FANUC Robot ARC Mate 100*i*C
FANUC Robot ARC Mate 100*i*Ce
FANUC Robot M-10*i*A
FANUC Robot M-10*i*Ae

MECHANICAL UNIT
MAINTENANCE MANUAL

B-82755EN/11

- **Original Instructions**

Thank you very much for purchasing FANUC Robot.
Before using the Robot, be sure to read the "FANUC Robot SAFETY HANDBOOK (B-80687EN)" and understand the content.

The products in this manual are controlled based on Japan's “Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan. Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government. Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual, we endeavor to include all pertinent matters. There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume. It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

SAFETY PRECAUTIONS

This chapter must be read before using the robot.

For detailed functions of the robot operation, read the relevant operator's manual to understand fully its specification.

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral equipment installed in a work cell.
For safe use of FANUC robots, you must read and follow the instructions in “FANUC Robot SAFETY HANDBOOK (**B-80687EN)**”.

1 DEFINITION OF USER

The personnel can be classified as follows.

Operator:
- Turns the robot controller power ON/OFF
- Starts the robot program from operator panel

Programmer or Teaching operator:
- Operates the robot
- Teaches the robot inside the safety fence

Maintenance technician:
- Operates the robot
- Teaches the robot inside the safety fence
- Performs maintenance (repair, adjustment, replacement)

- Operator is not allowed to work in the safety fence.
- Programmer/Teaching operator and maintenance technician are allowed to work in the safety fence. Works carried out in the safety fence include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safety fence, the person must be trained on proper robot operation.

Table 1 (a) lists the work outside the safety fence. In this table, the symbol "○" means the work allowed to be carried out by the worker.

Table 1 (a) List of work outside the fence

	Operator	Programmer or Teaching operator	Maintenance technician
Turn power ON/OFF to Robot controller	○	○	○
Select operating mode (AUTO/T1/T2)		○	○
Select remote/local mode		○	○
Select robot program with teach pendant		○	○
Select robot program with external device		○	○
Start robot program with operator's panel	○	○	○
Start robot program with teach pendant		○	○
Reset alarm with operator's panel		○	○
Reset alarm with teach pendant		○	○
Set data on teach pendant		○	○
Teaching with teach pendant		○	○
Emergency stop with operator's panel	○	○	○
Emergency stop with teach pendant	○	○	○
Operator's panel maintenance			○
Teach pendant maintenance			○

In the robot operating, programming and maintenance, the operator, programmer/teaching operator and maintenance technician take care of their safety using at least the following safety protectors.

- Use clothes, uniform, overall adequate for the work
- Safety shoes
- Helmet

2 DEFINITION OF SAFETY NOTATIONS

To ensure the safety of users and prevent damage to the machine, this manual indicates each precaution on safety with "**WARNING**" or "**CAUTION**" according to its severity. Supplementary information is indicated by "**NOTE**". Read the contents of each "**WARNING**", "**CAUTION**" and "**NOTE**" before using the robot.

Symbol	Definitions
⚠**WARNING**	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
⚠**CAUTION**	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

- Check this manual thoroughly, and keep it handy for the future reference.

3 PROCEDURE TO MOVE ARM WITHOUT DRIVE POWER IN EMERGENCY OR ABNORMAL SITUATIONS

(1) For emergency or abnormal situations (e.g. persons trapped in or pinched by the robot), brake release unit can be used to move the robot axes without drive power.
Please order following unit and cable.

Name	Specification		
Brake release unit	A05B-2450-J350		(Input voltage AC100-115V single phase)
	A05B-2450-J351		(Input voltage AC200-240V single phase)
Robot connection cable	A05B-2525-J047	(5m)	
	A05B-2525-J048	(10m)	
Power cable	A05B-2525-J010	(5m)	(AC100-115V Power plug) (*)
	A05B-2525-J011	(10m)	(AC100-115V Power plug) (*)
	A05B-2450-J364	(5m)	(AC100-115V or AC200-240V No power plug)
	A05B-2450-J365	(10m)	(AC100-115V or AC200-240V No power plug)

(*) Not supporting CE Marking.

(2) Prepare and store adequate numbers of brake release units which are ready and readily accessible for robot system before installation.
(3) Regarding how to use brake release unit, please refer to "**Robot controller maintenance manual**".

NOTE
Robot systems installed without adequate number of brake release units or similar means are neither in compliance with EN ISO 10218-1 nor with the Machinery Directive and therefore cannot bear the CE marking.

⚠ **WARNING**
Robot arm would fall down by releasing its brake because of the gravity. Therefore, it is strongly recommended to take adequate measures such as hanging Robot arm by a crane before releasing a brake.

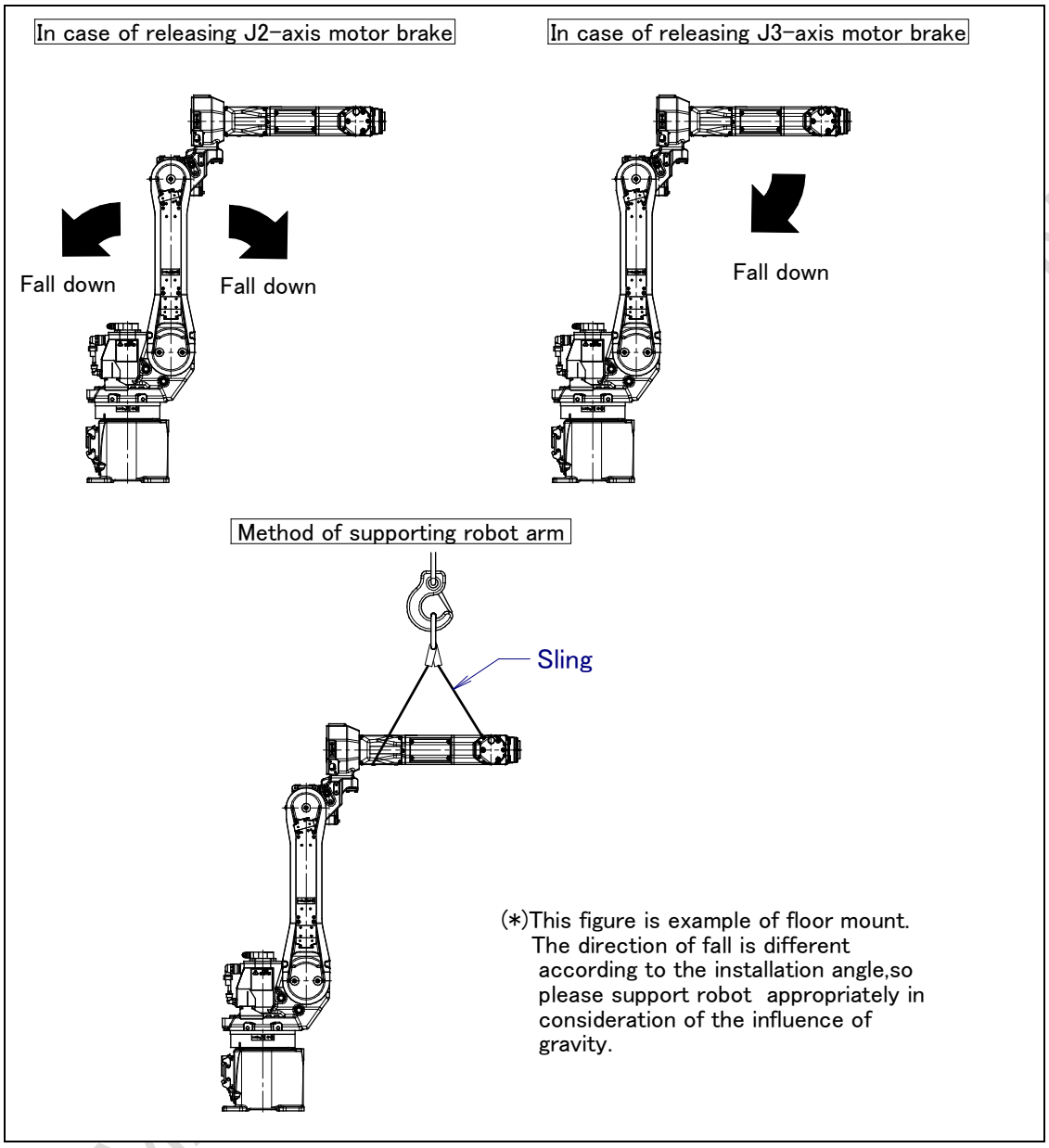


Fig. 3 (a) Releasing J2 and J3 motor brake and measures

4 WARNING & CAUTION LABEL

(1) Greasing and degreasing label

Fig. 4 (a) Greasing and degreasing label

Description

When greasing and degreasing, observe the instructions indicated on this label.

(1) Open the grease outlet at greasing.
(2) Use a hand pump at greasing.
(3) Use designated grease at greasing.

> ⚠ **CAUTION**
> See Subsection 3.2, 4.2 and 4.3 for explanations about specified greases, the amount of grease to be supplied, and the locations of grease and degrease outlets for individual models.

(2) Step-on prohibitive label

Fig. 4 (b) Step-on prohibitive label

Description

Do not step on or climb the robot or controller as it may adversely affect the robot or controller and you may get hurt if you lose your footing as well.

(3) High-temperature warning label

Fig. 4 (c) High-temperature warning label

Description

Be cautious about a section where this label is affixed, as the section generates heat. If you have to inevitably touch such a section when it is hot, use a protective provision such as heat-resistant gloves.

(4) Transportation label

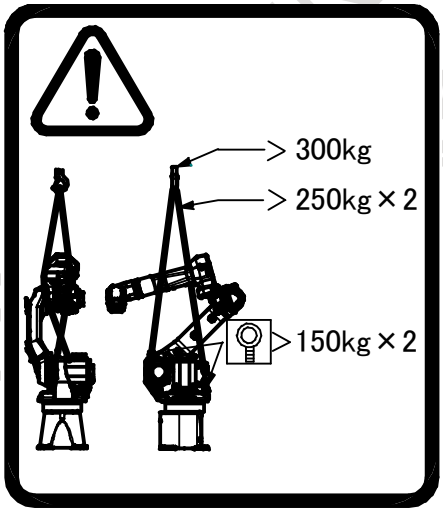


Fig. 4 (d) Transportation label

Description

When transporting the robot, observe the instructions indicated on this label.

Using a crane

- Use a crane with a load capacity of 2940N (300kgf) or greater.
- Use two slings with each load capacity of 2450N (250 kgf) or greater, sling the robot as shown Chapter 1 of the mechanical unit operator's manual (B-82754EN).
- Use two M10 eyebolts with each load capacity of 1470N (150 kgf) or greater.

> ⚠ **CAUTION**
> See Section 1.1 TRANSPORTATION of OPERATOR'S MANUAL (B-82754EN) for explanations about the posture a specific model should take when it is transported.

(5) Transportation prohibitive label (When transport equipment option A05B-1221-H072 is specified.)

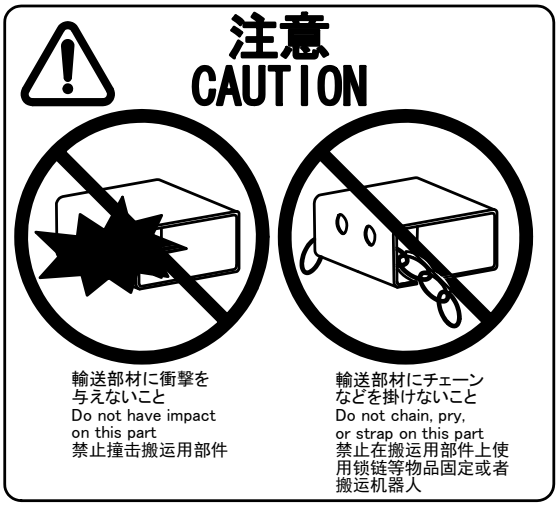


Fig. 4 (e) Transportation prohibitive label

Description

Keep the following in mind when transporting the robot.

(1) Prevent the forks of the forklift from having impact on a transport equipment
(2) Do not thread a chain or the like through transport equipment.

(6) High current attention label

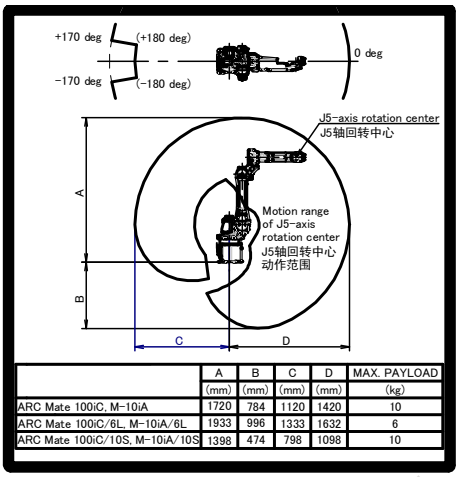
Fig. 4 (f) High current attention Label

Description

Do not access during energized high current inside.

(7) Operating space and payload label

Below label is added when CE specification is specified.



	A	B	C	D	MAX. PAYLOAD
	(mm)	(mm)	(mm)	(mm)	(kg)
ARC Mate 100iC, M-10iA	1720	784	1120	1420	10
ARC Mate 100iC/6L, M-10iA/6L	1933	996	1333	1632	6
ARC Mate 100iC/10S, M-10iA/10S	1398	474	798	1098	10

Fig. 4 (g) Operating space and payload mark label
(Example of ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

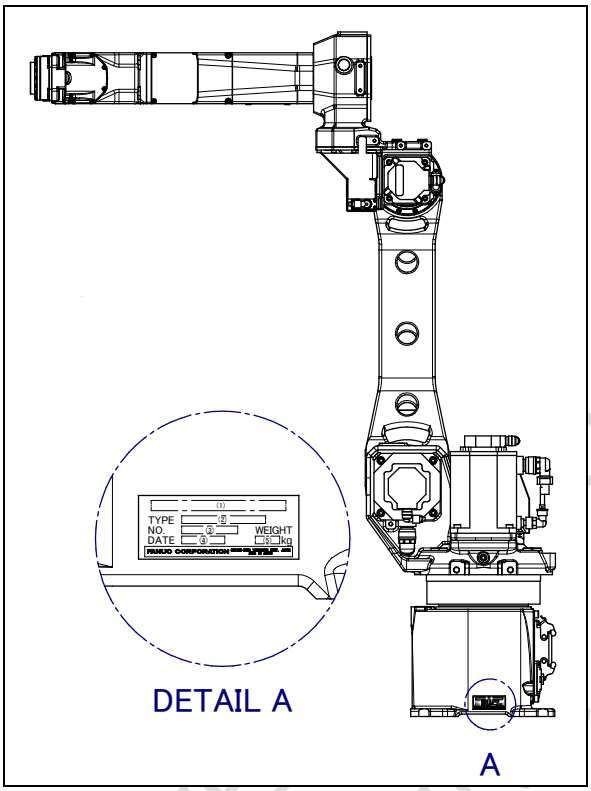
PREFACE

This manual explain that operation procedures for the following mechanical unit:

Model name	Mechanical unit specification No.	Maximum load
FANUC Robot ARC Mate 100*i*C (With all axes brakes)	A05B-1221-B201	3kg or 6kg or 10kg
	A05B-1221-B401	
FANUC Robot M-10*i*A (With all axes brakes)	A05B-1221-B202	3kg or 6kg or 10kg
	A05B-1221-B402	
FANUC Robot ARC Mate 100*i*C/6L (With all axes brakes)	A05B-1221-B301	3kg or 6kg
	A05B-1221-B501	
FANUC Robot M-10*i*A/6L (With all axes brakes)	A05B-1221-B302	3kg or 6kg
	A05B-1221-B502	
FANUC Robot ARC Mate 100*i*C/10S (With all axes brakes)	A05B-1221-B601	3kg or 10kg
FANUC Robot M-10*i*A/10S (With all axes brakes)	A05B-1221-B602	
FANUC Robot ARC Mate 100*i*Ce (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B451	3kg or 6kg or 10kg
FANUC Robot M-10*i*Ae (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B452	3kg or 6kg or 10kg
FANUC Robot ARC Mate 100*i*Ce/6L (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B551	3kg or 6kg
FANUC Robot M-10*i*Ae/6L (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B552	3kg or 6kg
FANUC Robot M-10*i*A/10M (With all axes brakes)	A05B-1221-B702	10kg
FANUC Robot M-10*i*A/10MS (With all axes brakes)	A05B-1221-B902	10kg

NOTE
These robots cannot support Wall & Angle mount.

The label stating the mechanical unit specification number is affixed in the following position. Before reading this manual, verify the specification number of the mechanical unit.



Position of label indicating mechanical unit specification number

TABLE 1 (a)

	(1)	(2)	(3)	(4)	(5)
CONTENTS	**Model name**	**TYPE**	**No.**	**DATE**	**WEIGHT kg (Without controller)**
LETTERS	FANUC Robot ARC Mate 100*i*C	A05B-1221-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	130
		A05B-1221-B401			
	FANUC Robot M-10*i*A	A05B-1221-B202			130
		A05B-1221-B402			
	FANUC Robot ARC Mate 100*i*C/6L	A05B-1221-B301			135
		A05B-1221-B501			
	FANUC Robot M-10*i*A/6L	A05B-1221-B302			135
		A05B-1221-B502			
	FANUC Robot ARC Mate 100*i*C/10S	A05B-1221-B601			130
	FANUC Robot M-10*i*A/10S	A05B-1221-B602			130
	FANUC Robot ARC Mate 100*i*Ce	A05B-1221-B451			130
	FANUC Robot M-10*i*Ae	A05B-1221-B452			130
	FANUC Robot ARC Mate 100*i*Ce/6L	A05B-1221-B551			135
	FANUC Robot M-10*i*Ae/6L	A05B-1221-B552			135
	FANUC Robot M-10*i*A/10M	A05B-1221-B702			130
	FANUC Robot M-10*i*A/10MS	A05B-1221-B902			130

RELATED MANUALS

For the FANUC Robot series, the following manuals are available:

Safety handbook B-80687EN All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers: Operator , system designer Topics: Safety items for robot system design, Operation, Maintenance
R-30*i*A controller	Operator's Manual HANDLING TOOL **B-83124EN-2** ARC TOOL **B-83124EN-3** DISPENSE TOOL **B-83124EN-4** ALARM CODE LIST **B-83124EN-6**	Intended readers : Operator, programmer, Teaching operator, Maintenance engineer, System designer Topics : Robot functions, Operations, Programming, Setup, Interfaces, Alarms Use : Robot operation, Teaching, System design
	Maintenance Manual **B-82595EN** **B-82595EN-1** (For Europe) **B-82595EN-2** (For RIA)	Intended readers : Maintenance engineer, System designer Topics : Installation, Start-up, Connection, Maintenance Use : Installation, Start-up, Connection, Maintenance
R-30*i*A Mate controller	Operator's Manual LR HANDLING TOOL **B-83134EN-1** LR ARC TOOL **B-83134EN-2** ALARM CODE LIST **B-83124EN-6**	Intended readers : Operator, programmer, Teaching operator, Maintenance engineer, System designer Topics : Robot functions, Operations, Programming, Setup, Interfaces, Alarms Use : Robot operation, Teaching, System design
	Maintenance Manual **B-82725EN** **B-82725EN-1** (For Europe) **B-82725EN-2** (For RIA)	Intended readers : Maintenance engineer, System designer Topics : Installation, Start-up, Connection, Maintenance Use : Installation, Start-up, Connection, Maintenance

R-30*i*B, **R-30*i*B Mate,** **R-30*i*B Plus,** **R-30*i*B Mate Plus** **controller**	Operator's Manual (Basic Operation) **B-83284EN** Operator's Manual (Alarm Code List) **B-83284EN-1** Operator's Manual (Optional Function) **B-83284EN-2** ARC WELDING FUNCTION Operator's Manual **B-83284EN-3** Spot WELDING FUNCTION Operator's Manual **B-83284EN-4** DISPENSE FUNCTION Operator's Manual **B-83284EN-5**	Intended readers : Operator, programmer, Teaching operator, Maintenance engineer, System designer Topics : Robot functions, Operations, Programming, Setup, Interfaces, Alarms Use : Robot operation, Teaching, System design
	MAINTENANCE MANUAL **R-30*i*B, R-30*i*B Plus** **: B-83195EN** **R-30*i*B Mate, R-30*i*B Mate Plus** **: B-83525EN**	Intended readers : Maintenance engineer, System designer Topics : Installation, Start-up, Connection, Maintenance Use : Installation, Start-up, Connection, Maintenance
FANUC Robot **ARC Mate 100*i*C,** **ARC Mate 100*i*Ce,** **M-10*i*A,** **M-10*i*Ae** **Mechanical unit**	Operator's manual **B-82754EN**	Intended readers: System designer, Maintenance engineer Topics: Installation, Connection to controller, Maintenance Use: Installation, Start-up, Connection, Maintenance

This manual uses following terms.

Name	Terms in this manual
Connection cable between robot and controller	Robot connection cable
Robot mechanical unit	Mechanical unit

TABLE OF CONTENTS

1 CHECKS AND MAINTENANCE (EXCEPT 10M/10MS)

Optimum performance of the robot can be maintained by performing the checks and maintenance procedures presented in this chapter. (See the APPENDIX C PERIODIC MAINTENANCE TABLE.)

NOTE
The periodic maintenance procedures described in this chapter assume that the FANUC robot is used for up to 3840 hours a year. In cases where robot use exceeds 3840 hours/year, adjust the given maintenance frequencies accordingly. The ratio of actual operation time/year vs. the 3840 hours/year should be used to calculate the new (higher) frequencies. For example, when using the robot 7680 hours a year with a recommended maintenance interval of 3 years or 11520 hours, use the following calculation to determine the maintenance frequency: 3 years / 2 = perform maintenance every 1.5 years.

1.1 PERIODIC MAINTENANCE

1.1.1 Daily Checks

Check the following items when necessary before daily system operation.

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is an oil seepage, clean it. **⇒"1.2.1 Confirmation of Oil Seepage"**
Air control set	When air control set is used) **⇒"1.2.2 Confirmation of the Air Control Set"**
Vibration, Abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: **⇒"5.1 TROUBLESHOOTING"(symptom：Vibration, Noise)**
Positioning accuracy	Check whether the taught positions of the robot have not deviated from the previous taught positions. When the displacement occurs, perform the measures as described in the following section: **⇒"5.1 TROUBLESHOOTING"(Symptom：Displacement)**
Peripheral equipment for proper operation	Check whether the peripheral equipment operate properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the droppage of the end effector is within 5 mm when the servo power turned off. If the end effector (hand) drops, perform the measures as described in the following section: **⇒"5.1 TROUBLESHOOTING"(symptom：Dropping axis)**
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: **⇒"R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1) or R-30*i*A/R-30*i*A Mate CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83124EN-6)"**

1.1.2 Periodic Check and Maintenance

Check the following items at the intervals recommended below based on the period or the accumulated operating time, whichever comes first. (○ : Item needs to be performed.)

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
○ Only 1st check	○					Check the oil sight glasses of J4/J5/J6-axes gearboxes	Please confirm whether the amount of oil of the oil sight glass of J4/J5/J6-axes gearboxes has come above the 3/4 of total height. **⇒"1.2.3 Check the Oil Sight Glasses"**	11
○ Only 1st check	○					Check the failure of the wrist part fluoric resin ring	Check to see whether there is failure on the wrist part fluoric resin ring. If it is broken, replace it with a new one. **⇒"1.2.4 Check the Failure of the Wrist Part Fluoric Resin Ring"**	21
○ Only 1st check	○					Cleaning the controller ventilation system	If the controller ventilation system is dusty, turn the power off, and clean the unit.	23
	○					Check the external damage or peeling paint	Check whether the robot has external damage due to the interference with the peripheral devices or peeled paint. If it interferes, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check damages of the cable protective sleeve	Check whether the cable protective sleeves of the mechanical unit cable have holes or tears. If damage is found, replace the cable protective sleeve. If the cable protective sleeve is damaged due to the interference with peripheral devices, eliminate the cause. **⇒"1.2.5 Check the Mechanical Unit Cables and Connectors"**	2
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If liquid was found, remove the cause, and wipe the liquid off.	3
	○ Only 1st check	○				Check for damages to the teach pendant cable, the operation box connection cable or the robot connection cable	Check whether the cable connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace them.	22
	○ Only 1st check	○				Check for damage to the mechanical unit cable (movable part) and welding cable	Observe the movable part of the mechanical unit cable and welding cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted. **⇒"1.2.5 Check the Mechanical Unit Cables and Connectors"**	4

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Check for damage to the end effector (hand) connection cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace them.	5
	○ Only 1st check	○				Check the connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"1.2.5 Check the Mechanical Unit Cables and Connectors"**	6
	○ Only 1st check	○				Retightening the end effector mounting bolts	Retighten the end effector mounting bolts. Refer to the following section for tightening torque information: **⇒"4.1 MECHANICAL COUPLING OF END EFFECTOR TO WRIST of OPERATOR'S MANUAL (B-82754EN)"**	7
	○ Only 1st check	○				Retightening the external main bolts	Retighten the bolts which are installed, removed in the inspection, and exposed. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	8
	○ Only 1st check	○				Check the mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the mechanical stopper, the adjustable mechanical stopper, and check the looseness of the stopper mounting bolts. **⇒"1.2.6 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"**	9
	○ Only 1st check	○				Clean spatters, sawdust and dust	Check that spatters, sawdust, or dust does not exist on the robot main body. If dust has accumulated, remove it. Especially, clean the robot movable parts well (each joint, around the welding torch, conduit part, wrist axis hollow part and the cable protective sleeve). The insulation failure occurs when the spatter has collected around the wrist flange or welding torch, and there is a possibility of damaging the robot mechanism by the welding current. (See Appendix E)	10

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
		○				Replacing the mechanical unit batteries	Replace the mechanical unit batteries. Regardless of operating time, replace batteries at 1 year. **⇒"3.1 REPLACING THE BATTERIES"**	12
			○			Replace the wrist part fluoric resin ring	Replace the wrist part fluoric resin ring Contact your local FANUC representative for information regarding replacing the fluoric resin ring. **⇒"1.2.4 Check the Failure of the Wrist Part Fluoric Resin Ring"**	21
			○			Replacing cable of Mechanical unit welding power	Replace the cable of Mechanical unit welding Refer to Chapter 8 for information regarding replacing the cable.	19
			○			Replacing the Material handling (M/H) conduit or No dust material handling conduit	Replace the Material handling (M/H) conduit Refer to Chapter 6 regarding replacing the Material handling (M/H) conduit or No dust material handling conduit	20
				○		Replacing the grease and oil of J1 to J3- axis reducer and J4 to J6-axis gearbox	Replace the grease and oil of each axis reducer and gearbox **⇒"3.2 REPLACING THE GREASE AND OIL OF THE DRIVE MECHANISM"**	13 to 17
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Please refer to Chapter 8 about replacing the cable.	18
					○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. **⇒Chapter 7 Replacing batteries of R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) or R-30*i*B Mate CONTROLLER MAINTENANCE MANUAL (B-83525EN) or R-30*i*A CONTROLLER MAINTENANCE MANUAL (B-82595EN) or R-30*i*A Mate CONTROLLER MAINTENANCE MANUAL (B-82725EN)**	24

1.2 CHECK POINTS

1.2.1 Confirmation of Oil Seepage

Check items

Check there is oil on sealed part of each joint parts. If there is oil seepage, clean them.

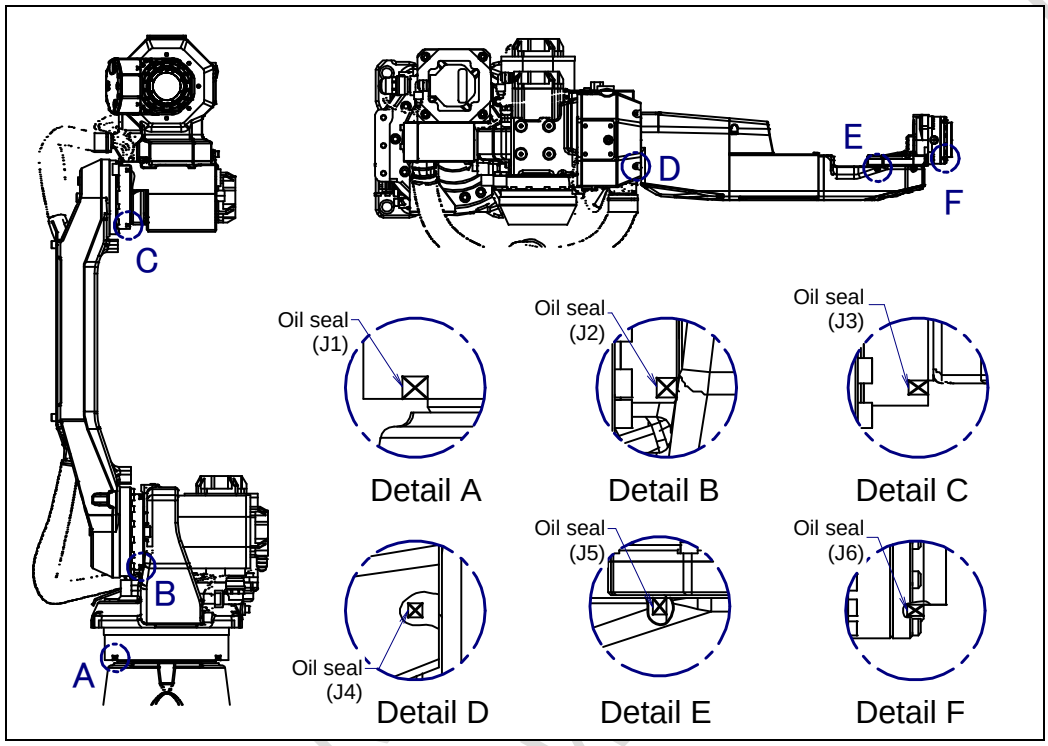


Fig. 1.2.1 (a) Check parts of oil seal

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil viscosity changes, the oil might drip depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components in Fig. 1.2.1 (a) before you operate the robot.
- In case of oil seepage, please consider replacing the grease and the oil altogether. This replacement potentially can help improving the seepage situation.
- Also, drive mechanism might become hot and the internal pressure of the grease bath or oil bath might rise. In these cases, normal internal can be restored by venting the grease outlet. (When opening the grease outlet, refer to Section 3.2 and ensure that grease is not expelled onto the machine or tooling. When opening the oil outlet, refer to Section 3.2, put a oil pan under the oil outlet or place the oil outlet at the upper side.)

> ⚠ **WARNING**
> Hot grease might eject suddenly when you open the grease outlet. Attach bags for collecting grease, and use appropriate protective equipment such as heat-resistant gloves, protective glasses, a face shield, or a body suit if necessary.

- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.

  ⇒"5.1 TROUBLESHOOTING" (symptom : Grease leakage , Oil leakage)

1.2.2 Confirmation of the Air Control Set

When an air control set is used, check the items below.

Item	Check items	Check points
1	Air pressure	Check the air pressure using the pressure gauge on the air control set as shown in Fig.1.2.2 (a). If it does not meet the specified pressure of 0.49 to 0.69 MPa (5-7 kgf/cm^2), adjust it using the regulator pressure-setting handle.
2	Lubricator oil mist quantity	Check the number of oil drops during wrist or hand motion. If it does not meet the specified value (1 drop/10-20 sec), adjust it using the lubricator control knob. Under normal usage, the lubricator will be empty in about 10 to 20 days.
3	Lubricator oil level	Check to see that the air control set oil level is within the specified level.
4	Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts as required.
5	Drain	Check the drain and release it. When volume of the drain is remarkable, examine the setting of the air dryer to the air supply side.

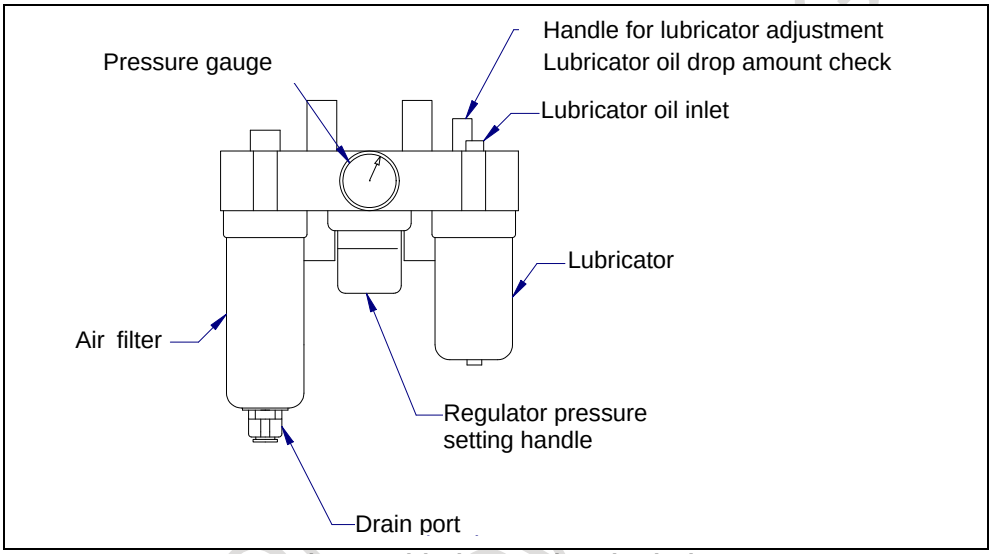


Fig. 1.2.2 (a) Air control set (option)

1.2.3 Check the Oil Sight Glasses

Please confirm whether the amount of oil of the oil sight glass of J4/J5/J6-axes gearboxes has come above the 3/4 of total height. Please replenish it in case of the shortage. Through the oil sight glass might not have air part, but this is not trouble. When oil does not fill enough, the red index of the oil sight glass shows the reflected heat of the light, and the outline of the index is seen clearly. When oil fills enough, it does not show this reflected heat, and the outline of the index is not clear. When the oil sight glass cannot be read at all because of the oil discoloration due to deterioration, like a right edge of Fig. 1.2.3 (a), exchange oil referring to Section 3.2.

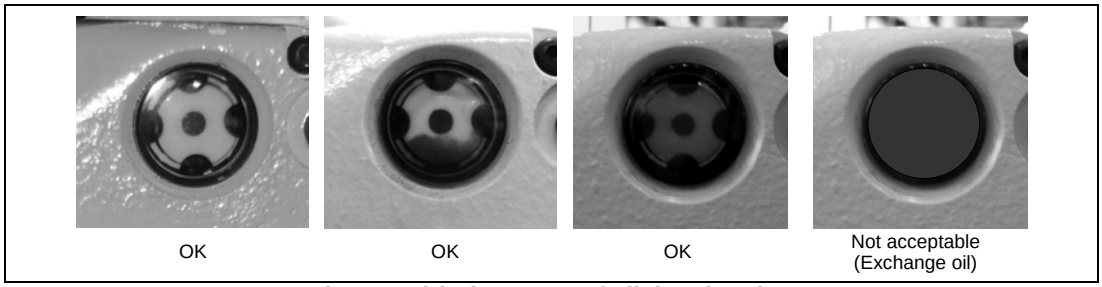


Fig. 1.2.3 (a) The extent of oil deterioration

> **⚠ CAUTION**
> If you continue using the oil in the dirty state, it reduce the seal performance of oil seal and cause the sludge outbreak, and cause vibration of robot.
> If operation condition is severe, oil is stained early, in that case we recommend early oil exchange.

1.2.4 Check the Failure of the Wrist Part Fluoric Resin Ring

Check to see whether there is failure on the wrist part fluoric resin ring. If is broken, replace it by new one. Two years are aims in an exchange period. If you operate robot with the state that hard mine dust is attached to rotated part, exchange period may shorten.
(Spec. of fluoric resin ring :A290-7221-X571)

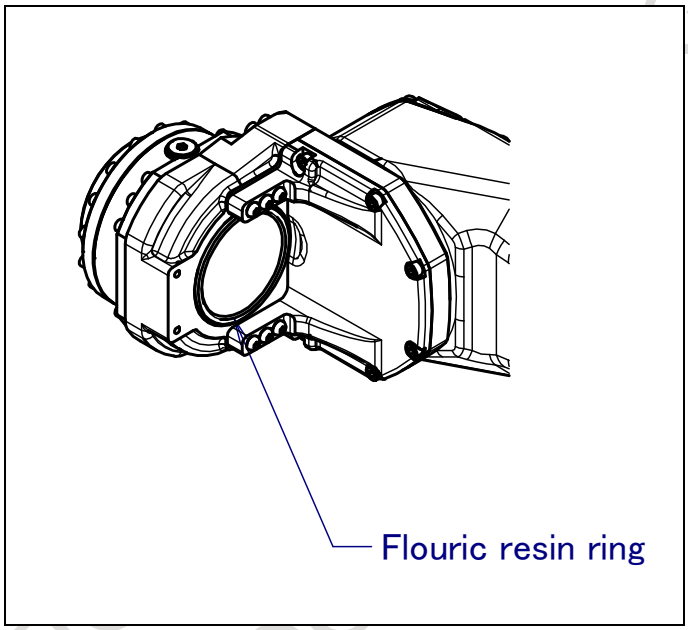


Fig. 1.2.4 (a) Fluoric resin ring

If the fluoric resin rig is broken as shown in Fig.1.2.4 (b), replace it.

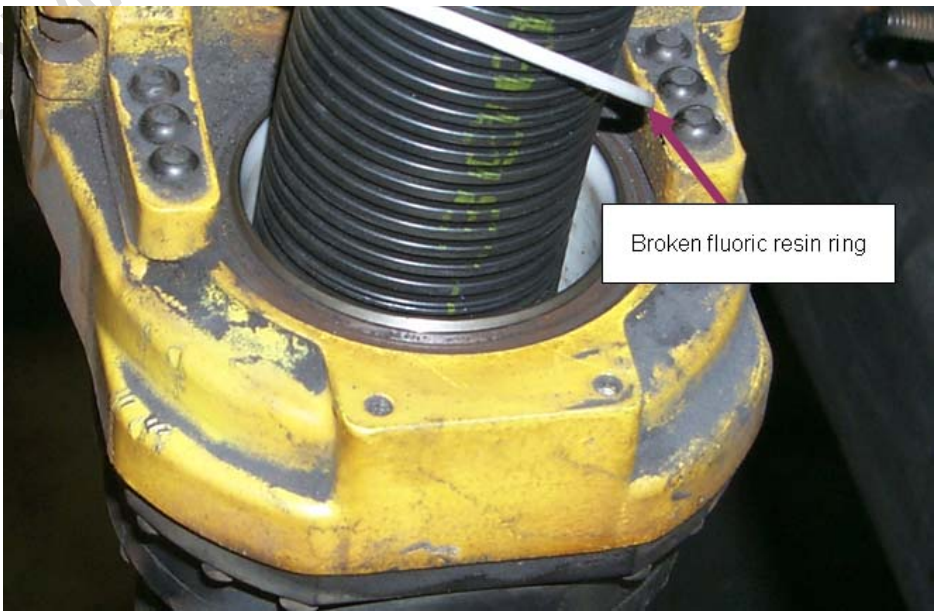


Fig .1.2.4 (b) Failure of the fluoric resin ring

1.2.5 Check the Mechanical Unit Cables and Connectors

Inspection points of the mechanical unit cables and welding cables

Check the cable for damage that has been exposed. Take special care for movable parts.
Clean it when the spatter adheres.

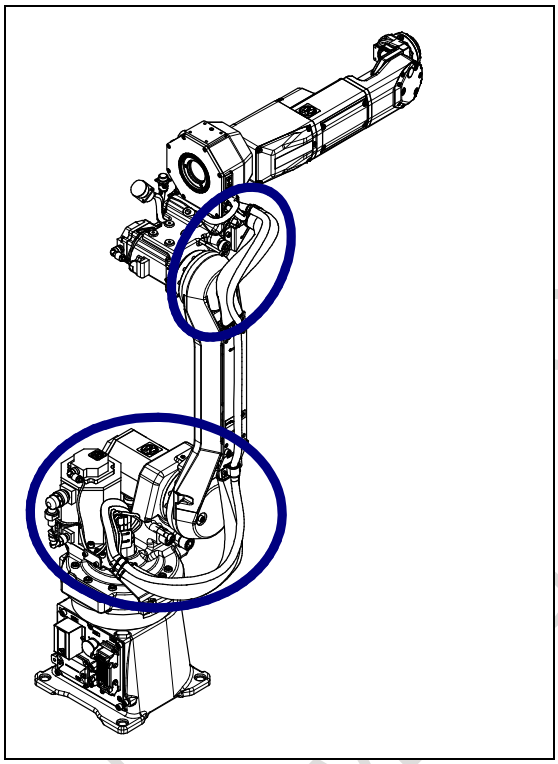


Fig. 1.2.5 (a) Inspection points of the mechanical unit cables

Check points

＜Cable protective sleeve＞

- Check that no holes or tears exist on the cable protective sleeves.
- If there is damage as shown in Fig. 1.2.5 (b), replace the cable protective sleeves.

Fig. 1.2.5 (b) Damage on the cable protective sleeve

＜Cables＞

- Check that there is no wear or damage on the coating.
- If the inside wire strands are exposed due to wear or damage, replace the cables.

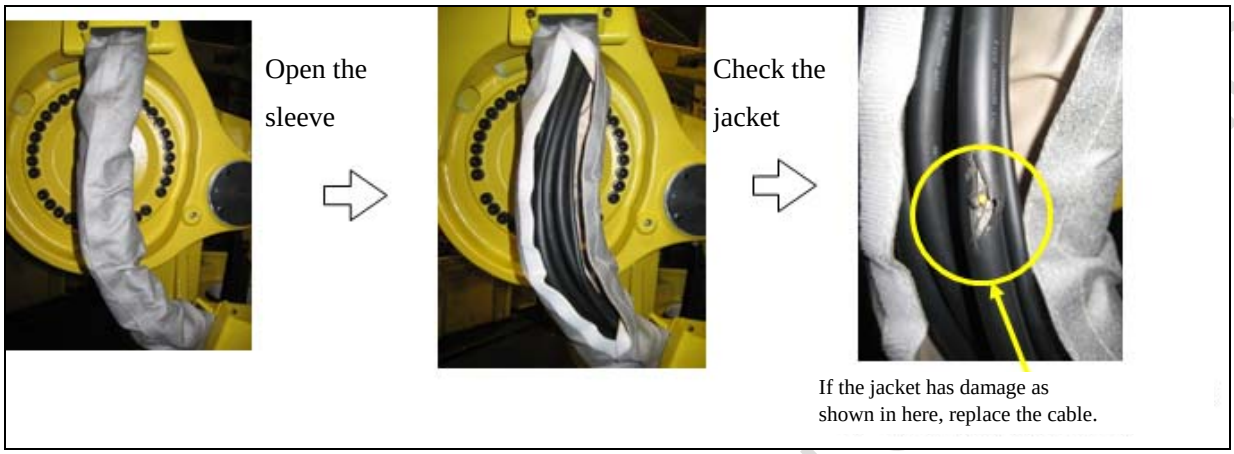


Fig. 1.2.5 (c) Cable check method

Inspection points of the connectors

- Power/brake connectors of the motor exposed externally
- Robot connection cables, earth terminal and user cables

Check items

- Circular connector : Check the connector for tightness by turning it manually.
- Square connector : Check the connector for engagement of its lever.
- Earth terminal : Check the terminal for tightness.

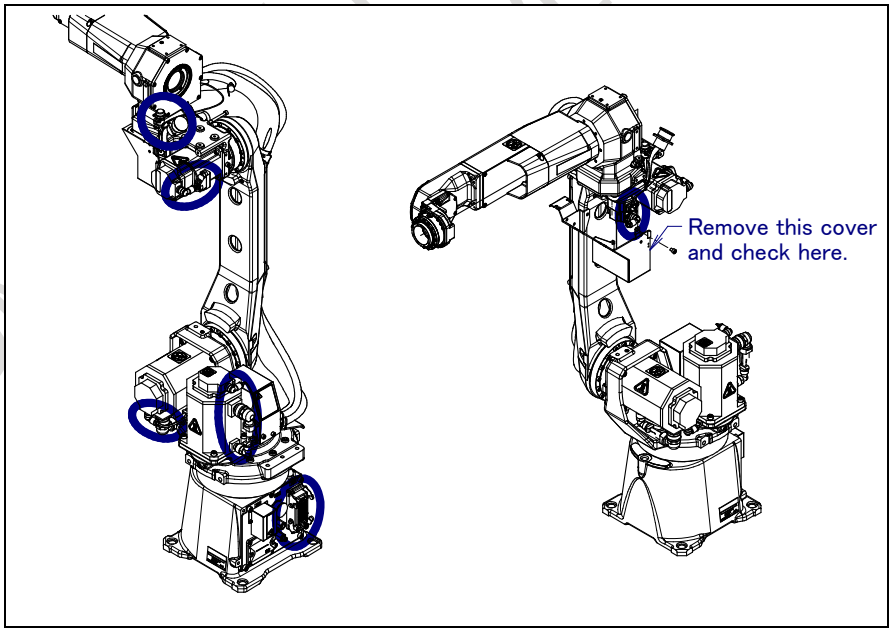


Fig. 1.2.5 (d) Connector Inspection points

1.2.6 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check that there is no evidence of a collision on the mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace the parts.
- Check the looseness of the stopper mounting bolts. If they are loose, retighten them.
  Be sure to check the looseness of the mounting bolts of the J1-axis swing stopper.
- Refer to Section 6.2 of the operator's manual for details regarding the adjustable mechanical stopper.

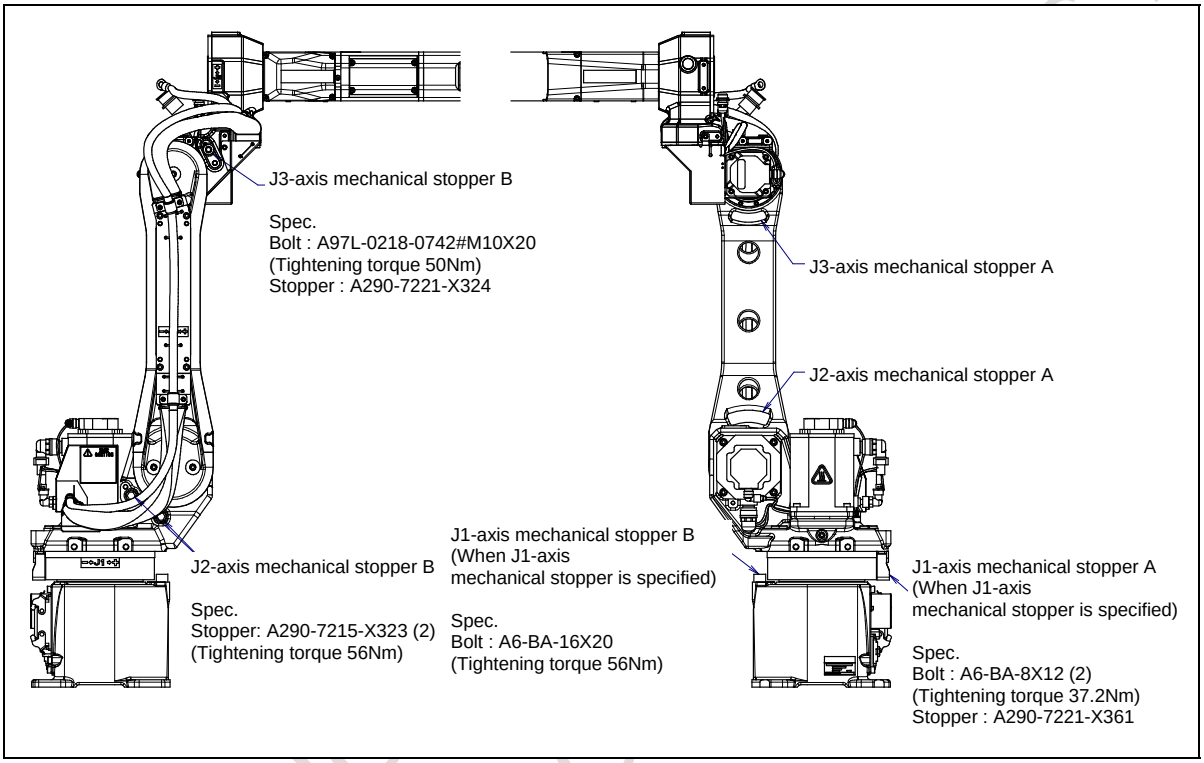


Fig. 1.2.6 (a) Check of mechanical stopper and adjustable mechanical stopper

1.3 MAINTENANCE TOOLS

You should have the following instruments and tools ready for maintenance.

a) Measuring instruments

Instrument	Condition	Use
Dial gauge	1/100mm	For positioning precision and backlash measurement
Vernier calipers	150mm	

b) Tools

Name	Remarks
Cross-head screwdrivers	(Large, medium, and small sizes)
Straight-head screwdrivers	(Large, medium, and small sizes)
Nut driver	Width across flats 7, 10 (for grease nipple)
Hexagonal wrench sets	Width across flats 2.5, 3, 4, 5, 6, 8, 10, 12 (for replacing parts)
Torque wrench	Width across flats 2.5, 3, 4, 5, 6, 8, 10, 12 (for replacing parts)
Long T wrenches	Width across flats 2.5, 3, 4, 5, 6, 8, 10, 12 (for replacing parts)
Adjustable wrenches	(Medium and small sizes)
Pliers	
Long-nose pliers	
Cutting pliers	
Both-ended wrench	
Grease gun	
Vacuum cleaner	
C-ring pliers	
Oil seal installation fixture for J4-axis	A290-7221-X921 (Fig.1.3 (a))
Guide pin for replacing J3-axis reducer	A290-7221-X925 (Fig.1.3 (b))
Oil seal installation fixture for J1-axis	A290-7221-X936 (Fig.1.3 (c))
J1/J2/J3-axis reducer rigging fixture	A290-7221-X946 (Fig.1.3 (d))
J6 motor wiring detaching tool	A290-7221-X971
Adaptor for J5/J6 axis oiling	A290-7221-X591
Mounting fixture for J3-axis motor	A290-7221-Y974 (Fig.1.3 (e)) (M-10*i*A/10M)
Mounting fixture for J3-axis motor	A290-7221-Y976 (Fig.1.3 (f)) (M-10*i*A/10MS)
Mounting fixture for J3-axis motor	A290-7221-Z972 (Fig.1.3 (g)) (For robot which is made before March, 2010 ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L)
Mounting fixture for J3-axis motor	A290-7221-Z974 (Fig.1.3 (h)) (For robot which is made after April, 2010)
Mounting fixture for gear of J3-axis motor	A290-7221-X974 (Fig.1.3 (i)) (For ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L)
Adapter	A290-7221-X975 (Fig.1.3 (j)) This is used with A290-7221-Y974, A290-7221-X974
Mounting fixture for gear of J3-axis motor	A290-7221-X976 (Fig.1.3 (k)) (For ARC Mate 100*i*C/10S, M-10*i*A/10S)
Adapter	A290-7221-X977 (Fig.1.3 (l)) This is used with A290-7221-Y976, A290-7221-X976
Flashlight	
LOCTITE 243,263,518,675	
Three bond TB1133K	A98L-0040-0290
Oil injection gun	A05B-1221-K005
Oil injection nipple with valve	A05B-1221-K006
Oil tray with valve	A05B-1221-K007

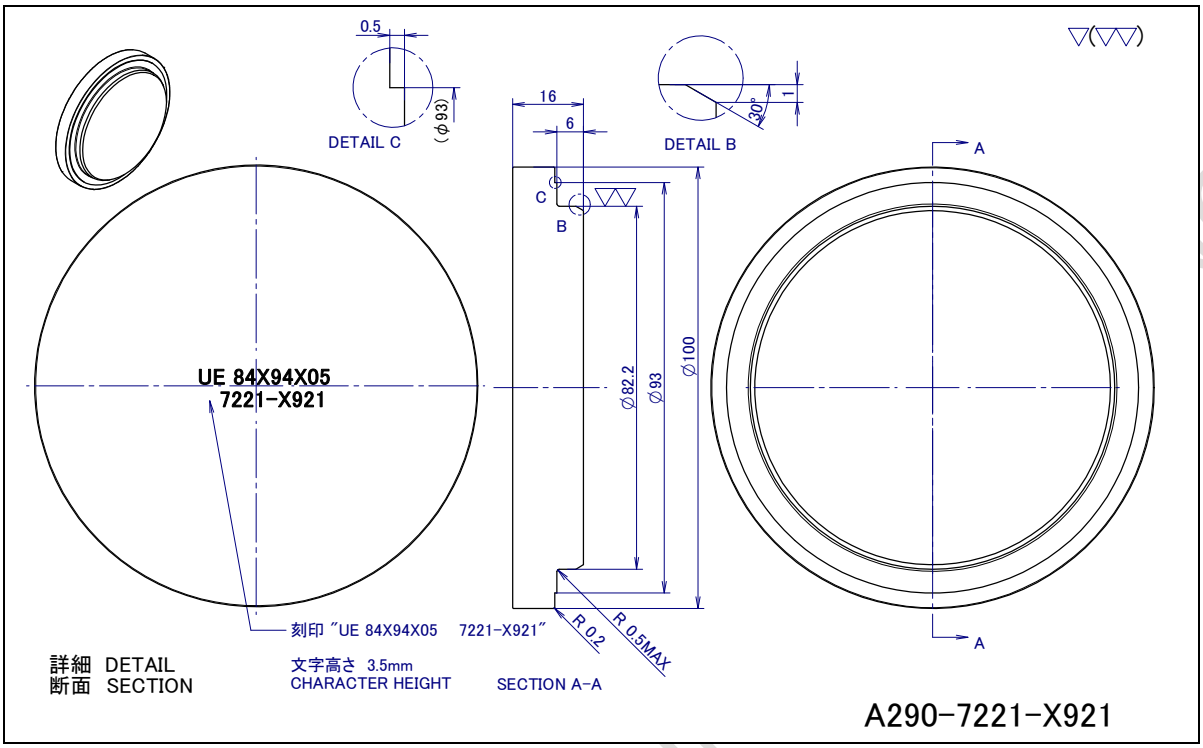


Fig. 1.3 (a) Oil seal installation fixture for J4-axis gearbox

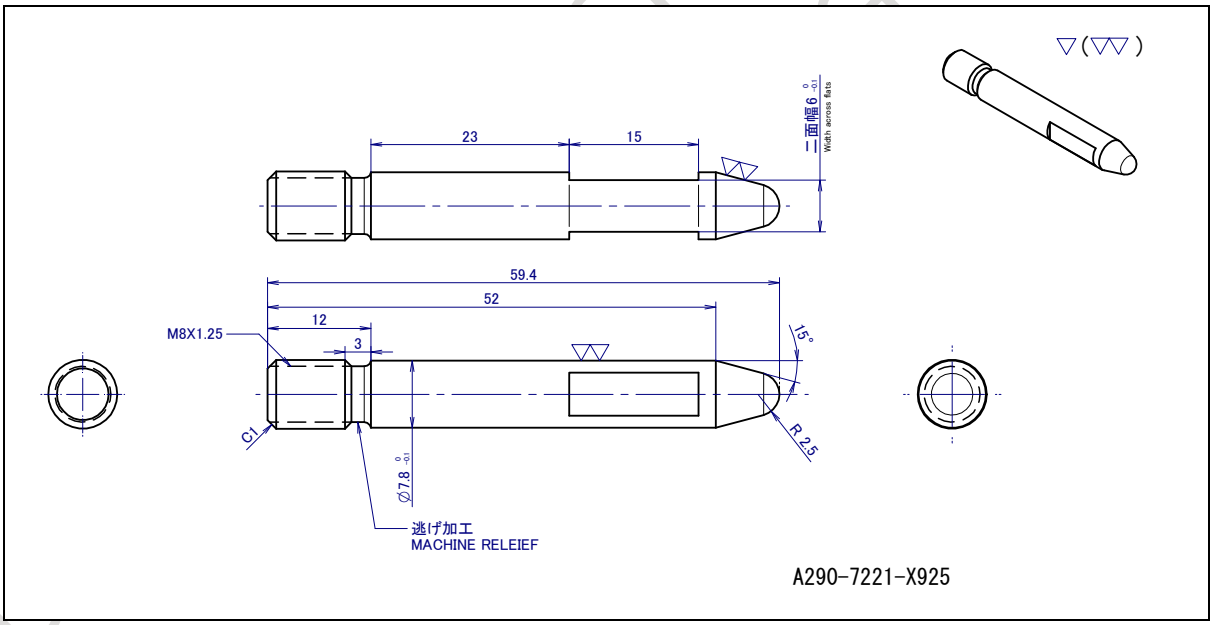


Fig. 1.3 (b) Guide pin for replacing J3-axis reducer (M8)

