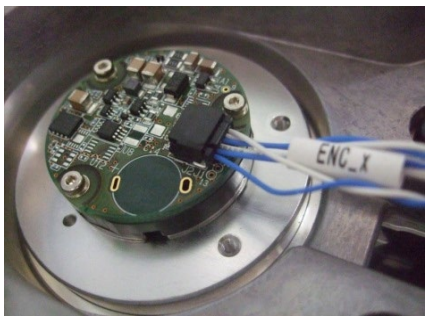
Installation

Joint #3 Actuator Unit

Relay Cable 1

(1) Connect the connector of the relay cable 1 to the encoder.

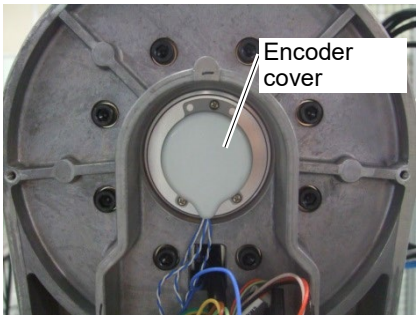
Connector: ENC_x



(2) Install the encoder cover.

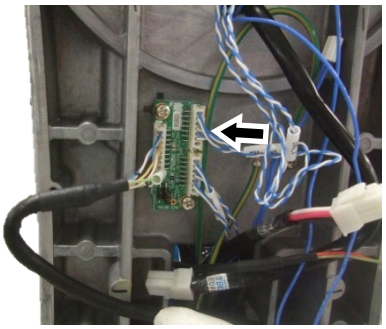
Cross recessed head screws: 3-M2.5×6

Tightening torque: 0.2 ± 0.1 N·m



(3) Connect the connector to the encoder board 2.

Connector: EB0x_CN2



(4) Install the Arm #2 cover (2 covers).

For details, refer to the following sections:

*3.7.1 N6-A1000** (Arm #2 Cover, Arm #1 Side)*

*3.7.2 N6- A850**R (Arm #2 Cover, Arm #1 Side)*

(5) Connect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(6) Perform calibration for the Joint #3.

For details, refer to "*8. Calibration*".

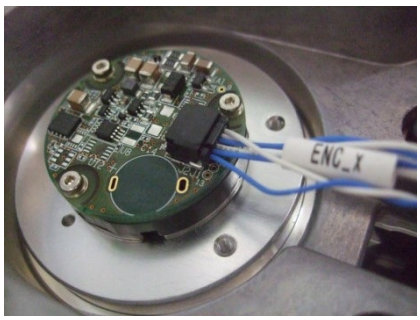
Installation

Joint #4 Actuator Unit

Relay Cable 1

(1) Connect the connector of the relay cable 1 to the encoder.

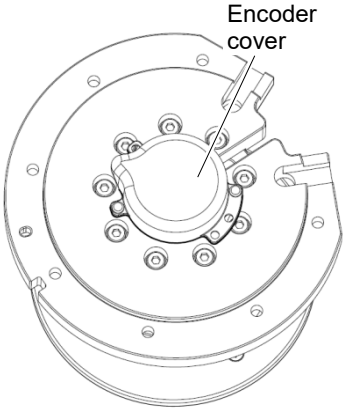
Connector: ENC_x



(2) Install the encoder cover.

Cross recessed head screws: 2-M2.5×6

Tightening torque: 0.2 ± 0.1 N·m



(3) Install the Joint #4 actuator unit to the Arm #3.

For details, refer to the following sections:

Installation steps (38) through (52) in *4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward).*

Installation steps (41) through (55) in *4.3 Replacing the Cable Unit (N6-A850*R): Cable direction Standard (backward).*

(4) Connect the M/C cable.
For details, refer to "*4.6. M/C Cable*".

(5) Perform calibration for the Joint #4.

For details, refer to "*8. Calibration*".

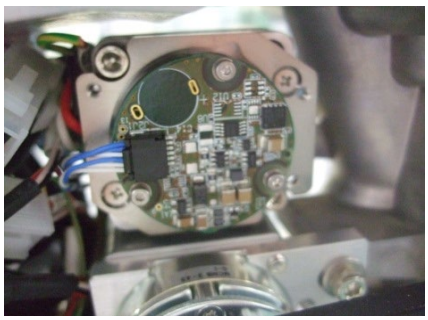
Installation

Joint #5
Motor Unit

Relay Cable 1

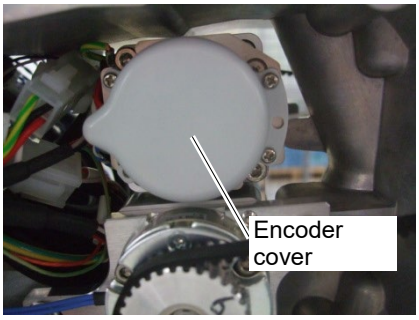
(1) Connect the connector of the relay cable 1 to the encoder.

Connector: ENC_x



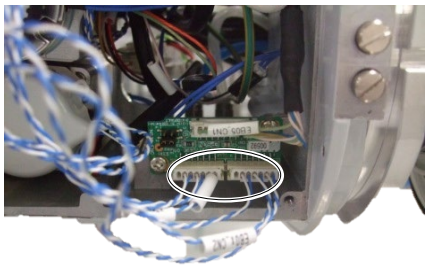
(2) Install the encoder cover.

Cross recessed head screws: 3-M2.5×6
Tightening torque: 0.2 ± 0.1 N·m



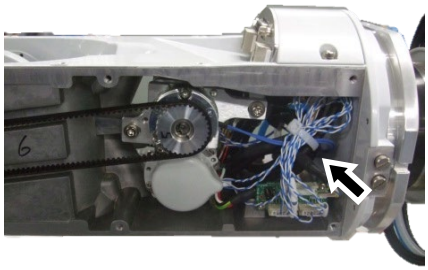
(3) Connect the connectors to the encoder board 4.

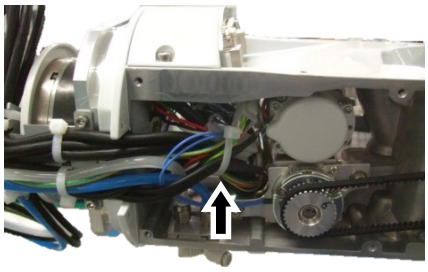
Connector: EB0x_CN2



(4) Bundle the cables with the cable tie to prevent the cables from interfering with the pulley or belt.

Cable ties (AB200) × 2





(5) Install the Arm #4 side cover.

For details, refer to "*3.14 Arm #4 Side Cover*".

(6) Connect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(7) Perform calibration for the Joint #5 and 6

For details, refer to "*8. Calibration*".

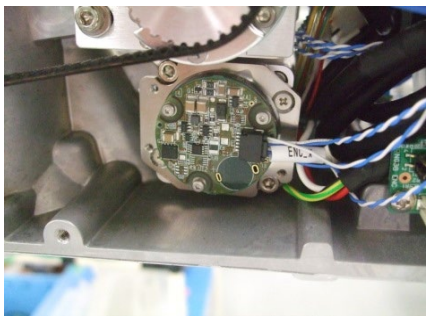
Installation

Joint #6
Motor Unit

Relay Cable 1

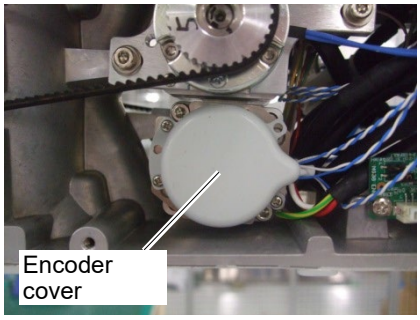
(1) Connect the connector of the relay cable 1 to the encoder.

Connector: ENC_x



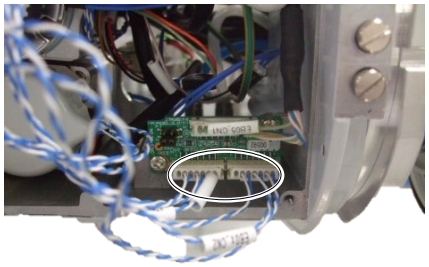
(2) Install the encoder cover.

Cross recessed head screws: 3-M2.5×6
Tightening torque: 0.2 ± 0.1 N·m



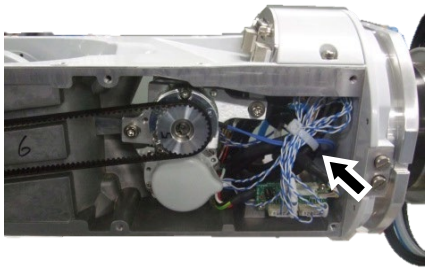
(3) Connect the connector to the encoder board 4.

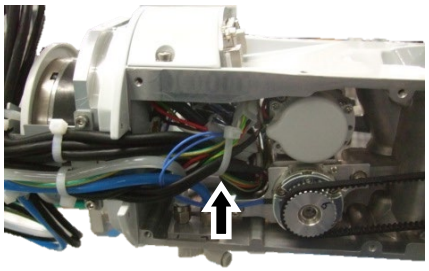
Connector: EB0x_CN2



(4) Bundle the cables with the cable tie to prevent the cables from interfering with the pulley or belt.

Cable ties (AB200) × 2





(5) Install the Arm #4 side cover (2 covers).

For details, refer to "*3.14 Arm #4 Side Cover*".

(7) Connect the M/C cable.

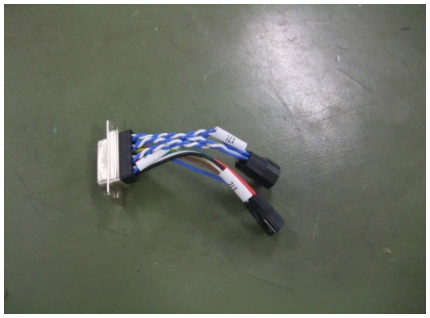
For details, refer to "*4.6. M/C Cable*".

(6) Perform calibration for the Joint #6.

For details, refer to "*8. Calibration*".

4.5.2 Relay Cable 2

Relay Cable 2



Removal

Relay Cable 2

(1) Remove the Arm #4 side cover (2 covers).

For details, refer to "*3.14 Arm #4 Side Cover*".

(2) Remove the user attachment.

For details, refer to the following sections:

Removal steps (9) through (11) in *4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward).*

Removal steps (9) through (11) in *4.3 Replacing the Cable Unit (N6-A850*R): Cable direction Standard (backward).*

(4) Disconnect the connector plate.

Hexagon socket head cap bolts: 3-M3×5

(5) Disconnect the relay cable 2.

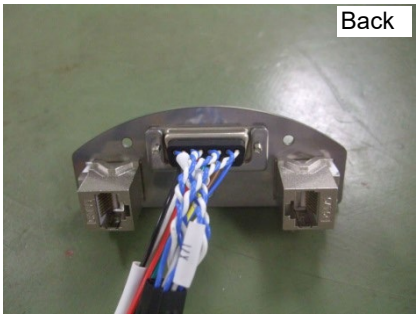
Be careful not to lose the fixing plate.

Installation

Relay Cable 2

(1) Connect the relay cable 2 to the connector plate.

Attached nut and washer will not be used.
Please dispose them by yourself.



(2) Install the connector plate on the user attachment.

Hexagon socket head cap bolts: 3-M3×5
Tightening torque: 2.0 ± 0.1 N·m

(3) Install the user attachment on the Arm #4.

For details, refer to the following section:
Installation steps (46), (51), and (52) in *4.1 Replacing the Cable Unit (N6-A1000*): Cable direction Standard (backward).*

Installation steps (49), (54), and (55) in *4.3 Replacing the Cable Unit (N6-A850*R): Cable direction Standard (backward).*

(4) Install the Arm #4 side cover (2 covers).

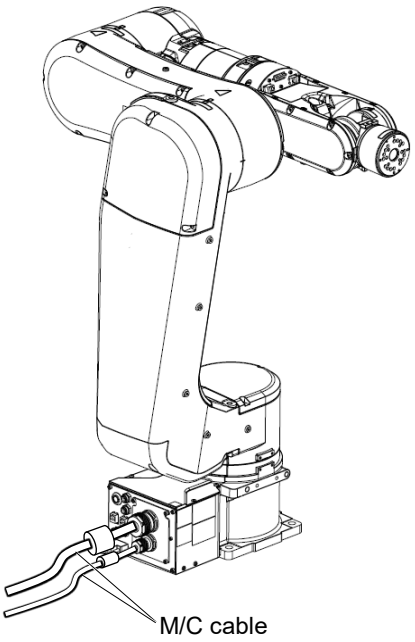
For details, refer to "*3.14 Arm #4 Side Cover*".

4.6 M/C Cable

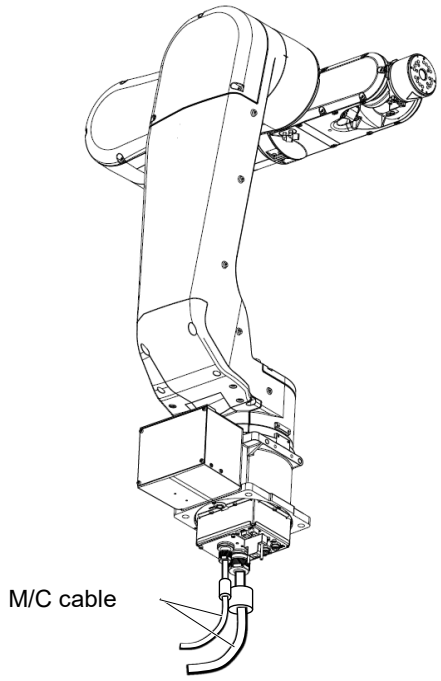
WARNING	■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. To shut off power to the robot system, disconnect the power plug from the power source. Performing any work while connecting the AC power cable to a factory power source is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be careful not to get any foreign substances in the Manipulator, connectors, and pins during maintenance. Turning ON the power to the robot system when any foreign substances exist in them is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) Unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. ■ When installing the cover, be careful not to allow the cables to interfere with the cover mounting and do not bend these cables forcibly to push them into the cover. Unnecessary strain on cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. When routing the cables, observe the cable locations after removing the cover. Be sure to place the cables back to their original locations.

CAUTION	■ When disconnecting the connectors during the replacement of the cable unit, be sure to reconnect the connectors to their proper positions. Improper connection of the connectors may result in improper function of the robot system. For details on the connections, refer to "*4.7 Connector Pin Assignment*".

N6-A1000**

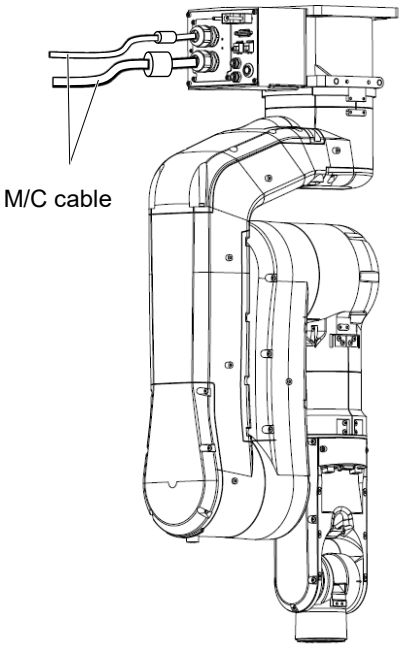


Cable direction: Standard (backward)

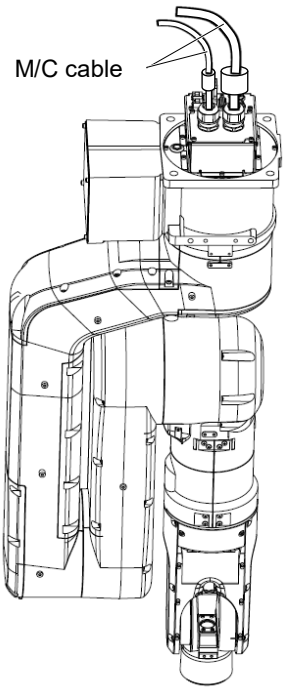


Cable direction: Downward

N6-A850**R



Cable direction: Standard (backward)



Cable direction: Upward

	Name				Qty	Code, Note
Optional Part Maintenance Part	M/C cable	Default	3 m	Straight	1	R12NZ900YF
				L-shaped	1	R12NZ900YM
			5 m	Straight	1	R12NZ900YH
				L-shaped	1	R12NZ900YN
			10m	Straight	1	R12NZ900YJ
				L-shaped	1	R12NZ900YP
			15m	Straight	1	R12NZ900YK
				L-shaped	1	R12NZ900YQ
			20m	Straight	1	R12NZ900YL
				L-shaped	1	R12NZ900YR
		Flexible	3m	Straight	1	R12NZ900YT
				L-shaped	1	R12NZ900YY
			5m	Straight	1	R12NZ900YU
				L-shaped	1	R12NZ900YZ
			10m	Straight	1	R12NZ900YV
				L-shaped	1	R12NZ900Z1
			15m	Straight	1	R12NZ900YW
				L-shaped	1	R12NZ900Z2
			20 m	Straight	1	R12NZ900YX
				L-shaped	1	R12NZ900Z3
Tool	Hexagonal wrench (width across flats: 3 mm)				1	For M4 hexagon socket head cap bolts

Removal

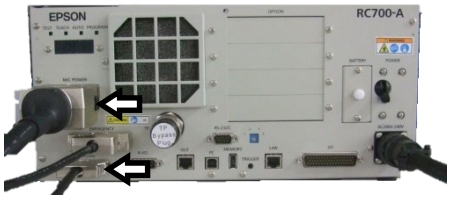
M/C cable

(1) Turn OFF the Controller.

(2) Disconnect the following connectors from the Controller.

Power cable connector

Signal cable connector



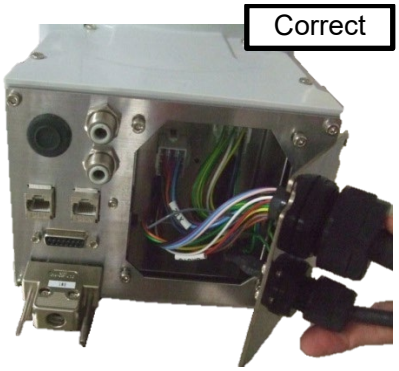
(3) Loosen the bolts fixing the plate.
You do not need to remove them completely.

Hexagon socket head cap bolts: 4-M4×8

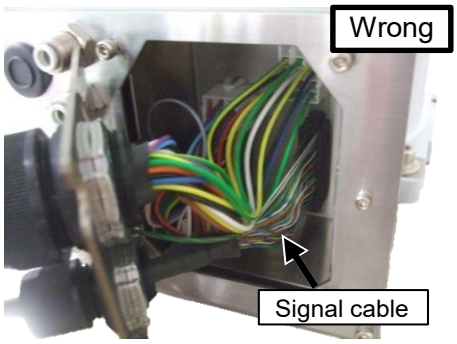
(4) Slide the plate upward to remove it.

NOTE Do not pull the M/C cable after removing the plate. M/C cables are connected by the connectors. Doing so may result in disconnection of the cables.

(5) As shown on the right, pull out the cables from the Manipulator.



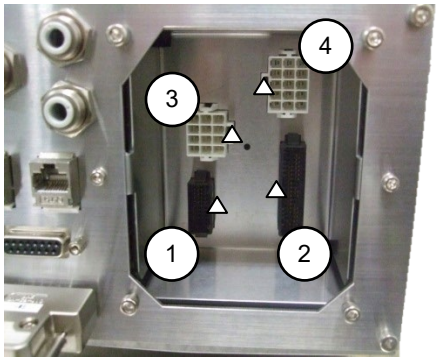
If you pull out the cables as shown on the right, force is applied to the signal cable and may result in the disconnection.



(6) Disconnect the connectors in the order as shown on the right.

NOTE

Clips of each connector are △ positions in the figure.
Push the clip to disconnect the connector.



NOTE

Connector (white) for the power cable is difficult to disconnect for safety purpose.

Do not pull the cables. Doing so may result in disconnection.

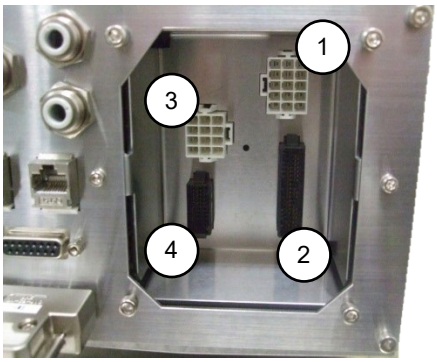
Do not remove the M/C cable from the plate.

Installation

M/C cable

(1) Set the M/C cable as shown on the right.

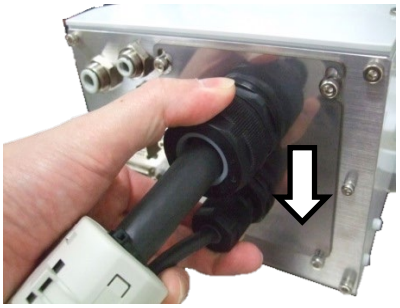
(2) Connect the connectors in the order as shown on the right.



(3) Slide the plate downward to install it.

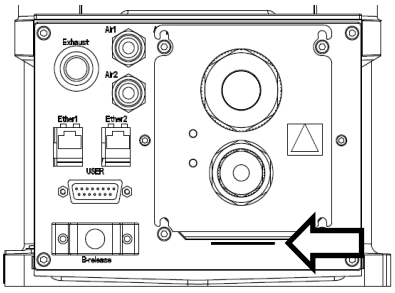
Hexagon socket head cap bolts: 4-M4×8

Tightening torque: 4.0 ± 0.2 N·m



NOTE

Slide the plate until the line on the base side plate will not be seen.



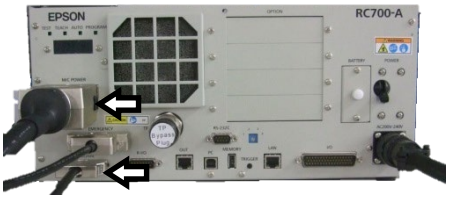
NOTE

Be careful not to tighten the screws with the cables get caught on the plate.

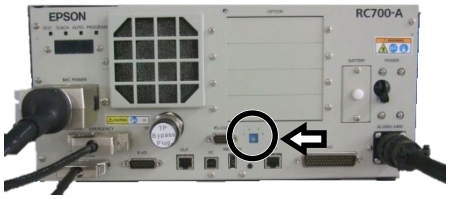
(4) Connect the connectors to the encoder board 2.

Power cable connector

Signal cable connector



(5) Change the encoder voltage adjustment switch depending on the length of the M/C cable.



Switch	M/C cable length
1	3m
2	5m
3	10m
4	15m, 20m

(6) Turn ON the Controller.

(7) Check operation to see if the Manipulator's position and posture are out of position.

Move the Manipulator to two or three points (poses) of the registered points.

(8) If the Manipulator is out of position, calibrate all the joints.

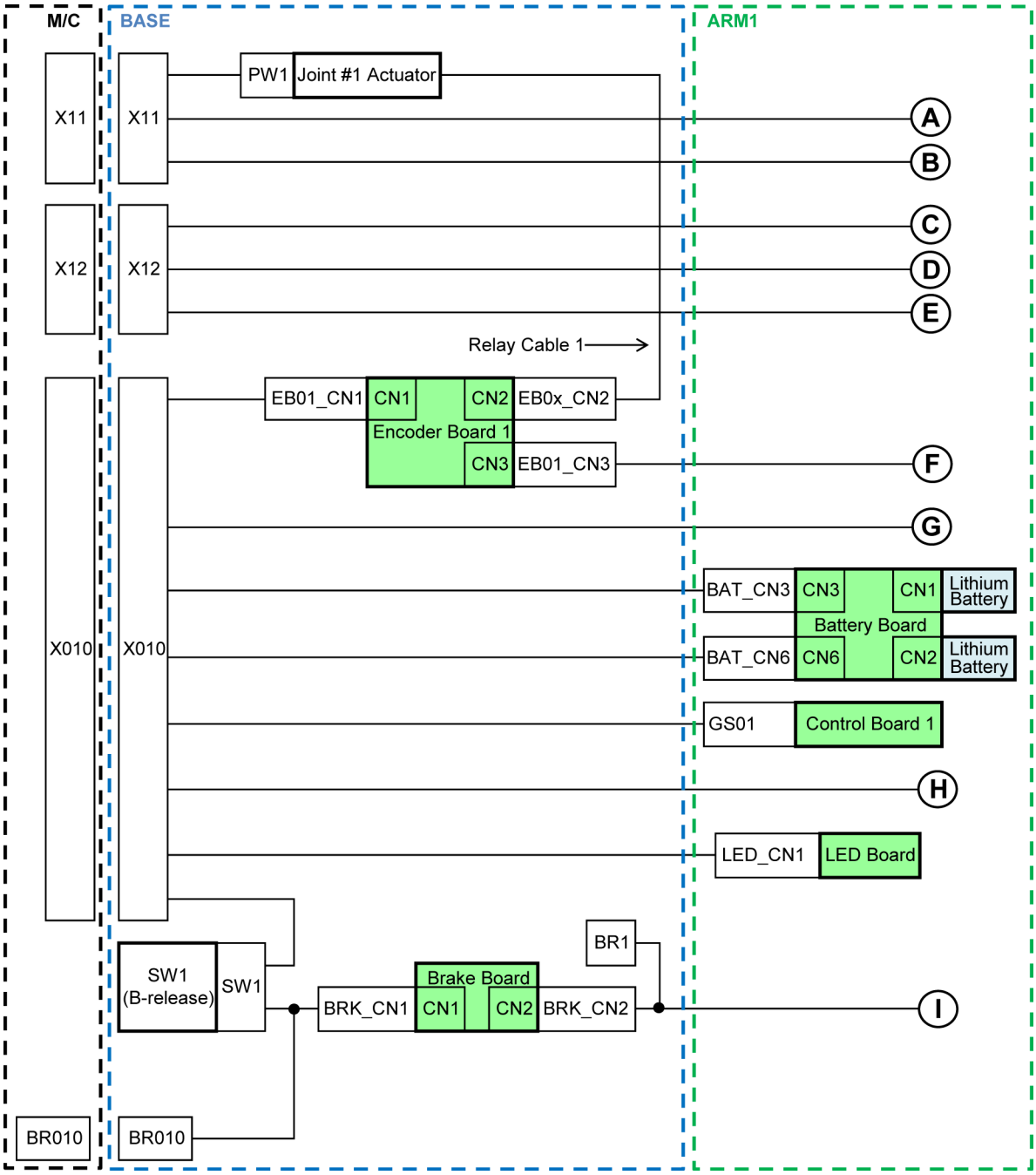
For details, refer to "*8. Calibration*".

