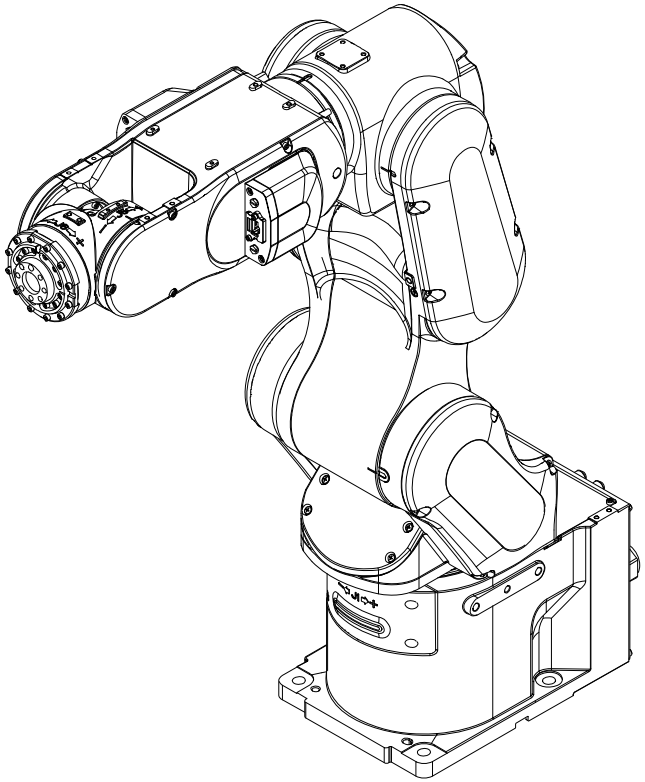
EPSON



6-Axis Robots

CX4-A/CX7-A

Service Manual

Rev.3

ENSM264R0044

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Table of Contents

Chapter 1 Maintenance Information

1.1 Safety Maintenance 1-1
1.2 General Maintenance 1-3
1.2.1 Schedule for Maintenance Inspection 1-3
1.2.2 Inspection Point 1-4
1.2.3 Overhaul (Parts Replacement) 1-6
1.2.4 Tools/Materials 1-12
1.2.5 Tightening Bolts/Screws 1-14
1.3 Parts Layout 1-16

Chapter 2 Maintenance

Overview 2-1
Precautions for Maintenance 2-1
Viewing the Maintenance Page 2-3
2.1 Joint #1 2-5
2.1.1 Replacing the J1 Brake (CX4-A) 2-5
2.1.2 Replacing the J1 Brake (CX7-A) 2-8
2.1.3 Replacing the J1 Motor (CX4-A) 2-11
2.1.4 Replacing the J1 Motor (CX7-A) 2-18
2.1.5 Replacing the J1 Timing Belt 2-25
2.1.6 Replacing the J1 Reduction Gear 2-32
2.2 Joint #2 2-38
2.2.1 Replacing the J2 Timing Belt 2-38
2.2.2 Replacing the J2 Brake 2-42
2.2.3 Replacing the J2 Motor 2-49
2.2.4 Replacing the J2 Reduction Gear 2-52
2.3 Joint #3 2-62
2.3.1 Replacing the J3 Timing Belt 2-62
2.3.2 Replacing the J3 Brake 2-66
2.3.3 Replacing the J3 Motor 2-71
2.3.4 Replacing the J3 Reduction Gear 2-74
2.4 Joint #4 2-79
2.4.1 Replacing the J4 Brake 2-79
2.4.2 Replacing the J4 Motor 2-88
2.4.3 Replacing the J4 Timing Belt 2-91
2.4.4 Replacing the J4 Reduction Gear (CX4-A) 2-97
2.4.5 Replacing the J4 Reduction Gear (CX7-A) 2-102
2.5 Joint #5 2-107
2.5.1 Replacing the J5 Timing Belt 2-107
2.5.2 Replacing the J5 Brake 2-111
2.5.3 Replacing the J5 Motor 2-118
2.5.4 Replacing the J5 and J6 Reduction Gear Units 2-121
2.5.5 Replacing the J5 Reduction Gear 2-130
2.6 Joint #6 2-136
2.6.1 Replacing the J6 Timing Belt 2-136
2.6.2 Replacing the J6 Brake 2-140
2.6.3 Replacing the J6 Motor 2-147
2.6.4 Replacing the J6 Reduction Gear 2-150
2.7 Replacing the Board 2-151
2.7.1 Replacing Gyro Board 1 2-151
2.7.2 Replacing Gyro Board 2 2-154
2.7.3 Replacing the SUB-B Board (DC/DC Board) 2-157
2.7.4 Replacing the LED Board 2-160
2.7.5 Replacing the Multi-drop Board 1 2-163
2.7.6 Replacing the Multi-drop Board 2 2-166
2.7.7 Replacing the Multi-drop Board 3 2-169
2.8 Replacing the M/C Cable 2-172
2.8.1 Removing the M/C Cable 2-173

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2.8.2 Installing the M/C Cable 2-174
2.9 Replacing the Cable Unit 2-175
2.9.1 Removing the Cable Unit 2-175
2.9.2 Installing the Cable Unit 2-179
2.10 Cover 2-182
2.10.1 Connector Plate 2-184
2.10.2 Base Maintenance Cover 2-187
2.10.3 Arm1 center cover 2-190
2.10.4 LED Cover 2-193
2.10.5 Arm1 side cover 2-194
2.10.6 Arm2 side cover 2-197
2.10.7 Arm3 head cover 2-200
2.10.8 Arm3 maintenance cover 2-203
2.10.9 Arm4 side cover 2-206

Chapter 3 Adjustment

3.1 Adjusting the Timing Belt Tension 3-1
3.1.1 Items to be prepared 3-1
3.1.2 Belt Tension Values 3-1
3.1.3 Adjustment Method 3-2
3.2 Calibration 3-8
3.2.1 What is Calibration? 3-8
3.2.2 Precautions for Calibration (for 6-axis robots) 3-9
3.2.3 Calibration Flowchart 3-10
3.2.4 Preparation 3-12
3.2.5 0-pulse Position of Each Joint 3-13
3.2.6 Key Groove Position of Each Joint 3-14
3.2.7 Performing the Calibration 3-15
3.2.8 Verification 3-28

Chapter 4 Block Diagram

4.1 CX4-A / CX7-A 4-1

Chapter 5 Exploded View/Maintenance Parts List

5.1 Exploded View 5-1
5.1.1 CX4-A 5-1
5.1.2 CX7-A 5-5
5.2 Maintenance Parts List 5-9
5.2.1 CX4-A 5-9
5.2.2 CX7-A 5-12

CHAPTER

1

Maintenance Information

1.1 Safety Maintenance

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

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

WARNING	● Do not remove any parts that are not covered in this manual. Follow the maintenance procedure strictly as described in this manual. Do not proceed using any methods other than described in this manual when you do replace a part or maintain the equipment. Improper removal of parts or improper maintenance may not only cause improper function of the robot system but also serious safety problems. ● Keep away from the Manipulator while the power is ON if you have not taken the training courses. Do not enter the operating area while the power is ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even when it seems to be stopped. ● When you check the operation of the Manipulator after replacing parts, be sure to check it while you are outside of the safeguarded area. Checking the operation of the Manipulator while you are inside of the safeguarded area may cause serious safety problems as the Manipulator may move unexpectedly. ● Before operating the robot system, make sure that both the Emergency Stop switches and safeguard switch function properly. Operating the robot system when the switches do not function properly is extremely hazardous and may result in serious bodily injury and/or serious damage to the robot system as the switches cannot fulfill their intended functions in an emergency. ● To shut off power to the robot system, 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. ・ Work clothes suitable for work ・ Helmet ・ Safety shoes

WARNING	● 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.

CAUTION	● Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) 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	-	-	-	-	-	√

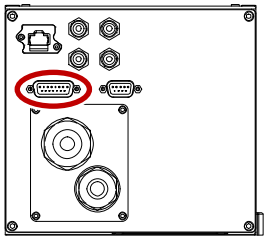
1.2.2 Inspection Point

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 1.2.5 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. 
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 during operation, no stiffness or looseness in the sliding parts or moving parts, and that the operation is performed smoothly. If an abnormality is suspected, replace the part in which the abnormality has occurred.

1.2.3 Overhaul (Parts Replacement)

CAUTION	● Overhaul timing is based on an assumption that all joints are operated for equal distance. If a particular joint has a high duty or high load, it is recommended to overhaul all joints (as many as possible) before exceeding 20,000 operation hours with the joint as a basis.

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

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

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

NOTE	The recommended replacement time of parts to be maintained (Motor, Reduction Gears and Timing Belts) can be checked in the [Maintenance] dialog box of EPSON RC+ 8.0.

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

For the parts subject to overhaul, refer to Chapter 5 Exploded View/Maintenance Parts List.

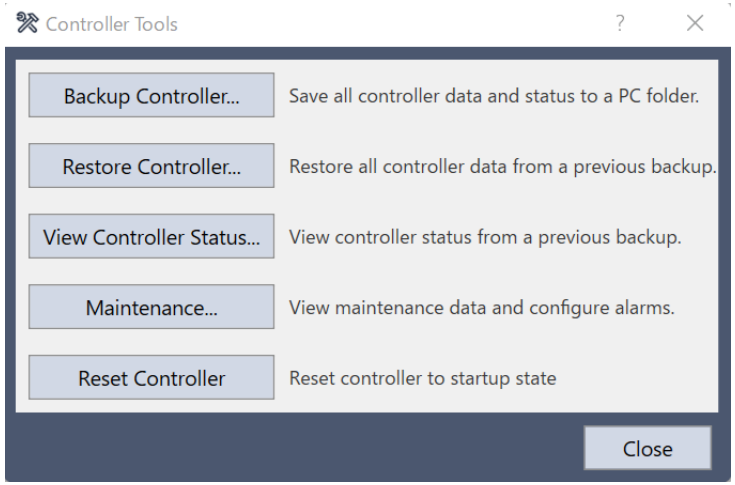
For details of replacement of each part, refer to Chapter 2 Maintenance.

Please contact the supplier of your region for further information.

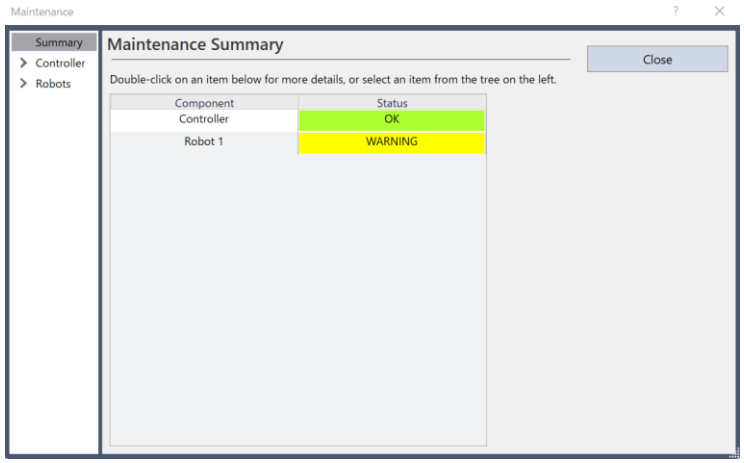
How to View the Maintenance Information

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

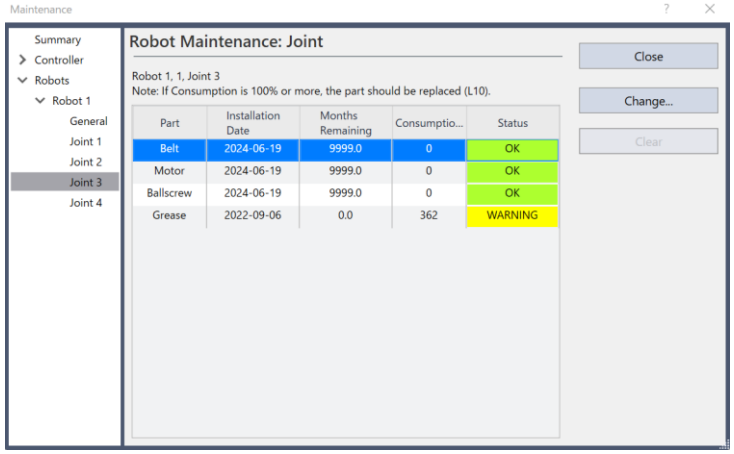
1. Select the EPSON RC+ 8.0 menu-[Tools]-[Maintenance] to display the [Controller Tools] dialog box.



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



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



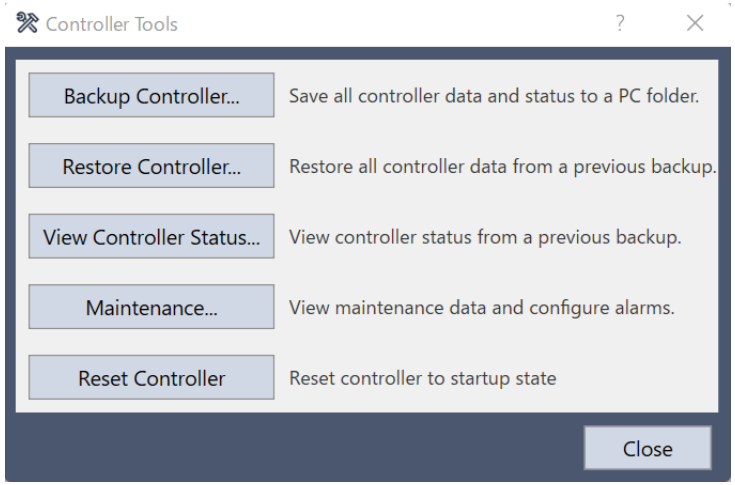
NOTE Remaining months is calculated based on the past operation conditions.

How to Edit the Maintenance Information

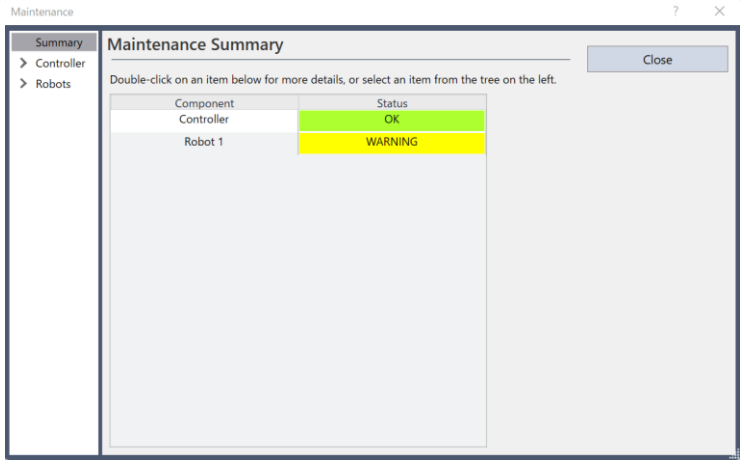
The configured maintenance information can be edited in the EPSON RC+ 8.0.

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

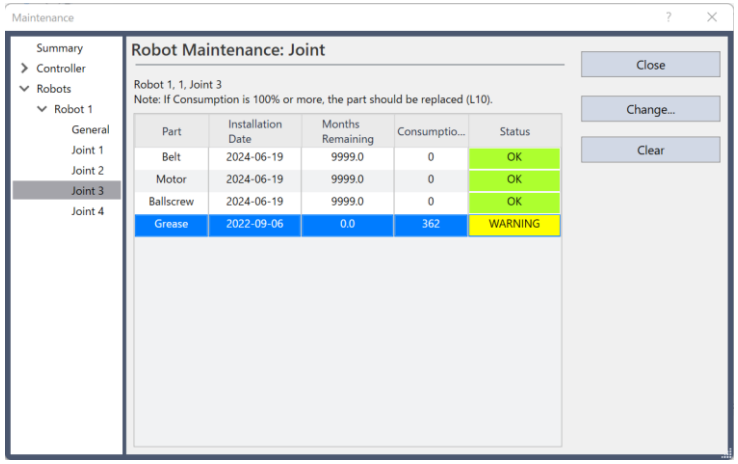
1. Select the EPSON RC+ 8.0 menu- [Tools] - [Maintenance] to display the [Controller Tools] dialog box.



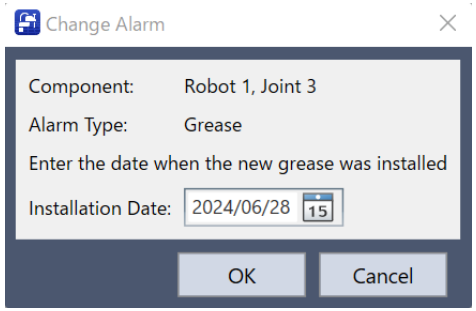
2. To edit the maintenance information, display the [Maintenance] dialog box.



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



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

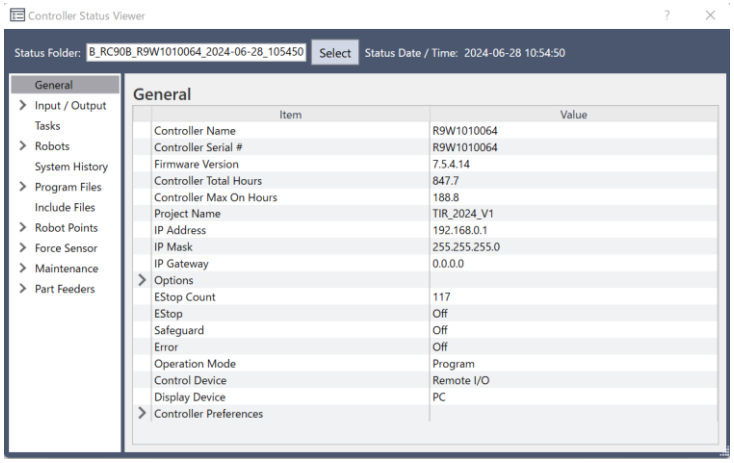


6. Click the <OK> button and change the specified alarm information.

How to check the Manipulator operation hours

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

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



1.2.4 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 1.2.5 Tightening Bolts/Screws.
Phillips screwdriver	Ph2	1	For covers, and for securing the Ground Wires
Flat head screwdriver		1	For grease plug
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
Grease up kit (A set of grease gun, nipple, and extension jig)		1	Maintenance Parts Code: 1674592

Materials used

Name		Quantity	Note
Grease		Proper quantity	For application to the Reduction Gear and the Cable Unit.
Liquid gasket		Proper quantity	For preventing oil leaks and securing parts
Adhesive		Proper quantity	For securing parts
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		
	AB350		

Grease, Liquid gasket, Adhesive

The manufacturer and URL details of each grease type are as follows. If there is anything unclear, please contact the supplier of your region.

Name	Product name	Manufacturer	URL
Grease	Harmonic Grease SK-1A	Harmonic Drive Systems Inc.	https://www.harmonicdrive.net/
	Harmonic Grease SK-2		
	Krytox®GPL-224	Chemours	https://www.chemours.com/en/brands-and-products
Liquid gasket	ThreeBond 1207B	ThreeBond Co.,Ltd	https://www.threebond.com
Loctite	LOCTITE® 243	Henkel	https://loctite.com/

1.2.5 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.

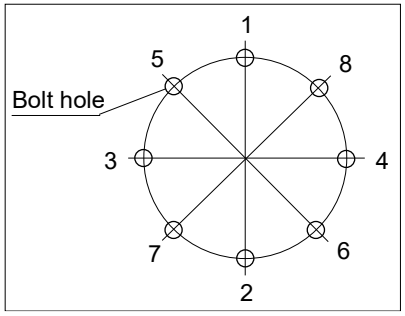
Example) S01: 6-M4x15

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 • Steel, Nickel plated, silver • Property class 10.9 (JIS B1051, ISO 898-1)	M2.5	1.0 +/- 0.1
		M3	2.0 +/- 0.1
		M4	4.0 +/- 0.2
		M5	8.0 +/- 0.4
		M6	13.0 +/- 0.65
		M8	32.0 +/- 1.6
S02	Hexagon socket head cap screw • Steel, Black dyed, black • Property class 12.9 (JIS B1051, ISO 898-1) • Reduction Gear, etc	M3	2.4 +/- 0.1
		M4	5.5 +/- 0.25
		M5	10.0 +/- 0.5
		M6	18.0 +/- 0.9
		M8	44.0 +/- 2.2
S03	Cross recessed pan head screw (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.)	M3	0.45 +/- 0.05
		M4	0.9 +/- 0.1

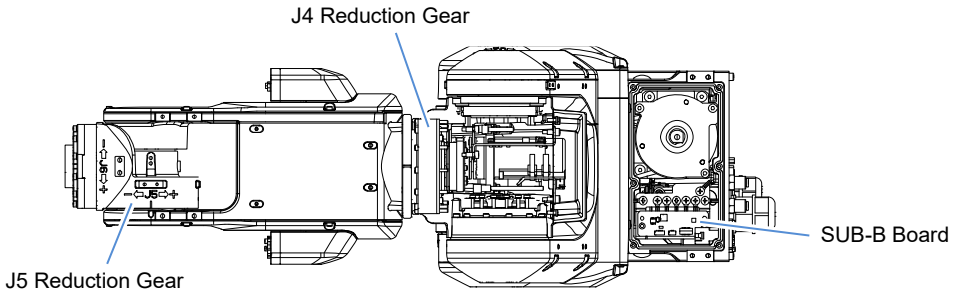
Type	Description	Size	Tightening torque (N·m)
S05	Hexagon socket head set screw • Steel, Nickel plated, silver • Property class 45H (JIS B1177, ISO 4026)	M3	0.9 +/- 0.1
		M4	2.4 +/- 0.1
		M5	4.0 +/- 0.2
S06	Cross recessed truss screw (Covers, etc.)	M3	0.45 +/- 0.1
S07	Cross recessed binding head screw (SUB-B Board (DC/DC Board))	M3	0.45 +/- 0.1

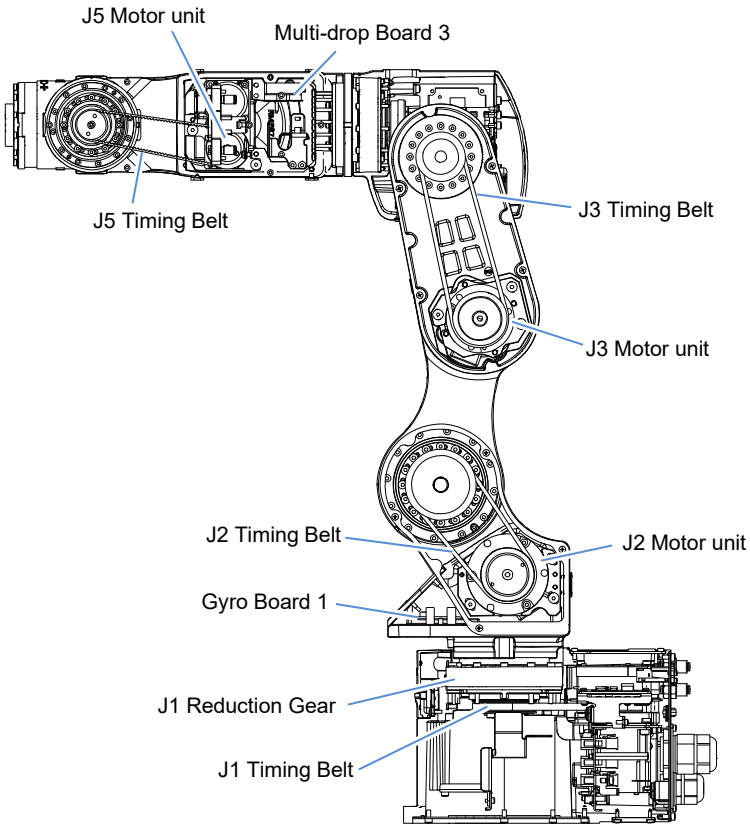
We recommend that the bolts aligned on a circumference should be fastened in a crisscross pattern as shown in the figure below.

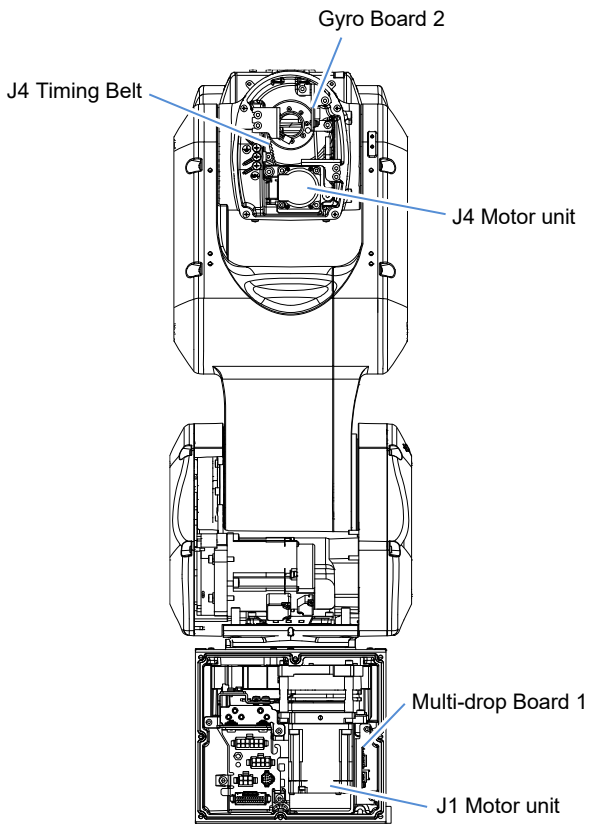


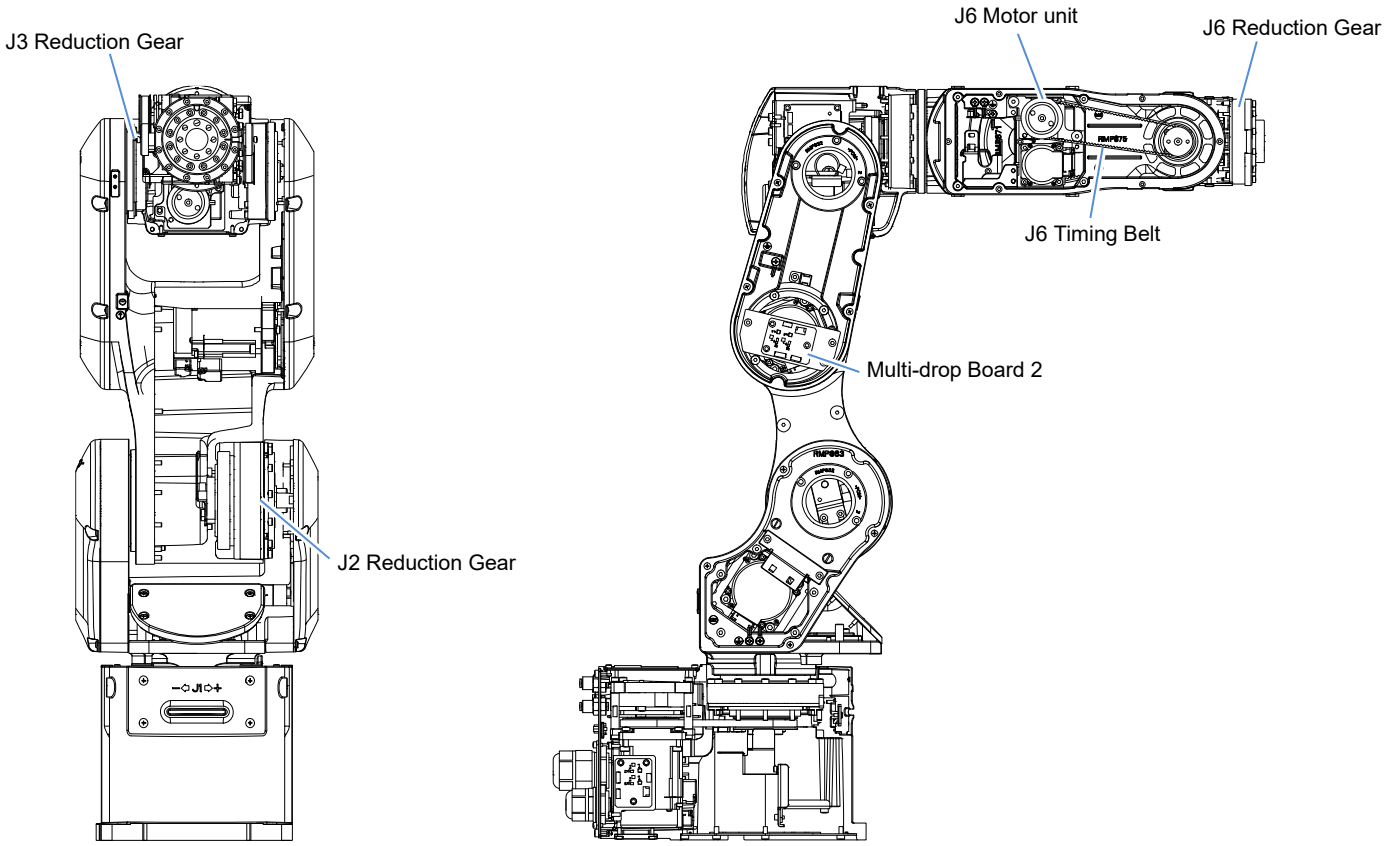
Do not fasten all bolts securely at one time. Divide the number of times that the bolts are fastened into two or three and fasten the bolts securely with a hexagonal wrench. Then, use a torque wrench so that the bolts are fastened with tightening torques shown in the table above.

1.3 Parts Layout








J3 Reduction Gear
J6 Motor unit
J6 Reduction Gear
J6 Timing Belt
Multi-drop Board 2
J2 Reduction Gear

CHAPTER

2

Maintenance

Overview

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 1.2.5 Tightening Bolts/Screws.
- Fasten the bolts aligned on a circumference in a crisscross pattern. For details, refer to 1.2.5 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.

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- If the work requires calibration, before starting the work, put the manipulator in the basic posture and make sure that the cables inside the manipulator are not twisted. For the basic posture, refer to the following manuals.

  CX-A series Manual

  CX4-A Manipulator 3.3.6 Checking the Basic orientation

  CX7-A Manipulator 4.3.6 Checking the Basic orientation

- Remove each of the covers to check for twisted cables inside the manipulator.

  Joint #1 : Base cover

  Joint #4 : Arm #3 head cover

CAUTION	● The Joint #1 and Joint #4 have no mechanical stops and they may be rotated more than 360 degrees. If the encoder initialization is performed with improper posture, the Manipulator moves outside the operation range. If the Manipulator was moved outside the operation range, the internal wiring may be damaged by being twisted or pinched and it may result in Manipulator malfunction.

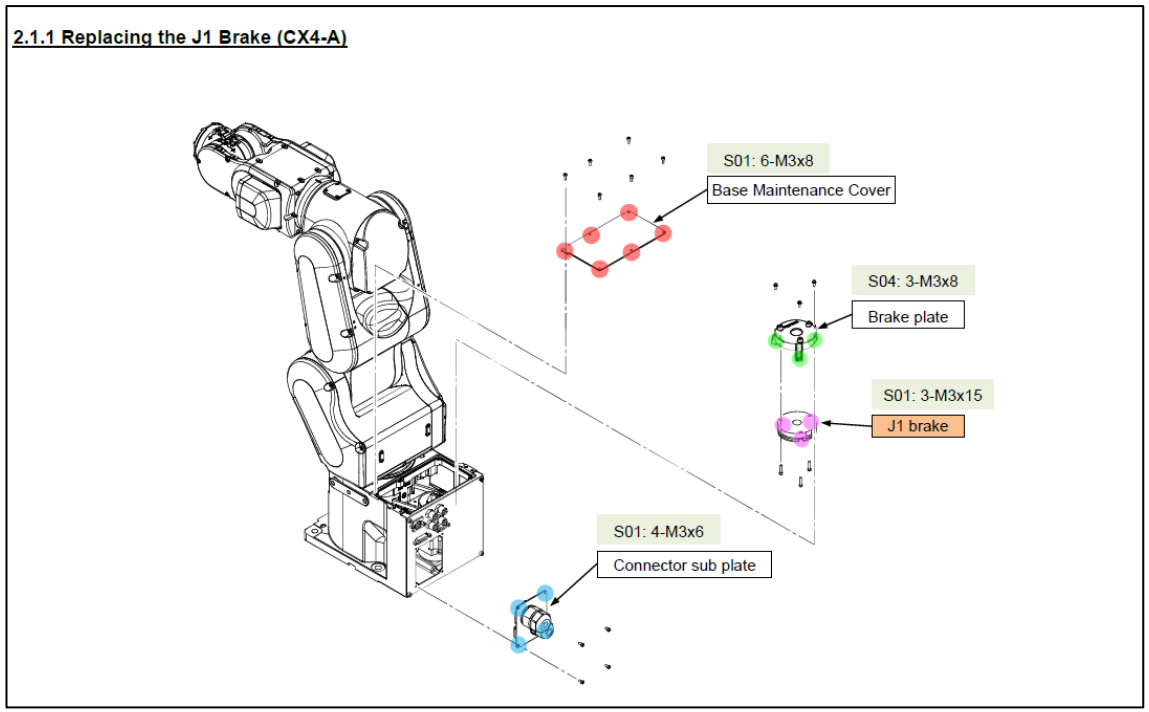
Viewing the Maintenance Page

Each page is configured as shown below.

Illustrations in the manual
Unless otherwise noted, illustrations of the CX7 are used. Although the part shapes and number of screws may differ between the CX7 and CX4, the work procedures are the same.

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

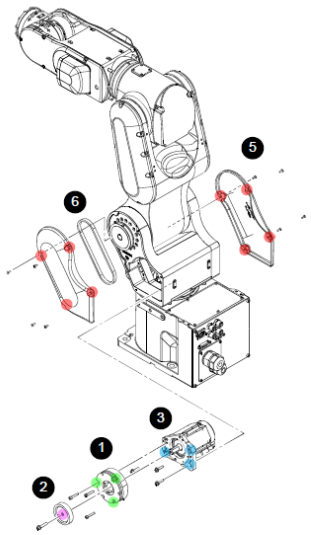
S01: 3-M4x20

S01 indicates the bolt or screw type.
For details on the type, the size, torque value, etc., refer to 1.2.5 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 Brake



❶	Install the J2 brake to the J2 Motor. CAUTION Install the J2 brake to the J2 Motor in the orientation shown in the figure. A S01: 3-M4x22 (4.0 +/- 0.2 N·m)
❷	Install the Motor pulley on the J2 Motor. POINT • Align the Motor pulley with the brake disc and install the Motor pulley on the motor shaft. If they are misaligned, adjust the brake disc position. • Fix the set screw while pressing the brake against the motor plate. A S01: 1-M5x25 (8.0 +/- 0.4 N·m)
❸	Install the J2 Motor unit on the Arm1. POINT • Insert the J2 Motor unit into the Arm1 in the orientation shown in the figure. • Follow the steps below to secure the J2 Motor unit to the Arm1.
❹	Connect the J2 Motor connectors (MP02-1, MS02-1) and the brake connector (BR021).
❺	Install the Arm1 side cover (right).
❻	Install the J2 Timing Belt.

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

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

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

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

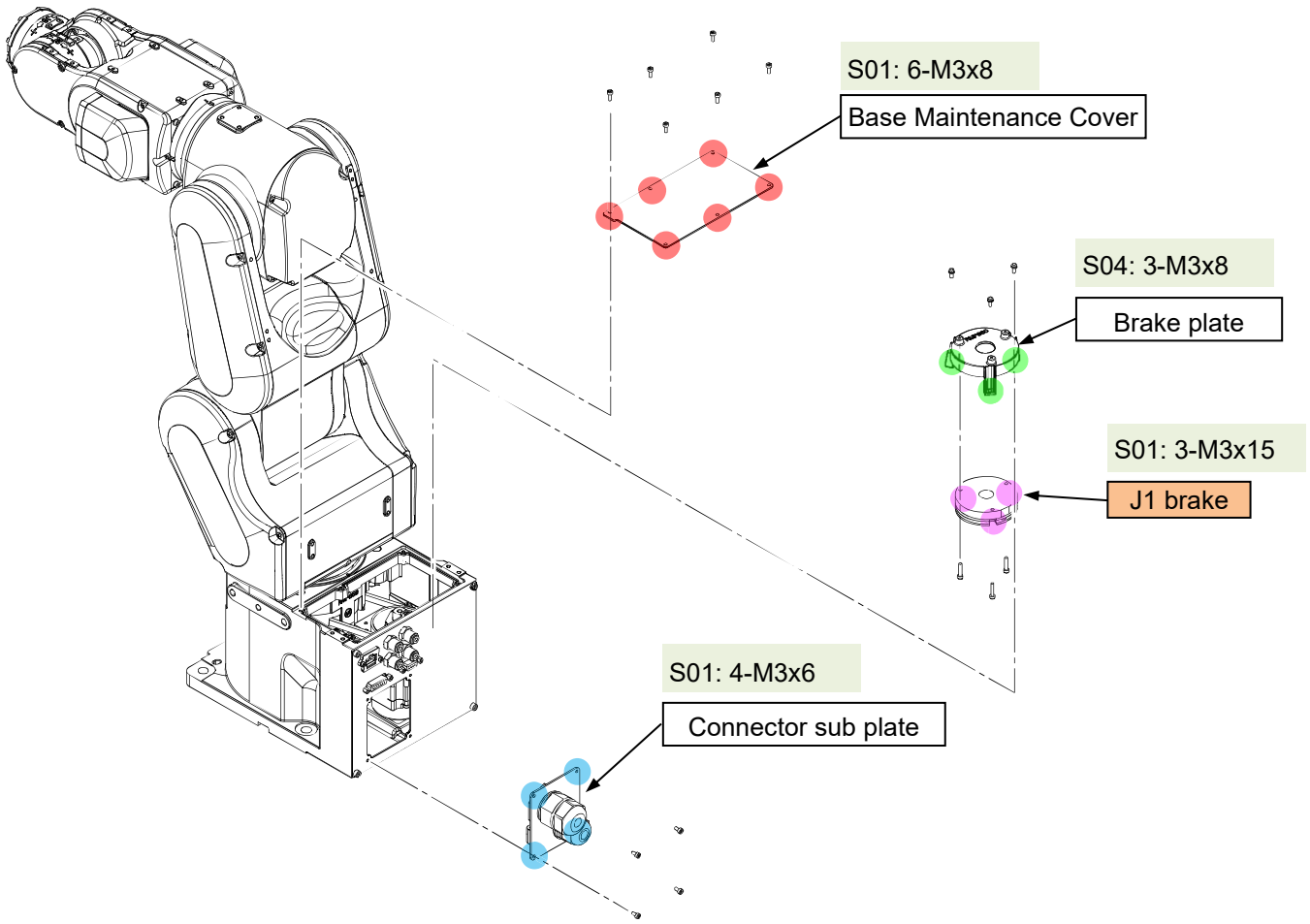
NOTE
Indicates information not concerning the work procedures.

SK-1A: 102g
Indicates that lubrication is required.
Refer to 1.2.4 Tools/Materials for grease manufacturer and other details.

Clicking the underlined blue characters will open the corresponding page.
You can return to the original page by simultaneously pressing the [Alt] key and the [←] key.
* The operation method may differ depending on the viewer. For details, refer to Help of each viewer.

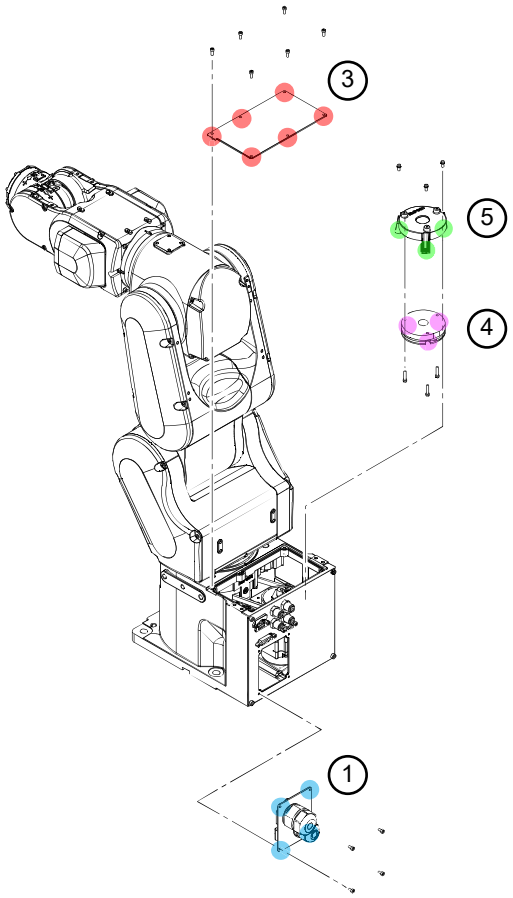
2.1 Joint #1

2.1.1 Replacing the J1 Brake (CX4-A)



Joint #1

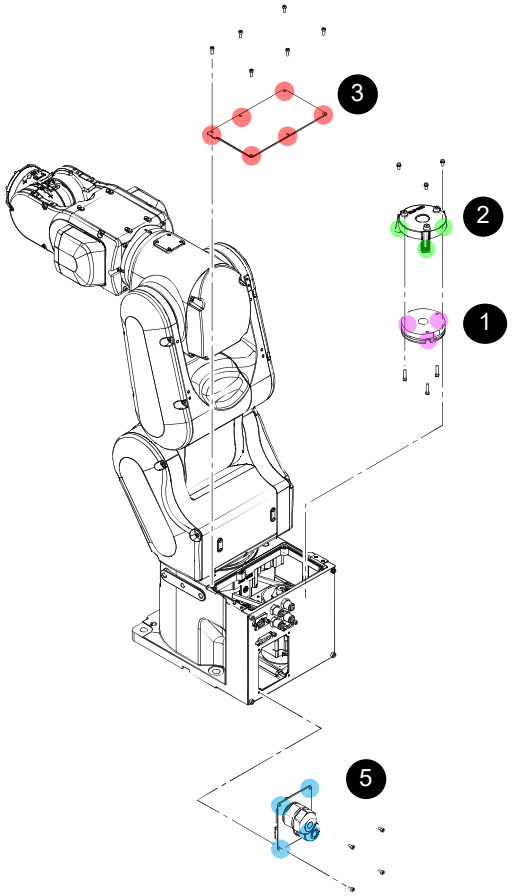
Removing the J1 Brake (CX4-A)

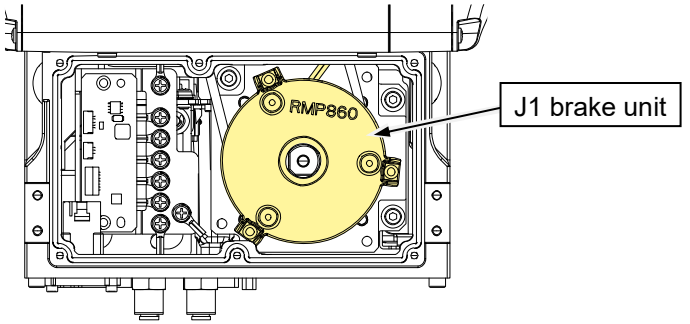


1	Remove the Connector Plate.
2	Disconnect the J1 brake connector (BR011).
3	Remove the Base Maintenance Cover.
4	Remove the J1 brake unit. A S04: 3-M3x8
5	Remove the J1 brake plate from the J1 brake. A S01: 3-M3x15

Joint #1

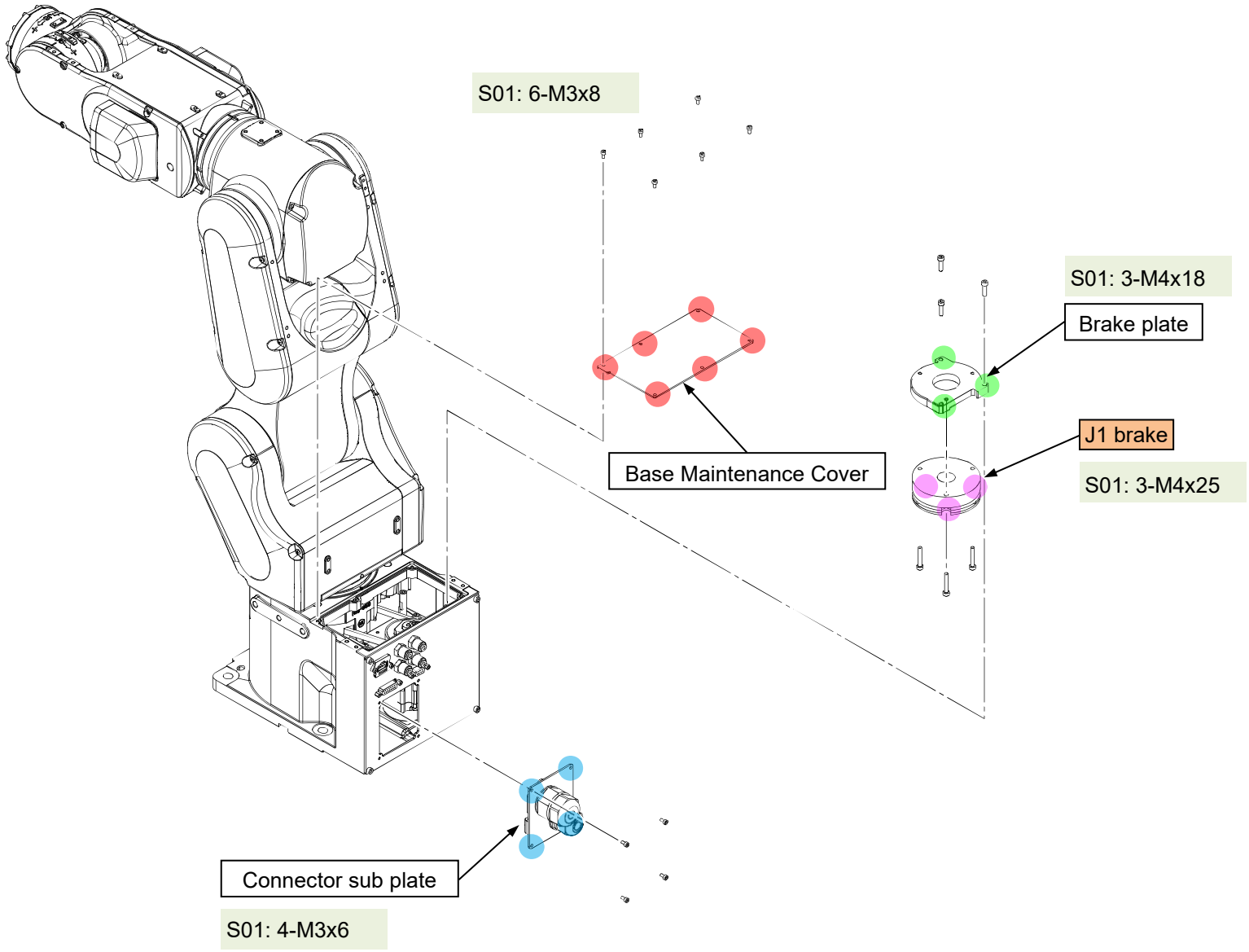
Installing the J1 Brake (CX4-A)



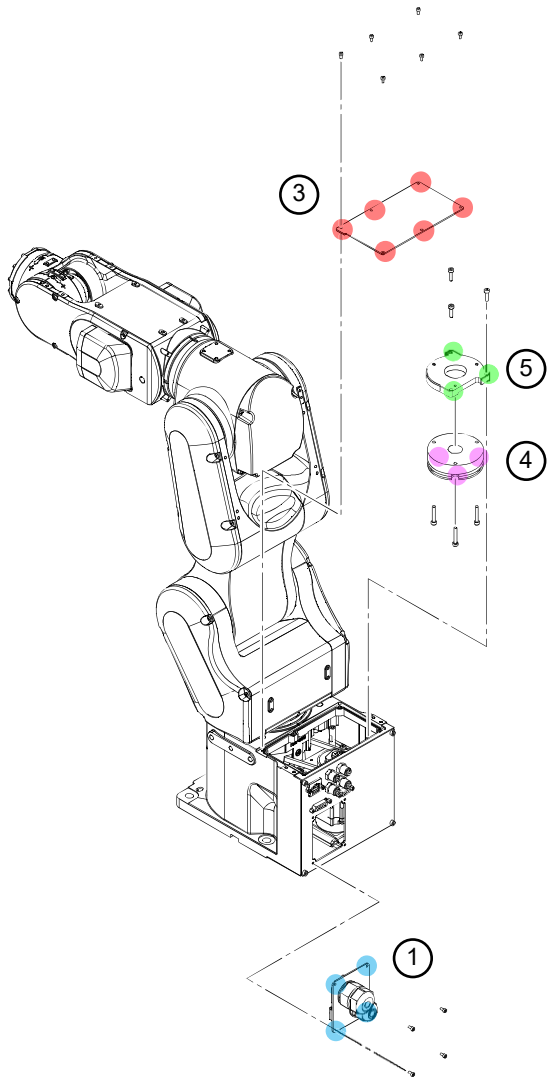
1	Install the J1 brake on the brake plate. A S01: 3-M3x15 (2.0 +/- 0.1 N·m)
2	Install the J1 brake unit on the J1 Motor unit. **POINT** Install with the orientation shown in the figure. A S04: 3-M3x8 (0.45 +/- 0.05 N·m) 
3	Install the Base Maintenance Cover.
4	Bundle the brake wires and secure them to the J1 motor plate with wire tie, then connect the J1 brake connector (BR011).
5	Install the Connector Plate.

Joint #1

2.1.2 Replacing the J1 Brake (CX7-A)



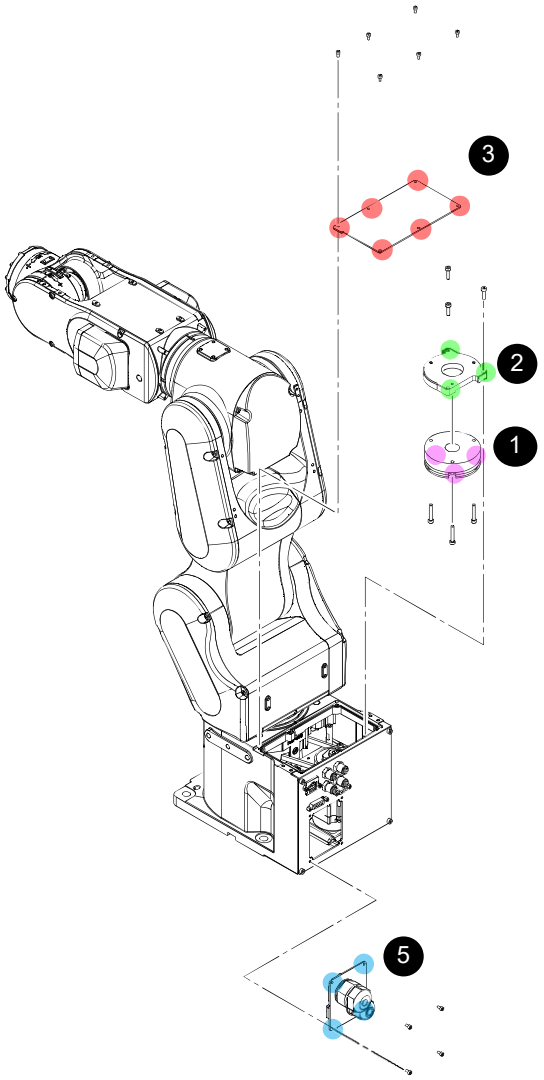
Removing the J1 Brake (CX7-A)



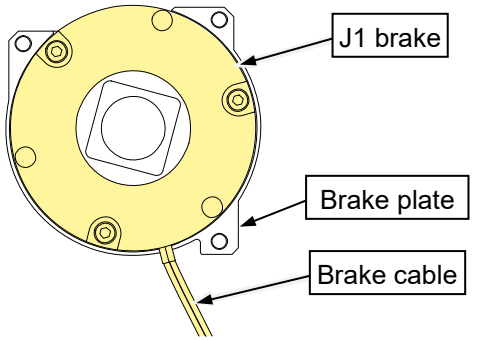
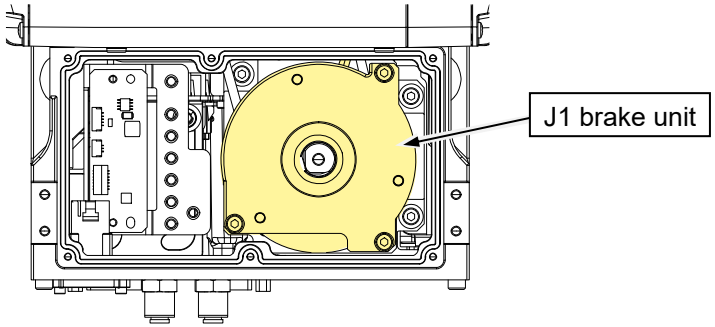
1	Remove the Connector Plate.
2	Disconnect the J1 brake connector (BR011).
3	Remove the Base Maintenance Cover.
4	Remove the J1 brake unit. A S01: 3-M4x18
5	Remove the J1 brake plate from the J1 brake. A S01: 3-M4x25

Joint #1

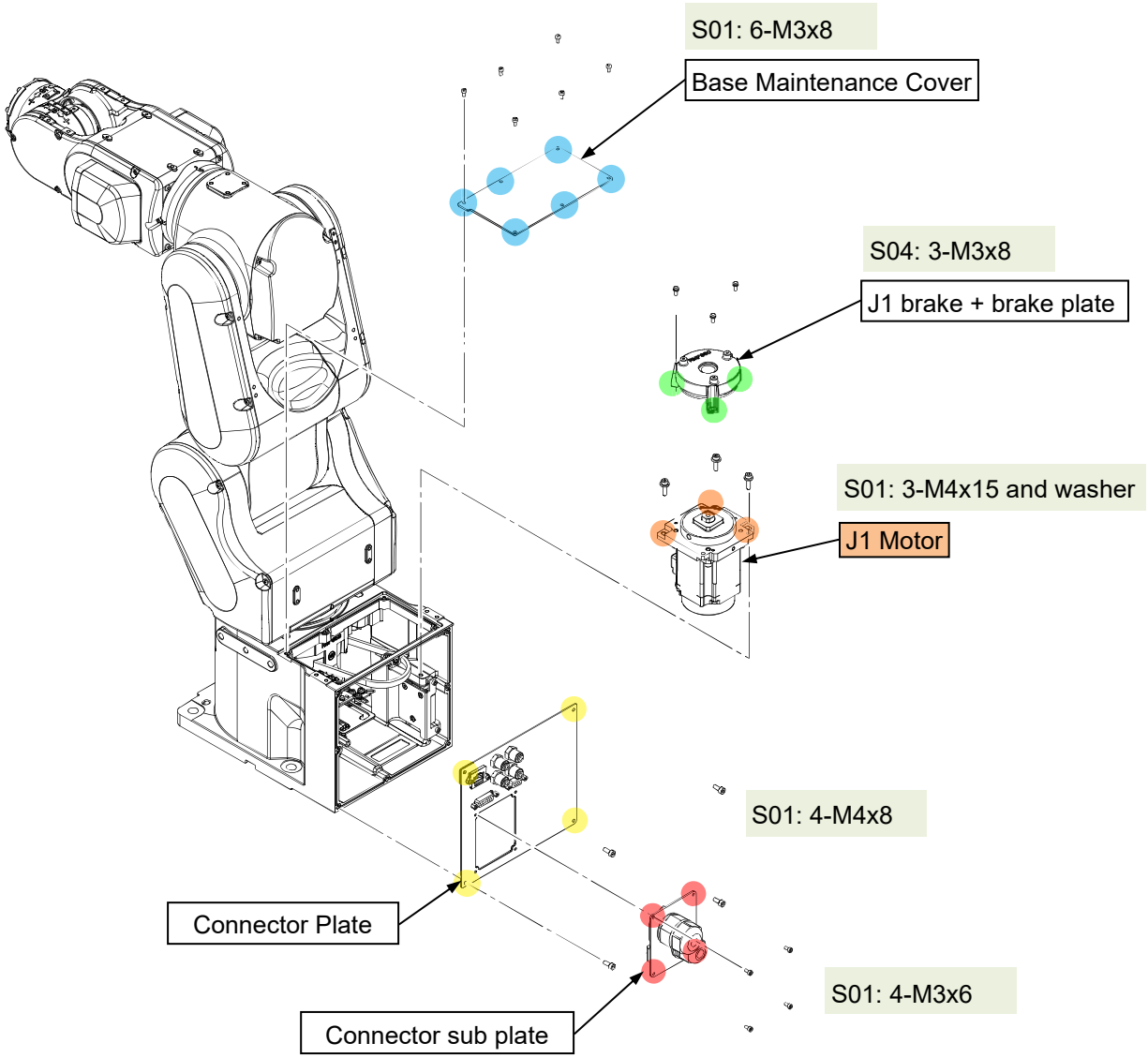
Installing the J1 Brake (CX7-A)



Joint #1

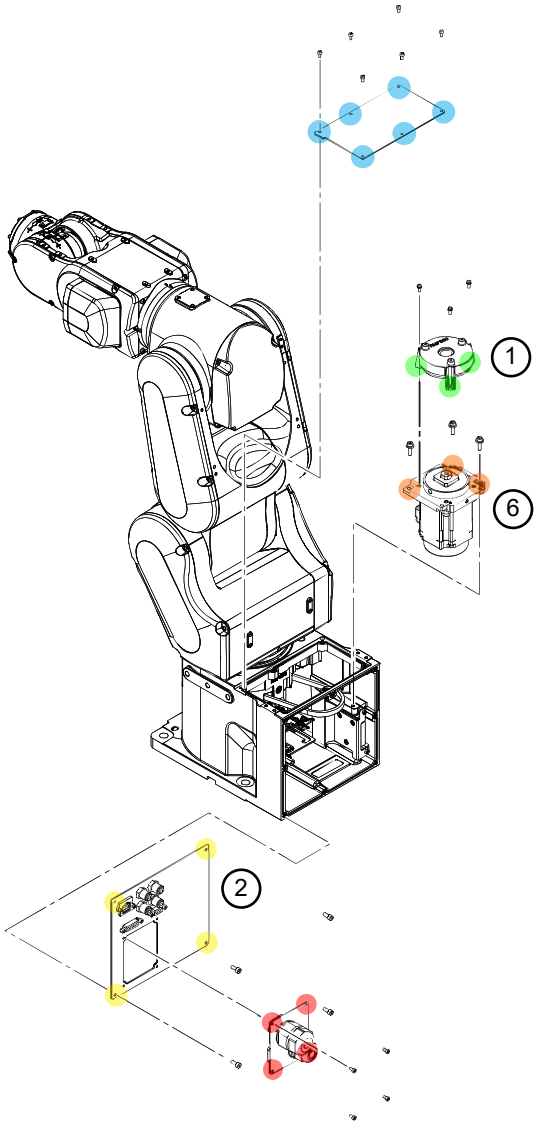
1	Install the J1 brake on the brake plate. **POINT** Install with the orientation shown in the figure. A S01: 3-M4x25 (4.0 +/- 0.2 N·m) 
2	Install the J1 brake unit on the J1 Motor unit. **POINT** Install with the orientation shown in the figure. A S01: 3-M4x18 (4.0 +/- 0.2 N·m) 
3	Install the Base Maintenance Cover.
4	Bundle the brake wires and secure them to the J1 motor plate with wire tie, then connect the J1 brake connector (BR011).
5	Install the Connector Plate.

2.1.3 Replacing the J1 Motor (CX4-A)



Joint #1

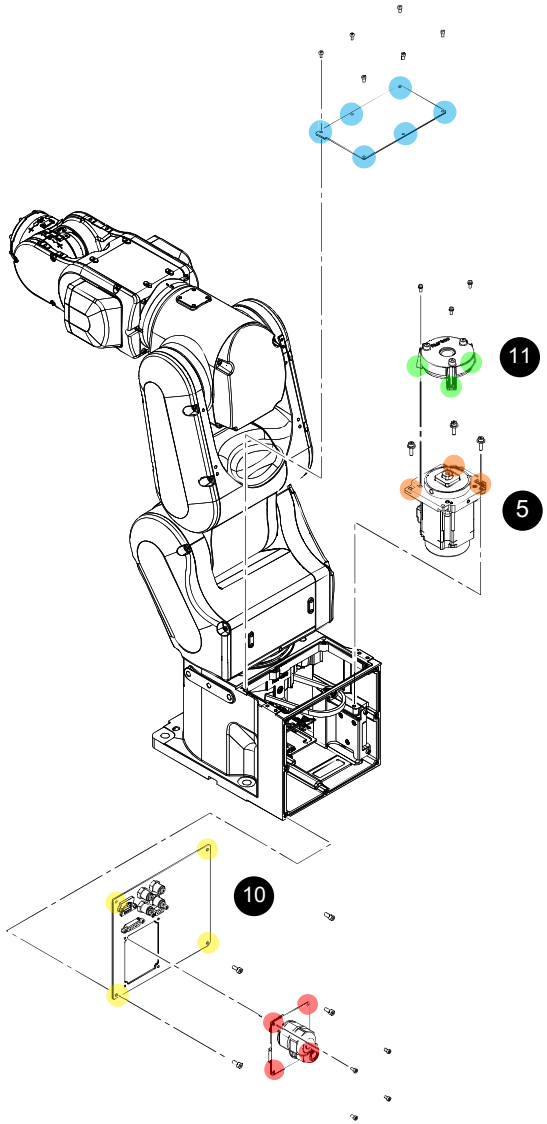
Removing the J1 Motor (CX4-A)

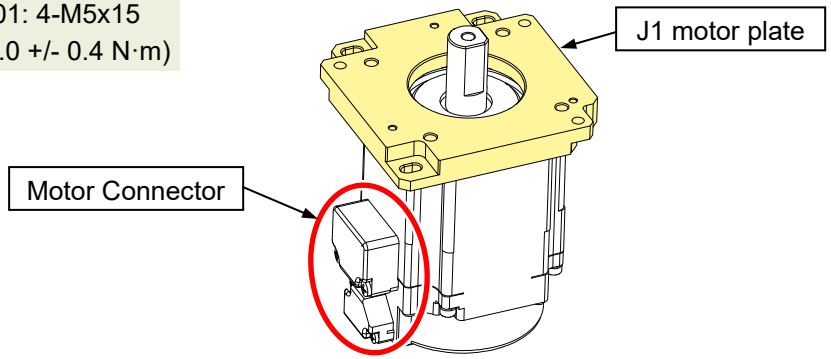


1	Remove the J1 brake.
2	Remove the connector plate from the base.
3	Remove the screws securing the J1 Motor to the base. A S01: 3-M4x15 and washer
4	Remove the wire tie securing the cables to the J1 motor plate, then disconnect the connectors (CN31-M1, CN11-M1).
5	Move the J1 Motor toward the J1 Reduction Gear and then remove the J1 timing belt from the pulley of the J1 Motor.
6	Remove the J1 Motor from the base.
7	Disconnect the J1 motor connectors (CN111, CN311).
8	Remove the J1 Motor pulley. **CAUTION** A brass bushing is included on one side of the set screw. Be careful not to lose it. A S05: 2-M5x8
9	Remove the J1 motor plate from the J1 Motor. A S01: 4-M5x15

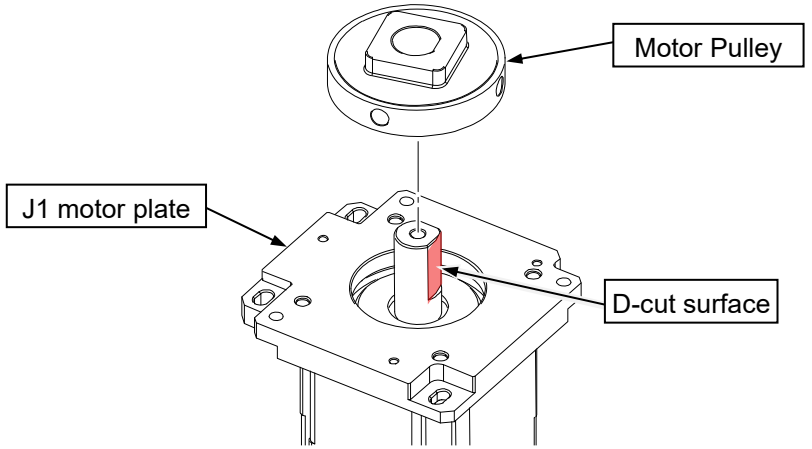
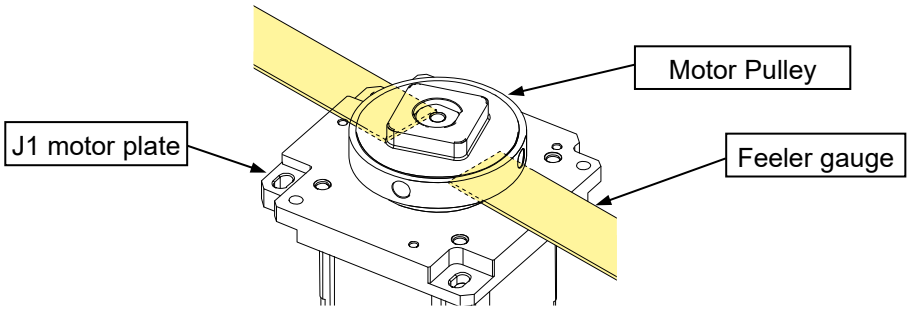
Joint #1

Installing the J1 Motor (CX4-A)

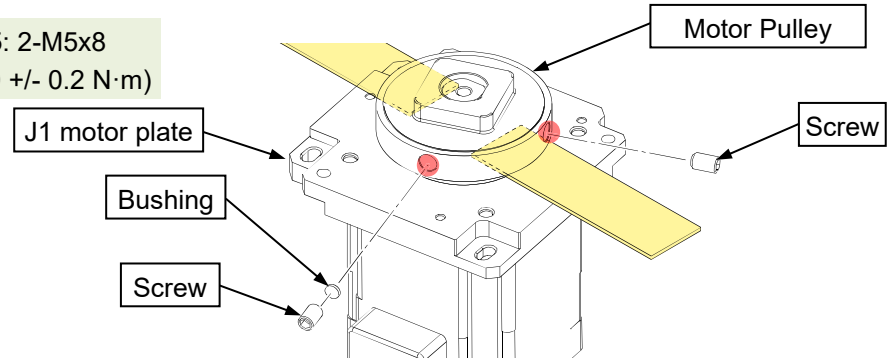


1	Attach connector labels to the J1 Motor. **POINT** A new J1 Motor comes with the connector labels. Attach the labels near the connectors. Refer to the old motor.
2	Install the J1 motor plate. **POINT** Install with the orientation shown in the figure. A S01: 4-M5x15 (8.0 +/- 0.4 N·m) 

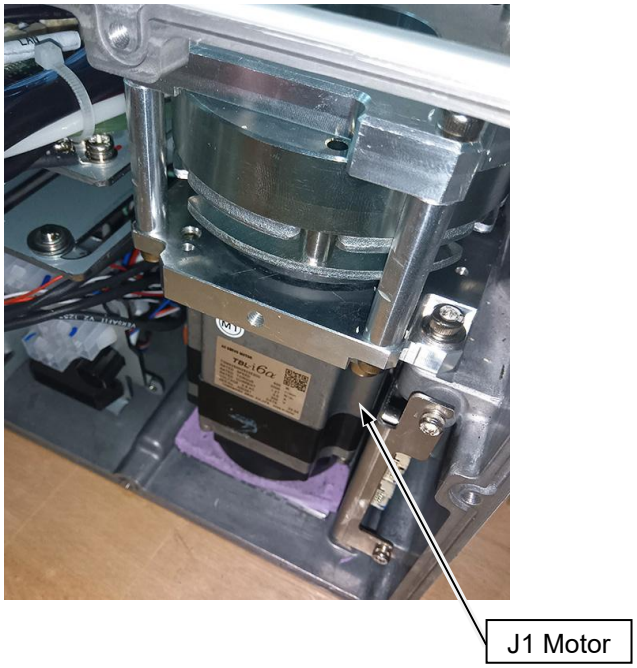
Joint #1

❸	Install the J1 motor pulley.
	1. Mount the motor pulley on the J1 Motor. **CAUTION** Align the motor pulley set screw positions with the D-cut surfaces of the motor shaft. 
	2. Insert a 0.5 mm feeler gauge between the J1 motor plate and the motor pulley. 

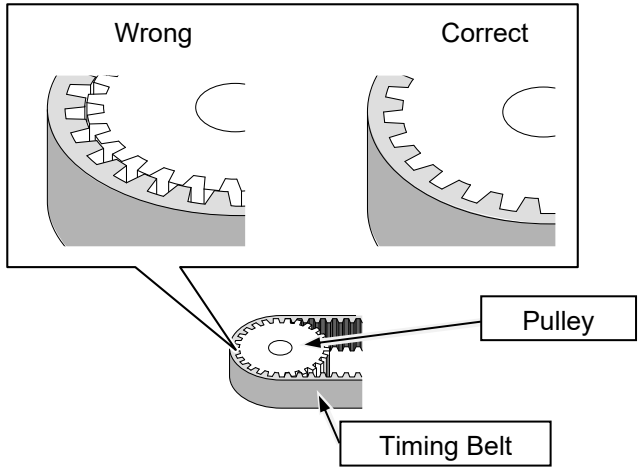
Joint #1

	3. Fix the motor pulley to the J1 Motor. **POINT** Attach the two screws as shown below. 1st screw: Ensure that the screw is perpendicular to the D-cut surface of the J1 Motor shaft. 2nd screw: Insert the bushing into the pulley and fix it to the J1 Motor. A S05: 2-M5x8 (4.0 +/- 0.2 N·m)  4. Remove the feeler gauge.
4	Connect the J1 Motor connectors (CN111, CN311).

Joint #1

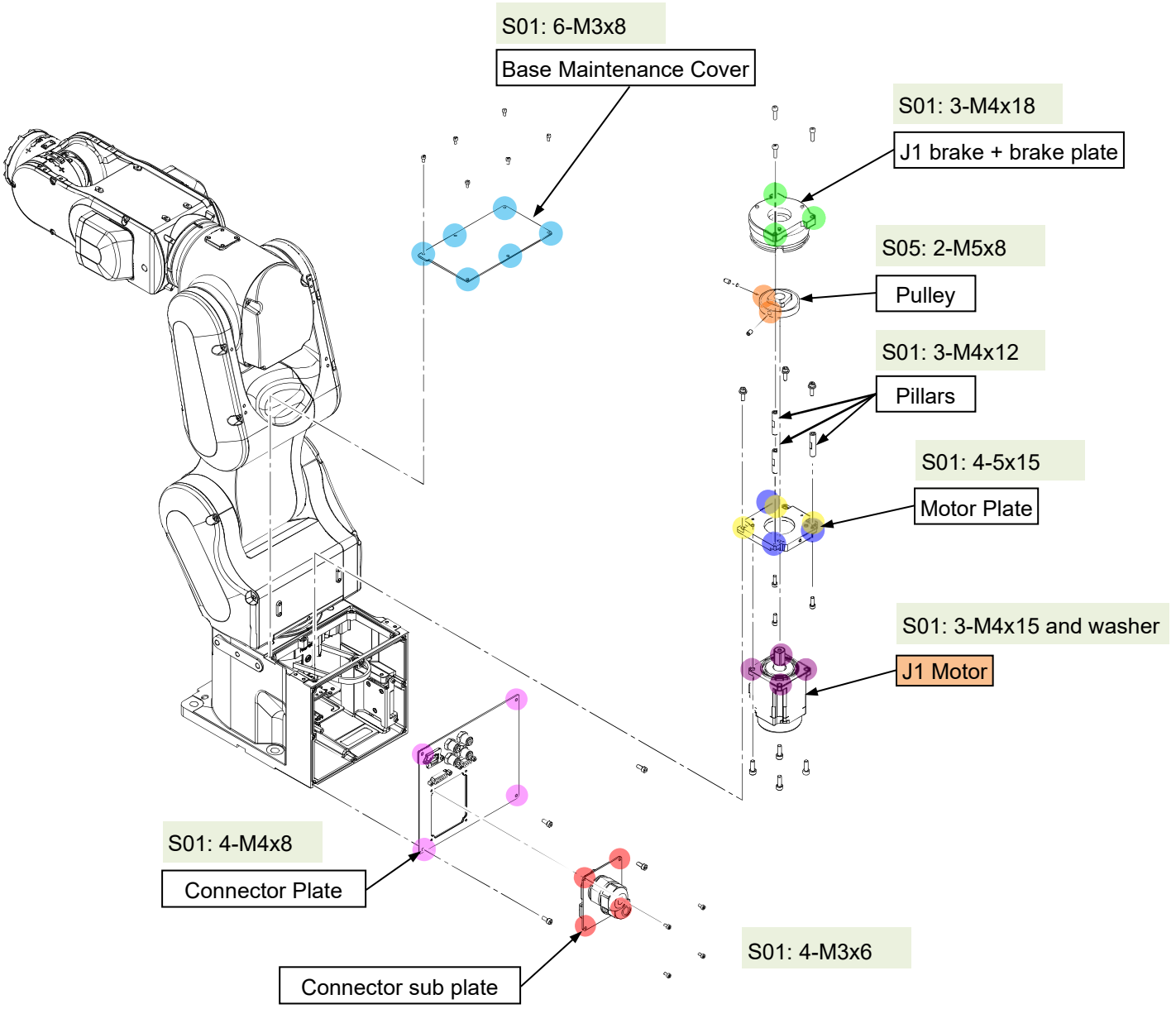
5	Place the J1 Motor in the base. **POINT** Place the J1 Motor in the base so that the connectors of the motor face toward the J1 Reduction Gear. 

