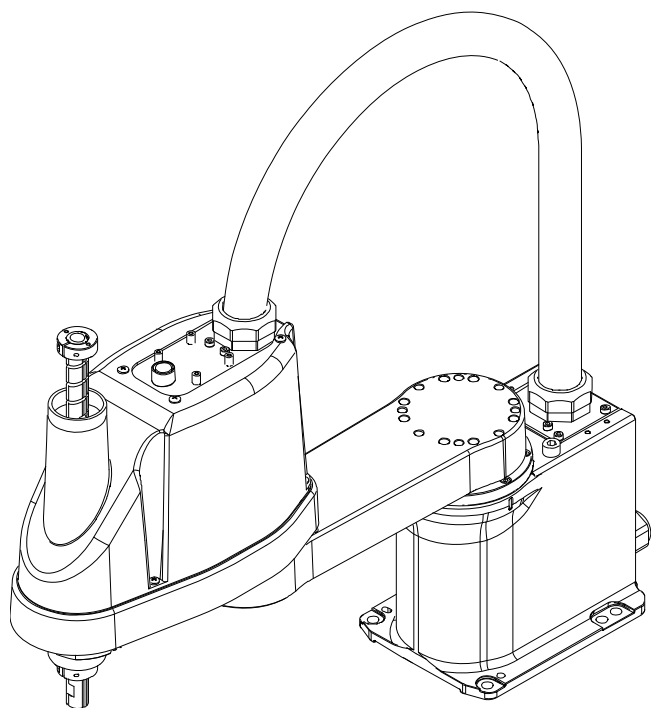


EPSON



SCARA ROBOT

LA3-A/LA6-A

Service Manual

Rev.6

ENSM266R0056

CAUTION

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CHAPTER

1

Maintenance Information

1.1 Safety Maintenance

Maintenance of robot system shall always be performed by personnel who has taken safety training.

Personnel who has taken safety training refers to a person who has taken safety training for workers engaged in activities related to industrial robots as stipulated by the laws and regulations of each country (such as the knowledge on industrial robots, knowledge on operations and teaching, knowledge on activities concerning inspection, etc., and training on related laws). Personnel who has taken training held by the manufacturer refers to a person who has completed the introduction training and maintenance training.

 WARNING	● Do not remove any parts that are not covered in this manual. Follow the maintenance procedure strictly as described in this manual. Do not proceed using any methods other than described in this manual when you do replace a part or maintain the equipment. Improper removal of parts or improper maintenance may not only cause improper function of the robot system but also serious safety problems. ● Keep away from the Manipulator while the power is ON if you have not taken the training courses. 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 when 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. ● To shut off power to the robot system, unplug the system or use a disconnecting device. Always connect the AC power cable using a plug or disconnecting device and do not directly connect it to the factory power supply. ● 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 maintaining the manipulator, wear at least the following protective gear. Working without protective gear may cause serious safety problems. • Work clothes suitable for work • Helmet • Safety shoes
---	--



- Do not allow foreign objects to enter the inside of the manipulator or the connection terminals. Energizing the manipulator with foreign objects in it may cause electric shock or malfunction, which is extremely dangerous.



- 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.) The unnecessary strain on the 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 operating maintenance of Manipulator, secure about 500 mm of empty space around the Manipulator.
- Carefully use alcohol, liquid gasket, and adhesive following respective instructions and instructions below. Careless use of alcohol, liquid gasket, or adhesive may cause a fire and/or safety problem.
 - Never put alcohol, liquid gasket, or adhesive close to fire.
 - Use alcohol, liquid gasket, or adhesive while ventilating the room.
 - Wear protective gear including a mask, protective goggles, and oil-resistant gloves.
 - If alcohol, liquid gasket, or adhesive gets on your skin, wash the area thoroughly with soap and water.
 - If alcohol, liquid gasket, or adhesive gets into your eyes or mouth, flush your eyes or wash out your mouth with clean water thoroughly, and then see a doctor immediately.
- Wear protective gear including a mask, protective goggles, and oil-resistant gloves during grease up. 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.

1.2 General Maintenance

Performing maintenance inspections properly is essential for preventing trouble and maintaining safety. This chapter describes the schedules for maintenance inspection and procedures.

Be sure to perform the maintenance inspections in accordance with the schedule.

1.2.1 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, 1,500 hours, and 3,000 hours operation.

	Inspection Point					
	Daily inspection	Monthly inspection	Quarterly inspection	Biannual inspection	Annual inspection	Overhaul (replacement)
1 month (250 h)	Inspect every day	√	-	-	-	-
2 months (500 h)		√	-	-	-	-
3 months (750 h)		√	√	-	-	-
4 months (1,000 h)		√	-	-	-	-
5 months (1,250 h)		√	-	-	-	-
6 months (1,500 h)		√	√	√	-	-
7 months (1,750 h)		√	-	-	-	-
8 months (2,000 h)		√	-	-	-	-
9 months (2,250 h)		√	√	-	-	-
10 months (2,500 h)		√	-	-	-	-
11 months (2,750 h)		√	-	-	-	-
12 months (3,000 h)		√	√	√	√	-
13 months (3,250 h)		√	-	-	-	-
:	:	:	:	:	:	:
20,000 h	-	-	-	-	-	√

1.2.2 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	Joint #3 break	√	√	√	√	√
Check whether unusual sound or vibration occurs.	Whole	√	√	√	√	√
Battery	Refer to 2.8.1 Replacing the Battery (lithium battery)					

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 1.2.6 Tightening Bolts/Screws 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. Check that connectors are not loose.
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 visible internal cable.
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.

Inspection Point	Inspection Method
Check the Brake operation	Check that the shaft does not fall when in MOTOR OFF. If the shaft falls when in MOTOR OFF and the brake is not released, contact the supplier. Also, if the break is not released even operated release the break, contact the supplier.
Check whether unusual sound or vibration occurs.	Check that there is no unusual sound or vibration during operation, no stiffness or looseness in the sliding parts or moving parts, and that the operation is performed smoothly. If an abnormality is suspected, replace the part in which the abnormality has occurred.

1.2.3 Overhaul (Parts Replacement)

**CAUTION**

- 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 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

The recommended replacement time for the parts subject to maintenance (Motors, Reduction Gears, Timing Belts, and Ball Screw Spline) can be checked in the [Maintenance] dialog box of the EPSON RC+8.0.

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%.

For the parts subject to overhaul, refer to [Chapter 5 Exploded View/Maintenance Parts List](#).

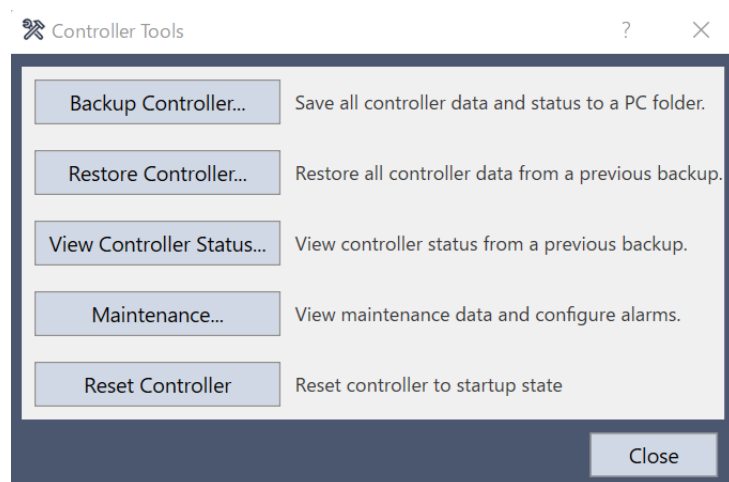
For details of replacement of each part, refer to [Chapter 2 Maintenance](#).

Please contact the supplier of your region for further information.

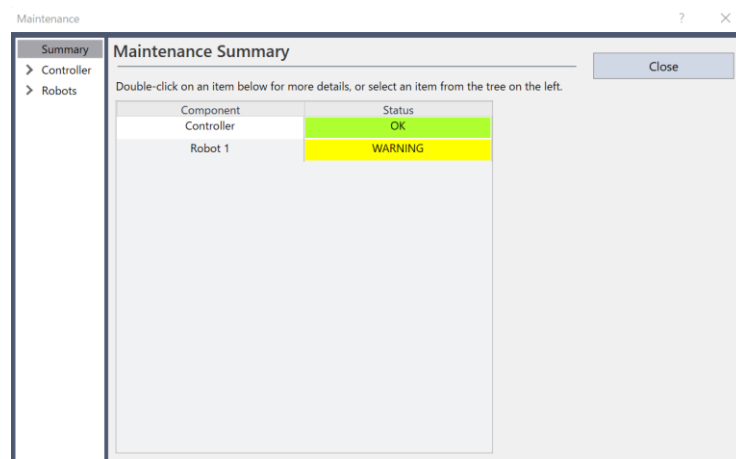
How to View the Maintenance Information

The configured maintenance information can be checked in the EPSON RC+8.0.

1. Select the EPSON RC+8.0 menu-[Tools]-[Maintenance] to display the [Controller Tools] dialog box.



2. To check the Controller maintenance information, click the <Maintenance> button and display the [Maintenance] dialog box.



3. Select “General” or specify the axis from the tree to display information of the target parts.

Maintenance

?

×

Summary

➤ Controller

▼ Robots

▼ Robot 1

General

Joint 1

Joint 2

Joint 3

Joint 4

Robot Maintenance: Joint

Robot 1, 1, Joint 3

Note: If Consumption is 100% or more, the part should be replaced (L10).

Part	Installation Date	Months Remaining	Consumptio...	Status
Belt	2024-06-19	9999.0	0	OK
Motor	2024-06-19	9999.0	0	OK
Ballscrew	2024-06-19	9999.0	0	OK
Grease	2022-09-06	0.0	362	WARNING

Close

Change...

Clear

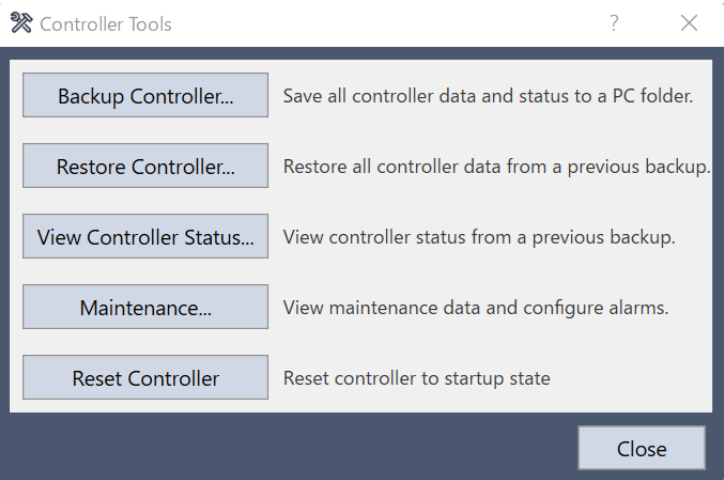
NOTE Remaining months is calculated based on the past operation conditions.

How to Edit the Maintenance Information

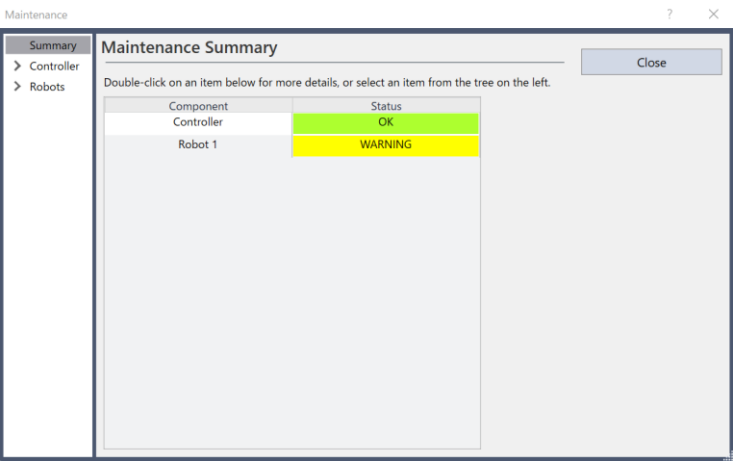
The configured maintenance information can be edited in the EPSON RC+8.0.

When the motor, Reduction Gear, Timing Belt, Ball Screw Spline or Battery is replaced with a new one, or when the Ball Screw Spline is greased, update the maintenance information following procedure below.

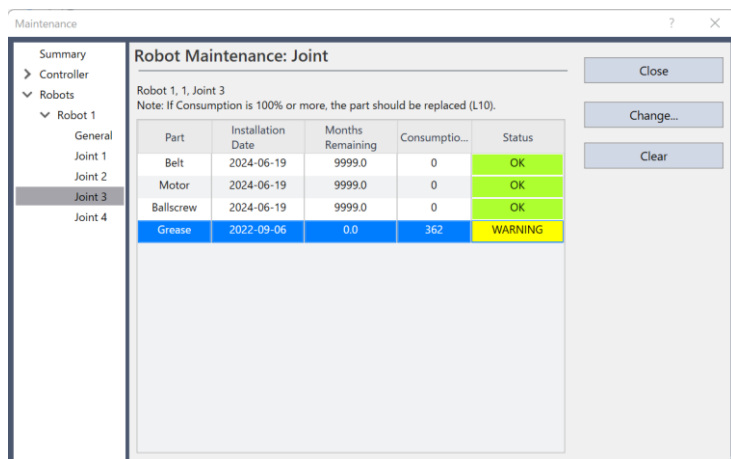
- 1. Select the EPSON RC+8.0 menu- [Tools] - [Maintenance] to display the [Controller Tools] dialog box.



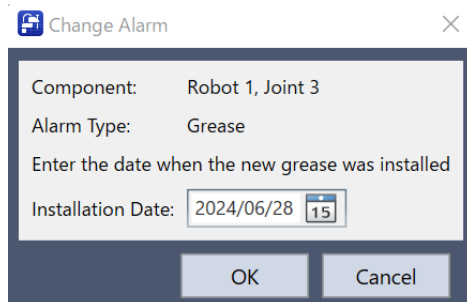
- 2. To edit the maintenance information, display the [Maintenance] dialog box.



3. Select “General” or specify the axis from the tree to display information of the target parts.
4. Select the alarm to be changed and click the <Change> button.



5. Display the [Change Alarm] dialog box and enter any of the followings.

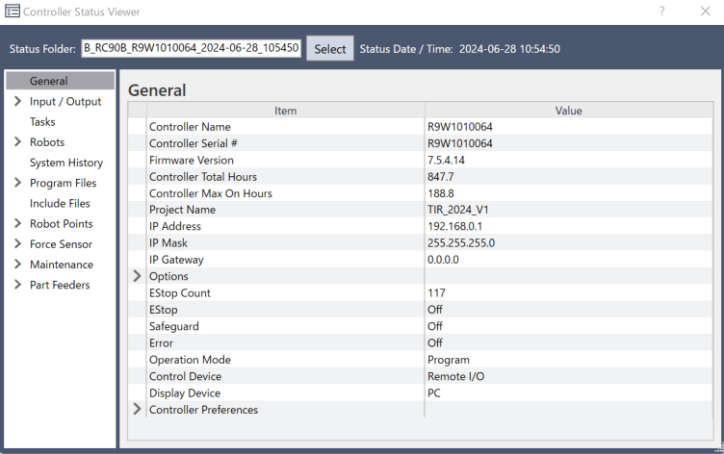


6. Click the <OK> button and change the specified alarm information.

How to check the Manipulator operation hours

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

- 1. Select EPSON RC+ menu- [Tools] - [Controller] to open the [Controller Tools] dialog.
- 2. Click the <View Controller Status> button to open the [Browse For Folder] dialog.
- 3. Select the folder where the information is stored.
- 4. Click <OK> to view the [Controller Status Viewer] dialog.
- 5. Select [Robots] from the tree menu on the left side (Dialog image: EPSON RC+8.0)



1.2.4 Greasing

The Ball Screw Spline and Reduction Gears need greasing regularly. Only use the specified grease.

 CAUTION	● Keep enough grease in the Manipulator. Operating the Manipulator with insufficient grease will 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.
---	--

Joint #1 and Joint #2 Reduction Gears

As a rough indication, perform greasing at the same timing as overhaul.

However, it may vary depending on 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.

How to grease the J1 Reduction Gear

①	Remove the J1 Motor following the procedure in Removing the J1 Motor Unit .
②	Wipe off old grease on the Wave Generator attached to the motor and inside the J1 Reduction Gear.
③	Apply the required amount of grease to the Reduction Gear following the instructions in Installing the J1 Motor and Installing the J1 Reduction Gear. Installing the J1 Motor: LA3-A , LA6-A Installing the J1 Reduction Gear: LA3-A , LA6-A
④	Reassemble the manipulator following the instructions in Installing the J1 Motor Unit .

How to grease the J2 Reduction Gear

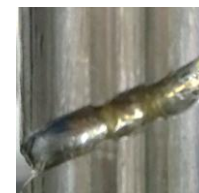
①	Remove the J2 Motor following the procedure in Removing the J2 Motor Unit .
②	Wipe off old grease on the Wave Generator attached to the motor and inside the J2 Reduction Gear.
③	Apply the required amount of grease to the Reduction Gear following the instructions in Installing the J2 Motor and Installing the J2 Reduction Gear .
④	Reassemble the manipulator following the instructions in Installing the J2 Motor Unit .

Ball Screw Spline Unit

The recommended greasing interval is at 100 km of operation.

However, greasing timing also can be checked from the grease condition. Perform greasing if the grease is discolored or becomes dry.

Perform greasing at 50 km of operation for the first time of greasing.



Normal grease



Discolored grease

Greasing procedure

For details, refer to [Greasing the Ball Screw Spline Unit](#).

NOTE

For the EPSON RC+8.0, the recommended replacement time for the grease on the Ball Screw Spline Unit can be checked in the [Maintenance] dialog box of the EPSON RC+8.0.

1.2.5 Tools/Materials

Tools used

	Name	Quantity	Note
Hexagonal wrench	width across flats: 1.5 mm	1	For M3 set screw
	width across flats: 2 mm	1	For M2.5 bolts and M4 set screw
	width across flats: 2.5 mm	1	For M3 bolts and M5 set screw
	width across flats: 3 mm	1	For M4 bolts
	width across flats: 4 mm	1	For M5 bolts
Torque wrench	0.45 N·m to 8.0 N·m	1	For details, refer to 1.2.6 Tightening Bolts/Screws .
Phillips screwdriver	Ph2	1	
Spanner		1	2.9.2 Replacing the M/C Cables 2.9.3 Replacing the Cable Unit
Nipper		1	For cutting wire tie
Spatula		1	For applying grease on the J1/J2 Reduction Gear
Wiping cloth		1	For wiping grease from the J1/J2 Reduction Gear and the Ball Screw Spline
Sonic Belt Tension Meter		1	3.1 Adjusting the Timing Belt Tension
Force gauge		1	3.1 Adjusting the Timing Belt Tension
Suitable cord (Length about 800 mm)		1	3.1 Adjusting the Timing Belt Tension

Grease used during maintenance

The parts to be greased and the amount of grease to be applied are listed on the maintenance page for each part.

Only use the grease specified in the following table.

The manufacturer and URL details of each grease type are as follows.

If there is anything unclear, please contact the supplier of your region.

	Parts to be greased	Product name	Manufacturer	URL
LA6-A	J1/J2 Reduction Gear	Harmonic Grease SK-1A	Harmonic Drive Systems Inc.	https://www.harmonicdrive.net/
LA3-A	J1 Reduction Gear	Harmonic Grease SK-1A		
	J2 Reduction Gear	Harmonic Grease SK-2		
Ball Screw Spline Unit		THK AFB-LF Grease	THK CO., LTD.	https://www.thk.com/

Materials used

Name		Quantity	Note
Alcohol		Proper quantity	For wiping grease from the J1/J2 Reduction Gear and the Ball Screw Spline
Wire tie	AB150	Proper quantity	Fixing the cables

1.2.6 Tightening Bolts/Screws

Hexagon socket head cap screws are used in places where mechanical strength is required. (A hexagon socket head cap screw may be called a "bolt" in this manual.) These bolts/screws are fastened with the tightening torques shown in the following table.

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

In the manual, the bolts and screws to be removed (attached) during maintenance are specified as follows:

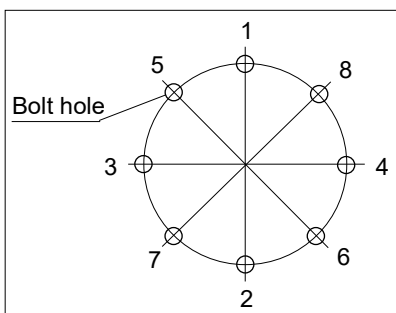
Example) S01: 6-M4x15

S01 indicates the "Type" in the table below. Be sure to tighten with the correct tightening torque after confirming the "Type" and "Size".

Type	Description	Size	Tightening torque (N·m)
S01	Hexagon socket head cap screw - Steel, Black dyed, black - Property class 10.9 (JIS B1051, ISO 898-1)	M3	2.0 +/- 0.1
		M4	4.0 +/- 0.2
		M5	8.0 +/- 0.4
		M6	13.0 +/- 0.6
		M8	32.0 +/- 1.6
		M10	58.0 +/- 2.9
		M12	100.0 +/- 5.0
S02	Hexagon socket head cap screw - Steel, Black dyed, black - Property class 12.9 (JIS B1051, ISO 898-1) - Reduction Gear, etc	M3	2.4 +/- 0.1
		M4	5.5 +/- 0.25
S03	Cross recessed pan head screw Circuit boards, etc.	M3	0.45 +/- 0.1
S05	Hexagon socket head set screw - Steel, Black dyed, black - Property class 45H (JIS B1177, ISO 4026)	M4	2.4 +/- 0.1
		M5	3.9 +/- 0.2

Type	Description	Size	Tightening torque (N·m)
S07	Cross recessed binding head screw • Covers, etc.	M4	0.45 +/- 0.1
S08	Cross recessed binding head screw • Plates, etc.	M4	0.9 +/- 0.1

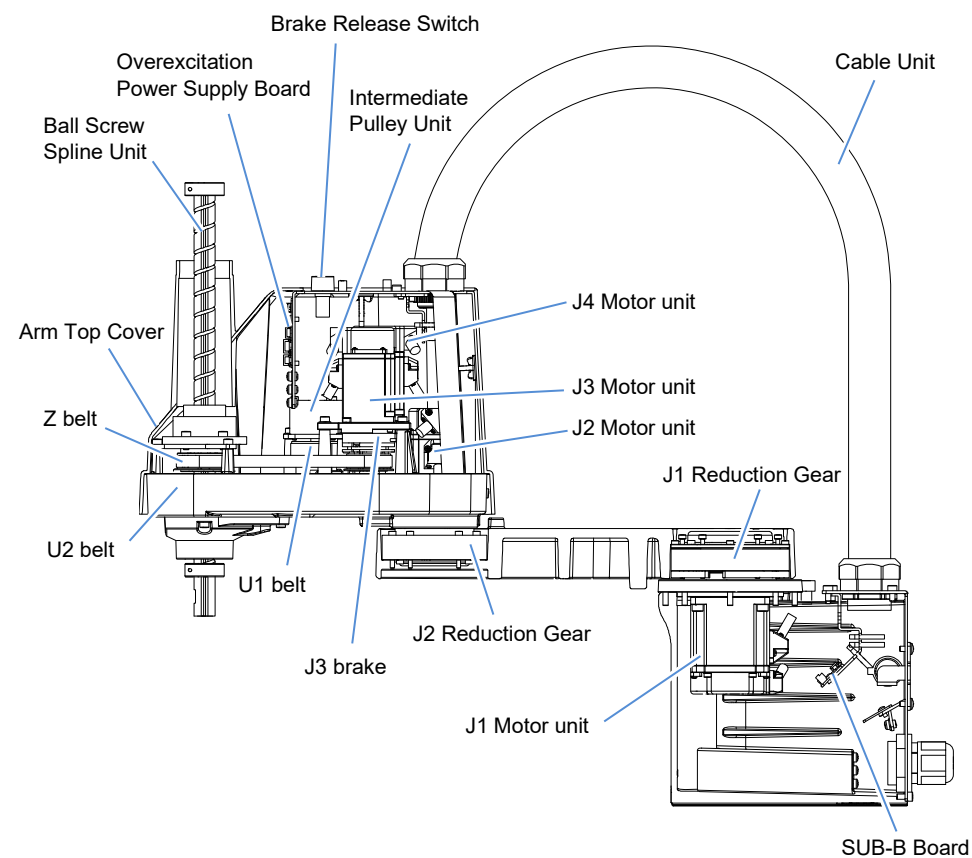
We recommend that the bolts aligned on a circumference should be fastened in a crisscross pattern as shown in the figure below.



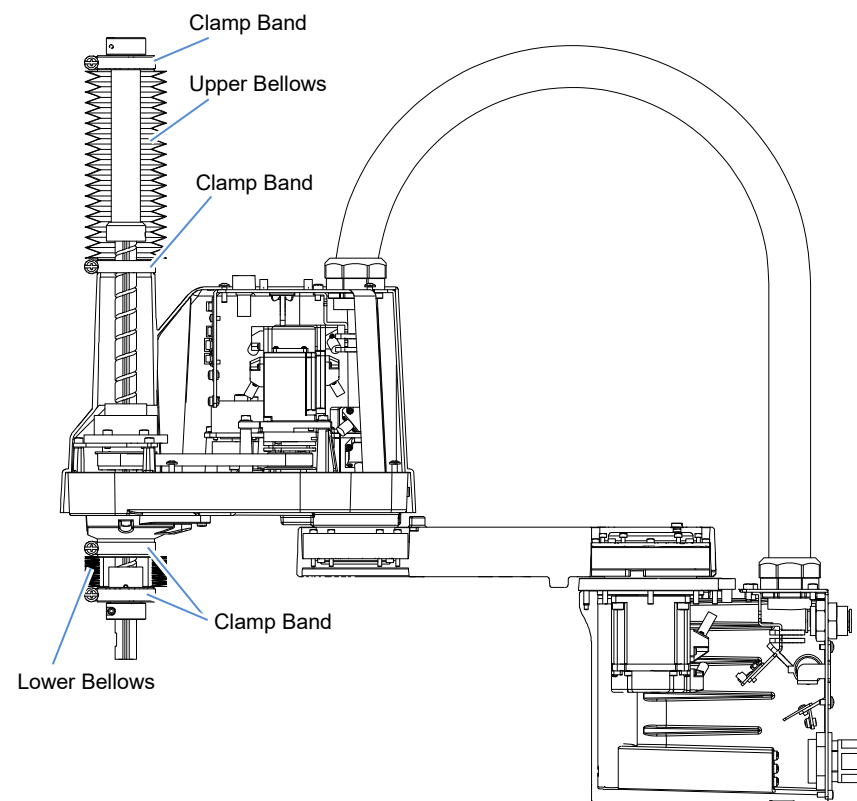
Do not fasten all bolts securely at one time. Divide the number of times that the bolts are fastened into two or three and fasten the bolts securely with a hexagonal wrench. Then, use a torque wrench so that the bolts are fastened with tightening torques shown in the table above.

1.3 Parts Layout

Standard environment model



Clean room environment model



CHAPTER

2

Maintenance

2.1 Overview

2.1.1 Precautions for Maintenance

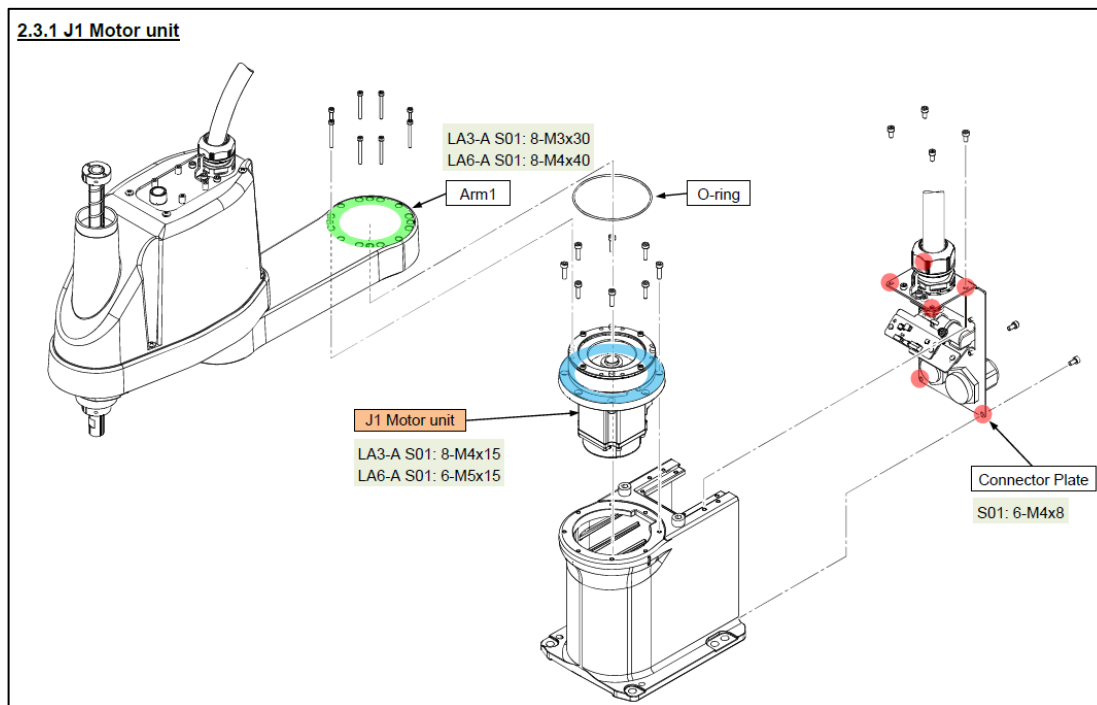
- Perform disassembly and assembly according to the procedures described in the manual.
- The parts for the Reduction Gear Unit are managed with serial numbers. Before installing parts, make sure the serial numbers of each match. Combining parts with different serial numbers may result in vibrations, abnormal noise, or other issues that may affect the accuracy of the robot.
- Remove connectors by releasing the latch. When connecting connector, make sure the latch is closed.
- Do not pull the connector or cable with force. Doing so may cause damage.
- When fixing the covers and plates, be careful not to pinch the cables.
- When cutting a wire tie, be careful not to damage the cables.
- Installation of a Silicone Sheet or securing with a wire tie are measures to prevent pulling or grazing of the cable when the robot moves, and also to prevent friction between connectors. Use the Silicone Sheet and wire tie according to the instructions in the manual to fix the cables.
- Make sure that the wire tie is not over-tightened with force.
- When tightening screws, use the correct tightening torque. For details, refer to [1.2.6 Tightening Bolts/Screws](#).
- Fasten the bolts aligned on a circumference in a crisscross pattern. For details, refer to [1.2.6 Tightening Bolts/Screws](#).
- When loosening Motor Plate securing screws, or attaching or removing parts that affect belt tension, make sure to adjust the timing belt tension.
For details, refer to [3.1 Adjusting the Timing Belt Tension](#).
- Before applying grease, wipe off the old grease and anti-rust oil. If any old grease is left behind, the lubrication may deteriorate, the anti-rust oil may harden, and the robot accuracy may be affected.
- Apply the specified amount of grease to the parts specified in the manual.
- When applying grease, take care that the grease does not adhere on to the surrounding parts. Oil separation of the surrounding grease may result in oil leakage. Therefore, be sure to wipe off any adhering grease.

2.1.2 Viewing the Maintenance Page

Each page is configured as shown below.

Top page of each section

The exploded view shows all parts and units that need to be removed and reinstalled in the section.



About the bolt and screw type

S01: 3-M4x20

S01 indicates the bolt or screw type.

For details on the type, the size, torque value, etc., refer to [1.2.6 Tightening Bolts/Screws](#).

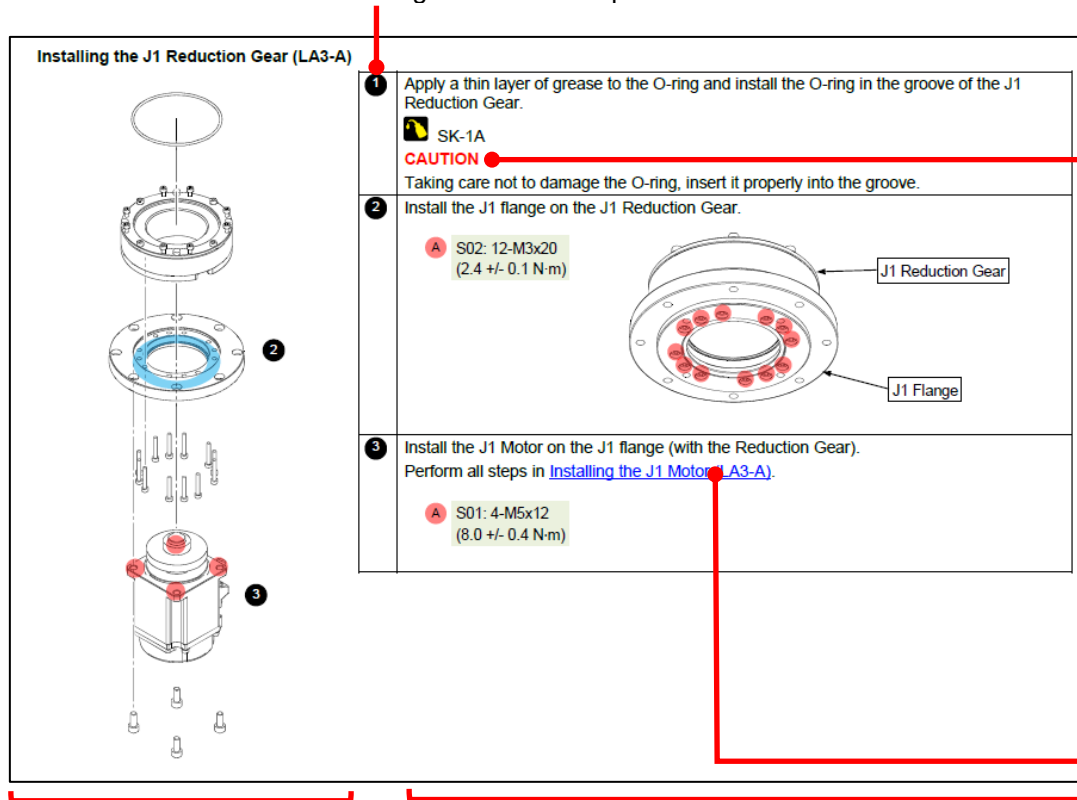
Body page for instructions

Work sequence

The white circle numbers (e.g. ①) are the step numbers for removing or disassembling the unit or component.

Black circle numbers (e.g. ❶) are step numbers for assembling or installing the unit or component.

Installing the J1 Reduction Gear (LA3-A)



❶ Apply a thin layer of grease to the O-ring and install the O-ring in the groove of the J1 Reduction Gear.

SK-1A

CAUTION
Taking care not to damage the O-ring, insert it properly into the groove.

❷ Install the J1 flange on the J1 Reduction Gear.

A S02: 12-M3x20
(2.4 +/- 0.1 N·m)

J1 Reduction Gear

J1 Flange

❸ Install the J1 Motor on the J1 flange (with the Reduction Gear).
Perform all steps in [Installing the J1 Motor \(LA3-A\)](#).

A S01: 4-M5x12
(8.0 +/- 0.4 N·m)

The configuration of parts to be removed/attached is shown by illustrations.

The details of the work, precautions for work, and points, etc., are described.

CAUTION

Indicates information about risks which may cause injury to persons and risks which the Manipulator functions cannot be implemented.

POINT

Indicates a method of proceeding with work in an efficient manner.

NOTE

Indicates information not concerning the work procedures.



SK-1A: 102g

Indicates that lubrication is required.

Refer to [1.2.5 Tools/Materials](#) for grease manufacturer and other details.

Clicking the underlined blue characters will open the corresponding page.

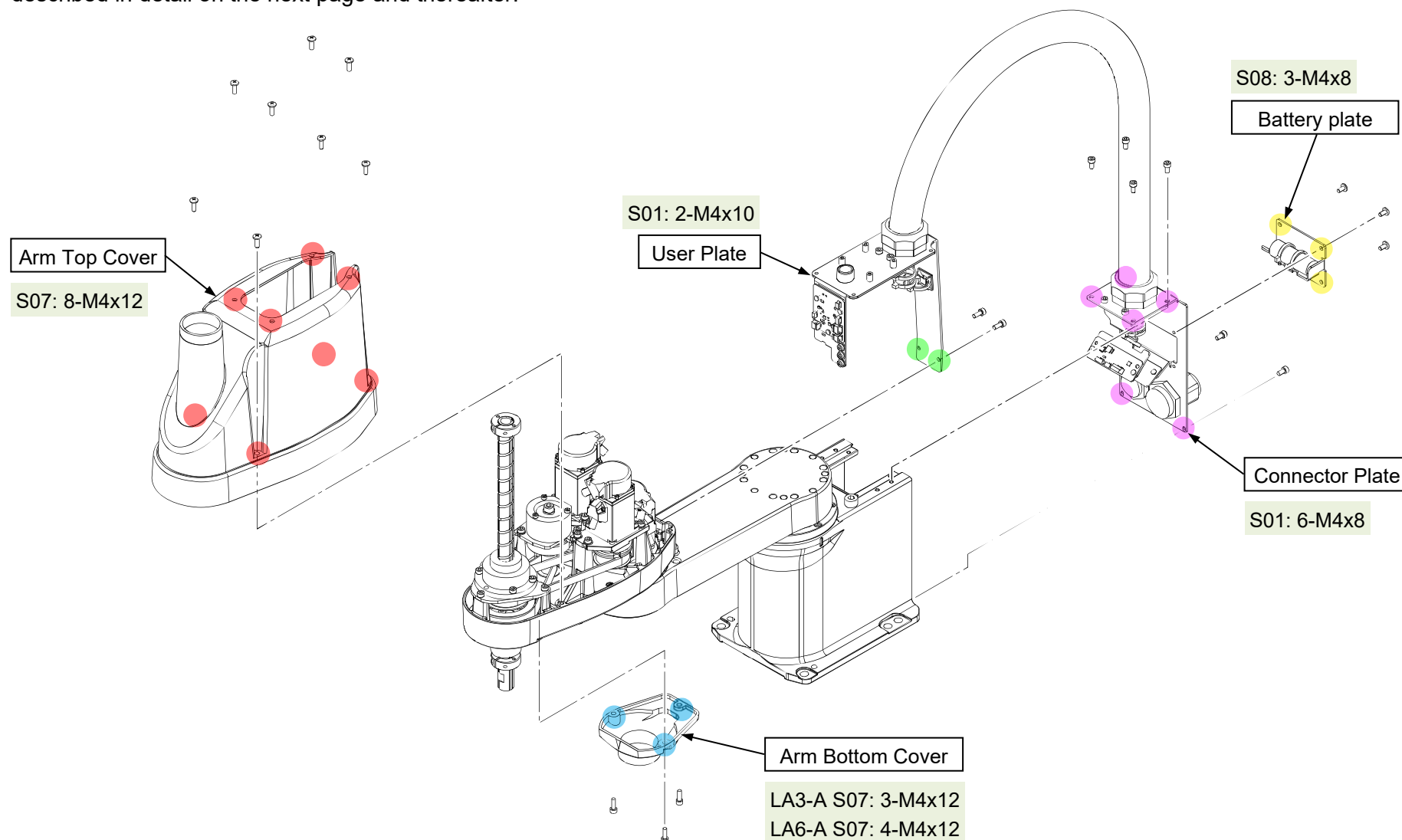
You can return to the original page by simultaneously pressing the [Alt] key and the [←] key.

* The operation method may differ depending on the viewer. For details, refer to Help of each viewer.

2.2 Covers

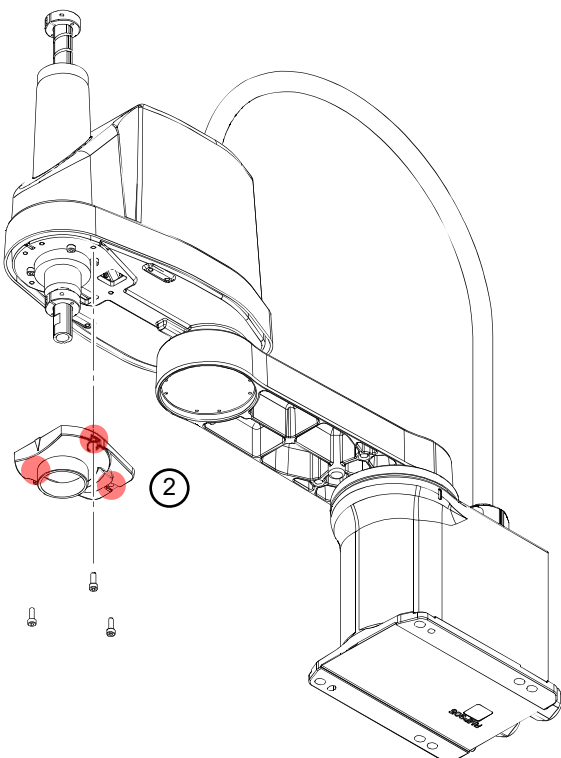
LA3-A and LA6-A have the following covers and plates.

The contents to be particularly noted during maintenance, and the covers and plates for which the cables need to be removed or connected are described in detail on the next page and thereafter.



2.2.1 Arm Bottom Cover

Removal

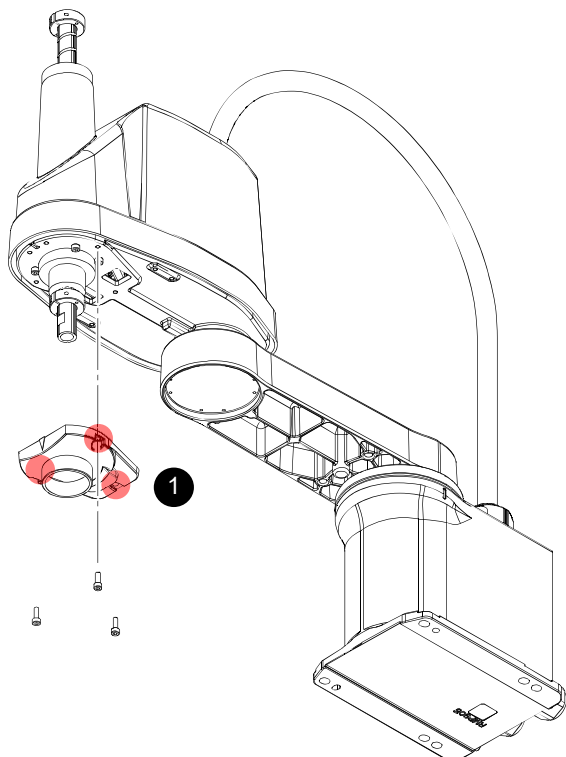


CAUTION

- The Arm Bottom Cover sometimes cannot be drawn out from the shaft if the end effector is installed. If the Arm Bottom Cover needs to be completely removed, remove the end effector in advance.
- When there be no issue if the Arm Bottom Cover is not completely removed, lower the shaft to the lower limit before turning OFF the controller.

①	For clean room environment models Remove or lower the Lower Bellows , depending on the task.
②	Remove the screws securing the Arm Bottom Cover on the bottom of Arm2 and remove the Arm Bottom Cover. POINT Support the Arm Bottom Cover with a hand when loosening the screws to ensure the cover does not fall. LA3-A A S07: 3-M4x12 LA6-A A S07: 4-M4x12 POINT For the LA6-A clean room environment model, the Rubber Gasket is installed on the Arm Bottom Cover.

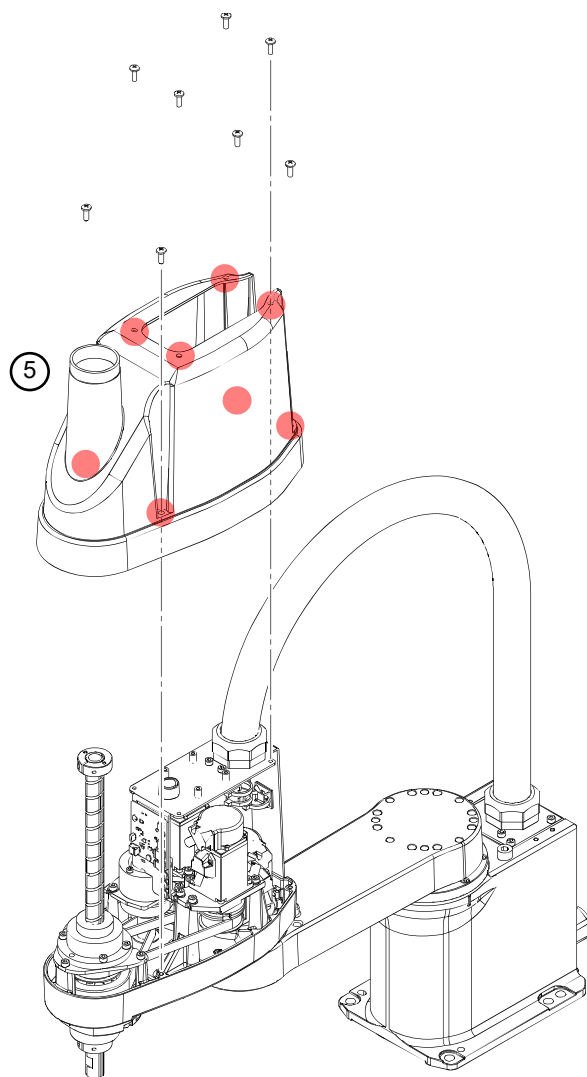
Installation



- | | |
|---|---|
| 1 | <p>Set the Arm Bottom Cover on the Arm2, and secure it with the screws shown in the figure.</p> <p>POINT</p> <p>For the LA6-A clean room environment model, install the Rubber Gasket in the groove of the Arm Bottom Cover.</p> <p>Install the Rubber Gasket with the ribbed side facing toward Arm2.</p> <p>LA3-A</p> <p>A S07: 3-M4x12
(0.45 +/- 0.1 N·m)</p> <p>LA6-A</p> <p>A S07: 4-M4x12
(0.45 +/- 0.1 N·m)</p> |
| 2 | <p>For clean room environment models</p> <p>Install the Lower Bellows.</p> |

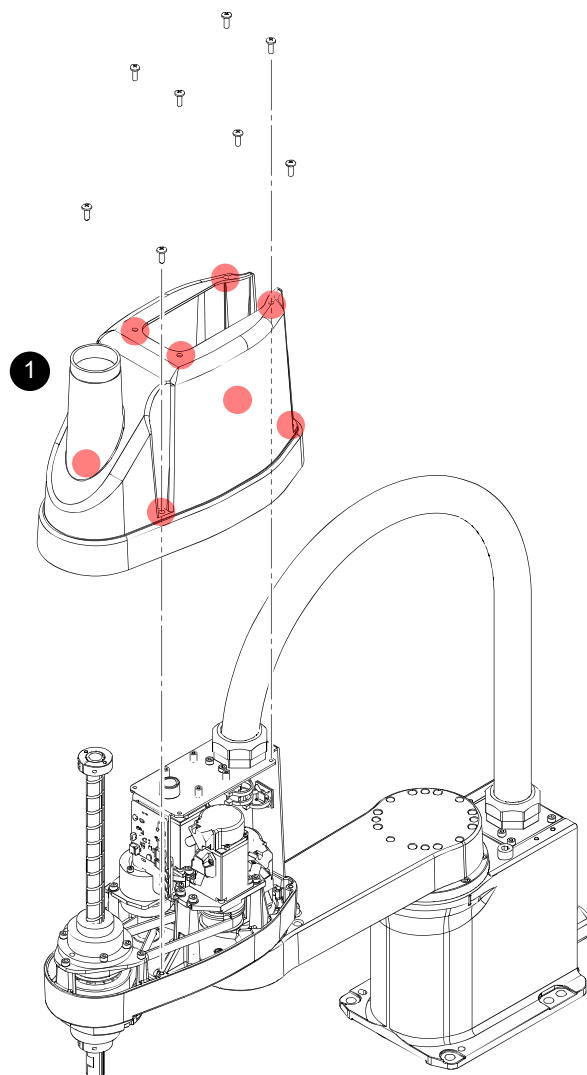
2.2.2 Arm Top Cover

Removal



	CAUTION Do not pull the Arm Top Cover with force. 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.
①	Turn ON the controller.
②	Press the Brake Release Switch and lower the Ball Screw Spline Unit to its lower limit. CAUTION - Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed. - When the brake is released by the Brake Release Switch, the J3 brake is released.
③	Turn OFF the controller.
④	For clean room environment models Remove the Upper Bellows .
⑤	Remove the Arm Top Cover. A S07: 8-M4x12

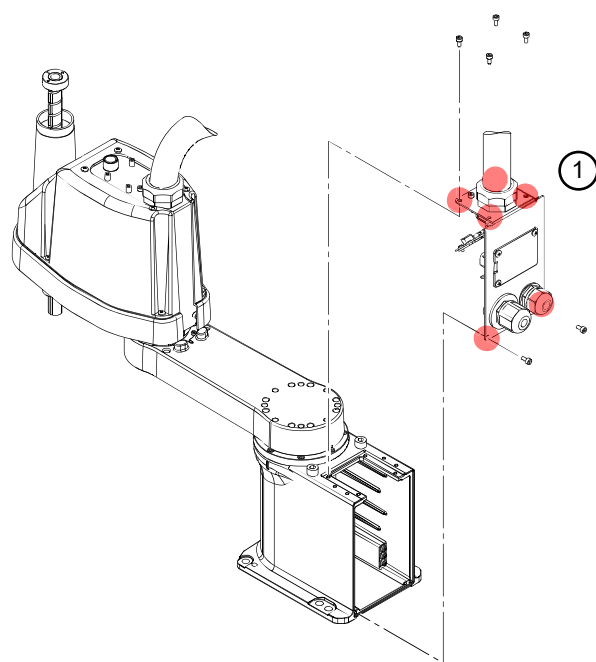
Installation



	CAUTION When installing the cover, be careful not to nip the cables.
1	Set the Arm Top Cover on the arm, and secure it with the screws shown in the figure. A S07: 8-M4x12 (0.45 +/- 0.1 N·m)
2	Turn ON the controller.
3	Press the Brake Release Switch and raise and lower the Ball Screw Spline Unit by hand and check that there is no place that interferes with the cover. CAUTION - Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed. - When the brake is released by the Brake Release Switch, the J3 brake is released.
4	If there is interference, turn OFF the controller. Loosen the screws securing the cover, and adjust the position of the cover.
5	For clean room environment models Install the Upper Bellows .

2.2.3 Connector Plate

Removal



CAUTION

- Do not pull the Connector Plate with force. 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 removing the Connector Plate, check the cable layout carefully so that you can return the wiring to a reasonable state when reassembling.

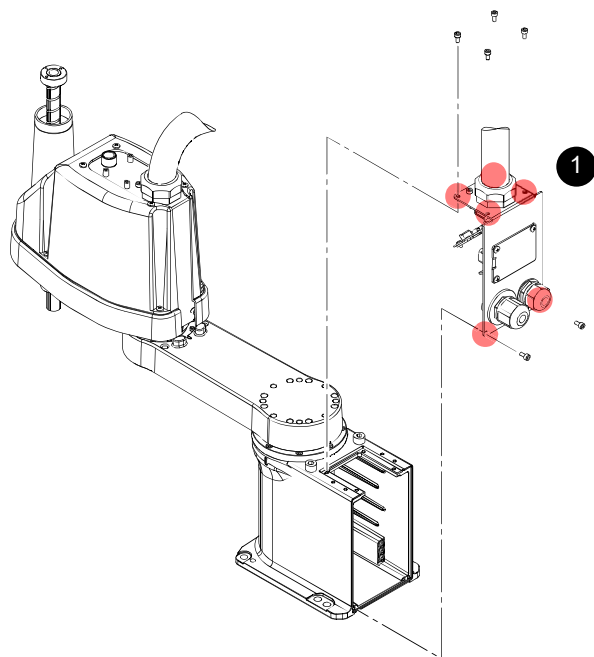
①

Remove the Connector Plate from the base.

A

S01: 6-M4x8

Installation



CAUTION

When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push the cables in using excessive force. 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.

1

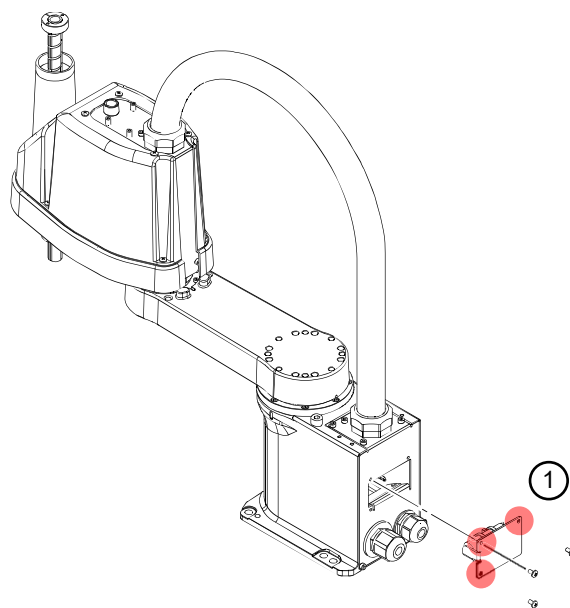
Install the Connector Plate to the base.

A

S01: 6-M4x8
(4.0 +/- 0.2 N·m)

2.2.4 Battery plate

Removal



CAUTION

Do not pull the battery plate with force. 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.

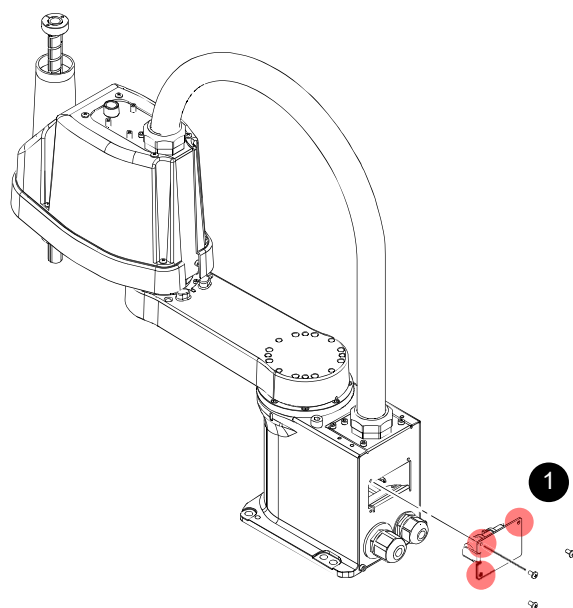
①

Remove the battery plate from the base.

A

S08: 3-M4x8

Installation



CAUTION

When installing the battery plate, do not nip the cables or bend and push them in using excessive force. 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.

1

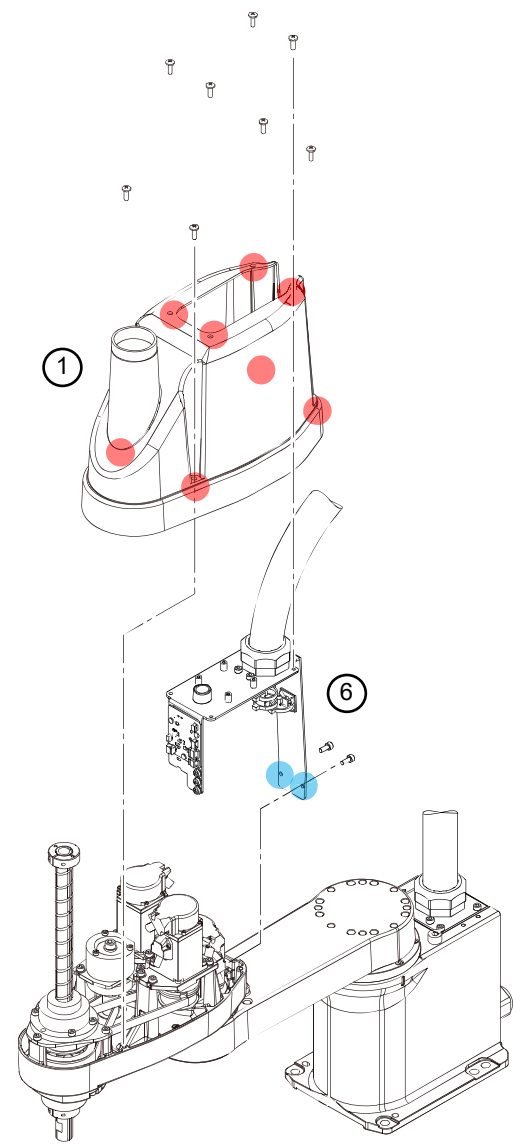
Install the battery plate on the base.

A

S08: 3-M4x8
(0.9 +/- 0.1 N·m)

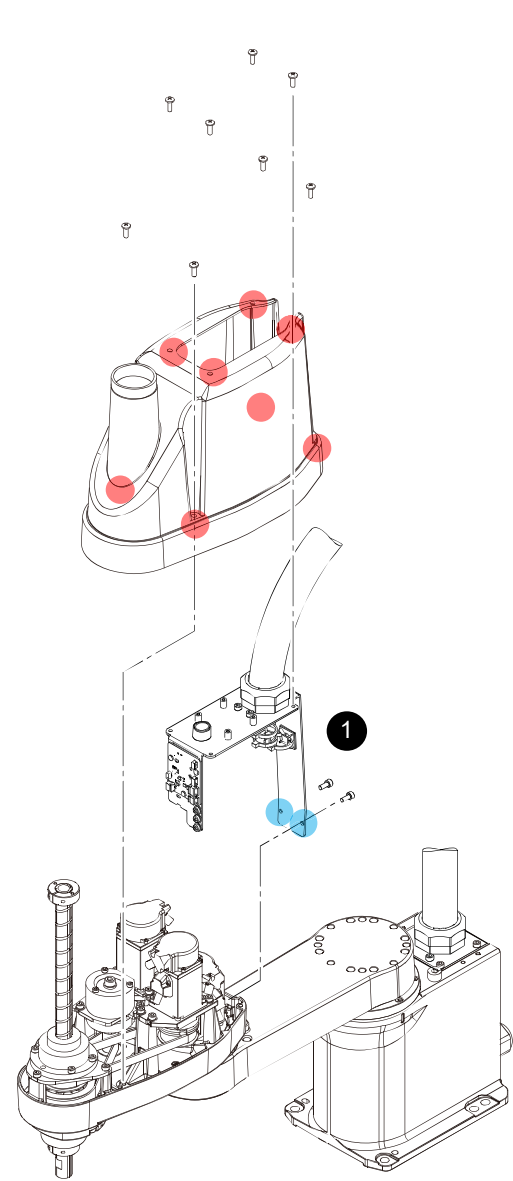
2.2.5 User Plate

Removal



①	When an Arm Top Cover is installed, remove the Arm Top Cover .
②	Cut the wire tie securing the cables to the top of the user plate. User plate A close-up photograph showing the user plate and a wire tie securing cables. The wire tie is circled in red. Labels 'User plate' and 'Wire tie' point to their respective parts. Wire tie
③	Disconnect the J3 brake connector (CN430-1).
④	Remove the screws securing the user plate to the Arm2. A S01: 2-M4x10
⑤	Disconnect the connectors from each Motor Unit. J2 Motor unit: CN120-1 and CN320-1 J3 Motor unit: CN130-1 and CN330-1 J4 Motor unit: CN140-1 and CN340-1
⑥	Remove the user plate from the Arm2.

