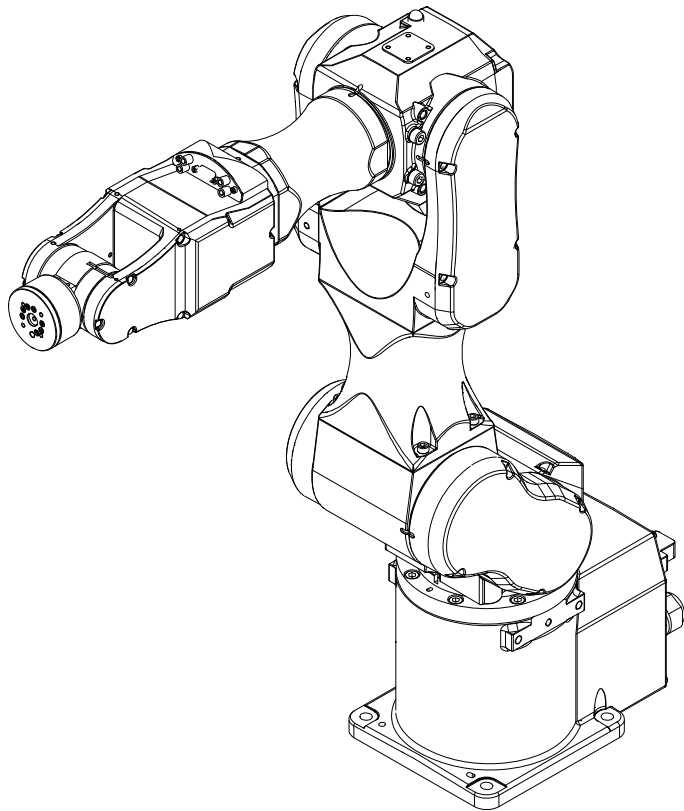


EPSON



6-Axis Robots

C4-B

Service Manual

Rev.1

ENSM237C0021

Disclosure Scope: Maintenance Trained Personnel Only

CAUTION

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- Please note that even after the establishment of this service manual, changes may be made in the mechanism or parts of the product with the purpose of improving the quality and functions. Therefore, the contents described here may not match the actual product.
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Revision History

If, even after the establishment and issue of the first edition of this manual, changes are made in the mechanism or parts of the product with the purpose of improving the performance and reliability, revised editions shall be issued as necessary. Always use this manual after ensuring that it is the latest version.

Revision	Date	Change Location	Change Contents
Rev.1	January 26, 2024	All pages	First edition

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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	<ul style="list-style-type: none">● 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, disconnect the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source.● Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.● When maintaining the manipulator, wear at least the following protective gear. Working without protective gear may cause serious safety problems.<ul style="list-style-type: none">· 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	-	-	-	-	-	√

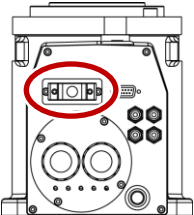
1.2.2 Inspection Point

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 either the external short connector or the brake release unit connector is connected.	The external short connector on the back side of the Manipulator, or the brake release unit connector.	√	√	√	√	√
Check the Brake operation	Joint #1 to 6 break	√	√	√	√	√
Check whether unusual sound or vibration occurs.	Whole	√	√	√	√	√

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.

Inspection Point	Inspection Method
Check for bends or improper location. Repair or place it properly if necessary.	Check that the safeguard, etc. are located properly. If the location is improper, place it properly.
Check either the external short connector or the brake release unit connector is connected.	Check whether external short connector or break release connector is connected. When neither is connected, connect either one. <div data-bbox="770 424 963 639" style="text-align: center;">  </div>
Check the Brake operation	Check that the arm does not fall when in MOTOR OFF. If the arm falls when in MOTOR OFF and the brake is not released, contact the supplier.
Check whether unusual sound or vibration occurs.	Check that there is no unusual sound or vibration when operating. If there is something wrong, contact the supplier.

1.2.3 Overhaul (Parts Replacement)



- 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

For the EPSON RC+ 7.0 Ver. 7.2.x or later (firmware Ver.7.2.x.x or later), the recommended replacement time for the parts subject to maintenance (Motors, Reduction Gears, and Timing Belts) can be checked in the [Maintenance] dialog box of the EPSON RC+ 7.0.

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](#).

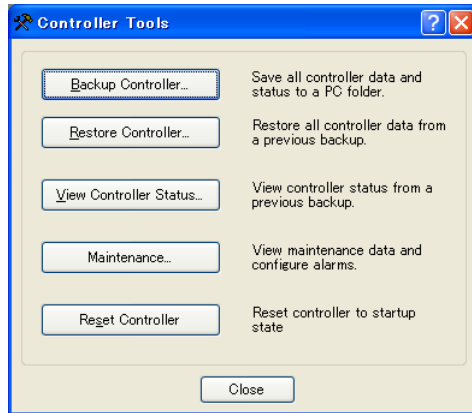
For details of replacement of each part, refer to [Chapter 2 Maintenance](#).

Please contact the supplier of your region for further information.

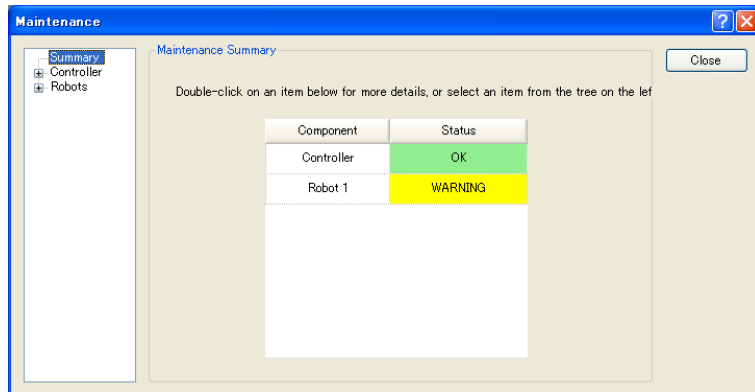
How to View the Maintenance Information

The configured maintenance information can be checked in the EPSON RC+ 7.0 Ver.7.2.x or later.

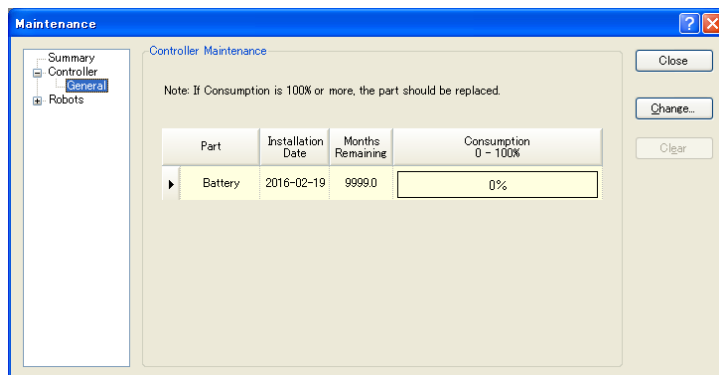
1. Select the EPSON RC+ 7.0 menu-[Tools]-[Maintenance] to display the [Controller Tools] dialog box.



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.



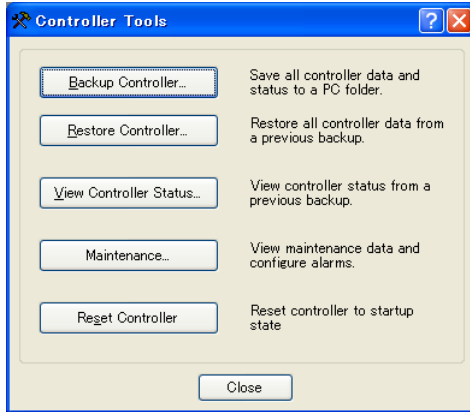
NOTE Remaining months is calculated based on the past operation conditions.

How to Edit the Maintenance Information

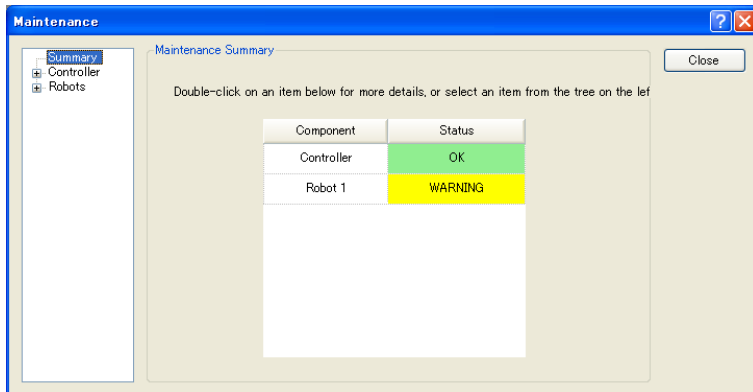
The configured maintenance information can be edited in the EPSON RC+ 7.0 Ver.7.2.x or later.

When replaced the parts subject to maintenance (Motors, Reduction Gears, and Timing Belts), please edit the Maintenance Information.

1. Select the EPSON RC+ 7.0 menu- [Tools] - [Maintenance] to display the [Controller Tools] dialog box.

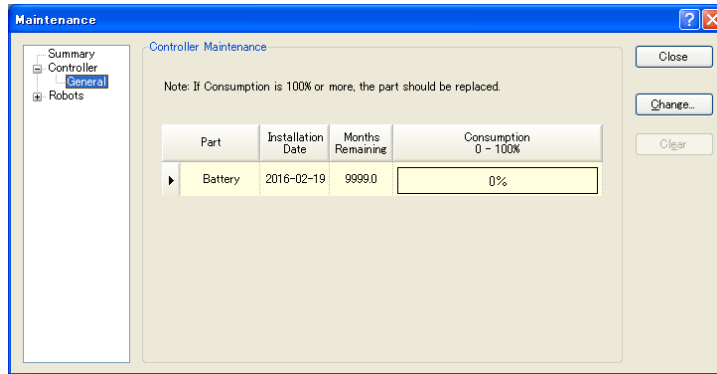


2. To edit the maintenance information, display the [Maintenance] dialog box.



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.

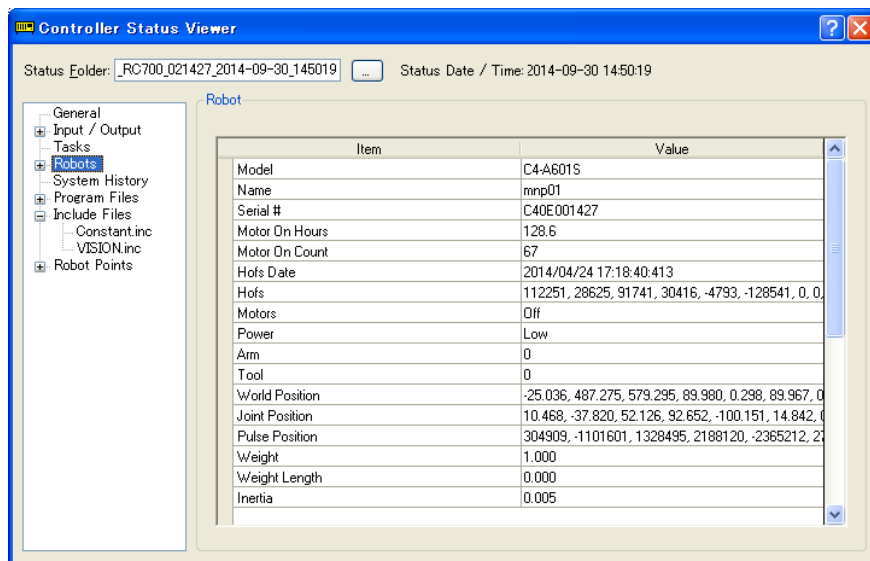


6. Click the <OK> button and change the specified alarm information.

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+ 7.0)



1.2.4 Greasing

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

 WARNING	<ul style="list-style-type: none"> ● Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
---	--

 CAUTION	<ul style="list-style-type: none"> ● 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. <ul style="list-style-type: none"> · 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.
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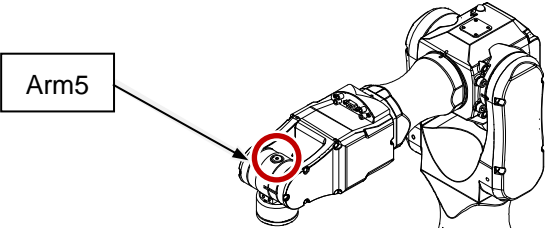
	Greasing part	Greasing Interval	Grease	Greasing method
Joint #1, 2, 3, 4	Reduction gear units	Overhaul timing	SK-1A	Refer to the following page. Joint #1: Installing the J1 Reduction Gear Unit Joint #2: Installing the J2 Reduction Gear Unit Joint #3: Installing the J3 Reduction Gear Unit Joint #4: Installing the J4 Reduction Gear Unit
Joint #5, 6			SK-2	Refer to the following page. Joint #5: Installing the J5 Reduction Gear Unit Joint #6: Installing the J6 Reduction Gear Unit
Joint # 6	Bevel gear	Overhaul timing	SK-2	Refer to the next page.

Joint #1, 2, 3, 4, 5, 6 reduction gear units

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

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

Joint #6 bevel gear

①	Remove the plug from Arm5. Removing the Arm5 O-ring Perform steps ① to ⑤.
②	Apply the grease.  SK-2: 2 g 
③	Insert the plug into Arm5. Installing the Arm5 O-ring Perform steps ② and ③.

1.2.5 Tools/Materials

Tools used

	Name	Quantity	Note
Hexagonal wrench	width across flats: 1.5 mm	1	For M3 hexagon socket head set screws
	width across flats: 2 mm	1	For M2.5 silver and black hexagon socket head cap screws, and for M4 hexagon socket head set screws
	width across flats: 2.5 mm	1	For M3 silver and black hexagon socket head cap screws, and for M5 hexagon socket head set screws
	width across flats: 3 mm	1	For M4 silver and black hexagon socket head cap screws
	width across flats: 4 mm	1	For M5 silver and black hexagon socket head cap screws
	width across flats: 5 mm	1	For M6 silver and black hexagon socket head cap screws
	width across flats: 6 mm	1	For M8 silver and black hexagon socket head cap screws
Torque wrench	0.7 N·m to 44.0 N·m	1	For details, refer to 1.2.6 Tightening Bolts/Screws .
Phillips screwdriver	Ph1	1	For covers
	Ph2	1	For securing the Ground Wires
Needle-nose pliers		1	For removing the Air Tubes
Feeler gauge (0.5 mm)		2	For adjusting the fixing position of the pulleys and Brake Hubs
Wrench	width across flats: 5 mm	1	2.9.1 Removing the Cable Unit (For removing the D-sub Connectors)
	width across flats: 8 mm	1	For removing and installing the air tube fittings
Box wrench	width across flats: 5 mm	1	2.9.1 Removing the Cable Unit (For removing the D-sub Connectors)
Nipper		1	For cutting wire tie
Spatula		1	For applying grease on the Reduction Gear
Wiping cloth		1	For wiping grease from the Reduction Gear
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
Cushioning or rags		1	To prevent the arms from being damaged

Materials used

Name		Quantity	Note
Grease		Proper quantity	For details, refer to 1.2.4 Greasing .
Alcohol		Proper quantity	For wiping grease from the J1/J2 Reduction Gear and the Ball Screw Spline
Wire tie	AB100	Proper quantity	Fixing the cables
	AB150		
	AB200		
	AB250		
	AB300		

Grease

Please contact the following manufacturers for the purchase. If there is anything unclear, please contact the supplier of your region.

Product name	Manufacturer	URL
Harmonic Grease SK-1A Harmonic Grease SK-2	Harmonic Drive Systems Inc.	https://www.harmonicdrive.net/
Krytox®GPL-224	Chemours	https://www.chemours.com/en/brands-and-products

1.2.6 Tightening Bolts/Screws

In the manual, bolts and screws that are removed or installed for maintenance are shown below.

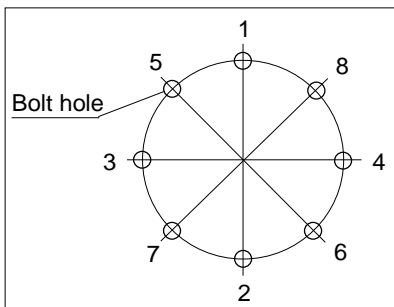
Unless otherwise specified, when re-tightening these bolts for maintenance tasks described in the manual, use a torque wrench and tighten them to the tightening torques noted in the table below.

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”.

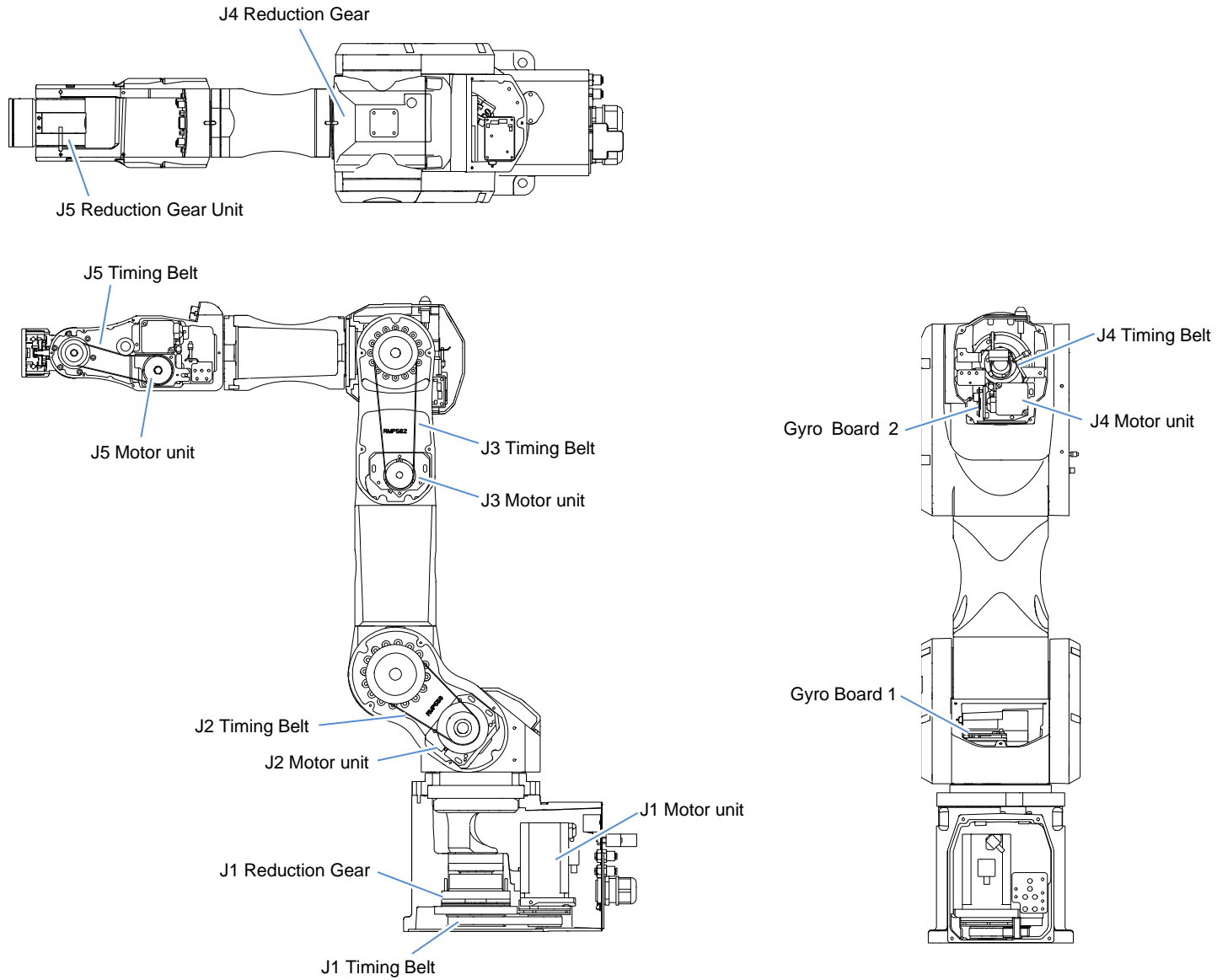
Type	Description	Size	Tightening torque (N·m)
S01	Hexagon socket head cap screw (silver)	M2.5	1.0 +/- 0.1
		M3	2.0 +/- 0.1
		M4	4.0 +/- 0.2
		M5	8.0 +/- 0.4
		M6	13.0 +/- 0.6
		M8	32.0 +/- 1.6
S02	Hexagon socket head cap screw (black) (Reduction Gear, etc.)	M3	2.5 +/- 0.15
		M4	5.0 +/- 0.25
		M5	10.0 +/- 0.5
		M8	44.0 +/- 2.2
S03	Cross recessed pan head screw (Covers, Circuit boards, etc.)	M2	0.2 +/- 0.03
		M3	0.45 +/- 0.1
		M4	0.45 +/- 0.1
S04	Cross recessed pan head screw (Ground Wires, etc.)	M4	0.9 +/- 0.1
S05	Hexagon socket head set screw	M3	0.9 +/- 0.1
		M4	2.4 +/- 0.1
		M5	4.0 +/- 0.2
S06	Cross recessed truss screw (Covers, etc.)	M4	0.9 +/- 0.1
S07	Cross recessed flat head screw (Base Cover)	M3	0.6 +/- 0.1

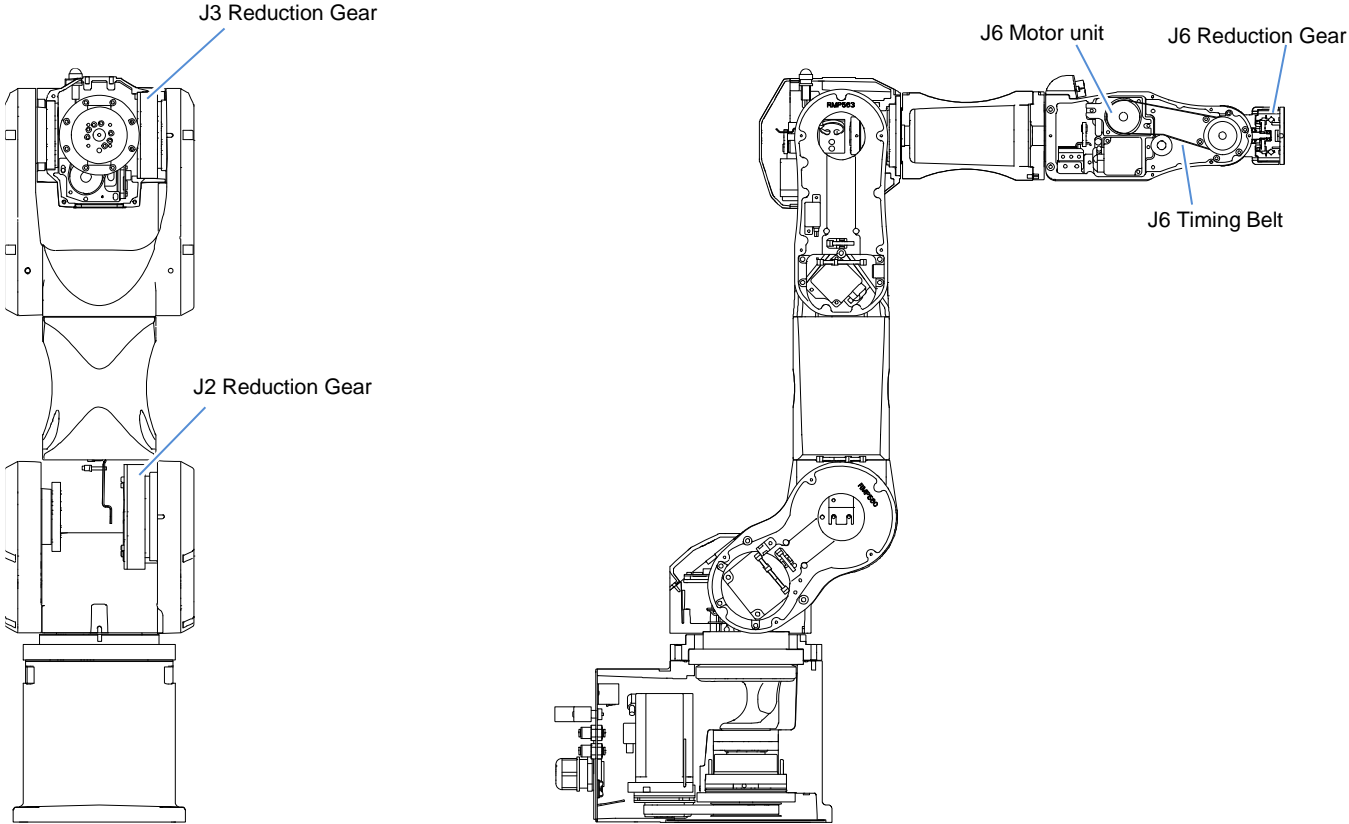
We recommend that the bolts aligned on a circumference should be fastened in a crisscross pattern as shown in the figure below.



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





CHAPTER

2

Maintenance

2.1 Overview

2.1.1 Precautions for Maintenance

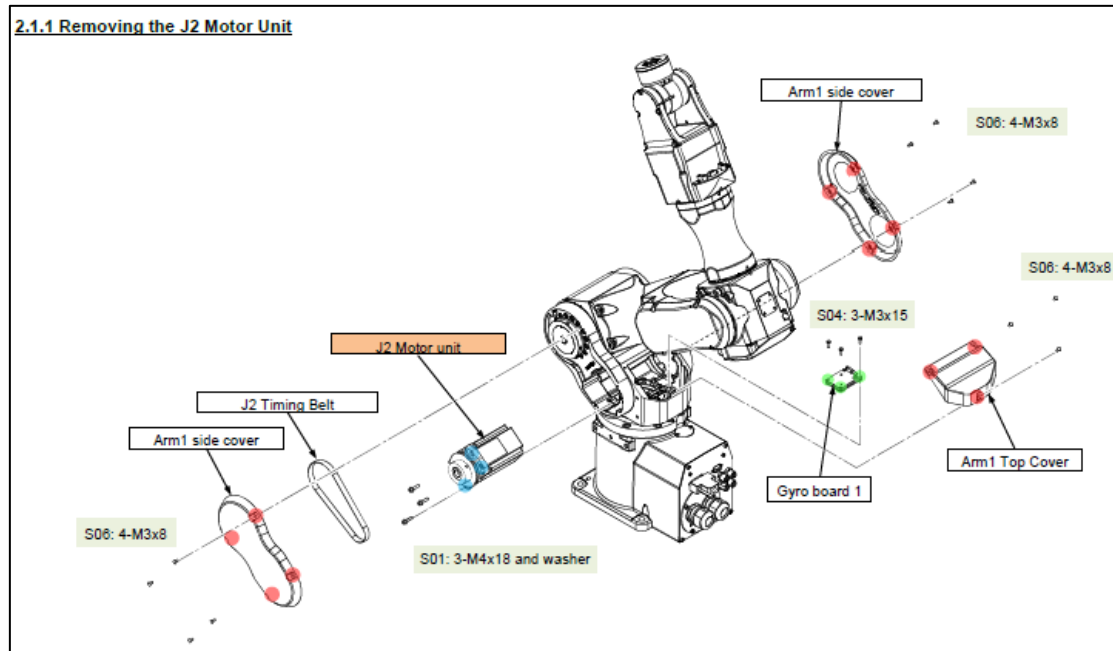
- Perform disassembly and assembly according to the procedures described in the manual.
- The parts for the Reduction Gear Unit are managed with serial numbers. Before installing parts, make sure the serial numbers of each match. Combining parts with different serial numbers may result in vibrations, 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

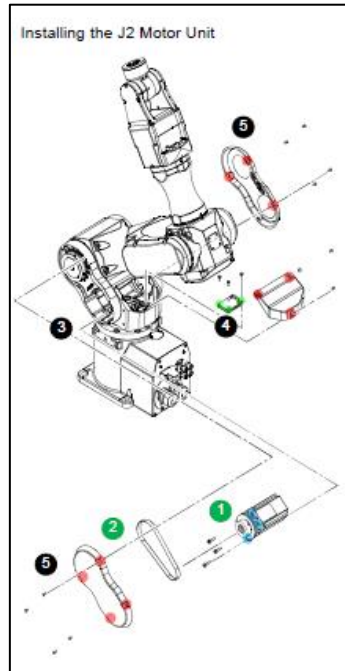
S01 indicates the bolt or screw type.

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 J2 Motor Unit


❶ Insert the J2 Motor unit inside Arm2.
CAUTION
The Motor Unit has a Radiation Sheet attached. When inserting the Motor Unit, be careful not to tear the Radiation Sheet.



Radiation Sheet

❷ Install the J2 Timing Belt.
Perform steps 1 and 2.

❸ Pull out the CN321 and BR021 cables as shown in the figure.



CN321 BR021

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.

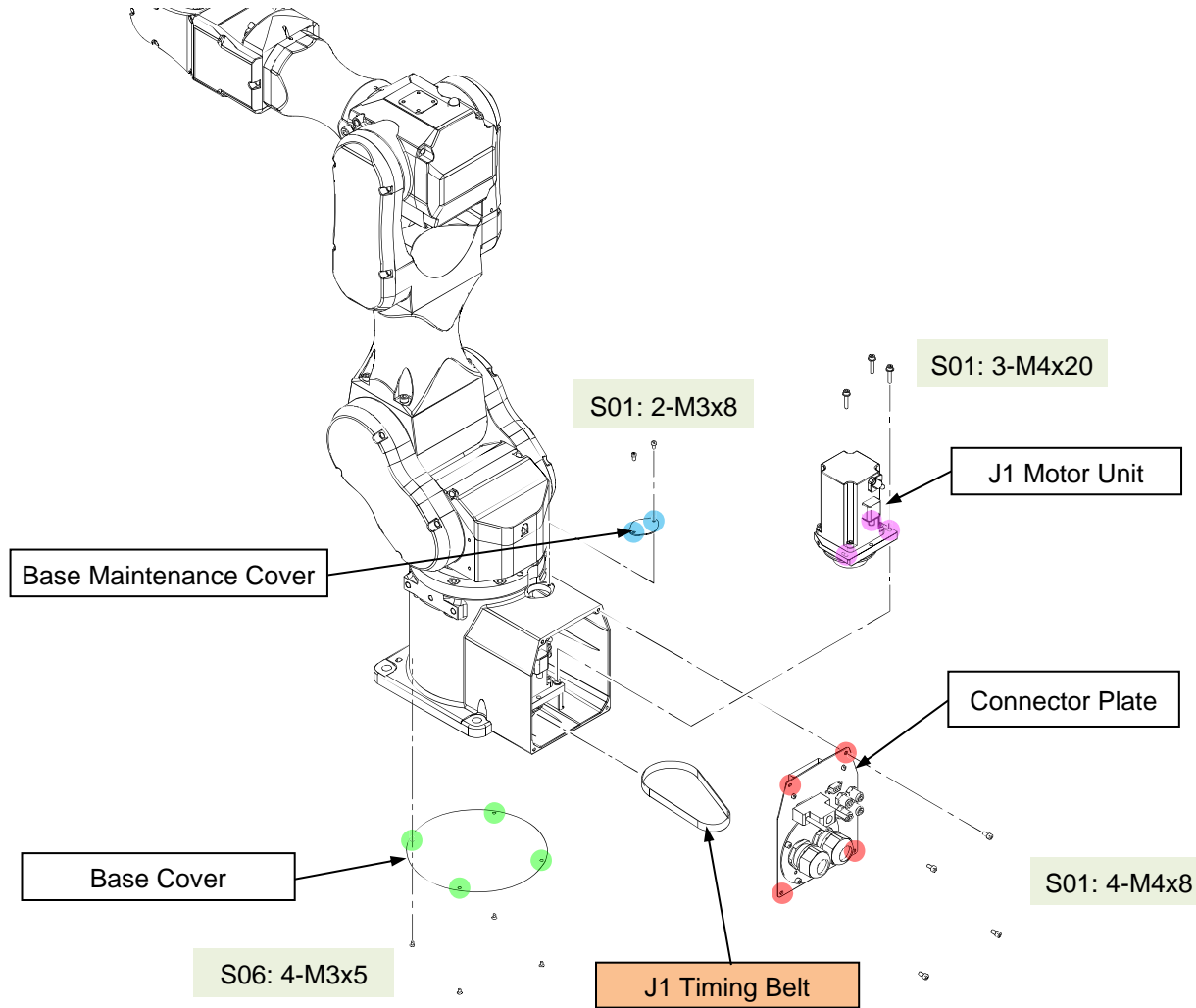
The configuration of parts to be removed/attached is shown by illustrations.

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

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.

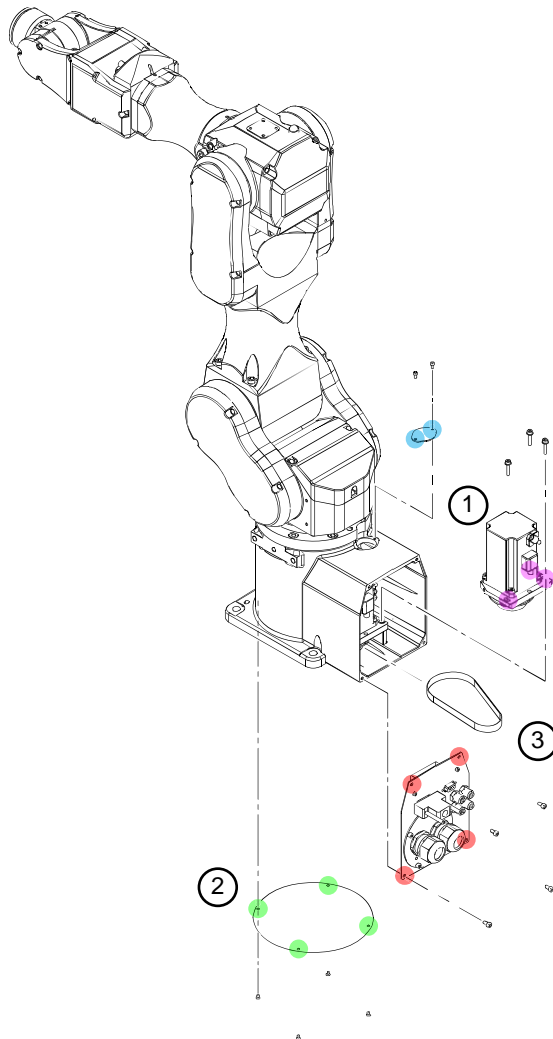
2.2 Joint #1

2.2.1 Joint #1 Replacing the Timing Belt



Joint #1

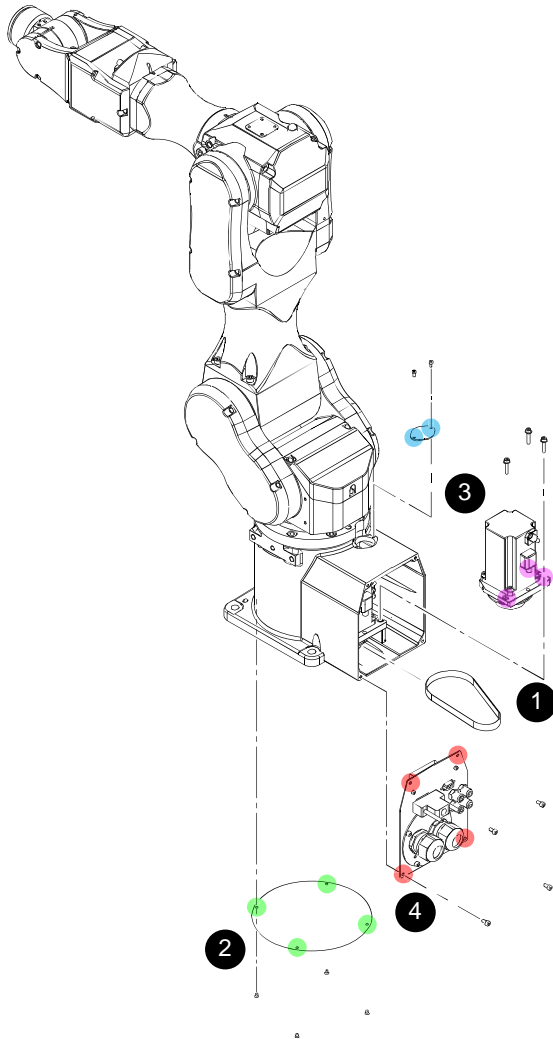
Removing the Timing Belt



①	Remove the J1 Motor unit .
②	Remove the Base Cover .
③	<p>Remove the J1 Timing Belt from pulley 2.</p> <p>POINT Perform the work after laying the Manipulator down on its side.</p> <div data-bbox="1032 491 2018 943" style="text-align: center;"> </div>

Joint #1

Installing the Timing Belt



1 Install the J1 Timing Belt on pulley 2.

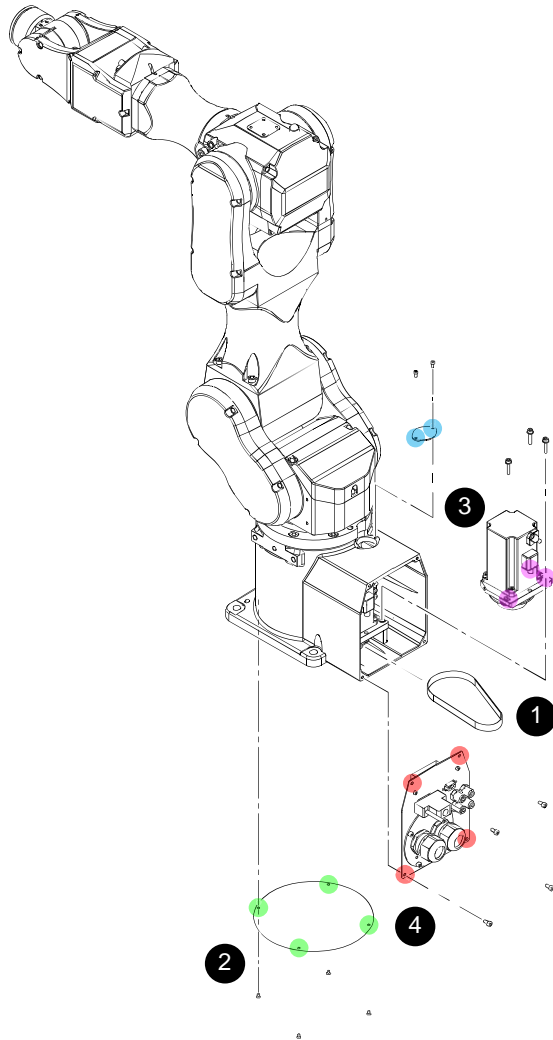
A close-up photograph of the J1 Reduction Gear Unit. A timing belt is being installed onto a pulley. Labels with arrows point to the 'Timing Belt', 'Pulley 2', and 'J1 Reduction Gear Unit'.

POINT
Make sure that the teeth of the Timing Belt and the pulley are properly engaged.

A diagram comparing two methods of timing belt engagement. The 'Wrong' side shows the timing belt teeth not fully seated in the pulley grooves. The 'Correct' side shows the teeth properly seated. Below this, a 3D perspective view shows a 'Pulley' and a 'Timing Belt' with arrows pointing to their respective parts.

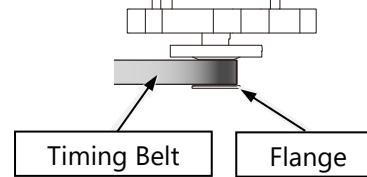
Joint #1

Installing the Timing Belt



CAUTION

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

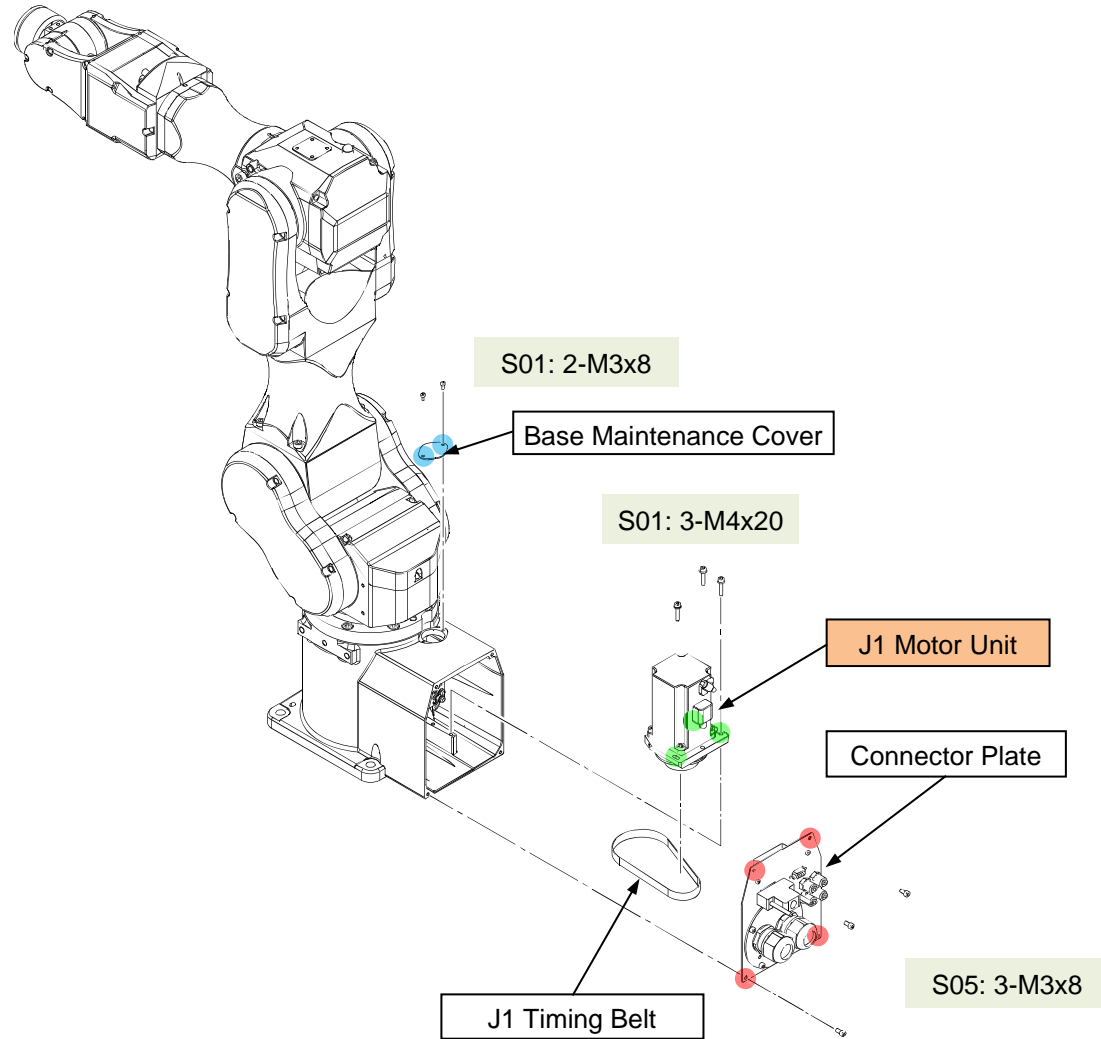


Set the belt so that it is level with respect to the pulley without it being placed on the flange.

- 2 Install the [Base Cover](#).
- 3 Install the [J1 Motor unit](#).
- 4 Install the [Connector Plate](#).

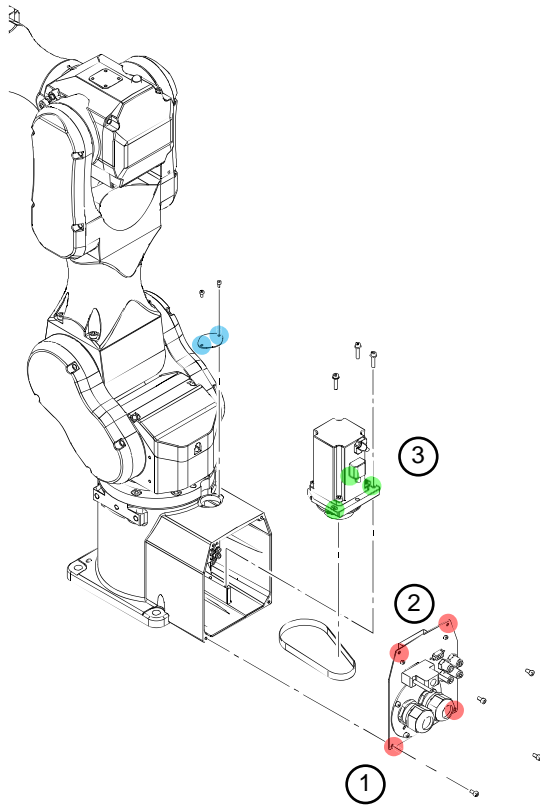
Joint #1

2.2.2 Joint #1 Replacing the Motor Unit



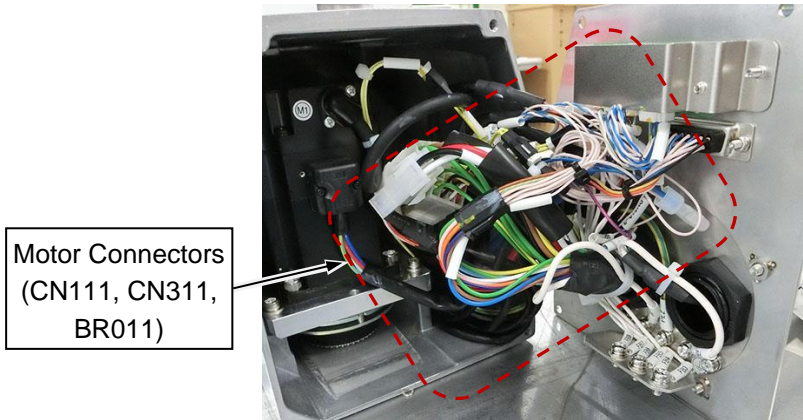
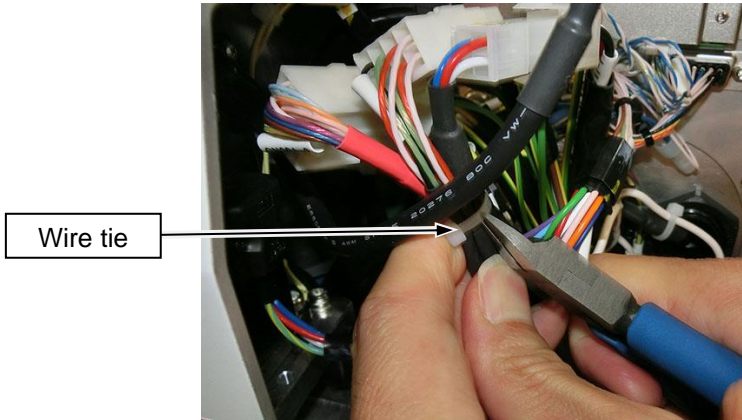
Joint #1

Removing the Motor Unit



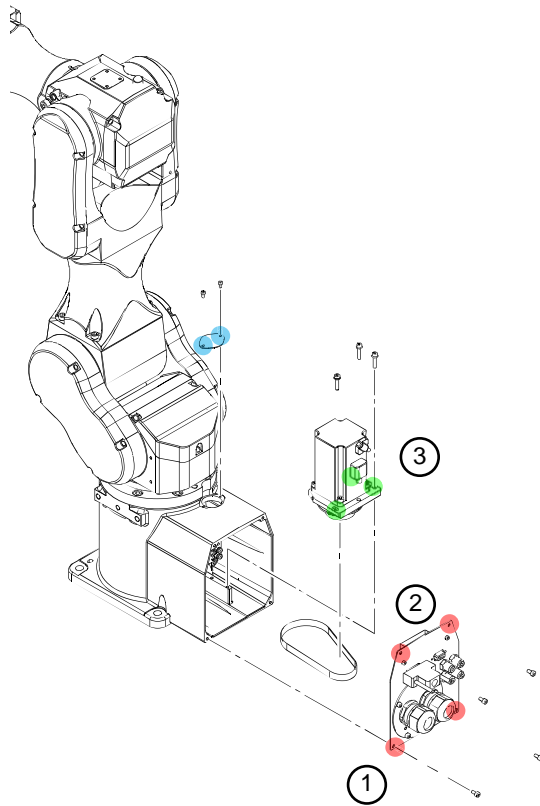
① Remove the [Connector Plate](#).

② Cut the wire tie binding the cables (CN111, CN200, CN201), and disconnect the J1 Motor Connectors (CN111, CN311, BR011).



Joint #1

Removing the Motor Unit



③

Remove the J1 Motor unit.

1. Remove the Base Maintenance Cover.

A

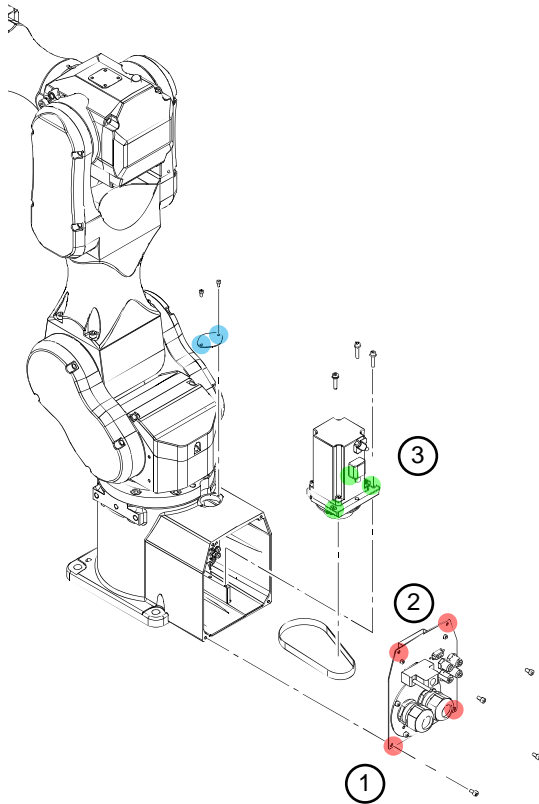
S01: 2-M3x8



Base Maintenance Cover

Joint #1

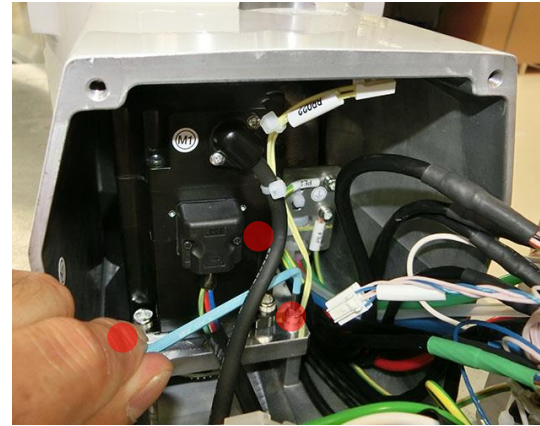
Removing the Motor Unit



Joint #1

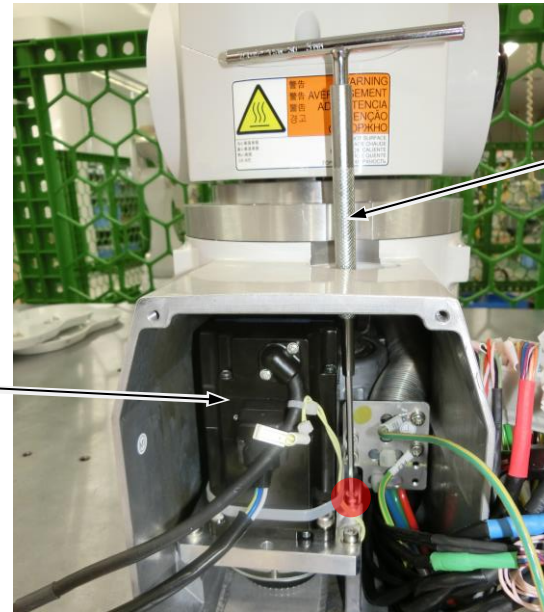
2. Remove the screws securing the J1 Motor unit.

A S01: 3-M4x20



POINT

Insert the hexagonal wrench through the hole in the Base Maintenance Cover to perform the work for the screws shown in the figure.

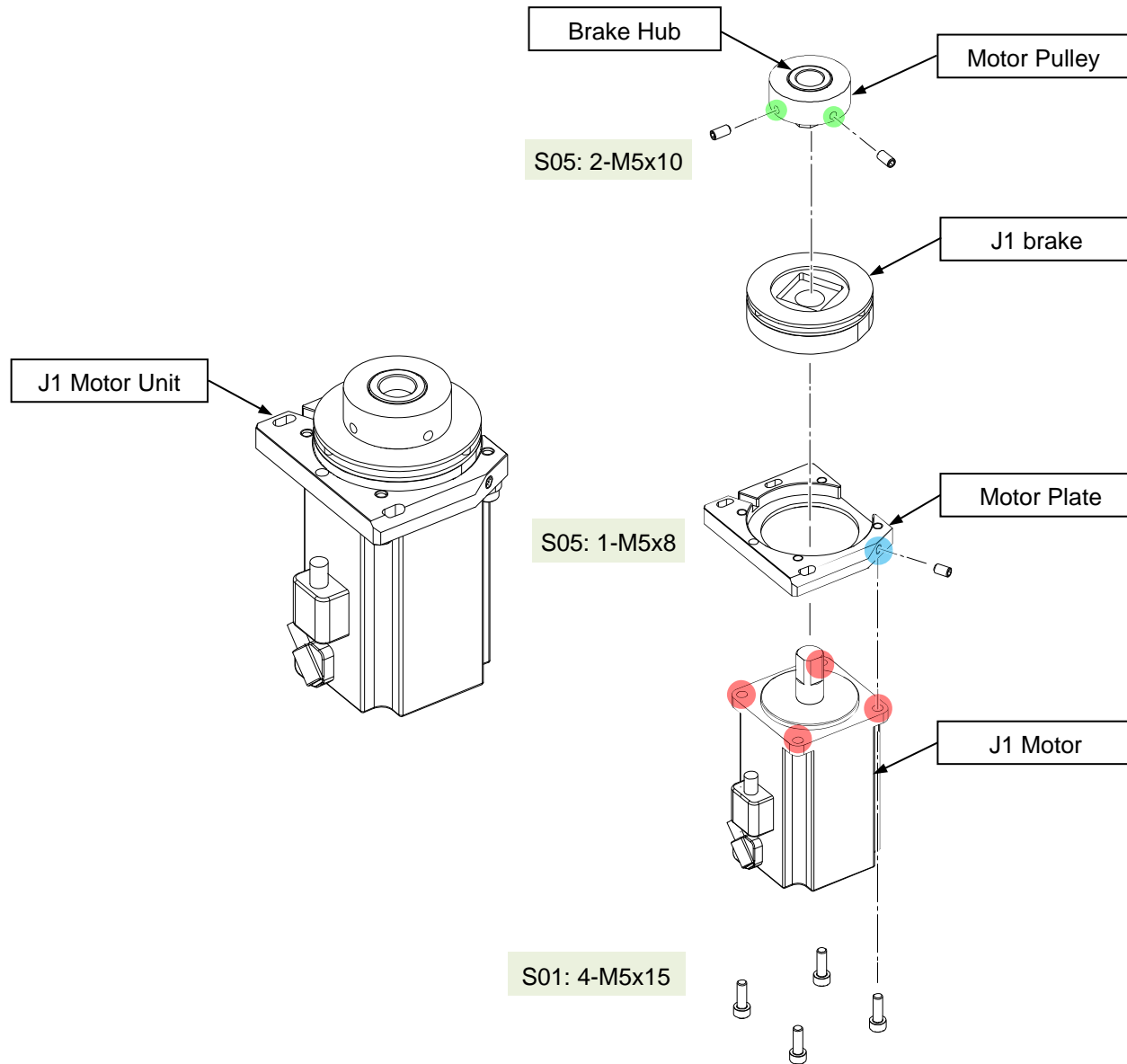


Hexagonal wrench

J1 Motor unit

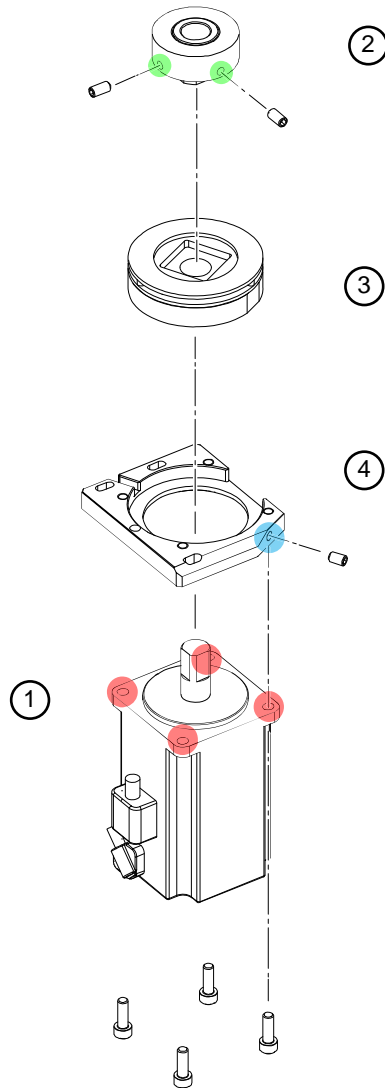
3. Remove the J1 Motor unit.

Motor Unit Disassembly



Joint #1

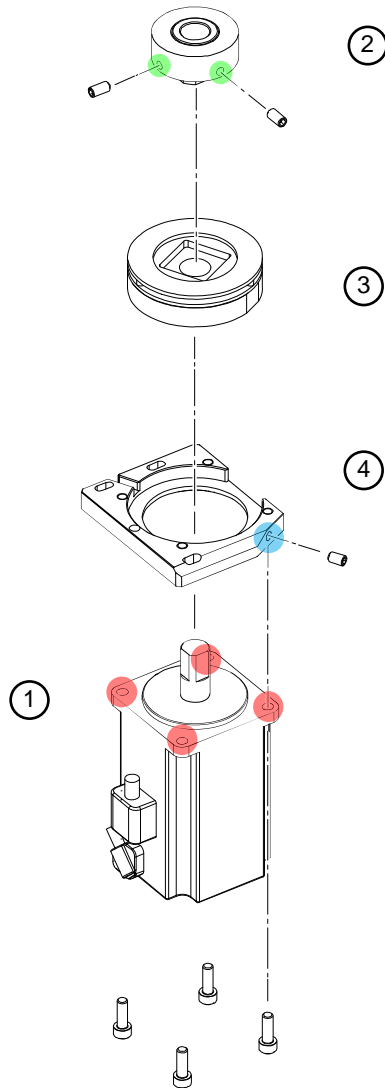
Motor Unit Disassembly



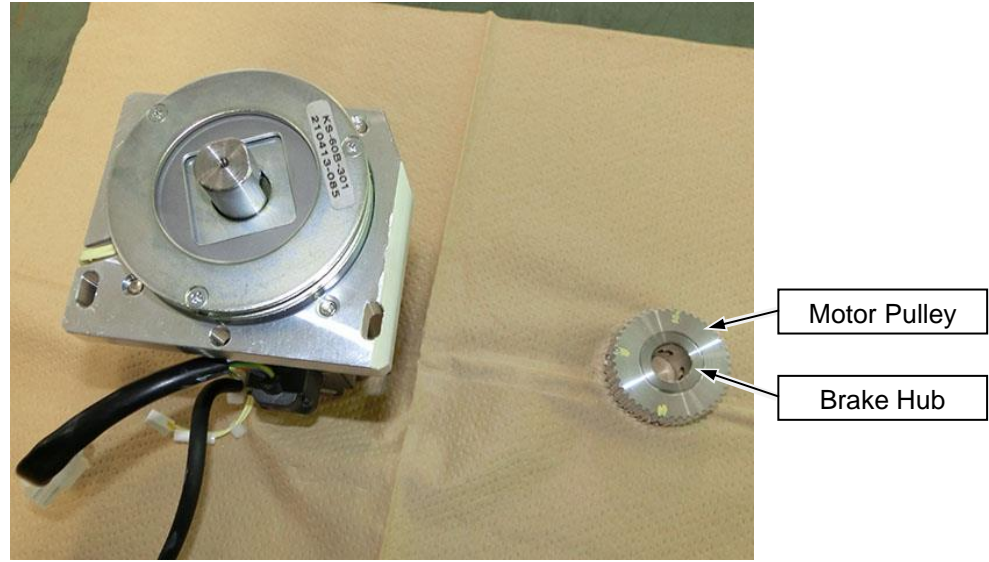
Joint #1

①	Remove the J1 Motor unit .
②	<p>Remove the Motor Pulley unit.</p> <p>POINT Remove the Motor Pulley and the Brake Hub together.</p> <p>1. Loosen the two screws on the D-cut surface of the motor shaft when viewing the J1 Motor unit from above.</p> <div data-bbox="896 462 1825 1404"> <p>A S05: 2-M5x10</p> </div>

Motor Unit Disassembly

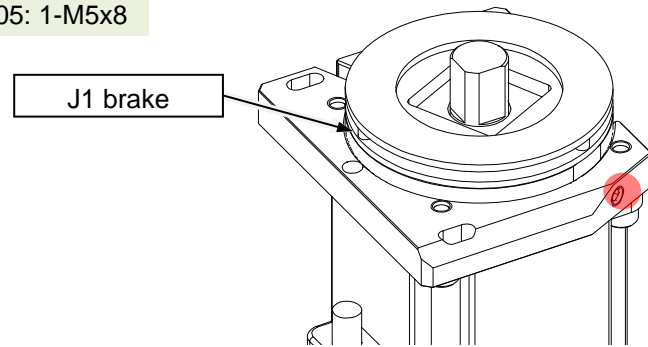


2. Remove the Motor Pulley unit from the motor shaft.



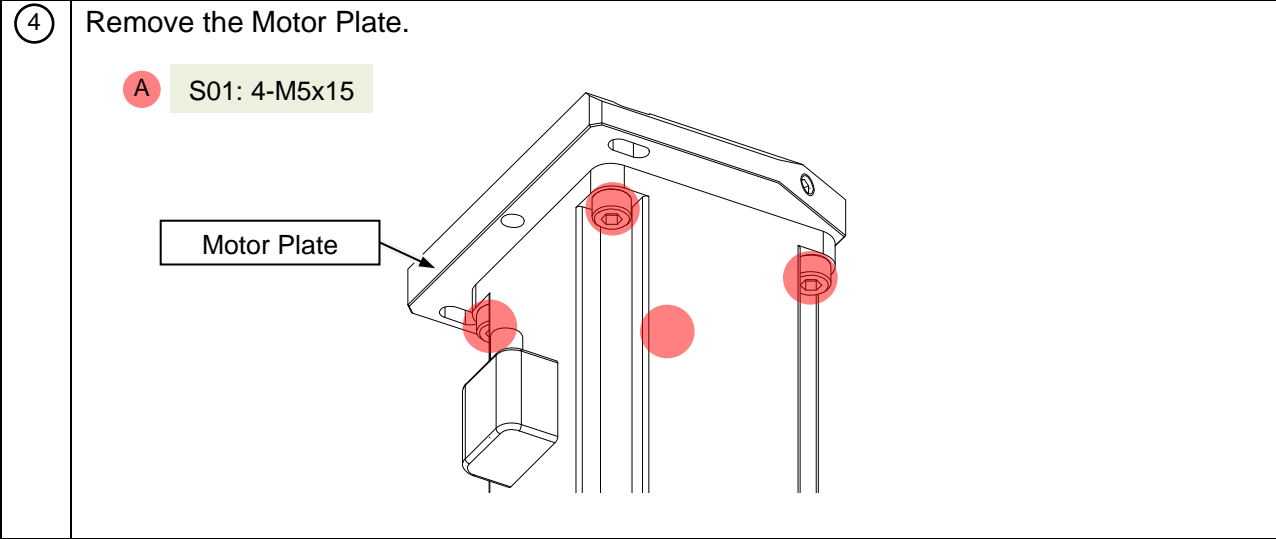
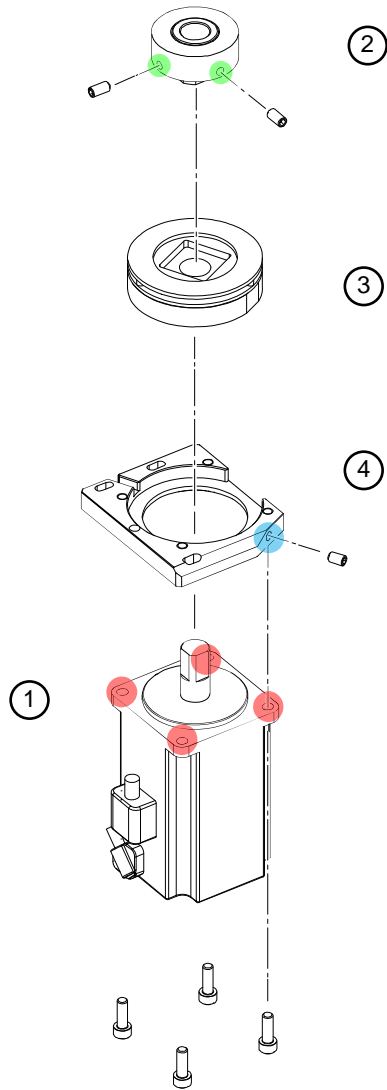
3. Remove the J1 brake.

A S05: 1-M5x8



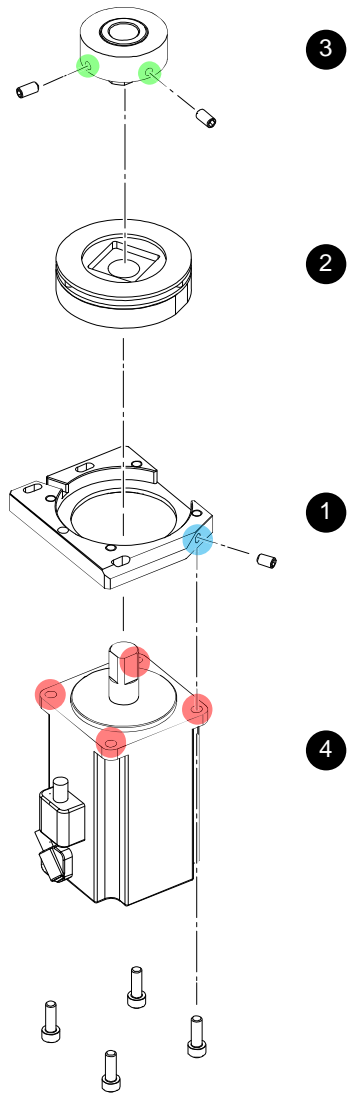
Joint #1

Motor Unit Disassembly



Joint #1

Motor Unit Assembly



1 Install the Motor Plate.

A S01: 4-M5x15
(8.0 +/- 0.4 N · m)

Motor Plate

POINT
Attach the Motor Plate according to the orientation shown in the figure.

Motor cable

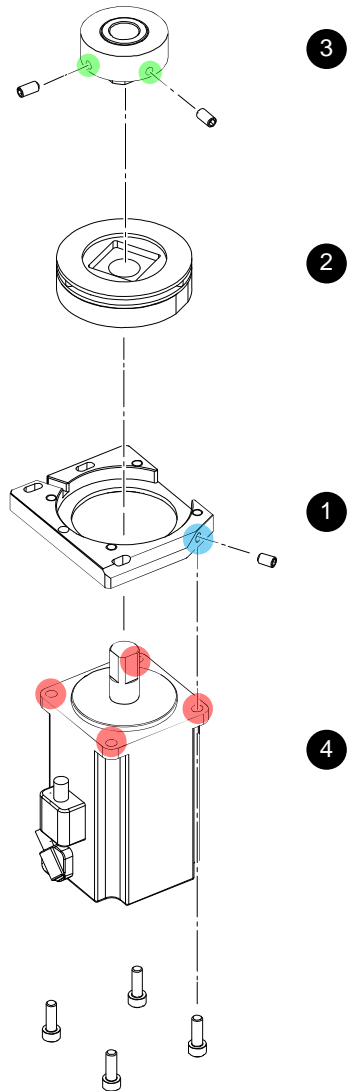
Hole

Groove

Motor Plate

Joint #1

Motor Unit Assembly

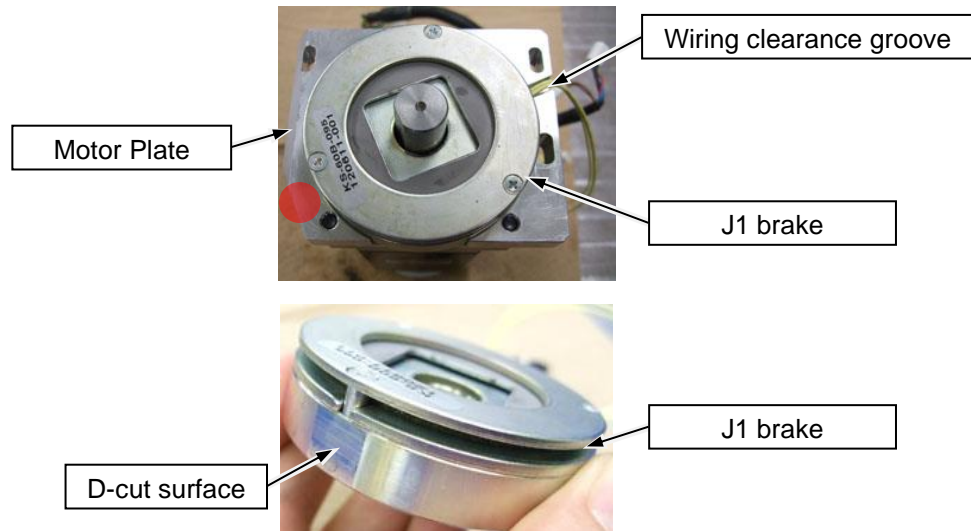


2 Install the J1 electromagnetic brake on the J1 Motor unit.

A S05: 1-M5x8 (4.0 +/- 0.2 N·m)

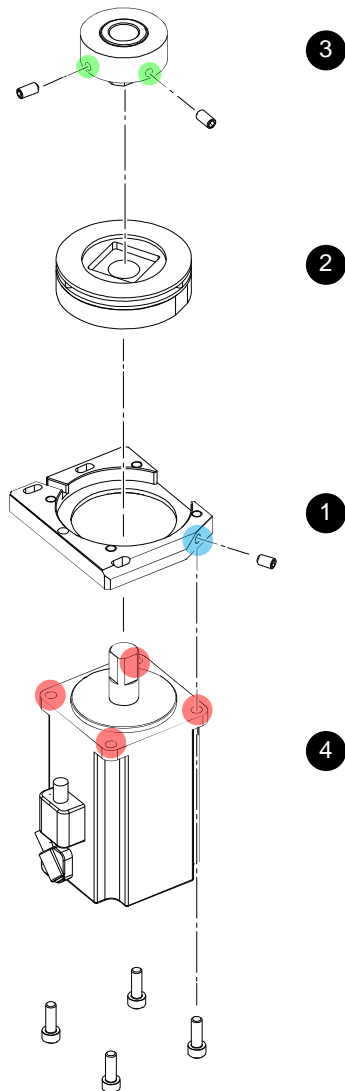
CAUTION

- Be careful not to let the electromagnetic brake wiring get caught in or cut by the Motor Plate.
- Align the position of the electromagnetic brake wiring with the position of the Motor Plate wiring clearance groove, and align the D-cut surface of the electromagnetic brake with the set screw side to secure.



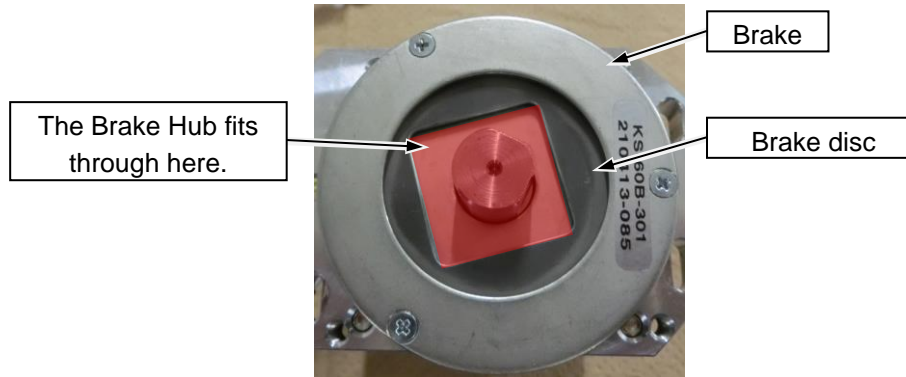
Joint #1

Motor Unit Assembly



POINT

- Align the Brake Hub and brake disc positions, and install the Brake Hub on the motor shaft. If they are misaligned, adjust the brake disc position.

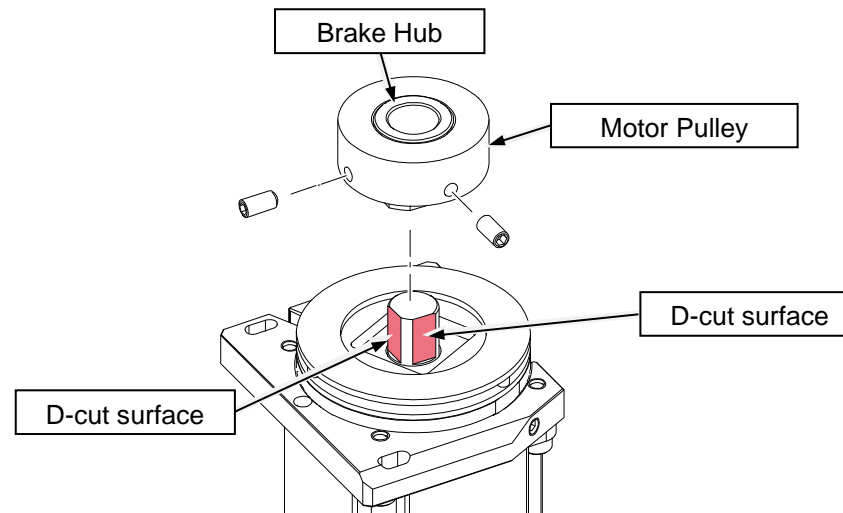


- Secure the set screw while pressing the electromagnetic brake to the Motor Plate.

3

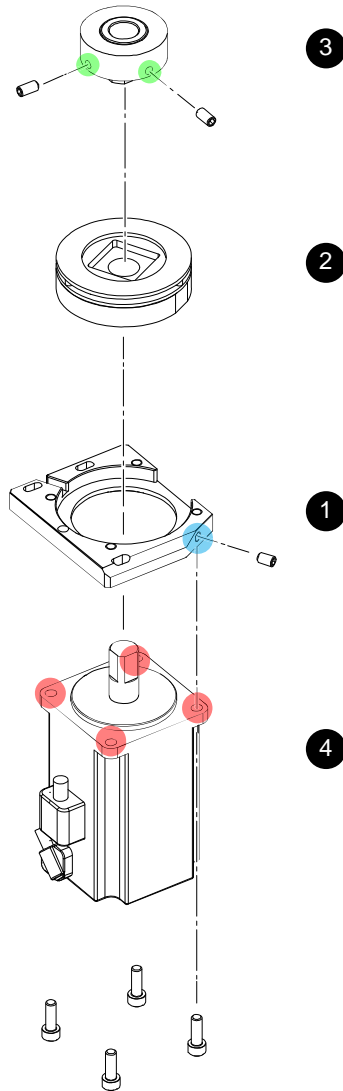
Install the Motor Pulley unit to the J1 Motor unit.

1. Insert the Motor Pulley unit so that the set screw position aligns with the motor shaft D-cut surface.



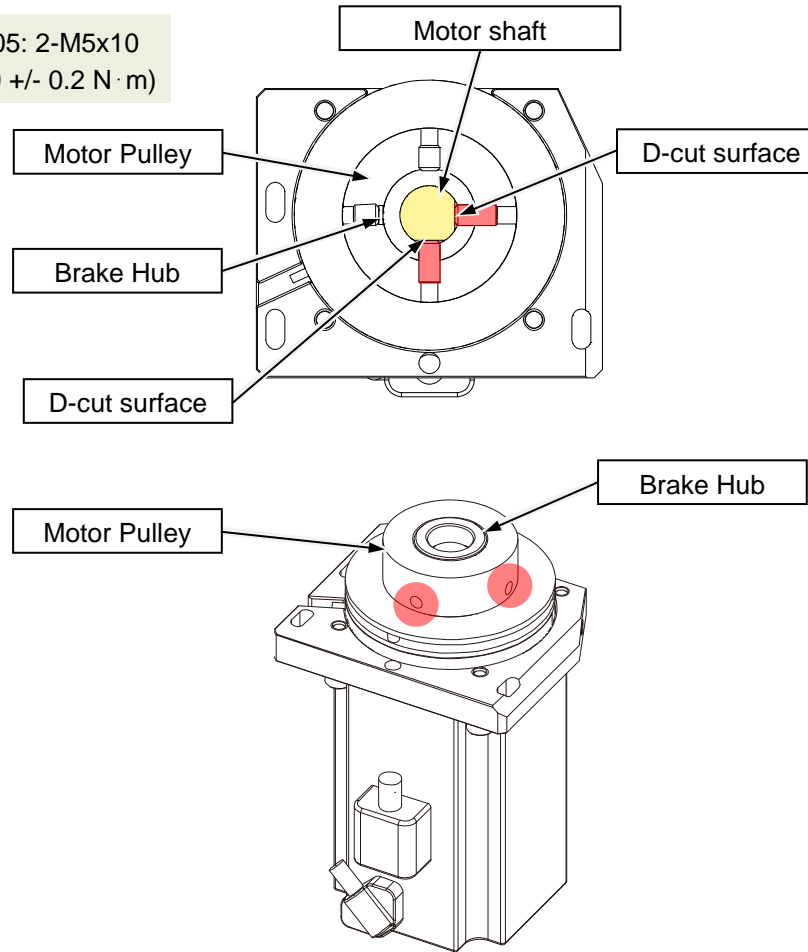
Joint #1

Motor Unit Assembly



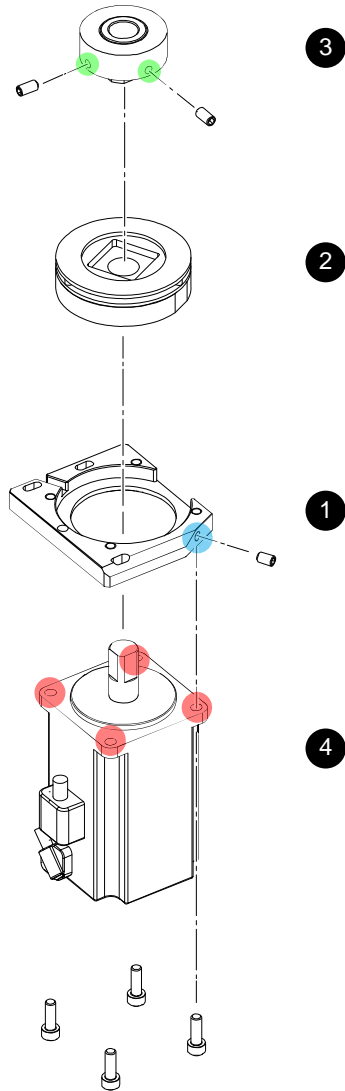
2. Secure the Motor Pulley unit to the motor shaft.

A S05: 2-M5x10
(4.0 +/- 0.2 N·m)



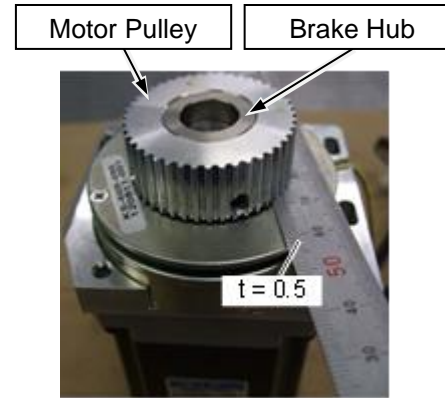
Joint #1

Motor Unit Assembly



POINT

Leave a 0.5-mm gap between the Motor Pulley and the electromagnetic brake. Create a gap using a feeler gauge (0.5 mm).



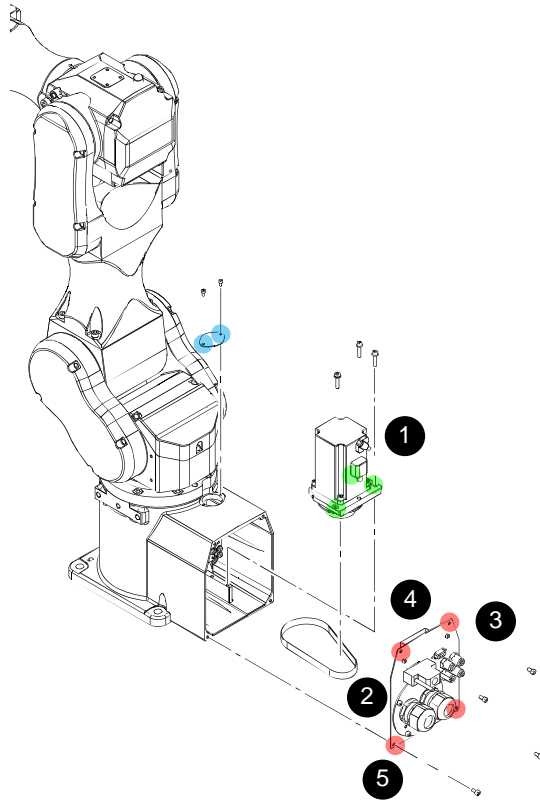
CAUTION

Failure to create a proper gap between the Motor Pulley and the brake may cause the parts to rub during motor operation, causing a malfunction.

4 Install the [J1 Motor unit](#).

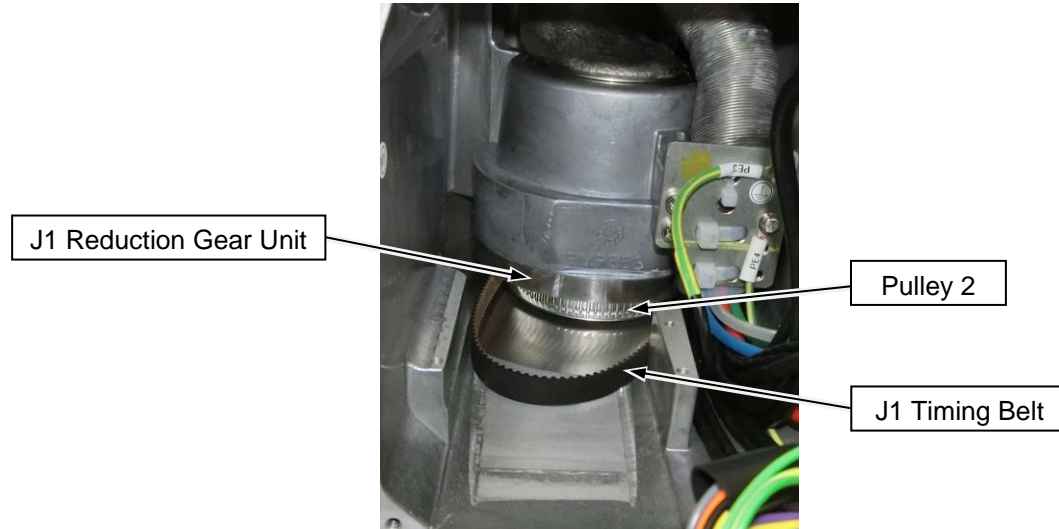
Joint #1

Installing the Motor Unit



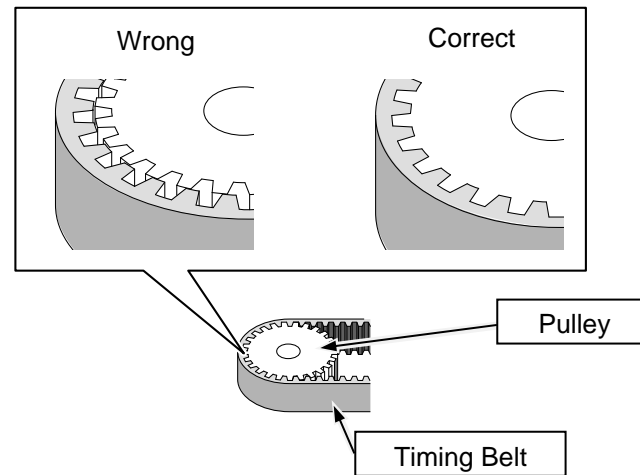
1 Install the J1 Motor unit.

1. Check that the J1 Timing Belt is around pulley 2.



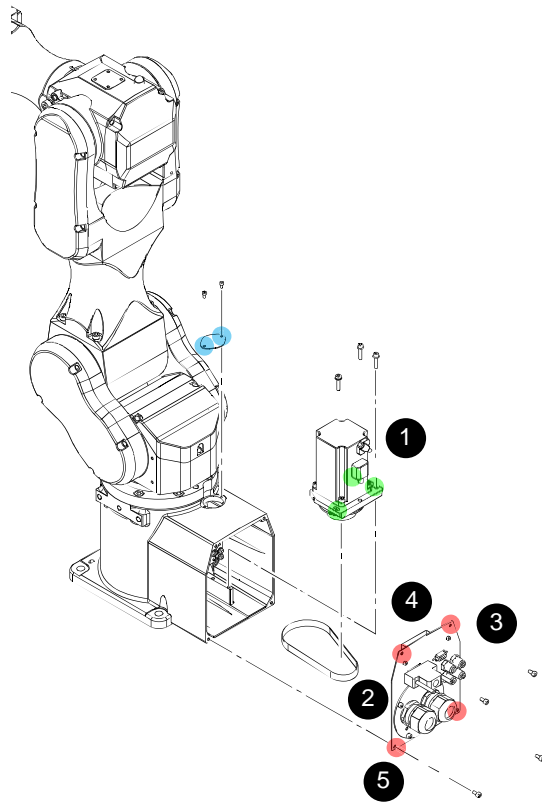
POINT

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



Joint #1

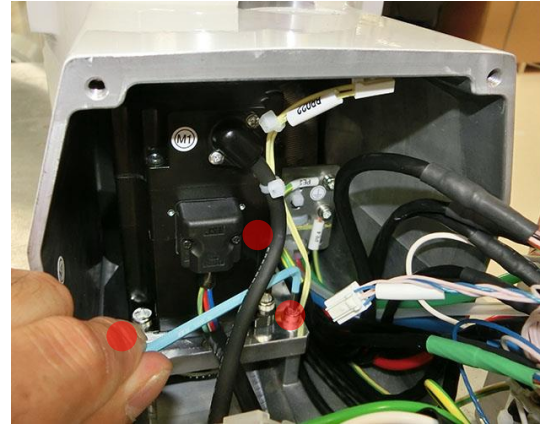
Installing the Motor Unit



Joint #1

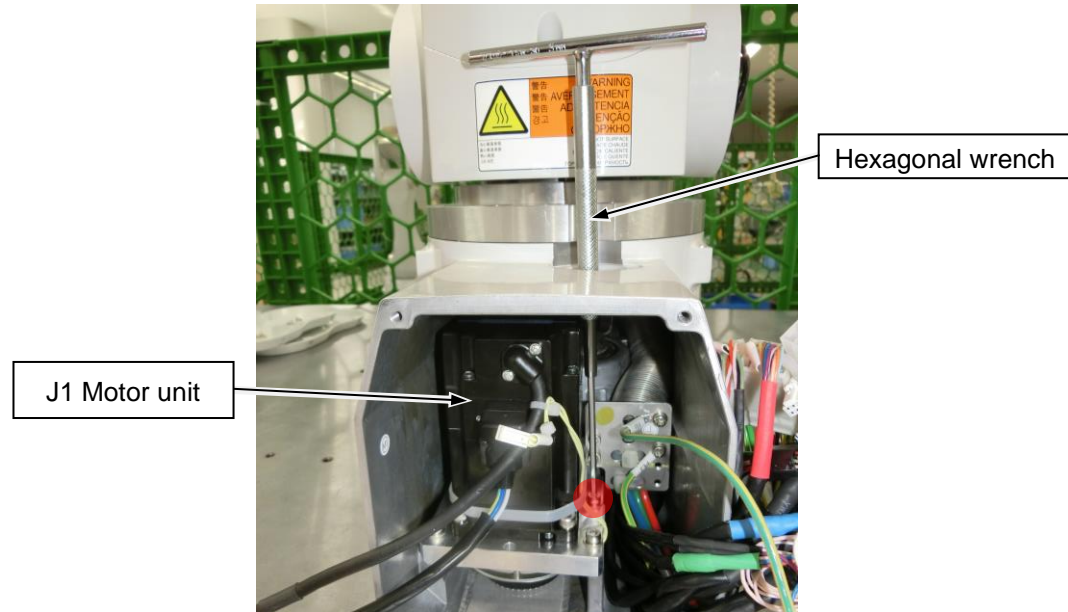
2. Set the J1 Timing Belt around pulley 2, and secure the Motor Unit to the base temporarily.

A S01: 3-M4x20

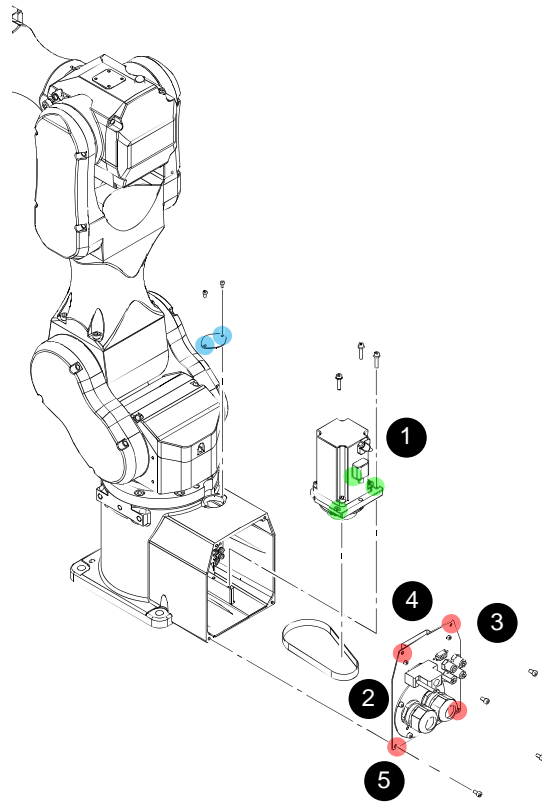


POINT

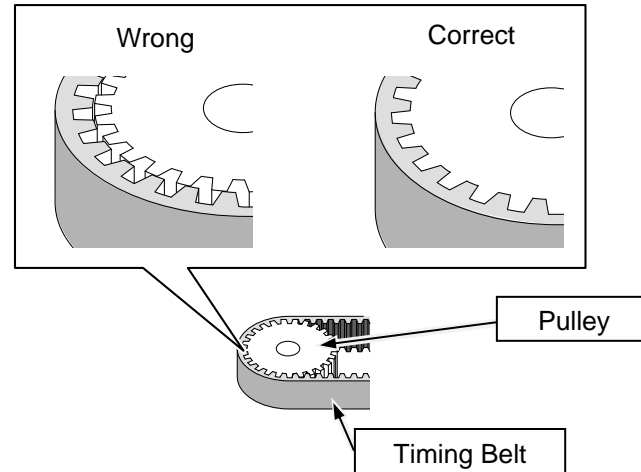
- Insert the hexagonal wrench through the hole in the Base Maintenance Cover to perform the work for the screw shown in the figure.



Installing the Motor Unit

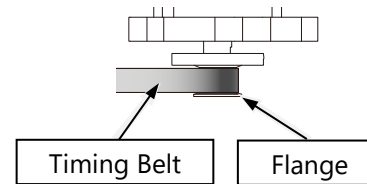


- Make sure that the teeth of the Timing Belt and the pulley are properly engaged.



CAUTION

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

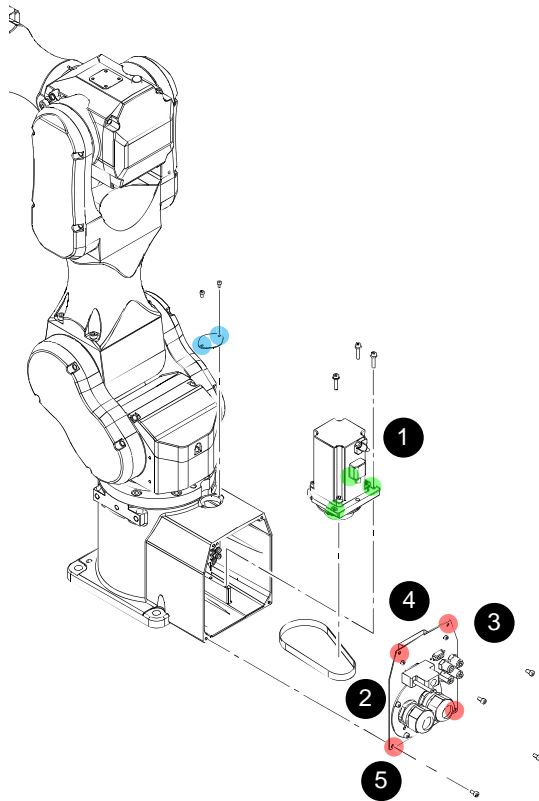


Set the belt so that it is level with respect to the pulley without it being placed on the flange.

- 2 Adjust the belt tension.
[3.1 Adjusting the Timing Belt Tension](#)

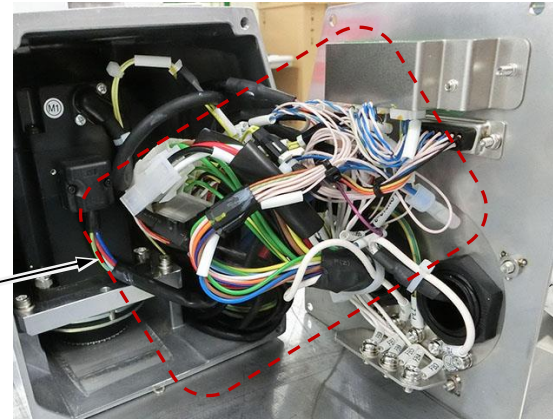
Joint #1

Installing the Motor Unit



3 Connect the J1 Motor Connectors (CN111, CN311, BR011).

Motor Connectors
(CN111, CN311,
BR011)



4 Bind the cables (CN111, CN200, CN201) using the wire tie (AB150).



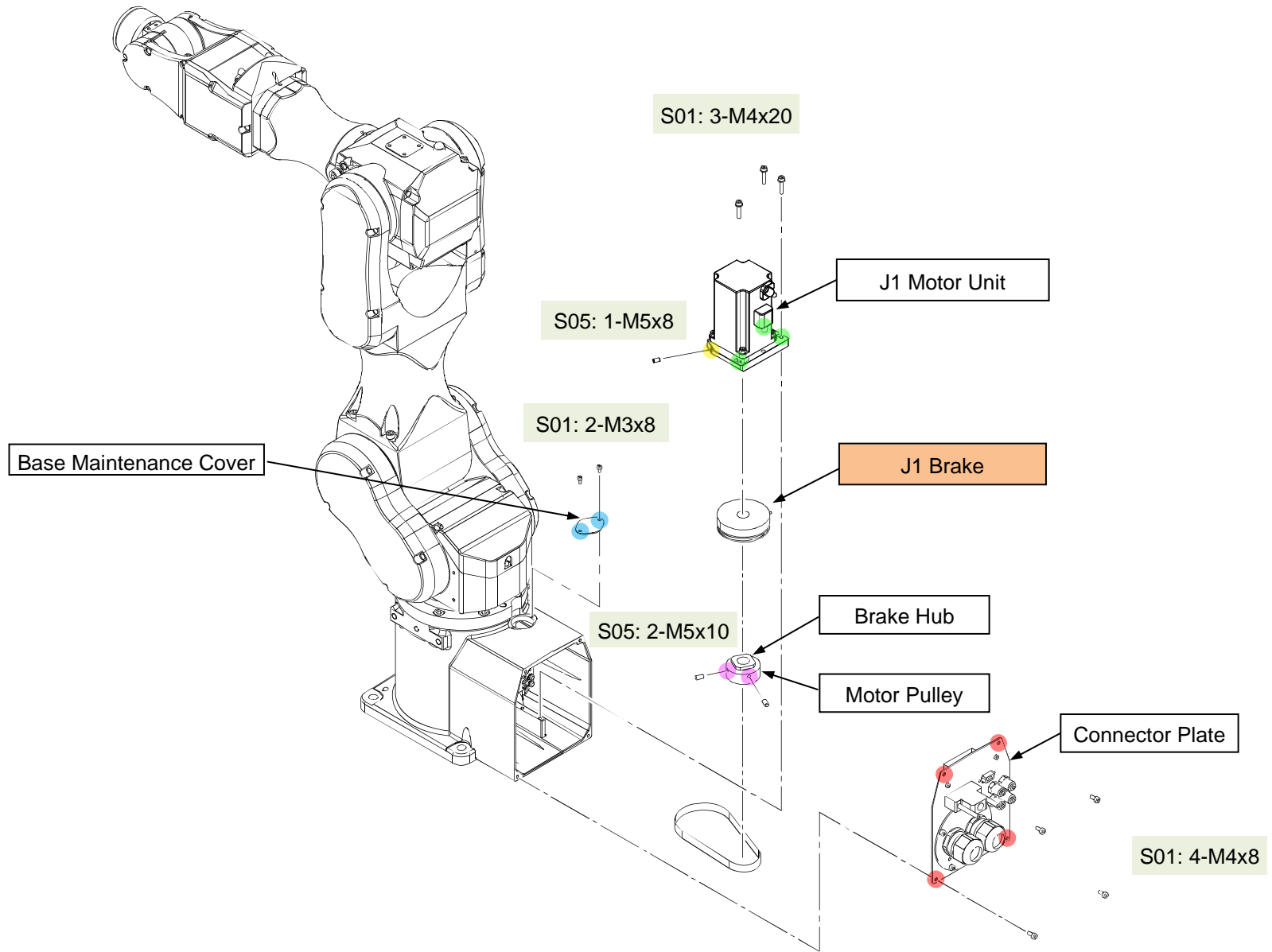
Wire tie

5 Install the [Connector Plate](#).

6 After assembly, perform calibration of Joint #1.
[3.2 Calibration](#)

Joint #1

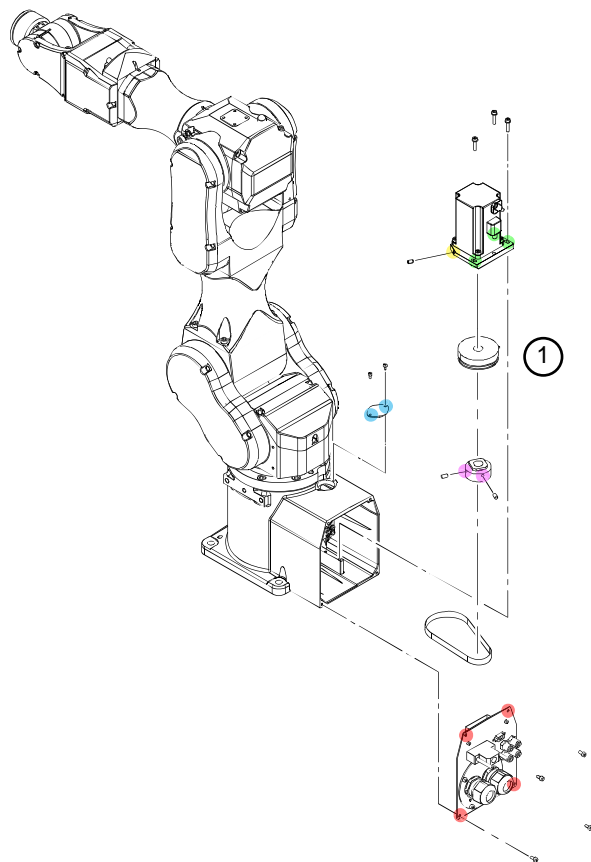
2.2.3 Joint #1 Replacing the Brake



Joint #1

Removing the Brake

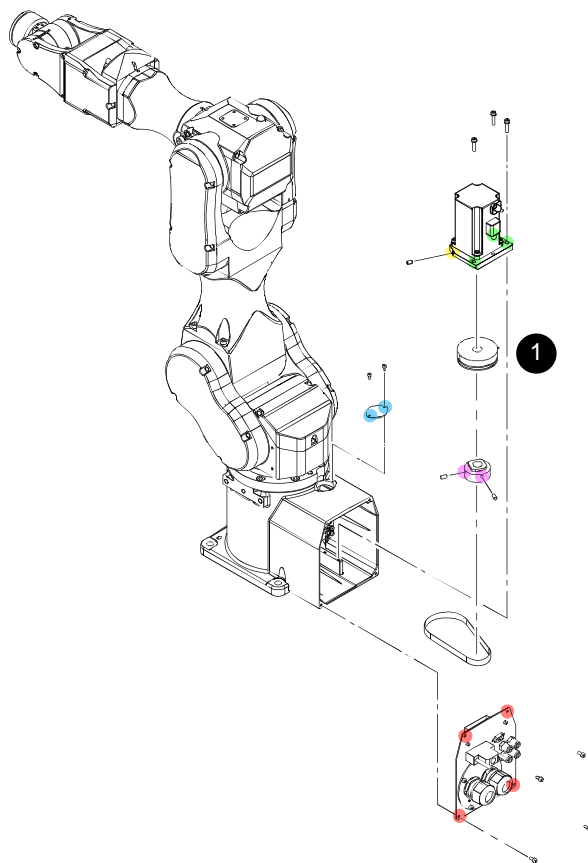
① Refer to [J1 Motor Unit Disassembly](#) and remove the J1 brake.



Joint #1

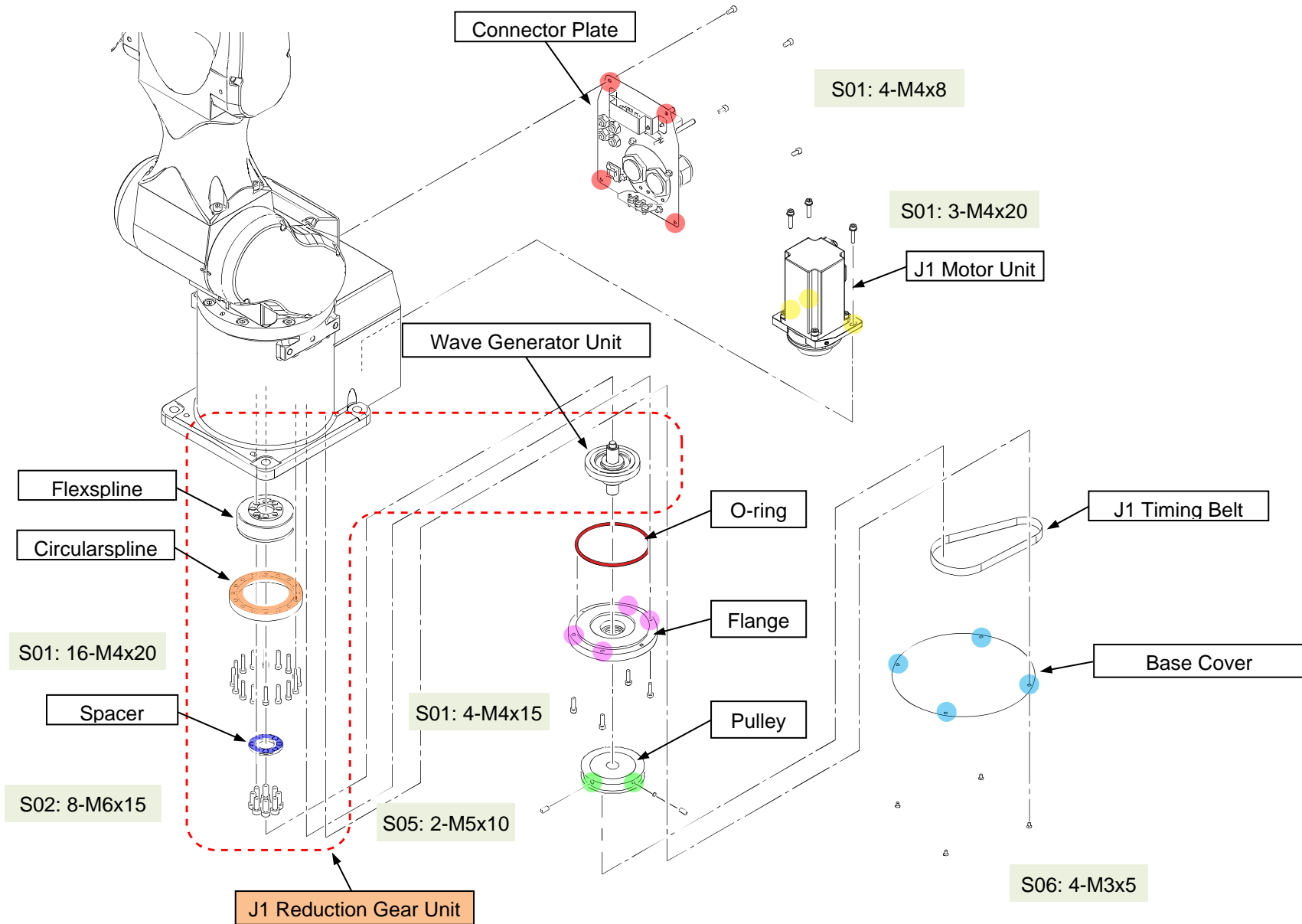
Installing the Brake

1 Refer to [J1 Motor Unit Assembly](#) and install the J1 brake.



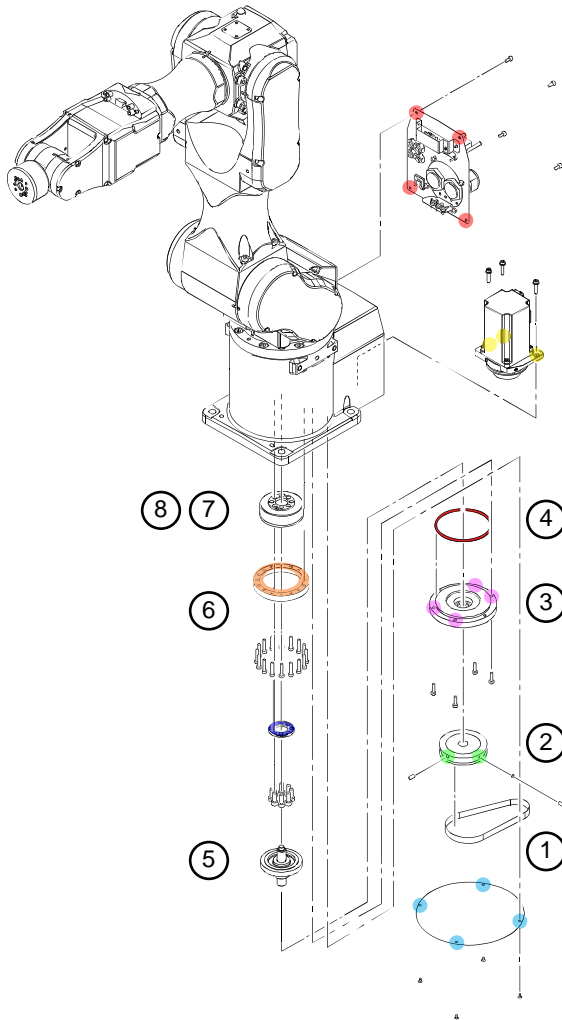
Joint #1

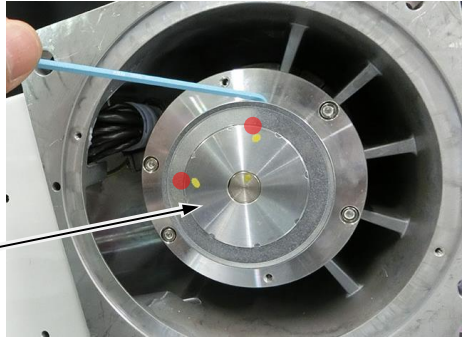
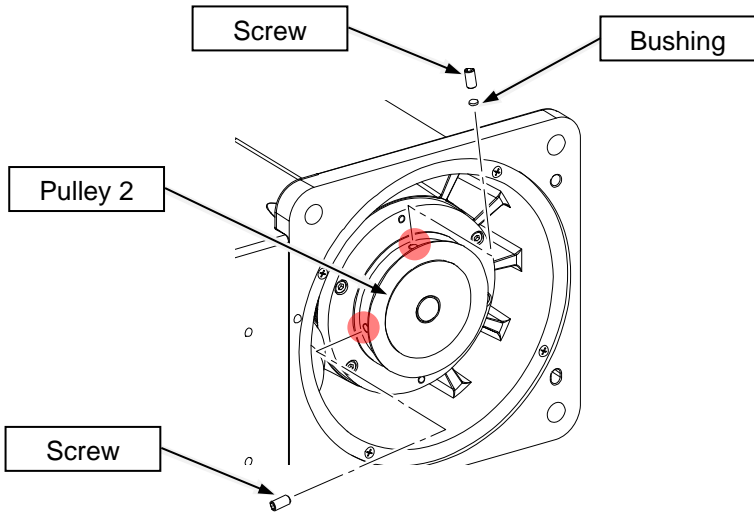
2.2.4 Joint #1 Replacing the Reduction Gear Unit



Joint #1

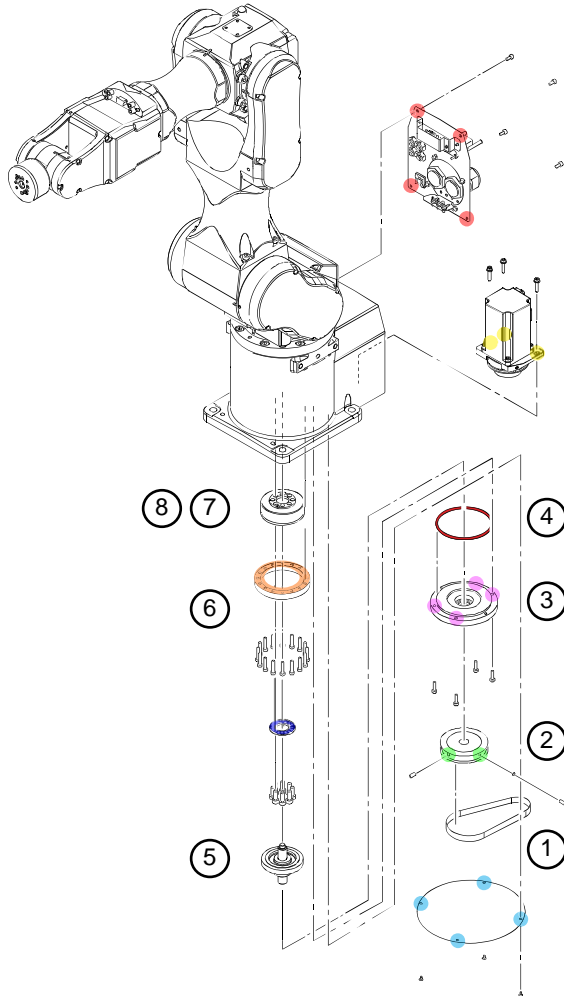
Removing the Reduction Gear Unit



①	Remove the J1 Timing Belt .
②	Using a 2.5-mm T-wrench, loosen the pulley 2 set screws. Remove pulley 2.
A	<p>S05: 2-M5x10</p>  <p>Pulley 2</p>
<p>CAUTION</p> <p>A brass bushing is included on one of the set screws. When removing the pulley, be careful not to drop and lose the bushing.</p>	
 <p>Screw</p> <p>Bushing</p> <p>Pulley 2</p> <p>Screw</p>	

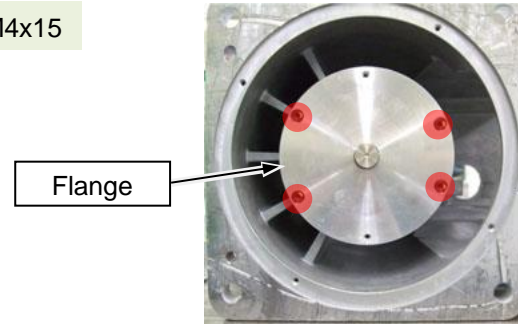
Joint #1

Removing the Reduction Gear Unit



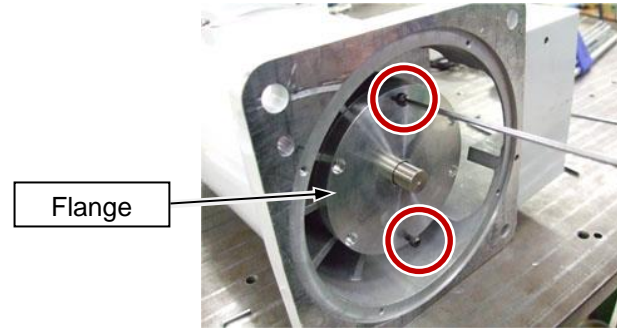
③ Remove the flange.

A S01: 4-M4x15

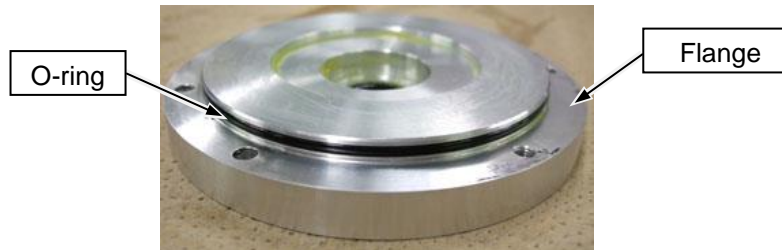


POINT

- If it is difficult to remove the flange, insert screws at the two locations as shown in the photograph, and tighten these screws evenly to remove. When removing, use flange fixing screws.
- The part has grease applied. Perform the work while wiping off the grease.

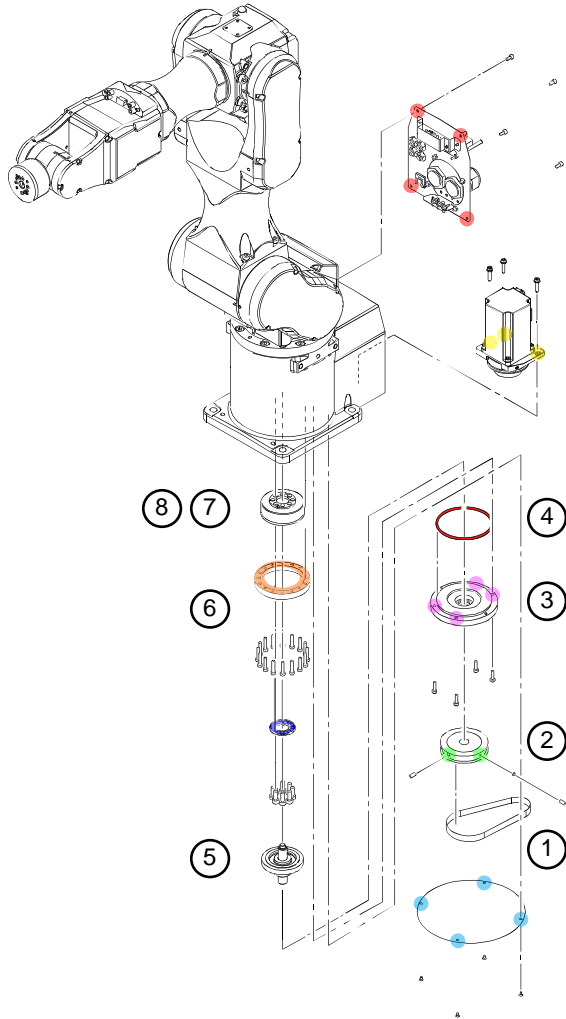


④ Remove the O-ring from the flange.

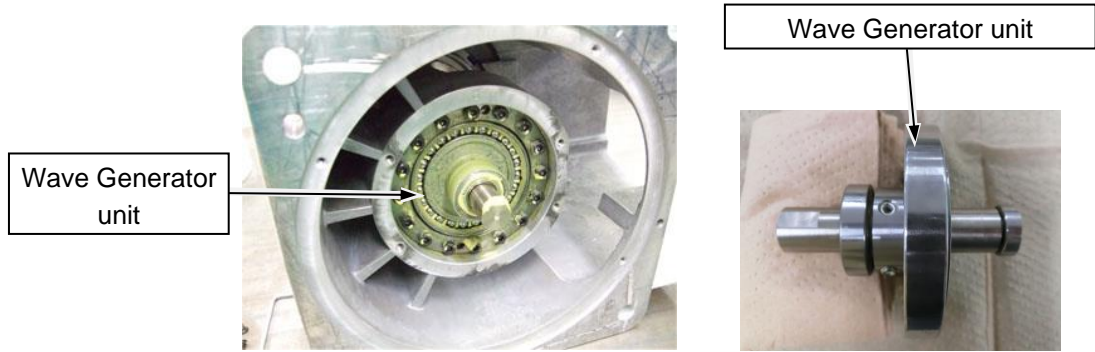


Joint #1

Removing the Reduction Gear Unit



⑤ Remove the Wave Generator unit from the J1 Reduction Gear.

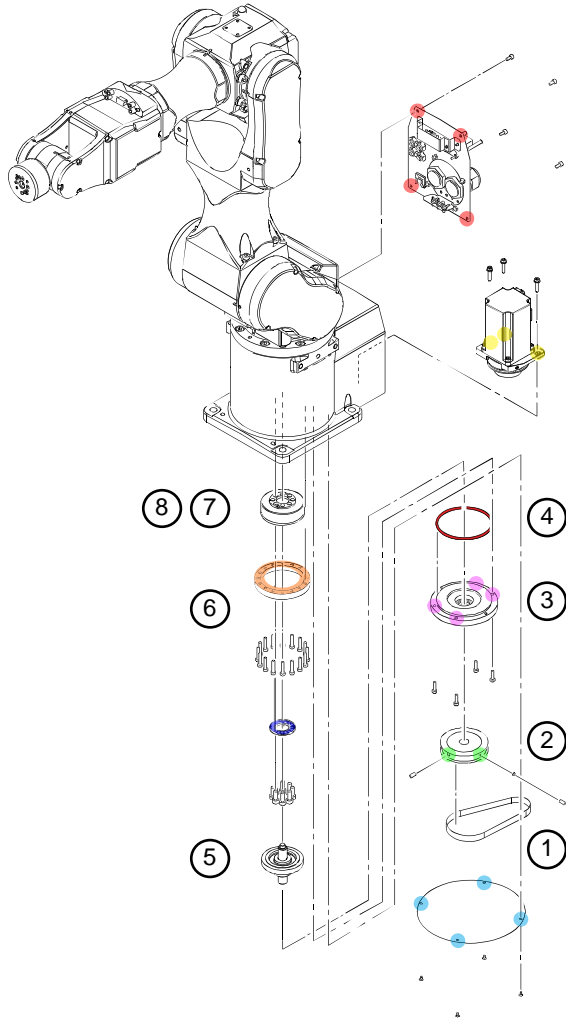


POINT

- The part has grease applied. Perform the work while wiping off the grease.
- If the Wave Generator unit is difficult to remove, attach the removed pulley 2 to the shaft and pull it out.

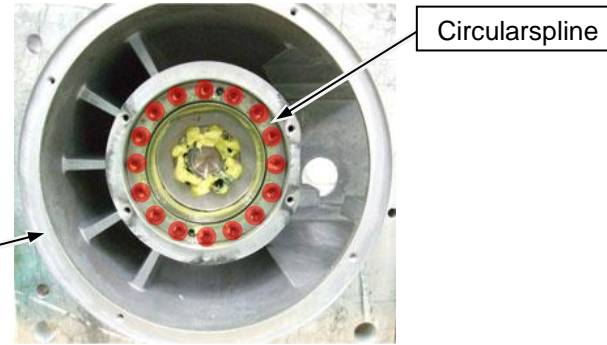


Removing the Reduction Gear Unit



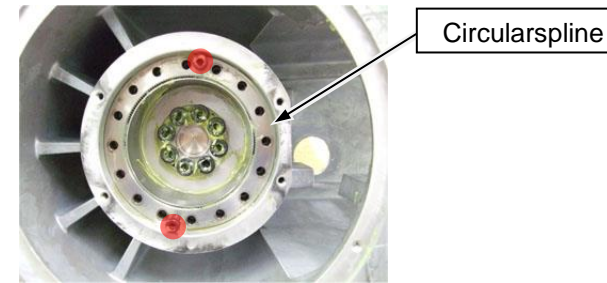
⑥ Remove the Circularspline from the base.

A S01: 16-M4x20



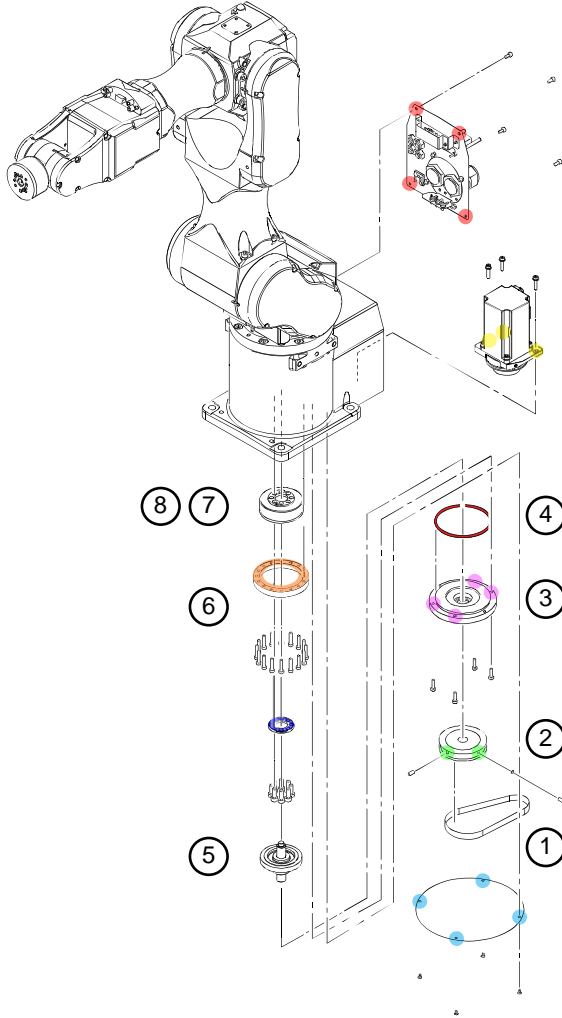
POINT

Insert screws at the two locations on the Circularspline as shown in the photograph, and tighten these screws evenly to remove. When removing, use Circularspline fixing screws.



Joint #1

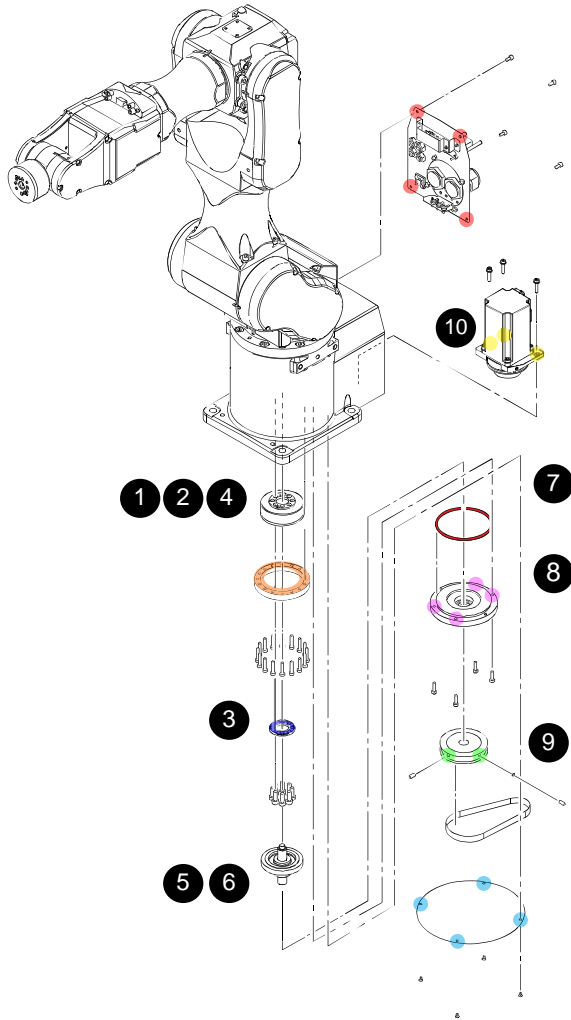
Removing the Reduction Gear Unit



⑦	Remove the spacer and Flexspline from the base. A S02: 8-M6x15	<p>A close-up photograph of the base assembly. The base is a circular metal plate with several radial spokes. In the center, there is a circular hub with eight red bolts. A green spacer is visible between the base and the hub. A flexspline is also visible, partially obscured by the spacer. Callouts point to the Base, Flexspline, and Spacer.</p>
⑧	If there is grease on the base, wipe it off with a cloth.	

Joint #1

Installing the Reduction Gear Unit




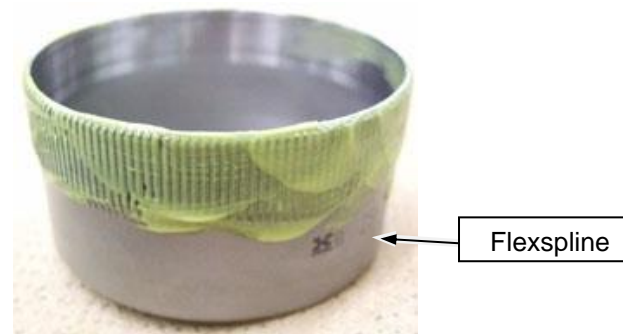
<Preparation>

1. Take the new Reduction Gear Unit out of the box, and check that the following parts are included.



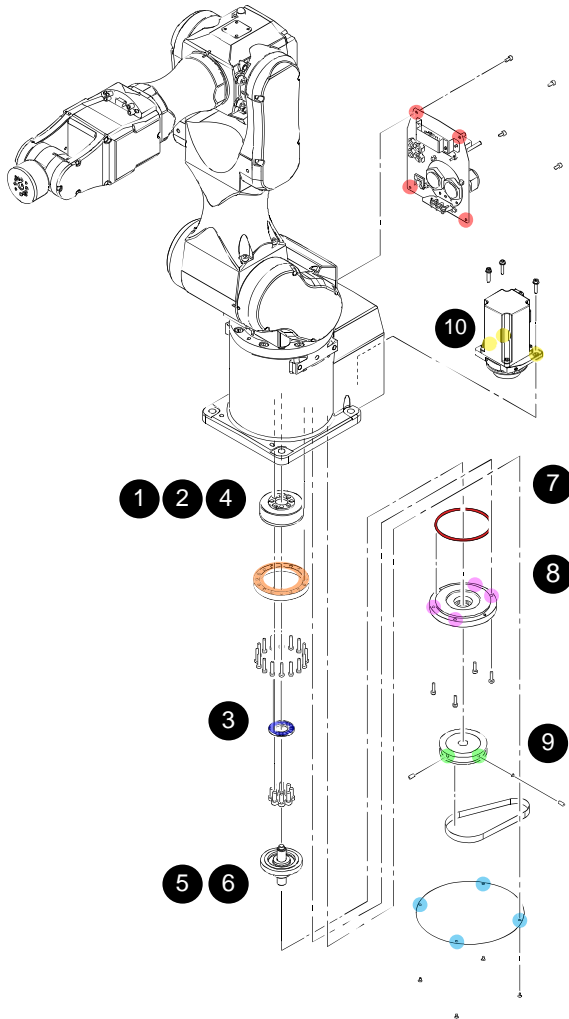
2. Apply grease around the entire gear surface of the Flexspline.

 SK-1: Apply enough grease to fill the grooves




Joint #1

Installing the Reduction Gear Unit



3. Apply grease around the entire gear surface of the Circularspline.

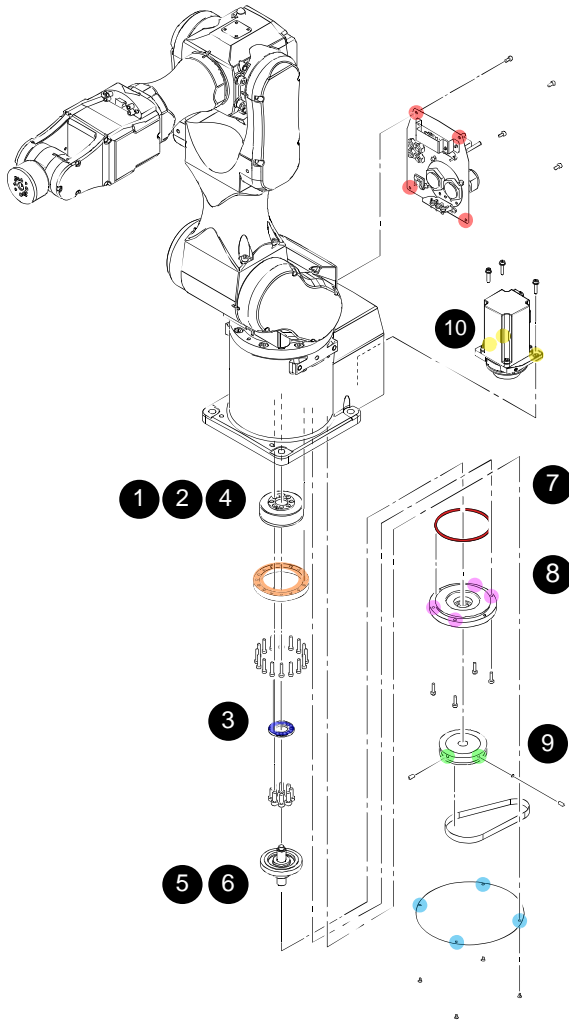
 SK-1A: Apply enough grease to fill the grooves



Circularspline

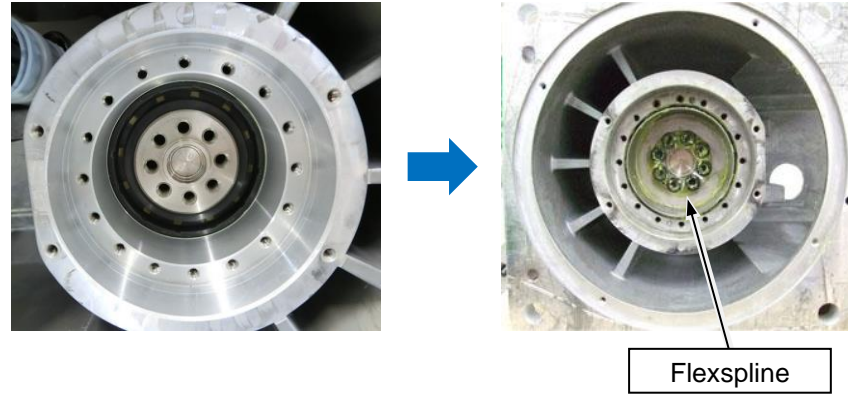
Joint #1

Installing the Reduction Gear Unit



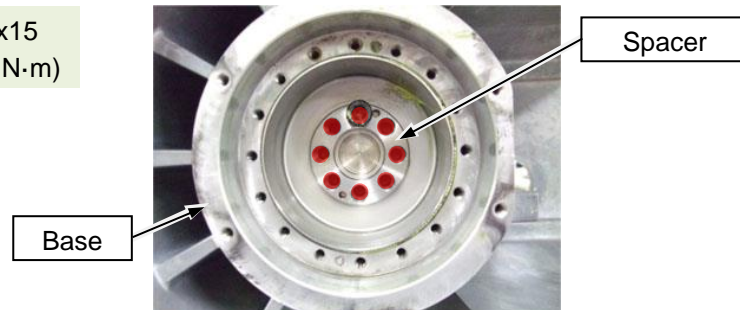
Joint #1

1 Install the Flexspline on the shaft end face.



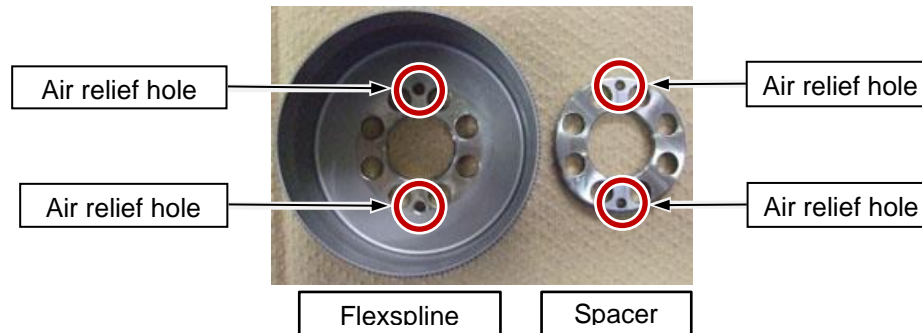
2 Install the spacer, and secure the Flexspline and spacer to the base.