Joint #1

6	Attach the J1 timing belt to the pulley of the J1 Motor. **POINT** Make sure that the teeth of the timing belt and the pulley are properly engaged. 
7	Secure the J1 Motor to the base. A S01: 3-M4x15 and washer
8	Adjust the belt tension. 3.1 Adjusting the Timing Belt Tension
9	Bundle the brake wires and secure them to the J1 motor plate with wire tie, then connect the connectors (CN31-M1, CN11-M1).
10	Install the Connector Plate.
11	Install the J1 brake.
12	After assembly, perform calibration of Joint #1. 3.2 Calibration

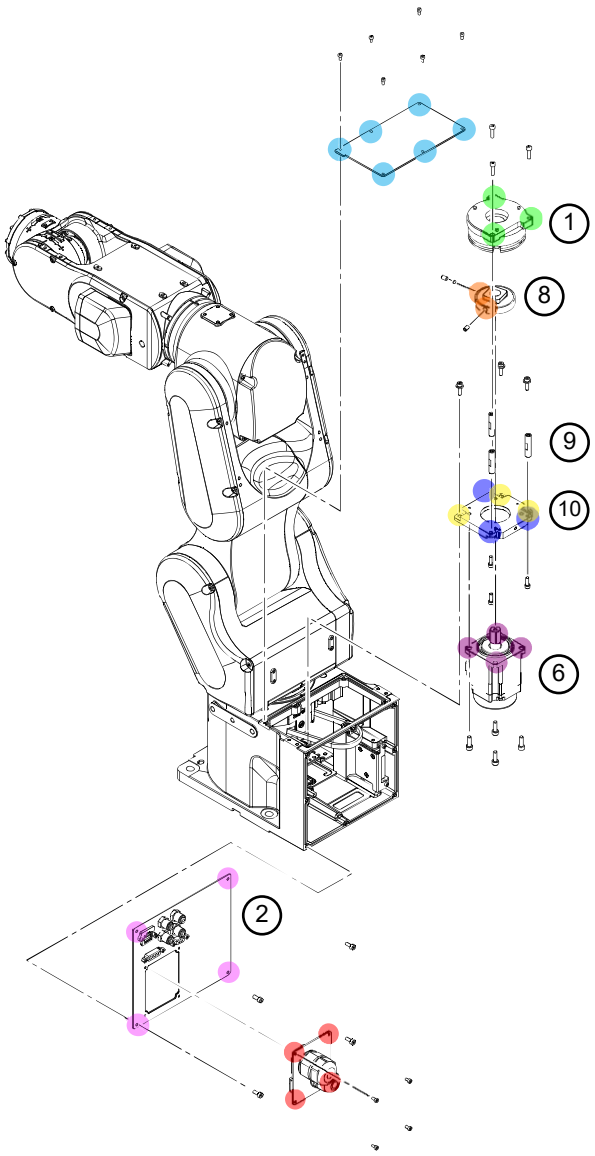
Joint #1

2.1.4 Replacing the J1 Motor (CX7-A)



Joint #1

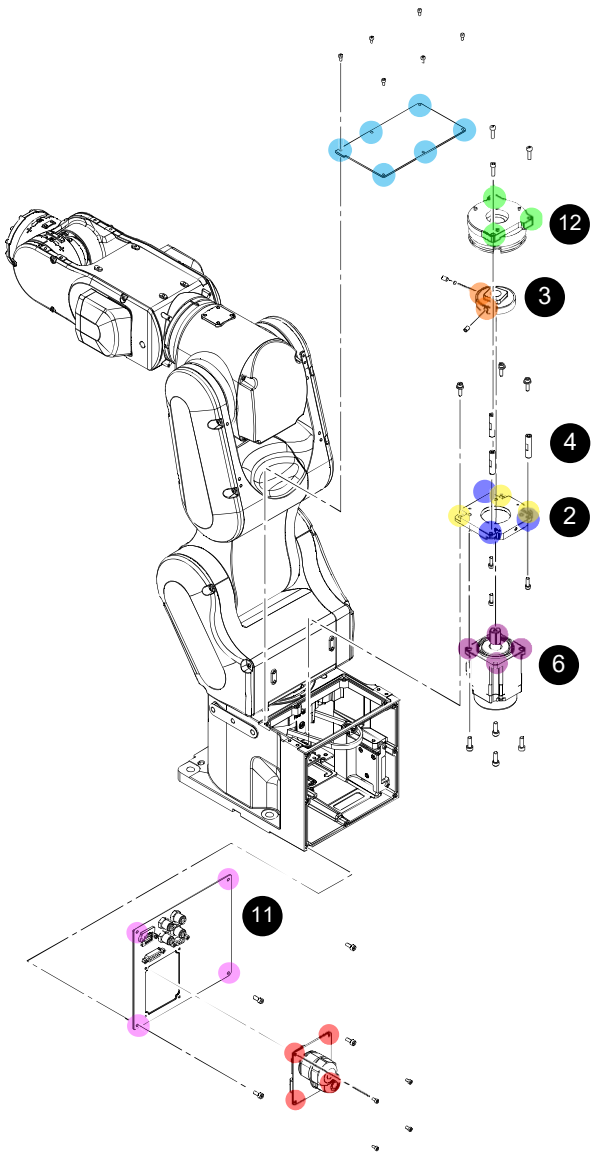
Removing the J1 Motor (CX7-A)

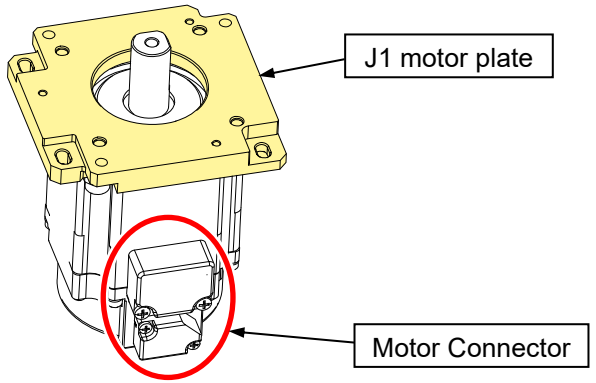


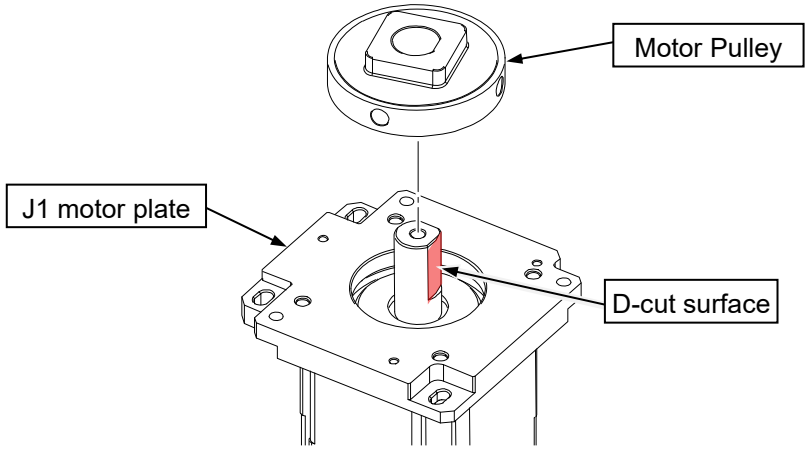
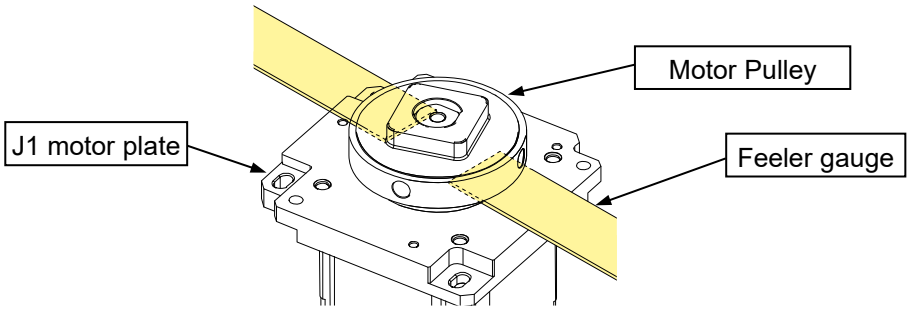
1	Remove the J1 brake.
2	Remove the connector plate from the base.
3	Remove the screws securing the J1 Motor to the base. A S01: 3-M4x15 and washer
4	Remove the wire tie securing the cables to the J1 motor plate, then disconnect the connectors (CN31-M1, CN11-M1).
5	Move the J1 Motor toward the J1 Reduction Gear and then remove the J1 timing belt from the pulley of the J1 Motor.
6	Remove the J1 Motor from the base.
7	Disconnect the J1 motor connectors (CN111, CN311).
8	Remove the J1 Motor pulley. **CAUTION** A brass bushing is included on one side of the set screw. Be careful not to lose it. A S05: 2-M5x8
9	Remove the pillars from the motor plate. A S01: 3-M4x12
10	Remove the J1 motor plate from the J1 Motor. A S01: 4-M5x15

Joint #1

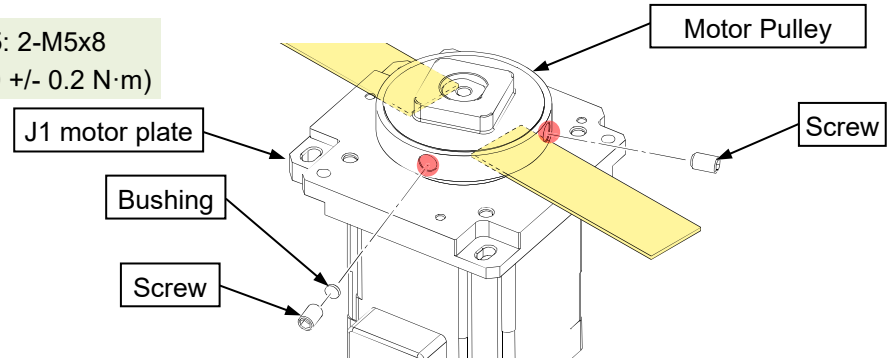
Installing the J1 Motor (CX7-A)



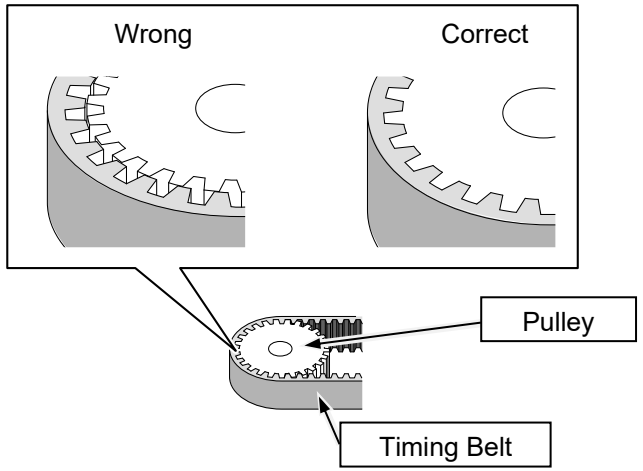
1	Attach connector labels to the J1 Motor. **POINT** A new J1 Motor comes with the connector labels. Attach the labels near the connectors. Refer to the old motor.
2	Install the J1 motor plate. **POINT** Install with the orientation shown in the figure. A S01: 4-M5x15 (4.0 +/- 0.2 N·m) 

❸	Install the J1 motor pulley.
	1. Mount the motor pulley on the J1 Motor. **CAUTION** Align the motor pulley set screw positions with the D-cut surfaces of the motor shaft. 
	2. Insert a 0.5 mm feeler gauge between the J1 motor plate and the motor pulley. 

Joint #1

	3. Fix the motor pulley to the J1 Motor. **POINT** Attach the two screws as shown below. 1st screw: Ensure that the screw is perpendicular to the D-cut surface of the J1 Motor shaft. 2nd screw: Insert the bushing into the pulley and fix it to the J1 Motor. A S05: 2-M5x8 (4.0 +/- 0.2 N·m) 
	4. Remove the feeler gauge.
4	Attach the pillars to the motor plate. A S01: 3-M4x12 (4.0 +/- 0.2 N·m)
5	Connect the J1 Motor connectors (CN111, CN311).

Joint #1

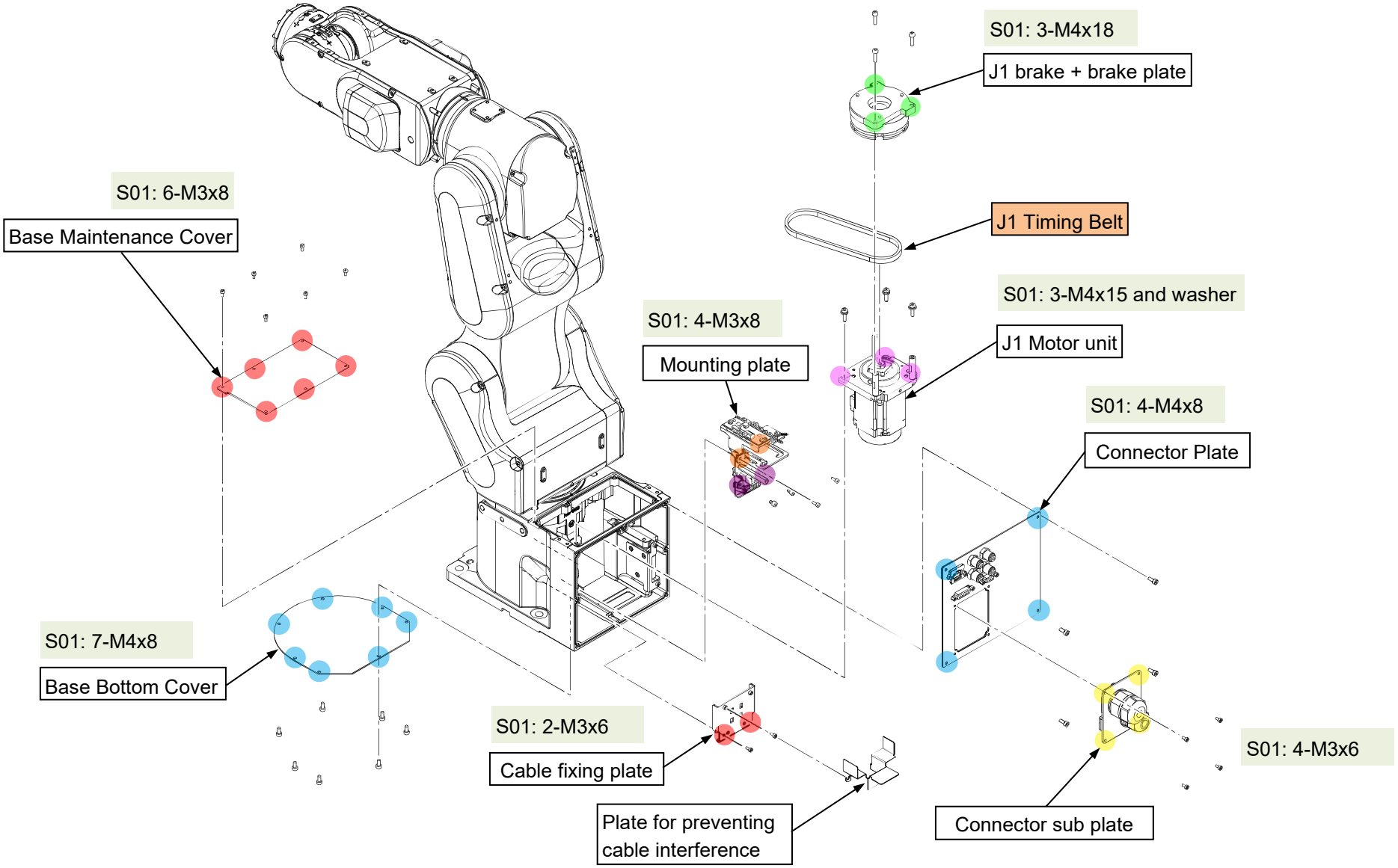
6	Place the J1 Motor in the base. **POINT** Place the J1 Motor in the base so that the connectors of the motor face toward the J1 Reduction Gear.
7	Attach the J1 timing belt to the pulley of the J1 Motor. **POINT** Make sure that the teeth of the timing belt and the pulley are properly engaged. 
8	Secure the J1 Motor to the base. A S01: 3-M4x15 and washer
9	Adjust the belt tension. 3.1 Adjusting the Timing Belt Tension
10	Bundle the brake wires and secure them to the J1 motor plate with wire tie, then connect the connectors (CN31-M1, CN11-M1).
11	Install the Connector Plate.
12	Install the J1 brake.

Joint #1

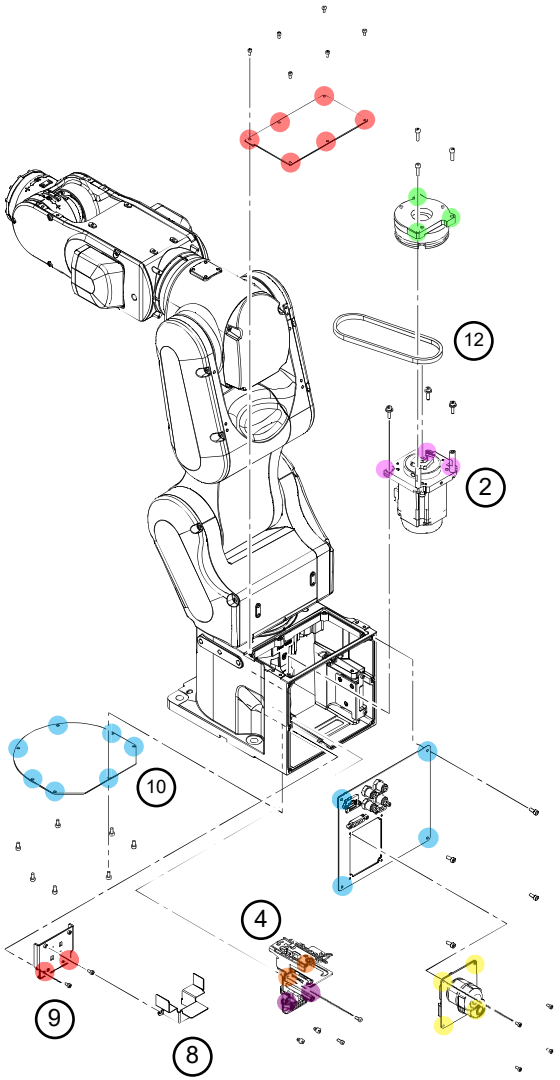
13	After assembly, perform calibration of Joint #1. 3.2 Calibration

Joint #1

2.1.5 Replacing the J1 Timing Belt



Removing the J1 Timing Belt

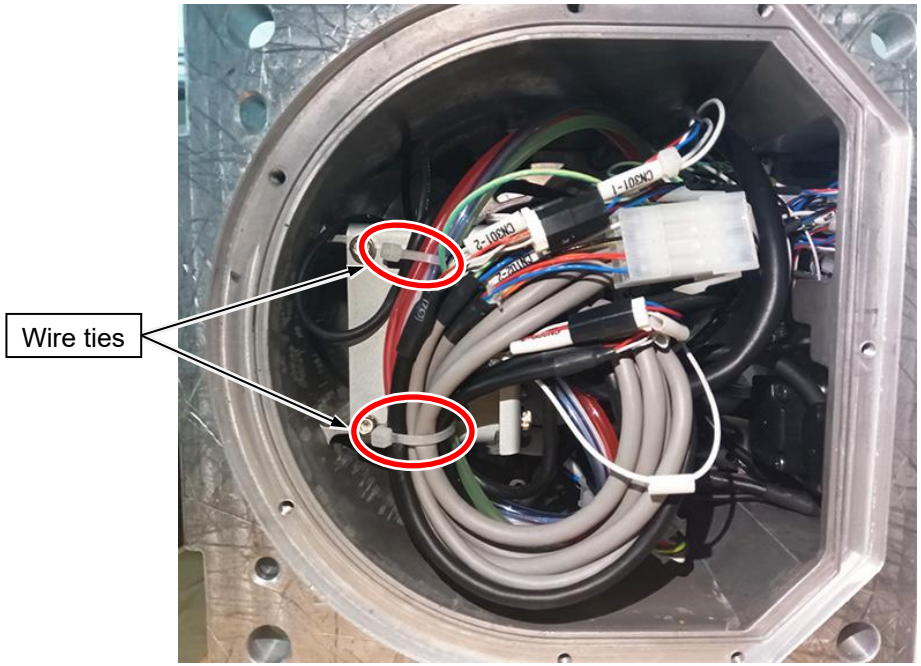


Joint #1

1	Disconnect the MC cable from the connector plate.
2	Remove the J1 Motor. Removing the J1 Motor (CX4-A), Removing the J1 Motor (CX7-A)
3	Disconnect the cables from the connector plate. 1. Disconnect the Air Tubes (blue/white/red/green). 2. Disconnect the ground wire of the RJ45 connector. **POINT** Holding down the connector by hand pull the ground wire. 3. Disconnect the LAN cable. **POINT** Disconnect the connector while pressing the tab on the connector. 4. Remove the B-Release plug and D-Sub connector. **POINT** The connector plate can now be removed from the Manipulator.
4	Remove the mounting plate to which the M/C cable was connected from the base. A S01: 4-M3x8
5	Disconnect the connector (CN2A2-2), FB wires (FB11, FB13), and PE wires (PE05, PE07, PE09) from the mounting plate.
6	Disconnect the connectors (CN32, CN12) of the multi-drop board 1.
7	Disconnect the following connectors from inside the base. CN102, CN101, CN301, CN401, CN3G0

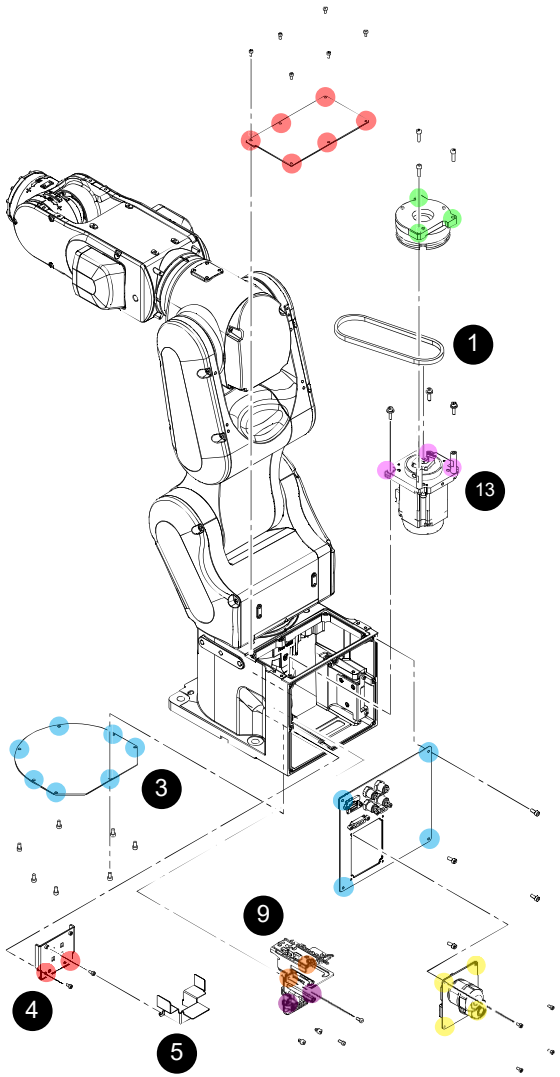
8	Loosen the screws securing the cable interference prevention plate to the cable fixing plate and remove the cable interference prevention plate. A S01: 2-M3x6
9	Remove the cable fixing plate from the base. A S01: 2-M3x6
10	Remove the Base Bottom Cover. 1. Remove the manipulator from the mounting frame or ceiling and lay it on its side. 2. Remove the Base Bottom Cover. A S01: 7-M4x8 **CAUTION** When turning the Manipulator laterally, there must be two or more people to work on it so that at least one of them can support the arm while the others are removing the bolts. Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.

Joint #1

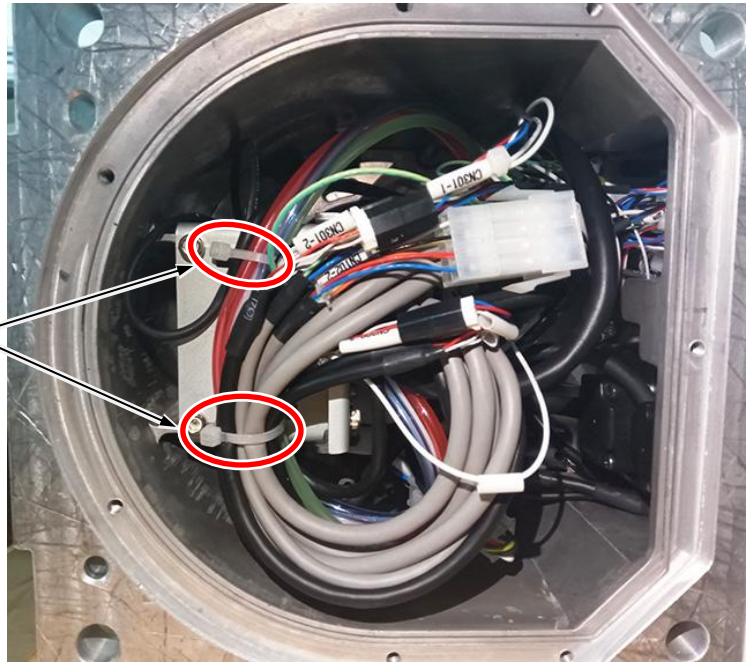
(11)	Access from the bottom of the base and cut the two wire ties securing the cables to the base. 
(12)	Remove the J1 timing belt through the cable unit.

Joint #1

Installing the J1 Timing Belt

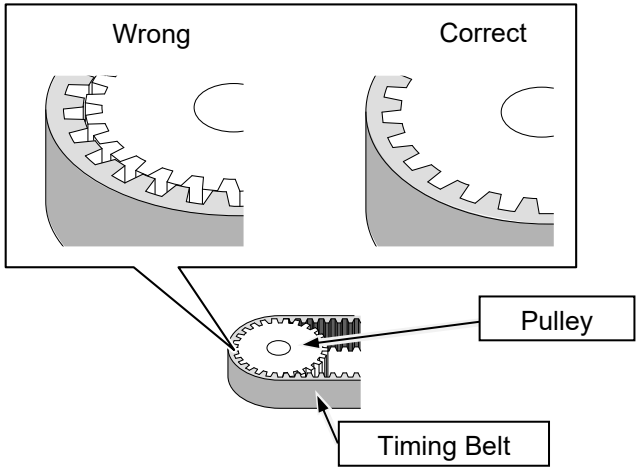


Joint #1

	<Preparation> Install this part with the manipulator laid on its side. Remove the manipulator from the mounting frame or ceiling and lay it on its side. **CAUTION** When turning the Manipulator laterally, there must be two or more people to work on it so that at least one of them can support the arm while the others are removing the bolts. Pay special attention to damage resulting from the Manipulator falling or hands or feet being caught in the Manipulator.
1	Pass the J1 timing belt through the cable unit.
2	Secure the internal cables to the base using two wire ties as shown below. 
3	Install the Base Bottom Cover. A S01: 7-M4x8 (4.0 +/- 0.2 N·m)

4	Install the cable fixing plate to the base. A S01: 2-M3x6 (2.0 +/- 0.1 N·m)
5	Attach the cable fixing plate to the cable interference prevention plate by sliding the fixing plate so that its cutouts engage with the screws of the cable interference prevention plate. A S01: 2-M3x6 (2.0 +/- 0.1 N·m)
6	Connect the following connectors inside the base. CN102, CN101, CN301, CN401, CN3G0
7	Connect the connectors (CN32, CN12) of the multi-drop board 1.
8	Connect the connector (CN2A2-2), FB wires (FB11, FB13), and PE wires (PE05, PE07, PE09) to the mounting plate.
9	Install the mounting plate on the base. A S01: 2-M3x8 (2.0 +/- 0.1 N·m)
10	Connect cables to the connector plate. 1. Connect the B-Release plug and D-Sub connector. 2. Connect the LAN cable. 3. Connect the F-sensor connector ground wire to the RJ45 connector. 4. Install the Air Tubes and connectors in the following combinations. 1: Green, 2: Red, 3: White, 4: Blue

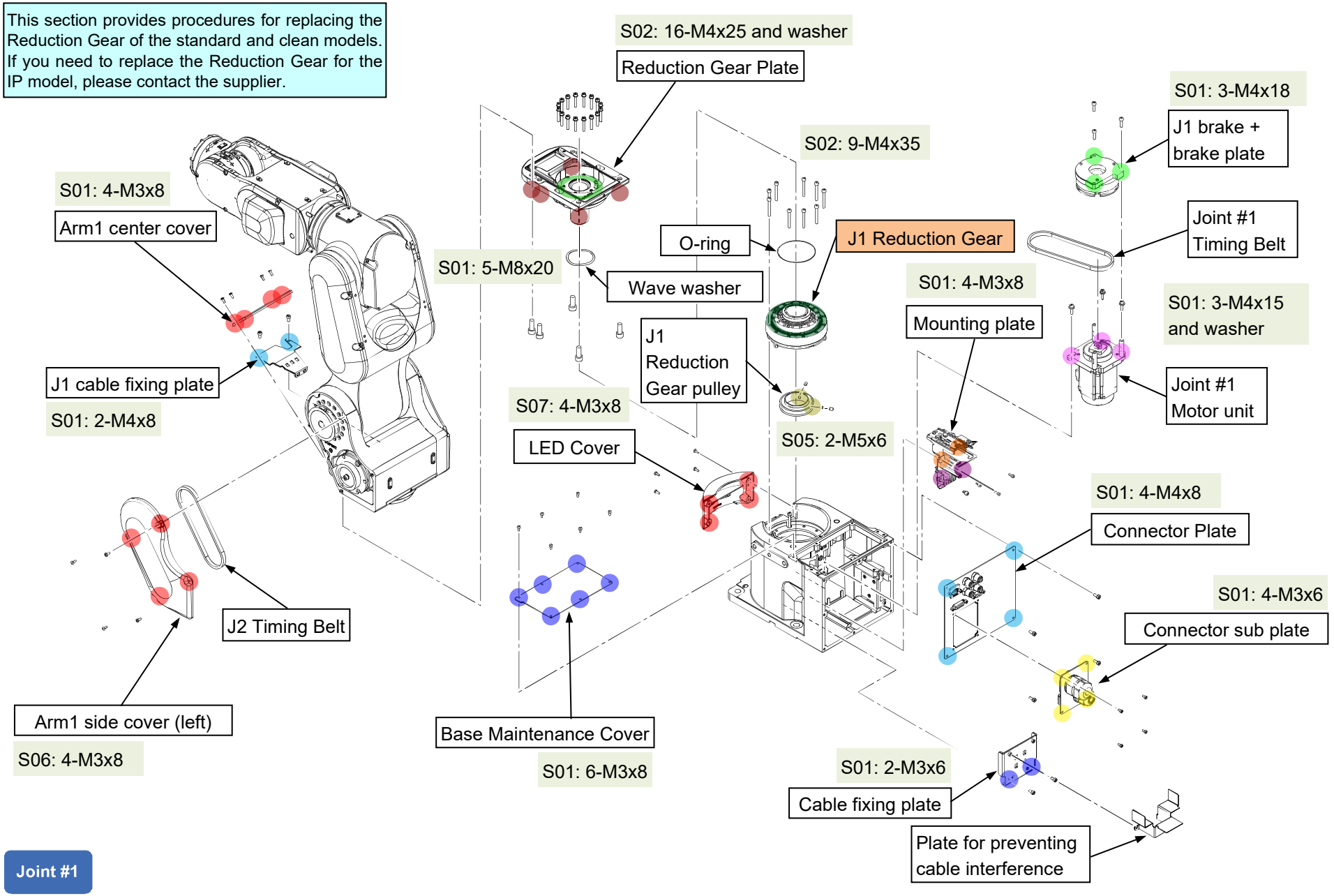
Joint #1

11	Connect the MC cable to the connector plate.
12	Attach the J1 timing belt to the J1 Reduction Gear pulley. **POINT** Make sure that the teeth of the timing belt and the pulley are properly engaged. 
13	Install the J1 Motor.

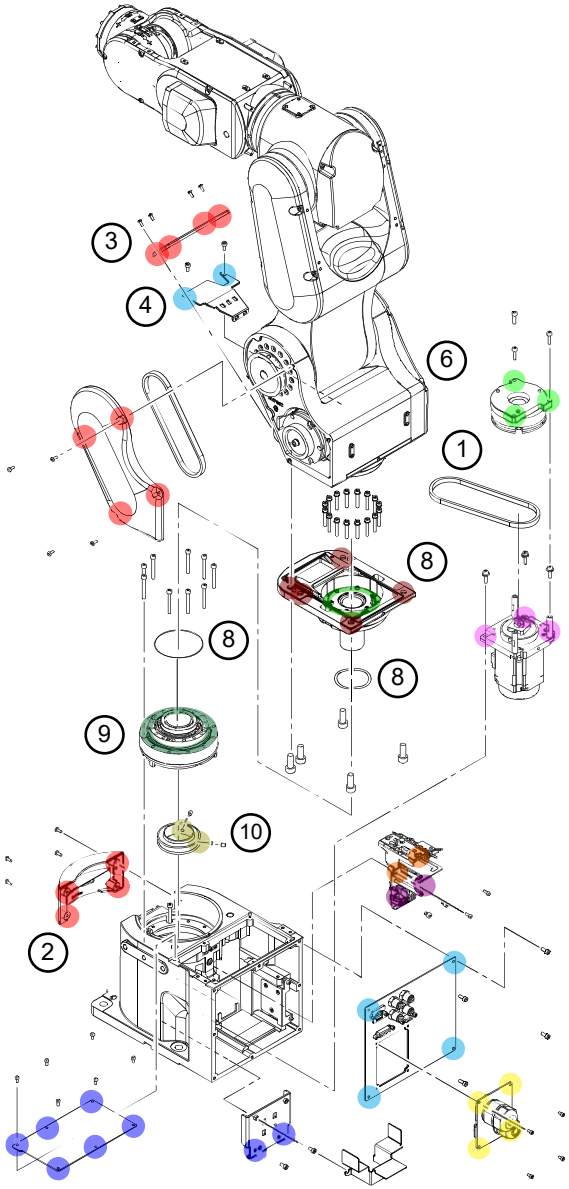
Joint #1

2.1.6 Replacing the J1 Reduction Gear

This section provides procedures for replacing the Reduction Gear of the standard and clean models. If you need to replace the Reduction Gear for the IP model, please contact the supplier.



Removing the J1 Reduction Gear



1	Remove the J1 Timing Belt.
2	Remove the LED cover.
3	Remove the Arm1 center cover.
4	Remove the J1 cable fixing plate. Perform steps (2) and (3) in Removing Gyro Board 1.
5	Protect the connectors of the cable unit with masking tape or similar. **POINT** This protects connector clips from breaking and adherence of grease during subsequent work.
6	Remove the Arm1 fixing bolts and remove the Arm1 from the base. A S01: 5-M8x20 **CAUTION** • When these bolts are removed, Arms 1 to 4 will come off. This may cause your fingers to get caught between the parts, damage the Manipulator, or cause it to malfunction. • Be very careful when removing the Arm1. Have at least two workers support the Manipulator while another worker removes the bolts.

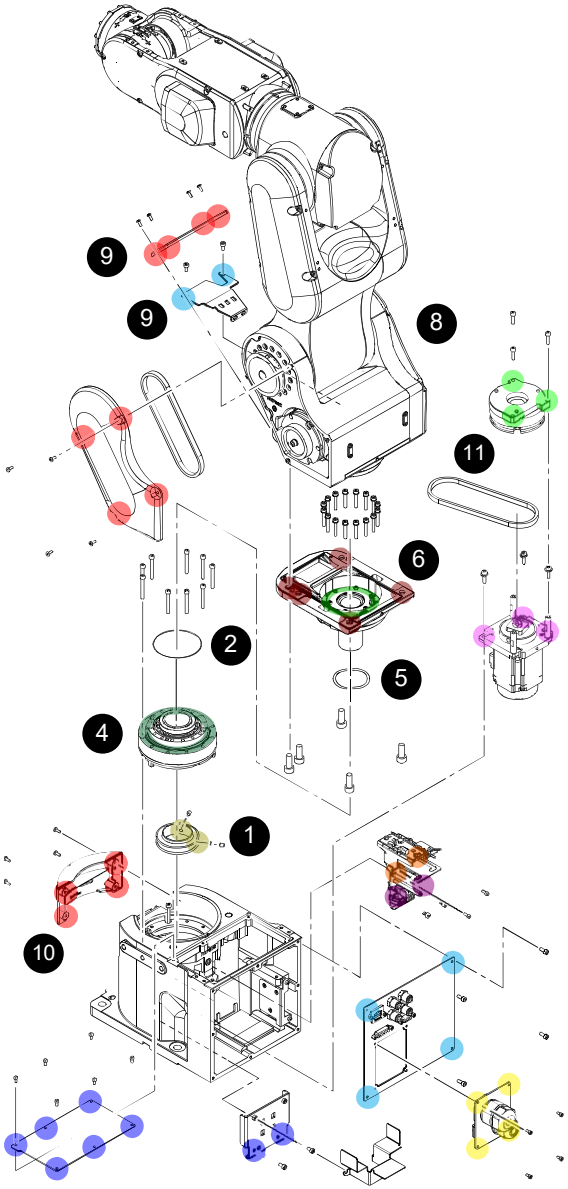
7	Pull the Cable Unit from the base. **CAUTION** When pulling out the cables, pull them out in sequence starting from the smallest connector. 
8	Remove the Reduction Gear plate. **CAUTION** An O-ring and a wave washer are installed between the Reduction Gear plate and the Reduction Gear. Do not lose them. A S02: 16-M4x25 and washer
9	Remove the J1 Reduction Gear Unit from the base. **CAUTION** Remove only the black screws. A S02: 9-M4x35

Joint #1

(10)	Remove the pulley from the J1 Reduction Gear. **CAUTION** A brass bushing is included on one side of the set screw. Be careful not to lose it. (A) S05: 2-M5x6

Joint #1

Installing the J1 Reduction Gear



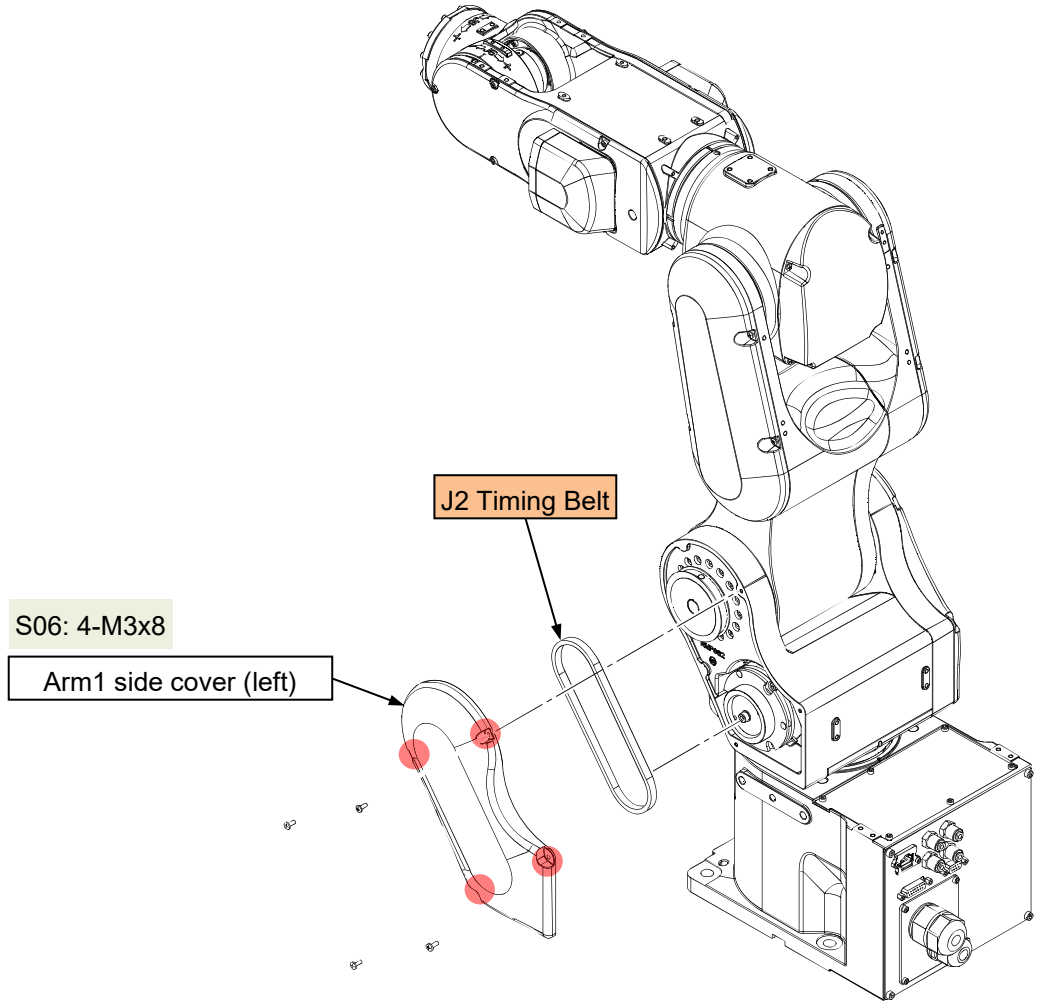
1	Install the pulley on the J1 Reduction Gear. **POINT** • Insert the pulley into the stop of the J1 Reduction Gear Unit and secure it. • Attach the two screws as shown below. 1st screw: Ensure that the screw is perpendicular to the D-cut surface of the J1 Reduction Gear Unit. 2nd screw: Apply a thin layer of Loctite on the bushing threads. Insert the bushing into the pulley and fix it to the J1 Reduction Gear Unit. A S05: 2-M5x6 (4.0 +/- 0.2 N·m)
2	Attach the O-ring to the J1 Reduction Gear. SK-1A **CAUTION** Be careful not to damage the O-ring and fit it properly in the groove.
3	Apply grease to the Arm1 side of the J1 Reduction Gear. SK-1A: 2.0 g
4	Fix the J1 Reduction Gear Unit to the base. A S02: 9-M4x35 (5.5 +/- 0.25 N·m)
5	Install the wave washer on the Reduction Gear plate.
6	Install the Reduction Gear plate on the J1 Reduction Gear Unit. A S02: 16-M4x25 and washer (5.5 +/- 0.25 N·m)

7	Insert the cable unit inside the base. **CAUTION** When inserting the cable unit inside the base, insert the connectors in sequence starting from the largest connector. 
8	Attach the Arm1 fixing bolts and secure the Arm1 to the base. **CAUTION** Be very careful when installing the Arm1. Have at least two workers support the Manipulator while another worker attaching the bolts. A S01: 4-M8x20 (32.0 +/- 1.6 N·m)
9	Install the J1 cable fixing plate. Perform steps (4) and (5) in Installing Gyro Board 1.
10	Install the LED cover.
11	Install the J1 Timing Belt.

Joint #1

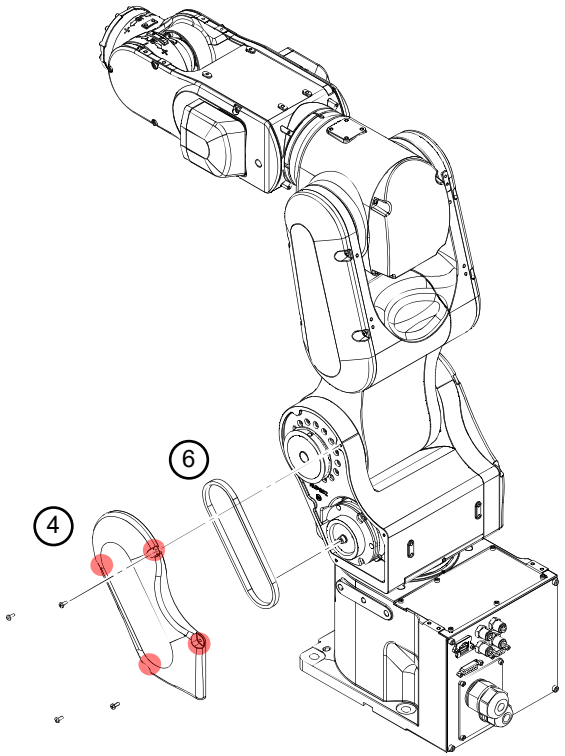
2.2 Joint #2

2.2.1 Replacing the J2 Timing Belt



Joint #2

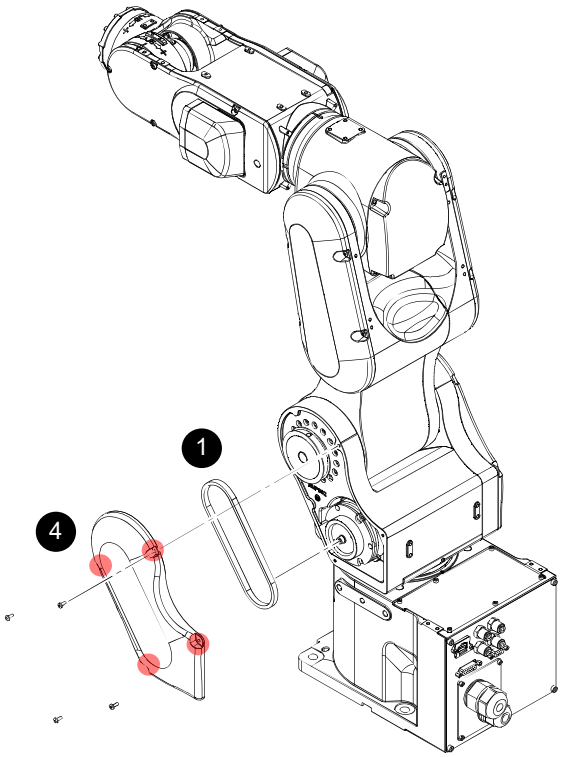
Removing the J2 Timing Belt



1	Turn ON the controller.
2	Release the J2 brake, and manually push and move Arm2 until it comes in contact with the mechanical stopper, and push it against Arm1. **WARNING** Arm2 falls by its weight when the J2 Motor unit is removed. Release the brake and tilt Arm2 in advance.
3	Turn OFF the Controller.
4	Remove the Arm1 side cover (left).
5	Loosen the screws securing the J2 Motor unit. A S01: 3-M4x20 and washer **WARNING** Loosening the screws while Arm2 is not tilted will result in the belt coming off and Arm2 falling, which is very dangerous. Prior to loosening the J2 Motor unit screws, ensure that work in step (2) is performed and that Arm2 is tilted.
6	Remove the J2 Timing Belt. **POINT** Remove the belt from the Motor pulley first.

Joint #2

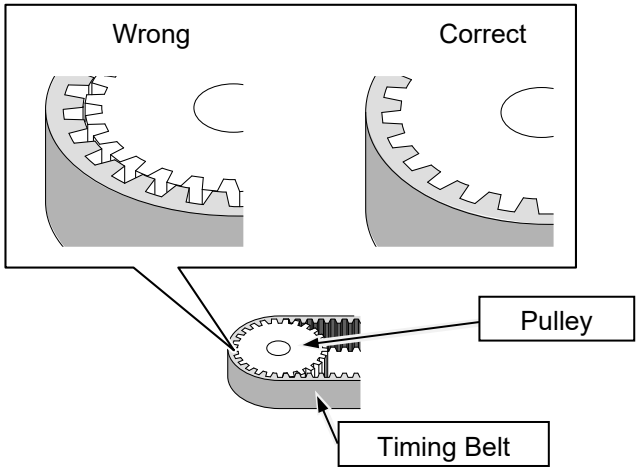
Installing the J2 Timing Belt



1 Install the J2 Timing Belt.

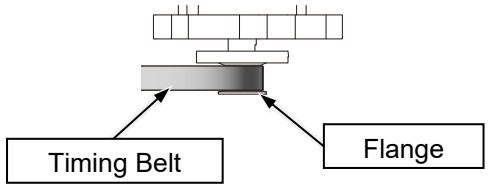
POINT

- First place the belt on the Reduction Gear pulley.
- 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.



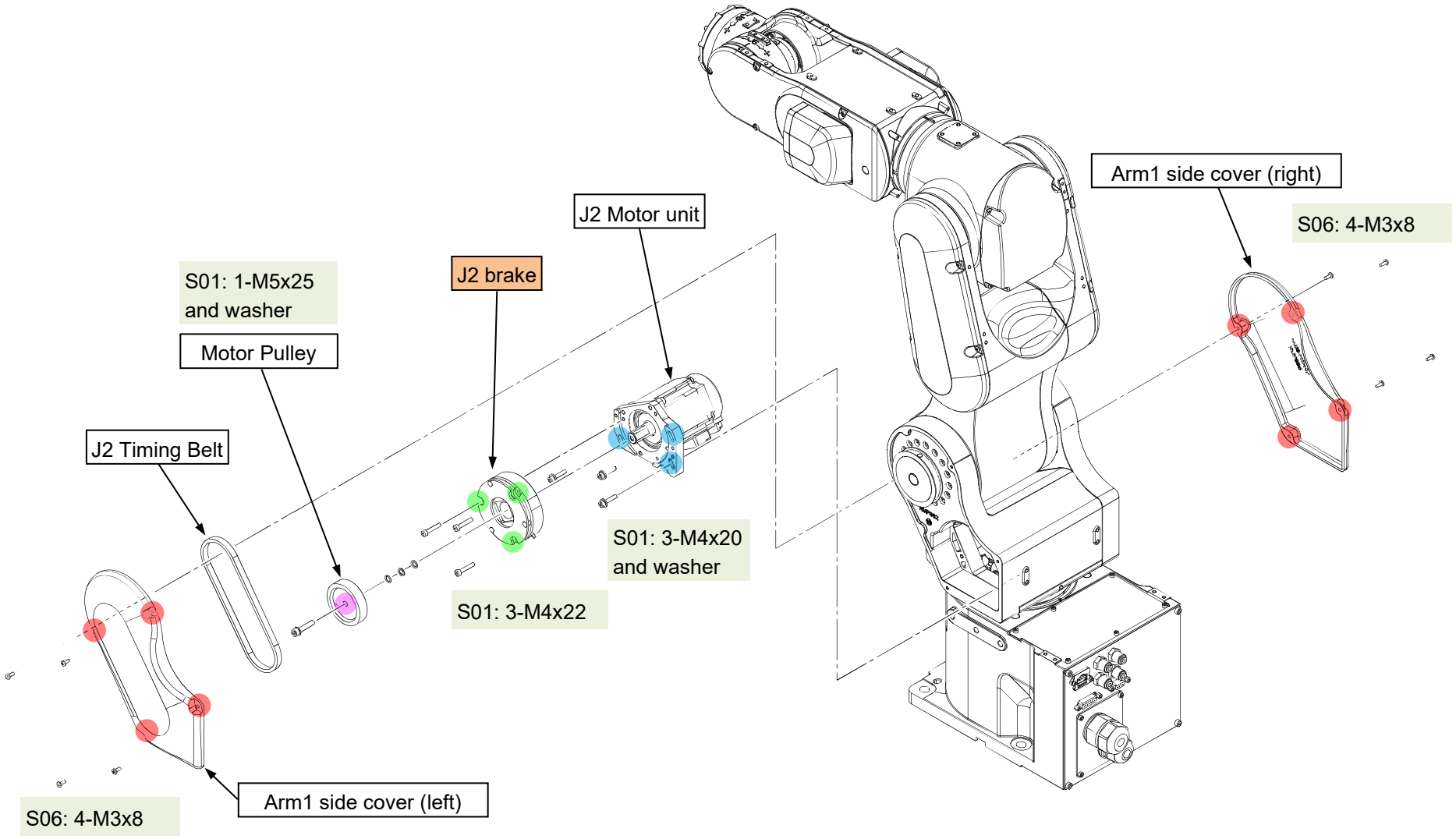
Set the belt so that it is level with respect to the pulley without it being placed on the flange.

Joint #2

2	Temporarily secure the J2 Motor unit. A S01: 3-M4x20 and washer **POINT** The standard for temporary fastening is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.
3	Adjust the belt tension. 3.1 Adjusting the Timing Belt Tension
4	Install the Arm1 side cover (left).
5	After assembly, perform calibration of Joint #2. 3.2 Calibration

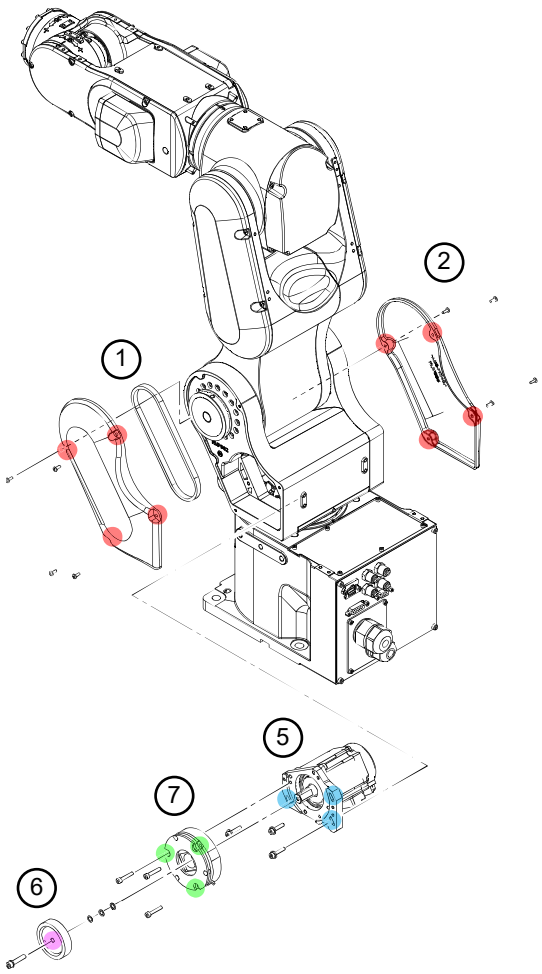
Joint #2

2.2.2 Replacing the J2 Brake



Joint #2

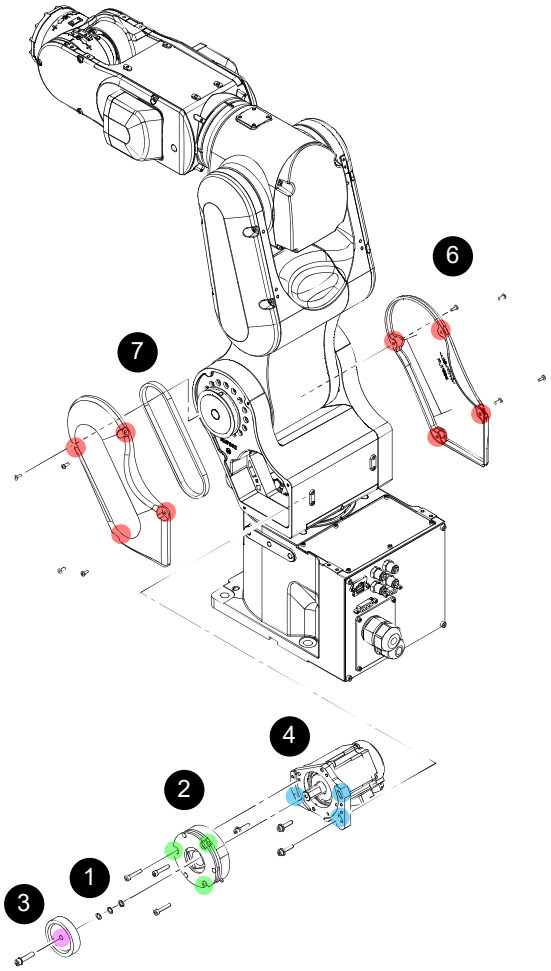
Removing the J2 Brake



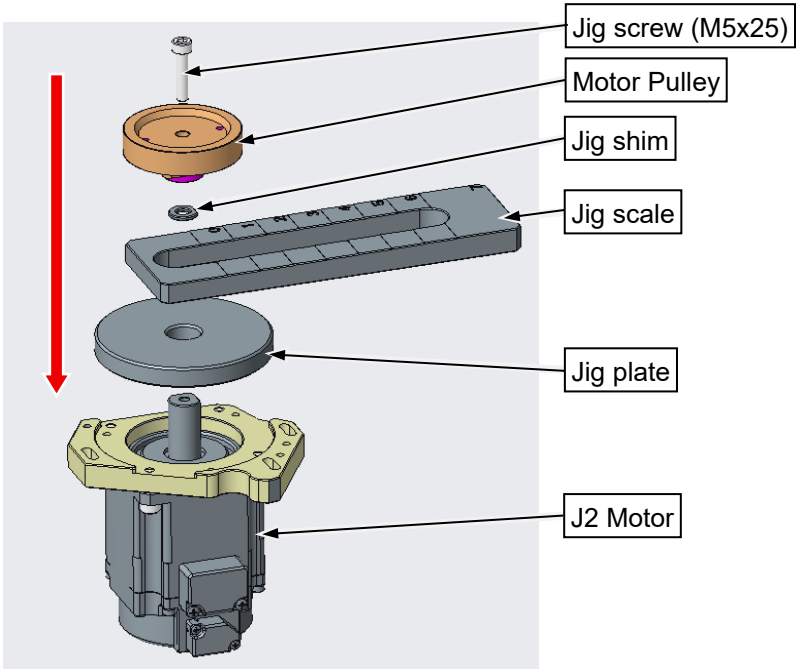
1	Remove the J2 Timing Belt.
2	Remove the Arm1 side cover (right).
3	Disconnect the J2 Motor connectors (MP02-1, MS02-1) and the brake connector (BR021).
4	Remove the screws securing the J2 Motor unit. A S01: 3-M4x20 and washer
5	Remove the J2 Motor unit from the Arm1.
6	Remove the motor pulley from the J2 Motor. **POINT** Remove the screws while pressing the brake against the Motor pulley to prevent it from rotating. **CAUTION** A shim is inserted between the motor pulley and motor shaft. Be careful not to lose it. A S01: 1-M5x25 and washer
7	Remove the J2 brake from the J2 Motor. A S01: 3-M4x22

Joint #2

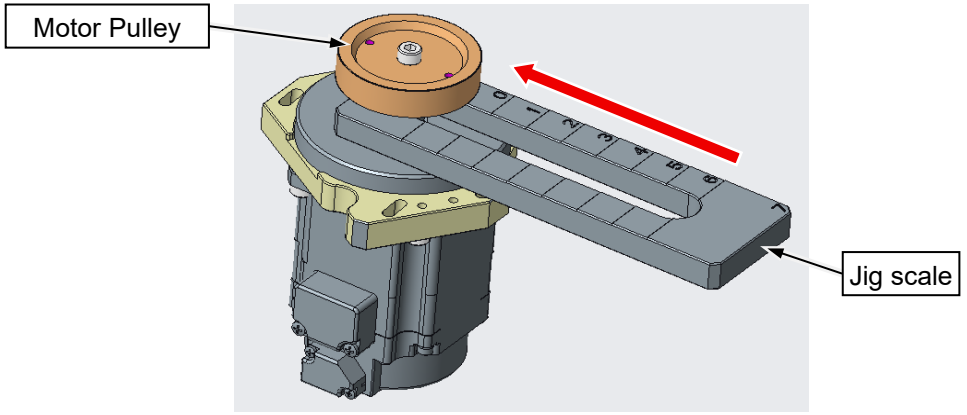
Installing the J2 Brake



Joint #2

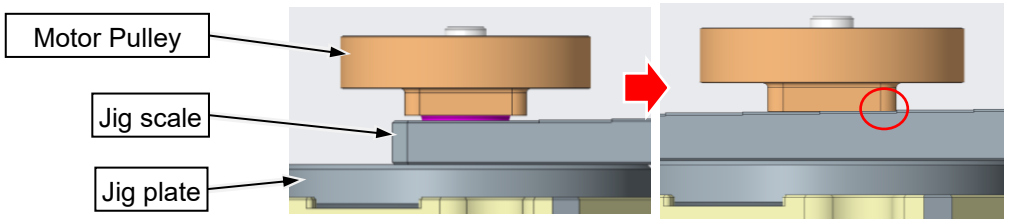
1	Attach the shim to the motor pulley. **POINT** Installing a shim prevents wear of the motor pulley. Perform a measurement with the J2 shim adjustment jig to determine which shim to attach to the motor pulley.
	1. Attach the jig shim to the motor pulley.
	2. In the order shown in the figure, pass the jig plate and jig scale over the motor shaft and place them on the motor plate. **POINT** • Pass the end of the jig scale with the 0 marking over the shaft. • Place the jig scale horizontally on the jig plate and make sure it is in good contact.
	3. Secure the motor pulley to the shaft with the jig screw. **POINT** Tighten the jig screw until it contacts the motor shaft. 

4. Slide the jig scale toward the shaft until it makes contact with the motor pulley.



POINT

The jig scale has a series of steps that make contact with the motor pulley when it is slid. The scale marking at the point of contact determines which shim to attach to the motor pulley.

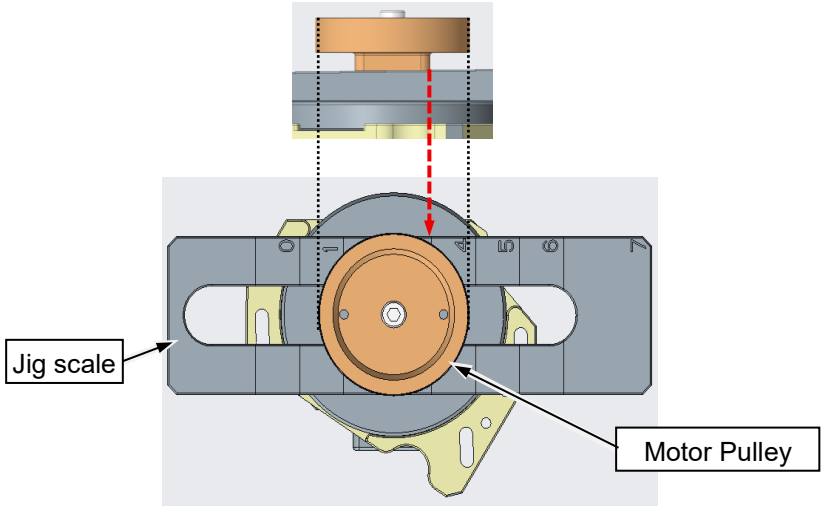


Joint #2

5. Read the jig scale marking from directly above.

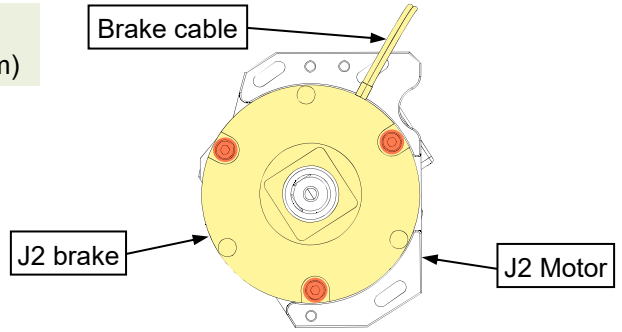
POINT

In the case of the figure below, use the shim “SIM,ADJUST,M5,t06,N054(1961536)” at jig scale marking 4.

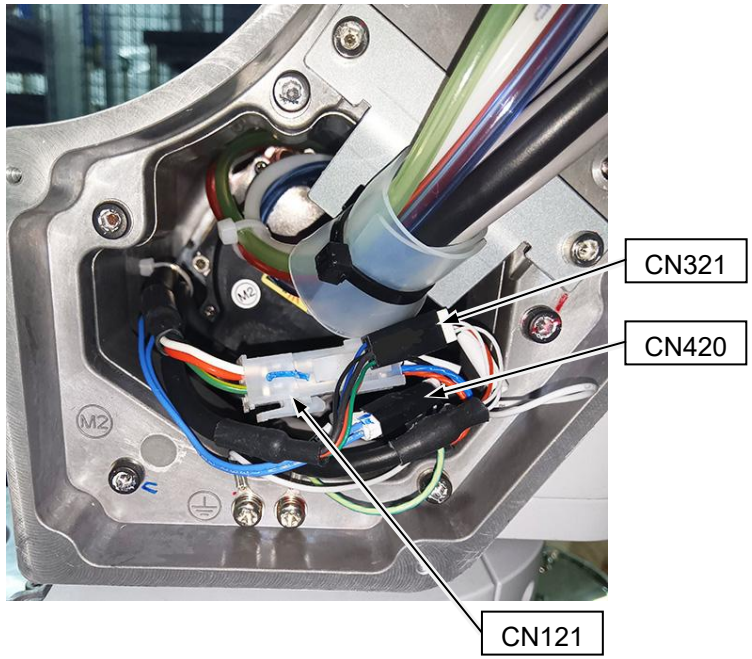


Jig scale marking	Shim to use
0	Process error (please contact the supplier)
1	SIM,ADJUST,M5,t06,N054(1961536) *2
2	SIM,ADJUST,M5,t04,N054(1961522) *1 SIM,ADJUST,M5,t06,N054(1961536) *1
3	SIM,ADJUST,M5,t02,N054(1961521) *1 SIM,ADJUST,M5,t06,N054(1961536) *1
4	SIM,ADJUST,M5,t06,N054(1961536) *1
5	SIM,ADJUST,M5,t04,N054(1961522) *1
6	SIM,ADJUST,M5,t02,N054(1961521) *1
7	Process error (please contact the supplier)

Joint #2

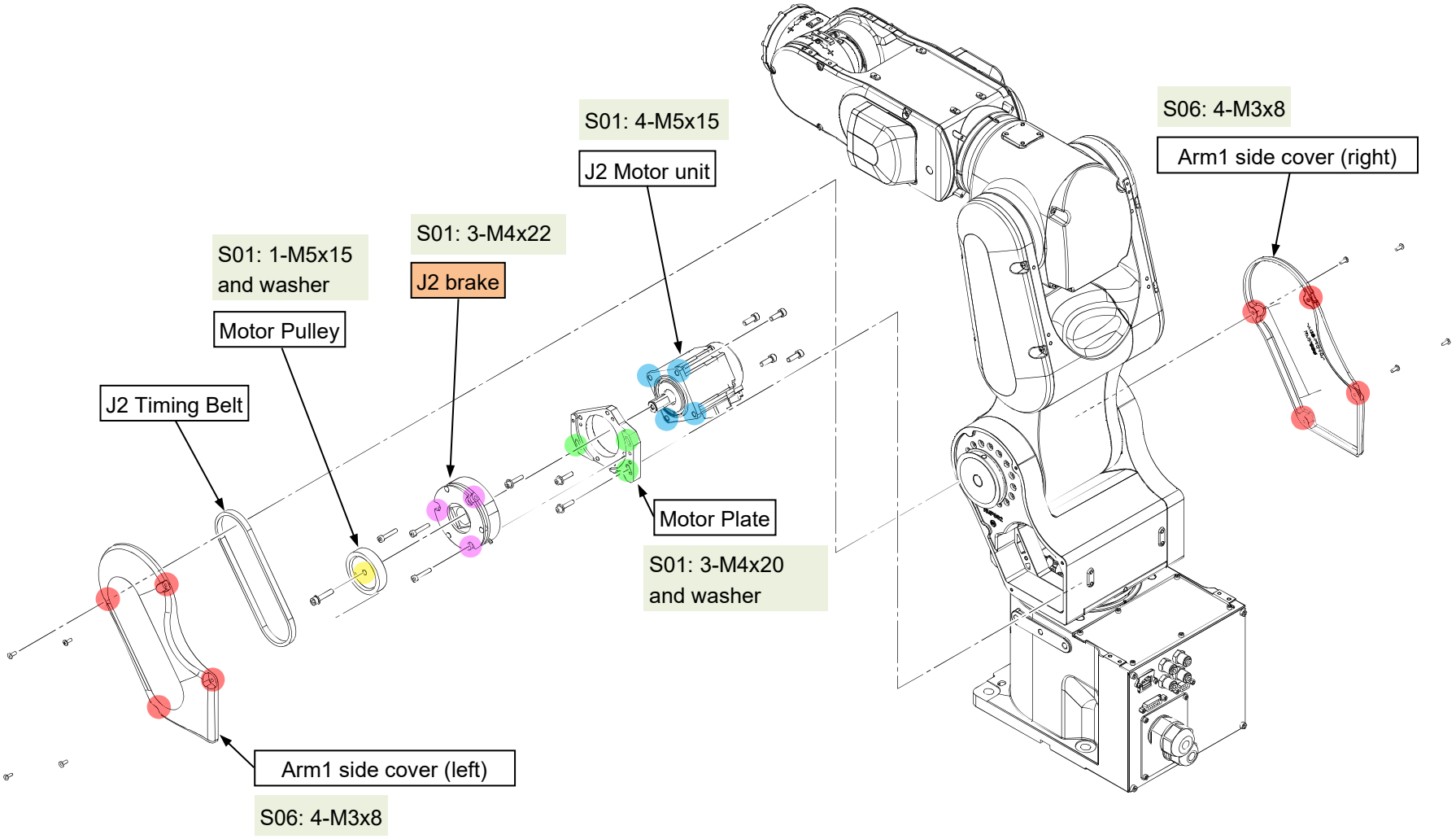
	6. Remove the jig screw and remove the motor pulley and jigs from the J2 Motor. 7. Attach the specified shim to the motor pulley.
2	Install the J2 brake to the J2 Motor. **CAUTION** Install the J2 brake to the J2 Motor in the orientation shown in the figure. A S01: 3-M4x22 (4.0 +/- 0.2 N·m) 
3	Install the motor pulley on the J2 Motor. **POINT** • Make sure that a shim is attached to the motor pulley. • Align the motor pulley with the brake disc and install the motor pulley on the motor shaft. If they are misaligned, adjust the brake disc position. • Apply Loctite 243 to the screw. • Tighten the screws while pressing the brake against the motor pulley to prevent it rotating. • After tightening the screw, allow it to sit for about 15 minutes to let the Loctite dry. A S01: 1-M5x25 and washer (8.0 +/- 0.4 N·m)

Joint #2

4	Install the J2 Motor unit on the Arm1. **POINT** Follow the steps below to secure the J2 Motor unit to Arm1.
5	Connect the J2 Motor connectors (CN121, CN321) and the brake connector (CN420). 
6	Install the Arm1 side cover (right).
7	Install the J2 Timing Belt.

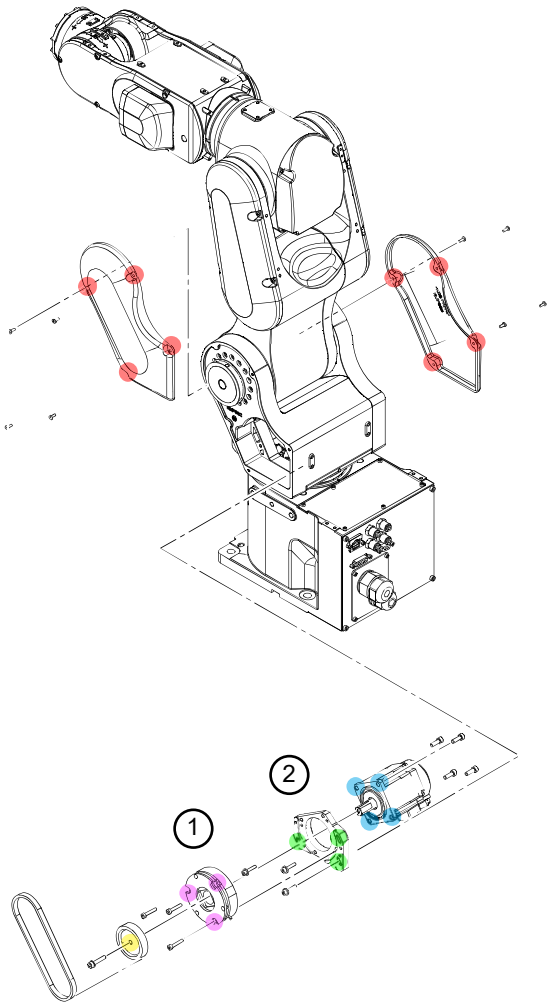
Joint #2

2.2.3 Replacing the J2 Motor



Joint #2

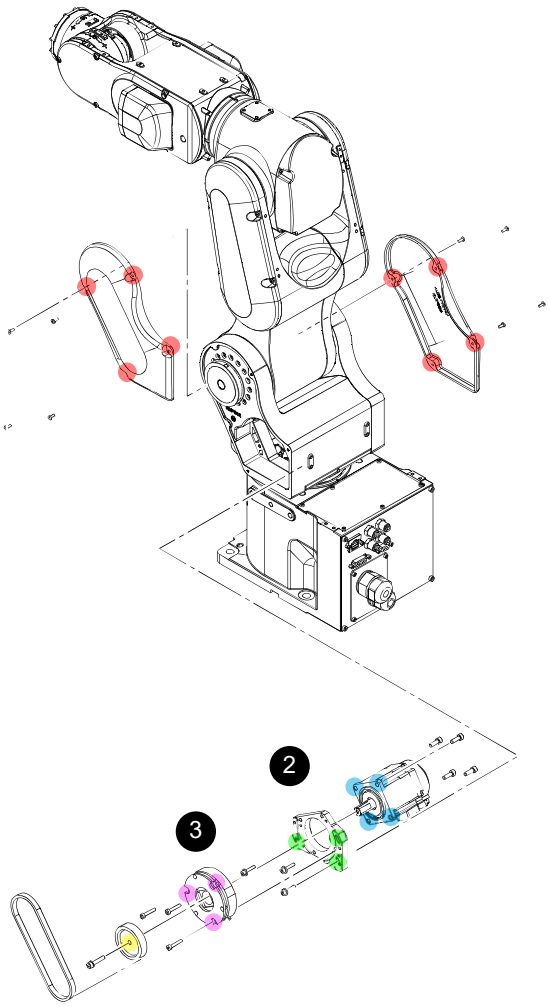
Removing the J2 Motor

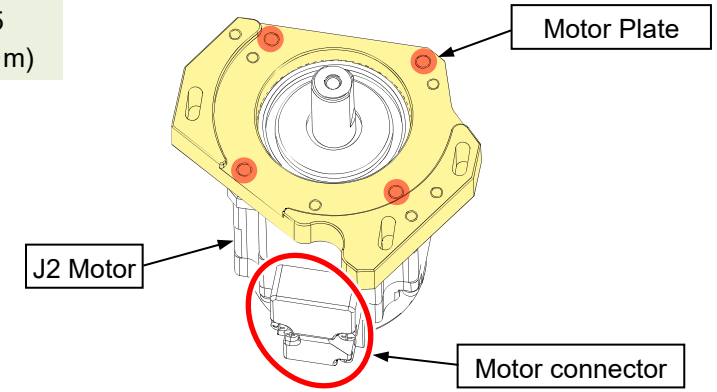


1	Remove the J2 brake.
2	Remove the motor plate from the J2 Motor. A S01: 4-M5x15

Joint #2

Installing the J2 Motor

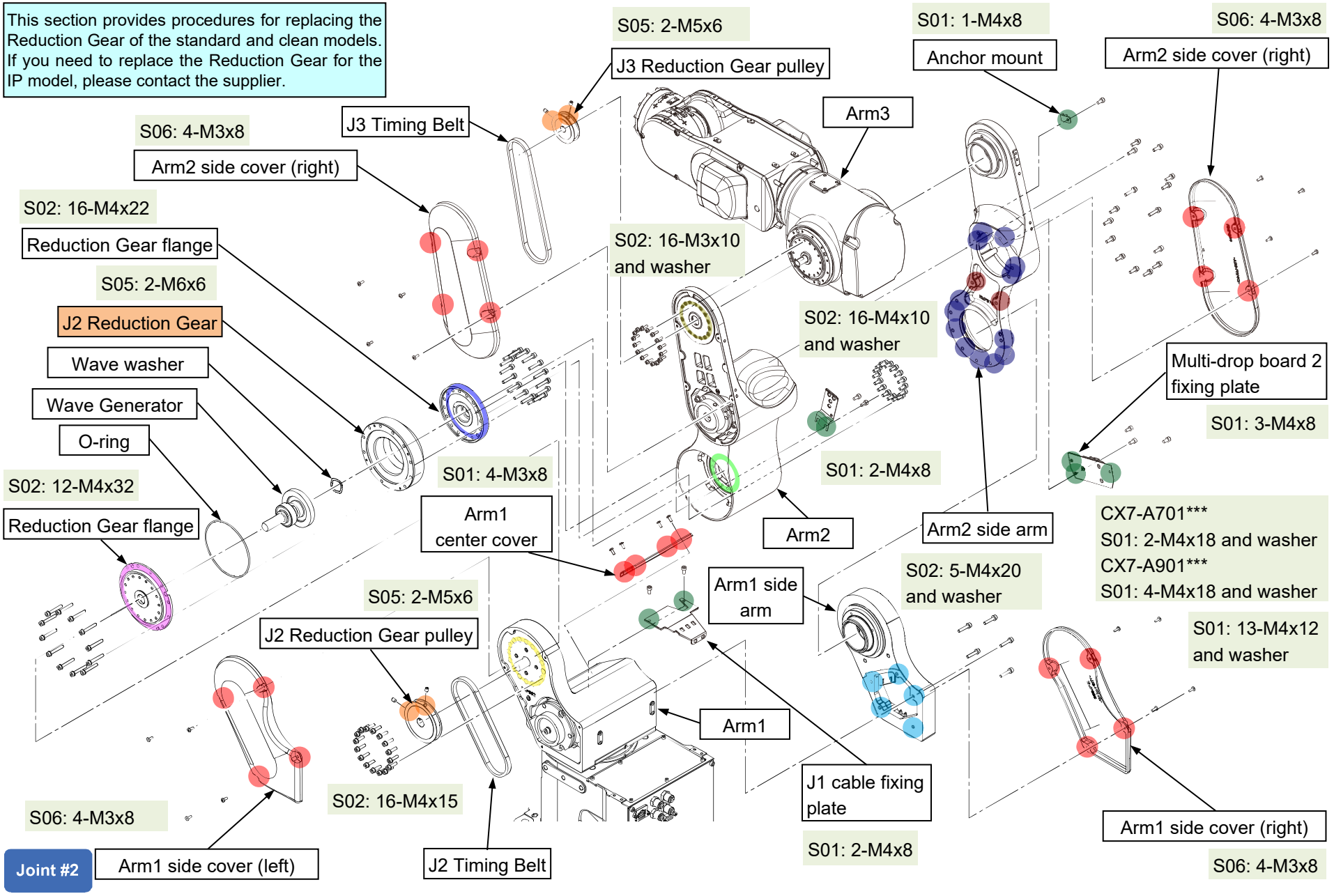


1	Attach connector labels to the J2 Motor. **POINT** A new motor comes with the connector labels. Attach the labels near the connectors. Refer to the old motor.
2	Install the motor plate on the J2 Motor. **POINT** Install the motor plate on the J2 Motor in the orientation shown in the figure. A S01: 4-M5x15 (4.0 +/- 0.2 N·m) 
3	Install the J2 brake.