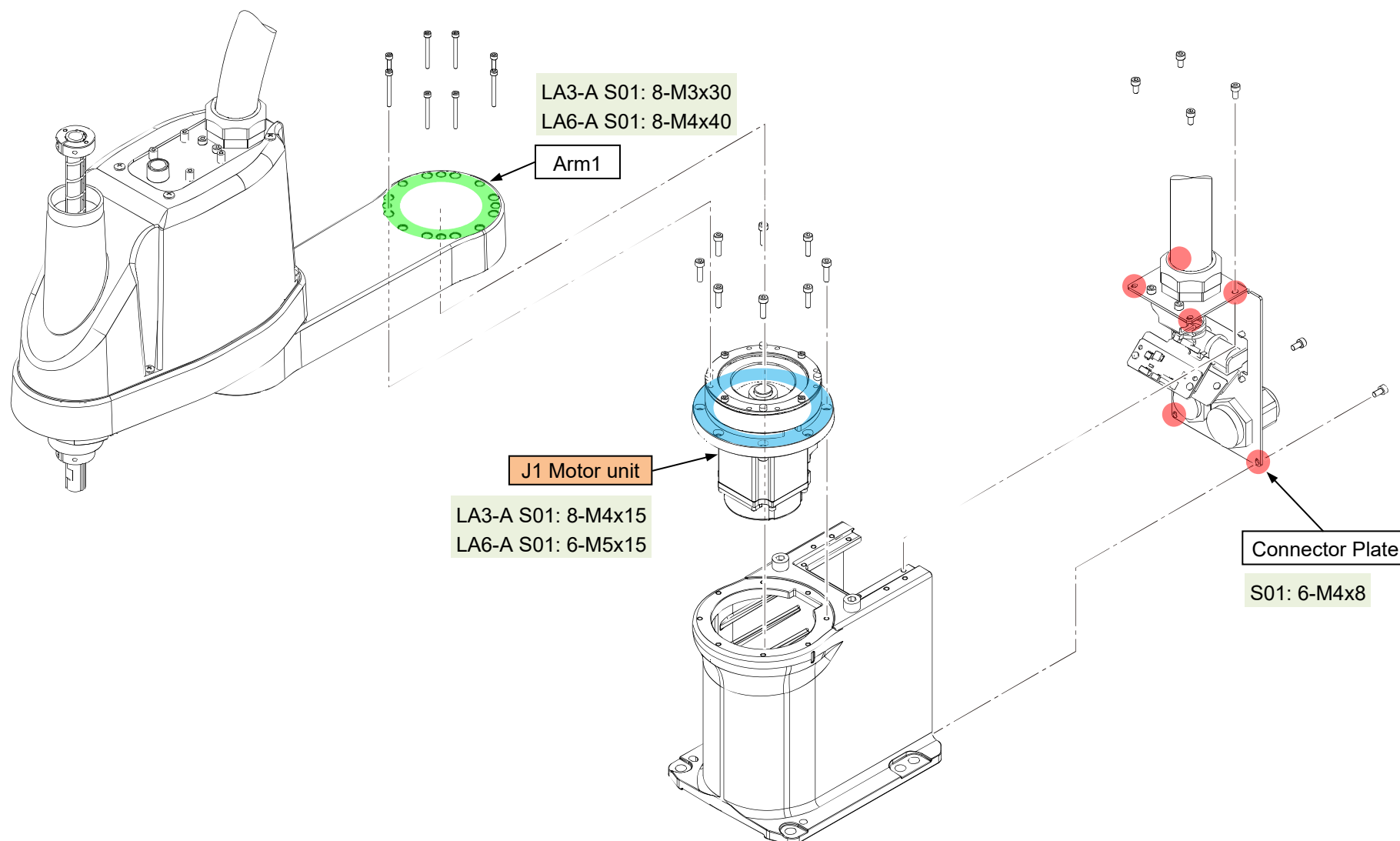
Installation



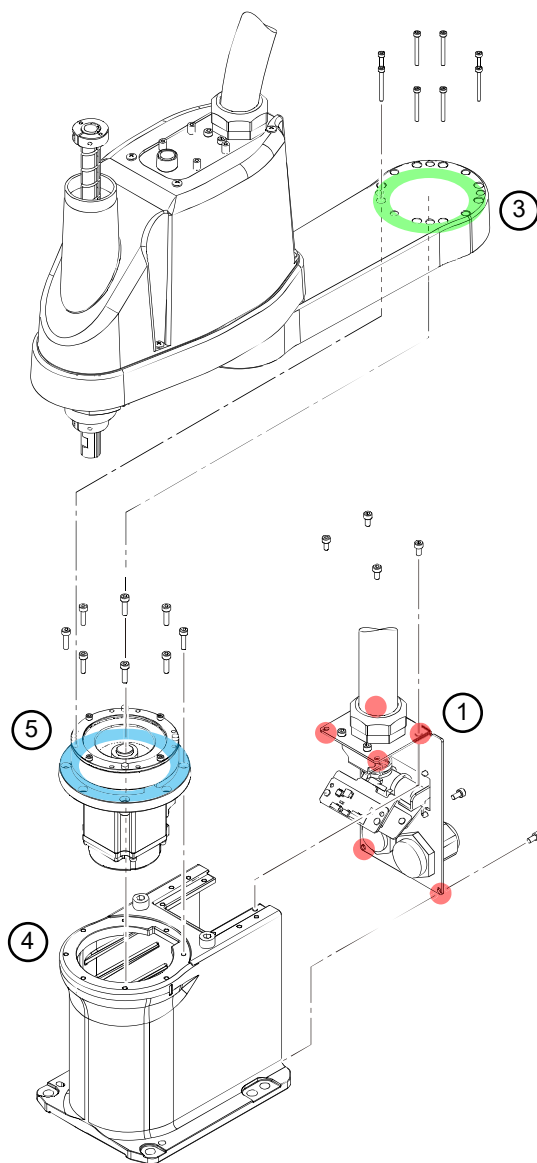
1	Attach the user plate to the Arm2.
2	Connect the connectors to each Motor Unit. J2 Motor unit: CN120-1 and CN320-1 J3 Motor unit: CN130-1 and CN330-1 J4 Motor unit: CN140-1 and CN340-1
3	Secure the user plate to the Arm2. A S01: 2-M4x10 (4.0 +/- 0.2 N·m)
4	Connect the J3 brake connector (CN430-1).
5	Secure the cables connected to the Overexcitation Power Supply Board to the top surface of the user plate with wire tie. User plate  Wire tie

2.3 Joint #1

2.3.1 J1 Motor unit



Removing the J1 Motor Unit



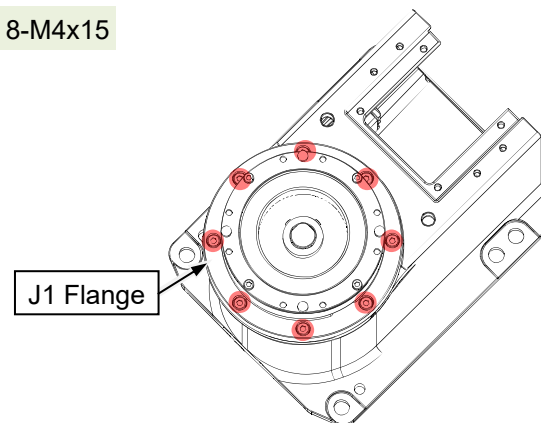
①	Remove the Connector Plate .
②	Disconnect the J1 Motor unit connectors (CN11, CN310-1).
③	Remove Arm1 from the J1 Motor unit.
	CAUTION - Support Arm1 with a hand when removing the screws to ensure Arm1 does not fall. - Remove only the screws shown in the figure.
	LA3-A A S01: 8-M3x30 LA6-A A S01: 8-M4x40

④

Remove the screws securing the J1 flange to the base.

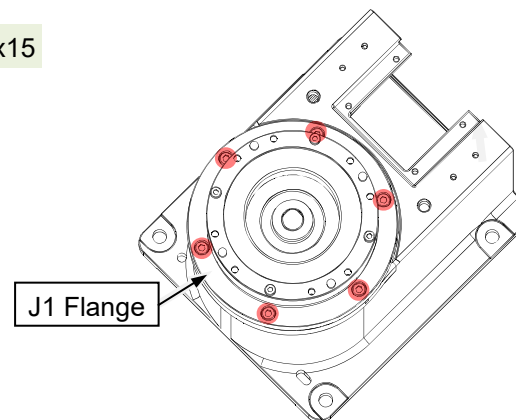
LA3-A

A S01: 8-M4x15



LA6-A

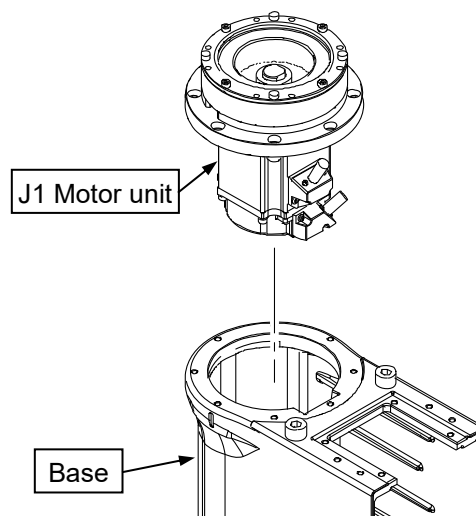
A S01: 6-M5x15



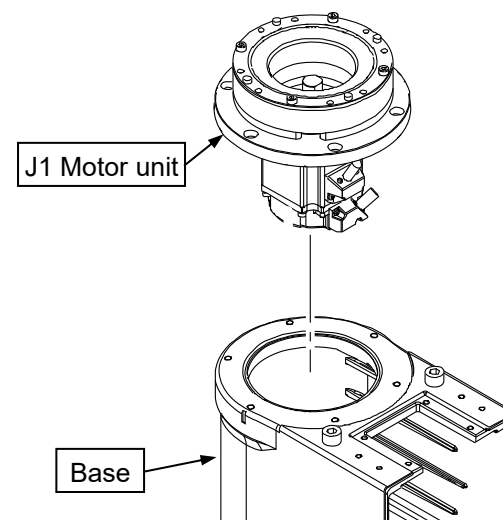
⑤

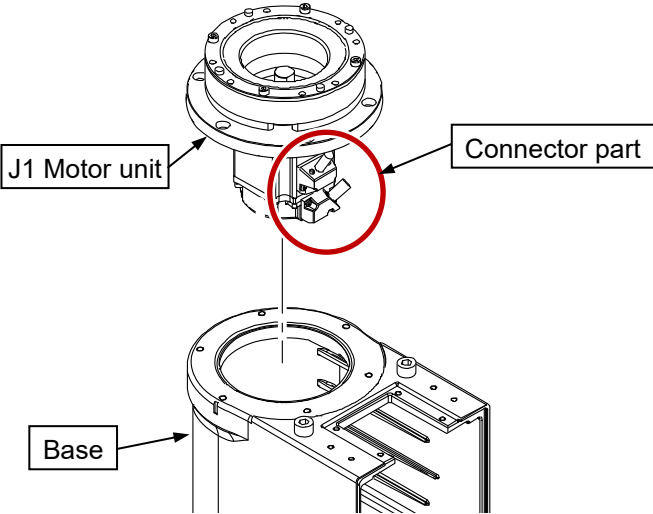
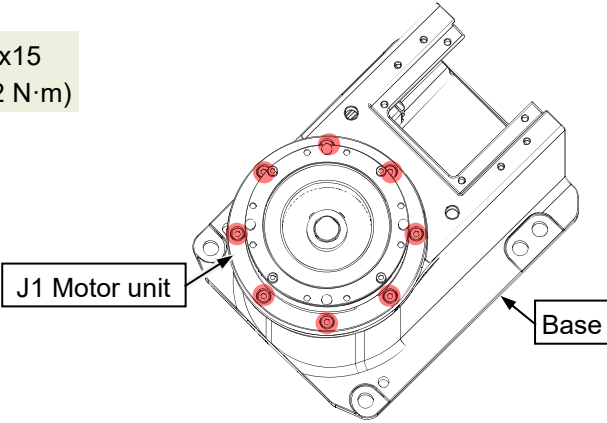
Remove the J1 Motor unit from the base.

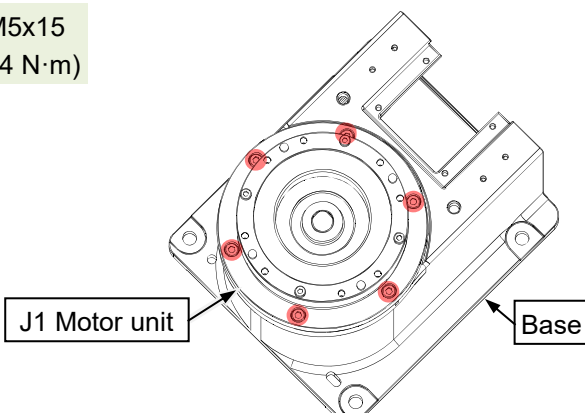
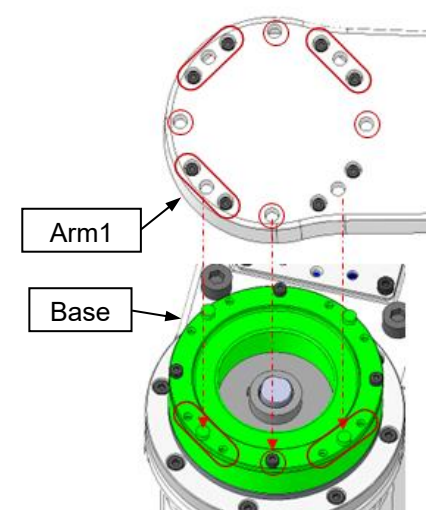
LA3-A



LA6-A

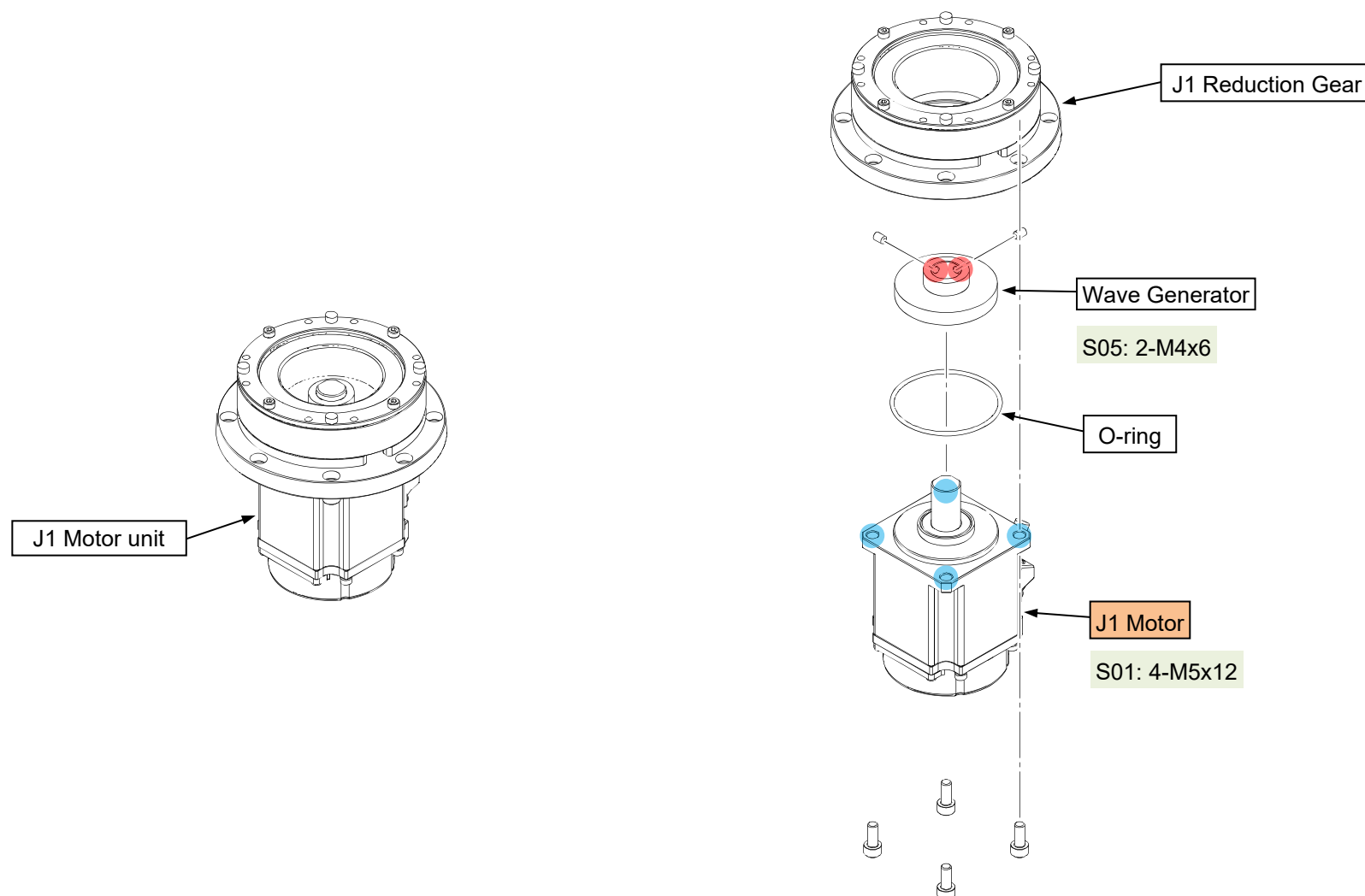


	LA6-A  The diagram shows the J1 Motor unit being aligned with the Base. A red circle highlights the Connector part on the motor unit, which is being inserted into the Base. Labels with arrows point to the J1 Motor unit, Connector part, and Base.
2	Secure the J1 Motor unit in the base.
	LA3-A A S01: 8-M4x15 (4.0 +/- 0.2 N·m)  The diagram shows the J1 Motor unit mounted on the Base. Eight screws are indicated by red circles around the perimeter of the motor unit. Labels with arrows point to the J1 Motor unit and Base.

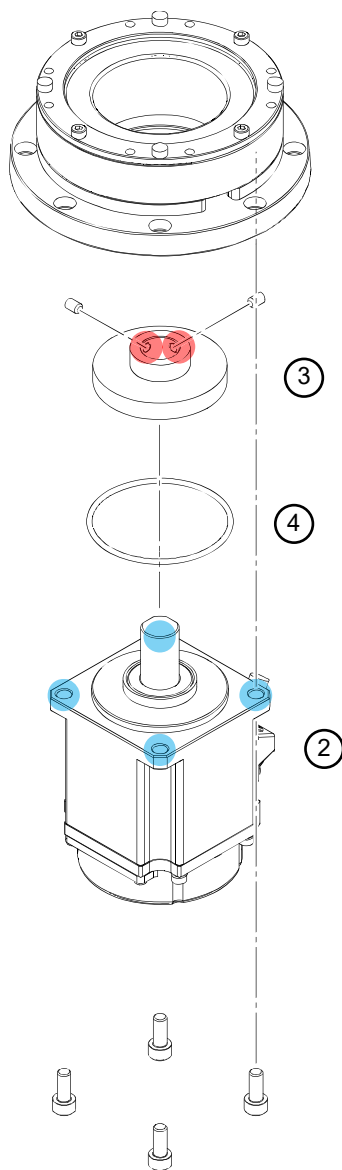
	LA6-A A S01: 6-M5x15 (8.0 +/- 0.4 N·m) 
3	Place Arm1 on the J1 Motor unit, and secure it with the screws. CAUTION Support Arm1 with a hand when tightening the screws to ensure Arm1 does not fall.
	LA3-A A S01: 8-M3x30 (2.0 +/- 0.1 N·m) LA6-A A S01: 8-M4x40 (4.0 +/- 0.2 N·m) 

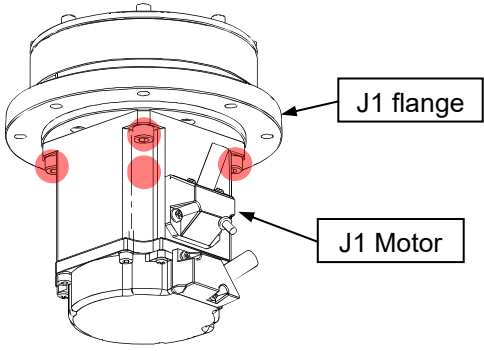
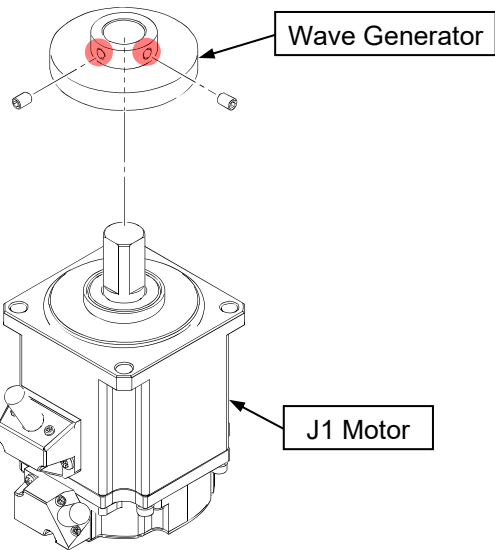
4	Move the Arm1 back and forth three times to check that there are no abnormalities in the arm rotation.
5	Connect the J1 Motor unit connectors (CN11, CN310-1).
6	Install the Connector Plate .
7	Perform the calibration of Joint #1.

2.3.2 Replacing the J1 Motor (LA3-A)



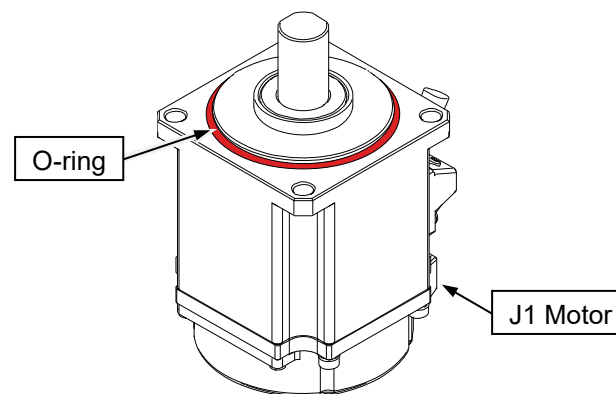
Removing the J1 Motor (LA3-A)

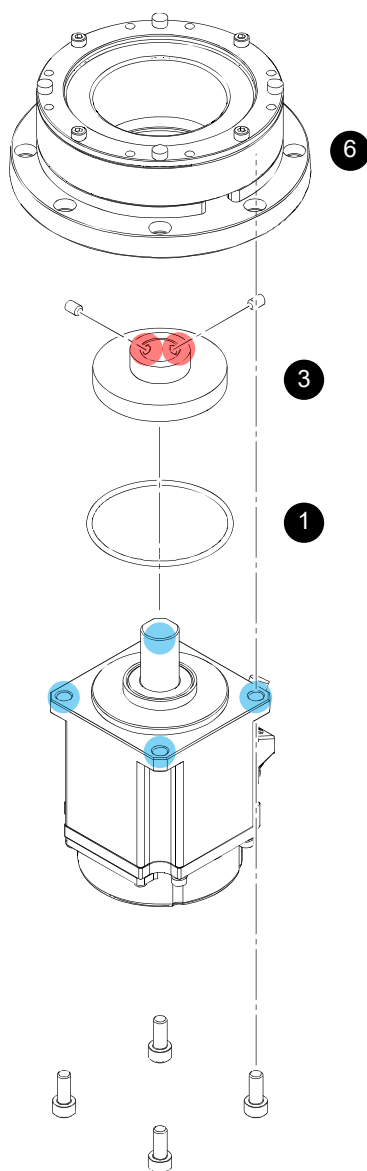


①	Remove the J1 Motor unit. Perform all steps of Removing the J1 Motor Unit.
②	Remove the J1 Motor from the J1 flange. A S01: 4-M5x12  J1 flange J1 Motor
③	Remove the Wave Generator from the J1 Motor. A S05: 2-M4x6  Wave Generator J1 Motor

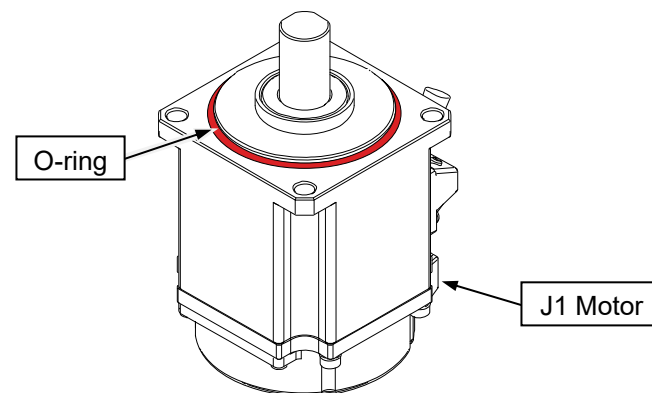
④

Remove the O-ring from the J1 Motor.



Installing the J1 Motor (LA3-A)

- 1 Apply a thin layer of grease to the O-ring and attach the O-ring to the J1 Motor.



- 2 Using a wiping cloth and alcohol, wipe off the anti-rust oil on the motor shaft.

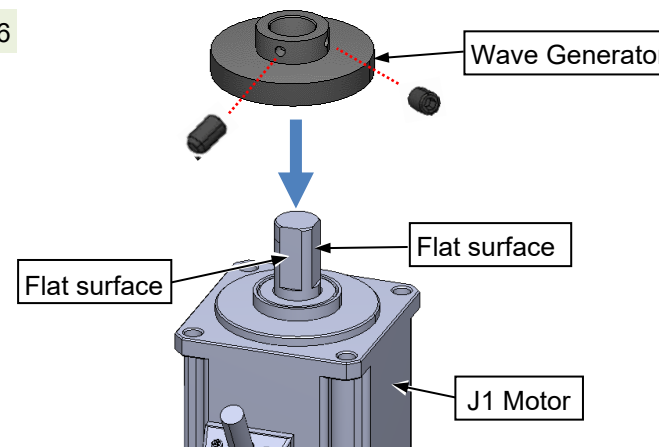
3

Attach the Wave Generator to the J1 Motor.

1. Place the wave generator on the shaft of the J1 Motor in the orientation shown in the figure, and fix it temporarily with the screws touching the two flat surfaces of the shaft.

CAUTION

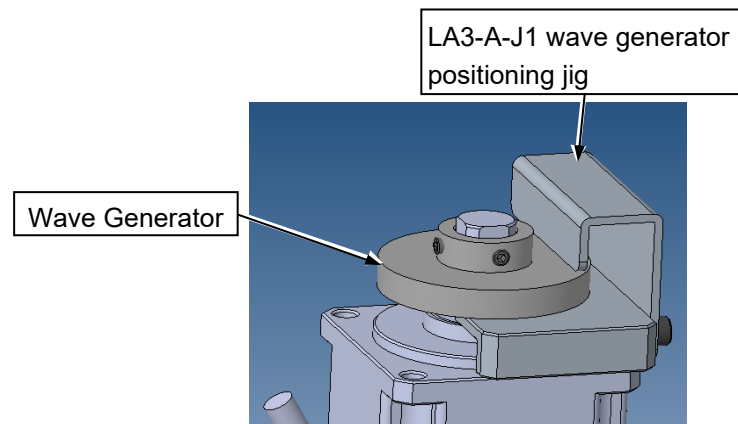
- Be careful not to place the wave generator upside down.
- Place the wave generator so that its set screws are on the flat surfaces of the motor shaft.

A S05: 2-M4x6

2. Set the LA3-A-J1 wave generator positioning jig to properly position the wave generator.

CAUTION

Press the jig and wave generator against the motor side to position the wave generator.



3. Tighten the set screws to fix the wave generator.

A

S05: 2-M4x6
(2.4 +/- 0.1 N·m)

4. Remove the LA3-A-J1 wave generator positioning jig from the J1 Motor.

- 4 Apply grease between the J1 Motor and the wave generator.

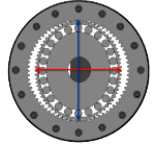
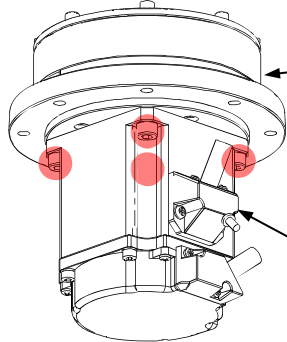


SK-1A: 4 g

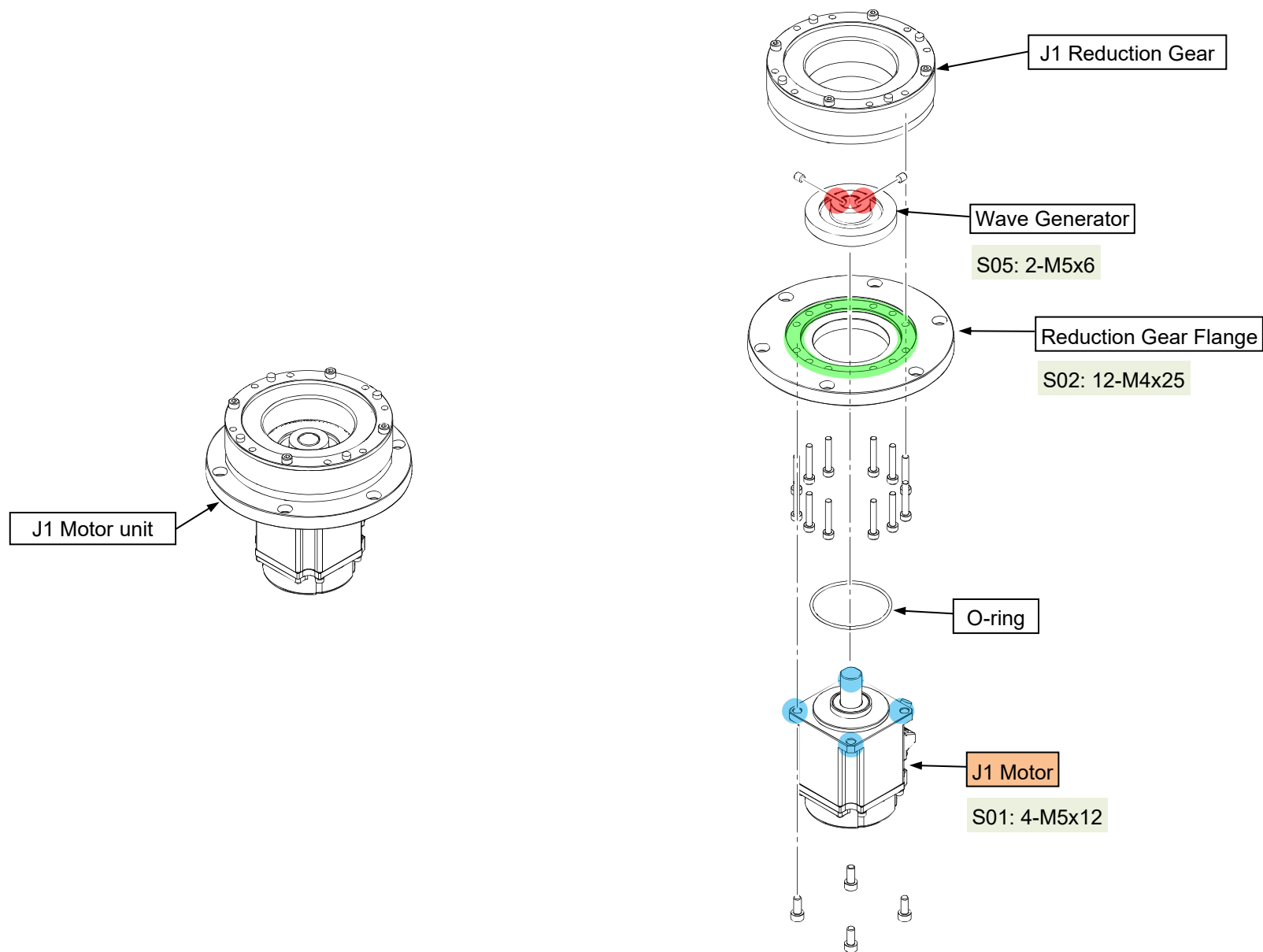
- 5 Apply grease to the inside of the Flexspline.



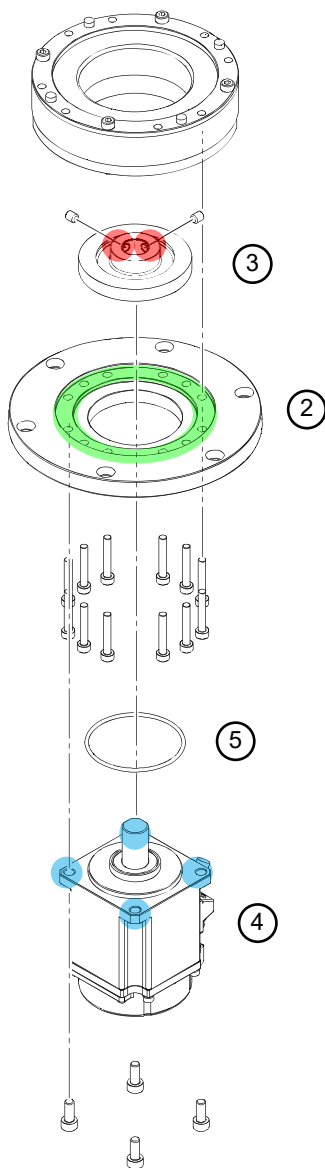
SK-1A: 19 g

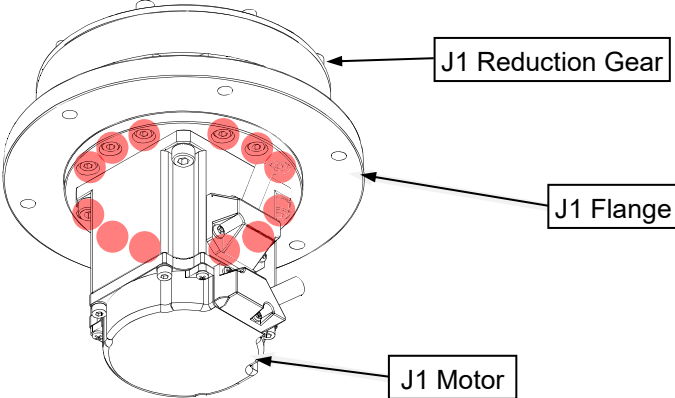
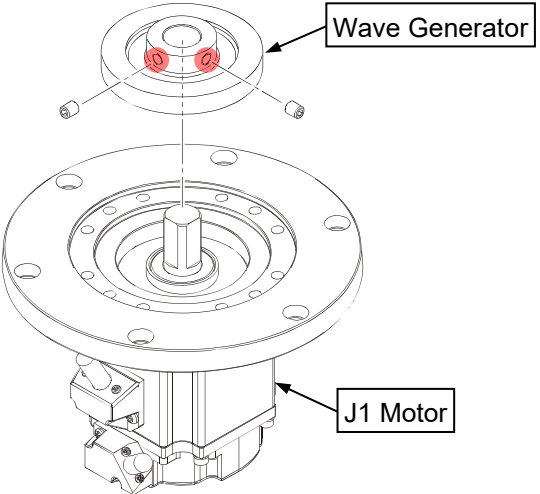
6	Temporarily fix the J1 Motor to the J1 Reduction Gear Unit (J1 Reduction Gear + J1 flange). A S01: 4-M5x12 Temporary tightening torque: 0.3 +/- 0.1 N·m POINT Install so that the longside of the Flexspline and the Wave Generator match.  Longside Shortside Reduction Gear
7	Perform centering of the J1 Reduction Gear.
8	Secure the J1 Motor to the J1 Reduction Gear Unit. A S01: 4-M5x12 (8.0 +/- 0.4 N·m)  J1 Reduction Gear Unit J1 Motor
9	Install the J1 Motor unit. Perform all steps in Installing the J1 Motor Unit.

2.3.3 Replacing the J1 Motor (LA6-A)



Removing the J1 Motor (LA6-A)

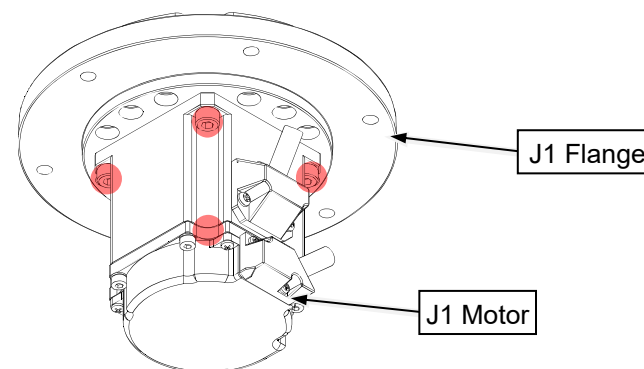


①	Remove the J1 Motor unit. Perform all steps of Removing the J1 Motor Unit.
②	Remove the J1 flange (with the J1 Motor) from the J1 Reduction Gear. A S02: 12-M4x25  J1 Reduction Gear J1 Flange J1 Motor
③	Remove the Wave Generator from the J1 Motor. A S05: 2-M5x6  Wave Generator J1 Motor

④

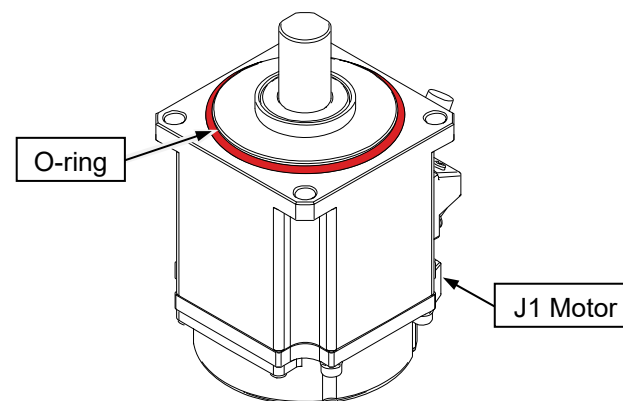
Remove the J1 flange from the J1 Motor.

A S01: 4-M5x12

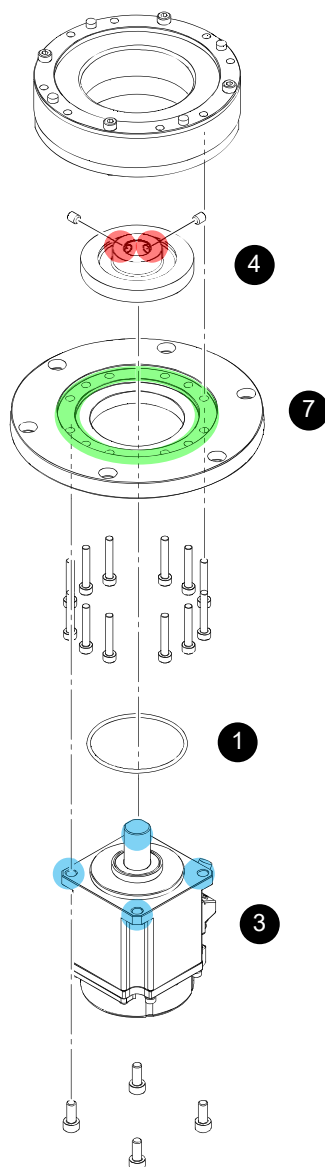


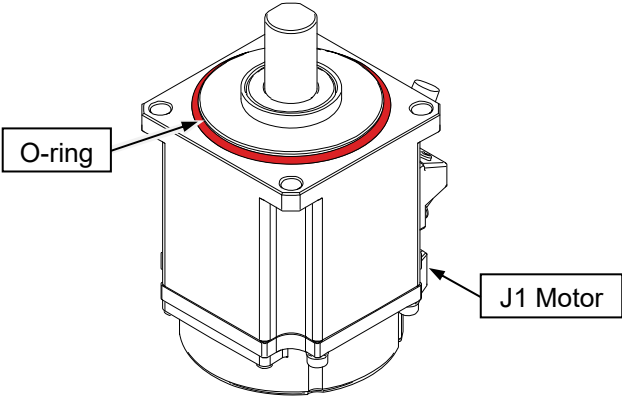
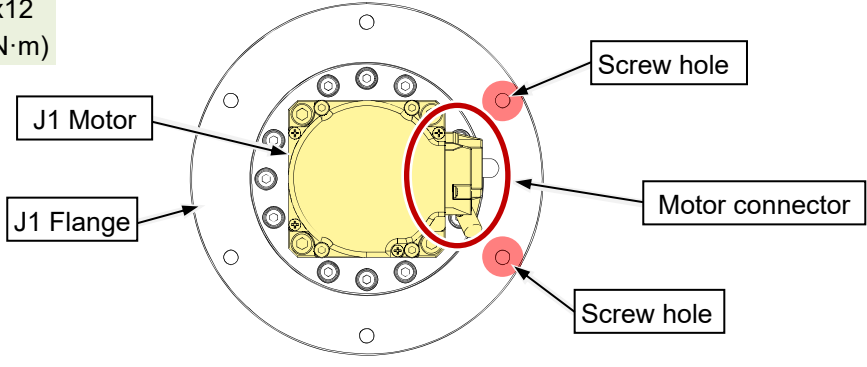
⑤

Remove the O-ring from the J1 Motor.



Installing the J1 Motor (LA6-A)



1	Apply a thin layer of grease to the O-ring and attach the O-ring to the J1 Motor.  SK-1A  O-ring J1 Motor
2	Using a rag and ethanol, wipe off the anti-rust oil on the motor shaft.
3	Install the J1 Motor on the J1 flange. POINT Attach the J1 Motor to the J1 flange so that the J1 Motor connector is located between the two screw holes of the J1 flange. A S01: 4-M5x12 (8.0 +/- 0.4 N·m)  J1 Motor J1 Flange Screw hole Motor connector Screw hole

4

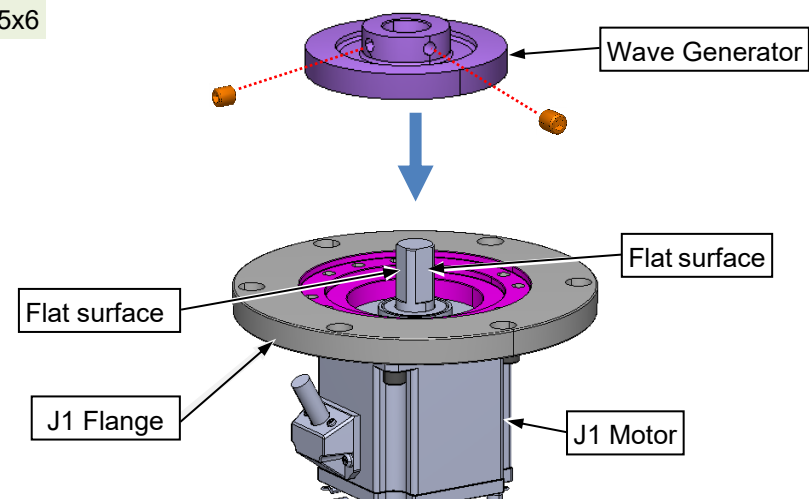
Attach the Wave Generator to the J1 Motor.

1. Place the wave generator on the shaft of the J1 Motor in the orientation shown in the figure, and fix it temporarily with the screws touching the two flat surfaces of the shaft.

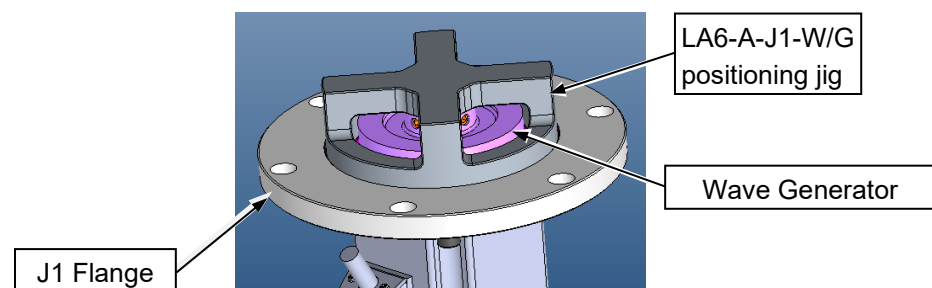
CAUTION

- Be careful not to place the wave generator upside down.
- Place the wave generator so that its set screws are on the flat surfaces of the motor shaft.

A S05: 2-M5x6



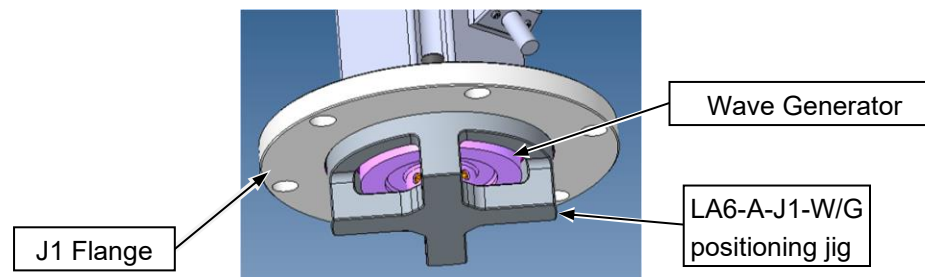
2. Attach the LA6-A-J1-W/G positioning jig over the wave generator on the J1 flange.



3. Place the J1 Motor with the jig-attached side down so that the wave generator lowers under its own weight.

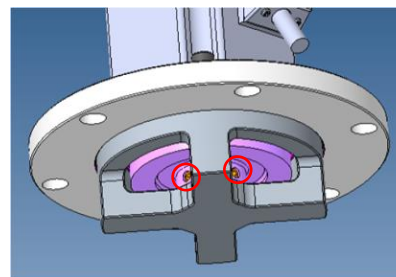
POINT

Make sure there are no gaps between the wave generator and the jig.



4. Tighten the set screws to fix the wave generator.

A S05: 2-M5x6
(3.9 +/- 0.2 N·m)



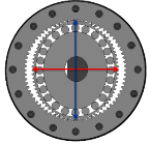
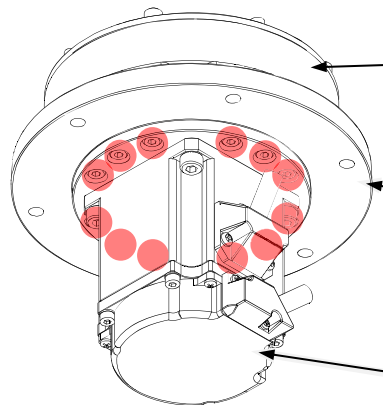
5. Remove the LA6-A-J1-W/G positioning jig from the J1 Motor.

- 5** Apply grease between the J1 Motor and the wave generator.

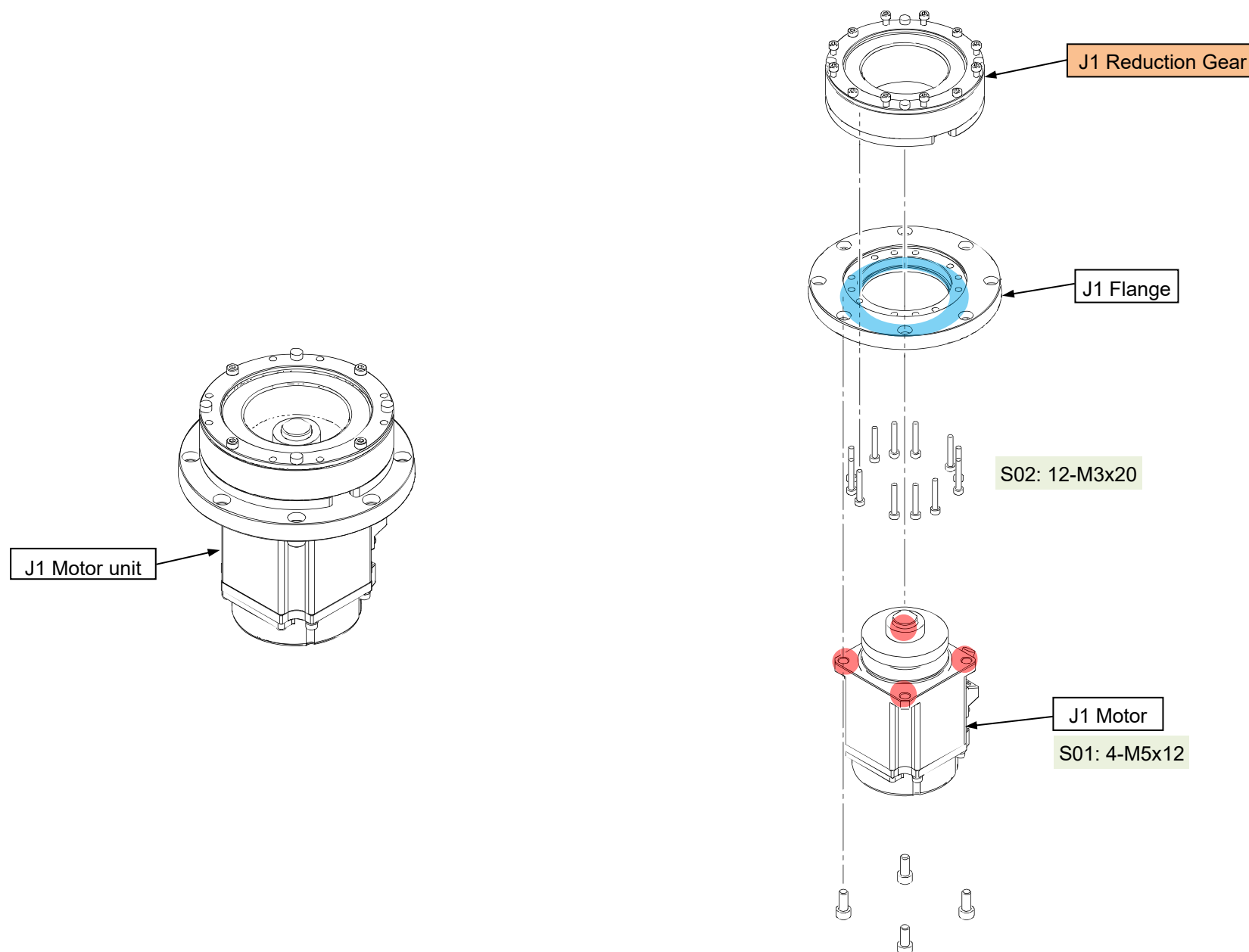
 SK-1A: 13 g

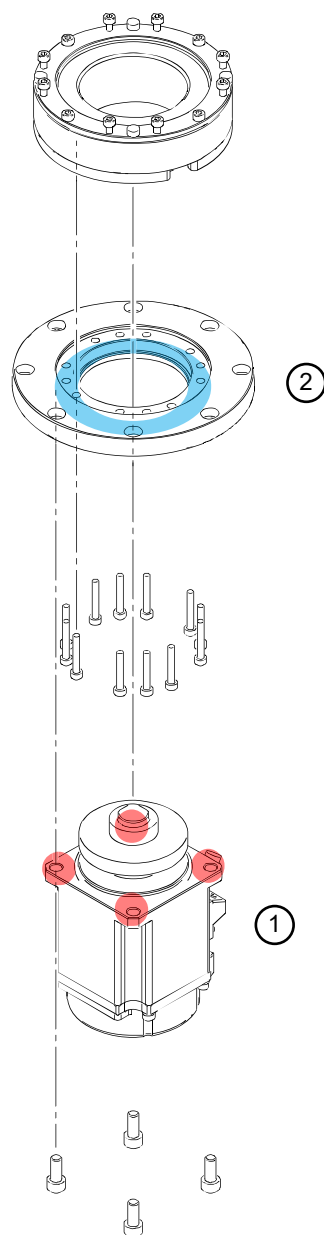
- 6** Apply grease to the inside of the Flexspline.

 SK-1A: 37 g

7	Temporarily fix the J1 flange (with the J1 Motor) to the J1 Reduction Gear. A S02: 12-M4x25 Temporary tightening torque: 0.3 +/- 0.1 N·m POINT Install so that the longside of the Flexspline and the Wave Generator match.  Longside Shortside Reduction Gear
8	Perform centering of the J1 Reduction Gear.
9	Install the J1 flange (with the J1 Motor) on the J1 Reduction Gear. A S02: 12-M4x25 (5.5 +/- 0.25 N·m)  J1 Reduction Gear J1 Flange J1 Motor
10	Install the J1 Motor unit. Perform all steps of Installing the J1 Motor Unit.