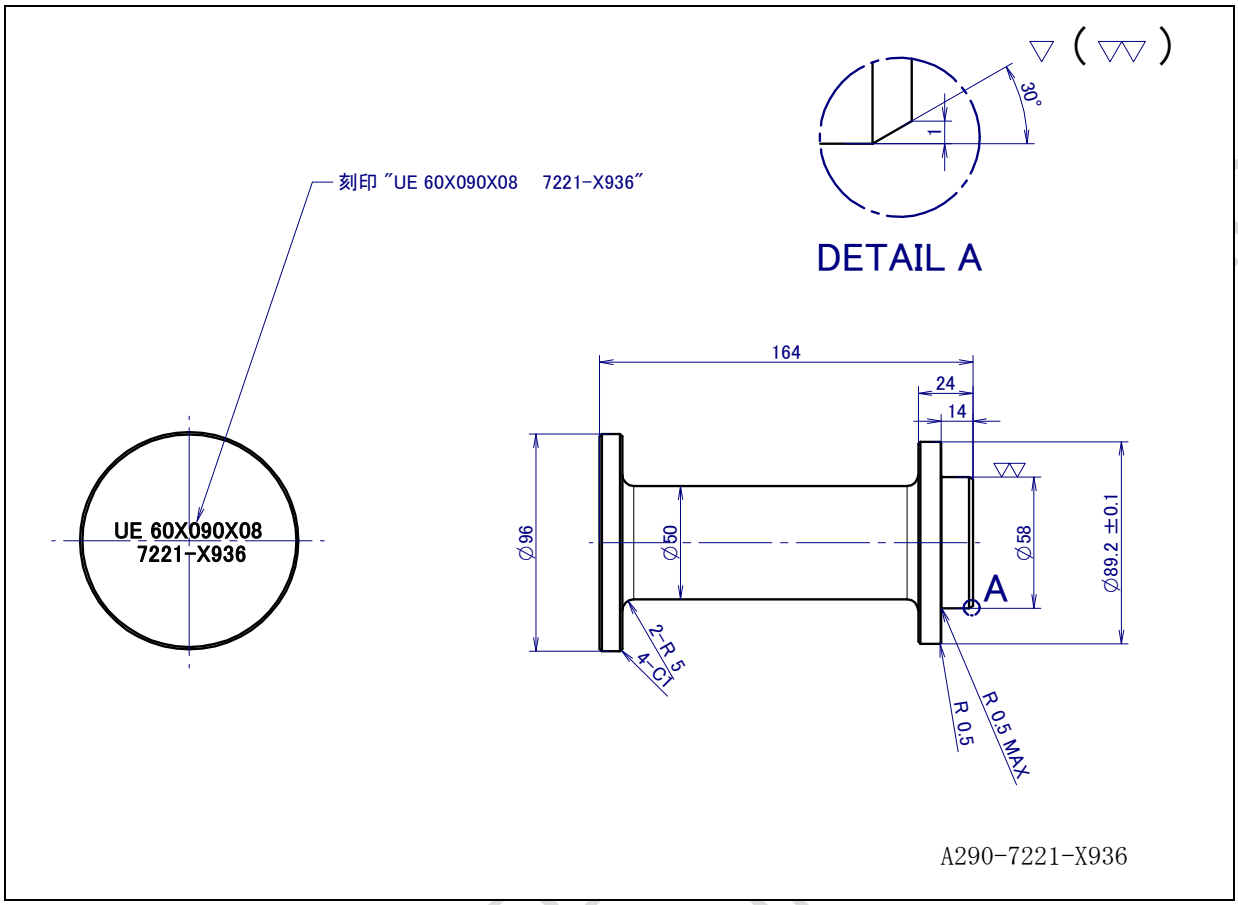


Fig. 1.3 (c) Oil seal installation fixture for J1-axis reducer

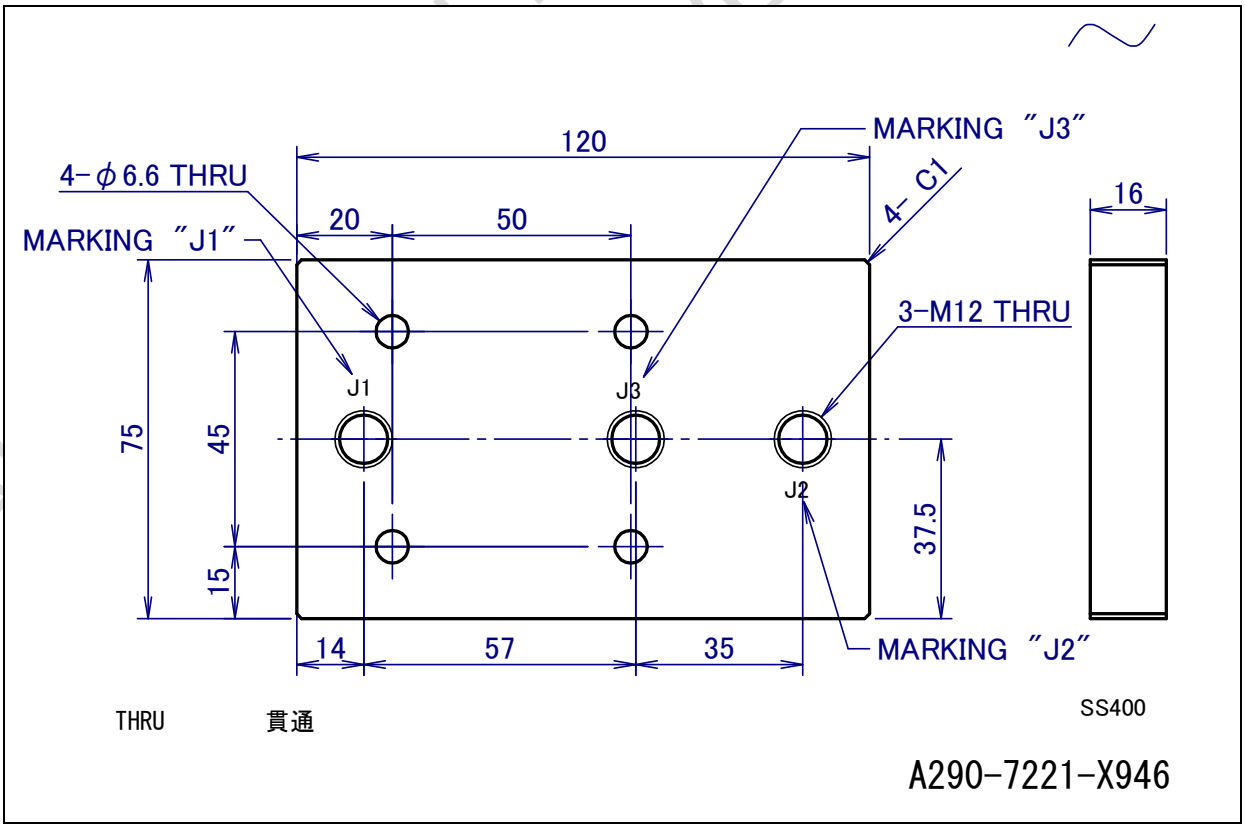


Fig. 1.3 (d) J1/J2/J3-axis reducer rigging fixture

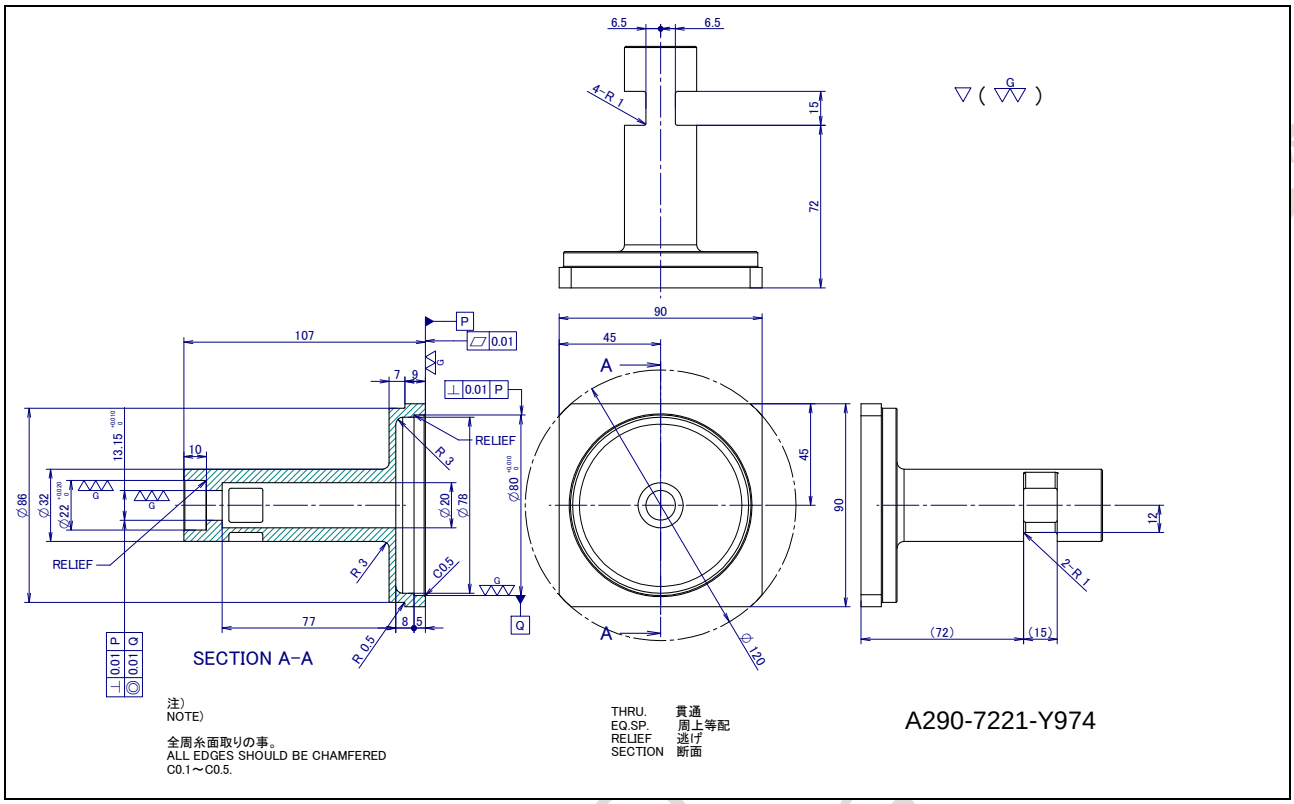


Fig. 1.3 (e) Mounting fixture for gear of J3-axis motor

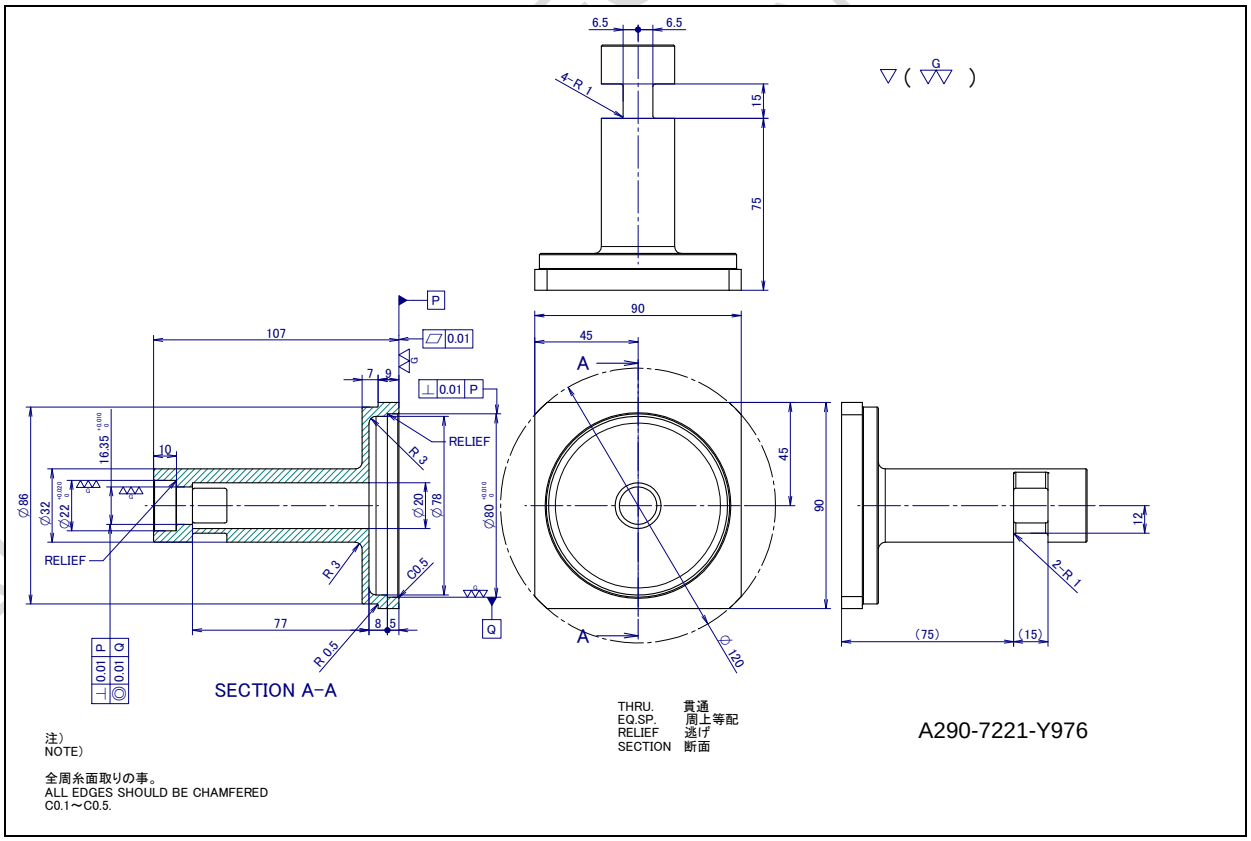


Fig. 1.3 (f) Mounting fixture for gear of J3-axis motor

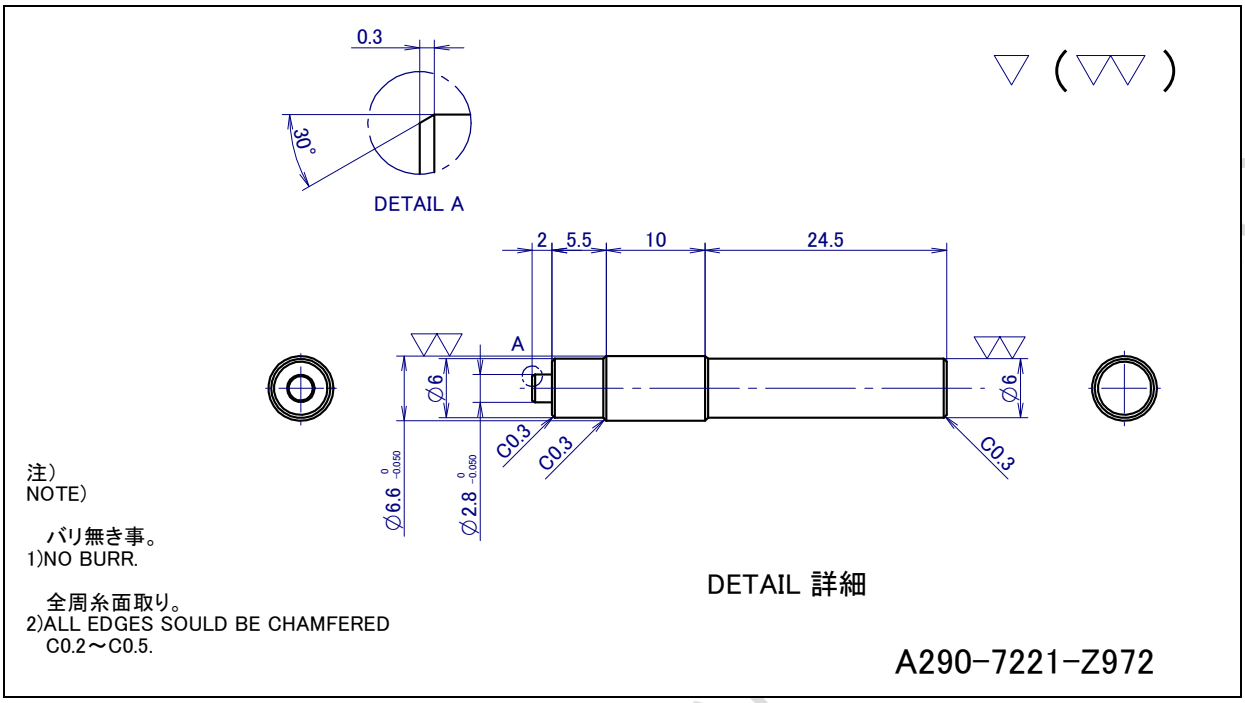


Fig. 1.3 (g) Mounting fixture for J3-axis motor

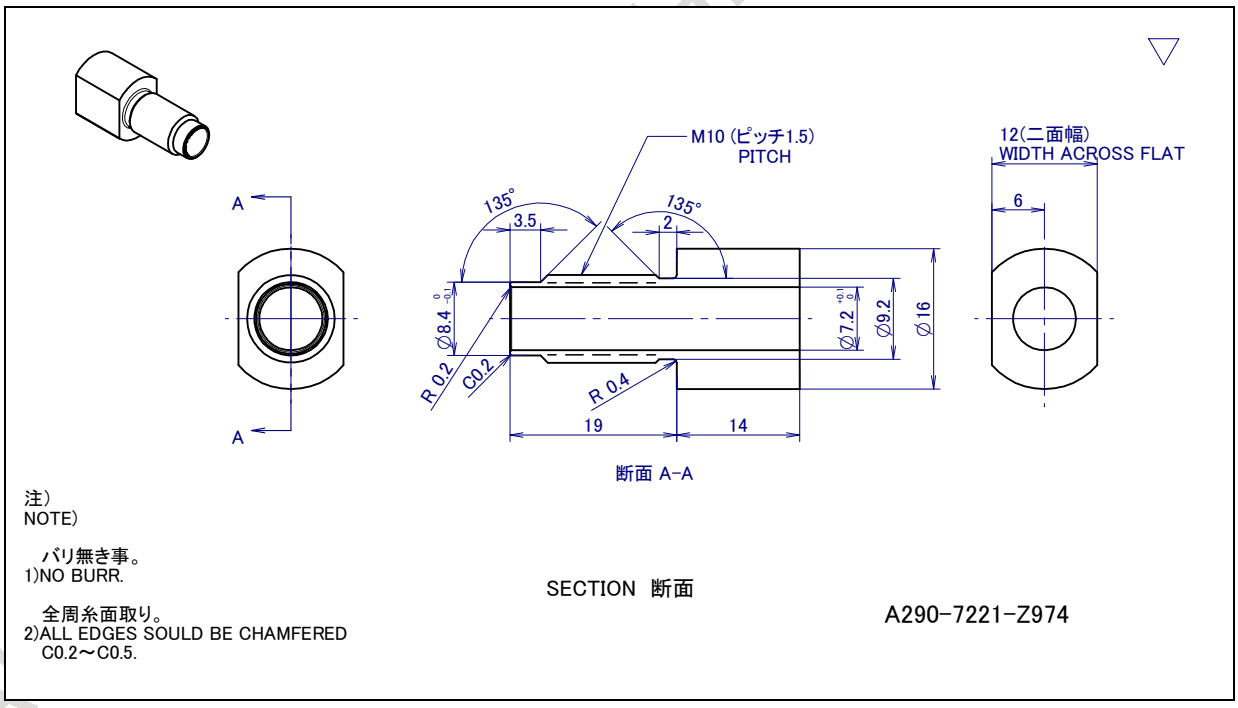


Fig. 1.3 (h) Mounting fixture for J3-axis motor

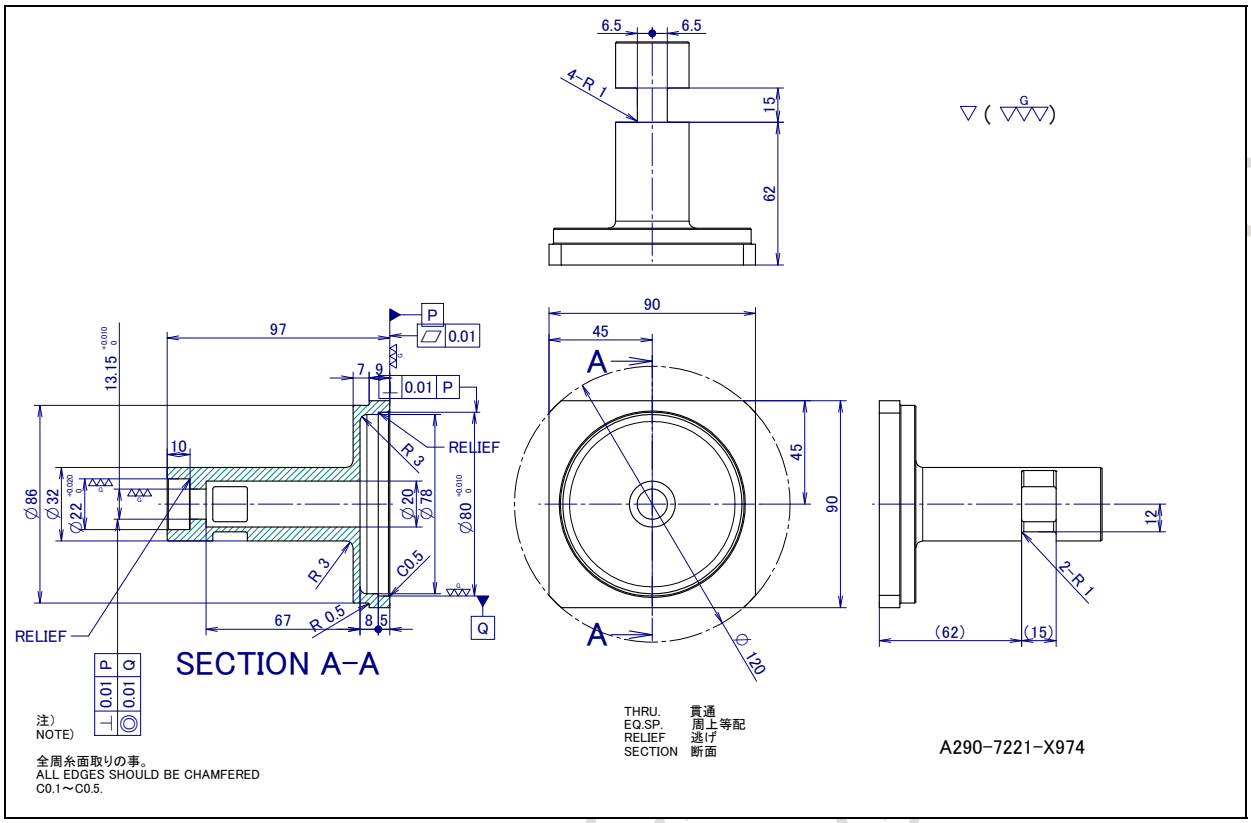


Fig. 1.3 (i) Mounting fixture for gear of J3-axis motor

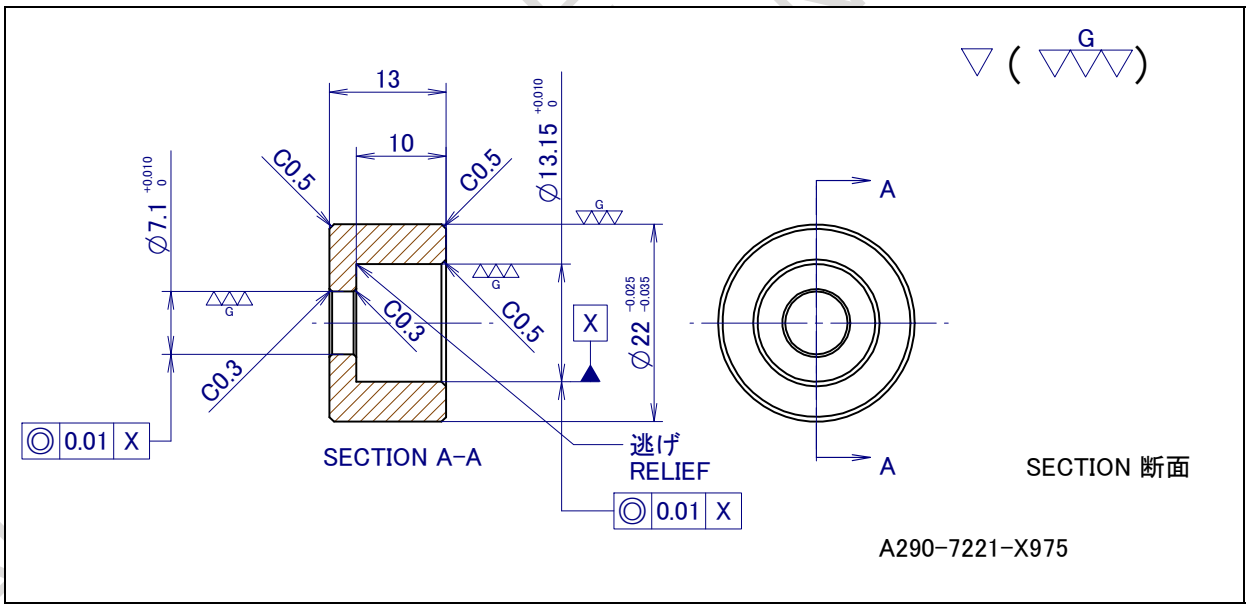


Fig. 1.3 (j) Mounting fixture for gear of J3-axis motor

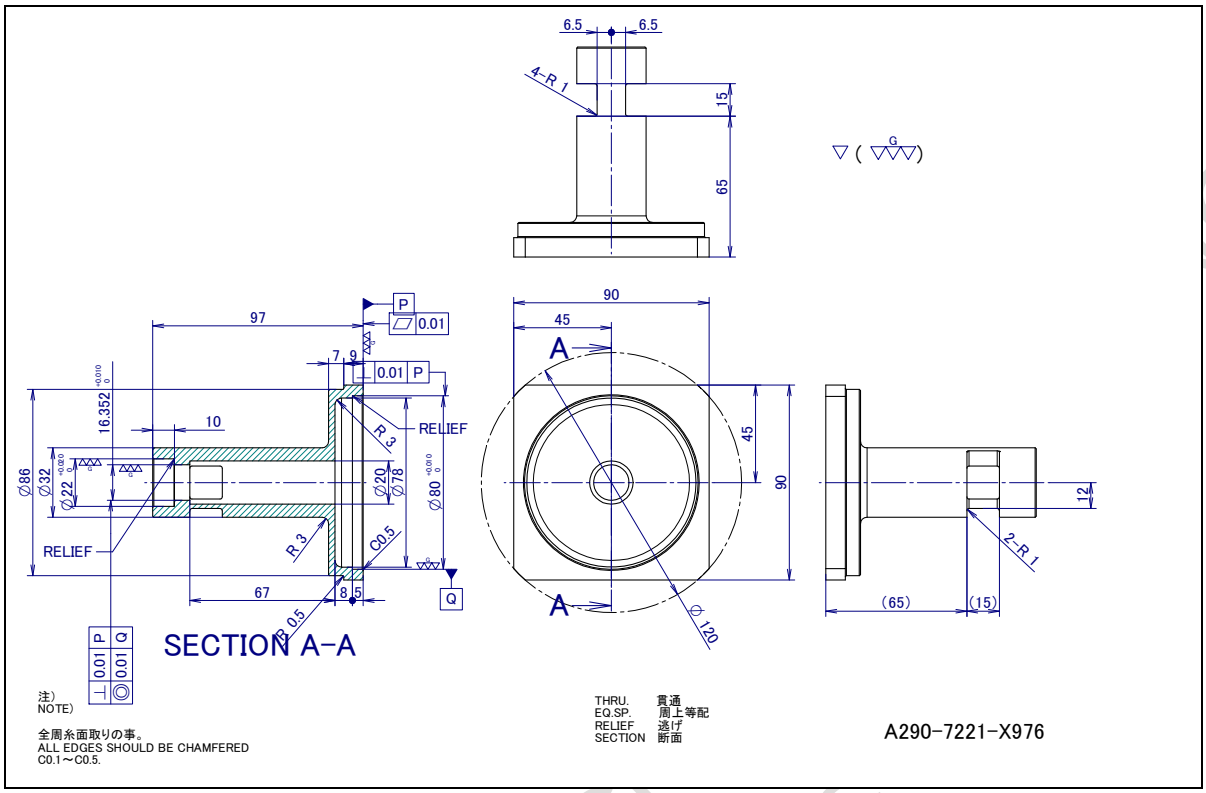


Fig. 1.3 (k) Mounting fixture for gear of J3-axis motor

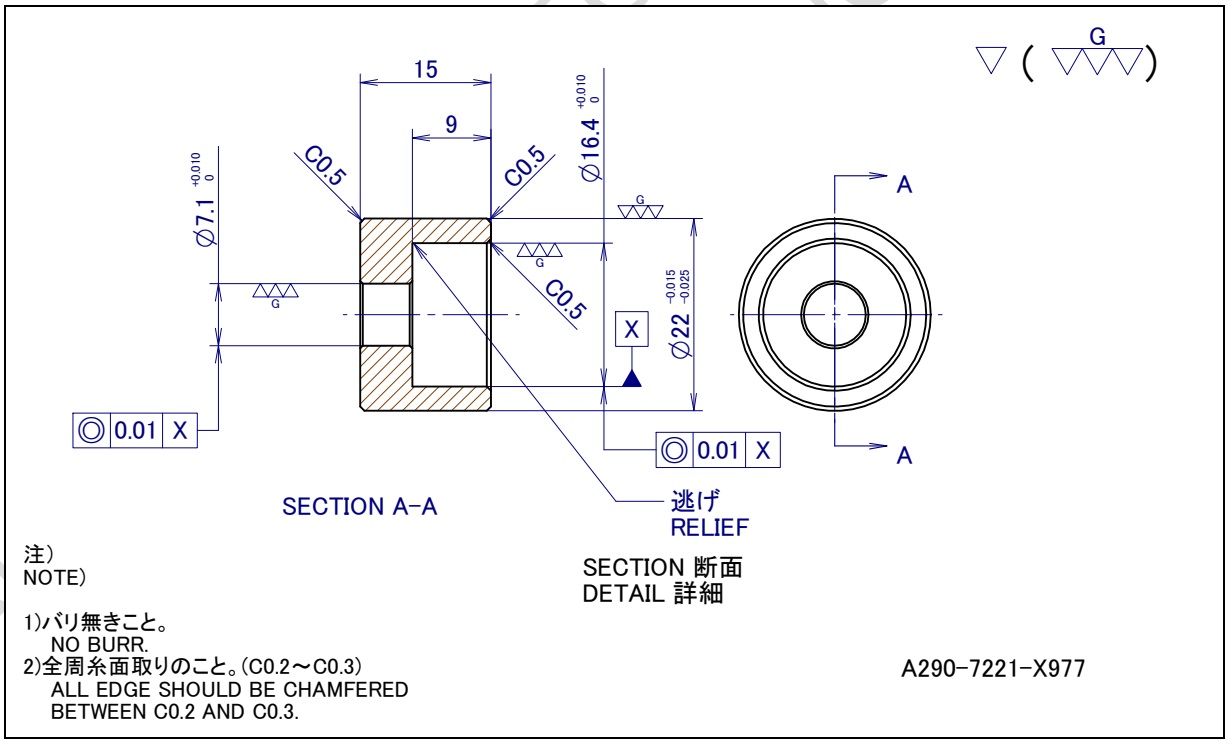


Fig. 1.3 (l) Mounting fixture for gear of J3-axis motor

2 CHECKS AND MAINTENANCE (10M/10MS)

Optimum performance of the robot can be maintained by performing the checks and maintenance procedures presented in this chapter. (See the APPENDIX C PERIODIC MAINTENANCE TABLE.)

NOTE
The periodic maintenance procedures described in this chapter assume that the FANUC robot is used for up to 3840 hours a year. In cases where robot use exceeds 3840 hours/year, adjust the given maintenance frequencies accordingly. The ratio of actual operation time/year vs. the 3840 hours/year should be used to calculate the new (higher) frequencies. For example, when using the robot 7680 hours a year with a recommended maintenance interval of 3 years or 11520 hours, use the following calculation to determine the maintenance frequency: 3 years / 2 = perform maintenance every 1.5 years.

2.1 PERIODIC MAINTENANCE

2.1.1 Daily Checks

Check the following items when necessary before daily system operation.

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is an oil seepage, clean it. **⇒"2.2.1 Confirmation of Oil Seepage"**
Air control set	(When air control set is used) **⇒"2.2.2 Confirmation of the Air Control Set"**
Vibration, Abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: **⇒"5.1 TROUBLESHOOTING" (symptom : Vibration, Noise)**
Repeatability	Check whether the taught positions of the robot have not deviated from the previous taught positions. When the displacement occurs, perform the measures as described in the following section: **⇒"5.1 TROUBLESHOOTING" (symptom : Displacement)**
Peripheral devices for proper operation	Check whether the peripheral devices operate properly according to commands from the robot and the peripheral devices.
Brakes for each axis	Check that the droppage of the end effector is within 5 mm when the servo power turned off. If the end effector (hand) drops, perform the measures as described in the following section: **⇒"5.1 TROUBLESHOOTING" (symptom : Dropping axis)**
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: **⇒"R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)"**

2.1.2 Periodic Check and Maintenance

Check the following items at the intervals recommended below based on the period or the accumulated operating time, whichever comes first. (○ : Item needs to be performed.)

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
○ Only 1st check	○					Cleaning the controller ventilation system	If the controller ventilation system is dusty, turn the power off, and clean the unit.	20
	○					Check the external damage or peeling paint	Check whether the robot has external damage due to the interference with the peripheral devices or peeled paint. If an interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check damages of the cable protective sleeve	Check whether the cable protective sleeves of the mechanical unit cable have holes or tears. If damage is found, replace the cable protective sleeve. If the cable protective sleeve is damaged due to the interference with peripheral devices, eliminate the cause. **⇒"2.2.3 Check the Mechanical Unit Cables and Connectors"**	2
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If liquid was found, remove the cause, and wipe the liquid off.	3
	○ Only 1st check	○				Check for damages to the teach pendant cable, the operation box connection cable or the robot connection cable	Check whether the cable connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.	19
	○ Only 1st check	○				Check for damage to the mechanical unit cable (movable part) cable	Observe the movable part of the mechanical unit cable and welding cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted. **⇒"2.2.3 Check the Mechanical Unit Cables and Connectors"**	4
	○ Only 1st check	○				Check for damage to the end effector (hand) connection cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.	5
	○ Only 1st check	○				Check the connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"2.2.3 Check the Mechanical Unit Cables and Connectors"**	6

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Retightening the end effector mounting bolts	Retighten the end effector mounting bolts. Refer to the following section for tightening torque information: **⇒"4.1 MECHANICAL COUPLING OF END EFFECTOR TO WRIST of OPERATOR'S MANUAL (B-82754EN)"**	7
	○ Only 1st check	○				Retightening the external main bolts	Retighten the bolts which are installed, removed in the inspection, and exposed. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	8
	○ Only 1st check	○				Check the mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the mechanical stopper, the adjustable mechanical stopper, and check the looseness of the stopper mounting bolts. **⇒"2.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"**	9
	○ Only 1st check	○				Clean spatters, sawdust and dust	Check that spatters, sawdust, or dust does not exist on the robot main body. If dust has accumulated, remove it. Especially, clean the robot movable parts well (each joint, around the welding torch, conduit part, wrist axis hollow part and the cable protective sleeve).	10
		○				Replacing the mechanical unit batteries	Replace the mechanical unit batteries. Regardless of operating time, replace batteries at 1 year. **⇒"4.1 REPLACING THE BATTERIES"**	11
		○				Apply grease	Apply grease to the J6-axis reducer **⇒"4.2 GREASING**	17
				○		Replacing the grease of J1 to J3- axis reducer and J4 to J5-axis gearbox	Replace the grease of each axis reducer and gearbox **⇒"4.3 REPLACING THE GREASE OF THE DRIVE MECHANISM"**	12 to 16
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Please refer to Chapter 8 about the replacing the cable.	18
					○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. **⇒Chapter 7 Replacing batteries of R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) or R-30*i*B Mate CONTROLLER MAINTENANCE MANUAL (B-83525EN)"**	21

2.2 CHECK POINTS

2.2.1 Confirmation of Oil Seepage

Check items
Check there is oil on sealed part of each joint parts. If there is oil seepage, clean them.

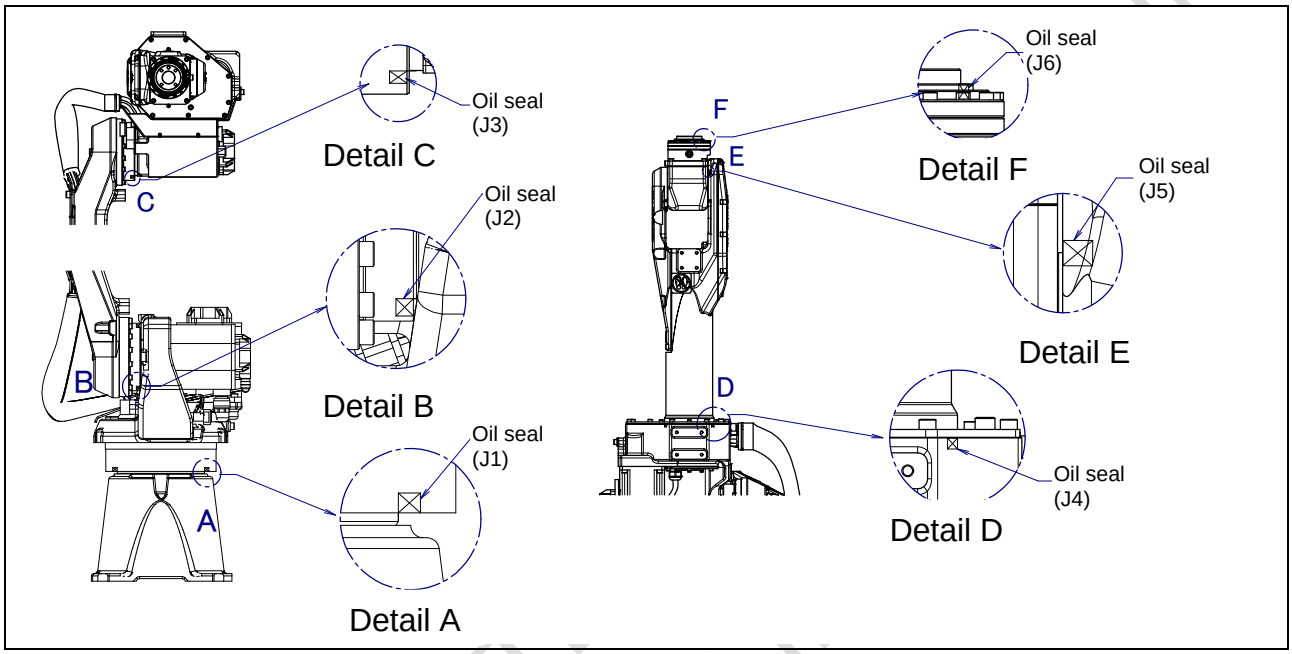


Fig. 2.2.1 (a) Check parts of oil seal

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil viscosity changes, the oil might drip depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components in Fig. 2.2.1 (a) before you operate the robot.
- In case of oil seepage, please consider replacing the grease. This replacement potentially can help improving the seepage situation.
- Also, drive mechanism might become hot and the internal pressure of the grease bath or oil bath might rise. In these cases, normal internal can be restored by venting the grease outlet. (When opening the grease outlet, refer to Section 4.2, 4.3 and ensure that grease is not expelled onto the machine or tooling.)

> ⚠ **WARNING**
> Hot grease might eject suddenly when you open the grease outlet. Attach bags for collecting grease, and use appropriate protective equipment such as heat-resistant gloves, protective glasses, a face shield, or a body suit if necessary.

- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.
  ⇒"5.1 TROUBLESHOOTING"(symptom : Grease leakage , Oil leakage)

2.2.2 Confirmation of the Air Control Set

When an air control set is used, check the items below.

Item	Check items	Check points
1	Air pressure	Check the air pressure using the pressure gauge on the air control set as shown in Fig. 2.2.2 (a). If it does not meet the specified pressure of 0.49 to 0.69 MPa (5-7 kgf/cm^2), adjust it using the regulator pressure-setting handle.
2	Lubricator oil mist quantity	Check the number of oil drops during wrist or hand motion. If it does not meet the specified value (1 drop/10-20 sec), adjust it using the lubricator control knob. Under normal usage, the lubricator will be empty in about 10 to 20 days.
3	Lubricator oil level	Check to see that the air control set oil level is within the specified level.
4	Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts as required.
5	Drain	Check the drain and release it. When volume of the drain is remarkable, examine the setting of the air dryer to the air supply side.

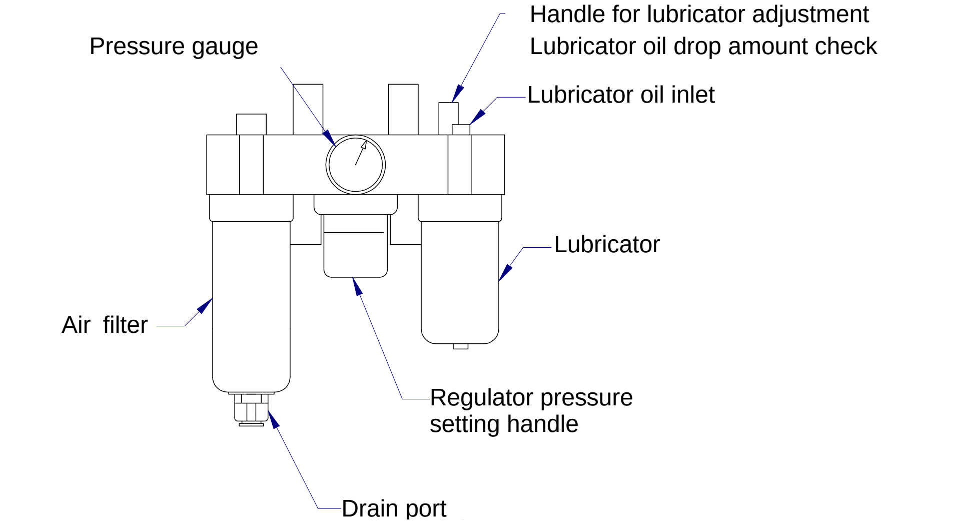


Fig. 2.2.2 (a) Air control set (option)

2.2.3 Check the Mechanical Unit Cables and Connectors

Inspection points of the mechanical unit cables and welding cables

Check the cable for damage that has been exposed. Take special care for movable parts.
Clean it when the spatter adheres.

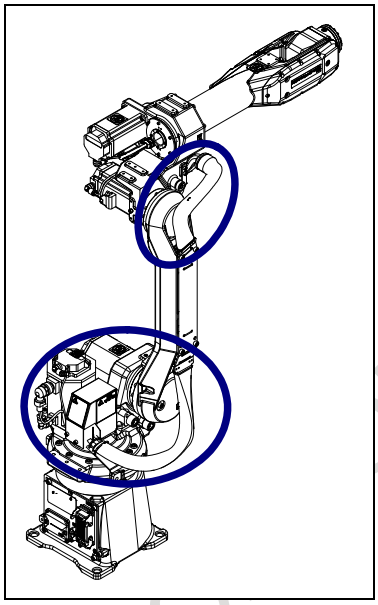


Fig. 2.2.3 (a) Inspection points of the mechanical unit cables

Check points

＜Cable protective sleeve＞

- Check that no holes or tears exist on the cable protective sleeves.
- If there is damage as shown in Fig. 2.2.3 (b), replace the cable protective sleeves.

Fig. 2.2.3 (b) Damage on the cable protective sleeve

＜Cables＞

- Check that there is no wear or damage on the coating.
- If the inside wire strands are exposed due to wear or damage, replace the cables.

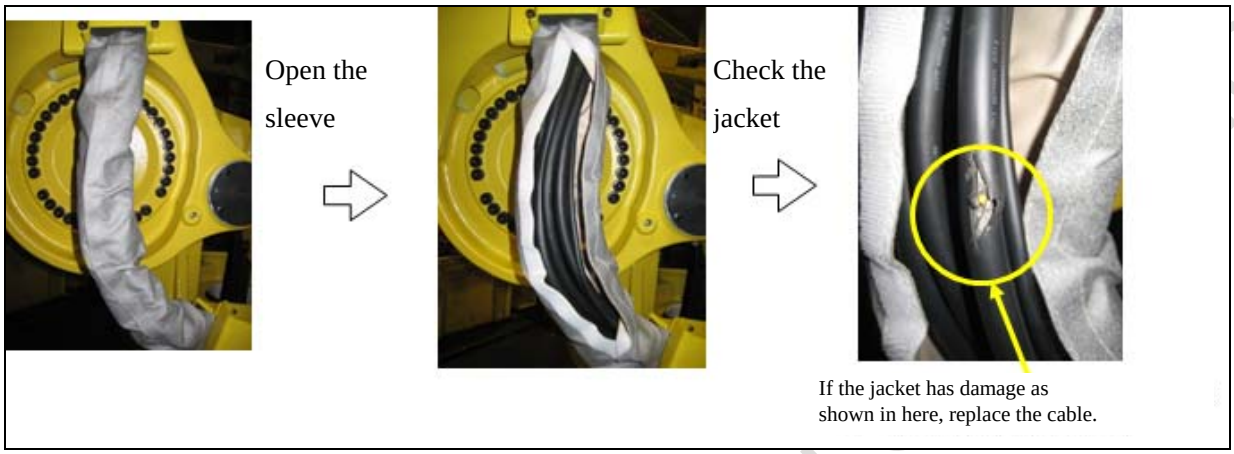


Fig. 2.2.3 (c) Cable check method

Inspection points of the connectors

- Power/brake connectors of the motor exposed externally
- Robot connection cables, earth terminal and user cables

Check items

- Circular connector : Check the connector for tightness by turning it manually.
- Square connector : Check the connector for engagement of its lever.
- Earth terminal : Check the terminal for tightness.

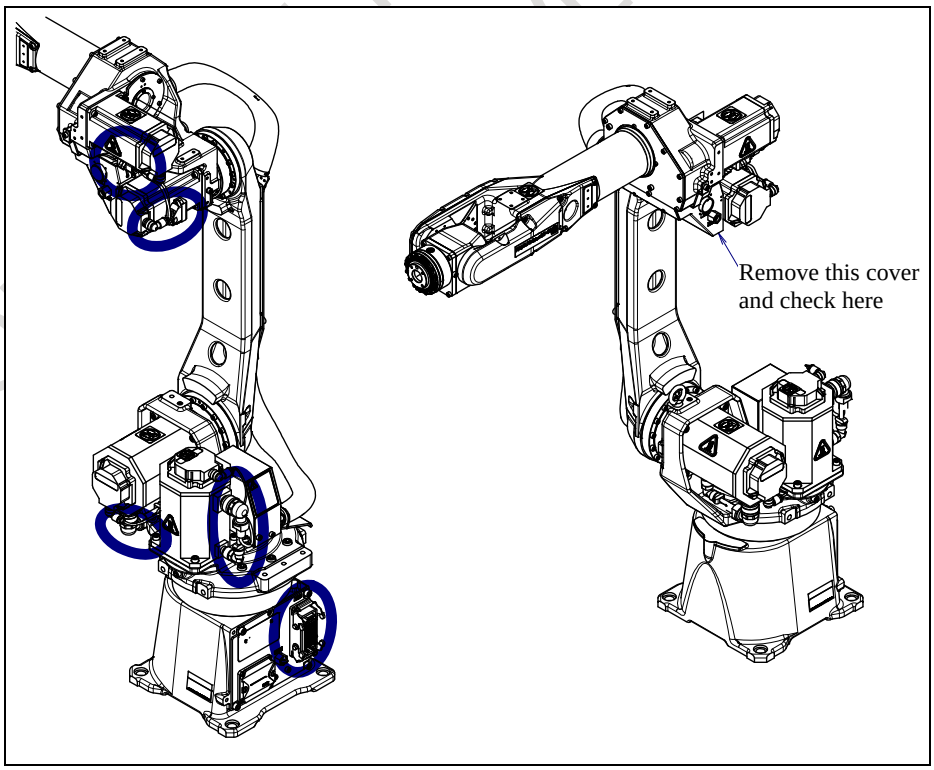


Fig. 2.2.3 (d) Connector Inspection points

2.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check that there is no evidence of a collision on the mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace the parts.
- Check the looseness of the stopper mounting bolts. If they are loose, retighten them.
  Be sure to check the tightness of the mounting bolts of the J1-axis swing stopper.
- Refer to Section 6.2 of the operator's manual for details regarding the adjustable mechanical stopper.

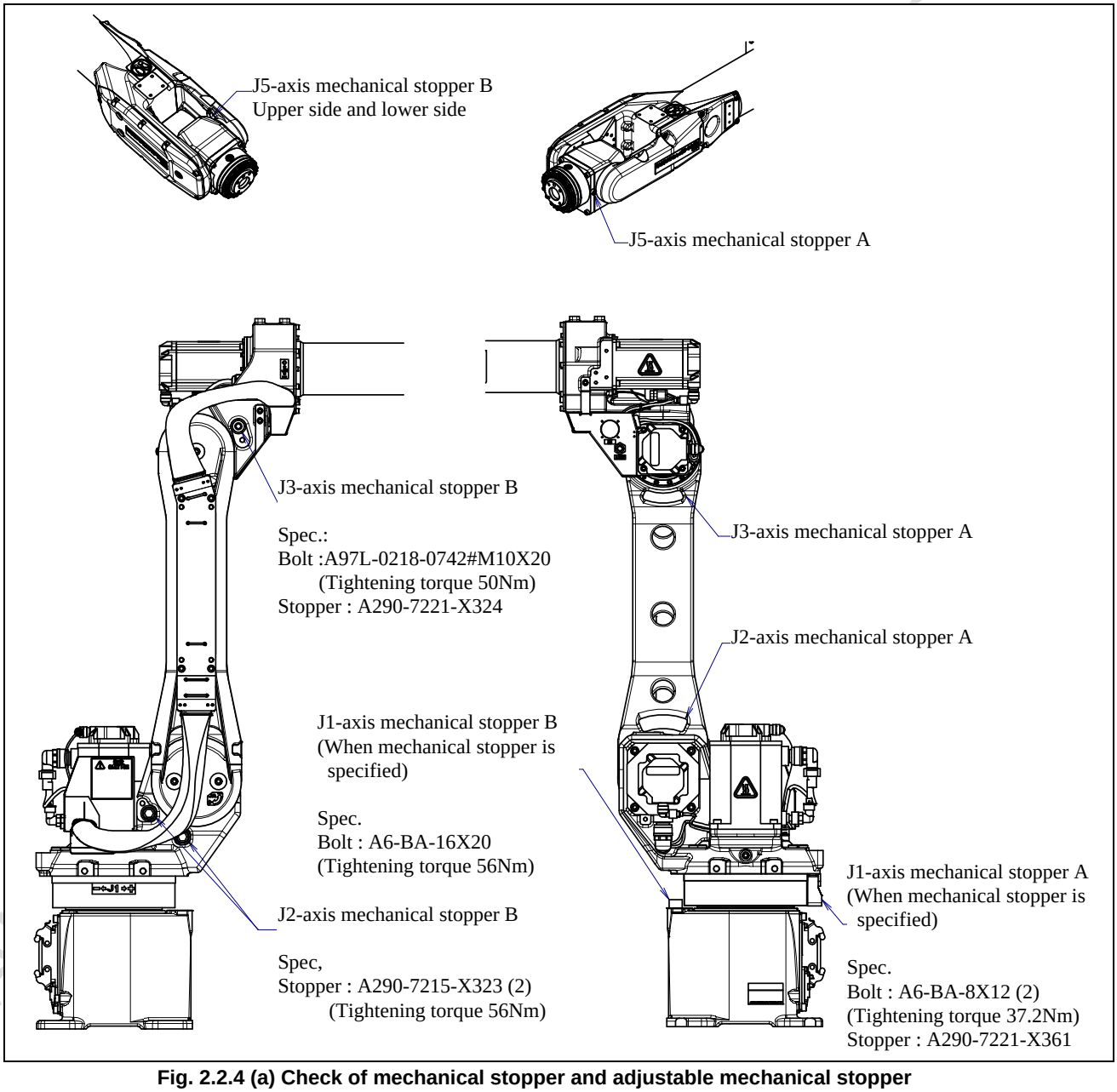


Fig. 2.2.4 (a) Check of mechanical stopper and adjustable mechanical stopper

2.3 MAINTENANCE TOOLS

Please refer to Section 1.3.

3 PERIODIC MAINTENANCE (EXCEPT 10M/10MS)

3.1 REPLACING THE BATTERIES (1 YEAR (3840 HOURS) OR (1.5 YEAR (5760 HOURS) CHECKS)

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1 year in case of ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S and 1.5 year in case of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L. Also, use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery

1 Press the EMERGENCY STOP button to prohibit the robot motion.

> ⚠ **CAUTION**
> Be sure to keep the power on. Replacing the batteries with the power supply turned off causes all current position data to be lost. Therefore, mastering will be required again.

2 Remove the battery case cap. (Fig. 3.1 (a) to (c)) If it cannot be removed, tap it to side direction with a plastic hammer.
3 Take out the old batteries from the battery case. In this time, battery can be taken out by pulling the stick of the center of the battery box.
4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
5 Close the battery case cap.

> ⚠ **CAUTION**
> When using a robot with the severe dust/liquid protection option, remove the cover from the battery case as shown in Fig. 3.1 (b) to replace the battery. After replacing the battery, reinstall the cover. At this time, please be sure to replace gasket with new one for severe dust/liquid protection. When sticking a gasket on a battery cover, please stick it not to have gaps between them.

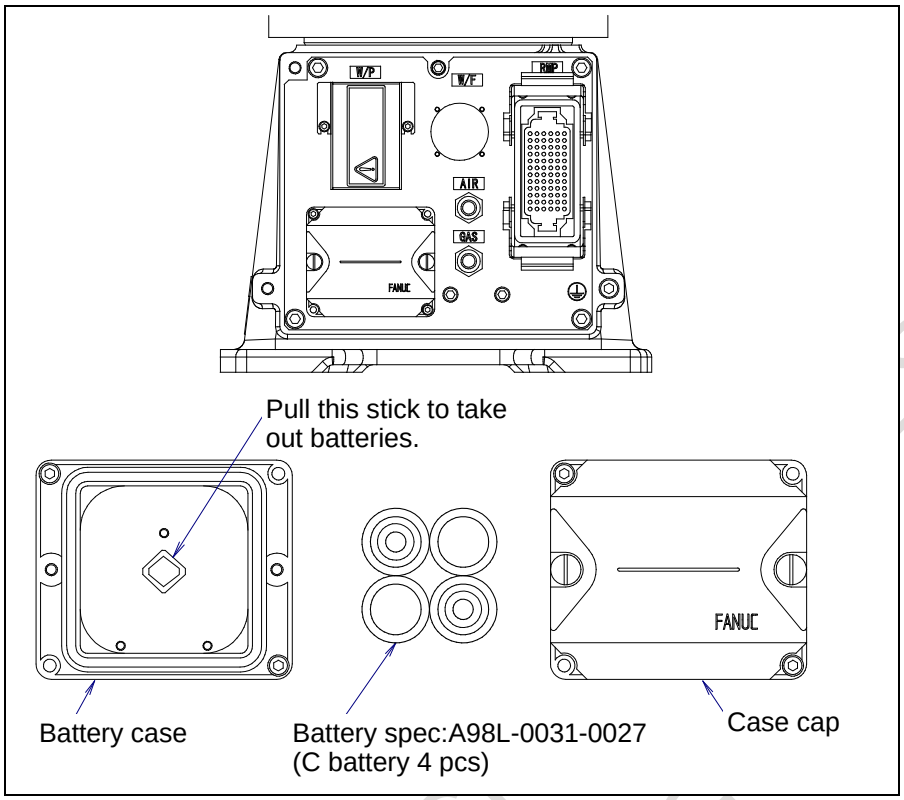


Fig. 3.1 (a) Replacing the battery
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

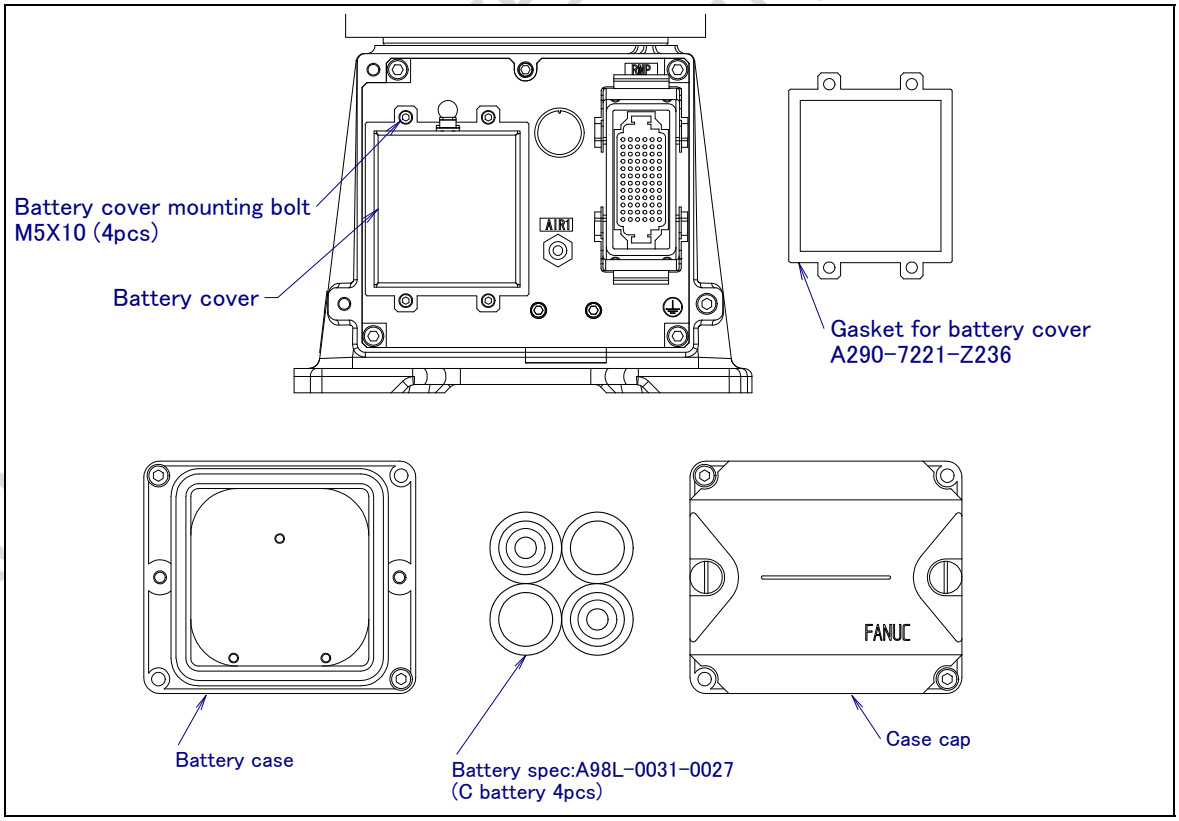


Fig. 3.1 (b) Replacing the battery (When severe dust/liquid protection option is specified)

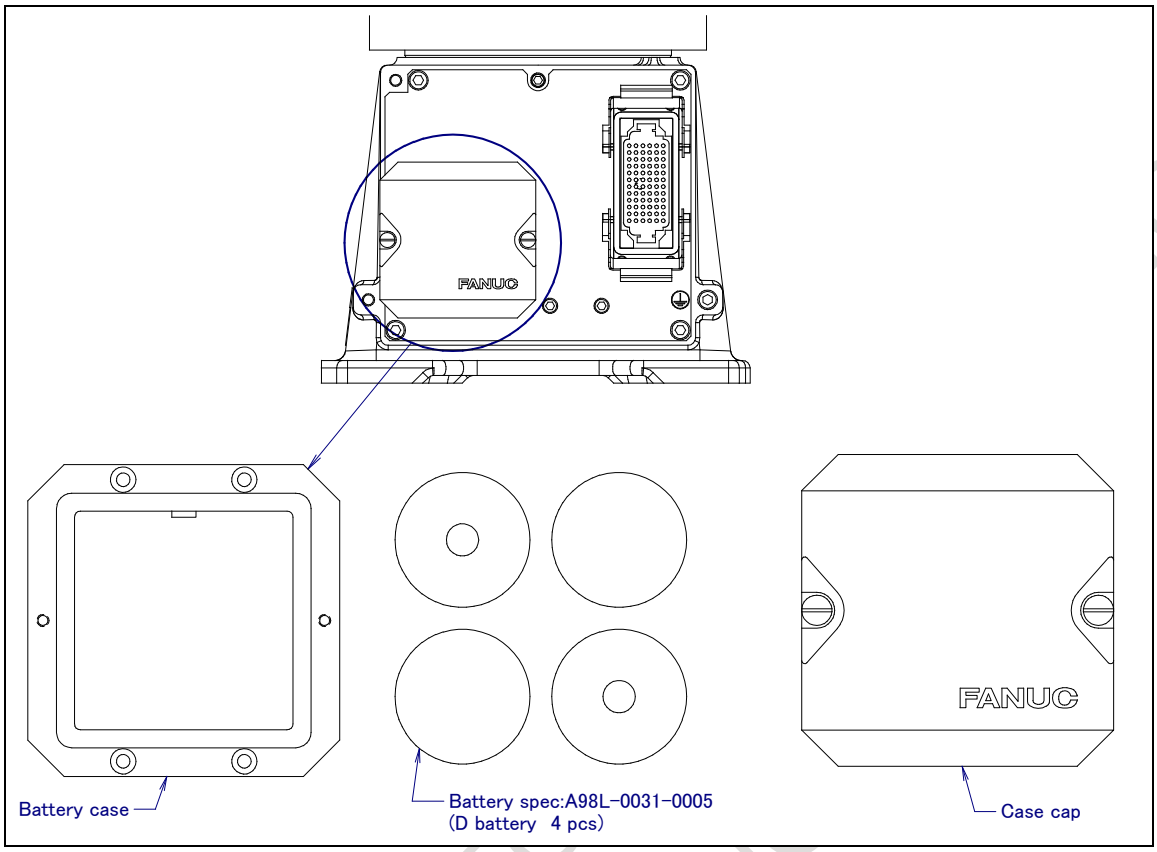


Fig. 3.1 (c) Replacing the battery
(ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

3.2 REPLACING THE GREASE AND OIL OF THE DRIVE MECHANISM (3-YEAR (11520 HOURS) CHECKS)

According to below, replace the grease and of the reducers of J1, J2, and J3 axes and J4/J5/J6-axis gearbox at the intervals based on every 3 years or 11520 hours, whichever comes first.