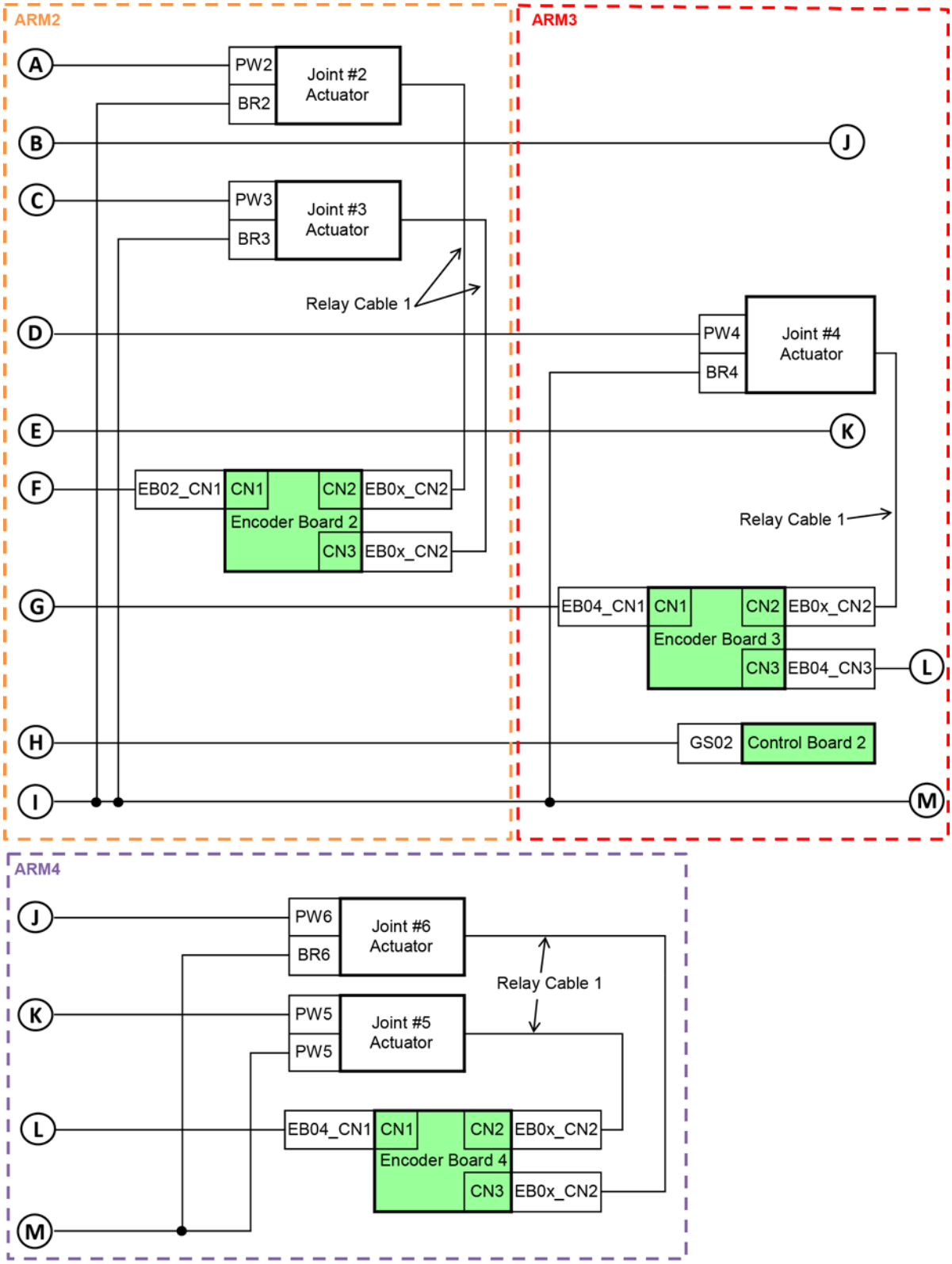
4.7 Connector Pin Assignment

The following table shows the codes and cable colors indicated in the pin assignments.

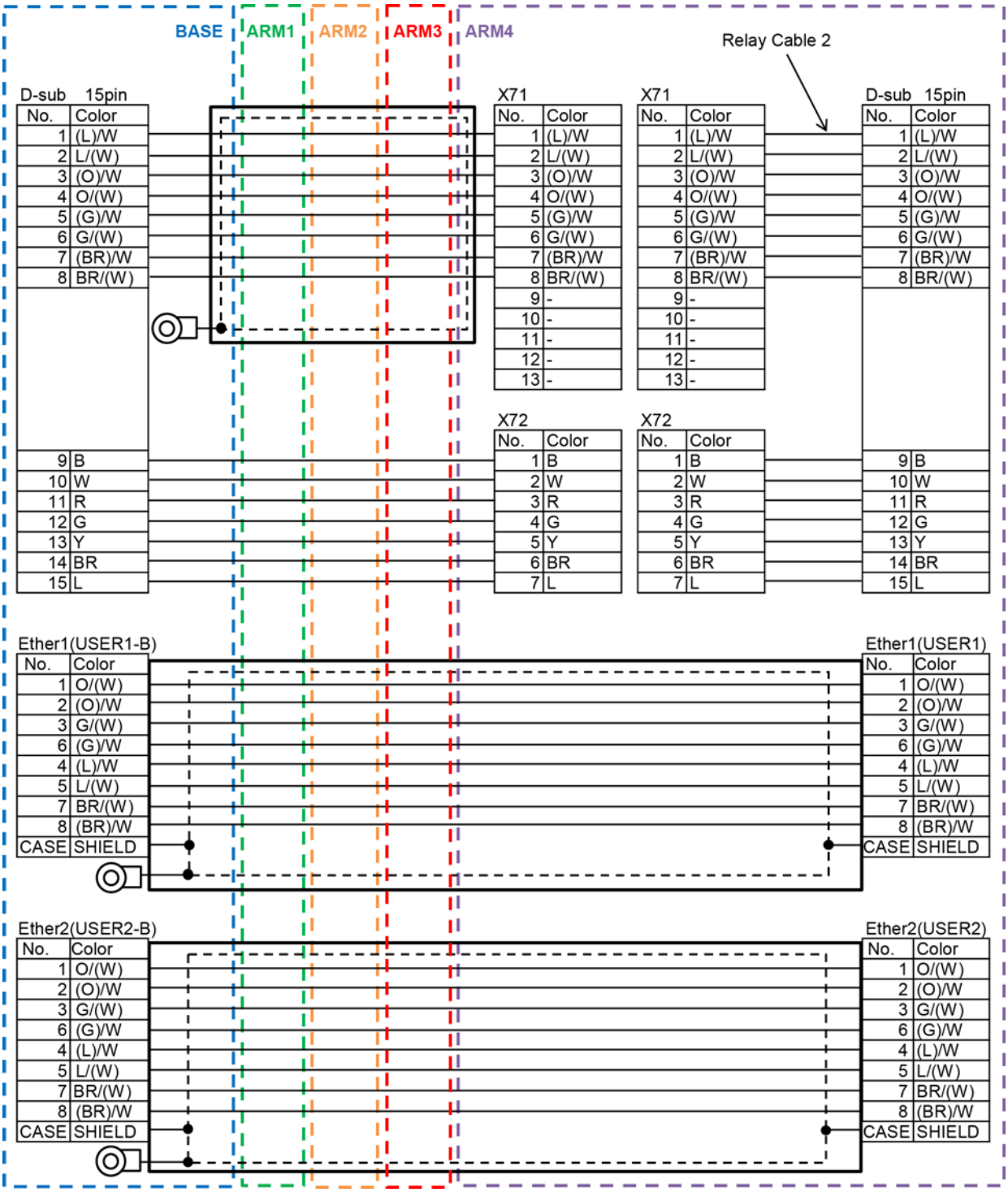
Code	Cable color
B	Black
W	White
R	Red
G	Green
Y	Yellow
BR	Brown
L	Blue
V	Violet
A	Azure
O	Orange
GL	Gray
P	Pink

4.7.1 Signal, Power cable




ARM2
ARM3
A
PW2
BR2
Joint #2 Actuator
B
J
C
PW3
BR3
Joint #3 Actuator
Relay Cable 1
D
PW4
BR4
Joint #4 Actuator
E
K
F
EB02_CN1
CN1
CN2
EB0x_CN2
Encoder Board 2
CN3
EB0x_CN2
Relay Cable 1
G
EB04_CN1
CN1
CN2
EB0x_CN2
Encoder Board 3
CN3
EB04_CN3
L
H
GS02
Control Board 2
I
M
ARM4
J
PW6
BR6
Joint #6 Actuator
Relay Cable 1
K
PW5
PW5
Joint #5 Actuator
L
EB04_CN1
CN1
CN2
EB0x_CN2
Encoder Board 4
CN3
EB0x_CN2
M

4.7.2 User Cable



5. Actuator Units

 WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

 CAUTION	■ Be careful not to apply excessive shock to the actuator units and motor shaft during replacement procedures. The shock may shorten the life of the actuator units and motor and/or damage them. ■ Never disassemble the parts (units). Disassembled the parts will cause a positional gap and cannot be used again.

After parts (units) have been replaced, the Manipulator cannot perform positioning properly because a gap exists between the origin stored in the parts and its corresponding origin stored in the Controller.
After replacing the parts, it is necessary to match these origins.
The process of aligning the two origins is called “Calibration”.
Refer to “*8. Calibration*” and follow the steps to perform calibration.

NOTE

The Joint #5 and #6 are not equipped with an actuator unit. Replace the following parts for each.

Motor unit, timing belt, electromagnetic brake, Joint #5 and # 6 units

 CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ When removing the Arm #1, there must be two or more people to work on it so that at least one of them can support the arm while the others are removing the bolts. Removing the bolts without supporting the arm may result in the arm falling, bodily injury, and/or malfunction of the robot system. ■ Handling heavy parts during maintenance operations. Be sure to have at least 2 people when operating heavy parts.

NOTE

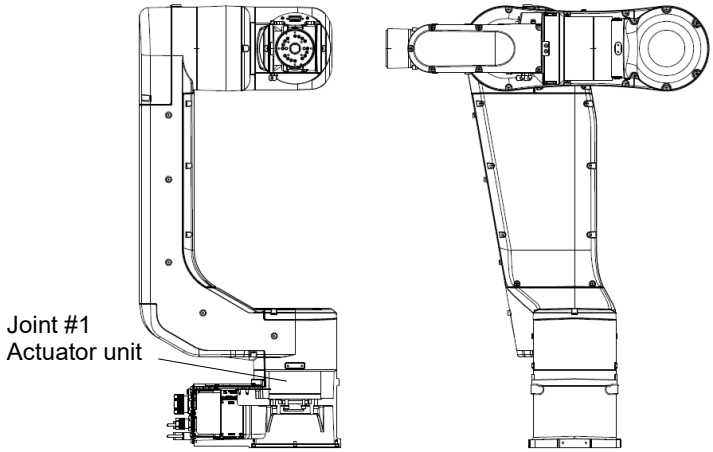
After replacing the Joint #1 actuator unit, teaching points will need to be re-taught.

5.1 Replacing the Joint #1 Actuator Unit

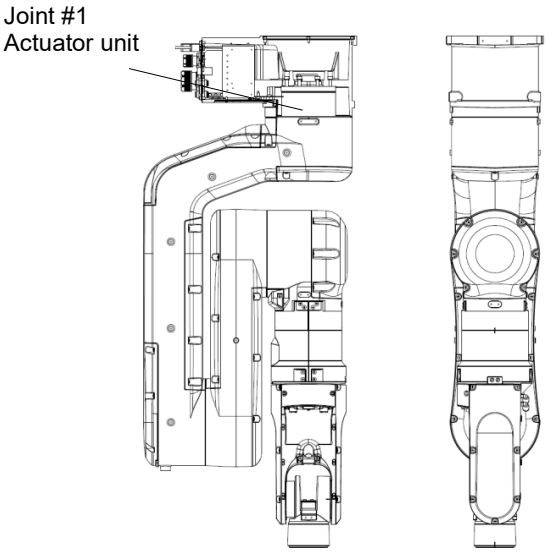
	Name		Qty	Note
Maintenance Parts	Joint #1 actuator unit		1	1749168
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose plier		1	For removing air tubes
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Nippers		1	For cutting a cable tie

The Joint #1 is not equipped with the brake. When performing maintenance, be careful not to exceed the motion range of the Joint #1.

N6-A1000**



N6-A850**R



5.1.1 Joint #1 (N6-A1000*): Cable direction: Standard (backward)

Removal

Joint #1
Actuator Unit

N6-A1000*

Cable direction:
Standard
(backward)

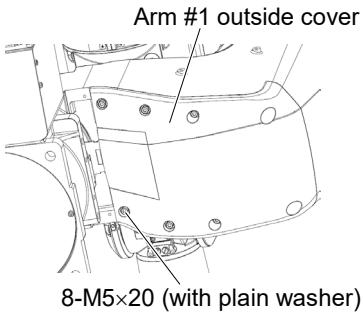
(1) Remove the covers.

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(2) Remove the Arm #1 outside cover.

Hexagon socket head cap bolts:
8-M5×20 (with plain washer)



(3) Remove the cable unit inside the Joint #1.

For details, refer to the Removal steps (7), (47) through (56), and (58) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(4) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

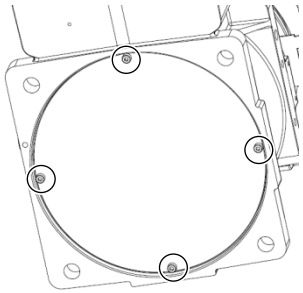
(5) Lay down the Manipulator.

NOTE

Be sure to have at least 2 people to lay down the Manipulator.

(6) Remove the base bottom plate.

Hexagon socket head cap bolts: 4-M4×8

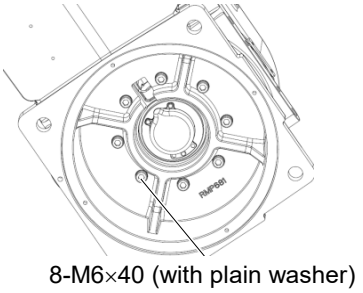


(7) Remove the base.

Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

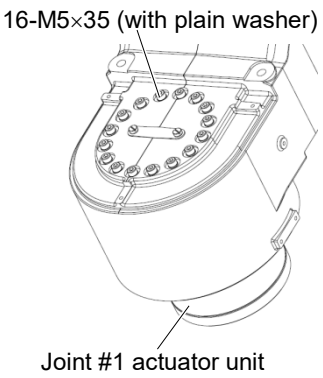
NOTE

When you remove it, be careful not to catch the cables on the Joint #1 actuator unit.



(8) Remove the Joint #1 actuator unit and the O-ring.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)



NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

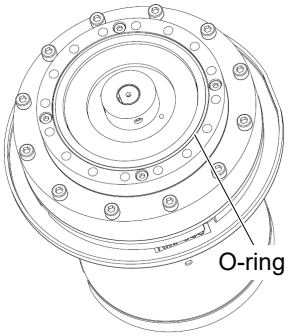
Installation

(1) Install the attached O-ring to the Joint #1 actuator unit.

NOTE

Apply a thin coat of grease to the O-ring.

Grease: SK-1A



Joint #1
Actuator Unit

N6-A1000*

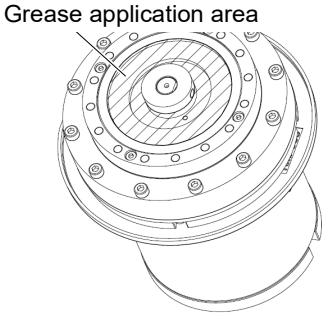
Cable direction:
Standard
(backward)

(2) Apply the grease to the Joint #1 actuator unit.

Grease: SK-1A 15g

NOTE

Be careful not to leak the grease from the shaded area shown in the right.



(3) Install the Joint #1 actuator unit to the Arm #1.

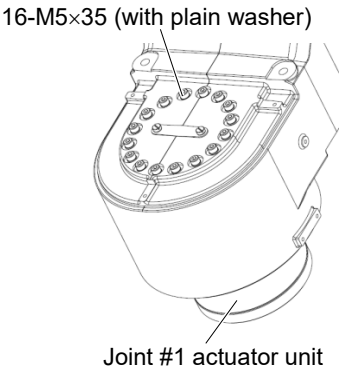
Hexagon socket head cap bolts:
16-M5×35 (with plain washer)
Tightening torque: 10 ± 0.5 N·m

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

Be sure to install the O-ring properly.



(4) Install the base.

Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

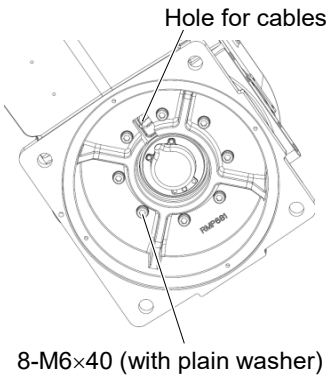
Tightening torque: 18 ± 0.9 N·m

NOTE

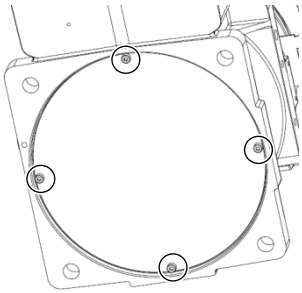
When installing it, make sure to align the directions of the hole of the base and the cable exit of Joint #1 actuator unit.

Pass the cables of the Joint #1 actuator unit through the hole of the base.

Be careful not to catch the cables.



(5) Install the base bottom plate.



Hexagon socket head cap bolts: 4-M4×8

Tightening torque: 4.0 ± 0.2 N·m

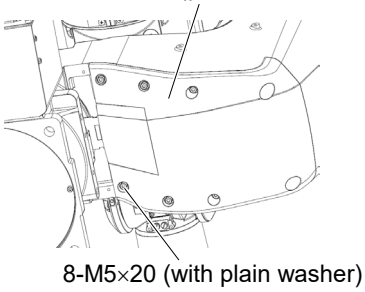
NOTE

Be careful not to catch the cables.

(6) Install the cable unit inside the Joint #1.

For details, refer to the Installation steps (4) through (8), (53) through (61), and (63) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(7) Install the Arm #1 outside cover.



Hexagon socket head cap bolts:
8-M5×20 (with plain washer)

Tightening torque: 8.0 ± 0.4 N·m

(8) Install the following covers:

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(9) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(10) Perform calibration for the Joint #1.

For details, refer to "*8. Calibration*".

5.1.2 Joint #1 (N6-A1000*B): Cable direction: Upward and Downward

Removal

Joint #1 Actuator Unit

N6-A1000*B

Cable direction: Upward and Downward

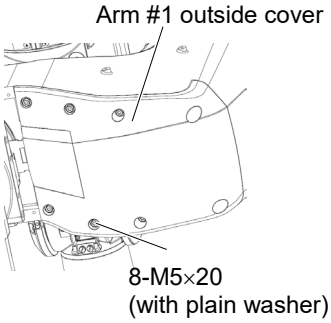
(1) Remove the covers.

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(2) Remove the Arm #1 outside cover.

Hexagon socket head cap bolts:
8-M5×20 (with plain washer)



(3) Remove the J1 cable fixing plate fixed on the Arm #1.

For details, refer to the Removal step (47) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(4) Remove the cable unit inside the base.

For details, refer to the Removal steps (2), (4) through (7), and (9) through (15) in "*4.2 Cable Unit (N6-A1000*B): Cable direction Upward and Downward*".

(5) Remove the cable unit inside the Joint #1.

For details, refer to the Removal steps (54) through (56), and (58) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(6) Disconnect the M/C cable.

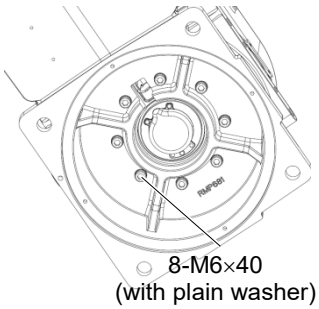
For details, refer to "*4.6. M/C Cable*".

(7) Remove the base.

Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

NOTE

When you remove it, be careful not to catch the cables on the Joint #1 actuator unit.



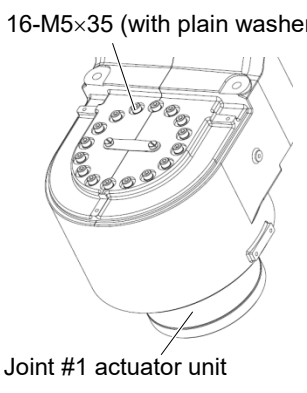
(8) Remove the Joint #1 actuator unit and the O-ring.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.



Installation

Joint #1
Actuator Unit

N6-A1000**

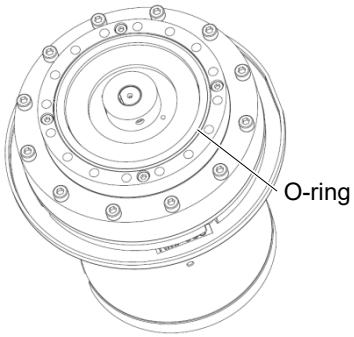
Cable direction:
Downward

(1) Install the attached O-ring on the Joint #1 actuator unit.

NOTE

Apply a thin coat of grease to the O-ring.

Grease: SK-1A

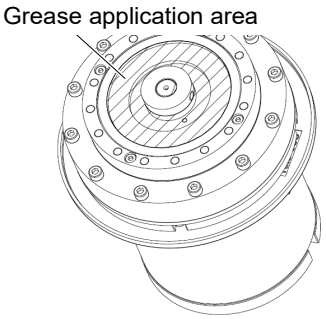


(2) Apply the grease to the Joint #1 actuator unit.

Grease: SK-1A 15g

NOTE

Be careful not to leak the grease from the shaded area shown in the right.



(3) Install the Joint #1 actuator unit to the Arm #1.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)

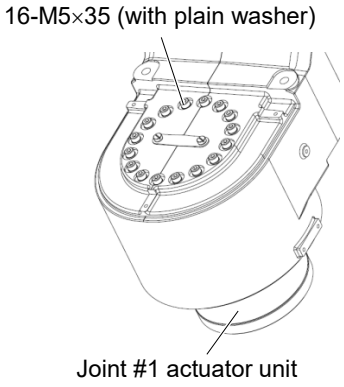
Tightening torque: 10 ± 0.5 N·m

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

Be sure to install the O-ring properly.



(4) Install the base.

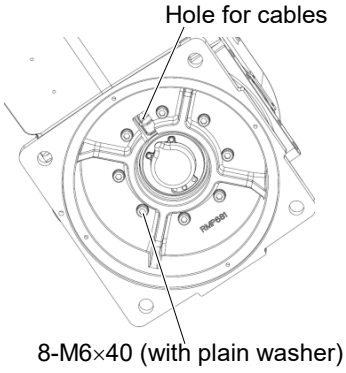
Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

Tightening torque: 18 ± 0.9 N·m

NOTE

Refer to the picture for installing direction. When installing it, pass the cables of the Joint #1 actuator unit through the hole of the base.

Be careful not to get the cables caught in the base.



(5) Install the cable unit.

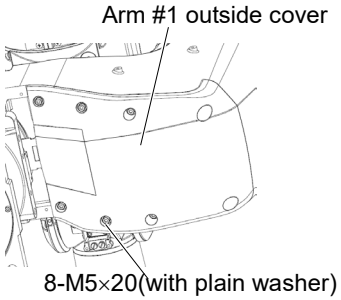
For details, refer to the Installation steps (4) through (8) in "*4.1 Cable Unit (N6-A1000*) Cable direction Standard (backward)*".

(6) Install the cable unit inside the base.

For details, refer to the Installation steps (2) through (11), (13) through (18) in "*4.2 Cable Unit (N6-A1000*B): Cable direction Upward and Downward*".

(7) Install the Arm #1 outside cover.

Hexagon socket head cap bolts:
8-M5×20 (with plain washer)
Tightening torque: 8 ± 0.4 N·m



(8) Install the following covers:

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(9) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(10) Perform calibration for the Joint #1.

For details, refer to "*8. Calibration*".

5.1.3 Joint #1 (N6-A850*R): Cable direction: Standard (backward)

Removal

Joint #1 Actuator Unit

N6-A850*R

Cable direction: Standard (backward)

(1) Remove the covers.

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(2) Remove the cable unit inside the Joint #1.

For details, refer to the Removal steps (7), (49) through (58), and (60) in "*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(3) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

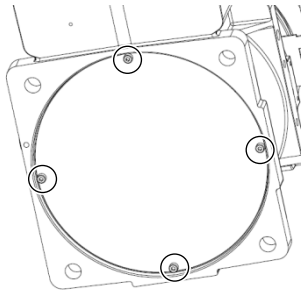
(4) Lay down the Manipulator.

NOTE

Be sure to have at least 2 people to lay down the Manipulator.

(5) Remove the base bottom plate.

Hexagon socket head cap bolts: 4-M4×8

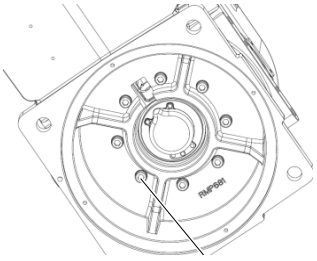


(6) Remove the base.

Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

NOTE

When you remove it, be careful not to catch the cables on the Joint #1 actuator unit.



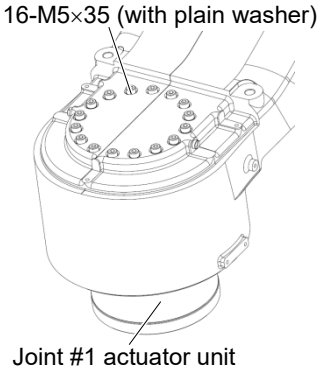
(7) Remove the Joint #1 actuator unit and the O-ring.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.



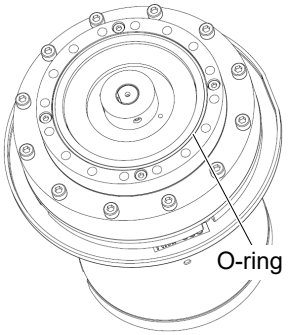
Installation

(1) Install the attached O-ring to the Joint #1 actuator unit.

NOTE

Apply a thin coat of grease to the O-ring.

Grease: SK-1A



Joint #1
Actuator Unit

N6-A850*R

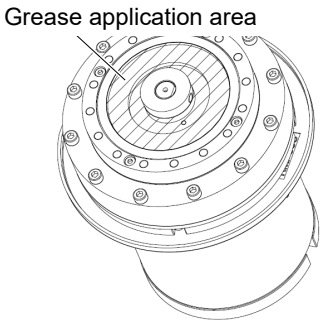
(Cable direction: Standard (backward)

(2) Apply the grease to the Joint #1 actuator unit.

Grease: SK-1A 15g

NOTE

Be careful not to leak the grease from the shaded area shown in the right.



(3) Install the Joint #1 actuator unit to the Arm #1.

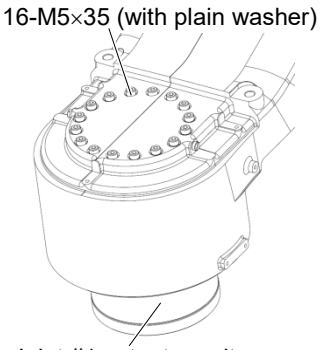
Hexagon socket head cap bolts:
16-M5×35 (with plain washer)
Tightening torque: 10 ± 0.5 N·m

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

Be sure to install the O-ring properly.



(4) Install the base.

Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

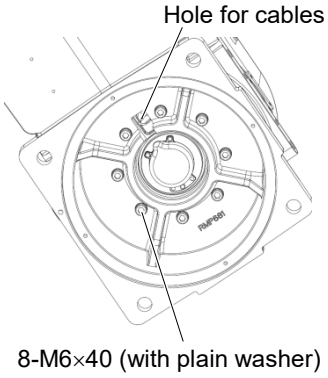
Tightening torque: 18 ± 0.9 N·m

NOTE

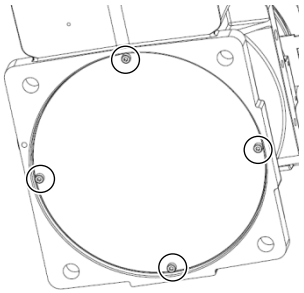
When installing it, make sure to align the directions of the hole of the base and the cable exit of Joint #1 actuator unit.

Pass the cables of the Joint #1 actuator unit through the hole of the base.

Be careful not to catch the cables.



(5) Install the base bottom plate.



Hexagon socket head cap bolts: 4-M4×8

Tightening torque: 4.0 ± 0.2 N·m

NOTE

Be careful not to catch the cables.

(6) Install the cable unit inside the Joint #1.

For details, refer to the Removal steps (4) through (8), (56) through (64), and (66) in "*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(7) Install the following covers:

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(8) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(9) Perform calibration for the Joint #1.

For details, refer to "*8. Calibration*".

5.1.4 Joint #1 (N6-A850*BR): Cable direction: Upward

Removal

Joint #1 Actuator Unit

N6-A850*BR

Cable direction: Upward

(1) Remove the covers.

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(2) Remove the J1 cable fixing plate fixed on the Arm #1.

For details, refer to the Removal step (49) in "*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(3) Remove the cable unit inside the base.

For details, refer to the Removal steps (2), (4) through (7), and (9) through (15) in "*4.4 Cable Unit (N6-A850*BR): Cable direction Upward*".

(4) Remove the cable unit inside the Joint #1.

For details, refer to the Removal steps (56) through (58), and (60) in "*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(5) Disconnect the M/C cable.

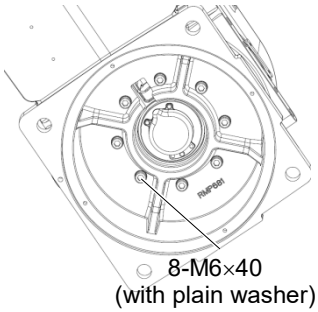
For details, refer to "*4.6. M/C Cable*".

(6) Remove the base.

Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

NOTE

When you remove it, be careful not to catch the cables on the Joint #1 actuator unit.