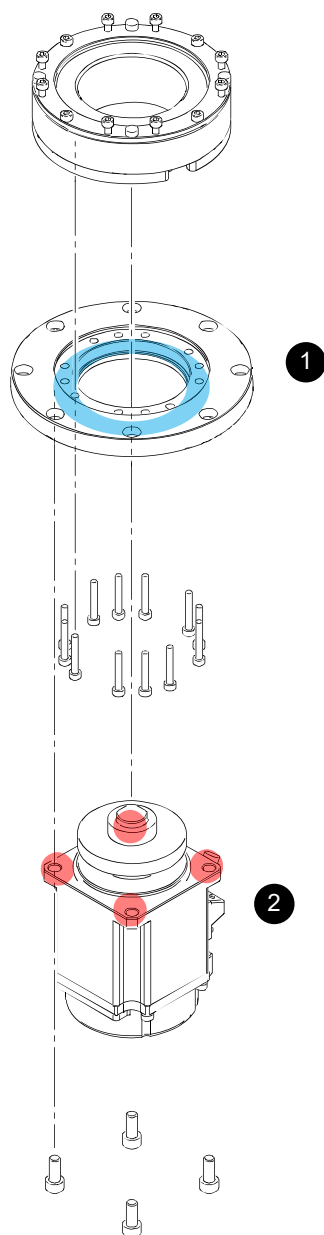
2.3.4 Replacing the J1 Reduction Gear (LA3-A)

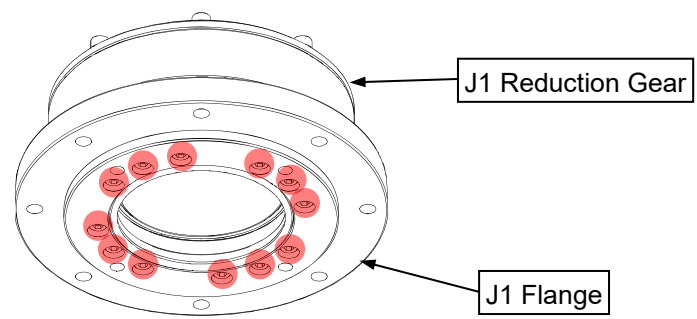


Removing the J1 Reduction Gear (LA3-A)

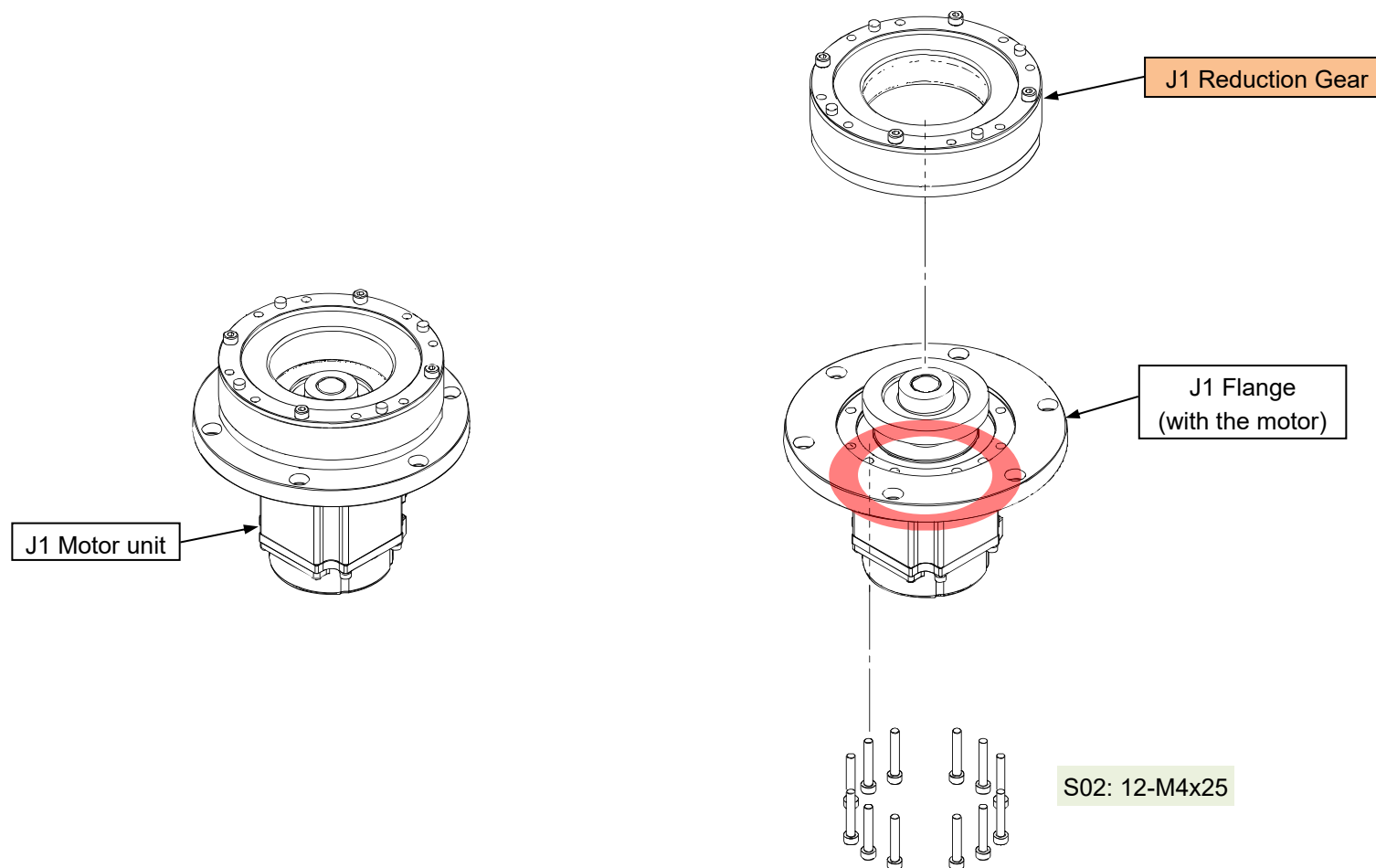
①	Remove the J1 Motor from the J1 flange. Perform the steps up to ② in Removing the J1 Motor (LA3-A) .
②	Remove the J1 flange from the J1 Reduction Gear. CAUTION When removing the J1 flange, be careful not to drop the O-ring. A S02: 12-M3x20

Installing the J1 Reduction Gear (LA3-A)



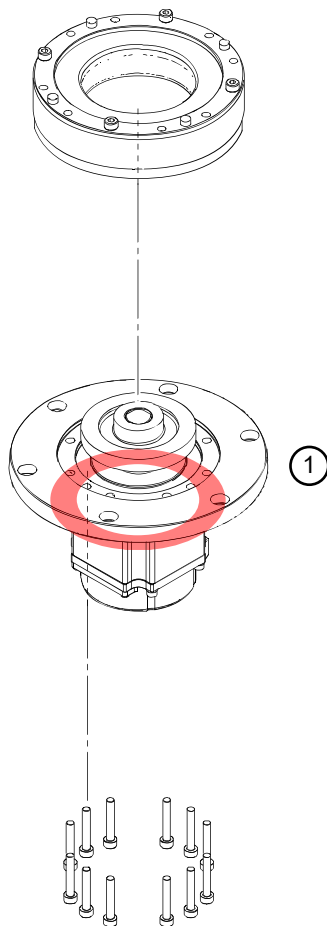
1	Install the J1 flange on the J1 Reduction Gear. A S02: 12-M3x20 (2.4 +/- 0.1 N·m)  J1 Reduction Gear J1 Flange
2	Install the J1 Motor on the J1 flange (with the Reduction Gear). Perform all steps in Installing the J1 Motor (LA3-A). A S01: 4-M5x12 (8.0 +/- 0.4 N·m)

2.3.5 Replacing the J1 Reduction Gear (LA6-A)



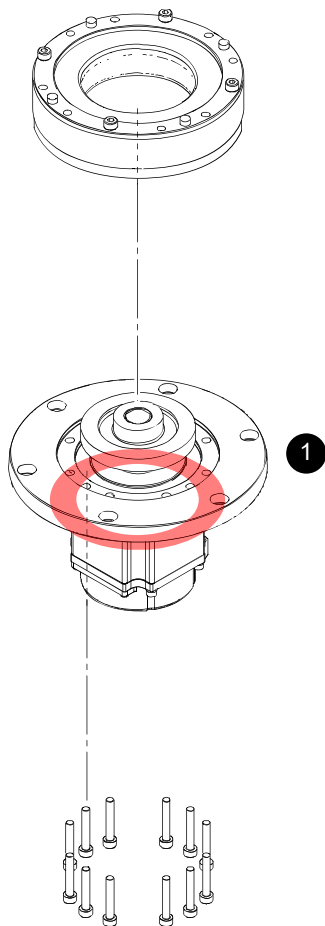
Removing the J1 Reduction Gear (LA6-A)

- | | |
|---|---|
| ① | Remove the J1 flange (with the motor) from the J1 Reduction Gear.
Perform the steps up to ③ in Removing the J1 Motor (LA6-A) . |
|---|---|



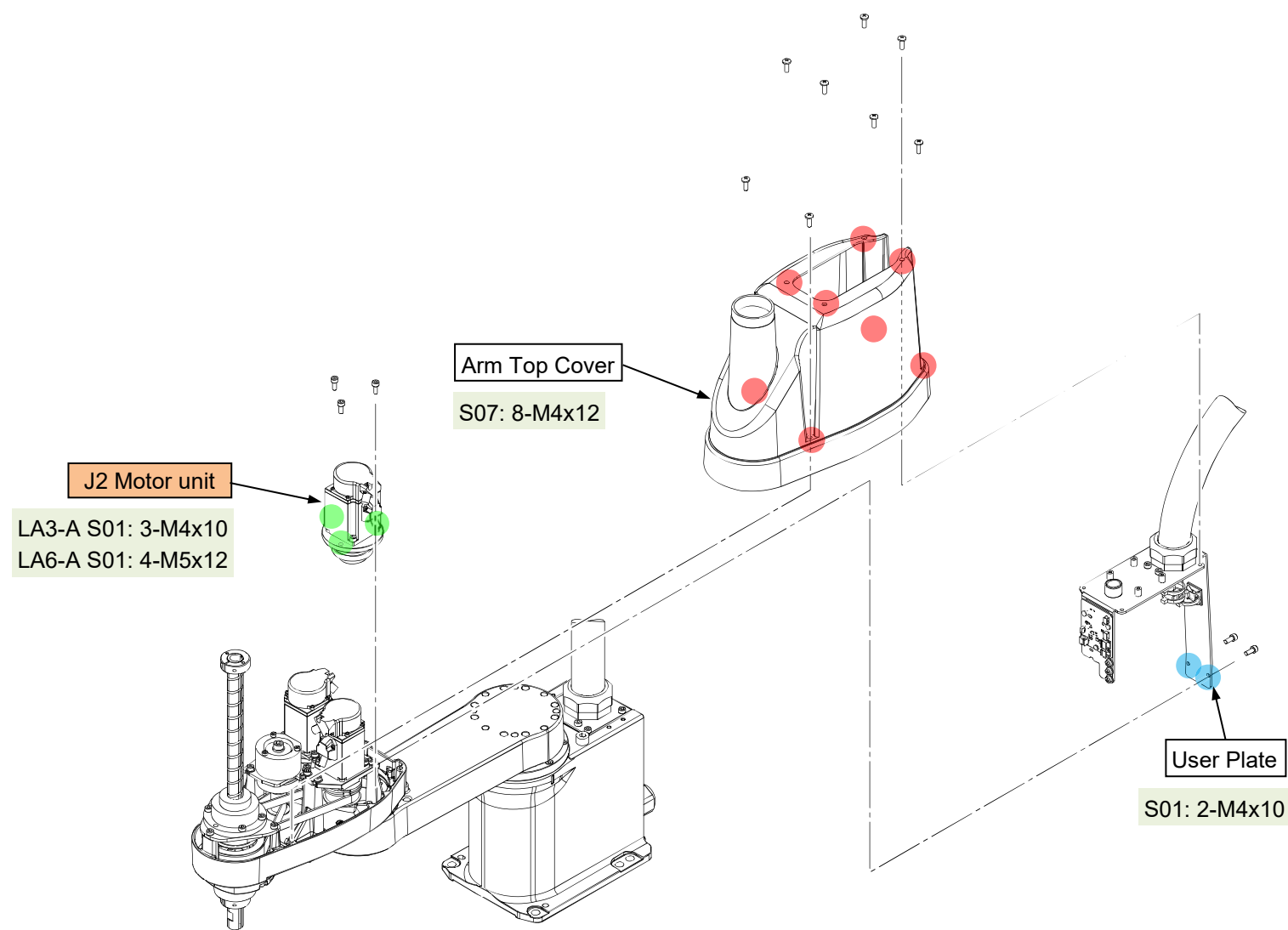
Installing the J1 Reduction Gear (LA6-A)

- | | |
|----------|--|
| 1 | Install the J1 Reduction Gear on the J1 flange (with the motor).
Perform all steps in Installing the J1 Motor (LA6-A) . |
|----------|--|

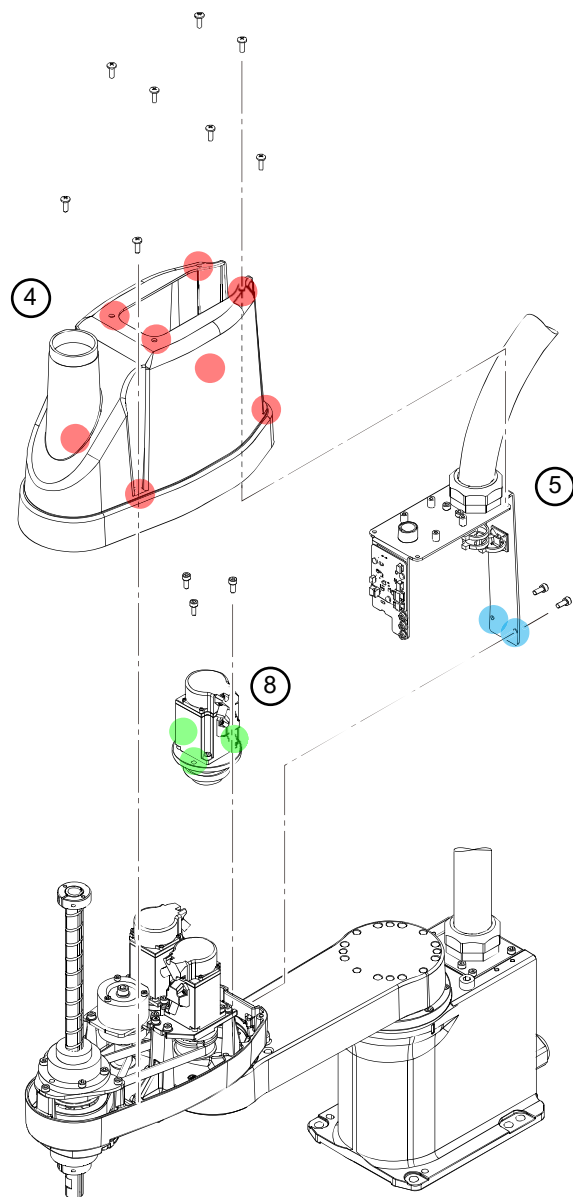


2.4 Joint #2

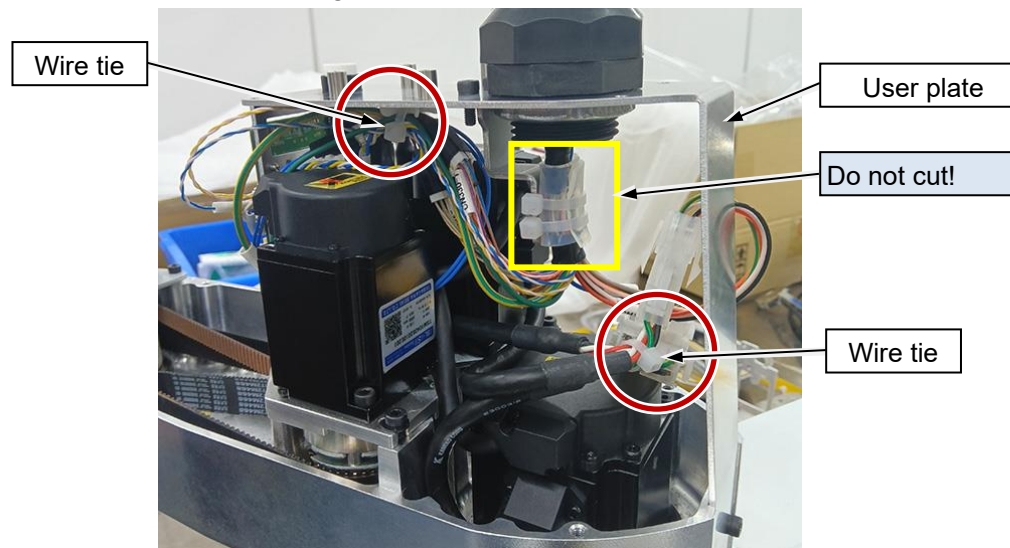
2.4.1 Replacing the J2 Motor Unit

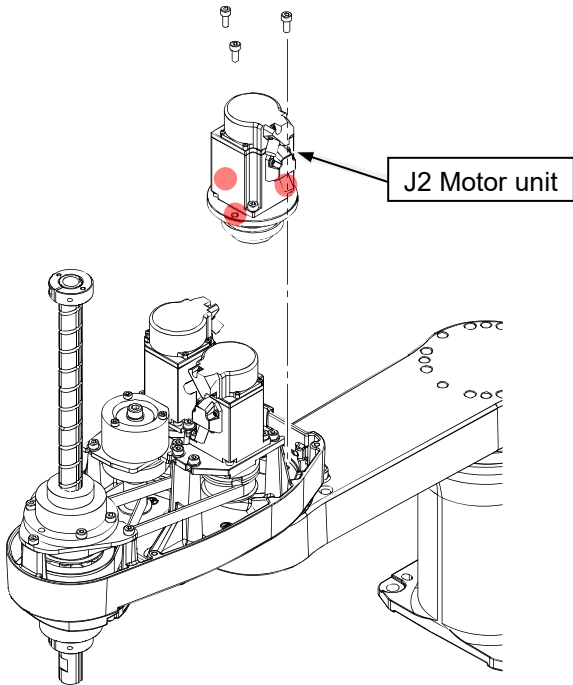


Removing the J2 Motor Unit



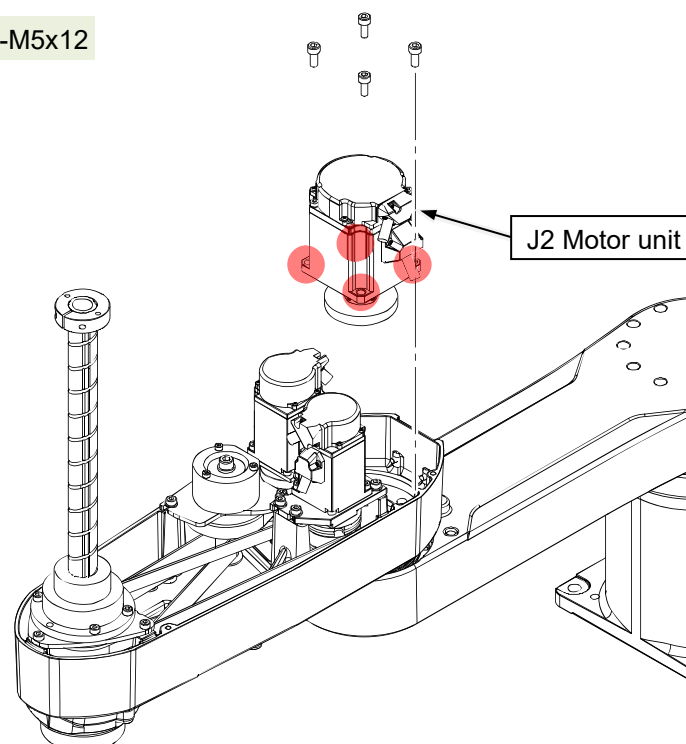
①	Turn ON the controller.
②	Press the Brake Release Switch and lower the Ball Screw Spline Unit to its lower limit. CAUTION - Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed. - When the brake is released by the Brake Release Switch, the J3 brake is released.
③	Turn OFF the controller.
④	Remove the Arm Top Cover .
⑤	Remove the User Plate .
⑥	Cut the wire tie securing the cables to the top of the user plate and the wire tie binding the power cables of the motors. CAUTION Do not cut the wire ties securing the cable to the cable support.



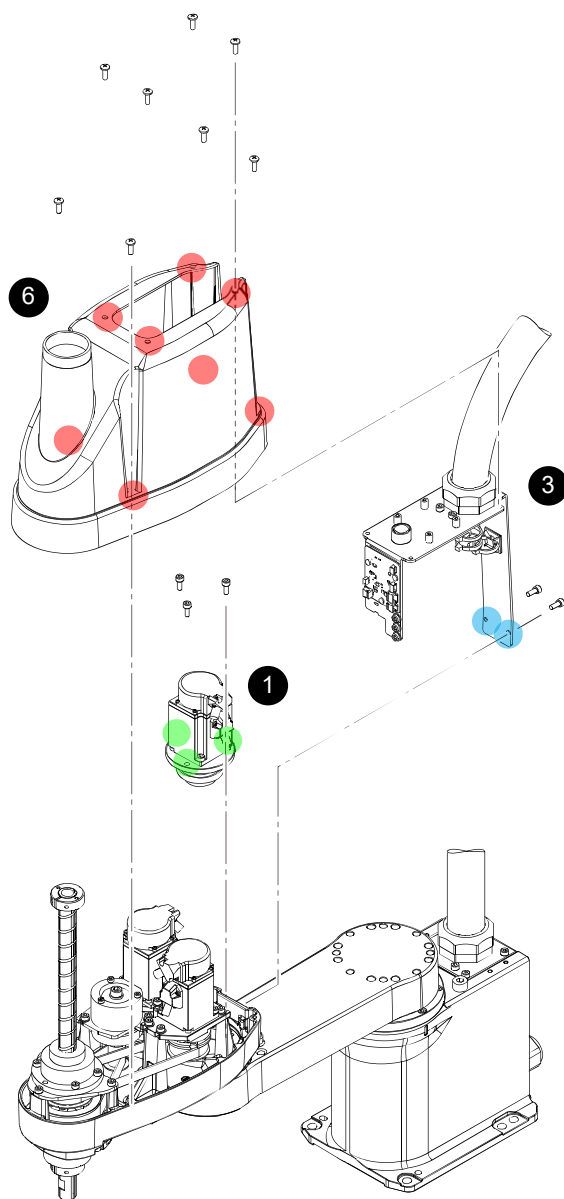
⑦	Disconnect the J2 Motor unit connectors (CN120-1, CN320-1).
⑧	Remove the J2 Motor unit from the Arm2. POINT If it is difficult to pull out the motor, pull out the motor while moving the Arm2 slowly by hand.
	LA3-A A S01: 3-M4x10 

LA6-A

A S01: 4-M5x12



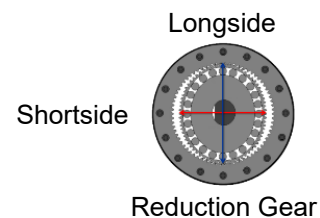
Installing the J2 Motor Unit



- 1 Install the J2 Motor unit on the Arm2.

POINT

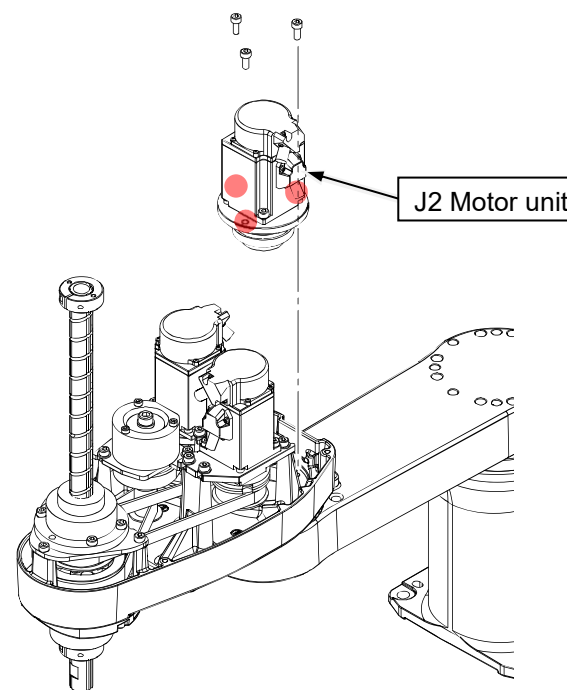
- If it is difficult to insert the motor, push it in while moving the Arm2 slowly.
- Install so that the longside of the Flexspline and the Wave Generator match.

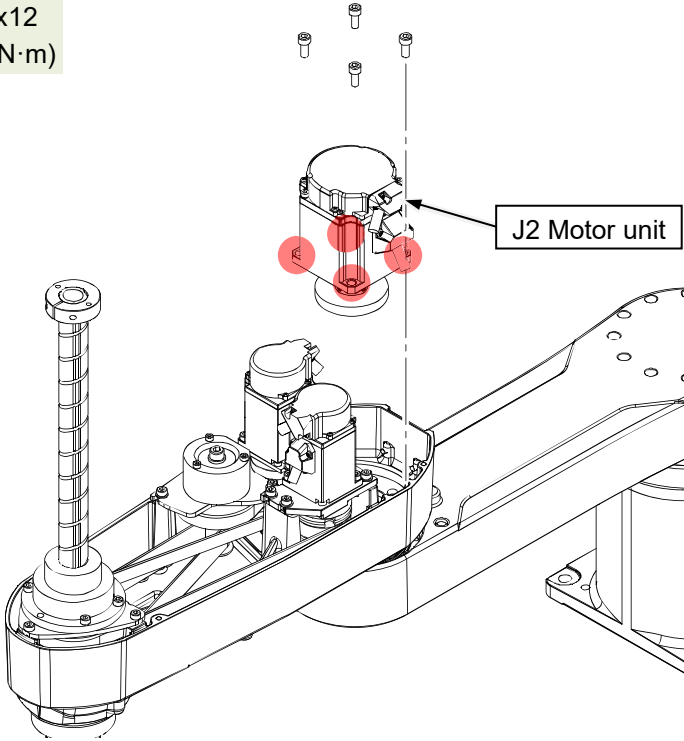


- Secure the J2 Motor unit to the Arm2 in the orientation shown in the figure.

LA3-A

- A S01: 3-M4x10
(4.0 +/- 0.2 N·m)

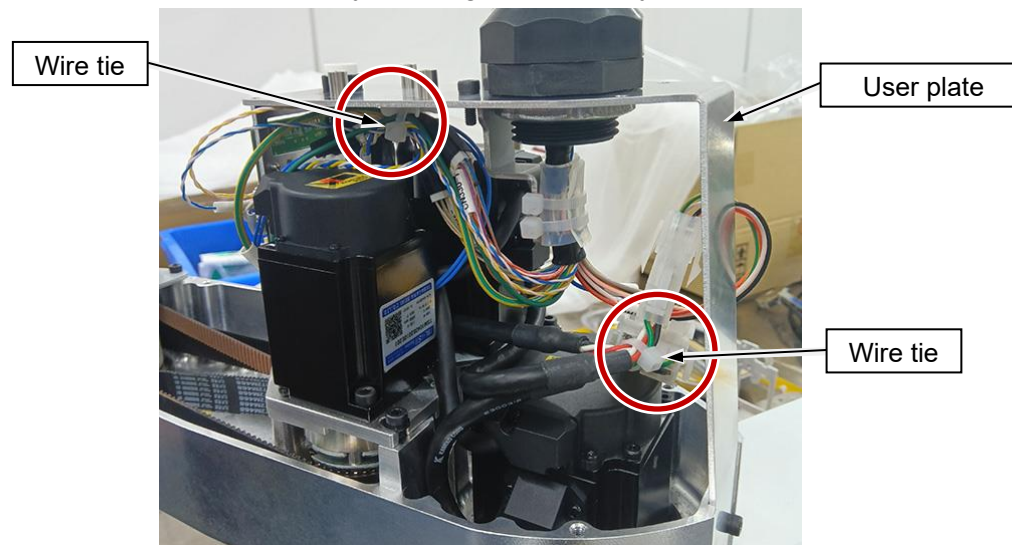


	LA6-A A S01: 4-M5x12 (4.0 +/- 0.2 N·m) 
2	Perform centering of the J2 Reduction Gear.
3	Install the User Plate .
4	Connect the J2 Motor unit connectors (CN120-1, CN320-1).

- 5 Using new wire ties, bind the cables in the same manner as the wire ties you cut in removal step ⑥.

CAUTION

Do not put strain on the cables by bending them forcibly.

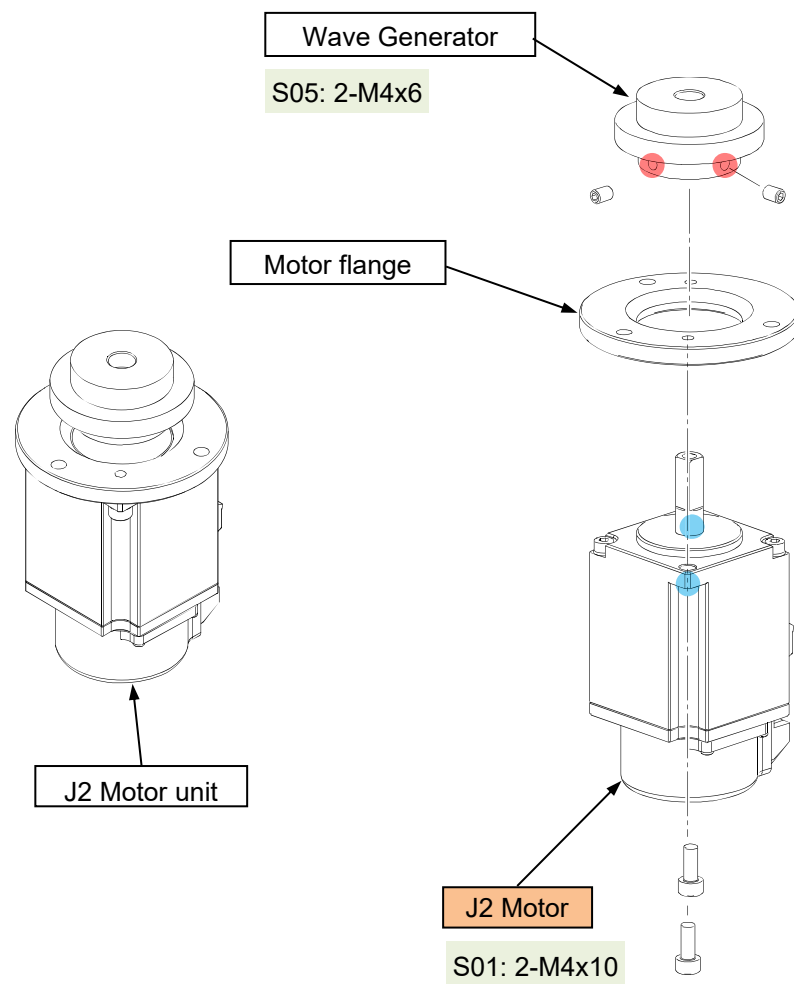


- 6 Install the [Arm Top Cover](#).

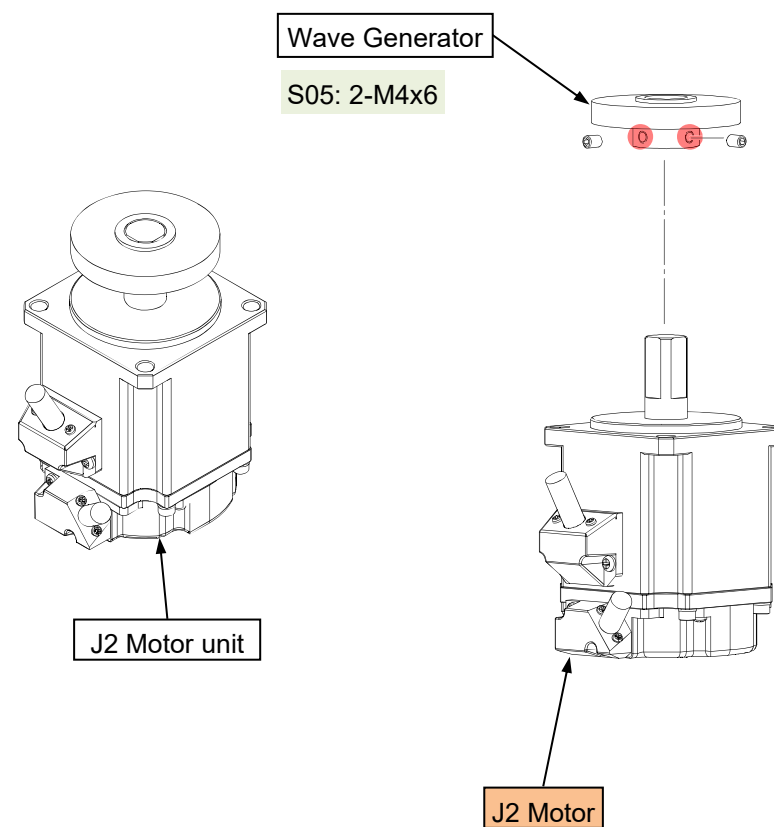
- 7 Perform the [calibration](#) of Joint #2.

2.4.2 Replacing the J2 Motor

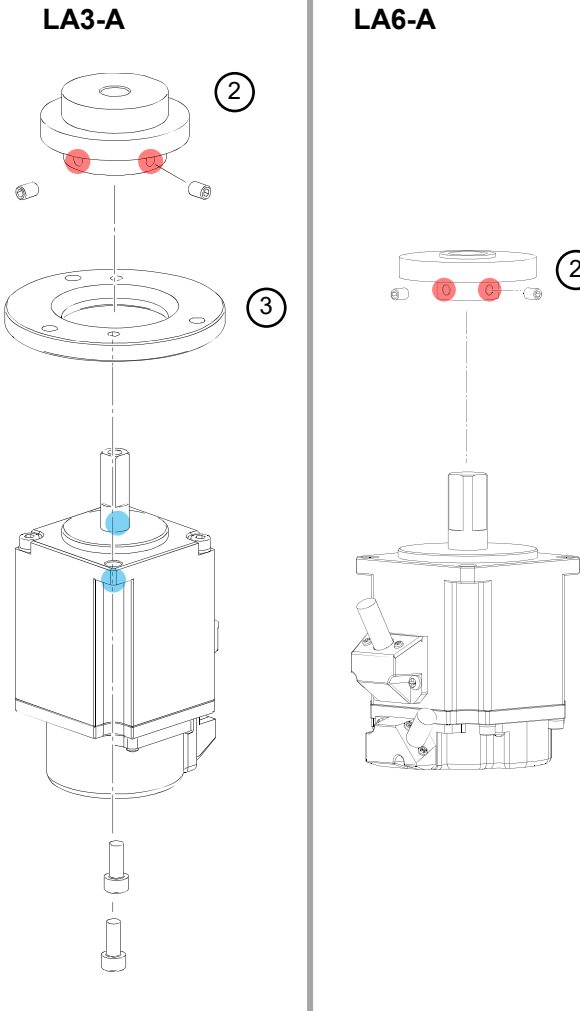
LA3-A

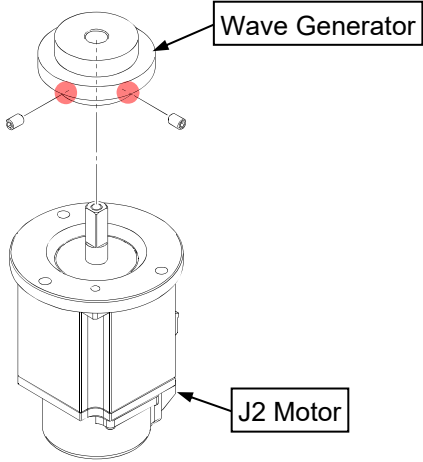
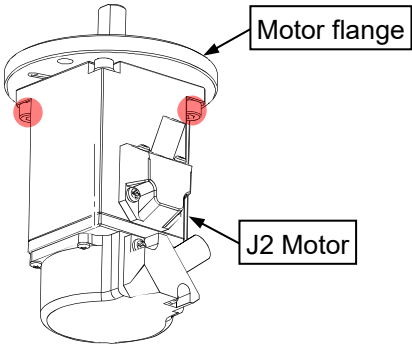


LA6-A

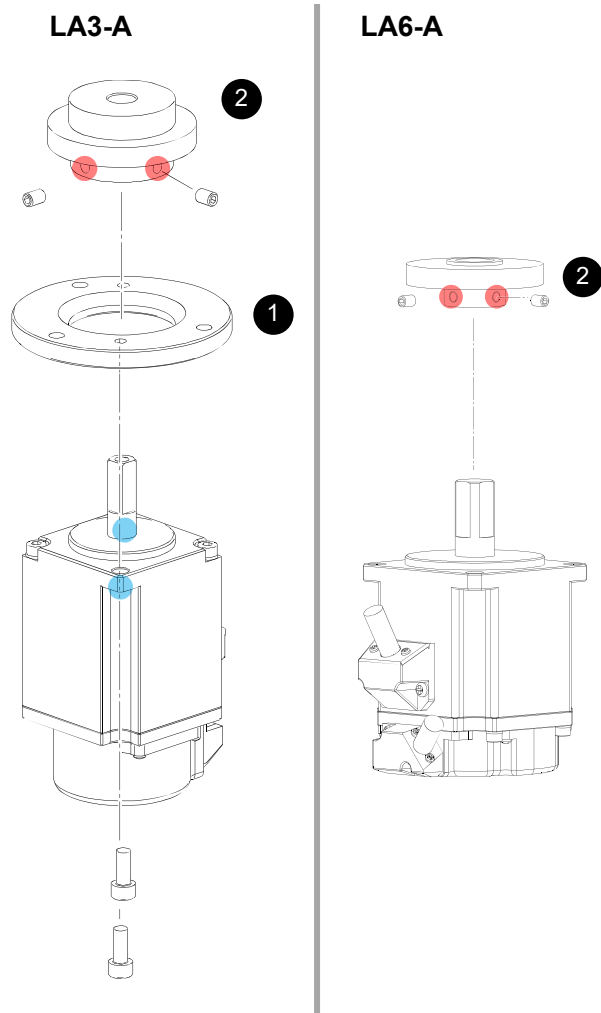


Removing the J2 Motor



①	Remove the J2 Motor unit. Perform all steps of Removing the J2 Motor Unit .
②	Remove the wave generator from the J2 Motor. A S05: 2-M4x6 
③	Only for LA3-A Remove the motor flange from the J2 Motor. NOTE LA6-A does not have a motor flange. A S01: 2-M4x10 

Installing the J2 Motor



1

Only for LA3-A

Attach the motor flange to the J2 Motor.

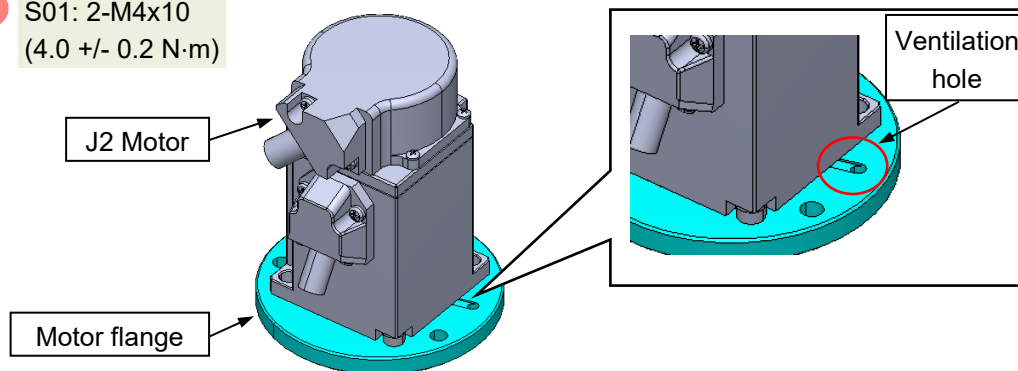
CAUTION

Install the J2 Motor so that the ventilation hole in the motor flange is positioned as shown in the figure.

NOTE

LA6-A does not have a motor flange.

A

S01: 2-M4x10
(4.0 +/- 0.2 N·m)

2

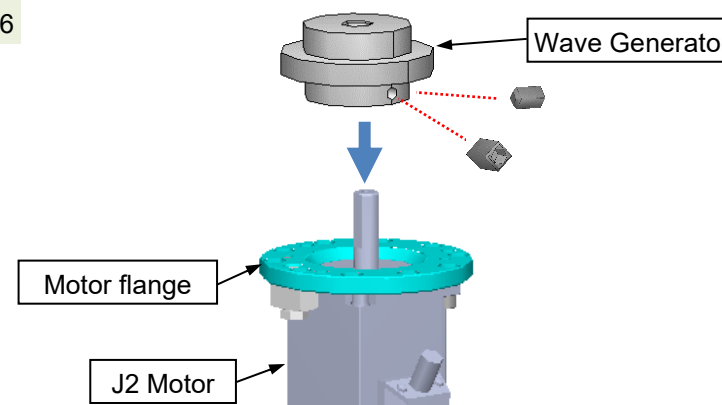
Attach the wave generator to the J2 Motor.

For LA3-A

1. Using a wiping cloth and alcohol, wipe off the anti-rust oil on the motor shaft.
2. Place the wave generator on the shaft of the J2 Motor in the orientation shown in the figure, and fix it temporarily with the screws touching the two flat surfaces of the shaft.

CAUTION

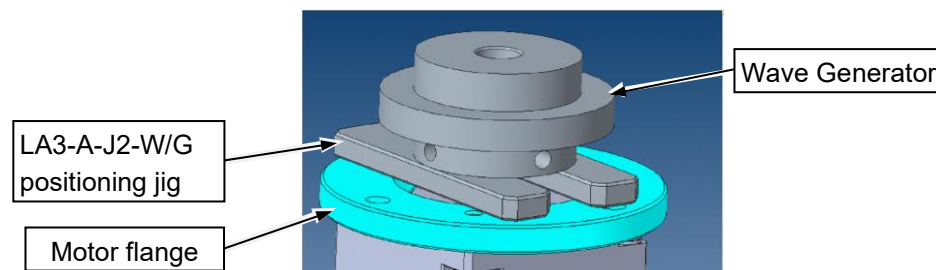
- Be careful not to place the wave generator upside down.
- Place the wave generator so that its set screws are on the flat surfaces of the motor shaft.

A S01: 2-M4x6

3. Attach the LA3-A-J2-W/G positioning jig to the J2 Motor.

CAUTION

- Attach the jig so that it comes into contact with the motor shaft.
- Make sure there are no gaps between the motor flange and the jig, and between the jig and the wave generator.



4. Tighten the set screws to fix the wave generator.

A S05: 2-M4x6
(2.4 +/- 0.1 N·m)

5. Remove the LA3-A-J2-W/G positioning jig from the J2 Motor.

For LA6-A

1. Using a wiping cloth and alcohol, wipe off the anti-rust oil on the motor shaft.

2. Attach the LA6-A-J2-W/G positioning jig to the J2 Motor.

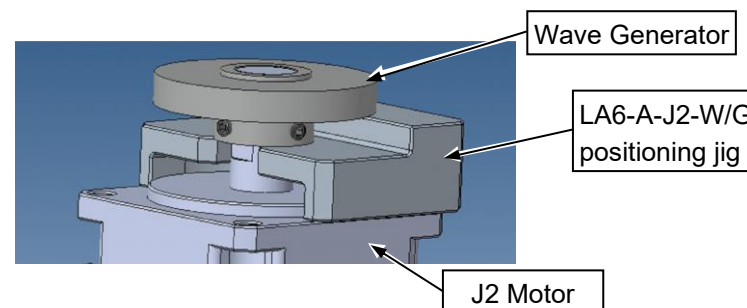
CAUTION

- Be careful not to place the LA6-A-J2-W/G positioning jig upside down.
- Attach the jig so that it comes into contact with the motor shaft.

3. Place the wave generator on the shaft of the J2 Motor in the orientation shown in the figure, so that the wave generator is on the LA6-A-J2-W/G positioning jig.

CAUTION

- Be careful not to place the wave generator upside down.
- Place the wave generator so that its set screws are on the flat surfaces of the motor shaft.



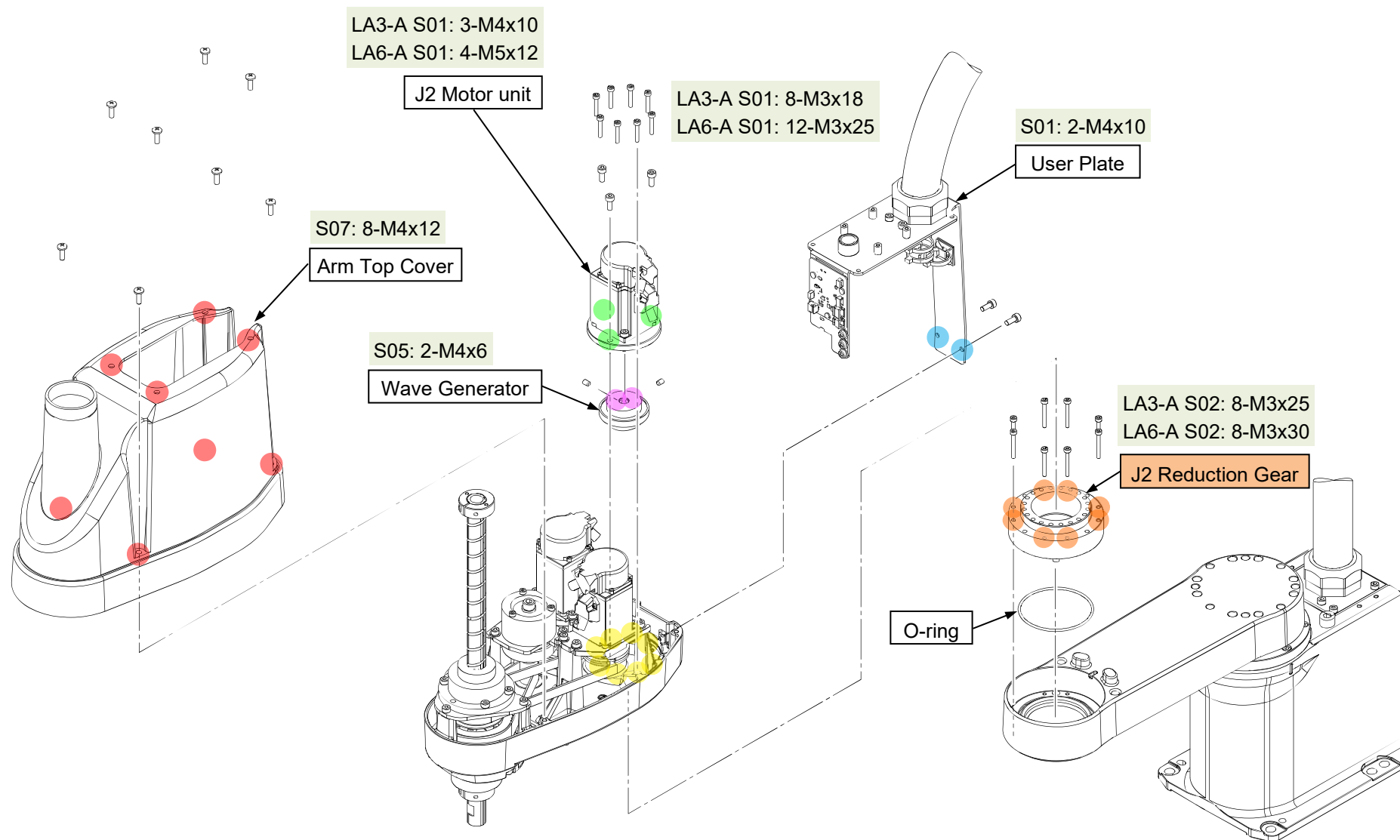
4. Fix the wave generator to the motor shaft.

A S05: 2-M4x6
(2.4 +/- 0.1 N·m)

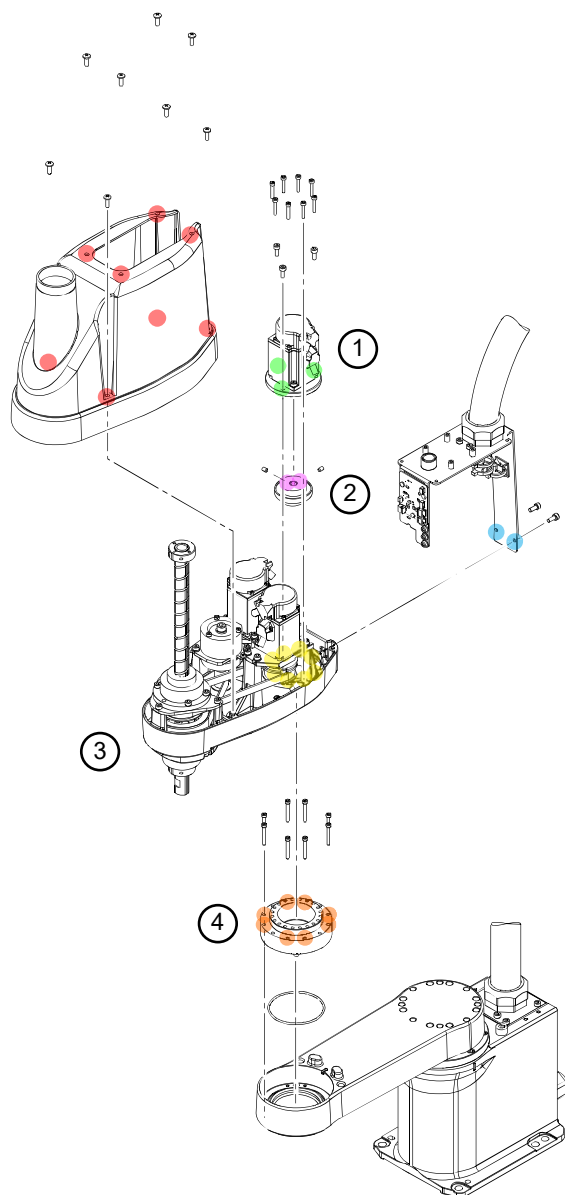
5. Remove the Gap Adjustment jig from the J2 Motor.

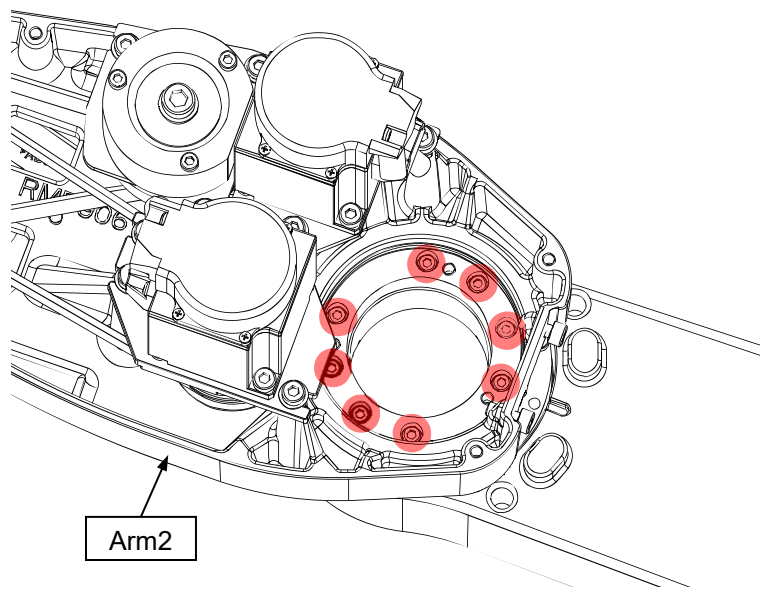
3	Apply grease to the following areas. For LA3-A: Between the wave generator and the motor flange  SK-2: 4 g For LA6-A: Between the wave generator and the J2 Motor  SK-1A: 6 g
4	Install the J2 Motor unit.

2.4.3 Replacing the J2 Reduction Gear



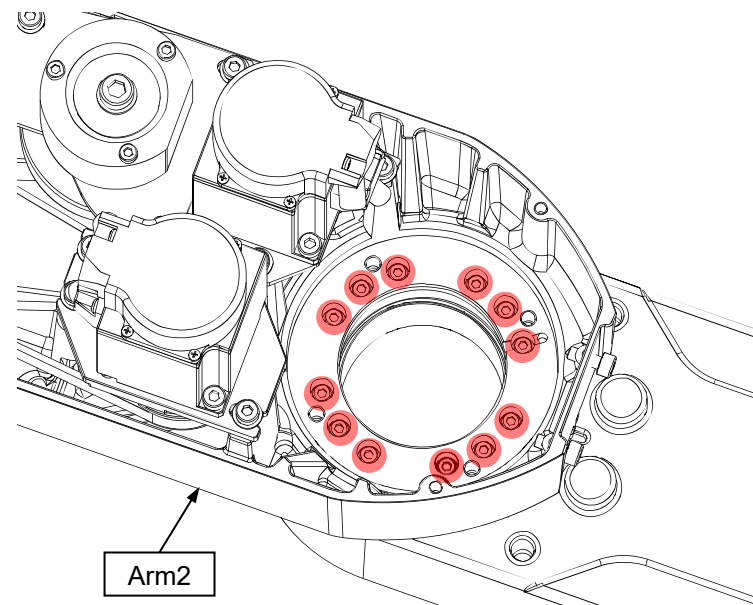
Removing the J2 Reduction Gear



①	Remove the J2 Motor unit .
②	Remove the wave generator from the J2 Motor. Perform the steps up to ② in Removing the J2 Motor .
③	Remove the Arm2 from the J2 Reduction Gear. CAUTION - Support Arm2 with a hand when removing the screws to ensure Arm2 does not fall. - Remove Arm2 straight upwards.
LA3-A A S01: 8-M3x18  Arm2	

LA6-A

A S01: 12-M3x25



④

Remove the J2 Reduction Gear from the Arm1.

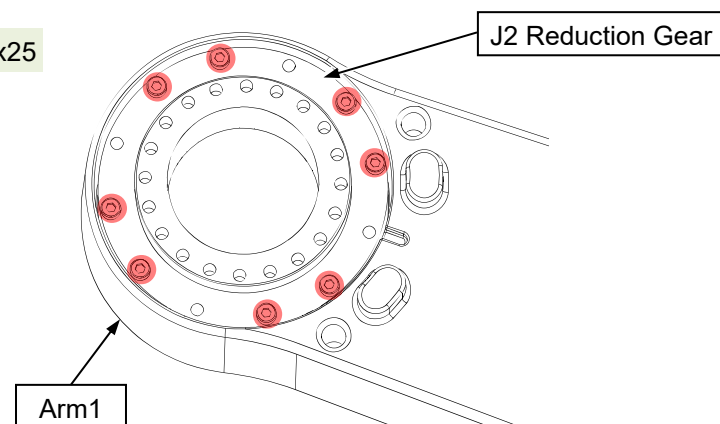
CAUTION

There is an O-ring between the Arm1 and the Reduction Gear.
Be careful not to lose the O-ring.

LA3-A

A

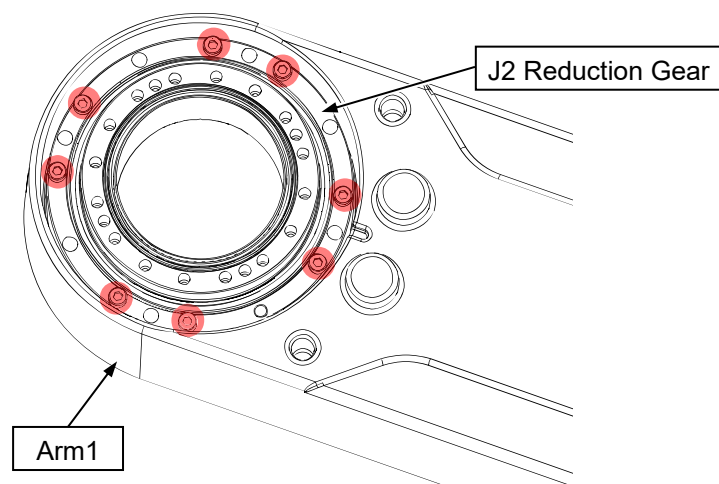
S02: 8-M3x25



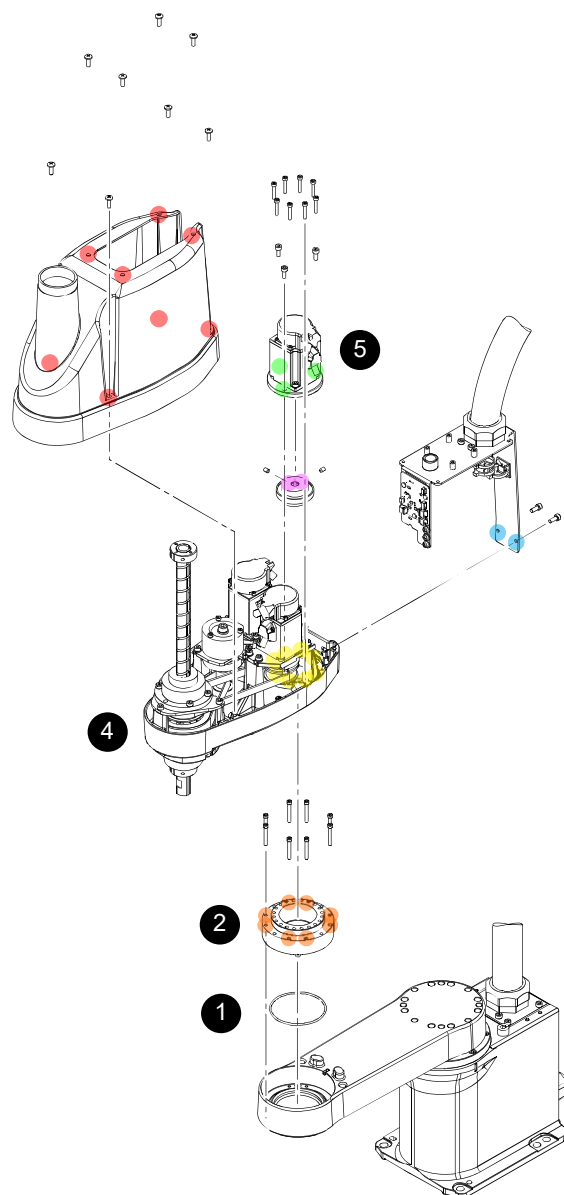
LA6-A

A

S02: 8-M3x30



Installing the J2 Reduction Gear



- 1 Apply a thin layer of grease to the O-ring and install the O-ring in the groove of the Arm1.

LA3-A



SK-2

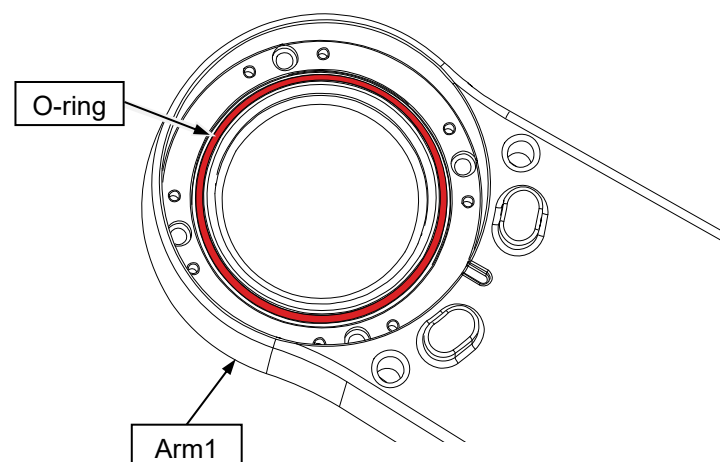
LA6-A



SK-1A

CAUTION

Taking care not to damage the O-ring, insert it properly into the groove.

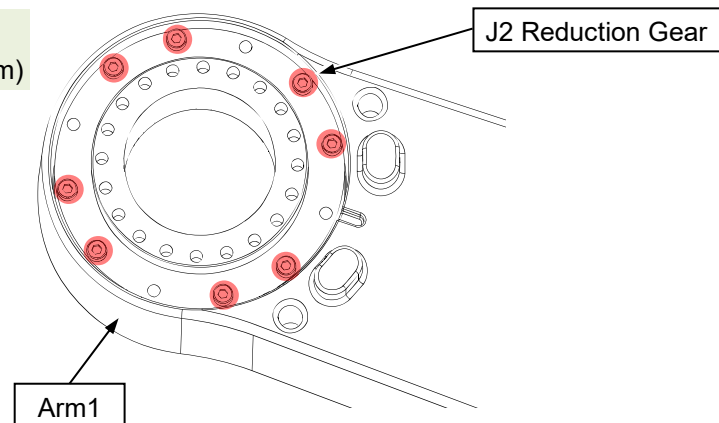


2

Install the J2 Reduction Gear to the Arm1.

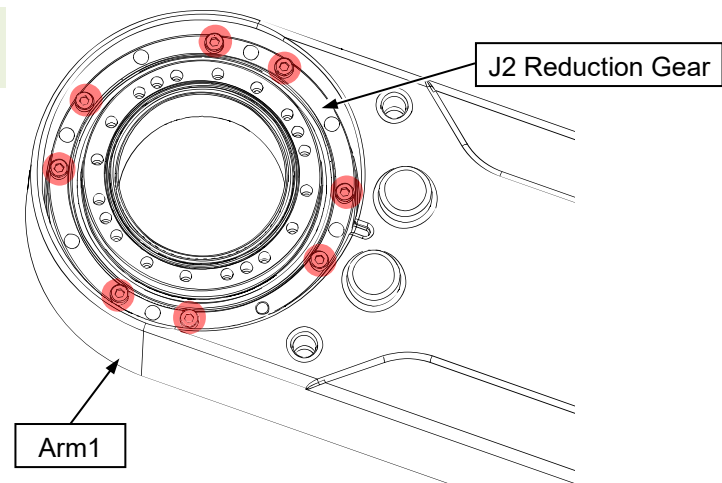
LA3-A

A S02: 8-M3x25
(2.4 +/- 0.1 N·m)



LA6-A

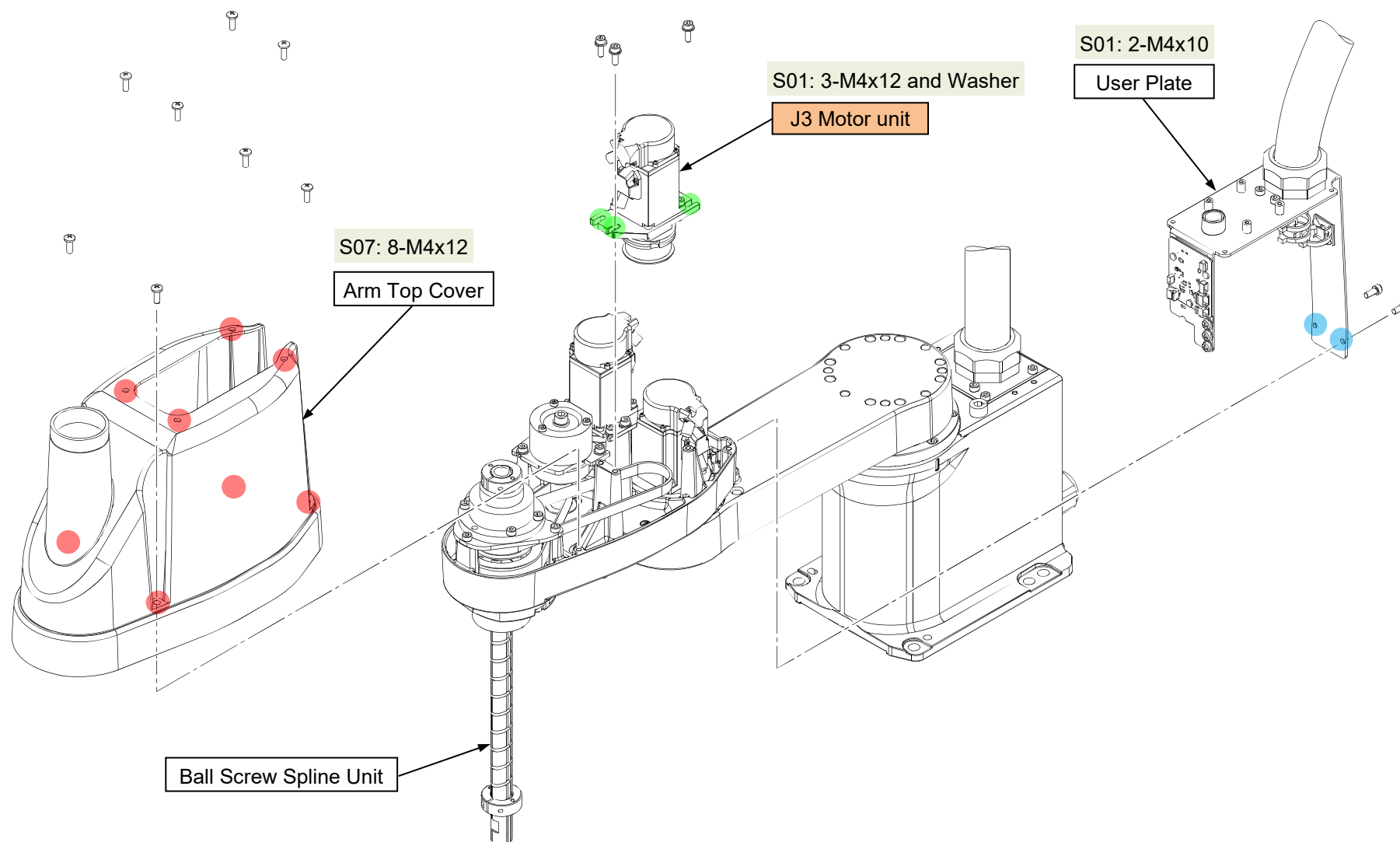
A S02: 8-M3x30
(2.4 +/- 0.1 N·m)



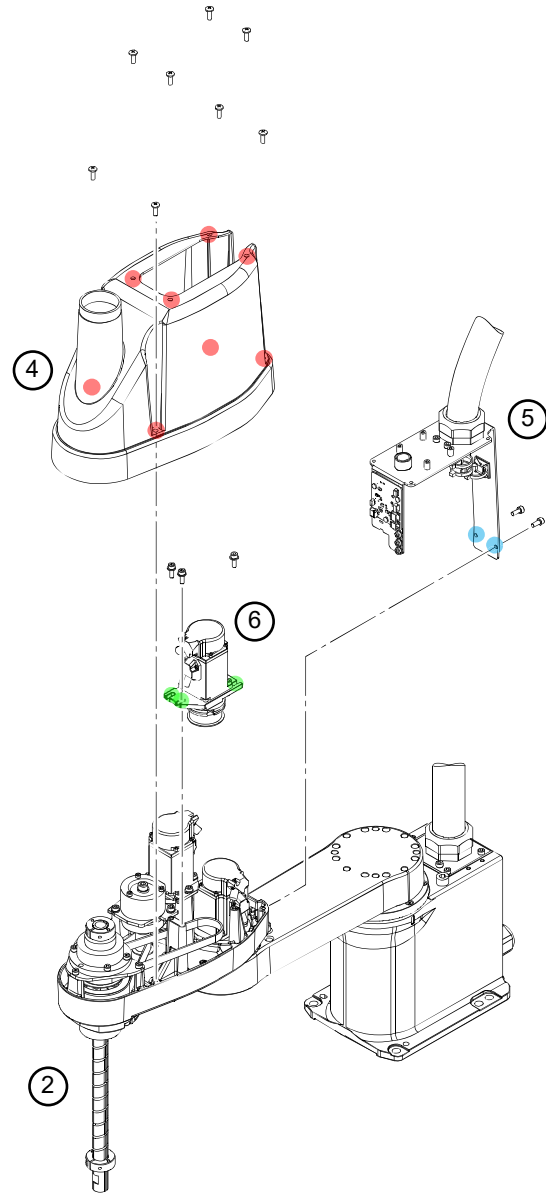
3	Apply grease to the inside of the flexspline. LA3-A  SK-2: 11 g LA6-A  SK-1A: 16 g
4	Install the Arm2 to the J2 Reduction Gear. CAUTION Support the Arm2 with a hand when installing the screw to ensure the Arm2 does not fall.
5	Install the J2 Motor. Perform all steps in Installing the J2 Motor.