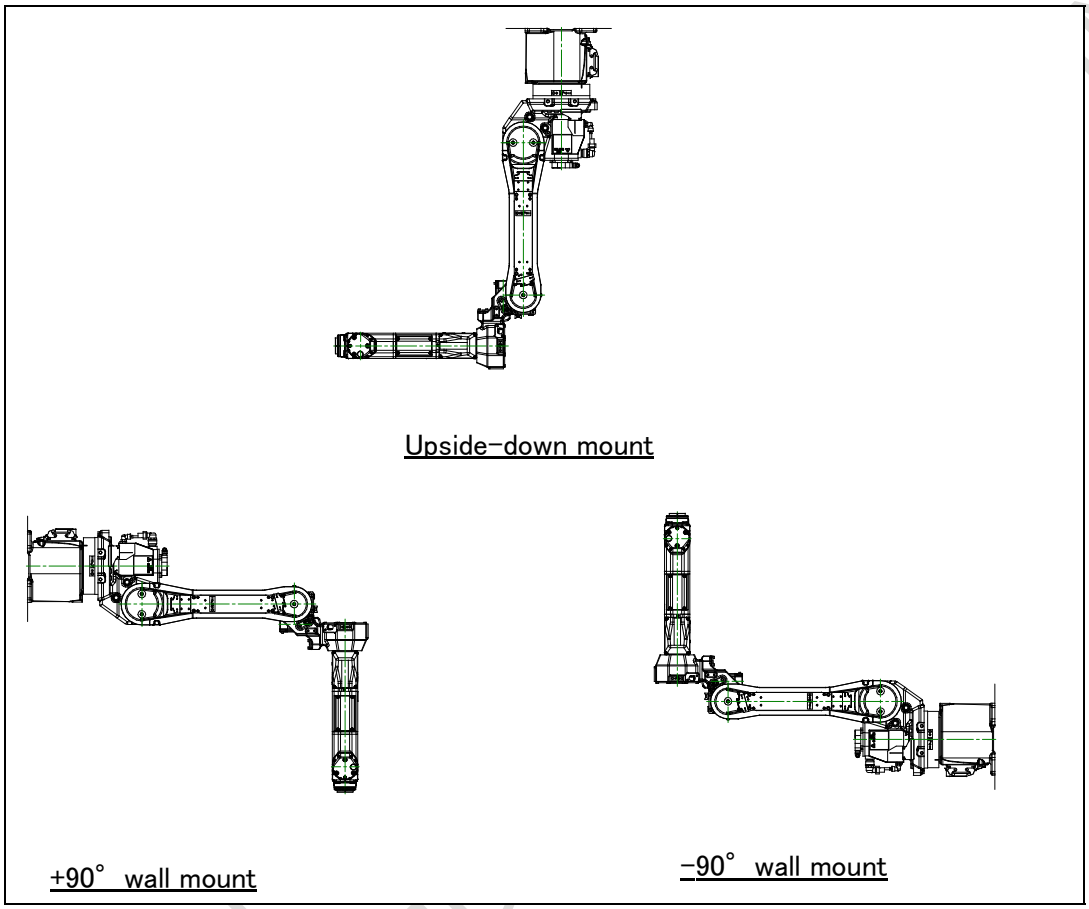


Fig. 3.2 (a) Installation method

3.2.1 Grease Replacement Procedure for J1 to J3-axis Reducer

⚠ CAUTION

Failure to supply grease correctly may cause an increase of the internal pressure of the grease bath. Such pressure increase will then damage the seal, which in turn leads to grease leakage and abnormal robot operation.
When performing greasing, therefore, observe the following precautions.

1 Before starting to grease, remove the seal bolt of the grease outlet to allow the grease to come out.
2 Supply grease slowly, using a manual pump. (once per two seconds)
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply. If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 3.2.1 (a)).
4 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 3.2.2, and then close the grease outlet.
6 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.

Table 3.2.1 (a) Grease name and amount to be replaced at regular intervals of three years (11520 hours)

Grease supplying position	Amount of grease to be applied	Gun tip pressure	Specified grease
J1-axis reducer	790 g (870ml)	0.1MPa or less (NOTE)	Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174)
J2-axis reducer	300 g (330ml)		
J3-axis reducer	170 g (190ml)		

NOTE

When a manual pump is used for greasing, the standard rate is one pumping cycles per two seconds.

⚠ WARNING

Hot grease might eject suddenly when you open the grease outlet. Attach bags for collecting grease, and use appropriate protective equipment such as heat-resistant gloves, protective glasses, a face shield, or a body suit if necessary.

For grease replacement or replenishment, use the Postures indicated below.
Consider relative angle of from posture of floor mount when robot is angle mount.

Table 3.2.1 (b) Postures for greasing (J1, J2, J3-axis reducer)

Grease supplying position		Posture					
		J1	J2	J3	J4	J5	J6
J1-axis reducer grease supplying posture	Floor mount	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
	Upside-down mount						
	Wall mount -90°						
	Wall mount +90°						
J2-axis reducer grease supplying posture	Floor mount)		0°	Arbitrary			
	Upside-down mount		-90°				
	Wall mount -90°		90°				
	Wall mount +90°		-90°				
J3-axis reducer grease supplying posture	Floor mount		0°	0°			
	Upside-down mount		0°	180°			
	Wall mount -90°		0°	0°			
	Wall mount +90°		0°	0°			

1 Move the robot to the greasing posture described in Table 3.2.1 (b).
2 Turn off the controller power.
3 Remove the seal bolt or taper plug from grease outlet. (Fig. 3.2.1 (a))
  J1-axis : 1 location (seal bolt M8 x 10)
  J2-axis : 2 locations (seal bolt M8 x 10)
  J3-axis : 1 location (seal bolt M8 x 10)
4 Remove the seal bolt or taper plug from grease inlet and attach grease nipple.
5 Keep greasing until the new grease pushes out the old grease and comes out from each grease outlet.
6 Release the remaining pressure using the procedure given in Subsection 3.2.2. In case of upside-down mount, pull out about 100ml grease to make space of grease bath.

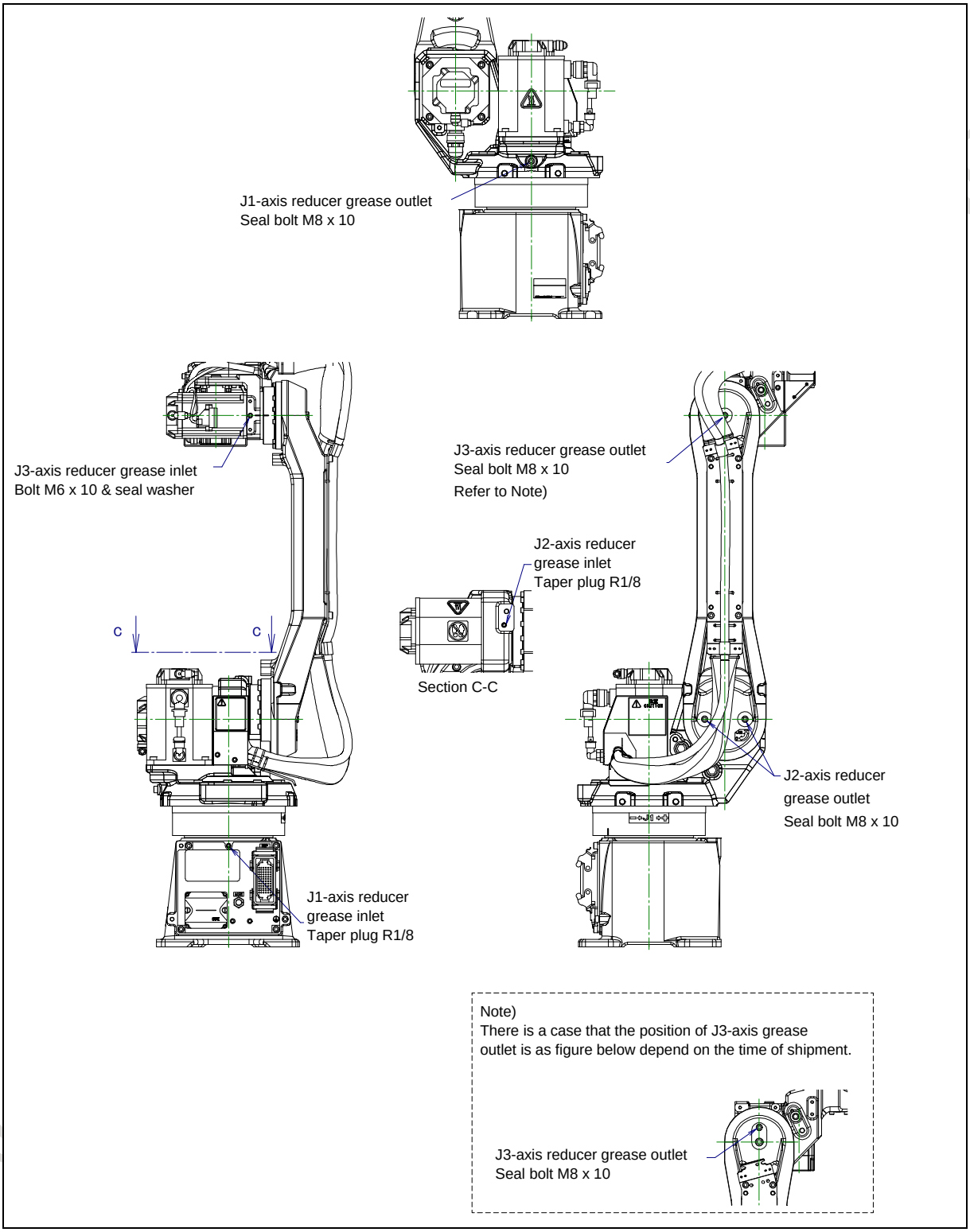


Fig. 3.2.1 (a) Greasing points of J1 to J3-axis reducer

Table 3.2.1 (c) Specification of the seal bolts, the taper plug and the seal washer

Parts name		Specification
Seal bolt	(M8 x 10)	A97L-0218-0417#081010
Taper plug	(R1/8)	A97L-0001-0436#1-1D
Seal washer	(M6)	A30L-0001-0048#6M

3.2.2 Procedure for Releasing the Remaining Pressure from the Grease Bath (J1 to J3-axis)

After applying grease, operate the robot more than 10 minutes as instructed below with the taper plug and seal bolt of the grease inlet and outlet uncapped to release the remaining pressure within the grease bath. In case of J2-axis, there are two seal bolts for grease outlet, so uncap both of them.
Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

Operating axis / Grease replacement part	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
J1-axis reducer	Axis angle of 60° or more OVR 100%	Arbitrary				
J2-axis reducer	Arbitrary	Axis angle of 60° or more OVR 100%	Arbitrary			
J3-axis reducer	Arbitrary		Axis angle of 60° or more OVR 100%	Arbitrary		

If the above operations cannot be performed because of workcell constraints, adjust the operating time according to the operating angle. (For example, when the maximum allowable axis angle is 30 degrees, perform the twice operation for 20 minutes or more.) If you grease or replacing oil multiple axes, you can exercise multiple axes at the same time. After completion of the operation, attach the taper plug and seal bolts to the grease inlets and outlets. When reusing the seal bolts, be sure to seal them with seal tape.

After replacing grease or oil, the internal pressure of the grease bath or oil bath may rise if the robot is operated again under frequent inversion movement or a high temperature environment. In these cases, you can return to normal internal pressure by releasing the grease outlet or oil outlet just after robot operation. (When opening grease outlet or oil outlet, be sure that grease or oil is not spattered.)

3.2.3 Oil Replacement Procedure for J4-axis Gearbox

⚠ CAUTION

1 There is severe risk of gear damage in case robot is operated with oil shortage. Please make sure the gearbox is always filled with correct amount of oil.
2 Failure to supply oil correctly may cause damage to the seal, which would in turn lead to oil leakage and abnormal operation. When performing oiling, therefore, observe the following cautions.
(1) Use specified oil. Use of non-approved oil may damage the reducer or lead to other problems.
(2) After oiling, release remaining pressure from the grease bath using the procedure given in Subsection 3.2.5, and then close the grease outlet.
(3) To prevent slipping accidents and catching fire, completely remove any excess oil from the floor or robot.

Table 3.2.3 (a) Oil name and amount of oiling of standard to be replaced at regular intervals of three years (11520 hours)

Oiling points	Amount of oil to be applied (NOTE)	Gun tip pressure	Specified oil
J4-axis gearbox	410g(480ml)	0.1MPa or less (NOTE)	JXTG Nippon Oil & Energy Corporation BONNOC AX68 (Specification: A98L-0040-0233)

NOTE) It is not a regulated amount injection. Please confirm height of oil sight glass oil surface is 3/4 or more of all heights. Refer to Fig. 3.2.3 (a).

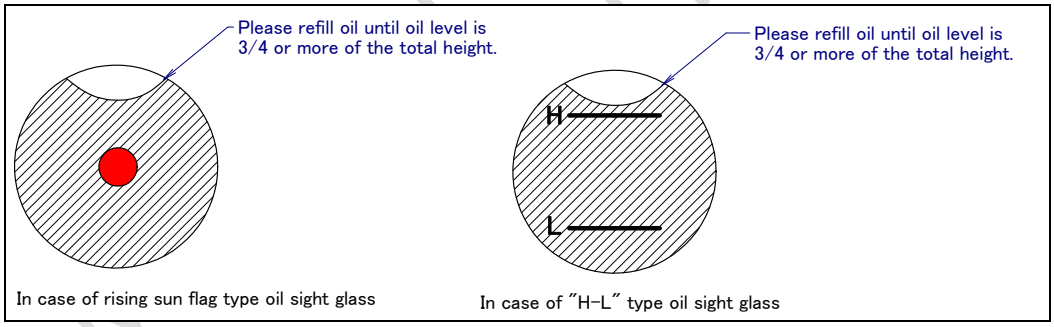


Fig. 3.2.3 (a) Oil sight glass

For oil replacement or replenishment, use the Postures indicated below.
Consider relative angle of from posture of floor mount when robot is angle mount.

Table 3.2.3 (b) Postures for oiling (J4-axis gearbox)

Supply position		Posture					
		J1	J2	J3	J4	J5	J6
J4-axis gearbox	Floor mount	Arbitrary	Arbitrary	0°	Arbitrary	Arbitrary	Arbitrary
	Upside-down mount			180°			
	-90° wall mount	0°		-90°			
	+90° wall mount			90°			

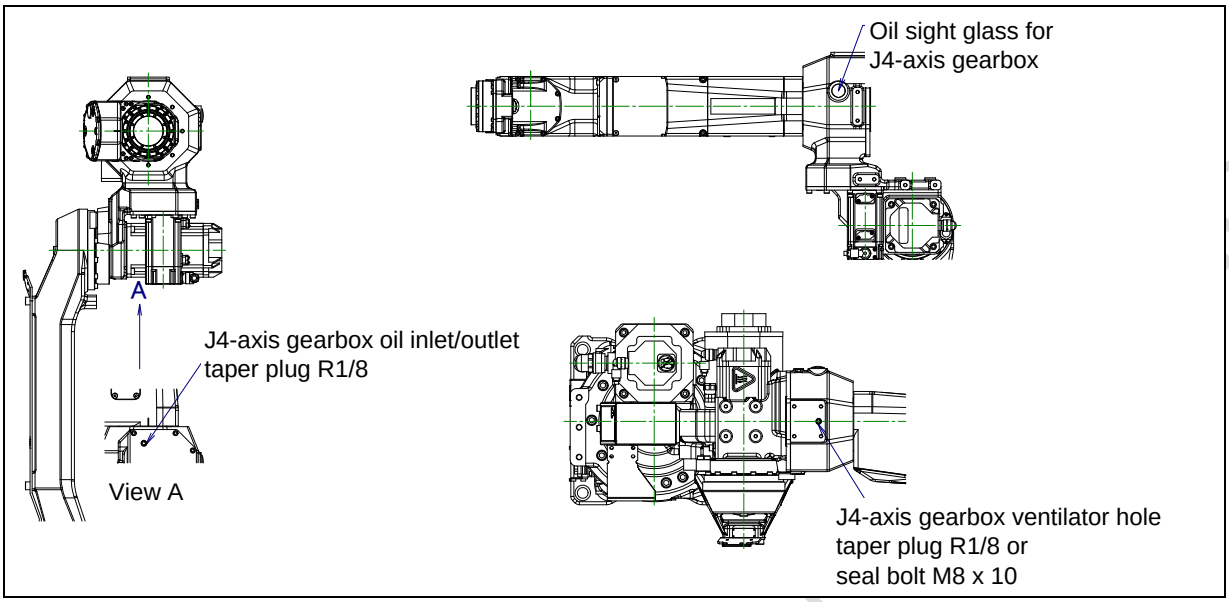


Fig. 3.2.3 (b) Greasing point of J4-axis gearbox
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

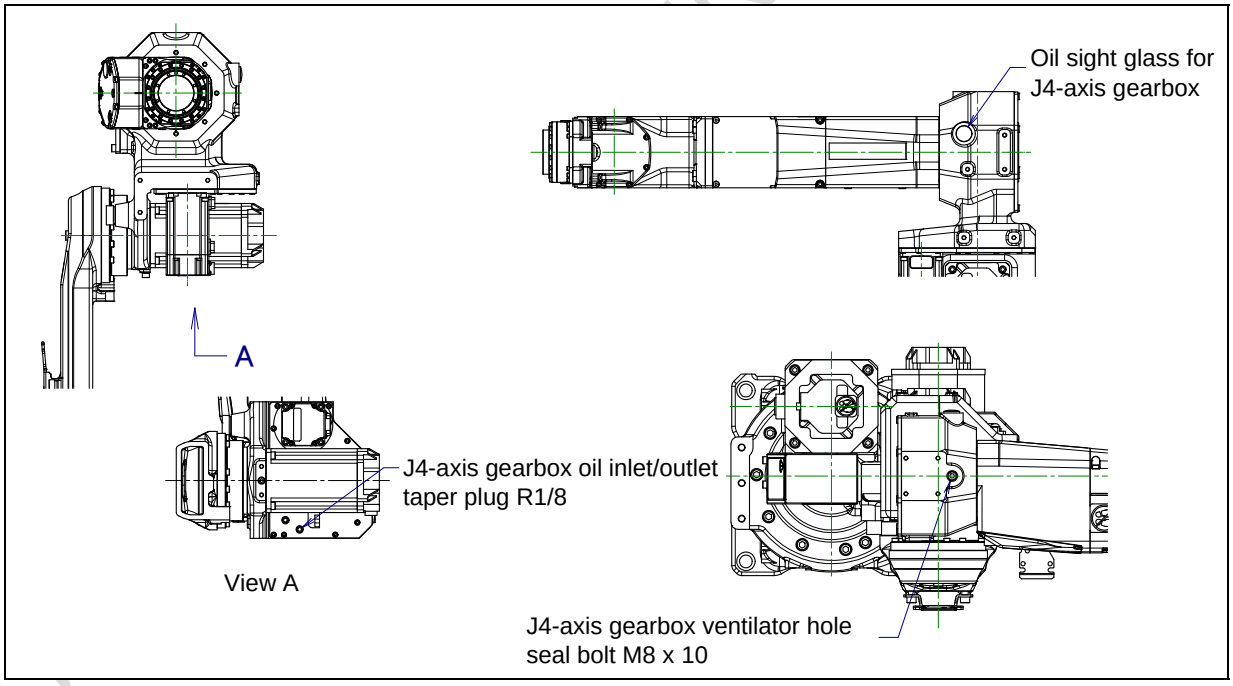


Fig. 3.2.3 (c) Greasing point of J4-axis gearbox
(ARC Mate 100*i*C/10S, M-10*i*A/10S)

Table 3.2.3 (c) Specification of the seal bolts and the taper plug

Parts name	Specification
Seal bolt (M8 x 10)	A97L-0218-0417#081010
Taper plug (R1/8)	A97L-0001-0436#1-1D

Exhausting oil method

1 Move the robot to the oil discharge Posture for J4-axis gearbox described in Table 3.2.3 (b).
2 Turn off the controller power.
3 Put the oil pan under the oil outlet. For oil inlet/outlet, remove J4 connector panel mounting bolts and make it so that the plug of oil inlet/outlet can be seen. When moving the connector, remove user side connector and air joint if necessary. If equipment is installed on the ventilator hole, remove it. Then remove plug or seal bolt of oil inlet/outlet and ventilator hole.

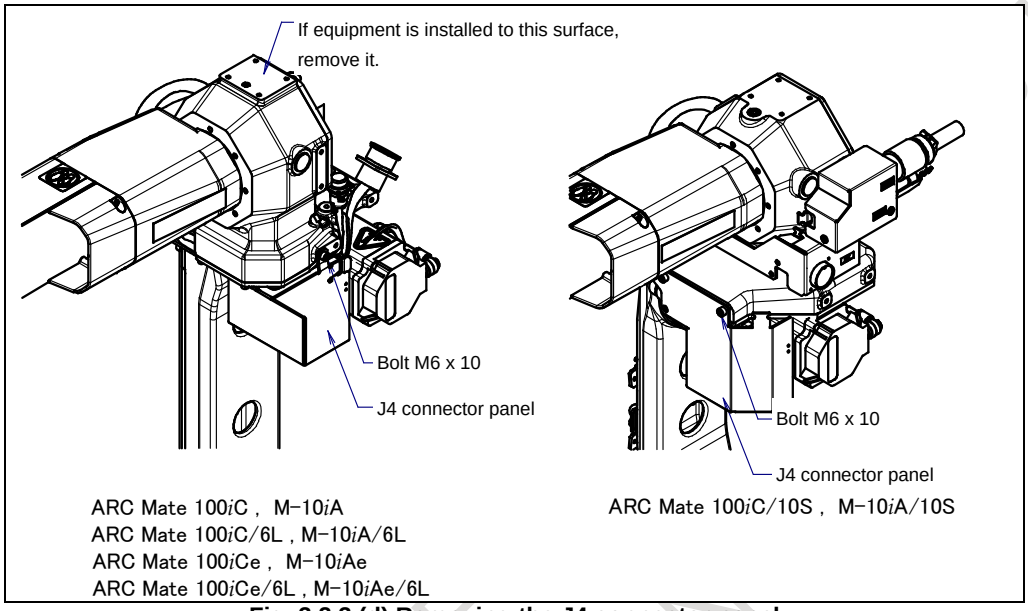


Fig. 3.2.3 (d) Removing the J4 connector panel

Injecting oil method

According to description below, inject oil.

1 Install the oil injection nipple with valve (A05B-1221-K008) to the oil inlet.
2 Confirm the valve is open, Perform oiling using the oil gun (A05B-1221-K005) as shown in Fig. 3.2.3 (e). If the oil sight glass is filled with oil, push the oil gun about 2 to 3 cm (about 50ml).
3 Close the valve of oil injection nipple, then remove the oil gun.
4 Attach the seal bolt to the ventilator hole. Replace the seal bolt by new one. When reusing it, be sure to wind it with a seal tape.
5 Remove oil injection nipple, and attach seal bolt to oil inlet. Replace seal bolt by new one. When reusing it, be sure to wind it with seal tape.
6 Release the remaining pressure of oil bath referring to Subsection 3.2.5 and confirm oil quantity with oil sight glass.

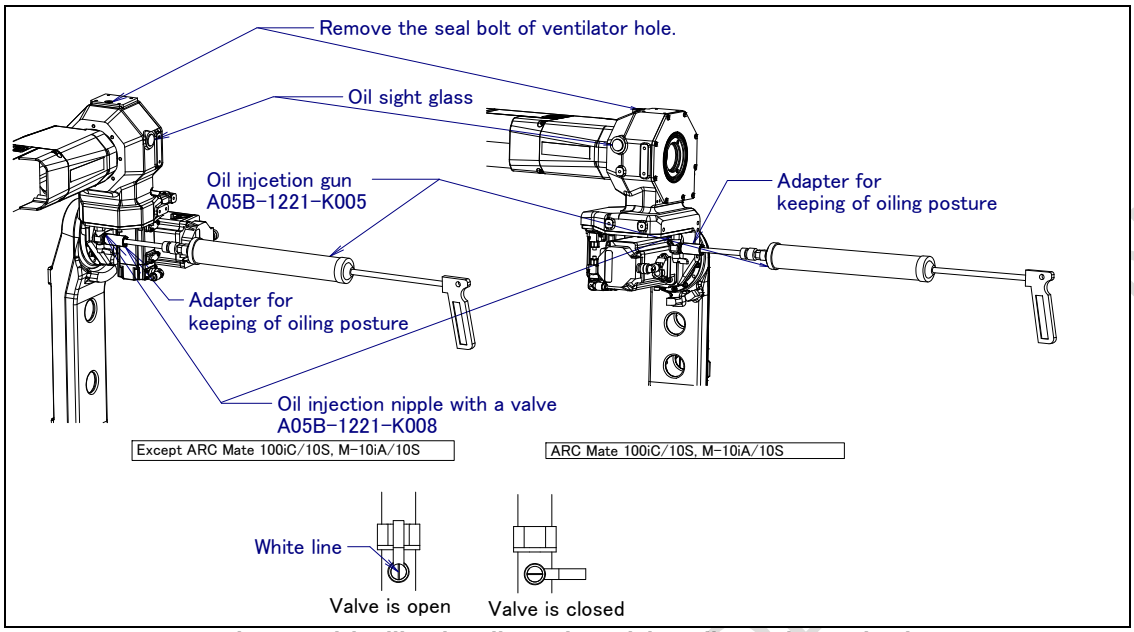


Fig. 3.2.3 (e) Oiling by oil gun (supplying oil J4-axis gearbox)

3.2.4 Oil Replacement Procedure for J5/J6-axis Gearbox

⚠ CAUTION

1 There is severe risk of gear damage in case robot is operated with oil shortage. Please make sure the gearbox is always filled with correct amount of oil.
2 Failure to supply oil correctly may cause damage to the seal, which would in turn lead to oil leakage and abnormal operation. When performing oiling, therefore, observe the following cautions.
   1 Use specified oil. Use of non-approved oil may damage the reducer or lead to other problems.
   2 After oiling, release remaining pressure from the oil bath using the procedure given in Subsection 3.2.5, and then close the oil outlet.
   3 To prevent slipping accidents and catching fire, completely remove any excess oil from the floor or robot.

Table 3.2.4 (a) Oil name and amount of oiling of standard to be replaced at regular intervals of three years (11520 hours)

Oiling points	Amount of oil to be applied	Gun tip pressure	Specified oil
J5/J6-axis gearbox	340g(400ml)	0.1MPa or less	JXTG Nippon Oil & Energy Corporation BONNOC AX68 (Specification: A98L-0040-0233)

NOTE

It is not a regulated amount injection. Be sure to confirm the amount of oil with the oil sight glass.

For oil replacement or replenishment, use the Postures indicated below.
Consider relative angle of from posture of floor mount when robot is angle mount.
There is no brake for wrist axes of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/ 6L, M-10*i*Ae/6L, so be careful not to drop the axes.

Table 3.2.4 (b) Postures for oiling (J5/J6-axis gearbox)

Supply position		Posture					
		J1	J2	J3	J4	J5	J6
J5/J6-axis gearbox (Oiling posture) (When oil gun is used)	Floor mount	Arbitrary	Arbitrary	18°	-40°	0°	Arbitrary
	Upside-down mount			-18°	140°		
	-90°wall mount	0°		-72°	-40°		
	+90°wall mount			108°	-40°		
J5/J6-axis gearbox (Oiling posture) (When oil gun is not used)	Floor mount	Arbitrary		18°	90°		
	Upside-down mount			-18°	-90°		
	-90°wall mount	0°		-72°	90°		
	+90°wall mount			108°	90°		
J5/J6-axis gearbox (replenishing oil)	Floor mount	Arbitrary		90°	0°		
	Upside-down mount			-90°	0°		
	-90°wall mount	0°		0°	0°		
	+90°wall mount			180°	0°		
J5/J6-axis gearbox (discharging oil)	Floor mount	Arbitrary		-30°	-70°		
	Upside-down mount			30°	110°		
	-90°wall mount	0°		-210°	-70°		
	+90°wall mount			150°	-70°		
J5/J6-axis gearbox (confirm oiling)	Floor mount	Arbitrary		0°	0°		
	Upside-down mount			180°	0°		
	-90°wall mount	0°		-90°	0°		
	+90°wall mount			90°	0°		
J5/J6-axis gearbox (release remaining pressure)	Floor mount	Arbitrary		20° to 90°	90°		
	Upside-down mount			-20° to-90°	-90°		
	-90°wall mount	0°		0° to 70°	-90°		
	+90°wall mount			110° to 180	90°		

NOTE) Choose the one of the posture taken easily when there is two or more posture.

Exhausting oil method

1 Move the robot to the posture of J5/J6-axis (oil discharge) described in Table 3.2.4 (b).
2 Turn off the controller power.
3 Put the oil pan under the oil outlet. Remove the extra low bolt and seal washer of first oil inlet and seal washer. (See Fig. 3.2.4 (a)) (In this time, if you remove bolt of oil outlet firstly, you can prevent spilling oil on surroundings.

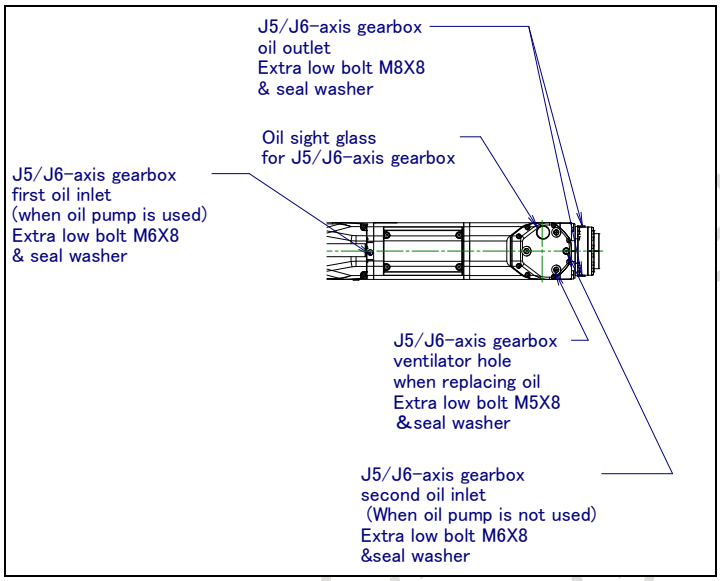


Fig .3.2.4 (a) Oil inlet and outlet

Table 3.2.4 (c) Spec. of the seal washers

Parts name	Specification
Seal washer (M6)	A30L-0001-0048#6M
Seal washer (M8)	A30L-0001-0048#8M

4 Install the taper plug or extra low bolt and seal washer to the first oil outlet and oil outlet after all oil is exhausted.
5 Turn on the controller power.

Injecting oil method

A When oil gun is used

(1) Install oil injection nipple with valve to J5/J6-axis gearbox first oil inlet (A05B-1221-K006) (Fig. 3.2.4 (c)) referring to Fig. 3.2.4 (b).
(2) Attach oil tray with valve (A05B-1221-K007) to J5/J6-axis gearbox oil outlet (J6-axis bearing part).
(3) Confirm valve of oil inlet and oil outlet are open referring to Fig. 3.2.4 (b). Supply oil to J5/J6-axis gearbox by oil injection gun (A05B-1221-K005). If oil comes out in oil tray from oil outlet, stop supplying oil, close the valve oil injection nipple, and remove oil gun
(4) Close the valve of oil tray, remove tray and close the oil outlet.
(5) Remove the oil injection nipple, then attach extra low bolt and seal washer to first oil inlet.
(6) Move robot to the posture for J5/J6-axis gearbox (replenishment) of Table 3.2.4 (b) and add oil from second oil inlet (M5) by a syringe fountain pen filler. If about 15ml of oil is added, oil comes out from oil inlet. Then close the oil inlet.
(7) Move robot to the posture for J5/J6-axis gearbox (confirm oiling) of Table 3.2.4 (b) and confirm the quantity of oil. (See Fig. 3.2.4 (d).)
(8) Turn J4-axis 90 degree by each axis jog, back to the original posture, confirm oil amount height is 3/4 or more. If oil is insufficient, add oil by a syringe fountain pen filler.
(9) Release the remaining pressure using the procedure given in Subsection 3.2.5 and confirm the oil sight glass again.

> ⚠ **CAUTION**
> If supplying oil forcibly when valve is closed, internal pressure of oil bath rise abnormally and cause oil leak from seal part or oil seal falling out. Be careful

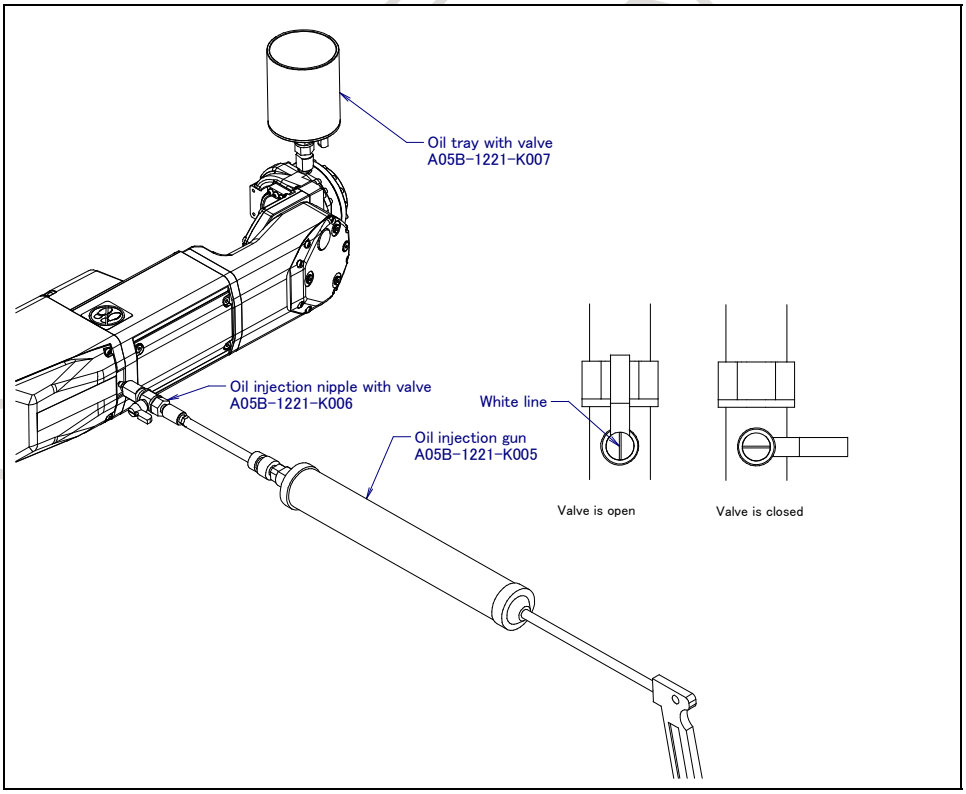


Fig. 3.2.4 (b) Oil injection with a oil gun

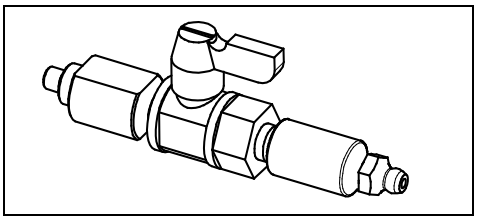


Fig. 3.2.4 (c) Oil injection nipple with valve (A05B-1221-K006)

B When oil gun is not used

(1) Remove extra low bolt and seal washer of ventilator hole and second oil inlet of Fig 3.2.4 (a) and supply oil. When the adaptor for oiling (A290-7221-X591) is used, oiling is easy. (Fig. 3.2.4 (e)) In case of using adaptor for oiling, install it to second oil inlet, remove J5/J6-axis gearbox ventilator hole and supply oil. The amounts of oiling are about as many as two adaptors. It takes about five minutes to supply one cup of oil.

(2) When oil comes out from ventilator hole, in case of using adapter for oiling ,remove it, close the ventilator hole, move robot to the posture (confirm oiling) and confirm amount of oil sight glass. (See Fig.3.2.4 (d)) If oil is not sufficient, replenish it by a syringe fountain pen filler.

(3) Move the robot to the posture (replenishment) and add oil from second oil inlet (M6). If about 15ml of oil is added, oil comes out from oil inlet. Then close the oil inlet.

(4) Move robot to the posture for J5/J6-axis gearbox (confirm oiling) of Table 3.2.4 (b).In this time, rotate the J4-axis to +/- direction and confirm oil does not decrease. If it decreased, move the robot to the posture for J5/J6-axis gearbox (confirm oiling) of Table 3.2.4 (b). And add oil from second oil inlet (M6) by a syringe fountain pen filler.

(5) Release the remaining pressure using the procedure given in Subsection 3.2.5.

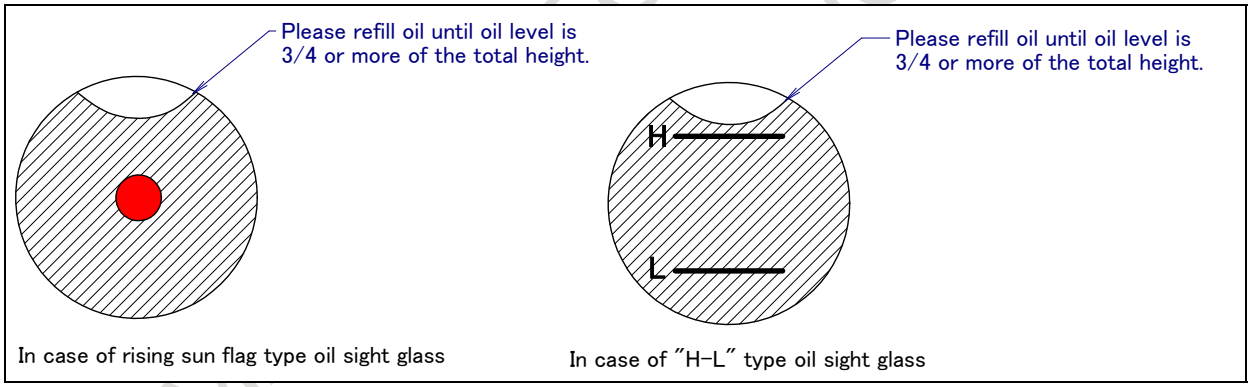


Fig. 3.2.4 (d) Standard of oil sight glass (supplying oil J5/J6-axis gearbox)

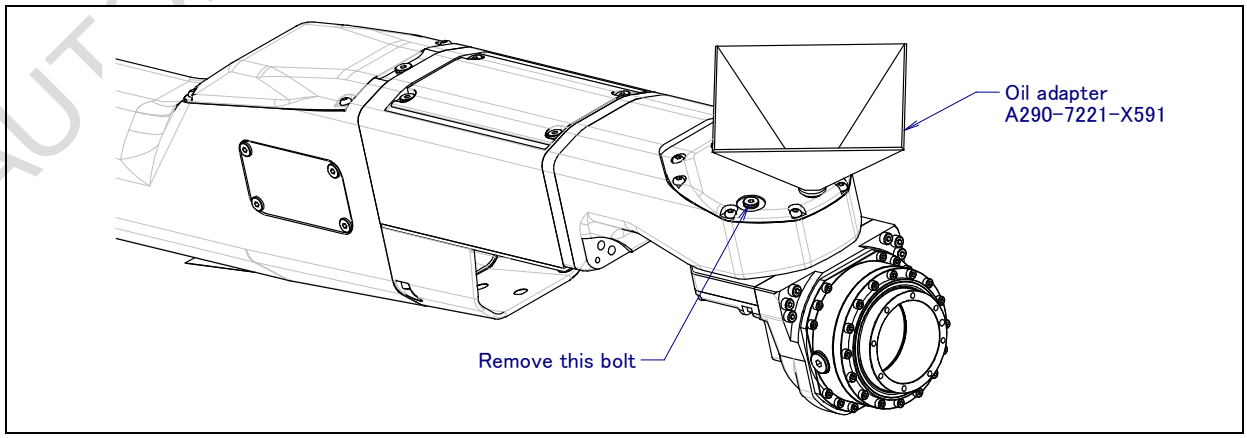


Fig. 3.2.4 (e) Oil adapter (supplying oil J5/J6-axis gearbox)

3.2.5 Procedure for Releasing Remaining Pressure from Oil Bath (J4 to J6-axis)

After replacing oil, please do the following operation to adjust the amount of oil properly.

In case of J4-axis gearbox

Confirm that oil level seen in oil sight glass is as per Fig. 3.2.3 (a). If confirmed then please operate robot J4 axis during 10 minutes, at 100% override, making 90° motion (or more). Keep oil inlet and oil outlet closed during this operation. When completed, move the robot to the posture outlet comes to right above position (In case of floor mount, J3=0°.) and remove seal bolt of J4-axis gearbox oil outlet. Remaining pressure is released at once if it is removed. After operation, confirm whether the oil side of the oil sight glass has come above Fig. 3.2.4 (b), and attach plug of the oil inlet. In case oil level is insufficient, please add oil from the oil outlet with the syringe etc. Wipe off the oil that adhered to the surface of the robot and attach the taper plug on the oil inlet, the seal bolt on the oil outlet completely then attach seal bolt of oil outlet.

In case of J5/J6-axis gearbox

Confirm that oil level seen in oil sight glass is as Fig. 3.2.4 (d). Then move the robot to the posture J5/J6-axis (release remaining pressure), attach extra low bolt and seal washer to second oil inlet but keep them loose. Operate robot J5 and J6 axis during 10 minutes, at 100% override, making 90° motion (or more) on both axes. In this time, make program that move both of J5-axis and J6-axis.
When completed, move the robot to the J5/J6-axis confirming posture. Remaining pressure is released at once if the second oil inlet (M5) is opened. Confirm that oil level is 3/4 or more. At this time, please rotate the J4 axis in the direction of +/-, and confirm that the amount of oil doesn't decrease. If oil decreases, move robot to the posture J5/J6-axis gearbox (replenish oil) and add oil from the second oil inlet with the syringe etc. After it is confirmed, wipe off the oil that adhered to the surface of the robot and attach the extra low bolt on the oil inlet completely.

If the above operation cannot be performed due to the environment of the robot, adjust the operating time according to the operating angle. (When the maximum allowable axis angle is 45 degrees, perform the twice operation for 20 minutes or more.)
When two or more axes are supplied at the same time, it is possible to release grease or oil at the same time in two or more axes.

After replacing grease or oil, the internal pressure of the grease bath or oil bath may rise if the robot is operated again under frequent inversion movement or a high temperature environment. In these cases, you can return to normal internal pressure by releasing the grease outlet or oil outlet just after robot operation. (When opening grease outlet or oil outlet, be sure that grease or oil is not spattered.)

> ⚠ **CAUTION**
> When reusing seal bolt and taper plug, be sure to seal t thread part with seal tape. As for the seal washer, one side, rubber sticks to the entire and the other side, rubber sticks to only around hole and rubber sticks is incomplete state, Attach later face to bolt side. Confirm seal washer by viewing. If it is damaged obviously, replace it by new one.
> See Table 3.2.3 (c), Table 3.2.4 (c) about specification of seal bolts and seal washer.

4 PERIODIC MAINTENANCE (10M/10MS)

4.1 REPLACING THE BATTERIES (1-YEAR CHECKS)

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1 year. Also, use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery

1 Press the EMERGENCY STOP button to prohibit the robot motion.

> ⚠ **CAUTION**
> Be sure to keep the power on. Replacing the batteries with the power supply turned off causes all current position data to be lost. Therefore, mastering will be required again.

2 Remove the battery case cap. (Fig. 4.1 (a), (b)) If it cannot be removed, tap it to side direction with a plastic hammer.
3 Take out the old batteries from the battery case. In this time, battery can be taken out by pulling the stick of the center of the battery box.
4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
5 Close the battery case cap.

> ⚠ **CAUTION**
> When using a robot with the severe dust/liquid protection option, remove the cover from the battery case as shown in Fig. 4.1 (b) to replace the battery. After replacing the battery, reinstall the cover. At this time, please be sure to replace gasket with new one for severe dust/liquid protection. When sticking a gasket on a battery cover, please stick it not to have gaps between them.

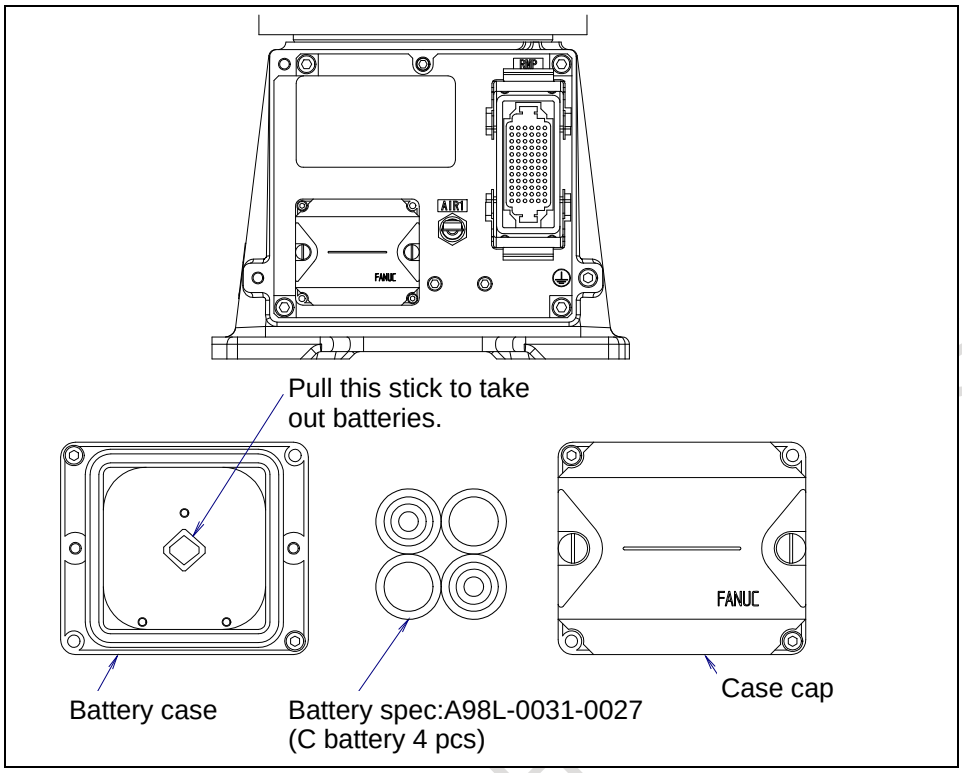


Fig. 4.1 (a) Replacing the battery

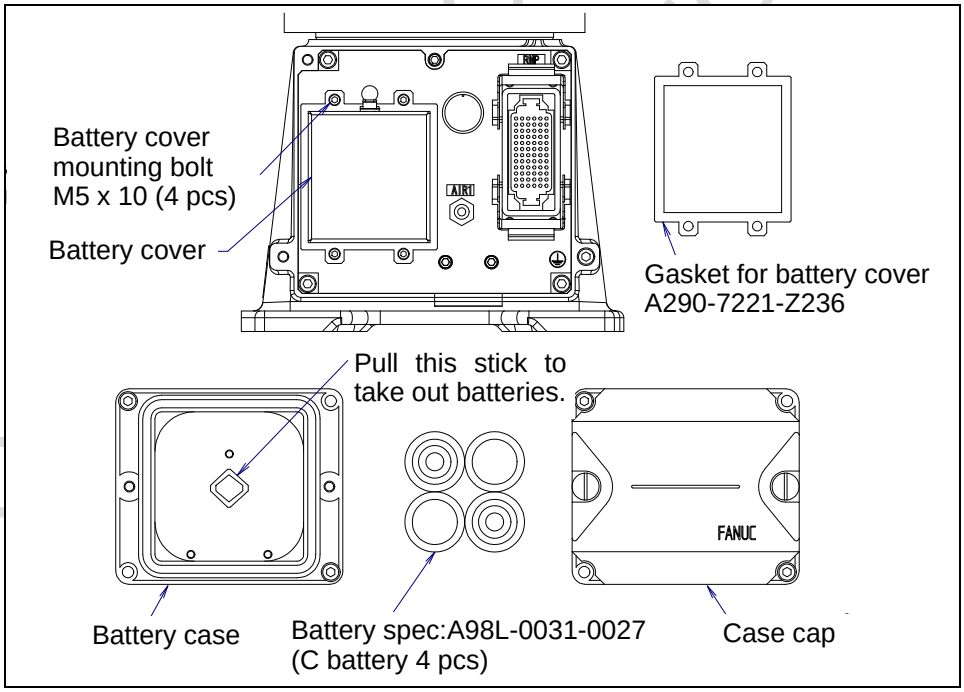


Fig. 4.1 (b) Replacing the battery (When severe dust/liquid protection option is specified)

4.2 GREASING

Following is the greasing procedure for J6-axis reducer.
When greasing the robot, keep its power turned off.

i) Replenish the reducer with grease about every 12 months or after 3840 hours of operation.
ii) See Fig. 4.2 (a) and Table 4.2 (a) for greasing points and the method.
iii) After applying grease, release the remaining pressure within the grease bath as described in the procedure in Subsection 4.3.4.

Table 4.2 (a) Greasing points

Greasing point	Specified grease	Amount of grease	Gun tip pressure	Greasing method
J6-axis reducer	Harmonic grease 4BNo.2 Specification : A98L-0040-0230	35ml (31g)	0.1 MPa or less (NOTE)	Remove the Extra low bolts and sealing washers of the J6-axis grease inlet and outlet, and attach the supplied grease nipple of the J6-axis to the grease inlet of the J6-axis. After greasing, remove the grease nipple, and attach the extra low bolts and sealing washers to the grease inlet and outlet.

NOTE
When using a hand pump, apply grease approximately once per two seconds.

⚠ CAUTION
If you grease incorrectly, the pressure in the grease bath may increase steeply, leading to a broken seal, which will eventually cause grease leakage or malfunction. When greasing, be sure to follow the cautions stated in Subsection 4.3.1.

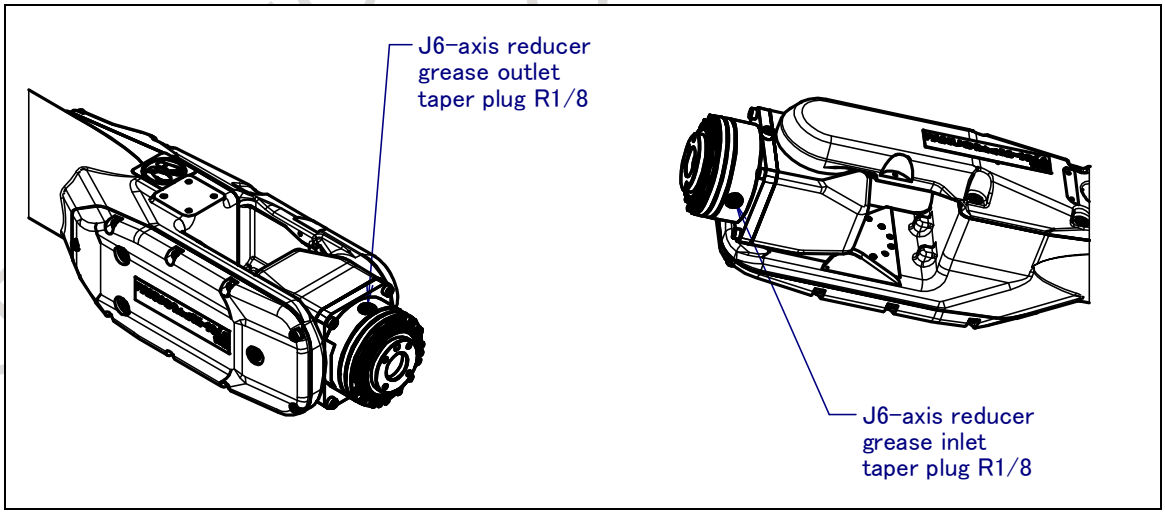


Fig. 4.2 (a) J6-axis grease supply position

4.3 REPLACING THE GREASE OF THE DRIVE MECHANISM (3-YEAR (11520 HOURS) CHECKS)

According to below, replace the grease of the reducers of J1, J2, and J3 axes and J4/J5-axis gearbox at the intervals based on every 3 years or 11520 hours, whichever comes first.

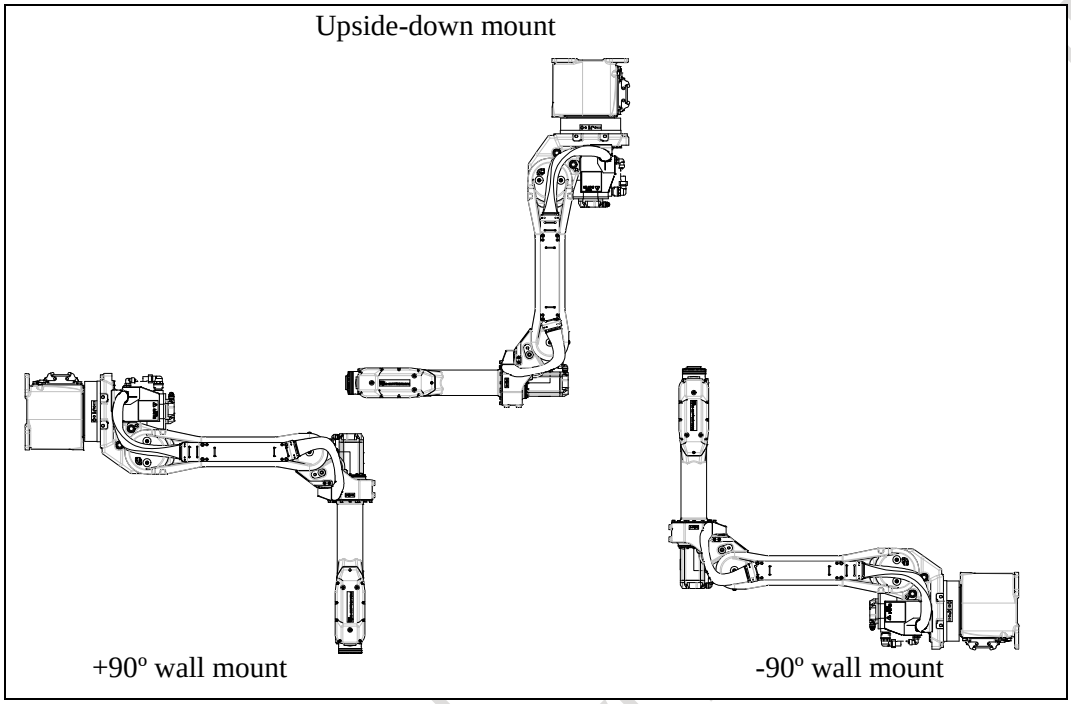


Fig. 4.3 (a) Installation method

4.3.1 Grease Replacement Procedure for J1 to J3-axis Reducer

⚠ CAUTION

Failure to supply grease correctly may cause an increase of the internal pressure of the grease bath. Such pressure increase will then damage the seal, which in turn leads to grease leakage and abnormal robot operation.
When performing greasing, therefore, observe the following precautions.

1 Before starting to grease, remove the seal bolt of the grease outlet to allow the grease to come out.
2 Supply grease slowly, using a manual pump. (once per two seconds)
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply. If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 4.3.1 (a)).
4 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 4.3.3, and then close the grease outlet.
6 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.

Table 4.3.1 (a) Grease name and amount (J1, J2, J3-axis reducer)

Grease supplying position	Amount of grease to be applied	Gun tip pressure	Specified grease
J1-axis reducer	790 g (870ml)	0.1MPa or less (NOTE)	Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174)
J2-axis reducer	300 g (330ml)		
J3-axis reducer	170 g (190ml)		

NOTE
When a manual pump is used for greasing, the standard rate is one pumping cycles per two seconds.

⚠ WARNING
Hot grease might eject suddenly when you open the grease outlet. Attach bags for collecting grease, and use appropriate protective equipment such as heat-resistant gloves, protective glasses, a face shield, or a body suit if necessary.

For grease replacement or replenishment, use the Postures indicated below.
Consider relative angle of from posture of floor mount when robot is angle mount.

Table 4.3.1 (b) Postures for greasing (J1, J2, J3-axis reducer)

Grease supplying position		Posture					
		J1	J2	J3	J4	J5	J6
J1-axis reducer grease supplying posture	Floor mount	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
	Upside-down mount						
	Wall mount -90°						
	Wall mount +90°						
J2-axis reducer grease supplying posture	Floor mount		0°	Arbitrary			
	Upside-down mount		-90°				
	Wall mount -90°		90°				
	Wall mount +90°		-90°				
J3-axis reducer grease supplying posture	Floor mount		0°	0°			
	Upside-down mount		0°	180°			
	Wall mount -90°		0°	0°			
	Wall mount +90°		0°	0°			

1 Move the robot to the greasing posture described in Table 4.3.1 (b).
2 Turn off the controller power.
3 Remove the seal bolt or taper plug from grease outlet. (Fig. 4.3.1 (a))
J1-axis : 1 location (seal bolt M8 x 10)
J2-axis : 2 locations (seal bolt M8 x 10)
J3-axis : 1 location (J3-axis reducer first grease outlet ,seal bolt M8 x 10. Robot has 2 grease outlet. Remove only first grease outlet.)
4 Remove the seal bolt or taper plug from grease inlet and attach grease nipple.
5 Keep greasing until the new grease pushes out the old grease and comes out from each grease outlet.
6 Release the remaining pressure using the procedure given in Subsection 4.3.3. In case of upside-down mount, pull out about 100ml grease to make space of grease bath.

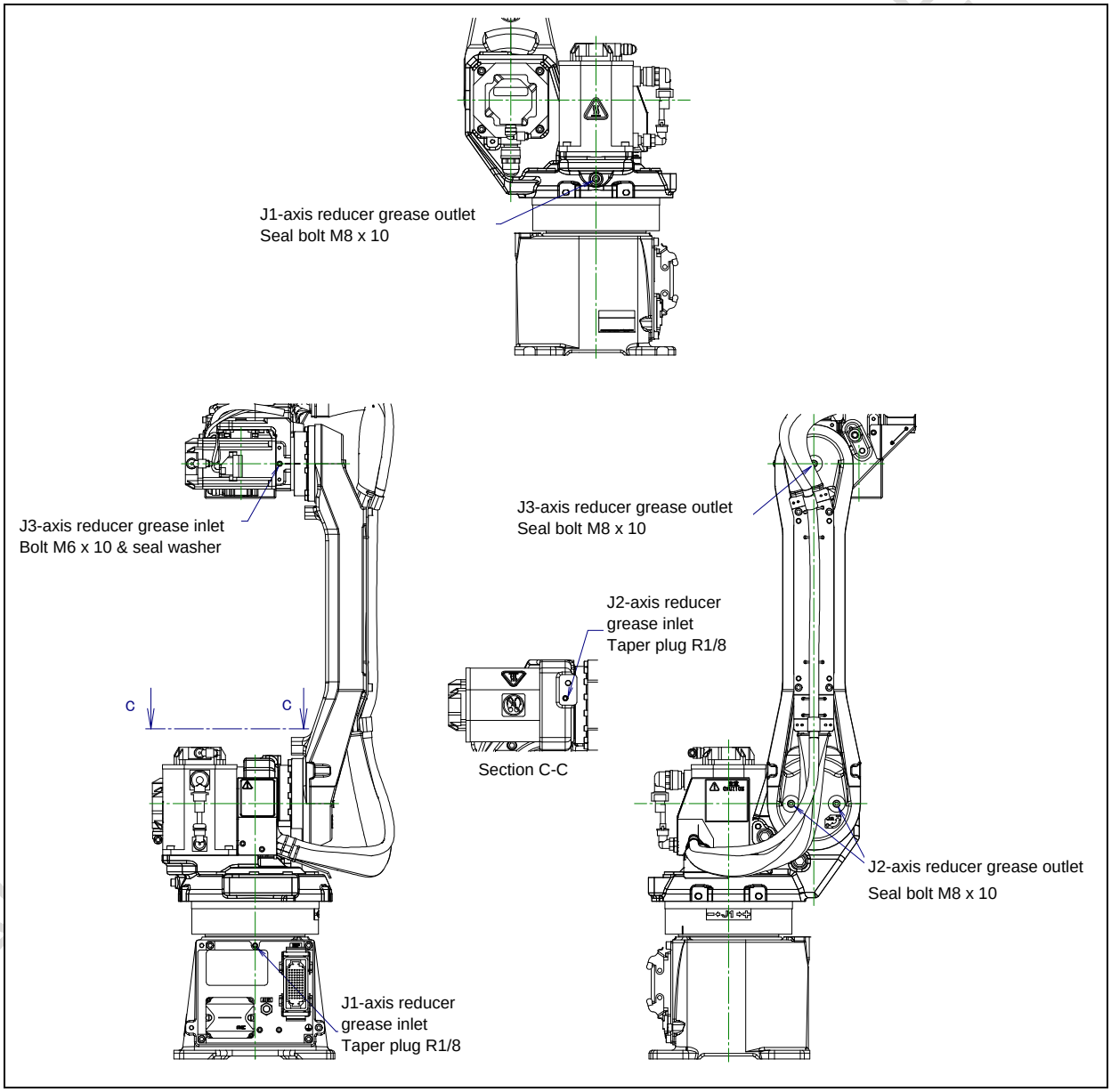


Fig. 4.3.1 (a) Greasing points of J1 to J3-axis reducer

Table 4.3.1 (c) Specification of the seal bolts, the taper plug and the seal washer

Parts name		Specification
Seal bolt	(M8 x 10)	A97L-0218-0417#081010
Taper plug	(R1/8)	A97L-0001-0436#1-1D
Seal washer	(M6)	A30L-0001-0048#6M

4.3.2 Grease Replacement Procedure for J4, J5-axis Gearbox

⚠ CAUTION

Failure to supply grease correctly may cause an increase of the internal pressure of the grease bath. Such pressure increase will then damage the seal, which in turn leads to grease leakage and abnormal robot operation.
When performing greasing, therefore, observe the following precautions.