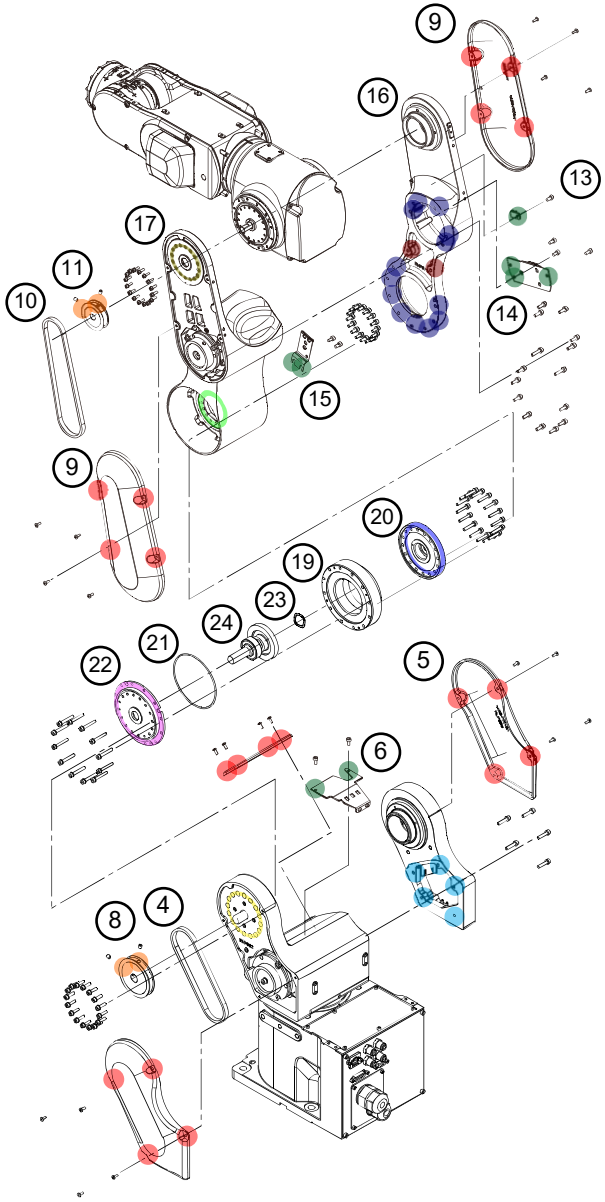
Joint #2

2.2.4 Replacing the J2 Reduction Gear

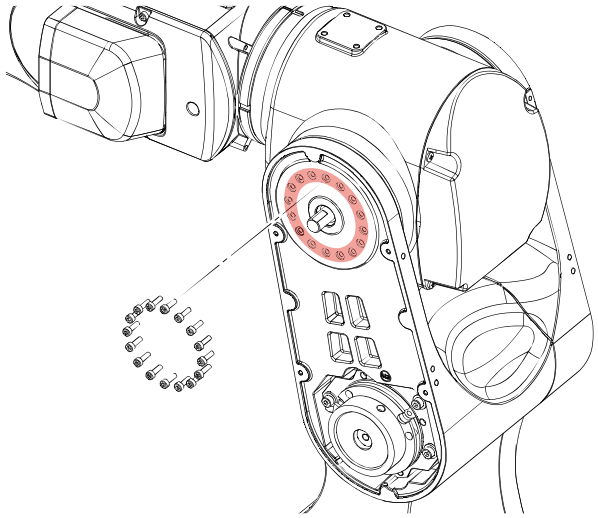
This section provides procedures for replacing the Reduction Gear of the standard and clean models. If you need to replace the Reduction Gear for the IP model, please contact the supplier.



Removing the J2 Reduction Gear



	<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 1.0 m Height: 300 mm to 500 mm from bottom of the Manipulator Load capacity: 20 kg
1	Turn ON the controller.
2	Release the J2 brake, and manually push and move Arm2 until it comes in contact with the mechanical stopper, and push it against Arm1. **CAUTION** Arm2 falls by its weight when the J2 Motor unit is removed. Release the brake and tilt Arm2 in advance.
3	Turn OFF the Controller.
4	Remove the J2 Timing Belt.
5	Remove the Arm1 side cover (right).
6	Remove the J1 cable fixing plate. Perform steps (2) and (3) in Removing Gyro Board 1.
7	Remove the screws that secure the Arm1 side arm to Arm1. A S02: 5-M4x20 and washer
8	Remove the J2 Reduction Gear pulley. A S05: 2-M5x6

9	Remove the Arm2 side cover.
10	Remove the J3 Timing Belt.
11	Remove the J3 Reduction Gear pulley. A S05: 2-M5x6
12	Remove the screws that link Arm2 to Arm3. A S02: 16-M3x10 and washer 
13	Remove the anchor mount of the Arm2 side arm. A S01: 1-M4x8

Joint #2

(14)	Remove the multi-drop board 2 fixing plate. **CAUTION** Connectors are still connected to the board. Do not pull hard on the plate when removing it. A S01: 3-M4x8
(15)	Remove the plate from the J2 Reduction Gear flange. A S01: 2-M4x8
(16)	Remove the Arm2 side arm. **WARNING** When these bolts are removed, Arm2, Arm3, Arm4, Arm5, and Arm6 (tip) will come off. 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. **CAUTION** 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 S01: 13-M4x12 and washer B CX7-A701*** S01: 2-M4x18 and washer CX7-A901*** S01: 4-M4x18 and washer

Joint #2

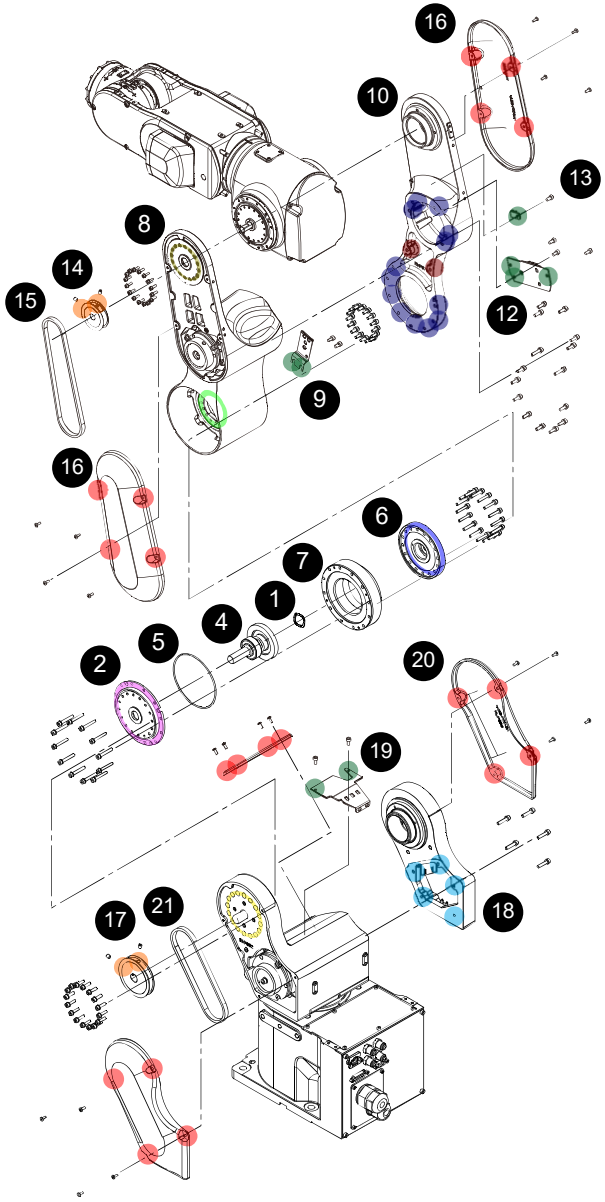
(17)	Remove Arm2. **CAUTION** The O-ring attached to the wave generator fixing plate may be sticking to the Arm2. Be careful not to lose it. (A) S02: 16-M4x10 and washer
(18)	Remove the screws securing the Reduction Gear Unit to the Arm2. (A) S02: 16-M4x15 and washer
(19)	Remove the Reduction Gear Unit from the Arm2.
(20)	Remove the Reduction Gear flange (inner side) from the J2 Reduction Gear Unit. (A) S02: 16-M4x22 and washer
(21)	Remove the O-ring from the J2 Reduction Gear Unit.
(22)	Remove the Reduction Gear flange (outer side) from the J2 Reduction Gear Unit. (A) S02: 12-M4x32
(23)	Remove the wave washer. **CAUTION** The wave washer will be used again. Be careful not to lose it when performing the work. **POINT** The part has grease applied. Perform the work while wiping off the grease.

Joint #2

(24)	Remove the Waveform Generator unit. **POINT** Turn the Reduction Gear Unit with the Waveform Generator unit built in upside down. Remove the Waveform Generator unit by tapping it lightly near the center axis with a plastic hammer.

Joint #2

Installing the J2 Reduction Gear



Joint #2

1	Install the wave washer in the Reduction Gear flange.
2	Install the Reduction Gear flange (outer side) on the J2 Reduction Gear. A S02: 12-M4x32 (5.5 +/- 0.25 N·m)
3	Apply grease to the inside of the Flexspline of the Reduction Gear. SK-1A: 30 g
4	Install the Waveform Generator unit. **POINT** Install so that the longside of the Flexspline and the Waveform Generator match. Longside Shortside Reduction Gear
5	Attach the O-ring to the J2 Reduction Gear Unit. **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.
6	Install the Reduction Gear flange (inner side) on the J2 Reduction Gear. A S02: 16-M4x22 and washer (5.5 +/- 0.25 N·m)

7	Secure the J2 Reduction Gear Unit to Arm2. A S01: 16-M4x10 and washer (4.0 +/- 0.2 N·m)
8	Attach Arm2 to Arm1. **CAUTION** 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. A S02: 16-M4x15 and washer (5.5 +/- 0.25 N·m)
9	Fix the plate to the Reduction Gear flange. A S01: 2-M4x8 (4.0 +/- 0.2 N·m)

Joint #2

10	Install the Arm2 side arm. **POINT** Lift up Arm2, Arm3, Arm4, Arm5, and Arm6 (tip) to install it. A S01: 13-M4x12 and washer (4.0 +/- 0.2 N·m) B CX7-A701*** S01: 2-M4x18 and washer (4.0 +/- 0.2 N·m) CX7-A901*** S01: 4-M4x18 and washer (4.0 +/- 0.2 N·m)
11	Insert the screws that link Arm2 to Arm3. A S02: 16-M3x10 and washer (2.4 +/- 0.1 N·m)
12	Install the multi-drop board 2 fixing plate. A S01: 3-M4x8 (4.0 +/- 0.2 N·m)
13	Install the anchor mount of the Arm2 side arm. A S01: 1-M4x8 (4.0 +/- 0.2 N·m)
14	Install the J3 Reduction Gear pulley. A S05: 2-M5x6 (4.0 +/- 0.2 N·m)
15	Install the J3 Timing Belt.

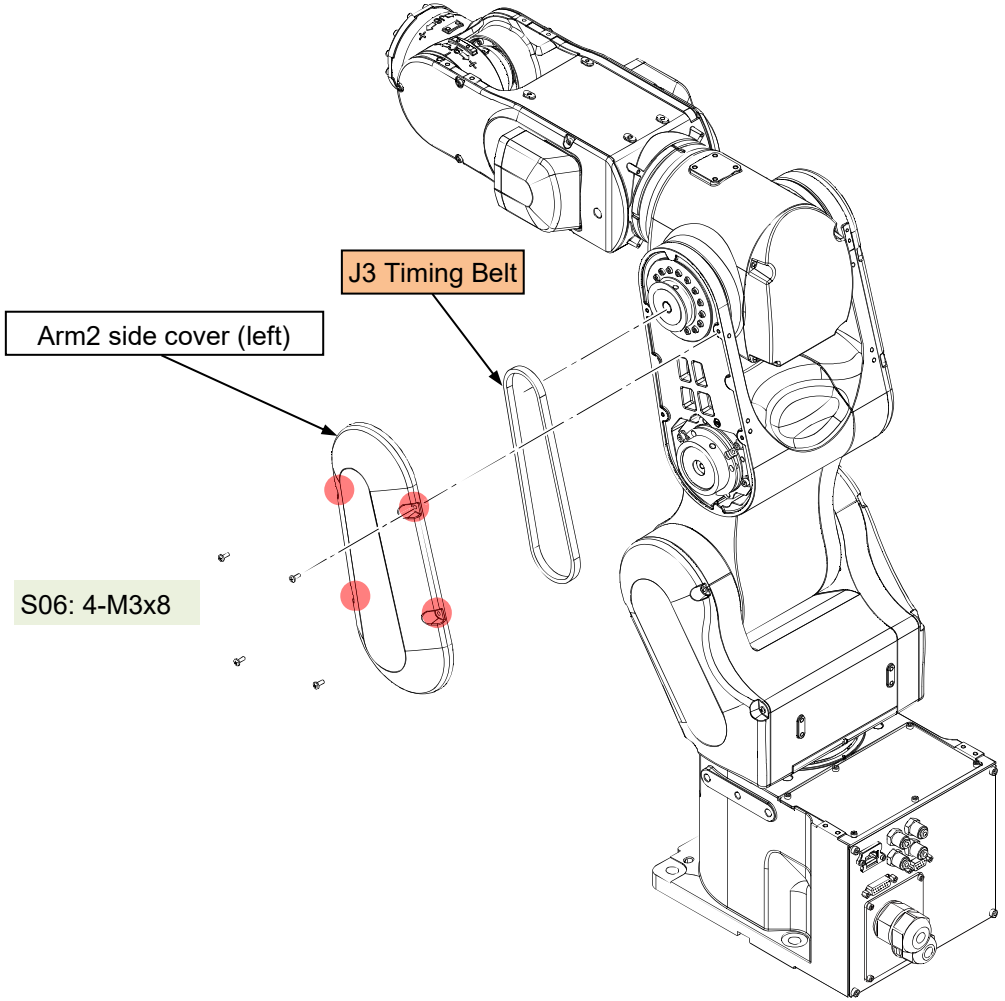
Joint #2

16	Install the Arm2 side cover.
17	Install the J2 Reduction Gear pulley. A S05: 2-M5x6 (4.0 +/- 0.2 N·m)
18	Insert the screws in the Arm1 side arm. A S02: 5-M4x20 and washer (5.5 +/- 0.25 N·m)
19	Install the J1 cable fixing plate. Perform steps (4) and (5) in Installing Gyro Board 1.
20	Install the Arm1 side cover (right).
21	Install the J2 Timing Belt.
22	After assembly, perform calibration of Joint #2 and Joint #3. 3.2 Calibration

Joint #2

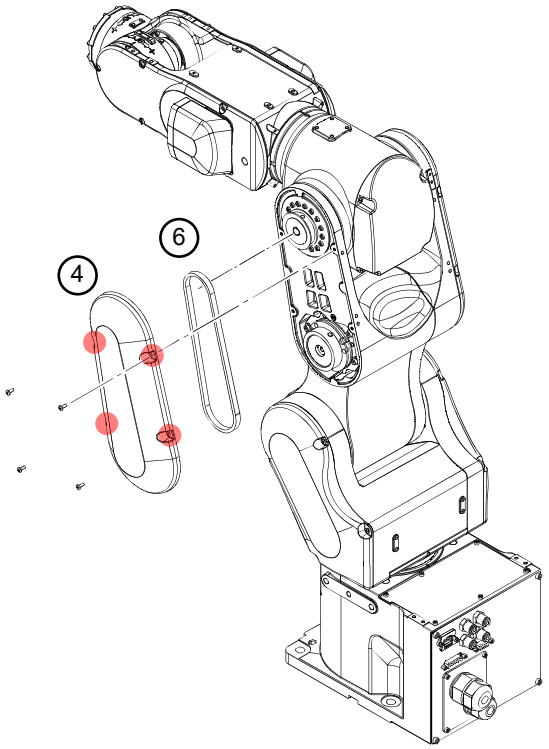
2.3 Joint #3

2.3.1 Replacing the J3 Timing Belt



Joint #3

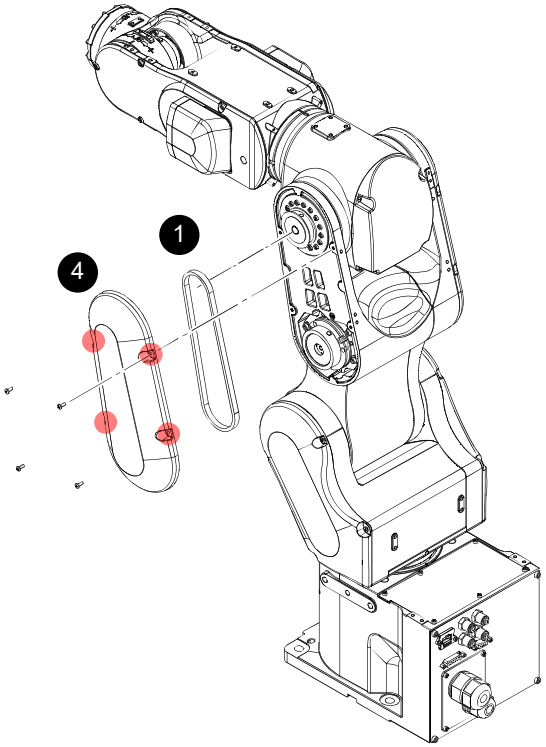
Removing the J3 Timing Belt



1	Turn ON the controller.
2	Release the J3 brake, manually push and move Arm3, and push it against Arm2. **POINT** At this time, place cushioning between arms to prevent damage to them. **CAUTION** • 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 (left).
5	Loosen the screws securing the J3 Motor unit. A S01: 3-M4x20 and washer **WARNING** Loosening the screws while Arm3 is not tilted will result in the belt coming off and Arm3 falling, which is very dangerous. Prior to loosening the J3 Motor unit screws, ensure that Arm3 is tilted.
6	Remove the J3 Timing Belt. **POINT** First remove the Timing Belt from the Motor pulley, then remove it from the Reduction Gear pulley.

Joint #3

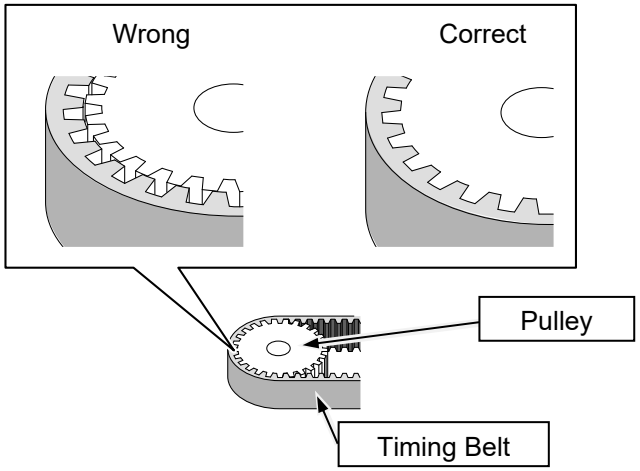
Installing the J3 Timing Belt



1 Install the J3 Timing Belt.

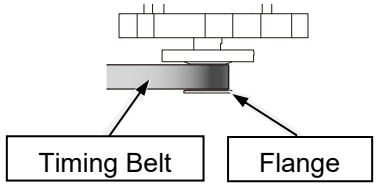
POINT

- First place the belt on the Reduction Gear pulley.
- 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.



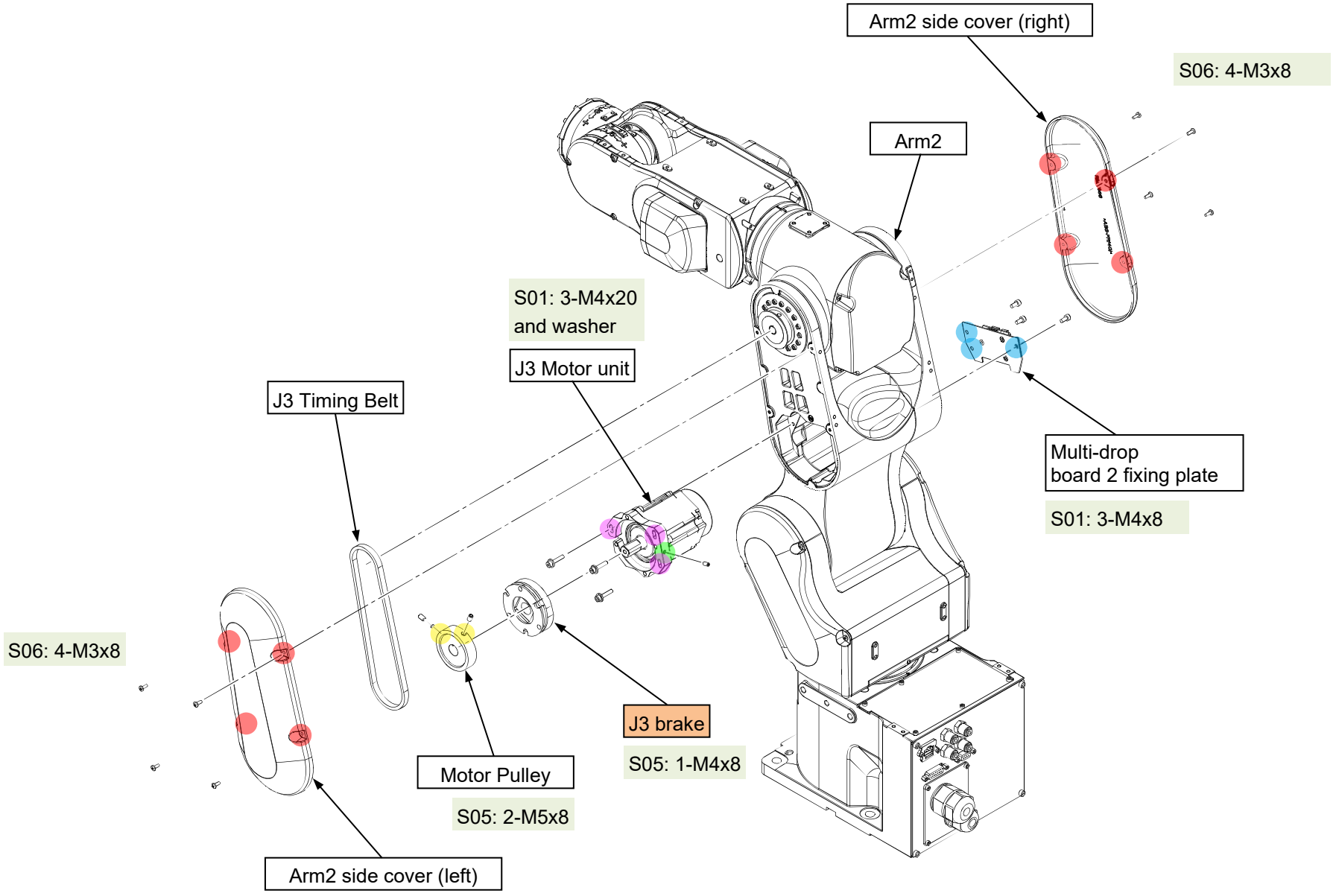
Set the belt so that it is level with respect to the pulley without it being placed on the flange.

Joint #3

2	Temporarily secure the J3 Motor unit. A S01: 3-M4x20 and washer **POINT** The standard for temporary fastening is where the Motor Unit can be moved by hand and will not tilt when pulled. If this is either too loose or too tight, it will not provide the proper tension to the belt.
3	Adjust the belt tension. 3.1 Adjusting the Timing Belt Tension
4	Install the Arm2 side cover (left).
5	After assembly, perform calibration of Joint #3. 3.2 Calibration

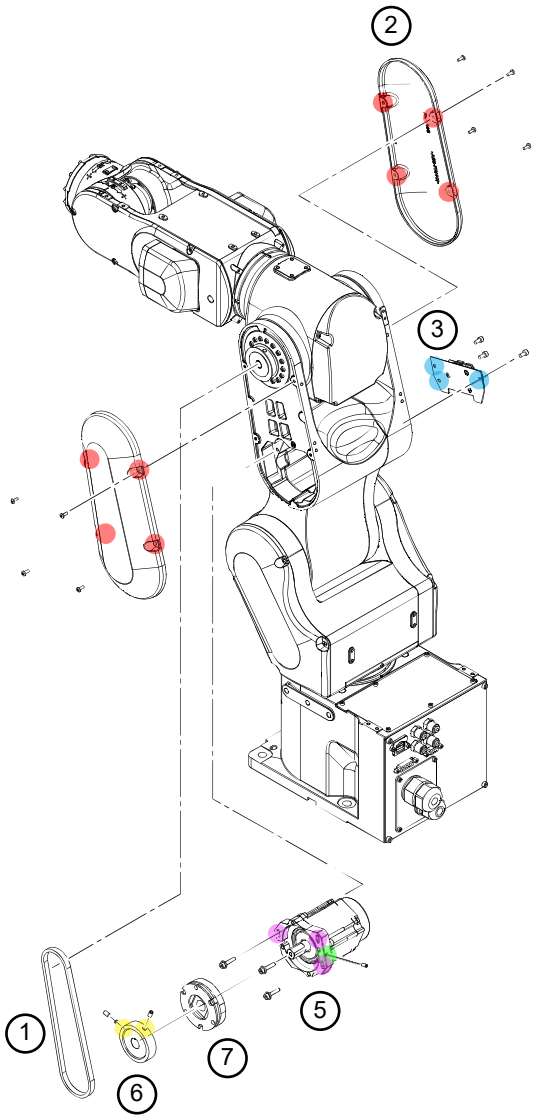


2.3.2 Replacing the J3 Brake



Joint #3

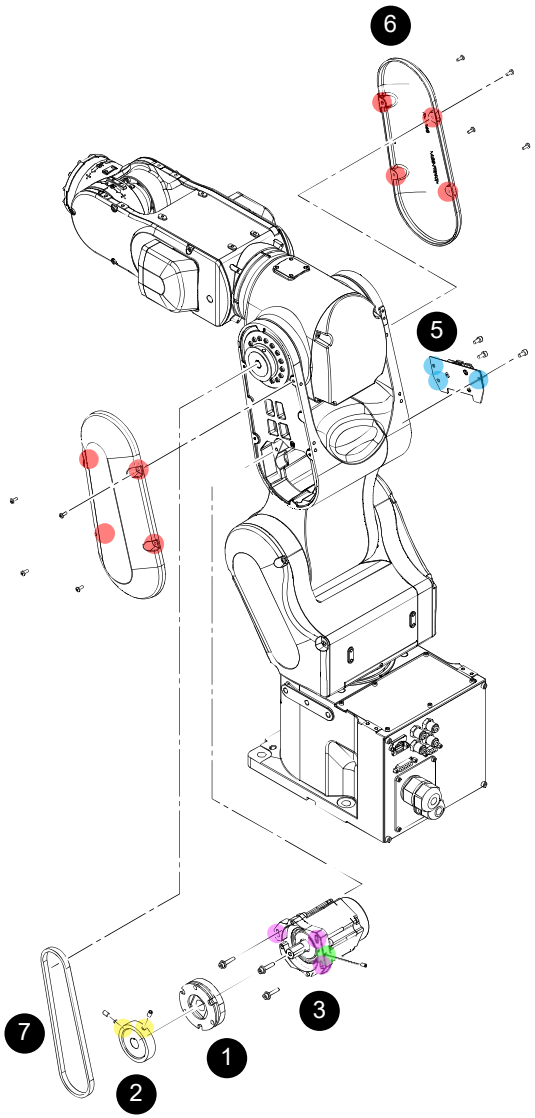
Removing the J3 Brake



1	Remove the J3 Timing Belt.
2	Remove the Arm2 side cover (right).
3	Remove the multi-drop board 2 fixing plate from the Arm2. **CAUTION** Connectors are still connected to the board. Do not pull hard on the plate when removing it. A S01: 3-M4x8
4	Disconnect the J3 Motor connectors (MS03-1, MP03-1) and the brake connector (BR031).
5	Remove the J3 Motor unit from the Arm2. A S01: 3-M4x20 and washer
6	Remove the motor pulley from the J3 Motor. **CAUTION** A brass bushing is included on one side of the set screw. Be careful not to lose it. A S05: 2-M5x8
7	Remove the J3 brake from the J3 Motor. A S05: 1-M4x8

Joint #3

Installing the J3 Brake

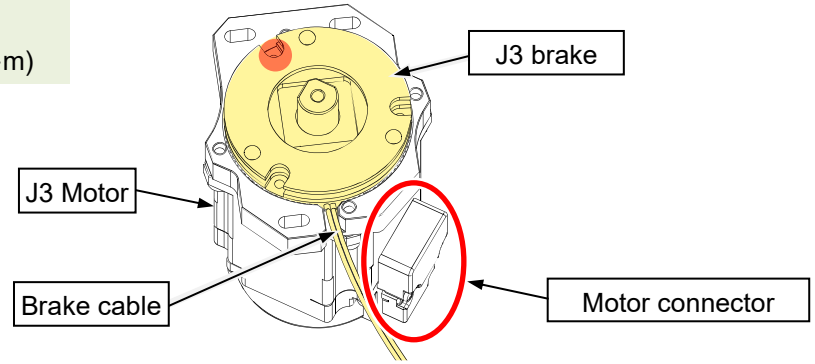


1 Install the J3 brake to the J3 Motor.

POINT

Install the J3 brake to the J3 Motor in the orientation shown in the figure.

A S05: 1-M4x8
(2.4 +/- 0.1 N·m)



2 Install the motor pulley on the J3 Motor.

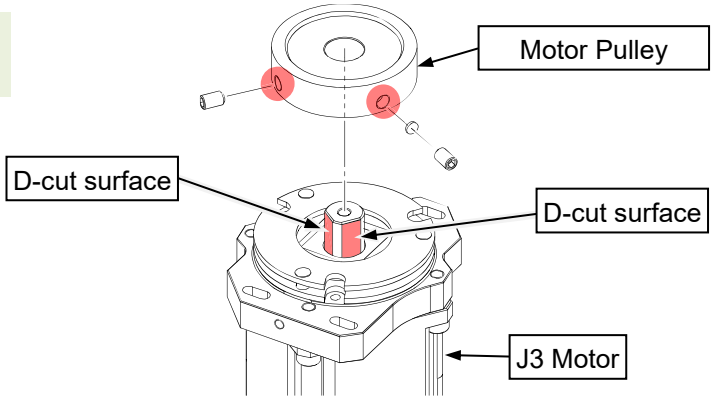
POINT

- Attach the two screws as shown below.

  1st screw: Ensure that the screw is perpendicular to the D-cut surface of the motor shaft.

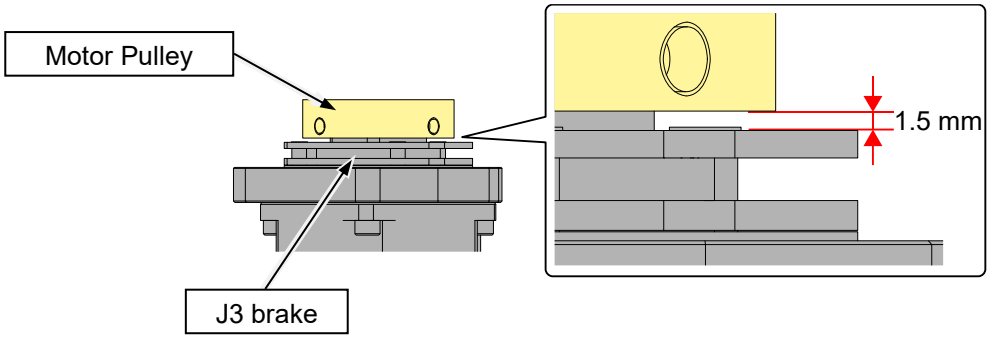
  2nd screw: Insert the bushing into the pulley and fix it to the J3 Motor.

A S05: 2-M5x8
(4.0 +/- 0.2 N·m)



Joint #3

- Secure the motor pulley so that the gap between it and the brake is 1.5 mm.



3. Insert the J3 Motor unit in the Arm2.

POINT

At this stage, do not secure the Motor unit to the Arm2 yet.

4. Connect the J3 Motor connectors (CN331, CN131) and the brake connector (CN430).

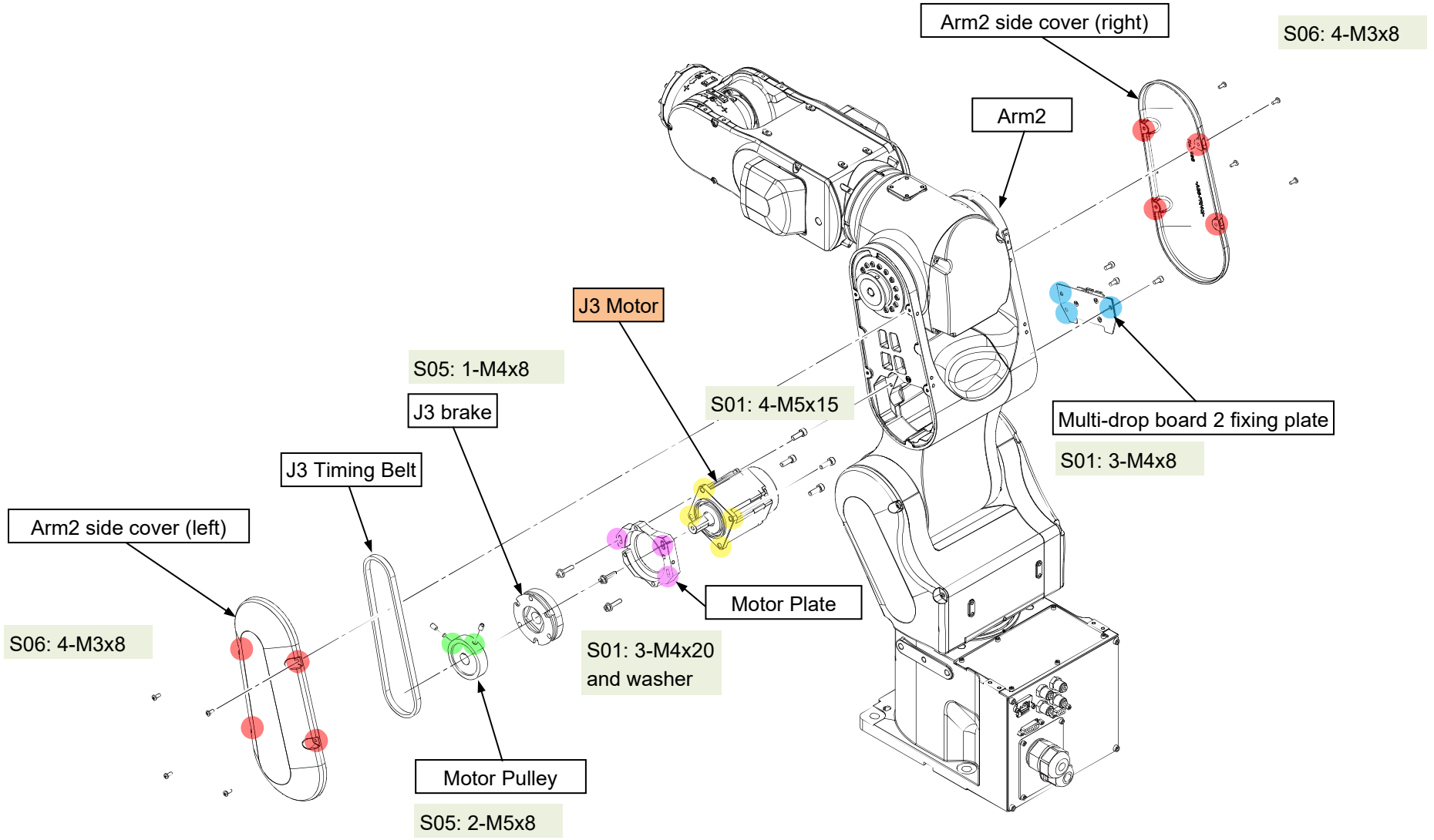


Joint #3

5	Secure the multi-drop board 2 fixing plate to the Arm2. A S01: 3-M4x8 (4.0 +/- 0.2 N·m) **CAUTION** Be careful not to get the cables connected to the board caught between the plate and the arm.
6	Install the Arm2 side cover (right).
7	Install the J3 Timing Belt.
8	After assembly, perform calibration of Joint #3. 3.2 Calibration

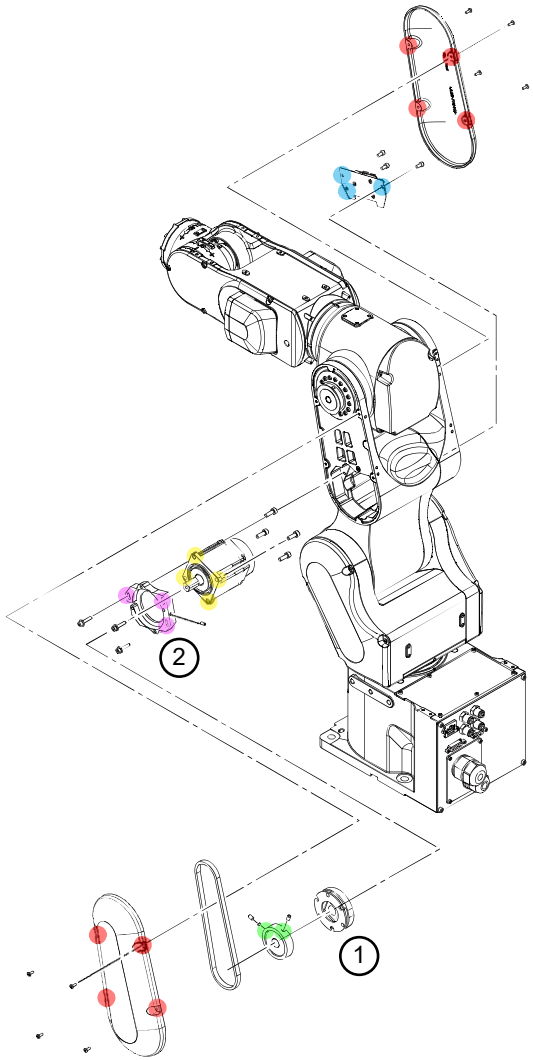
Joint #3

2.3.3 Replacing the J3 Motor



Joint #3

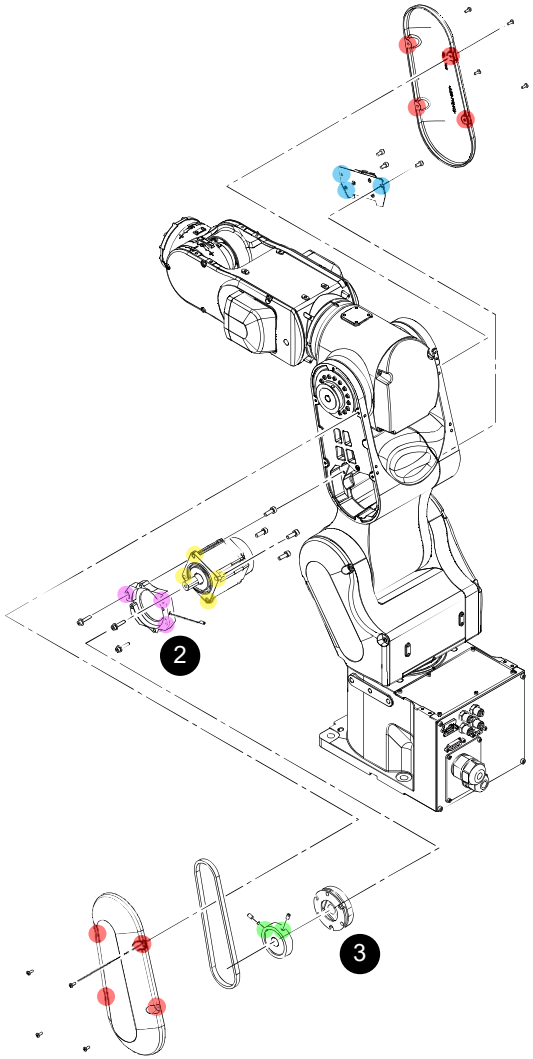
Removing the J3 Motor

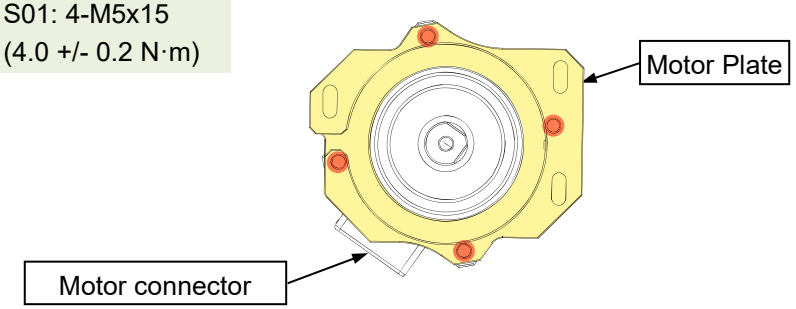


1	Remove the J3 brake.
2	Remove the motor plate from the J3 Motor. A S01: 4-M5x15

Joint #3

Installing the J3 Motor

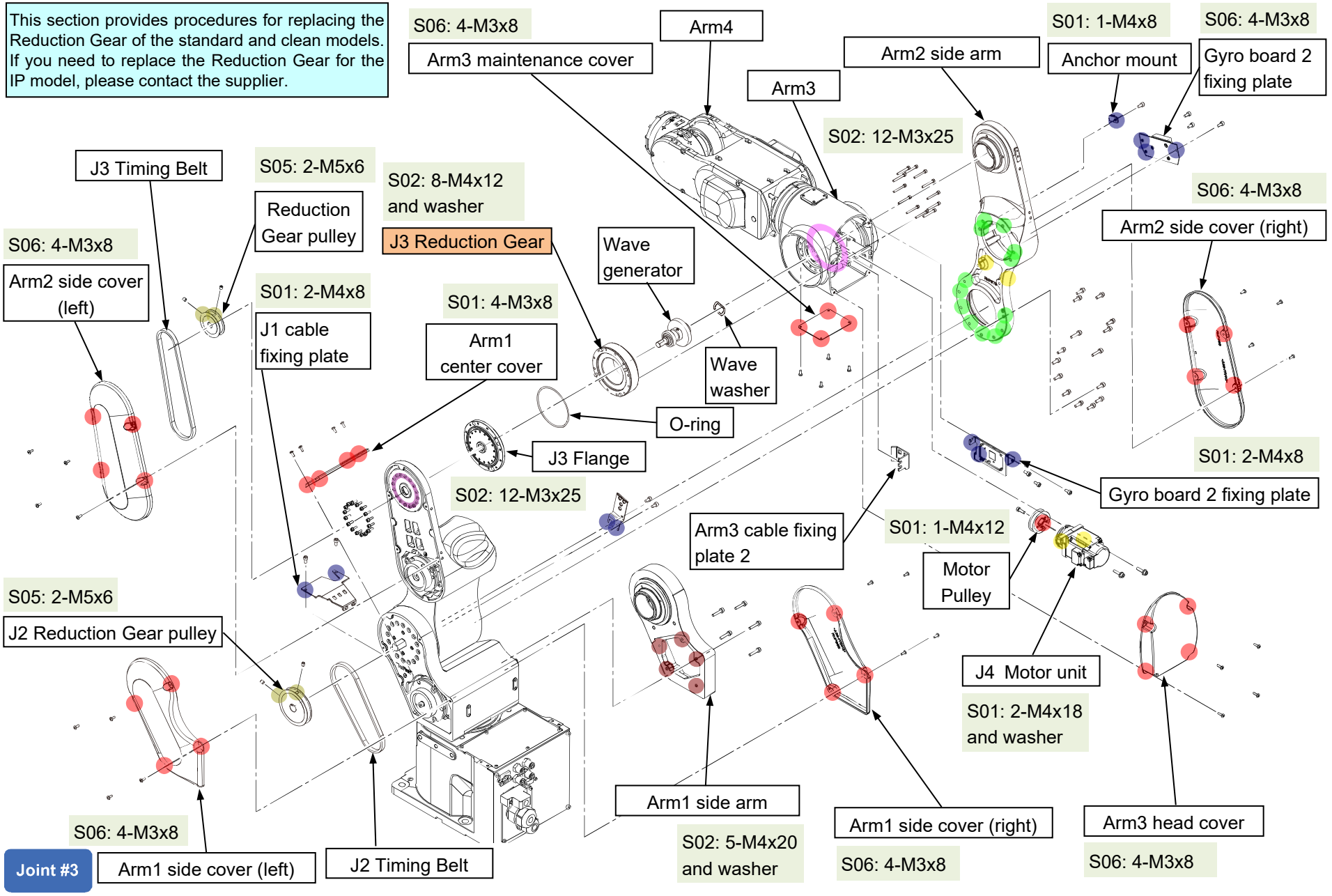


1	Attach connector labels to the J3 Motor. **POINT** A new motor comes with the connector labels. Attach the labels near the connectors. Refer to the old motor.
2	Install the Motor Plate. **POINT** Attach the Motor Plate according to the orientation shown in the figure. A S01: 4-M5x15 (4.0 +/- 0.2 N·m) 
3	Install the J3 brake.

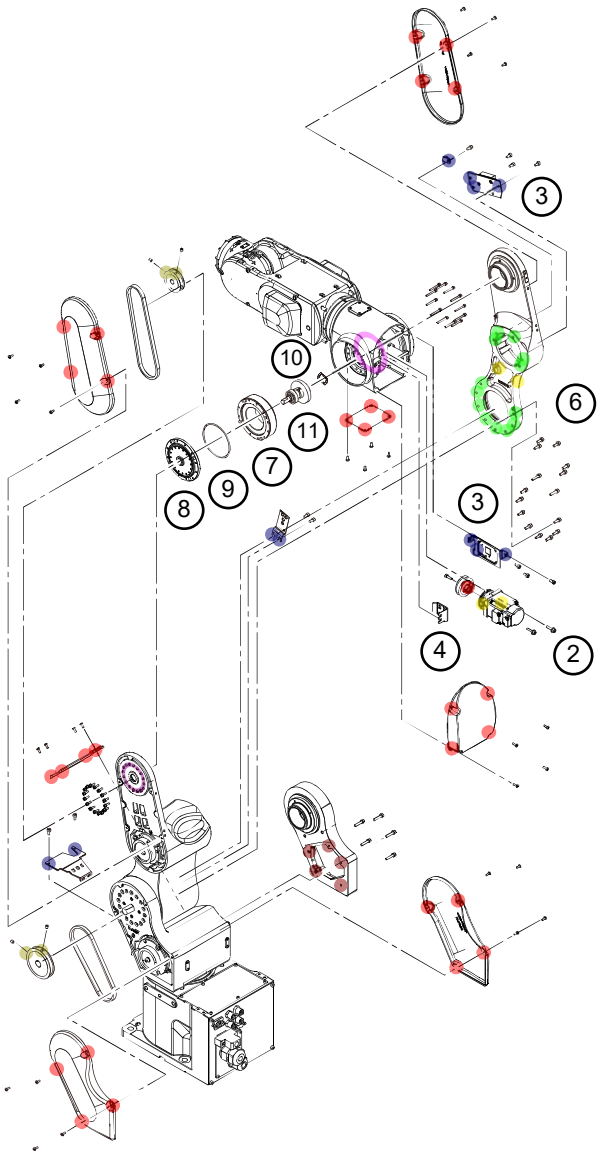
Joint #3

2.3.4 Replacing the J3 Reduction Gear

This section provides procedures for replacing the Reduction Gear of the standard and clean models. If you need to replace the Reduction Gear for the IP model, please contact the supplier.



Removing the J3 Reduction Gear

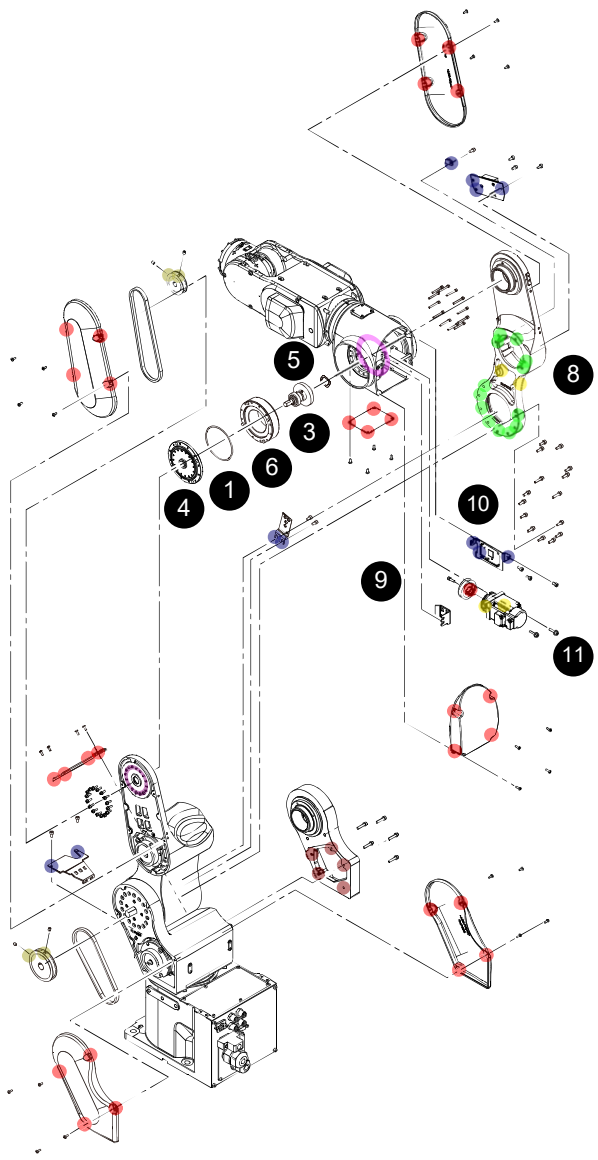


	<Preparation> Prepare a work stand upon which to place the arm removed from the Manipulator. Guidelines for work stand Width x Depth: 1.0 x 1.0 m Height: 300 mm to 500 mm from bottom of the Manipulator Load capacity: 20 kg
1	Turn ON the controller.
2	Remove the J4 Motor unit. Perform the steps from the first step to step (9) in Removing the J4 Brake.
3	Remove the gyro board 2 fixing plate. Perform steps (3) and (4) in Removing Gyro Board 2.
4	Remove the Arm3 cable fixing plate2 from inside Arm3. A S01: 2-M4x8
5	Remove the screws securing the J3 Reduction Gear Unit to the Arm3. A S02: 16-M3x22 and washer
6	Remove the Arm2 side arm. Perform steps (2) through (7) and steps (13) through (16) in Removing the J2 Reduction Gear. **WARNING** When these screws are removed, Arm3, Arm4, Arm5, and Arm6 (tip) will come off. 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 screws. **CAUTION** 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.

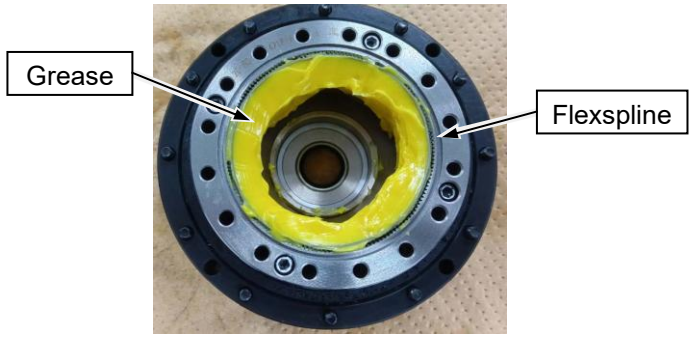
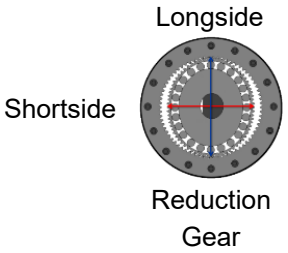
⑦	Remove the J3 Reduction Gear Unit from the Arm2. **CAUTION** At this stage, the J3 Reduction Gear Unit is not secured to Arm2. Ensure that the J3 Reduction Gear Unit does not fall.
⑧	Remove the Reduction Gear flange from the J3 Reduction Gear Unit. Ⓐ S02: 12-M3x25
⑨	Remove the O-ring from the J3 Reduction Gear.
⑩	Remove the wave washer from the J3 Reduction Gear. **CAUTION** The wave washer will be used again. Be careful not to lose it when performing the work. **POINT** The part has grease applied. Perform the work while wiping off the grease.
⑪	Remove the wave generator from the J3 Reduction Gear. **POINT** Turn the Reduction Gear Unit with the Waveform Generator built in upside down. Remove the Waveform Generator by tapping it lightly near the center axis with a plastic hammer.

Joint #3

Installing the J3 Reduction Gear



Joint #3

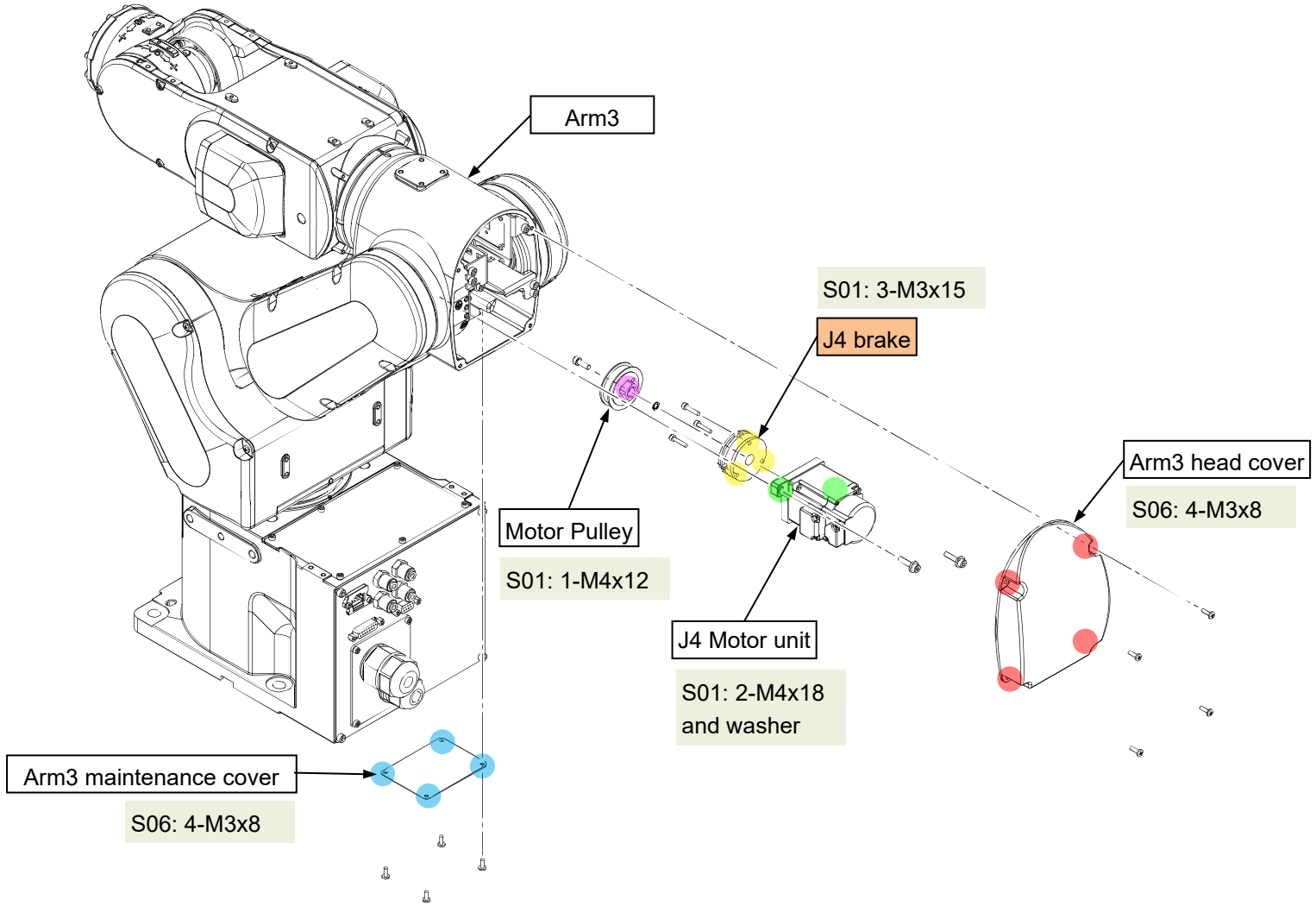
1	Attach the O-ring to the J3 Reduction Gear.
2	Apply grease to the inside of the Flexspline. **POINT** Wipe off the old grease before applying new grease. SK-2: 13.2 +/- 1.3 g 
3	Install the wave generator on the J3 Reduction Gear Unit. **POINT** Install so that the longside of the Flexspline and the wave generator match. 
4	Install the Reduction Gear flange on the J3 Reduction Gear Unit. A S02: 12-M3x25 (2.4 +/- 0.1 N·m)

5	Install the wave washer in Arm3.
6	Temporarily install the J3 Reduction Gear Unit on the Arm3. A S02: 16-M3x22 and washer
7	Center the J3 Reduction Gear.
	1. Rotate the wave generator shaft 10 turns in either the left or right direction.
	2. Fully tighten the J3 Reduction Gear Unit. A S02: 16-M3x22 and washer (2.4 +/- 0.1 N· m)
8	Install the Arm2 side arm. Perform steps (10) through (16) in Installing the J2 Reduction Gear.
9	Install the Arm3 cable fixing plate2 inside Arm3. A S01: 2-M4x8 (4.0 +/- 0.2 N·m)
10	Install the gyro board 2 fixing plate. Perform steps (2) and (3) in Installing Gyro Board 2.
11	Install the J4 Motor unit. Perform steps (3) through (7) in Installing the J4 Brake.
12	After assembly, perform calibration of the joints 2 to 6. 3.2 Calibration

Joint #3

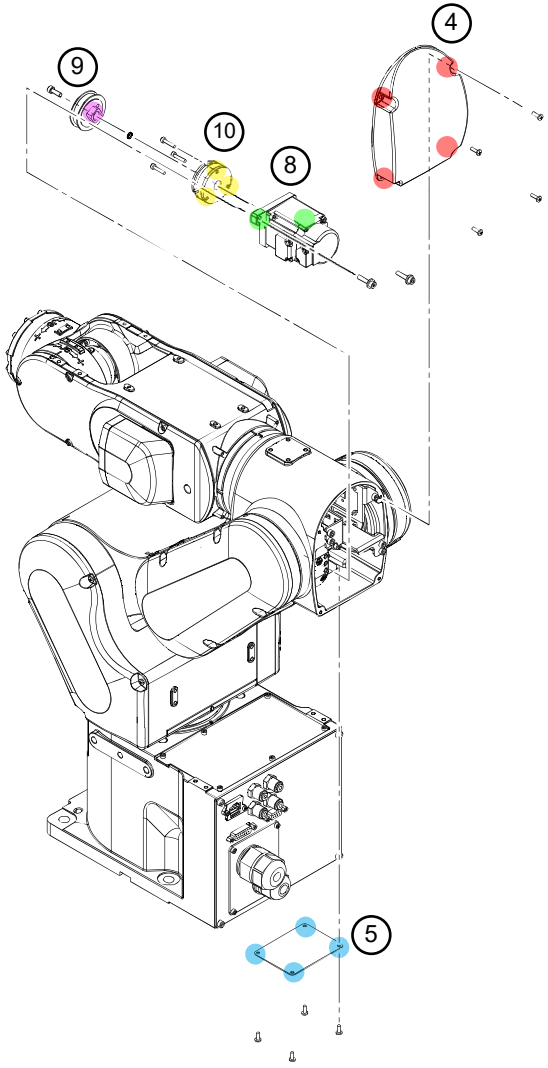
2.4 Joint #4

2.4.1 Replacing the J4 Brake



Joint #4

Removing the J4 Brake



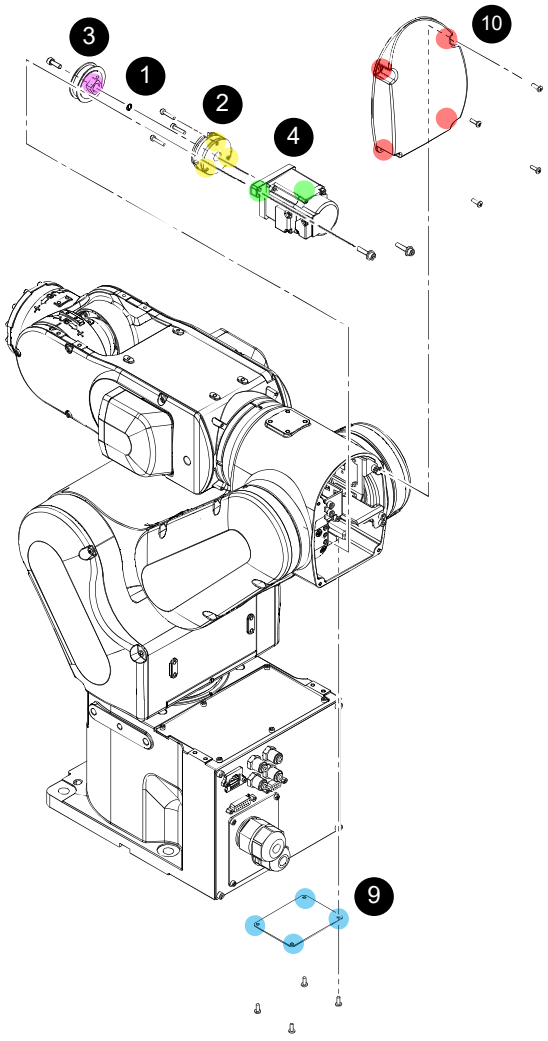
1	Turn ON the controller.
2	Release the J3 brake, manually push and move Arm3, and push it against Arm2. **POINT** At this time, place cushioning between arms to prevent damage to them. **CAUTION** • Arm3 falls by its weight when the J3 Motor unit is removed. Release the brake and tilt Arm3 in advance. • 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 Arm3 head cover.
5	Remove the Arm3 maintenance cover.
6	Disconnect the ground wires (FB08, PE10, PE11) from the Arm3.
7	Disconnect the J4 Motor connectors (CN141, CN341) and the brake connector (CR440).
8	Remove the J4 Motor unit from the Arm3. A S01: 2-M4x18 and washer

Joint #4

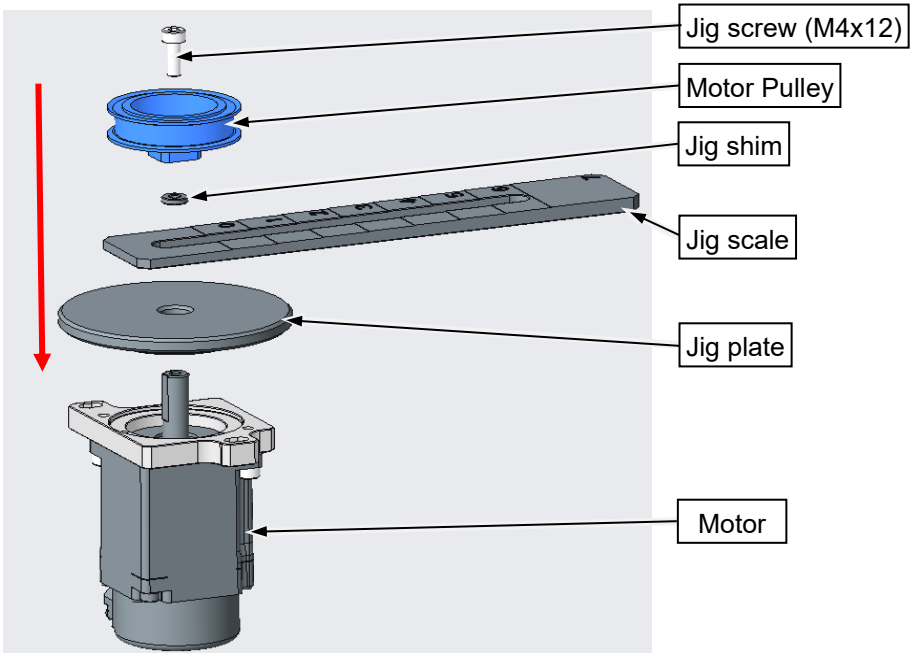
9	Remove the motor pulley from the J4 Motor. **POINT** Remove the screws while pressing the brake against the Motor pulley to prevent it from rotating. **CAUTION** A shim is inserted between the motor pulley and motor shaft. Be careful not to lose it. A S01: 1-M4x12
10	Remove the J4 brake from the J4 Motor. A S01: 3-M3x15

Joint #4

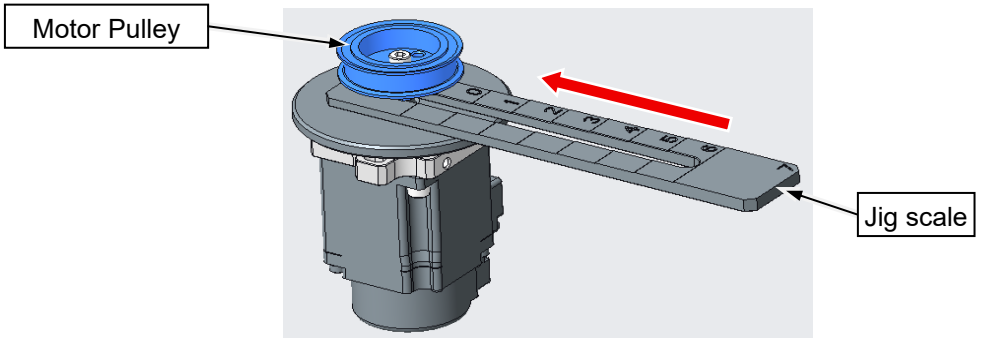
Installing the J4 Brake



Joint #4

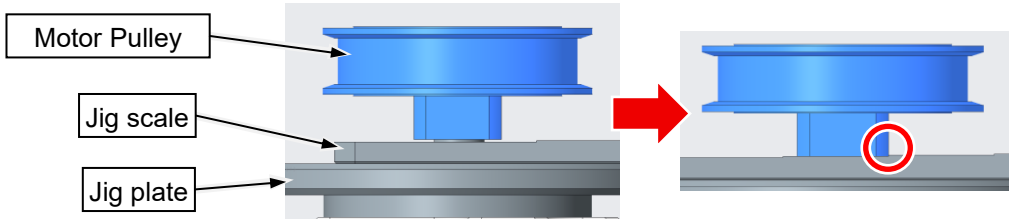
1	Attach the shim to the motor pulley. **POINT** Perform a measurement with the J4/J5/J6 shim adjustment jigs to determine which shim to attach to the motor pulley.
	1. Attach the jig shim to the motor pulley.
	2. In the order shown in the figure, pass the jig plate and jig scale over the motor shaft and place them on the motor plate. **POINT** • Pass the end of the jig scale with the 0 marking over the shaft. • Place the jig scale horizontally on the jig plate and make sure it is in good contact.
	3. Secure the motor pulley to the shaft with the jig screw. **POINT** Tighten the jig screw until it contacts the motor shaft. 

4. Slide the jig scale toward the shaft until it makes contact with the motor pulley.



POINT

The jig scale has a series of steps that make contact with the motor pulley when it is slid. The scale marking at the point of contact determines which shim to attach to the motor pulley.

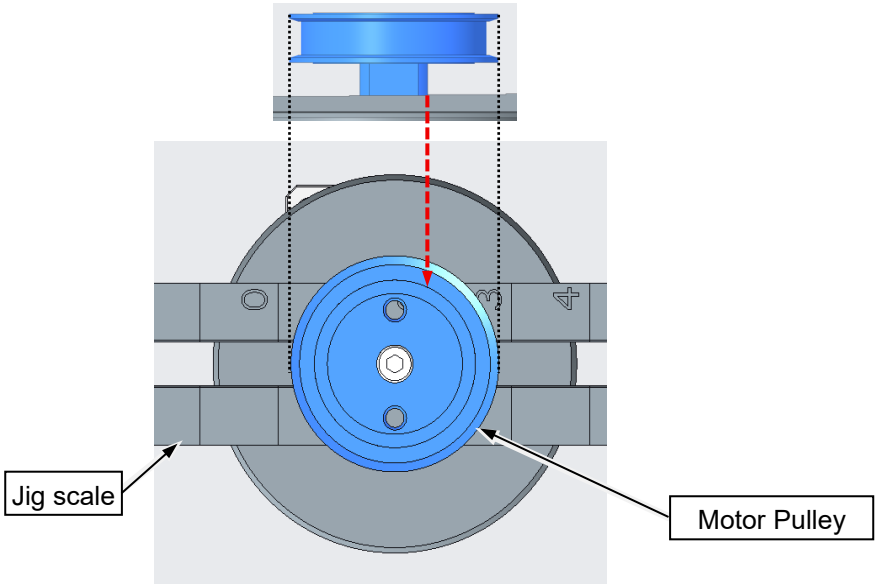


Joint #4

5. Read the jig scale marking from directly above.

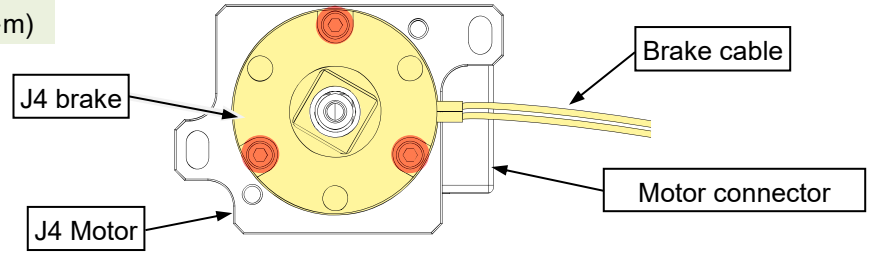
POINT

In the case of the figure below, use the shim “SIM,ADJUST,M4,t06,N054(1961529)” at jig scale marking 3.