2.5 Joint #3

2.5.1 Replacing the J3 Motor Unit

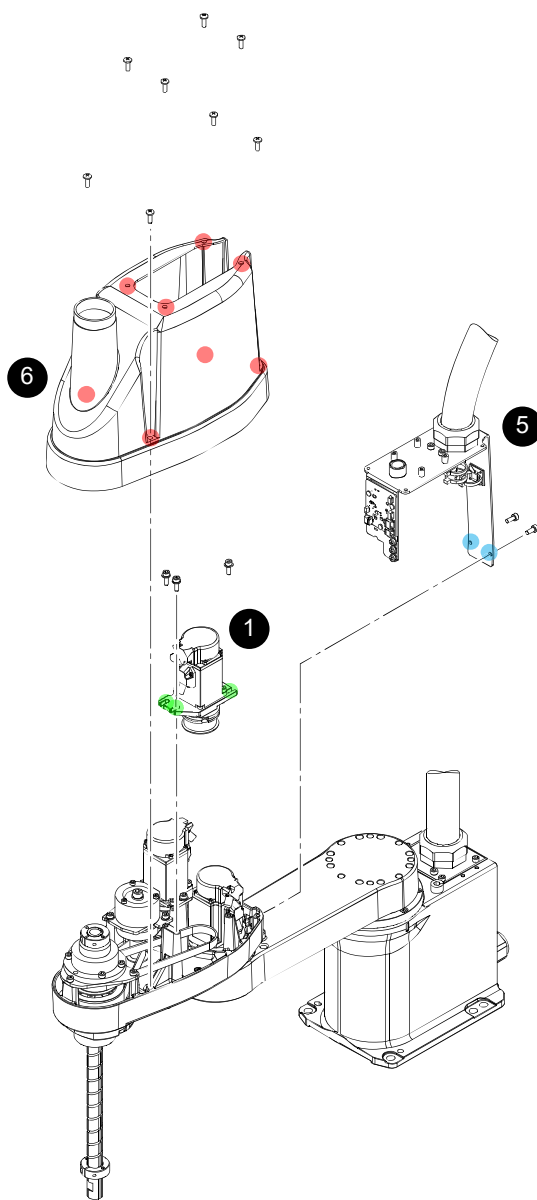


Removing the J3 Motor Unit



①	Turn ON the controller.
②	Press the Brake Release Switch and lower the Ball Screw Spline Unit to its lower limit. CAUTION • Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed. • When the brake is released by the Brake Release Switch, the J3 brake is released.
③	Turn OFF the controller.
④	Remove the Arm Top Cover .
⑤	Remove the User Plate .
⑥	Remove the J3 Motor unit (with the brake) from the Arm2. A S01: 3-M4x12 and Washer This diagram shows the J3 Motor unit (with the brake) being removed from the Arm2. The unit is shown with the brake released, and the Arm2 is labeled. The J3 Motor unit (with the brake) is shown being lifted away from the Arm2.

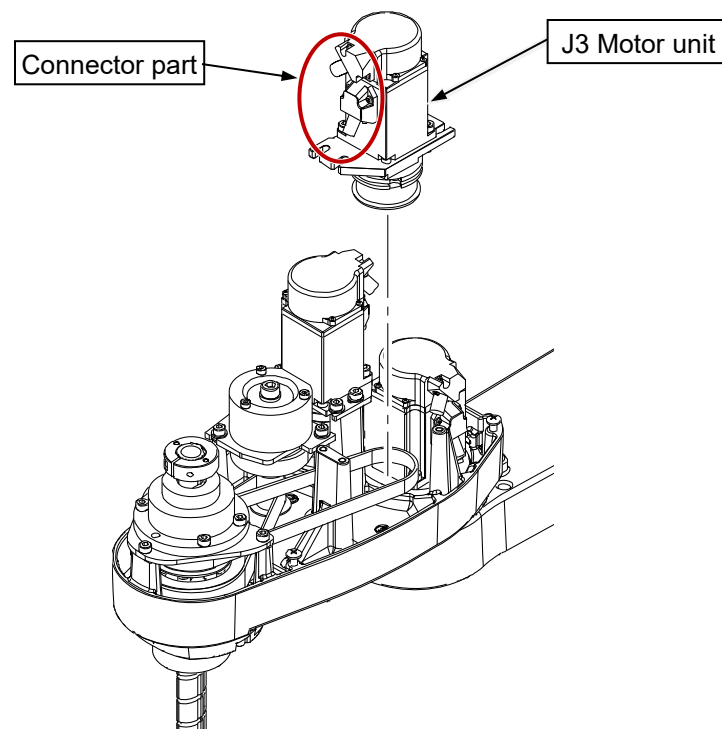
Installing the J3 Motor Unit



- 1 Set the J3 Motor unit in Arm2.

CAUTION

Orient the connector part for the power cable of the J3 Motor so that it faces the Ball Screw Spline side.



2

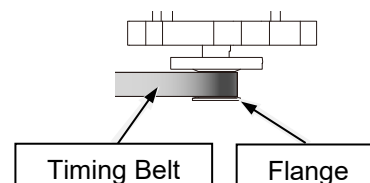
Place the Z belt on the pulley of the J3 Motor unit.

POINT

Make sure that the teeth of the belt and the pulley are properly engaged.

CAUTION

If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



Set the belt so that it is level with respect to the pulley without it being placed on the flange.

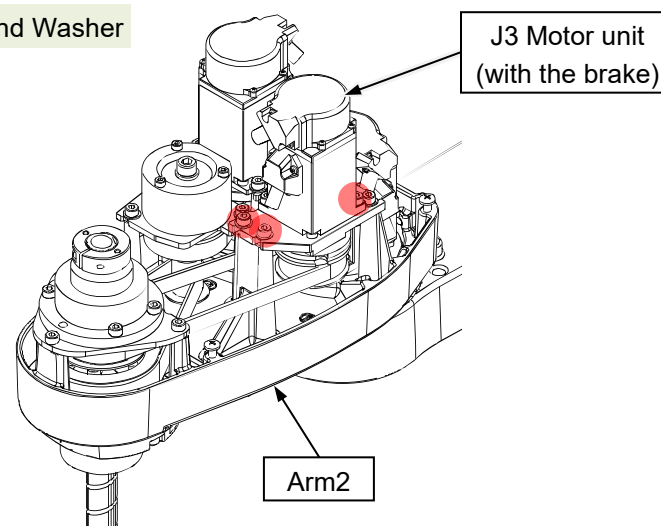
3

Temporarily secure the J3 Motor unit.

POINT

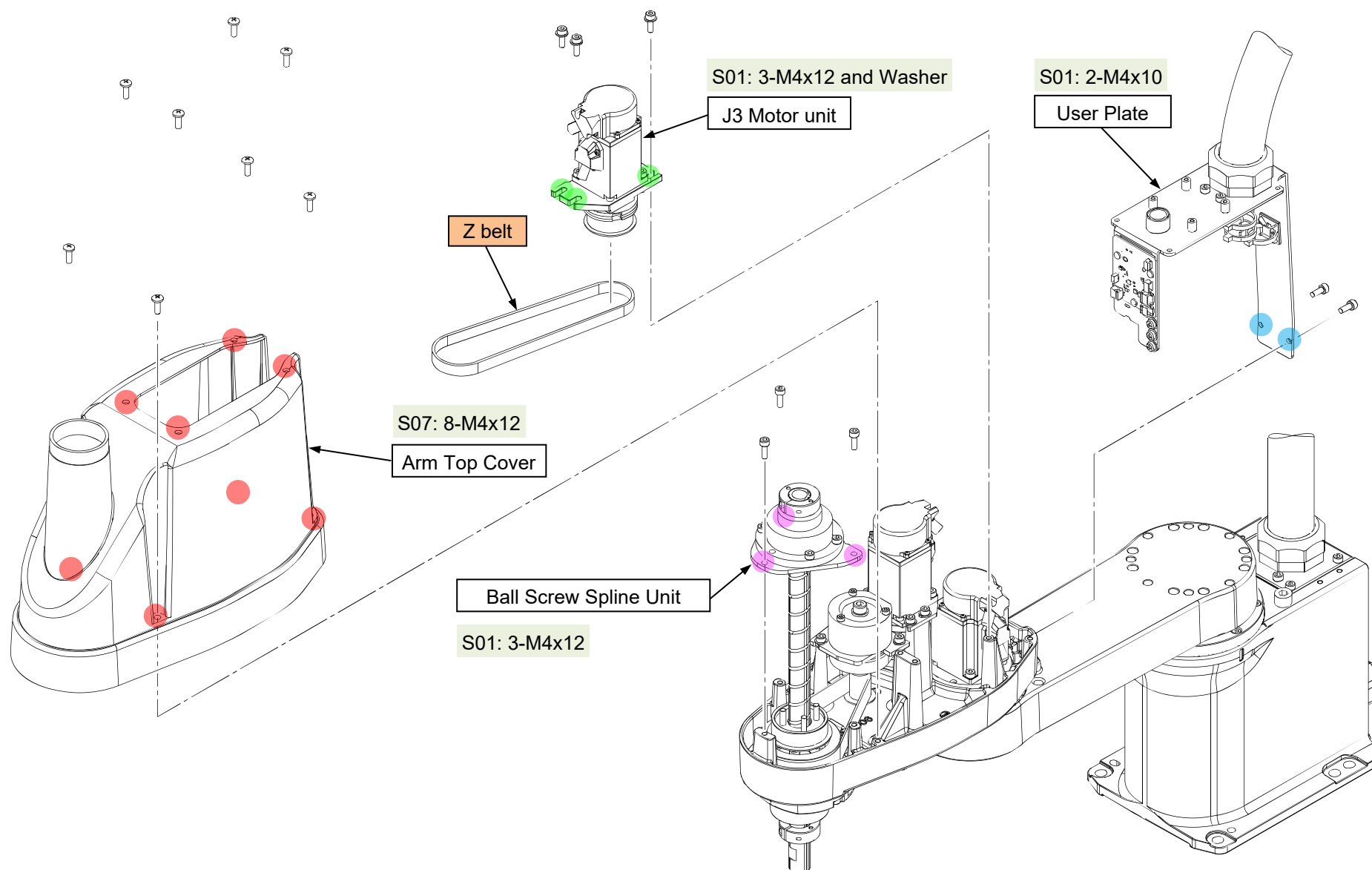
The standard for temporary securing is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.

A S01: 3-M4x12 and Washer

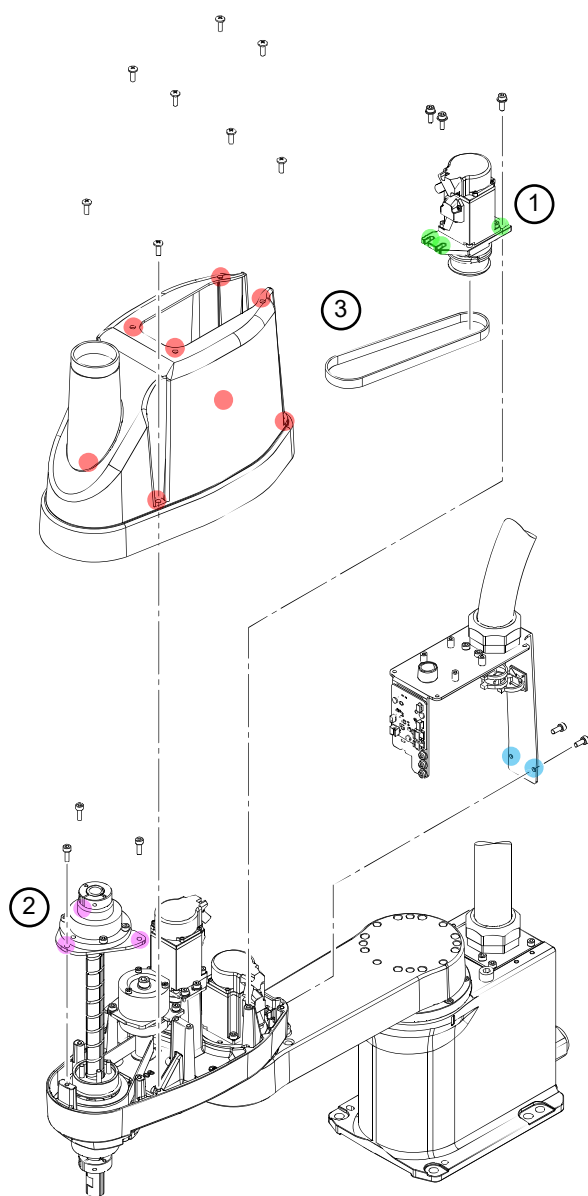


4	Perform Z belt tension adjustment .
5	Secure the User Plate .
6	Install the Arm Top Cover .
7	Perform the calibration of Joint #3 and Joint #4.

2.5.2 Replacing the J3 Timing Belt

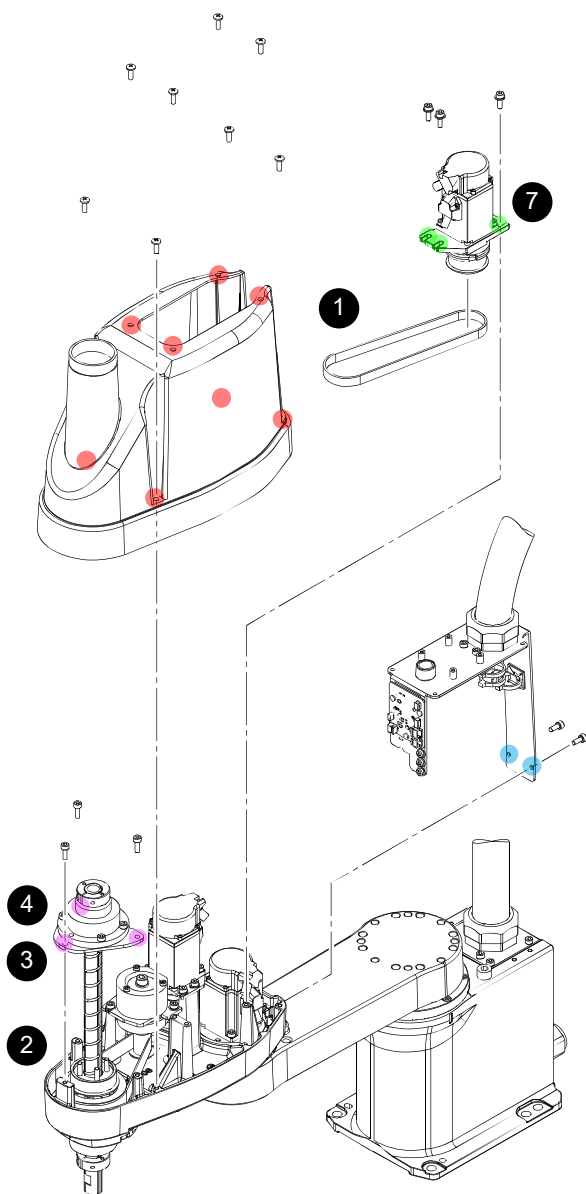


Removing the Z Belt



①	Remove the J3 Motor unit. Perform all steps of Removing the J3 Motor Unit .
②	Remove the screws securing the Spline Plate to Arm2. A S01: 3-M4x12 Spline Plate
③	Lift up the Ball Screw Nut Unit to the extent that the belt can pass along the Ball Screw Spline, and remove the Z belt from the upper part of the Ball Screw Spline. CAUTION - Support the Ball Screw Nut Unit with a hand when removing the belt to ensure the lifted up Ball Screw Nut Unit does not fall. - Be careful not to get your hands or fingers caught between the Arm2 and the Ball Screw Nut Unit during the work.

Installing the Z Belt

**CAUTION**

- Support the Ball Screw Nut Unit with a hand when installing the belt to ensure the lifted up Ball Screw Nut Unit does not fall.
- Be careful not to get your hands or fingers caught between the Arm2 and the Ball Screw Nut Unit during the work.

1

Lift up the Ball Screw Nut Unit to the extent that the belt can pass along the Ball Screw Spline, and pass the Z belt from the upper part of the Ball Screw Spline.

2

Place the Z belt on the pulley of the Ball Screw Nut Unit.

POINT

Make sure that the teeth of the belt and the pulley are properly engaged.

CAUTION

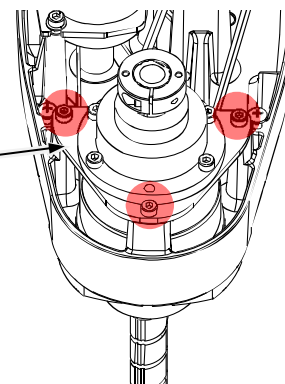
Take care that the Z belt does not get trapped between the Ball Screw Nut Unit and Arm2.

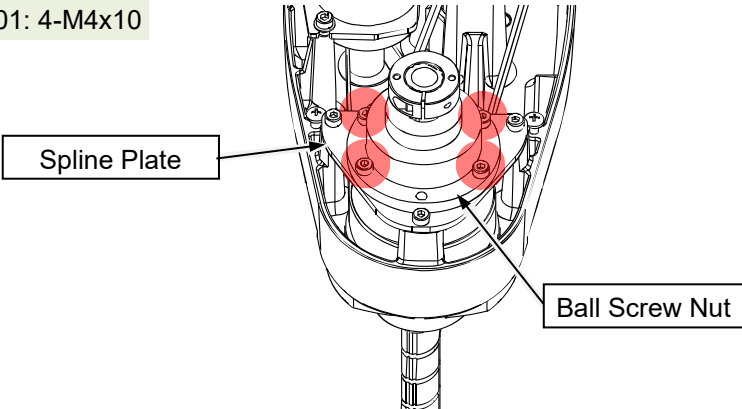
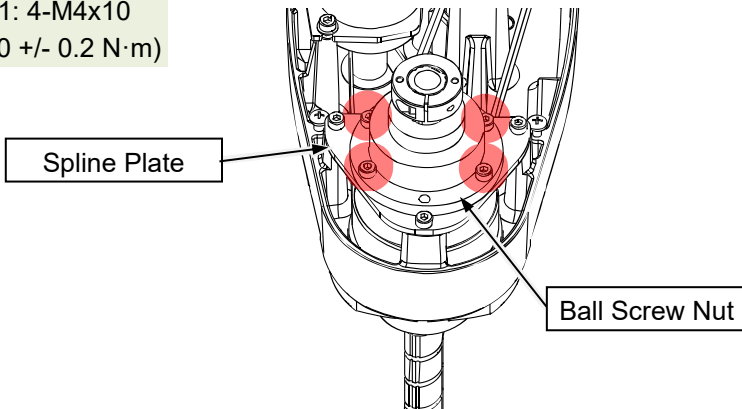
3

Secure the Spline Plate on Arm2.

A S01: 3-M4x12
(4.0 +/- 0.2 N·m)

Spline Plate



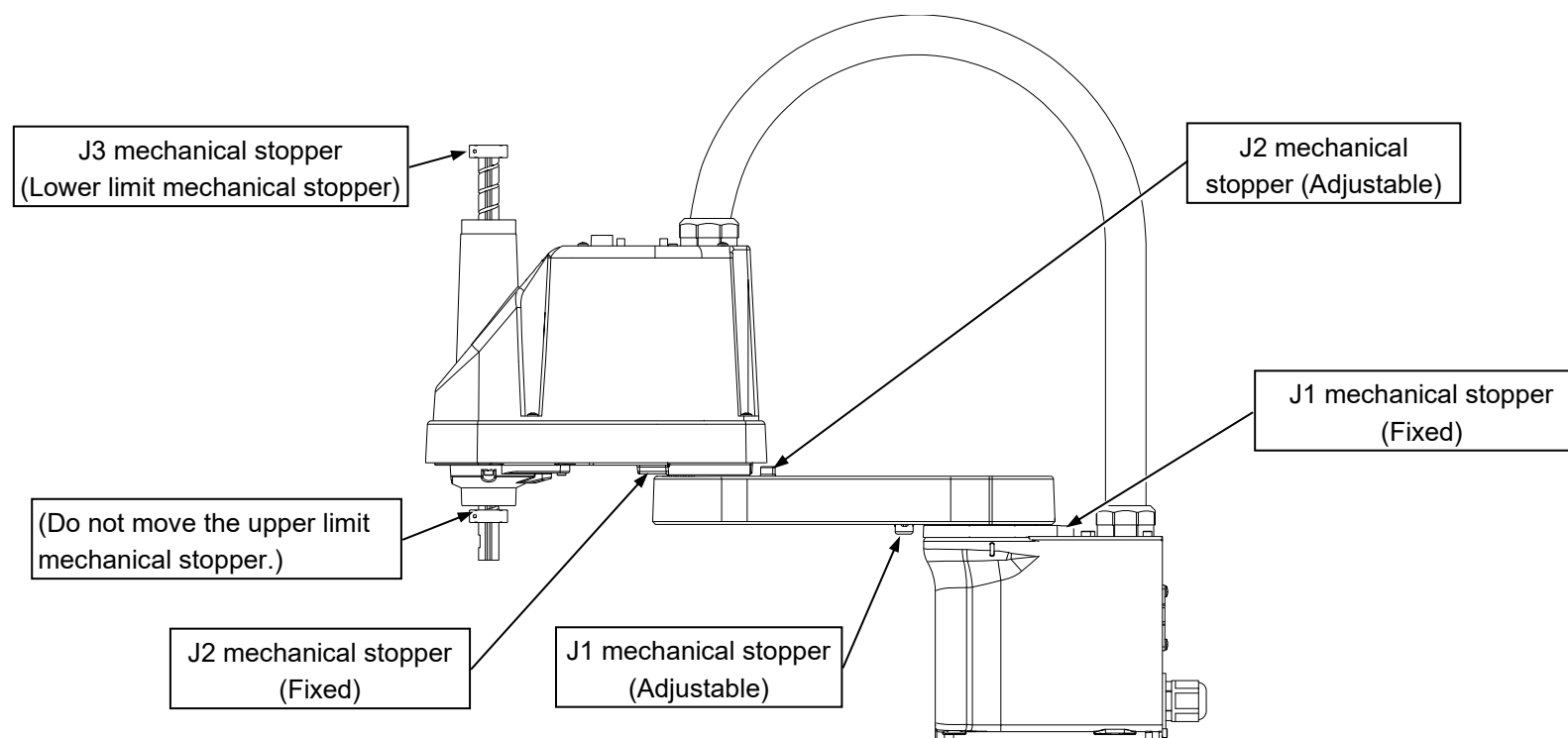
4	Temporarily secure the ball screw nut to the Spline Plate. POINT Loosen the screws securing the ball screw nuts once and retighten them to the specified torque after centering. A S01: 4-M4x10  Spline Plate Ball Screw Nut
5	Perform centering of the Ball Screw Spline Unit. Move the shaft of the Ball Screw Spline Unit up and down 5 times by hand.
6	Secure the ball screw nut to the Spline Plate. A S01: 4-M4x10 (4.0 +/- 0.2 N·m)  Spline Plate Ball Screw Nut
7	Install the J3 Motor unit. Perform all steps of Installing the J3 Motor Unit.

2.5.3 Setting Motion Range with the Mechanical Stopper

With the mechanical stoppers, you can set an absolute motion range where the manipulator cannot mechanically move any further.

The J1 and J2 have screw holes at positions corresponding to the angles that determine the motion range. Change the positions of the mechanical stoppers according to the motion range you want to set. Install the bolts in the screw holes corresponding to the angle you want to set.

The motion range of the J3 can be set to any length less than the maximum stroke.

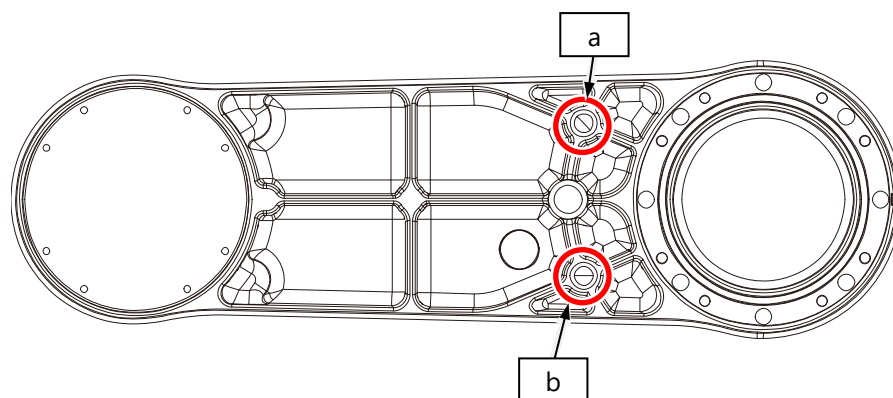


Setting Motion Range with the J1 and J2 Mechanical Stoppers

The J1 and J2 have screw holes at positions corresponding to the angles that determine the motion range. Change the positions of the mechanical stoppers according to the motion range you want to set. Install the bolts in the screw holes corresponding to the angle you want to set.

Install the bolts as mechanical stoppers in the positions shown below.

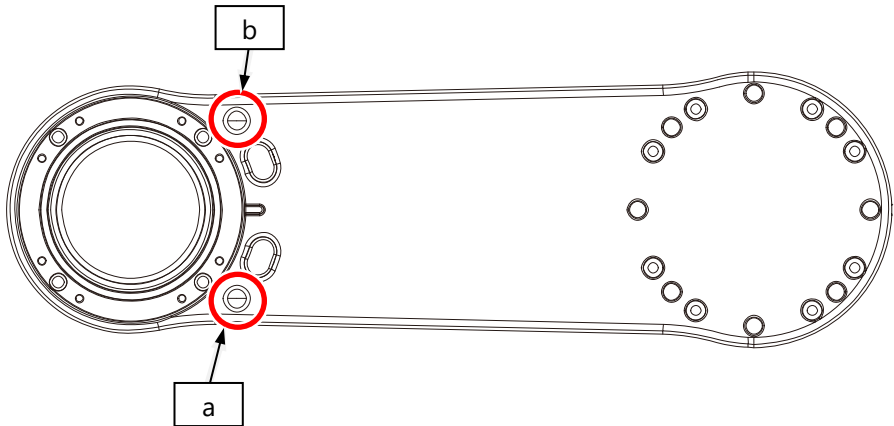
J1 mechanical stopper



This illustration shows the Arm1 seen from the bottom.

		a	b
LA3-A	Angle to be set	110°	-110°
	Pulse value	455111 pulses	-45511 pulses
LA6-A	Angle to be set	115°	-115°
	Pulse value	746382 pulses	-91022 pulses

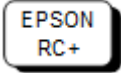
J2 mechanical stopper



This illustration shows the Arm1 seen from the top.

		a	b
LA3-A LA6-A	Angle to be set	110°	-110°
	Pulse value	455111 pulses	-45511 pulses

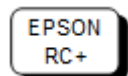
①	Turn OFF the controller.			
②	Install the hexagon socket head cap screw in the threaded hole corresponding to the angle you want to set.			
	Joint	Hexagon socket head cap screw	No. of screws	Recommended tightening torque
	1	M8x10 fully threaded	1 on each side	12.3 N·m (125 kgf·cm)
③	Turn ON the controller.			

- | | |
|---|--|
| ④ | <p>Set the pulse range corresponding to the changed mechanical stopper position.</p> <p>NOTE</p> <p>Be sure to set the pulse range inside the range set by the mechanical stopper.</p> <p><Example: when setting the motion range of the J1 to -110° to $+110^{\circ}$ and the J2 to -110° to $+110^{\circ}$ for LA6-A602S></p> <div data-bbox="360 312 479 384"></div> <p>Execute the following commands using the [Command Window].</p> <p>>JRANGE 1, -72817, 728177 ` This sets the pulse range for the J1</p> <p>>JRANGE 2, -250311, 250311 ` This sets the pulse range for the J2</p> <p>>RANGE ` Confirm the settings using the Range command</p> <p>-72817, 728177, -250311, 250311, -245760, 0, -245760, 245760</p> |
| ⑤ | <p>Move the arm by hand until it stops by the mechanical stoppers, and confirm that there are no problems such as the arm hitting peripheral devices.</p> |

- ⑥ Operate the joint with the changed motion range setting at low speed to the minimum and maximum pulse range positions, and confirm that the arm does not hit the mechanical stoppers.

(Confirm the set stopper position and motion range.)

<Example: when setting the motion range of the J1 to -110° to $+110^{\circ}$ and the J2 to -110° to $+110^{\circ}$ for LA6-A602S>



Execute the following commands using the [Command Window].

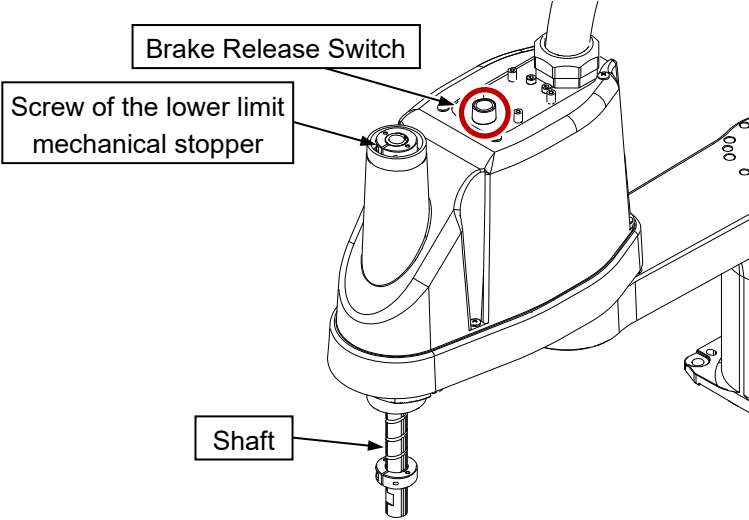
>MOTOR ON `	Turns on the motor
>POWER LOW `	Puts it in low power mode
>SPEED 5 `	Sets the motion speed to low
>PULSE -72817,0,0,0 `	Moves the J1 to the minimum pulse position
>PULSE 72817,0,0,0 `	Moves the J1 to the maximum pulse position
>PULSE 327680,-250311,0,0 `	Moves the J2 to the minimum pulse position
>PULSE 327680,250311,0,0 `	Moves the J2 to the maximum pulse position

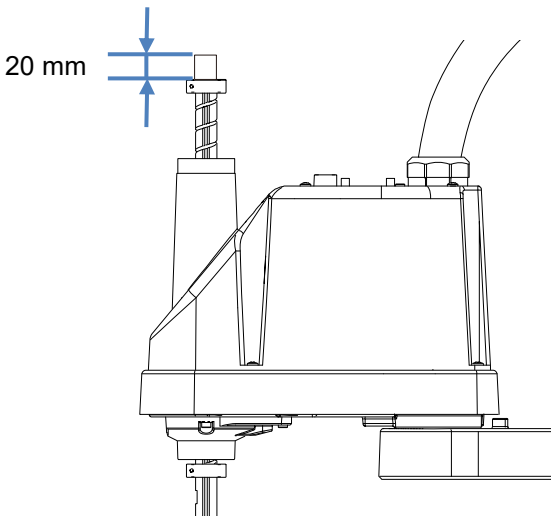
The Pulse command (Go Pulse command) moves all joints to the set position simultaneously. Specify positions within the range where it is safe to move not only the joint whose motion range has been changed but also other joints at the same time.

In this example, when checking the J2, the J1 is set to move to a 0° position (pulse value "327680") near the center of the motion range.

If the arm hits the mechanical stopper, or if it does and an error occurs, set the pulse range narrower or the position of the mechanical stopper wider to avoid such a collision.

Setting Motion Range with the J3 Mechanical Stoppers

①	Turn ON the controller, and turn the motor off using the MOTOR OFF command.
②	Push up the shaft while pressing the Brake Release Switch. When the shaft is pushed up to the upper limit, the Arm Top Cover becomes difficult to remove. The amount of push-up should be just enough to change the position of the J3 mechanical stopper. NOTE When the Brake Release Switch is pressed, the shaft may descend due to the weight of the hand or other parts. Press the switch while supporting the shaft with your hand. LA3-A A S01: 1-M3x10 LA6-A A S01: 1-M4x15 
③	Turn OFF the controller.
④	Loosen the screw of the lower limit mechanical stopper. NOTE The J3 has upper and lower mechanical stoppers, but only the lower mechanical stopper on the upper side can be repositioned. The upper mechanical stopper on the lower side defines the origin position of the J3 and should not be moved.

⑤	The upper end of the shaft is the maximum stroke position of the joint. Lower the lower limit mechanical stopper by the amount of stroke you want to limit. Example: For a 150 mm stroke, the lower Z-coordinate limit is -150. To set this to -130, lower the lower mechanical stopper by 20 mm. Lower the mechanical stopper while measuring the distance with calipers, etc. 
⑥	Tighten the screw of the lower limit mechanical stopper. Recommended tightening torque: LA3 2.4 N·m, LA6 5.5 N·m
⑦	Turn ON the controller.
⑧	While pressing the Brake Release Switch, push down the J3 and check the lower end position. Note that if the mechanical stopper is lowered too far, it will not reach the target position.

⑨

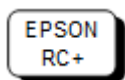
Calculate and set the lower limit of the pulse range using the following formula.

Note that the lower limit Z-coordinate value is a negative value (minus). The calculation result is always negative.

Lower limit pulse value (Pulse) = Lower limit Z-coordinate value (mm)/J3 resolution** (mm/pulse)

** J3 resolution

Joint	LA3-A	LA6-A
J1	0.000439°/pulse	0.000275°/pulse
J2	0.000439°/pulse	
J3	0.000799 mm/pulse	0.000814 mm/pulse
J4	0.001927°/pulse	0.001465°/pulse



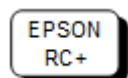
Execute the following commands using the [Command Window]. Put the calculated value in the X position.

>JRANGE 3, X, 0 ' This sets the pulse range for the J3

- ⑩ Move the J3 at low speed to the lower limit position within the set pulse range using the Pulse command (Go Pulse command). If the motion range set by the mechanical stopper is narrower than the pulse range, the J3 will hit the mechanical stopper and an error will occur. If an error occurs, reset the pulse range narrower or move the stopper to widen the physical motion range and start over.

NOTE

If it is difficult to confirm that the J3 is not hitting the mechanical stopper, turn off the controller, lift the Arm Top Cover, and look at it from the side.



Execute the following commands using the [Command Window]. Put the value calculated in step ⑨ into the X position.

>MOTOR ON ' Turns on the motor

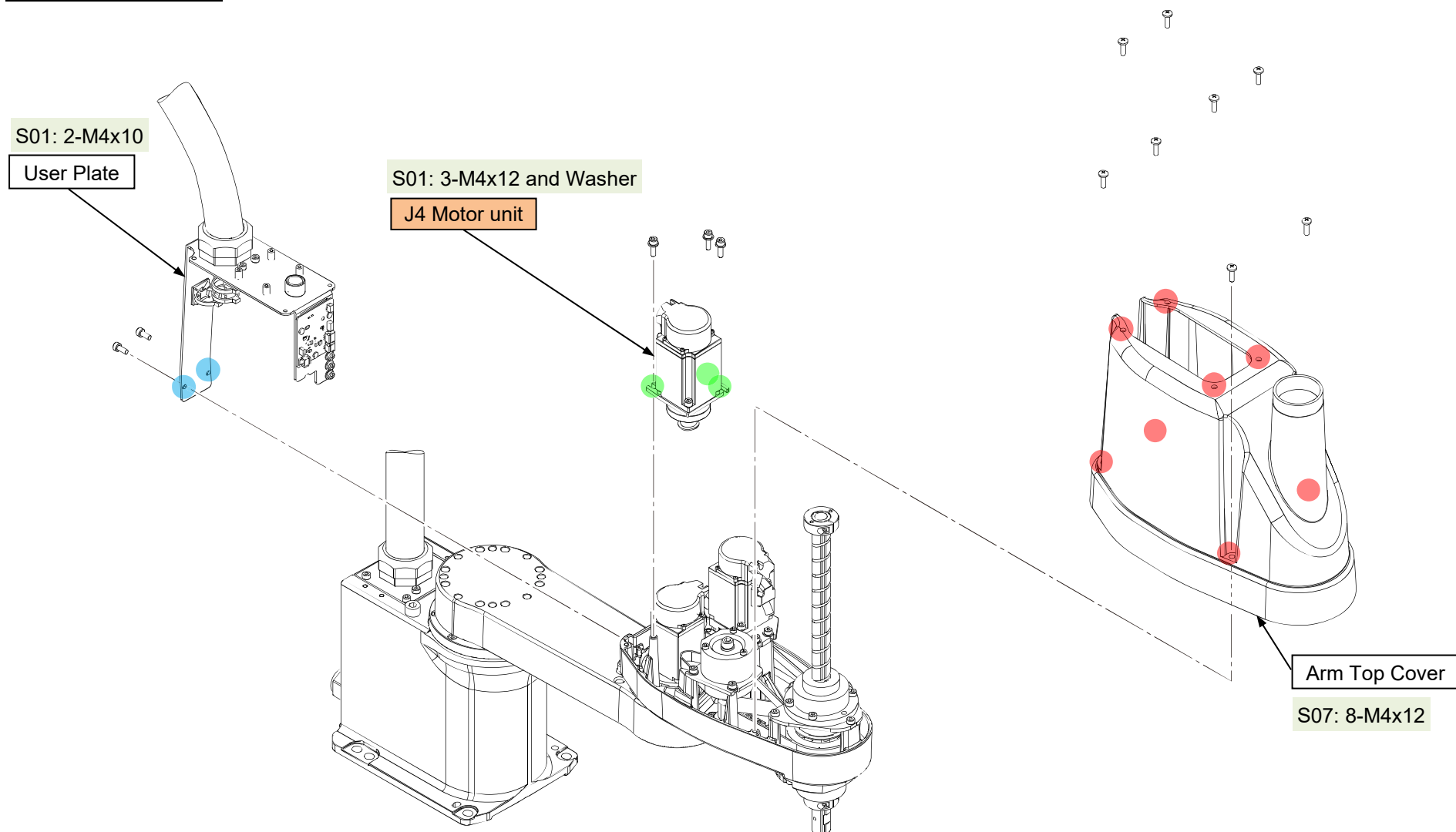
>SPEED 5 ' Sets the motion speed to low

>PULSE 0, 0, X, 0 ' Moves the J3 to the lowest pulse position

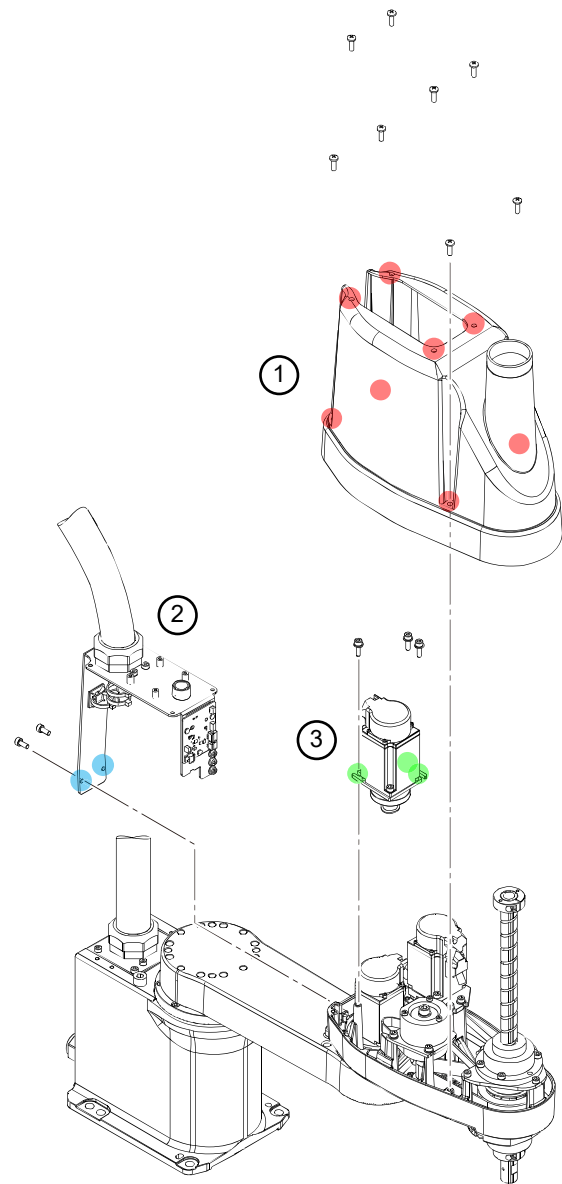
(In this example, the pulse values for all joints except the J3 are set to "0". Set the pulse values to a position where lowering the J3 does not cause any problems.)

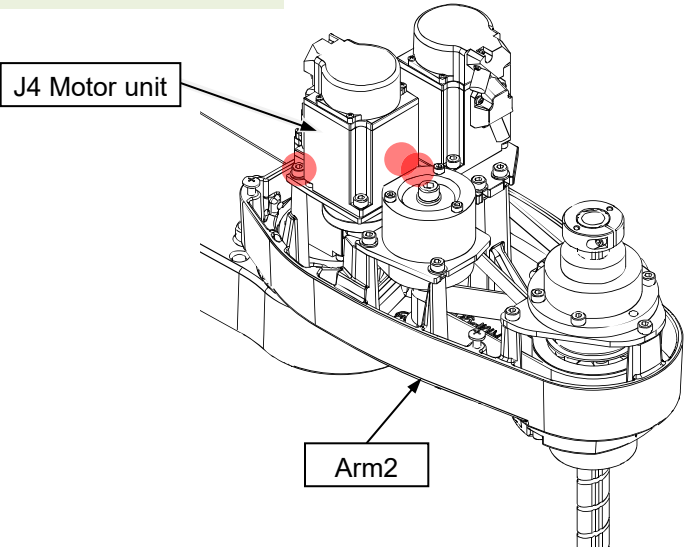
2.6 Joint #4

2.6.1 J4 Motor unit

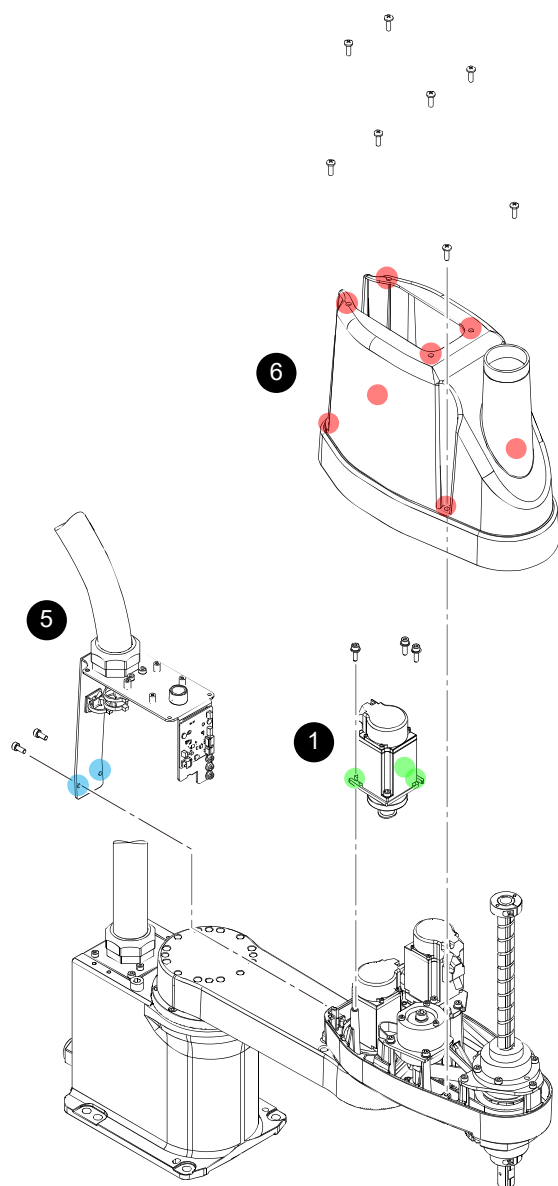


Removing the J4 Motor Unit



①	Remove the Arm Top Cover .
②	Remove the User Plate .
③	Remove the J4 Motor unit from the Arm2. A S01: 3-M4x12 and Washer  The diagram shows the J4 Motor unit and Arm2 assembly. The J4 Motor unit is labeled, and the Arm2 is also labeled. Red dots indicate the locations of the 3-M4x12 screws and washers that need to be removed.

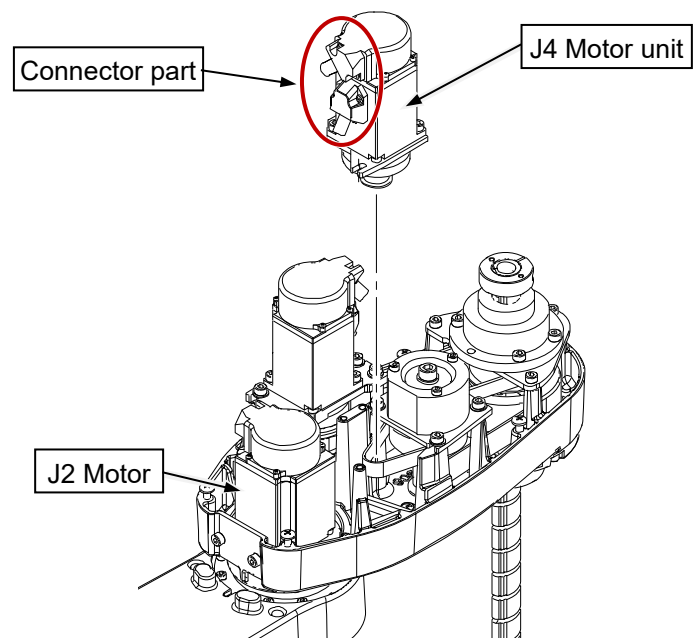
Installing the J4 Motor Unit



- 1 Set the J4 Motor unit in Arm2.

CAUTION

Orient the connector part for the power cable of the J4 Motor so that it faces the J2 Motor side.



2

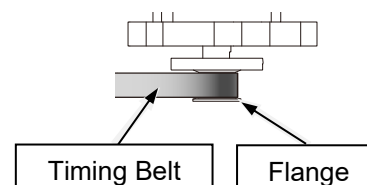
Place the U1 belt on the pulley of the J4 Motor unit.

POINT

Make sure that the teeth of the belt and the pulley are properly engaged.

CAUTION

If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



Set the belt so that it is level with respect to the pulley without it being placed on the flange.

3

Temporarily secure the J4 Motor unit to the Arm2.

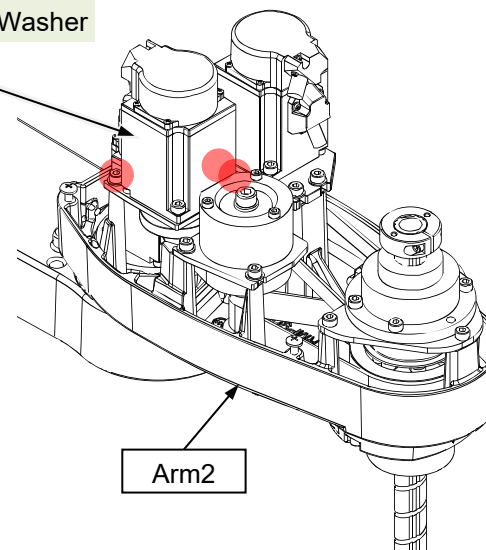
POINT

The standard for temporary securing is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.

A

S01: 3-M4x12 and Washer

J4 Motor unit



Arm2

4

Perform [U1 belt tension adjustment](#).

5

Install the [User Plate](#).

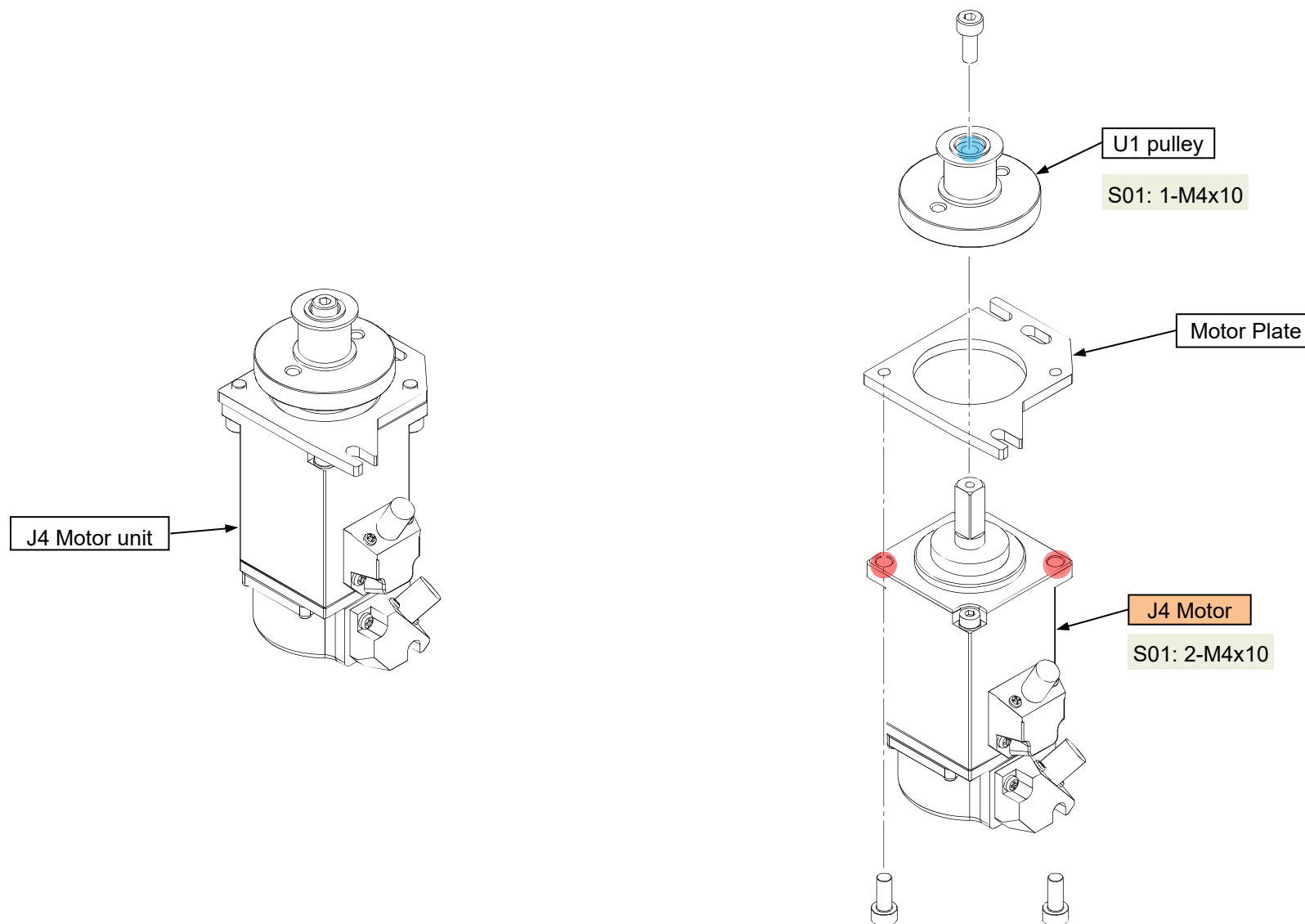
6

Install the [Arm Top Cover](#).

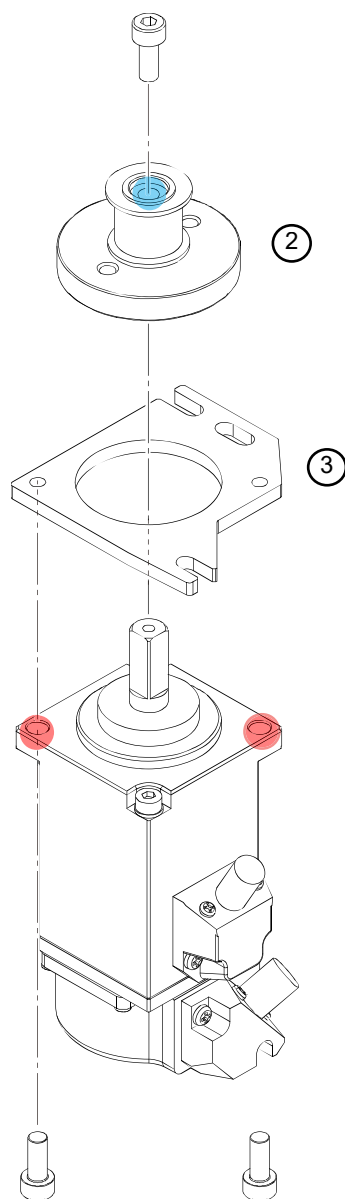
7

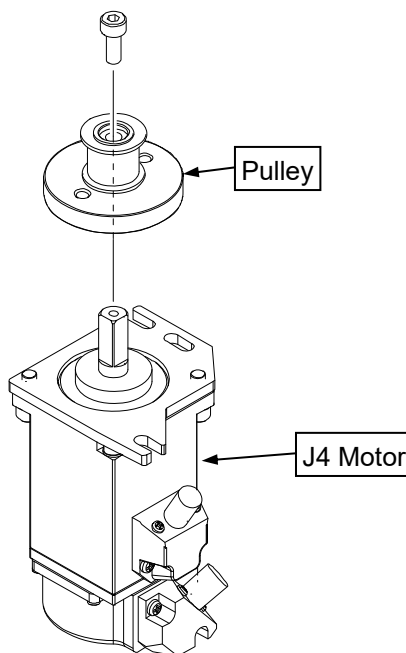
Perform the [calibration](#) of Joint #3 and Joint #4.

2.6.2 Replacing the J4 Motor



Removing the J4 Motor



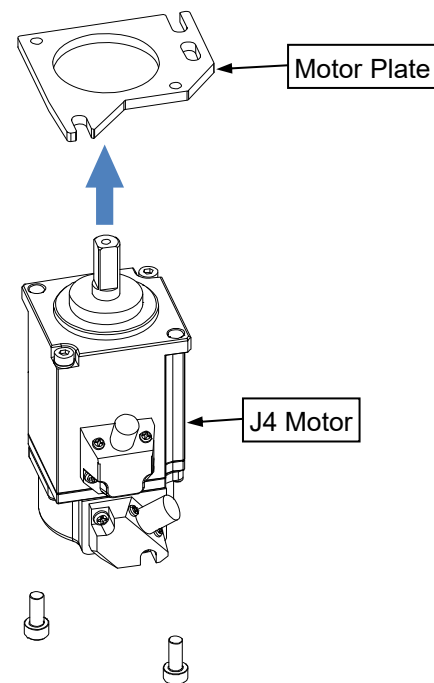
①	Remove the J4 Motor unit. Perform all steps of Removing the J4 Motor Unit.
②	Remove the pulley from the J4 Motor. POINT To prevent the pulley from rotating while working, wrap the U1 belt around the pulley before working. A S01: 1-M4x10 

③

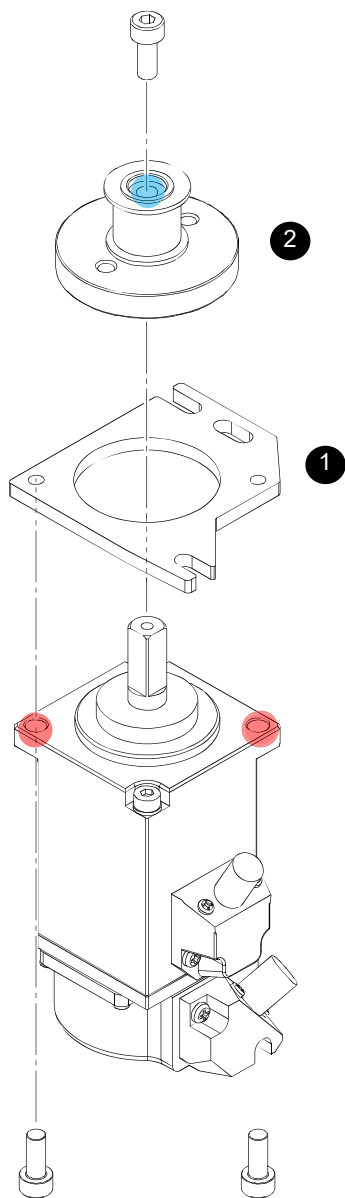
Remove the Motor Plate from the J4 Motor.

A

S01: 2-M4x10



Installing the J4 Motor

**1**

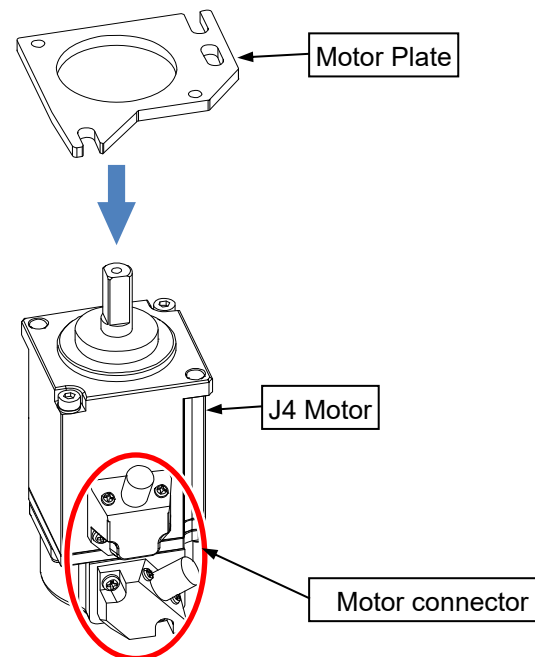
Attach the Motor Plate to the J4 Motor.

POINT

Attach the Motor Plate to the J4 Motor while it is oriented as shown in the figure.

A

S01: 2-M4x10
(4.0 +/- 0.2 N·m)



2

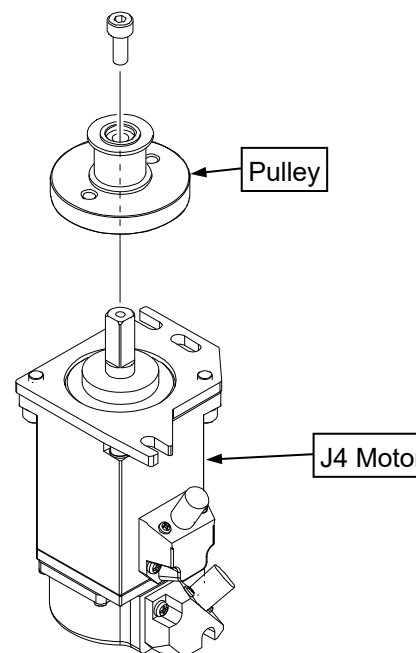
Attach the pulley to the J4 Motor.

POINT

To prevent the pulley from rotating while working, wrap the U1 belt around the pulley before working.