1 Before starting to grease, remove the seal bolt of the grease outlet to allow the grease to come out.
2 Supply grease slowly, using a manual pump. (once per two seconds)
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply.
If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 4.3.2 (a)).
4 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 4.3.4, and then close the grease outlet.
6 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.

Table 4.3.2 (a) Grease name and amount (J4, J5-axis gearbox)

Greasing points	Amount of grease to be applied	Gun tip pressure	Specified grease
J4-axis gearbox	340 g (390ml)	0.1MPa or less (NOTE)	Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174)
J5-axis gearbox	220 g (250ml)		

NOTE

When a manual pump is used for greasing, the standard rate is one pumping cycles per two seconds.

Table 4.3.2 (b) Grease supplying posture (J4, J5-axis gearbox)

Greasing points		Posture					
		J1	J2	J3	J4	J5	J6
J4-axis gearbox Greasing posture	Floor mount	Arbitrary	Arbitrary	0°	Arbitrary	Arbitrary	Arbitrary
	Upside-down mount			0°			
	-90° wall mount			90°			
	+90° wall mount			90°			
J5-axis gearbox Greasing posture	Floor mount	Arbitrary	Arbitrary	-90°			
	Upside-down mount			90°			
	-90° wall mount	0°	0°	180°			
	+90° wall mount			0°			

1 Move the robot to the greasing posture described in Table 4.3.2 (b).
2 Turn off the controller power.
3 Remove the seal bolt. (Fig.4.3.2 (a))
J4-axis : 1 location (seal bolt M6 x 8)
J5-axis : 1 location (bolt M8 x 12 + seal washer)
4 Remove the seal bolt or taper plug from grease inlet and attach grease nipple.
5 Keep greasing until the new grease pushes out the old grease and comes out from each grease outlet.
6 Release the remaining pressure using the procedure given in Subsection 4.3.4.

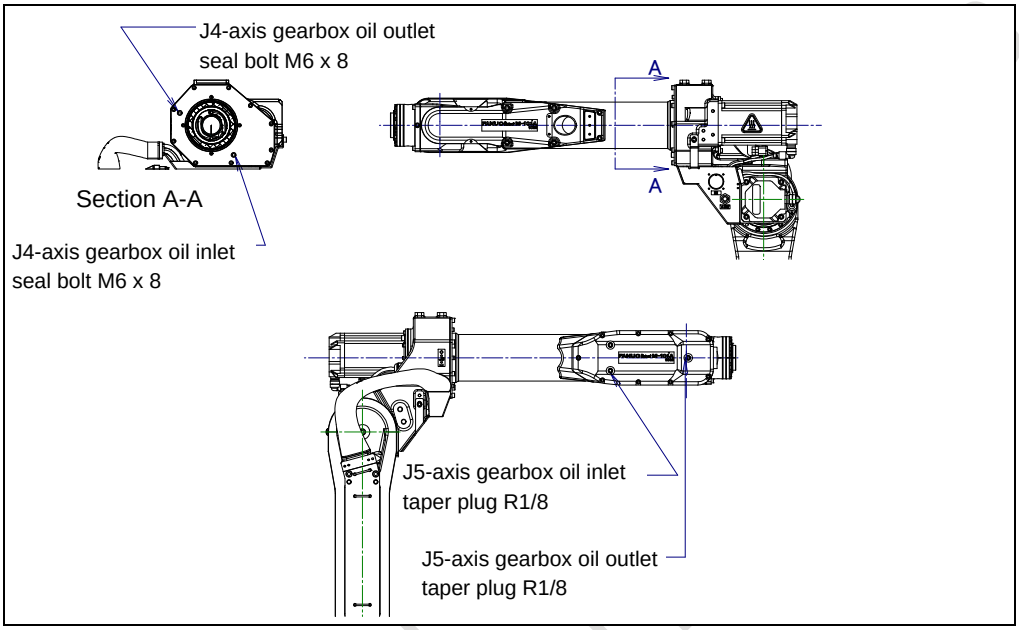


Fig. 4.3.2 (a) Greasing point of J4, J5-axis gearbox

Table 4.3.2 (c) Spec. of the seal bolt and the seal washer

Parts name	Specification
Seal bolt (M6 x 8)	A97L-0218-0417#060808
Seal washer (M8)	A30L-0001-0048#8M

4.3.3 Procedure for Releasing Remaining Pressure from the Grease Bath (J1 to J3-axis)

After applying grease, operate the robot as instructed below with the plug and seal bolt of the grease inlet and outlet uncapped to release the remaining pressure within the grease bath. In case of J2-axis, there are three seal bolts for grease outlet. So uncap all of them.
Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

<table>
<tr><th>Operating axis / Grease replacement part</th><th>J1-axis</th><th>J2-axis</th><th>J3-axis</th><th>J4-axis</th><th>J5-axis</th><th>J6-axis</th></tr>
<tr><td>J1-axis reducer</td><td>Axis angle of 60° or more OVR 100%</td><td colspan="5">Arbitrary</td></tr>
<tr><td>J2-axis reducer</td><td>Arbitrary</td><td>Axis angle of 60° or more OVR 100%</td><td colspan="4">Arbitrary</td></tr>
<tr><td>J3-axis reducer</td><td colspan="2">Arbitrary</td><td>Axis angle of 60° or more OVR 100%</td><td colspan="3">Arbitrary</td></tr>
</table>

If the above operations cannot be performed because of workcell constraints, adjust the operating time according to the operating angle. (For example, when the maximum allowable axis angle is 30 degrees, perform the twice operation for 20 minutes or more.) If you grease or replacing oil multiple axes, you can exercise multiple axes at the same time. After completion of the operation, attach the taper plug and seal bolts to the grease inlets and outlets. When reusing the seal bolts, be sure to seal them with seal tape.

After replacing grease, the internal pressure of the grease bath may rise if the robot is operated again under frequent inversion movement or a high temperature environment. In these cases, you can return to normal internal pressure by releasing the grease outlet just after robot operation. (When opening grease outlet, be sure that grease is not spattered.)

4.3.4 Procedure for Releasing Remaining Pressure from the Grease Bath (J4 to J6-axis)

To release remaining pressure, perform the procedure below.

(For the J4-axis)

Operate the robot as described in the table below for at least 10 minutes, with the seal bolts removed from the grease inlet and outlet.

(For the J5-axis gearbox)

- After greasing, remove the grease nipple from the grease inlet.
- Move the robot to J3=-90°, perform ±90° repeating operation during 5 minutes for only J5-axis. Make wait time between 2 points 0, perform the continuous operation with position pass is fine.
- After 5 minutes, confirm about 50ml grease is pulled out. (just as volume of 2 golf balls.)
- Attach the bolts and seal washers of grease inlet and outlet.

(For the J6-axis)

Operate the robot as described in the table below for at least 10 minutes, with the extra low bolts and seal washers removed from the grease inlet and outlet.

Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

<table>
<tr><th>Operating axis / Grease replacement part</th><th>J1-axis</th><th>J2-axis</th><th>J3-axis</th><th>J4-axis</th><th>J5-axis</th><th>J6-axis</th></tr>
<tr><td>J4-axis gearbox</td><td colspan="3">Arbitrary</td><td>Axis angle of 60° or more OVR 100%</td><td colspan="2">Arbitrary</td></tr>
<tr><td>J5-axis gearbox</td><td colspan="4">Arbitrary</td><td>Axis angle of 180° or more OVR 100%</td><td>Arbitrary</td></tr>
<tr><td>J6-axis reducer</td><td colspan="5">Arbitrary</td><td>Axis angle of 60° or more OVR 100%</td></tr>
</table>

If the above operations cannot be performed because of workcell constraints, adjust the operating time according to the operating angle. (For example, when the maximum allowable axis angle is 30 degrees, perform the twice operation for 20 minutes or more.) If you grease or replacing oil multiple axes, you can exercise multiple axes at the same time. (except J5-axis) After completion of the operation, attach the taper plug, seal bolts or bolts and seal washers to the grease inlets and outlets. When reusing the seal bolts or the taper plug, be sure to seal them with seal tape.

After replacing grease, the internal pressure of the grease bath may rise if the robot is operated again under frequent inversion movement or a high temperature environment. In these cases, you can return to normal internal pressure by releasing the grease outlet just after robot operation. (When opening grease outlet, be sure that grease is not spattered.)

5 TROUBLESHOOTING

The source of mechanical unit problems may be difficult to locate because of overlapping causes. Problems may become further complicated, if they are not corrected properly. Therefore, you must keep an accurate record of problems and take proper corrective actions.

5.1 TROUBLESHOOTING

Table 5.1 (a) shows the major troubleshooting symptoms that may occur in the mechanical unit and their probable causes. If you cannot pinpoint a failure cause or which measures to apply, contact your local FANUC representative.

Table 5.1 (a) Troubleshooting

Symptoms	Descriptions	Causes	Measures
Vibration Noise	- The J1 base lifts off the floor plate as the robot operates. - There is a gap between the J1 base and floor plate. - A J1 base-retaining bolt is loose.	[J1 base fastening] - It is likely that the robot J1 base is not securely fastened to the floor plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or foreign material caught between the J1 base and floor plate. - If the robot is not securely fastened to the floor plate, the J1 base lifts the floor plate as the robot operates, allowing the base and floor plates to strike each other. That, in turn, leads to vibration.	- If a bolt is loose, apply LOCTITE and tighten it to the appropriate torque. - Adjust the floor plate surface flatness to within the specified tolerance. - If there is any foreign matter between the J1 base and floor plate, remove it.
	- The rack or floor plate vibrates during operation of the robot.	[Rack or floor] - It is likely that the rack or floor is not rigid enough. - If they are not rigid enough, counterforce can deform the rack or floor, and cause vibration.	- Reinforce the rack or floor to make it more rigid. - If reinforcing the rack or floor is impossible, modify the robot control program; doing so might reduce the vibration.
	- Vibration becomes more serious when the robot adopts a specific posture. - If the operating speed of the robot is reduced, vibration stops. - Vibration is most noticeable when the robot is accelerating. - Vibration occurs when two or more axes operate at the same time.	[Overload] - It is likely that the load on the robot is greater than the maximum rating. - It is likely that the robot control program is too demanding for the robot hardware. - It is likely that the ACCELERATION value is excessive.	- Check the maximum load that the robot can handle once more. If the robot is found to be overloaded, reduce the load, or modify the robot control program. - Vibration in a specific portion can be reduced by modifying the robot control program while slowing the robot and reducing its acceleration (to minimize the influence on the entire cycle time).

Symptoms	Descriptions	Causes	Measures
Vibration Noise (Continued)	- Vibration was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating axis has not been exchanged for a long period. - There is vibration or unusual sound just after replacing grease or oil or parts. - Periodic vibration and noise occur.	[Gear, bearing, or reducer] - It is likely that collision or overload applied an excessive force on the drive mechanism, thus damaging the tooth surface or rolling contact surface of a bearing, or reducer. - It is likely that prolonged use of the robot while overloaded caused fretting of the tooth surface or rolling contact surface of a bearing, or reducer due to resulting metal fatigue. - It is likely that foreign material caught in a gear, bearing, or within a reducer caused damage on the tooth surface or rolling contact surface of the bearing, or reducer. - It is likely that foreign material caught in a gear, bearing, or within a reducer caused vibration. - It is likely that, because the grease has not been changed for a long period, fretting occurred on the tooth surface or rolling contact surface of a bearing, or reducer due to metal fatigue. - There is a possibility of Grease or oil has not been replaced accurately. The amount of grease or oil may be insufficient.	- Operate one axis at a time to determine which axis is vibrating. - Confirm the oil side of the oil sight glass of J4-J6 axis. Replenish oil when the oil side has not reached above the half. - Remove the motor, and replace the gear, the bearing, and the reducer. For the spec. of parts and the method of replacement, contact your local FANUC representative. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Supplying the specified grease at the recommended interval will prevent problems. - If vibration can no be removed by replacing grease or oil, Perform the continuous operation before replacing grease or oil, then it may be improved.

Symptoms	Descriptions	Causes	Measures
Vibration Noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical unit.	[Controller, cable, and motor] - If a failure occurs in a controller circuit, preventing control commands from being supplied to the motor normally, or preventing motor information from being sent to the controller normally, vibration might occur. - Pulsecoder defect may be the cause of the vibration as the motor cannot propagate the accurate position to the controller. - If the motor becomes defective, vibration might occur because the motor cannot deliver its rated performance. - If a power line in a movable cable of the mechanical unit has an intermittent break, vibration might occur because the motor cannot accurately respond to commands. - If a Pulsecoder wire in a movable part of the mechanical unit has an intermittent break, vibration might occur because commands cannot be sent to the motor accurately. - If a robot connection cable has an intermittent break, vibration might occur. - If the power supply cable is about to be snapped, vibration might occur. - If the power source voltage drops below the rating, vibration might occur. - It may vibrate when an invalid value parameter was set.	- Refer to the Controller Maintenance Manual for troubleshooting related to the controller and amplifier. - Replace the motor of the axis that is vibrating, and check whether vibration still occurs. For the method of replacement, contact your local FANUC representative. - If vibration occurs only when the robot assumes a specific posture, it is likely that a cable in the mechanical unit is broken. - Shake the movable part cable while the robot is at rest, and check whether an alarm occurs. If an alarm or any other abnormal condition occurs, replace the mechanical unit cable. - Check whether the jacket of the robot connection cable is damaged. If so, replace the connection cable, and check whether vibration still occurs. - Check whether the power cable jacket is damaged. If so, replace the power cable, and check whether vibration still occurs. - Check that the robot is supplied with the rated voltage. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct it. Contact FANUC for further information if necessary.

Symptoms	Descriptions	Causes	Measures
Vibration Noise (Continued)	- There is some relationship between the vibration of the robot and the operation of a machine near the robot.	[Noise from a nearby machine] - If the robot is not grounded properly, electrical noise is induced on the grounding wire, preventing commands from being transferred accurately, thus leading to vibration. - If the robot is grounded at an unsuitable point, its grounding potential becomes unstable, and noise is likely to be induced on the grounding line, thus leading to vibration.	- Connect the grounding wire firmly to ensure a reliable ground potential and prevent extraneous electrical noise.
	- There is an abnormal noise after replacing grease. - There is an abnormal noise after a long time pause. - There is an abnormal noise during operation at low speed.	- There may be an abnormal noise when using other than the specified grease. - Even if using the specified grease, there may be an abnormal noise during operation at low speed immediately after replacement or after a long time pause.	- Use the specified grease. - When there is an abnormal noise even when using the specified grease, operate for one or two days as an experiment. Generally, the abnormal noise will disappear.
	- There is an unusual sound when operating right immediately the replacing part, grease or oil.	- There is a possibility of Grease or oil has not been exchanged accurately. The amount of grease or oil may be insufficient.	- Stop the robot, and confirm the damage situation at once. Replenish grease or oil when they are insufficient.
	- The movement speed of robots not constant	- Sludge may be generated by the deterioration of the oil, and it may be attached to bearing etc.	- Perform continuous operation and destroy the sludge. Then replace oil.

Symptoms	Descriptions	Causes	Measures
Rattling	- While the robot is not supplied with power, pushing it with the hand causes part of the mechanical unit to wobble. - There is a gap on the mounting face of the mechanical unit.	[Mechanical section coupling bolt] - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical section.	- Check that the following bolts for each axis are tight. If any of these bolts is loose, apply LOCTITE and tighten it to the appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Reducer shaft retaining bolt - Base retaining bolt - Arm retaining bolt - Casting retaining bolt - End effector retaining bolt
	- Backlash is greater than the tolerance stated in the applicable maintenance manual. (See Section 5.2.)	[Increase in backlash] - It is likely that excessive force applied to the drive system, due to a collision or overloading, has damaged a gear or the inside of the reducer, resulting in an increase in the amount of backlash. - It is likely that prolonged use has caused the tooth surfaces of a gear and the inside of the reducer to wear out, resulting in an increase in the amount of backlash. - It is likely that prolonged use without changing the grease has caused the tooth surfaces of a gear and the inside of the reducer to wear out, resulting in an increase in the amount of backlash.	- Operate each axis individually to judge which axis has been vibrating. - Remove the motor, and check whether any of its gears are damaged. If any gear is damaged, replace it. - Check whether any other gear of the drive system is damaged. If there is no damages to the gear, replace the reducer. - If the reducer is broken, or if a gear tooth is missing, replace the relevant component. Also, remove all the grease or oil from the gearbox and wash the inside of the gearbox. - After replacing the gear or reducer, add an appropriate amount of grease or oil. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Regularly applying the grease or oil at the specified interval with a specified type can help prevent problems.

Symptoms	Descriptions	Causes	Measures
Motor overheating	- The ambient temperature of the installation location increases, causing the motor to overheat. - After a cover was attached to the motor, the motor overheated. - After the robot control program or the load was changed, the motor overheated.	[Ambient temperature] - It is likely that a rise in the ambient temperature or attaching the motor cover prevented the motor from releasing heat efficiently, thus leading to overheating. [Operating condition] - It is likely that the condition is above the robot's operating performance.	- Reducing the ambient temperature is the most effective means of preventing overheating. - Having the surroundings of the motor well ventilated enables the motor to release heat efficiently, thus preventing overheating. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is an effective way to reduce the average current. Thus, prevent overheating. - The teach pendant can be used to monitor the average current. Check the average current when the robot control program is operating.
	- After a control parameter (load setting etc.) was changed, the motor overheated.	[Parameter] - If data input for a workpiece is invalid, the robot cannot be accelerate or decelerate normally, so the average current increases, leading to the motor overheating.	- As for load setting, Input an appropriate parameter referring to Section 4.3 of OPERATOR'S MANUAL (B-82754EN).
	- Symptom other than stated above	[Mechanical section problems] - It is likely that problems occurred in the mechanical drive system, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor operating with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor.	- Repair the mechanical unit while referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - If the average current falls after the motor is replaced, it indicates that the first motor was faulty.

Symptoms	Descriptions	Causes	Measures

Grease , oil leakage	- Grease or oil is leaking from the mechanical unit.	[Poor sealing]
		- Probable cause is a crack in the casting, a broken O-ring, a damaged oil seal, or a loose seal bolt.
		- A crack in a casting can occur due to excessive force that might be caused in collision.
		- An O-ring can be damaged if it is trapped or cut during disassembling or re-assembling.
		- An oil seal might be damaged if extraneous dust scratches the lip of the oil seal.
		- A loose seal bolt might allow grease to leak along the threads.
			- If a crack develops exist in the casting, sealant can be used as a quick-fix to prevent further grease leakage. However, the component should be replaced as soon as possible, because the crack might propagate.
			- O-rings are used in the locations listed below.
			  - Motor coupling section
			  - Reducer (case and shaft) coupling section
			  - Connection part of the wrist
			  - J3 arm coupling section
			  - Inside the wrist
			- Oil seals are used in the locations stated below.
			  - Inside the reducer
			  - Inside the wrist
			- Seal bolts are used in the locations stated below.
			  - Grease inlet/outlet
			  - Oil inlet/outlet
			  - For fix of cover

Symptoms	Descriptions	Causes	Measures

Dropping axis	- An axis drops because the brake does not function.
	- An axis falls while standing still.
		[Brake drive relay and motor]
		- It is likely that brake drive relay contacts are stuck to each other to keep the brake current flowing, thus preventing the brake from operating when the motor is reenergized.
		- It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently.
		- It is likely that oil or grease has entered the motor, causing the brake to slip.
		- In case of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L brake is not installed for J1/J4/J5/J6-axes. If you turn off the controller power at wait position, robot may move greatly by weight or exceeds stroke limit depend on the posture of robot or wrist load condition. Adjust the wait position so that axis does not move greatly when controller power is turned off.
			- Check whether the brake drive relays are stuck to each other or not. If they are found to be stuck, replace the relays.
			- Replace the motor after confirming whether the following symptoms have occurred.
			  - Brake shoe is worn out
			  - Brake main body is damaged
			  - Oil soaked through the motor
			- J4-axis cable has movable part .So if robot exceeds stroke limit, load depends on cable and it may cause damage of cables . If robot exceeds stroke limit, remove plate of back of J4, return axis to motion range during checking condition of cables. If cable tie is cut, attach new articles. If you operate robot with cable tie is cut, it cause damage of cables. (See Section 6.1).

Symptoms	Descriptions	Causes	Measures
Displace-ment	- The robot moves to at a point other than the taught position. - The repeatability is not within the tolerance.	[Mechanical section problems] - If the repeatability is unstable, probable causes are a failure in the drive mechanism or a loose bolt. - If the repeatability becomes stable, it is likely that a collision imposed an excessive load, leading to slipping on the base surface or the mating surface of an arm or reducer. - It is likely that the Pulsecoder is abnormal.	- If the repeatability is unstable, repair the mechanical section by referring to the above descriptions of vibration, noise, and rattling. - If the repeatability is stable, correct the taught program. Variation will not occur unless another collision occurs. - If the Pulsecoder is abnormal, replace the motor.
	- Displacement occurs only in a specific peripheral unit.	[Peripheral unit displacement] - It is likely that an external force was applied to the peripheral unit, thus shifting its position relative to the robot.	- Correct the setting of the peripheral unit position. - Correct the taught program.
	- Displacement occurred after a parameter was changed.	[Parameter] - It is likely that the mastering data was rewritten in such a way that the robot origin was shifted.	- Re-enter the previous mastering data, which is known to be correct. - If correct mastering data is unavailable, perform mastering again.
BZAL alarm occurred	- BZAL is displayed on the teach pendant screen	- It is likely that the voltage of the memory backup battery is low. - It is likely that the Pulsecoder cable is defected.	- Replace the battery. - Replace the cable.

Table 5.1 (b) Allowable drops

At power off	5mm
At Power-Off stop	5mm

NOTE
Each value indicates the amount by which an end effector mounting face may fall.

5.2 BACKLASH MEASUREMENT

Measurement method

1 Put the robot in a specified posture. (See Fig. 5.2 (b) to (e).)
2 Apply positive and negative loads to each axis as shown in Fig. 5.2 (a).
3 Remove the loads and measure the displacement.

Measure backlash by applying positive and negative loads to each axis three times. Average the values measured in the last two measurements for each axis, and use the averages as a measured backlash for the respective axes.

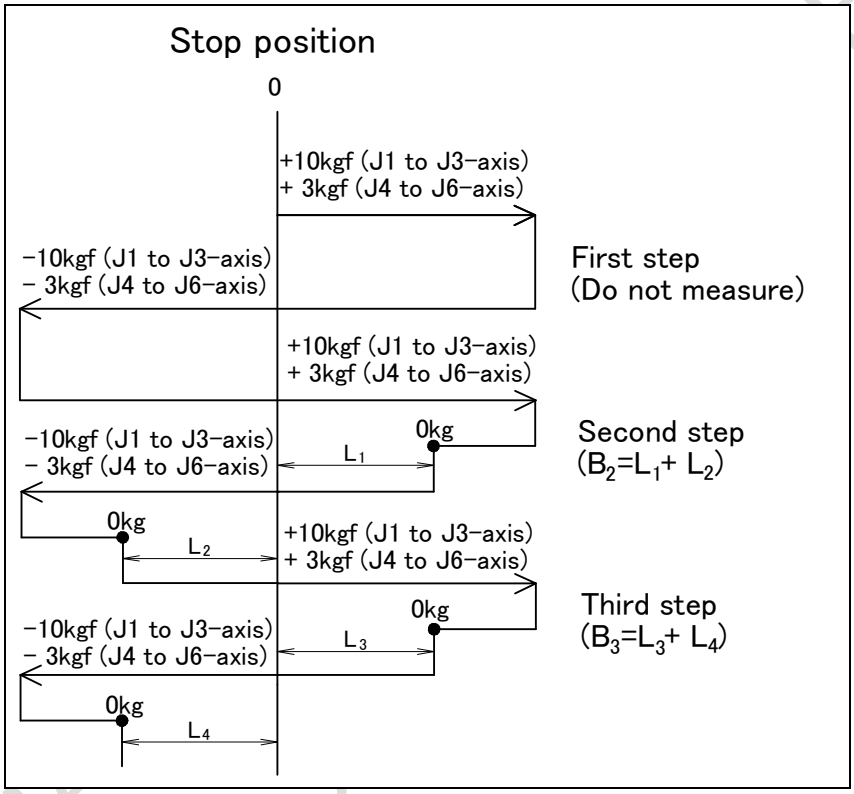


Fig. 5.2 (a) Backlash measurement method

Backlash B is calculated using the following expression: $B=\frac{B_2+B_3}{2}$

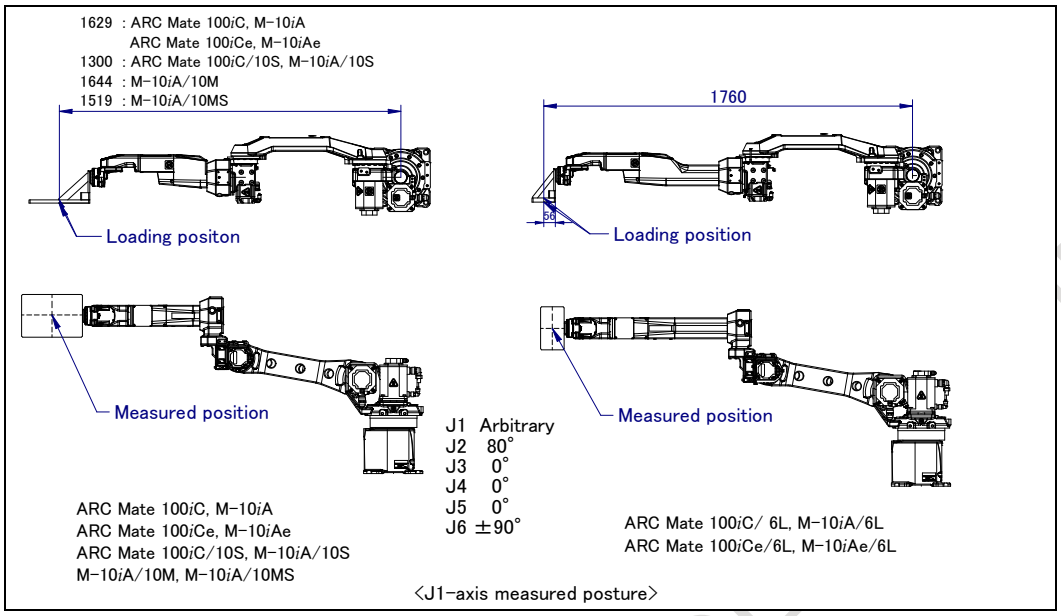


Fig. 5.2 (b) Backlash measured posture (1/4)

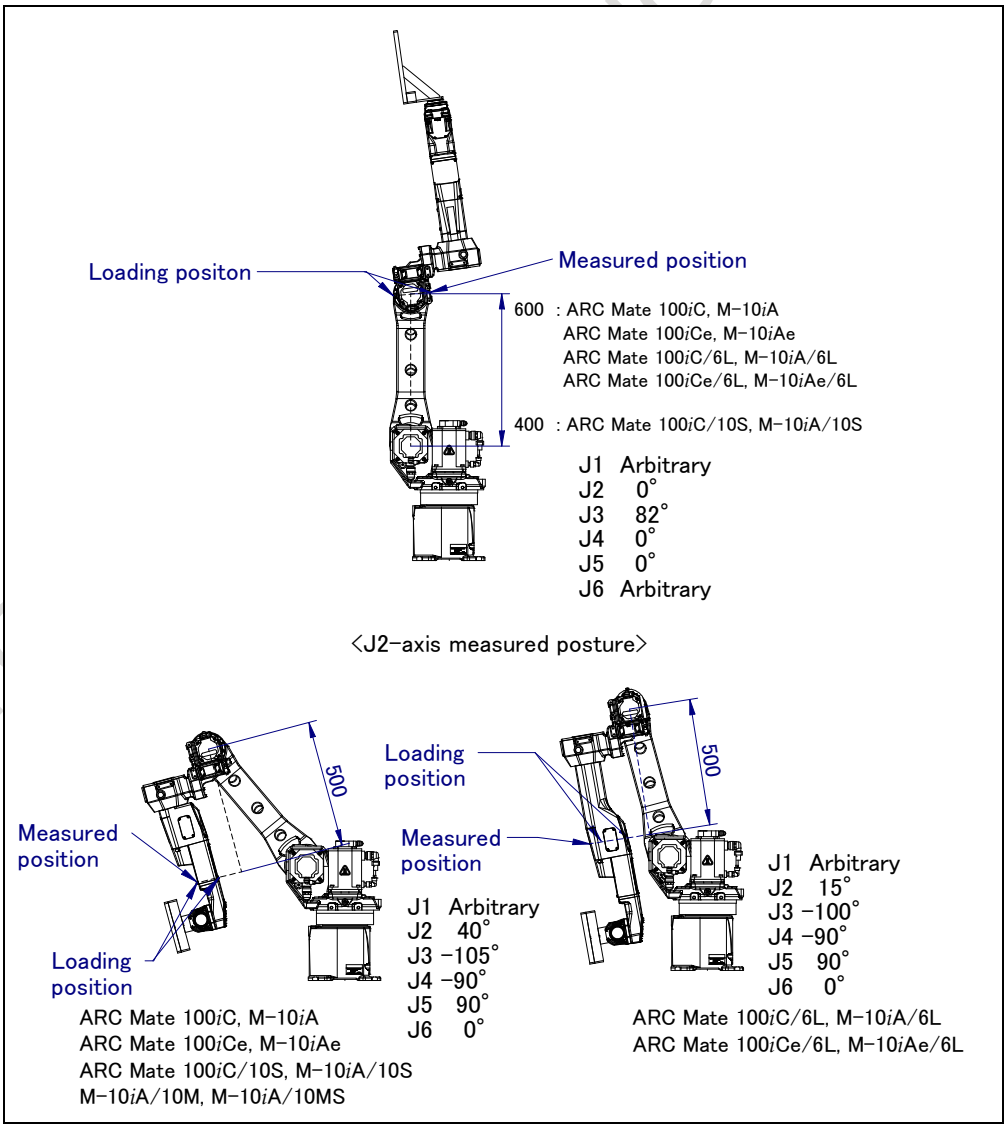


Fig. 5.2 (c) Backlash measured posture (2/4)

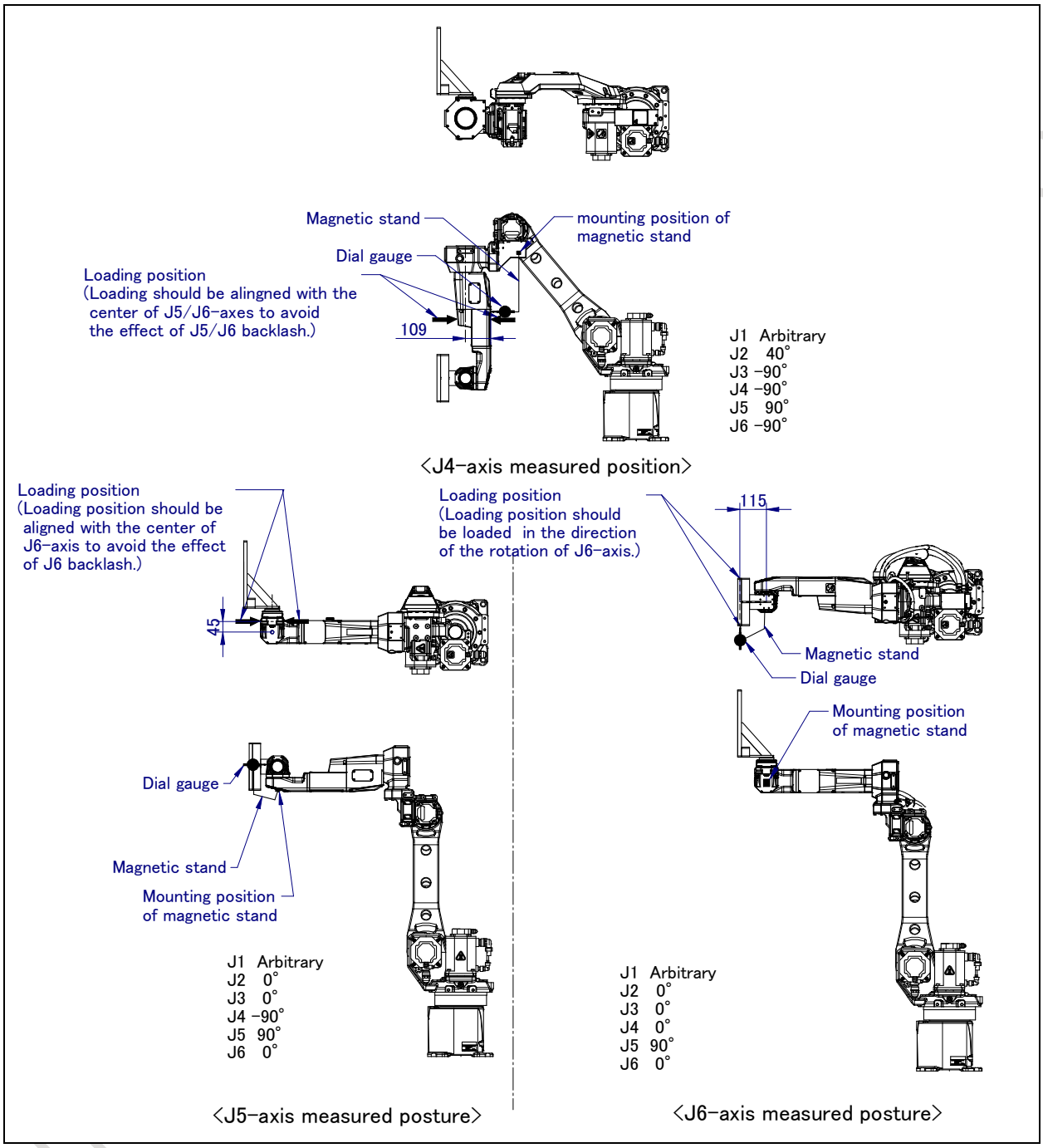


Fig. 5.2 (d) Backlash measured posture (3/4)
(except 10M/10MS)

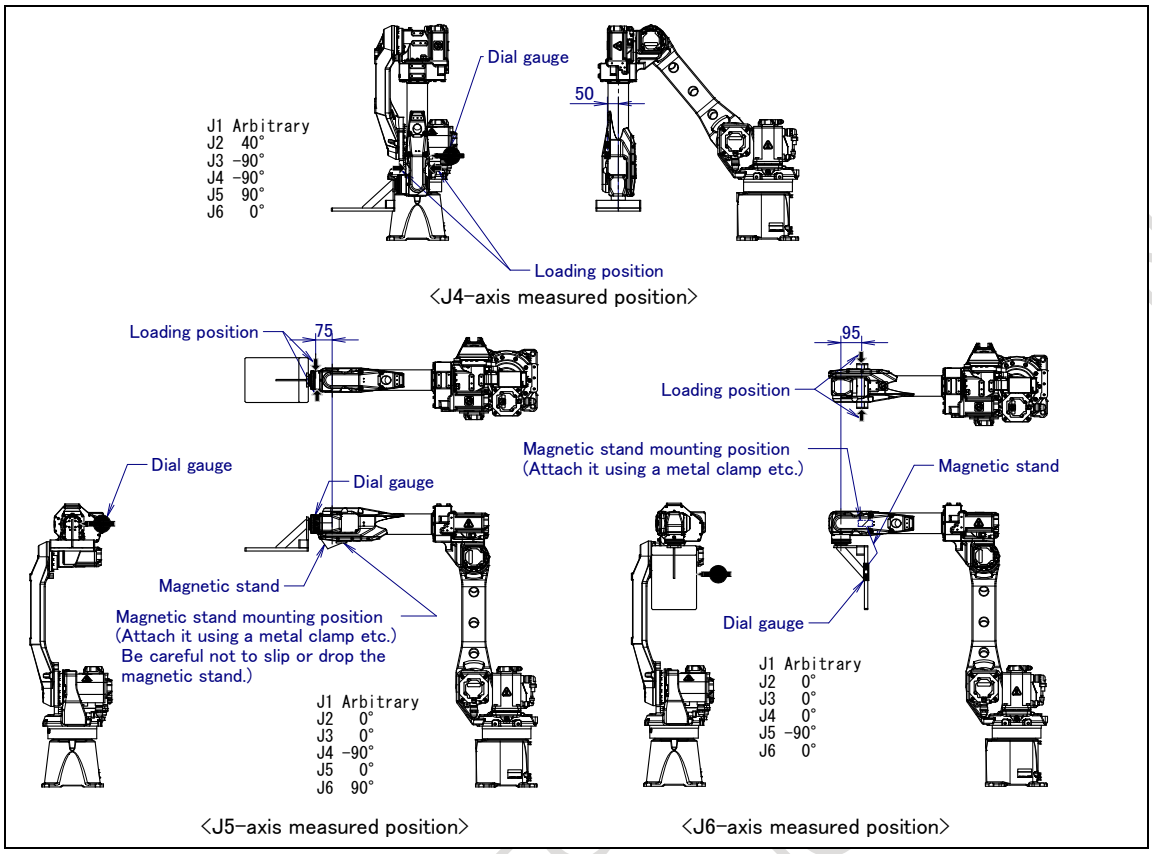


Fig. 5.2 (e) Backlash measured posture (4/4) (10M/10MS)

Table.5.2 (a) Backlash allowance (ARC Mate 100*i*C, ARC Mate 100*i*Ce)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	3.00	3.00	5.00
Displacement conversion (mm)	1.18	0.44	0.36	0.10	0.04	0.17
Distance between the rotation center and dial gauge (mm)	1629	600	500	109	45	115

Table.5.2 (b) Backlash allowance (M-10*i*A, M-10*i*Ae)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	4.00	4.00	6.00
Displacement conversion (mm)	1.18	0.44	0.36	0.13	0.05	0.20
Distance between the rotation center and dial gauge (mm)	1629	600	500	109	45	115

Table.5.2 (c) Backlash allowance (ARC Mate 100*i*C/6L, ARC Mate 100*i*Ce/6L)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	3.00	3.00	5.00
Displacement conversion (mm)	1.28	0.44	0.36	0.10	0.04	0.17
Distance between the rotation center and dial gauge (mm)	1760	600	500	109	45	115

Table.5.2 (d) Backlash allowance (M-10*i*A/6L, M-10*i*Ae/6L)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	4.00	4.00	6.00
Displacement conversion (mm)	1.28	0.44	0.36	0.13	0.05	0.20
Distance between the rotation center and dial gauge (mm)	1760	600	500	109	45	115

Table.5.2 (e) Backlash allowance (ARC Mate 100*i*C/10S)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	3.00	3.00	5.00
Displacement conversion (mm)	0.94	0.29	0.36	0.10	0.04	0.17
Distance between the rotation center and dial gauge (mm)	1300	400	500	109	45	115

Table.5.2 (f) Backlash allowance (M-10*i*A/10S)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	4.00	4.00	6.00
Displacement conversion (mm)	0.94	0.29	0.36	0.13	0.05	0.20
Distance between the rotation center and dial gauge (mm)	1300	400	500	109	45	115

Table.5.2 (g) Backlash allowance (M-10*i*A/10M)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	3.00	4.50	6.00
Displacement conversion (mm)	1.19	0.44	0.36	0.04	0.09	0.26
Distance between the rotation center and dial gauge (mm)	1644	600	500	50	75	95

Table.5.2 (h) Backlash allowance (M-10*i*A/10MS)

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.50	2.50	2.50	3.00	4.50	6.00
Displacement conversion (mm)	1.10	0.29	0.36	0.04	0.09	0.26
Distance between the rotation center and dial gauge (mm)	1519	600	500	50	75	95

NOTE

When measuring backlash in cases where the distance between the rotation center and the dial gauge is different from those in the above table, make angle and displacement conversions according to the table.

6 REPLACING PARTS (EXCEPT 10M/10MS)

Once motors, reducers, gearbox and wrist unit are replaced, mastering becomes necessary, perform mastering according to Chapter 9 after any of these components are replaced.

NOTE
1 Be very careful when dismounting and mounting the heavy components that are listed below.
2 This Chapter assumes that robot is floor mount. If other installation is adopted, consider relative angle of from posture of floor mount.

Component	Model	Weight (approximate)
Wrist unit (See Fig. 6.11 (a),(b), Fig. 6.12 (a))	ARC Mate 100*i*C, M-10*i*A ARC Mate 100*i*C/10S, M-10*i*A/10S ARC Mate 100*i*Ce, M-10*i*Ae	12.5 kg
Wrist unit (See Fig. 6.11 (a),(b))	ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L	14 kg
All components from J3-axis reducer to wrist unit (See Fig. 6.11 (c), Fig. 6.12 (b))	ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/10S, M-10*i*A/10S, ARC Mate 100*i*Ce, M-10*i*Ae	28 kg
All components from J3-axis reducer to wrist unit (See Fig. 6.11 (c))	ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L	29.5 kg
All components from J2 arm to wrist unit (The J2-axis reducer is not included) (See Fig. 6.5 (a))	ARC Mate 100*i*C, M-10*i*A ARC Mate 100*i*C/10S, M-10*i*A/10S ARC Mate 100*i*Ce, M-10*i*Ae, M-10*i*A/10M, M-10*i*A/10MS	45 kg
All components from J2 arm to wrist unit (The J2-axis reducer is not included) (See Fig. 6.5 (a))	ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L	46.5 kg
All components from J2 base to wrist unit (See Fig. 6.3 (b))	ARC Mate 100*i*C, M-10*i*A ARC Mate 100*i*C/10S, M-10*i*A/10S ARC Mate 100*i*Ce, M-10*i*Ae	80 kg
All components from J2 base to wrist unit (See Fig. 6.3 (b))	ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L	81.5 kg
J5/J6-axis gearbox (See Fig. 6.15 (a))	ARC Mate 100*i*C, M-10*i*A ARC Mate 100*i*C/10S, M-10*i*A/10S ARC Mate 100*i*Ce, M-10*i*Ae ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L	6 kg

NOTE
1 When applying LOCTITE to a part, spread the LOCTITE on the entire length of the engaging part of the female thread. If applied to the male threads, poor adhesion can occur, potentially loosening the bolt. Clean the bolts and the threaded holes and wipe off any oil on the engaging section. Make sure that there is no solvent left in the threaded holes. When finished, remove all the excess LOCTITE when you are finished screwing the bolts into the threaded holes.
2 Description of [LT243] means LOCTITE 243.
3 Description of [LT263] means LOCTITE 263.
4 Description of [LT518] means LOCTITE 518.
5 Description of [LT675] means LOCTITE 675.

6.1 DRIVE MECHANISM

The drive mechanisms of each axis are shown in the following figures.

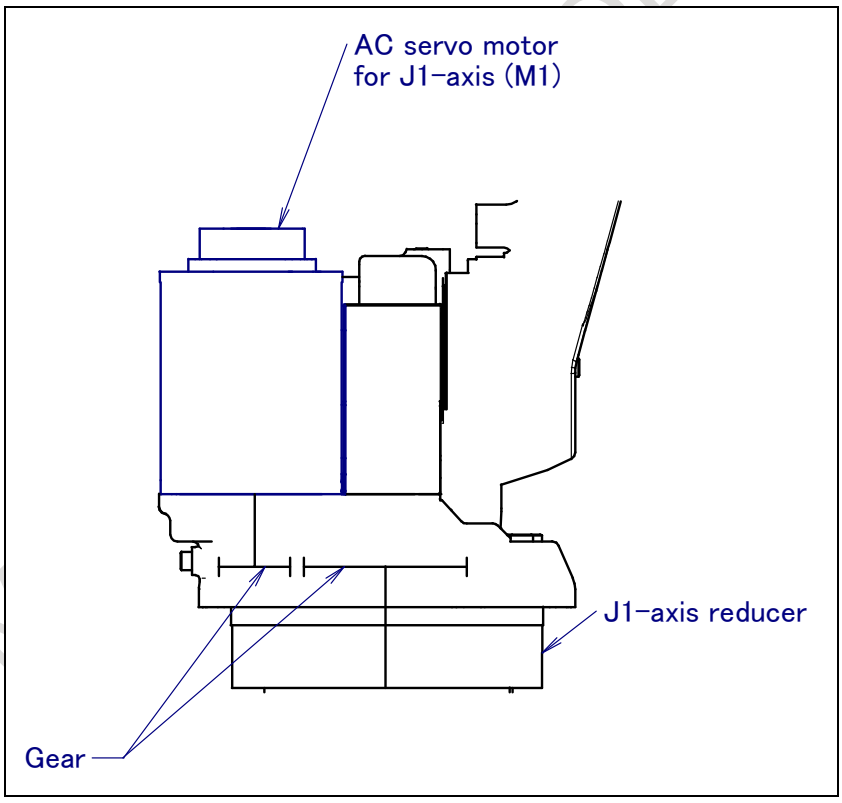


Fig. 6.1 (a) Drive mechanism of J1-axis

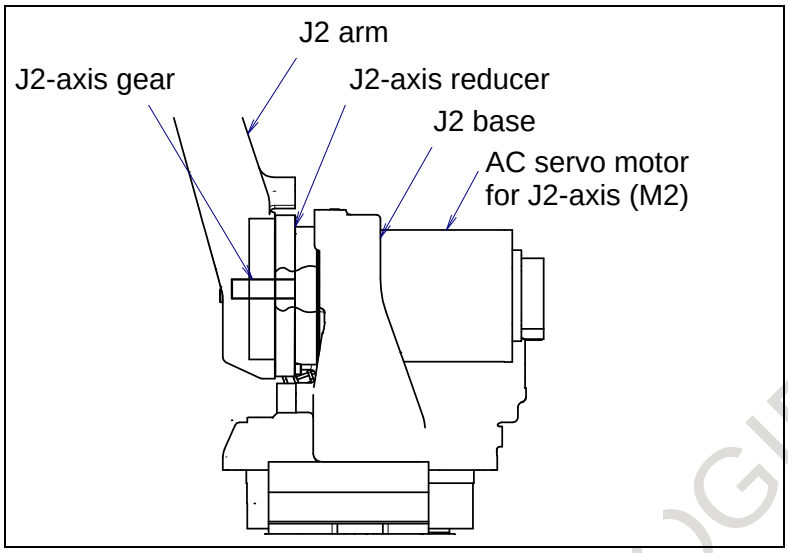


Fig. 6.1 (b) Drive mechanism of J2-axis

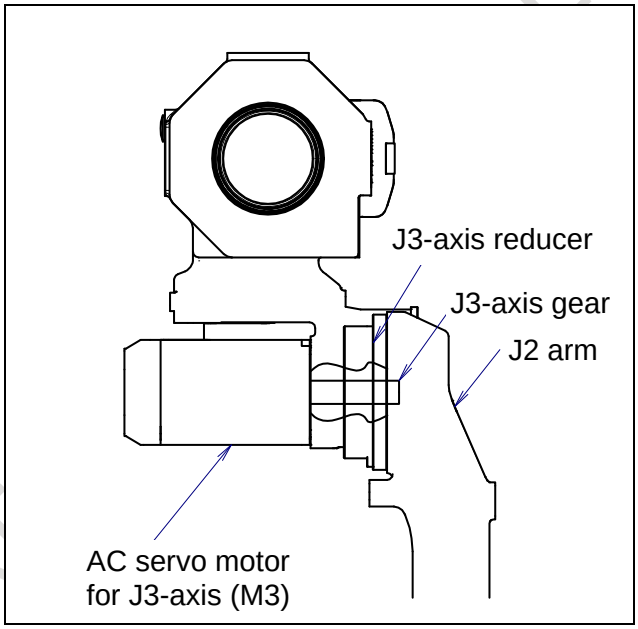


Fig. 6.1 (c) Drive mechanism of J3-axis

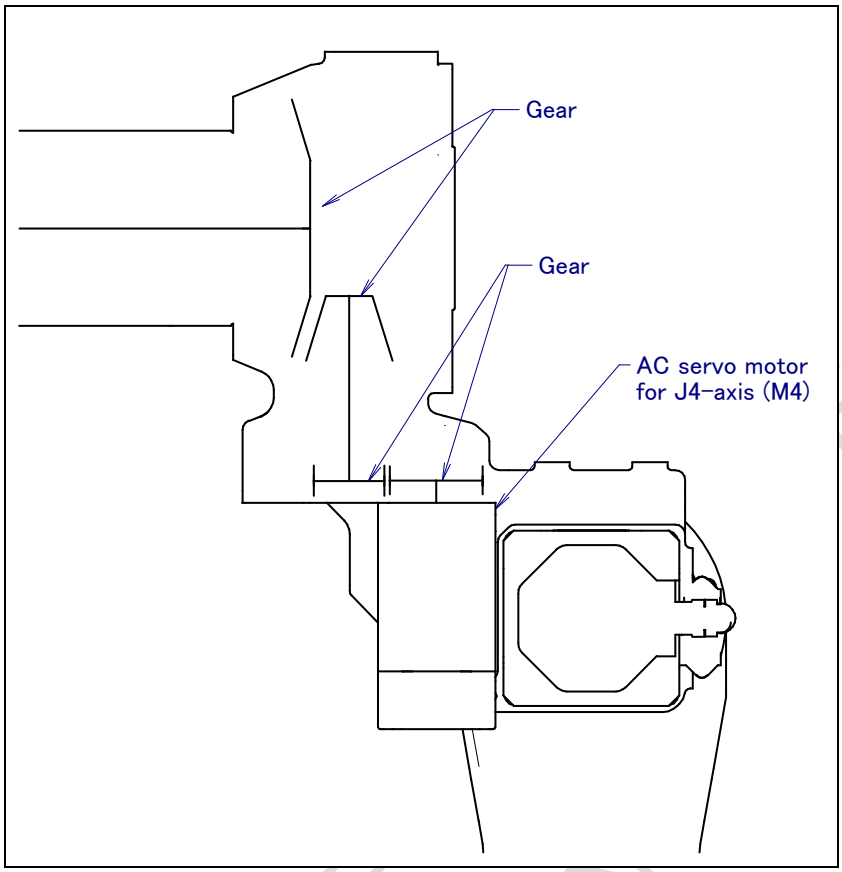


Fig. 6.1 (d) Drive mechanism of J4-axis

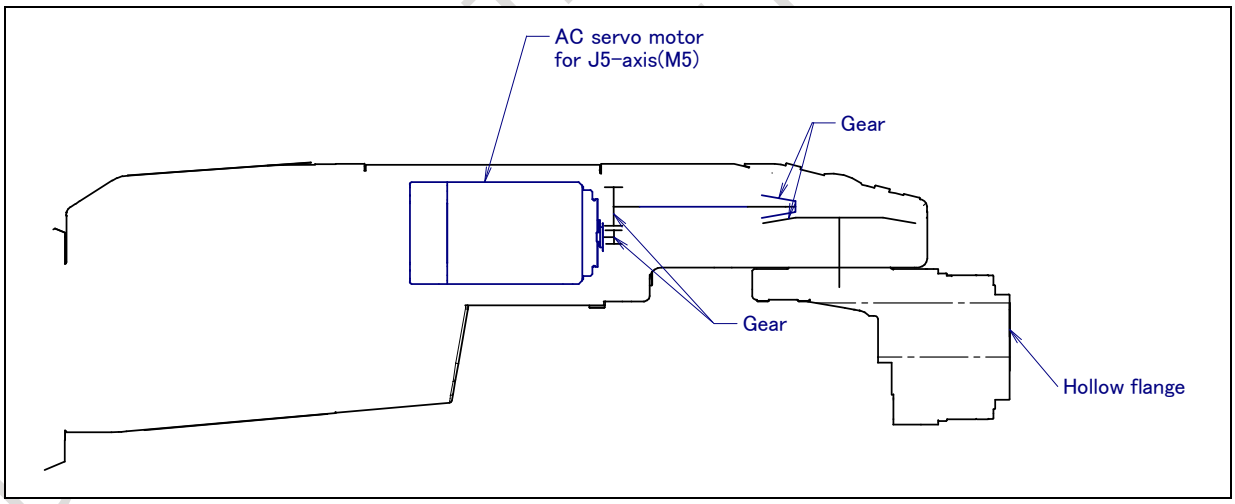


Fig. 6.1 (e) Drive mechanism of J5-axis

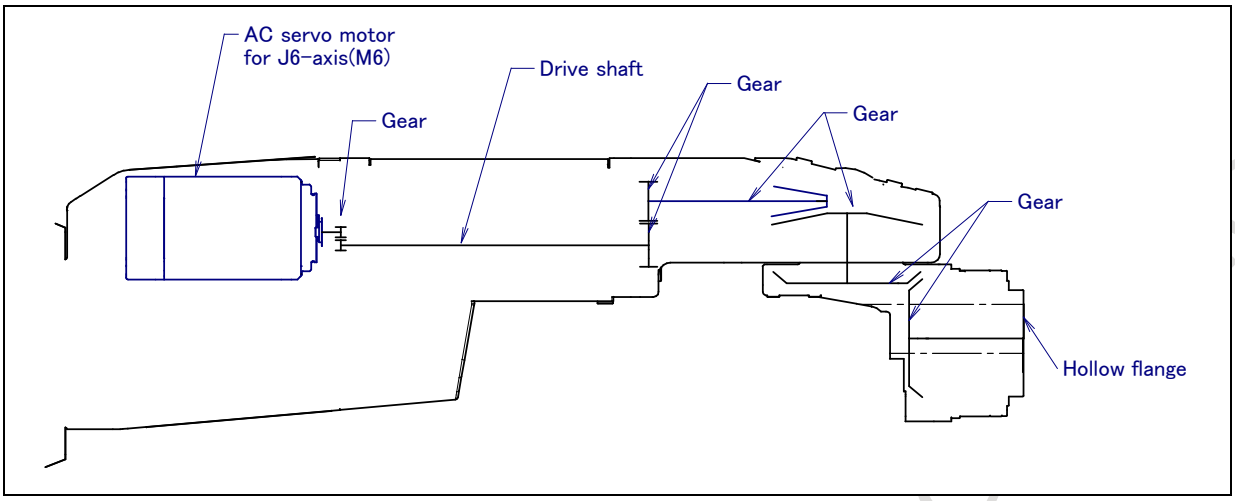


Fig. 6.1 (f) Drive mechanism of J6-axis

6.2 REPLACING THE J1-AXIS MOTOR (M1)

1 Set a dial gauge at the J1-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Turn off the controller power.
3 When the J2 cover (option) is attached, remove it referring to Section 6.16.
4 Remove the connector of a cable leading to the J1-axis motor.
5 Remove the motor mounting bolts (1). Dismount the motor from the J2 base. When dismounting the motor, be careful of the grease that may drop from the motor if the robot is suspended from a ceiling or mounted on a wall.
6 Remove the M10 hexagonal nut (5) from the motor shaft, and pull out the gear (3).
7 Attach the gear (3) to a new motor (2).
8 Attach an M10 spring washer (4), apply LOCTITE 243 to the M10 threaded n of the nut (5), and tighten the M10 nut with a specified torque of [20 Nm].
9 Replace the O-ring (6) by a new one and put it into the J2 base where the J1-axis motor is to be mounted, and fasten them with bolt (1).
10 Connect cable connectors to the J1-axis motor.
11 When the J2 cover (option) was attached, attach it referring to Section 6.16.
12 According to Section 3.2, supply the J1-axis reducer with the specified grease if grease is overflowed.
13 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

NOTE
If there is a danger that the J1-axis section may fall, for example, because the robot is installed except floor mount, fix the J1-axis section during replacement work, for example, by pushing the J1-axis mechanical stopper against the J1-axis section.

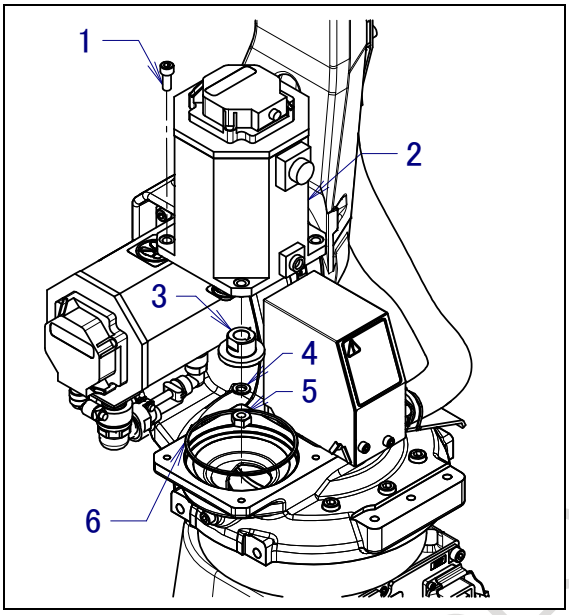


Fig. 6.2 (a) Replacing the J1-axis motor

	Parts name	Specification	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-8X20	4		
2	MOTOR	A06B-0235-B605 #S000 (*1)	1		
		A06B-0235-B005#S000 (*2)			
3	GEAR	A290-7215-X211	1		
4	WASHER (Attached to motor)	A6-WB-10S-M-NI	1		
5	NUT (Attached to motor)	A6-N1-10X1.25S-M-NI	1	LT243	20
6	O-RING	JB-OR1A-G105	1		

(*1) ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S
(*2) ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L

6.3 REPLACING THE J1-AXIS REDUCER

1 Set a dial gauge at the J1-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
3 Put the robot in such a position that the J2 base and the portions above it can be suspended with a crane or the like (hereafter abbreviated as a crane), and then turn off controller power. (See Fig. 6.3 (b))
4 While referencing Section 8.3, pull out the cables below the J2 base from the J1-axis hollow pipe section toward the upper portion of the J2 base.
5 While referencing Section 6.2, remove the J1-axis motor from the J2 base.
6 Suction the grease with a vacuum cleaner to prevent grease from splattering.
7 As shown in Fig. 6.3 (c), remove the bolts (1) that fasten the J2 base to the J1-axis reducer.
8 While referencing Section 6.3 (b), hoist the J2 base and portions above it slowly.
9 As shown in Fig. 6.3 (c), remove the O-ring (2), and gear (4) which bearings are attached. Bearing (3) rarely left in J2 base. It is not necessary to remove bearing in this case, when bearing (3) was broken, break oil seal (11) and remove both oil seal and bearing then replace them by new article referring to Fig. 6.3 (d).
10 Remove the bolts (6) that fasten the J1-axis reducer to the J1 base, and dismount the reducer (7).
11 Disconnect the pipe (8).
12 Replace the O-ring (9) with a new one and fit it with the pipe (8) correctly.
13 Replace the O-ring (10) with a new one and attach it to a new reducer, and fasten the reducer to J1 base with bolts (6) (by applying LOCTITE 263 and tightening with a torque of [129 Nm]).
14 Mount the center gear, bearing (with LOCTITE 675 applied to its outer ring), and O-ring (2) to the reducer. When bearing is broken in this process, replace bearing by new one. When replacing oil seal (11), press-fit it by using fixture in Fig.1.3 (c).
15 Fasten the J2 base to the reducer with bolts (1) (by applying LOCTITE 263 and tightening with a torque of [73.5 Nm]). Be careful not to let the pipe damage the oil seal.
16 According to Section 6.2, mount the J1-axis motor on the J2 base.
17 According to Section 8.3, mount the cables.
18 According to Section 3.2, supply the J1-axis reducer with the specified grease.
19 Perform quick mastering and perform single axis mastering for J1-axis. Refer to the QUICK MASTERING and SINGLE AXIS MASTERING of the mechanical unit operator's manual (B-82754EN).