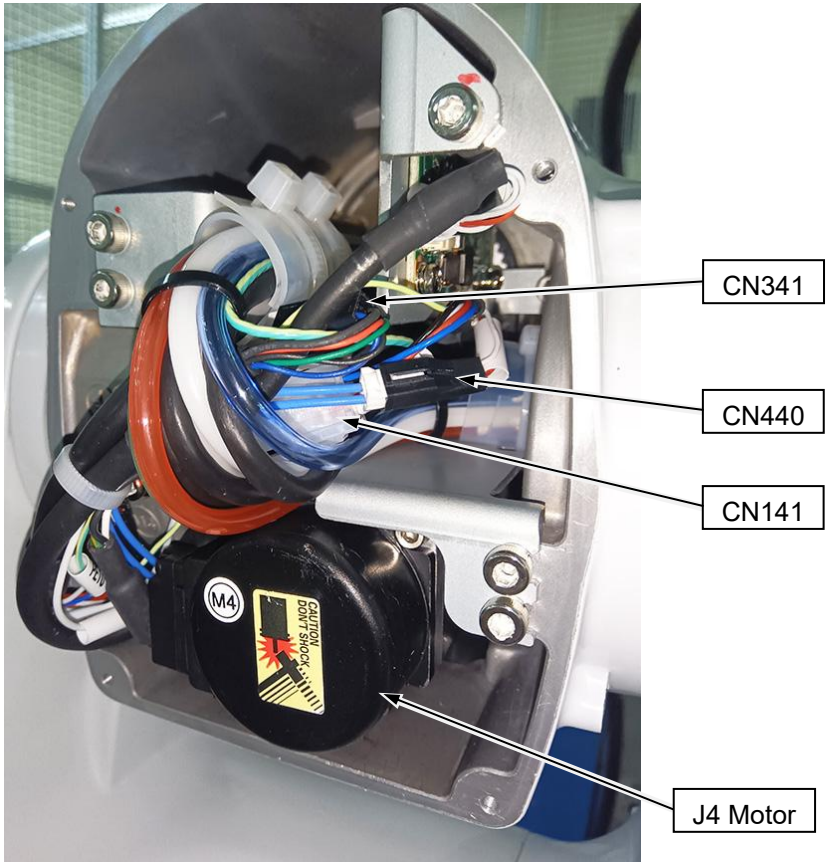


Jig scale marking	Shim to use
0	Process error (please contact the supplier)
1	SIM,ADJUST,M4,t04,N054(1961528) *1 SIM,ADJUST,M4,t06,N054(1961529) *1
2	SIM,ADJUST,M4,t02,N054(1961527) *1 SIM,ADJUST,M4,t06,N054(1961529) *1
3	SIM,ADJUST,M4,t06,N054(1961529) *1
4	SIM,ADJUST,M4,t04,N054(1961528) *1
5	SIM,ADJUST,M4,t02,N054(1961527) *1
6	Do not use shims
7	Process error (please contact the supplier)

Joint #4

	6. Remove the jig screw and remove the motor pulley and jigs from the motor. 7. Attach the specified shim to the motor pulley.
2	Install the J4 brake to the J4 Motor. **POINT** Install the J4 brake to the J4 Motor in the orientation shown in the figure. A S01: 3-M3x15 (2.0 +/- 0.1 N·m) 
3	Install the motor pulley on the J4 Motor. **POINT** • Make sure that a shim is attached to the motor pulley. • Align the motor pulley with the brake disc and install the motor pulley on the motor shaft. If they are misaligned, adjust the brake disc position. • Apply Loctite 243 to the screw. • Tighten the screws while pressing the brake against the motor pulley to prevent it rotating. • After tightening the screw, allow it to sit for about 15 minutes to let the Loctite dry. A S01: 1-M4x12 (4.0 +/- 0.2 N·m)
4	Insert the J4 Motor unit in the Arm3, and attach the J4 timing belt to the motor pulley.

Joint #4

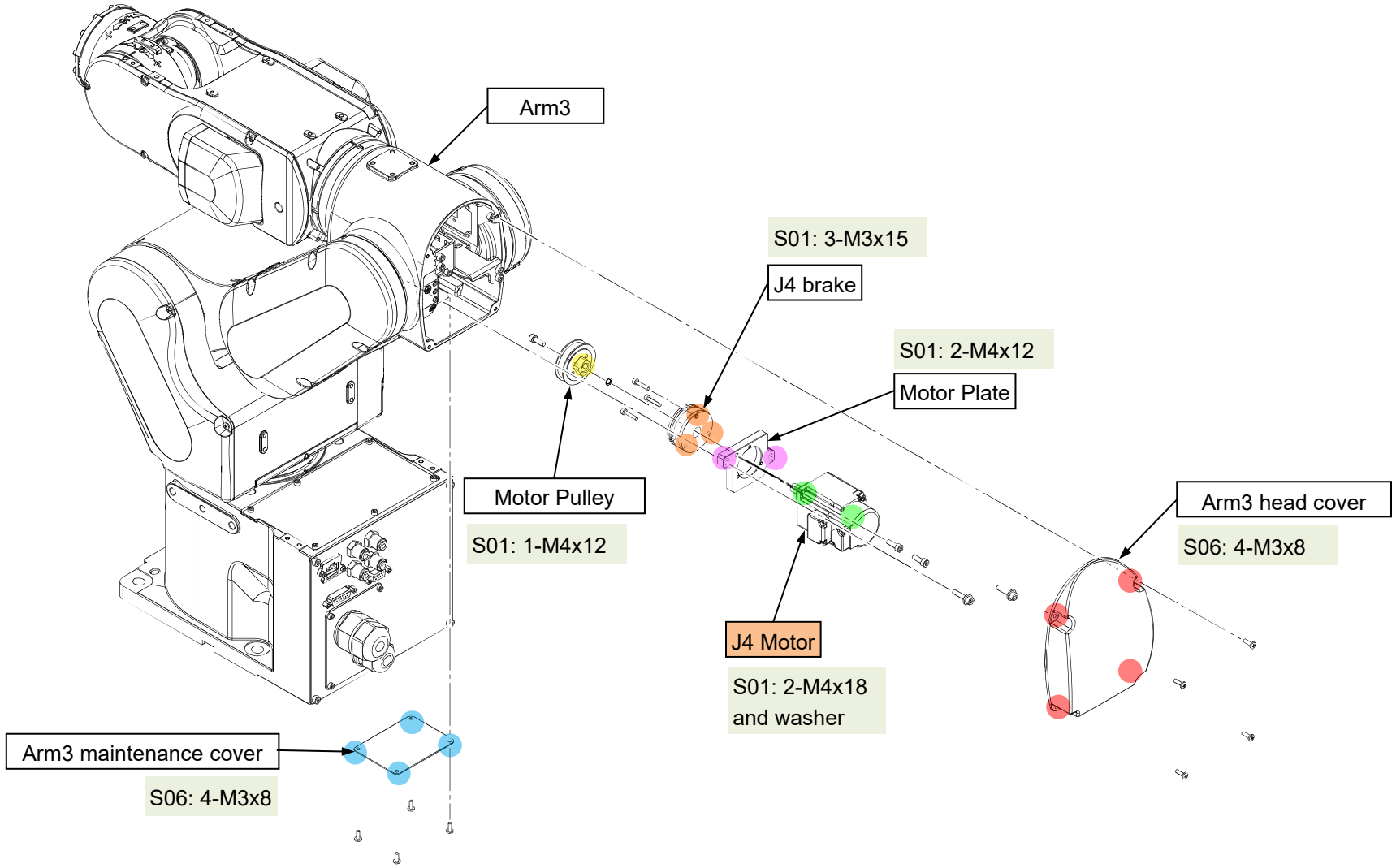
5	Temporarily secure the J4 Motor unit to the Arm3. A S01: 2-M4x18 and washer
6	Perform the Belt Tension Adjustment for the J4 timing belt.
7	Connect the J4 Motor unit connectors (CN141, CN341) and the J4 brake connector (CN440). 

Joint #4

8	Connect the ground wires (FB08, PE10, PE11) to the Arm3.
9	Install the Arm3 maintenance cover.
10	Install the Arm3 head cover.
11	After assembly, perform calibration of Joint #4. 3.2 Calibration

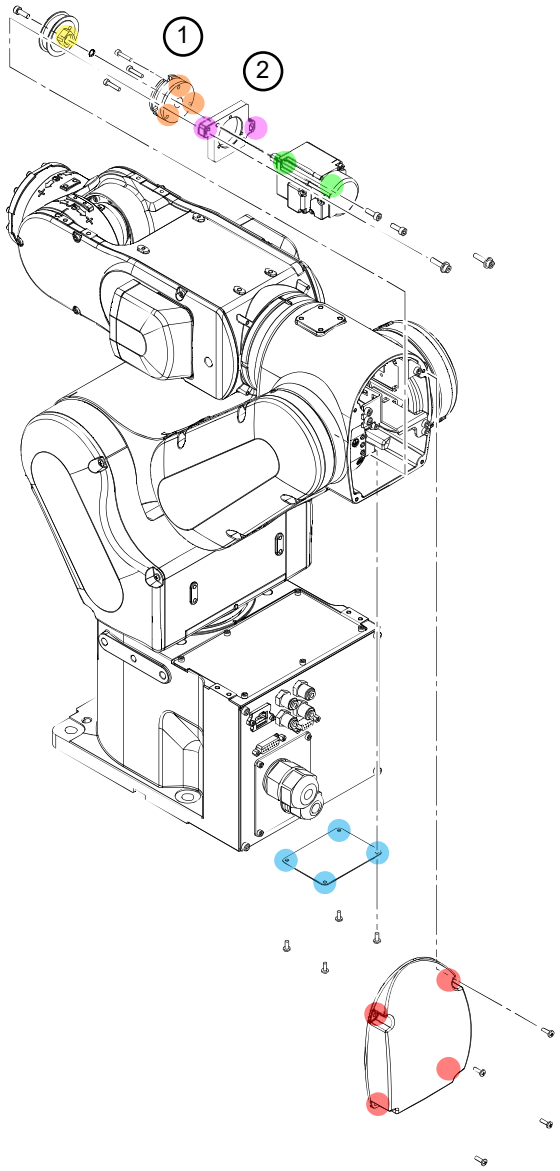
Joint #4

2.4.2 Replacing the J4 Motor



Joint #4

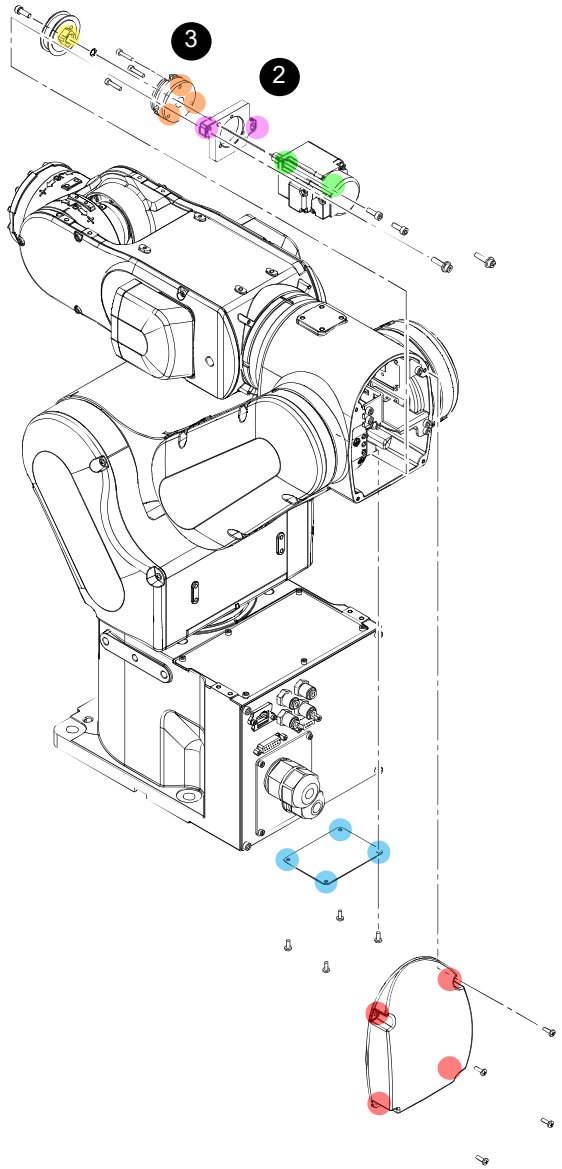
Removing the J4 Motor

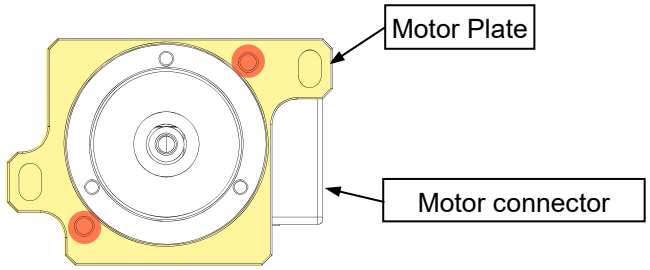


1	Remove the J4 brake.
2	Remove the motor plate from the J4 Motor. A S01: 2-M4x12

Joint #4

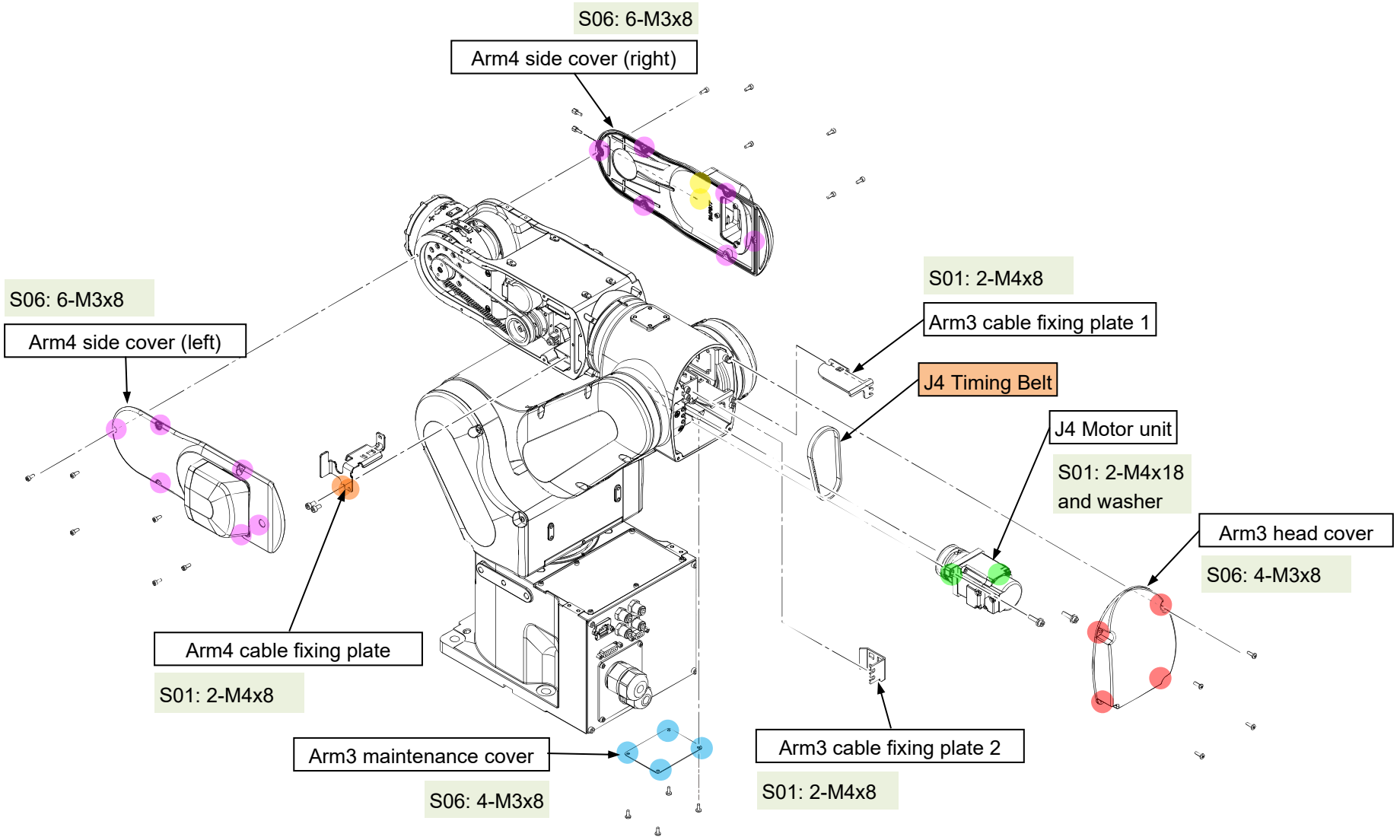
Installing the J4 Motor



1	Attach connector labels to the J4 Motor. **POINT** A new motor comes with the connector labels. Attach the labels near the connectors. Refer to the old motor.
2	Install the motor plate on the J4 Motor. **POINT** Install with the orientation shown in the figure. A S01: 2-M4x12 (4.0 +/- 0.2 N·m) 
3	Install the J4 brake.

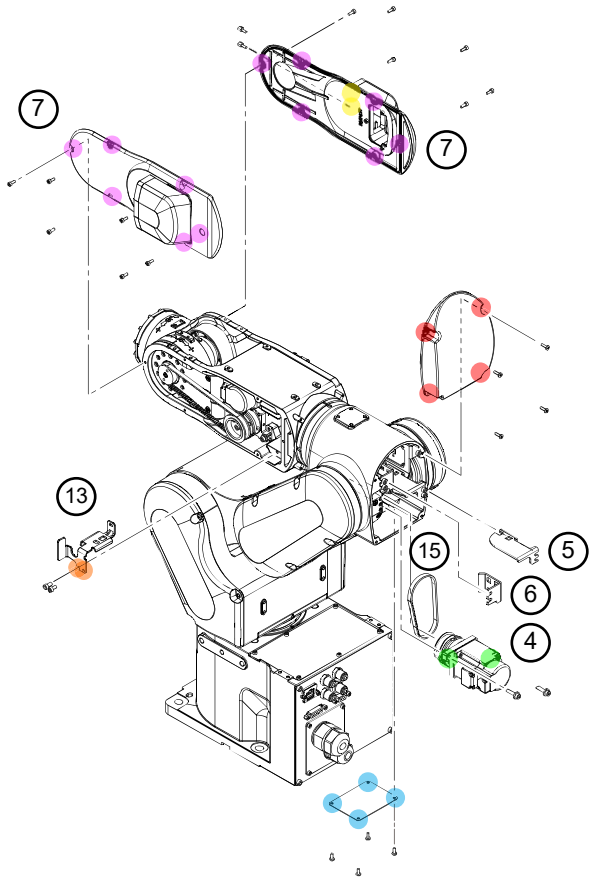
Joint #4

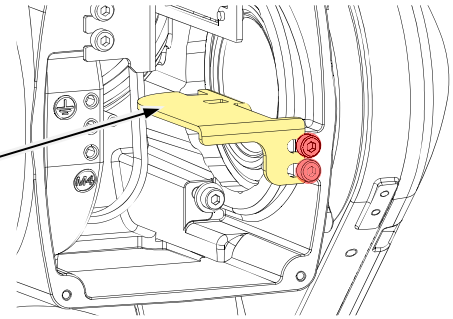
2.4.3 Replacing the J4 Timing Belt



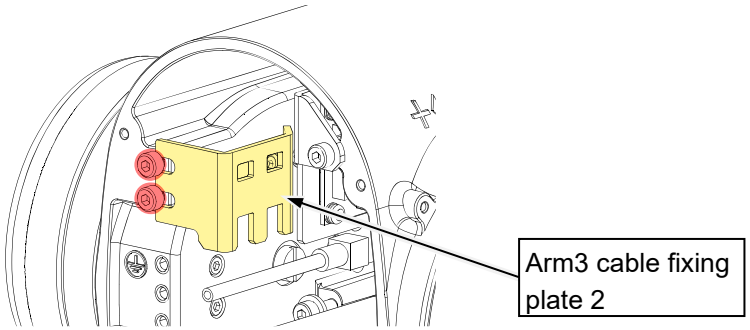
Joint #4

Removing the J4 Timing Belt



1	Turn ON the controller.
2	Release the J3 brake, manually push and move Arm3, and push it against Arm2. **POINT** At this time, place cushioning between arms to prevent damage to them. **CAUTION** • 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 J4 Motor unit from the Arm3. Perform steps (4) through (8) in Removing the J4 Brake.
5	Remove the Arm3 cable fixing plate1 from the Arm3. **POINT** Loosen the screws securing the cable fixing plate, and slide the plate to remove it. A S01: 2-M4x8 Arm3 cable fixing plate 1 

Joint #4

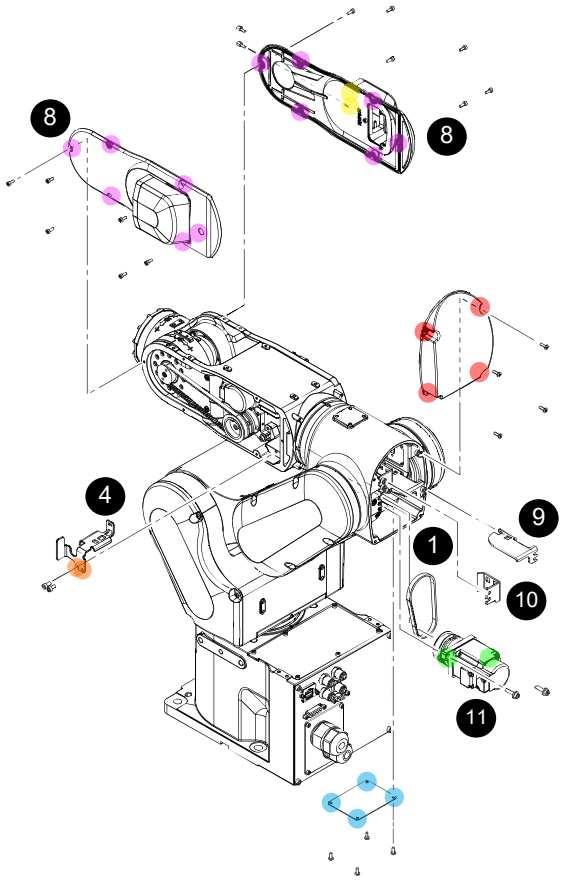
6	Remove the Arm3 cable fixing plate2 from the Arm3. **POINT** Loosen the screws securing the cable fixing plate, and slide the plate to remove it. A S01: 2-M4x8 
7	Remove the Arm4 side cover (both sides).
8	Disconnect the ground wires (FB10, PE12) from the Arm4.
9	Disconnect the J5 Motor connector (CN151) and the J6 Motor connector (CN161).
10	Disconnect the following connectors from the multi-drop board 3. CN11-M3, CN31-M3
11	Protect the connectors with masking tape or similar. **POINT** This protects connector clips from breaking and adherence of grease during subsequent work.
12	Loosen the screws securing the Arm4 cable fixing plate inside Arm4. A S01: 2-M4x8
13	Cut the wire ties bundling the cables, and remove the Arm4 cable fixing plate from the cable unit.
14	Pull the cables from the Arm4 side to the Arm3 side.

Joint #4

15	Remove the J4 timing belt from the Arm3.

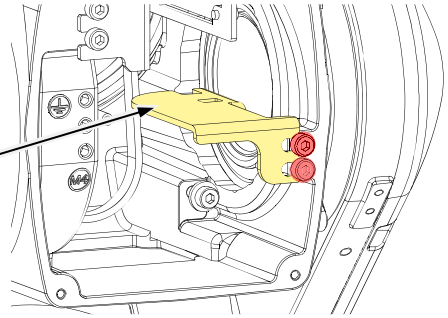
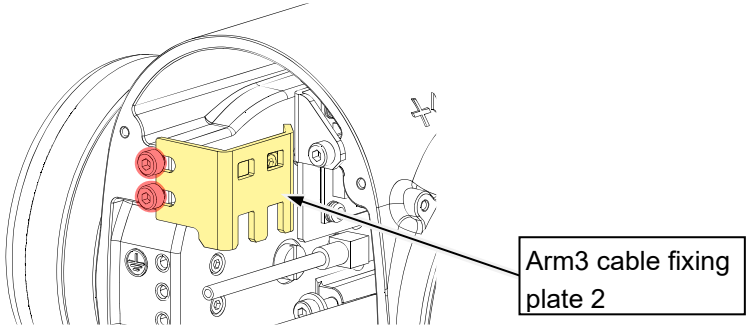
Joint #4

Installing the J4 Timing Belt



1	Set the J4 Timing Belt on the Reduction Gear pulley.
2	Pull the Cable Unit to the Arm4 side.
3	Secure the cables pulled out to the Arm4 side to the Arm4 cable fixing plate. **POINT** Wrap the cables with the silicone sheet and secure the cables by putting the wire ties through the hole in the Arm4 cable fixing plate.
4	Secure the Arm4 cable fixing plate to the Arm4. A S01: 2-M4x8 (4.0 +/- 0.2 N·m)
5	Connect the following connectors to the multi-drop board 3. CN11-M3, CN31-M3
6	Connect the J5 Motor connector (CN151) and the J6 Motor connector (CN161).
7	Connect the ground wires (FB10, PE12) to the Arm4.
8	Install the Arm4 side cover (both sides).

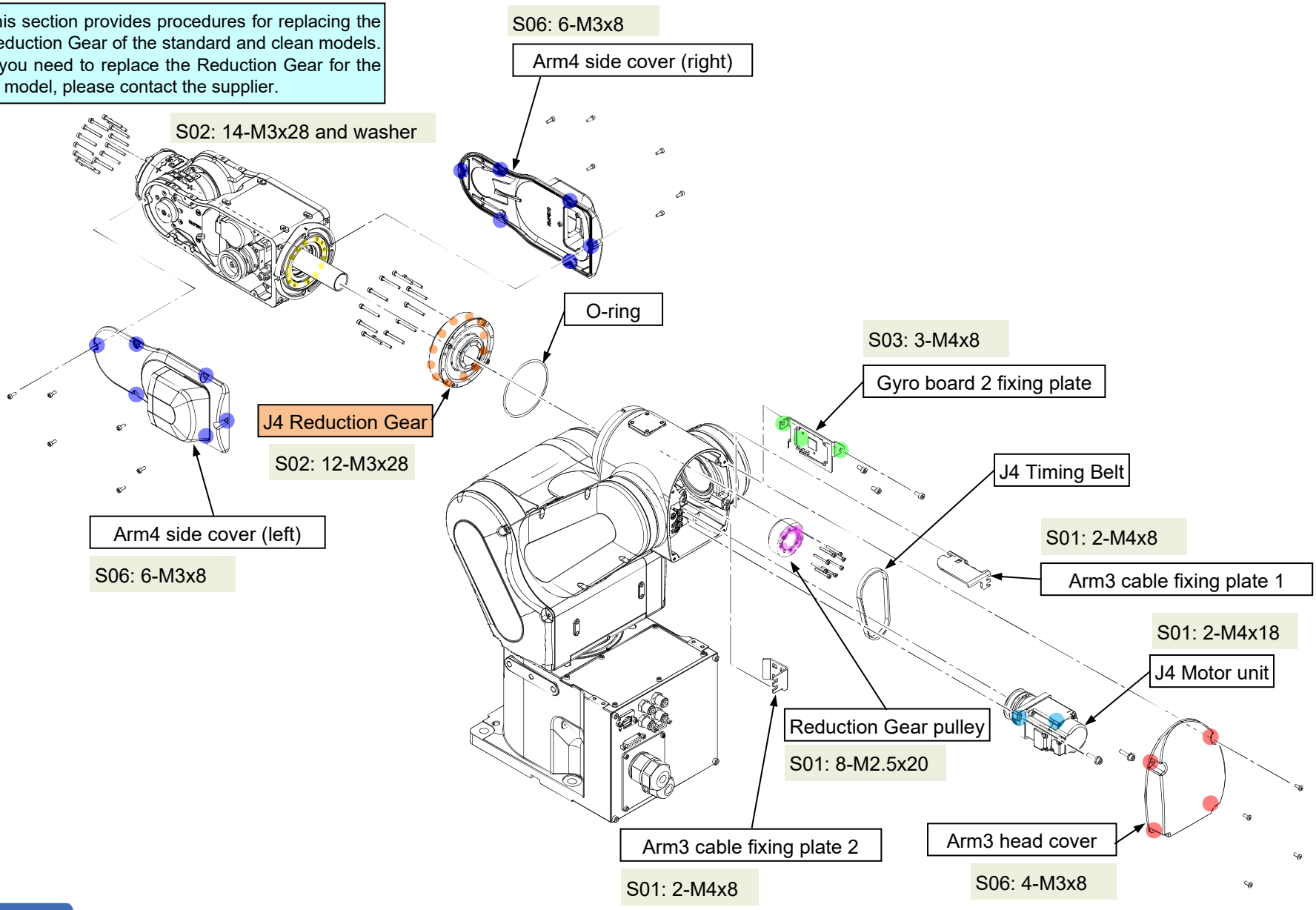
Joint #4

9	Install the cable fixing plate1 to the Arm3. **POINT** Slide the cutout section on the cable fixing plate to install it. A S01: 2-M4x8 (4.0 +/- 0.2 N·m) Arm3 cable fixing plate 1 
10	Install the cable fixing plate2 to the Arm3. **POINT** Slide the cutout section on the cable fixing plate to install it. A S01: 2-M4x8 (4.0 +/- 0.2 N·m)  Arm3 cable fixing plate 2
11	Install the J4 Motor unit to the Arm3. Perform steps (3) through (9) in Installing the J4 Brake.
12	After assembly, perform calibration of Joint #4. 3.2 Calibration

Joint #4

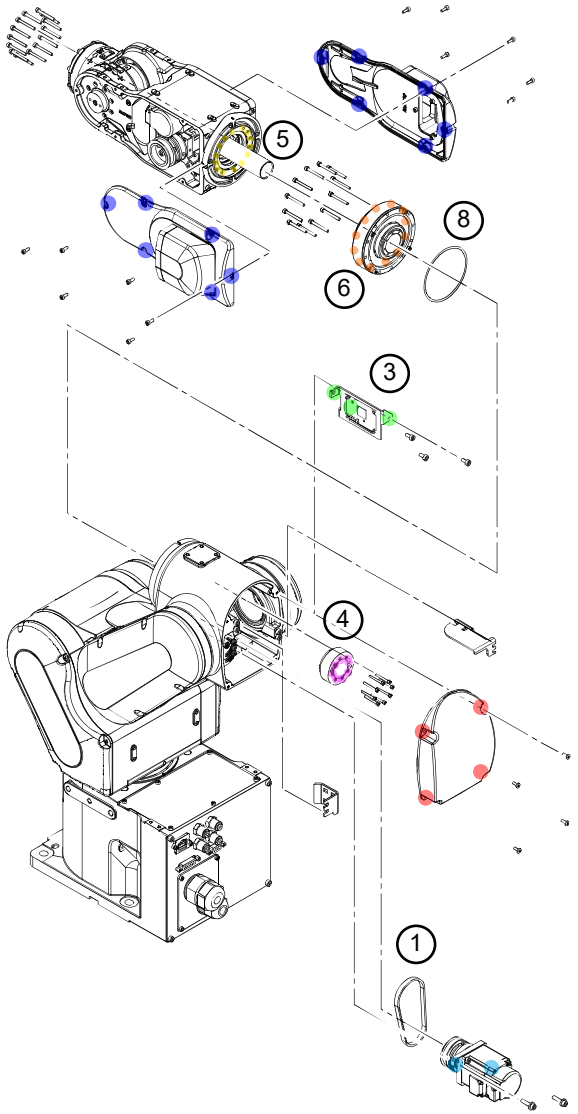
2.4.4 Replacing the J4 Reduction Gear (CX4-A)

This section provides procedures for replacing the Reduction Gear of the standard and clean models. If you need to replace the Reduction Gear for the IP model, please contact the supplier.



Joint #4

Removing the J4 Reduction Gear (CX4-A)



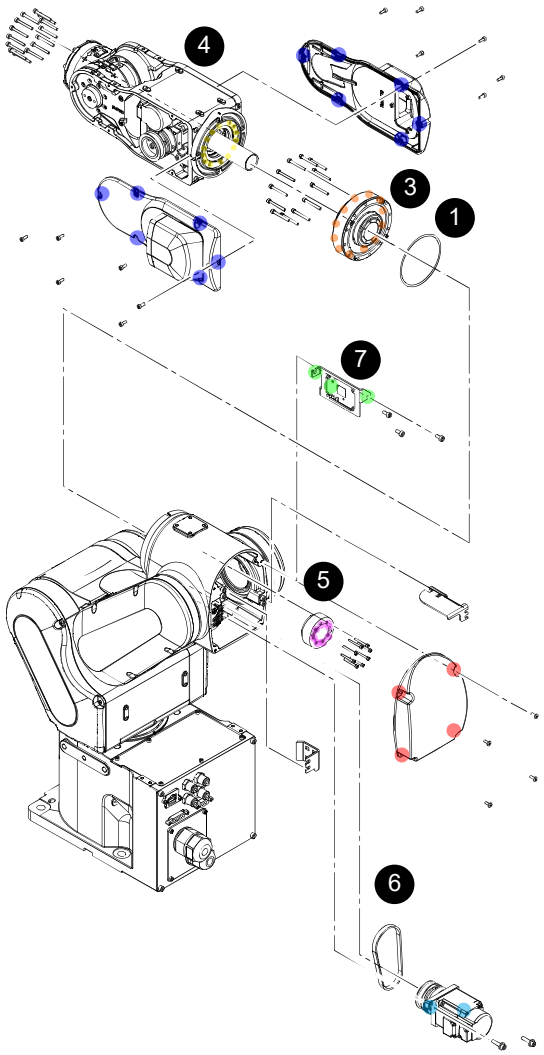
1	Remove the J4 Timing Belt.
2	Disconnect the connector (CN3) of gyro board 2 inside the Arm3.
3	Remove the gyro board 2 fixing plate from the Arm3. A S03: 3-M4x8
4	Remove the Reduction Gear pulley. **POINT** Hang the timing belt on the pulley and remove the screws while holding the pulley so that the it does not rotate. A S01: 8-M2.5x20
5	Remove the bolts securing the Arm4 and J4 Reduction Gear Unit, and remove the Arm4. **WARNING** When these bolts are removed, Arm4, Arm5, and Arm6 (tip) will come off. 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. A S02: 14-M3x28 and washer

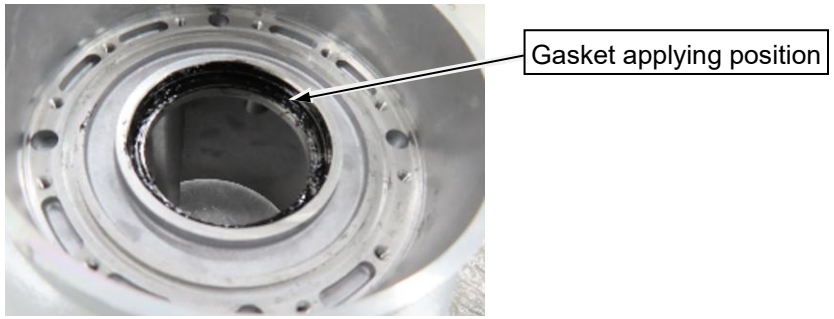
Joint #4

6	Remove the bolts securing the J4 Reduction Gear Unit to the Arm3, and remove the J4 Reduction Gear Unit. **CAUTION** Some bearings are secured to Arm3 by a gasket. When removing the J4 Reduction Gear Unit, be careful not to damage other parts. A S02: 12-M3x28
7	Remove the gasket attached to Arm3.
8	Remove the O-ring from Arm3. **POINT** Reuse the O-ring during installation. Store it and do not dispose of it.

Joint #4

Installing the J4 Reduction Gear (CX4-A)



1	Apply a thin layer of grease to the O-ring and install the O-ring on the Arm3. **CAUTION** Be careful not to damage the O-ring and fit it properly in the groove.
2	Apply the gasket to the position where the Arm3 bearing will be assembled. 
3	Install the J4 Reduction Gear Unit on the Arm3. A S02: 12-M3x28 (2.4 +/- 0.1 N·m)
4	Install the Arm4 on the J4 Reduction Gear Unit. **CAUTION** 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. A S02: 14-M3x28 and washer (2.4 +/- 0.1 N·m)

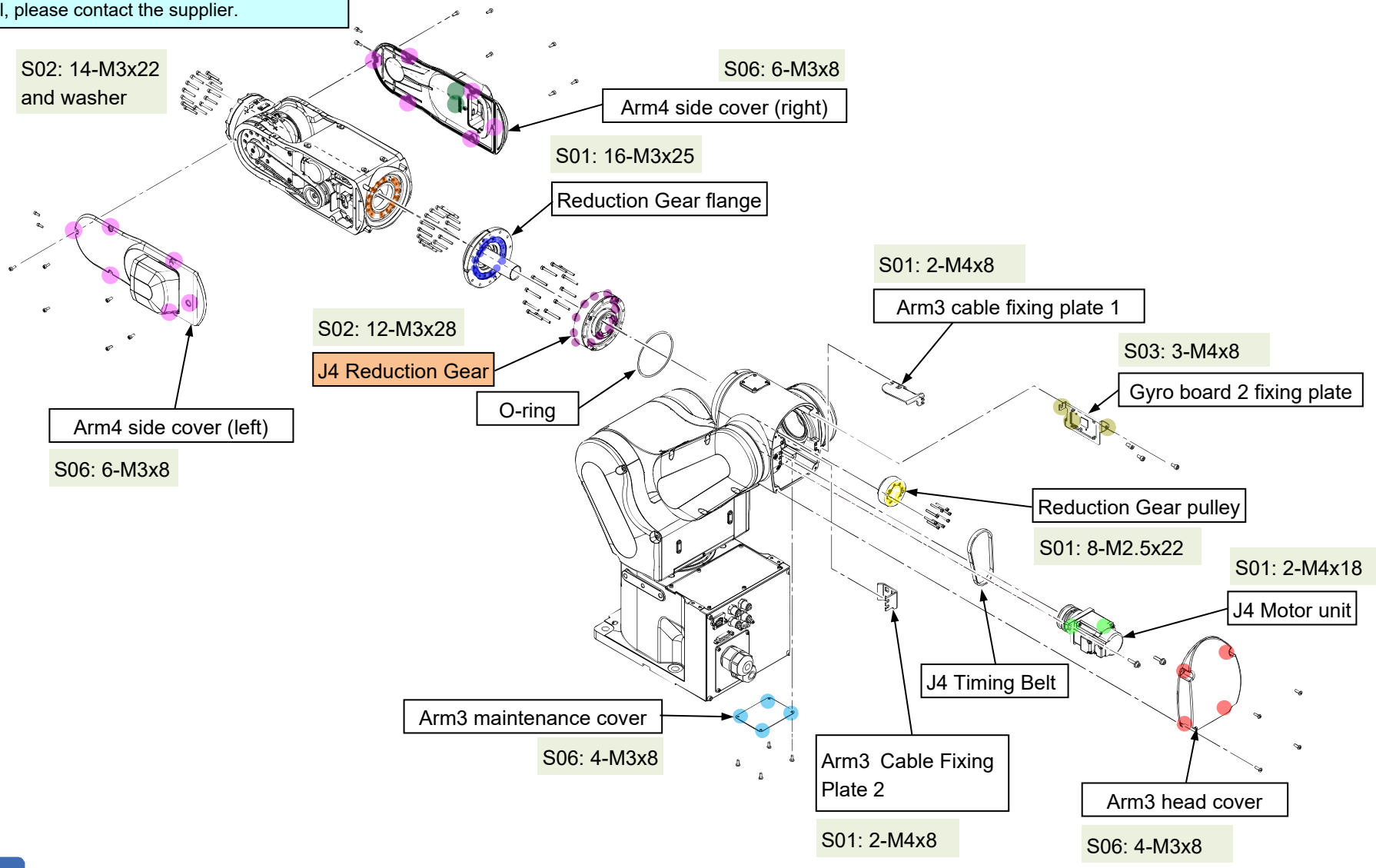
Joint #4

5	Attach the Arm 3 Reduction Gear pulley. **POINT** Hang the timing belt on the pulley and remove the screws while holding the pulley so that the it does not rotate. A S01: 8-M2.5x20 (1.0 +/- 0.1 N·m)
6	Install the J4 Timing Belt. Perform the steps from the first step to step (11) in Installing the J4 Timing Belt.
7	Install the gyro board 2 fixing plate on Arm3. A S03: 2-M4x8 (0.45 +/- 0.1 N·m)
8	Connect the connector (CN3) of the gyro board 2.
9	Leave it for at least 4 hours until the gasket is completely dry.
10	After assembly, perform calibration of Joint #4. 3.2 Calibration

Joint #4

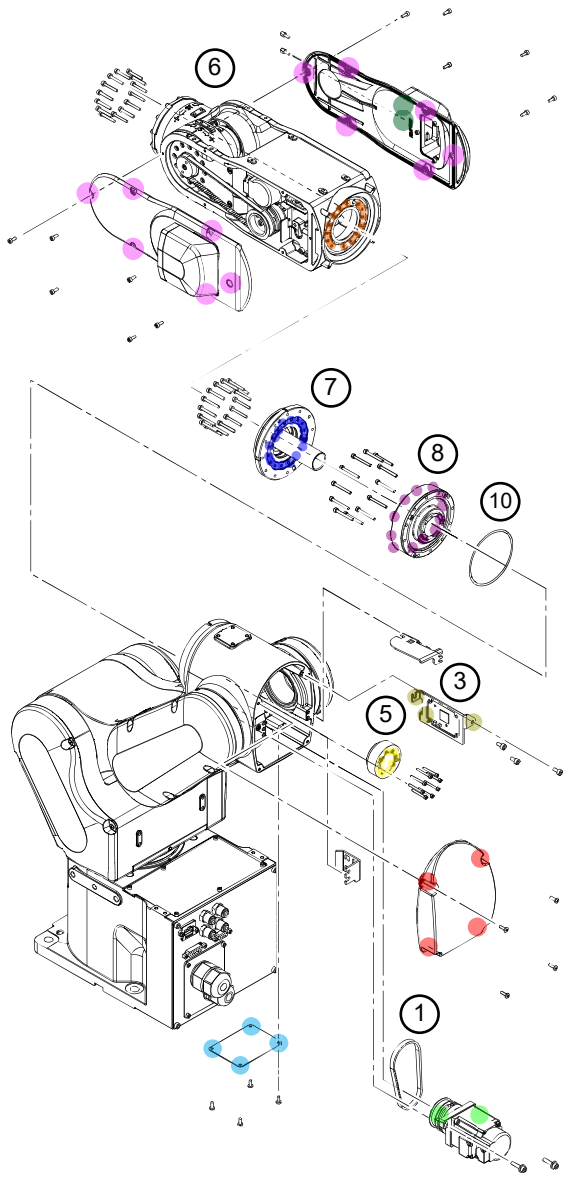
2.4.5 Replacing the J4 Reduction Gear (CX7-A)

This section provides procedures for replacing the Reduction Gear of the standard and clean models. If you need to replace the Reduction Gear for the IP model, please contact the supplier.



Joint #4

Removing the J4 Reduction Gear (CX7-A)



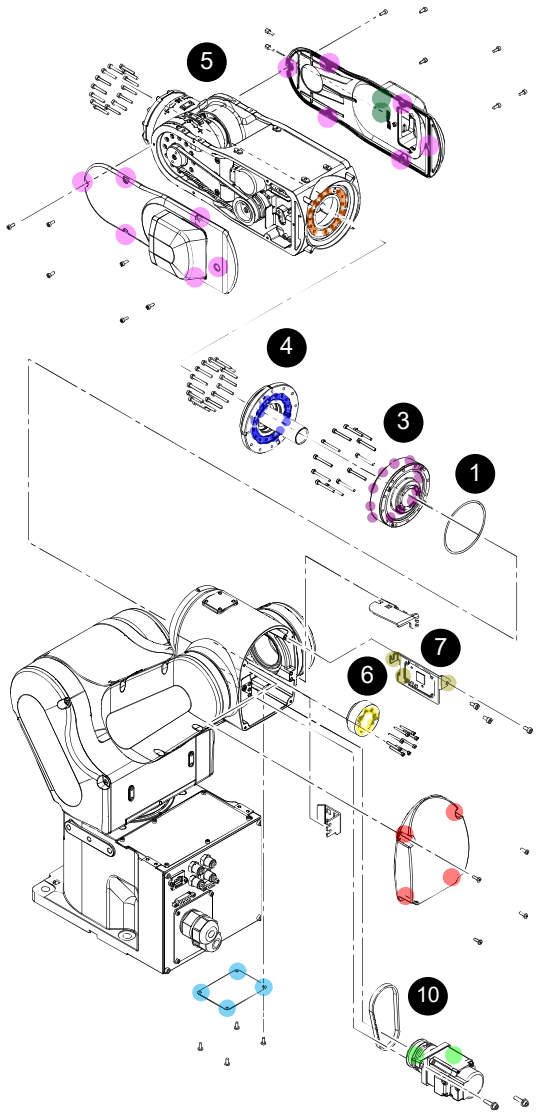
1	Remove the J4 Timing Belt.
2	Disconnect the connector (CN3) of gyro board 2 inside the Arm3.
3	Remove the gyro board 2 fixing plate from the Arm3. A S03: 3-M4x8
4	Remove the screws securing the Reduction Gear pulley to the Arm3. **POINT** Hang the timing belt on the pulley and remove the screws while holding the pulley so that the it does not rotate. A S01: 8-M2.5x22
5	Remove the Reduction Gear pulley from Arm3.
6	Remove the bolts securing the Arm4 to the Reduction Gear flange, and remove the Arm4. **WARNING** When these bolts are removed, Arm4, Arm5, and Arm6 (tip) will come off. 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. A S02: 14-M3x22 and washer

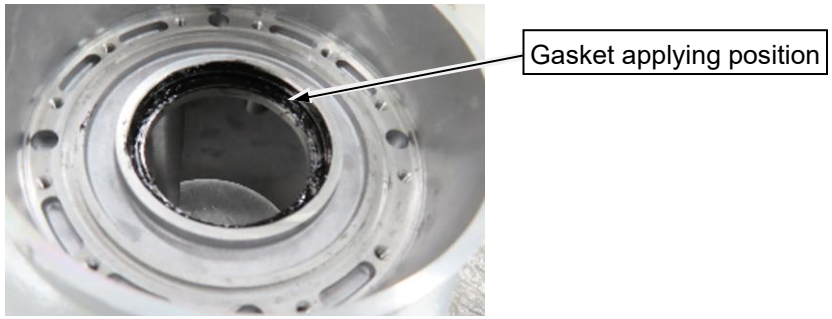
Joint #4

7	Remove the Reduction Gear flange from the J4 Reduction Gear Unit. A S01: 16-M3x25
8	Remove the J4 Reduction Gear Unit from the Arm3. A S02: 12-M3x28
9	Remove the gasket attached to Arm3.
10	Remove the O-ring from Arm3. **POINT** The O-ring will be used again during installation. Store it and do not dispose of it.

Joint #4

Installing the J4 Reduction Gear (CX7-A)



1	Apply a thin layer of grease to the O-ring and install the O-ring on the Arm3. **CAUTION** Be careful not to damage the O-ring and fit it properly in the groove.
2	Apply the gasket to the position where the Arm3 bearing will be assembled. 
3	Install the J4 Reduction Gear Unit on the Arm3. A S02: 12-M3x28 (2.4 +/- 0.1 N·m)
4	Install the Reduction Gear flange on the J4 Reduction Gear Unit. A S01: 16-M3x25 (2.0 +/- 0.1 N·m)

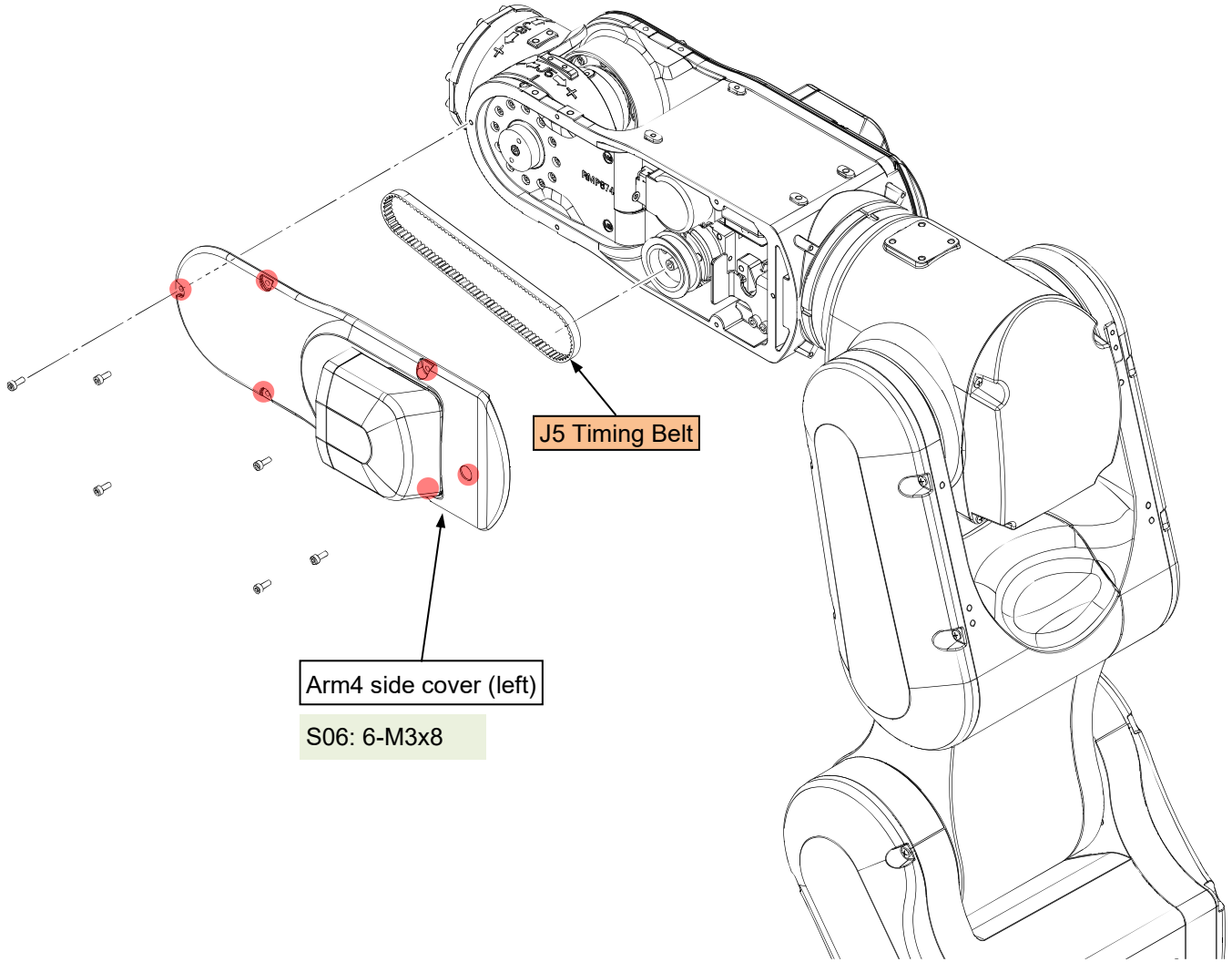
Joint #4

5	Install the Arm4 on the Reduction Gear flange. **CAUTION** 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. A S02: 14-M3x22 and washer (2.4 +/- 0.1 N·m)
6	Attach the Arm 3 Reduction Gear pulley. **POINT** Hang the timing belt on the pulley and remove the screws while holding the pulley so that the it does not rotate. A S01: 8-M2.5x22 (1.0 +/- 0.1 N·m)
7	Install the gyro board 2 fixing plate on Arm3. A S03: 2-M4x8 (0.45 +/- 0.1 N·m)
8	Connect the connector (CN3) of the gyro board 2.
9	Leave it for at least 4 hours until the gasket is completely dry.
10	Install the J4 Timing Belt.
11	After assembly, perform calibration of the joints 4 to 6. 3.2 Calibration

Joint #4

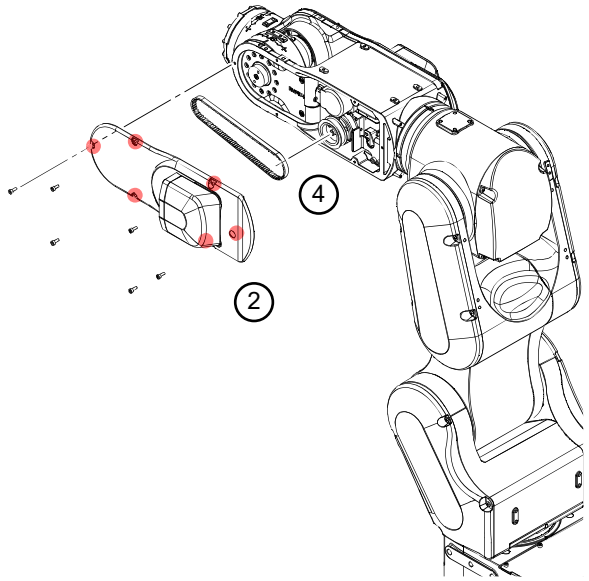
2.5 Joint #5

2.5.1 Replacing the J5 Timing Belt



Joint #5

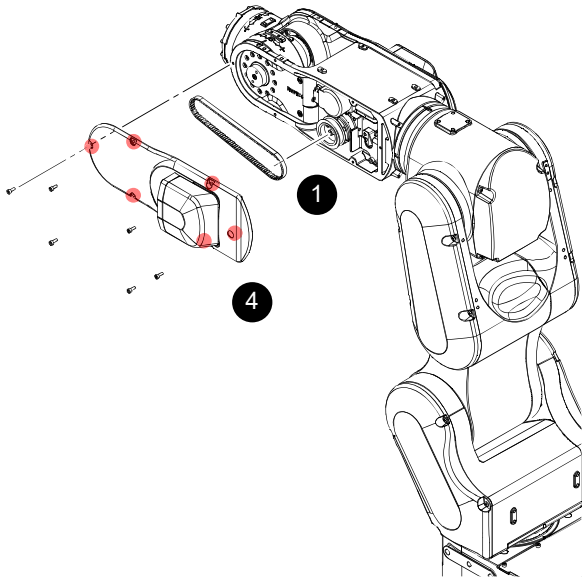
Removing the Timing Belt



1	Turn OFF the Controller.
2	Remove the Arm4 side cover (left).
3	Loosen the screws securing the J5 Motor unit. A S01: 2-M4x18 and washer
4	Remove the J5 Timing Belt. **POINT** First remove the Timing Belt from the Motor pulley, then remove it from the Reduction Gear pulley.

Joint #5

Installing the Timing Belt

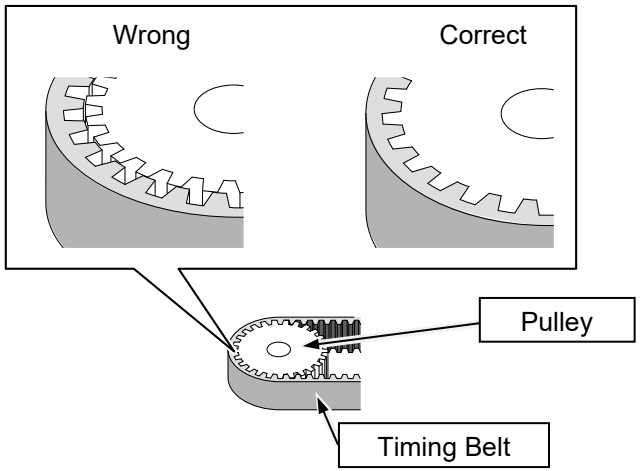


Joint #5

1 Install the J5 Timing Belt.

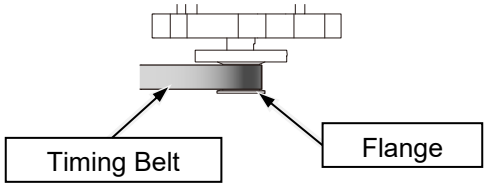
POINT

- First place the belt on the motor pulley.
- 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 Temporarily secure the J5 Motor unit.

A S01: 2-M4x18 and washer

POINT

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

3 Adjust the belt tension.

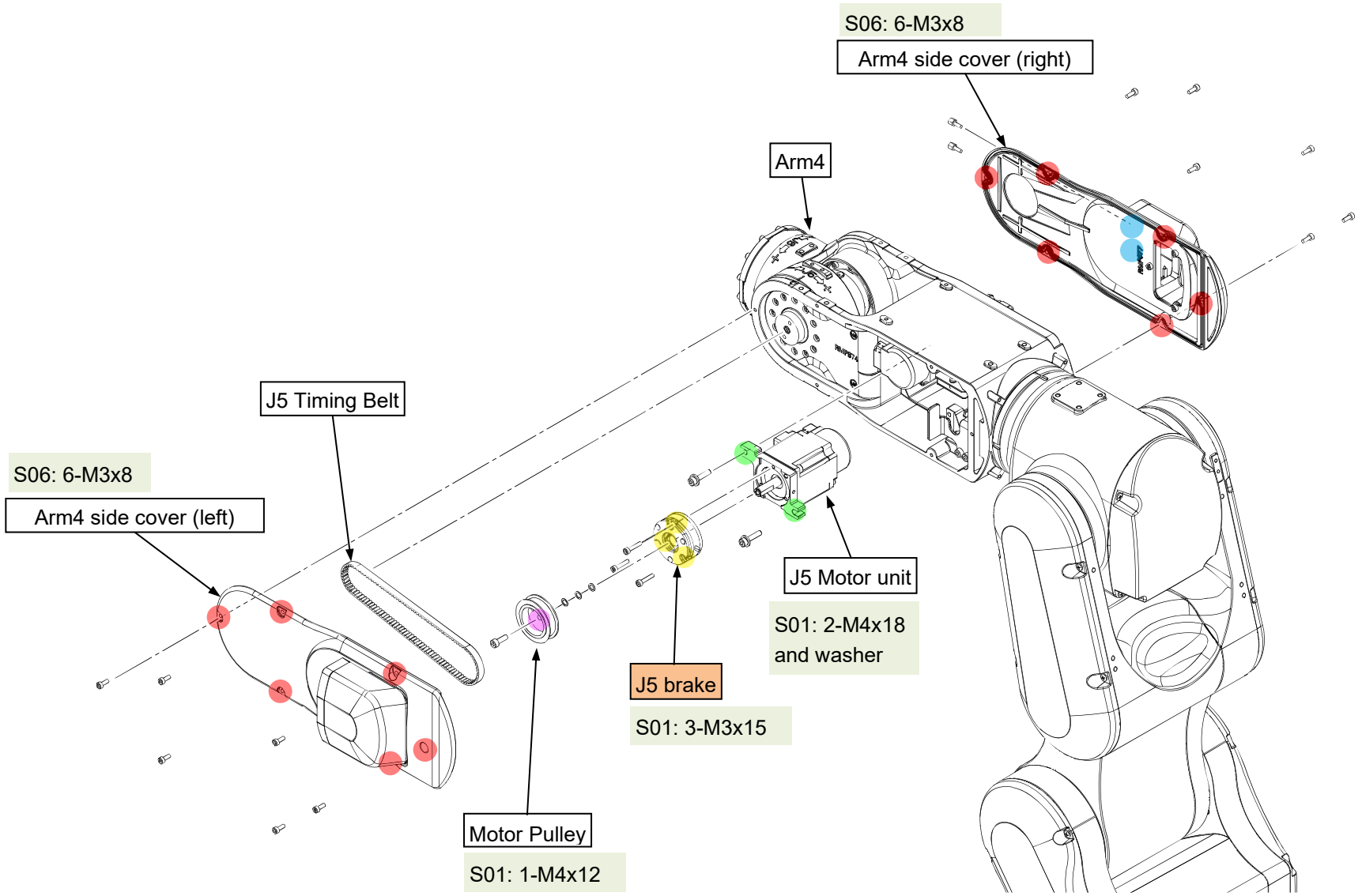
3.1 Adjusting the Timing Belt Tension

4 Install the Arm4 side cover (left).

5	After assembly, perform calibration of Joint #5. 3.2 Calibration

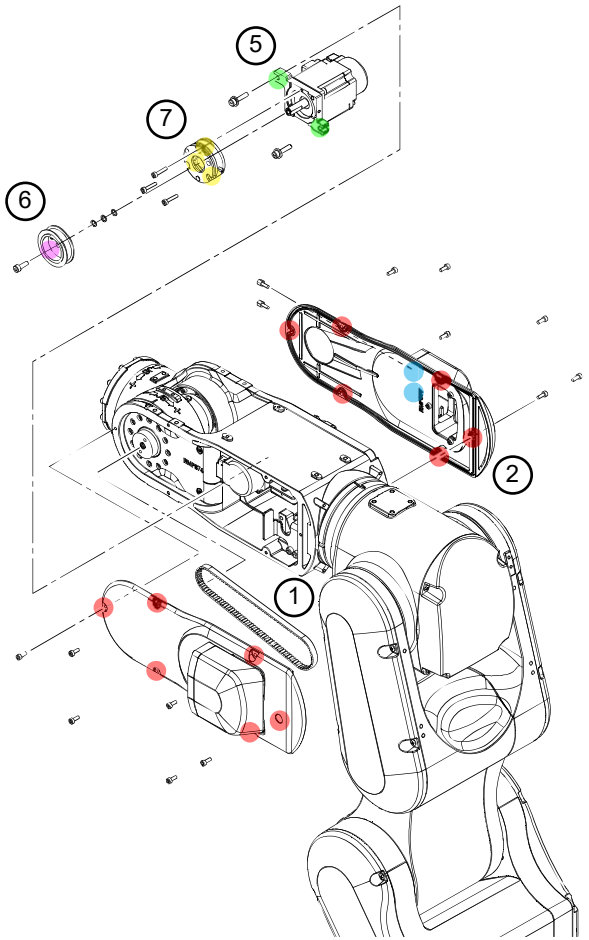
Joint #5

2.5.2 Replacing the J5 Brake



Joint #5

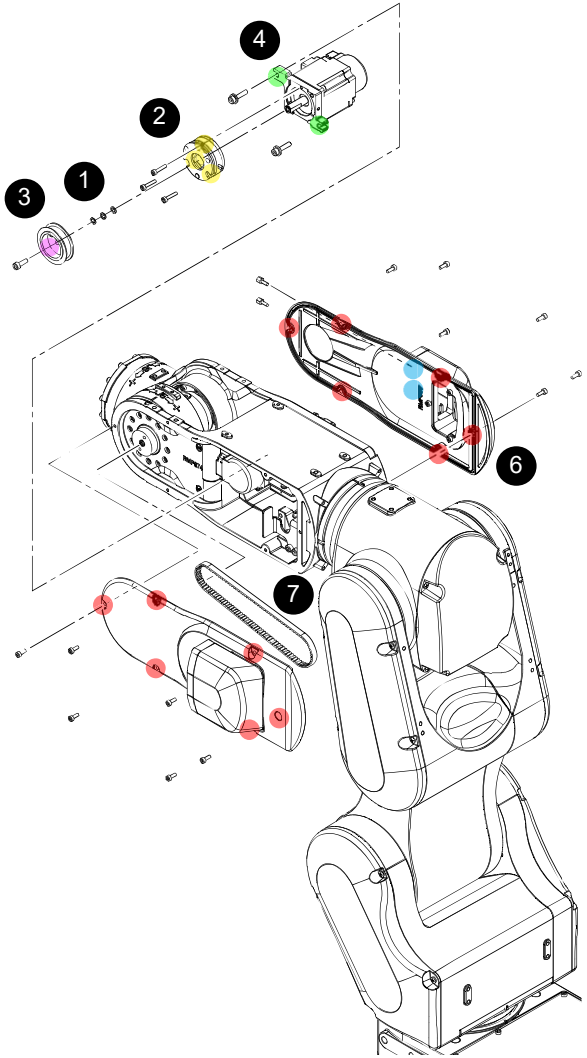
Removing the J5 Brake



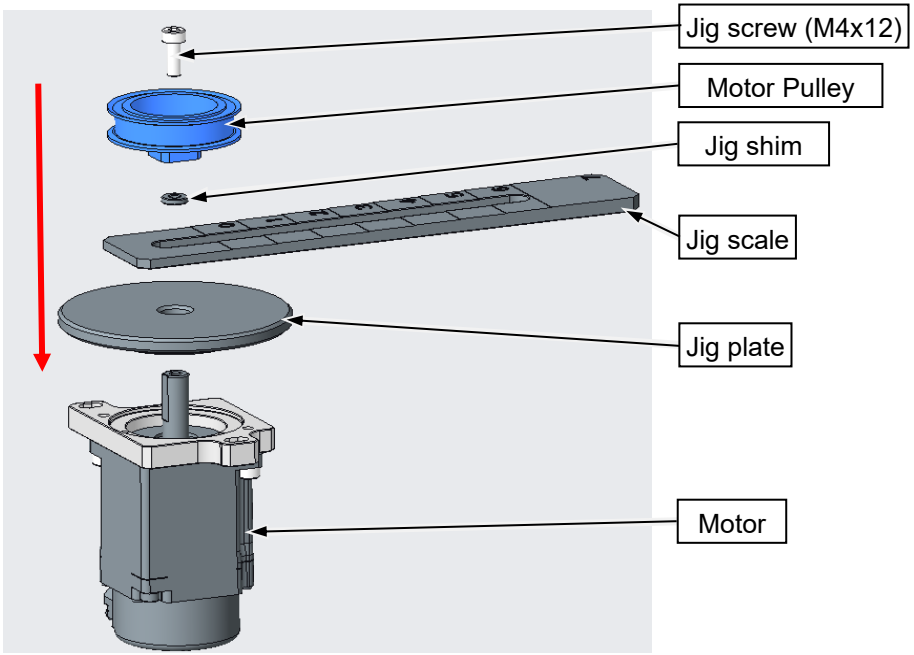
1	Remove the J5 Timing Belt.
2	Remove the Arm4 side cover (right).
3	Disconnect the J5 Motor connectors (BR051, MS05-1, MP05-1).
4	Remove the screws securing the J5 Motor unit to the Arm4. A S01: 2-M4x18 and washer
5	Remove the J5 Motor unit from the Arm4.
6	Remove the motor pulley from the J5 Motor. **POINT** Remove the screws while pressing the brake against the Motor pulley to prevent it from rotating. **CAUTION** A shim is inserted between the motor pulley and motor shaft. Be careful not to lose it. A S01: 1-M4x12
7	Remove the J5 brake from the motor plate. A S01: 3-M3x15

Joint #5

Installing the J5 Brake

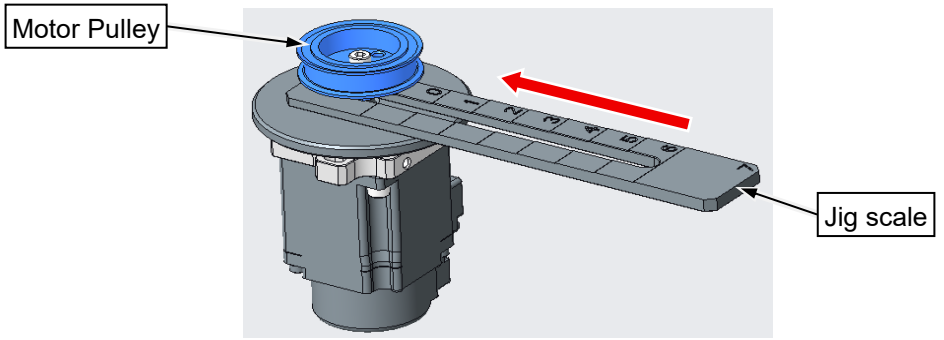


1	Attach the shim to the motor pulley. **POINT** Perform a measurement with the J4/J5/J6 shim adjustment jigs to determine which shim to attach to the motor pulley.
	1. Attach the jig shim to the motor pulley.
	2. In the order shown in the figure, pass the jig plate and jig scale over the motor shaft and place them on the motor plate. **POINT** • Pass the end of the jig scale with the 0 marking over the shaft. • Place the jig scale horizontally on the jig plate and make sure it is in good contact.
	3. Secure the motor pulley to the shaft with the jig screw. **POINT** Tighten the jig screw until it contacts the motor shaft.



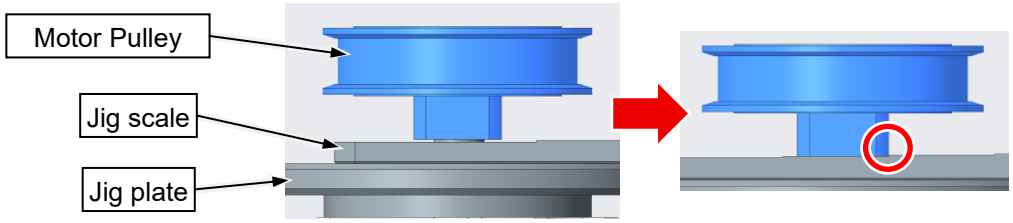
Joint #5

4. Slide the jig scale toward the shaft until it makes contact with the motor pulley.



POINT

The jig scale has a series of steps that make contact with the motor pulley when it is slid. The scale marking at the point of contact determines which shim to attach to the motor pulley.

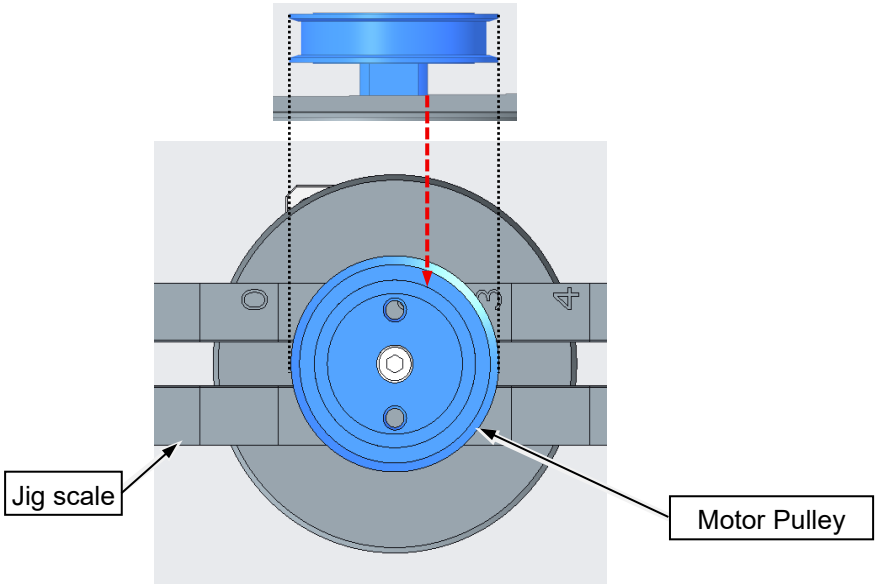


Joint #5

5. Read the jig scale marking from directly above.

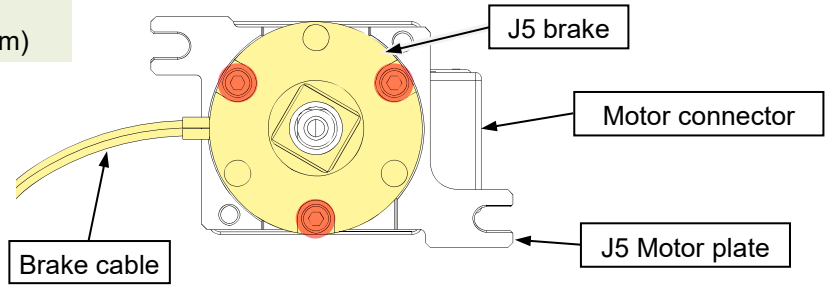
POINT

In the case of the figure below, use the shim “SIM,ADJUST,M4,t06,N054(1961529)” at jig scale marking 3.