A

S01: 1-M4x10
(4.0 +/- 0.2 N·m)

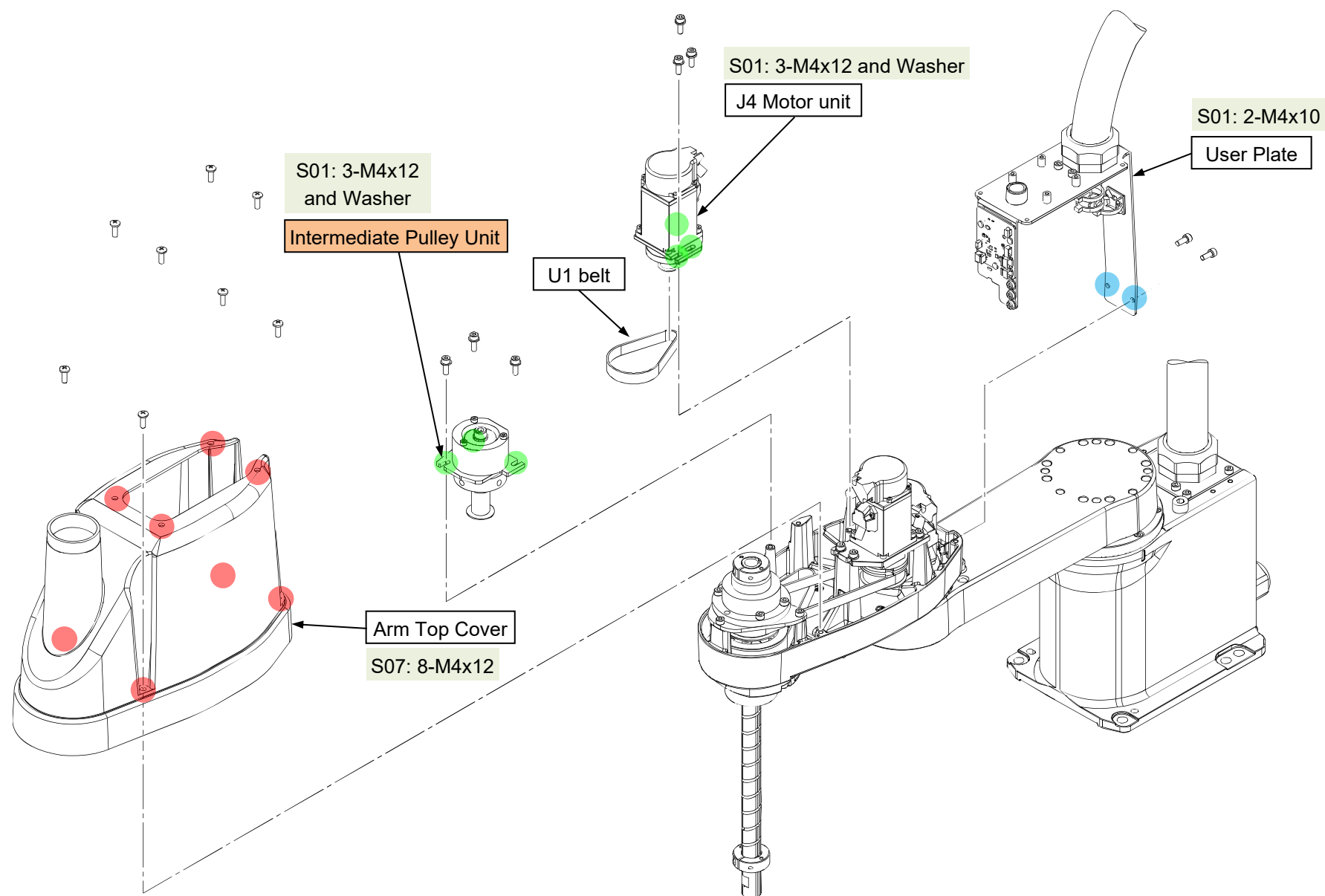


3

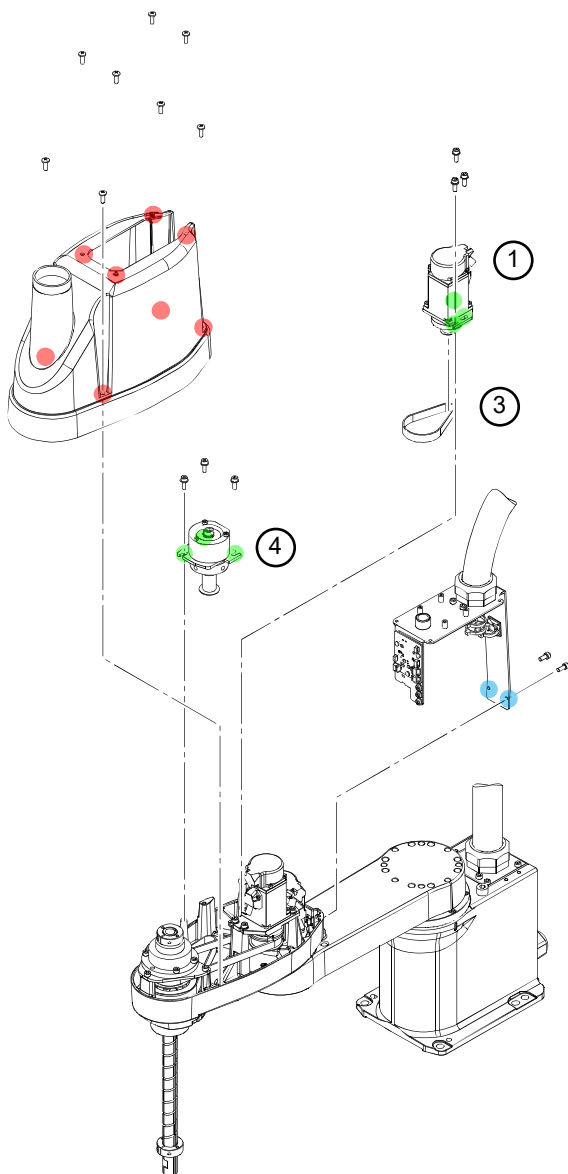
Install the J4 Motor unit.

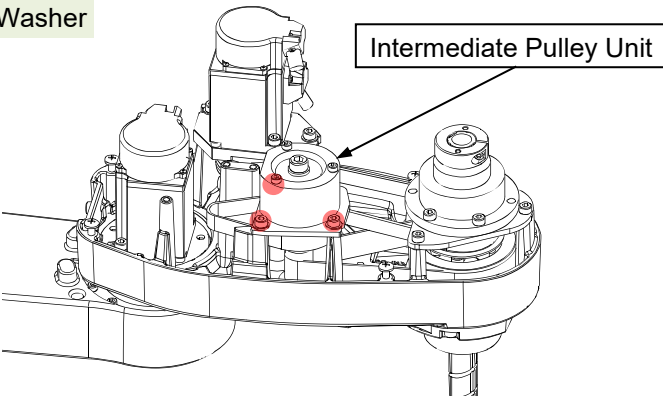
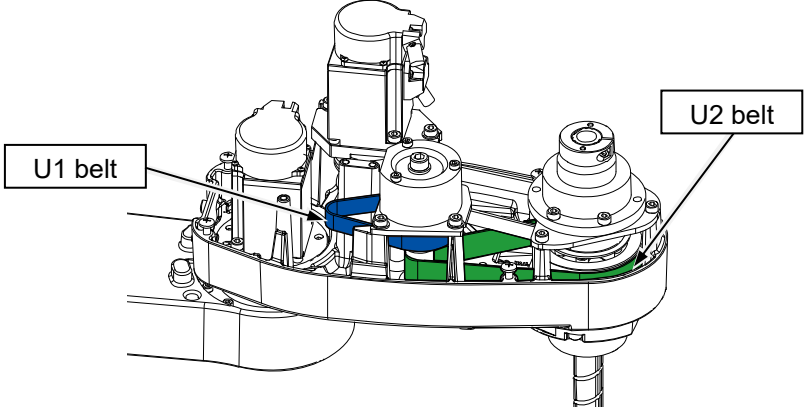
Perform all steps of [Installing the J4 Motor Unit](#).

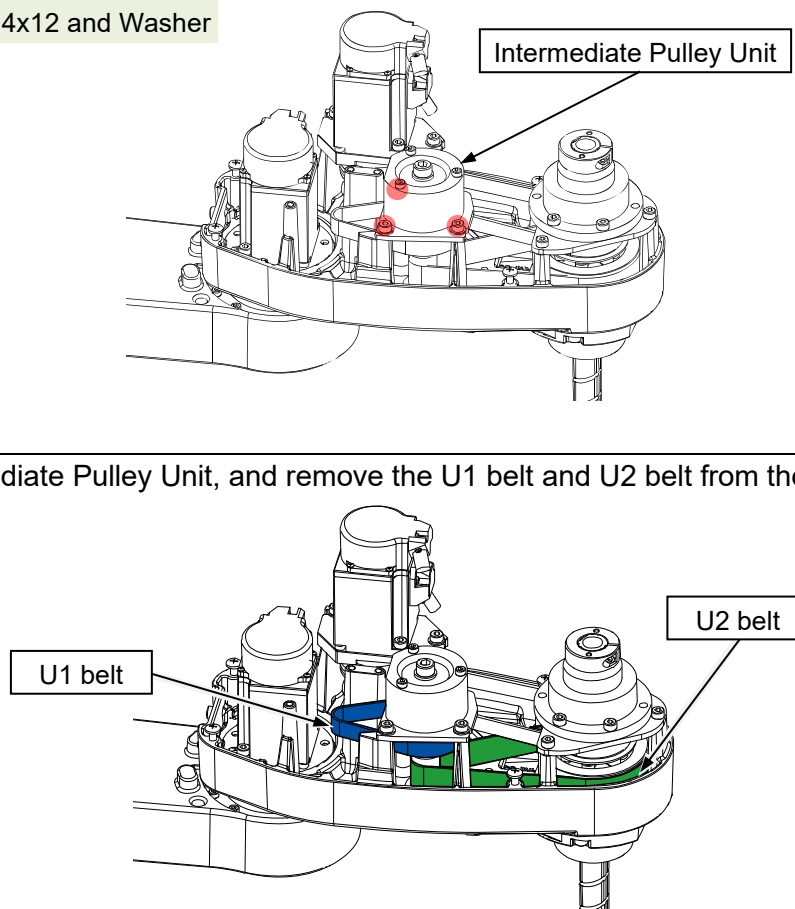
2.6.3 Replacing the J4 Intermediate Pulley Unit



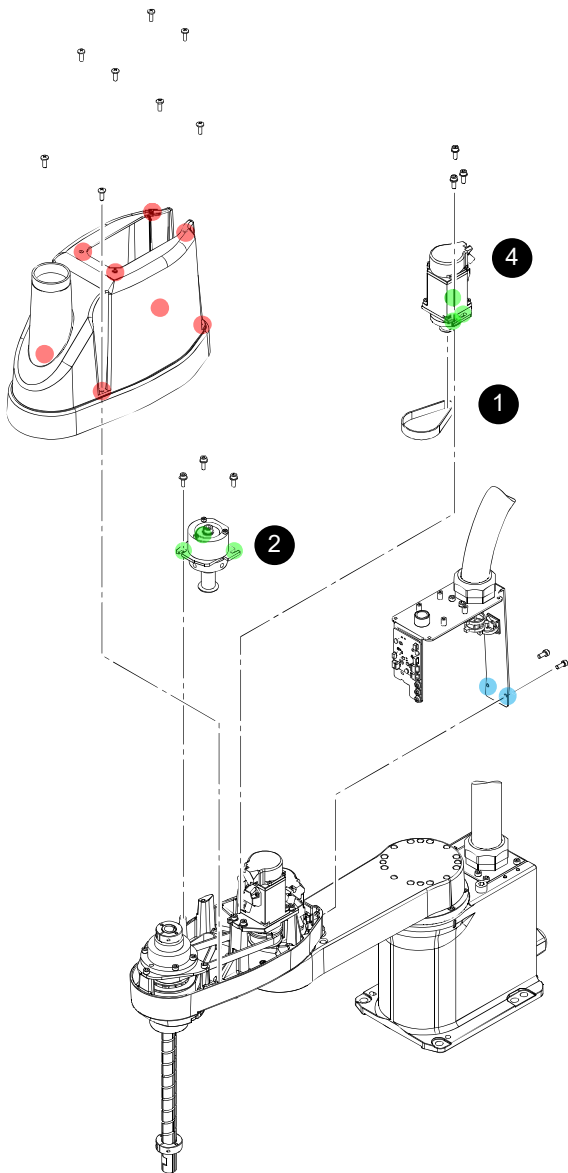
Removing the J4 Intermediate Pulley Unit

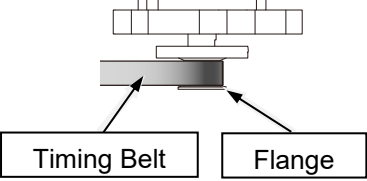
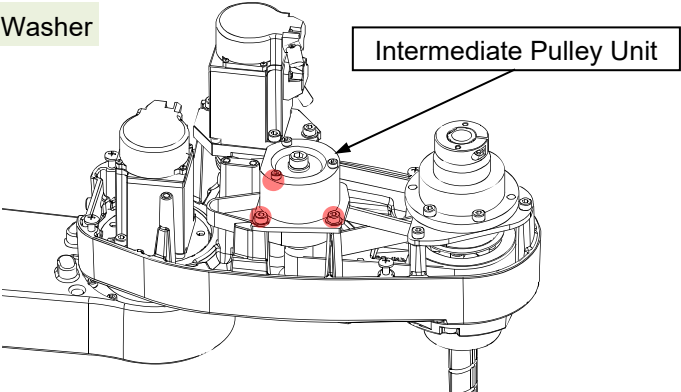


- | | |
|---|---|
| ① | <p>Remove the J4 Motor unit.
Perform all steps in Removing the J4 Motor Unit.</p> |
| ② | <p>Remove the screws securing the Intermediate Pulley Unit to Arm2.</p> <p>A S01: 3-M4x12 and Washer</p>  |
| ③ | <p>Tilt the Intermediate Pulley Unit, and remove the U1 belt and U2 belt from the pulley.</p>  |
| ④ | <p>Remove the Intermediate Pulley Unit.</p> |

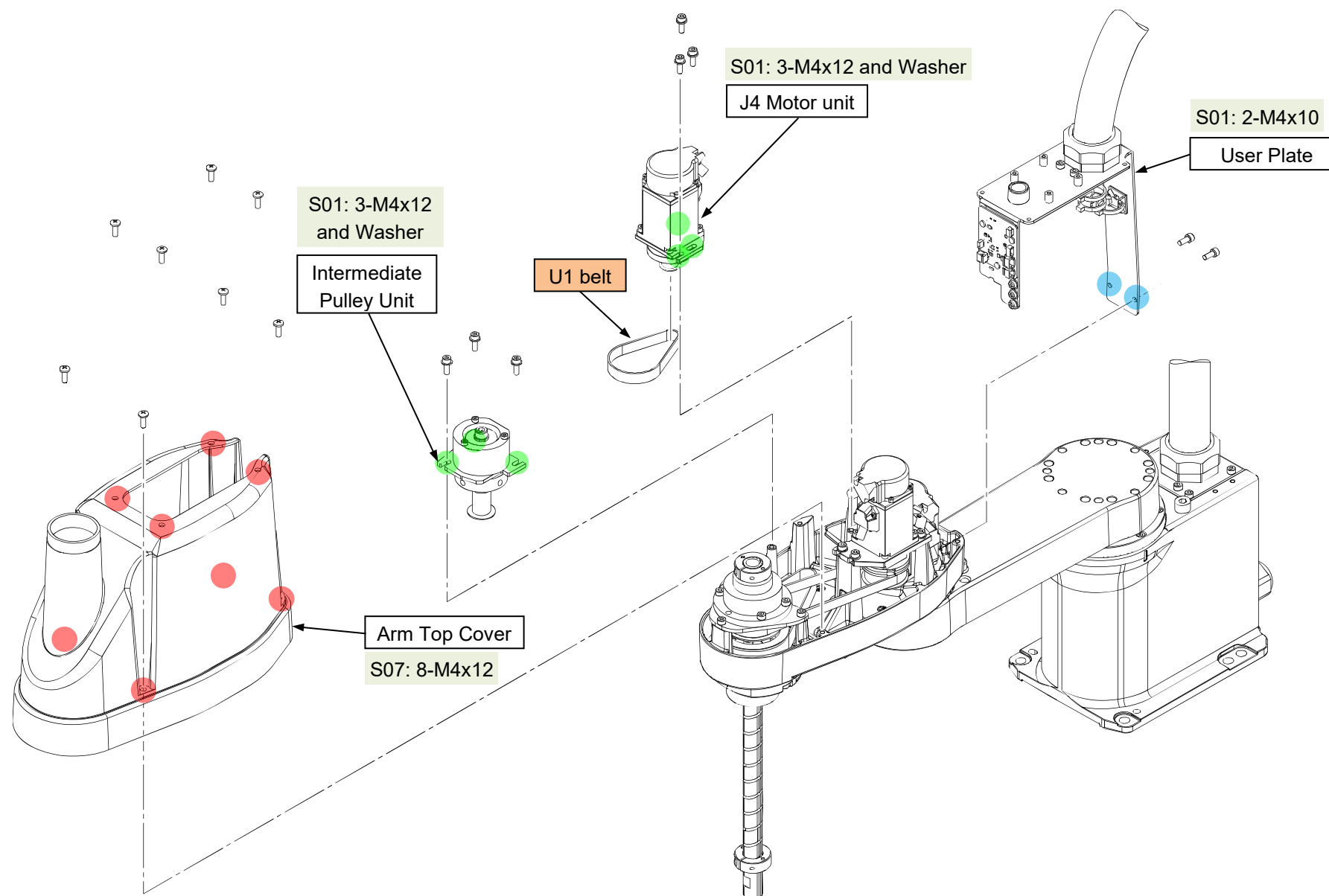


Installing the J4 Intermediate Pulley Unit

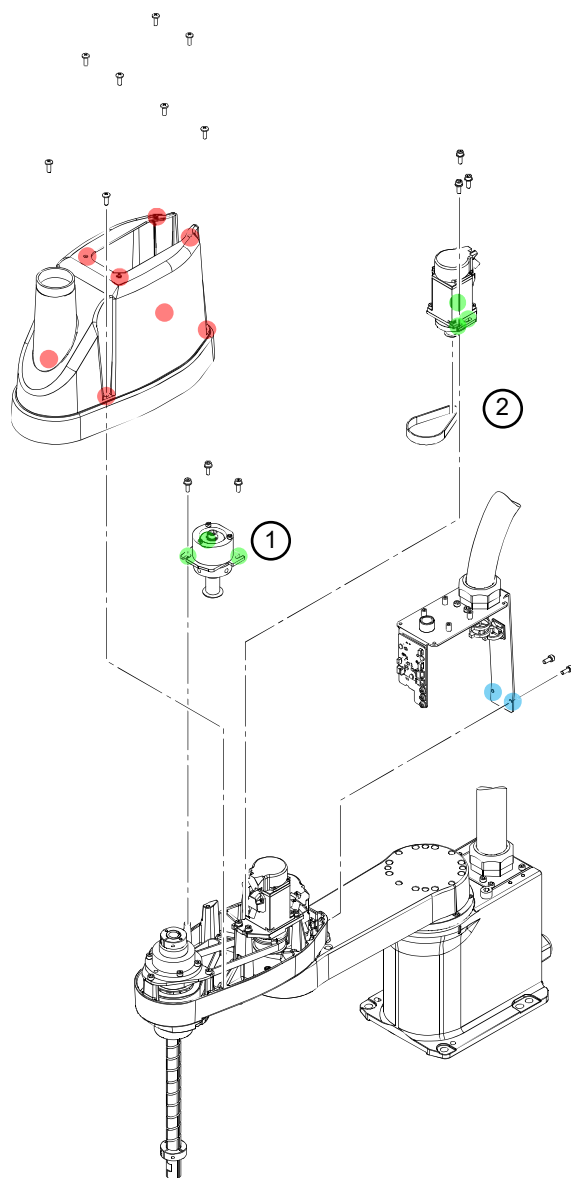


1	With the U1 belt still attached to the large pulley of the J4 Intermediate Pulley Unit, attach the U2 belt inside the Arm2 to the small pulley, and place the unit on the Arm2. POINT Make sure that the teeth of the belt and the pulley are properly engaged.
	CAUTION If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.  Timing Belt Flange Set the belt so that it is level with respect to the pulley without it being placed on the flange.
2	Temporarily secure the Intermediate Pulley Unit to Arm2. A S01: 3-M4x12 and Washer  Intermediate Pulley Unit
3	Perform U2 belt tension adjustment.
4	Install the J4 Motor unit.

2.6.4 Replacing the J4 Timing Belt (U1 Belt)

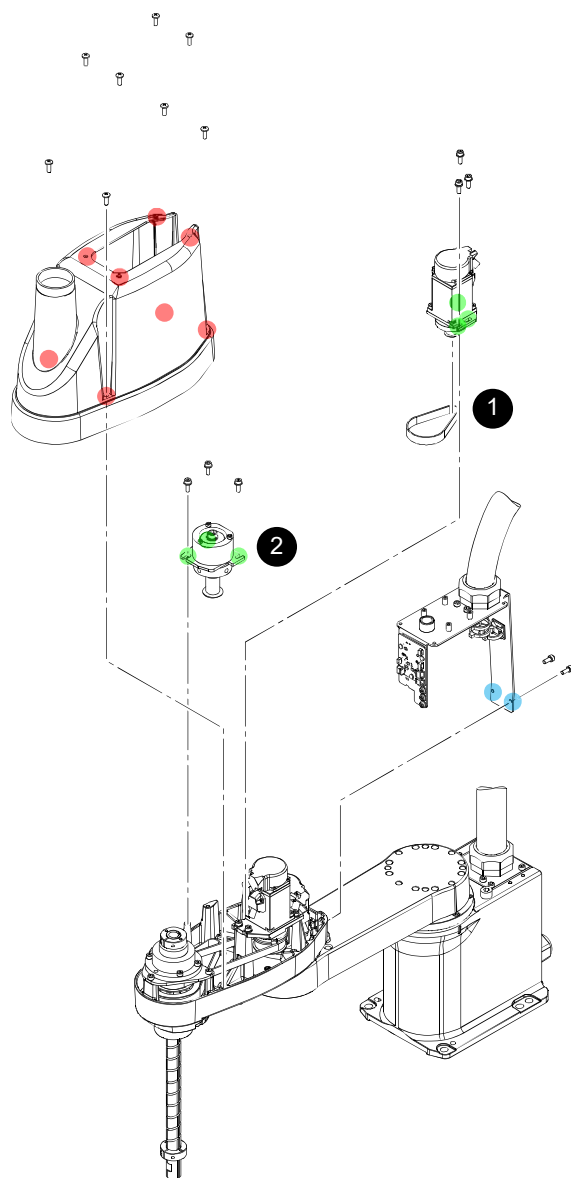


Removing the U1 Belt



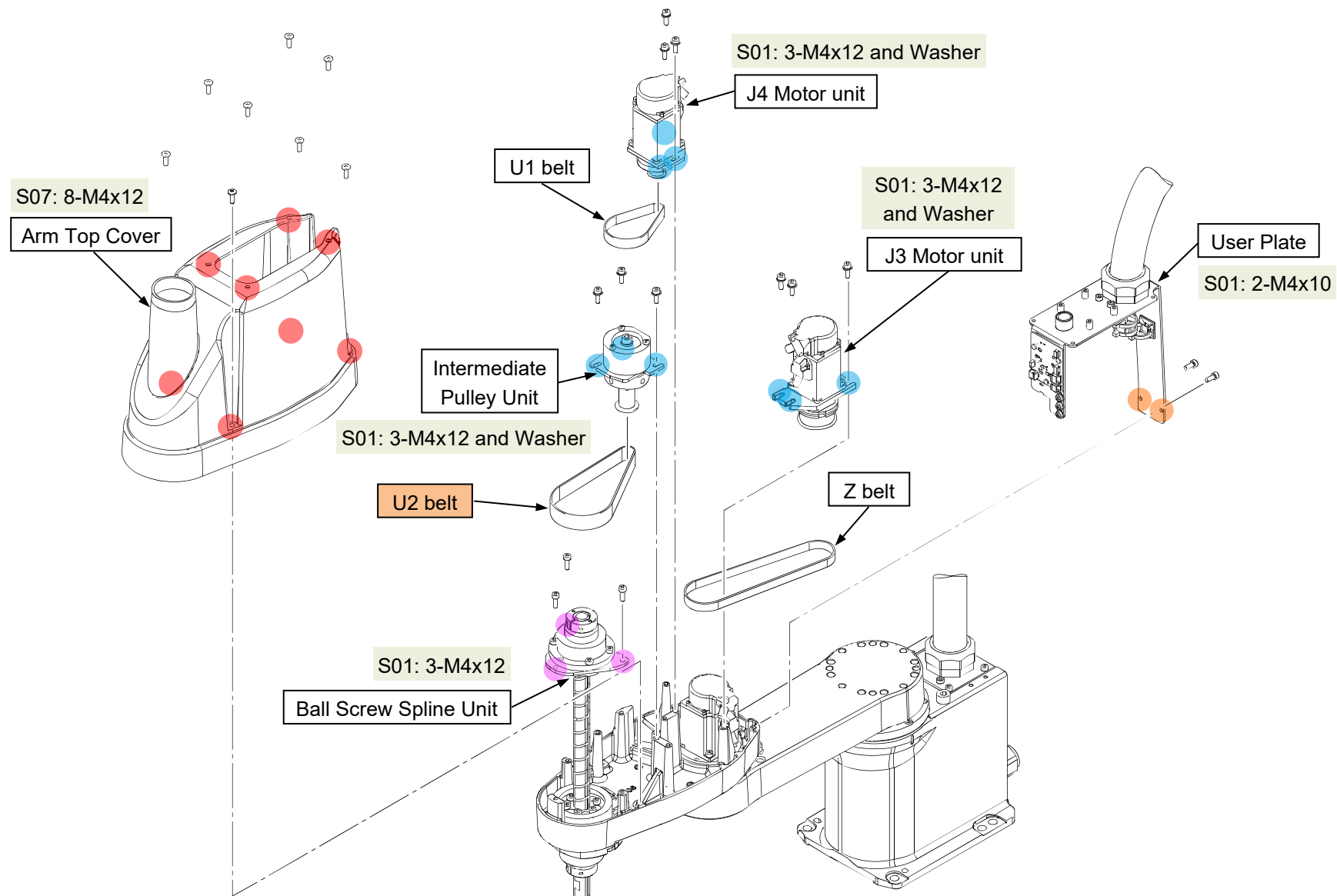
①	Remove the J4 Intermediate Pulley Unit .
②	Remove the U1 belt.

Installing the U1 Belt

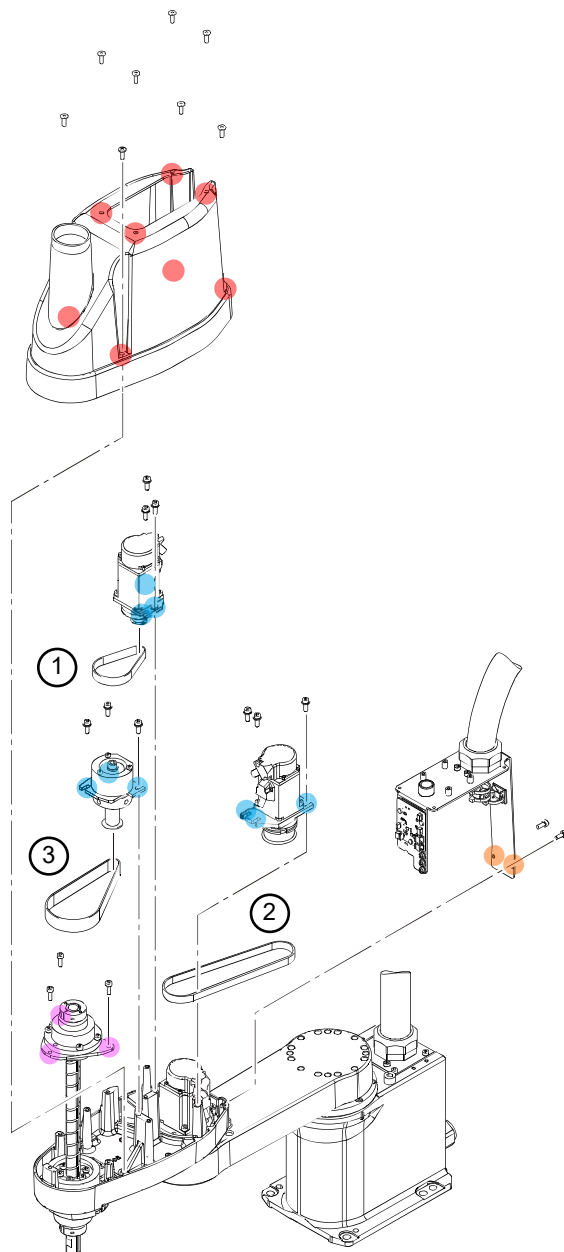


- | | |
|---|---|
| 1 | Place the U1 belt on the Intermediate Pulley Unit.
POINT
Make sure that the teeth of the belt and the pulley are properly engaged. |
| 2 | Install the J4 Intermediate Pulley Unit . |

2.6.5 Replacing the J4 Timing Belt (U2 Belt)

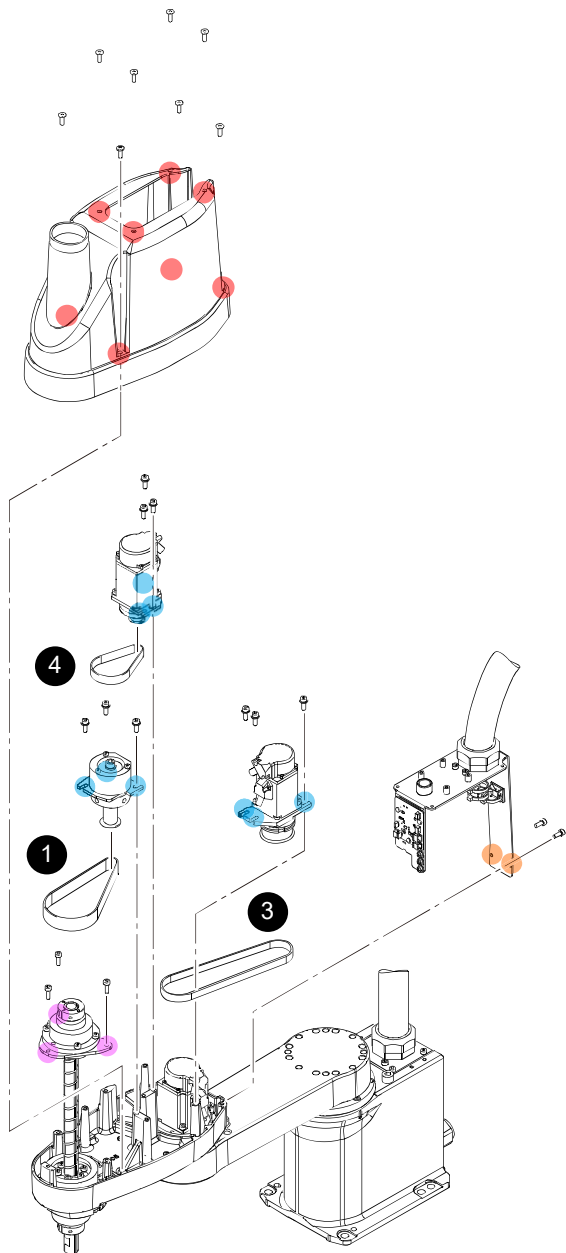


Removing the U2 Belt



①	Remove the U1 belt. Perform all steps in Removing the U1 Belt .
②	Remove the Z belt. Perform all steps in Removing the Z Belt .
③	Lift up the Ball Screw Nut Unit to the extent that the belt can pass along the Ball Screw Spline, and remove the U2 belt from the upper part of the Ball Screw Spline. CAUTION - Support the Ball Screw Nut Unit with a hand when removing the belt to ensure the lifted up Ball Screw Nut Unit does not fall. - Take care that a finger or other item does not get trapped between Arm2 and Ball Screw Nut Unit during the work.

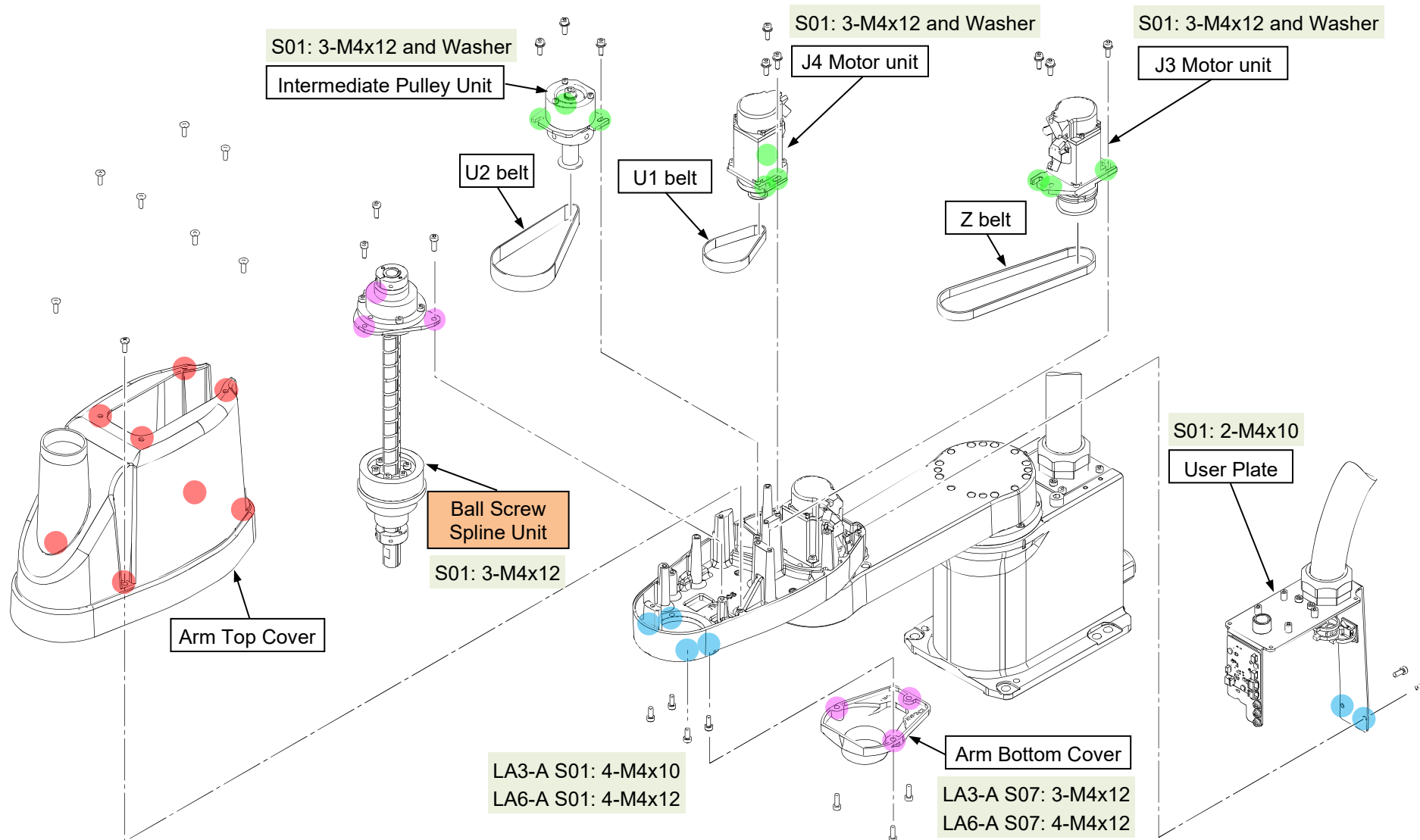
Installing the U2 Belt



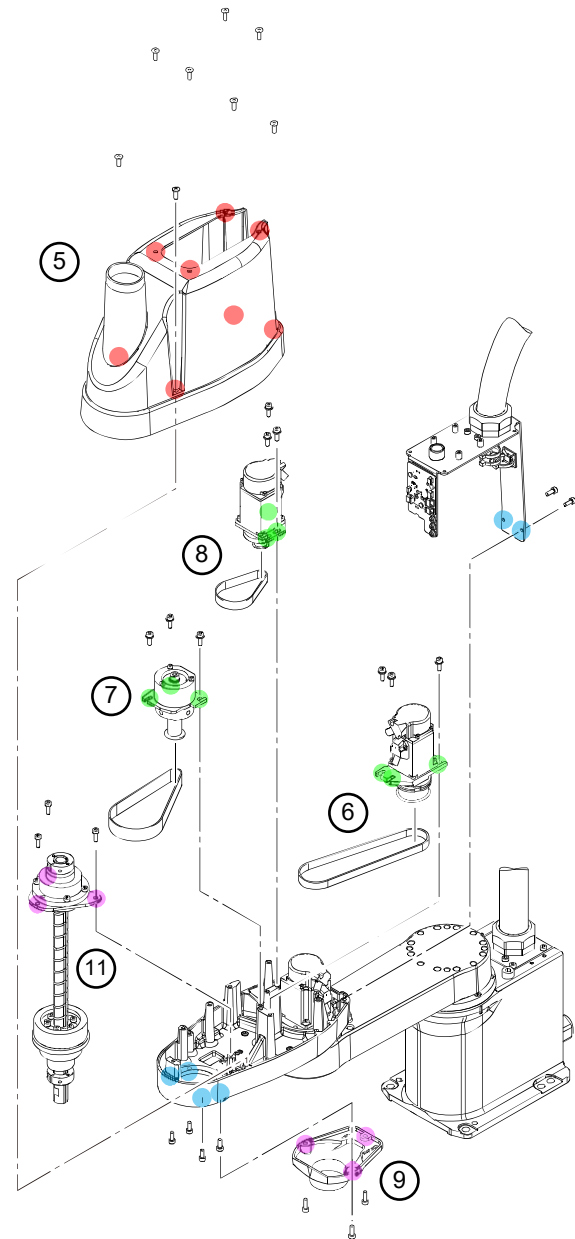
	CAUTION • Support the Ball Screw Nut Unit with a hand when installing the belt to ensure the lifted up Ball Screw Nut Unit does not fall. • Take care that a finger or other item does not get trapped between Arm2 and Ball Screw Nut Unit during the work.
1	Lift up the Ball Screw Nut Unit to the extent that the belt can pass along the Ball Screw Spline, and pass the U2 belt from the upper part of the Ball Screw Spline.
2	Place the U2 belt on the pulley of the spline nut. POINT Make sure that the teeth of the belt and the pulley are properly engaged.
3	Install the Z belt. Installing the Z Belt Complete the procedure up to the point where the ball screw nuts are fixed to the spline plate.
4	Perform all steps of Installing the J4 Intermediate Pulley Unit .

2.7 Ball Screw Spline Unit

2.7.1 Replacing the Ball Screw Spline Unit



Removing the Ball Screw Spline Unit

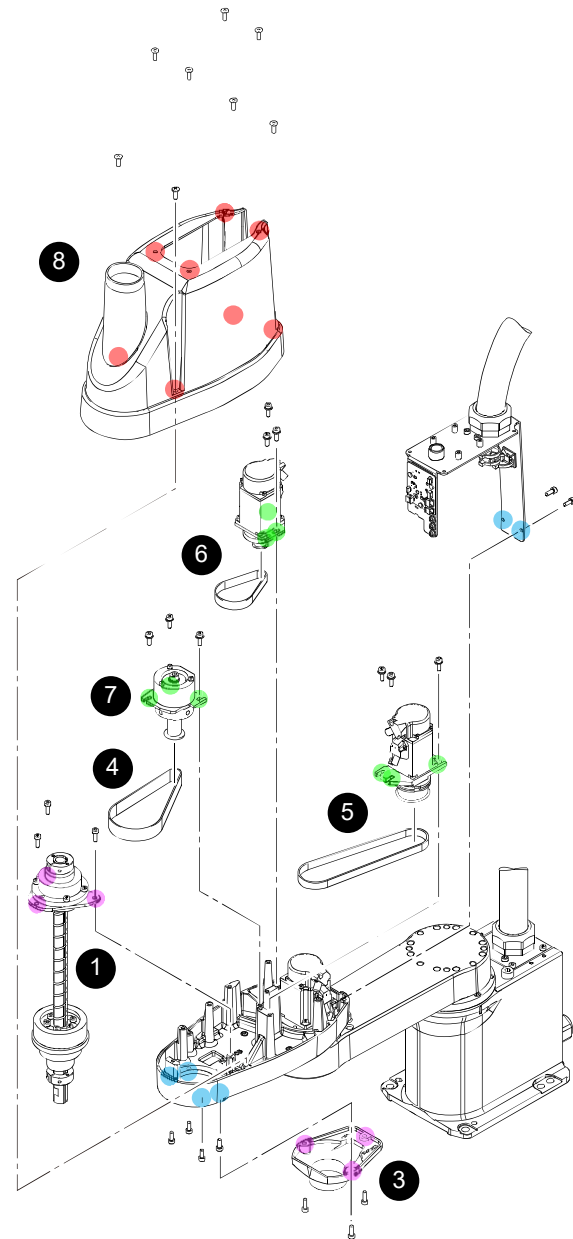


①	Turn ON the controller.
②	Press the Brake Release Switch and lower the Ball Screw Spline Unit to its lower limit. CAUTION • Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed. • When the brake is released by the Brake Release Switch, the J3 brake is released.
③	Turn OFF the controller.
④	Remove the end effector and remove the cables and tubes from the end effector.
⑤	Remove the Arm Top Cover .
⑥	Remove the Z belt .
⑦	Remove the J4 Intermediate Pulley .
⑧	Remove the U1 belt .
⑨	Remove the Arm Bottom Cover .
⑩	Remove the bolts securing the spline nuts to the Arm2. LA3-A A S01: 4-M4x10 LA6-A A S01: 4-M4x12

⑪

Remove the Ball Screw Spline Unit.

Installing the Ball Screw Spline Unit



1	Insert a new Ball Screw Spline Unit into the Arm2.
2	Secure the spline nuts from the underside of the Arm2. LA3-A A S01: 4-M4x10 (4.0 +/- 0.2 N·m) LA6-A A S01: 4-M4x12 (4.0 +/- 0.2 N·m)
3	Install the Arm Bottom Cover .
4	Install the U2 belt .
5	Install the Z belt. Perform all steps in Installing the Z belt .
6	Install the U1 belt .
7	Install the J4 Intermediate Pulley .
8	Install the Arm Top Cover .
9	Perform Greasing the Ball Screw Spline Unit .
10	Install the end effector and connect the cables and tubes.

11

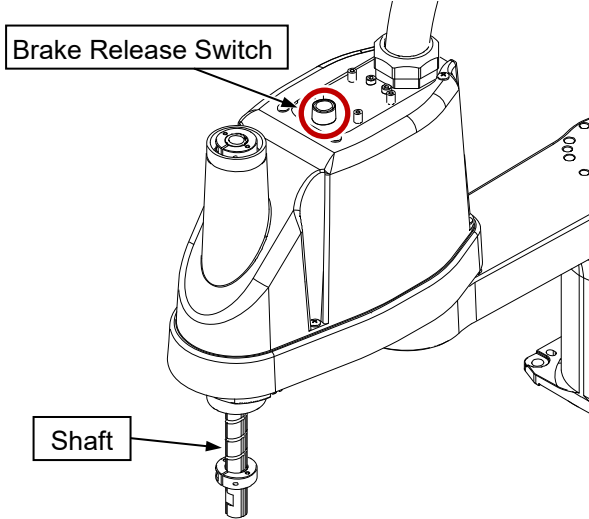
Perform the [calibration](#) of Joint #3 and Joint #4.

2.7.2 Greasing the Ball Screw Spline Unit

Standard Environment Model

NOTE

Consider measures such as covering the end effector and peripheral devices to ensure there will be no issues even if grease falls.

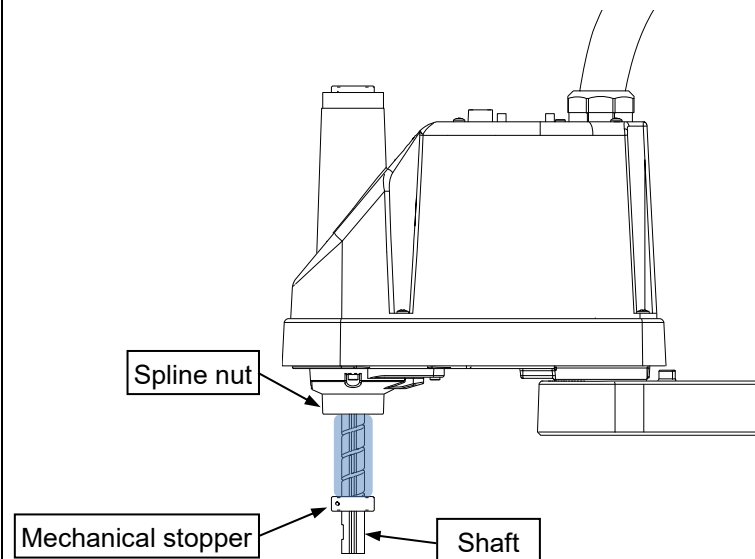
①	Turn ON the controller.
②	Press the Brake Release Switch and lower the Ball Screw Spline Unit to its lower limit. CAUTION • Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed. • When the brake is released by the Brake Release Switch, the J3 brake is released.  The diagram shows a 3D perspective view of the Ball Screw Spline Unit. A label 'Brake Release Switch' with an arrow points to a small circular button on the top surface of the unit, which is highlighted with a red circle. Another label 'Shaft' with an arrow points to the vertical shaft extending from the bottom of the unit.
③	Turn OFF the controller.

- ④ Wipe off the old grease on the top of the shaft and then apply new grease.



AFB

Grease application range: From spline nut end to mechanical stopper



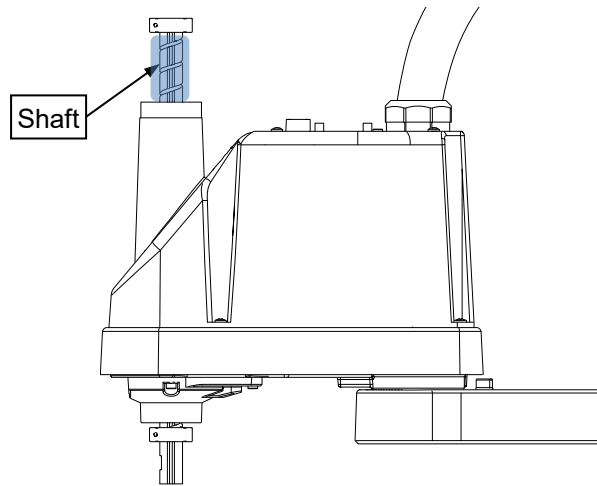
POINT

- Apply grease so that the spiral groove and vertical groove of the Ball Screw Spline are filled with grease.



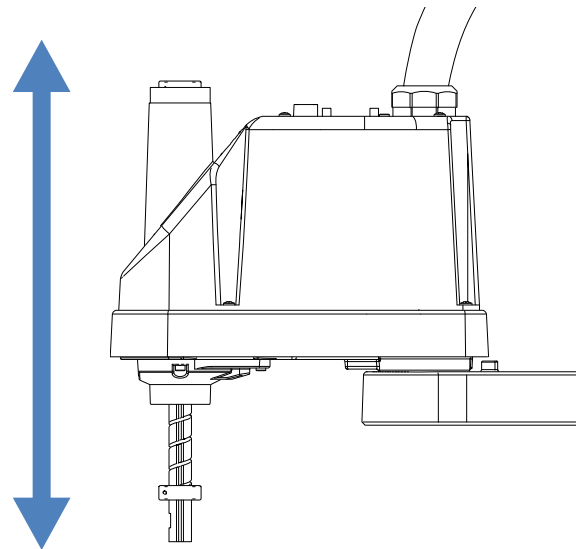
Grease application example

- If the application range at the Ball Screw Spline Shaft end cannot be sufficiently secured due to the positional relationship with peripheral devices, raise the Ball Screw Spline Shaft to its upper limit and then apply grease to the upper part of the shaft.



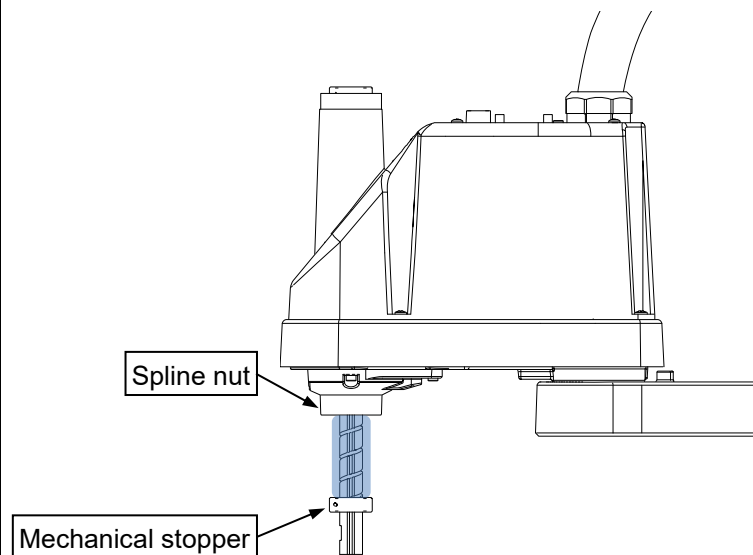
⑤ Turn ON the controller.

⑥ Move the shaft in the movable range from the upper limit to lower limit about 5 times while pressing the Brake Release Switch so that the grease spreads uniformly on the shaft.



⑦ Turn OFF the controller.

⑧ Wipe off any excess grease on the spline nut end and mechanical stopper.



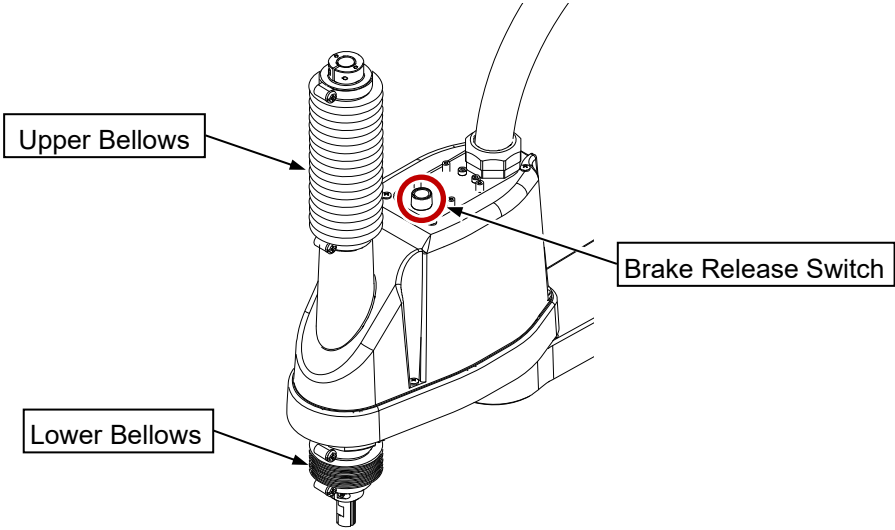
POINT

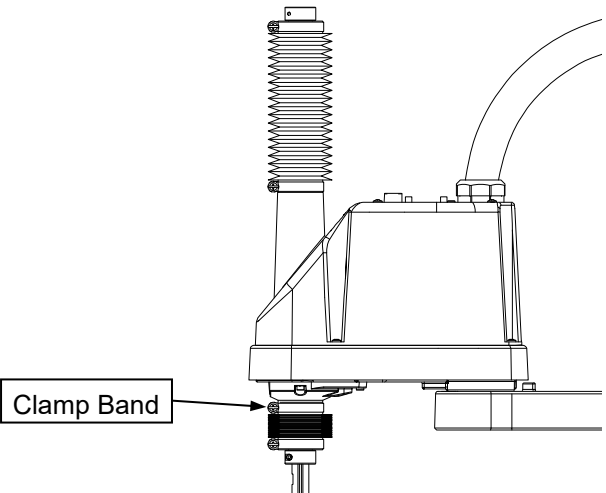
When applying grease to the upper part of the Ball Screw Spline Shaft, wipe off the grease on the shaft using the following procedure.

1. Remove the [Arm Top Cover](#).
2. Wipe off any excess grease on the ball screw nut.
3. After wiping, install the [Arm Top Cover](#).

Clean Room Environment Model**NOTE**

Greasing is accompanied by generation of dust. Either perform the work in a pre-clean room, or after adopting dust prevention measures beforehand. Consider measures such as covering the end effector and peripheral devices to ensure there will be no issues even if grease falls.

①	Turn ON the controller.
②	Use one of the following methods to raise the shaft to its upper limit. • Raise the shaft to its upper limit manually while pressing the Brake Release Switch. • Use EPSON RC+ 8.0 [Tools] - [Robot Manager] - [Jog & Teach] panel to raise the shaft to its upper limit. CAUTION • Take care that the end effector does not interfere with the peripheral devices and other items. • The Brake Release Switch is for Joint #3. When the Brake Release Switch is pressed, the J3 brake is released. Be careful of lowering and rotating due to the weight of the end effector while the Brake Release Switch is being pressed.  The diagram shows a 3D perspective view of a robot joint. A red circle highlights a button labeled 'Brake Release Switch' on the side of the joint housing. Two labels with arrows point to bellows: 'Upper Bellows' points to the bellows above the joint, and 'Lower Bellows' points to the bellows below the joint.
③	Turn OFF the controller.

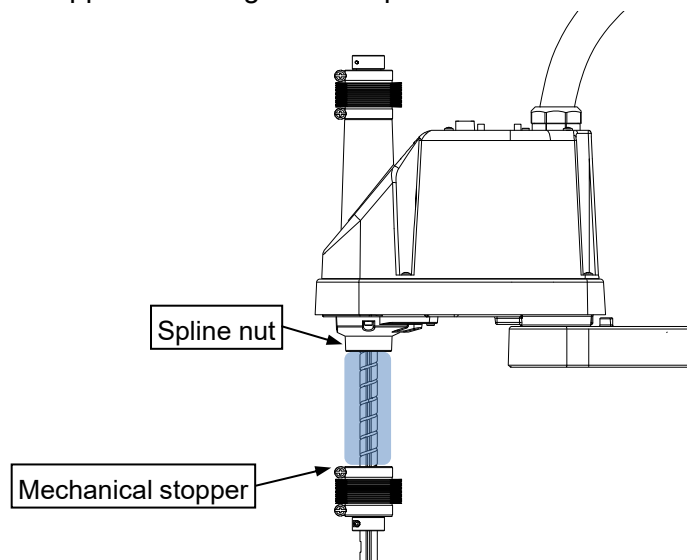
④	Loosen the Clamp Band at the upper part of the Lower Bellows, and then lower the Lower Bellows.  The diagram shows a cross-section of the printer's internal mechanism. A vertical shaft with a series of horizontal ridges (bellows) is shown. A clamp band is wrapped around the upper part of the bellows. An arrow points from the text 'Clamp Band' to the band. The lower part of the bellows is shown being lowered.
⑤	Turn ON the controller.
⑥	Use the same method as step ② to lower the shaft to its lower limit.
⑦	Turn OFF the controller.

- ⑧ Wipe off the old grease on the shaft and then apply new grease.



AFB

Grease application range: From spline nut end to mechanical stopper



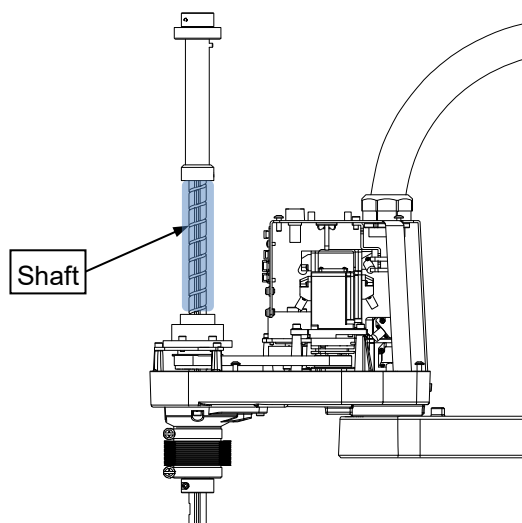
POINT

- Apply grease so that the spiral groove and vertical groove of the Ball Screw Spline are filled with grease.



Grease application example

- If the lower part of the Ball Screw Spline shaft cannot be sufficiently covered with grease due to the positional relationship with peripheral device, remove the Upper Bellows and the Arm Top Cover, raise the Ball Screw Spline shaft to its upper limit, and apply grease to the upper part of the shaft.

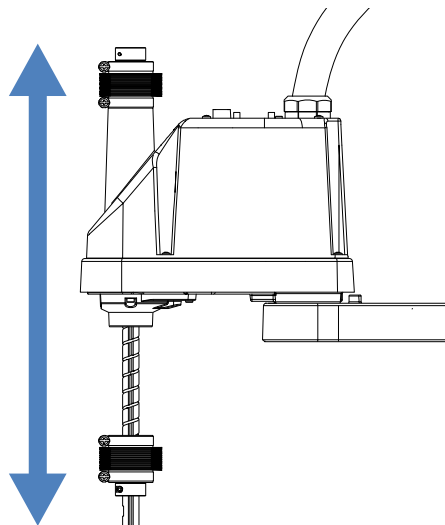


⑨ Turn ON the controller.

- ⑩ Move the shaft in the movable range from the upper limit to lower limit about 5 times while pressing the Brake Release Switch so that the grease spreads uniformly on the shaft.

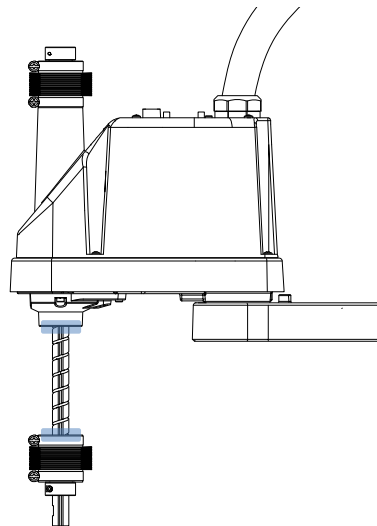
CAUTION

When moving the shaft up and down, take care that the bellows does not touch the cover.



- ⑪ Turn OFF the controller.

- ⑫ Wipe off any excess grease on the spline nut end and mechanical stopper.



POINT

When applying grease to the upper part of the Ball Screw Spline Shaft, wipe off the grease on the shaft using the following procedure.

1. Remove the [Upper Bellows](#).
2. Remove the [Arm Top Cover](#).
3. Wipe off any excess grease on the ball screw nut.
4. After wiping, install the [Arm Top Cover](#).

- ⑬ Secure the [Upper Bellows](#) and [Lower Bellows](#).

2.8 Batteries and Circuit Boards

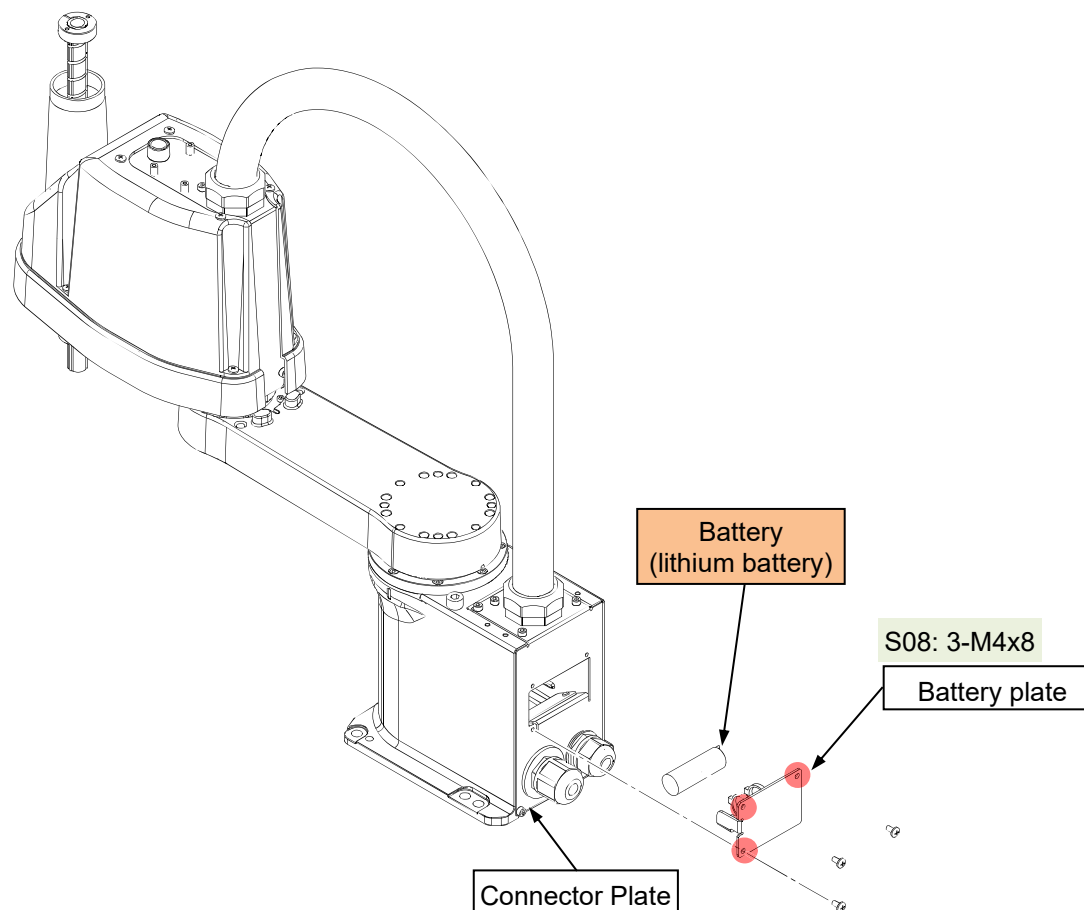
2.8.1 Replacing the Battery (lithium battery)

The life span of the lithium battery varies depending on the energizing hours and installation environment of the Controller.