NOTE
1 Reducer and gear of upper of reducer are can be installed only in combination below.
(1) Spec of reducer: A97L-0218-0822#33 Gear: A290-7215-X212
(2) Spec of reducer: A97L-0218-0885#33 Gear: A290-7221-Z212
See Fig. 6.3 (a) when distinguishing it.
2 When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear (A290-7215-X211) of J1-axis motor shaft, gear (A290-7215-X212 or A290-7221-Z212) on J1-axis reducer and bearing (A97L-0001-0192#1400000).

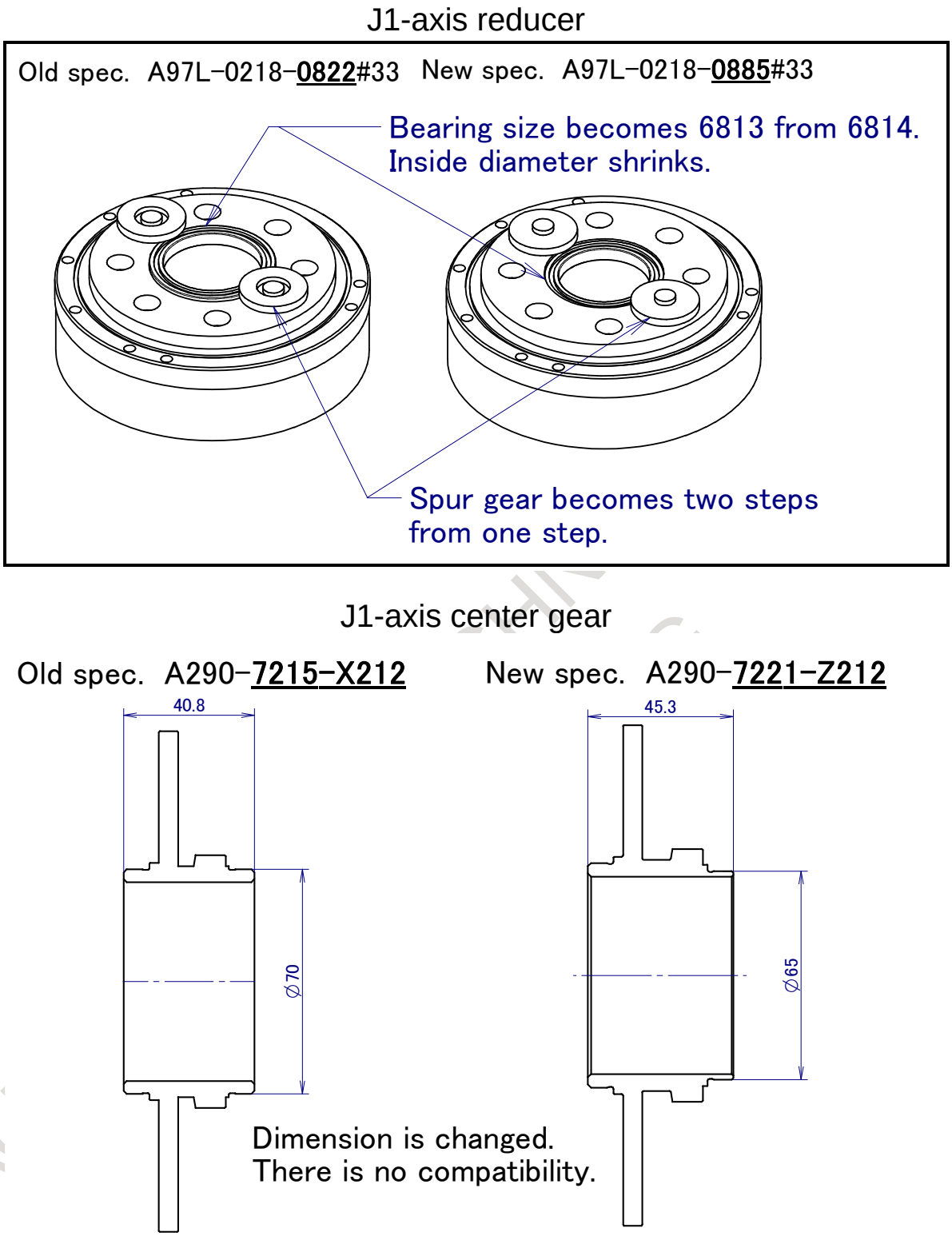


Fig. 6.3 (a) Distinction of new and old reducer and gear

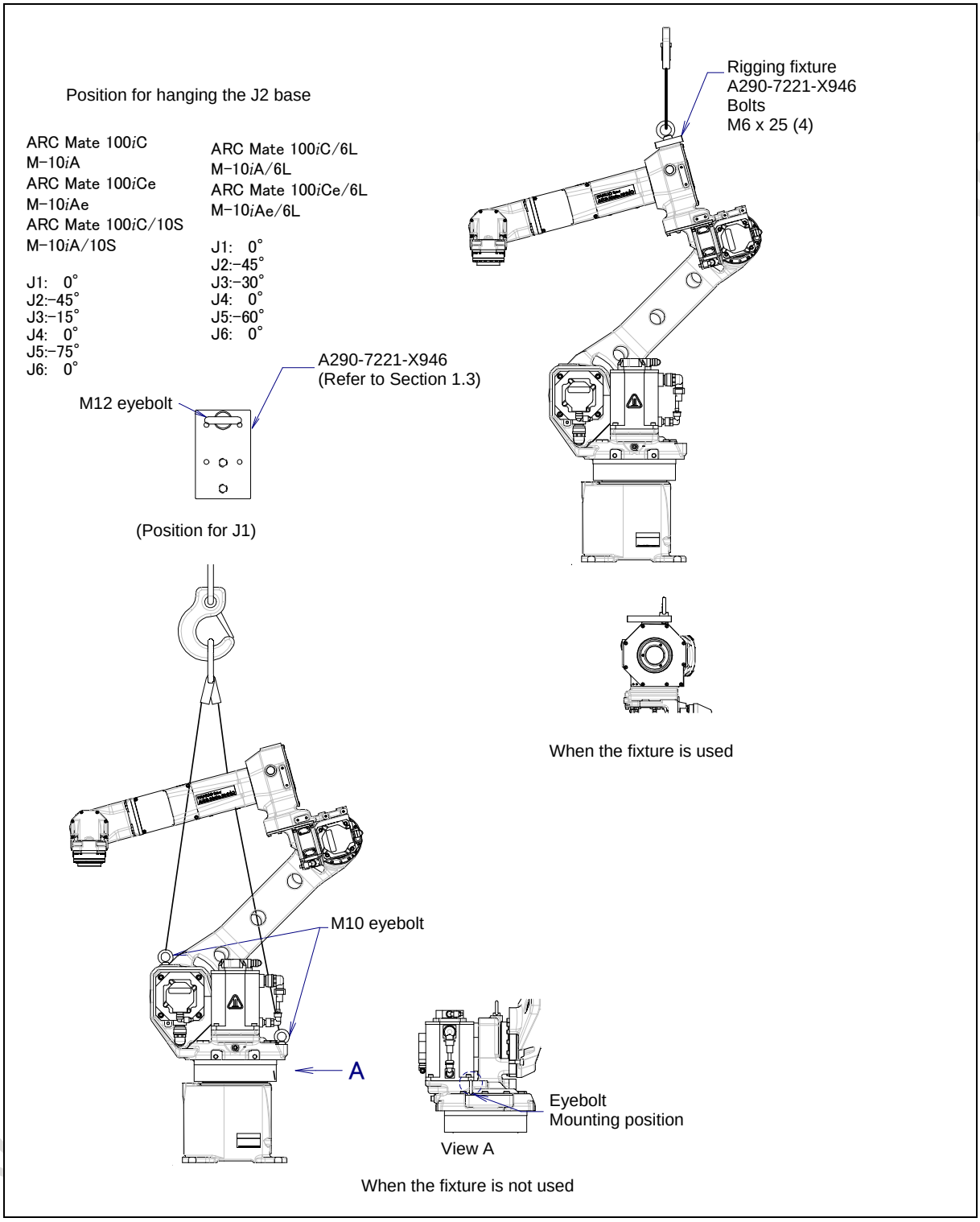


Fig. 6.3 (b) Sling the J2 base unit

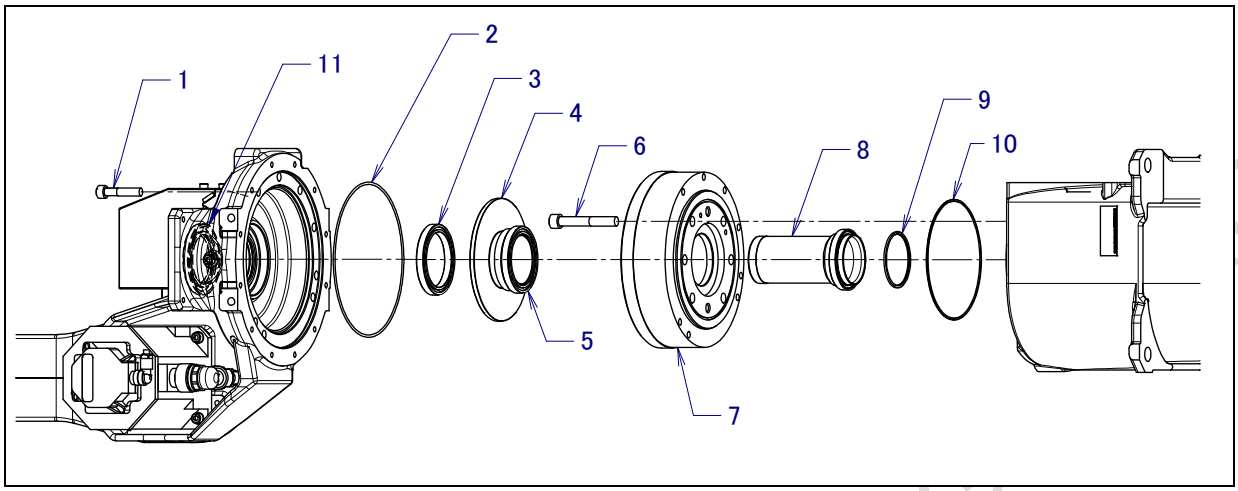


Fig. 6.3 (c) Replacing the J1-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-10X50	8	LT263	73.5
2	O-RING	A290-7207-X342	1		
3	BEARING	A97L-0001-0192#1400000	1		
4	GEAR	A290-7215-X212 (*1)	1		
		A290-7221-Z212 (*2)			
5	BEARING	A97L-0001-0192#1400000	2		
6	BOLT	A6-BA-12X80	6	LT263	129
7	REDUCER	A97L-0218-0822#33 (*1)	1		
		A97L-0218-0885#33 (*2)			
8	PIPE	A290-7215-X215	1		
9	O-RING	JB-OR1A-G65	1		
10	O-RING	A98L-0001-0347#S150	1		
11	OIL SEAL	A98L-0040-0047#06009008	1		

(*1) Old spec: robot shipped before March, 2010.
(*2) New spec: robot shipped after April, 2010.

6.4 REPLACING THE J2-AXIS MOTOR (M2)

1 Set a dial gauge at the J2-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Push the J2-axis section against the mechanical stopper, or refer to Fig .6.5 (a), fix it in such a way that it will not swivel when the motor is dismounted.

NOTE
If the J2-axis section is not pushed against the stopper correctly, or it is not placed in the direction of gravity, there is a danger that the J2-axis section will swivel when the J2-axis motor is removed.

3 Turn off controller power.
4 When the J2 cover (option) is attached, remove it referring to Section 6.16.
5 Remove the connector of a cable leading to the J2-axis motor.
6 Remove the motor mounting bolts (1), and dismount the motor from the J2 base.
7 Remove the bolt (5) that fastens the gear (4), and dismount the gear (4). Also, remove the draw nut (3) from the motor shaft.
8 Apply LOCTITE 243 to the threaded portion of a draw nut (3) and tighten the draw nut to shaft of new motor (2) with a torque of [16.7 Nm].
9 Put the gear (4) over the draw nut (3), apply LOCTITE 243 to the M6 threaded portion of the draw nut (3), and tighten the bolt (5) with a torque of [6.8 Nm].
10 Replace the O-ring (6) with a new one and put it into the J2 base portion where the motor is to be mounted, and fasten the motor to the J2 base with bolts (1). Do not force in the motor. Otherwise, the gear may not settle in the correct place, possibly causing vibration (if the gear is engaged correctly, the motor will be mounted smoothly).
11 Connect cable connectors to the J2-axis motor.
12 When the J2 cover (option) was attached, attach it referring to Section 6.16.
13 According to Section 3.2, supply the J2-axis reducer with the specified grease.
14 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

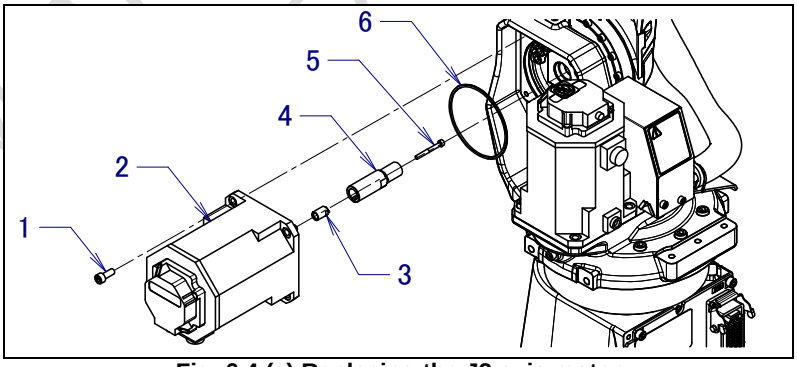


Fig. 6.4 (a) Replacing the J2-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-8X20	4		
2	MOTOR	A06B-0235-B605#S000	1		
3	DRAW NUT	A290-7221-X321	1	LT243	16.7
4	GEAR	A290-7221-X311 (*1)	1		
		A290-7221-Y311 (*2)			
5	BOLT	A6-BA-5X45	1	LT243	6.8
6	O-RING	JB-OR1A-G105	1		

(*1) Except ARC Mate 100*i*C/10S, M-10*i*A/10S
(*2) ARC Mate 100*i*C/10S, M-10*i*A/10S

6.5 REPLACING THE J2-AXIS REDUCER

1 Set a dial gauge at the J2-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Put the robot in such a posture that the J2 arm and the components on it can be suspended with a crane.
3 Turn off the controller power.
4 Suspend the J2 arm and the components on it as shown Fig. 6.5 (a) with a crane so that they will not drop when the J2 arm is dismounted. (If there is the fixture shown in Fig. 6.5 (a), work improves. Use the eyebolts delivered with the J2 base when robot is shipped.)
5 Remove the J2-axis motor as described in Section 6.4 (If the reducer is replaced while the motor is still mounted, the gear may be damaged.)
6 Suction the grease with a vacuum cleaner to prevent grease from splattering.
7 As shown in Fig. 6.5 (b), remove the bolts (1) that fasten the reducer (4) to J2 base and the adapter (2) and remove bolts (3) that fasten the reducer (4) to J2 arm .Be careful not to allow an excessive load to be put on the cables (because the cables are left attached when the reducer is dismounted).
8 Insert new O-ring (5) to the J2 arm reducer mounting part referring to Fig. 6.5 (c), then insert the new reducer (4), and fasten them with bolts (3) (by applying LOCTITE 263 and tightening with a torque of [15.6 Nm]).
9 Degrease both the J2 base and the J2-axis reducer surfaces that are to meet each other, and as shown in Fig. 6.5 (d), apply sealant (LOCTITE 518) to the J2-axis reducer on which the J2 base is to be mounted.
10 Mount the reducer to the J2 arm with bolts (1) (by applying LOCTITE 263 and tightening with a torque of [73.5 Nm]).
11 Mount the J2-axis motor as described in Section 6.4.
12 According to Section 3.2, supply the J2-axis reducer with the specified grease.
13 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

NOTE
When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear of J2-axis motor shaft.

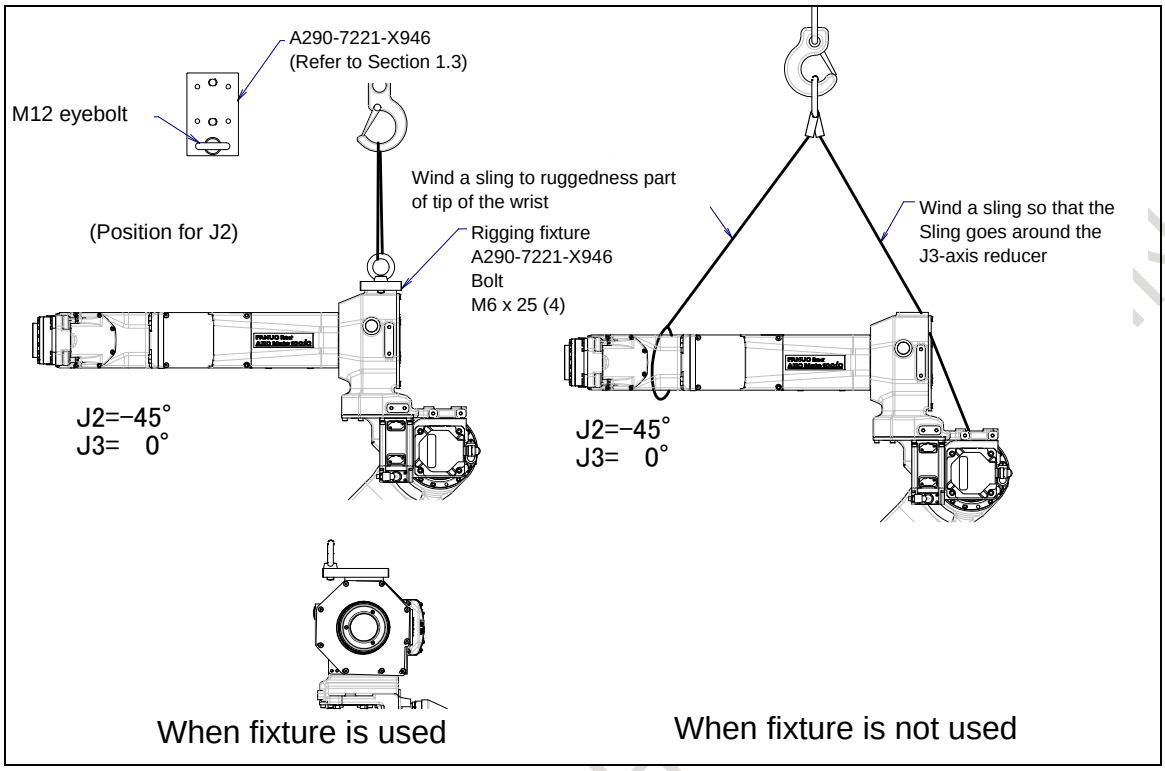


Fig. 6.5 (a) Sling to the J2 and the J3 arm

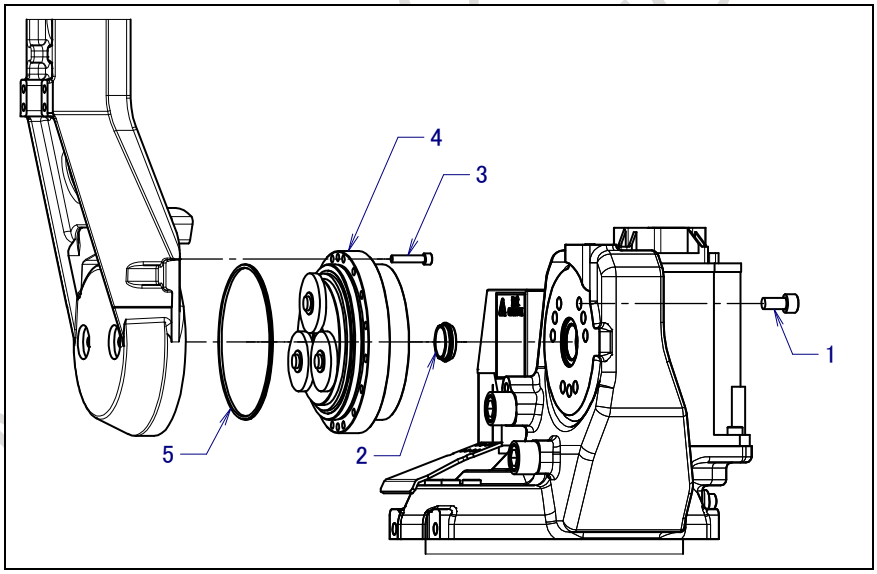


Fig. 6.5 (b) Replacing the J2-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-10X20	9	LT263	73.5
2	ADAPTER	A290-7221-X322	1		
3	BOLT	A6-BA-6X30	16	LT263	15.6
4	REDUCER	A97L-0218-0886#127 (*1)	1		
		A97L-0218-0886#93 (*2)			
5	O-RING	JB-OR1A-G130	1		

(*1) Except ARC Mate 100*i*C/10S, M-10*i*A/6S
(*2) ARC Mate 100*i*C/10S, M-10*i*A/6S

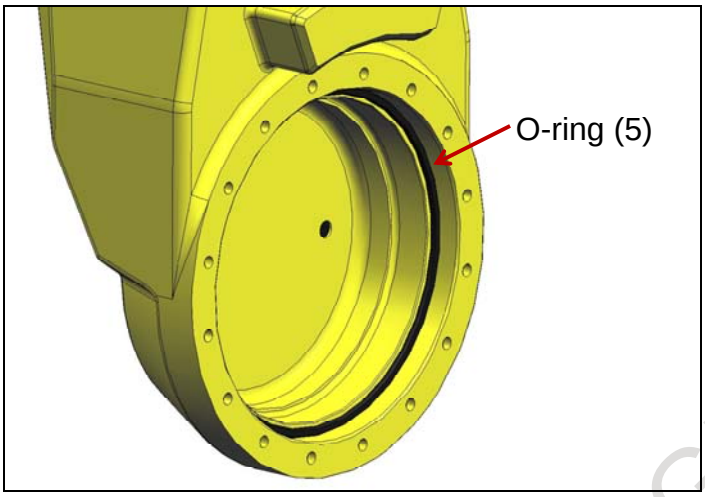


Fig. 6.5 (c) Inserting position of the O-ring (5)

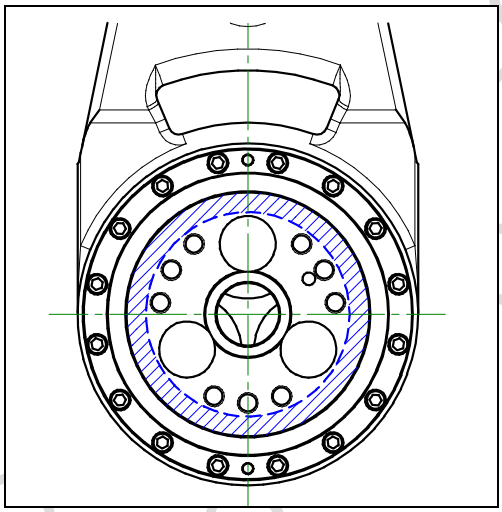


Fig. 6.5 (d) Applying sealant on the J2-axis reducer

NOTE
Refer to Section 6.23 about applying sealant (LOCTITE 518).

6.6 REPLACING THE J3-AXIS MOTOR (M3)

NOTE
Fixtures are necessary for replacing J3-axis motor and reducer. See Section1.3.

1 Set a dial gauge at the J3-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Place the robot in the posture J2=0^{o}. At this chance, confirm J1 base is fixed to prevent from falling.
3 Put the robot in such a posture that the J3-axis section and the components on it can be suspended with a crane, (If there is the fixture shown in Fig. 6.6 (a), work improves.)
4 Turn off controller power.
5 When the J4 cover (option) is attached, remove it referring to Section 6.17.
6 Remove the connector of a cable leading to the J3-axis motor.
7 Remove the bolts (1) that fasten the J3-axis motor to the J3 casing, and dismount the motor (2) and gasket (7).
8 Remove the bolt (6) from the motor shaft, and dismount the gear (5) and draw nut (4).
9 Apply LOCTITE 243 to the threaded portion of draw nut (4) and tighten it to the new motor with a torque of [3.1 Nm].
10 Put the gear (5) over the draw nut (4), apply LOCTITE 243 to the M5 threaded portion of the draw nut (4), and tighten the bolt (6) with a torque of [3.4 Nm]. Refer to Section 6.7 about mounting gear to J3-axis motor. In this time, be sure to attach key (3), too.
11 Attach new gasket (7), and insert the motor into the reducer. Keep the J3-axis degrease outlet on the J2 arm side open (see Fig. 6.7 (b), (c)), and look into the outlet to make sure that the gear has settled in the correct place. Even one tooth of a shift in engagement can cause vibration. (If the gear (5) is engaged correctly, the motor can get in the reducer smoothly.) In this case, if robot is shipped before March, 2010, please confirm whether attaching the motor to the reducer is appropriate referring to Section 6.7. Please confirm whether the flange of the motor floats, and install it with the phase that spur gears form a line like figure 6.6 (e) up and down.
12 Fasten the motor to the J3-axis reducer with bolts (1). Be sure to use a new gasket to prevent grease leakage. Refer to section 6.8 about mounting J3-axis motor to reducer.
13 Connect cable connectors to the J3-axis motor.
14 When the J4 cover (option) was attached, attach it referring to Section 6.17.
15 According to Section 3.2, supply the J3-axis reducer with the specified grease.
16 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

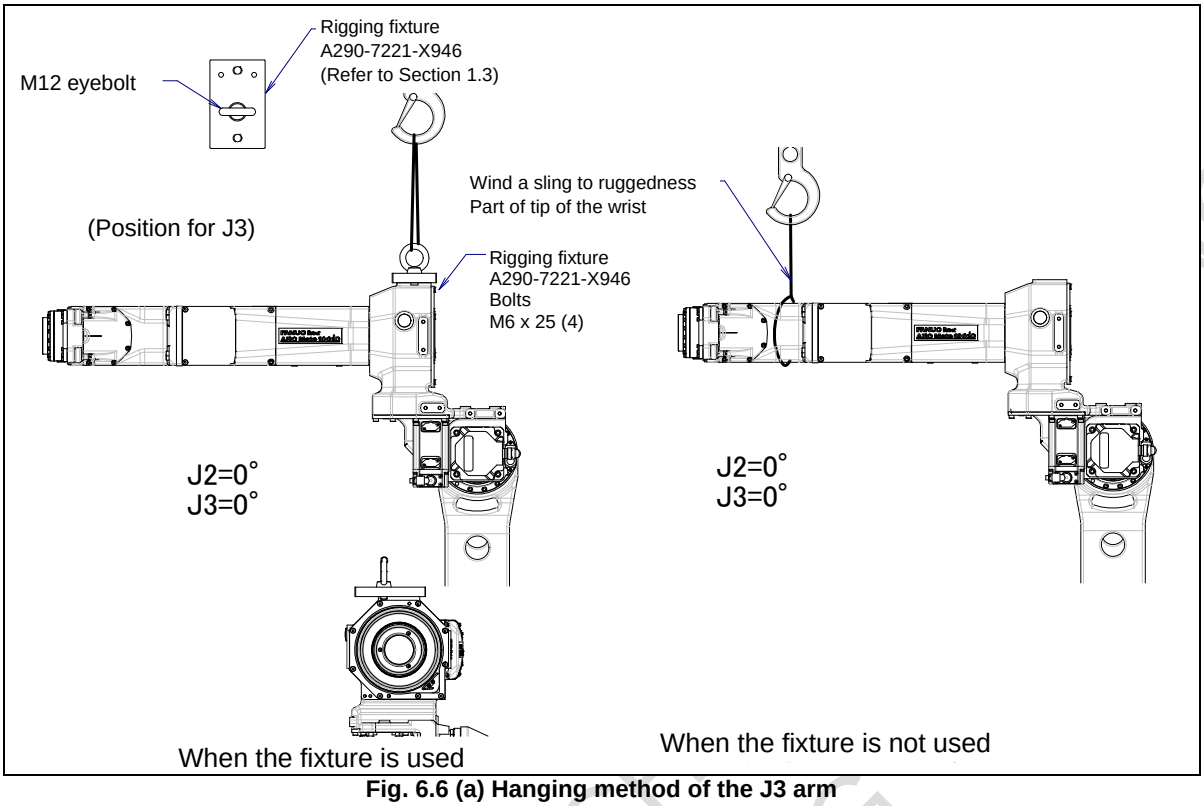


Fig. 6.6 (a) Hanging method of the J3 arm

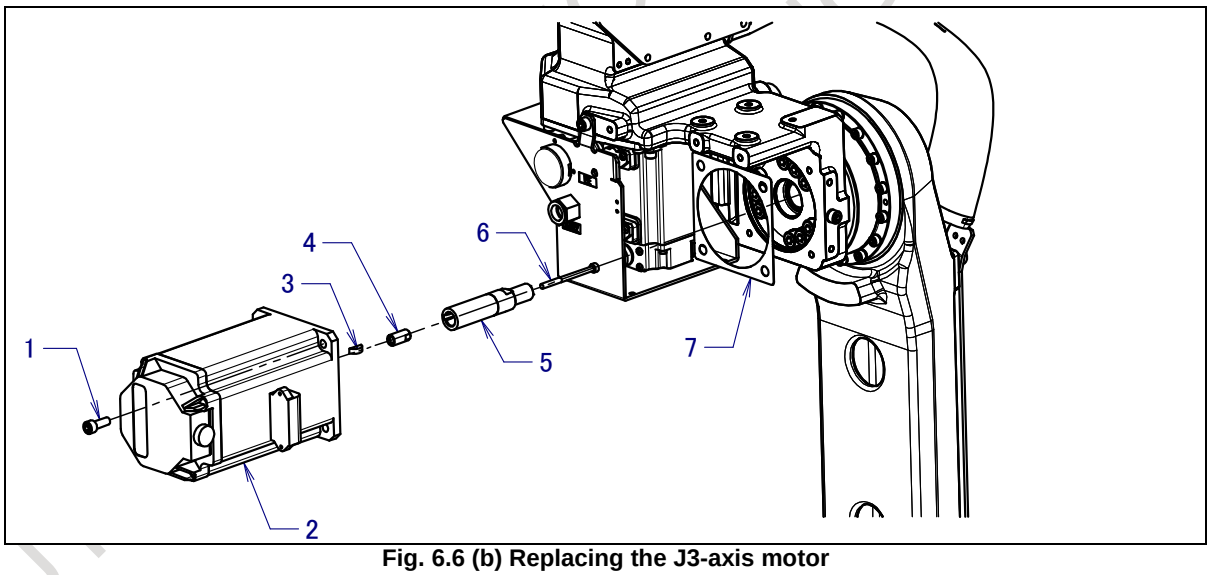


Fig. 6.6 (b) Replacing the J3-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X16	4		
2	MOTOR	A06B-0212-B605#S000	1		
3	KEY (Attached to motor)	JB-HGKYA-4X13	1		
4	DRAW NUT	A290-7221-X421	1	LT243	3.1
5	GEAR	A290-7221-X411 (*1)	1		
		A290-7221-Z411 (*2)			
		A290-7221-Z415 (*3)			
6	BOLT	A6-BA-4X55	1	LT243	3.4
7	GASKET	A98L-0040-0042#03	1		

(*1) Old spec robot ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L shipped before March, 2010.
(*2) New spec: robot ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A6L shipped after April, 2010 or ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae6L.
(*3) ARC Mate 100*i*C/10S, M-10*i*A/10S

Note Distinction of robot which is shipped before March 2010 and after April 2010

In case of ARC Mate 100iC, M-10iA, ARC Mate 100iC/6L, M-10iA/6L, it is possible to distinct by name plate on J3 arm. Please refer to below.

In case of robot which is shipped after April 2010, under line was added to the name plate.

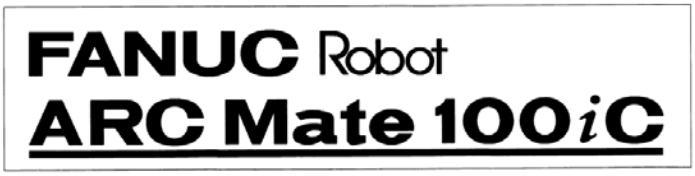


Fig. 6.6 (c) Distinction of robot which is shipped before March 2010 and after April 2010 (example of ARC Mate 100*i*C)

The old and new gear is incompatible. See Fig. 6.6 (d) when distinguish it.

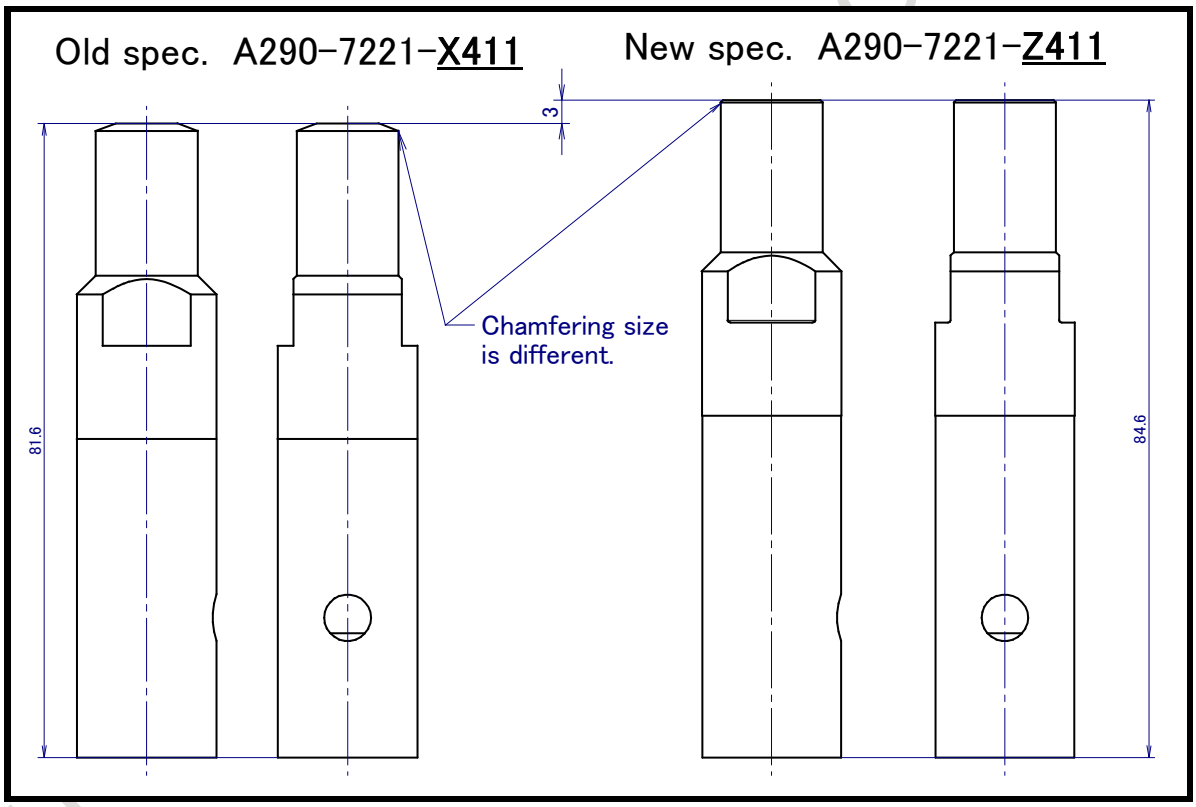


Fig. 6.6 (d) Distinction of new and old gear

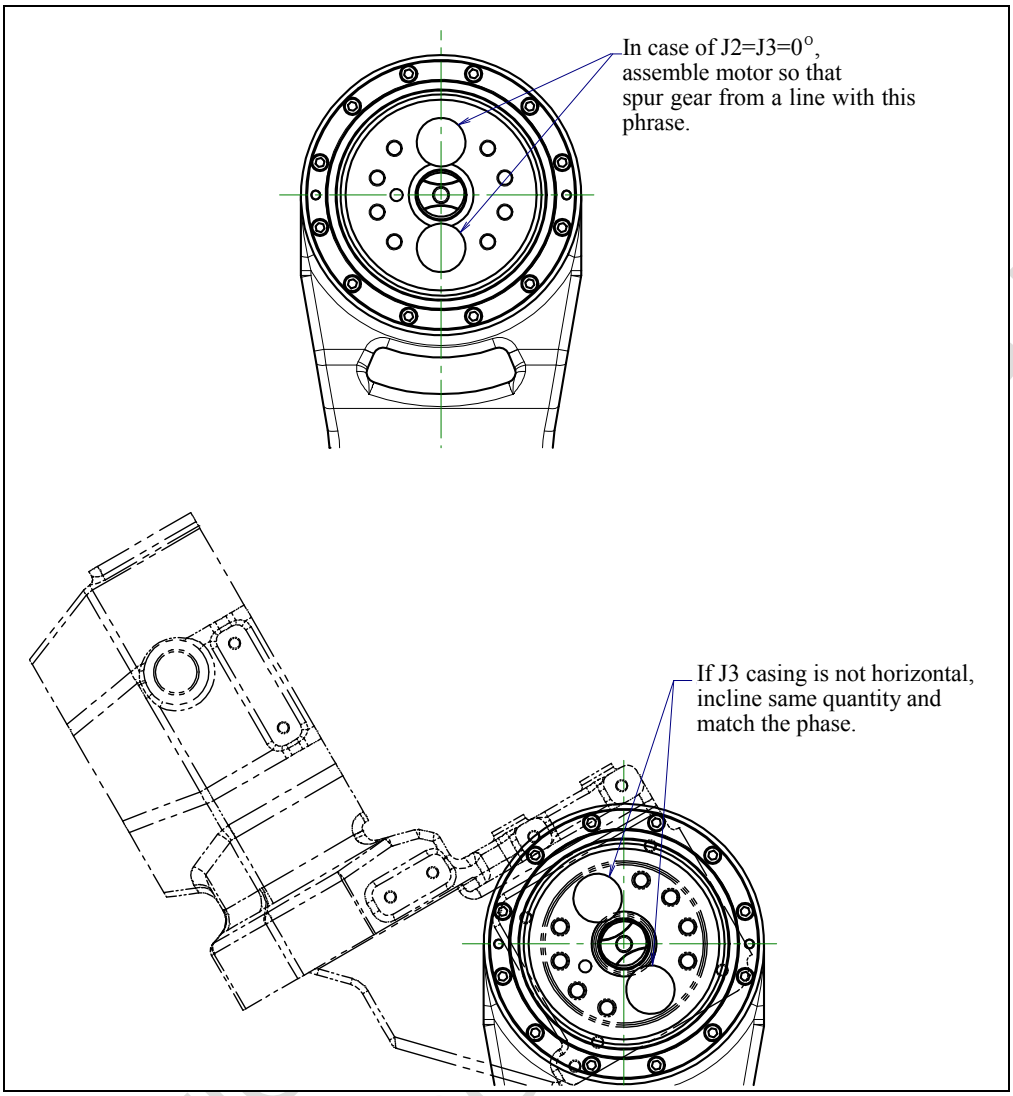


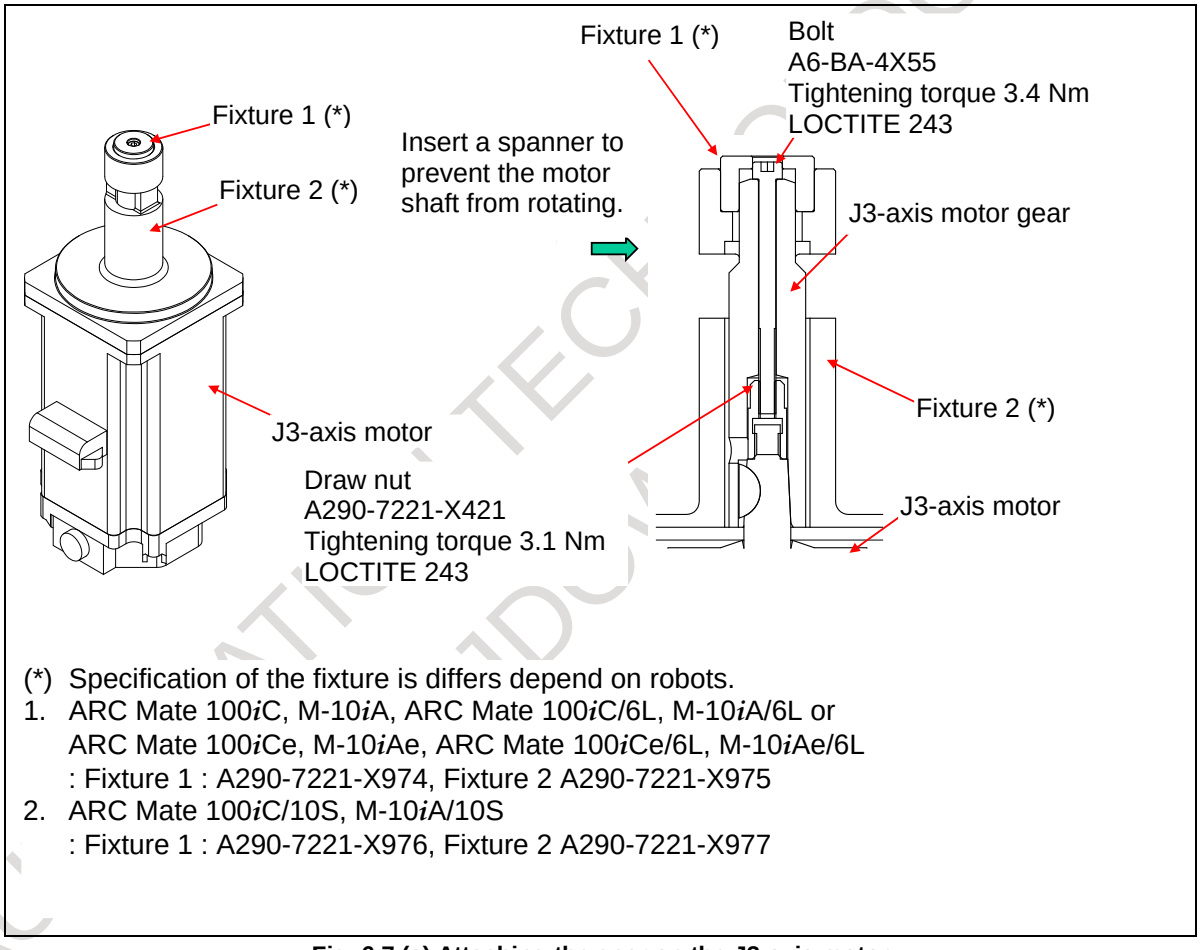
Fig. 6.6 (e) Phase for mounting the J3-axis motor to the reducer
(Only for robot which is shipped before March, 2010)

NOTE
In case of J2=J3=0° (figure of upper side) If J3 casing is not horizontal, check in the inclined situation when attaching reducer and motor and centering (figure of lower side).

6.7 NOTES OF ATTACHING J3-AXIS MOTOR TO REDUCER

1) Procedure of J3 Motor Gear Alignment

1 Apply LOCTITE 243 to thread the Draw Nut (A290-7221-X421) and mount it to the motor shaft by using torque wrench with regulated torque set at 3.1Nm.
2 Attach the woodruff key to motor shaft, confirm there is no dust on taper shaft of motor and insert gear to motor shaft.
3 Mount fixture to motor as Fig. 6.7 (a) for centering.
4 Apply LOCTITE 243 to thread and tighten bolt (M4 x 55) with regulated torque 3.4Nm while supporting gear with spanner wrench preventing the gear from rotating. (To prevent motor brake slips) Turn the torque wrench until the you hear the ratchet sound. This completes setting of the gear on the motor taper shaft. Without this work might cause motor shaft failure. Be careful.
5 Remove the Fixture from the Motor Shaft.



(*) Specification of the fixture is differs depend on robots.
1. ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L or ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L
   : Fixture 1 : A290-7221-X974, Fixture 2 A290-7221-X975
2. ARC Mate 100*i*C/10S, M-10*i*A/10S
   : Fixture 1 : A290-7221-X976, Fixture 2 A290-7221-X977

Fig. 6.7 (a) Attaching the gear on the J3-axis motor

There are 3 cases about method of installing J3-axis motor to reducer depend on the shipment time of robot.

1 Robot which is made before June, 2009
J3-axis reducer grease outlet is made in J3-axis rotation center of J2 arm.
Mount J3-axis motor referring to procedure 2) of this Section.

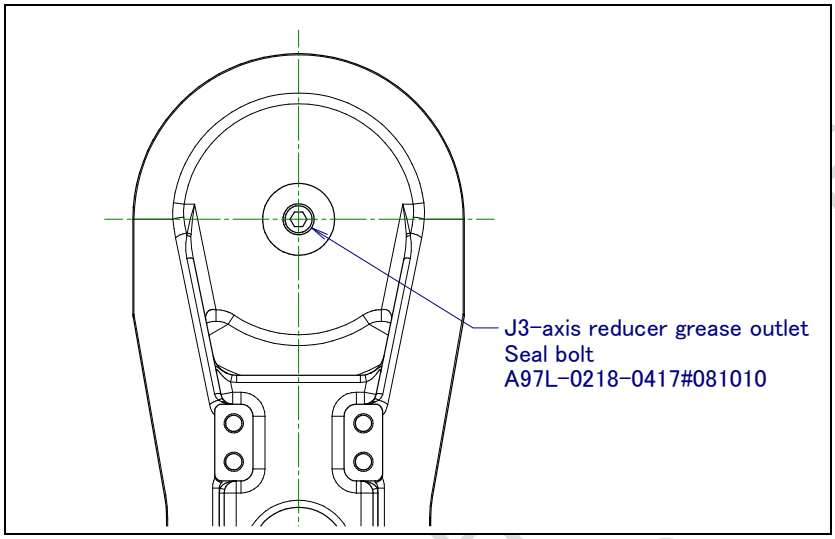


Fig. 6.7 (b) Robot which is made before June, 2009

2 Robot which is made after July, 2009 and before March, 2010
J3-axis reducer grease outlet is at the position upper than J3-axis rotation center of J2 arm.
Seal bolt is attached to tap for mounting fixture. Mount J3-axis motor referring to procedure 3) of this Section.

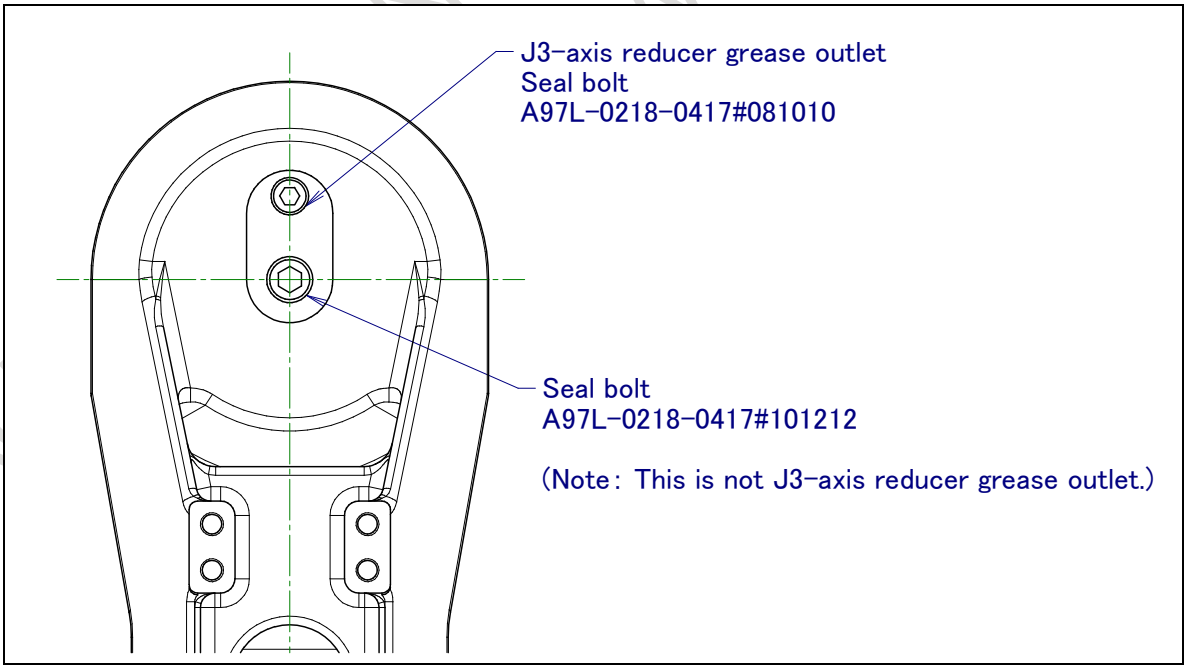


Fig. 6.7 (c) Robot which is made after July, 2009 and before March, 2010

3 Robot which is made after April, 2010
No fixture is needed while mounting J3-axis motor to reducer.

2) Procedure of J3-axis Reducer Alignment (Robot which is made before June, 2009)

1 Mount J3-axis motor that is aligned to J3 casing after attaching gasket to motor flange referring to previous section. Confirm that the Motor Flange is not floating from the attaching surface of the J3 casing from the three sight direction of Fig. 6.7 (e). If there is clearance between motor and J3 casing, gear is not aligned, insert it again. If you confirm there is no gap, work is completion.

2 Insert the Fixture (A290-7221-Z972) into the J3 grease outlet as Fig. 6.7 (f) until it touches the face of the bolt. You can judge that it is the good condition in case that the male screw part is not sticking out of the surface of the counter bore. If gear is not aligned, the male screw part is sticking out of the surface of the counterbored hole (2mm) as Fig. 6.7 (f).

If the centering is good, the top of the Fixture can enter into the hexagon socket on the bolt head.

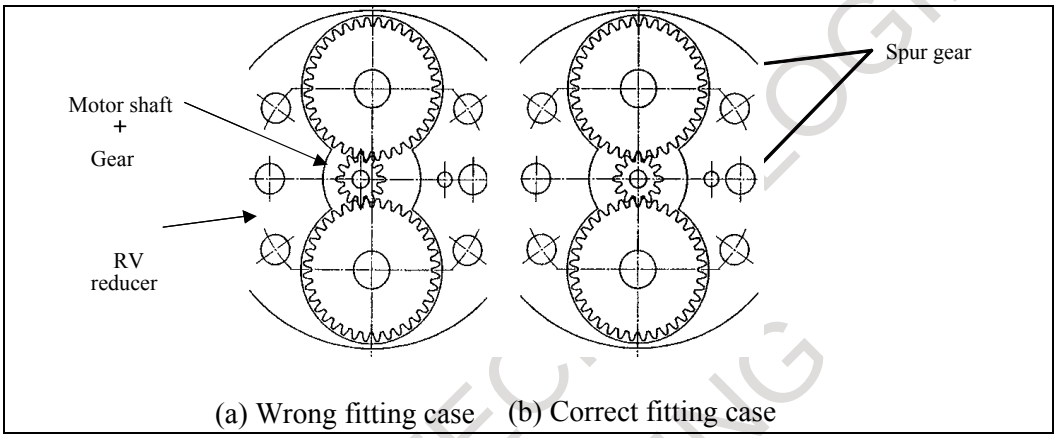


Fig. 6.7 (d) Attaching J3-axis motor to reducer

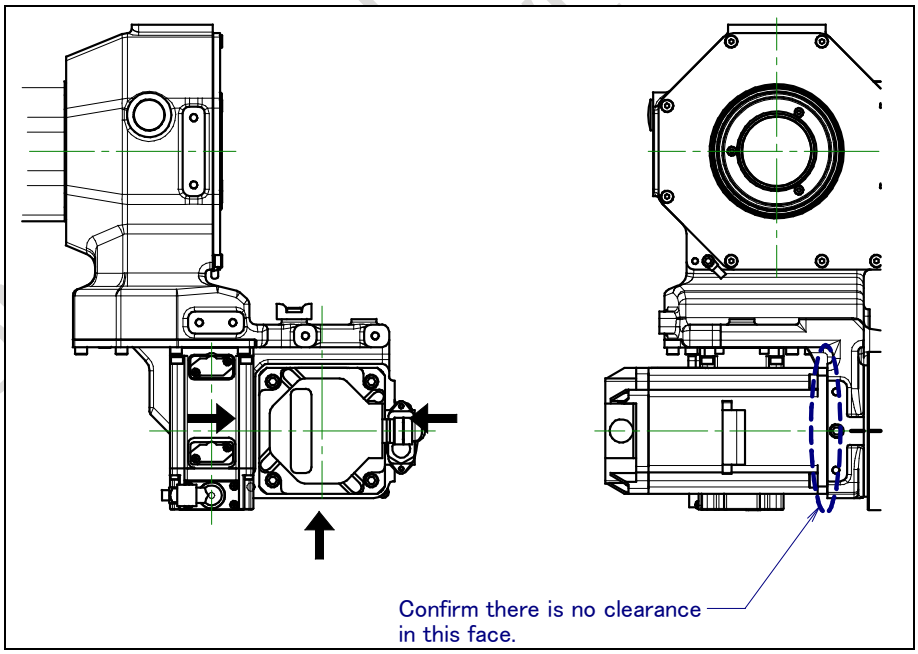


Fig. 6.7 (e) Confirming the mounting of J3-axis motor

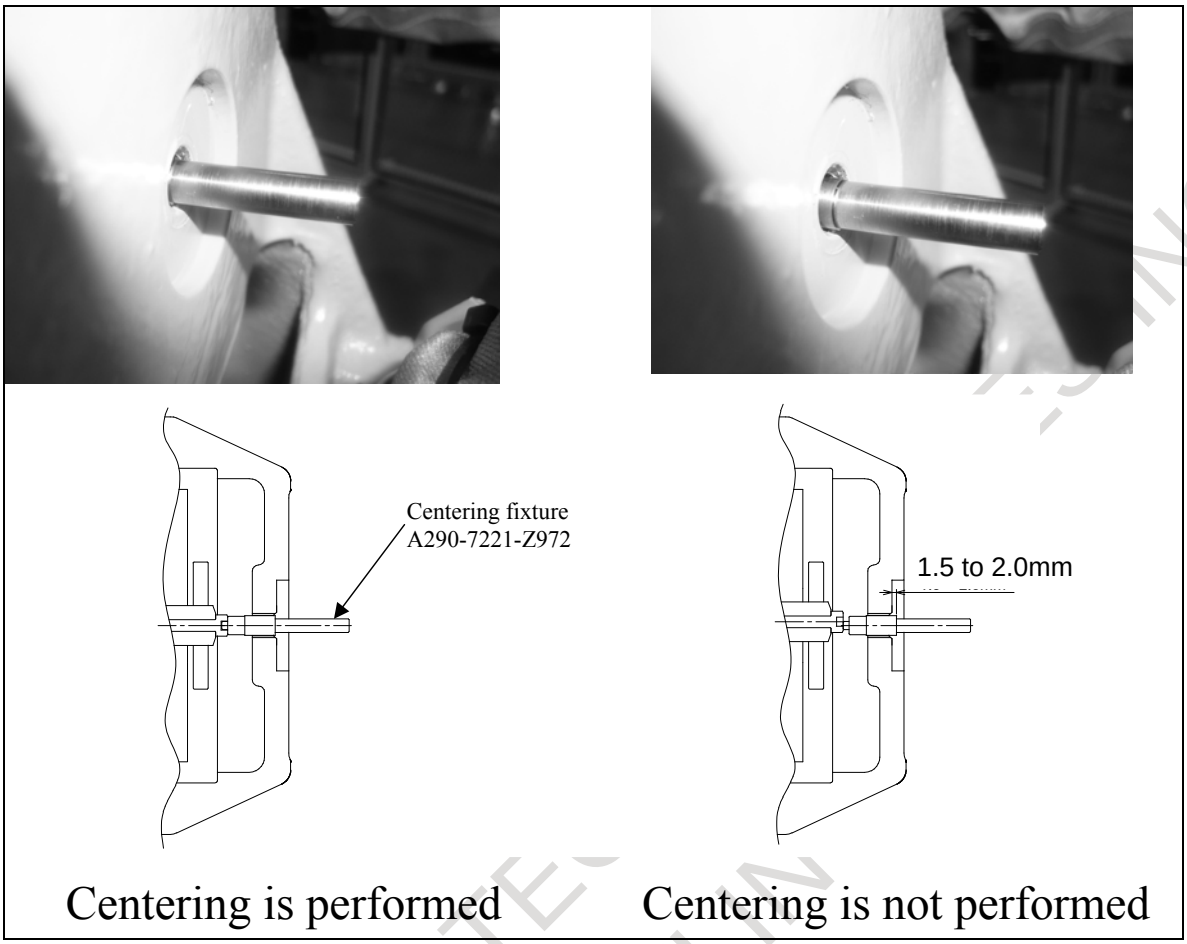


Fig. 6.7 (f) Confirming the gap of the core of J3-axis motor

3) Procedure of J3-axis Reducer Alignment (Robot which is made after July, 2009 and before March, 2010)

1 Remove seal bolt of J3-axis rotation center of J2 arm in Fig. 6.7 (c), mount fixture (A290-7221-Z974) and tighten it well.
2 Attach J3-axis motor which gear is attached to J3 casing. Attach it so that motor flange surface is mounted to J3 casing without clearance. (If centering is performed, it is hard to pull out motor. So try to pull out to confirm it.)
3 Look the center of fixture which is attached to J2 arm with flashlight and confirm bolt of center gear is center of fixture. If centering of gear is performed, center of bolt of gear accords in center of hole of fixture. Confirm it referring to Fig. 6.7 (g). If centering is not performed, motor is not mounted to J3 casing.
4 If it is confirmed, attach the seal bolt. If the seal bolt is reused, be sure to wind it with seal tape.