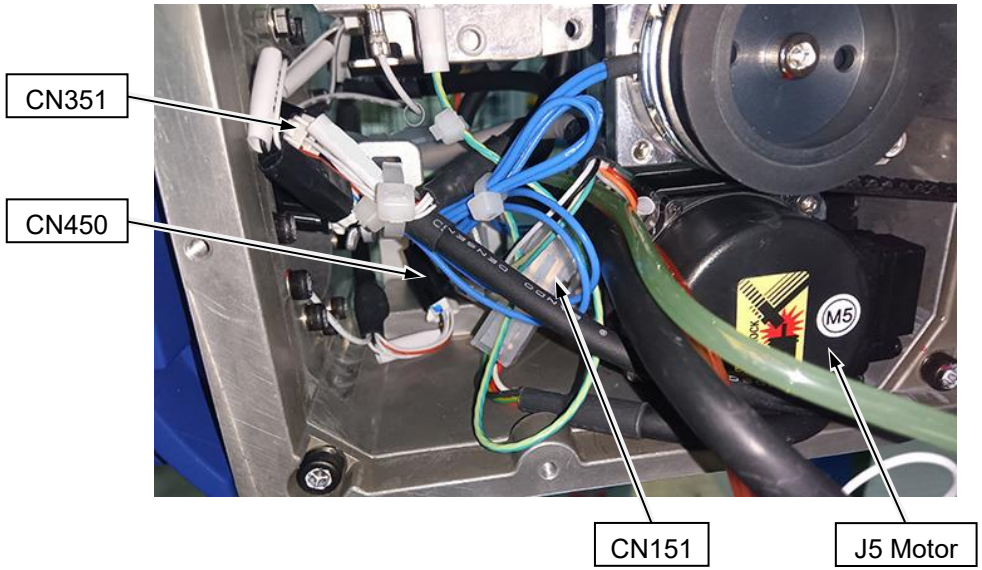


Jig scale marking	Shim to use
0	Process error (please contact the supplier)
1	SIM,ADJUST,M4,t04,N054(1961528) *1 SIM,ADJUST,M4,t06,N054(1961529) *1
2	SIM,ADJUST,M4,t02,N054(1961527) *1 SIM,ADJUST,M4,t06,N054(1961529) *1
3	SIM,ADJUST,M4,t06,N054(1961529) *1
4	SIM,ADJUST,M4,t04,N054(1961528) *1
5	SIM,ADJUST,M4,t02,N054(1961527) *1
6	Do not use shims
7	Process error (please contact the supplier)

Joint #5

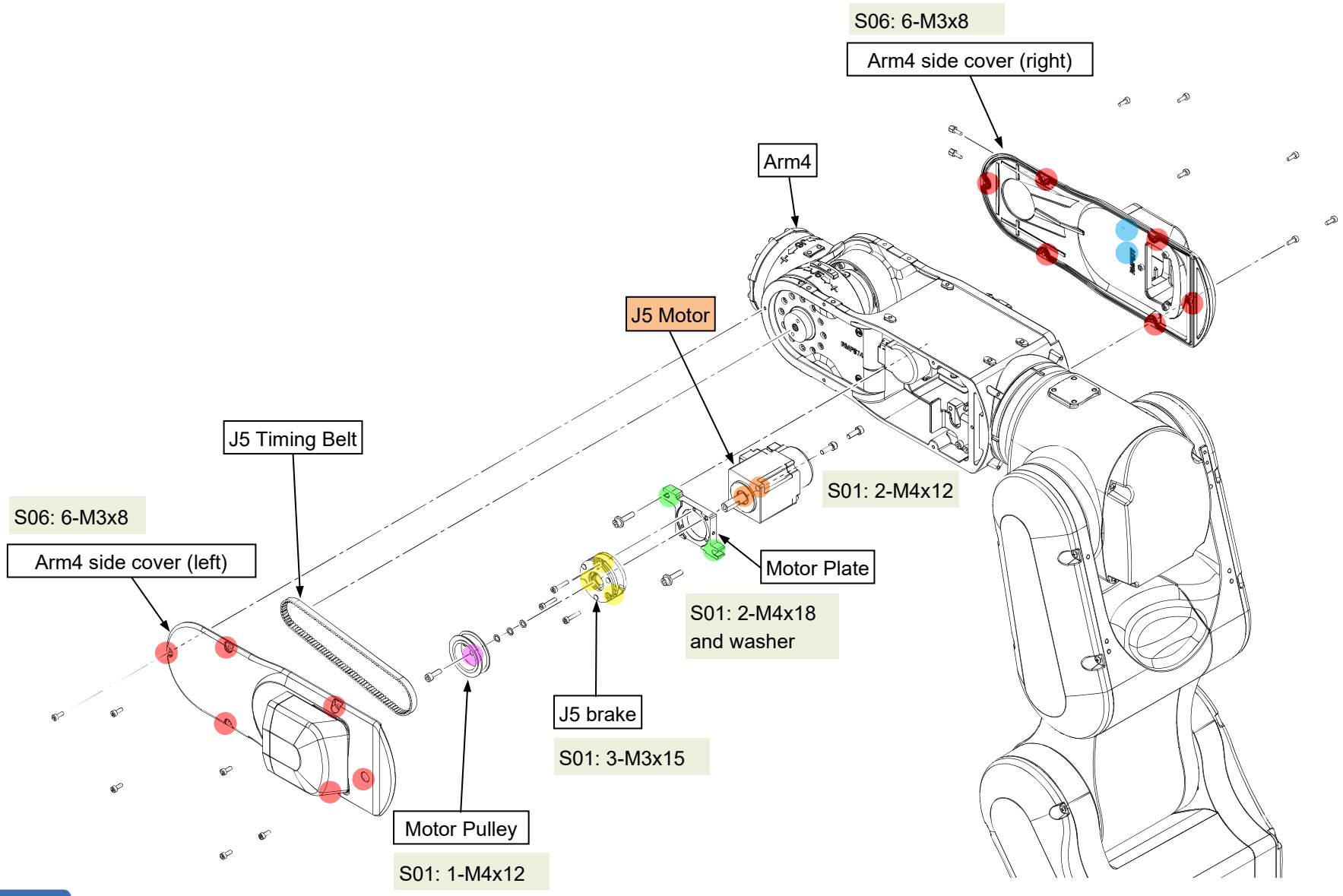
	6. Remove the jig screw and remove the motor pulley and jigs from the motor. 7. Attach the specified shim to the motor pulley.
2	Install the J5 brake on the motor plate. **POINT** Install the brake on the J5 Motor plate in the orientation shown in the figure. A S01: 3-M3x15 (2.0 +/- 0.1 N·m) 
3	Install the motor pulley. **POINT** • Make sure that a shim is attached to the motor pulley. • Align the motor pulley with the brake disc and install the motor pulley on the motor shaft. If they are misaligned, adjust the brake disc position. • Apply Loctite 243 to the screw. • Tighten the screws while pressing the brake against the motor pulley to prevent it rotating. • After tightening the screw, allow it to sit for about 15 minutes to let the Loctite dry. A S01: 1-M4x12 (4.0 +/- 0.2 N·m)

Joint #5

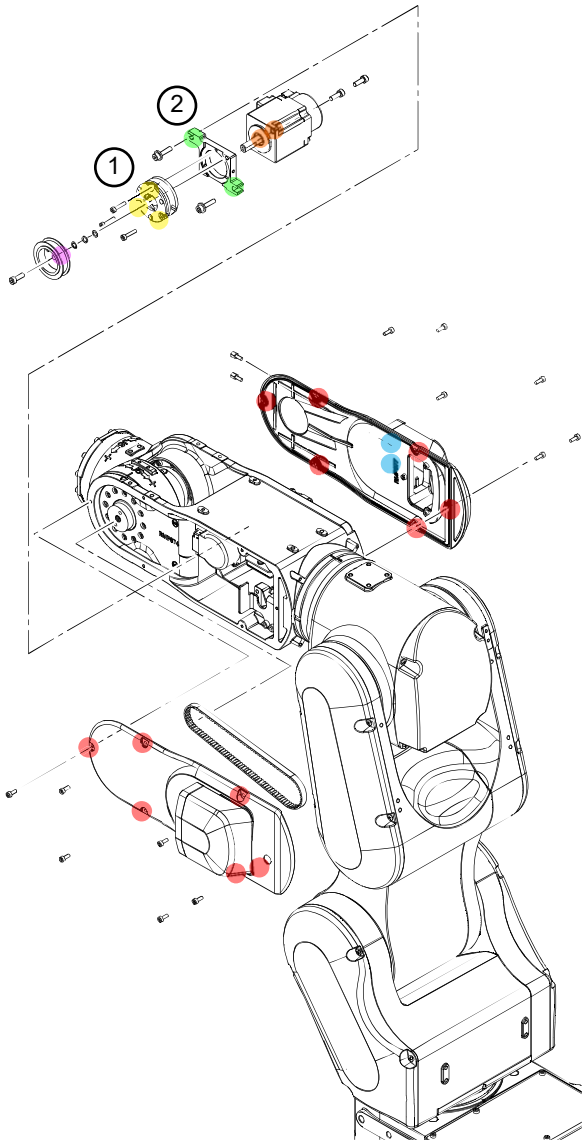
4	Insert the J5 Motor unit in the Arm4.
5	Connect the J5 Motor connectors (CN450, CN351, CN151). 
6	Install the Arm4 side cover (right).
7	Install the J5 Timing Belt.

Joint #5

2.5.3 Replacing the J5 Motor



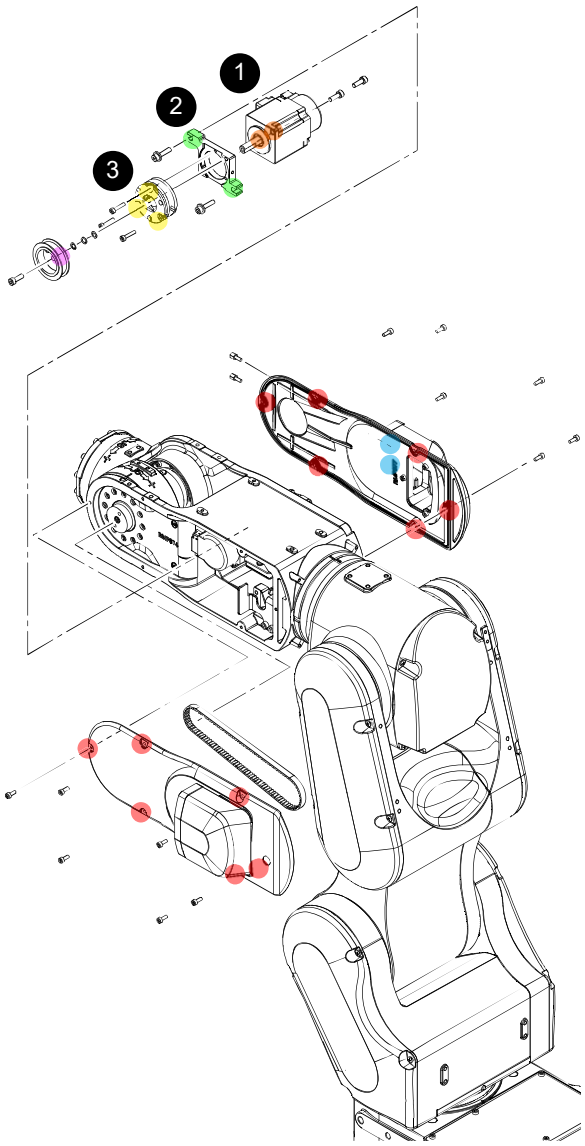
Removing the J5 Motor

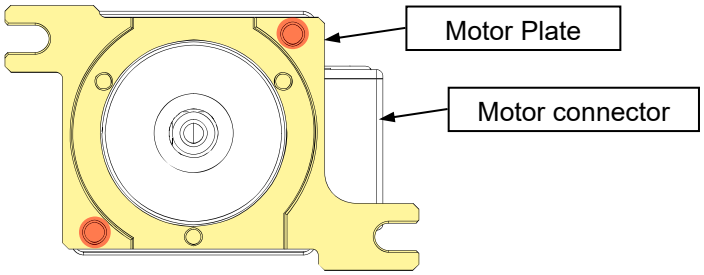


1	Remove the J5 brake.
2	Remove the Motor Plate. A S01: 2-M4x12

Joint #5

Installing the J5 Motor

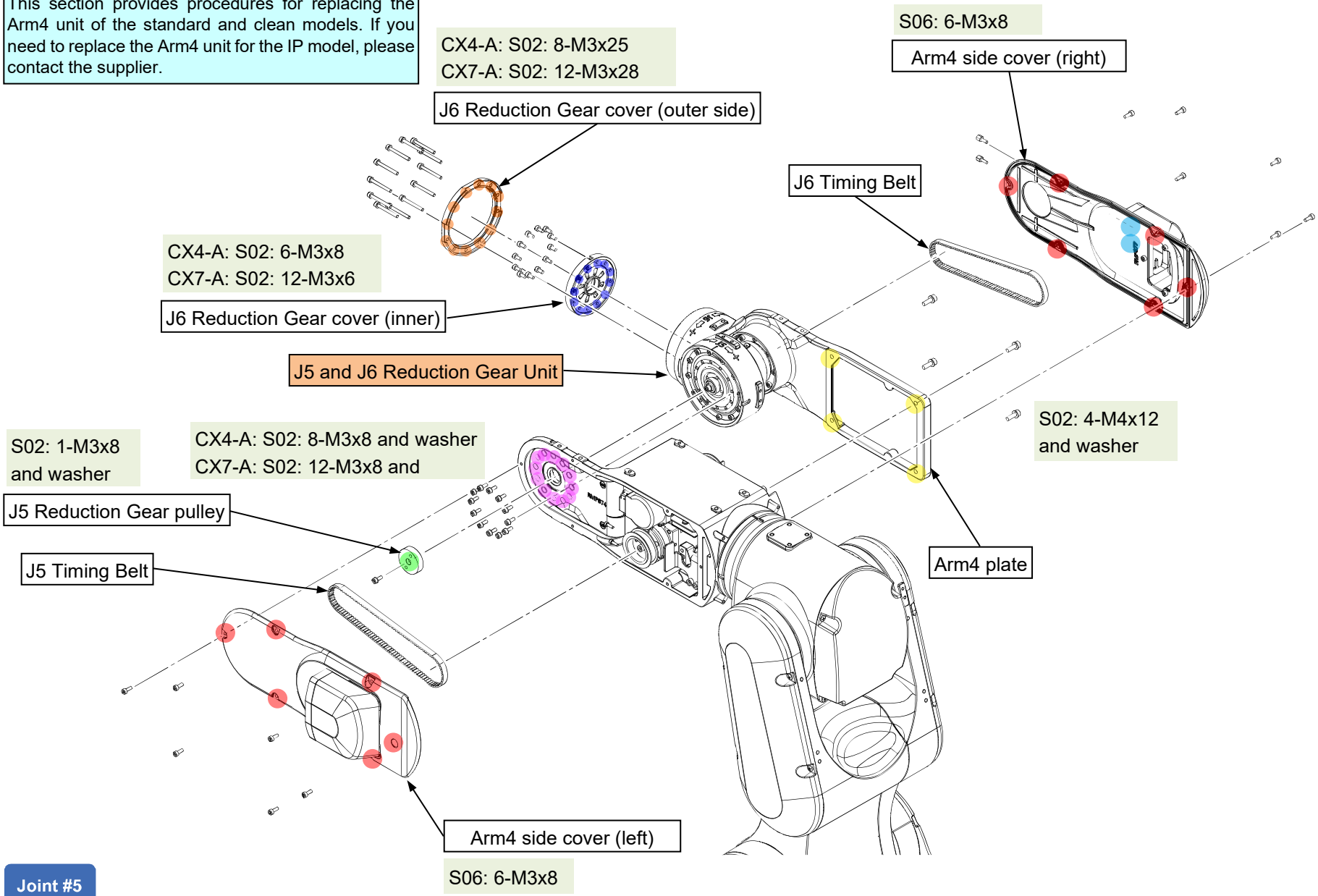


1	Attach connector labels to the J5 Motor. **POINT** A new motor comes with the connector labels. Attach the labels near the connectors. Refer to the old motor.
2	Install the Motor Plate. **POINT** Install with the orientation shown in the figure. A S01: 2-M4x12 (4.0 +/- 0.2 N·m) 
3	Install the J5 brake.

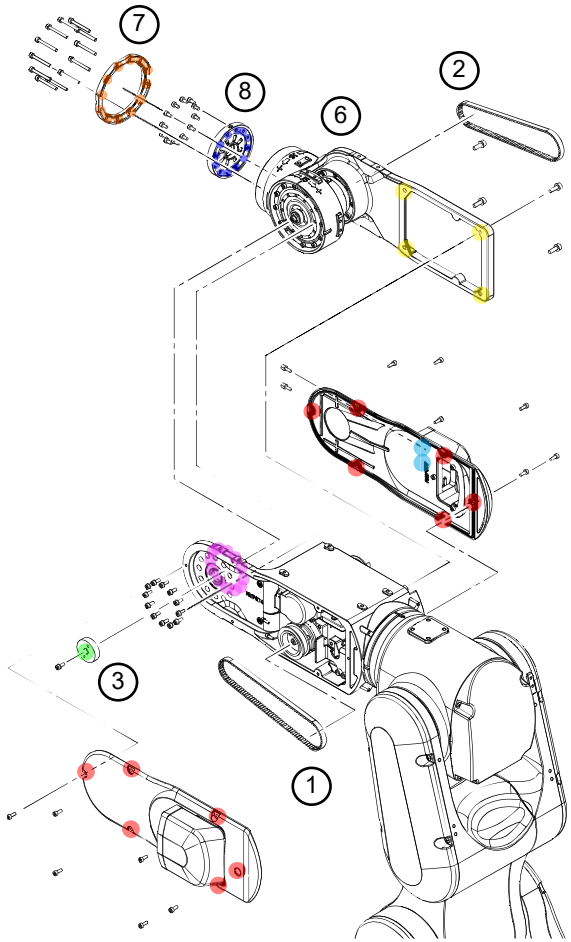
Joint #5

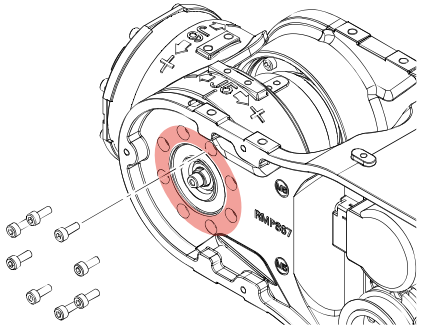
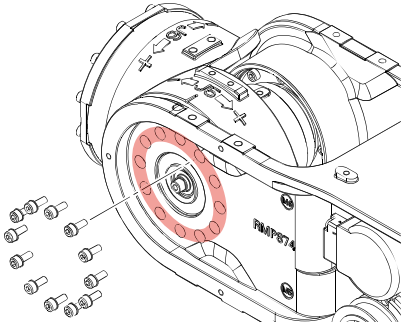
2.5.4 Replacing the J5 and J6 Reduction Gear Units

This section provides procedures for replacing the Arm4 unit of the standard and clean models. If you need to replace the Arm4 unit for the IP model, please contact the supplier.

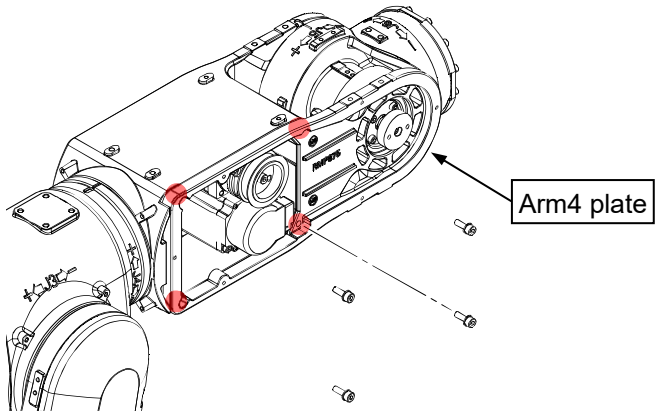
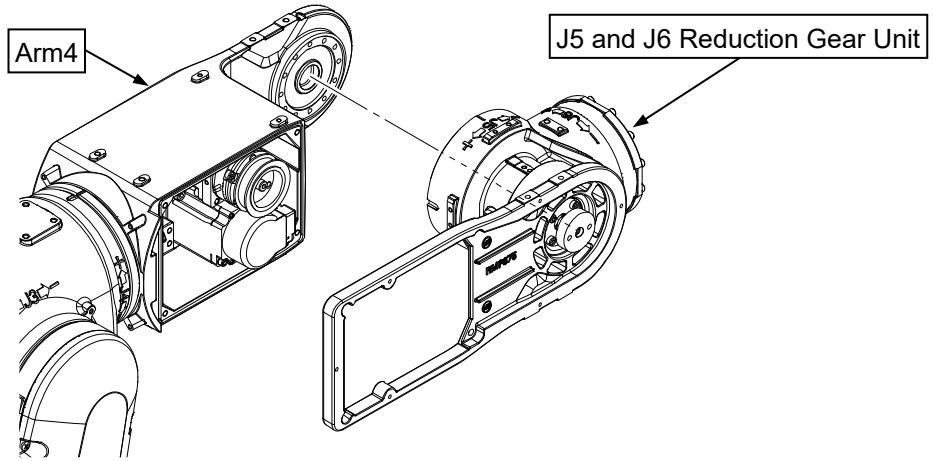


Removing the J5 and J6 Reduction Gear Units

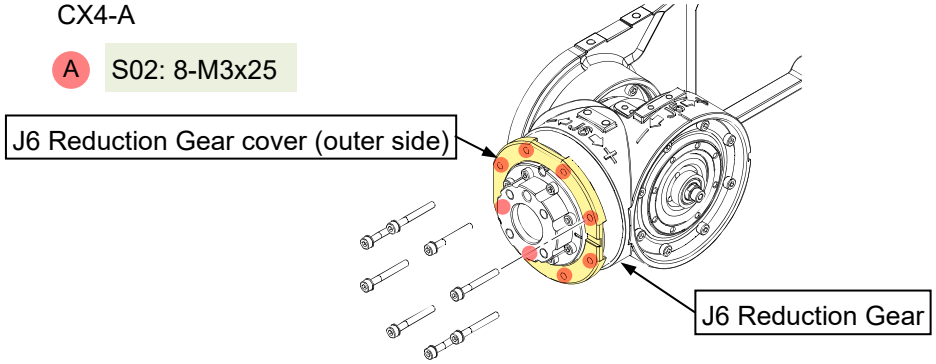
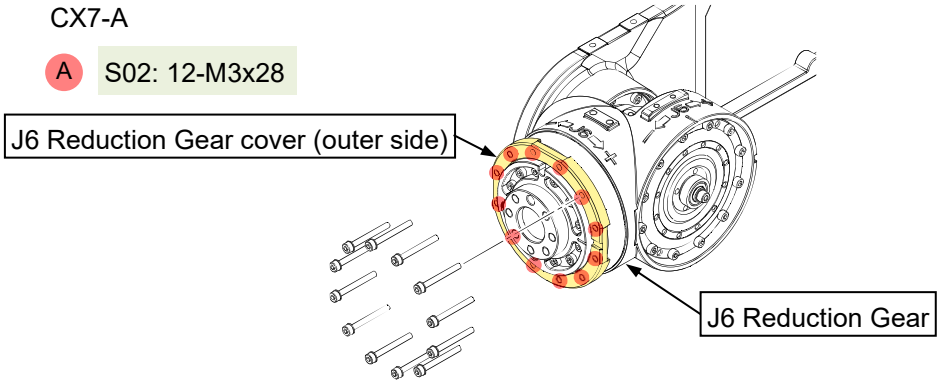


1	Remove the J5 Timing Belt.
2	Remove the J6 Timing Belt.
3	Remove the J5 Reduction Gear pulley. A S02: 1-M3x8 and washer
4	Remove the bolts on the J5 Reduction Gear pulley side of the Arm4. CX4-A A S02: 8-M3x8 and washer  CX7-A A S02: 12-M3x8 and washer 

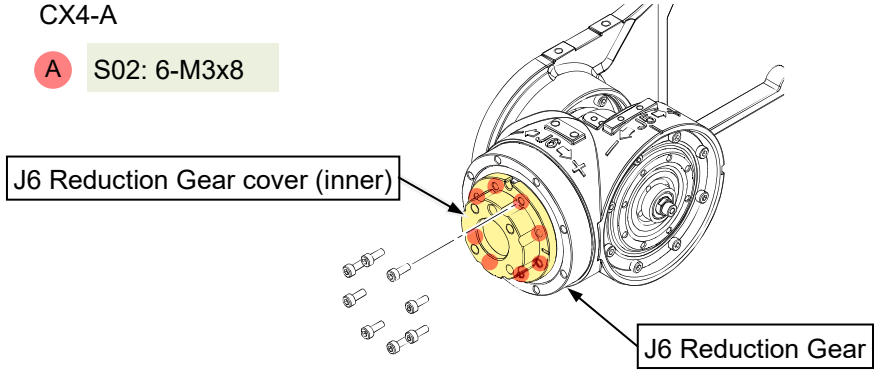
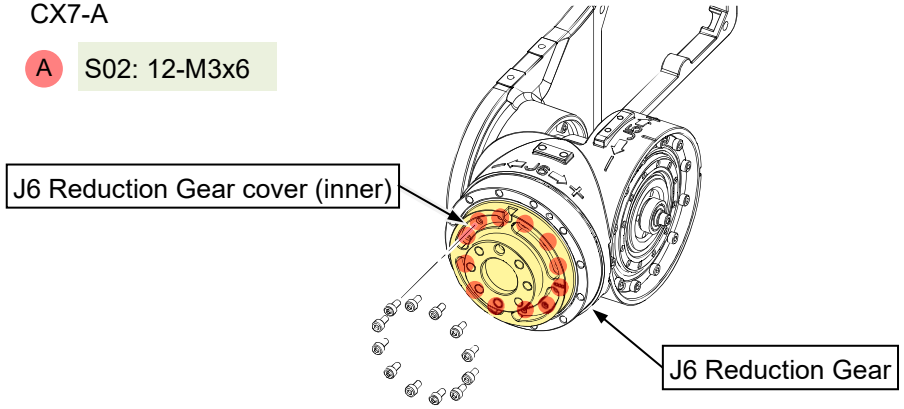
Joint #5

5	Remove the bolts securing the Arm4 plate. **CAUTION** Be very careful when removing the Arm4 plate. Have at least two workers support the Manipulator while the other worker removes the bolts. A S02: 4-M4x12 and washer 
6	Remove the J5 and J6 Reduction Gear Units from the Arm4. **CAUTION** When these bolts are removed at step (4), the Arm4 plate attached to the J5 and J6 Reduction Gear Units will come off. Be careful not to get your fingers caught between the parts. 

Joint #5

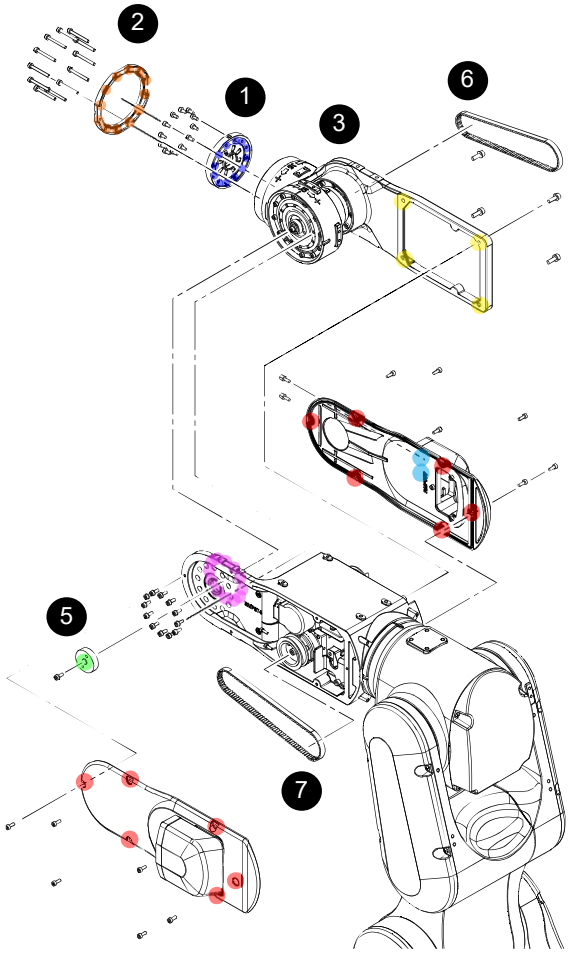
7	Remove the J6 Reduction Gear cover (outer side) from the J6 Reduction Gear. CX4-A A S02: 8-M3x25  CX7-A A S02: 12-M3x28 

Joint #5

⑧	Remove the J6 Reduction Gear cover (inner side) from the J6 Reduction Gear. CX4-A Ⓐ S02: 6-M3x8  CX7-A Ⓐ S02: 12-M3x6 

Joint #5

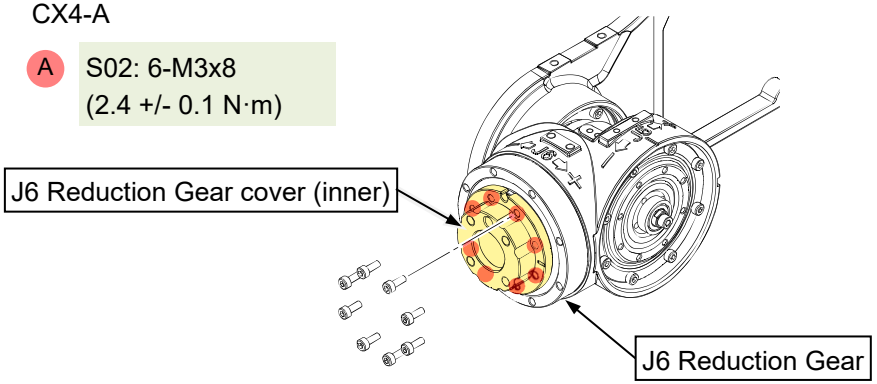
Installing the J5 and J6 Reduction Gear Units



1 Attach the J6 Reduction Gear cover (inner side) to the J6 Reduction Gear.

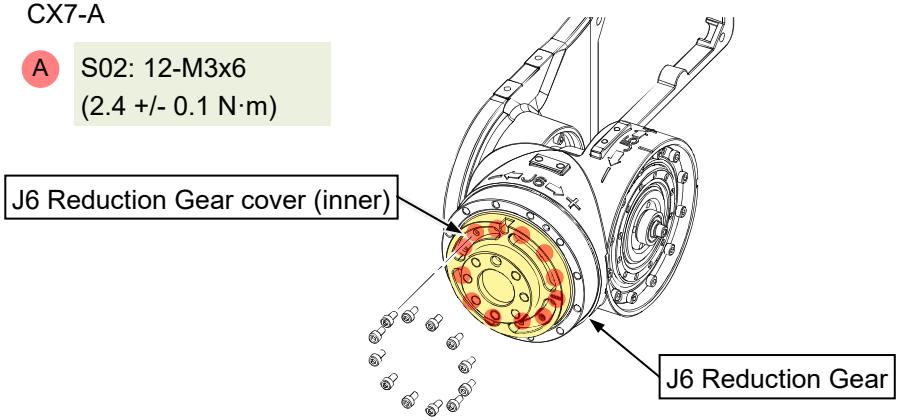
CX4-A

A S02: 6-M3x8
(2.4 +/- 0.1 N·m)



CX7-A

A S02: 12-M3x6
(2.4 +/- 0.1 N·m)

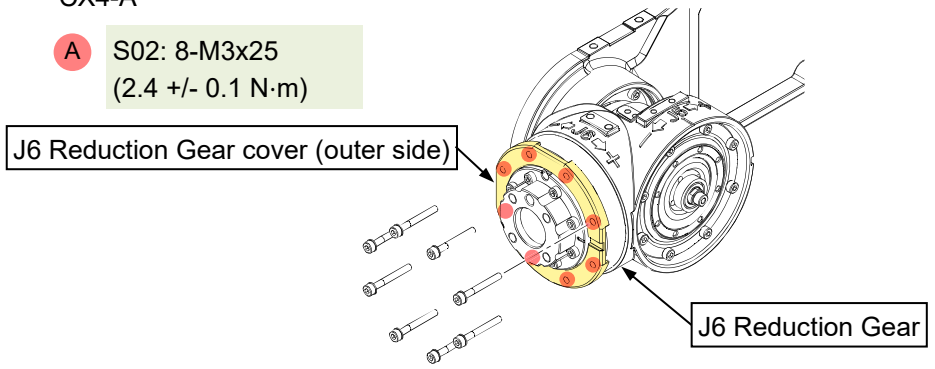


Joint #5

2 Attach the J6 Reduction Gear cover (outer side) to the J6 Reduction Gear.

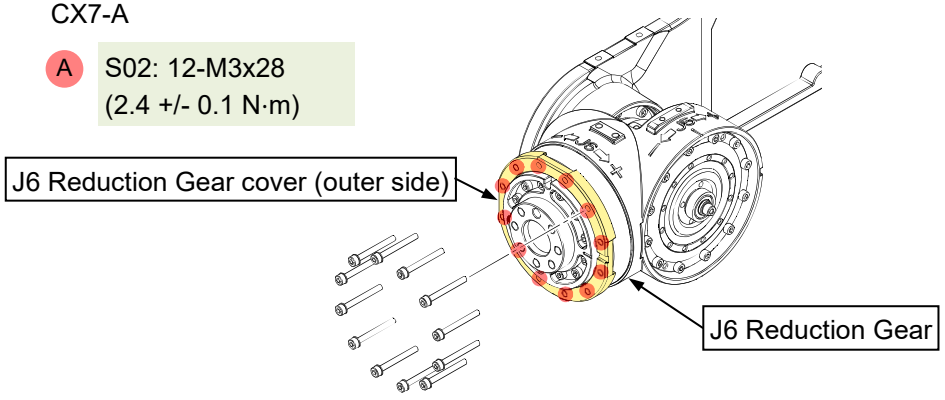
CX4-A

A S02: 8-M3x25
(2.4 +/- 0.1 N·m)



CX7-A

A S02: 12-M3x28
(2.4 +/- 0.1 N·m)



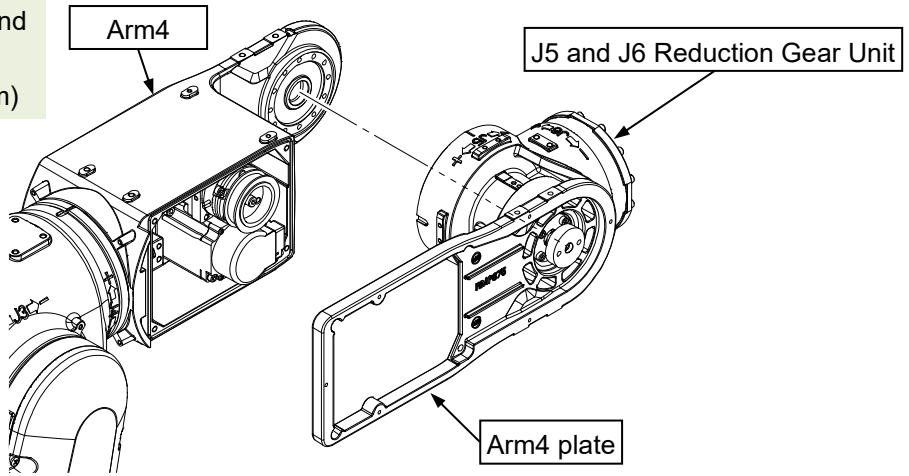
Joint #5

3 Place the J5 and J6 Reduction Gear Units on the Arm4, and secure the Arm4 plate to the Arm4.

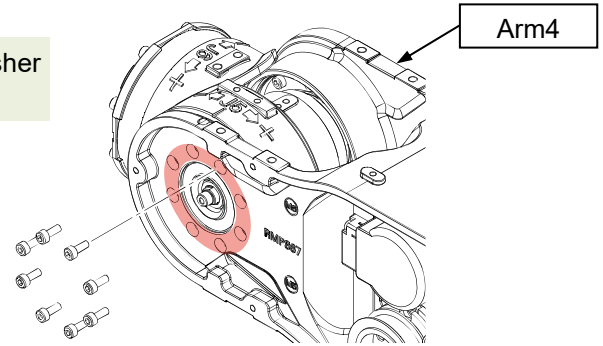
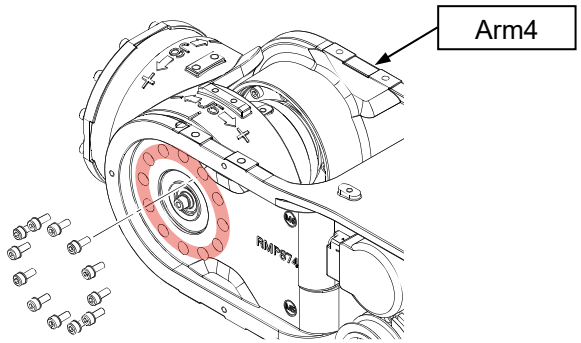
CAUTION

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.

A S02: 4-M4x12 and washer (5.5 +/- 0.25 N·m)



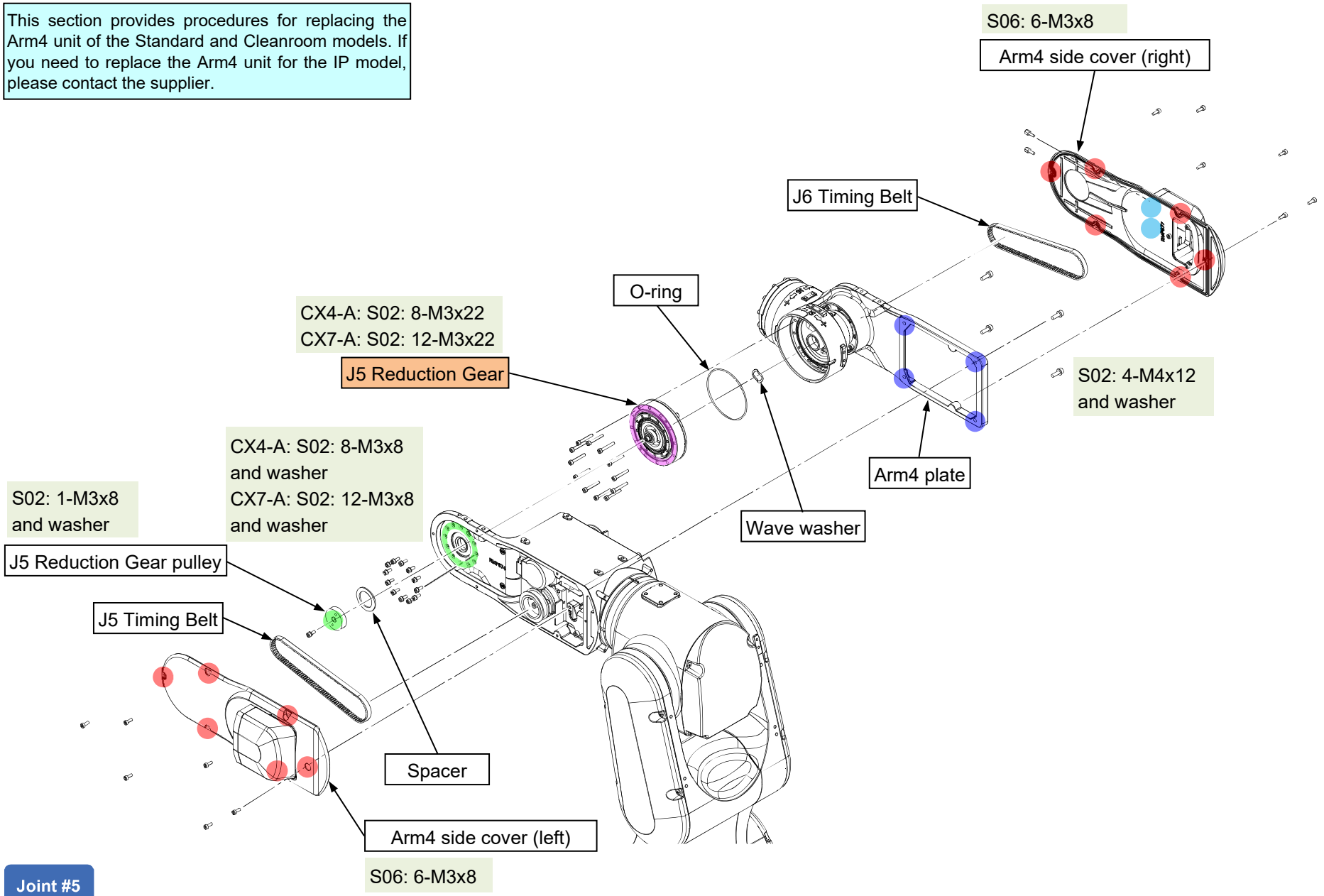
Joint #5

4	Install the bolts on the J5 Reduction Gear pulley side of the Arm4. CX4-A A S02: 8-M3x8 and washer (2.4 +/- 0.1 N·m)  CX7-A A S02: 12-M3x8 and washer (2.4 +/- 0.1 N·m) 
5	Install the J5 Reduction Gear pulley. A S02: 1-M3x8 (2.4 +/- 0.1 N·m)
6	Install the J6 Timing Belt.
7	Install the J5 Timing Belt.

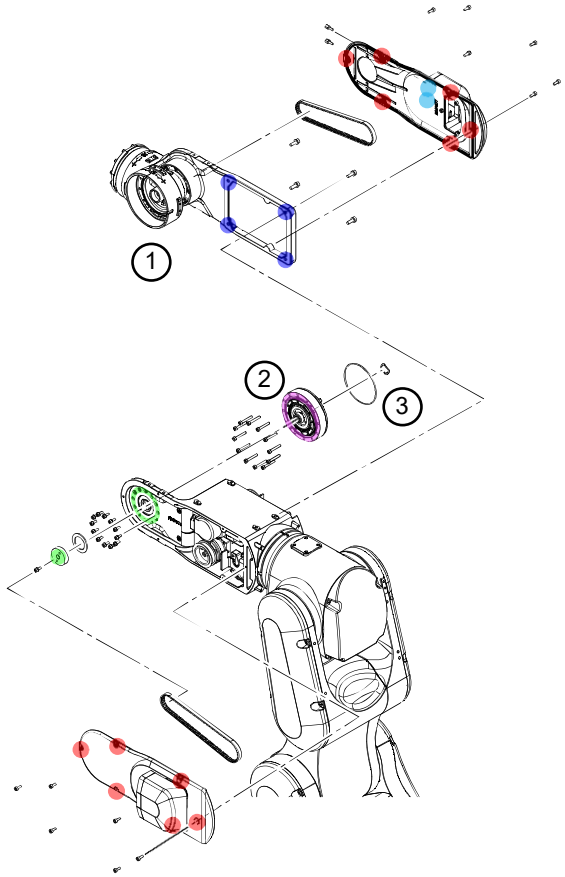
Joint #5

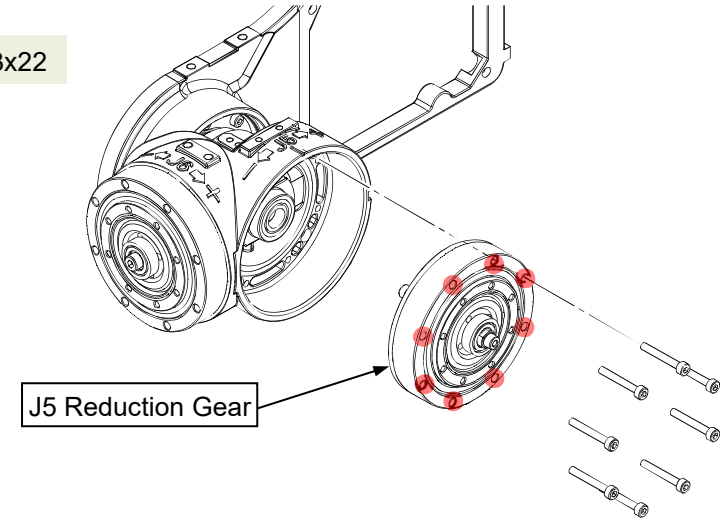
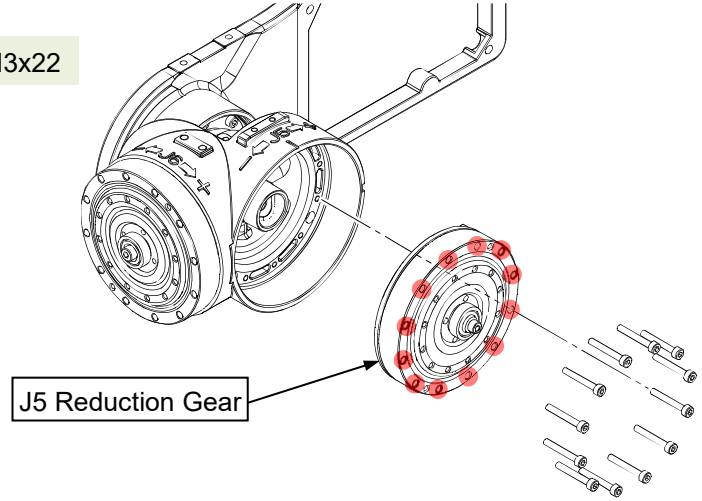
2.5.5 Replacing the J5 Reduction Gear

This section provides procedures for replacing the Arm4 unit of the Standard and Cleanroom models. If you need to replace the Arm4 unit for the IP model, please contact the supplier.



Removing the J5 Reduction Gear



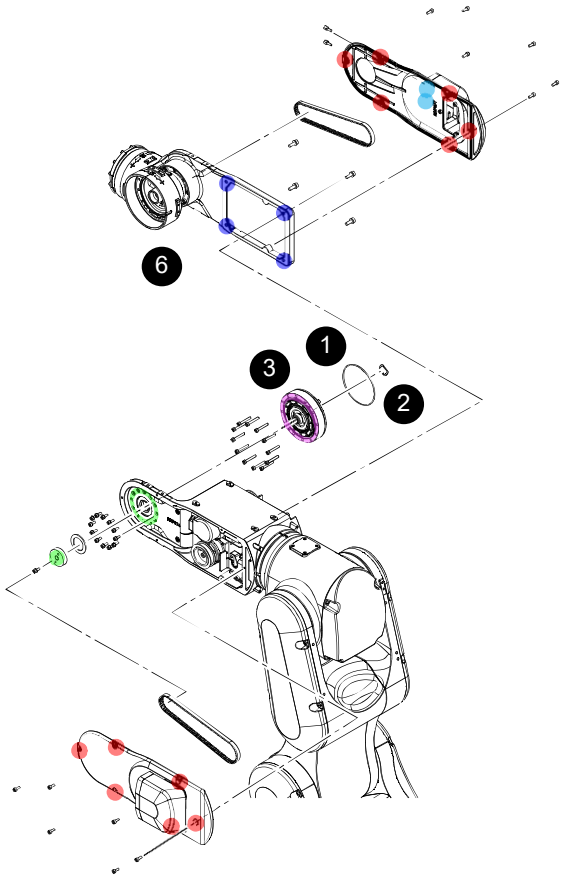
1	Remove the J5 and J6 Reduction Gear Units.
2	Remove the J5 Reduction Gear from the Arm4. CX4-A A S02: 8-M3x22  CX7-A A S02: 12-M3x22 

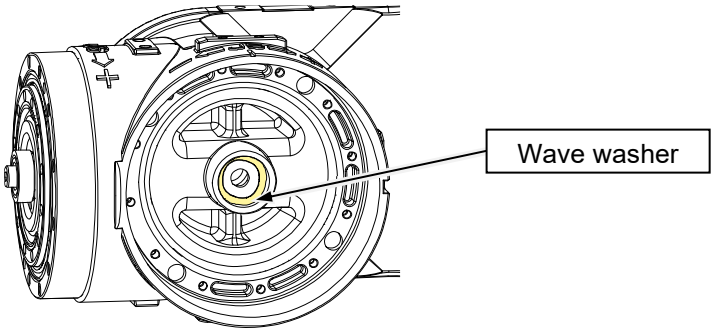
Joint #5

③	Remove the O-ring and wave washer from inside the flange. **POINT** The O-ring and the wave washer will be used again during installation. Store them and do not dispose of them.

Joint #5

Installing the J5 Reduction Gear



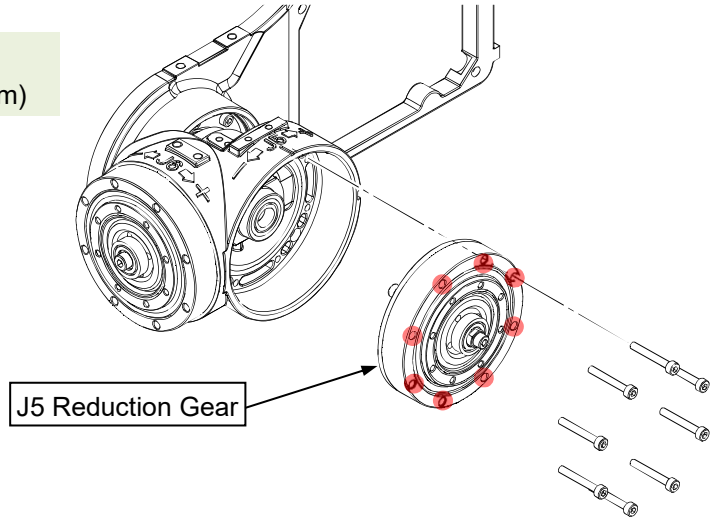
1	Apply a thin layer of grease to the O-ring and install the O-ring inside the flange. **CAUTION** Be careful not to damage the O-ring and fit it properly in the groove.
2	Install the wave washer in the center of the flange. 

Joint #5

3 Install the J5 Reduction Gear on Arm4.

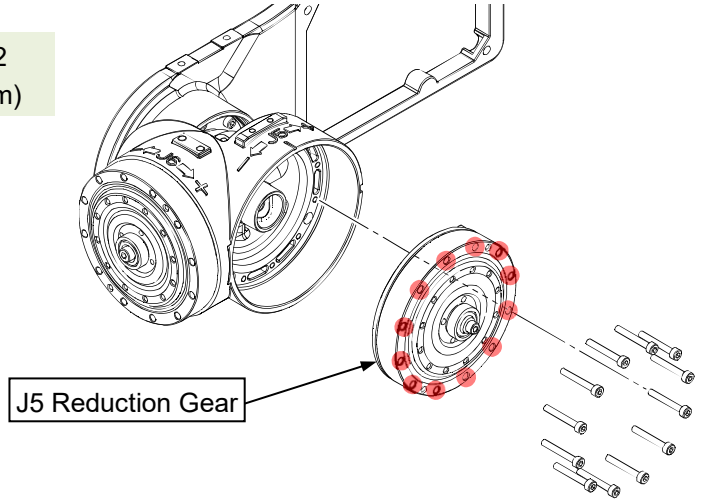
CX4-A

A S02: 8-M3x22
(2.4 +/- 0.1 N·m)

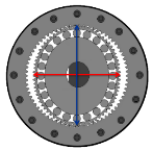


CX7-A

A S02: 12-M3x22
(2.4 +/- 0.1 N·m)



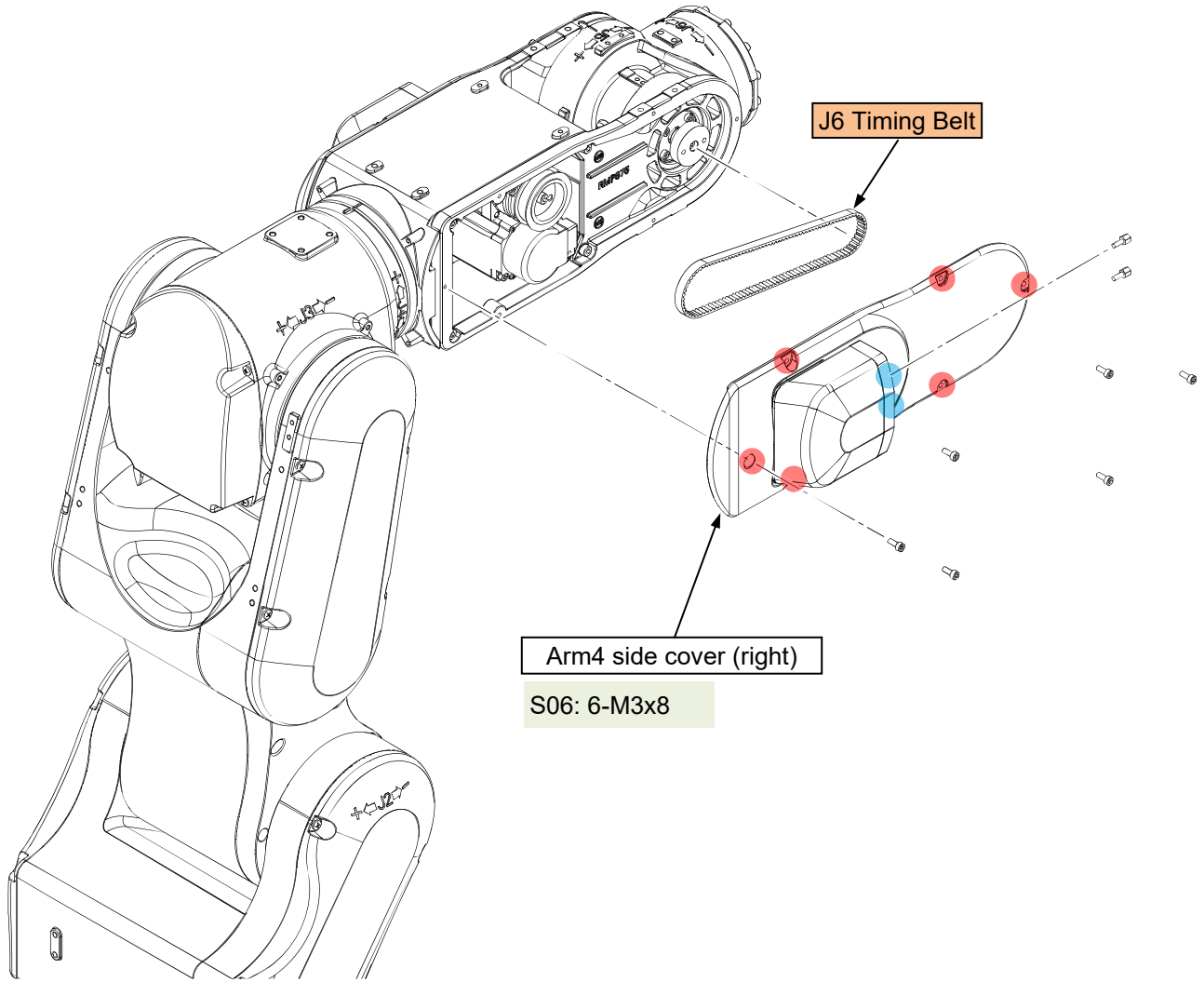
Joint #5

4	Apply grease to the wave generator. SK-2: 2.7 g (CX4-A), 4.6 g (CX7-A)
5	Install the Waveform Generator. **POINT** Install so that the longside of the Flexspline and the Waveform Generator match. Longside Shortside  Reduction
6	Install the J5 and J6 Reduction Gear Units.

Joint #5

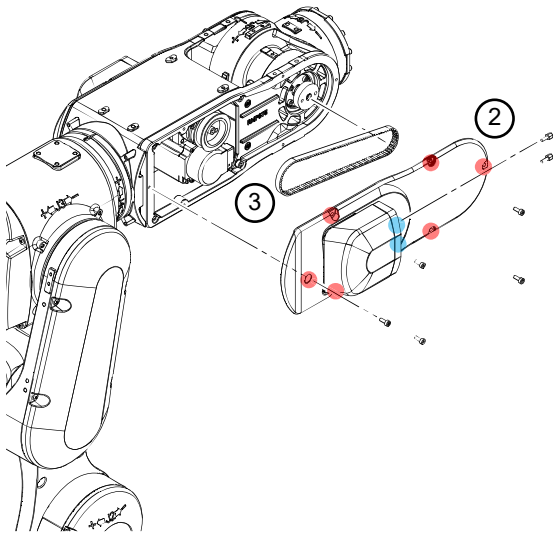
2.6 Joint #6

2.6.1 Replacing the J6 Timing Belt



Joint #6

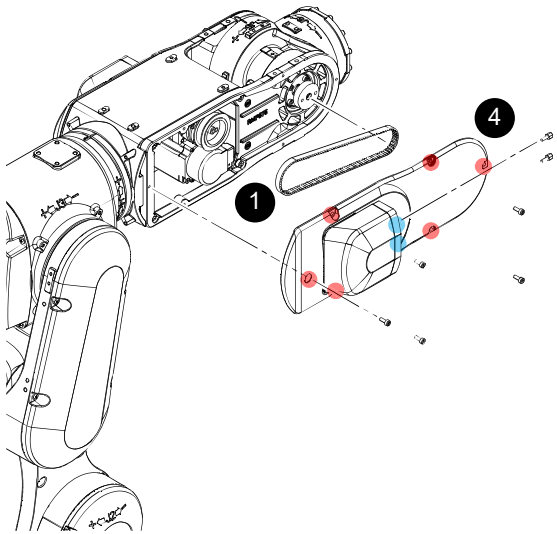
Removing the J6 Timing Belt



1	Turn OFF the Controller.
2	Remove the Arm4 side cover (right).
3	Loosen the screws securing the J6 Motor unit, and remove the J6 Timing Belt. **POINT** First, remove the belt from the Motor pulley. A S01: 2-M4x18 and washer

Joint #6

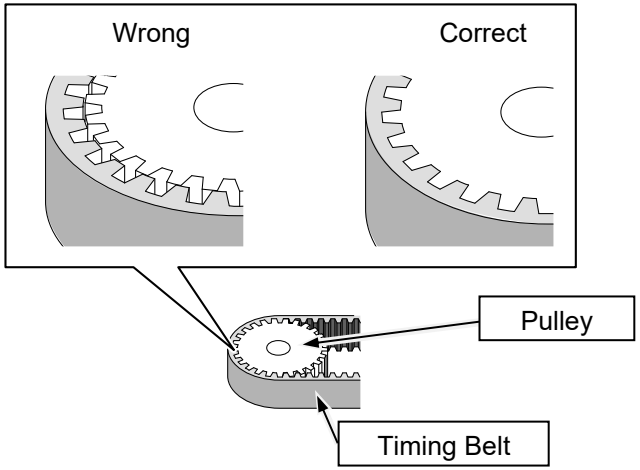
Installing the J6 Timing Belt



1 Install the J6 Timing Belt.

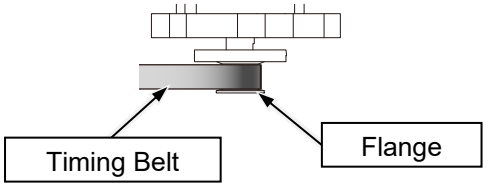
POINT

- First place the belt on the Motor pulley.
- 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 Temporarily secure the J6 Motor unit.

A S01: 2-M4x18 and washer

POINT

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

3 Adjust the belt tension.

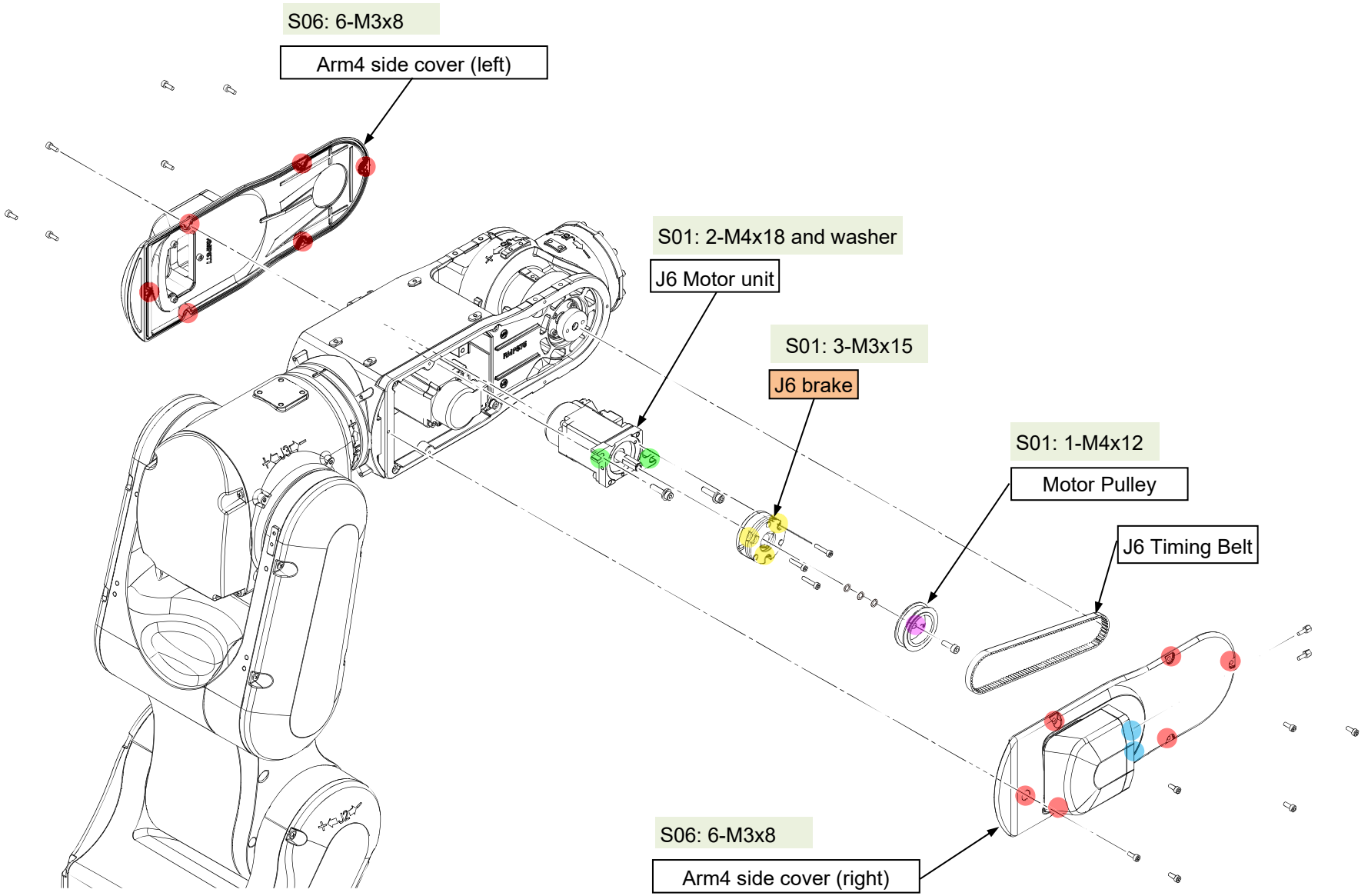
3.1 Adjusting the Timing Belt Tension

Joint #6

4	Install the Arm4 side cover (right).
5	After assembly, perform calibration of Joint #6. 3.2 Calibration

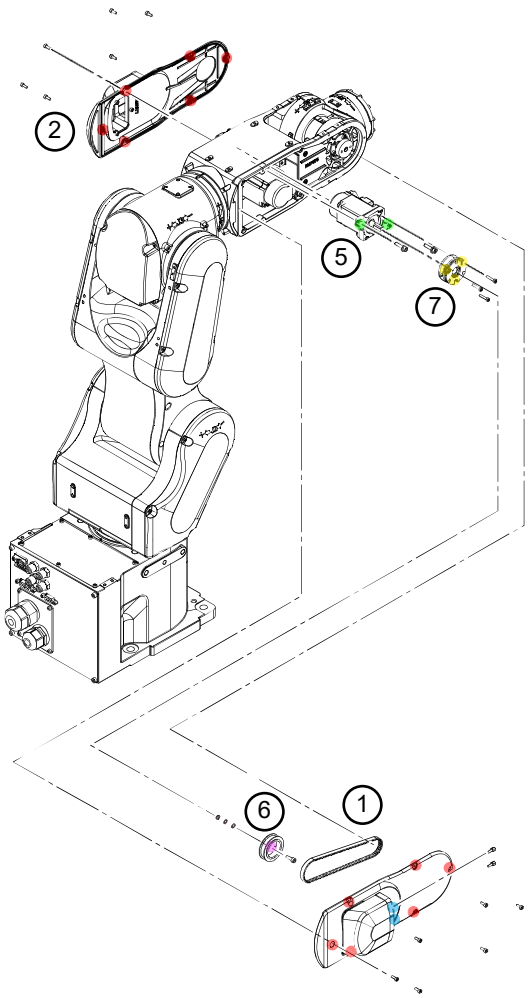


2.6.2 Replacing the J6 Brake



Joint #6

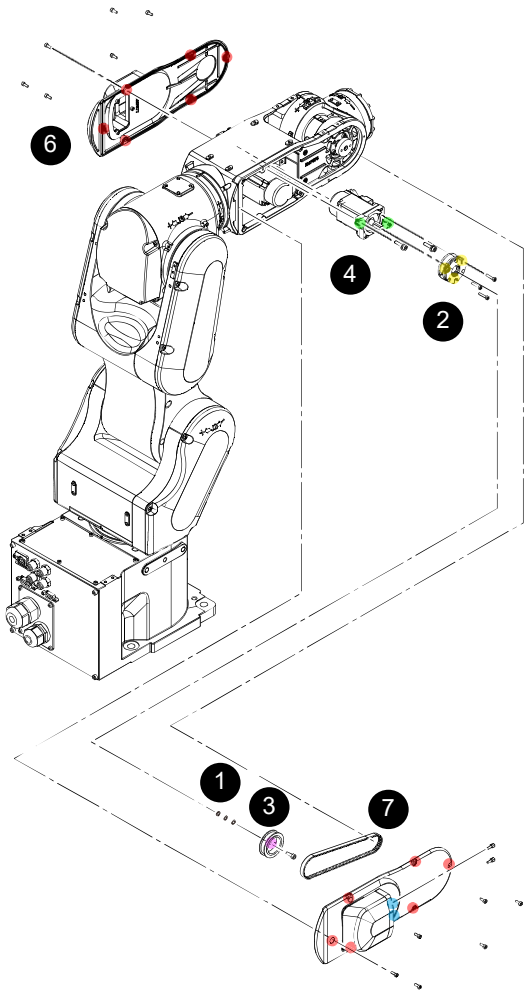
Removing the J6 Brake

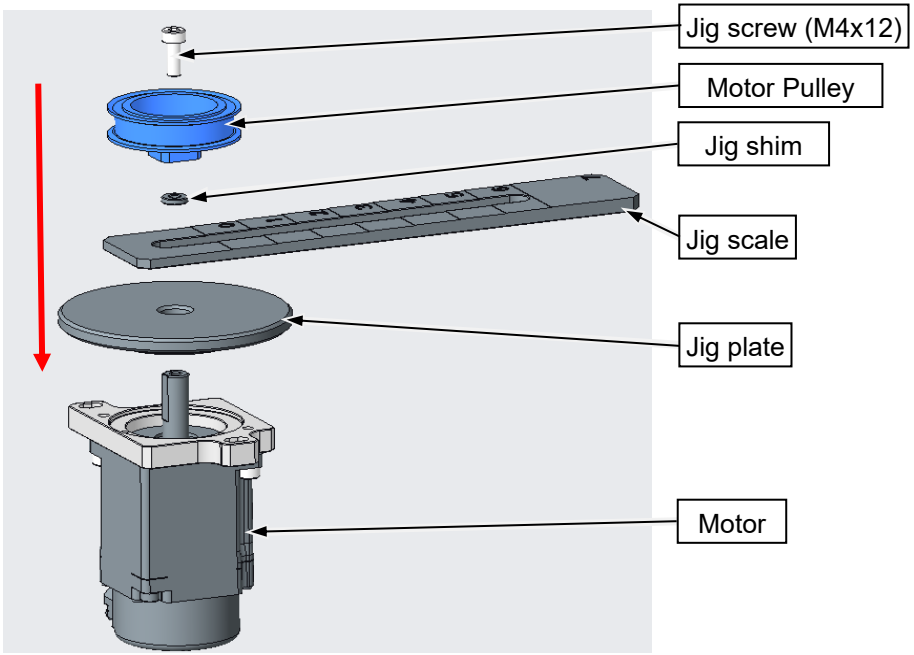


1	Remove the J6 Timing Belt.
2	Remove the Arm4 side cover (left).
3	Disconnect the J6 Motor connectors (BR0561, MS06-1, MP06-1).
4	Remove the screws securing the J6 Motor unit to the Arm4. A S01: 2-M4x18 and washer
5	Remove the J6 Motor unit from the Arm4.
6	Remove the motor pulley from the J6 Motor. **POINT** Remove the screws while pressing the brake against the Motor pulley to prevent it from rotating. **CAUTION** A shim is inserted between the motor pulley and motor shaft. Be careful not to lose it. A S01: 1-M4x12
7	Remove the J6 brake from the motor plate. A S01: 3-M3x15

Joint #6

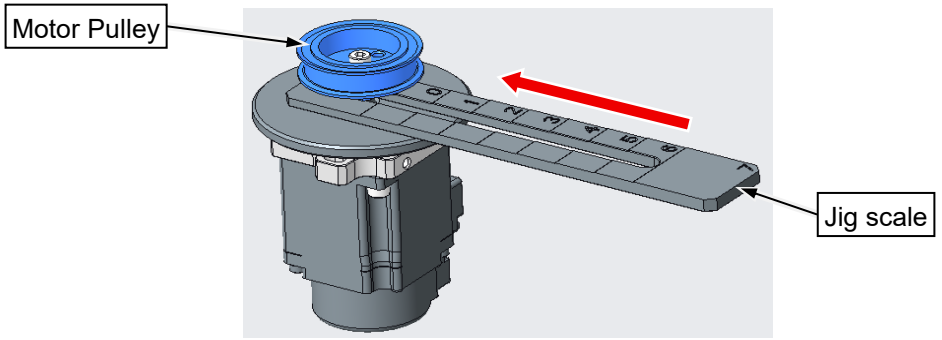
Installing the J6 Brake



1	Attach the shim to the motor pulley. **POINT** Perform a measurement with the J4/J5/J6 shim adjustment jigs to determine which shim to attach to the motor pulley.
	1. Attach the jig shim to the motor pulley.
	2. In the order shown in the figure, pass the jig plate and jig scale over the motor shaft and place them on the motor plate. **POINT** • Pass the end of the jig scale with the 0 marking over the shaft. • Place the jig scale horizontally on the jig plate and make sure it is in good contact.
	3. Secure the motor pulley to the shaft with the jig screw. **POINT** Tighten the jig screw until it contacts the motor shaft. 

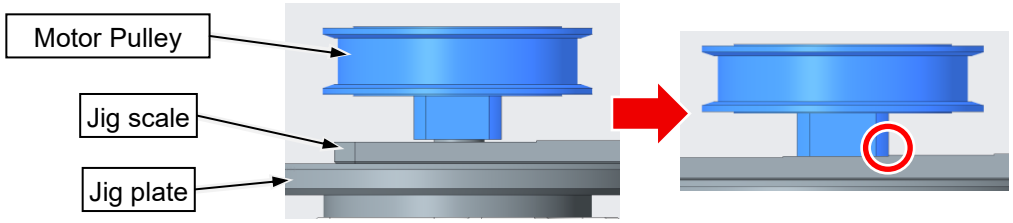
Joint #6

4. Slide the jig scale toward the shaft until it makes contact with the motor pulley.



POINT

The jig scale has a series of steps that make contact with the motor pulley when it is slid. The scale marking at the point of contact determines which shim to attach to the motor pulley.

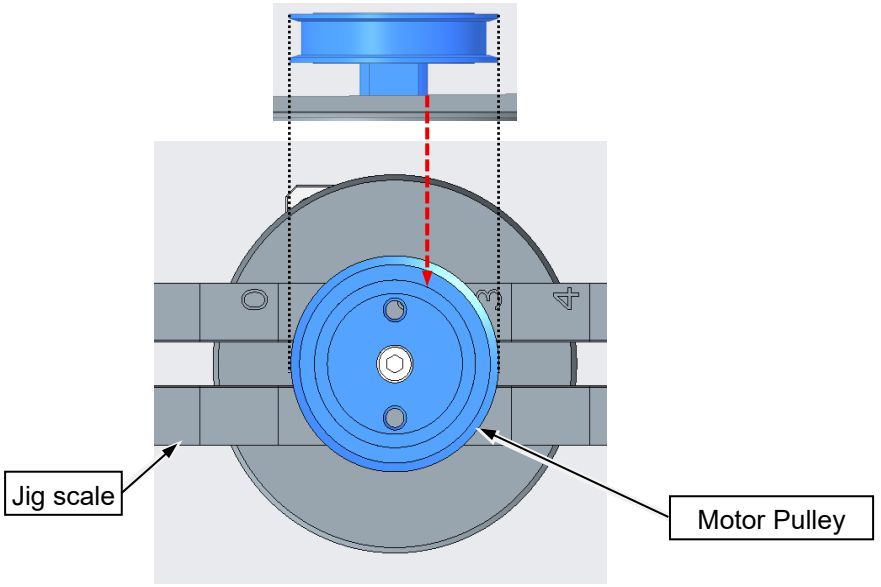


Joint #6

5. Read the jig scale marking from directly above.

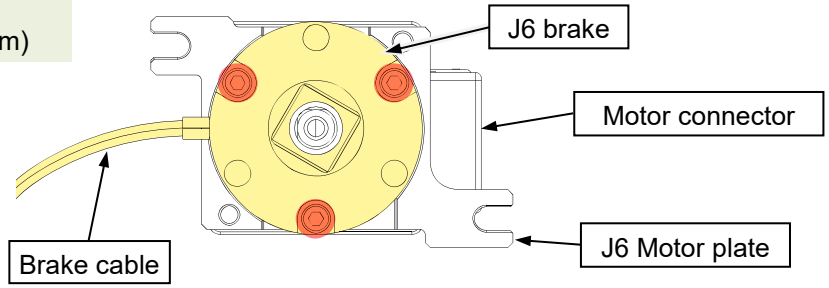
POINT

In the case of the figure below, use the shim “SIM,ADJUST,M4,t06,N054(1961529)” at jig scale marking 3.