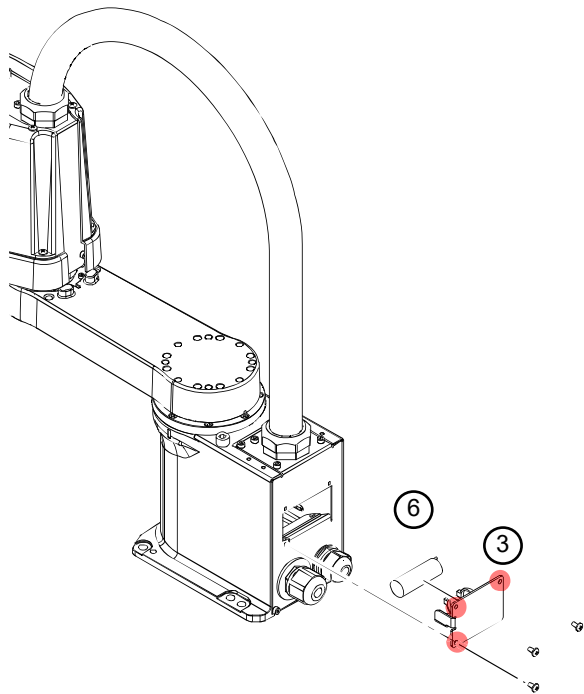
It is about 3 years as a rough guide (when the Controller is connected to power for 8 hours a day).

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 battery even if it has not reached the above product life.

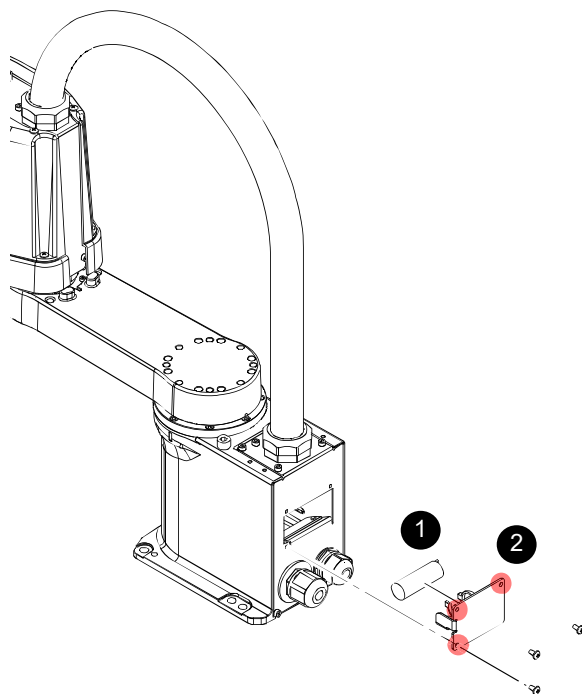


Removing the Battery (lithium battery)



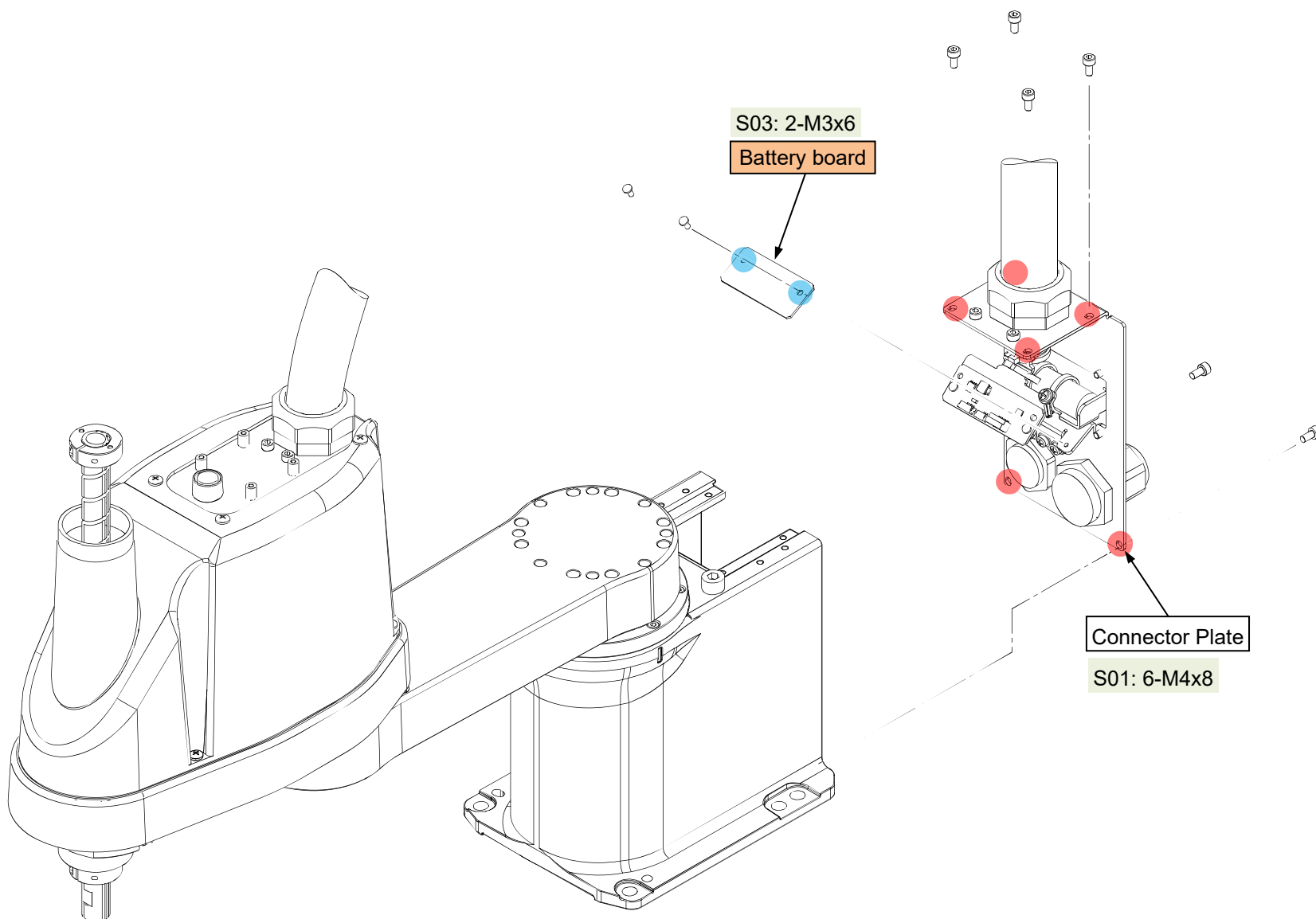
①	Turn OFF the controller.
②	Loosen the battery plate screws on the connector plate. A S08: 3-M4x8
③	Remove the battery plate from the base. CAUTION Do not disconnect the battery connector from the board. If the old battery connector is removed before the new battery connector is connected to the board, the home position data will be lost and calibration (ENCRESET) will be required.
④	Connect the new battery connector to the battery board. POINT Use the one of the two connectors on the battery board that is not connected to anything.
⑤	Disconnect the old battery connector from the battery board.
⑥	Cut the wire ties securing the old battery to the battery plate and remove the old battery.

Installing the Battery (lithium battery)

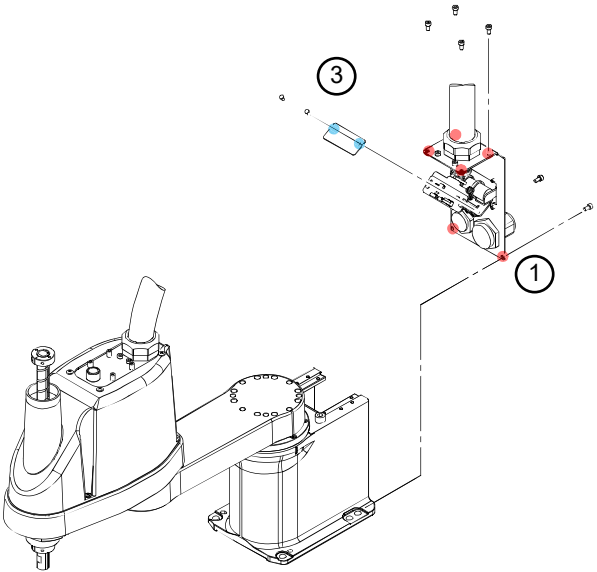


1	Secure the new battery to the battery plate with wire ties. CAUTION Be sure to keep at least one battery connector connected. If the old battery connector is removed before the new battery connector is connected to the board, the home position data will be lost and calibration (ENCRESET) will be required.
2	Attach the battery plate to the connector plate. A S08: 3-M4x8 (0.9 +/- 0.1 N·m)
3	Turn ON the controller.
4	Operate the manipulator to check for any misalignment in position or posture. POINT Move the manipulator to two or three of the registered points.
5	If the position or posture of the manipulator is misaligned, perform calibration for all joints and axes.

2.8.2 Replacing the Battery Board

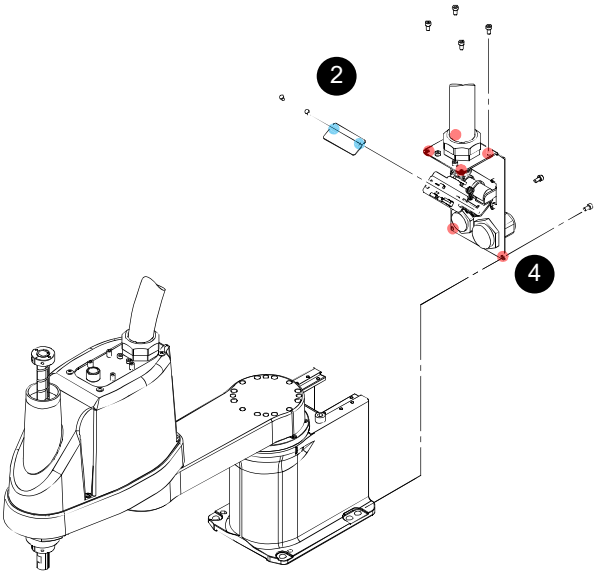


Removing the Battery Board



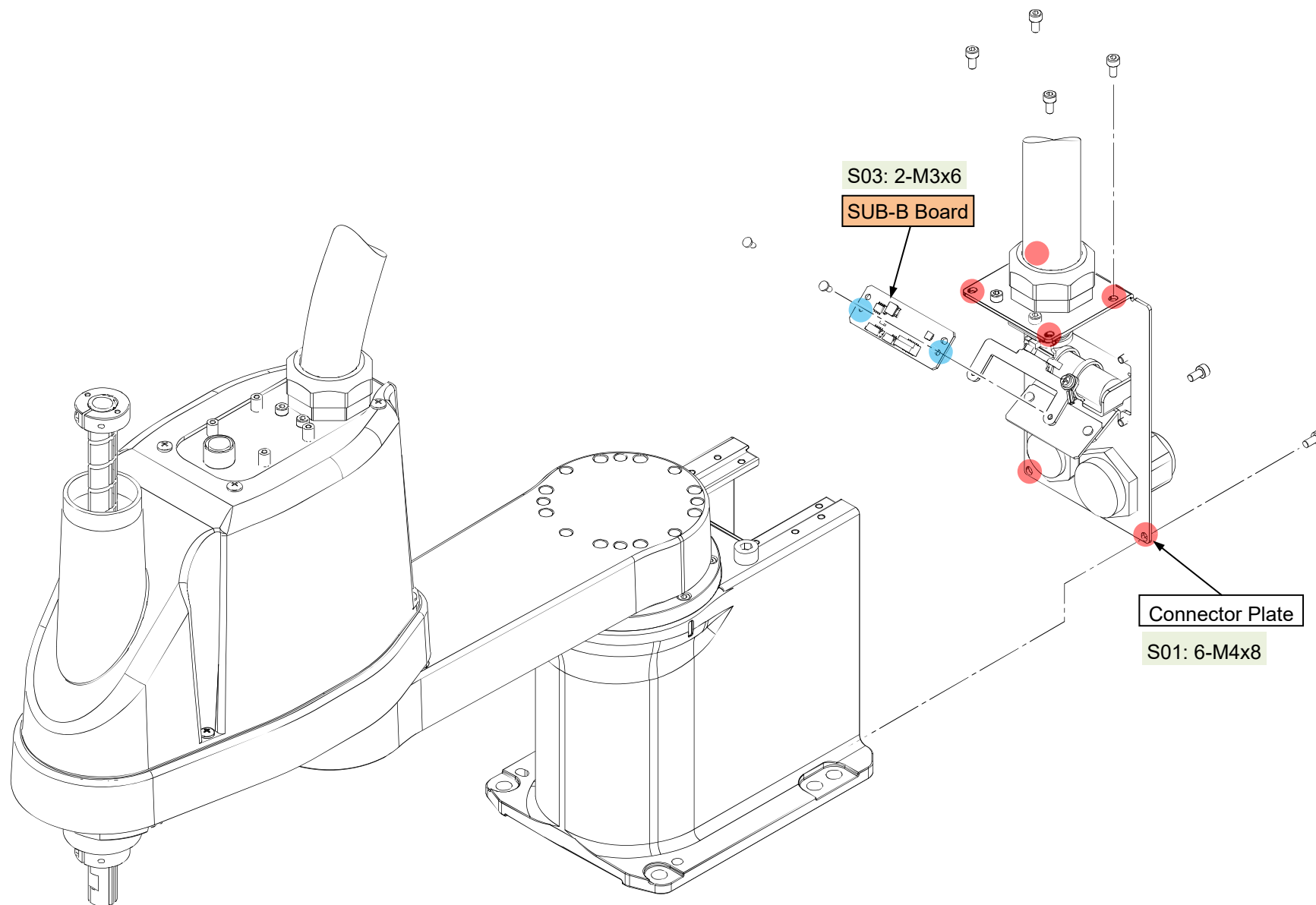
①	Remove the Connector Plate .
②	Disconnect the connectors (CN62, CN63) from the battery board.
③	Remove the screws securing the battery board to the connector plate. A S03: 2-M3x6
④	Disconnect the battery connector from the battery board. POINT Keep the battery in a safe place as it will be reinstalled.

Installing the Battery Board

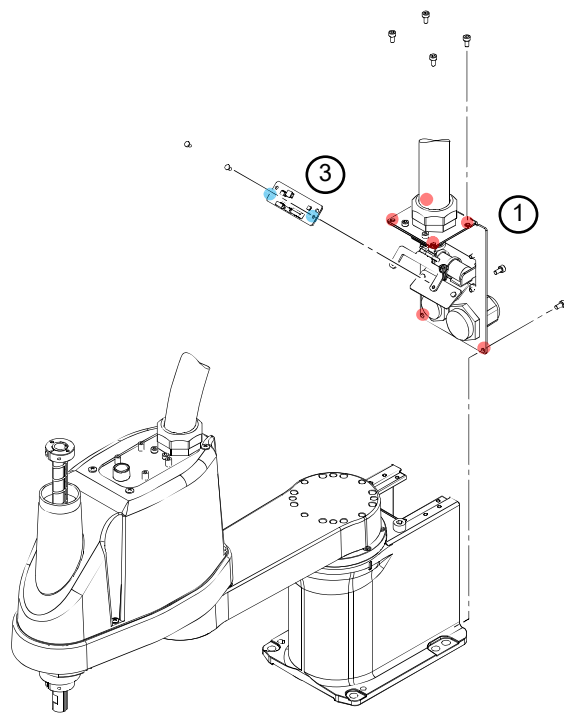


1	Connect the battery connector to the battery board.
2	Install the battery board on the connector plate. A S03: 2-M3x6 (0.45 +/- 0.1 N·m)
3	Connect the connectors (CN62, CN63) to the battery board.
4	Install the Connector Plate .
5	Perform calibration .

2.8.3 Replacing the SUB-B Board

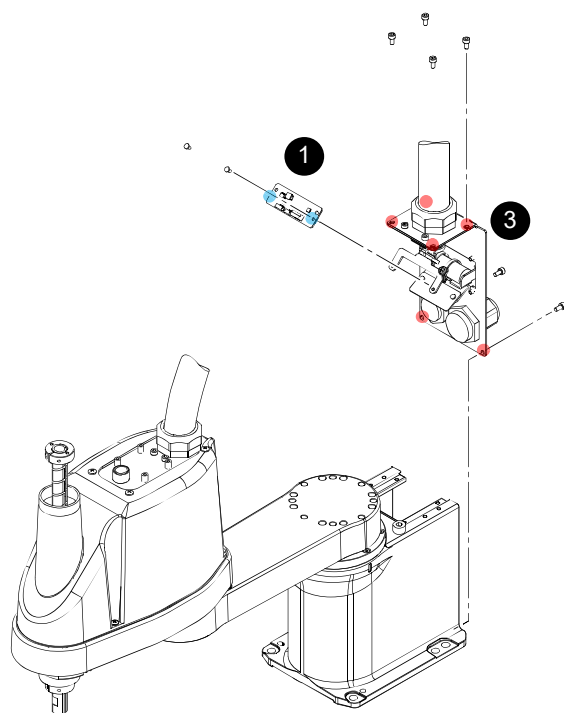


Removing the SUB-B Board



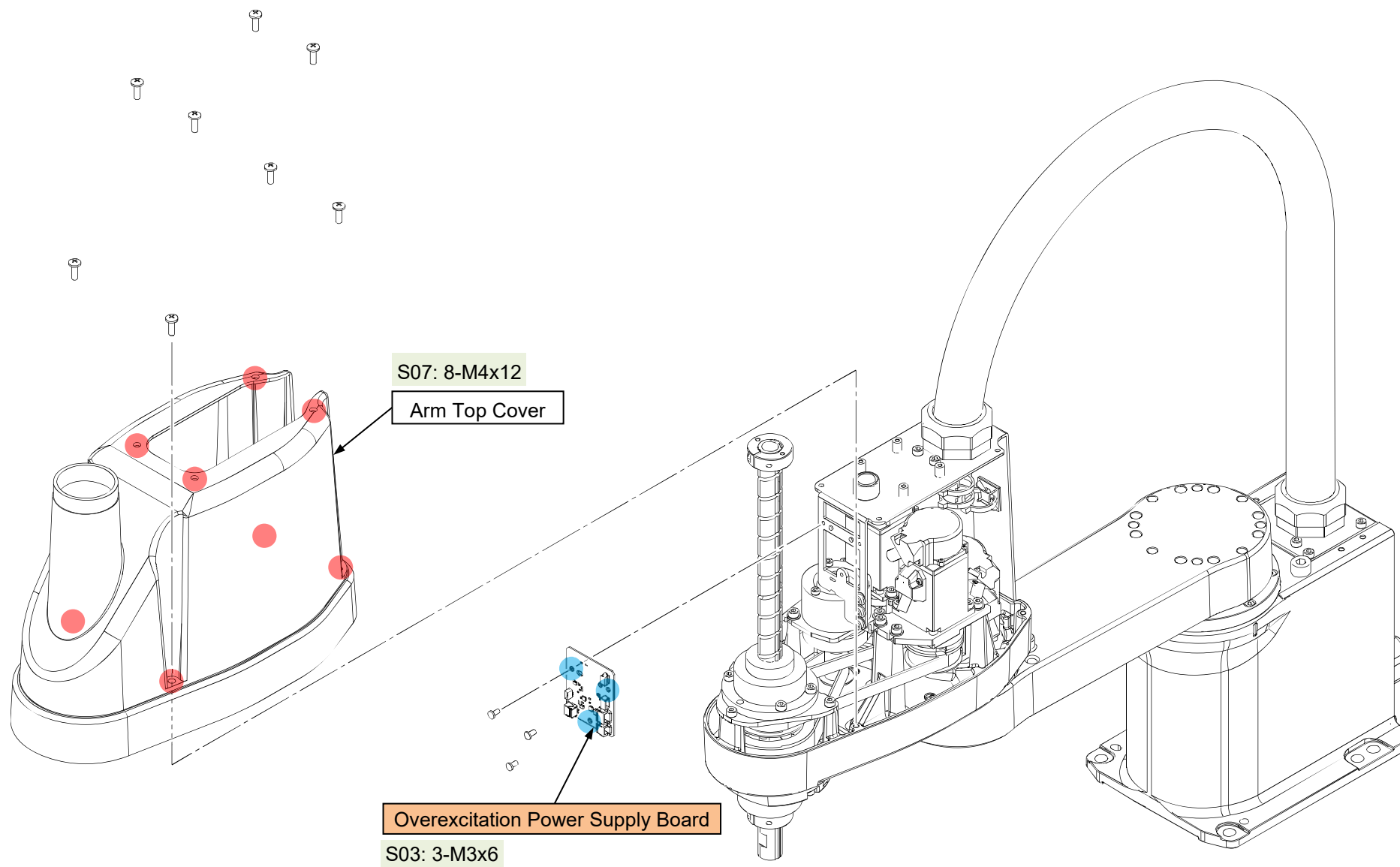
①	Remove the Connector Plate .
②	Disconnect the connectors (CN1, CN2, and CN3) from the SUB-B board.
③	Remove the SUB-B board. A S03: 2-M3x6

Installing the SUB-B Board

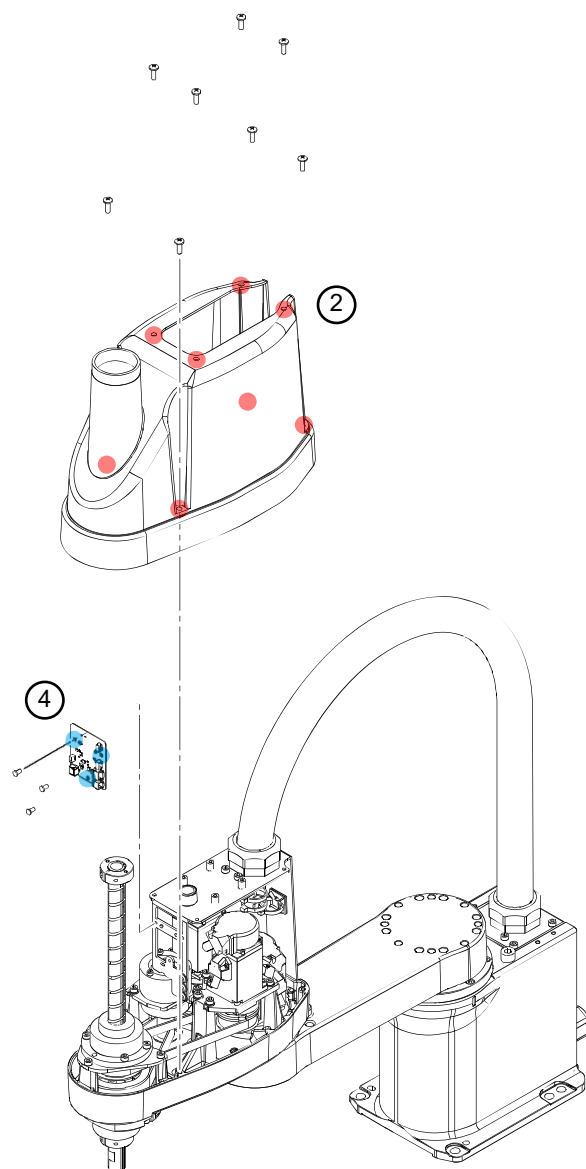


1	Install the SUB-B board. POINT Attach the SUB-B board to the cable fixing plate in the orientation shown in the figure. A S03: 2-M3x6 (0.45 +/- 0.1 N·m)
2	Connect the connectors (CN1, CN2, and CN3) to the SUB-B board.
3	Install the Connector Plate.

2.8.4 Replacing the Overexcitation Power Supply Board

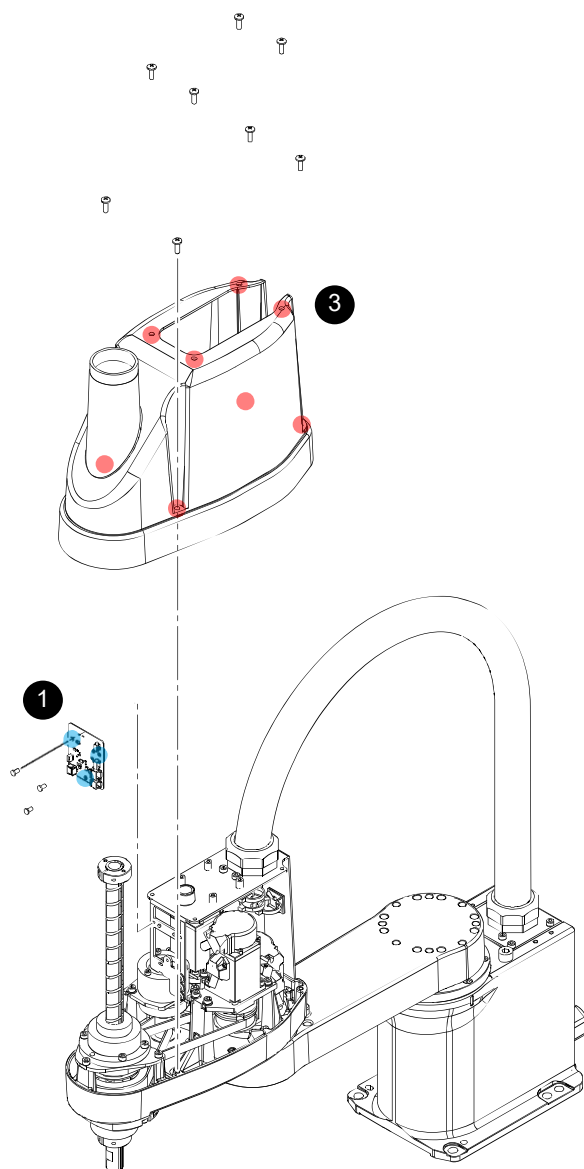


Removing the Overexcitation Power Supply Board



①	Turn OFF the controller.
②	Remove the Arm Top Cover .
③	Disconnect the connectors (CN11, CN13, CN15) from the Overexcitation Power Supply Board.
④	Remove the Overexcitation Power Supply Board. A S03: 3-M3x6

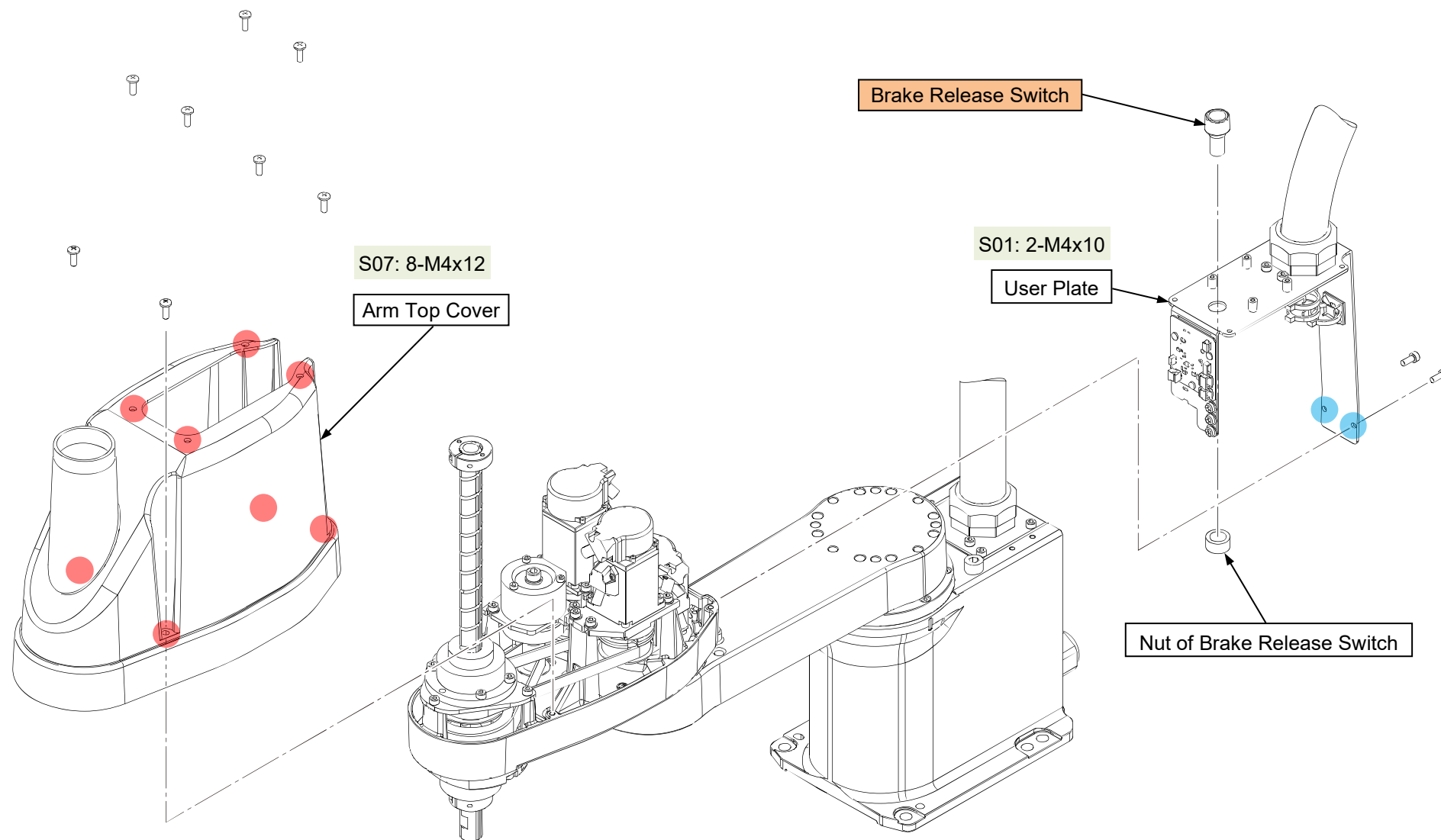
Installing the Overexcitation Power Supply Board



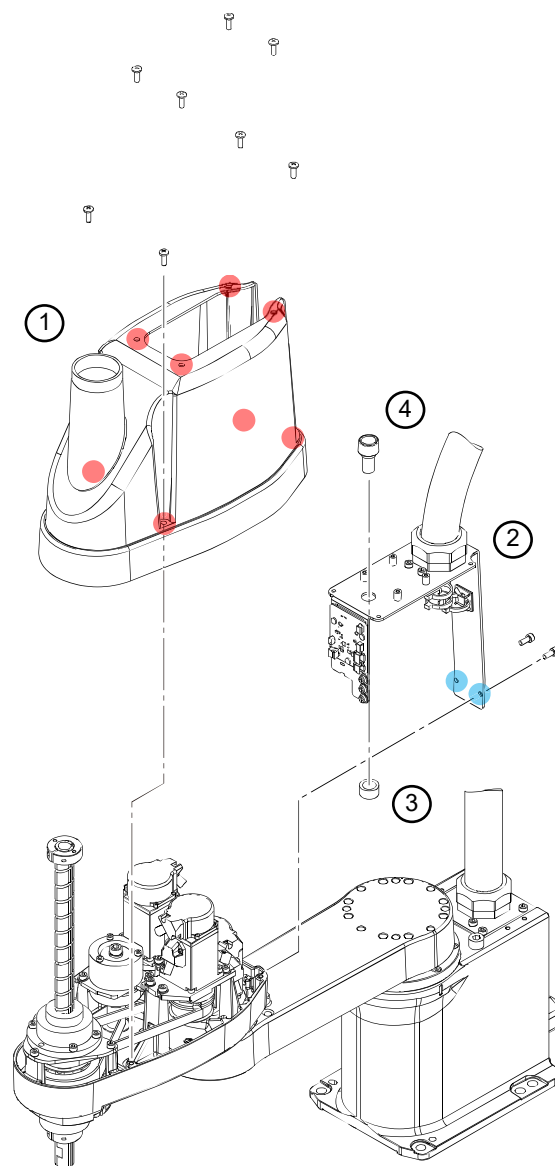
1	Install the Overexcitation Power Supply Board. POINT Install the Overexcitation Power Supply Board in the orientation shown in the figure. A S03: 3-M3x6 (0.45 +/- 0.1 N·m)
2	Connect the connectors (CN11, CN13, CN15) to the Overexcitation Power Supply Board.
3	Install the Arm Top Cover.
4	Turn ON the controller.

2.9 Cables

2.9.1 Replacing the Brake Release Switch

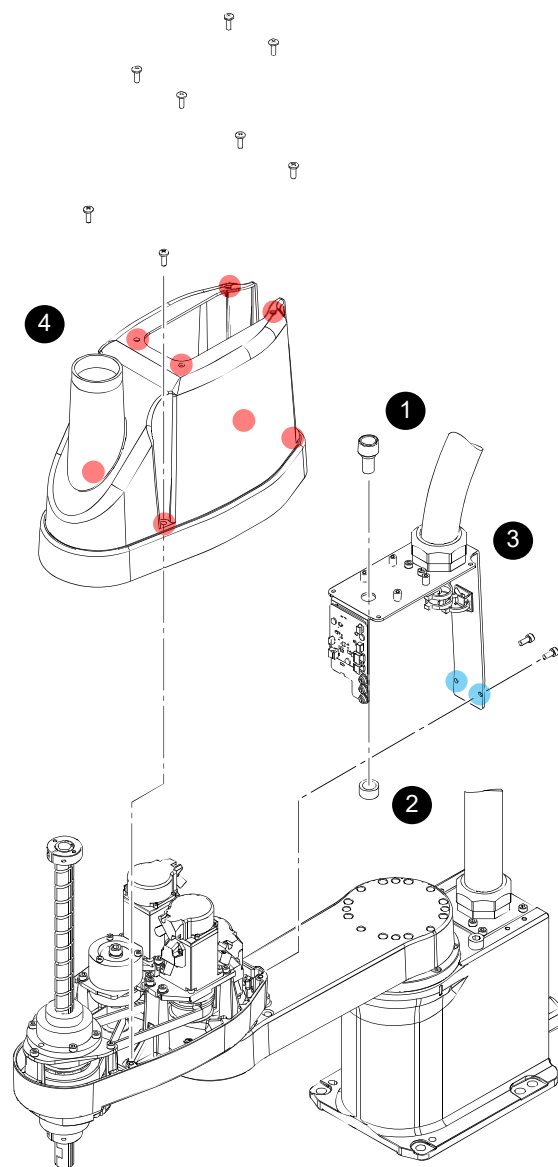


Removing the Brake Release Switch



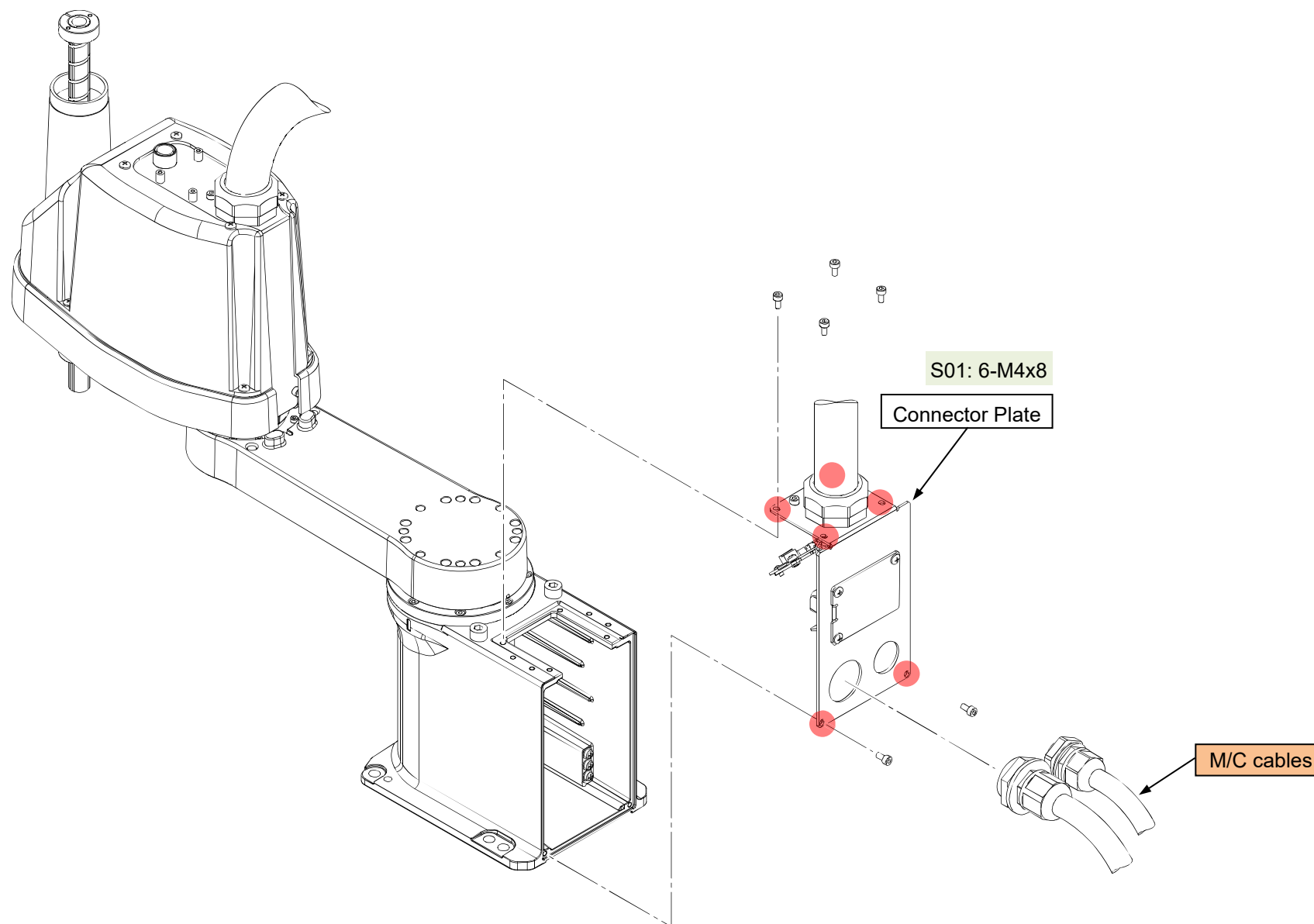
①	Remove the Arm Top Cover .
②	Remove the User Plate .
③	Remove the nut of the Brake Release Switch. POINT Turn the nut of the Brake Release Switch counterclockwise and then remove it.
④	Remove the Brake Release Switch from the top side of the User Plate.

Installing the Brake Release Switch

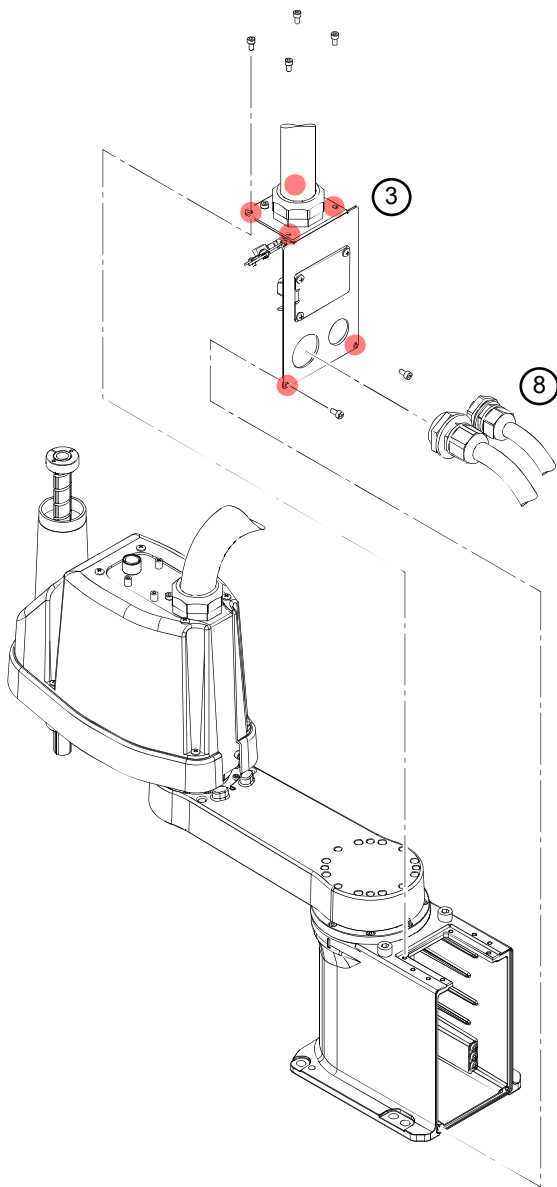


1	Insert the Brake Release Switch into the User Plate.
2	Install the nut of the Brake Release Switch from the bottom side of the User Plate. POINT Turn the nut of the Brake Release Switch clockwise to secure it. A (0.5 +/- 0.05 N·m)
3	Install the User Plate .
4	Install the Arm Top Cover .

2.9.2 Replacing the M/C Cables

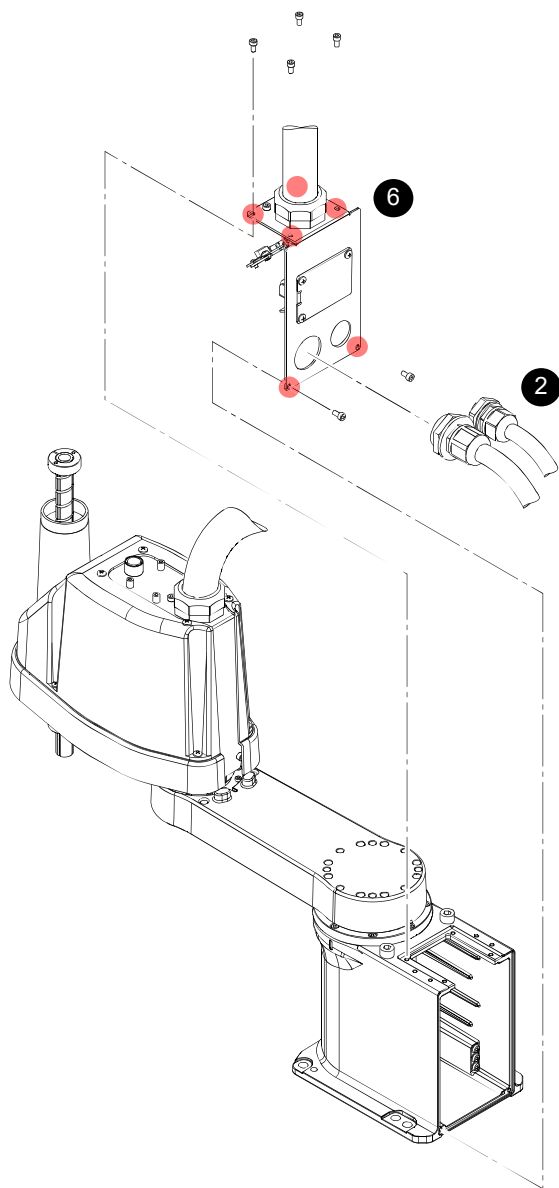


Removing the M/C Cables



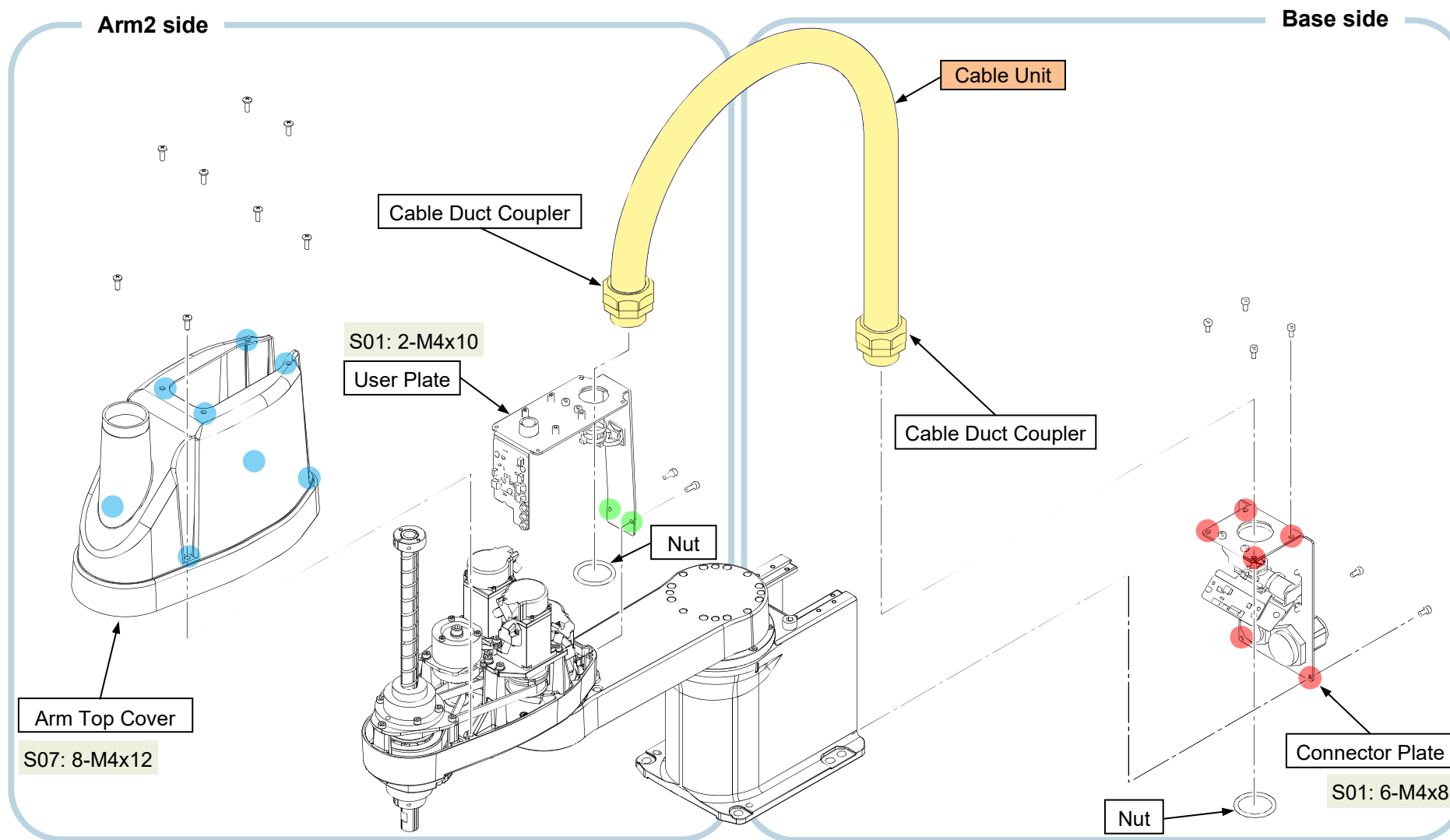
CAUTION Do not pull the Connector Plate with force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.	
①	Turn OFF the controller.
②	Disconnect the following connectors from the controller. Power cable connector, Signal cable connector
③	Remove the Connector Plate .
④	Disconnect the power cable connectors (CN101-1, CN111-1), and signal cable connector (CN201-1).
⑤	Disconnect the ground wires (FB1, PE7) for the power cable, and the ground wire (FB2) for the signal cable.
⑥	Remove the ferrite core for the M/C signal cable. Ferrite core M/C signal cable FB2
⑦	Loosen the resin nuts securing the M/C cable to the connector plate with a wrench and remove the them. CAUTION The nuts are made of resin. Be careful not to damage them with a wrench.
⑧	Pass the power and signal cable connectors through the locknut (silver) holes on the inside of the manipulator and pull out the M/C cable.

Installing the M/C Cables

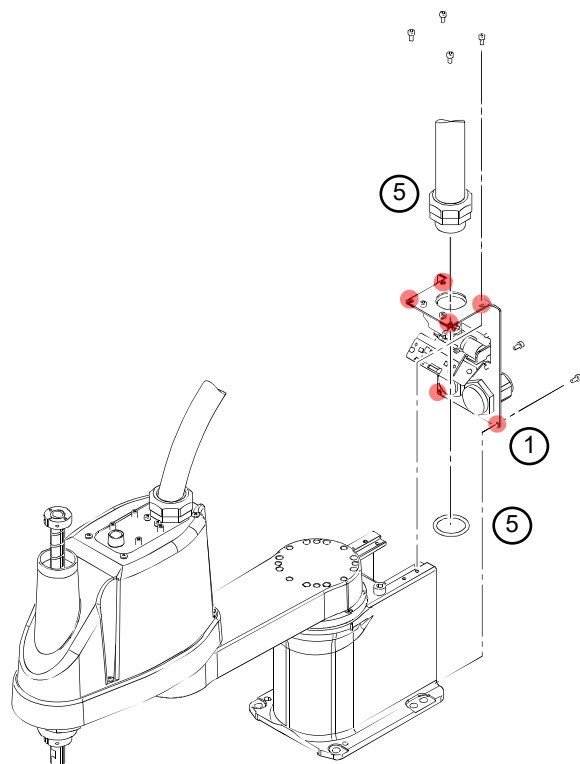


1	Pass the M/C cable through the hole in the connector plate and then through the lock nut (silver). POINT Make sure the lock nut (silver) is on the inside of the manipulator.
2	Tighten the resin nuts with a wrench to secure the M/C cable to the connector plate. CAUTION The nuts are made of resin. Be careful not to damage them with a wrench.
3	Attach the ferrite core to the M/C signal cable. POINT Attach the ferrite core so that it is between the wire ties that bind the M/C signal cable. Wire ties Ferrite core M/C signal cable
4	Connect the ground wires (FB1, PE7) for the power cable, and the ground wire (FB2) for the signal cable.
5	Connect the power cable connectors (CN101-1, CN111-1), and signal cable connector (CN201-1).
6	Install the connector plate.
7	Connect the following connectors to the controller. Power cable connector, Signal cable connector
8	Turn ON the controller.

2.9.3 Replacing the Cable Unit



Removing the Cable Unit (Base Side)



POINT

First, remove the connectors, ground wire, and other parts on the base side.

① Remove the [Connector Plate](#).

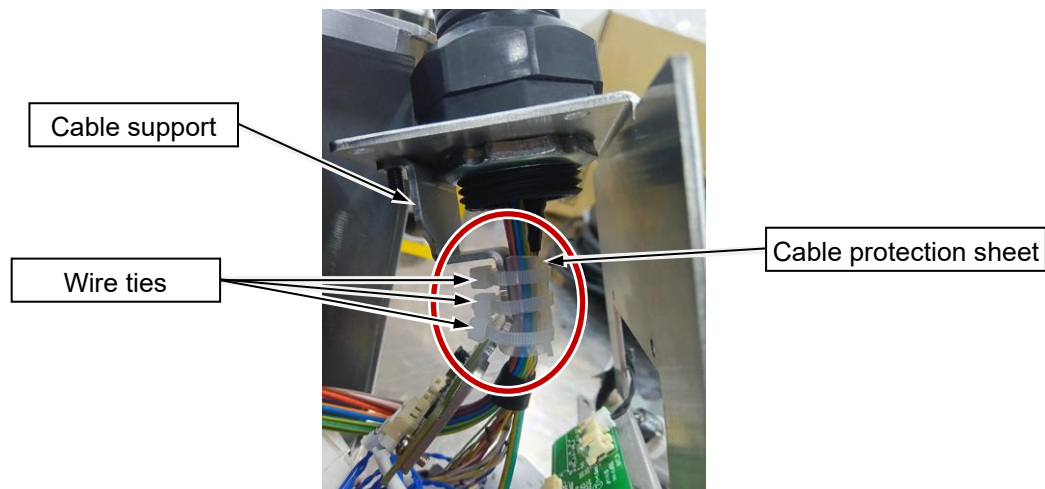
② Remove the connectors (CN101, CN211) on the base side.

③ Disconnect the ground wire (PE8) from the base.

④ Cut the wire ties securing the cables to the base-side cable support.

POINT

- For the clean room environment models, the Air Tube is also secured with wire ties along with the cables.
- To protect the cables, a cable protection sheet is wrapped around the cables. Do not lose the cable protection sheet, as it is used when attaching the cables.

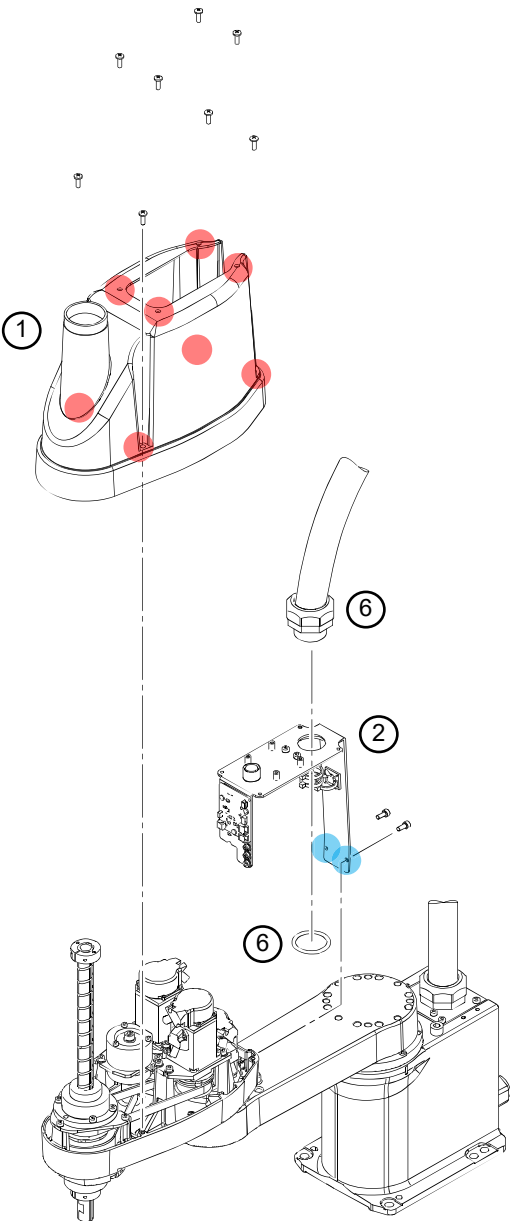


⑤ Remove the nut securing the Cable Duct Coupler to the base and pull the cables out of the base.

POINT

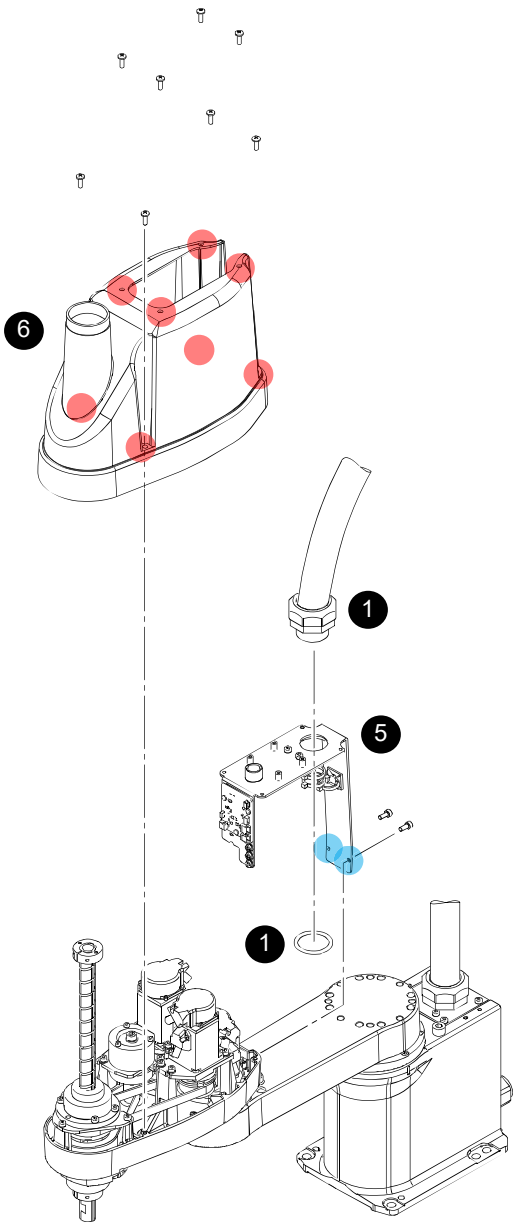
The work up until now removes the Cable Unit (base side) from the robot main unit.

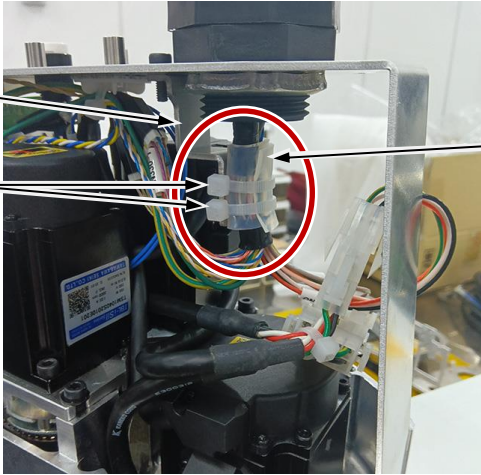
Removing the Cable Unit (Arm2 Side)



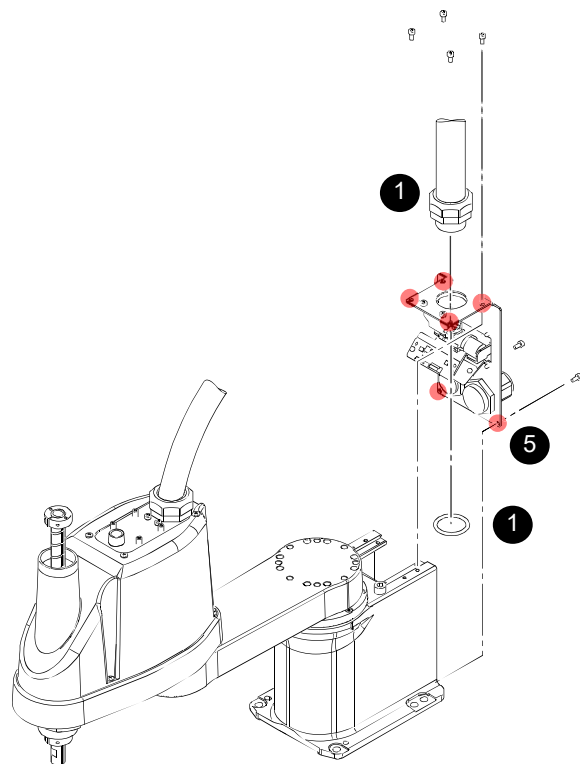
①	Remove the Arm Top Cover.
②	Remove the User Plate. Perform all steps in Removing the User Plate .
③	Disconnect the connector (CN11) from the Overexcitation Power Supply Board.
④	Disconnect the ground wires (PE9, FB3) from the user plate.
⑤	Cut the wire ties securing the cables to the arm-side cable support. POINT - For the clean room environment models, the Air Tube is also secured with wire ties along with the cables. - To protect the cables, a cable protection sheet is wrapped around the cables. Do not lose the cable protection sheet, as it is used when attaching the cables. The photograph shows the internal cable support area. A red circle highlights the cable support, wire ties, and cable protection sheet. Labels with arrows point to these components: 'Cable support', 'Wire ties', and 'Cable protection sheet'.
⑥	Remove the nut securing the Cable Duct Coupler to the user plate and pull the cables out of the user plate. POINT The work up until now removes the Cable Unit (arm side) from the robot main unit.