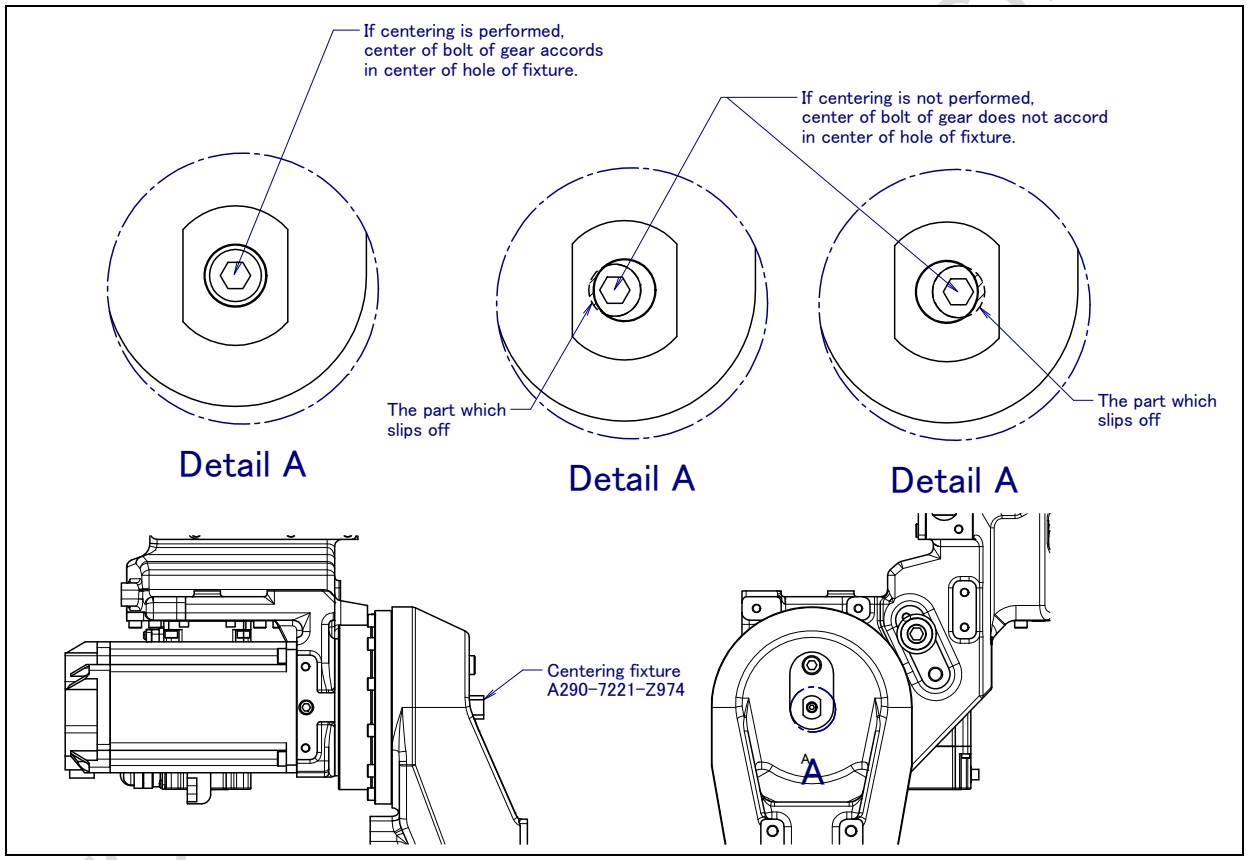


Fig. 6.7 (g) Confirming the adhering of J3-axis motor

NOTE
This is in case of J2=J3=0º. If the J3 casing is not horizontal, consider slope when checking phase of the reducer and the motor and adhering.

6.8 REPLACING THE J3-AXIS REDUCER

NOTE
Fixtures are necessary for replacing J3-axis motor and reducer. See Fig.1.3 (a) to (j).

1 Set a dial gauge at the J3-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Put the robot in such a posture that the J3-axis section and the components on it can be suspended with a crane, (If there is the fixture shown in Fig. 6.8 (a), work improves.)
3 Turn off controller power.
4 While referencing Section 8.3, remove the cable from the J2 arm section. While referencing Fig. 6.8 (a), suspend the J3-axis section and the components on it with a crane so that they will not drop when the reducer is dismounted from the J2 arm. Be careful not to allow an excessive load to be put on the cable assembly (because the cables are left attached when the reducer is dismounted).
5 While referencing Section 6.6, dismount the J3-axis motor from the J3 arm unit.
6 Suction the grease with a vacuum cleaner to prevent grease from splattering.
7 Remove bolt (1) that fasten J3-axis reducer (6) to J3 casing via the guide pin (A290-7221-X925 2pcs) (Fig.1.3 (b)) (See Fig. 6.7 (c)). In addition, remove J3-axis reducer from J3 casing.
8 As shown in Fig. 6.8 (b), remove bolts (4) and washers (5) that fasten the J3-axis reducer to the J2 arm and dismount the J3 arm unit that reducer attaches from the J2 arm.
9 Remove the O-ring (7) and attach new O-ring (7) to the J3-axis reducer installation part of J2 arm. Refer to Fig. 6.8 (e).
10 Suspend the J3-axis section and the components on it with a crane, and fasten the J2 arm and J3-axis reducer with bolts (4) (by applying LOCTITE 263 and tightening with a torque of [9.0 Nm]). In this time, refer to Fig. 6.8 (e) about attaching phase.
11 Degrease both the J3-axis reducer and the J3 casing surfaces that are to meet each other, and as shown in Fig. 6.8 (f), apply sealant (LOCTITE 518) to the J3-axis reducer surface on which the J3 casing is to be mounted. Attach new reducer to J3 casing, fix it with bolt (1) (by applying LOCTITE 263 and tightening with a torque of [37.2Nm]) via the guide pin (A290-7221-X925 2pcs) (Fig.1.3 (b)).
12 While referencing Section 6.6, mount the J3-axis motor on the J3 arm unit. In this case, if robot is shipped before March, 2010, please confirm whether attaching the motor to the reducer is appropriate referring to Section 6.7.
13 While referencing Section 8.3, dress the cable into the previous form.
14 According to Section 3.2, supply the J3-axis reducer with the specified grease.
15 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).
16 Confirm software version and cope as needed.

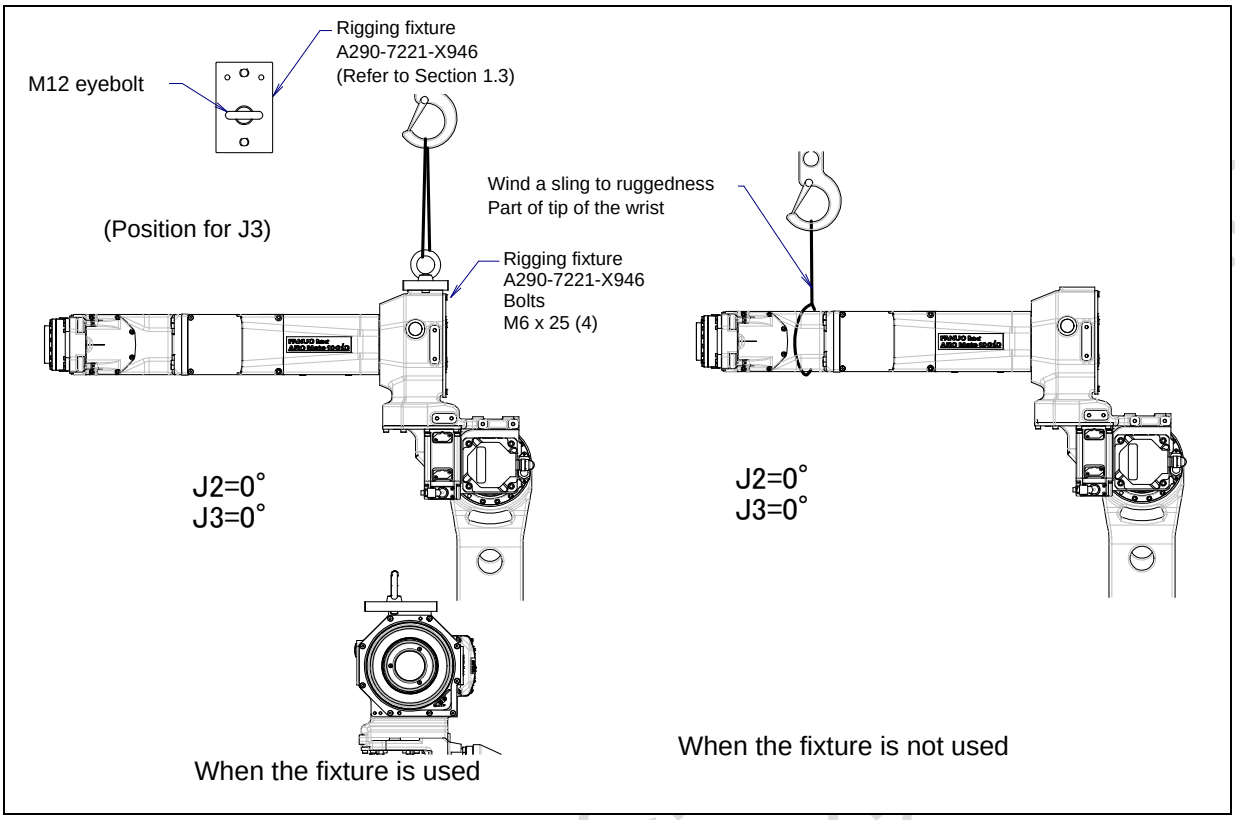


Fig. 6.8 (a) Hanging method of the J3 arm

The shipment time of robot	Specifications of mechanical unit	Software version	Cope when replacing J3-axis reducer
Before March, 2010	A05B-1221-B201 A05B-1221-B202 A05B-1221-B301 A05B-1221-B302	V7.30P-27 or earlier V7.40P-06 or earlier	J3-axis reducer mounting phase auto adjusting function is not necessary.
		V7.30P-28 or later V7.40P-07 or later	Be sure to perform J3-axis reducer mounting phase auto adjusting function referring to Subsection 6.8.1.
After April, 2010	A05B-1221-B401 A05B-1221-B402 A05B-1221-B451 A05B-1221-B452 A05B-1221-B501 A05B-1221-B502 A05B-1221-B551 A05B-1221-B552 A05B-1221-B601 A05B-1221-B602	All	J3-axis reducer mounting phase auto adjusting function is not necessary.

NOTE
When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear of J3-axis motor shaft. At this time, confirm there is no clearance between gear and J2 arm referring to Section 6.7.

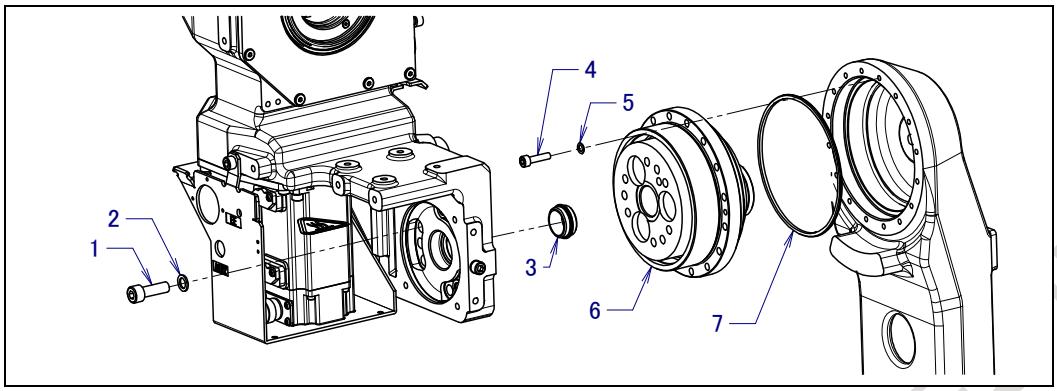


Fig. 6.8 (b) Replacing the J3-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-8X25	8	LT263	37.2
2	WASHER	A97L-0001-0823#M8H	8		
3	ADAPTER	A290-7221-X422	1		
4	BOLT	A6-BA-5X20	12 or 16	LT263	9.0
5	WASHER	A97L-0001-0823#M5L	12 or 16		
6	J3 REDUCER	A97L-0218-0824#150 (*1)	1		
		A97L-0218-0887#150 (*2)			
		A97L-0218-0887#108 (*3)			
7	O-RING	JB-OR1A-G108	1		

(*1) Old spec : ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L which are shipped before March, 2010

(*2) New spec : ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L which are shipped after April, 2010 or ARC Mate 100*i*Ce,M-10*i*Ae,ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L.

(*3) ARC Mate 100*i*C/10S, M-10*i*A/10S

The old and new reducer is incompatible. See Fig. 6.8 (c) when distinguish it.

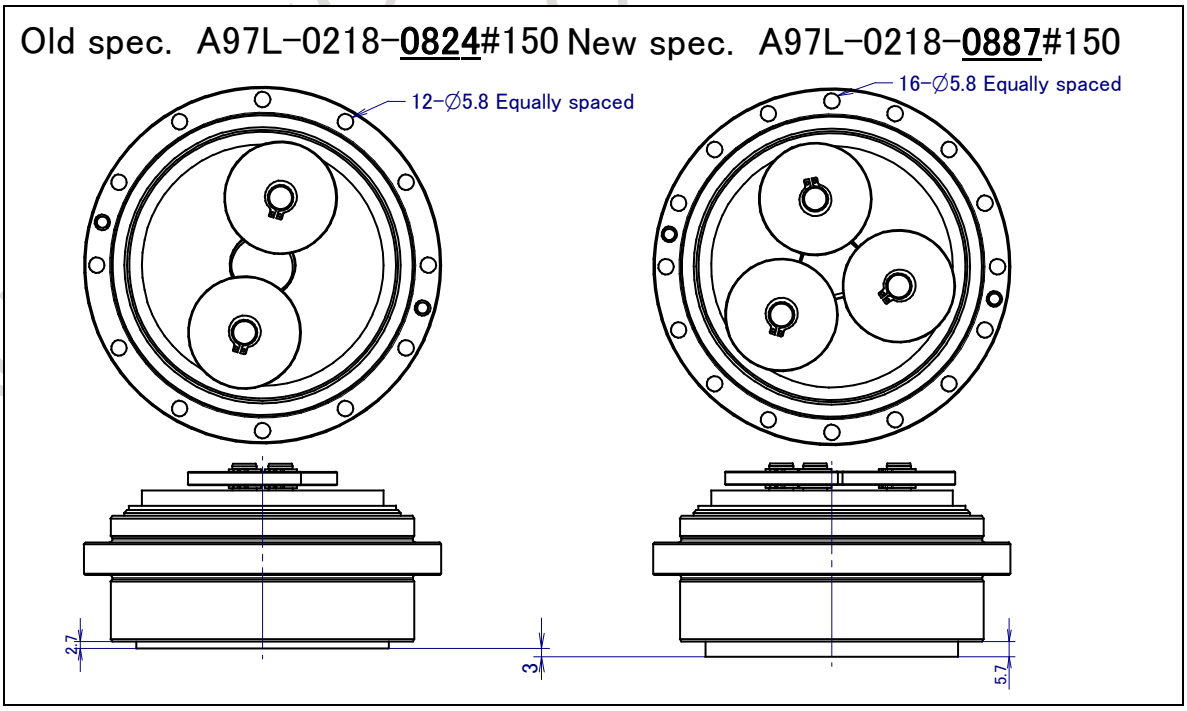


Fig. 6.8 (c) Distinction of new and old J3-axis reducer

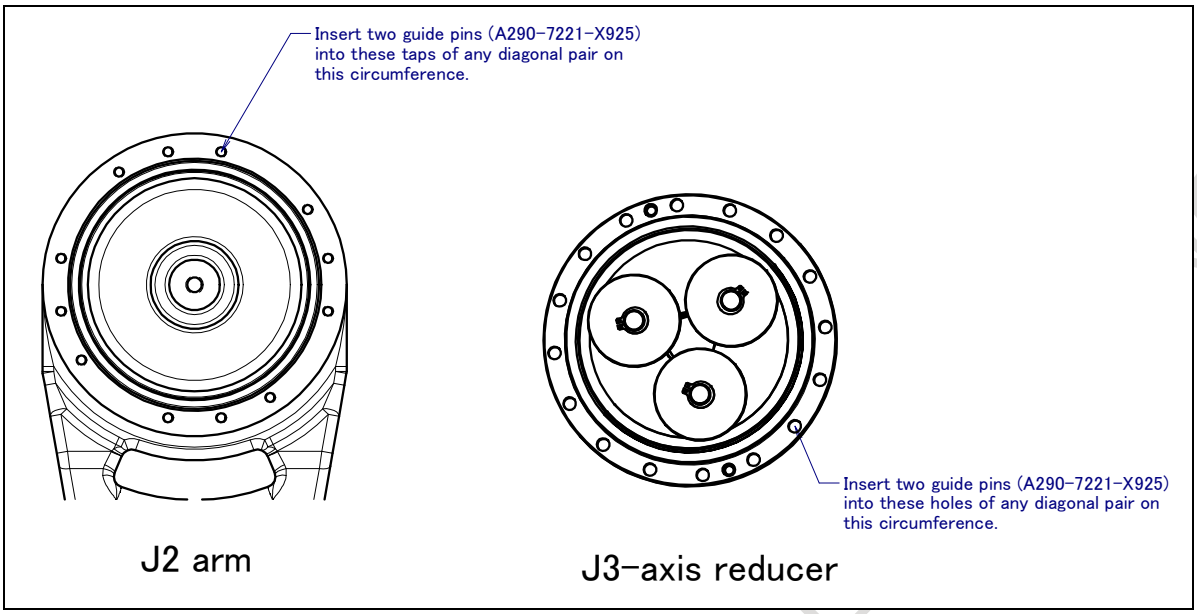


Fig. 6.8 (d) Guide pin inserting position

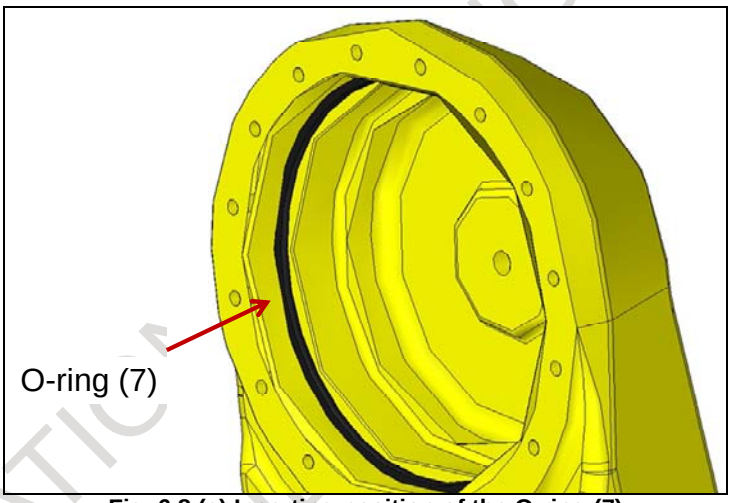


Fig. 6.8 (e) Inserting position of the O-ring (7)

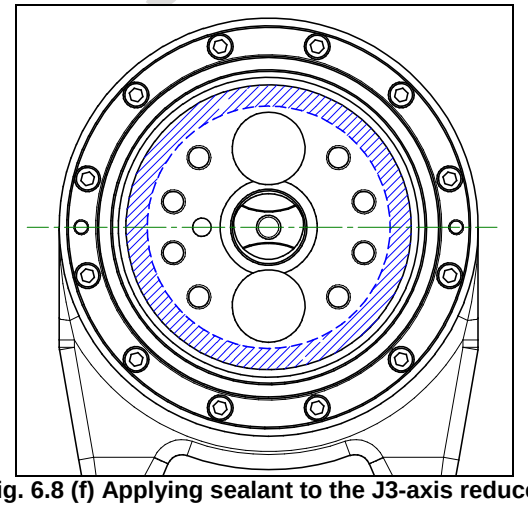


Fig. 6.8 (f) Applying sealant to the J3-axis reducer

NOTE
Refer to Section 6.23 about applying sealant (LOCTITE 518).

6.8.1 J3-Axis Reducer Mounting Phase Auto Adjusting Function

1 If H839INIT program and H839RVAT program are not installed to controller, contact FANUC.
2 Perform H839INIT program.
3 In H839RVAT program, disturbance torque is measured with J1=J2=J4=J6=0°, J5= -90° and J3 moves between 0° and 40° with override 10%.
Before executing H839RVAT.TP, keep the space so at to move the robot arm without interference with peripheral. And to avoid the harmful effect by vibration of a robot hand, the position of J5 axis is set to –90°. Check the interference between a robot arm and a robot hand, too.
4 Perform H839RVAT program.

NOTE
The H839RVAT-related parameter is stored away by SYSMAST.SV. In addition, a value is listed in inspection certification attached at the time of shipment. After 7DA3 (V7.30P), it is necessary to restore backup of SYSMAST.SV at the time of the update of the software.
In addition, contact your local FANUC representative about group 2 or later for robots of multiple control.

6.9 REPLACING THE J4-AXIS MOTOR (M4) (ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

1 Place the robot in a posture of J3 = +180°.
2 Set a dial gauge at the J4-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
3 Turn off controller power.
4 Remove the J4 connector panel referring to Section 8.3.
5 Remove the connector of a cable leading to the J4-axis motor.
6 As shown in Fig. 6.9 (a), remove the three bolts (1) that fasten the J4-axis motor to the J3 casing, and dismount the motor.
7 Remove the bolt (6) that fastens the gear (4) to the motor shaft, and dismount the washer (5), gear (4) and key (3).
8 Mount the gear (4) to a new motor, apply LOCTITE 243 to the threaded portion of the motor shaft, and fasten them with a bolt by tightening with a torque of [1.3 Nm]. (Ensure the specified torque is achieved otherwise, the J4-axis may get out of place.)
9 Replace the gasket (7) with a new one and put it in the J3 casing portion where the motor is to be mounted accurately, and fasten the motor to the J3 casing with bolts (1).
10 Connect cable connectors to the J4-axis motor.
11 According to Section 3.2, supply the J4-axis gearbox with the specified oil.
12 Attach the J4 connector panel referring to Section 8.3.
13 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

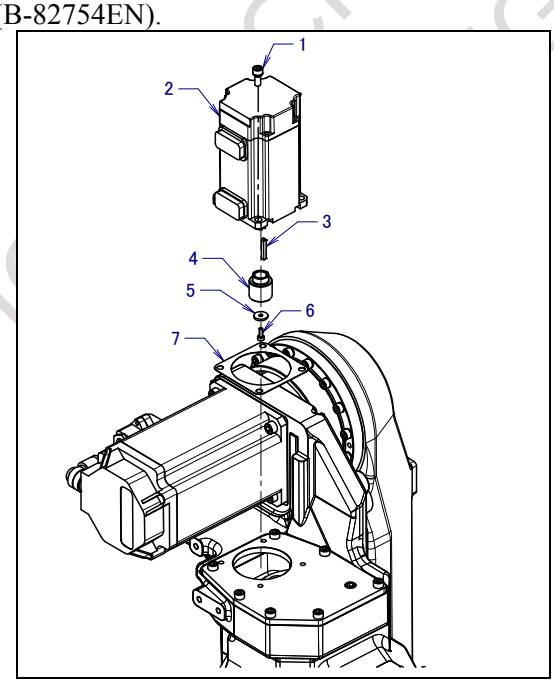


Fig. 6.9 (a) Replacing the J4-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A97L-0218-0621#051212	4		
2	MOTOR	A06B-0115-B804 (*1)	1		
		A06B-0115-B205#0048 (*2)			
3	KEY	JB-HKY-3X3X20B	1	LT675	
4	GEAR	A290-7221-X412	1		
5	WASHER	A290-7210-X532	1		
6	BOLT	A6-BA-3X8	1	LT243	1.3
7	GASKET	A98L-0040-0042#07	1		

(*1) ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L
(*2) ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L

6.10 REPLACING THE J4-AXIS MOTOR (M4) (ARC Mate 100*i*C/10S, M-10*i*A/10S)

1 Place the robot in a posture of J3 = +180°.
2 Set a dial gauge at the J4-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
3 Turn off controller power.
4 Remove the J4 connector panel referring to Section 8.3.
5 Remove the connector of a cable leading to the J4-axis motor.
6 As shown in Fig. 6.10 (a), remove the three bolts (1) that fasten the J4-axis motor to the J3 casing, and dismount the motor.
7 Remove the set screw (5) that fastens the gear (4) to the motor shaft, and dismount the gear (4) and key (3).
8 Attach key (3) and gear (4) by new motor. Apply LOCTITE 243 to set screw (5) and tighten it with torque of [0.54 Nm]. (Ensure the specified torque is achieved otherwise, the J4-axis may get out of place.)
9 Replace the gasket (6) with a new one and put it in the J3 casing portion where the motor is to be mounted accurately, and fasten the motor to the J3 casing with bolts (1).
10 Attach the cable connector to the J4-axis motor.
11 According to Section 3.2, supply the J4-axis gearbox with the specified oil.
12 Attach the J4 connector panel referring to Section 8.3.
13 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

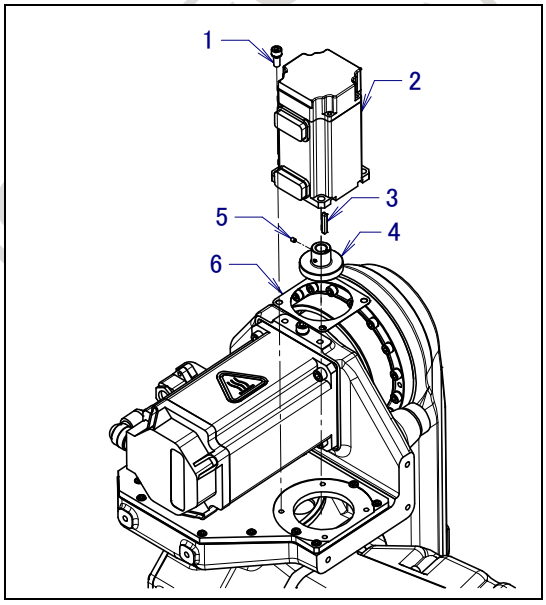


Fig. 6.10 (a) Replacing the J4-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A97L-0218-0621#051212	4		
2	MOTOR	A06B-0115-B804	1		
3	KEY	JB-HKY-3X3X20B	1	LT675	
4	GEAR	A290-7221-Z412	1		
5	SET SCREW	A6-SAKT-3X4	2	LT243	0.54
6	GASKET	A98L-0040-0042#07	1		

6.11 REPLACING THE J4-AXIS GEARBOX (ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

Pay attention that specification of J4-axis gearbox is different by time of robot shipment.
Before March 2010 (Spec. of mechanical unit: A05B-1221-B201, B202, B301, B302): A05B-1221-K401
After April 2010 (Spec. of mechanical unit: A05B-1221-B401, B402, B451, B452, B501, B502, B551, B552): A05B-1221-K411

1 Set dial gauges at the J3/J4-axes, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
3 Turn off controller power.
4 Pull out all oil of J4-axis gearbox referring to Section 3.2.
5 Wrap and hang Sling in two places of the J3 arm referring to Fig.6.11 (a) and (b).
6 Referring to Section 8.3, remove the wiring and piping between J3-axis and wrist. When cable installed in M/H conduit is removed, refer to Section 6.19 or 6.21.
7 Remove option cables from the J3 casing.
8 Referring to Section 6.10, remove J4-axis motor.
9 Remove bolts (1), the J3 arm and the O-ring (2).

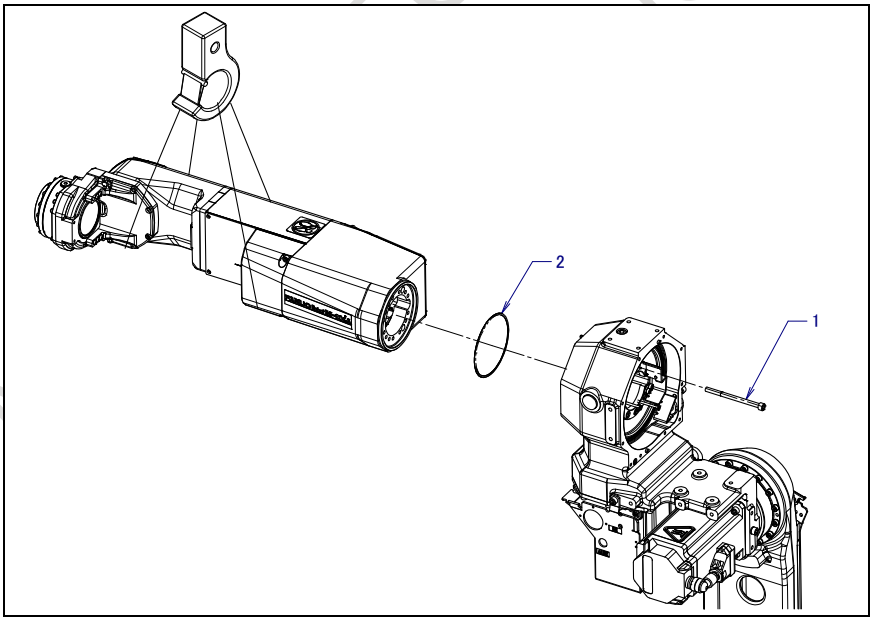


Fig. 6.11 (a) Replacing the J4-axis gearbox unit (1/4)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X85	9 or 14	LT263	15.7
2	O-RING	A290-7221-X444	1		

(*1) ARC Mate 100*i*C, M-10*i*A
(*2) ARC Mate 100*i*C/6L, M-10*i*A/6L

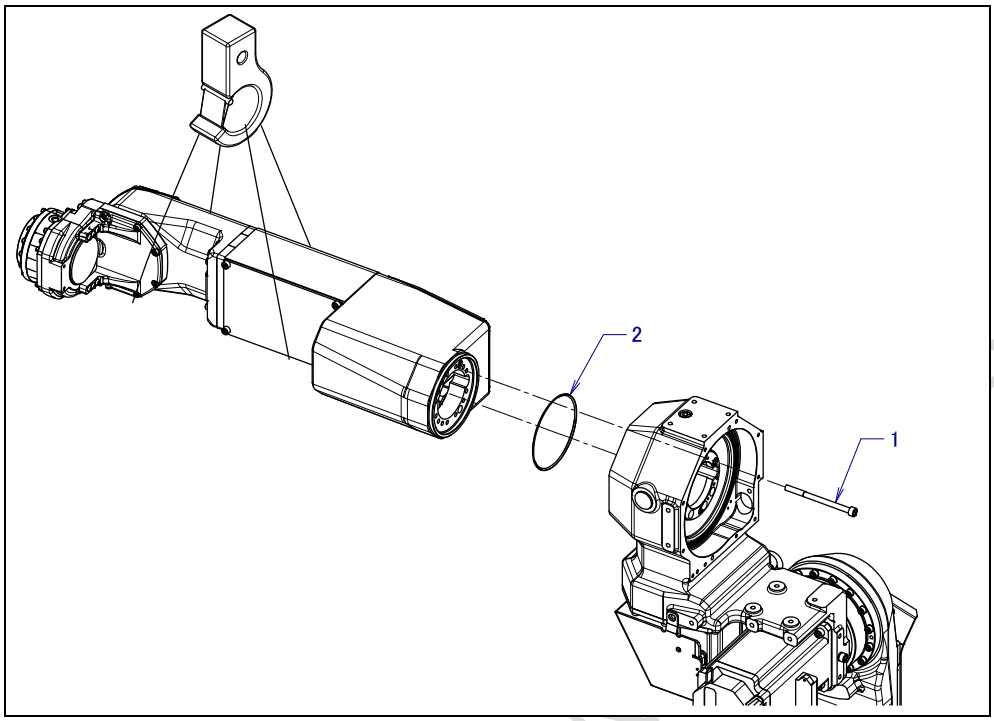


Fig. 6.11 (b) Replacing the J4-axis gearbox unit (2/4)
(ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X85	9 or 14	LT263	15.7
2	O-RING	A290-7221-X444	1		

10 Referring to Section 6.6, remove J3-axis motor.
11 Remove bolts (3) and the J4 connector plate (4).
12 Remove bolts (5) and washers (6) that fasten the J3 unit (7) to the J2 arm, and remove the J3 unit (7) from the J3-axis reducer.
13 Remove the adapter (8).

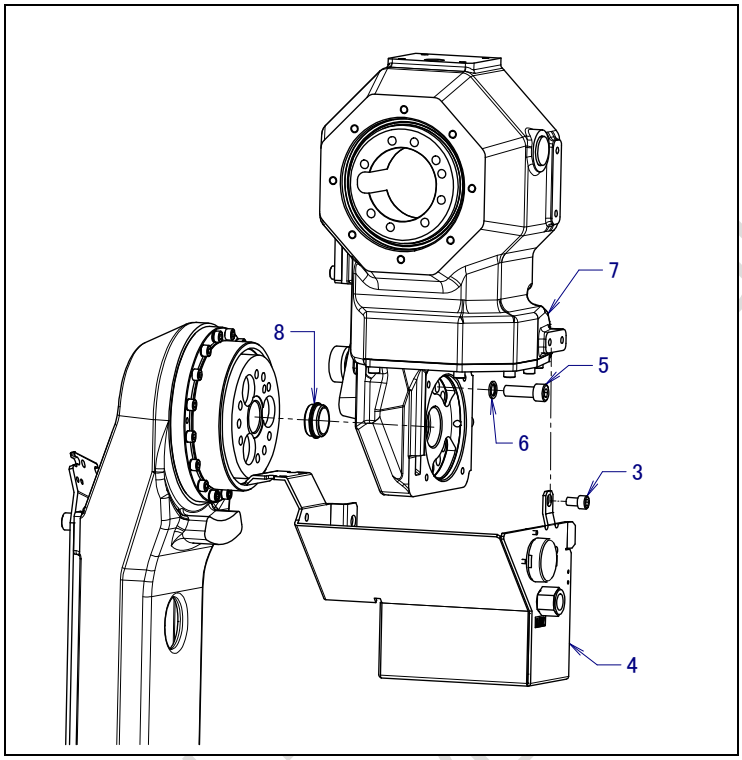


Fig. 6.11 (c) Replacing the J4-axis gearbox unit (3/4)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L
ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
3	BOLT	A6-BA-6X10	2		
4	CON.PLATE	Specification is depend on mechanical unit cable	1		
5	BOLT	A6-BA-8X25	8 or 9	LT263	37.2
6	WASHER	A97L-0001-0823#M8H	8 or 9		
7	J3 UNIT	Specification is depend on mechanical unit cable	1		
8	ADAPTER	A290-7221-X422	1		

14 Remove bolts (9) and the pipe A (10). Then remove bolts (11), the cover (12) and the gasket (13). Referring to Section 6.23, remove old sealant of reducer shaft.

15 Please apply parts removed to new J4 axis gearbox by 9 to 14. Please spread LOCTITE according to the table of this paragraph, and tighten by the regulated tightening torque when you install the bolt. In this time, replace gasket (13) by new one. When installing the J3 unit to the J2 arm, apply LOCTITE 518 to J3-axis reducer referring to Section 6.8. When attaching bolts (1), refer to Fig. 6.11 (d).

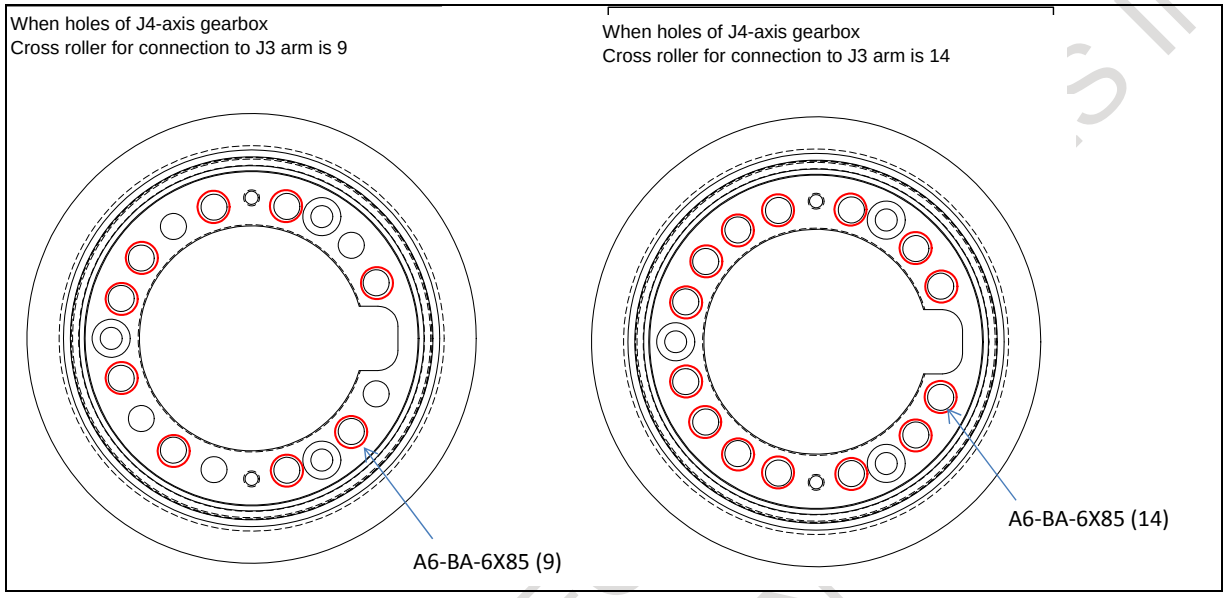


Fig. 6.11 (d) Bolt (1) inserting position

16 Do process of 5 to 8 in reverse sequence. Please spread LOCTITE according to the table of this paragraph, and tighten by the regulated tightening torque when you install the bolt. In this time, replace the gasket and the O-ring by new one.

17 Referring to Section 6.6 and 6.9 attach J3/J4-axis motor. In this time replace gasket and seal bolt to new one.

18 Referring to Section 8.3, attach cables to the J3 arm and the J3 casing.

19 According to Section 3.2, supply grease to J3-axis reducer with specified grease and supply oil to J4-axis gearbox with specified oil.

20 Perform quick mastering and perform single axis mastering of J3 and J4-axis. Refer to the QUICK MASTERING and SINGLE AXIS MASTERING of the mechanical unit operator's manual (B-82754EN).

NOTE
When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear (A290-7221-X412) of J4-axis motor shaft. In this time, confirm sitting sate of gear referring to Section 6.8.

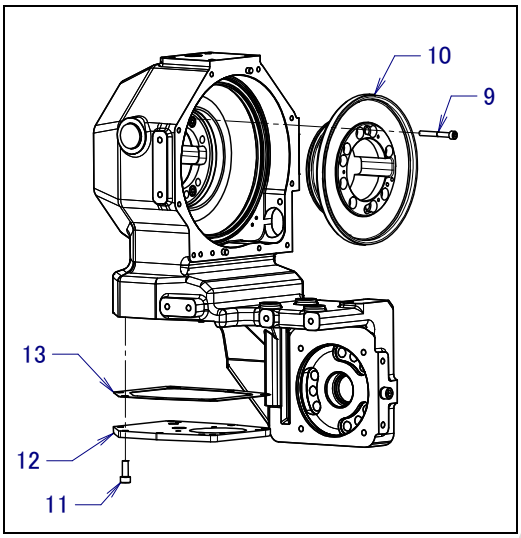


Fig. 6.11 (e) Replacing the J4-axis gearbox unit (4/4)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L
ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
9	BOLT	A6-BA-4X35	2		
10	PIPE A	A290-7221-X427	1		
11	BOLT	A6-BA-5X14	7		
12	COVER	A290-7221-X426 or A290-7221-Y426	1		
13	GASKET	A290-7221-X442	1		

The following service parts are appended to J4-axis gearbox (A05B-1221-K401, A05B-1221-K411) for maintenance. Please replace these with the J4-axis gearbox.

Parts name	Specifications	Q'ty	Used place
GASKET	A98L-0040-0042#03	1	J3-axis Motor
GASKET	A98L-0040-0042#07	1	J4-axis Motor
BOLT	A6-BA-8X25	8 or 9	Between J3 casing and J3-axis reducer
BOLT	A6-BA-5X14	7	J4-axis Motor mounting part
BOLT	A6-BA-6X10	1	J3-axis grease inlet
WASHER	A97L-0001-0823#M8H	8 or 9	Between J3 casing and J3-axis reducer
SEAL BOLT	A97L-0218-0502#5X10	4	J4-axis Motor
SEAL BOLT	A97L-0218-0417#081010	1	J4-axis oil outlet
SEAL WASHER	A30L-0001-0048#6M	1	J3-axis grease inlet
GASKET	A290-7221-X441	1	J4-axis hollow part
GASKET	A290-7221-X442	1	J4-axis Motor mounting part
O-RING	A290-7221-X444	1	Between J3 arm and J3 casing
PIN	JB-PH-H7A-5X10S45C	4	Z424, Z425

Note when attaching J4 cover

When J4-axis gearbox for maintenance (A05B-1221-K411) is ordered, there is a case that J4 cover cannot be attached because shape of J3 casing differs depend on the shipment time of the robot. In that case, perform chamfering using a nipper referring to Fig. 6.11 (f).

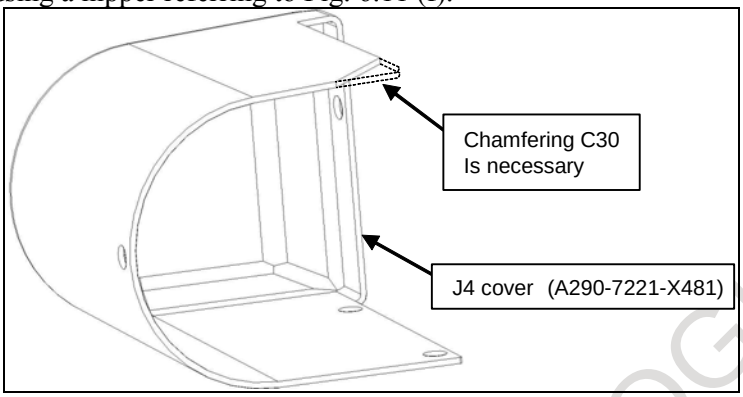


Fig. 6.11 (f) Chamfering of J4 cover

6.12 REPLACING THE J4-AXIS GEARBOX (ARC Mate 100*i*C/10S, M-10*i*A/10S)

1 Set dial gauges at the J3/J4-axes, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
3 Turn off controller power.
4 Pull out all oil of J4-axis gearbox referring to Section 3.2.
5 Wrap and hang Sling in two places of the J3 arm referring to Fig. 6.12 (a).
6 Referring to Section 8.3, remove the wiring and piping between J3-axis and wrist, When cable installed in M/H conduit or No dust M/H conduit is removed, refer to Section 6.19 or 6.21.
7 Remove option cables from the J3 casing.
8 Referring to Section 6.10, remove J4-axis motor.
9 Remove bolt (1), the J3 arm and the O-ring (2).

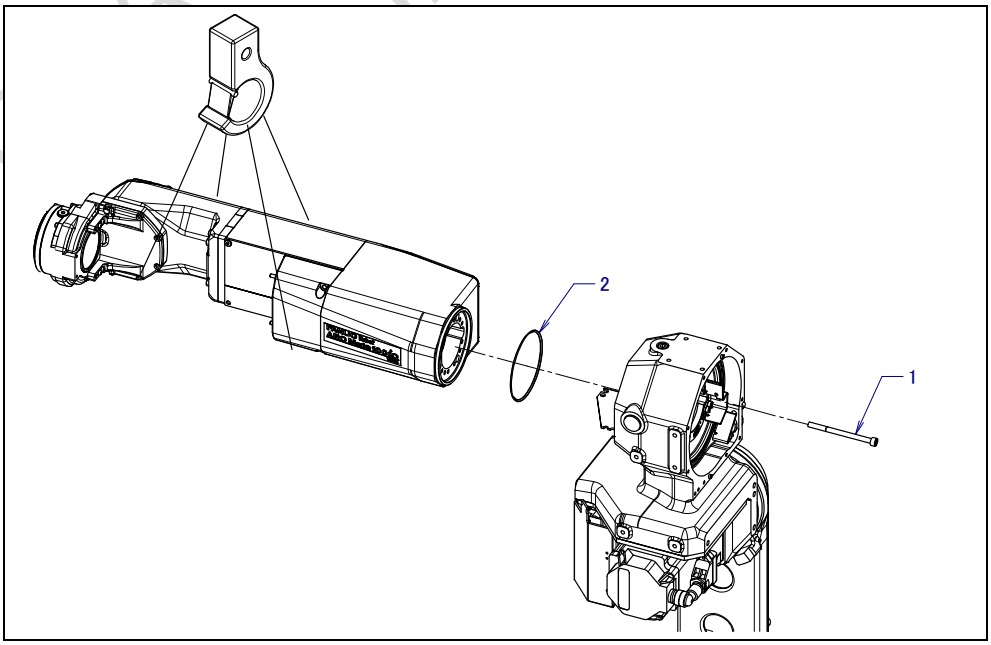


Fig. 6.12 (a) Replacing the J4-axis gearbox unit (ARC Mate 100*i*C/10S, M-10*i*A/10S) (1/3)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X85	9 or 14	LT263	15.7
2	O-RING	A290-7221-X444	1		

10 Referring to Section 6.6, remove J3-axis motor.
11 Remove bolts (3) and the J4 connector plate (4).
12 Remove bolts (5) and the plate (6).
13 Remove bolts (8) and washers (9) that fasten the J3 unit (7) to the J2 arm, and remove the J3 unit (7) from the J3-axis reducer.
14 Remove the adapter (10).

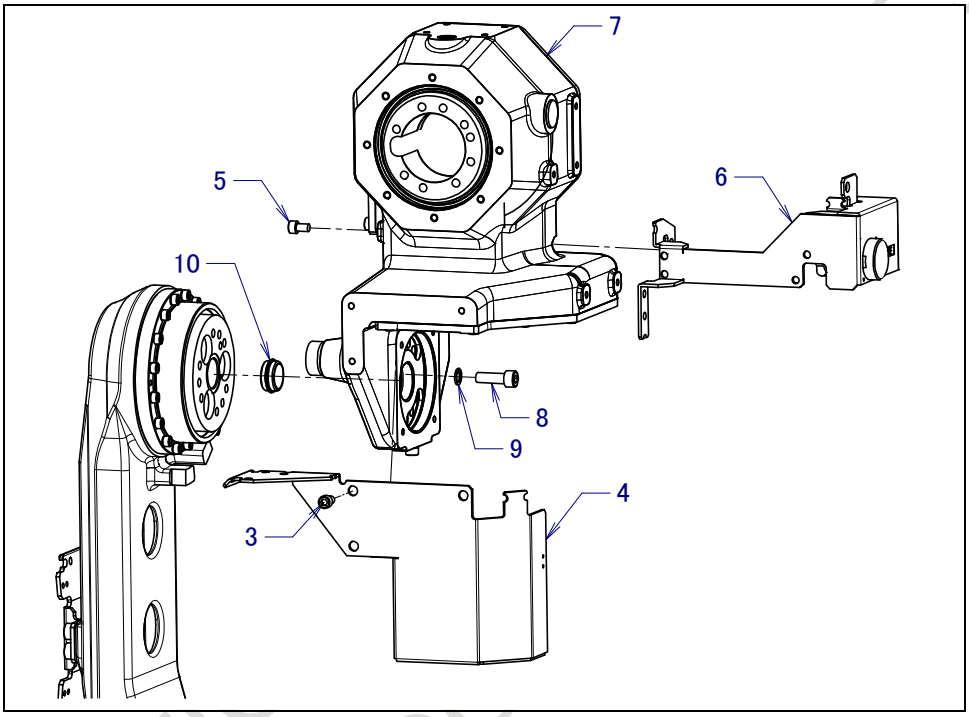


Fig. 6.12 (b) Replacing the J4-axis gearbox unit (ARC Mate 100*i*C/10S, M-10*i*A/10S) (2/3)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
3	BOLT	A6-BA-6X10	2		
4	PLATE	A290-7221-Z471	1		
5	BOLT	A6-BA-6X10	1		
6	PLATE	A290-7221-Z472	1		
7	J3 UNIT	A290-7221-T413	1		
8	BOLT	A6-BA-8X25	9	LT263	37.2
9	WASHER	A97L-0001-0823#M8H	9		
10	ADAPTER	A290-7221-X422	1		

15 Remove bolts (11) and the pipe A (12). Then remove bolts (14), the pin (15), the cover (16) and the gasket (17). Referring to Section 6.23, remove old sealant of reducer shaft.
16 Please apply parts removed to new J4 axis gearbox by 10 to 19. Please spread LOCTITE according to the table of this paragraph, and tighten by the regulated tightening torque when you install the bolt. In this time, replace gasket (17) by new one. When installing J3 unit to J2 arm, apply LOCTITE 518 to J3-axis reducer referring to Section 6.8. When attaching bolts (1), refer to Fig. 6.12 (c).

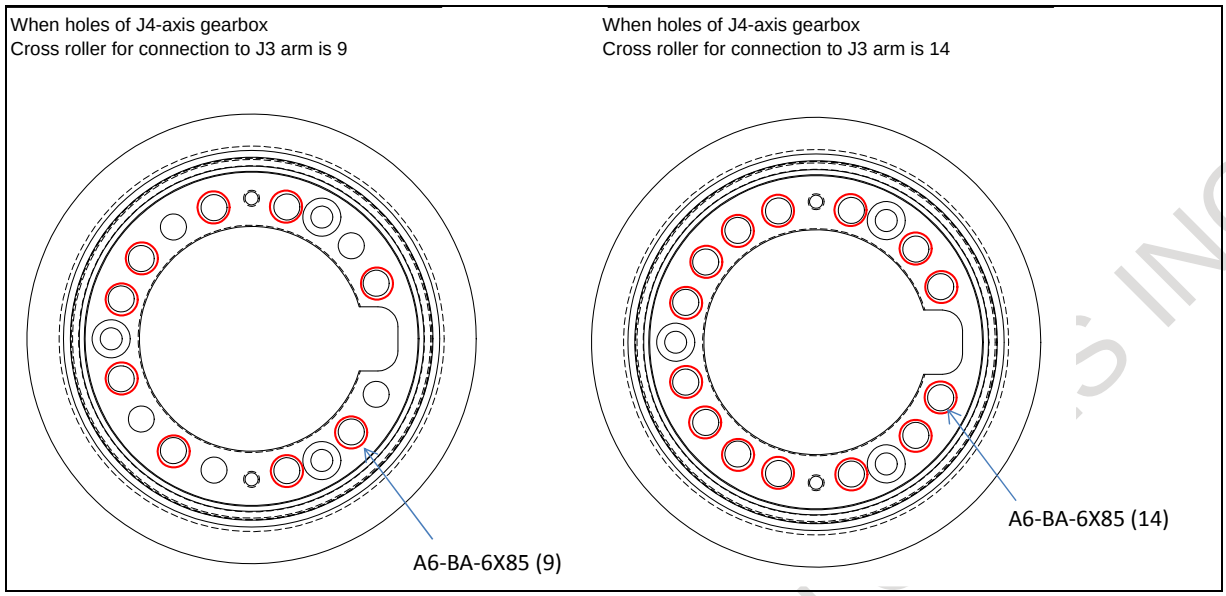


Fig. 6.12 (c) Bolt (1) inserting position

17 Do process of 5 to 9 in reverse sequence. Please spread LOCTITE according to the table of this paragraph, and tighten by the regulated tightening torque when you install the bolt. In this time, replace the gasket and the O-ring by new one.
18 Referring to Section 6.6 and 6.10 attach J3/J4-axis motor. In this time replace gasket and seal bolt by new one.
19 Referring to Section 8.3, attach cables to J3 arm and J3 casing.
20 According to Section 3.2, supply grease to J3-axis reducer with specified grease and supply oil to J4-axis gearbox with specified oil.
21 Perform quick mastering and perform single axis mastering of J3 and J4-axis. Refer to the QUICK MASTERING and SINGLE AXIS MASTERING of the mechanical unit operator's manual (B-82754EN).

NOTE
When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear (A290-7221-Z412) of J4-axis motor shaft.

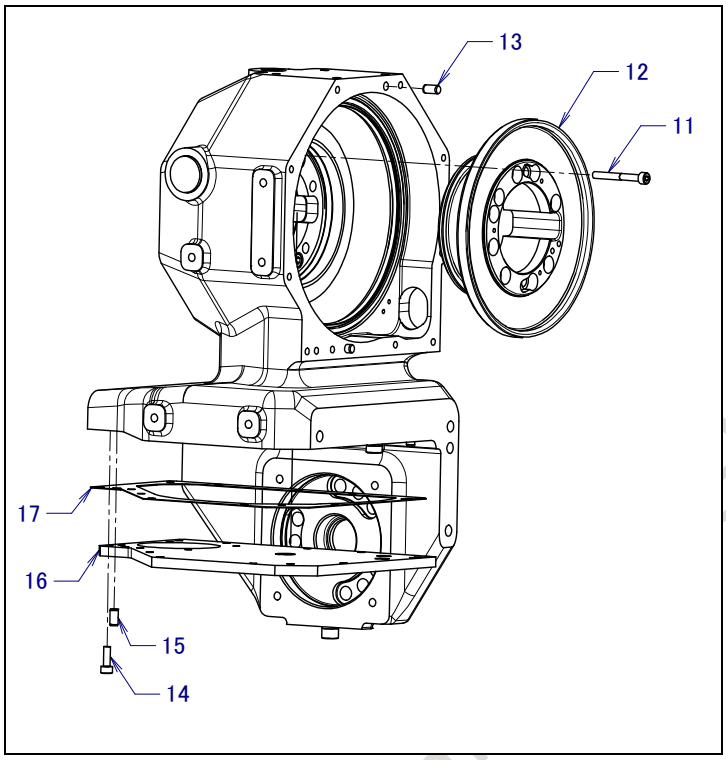


Fig. 6.12 (d) Replacing the J4-axis gearbox unit (ARC Mate 100*i*C/10S, M-10*i*A/10S) (3/3)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
11	BOLT	A6-BA-4X35	2		
12	PIPE A	A290-7221-X427	1		
13	PIN	JB-PH-H7A-5X10S45C	2		
14	BOLT	A6-BA-5X14	7		
15	PIN	JB-PH-H7A-5X10S45C	2		
16	COVER	A290-7221-Z424	1		
17	GASKET	A290-7221-X442	1		

The following service parts are appended to J4-axis gearbox (A05B-1221-K413) for maintenance. Please replace these with the J4-axis gearbox.

Parts name	Specifications	Q'ty	Used place
GASKET	A98L-0040-0042#03	1	J3-axis Motor
GASKET	A98L-0040-0042#07	1	J4-axis Motor
BOLT	A6-BA-8X25	9	Between J3 casing and J3-axis reducer
BOLT	A6-BA-5X14	7	J4-axis Motor mounting part
BOLT	A6-BA-6X10	1	J3-axis grease inlet
WASHER	A97L-0001-0823#M8H	9	Between J3 casing and J3-axis reducer
SEAL BOLT	A97L-0218-0502#5X10	4	J4-axis Motor
SEAL BOLT	A97L-0218-0417#081010	1	J4-axis oil outlet
SEAL WASHER	A30L-0001-0048#6M	1	J3-axis grease inlet
GASKET	A290-7221-X441	1	J4-axis hollow part
GASKET	A290-7221-Z442	1	J4-axis Motor mounting part
O-RING	A290-7221-X444	1	Between J3 arm and J3 casing
PIN	JB-PH-H7A-5X10S45C	4	Z424, Z425

6.13 REPLACING THE J5-AXIS MOTOR (M5)

NOTE

If you remove only one of the motors (J5 or J6) you will not have to drain the oil from the J5/J6-axis gearbox. However, the J5/J6 gearbox will drain automatically if both motors and drain plugs are removed at one time.

Remove J5 and J6 motors, only one at a time. Replace motor prior to removing other one. This enables you to do so without loosening the oil in the arm. All drain and fill plugs must remain sealed in position.
(NOTE: J3 must be at -90 degrees for this to work properly)

1 Place the robot in a posture of J3 = -90°. If it is impossible to make the posture in the on-site environment, put the collection bottle under the robot.
2 Set a dial gauge at the J5-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
3 Turn off controller power.
4 Remove seal bolts (1) and the J5 motor cover (2).
5 For M-10*i*A or M-10*i*A/6L or M-10*i*A/10S, replace the gasket (3). (Remove adhesive tape completely.)
6 Remove bolts (4) and the duct cover (5).
7 Remove cables of motor.
8 Remove cable ties of Pulsecoder line.
9 Remove seal bolts (6) and the plate cover 1 (7).
10 In case of M-10*i*A or M-10*i*A/6L or M-10*i*A/10S, replace gasket (8). (Remove adhesive tape completely.)
11 Remove bolts (9) and the motor (10) that gear (13) attaches.
12 Replace motor new one and assemble it applying the steps above in reverse sequence. Refer to Fig. 6.13 (b) when motor (10) is assembled. Please wrap the seal tape when you recycle seal bolt (1), (6). Replace gasket (3), (8) and O-ring (16) by new article. Apply LOCTITE 675 on the key.
13 Attach cable tie of Pulsecoder line.
14 According to Section 3.2, supply the J5/J6-axis gearbox with the specified oil.
15 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

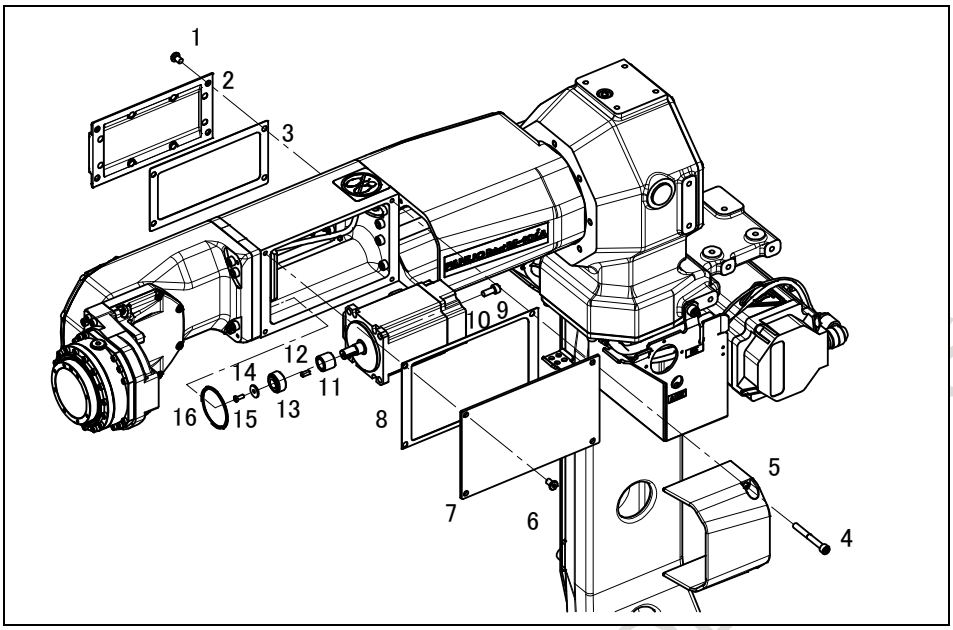


Fig. 6.13 (a) Replacing the J5-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	SEAL BOLT	A97L-0218-0736#050808	4		4.5
2	J5M COVER	A290-7221-X509	1		
3	GASKET (*1)	A290-7221-X579	1		
4	BOLT	A97L-0218-0496#M5X45BC	2	LT263	5.6
5	DUCT COVER	A290-7221-X506	1		
6	SEAL BOLT	A97L-0218-0736#050808	2		4.5
7	PLATE COVER 1	A290-7221-X561	1		
8	GASKET (*1)	A290-7221-X581	1		
9	BOLT	A6-BA-5X12	3		
10	MOTOR	A06B-0115-B855#0048 (*2) A06B-0115-B205#0048 (*3)	1		
11	SPACER	A290-7221-X529	1		
12	KEY	JB-HKY-3X3X8A	1	LT675	
13	GEAR J6-1	A290-7221-X511	1		
14	WASHER	A290-7210-X532	1		
15	BOLT	A97L-0218-0514#M3X8	1	LT243	1.0
16	O-RING	A98L-0001-0347#S39	1		

(*1) In case of M-10*i*A, M-10*i*A/6L, M-10*i*A/10S
(*2) ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S
(*3) ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L

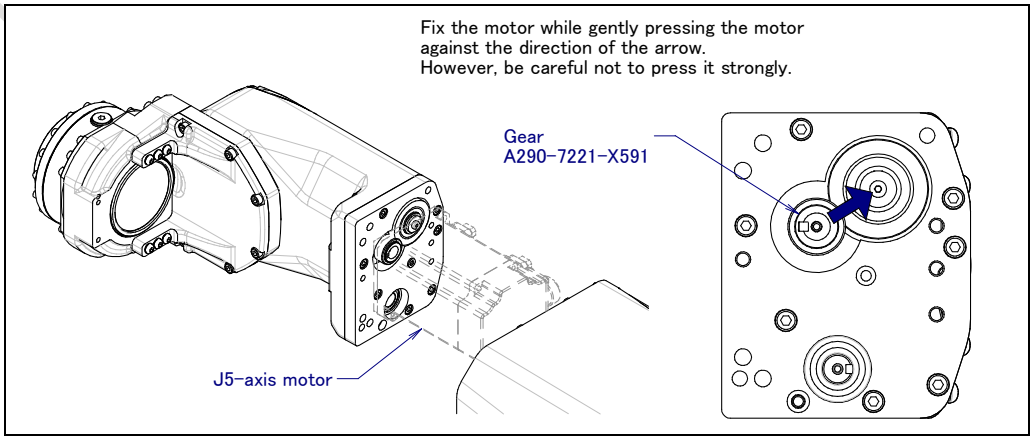


Fig. 6.13 (b) Note of assembling J5-axis motor

6.14 REPLACING THE J6-AXIS MOTOR (M6)

NOTE

If you remove only one of the motors (J5 or J6) you will not have to drain the oil from the J5/J6-axis gearbox. However, the J5/J6 gearbox will drain automatically if both motors and drain plugs are removed at one time.