A S02: 8-M6x15
(22.0 +/- 1.1 N·m)

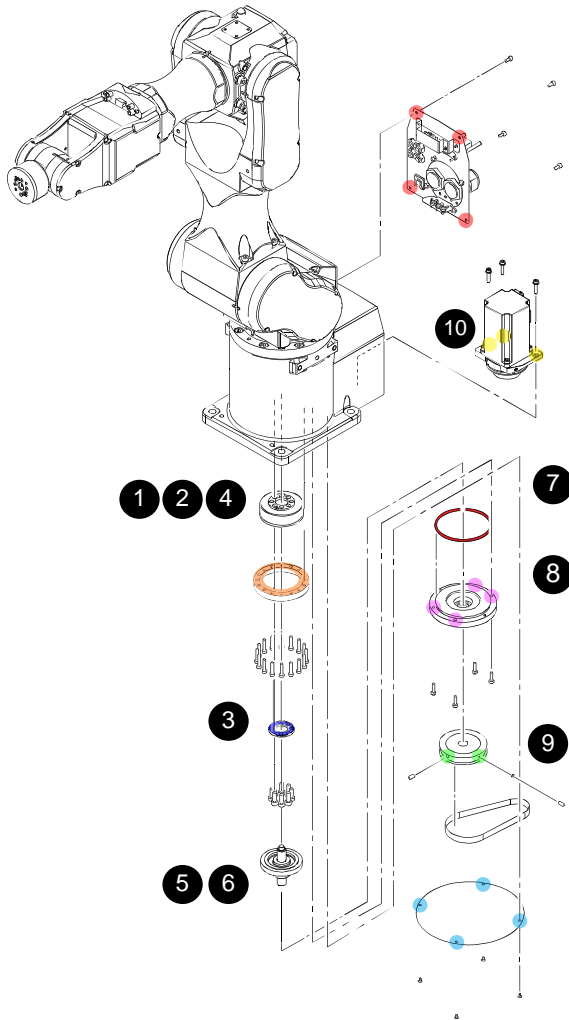


POINT

Align the air relief holes of the Flexspline with the air relief holes of the spacer to install.

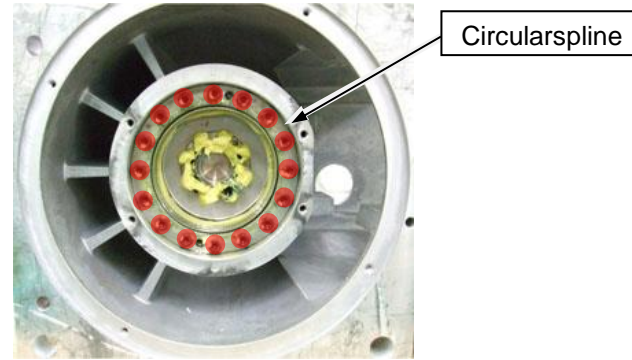


Installing the Reduction Gear Unit




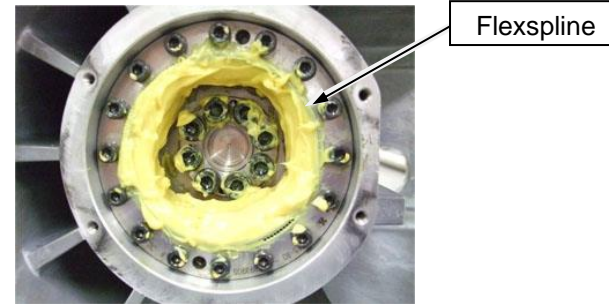
3 Install the Circularspline.

A S01: 16-M4x20
(4.0 +/- 0.2 N·m)



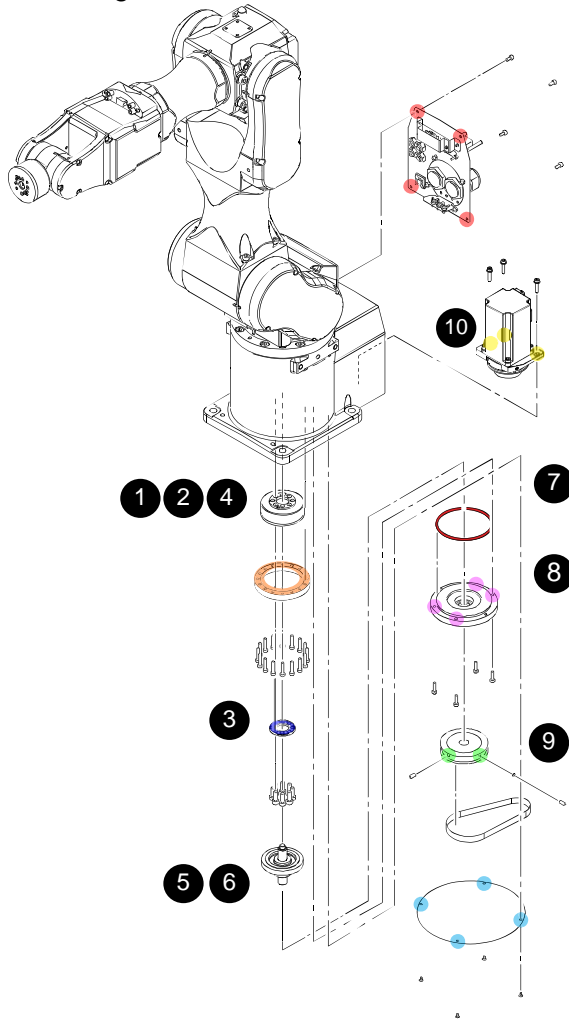
4 Apply grease to the inside of the Flexspline.

 SK-1A: 40 g



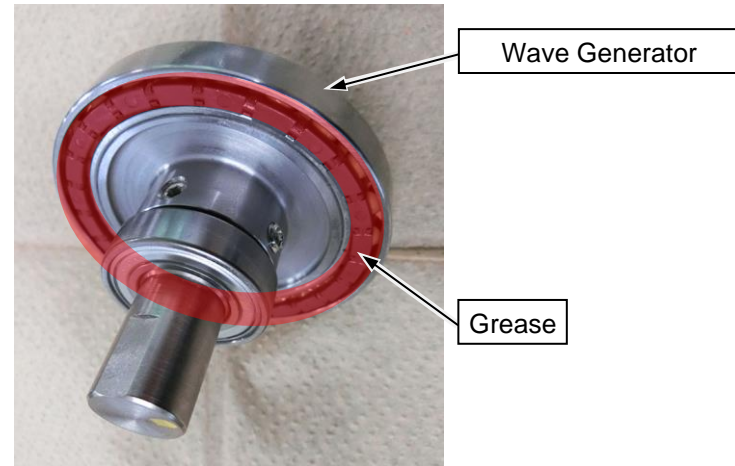
Joint #1

Installing the Reduction Gear Unit

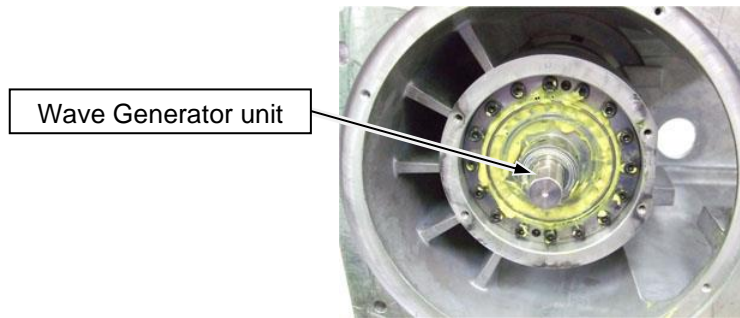


5 Apply grease to the bearing of the Wave Generator.

 SK-1A: Suitable amount

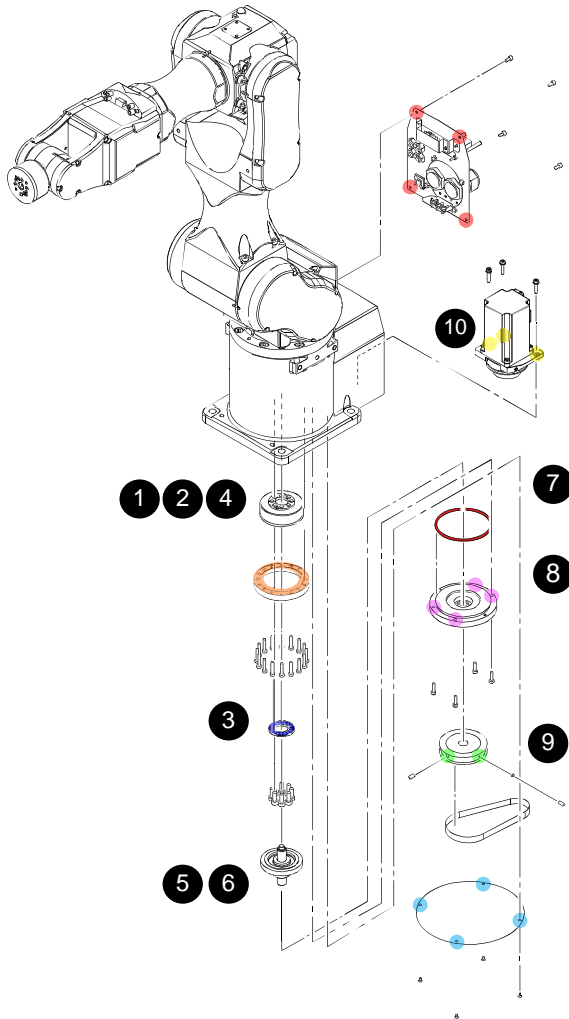


6 Install the Wave Generator unit on the Reduction Gear.



Joint #1

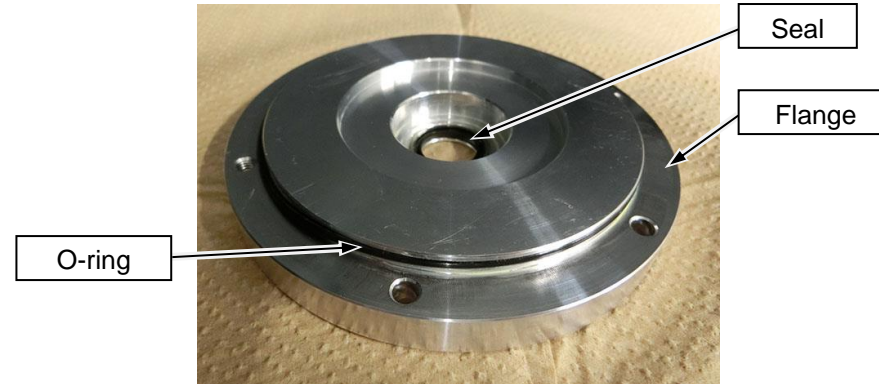
Installing the Reduction Gear Unit



7 Install the O-ring in the groove of the flange as shown in the figure.

CAUTION

- Be careful not to damage the O-ring when handling it.
- Insert the O-ring firmly into the groove of the flange.

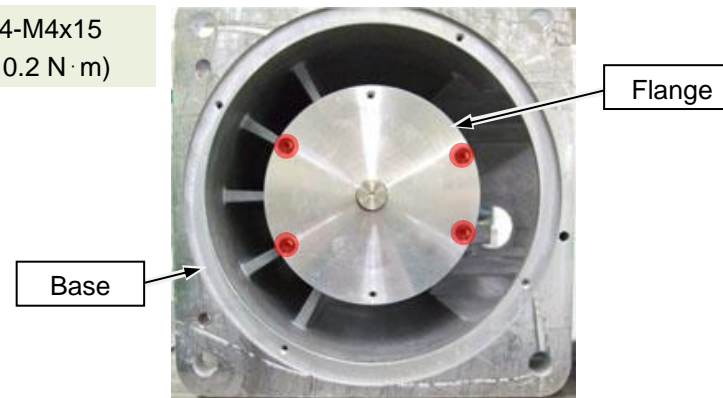


8 Install the flange on the base.

CAUTION

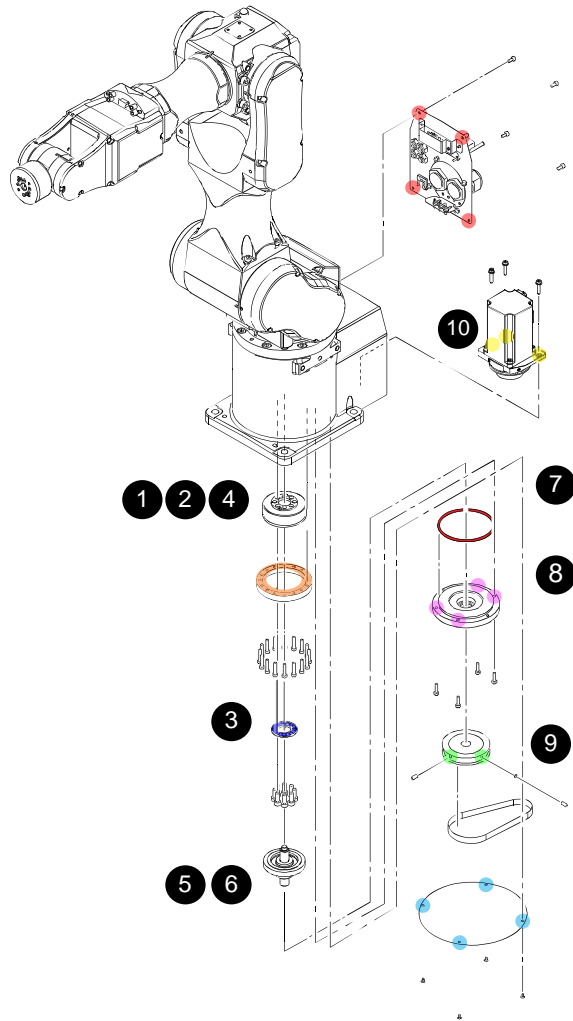
When inserting the flange hole over the shaft, take care not to damage the seal.

A S01: 4-M4x15
(4.0 ± 0.2 N·m)



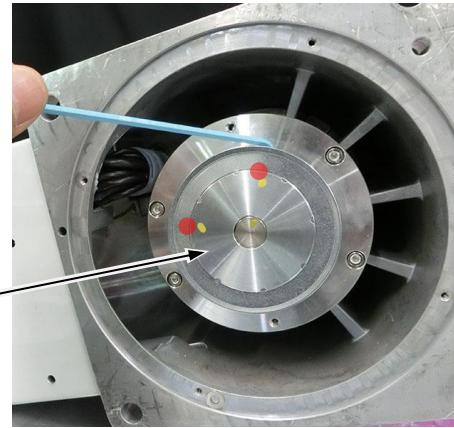
Joint #1

Installing the Reduction Gear Unit



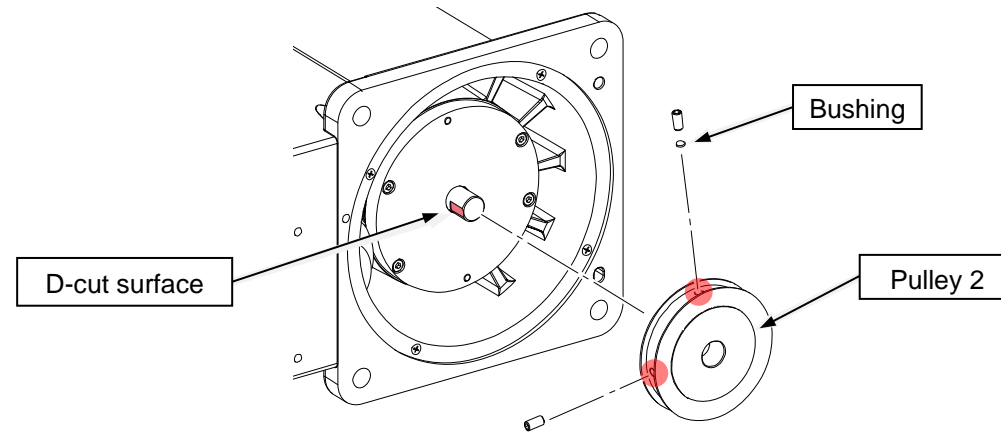
9 Install pulley 2.

A S05: 2-M5x10
(4.0 +/- 0.2 N·m)



POINT

- Align the shaft D-cut surface with the screw holes, and install pulley 2.
- Align the shaft end and pulley 2 surface, and secure.

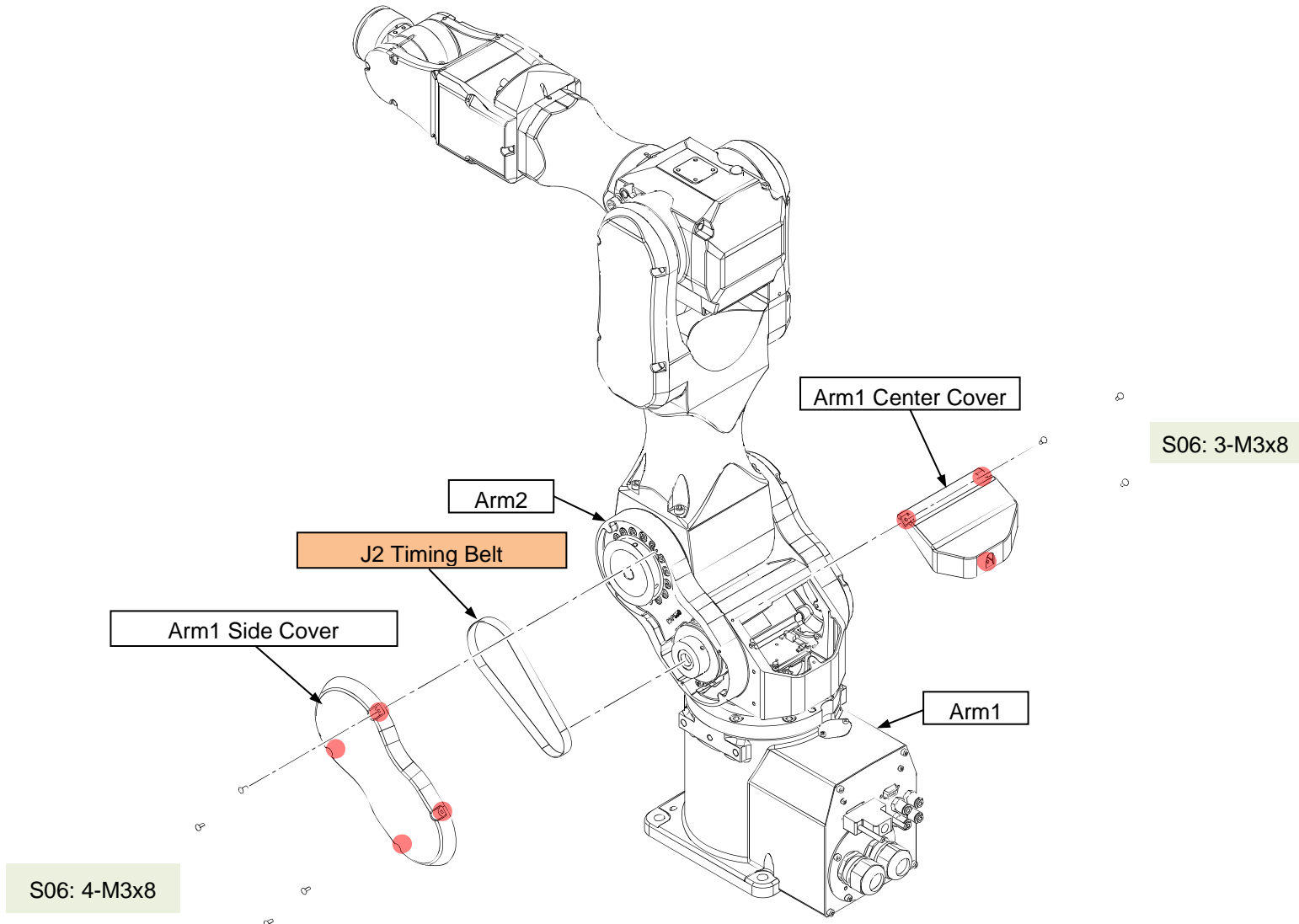


10 Install the [J1 Motor unit](#).

Joint #1

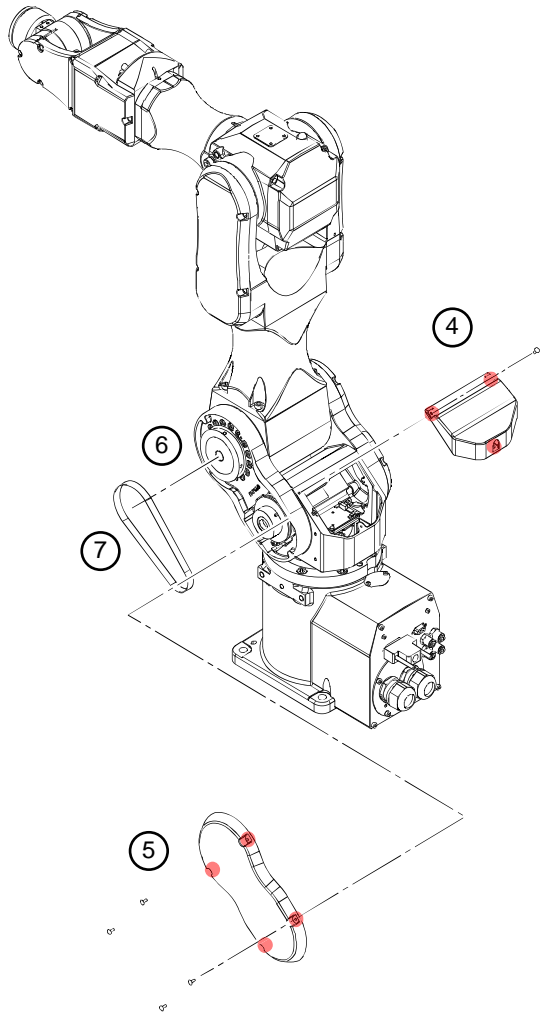
2.3 Joint #2

2.3.1 Joint #2 Replacing the Timing Belt

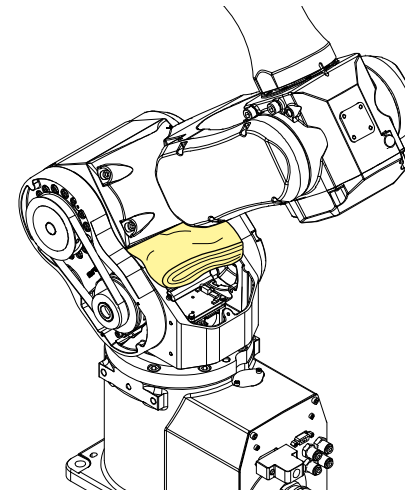


Joint #2

Removing the Timing Belt

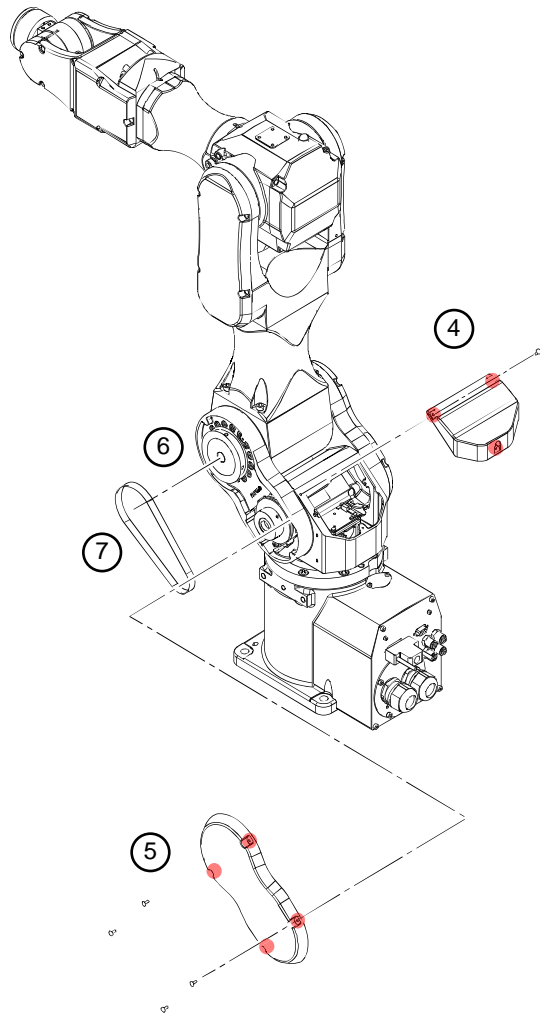


①	Turn ON the controller.
②	<p>Release the J2 brake, manually push and move Arm2, and push it against Arm1. At this time, place cushioning between Arm1 and Arm2 to prevent damage to them.</p> <p>WARNING</p> <ul style="list-style-type: none"> • Arm2 falls by its weight when the J2 Timing Belt is removed. Release the brake and tilt Arm2 in advance. • There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.
③	Turn OFF the Controller.

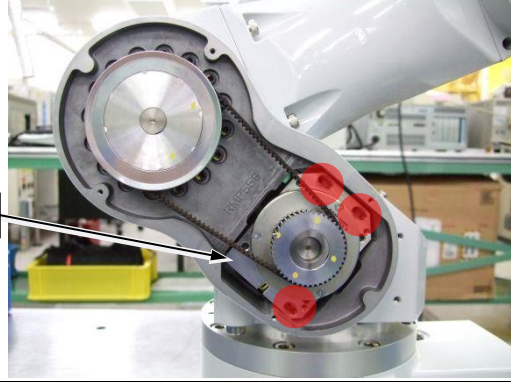
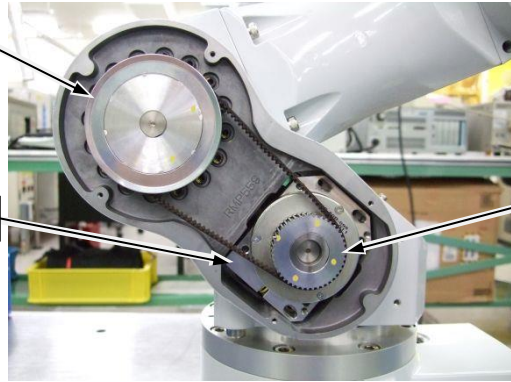


Joint #2

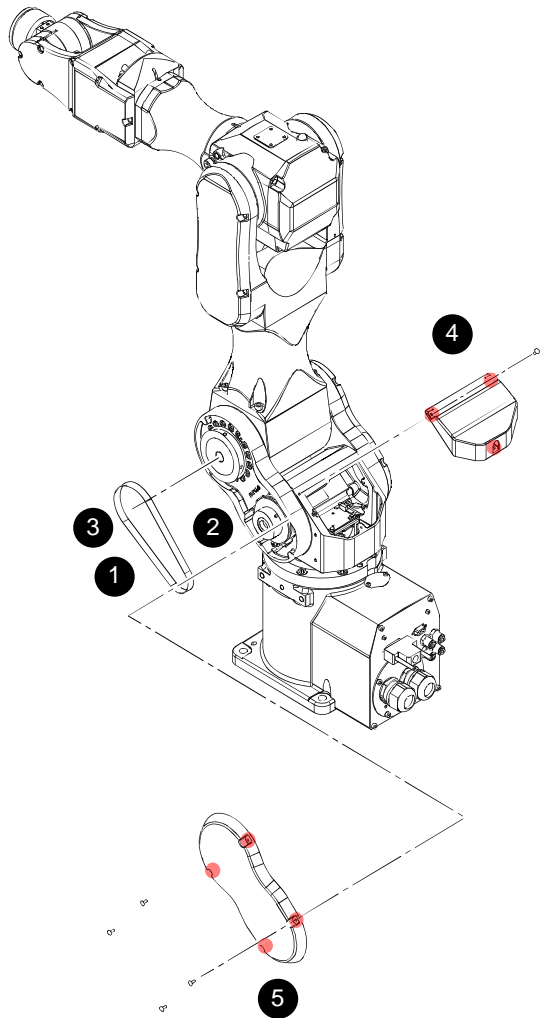
Removing the Timing Belt



Joint #2

④	Remove the Arm1 Center Cover .
⑤	Remove the Arm1 side cover .
⑥	<p>Loosen the screws securing the J2 Motor unit.</p> <p>A S01: 3-M4x18 and washer</p> 
⑦	<p>Remove the J2 Timing Belt.</p> <p>CAUTION Removing the Timing Belt while Arm2 is not tilted will result in Arm2 falling, which is very dangerous. Before removing the Timing Belt, ensure that you perform step ②.</p> <p>POINT First remove the belt from pulley 1.</p> 

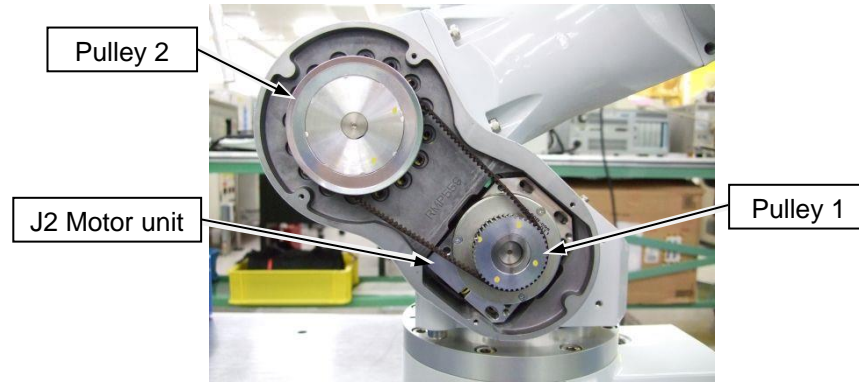
Installing the Timing Belt



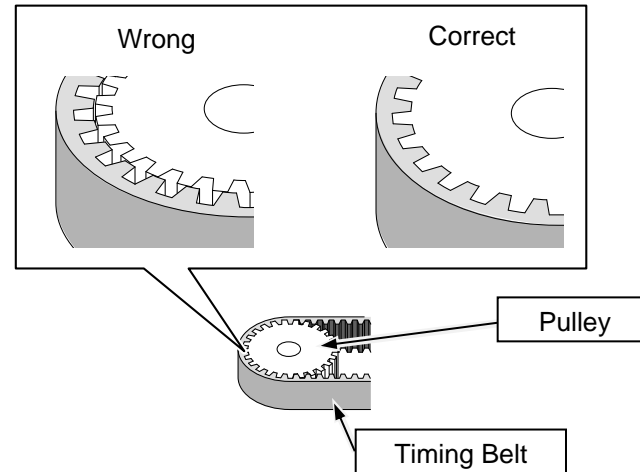
1 Install the J2 Timing Belt.

POINT

- First place the belt on pulley 2.

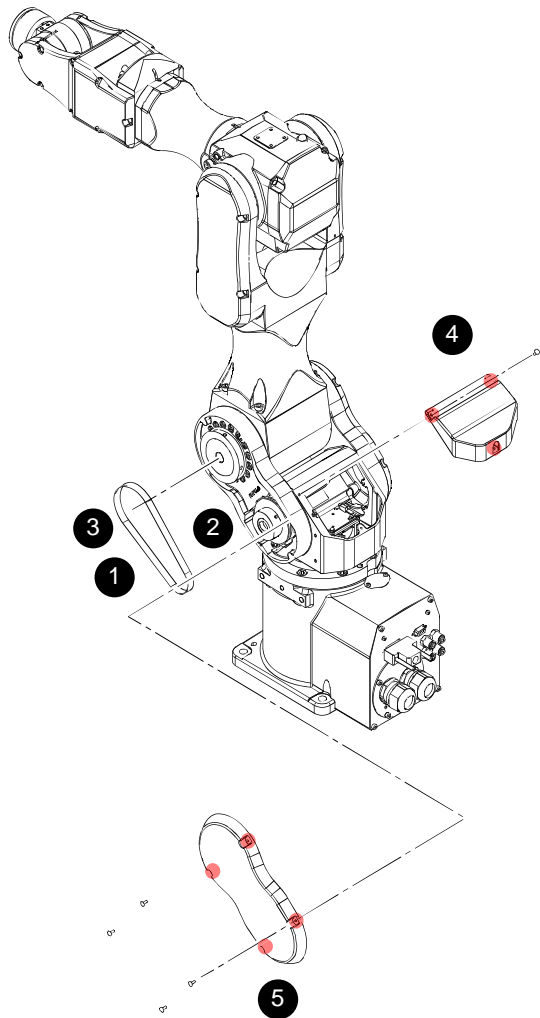


- Make sure that the teeth of the Timing Belt and the pulley are properly engaged.



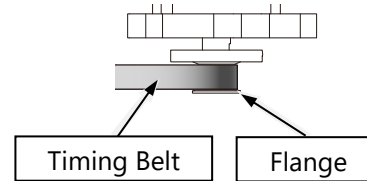
Joint #2

Installing the Timing Belt



CAUTION

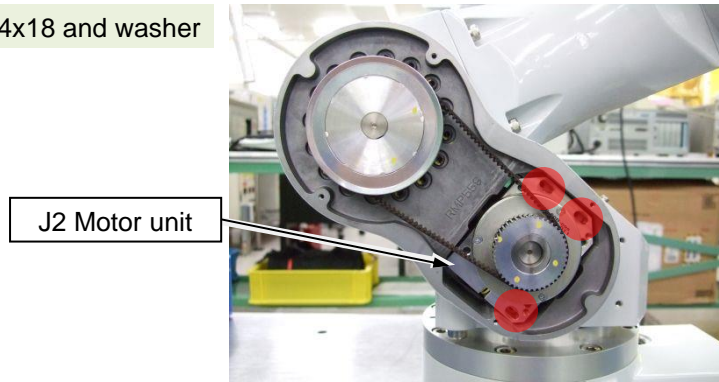
If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



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

2 Temporarily secure the J2 Motor unit.

A S01: 3-M4x18 and washer



3 Adjust the belt tension.
[3.1 Adjusting the Timing Belt Tension](#)

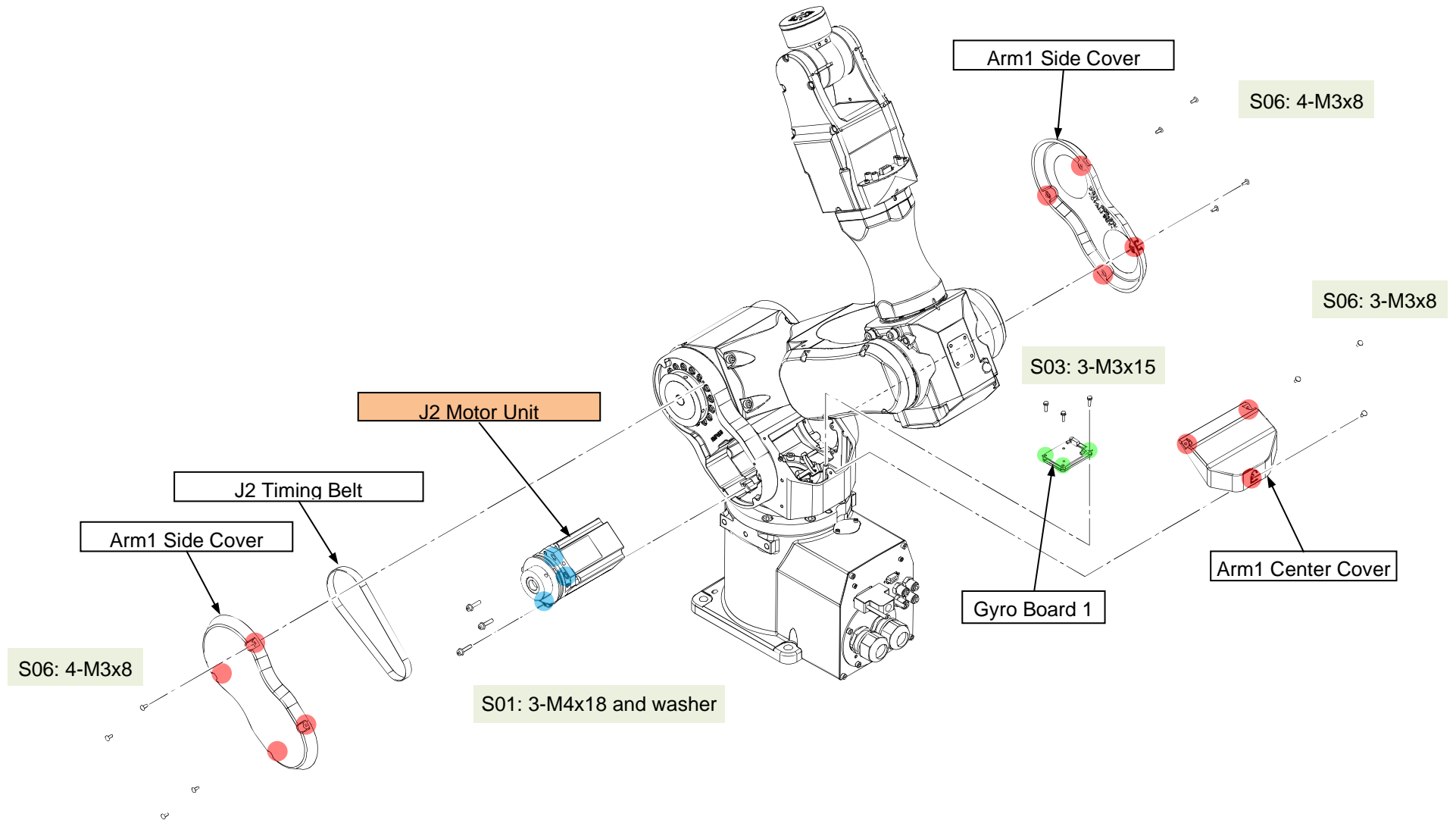
4 Install the [Arm1 Center Cover](#).

5 Install the [Arm1 side cover](#).

6 After assembly, perform calibration of Joint #2.
[3.2 Calibration](#)

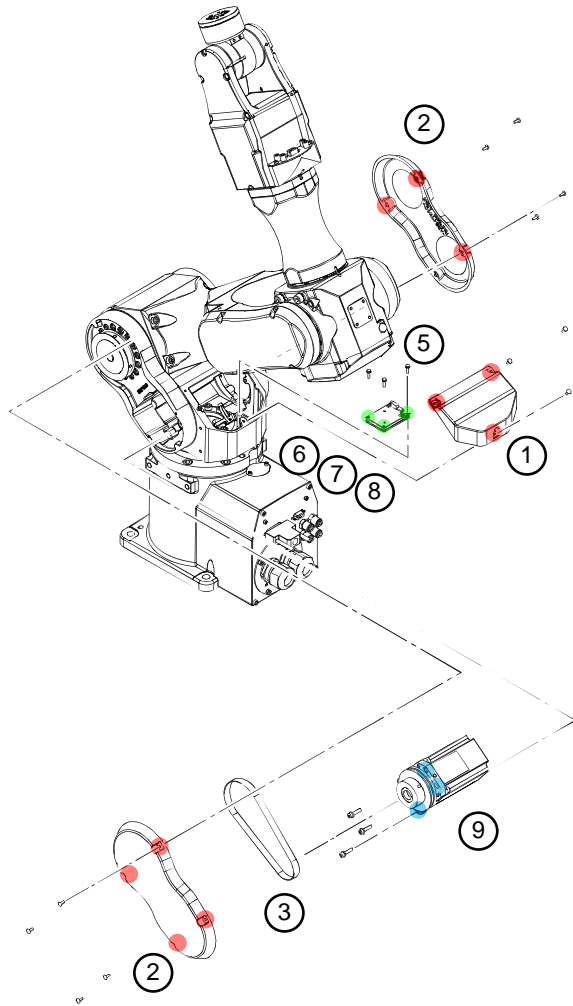
Joint #2

2.3.2 Joint #2 Replacing the Motor Unit

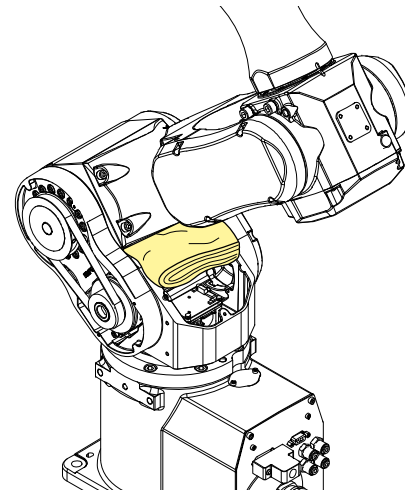


Joint #2

Removing the Motor Unit

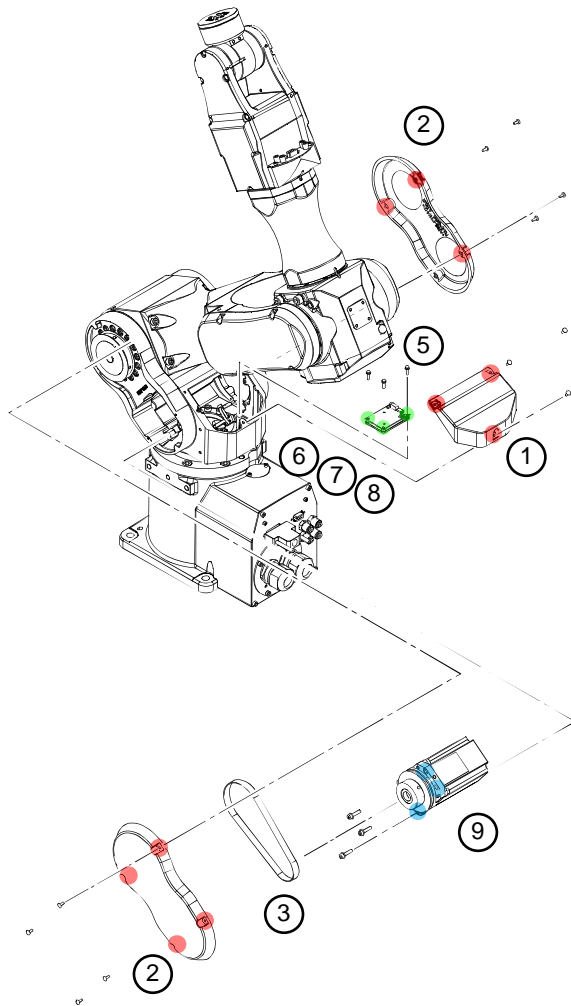


①	Turn ON the controller.
②	Release the J2 brake, manually push and move Arm2, and push it against Arm1. At this time, place cushioning or rags between Arm1 and Arm2 to prevent damage to them. WARNING <ul style="list-style-type: none"> • Arm2 falls by its weight when the J2 Motor unit is removed. Release the brake and tilt Arm2 in advance. • There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.
③	Turn OFF the Controller.
④	Remove the J2 Timing Belt .



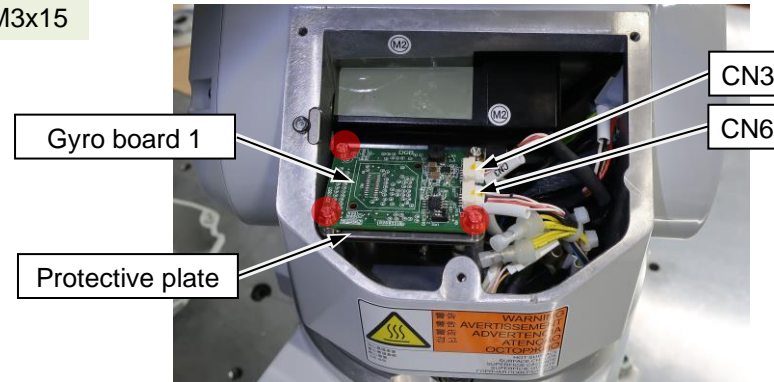
Joint #2

Removing the Motor Unit



⑤ Disconnect the connectors (CN3, CN6), and remove gyro board 1 together with the protective plate.

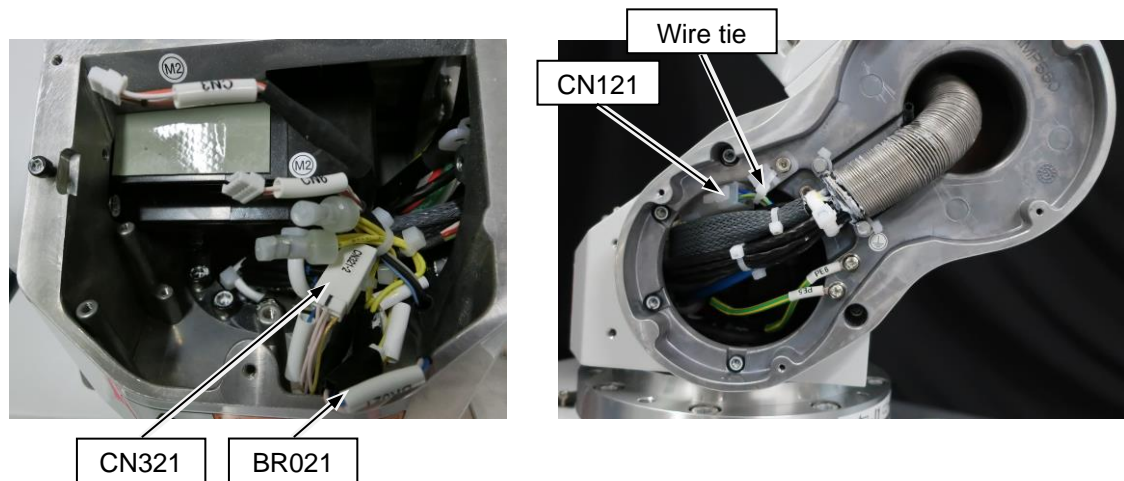
A S03: 3-M3x15



⑥ Disconnect the J2 Motor Connectors (CN121, CN321, BR021), and cut the wire tie securing CN121.

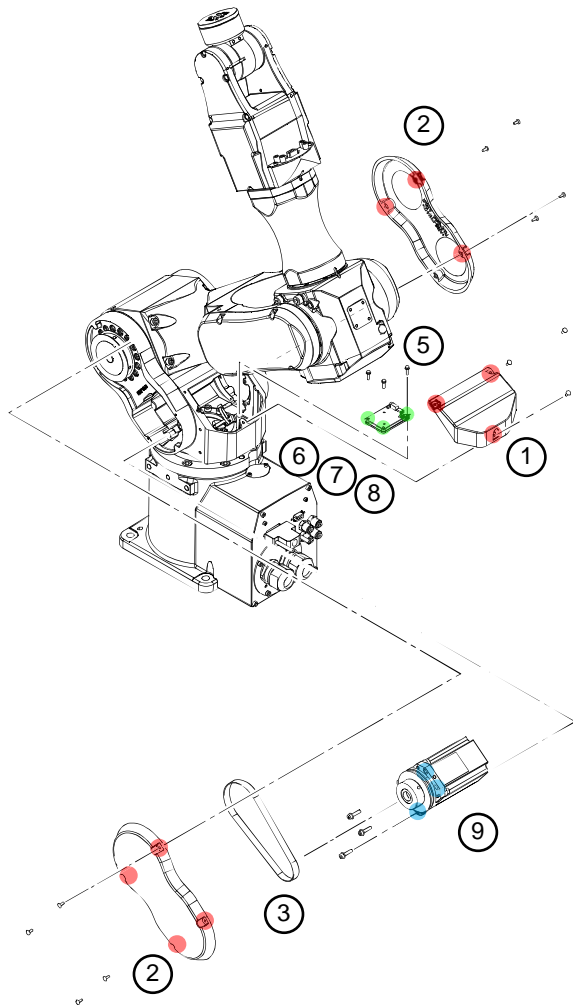
POINT

Press the connector clip, and pull out.

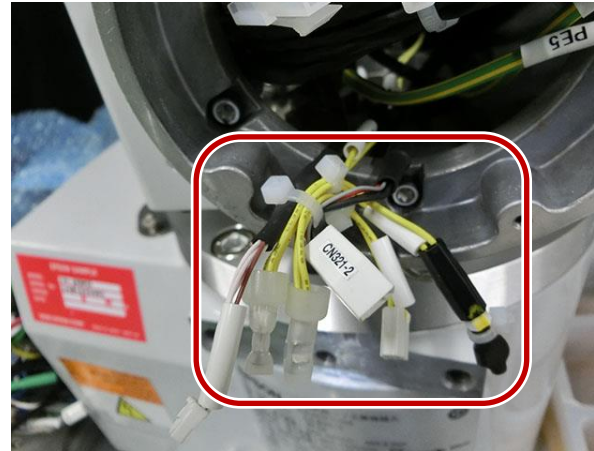


Joint #2

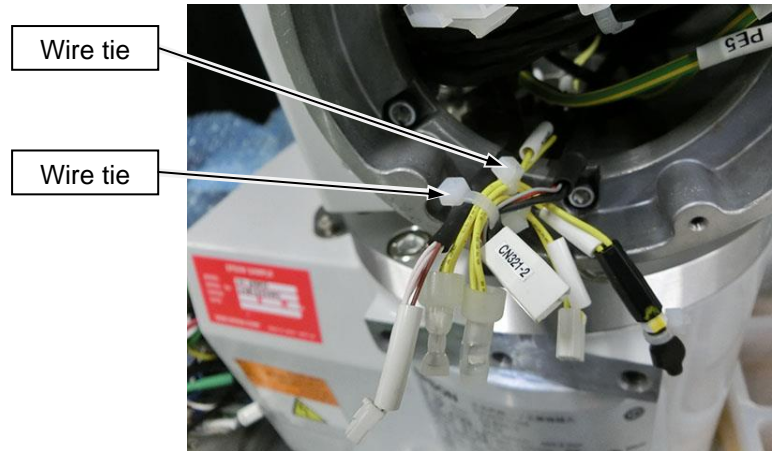
Removing the Motor Unit



⑦ Pull out the CN121, BR021, and CN6 cables as shown in the figure.

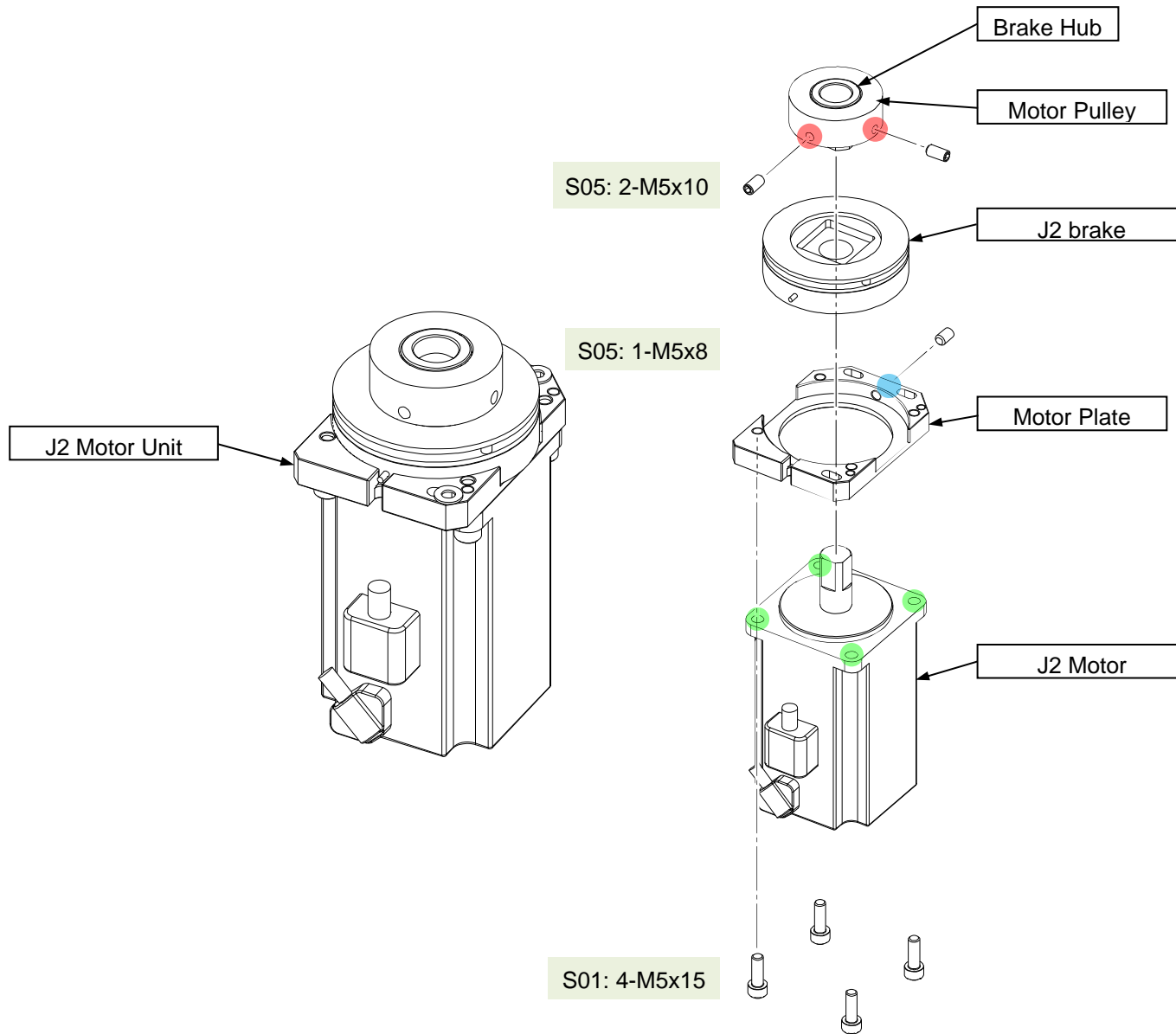


⑧ Cut the wire ties.



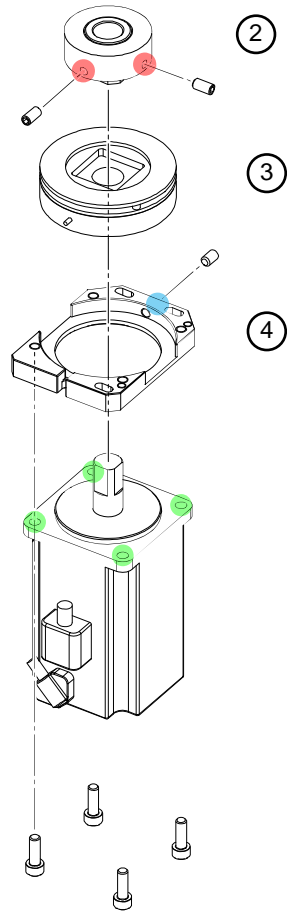
⑨ Remove the loosened screws, then remove the J2 Motor unit.

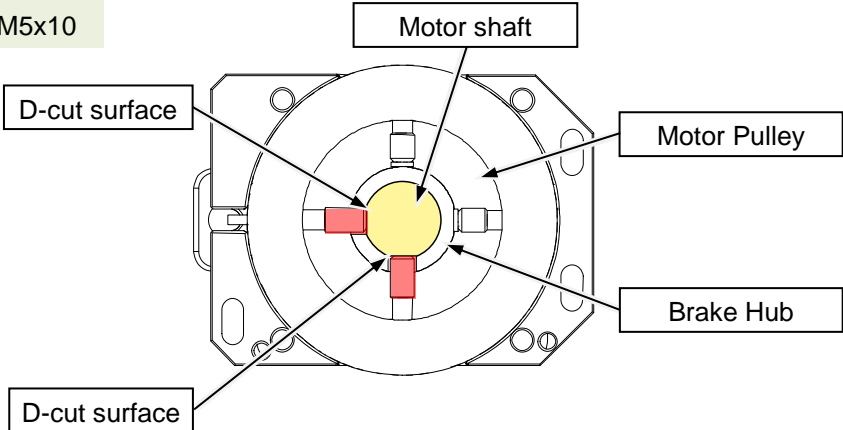
Motor Unit Disassembly



Joint #2

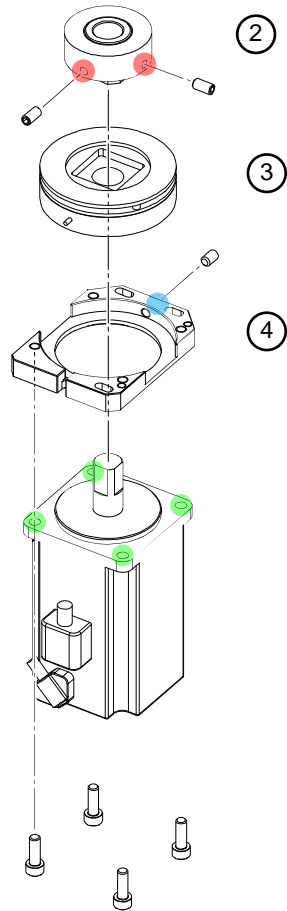
Motor Unit Disassembly



①	Remove the J2 Motor unit .
②	<p>Remove the Motor Pulley unit.</p> <p>POINT</p> <p>Remove the Motor Pulley and the Brake Hub together.</p> <p>1. Loosen the two screws on the D-cut surface of the motor shaft when viewing the J2 Motor unit from above.</p> <p>A S05: 2-M5x10</p>  <p>2. Remove the Motor Pulley unit from the motor shaft.</p>

Joint #2

Motor Unit Disassembly

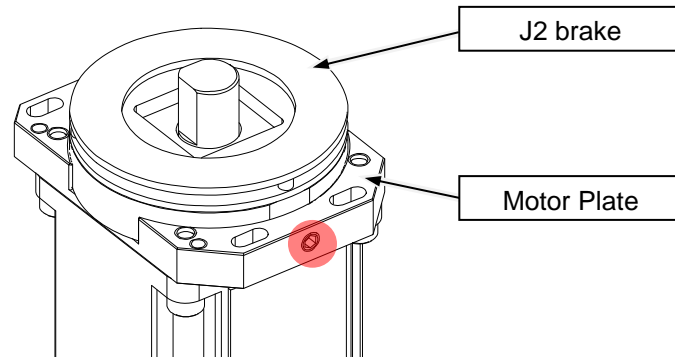


③

1. Remove the J2 brake.

A

S05: 1-M5x8



2. When replacing the brake, connect the connector (D) to the brake.

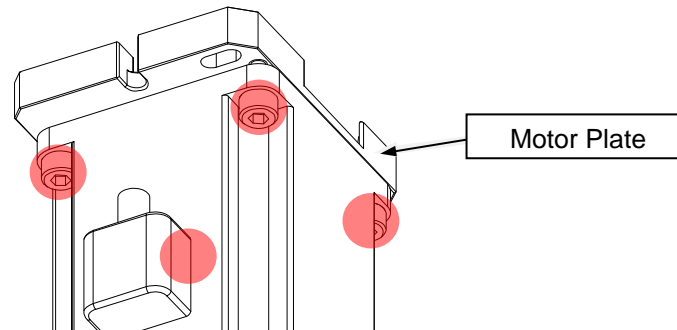


④

Remove the Motor Plate.

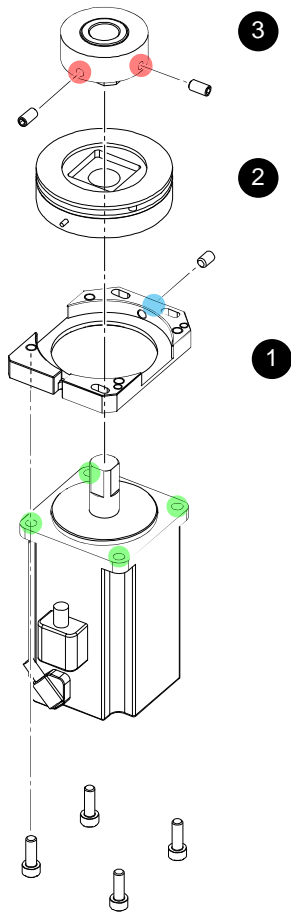
A

S01: 4-M5x15



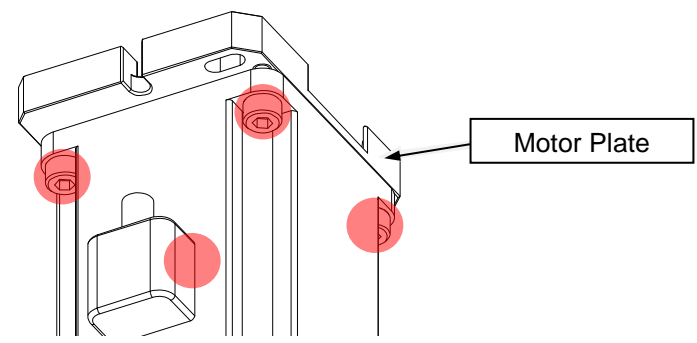
Joint #2

Motor Unit Assembly



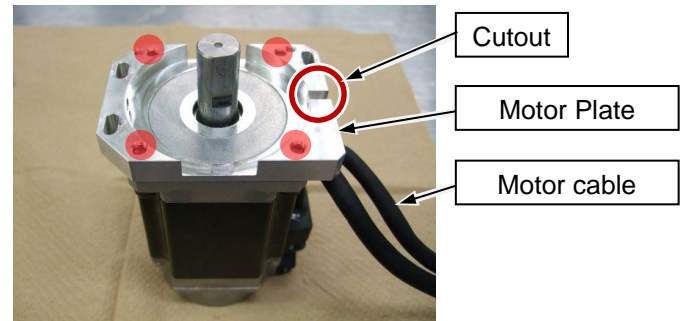
1 Install the Motor Plate.

A S01: 4-M5x15
(8.0 +/- 0.4N·m)



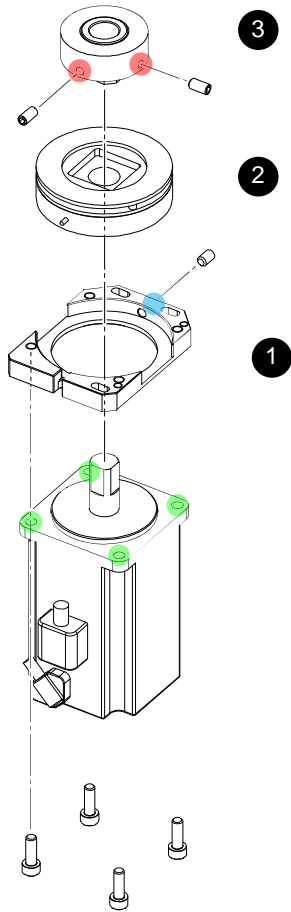
POINT

Attach the Motor Plate according to the orientation shown in the figure.



Joint #2

Motor Unit Assembly



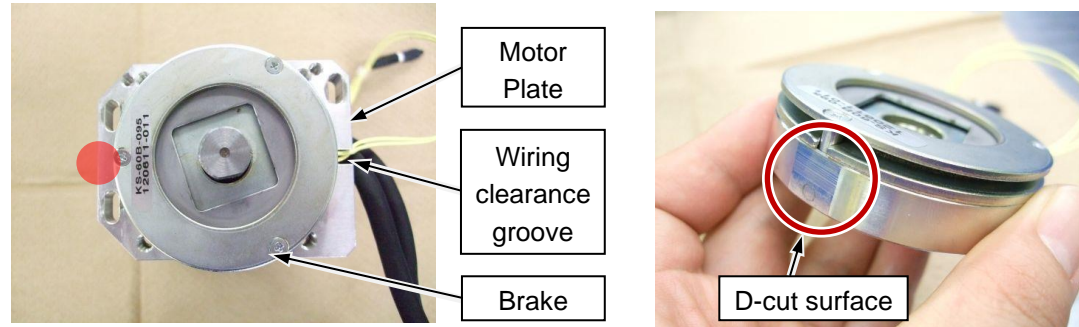
2

1. Install the J2 brake.

A S05: 1-M5x8 (4.0 +/- 0.2 N·m)

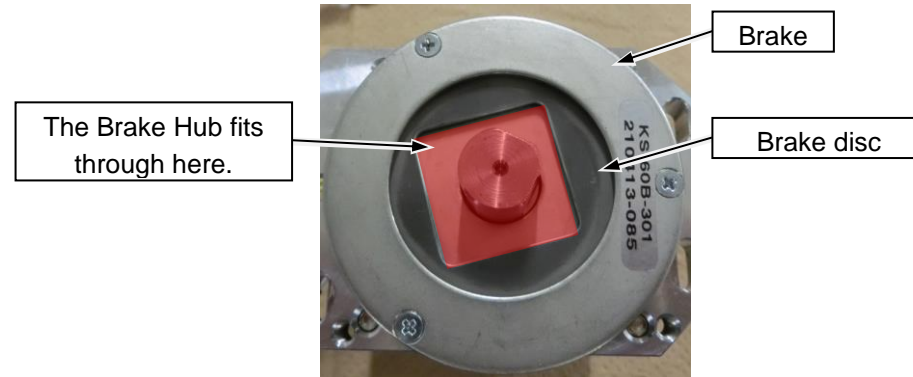
CAUTION

- Be careful not to let the brake wiring get caught in or cut by the Motor Plate.
- Align the position of the brake wiring with the position of the Motor Plate wiring clearance groove, and align the D-cut surface of the brake with the set screw side to secure.



POINT

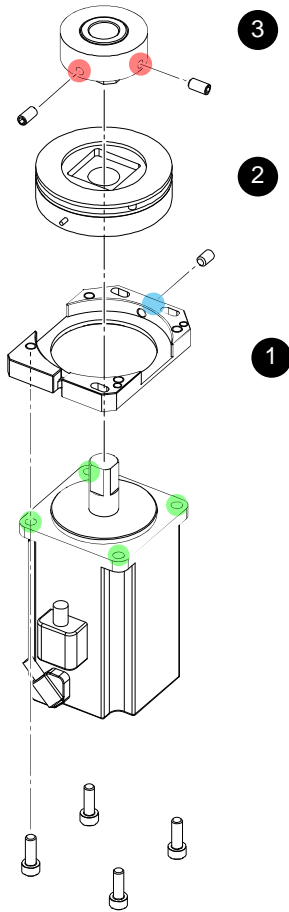
- Align the Brake Hub and brake disc positions, and install the Brake Hub on the motor shaft. If they are misaligned, adjust the brake disc position.



- Secure the set screw while pressing the brake to the Motor Plate.

Joint #2

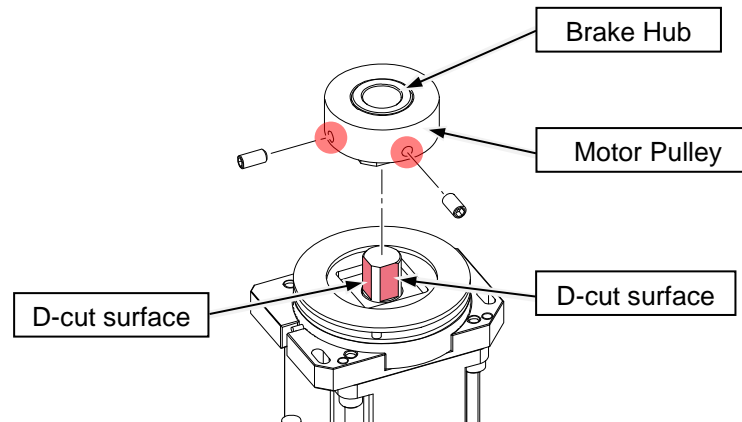
Motor Unit Assembly



2. When replacing the brake, connect the connector (D) to the brake.

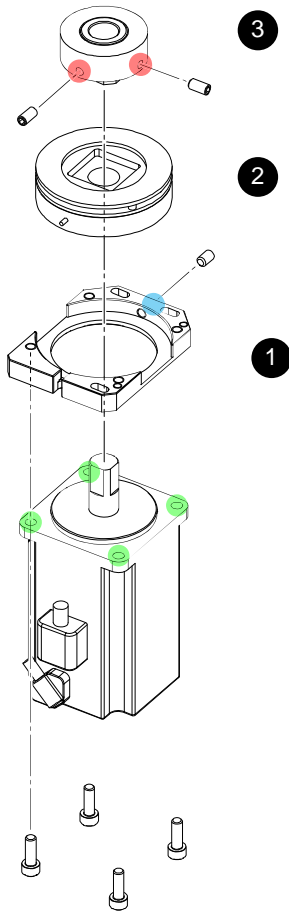


3. Install the Motor Pulley unit to the J2 Motor unit.
1. Insert the Motor Pulley so that the set screw position aligns with the motor shaft D-cut surface.



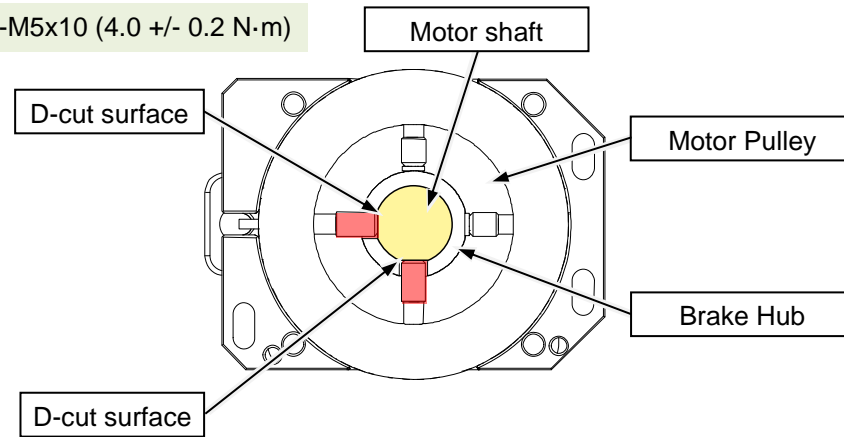
Joint #2

Motor Unit Assembly

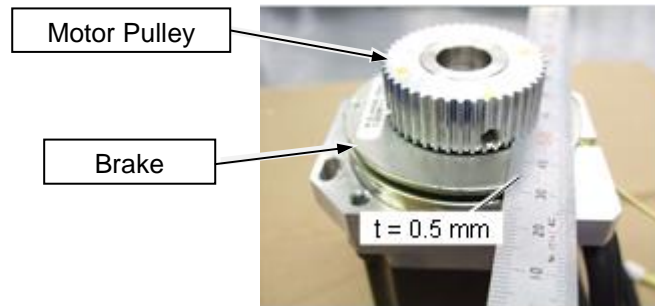


2. Secure the Motor Pulley unit to the motor shaft.

A S05: 2-M5x10 (4.0 +/- 0.2 N·m)



Place a feeler gauge (0.5 mm) between the Motor Pulley and the brake, to ensure a 0.5-mm gap during installation.

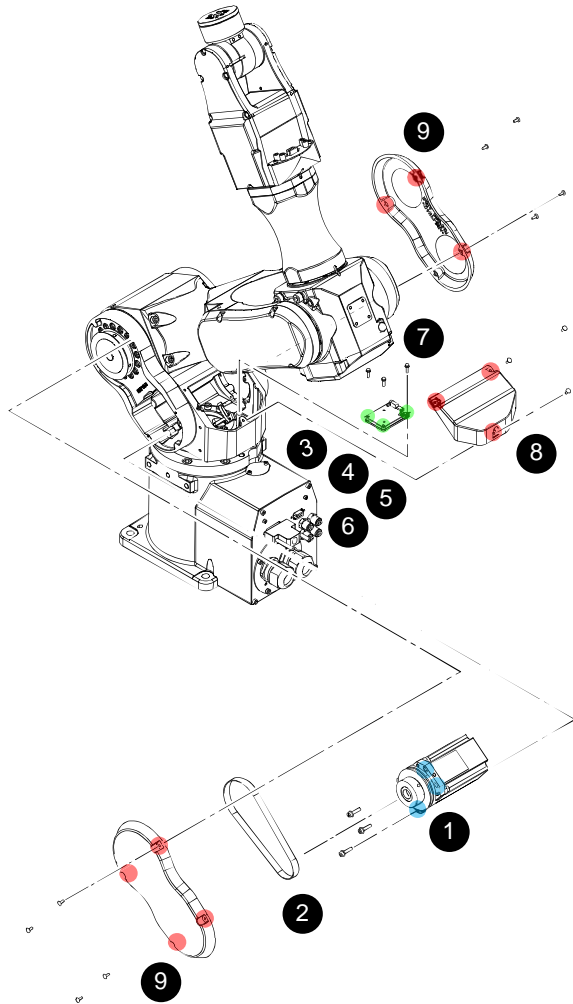


CAUTION

Failure to create a proper gap between the Motor Pulley and the brake may cause the parts to rub during motor operation, causing a malfunction.

4 Install the [J2 Motor unit](#).

Installing the Motor Unit



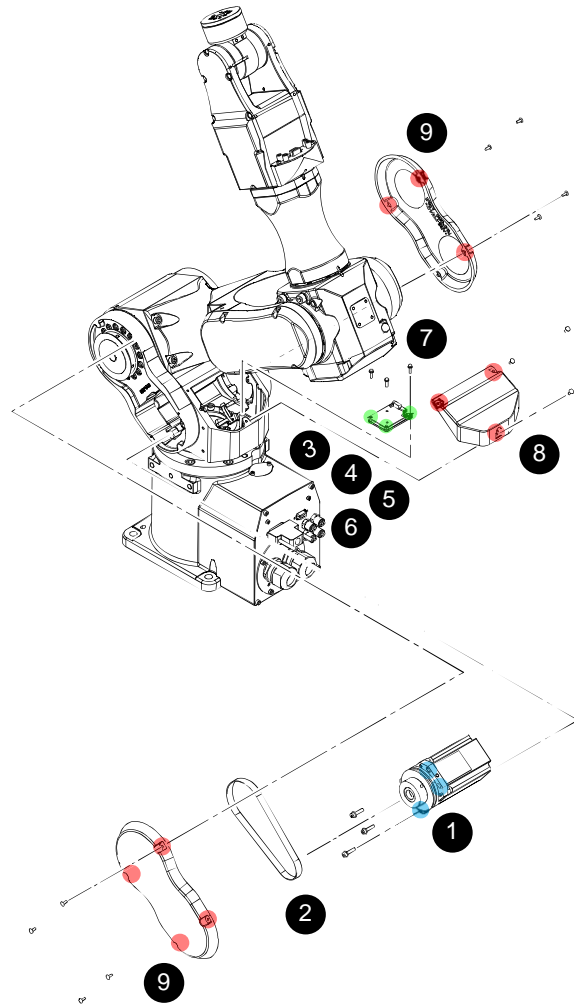
1 Insert the J2 Motor unit inside Arm2.
CAUTION
 The Motor Unit has a Radiation Sheet attached. When inserting the Motor Unit, be careful not to tear the Radiation Sheet.

2 Install the [J2 Timing Belt](#).
 Perform steps **1** to **3**.

3 Pull out the CN321 and BR021 cables as shown in the figure.

Joint #2

Installing the Motor Unit

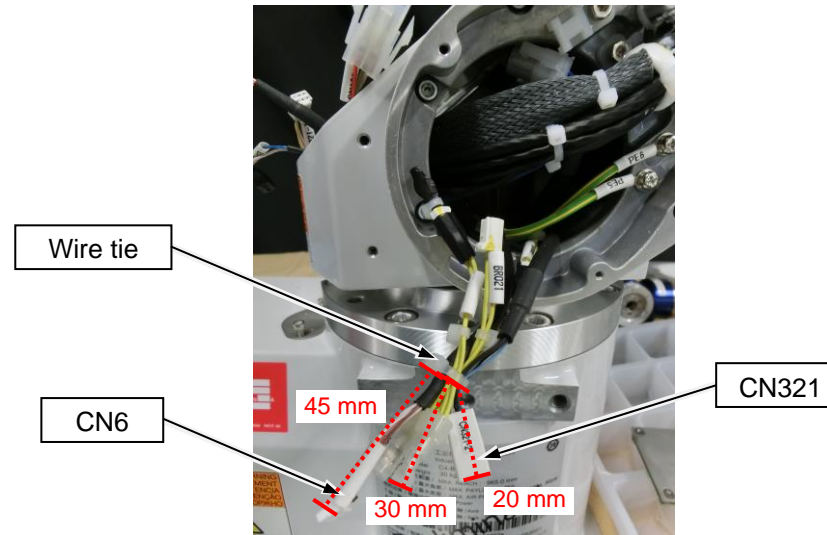


Joint #2

4 Secure the cables using wire tie (AB100).

POINT

Bind each cable in the position as shown in the figure.

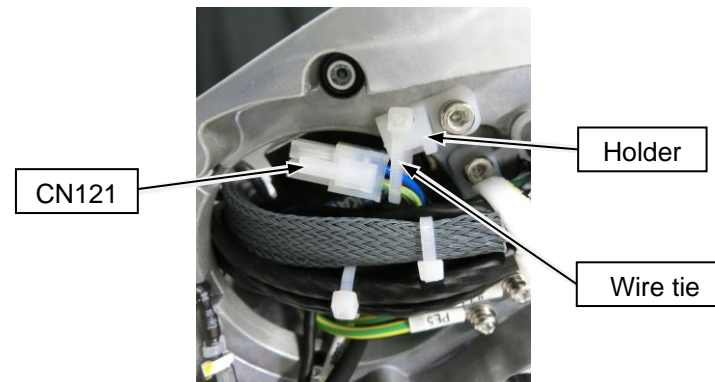


5 Bind CN121 to the holder with the wire tie (AB100).

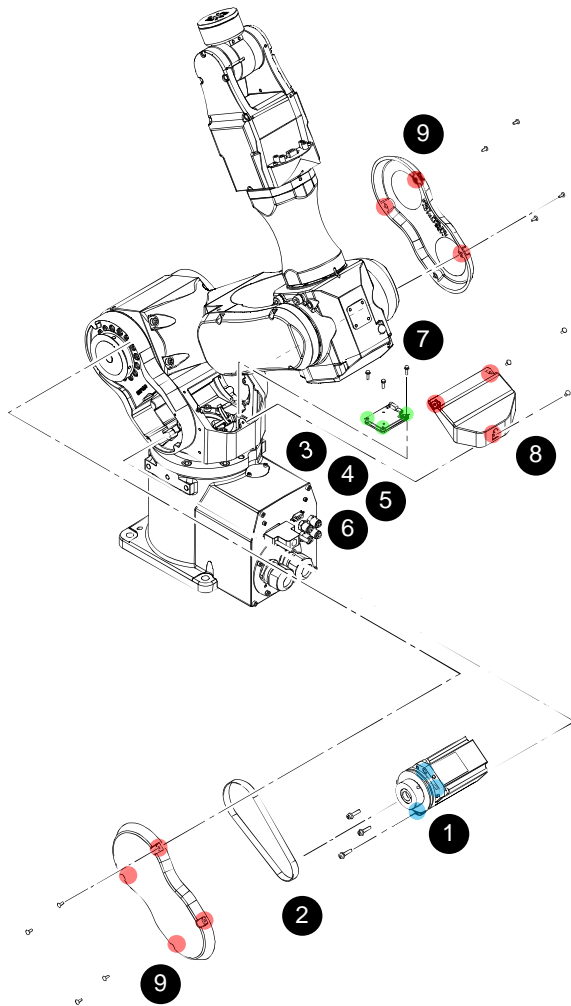
Adjust the wire tie (AB100) to the extent that the connector does not come out.

CAUTION

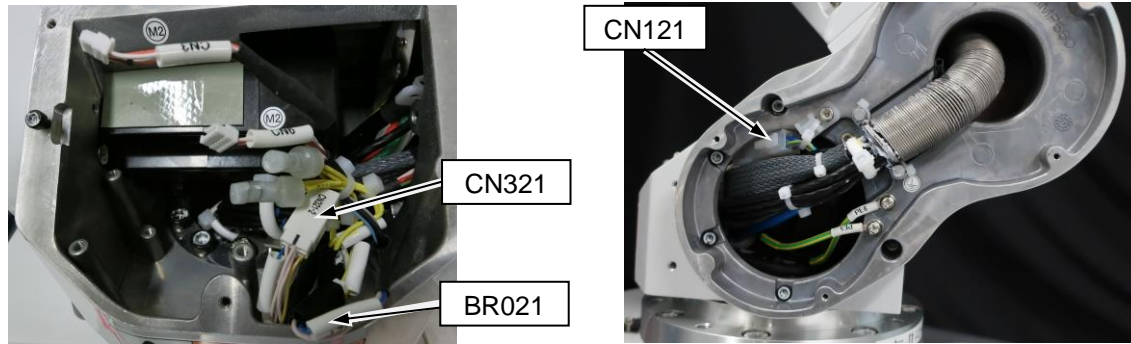
To allow the connector to still move a little, do not excessively tighten the wire tie (AB100).



Installing the Motor Unit



6 Connect the J2 Motor Connectors (CN121, CN321, BR021).

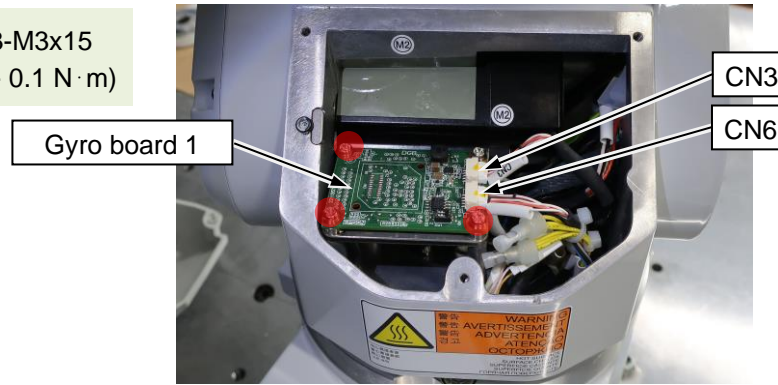


7 Install gyro board 1, and connect the connectors (CN3, CN6).

CAUTION

Check the board markings and connector labels before connecting the connectors to ensure that the connectors are not inserted incorrectly.

A S03: 3-M3x15
(0.45 +/- 0.1 N·m)



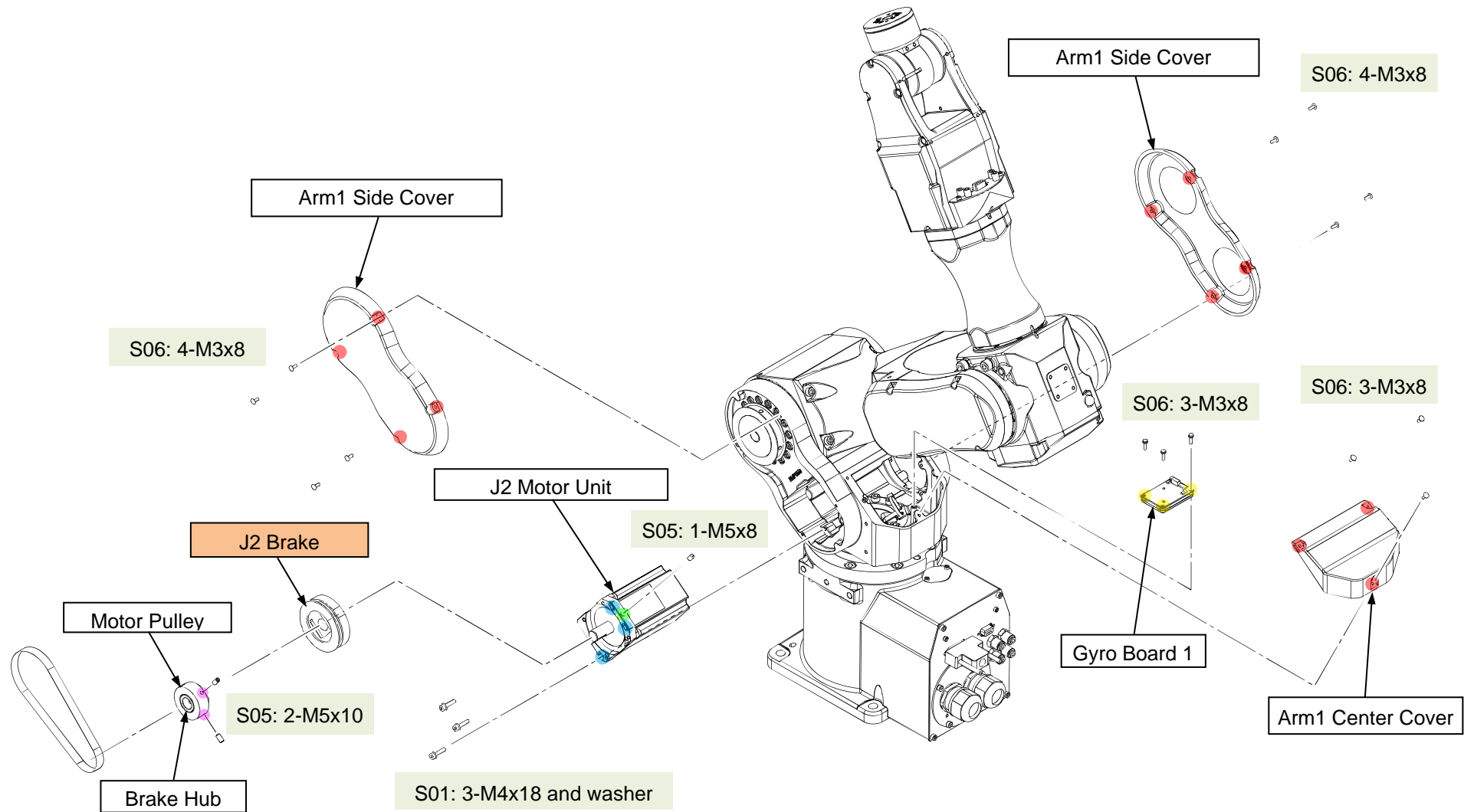
8 Install the [Arm1 Center Cover](#).

9 Install the [Arm1 side cover](#).

10 After assembly, perform calibration of Joint #2.
[3.2 Calibration](#)

Joint #2

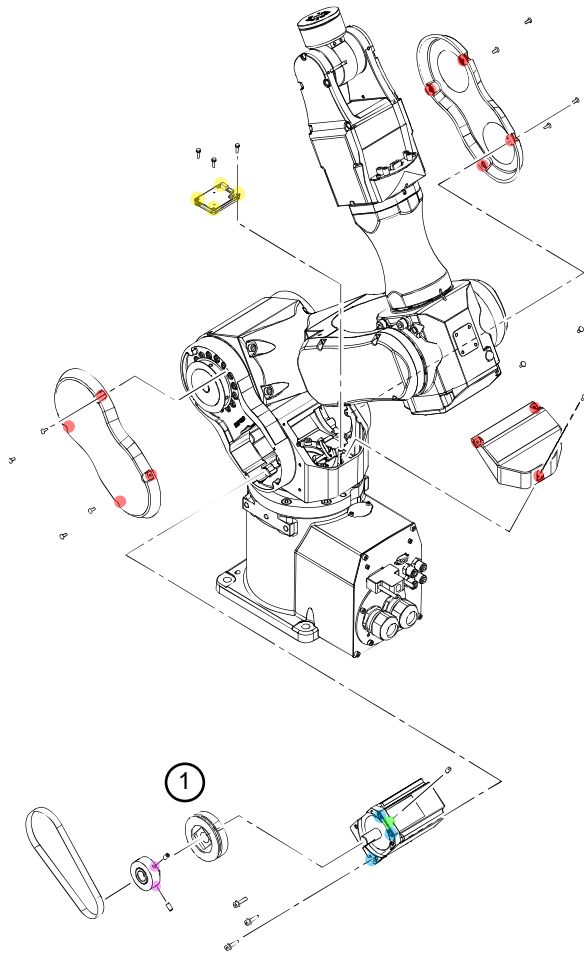
2.3.3 Joint #2 Replacing the Brake



Joint #2

Removing the Brake

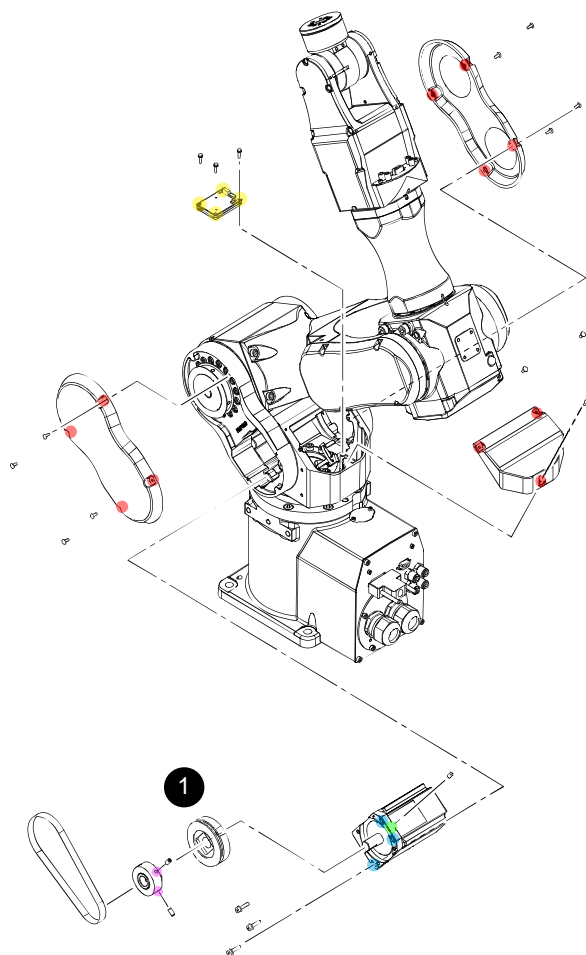
①	Refer to J2 Motor Unit Disassembly and remove the J2 brake.
---	---



Joint #2

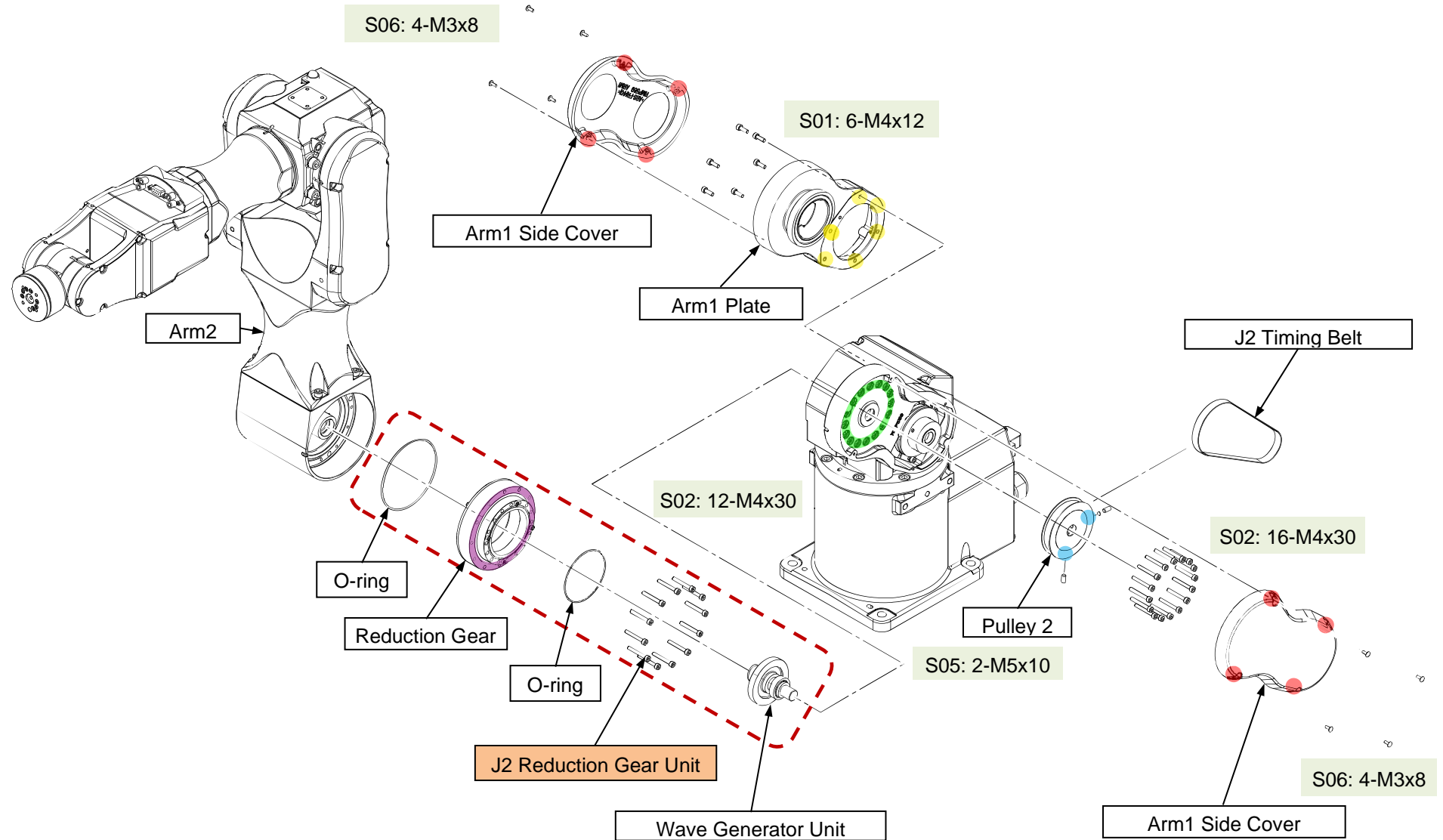
Installing the Brake

1 Refer to [J2 Motor Unit Assembly](#) and install the J2 brake.



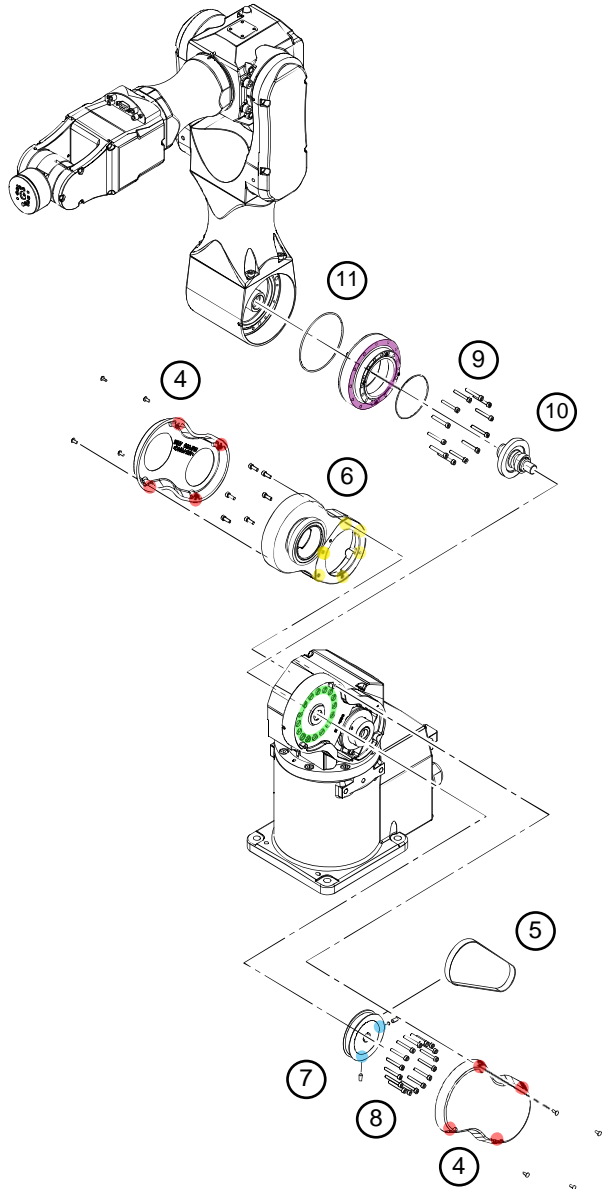
Joint #2

2.3.4 Joint #2 Replacing the Reduction Gear Unit

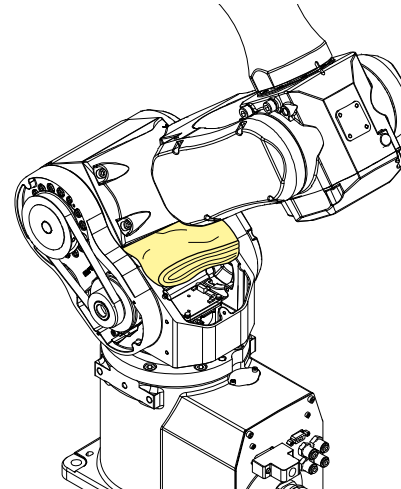


Joint #2

Removing the Reduction Gear Unit

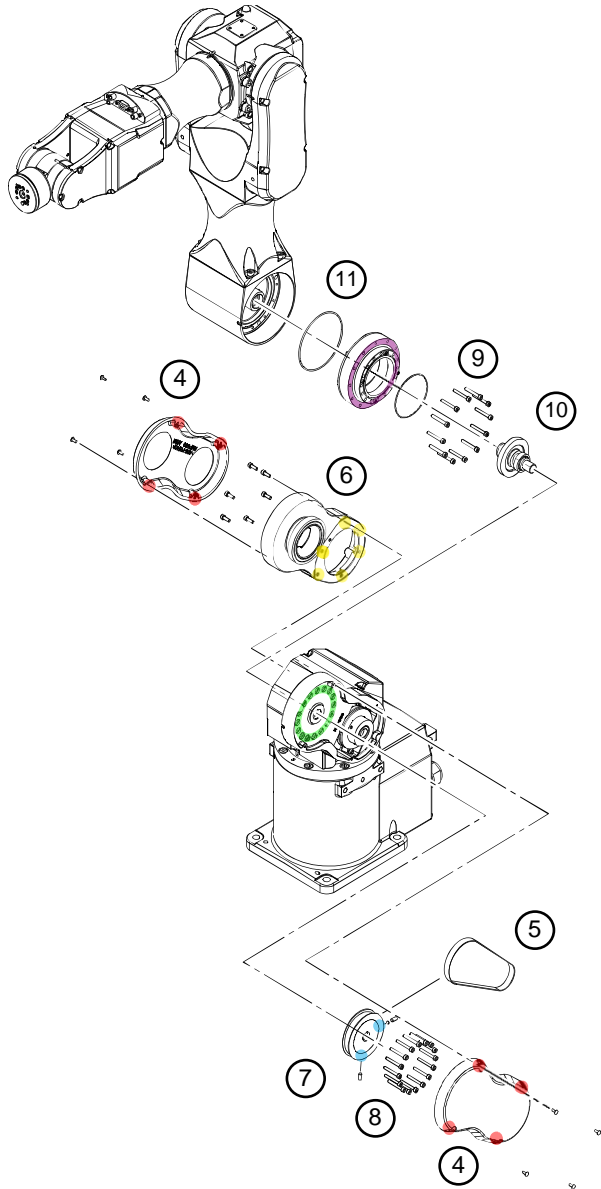


	<p><Preparation> Prepare a work stand upon which to place the arm removed from the Manipulator. Guidelines for work stand Width x Depth: 1.0 x 0.5 m Height: 200 mm to 300 mm from bottom of the Manipulator Load capacity: 10 kg</p>
①	Turn ON the controller.
②	<p>Release the J2 brake, manually push and move Arm2, and push it against Arm1. At this time, place cushioning between Arm1 and Arm2 to prevent damage to them.</p> <p>WARNING</p> <ul style="list-style-type: none"> • Arm2 falls by its weight when the J2 Timing Belt is removed. Release the brake and tilt Arm2 in advance. • There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.
③	Turn OFF the Controller.

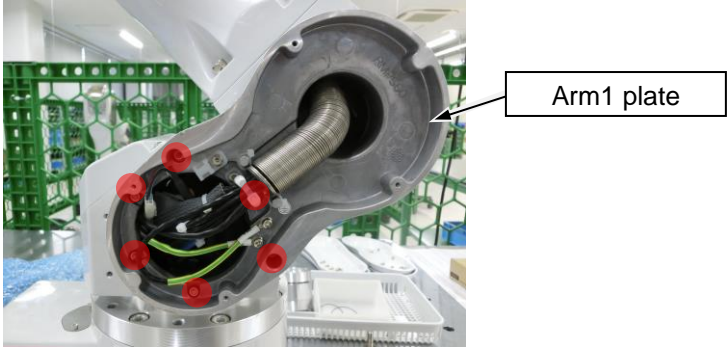


Joint #2

Removing the Reduction Gear Unit

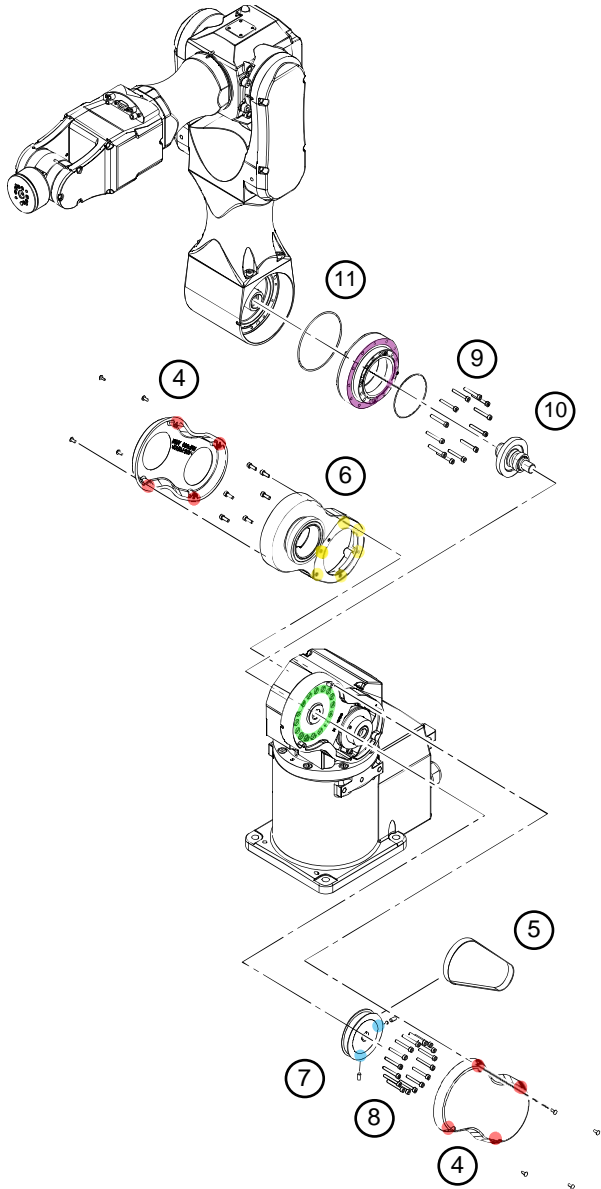


④	Remove the Arm1 side cover (both sides).
⑤	Remove the J2 Timing Belt .
⑥	Remove the Arm1 plate. A S01: 6-M4x12



Joint #2

Removing the Reduction Gear Unit



Joint #2

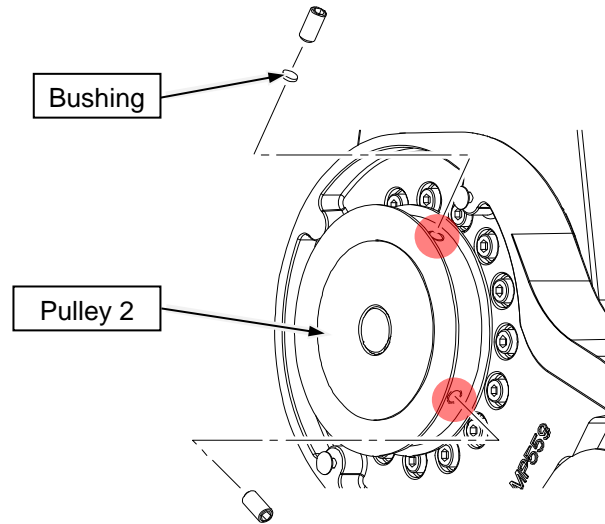
⑦ Remove pulley 2.

A S05: 2-M5x10
(Brass bushing x 1)

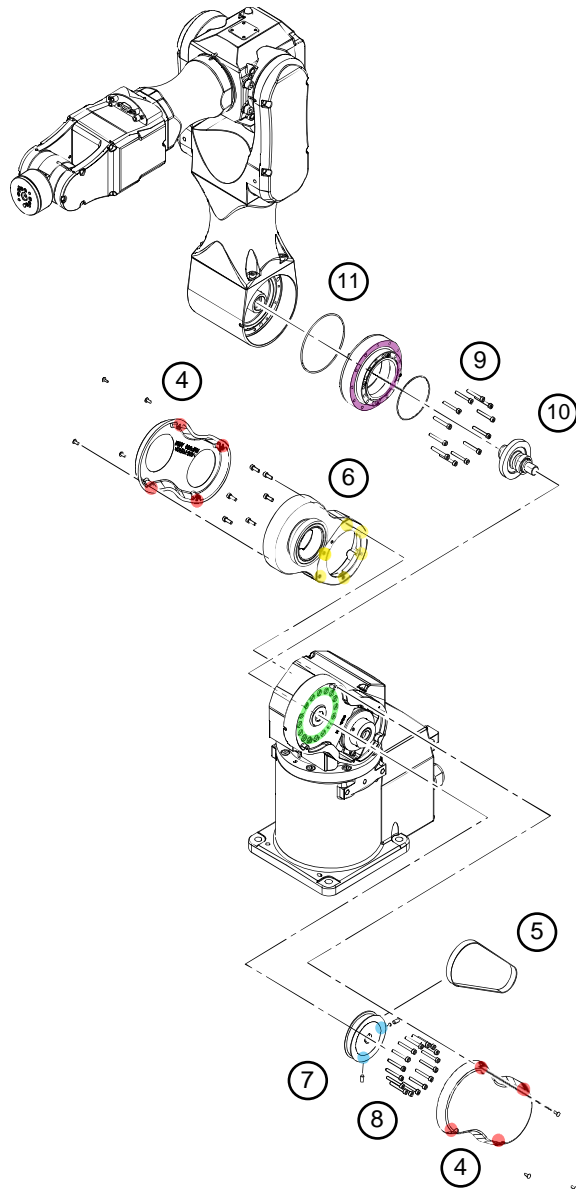


CAUTION

A brass bushing is included on one of the set screws. When removing the pulley, be careful not to drop and lose the bushing.



Removing the Reduction Gear Unit



Joint #2

⑧

Remove the bolts securing the Reduction Gear.

Remove Arm2, lay it down on its side, and place it on the work stand.

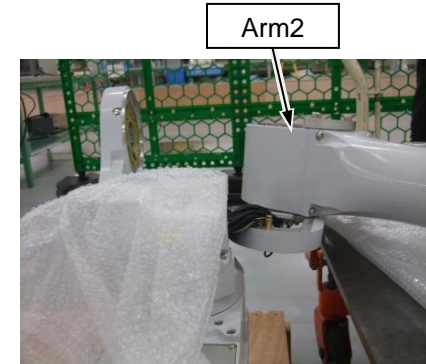
WARNING

- Remove the bolts securing the Reduction Gear to remove the Arm1 side arm and Arms 2, 3, 4, 5, and 6 (end effector).

There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Be very careful when removing the arms. Have at least two workers support the Manipulator while another worker removes the bolts.

- The arms are connected by internal cables. Place the removed arms on the work stand in order to not apply load on the cables. Applying load on the cables may result in cable disconnection.

A S02: 16-M4x30



⑨

Remove the Reduction Gear Unit with the Wave Generator unit built in.

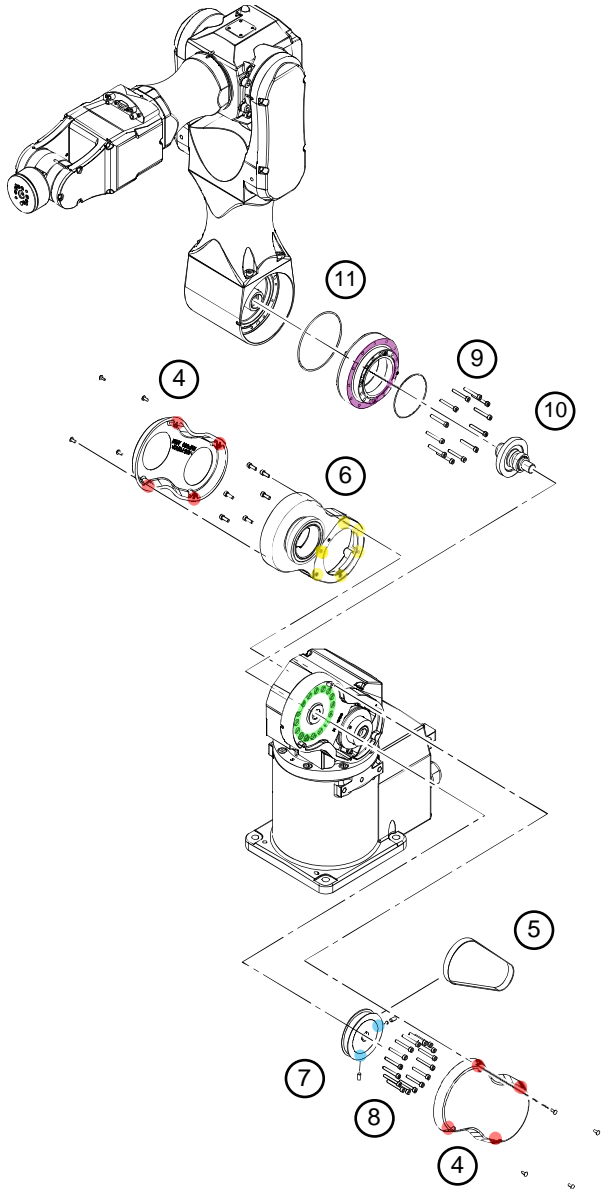
POINT

The part has grease applied. Perform the work while wiping off the grease.

A S02: 12-M4x30



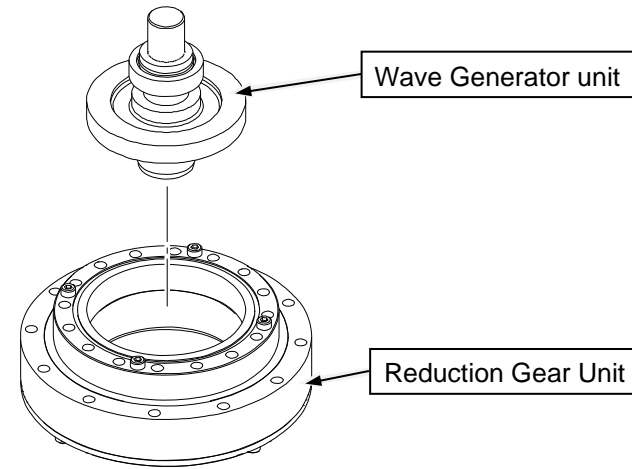
Removing the Reduction Gear Unit



Joint #2

10

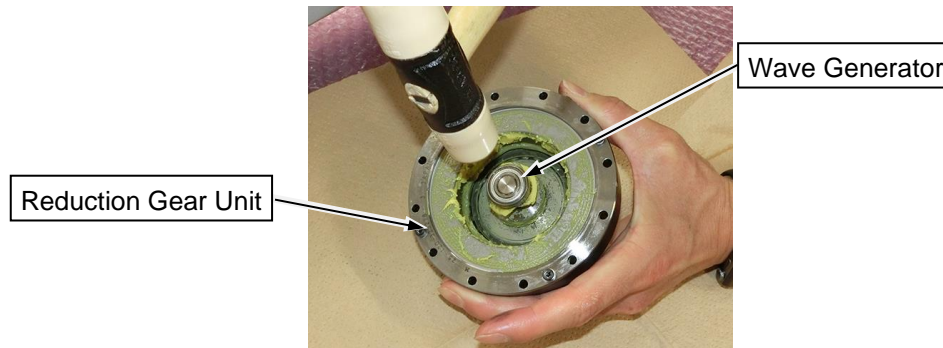
Remove the Wave Generator unit from the Reduction Gear.



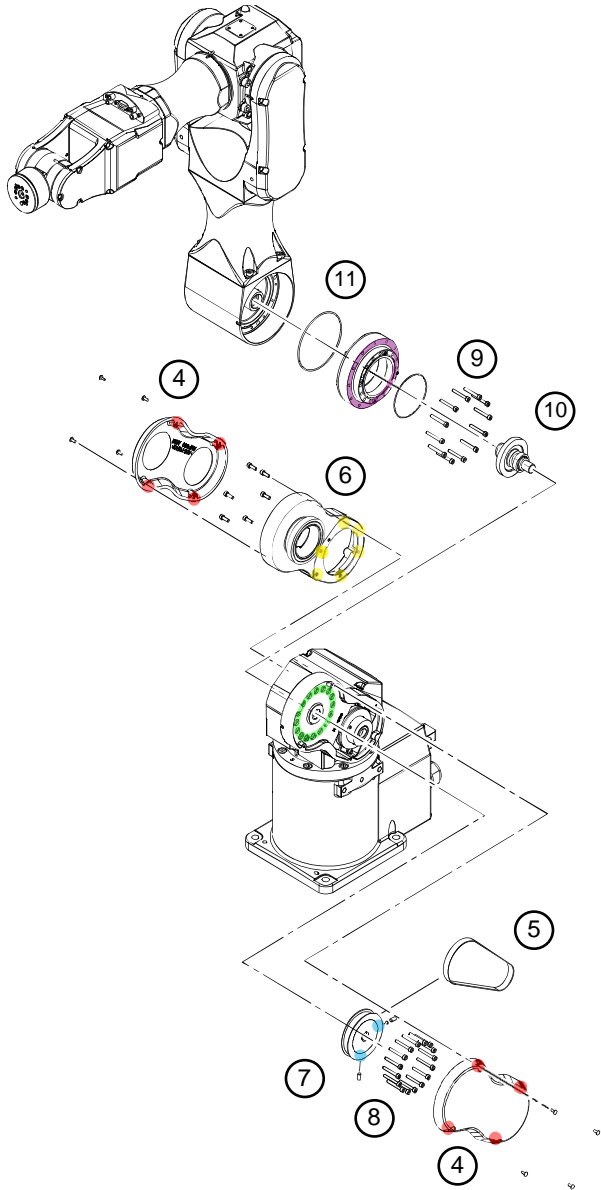
POINT

Turn the Reduction Gear Unit over.

Remove the Wave Generator unit by tapping it lightly near the center axis with a plastic hammer.



Removing the Reduction Gear Unit



⑪ Remove the O-ring on Arm2.

POINT

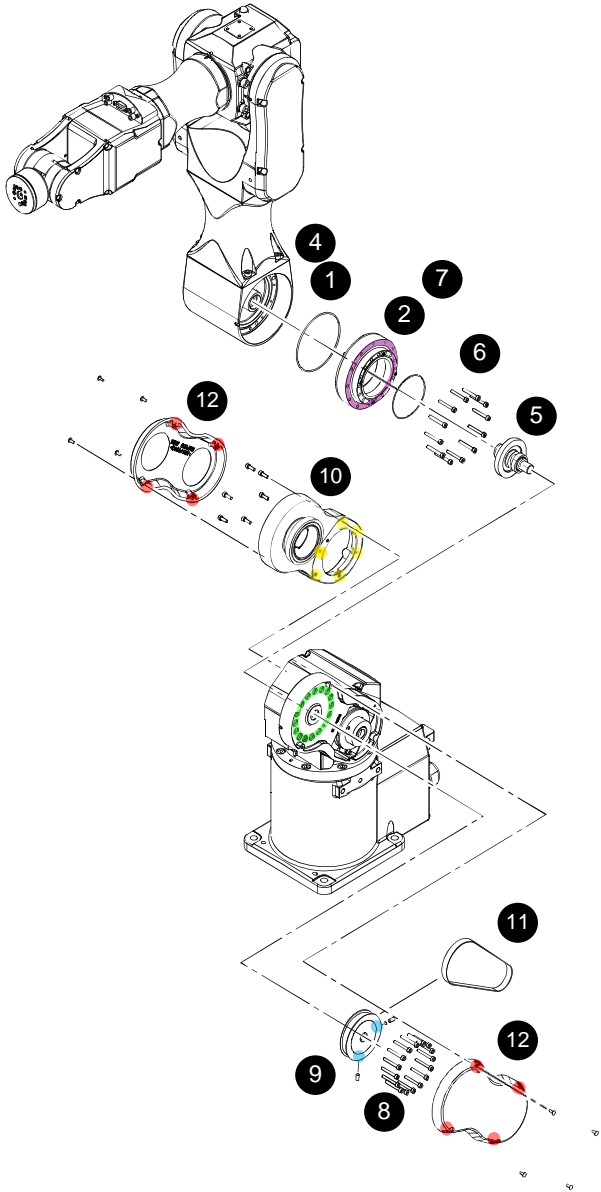
The part has grease applied. Perform the work while wiping off the grease.



⑫ If there is grease on Arm1 or Arm2, wipe it off with a cloth.

Joint #2

Installing the Reduction Gear Unit



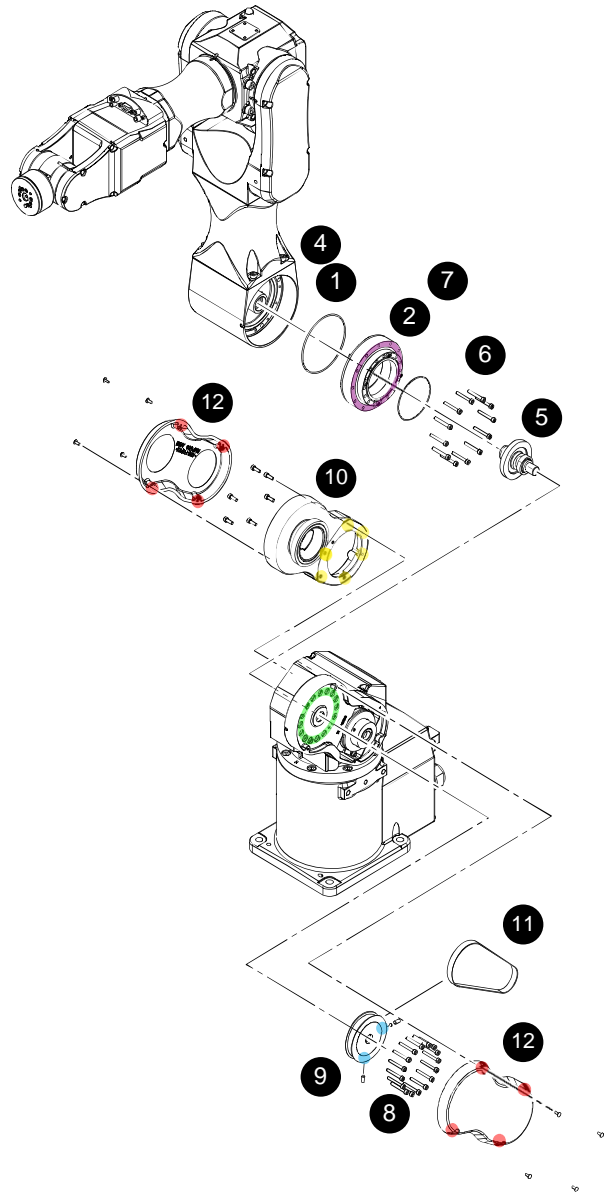
<Preparation>

Take the new Reduction Gear Unit out of the box, and check that the following parts are included.



Joint #2

Installing the Reduction Gear Unit




Joint #2

1 Install the O-ring.

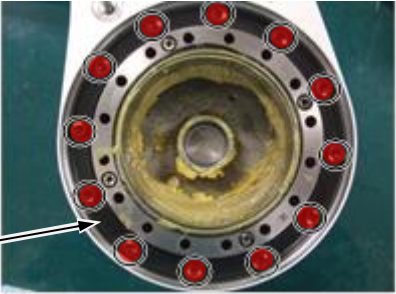
CAUTION

- Applying a small amount of grease (SK-1A) to the O-ring will make it stick to the arm, facilitating subsequent work.
- Insert the O-ring firmly into the groove.
- If the O-ring is stretched, damaged, or has deteriorated, replace with a new one.



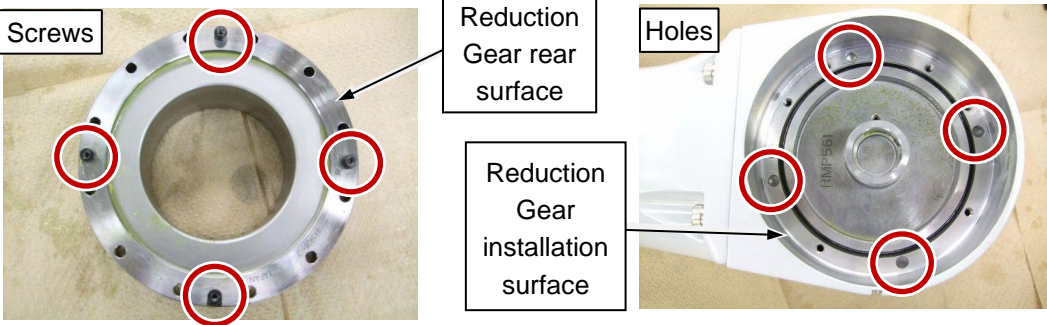
2 Set the Reduction Gear Unit on Arm2, then secure the fixing bolts temporarily.

A S02: 12-M4x30

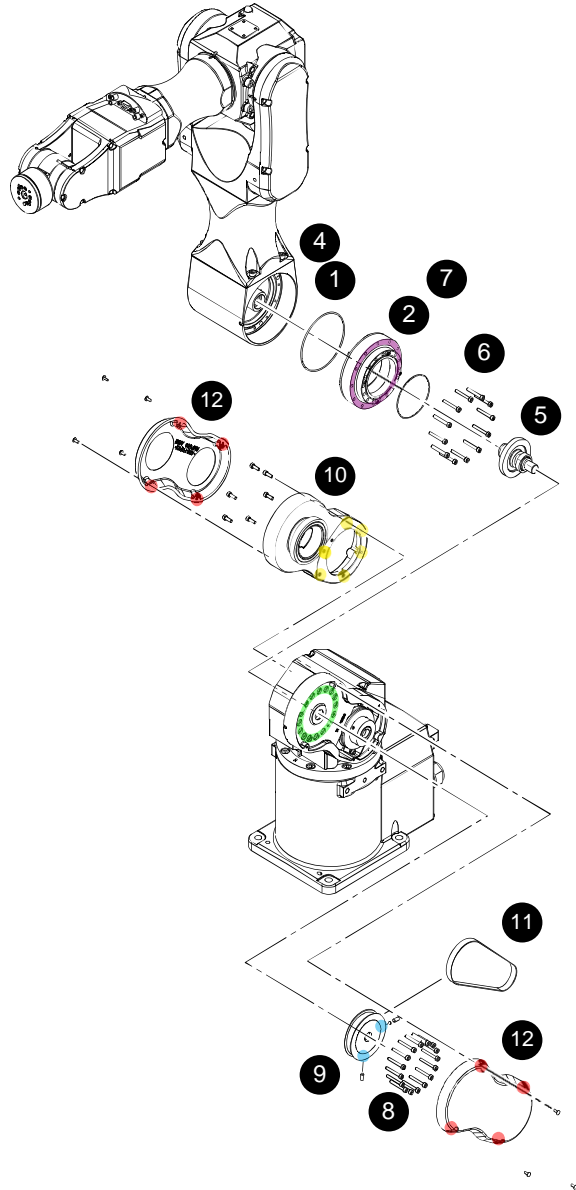


POINT


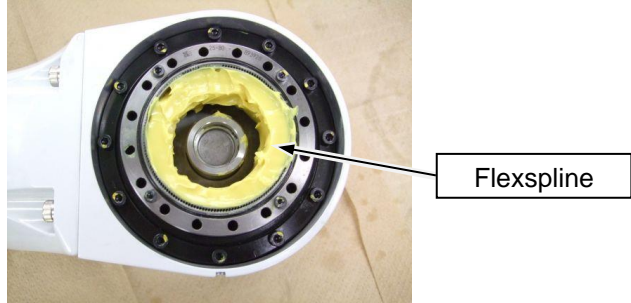
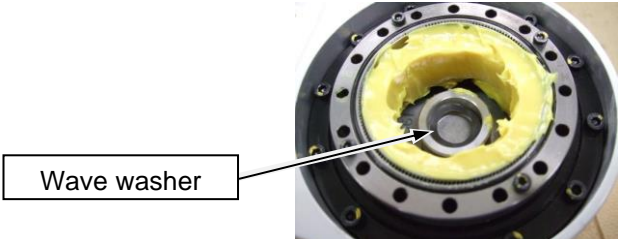
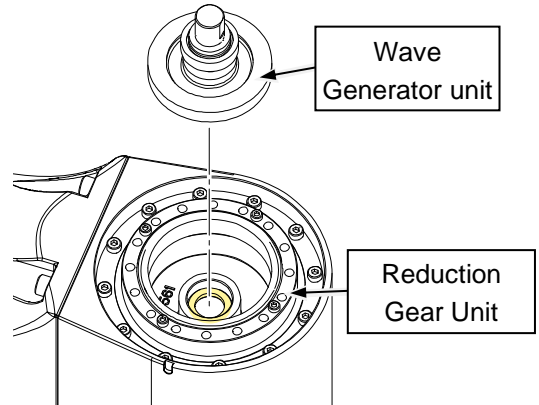
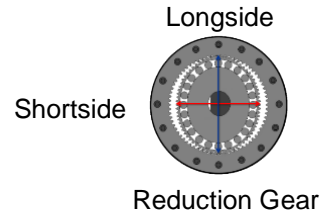
The Arm2 Reduction Gear installation surface has clearance holes for the screws on the Reduction Gear rear surface. Align the screws and the hole positions to install.



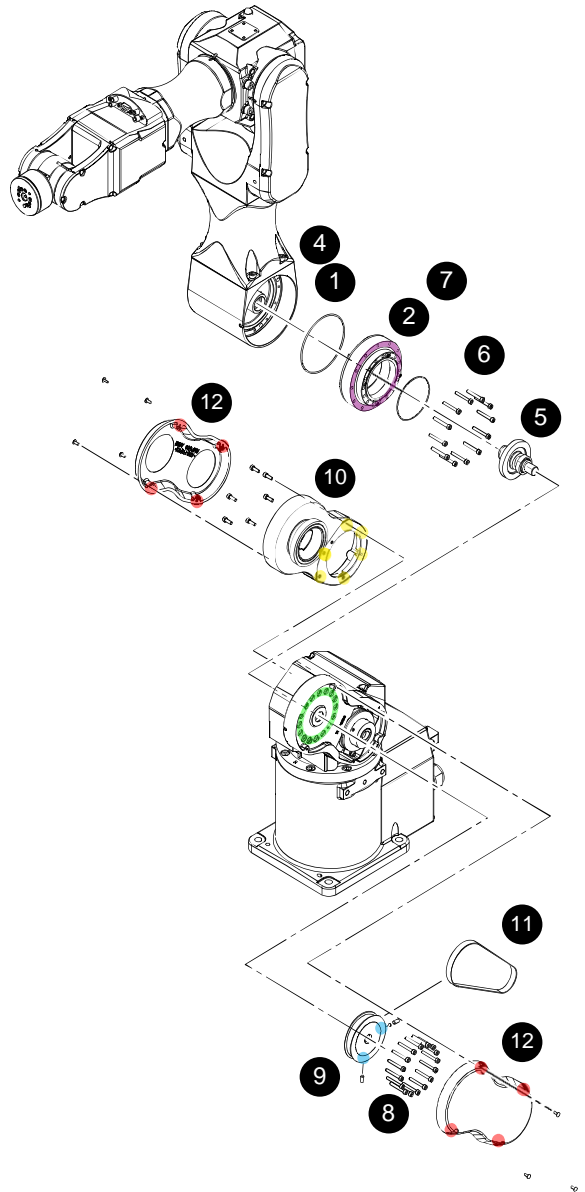
Installing the Reduction Gear Unit



Joint #2

<p>3</p>	<p>Apply grease to the inside of the Flexspline.</p> <p> SK-1A: 30 g</p> 
<p>4</p>	<p>Check that there is a wave washer at the Arm2 bearing setting position.</p> 
<p>5</p>	<p>Insert the Wave Generator in the Reduction Gear.</p>  <p>POINT Install so that the longside of the Flexspline and the Wave Generator match.</p> 

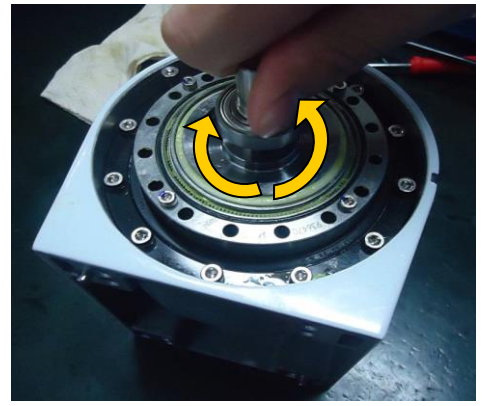
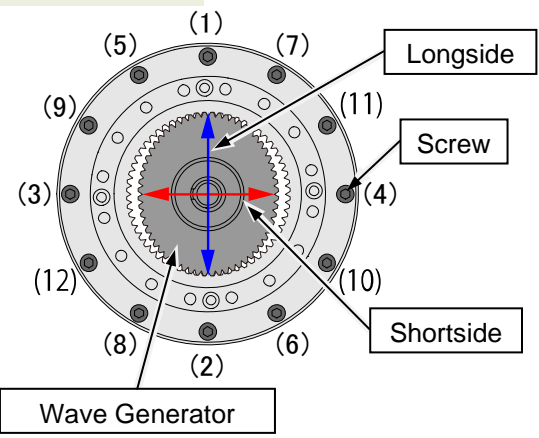
Installing the Reduction Gear Unit



Joint #2

6 Secure the J2 Reduction Gear Unit to Arm2.

S02: 12-M4x12



Tighten the screws using the following procedure. Refer to the figure above.

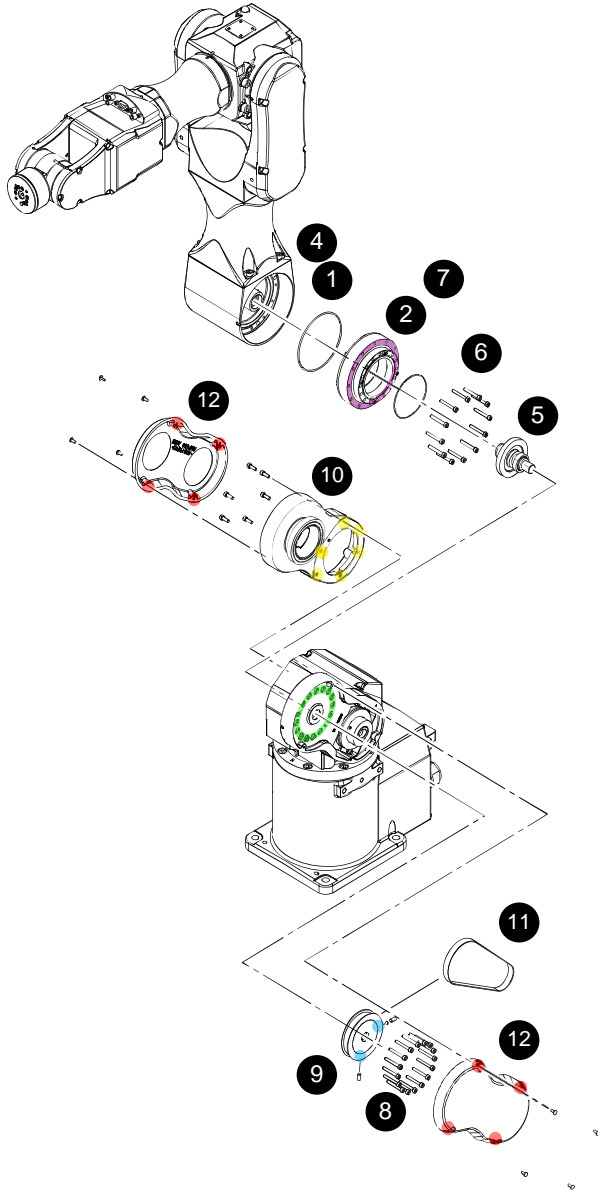
CAUTION

- Ensure that diagonally opposite screws are tightened alternately.
- Do not tighten the screws all the way at once. Instead, divide this into four times and tighten to the following torques.

Percentage of the specified torque	Torque value	Unit
20%	1.375 +/- 0.25	N · m
40%	2.75 +/- 0.25	
80%	4.125 +/- 0.25	
100%	5.5 +/- 0.25	

1. Rotate the Wave Generator so that its longside aligns with the positions of screws (1) and (2).
2. Tighten screws (1) and (2) to 20% of the torque value.
3. Tighten screws (1) and (2) to 40% of the torque value.
4. Rotate the Wave Generator longside so that it aligns with the positions of screws (3) and (4).

Installing the Reduction Gear Unit

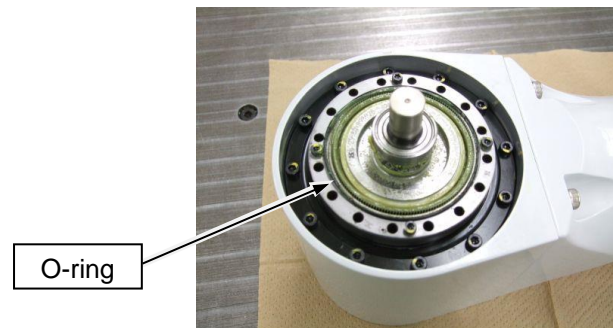


5. Tighten screws (3) and (4) to 20% of the torque value.
6. Tighten screws (3) and (4) to 40% of the torque value.
7. Rotate the Wave Generator longside and tighten screws (5) through (12) to the 20% and 40% of the torque value.
8. Rotate the Wave Generator so that its longside aligns with the positions of screws (1) and (2).
9. Tighten screws (1) and (2) to 80% of the torque value, then tighten screws (1) and (2) to 100% of the torque value.
10. Rotate the Wave Generator longside so that it aligns with the positions of screws (3) and (4).
11. Tighten screws (3) and (4) to 80% of the torque value, then tighten screws (3) and (4) to 100% of the torque value.
12. Rotate the Wave Generator longside and tighten screws (5) through (12) to the 80% and 100% of the torque value.