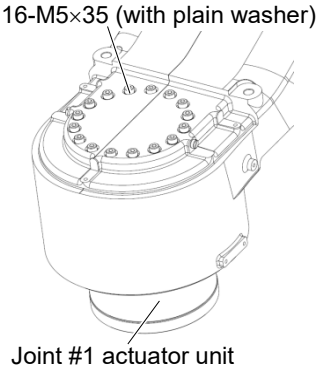
(7) Remove the Joint #1 actuator unit and the O-ring.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)

NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.



Installation

Joint #1 Actuator Unit

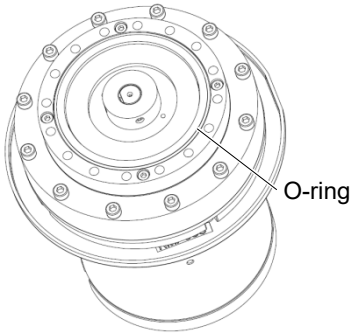
N6-A850*BR

Cable direction: Upward

(1) Install the attached O-ring on the Joint #1 actuator unit.

NOTE Apply a thin coat of grease to the O-ring.

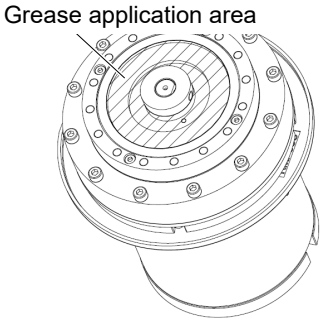
Grease: SK-1A



(2) Apply the grease to the Joint #1 actuator unit.

Grease: SK-1A 15g

NOTE Be careful not to leak the grease from the shaded area shown in the right.



(3) Install the Joint #1 actuator unit to the Arm #1.

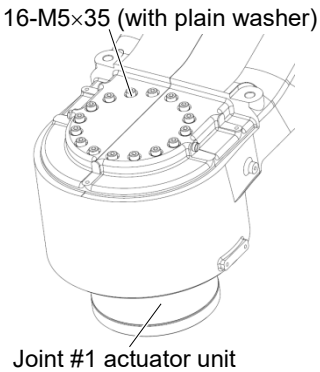
Hexagon socket head cap bolts:
16-M5×35 (with plain washer)

Tightening torque: 10 ± 0.5 N·m

NOTE Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

Be sure to install the O-ring properly.



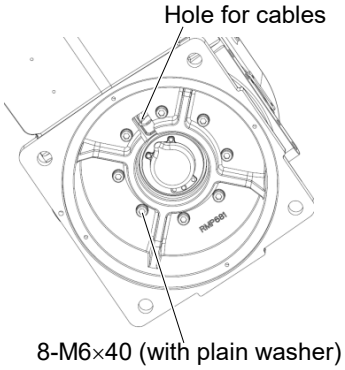
(4) Install the base.

Hexagon socket head cap bolts:
8-M6×40 (with plain washer)

Tightening torque: 18 ± 0.9 N·m

NOTE Refer to the picture for installing direction. When installing it, pass the cables of the Joint #1 actuator unit through the hole of the base.

Be careful not to get the cables caught in the base.



(5) Install the cable unit.

For details, refer to the Removal steps (4) through (8) in "*4.3 Cable Unit (N6-A850*R) Cable direction Standard (backward)*".

(6) Install the cable unit inside the base.

For details, refer to the Removal steps (2) through (11), (13) through (18) in "*4.4 Cable Unit (N6-A850*BR): Cable direction Upward*".

(7) Install the following covers:

Base cover, Joint #1 cover, and Joint #1 inside cover

For details, refer to "*3. Covers*".

(8) Disconnect the M/C cable.

For details, refer to "*4.6. M/C Cable*".

(9) Perform calibration for the Joint #1.

For details, refer to "*8. Calibration*".

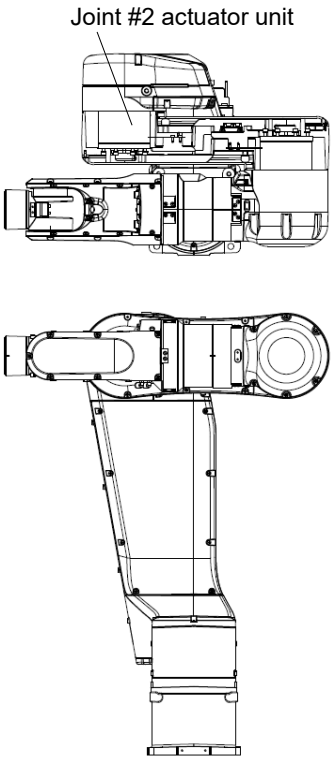
5.2 Replacing the Joint #2 Actuator Unit

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ Handling heavy parts during maintenance operations. Be sure to have at least 2 people when operating heavy parts.

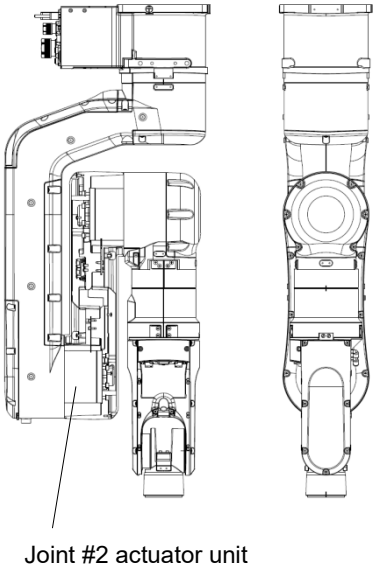
	Name		Qty	Code, Note
Maintenance Parts	Joint #2 actuator unit		1	1749169
	Cable tie	AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 4 mm	1	For M5 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Box wrench	width across flats: 5 mm	1	For D-Sub connector
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

N6-A1000**



N6-A850**R



5.2.1 Joint #2 (N6-A1000**)

Removal

Joint #2
Actuator Unit

N6-A1000**

(1) Remove the covers.

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side cover (2 covers), Arm #3 cover, Arm 3 inside cover,
Arm #2 cover (2 covers), Joint #2 cover, Joint #2 outside cover

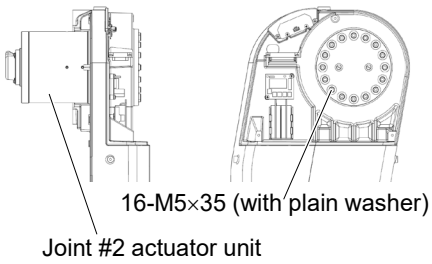
For details, refer to "*3. Covers*".

(2) Remove the cable unit from Joint #1 to Joint #2.

For details, refer to the Removal steps (2) through (5), (9) through (37), and (42) in "*4.1 Cable Unit (N6-A1000*) : Cable direction Standard (backward)*".

(3) Remove the Joint #2 actuator unit and the O-ring.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)



NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

Installation

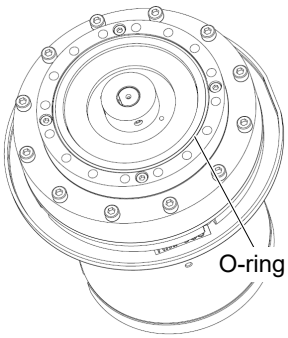
Joint #2
Actuator Unit

N6-A1000**

(1) Install the attached O-ring on the Joint #2 actuator unit.

NOTE Apply a thin coat of grease to the O-ring.

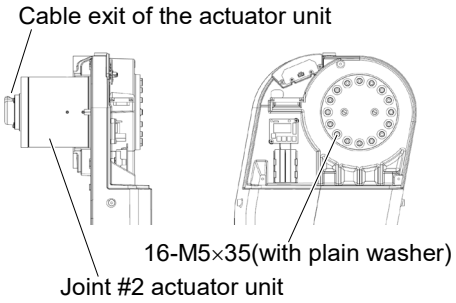
Grease: SK-1A



(2) Install the Joint #2 actuator unit to the Arm #1.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)

Tightening torque: 10 ± 0.5 N·m



NOTE Refer to the figure and install it so that the cable exit of the actuator unit will be the opposite side of the base.

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

Be sure to install the O-ring properly.

(3) Install the robot arm and the cable unit.

For details, refer to the Removal steps (14) through (52) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(4) Install the following covers:

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side cover (2 covers), Arm #3 cover, Arm #3 inside cover
Arm #2 cover (2 covers), Joint #2 cover, Joint #2 outside cover

For details, refer to "*3. Covers*".

(5) Perform calibration.

For details, refer to "*8. Calibration*".

5.2.2 Joint #2 (N6-A850**R)

Removal

Joint #2 Actuator Unit

N6-A850**R

(1) Remove the covers.

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side cover (2 covers), Arm #3 cover, Arm 3 inside cover,
Arm #2 cover (2 covers), Joint #2 outside cover, Arm #1 inside cover

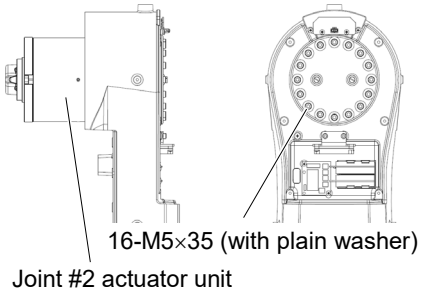
For details, refer to "*3. Covers*".

(2) Remove the cable unit from Joint #1 to Joint #2.

For details, refer to the Removal steps (3) through (6), (9) through (37), and (44) in "*4.3 Cable Unit (N6-A850*R) : Cable direction Standard (backward)*".

(3) Remove the Joint #2 actuator unit and the O-ring.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)



NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

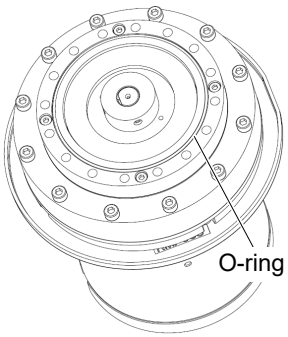
Installation

Joint #2
Actuator Unit
N6-A850**R

(1) Install the attached O-ring on the Joint #2 actuator unit.

Apply a thin coat of grease to the O-ring.

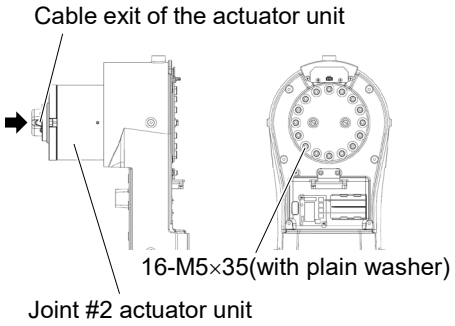
Grease: SK-1A



(2) Install the Joint #2 actuator unit to the Arm #1.

Hexagon socket head cap bolts:
16-M5×35 (with plain washer)

Tightening torque: 10 ± 0.5 N·m



NOTE

Refer to the figure and install it so that the cable exit of the actuator unit will be the right side when viewed from the arrow.

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

Be sure to install the O-ring properly.

(3) Install the robot arm and the cable unit.

For details, refer to the Removal steps (17) through (55) in "*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(4) Install the following covers:

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side cover (2 covers), Arm #3 cover, Arm #3 inside cover
Arm #2 cover (2 covers), Joint #2 outside cover, Arm #1 inside cover

For details, refer to "*3. Covers*".

(5) Perform calibration.

For details, refer to "*8. Calibration*".

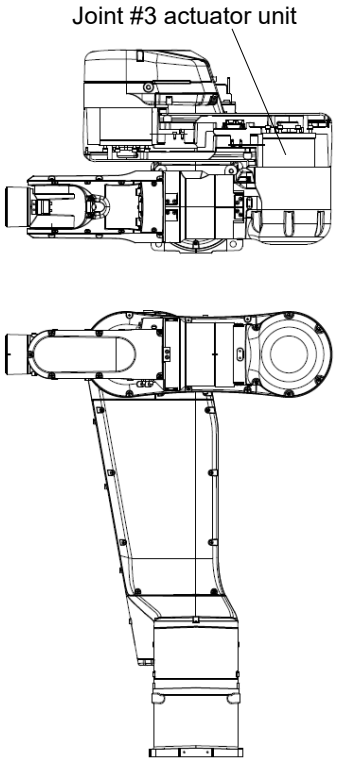
5.3 Replacing the Joint #3 Actuator Unit

⚠ CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ Handling heavy parts during maintenance operations. Be sure to have at least 2 people when operating heavy parts.

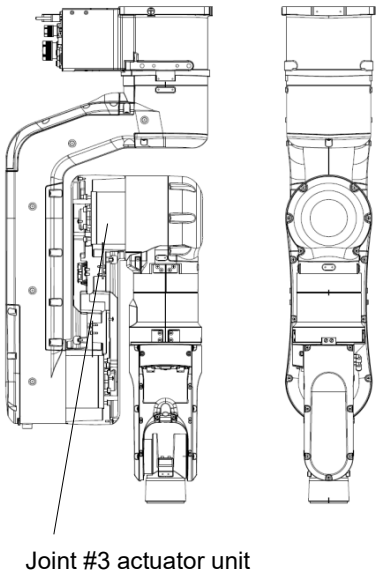
	Name		Qty	Code, Note
Maintenance Parts	Joint #3 actuator unit		1	1749170
	Cable tie	AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
		width across flats: 5 mm	1	For M6 hexagon socket head cap bolts
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

N6-A1000**



N6-A850**R



5.3.1 Joint #3 (N6-A1000**)

Removal

Joint #3 Actuator Unit

N6-A1000**

(1) Remove the covers.

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side cover (2 covers), Arm #3 cover, Arm #3 inside cover
Arm #2 cover (2 covers)

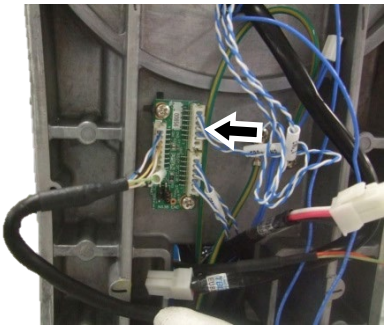
For details, refer to "*3. Covers*".

(2) Remove the cable unit from Joint #1 to Joint #3.

For details, refer to the Removal steps (2) through (5), (9) through (25), (27), (29), and (33) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(3) Disconnect the connector connected to the encoder board 2.

Connector:
EB0x_CN2 (Joint #3 side)

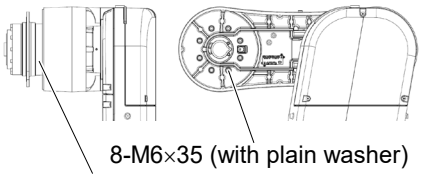


NOTE

Be careful that the jumper pins on the board do not come off.

(4) Remove the Joint #3 actuator unit and the O-ring.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)



NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

When you remove it, be careful not to catch the cables on the Joint #3 actuator unit.

Installation

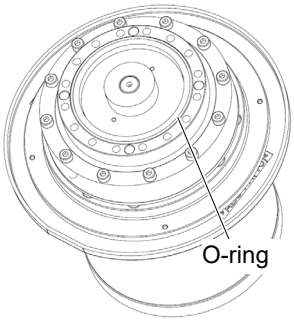
Joint #3 Actuator Unit

N6-A1000**

(1) Install the attached O-ring on the Joint #3 actuator unit.

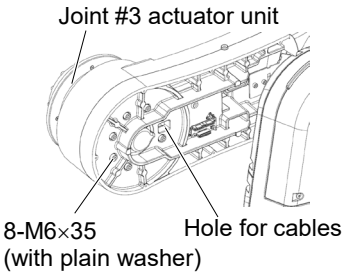
NOTE Apply a thin coat of grease to the O-ring.

Grease: SK-1A



(2) Install the Joint #3 actuator unit to the Arm #2.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)
Tightening torque: 18 ± 0.9 N·m



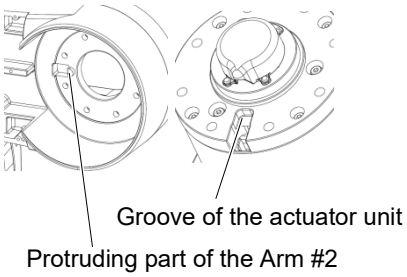
NOTE When installing it, make sure to align the protruding part on the Arm #2 and the groove on the Joint #3 actuator unit.

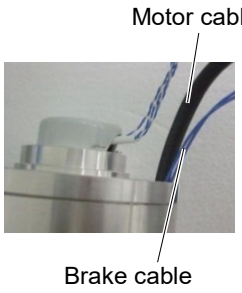
Pass the brake cable and the motor cable of the Joint #3 actuator unit through the hole of the Arm #2.

Be careful not to get the cables caught in the Arm and the actuator unit.

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.





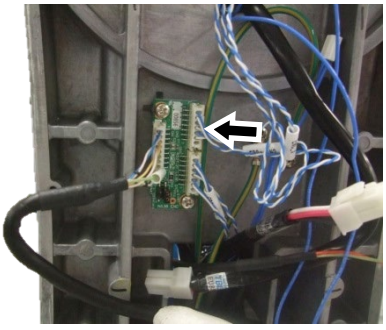
(3) Install the robot arm and the cable unit.

For details, refer to the Removal steps (25), (26), (29) through (52) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(4) Connect the connector to the encoder board 2.

Connector:
EB0x_CN2 (Joint #3 side)

NOTE Be careful that the jumper pins on the board do not come off.



(5) Install the following covers:

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side covers (2 covers), Arm #3 cover, Arm #3 inside cover

Arm #2 cover (2 cover)

For details, refer to "*3. Covers*".

(6) Perform calibration.

For details, refer to "*8. Calibration*".

5.3.2 Joint #3 (N6-A850**R)

Removal

Joint #3 Actuator Unit

N6-A850**R

(1) Remove the covers.

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side cover (2 covers), Arm #3 cover, Arm #3 inside cover
Arm #2 cover (2 covers), Arm #1 inside cover

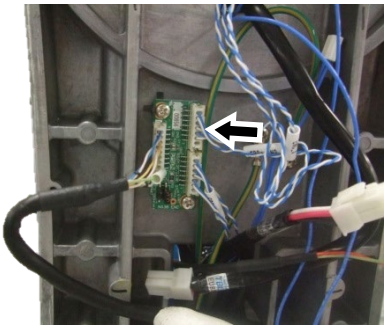
For details, refer to "*3. Covers*".

(2) Remove the cable unit from Joint #1 to Joint #3.

For details, refer to the Removal steps (3) through (6), (9) through (25), (27), (29), (33) in "*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(3) Disconnect the connector connected to the encoder board 2.

Connector:
EB0x_CN2 (Joint #3 side)

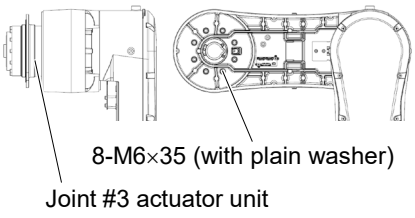


NOTE

Be careful that the jumper pins on the board do not come off.

(4) Remove the Joint #3 actuator unit and the O-ring.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)



NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

When you remove it, be careful not to catch the cables on the Joint #3 actuator unit.

Installation

Joint #3 Actuator Unit

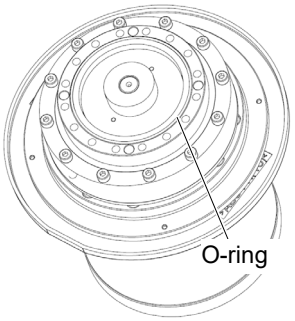
N6-A850**R

(1) Install the attached O-ring on the Joint #3 actuator unit.

NOTE

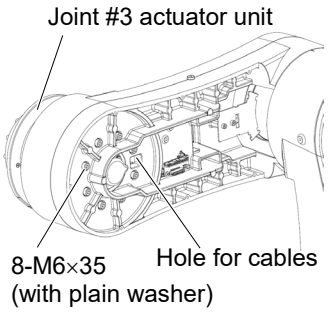
Apply a thin coat of grease to the O-ring.

Grease: SK-1A



(2) Install the Joint #3 actuator unit to the Arm #2.

Hexagon socket head cap bolts:
8-M6×35 (with plain washer)
Tightening torque: 18 ± 0.9 N·m



NOTE

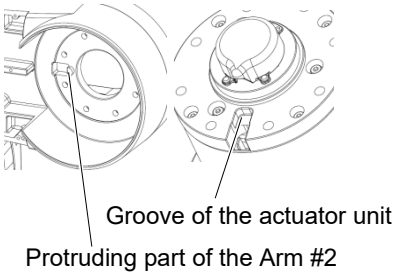
When installing it, make sure to align the protruding part on the Arm #2 and the groove on the Joint #3 actuator unit.

Pass the brake cable and the motor cable of the Joint #3 actuator unit through the hole of the Arm #2.

Be careful not to get the cables caught in the Arm and the actuator unit.

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Do not apply excessive shock to the parts.

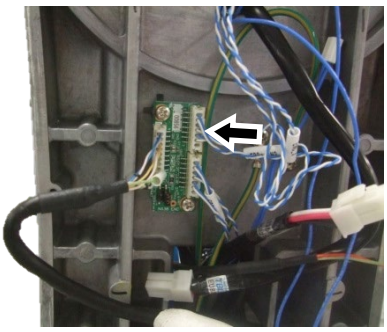


(3) Install the robot arm and the cable unit.

For details, refer to the Removal steps (28), (29), (32) through (55) in "*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward)*".

(4) Connect the connector to the encoder board 2.

Connector:
EB0x_CN2 (Joint #3 side)



NOTE

Be careful that the jumper pins on the board do not come off.

(5) Install the following covers:

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint #4 side covers (2 covers), Arm #3 cover, Arm #3 inside cover
Arm #2 cover (2 cover), Arm #1 inside cover

For details, refer to "*3. Covers*".

(6) Perform calibration.

For details, refer to "*8. Calibration*".

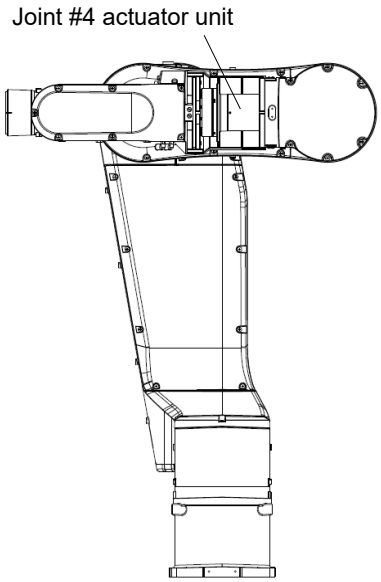
5.4 Replacing the Joint #4 Actuator Unit

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance. ■ Handling heavy parts during maintenance operations. Be sure to have at least 2 people when operating heavy parts.

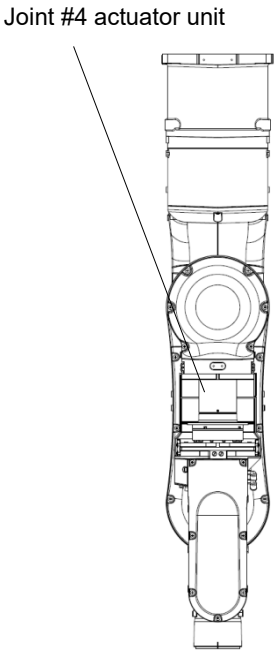
	Name		Qty	Code, Note
Maintenance Parts	Joint #4 actuator unit		1	1749171
	O-ring		1	1554675
	Cable tie	AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Cable tie gun		1	Refer: HellermannTyton MK8
	Cable tie gun tester		1	Refer: HellermannTyton DGT500-MK8

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

N6-A1000**



N6-A850**R



Removal

Joint #4 Actuator Unit

(1) Turn ON the Controller.

(2) Release the brake on the Joint #3.

EPSON RC+

Command

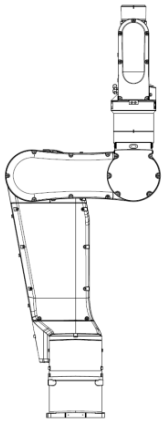
```
> Brake Off,3
```

NOTE

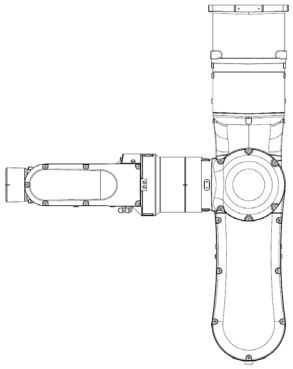
When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the angle of the Arm #3 about 90 degrees from the origin position.

N6-A1000**



N6-A850**R



(4) Turn OFF the Controller.

(5) Remove the covers.

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover
Joint 4 side cover (2 covers), Arm #3 cover

For details, refer to "*3. Covers*".

(6) Remove the cable unit from Joint #1 to Joint #4.

For more details, refer to the following sections:

N6-A1000**

Removal steps (9) through (16), (18)
4.1 Cable Unit (N6-A1000): Cable direction Standard (backward).*

N6-A850**R

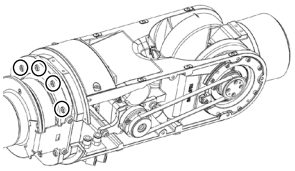
Removal steps (9) through (16), (18)
*4.3 Cable Unit (N6-A850*R): Cable direction Standard (backward).*

(7) Disconnect the connectors.

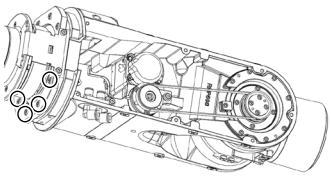
Connectors: PW4, BR4, EB0x_CN2

(8) Remove the Arm #4.

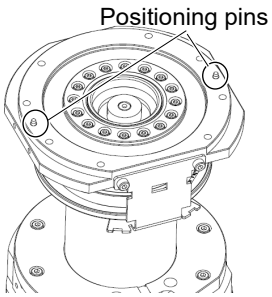
Hexagon socket head cap bolts:
8-M4×20 (with plain washer)



NOTE Be sure to have at least 2 people to perform the operation since the parts being heavy.



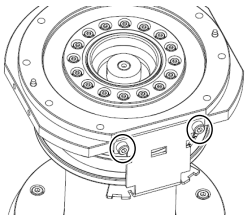
NOTE When removing it, make sure not to lose the two positioning pins.



(9) Remove the cable fixing plate.

Hexagon socket head cap bolts 2-M4×8

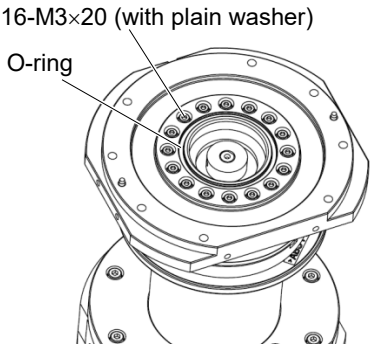
NOTE Do not disconnect the cable from the plate.



(10) Remove the Joint #4 flange.

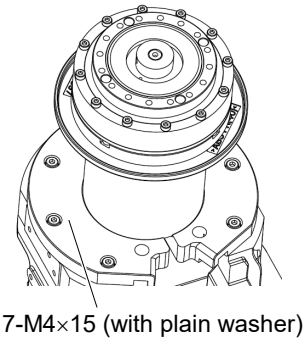
Hexagon socket head cap bolts:
16-M3×20 (with plain washer)

NOTE Remove the O-ring as well.



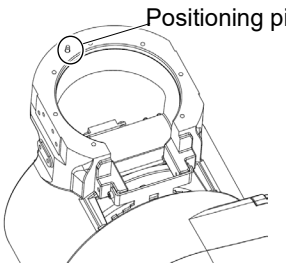
(11) Remove the Joint #4 actuator unit.

Hexagon socket head cap bolts:
7-M4×15 (with plain washer)



NOTE When removing it, make sure not to lose the positioning pin.

Also, be careful not to catch the cables on the Joint #4 actuator unit.



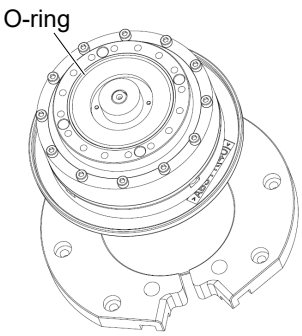
Installation

Joint #4
Actuator Unit

(1) Install the attached O-ring to Joint #4 actuator unit.

NOTE

Apply a thin coat of grease to the O-ring.
Grease: SK-1A



(2) Confirm that the positioning pin is installed on the Arm #3. Install the Joint #4 actuator unit.