Remove J5 and J6 motors, only one at a time. Replace motor prior to removing other one. This enables you to do so without loosening the oil in the arm. All drain and fill plugs must remain sealed in position.
(NOTE: J3 must be at -90 degrees for this to work properly)

1 Place the robot in a posture of J3 = -90°. If it is impossible to make the posture in the on-site environment, put the collection bottle under the robot.
2 Set a dial gauge at the J6-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
3 Turn off controller power.
4 Remove seal bolt (1) and plate cover 2 (2).
5 In case of M-10*i*A, M-10*i*A/6L and M-10*i*A/10S replace the gasket (3). (Remove adhesive tape completely.)
6 Remove seal bolt (4) and J6 motor cover (5).
7 In case of M-10*i*A or M-10*i*A/6L, M-10*i*A/10S replace the gasket (6). (Remove adhesive tape completely.)
8 Remove cables of motor.
9 Remove bolt (7) and motor (8) that gears attaches.
10 Replace motor new one and assemble it in reverse sequence. Refer to Fig. 6.14 (c) when motor (8) is assembled. Please wrap the seal tape when you recycle seal bolt (1), (4). Replace O-ring (14) by new one, too. Please put O-ring in the groove surely. Confirm the gear passes O-ring and the gear has not come in contact with O-ring. Apply LOCTITE 675 to key.
11 According to Section 3.2, supply the J5/J6-axis gearbox with the specified oil.
12 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

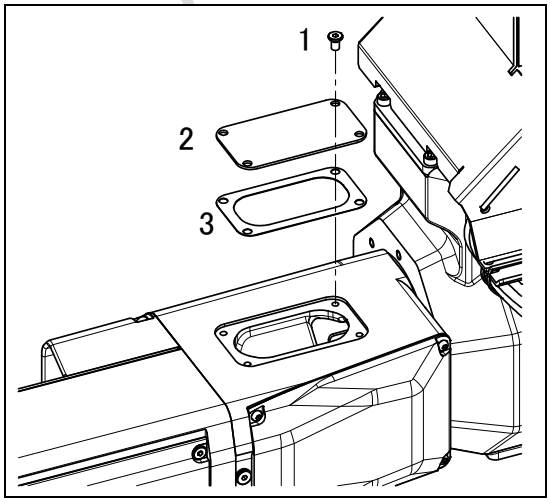


Fig. 6.14 (a) Replacing the J6-axis motor

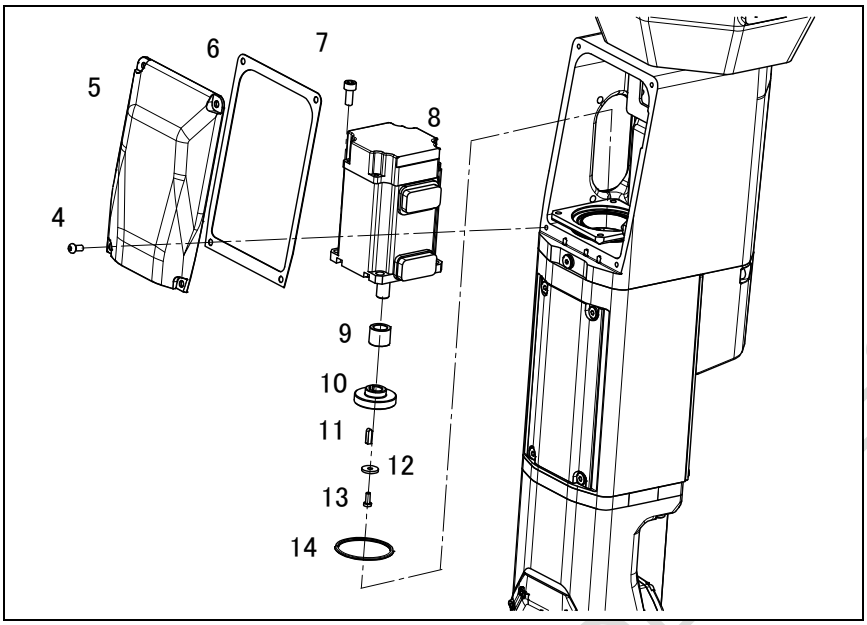


Fig. 6.14 (b) Replacing the J6-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	SEAL BOLT	A97L-0218-0736#050808	4		4.5
2	PLATE COVER 2	A290-7221-X562	1		
3	GASKET (*1)	A290-7221-X582	1		
4	SEAL BOLT	A97L-0218-0735#040808	4		4.5
5	J6M COVER	A290-7221-X505	1		
6	GASKET (*1)	A290-7221-X575	1		
7	BOLT	A6-BA-5X12	3		
8	MOTOR	A06B-0115-B855#0048 (*2) A06B-0115-B205#0048 (*3)	1		
9	SPACER	A290-7221-X529	1		
10	GEAR J6-1	A290-7221-X521	1		
11	KEY	JB-HKY-3X3X8A	1	LT675	
12	WASHER	A290-7210-X532	1		
13	BOLT	A97L-0218-0514#M3X8	1	LT243	1.0
14	O-RING	A98L-0001-0347#S39	1		

(*1) In case of M-10*i*A, M-10*i*A/6L, M-10*i*A/10S
(*2) ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S
(*3) ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L

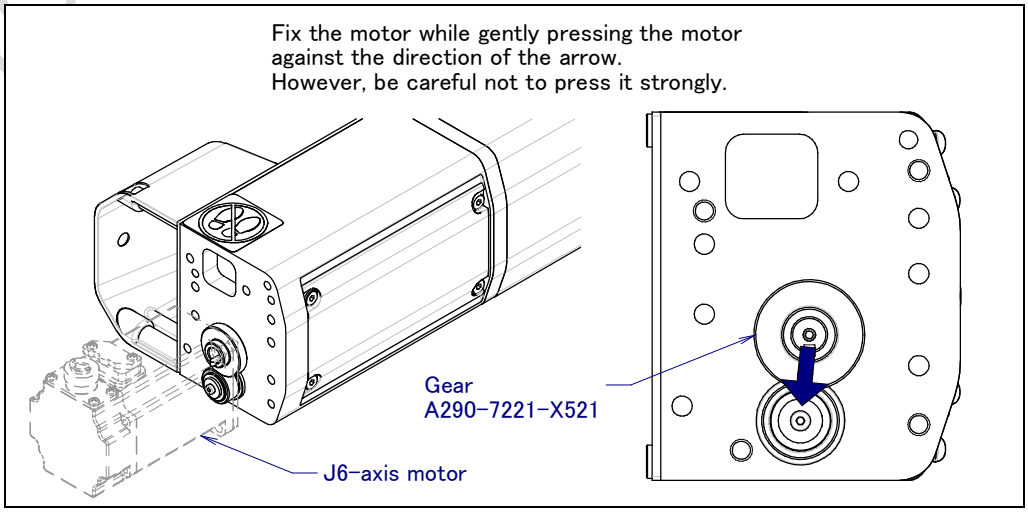


Fig. 6.14 (c) Note of assembling J6-axis motor

6.15 REPLACING THE J5/J6-AXIS GEARBOX

1 Place the robot in a posture of J3 = -90° and J4 = J5 =0° .
2 Release all oil of J5/J6 gearbox referring to Section 3.2.
3 Make robot to the posture of J3=5° and J4=±180° while being careful not to move the J5/J6-axes enough. (If J5/J6-axis are moved without oil, it causes burning of the gear.)
4 Set dial gauges at the J5/J6-axes, and prepare for single axis mastering after replacement. Refer to Section 9.5.
5 Turn off controller power.
6 Remove the J5-axis motor as described in Section 6.13.
7 Remove seal bolt (1), (3) and the J5/J6-axis gearbox (2). In this case, it is possible to remove by evenly tightening the M5 bolt in the removal tap of two places shown in Fig. 6.15 (b).
8 Remove sealant on the sealing face of the J3 arm side completely and use a cleaning agent to remove the grease thoroughly. Spread three bond TB1133K (Spec: A98L-0040-0290#0.33KG) or LOCTITE 518 sealant thinly to the J3 arm side. When using the roller method reference Fig.6.15 (d). In case of using the spatula method, reference Fig.6.15 (e). In both cases, apply sealant to the hollow part of the two counter bores of Fig. 6.15 (c). Refer to right side of Fig. 6.15 (e) about sealant thickness, and remove excess sealant of holes and the cavity reference Fig. 6.15 (f).
9 Confirm there are two parallel φ5 pins for the positioning on the J3 arm. Then replace the J5/J6-axis gearbox by new one and assemble it applying the procedure in reverse sequence. Please wrap the seal tape when you re-use the seal bolt (1) and (3). Please do not forcibly pull with the bolt and do not fix the J5/J6-axis gearbox. The gear might not enter the drive shaft easily when the J5/J6-axis gearbox is installed. And it must enter smoothly and not forcibly. For this case, remove the J6 axis motor referring to Section 6.14 and mount the J5/J6-axis gearbox while rotating the drive shaft by the hand. Please fix the bolt when you confirm the installation is easily obtained neatly.
10 Please leave the robot for five hours or more and monitor the firmness the seal sealant material.
11 Referring to Section 6.13, attach J5-axis motor.
12 According to Section 3.2, supply the J5/J6-axis gearbox with the specified oil.
13 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

NOTE
If gear damage has occurred then please replace gear (A290-7221-X511) of J5-axis motor shaft and gear (A290-7221-X521) of J6-axis motor shaft.

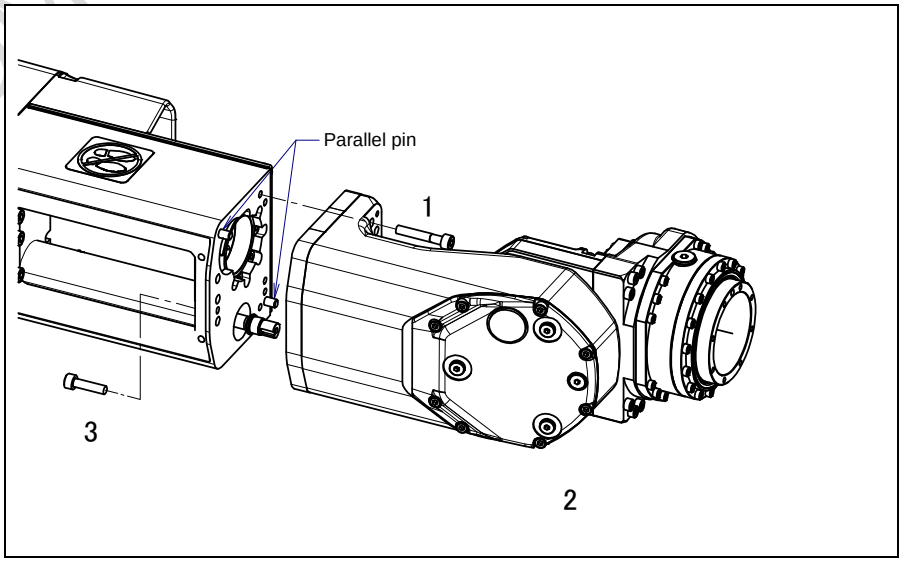


Fig. 6.15 (a) Replacing the J5/J6-axis gearbox

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	SEAL BOLT	A97L-0218-0423#053016	4		9.0
2	J5/J6-AXIS GEARBOX	A290-7221-V564	1		
3	SEAL BOLT	A97L-0218-0423#052016	3		9.0

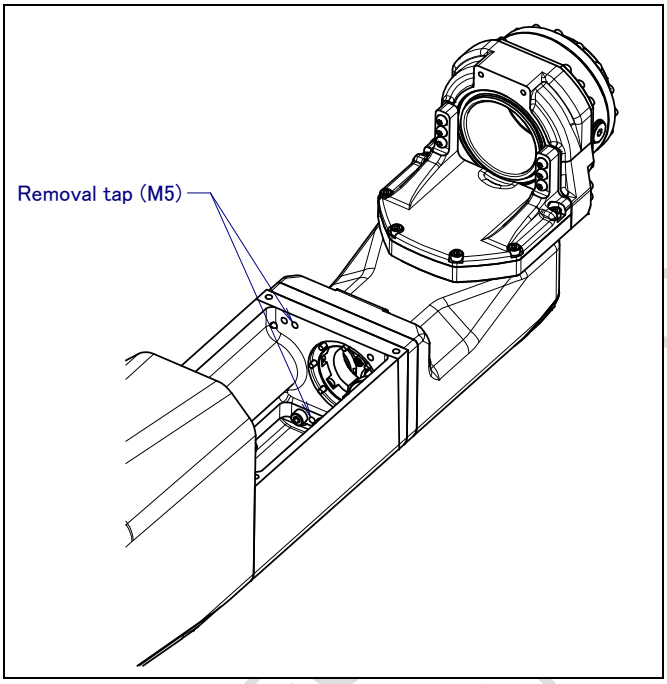


Fig. 6.15 (b) Position of removal tap of the J5/J6-axis gearbox

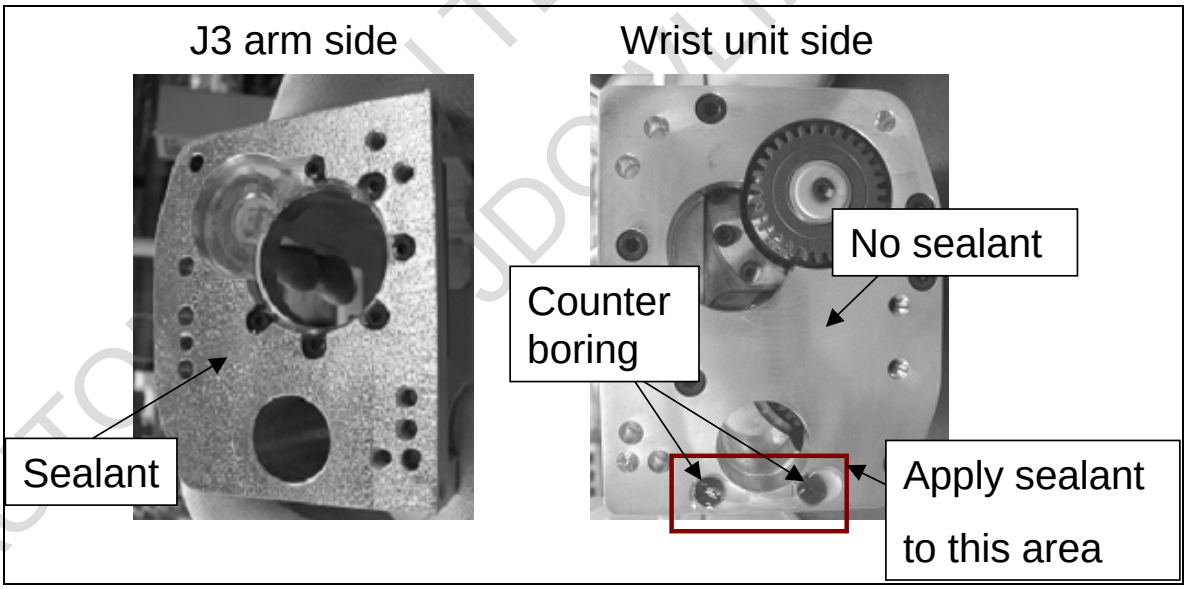


Fig. 6.15 (c) Sealant applying area method

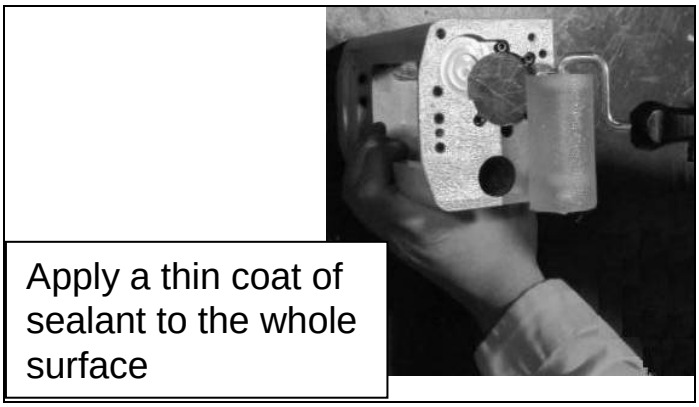


Fig. 6.15 (d) Example of the roller

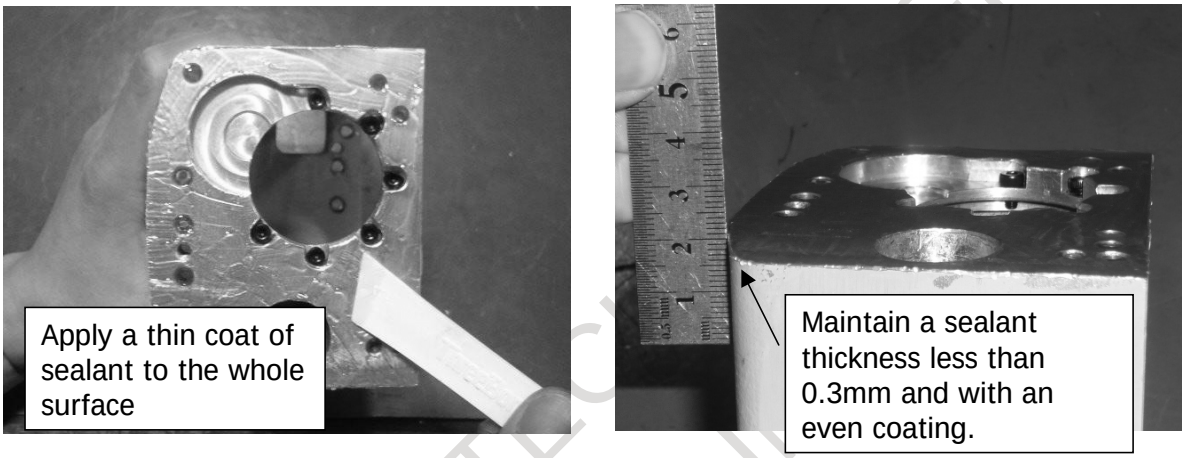


Fig. 6.15 (e) Example of the spatula method

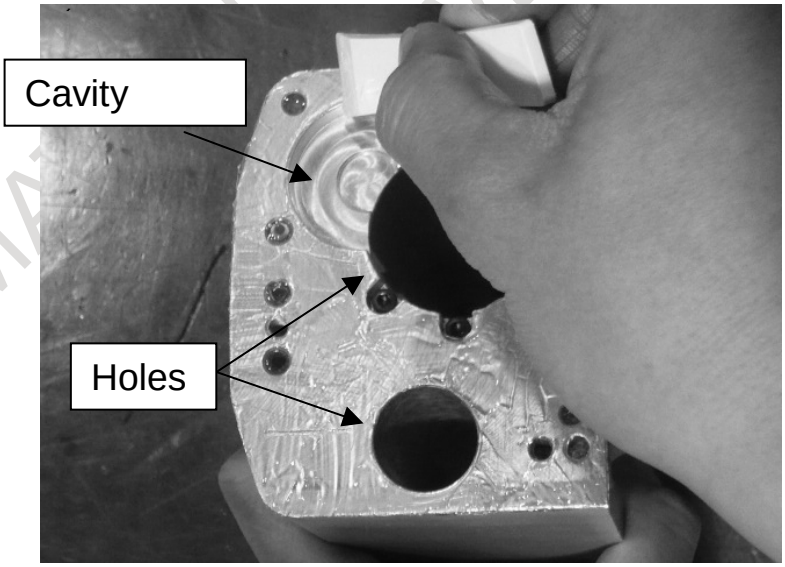


Fig. 6.15 (f) Removal of the excess sealant

6.16 REPLACING THE J2 COVER (OPTION)

1 Remove bolts (1) and washers (2).
2 Remove the J2 cover (3). When replacing only the J2 cover, omit the procedure 3 to 5.
3 Remove bolts (5) and washers (6).
4 Remove the base support (4).
5 Remove bolts (8) and support (7).
6 Replace J2 cover by new one. For its assembly, please apply the steps above in reverse sequence.

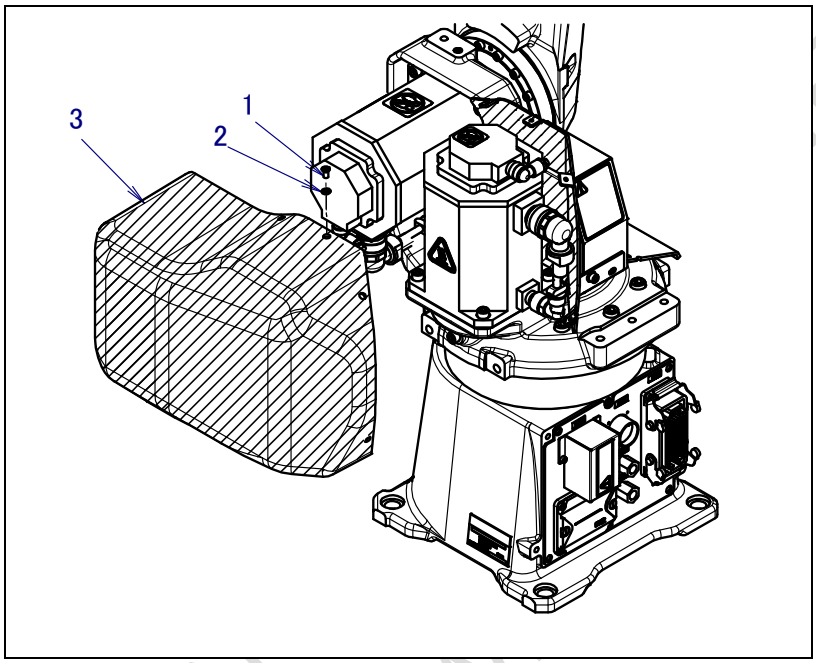


Fig. 6.16 (a) Replacing the J2 cover (1/3)

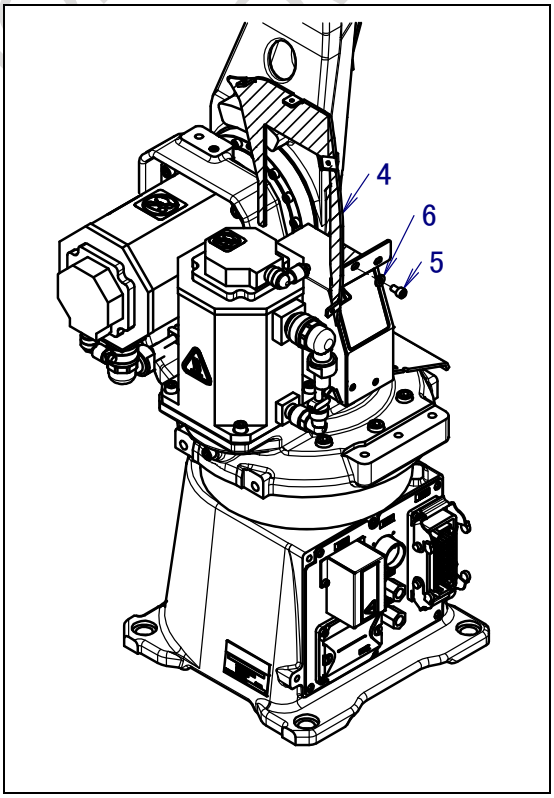


Fig. 6.16 (b) Replacing the J2 cover (2/3)

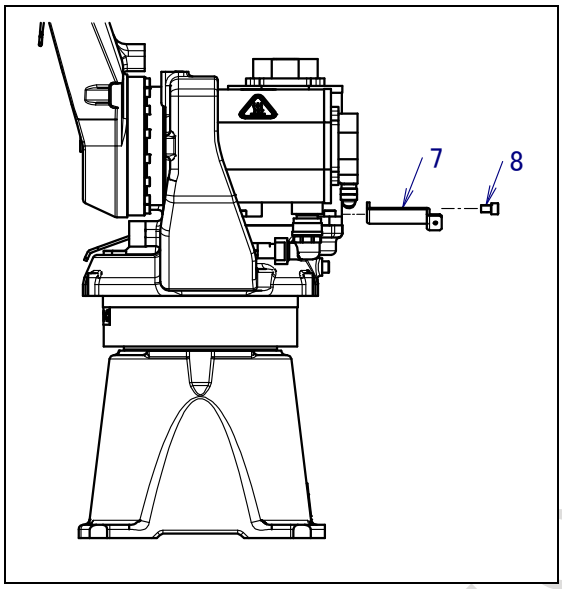


Fig. 6.16 (c) Replacing the J2 cover (3/3)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A97L-0218-0502#M5X10	5		
2	WASHER	A6-WM-5S	5		
3	J2 COVER	A290-7221-X381	1		
4	BASE SUPPORT	A290-7221-X382	1		
5	SEAL BOLT	A97L-0218-0736#050808	2		
6	WASHER	A6-WM-6S	2		
7	SUPPORT	A290-7221-X383	1		
8	BOLT	A6-BA-8X12	1		

6.17 REPLACING THE J4 COVER (OPTION)

1 Remove bolts (1) and washers (2).
2 Remove the J4 cover (3). When replacing only the J4 cover, omit the procedure 3 and 4.
3 Remove bolts (5) and the support A (4).
4 Remove bolts (6) and the support B (7).
5 Replace the J4 cover (3) by new one. For its assembly, please apply the steps above in reverse sequence.

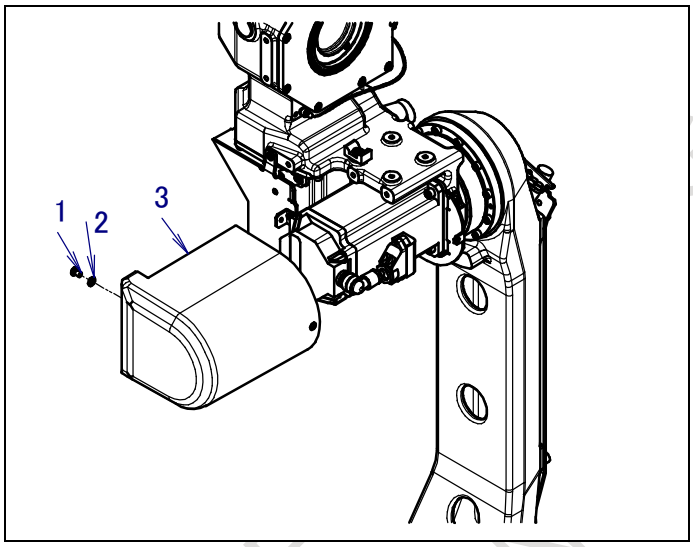


Fig. 6.17 (a) Replacing the J4 cover (1/2)

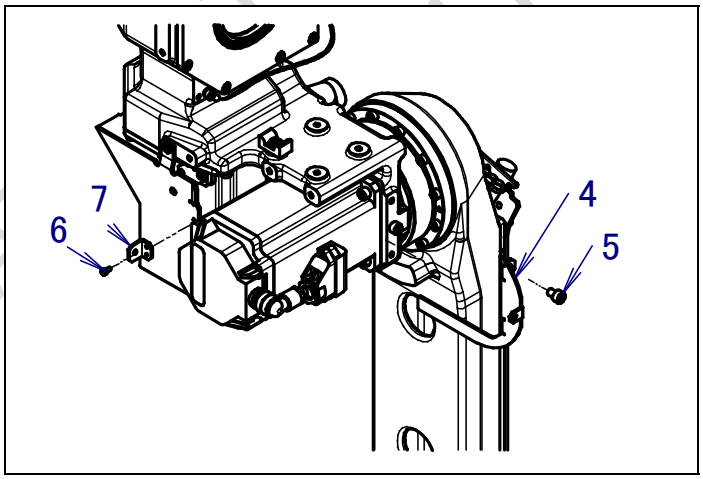


Fig. 6.17 (b) Replacing the J4 cover (2/2)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A97L-0218-0502#M5X10	4		
2	WASHER	A6-WM-6S	4		
3	J4 COVER	A290-7221-X481	1		
4	SUPPORT A	A290-7221-X482	1		
5	BOLT	A6-BA-6X10	2		
6	BOLT	A6-BA-3X5	2		
7	SUPPORT B	A290-7221-X483	1		

6.18 NOTES FOR ASSEMBLING CABLES WITH MATERIAL HANDLING (M/H) CONDUIT

1 M/H conduit is option to protect hand cable etc. You can prevent cables interference with arm directly by installing this and can postpone life of cables. Instead conduit is expendable supplies> replace it regularly.

2 The cable is clamped at a position 70mm or more away for the wrist side is recommended. A position 30mm or more away is recommended for the J3 back side. In case of M-10*i*A and M-10*i*A/10S, adjust the length of the cable between clamping to 785±5mm. In case of M-10*i*A/6L, adjust the length of the cable between clamping to 1005±5mm. Please absorb extra length to Conduit. If cables are not clamped, it cause broken of cable and conduit, be sure to clamp cables.

3 The longevity of the cable improves by spreading grease on the surface of the cable in Conduit. Shell Alvania grease S2 is recommended. In this case, please use the cable with performance that can endure oil. If grease is not applied, it causes early damage of cables and conduit.

Table 6.18 (a) Recommended cables and air tube

Cable name	Maker	Spec of FANUC	Specifications
End effector cable	Oki cable co. Ltd	A66L-0001-0459	0.2mm^2 24-core Cable for moving part
Signal line 3D Laser Vision sensor cable	Oki cable co. Ltd	A66L-0001-0464#1	0.2mm^2 2-core 4 pairs (8-core) Cable for moving part
Power line	Oki cable co. Ltd	A66L-0001-0401#10	1.25mm^2 10-core Cable for moving part
Force sensor cable	Okano cable co. Ltd	A66L-0001-0178#03P	0.3mm^2 2-core 3 pairs (6-core) Cable for moving part
3D Laser Vision sensor camera cable	Hitachi cable co. Ltd	A66L-0001-0525	0.26mm^2 4-core 0.13mm^2 2-core 0.08mm^2 2-core Cable for moving part
LED lighting cable	Hitachi cable co. Ltd	A66L-0001-0143	0.2mm^2 6-core Cable for moving part
Air tube	SMC	A97L-0218-0010	TU0604 (Outside diameter=Φ6mm, Inside diameter=Φ4mm)

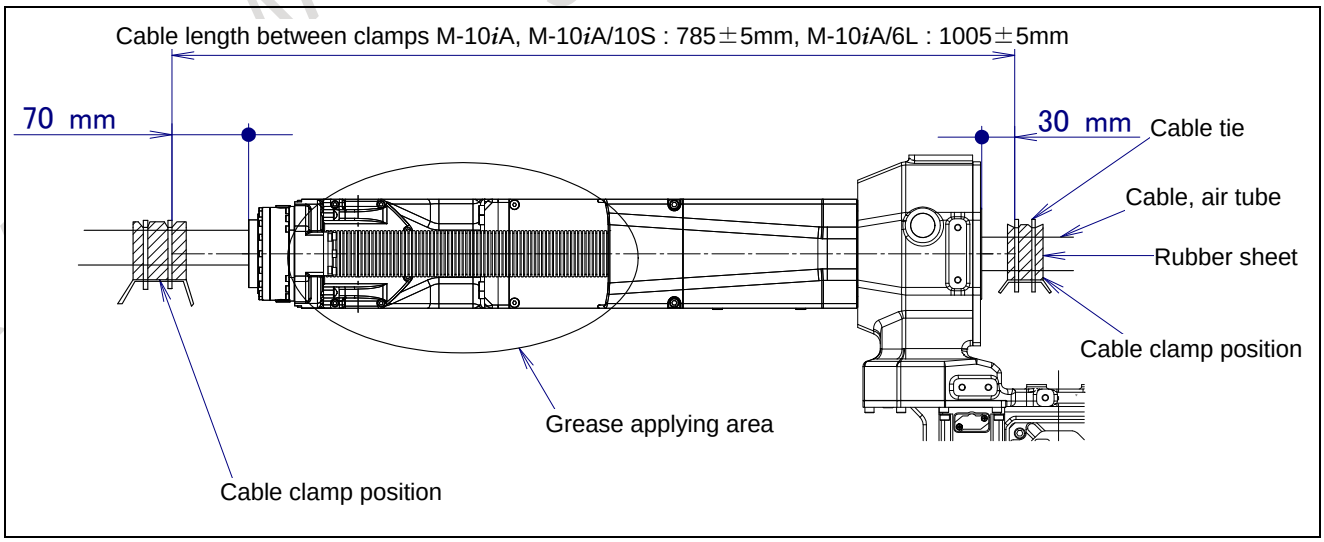


Fig. 6.18 (a) Cable length between clamps

4 Please make sure that all cables form a bunch 30mm or less in diameter as shown in the figure so that the cables do not rub at the edge of the J6 midair flange. If filling degree is over , it causes early damage of conduit.

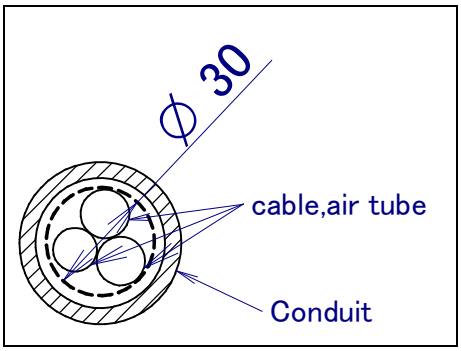


Fig. 6.18 (b) Diameter of cable and air tube in conduit

5 It is recommended to install a protect ring, if necessary, so that neither cables nor the bolt attached to the J6 midair flange may interfere.

6 Please roll cables in the rubber seat etc. so as not to damage the surfaces of the cables by the edge of the cable tie, and bind them with a cable tie.

7 When M/H conduit is installed, limiting J6 axis range of motion to ±190° is recommended. Cable life shortens when the range exceeds ±190° though it is possible to use a range of motion more than this (maximum ±270°).

Table 6.18 (b) Regular replace cycle

	Replace cycle
J5-axis:±140°	Cycle that is shorter among 1.2 million cycles (As one cycle every 30 seconds) and 2 years
J6-axis:±190°	

NOTE
Please note that it is a standard at the replacing cycle when the cable wire strand and the air tube of the FANUC recommendation are used. If cable is not clamped or grease is not applied or filling degree of cable in conduit is over or robot is operated with fluoric resin ring is broken, it causes early damage of cables and conduit.

8 Please examine the structure that the cutting powder etc. do not invade in Conduit when you specify M/H conduit and severe dust/liquid protection option simultaneously.

9 Fluoric resin ring is installed to J6 hollow part and white powder is generated to reduce friction of rotation. This is not trouble. Fluoric resin ring is expendable supply. (Spec.: A290-7221-X571) Two years are aims in an replace period. If you operate robot with the state that hard mine dust is attached to rotated part, replace period may shorten. If the robot is operated with fluoric resin rig is broken, it causes early damage of conduit.

6.19 REPLACING THE MATERIAL HANDLING (M/H) CONDUIT (OPTION)

(When replacing the unit)

1 Remove all cables, the air tubes, and the cable clamping, etc. that go in M/H conduit.
2 Remove M4 x 10 bolts (2 pcs) in Fig. 6.19 (a) and remove unit of M/H conduit.
3 Attach new M/H conduit applying reverse sequence. In this time, according to Fig. 6.19 (a) apply LOCTITE 243 to internal thread and tighten by regulated torque. Assemble them while paying attention that circumference of adapter does not interfere inside of out shaft of J6 hollow part. (Otherwise abnormal noise occurs.) Confirm there is a clearance between them. Pay attention that ring does not protrude from circumference of adapter, too.

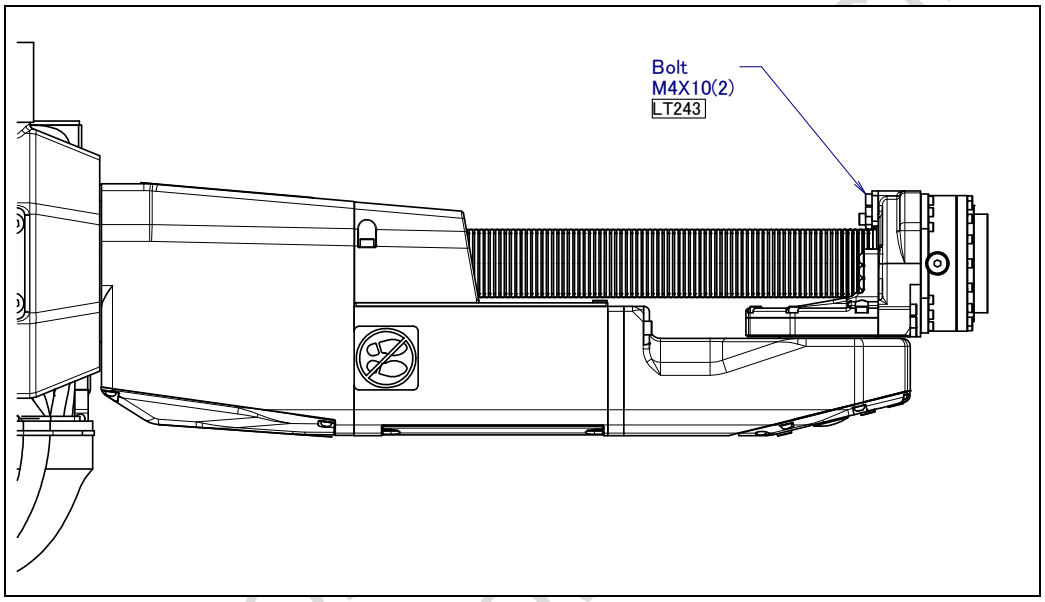


Fig. 6.19 (a) Replacing the M/H conduit (1/2)

(When replacing only the conduit)

1 Remove all cables, the air tubes, and the cable clamping, etc. that go in M/H conduit.
2 Remove M4 x 10 bolts (2 pcs) in Fig. 6.19 (a) and remove unit of the M/H conduit.
3 Remove set screws that fix the ring.
4 Sleeve might be attached depending on the shipping time, then remove the sleeve.
5 Remove the conduit from the adapter.
6 Attach new M/H conduit applying reverse sequence. In this time, according to Fig. 6.19 (a), (b) apply LOCTITE 243 to internal thread and tighten by regulated torque. If you cut conduit, be sure to refer NOTE in Appendix A. Assemble them while paying attention that circumference of adapter does not interfere inside of out shaft of J6 hollow part. (Otherwise abnormal noise occurs.) Confirm there is a clearance between them. Pay attention that the ring does not protrude from circumference of adapter, too.

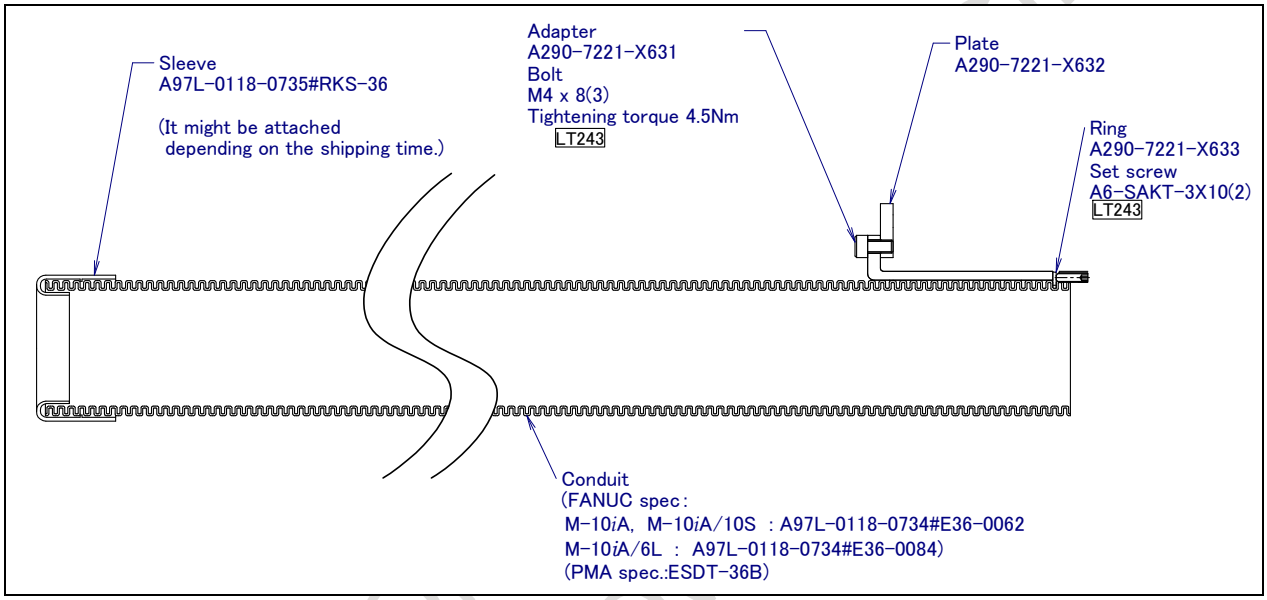


Fig. 6.19 (b) Replacing the M/H conduit (2/2)

6.20 NOTES FOR ASSEMBLING CABLES WITH NO DUST MATERIAL HANDLING (M/H) CONDUIT

1 No dust M/H conduit is option to protect hand cable etc. You can prevent cables interference with arm directly by installing this and can postpone life of cables. Instead conduit is expendable supplies> replace it regularly.
2 Please prepare rubber bush as figure below. Please make thickness between wrist flange and tip of rubber bush is 9mm, thickness of rubber bush is 6mm. In case of J3 casing side, please make thickness between back of J3 casing and tip of rubber bush is 11.4mm and thickness of rubber bush is 6mm.Make length of cable between rubber bush is 721±5mm (in case of M-10*i*A and M-10*i*A/10S) or 941±5mm (in case of M-10*i*A/6L) and absorb extra length to Conduit. If cables are not clamped, cable and conduit may break. Be sure to clamp cables.
3 Apply shell Alvania grease S2 to the surface of cables and air tubes inside the conduit to prevent cables and air tubes from damage. If grease is not applied, it causes early damage of cables and conduit
4 Confirm there is no gap in slit part of rubber bush. If there is a gap, clean degree turn worse. Please be careful.

Table 6.20 (a) Recommended cables and air tube

Cable name	Maker	Spec of FANUC	Specifications
End effector cable	Oki cable co. Ltd	A66L-0001-0459	0.2mm^2 24-core Cable for moving part
Signal line 3D Laser Vision sensor cable	Oki cable co. Ltd	A66L-0001-0464#1	0.2mm^2 2-core 4 pairs (8-core) Cable for moving part
Power line	Oki cable co. Ltd	A66L-0001-0401#10	1.25mm^2 10-core Cable for moving part
Force sensor cable	Okano cable co. Ltd	A66L-0001-0178#03P	0.3mm^2 2-core 3 pairs (6-core) Cable for moving part
3D Laser Vision sensor camera cable	Hitachi cable co. Ltd	A66L-0001-0525	0.26mm^2 4-core 0.13mm^2 2-core 0.08mm^2 2-core Cable for moving part
LED lighting cable	Hitachi cable co. Ltd	A66L-0001-0143	0.2mm^2 6-core Cable for moving part
Air tube	SMC	A97L-0218-0010	TU0604 (Outside diameter=Φ6mm, Inside diameter=Φ4mm)

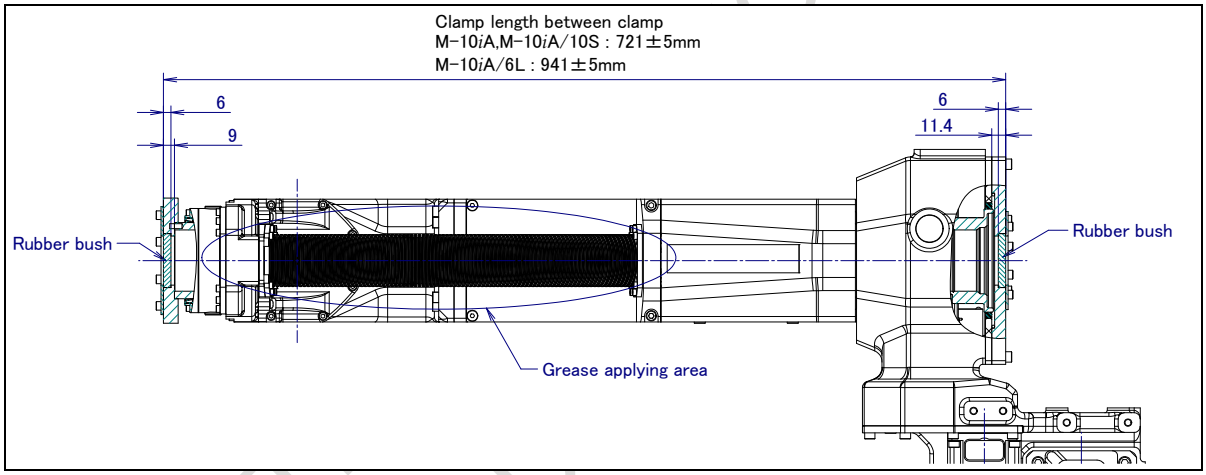


Fig. 6.20 (a) Cable length between clamp

5 Please install circumscription yen of bunches of cables on 30mm or less as shown in figure so that cables should not rub at the edge of the J6 hollow flange. If filling degree exceed the recommended value, it causes premature failure of cables and the conduit.

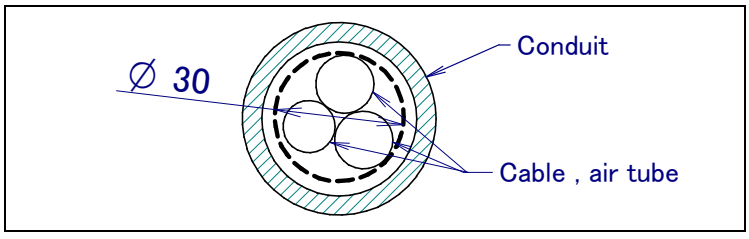


Fig. 6.20 (b) Diameter of cable and air tube in conduit

6 Refer to Fig.6.20 (c) about shape of rubber bush and structure of cables in conduit.

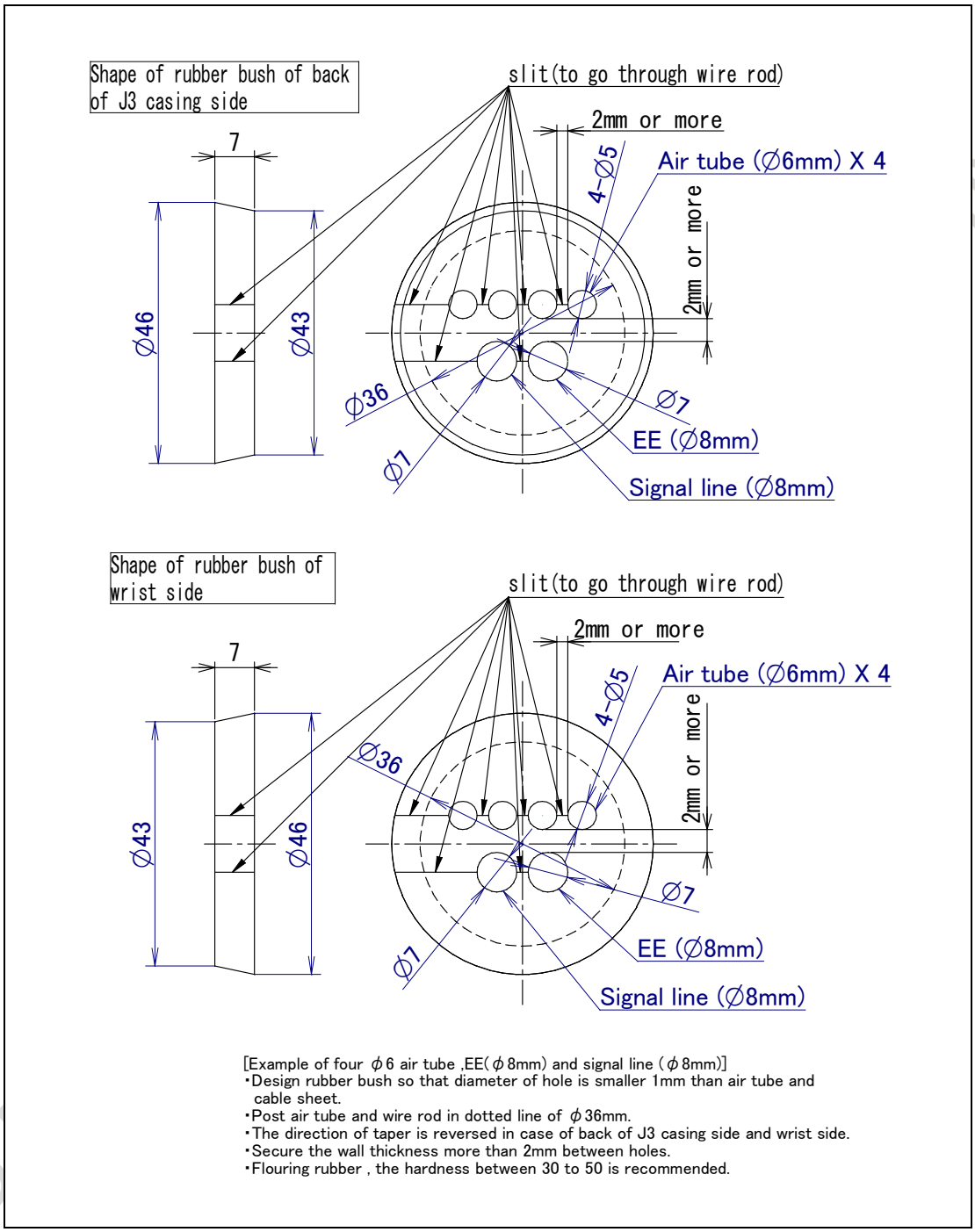


Fig. 6.20 (c) Shape of rubber bush (example)

7 Refer to Fig.6.20 (d) about structure of seal of back of J3 casing.

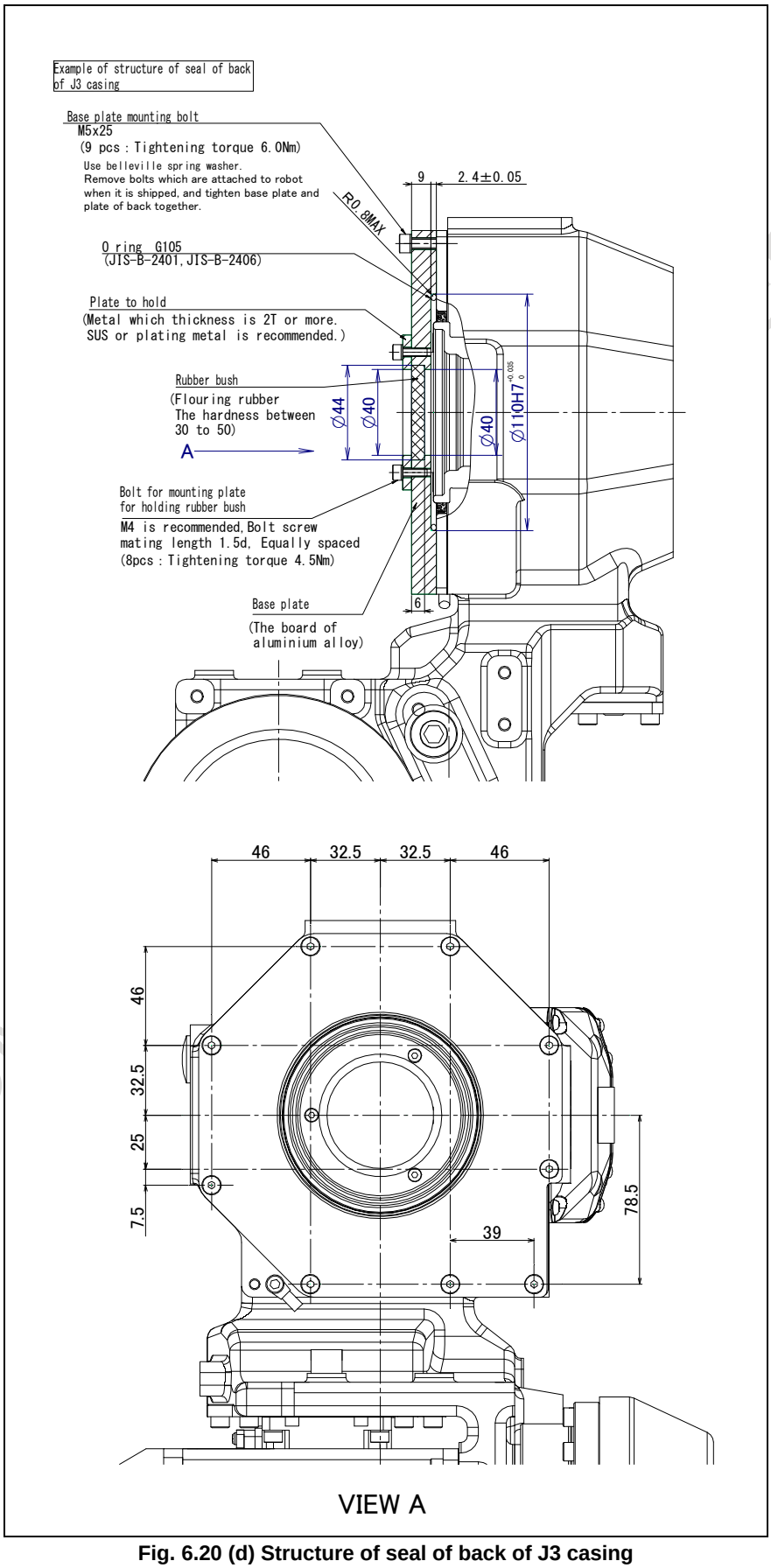


Fig. 6.20 (d) Structure of seal of back of J3 casing

8 Refer to Fig. 6.20 (e) about structure of seal of wrist.
If wrist is not sealed, dust come from hollow hole. Be sure to seal wrist.

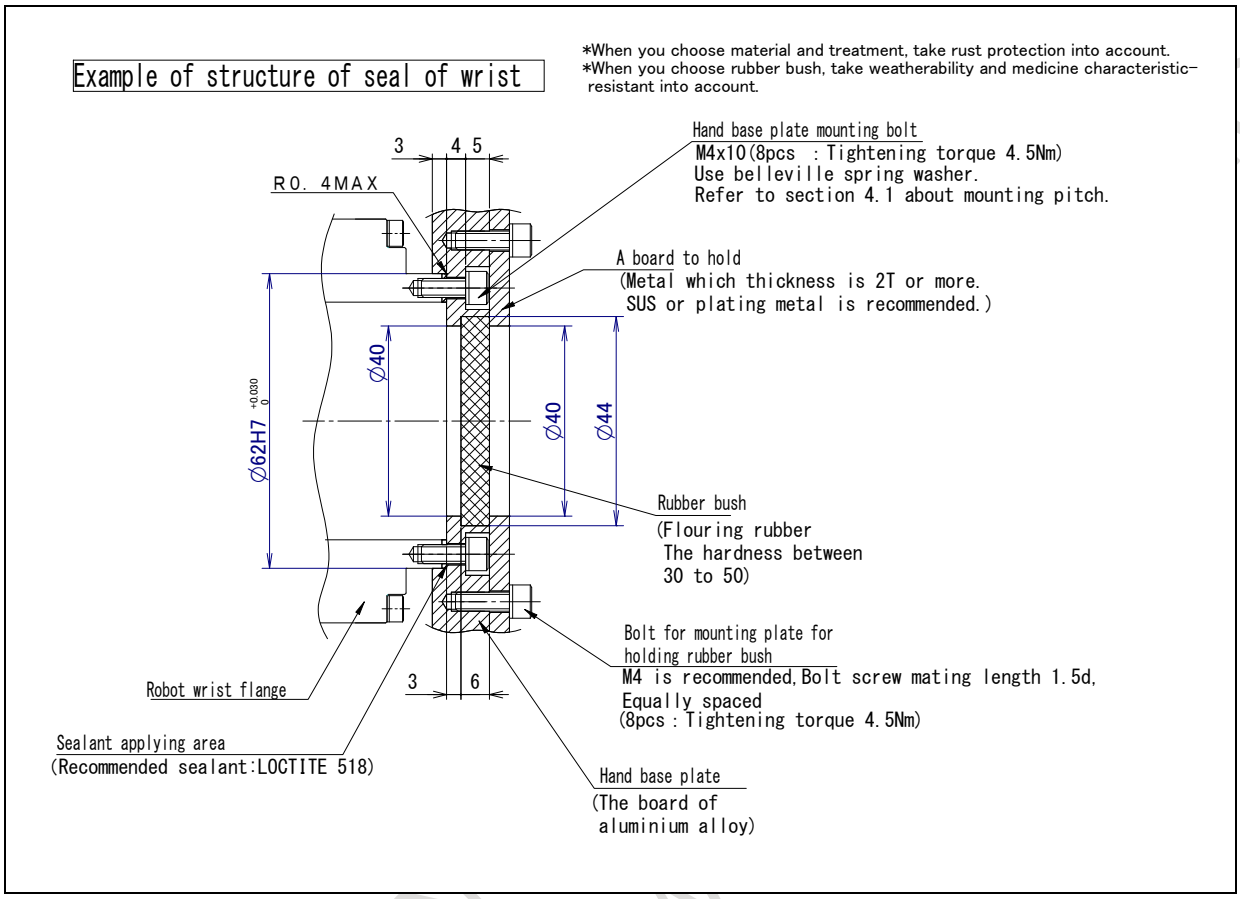


Fig. 6.20 (e) Structure of seal of wrist (example)

9 When No dust M/H conduit is installed, use by the range limitation of J6 axis range of motion ±190° is recommended. The longevities of cables shortens when using it exceeding ±190° though it is possible to use even in range of motion more than this (maximum ±270°). For J5-axis use it motion range in ±120°. If J5-axis move more than ±120°, it cause break of conduit, be careful.

NOTE
If cable is not clamped or grease is not applied or filling degree of cable in conduit is over or robot is operated with fluoric resin ring is broken, it causes early damage of cables and conduit.

10 Specification is ISO class 5 (equal to clean class 100).

6.21 REPLACING NO DUST MATERIAL HANDLING (M/H) CONDUIT (OPTION)

(When replacing unit)

1 Remove all cables, the air tubes, and the cable clamping, etc. that go in No dust M/H conduit.
2 Remove M4 x 10 bolts (2 pcs) and M5 x 45 bolts (2 pcs) in Fig. 6.21 (a) and remove unit of M/H conduit.
3 Attach new No dust M/H conduit applying reverse sequence. In this time, according to Fig. 6.21 (a) apply LOCTITE 243 and 263 to internal thread and tighten by regulated torque.