7. Install the O-ring.

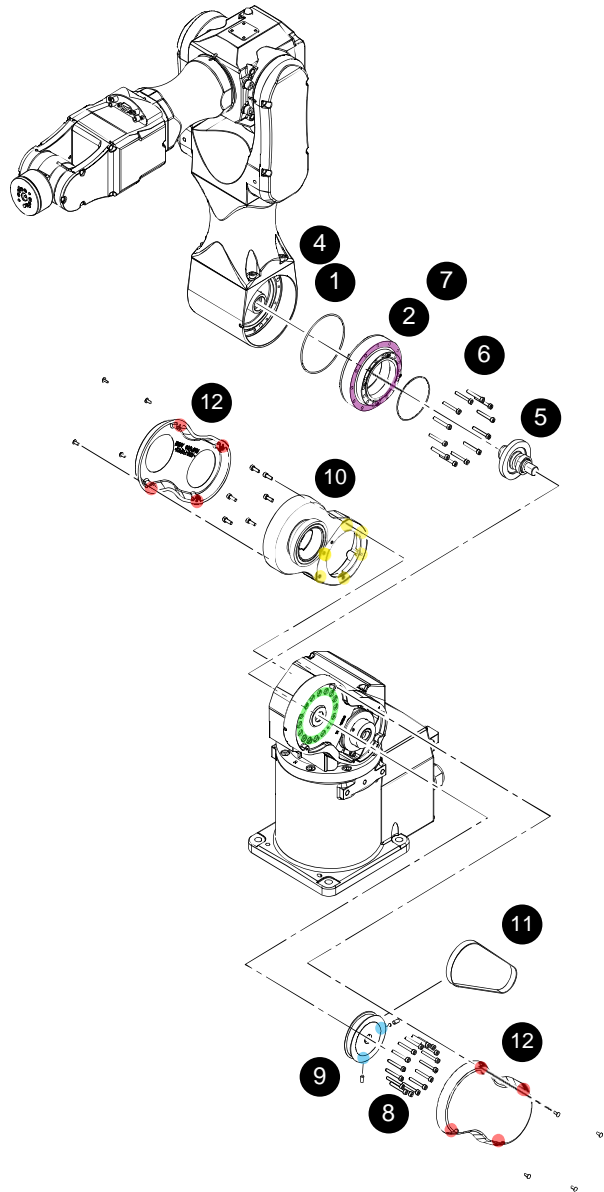
POINT

- Applying a small amount of grease (SK-1A) to the O-ring will make it stick to the arm, facilitating subsequent work.
- Insert the O-ring firmly into the groove.
- If the O-ring is stretched, damaged, or has deteriorated, replace with a new one.



Joint #2

Installing the Reduction Gear Unit



Joint #2

8 Install Arm2 and the Reduction Gear on Arm1.

WARNING

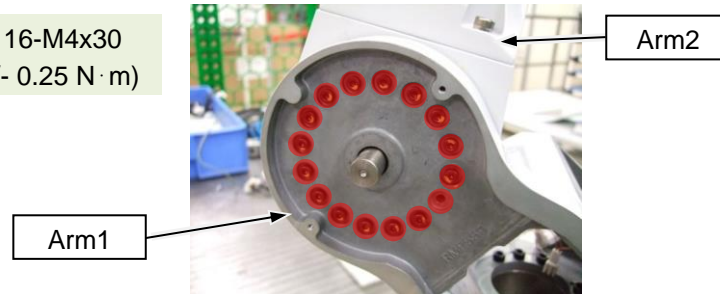
Have at least two workers perform this work. At least one worker must support the Manipulator to prevent its arm from falling.

Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.

CAUTION

- When inserting the shaft in the Arm1 hole, be careful not to damage the seal.
- Take care during installation to ensure that the O-ring in the Circularity groove does not come out.

A S02: 16-M4x30
(5.0 +/- 0.25 N·m)

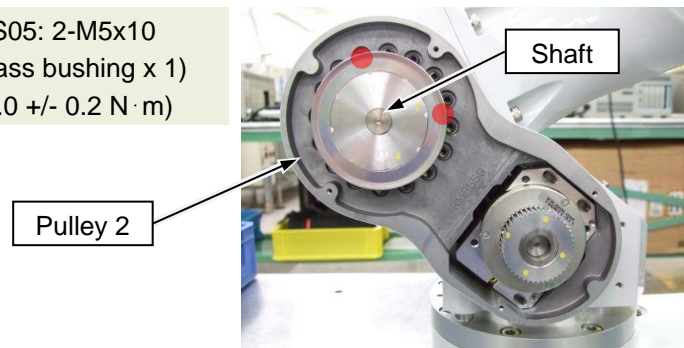


POINT

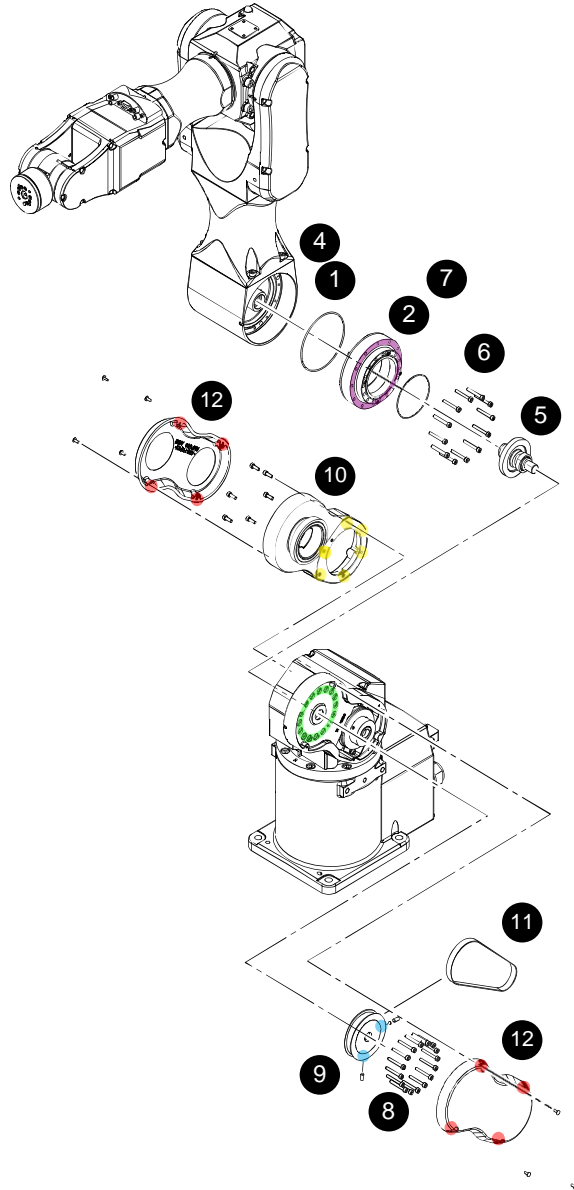
After securing the arm, manually move the arm to check that there is no rattling or misalignment of the Reduction Gear.

9 Install pulley 2.

A S05: 2-M5x10
(Brass bushing x 1)
(4.0 +/- 0.2 N·m)



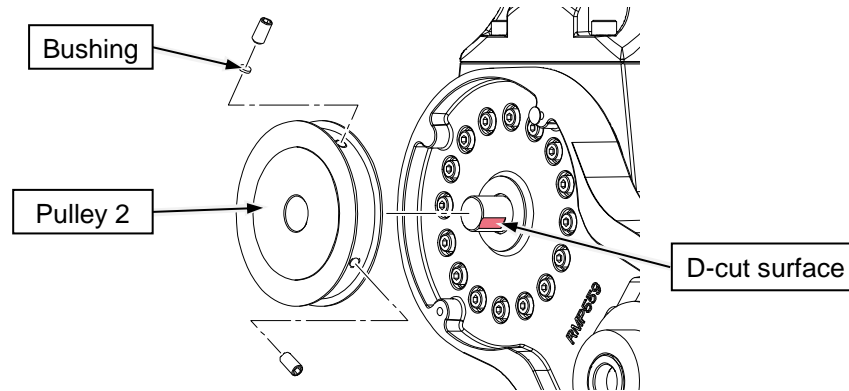
Installing the Reduction Gear Unit



Joint #2

POINT

- Align the shaft end and pulley surface, and secure.
- Align the shaft D-cut surface with the screw holes, and install pulley 2.



10 Install the Arm1 plate.

A S01: 6-M4x12
(5.0 +/- 0.25 N·m)



Arm1 plate

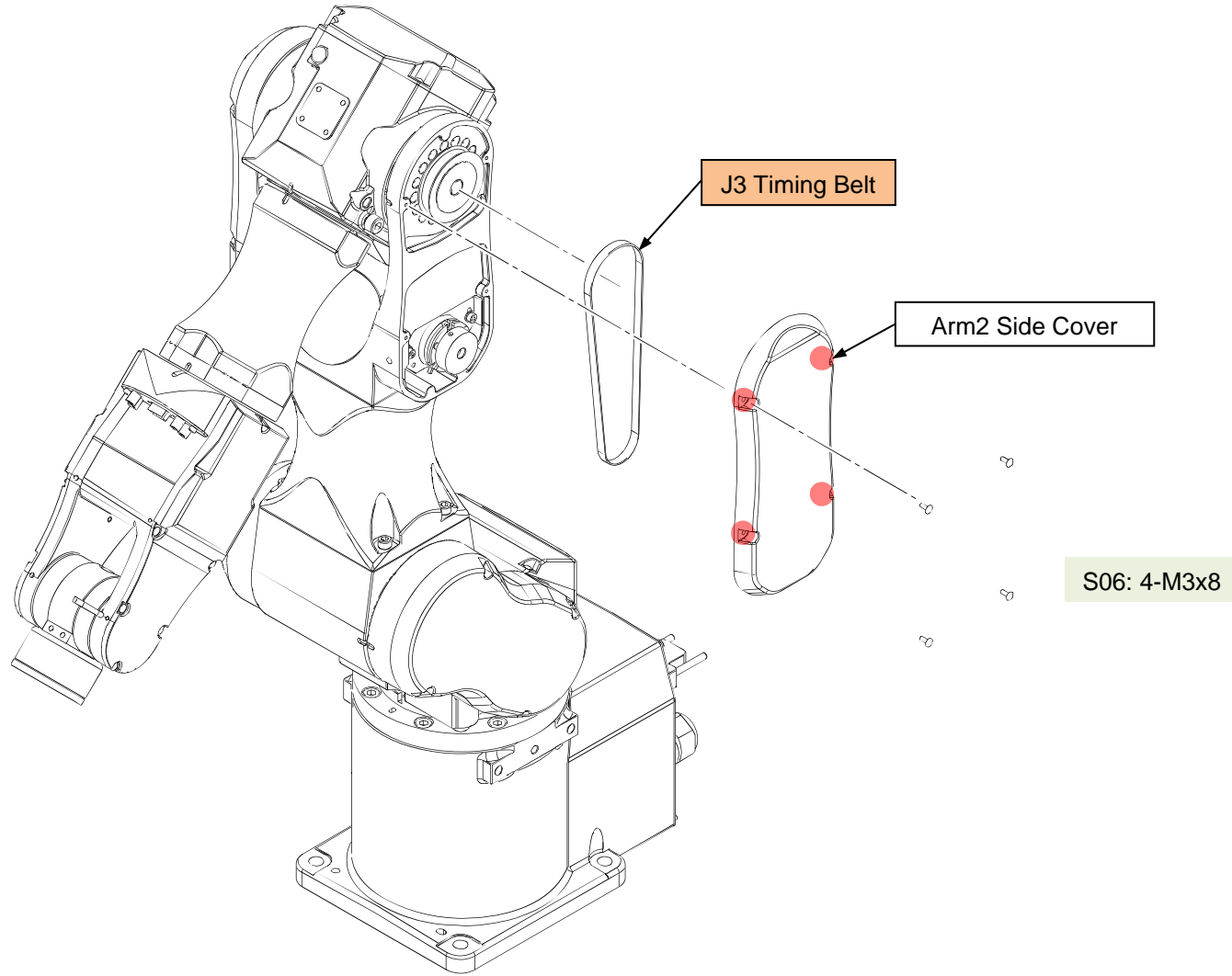
11 Install the [J2 Timing Belt](#).

12 Install the [Arm1 side cover](#) (both sides).

13 After assembly, perform calibration of Joint #2.
[3.2 Calibration](#)

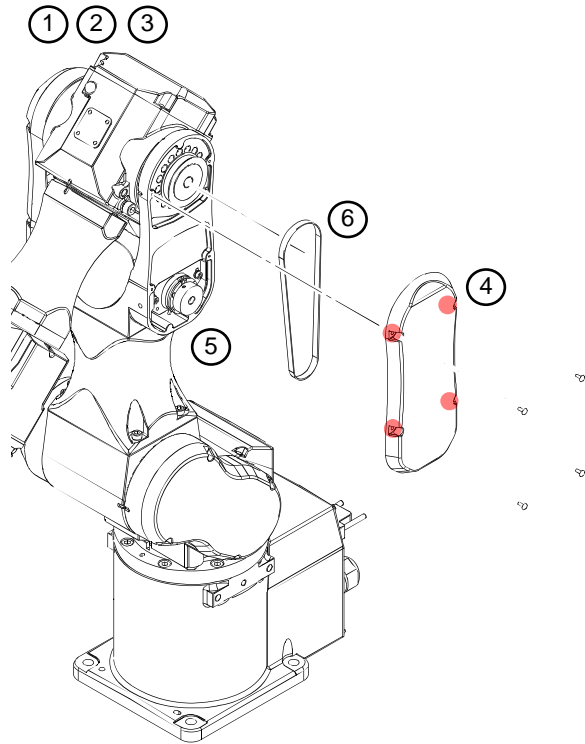
2.4 Joint #3

2.4.1 Joint #3 Replacing the Timing Belt

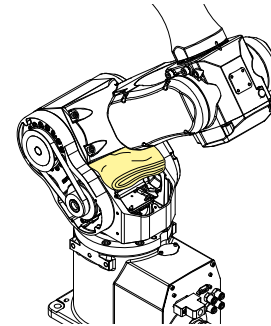


Joint #3

Removing the Timing Belt



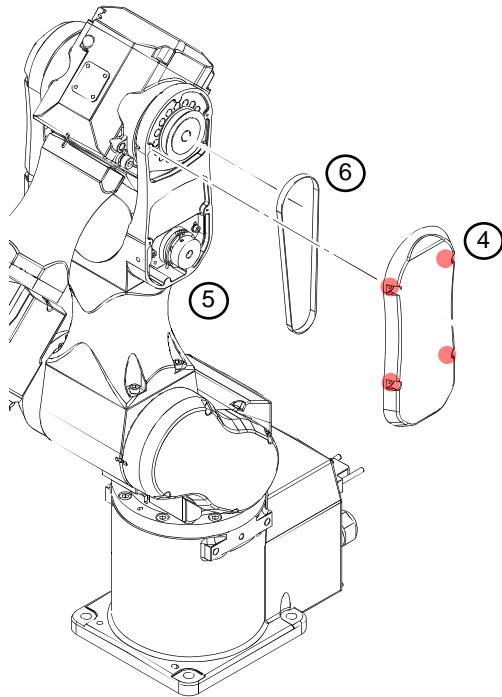
①	Turn ON the controller.
②	Release the J3 brake, and manually push and move Arm3 until it comes in contact with the mechanical stopper, and push it against Arm2. WARNING <ul style="list-style-type: none"> • Arm3 falls by its weight when the J3 Timing Belt is removed. Release the brake and tilt Arm3 in advance. • There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.
③	Turn OFF the Controller.
④	Remove the Arm2 side cover .



Joint #3

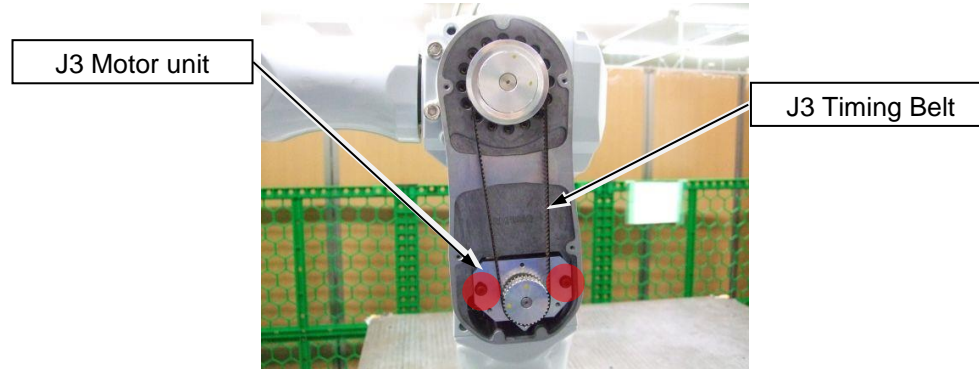
Removing the Timing Belt

① ② ③



⑤ Loosen the screws securing the J3 Motor unit.

A S01: 2-M4x15 and washer



⑥ Remove the J3 Timing Belt.

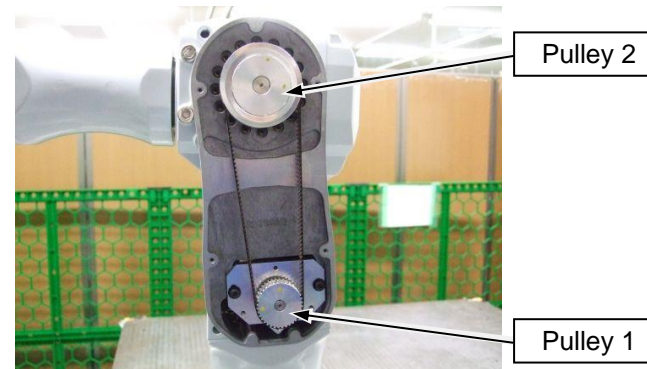
CAUTION

Removing the Timing Belt while Arm3 is not tilted will result in Arm3 falling, which is very dangerous.

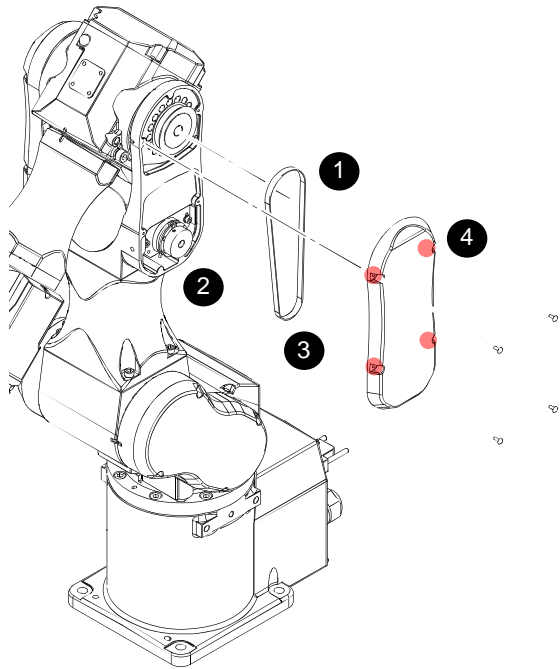
Before removing the Timing Belt, ensure that you perform step ②.

POINT

First remove the belt from pulley 1.



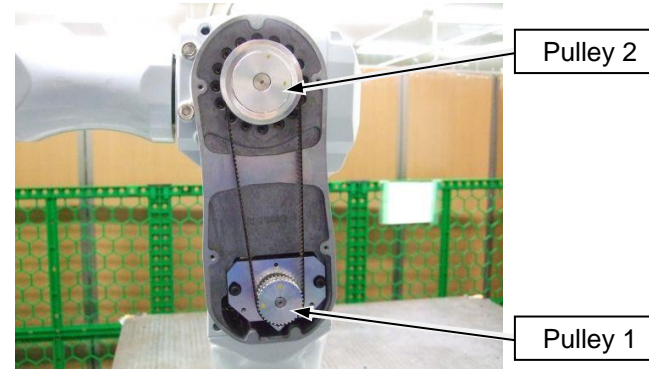
Installing the Timing Belt



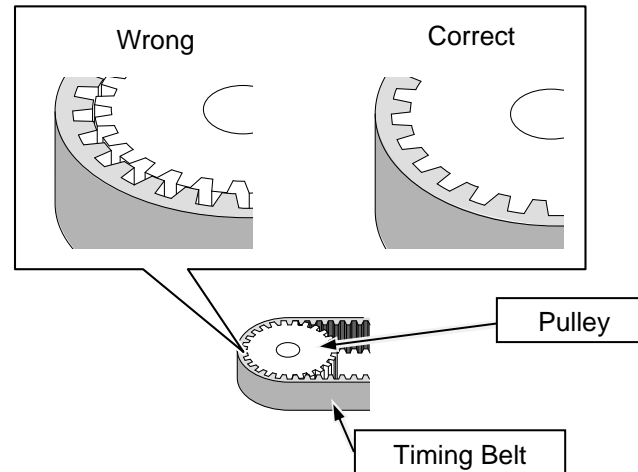
1 Install the J3 Timing Belt.

POINT

- First place the belt on pulley 2.

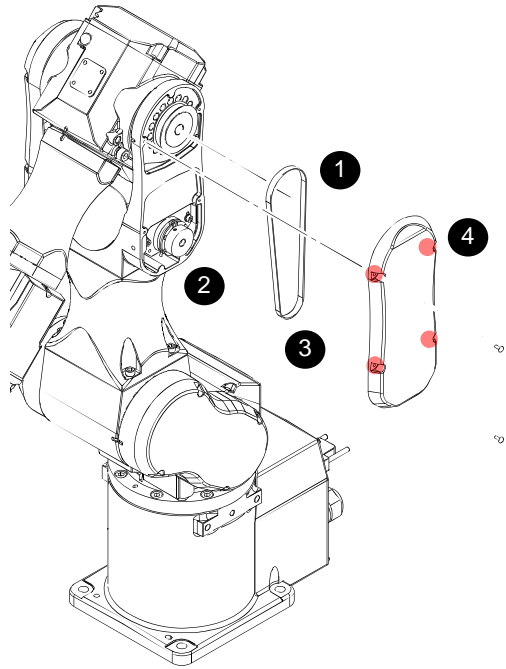


- Make sure that the teeth of the Timing Belt and the pulley are properly engaged.



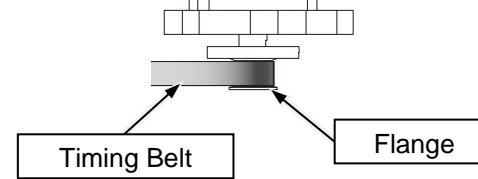
Joint #3

Installing the Timing Belt



CAUTION

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

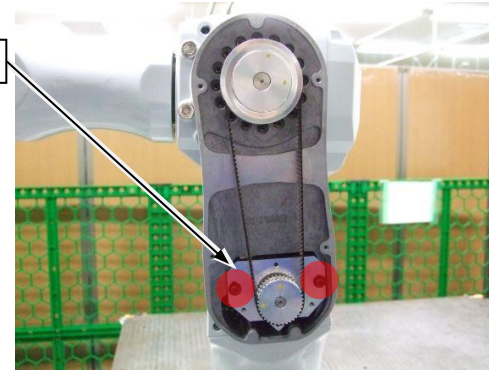


Set the belt so that it is level with respect to the pulley without it being placed on the flange.

2. Temporarily secure the J3 Motor unit.

A S01: 2-M4x15 and washer

J3 Motor unit



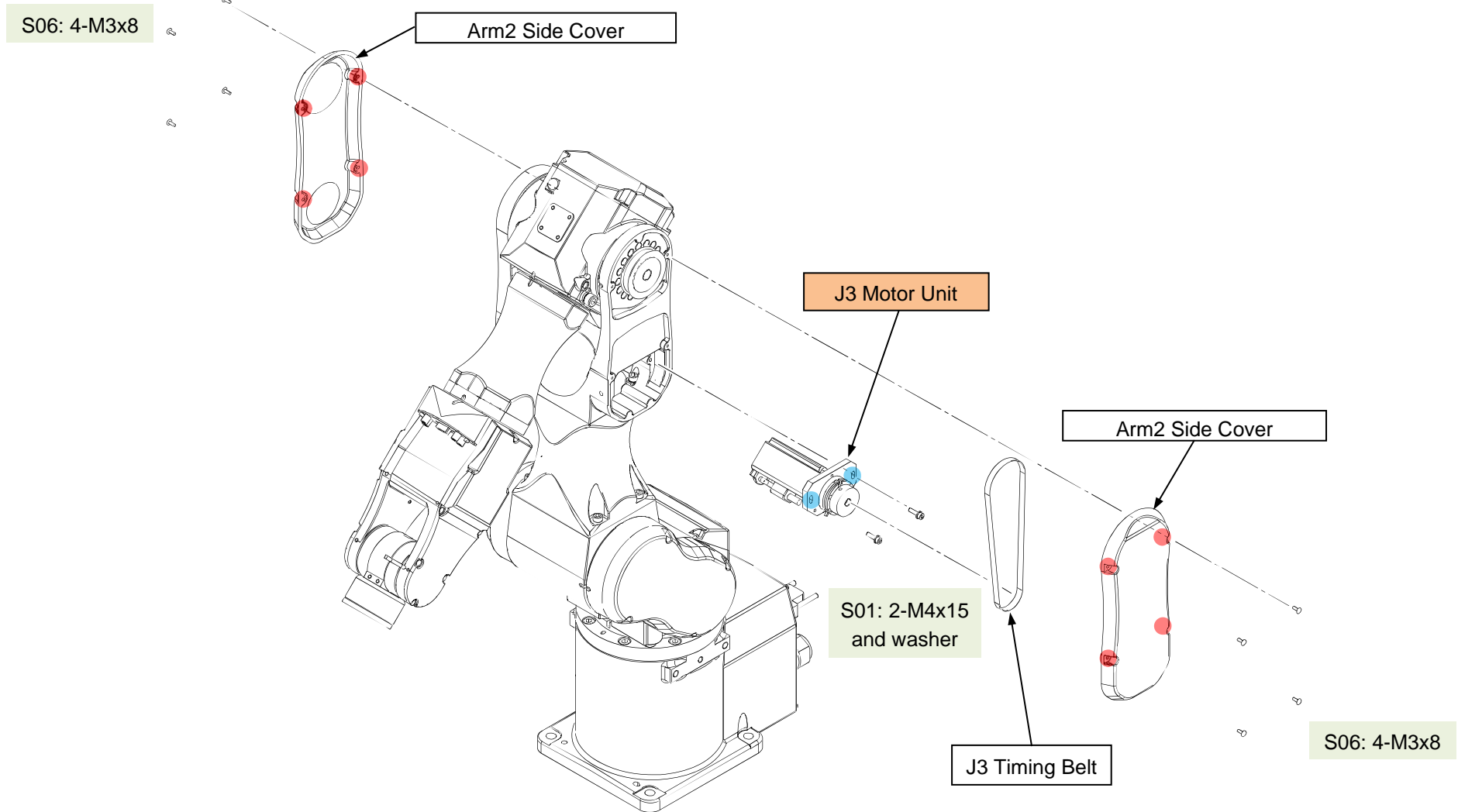
3. Adjust the belt tension.
[3.1 Adjusting the Timing Belt Tension](#)

4. Install the [Arm2 side cover](#).

5. After assembly, perform calibration of Joint #3.
[3.2 Calibration](#)

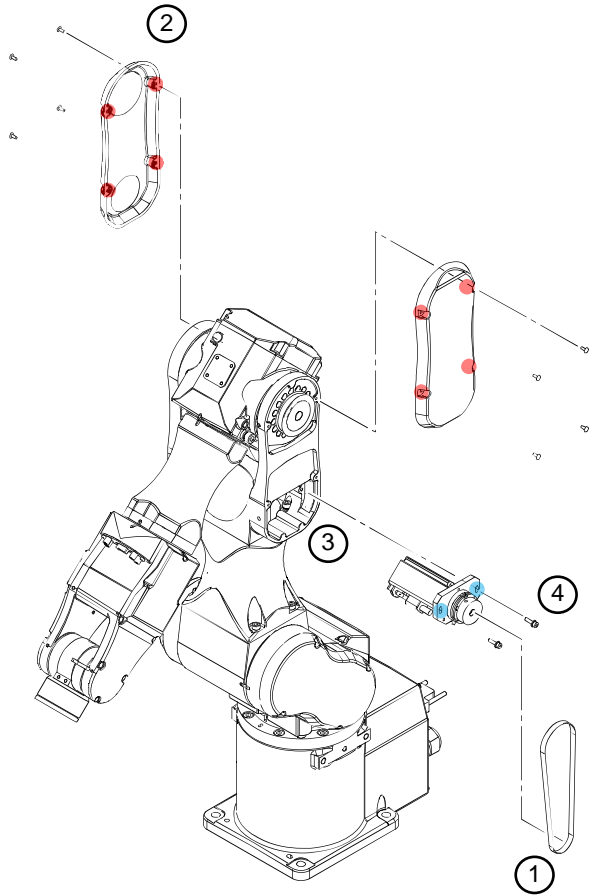
Joint #3

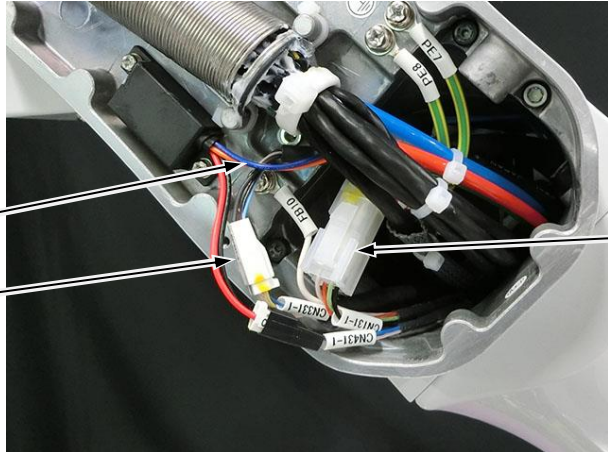
2.4.2 Joint #3 Replacing the Motor Unit



Joint #3

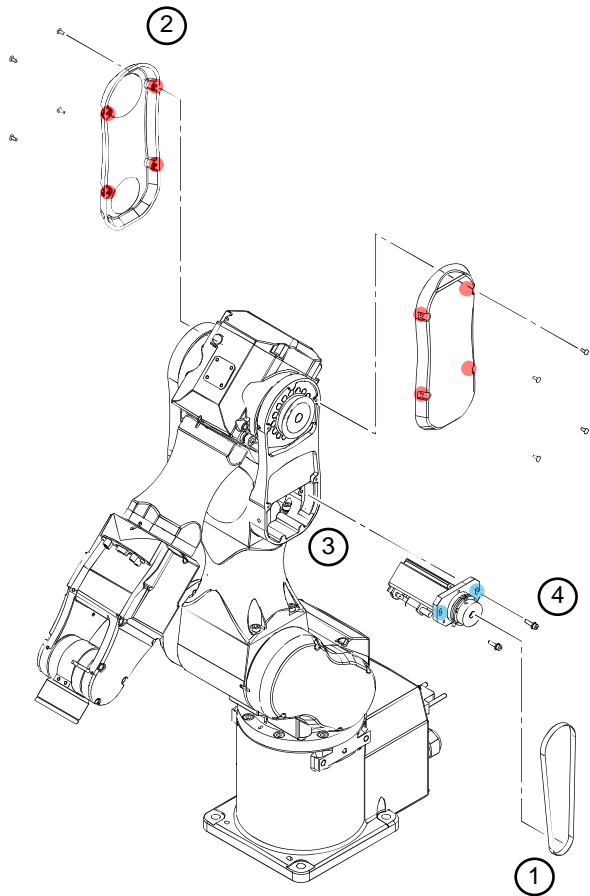
Removing the Motor Unit



①	Remove the J3 Timing Belt .
②	Remove the Arm2 side cover .
③	Disconnect the J3 Motor unit connectors (CN131, CN331, CN430).  <p>A close-up photograph of the motor unit's internal wiring. Three connectors are labeled with callouts: CN430 (top left), CN331 (middle left), and CN131 (right). The connectors are multi-pin plastic housings with various colored wires (red, blue, green, black) plugged into them. The motor unit is partially visible in the background.</p>

Joint #3

Removing the Motor Unit

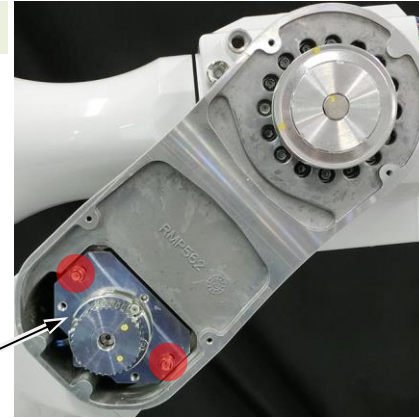


④

Remove the loosened screws, then remove the J3 Motor unit.

A

S01: 2-M4x15 and washer

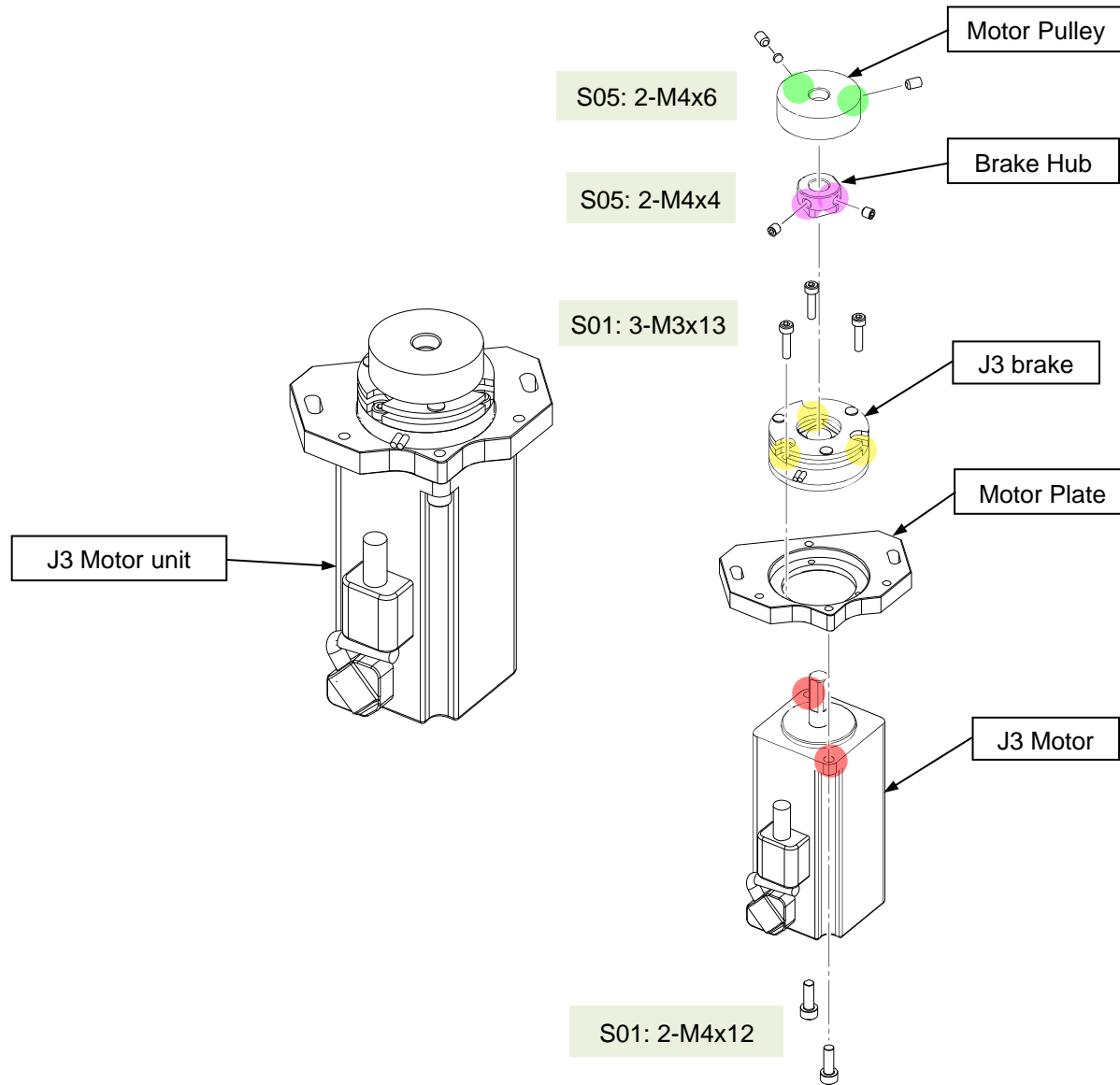


J3 Motor unit

CAUTION

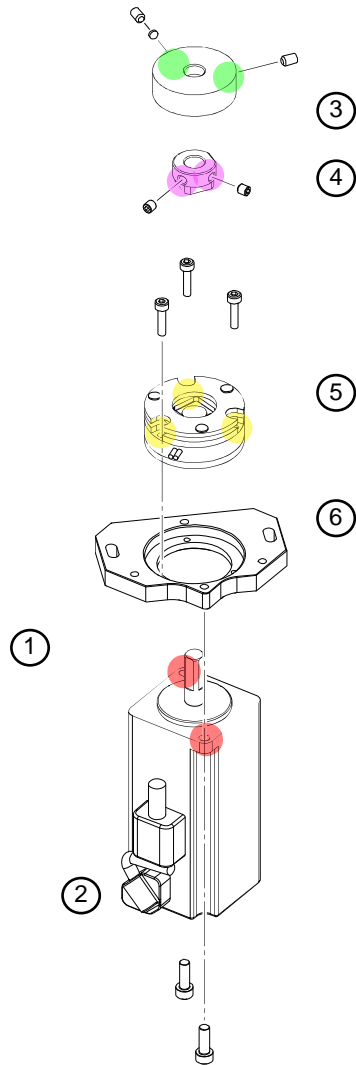
When pulling off the motor unit, the CN131-2 connector clip may catch on the arm and be damaged, or the CN131-1 cable may be pulled inside the arm. Take care during work.

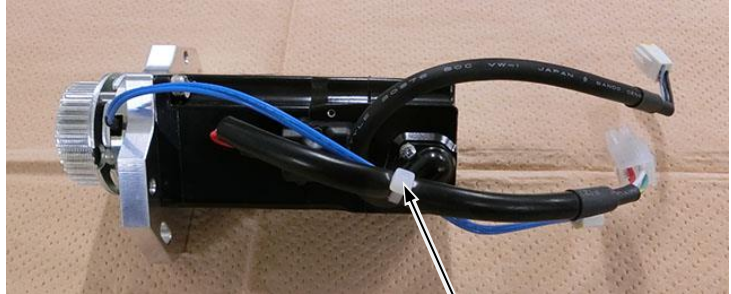
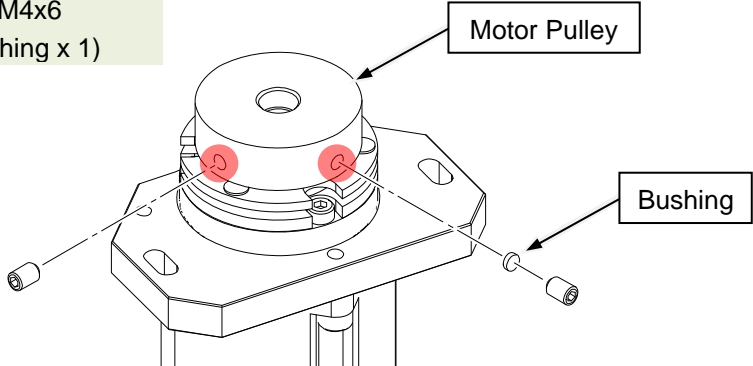
Motor Unit Disassembly



Joint #3

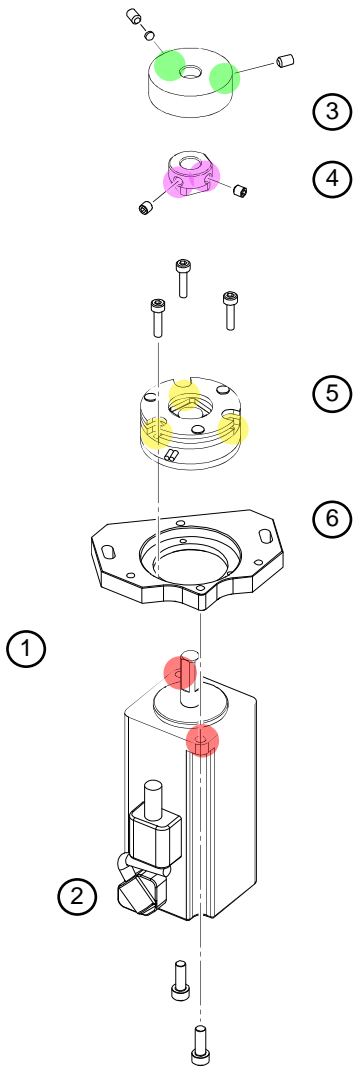
Motor Unit Disassembly



①	Remove the J3 Motor unit .
②	Cut the wire tie (AB100) binding the motor cable.  <div style="border: 1px solid black; padding: 2px; display: inline-block;">Wire tie (AB100)</div>
③	Remove the Motor Pulley. <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 10px;"> A S05: 2-M4x6 (Brass bushing x 1) </div>  <p>CAUTION A brass bushing is included on one of the set screws. When removing the pulley, be careful not to drop and lose the bushing.</p>

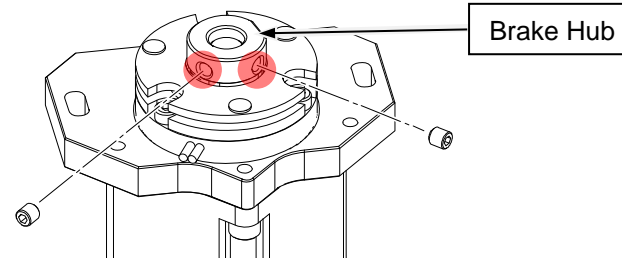
Joint #3

Motor Unit Disassembly



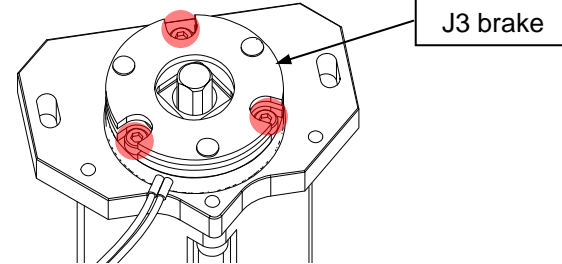
④ Remove the Brake Hub.

A S05: 2-M4x4



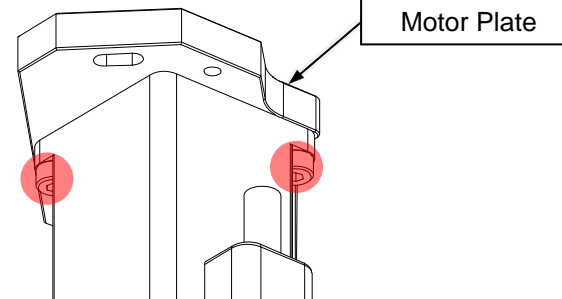
⑤ Remove the J3 brake.

A S01: 3-M3x13



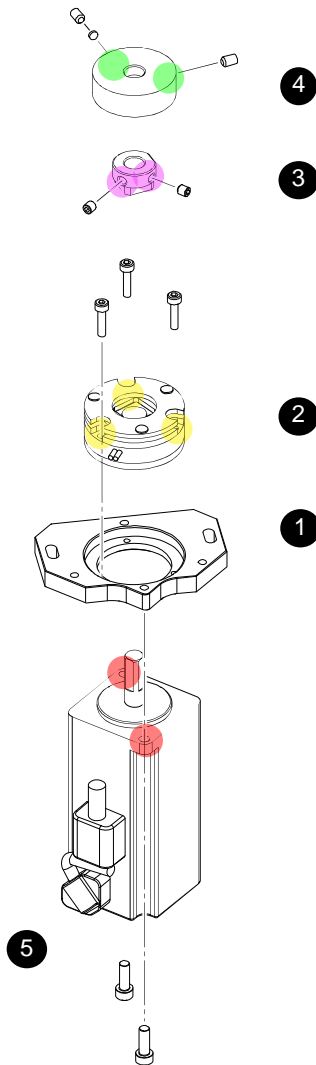
⑥ Remove the Motor Plate.

A S01: 2-M4x12



Joint #3

Motor Unit Assembly



1 Install the Motor Plate.

A S01: 2-M4x12
(4.0 +/- 0.2 N·m)

Motor Plate

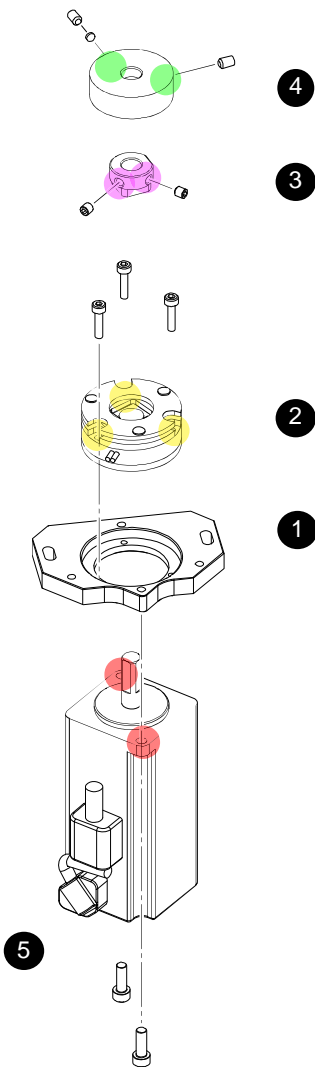
POINT
Attach the Motor Plate according to the orientation shown in the figure.

Motor cable

Motor Plate

Joint #3

Motor Unit Assembly

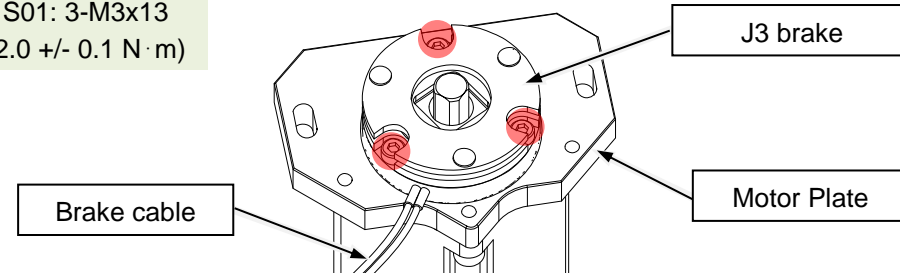


2 Install the J3 brake.

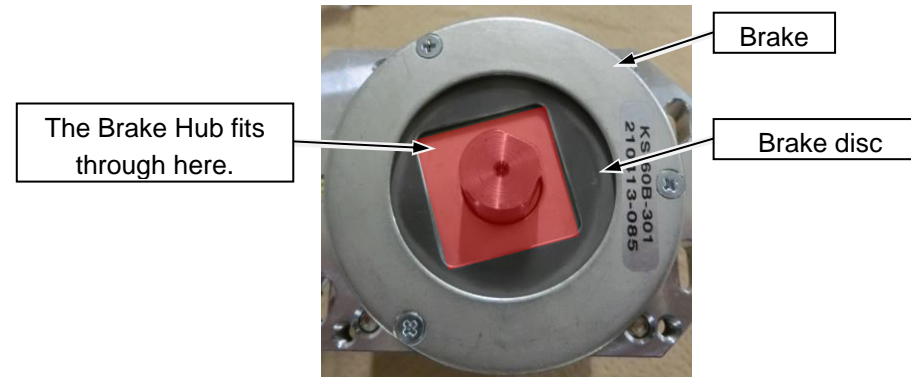
POINT

- Install the brake with the orientation as shown in the figure.

A S01: 3-M3x13
(2.0 +/- 0.1 N·m)

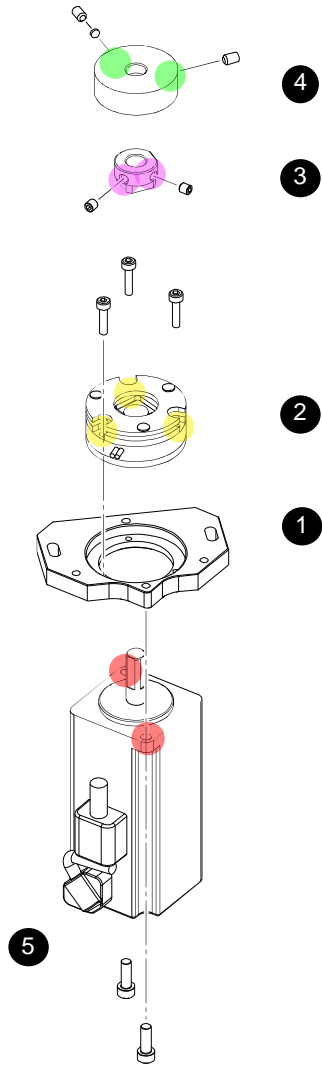


- Align the Brake Hub and brake disc positions, and install the Brake Hub on the motor shaft. If they are misaligned, adjust the brake disc position.



Joint #3

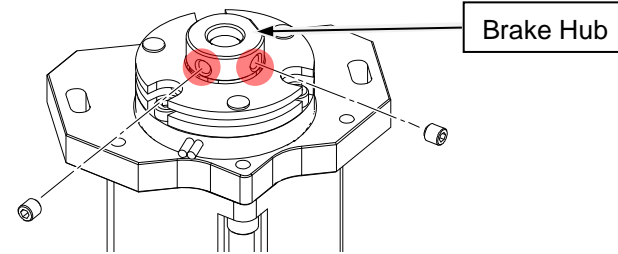
Motor Unit Assembly



3

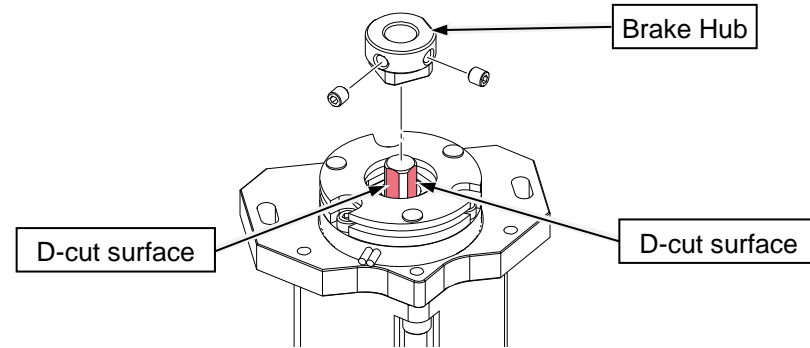
Install the Brake Hub.

A S05: 2-M4x4
(2.4 +/- 0.1 N·m)



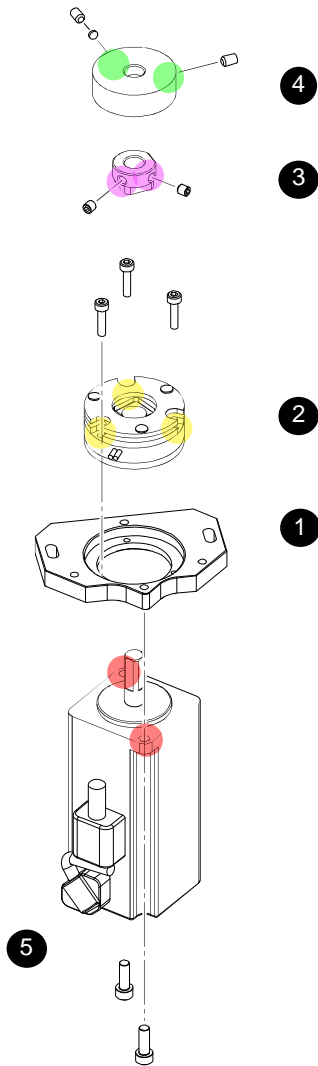
POINT

Install the two screws so that they are vertical with respect to the motor shaft D-cut surface.



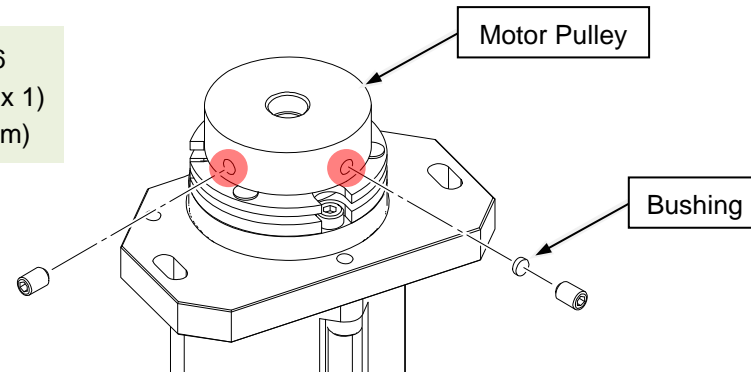
Joint #3

Motor Unit Assembly



4 Install the Motor Pulley.

A S05: 2-M4x6
(Brass bushing x 1)
(2.4 +/- 0.1 N·m)

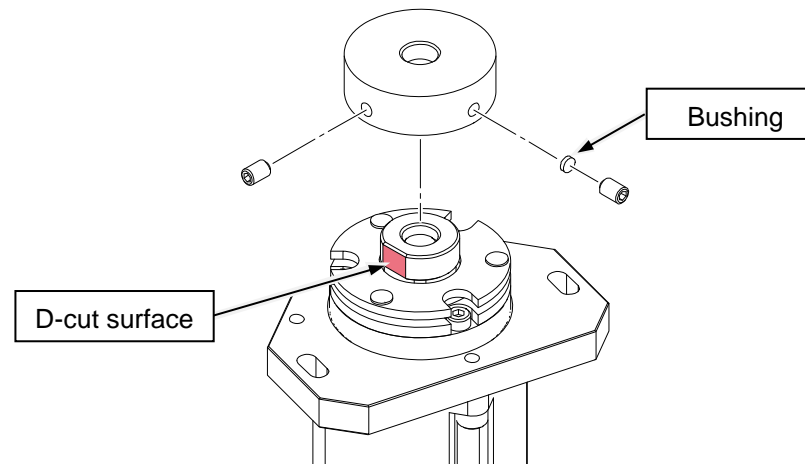


POINT

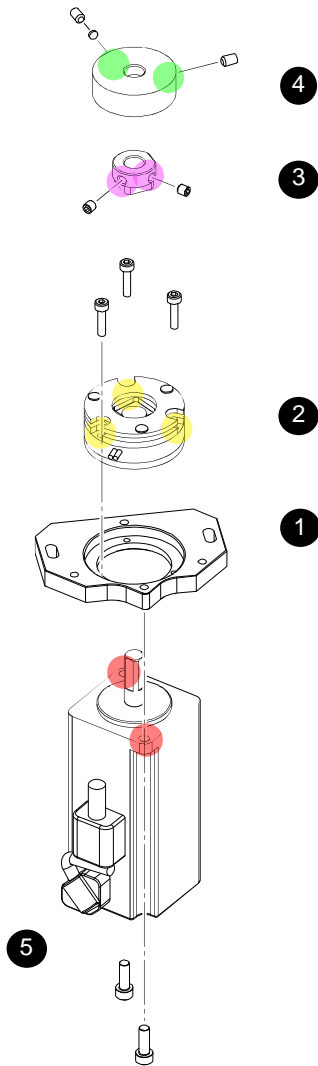
Attach the two screws as shown below.

1st screw: Make sure it vertically contacts the Brake Hub D-cut surface.

2nd screw: Insert the bushing and secure it, making sure not to scratch the Brake Hub.



Motor Unit Assembly



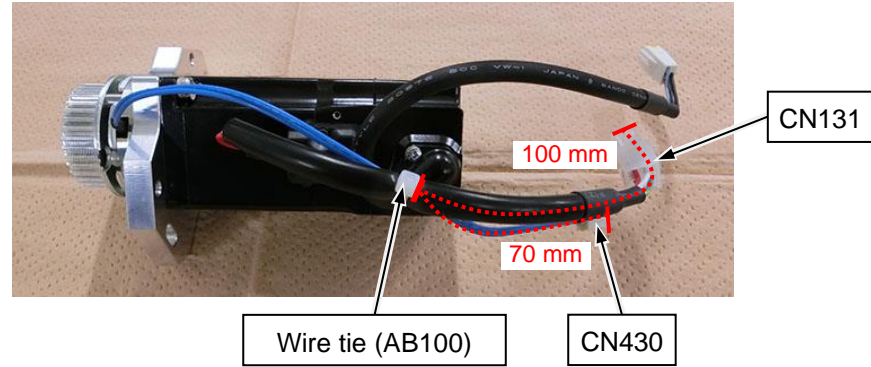
5 Bind CN131 and CN430 using the wire tie (AB100).

POINT

Bind each cable in the position as shown in the figure.

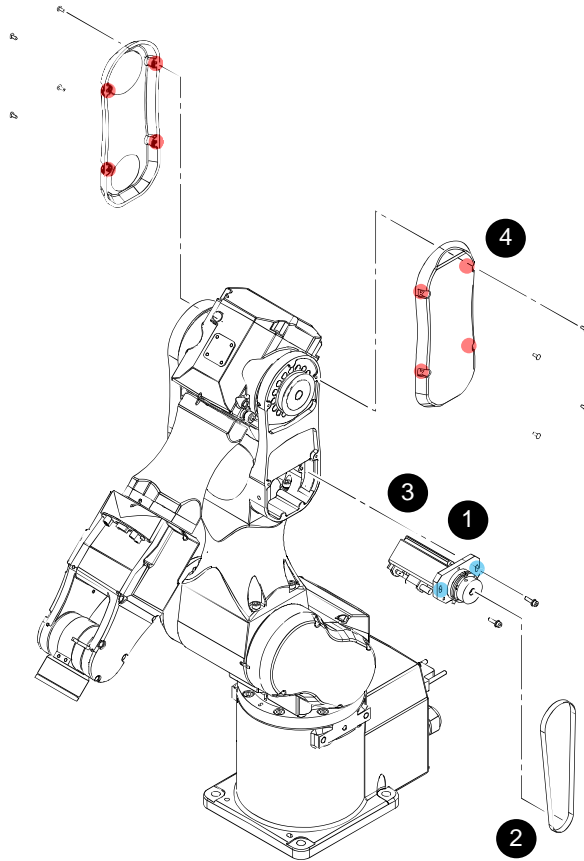
CN131: Approx. 100 mm from the connector end


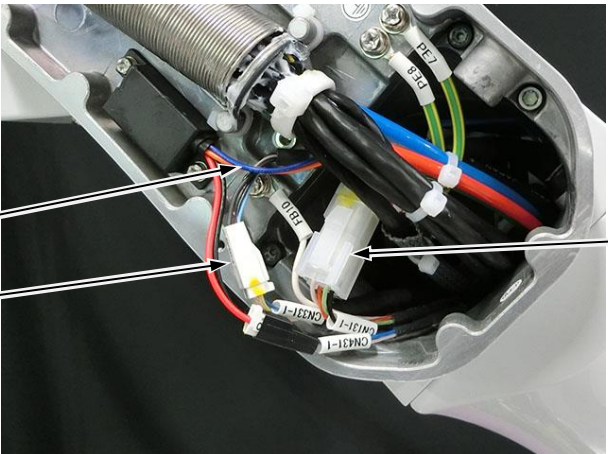
CN430: Approx. 70 mm from the connector end



Joint #3

Installing the Motor Unit

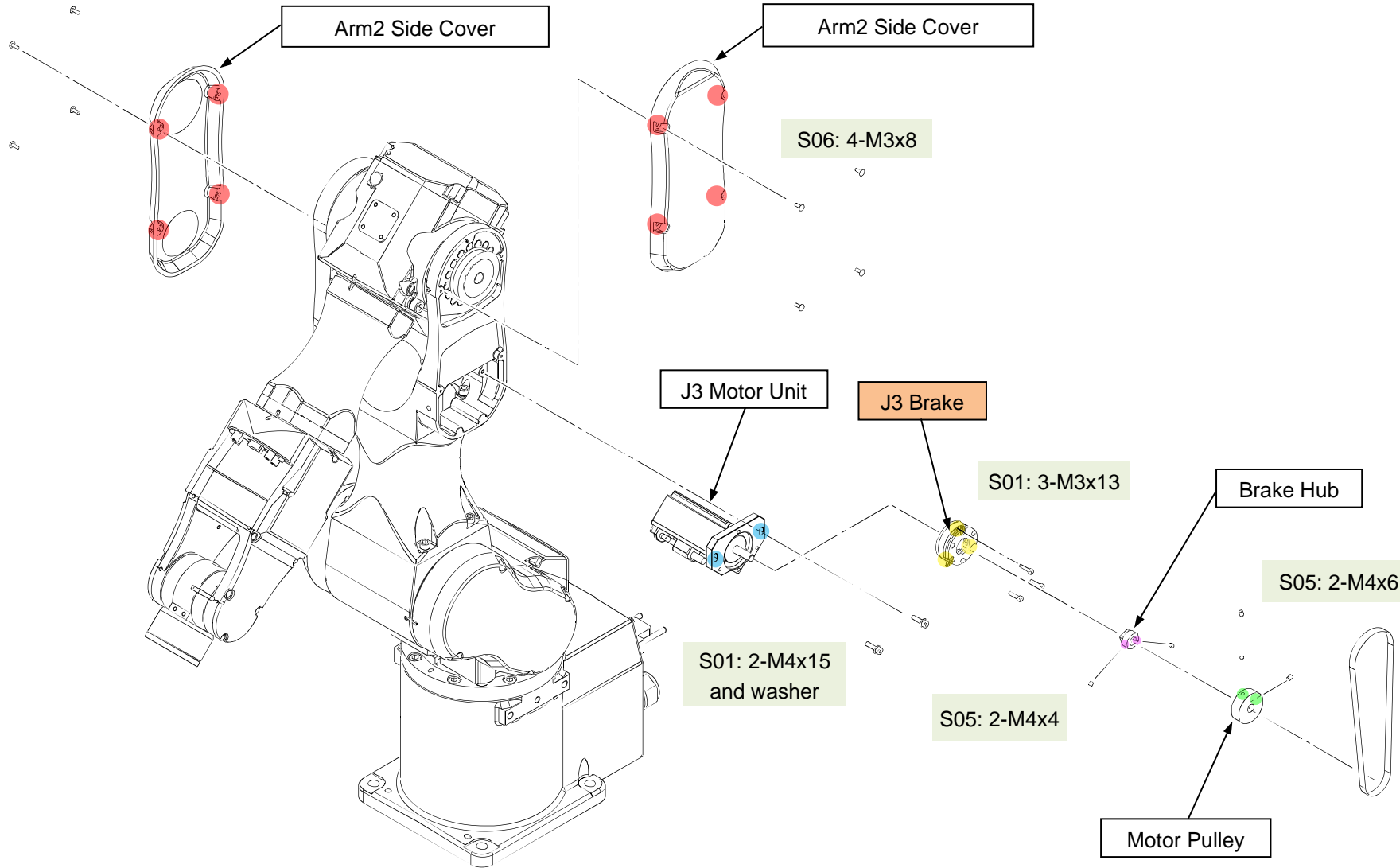


<p>1</p>	<p>Insert the J3 Motor unit inside Arm3.</p>  <p>J3 Motor unit</p>
<p>2</p>	<p>Install the J3 Timing Belt. Perform steps 1 to 3.</p>
<p>3</p>	<p>Connect the J3 Motor Connectors (CN131, CN331, CN430).</p>  <p>CN430</p> <p>CN331</p> <p>CN131</p>
<p>4</p>	<p>Install the Arm2 side cover (both sides).</p>
<p>5</p>	<p>After assembly, perform calibration of Joint #3. 3.2 Calibration</p>

Joint #3

2.4.3 Joint #3 Replacing the Brake

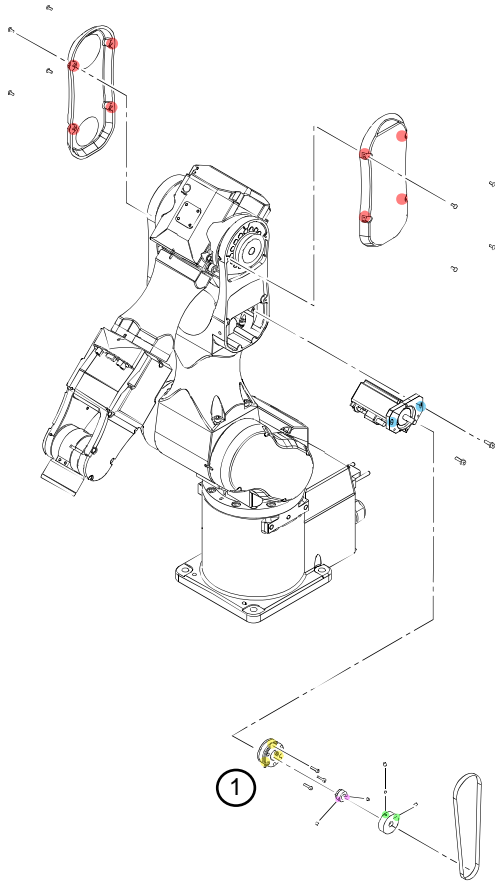
S06: 4-M3x8



Joint #3

Removing the Brake

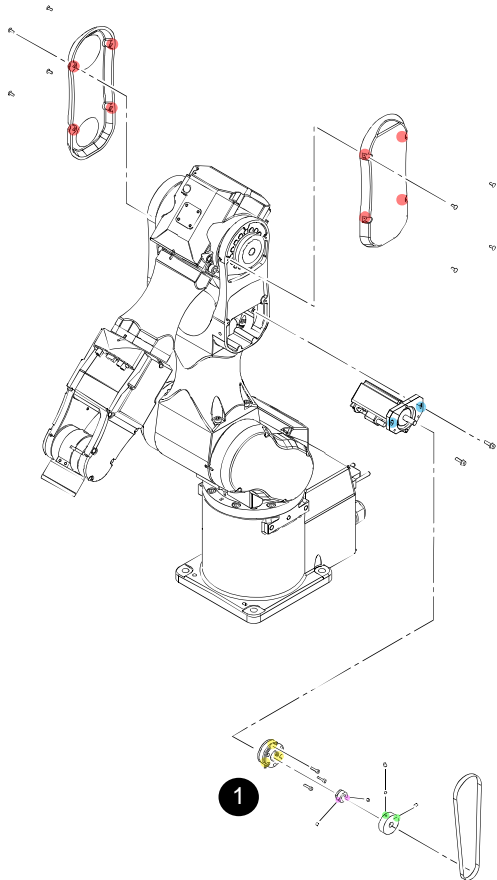
①	Refer to J3 Motor Unit Disassembly and remove the J3 brake.
---	---



Joint #3

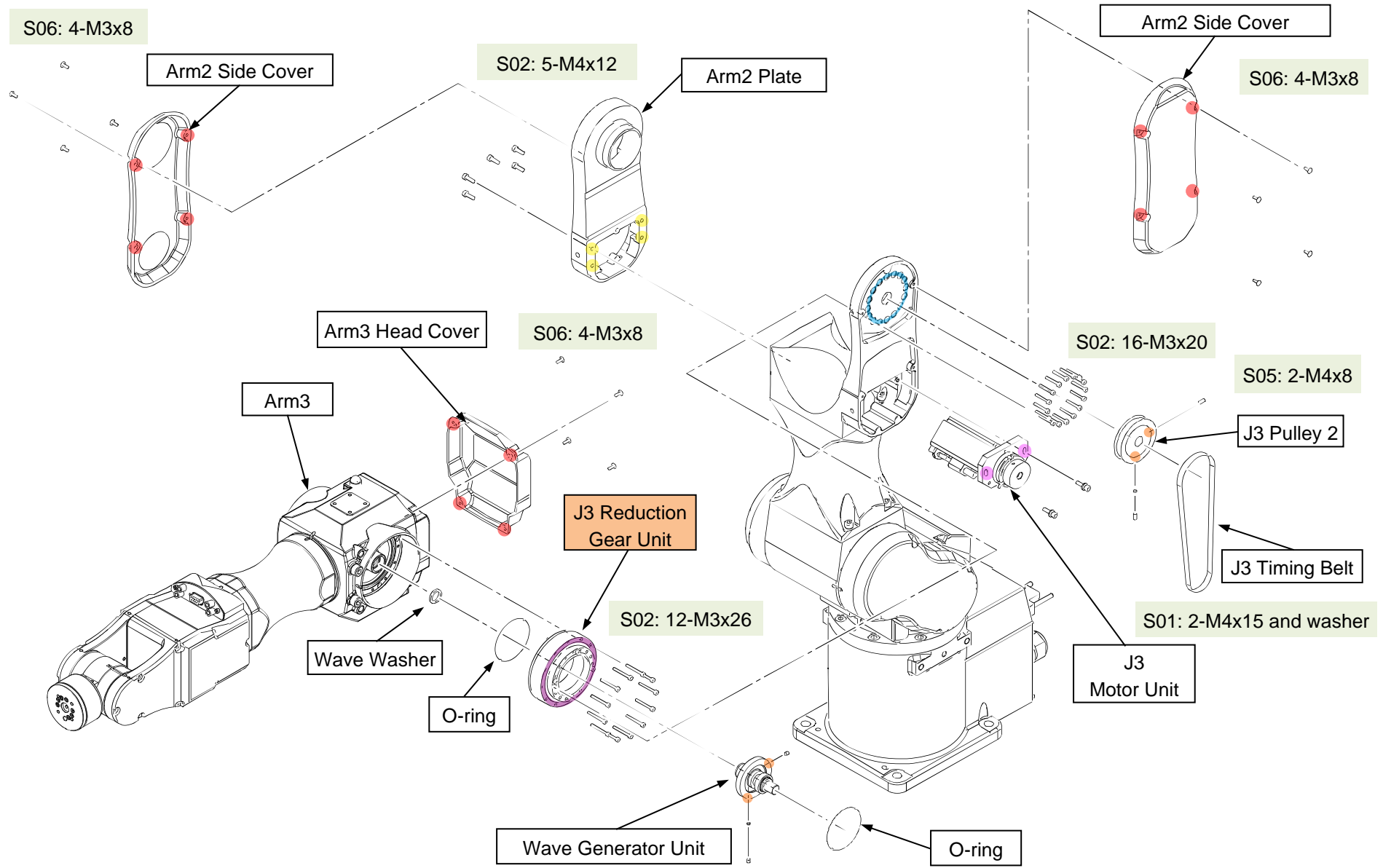
Installing the Brake

- | | |
|----------|---|
| 1 | Refer to J3 Motor Unit Assembly and install the J3 brake. |
|----------|---|



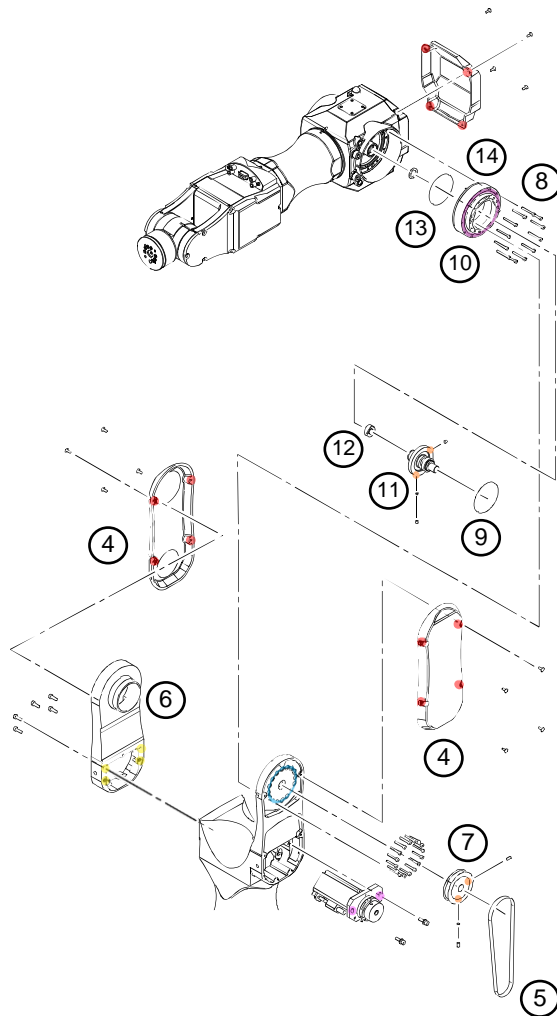
Joint #3

2.4.4 Joint #3 Replacing the Reduction Gear Unit

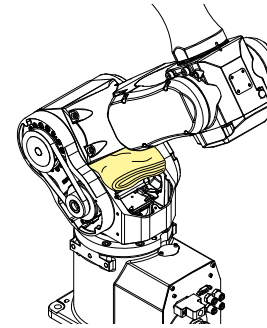


Joint #3

Removing the Reduction Gear Unit

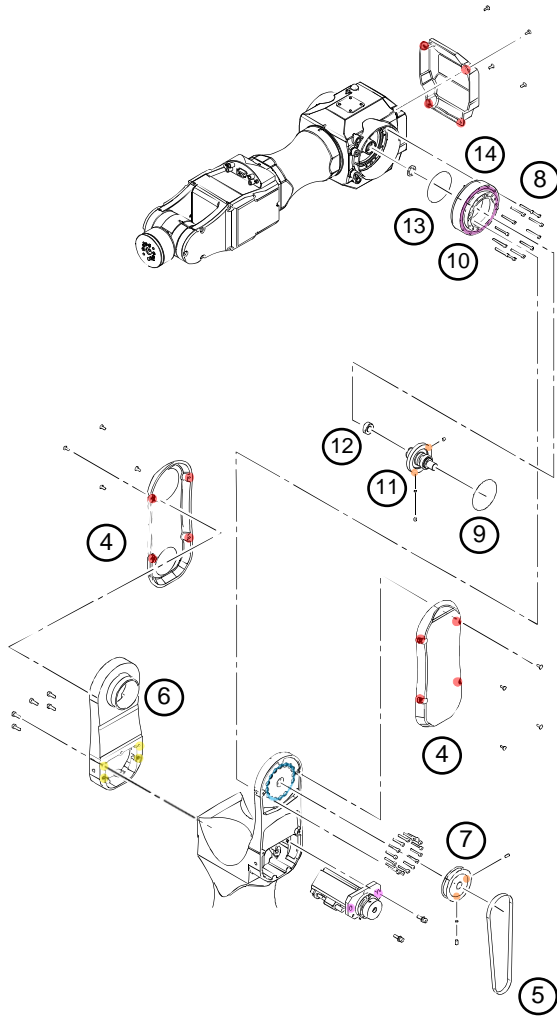


	<p><Preparation> Prepare a work stand upon which to place the arm removed from the Manipulator. Guidelines for work stand Width x Depth: 1.0 x 0.5 m Height: 500 mm to 800 mm from bottom of the Manipulator Load capacity: 10 kg</p>
①	Turn ON the controller.
②	Release the J3 brake, and manually push and move Arm3 until it comes in contact with the mechanical stopper, and push it against Arm2. WARNING <ul style="list-style-type: none"> • Arm3 falls by its weight when the J3 Motor unit is removed. Release the brake and tilt Arm3 in advance. • There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Take care during operation.
③	Turn OFF the Controller.
④	Remove the Arm2 side cover (both sides).
⑤	Remove the J3 timing belt .



Joint #3

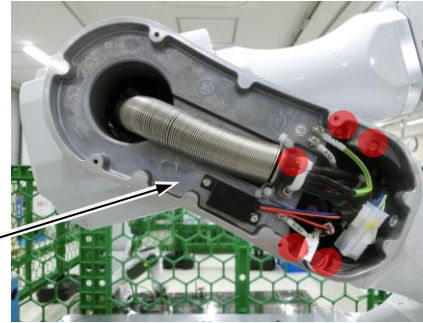
Removing the Reduction Gear Unit



⑥ Remove the Arm2 plate.

A S02: 5-M4x12

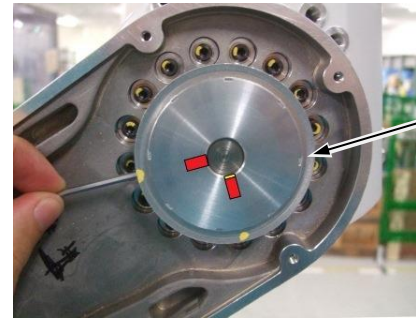
Arm2 plate



⑦ Remove the J3 pulley 2.

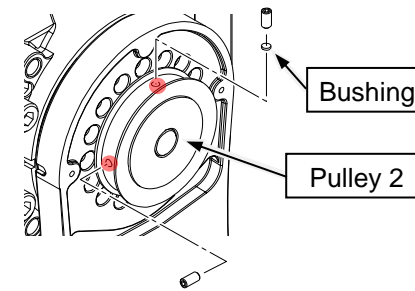
A S05: 2-M4x8

J3 pulley 2



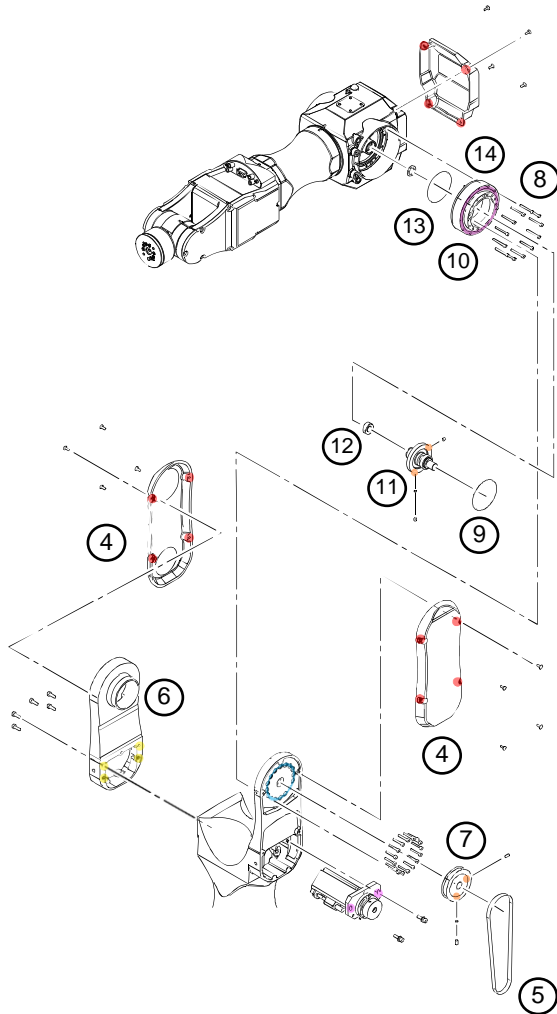
CAUTION

A brass bushing is included on one of the set screws. When removing the pulley, be careful not to drop and lose the bushing.



Joint #3

Removing the Reduction Gear Unit



Joint #3

8

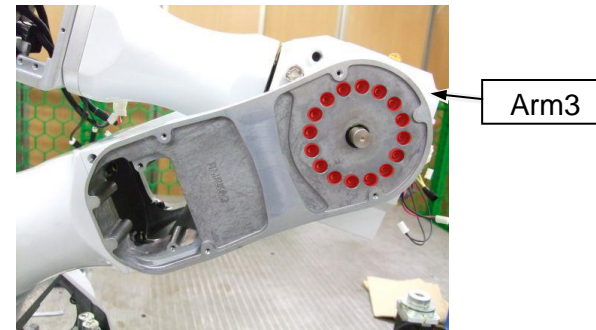
Remove the bolts securing the Reduction Gear.
Remove Arm3, lay it down on its side, and place it on the work stand.

WARNING

Remove the bolts securing the Reduction Gear to remove the Arm2 side arm and Arms 3, 4, 5, and 6 (end effector).
There is a possibility of hands and fingers being caught, and/or damage to or malfunction in the Manipulator. Be very careful when removing the arms. Have at least two workers support the Manipulator while another worker removes the bolts.

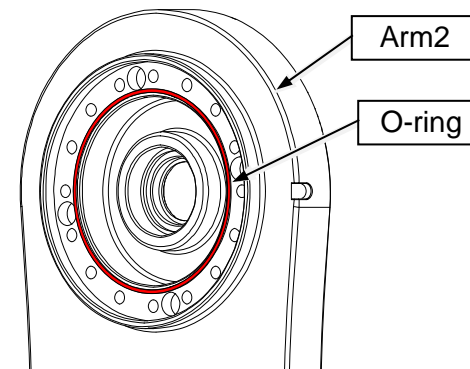
- The arms are connected by internal cables. Place the removed arms on the work stand in order to not apply load on the cables. Applying load on the cables may result in cable disconnection.

A S02: 16-M3x20

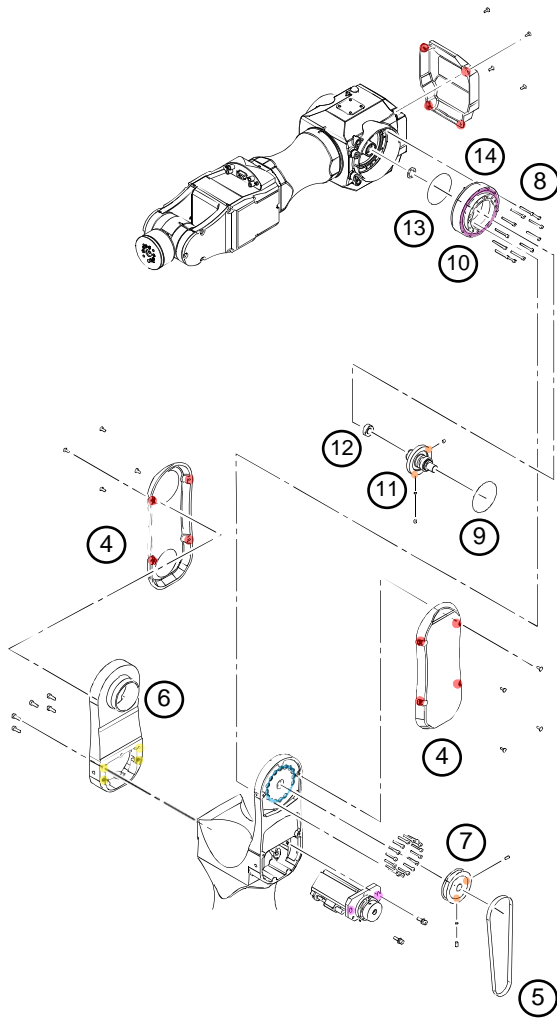


9

Remove the O-ring on Arm2.



Removing the Reduction Gear Unit



⑩

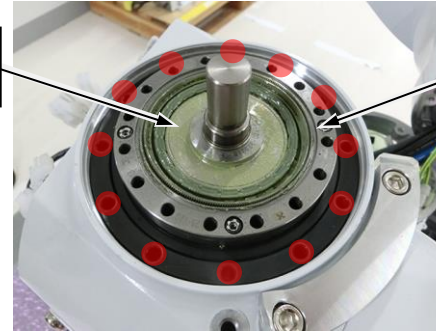
Remove the Reduction Gear Unit with the Wave Generator unit built in.

POINT

The part has grease applied. Perform the work while wiping off the grease.

A S02: 12-M3x26

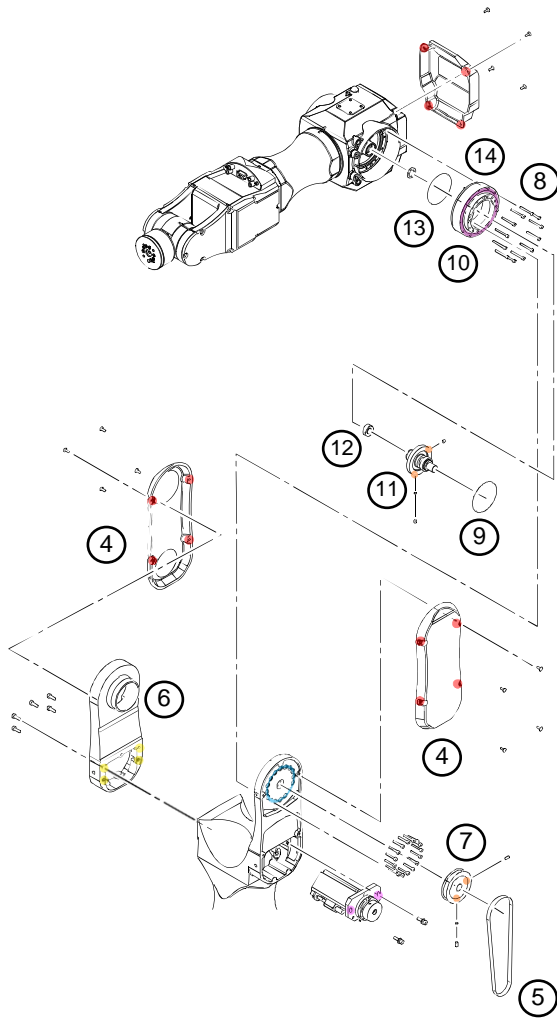
Wave Generator unit



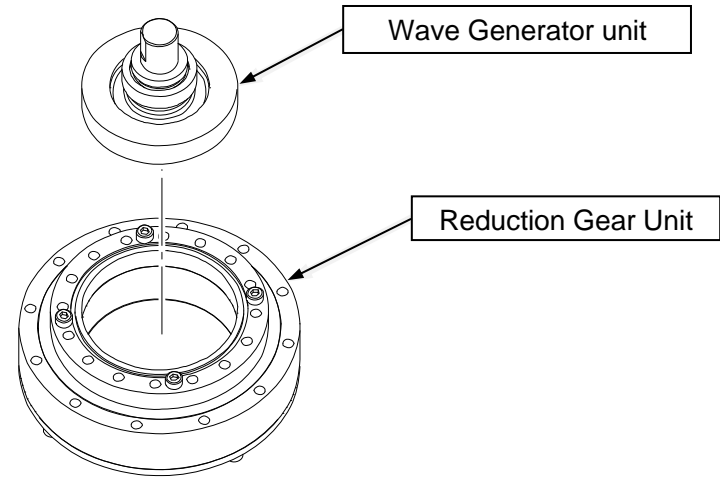
Reduction Gear

Joint #3

Removing the Reduction Gear Unit



⑪ Remove the Wave Generator unit from the Reduction Gear.



POINT

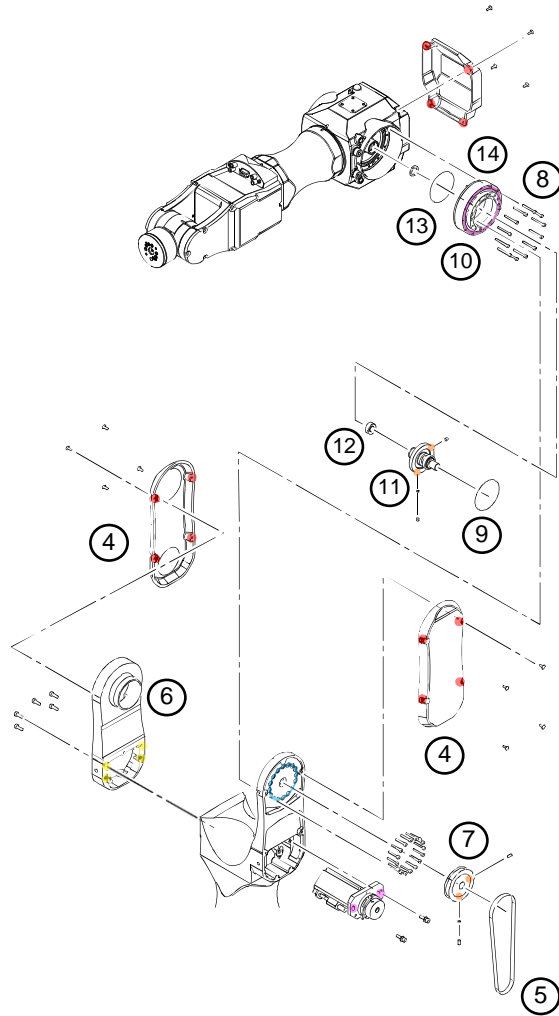
Turn the Reduction Gear Unit over.

Remove the Wave Generator unit by tapping it lightly near the center axis with a plastic hammer.



Joint #3

Removing the Reduction Gear Unit

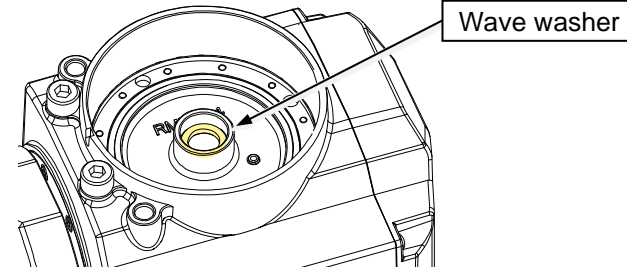


⑫

Remove the wave washer in the Arm2 hole.

POINT

The wave washer will be used again. Store it so that you do not lose it.

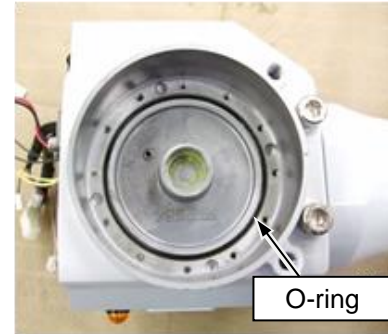


⑬

Remove the O-ring on Arm3.

POINT

The part has grease applied. Perform the work while wiping off the grease.

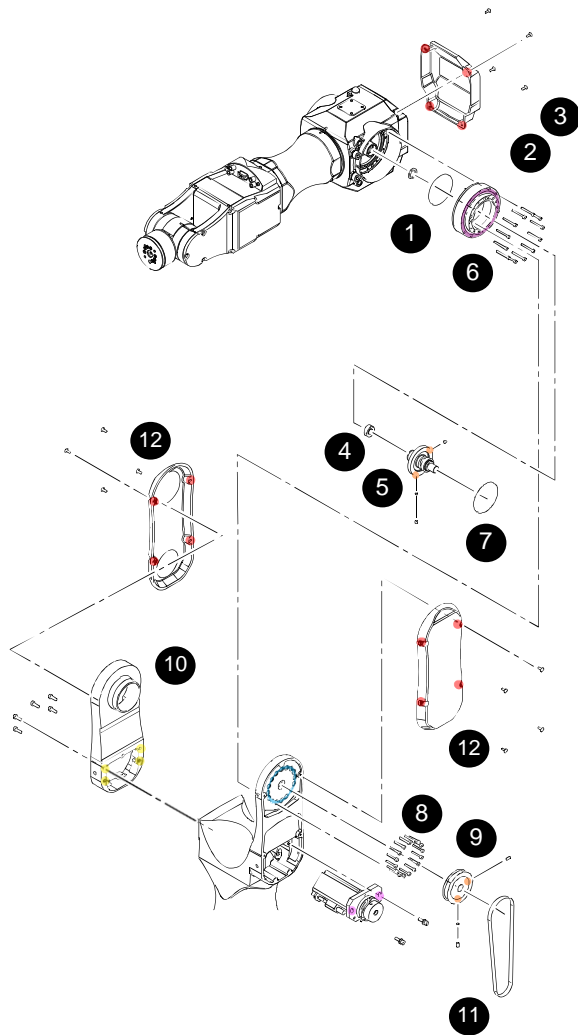


⑭

If there is grease on the Arm2 or Arm3 parts, wipe it off with a cloth.

Joint #3

Installing the Reduction Gear Unit



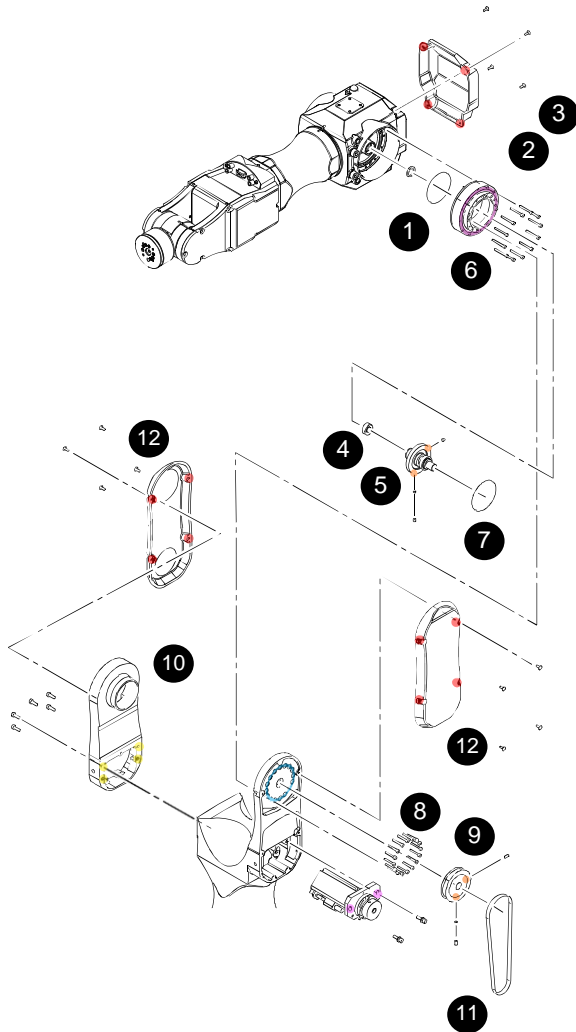
<Preparation>

Take the new Reduction Gear Unit out of the box, and check that the following parts are included.

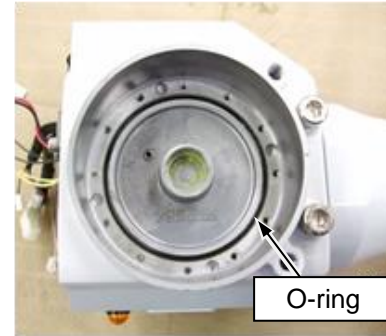


Joint #3

Installing the Reduction Gear Unit

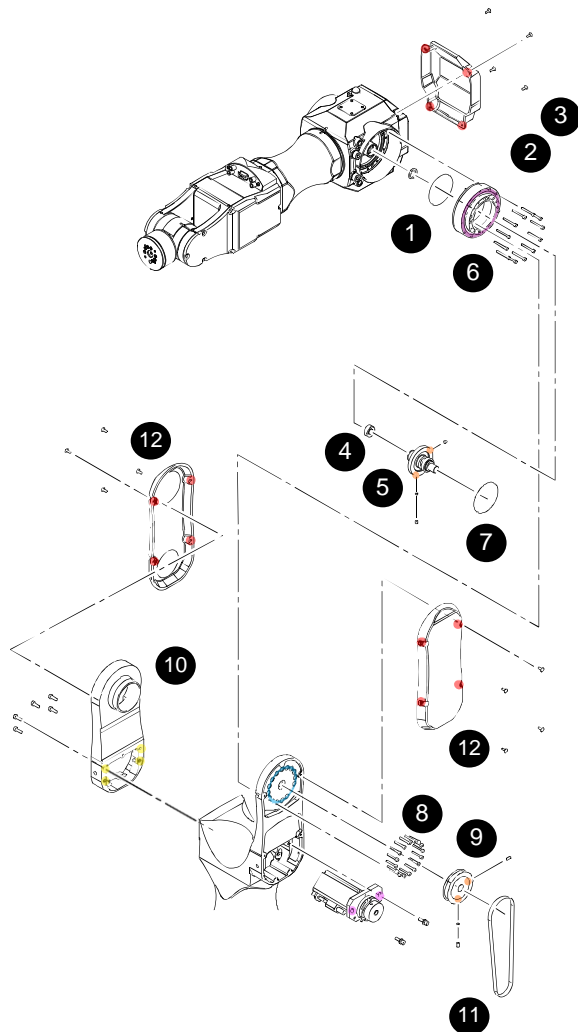

1 Install the O-ring.
CAUTION

- Applying a small amount of grease (SK-1A) to the O-ring will make it stick to the arm, facilitating subsequent work.
- Insert the O-ring firmly into the groove.
- If the O-ring is stretched, damaged, or has deteriorated, replace with a new one.



Joint #3

Installing the Reduction Gear Unit



2

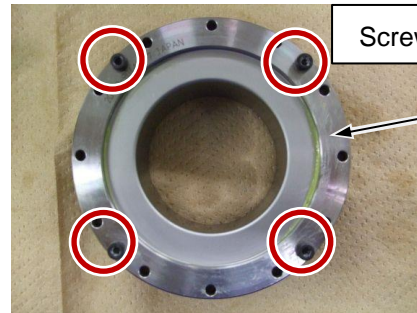
Set the Reduction Gear Unit on Arm3, then secure the fixing bolts temporarily.

A S02: 12-M3x26



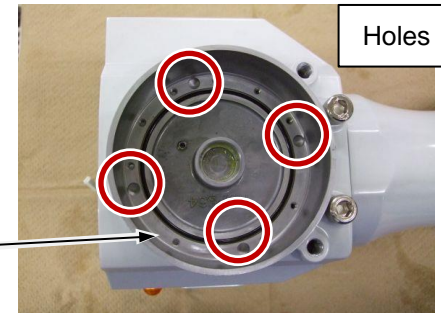
POINT

The Arm3 Reduction Gear installation surface has clearance holes for the screws on the Reduction Gear rear surface. Align the screws and the hole positions to install.



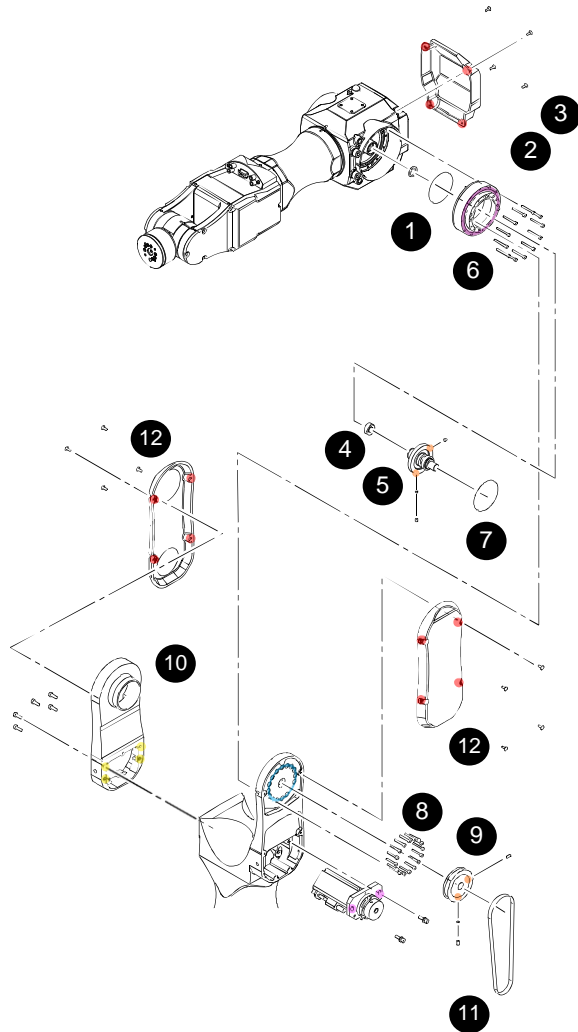
Reduction Gear rear surface

Reduction Gear installation surface




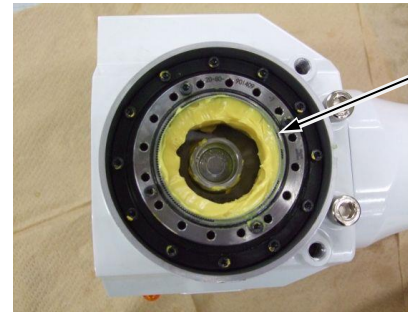
Joint #3

Installing the Reduction Gear Unit



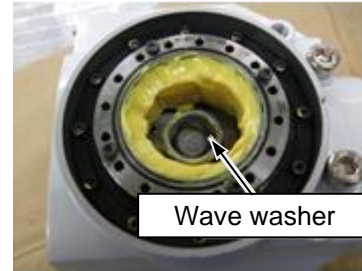
3 Apply grease to the inside of the Flexspline.

 SK-1A: 20 g



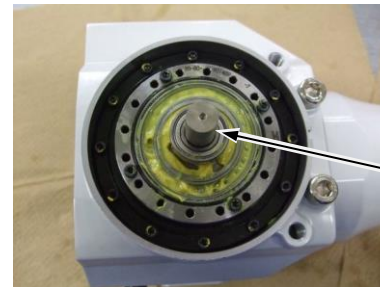
Flexspline

4 Insert a wave washer in the Arm3 bearing setting position.



Wave washer

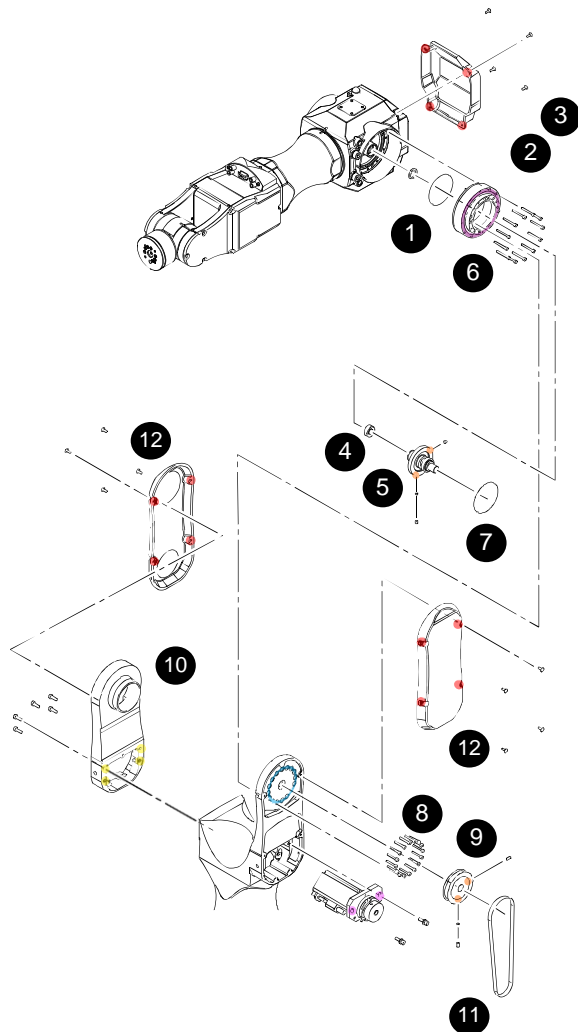
5 Install the Wave Generator unit.



Wave Generator unit

Joint #3

Installing the Reduction Gear Unit

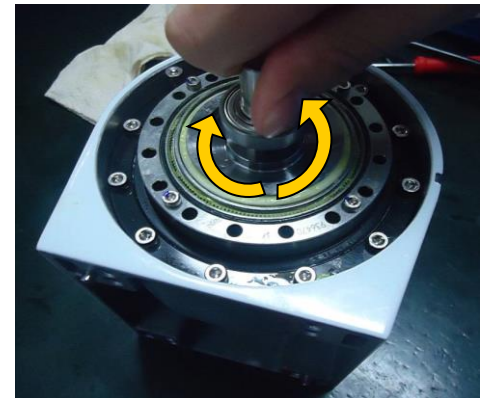
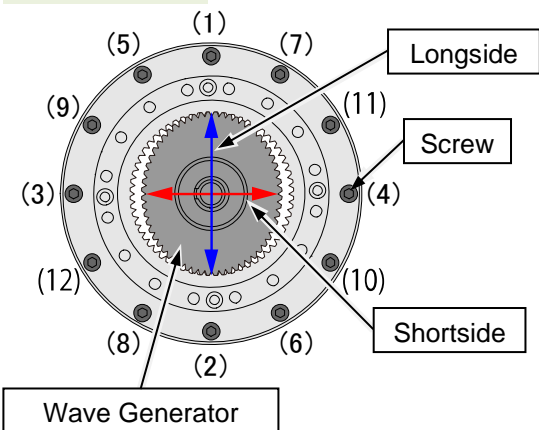


Joint #3

6

Secure the J3 Reduction Gear Unit to Arm3.

S02: 12-M3x26



Tighten the screws using the following procedure. Refer to the figure above.

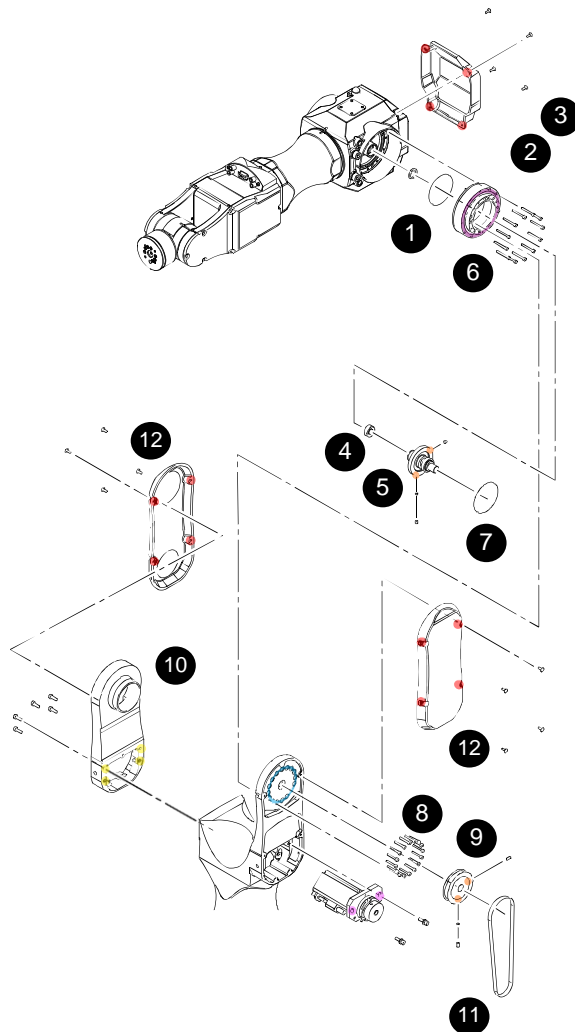
CAUTION

- Ensure that diagonally opposite screws are tightened alternately.
- Do not tighten the screws all the way at once. Instead, divide this into four times and tighten to the following torques.

Percentage of the specified torque	Torque value	Unit
20%	0.625 +/- 0.15	N · m
40%	1.25 +/- 0.15	
80%	1.875 +/- 0.15	
100%	2.5 +/- 0.15	

1. Rotate the Wave Generator so that its longside aligns with the positions of screws (1) and (2).
2. Tighten screws (1) and (2) to 20% of the torque value.
3. Tighten screws (1) and (2) to 40% of the torque value.
4. Rotate the Wave Generator longside so that it aligns with the positions of screws (3) and (4).
5. Tighten screws (3) and (4) to 20% of the torque value.

Installing the Reduction Gear Unit

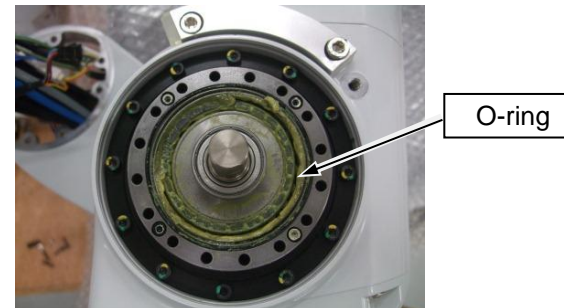


6. Tighten screws (3) and (4) to 40% of the torque value.
7. Rotate the Wave Generator longside and tighten screws (5) through (12) to the 20% and 40% of the torque value.
8. Rotate the Wave Generator so that its longside aligns with the positions of screws (1) and (2).
9. Tighten screws (1) and (2) to 80% of the torque value, then tighten screws (1) and (2) to 100% of the torque value.
10. Rotate the Wave Generator longside so that it aligns with the positions of screws (3) and (4).
11. Tighten screws (3) and (4) to 80% of the torque value, then tighten screws (3) and (4) to 100% of the torque value.
12. Rotate the Wave Generator longside and tighten screws (5) through (12) to the 80% and 100% of the torque value.

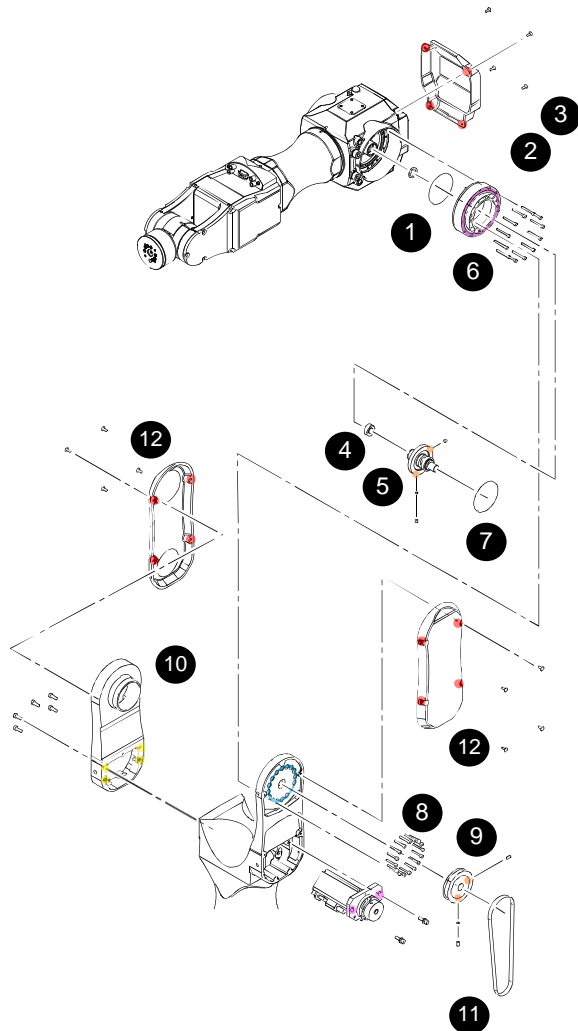
7. Install the O-ring.

POINT

- Applying a small amount of grease (SK-1A) to the O-ring will make it stick to the arm, facilitating subsequent work.
- Insert the O-ring firmly into the groove.
- If the O-ring is stretched, damaged, or has deteriorated, replace with a new one.



Installing the Reduction Gear Unit



8

Secure Arm3 and the Reduction Gear to Arm2.

WARNING

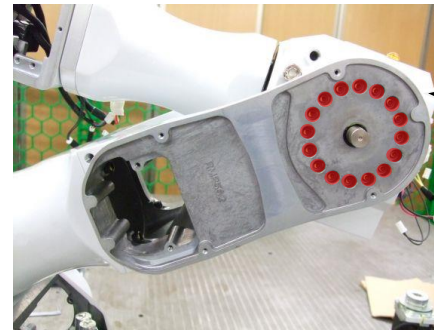
Have at least two workers perform this work. At least one worker must support the Manipulator to prevent its arm from falling. Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.

CAUTION

- When inserting the shaft in the Arm2 hole, be careful not to damage the seal.
- Take care to ensure that the O-ring in the Circularity groove does not come out.

A

S02: 16-M3x20
(3.0 +/- 0.15 N·m)

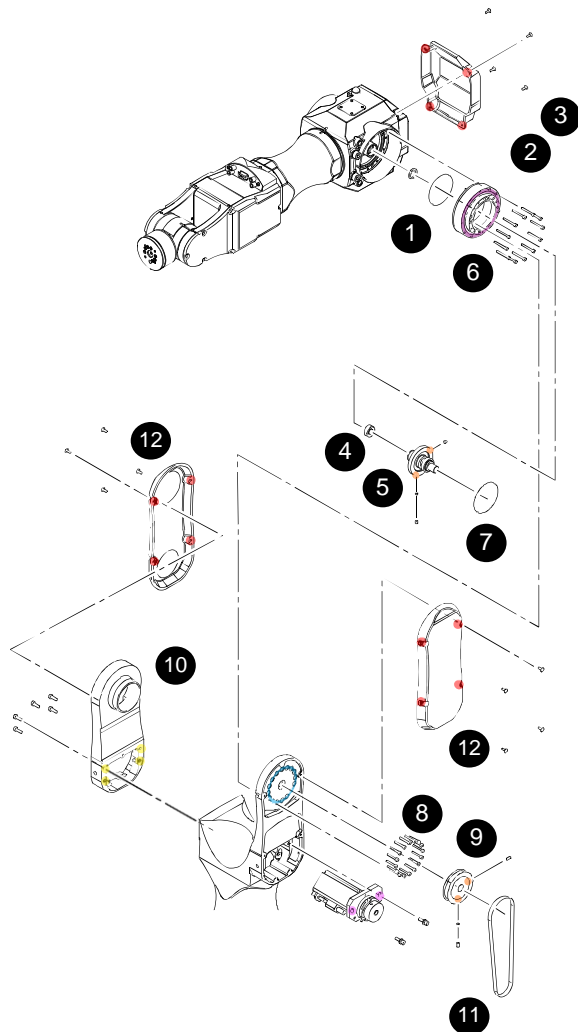


POINT

After securing the arm, manually move the arm to check that there is no rattling or misalignment of the Reduction Gear.

Joint #3

Installing the Reduction Gear Unit

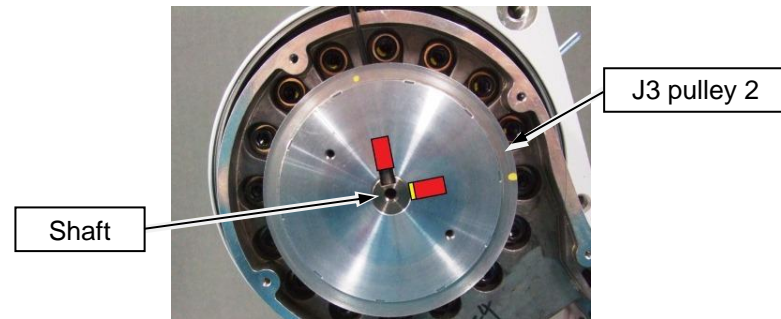


9

Install the J2 pulley 3.

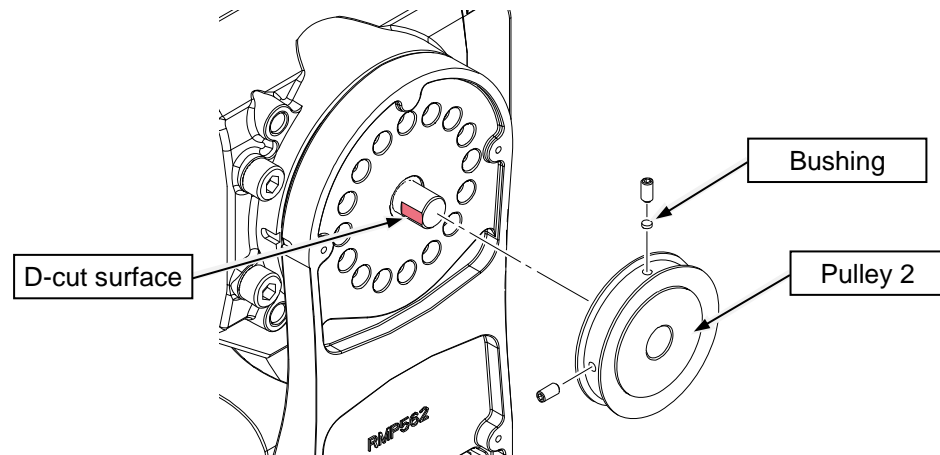
A

S05: 2-M4x8 (Brass bushing x 1) (2.4 +/- 0.1 N·m)



POINT

Align the shaft D-cut surface with the screw hole, and install pulley 2.

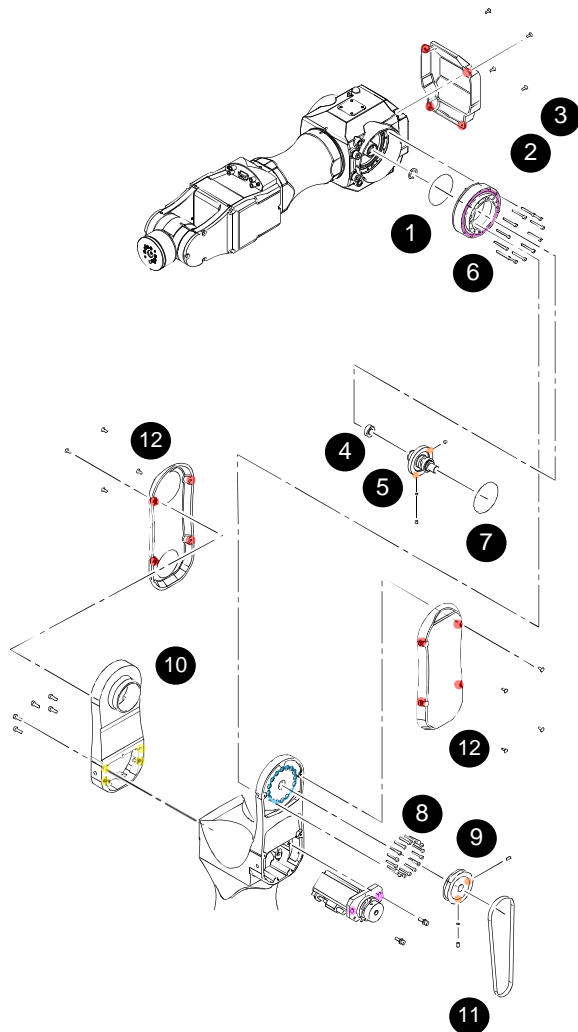


CAUTION

If the screw positions are incorrect or the bushing is not set, this may cause damage on the side, and may result in the part being unable to be removed.

Joint #3

Installing the Reduction Gear Unit

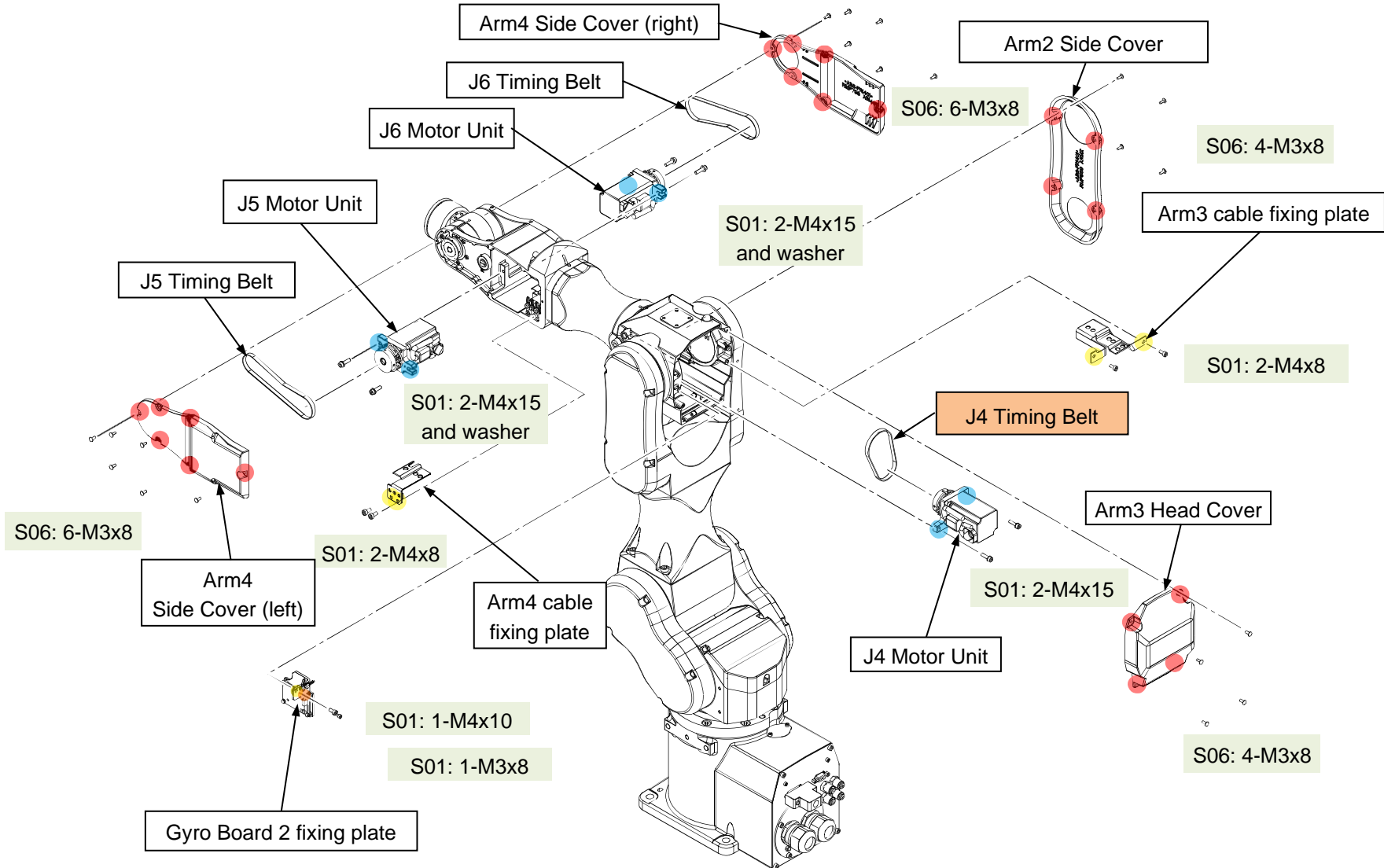


<p>10</p>	<p>Install the Arm2 plate.</p> <p>A S02: 5-M4x12 (5.0 +/- 0.25 N·m)</p>	<p>Arm2 plate</p>
<p>11</p>	<p>Install the J3 timing belt.</p>	
<p>12</p>	<p>Install the Arm2 side cover (both sides).</p>	
<p>13</p>	<p>After assembly, perform calibration of Joint #3. 3.2 Calibration</p>	

Joint #3

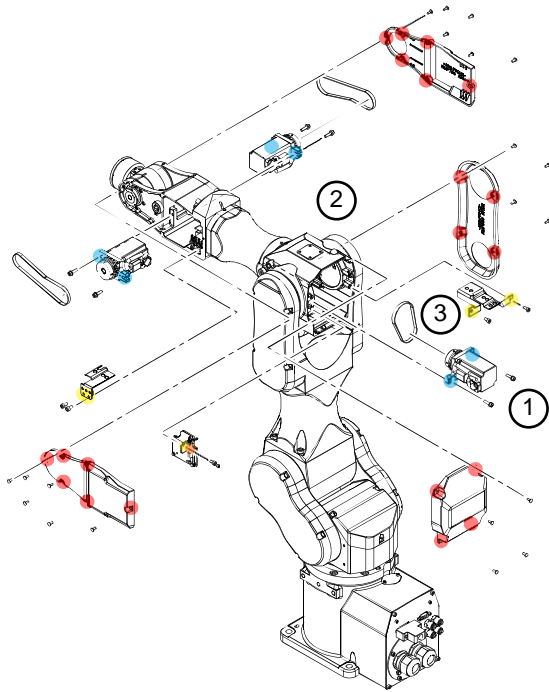
2.5 Joint #4

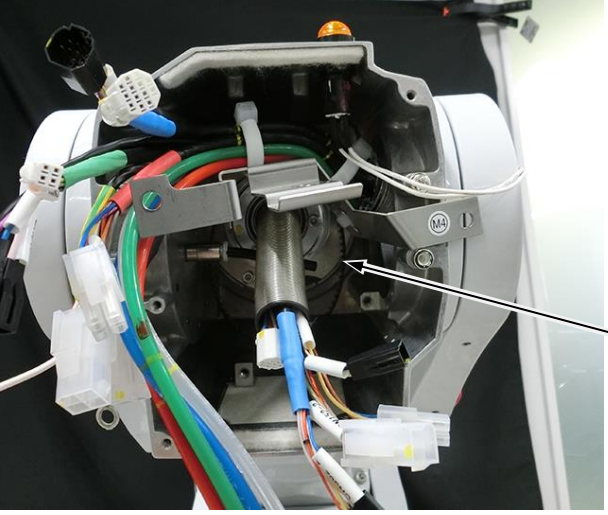
2.5.1 Joint #4 Replacing the Timing Belt



Joint #4

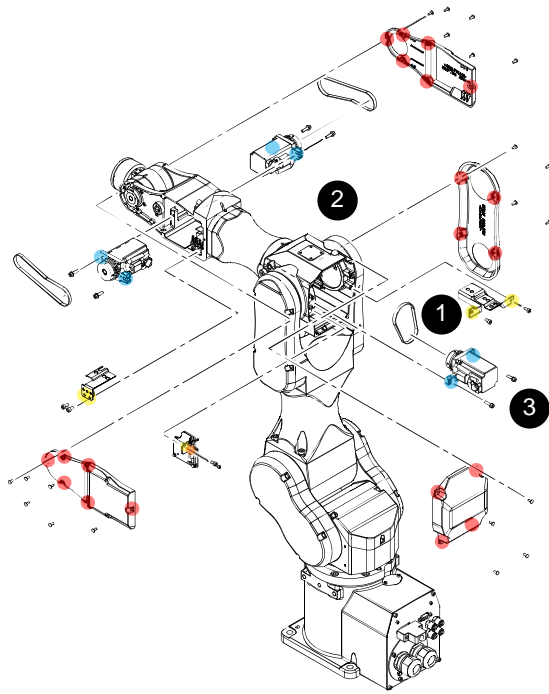
Removing the Timing Belt



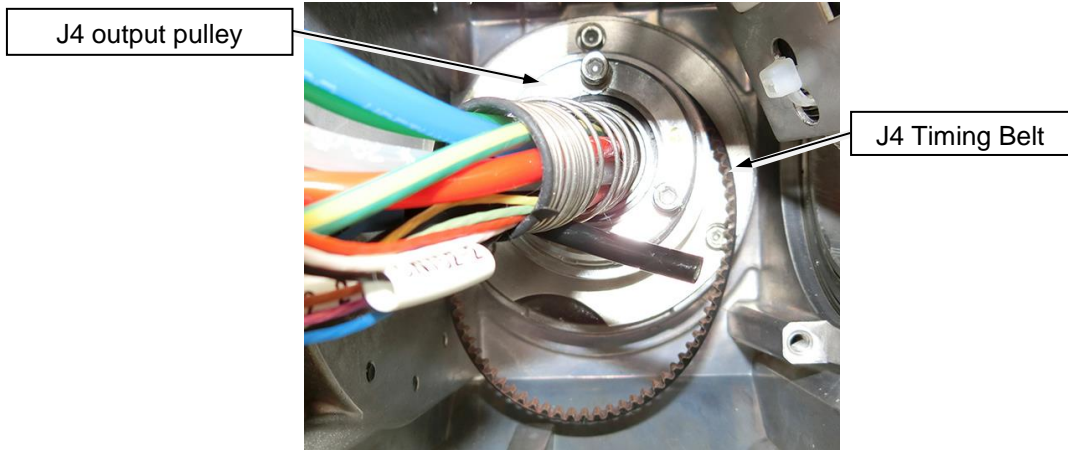
①	Remove the J4 Motor unit .
②	Perform the Cable Unit removal procedure up to removing the four tubes and the Ground Wire toward Arm3. Removing the Cable Unit
③	Remove the J4 Timing Belt.  <p data-bbox="1792 730 2011 817">J4 Timing Belt</p>

Joint #4

Installing the Timing Belt

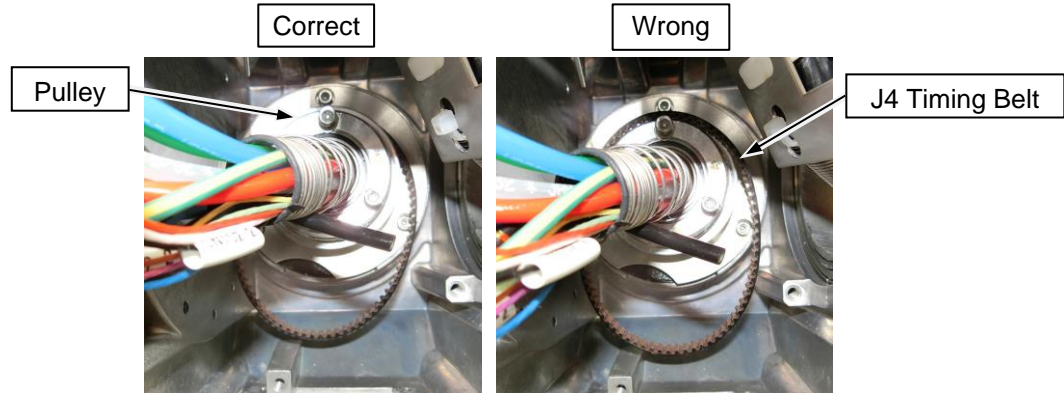


1 Attach the J4 Timing Belt to the J4 output pulley.



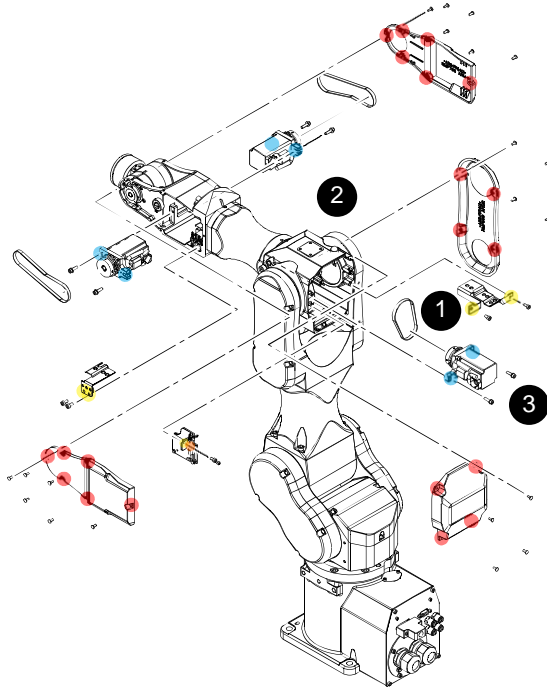
CAUTION

Attach the J4 Timing Belt at the position shown in the figure.



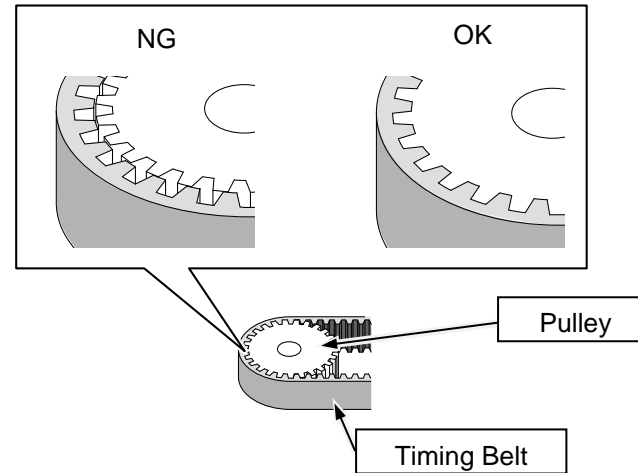
Joint #4

Installing the Timing Belt



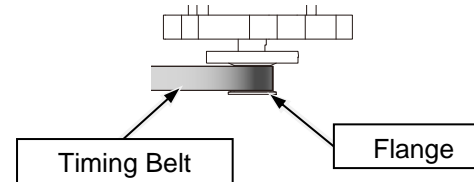
POINT

Make sure that the teeth of the Timing 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.

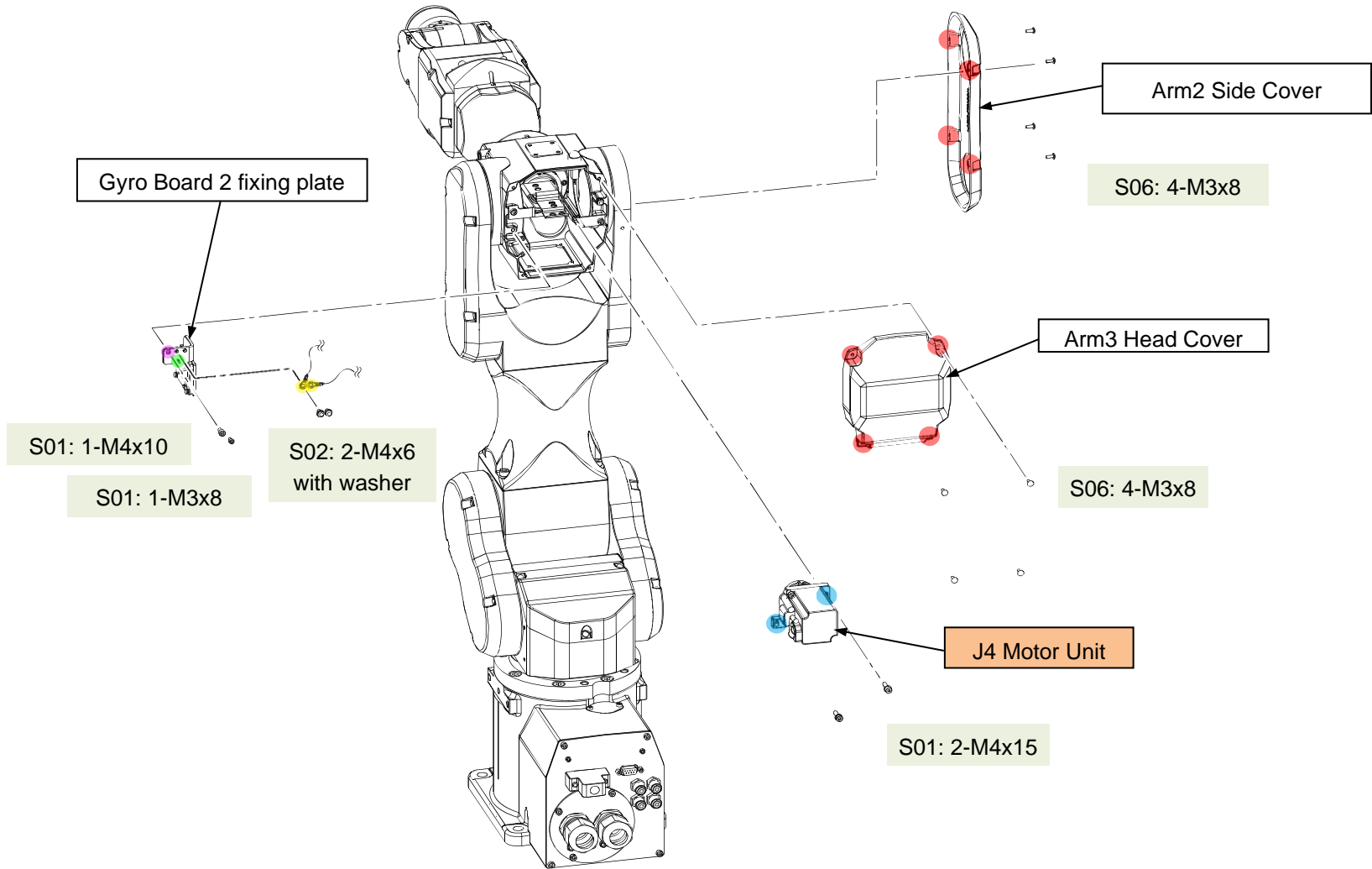


Set the belt so that it is level with respect to the pulley without it being placed on the flange.