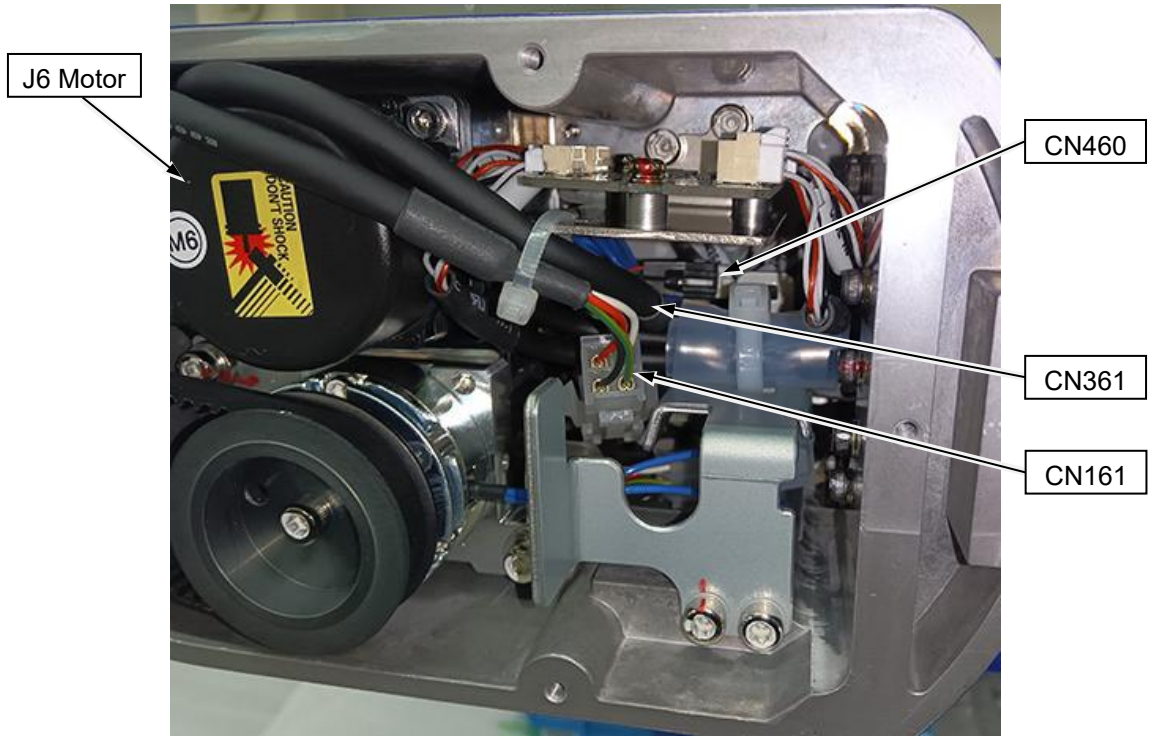


Jig scale marking	Shim to use
0	Process error (please contact the supplier)
1	SIM,ADJUST,M4,t04,N054(1961528) *1 SIM,ADJUST,M4,t06,N054(1961529) *1
2	SIM,ADJUST,M4,t02,N054(1961527) *1 SIM,ADJUST,M4,t06,N054(1961529) *1
3	SIM,ADJUST,M4,t06,N054(1961529) *1
4	SIM,ADJUST,M4,t04,N054(1961528) *1
5	SIM,ADJUST,M4,t02,N054(1961527) *1
6	Do not use shims
7	Process error (please contact the supplier)

Joint #6

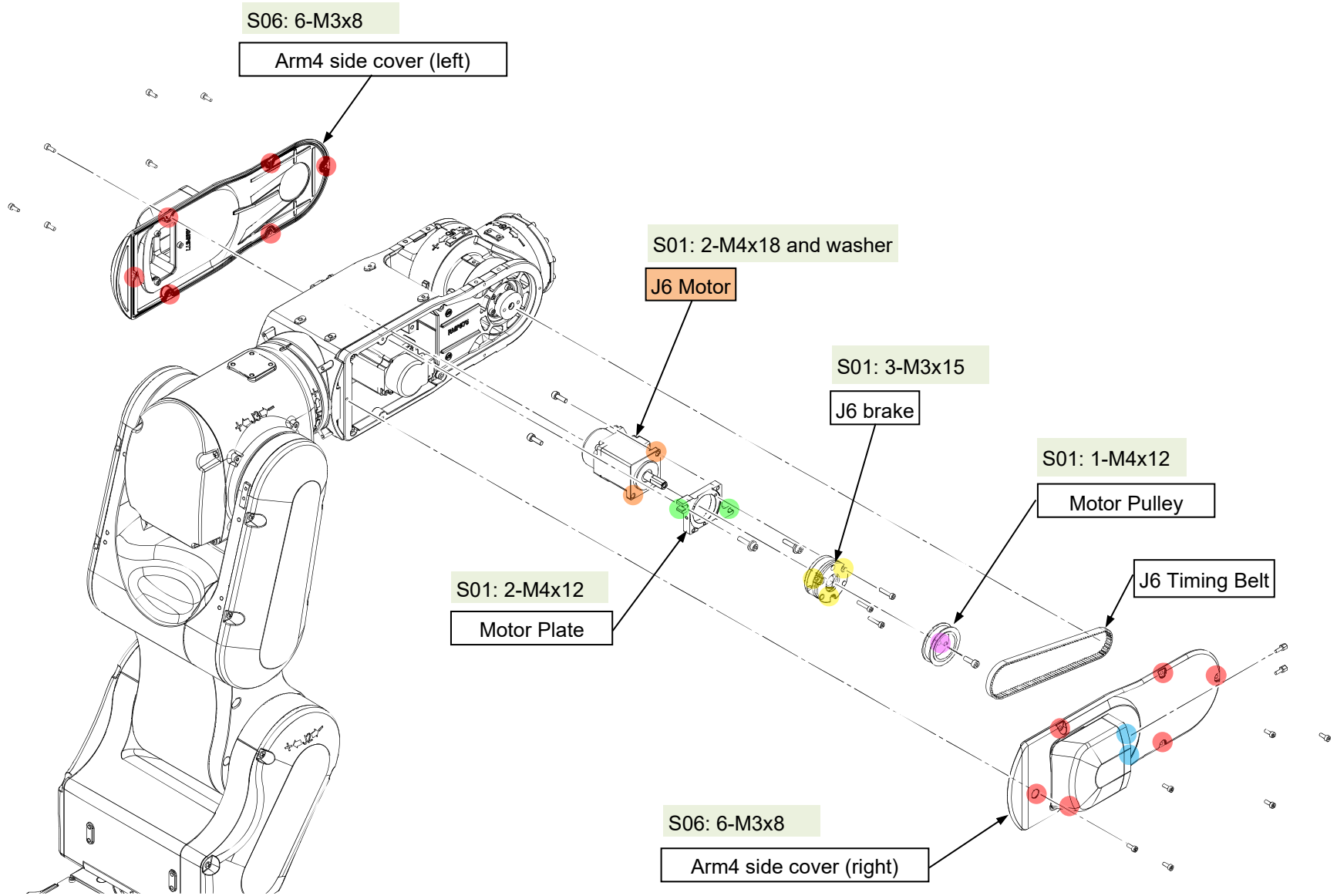
	6. Remove the jig screw and remove the motor pulley and jigs from the motor. 7. Attach the specified shim to the motor pulley.
2	Install the J6 brake on the motor plate. **POINT** Install the brake on the J6 Motor plate in the orientation shown in the figure. A S01: 3-M3x15 (2.0 +/- 0.1 N·m) 
3	Install the Motor Pulley. **POINT** • Make sure that a shim is attached to the motor pulley. • Align the motor pulley with the brake disc and install the motor pulley on the motor shaft. If they are misaligned, adjust the brake disc position. • Apply Loctite 243 to the screw. • Tighten the screws while pressing the brake against the motor pulley to prevent it rotating. • After tightening the screw, allow it to sit for about 15 minutes to let the Loctite dry. A S01: 1-M4x12 (4.0 +/- 0.2 N·m)

Joint #6

4	Insert the J6 Motor unit in the Arm4.
5	Connect the J6 Motor connectors (CN460, CN361, CN161). 
6	Install the Arm4 side cover (left).
7	Install the J6 Timing Belt.

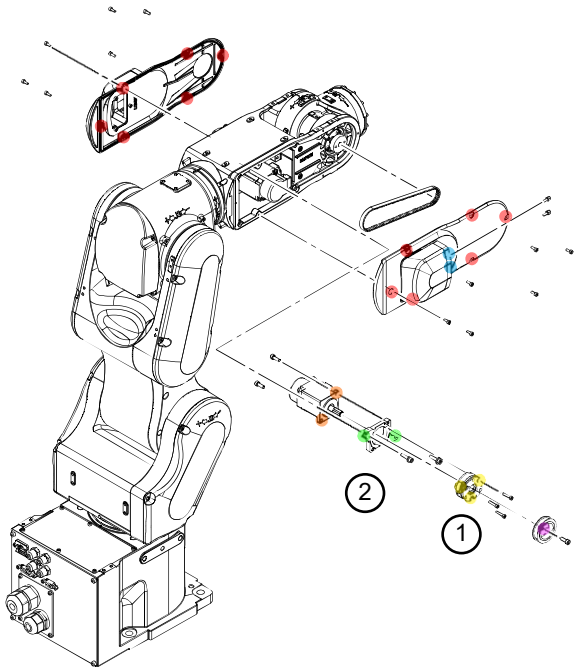
Joint #6

2.6.3 Replacing the J6 Motor



Joint #6

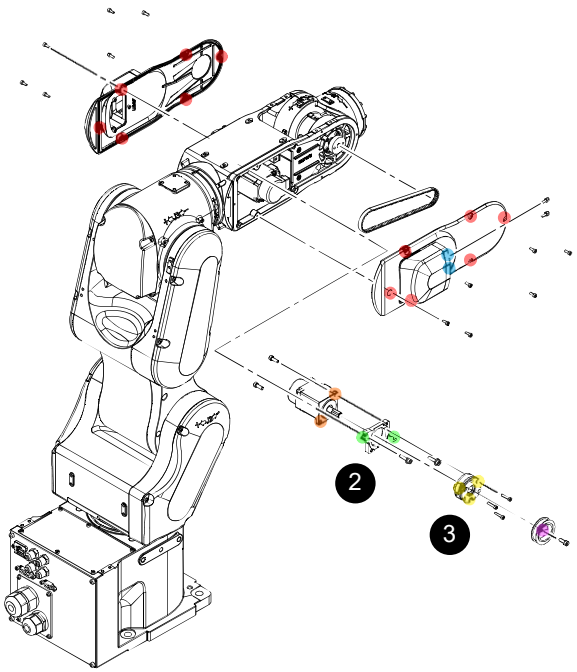
Removing the J6 Motor

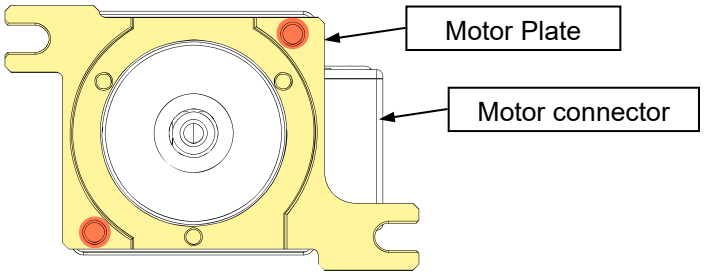


1	Remove the J6 brake.
2	Remove the Motor Plate. A S01: 2-M4x12

Joint #6

Installing the J6 Motor



1	Attach connector labels to the J6 Motor. **POINT** A new motor comes with the connector labels. Attach the labels near the connectors. Refer to the old motor.
2	Install the Motor Plate. **POINT** Install with the orientation shown in the figure. A S01: 2-M4x12 (4.0 +/- 0.2 N·m) 
3	Install the J6 brake.

Joint #6

2.6.4 Replacing the J6 Reduction Gear

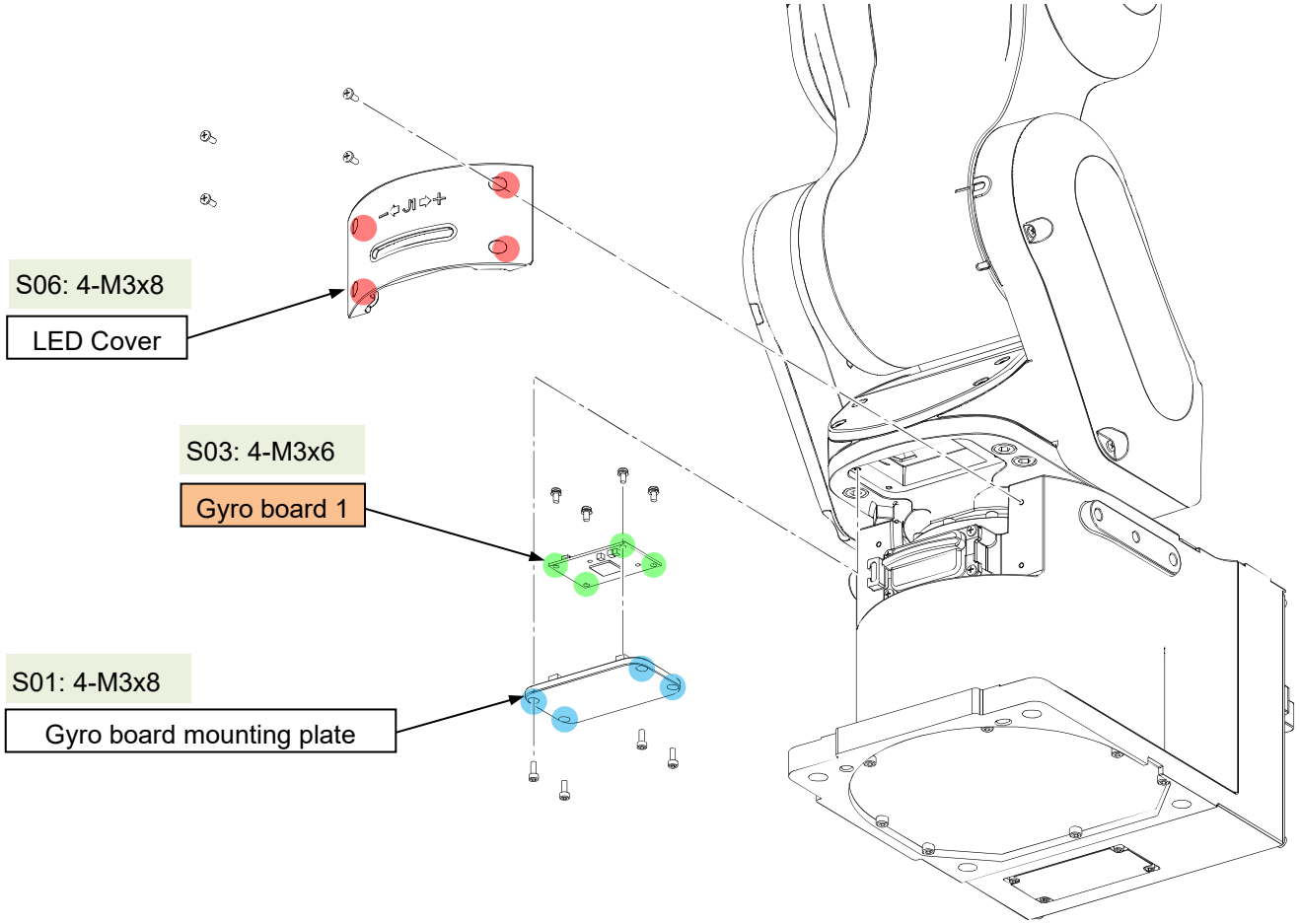
The J6 Reduction Gear must be replaced as a set with the J5 Reduction Gear.

If you want to replace the J6 Reduction Gear only, please contact your service representative.

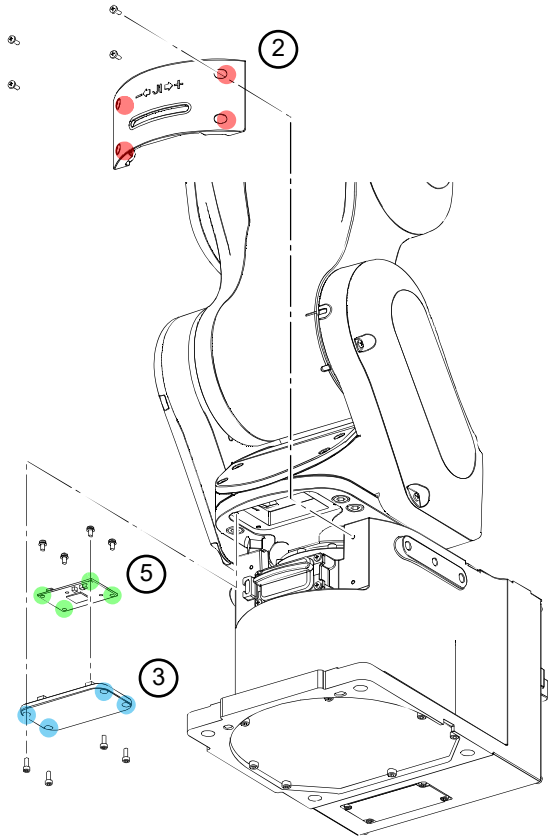
Joint #6

2.7 Replacing the Board

2.7.1 Replacing Gyro Board 1

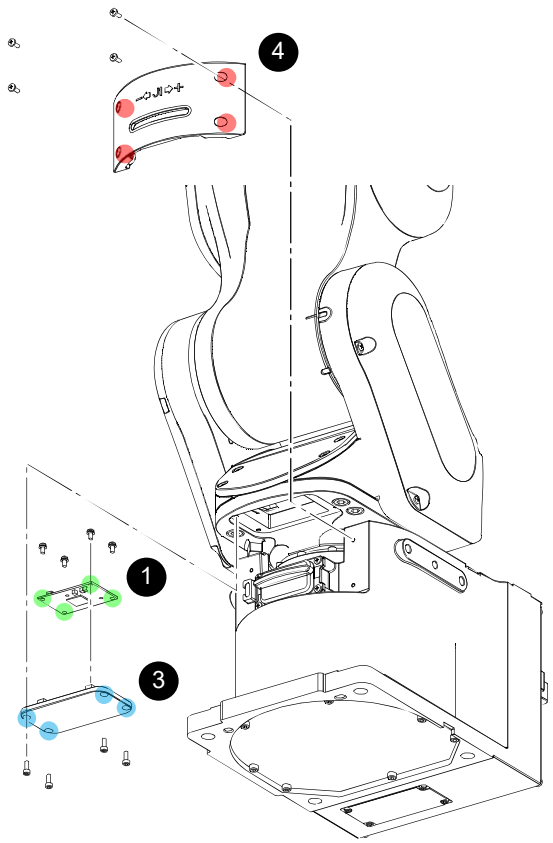


Removing Gyro Board 1



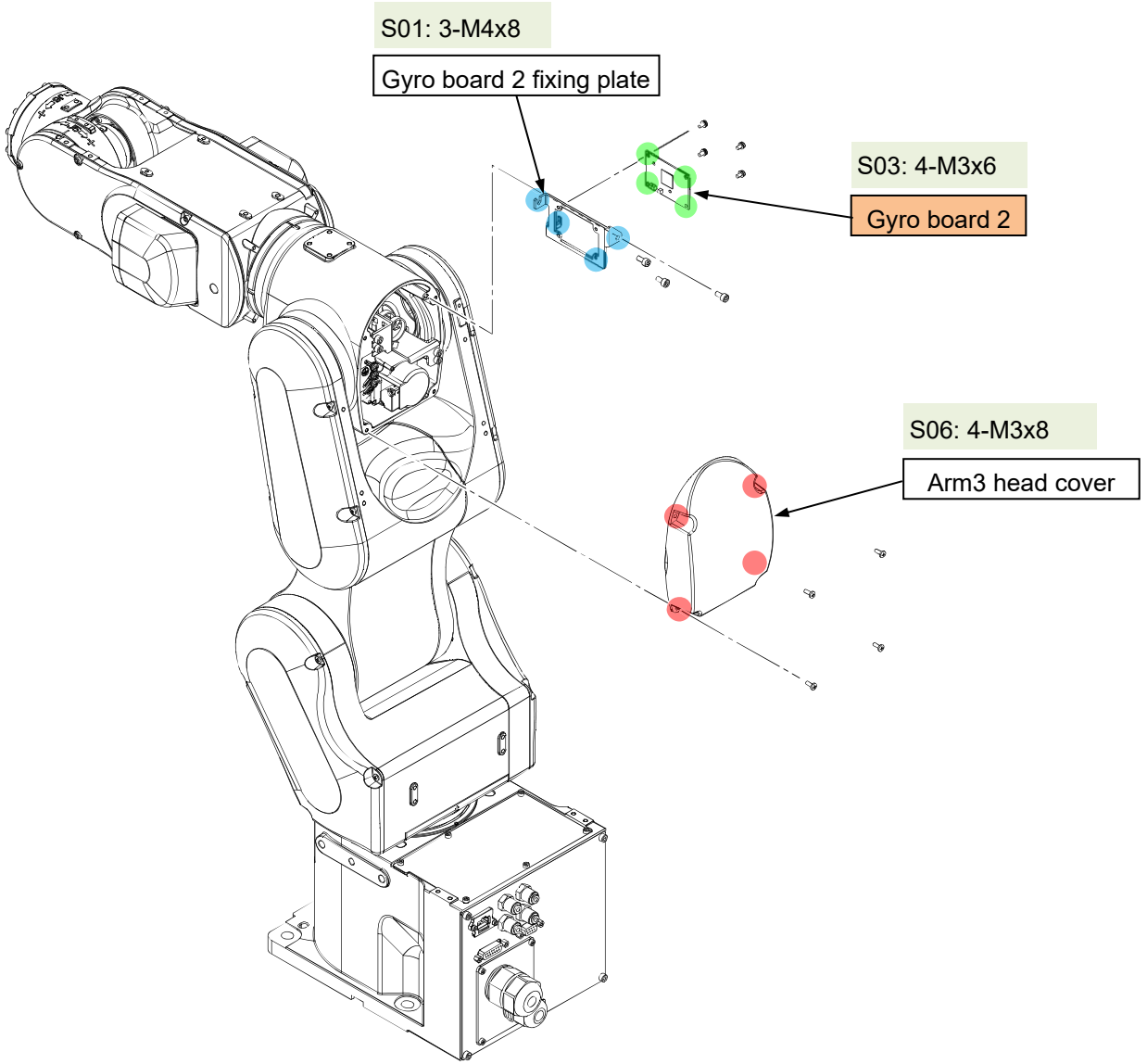
1	Turn OFF the Controller.
2	Remove the LED Cover.
3	Remove the gyro board mounting plate. A S01: 4-M3x8
4	Disconnect the connectors (CN3, CN6).
5	Loosen the screws securing the board and remove gyro board 1 from the gyro board mounting plate. A S03: 4-M3x6

Installing Gyro Board 1

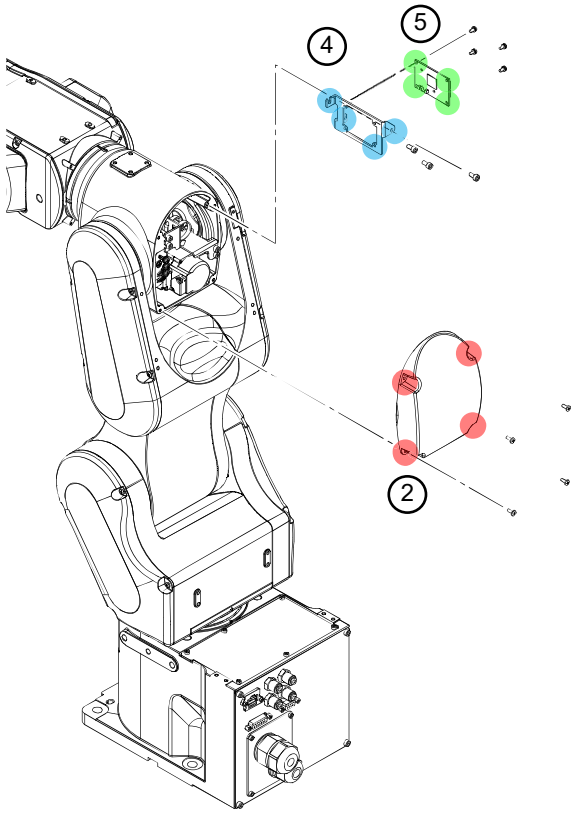


1	Attach gyro board 1 to the gyro board mounting plate. A S03: 4-M3x6 (0.45 +/- 0.1 N·m)
2	Connect the connectors (CN3, CN6).
3	Attach the gyro board mounting plate to Arm1. A S01: 4-M3x8 (2.0 +/- 0.1 N·m)
4	Install the LED Cover.

2.7.2 Replacing Gyro Board 2

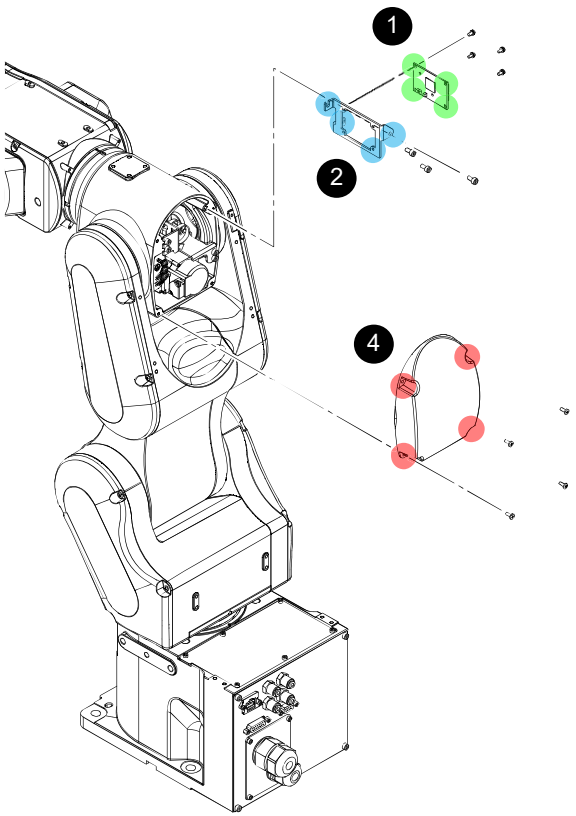


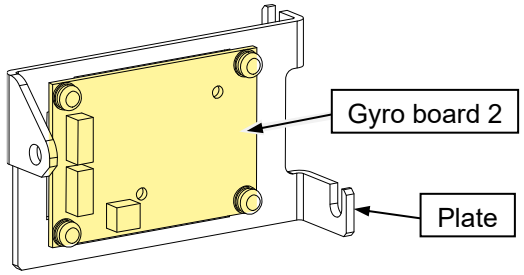
Removing Gyro Board 2



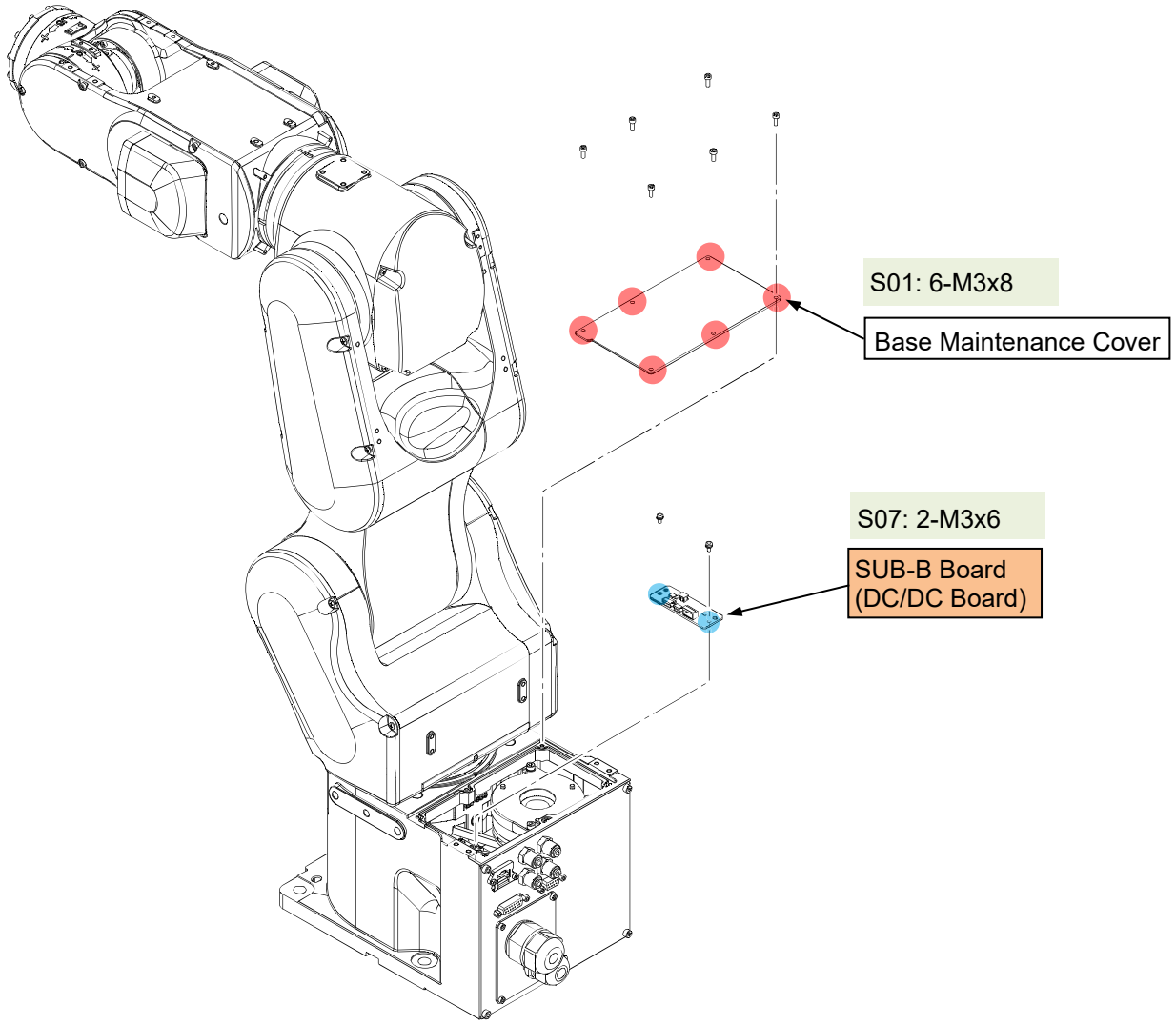
1	Turn OFF the Controller.
2	Remove the Arm3 head cover.
3	Disconnect the connector (CN3).
4	Remove the screws fixing the plate, and pull out gyro board 2 and the plate from Arm3. A S01: 3-M4x8
5	Remove gyro board 2 from the plate. A S03: 4-M3x6

Installing Gyro Board 2

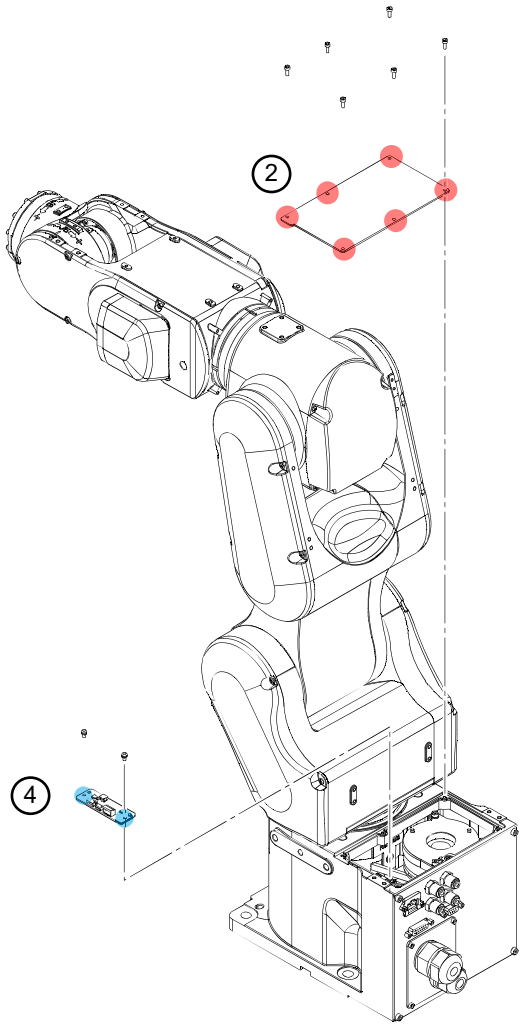


1	Install gyro board 2 on the plate. **CAUTION** Gyro board 2 installation has an assembly orientation. Be careful with the installation orientation. A S03: 4-M3x6 (0.45 +/- 0.1 N·m) 
2	Install the plate with gyro board 2 installed on Arm3. A S01: 3-M4x8 (4.0 +/- 0.2 N·m)
3	Connect the connector (CN3) to gyro board 2.
4	Install the Arm3 head cover.

2.7.3 Replacing the SUB-B Board (DC/DC Board)

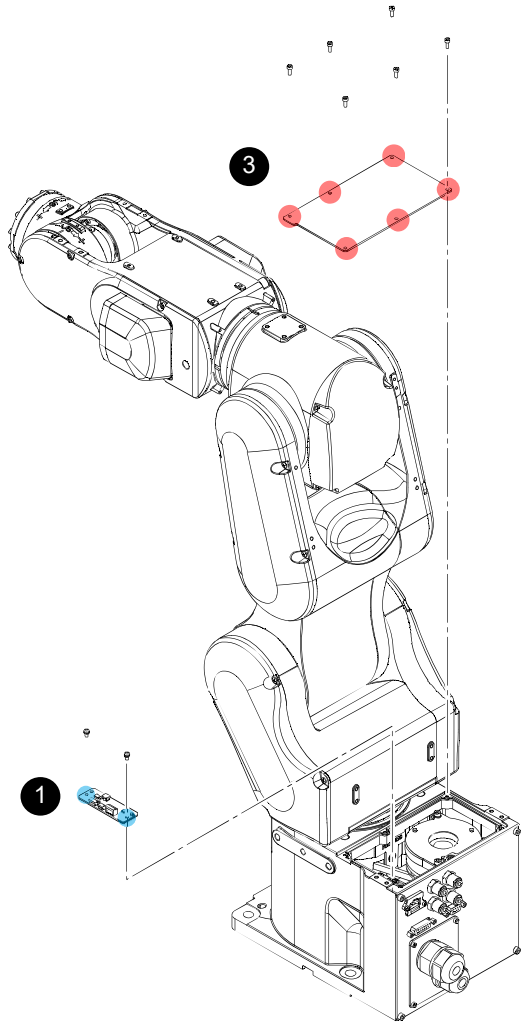


Removing the SUB-B Board (DC/DC Board)



1	Turn OFF the Controller.
2	Remove the Base Maintenance Cover.
3	Disconnect the connectors (CN1, CN2, CN3).
4	Remove the SUB-B Board (DC/DC Board). A S07: 2-M3x6

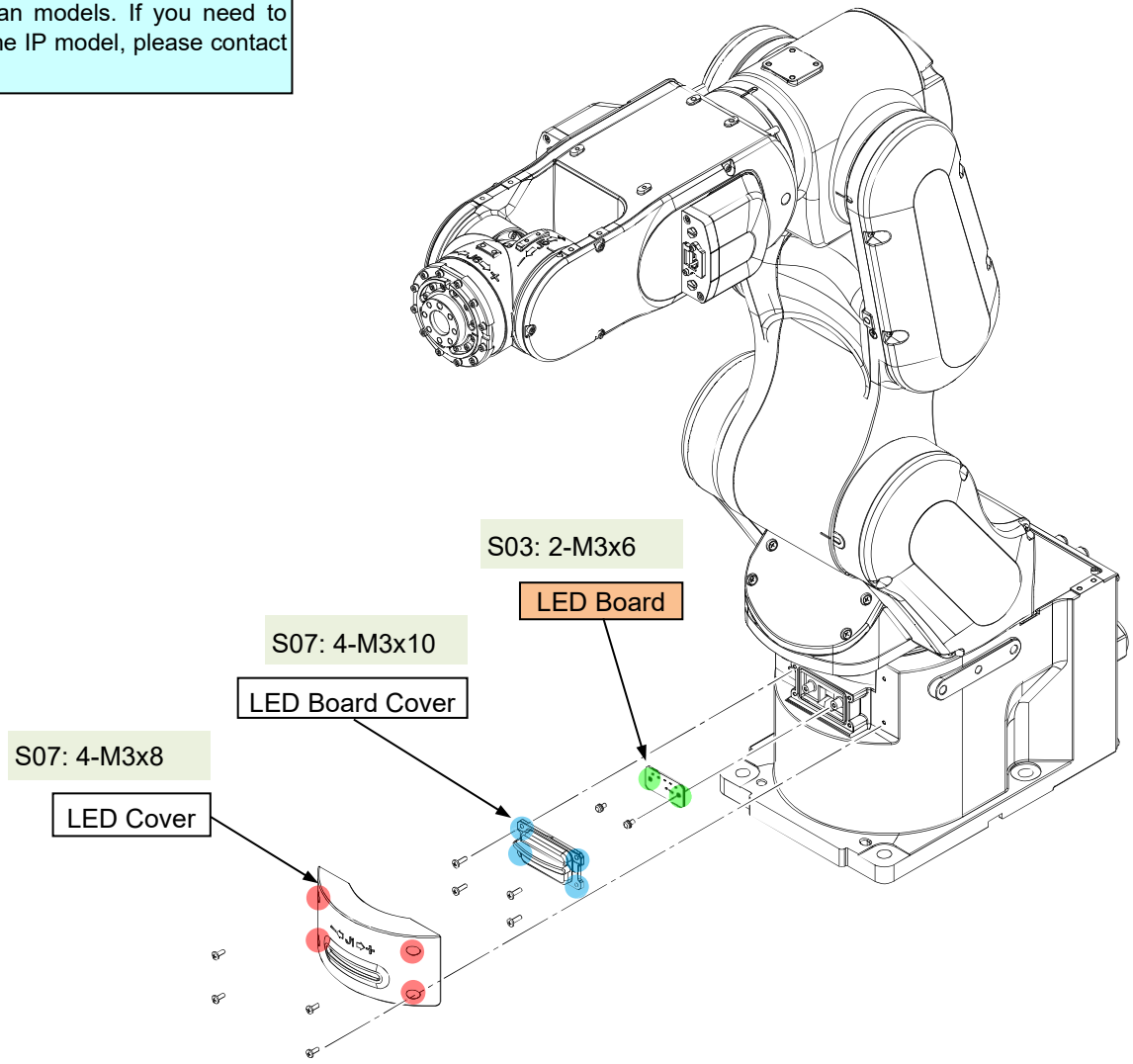
Installing the SUB-B Board (DC/DC Board)



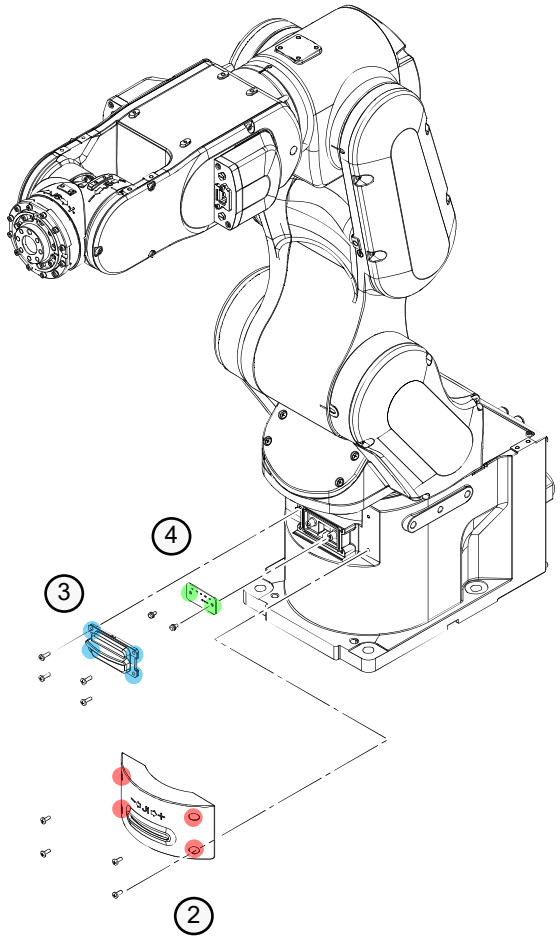
1	Install the SUB-B Board (DC/DC Board). A S07: 2-M3x6 (0.45 +/- 0.1 N·m)
2	Connect the connectors (CN1, CN2, CN3).
3	Install the Base Maintenance Cover.

2.7.4 Replacing the LED Board

This section provides procedures for replacing the LED Lamp on standard and clean models. If you need to replace the LED Lamp for the IP model, please contact the supplier.

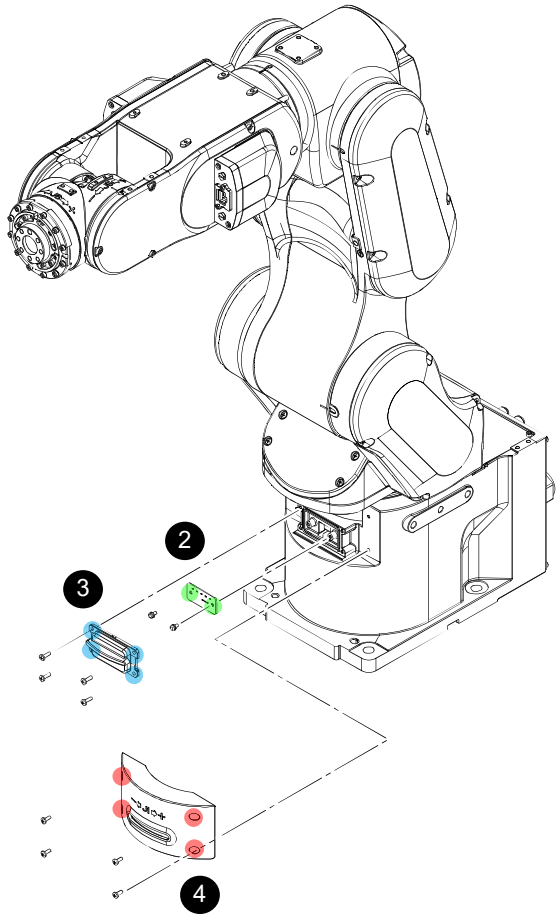


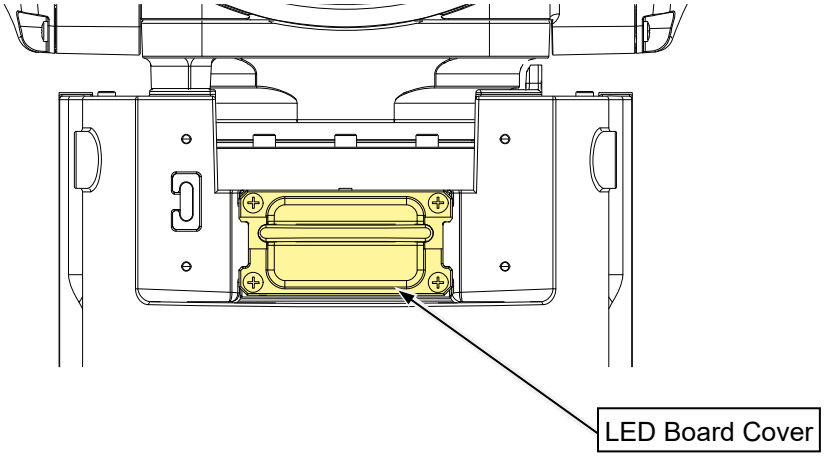
Removing the LED Board



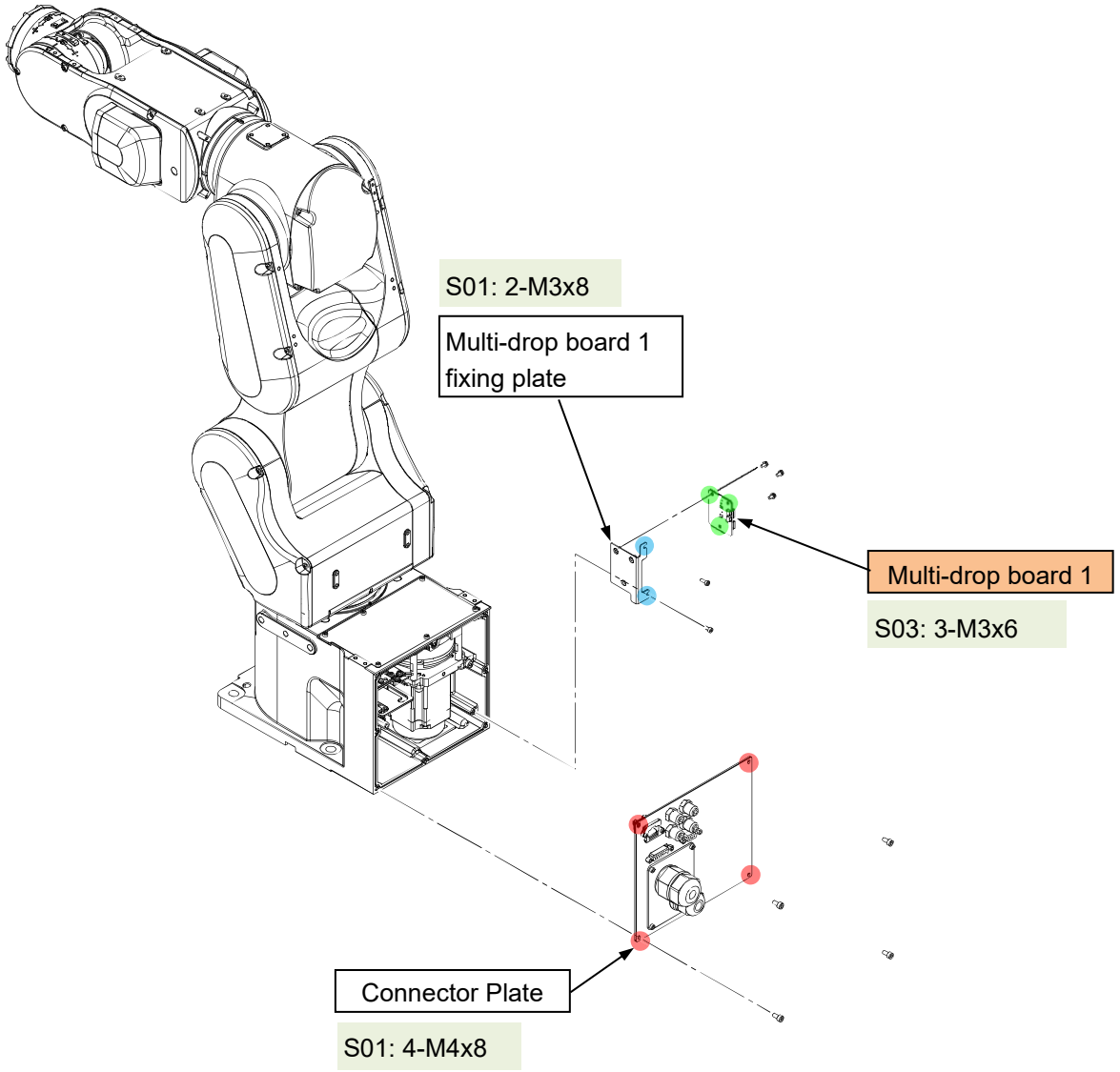
1	Turn OFF the Controller.
2	Remove the LED cover.
3	Remove the LED board cover. A S03: 4-M3x10
4	Remove the LED board from the base. A S03: 2-M3x6
5	Disconnect the following connectors. LED1-2, CN203-2

Installing the LED Board

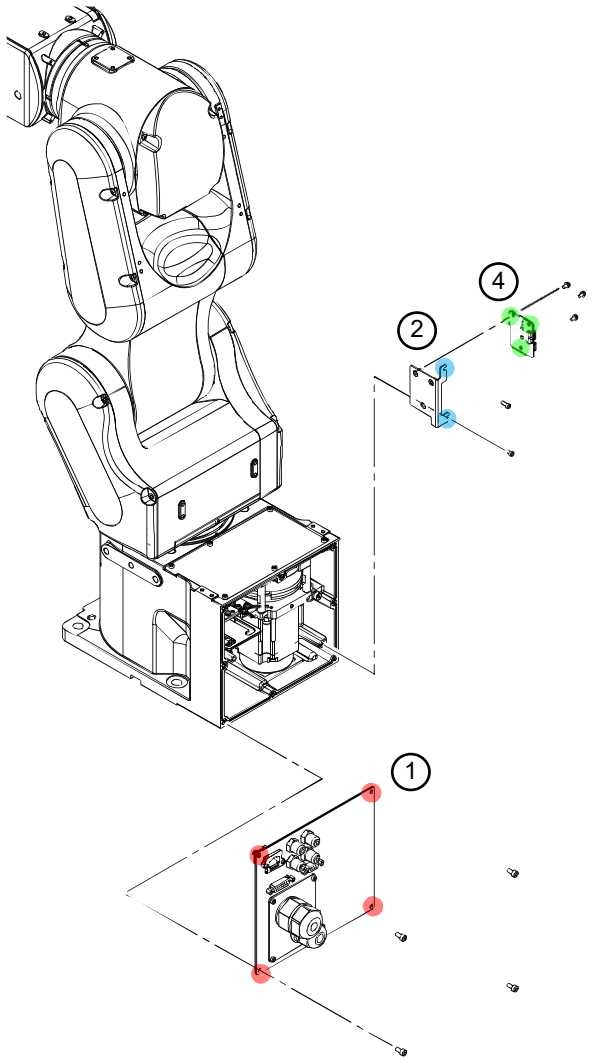


1	Connect the following connectors. LED1-2, CN203-2
2	Install the LED board on the base. A S03: 2-M3x6 (0.45 +/- 0.1 N·m)
3	Attach the LED board cover. **POINT** Install with the orientation shown in the figure. A S03: 4-M3x10 (0.45 +/- 0.1 N· m) 
4	Install the LED cover.

2.7.5 Replacing the Multi-drop Board 1

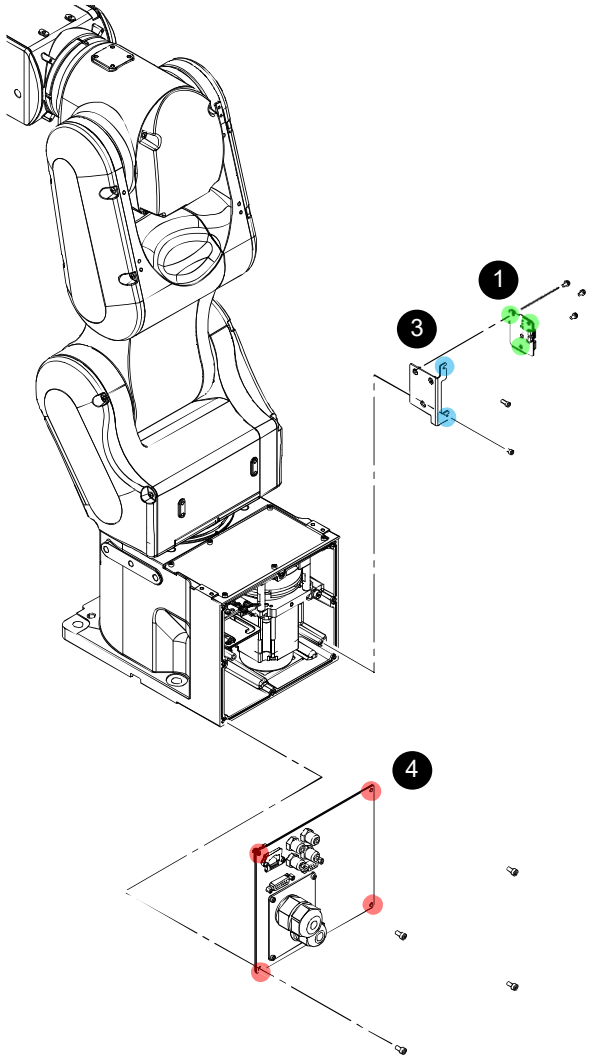


Removing the Multi-drop Board 1



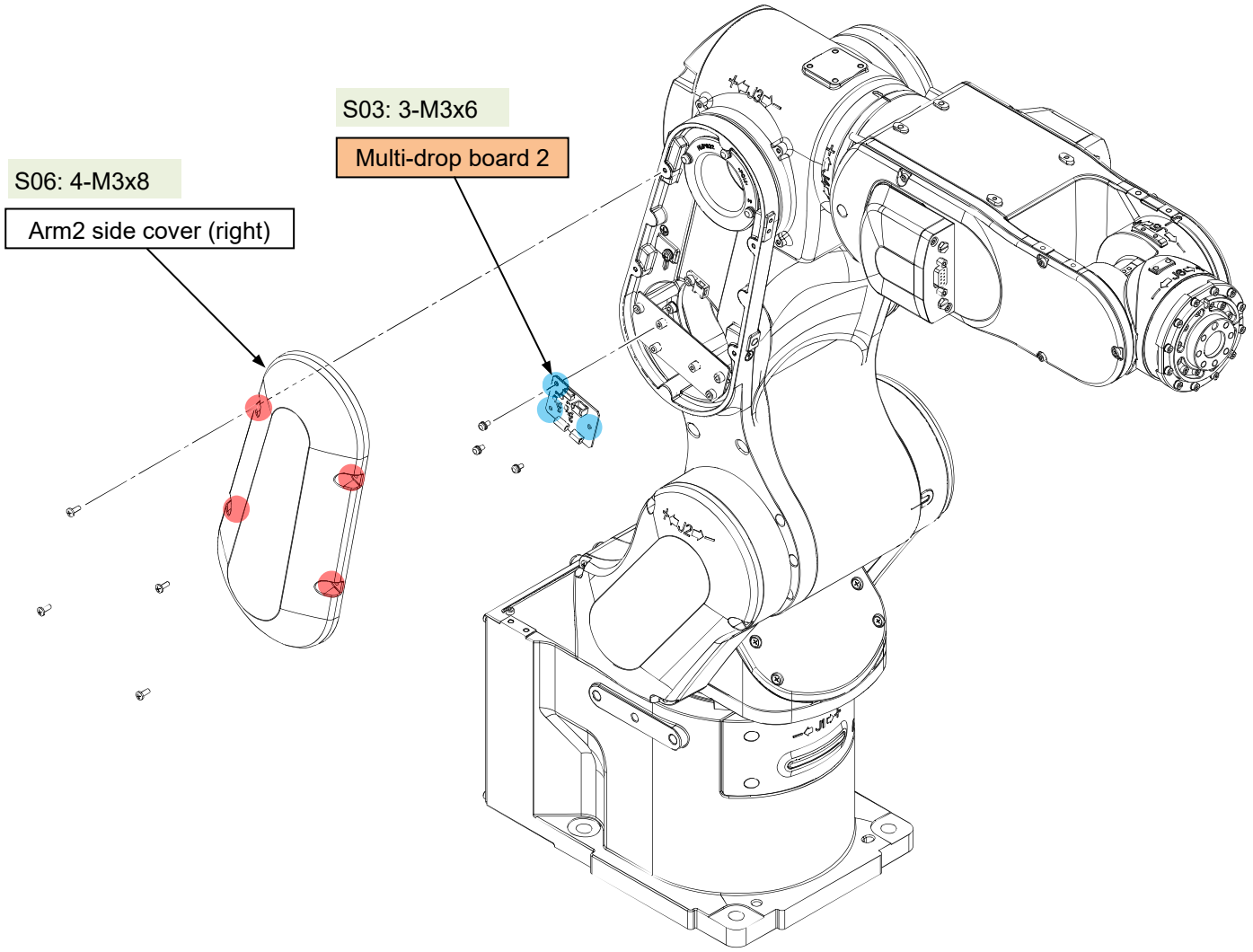
1	Remove the Connector Plate.
2	Remove the plate securing the multi-drop board 1 from the base. A S01: 2-M3x8
3	Disconnect the following connectors from the multi-drop board 1. CN11, CN12, CN31, CN32
4	Remove the multi-drop board 1 from the plate. A S03: 3-M3x6

Installing the Multi-drop Board 1

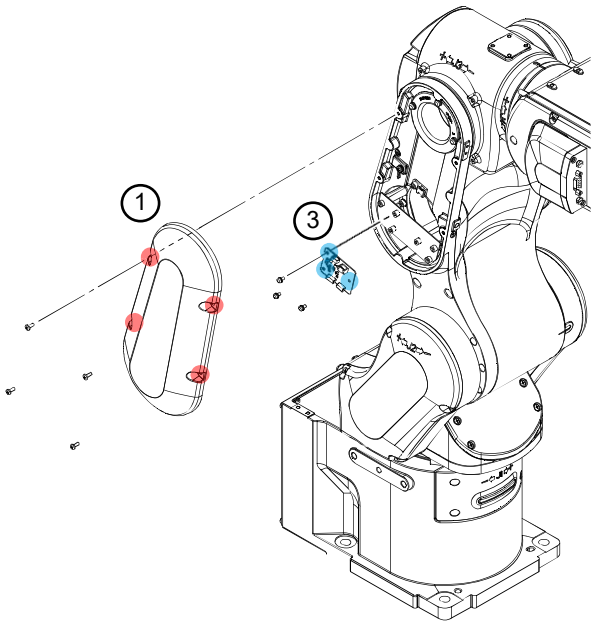


1	Install the multi-drop board 1 on the plate. A S03: 3-M3x6
2	Connect the following connectors to the multi-drop board 1. CN11, CN12, CN31, CN32
3	Attach the plate securing the multi-drop board 1 to the base. A S01: 2-M3x8
4	Install the Connector Plate.

2.7.6 Replacing the Multi-drop Board 2

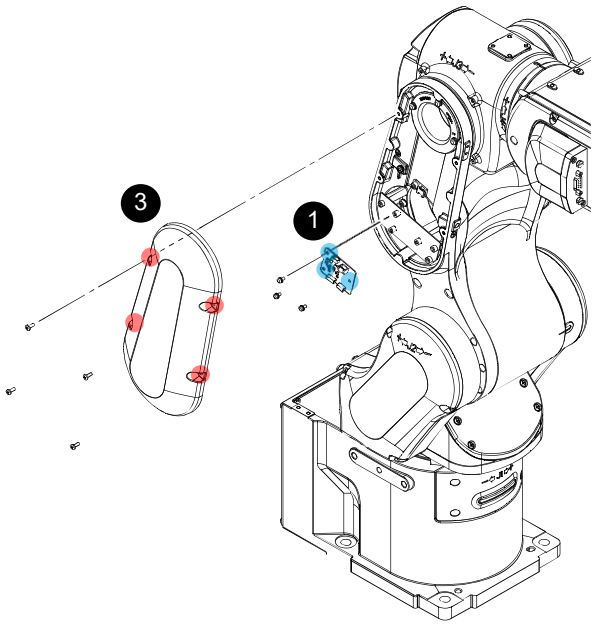


Removing the Multi-drop Board 2



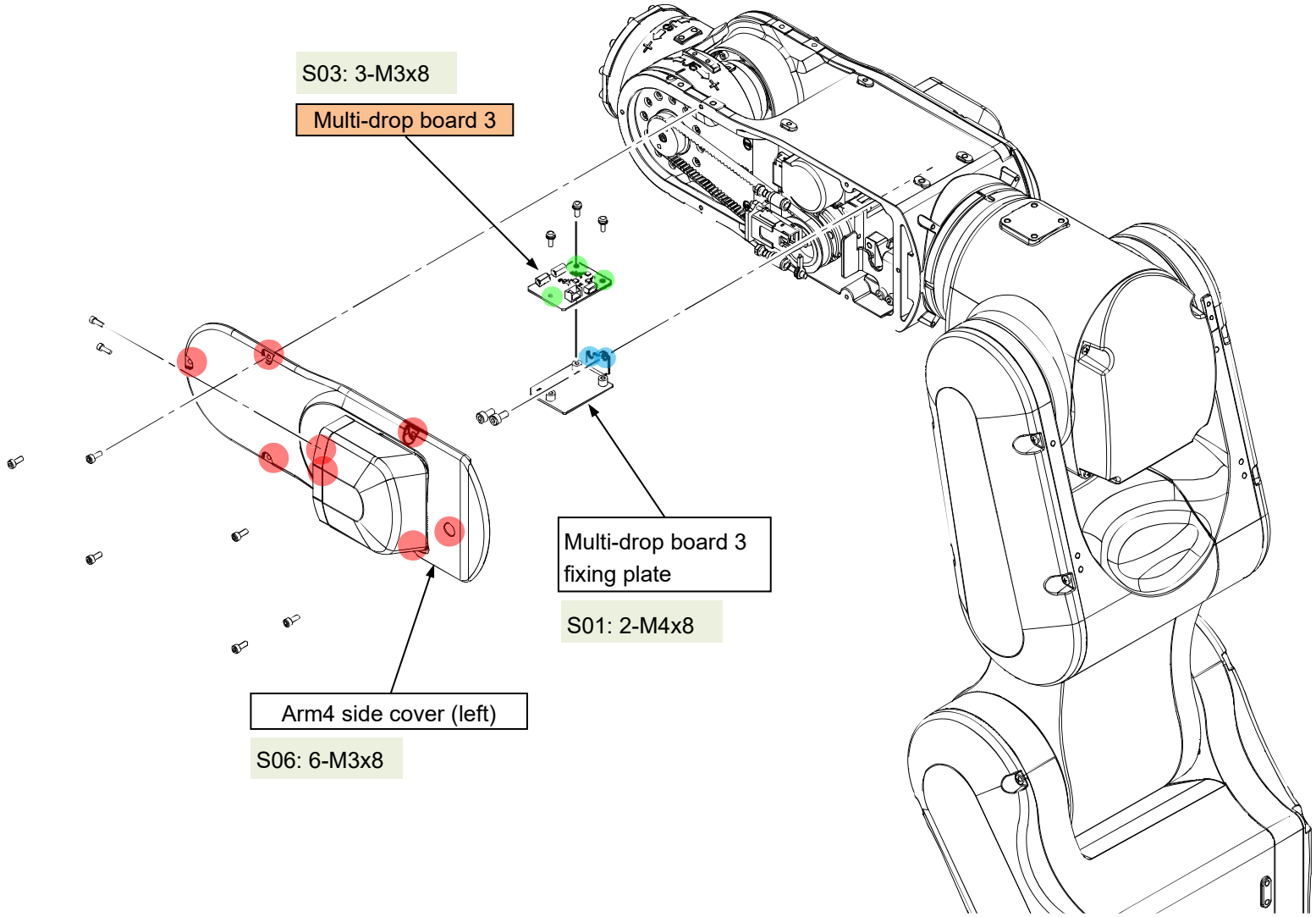
1	Remove the Arm2 side cover (right).
2	Disconnect the following connectors from the multi-drop board 2. CN11, CN12, CN31, CN32
3	Remove the multi-drop board 2 from the plate securing the multi-drop board 2. A S03: 3-M3x6

Installing the Multi-drop Board 2

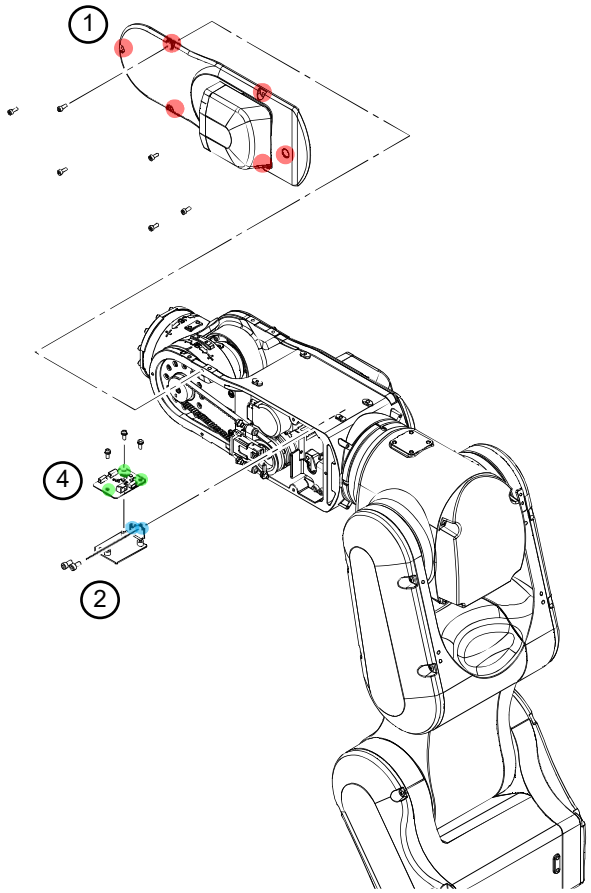


1	Install the multi-drop board 2 on the plate. A S03: 3-M3x8
2	Connect the following connectors to the multi-drop board 2. CN11, CN12, CN31, CN32
3	Install the Arm2 side cover (right).

2.7.7 Replacing the Multi-drop Board 3

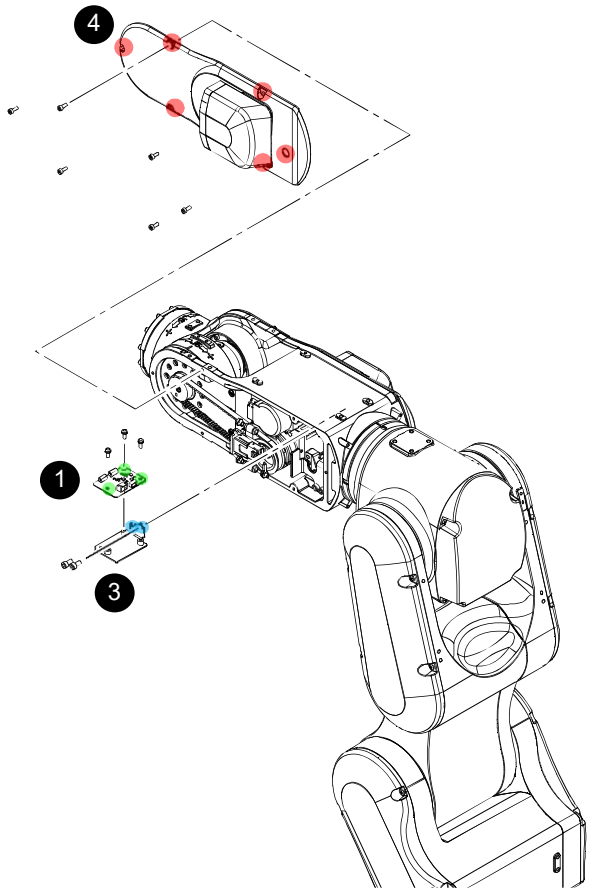


Removing the Multi-drop Board 3



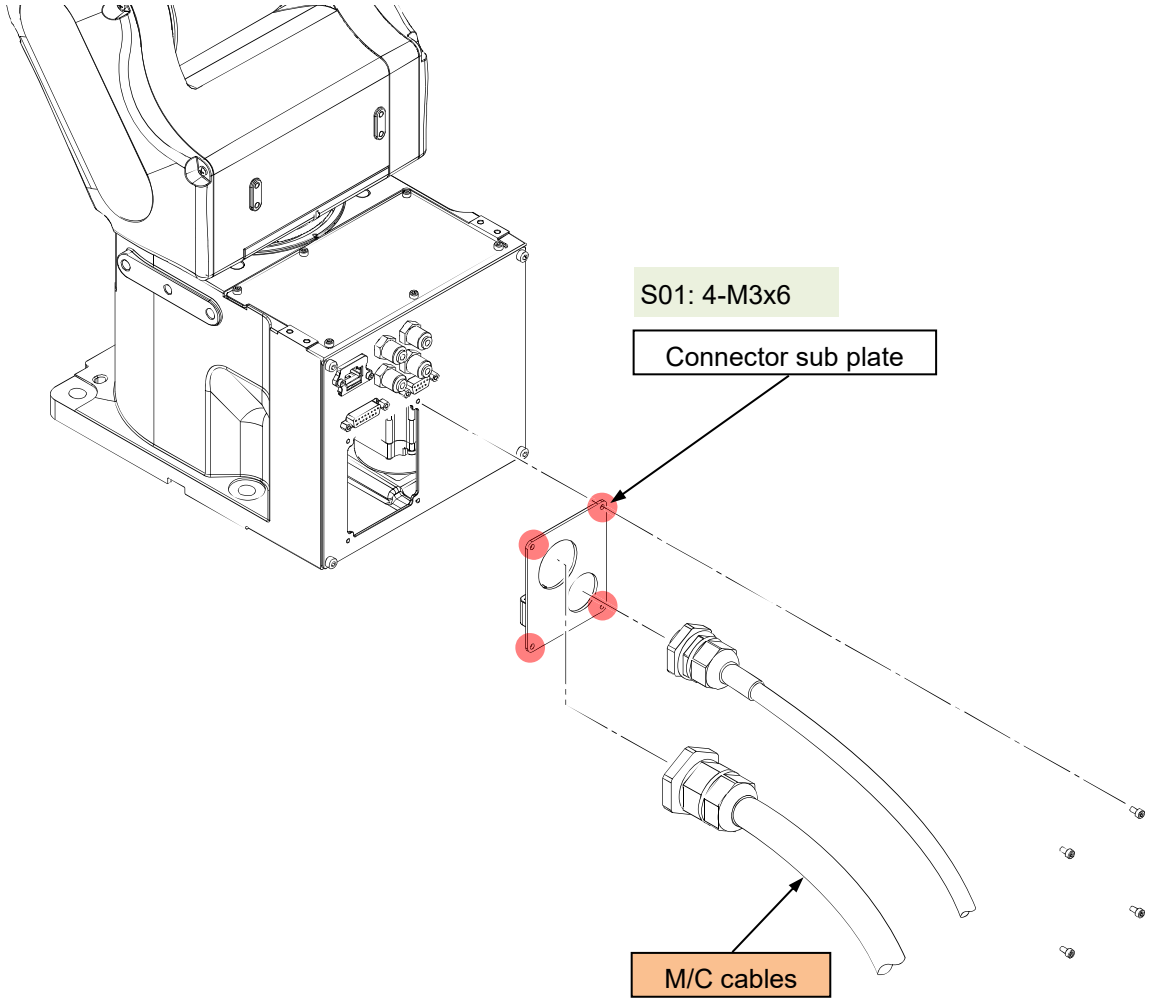
1	Remove the Arm4 side cover (left).
2	Remove the plate securing the multi-drop board 3 from the Arm4. A S01: 2-M4x8
3	Disconnect the following connectors from the multi-drop board 3. CN11, CN12, CN31, CN32
4	Remove the multi-drop board 3 from the plate. A S03: 3-M3x8

Installing the Multi-drop Board 3

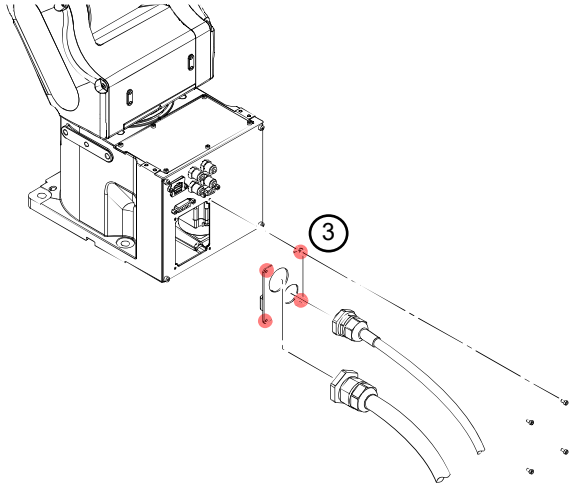


1	Install the multi-drop board 3 on the plate. A S03: 3-M3x8
2	Connect the following connectors to the multi-drop board 3. CN11, CN12, CN31, CN32
3	Attach the plate securing the multi-drop board 3 to the Arm4. A S01: 2-M4x8
4	Install the Arm4 side cover (left).

2.8 Replacing the M/C Cable

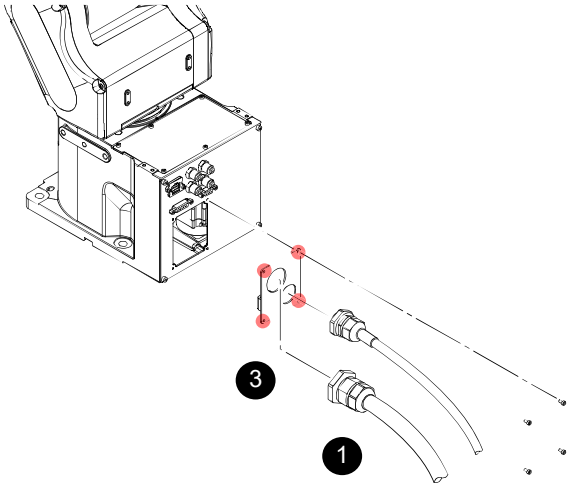


2.8.1 Removing the M/C Cable



1	Turn OFF the Controller.
2	Disconnect the following connectors from the Controller. Power cable connector, Signal cable connector
3	Remove the connector sub plate from the connector plate. A S01: 4-M3x6
4	Remove the screws securing the connector plate inside the base, then slide the connector plate toward you. A S01: 2-M3x8
5	Disconnect the following M/C cable connectors. CN2A3-1, CN2A2-1, CN2A1-1, CN2B2-1, CN2B1-1

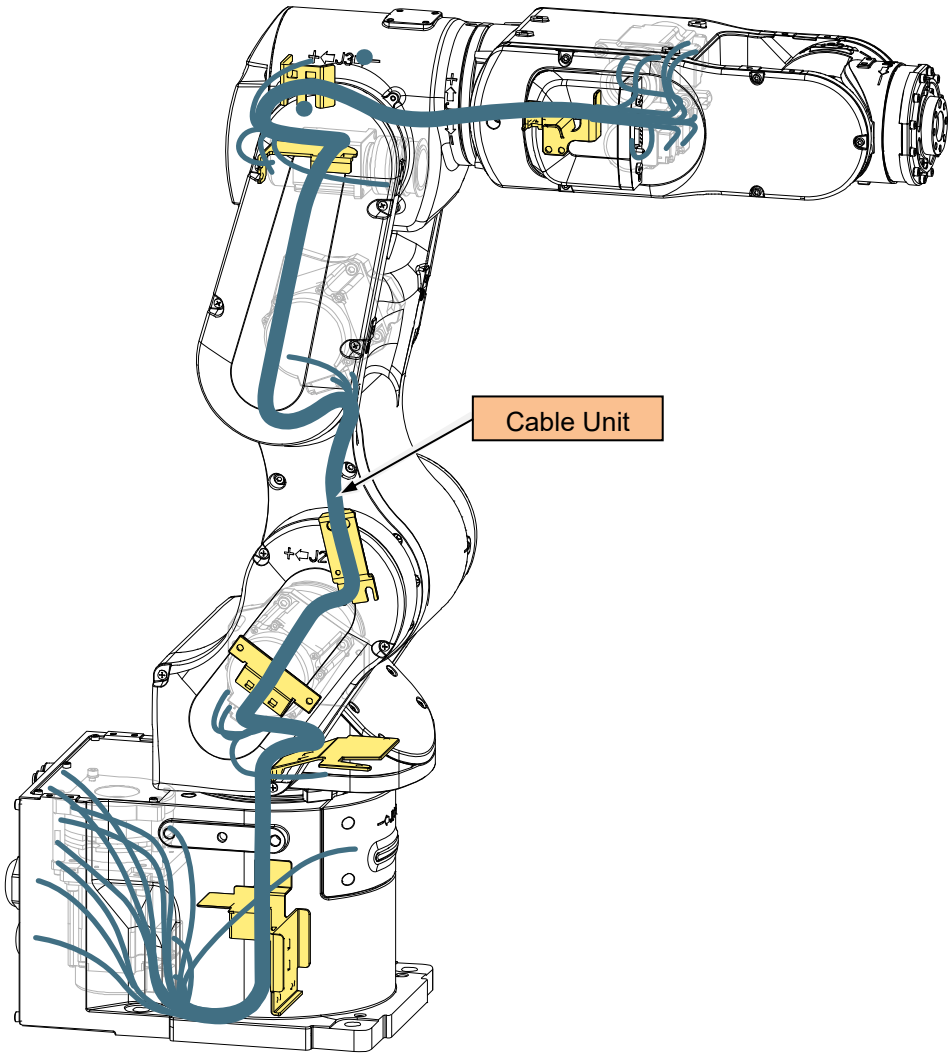
2.8.2 Installing the M/C Cable



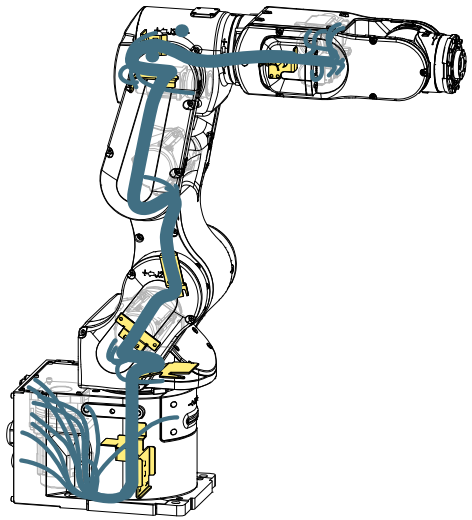
1	Connect the connectors of the M/C cable to the connectors of the cable unit. CN2A3-1, CN2A2-1, CN2A1-1, CN2B2-1, CN2B1-1
2	Slide the connector plate toward the rear inside the base to install it. A S01: 2-M3x8 (2.0 +/- 0.1 N·m)
3	Attach the connector sub plate to the connector plate. A S01: 4-M3x6 (2.0 +/- 0.1 N·m)
4	Connect the following connectors to the Controller. Power cable connector, Signal cable connector
5	Turn ON the controller.