Hexagon socket head cap bolts:
7-M4×15 (with plain washer)

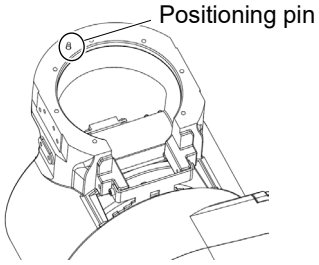
Tightening torque: 5.5 ± 0.25 N·m

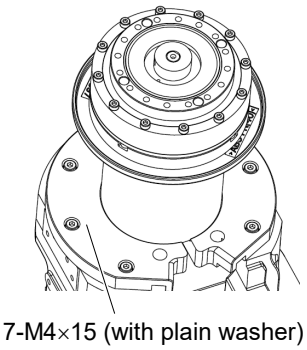
NOTE

When installing it, make sure to align the pin with the Joint #4 of the actuator unit.

Be careful not to get the cables caught in the actuator unit.

Pass the cables of the Joint #4 actuator unit to be out from the Arm #3 board side.





(3) Connect the connectors.
Connector: PW4, BR4, EB0x_CN2

(4) Install the Joint #4 flange.

Hexagon socket head cap bolts:
16-M3×20 (with plain washer)
Tightening torque: 2.4 ± 0.1 N·m

NOTE

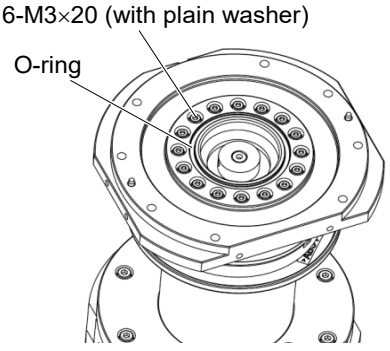
Be sure to install the O-ring properly.

NOTE

After installing the Joint #4 flange, install the O-ring on the Joint #4 flange.

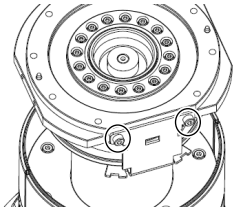
O-ring Inner diameter ø 47.5 mm
Wire diameter ø 2.0 mm

Apply a thin coat of grease to the O-ring.
Grease: SK-1A



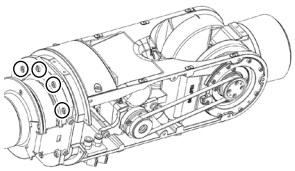
(5) Install the cable fixing plates.

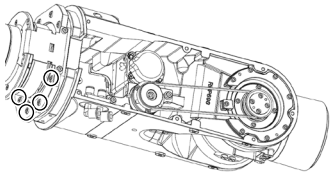
Hexagon socket head cap bolts:
2-M4×8 (with plain washer)
Tightening torque: 4.0 ± 0.2 N·m



(6) Install the Arm #4.

Hexagon socket head cap bolts:
8-M4×20 (with plain washer)
Tightening torque: 5.5 ± 0.25 N·m





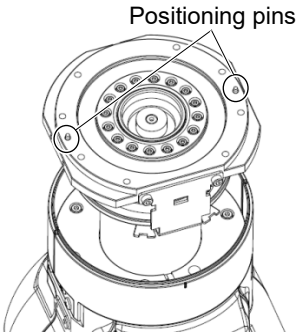
NOTE

Be sure to have at least 2 people to perform the operation since the parts being heavy.

Confirm that the two pins are installed on the Joint #4 flange. Then install the Arm #4 to align the pins with the Joint #5 and #6 units.

Be sure to install the O-ring properly.

Be careful not to get the cables caught in the Arm.



(7) Install the cable unit.

For more details, refer to the following sections:

N6-A1000**	N6-A850**R
Installation steps (40) through (42), (44) through (52) *4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*.	Installation steps (43) through (45), (47) through (55) *4.1 Cable Unit (N6-A850*R): Cable direction Standard (backward)*.

(8) Install the following covers:

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint 4 outside cover
Joint #4 side cover (2 covers), Arm #3 cover

For details, refer to "*3. Covers*".

(9) Perform calibration.

For details, refer to "*8. Calibration*".

5.5 Joint #5

CAUTION

■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance.

NOTE

The Joint #5 is not equipped with an actuator unit. Replace the following parts for each Motor unit, timing belt, electromagnetic brake

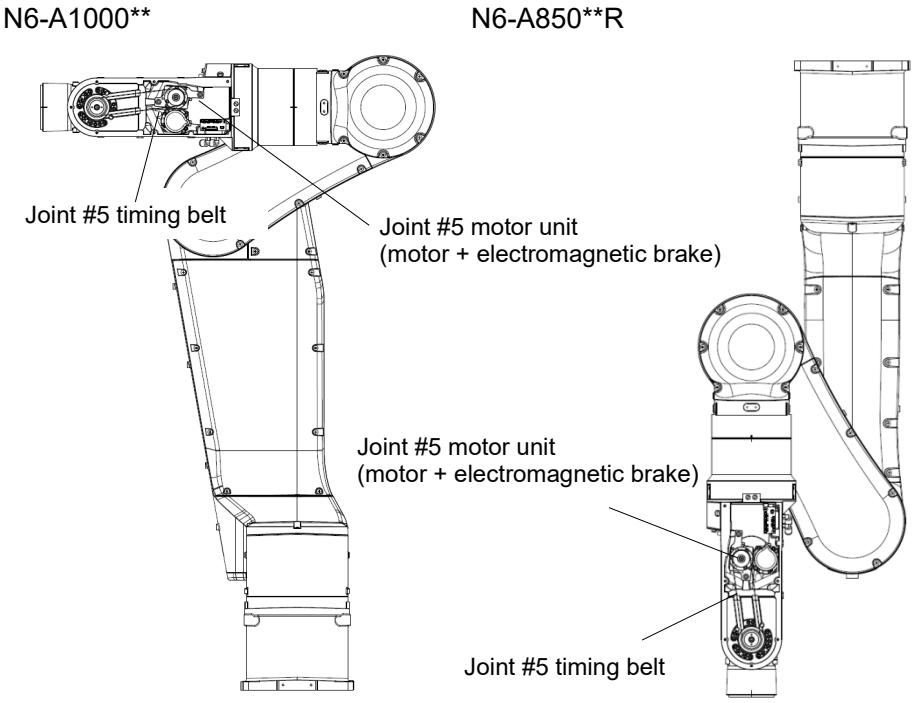
5.5.1 Replacing the Joint #5 Motor Unit

	Name		Qty	Code, Note
Maintenance Parts	Joint #5 motor unit *		1	1749172
	Belt tensile jig **		1	1749184
	Cable tie	AB200	-	1684328 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2 mm	1	For M4 hexagon socket set screws
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Feeler gauge (0.5 mm)		2	For positioning of drive boss
	Belt tension meter		1	Refer: Unitta U-505

* Joint #5 motor unit (1749172) is a dedicated motor unit. Do not use it for the Joint #6 motor unit.

** The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.



Removal

Joint #5 Motor Unit

(1) Turn ON the Controller.

(2) Release the brake on the Joint #2 and Joint #3.

EPSON RC+

Command

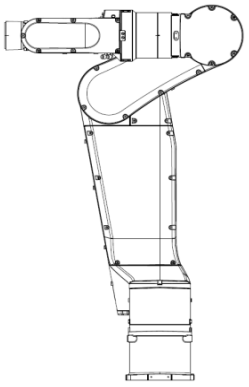
```
> brake off, 2
> brake off, 3
```

NOTE

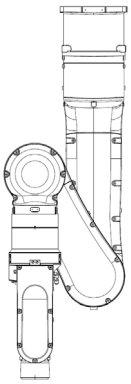
When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the angles of the Arm #2 and the Arm #3 about 30 degrees from the origin positions.

N6-A1000**



N6-A850**R



(4) Turn OFF the Controller.

(5) Remove the Arm #4 side cover (2 covers).

For details, refer to "*3. Covers*".

(6) Cut off the cable tie of the cables.

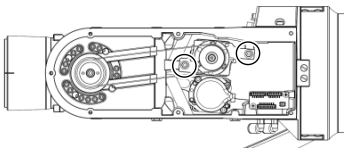
NOTE

Be careful not to cut the cables.

(7) Disconnect the connectors.

Connectors: PW5, BR5, EB0x_CN2 (Joint #5 motor side)

(8) Remove the bolts fixing the Arm #4 and the Joint #5 motor unit. Then, remove the timing belts on the Joint #5 motor unit and the Joint #5.



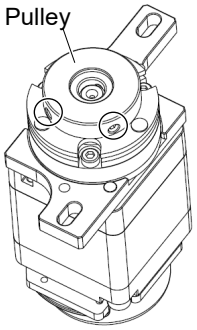
Hexagon socket head cap bolts 2-M4×15
(with plain washer for slotted hole
thickness: 1.5mm)

NOTE

If heavy part such as end effector is installed on the end of the Manipulator, the Arm #5 will move. Be very careful.

(9) Remove the Joint #5 motor pulley.

Hexagon socket set screws:
2-M4×4 (brass bushing × 1)

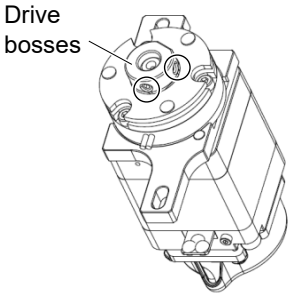


NOTE

One of the screws fixing the pulley contains the brass bushing. Be careful not to lose it.

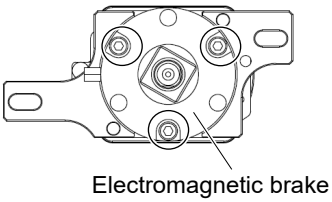
(10) Remove the drive bosses from the motor shaft of the Joint #5 motor unit.

Hexagon socket set screws: 2-M4×4



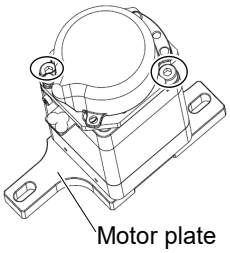
(11) Remove the Joint #5 electromagnetic brake.

Hexagon socket head cap bolts: 3-M3×13



(12) Remove the motor plate from the Joint #5 motor.

Hexagon socket head cap bolts: 2-M4×55



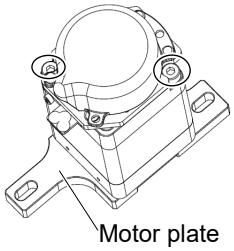
Installation

Joint #5
Motor Unit

(1) Install the motor plate on the Joint #5 motor.

Hexagon socket head cap bolts: 2-M4×55

Tightening torque: 4.0 ± 0.2 N·m



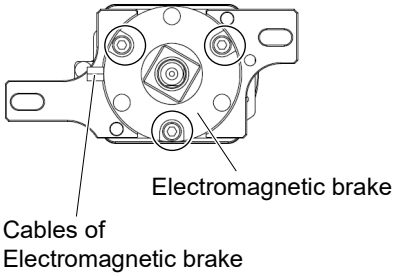
NOTE

Be careful of the installation direction of the motor plate. Refer to the figure and install it in the proper position.

(2) Install the Joint #5 electromagnetic brake on the Joint #5 motor unit. Install the spacer between the hexagon socket head cap bolts and the Joint #5 electromagnetic brake.

Hexagon socket head cap bolts: 3-M3×13

Tightening torque: 2.0 ± 0.1 N·m



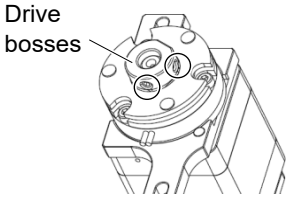
NOTE

Direction to exit the cables of the electromagnetic brake is set.
Install the electromagnetic brake so that the cables of the electromagnetic brake are positioned in the same direction as the motor cables.

(3) Install the drive bosses on the motor shaft on the Joint #5 motor.

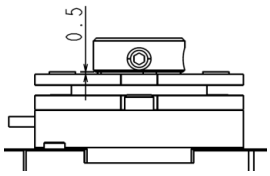
Hexagon socket set screws: 2-M4×4

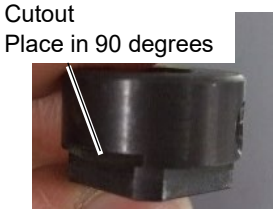
Tightening torque: 2.4 ± 0.1 N·m



NOTE

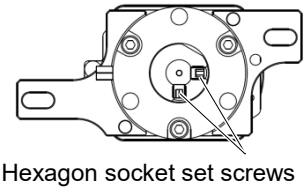
When fixing the drive bosses, make sure that the clearance between the drive bosses and the brake will be 0.5mm.
Use a feeler gauge (0.5 mm) of the drive boss to make clearance (0.5 mm).



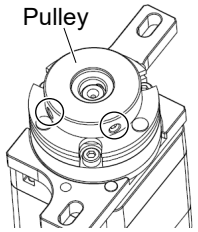


NOTE

Fix the set screws to be aligned with the D-cut surface on the motor shaft. If the screw positions are not correct, the side of part will get damage and you cannot pull out the part.



(4) Install the pulley on the drive boss.

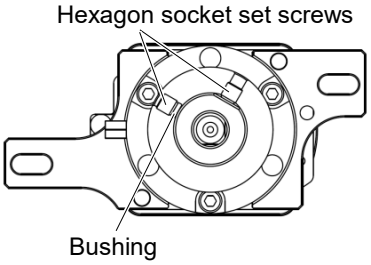


Hexagon socket set screws:
2-M4×4 (brass bushing × 1)
Tightening torque: 2.4 ± 0.1 N·m

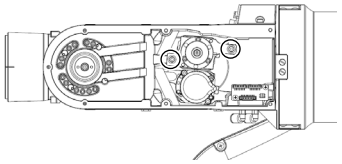
NOTE

Push the pulley to the drive boss and fix it.

Fix the set screw to align with the D-cut surface. Fix the other one after installing the bushing. If the screw positions are not correct or you forget to install the bushing, the side of part will get damage and you cannot pull out the part.



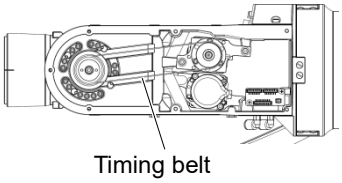
(5) Install the Joint #5 motor unit on the Arm #4.



Hexagon socket head cap bolts: 2-M4×15
(with plain washer for slotted hole
thickness: 1.5mm)

Do not tighten the screws completely. Loosen them so that the motor unit will not fall.

(6) Install the timing belt and temporarily fix the Joint #5 motor unit.

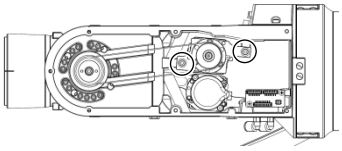


Hexagon socket head cap bolts: 2-M4×15
(with plain washer for slotted hole
thickness: 1.5mm)

NOTE

When temporary fixing the Joint #5 motor unit, make sure that the motor unit can be moved by hand and does not tilt when being pulled. If the unit is fixed too loose or too tight, the belt will not have proper tension.

(7) Apply the proper tension to the Joint #5 timing belt and fix the Joint #5 motor unit.



Tension of Joint #5 timing belt: 23 ± 5 N
Belt tension meter setting value
Weight: 2.5g/mm Width×m Span, Width:6 mm, Span:142 mm
Hexagon socket head cap bolts:
2-M4×15 (with plain washer for slotted hole thickness: 1.5mm)
Tightening torque: 4.0 ± 0.2 N·m

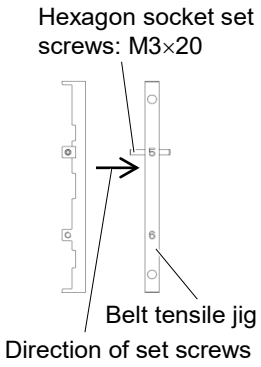
NOTE

Regarding belt tension:

- Jumping (position gap) may occur if the value is below the lower limit.
- Vibration (abnormal noise) or reduction of life of the parts may occur if the value exceeds the upper limit.

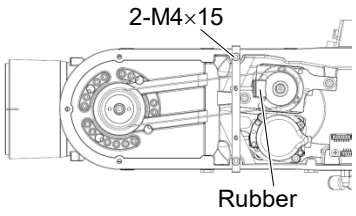
When using belt tensile jig (maintenance part):

1. Install the hexagon socket set screws (M3×20) to the holes on inscribed side of "5" on the belt tensile jig.
2. Fix the belt tensile jig on the Arm #4 with the hexagon socket head cap bolts (2-M4×15).
3. Push the rubber to the pulley. Push the rubber with the hexagon socket set screws (M3×20) to apply tension.



NOTE

Be careful not to push the set screws forcibly.



(8) Connect the connectors.

Connector: PW5, BR5, EB0x_CN2 (Joint #5 motor side)

(9) Bundle the cables with the cable tie to prevent the cables from interfering with the pulley or belt.

(10) Install the Arm #4 side cover (2 covers).

For details, refer to "*3. Covers*".

(11) Perform calibration.

For details, refer to "*8. Calibration*".

5.5.2 Replacing the Joint #5 Timing Belt

	Name	Qty	Code, Note
Maintenance Parts	Timing belt	1	1739205 (Common to Joint #5 and #6)
	Belt tensile jig*	1	1749184
Tools	Hexagonal wrench | width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)	1	For cross recessed head screws
	Torque wrench	1	For tightening torque control
	Belt tension meter	1	Refer: Unitta U-505

* The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Removal

Joint #5 timing belt:

(1) Turn ON the Controller.

(2) Release the brake on the Joint #2 and Joint #3.

EPSON RC+

Command

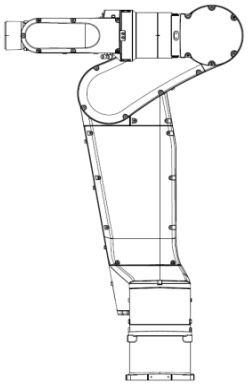
```
> brake off, 2
> brake off, 3
```

NOTE

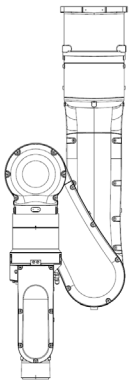
When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the angles of the Arm #2 and the Arm #3 about 30 degrees from the origin positions.

N6-A1000**



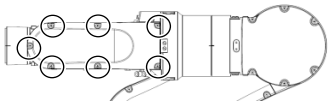
N6-A850**R



(4) Turn OFF the Controller.

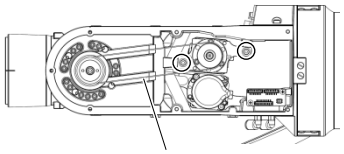
(5) Remove the Arm #4 side cover.

Cross recessed binding head machine screw:
7-M4×8



(6) Loosen the screws fixing the Arm #4 and the Joint #5 motor unit. Then, remove the timing belt of the Joint #5.

Hexagon socket head cap bolts: 2-M4×15
(with plain washer for slotted hole
thickness: 1.5mm)



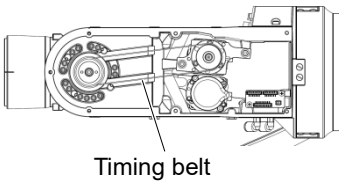
NOTE

If a heavy part such as end effector is installed on the end of the Manipulator, the Arm #5 will move. Be very careful.

Installation

Joint #5 timing belt:

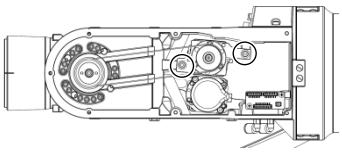
(1) Install the timing belt and temporarily fix the Joint #5 motor unit.



Hexagon socket head cap bolts: 2-M4×15
(with plain washer for slotted hole thickness: 1.5mm)

NOTE ☞ When temporary fixing the Joint #5 motor unit, make sure that the motor unit can be moved by hand and does not tilt when being pulled. If the unit is fixed too loose or too tight, the belt will not have proper tension.

(2) Apply the proper tension to the Joint #5 timing belt and fix the Joint #5 motor unit.

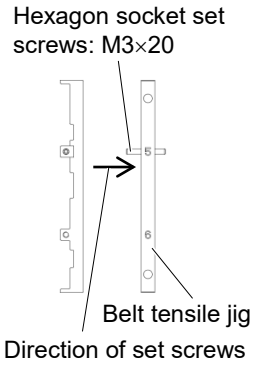


Tension of Joint #5 timing belt: 23 ± 5 N
Belt tension meter setting value
Weight: 2.5g/mm Width×m Span, Width:6 mm, Span:142 mm
Hexagon socket head cap bolts:
2-M4×15 (with plain washer for slotted hole thickness: 1.5mm)
Tightening torque: 4.0 ± 0.2 N·m

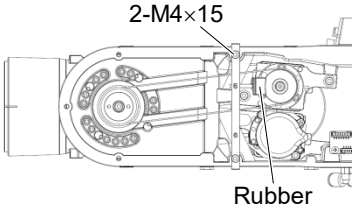
NOTE ☞ Regarding belt tension:
- Jumping (position gap) may occur if the value is below the lower limit.
- Vibration (abnormal noise) or reduction of life of the parts may occur if the value exceeds the upper limit.

When using belt tensile jig (maintenance part):

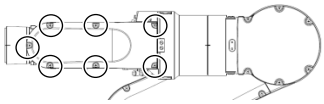
1. Install the hexagon socket set screws (M3×20) to the holes on inscribed side of "5" on the belt tensile jig.
2. Fix the belt tensile jig on the Arm #4 with the hexagon socket head cap bolts (2-M4×15).
3. Push the rubber to the pulley. Push the rubber with the hexagon socket set screws (M3×20) to apply tension.



NOTE ☞ Be careful not to push the set screws forcibly.



(3) Install the Arm #4 side cover.



Cross recessed binding head machine screw:
7-M4×8

Tightening torque: 0.45 ± 0.05 N·m

NOTE ☞ Be careful not to catch the cables. The cables will be disconnected.

(4) Perform calibration for the Joint #5.

For details, refer to "*8. Calibration*".

5.5.3 Replacing the Joint #5 Electromagnetic Brake

	Name		Qty	Code, Note
Maintenance Parts	Electromagnetic Brake		1	1670649 (Common to Joint #5 and #6)
	Belt tensile jig*		1	1749184
	Cable tie	AB200	-	1684328 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2 mm	1	For M4 hexagon socket set screws
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Feeler gauge (0.5 mm)		2	For positioning of drive boss
	Belt tension meter		1	Refer: Unitta U-505

* The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Removal

(1) Remove the Joint #5 electromagnetic brake.

For details, refer to Removal steps (1) through (10) in "*5.5.1 Replacing the Joint #5 Motor Unit*".

Installation

(1) Install the Joint #5 electromagnetic brake.

For details, refer to Installation steps (2) through (10) in "*5.5.1 Replacing the Joint #5 Motor Unit*".

5.6 Joint #6

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance.

NOTE
The Joint #6 is not equipped with an actuator unit. Replace the following parts for each Motor unit, timing belt, electromagnetic brake

5.6.1 Replacing the Joint #6 Motor Unit

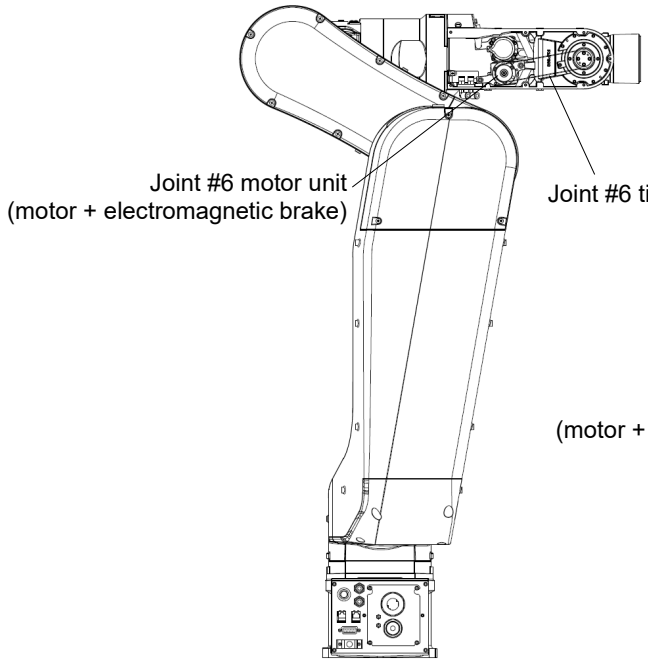
	Name		Qty	Code, Note
Maintenance Parts	Joint #6 motor unit *		1	1749173
	Belt tensile jig **		1	1749184
	Cable tie	AB200	-	1684328 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2 mm	1	For M4 hexagon socket set screw
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Feeler gauge (0.5 mm)		2	For positioning of drive boss
	Belt tension meter		1	Refer: Unitta U-505

* Joint #6 motor unit (1749173) is a dedicated motor unit. Do not use it for the Joint #5 motor unit.

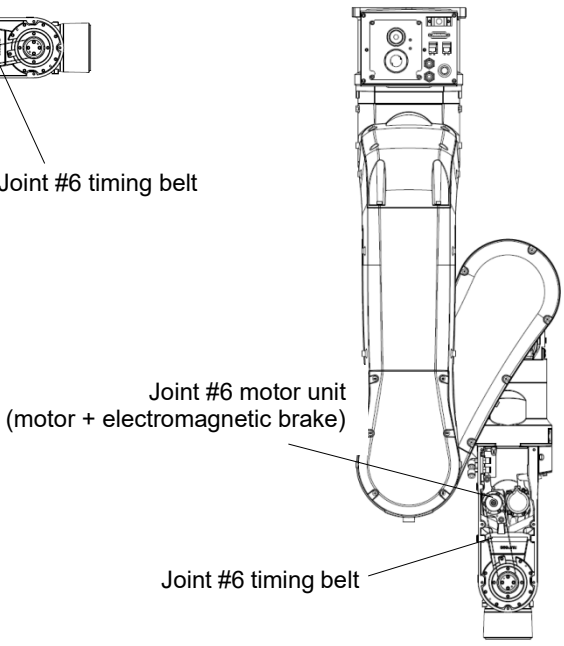
** The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

N6-A1000**



N6-A850**R



Removal

Joint #6 Motor Unit

(1) Turn ON the Controller.

(2) Release the brake on the Joint #2 and Joint #3.

EPSON RC+

Command

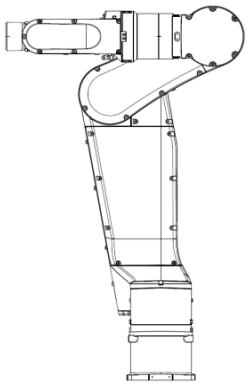
```
> brake off, 2
> brake off, 3
```

NOTE

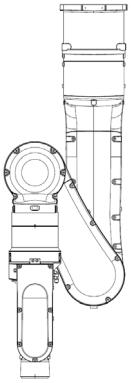
When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the angles of the Arm #2 and the Arm #3 about 30 degrees from the origin positions.

N6-A1000**



N6-A850**R



(4) Turn OFF the Controller.

(5) Remove the Arm #4 side cover (2 covers).

For details, refer to "*3. Covers*".

(6) Cut off the cable tie of the cables.

NOTE

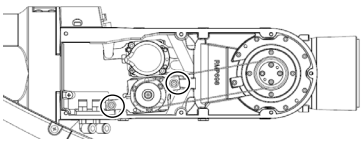
Be careful not to cut the cables.

(7) Disconnect the connectors.

Connectors: PW6, BR6, EB0x_CN2 (Joint #6 motor side)

(8) Remove the bolts fixing the Arm #4 and the Joint #6 motor unit. Then, remove the timing belt of the Joint #6 motor unit and the Joint #6.

Hexagon socket head cap bolts: 2-M4×15 (with plain washer for slotted hole thickness: 1.5mm)

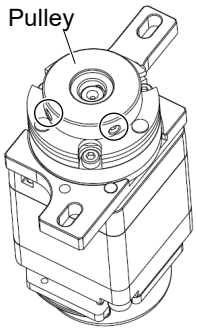


NOTE

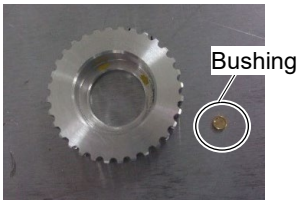
If a heavy part such as end effector is installed on the end of the Manipulator, the Arm #6 flange will move. Be very careful.

(9) Remove the Joint #6 motor pulley.