- 2 Perform the Cable Unit installation procedure up to passing the four tubes and the Ground Wire into Arm4.
[Installing the Cable Unit](#)
- 3 Install the [J4 Motor unit](#).

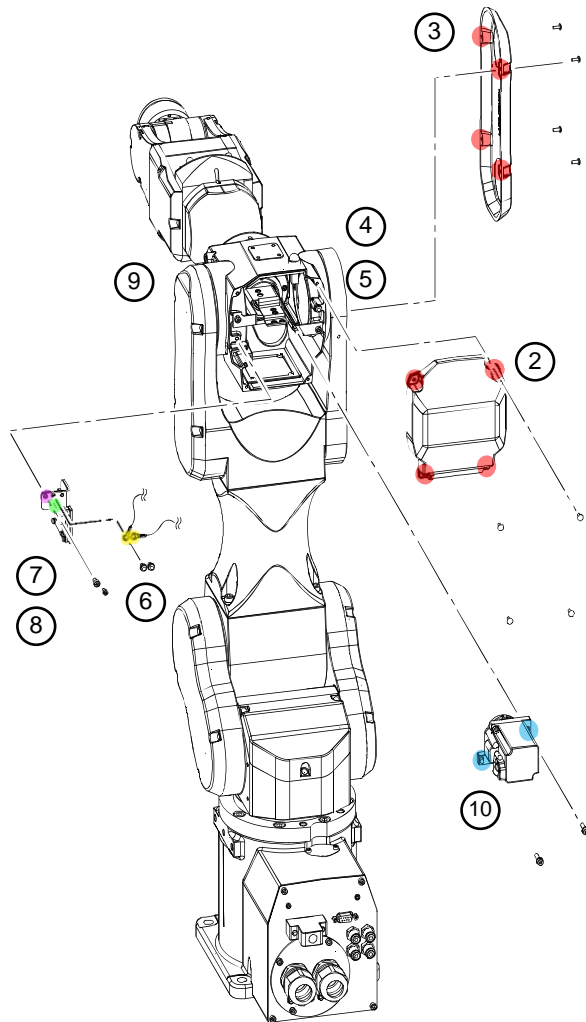
Joint #4

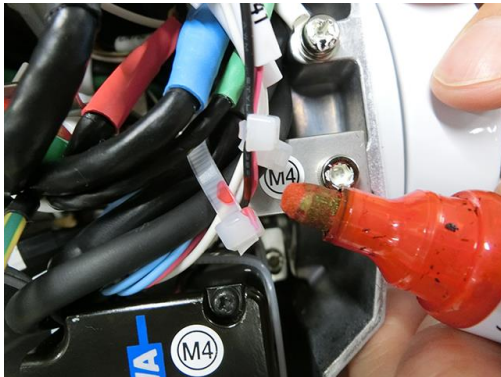
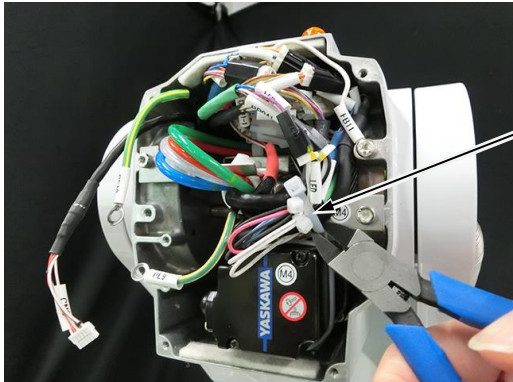
2.5.2 Joint #4 Replacing the Motor Unit



Joint #4

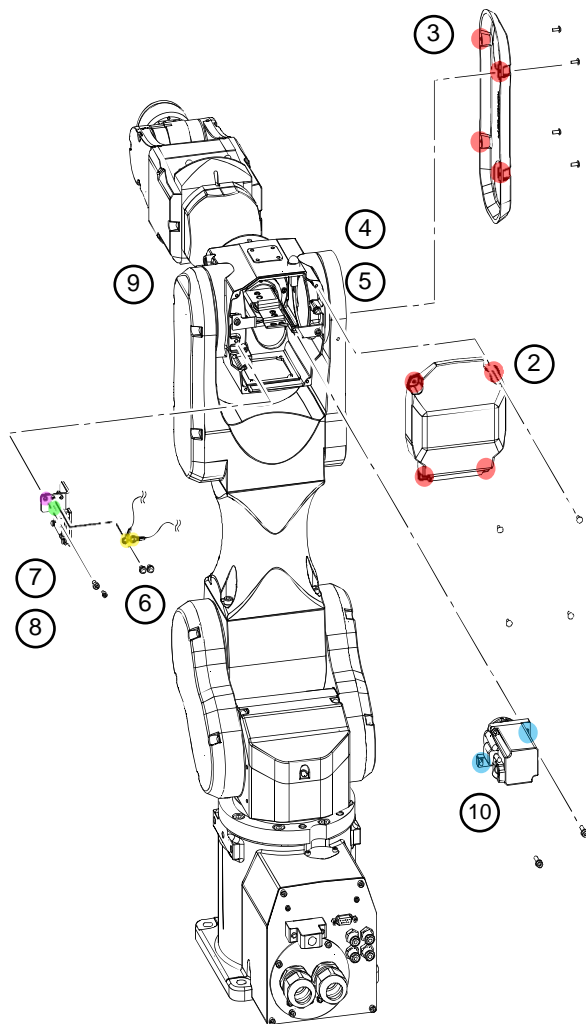
Removing the Motor Unit



①	Turn OFF the Controller.
②	Remove the Arm3 head cover .
③	Remove the Arm2 side cover .
④	<p>The cables are fixed with a wire tie to the plate with the M4 sticker.</p> <p>In preparation for reassembly, mark the wire tie and the cable positions so that you can see the positional relationship.</p> 
⑤	<p>Cut the wire tie securing the cables.</p> 

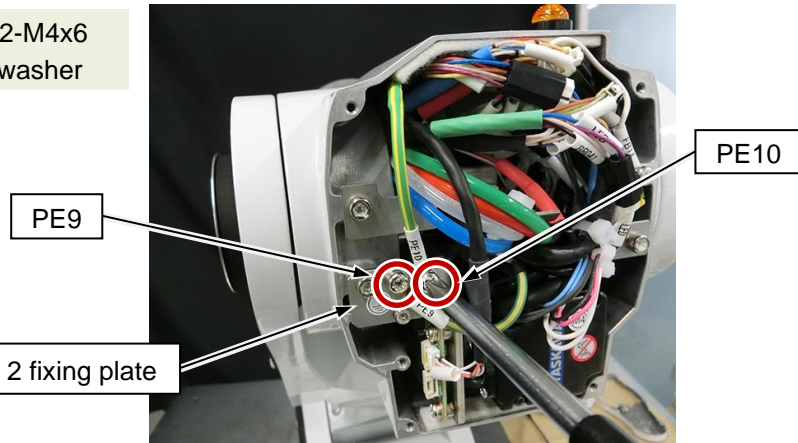
Joint #4

Removing the Motor Unit

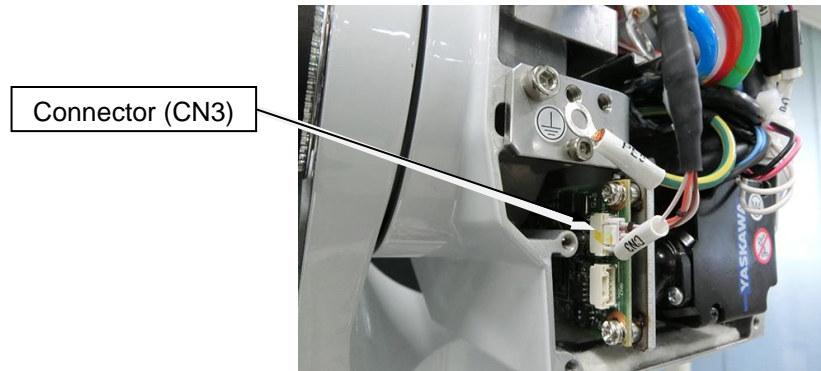


⑥ Remove the Ground Wires (PE9, PE10) from the gyro board 2 fixing plate.

A S02: 2-M4x6 with washer

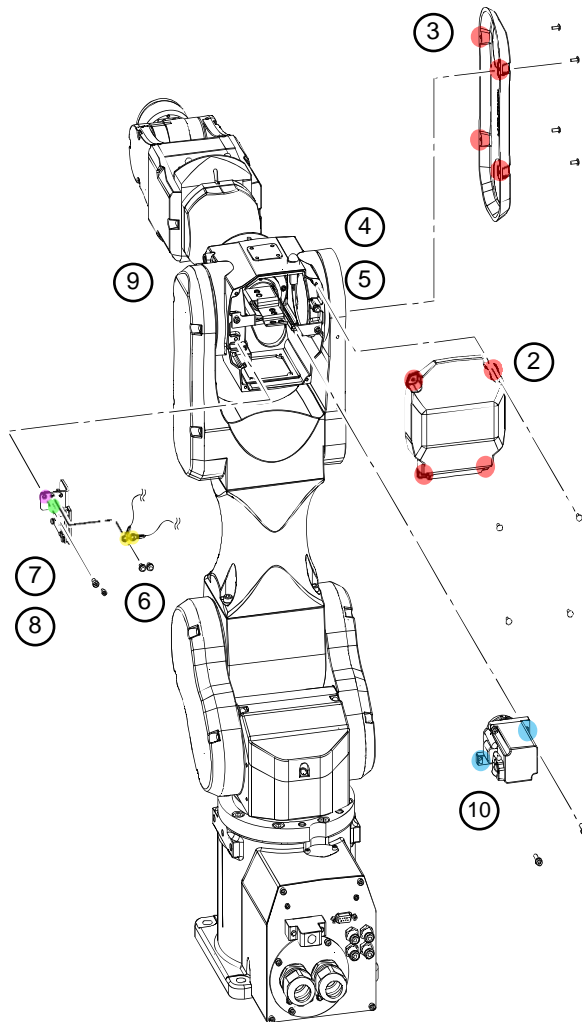


⑦ Disconnect the gyro board 2 connector (CN3) from the board.



Joint #4

Removing the Motor Unit



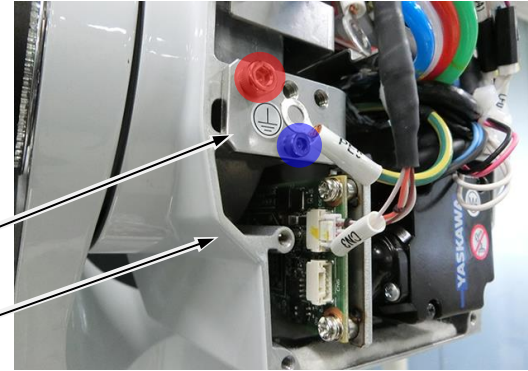
⑧ Remove the gyro board 2 fixing plate from Arm3.

A S01: 1-M4x10

B S01: 1-M3x8

Gyro board 2 fixing plate

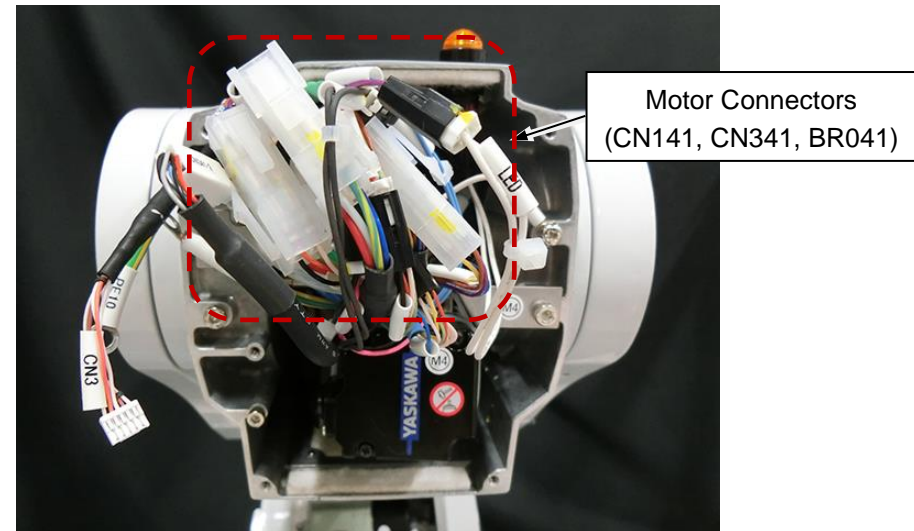
Arm3



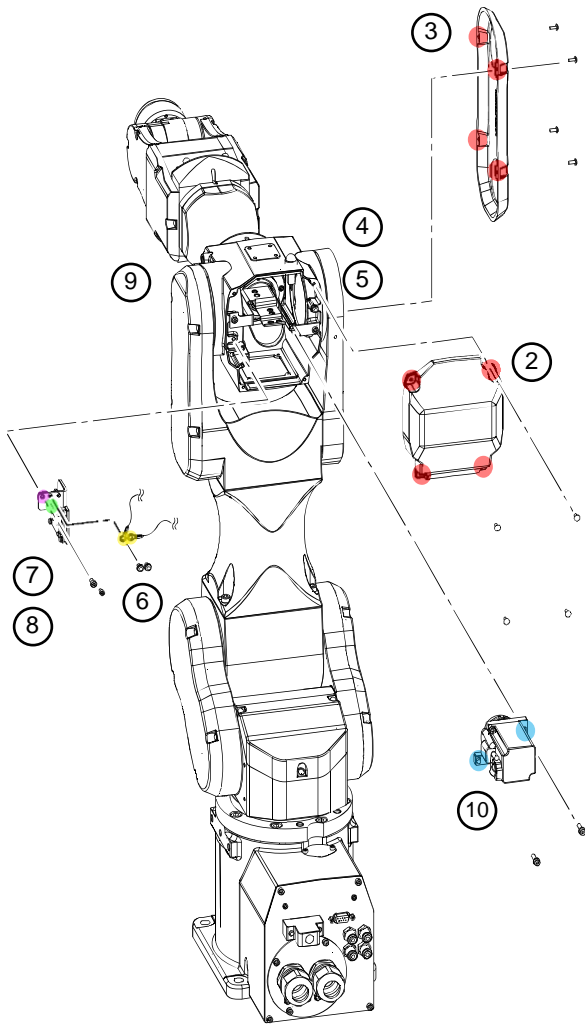
⑨ Disconnect the J4 Motor Connectors (CN141, CN341, BR041).

POINT

Press in the connector clips and pull out the connectors.



Removing the Motor Unit



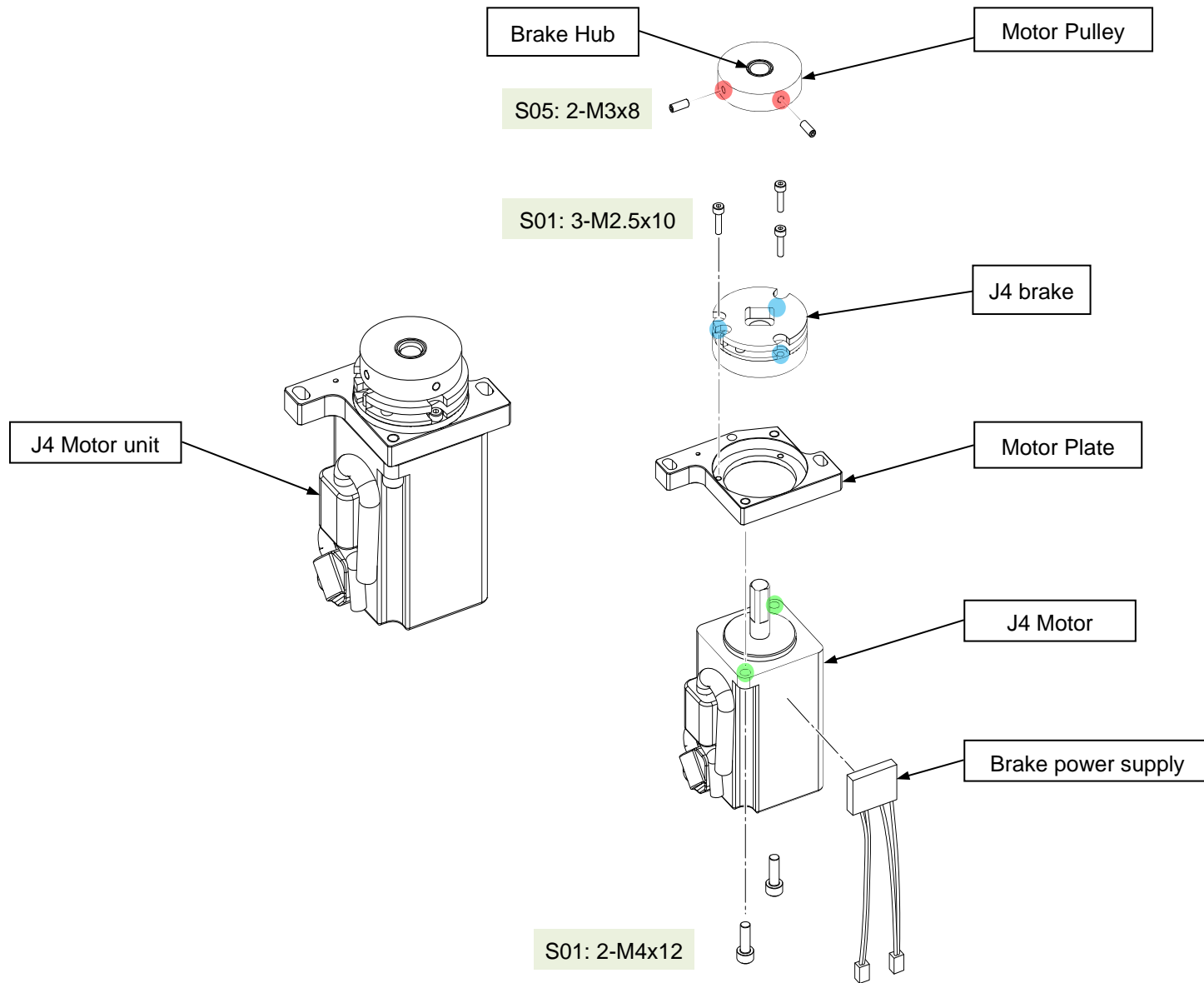
⑩ Remove the screws securing the J4 Motor unit, and remove the J4 Motor unit from Arm3.

A S01: 2-M4x15

A diagram showing the J4 Motor unit being removed from Arm3. The motor unit is highlighted in yellow. The screws being removed are marked with red circles. Labels 'J4 Motor unit' and 'Arm3' are present with arrows pointing to the respective parts.

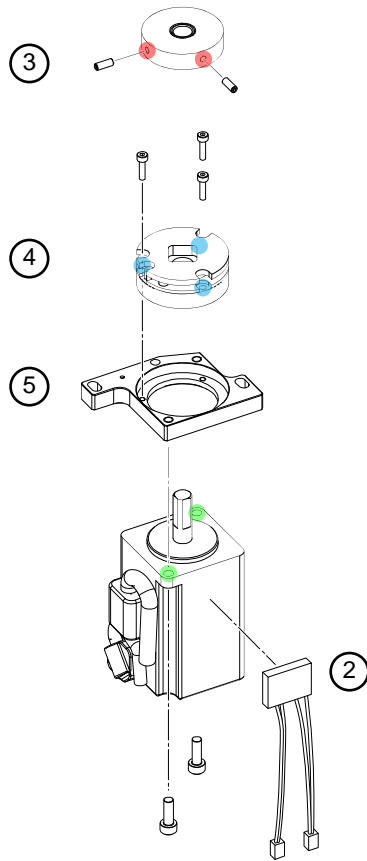
Joint #4

Motor Unit Disassembly



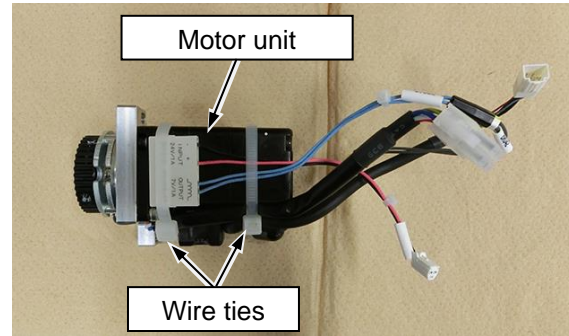
Joint #4

Motor Unit Disassembly



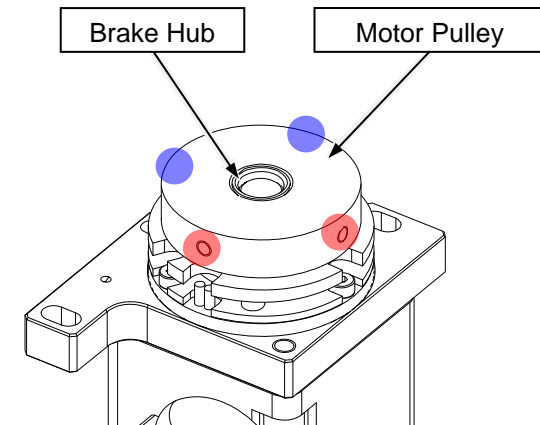
① Remove the [J4 Motor unit](#).

② Cut the wire ties bundling the cables on the Motor Unit.

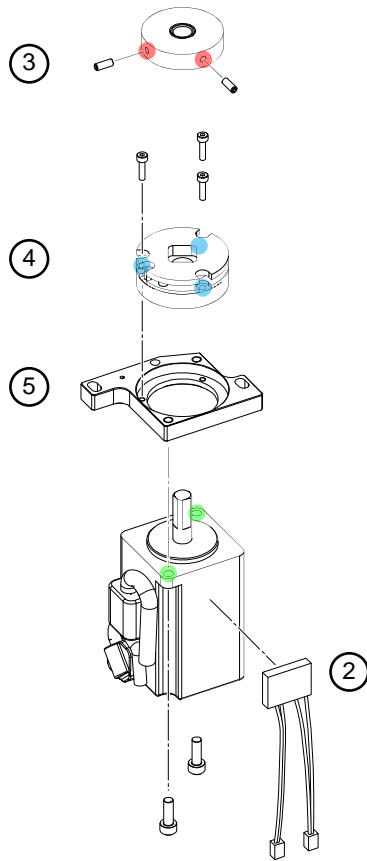


③ Remove the Motor Pulley and the Brake Hub.

- A** For securing the pulley and shaft
S05: 2-M3x8
- B** For securing the pulley and Brake Hub
S05: 2-M3x8 (Brass bushing x 1)

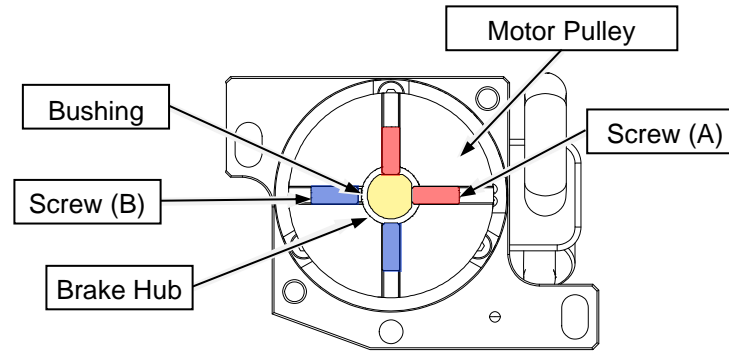


Motor Unit Disassembly



POINT

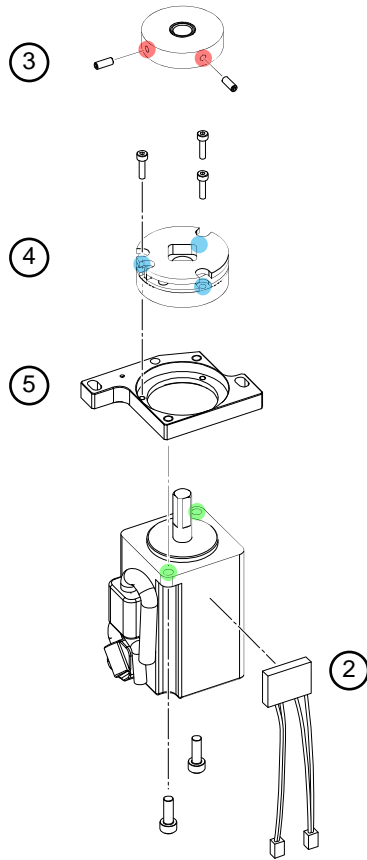
It may not be possible to remove the Brake Hub and Motor Pulley simply by loosening screws (A). In this case, also loosen screws (B).



CAUTION

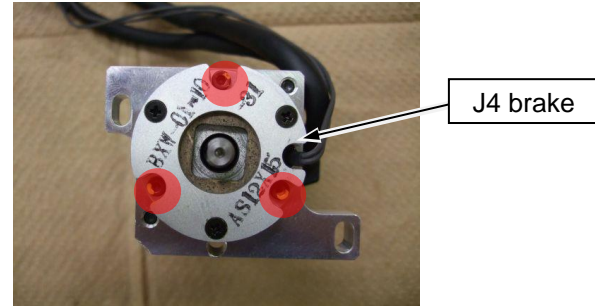
A brass bushing is included on one of the screws (B). When removing the part, be careful not to drop and lose the bushing.

Motor Unit Disassembly



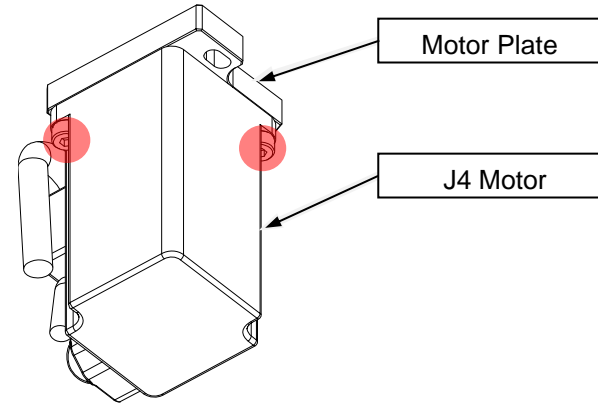
④ Remove the J4 brake.

A S01: 3-M2.5x10

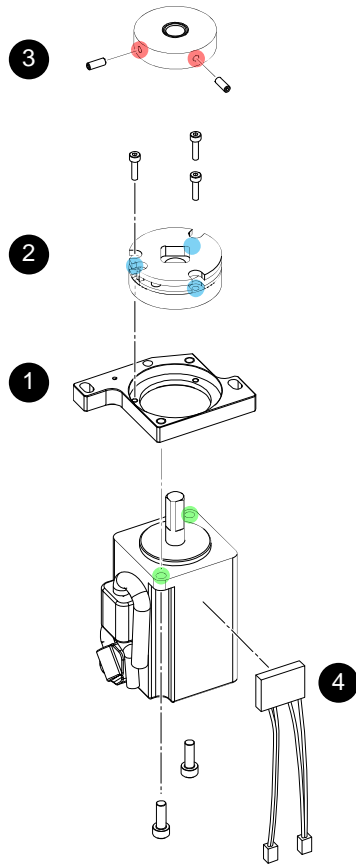


⑤ Remove the Motor Plate from the J4 Motor.

A S01: 2-M4x12



Motor Unit Assembly



1 Install the Motor Plate.

A S01: 2-M4x12 (4.0 +/- 0.2 N·m)

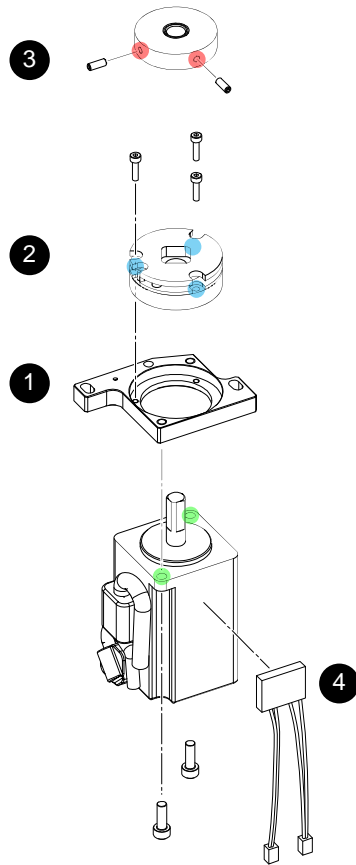
POINT
Attach the Motor Plate according to the orientation shown in the figure.

The photograph shows the motor unit with the following labels:

- J4 Motor**: Points to the central motor shaft.
- Motor cable**: Points to the black cable connected to the side of the motor.
- Motor Plate**: Points to the metal plate mounted on top of the motor housing.

Joint #4

Motor Unit Assembly



2

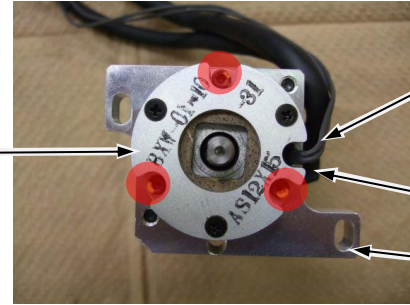
Install the J4 electromagnetic brake.

POINT

Install the brake in the orientation shown in the figure.

A S01: 3-M2.5x10
(1.0 +/- 0.1 N·m)

J4 electromagnetic
brake



Brake cable

Motor cable

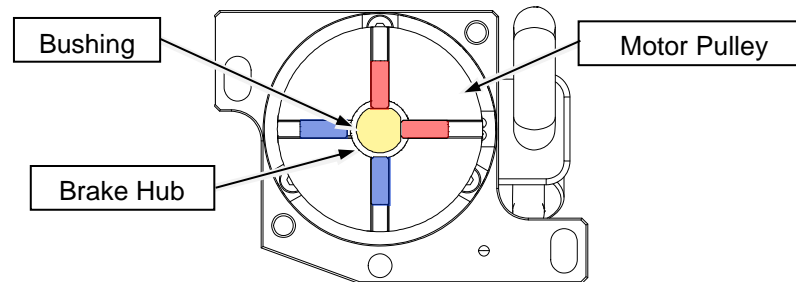
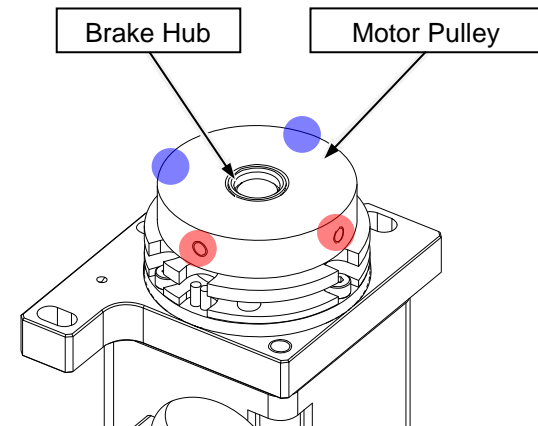
J4 Motor Plate

3

Install the Brake Hub and Motor Pulley on the J4 Motor unit.

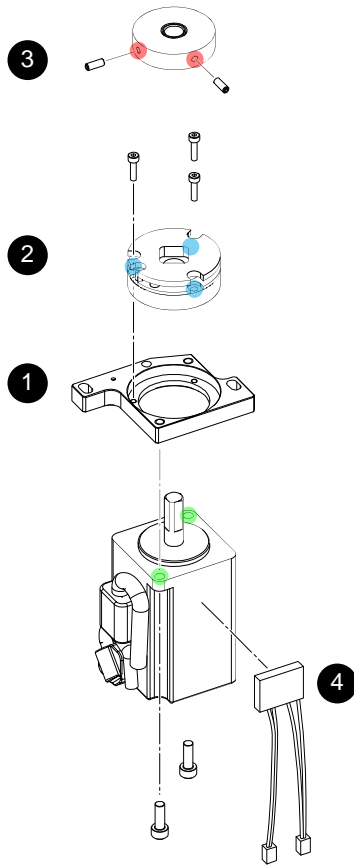
A For securing the pulley and shaft
S05: 2-M3x8
(0.9 +/- 0.1 N·m)

B For securing the pulley and Brake Hub
S05: 2-M3x8 (Brass bushing x 1)
(0.9 +/- 0.1 N·m)



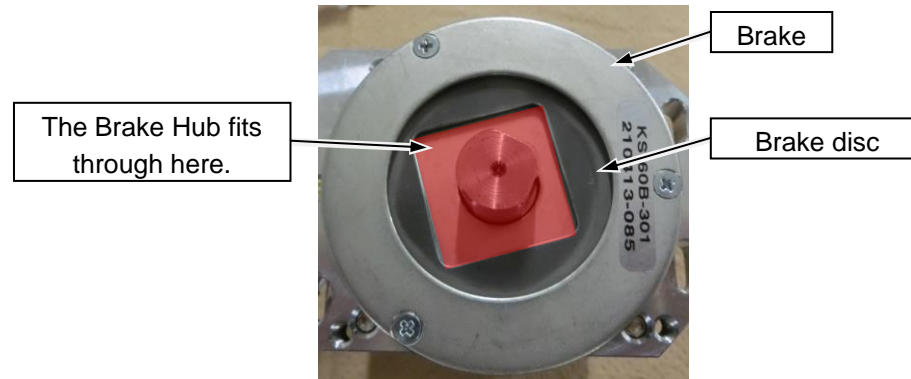
Joint #4

Motor Unit Assembly

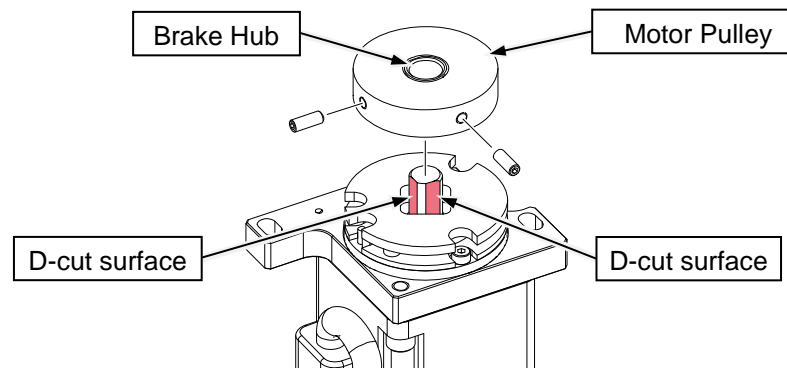


POINT

- Align the Brake Hub and brake disc positions, and install the Brake Hub on the motor shaft. If they are misaligned, adjust the brake disc position.

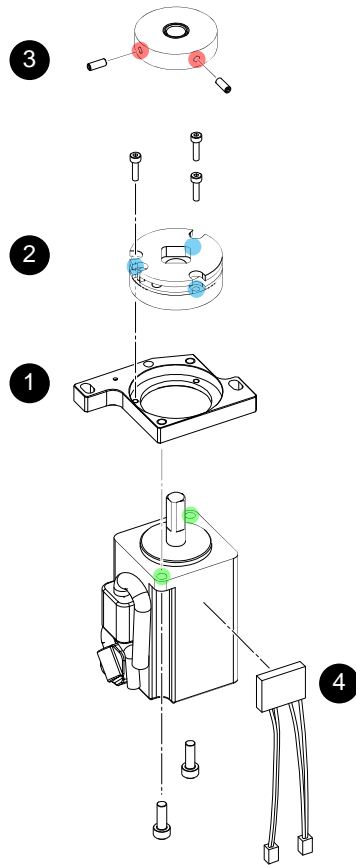


- Align the motor shaft D-cut surface with the screw holes, and install the Motor Pulley.

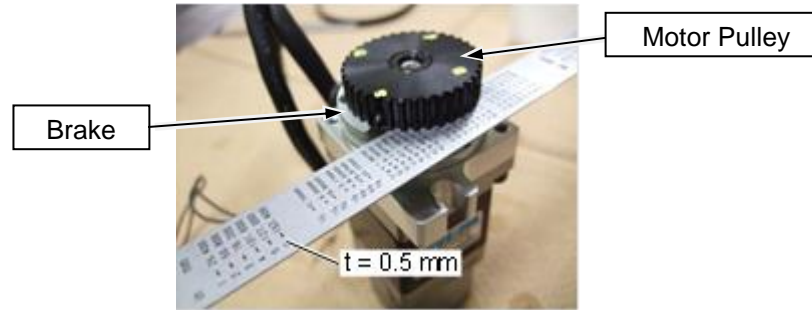


Joint #4

Motor Unit Assembly



- Place a feeler gauge (0.5 mm) between the Motor Pulley and the brake, to ensure a 0.5-mm gap during installation.



CAUTION

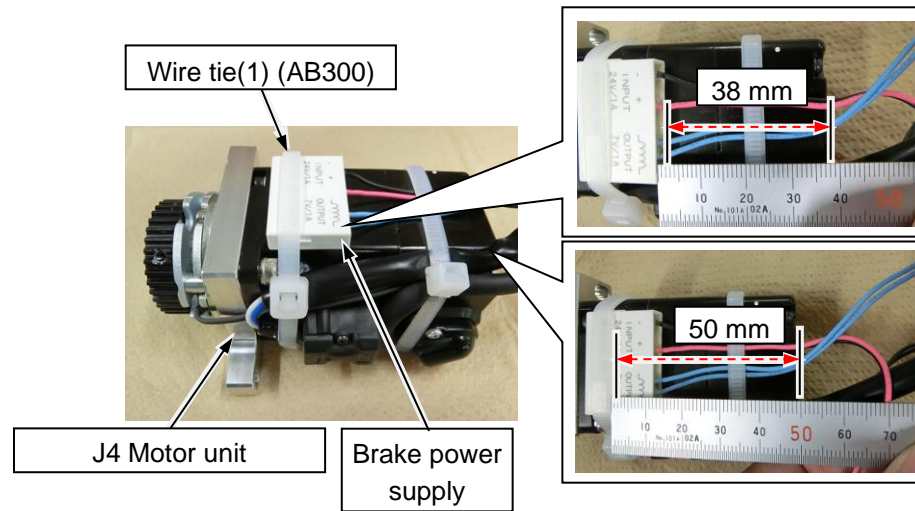
Failure to create a proper gap between the Motor Pulley and the brake may cause the parts to rub during motor operation, causing a malfunction.

4

Bundle the cables on the J4 Motor unit with wire ties.

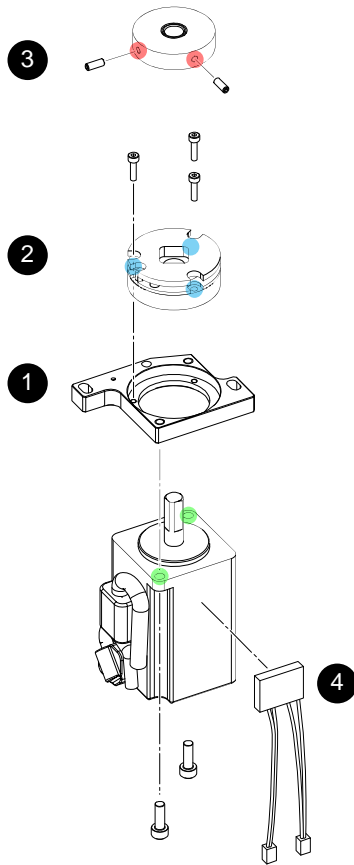
1. Determine the position of the wire tie (1) (AB300) based on the reference dimensions below and apply the wire tie.

- From brake power supply bottom edge to motor bottom surface: 38 mm
- From wire tie (1) bottom edge to motor bottom surface: 50 mm



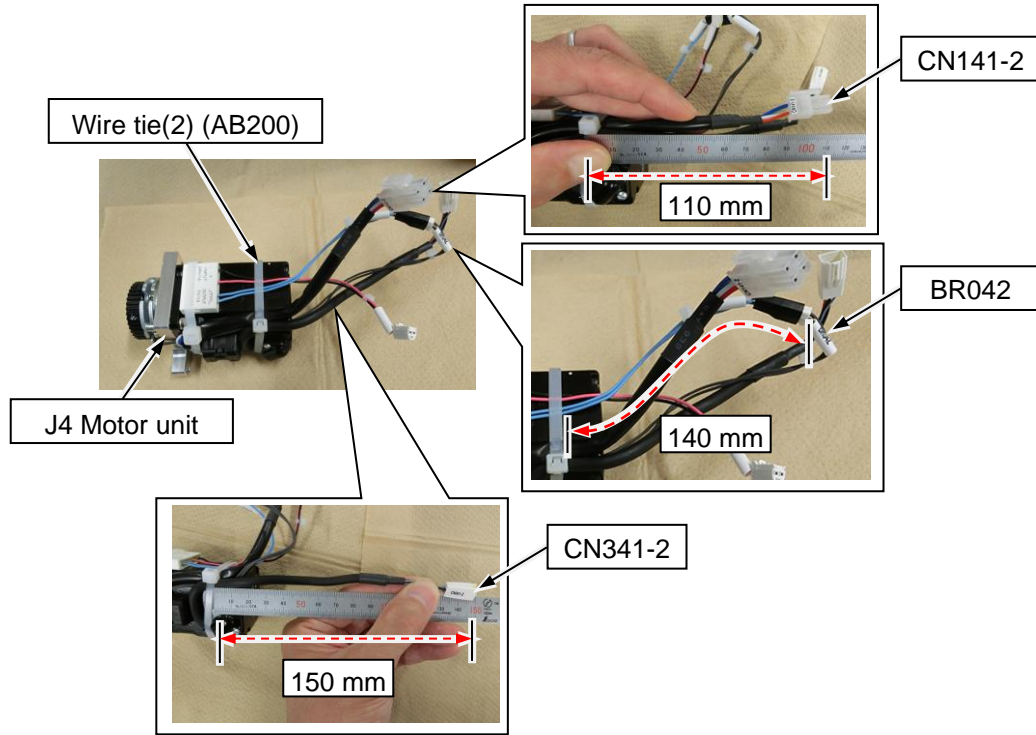
Joint #4

Motor Unit Assembly



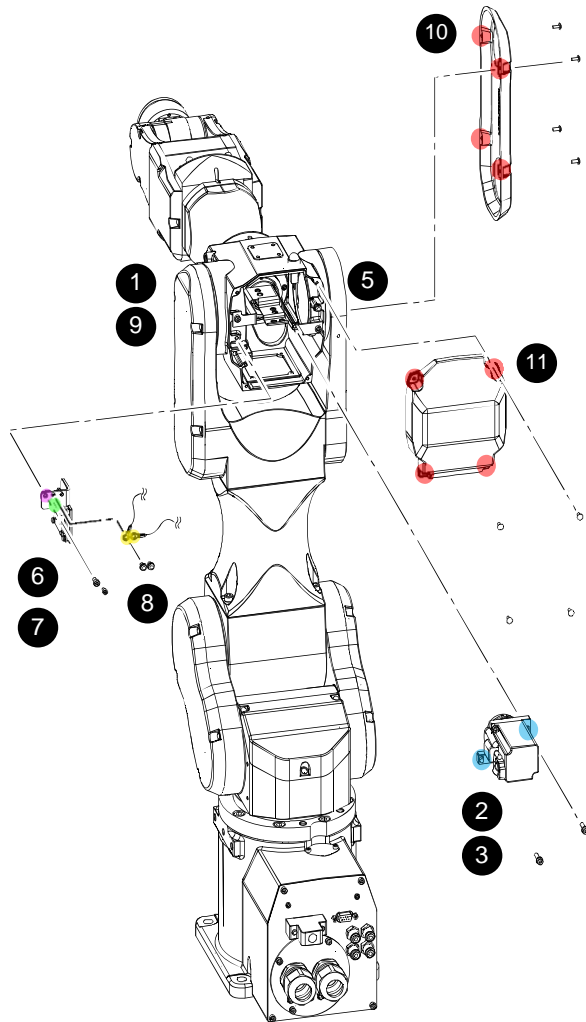
2. Determine the position of the wire tie (2) (AB200) according to the distance from the tip of each cable connector.

- CN341-2: 150 mm
- CN141-2: 110 mm
- BR042: 140 mm

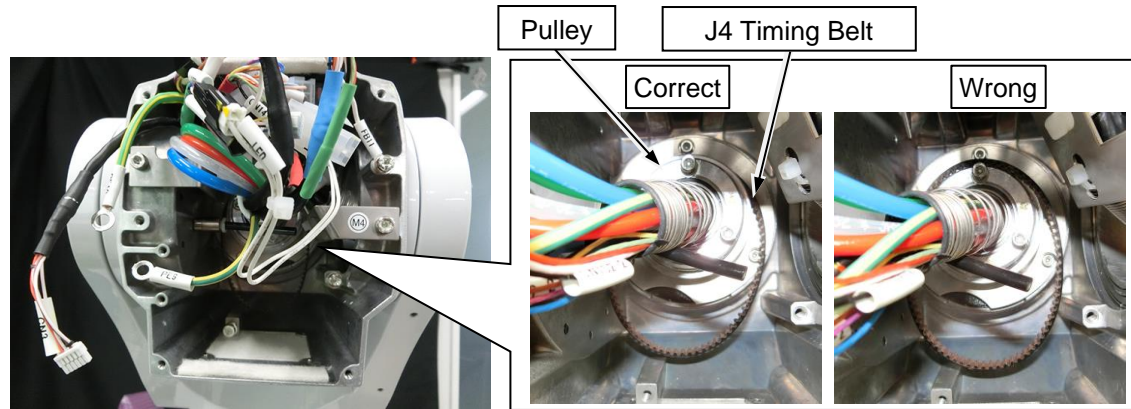


5 Install the [J4 Motor unit](#).

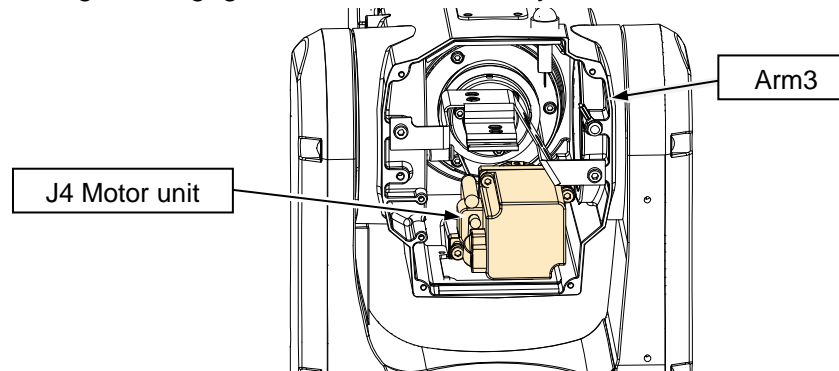
Installing the Motor Unit



1 Check that the J4 Timing Belt is correctly engaged with the pulley on the J4 Reduction Gear.

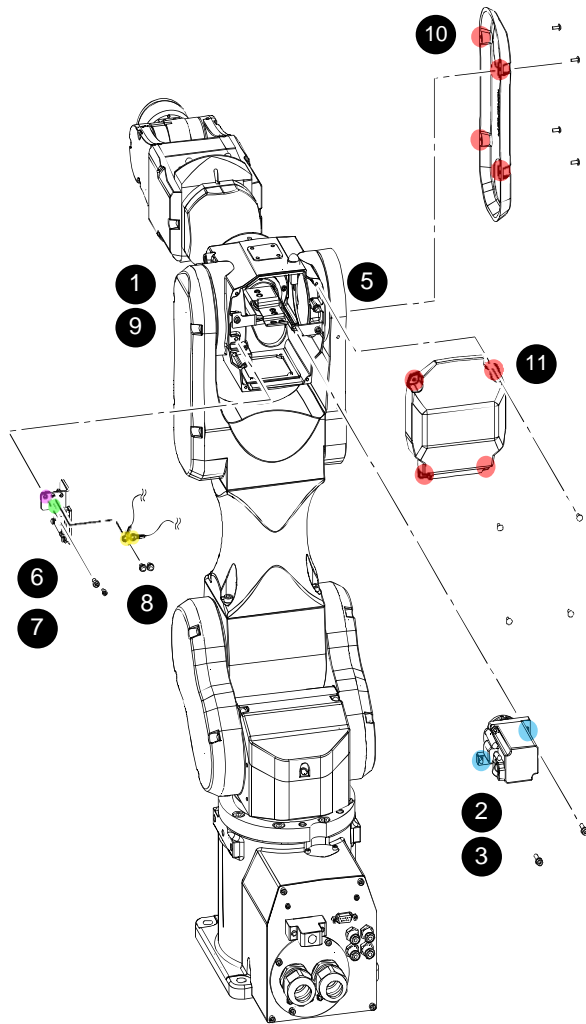


2 With the timing belt engaged with the Motor Pulley, insert the J4 Motor unit into Arm3.



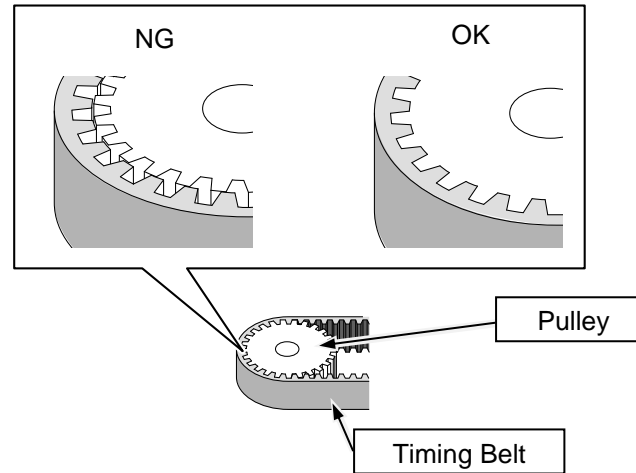
Joint #4

Installing the Motor Unit



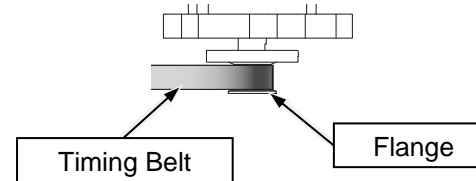
POINT

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



CAUTION

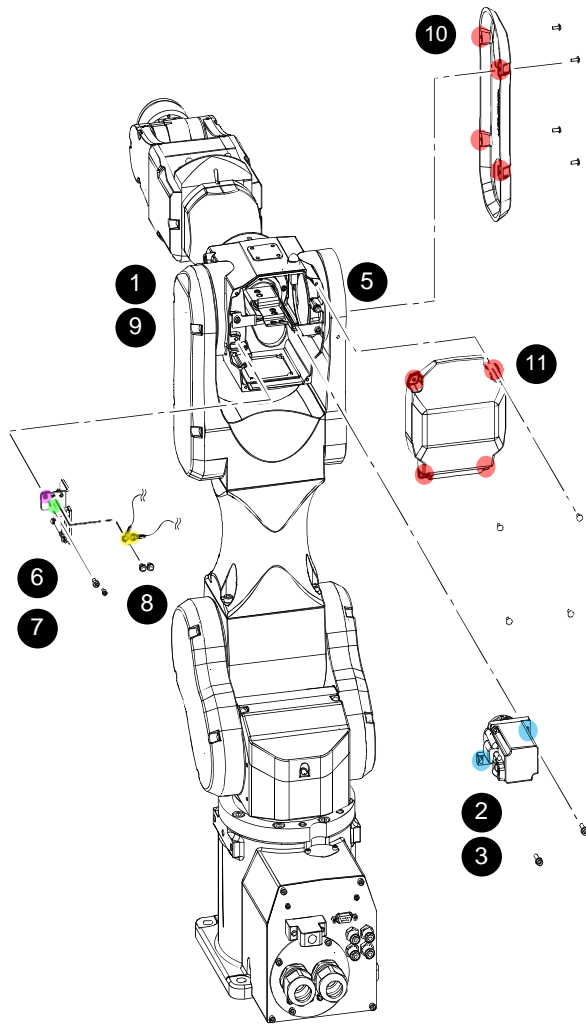
If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



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

Joint #4

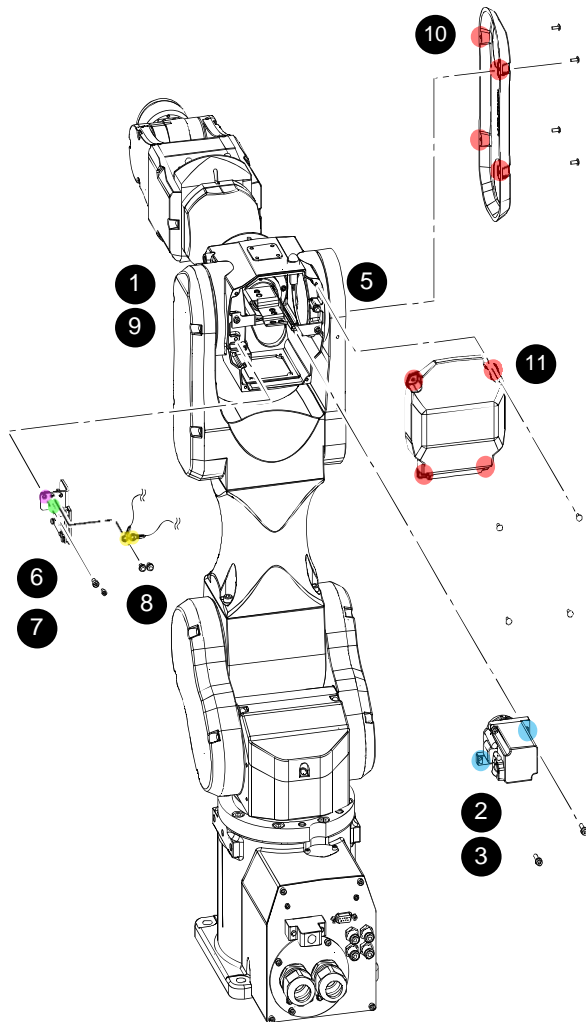
Installing the Motor Unit



<p>3</p>	<p>Temporarily secure the J4 Motor unit.</p> <p>A S01: 2-M4x15</p> <p>J4 Motor unit</p> <p>Arm3</p>
<p>4</p>	<p>Adjust the belt tension.</p> <p>3.1 Adjusting the Timing Belt Tension</p>
<p>5</p>	<p>Connect the J4 Motor Connectors (CN141, CN341, BR041).</p> <p>Motor Connectors (CN141, CN341, BR041)</p>

Joint #4

Installing the Motor Unit



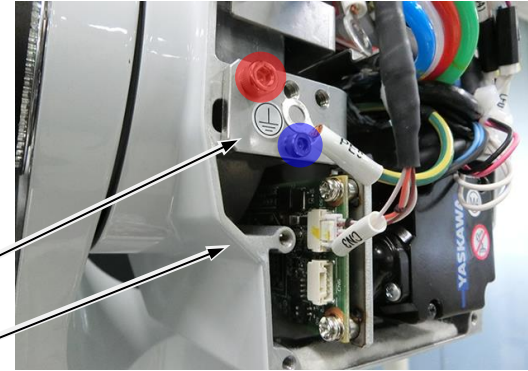
6 Install the gyro board 2 fixing plate on Arm3.

A S01: 1-M4x10
(4.0 +/- 0.2 N·m)

B S01: 1-M3x8
(2.0 +/- 0.1 N·m)

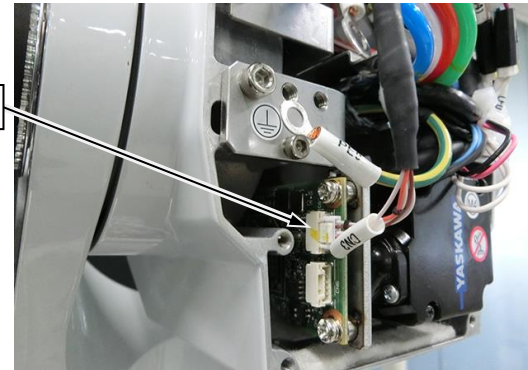
Gyro board 2
fixing plate

Arm3



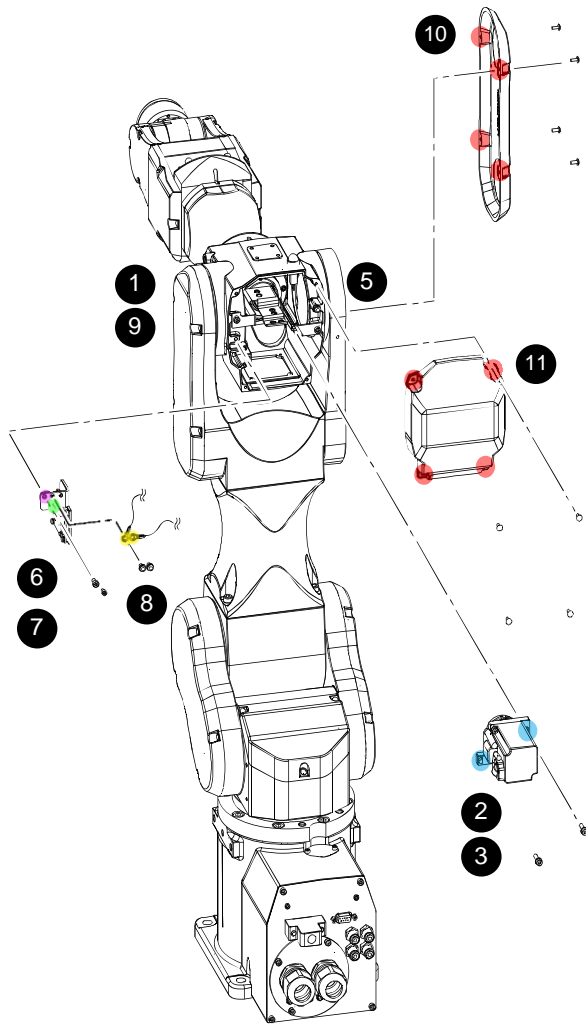
7 Connect the gyro board 2 connector (CN3) to the board.

Connector (CN3)



Joint #4

Installing the Motor Unit



8 Attach the Ground Wires (PE9/PE10) to the gyro board 2 fixing plate.

A S02: 2-M4x6 with washer (0.9 +/- 0.1 N·m)

PE9

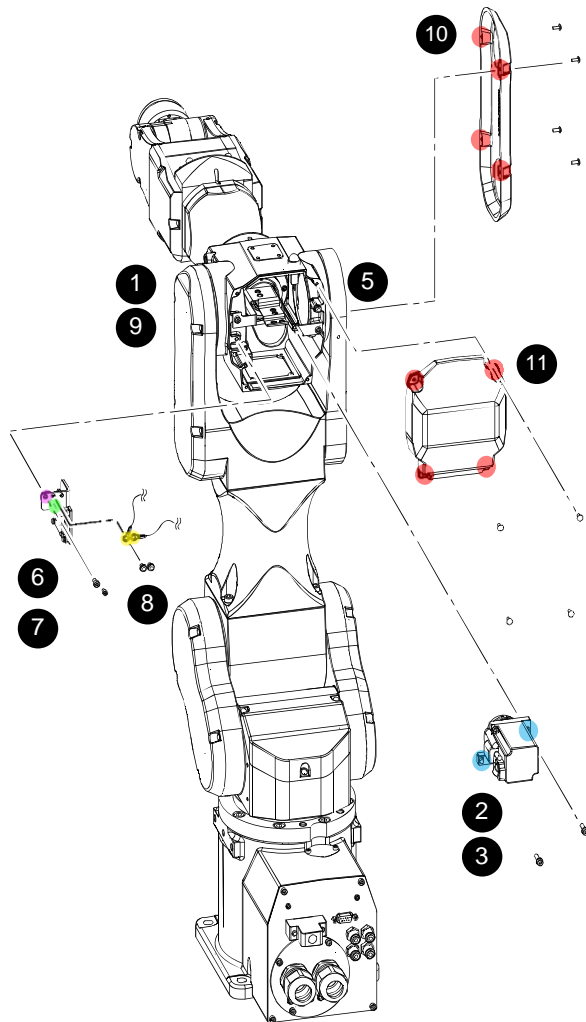
PE10

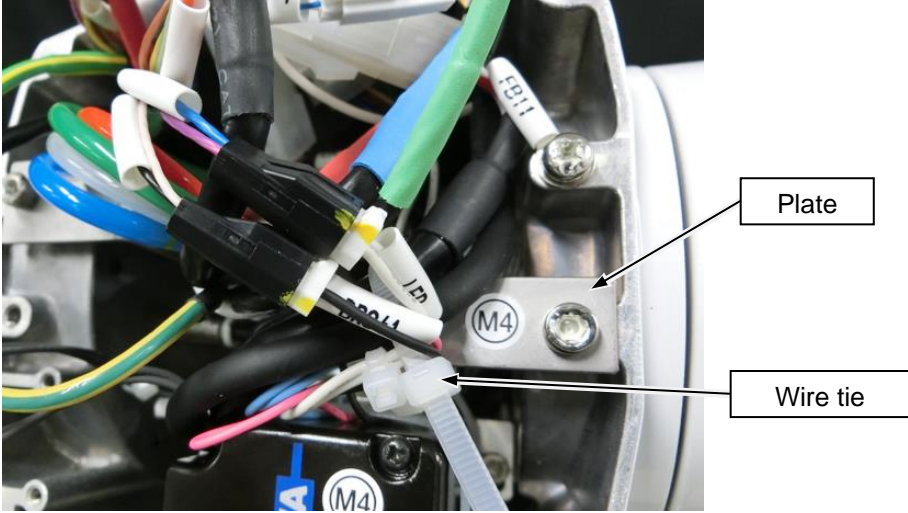
Gyro board 2 fixing plate

Detailed description: This block contains a numbered step (8) and a sub-step (A) for attaching ground wires. It includes a close-up photograph of the gyro board 2 fixing plate. The photograph shows two screws being used to secure the ground wires PE9 and PE10. The screws are circled in red. Labels with arrows point to the PE9 and PE10 wires and the gyro board 2 fixing plate. A callout box 'A' specifies the screw type and torque.

Joint #4

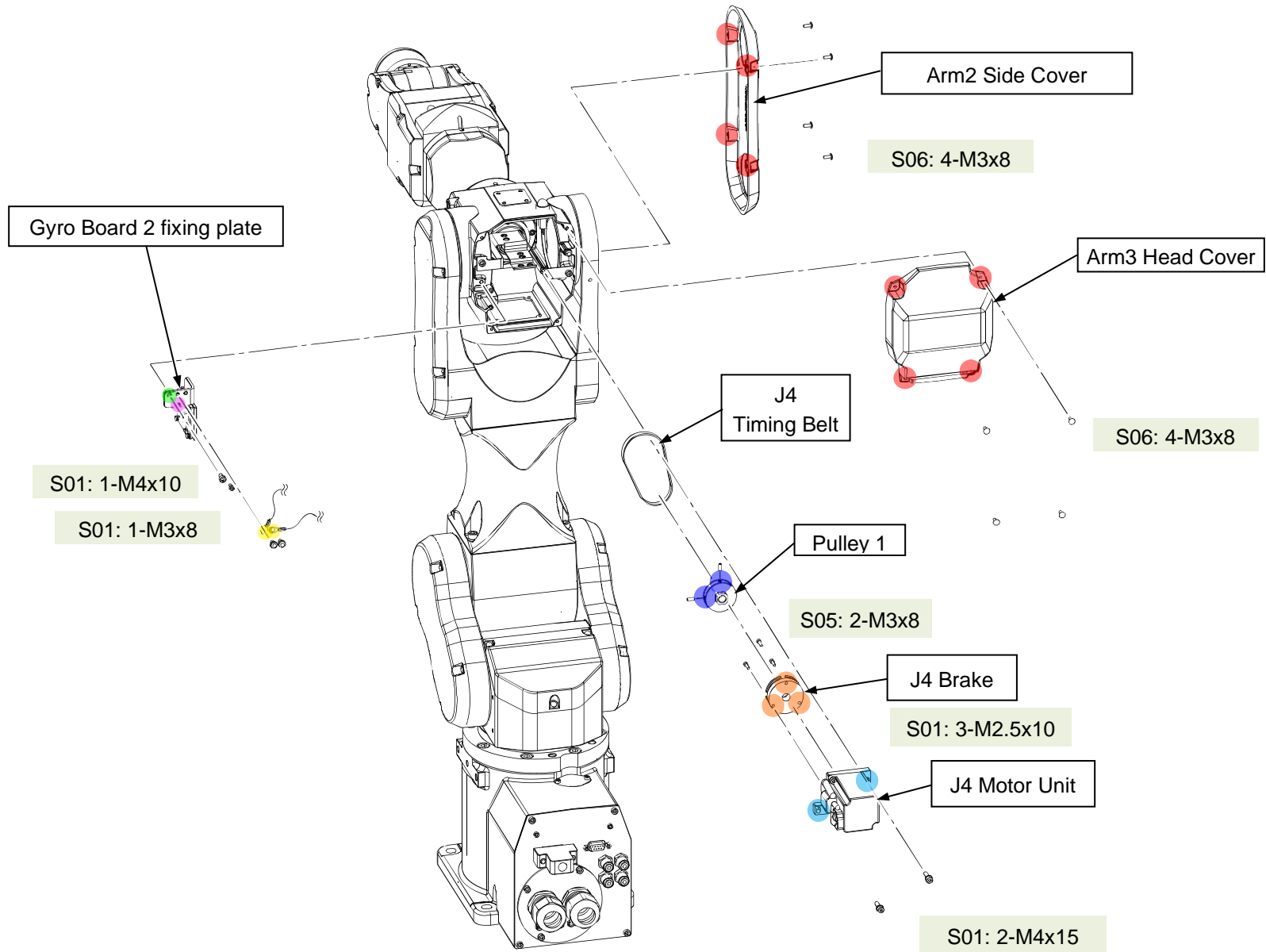
Installing the Motor Unit



<p>9</p>	<p>Fix the following cables with a wire tie (AB100) to the plate marked with the M4 sticker. Bundled cables: BR041, BR042, BR042, LED, CN141-2, CN341-2</p> 
<p>10</p>	<p>Install the Arm2 side cover.</p>
<p>11</p>	<p>Install the Arm3 head cover.</p>
<p>12</p>	<p>After assembly, perform calibration of Joint #4. 3.2 Calibration</p>

Joint #4

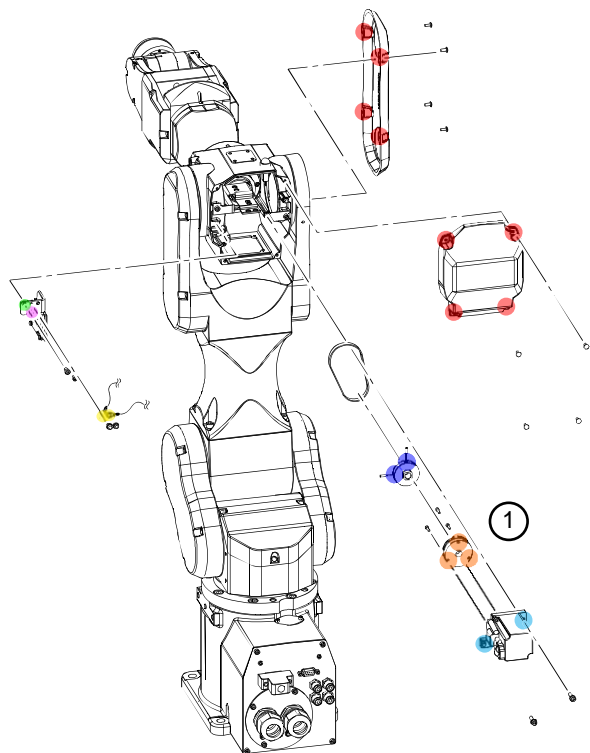
2.5.3 Joint #4 Replacing the Brake



Joint #4

Removing the Brake

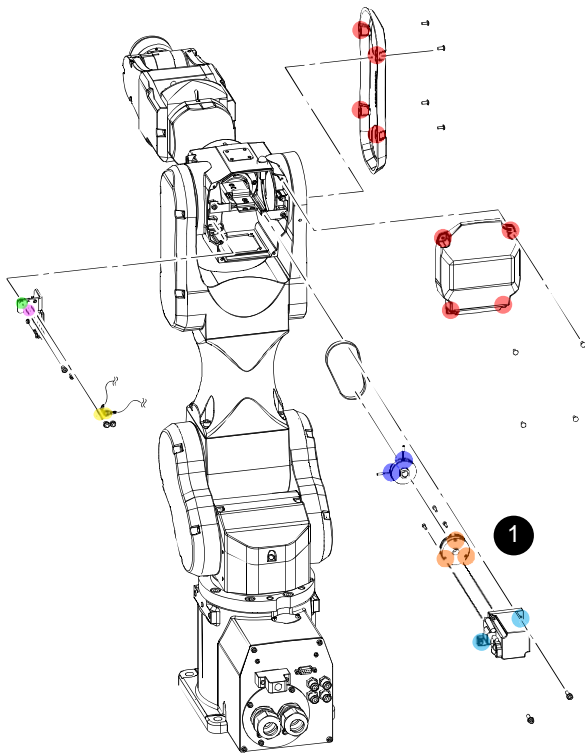
①	Refer to J4 Motor Unit Disassembly and remove the J4 brake.
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Joint #4

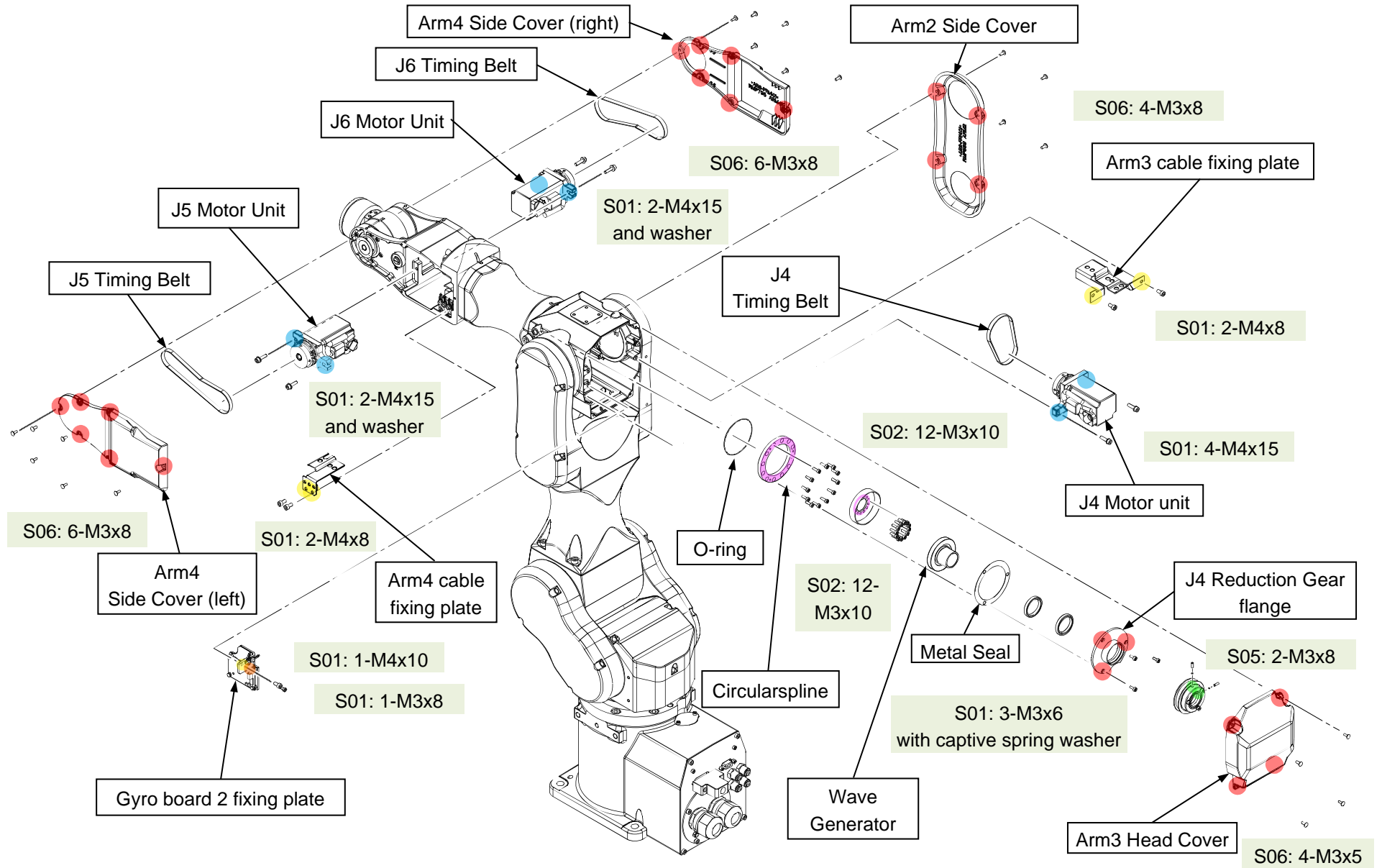
Installing the Brake

- | | |
|----------|---|
| 1 | Refer to J4 Motor Unit Assembly and install the J4 brake. |
|----------|---|



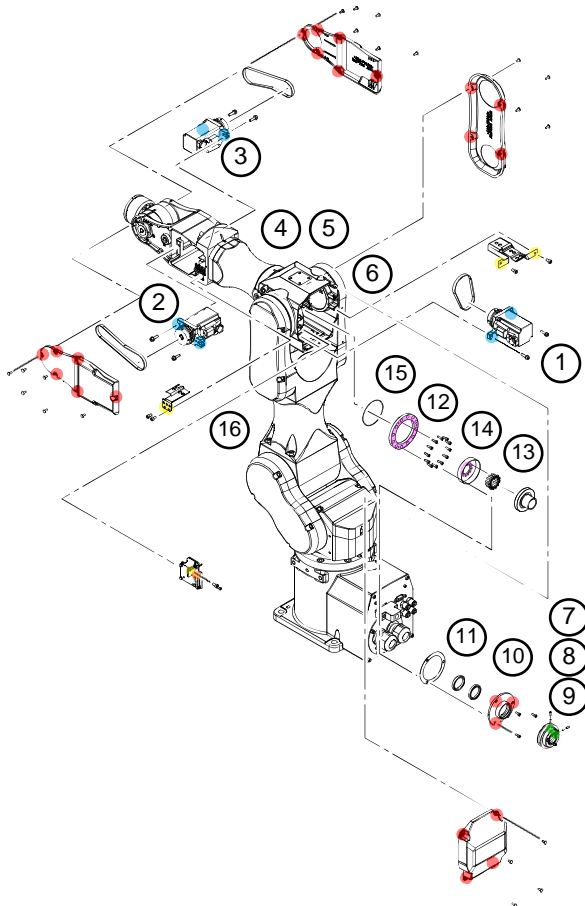
Joint #4

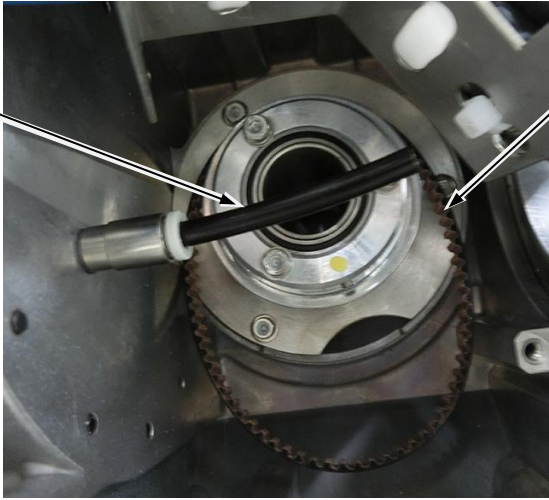
2.5.4 Joint #4 Replacing the Reduction Gear Unit



Joint #4

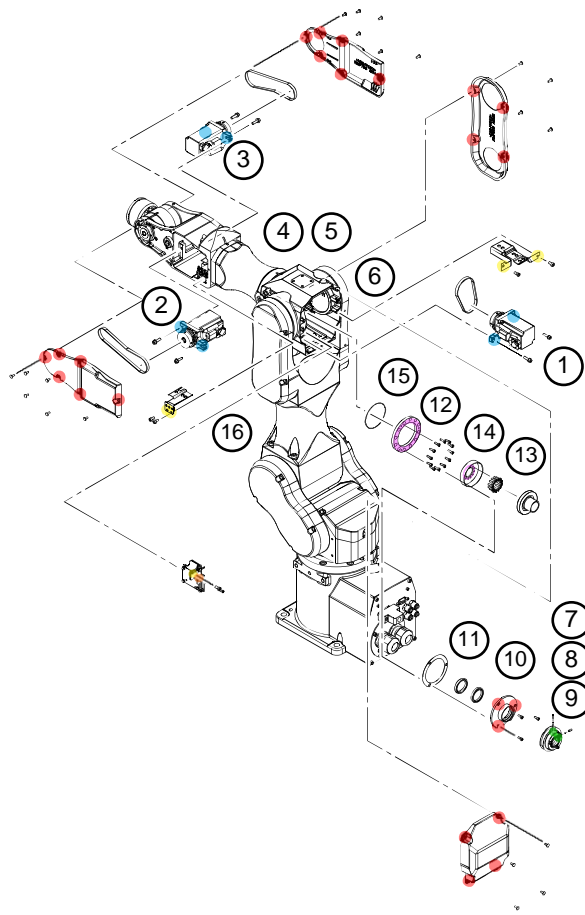
Removing the Reduction Gear Unit



①	Remove the J4 Motor unit .
②	Remove the J5 Motor unit .
③	Remove the J6 Motor unit .
④	Remove the cable unit . POINT Perform step ⑦ (removing the cables, connectors, and Motor Unit from Arm4) through 7 of Step ⑧ (removing the cables, connectors, and Motor Unit from Arm3).
⑤	Remove the LED lamp .
⑥	Remove the J4 Timing Belt and tube. 

Joint #4

Removing the Reduction Gear Unit



⑦ Loosen the screws restraining the bearing.

CAUTION

Do not fully remove the screws.

- A S01: 3-M3x6 with captive spring washer



⑧ As shown in the figure, use a hexagonal wrench to loosen the fixing screws of the J4 output pulley.

- A S05: 2-M3x8 (Brass bushing x 2)



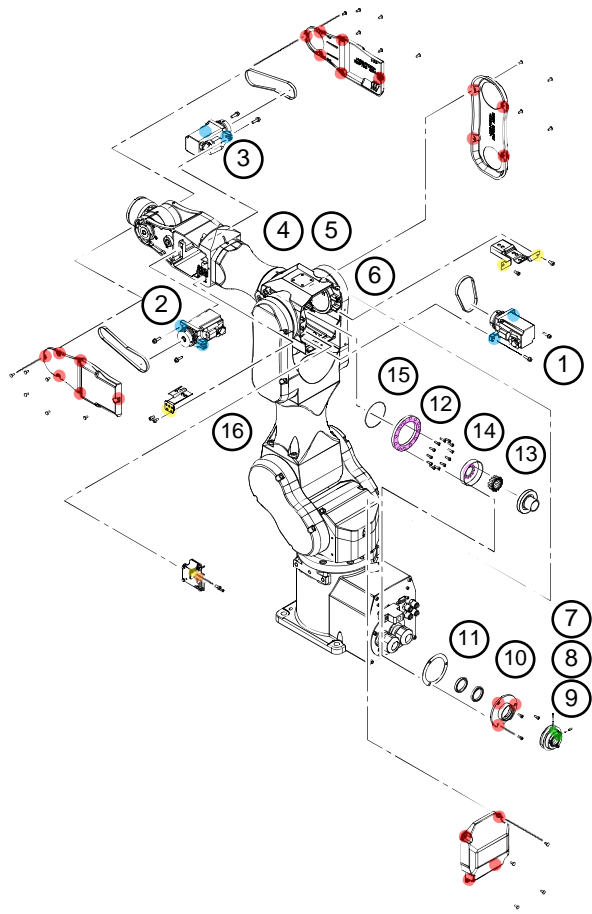
Hexagonal wrench

CAUTION

A brass bushing is included on the set screw. When removing the pulley, be careful not to drop and lose the bushing.

Joint #4

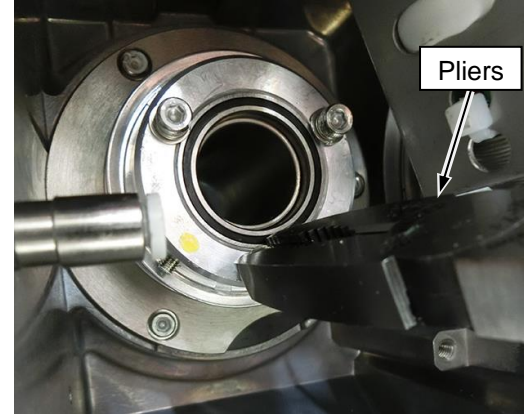
Removing the Reduction Gear Unit



⑨ Remove the J4 output pulley and bearing.

POINT

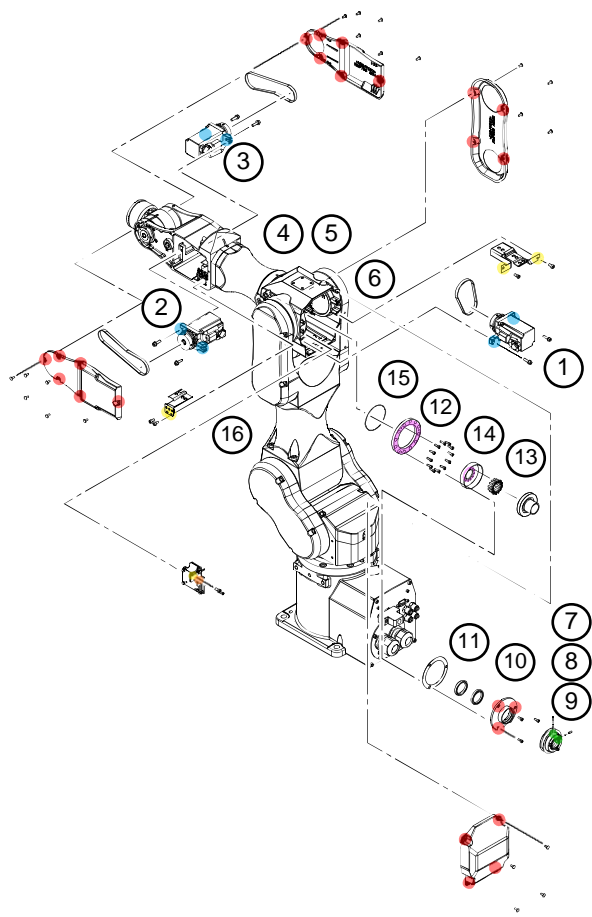
- To make it easier to remove the screws, rotate Arm4 slightly to the left and right while pulling on the screw heads with pliers.



- Re-use the bearing. Store it so that you do not lose it.

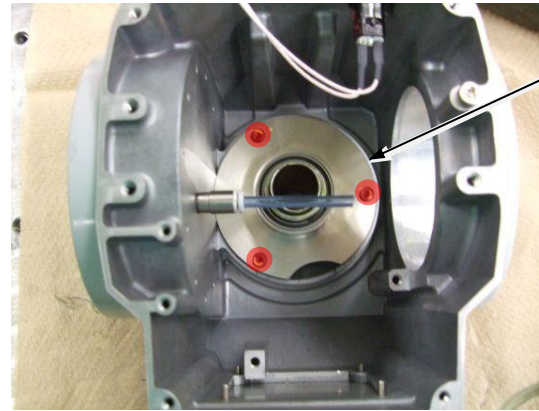
Joint #4

Removing the Reduction Gear Unit



⑩ Remove the J4 Reduction Gear flange.

A S01: 3-M3x8



J4 Reduction Gear flange

POINT

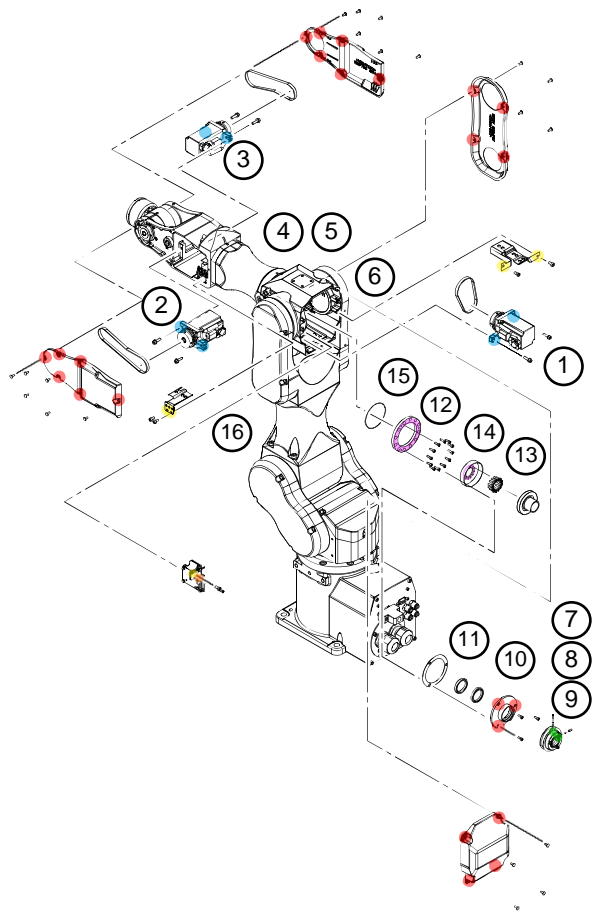
- The part has grease applied. Perform the work while wiping off the grease.
- When removing the J4 Reduction Gear flange, also remove the two bearings.



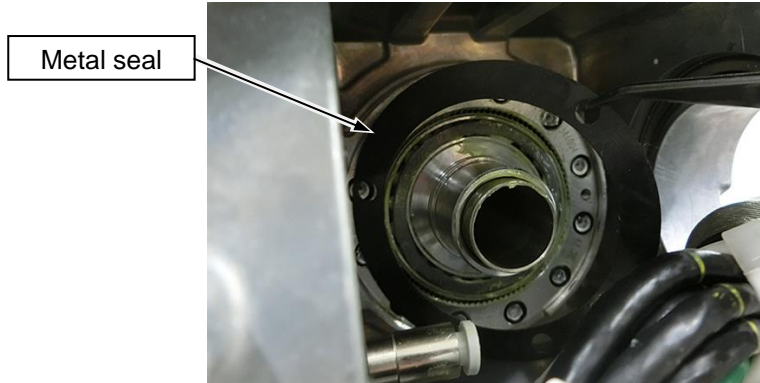
Bearings

Joint #4

Removing the Reduction Gear Unit

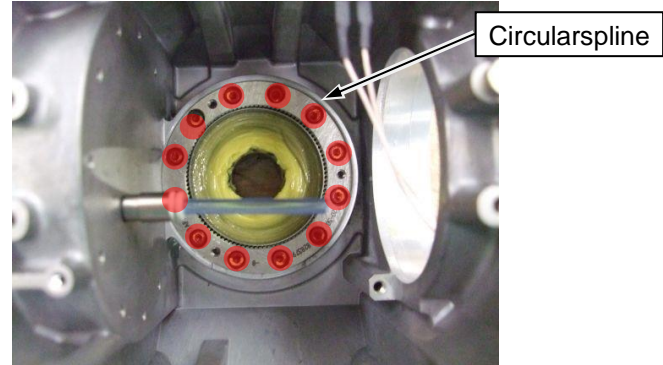


⑪ Use tweezers to remove the metal seal.



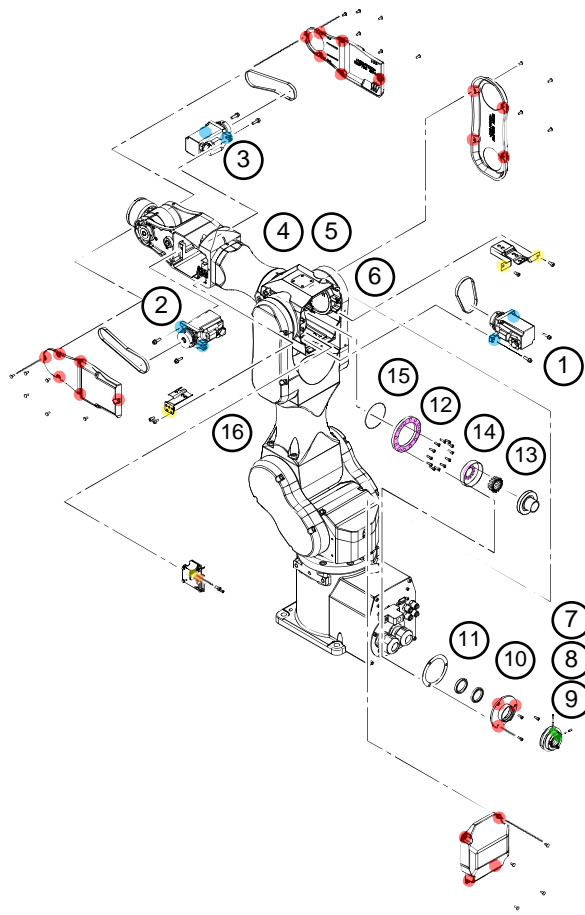
⑫ Remove the Circularspline.

A S02: 12-M3x10



Joint #4

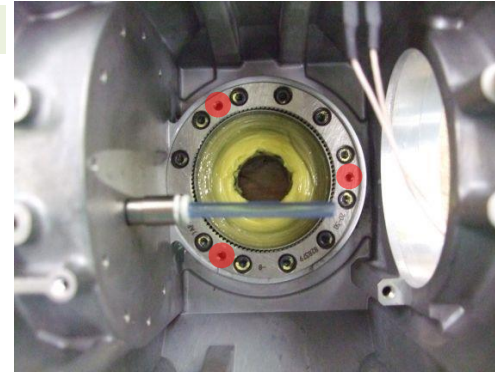
Removing the Reduction Gear Unit



POINT

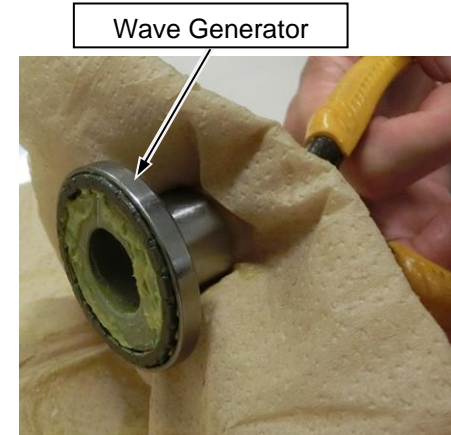
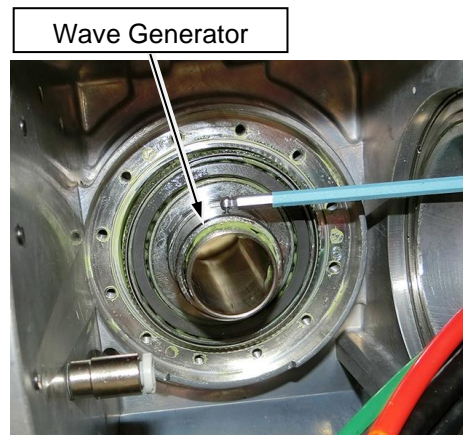
- Insert screws into the tapped removal holes in the Circularspline and tighten the screws evenly to remove it.
- The part has grease applied. Perform the work while wiping off the grease.

A 3-M3x10 or longer



13 Pull the Wave Generator from the J4 Reduction Gear Unit.

Taking care not to scratch the outside of the hollow shaft of the Wave Generator, grab it with pliers and pull it out toward you.

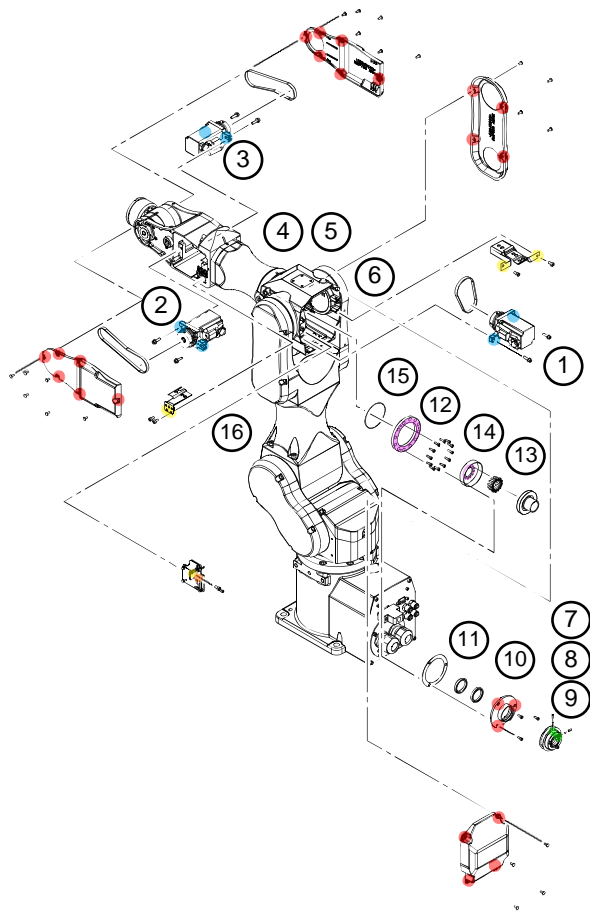


POINT

The part has grease applied. Perform the work while wiping off the grease.

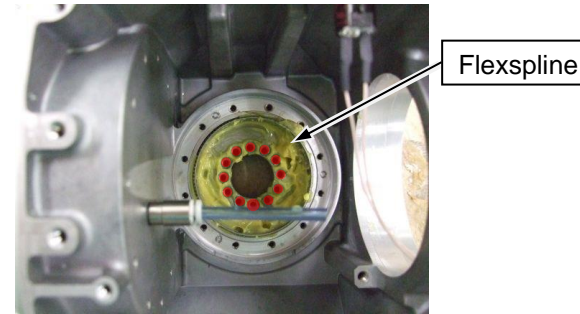
Joint #4

Removing the Reduction Gear Unit



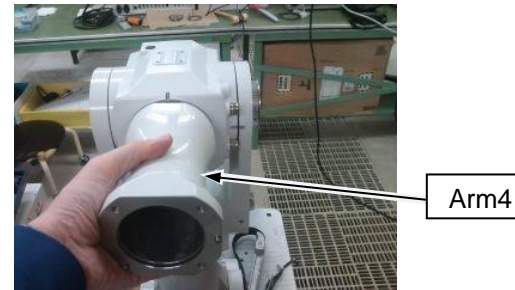
14 Remove the Flexspline.

A S02: 12-M3x10

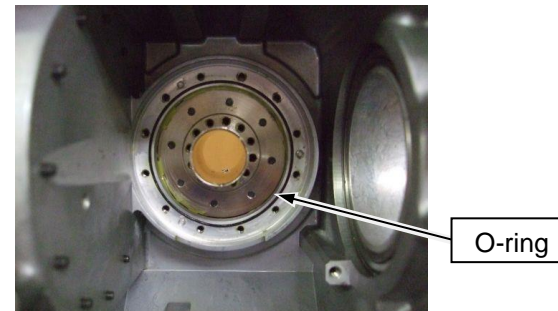


POINT

- When the screws are loosened, the Flexspline can rotate and is difficult to remove. Therefore, work with two people and hold Arm4 as shown in the figure.
- The part has grease applied. Perform the work while wiping off the grease.



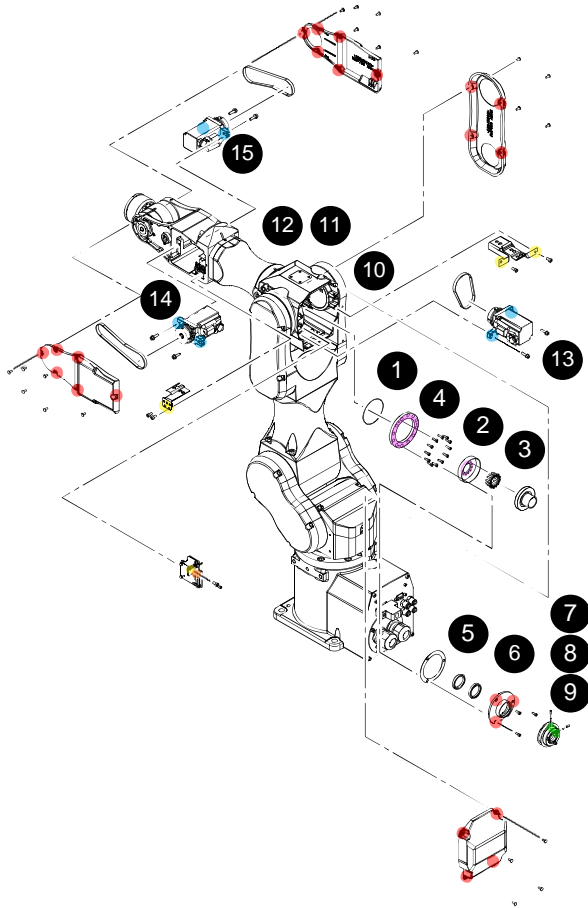
15 Remove the O-ring.



16 Wipe any grease off Arm3 with a cloth.

Joint #4

Installing the Reduction Gear Unit




<Preparation>

1. Remove the new Reduction Gear Unit from its box and confirm that it contains the following parts.




2. Apply grease around the entire gear surface of the Circularspline.

 SK-1A: Apply enough grease to fill the grooves in the teeth in the Circularspline



Circularspline

3. Apply grease around the entire gear surface of the Flexspline.

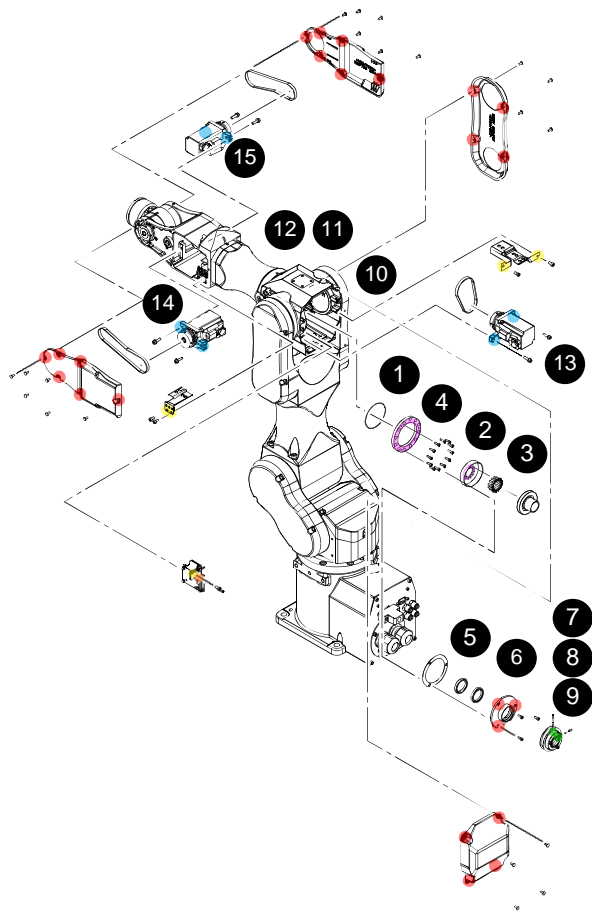
 SK-1A: Apply enough grease to fill the grooves in the teeth in the Flexspline




Flexspline

Joint #4

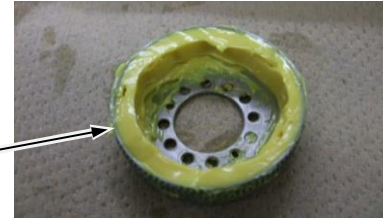
Installing the Reduction Gear Unit



4. Apply grease to the inside of the Flexspline.

 SK-1A: 10 g

Flexspline



5. Apply grease to the bearing of the Wave Generator.

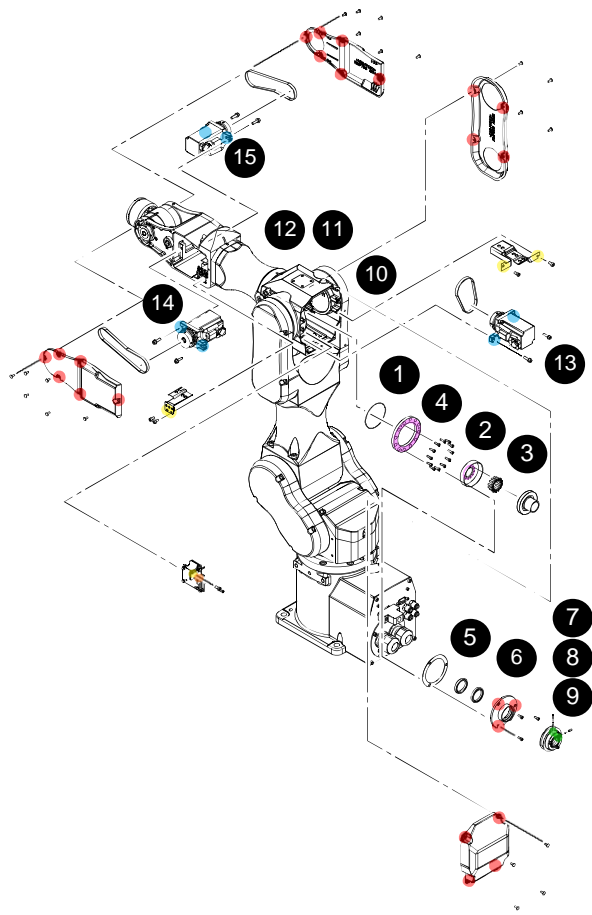
 SK-1A: Suitable amount

Wave Generator

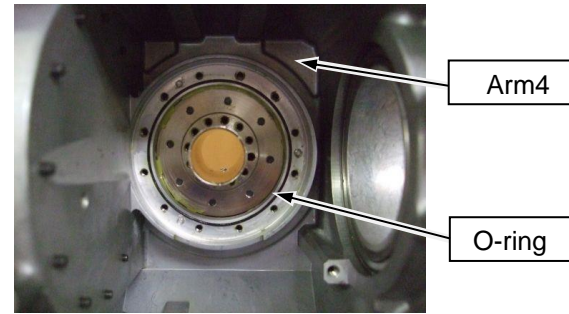


Joint #4

Installing the Reduction Gear Unit



1 Install the O-ring in Arm4.

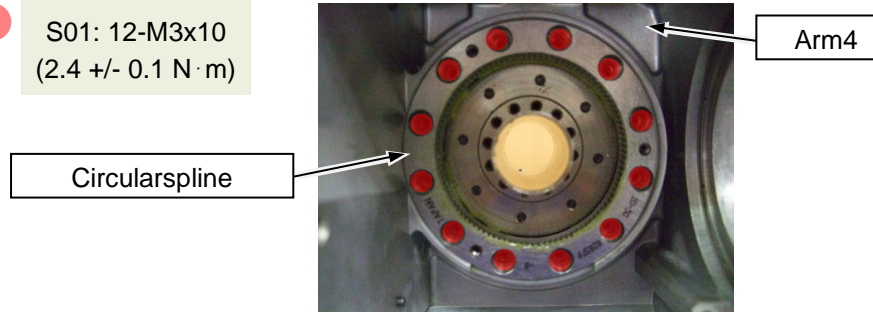


2 Install the Circularity into Arm4.

POINT

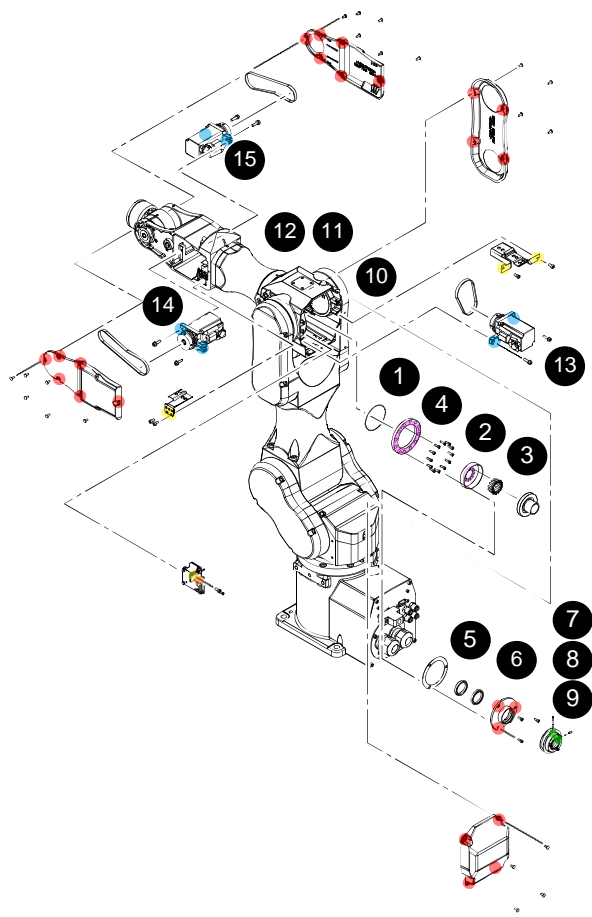
- Face the surface of the Circularity with the engraved section toward you.
- Install the Circularity by aligning the M3 female threads of the housing with the counterbored hole positions on the Circularity.

A S01: 12-M3x10
(2.4 +/- 0.1 N · m)



Joint #4

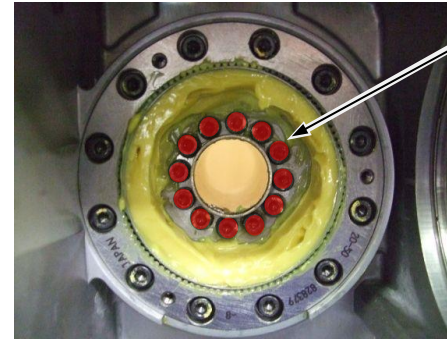
Installing the Reduction Gear Unit



3

Install the Flexspline.

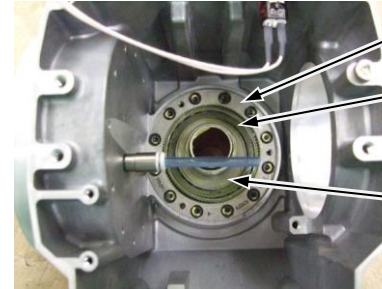
A S01: 12-M3x10
(2.4 +/- 0.1 N·m)



Flexspline

4

Install the bearing in the Wave Generator and then install the Flexspline.



Flexspline

Bearing

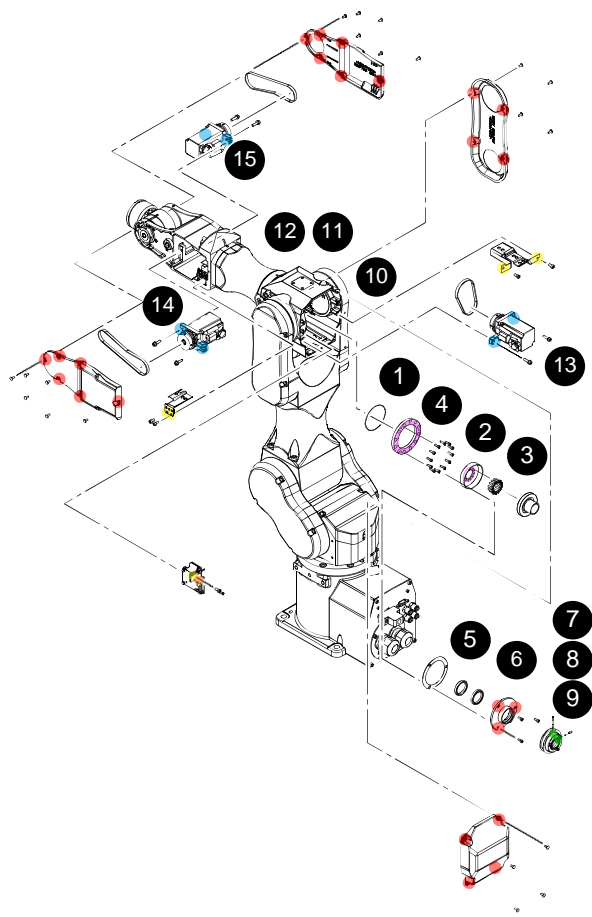
Wave Generator

POINT

The bearing can be installed in either direction (front and back).

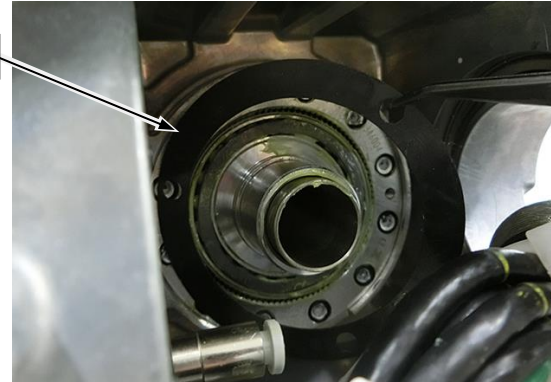
Joint #4

Installing the Reduction Gear Unit



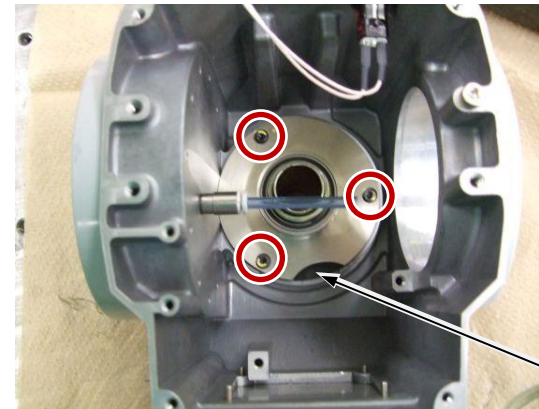
5 Install the metal seal.

Metal seal



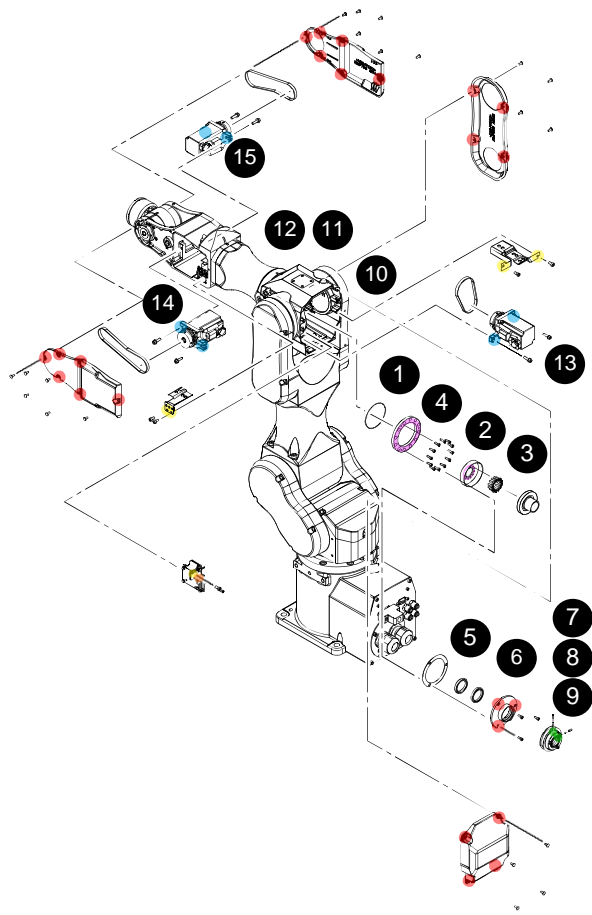
POINT

Align the M3 female threads in the housing with the hole positions in the metal seal and install the metal seal.



Joint #4

Installing the Reduction Gear Unit

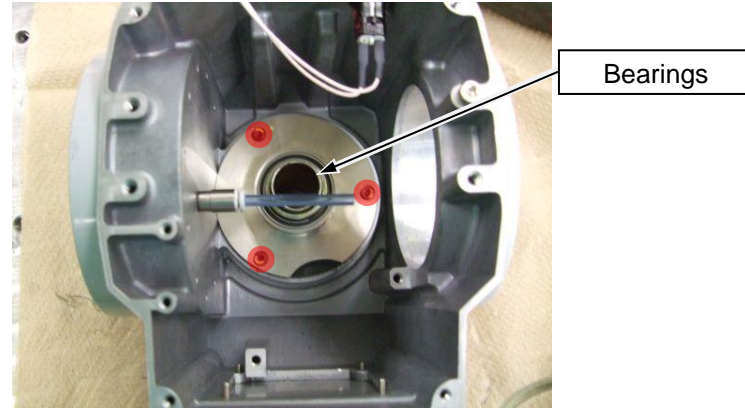


Joint #4

6

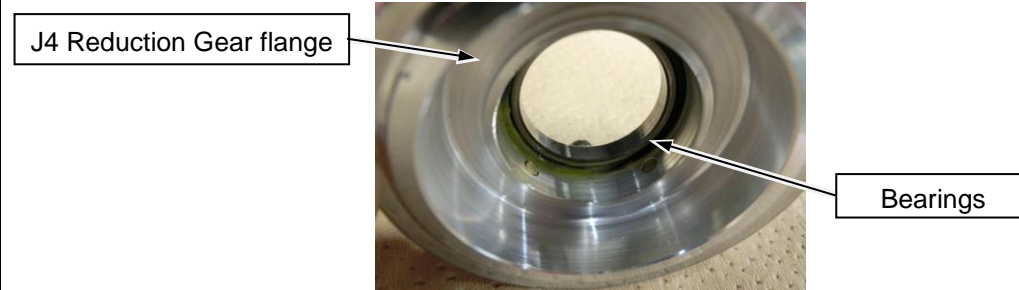
Attach the bearings to the J4 Reduction Gear flange and insert it into the cylinder of the Circularity.

A S01: 3-M3x8
(2.4 +/- 0.1 N·m)

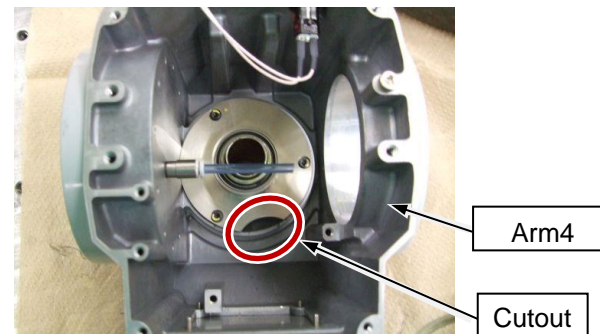


POINT

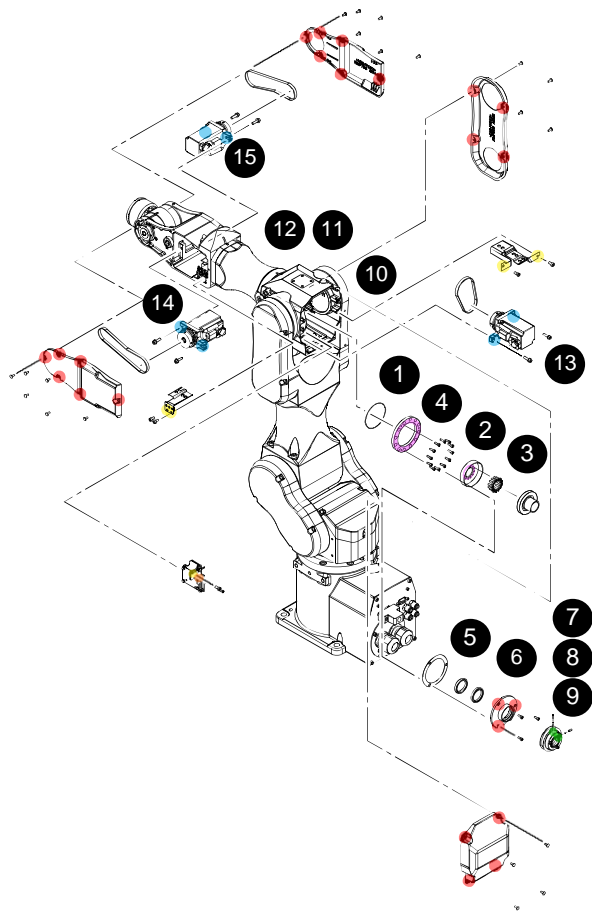
- Install the bearings in the J4 Reduction Gear flange as shown in the figure.



- Position the cutout in the J4 Reduction Gear flange as shown in the figure and attach it to Arm4.

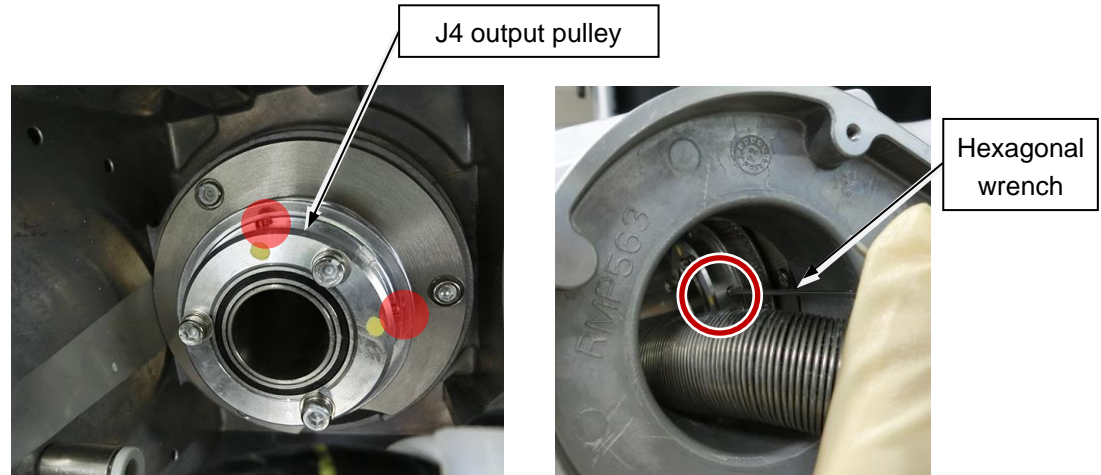


Installing the Reduction Gear Unit



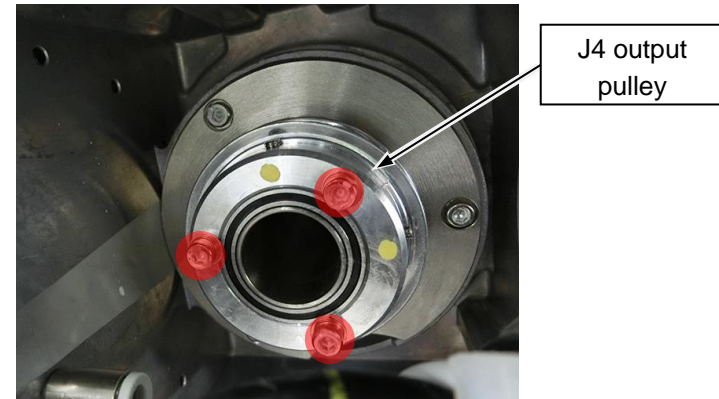
7 Install the J4 output pulley and bearing unit.

A S05: 2-M3x8 (Brass bushing x 2) (0.9 +/- 0.1 N·m)



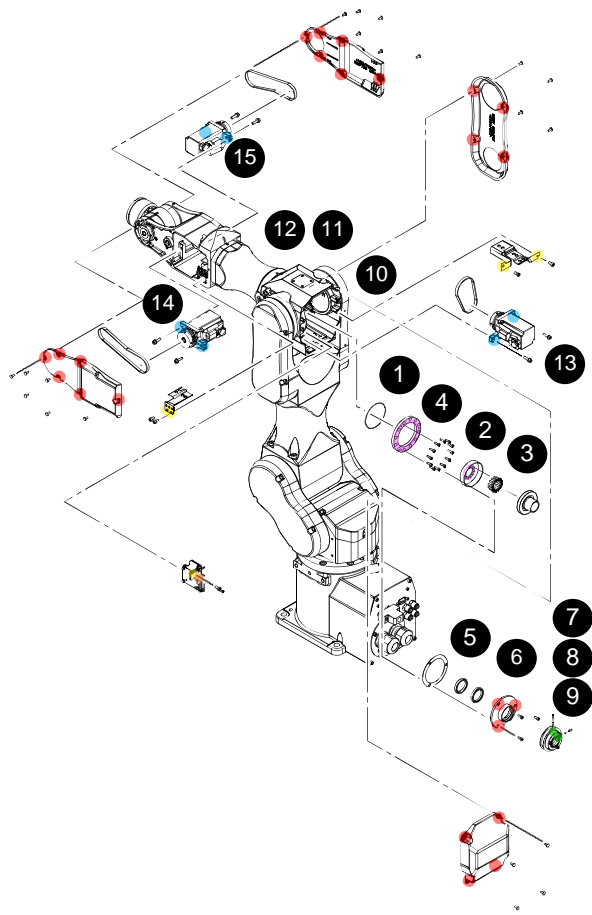
8 Tighten the bearing fixing screws.

A S01: 3-M3x6 with captive spring washer (2.0 +/- 0.1 N·m)



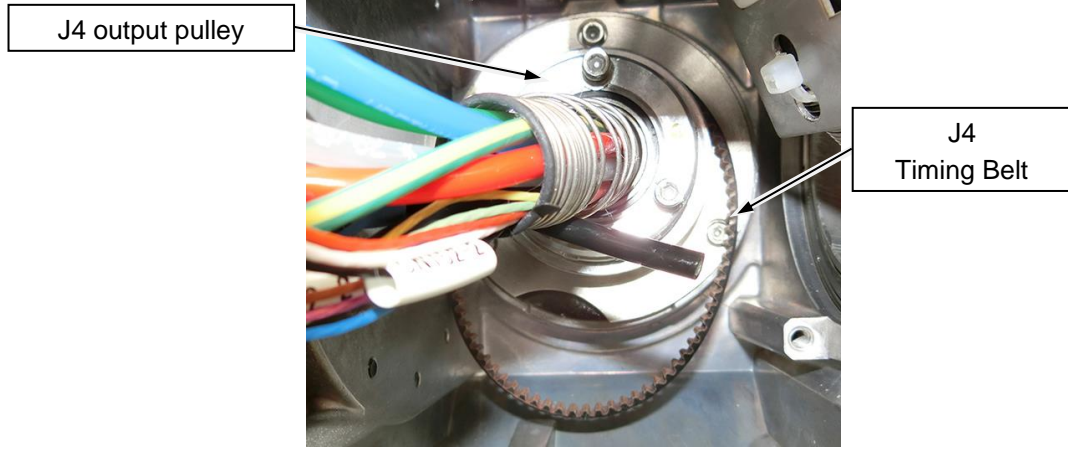
Joint #4

Installing the Reduction Gear Unit



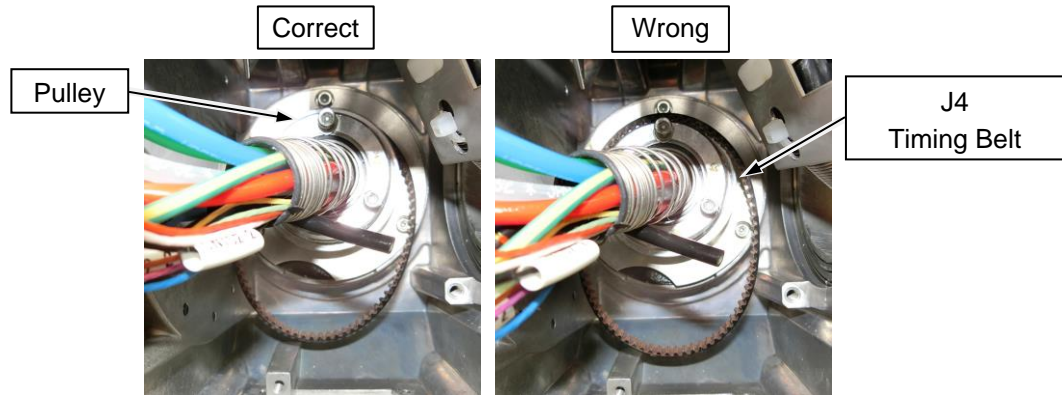
9

Attach the J4 Timing Belt to the J4 output pulley.



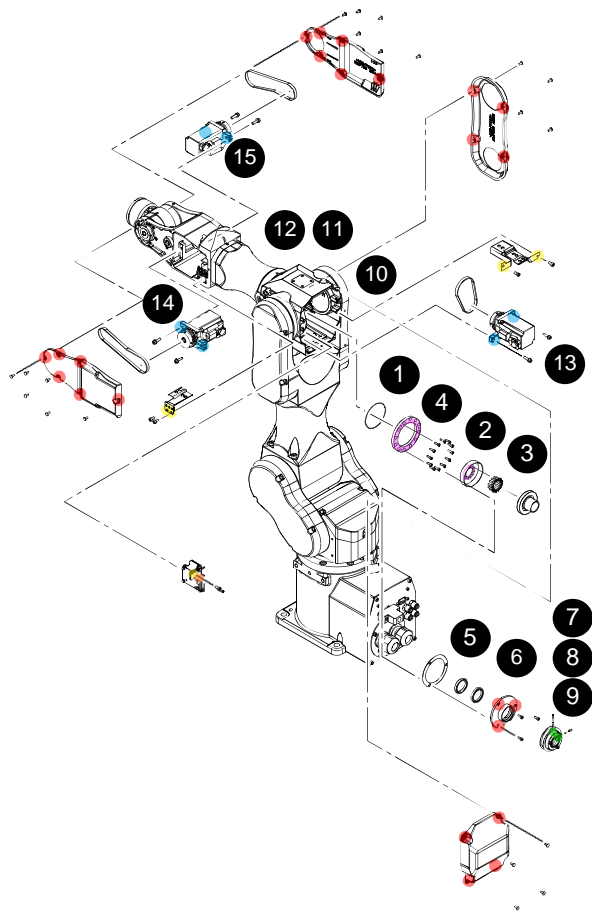
CAUTION

Attach the J4 Timing Belt at the position shown in the figure.