Installing the Cable Unit (Arm2 Side)



1	Pass the cables through the user plate and nut, in that order, and turn the coupler to secure it to the base.
2	Wrap the cable protection sheet around the cables and secure it to the cable support on the arm side with the wire ties. For the clean room environment models, after securing the cables as described above, secure the Air Tube to the cables using wire ties.  Cable support Wire ties Cable protection sheet
3	Connect the ground wires (PE9, FB3) to the user plate.
4	Connect the connector (CN11) to the Overexcitation Power Supply Board.
5	Install the user plate. Perform all steps in Installing the User Plate .
6	Install the Arm Top Cover .

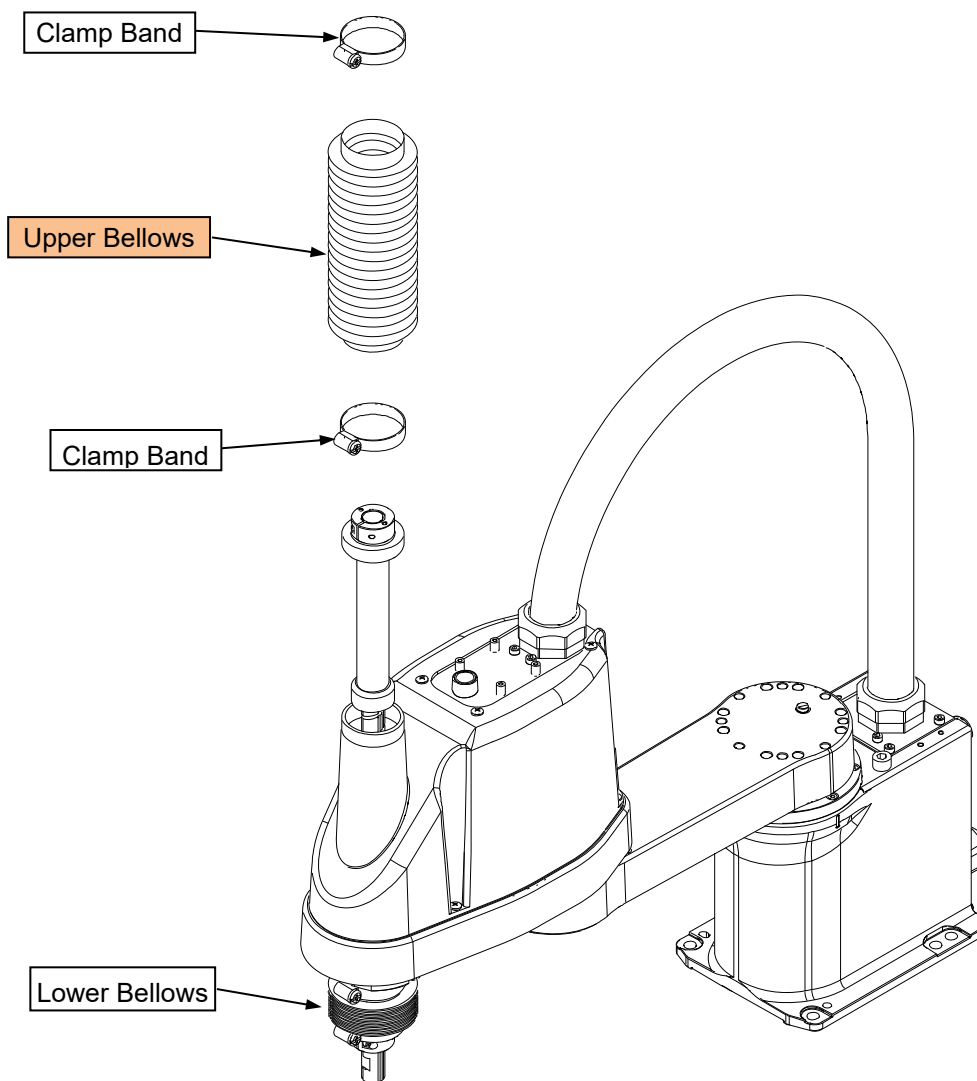
Installing the Cable Unit (Base Side)



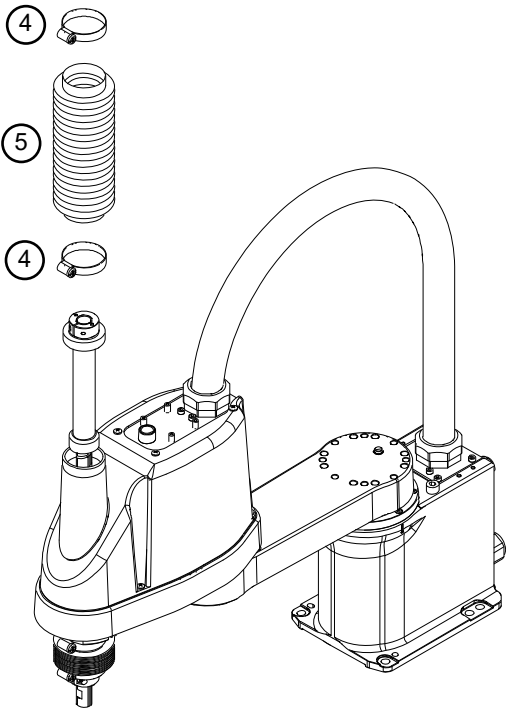
1	Pass the cables through the base and nut, in that order, and turn the coupler to secure it to the connector plate.
2	Connect the connectors (CN101, CN211) on the base side.
3	Wrap the cable protection sheet around the cables and secure it to the cable support on the arm side with the wire ties. For the clean room environment models, after securing the cables as described above, secure the Air Tube to the cables using wire ties. A close-up photograph of the cable assembly. A red circle highlights the area where the cable protection sheet is being secured. Labels with arrows point to the 'Cable support', 'Wire ties', and 'Cable protection sheet'.
4	Connect the ground wire (PE8) in the base.
5	Install the Connector Plate .

2.10 Bellows

2.10.1 Replacing the Upper Bellows

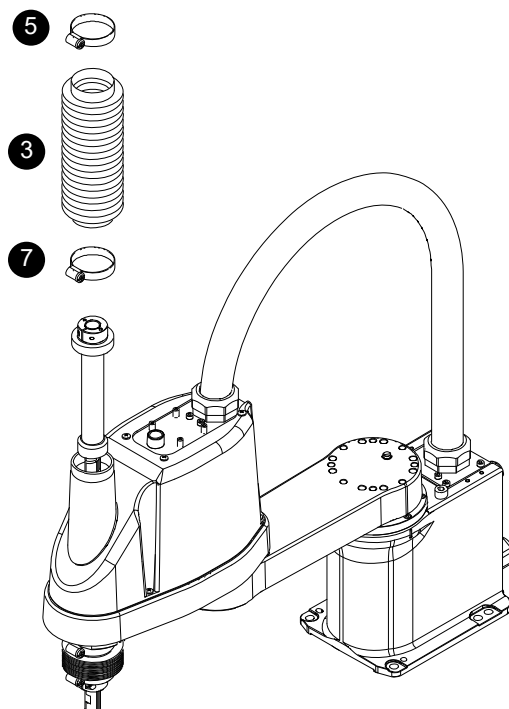


Removing the Upper Bellows



	CAUTION • Replacement of the bellows is accompanied by generation of large amounts of dust. Either perform replacement in a pre-clean room, or after adopting dust prevention measures beforehand. • The shaft of the Ball Screw Spline Unit may lower due to the weight of the end effector. • Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed.
①	Remove the cables and tubes from the end effector.
②	Remove the end effector.
③	Turn ON the controller and put the motor in the de-energized (MOTOR OFF) state.
④	Loosen the two clamp bands securing the Upper Bellows.
⑤	Remove the bellows and clamp bands from the shaft.

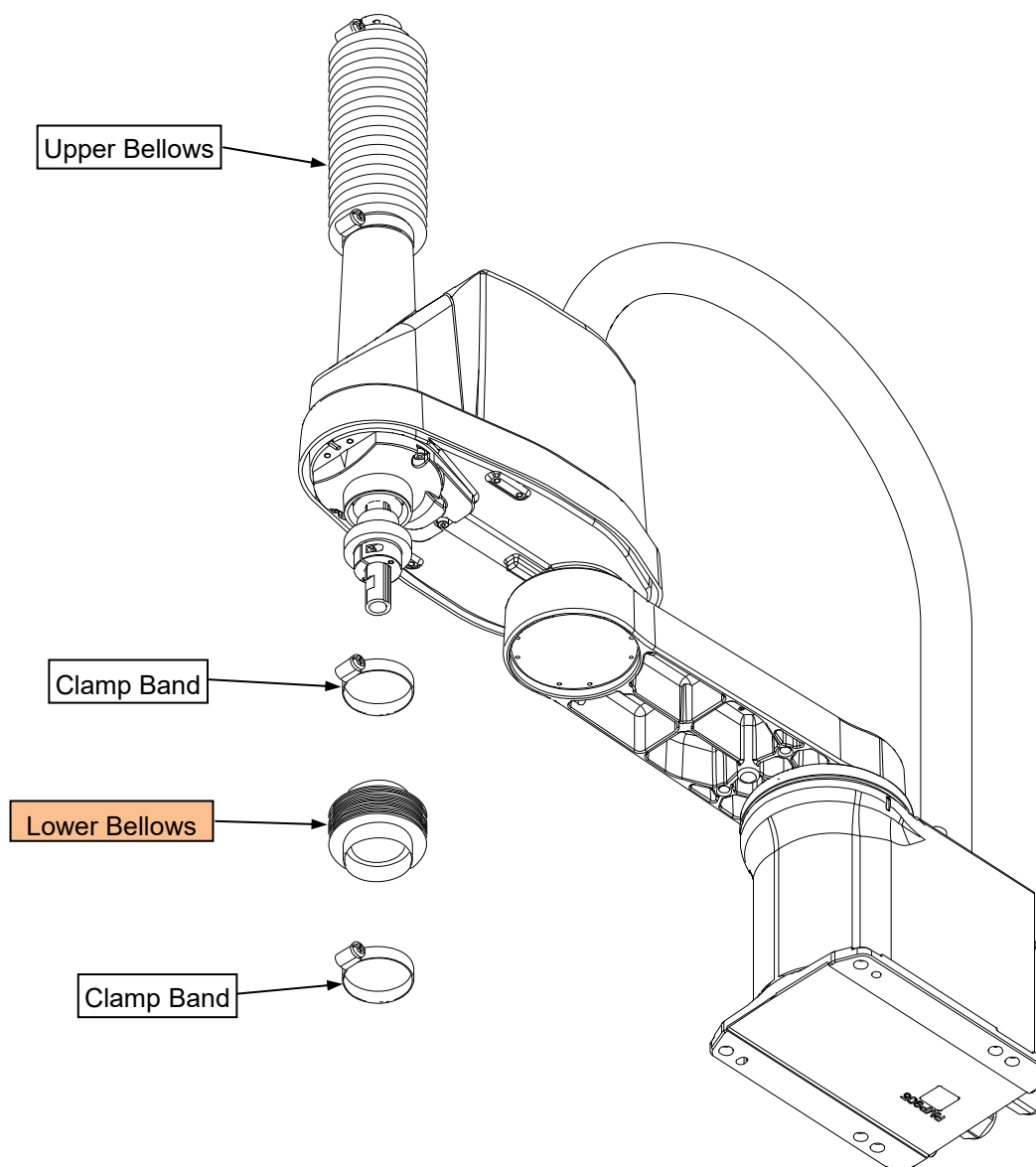
Installing the Upper Bellows



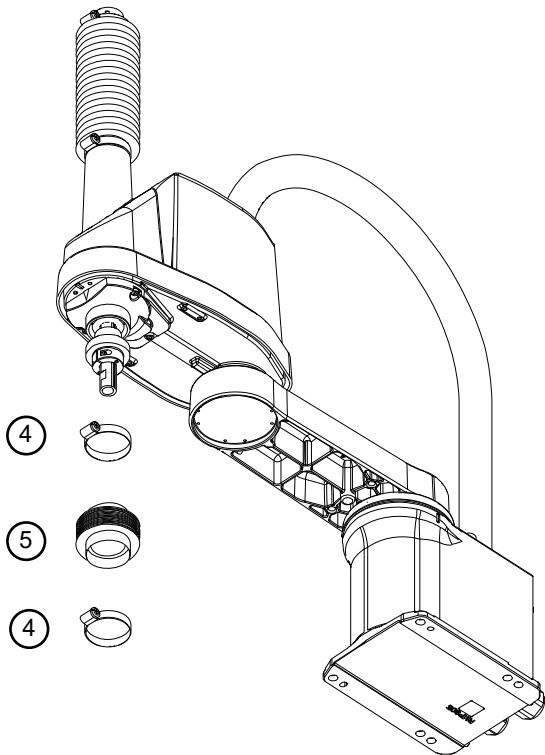
1	Check the state of the grease of the Ball Screw Spline Unit. Perform greasing as necessary.
2	Move the shaft of the Ball Screw Spline Unit to a position where the Upper Bellows is easy to install as necessary. Shaft Movement Procedure 1. Turn ON the robot system. 2. Taking care to prevent interference with peripheral devices and other items, move the shaft to an appropriate position while pressing the Brake Release Switch. CAUTION Be careful of the shaft lowering and rotating due to the weight of the end effector while the Brake Release Switch is being pressed. 3. Turn OFF the robot system.
3	Pass the Upper Bellows onto the shaft. POINT Orient the Upper Bellows so that the larger diameter of the bellows installation section is on the Arm Top Cover side.
4	Fit the bellows installation section over the cylinder part of the Arm Top Cover, and insert it until it contacts the Arm Top Cover.
5	Fit the clamp band over the bellows installation section, and tighten the screw of the clamp band. A (0.7 +/- 0.05 N·m)
6	Fit the bellows installation section over the bearing case.
7	Tighten the screws on the clamp band. A (0.7 +/- 0.05 N·m)
8	Check that the bellows expand and contract smoothly and that no excessive force is applied when the shaft moves up/down and rotates.

9	Turn OFF the controller and peripheral devices.
10	Install the end effector.
11	Connect the cables and tubes to the end effector.

2.10.2 Replacing the Lower Bellows

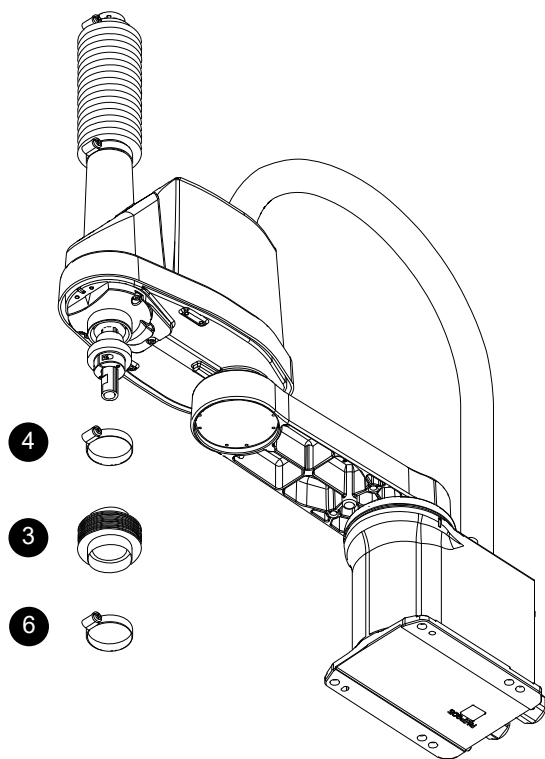


Removing the Lower Bellows



	CAUTION • Replacement of the bellows is accompanied by generation of large amounts of dust. Either perform replacement in a pre-clean room, or after adopting dust prevention measures beforehand. • The shaft of the Ball Screw Spline Unit may lower due to the weight of the end effector. • Be careful of the shaft falling and rotating while the Brake Release Switch is being pressed.
①	Remove the cables and tubes from the end effector.
②	Remove the end effector.
③	Turn ON the controller and put the motor in the de-energized (MOTOR OFF) state.
④	Loosen the clamp bands securing the top and bottom of the Lower Bellows.
⑤	Remove the Bellows and clamp bands from the shaft.

Installing the Lower Bellows



1	Check the state of the grease of the Ball Screw Spline Unit. Perform greasing as necessary.
2	Move the shaft of the Ball Screw Spline Unit to a position where the Lower Bellows is easy to install as necessary. Shaft Movement Procedure 1. Turn ON the robot system. 2. Taking care to prevent interference with peripheral devices and other items, move the shaft to an appropriate position while pressing the Brake Release Switch. CAUTION Be careful of the shaft lowering and rotating due to the weight of the end effector while the Brake Release Switch is being pressed. 3. Turn OFF the robot system.
3	Pass the Lower Bellows onto the shaft. POINT Orient the Lower Bellows so that the larger diameter of the bellows installation section is on the Arm Top Cover side.
4	Fit the clamp band over the bellows installation section, and tighten the screw of the clamp band. A (0.7 +/- 0.05 N·m)
5	Fit the bellows installation section over the bearing case.
6	Tighten the screws on the clamp band. A (0.7 +/- 0.05 N·m)
7	Check that the bellows expand and contract smoothly and that no excessive force is applied when the shaft moves up/down and rotates.
8	Turn OFF the controller and peripheral devices.

9	Install the end effector.
10	Connect the cables and tubes to the end effector.

CHAPTER

3

Adjustment

3.1 Adjusting the Timing Belt Tension

The Manipulator uses three types of timing belts.

When removing or replacing parts related to the belt, be sure to adjust the tension of the timing belt.

 CAUTION	● If the belt tension falls below the lower limit, the belt may jump off the teeth and cause positioning failure. If the belt tension exceeds the upper limit, it may cause oscillation (abnormal noise) and reduce the service life of parts. ● When the belt is replaced with a new one, the belt may stretch and lose tension at first. Be sure to check the belt tension again after operating the robot for a few days.
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3.1.1 Items to be prepared

- Force gauge
- Sonic Belt Tension Meter Recommended: U-508 (Gates Unitta)
- Non-stretchable string (approx. 800 mm long)

3.1.2 Belt Tension Values

LA3-A

Tension Meter setting values

	Z	U1	U2
Unit mass (g/mm width x m span)	1.9	1.5	1.5
Belt width (mm)	9	10	16
Belt span (mm)	127	45	92

Tension standard values

	Z	U1	U2
Belt tension (Minimum to maximum) (N)	31 to 36	17 to 22	32 to 37

LA6-A

Tension Meter setting values

	Z	U1	U2
Unit mass (g/mm width x m span)	1.9	1.5	1.5
Belt width (mm)	10	10	20
Belt span (mm)	212	55	169

Tension standard values

	Z	U1	U2
Belt tension (Minimum to maximum) (N)	32 to 37	26 to 31	56 to 61

3.1.3 Adjustment Method

 CAUTION	Before adjustment ● Make sure that the belt is set to be level with respect to the pulley without it being placed on the flange.	During adjustment ● Take care not to apply excessive tension to the belt. ● Measure the tension near the center of the belt.
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Z belt

Apply the proper tension to the Z belt, and then secure the J3 Motor unit.

Adjust the belt tension by hanging a non-stretchable string or similar on the part near the motor plate and pulling it with a force gauge or similar device.

1. Hang a non-stretchable string or similar on the part near the J3 motor plate.

2. Pull the string with a force gauge or similar device to apply the specified tension and temporarily tighten the motor plate screws.

LA3-A

Z belt tension: 31 to 36 N

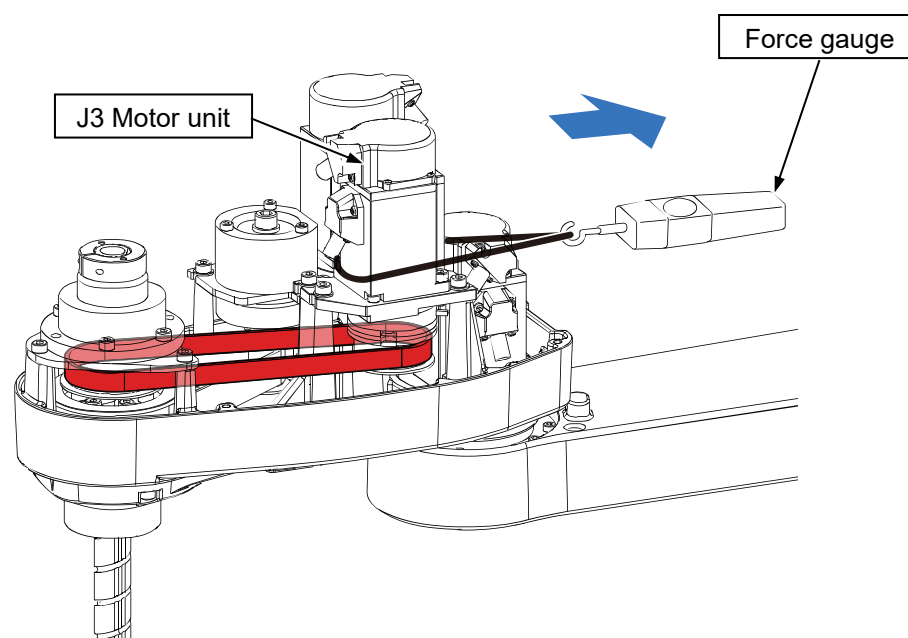
Axial tension (pulling force): 62 to 72 N

LA6-A

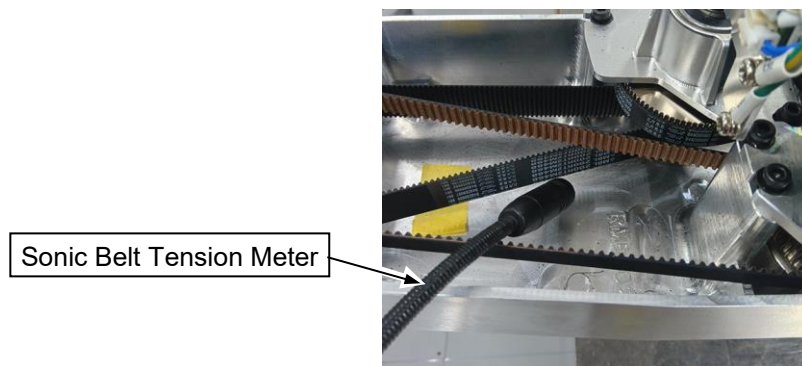
Z belt tension: 32 to 37 N

Axial tension (pulling force): 64 to 74 N

A S01: 3-M4x15 and Washer

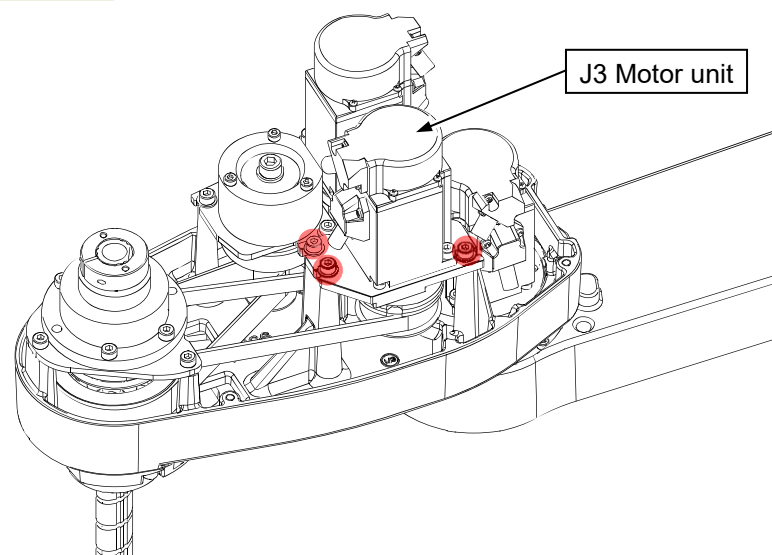


3. Measure the tension using a sonic tension meter.



4. Tighten the screws securing the plate of the J3 Motor unit to the specified torque.

A S01: 3-M4x15 and Washer
(4.0 +/- 0.2 N·m)



5. Measure the belt tension again for confirmation.

U2 belt

Apply the proper tension to the U2 belt, and then secure the Intermediate Pulley Unit.

Adjust the belt tension by hanging a non-stretchable string or similar on the part near the Intermediate Pulley plate and pulling it with a force gauge or similar device.

1. Hang a non-stretchable string or similar on the part near the Intermediate Pulley plate.
2. Pull the string with a force gauge or similar device to apply the specified tension and temporarily secure the Intermediate Pulley Unit plate with the screws.

LA3-A

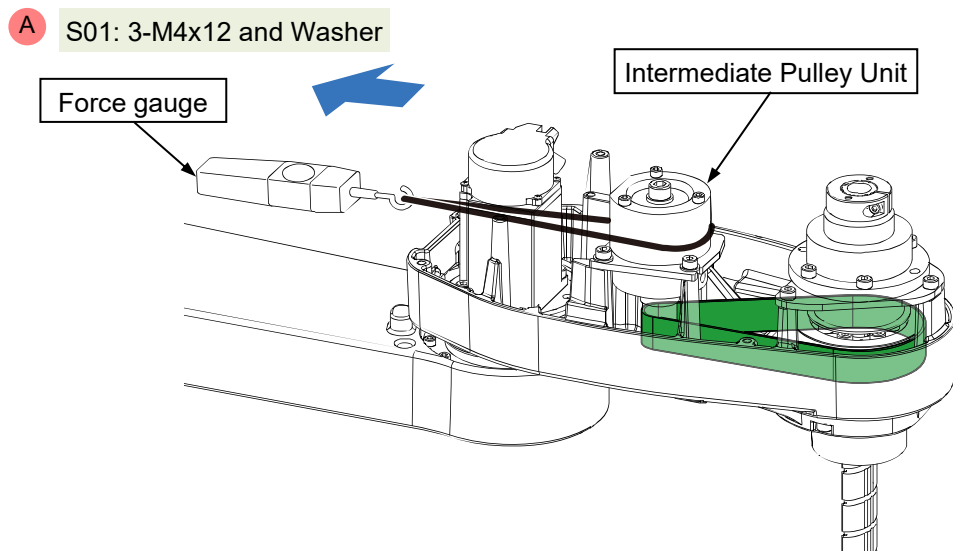
U2 belt tension: 32 to 37 N

Axial tension (pulling force): 64 to 74 N

LA6-A

U2 belt tension: 56 to 61 N

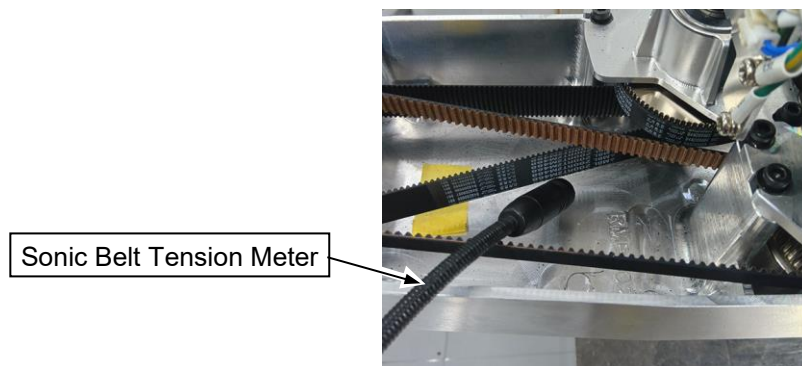
Axial tension (pulling force): 112 to 122 N



3. Measure the tension using a sonic tension meter.

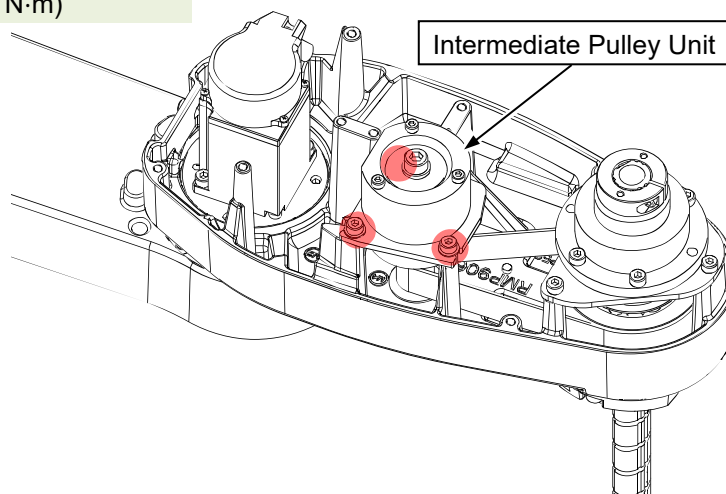
POINT

Turn the Ball Screw Spline shaft to move the U2 belt and measure the tension at four points on the U2 belt.



4. Tighten the screws securing the plate of the Intermediate Pulley Unit to the specified torque.

A S01: 3-M4x12 and Washer
(4.0 +/- 0.2 N·m)



5. Measure the belt tension again at four points for confirmation.

U1 belt

Apply the proper tension to the U1 belt, and then secure the J4 Motor unit.

Adjust the belt tension by hanging a non-stretchable string or similar on the part near the motor plate and pulling it with a force gauge or similar device.

1. Hang a non-stretchable string or similar on the part near the J4 motor plate.
2. Pull the string with a force gauge or similar device to apply the specified tension and temporarily tighten the motor plate screws.

LA3-A

U1 belt tension: 17 to 22 N

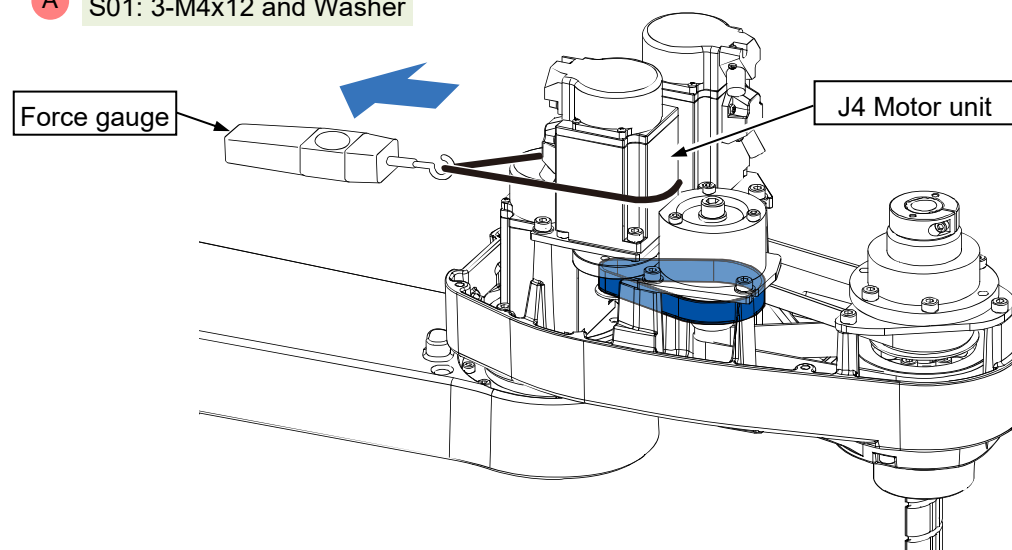
Axial tension (pulling force): 34 to 44 N

LA6-A

U1 belt tension: 26 to 31 N

Axial tension (pulling force): 52 to 62 N

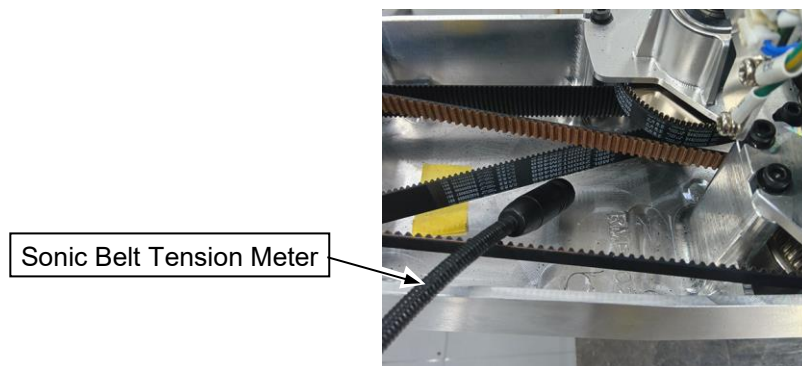
A S01: 3-M4x12 and Washer



3. Measure the tension using a sonic tension meter.

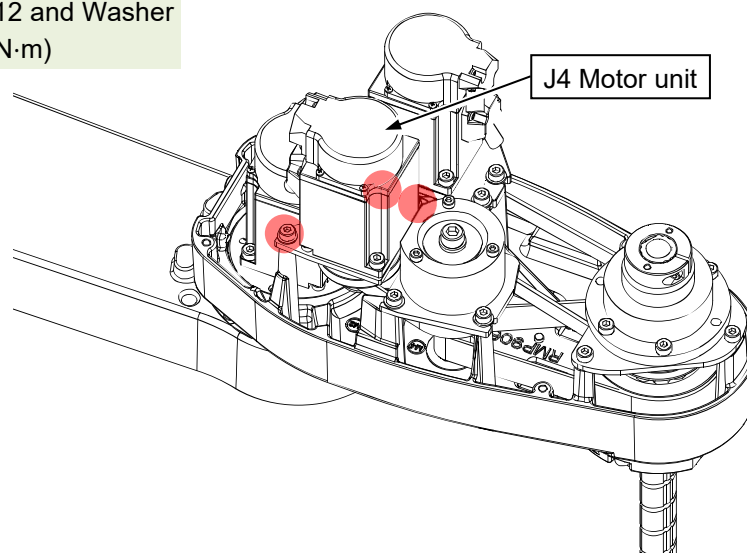
POINT

Turn the Ball Screw Spline shaft to move the U1 belt and measure the tension at four points on the U1 belt.



4. Tighten the screws securing the plate of the J4 Motor unit to the specified torque.

A S01: 3-M4x12 and Washer
(4.0 +/- 0.2 N·m)



5. Measure the belt tension again at four points for confirmation.

3.2 Calibration

3.2.1 What is Calibration?

Calibration

When parts (Motors, Reduction Gears, Brakes, Timing Belts, Ball Screw Spline Units, etc.) are replaced, the origin stored in the Motor and the origin stored in the Controller become misaligned, and the Manipulator cannot be controlled correctly.

Therefore, after the parts are replaced, resetting the encoder and then calibration are required to bring these origins into alignment.

Calibration is performed using the Calibration Marks that indicates the 0-pulse position.

NOTE

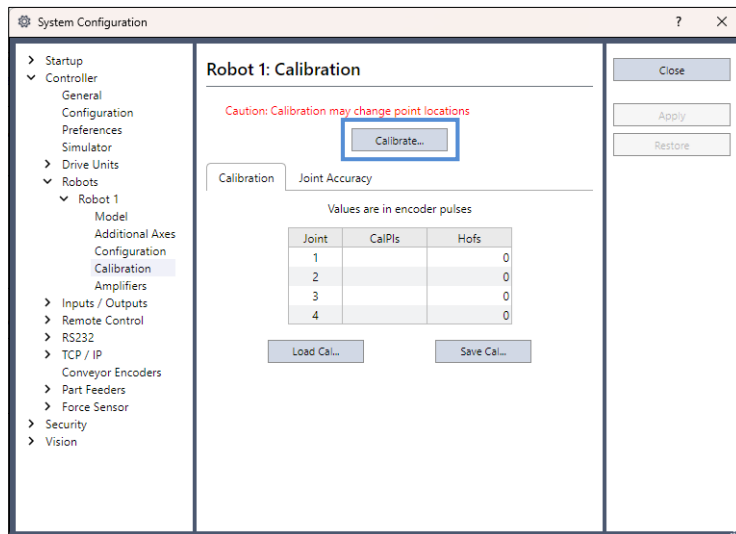
- Calibration is different from teaching*.
* Teaching is the operation of teaching set coordinate points (including the posture) within the Manipulator's operating area.
- When coordinates for the Manipulator working point require calculation, it is important for Joint #2 to be calibrated accurately. Execute the procedure in "Calibration Using Right / Left Arm Orientations" to accurately calibrate Joint #2. For details, refer to [Accurate Calibration of Joint #2](#).
- When calibrating Joint #4, due to the structure of the Manipulator Joint #3 and #4 must be calibrated at the same time.

3.2.2 Calibration Methods

Implementing Calibration using the Wizard

EPSON RC+ has a wizard for calibration.

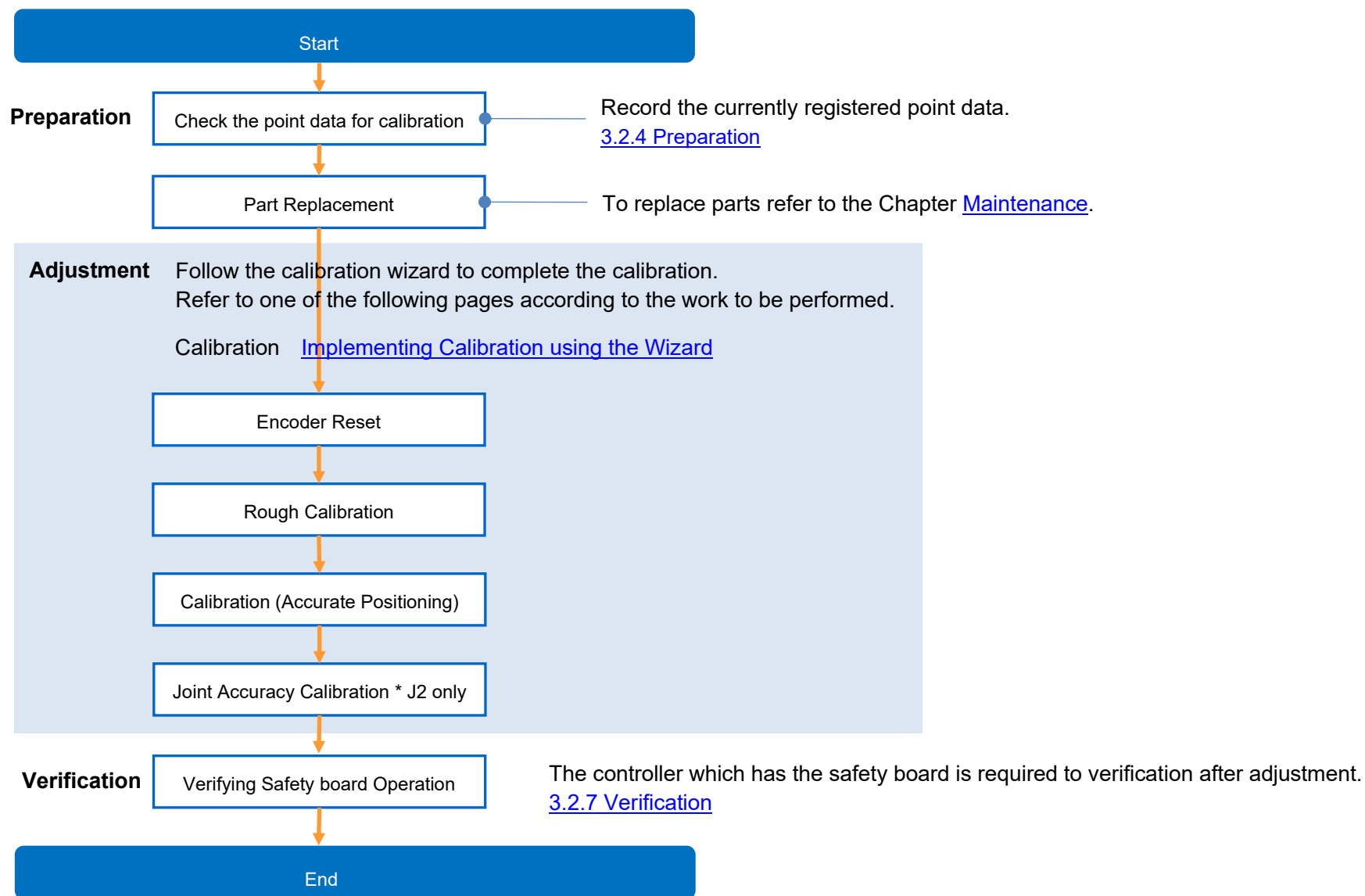
The wizard guides you through the calibration process from specifying the joints to be adjusted and the adjustment items (calibration to be performed).

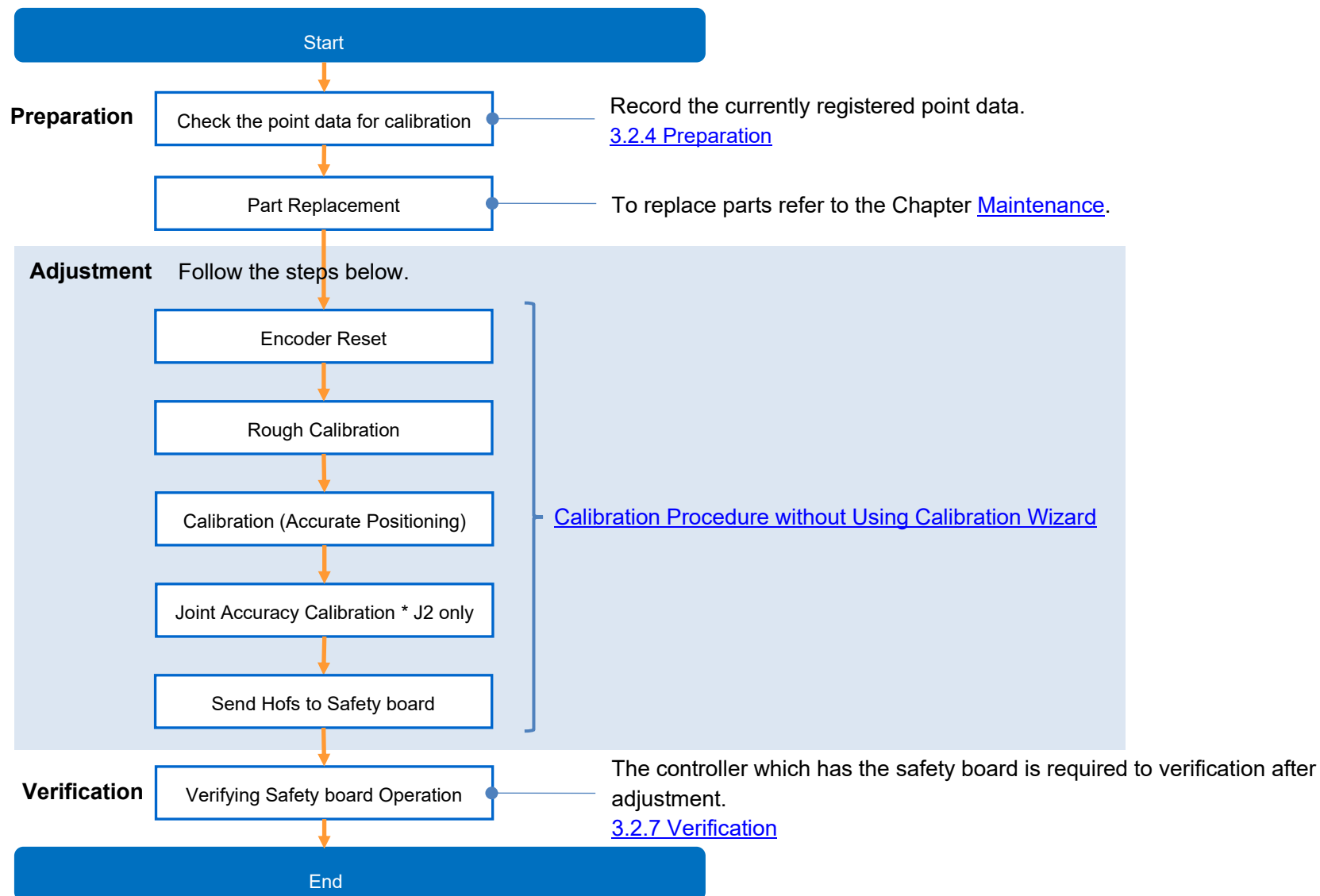


To calibrate without using the calibration wizard, refer to [Calibration Procedure without Using Calibration Wizard](#).

3.2.3 Workflow

When using the calibration wizard

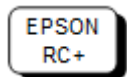


When performing calibration manually (without using the calibration wizard)

3.2.4 Preparation

To reproduce the exact manipulator position, check the point data for calibration before starting the calibration.

Before replacing parts, select point data in the currently registered point (pose) data where accuracy can be easily checked, and display the pulse value using the following procedure to record it.



Execute the following command from the [Command Window].

>PULSE

PULSE: [Joint #1 Pulse value] pls [Joint #2 Pulse value] pls [Joint #3 Pulse value] pls [Joint #4 Pulse value] pls

3.2.5 0-Pulse Position of Each Joint

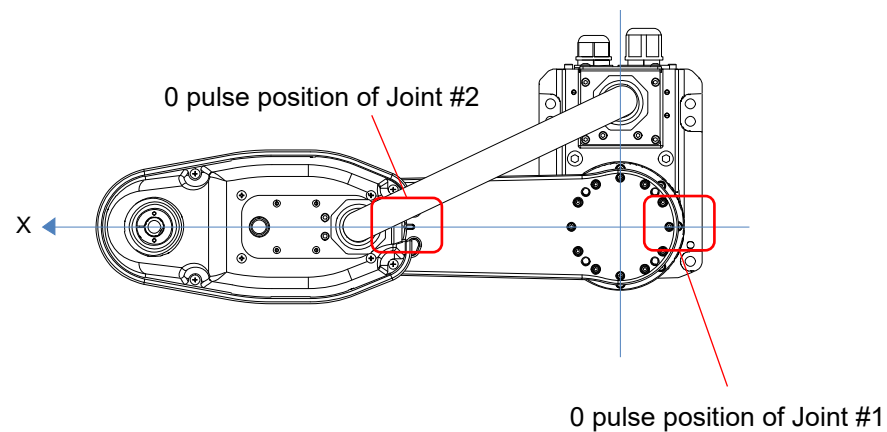
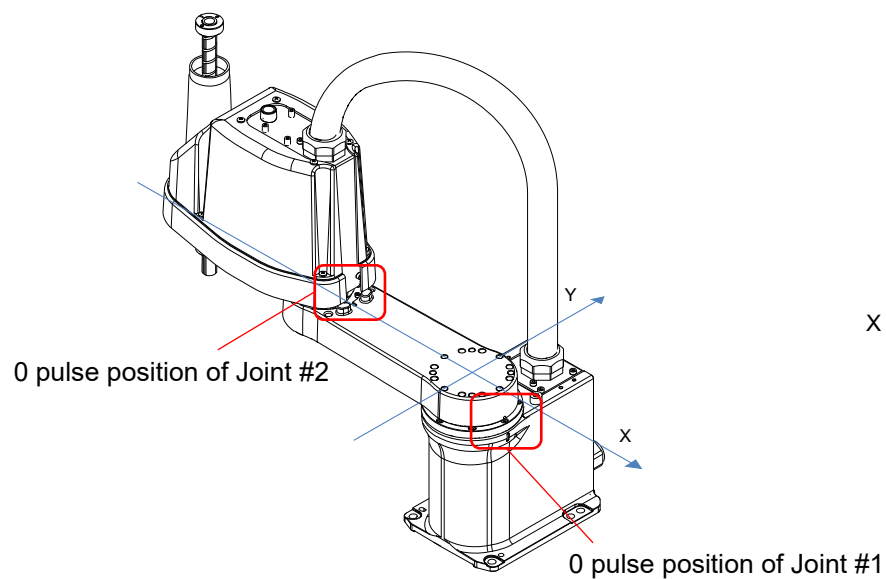
To perform calibration using the 0 pulse position, refer to the figure below.

Joint #1/Joint #2

Guideline for the 0-pulse position

Joint #1: position aligned with X-axis in Robot coordinate system

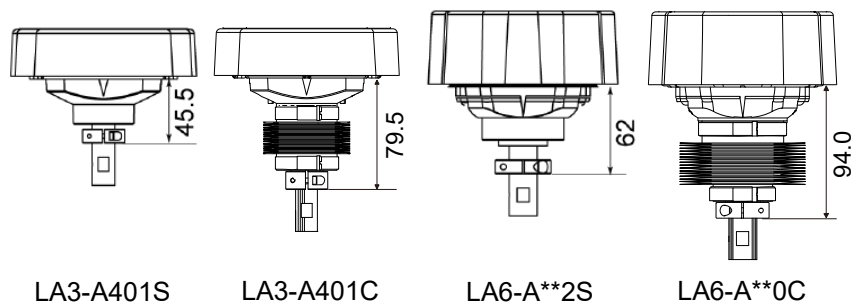
Joint #2: position where Arms #1 and #2 are in a straight line



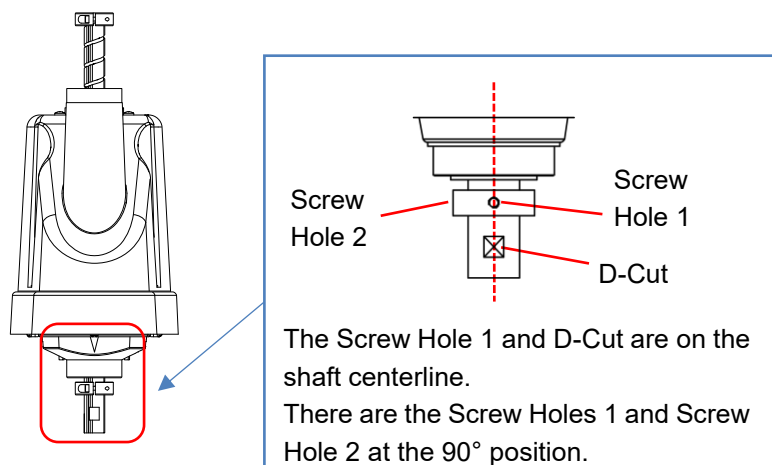
Joint #3**Guideline for the 0-pulse position of Joint #3**

Upper limit position within the range of motion

The height of Joint #3 depends on Manipulator model. (Unit: mm)

**Joint #4****Guideline for the 0-pulse position of Joint #4**

Position where the flat surface on the shaft faces toward the tip of Arm #2.



3.2.6 Implementing Calibration

**WARNING**

- To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to EPSON RC+ User's Guide: Installation and Design Precautions in the Safety chapter.
- 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.

NOTE

If Err9719 or 5019 (Position failure of the absolute encoder.) occurs after replacing the motor or in other situations, apply the procedure of [Calibration Procedure without Using Calibration Wizard](#)- 3. Encoder Initialization and then, start the calibration wizard.

The reference point (a point to check the accuracy) needs to be specified for calibration.

Command Input

Calibration procedures include the process to input commands. Select EPSON RC+ menu - [Tools] - [Command Window] to use the command window.

The information above is omitted in the calibration procedure.

Jog Motion

The process to set the jog motion is included in the [Jog & Teach] page of the Robot Manager. Select EPSON RC+ menu - [Tools] - [Robot Manager] and select the [Jog & Teach] tab to use the [Jog & Teach] page.

The information above is indicated as [Jog & Teach] in the calibration procedure, and omitted in the calibration page.

Implementing Calibration using the Wizard

The same calibration procedure is used for each joint.

The steps below are calibration using Joint #1. Follow the steps below to calibrate other joints.

(1) Start the calibration wizard.

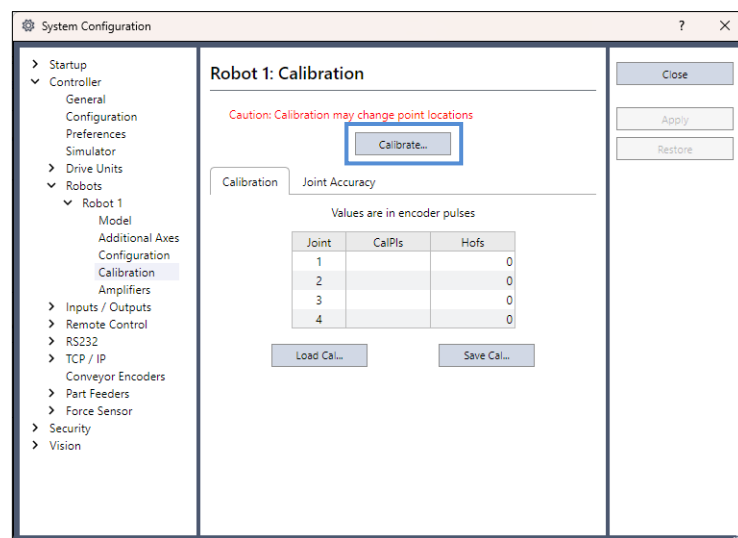
I. Select EPSON RC+ menu - [Setup] - [System Configuration].

II. Select [Robots] - [Robot**] - [Calibration].

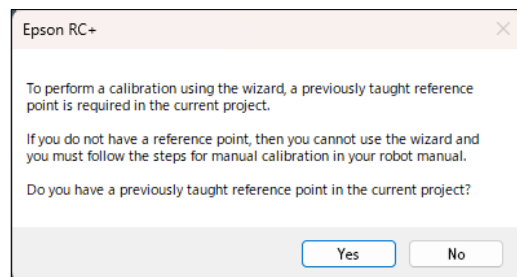
NOTE

Only selected robot can be calibrated.

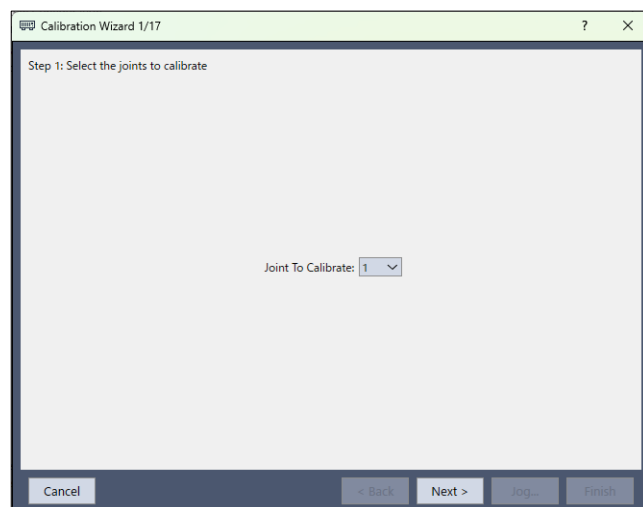
III. Click the <Calibrate...> button.



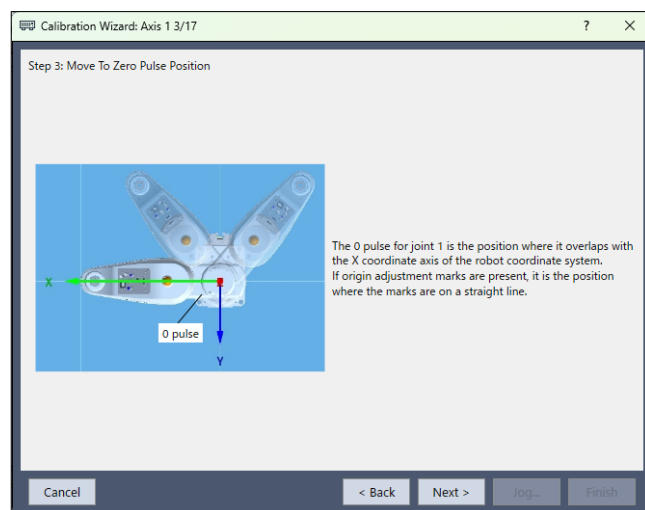
- (2) Confirm the warning message and click the <Yes> button.



- (3) Select the joint.

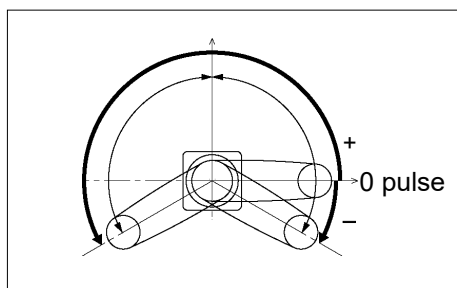


- (4) Move the joint to calibrate manually to approximate 0 pulse position, as shown in the dialog. After moving the joint click the <Next> button.



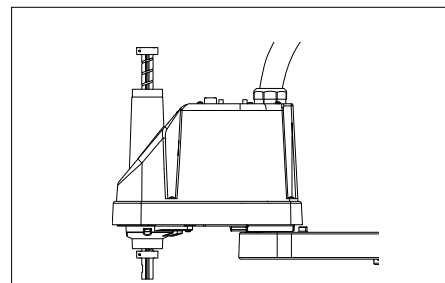
0 pulse position of Joint #1

Position aligned with X-axis in Robot coordinate system

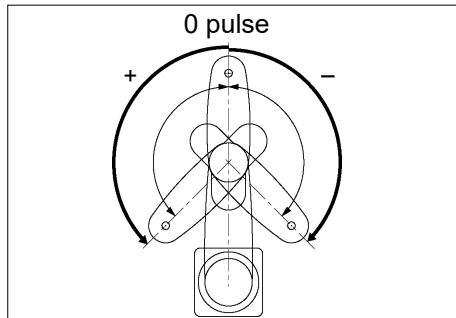


0 pulse position of Joint #3

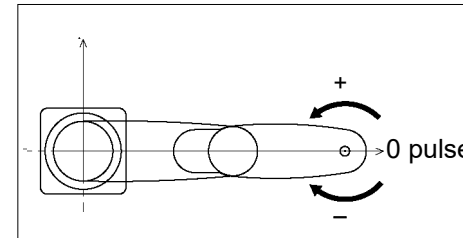
Upper limit position in motion range



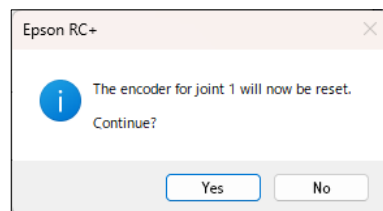
0 pulse position of Joint #2

Position where Arm1 and Arm2 are in a straight line
(Regardless of the Joint #1 direction.)

0 pulse position of Joint #4

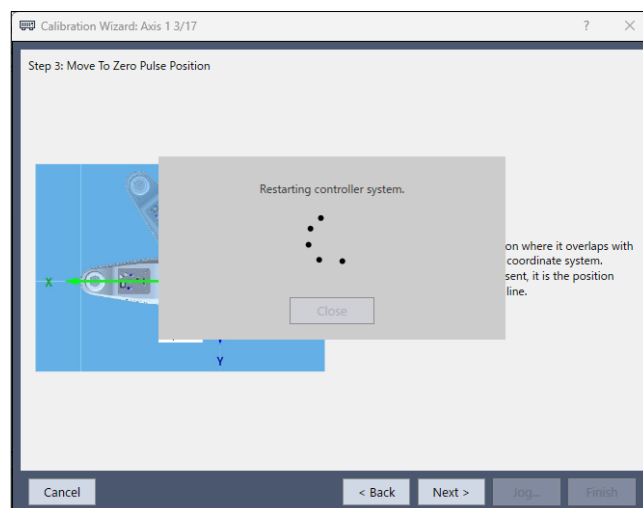
Position where the D-Cut on the shaft faces toward the tip
of Arm2**NOTE**For details on the 0-pulse position, refer to [3.2.5 0-Pulse Position of Each Joint](#).

- (5) Reset the encoder. Click the <Yes> button.