Hexagon socket set screws:
2-M4×4 (brass bushing × 1)

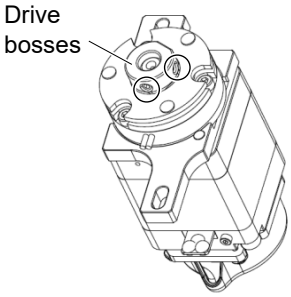


NOTE
One of the screws fixing the pulley contains the brass bushing. Be careful not to lose it.



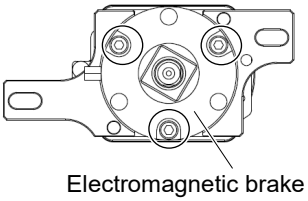
(10) Remove the drive bosses from the motor shaft on the Joint #6 motor unit.

Hexagon socket set screws: 2-M4×4



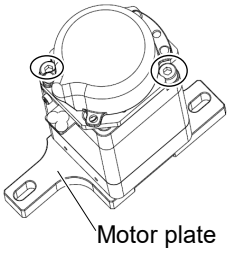
(11) Remove the Joint #6 electromagnetic brake.

Hexagon socket head cap bolts: 3-M3×13



(12) Remove the motor plate from the Joint #6 motor.

Hexagon socket head cap bolts: 2-M4×55

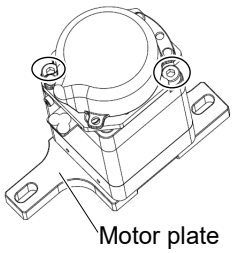


Installation

Joint #6
Motor Unit

(1) Install the motor plate on the Joint #6 motor.

Hexagon socket head cap bolts: 2-M4×55
Tightening torque: 4.0 ± 0.2 N·m

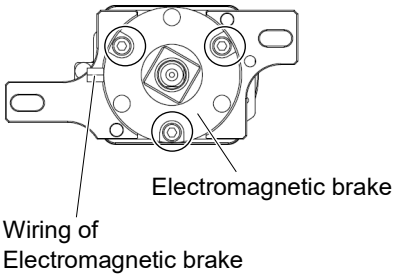


NOTE

Be careful of the installation direction of the motor plate. Refer to the figure and install it in the proper position.

(2) Install the Joint #6 electromagnetic brake on the Joint #6 motor unit. Install the spacer between the hexagon socket head cap bolts and the Joint #6 electromagnetic brake.

Hexagon socket head cap bolts: 3-M313
Tightening torque: 2.0 ± 0.1 N·m

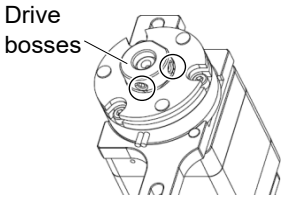


NOTE

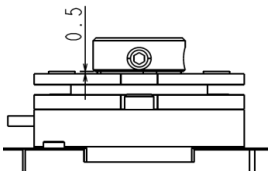
Direction to exit the cables of the electromagnetic brake is set. Install the electromagnetic brake so that the cables of the electromagnetic brake are positioned in the same direction as the motor cables.

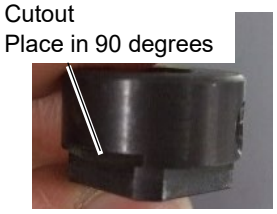
(3) Install the drive bosses on the motor shaft of the Joint #6 motor.

Hexagon socket set screws: 2-M4×4
Tightening torque: 2.0 ± 0.1 N·m



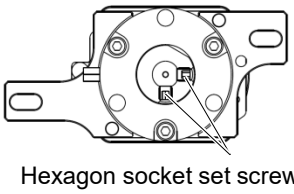
When fixing the drive bosses, make sure that the clearance between the drive bosses and the brake will be 0.5mm.
Use a feeler gauge (0.5 mm) of the drive boss to make clearance (0.5 mm).



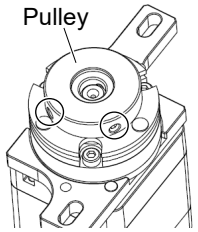


NOTE

Fix the set screws to be aligned with the D-cut surface on the motor shaft. If the screw positions are not correct, the side of part will get damage and you cannot pull out the part.



(4) Install the Joint #6 motor pulley on the drive boss.

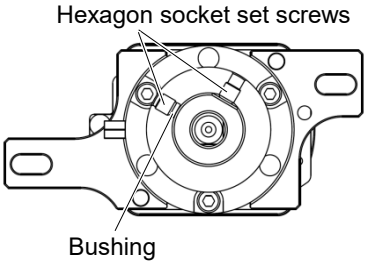


Hexagon socket set screws:
2-M4×4 (brass bushing × 1)
Tightening torque: 2.0 ± 0.1 N·m

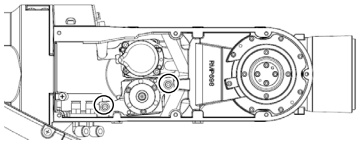
NOTE

Push the pulley to the drive boss and fix it.

Fix the set screw to align with the D-cut surface.
Fix the other one after installing the bushing.
If the screw positions are not correct or you forget to install the bushing, the side of part will get damage and you cannot pull out the part.



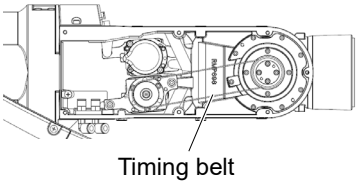
(5) Install the Joint #6 motor unit on the Arm #4.



Hexagon socket head cap bolts: 2-M4×15
(with plain washer for slotted hole
thickness: 1.5mm)

Do not tighten the screws completely. Loosen them so that the motor unit will not fall.

(6) Install the timing belt and temporarily fix the Joint #6 motor unit.

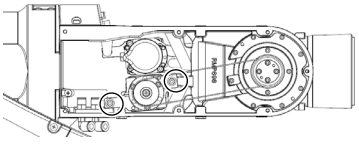


Hexagon socket head cap bolts: 2-M4×15
(with plain washer for slotted hole
thickness: 1.5mm)

NOTE

When temporary fixing the Joint #6 motor unit, make sure that the motor unit can be moved by hand and does not tilt when being pulled. If the unit is fixed too loose or too tight, the belt will not have proper tension.

(7) Apply the proper tension to the Joint #6 timing belt and fix the Joint #6 motor unit.



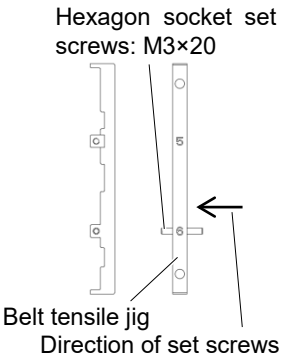
Tension of Joint #6 timing belt: 23 ± 5 N
Belt tension meter setting value
Weight: 2.5g/mm Width×m Span, Width:6 mm, Span:142 mm
Hexagon socket head cap bolts:
2-M4×15 (with plain washer for slotted hole thickness: 1.5mm)
Tightening torque: 4.0 ± 0.2 N·m

NOTE

Regarding belt tension:
- Jumping (position gap) may occur if the value is below the lower limit.
- Vibration (abnormal noise) or reduction of life of the parts may occur if the value exceeds the upper limit.

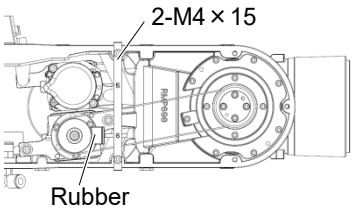
When using belt tensile jig (maintenance part):

1. Install the hexagon socket set screws (M3×20) to the holes on inscribed side of "6" on the belt tensile jig.
2. Fix the belt tensile jig on the Arm #4 with the hexagon socket head cap bolts (2-M4×15).
3. Push the rubber to the pulley. Push the rubber with the hexagon socket set screws (M3×20) to apply tension.



NOTE

Be careful not to push the set screws forcibly.



(8) Connect the connectors.

Connector: PW6, BR6, EB0x_CN2 (Joint #6 motor side)

(9) Bundle the cables with the cable tie to prevent the cables from interfering with the pulley or belt.

(10) Install the Arm #4 side cover (2 covers).

For details, refer to "*3. Covers*".

(11) Perform calibration.

For details, refer to "*8. Calibration*".

5.6.2 Replacing the Joint #6 Timing Belt

	Name	Qty	Code, Note
Maintenance Parts	Timing belt	1	1739205 (Common to Joint #5 and #6)
	Belt tensile jig*	1	1749184
Tools	Hexagonal wrench | width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)	1	For cross recessed head screws
	Torque wrench	1	For tightening torque control
	Belt tension meter	1	Refer: Unitta U-505

* The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Removal

Joint #6 timing belt

(1) Turn ON the Controller.

(2) Release the brake on the Joint #2 and Joint #3.

EPSON RC+

Command

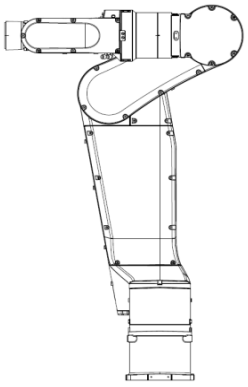
```
> brake off, 2
> brake off, 3
```

NOTE

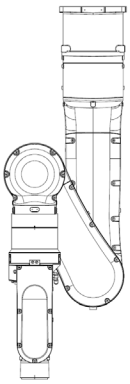
When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the angles of the Arm #2 and the Arm #3 about 30 degrees from the origin positions.

N6-A1000**



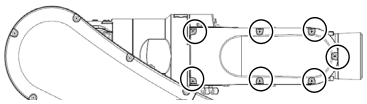
N6-A850**R



(4) Turn OFF the Controller.

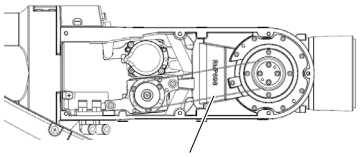
(5) Remove the Arm #4 side cover.

Cross recessed binding head machine screws: 7-M4×8



(6) Loosen the screws fixing the Arm #4 and the Joint #6 motor unit. Then, remove the timing belt of the Joint #6.

Hexagon socket head cap bolts: 2-M4×15 (with plain washer for slotted hole thickness: 1.5mm)



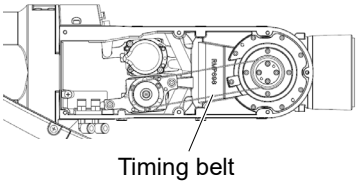
NOTE

If a heavy part such as end effector is installed on the end of the Manipulator, the Arm #6 flange will move. Be very careful.

Installation

Joint #6 timing belt:

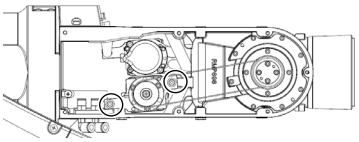
(1) Install the timing belt and temporarily fix the Joint #6 motor unit.



Hexagon socket head cap bolts: 2-M4×15
(with plain washer for slotted hole thickness: 1.5mm)

NOTE ☞ When temporary fixing the Joint #6 motor unit, make sure that the motor unit can be moved by hand and does not tilt when being pulled. If the unit is fixed too loose or too tight, the belt will not have proper tension.

(2) Apply the proper tension to the Joint #6 timing belt and fix the Joint #6 motor unit.

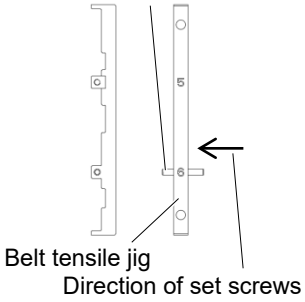


Tension of Joint #6 timing belt: 23 ± 5 N
Belt tension meter setting value
Weight: 2.5g/mm Width×m Span, Width:6 mm, Span:142 mm
Hexagon socket head cap bolts:
2-M4×15 (with plain washer for slotted hole thickness: 1.5mm)
Tightening torque: 4.0 ± 0.2 N·m

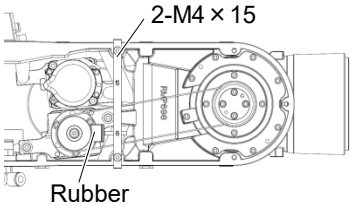
NOTE ☞ Regarding belt tension:
- Jumping (position gap) may occur if the value is below the lower limit.
- Vibration (abnormal noise) or reduction of life of the parts may occur if the value exceeds the upper limit.

When using belt tensile jig (maintenance part):

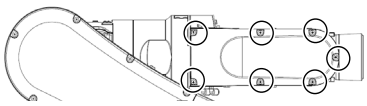
1. Install the hexagon socket set screws (M3×20) to the holes on inscribed side of "6" on the belt tensile jig.
2. Fix the belt tensile jig on the Arm #4 with the hexagon socket head cap bolts (2-M4×15).
3. Push the rubber to the pulley. Push the rubber with the hexagon socket set screws (M3×20) to apply tension.



NOTE ☞ Be careful not to push the set screws forcibly.



(3) Install the Arm #4 side cover.



Cross recessed binding head machine screws:
7-M4×8

Tightening torque: 0.45 ± 0.05 N·m

NOTE ☞ Be careful not to get the cables caught in the cover. The cables will be disconnected.

(4) Perform calibration for the Joint #6. For details, refer to "*8. Calibration*".

5.6.3 Replacing the Joint #6 Electromagnetic Brake

	Name		Qty	Code, Note
Maintenance Parts	Electromagnetic Brake		1	1670649 (Common to Joint #5 and #6)
	Belt tensile jig*		1	1749184
	Cable tie	AB200	-	1684328 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 2 mm	1	For M4 hexagon socket set screw
		width across flats: 2.5 mm	1	For M3 hexagon socket head cap bolts
		width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Feeler gauge (0.5 mm)		2	For positioning of drive boss
	Belt tension meter		1	Refer: Unitta U-505

* The belt tensile jig is an assembly jig. Use this jig when adjusting belt tension.

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.

Removal

(1) Remove the Joint #6 electromagnetic brake.

For details, refer to Removal steps (1) through (10) in "*5.6.1 Replacing the Joint #6 Motor Unit*".

Installation

(1) Install the Joint #6 electromagnetic brake.

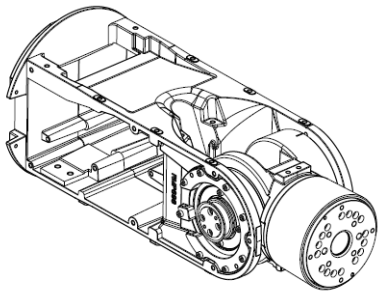
For details, refer to Installation steps (2) through (10) in "*5.6.1 Replacing the Joint #6 Motor Unit*".

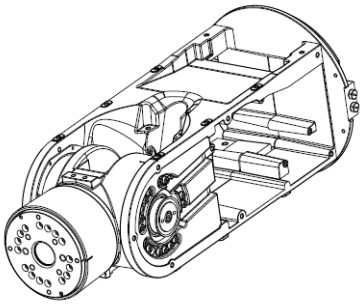
5.7 Joint #5 and #6 Units

CAUTION	■ This procedure has possibility of hands and fingers being caught and/or damage or malfunction to the Manipulator. Be very careful when performing maintenance.

	Name		Qty	Code, Note
Maintenance Parts	Joint #5 and #6 unit		1	1749174
	O-ring		1	1554675
	Cable tie	AB200	-	1684328, 1 bag (100 ties: white)
Tools	Hexagonal wrench	width across flats: 3 mm	1	For M4 hexagon socket head cap bolts
	Long nose pliers		1	For removing air tubes
	Nippers		1	For cutting a cable tie
	Cross-point screwdriver (#2)		1	For cross recessed head screws
	Torque wrench		1	For tightening torque control
	Spanner (width across flats: 8 mm)		1	For air tube fittings

The brake is mounted on each joint to prevent the arm from lowering due to its own weight while the Controller power is OFF or the motor is OFF status. The brake does not work during replacement. Be careful when performing maintenance work.





Removal

Joint #5 and #6 Unit

(1) Turn ON the Controller.

(2) Release the brake on the Joint #3.

EPSON RC+

Command

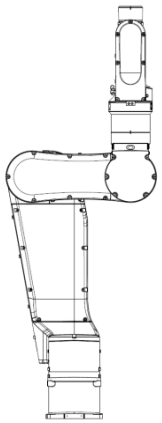
```
> brake off, 3
```

NOTE

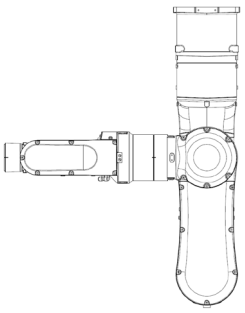
When releasing the brake, be careful of the arm falling due to its own weight.

(3) Move the angle of the Arm #3 about 90 degrees from the origin position.

N6-A1000**



N6-A850**R



(4) Turn OFF the Controller.

(5) Remove the covers.

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover

For details, refer to "*3. Covers*".

(6) Remove the cable unit from Joint #1 to Arm #4.

For details, refer to the Removal steps (9) through (15) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(7) Remove the Joint #5 motor unit and the timing belt.

For details, refer to the Removal steps (7) and (8) in "*5.5.1 Replacing the Joint #5 Motor Unit*".

NOTE

Place a mark on the Joint #5 motor unit to distinguish it later.
(To distinguish the Joint #5 motor unit from the Joint #6 motor unit.)

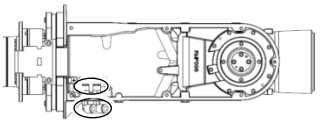
(8) Remove the Joint #6 motor unit and the timing belt.

For details, refer to the Removal steps (7) and (8) in "*5.6.1 Replacing the Joint #6 Motor Unit*".

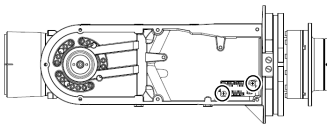
NOTE

Place a mark on the Joint #6 motor unit to distinguish it later. (To distinguish the Joint #6 motor unit from the Joint #5 motor unit.)

(9) Remove the four air tube fittings.

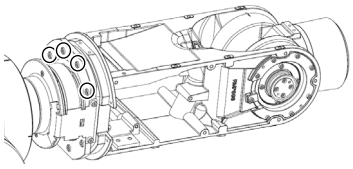


(10) Remove the encoder board #4.



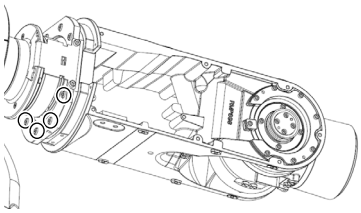
Cross recessed binding head machine screws:
2-M3×6

(11) Remove the Arm #4.

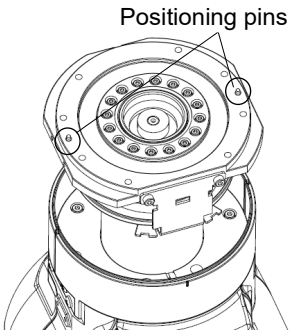


Cross recessed head bolts:
8-M4×20 (with plain washer)

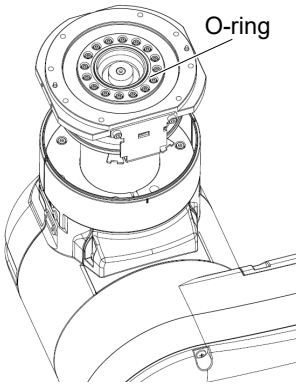
NOTE
Be sure to have at least 2 people to perform the operation since the parts being heavy.



NOTE
When removing it, make sure not to lose the two positioning pins.



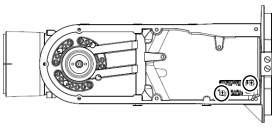
(12) Remove the O-ring from the Joint #4 flange.



Installation

Joint #5 and #6 Unit

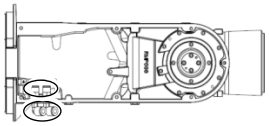
(1) Install the encoder board #4 to the Joint #5 and #6 units.



Cross recessed binding head machine screws:
2-M3×6

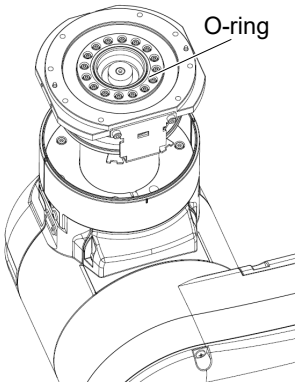
Tightening torque: 0.45 ± 0.05 N·m

(2) Install the air tube fittings to the Joint #5 and #6 units.



(3) Install the O-ring to the Joint #4 flange.

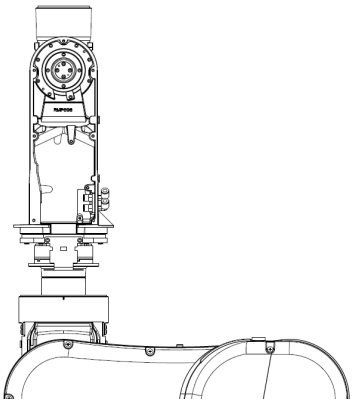
O-ring Inner diameter ø 47.5 mm
Wire diameter ø 2.0 mm



NOTE

Apply a thin coat of grease to the O-ring.
Grease: SK-1A

(4) Install the Joint #5 and #6 units on the Joint #4 actuator unit.



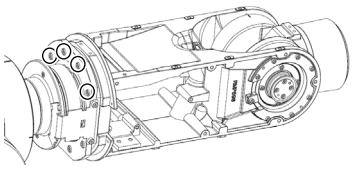
Hexagon socket head cap bolts:
8-M4×20 (with plain washer)

Tightening torque: 5.5±0.25 N·m

NOTE

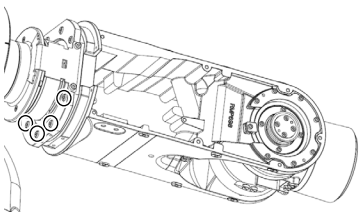
Be sure to have at least 2 people to perform the operation since the parts being heavy.

Confirm that the two pins are installed on the Joint #4 flange. When installing it, make sure to align the pins with the Joint #5 and #6 units.



Be sure to install the O-ring properly.

Be careful not to get the cables caught in the units and the actuator unit.



(5) Install the Joint #5 motor unit and the timing belt.

For details, refer to the Removal steps (5) through (8) in "*5.5.1 Replacing the Joint #5 Motor Unit*".

NOTE

When installing the Joint #5 motor unit and the Joint #6 motor unit, make sure to use the proper part. If the wrong part is installed, the Manipulator will move abnormally.

(6) Install the Joint #6 motor unit and the timing belt.

For details, refer to the Removal steps (5) through (8) in "*5.6.1 Replacing the Joint #6 Motor Unit*".

NOTE

When installing the Joint #5 motor unit and the Joint #6 motor unit, make sure to use the proper part. If the wrong part is installed, the Manipulator will move abnormally.

(7) Install the cable unit.

For details, refer to the Removal steps (46) through (52) in "*4.1 Cable Unit (N6-A1000*): Cable direction Standard (backward)*".

(8) Install the following covers:

Arm #4 side cover (2 covers), Joint #4 inside cover, Joint #4 outside cover

For details, refer to "*3. Covers*".

(9) Perform calibration.

For details, refer to "*8. Calibration*".

6. Battery

WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

WARNING	■ Take meticulous care when handling the lithium metal battery. Improper handling of the battery as mentioned below is extremely hazardous and may result in heat generation, leakage, explosion, or inflammation. It also may cause serious safety problems. <Improper Handling> Attempting to charge Disassembling Connecting batteries improperly Exposing to fire Forcing discharge Deforming by pressure Short-circuit (Polarity; Positive/Negative) Heating (85 °C or more) Soldering the terminal of the lithium battery directly ■ When disposing the battery, consult with the professional disposal services or comply with the local regulation. Make sure that the battery terminal is insulated, even for a used buttery. If the terminal contacts with the other metals, it may short and result in heat generation, leakage, explosion, or inflammation.

In case of the low battery (lithium metal battery) power, the error to warn the voltage reduction occurs at the Controller startup (the software startup). All position data will be lost and you will need to calibrate all joints.

The life span of the lithium metal battery varies depending on the energizing hours and installation environment of the Controller. It is about 3 years as a rough guide (when the Controller is connected to power for 8 hours a day). When the Controller is not connected to power, the battery consumption will significantly increase compared to when the Controller is energized. If warnings of voltage reduction occur, replace the lithium metal battery even if it has not reached the above product life.

NOTE

For the EPSON RC+ 7.0 Ver. 7.2.x or later (firmware Ver.7.2.x.x or later), the recommended replacement time for the battery can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.

For details, refer to the following manual.

RC700 series Maintenance Manual Maintenance 6. Alarm

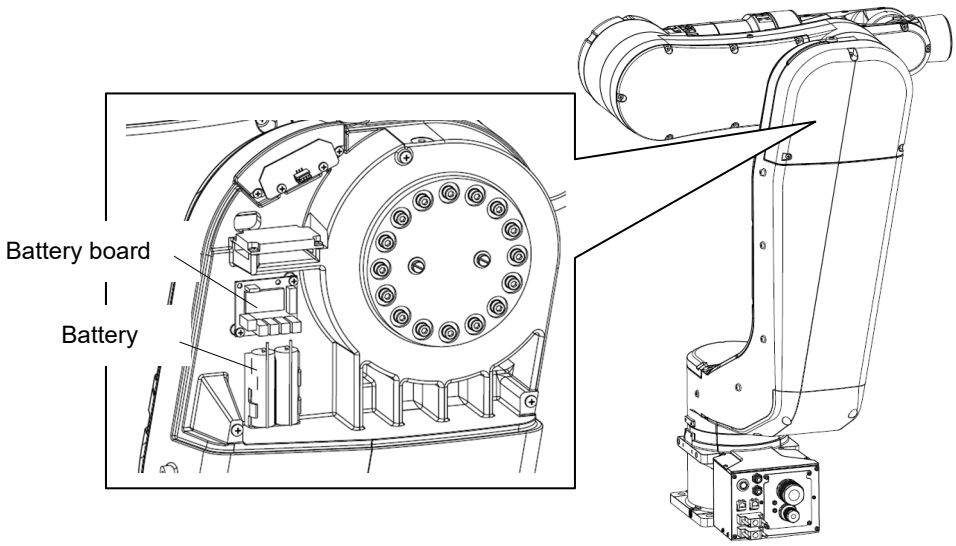
The battery may run out if it passes the recommended replacement time.

If no warnings of voltage reduction occur, calibration for all joints is not necessary. You need to perform calibration if the position moves from the originals after replaced the battery.

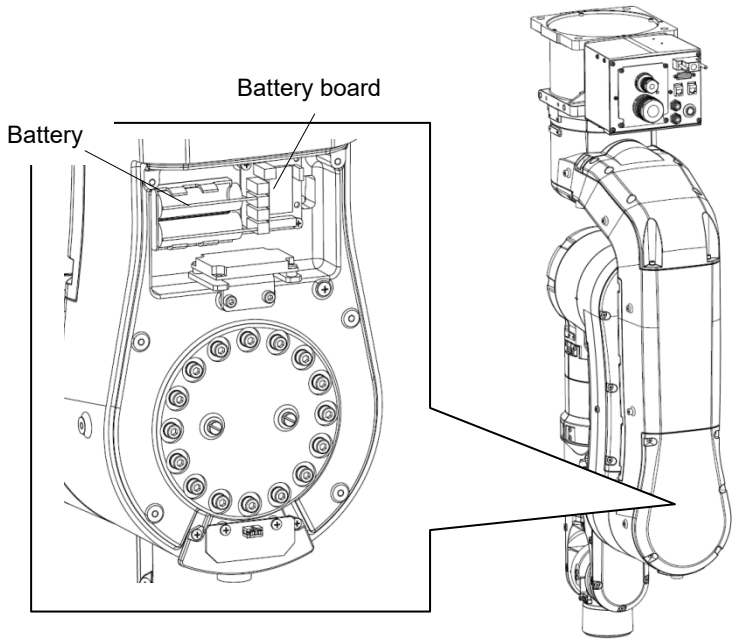
Always use the lithium metal battery and battery board designated by us.

Be careful of the battery polarity to connect it correctly.

N6-A1000**



N6-A850**R



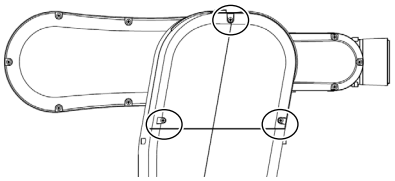
	Name	Qty	Note
Maintenance Parts	Battery	1	2172925 (2 lithium metal batteries for replacement)
	Battery board	1	2173216
Tools	Cross-point screwdriver (#2)	1	For cross recessed head screws

6.1 Replacing the Battery Unit (Lithium Metal Battery)

(1) Turn OFF the Controller.