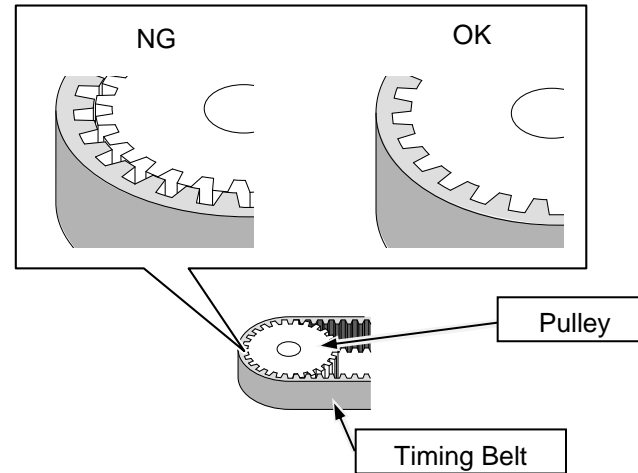
Joint #4

Installing the Reduction Gear Unit



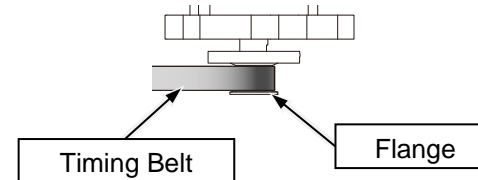
POINT

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



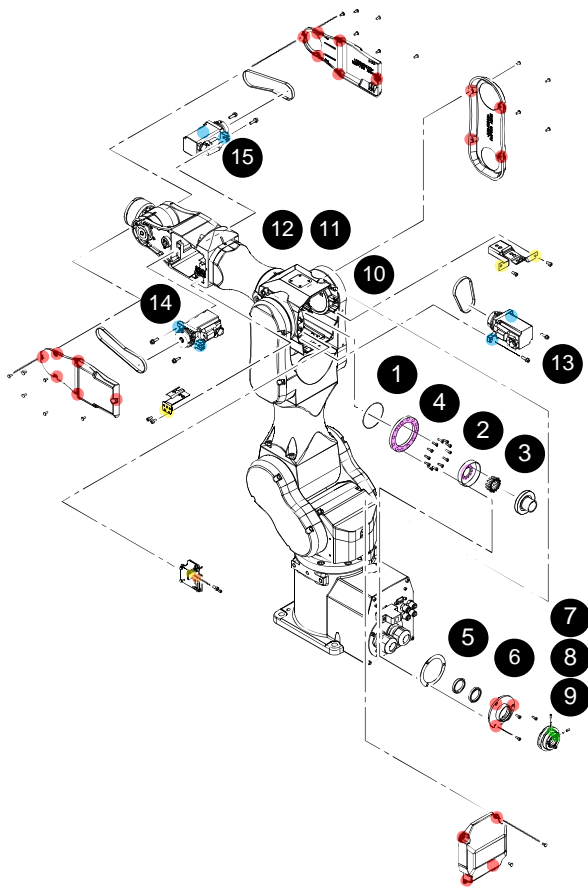
CAUTION

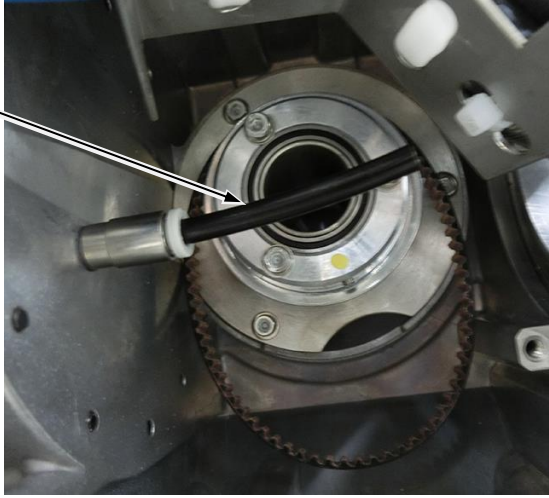
If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



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

Installing the Reduction Gear Unit

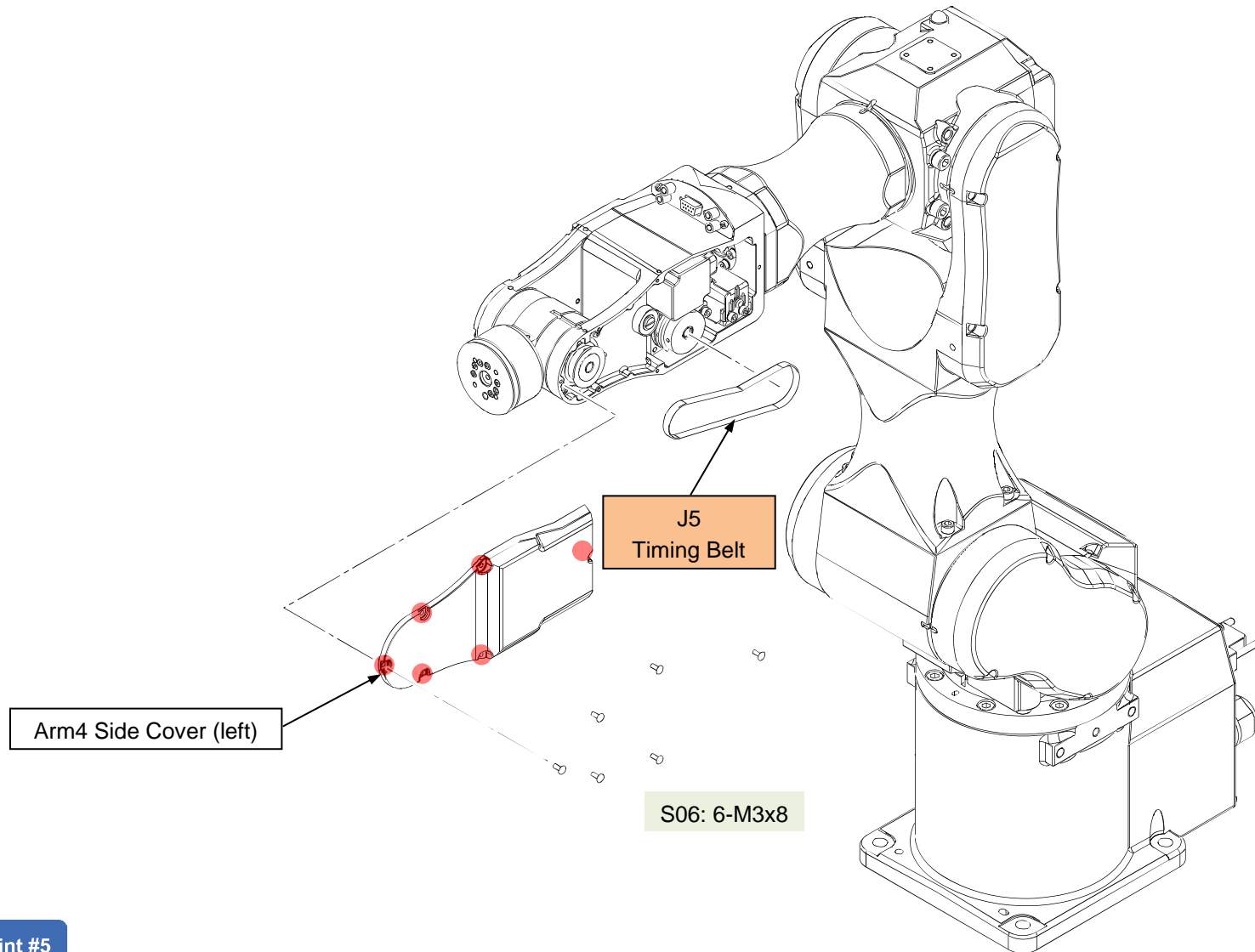


<p>10</p>	<p>Install the J4 tube.</p> 
<p>11</p>	<p>Install the LED lamp.</p>
<p>12</p>	<p>Install the Cable Unit. POINT Perform step 2.</p>
<p>13</p>	<p>Install the J4 Motor unit.</p>
<p>14</p>	<p>Install the J5 Motor unit.</p>
<p>15</p>	<p>Install the J6 Motor unit.</p>
<p>16</p>	<p>After assembly, perform calibration of Joint #4, Joint #5, and Joint #6. 3.2 Calibration</p>

Joint #4

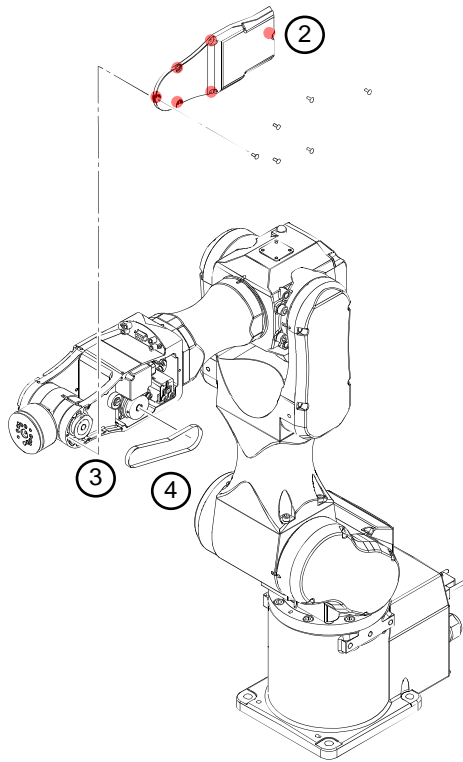
2.6 Joint #5

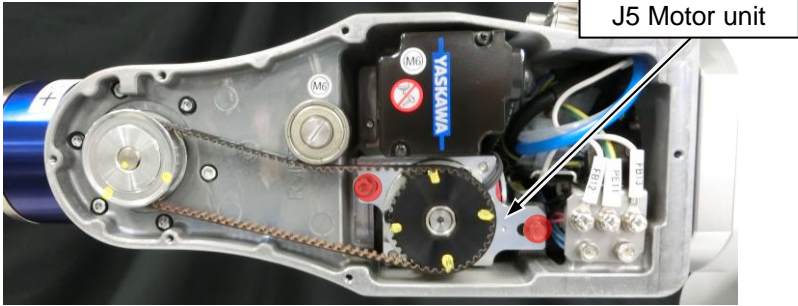

2.6.1 Joint #5 Replacing the Timing Belt



Joint #5

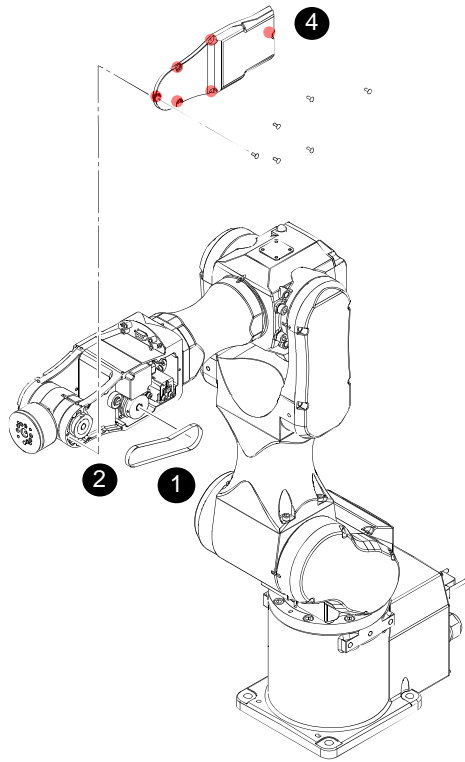
Removing the Timing Belt



①	Turn OFF the Controller.
②	Remove the Arm4 side cover (left).
③	<p>Loosen the screws securing the J5 Motor unit.</p> <p>A S01: 2-M4x15 and washer</p> 
④	<p>Remove the J5 Timing Belt.</p> <p>POINT First remove the Timing Belt from pulley 1, then from pulley 2.</p> 

Joint #5

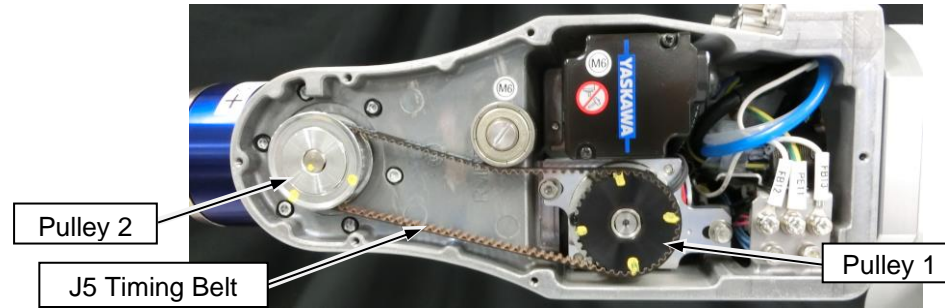
Installing the Timing Belt



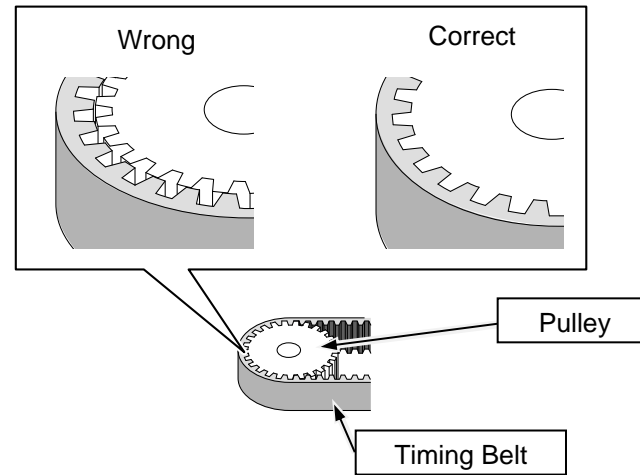
1

Install the J5 Timing Belt.

- First place the belt on pulley 1.

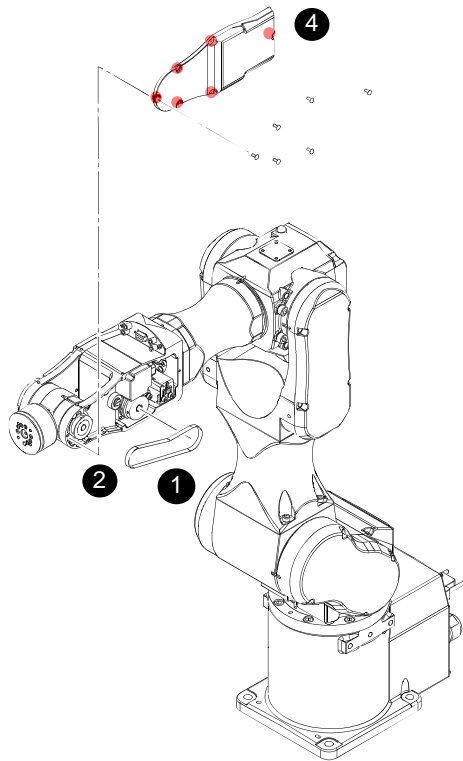


- Make sure that the teeth of the Timing Belt and the pulley are properly engaged.



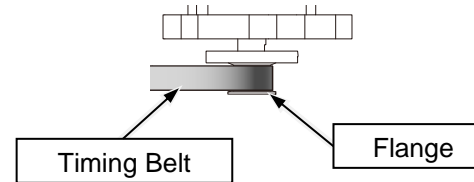
Joint #5

Installing the Timing Belt



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.

2 Temporarily secure the J5 Motor unit.

A S01: 2-M4x15 and washer



3 Adjust the belt tension.

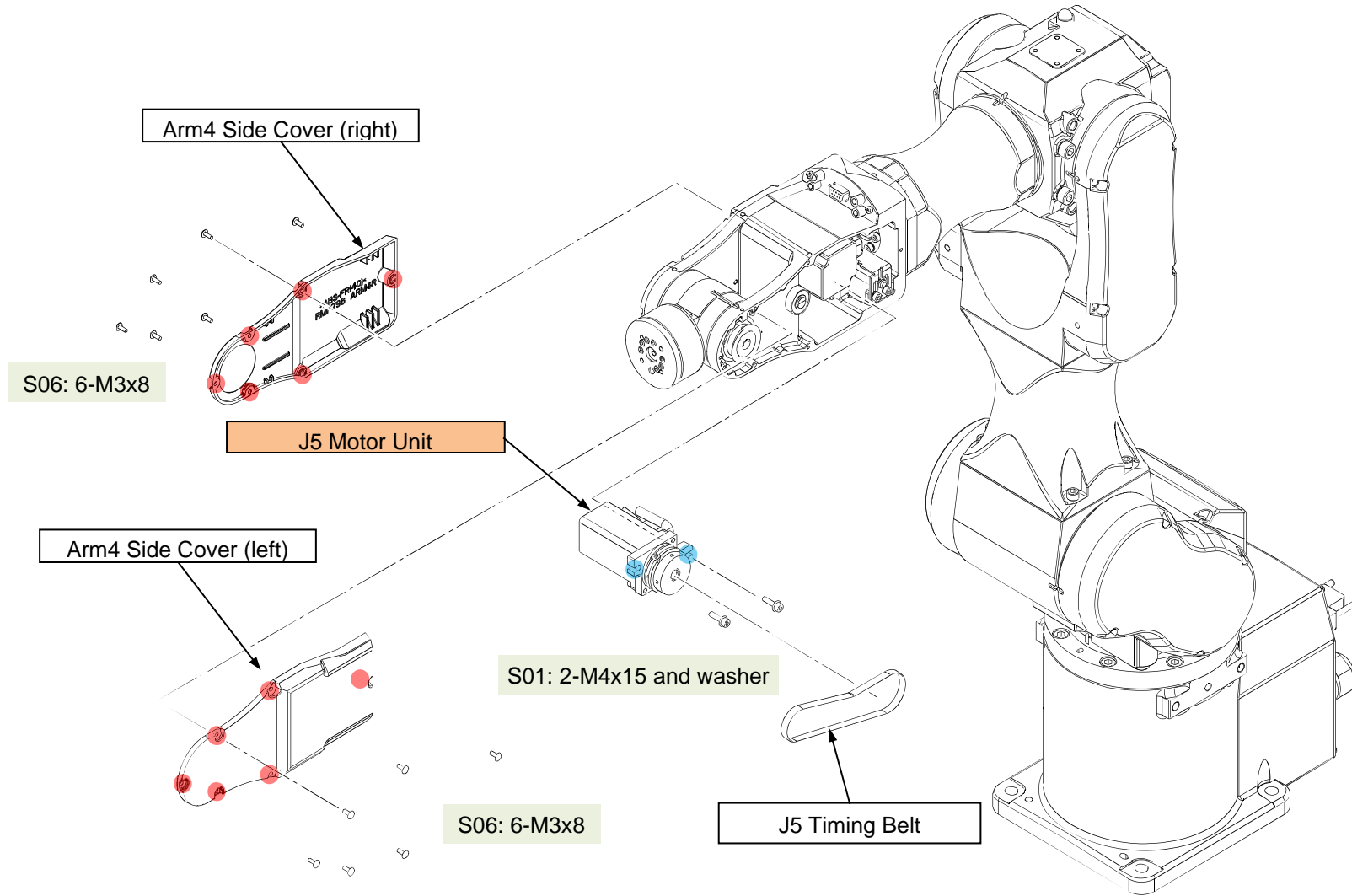
[3.1 Adjusting the Timing Belt Tension](#)

4 Install the [Arm4 side cover](#).

5 After assembly, perform calibration of Joint #5.

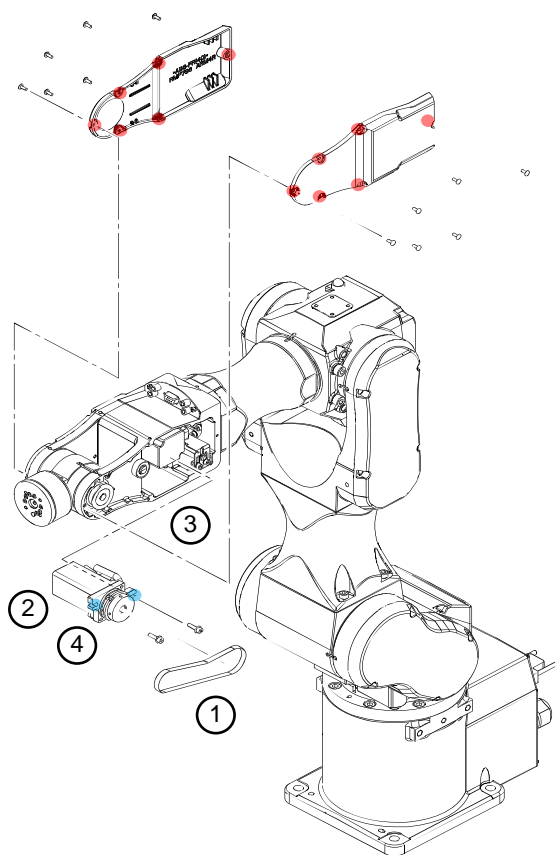
[3.2 Calibration](#)


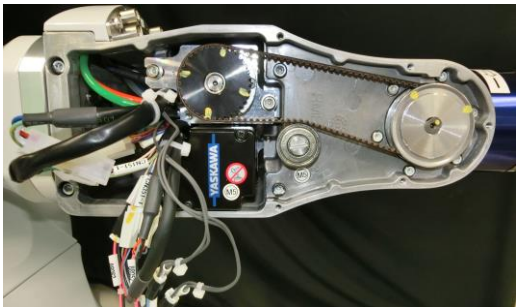
2.6.2 Joint #5 Replacing the Motor Unit



Joint #5

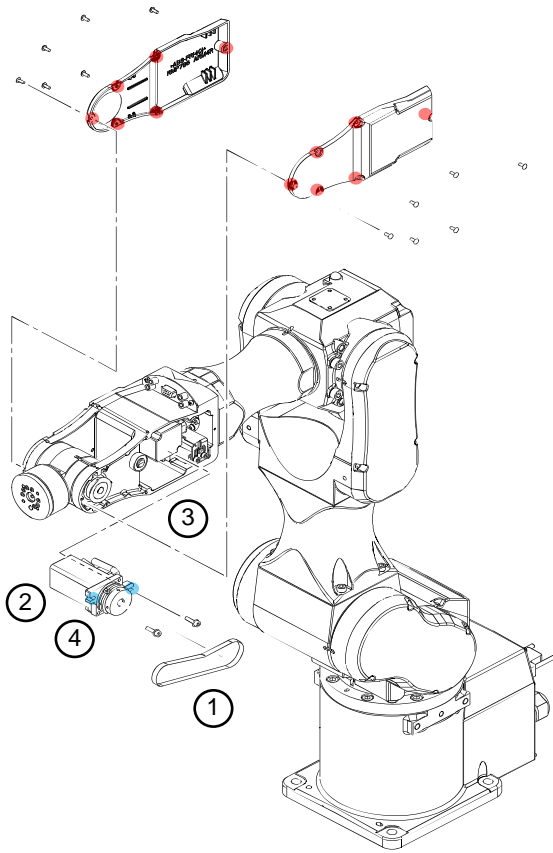
Removing the Motor Unit



①	Remove the J5 Timing Belt .
②	Cut the wire ties (AB100) binding the motor cables. 
③	Disconnect the J5 Motor Connectors (CN151, CN351, BR053). 

Joint #5

Removing the Motor Unit



④

Remove the loosened screws, then remove the J5 Motor unit from Arm4.

CAUTION

Remove while checking that the removed connectors are not catching on other cables.

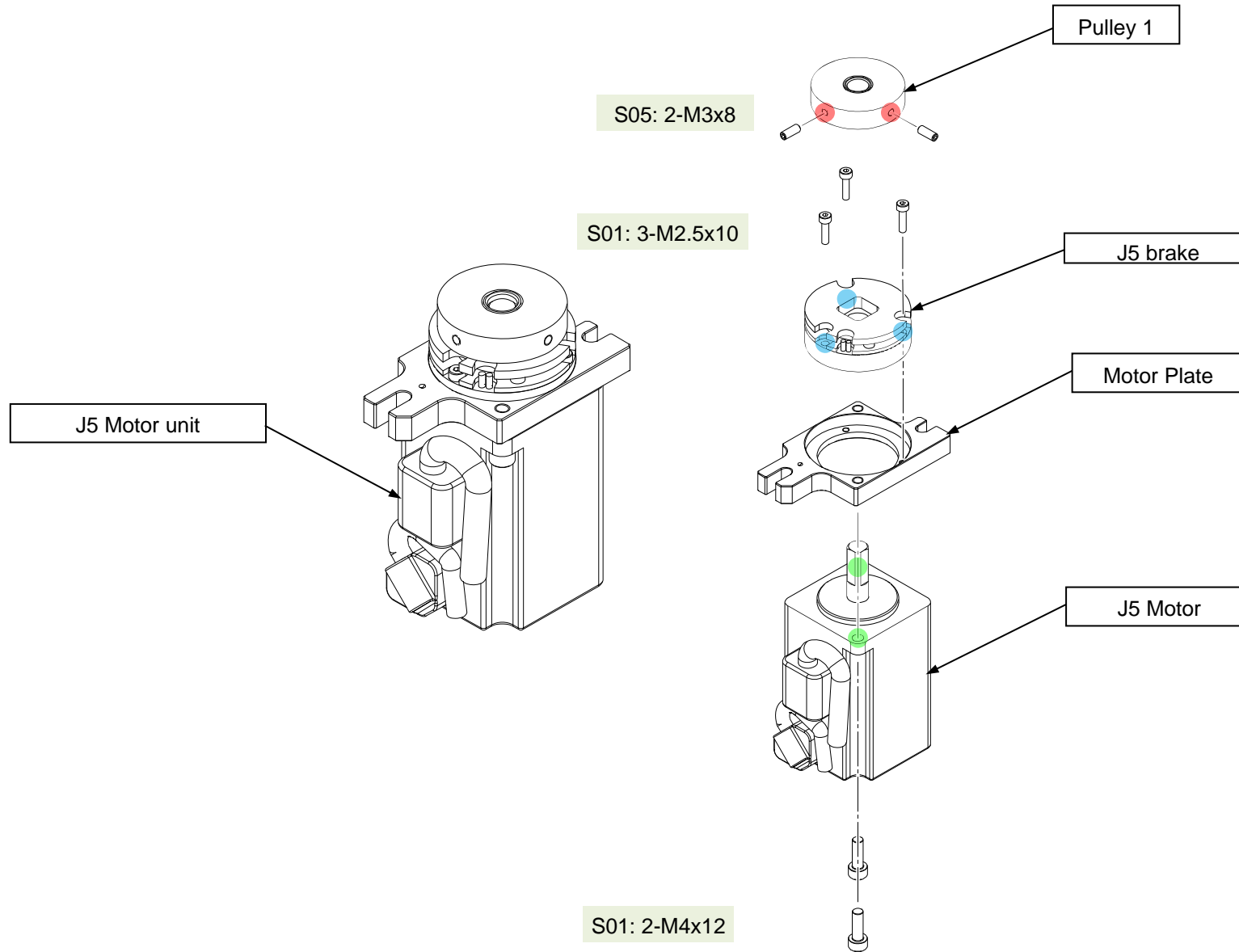
A

S01: 2-M4x15 and washer



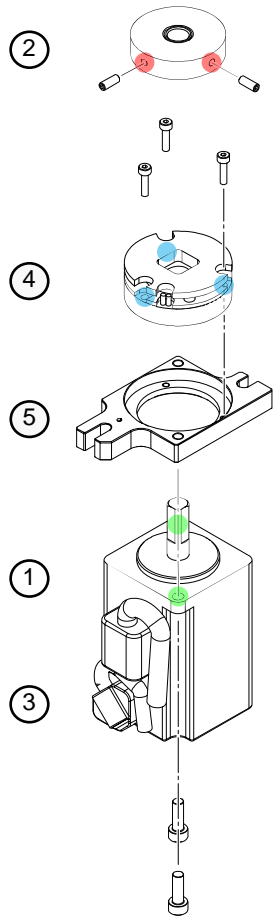
J5 Motor unit

Motor Unit Disassembly



Joint #5

Motor Unit Disassembly



①

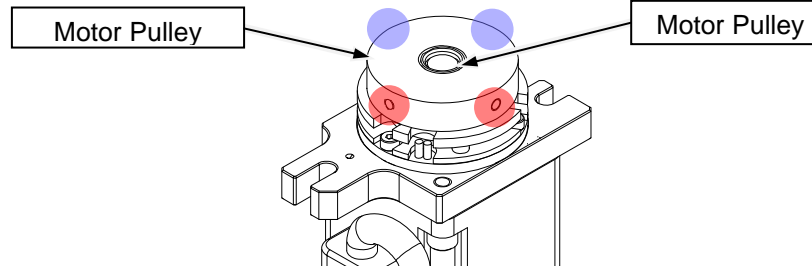
Remove the [J5 Motor unit](#).

②

Remove the Motor Pulley and the Brake Hub.

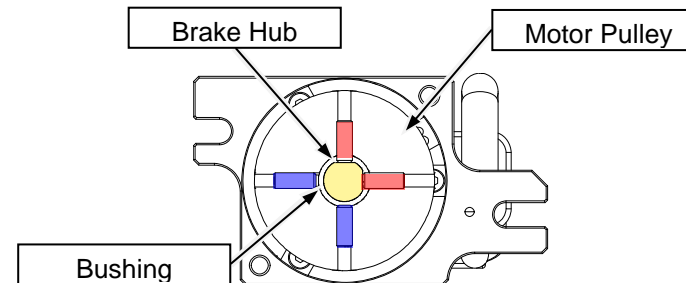
A For securing the pulley and shaft
S05: 2-M3x8

B For securing the pulley and Brake Hub
S05: 2-M3x8 (Brass bushing x 1)



POINT

It may not be possible to remove the Brake Hub and Motor Pulley simply by loosening screws (A). In this case, also loosen screws (B).

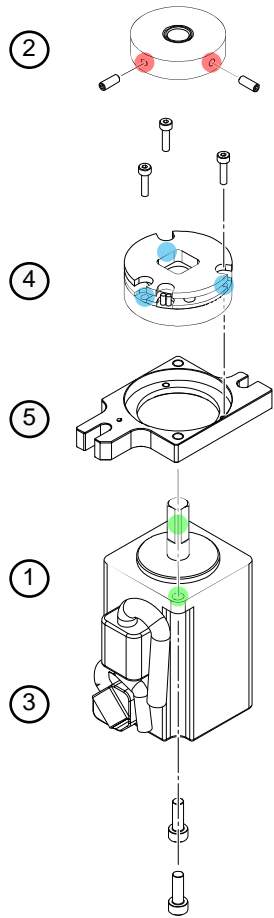


CAUTION

A brass bushing is included on one of the screws (B). When removing the part, be careful not to drop and lose the bushing.

Joint #5

Motor Unit Disassembly



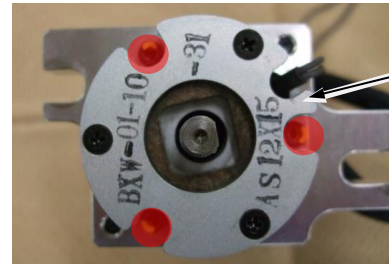
③ Cut the wire tie binding the cables.



Wire tie

④ Remove the J5 brake.

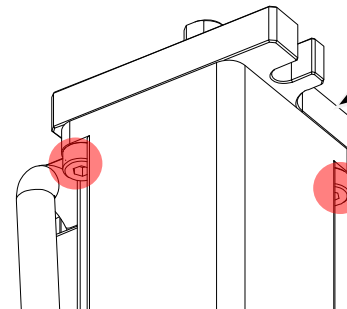
A S01: 3-M2.5x10



J5 brake

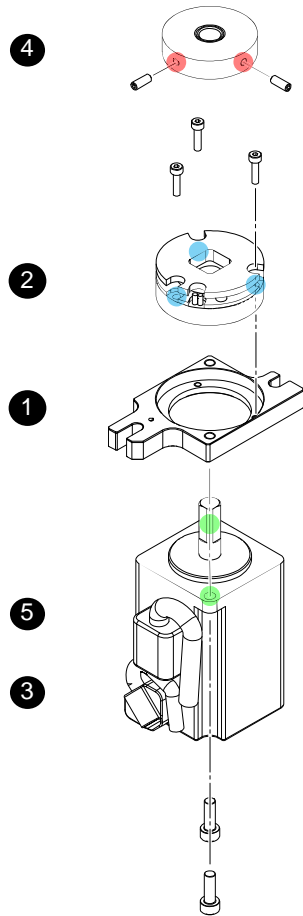
⑤ Remove the Motor Plate from the J5 Motor.

A S01: 2-M4x12

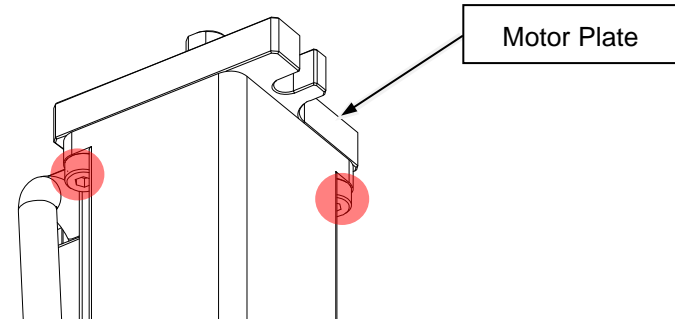
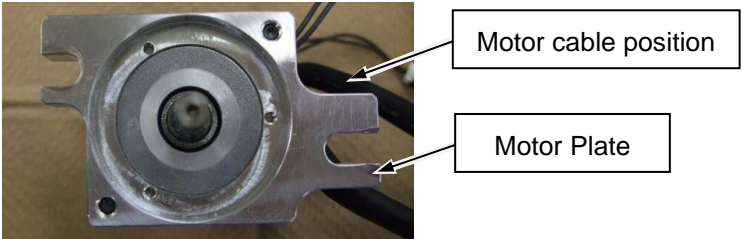
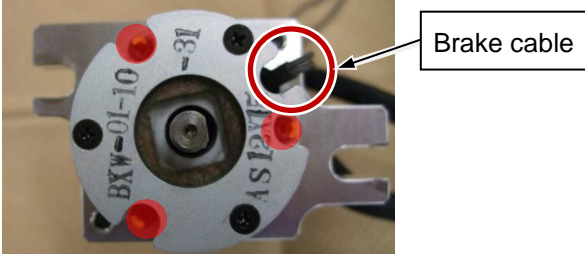


Motor Plate

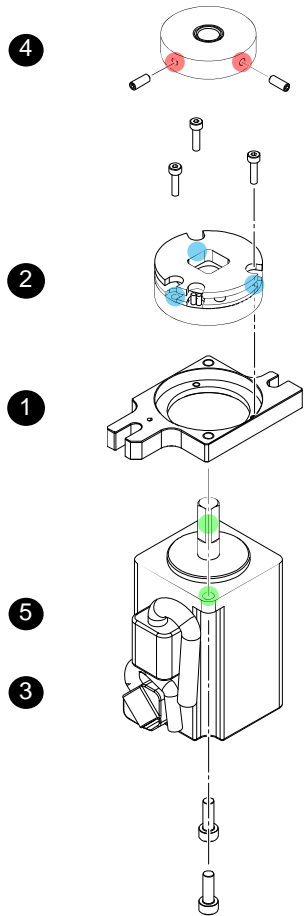
Motor Unit Assembly



Joint #5

<p>1</p>	<p>Install the Motor Plate.</p> <p>A S01: 2-M4x12 (4.0 +/- 0.2 N·m)</p> <p>POINT Attach the Motor Plate according to the orientation shown in the figure.</p>  
<p>2</p>	<p>Install the J5 electromagnetic brake.</p> <p>A S01: 3-M2.5x10 (1.0 +/- 0.1 N·m)</p> <p>POINT Install the brake in the orientation shown in the figure.</p> 

Motor Unit Assembly



3

Bind the Motor Power cable and brake cable using the wire tie (AB100).

Binding position

CN351: Approx. 140 mm from the connector end

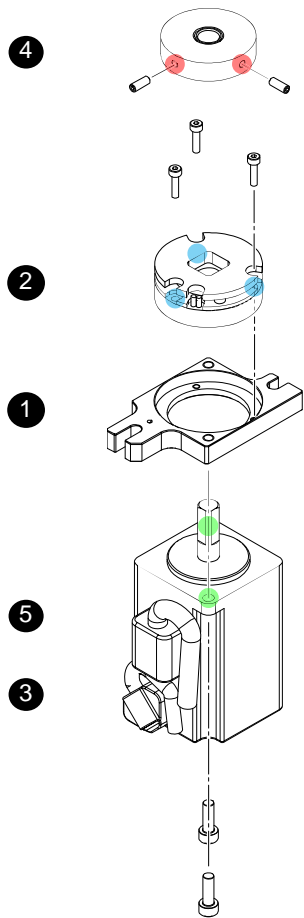
CN151: Approx. 160 mm from the connector end



Wire tie (AB100)

Joint #5

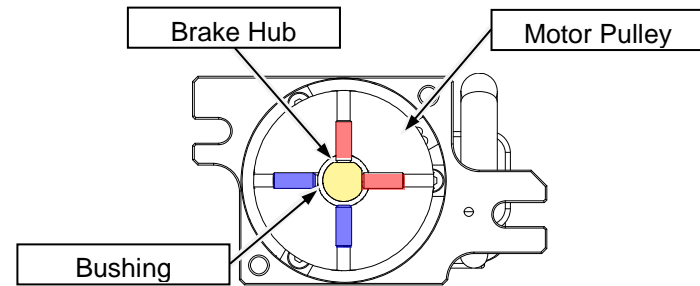
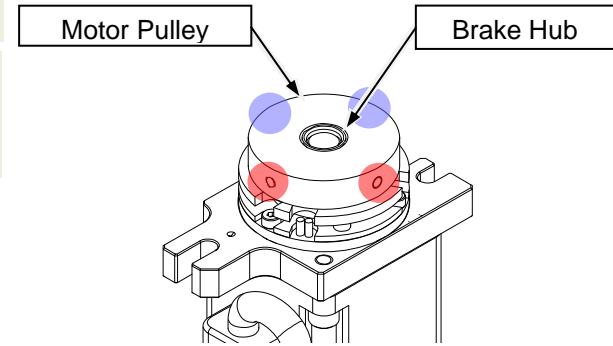
Motor Unit Assembly



4

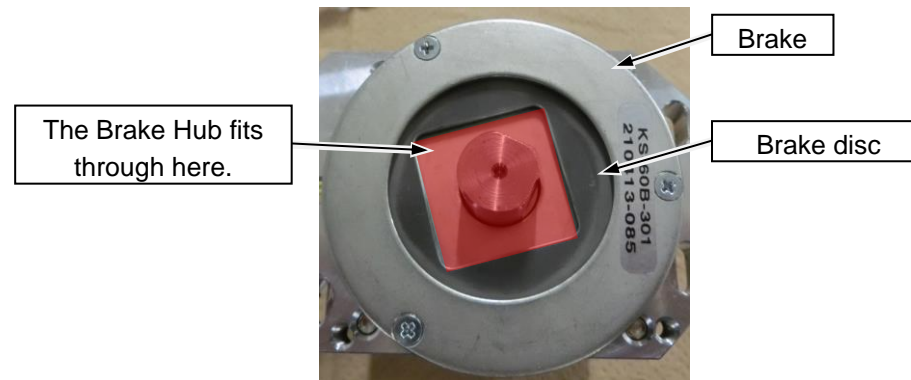
Install the Brake Hub and Motor Pulley on the J5 Motor unit.

- A For securing the pulley and shaft
S05: 2-M3x8 (0.9 +/- 0.1 N·m)
- B For securing the pulley and Brake Hub
S05: 2-M3x8 (Brass bushing x 1)
(0.9 +/- 0.1 N·m)



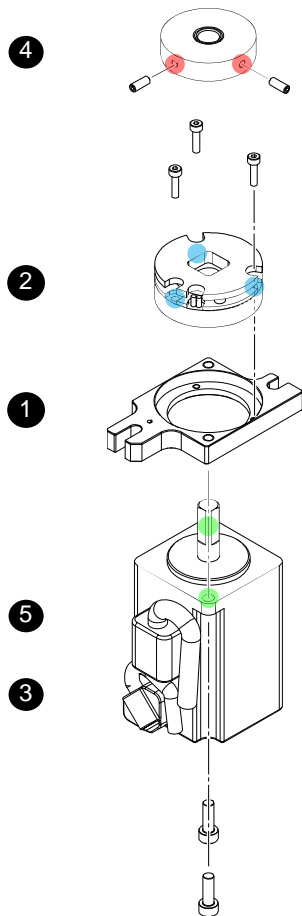
POINT

- Align the Brake Hub and brake disc positions, and install the Brake Hub on the motor shaft. If they are misaligned, adjust the brake disc position.

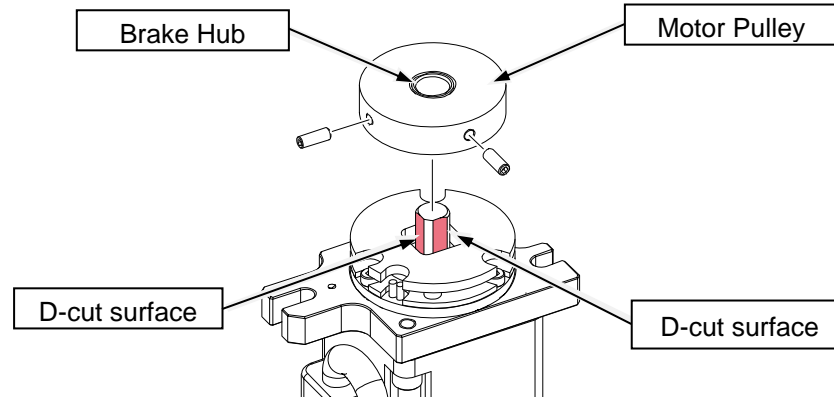


Joint #5

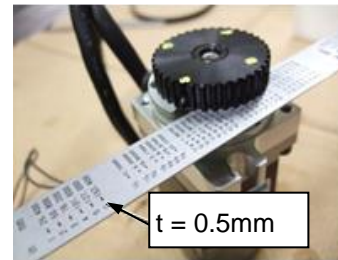
Motor Unit Assembly



- Align the motor shaft D-cut surface with the screw holes, and install the Motor Pulley.



- Place a feeler gauge (0.5 mm) between the Motor Pulley and the brake, to ensure a 0.5-mm gap during installation.

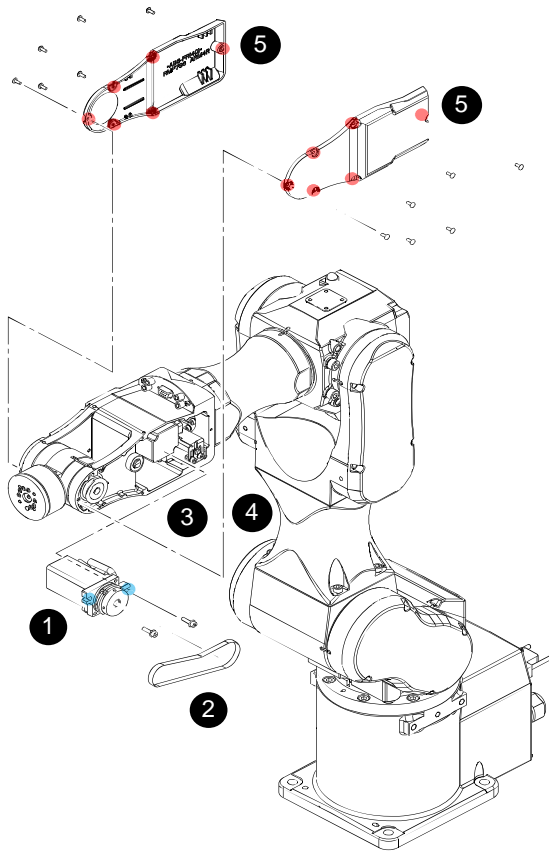


CAUTION

Failure to create a proper gap between the Motor Pulley and the brake may cause the parts to rub during motor operation, causing a malfunction.

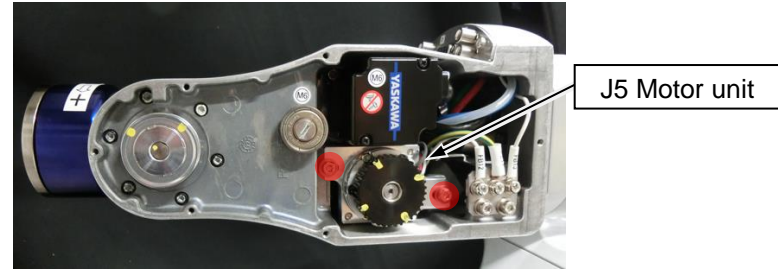
- Install the [J5 Motor unit](#).

Installing the Motor Unit



1 Insert the J5 Motor unit into Arm4, and temporarily secure the Motor Unit.

A S01: 2-M4x15 and washer



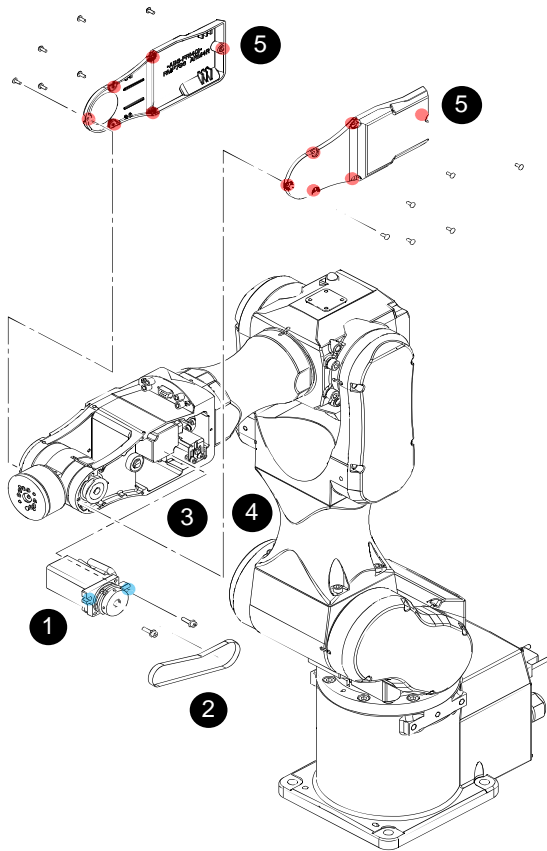
2 Install the [J5 Timing Belt](#).

POINT

Perform steps **1** to **3**.

Joint #5

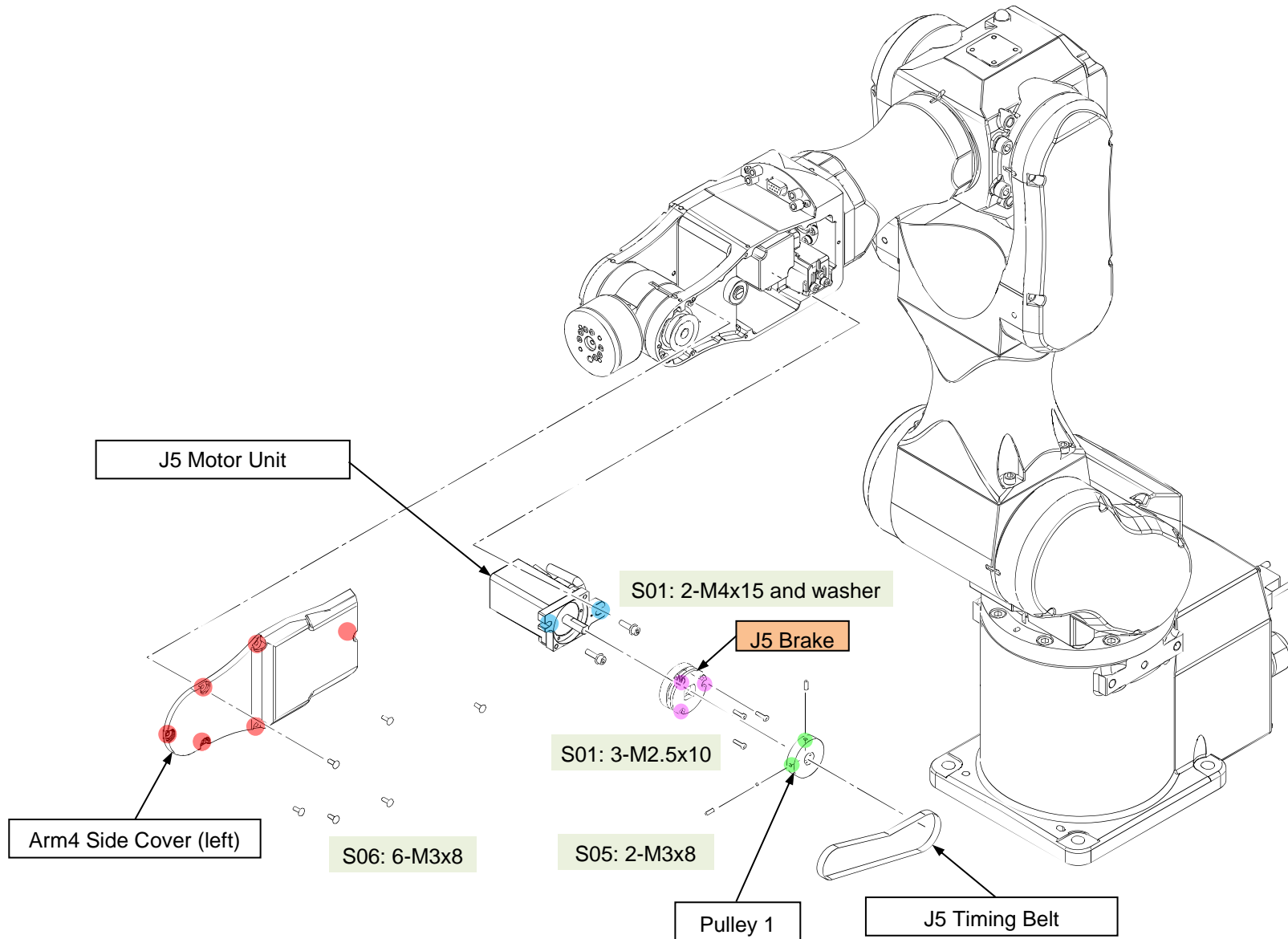
Installing the Motor Unit



Joint #5

<p>3</p>	<p>Bind the following cables using wire ties (AB100).</p> <ul style="list-style-type: none"> • CN151 and CN161 Wire tie position CN151: Approx. 90 mm from the connector end CN161: Approx. 120 mm from the connector end • CN351 and CN361 Wire tie position CN351: Approx. 130 mm from the connector end CN361: Approx. 80 mm from the connector end
<p>4</p>	<p>Connect the J5 Motor Connectors (CN151, CN351, BR053).</p>
<p>5</p>	<p>Install the Arm4 side cover.</p>
<p>6</p>	<p>After assembly, perform calibration of Joint #5. 3.2 Calibration</p>

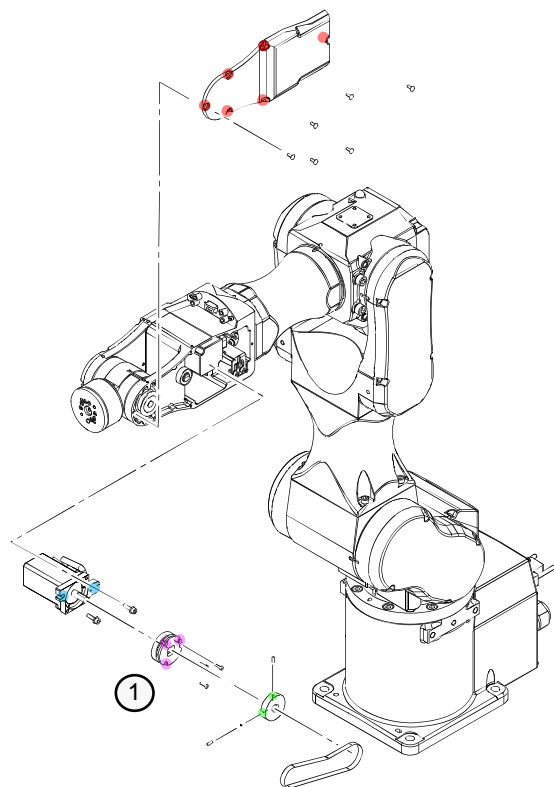
2.6.3 Joint #5 Replacing the Brake



Joint #5

Removing the Brake

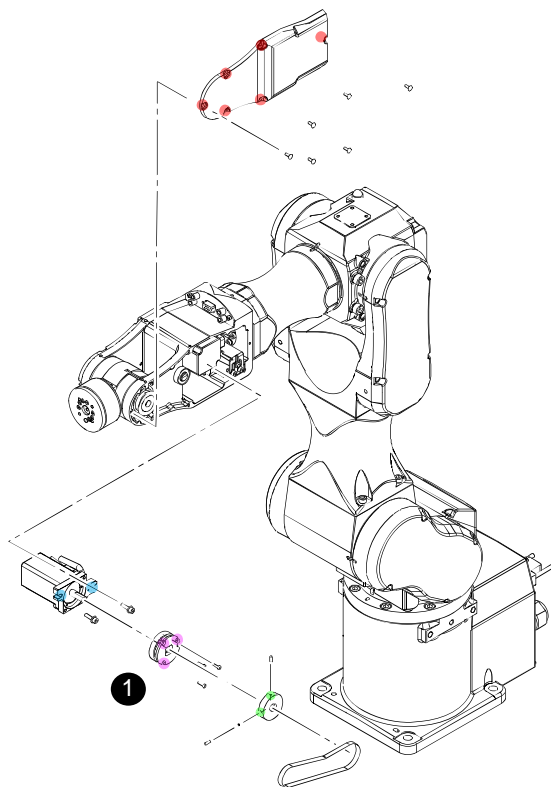
- | | |
|---|---|
| ① | Refer to J5 Motor Unit Disassembly and remove the J5 brake. |
|---|---|



Joint #5

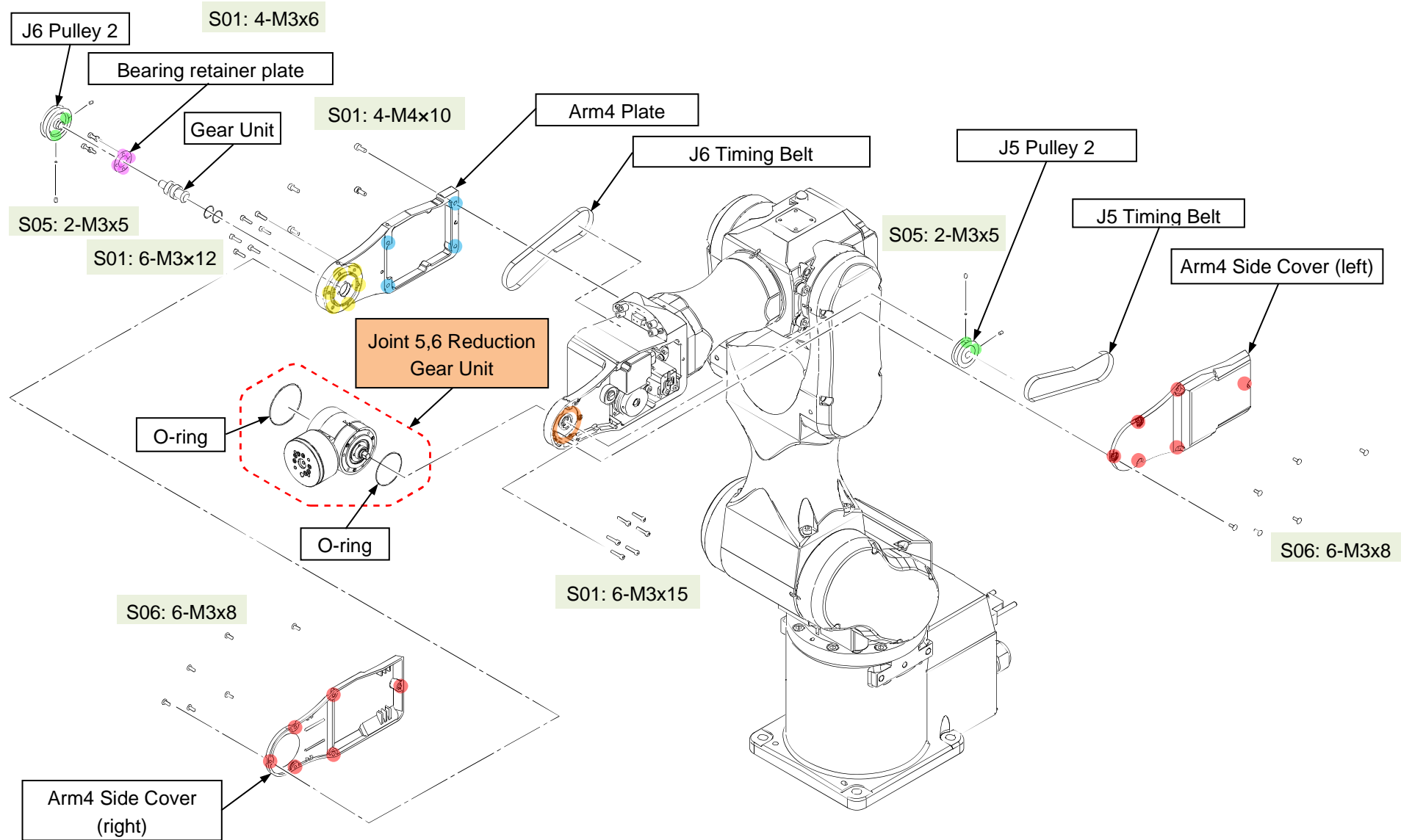
Installing the Brake

- | | |
|----------|---|
| 1 | Refer to J5 Motor Unit Assembly and install the J5 brake. |
|----------|---|



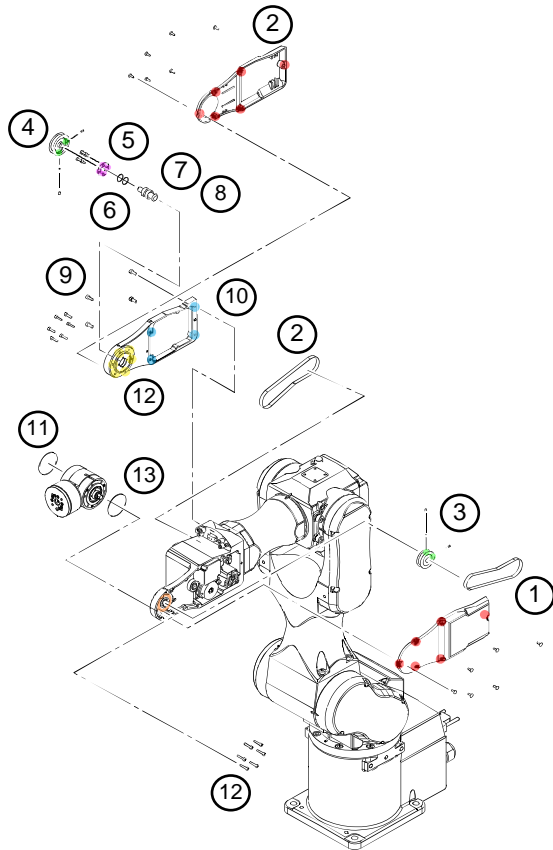
Joint #5


2.6.4 Replacing the Joint 5,6 Reduction Gear Unit



Joint #5

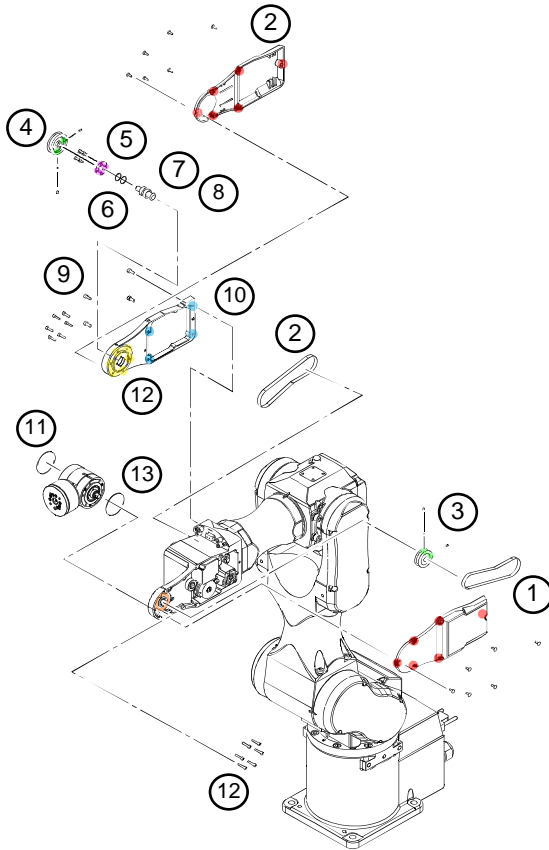
Removing the Joint 5,6 Reduction Gear Unit



①	Remove the J5 Timing Belt .
②	Remove the J6 Timing Belt .
③	<p>Remove the J5 pulley 2.</p> <ol style="list-style-type: none"> 1. Using a 1.5-mm hexagonal wrench, loosen the two screws securing the J5 pulley 2. 2. Remove the J5 pulley 2. <p>A S05: 2-M3x5 (Brass bushing x 1)</p>  <p>J5 pulley 2</p> <p>POINT A brass bushing is included on one side of the set screw. When removing the pulley, be careful not to drop and lose the bushing.</p>

Joint #5

Removing the Joint 5,6 Reduction Gear Unit

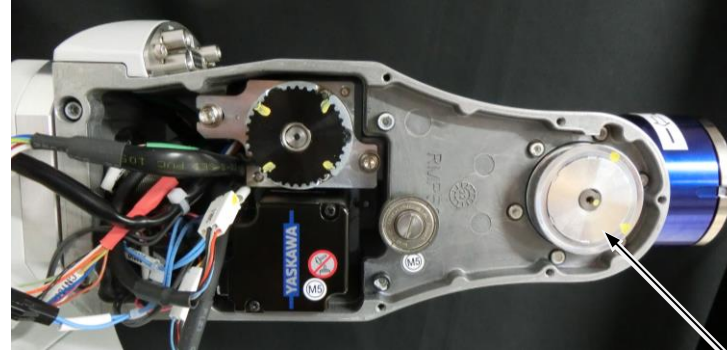


④

Remove the J6 pulley 2.

1. Using a 1.5-mm hexagonal wrench, loosen the two screws securing the J6 pulley 2.
2. Remove the J5 pulley 2.

A S05: 2-M3x5 (Brass bushing x 1)



J6 pulley 2

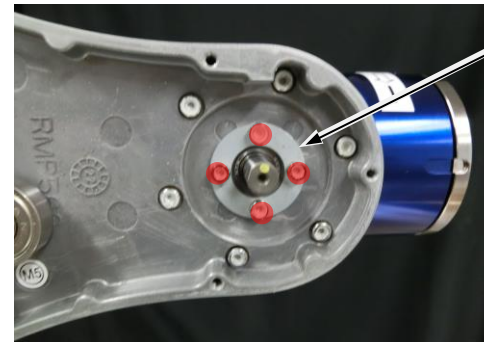
POINT

A brass bushing is included on one side of the set screw. When removing the pulley, be careful not to drop and lose the bushing.

⑤

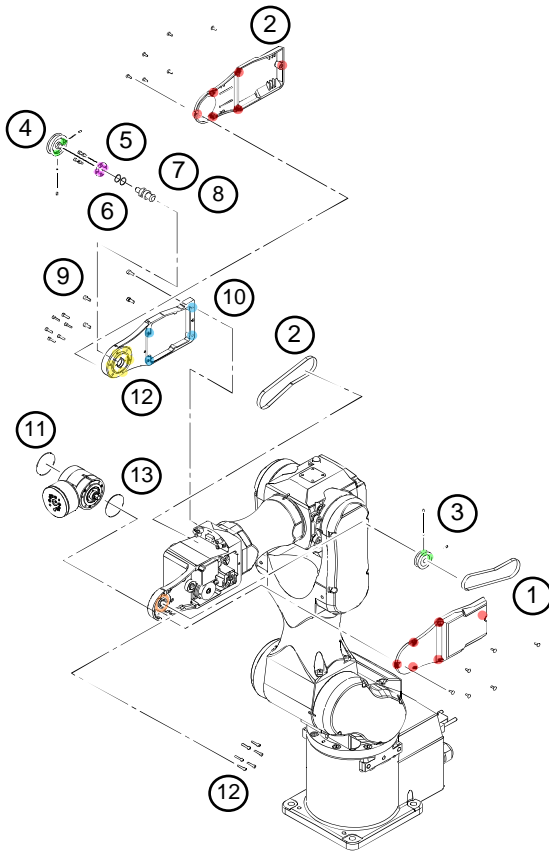
Remove the bearing retainer plate.

A S01: 4-M3x6



Bearing retainer plate

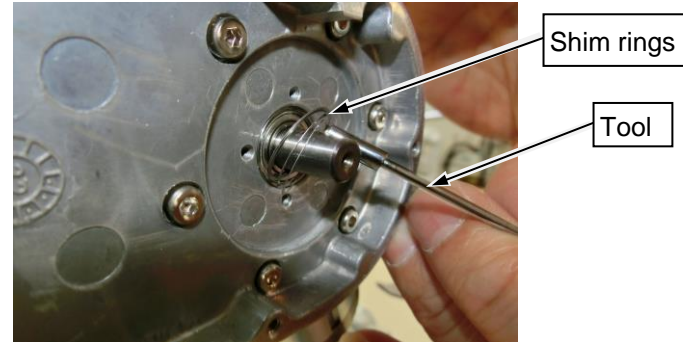
Removing the Joint 5,6 Reduction Gear Unit



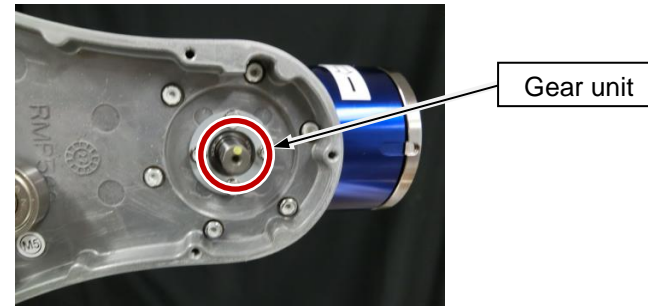
⑥ Remove all shim rings in front of the bearing.

POINT

- Thickness and number of shim rings used will differ depending on the device. Make a note of their condition when they are removed.
- Using tools with magnetized tips will make it easier to remove shim rings.



⑦ Pull out the gear unit from the Arm4 plate.



POINT

If the gear unit is difficult to remove, attach the removed pulley 2 to the shaft to remove the gear unit.

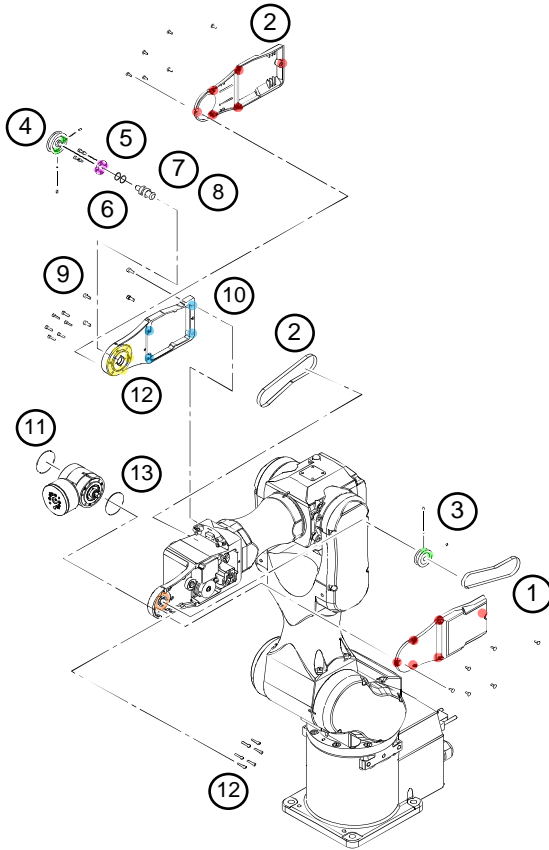
CAUTION

There are also shim rings on the Reduction Gear side of the gear unit. When removing the gear unit from the arm, be careful not to drop the shim rings inside the arm.



Joint #5

Removing the Joint 5,6 Reduction Gear Unit

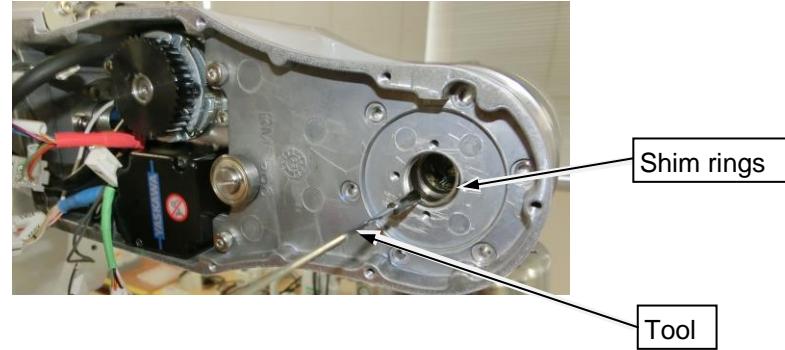


⑧

Remove the shim rings on the Reduction Gear side of the gear unit.

POINT

- Thickness and number of shim rings used will differ depending on the device. Make a note of their condition when they are removed.
- Using tools with magnetized tips will make it easier to remove shim rings.

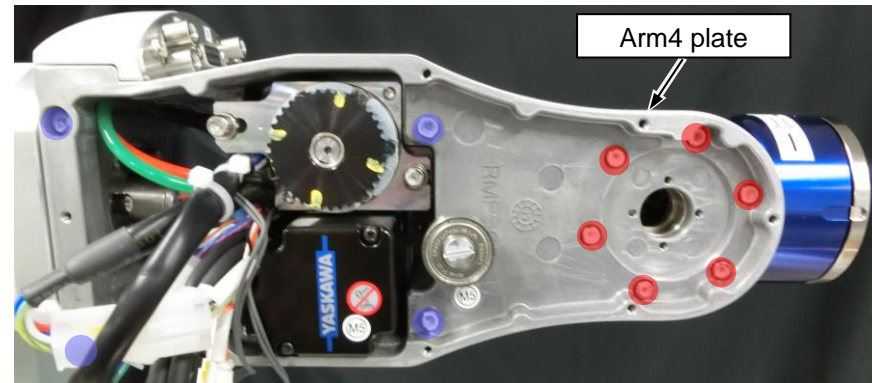


⑨

Remove the screws securing the Arm4 plate.

A S01: 6-M3x12

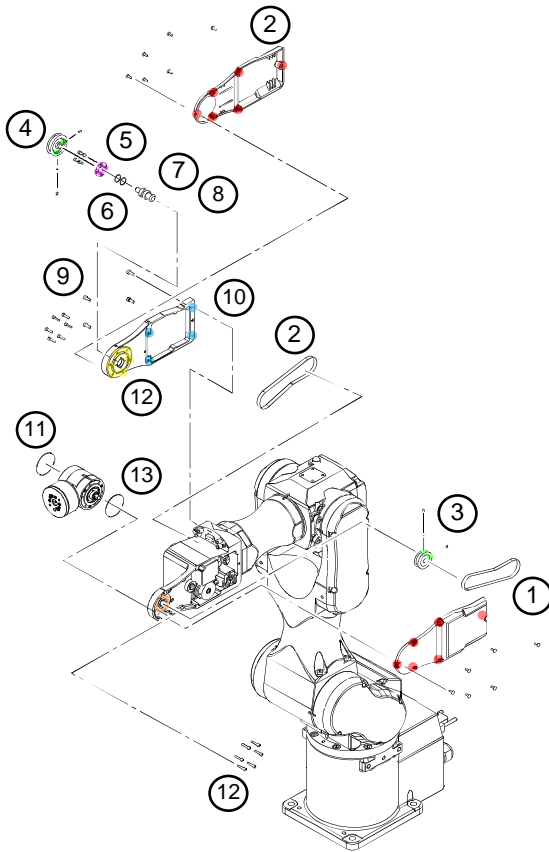
B S01: 4-M4x10





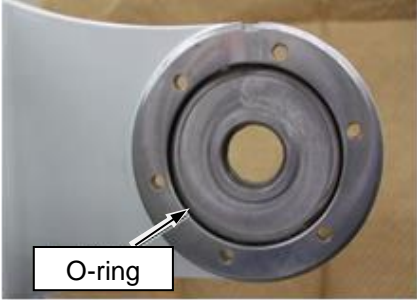
⑩

Remove the Arm4 plate.

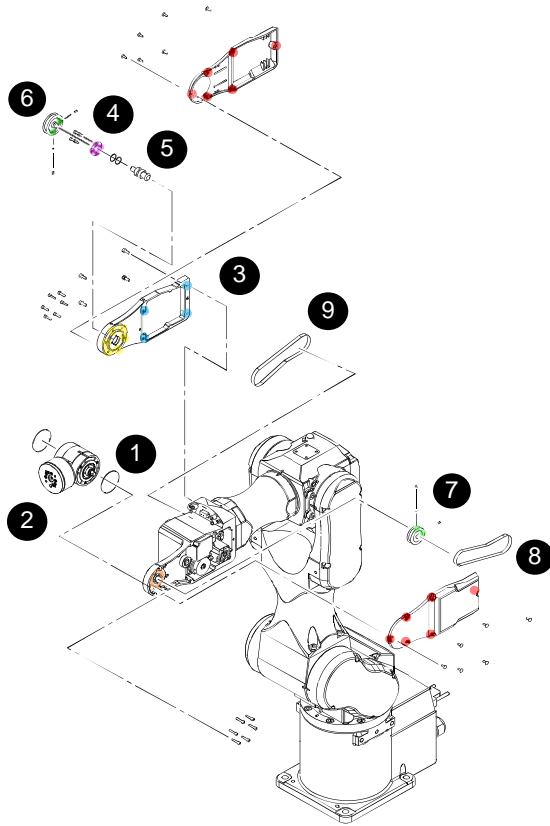
Removing the Joint 5,6 Reduction Gear Unit



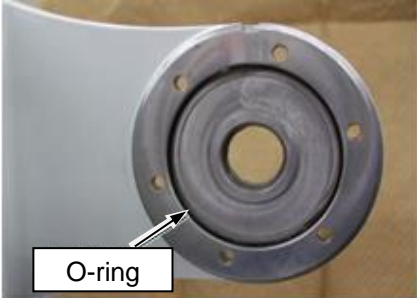
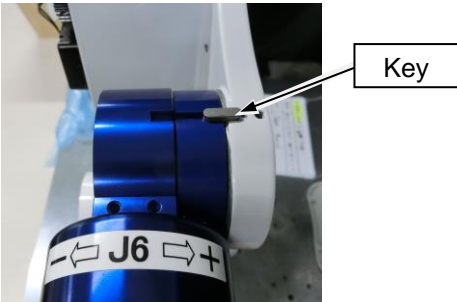

Joint #5

<p>⑪</p>	<p>Remove the O-ring in the position in the figure.</p> 
<p>⑫</p>	<p>Remove the screws securing the J5 Reduction Gear, and remove the Joint 5,6 reduction gear unit.</p> <p>POINT The part has grease applied. Perform the work while wiping off the grease.</p> <p>A S01: 6-M3x15</p> 
<p>⑬</p>	<p>Remove the O-ring.</p> 

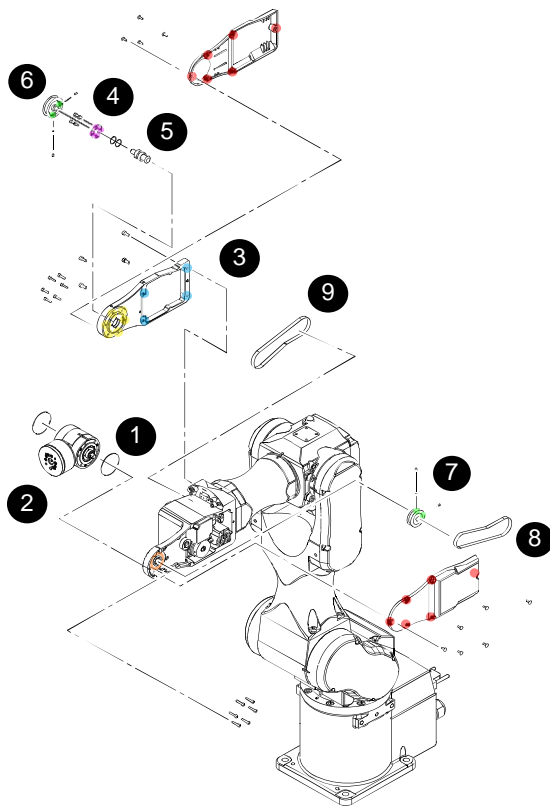
Installing the Joint 5,6 Reduction Gear Unit



Joint #5

<p>1</p>	<p>Install the O-ring (included with the J5 Reduction Gear) on Arm4.</p> 
<p>2</p>	<p>Install the Joint 5,6 Reduction Gear Unit on Arm4.</p> <p>1. Insert the key in the groove as shown in the figure, and align the Joint 5,6 Reduction Gear Unit with the Arm4 position.</p>  <p>POINT</p> <p>The key is secured to Arm1 with a screw. Remove the Arm1 Center Cover and remove the key. After securing the arm unit, return the key to its original position.</p> <p>A S01: M3x6</p> 

Installing the Joint 5,6 Reduction Gear Unit



2. Secure the Joint 5,6 reduction gear unit to Arm4.

- A S01: 6-M3x15
(2.4 +/- 0.1 N·m)

Joint 5,6 reduction gear unit



3. Install the Arm4 plate.

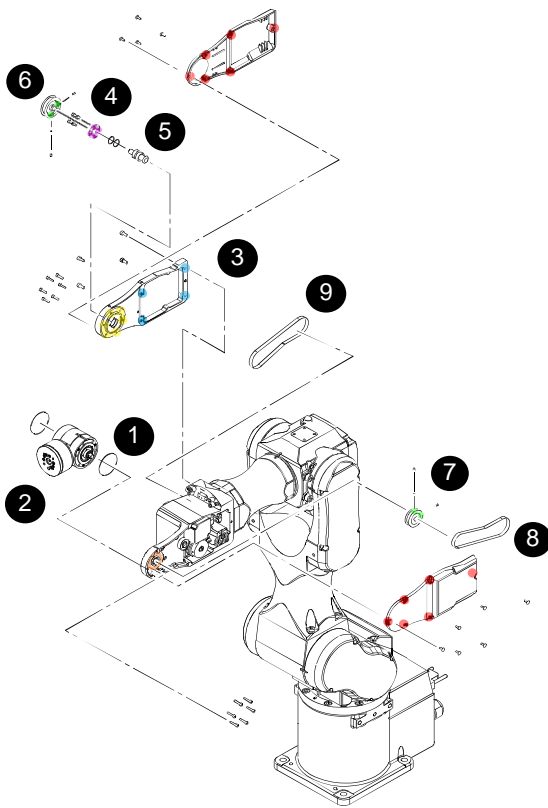
- A S01: 6-M3x12
(2.0 +/- 0.1 N·m)
- B S01: 4-M4x10
(4.0 +/- 0.2 N·m)

Arm4 plate



Joint #5

Installing the Joint 5,6 Reduction Gear Unit



4

Install the shim rings in the position in the figure.

CAUTION

Install the same number of shim rings of the same thickness as when removed.



Shim rings

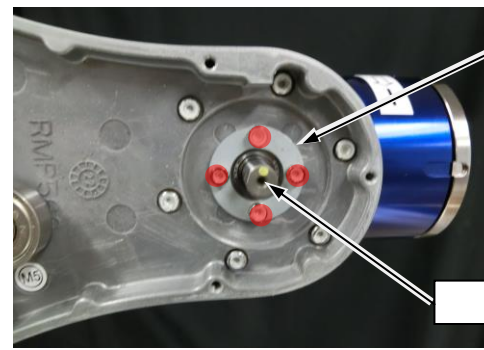
5

Insert the shim rings along with the gear unit, and install the bearing retainer plate.



Shim rings

A S01: 4-M3x6
(2.0 +/- 0.1 N·m)

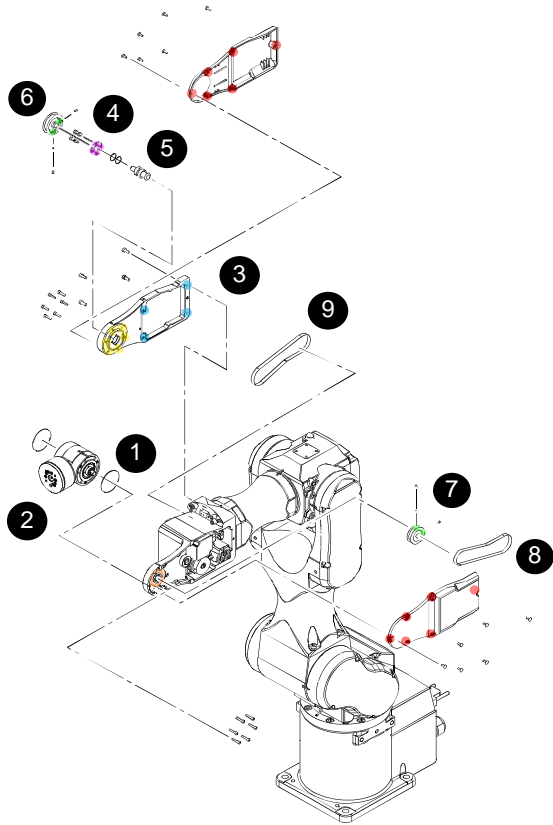


Bearing retainer plate

Gear unit

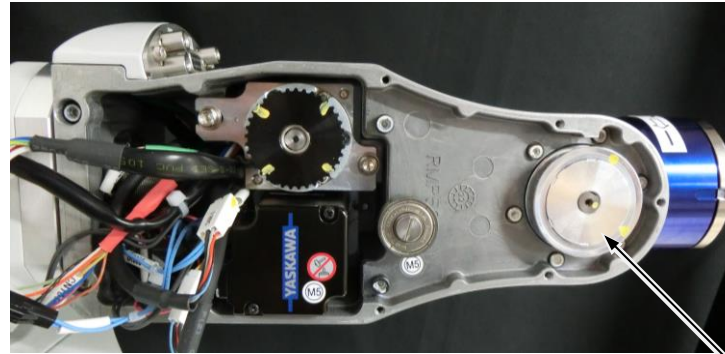
Joint #5

Installing the Joint 5,6 Reduction Gear Unit



6 Install the J2 pulley 6.

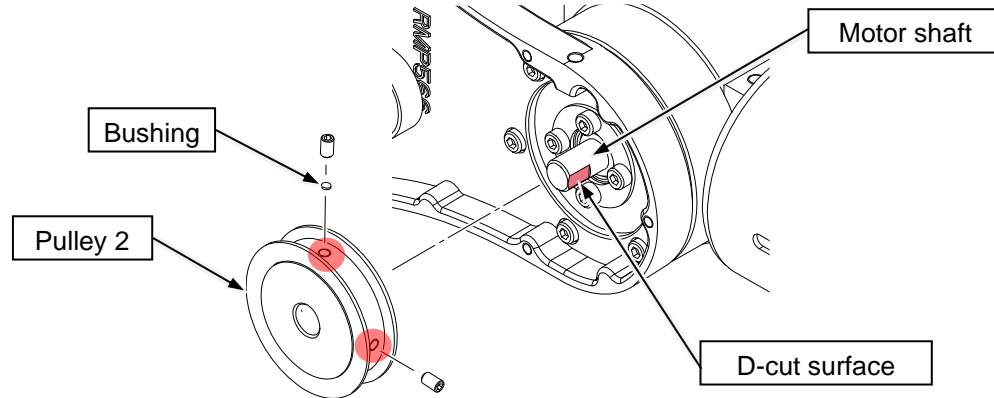
- A S05: 2-M3x5 (Brass bushing x 1) (0.9 +/- 0.1 N·m)



J6 pulley 2

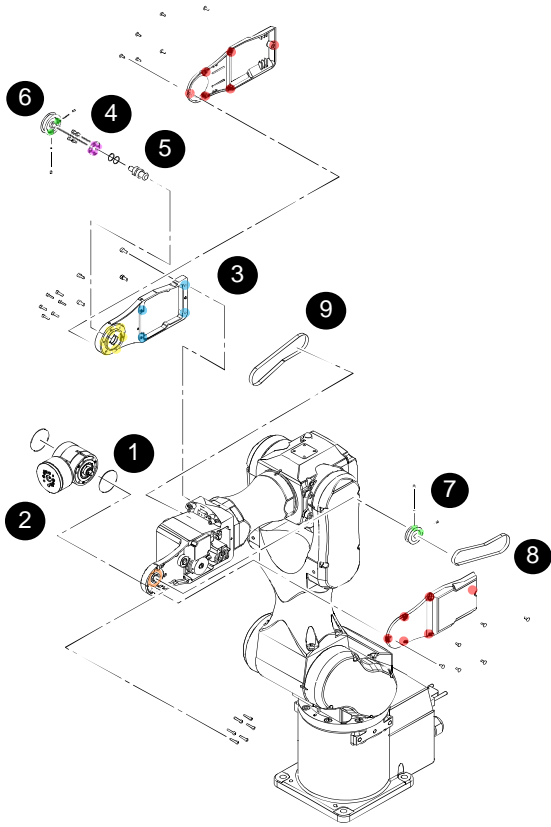
POINT

Align the shaft D-cut surface with the screw hole, and install pulley 2.



Joint #5

Installing the Joint 5,6 Reduction Gear Unit



Joint #5

7 Install the J2 pulley 5.

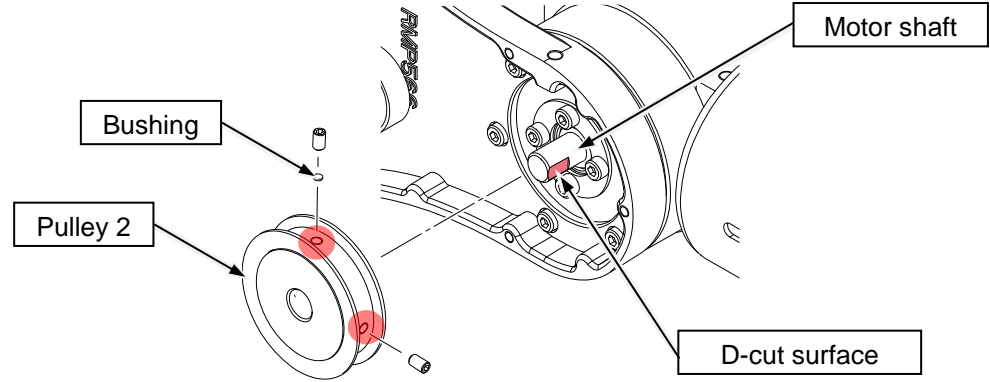
A S05: 2-M3x5 (Brass bushing x 1) (0.9 +/- 0.1 N·m)



J5 pulley 2

POINT

Align the shaft D-cut surface with the screw hole, and install pulley 2.

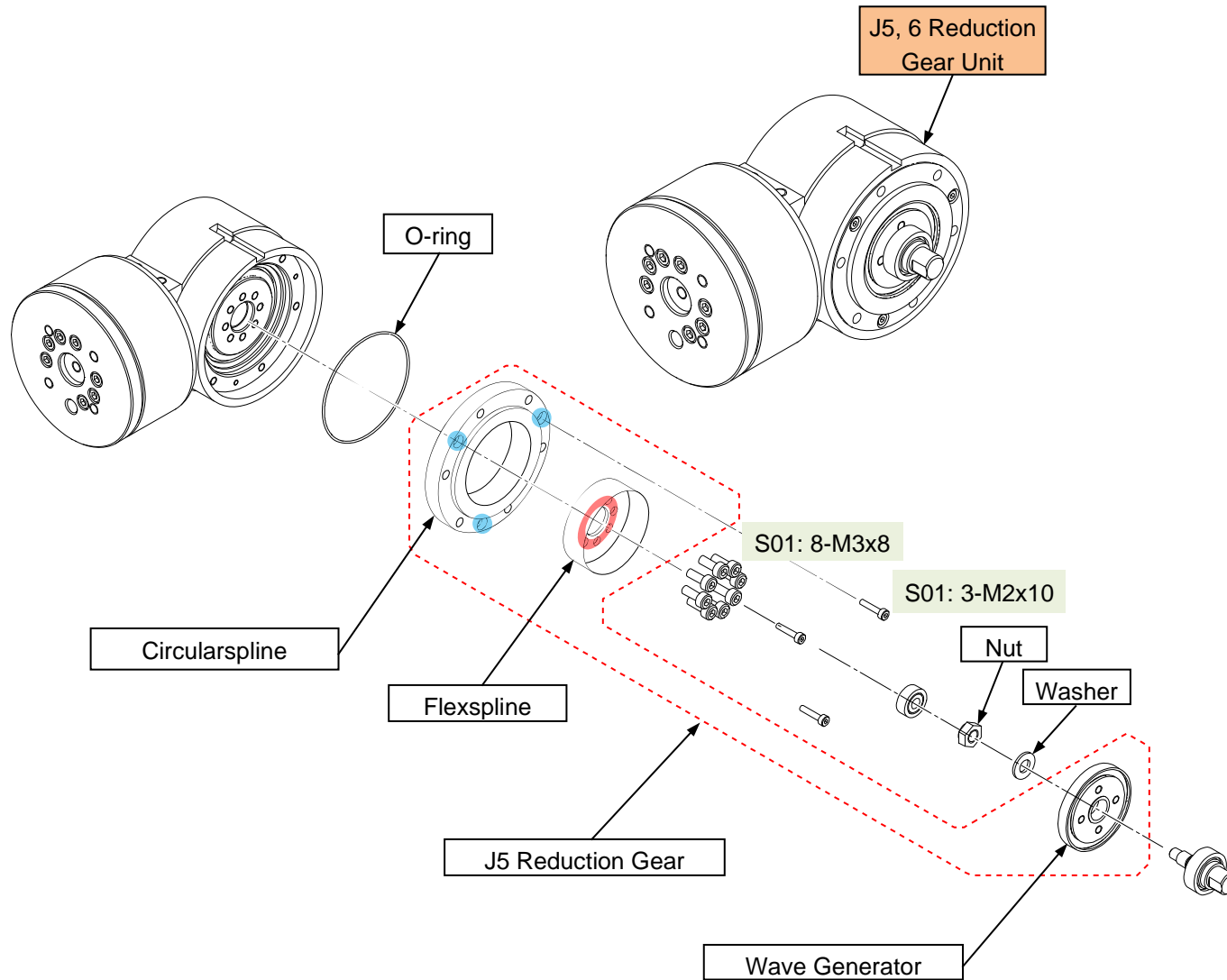


8 Install the [J5 Timing Belt](#).

9 Install the [J6 Timing Belt](#).

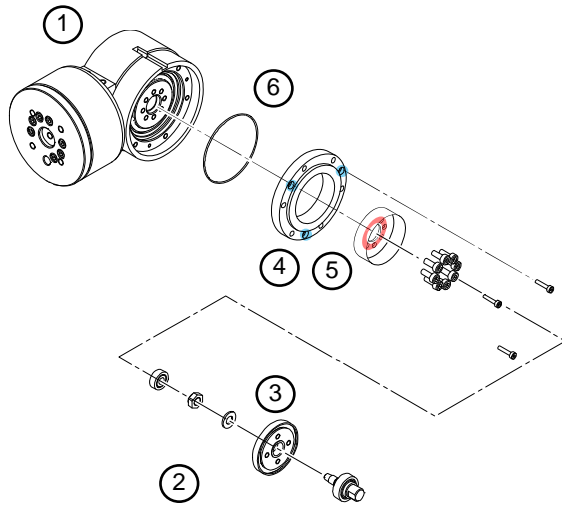
10 After assembly, perform calibration of Joint #5 and Joint #6.
[3.2 Calibration](#)

2.6.5 Joint #5 Replacing the Reduction Gear Unit



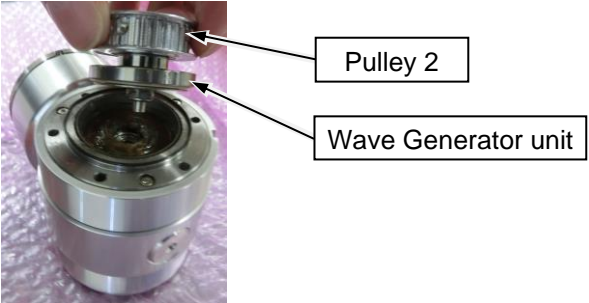


Joint #5

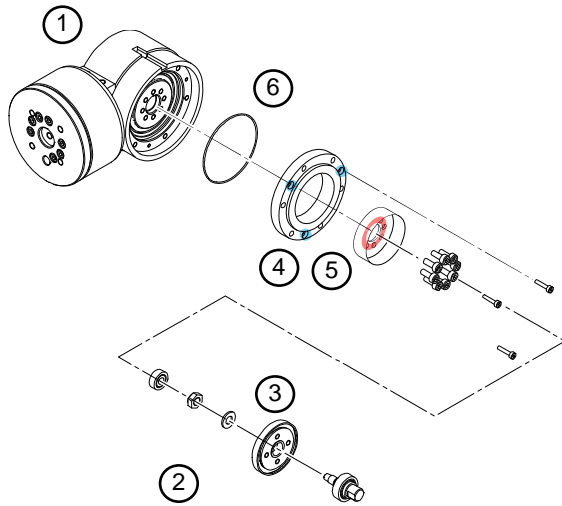
Removing the Reduction Gear Unit



Joint #5

①	Remove the Joint 5,6 reduction gear unit .
②	<p>Remove the Wave Generator unit from the Reduction Gear.</p>  <p style="text-align: right;">Wave Generator unit</p> <p>CAUTION Removing the Wave Generator unit will at the same time remove the shaft end bearing. The bearing will be used again during installation. Be careful not to lose it.</p>  <p style="text-align: center;">Bearing Wave Generator unit</p> <p>POINT</p> <ul style="list-style-type: none"> If the Wave Generator unit is difficult to remove, attach the removed pulley 2 to the shaft and pull it out.  <p style="text-align: right;">Pulley 2 Wave Generator unit</p> <ul style="list-style-type: none"> The parts around the Reduction Gear have grease applied. Perform the work while wiping off the grease.

Removing the Reduction Gear Unit



③ Remove the Wave Generator from the shaft.

POINT

- Using the Wave Generator width across flats (7 mm), remove the nut and washer from the Wave Generator.



CAUTION

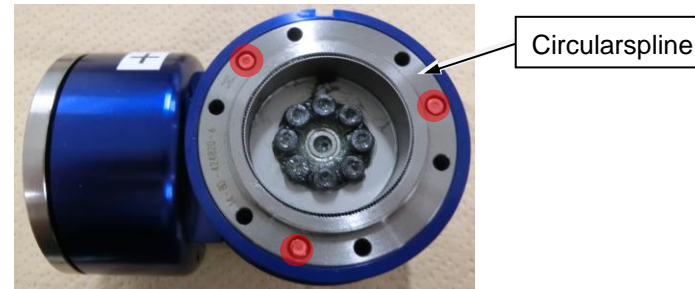
The bearing, washer, and nut removed from the shaft will be used again during installation. Be careful not to lose it.

④ Remove the Circularspline fixing screws, and remove the Circularspline.

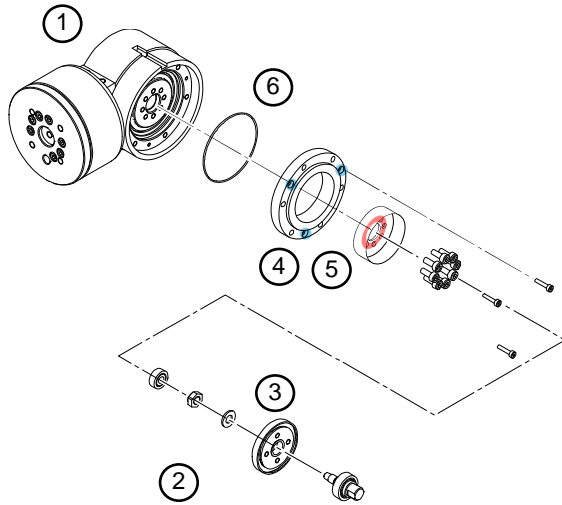
POINT

The part has grease applied. Perform the work while wiping off the grease.

A S01: 3-M2x10



Removing the Reduction Gear Unit

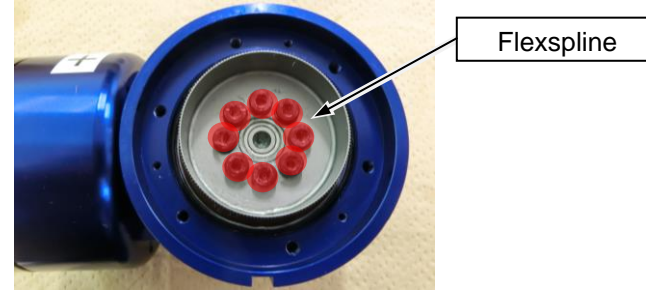


⑤ Remove the Flexspline fixing screws, and remove the Flexspline.

POINT

The part has grease applied. Perform the work while wiping off the grease.

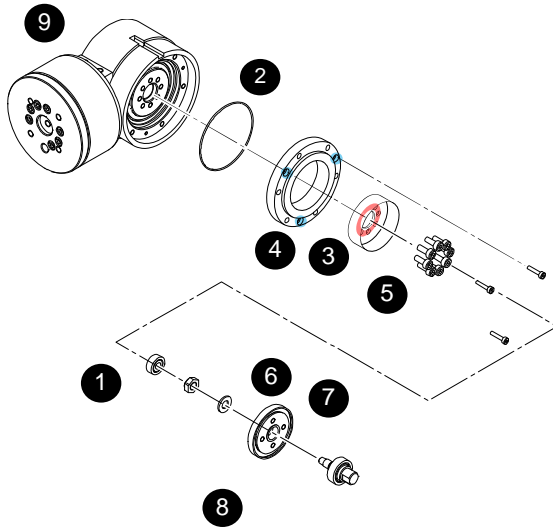
A S01: 8-M3x8



⑥ Remove the O-ring from the Joint 5,6 reduction gear unit.



Installing the Reduction Gear Unit




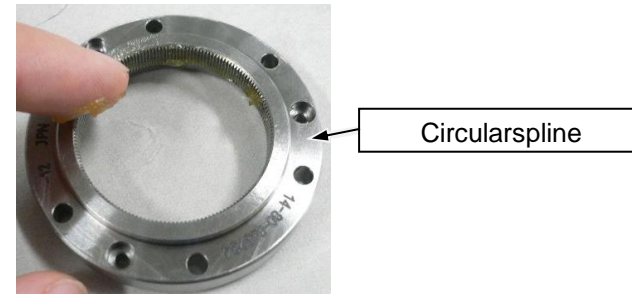
<Preparation>

1. Take the new Reduction Gear Unit out of the box, and check that the following parts are included.




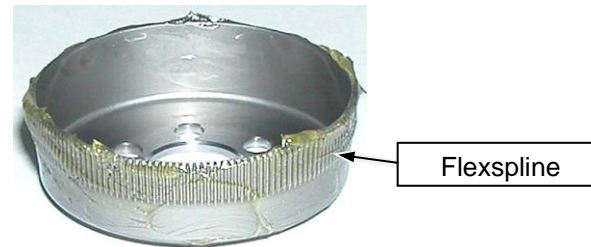
2. Apply grease around the entire gear surface of the Circularspline.

 SK-2: Apply enough grease to fill the grooves in the teeth in the Circularspline



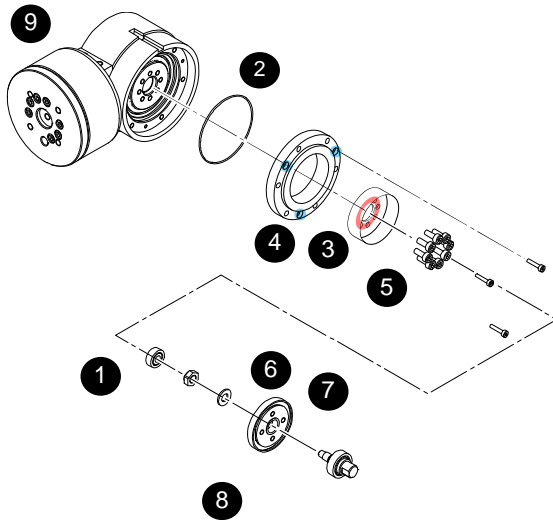
3. Apply grease around the entire gear surface of the Flexspline.

 SK-2A: Apply enough grease to fill the grooves in the teeth in the Flexspline

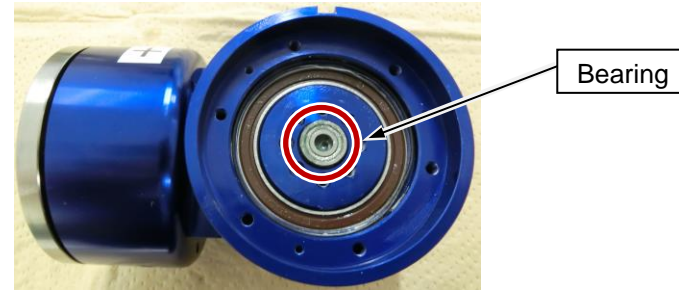


Joint #5

Installing the Reduction Gear Unit



1 Install the shaft end bearing removed from the Wave Generator on Arm5.

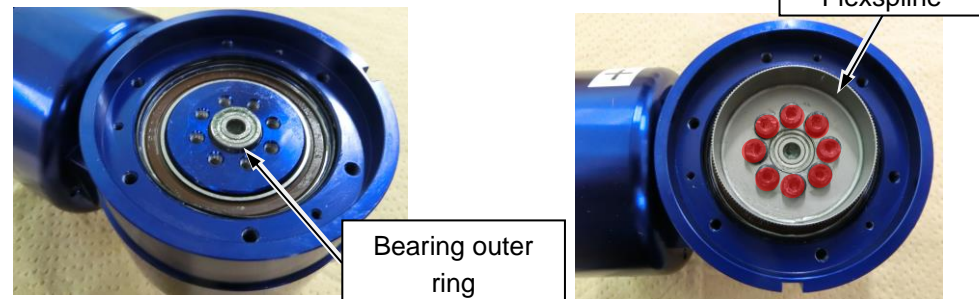


2 Install the O-ring (included with the J5 Reduction Gear) on the housing.



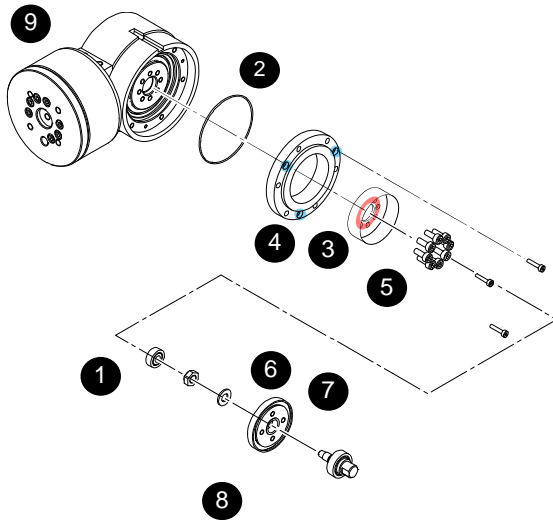
3 Install the Flexspline so that the hole on its inner side aligns with the bearing's outer ring.

A S01: 8-M3x8 (2.0 +/- 0.1 N·m)



Joint #5

Installing the Reduction Gear Unit



4 Install the Circularspline.


POINT

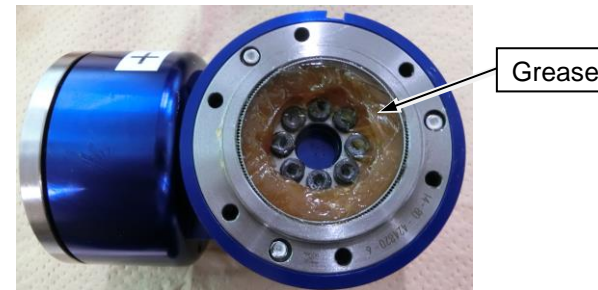
- Face the surface of the Circularspline with the engraved section toward you.
- Install the Circularspline by aligning the M2 female threads of the housing with the counterbored hole positions on the Circularspline.

A S01: 3-M2x10
(0.5 +/- 0.1 N·m)

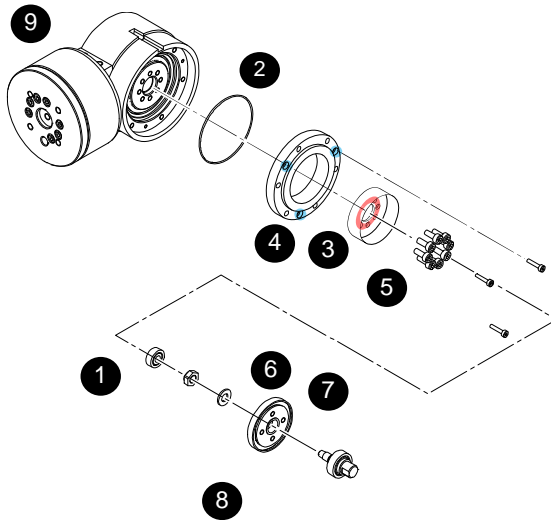


5 Apply grease to the inside of the Flexspline.

 SK-2: 3 g



Installing the Reduction Gear Unit



6

Install the Wave Generator on the J5 shaft unit.

1. Insert the Wave Generator into the shaft.

POINT

Insert so that the central, not-hollowed-out part is on the bearing side.

2. Insert the Wave Generator into the shaft.

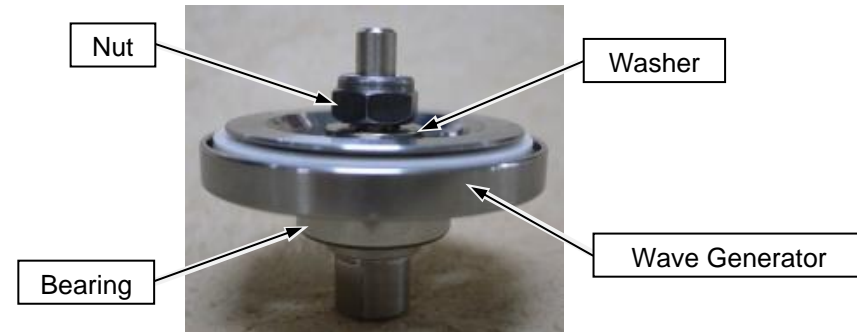
POINT

Insert so that the central, not-hollowed-out part is on the bearing side.

3. Install the washer and nut on the shaft.

POINT

Install the washer with the side without a step toward the shaft.



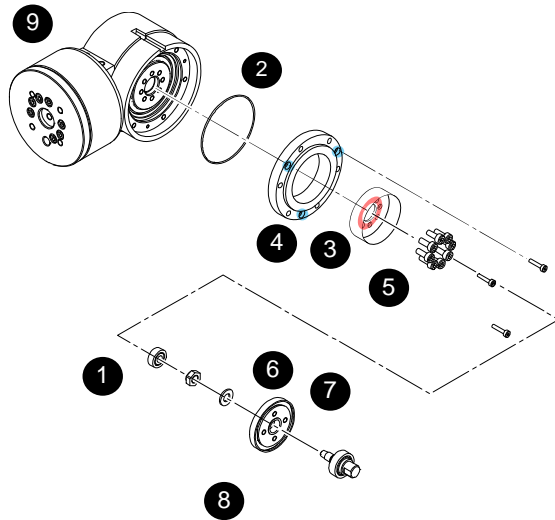
4. Place a vice or 7-mm spanner on two sides of the shaft to secure it, then tighten the nut with an 8 mm box wrench to secure the Wave Generator.

Tightening torque: 2.5 +/- 0.25 N·m




Joint #5

Installing the Reduction Gear Unit

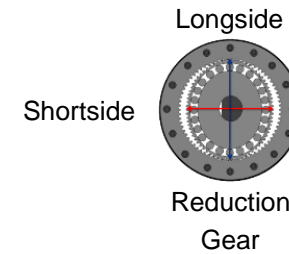


7 Apply grease to the bearing of the Wave Generator.

 SK-2: Apply enough grease to fill the ball gap



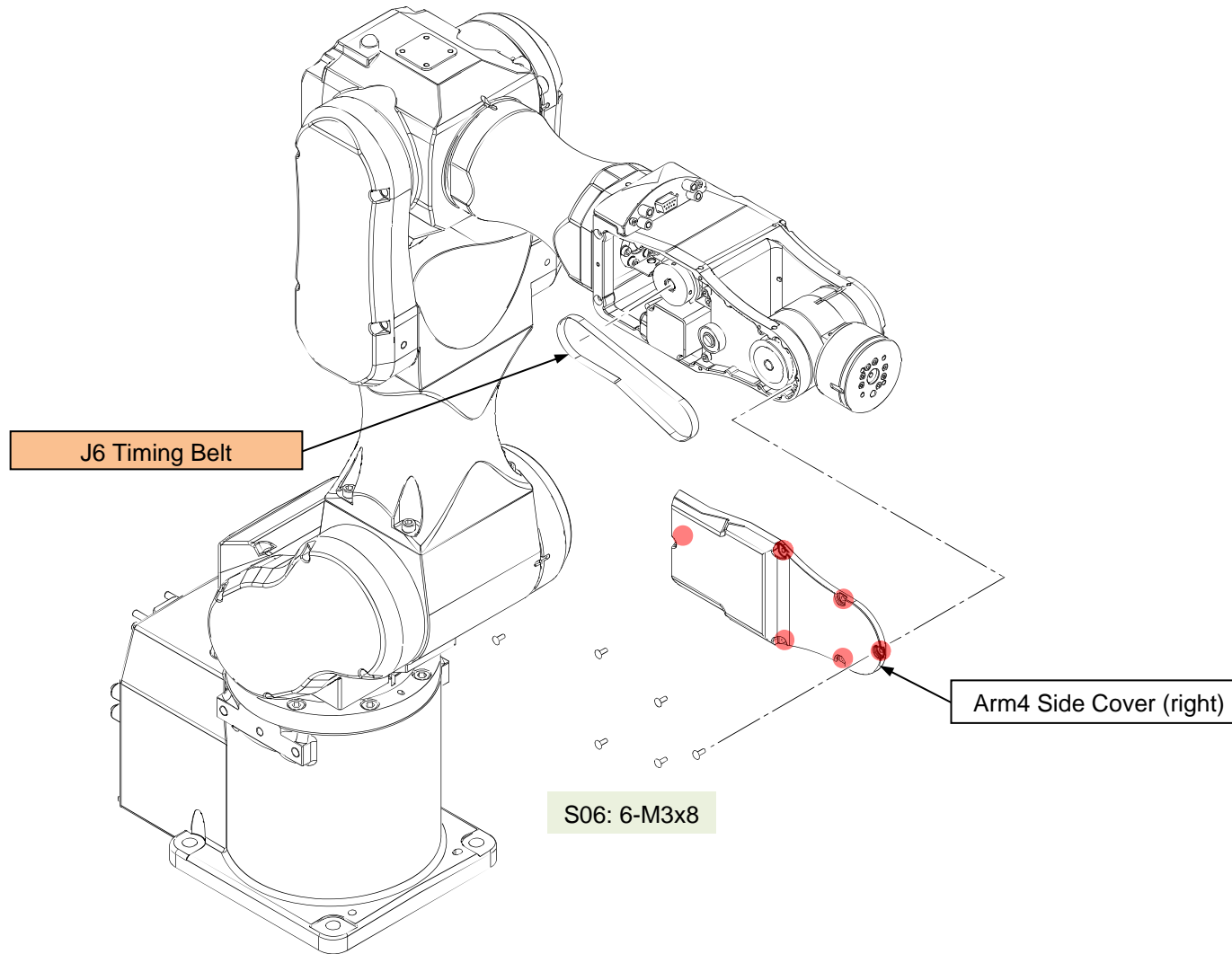
8 Align the axial direction of the Wave Generator and the Flexspline, and insert the Wave Generator unit.



9 Install the [Joint 5,6 Reduction Gear Unit](#).

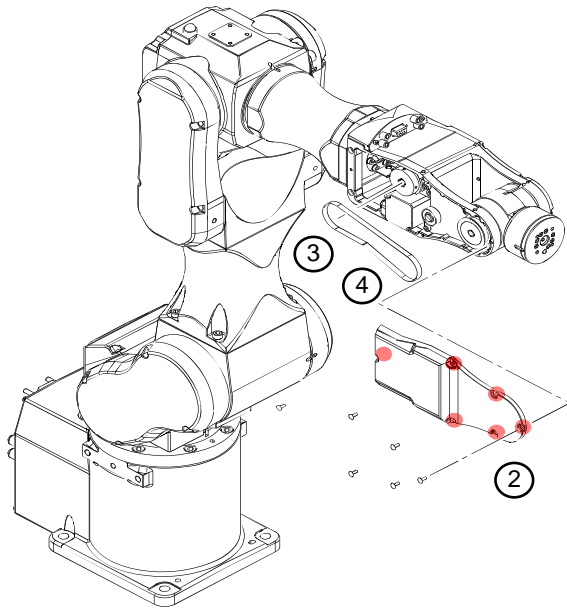
2.7 Joint #6

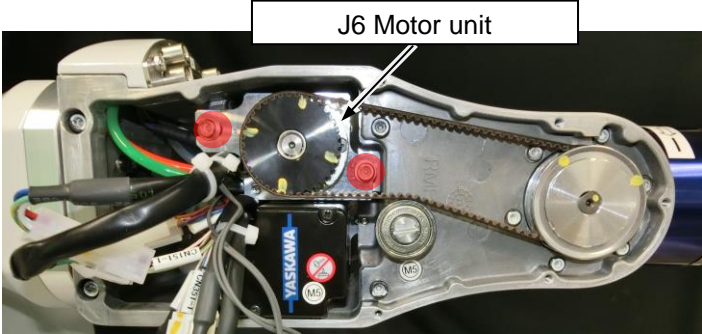
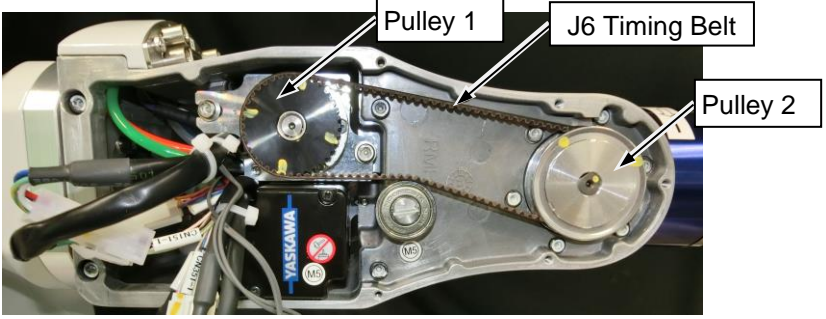
2.7.1 Joint #6 Replacing the Timing Belt



Joint #6

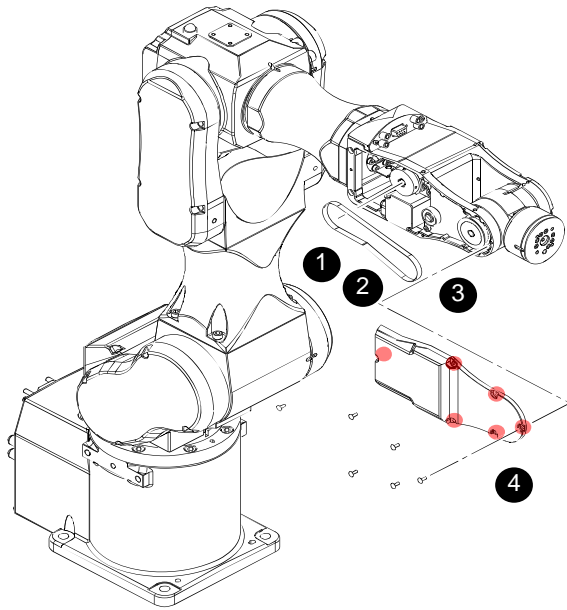
Removing the Timing Belt



①	Turn OFF the Controller.
②	Remove the Arm4 side cover (right).
③	<p>Loosen the screws securing the J6 Motor unit.</p> <p>A S01: 2-M4x15 and washer</p> 
④	<p>Remove the J6 Timing Belt.</p> <p>POINT First remove the Timing Belt from pulley 1, then from pulley 2.</p> 

Joint #6

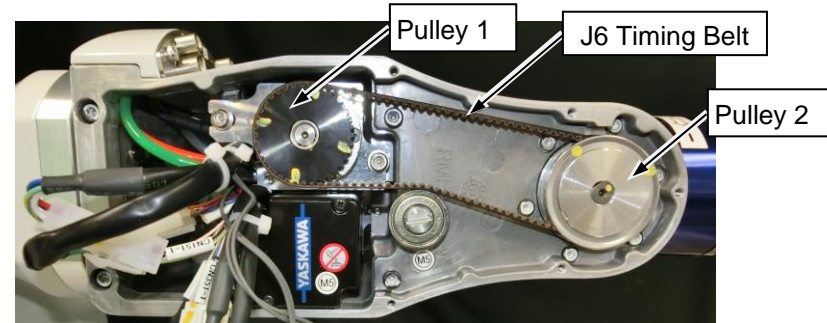
Installing the Timing Belt



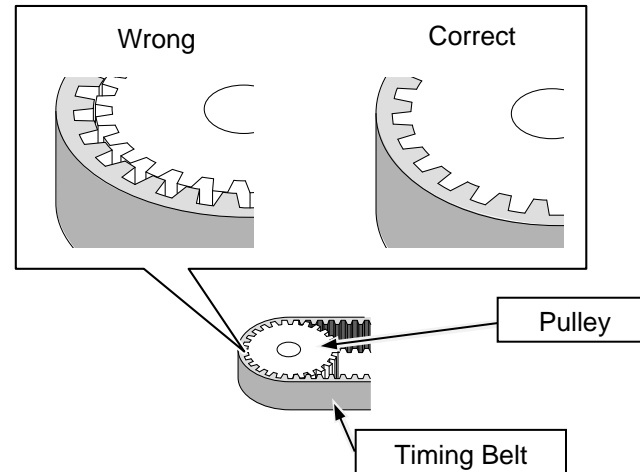
1 Install the J6 Timing Belt.

POINT

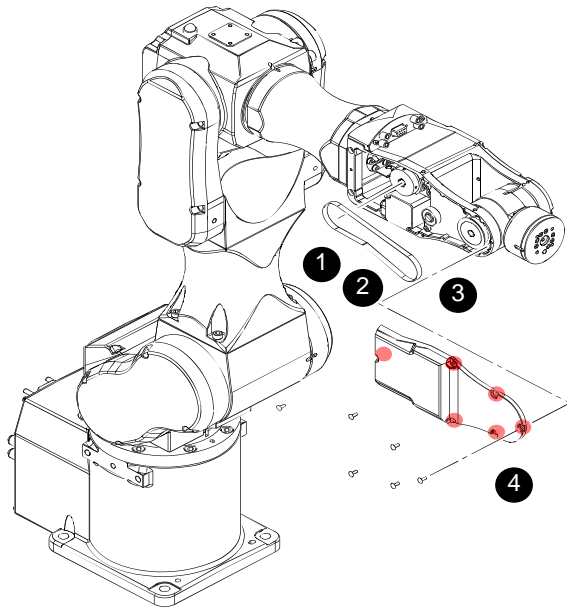
- First place the belt on pulley 1.



- Make sure that the teeth of the Timing Belt and the pulley are properly engaged.

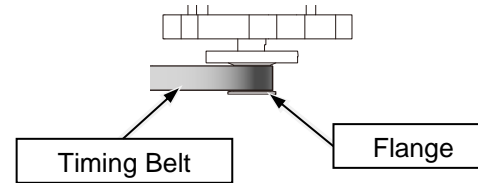


Installing the Timing Belt



CAUTION

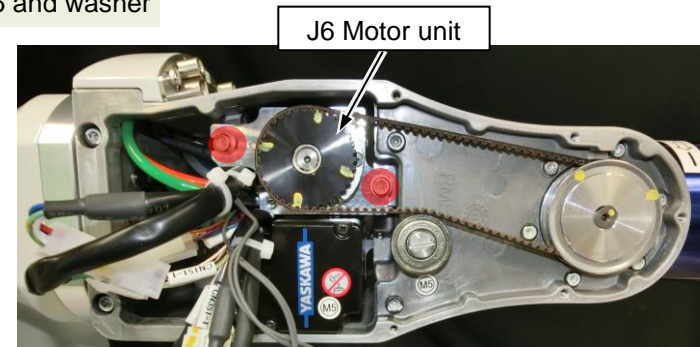
If the Timing Belt is placed on the flange, correct tension will not be obtained during belt tension adjustment.



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

2 Temporarily secure the J6 Motor unit.

A S01: 2-M4x15 and washer

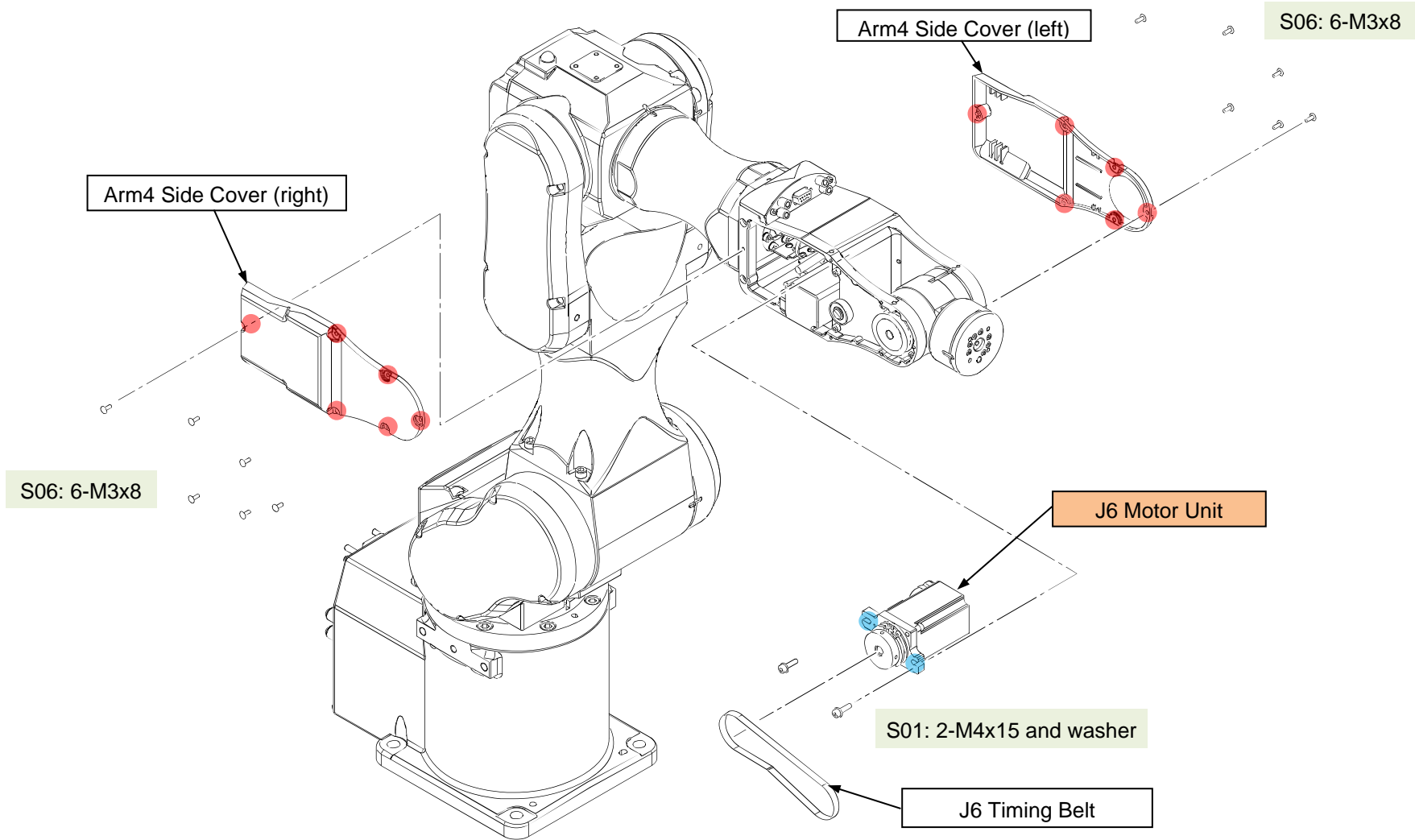


3 Adjust the belt tension.
[3.1 Adjusting the Timing Belt Tension](#)

4 Install the [Arm4 side cover](#).

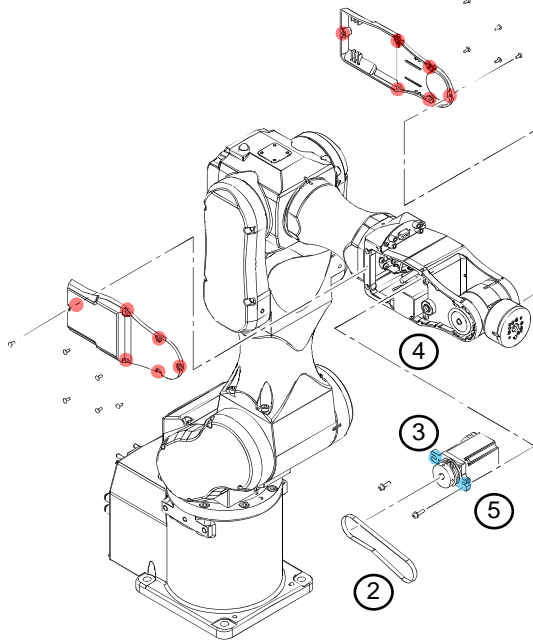
5 After assembly, perform calibration of Joint #6.
[3.2 Calibration](#)


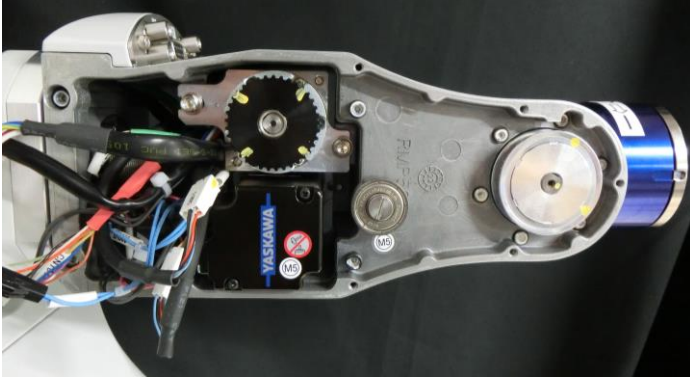
2.7.2 Joint #6 Replacing the Motor Unit



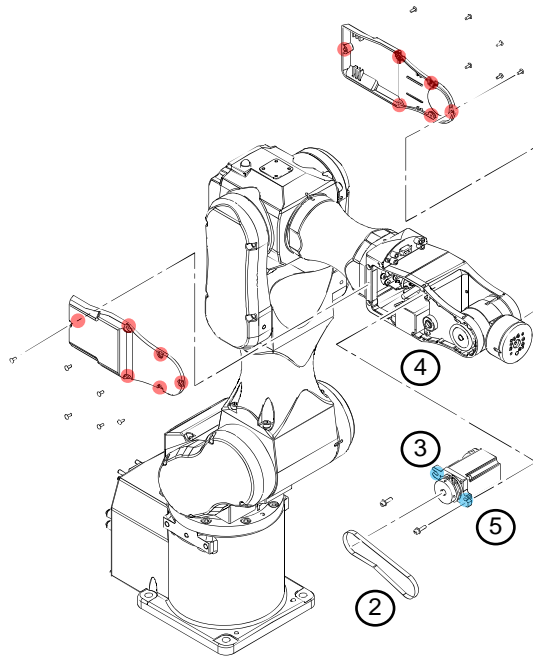
Joint #6

Removing the Motor Unit



①	Turn OFF the Controller.
②	Remove the J6 Timing Belt .
③	Cut the wire ties (AB100) binding the motor cables.
 <p>Wire tie (AB100)</p> <p>Wire tie (AB100)</p>	
④	Disconnect the J6 Motor Connectors (CN161, CN361, BR063).
	

Removing the Motor Unit



⑤

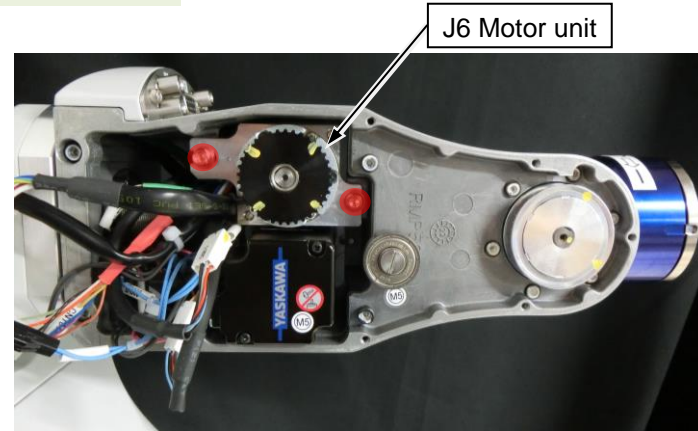
Remove the loosened screws, then remove the J6 Motor unit from Arm4.

CAUTION

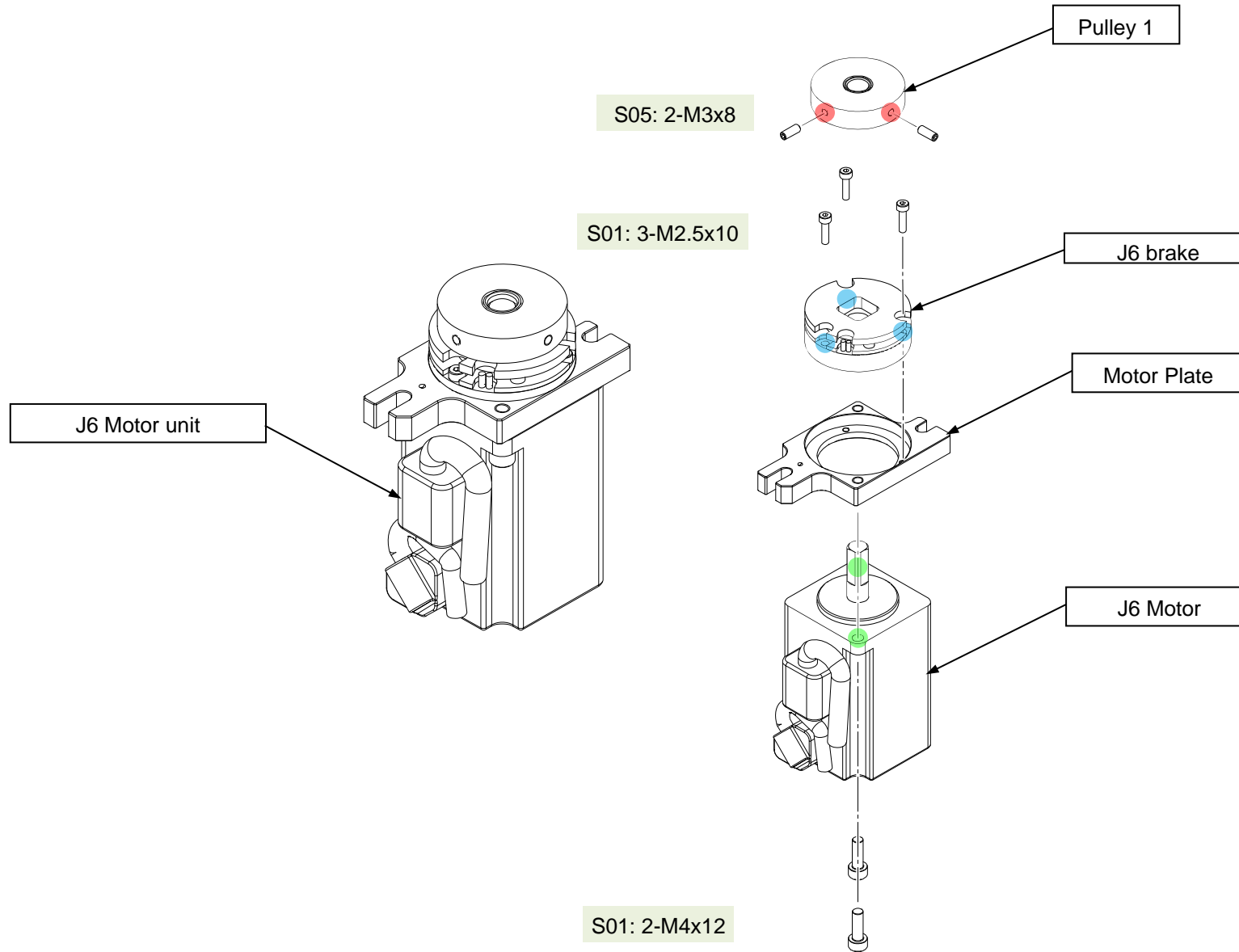
Remove while checking that the removed connectors are not catching on other cables.

A

S01: 2-M4x15 and washer

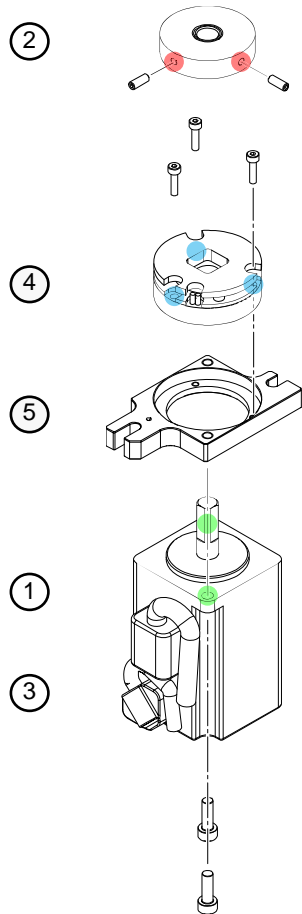


Motor Unit Disassembly



Joint #6

Motor Unit Disassembly

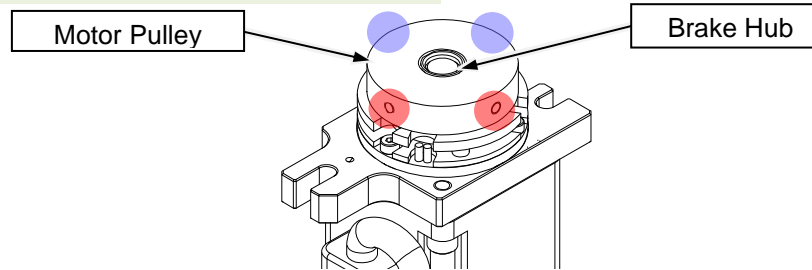


① Remove the [J6 Motor unit](#).

② Remove the Motor Pulley and the Brake Hub.

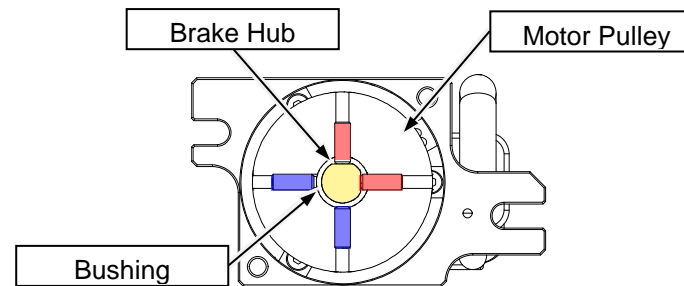
A For securing the pulley and shaft
S05: 2-M3x8

B For securing the pulley and Brake Hub
S05: 2-M3x8 (Brass bushing x 1)



POINT

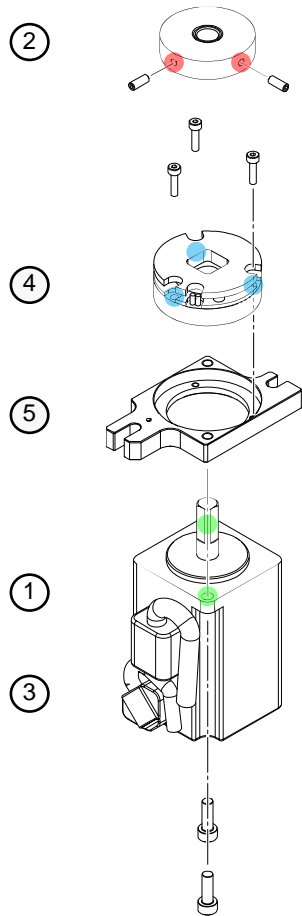
It may not be possible to remove the Brake Hub and Motor Pulley simply by loosening screws (A). In this case, also loosen screws (B).



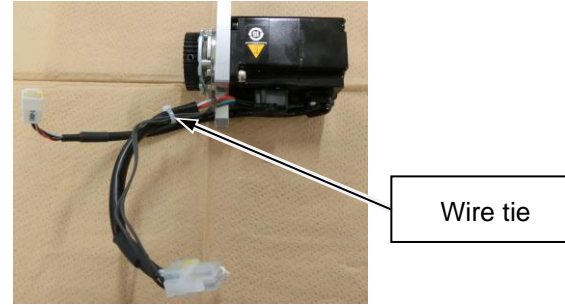
CAUTION

A brass bushing is included on one of the screws (B). When removing the part, be careful not to drop and lose the bushing.

Motor Unit Disassembly

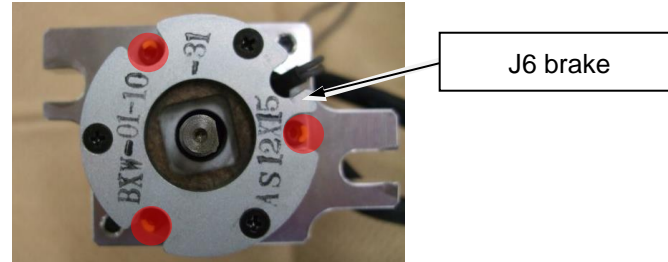


③ Cut the wire tie binding the cables.



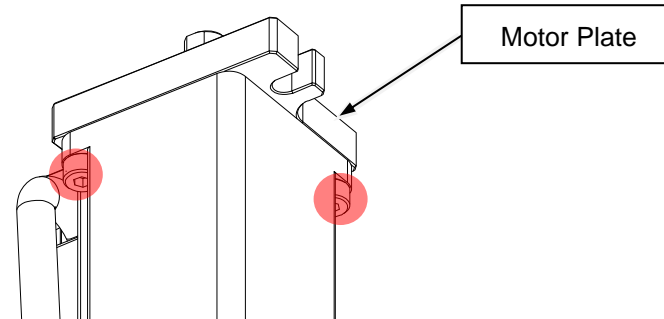
④ Remove the J6 brake.

A S01: 3-M2.5x10

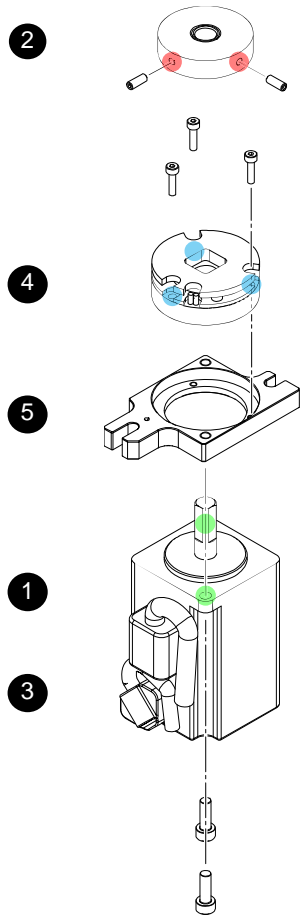


⑤ Remove the Motor Plate from the J6 Motor.