2.9 Replacing the Cable Unit

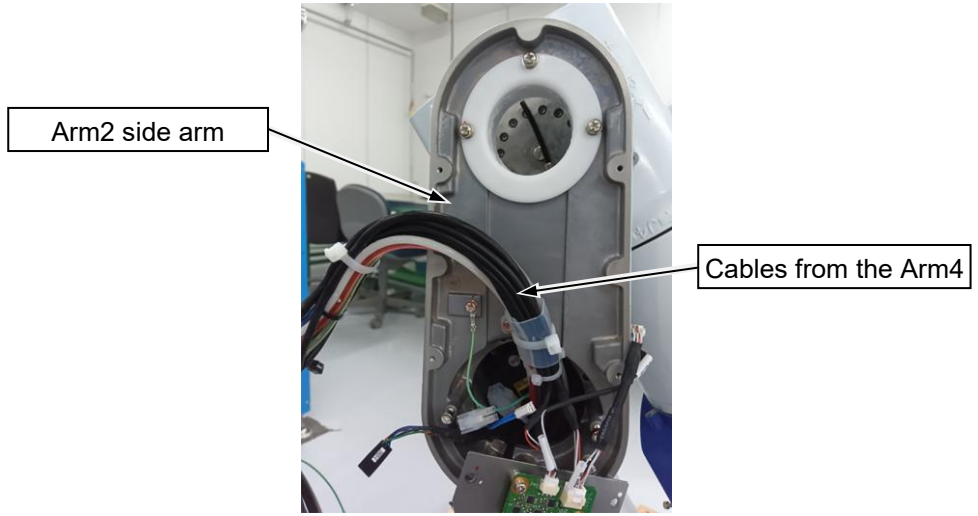
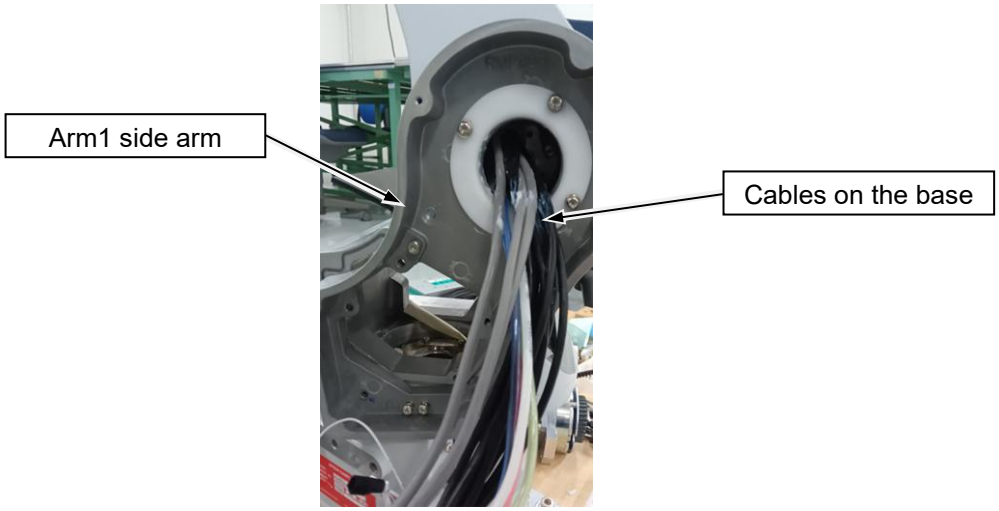
2.9.1 Removing the Cable Unit

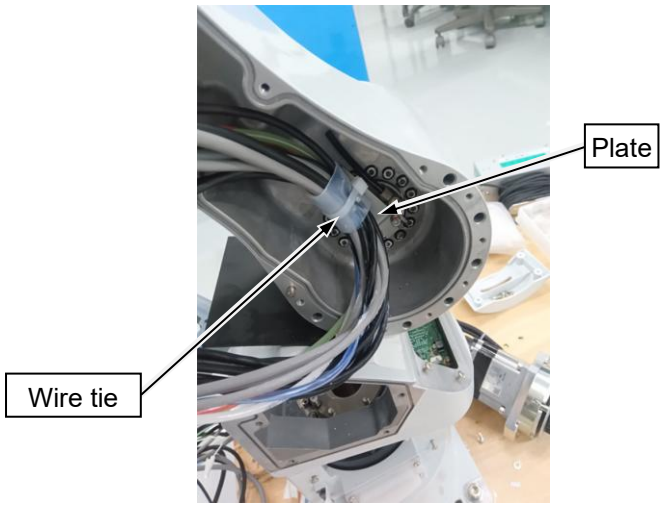


Removing the Cable Unit

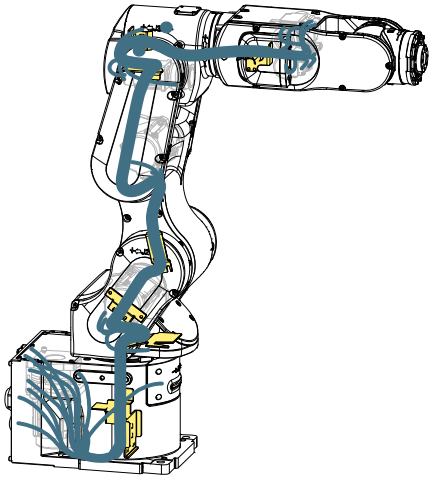


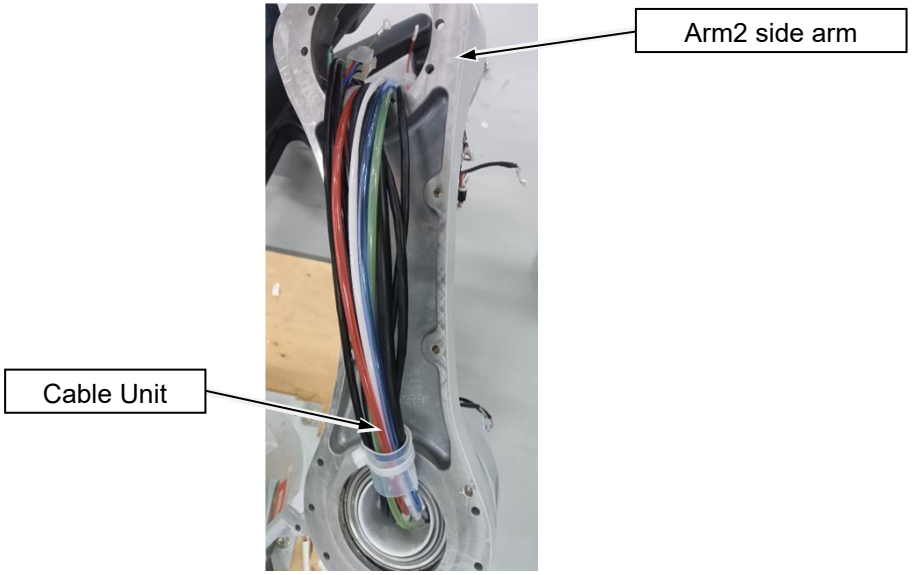
1	Remove the Arm1 side cover, Arm1 center cover, Arm2 side cover, Arm3 head cover, and Arm4 side cover.
2	Remove the J1 Timing Belt. Perform all steps in Removing the J1 Timing Belt.
3	Disconnect the following connectors and ground wires connected to the cable unit. CN3, CN6 (Arm1, Arm3), CN11-M3, CN31-M3, CN321, CN331, CN341, CN121, CN131, CN141, CN151, CN161, CN420, CN430, CN440, CN402,FB06, FB08, FB14, PE11, PE12, LED, RJ45 (Arm4), D-sub (Arm4)
4	Remove the J3 Timing Belt.
5	Remove the J3 Reduction Gear pulley.
6	Remove Gyro Board 2.
7	Remove the multi-drop board 2 fixing plate.
8	Remove the multi-drop board 3 fixing plate. Perform steps (1) and (2) in Removing Multi-drop Board 3.
9	Cut the wire ties binding the cable unit, except those near the Reduction Gear in Arm2.
10	Remove the plates attached to the cable unit, except those near the Reduction Gear in Arm2.

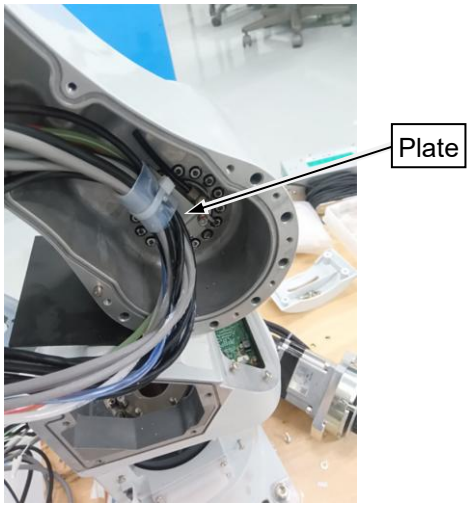
(11)	Pull the cables from the Arm4 side to the Arm3 side and let the cables hang down from the Arm2 side arm as shown in the photograph. 
(12)	Pull the cables coming from the base towards Arm1 and let the cables hang down from the Arm1 side arm as shown in the photograph. 

(13)	Remove the Arm1 and Arm2 side arms, and Arm3, Arm4, Arm5, and Arm6. Perform steps (2) through (7) and steps (13) through (16) in Removing the J2 Reduction Gear.
(14)	Remove the plate fixed to the Arm2 Reduction Gear flange, and cut the wire tie. 
(15)	Remove the cable from the Arm2 side arm.

2.9.2 Installing the Cable Unit



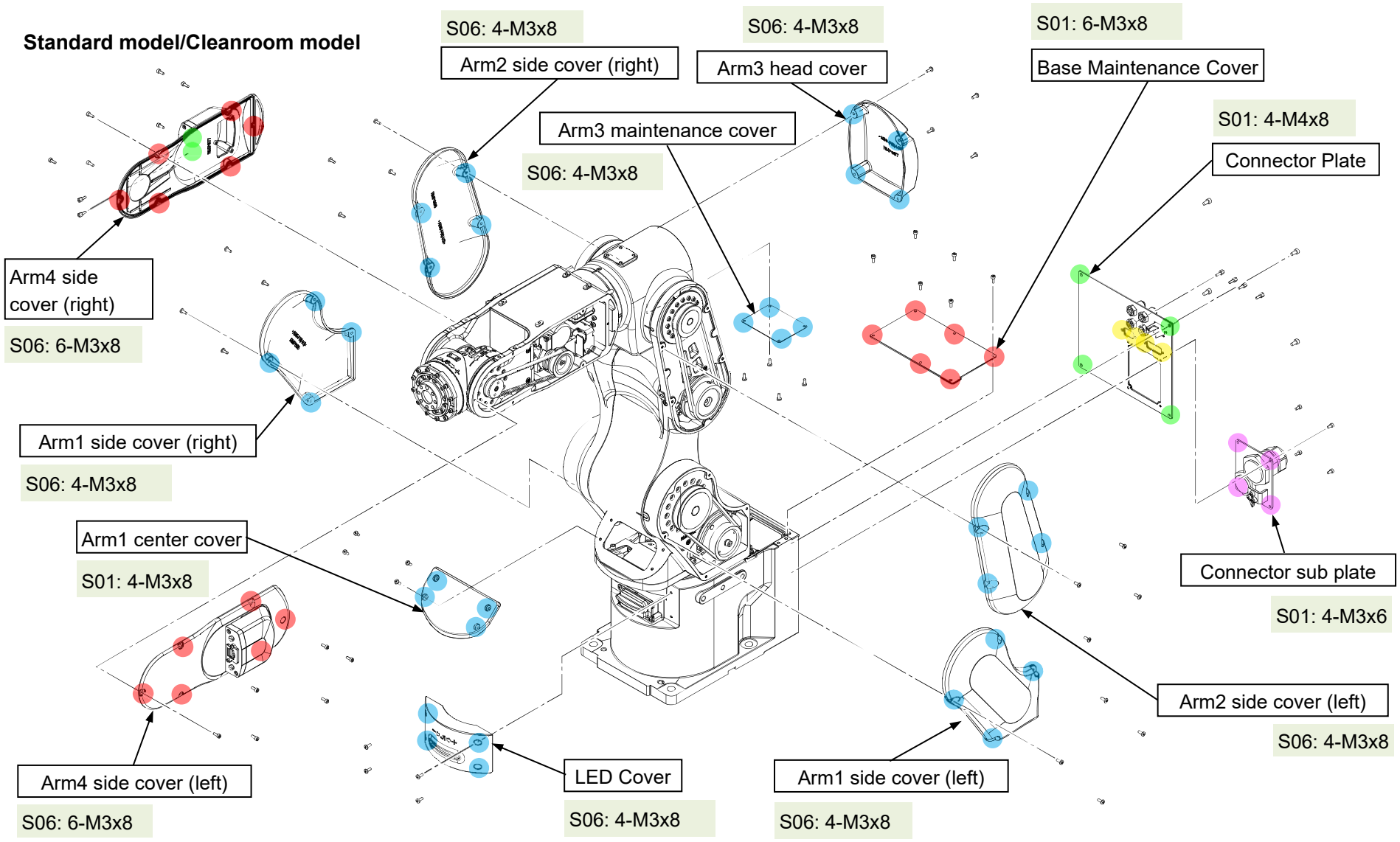
1	Wind masking tape around the connectors of the cable unit.
2	Pass the cable unit through the Arm2 side arm. 
3	Attach the plate fixed to the Reduction Gear flange inside Arm2 to the cable unit. **POINT** Wrap the silicone sheet around the cable unit and secure the plate with a wire tie.

4	Attach the plate that was installed at step (3) to the Reduction Gear flange inside Arm2. 
5	Install the Arm1 and Arm2 side arms, and Arm3, Arm4, Arm5, and Arm6. Perform steps (10) to (16) in Installing the J2 Reduction Gear.
6	Pass the cable unit from the base to Arm4.
7	Install the J1 Timing Belt. Perform steps (2) to (13) in Installing the J1 Timing Belt.
8	Attach the remaining plate and the cable unit wrapped with silicone sheets using wire ties.
9	Install Gyro Board 2.
10	Install the multi-drop board 2 fixing plate.
11	Install the multi-drop board 3 fixing plate. Perform the steps from the first step to step (3) in Installing Multi-drop Board 3.

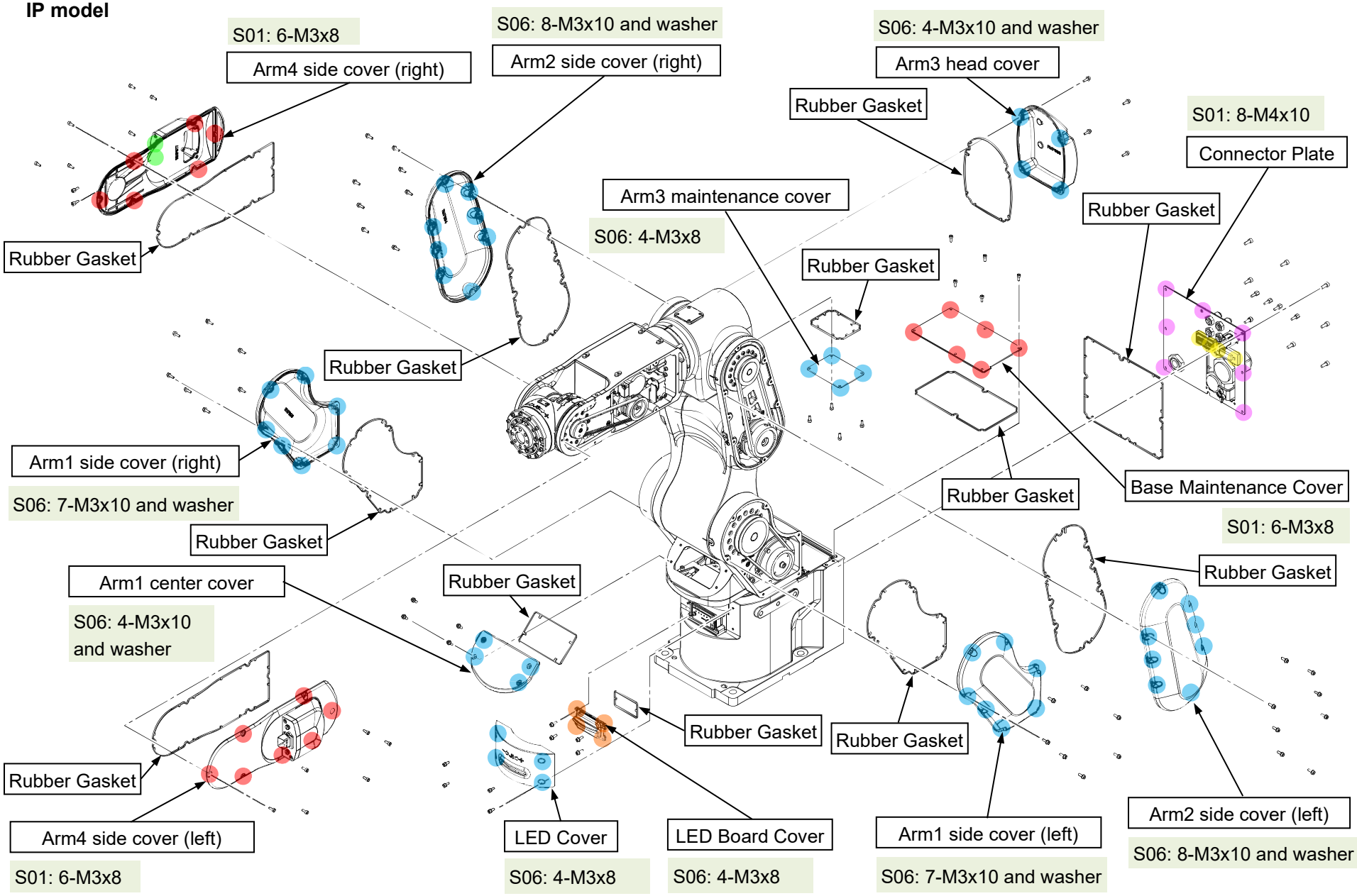
12	Install the J3 Reduction Gear pulley.
13	Install the J3 Timing Belt. Perform the steps from the first step to step (3) in Installing the J3 Timing Belt.
14	Connect the following connectors. CN3, CN6 (Arm1, Arm3), CN11-M3, CN31-M3, CN321, CN331, CN341, CN121, CN131, CN141, CN151, CN161, CN420, CN430, CN440, CN402,FB06, FB08, FB14, PE11, PE12, LED, RJ45 (Arm4), D-sub (Arm4)
15	Install the Arm1 side cover, Arm1 center cover, Arm2 side cover, Arm3 head cover, and Arm4 side cover.

2.10 Cover

Here are the main covers along with their names.

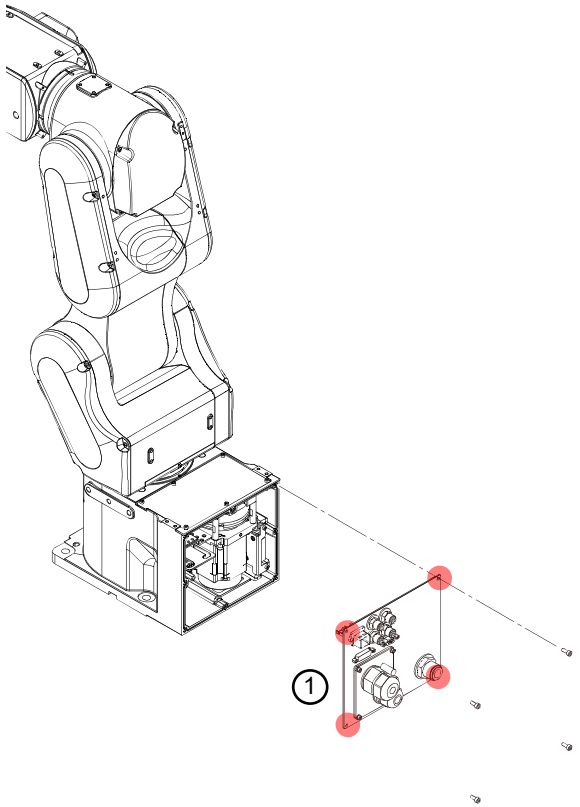


IP model


S01: 6-M3x8
Arm4 side cover (right)
S06: 8-M3x10 and washer
Arm2 side cover (right)
S06: 4-M3x10 and washer
Arm3 head cover
Rubber Gasket
S01: 8-M4x10
Connector Plate
Arm3 maintenance cover
S06: 4-M3x8
Rubber Gasket
Rubber Gasket
Rubber Gasket
Arm1 side cover (right)
S06: 7-M3x10 and washer
Rubber Gasket
Rubber Gasket
Base Maintenance Cover
S01: 6-M3x8
Arm1 center cover
S06: 4-M3x10 and washer
Rubber Gasket
Rubber Gasket
Rubber Gasket
Rubber Gasket
Rubber Gasket
Arm4 side cover (left)
S01: 6-M3x8
LED Cover
S06: 4-M3x8
LED Board Cover
S06: 4-M3x8
Arm1 side cover (left)
S06: 7-M3x10 and washer
Arm2 side cover (left)
S06: 8-M3x10 and washer

2.10.1 Connector Plate

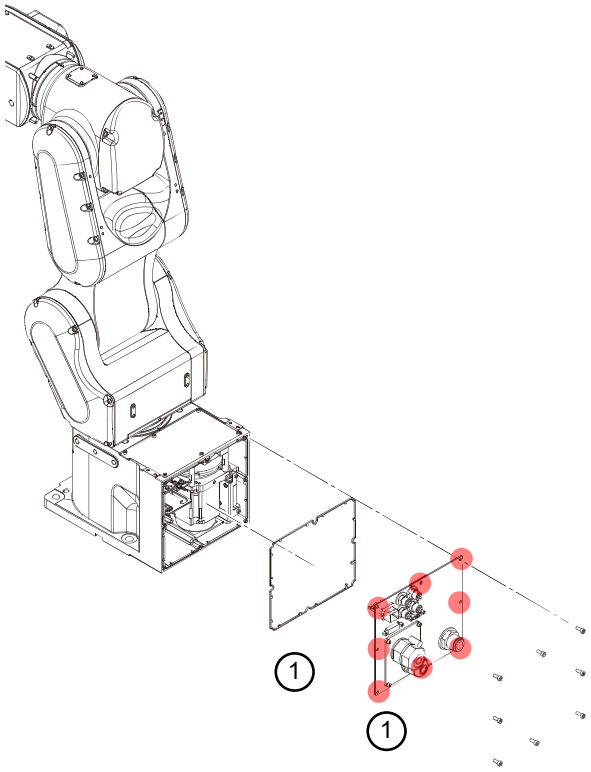
Standard model/Cleanroom model



	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. • At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement. • When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
1	Remove the Connector Plate. A S01: 4-M4x8 (4.0 +/- 0.2 N·m)

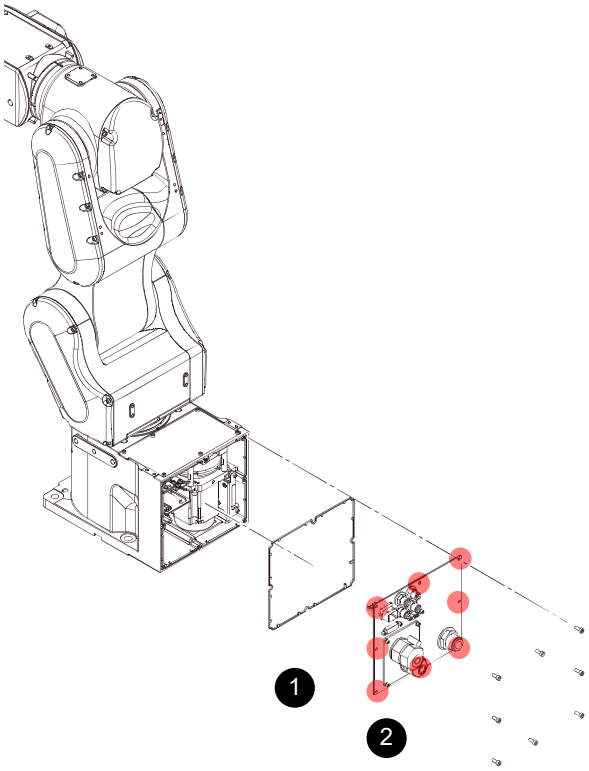
IP model

A. Removal



	CAUTION • Do not pull the Connector Plate with force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system. • At reassembly, check the cable arrangement when removing the Connector Plate in order to return to a reasonable wiring arrangement.
1	Remove the Connector Plate. **POINT** When removing the Connector Plate, also remove the base rear gasket. A S01: 8-M4x10

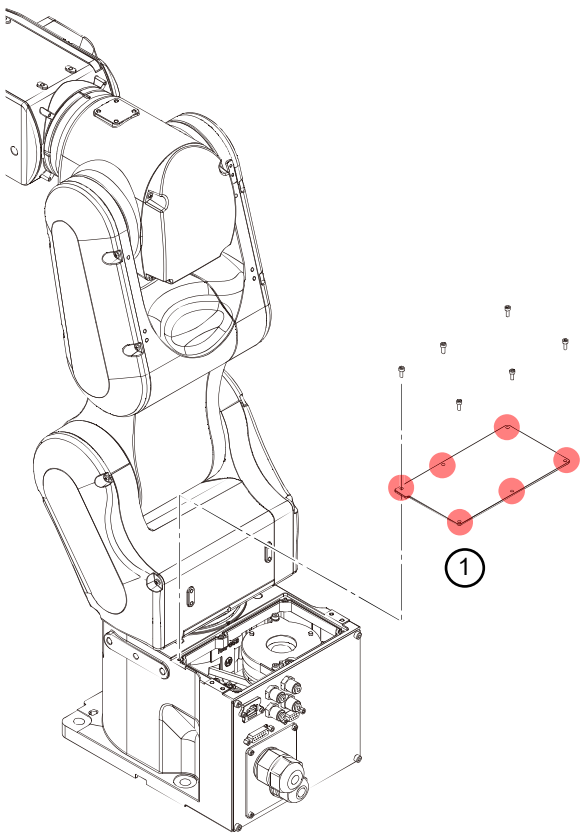
B. Installation



	CAUTION When installing the Connector Plate, do not nip the Rubber Gasket or cables, or bend and push them in using excessive force. It may result in damage to the cables, disconnection, and/or contact failure. These are extremely hazardous and may result in electric shock and/or improper function of the robot system.
1	Install the Base Rear Rubber Gasket into the base groove. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Install the Connector Plate. A S01: 8-M4x10 (4.0 +/- 0.2 N·m)

2.10.2 Base Maintenance Cover

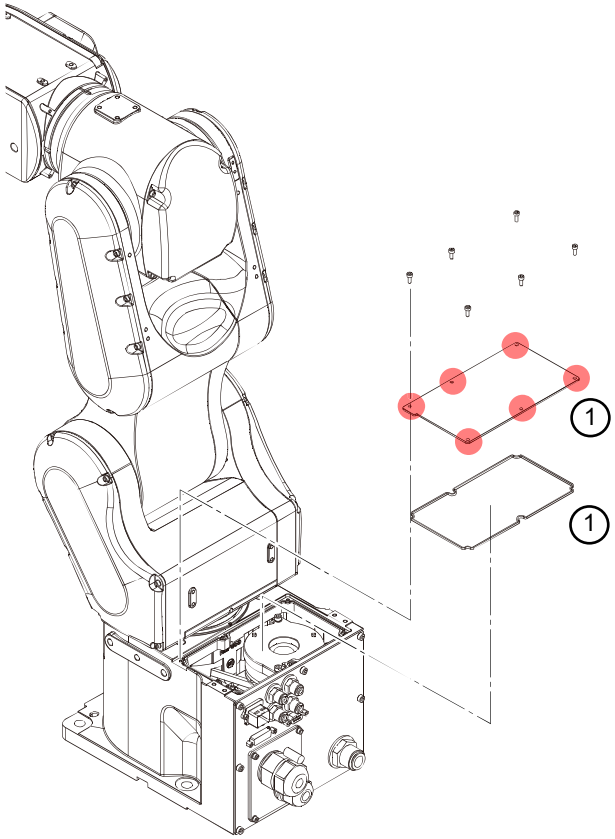
Standard model/Cleanroom model



1	Remove the Base Maintenance Cover. A S01: 6-M3x8 (2.0 +/- 0.1 N·m)

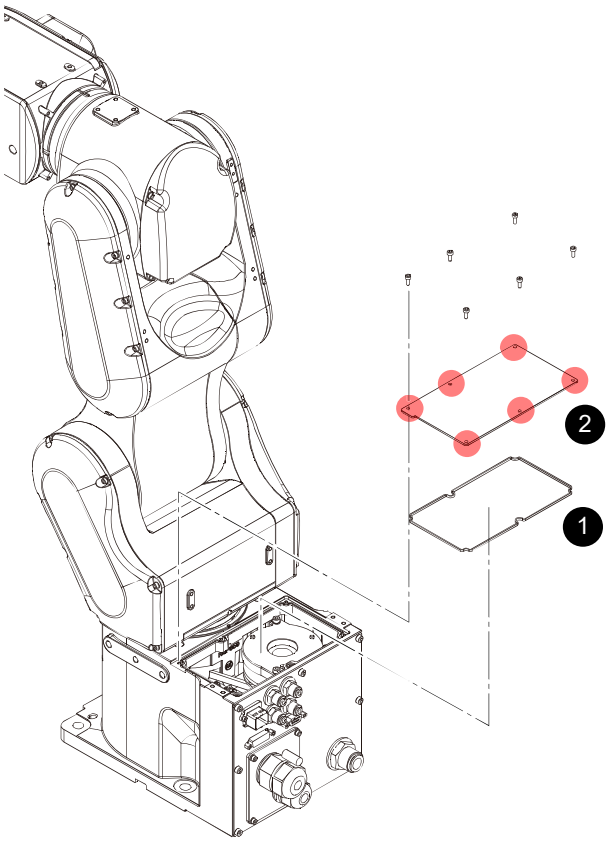
IP model

A. Removal



1	Remove the Base Maintenance Cover. **POINT** When removing the Base Maintenance Cover, also remove the base maintenance gasket. A S01: 6-M3x8

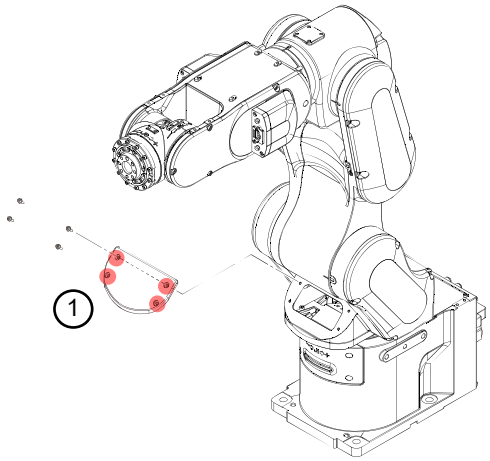
B. Installation



1	Install the Base Rear Rubber Gasket into the base groove. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Install the Base Maintenance Cover. **CAUTION** When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force. A S01: 6-M3x8 (2.0 +/- 0.1 N·m)

2.10.3 Arm1 center cover

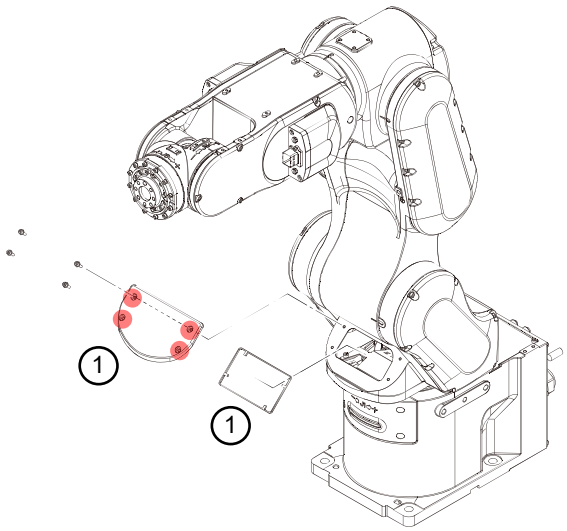
Standard model/Cleanroom model



1	Remove the Arm1 center cover. A S06: 4-M3x8 (0.9 +/- 0.1 N·m)

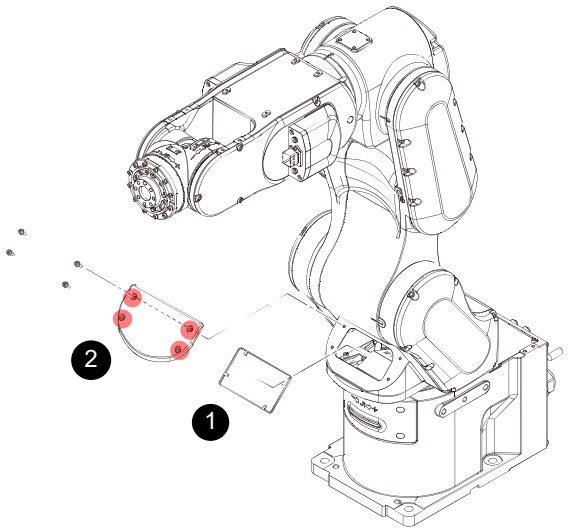
IP model

A. Removal



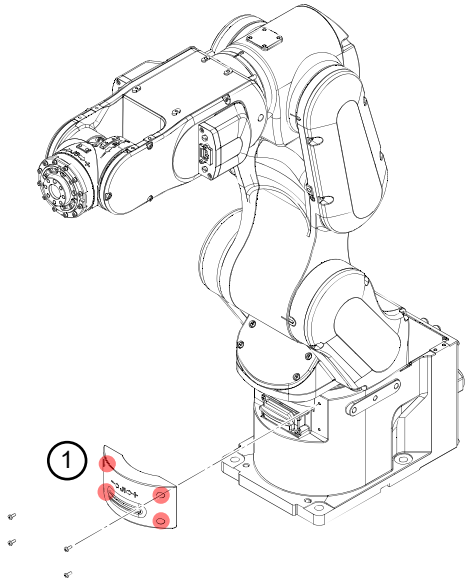
1	Remove the Arm1 center cover. **POINT** When removing the Arm1 center gasket. A S01: 4-M3x10 and washer

B. Installation



1	Install the Arm1 center gasket in the groove on the Arm1 center cover. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Install the Arm1 center cover. **CAUTION** When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force. A S01: 4-M3x10 and washer (2.0 +/- 0.1 N·m)

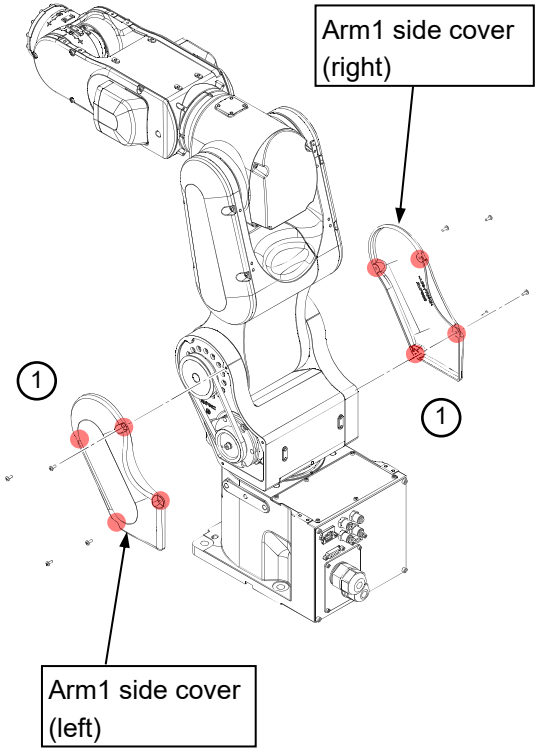
2.10.4 LED Cover



1	Remove the LED cover from the base. A S06: 4-M3x8 (0.9 +/- 0.1 N·m)

2.10.5 Arm1 side cover

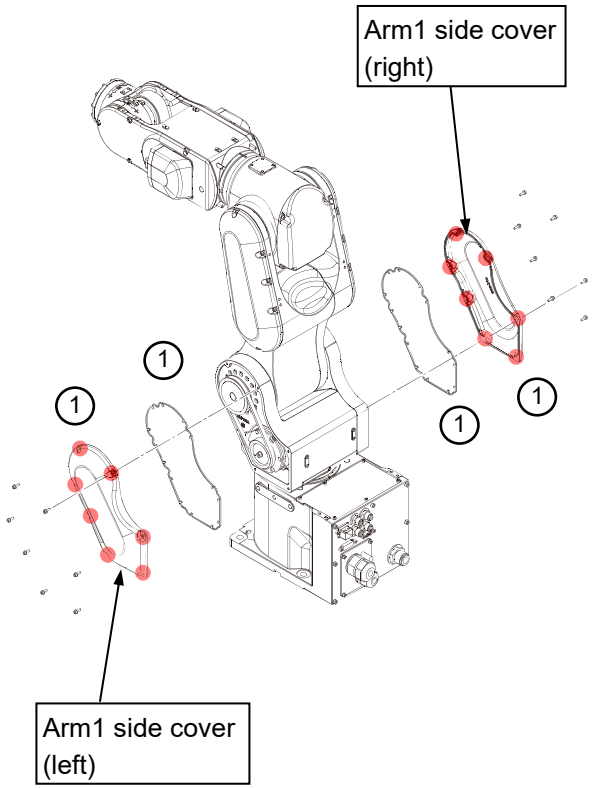
Standard model/Cleanroom model



1	Remove the Arm1 side cover. A S06: 4-M3x8 (0.45 +/- 0.1 N·m)

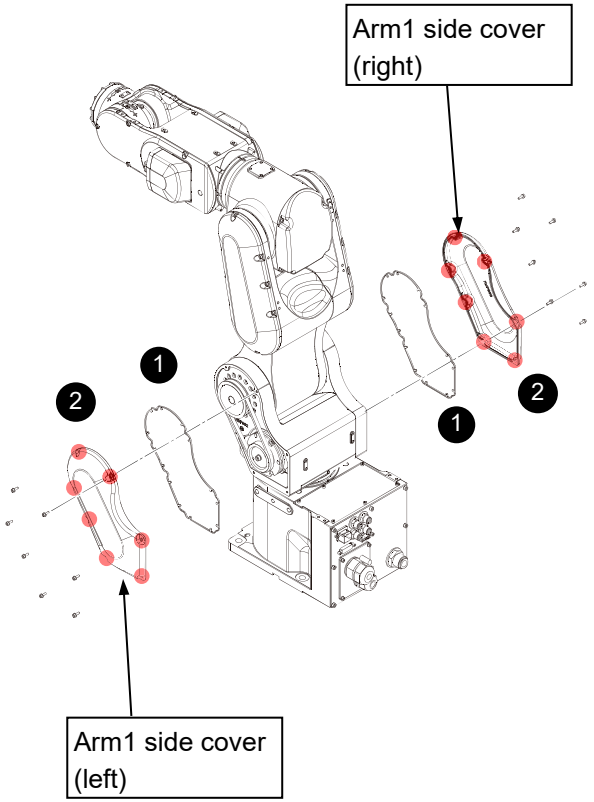
IP model

A. Removal



1	Remove the Arm1 side cover. **POINT** When removing the Arm1 side cover, also remove the Arm1 side gasket. A S01: 7-M3x10 and washer

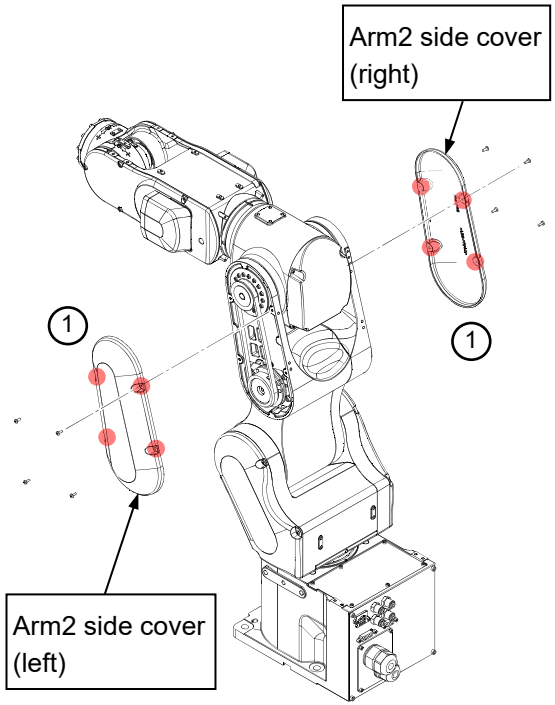
B. Installation



1	Install the Arm1 side gasket in the groove on the Arm1 side cover. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Install the Arm1 side cover on the Manipulator. **CAUTION** When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force. A S01: 7-M3x10 and washer (2.0 +/- 0.1 N·m)

2.10.6 Arm2 side cover

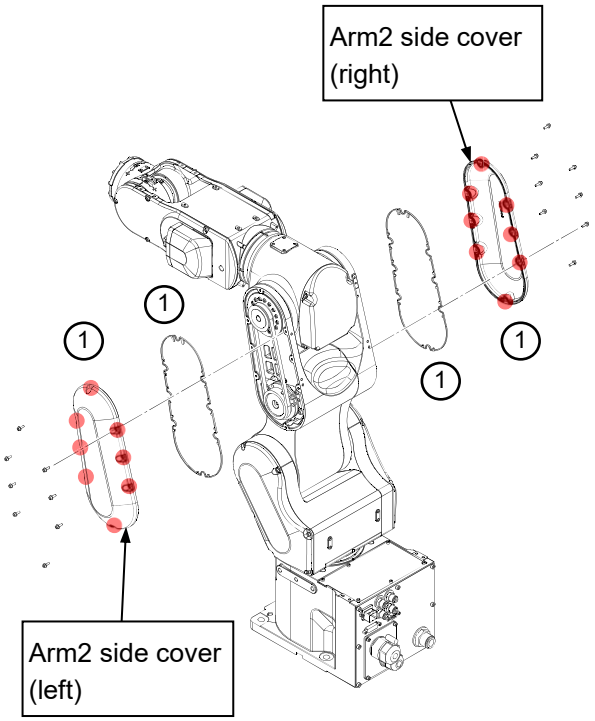
Standard model/Cleanroom model



1	Remove the Arm2 side cover. A S06: 4-M3x8 (0.45 +/- 0.1 N·m)

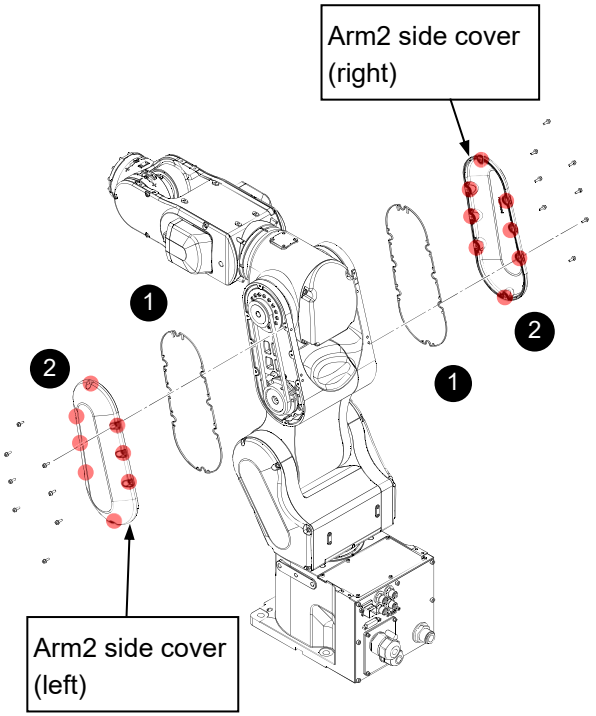
IP model

A. Removal



1	Remove the Arm2 side cover. **POINT** When removing the Arm2 side cover, also remove the Arm2 side gasket. A S01: 8-M3x10 and washer

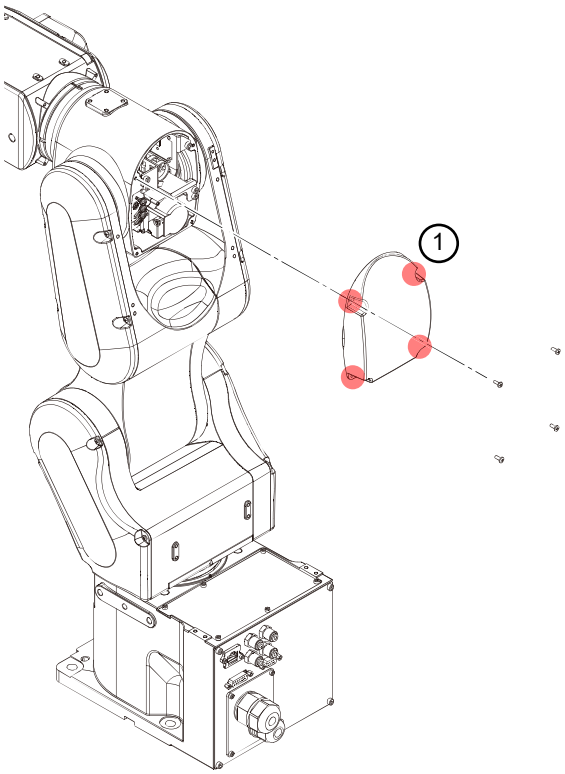
B. Installation



1	Install the Arm2 side gasket in the groove on the Arm2 side cover. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Install the Arm2 side cover on the Manipulator. **CAUTION** When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force. A S01: 8-M3x10 and washer (2.0 +/- 0.1 N·m)

2.10.7 Arm3 head cover

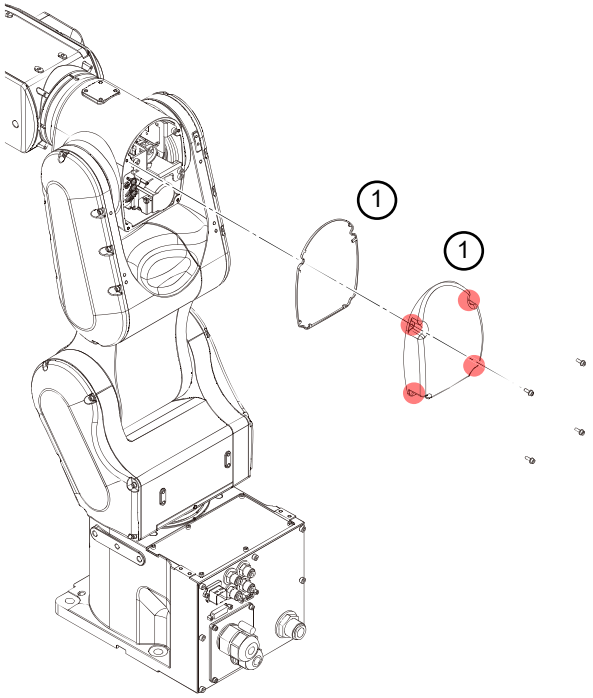
Standard model/Cleanroom model



1	Remove the Arm3 head cover. A S06: 4-M3x8 (0.45 +/- 0.1 N·m)

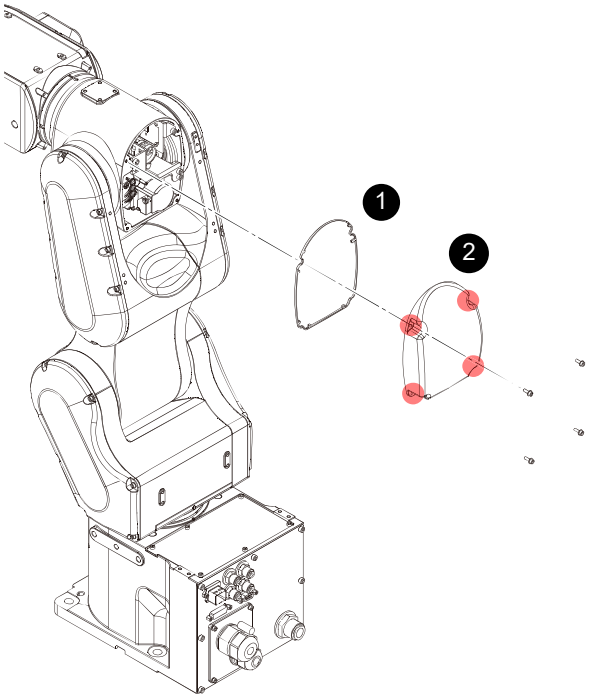
IP model

A. Removal



1	Remove the Arm3 head cover. **POINT** When removing the Arm3 gasket. A S01: 4-M3x10 and washer

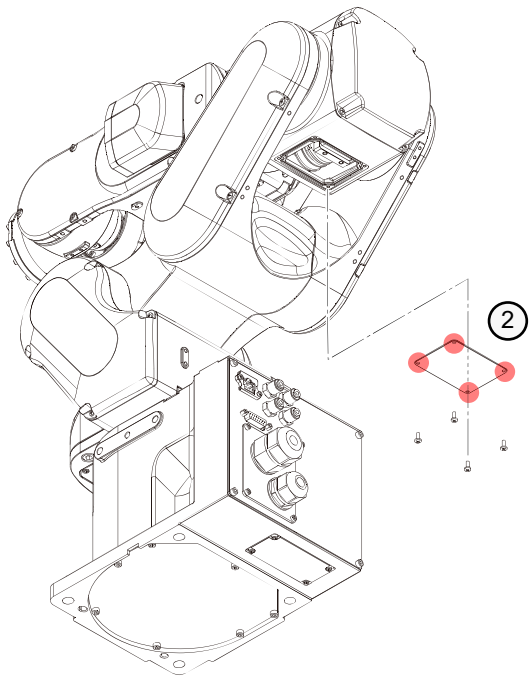
B. Installation



1	Install the Arm3 gasket in the groove on the Arm3 head cover. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Install the Arm3 head cover on the Manipulator. **CAUTION** When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force. A S01: 4-M3x10 and washer (2.0 +/- 0.1 N·m)

2.10.8 Arm3 maintenance cover

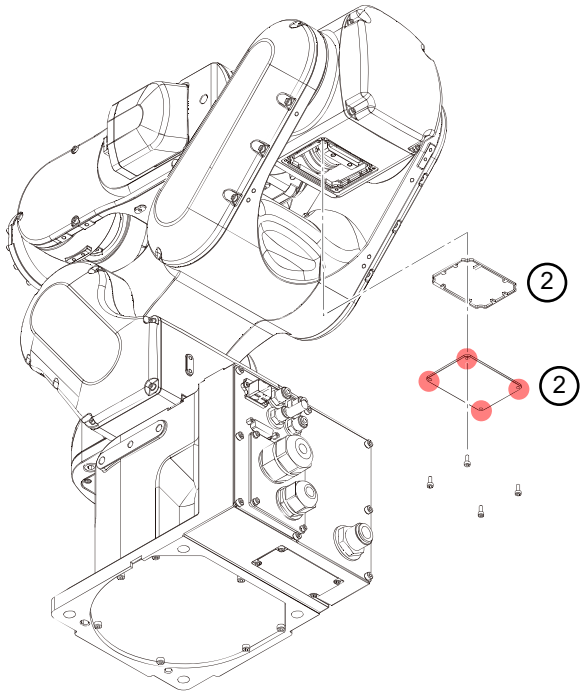
Standard model/Cleanroom model



1	Move the arm to a position where the cover can be easily removed.
2	Remove the Arm3 maintenance cover. A S06: 4-M3x8 (0.45 +/- 0.1 N·m)

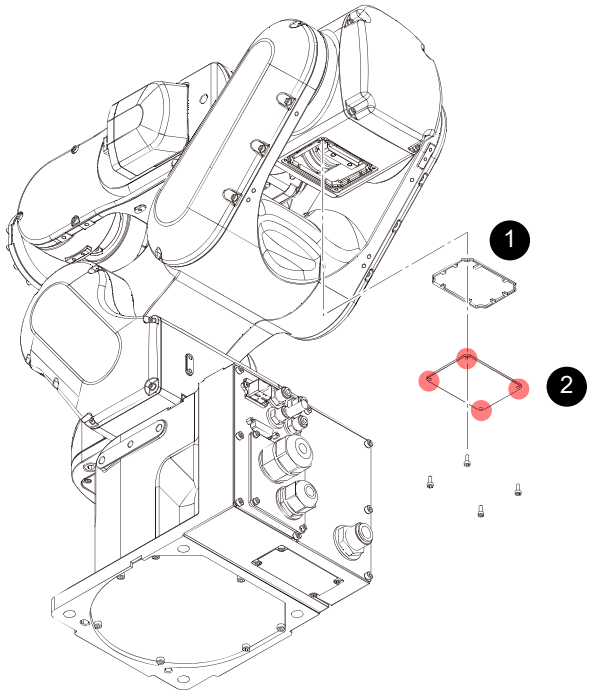
IP model

A. Removal



1	Move the arm to a position where the cover can be easily removed.
2	Remove the Arm3 maintenance cover. **POINT** When removing the Arm3 maintenance cover, also remove the Arm3 maintenance gasket. A S01: 4-M3x8

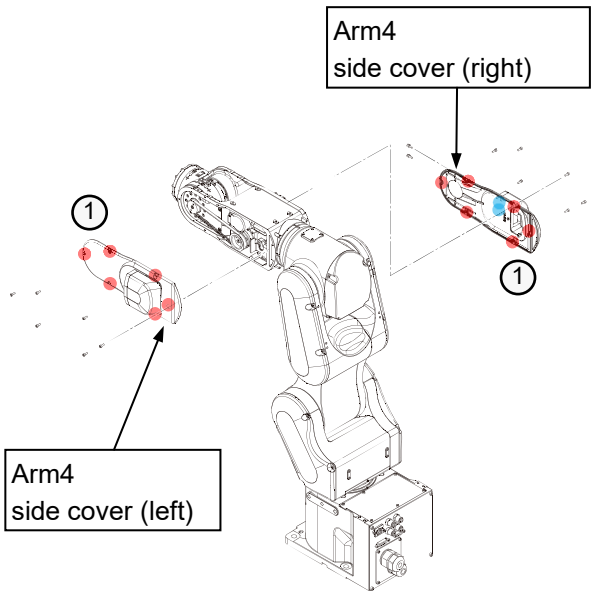
B. Installation

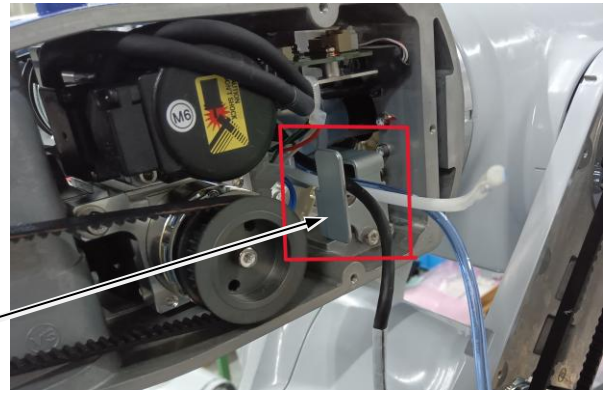


1	Install the Arm3 Maintenance Rubber Gasket into the groove of Arm3. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Install the Base Maintenance Cover. **CAUTION** When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force. A S01: 4-M3x8 (2.0 +/- 0.1 N·m)

2.10.9 Arm4 side cover

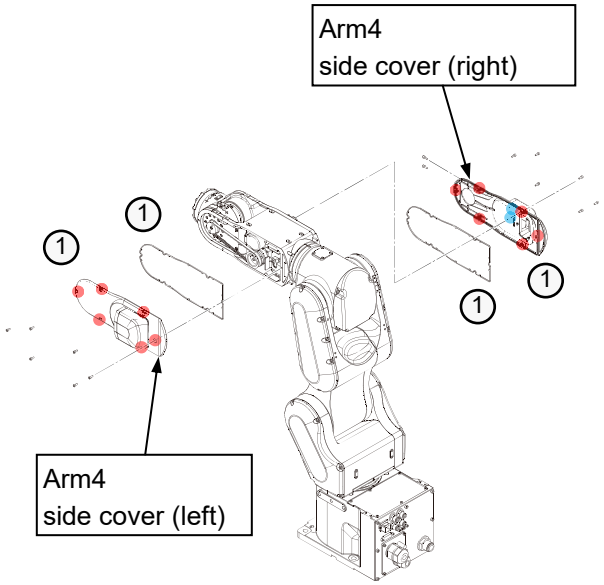
Standard model/Cleanroom model



1	Remove the Arm4 side cover. A Model with user wiring S01: 12-M3x8 A Model without user wiring S06: 10-M3x8
2	Perform this procedure only for the “model with user wiring”. 1. Remove the user wiring plate. A S01: 4-M3x10 2. Disconnect the following cables. • Cover (left): LAN cable for F-sensor, Air Tubes (blue/white) • Cover (right): D-sub connector, Air Tubes (red/green), FB14 Open the two plastic clips of the connector on the cover and pull out the metallic connector. **CAUTION** • When installing the cover, be careful not to pinch the cables. Also, do not bend or push the cables in using excessive force. • When attaching the Arm4 side cover (left), place the cable close to the Joint #4 as shown in the red frame in the photo. Arm4 cable fixing plate 

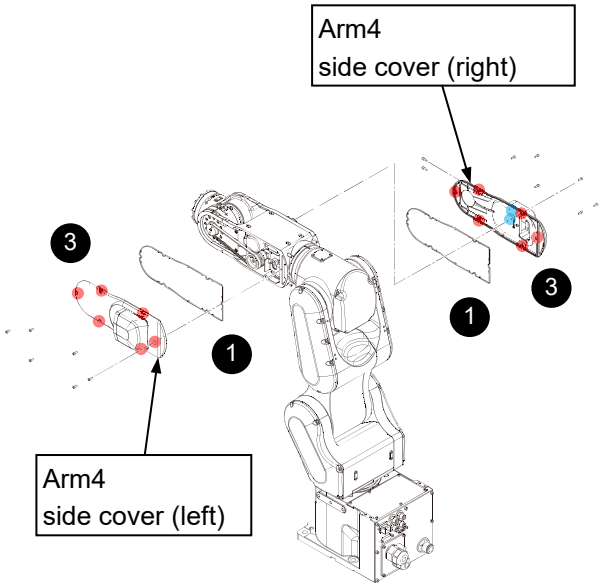
IP model

A. Removal



1	Remove the Arm4 side cover. **POINT** When removing the Arm4 side cover, also remove the Arm4 side gasket. A S01: 6-M3x8
2	Perform this procedure only for the “model with user wiring”. 1. Remove the user wiring plate. A S01: 4-M3x10 2. Disconnect the following cables. • Cover (left): LAN cable for F-sensor, Air Tubes (blue/white) • Cover (right): D-sub connector, Air Tubes (red/green), FB14 Open the two plastic clips of the connector on the cover and pull out the metallic connector. **CAUTION** Install the Air Tubes and connectors in the following combinations. 1: Green, 2: Red, 3: White, 4: Blue

B. Installation



1	Install the Arm4 side gasket in the groove on the Arm4 side cover. **POINT** If any damage or deterioration is observed in the Rubber Gasket, replace the Rubber Gasket.
2	Perform this procedure only for the “model with user wiring”. 1. Attach the following cables to the user wiring plate. • Cover (left): LAN cable for F-sensor, Air Tubes (blue/white) • Cover (right): D-sub connector, Air Tubes (red/green), FB14 2. Attach the user wiring plate to the Arm4 side cover. A S01: 4-M3x10 (2.0 +/- 0.1 N· m)

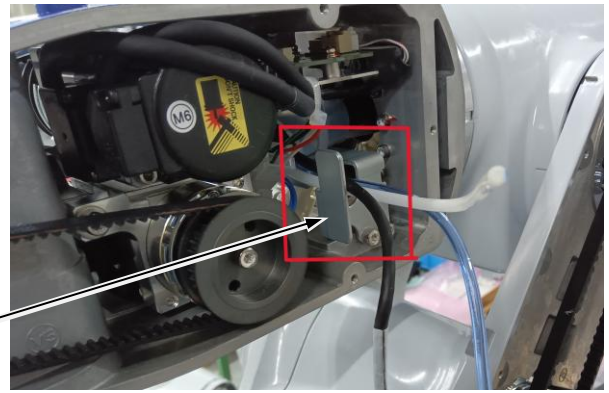
3 Install the Arm4 side cover on the Manipulator.

A Model with user wiring
S01: 12-M3x8
(4.0 +/- 0.2 N·m)

A Model without user wiring
S06: 10-M3x8
(0.45 +/- 0.1 N·m)

CAUTION

- When installing the cover, be careful not to pinch the Rubber Gasket and cables. Also, do not bend or push the cables in using excessive force.
- When attaching the Arm4 side cover (left), place the cable close to the Joint #4 as shown in the red frame in the photo.



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	● 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.

3.1.1 Items to be prepared

- Force gauge
- Sonic Belt Tension Meter Recommended: U-508 (Gates Unitta)
- Non-shrinkable string (approximately 800 mm)
- Belt Tensioner JIG (Maintenance Parts Code: 1674582)

3.1.2 Belt Tension Values

Tension Meter setting values

	J1	J2	J3	J4	J5	J6
Unit mass (g/mm width x m span)	4.0	4.0	4.0	2.5	2.5	2.5
Belt width (mm)	7	7	7	6	CX4-A: 4 CX7-A: 6	CX4-A: 4 CX7-A: 6
Belt span (mm)	112	106	157	60	CX4-A: 116 CX7-A: 130	CX4-A: 116 CX7-A: 130

Tension standard values

	J1	J2	J3	J4	J5	J6
Belt tension (Minimum to maximum) (N)	48.0 to 65.0	48.0 to 65.0	48.0 to 65.0	14.5 to 24.2	CX4-A: 10.0 to 24.2 CX7-A: 14.5 to 24.2	CX4-A: 10.0 to 24.2 CX7-A: 14.5 to 24.2

3.1.3 Adjustment Method

CAUTION	● 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 the proper tension to the J1 timing belt and secure the J1 Motor unit.

1. Hang a non-stretchable string (such as a cable tie) the motor and pull it with a push-pull gauge or the like to apply the specified tension.
   Belt tension: 48.0 to 65.0 N

2. Fix the J1 Motor unit while applying tension.

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

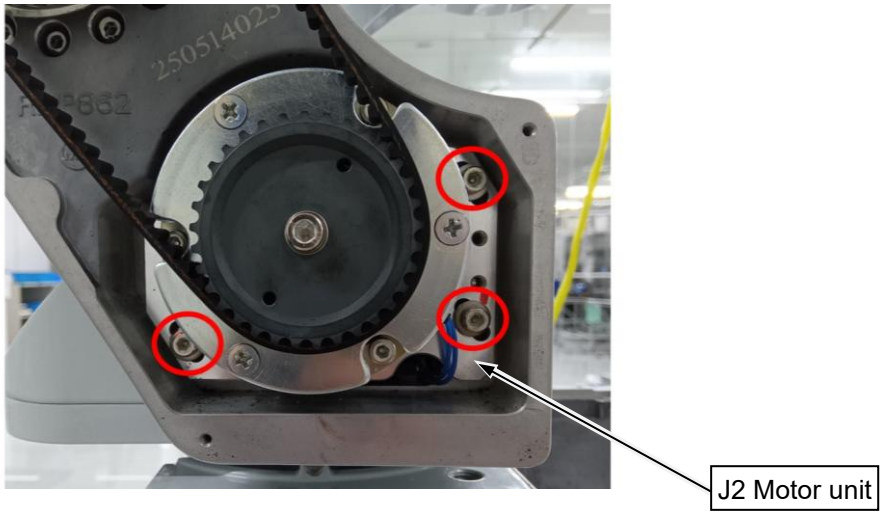
Joint #2 Timing Belt

Apply the proper tension to the J2 timing belt and secure the J2 Motor unit.

1. Hang a non-stretchable string (such as a cable tie) the motor and pull it with a push-pull gauge or the like to apply the specified tension.
   Belt tension: 48.0 to 65.0 N

2. Fix the J2 Motor unit while applying tension.

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



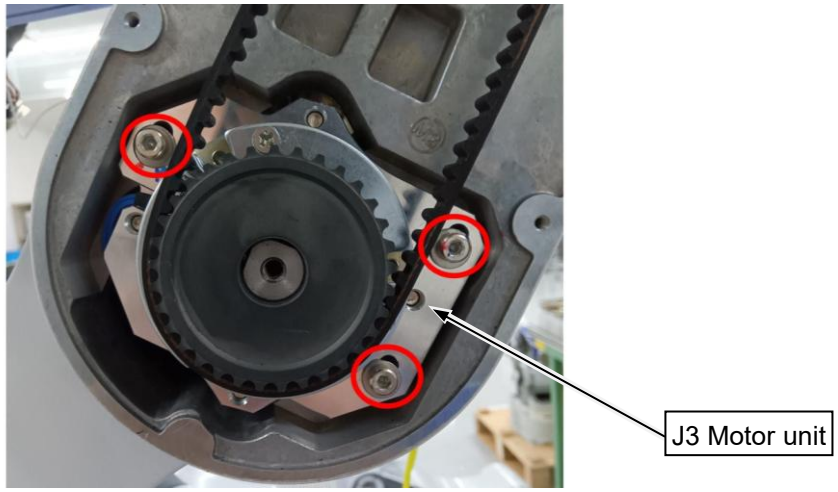
Joint #3 Timing Belt

Apply the proper tension to the J3 timing belt and secure the J3 Motor unit.

1. Hang a non-stretchable string (such as a cable tie) the motor and pull it with a push-pull gauge or the like to apply the specified tension.
   Belt tension: 48.0 to 65.0 N

2. Fix the J3 Motor unit while applying tension.

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



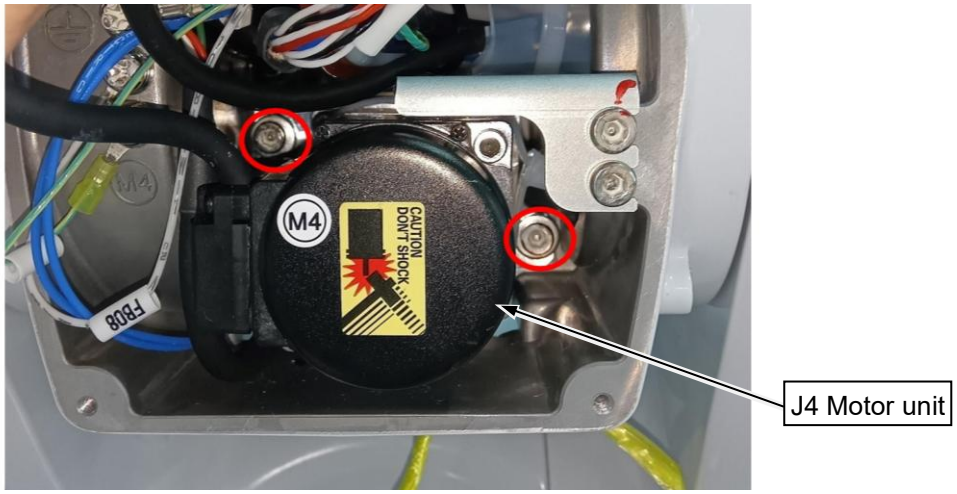
Joint #4 Timing Belt

Apply the proper tension to the J4 timing belt and secure the J4 Motor unit.

1. Hang a non-stretchable string (such as a cable tie) the motor and pull it with a push-pull gauge or the like to apply the specified tension.
   Belt tension: 14.5 to 24.2 N

2. Fix the J4 Motor unit while applying tension.

A S01: 2-M4x18 and washer (4.0 +/- 0.2 N·m)



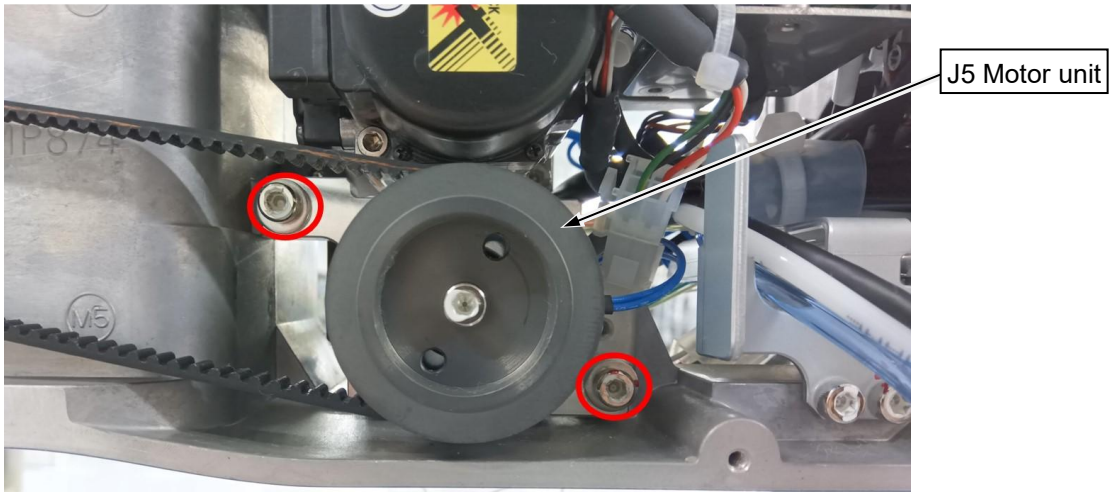
Joint #5 Timing Belt

Apply the proper tension to the J5 timing belt and secure the J5 Motor unit.

1. Hang a non-stretchable string (such as a cable tie) the motor and pull it with a push-pull gauge or the like to apply the specified tension.
   Belt tension:
   CX4-A: 10.0 to 24.2 N
   CX7-A: 14.5 to 24.2 N

2. Fix the J5 Motor unit while applying tension.

   A S01: 2-M4x18 and washer (4.0 +/- 0.2 N· m)



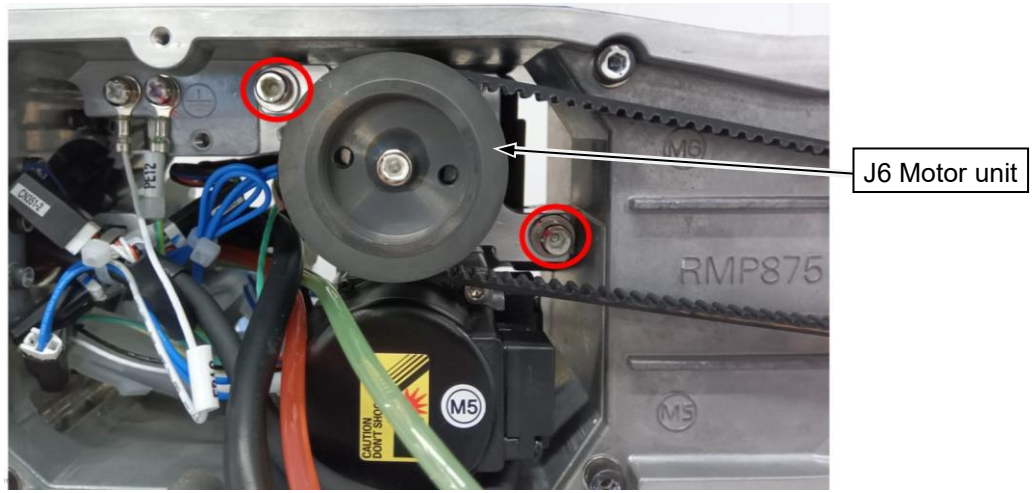
Joint #6 Timing Belt

Apply the proper tension to the J6 timing belt and secure the J6 Motor unit.

1. Hang a non-stretchable string (such as a cable tie) the motor and pull it with a push-pull gauge or the like to apply the specified tension.
   Belt tension:
   CX4-A: 10.0 to 24.2 N
   CX7-A: 14.5 to 24.2 N

2. Fix the J6 Motor unit while applying tension.

   A S01: 2-M4x18 and washer (4.0 +/- 0.2 N·m)



3.2 Calibration

3.2.1 What is Calibration?

Removal or replacement of the motors, reduction gears, or timing belt will cause a mismatch between the origin stored on the motor side and the origin stored on the controller side, and the manipulator will not be able to perform correct positioning.

Therefore, it is necessary to align the origins after attaching, detaching, or replacing the motors, reduction gears or timing belt.

NOTE	The calibration is different from teaching. Teaching is the process of instructing the manipulator on arbitrarily set coordinate points (including posture) within the manipulator's operating area.

3.2.2 Precautions for Calibration (for 6-axis robots)

- Be sure to perform the motor, reduction gear, and timing belt removal/replacement work and subsequent calibration for each joint. Calibrating multiple joints simultaneously at one time may require re-teaching the manipulator to restore the points set by the customer.
  However, due to the structure of the manipulator, the joint #5 cannot be calibrated alone. It must be calibrated at the same time as the joint #6.
- After calibration, be sure to check the accuracy at the points set by the customer. See the section below on how to check the accuracy.
  3.2.7 Performing the Calibration (7) Accuracy Testing
- There are two methods to move the Manipulator during calibration.

  A) Moving the Manipulator using Jog & Teach

  For detailed instructions, please refer to the following manuals.

  EPSON RC+ User's Guide

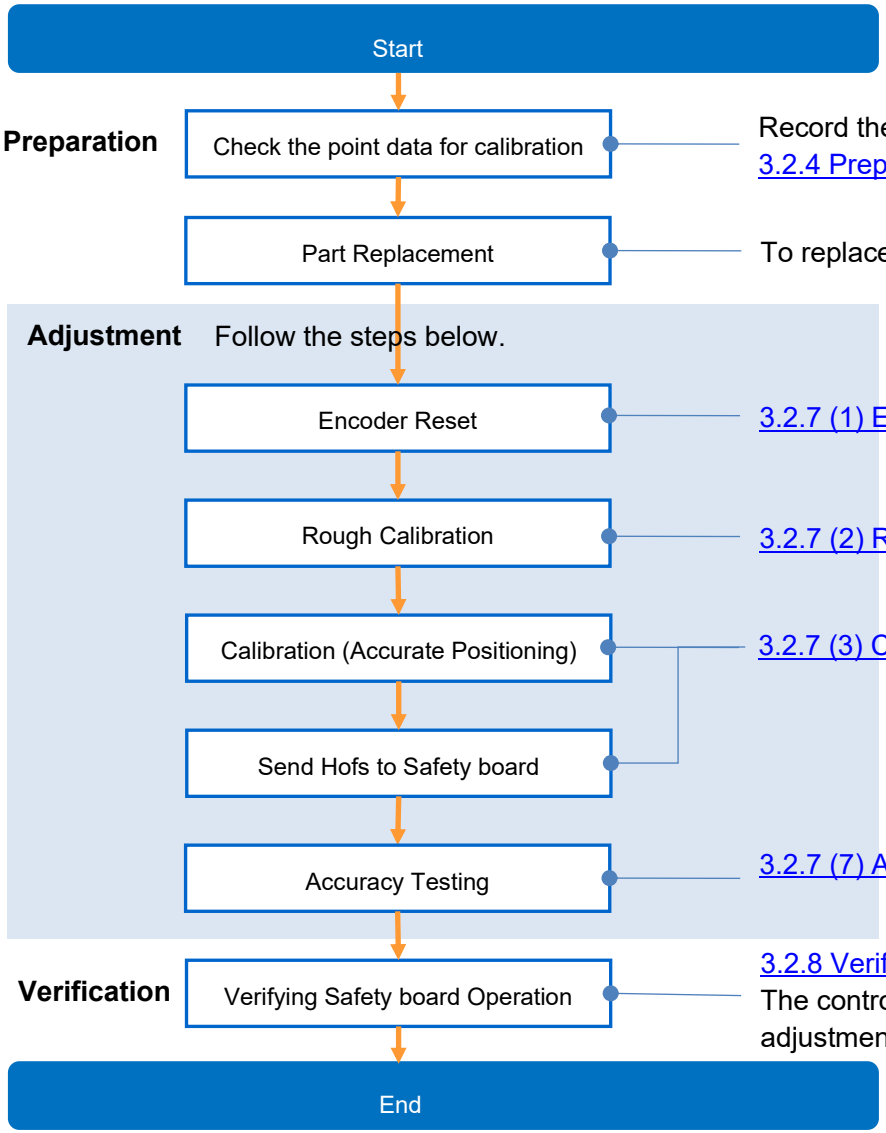
  B) Releasing the electromagnetic brake and moving the arms manually.