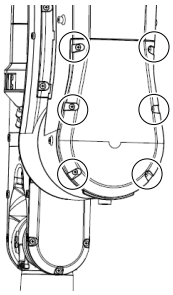
(2) Remove the Joint #2 outside cover.

N6-A1000**



Cross recessed binding head machine screws: 3-M4×8

N6-A850**R



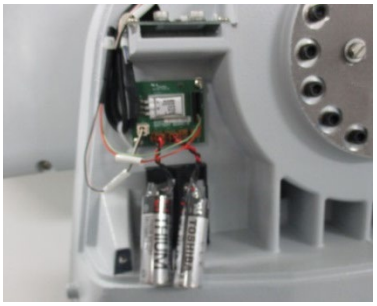
Cross recessed binding head machine screws: 6-M4×8

(3) Remove the old batteries from the battery box.

NOTE Do not disconnect the connectors.

If you remove all batteries before connecting the new ones, the calibration data will be deleted and you will need to perform calibration.

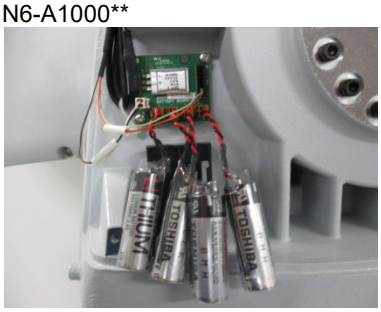
N6-A1000**



N6-A850**R

(4) Connect the two new batteries to the connectors of the battery board which is nothing is connected.

N6-A1000**



N6-A850**R

(5) Remove the old batteries.
Hold the board by hand and pull the battery cable upward to remove the connector.

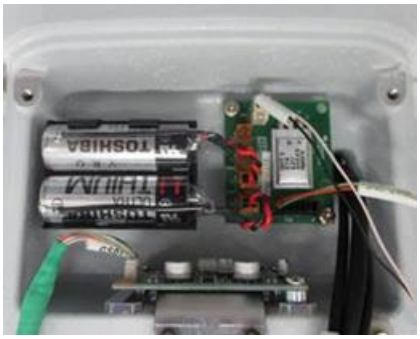
N6-A1000**

N6-A850**R

(6) Install new batteries to the battery box.

N6-A1000**

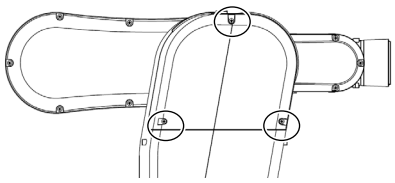
N6-A850**R



(7) Install the Joint #2 outside cover.

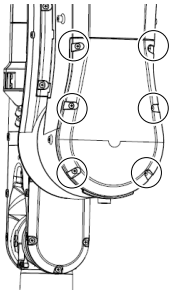
NOTE Be careful not to get the cables caught in the arm.

N6-A1000**



Cross recessed binding head
machine screws: 3-M4×8
Tightening torque: 0.45 ± 0.05 N·m

N6-A850**R



Cross recessed binding head
machine screws: 6-M4×8
Tightening torque: 0.45 ± 0.05 N·m

(8) Turn ON the Controller.

(9) Check operation to see if the Manipulator's position and posture are out of position.
Move the Manipulator to two or three points (poses) of the registered points.

NOTE Make sure to operate the robot in LowPower mode.

(10) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

6.2 Replacing the Battery Board

After parts (actuator units, timing belts, etc.) or the battery board have been replaced, the Manipulator cannot perform positioning properly because a gap exists between the origin stored in each actuator unit and its corresponding origin stored in the Controller.
After replacing the parts, it is necessary to match these origins.
The process of aligning the two origins is called “Calibration”.

Refer to “*8. Calibration*” and follow the steps to perform calibration.

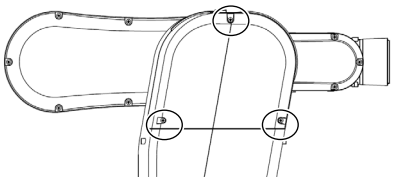
Removal

Battery Board

(1) Turn OFF the Controller.

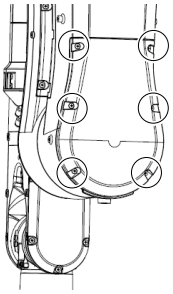
(2) Remove the Joint #2 outside cover.

N6-A1000**



Cross recessed binding head machine screws: 3-M4×8

N6-A850**R



Cross recessed binding head machine screws: 6-M4×8

(3) Remove the battery connectors.

NOTE

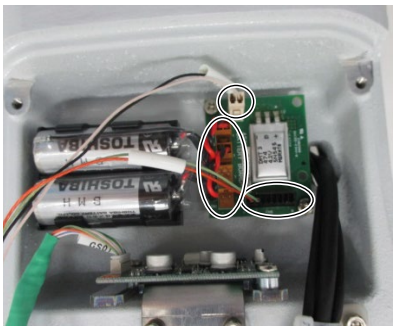
Hold the board by hand and pull the battery cable upward to remove the connector.

(4) Remove the connectors from the battery board.

Connector: BAT_CN3,
BAT_CN6

N6-A1000**

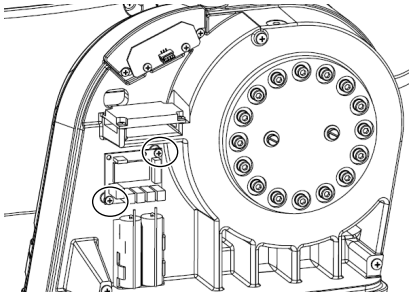
N6-A850**R



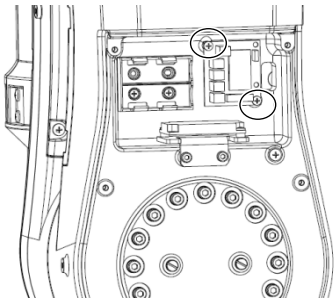
(5) Remove the battery board.

Cross recessed binding head machine screws: 2-M3×6

N6-A1000**



N6-A850**R



Installation

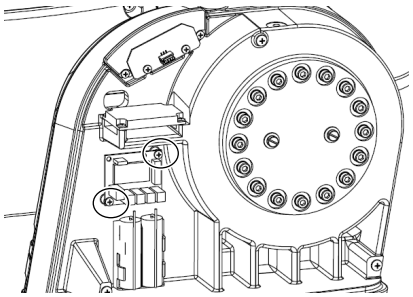
Battery Board

(1) Install the battery board to the Arm #1.

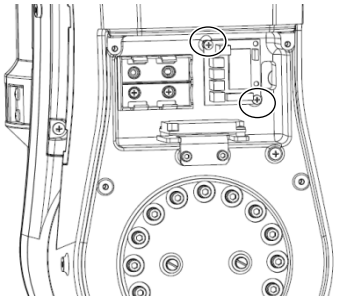
Cross recessed binding head machine screws:2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

N6-A1000**



N6-A850**R



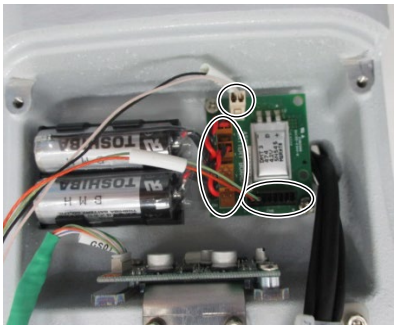
(2) Connect the connectors to the battery board.

Connector: BAT_CN3
BAT_CN6

(3) Connect the battery connector to the battery board.

N6-A1000**

N6-A850**R

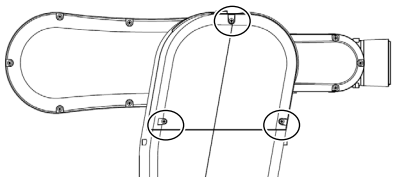


(4) Install the Joint #2 outside cover.

NOTE

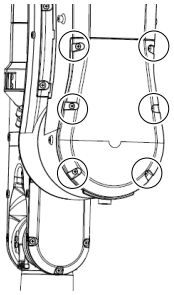
Be careful not to get the cables caught in the arm.

N6-A1000**



Cross recessed binding head machine screws: 3-M4×8
Tightening torque: 0.45 ± 0.05 N·m

N6-A850**R



Cross recessed binding head machine screws: 6-M4×8
Tightening torque: 0.45 ± 0.05 N·m

(5) Perform calibration.

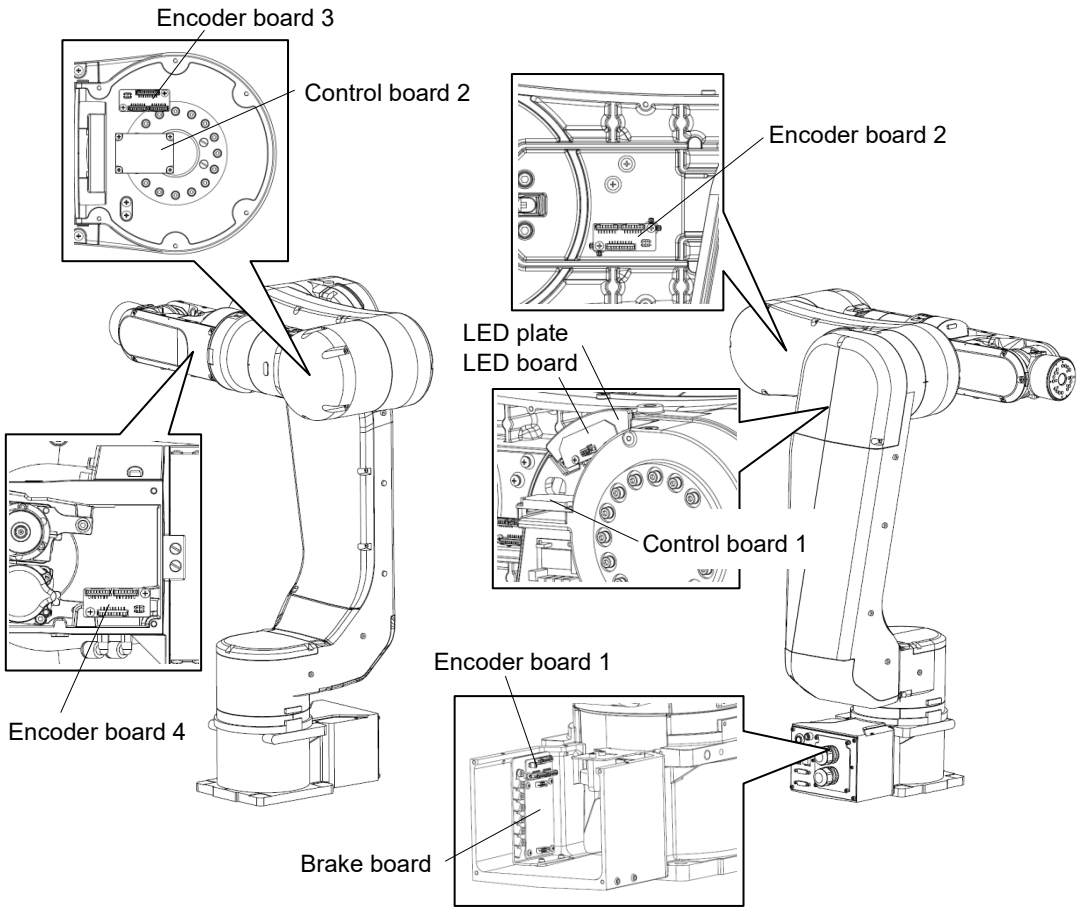
For details, refer to "*8. Calibration*".

7. Boards

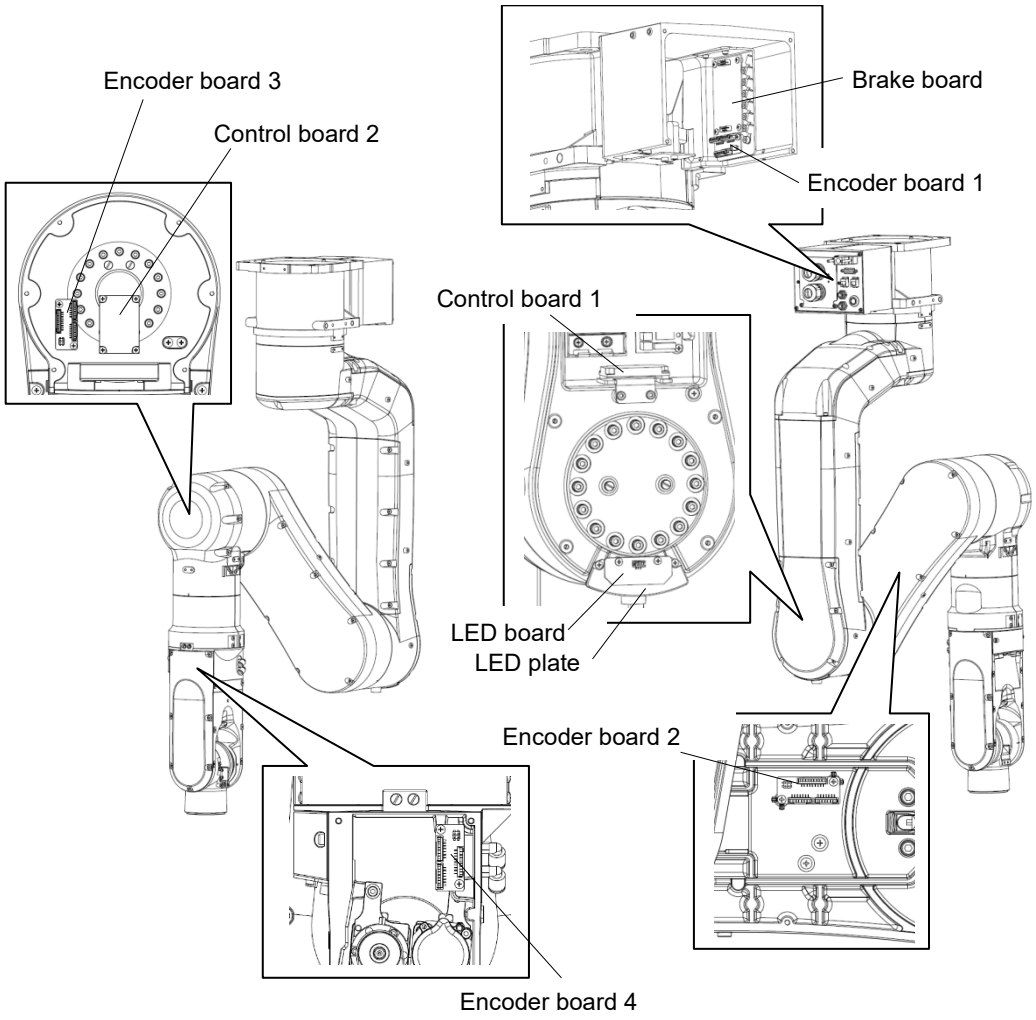
WARNING	■ Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. Connecting or disconnecting the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. ■ To shut off power to the robot system, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

Always use the boards designated by us.

N6-A1000**



N6-A850**R



	Name	Qty	Note
Maintenance Part	Control board (1, 2)	1	2138032
	Encoder board (1, 2, 3, 4)	1	2179137
	Brake board	1	2178379
	LED board	1	2190495
Tools	Hexagonal wrench (width across flats: 2.5 mm)	1	For M3 hexagon socket head cap bolts
	Hexagonal wrench (width across flats: 3 mm)	1	For M4 hexagon socket head cap bolts
	Cross-point screwdriver (#2)	1	For cross recessed head screws

7.1 Replacing the Control Board 1

7.1.1 N6-A1000** (Control Board 1)

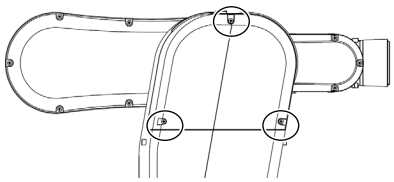
Removal

Control Board 1

(1) Turn OFF the Controller.

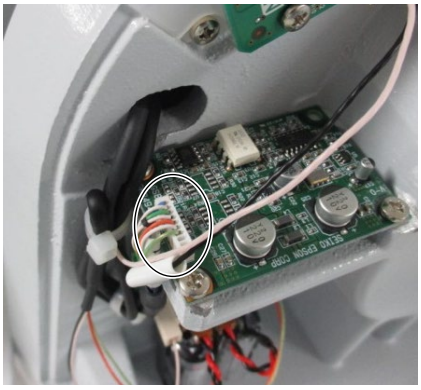
(2) Remove the Joint #2 outside cover.

Cross recessed binding head machine screws:
3-M4×8



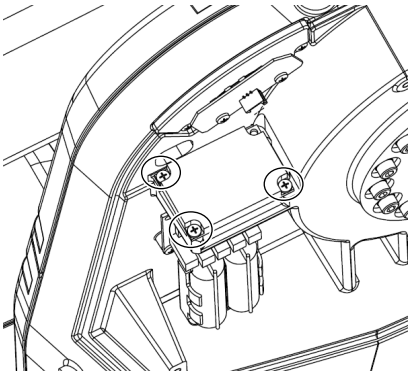
(3) Disconnect the connector connected to the control board 1.

Connector: GS01



(4) Remove the control board 1.

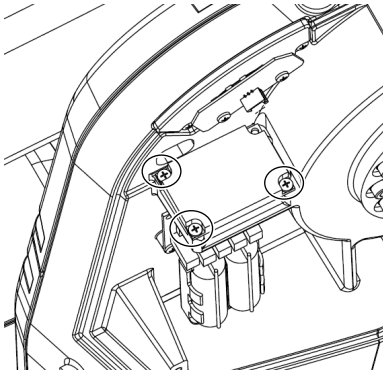
Cross recessed binding head machine screws:
3-M3×6



Installation

Control Board 1

(1) Install the control board 1 to the Arm #1.



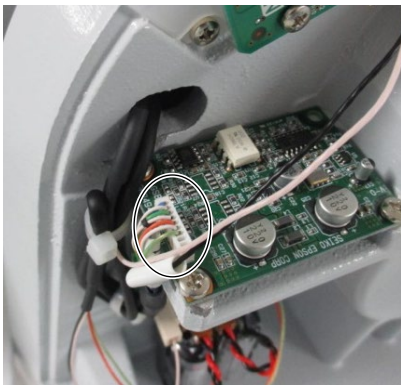
Cross recessed binding head machine screws:
3-M3×6

Tightening torque: 0.45 ± 0.05 N·m

NOTE

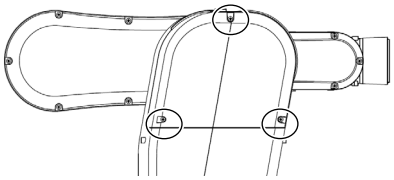
As shown in the step (2), when installing the board, make sure that the connector of the board is on the cable hole side.

(2) Connect the connector to the control board 1.



Connector: GS01

(3) Install the Joint #2 outside cover.



Cross recessed binding head machine screws:
3-M4×8

Tightening torque: 0.45 ± 0.05 N·m

NOTE

Be careful not to get the cables caught in the arm.

(4) Turn ON the Controller.

(5) Check operation to see if the Manipulator's position and posture are out of position.

Move the Manipulator to two or three points (poses) of the registered points.

(6) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

7.1.2 N6-A850**R (Control Board 1)

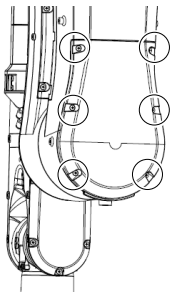
Removal

Control Board 1

(1) Turn OFF the Controller.

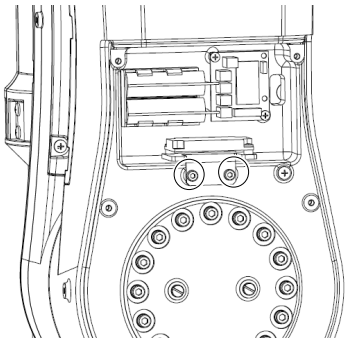
(2) Remove the Joint #2 outside cover.

Cross recessed binding head machine screws:
6-M4×8



(3) Remove the control board fixing plate.

Cross recessed binding head machine screws:
2-M4×8

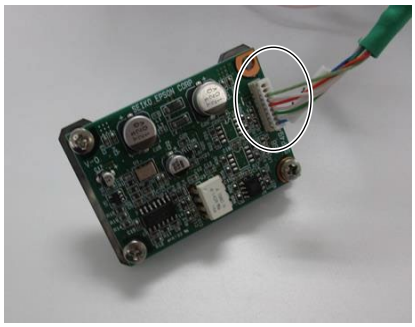


NOTE

Cable is connected. Be careful not to pull the plate forcibly.

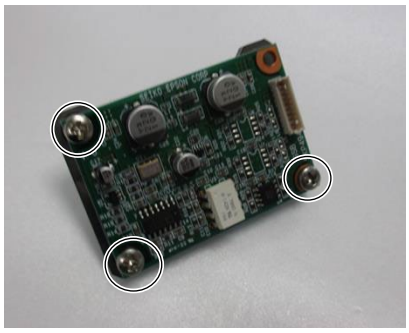
(4) Disconnect the connector connected to the control board 1.

Connector: GS01



(5) Remove the control board 1.

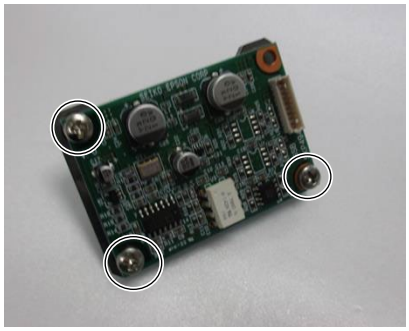
Cross recessed binding head machine screws:
3-M3×6



Installation

Control Board 1

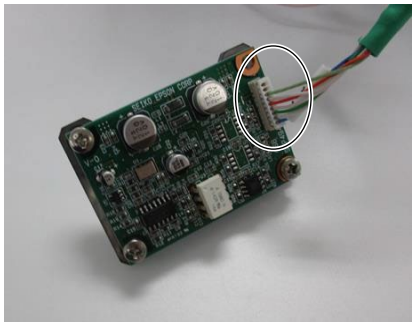
(1) Install the control board 1 to the control board fixing plate.



Cross recessed binding head machine screws:
3-M3×6
Tightening torque: 0.45 ± 0.05 N·m

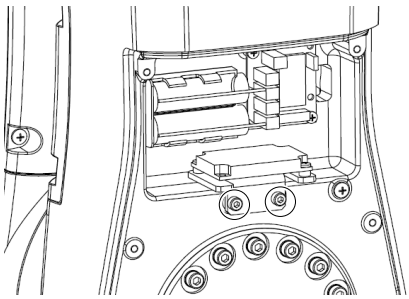
NOTE
Make sure to install it in the direction as shown in the picture.

(2) Connect the connector to the control board 1.



Connector: GS01

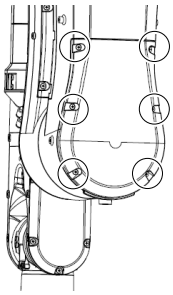
Install the control board fixing plate to the Arm #1.



Cross recessed binding head machine screws:
2-M4×8
Tightening torque: 4.0 ± 0.2 N·m

NOTE
Make sure to install it in the direction as shown in the picture.

(3) Install the Joint #2 outside cover.



Cross recessed binding head machine screws:
6-M4×8
Tightening torque: 0.45 ± 0.05 N·m

NOTE
Be careful not to get the cables caught in the arm.

(4) Turn ON the Controller.

(5) Check operation to see if the Manipulator's position and posture are out of position.

Move the Manipulator to two or three points (poses) of the registered points.

(6) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

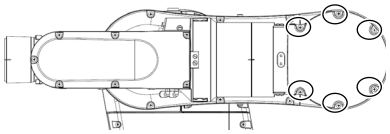
7.2 Replacing the Control Board 2

Removal

Control Board 2

(1) Remove the Arm #3 cover.

Cross recessed binding head machine screws:
6-M4×8

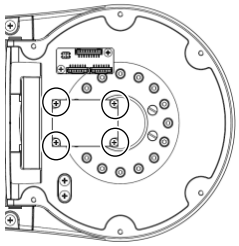


(2) Disconnect the connector connected to the control board 2.

Connector: GS02

(3) Remove the control board 2.

Cross recessed binding head machine screws: 4-M3×6



NOTE

Be careful not to drop the screws inside the Manipulator while removing them.

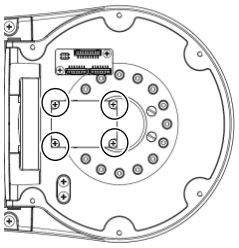
Installation

Control Board 2

(1) Install the control board #2 to the Arm #3.

Cross recessed binding head machine screws: 4-M3×6

Tightening torque: 0.45 ± 0.05 N·m



NOTE

Be careful not to drop the screws inside the Manipulator while removing them.

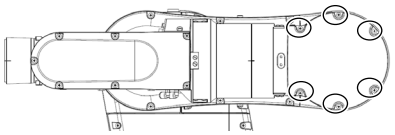
(2) Connect the connector to the control board 2.

Connector: GS02

(3) Install the Arm #3 cover.

Cross recessed binding head machine screws: 6-M4×8

Tightening torque: 0.45 ± 0.05 N·m



NOTE

Be careful not to get the cables caught in the cover.

(4) Turn ON the Controller.

(5) Check operation to see if the Manipulator's position and posture are out of position.

Move the Manipulator to two or three points (poses) of the registered points.

(6) If the Manipulator is out of position, calibrate all the joints and axes.

For details, refer to "*8. Calibration*".

7.3 Replacing the Encoder Board 1

Removal

Encoder Board 1

(1) Turn OFF the Controller.

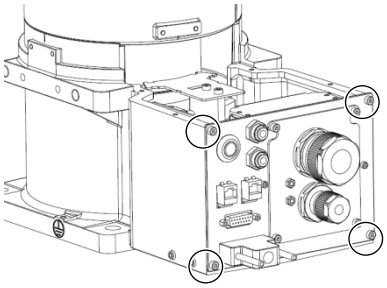
(2) Remove the base cover.

For details, refer to "*3. Covers*".

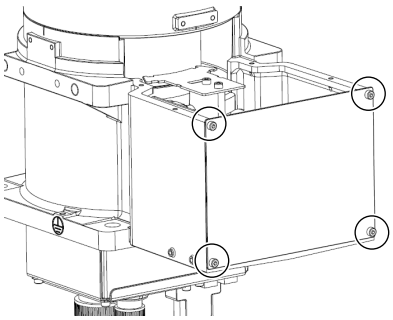
(3) Remove the base side plate.

Hexagon socket head cap bolts: 4-M4×8

M/C cable direction: Standard (backward)

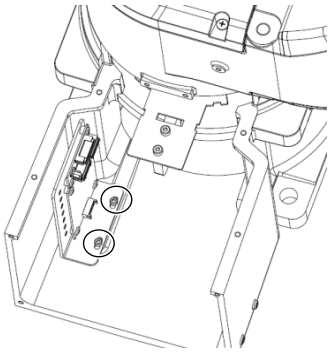


Upward and downward



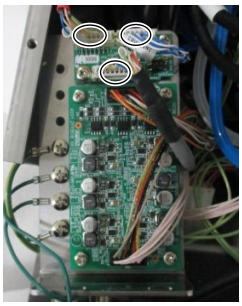
(4) Remove the board fixing plate in the base.

Hexagon socket head cap bolts: 2-M3×6



(5) Disconnect the connectors connected to the encoder board 1

Connectors:
EB01_CN1, EB01_CN3, EB0x_CN2

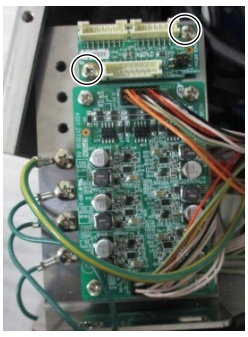


NOTE

Be careful that the jumper pins on the board do not come off.

(6) Remove the encoder board 1.

Cross recessed binding head machine screws: 2-M3×6

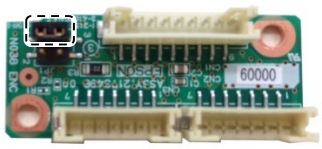


CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

Installation

Encoder Board 1

(1) Check that the jumper pin of the encoder board 1 is at "3-4 short".