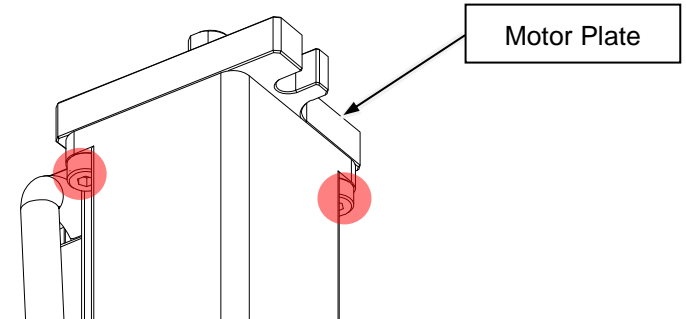
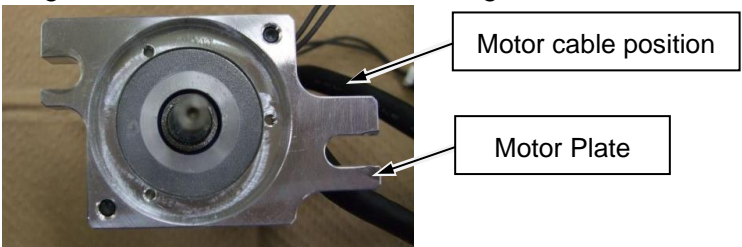
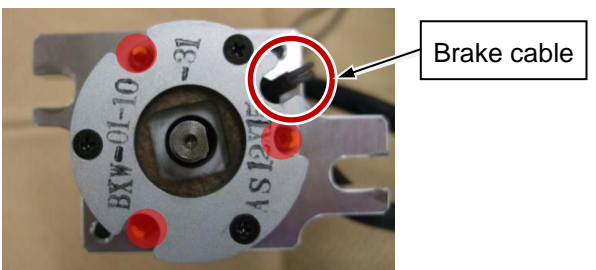
A S01: 2-M4x12



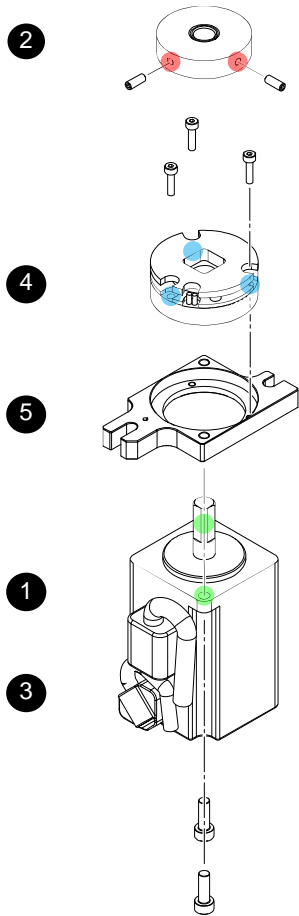
Motor Unit Assembly



Joint #6

<p>1</p>	<p>Install the Motor Plate.</p> <p>A S01: 2-M4x12 (4.0 +/- 0.2 N·m)</p> <p>POINT Attach the Motor Plate according to the orientation shown in the figure.</p>  
<p>2</p>	<p>Install the J6 electromagnetic brake.</p> <p>A S01: 3-M2.5x10 (1.0 +/- 0.1 N·m)</p> <p>POINT Install the brake in the orientation shown in the figure.</p> 

Motor Unit Assembly



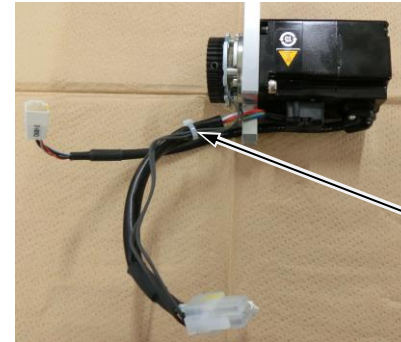
3

Bind the Motor Power cable and brake cable using the wire tie (AB100).

Binding position

CN361: Approx. 140 mm from the connector end

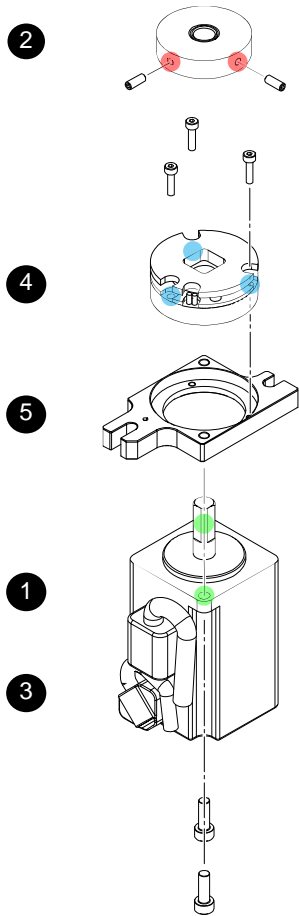
CN161: Approx. 160 mm from the connector end



Wire tie (AB100)

Joint #6

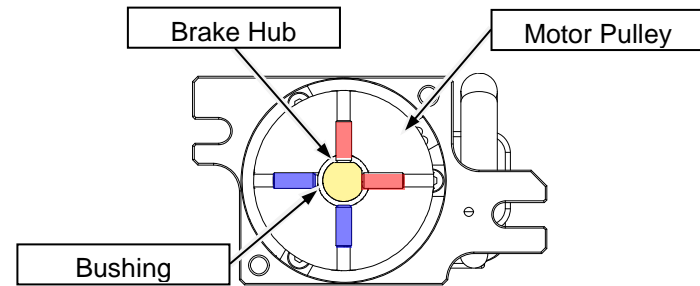
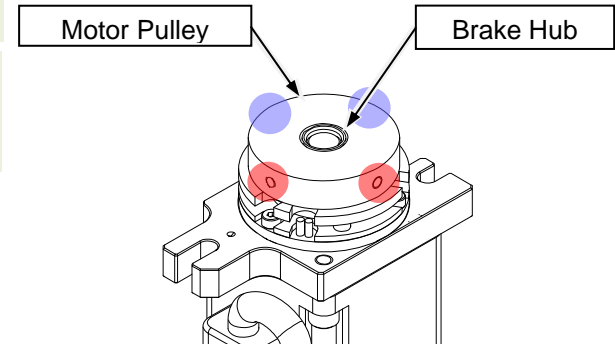
Motor Unit Assembly



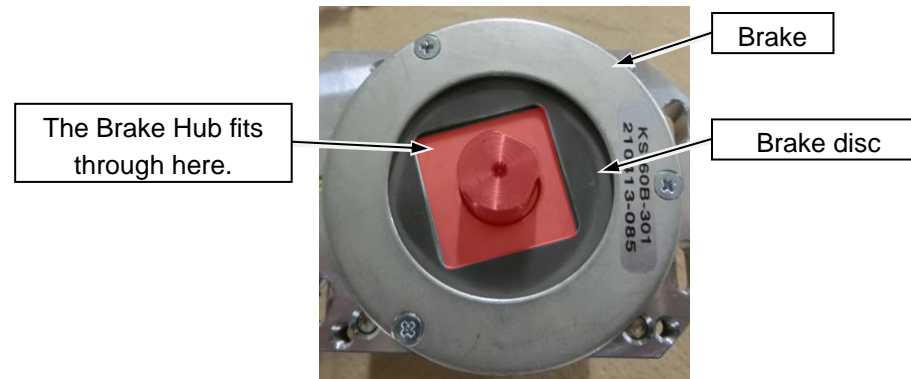
4

Install the Brake Hub and Motor Pulley on the J5 Motor unit.

- A For securing the pulley and shaft
S05: 2-M3x8 (0.9 +/- 0.1 N·m)
- B For securing the pulley and Brake Hub
S05: 2-M3x8 (Brass bushing x 1)
(0.9 +/- 0.1 N·m)

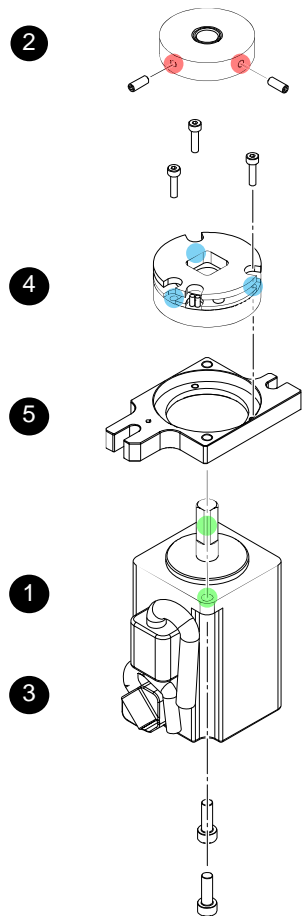


- Align the Brake Hub and brake disc positions, and install the Brake Hub on the motor shaft. If they are misaligned, adjust the brake disc position.

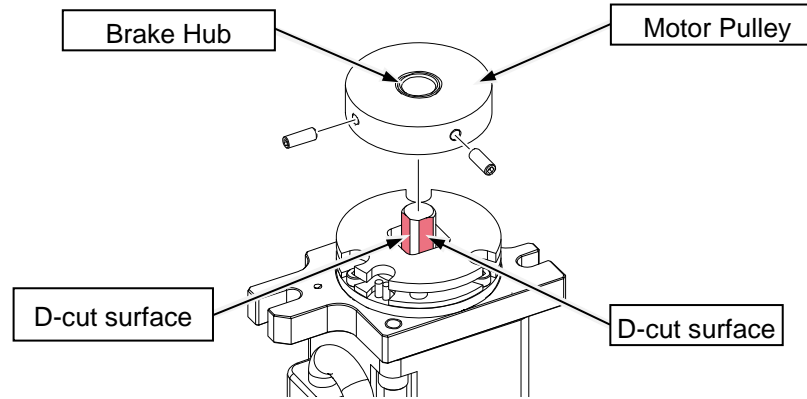


Joint #6

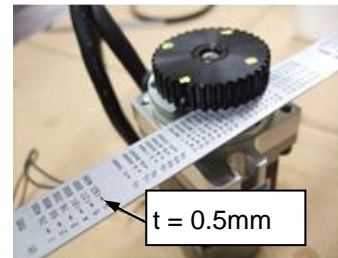
Motor Unit Assembly



- Align the motor shaft D-cut surface with the screw holes, and install the Motor Pulley.



- Place a feeler gauge (0.5 mm) between the Motor Pulley and the brake, to ensure a 0.5-mm gap during installation.

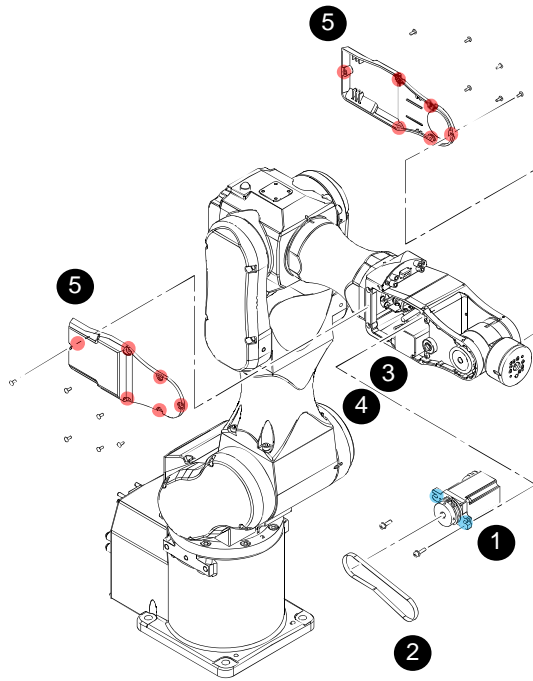


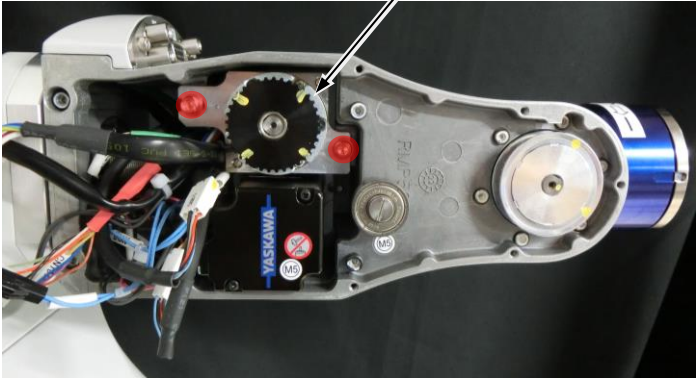
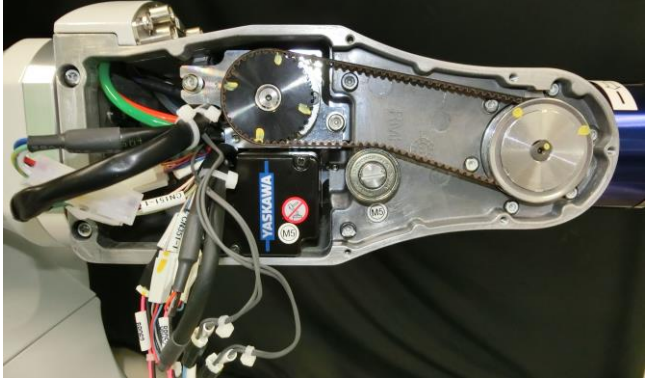
CAUTION

Failure to create a proper gap between the Motor Pulley and the brake may cause the parts to rub during motor operation, causing a malfunction.

- 5 Install the [J6 Motor unit](#).

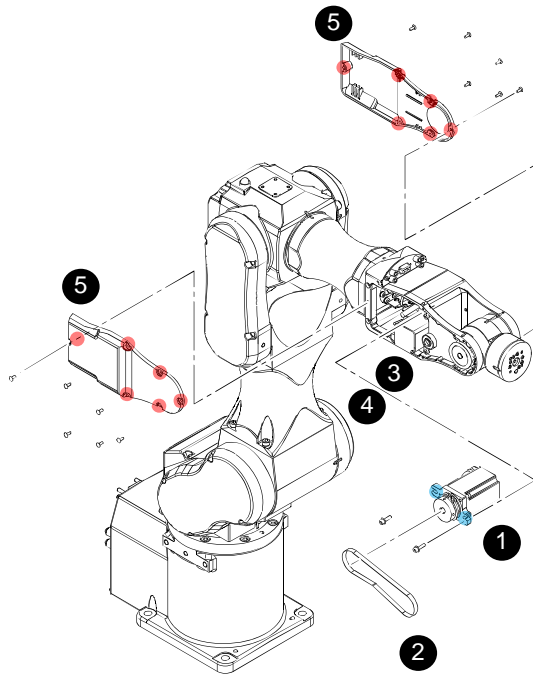
Installing the Motor Unit



<p>1</p>	<p>Insert the J6 Motor unit into Arm4, and temporarily secure the Motor Unit.</p> <p>A S01: 2-M4x15 and washer (4.0 +/- 0.2 N·m)</p> 
<p>2</p>	<p>Install the J6 Timing Belt.</p> <p>POINT Perform steps 1 to 3.</p>
<p>3</p>	<p>Connect the J6 Motor Connectors (CN161, CN361, BR063).</p> 

Joint #6

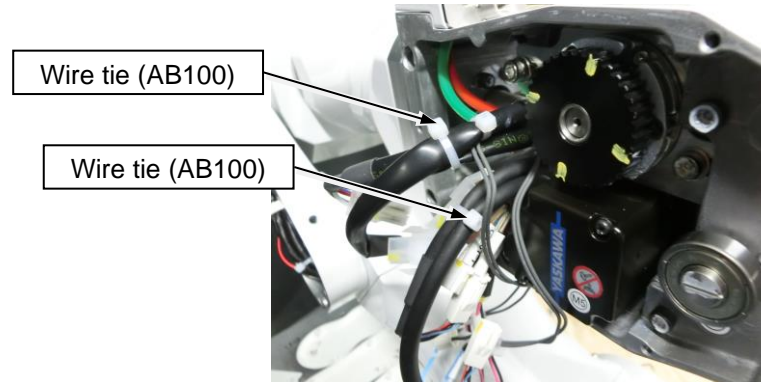
Installing the Motor Unit



4

Bind the following cables using wire ties (AB100).

- CN151 and CN161
Wire tie position
CN151: Approx. 90 mm from the connector end
CN161: Approx. 120 mm from the connector end
- CN351 and CN361
Wire tie position
CN351: Approx. 130 mm from the connector end
CN361: Approx. 80 mm from the connector end



5

Install the [Arm4 side cover](#).

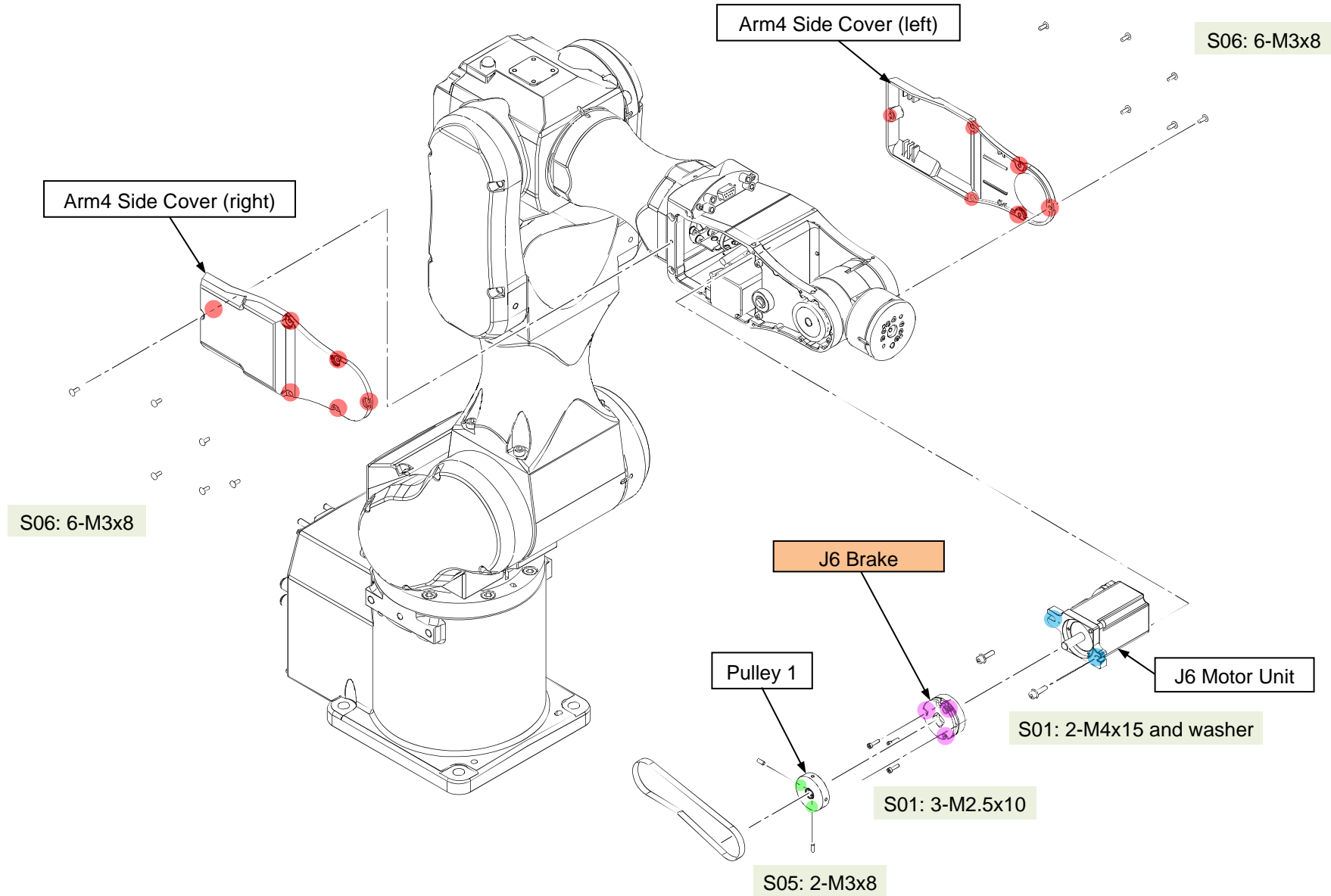
6

After assembly, perform calibration of Joint #6.

[3.2 Calibration](#)

Joint #6

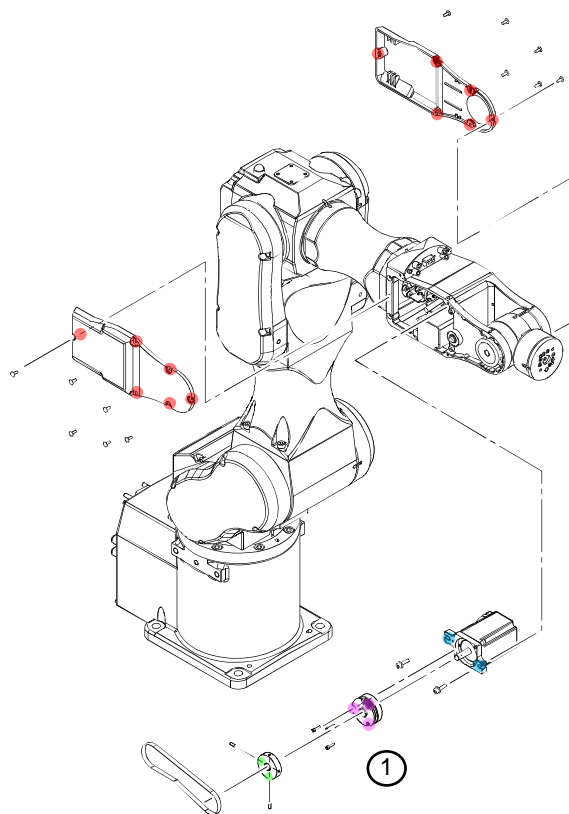
2.7.3 Joint #6 Replacing the Brake



Joint #6

Removing the Brake

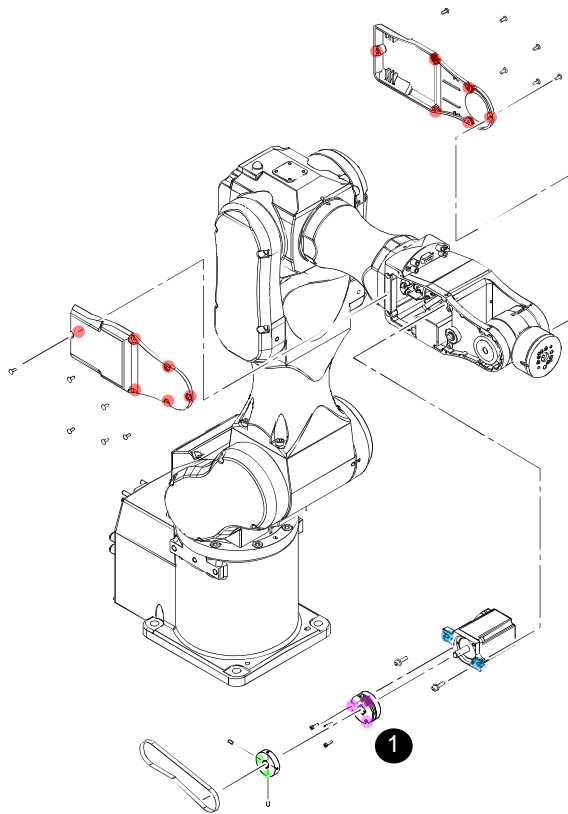
- | | |
|---|---|
| ① | Refer to J6 Motor Unit Disassembly and remove the J6 brake. |
|---|---|



Joint #6

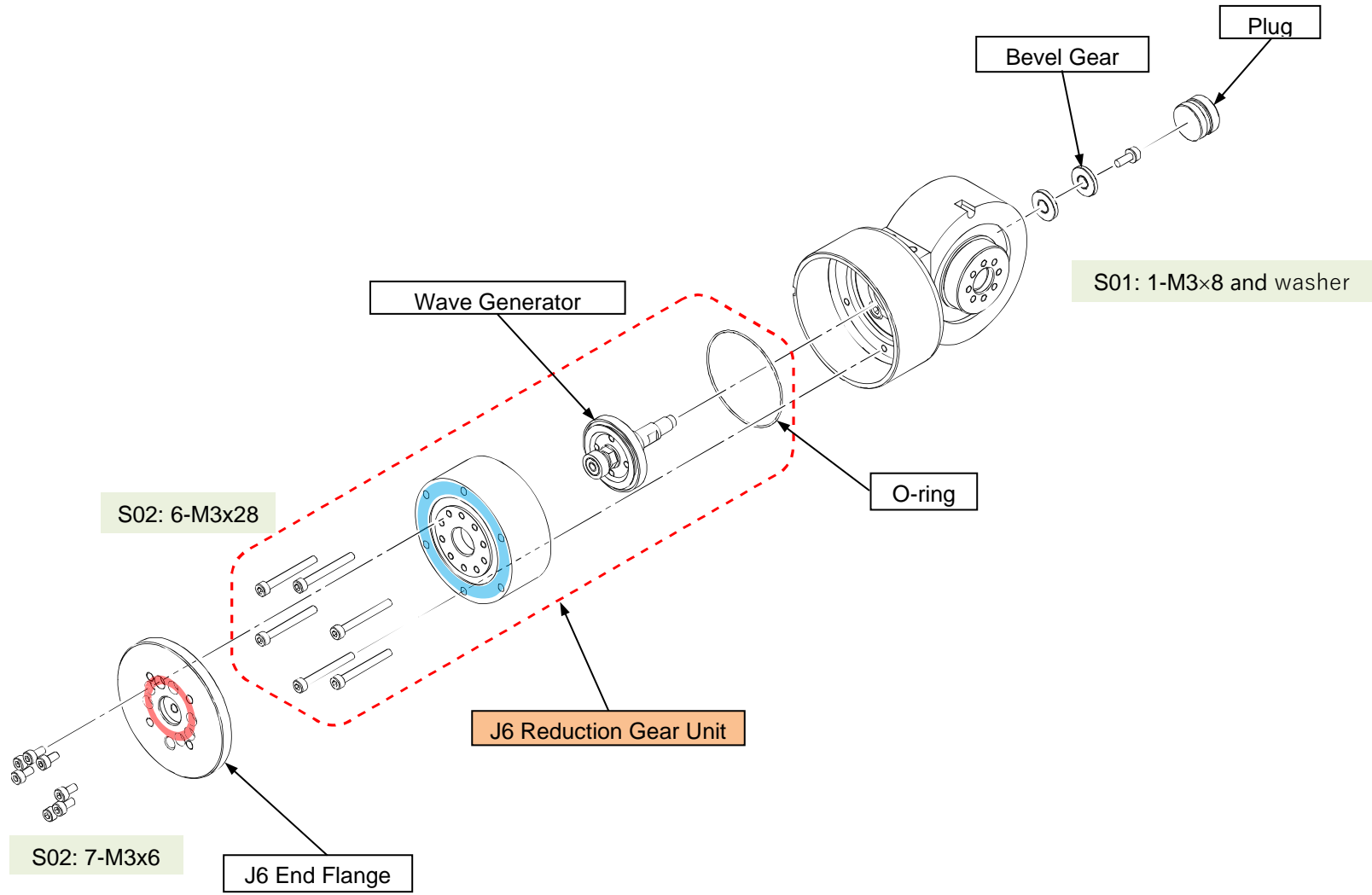
Installing the Brake

- | | |
|----------|---|
| 1 | Refer to J6 Motor Unit Assembly and install the J6 brake. |
|----------|---|



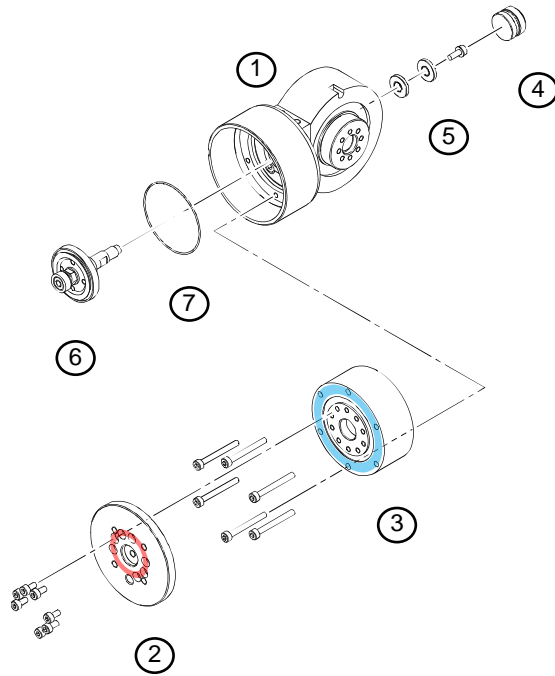
Joint #6

2.7.4 Joint #6 Replacing the Reduction Gear Unit

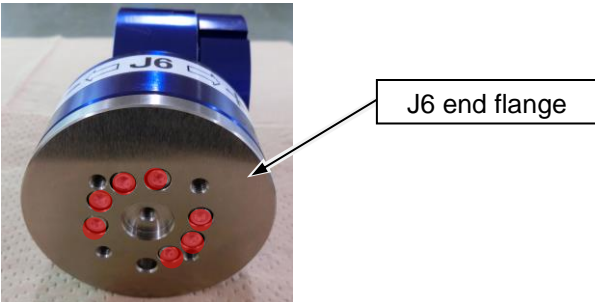




Joint #6

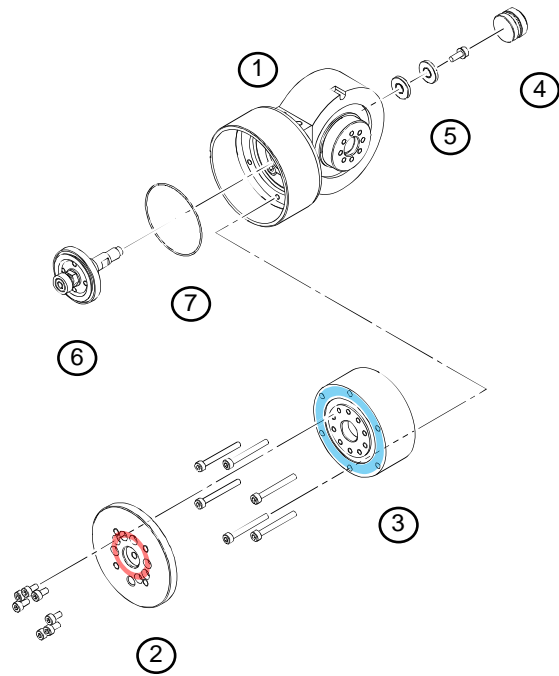
Removing the Reduction Gear Unit



Joint #6

①	Remove the Joint 5,6 Reduction Gear Unit
②	<p>Remove the J6 end flange.</p> <p>A S02: 7-M3x6</p> 
③	<p>Remove the J6 Reduction Gear from Arm5.</p> <p>1. Remove the screws securing the J6 Reduction Gear.</p> <p>A S02: 6-M3x28</p>  <p>2. Install the screws (recommended: M3x15 or longer) in the screw holes shown in the figure, and pull out the Reduction Gear.</p> 

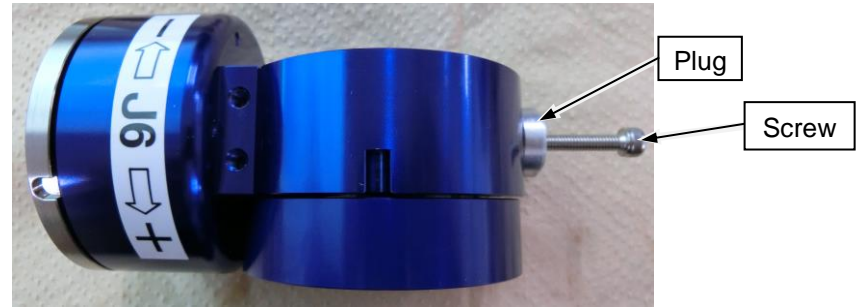
Removing the Reduction Gear Unit



④ Remove the plug from Arm5.

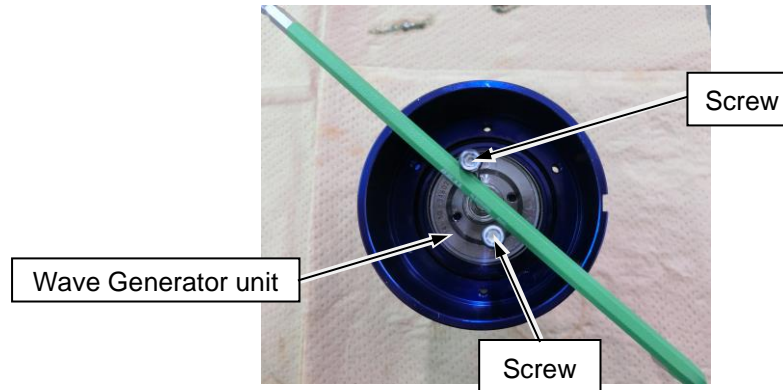
POINT

Install the screw (recommended: M4x15 or longer) in the plug screw hole, and pull out the plug.



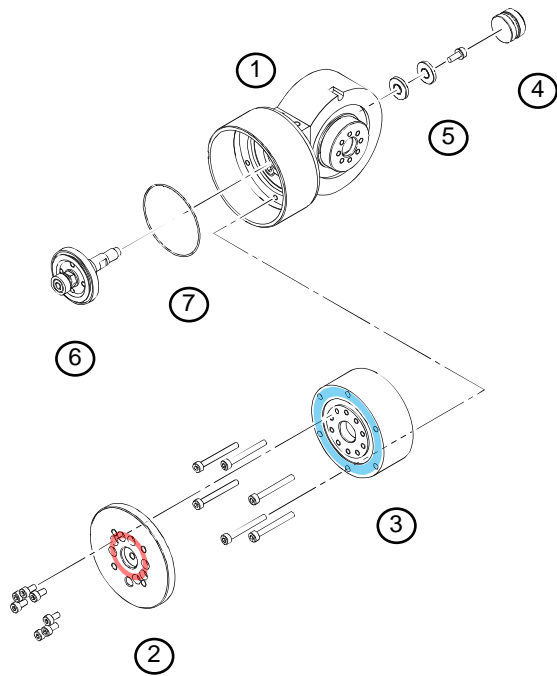
⑤ Remove the bevel gear.

1. Install the screws (recommended: M3x28 or longer) in the screw holes as shown in the figure to hold the Wave Generator to prevent it from rotating.



Joint #6

Removing the Reduction Gear Unit

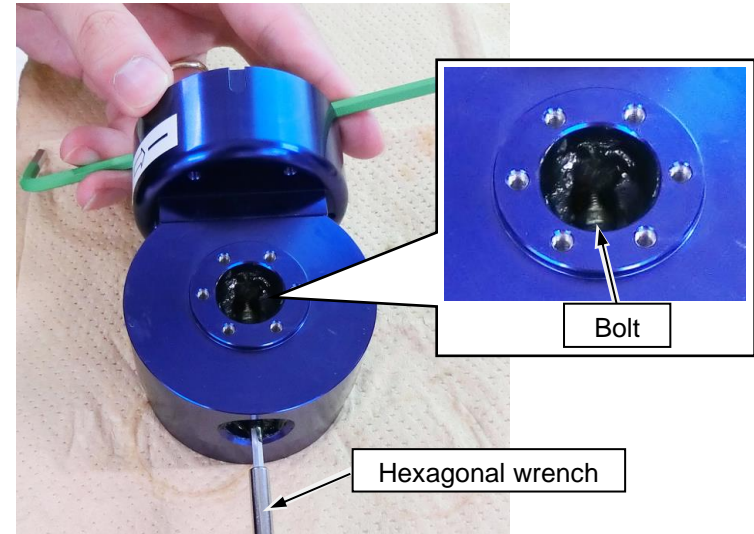


2. Insert a hexagonal wrench through the Arm5 plug hole, and remove the bolt (S01) securing the bevel gear.

CAUTION

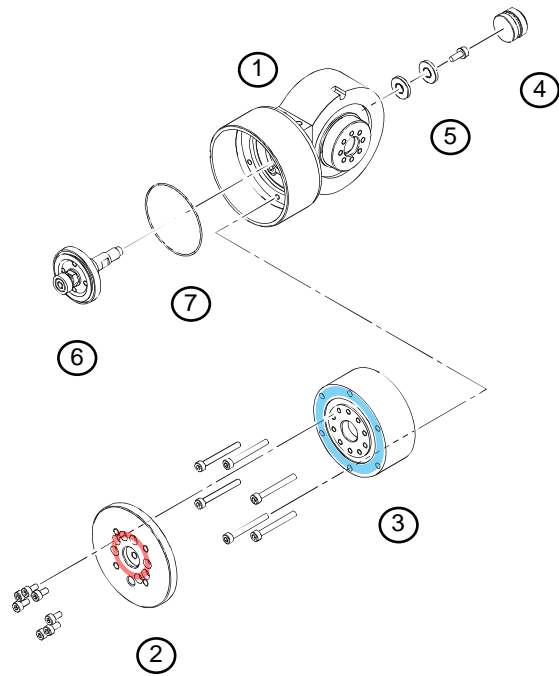
The washer will be used again during installation. Be careful not to lose it.

A S01: 1-M3x8 and washer



Joint #6

Removing the Reduction Gear Unit



⑥ Remove the Wave Generator unit from Arm5.



POINT

Insert a hexagonal wrench through the Arm5 plug hole, push the Wave Generator unit shaft, and push the Wave Generator out of Arm5.

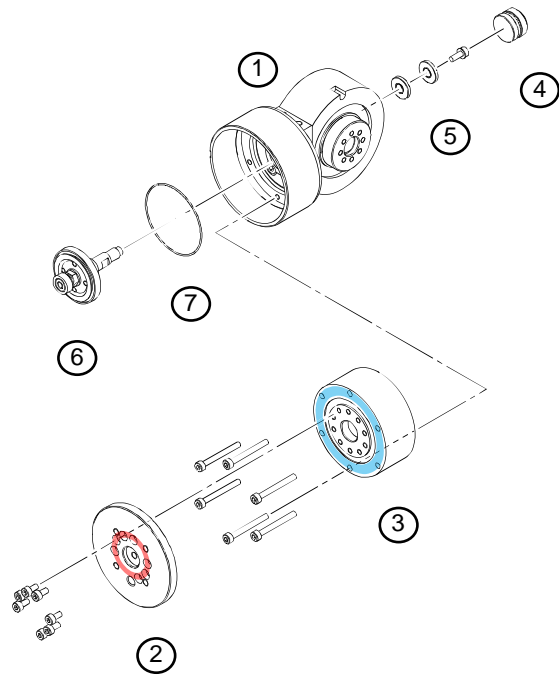
Recommended: M2.5 hexagonal wrench



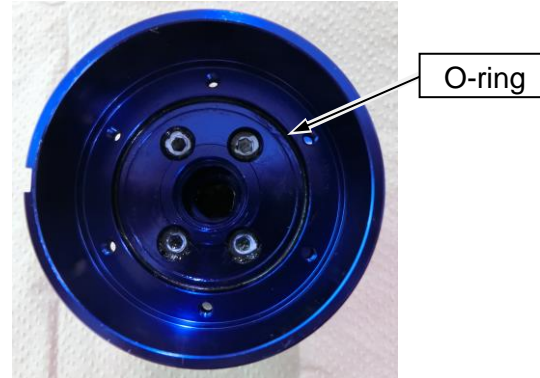
CAUTION

The bearing may not fit into the removed Wave Generator end. In these cases, check that it fits into the Reduction Gear side.

Removing the Reduction Gear Unit

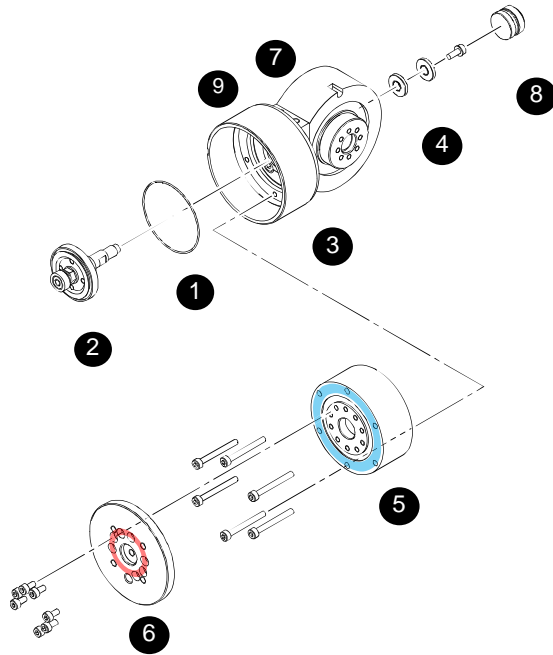


⑦ Remove the O-ring from Arm5.



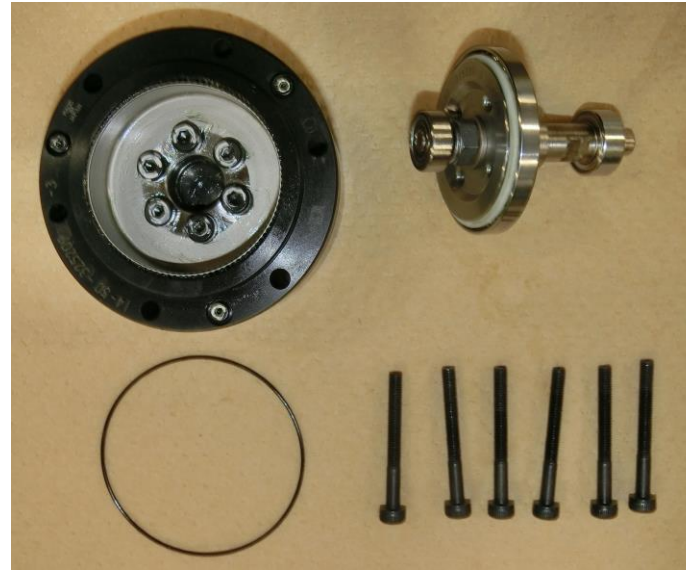
Joint #6

Installing the Reduction Gear Unit



<Preparation>

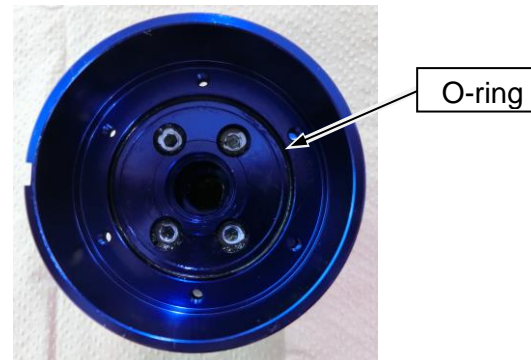
Take the new Reduction Gear Unit out of the box, and check that the following parts are included.



- 1 Install the O-ring on Arm5.

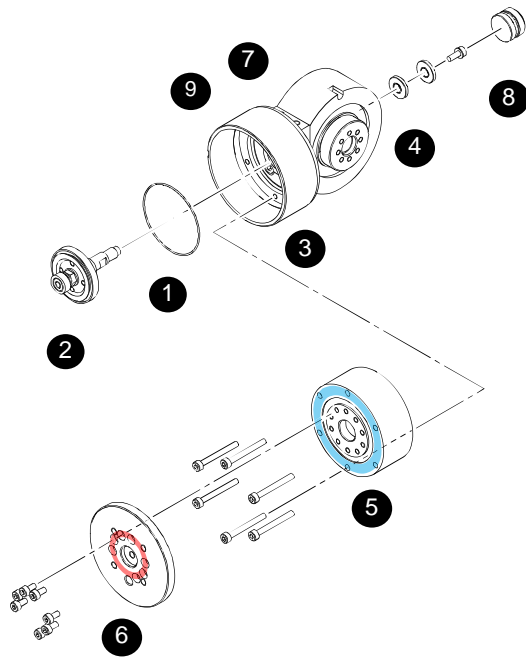
POINT

When replacing the Reduction Gear Unit, use the O-ring included with the Reduction Gear Unit.



Joint #6

Installing the Reduction Gear Unit

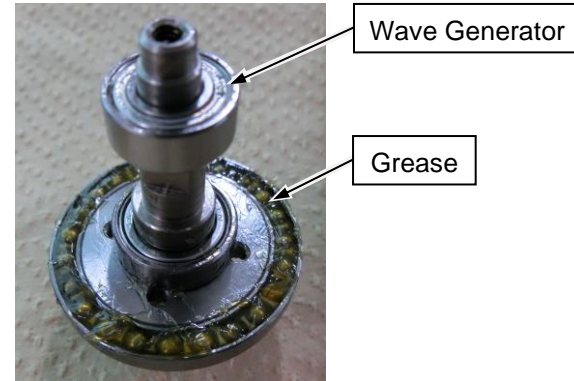


2

Apply grease to the bearing of the Wave Generator.

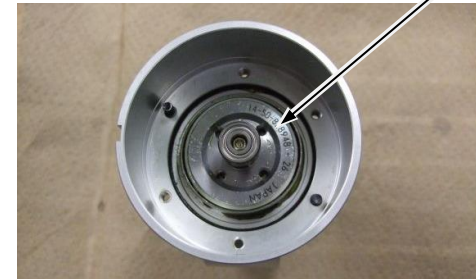


SK-2: Apply enough grease to fill the ball gap



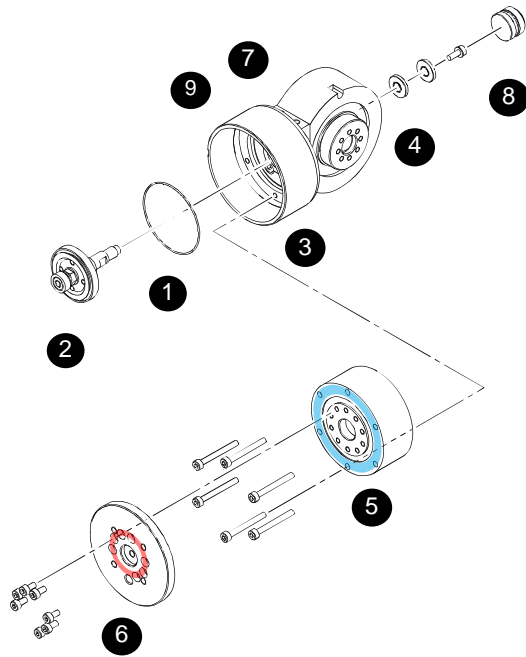
3

Insert the Wave Generator unit into Arm5, and install.



Joint #6

Installing the Reduction Gear Unit



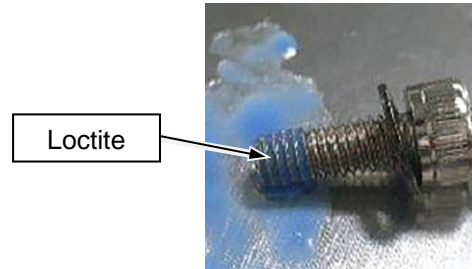
4

Install the bevel gear.

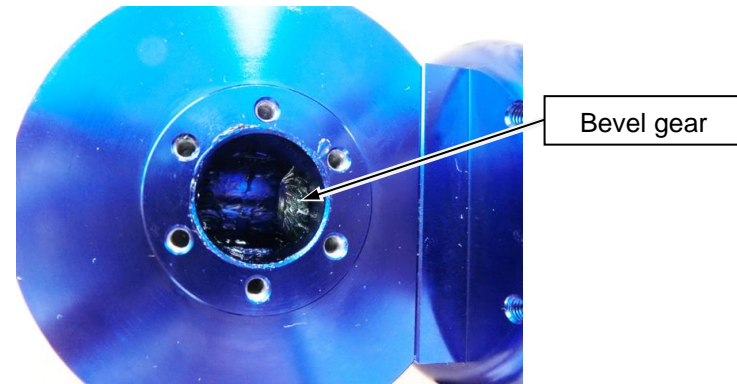
1. Pass the bolt securing the bevel gear to the shaft through the washer, and apply Loctite 242.

POINT

Apply to five threads from the bolt end.

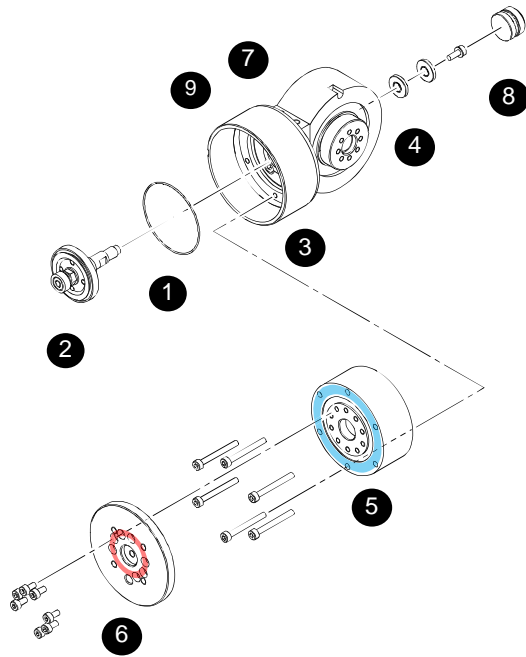


2. Install the bevel gear on the Wave Generator unit end.

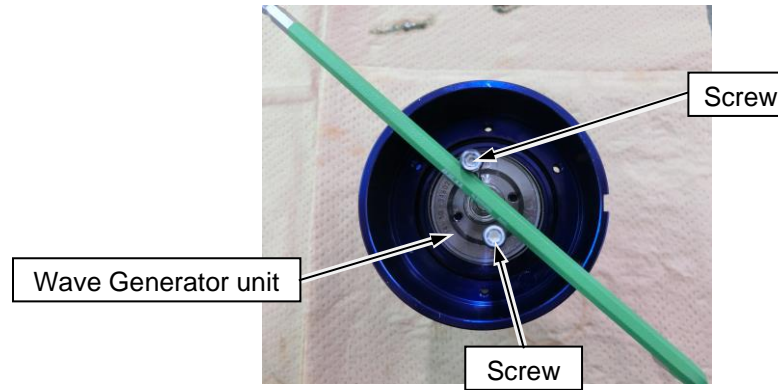


Joint #6

Installing the Reduction Gear Unit

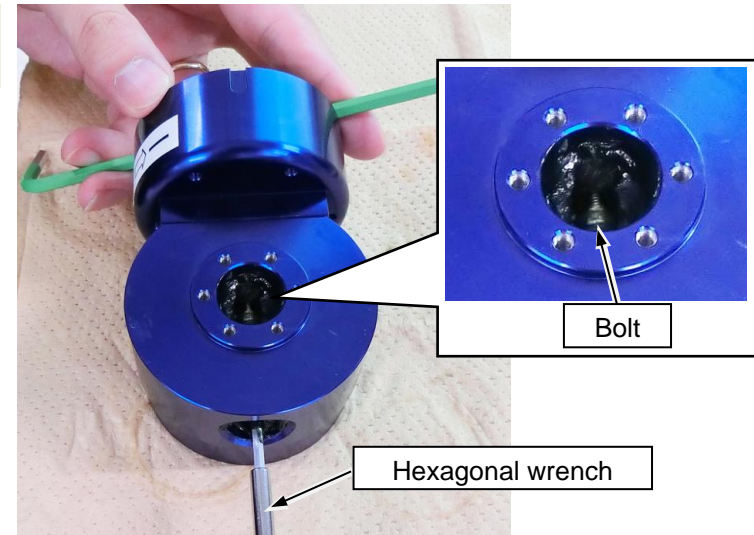


3. Install the screws (recommended: M3x28 or longer) in the screw holes as shown in the figure to hold the Wave Generator to prevent it from rotating.



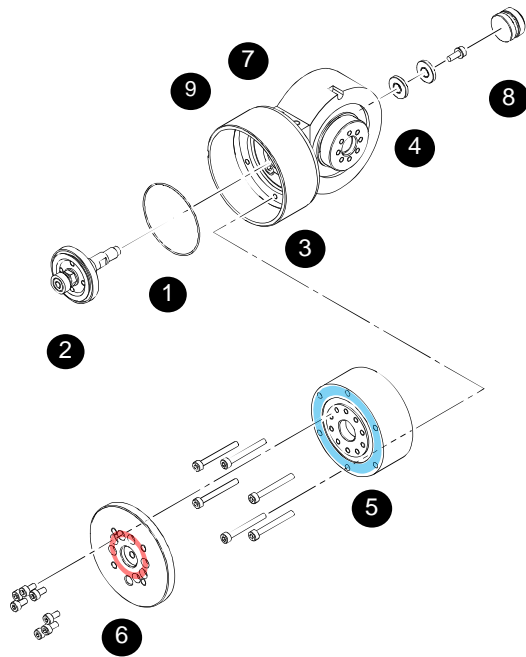
4. Insert a hexagonal wrench through the Arm5 plug hole, and tighten the bolts.

A S01: 1-M3x8 and washer
(2.0 +/- 0.1 N·m)



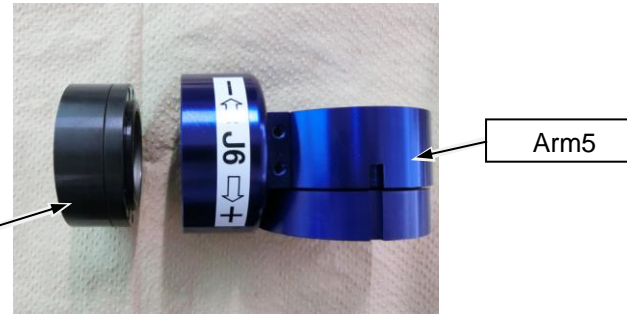
Joint #6

Installing the Reduction Gear Unit



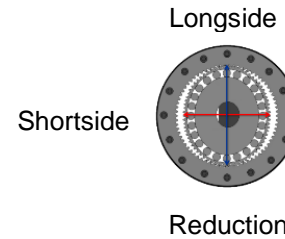
5 Install the J6 Reduction Gear on Arm5.

A S02: 6-M3x28
(2.4 +/- 0.1 N·m)



POINT

Align the longside of the Wave Generator and Flexspline, and install the Reduction Gear.

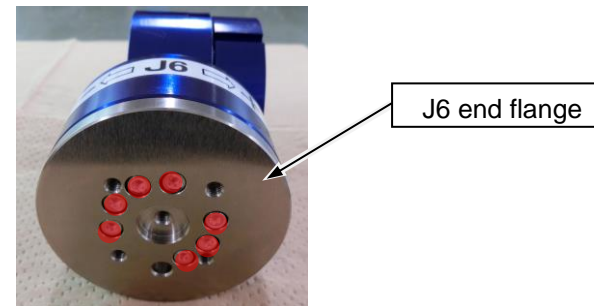


6 Install the J6 end flange.

CAUTION

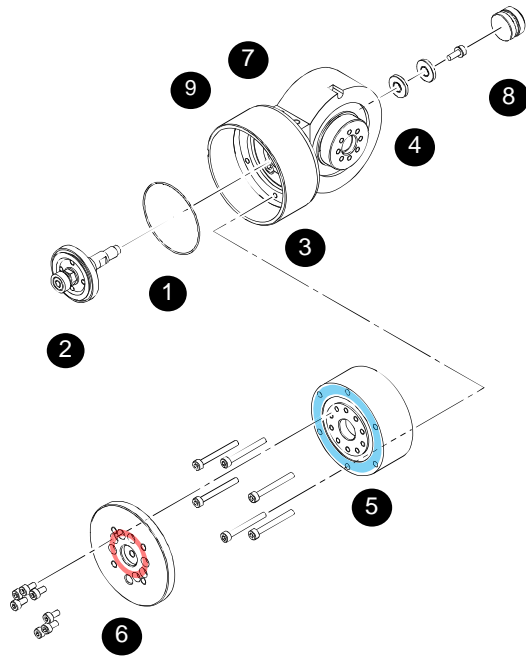
When Arm5 is removed from the Manipulator, applying torque may be difficult. After installing on Arm4, check that this is at the specified torque.

A S02: 7-M3x6
(2.0 +/- 0.1 N·m)




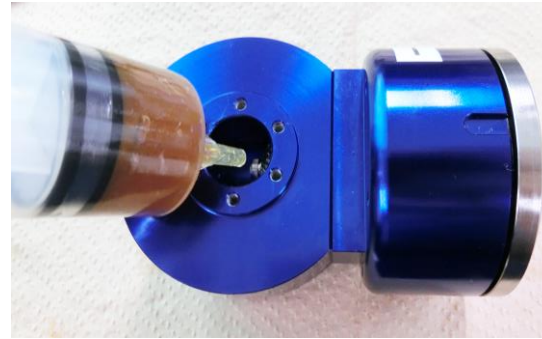
Joint #6

Installing the Reduction Gear Unit



7 Apply grease around the bevel gear.

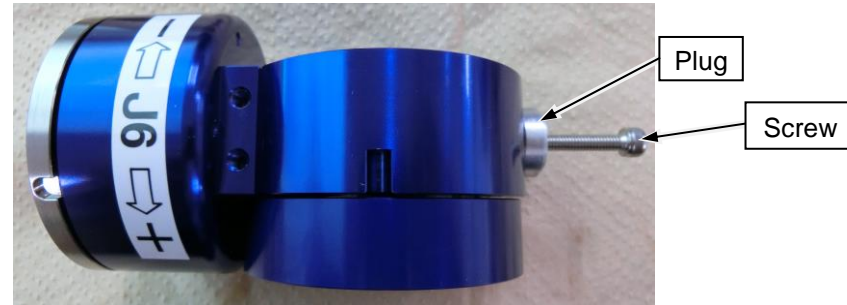
 SK-2: 2 g



8 Insert the plug into Arm5.

POINT

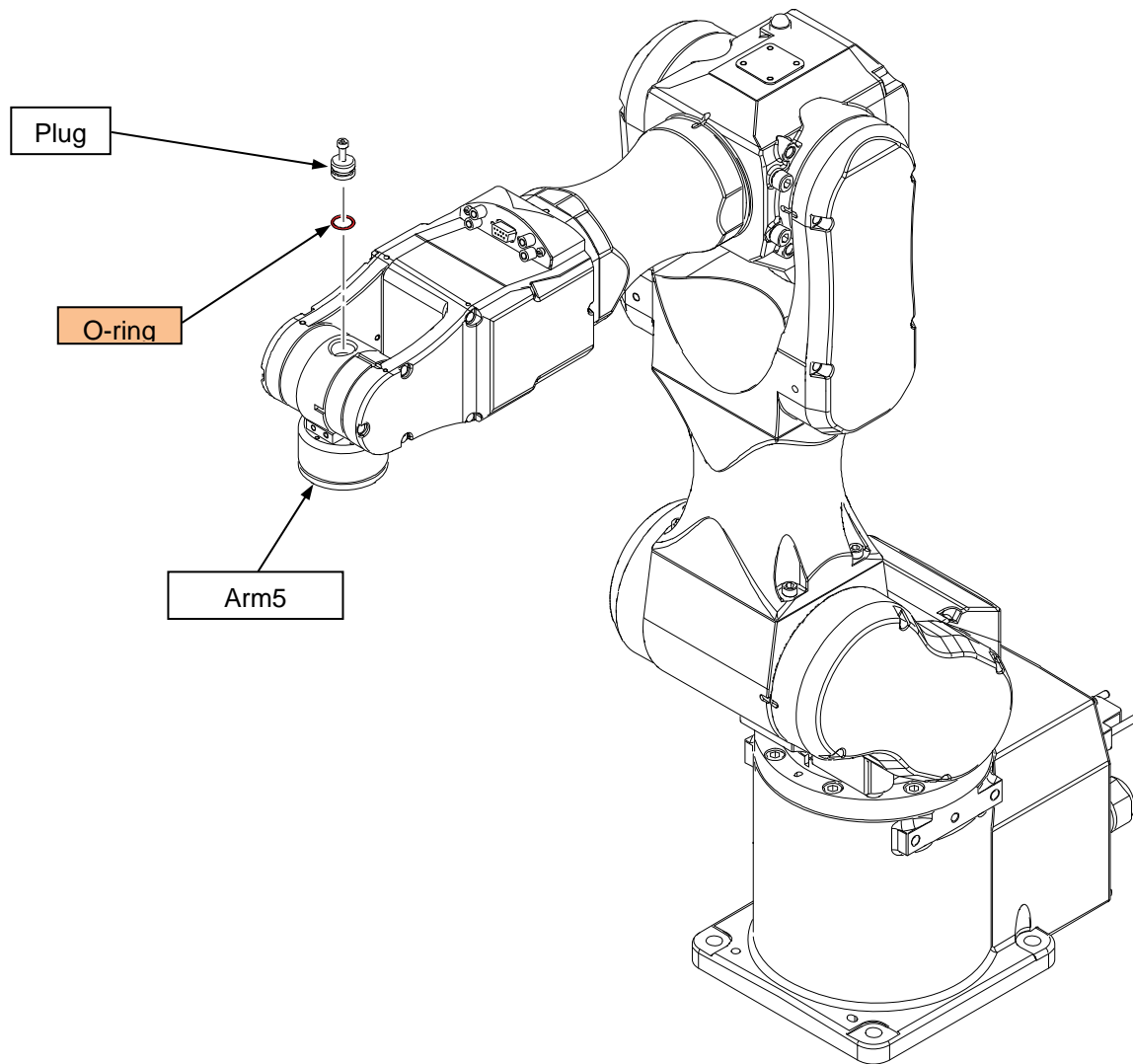
Install the screw (recommended: M4x15 or longer) in the plug screw hole, and push in the plug.



9 Install the [J5 Reduction Gear Unit](#).

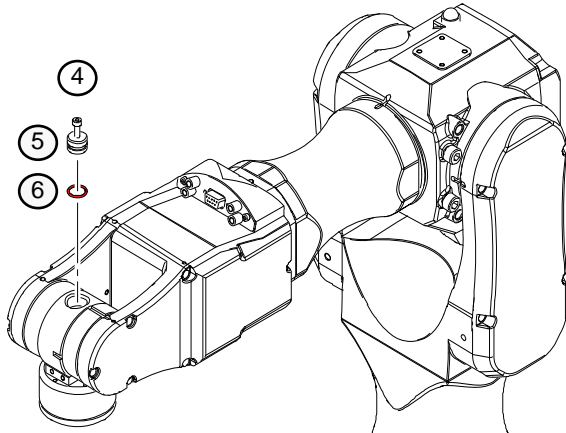
Joint #6

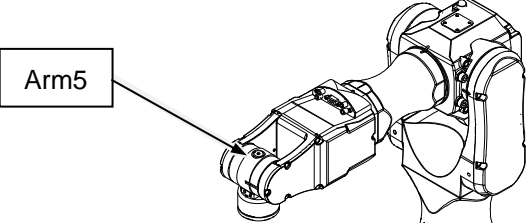
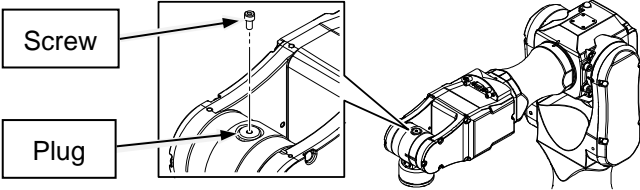
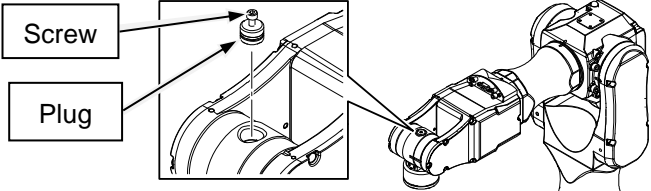
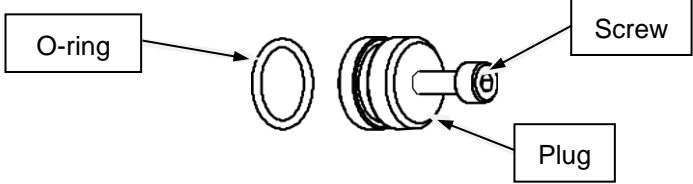
2.8 Replacing the Arm5 O-ring



Joint #6

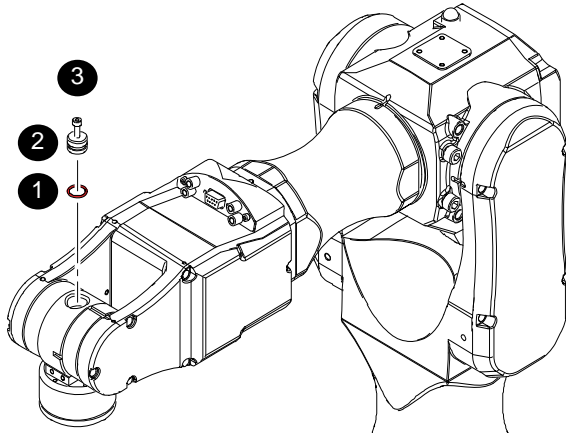
2.8.1 Removing the Arm5 O-ring

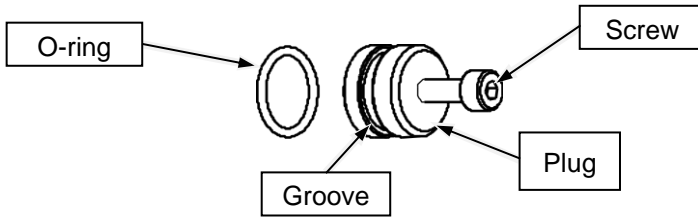
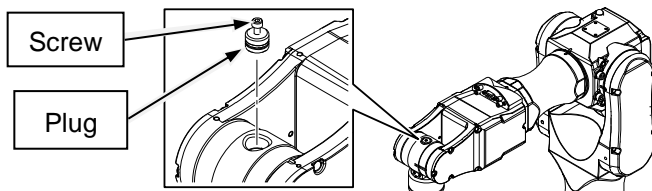


①	Turn ON the controller.
②	In order to make the plug easy to remove, change the angle of Arm5. 
③	Turn OFF the Controller.
④	Insert the screw into the plug. Screw used: M4x15 or longer 
⑤	Hold the inserted screw, and remove the plug from Arm5. 
⑥	Remove the O-ring from the plug. 

Joint #6

2.8.2 Installing the Arm5 O-ring

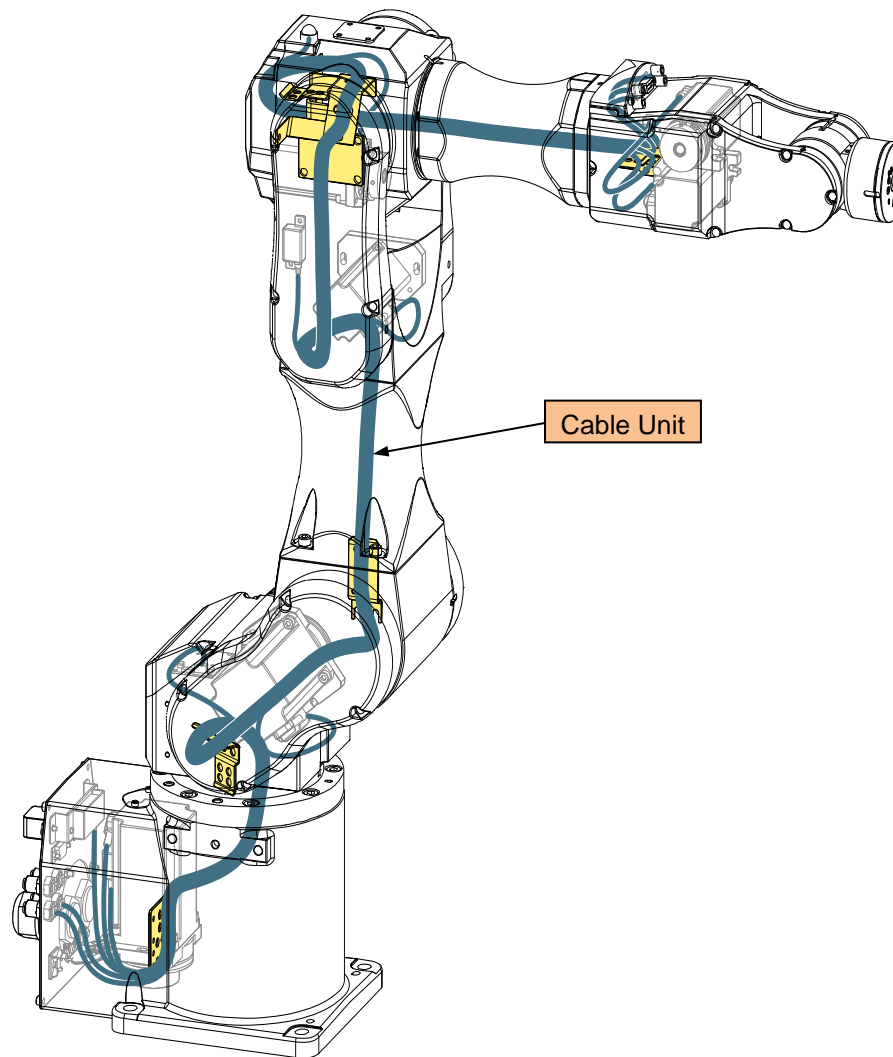


<p>1</p>	<p>Install the O-ring on the plug. CAUTION Insert the O-ring firmly into the groove of the plug.</p> 
<p>2</p>	<p>Hold the inserted screw, and insert the plug into Arm5. POINT Insert until it bottoms out.</p> 
<p>3</p>	<p>Remove the screw in the plug. CAUTION Moving the arm with the screw installed may result in it contacting the Manipulator body. Ensure that the screw is removed.</p>

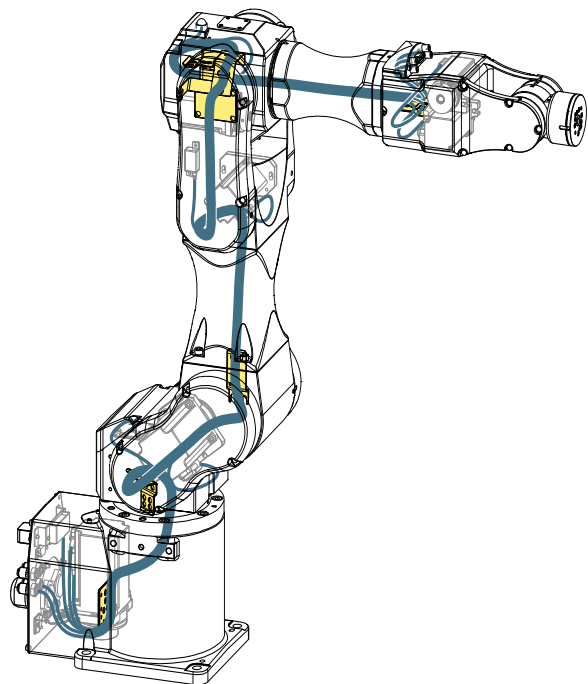
Joint #6

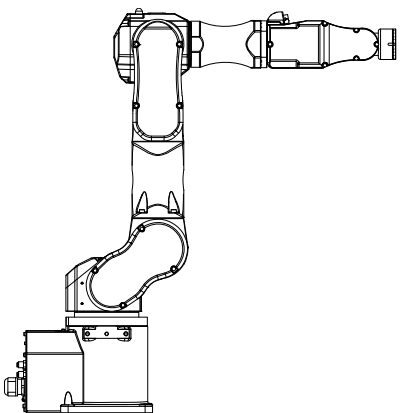
2.9 Replacing the Cable Unit

2.9.1 Removing the Cable Unit

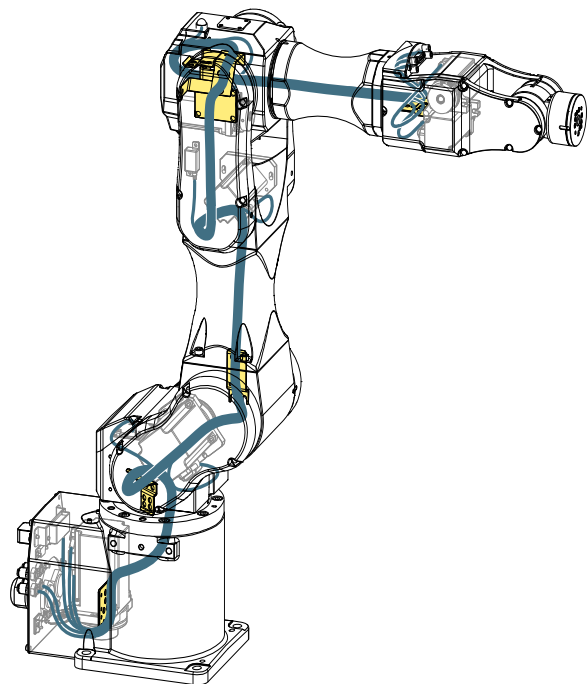


Removing the Cable Unit



①	Move the Manipulator to the origin posture (0 pulse position). 
②	Turn OFF the Controller.
③	Remove the following parts. <ul style="list-style-type: none">• Arm4 side cover• Arm3 head cover• Arm3 Maintenance Cover• Arm2 side cover• Arm1 side cover• Arm1 Center Cover

Removing the Cable Unit



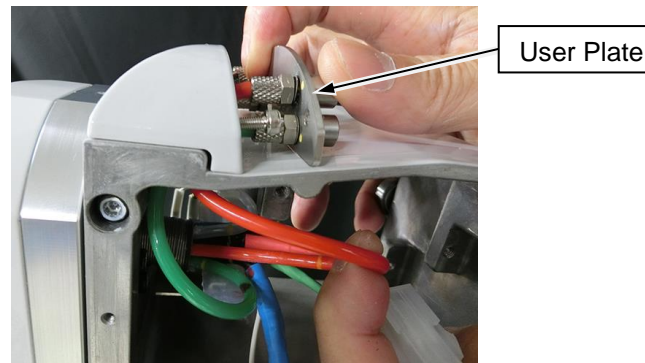
④

1. Remove the [User Plate](#).
2. Remove the D-sub 9-pin connectors and four Air Tubes from the User Plate.

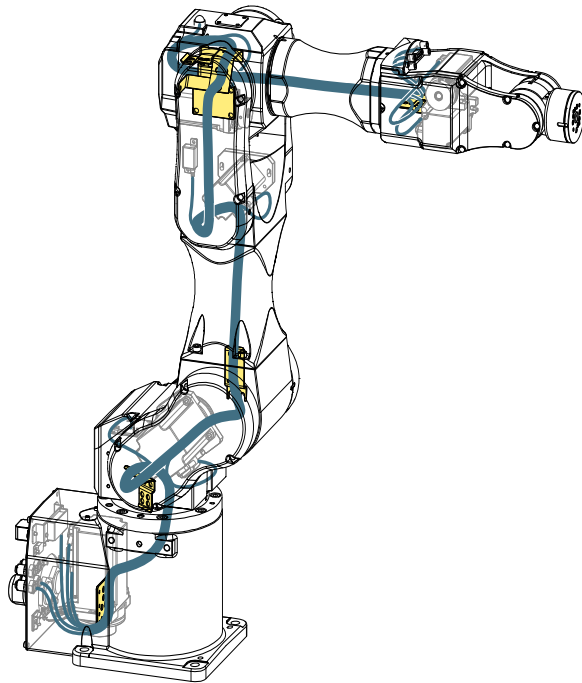
POINT

Pull the Air Tubes slightly out of the interior of Arm4.

Next, turn the Air Tube fittings with your fingers and remove the fittings from the User Plate.



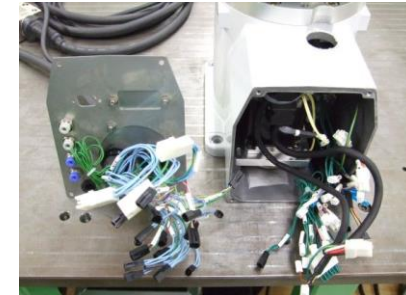
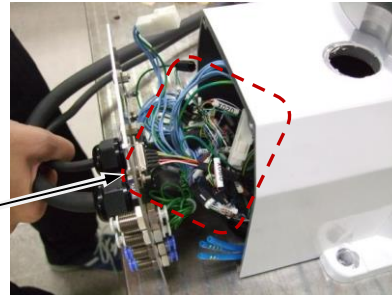
Removing the Cable Unit



⑤

1. Remove the [Connector Plate](#).
2. Disconnect the following connectors from the Connector Plate.
 - Remove the following connectors from inside the base.
SUB-B (CN1, CN2, CN3), CN3L1, CN3G0, CN111, CN200, CN201, CN202, CN300, CN301, CN312, D-sub 9-pin connector, B-release connector

Connectors

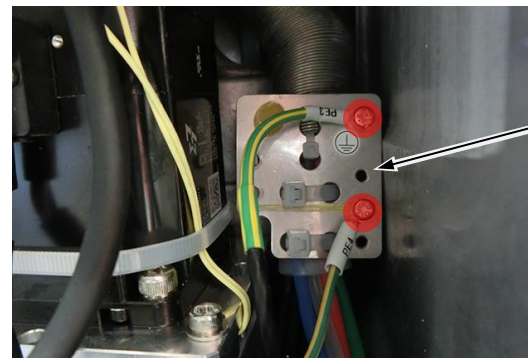


POINT

Press the connector clip, and pull out.

- Disconnect the following Ground Wires from the base cable bracket.
FB3, FB4:

A S04: 2-M4x6

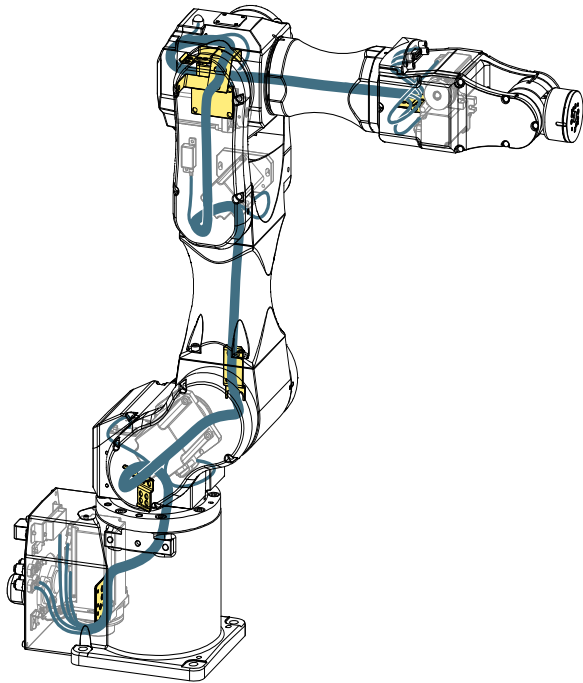


Base cable bracket

⑥

- Remove the following Motor Units.
- [J4 Motor unit](#)
 - [J5 Motor unit](#)
 - [J6 Motor unit](#)

Removing the Cable Unit

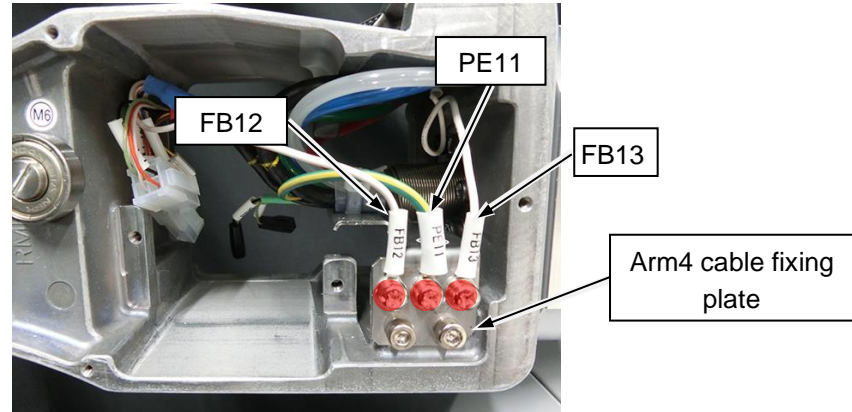


⑦

Remove the cables and connectors from Arm4.

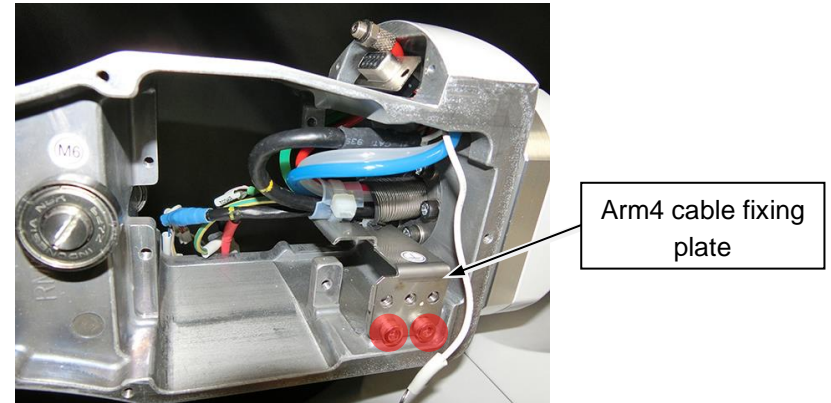
1. Disconnect the Ground Wires (PE11, FB12, FB13) from the Arm4 cable fixing plate.

A S04: 3-M4x8

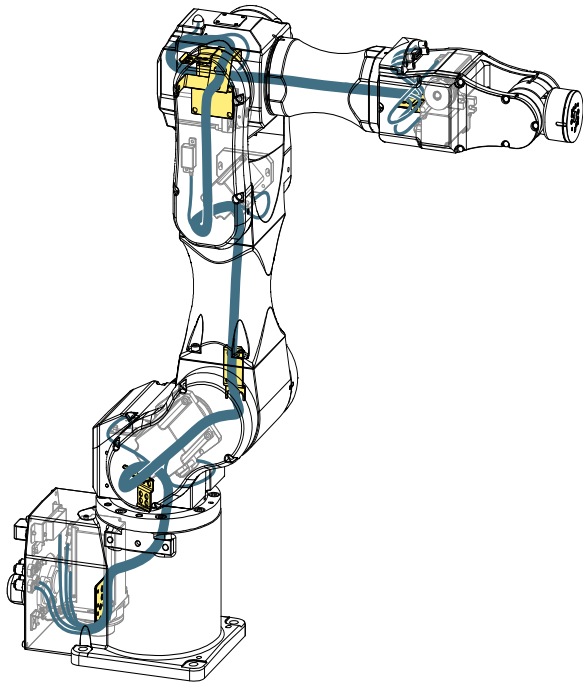


2. Remove the screws securing the Arm4 cable fixing plate.

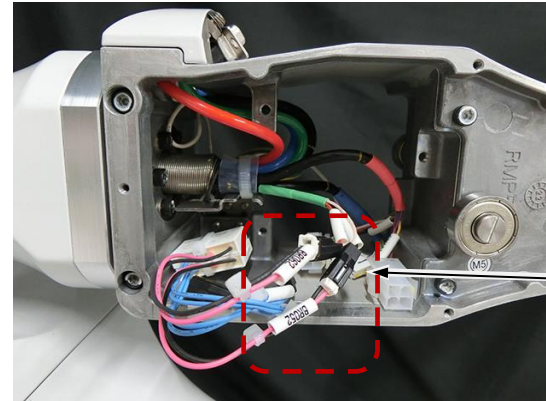
A S01: 2-M4x8



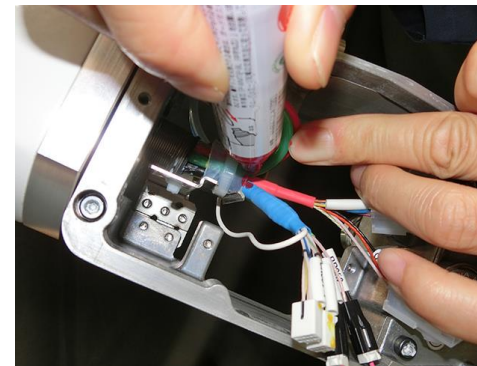
Removing the Cable Unit



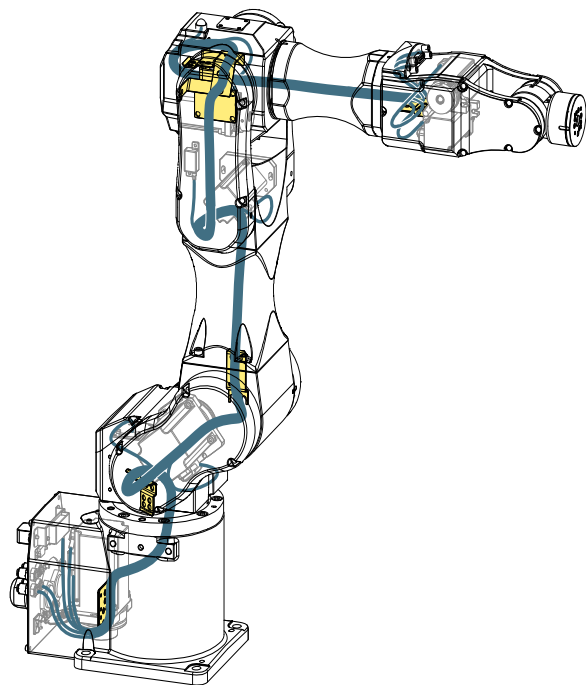
3. Remove the following connectors from inside Arm4.
BR052, BR062
Press the connector clip, and pull out.



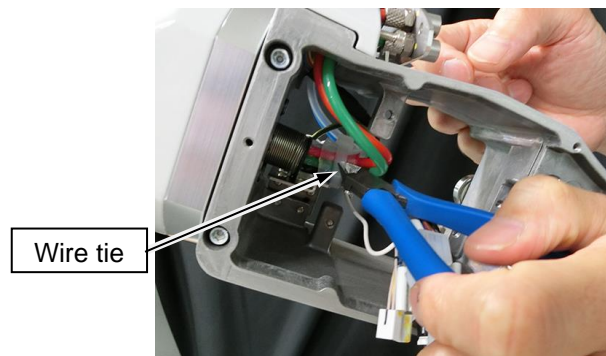
4. Mark each cable with a marker pen so that the positions of the cables fixed to the Arm4 cable fixing plate can be identified.



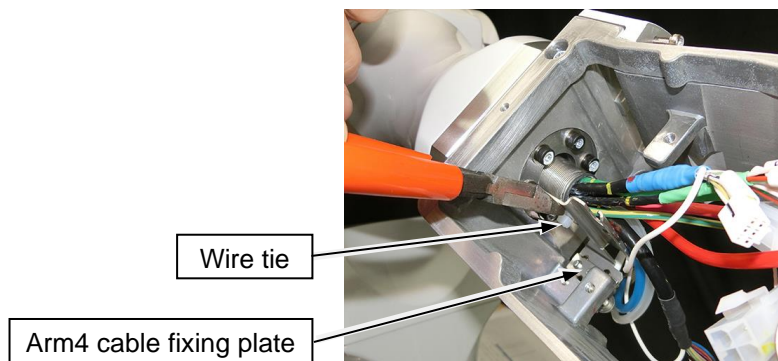
Removing the Cable Unit



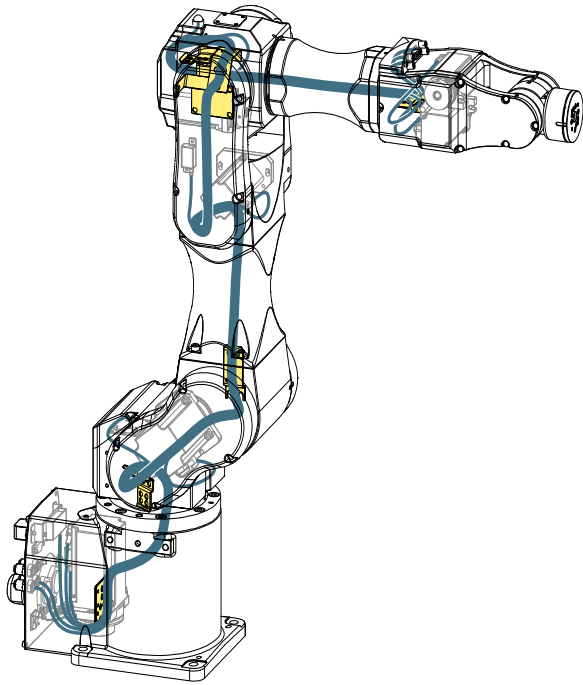
5. Cut the wire tie securing the cables to the Arm4 cable fixing plate.



6. Cut the wire tie securing the coil to the Arm4 cable fixing plate.



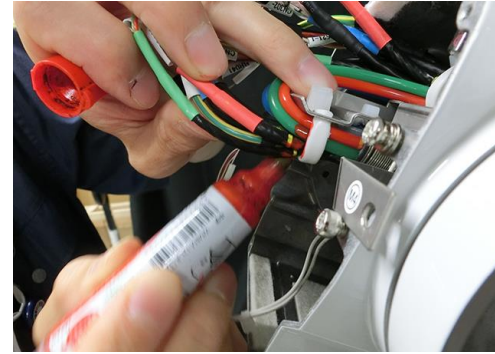
Removing the Cable Unit



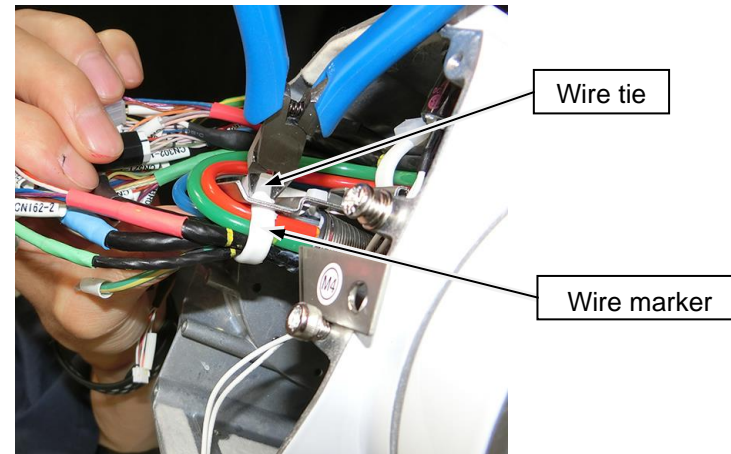
⑧

Remove the cables and connectors from Arm3.

1. Mark each cable with a marker pen so that the positions of the cables fixed to the fixing plate can be identified.



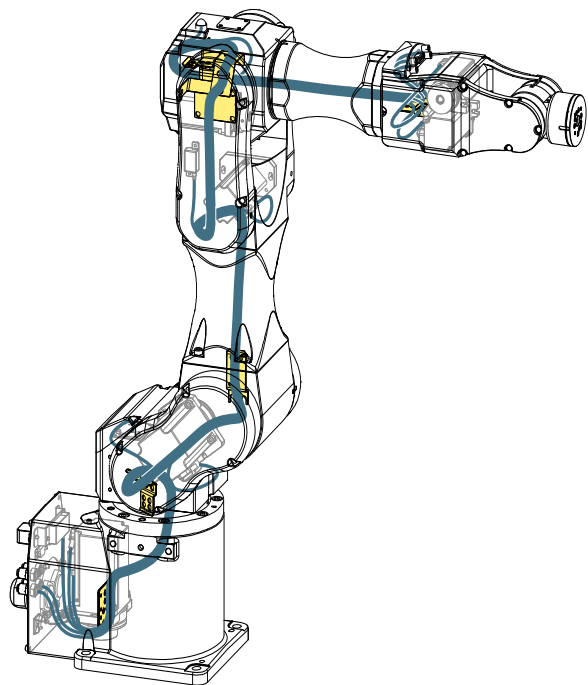
2. Cut the wire tie binding the cables.



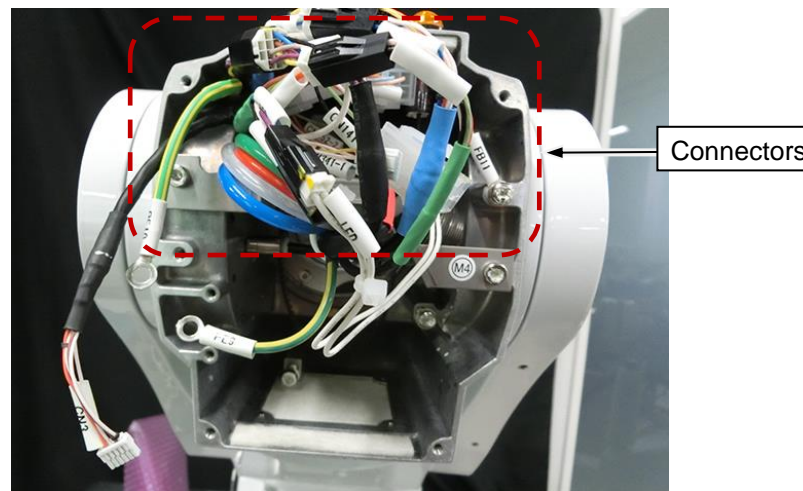
POINT

If you cut only the wire tie, the wire marker (white) protecting the wire tie can be reused.

Removing the Cable Unit

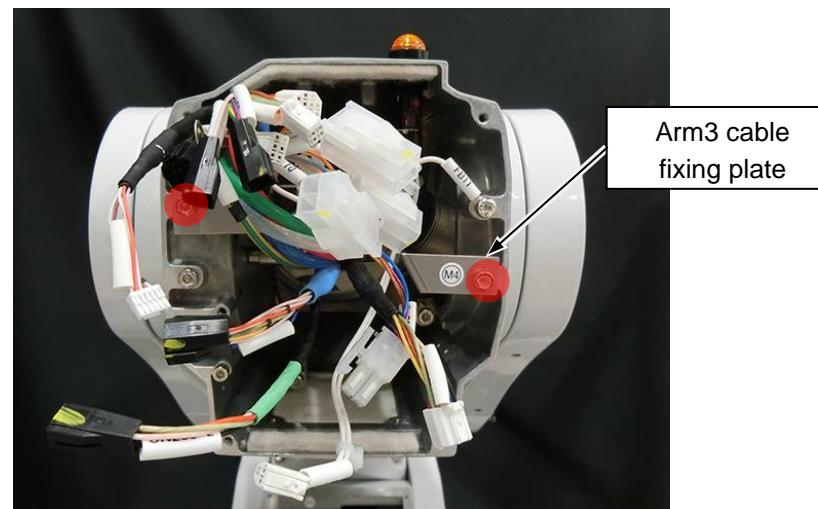


3. Remove the following connectors from inside Arm3.
LED, CN203, CN302, CN521, CN152, CN162

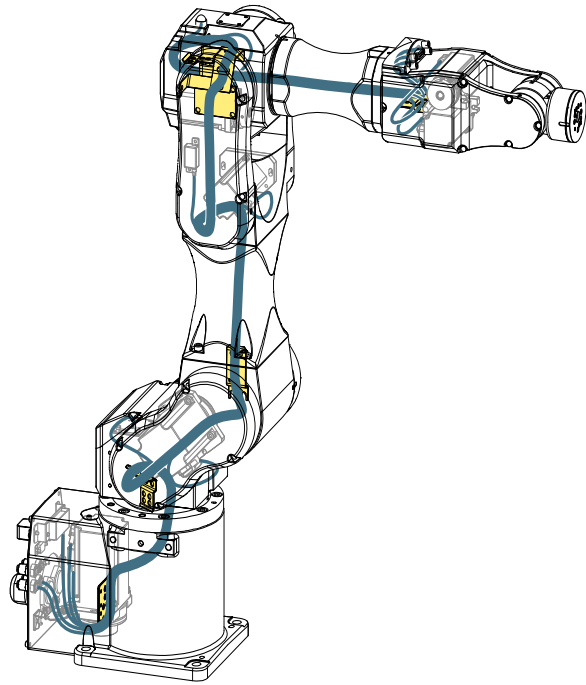


4. Remove the bolts securing the Arm3 cable fixing plate.

A S01: 2-M4x8

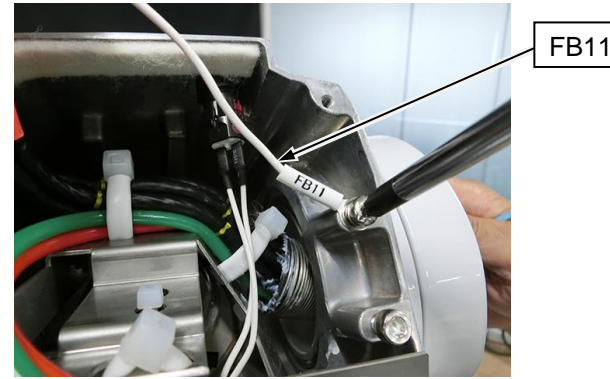


Removing the Cable Unit

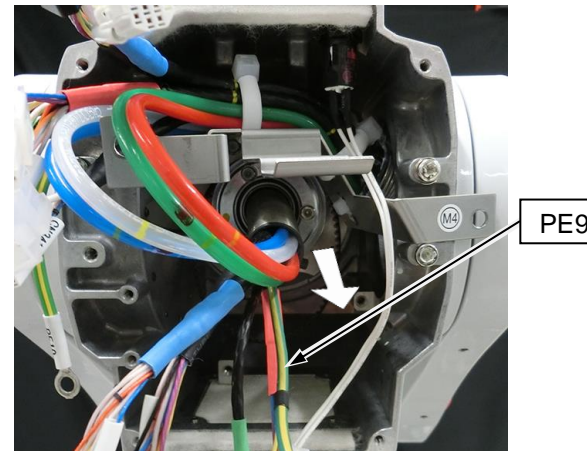


5. Disconnect the Ground Wire (FB11).

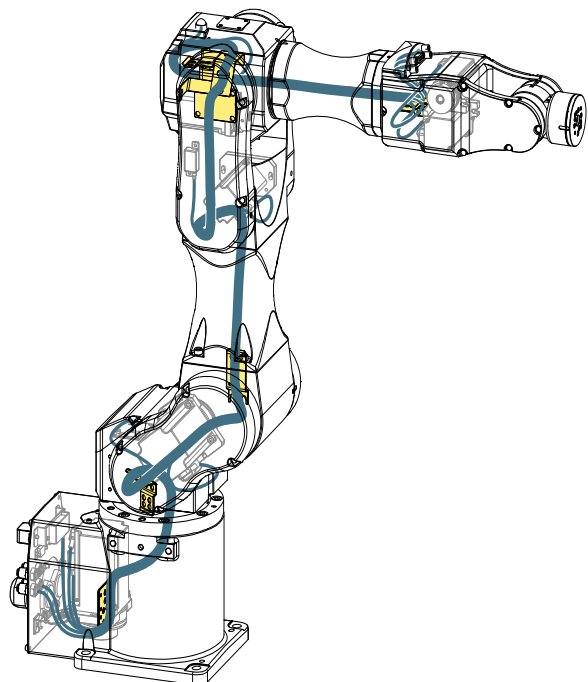
A S04: 1-M4x6 with washer



6. Pull the Ground Wire (PE9) out of the coil toward Arm3 (direction of the arrow in the figure).

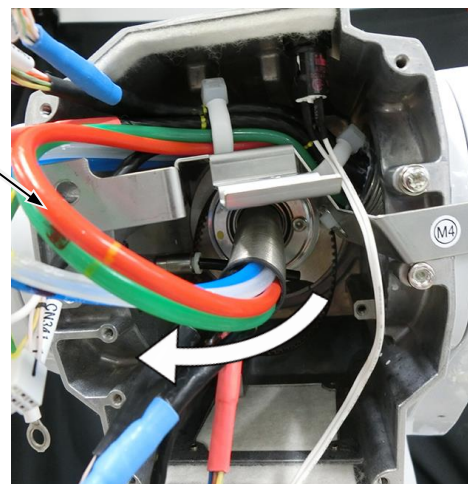


Removing the Cable Unit

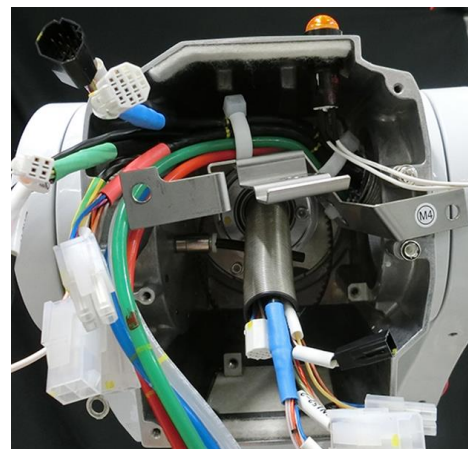


7. Pull the four air tubes individually out of the coil toward Arm3 (direction of the arrow in the figure).

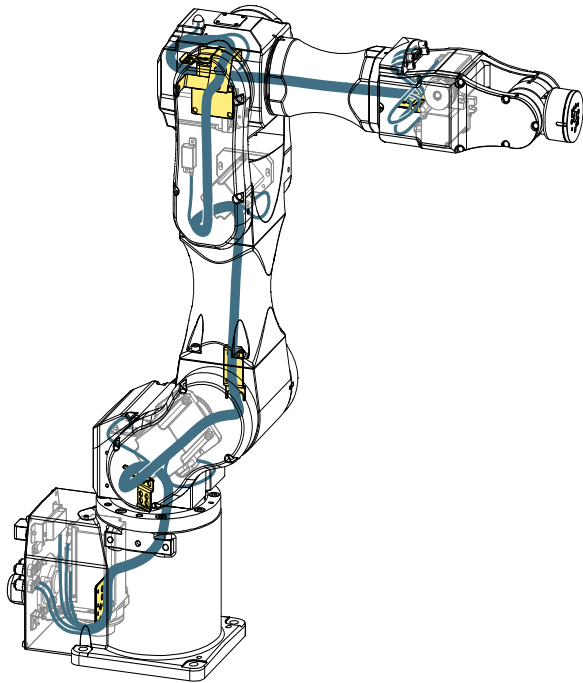
Air Tubes



After everything is pulled out



Removing the Cable Unit

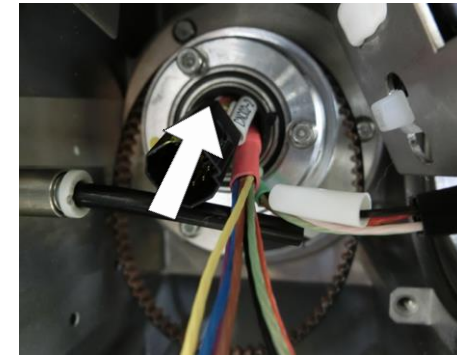


8. Pull the remaining cables out of each coil toward Arm4 (direction of the arrow in the figure). At the same time, pass the connectors on the ends of the cables one by one through the hole that the coil passed through on the Arm3. The work is easier to perform if you pass the smaller connectors through first. Pass the following connectors through the hole. CN152-2, CN162-2, CN203-2, CN302-2, CN521-2

Arm4 side



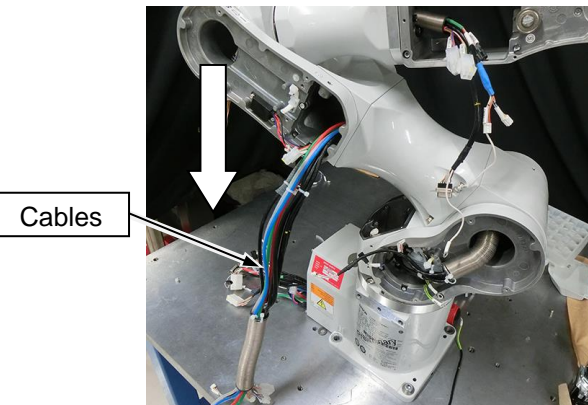
Arm3 side



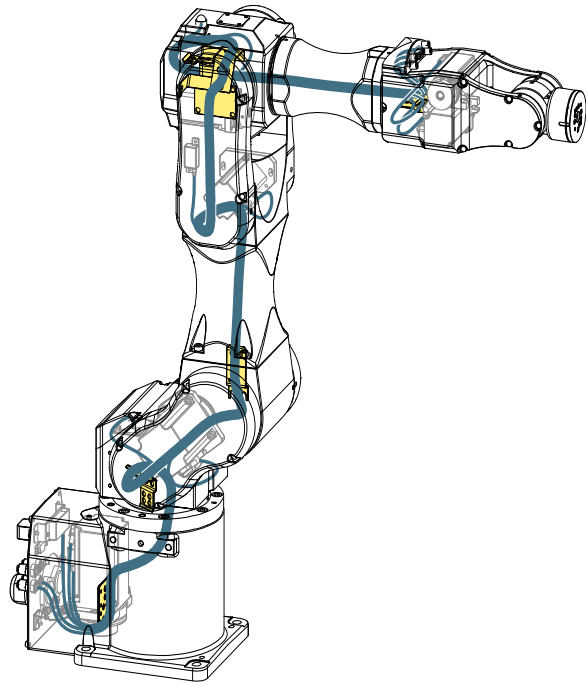
CAUTION

Be careful not to damage the cable or connectors when pulling them out.

9. Pull the cables from Arm3 toward Arm2 (direction of the arrow in the figure).



Removing the Cable Unit



⑨

Remove the cables, connectors, and the Motor Unit from Arm2.

1. Remove the [J3 Motor unit](#).

CAUTION

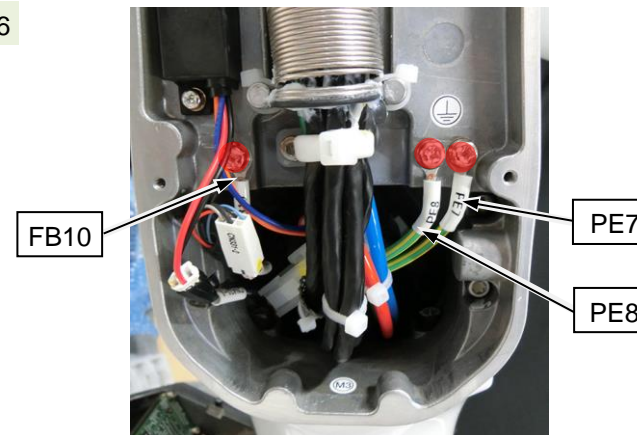
The arm attached to the end of Arm3 drops down when the motor is removed. Put the arm against the stopper before removing the motor.

2. Disconnect the brake connectors (CN430, CN431).

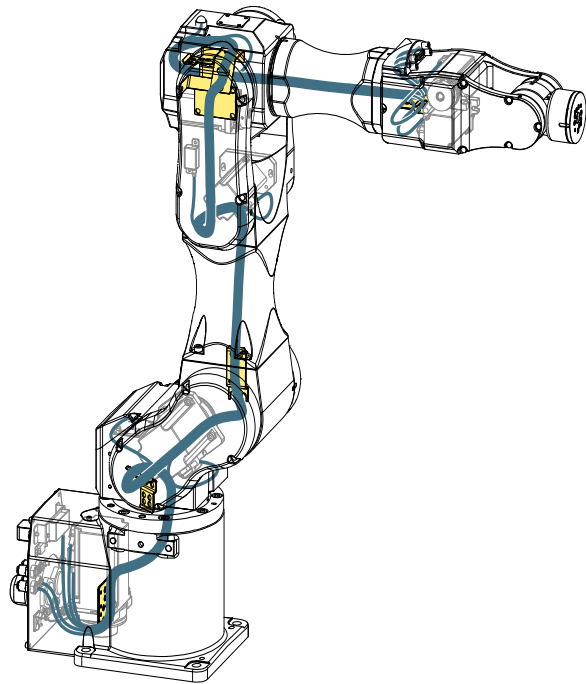


3. Disconnect the Ground Wires (PE7, PE8, FB10).

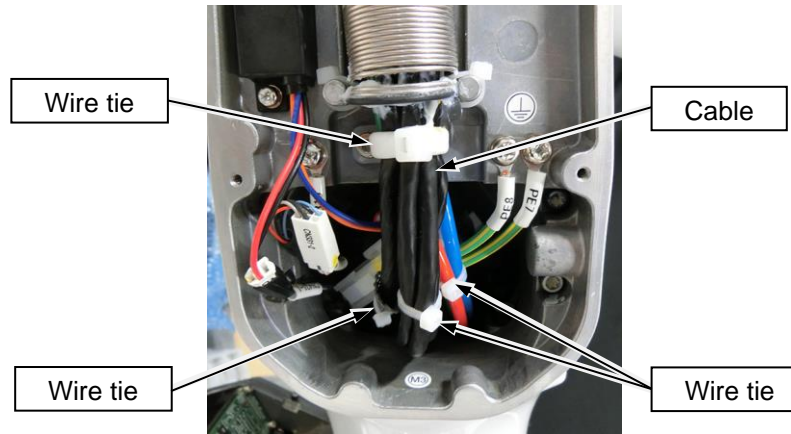
A S04: 3-M4x6



Removing the Cable Unit



4. Cut the wire ties securing the cables to Arm2 and the wire ties dividing the cables.

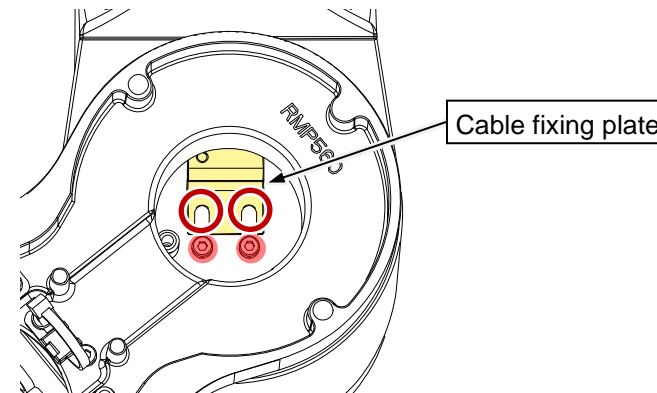


5. Loosen the fixing bolts and remove the cable fixing plate at the bottom of Arm2.

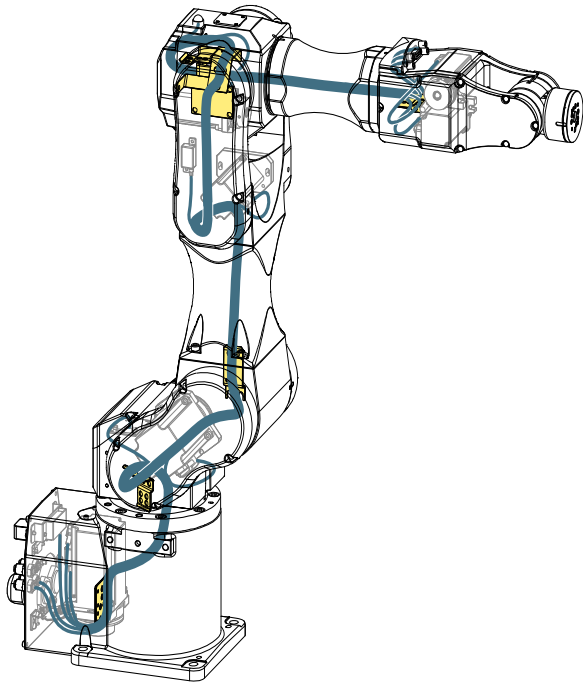
POINT

It is not necessary to fully remove the fixing bolts. Attaching the fixing bolts to Arm2 makes it easier to attach the Cable Unit.

A S01: 2-M4x8



Removing the Cable Unit



⑩

Remove the cables, connectors, and the Motor Unit from Arm1.

1. Cut the wire ties securing the cables to Arm1 and the wire ties dividing the cables.

Wire tie



Cables

2. Disconnect the Ground Wires (FB5, FB6) from Arm1.

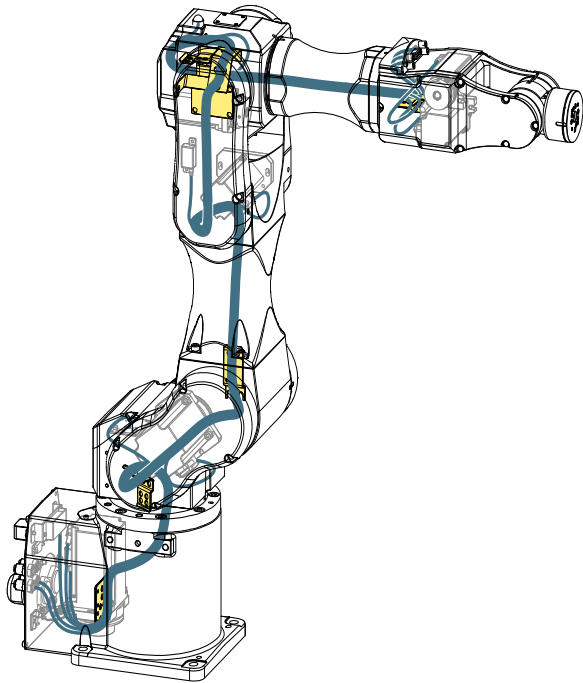
A S04: M4x6

Ground Wires



Arm1

Removing the Cable Unit

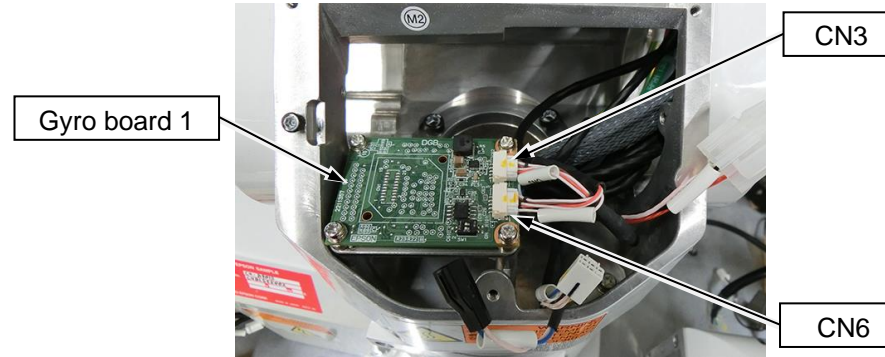


3. Remove the [J2 Motor unit](#).

CAUTION

The arm attached to the end of Arm3 drops down when the motor is removed. Put the arm against the stopper before removing the motor.

4. Disconnect the connectors (CN3, CN6) from gyro board 1.

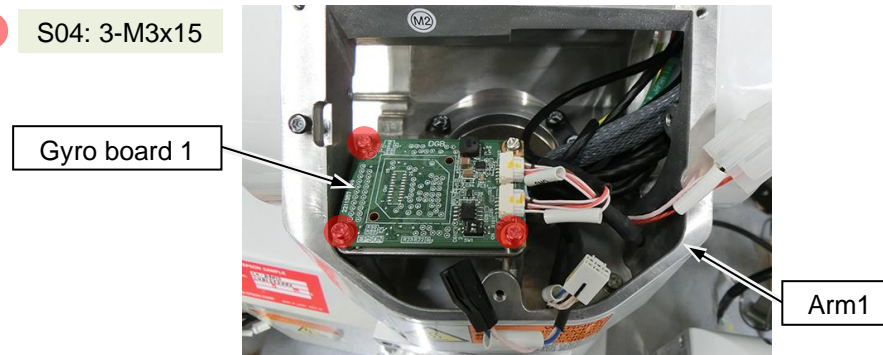


5. Remove gyro board 1 and the gyro board 1 protective plate.

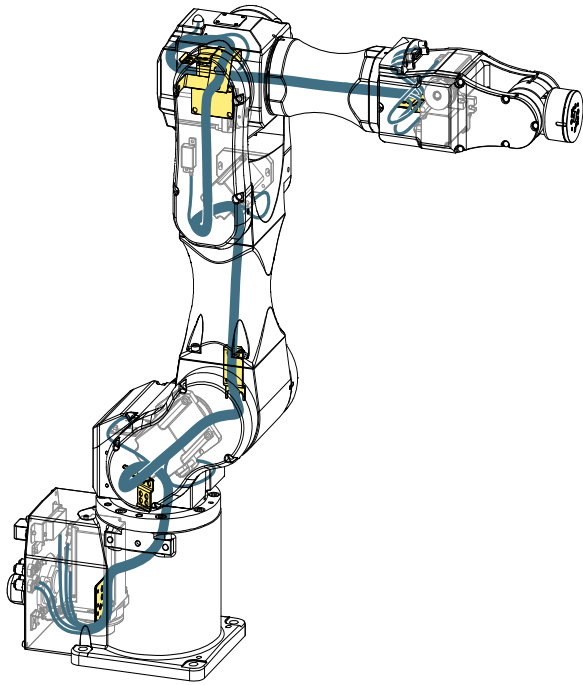
CAUTION

Remove gyro board 1 and the gyro board protective plate while they are assembled together. Do not remove the screws shown in the figure.

A S04: 3-M3x15

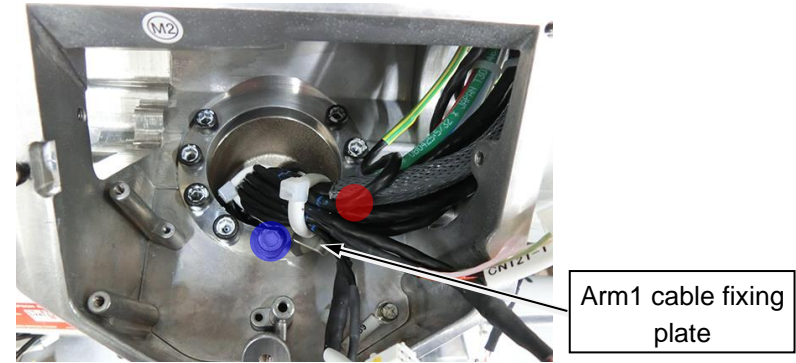


Removing the Cable Unit



6. Remove the Arm1 cable fixing plate.

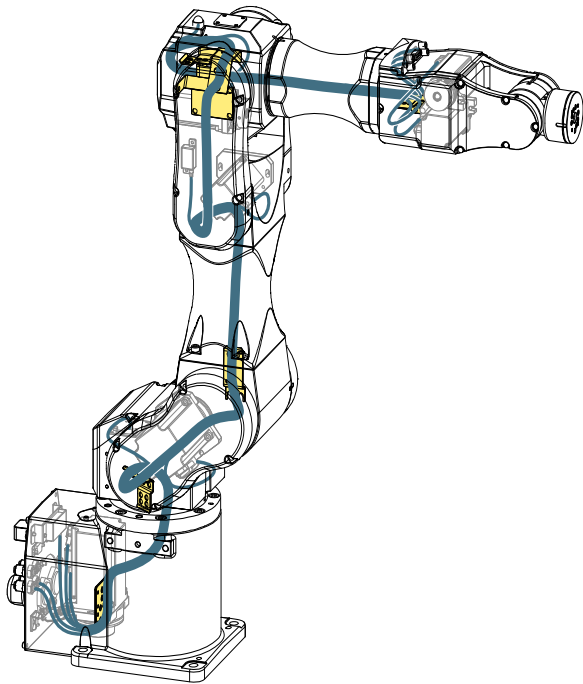
- A S01: 1-M4x8
- B S01: 1-M6x20



7. Cut the wire tie on the Arm1 cable fixing plate.



Removing the Cable Unit



11

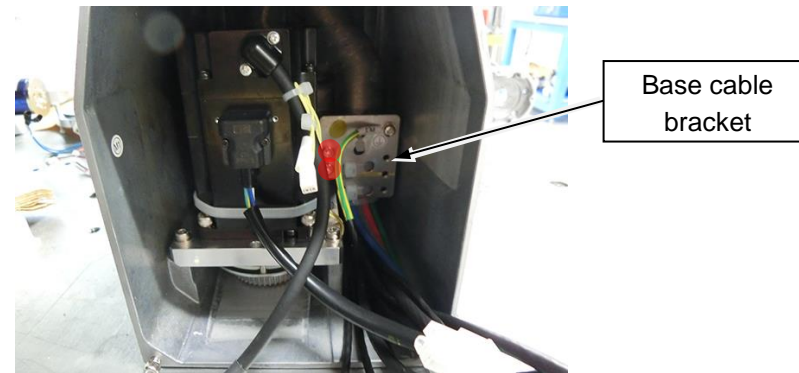
Remove the cables and connectors from the base.

1. Cut the wire tie binding the cables.

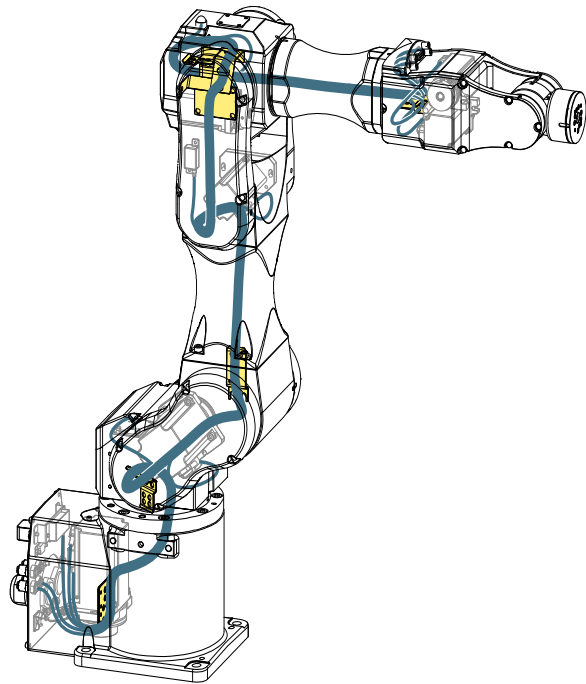


2. Remove the base cable bracket.

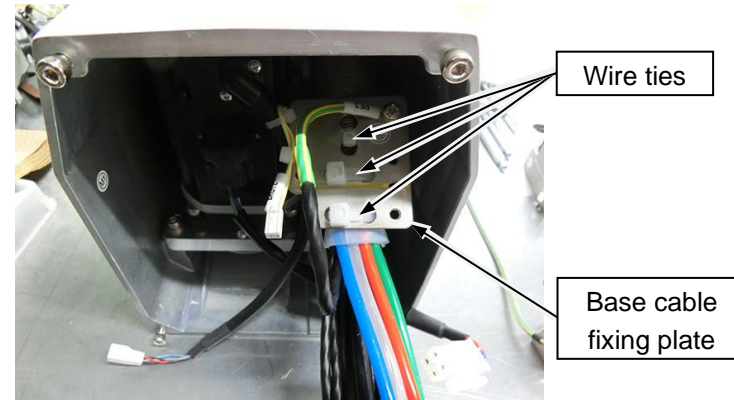
A S01: 2-M4x8



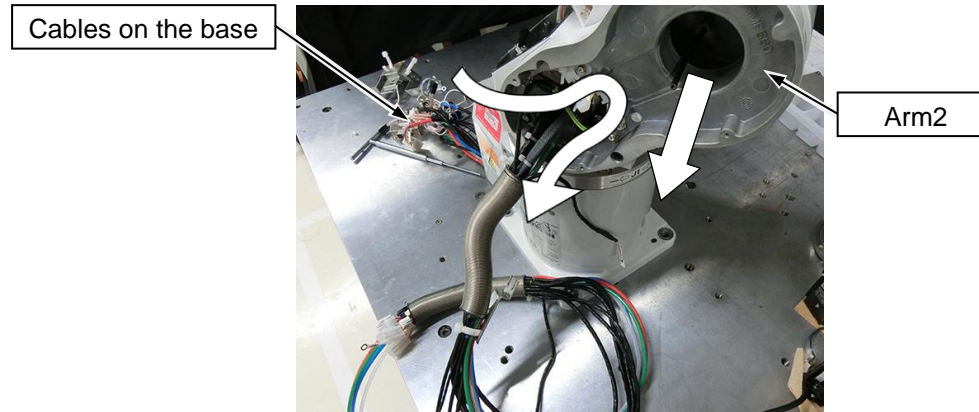
Removing the Cable Unit



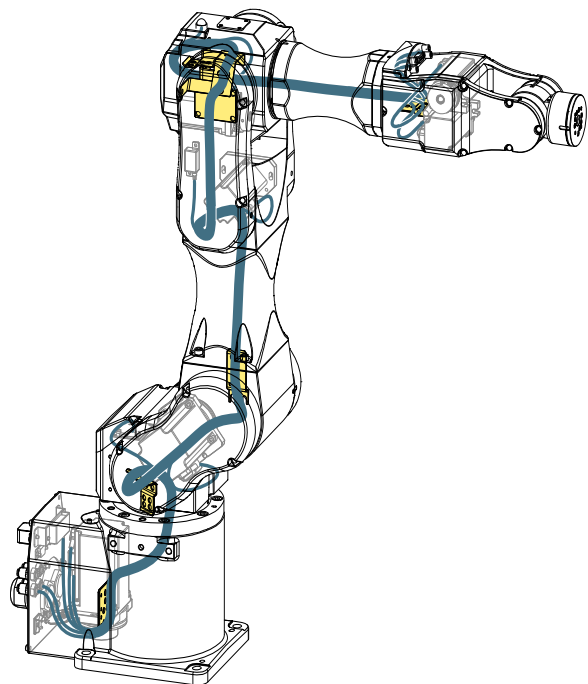
3. Cut the wire ties on the base cable fixing plate.



4. Pull the Arm2 cables and the cables on the base toward Arm1 (direction of the arrow in the figure).



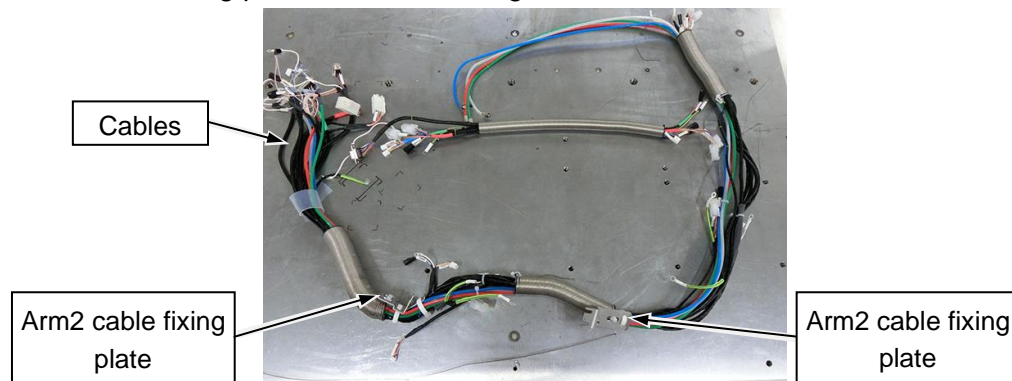
Removing the Cable Unit



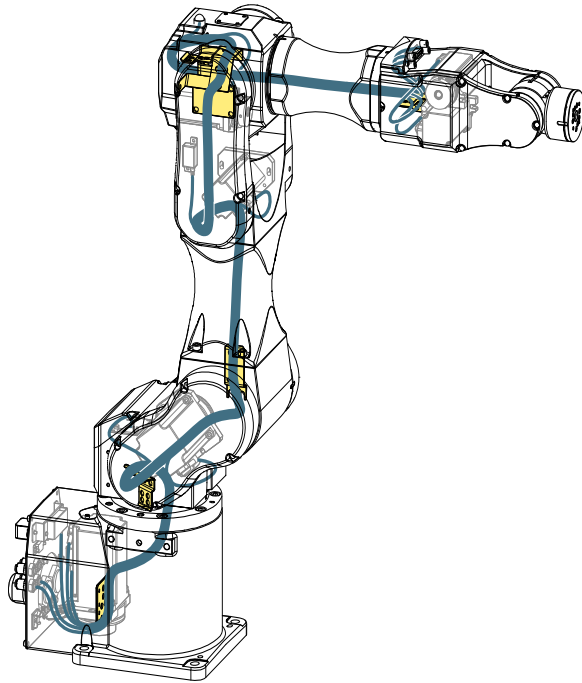
5. Remove from the Arm2 cable fixing plates from the cables.

POINT

The Arm2 cable fixing plates will be used again. Do not lose them.



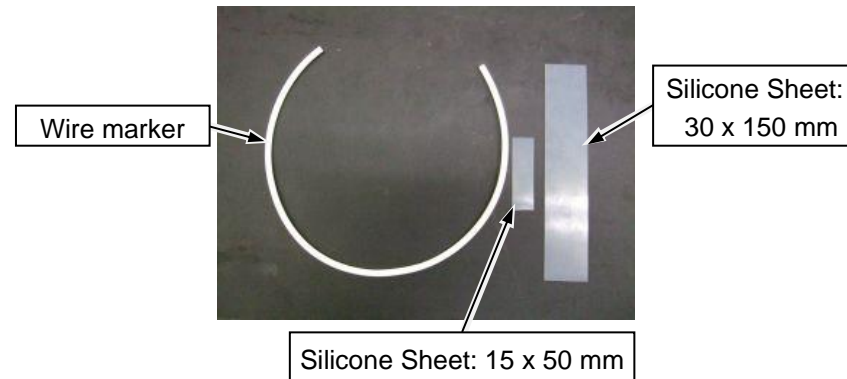
2.9.2 Installing the Cable Unit



<Preparation>

1. Check that the Cable Unit contains the following parts.

- Silicone Sheet: 30 x 150 mm
- Silicone Sheet: 15 x 50 mm
- Wire marker
- Wire tie: AB100, AB150, AB200

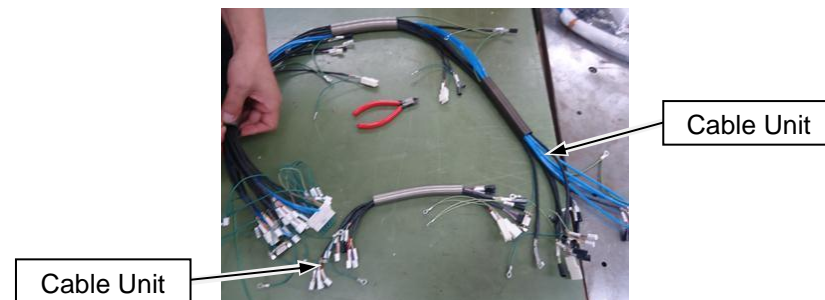


2. Disconnect the following connectors and separate the Cable Unit.

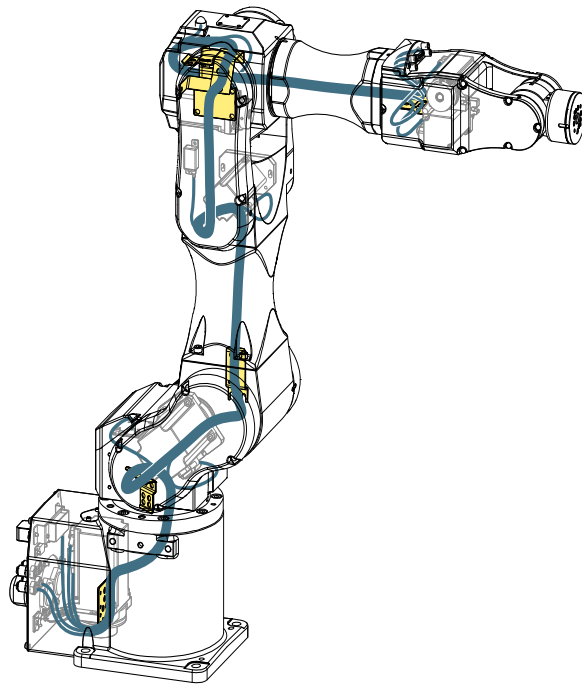
CN203, CN152, CN162, CN302, CN521

POINT

This work is not required if the Cable Unit is already separated from the beginning.



Installing the Cable Unit



3. Cut the wire marker into the following lengths:
 - 68 mm x 2 (for fixing the J1 wire tie)
 - 65 mm x 1 (for fixing the J2 wire tie)
 - 23 mm x 2 (for fixing the J2 wire tie)
 - 21 mm x 2 (for fixing the J3 wire tie)
 - 57 mm x 2 (for fixing the J3 wire tie)
 - 46 mm x 1 (for fixing the J4 wire tie)

4. Apply grease to the inside of the cable protection spring.

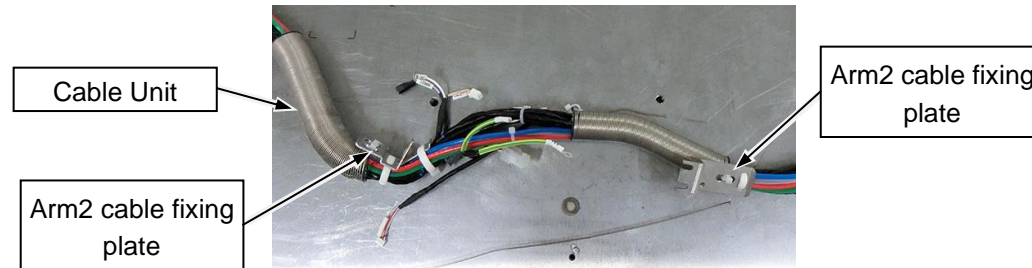
 Krytox: 19 g

Spring 17.5 dia.: 4 g
 25 dia.: 5 g x 2
 29 dia.: 5 g

5. Install the Arm2 cable fixing plate on the Cable Unit.

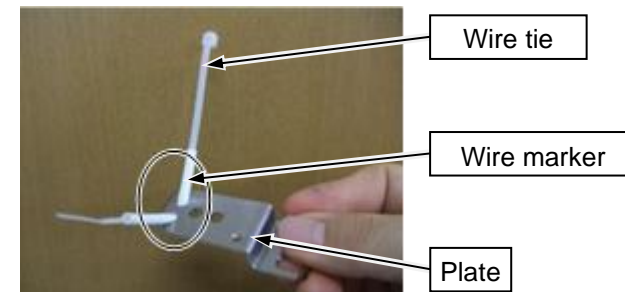
Wire tie: AB150

Wire marker: 65 mm

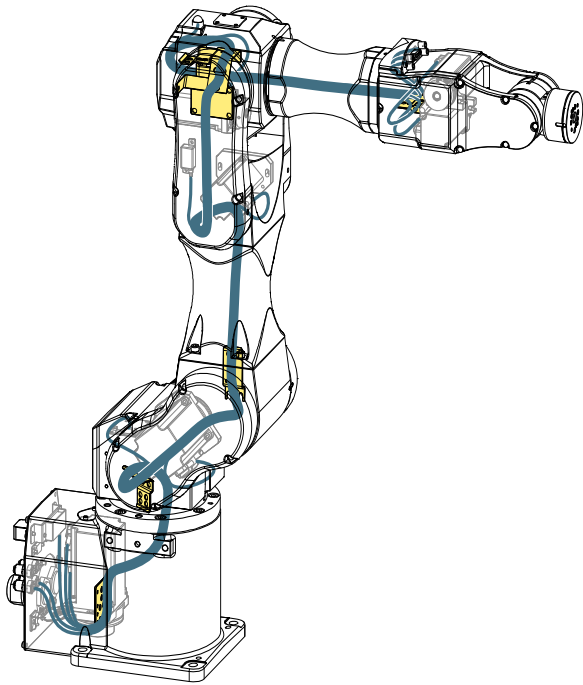


POINT

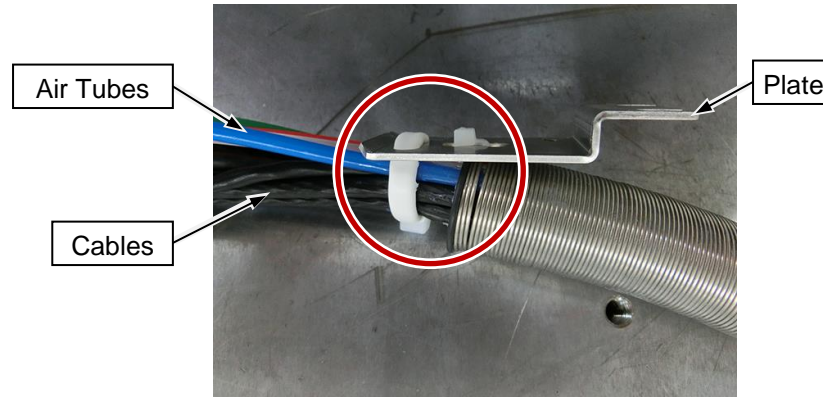
- Pass the wire marker and wire tie through the holes in the plate as shown in the figure.