CAUTION	● Normally, release the brake of joints one by one. Take extra care if you need to release the brakes of two or more joints simultaneously. Releasing the brakes of two or more joints simultaneously may cause hands and fingers to be caught and/or equipment damage to or malfunction of the Manipulator as the arms of the Manipulator may move in unexpected directions. ● Be careful of the arm falling when releasing the brake. While the brake is being released, the Manipulator's arm falls by its own weight. The arm falling may cause hands and fingers to be caught and/or may cause equipment damage to or malfunction of the Manipulator.

For detailed instructions, please refer to the following manuals.
CX-A series Manual
CX4-A Manipulator 3.1.6 How to Move Arms with the Electromagnetic Brake
CX7-A Manipulator 4.1.6 How to Move Arms with the Electromagnetic Brake

3.2.3 Calibration Flowchart

Calibration Using 0-Pulse Position



Record the currently registered point data.
3.2.4 Preparation

To replace parts refer to the Chapter Maintenance.

3.2.7 (1) Encoder Initialization

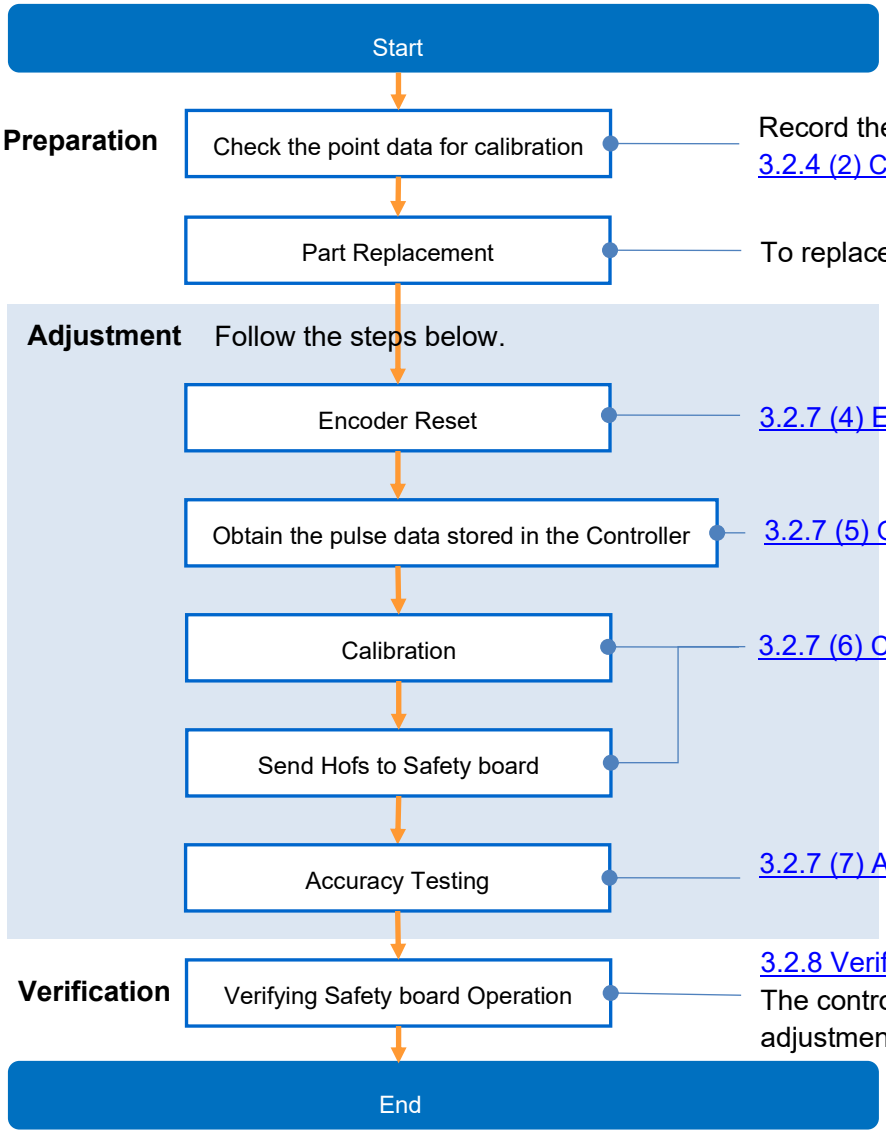
3.2.7 (2) Rough Calibration

3.2.7 (3) Calibration (More accurate positioning)

3.2.7 (7) Accuracy Testing

3.2.8 Verification
The controller which has the safety board is required to verification after adjustment.

Calibration Using Key Groove



Record the pulse values registered in the Controller.
3.2.4 (2) Calibration Using Key Groove

To replace parts refer to the Chapter Maintenance.

3.2.7 (4) Encoder Initialization [Using key groove]

3.2.7 (5) Obtaining Pulse Data

3.2.7 (6) Calibration [Using key groove]

3.2.7 (7) Accuracy Testing

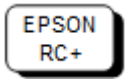
3.2.8 Verification
The controller which has the safety board is required to verification after adjustment.

3.2.4 Preparation

(1) Calibration Using 0-Pulse Position

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

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



Execute the following command from the [Command Window].

```
>PULSE
```

PULSE: [Joint #1 Pulse value] pls [Joint #2 Pulse value] pls [Joint #3 Pulse value] pls [Joint #4 Pulse value] pls [Joint #5 Pulse value] pls [Joint #6 Pulse value] pls

(Example)

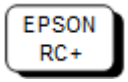
```
> PULSE:  1: 129 pls  2: 2952229 pls  3: -2311842 pls  4: 101 pls  5:-357478 pls  6: -14 pls
```

Record the pulse value of each joint with a sign (if there is a "-").

(2) Calibration Using Key Groove

To reproduce the exact position of the manipulator, check the point data stored in the Controller before performing the calibration work.

Before replacing parts, select a point from the currently registered point (pose) data that allows for easy accuracy verification. Then, display and record the pulse values following the procedure below.



Execute the following command in [Command Window].

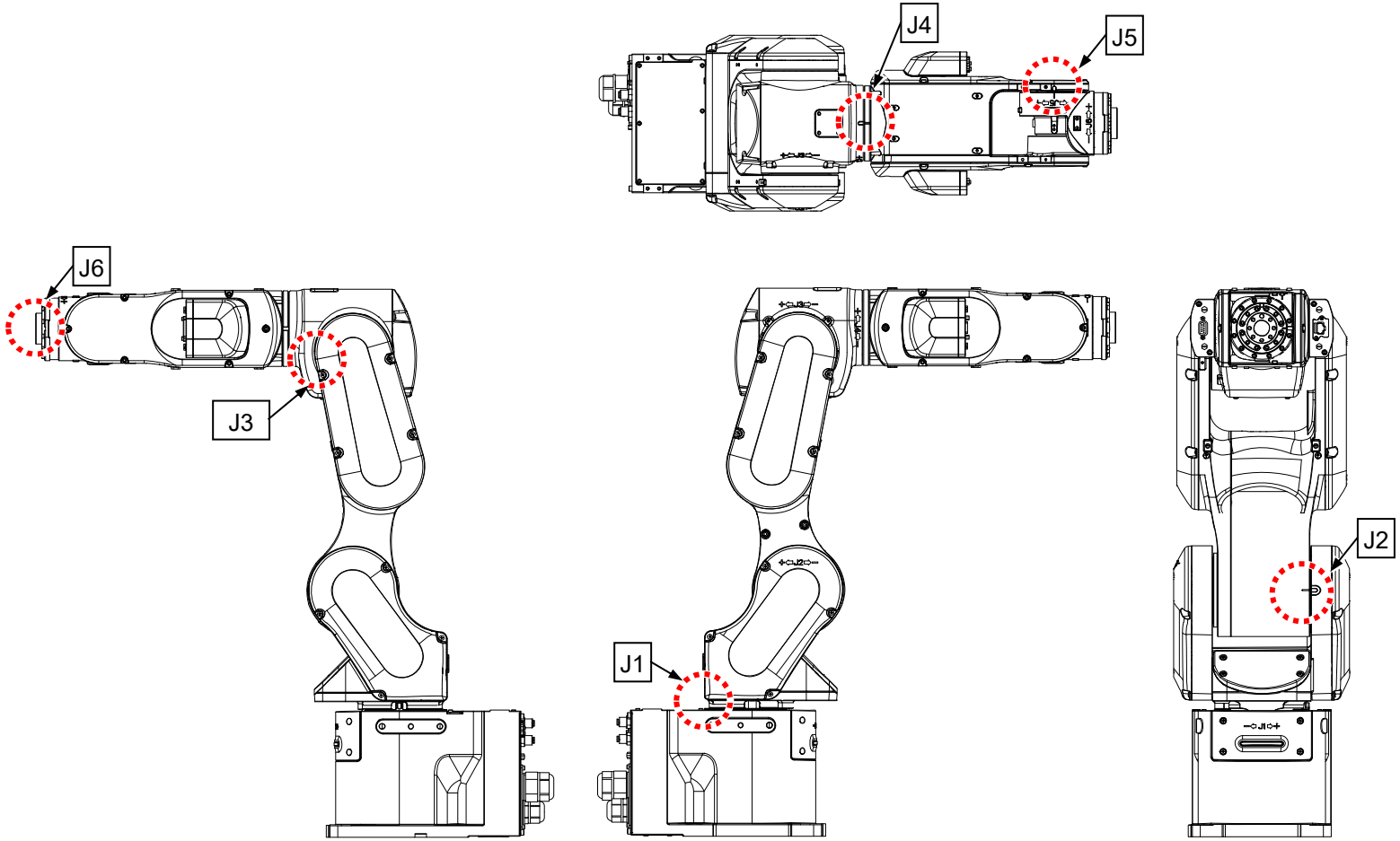
```
> CalibGrooveHomeSet
```

Record the pulse values of each joint with their signs (including “–” if present).

3.2.5 0-pulse Position of Each Joint

To calibrate at the 0-pulse position, refer to the figures below.

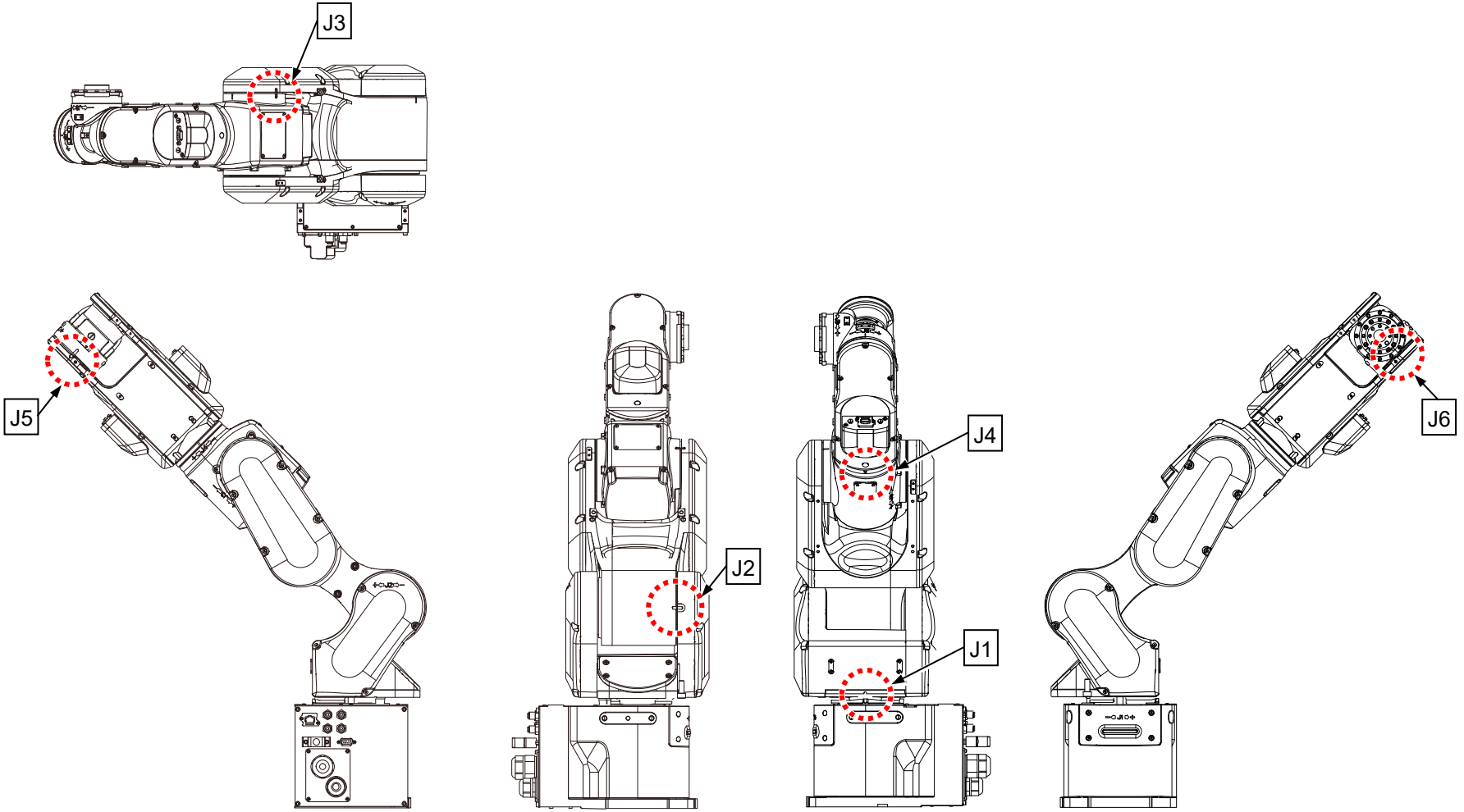
The 0-pulse position of each joint is the position where the marks at the positions shown in the figure below are approximately aligned with each other.



(CX7-A)

3.2.6 Key Groove Position of Each Joint

Refer to the figure below when performing calibration using the key groove position.



(CX7-A)

3.2.7 Performing the Calibration

WARNING	● To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the *Installation and Design Precautions* in the *Safety* chapter of the *EPSON RC+ User's Guide*. ● Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted (low speeds and low power) status to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly.

Command Input

The calibration procedure includes steps to enter commands using the command window.

To use the command window, select the EPSON RC+ menu [Tools] - [Command Window].

Jog Motion

The calibration procedure includes a procedure to make the manipulator perform jog and other operations using the [Jog & Teach] page of the Robot Manager. To use the [Jog & Teach] panel, select the EPSON RC+ menu [Tools] - [Robot Manager] and select the [Jog & Teach] page.

In the calibration procedure that follows, where the [Jog & Teach] operation is required, it is simply stated as [Jog & Teach], and the specific operation method is omitted.

Performing the Calibration

The calibration procedure is the same for all the joints. This section describes the procedure for calibrating the joint #3 as an example.
To calibrate other joints, change the number entered in the command window to the number of the target joint.

(1) Encoder Initialization

1. Move the joint to be calibrated to the 0-pulse position.

NOTE	• For details on the 0-pulse position, refer to 3.2.5 0-Pulse Position of Each Joint. • For details on how to move the joint, see 3.2.2 Precautions for Calibration (for 6-axis robots). • When moving the joint with [Jog & Teach], a pulse out-of-range error may occur. If this occurs, do the following. Open the command window. Execute the following command. `> Encreset 3` Reboot the controller. After the reboot, the jog operation will be available.

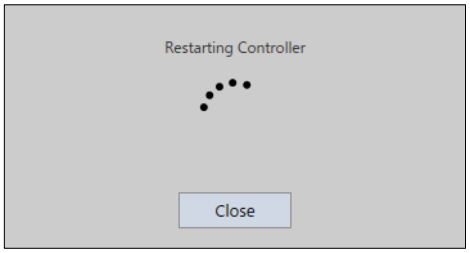
2. Execute the encoder initialization command.

   Open EPSON RC+ Menu - [Tools] - [Command Window].
   Type the following in the [Command Window] and execute.

```
> Encreset 3
```

3. Complete the encoder initialization.

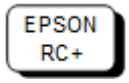
   Select EPSON RC+ menu- [Tools] - [Controller] and click the <Reset Controller> button.



   This window will disappear when the Controller starts up.

(2) Rough Calibration

1. Input the command in the Command window and execute it.

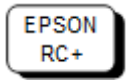


Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

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

* Manipulator does not move.

2. Perform the calibration.



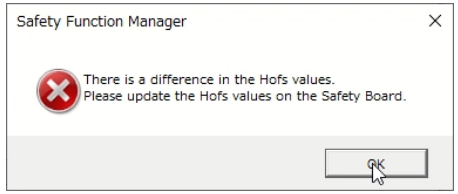
Execute one of the following commands to reset the encoder of the joint you want to calibrate from the menu-[Tool]-[Command Window].

```
>calib 3
```

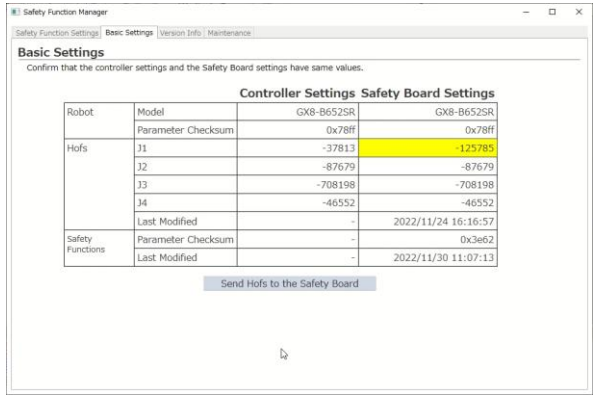
NOTE	Warning 590 (Detect the different of the calibration settings in the controller and Safety Board) occurs when the Calib command are executed.

3. Send the Hofs value to the safety board.

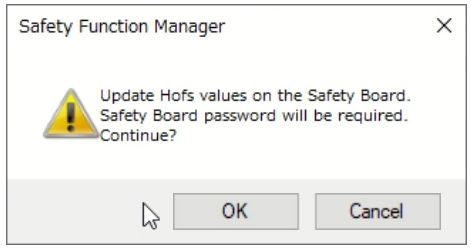
I. Confirm the warning message and click the <OK> button.



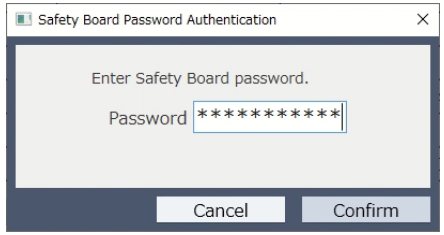
II. Click <Send Hofs to the Safety Board> button.



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

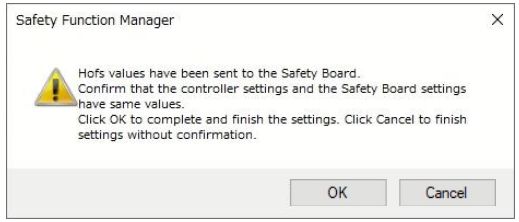


IV. Enter the password and click <Confirm> button.



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

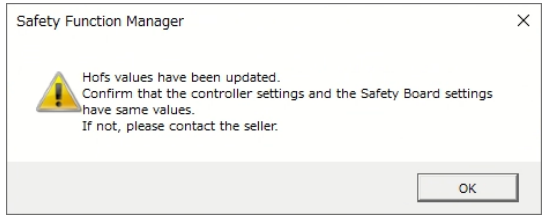
V. Confirm the warning message and click the <OK> button.



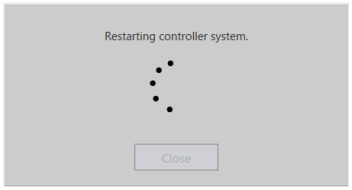
VI. Confirm the message and click the <OK> button.



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



VIII. The Controller restarts.



(3) Calibration (More accurate positioning)

EPSON RC+

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.

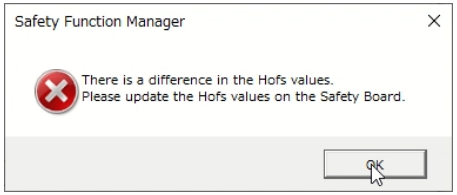
Perform the calibration. Input one of the following commands according to the joint being calibrated.

```
>Calib 3
```

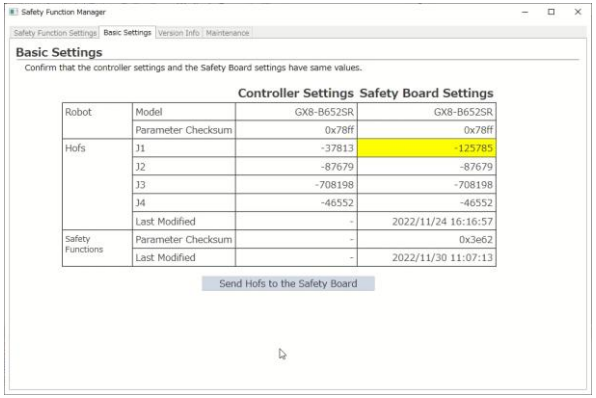
NOTE	Warning 590 (Detect the different of the calibration settings in the controller and Safety Board) occurs when the Calib command are executed.

Send the Hofs value to the safety board.

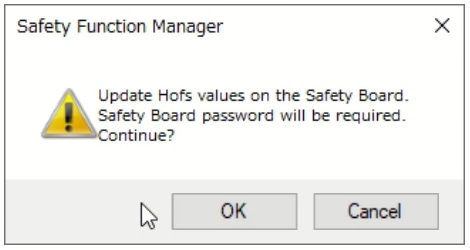
I. Confirm the warning message and click the <OK> button.



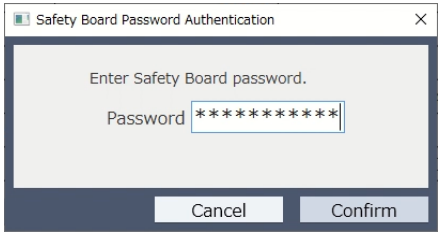
II. Click <Send Hofs to the Safety Board> button.



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

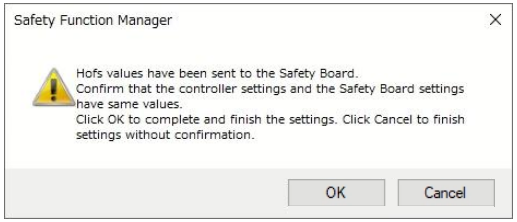


IV. Enter the password and click <Confirm> button.

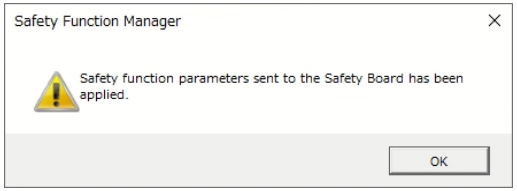


NOTE	Contact your robot safety manager for the Safety Board password.

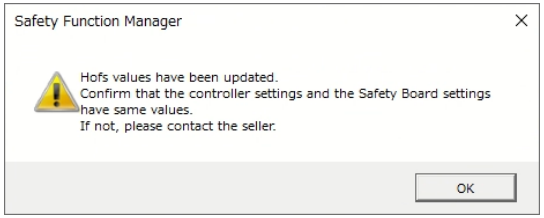
V. Confirm the warning message and click the <OK> button.



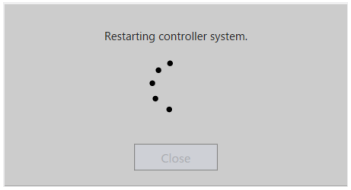
VI. Confirm the message and click the <OK> button.



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

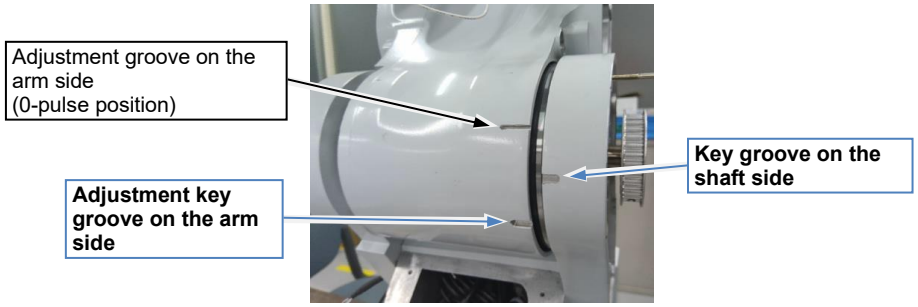


VIII. The Controller restarts.



(4) Encoder Initialization [Using key groove]

1. Align the adjustment key grooves on the arm side with the key groove on the shaft side.



2. Initialize the encoder.
3. Restart the Controller.

(5) Obtaining Pulse Data

EPSON RC+

Enter and execute the following command in the command window.

In the menu-[Tools]-[Command Window], execute the following command according to the joint being calibrated.

```
>CalibGrooveHomeSet
```

*1 If you want to obtain only the specified axis, execute the command "`>CalibGrooveHomeSet` [Axis number]"

*2 The Manipulator will not operate.

(6) Calibration [Using key groove]

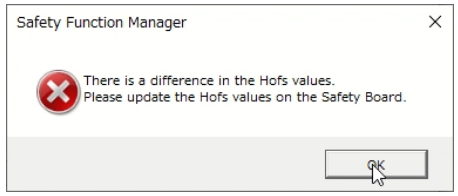
1. EPSON RC+

   Enter and execute the following command in the command window.
   In the menu-[Tools]-[Command Window], execute the following command according to the joint being calibrated.
   `>calpls a,b,c,d,e,f`
   * a, b, c, d, e, and f are the values obtained with "`>CalibGrooveHomeSet`".

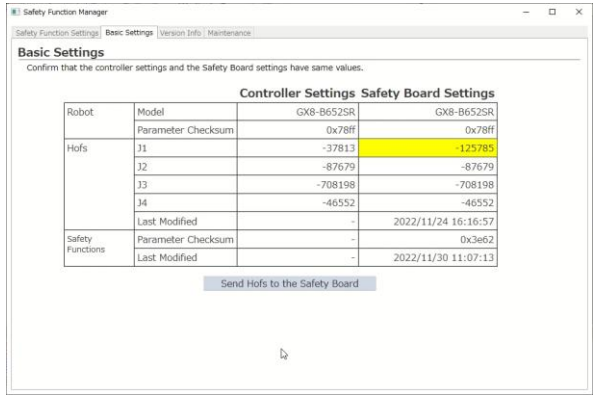
2. Perform the calibration.
   In the menu-[Tools]-[Command Window], execute the following command according to the joint being calibrated.
   `>calib 3`

3. Send the Hofs value to the safety board.

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



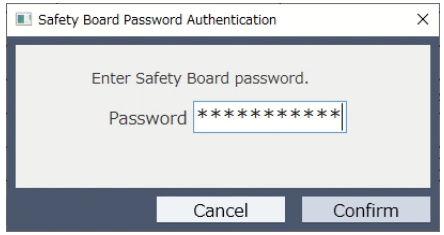
   II. Click <Send Hofs to the Safety Board> button.



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

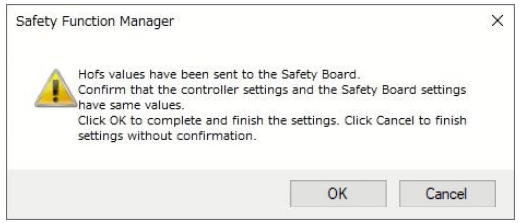


IV. Enter the password and click <Confirm> button.



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

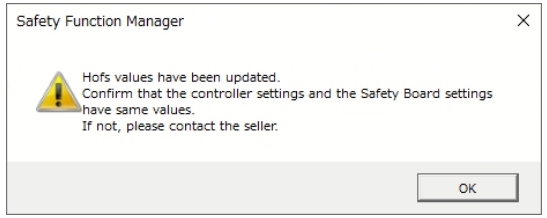
V. Confirm the warning message and click the <OK> button.



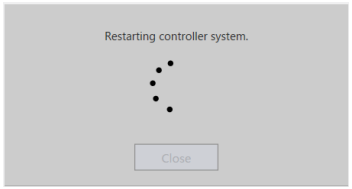
VI. Confirm the message and click the <OK> button.



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



VIII. The Controller restarts.



(7) Accuracy Testing

Move the manipulator to another point and confirm that it moves to the taught position. If the manipulator does not move to the taught position, it must be calibrated again at another point. If the manipulator still does not move to the taught position, it is necessary to reset the point.

3.2.8 Verification

For the CX-A series, it is necessary to check the operation of the Safety Board installed in the controller after completing the calibration.

For the procedure to check the operation of the Safety Board, refer to the following manuals.

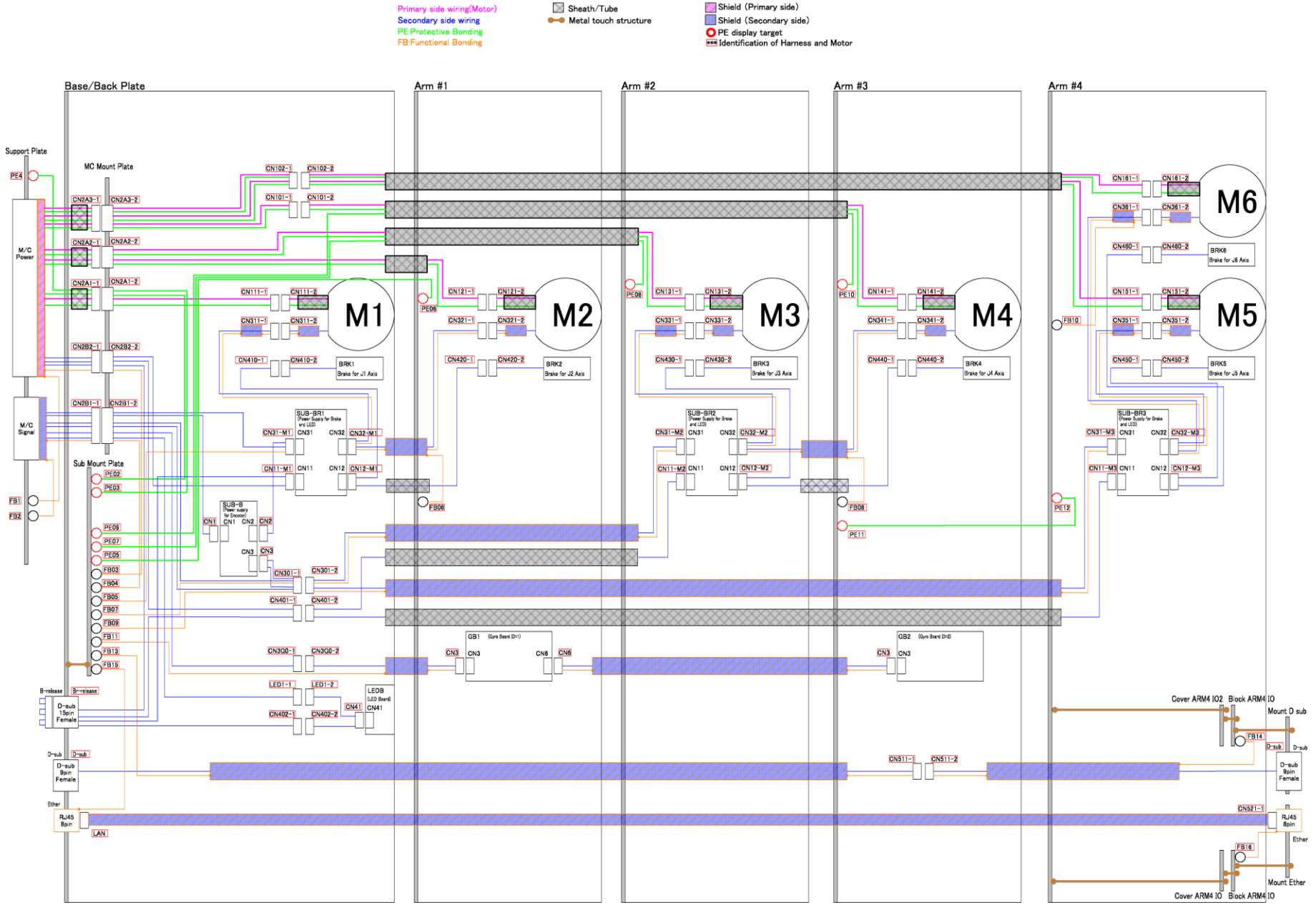
RC800-A Series Service Manual *3.4 Setup Procedure After Parts Replacement (Safety Board)*

CHAPTER

4

Block Diagram

4.1 CX4-A / CX7-A


Primary side wiring(Motor)
Secondary side wiring
PE:Protective Bonding
FB:Functional Bonding
Sheath/Tube
Metal touch structure
Shield (Primary side)
Shield (Secondary side)
PE display target
Identification of Harness and Motor
Base/Back Plate
Arm #1
Arm #2
Arm #3
Arm #4
Support Plate
MC Mount Plate
M/C Power
M/C Signal
Sub Mount Plate
M1
M2
M3
M4
M5
M6
BRK1 Brake for J1 Axis
BRK2 Brake for J2 Axis
BRK3 Brake for J3 Axis
BRK4 Brake for J4 Axis
BRK5 Brake for J5 Axis
BRK6 Brake for J6 Axis
SUB-BR1
SUB-BR2
SUB-BR3
SUB-B
GB1
GB2
LED8
D-sub 15pin Female
D-sub 9pin Female
RJ45 8pin
LAN
Ether
Cover ARM4 IO2
Block ARM4 IO
Mount D sub
Mount Ether
Cover ARM4 IO
Block ARM4 IO

CHAPTER

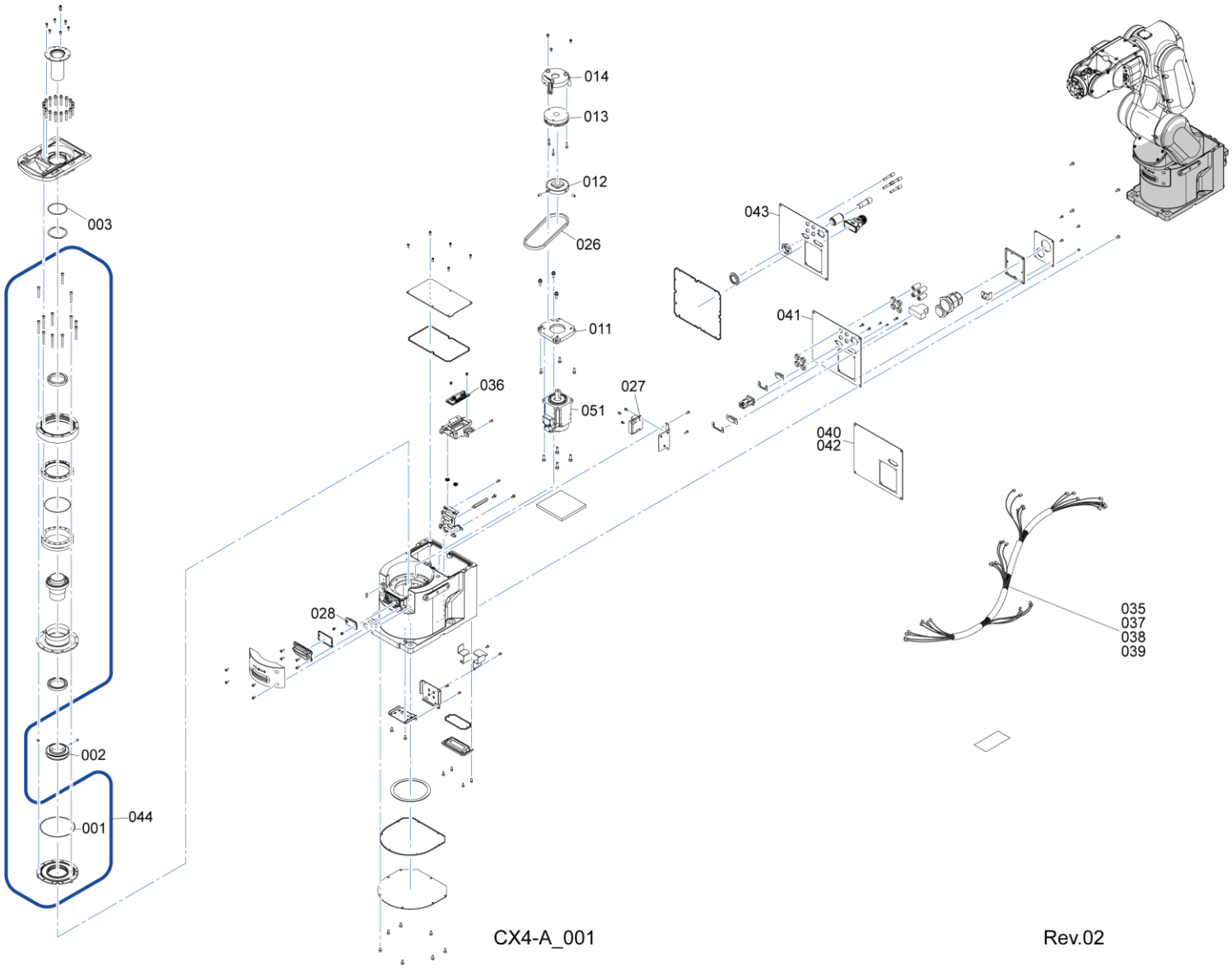
5

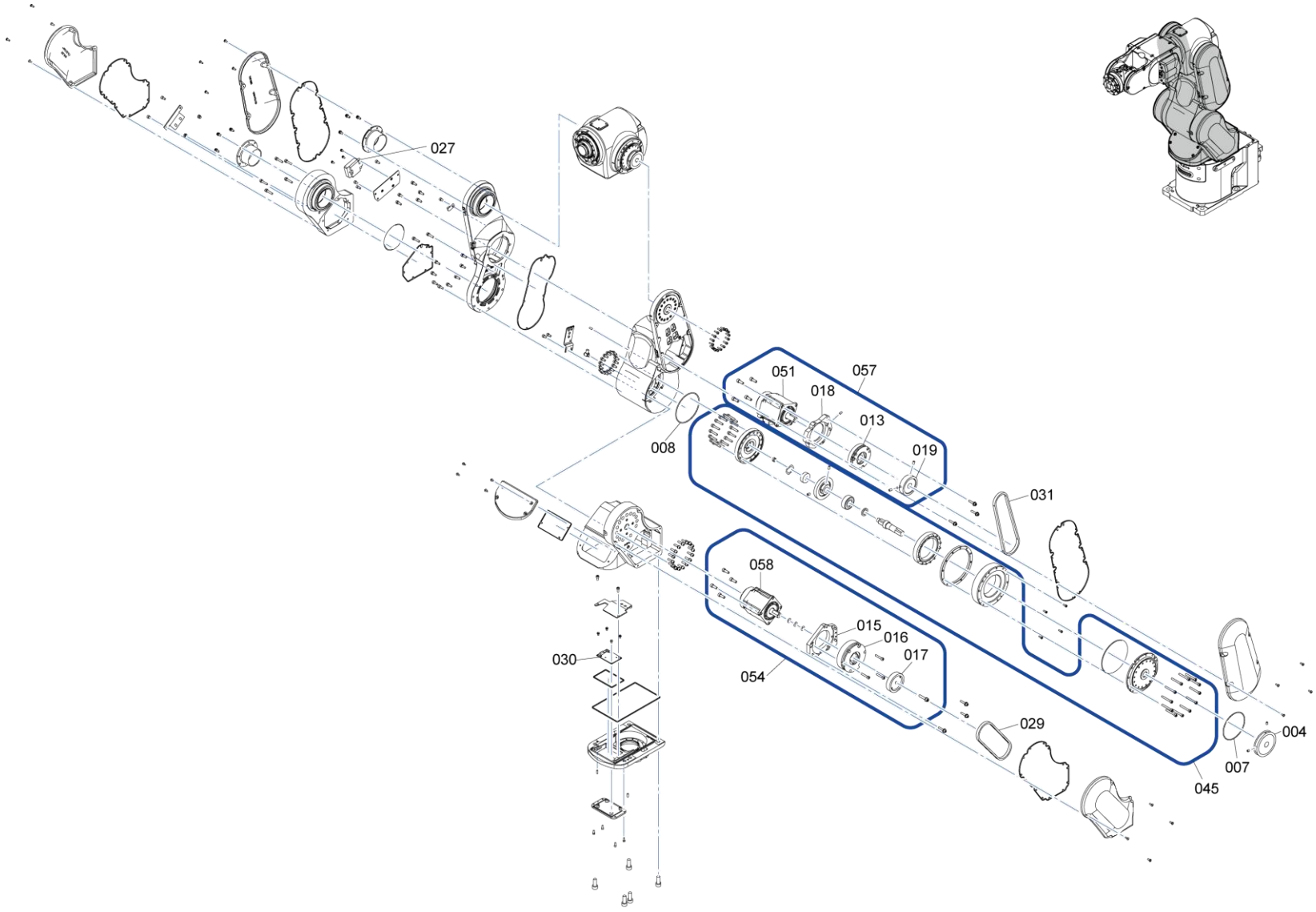
Exploded View/Maintenance Parts List

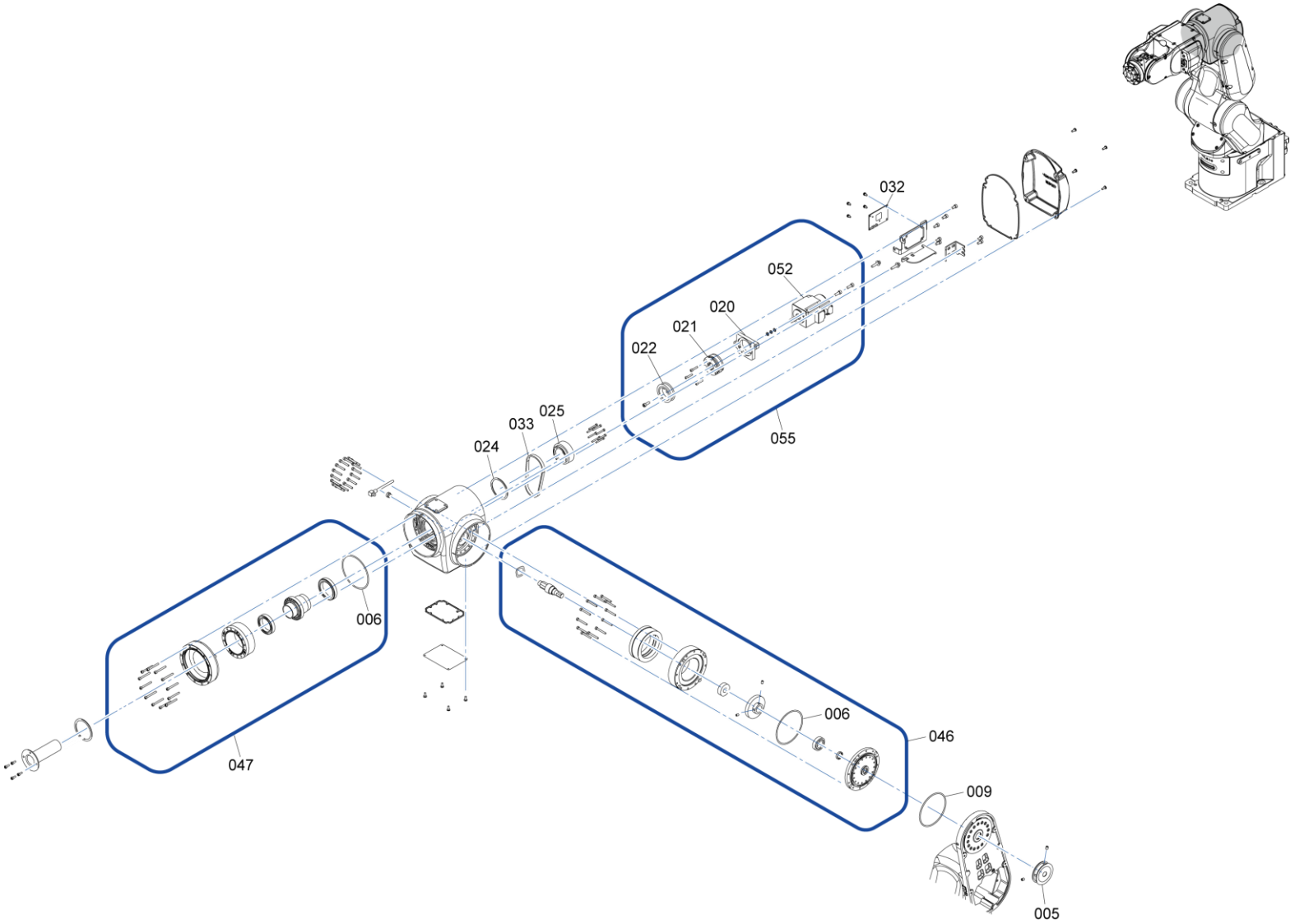
5.1 Exploded View

This is an exploded view of the standard and clean models.
For information about the IP model, please contact the supplier.

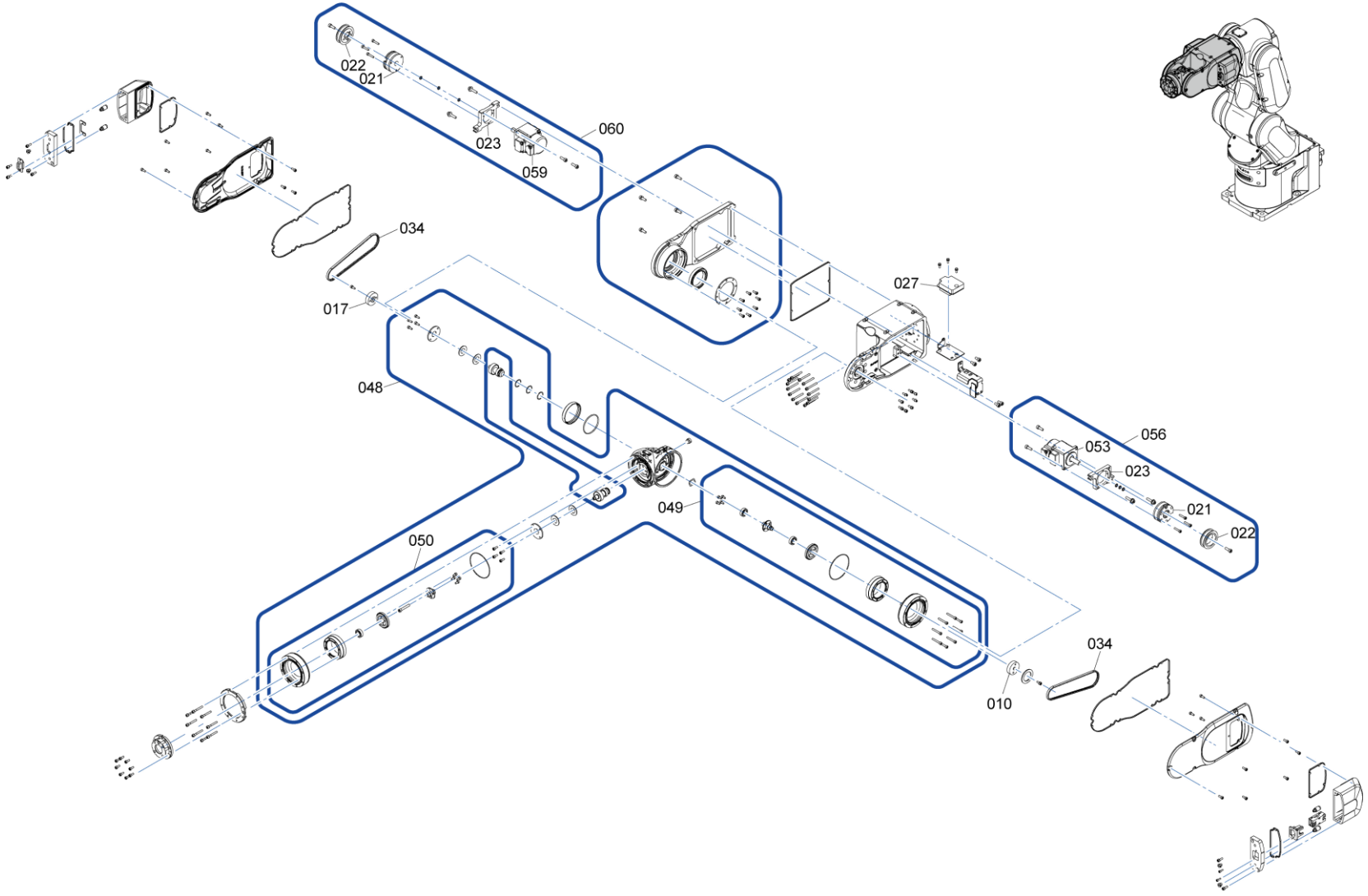
5.1.1 CX4-A




027
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051
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045
CX4-A_002
Rev.02

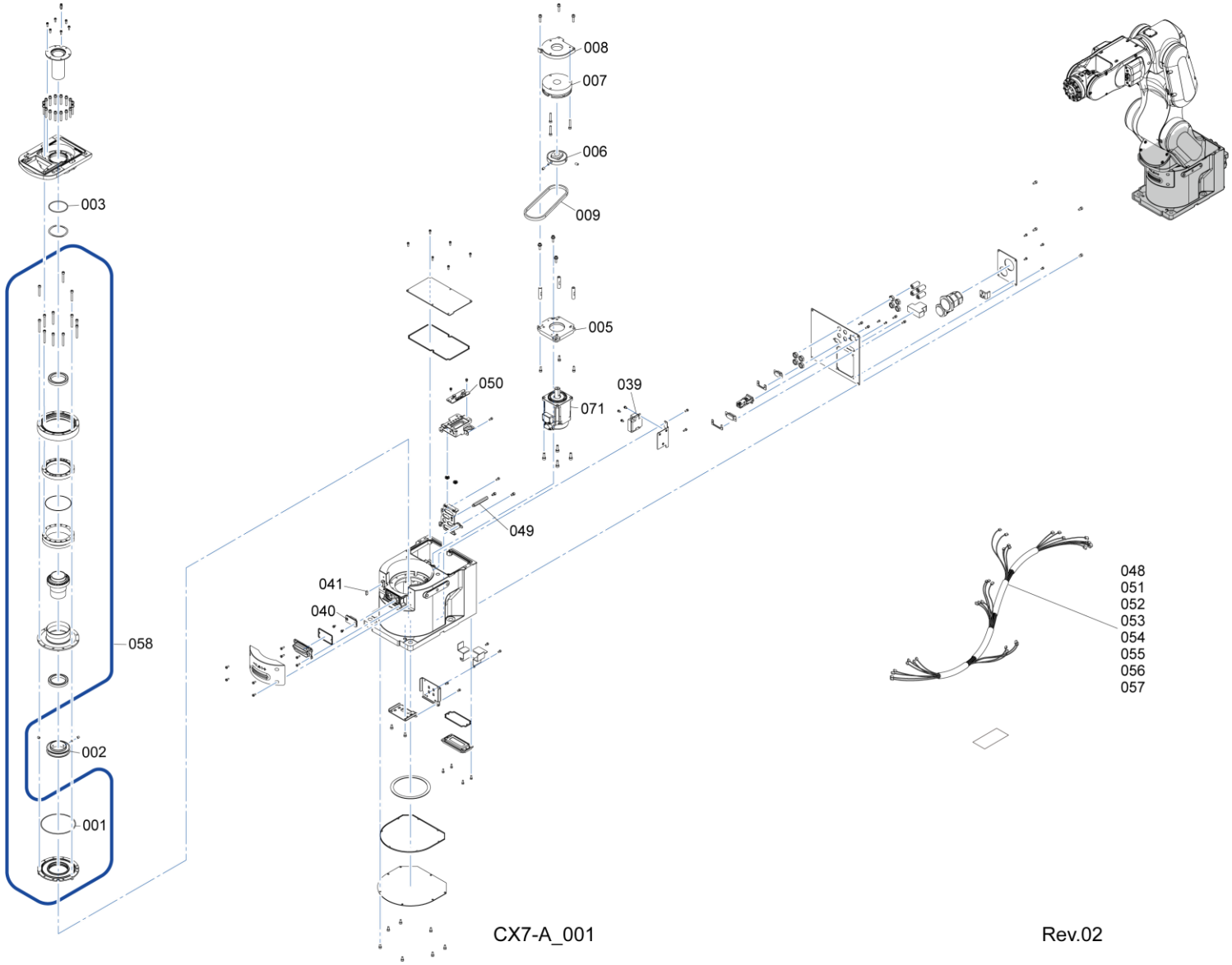


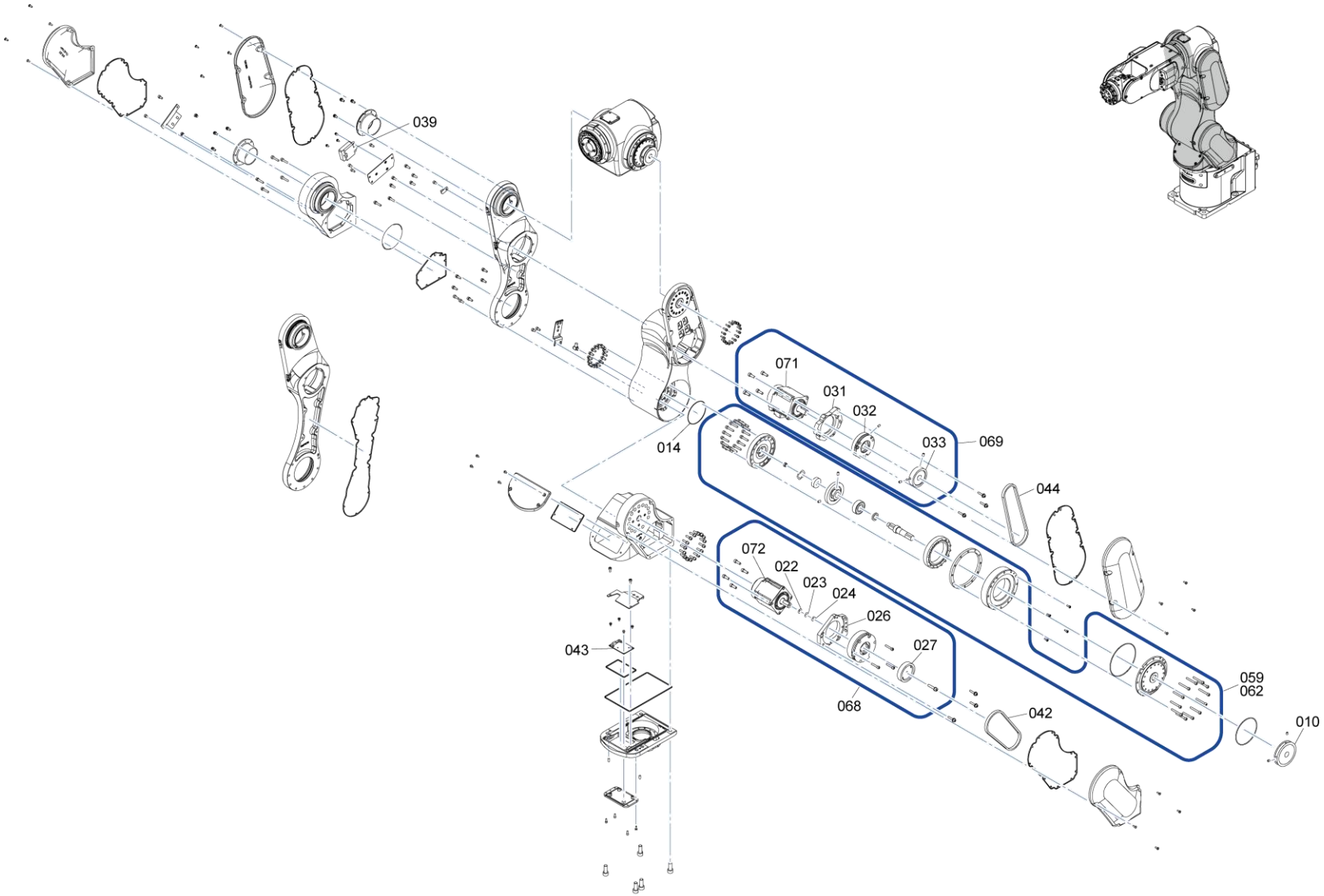
CX4-A_003 Rev.02

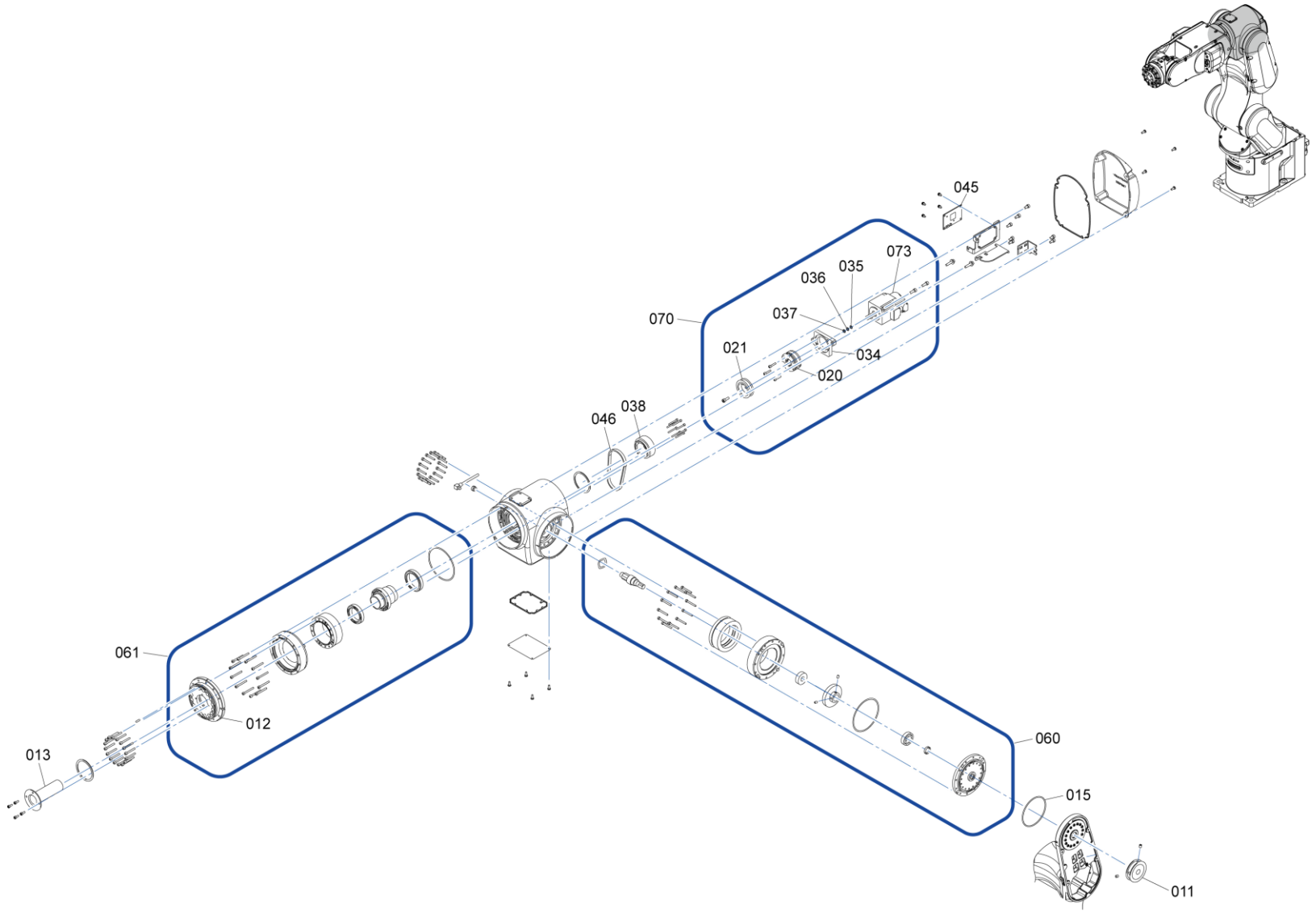


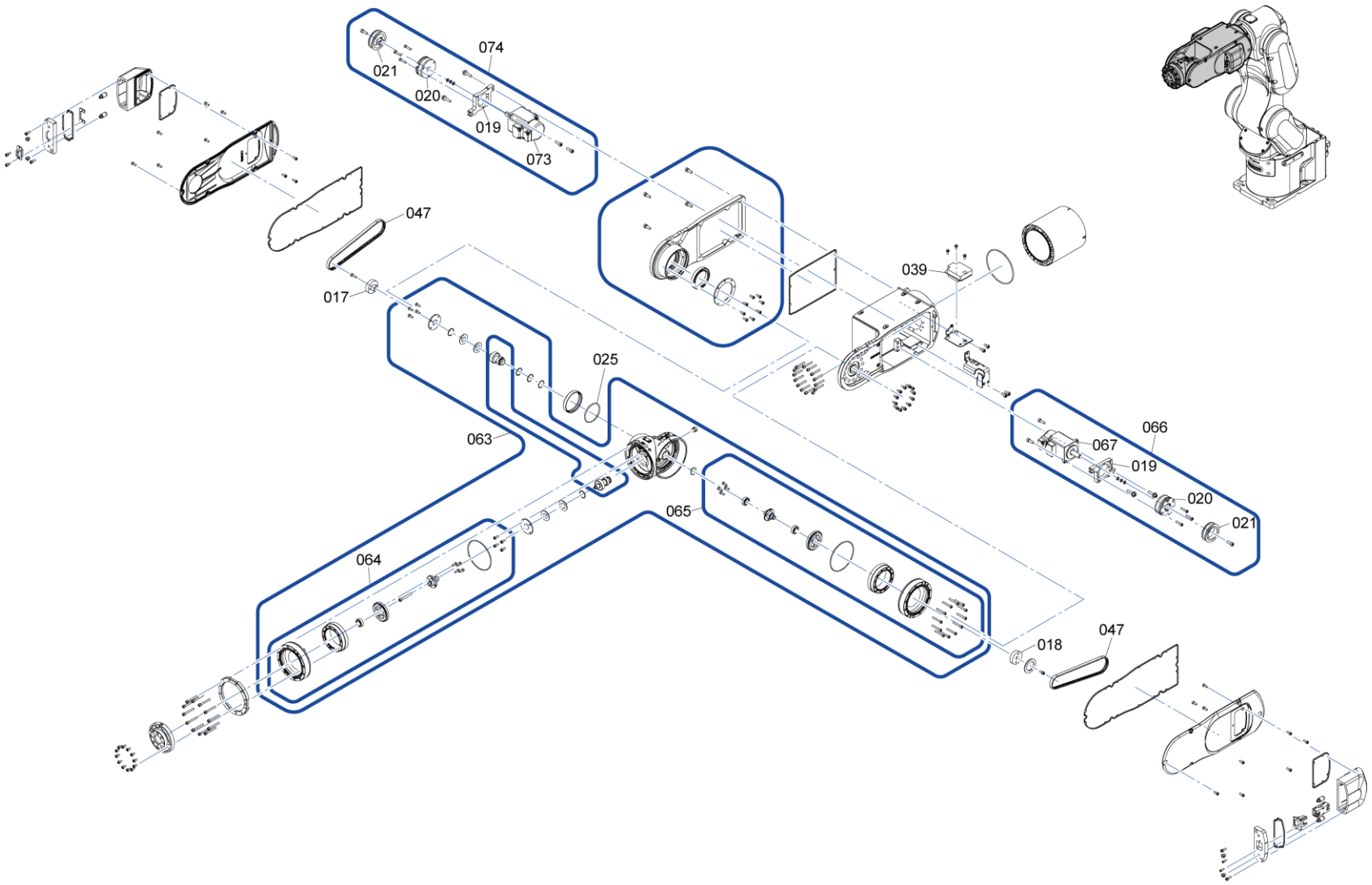
CX4-A_004 Rev.02

5.1.2 CX7-A


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057
CX7-A_001
Rev.02


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CX7-A_002
Rev.02


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021
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046
038
061
012
013
060
015
011
CX7-A_003
Rev.02



CX7-A_004 Rev.02

5.2 Maintenance Parts List

5.2.1 CX4-A

This is a maintenance parts list for standard/clean models. For information about the protection model, please contact the supplier.

Ref. No.	Parts Name	Parts Code	Overhaul
001	O-ring	1773897	
002	PLY ,P36-EV5GT, J1,N054	1959111	
003	O_RING/AS568-032-1A	1961954	
004	PLY,P32-EV5GT,J2,N054	1959114	
005	PLY,P27-EV5GT,J3,N054	1959116	
006	O_RING/CO0547A	1520370	
007	O_RING/CO0549A	1618362	
008	O_RING	1961816	
009	O_RING/CO0544A	1510529	
010	PLY,P30-3GT,J5J6,N054	1959118	
011	PLT,MOUNT,MOTOR,J1,N054	1961368	
012	PLY,P38-EV5GT,J1,N054	1959112	
013	Electromagnetic Brake_MCNB10-69-37028741	1851930	√
014	COVER,J1,BRAKE,N054	1958565	
015	PLT,MOUNT,MOTOR,J2,N054	1961369	
016	Electromagnetic Brake/RNB0.2G-45	1654164	√
017	PLY,P33-EV5GT,J2,N054	1959113	
018	PLT,MOUNT,MOTOR,J3,N054	1961371	

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Ref. No.	Parts Name	Parts Code	Overhaul
019	PLY,P33-EV5GT,J3,N054	1959115	
020	PLT,MOUNT,MOTOR,J4,N054	1961372	
021	Electromagnetic Brake/MCNB3-45	1654166	√
022	J456_MOTOR_PULLEY_LP/MMLP000-306	1749501	
023	PLT,MOUNT,MOTOR,J5,J6,N054	1961373	
024	FELT,OILABSORPTION,ARM3,N054	1961582	
025	PLY,P48-3GT,J4,N054	1959117	
026	TIMING BELT/410-EV5GT-7	1959772	√
027	BOARD ASSY. N054 SUB-BR	2234031	
028	BOARD ASSY. N054 LED	2234030	
029	TIMING BELT/375-EV5GT-7	1959774	√
030	BOARD ASSY.DGB_MULTI_ID1_ASP	2228302	
031	TIMING BELT/465-EV5GT-7	1959776	√
032	BOARD ASSY.DGB_MULTI_ID2_ASP	2228303	
033	TIMING BELT/249-3GT-6	1959777	√
034	TIMING BELT/333-3GT-4	1959778	√
035	HNS,06,N054,S,NIW	2238950	
036	BOARD ASSY. RC700-E SUB-B	2221989	
037	HNS,06,N054,S	2238951	
038	HNS,06,N054,IP,NIW	2238952	
039	HNS,06,N054,IP	2238953	
040	PLATE,BASE BACK,N054,NIW	1961494	

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Ref. No.	Parts Name	Parts Code	Overhaul
041	PLATE,BASE BACK,N054	1961495	
042	PLATE,BASE BACK,N054,C,NIW	1961496	
043	PLATE,BASE BACK,N054,C	1961497	
044	GEAR_UNIT_BASE_SHG-25-80_N054_ASP	1968936	√
045	GEAR_UNIT_ARM2_SHG-25-80_N054_ASP	1968942	√
046	GEAR_UNIT_ARM3_SHG-20-80_N054_ASP	1968944	√
047	GEAR_UNIT_ARM4_SHG-20-50_N054_ASP	1968946	√
048	FRAME_UNIT_ARM5_N054_ASP	1968950	
049	GEAR_UNIT_ARM5_SHG-14-80_N054_ASP	1968951	√
050	GEAR_UNIT_ARM6_SHG-14-50_N054_ASP	1968953	√
051	MOTOR_SET_400W_N054_ASP	2241013	√
052	MOTOR_SET_100W_N054_ASP	2241014	√
053	MOTOR_SET_50W_N054_ASP	2241015	√
054	MOTOR_UNIT_400W_N054_ASP	2241016	√
055	MOTOR_UNIT_100W_ARM4_N054_ASP	2241017	√
056	MOTOR_UNIT_50W_N054_ASP	2241018	√
057	MOTOR_UNIT_400W_ARM3_N054_ASP	2241019	√
058	MOTOR_SET_400W_ID1_N054_ASP	2244427	√
059	MOTOR_SET_50W_ID1_N054_ASP	2244428	√
060	MOTOR_UNIT_50W_ID1_N054_ASP	2244429	√

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5.2.2 CX7-A

This is a maintenance parts list for standard/clean models. For information about the protection model, please contact the supplier.

Ref. No.	Parts Name	Parts Code	Overhaul
001	O-ring	1773897	
002	PLY ,P36-EV5GT, J1,N054	1959111	
003	O_RING,CO3235A,AS568-032A	1961955	
005	PLT,MOUNT,MOTOR,J1,N054	1961368	
006	PLY,P34-EV5GT,J1,N055	1959119	
007	Electromagnetic Brake/RNB0.2G-45	1654164	√
008	PLT,MOUNT,BRAKE,J1,N055	1961382	
009	TIMING BELT/400-EV5GT-7	1959773	√
010	PLY,P40-EV5GT,J2,N055	1959120	
011	PLY,P27-EV5GT,J3,N054	1959116	
012	FLANGE,ARM4,EXT2,N055	1961285	
013	COLLAR,PROTECTION,J4,N054	1961278	
014	O_RING	1961816	
015	O_RING/CO0544A	1510529	
016	SEAL,RUBBER,ARM2,900,SIDE,N055	1961700	
017	PLY,P30-3GT,J6,N055	1959121	
018	PLY,P30-3GT,J5J6,N054	1959118	
019	PLT,MOUNT,MOTOR,J5,J6,N054	1961373	
020	Electromagnetic Brake/MCNB3-45	1654166	√

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Ref. No.	Parts Name	Parts Code	Overhaul
021	J456_MOTOR_PULLEY_LP/MMLP000-306	1749501	
022	SIM,ADJUST,M5,t02,N054	1961521	
023	SIM,ADJUST,M5,t04,N054	1961522	
024	SIM,ADJUST,M5,t06,N054	1961536	
025	O_RING	1961787	
026	PLT,MOUNT,MOTOR,J2,N054	1961369	
027	PLY,P33-EV5GT,J2,N054	1959113	
028	SIM,ADJUST,M5,t02,N054	1961521	
029	SIM,ADJUST,M5,t04,N054	1961522	
030	SIM,ADJUST,M5,t06,N054	1961536	
031	PLT,MOUNT,MOTOR,J3,N054	1961371	
032	Electromagnetic Brake_MCNB10-69-37028741	1851930	√
033	PLY,P33-EV5GT,J3,N054	1959115	
034	PLT,MOUNT,MOTOR,J4,N054	1961372	
035	SIM,ADJUST,M4,t02,N054	1961527	
036	SIM,ADJUST,M4,t04,N054	1961528	
037	SIM,ADJUST,M4,t06,N054	1961529	
038	PLY,P48-3GT,J4,N054	1959117	
039	BOARD ASSY. N054 SUB-BR	2234031	
040	BOARD ASSY. N054 LED	2234030	
041	P.K.-A,4X4X12,S/NA	1916793	
042	TIMING BELT/395-EV5GT-7	1959775	√

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Ref. No.	Parts Name	Parts Code	Overhaul
043	BOARD ASSY.DGB_MULTI_ID1_ASP	2228302	
044	TIMING BELT/465-EV5GT-7	1959776	√
045	BOARD ASSY.DGB_MULTI_ID2_ASP	2228303	
046	TIMING BELT/249-3GT-6	1959777	√
047	TIMING BELT/363-3GT-6	1959779	√
048	HNS,07,N055,S,NIW	2238954	
049	HEXAGONAL POSTS,C-PLSBWRK7-50	1961834	
050	BOARD ASSY. RC700-E SUB-B	2221989	
051	HNS,07,N055,S	2238955	
052	HNS,07,N055,IP,NIW	2238956	
053	HNS,07,N055,IP	2238957	
054	HNS,09,N055,S,NIW	2238958	
055	HNS,09,N055,S	2238959	
056	HNS,09,N055,IP,NIW	2238960	
057	HNS,09,N055,IP	2238961	
058	GEAR_UNIT_BASE_SHG-25-80_N054_ASP	1968936	√
059	GEAR_UNIT_ARM2_SHG-25-80_N054_ASP	1968942	√
060	GEAR_UNIT_ARM3_SHG-20-80_N054_ASP	1968944	√
061	GEAR_UNIT_ARM4_SHG-20-50_N054_ASP	1968946	√
062	GEAR_UNIT_ARM1_SHG-25-80_N055_ASP	1968992	√
063	FRAME_UNIT_ARM5_N055_ASP	1968994	
064	GEAR_UNIT_ARM6_SHG-17-50_N055_ASP	1968995	√

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Ref. No.	Parts Name	Parts Code	Overhaul
065	GEAR_UNIT_ARM5_SHG-17-50_N055_ASP	1968996	√
066	MOTOR_UNIT_100W_ARM5,6_N055_ASP	2241020	√
067	MOTOR_SET_100W_N055_ASP	2241021	√
068	MOTOR_UNIT_400W_N054_ASP	2241016	√
069	MOTOR_UNIT_400W_ARM3_N055_ASP	2241105	√
070	MOTOR_UNIT_100W_ARM4_N054_ASP	2241017	√
071	MOTOR_SET_400W_N054_ASP	2241013	√
072	MOTOR_SET_400W_ID1_N054_ASP	2244427	√
073	MOTOR_SET_100W_ID1_N055_ASP	2244431	√
074	MOTOR_UNIT_100W_ID1_ARM5,6_N055_ASP	2244430	√

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