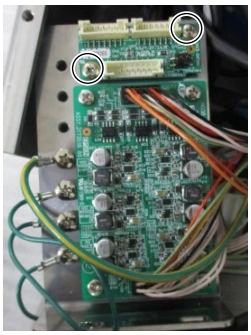
(2) Install the encoder board 1 to the board fixing plate.

Cross recessed binding head machine screws: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

NOTE

Make sure to install it in the direction as shown in the picture.



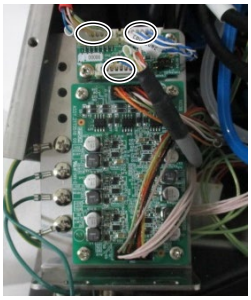
(3) Connect the connectors to the encoder board 1.

Connectors:

EB01_CN1, EB01_CN3, EB0x_CN2

NOTE

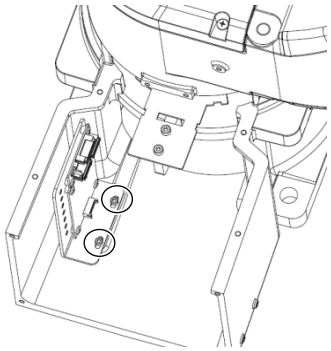
Be careful that the jumper pins on the board do not come off.



(4) Install the board fixing plate to the base.

Hexagon socket head cap bolts: 2-M3×6

Tightening torque: 2.0 ± 0.1 N·m

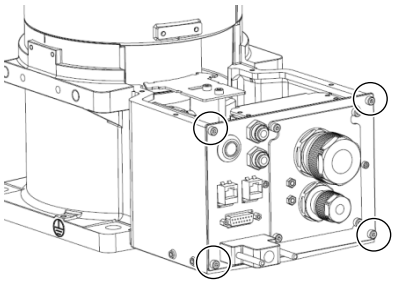


(5) Install the base side plate.

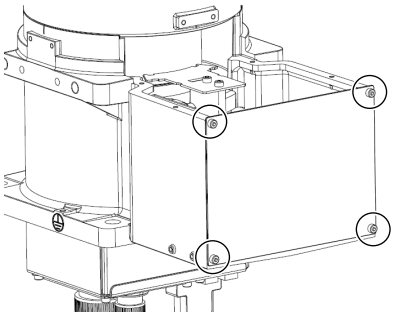
Hexagon socket head cap bolts: 4-M4×8

Tightening torque: 4.0± 0.2 N·m

M/C cable direction: Standard (backward)



Upward and downward



NOTE

Be careful not to get the cables caught in the base.

(6) Install the base cover.

For details, refer to "*3. Covers*".

(7) Turn ON the Controller.

(8) Calibrate all the Joints.

For details, refer to "*8. Calibration*".

7.4 Replacing the Encoder Board 2

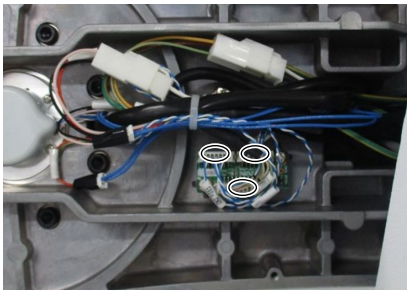
Removal

Encoder Board 2

(1) Remove the Arm #2 cover (Arm #1 side).

For details, refer to "*3. Covers*".

Disconnect the connectors connected to the encoder board 2.

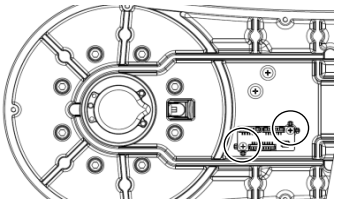


Connectors: EB02_CN1
EB0x_CN2 (Joint #2 side)
EB0x_CN2 (Joint #3 side)

NOTE

Be careful that the jumper pins on the board do not come off.

(2) Remove the encoder board 2.



Cross recessed binding head machine screws:
2-M3×6

NOTE

Be careful not to drop the screws inside the Manipulator while removing them.

CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

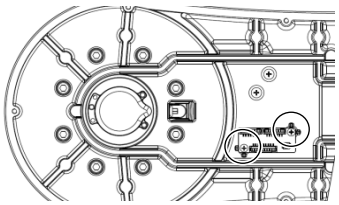
Installation

Encoder Board 2

(1) Change the position of the jumper pin on the encoder board 2 to “1-2 short”.

(2) Install the encoder board 2 to the Arm #2.

Cross recessed binding head machine screws:
2-M3×6
Tightening torque: 0.45 ± 0.05 N·m

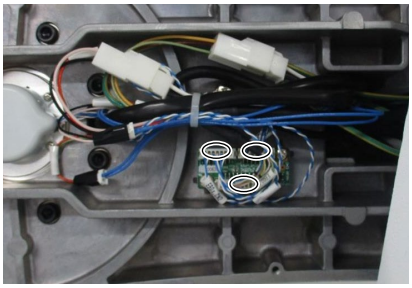


NOTE
Be careful not to drop the screws inside the Manipulator while removing them.

NOTE
Make sure to install as the same direction as the figure.

(3) Connect the connectors to the encoder board 2.

Connectors: EB02_CN1
EB0x_CN2 (Joint #2 side)
EB0x_CN2 (Joint #3 side)



NOTE
Be careful that the jumper pins on the board do not come off.

(4) Install the Arm #2 cover (Arm #1 side).

For details, refer to “*3. Covers*”.

(5) Turn ON the Controller.

(6) Calibrate the Joints #2 and #3.

For details, refer to “*8. Calibration*”.

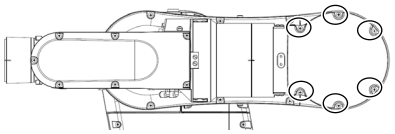
7.5 Replacing the Encoder Board 3

Removal

Encoder Board 3

(1) Remove the Arm #3 cover.

Cross recessed binding head machine screws: 6-M4×8



(2) Disconnect the connectors connected to the encoder board 3.

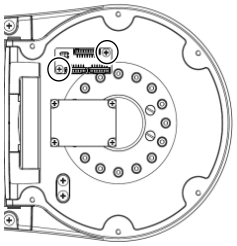
Connectors: EB04_CN1, EB04_CN3, EB0x_CN2

NOTE

Be careful that the jumper pins on the board do not come off.

(3) Remove the encoder board 3.

Cross recessed binding head machine screws: 2-M3×6



NOTE

Be careful not to drop the screws inside the Manipulator while removing them.

CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

Installation

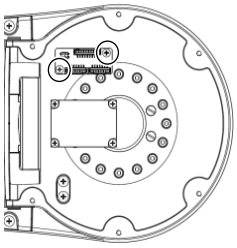
Encoder Board 3

(1) Check that the jumper pin of the encoder board 3 is at "3-4 short".

(2) Install the encoder board 3 to the Arm #2.

Cross recessed binding head machine screws: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m



NOTE

☞ Be careful not to drop the screws inside the Manipulator while removing them.

(3) Connect the connectors to the encoder board 3.

Connectors: EB04_CN1, EB04_CN3, EB0x_CN2

NOTE

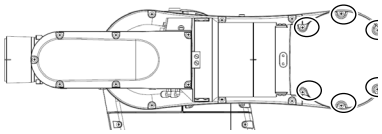
☞ Be careful that the jumper pins on the board do not come off.

(4) Install the Arm #3 cover.

Cross recessed binding head machine screws:
6-M4×8

Tightening torque: 0.45 ± 0.05 N·m

For details, refer to "*3. Covers*".



NOTE

☞ Be careful not to get the cables caught in the cover.

(5) Turn ON the Controller.

(6) Calibrate the Joints #4, #5, and #6.

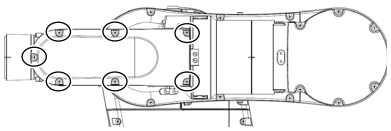
For details, refer to "*8. Calibration*".

7.6 Replacing the Encoder Board 4

Removal

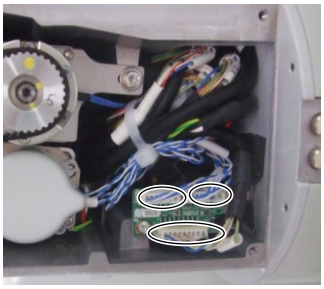
Encoder Board 4

(1) Remove the Arm #4 side cover.



Cross recessed binding head machine screws:
7-M4×8

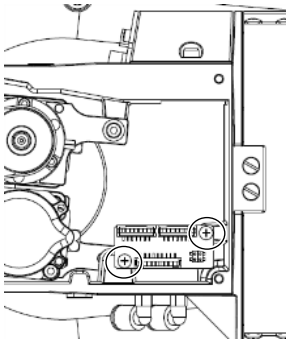
(2) Disconnect the connectors connected to the encoder board 4.



Connectors:
EB05_CN1
EB0x_CN2(Joint #5 motor side)
EB0x_CN2(Joint #6 motor side)

NOTE Be careful that the jumper pins on the board do not come off.

(3) Remove the encoder board 4.



Cross recessed binding head machine screws: 2-M3×6

NOTE Be careful not to drop the screws inside the Manipulator while removing them.

CAUTION	■ Improper jumper pin settings may result in occurrence of the errors such as below. Example: 5042: Position error overflow in high power state. Check the power cable connection, the robot, the driver and the motor. When replacing the boards, be careful not to configure them incorrectly.

Installation

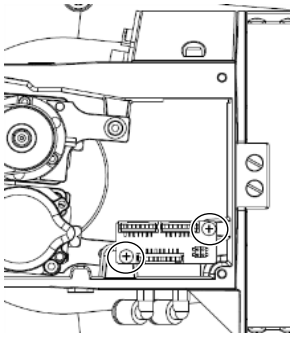
Encoder Board 4

(1) Check that the jumper pin of the encoder board 4 is at "1-2 short".

(2) Install the encoder board 4 to the Arm #4.

Cross recessed binding head machine screws: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

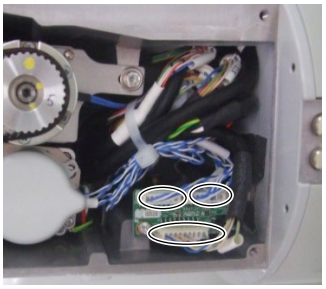


NOTE

Be careful not to drop the screws inside the Manipulator while installing them.

(3) Connect the connectors to the encoder board 4.

Connectors:
EB05_CN1
EB0x_CN2 (Joint #5 motor side)
EB0x_CN2 (Joint #6 motor side)



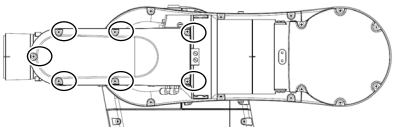
NOTE

Be careful that the jumper pins on the board do not come off.

(4) Install the Arm #4 side cover.

Cross recessed binding head machine screws:
7-M4×8

Tightening torque: 0.45 ± 0.05 N·m



NOTE

Be careful not to get the cables caught in the cover.

(5) Turn OFF the Controller.

(6) Calibrate the Joints #5 and #6.

For details, refer to "*8.Caribration*".

7.7 Replacing the Brake Board

Removal

Brake Board

(1) Turn OFF the Controller.

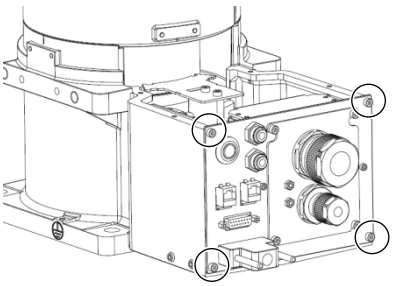
(2) Remove the base cover.

For details, refer to "*3. Covers*".

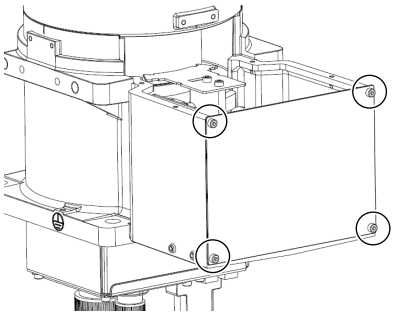
(3) Remove the base side plate.

Hexagon socket head cap bolts: 4-M4×8

M/C cable direction: Standard (backward)

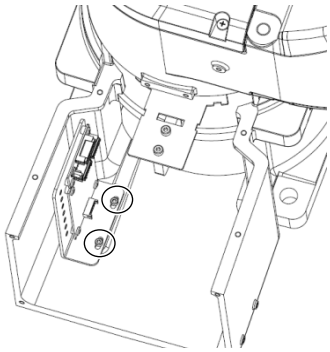


Upward and downward



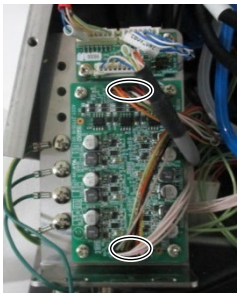
(4) Remove the board fixing plate in the base.

Hexagon socket head cap bolts: 2-M3×6



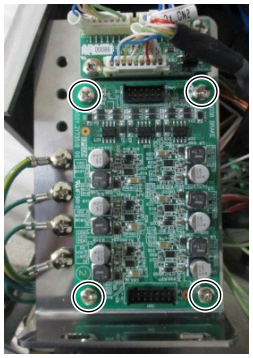
(5) Disconnect the connectors connected to the brake board.

Connectors:
BRK_CN1, BRK_CN2



(6) Remove the brake board.

Cross recessed binding head machine screws: 4-M3×6



Installation

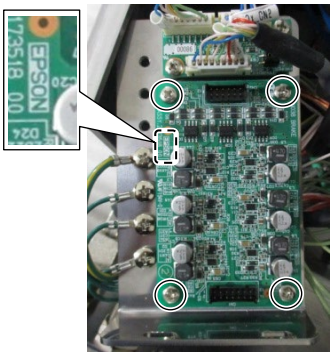
Brake Board

(1) Install the brake board to the board fixing plate.

Cross recessed binding head machine screws: 4-M3×6

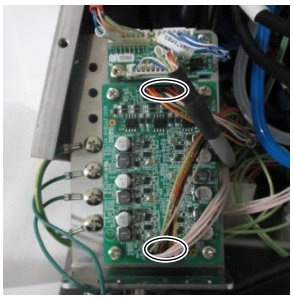
Tightening torque: 0.45 ± 0.05 N·m

Make sure to install as the same direction as the picture.



(2) Connect the connectors to the brake board.

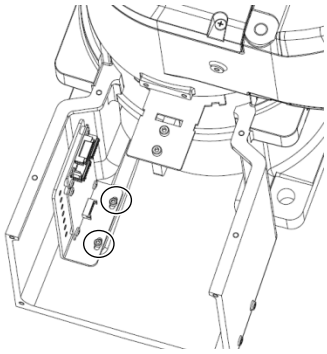
Connectors: BRK_CN1, BRK_CN2



(3) Install the board fixing plate on the base.

Cross recessed binding head machine screws: 2-M3×6

Tightening torque: 2.0 ± 0.1 N·m

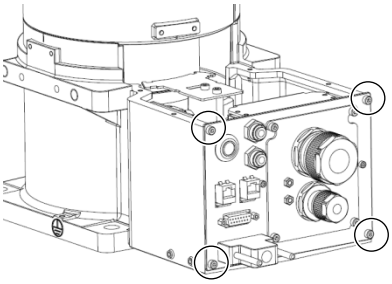


(4) Install the base side plate.

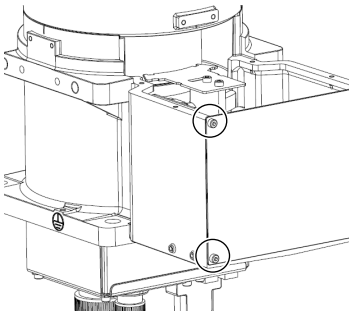
Hexagon socket head cap bolts: 4-M4×8

Tightening torque: 4.0± 0.2 N·m

M/C cable direction: Standard (backward)



Upward and downward



NOTE

Be careful not to get the cables caught in the base.

(5) Install the base cover.

For details, refer to "*3. Covers*".

(6) Turn ON the Controller.

7.8 Replacing the LED Board

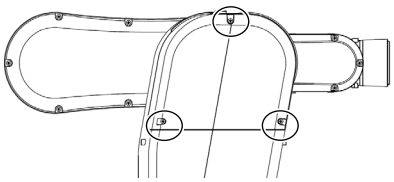
Removal

LED Board

(1) Turn OFF the Controller.

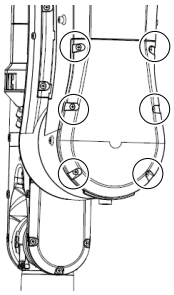
(2) Remove the Joint #2 outside cover.

N6-A1000**



Cross recessed binding head machine screws: 3-M4×8

N6-A850**R



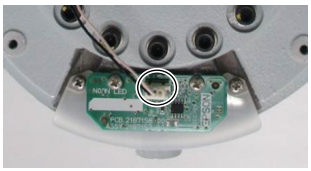
Cross recessed binding head machine screws: 6-M4×8

(3) Disconnect the connector connected to the LED board.

Connector: LED_CN1

N6-A1000**

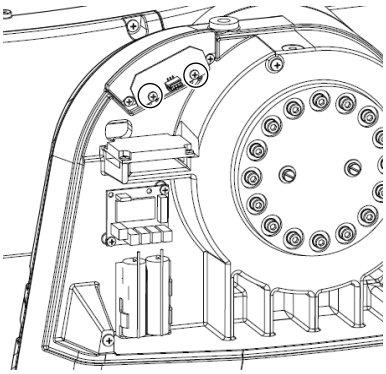
N6-A850**R



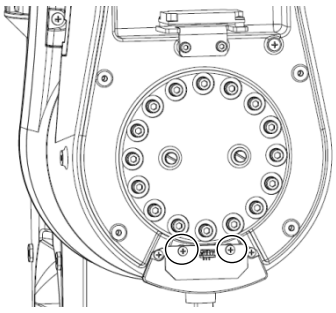
(4) Remove the LED board.

Cross recessed binding head machine screws: 2-M3×6

N6-A1000**



N6-A850**R



Installation

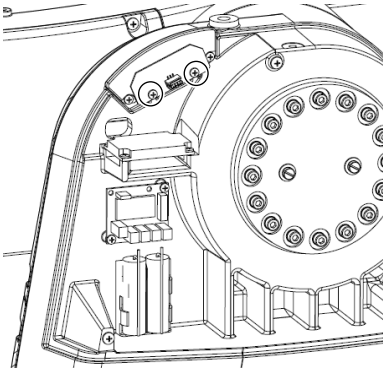
LED Board

(1) Install the LED board.

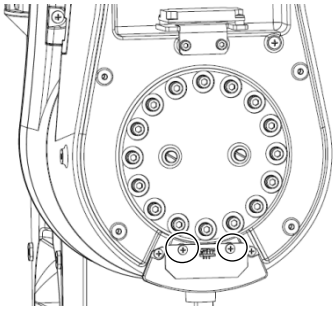
Cross recessed binding head machine screws: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

N6-A1000**



N6-A850**R

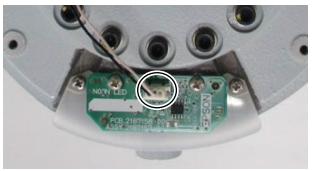


(2) Connect the connector to the LED board.

Connector: LED_CN1

N6-A1000**

N6-A850**R

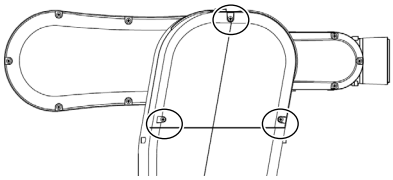


(3) Install the Joint #2 outside cover.

NOTE

Be careful not to get the cables caught in the cover.

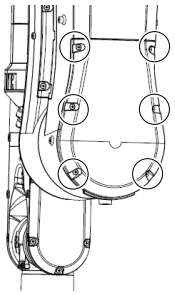
N6-A1000**



Cross recessed binding head machine screws: 3-M4×8

Tightening torque: 0.45 ± 0.05 N·m

N6-A850**R



Cross recessed binding head machine screws: 6-M4×8

Tightening torque: 0.45 ± 0.05 N·m

7.9 Replacing the LED Plate

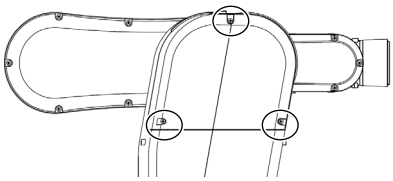
Removal

LED Plate

(1) Turn OFF the Controller.

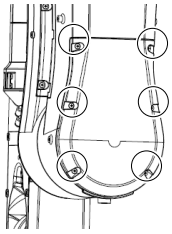
(2) Remove the Joint #2 outside cover.

N6-A1000**



Cross recessed binding head machine screws: 3-M4×8

N6-A850**R



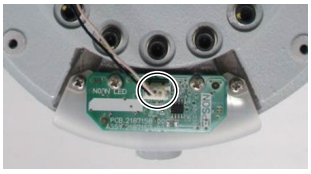
Cross recessed binding head machine screws: 6-M4×8

(3) Disconnect the connector connected to the LED board.

Connector: LED_CN1

N6-A1000**

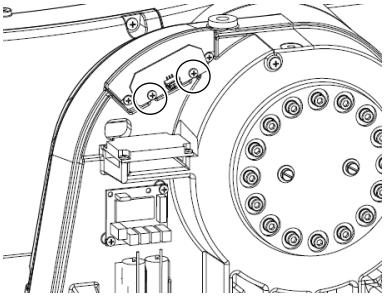
N6-A850**R



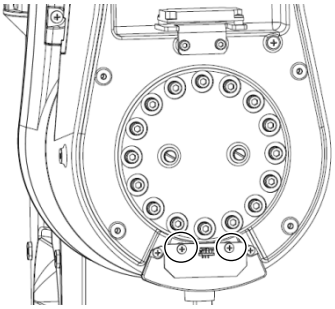
(4) Remove the LED board.

Cross recessed binding head machine screws: 2-M3×6

N6-A1000**



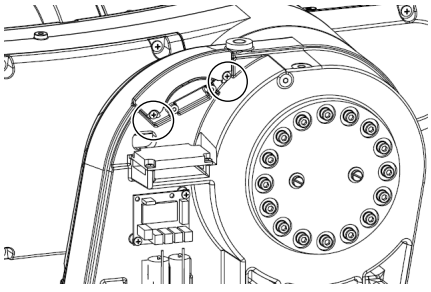
N6-A850**R



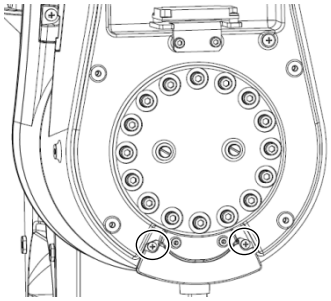
(5) Remove the LED plate.

Cross recessed binding head machine screws: 2-M3×6

N6-A1000**



N6-A850**R



Installation

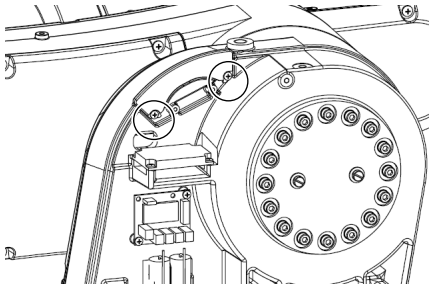
LED Plate

(1) Install the LED plate to the Arm #1.

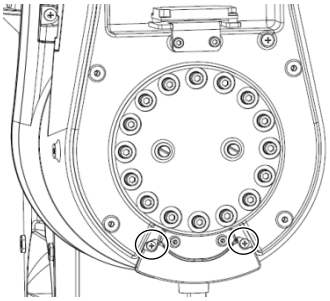
Cross recessed binding head machine screws: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

N6-A1000**



N6-A850**R

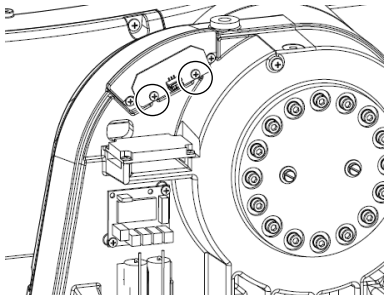


(2) Install the LED board.

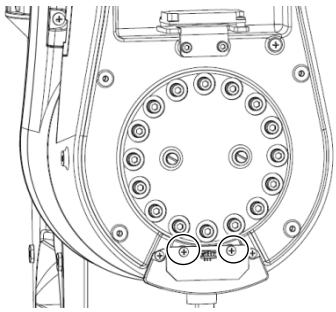
Cross recessed binding head machine screws: 2-M3×6

Tightening torque: 0.45 ± 0.05 N·m

N6-A1000**



N6-A850**R

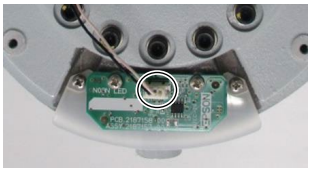


(3) Connect the connector to the LED board.

Connector: LED_CN1

N6-A1000**

N6-A850**R

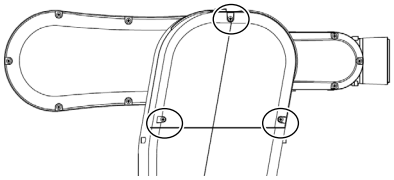


(4) Install the Joint #2 outside cover.

NOTE

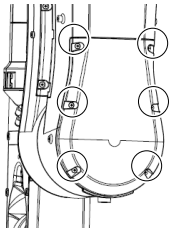
Be careful not to get the cables caught in the cover.

N6-A1000**



Cross recessed binding head machine screws: 3-M4×8
Tightening torque: 0.45 ± 0.05 N·m

N6-A850**R



Cross recessed binding head machine screws: 6-M4×8
Tightening torque: 0.45 ± 0.05 N·m

8. Calibration

8.1 Overview

After parts (actuator units, timing belts, etc.) or the battery board have been replaced, the Manipulator cannot perform positioning properly because a gap exists between the origin stored in each actuator unit and its corresponding origin stored in the Controller.
After replacing the parts, it is necessary to match these origins.
The process of aligning the two origins is called “Calibration”.
Note that calibration is not the same as teaching*

* “Teaching” means to teach the Controller coordinate points (including poses) anywhere in the operating area of the Manipulator.

 WARNING	■ To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the *Installation and Design Precautions* in the *Safety* chapter of the *EPSON RC+ User’s Guide*. ■ Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted (low speeds and low power) status to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly.

There are two methods to move the Manipulator during calibration.

- Releasing the Electromagnetic brake and moving the arms manually.
  For details, refer to N series Manual “*N6 Manipulator*”-“*1.6 How to Move Arms with the Solenoid brake*”.
- Moving the Manipulator using Jog & Teach.
  For details of Jog & Teach, refer to the following manual.
  EPSON RC+ User's Guide 5.12.1 [Robot Manager] Command (Tools Menu)-[Jog and Teach]

Moving the Manipulator while releasing the Electromagnetic brake involves risk as described below.

 CAUTION	■ Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may cause hands and fingers to be caught and/or equipment damage to or malfunction of the Manipulator as the arms of the Manipulator may move in unexpected directions. ■ Be careful of the arm falling when releasing the brake. While the brake is being released, the Manipulator’s arm falls by its own weight. The arm falling may cause hands and fingers to be caught and/or may cause equipment damage to or malfunction of the Manipulator.

Also, pay attention to the following points at the encoder initialization.

CAUTION	■ The Joints #1 to Joint #4 have no mechanical stops. If the encoder initialization is performed with improper posture, the Manipulator moves outside the operation range. If the Manipulator was moved outside the operation range, the internal wiring may be damaged by being twisted or pinched and it may result in Manipulator malfunction.

NOTE

When the Joint #1 to #4 rotates 360 degrees, the Manipulator will be the same posture. For example, posture at +180 degree and −180 degree is the same.
When you are not sure the current joint angle, check the internal wiring and tubing (cables).