Installing the Cable Unit



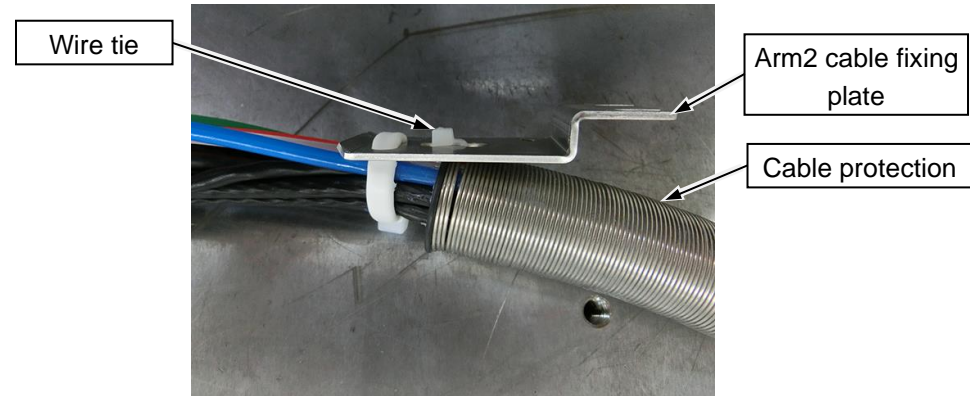
- As shown in the figure, insert the Air Tubes between the plate and the cables, and fix the plate to the Cable Unit.



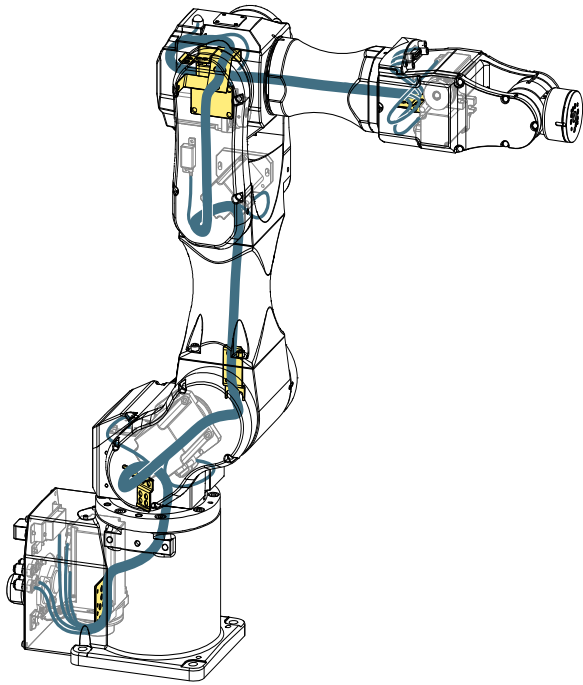
6. Secure the Arm2 cable fixing plate to the cable protection spring.

Wire tie: AB100

Number of turns of spring to fix: 4 turns



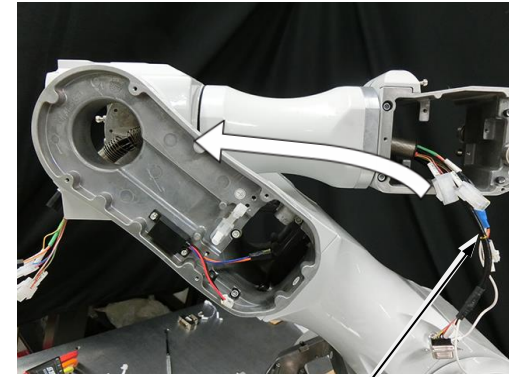
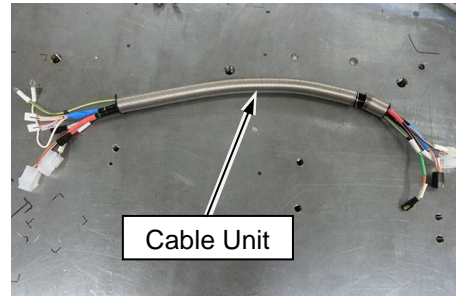
Installing the Cable Unit



1

Insert the Cable Unit in the Manipulator.

1. Insert the separated Cable Unit (with 17.5 dia. protection spring) from Arm4 into Arm3.



Cable Unit

2. Secure the Cable Unit protection spring to the Arm4 cable fixing plate.

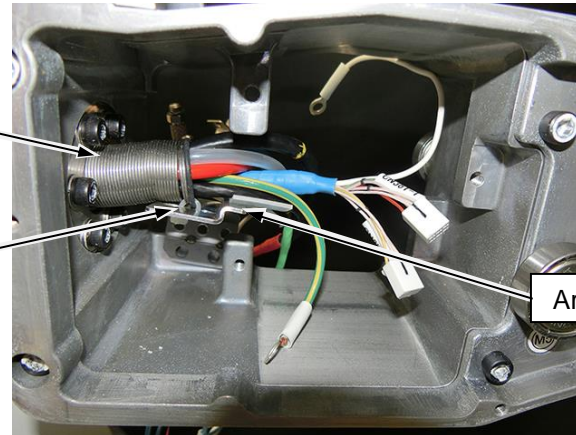
Wire tie: AB100

Number of turns of spring to fix: 3 turns

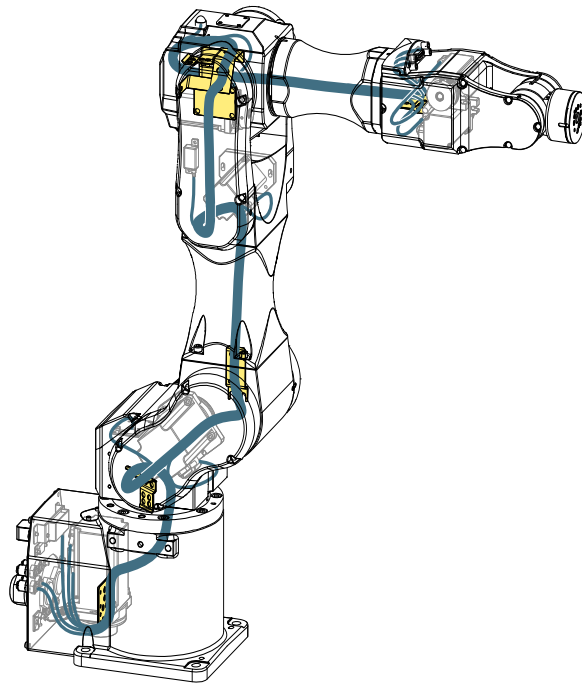
Protection spring

Wire tie

Arm4 cable fixing plate

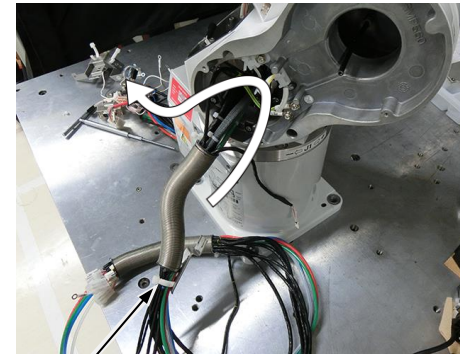
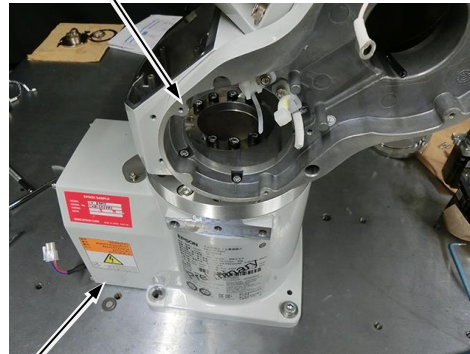


Installing the Cable Unit



3. Insert the cable (Cable Unit with 29 dia. protection spring) from Arm1 into the base. Connectors inserted into the base (CN1, CN2, CN3) for SUB-B , D-Sub, B-release, PE3, CN3L1, CN3G0, CN200, CN201, CN202, CN300, CN301

Arm1 side

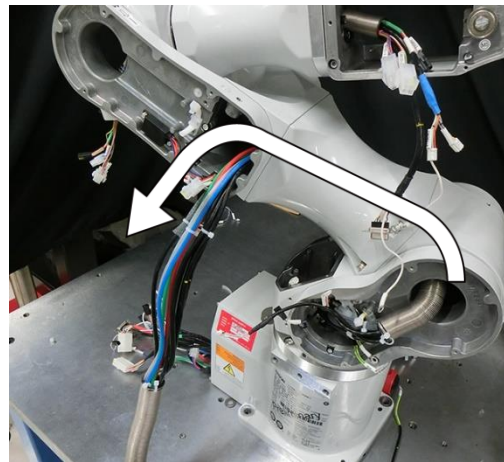
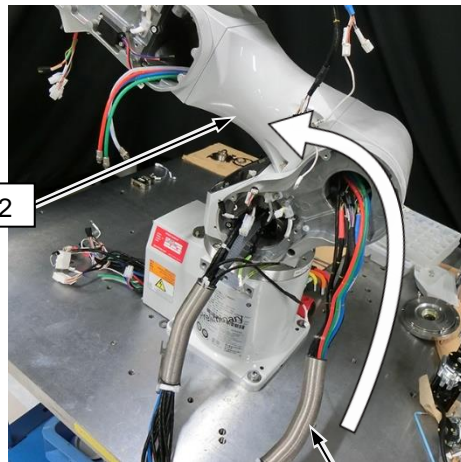


Base side

Cable Unit

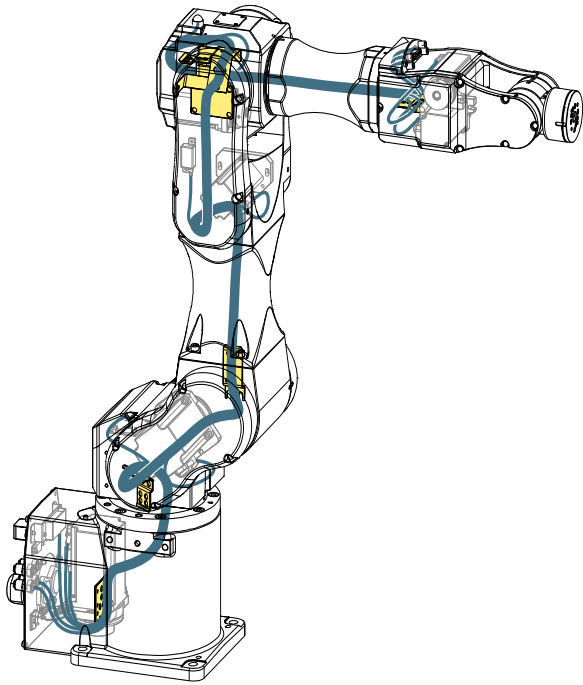
4. Insert the Cable Unit into Arm2 and pull it toward Arm2 (direction of the arrow in the figure).

Arm2

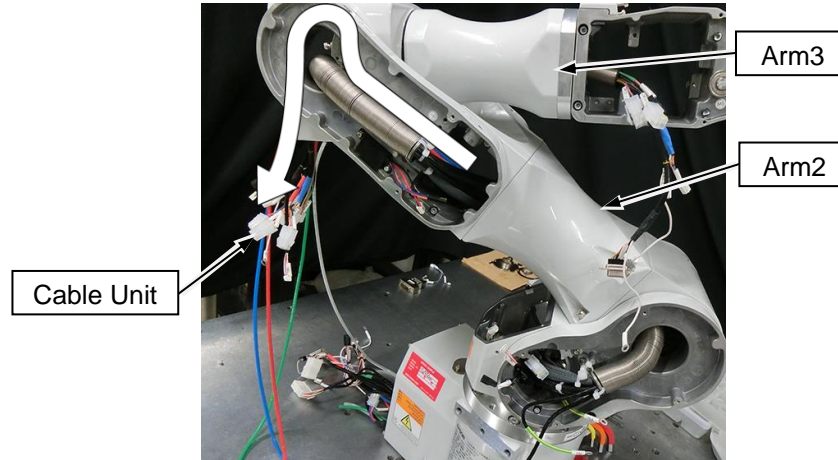


Cable Unit

Installing the Cable Unit

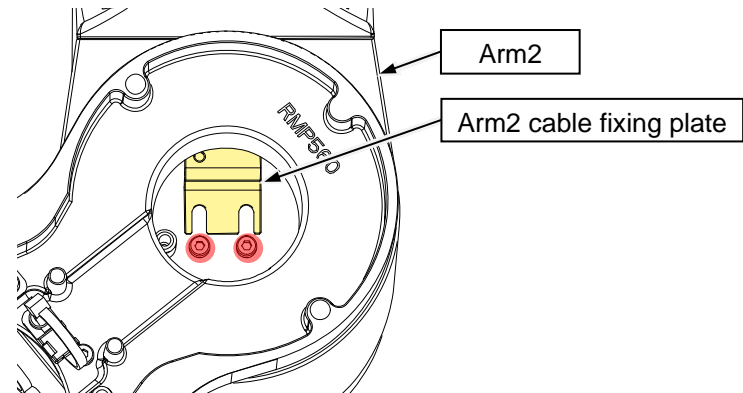


5. Insert the Cable Unit pulled out of Arm2 into Arm3 (direction of the arrow in the figure).

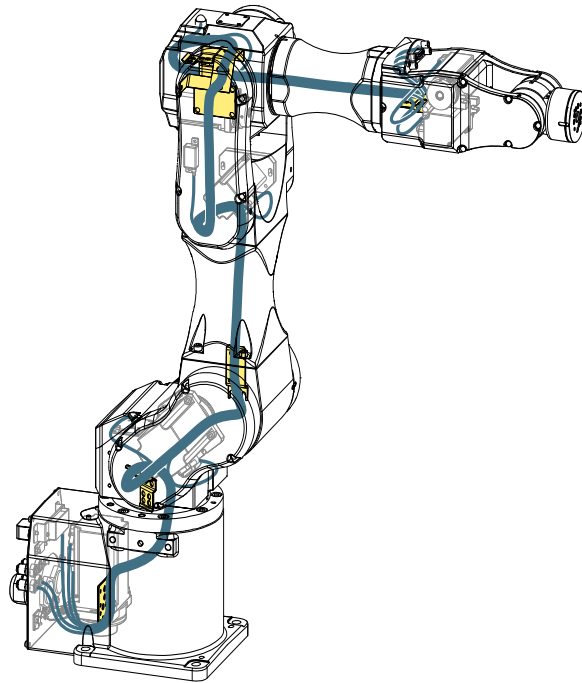


6. Secure the Arm2 cable fixing plate to Arm2.

- A S01: 2-M4x8
(4.0 +/- 0.2 N·m)



Installing the Cable Unit



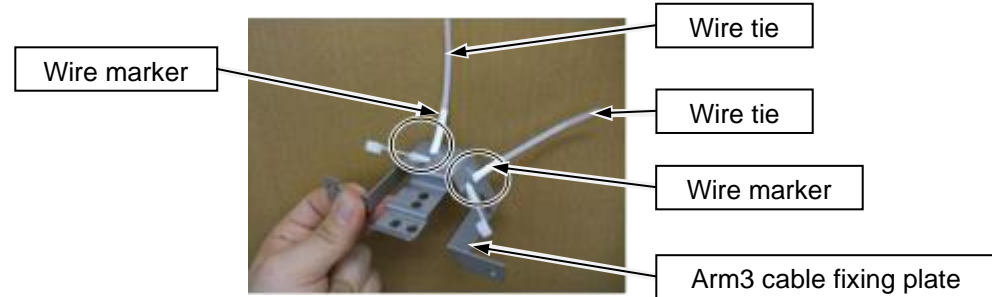
2

Secure the Cable Unit to Arm3 and Arm4.

1. Pass the wire markers and wire ties through the Arm3 cable fixing plate.

Wire tie: AB150 x 2

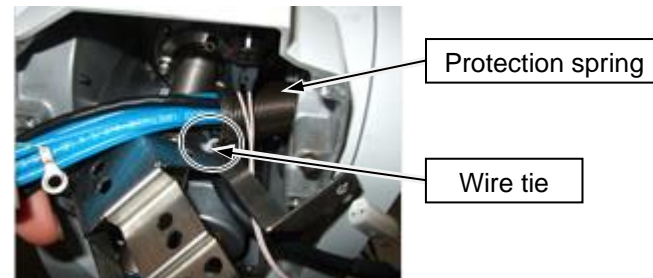
Wire marker: 57 mm x 2



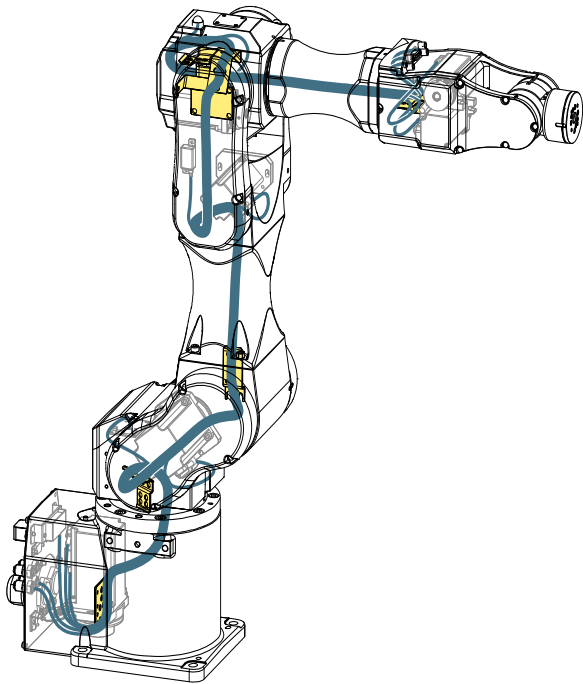
2. Bind the Cable Unit protection spring (25 dia. x 130 mm) pulled out of Arm2 to the Arm3 cable fixing plate.

Wire tie: AB100

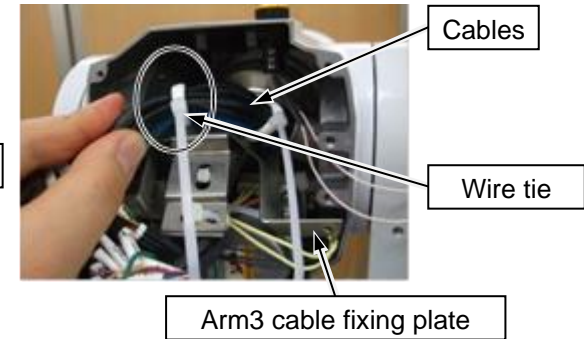
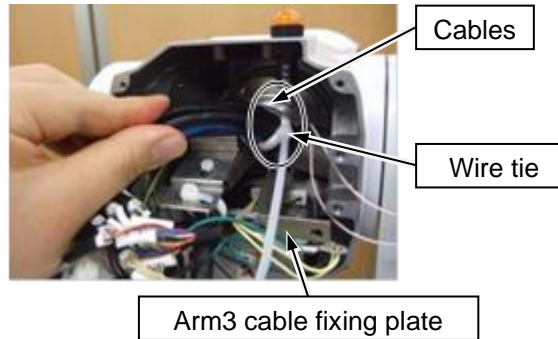
Number of turns of spring to fix: 3 turns



Installing the Cable Unit

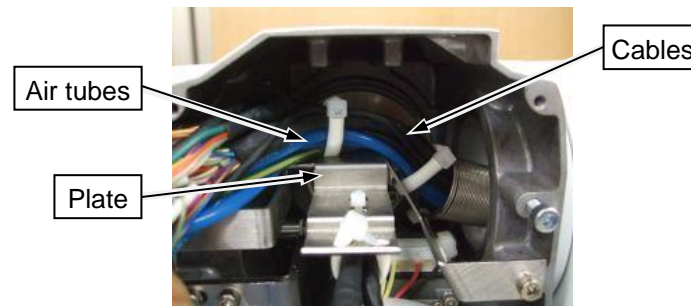


3. Temporarily bind the two cables to the Arm3 cable fixing plate.



POINT

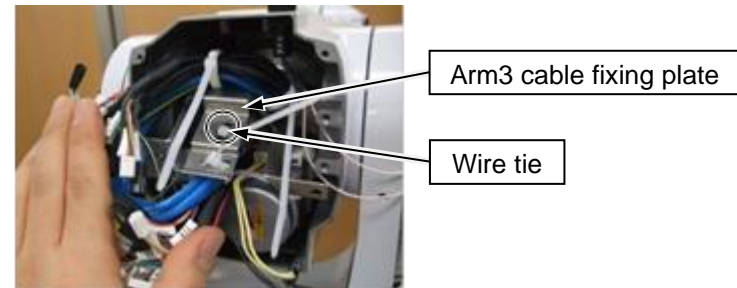
- Tighten the wire ties to a degree that the position of the wire ties can be adjusted.
- As shown in the figure, insert the Air Tubes between the plate and cables, and secure the cables to the plate.



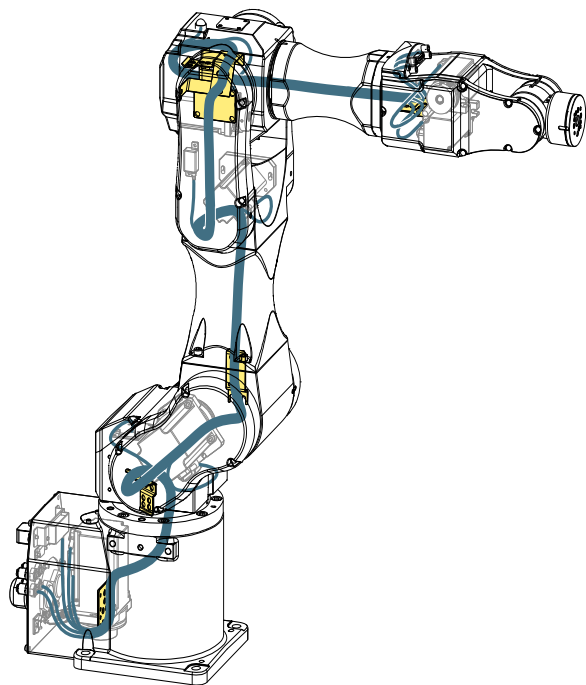
4. Bind the Arm3 cable fixing plate to the cable protection spring (17.5 dia.).

Wire tie: AB100

Number of turns of spring to fix: 3 turns



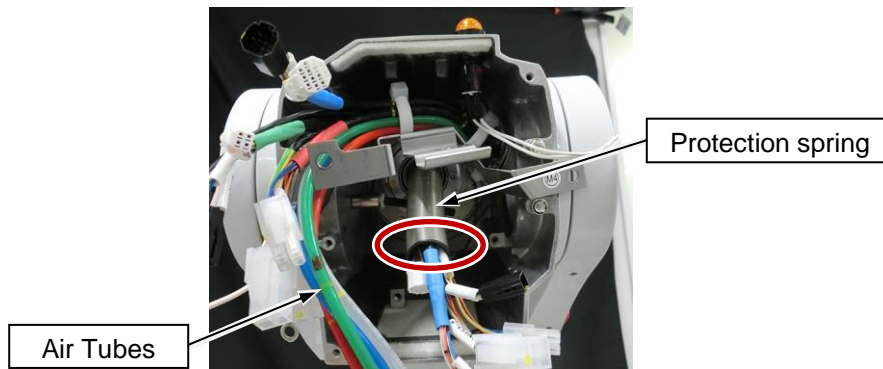
Installing the Cable Unit



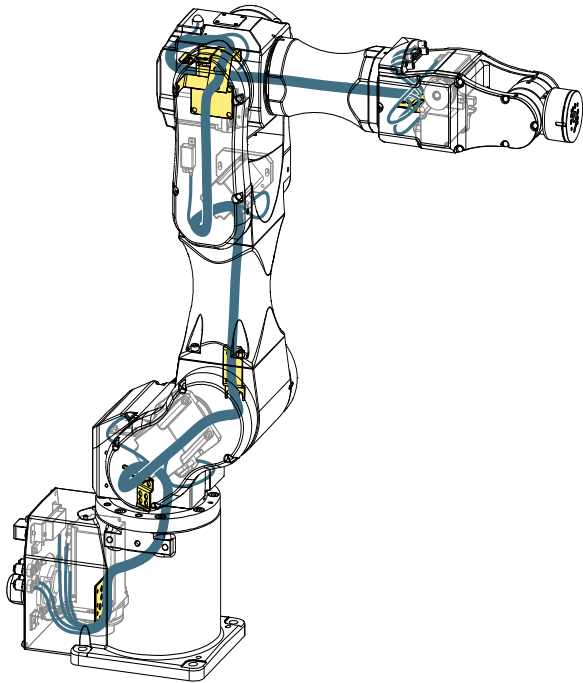
5. Pass the four Air Tubes of the Cable Unit and the Ground Wire (PE11) through the cable protection spring (17.5 dia.) and pull them out of Arm4.

POINT

Pass the Air Tubes through the space at the top of the protection spring such that it is not crushed by the cables.



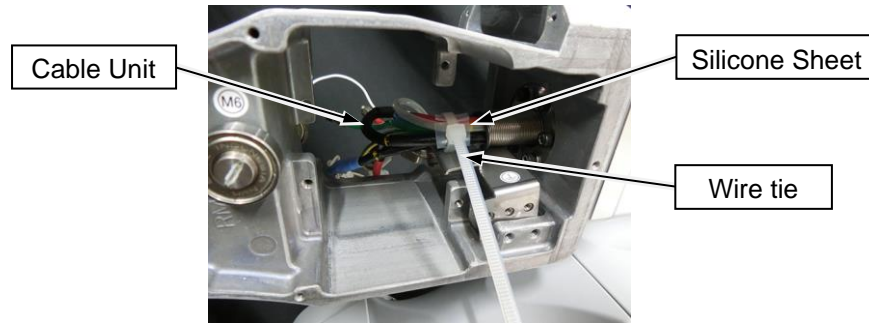
Installing the Cable Unit



6. Temporarily bind the Cable Unit to the Arm4 cable bracket.

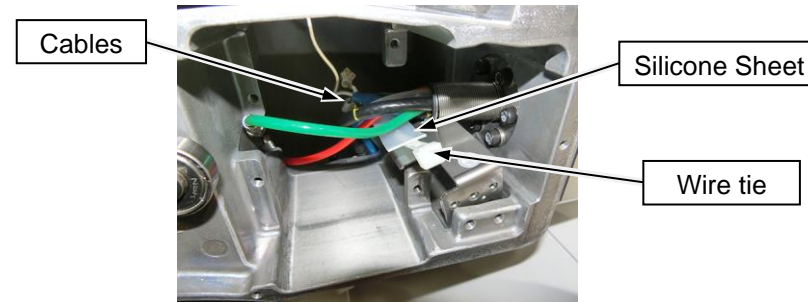
Wire tie: AB200

Silicone Sheet: 15 mm x 50 mm



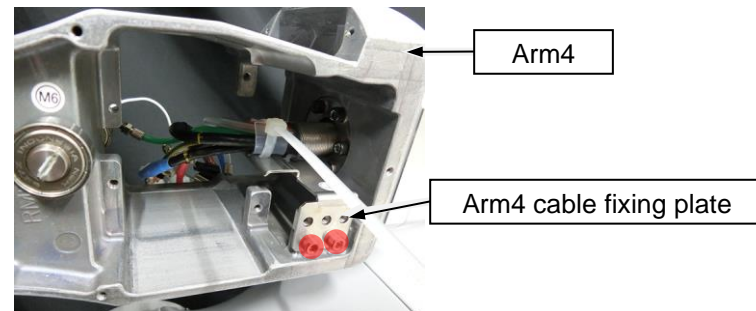
POINT

As shown in the figure, put the Silicone Sheet on the plate and wrap it around the cables. Adjust the position where the Silicone Sheet is placed so that it can be tied at its center position.

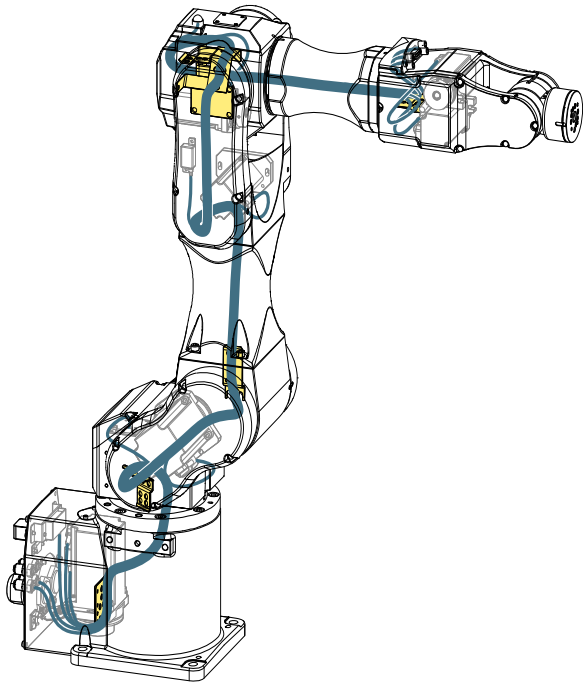


7. Secure the Arm4 cable fixing plate to Arm4.

A S01: 2-M4x8
(4.0 +/- 0.2 N·m)



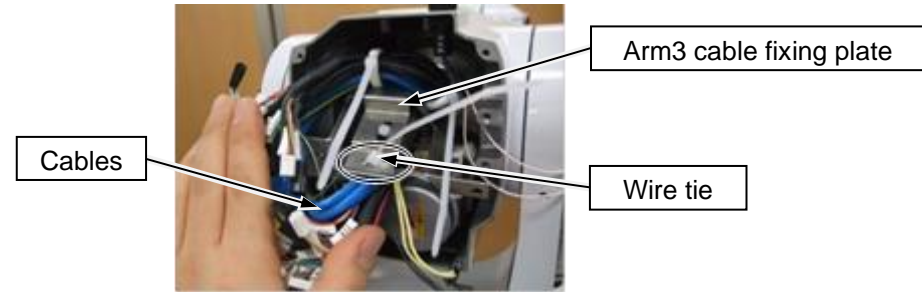
Installing the Cable Unit



8. Temporarily fasten the cables coming out of Arm4 to the Arm3 cable fixing plate.

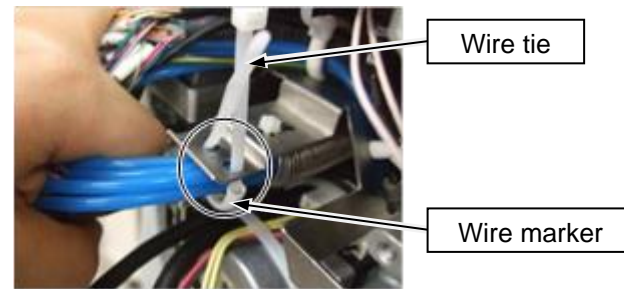
Wire tie: AB150

Wire marker: 46 mm

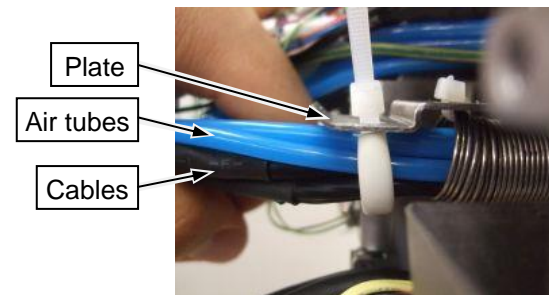


POINT

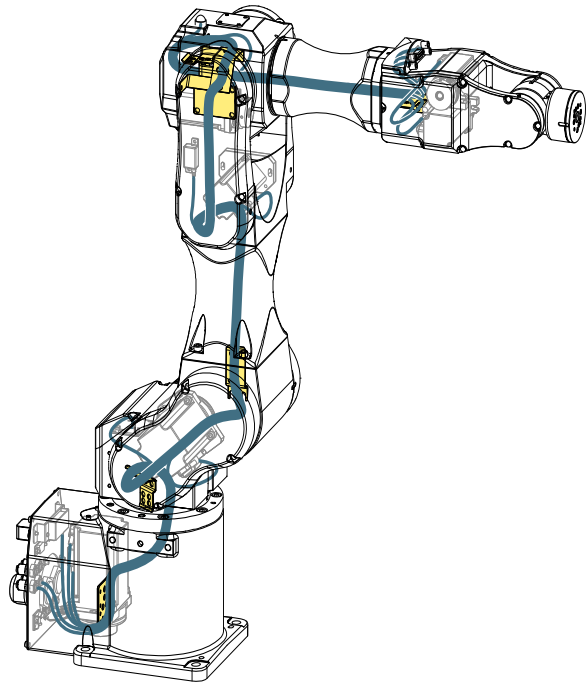
- Attach a wire marker to the wire tie.



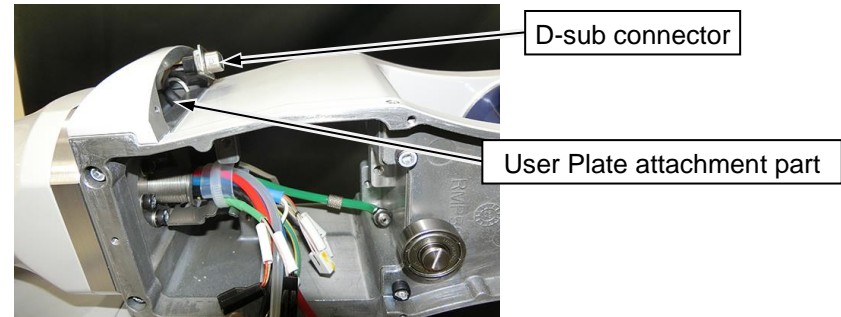
- As shown in the figure, insert the Air Tubes between the plate and cables, and secure the Cable Unit.



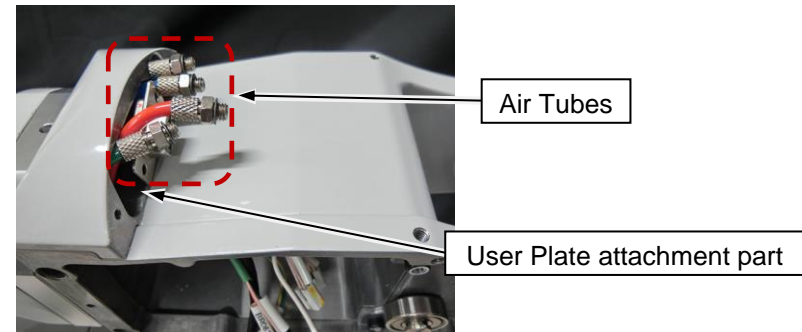
Installing the Cable Unit



9. Pull out the D-sub connector to the User Plate attachment part.

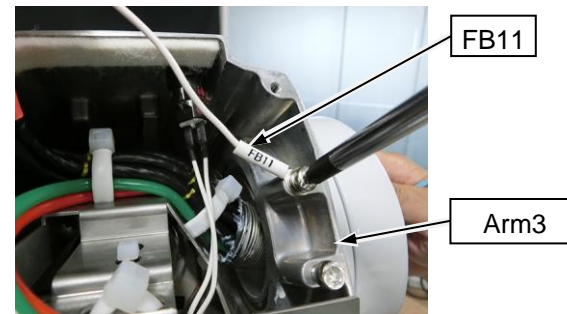


10. Pull out the four Air Tubes to the User Plate attachment part.

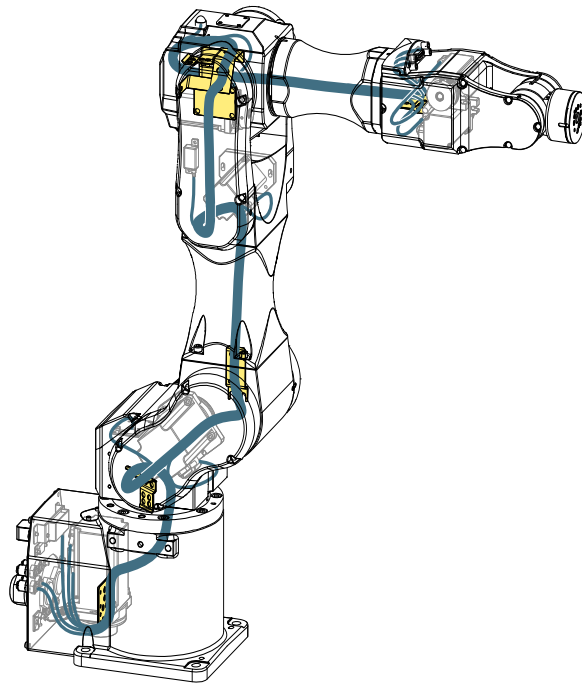


11. Connect the Ground Wire (FB11) to Arm3.

A S04: 1-M4x6
with washer
(0.9 +/- 0.1 N·m)

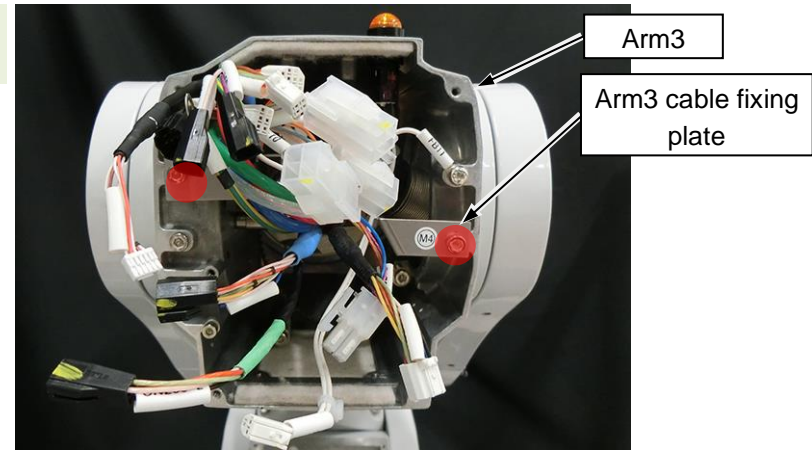


Installing the Cable Unit



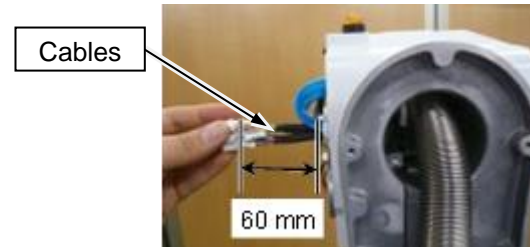
12. Temporarily secure the Arm3 cable fixing plate to Arm3.

- A S01: 2-M4x8
(4.0 +/- 0.2)

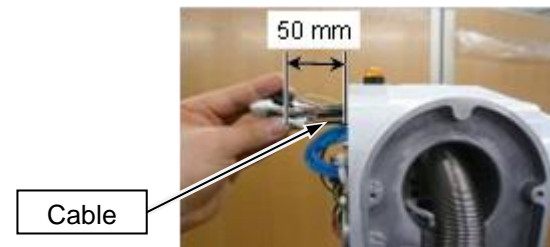


13. Adjust the lengths of the cables and Air Tubes inside Arm3.

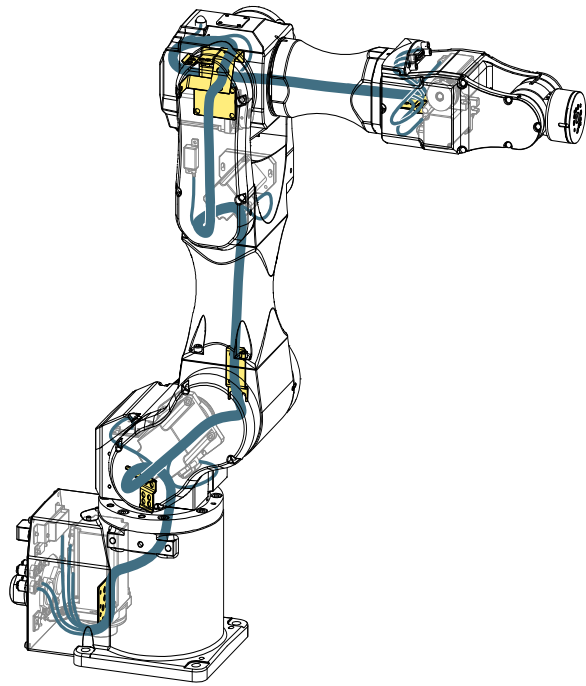
- Cables from Arm4
Set the length from the Arm3 cable fixing plate to each connector to 60 mm.
Connectors: CN203, CN152, CN162, CN521, PE9



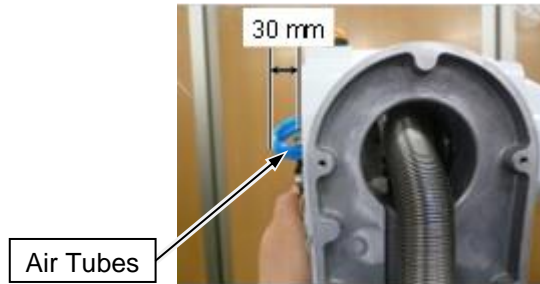
- Cables from Arm2
Set the length from Arm3 to each connector to 50 mm.
BR041, CN203, CN141, CN341, CN152, CN162, CN302, CN521, PE10, LED



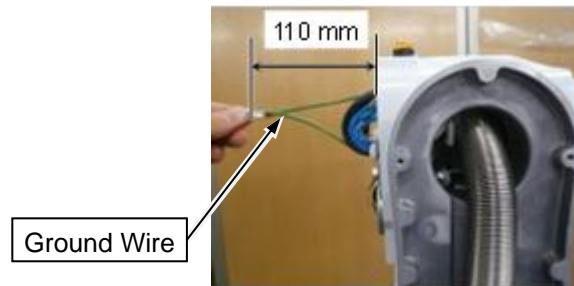
Installing the Cable Unit



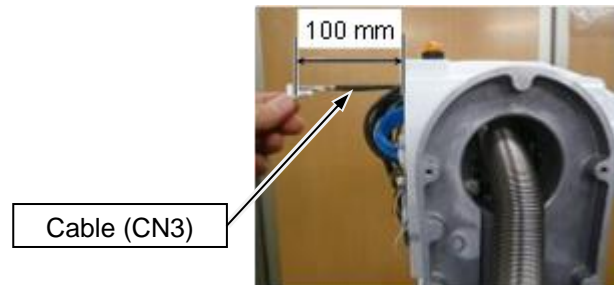
- Air Tubes
Set the bulge of the Air Tubes from Arm3 to 30 mm.



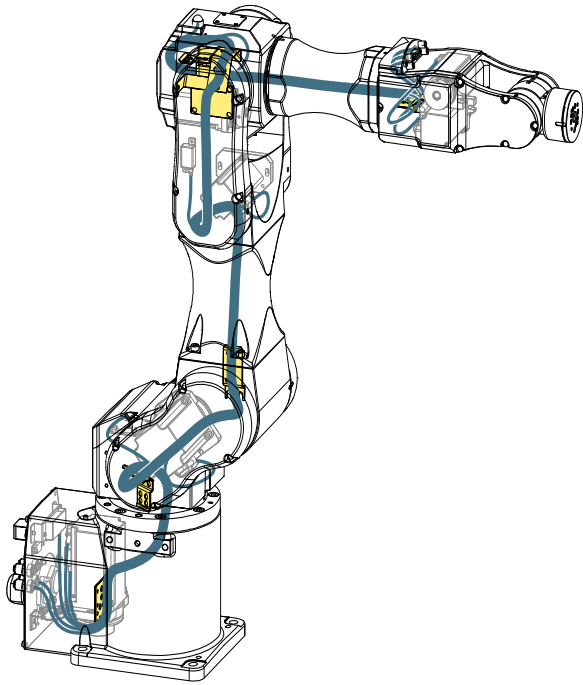
- Ground Wire
Set the length from the Arm3 cable fixing plate to the Ground Wire terminal to 110 mm.



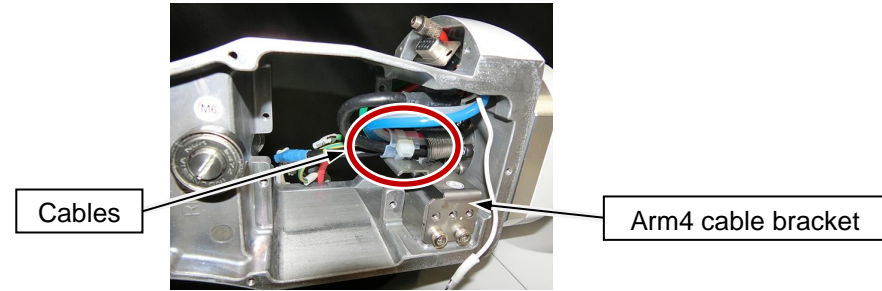
- Cable (CN3) connected to gyro board 2
Set the length from Arm3 to the connector to 100 mm.



Installing the Cable Unit

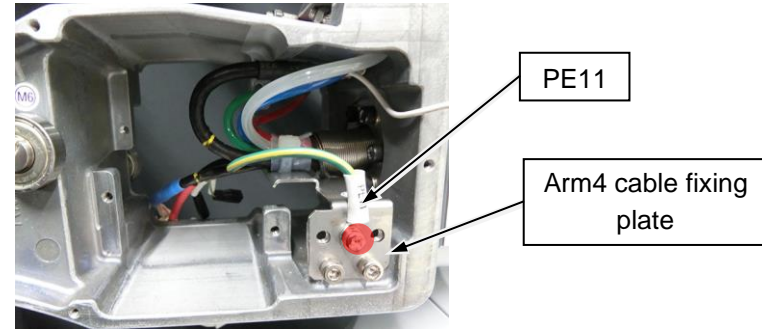


14. Secure the temporarily fixed cables to the Arm4 cable bracket.



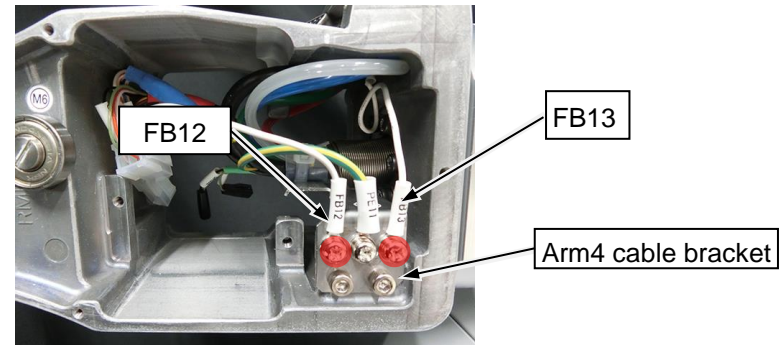
15. Attach the Ground Wire (PE11) to the Arm4 cable fixing plate.

A S04: 1-M4x8
(0.45 +/- 0.1 N·m)

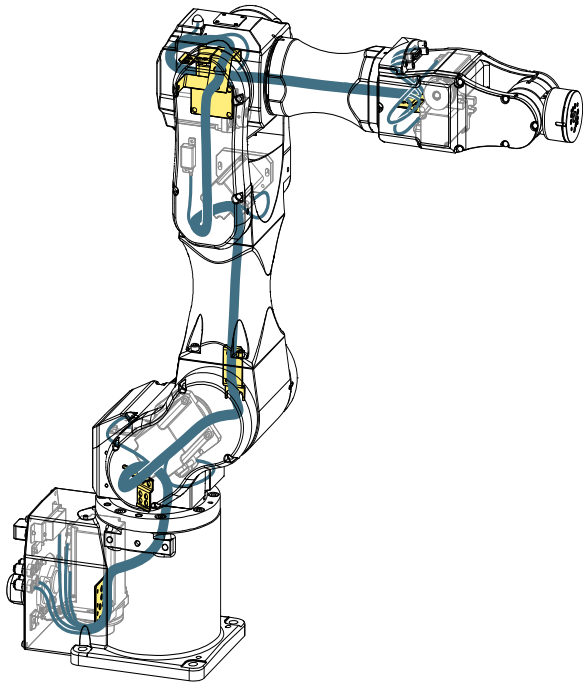


16. Secure the Ground Wires (FB12, FB13) to the Arm4 cable bracket.

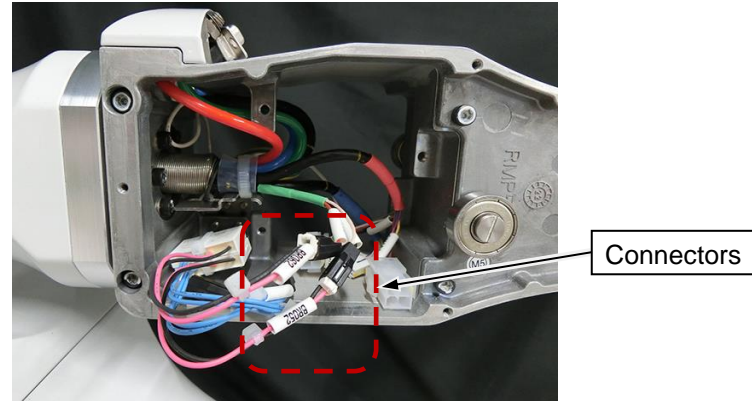
A S04: 2-M4x8
(0.45 +/- 0.1 N·m)



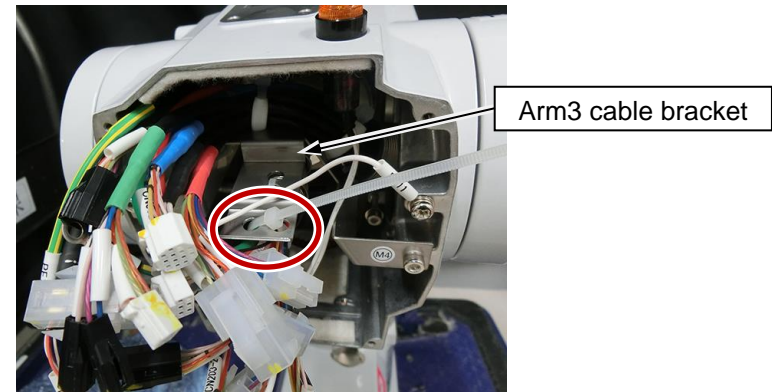
Installing the Cable Unit



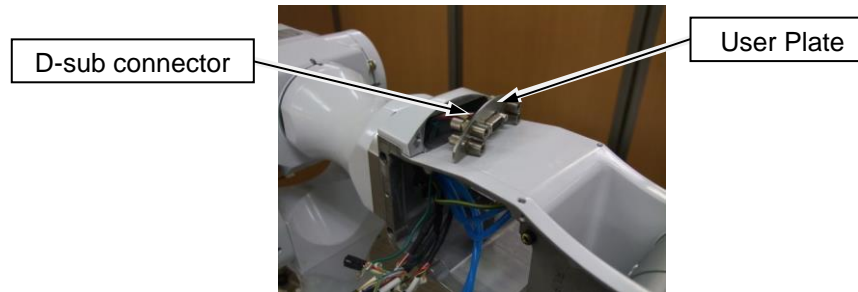
17. Connect the connectors (BR052, BR062) inside Arm4.



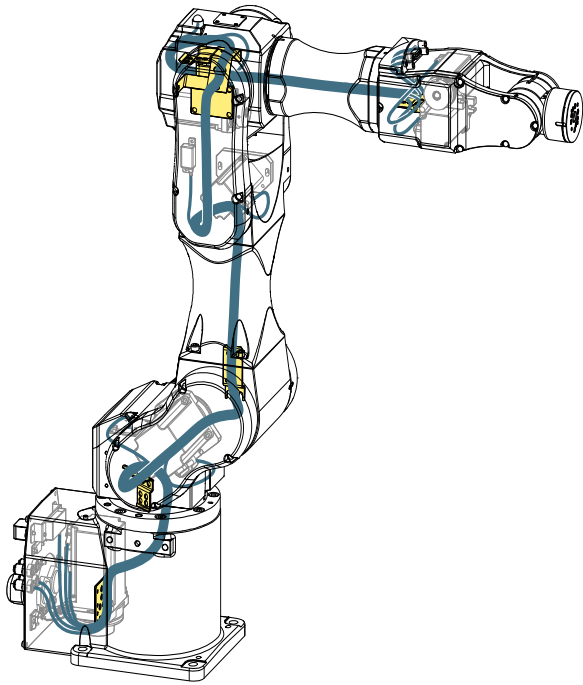
18. Secure the temporarily fixed cables to the Arm3 cable fixing plate.



19. Attach the D-sub connector to the User Plate.

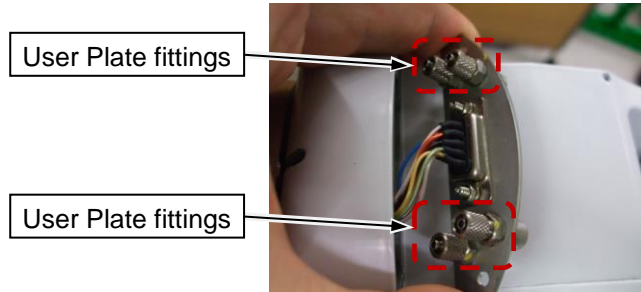


Installing the Cable Unit

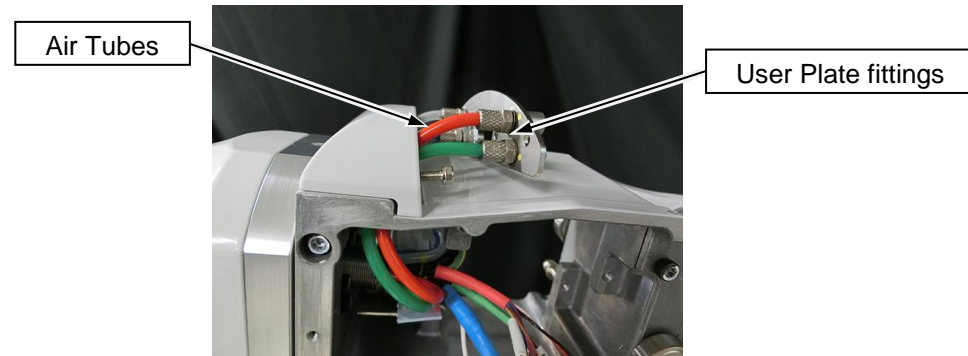


POINT

Attach the D-sub connector so that the User Plate fittings on the User Plate are oriented toward Arm4.

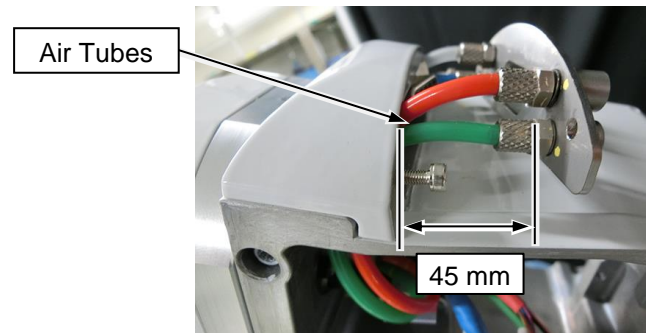


20. Attach the four Air Tubes to the User Plate fittings on the user plate.

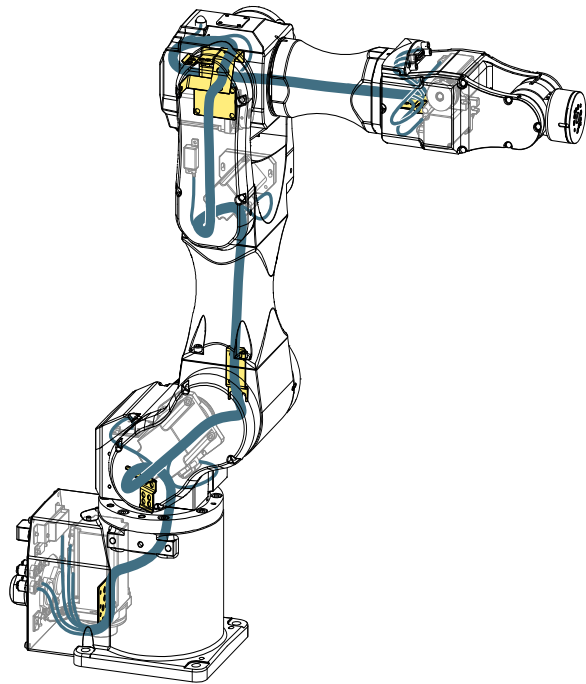


POINT

Set the amount that the Air Tubes protrude to 45 mm.



Installing the Cable Unit



21. Install the User Plate on Arm4.

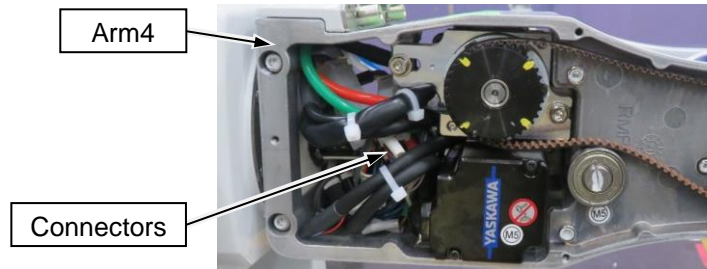
- A S01: 2-M3x6
(2.0 +/- 0.1 N·m)



22. Install the [J5 Motor unit](#) and [J5 Timing Belt](#).

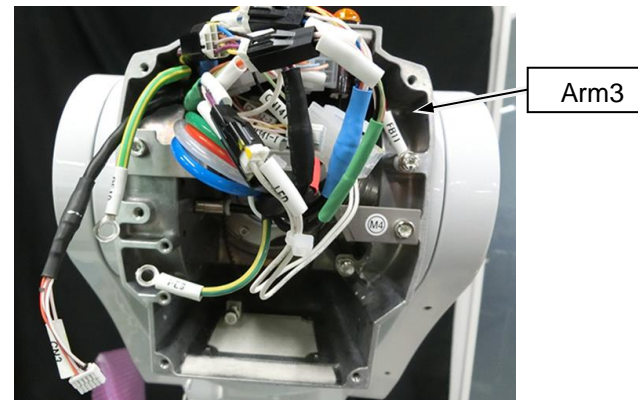
23. Install the [J6 Motor unit](#) and [J6 Timing Belt](#).

24. Gather the connected connectors inside Arm4.



25. Connect the following connectors inside Arm3.

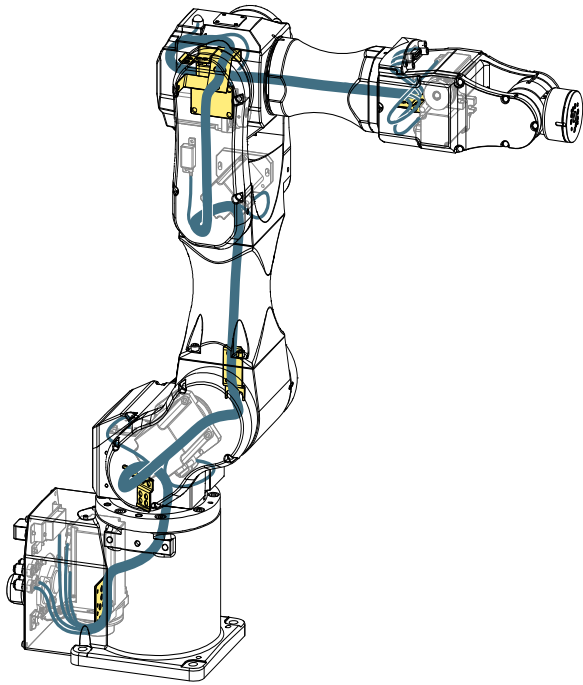
LED, CN203, CN152, CN162, CN302, CN521



26. Install the [J4 Motor unit](#).

Perform steps ❶ to ❹.

Installing the Cable Unit



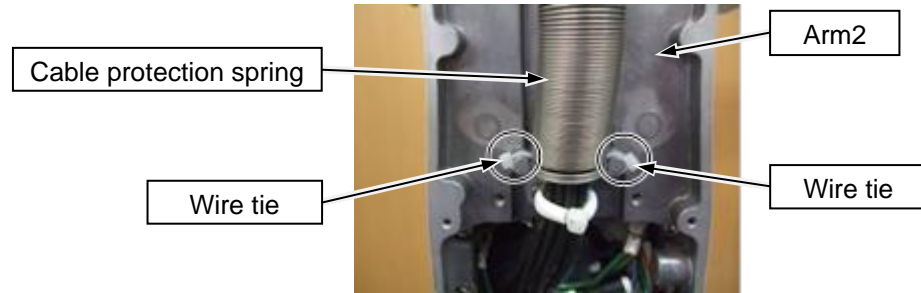
3

Secure the Cable Unit to Arm2.

1. Secure the cable protection spring (25 dia. x 130 mm) to Arm2.

Wire tie: AB100 x 2

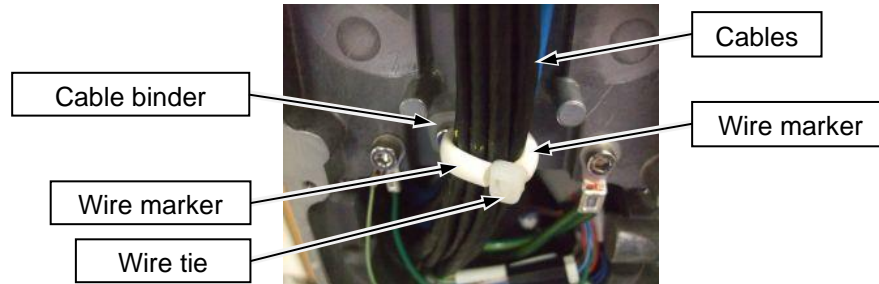
Number of turns of spring to fix: 3 turns



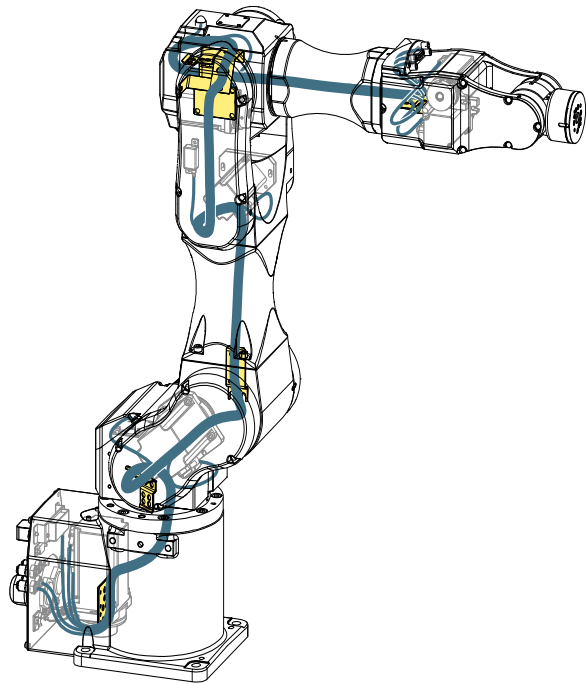
2. Temporarily secure the cables to the cable binder.

Wire tie: AB150

Wire marker: 21 mm x 2

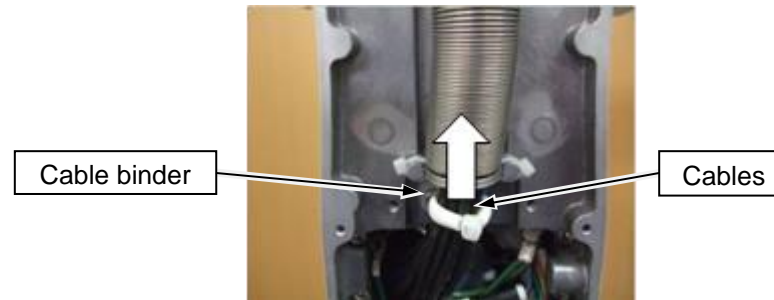


Installing the Cable Unit



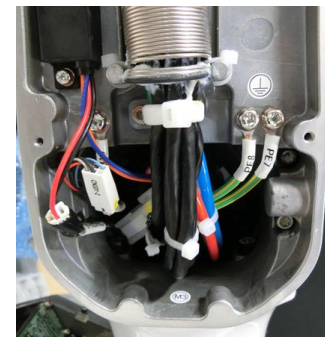
3. Push the cables in the direction of the arrow and secure the temporarily fixed cables to the cable binder.

Distance pushed in: 10 mm

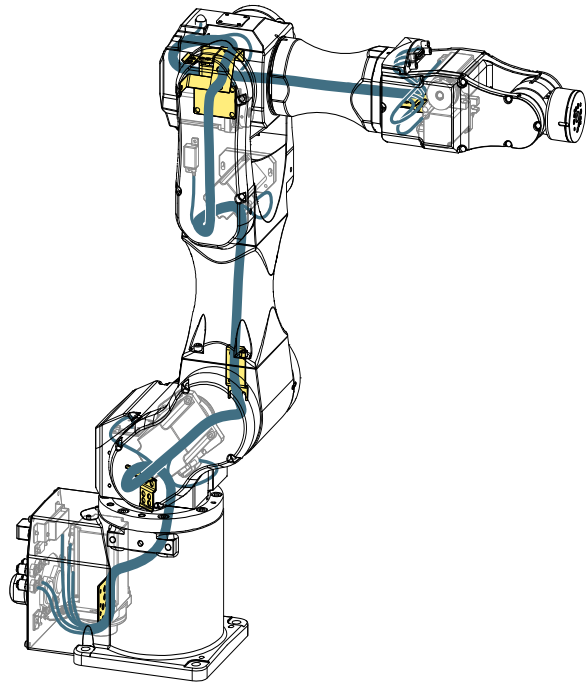


4. Install the [J3 Motor unit](#) and [J3 Timing Belt](#).

5. Connect the brake connectors (CN430, CN431) to the brake power supply.

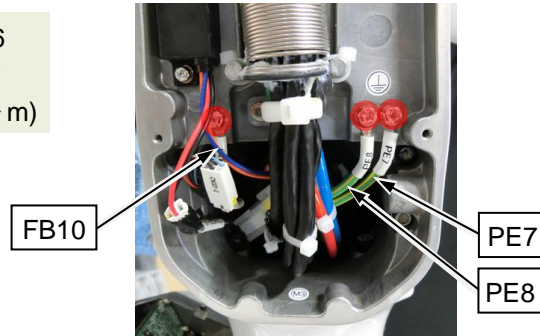


Installing the Cable Unit

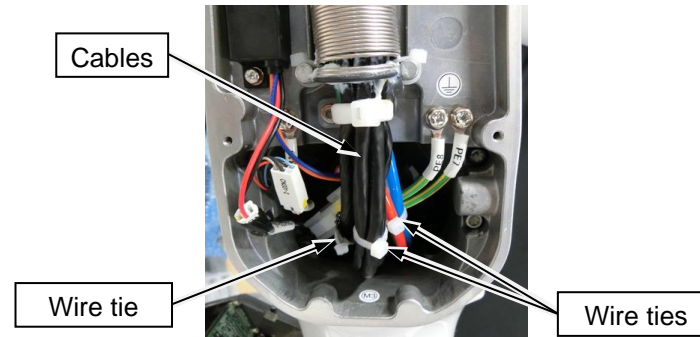


6. Connect the Ground Wires (PE7, PE8, FB10) to Arm2.

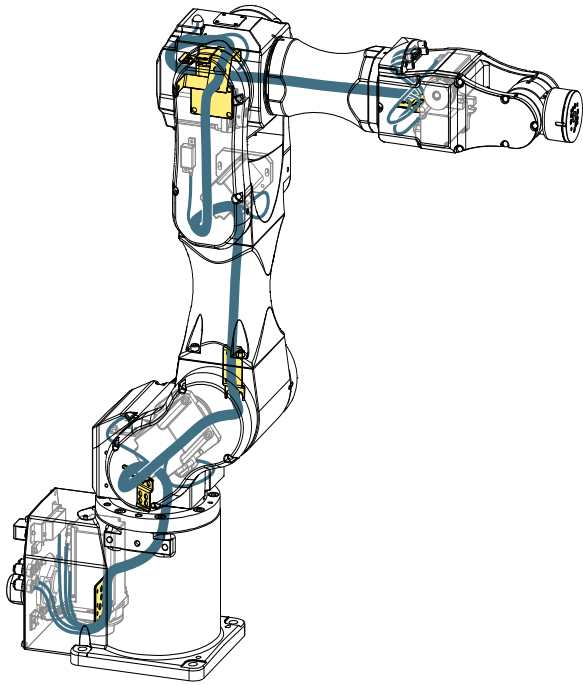
A S02: 3-M4x6
with washer
(0.45 +/- 0.1 N·m)



7. Bundle the Arm2 cables together with wire ties, as shown in the figure.



Installing the Cable Unit



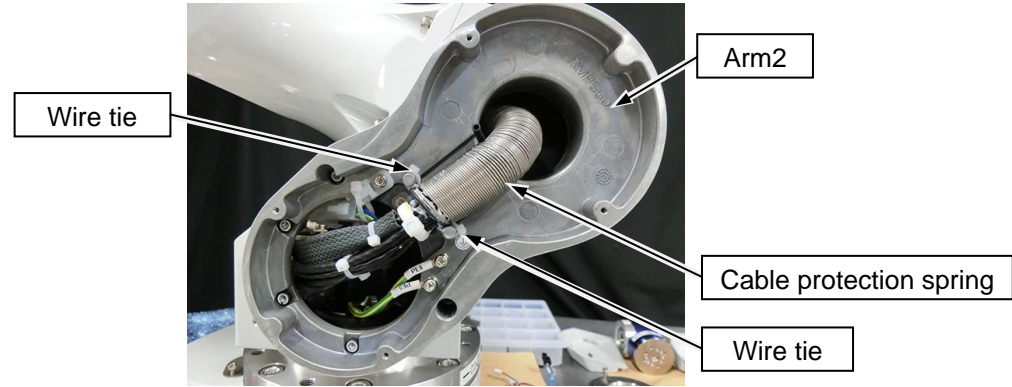
4

Secure the Cable Unit to Arm1.

1. Secure the cable protection spring (25 dia. x 130 mm) to Arm1.

Wire tie: AB100 x 2

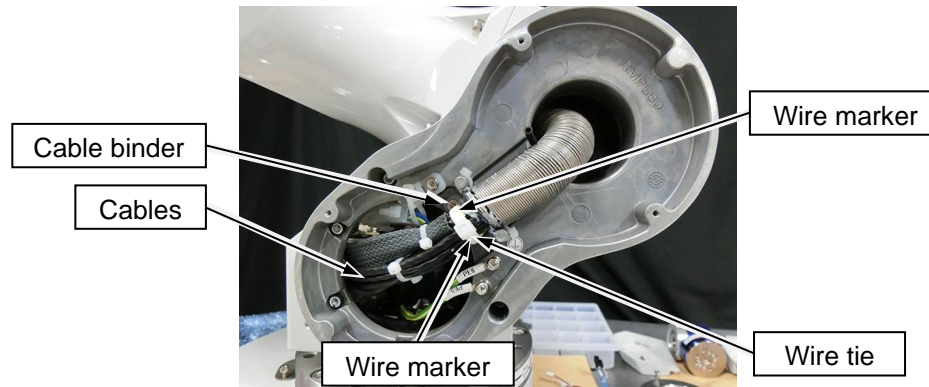
Number of turns of spring to fix: 3 turns



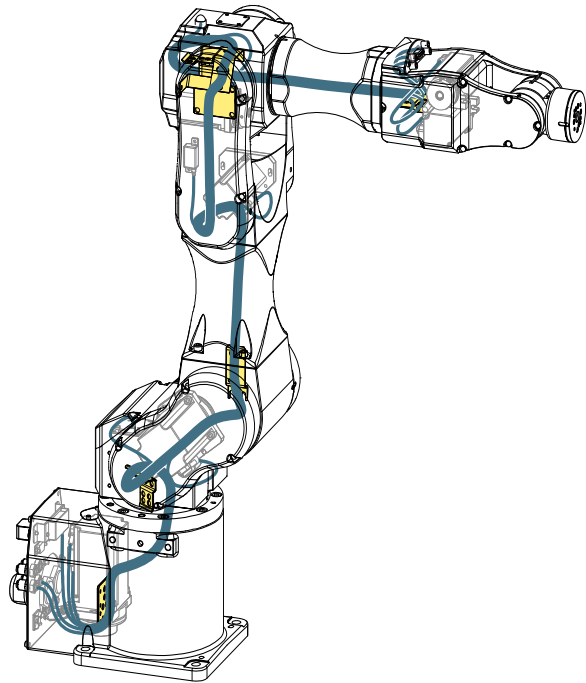
2. Temporarily secure the cables to the cable binder.

Wire tie: AB150

Wire marker: 23 mm x 2

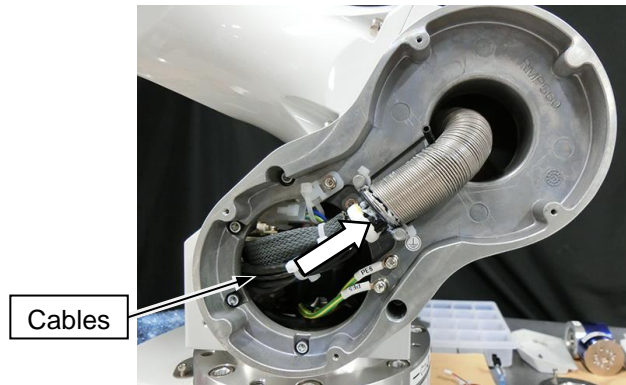


Installing the Cable Unit



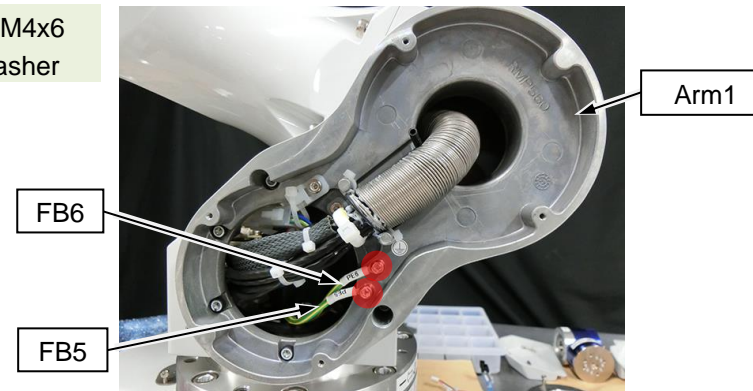
3. Push the cables in the direction of the arrow and secure the temporarily fixed cables to the cable binder.

Distance pushed in: 6 mm

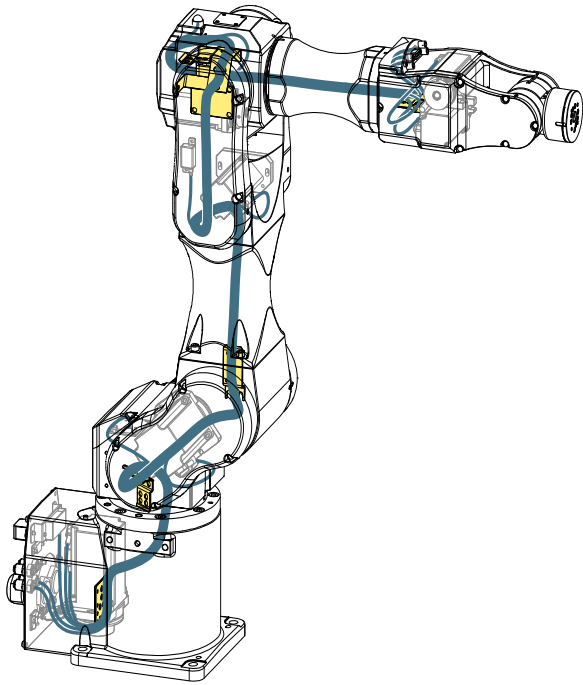


4. Connect the Ground Wires (FB5, FB6) to Arm1.

A S02: 3-M4x6 with washer



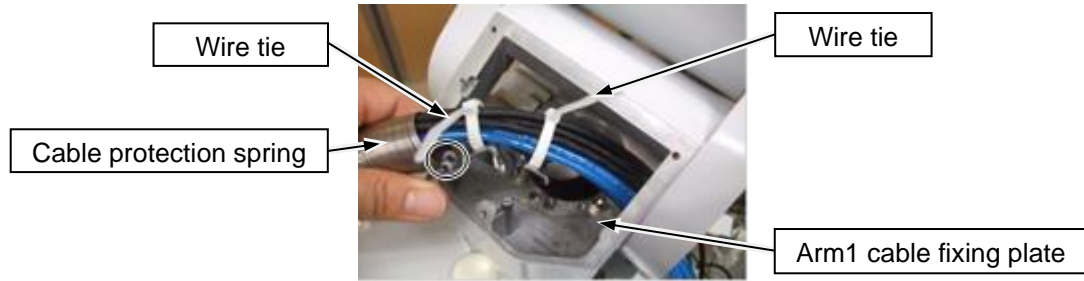
Installing the Cable Unit



5. Bind the cable protection spring (25 dia. x 130 mm) to the Arm1 cable fixing plate.

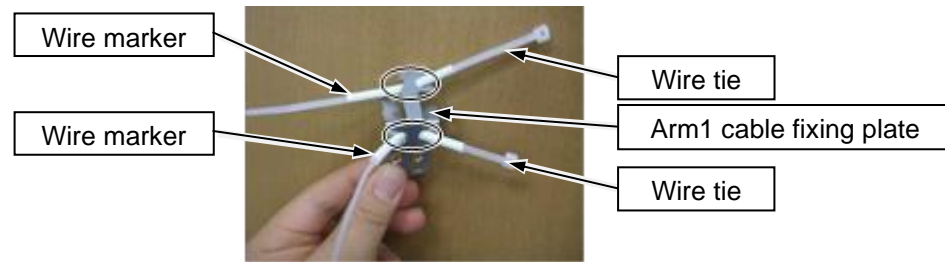
Wire tie: AB100 x 2

Number of turns of spring to fix: 3 turns

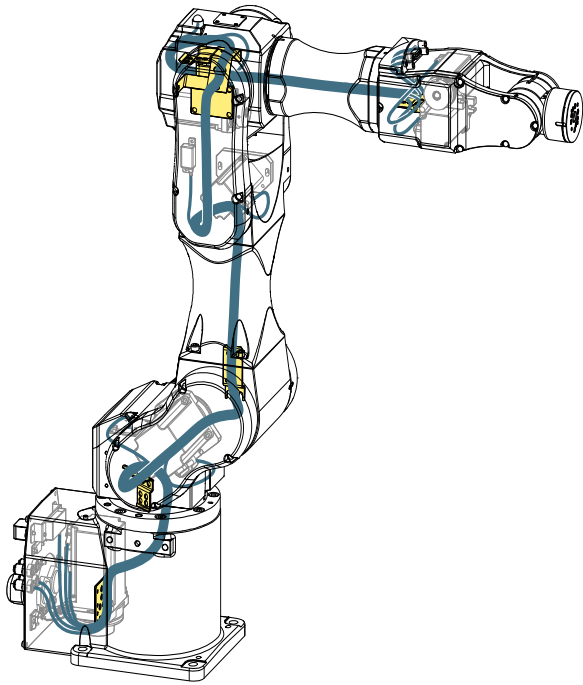


POINT

Bind the protection spring and the cables to the Arm1 cable fixing plate. Before binding the protection spring, put wire markers on the wire ties.



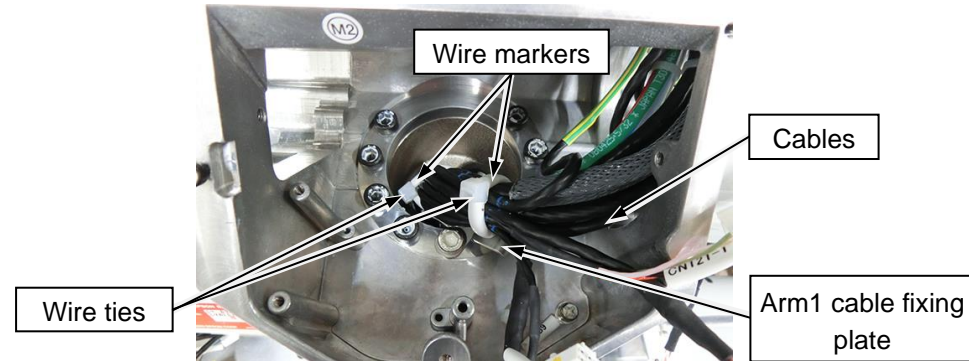
Installing the Cable Unit



6. Temporarily fasten the cables to the Arm1 cable fixing plate.

Wire tie: AB150 x 2

Wire marker: 68 mm x 2

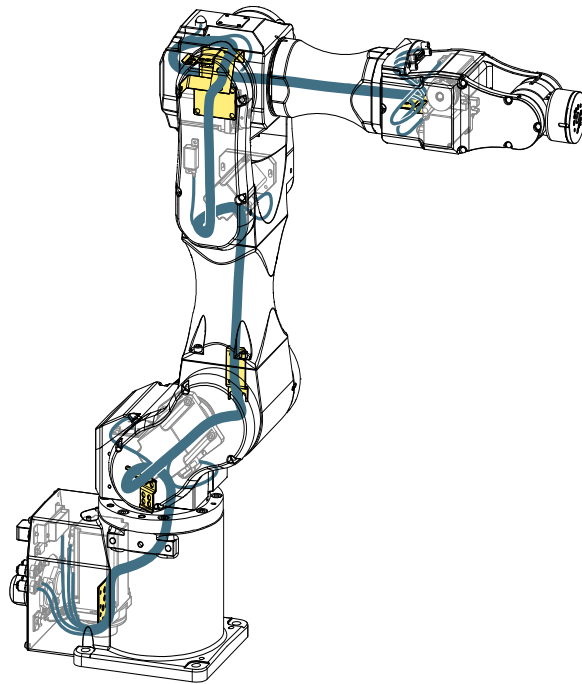


POINT

Position the head of the wire tie to the side of the cable, as shown in the figure.

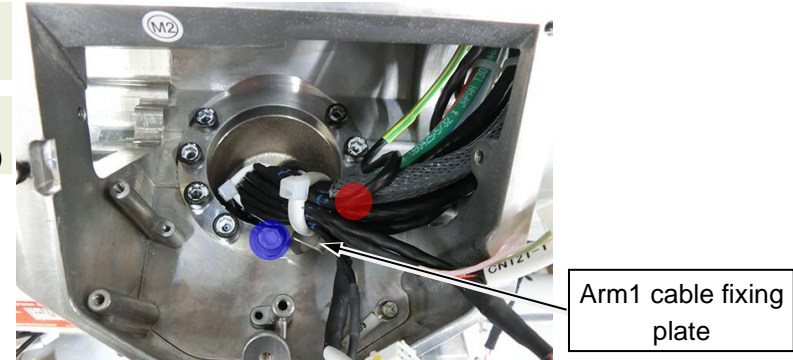


Installing the Cable Unit

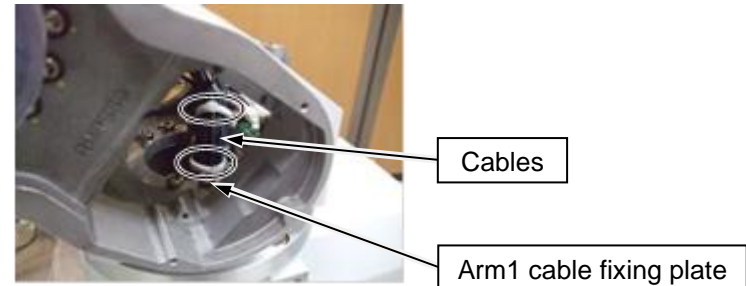


7. Secure the Arm1 cable fixing plate to Arm1.

- A S01: 1-M4x8
(4.0 +/- 0.2 N·m)
- B S01: 1-M6x20
(13.0 +/- 0.65 N·m)

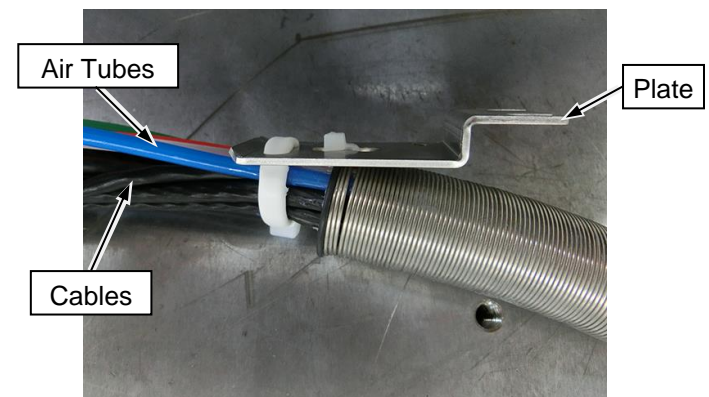


8. Secure the temporarily fixed cables to the Arm1 cable fixing plate.

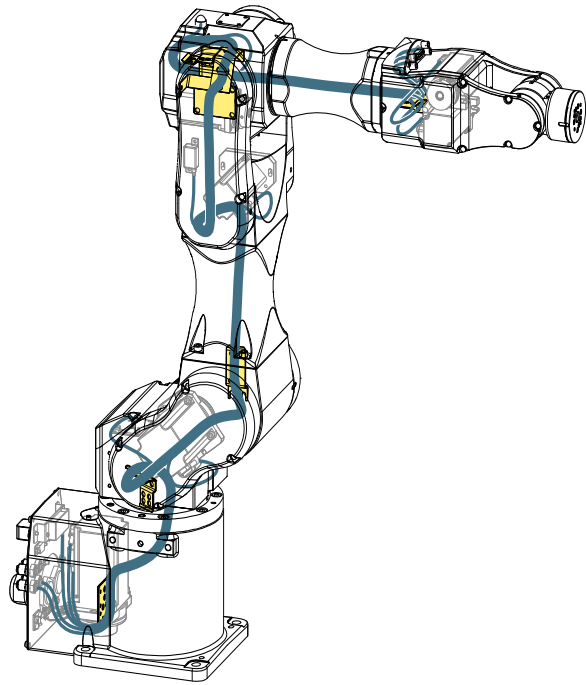


POINT

As shown in the figure, insert the Air Tubes between the plate and cables, and secure the cables to the plate.



Installing the Cable Unit

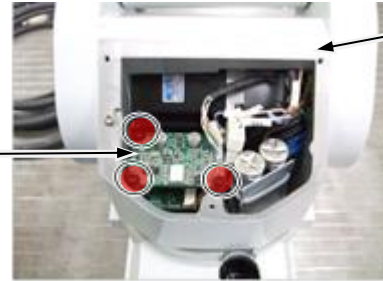


9. Install the [J2 Motor unit](#) and [J2 Timing Belt](#).

10. Install the gyro board 1 and gyro board 1 protective plate on Arm1.

A S04: 3-M3x15
(0.45 +/- 0.1 N·m)

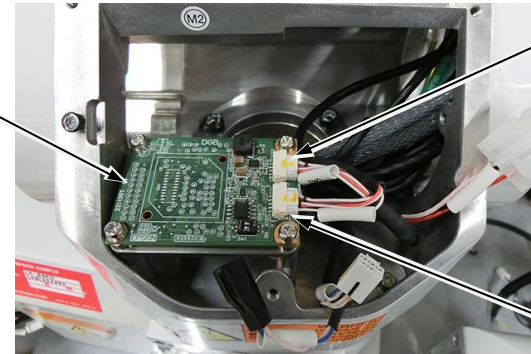
Gyro board 1



Arm1

11. Connect the connectors (CN3, CN6) to gyro board 1.

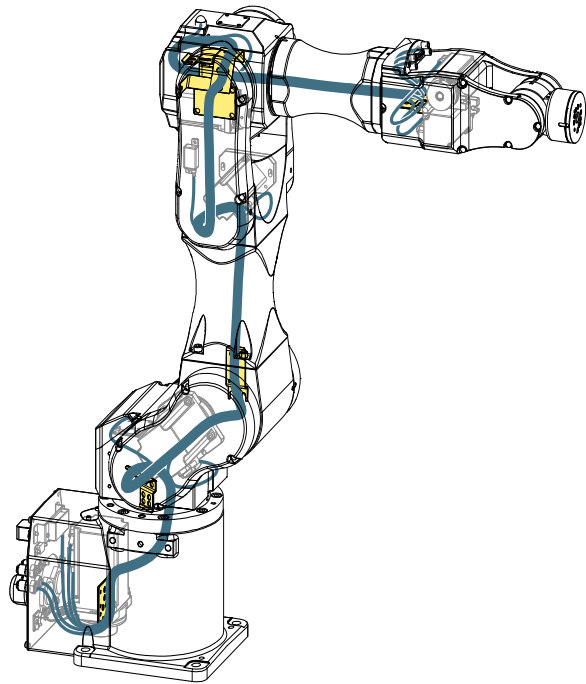
Gyro board 1



CN3

CN6

Installing the Cable Unit



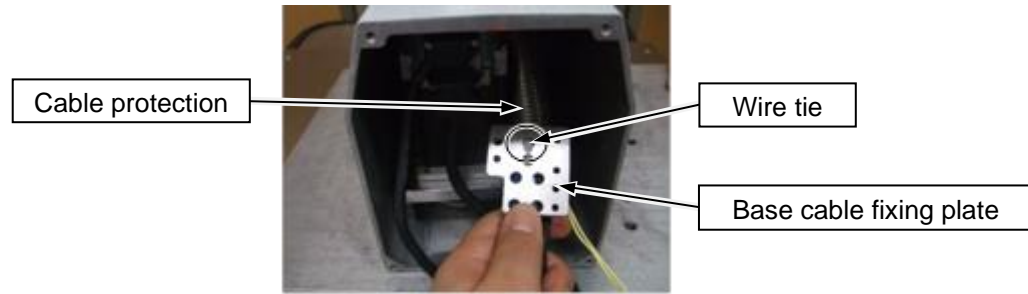
5

Secure the Cable Unit to the base.

1. Bind the cable protection spring (29 dia. x 130 mm) to the base cable fixing plate.

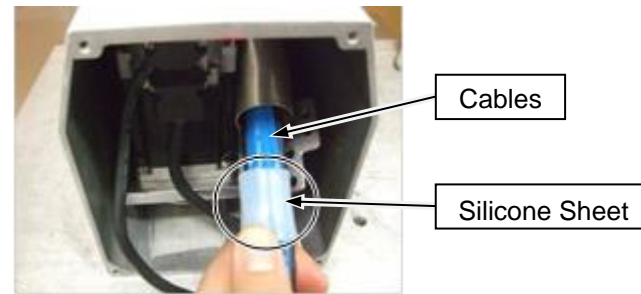
Wire tie: AB100

Number of turns of spring to fix: 3 turns

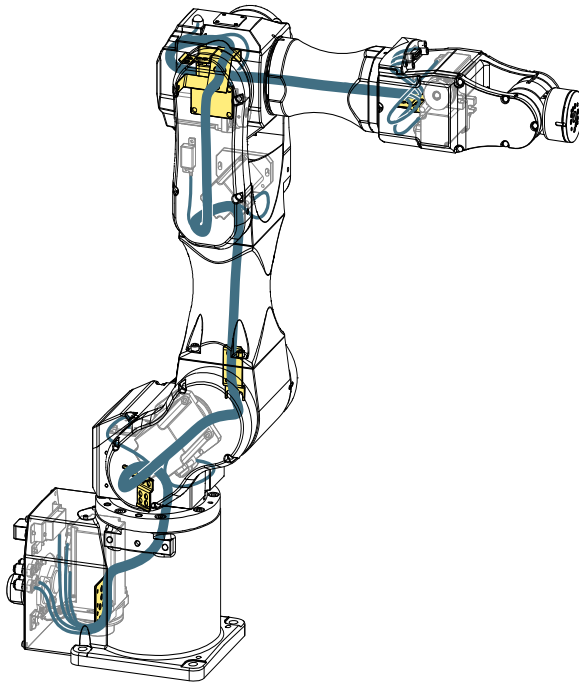


2. Wrap the Silicone Sheet around the cables, as shown in the figure.

Silicone Sheet: 30 mm x 150 mm

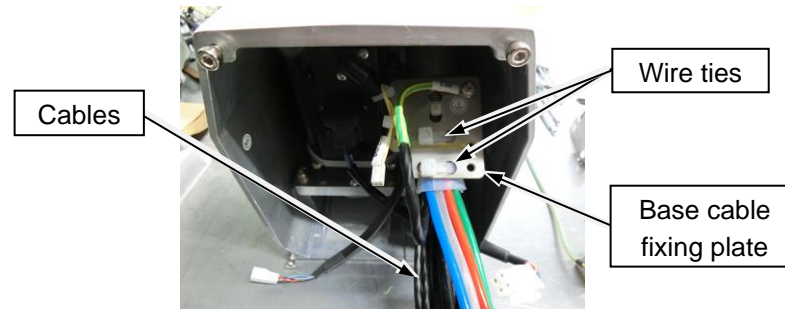


Installing the Cable Unit



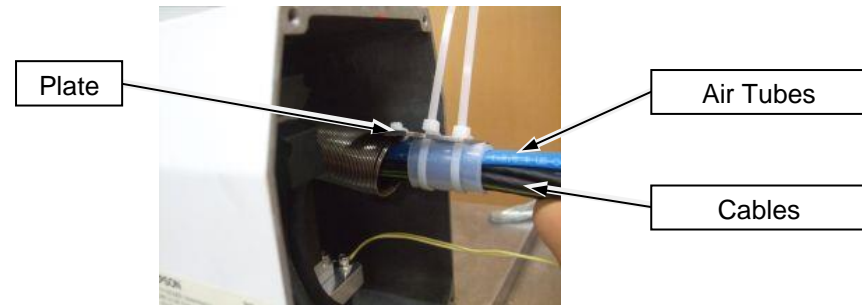
3. Temporarily secure the cables wrapped in the Silicone Sheet to the base cable fixing plate.

Wire tie: AB150 x 2

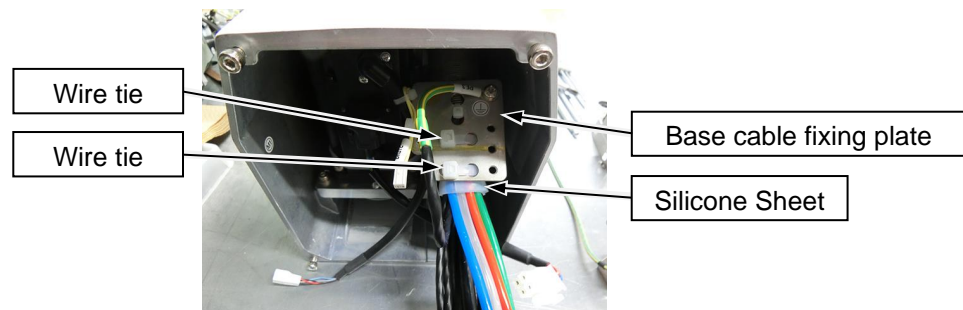


POINT

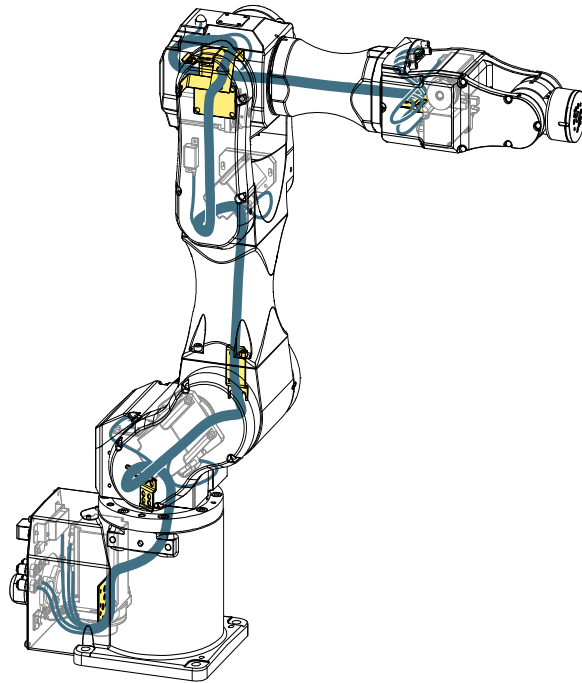
- As shown in the figure, insert the Air Tubes between the plate and cables, and secure the Cable Unit to the plate.



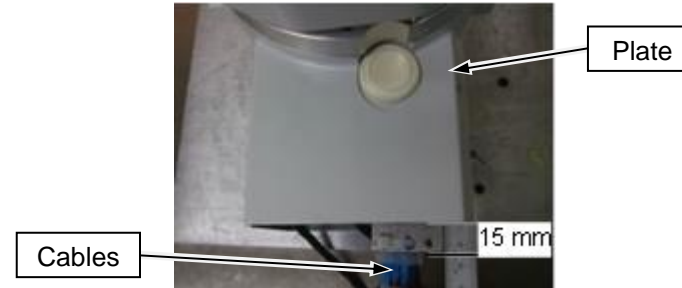
- Make sure that the Silicone Sheet is protruding 5 mm from the base cable fixing plate, and secure it with a wire tie.



Installing the Cable Unit



4. Pull the cables and adjust the position of the plate.
Plate position: 15 mm

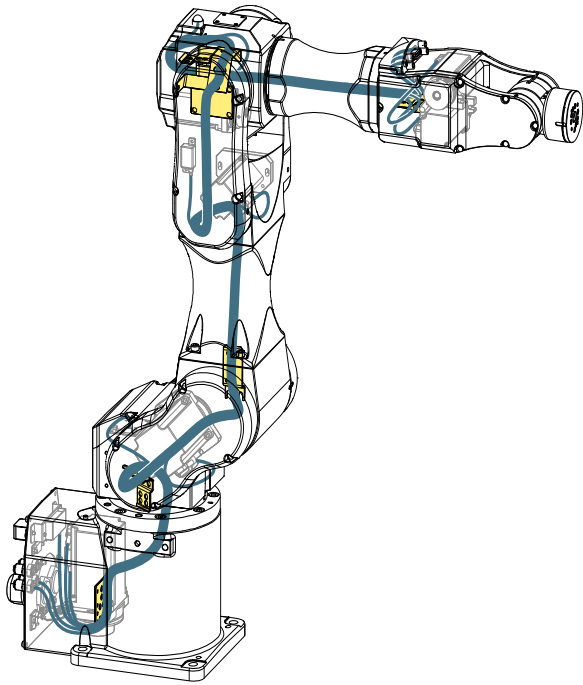


5. Secure the cables that are temporarily secured with wire ties to the base cable fixing plate.
6. Secure the base cable fixing plate to the base.

A S01: 2-M4x8
(4.0 +/- 0.2 N·m)



Installing the Cable Unit

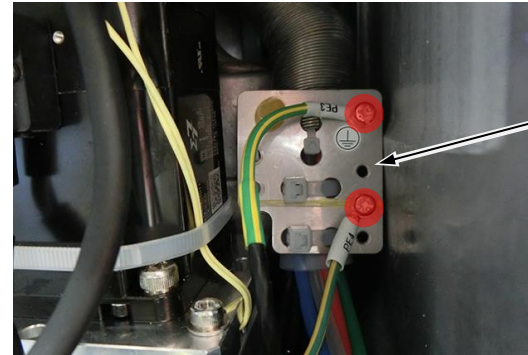


7. Attach the Ground Wires (PE3, PE4) to the base cable fixing plate.

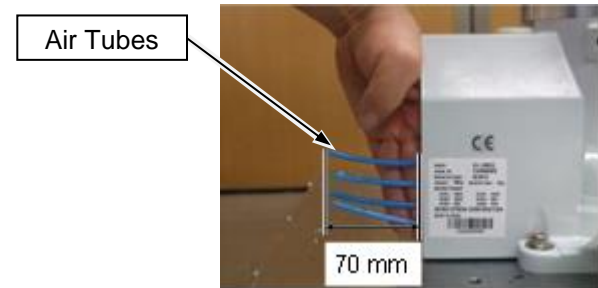
POINT

Orient the terminals as shown in the figure and secure them.

- A S02: 2-M4x6 with washer (0.45 +/- 0.1 N·m)



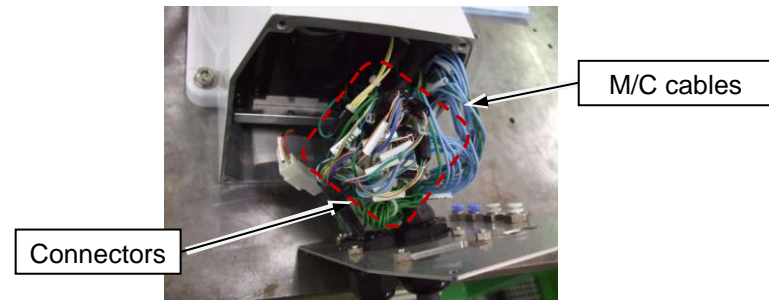
8. Cut the Air Tubes to a length of about 70 mm from the base end face.



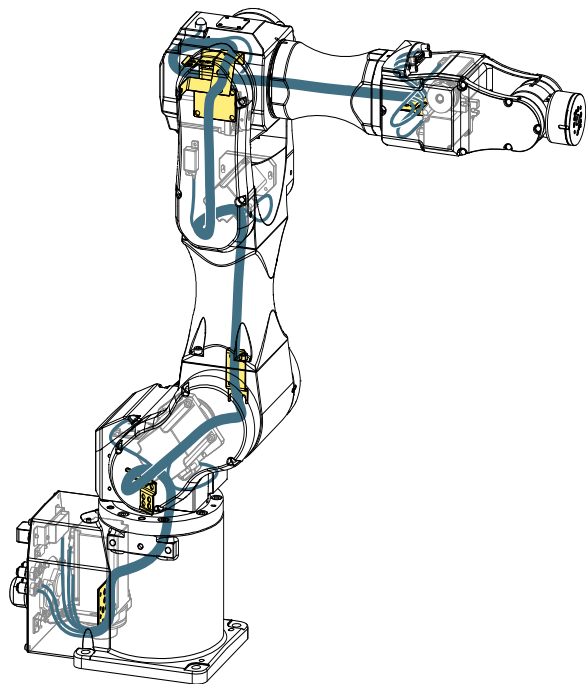
9. Insert the Air Tubes into the air tube fittings on the Connector Plate.

10. Connect the following connectors to the M/C cables.

- SUB-B (CN1, CN2, CN3),
- CN3L1, CN3G0, CN111,
- CN200, CN201, CN202,
- CN300, CN301, CN312,
- D-sub 9-pin connector,
- B-release connector



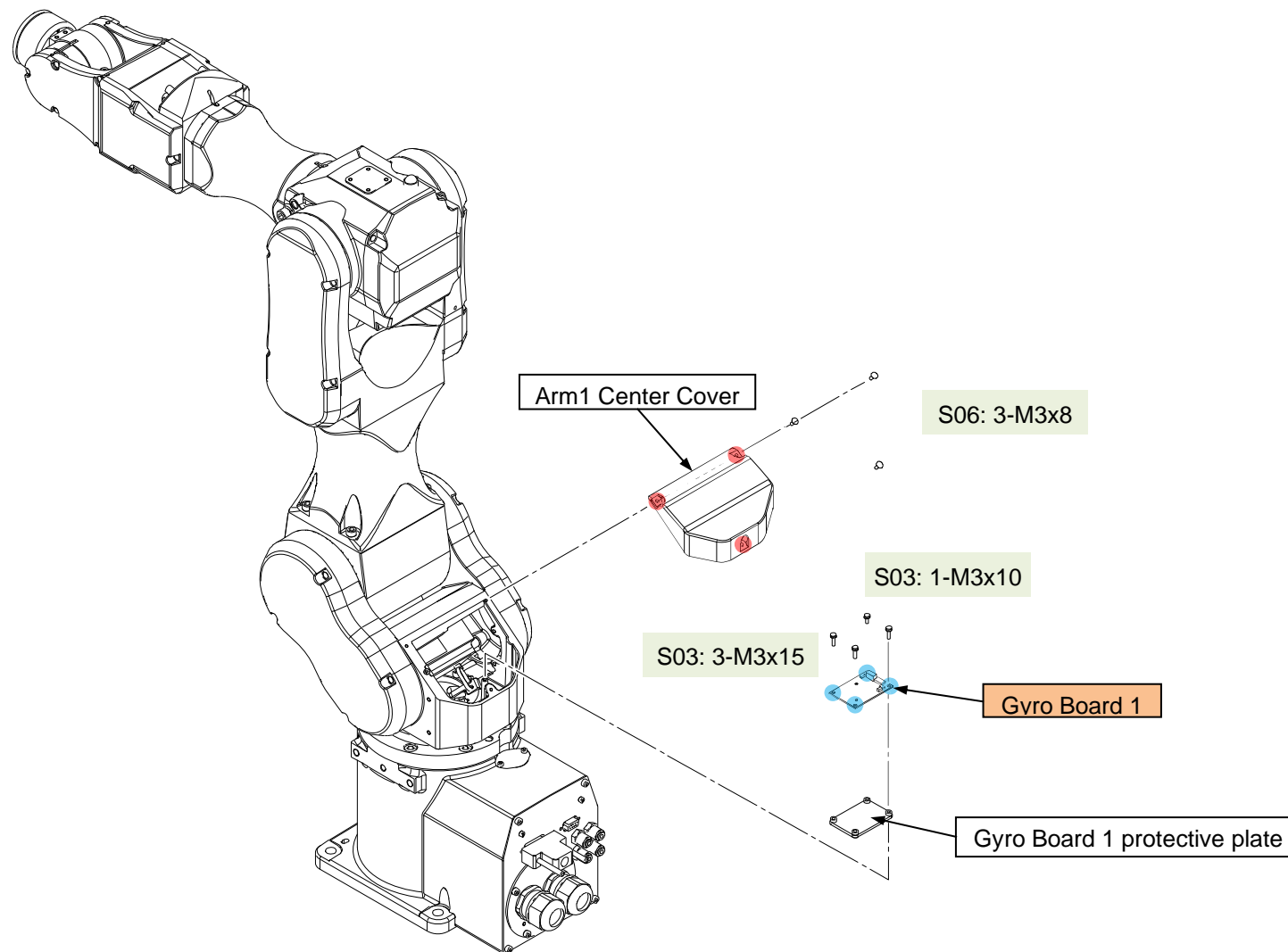
Installing the Cable Unit



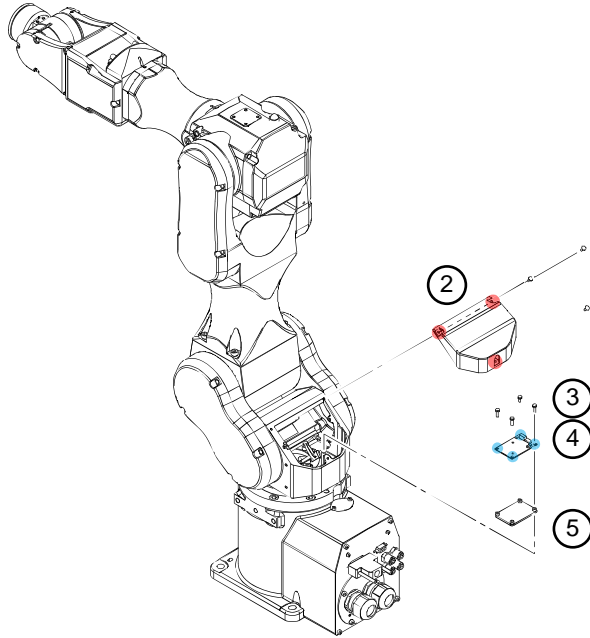
- | | |
|---|--|
| 6 | <p>Install the following parts.</p> <ul style="list-style-type: none">• Arm4 side cover• Arm3 head cover• Arm3 Maintenance Cover• Arm2 side cover• Arm1 side cover• Arm1 Center Cover• Connector Plate |
| 7 | <p>After assembly, perform calibration of each joint.
3.2 Calibration</p> |


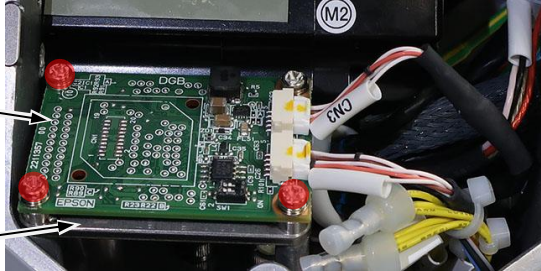
2.10 Replacing the Board

2.10.1 Replacing Gyro Board 1

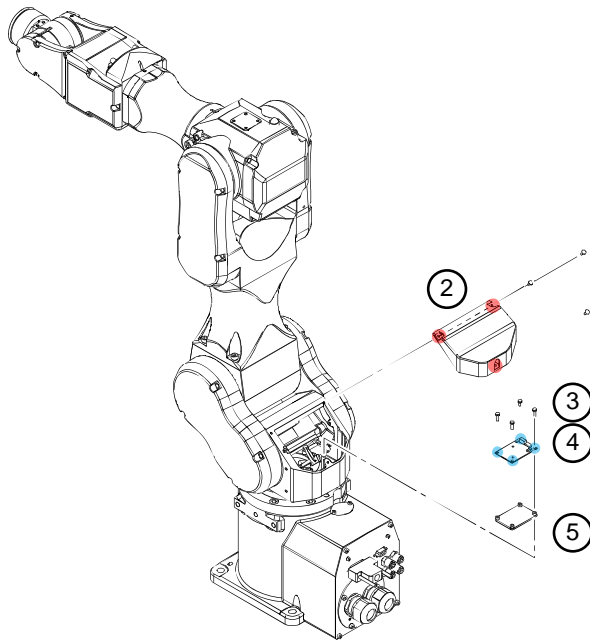


Removing Gyro Board 1



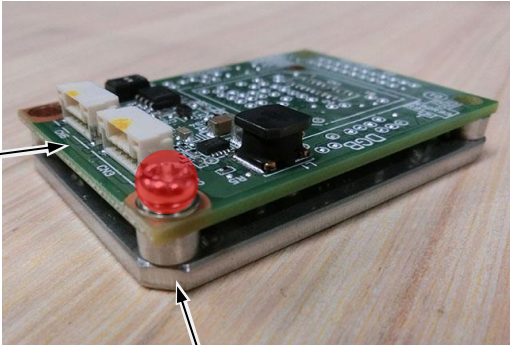
①	Turn OFF the Controller.
②	Remove the Arm1 Center Cover.
③	Disconnect the connectors (CN3, CN6). 
④	Remove gyro board 1 and the gyro board 1 protective plate. CAUTION Be careful not to drop the screws inside the Manipulator. <ul style="list-style-type: none"> <li data-bbox="904 874 1173 916">A S03: 1-M3x15 

Removing Gyro Board 1



⑤ Remove the gyro board 1 protective plate.

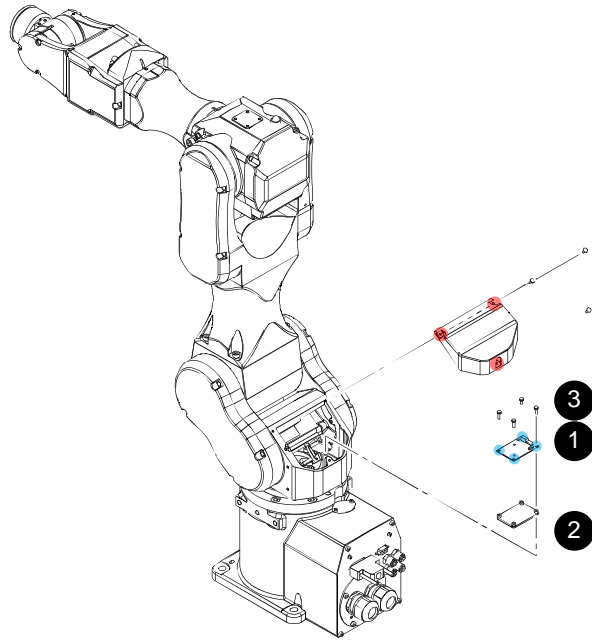
A S03: 1-M3x10



Gyro board 1

Gyro board 1 protective plate

Installing Gyro Board 1



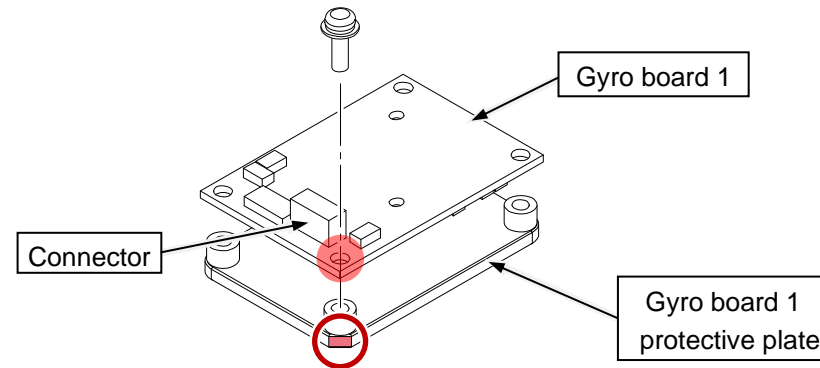
1 Install the gyro board 1 protective plate on gyro board 1.

A S03: 1-M3x10
(0.45 +/- 0.1 N·m)

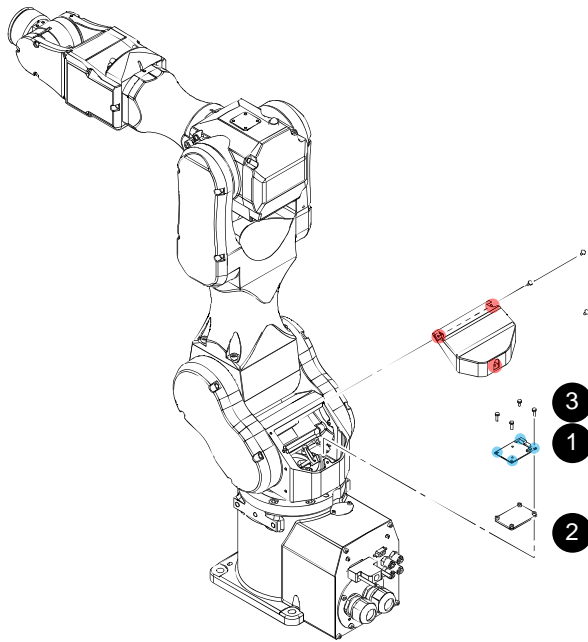


POINT

When installing, place the board connector and M3x10 screw as shown in the figure.



Installing Gyro Board 1

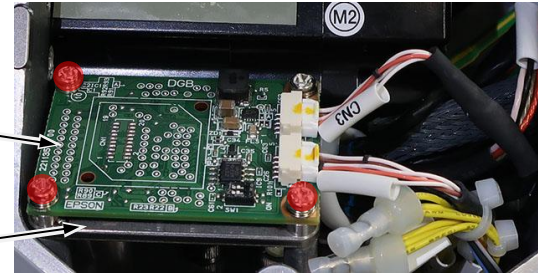


2 Install gyro board 1 and the gyro board 1 protective plate on Arm1.

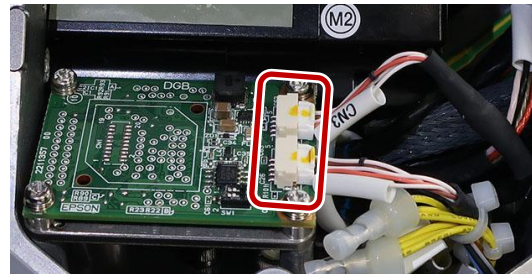
A S03: 3-M3x15
(0.45 +/- 0.1 N·m)

Gyro board 1

Gyro board 1
protective plate

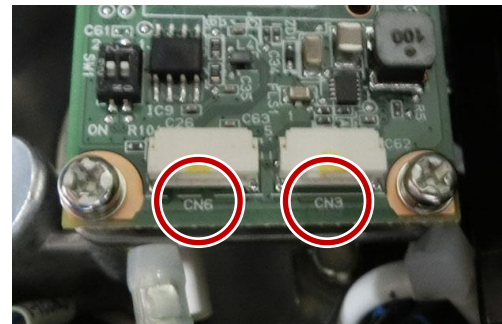


3 Connect the connectors (CN3, CN6) to the board.

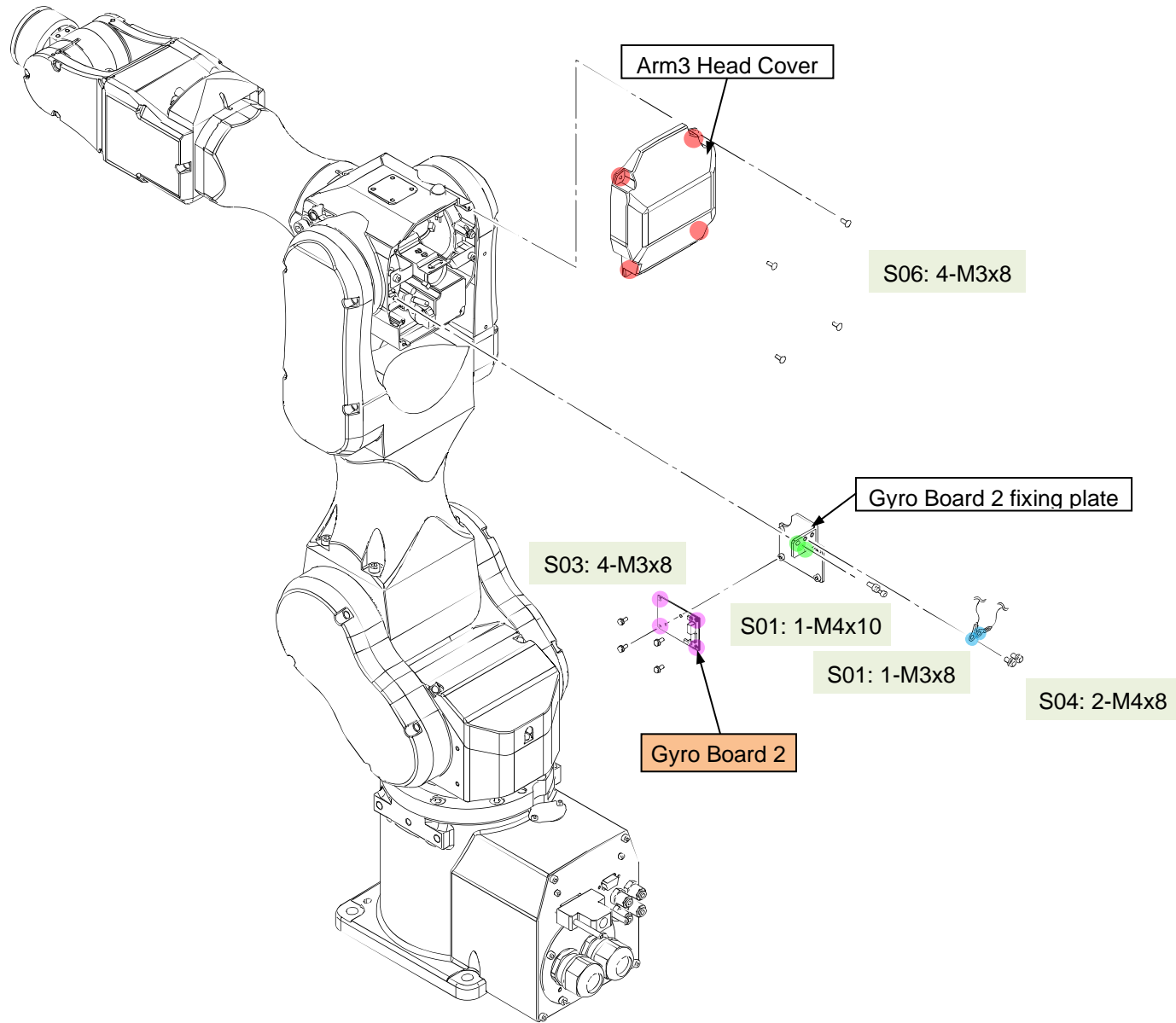


CAUTION

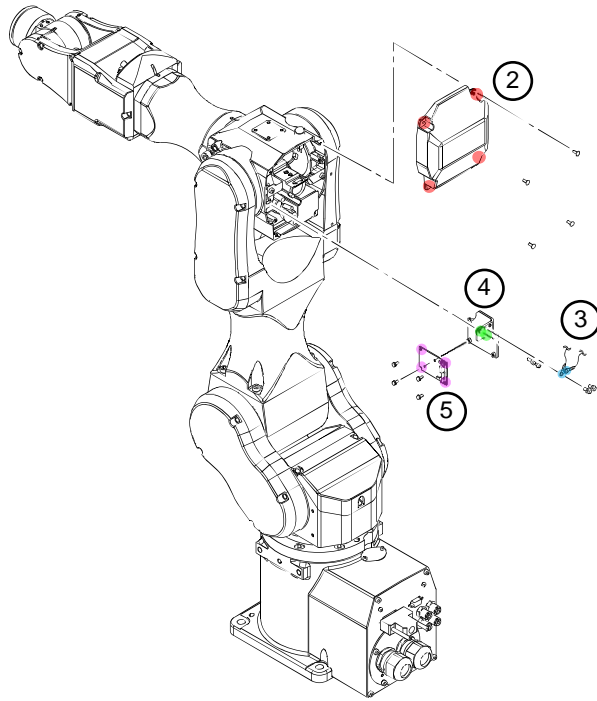
Check the board markings and connector labels, then connect the connectors.

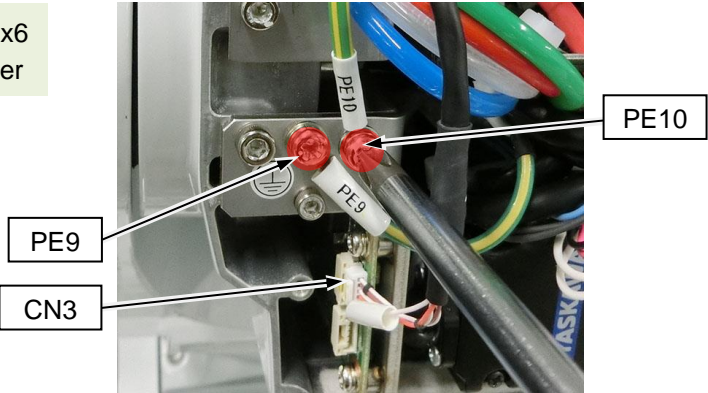
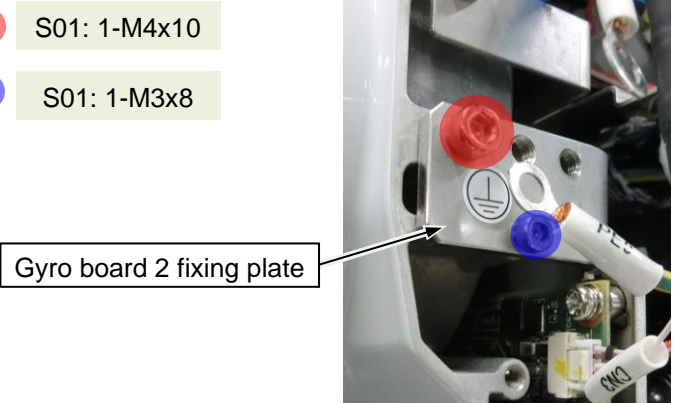


2.10.2 Replacing Gyro Board 2

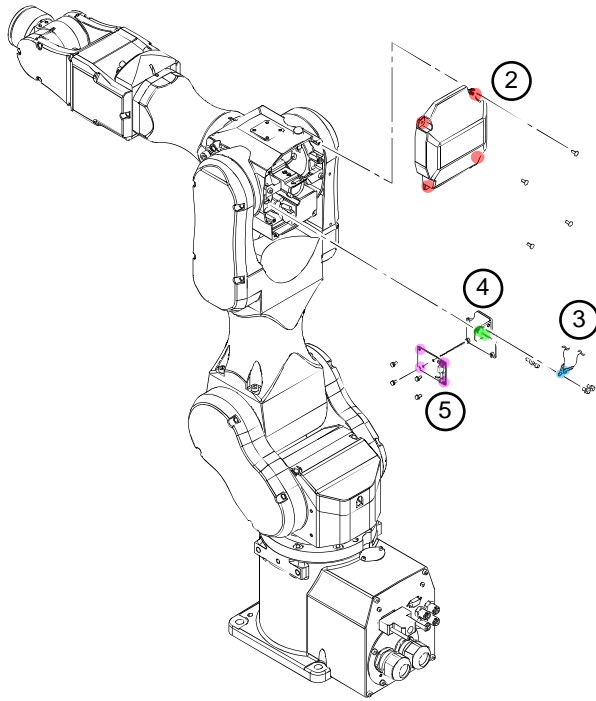


Removing Gyro Board 2



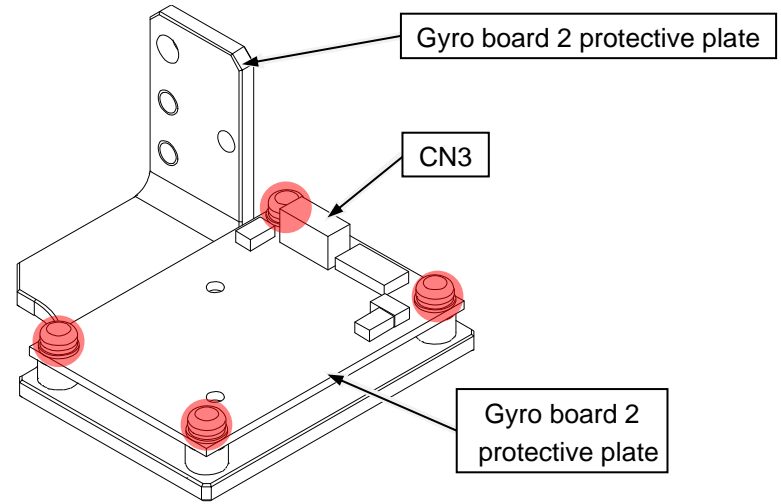
①	Turn OFF the Controller.
②	Remove the Arm3 head cover .
③	<p>Disconnect the gyro board connector (CN3), and remove the screws securing the Ground Wires (PE9, PE10).</p> <p>A S04: 2-M4x6 with washer</p> 
④	<p>Remove the gyro board 2 fixing plate.</p> <p>A S01: 1-M4x10</p> <p>B S01: 1-M3x8</p> 

Removing Gyro Board 2

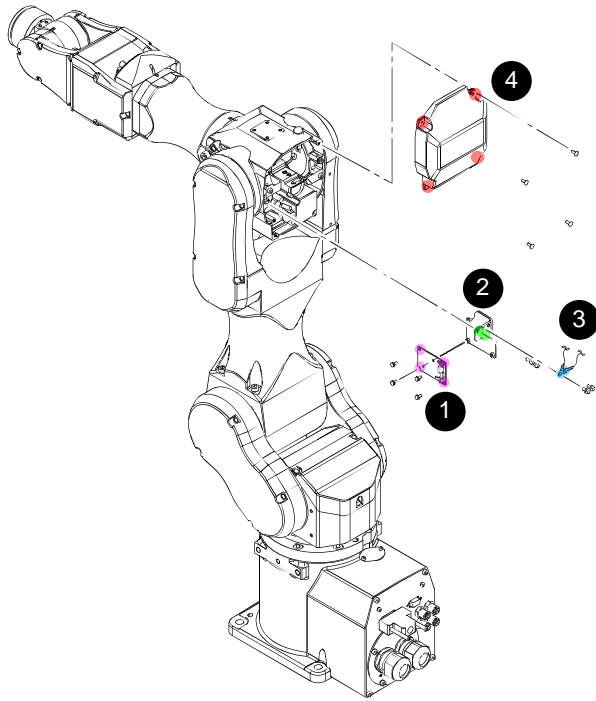


⑤ Remove gyro board 2.

A S03: 4-M3x8 with washer



Installing Gyro Board 2



1 Install gyro board 2.

POINT
Place the connector in the orientation shown in the figure.

A S03: 4-M3x8 with washer
(0.45 +/- 0.1 N·m)

Gyro board 2 protective plate

CN3

Gyro board 2 protective plate

2 Secure the gyro board 2 fixing plate on Arm3.

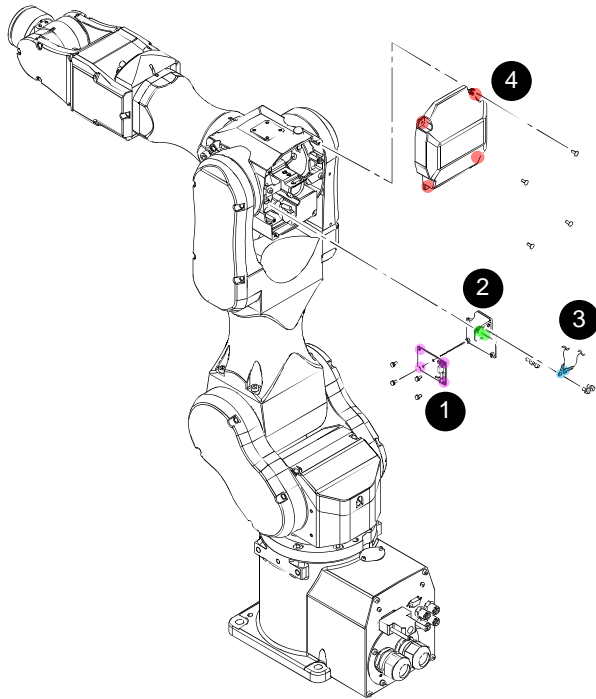
CAUTION
When installing the plate, be careful not to use the wrong screws.

A S01: 1-M4x10
(4.0 +/- 0.2 N·m)

B S01: 1-M3x8
(2.0 +/- 0.1 N·m)

Gyro board 2 fixing plate

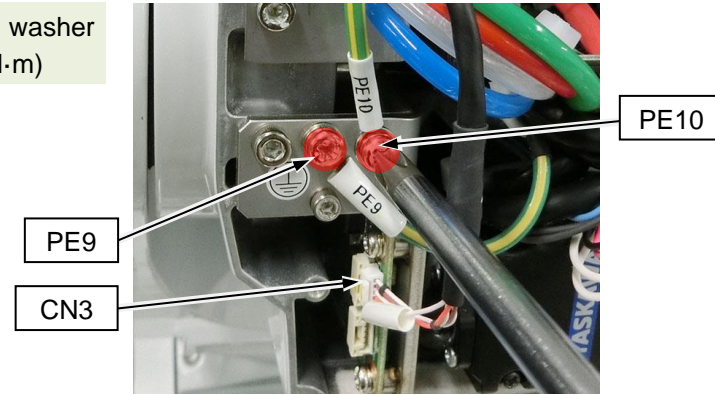
Installing Gyro Board 2



3

Connect the connector (CN3) to gyro board 2, and connect the Ground Wires (PE9, PE10) to the gyro board 2 fixing plate.