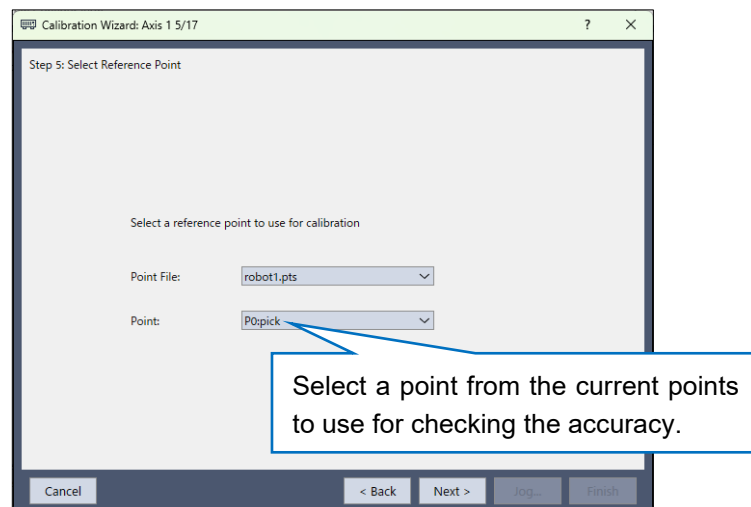
- (6) The Controller restarts.

* This window will disappear when the Controller starts up.

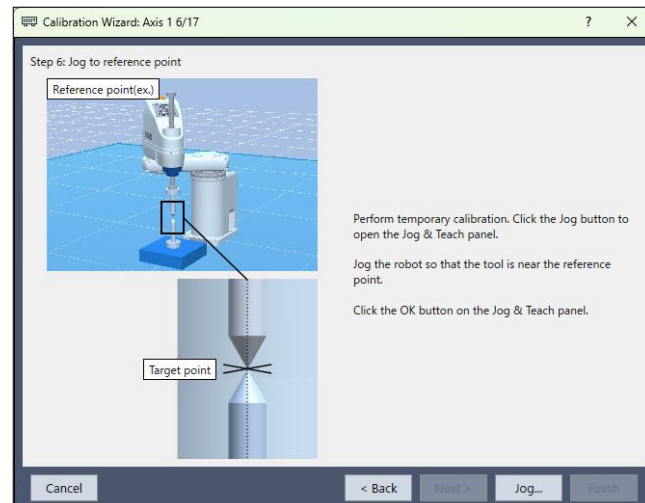
**NOTE**

- Warning 590 (Detect the different of the calibration settings in the controller and Safety Board) occurs when calibration settings in the controller are updated.
- Warning 590 is cleared by updating the Hofs value in the safety board after completing calibration. Step (20)

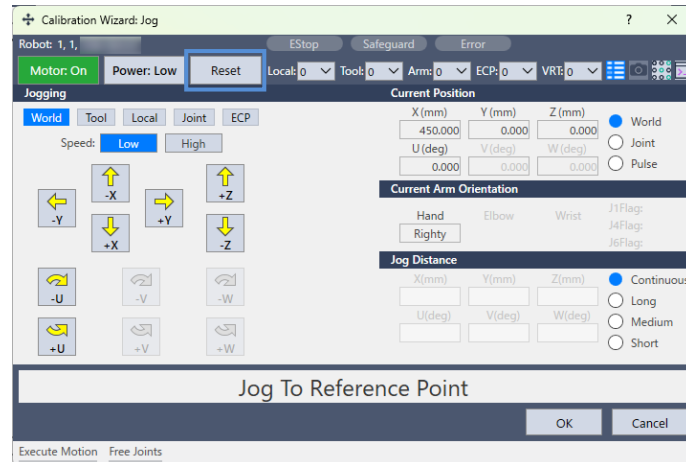
- (7) Select the reference point to use for calibration, and click the <Next> button.



- (8) Jog the end effector to approximate reference point for rough calibration. Click the <Jog> button.

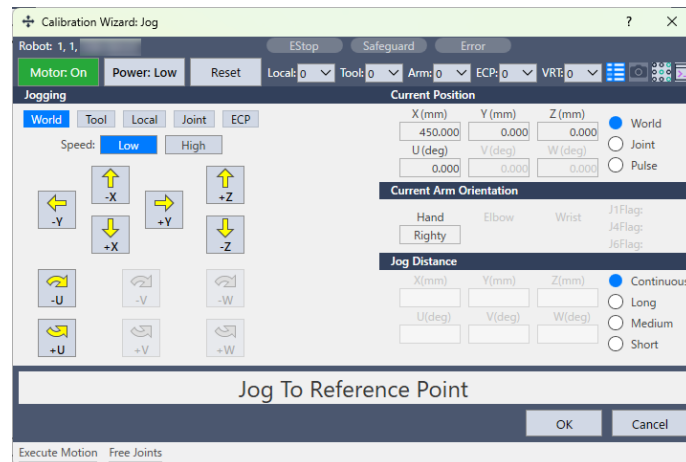


- (9) Open the [Control Panel] tab and execute <Reset> to clear an error related to the safety board.

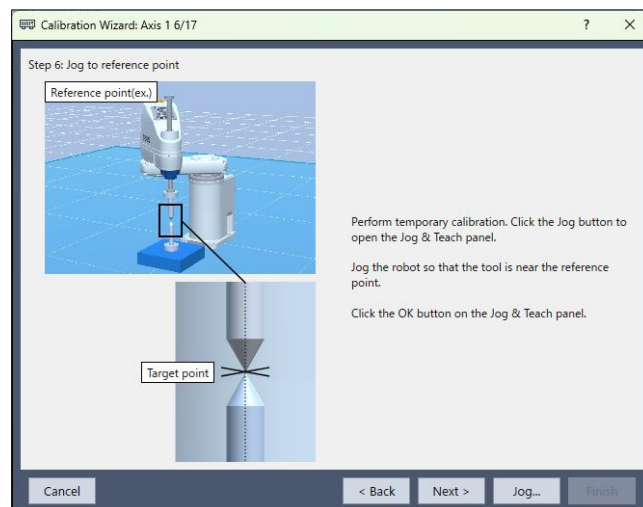


- (10) Click the <Motor: Off> button to turn on the motors.

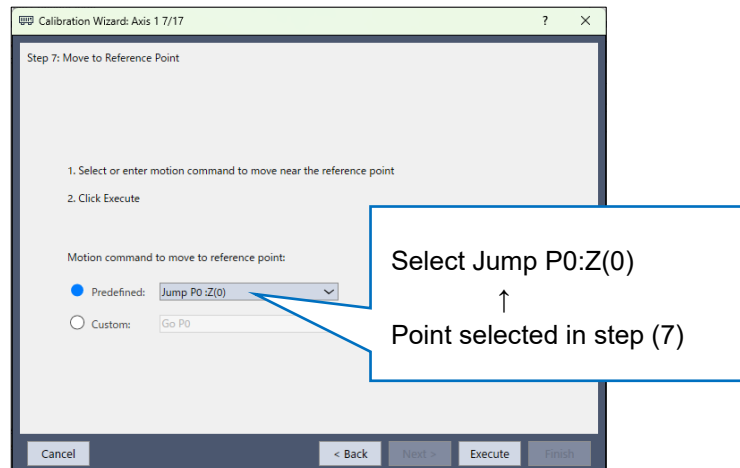
Jog the end effector to approximate reference point in the [Jog & Teach] dialog and then click the <OK> button.



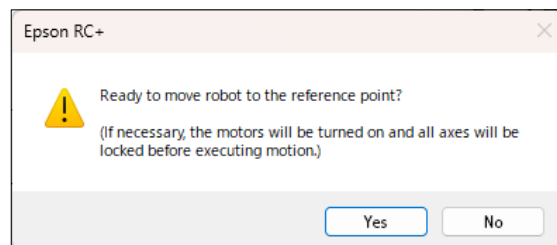
(11) Click the <Next> button.



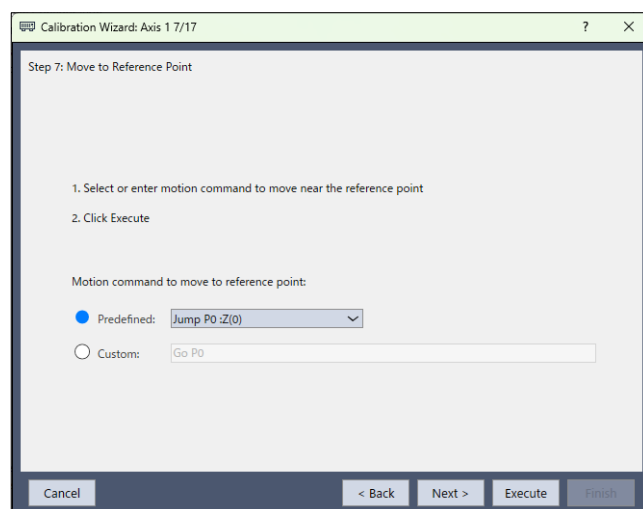
(12) The Manipulator moves to the reference point. Click the <Execute> button.



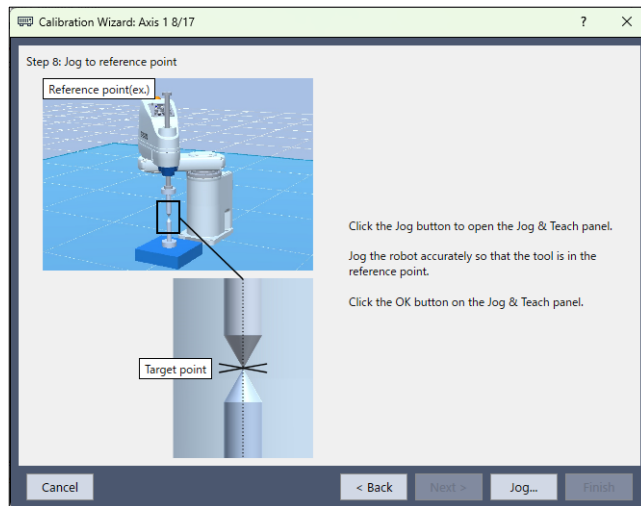
(13) Confirm the message and click the <Yes> button.



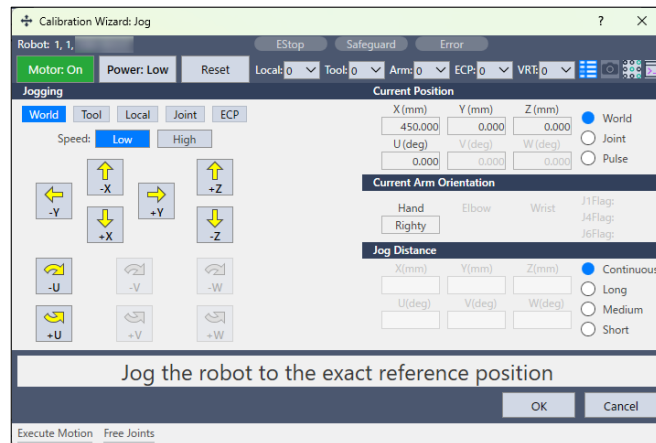
(14) After the Manipulator moves to the reference point, click the <Next> button.



(15) Jog to the accurate reference position. Click the <Jog> button.

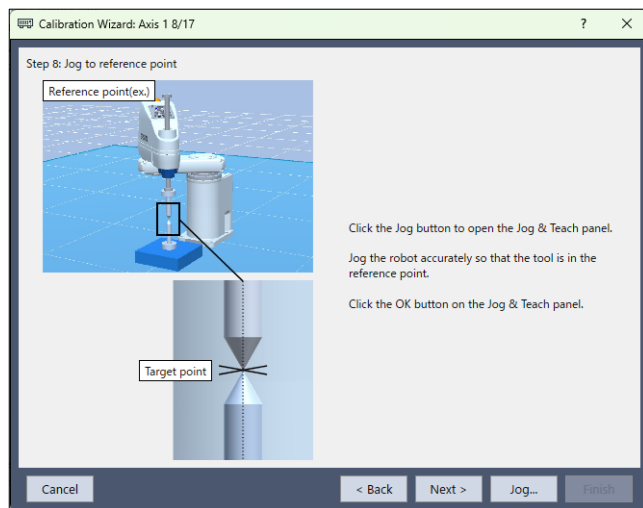


(16) Jog to the accurate reference position and adjust the position. Click the <OK> button.



* In the case of the J2, the arm posture changes significantly with the next movement. After setting to the accurate reference position, raise the J3 to around 0 pulse position to avoid interference with the surroundings.

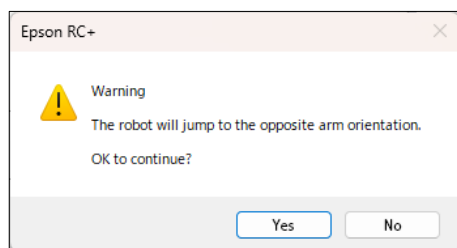
(17) Click the <Next> button.



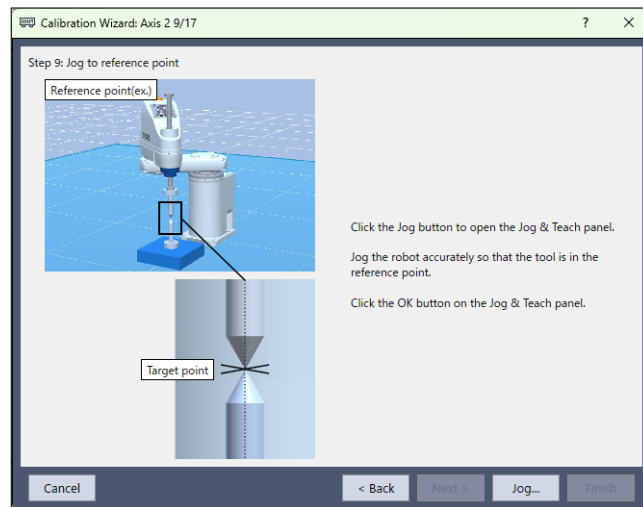
(18) Execute the procedure in "Calibration Using Right / Left Arm Orientations" to accurately calibrate Joint #2 only.

* Go on to the step (19) for the other joints calibration.

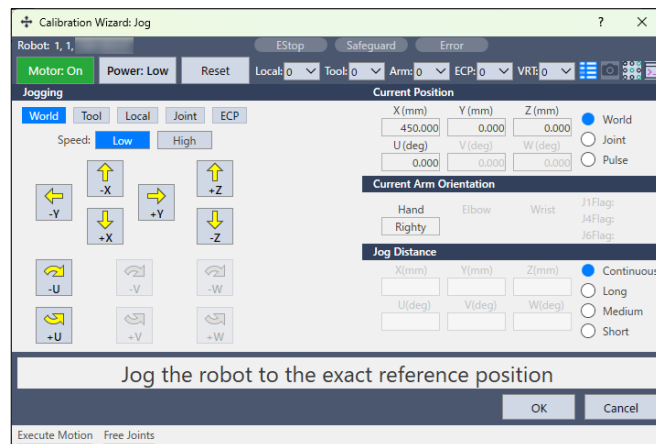
- I. Move to another point that has different pose (from righty to lefty) using Jump command.
Click the <Yes> button.



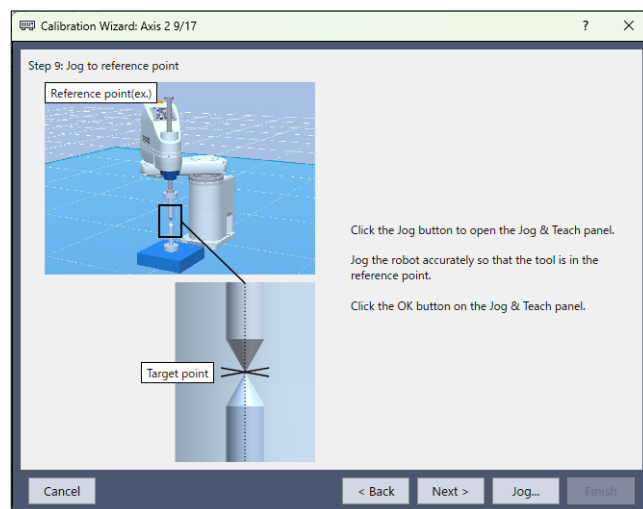
- II. Jog to the accurate reference position. Click the <Jog> button.



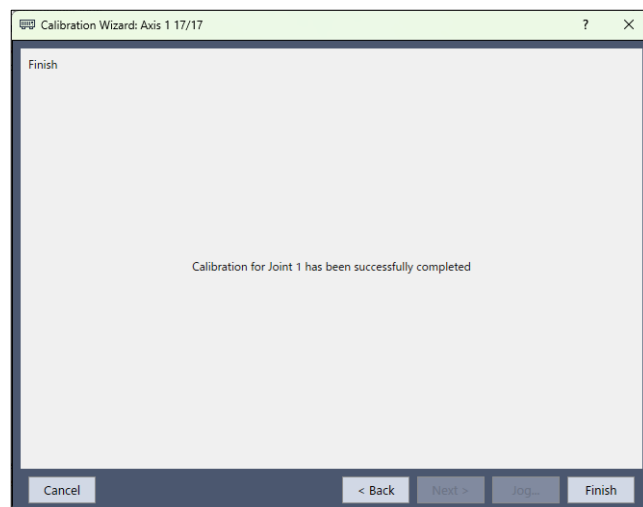
- III. Jog to the accurate reference position and adjust the position. Click the <OK> button.



IV. Click the <Next> button.

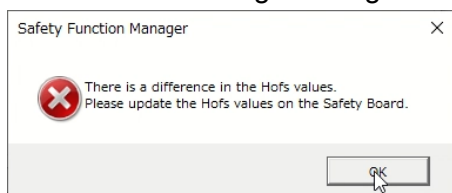


(19) Calibration is complete. Click the <Finish> button.

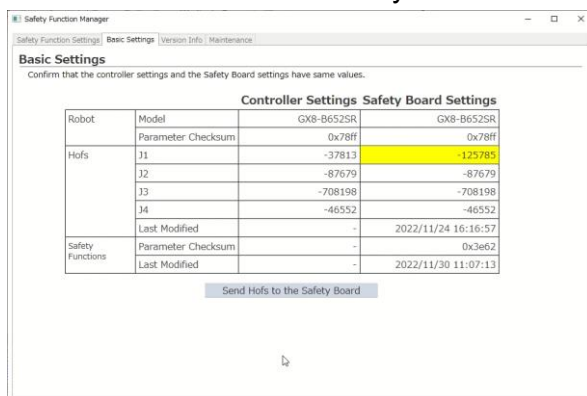


(20) Send the Hofs value to the safety board.

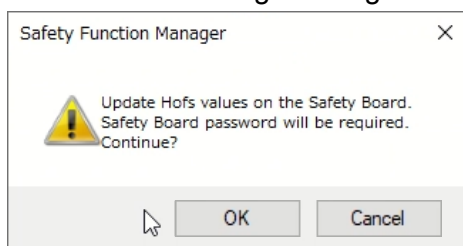
- I. Confirm the warning message and click the <OK> button.



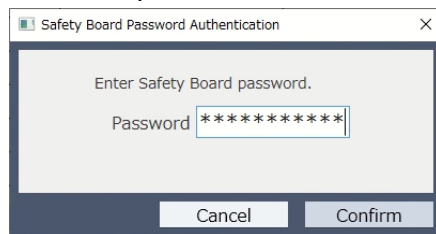
- II. Click <Send Hofs to the Safety Board> button.



- III. Confirm the warning message and click the <OK> button.

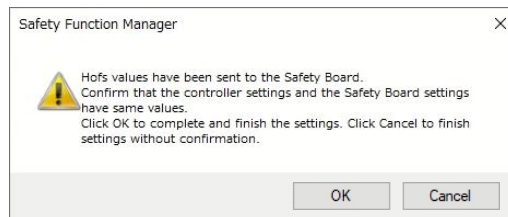


IV. Enter the password and click <Confirm> button.

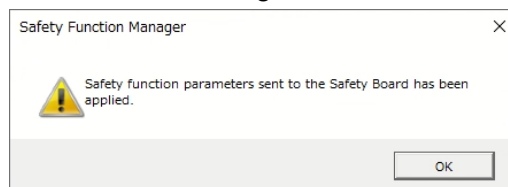
**NOTE**

Contact your robot safety manager for the Safety Board password.

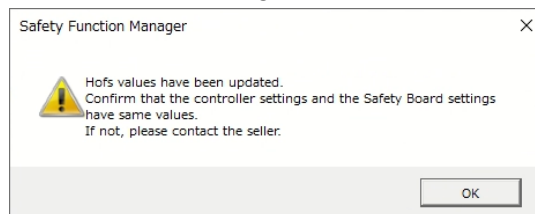
V. Confirm the warning message and click the <OK> button.



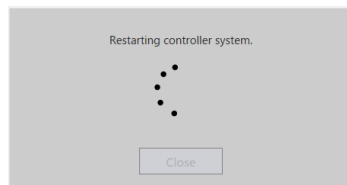
VI. Confirm the message and click the <OK> button.



VII. Confirm the message and click the <OK> button.



VIII. The Controller restarts.



- (21) Move the Manipulator to other points and check if it can move without problems.
Teach points where appropriate.

Accurate Calibration of Joint #2

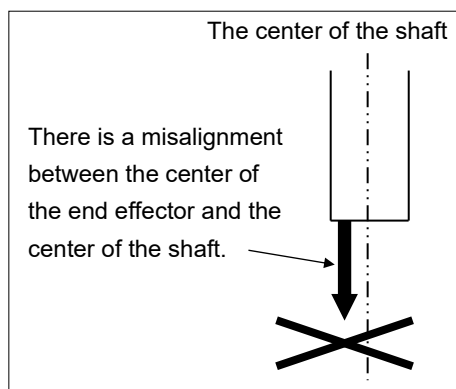
When coordinates for the Manipulator working point require calculation, it is important for Joint #2 to be calibrated accurately.

NOTE

If the calibration of Joint #2 is performed in [Calibration Procedure without Using Calibration Wizard](#), configure “Calibration Using Right / Left Arm Orientations” by the wizard.

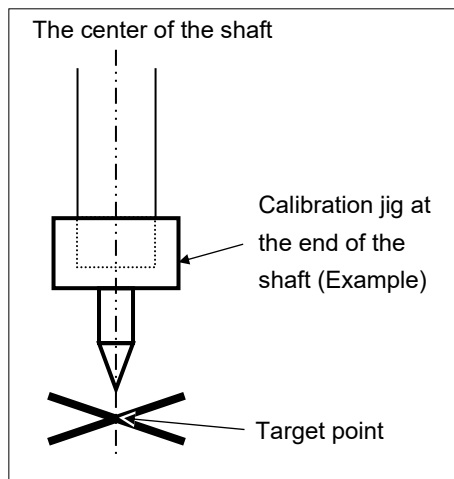
The reference point is the center of the Ball Screw Spline shaft during this calibration.

When there is a misalignment between the center of the end effector and the center of the Ball Screw Spline shaft, remove the end effector and perform the calibration of the shaft.



Make a calibration jig as shown in the right figure and attach it on the end of the shaft to make the center of the shaft clear.

Decide a target point and mark a cross (×) on it so that you can easily verify the center of the shaft after switching the arm pose between right and left.



After removing the end effector and performing the calibration, install the end effector and move the Manipulator to the teaching point to verify whether there is a positional gap. If there is a positional gap, fine-tune the installation position of the end effector and teach the point again.

Coordinates for the working point requires calculation in the following cases:

- Teaching the working point by entering the coordinate values (MDI teaching)
- Switching the arm orientation between right and left at a given point
- Using the Pallet command
- Executing CP control (such as linear or circular interpolation)
- Using the Local command
- Pose data specified with relative coordinates <Example: P1+X(100) >
- Vision Guide camera calibrations

Calibration Using Right / Left Arm Orientations

- (1) Check the point data for calibration

Use a pose (point) you can easily verify the accuracy within the work envelop of both right and left arm. Then, check the number of pose (point) you want to use.

- (2) Open the Tools menu | Robot Manager and click the <Motor: Off> button.

- (3) Click the <Free All> button in the [Jog & Teach]-[Free Joints] to free all joints. Now, you can move arms by hands.

- (4) Move the arms to the position of point data for calibration in rightly arm orientation.

- (5) From the current position, teach any point data number unused.

This point is now called P1.

Specify the point number "1" and click the <Teach> button in [Jog & Teach].

- (6) Click the <Lock All> button in the [Jog & Teach]-[Free Joints] to lock all the joints.

- (7) Switch to the lefty arm orientation. Then, move the arm to the same point.

`>Jump P1/L : Z (0)` ' Change the arm orientation from righty to lefty, Z is the maximum position

* If there is interference on the way from right to lefty, click the [Free All] button in the [Jog & Teach]-[Free Joints] and change the arm orientation to lefty by hands. Then, go to the step (6), (7).

- (8) The joints are slightly out of position.

Adjust the gap with the -Z in the Jogging group in the [Jog & Teach]. Then, teach another point data number unused.

This point is now called P2.

Specify the point number "2" and click the <Teach> button in [Jog & Teach].

- (9) Input the new Hofs value.

```
>Hofs Hofs (1), Hofs (2) + (Ppls(P1,2) + Ppls(P2,2)) / 2, Hofs(3), Hofs(4)
```

NOTE

- Warning 590 (Detect the different of the calibration settings in the controller and Safety Board) occurs when the Hofs command are executed.
- Warning 590 is cleared by updating the Hofs value in the safety board.

- (10) From the current lefty arm orientation (the position in the step (8)), teach the point data number used in the step (8).

This point is now called P2.

Specify the point number "2" and click the <Teach> button in [Jog & Teach].

- (11) Switch to the righty arm orientation. Then, make sure the Manipulator moves to the correct position.

```
>Jump P2/R ' Change the arm orientation from lefty to righty
```

* If there is any interference on the way from lefty to righty, click the [Free All] button in the [Jog & Teach]-[Free Joints] and change the arm orientation to righty by hands. Then, go to the step (6), (11).

- (12) Move the Manipulator to other point data and make sure it moves to the correct position.

Teach some more points if required.

* Delete the two points taught for the Joint #2 calibration.

Calibration Procedure without Using Calibration Wizard

NOTE

This section indicates the calibration without using the calibration wizard of EPSON RC+.
For details of calibration using the calibration wizard, refer to [Implementing Calibration using the Wizard](#).

Follow steps (1) to (6) described below in order to calibrate the origin.

(1) Basic Pose Confirmation

For details, refer to [3.2.4 Preparation](#).

(2) Part Replacement

Replace parts as dictated by this manual.

* Be careful not to injure yourself or damage parts during part replacement.

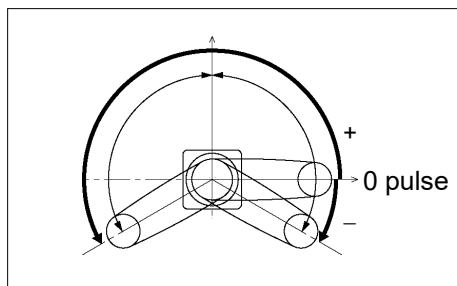
(3) Encoder Initialization

I. Turn ON the Controller when all joints are in the motion range.

II. Manually move the joint that needs origin alignment to its approximate 0 pulse position.

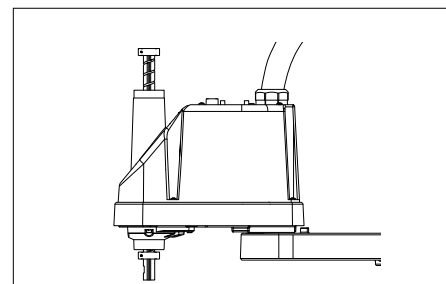
0 pulse position of Joint #1

Position aligned with X-axis in Robot coordinate system



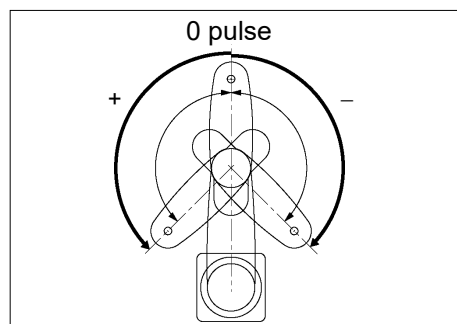
0 pulse position of Joint #3

Upper limit position in motion range



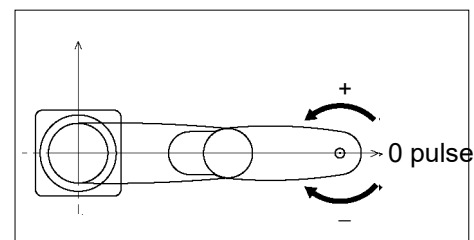
0 pulse position of Joint #2

Position where Arm1 and Arm2 are in a straight line
(Regardless of the Joint #1 direction.)



0 pulse position of Joint #4

Position where the D-Cut on the shaft faces toward the tip of Arm2



NOTE

For details on the 0-pulse position, refer to [3.2.5 0-Pulse Position of Each Joint](#).

III. Connect EPSON RC+ to the Controller.

Start the Command Window.

Menu -[Tools] -[Command Window]

Select the robot to be calibrated. Enter and execute the following command in [Command Window].

(This example uses “robot 1”.)

```
> robot 1
```

IV. Execute the absolute encoder initialization command.

Enter and execute one of the following commands in [Command Window] according to the joint being calibrated.

Joint #1 : >EncReset 1

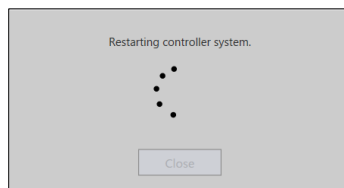
Joint #2 : >EncReset 2

Joint #3 : >EncReset 3

Joint #4 : >EncReset 3, 4

V. Reboot the Controller.

Select EPSON RC+ menu- [Tools] - [Controller] and click the <Reset Controller> button.



This window will disappear when the Controller starts up.

(4) Rough Calibration

- I. Execute the following command from the menu -[Tools] - [Command Window].

```
>calpls 0,0,0,0
```

* Manipulator does not move.

- II. Execute one of the following commands according to the joint you want to calibrate from the menu - [Tools] - [Command Window].

Joint #1 : >Calib 1

Joint #2 : >Calib 2

Joint #3 : >Calib 3

Joint #4 : >Calib 3, 4

NOTE

- Warning 590 (Detect the different of the calibration settings in the controller and Safety Board) occurs when the Calib command are executed.
- Warning 590 is cleared by updating the Hofs value in the safety board.

(5) Calibration (Accurate Positioning)

- I. Reboot the Controller.

Select EPSON RC+ menu - [Tools] - [Controller] and click the <Reset Controller> button.

- II. Click [Control Panel] - <Free All> button to free all joints. Now, you can move arms by hands.

- III. Move the Manipulator by hand to a rough position/posture of the calibration point data.

IV. Create the data from the calibration point data.

Enter and execute the following command in [Command Window].

(In this example, **P1** is used as the calibration point data.)

```
> Calpls Ppls (P1,1), Ppls (P1,2), Ppls (P1,3), Ppls (P1,4)
```

V. Move the joint to the specified point using a motion command.

For example, when the specified point data is "P1", execute "Jump P1:Z(0)" from [Jog & Teach].

* The joint NOT being calibrated moves to the original position.

VI. Accurately align the joint* being calibrated to the specified point using jog commands.

* You must move Joint #3 and #4 to the position when calibrating Joint #4.

Select the jog mode [Joint] from [Jog & Teach] to execute the jog motion.

VII. Execute the calibration.

Enter and execute one of the following commands in [Command Window] according to the joint being calibrated.

Joint #1 : >Calib 1

Joint #2 : >Calib 2

Joint #3 : >Calib 3

Joint #4 : >Calib 3, 4

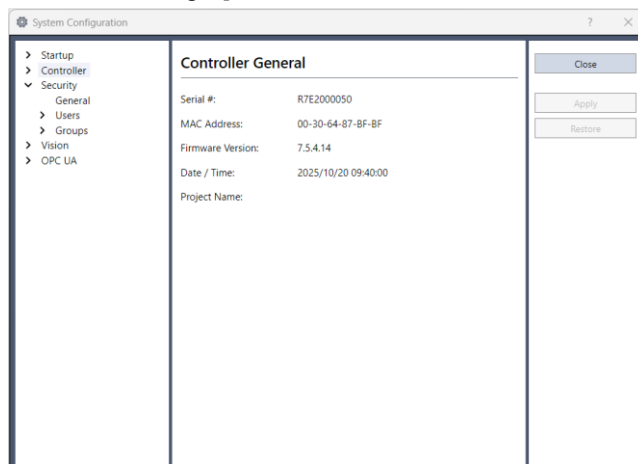
(6) Accurate Calibration of Joint #2

Perform accurate calibration for Joint #2 with reference to [Accurate Calibration of Joint #2](#).

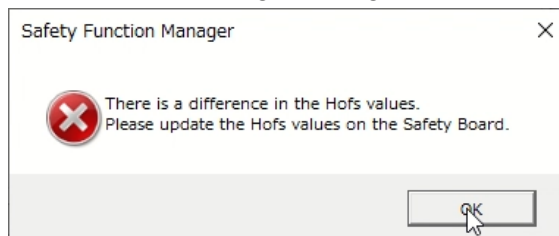
(7) Send Hofs to Safety board

Send the Hofs value to the safety board.

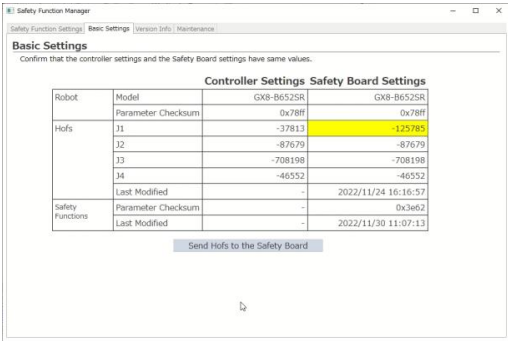
- I. In EPSON RC+, select [Setup] - [System Configuration], and then under [Controller] - [Safety Functions], click [Safety Function Manager].



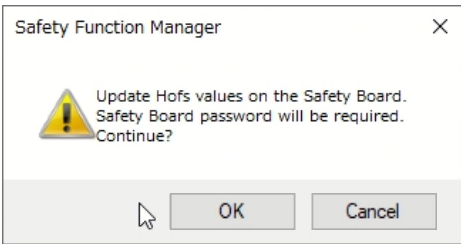
- II. Confirm the warning message and click the <OK> button.



III. Click <Send Hofs to the Safety Board> button.

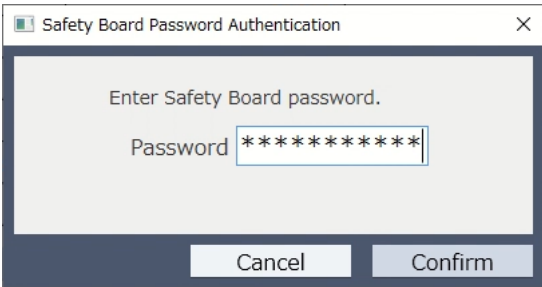


IV. Confirm the warning message and click the <OK> button.

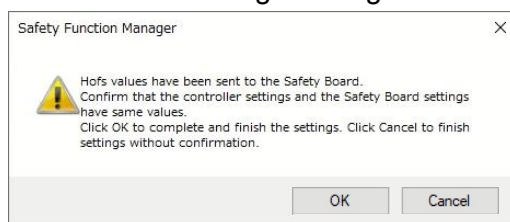


V. Enter the password and click <Confirm> button.

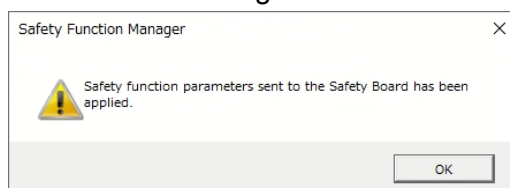
NOTE Contact your robot safety manager for the Safety Board password.



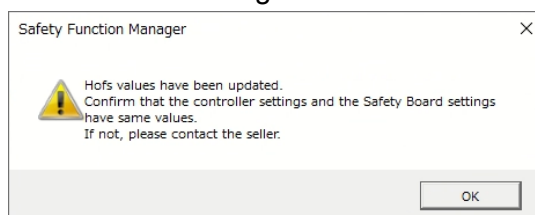
VI. Confirm the warning message and click the <OK> button.



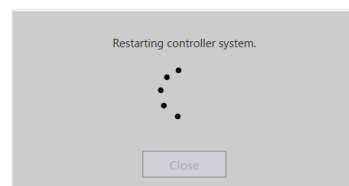
VII. Confirm the message and click the <OK> button.



VIII. Confirm the message and click the <OK> button.



IX. The Controller restarts.



(8) Accuracy Testing

Move the Manipulator to another point to confirm that it moves to the same position. If it does not move to the same position, recalibrate using another point. You must set the point again if reproducibility cannot be assured through calibration.

Calibration Procedure Using Mechanical Stopper

NOTE

This section describes the calibration procedure using a mechanical stopper.

To use this method, point data at the mechanical stopper position obtained in advance by the user is required.

For information on how to obtain the point data, refer to “Procedure for Acquiring Point Data at the Mechanical Stopper Position” in “ROBOT CONTROLLER RC800-A Manual”.

Perform the calibration according to the following steps (1) through (3).

(1) Perform steps (1) through (5) II. in [“Calibration Procedure without Using Calibration Wizard”](#).

(2) Calibration Using Mechanical Stopper

I. Move each joint by hand to the posture where it contacts the mechanical stopper, based on the pre-taught point.

Make sure that each joint is firmly pressed against the mechanical stopper.

Since J4 does not have a mechanical stopper, align it to the 0 pulse position or to the arbitrary position determined by the user when acquiring the point data in advance.

* Make sure the motor is turned off, and perform the work with sufficient attention to safety.

II. Create the data from the calibration point data.

Enter and execute the following command in [Command Window].

(In this example, P1 is used as the calibration point data.)

```
> Calpls Ppls(P1,1), Ppls(P1,2), Ppls(P1,3), Ppls(P1,4)
```

III. Execute the calibration.

Enter and execute one of the following commands in [Command Window] according to the joint being calibrated.

Joint #1 : >Calib 1

Joint #2 : >Calib 2

Joint #3 : >Calib 3

Joint #4 : >Calib 3, 4

IV. Move each joint into the operating area.

* Since the posture in contact with the mechanical stopper is outside the operating area, an error will occur if you try to operate it as is.

- (3) Perform steps (6) through (8) in "[Calibration Procedure without Using Calibration Wizard](#)".

3.2.7 Verification

RC800L is required to verifying the safety function after completing calibration.

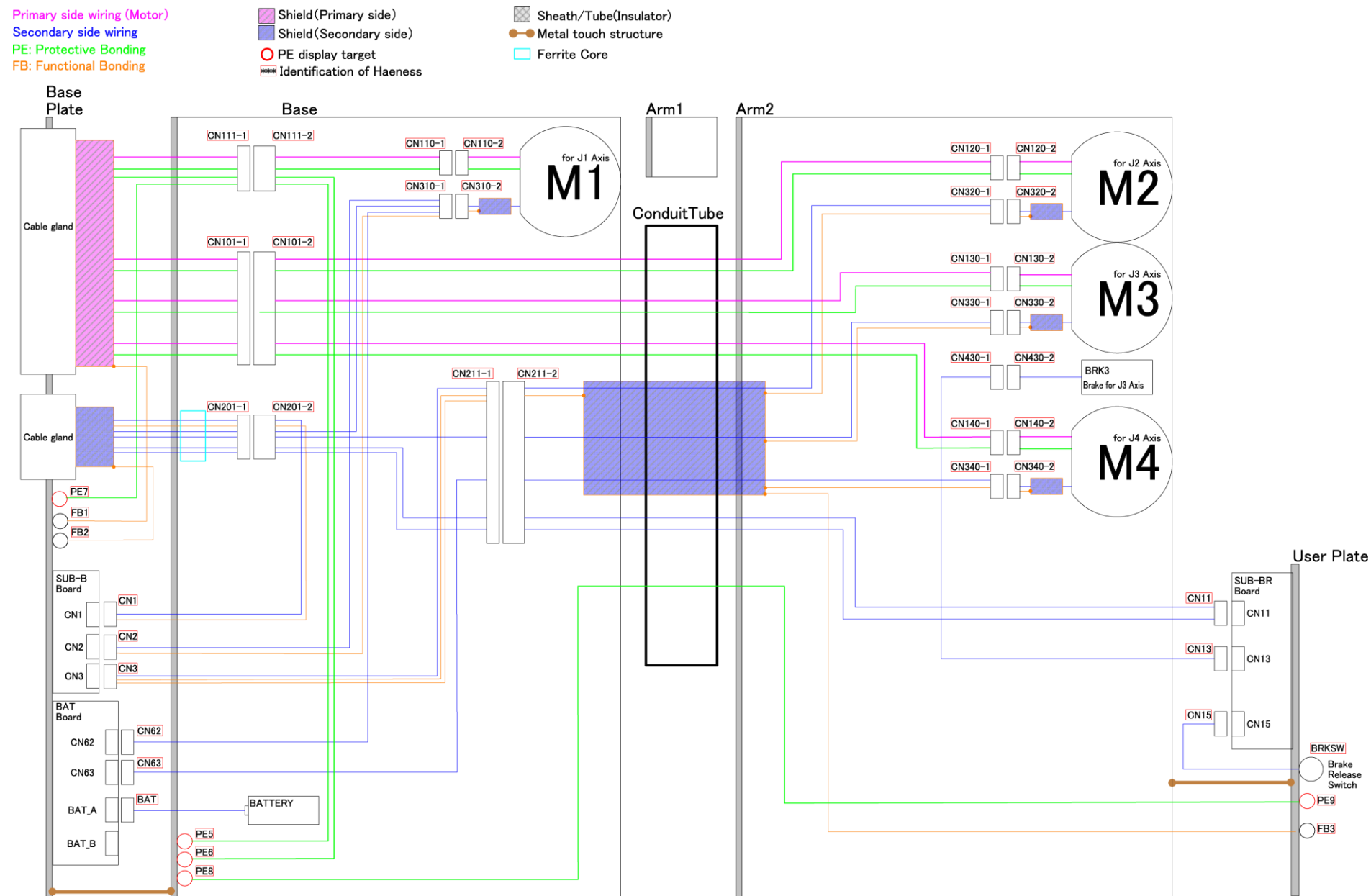
For details on the verification procedure, refer to “RC800L Series Service Manual 3.6 Verifying Safety board operation”.

CHAPTER

4

Block Diagram

4.1 Block Diagram



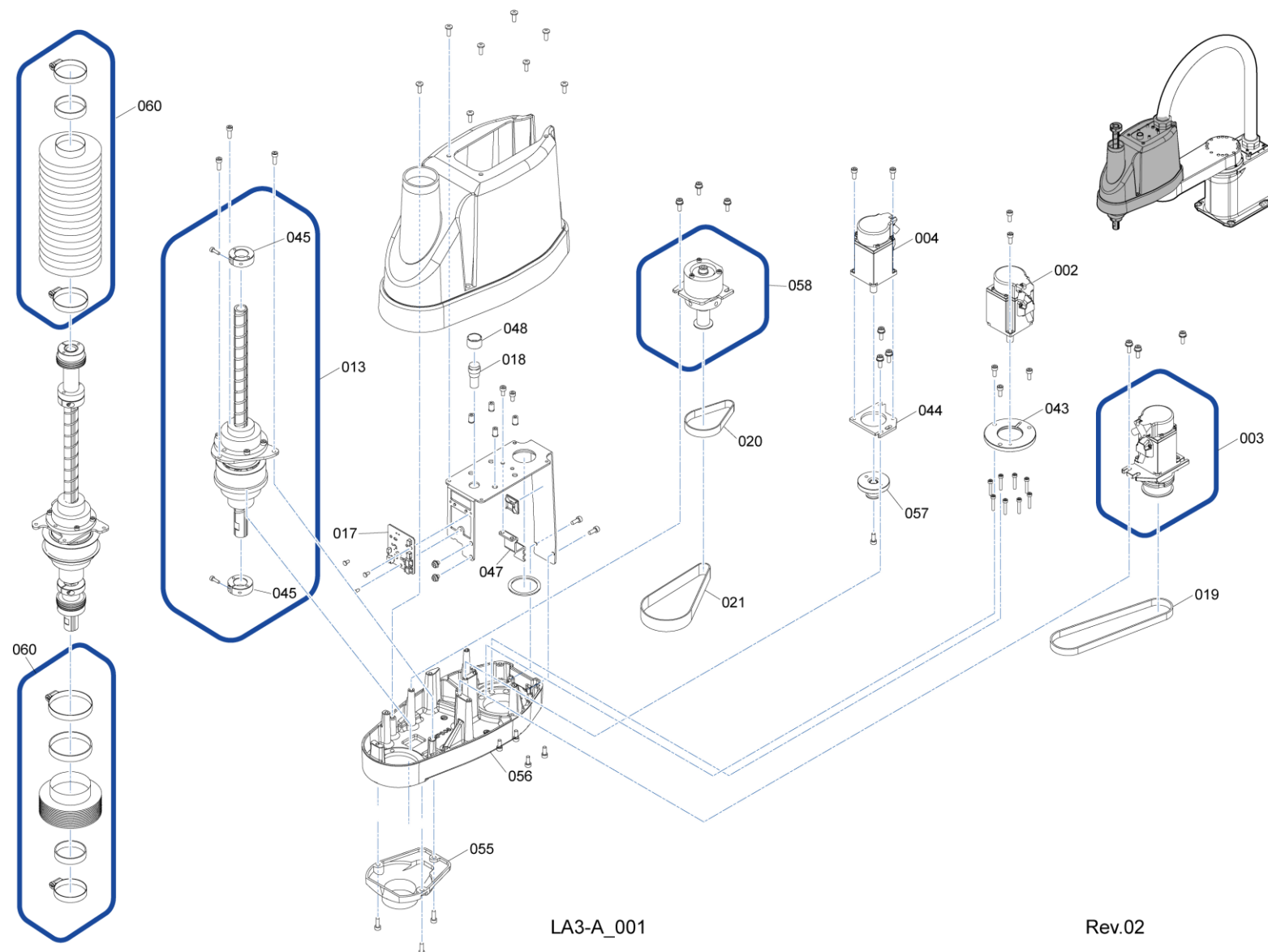
CHAPTER

5

Exploded View/Maintenance Parts List

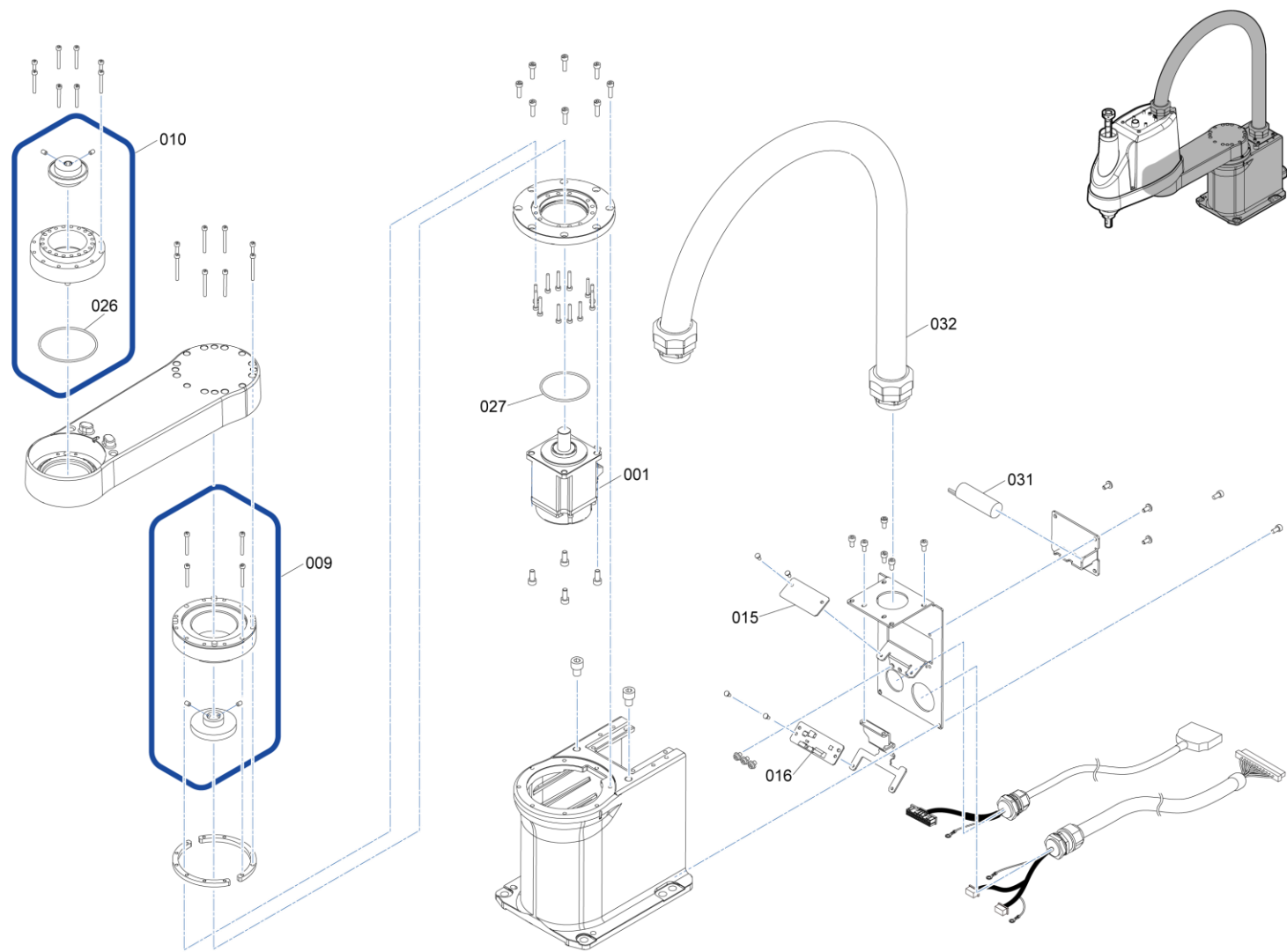
5.1 Exploded View

5.1.1 LA3-A



LA3-A_001

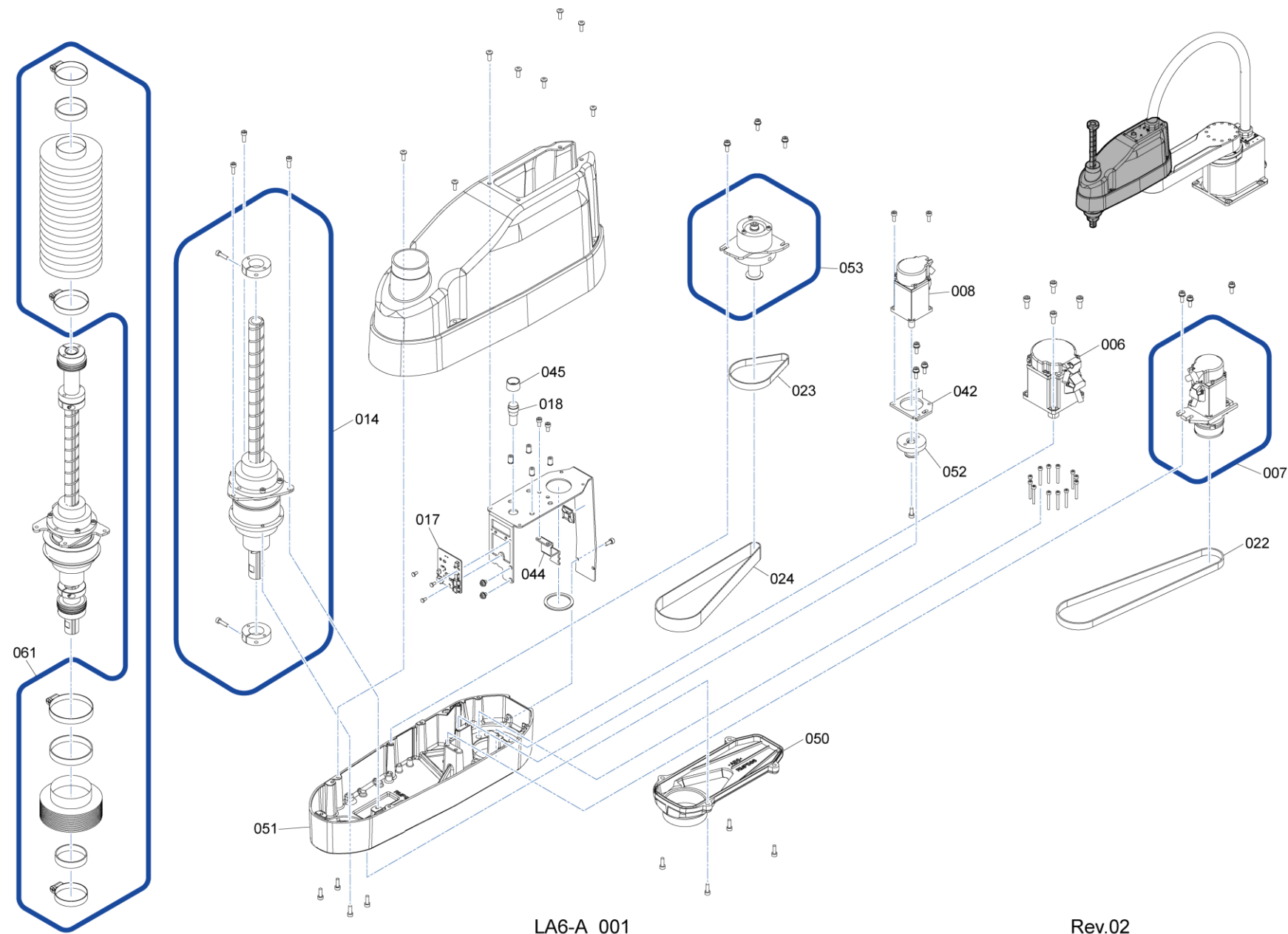
Rev.02



LA3-A_002

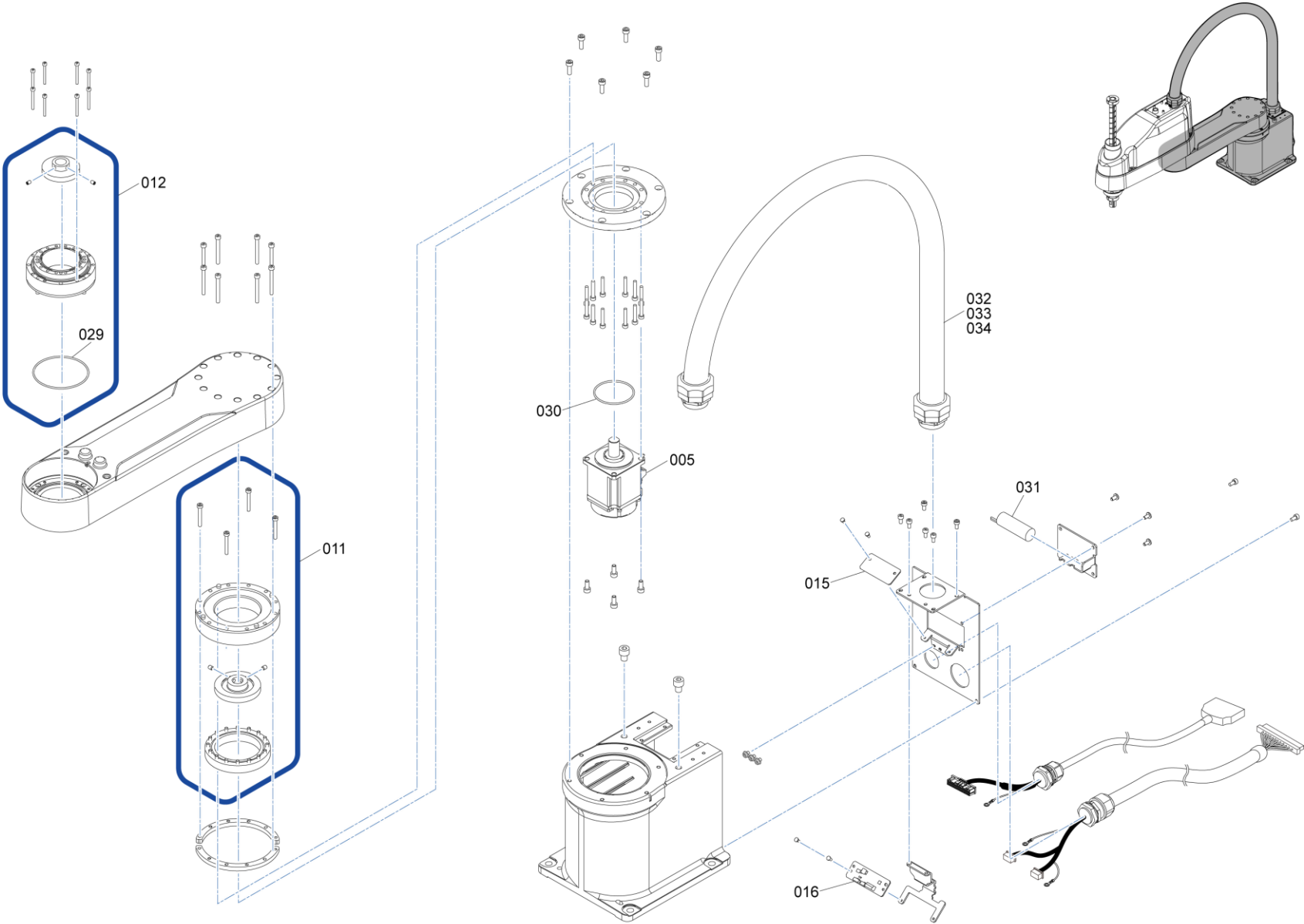
Rev.01

5.1.2 LA6-A



LA6-A_001

Rev.02



LA6-A_002

Rev.01

5.2 Maintenance Parts List

Ref. No.	Parts Name	Location		Parts Code	Note	Overhaul
001	AC Servo Motor Unit	LA3-A	Joint #1	2240108	200W	√
002			Joint #2	2240109	100W	√
003			Joint #3	2240110	100W	√
004			Joint #4	2240111	100W	√
005		LA6-A	Joint #1	2240108	200W	√
006			Joint #2	2240114	200W	√
007			Joint #3	2240115	100W	√
008			Joint #4	2240111	100W	√
009	Reduction Gears	LA3-A	Joint #1	1958369		√
010			Joint #2	1958368		√
011		LA6-A	Joint #1	1958372		√
012			Joint #2	1958369		√
013	Ball Screw Spline Unit	LA3-A		1965517		√
014		LA6-A		1965532		√
015	Battery Board	LA3-A / LA6-A		2240120		
016	SUB-B Board	LA3-A / LA6-A		2240974		
017	Overexcitation Power Supply Board	LA3-A / LA6-A		2236308		
018	Brake Release Switch	LA3-A / LA6-A		2235267		
019	Timing Belt	LA3-A	Joint #3	1554773	Z	√
020			Joint #4	1957967	U1	√
021				1957968	U2	√
022		LA6-A	Joint #3	1563316	Z	√
023			Joint #4	1958210	U1	√
024				1958211	U2	√

Ref. No.	Parts Name	Location		Parts Code	Note	Overhaul
026	O-ring	LA3-A	J2 Reduction Gear	1290323		√
027			For Joint #1 Motor	1520371		√
029		LA6-A	J2 Reduction Gear	1618361		√
030			For Joint #1 Motor	1520371		√
031	Battery (lithium battery)	RAMWAY		2245652	ER17505	
032	Cable Unit	LA3-A401S / LA6-A502S		2240040		√
033		LA6-A602S		2240041		√
034		LA6-A702S		2240042		√
		LA3-A401C / LA6-A502C		2244072		√
		LA6-A602C		2244074		√
		LA6-A702C		2244076		√
		LA3-A401S-C1 / LA6-A502S-C1		2245951		√
		LA6-A602S-C1		2245952		√
		LA6-A702S-C1		2245953		√
		LA3-A401C-C1 / LA6-A502C-C1		2244073		√
		LA6-A602C-C1		2244075		√
		LA6-A702C-C1		2244077		√
060	Bellows	LA3-A		1512293	1 piece/set	
061		LA6-A		1564795	2 pieces/set	