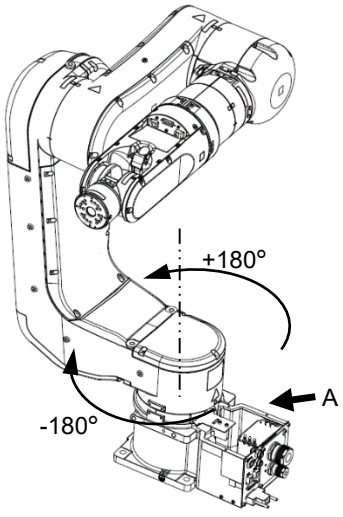
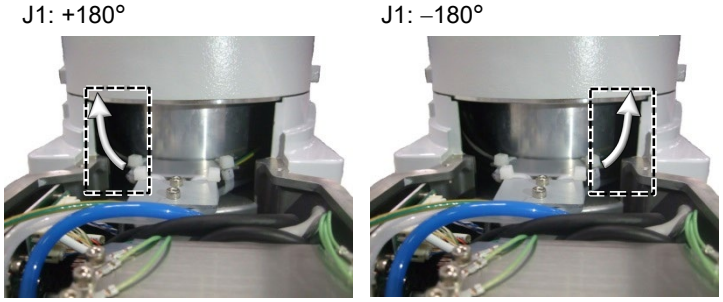
You can check the cable conditions by removing the each cover.

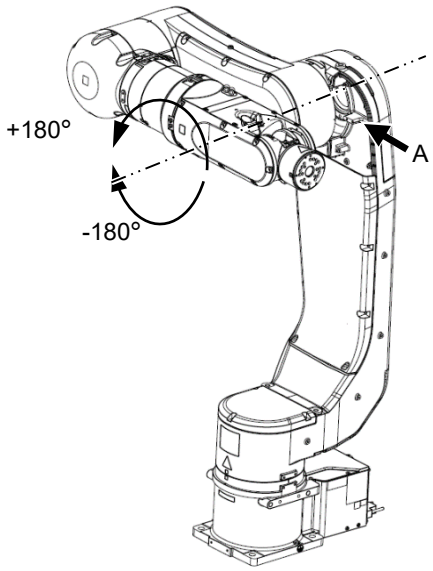
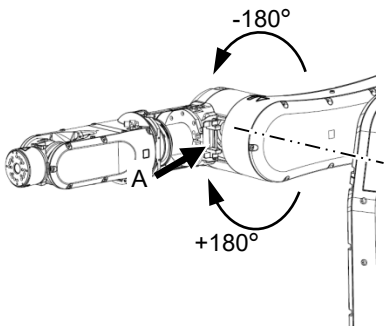
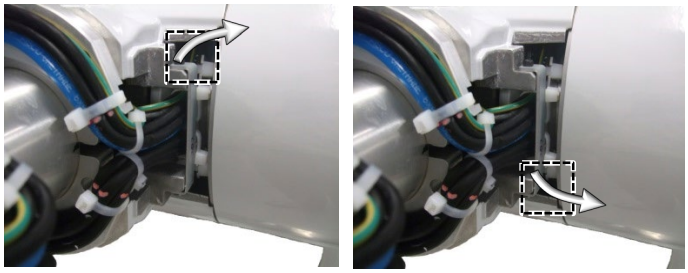
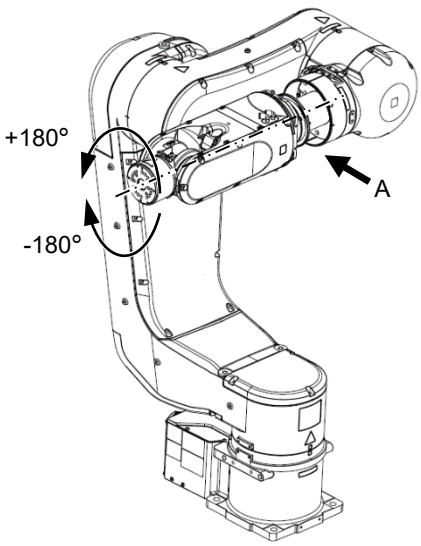
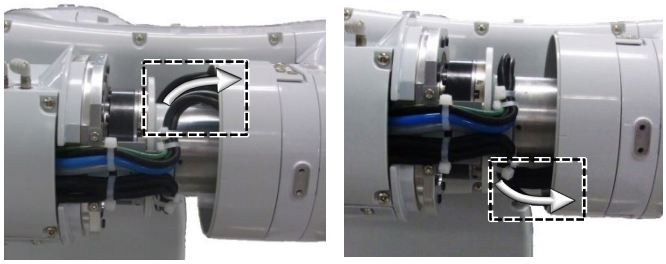
Joint #1 : Base cover
Joint #2 : Joint #2 cover (N6-A1000**), Arm #1 inside cover (N6-A850**R)
Joint #3 : Arm #3 inside cover
Joint #4 : Joint #4 inside cover, Joint #4 outside cover

For procedures of the cover removal, refer to "*3. Covers*".

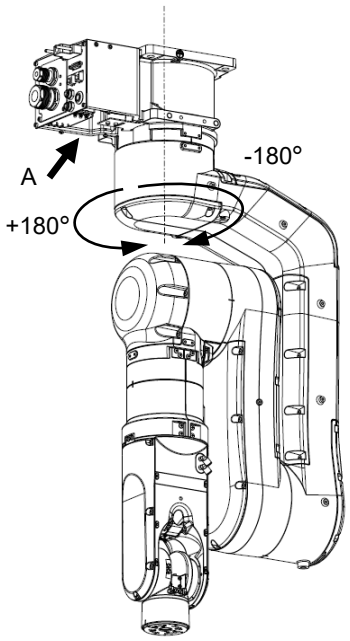
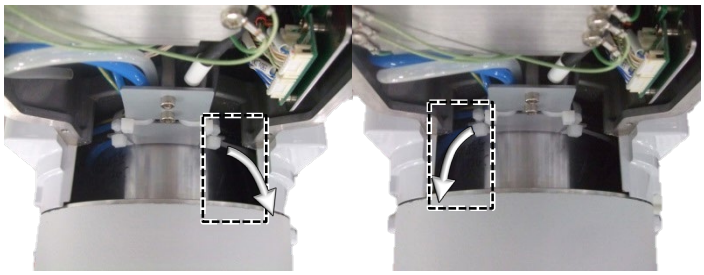
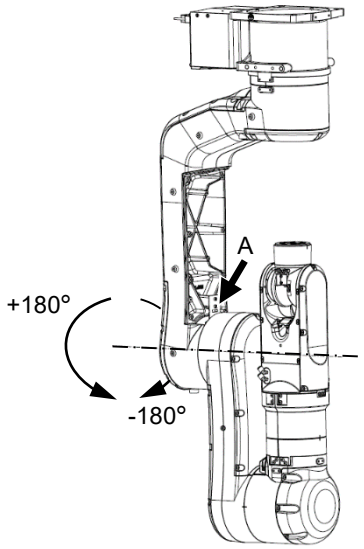
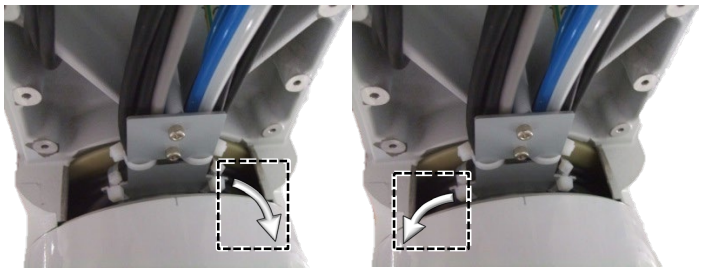
The following are examples of the cable conditions at ±180 degree posture.
(White arrow is an image of the cable.)

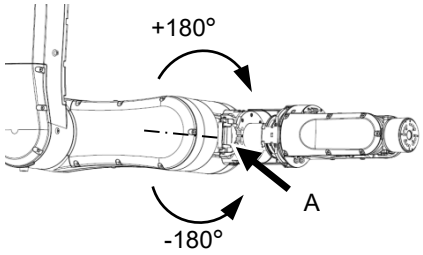
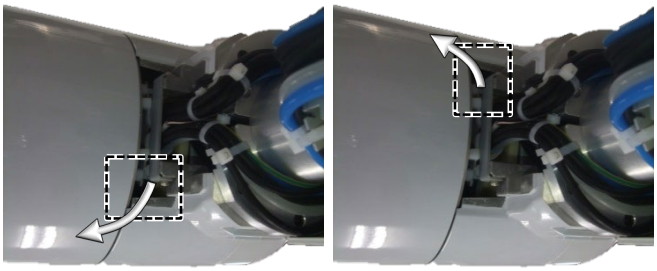
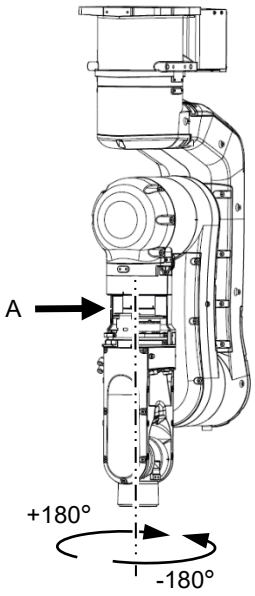
N6-A1000**

N6-A1000**	Detail of A
Joint #1 	 Cable direction: Arm #1 side

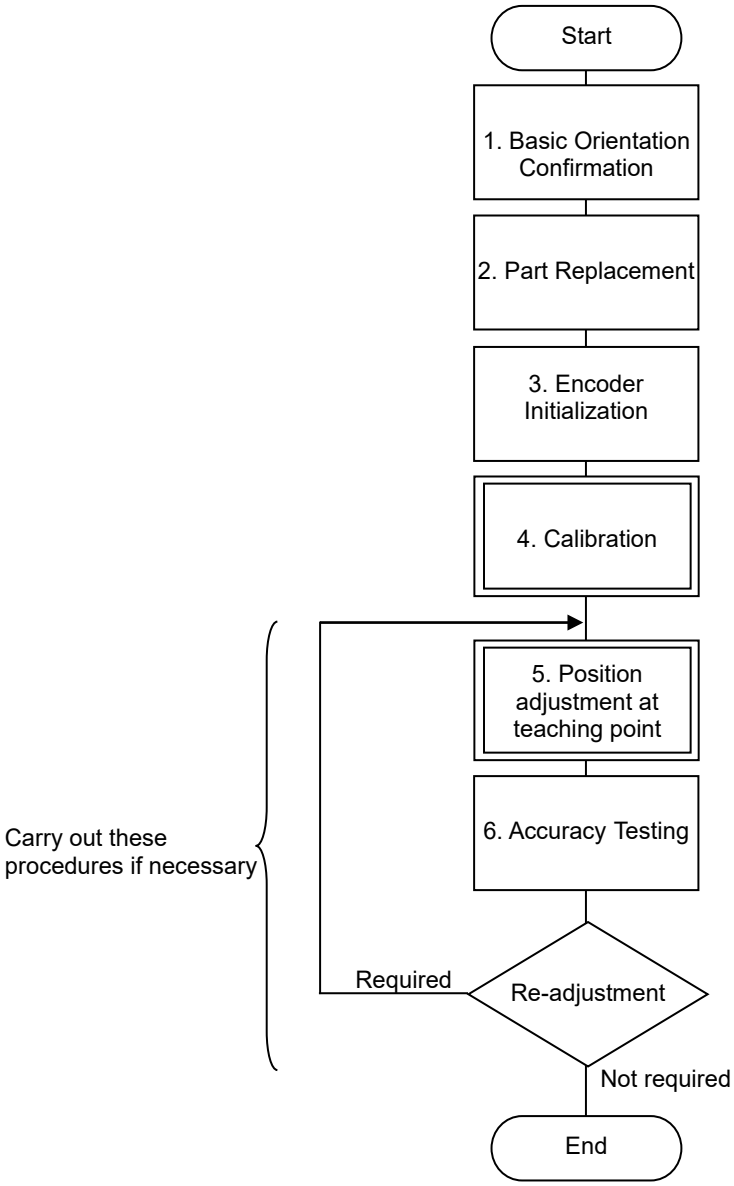
N6-A1000**	Detail of A
Joint #2  	J2: +180° J2: –180°  Cable direction: Arm #2 side
Joint #3  	J3: +180° J3: –180°  Cable direction: Arm #2 side
Joint #4  	J4: +180° J4: –180°  Cable direction: Arm #3 side

N6-A850**R

N6-A850**R	Detail of A
Joint #1  	J1: +180° J1: −180°  Cable direction: Arm #1 side
Joint #2  	J2: +180° J2: −180°  Cable direction: Arm #2 side

<table>
<tr><th>N6-A850**R</th><th>Detail of A</th></tr>
<tr><td>Joint #3
 
</td><td>J3: +180°
J3: –180°
 
Cable direction: Arm #2 side</td></tr>
<tr><td>Joint #4
 
</td><td>J4: +180°
J4: –180°
 
Cable direction: Arm #3 side</td></tr>
</table>

Calibration Flowchart



8.2 Calibration Procedure

Command Input

Command execution is required in some calibration procedures.
Select EPSON RC+ menu-[Tools]-[Command Window].

This step is omitted in the calibration procedures.

Jog Motion

Setting of the jog motion is required in some calibration procedures.
Select EPSON RC+ menu-[Tools]-[Robot Manager] and select the [Jog & Teach] page.

The panel, window, and page above are indicated as [Jog & Teach] in the calibration procedures.

Follow the steps 1 to 5 to calibrate the Manipulator.

1. Basic Orientation Confirmation

   Calibration is performed with the basic orientation of the Manipulator.
   For details about the basic orientation, refer to *N series Manual "N6 Manipulator"*-"*3.8 Checking the Basic Orientation*".

   When the Manipulator cannot have the basic orientation, define the reference orientation in advance, and record the point data. Also, put the "match marks" to indicate the orientation.

   The coordinate points including the Arm orientation are referred to as "points", and the data of the points are called "point data" in EPSON RC+.

2. Part Replacement

   Replace the parts as instructed in this manual.
   Be careful not to injure yourself or damage parts during part replacement.

3. Encoder Initialization:

   Connect the cables and turn ON the Controller while all joints are in the motion range.

   The following error message will be displayed on EPSON RC+ window
   "Encoder alarm has occurred. Check robot battery. EPSON RC+ must be restarted."

   Initialize the encoder at the current Manipulator position and reset the error.

   Execute the following command in the [Command Window] to initialize the encoder.

   EPSON RC+

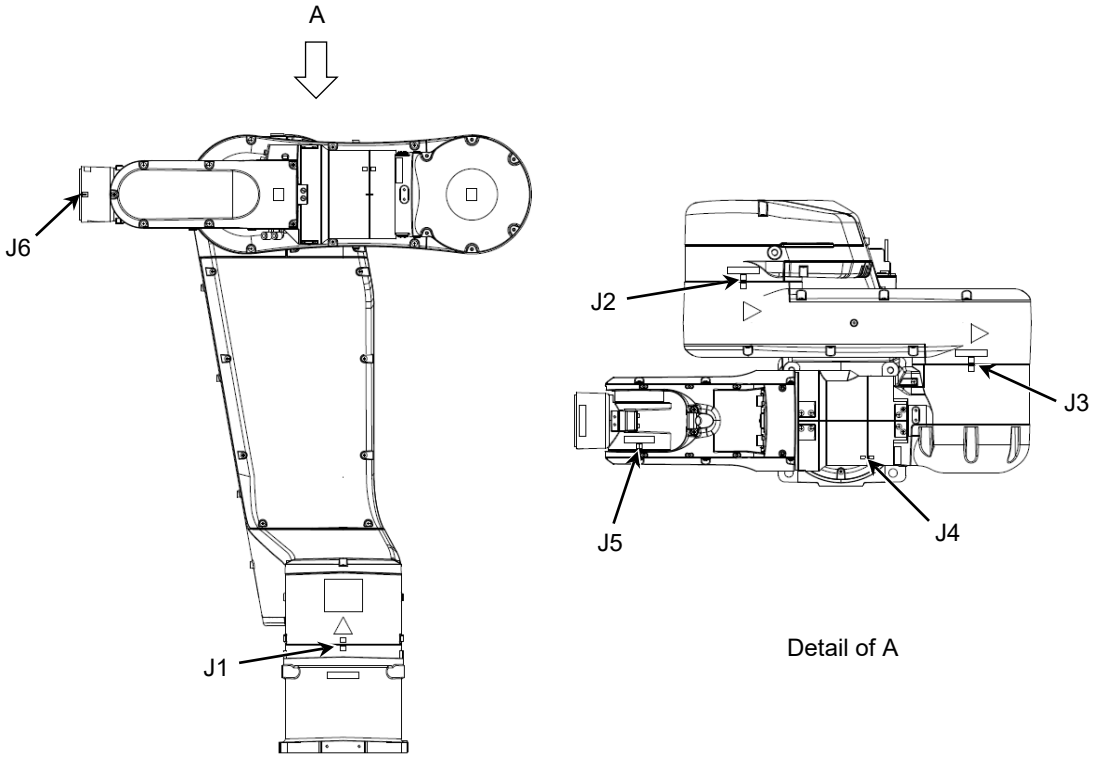
   `>Encreset` [The joint number (1 to 6) of the encoder to be reset]

   Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

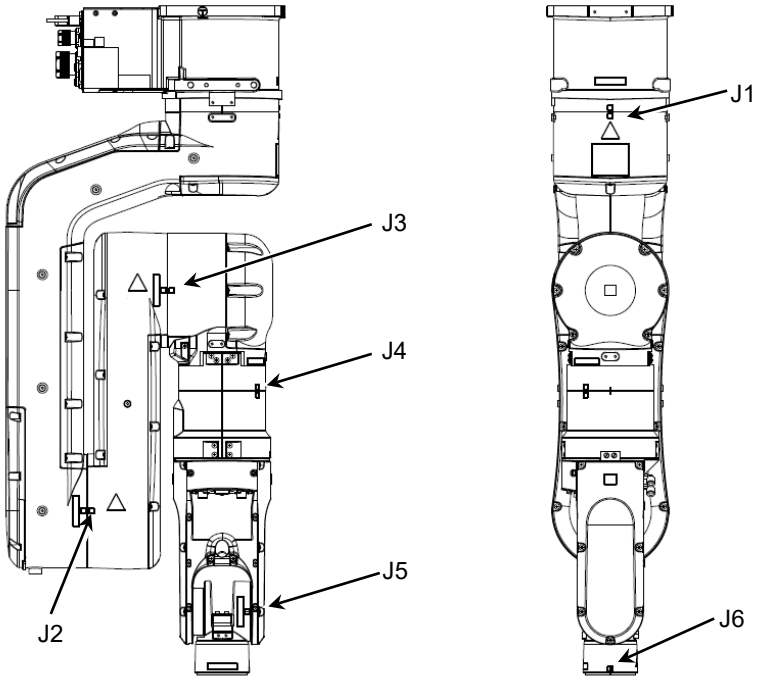
4. Calibration

Calibration marks of each joint

N6-A1000**



N6-A850**R



4-1. Align the calibration marks of the target joint

EPSON RC+

Set the jog mode to “Joint” in the [Jog & Teach] panel from EPSON RC+ menu - [Tools] - [Robot Manager], and then move the Manipulator in Jog motion so that the calibration marks on the target joint match as much as possible.

Refer to “Calibration marks of each joint” for location of the calibration marks.

When the Manipulator cannot have the basic orientation, move the Manipulator so that the “match marks” depending on the predetermined reference orientation are aligned.

4-2 Initialize the Encoder.

EPSON RC+

Execute the command in the [Command Window] from EPSON RC+ menu - [Tools] according to the joint to adjust as follows.

Joint #1 `>Encreset 1`
Joint #2 `>Encreset 2`
Joint #3 `>Encreset 3`
Joint #4 `>Encreset 4`
Joint #5 `>Encreset 5, 6`
Joint #6 `>Encreset 6`

Restart the Controller.

Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

4-3 Execute the origin point setting

EPSON RC+

Execute the following command in the [Command Window] to specify the pulse values to be set as the origin point.

`>calpls` J1 pulse, J2 pulse, J3 pulse, J4 pulse, J5 pulse, J6 pulse

* Manipulator will not move.

Specify the pulse values “0” when the Manipulator is aligned to the calibration marks, or the values recorded at the predetermined reference orientation (where the match marks are aligned) to the command parameters (pulse values).
If the point data for the reference orientation is “P1”, the command parameters can be specified as follows

```
>calpls ppls(P1,1), ppls(P1,2), ppls(P1,3),
ppls(P1,4), ppls(P1,5), ppls(P1,6)
```

Then, execute the following command in the [Command Window] to set the specified pulse values to the encoder according to the joint to set the origin point.

Joint #1 `>Calib 1`
Joint #2 `>Calib 2`
Joint #3 `>Calib 3`
Joint #4 `>Calib 4`
Joint #5 `>Calib 5,6`
Joint #6 `>Calib 6`

NOTE
☞ When the origin of the Joint #5 is calibrated, the Joint #6 will be out of position. (Due to the structure of the Manipulator, any offset in the position of the Joint #5 affects the Joint #6.)
Calibrate the origin of the Joint #6 together when calibrating the Joint #5.

5. Position adjustment by teaching point (perform if necessary)

EPSON RC+

After calibration, move the Manipulator to the selected point data by jogging in [Jog & Teach].

When the selected point data is “P1”,
Execute “Motor On” in [Control Panel] and execute “Go P1” in [Jog & Teach].

EPSON RC+

Adjust the calibrated joints accurately by jog command so that the end effector is aligned to the selected point data position.
*When the Joint #5 is calibrated, adjust the Joint #5 and #6.

Select the “Joint” jog mode from [Jog & Teach] to change and adjust the angle of the target joint in the jog motion.

Set the pulse values again at the adjusted point.

Execute the following command in the [Command Window] to specify the pulse values to set.

```
>calpls J1 pulse, J2 pulse, J3 pulse, J4 pulse, J5 pulse, J6 pulse
```

* Manipulator will not move.

Specify the pulse values of the selected point data to the command parameters.
If the point data for the reference orientation is “P1”, the command parameters can be specified as follows

```
>calpls ppls(P1,1), ppls(P1,2), ppls(P1,3),
ppls(P1,4), ppls(P1,5), ppls(P1,6)
```

* Manipulator will not move.

Then, execute the following command in the [Command Window] to set the specified pulse values to the encoder according to the joint to set the origin point.

Joint #1 `>Calib 1`
Joint #2 `>Calib 2`
Joint #3 `>Calib 3`
Joint #4 `>Calib 4`
Joint #5 `>Calib 5, 6`
Joint #6 `>Calib 6`

6. Accuracy Testing

Move the Manipulator to a different pose (point) to verify whether it moves back to the original position. If accuracy is inadequate, it is necessary to re-calibrate the origin using a different pose (point). You must set the pose (point) again if the Manipulator does not move back to the original position after re-calibration.

9. N6 Maintenance Parts List

Name		Code	Note	Reference	Overhaul *
Actuator unit	Joint #1	1749168	600 W, unit	5.1	✓
	Joint #2	1749169	600 W, unit	5.2	✓
	Joint #3	1749170	400 W, unit	5.3	✓
	Joint #4	1749171	100 W, unit	5.4	✓
AC servo motor	Joint #5	1749172	100 W, single item	5.7	✓
	Joint #6	1749173	100 W, single item	5.6	✓
Joint unit	Joint #5, 6	1749174	Unit	5.7	✓
Electromagnetic brake		1670649	(Solenoid brake)	5.5, 5.6	✓
Timing belt		1739205		5.5, 5.6	✓
Belt tensile jig		1749184	Assembly jig	5.5, 5.6	
Battery set		2172925	(2 lithium metal batteries for replacement)	6.1	
Battery board		2173216		6.2	

* Overhaul

As a rough indication, perform overhaul (parts replacement) before reaching 20,000 operation hours of the Manipulator.

The operation hours can be checked in [Controller Status Viewer] dialog box - [Motor On Hours].

For details, refer to *2.2 Overhaul (Parts Replacement)*.

Name		Code	Note	Reference
Grease **	Joint #1, 2, 3,4 ,5: SK-1A	-	For purchasing the grease, please contact the supplier of your region.	2.1.2, 2.3
	Joint #6, bevel gear: SK-2	-		
	Cable: GPL-224	-		4, 5

** Due to the chemicals regulations of individual countries (the UN GHS), we are requesting our customers to purchase grease required for maintenance from the manufacturers listed in the table below as of April 2015.

Regarding purchase of the grease and other materials, please contact the following manufacturers.

If there is anything unclear, please contact the supplier of your region.

Product name	Manufacturer	URL
Harmonic Grease SK-1A Harmonic Grease SK-2	Harmonic Drive Systems Inc.	https://www.harmonicdrive.net/
Krytox®GPL-224	Chemours	https://www.chemours.com/en/brands-and-products

Name			Code	Note	Reference
Control Board 1, 2			2138032		7.1, 7.2
LED plate			1739260		7.9
LED board			2190495		7.8
Encoder board 1, 2, 3, 4			2179137		7.3, 7.4, 7.5, 7.6
Brake board			2178379		7.7
O-ring	Joint #4		1554675	Wire diameter ø 2.0mm, Inner diameter ø 47.5mm	5.4
	Oil filler		1657289	Wire diameter ø 1.0mm, Inner diameter ø 17.0mm	2.3
M/C cable	3 m	Straight	R12NZ900YF		4.6
		L-shaped	R12NZ900YM		
	5 m	Straight	R12NZ900YH		
		L-shaped	R12NZ900YN		
	10 m	Straight	R12NZ900YJ		
		L-shaped	R12NZ900YP		
	15 m	Straight	R12NZ900YK		
		L-shaped	R12NZ900YQ		
	20 m	Straight	R12NZ900YL		
		L-shaped	R12NZ900YR		
M/C cable (flexible)	3 m	Straight	R12NZ900YT		
		L-shaped	R12NZ900YY		
	5 m	Straight	R12NZ900YU		
		L-shaped	R12NZ900YZ		
	10 m	Straight	R12NZ900YV		
		L-shaped	R12NZ900Z1		
	15 m	Straight	R12NZ900YW		
		L-shaped	R12NZ900Z2		
	20 m	Straight	R12NZ900YX		
		L-shaped	R12NZ900Z3		
Cable unit			2187251	Standard model	4.1
			2194258	Cleanroom & ESD model	4.1
Relay cable 1			2187252		4.5
Relay cable 2			2176220		4.5
Cable tie	AB150		1675754	100 ties/1 bag: white	
	AB200		1684328		

Name			Code	Note	Reference
Cover (Standard model)	Base	Base cover	1749181	Plastic cover	3
	Arm #1 (N6-A1000)	Joint #1 inside cover	1739211		
		Joint #2 cover	1739212		
		Joint #1 cover	1739213		
		Joint #2 outside cover	1739214		
		Arm #1 inside cover	1739215		
	Arm #1 (N6-A850)	Joint #1 cover	1755217		
		Joint #1 inside cover	1755218		
		Joint #2 outside cover	1755219		
		Arm #1 inside cover	1755220		
	Arm #2	Arm #2 cover	1749176		
	Arm #3	Arm #3 cover	1749177		
		Arm #3 inside cover	1739218		
		Joint #4 side cover	1749178		
	Arm #4	Arm #4 cable cover	1739221		
		Arm #4 side cover	1749179		
		Joint #4 inside cover	1739223		
		Joint #4 outside cover	1749180		
Cover (Cleanroom model)	Base	Base cover	1761617	Plastic cover (Plating)	3
	Arm #1 (N6-A1000)	Joint #1 cover	1755506		
		Joint #1 inside cover	1755504		
		Arm #1 inside cover	1755508		
		Joint #2 outside cover	1755507		
		Joint #2 cover	1755505		
	Arm #1 (N6-A850)	Joint #1 cover	1757779		
		Joint #1 inside cover	1757780		
		Arm #1 inside cover	1757782		
		Joint #2 outside cover	1757781		
	Arm #2	Arm #2 cover	1761612		
	Arm #3	Arm #3 inside cover	1755511		
		Arm #3 cover	1761613		
		Joint #4 side cover	1761614		
	Arm #4	Joint #4 inside cover	1755514		
		Joint #4 outside cover	1761616		
		Arm #4 side cover	1761615		
		Arm #4 cable cover	1739221		
Pad	Arm #4		1686754		
Calibration mark			1692799		8

10. N6 Option Parts List

Name		Code	Note	Reference*
Brake release unit (with M/C short connector)		R12NZ900N4	For Europe	6.1
		R12NZ900N5	For U.S. & Japan	
MC short connector		R12NZ900N7	For brake release unit	
Camera plate unit		R12NZ9003F	Common to C3, C4, C8, and N2	6.2
Tool adapter (ISO flange)		R12NZ900Z4		6.3
User connector kit	D-sub	R12NZ900LX		6.4

* : Refer to each Manipulator section of N series Manual