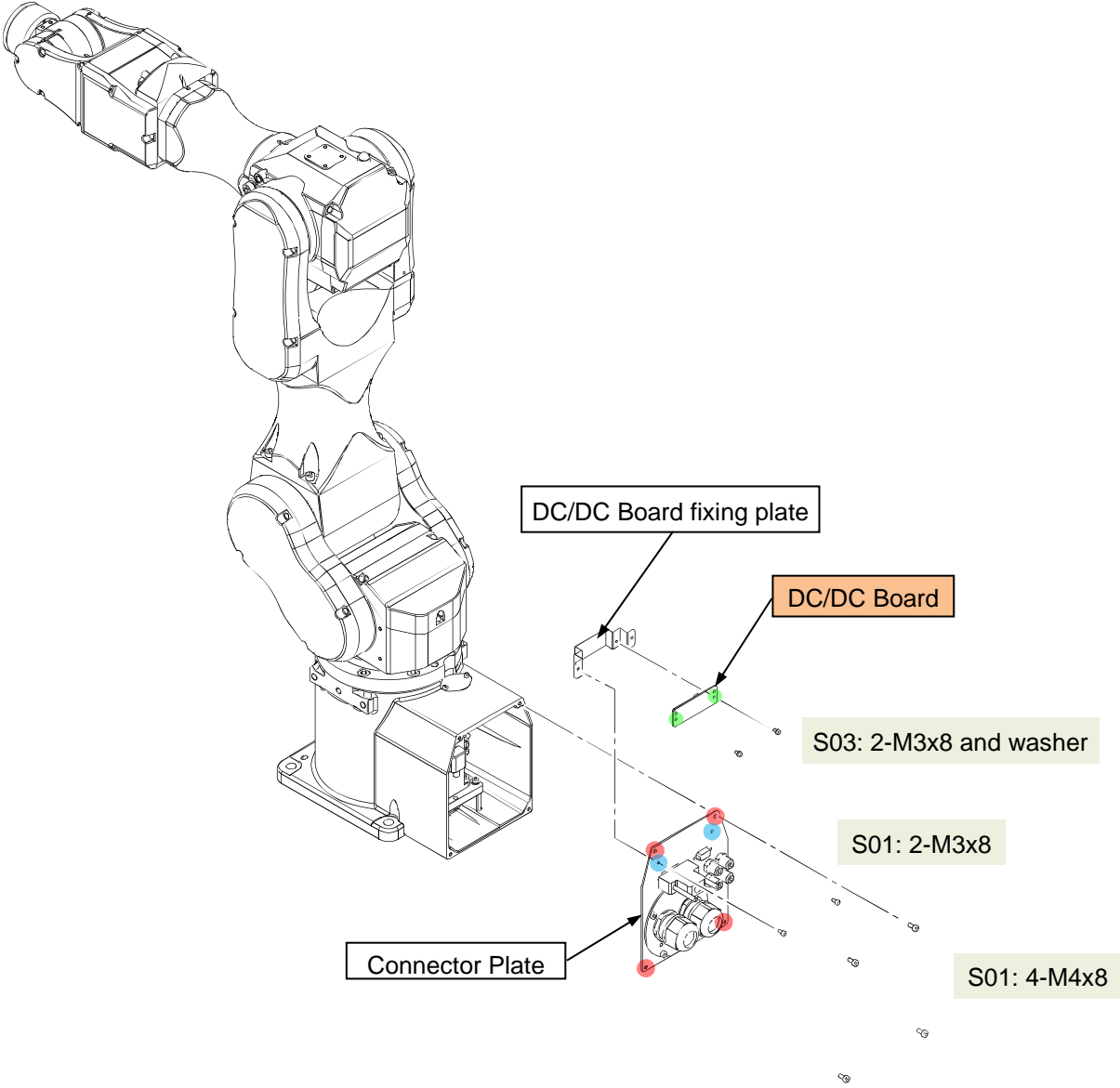
A S04: 2-M4x6 with washer
(0.9 +/- 0.1 N·m)



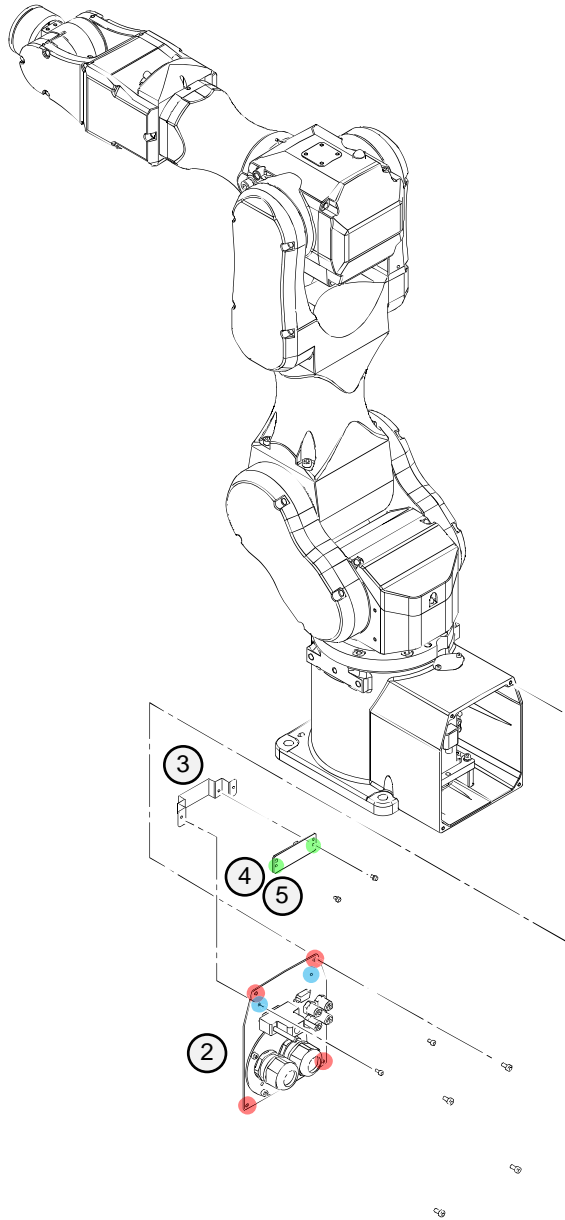
4

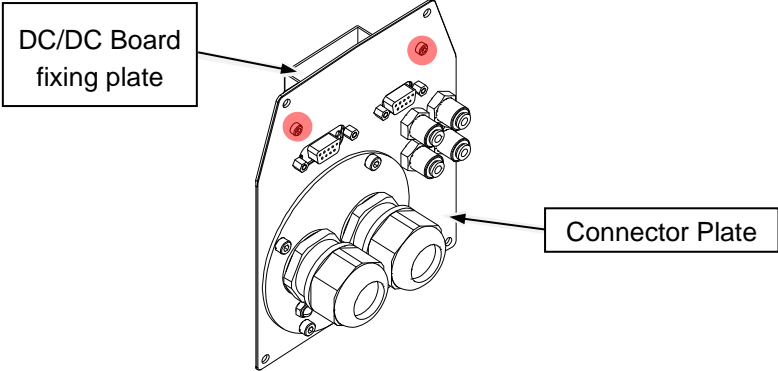
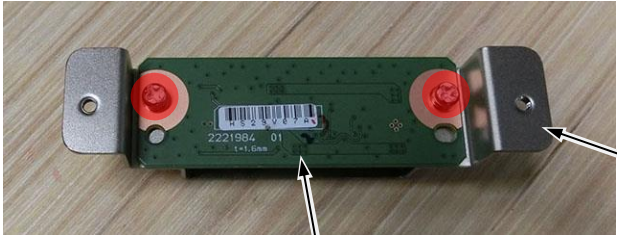
Install the [Arm3 head cover](#).

2.10.3 Replacing the DC/DC Board

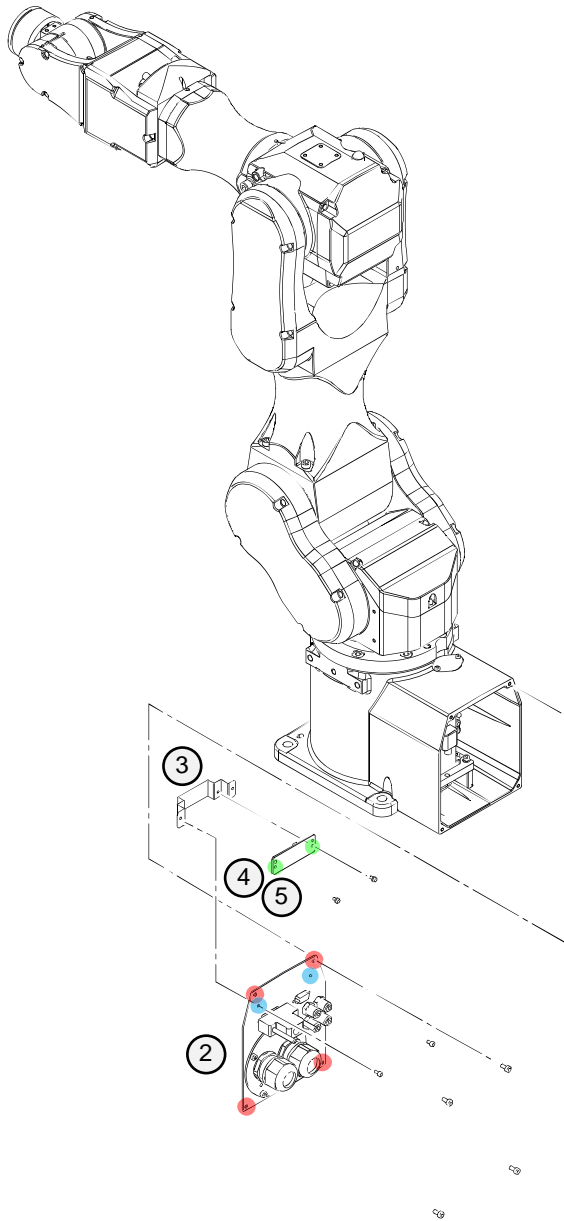


Removing the DC/DC Board



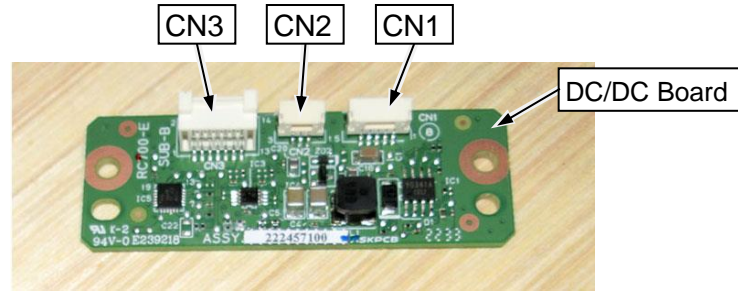
①	Turn OFF the Controller.
②	Remove the Connector Plate .
③	<p>Remove the connector plate screws, and remove the DC/DC Board fixing plate.</p> <p>A S01: 2-M3x8</p>  <p>DC/DC Board fixing plate</p> <p>Connector Plate</p>
④	<p>Remove the screws securing the DC/DC Board, and remove the DC/DC Board.</p> <p>A S03: 2-M3x8 with washer</p>  <p>DC/DC Board fixing plate</p> <p>Connector Plate</p>

Removing the DC/DC Board

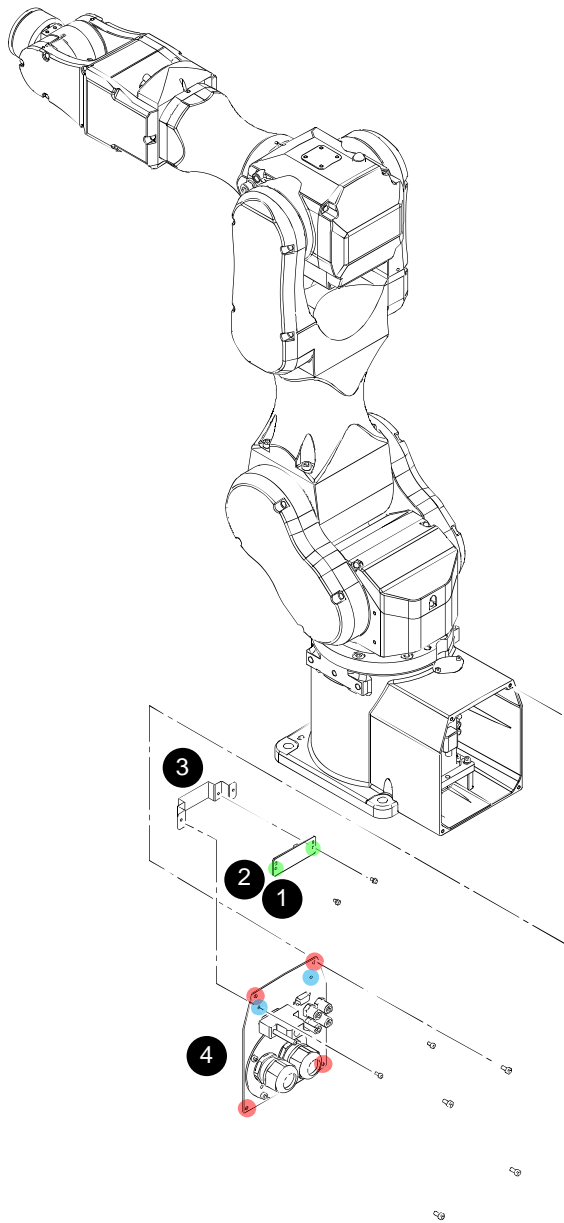


⑤

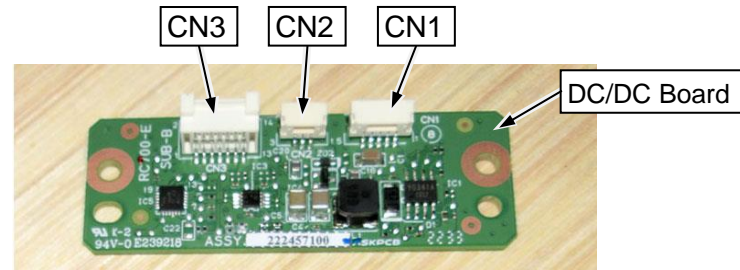
Disconnect the connectors (CN1, CN2, CN3) from the DC/DC Board.



Installing the DC/DC Board

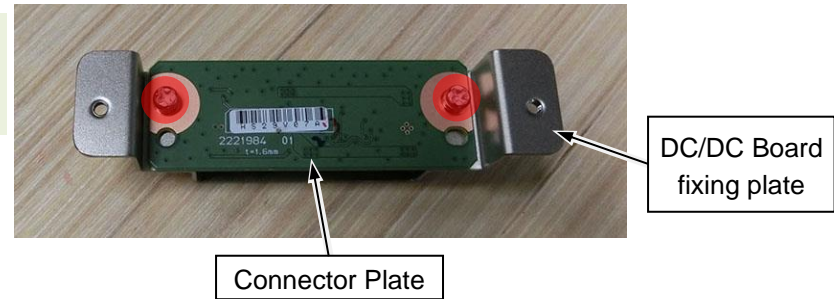


1 Connect the connectors (CN1, CN2, CN3) to the DC/DC Board.



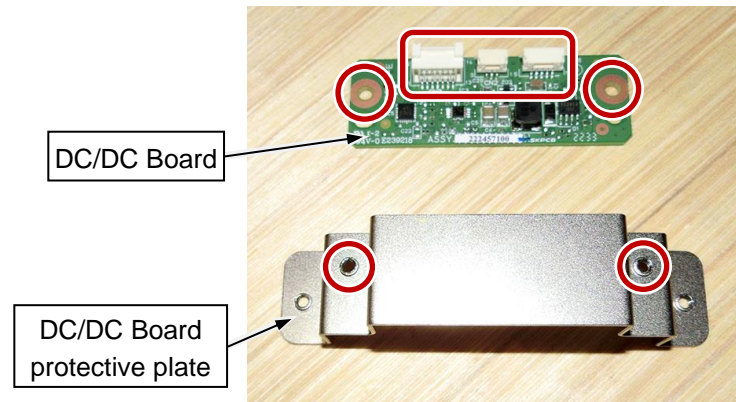
2 Install the DC Board on the DC/DC Board fixing plate.

A S03: 2-M3x8 with washer (0.45 +/- 0.1 N·m)

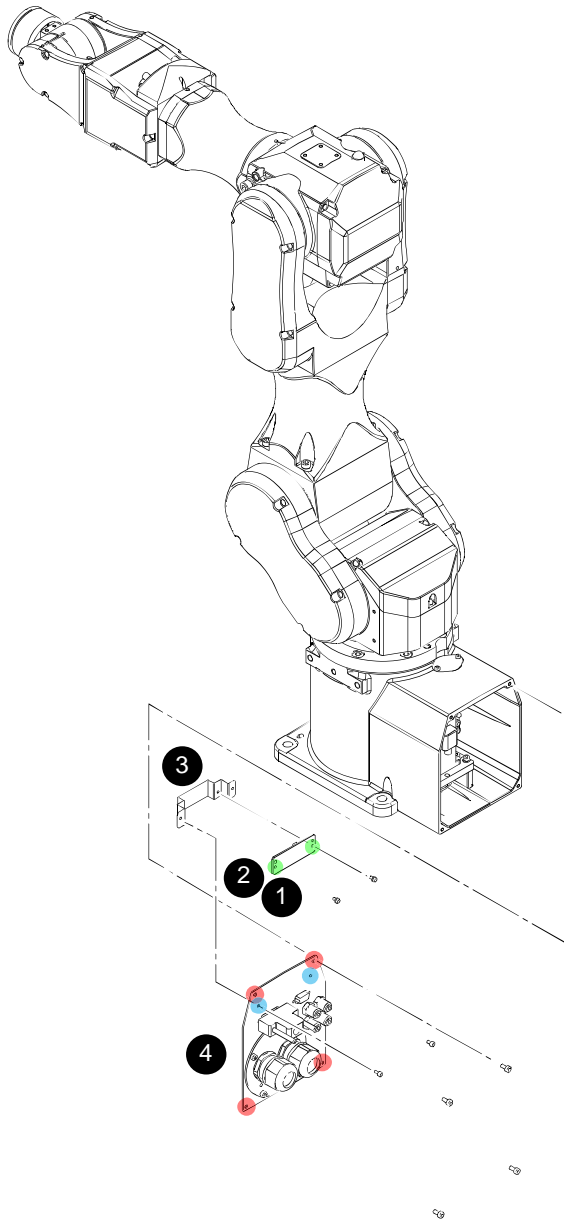


POINT

Position so that the board connector section is at the top. Align the screw holes shown in the figure of the board with the plate screw holes, and secure the board to the plate.



Installing the DC/DC Board



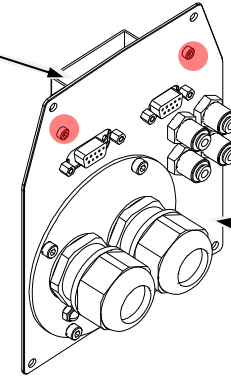
3

Install the DC/DC Board fixing plate on the Connector Plate.

A

S01: 2-M3x8
(2.0 +/- 0.1 N·m)

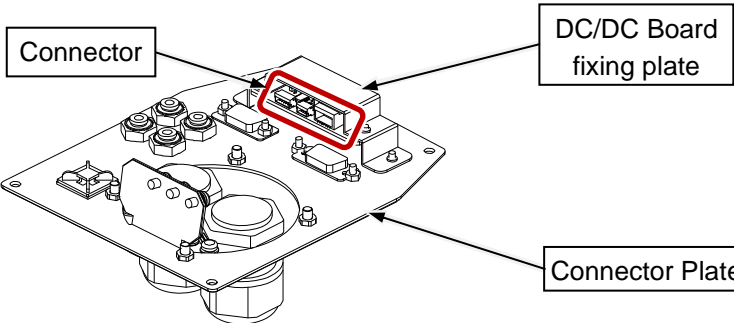
DC/DC Board
fixing plate



Connector Plate

POINT

Install on the Connector Plate with the orientation as shown in the figure.



Connector

DC/DC Board
fixing plate

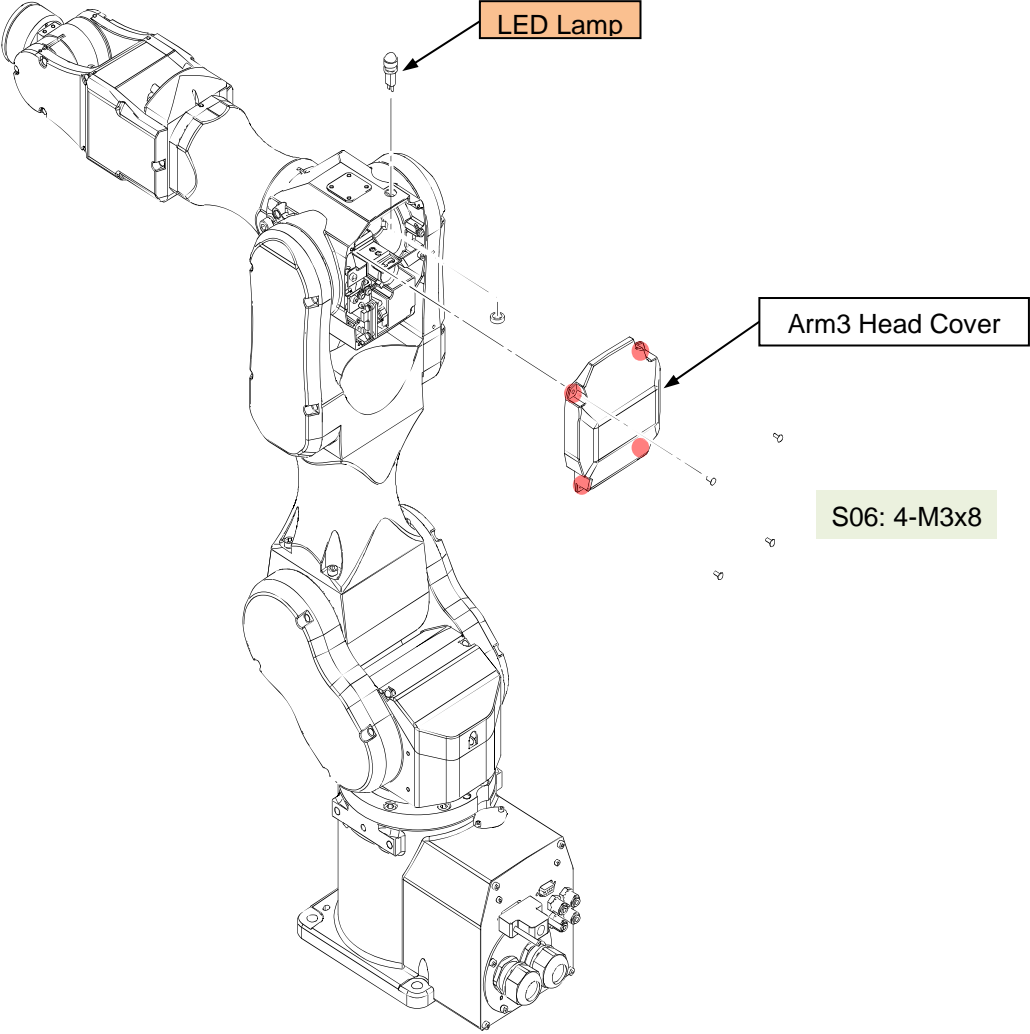
Connector Plate

4

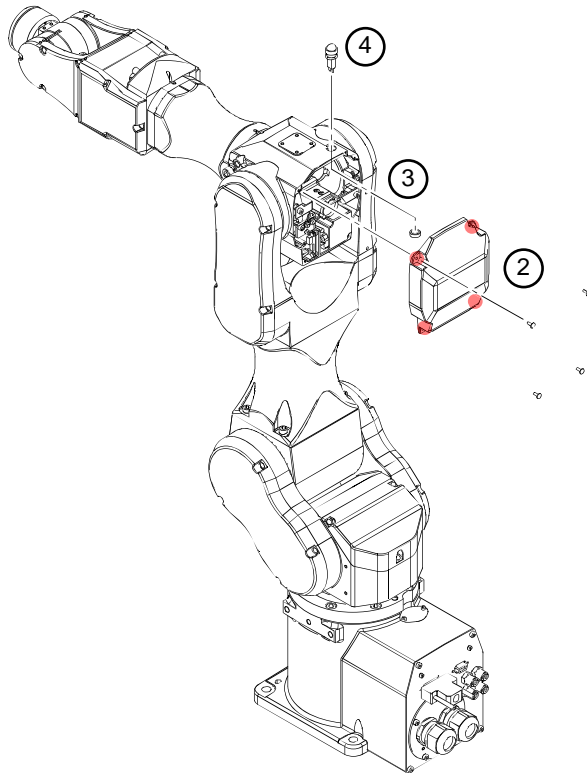
Install the [Connector Plate](#).

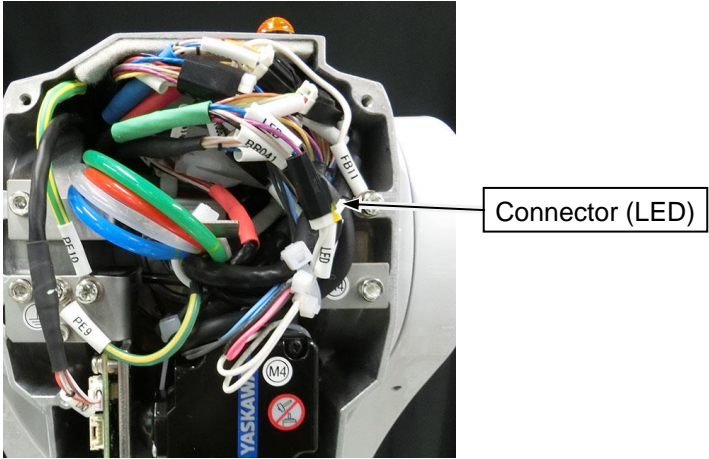
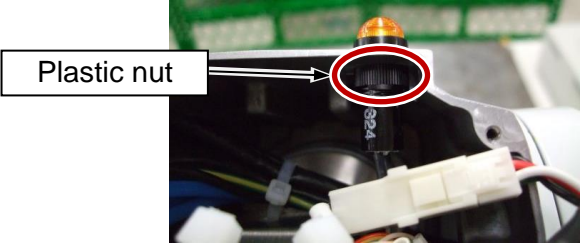
2.11 Replacing the LED Lamp

2.11.1 Removing the LED Lamp

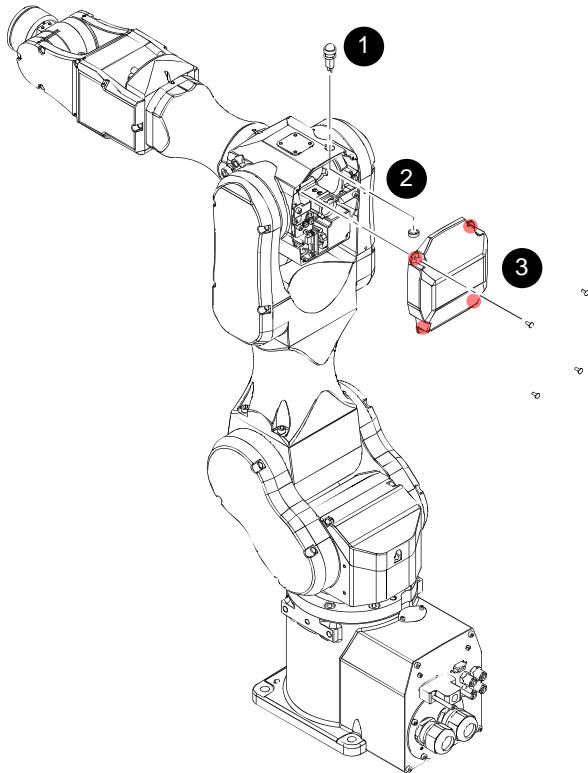


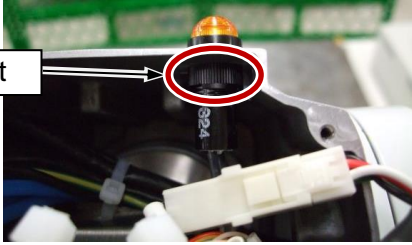
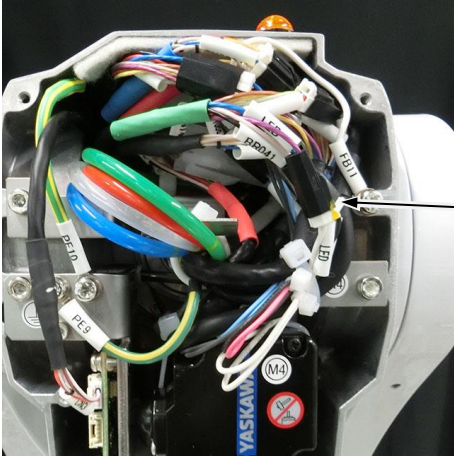
Removing the LED Lamp



①	Turn OFF the Controller.
②	Remove the Arm3 head cover .
③	<p>Disconnect the connector (LED) for the LED lamp.</p> <p>POINT The connector (LED) for the LED lamp is under the Arm3 cover when it is open.</p> 
④	<p>Remove the LED lamp.</p> <p>POINT Turn the plastic nut counterclockwise to remove.</p> 

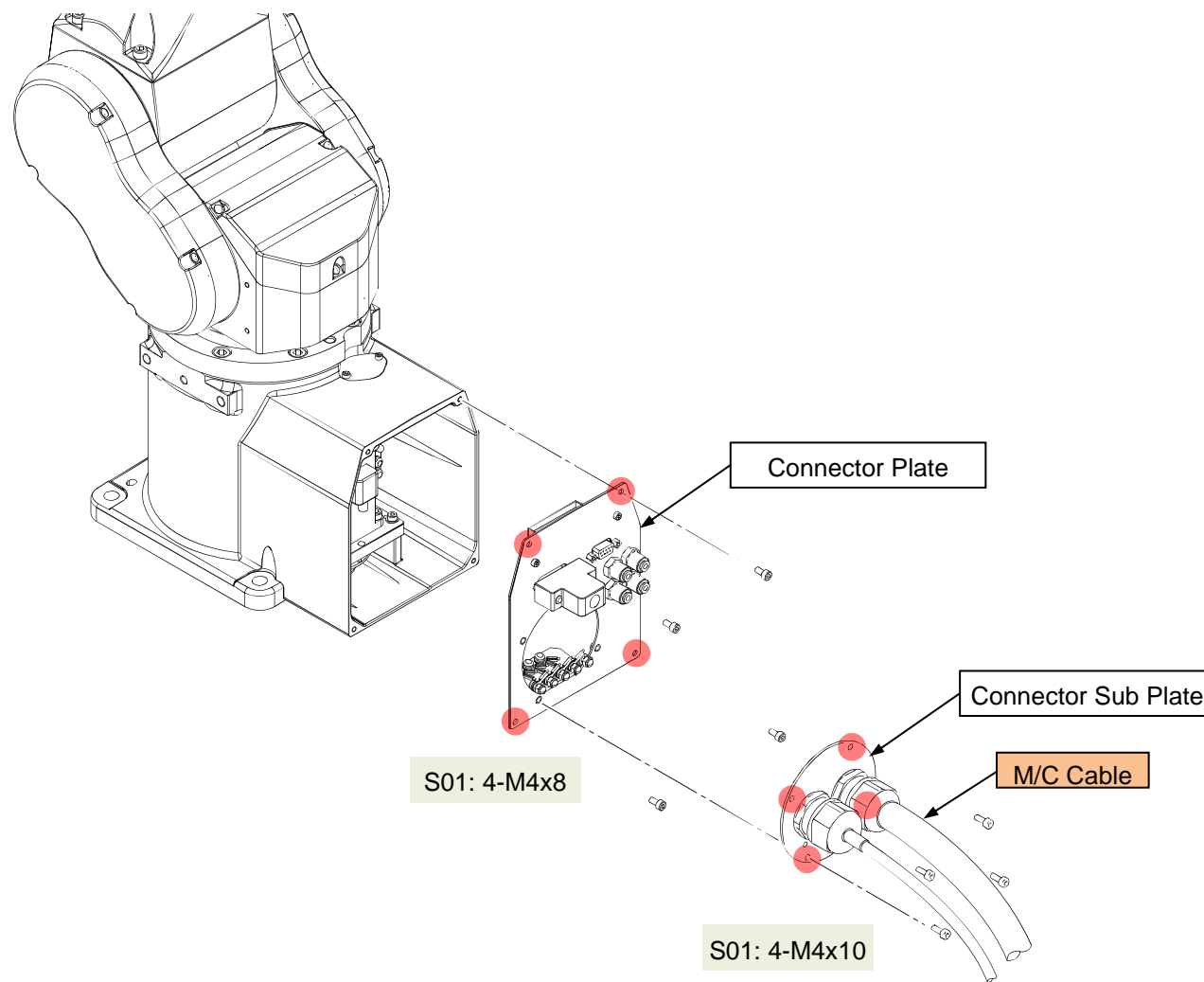
2.11.2 Installing the LED Lamp



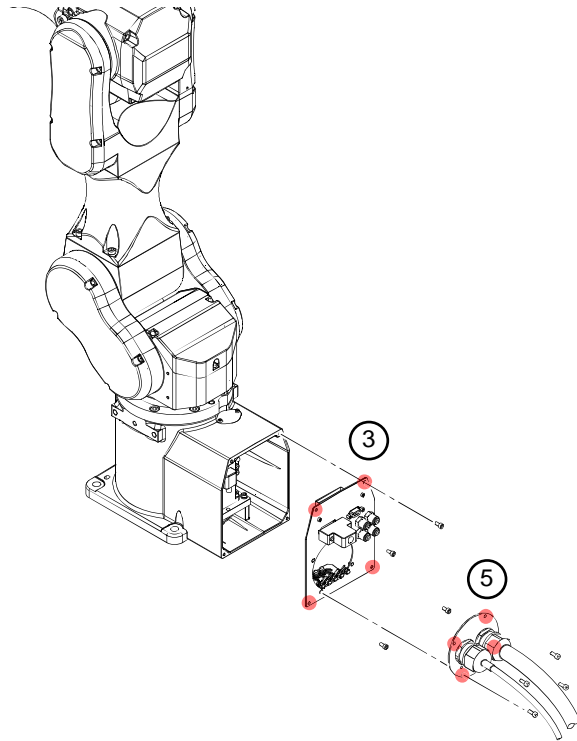
<p>1</p>	<p>Install the LED lamp on Arm3.</p> <p>POINT</p> <p>Insert the LED lamp from Arm3, and affix the plastic nut from inside Arm3. Turn the nut clockwise, and secure the LED lamp to Arm3.</p>  <p>A close-up photograph of the LED lamp being installed. A red circle highlights the plastic nut being turned clockwise to secure the lamp. A label 'Plastic nut' with an arrow points to the nut.</p>
<p>2</p>	<p>Connect the connector (LED).</p>  <p>A close-up photograph of the internal wiring of the head assembly. A label 'Connector (LED)' with an arrow points to the specific connector being connected to the wires.</p>
<p>3</p>	<p>Install the Arm3 head cover.</p>

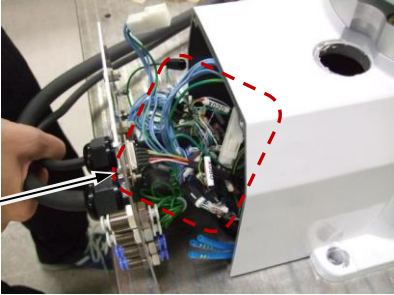
2.12 Replacing the M/C Cable

2.12.1 Removing the M/C Cable

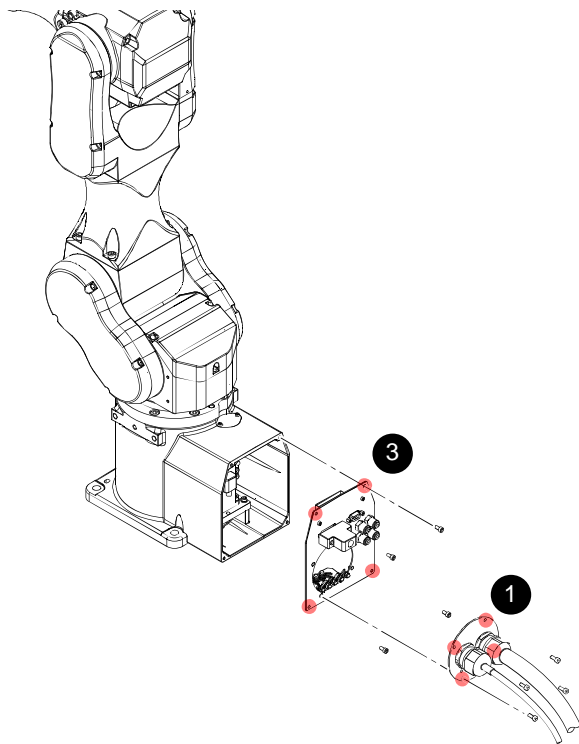


Removing the M/C Cable



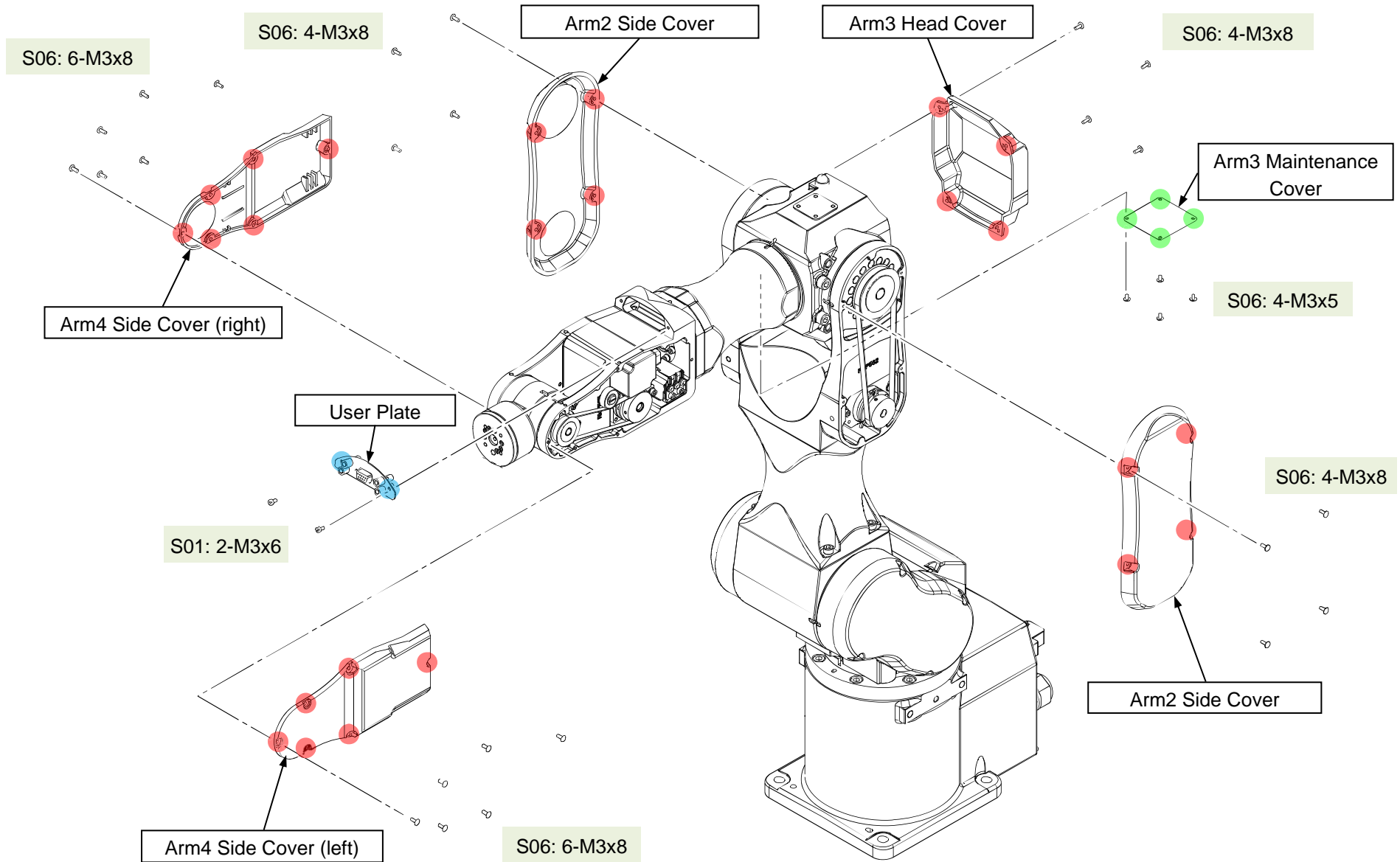
①	Turn OFF the Controller.
②	Disconnect the following connectors from the Controller. Power cable connector, Signal cable connector
③	Remove the Connector Plate .
④	<p>Remove the connectors. Connectors: CN3L1, CN3G0, CN111, CN200, CN201, CN202, CN300, CN301, CN312</p> 
⑤	Remove the Connector sub plate .

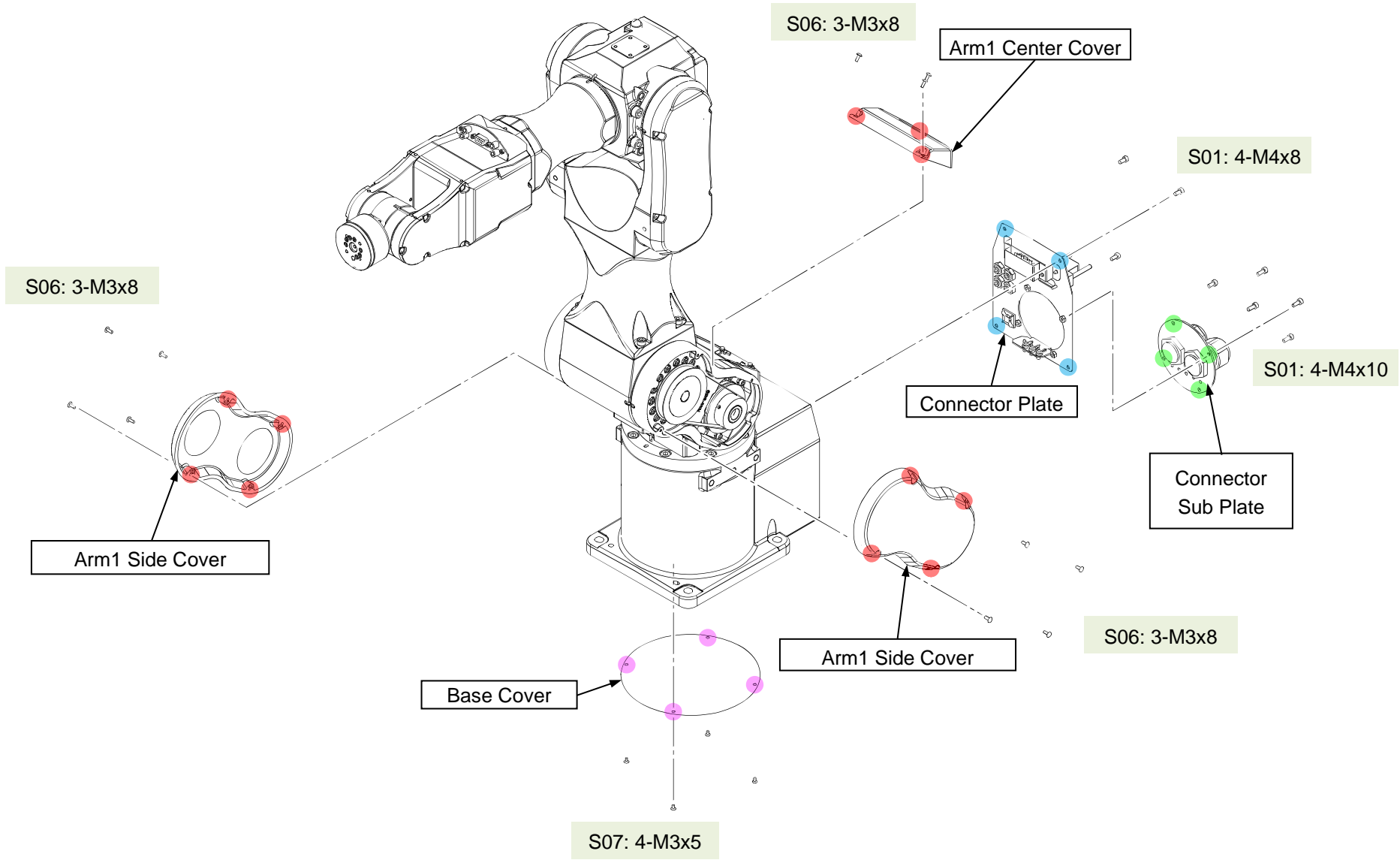
2.12.2 Installing the M/C Cable



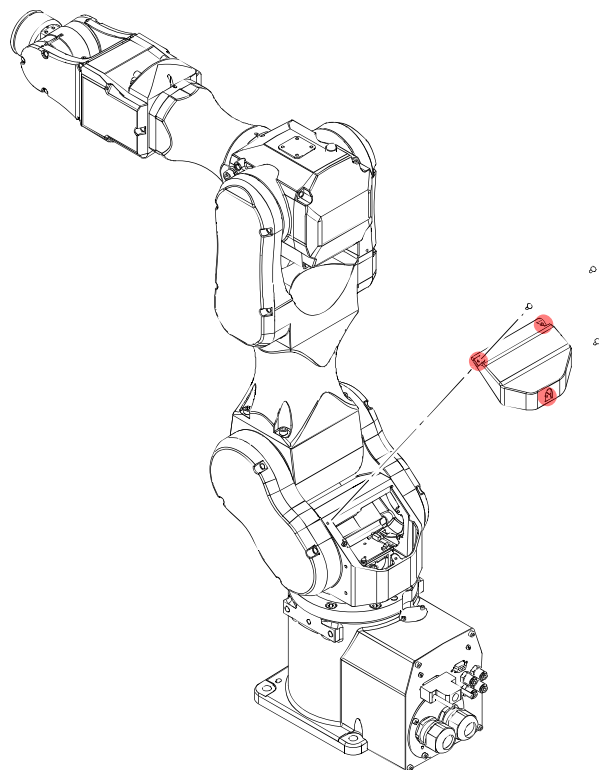
1	Install the Connector sub plate to the connector plate.
2	<p>Connect the connectors of the new M/C cable to these of the cable unit. Connectors: CN3L1, CN3G0, CN111, CN200, CN201, CN202, CN300, CN301, CN312</p> <p>POINT Connect the connectors with the same number.</p> <div data-bbox="1025 459 1615 751" style="text-align: center;"> </div>
3	Install the Connector Plate .
4	Connect the following connectors to the Controller. Power cable connector, Signal cable connector
5	Turn ON the Controller power.

2.13 Cover





2.13.1 Arm1 Center Cover

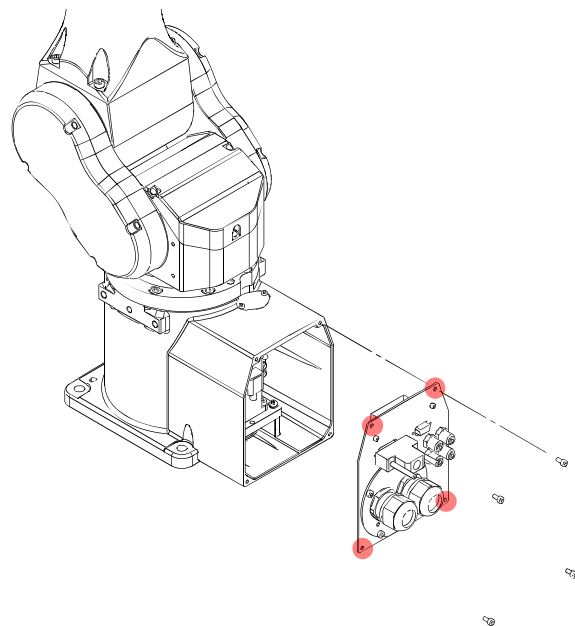


A S06: 3-M3x8 (0.45 +/- 0.1 N · m)

CAUTION

When installing the cover, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

2.13.2 Connector Plate

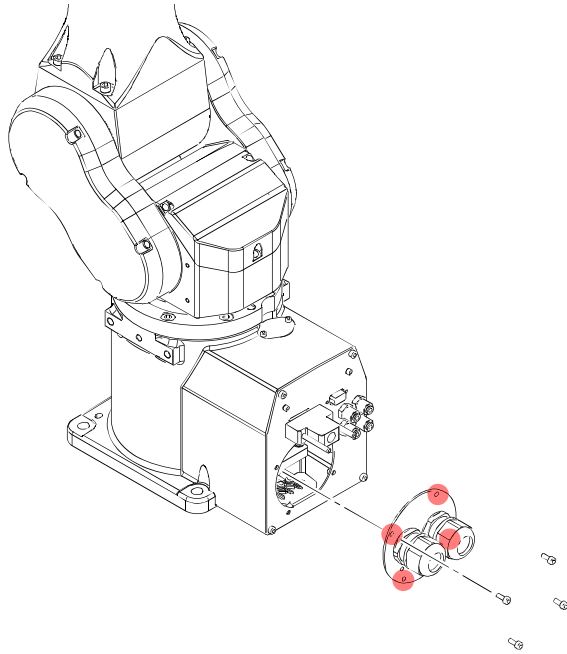


A S01: 4-M4x8 (4.0 +/- 0.2 N·m)

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 installing the Connector 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. When moving cables, check the location of the cables when the Connector Plate is removed and return the wiring to a state that will not result in excessive force being placed on the wiring.

2.13.3 Connector Sub Plate

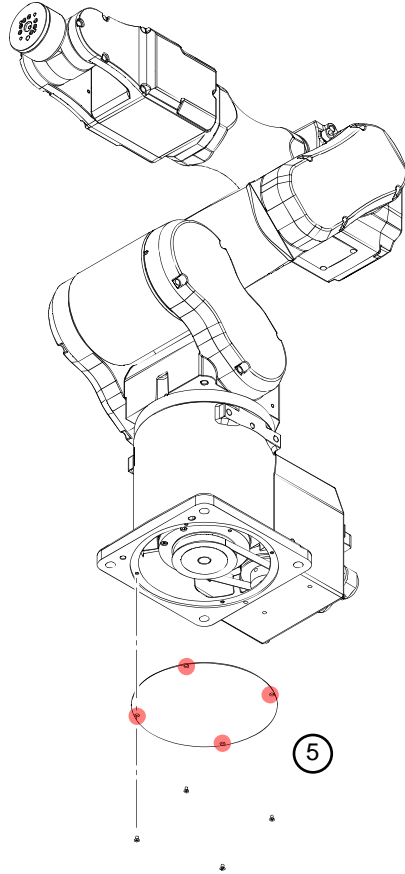


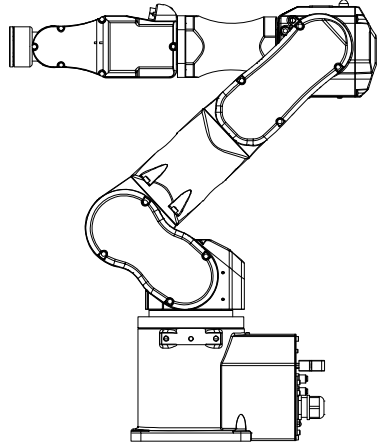
A S01: 4-M4x10 (4.0 +/- 0.2 N·m)

CAUTION

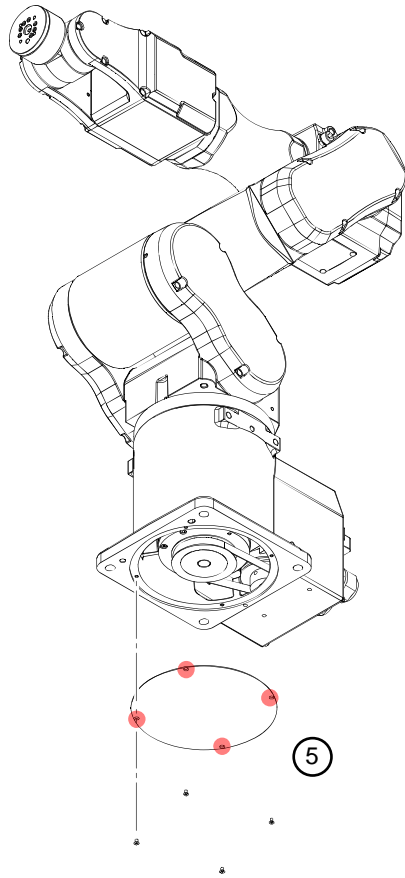
- Do not pull the Connector Plate with force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
- When installing the Connector Plate, do not nip the cables or bend 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. When moving cables, check the location of the cables when the Connector Plate is removed and return the wiring to a state that will not result in excessive force being placed on the wiring.

2.13.4 Base Cover



<p>①</p>	<p>Position the Manipulator as shown in the figure.</p> 
<p>②</p>	<p>Turn OFF the Controller.</p>
<p>③</p>	<p>Remove the bolts securing the Manipulator to the platform.</p>
<p>④</p>	<p>Lay the Manipulator down on its side.</p> <p>WARNING</p> <p>Work required to lay the Manipulator down on its side requires at least two workers. At least one worker must support the Manipulator to prevent its arm from falling.</p> <p>Removing the bolts securing the Manipulator to the platform or similar will make the Manipulator fall to the arm side from the weight of the arm, which could result in damage or malfunction.</p>
<p>⑤</p>	<p>Remove the Base Cover.</p> <p>A S07: 4-M3x5 (0.6 +/- 0.1 N·m)</p>

Base Cover



Installing the Cover

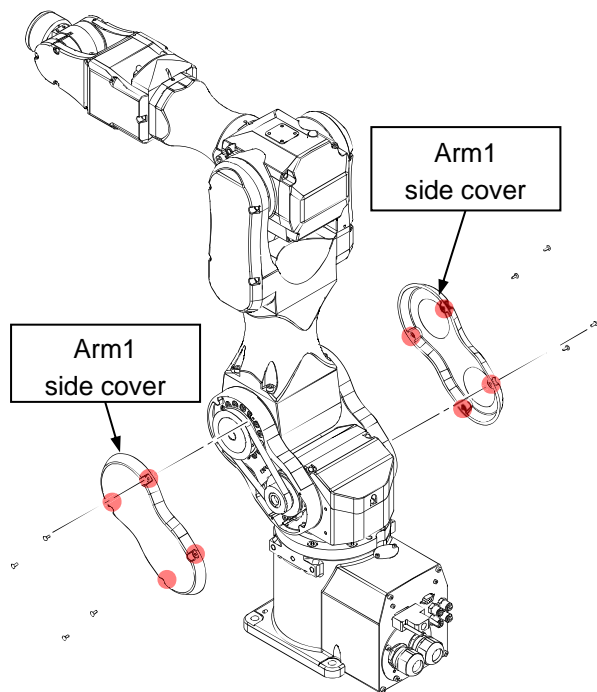
Installation uses the opposite order to removal as described earlier.

For securing the Manipulator to the platform, refer to “2.3 Environment and Installation” in the “6-Axis Robots C-B series Manual.”

CAUTION

- Do not use other than the specified bolts (S07). Use of other than the specified bolts may result in bolt heads protruding from the end face of the base, which may lead to an unstable product installation when installed on the floor.
- When installing the cover, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

2.13.5 Arm1 Side Cover

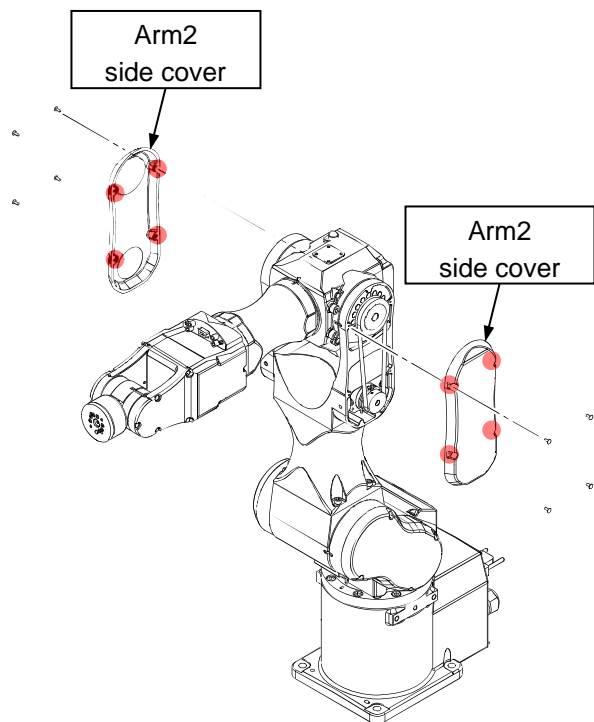


A S06: 3-M3x8 (0.45 +/- 0.1 N · m)

CAUTION

When installing the cover, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

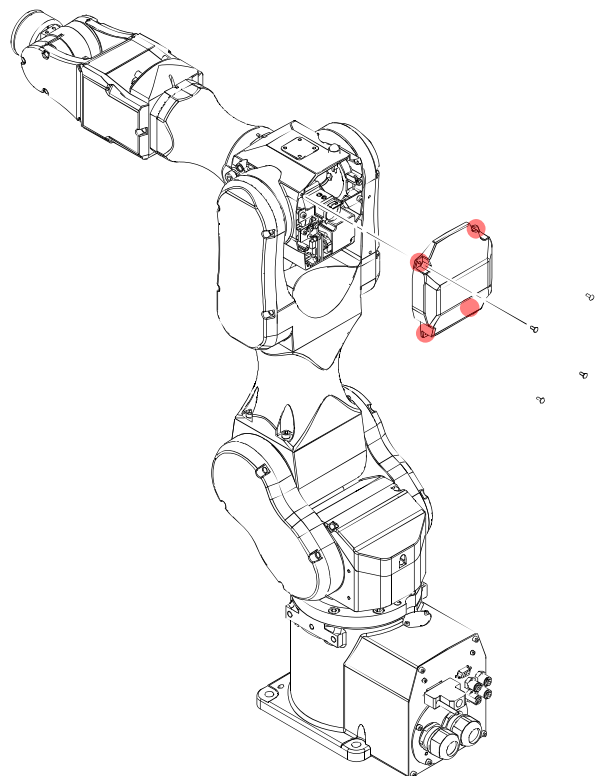
2.13.6 Arm2 Side Cover



A S06: 4-M3x8 (0.45 +/- 0.1 N · m)

CAUTION
When installing the cover, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

2.13.7 Arm3 Head Cover

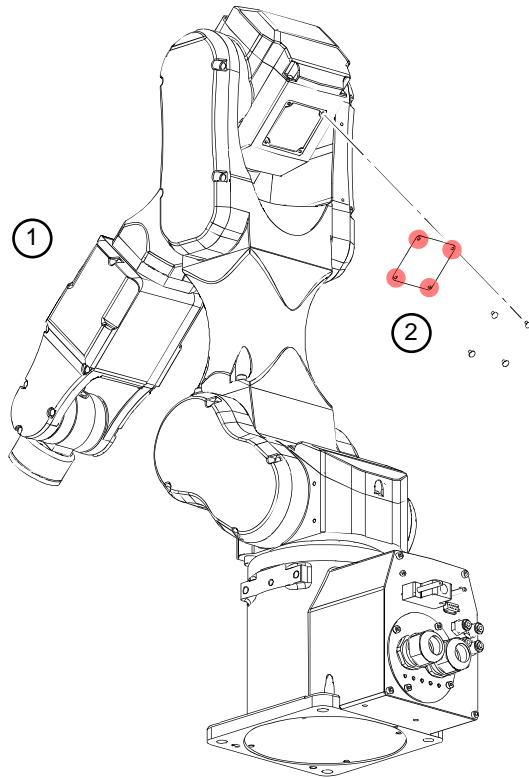


A S06: 4-M3x8 (0.45 +/- 0.1 N · m)

CAUTION

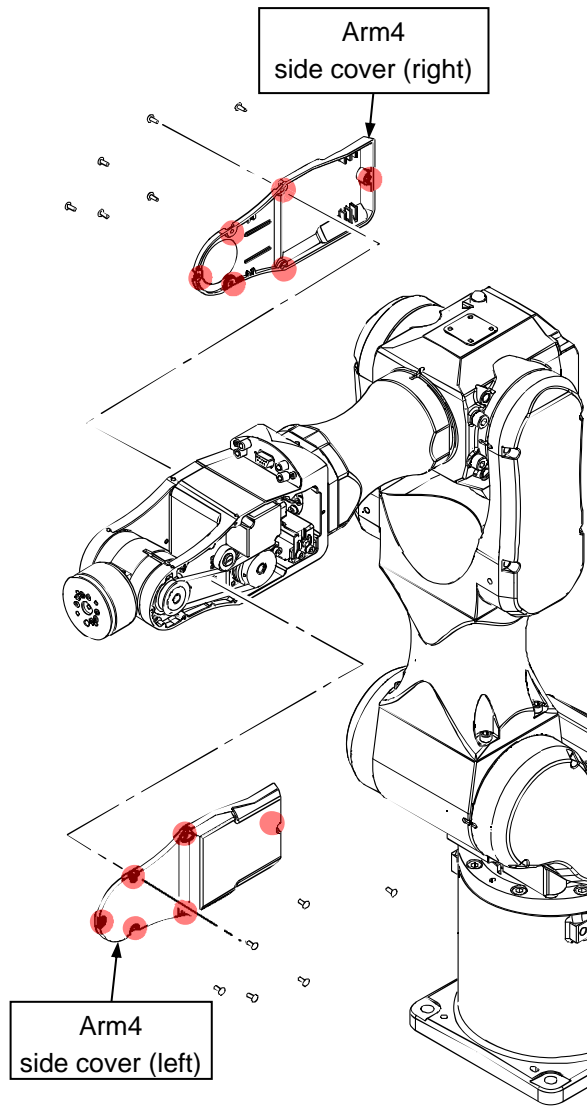
When installing the cover, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

2.13.8 Arm3 Maintenance Cover



①	Move the arm to a position where the cover can be easily removed.
②	Remove the Arm3 Maintenance Cover. A S06: 4-M3x5 (0.6 +/- 0.1 N·m) CAUTION When installing the cover, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

2.13.9 Arm4 Side Cover

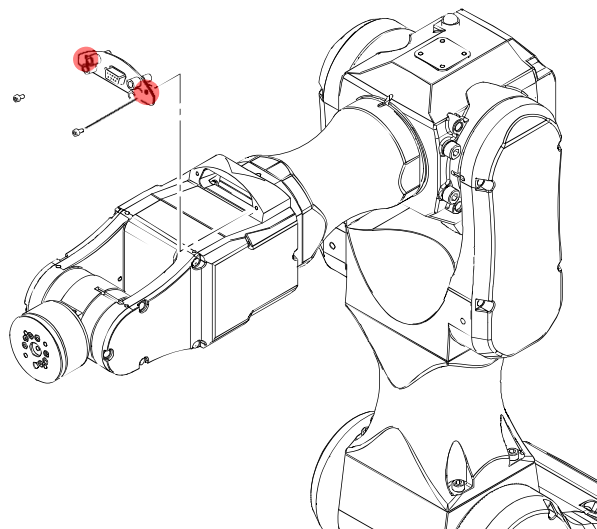


A S06: 6-M3x8 (0.45 +/- 0.1 N · m)

CAUTION

When installing the cover, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

2.13.10 User Plate



A S01: 2-M3x6 (2.0 +/- 0.1 N·m)

CAUTION

- Cables are connected internally, so do not pull with force when removing the User Plate.
- When installing the User Plate, be careful not to pinch the cables. Also, do not bend or push in using excessive force.

CHAPTER


3

Adjustment

3.1 Adjusting the Timing Belt Tension

The Manipulator uses six types of Timing Belts.

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

 CAUTION	<ul style="list-style-type: none">● 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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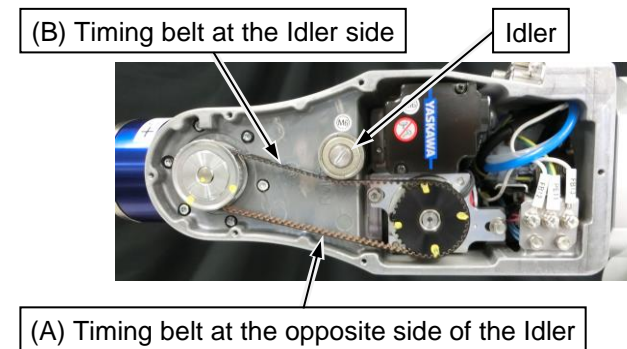
3.1.1 Items to be prepared

- Force gauge
- Sonic Belt Tension Meter
Recommended: U-508 (Gates Unitta)
- Suitable cord (Length about 800 mm)

3.1.2 Belt Tension Values

Tension Meter setting values

	J1	J2	J3	J4	J5	J6
Unit mass (g/mm width x m span)	1.9	1.9	1.9	1.9	1.9	1.9
Belt width (mm)	10	10	7	6	6	6
Belt span (mm)	110	110	155	47	(A) 107 (B) 60	(A) 107 (B) 59




Tension standard values

	J1	J2	J3	J4	J5	J6
Belt tension (Minimum to maximum) (N)	34.3 to 44.1	34.3 to 44.1	22.1 to 31.9	14.7 to 24.5	14.7 to 24.5	14.7 to 24.5

CAUTION

When measuring tension with a force gauge, the belt tension on both sides of the pulley are to be measured. Therefore, make sure to adjust the tension so that it is double the standard value.

3.1.3 Adjustment Method

 CAUTION	<ul style="list-style-type: none">● Make sure that the belt is set to be level with respect to the pulley without it being placed on the flange.● Temporarily tighten the parts used to adjust the belt tension. After adjusting the tension, tighten the bolts with the correct tightening torque.● Take care not to apply excessive tension to the belt.● Measure the tension near the center of the belt.
---	---

Joint #1 Timing belt

Apply proper tension to the Joint #1 Timing belt and fix the Joint #1 motor unit.

1. Pass a suitable cord or a string (insulation lock) to the drilled hole on the motor plate. Pull the cord using a force gauge or a similar tool to apply specified tension.

Joint #1 timing belt tension: 68.6 to 88.2 N



Force gauge

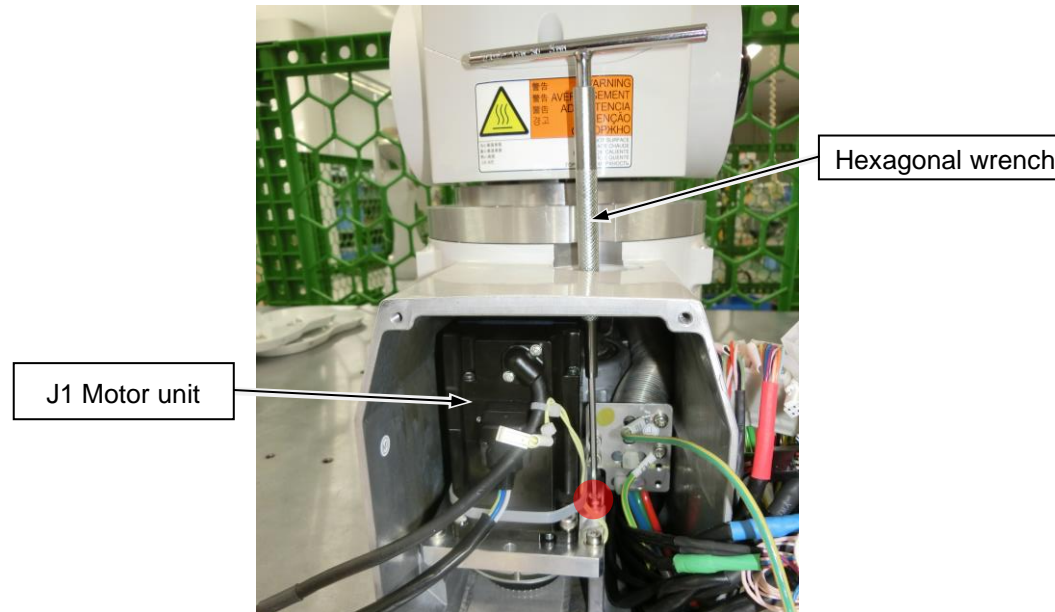
2. Secure the Joint #1 motor unit by applying tension.

A S01: 3-M4x20 and washer
(4.0 +/- 0.2 N·m)



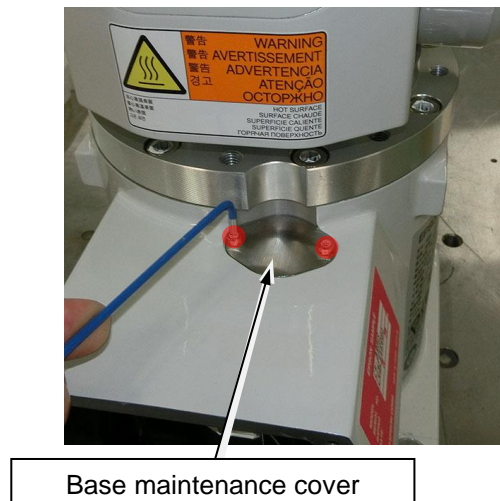
POINT

Insert a hexagonal wrench through the hole in the base maintenance cover to work on the screw shown below.



3. Attach the base maintenance cover after fixing the Joint #1 motor unit.

A S01: 2-M3x8
(2.0 +/- 0.1 N·m)

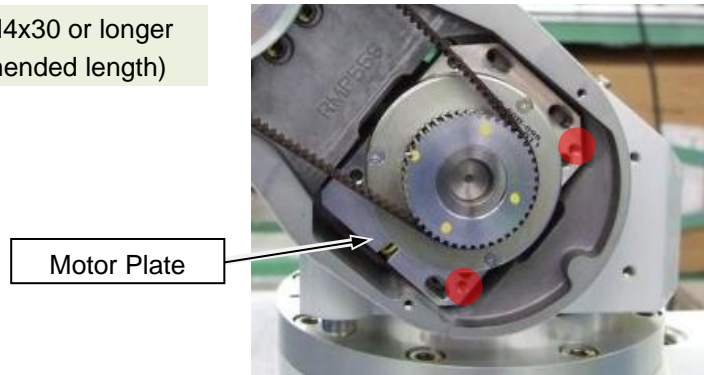


Joint #2 Timing belt

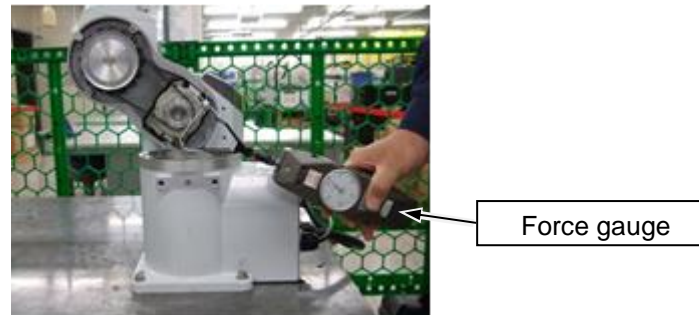
Apply tension to the Joint #2 Timing belt and fix the Joint #2 motor unit.

1. Install the screws for tension adjustment to the motor plate.

A Screw: M4x30 or longer
(recommended length)

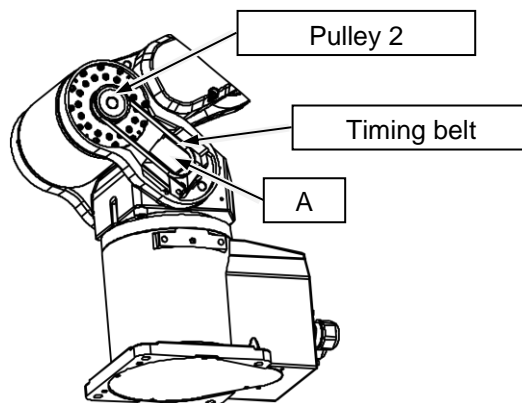


2. Pass a suitable cord or a string (insulation lock) to the screw. Pull the cord using a force gauge or a similar tool to apply specified tension.
Joint #2 timing belt tension: 68.6 to 88.2 N

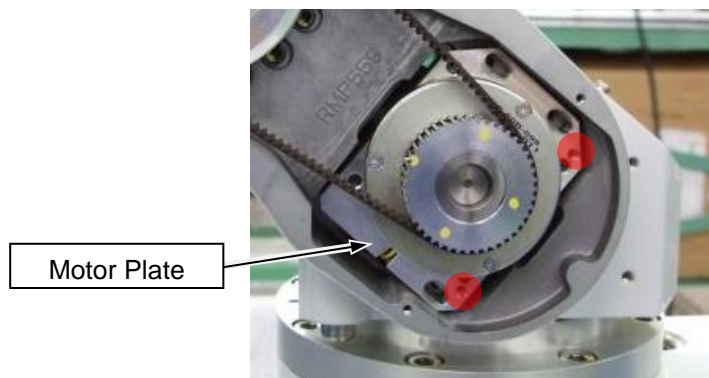


3. Apply tension by pressing toward the "A" surface in the figure and secure the motor unit.

A S01: 3-M4x18 and washer
(4.0 +/- 0.2 N·m)



4. Make sure to remove the screws for tension adjustment.



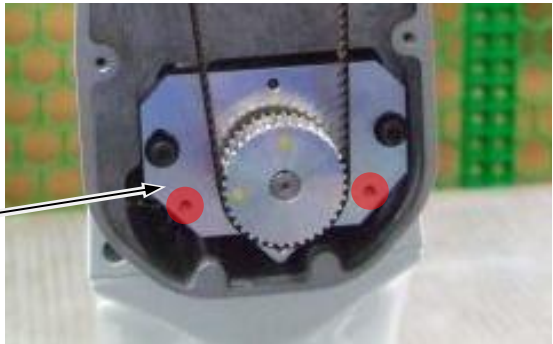
Joint #3 Timing belt

Apply tension to the Joint #3 Timing belt and fix the Joint #3 motor unit.

1. Install the screws for tension adjustment to the motor plate.

A Screw: M4x40 or longer
(recommended length)

Motor Plate



2. Pass a suitable cord or a string (insulation lock) to the screw. Pull the cord using a force gauge or a similar tool to apply specified tension.
Joint #3 timing belt tension: 44.2 to 63.8 N

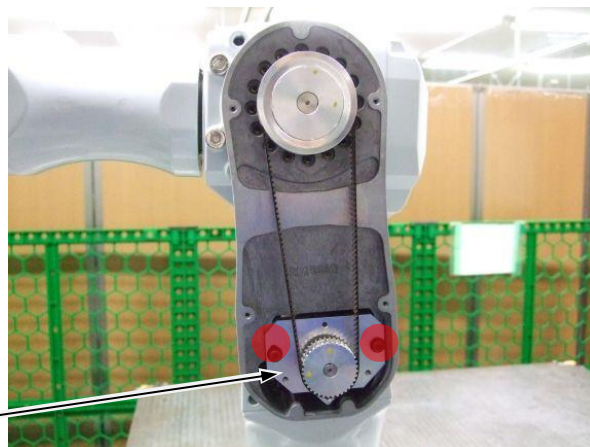
Force gauge



3. Secure the Joint #3 motor unit by applying tension.

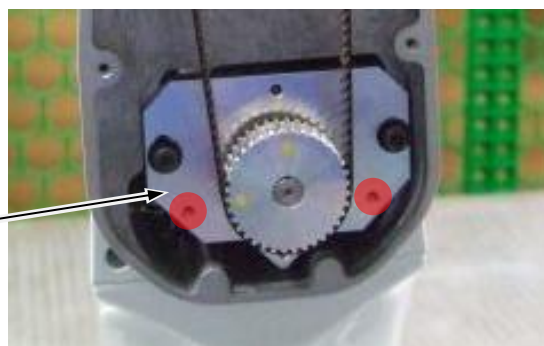
A S01: 2-M4x15 and washer
(4.0 +/- 0.2 N·m)

Joint #3 motor unit



4. Make sure to remove the screws for tension adjustment.

Motor Plate

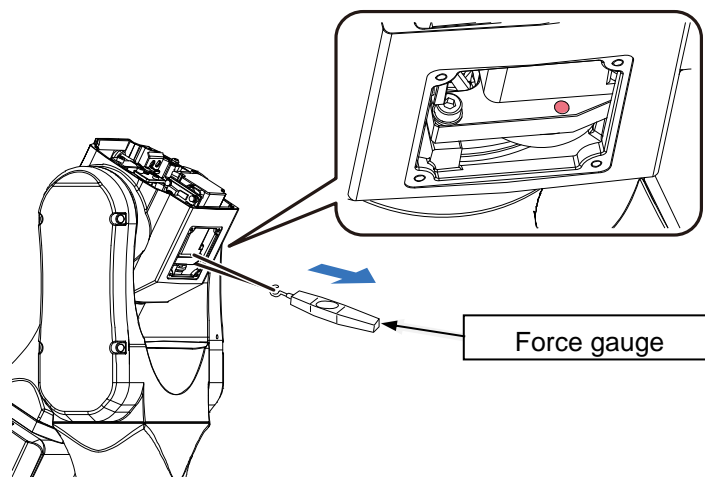


Joint #4 Timing belt

Apply tension to the Joint #4 timing belt and fix the Joint #4 motor unit.

1. Pass a suitable cord or a string (insulation lock) to the drilled hole of the motor plate. Then, pull the cord using a force gauge or a similar tool and apply specified tension to fix the motor unit.

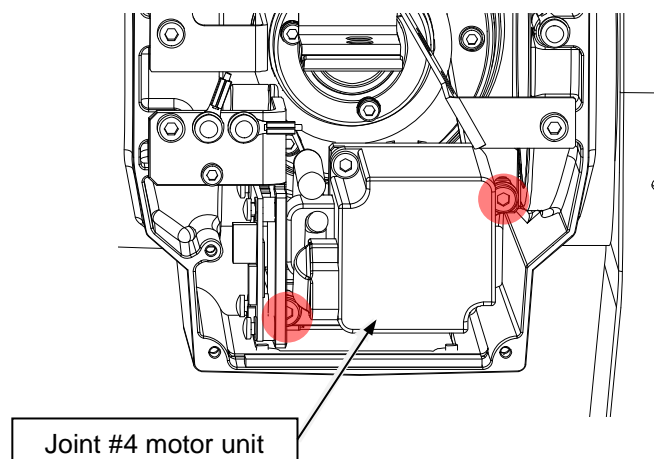
Joint #4 timing belt tension: 29.4 to 49.0 N



2. Secure the Joint #4 motor unit by applying tension.

A

S01: 2-M4x15
(4.0 +/- 0.2 N·m)



Joint #5 Timing belt

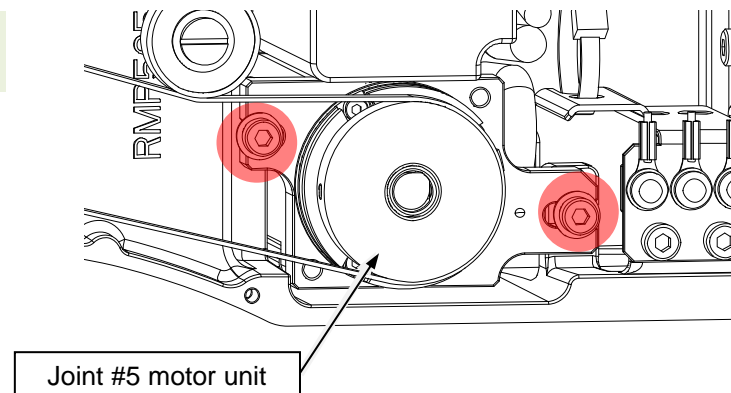
Apply tension to the Joint #5 Timing belt and fix the Joint #5 motor unit.

1. Hang a non-stretchable cord (such as a wire tie) near the motor plate and pull it with a push-pull gauge or similar device to apply the specified tension.

Joint #5 timing belt tension: 29.4 to 49.0 N

2. Secure the Joint #5 motor unit by applying tension.

A S01: 2-M4x15 and washer
(4.0 +/- 0.2 N·m)



Joint #6 Timing belt

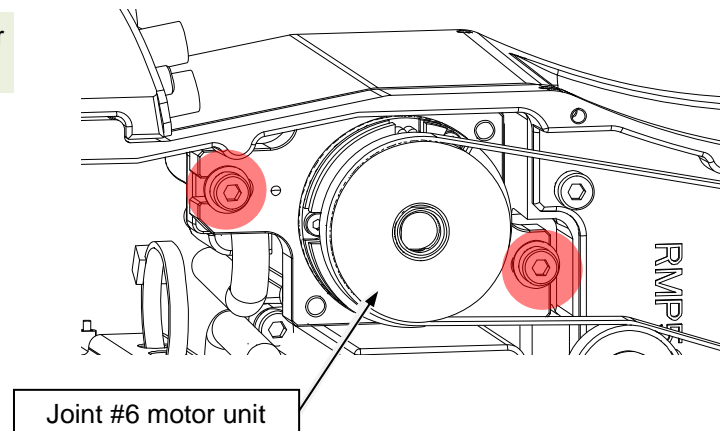
Apply tension to the Joint #6 Timing belt and fix the Joint #6 motor unit.

1. Hang a non-stretchable cord (such as a wire tie) near the motor plate and pull it with a push-pull gauge or similar device to apply the specified tension.

Joint #6 timing belt tension: 29.4 to 49.0 N

2. Secure the Joint #6 motor unit by applying tension.

A S01: 2-M4x15 and washer
(4.0 +/- 0.2 N·m)



3.2 Calibration


3.2.1 What is Calibration?

After parts have been replaced (motors, reduction gear units, timing belts, etc.), the Manipulator cannot perform positioning properly because a gap exists between the origin stored in each motor encoder and its corresponding origin stored in the Controller.

Therefore, it is necessary to match these origins after replacing the parts.

The process of aligning the two origins is called “Calibration”. Note that calibration is not the same as teaching*.

* “Teaching” means to teach the Controller coordinate points (including poses) anywhere in the operating area of the Manipulator.

 WARNING	<ul style="list-style-type: none">● To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the <i>Installation and Design Precautions</i> in the <i>Safety</i> chapter of the <i>EPSON RC+ User's Guide</i>.● 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.
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In EPSON RC+, a coordinate point including the arm pose is defined as “point” and its data is called “point data”.

There are two methods to move the Manipulator during calibration.


- Releasing the electromagnetic brake and moving the arms manually.

For details, refer to the *C-B series Manual C4 Manipulator 2.1.6 How to Move Arms with the Electromagnetic Brake*.


- Moving the Manipulator using Jog & Teach.

Moving the Manipulator while releasing the electromagnetic brake involves risk as described below.

It is recommended to move the Manipulator using Jog & Teach.

 CAUTION	<ul style="list-style-type: none">● Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may cause hands and fingers to be caught and/or equipment damage to or malfunction of the Manipulator as the arms of the Manipulator may move in unexpected directions.● Be careful of the arm falling when releasing the brake. While the brake is being released, the Manipulator's arm falls by its own weight. The arm falling may cause hands and fingers to be caught and/or may cause equipment damage to or malfunction of the Manipulator.
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Also, pay attention to the following points at the encoder initialization.

 CAUTION	<ul style="list-style-type: none">● The Joint #1 and Joint #4 have no mechanical stops and they may be rotated more than 360 degrees. If the encoder initialization is performed with improper posture, the Manipulator moves outside the operation range. If the Manipulator was moved outside the operation range, the internal wiring may be damaged by being twisted or pinched and it may result in Manipulator malfunction.
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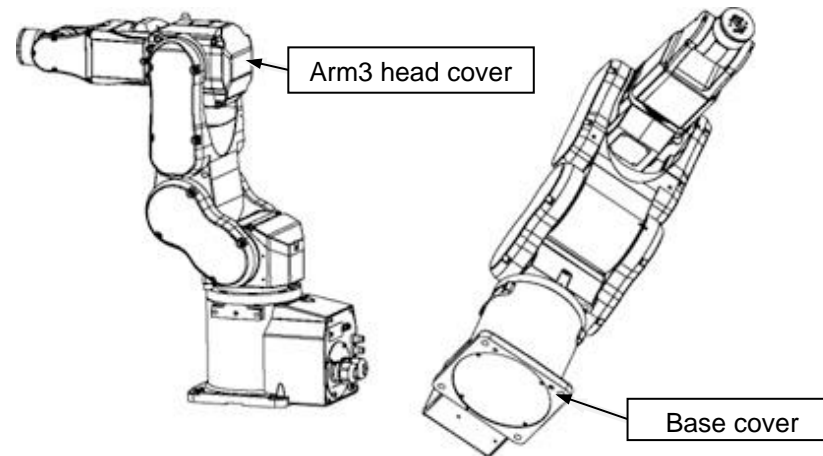
NOTE

When the home positions of the Joints #1 and #4 are uncertain, check torsion of the internal cables. The home positions are where the Manipulator has the internal cables not twisted at the basic orientation described in *C-B Series Manual C4 Manipulator 3.7 Checking the Basic orientation*.

Torsion of the internal cables can be checked by removing the following covers.

Joint #1 : Base cover

Joint #4 : Arm 3 head cover



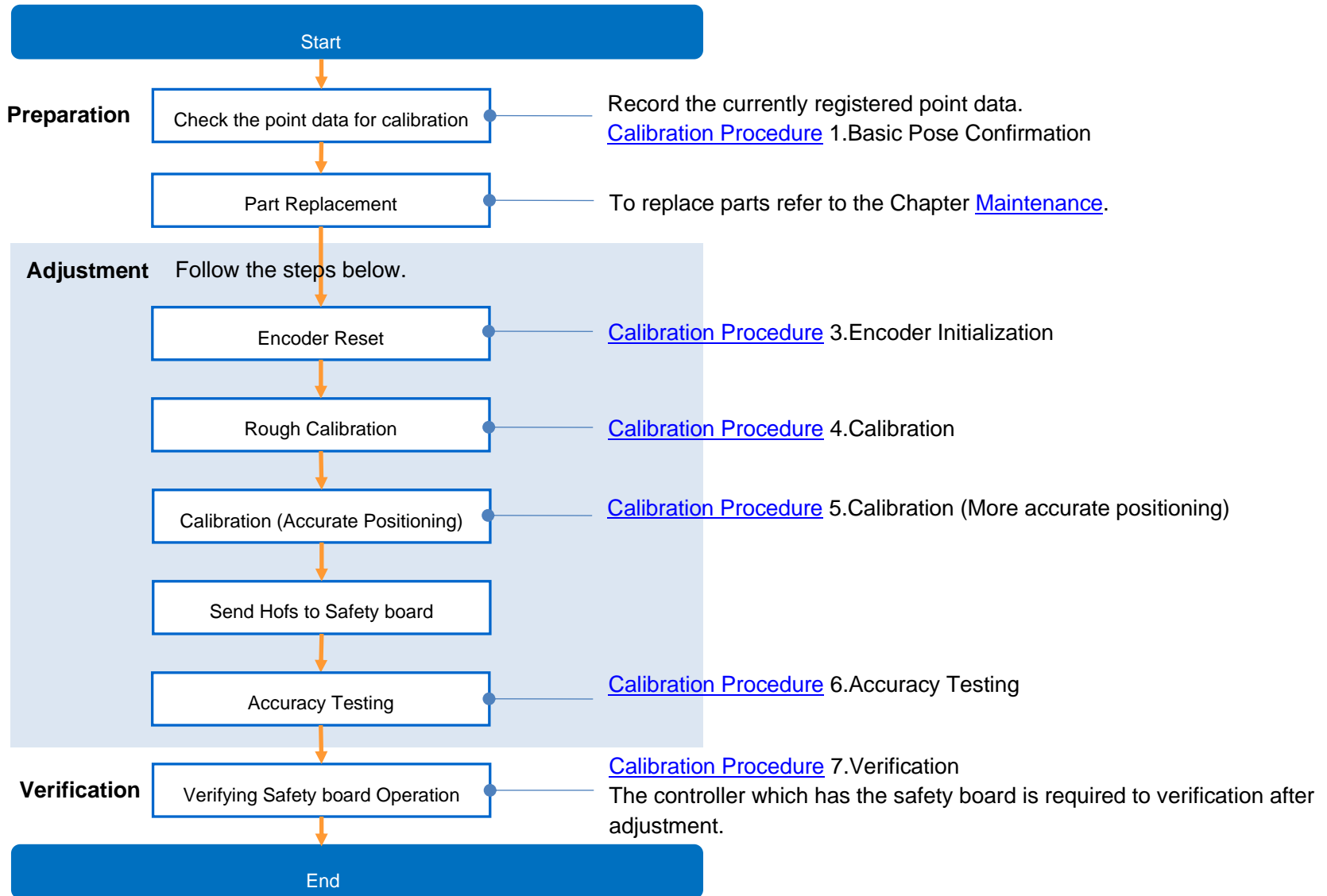
For details on Jog & Teach, refer to the following manual.

EPSON RC+ User's Guide

NOTE

- For details about the basic orientation, refer to *C-B Series Manual C4 Manipulator 2.3.6 Checking the Basic orientation*.
- Whenever possible, calibrate one joint at a time. (Also, replace parts of one joint at a time whenever possible.) If you calibrate the origins for multiple joints simultaneously, it will be more difficult to verify their origins and obtain the origin correct positions.
However, joint #5 cannot be calibrated alone due to the structure of the Manipulator. Make sure you calibrate joint #5 and #6 at the same time.

3.2.2 Calibration Flowchart



3.2.3 Calibration Procedure

Command Input

Command execution is required in some calibration procedures.

Select the EPSON RC+ menu-[Tools]-[Command Window].

This step is omitted in the calibration procedures.

Jog Motion

Setting of the jog motion is required in some calibration procedures.

Select EPSON RC+ menu-[Tools]-[Robot Manager] and select the [Jog & Teach] page.

The panel, window, and page above are indicated as [Jog & Teach] in the calibration procedures.

Calibration Procedure

Follow steps 1 to 6 to calibrate the Manipulator.

1. Basic Pose Confirmation

Pose data (Point data) prior to the part replacement (motors, reduction gear unit, or belt) is necessary for the calibration.

Verify the recorded pulse values of the basic pose obtained in the *C-B series Manual C4 Manipulator 2.3.6 Checking the Basic Orientation*.

2. Part Replacement

Replace parts as instructed in this manual.

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

3. Encoder Initialization

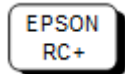
Turn ON the Controller while all joints are in the motion range.

The error message “Encoder alarm has occurred. Check robot battery. EPSON RC+ must be restarted.” will be displayed.

Initialize the encoder at the current position and reset the error.

Initialize the encoder using one of the following procedures.

Execute the following command at the [Monitor Window].



`>Encreset` [The joint number (1 to 6) of the encoder to be reset]

Select EPSON RC+ menu-[Tools]-[Controller], then click <Reset Controller>.

After resetting the error, the motor encoder of the joint whose parts have been replaced will be initialized.

Set the jog mode to “Joint” in [Jog & Teach] and operate the Manipulator in jog motion to match the home position marks (0 pulse position) of the joint accurately.

When the joint cannot move to the home position, operate the Manipulator to match the tram mark placed in *C-B series Manual C4 Manipulator 2.3.6 Checking the Basic orientation* as accurate as possible.

Initialize the encoder when the joint matches the home position or the tram mark.

For the encoder initialization, refer to the procedure indicated above.

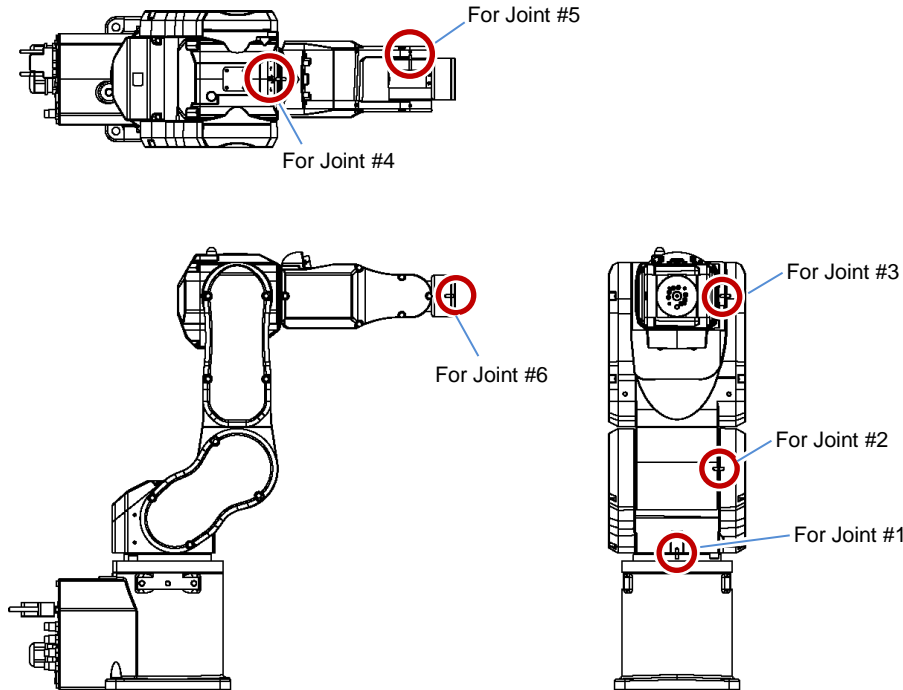
NOTE

When the origin of the Joint #5 is calibrated, the Joint #6 will be out of position. (Due to the structure of the Manipulator, any offset in the position of the Joint #5 affects the Joint #6.)

Calibrate the origin of the Joint #6 together when calibrating the Joint #5.

4. Calibration

Position of grooves for calibration



Position of the calibration key

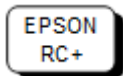
The key is secured to the inside of the Arm #1 center cover.

Be sure to put the key back to the original position after use.



A S02: 1-M3x6
(3.0 +/- 0.2 N·m)

4-1 Move the arm you want to calibrate to the position of the grooves for calibration.

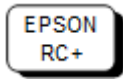


Select menu-[Tool]-[Robot Manager]-[Jog & Teach] panel to move the Manipulator.

If an error occurs after replacing the motor and you cannot use the [Jog & Teach] panel or “Brake OFF, *” does not work (* is an axis number to calibrate.), go through the steps 4 and 5 now.

Then, [Jog & Teach] panel and “Brake OFF, *” will be available. Move the arm you want to calibrate to the position of the calibration mark.

4-2 Reset the encoder.



Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

Joint #1 >Encreset 1

Joint #2 >Encreset 2

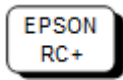
Joint #3 >Encreset 3

Joint #4 >Encreset 4

Joint #5 >Encreset 5, 6

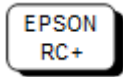
Joint #6 >Encreset 6

4-3 Reboot the Controller.



Click EPSON RC+ menu-[Tool]-[Controller]-<Reset Controller>.

4-4 Input the command in the Command window and execute it.

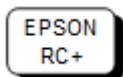


Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

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

* Manipulator does not move.

4-5 Perform the calibration.



Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

Joint #1 >calib 1

Joint #2 >calib 2

Joint #3 >calib 3

Joint #4 >calib 4

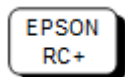
Joint #5 >calib 5, 6

Joint #6 >calib 6

NOTE

- 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 (More accurate positioning)



Move the Manipulator to the selected point data by jogging in [Jog & Teach].

Move the joint* which is not calibrated to the specified point by motion command.

* When the Joint #5 is being calibrated, move the Joints #1 - #4 to the home positions.

For example, when the selected point data is "P1", execute "Motor On" in [Control Panel] and execute "Go P1" in [Jog & Teach].

Position the calibrating joint* to the selected point data position accurately by jog command.

* When the Joint #5 is being calibrated, move the Joint #5 and #6 to the home positions.

Select the "Joint" jog mode from [Jog & Teach] to operate in the jog motion.

Enter the command below in the command window and execute it.

Execute the command below in the menu -[Tools]-[Command Window].

```
>calpls ppls (P1,1) , ppls (P1,2) , ppls (P1,3) , ppls (P1,4) , ppls (P1,5) , ppls (P1,6)
```

* The Manipulator will not move.

Perform the calibration. Input one of the following commands according to the joint being calibrated.

Joint #1 : >Calib 1

Joint #2 : >Calib 2

Joint #3 : >Calib 3

Joint #4 : >Calib 4

Joint #5 : >Calib 5,6

Joint #6 : >Calib 6

NOTE

- 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.

6. Accuracy Testing

Move the Manipulator to a different pose (point) to verify whether it moves back to the original position. If accuracy is inadequate, it is necessary to re-calibrate the origin using a different pose (point). You must set the pose (point) again if the Manipulator does not move back to the original position after re-calibration.

7. Verification

RC700E is required to verifying the safety function after completing calibration.

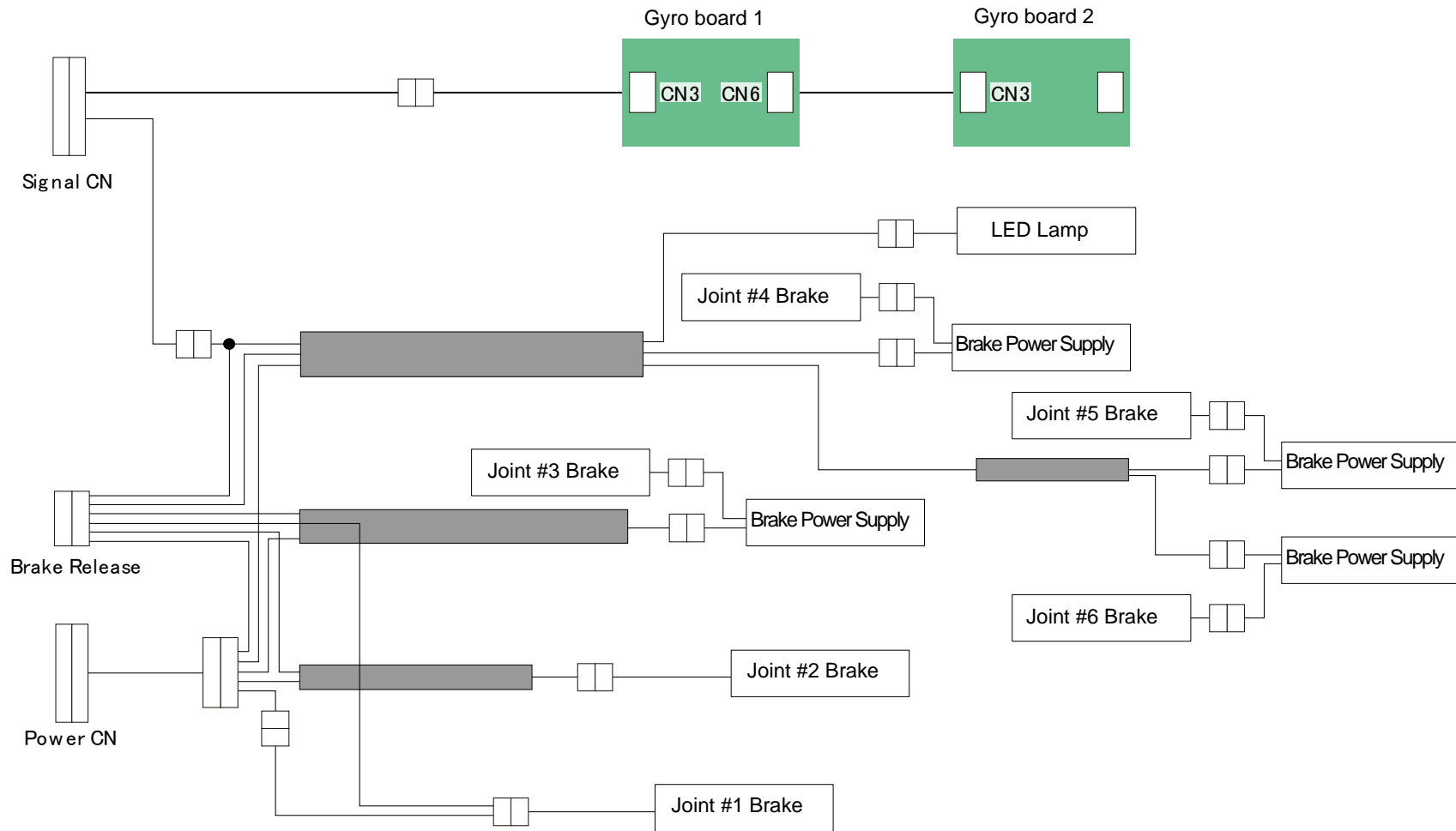
For details on the verification procedure, refer to *RC700-E Service Manual 3.4 Setup Procedure After Parts Replacement (Safety Board)*.

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4

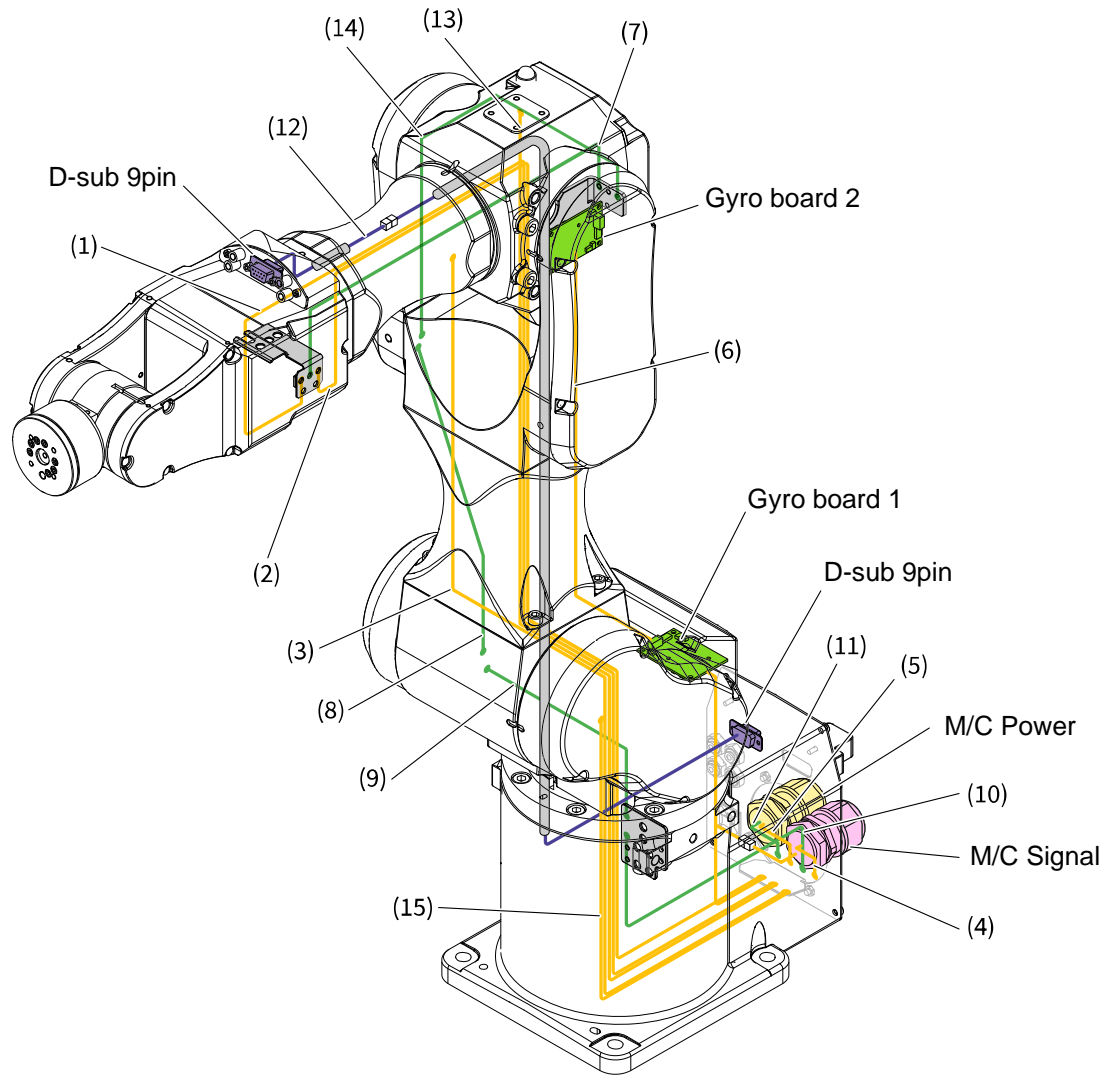
Block Diagram/Wiring Diagram

4.1 Block Diagram



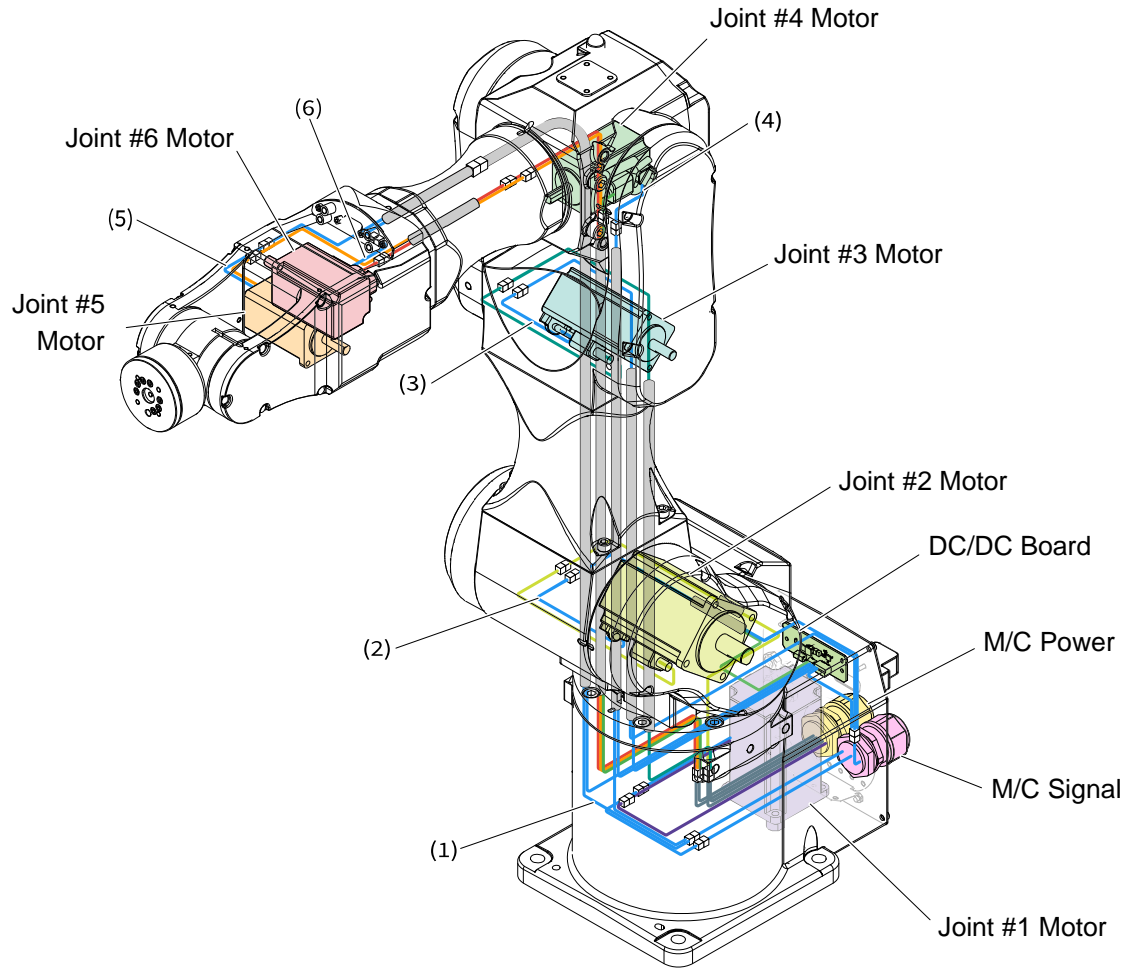
4.2 Wiring Diagram

4.2.1 Ground Wire (PE, FB), D-sub 9pin



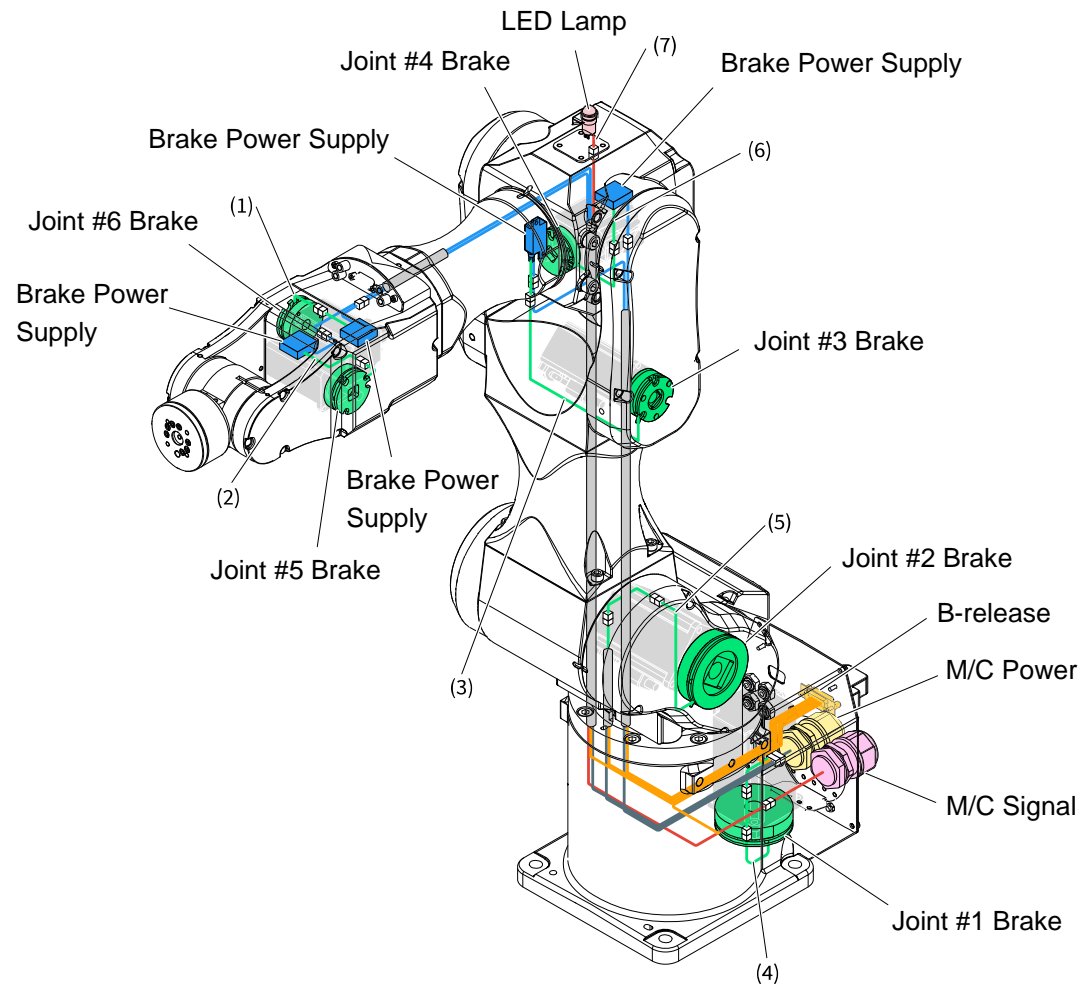
No.	Connection
(1)	FB12 - FB6
(2)	FB13 - FB8
(3)	FB10 - FB4
(4)	FB2 - M/C Signal
(5)	FB1 - M/C Power
(6)	Gyro board 1 - CN6 - Gyro board 2 - CN3G0 - M/C Signal
(7)	PE7 - PE10
(8)	PE8 - PE5
(9)	PE6 - PE3
(10)	PE2 - PE4
(11)	PE1 - M/C Power
(12)	D-sub 9pin - CN521 - D-sub 9pin
(13)	FB11 - FB5
(14)	PE10 - PE7
(15)	FB4 - FB9

4.2.2 Motor Cable



No.	Connection
(1)	Joint #1 Motor - CN311 - CN312 - M/C Signal
(2)	Joint #2 Motor - CN321 - CN300 - M/C Signal
(3)	Joint #3 Motor - CN331
(4)	Joint #4 Motor - CN341
(5)	Joint #5 Motor - CN351 - CN301 - M/C Signal
(6)	Joint #6 Motor - CN361

4.2.3 Brake Wire, LED Wire



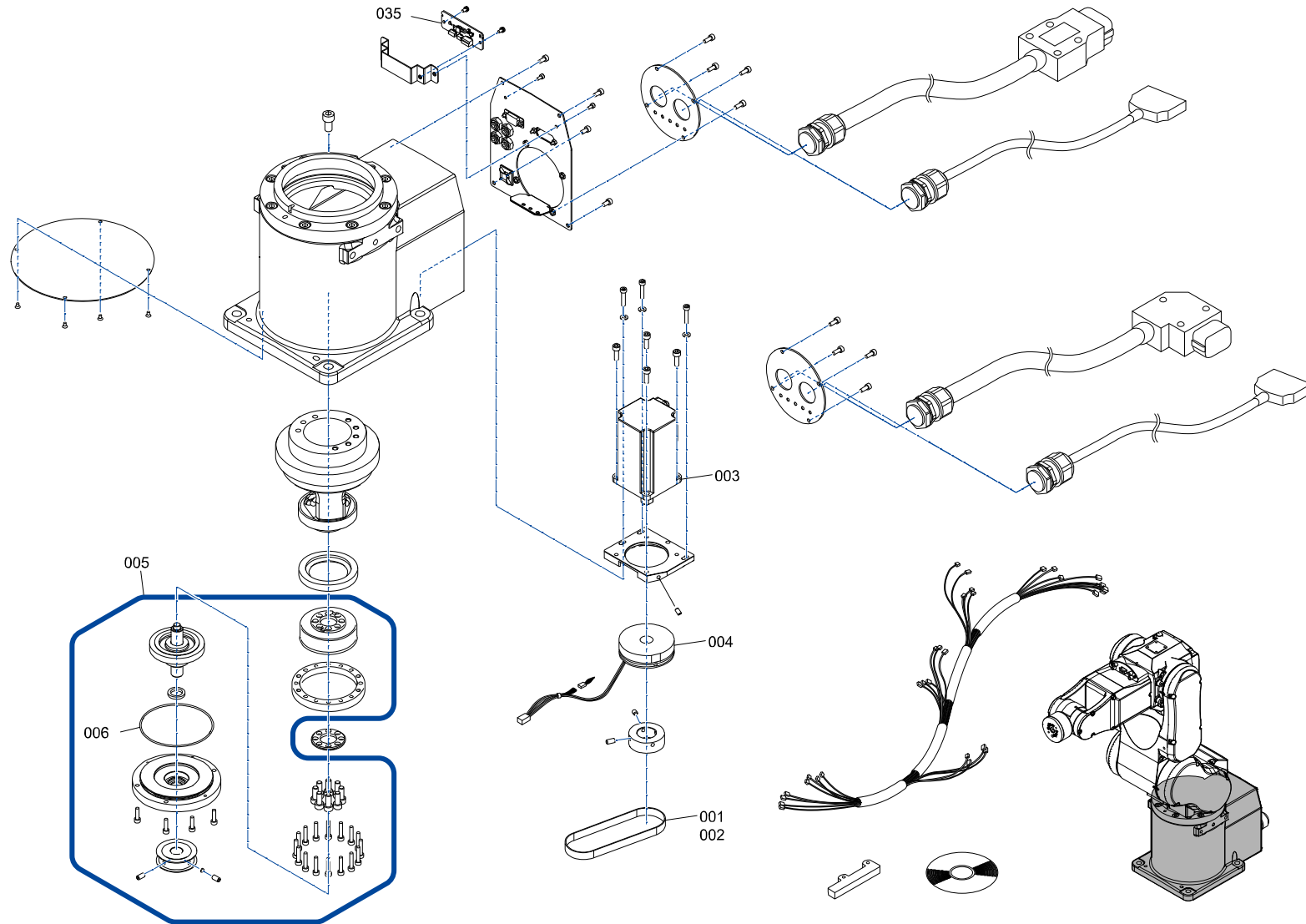
No.	Connection
(1)	J6 Brake - BR063 - Brake Power Supply - BR062 - CN203 - B-release - CN202 - M/C Power
(2)	J5 Brake - BR053 - Brake Power Supply - BR052 - CN203 - B-release - CN202 - M/C Power
(3)	J3 Brake - CN430 - Brake Power Supply - CN431 - B-release - CN202 - M/C Power
(4)	J1 Brake - BR012 - BR011 - CN202 - M/C Power - B-release - CN202 - M/C Power
(5)	J2 Brake - BR022 - BR021 - CN202 - M/C Power - B-release - CN202 - M/C Power
(6)	J4 Brake - BR042 - Brake Power Supply - BR041 - B-release - CN202 - M/C Power
(7)	LED - LED - B-release - CN3L1 - M/C Signal

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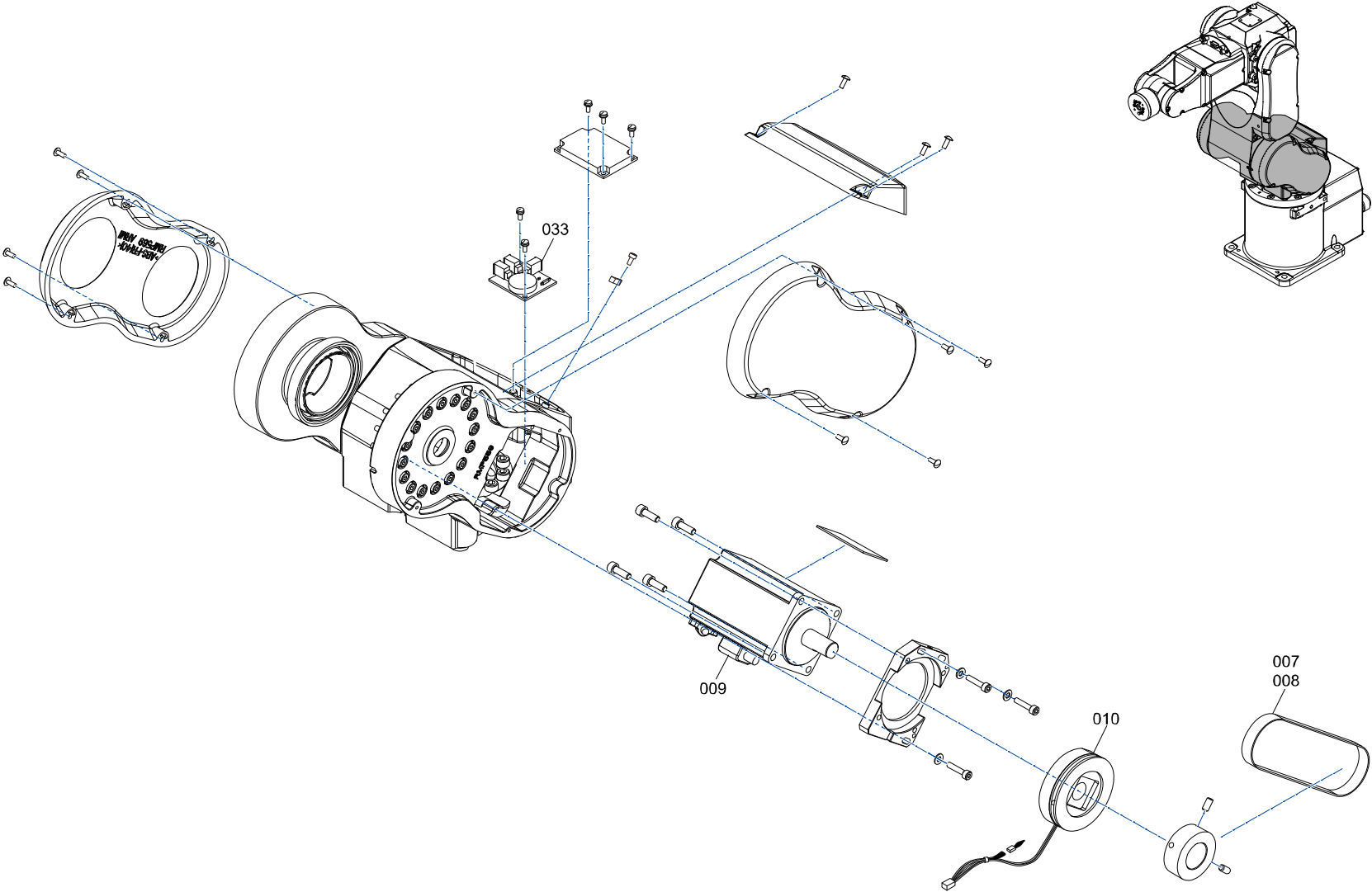
5

Exploded View/Maintenance Parts List

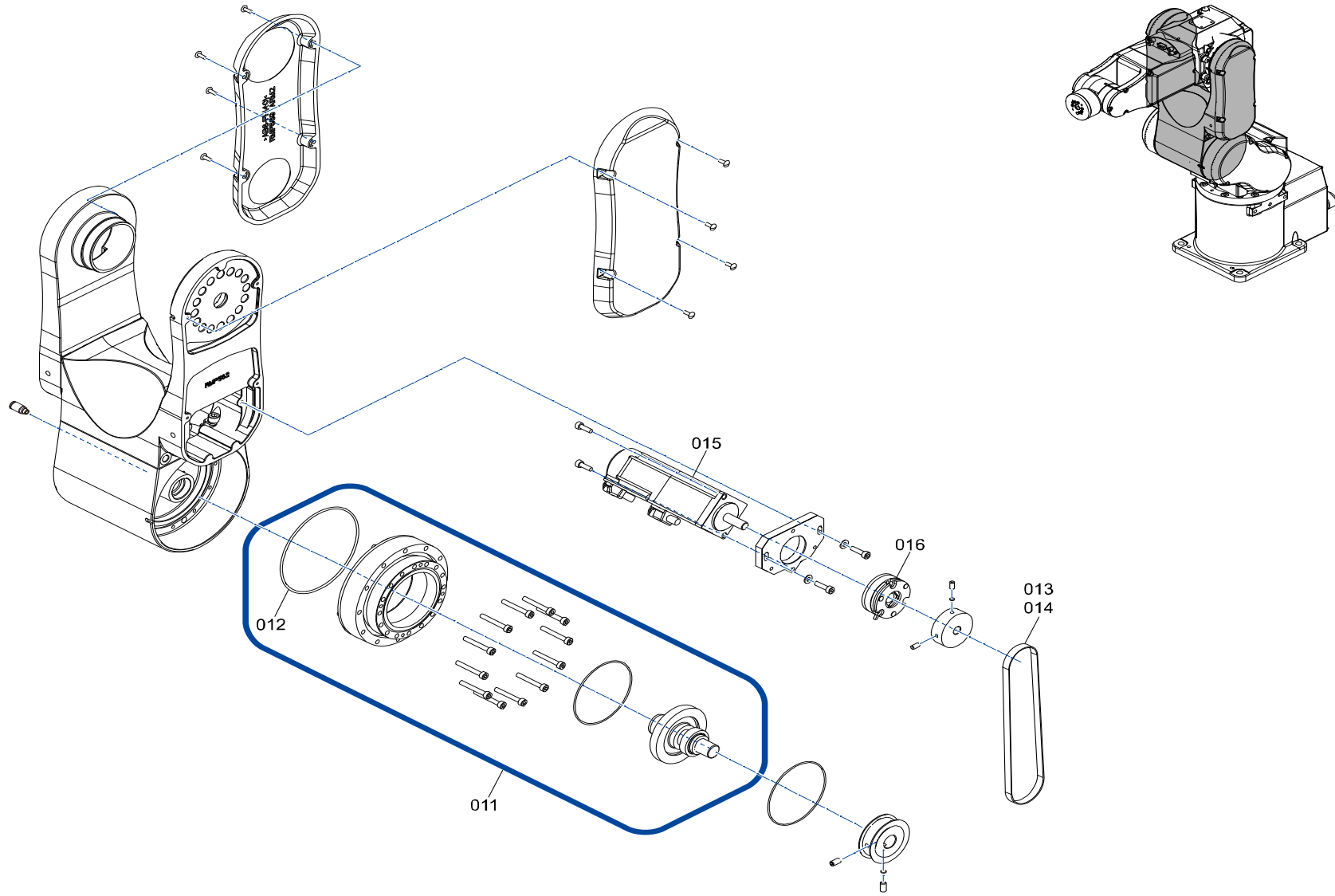
5.1 Exploded View



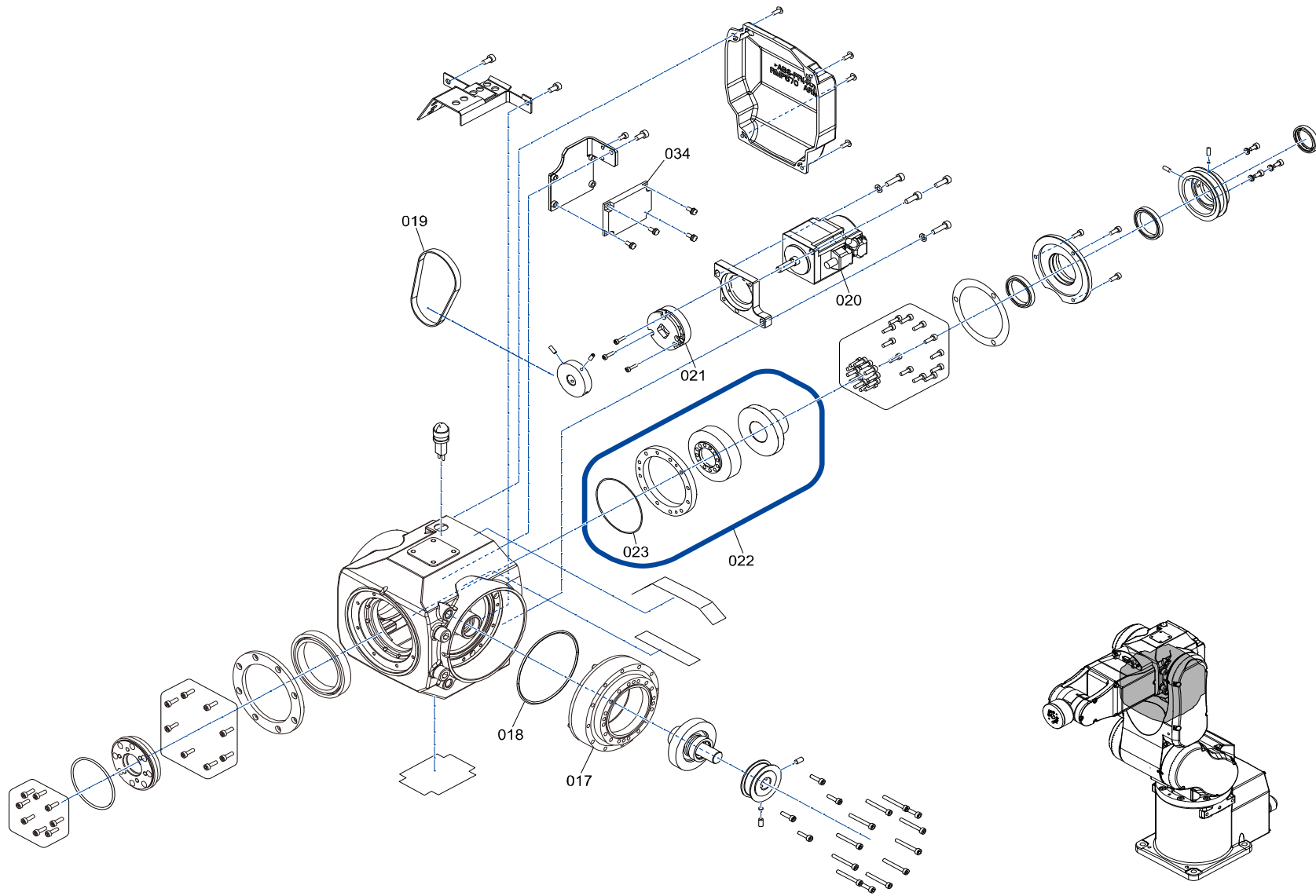
C4/C4L No.1



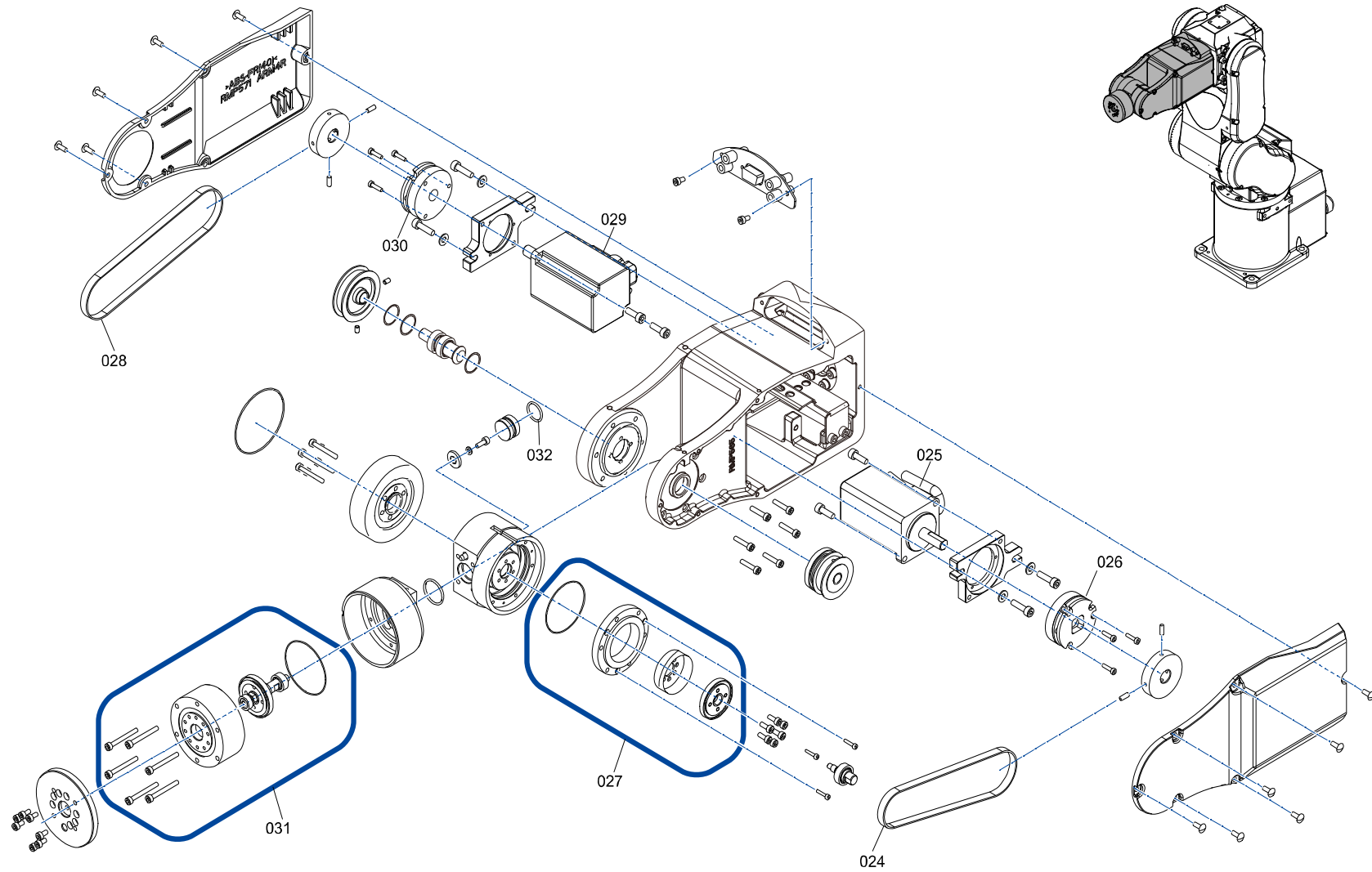
C4/C4L No.2



C4/C4L No.3



C4/C4L No.4



C4/C4L No.5

5.2 Maintenance Parts List

Ref. No.	Parts Name	Parts Code	Note	Overhaul
001	Timing Belt	1520394	Joint #1 (C4-B)	✓
002	Timing Belt	1593695	Joint #1 (C4L-B)	✓
003	Motor	2230549	Joint #1	✓
004	Brake	2167707	Joint #1	✓
005	Reduction Gear Unit	1934754	Joint #1	✓
006	O-ring	1480857	Joint #1 Reduction Gear	✓
007	Timing Belt	1520354	Joint #2 (C4-B)	✓
008	Timing Belt	1593696	Joint #2 (C4L-B)	✓
009	Motor	2230549	Joint #2	✓
010	Brake	2167830	Joint #2	✓
011	Reduction Gear Unit	1934756	Joint #2	✓
012	O-ring	1510528	Joint #2 Reduction Gear	
013	Timing Belt	1593697	Joint #3 (C4-B)	✓
014	Timing Belt	1593698	Joint #3 (C4L-B)	✓
015	Motor	2230550	Joint #3	✓
016	Brake	2232998	Joint #3	✓
017	Reduction Gear Unit	1934761	Joint #3	✓
018	O-ring	1520370	Joint #3 Reduction Gear	
019	Timing Belt	1593699	Joint #4 (C4-B, C4L-B)	✓
020	Motor	2232754	Joint #4	✓
021	Brake	2202712	Joint #4	✓
022	Reduction Gear Unit	1533648	Joint #4	✓
023	O-ring	1520372	Joint #4 Reduction Gear	
024	Timing Belt	1599367	Joint #5 (C4-B, C4L-B)	✓

Ref. No.	Parts Name	Parts Code	Note	Overhaul
025	Motor	2232754	Joint #5	✓
026	Brake	2202713	Joint #5	✓
027	Reduction Gear Unit	1934764	Joint #5	✓
028	Timing Belt	1593701	Joint #6 (C4-B, C4L-B)	✓
029	Motor	2232754	Joint #6	✓
030	Brake	2202714	Joint #6	✓
031	Reduction Gear Unit	1939261	Joint #6	✓
NONFIG	Bevel Gear Unit	1935984	Joint #6	✓
032	O-ring	1520374	Arm5 plug	
033	Gyro Board 1	2228302		
034	Gyro Board 2	2228303		
035	DC/DC Board	2224571		