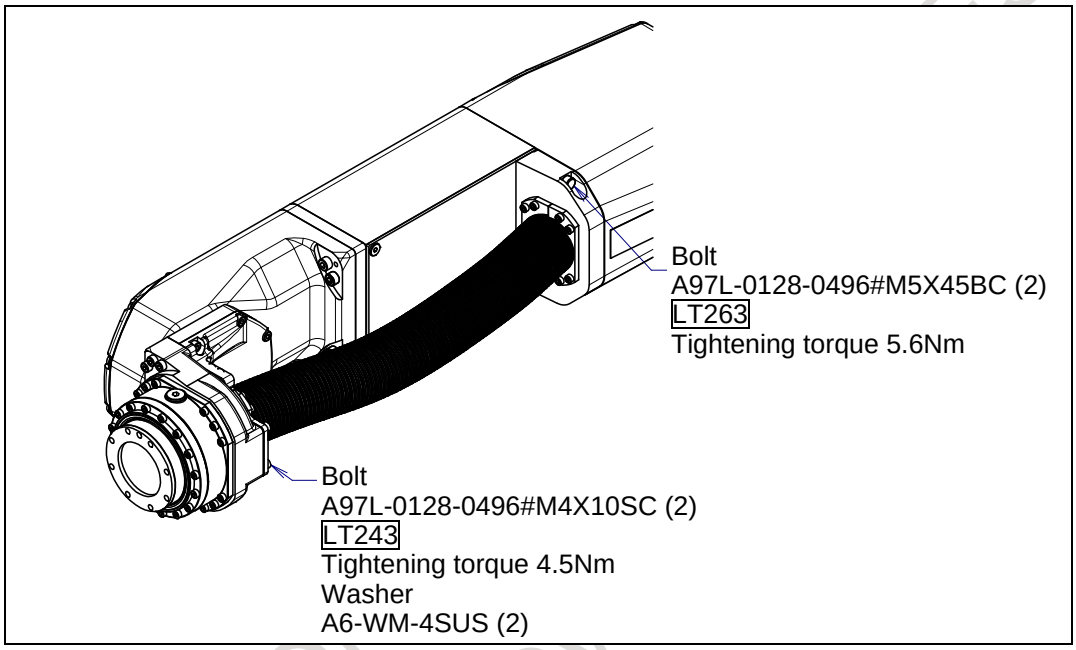


Fig. 6.21 (a) Replacing No dust M/H conduit (1/3)

(When replacing only conduit)

1 Remove all cables, the air tubes, and the cable clamping, etc. that go in No dust M/H conduit.
2 Remove bolt M3 x 8 (8 pcs), holder (2 pcs) of the wrist side.
3 Remove bolt M3 x 8 (8 pcs), holder (2 pcs) of the J3 casing side.
4 Cut conduit referring to note of Appendix A.
5 Polish conduit with a brush made by nylon.
6 Attach new No dust M/H conduit applying reverse sequence referring to Fig. 6.21 (a) to (c). Replace gasket, seal bolt and bolts that LOCTITE is applied. Remove old gasket of holder and attach new gasket referring to Fig.6.21 (b). When attaching gasket, put it on the oil seal inside the wrist unit and put J6 adapter on it, and fix them with bolts. Apply LOCTITE 243 and 263 to thread of bolt and tighten bolts with regulated torque.

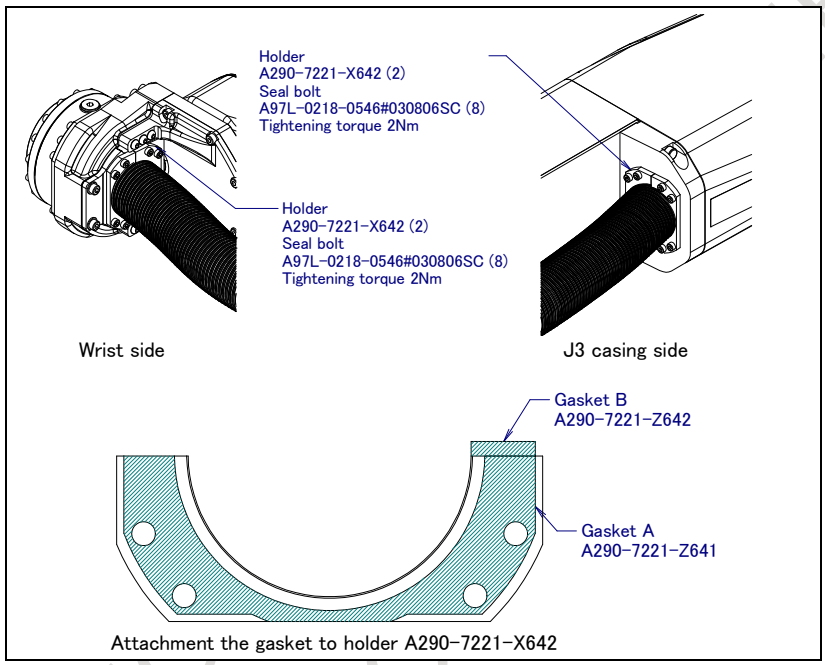


Fig. 6.21 (b) Replacing No dust M/H conduit (2/3)

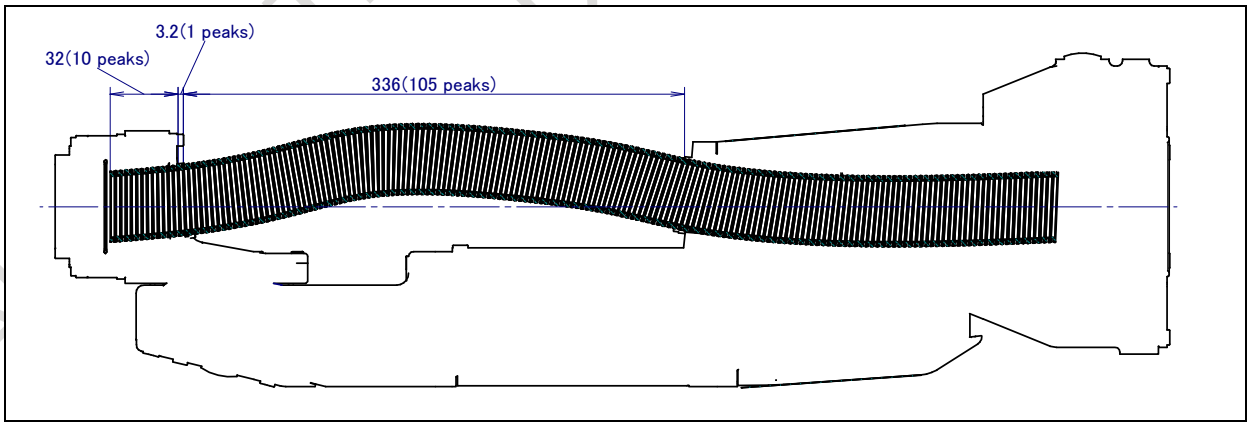


Fig. 6.21 (c) Replacing No dust M/H conduit (3/3)

(When attaching No dust M/H conduit to which is ordered after shipment of the robot)

1 Remove fluoric resin ring referring to Section 6.22.
2 Remove the duct cover and clean the tap hole.
3 Remove the plate cover and clean the tap hole.

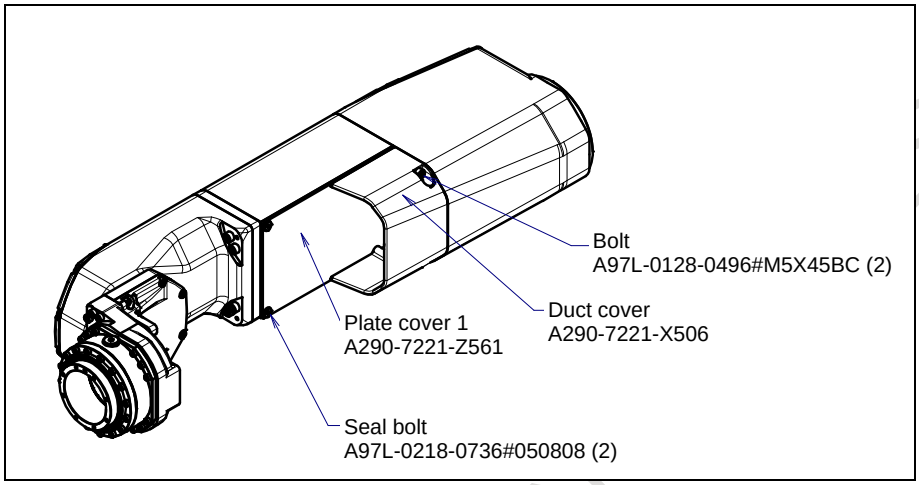


Fig. 6.21 (d) Attach No dust M/H conduit (1/4)

4 Paste the gasket (A290-7221-X647) to the plate cover 1 (A290-7221-X561).

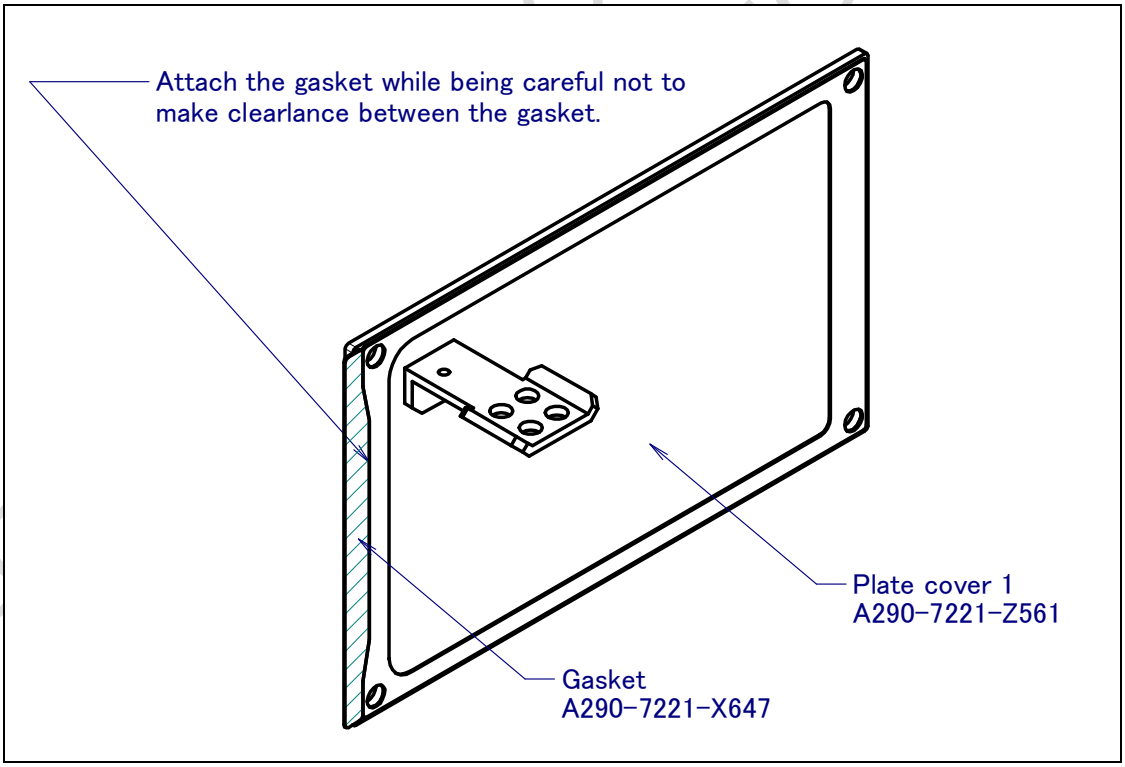


Fig. 6.21 (e) Attach No dust M/H conduit (2/4)

5 Fix the plate cover 1 (A290-7221-Z561) with 2 seal bolts. Tightening torque is 4.5Nm. Bend the gasket (A290-7221-X647) to have no gap at the corner.

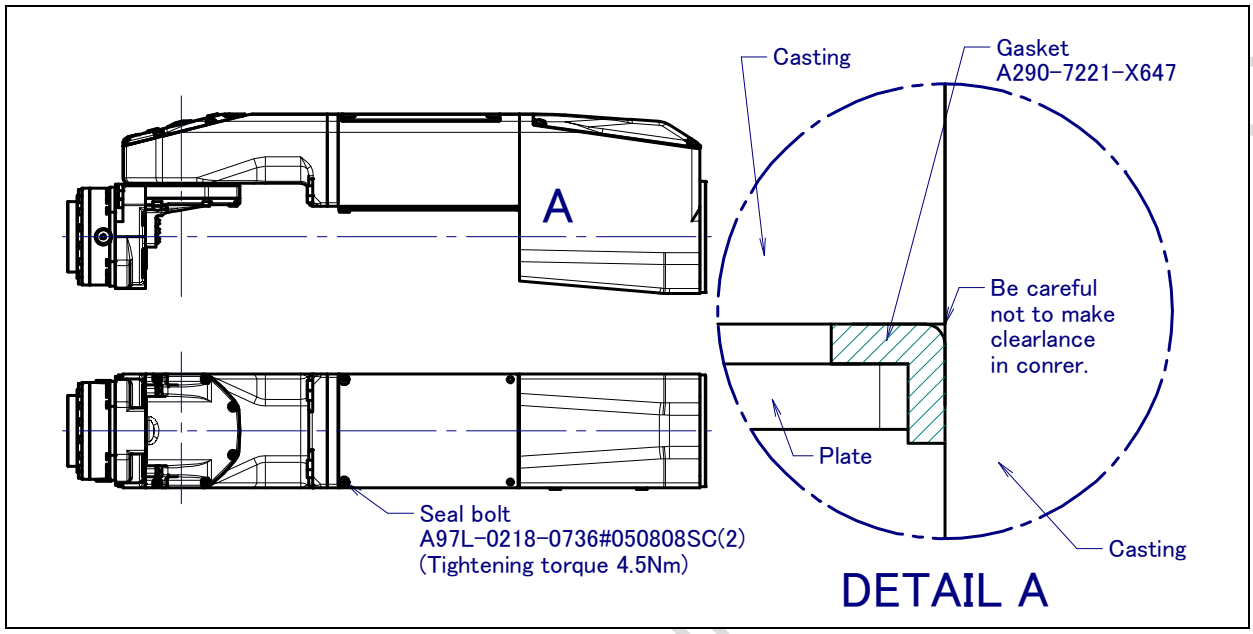


Fig. 6.21 (f) Attach No dust M/H conduit (3/4)

6 Fix the J3 adapter (A290-7221-X643) of no dust M/H conduit to J3 arm. Bolts are 2 RF coating bolts. Tighten them with tightening torque 9Nm after applying LOCTITE 263 into taps.

7 Fix the J6 adapter (A290-7221-X641) of no dust M/H conduit to J6 housing (A290-7221-X503) pushing it to the direction of arrow D of Fig. 6.21 (g). Then confirm that the gap between J5 adapter (A290-7221-X502) and J6 adapter (A290-7221-X641) is less than 2.5mm. Bolts are 2 stainless coating bolts. Washers are 2 stainless washers. Tighten them with tightening torque 4.5Nm after applying LOCTITE 243 into taps.

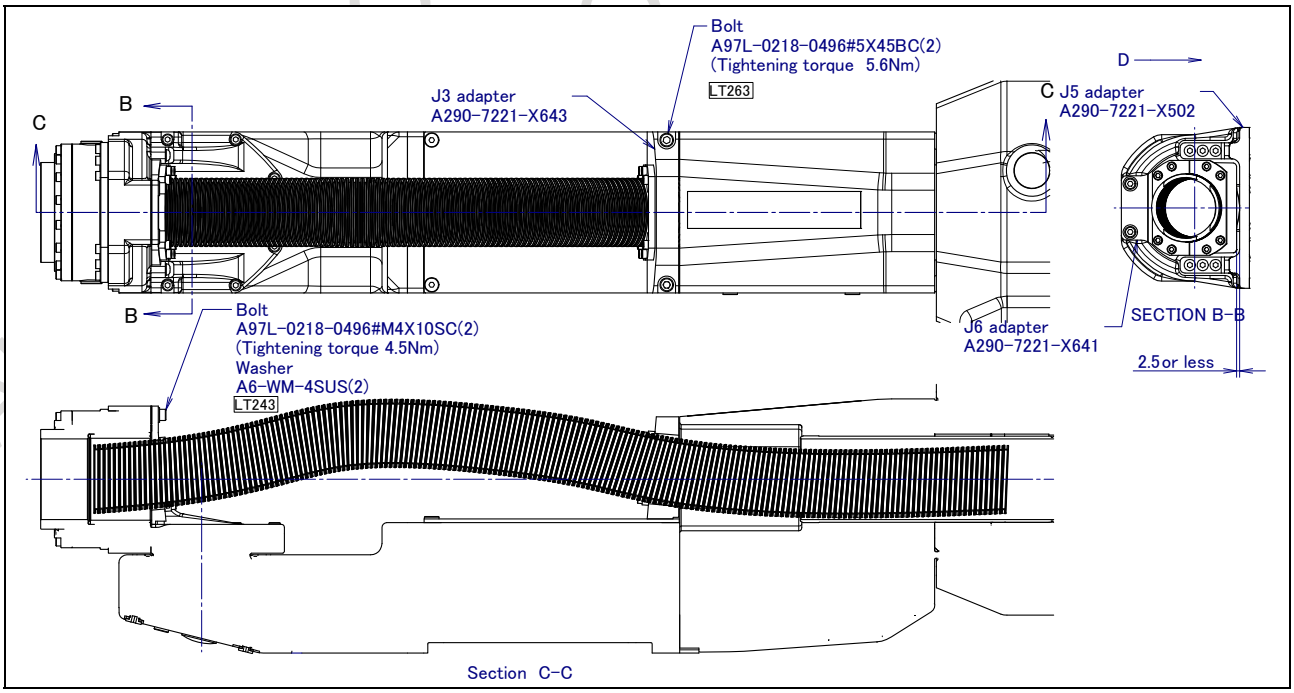


Fig. 6.21 (g) Attach No dust M/H conduit (4/4)

6.22 REPLACING FLUORIC RESIN RING

1 Remove the all cable connection of J3 casing.
2 Remove the plated bolts (2pcs) as shown Fig. 6.22 (a), then remove the end of M/H conduit unit from J6 hollow part.
3 Remove the fluoric resin ring using needle-nose pliers and other tool. Be careful not to hurt the J6 housing.
4 Replace the fluoric resin ring, and insert it to J6 hollow part until the edge of it get in groove inside of J6 hollow part.
5 Correct the strained of the fluoric resin ring using the screwdriver and other tool.
6 Attach the M/H conduit unit and the cable connection of J3 casing. Assemble them while paying attention that circumference of adapter does not interfere inside of out shaft of J6 hollow part. (Otherwise abnormal noise occurs.) Confirm there is a clearance between them. In this time, note that the plated bolts are applied LOCTITE 243 to internal thread and are tightened by regulated torque.

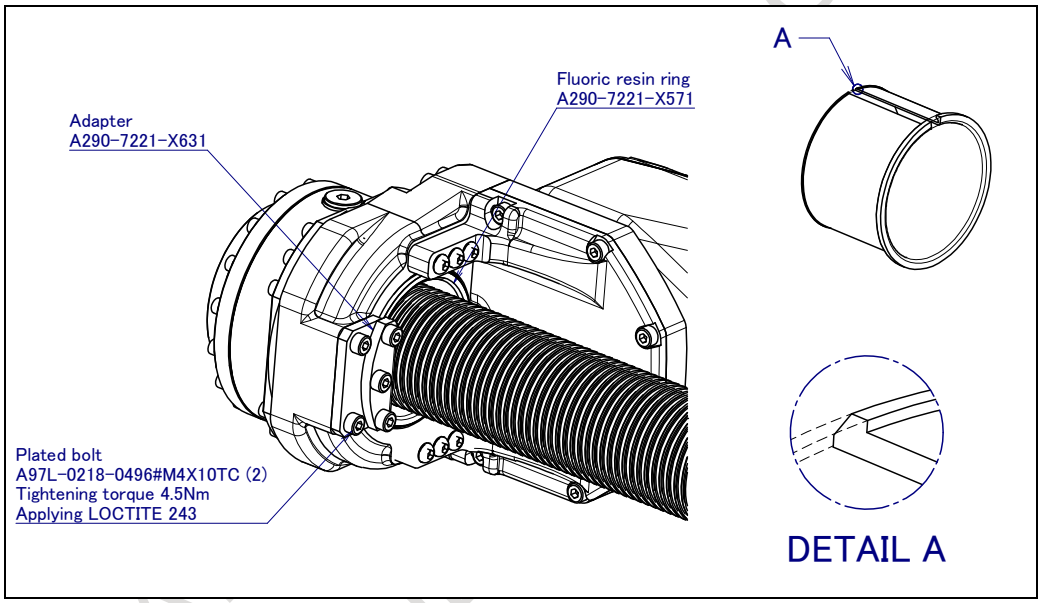


Fig. 6.22 (a) Replacing fluoric resin ring

6.23 SEALANT APPLICATION

Washing and degreasing the surfaces to be sealed

1 After removing the reducer, the surfaces that were sealed with LOCTITE 518 must be cleaned and all old LOCTITE 518 must be removed. Apply LOCTITE Gasket Remover to the surface to be cleaned. Allow 10 minutes to soften the old LOCTITE 518. After the LOCTITE has softened it can be removed using a scraper.
2 Blow air onto the surface to be sealed to remove dust from the tapped holes.
3 Sufficiently degrease the reducer's surface to be sealed and the arm's surface to be sealed, using a cloth dampened with solvent. Do not spray solvent directly onto the surface.
4 Polish the surfaces of the reducer to be sealed with an oil stone, and degrease them with removal and cleaner again.

> ⚠ **CAUTION**
> Oil may drip from inside of the reducer. Check that there are no oil drips thoroughly after you have finished degreasing.

Applying sealant

5 Make sure that the reducer and surfaces of the items to be sealed are dry (with no oil and grease remover remaining). If they are still wet with oil and grease remover, wipe them dry. Always use a new surface of a cloth so that the grease once wiped up with the cloth will not get on the degreased surface. Make sure that no wet solvent exists in the threaded holes or on any sealing surfaces. If solvent is still present, it can prevent the LOCTITE from curing.
6 Apply sealant (LOCTITE 518) to the surfaces.

> ⚠ **CAUTION**
> See descriptions of reducer replacement and check the areas to which sealant is to be applied to be sure they are clean and dry. Otherwise, the sealant will not adhere properly.

Assembly

7 To prevent dust from sticking to the areas to which sealant was applied, mount the reducer as quickly as possible after sealant application. Be careful not to touch the applied sealant. If sealant was wiped off, apply again.
8 After installing the reducer, fasten it with bolts and washers quickly so that the mated surfaces are pressed together.
9 After attaching the reducer, wipe off any excessive sealant that comes out from the sealed section with a cloth or spatula. Do not use oil and grease remover.

> ⚠ **CAUTION**
> Do not grease or move the reducer before the sealant sets, as it may allow grease to leak. Before greasing or moving, wait for at least one hour after the reducer is mounted.

7 REPLACING PARTS (10M/10MS)

Once motors, reducers, gearbox and wrist unit are replaced, mastering becomes necessary, perform mastering according to Chapter 9 after any of these components are replaced.

NOTE
1 Be very careful when dismounting and mounting the heavy components that are listed below.
2 This Chapter assumes that robot is floor mount. If other installation is adopted, consider relative angle of from posture of floor mount.

Component	Model	Weight (approximate)
J3 arm (See Fig. 7.10 (a))	10M/10MS	12.5 kg
All components from J3-axis reducer to wrist unit (See Fig. 7.10 (c))	10M/10MS	28 kg
All components from J2 arm to wrist unit (The J2-axis reducer is not included) (See Fig. 7.5 (a))	10M/10MS	45 kg
All components from J2 base to wrist unit (See Fig. 7.3 (a))	10M/10MS	80 kg
Wrist unit (See Fig. 7.13 (a))	10M/10MS	7 kg

NOTE
1 When applying LOCTITE to a part, spread the LOCTITE on the entire length of the engaging part of the female thread. If applied to the male threads, poor adhesion can occur, potentially loosening the bolt. Clean the bolts and the threaded holes and wipe off any oil on the engaging section. Make sure that there is no solvent left in the threaded holes. When finished, remove all the excess LOCTITE when you are finished screwing the bolts into the threaded holes.
2 Description of [LT243] means LOCTITE 243.
3 Description of [LT263] means LOCTITE 263.
4 Description of [LT518] means LOCTITE 518.
5 Description of [LT675] means LOCTITE 675.

7.1 DRIVE MECHANISM

The drive mechanisms of each axis are shown in the following figures.

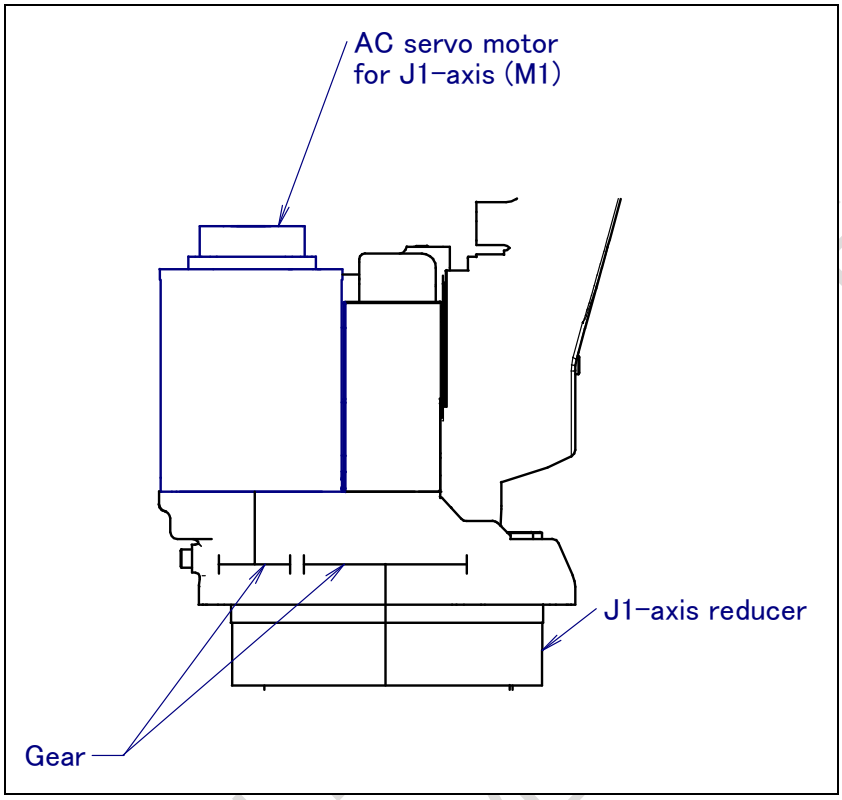


Fig. 7.1 (a) Drive mechanism of J1-axis

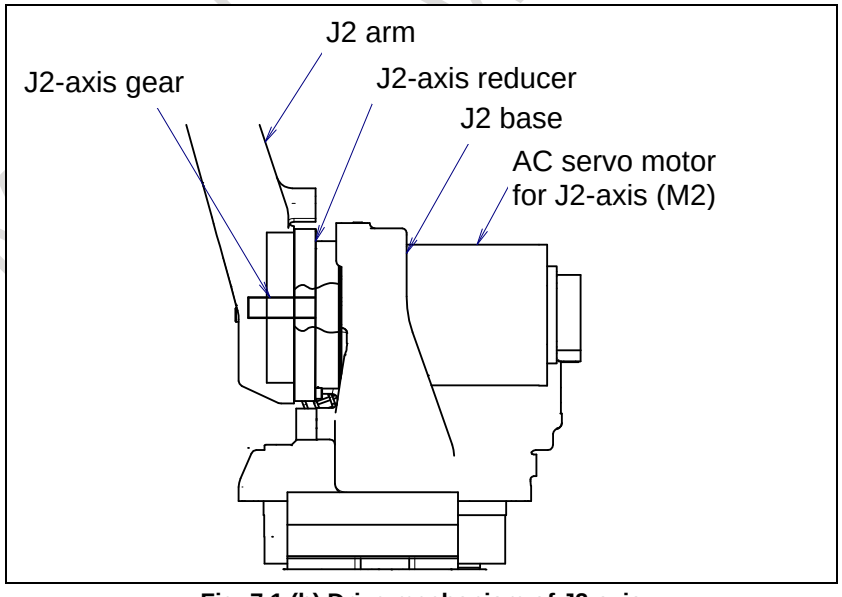


Fig. 7.1 (b) Drive mechanism of J2-axis

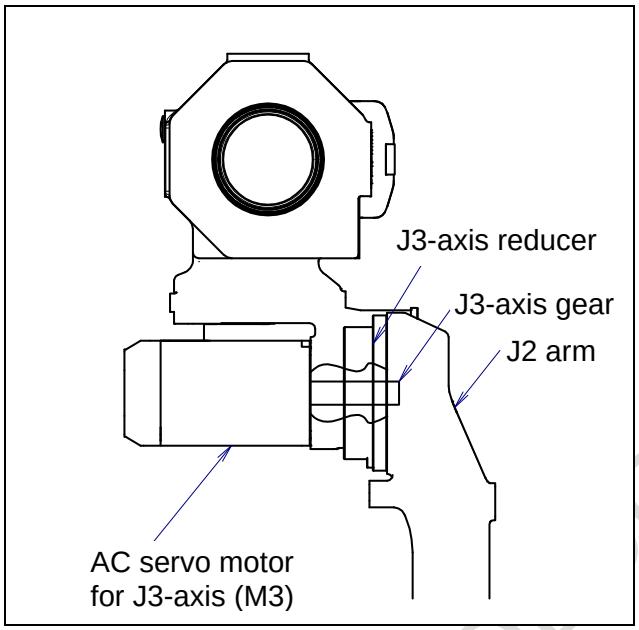


Fig. 7.1 (c) Drive mechanism of J3-axis

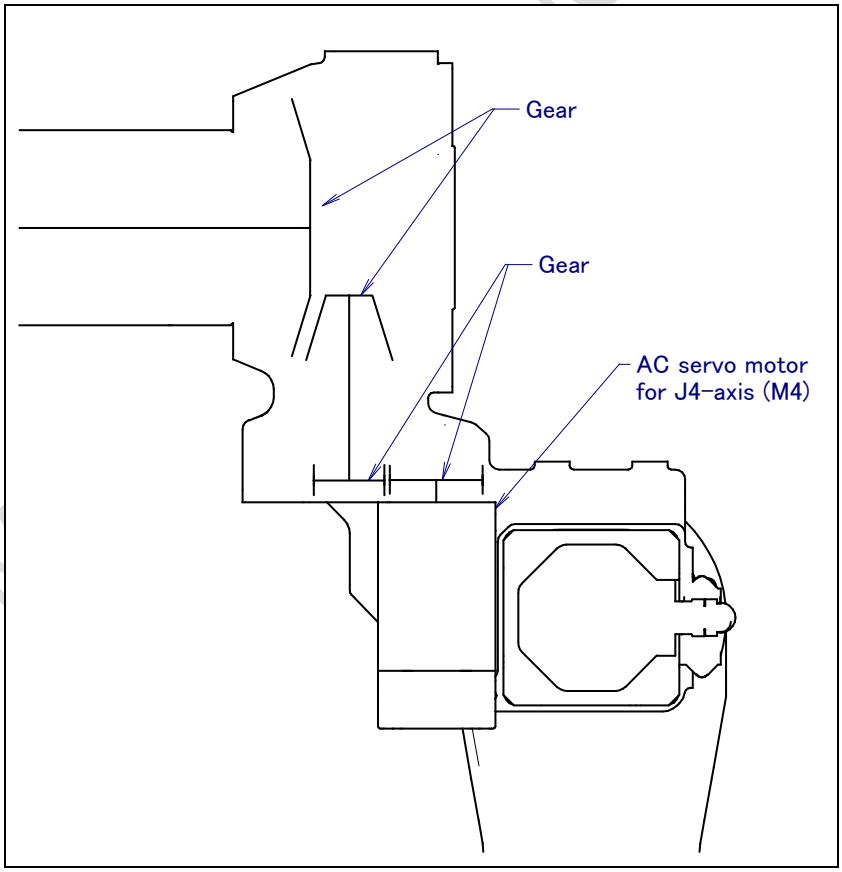


Fig. 7.1 (d) Drive mechanism of J4-axis

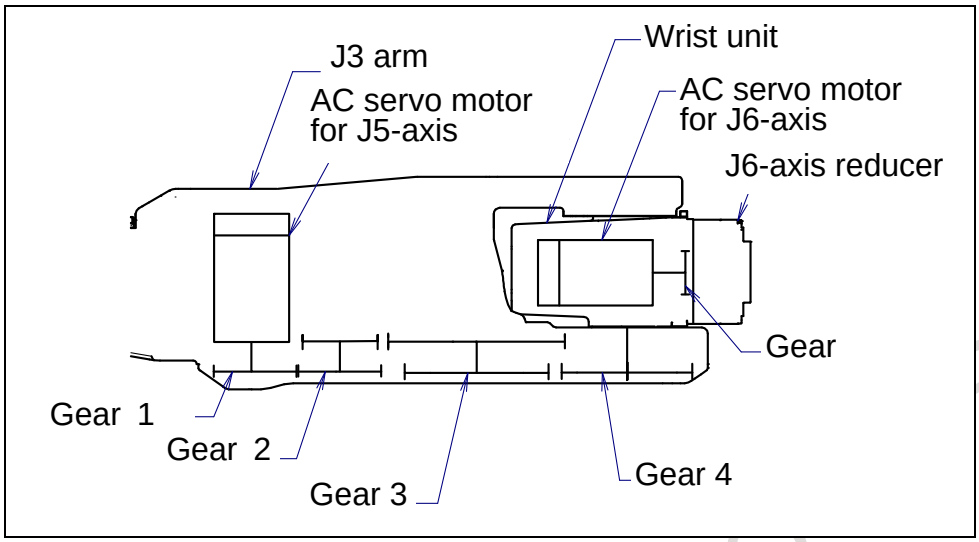


Fig. 7.1 (e) Drive mechanism of J5/J6-axis

7.2 REPLACING THE J1-AXIS MOTOR (M1)

1 Set a dial gauge at the J1-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Turn off controller power.
3 When the J2 cover (option) is attached, remove it referring to Section 7.13.
4 Remove the connector of a cable leading to the J1-axis motor.
5 Remove the motor mounting bolts (1). Dismount the motor from the J2 base. When dismounting the motor, be careful of the grease that may drop from the motor if the robot is suspended from a ceiling or mounted on a wall.
6 Remove the M10 hexagonal nut (5) from the motor shaft, and pull out the gear (3).
7 Attach the gear (3) to a new motor (2).
8 Attach an M10 spring washer (4), apply LOCTITE 243 to the M10 threaded n of the nut (5), and tighten the M10 nut with a specified torque of [20 Nm].
9 Replace the O-ring (6) by a new one and put it into the J2 base where the J1-axis motor is to be mounted, and fasten them with bolt (1).
10 Connect cable connectors to the J1-axis motor.
11 When the J2 cover (option) was attached, attach it referring to Section 7.13.
12 According to Section 4.3, supply the J1-axis reducer with the specified grease if grease is overflowed.
13 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

NOTE
If there is a danger that the J1-axis section may fall, for example, because the robot is installed except floor mount, fix the J1-axis section during replacement work, for example, by pushing the J1-axis mechanical stopper against the J1-axis section.

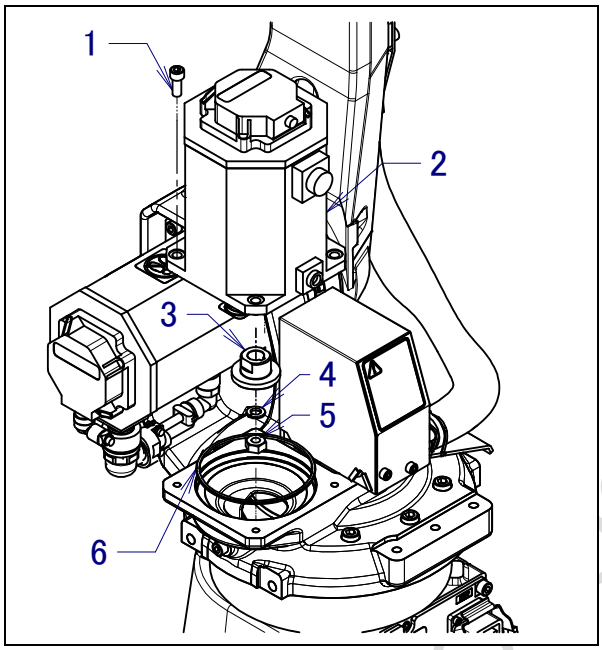


Fig. 7.2 (a) Replacing the J1-axis motor

	Parts name	Specification	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-8X20	4		
2	MOTOR(NOTE)	A06B-0235-B605 #S000 (*1)	1		
		A06B-2235-B605 (*2)			
3	GEAR	A290-7215-X211	1		
4	WASHER (Attached to motor)	A6-WB-10S-M-NI	1		
5	NUT (Attached to motor)	A6-N1-10X1.25S-M-NI	1	LT243	20
6	O-RING	JB-OR1A-G105	1		

NOTE
Both of (*1), (*2) motors can be used. However, we recommend (*2) when ordering motors.

7.3 REPLACING THE J1-AXIS REDUCER

1 Set a dial gauge at the J1-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
3 Put the robot in such a position that the J2 base and the portions above it can be suspended with a crane or the like (hereafter abbreviated as a crane), and then turn off controller power. (See Fig. 7.3 (a))
4 While referencing Section 8.4, pull out the cables below the J2 base from the J1-axis hollow pipe section toward the upper portion of the J2 base.
5 While referencing Section 7.2, remove the J1-axis motor from the J2 base.
6 Suction the grease with a vacuum cleaner to prevent grease from splattering.
7 As shown in Fig. 7.3 (b), remove the bolts (1) that fasten the J2 base to the J1-axis reducer.
8 While referencing Section 7.3 (a), hoist the J2 base and portions above it slowly.
9 As shown in Fig. 7.3 (b), remove the O-ring (2), and gear (4) which bearings are attached. Bearing (3) rarely left in J2 base. It is not necessary to remove bearing in this case, when bearing (3) was broken, break oil seal (11) and remove both oil seal and bearing then replace them by new article referring to Fig. 7.3 (c).
10 Remove the bolts (6) that fasten the J1-axis reducer to the J1 base, and dismount the reducer.
11 Disconnect the pipe (8).
12 Replace the O-ring (9) with a new one and fit it with the pipe (8) correctly.
13 Replace the O-ring (10) with a new one and attach it to a new reducer, and fasten the reducer to J1 base with bolts (6) (by applying LOCTITE 263 and tightening with a torque of [129 Nm]).
14 Mount the center gear, bearing (with LOCTITE 675 applied to its outer ring), and O-ring (2) to the reducer. When bearing is broken in this process, replace bearing by new one. When replacing oil seal (11), press-fit it by using fixture in Fig. 1.3 (c).
15 Fasten the J2 base to the reducer with bolts (1) (by applying LOCTITE 263 and tightening with a torque of [73.5 Nm]). Be careful not to let the pipe damage the oil seal.
16 According to Section 7.2, mount the J1-axis motor on the J2 base.
17 According to Section 8.4, mount the cables.
18 According to Section 4.3, supply the J1-axis reducer with the specified grease.
19 Perform quick mastering and perform single axis mastering for J1-axis. Refer to the QUICK MASTERING and SINGLE AXIS MASTERING of the mechanical unit operator's manual (B-82754EN).

NOTE
When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear (A290-7215-X211) of J1-axis motor shaft, gear (A290-7215-X212) on J1-axis reducer and bearing (A97L-0001-0192#1400000).

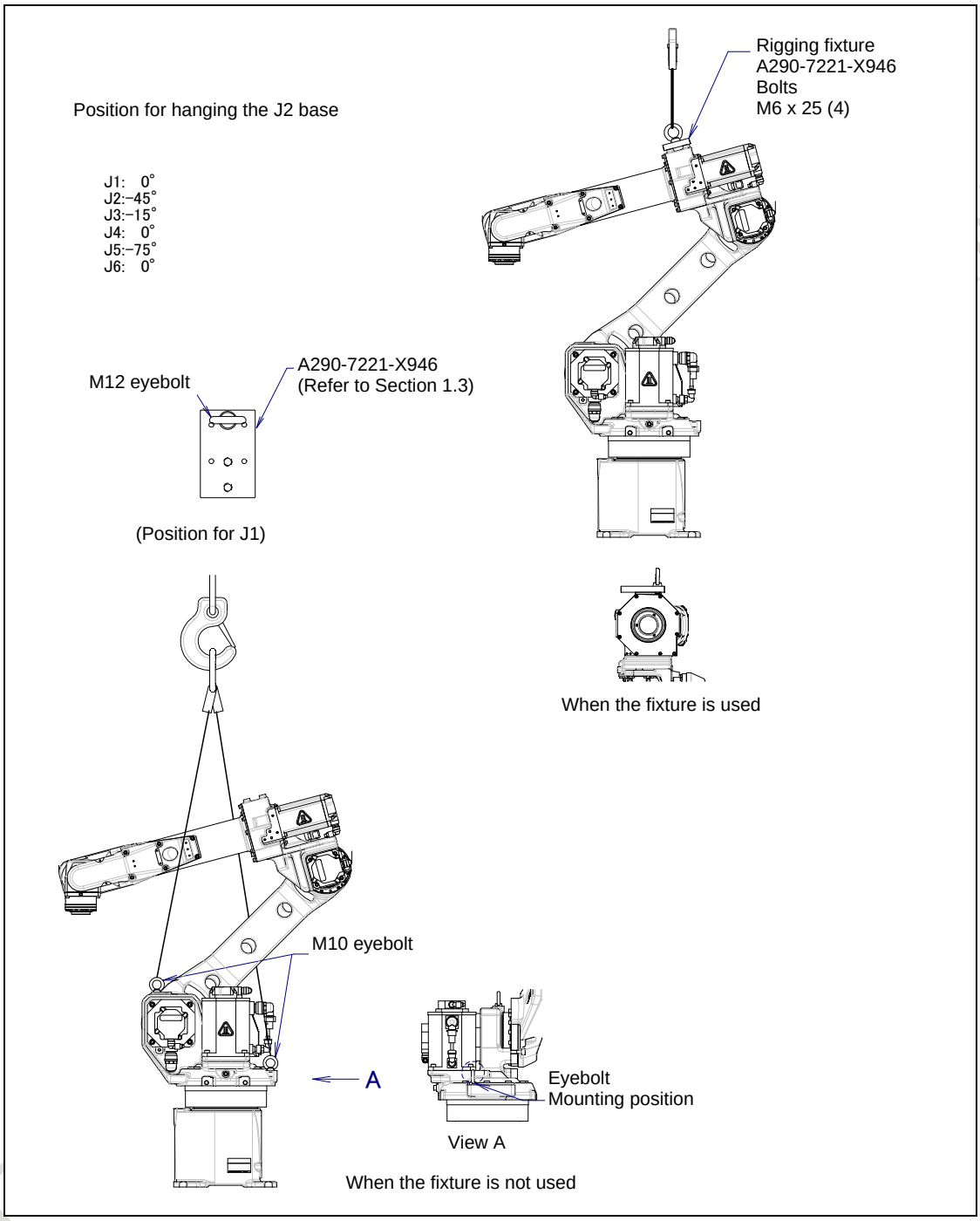


Fig. 7.3 (a) Hanging method of the J2 base

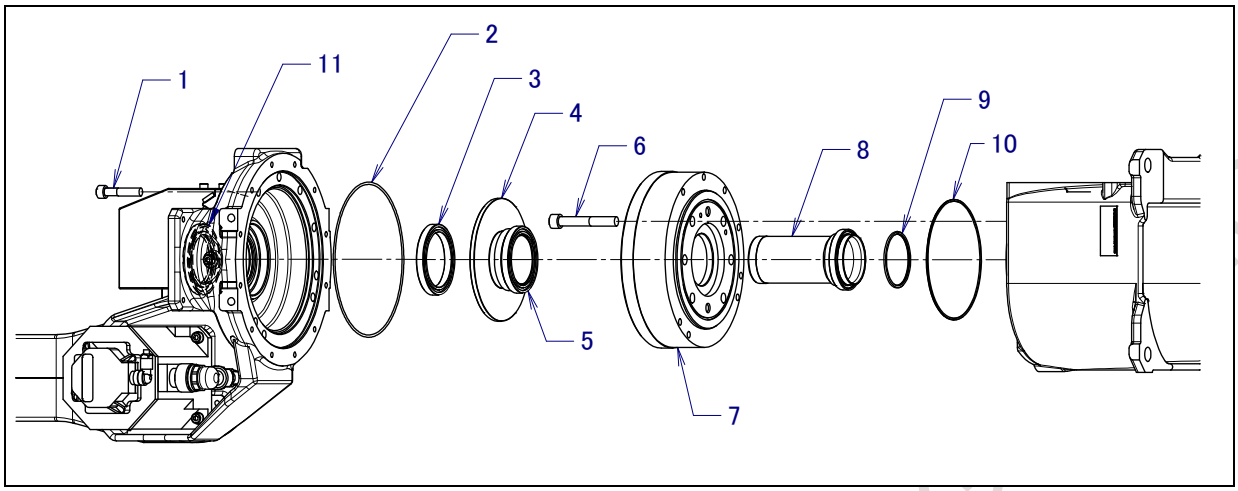


Fig. 7.3 (b) Replacing the J1-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-10X50	8	LT263	73.5
2	O-RING	A290-7207-X342	1		
3	BEARING	A97L-0001-0192#1400000	1		
4	GEAR	A290-7221-Z212	1		
5	BEARING	A97L-0001-0192#1400000	1		
6	BOLT	A6-BA-12X80	6	LT263	129
7	REDUCER	A97L-0218-0885#33	1		
8	PIPE	A290-7215-X215	1		
9	O-RING	JB-OR1A-G65	1		
10	O-RING	A98L-0001-0347#S150	1		
11	OIL SEAL	A98L-0040-0047#06009008	1		

7.4 REPLACING THE J2-AXIS MOTOR (M2)

1 Set a dial gauge at the J2-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Push the J2-axis section against the mechanical stopper, or refer to Fig .7.5 (a), fix it in such a way that it will not swivel when the motor is dismounted.

NOTE
If the J2-axis section is not pushed against the stopper correctly, or it is not placed in the direction of gravity, there is a danger that the J2-axis section will swivel when the J2-axis motor is removed.

3 Turn off controller power.
4 When the J2 cover (option) is attached, remove it referring to Section 7.14.
5 Remove the connector of a cable leading to the J2-axis motor.
6 Remove the motor mounting bolts (1), and dismount the motor from the J2 base.
7 Remove the bolt (5) that fastens the gear (4), and dismount the gear (4). Also, remove the draw nut (3) from the motor shaft.
8 Apply LOCTITE 243 to the threaded portion of a draw nut (3) and tighten the draw nut to shaft of new motor (2) with a torque of [16.7 Nm].
9 Put the gear (4) over the draw nut (3), apply LOCTITE 243 to the M6 threaded portion of the draw nut (3), and tighten the bolt (5) with a torque of [6.8 Nm].
10 Replace the O-ring (6) with a new one and put it into the J2 base portion where the motor is to be mounted, and fasten the motor to the J2 base with bolts (1). Do not force in the motor. Otherwise, the gear may not settle in the correct place, possibly causing vibration (if the gear is engaged correctly, the motor will be mounted smoothly).
11 Connect cable connectors to the J2-axis motor.
12 When the J2 cover (option) was attached, attach it referring to Section 7.14.
13 According to Section 4.3, supply the J2-axis reducer with the specified grease.
14 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

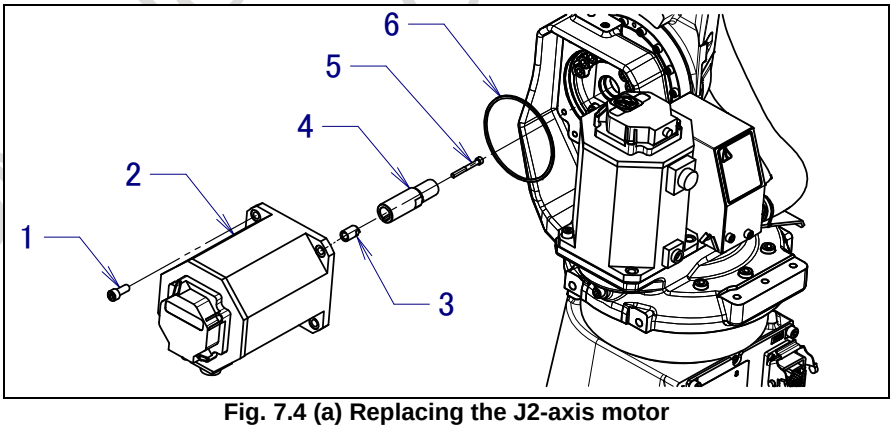


Fig. 7.4 (a) Replacing the J2-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-8X20	4		
2	MOTOR (NOTE)	A06B-0235-B605 #S000 (*1) A06B-2235-B605 (*2)	1		
3	DRAW NUT	A290-7221-X321	1	LT243	16.7
4	GEAR	A290-7221-X311	1		
5	BOLT	A6-BA-5X45	1	LT243	6.8
6	O-RING	JB-OR1A-G105	1		

NOTE
Both of (*1), (*2) motors can be used. However, we recommend (*2) when ordering motors.

7.5 REPLACING THE J2-AXIS REDUCER

1 Set a dial gauge at the J2-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Put the robot in such a posture that the J2 arm and the components on it can be suspended with a crane.
3 Turn off controller power.
4 Suspend the J2 arm and the components on it as shown Fig. 7.5 (a) with a crane so that they will not drop when the J2 arm is dismounted. (If there is the fixture shown in Fig. 7.5 (a), work improves. Use the eyebolts delivered with the J2 base when robot is shipped.)
5 Remove the J2-axis motor as described in Section 7.4 (If the reducer is replaced while the motor is still mounted, the gear may be damaged.)
6 Suction the grease with a vacuum cleaner to prevent grease from splattering.
7 Remove the bolts (1) that fasten the reducer (4) to J2 base and the adapter (2) and remove bolts (3) that fasten the reducer (4) to J2 arm .Be careful not to allow an excessive load to be put on the cables (because the cables are left attached when the reducer is dismounted).
8 Insert new O-ring (5) to the J2 arm reducer mounting part referring to Fig. 7.5 (c), then insert the new reducer (4), and fasten them with bolts (3) (by applying LOCTITE 263 and tightening with a torque of [15.6 Nm]).
9 Degrease both the J2 base and the J2-axis reducer surfaces that are to meet each other, and as shown in Fig. 7.5 (d), apply sealant (LOCTITE 518) to the J2-axis reducer on which the J2 base is to be mounted.
10 Mount the reducer to the J2 arm with bolts (1) (by applying LOCTITE 263 and tightening with a torque of [73.5 Nm]).
11 Mount the J2-axis motor as described in Section 7.4.
12 According to Section 4.3, supply the J2-axis reducer with the specified grease.
13 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

NOTE
When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear of J2-axis motor shaft.

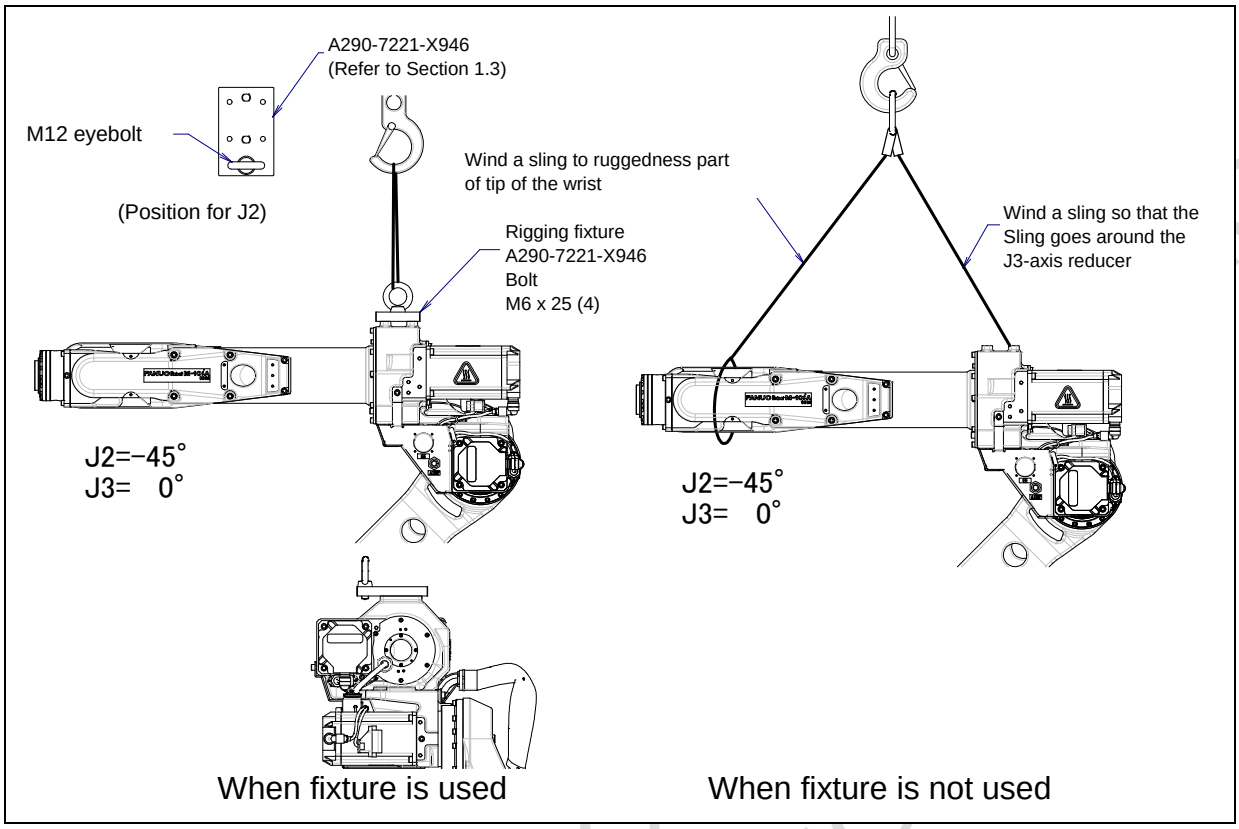


Fig. 7.5 (a) Sling to the J2 and the J3 arm

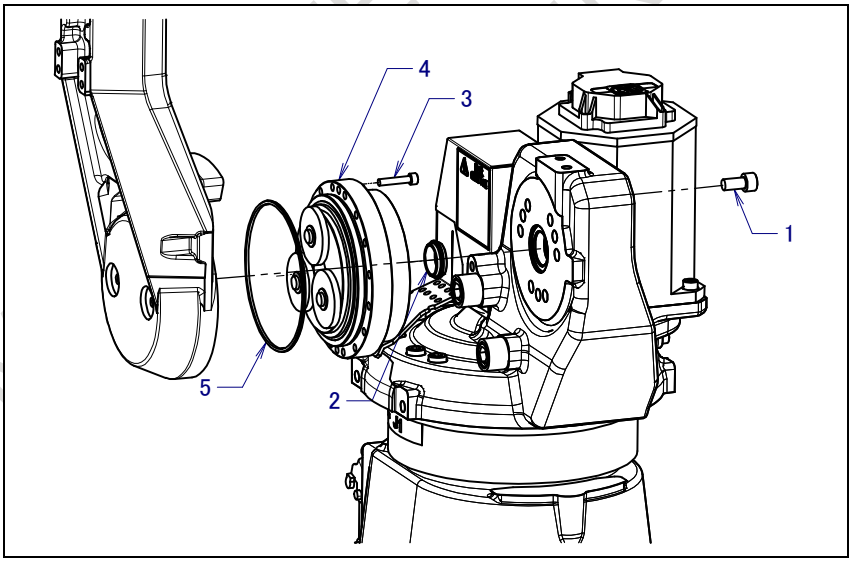


Fig. 7.5 (b) Replacing the J2-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-10X20	9	LT263	73.5
2	ADAPTER	A290-7221-X322	1		
3	BOLT	A6-BA-6X30	16	LT263	15.6
4	REDUCER	A97L-0218-0886#127 (*1)	1		
		A97L-0218-0886#93 (*2)			
5	O-RING	JB-OR1A-G130	1		

(*1) M-10*i*A/10M
(*2) M-10*i*A/10MS

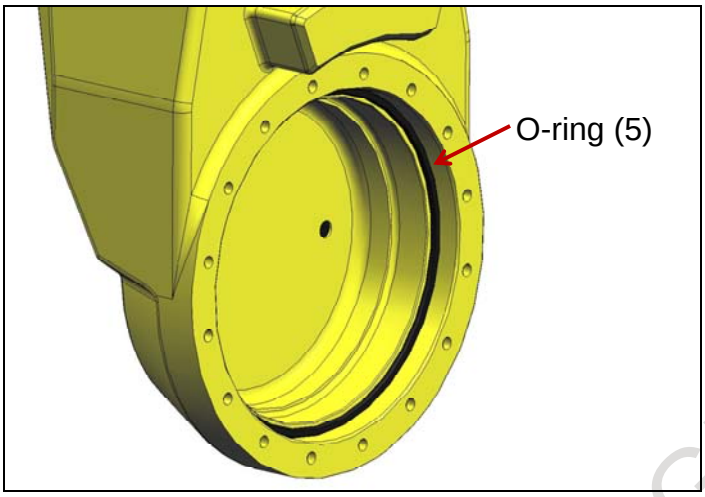


Fig. 7.5 (c) Inserting position of the O-ring (5)

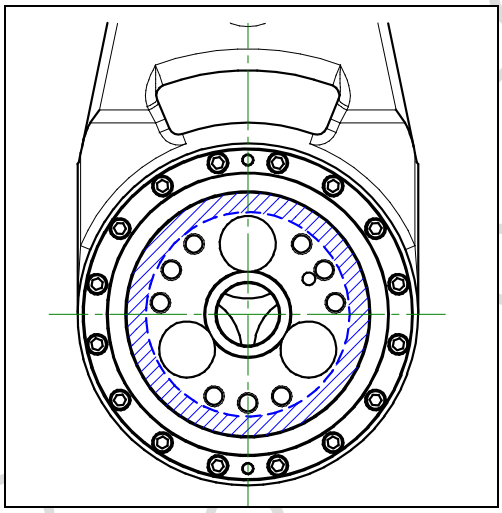


Fig. 7.5 (d) Applying sealant on the J2-axis reducer

NOTE
Refer to Section 7.15 about applying sealant (LOCTITE 518).

7.6 REPLACING THE J3-AXIS MOTOR (M3)

NOTE
Fixtures are necessary for replacing J3-axis motor and reducer. See Section1.3.

1 Set a dial gauge at the J3-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Place the robot in the posture J2=0^{o}. At this chance, confirm J1 base is fixed to prevent from falling.
3 Put the robot in such a posture that the J3-axis section and the components on it can be suspended with a crane, (If there is the fixture shown in Fig. 7.6 (a), work improves.)
4 Turn off controller power.
5 When the J3 cover (option) is attached, remove it referring to Section 7.15.
6 Remove the connector of a cable leading to the J3-axis motor.
7 Remove the bolts (1) that fasten the J3-axis motor to the J3 casing, and dismount the motor (2) and gasket (7).
8 Remove the bolt (6) from the motor shaft, and dismount the gear (5) and draw nut (4).
9 Apply LOCTITE 243 to the threaded portion of draw nut (4) and tighten it to the new motor with a torque of [3.1 Nm].
10 Put the gear (5) over the draw nut (4), apply LOCTITE 243 to the M5 threaded portion of the draw nut (4), and tighten the bolt (6) with a torque of [3.4 Nm]. Refer to Section 7.7 about mounting gear to J3-axis motor. In this time, be sure to attach the key (3), too.
11 Attach new gasket (7), and insert the motor into the reducer. Keep the J3-axis degrease outlet on the J2 arm side open (see Fig. 4.3.1 (a)), and look into the outlet to make sure that the gear has settled in the correct place. Even one tooth of a shift in engagement can cause vibration. (If the gear (5) is engaged correctly, the motor can get in the reducer smoothly.)
12 Fasten the motor to the J3-axis reducer with bolts (1). Be sure to use a new gasket to prevent grease leakage.
13 Connect cable connectors to the J3-axis motor.
14 When the J3 cover (option) was attached, attach it referring to Section 7.15.
15 According to Section 4.3, supply the J3-axis reducer with the specified grease.
16 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

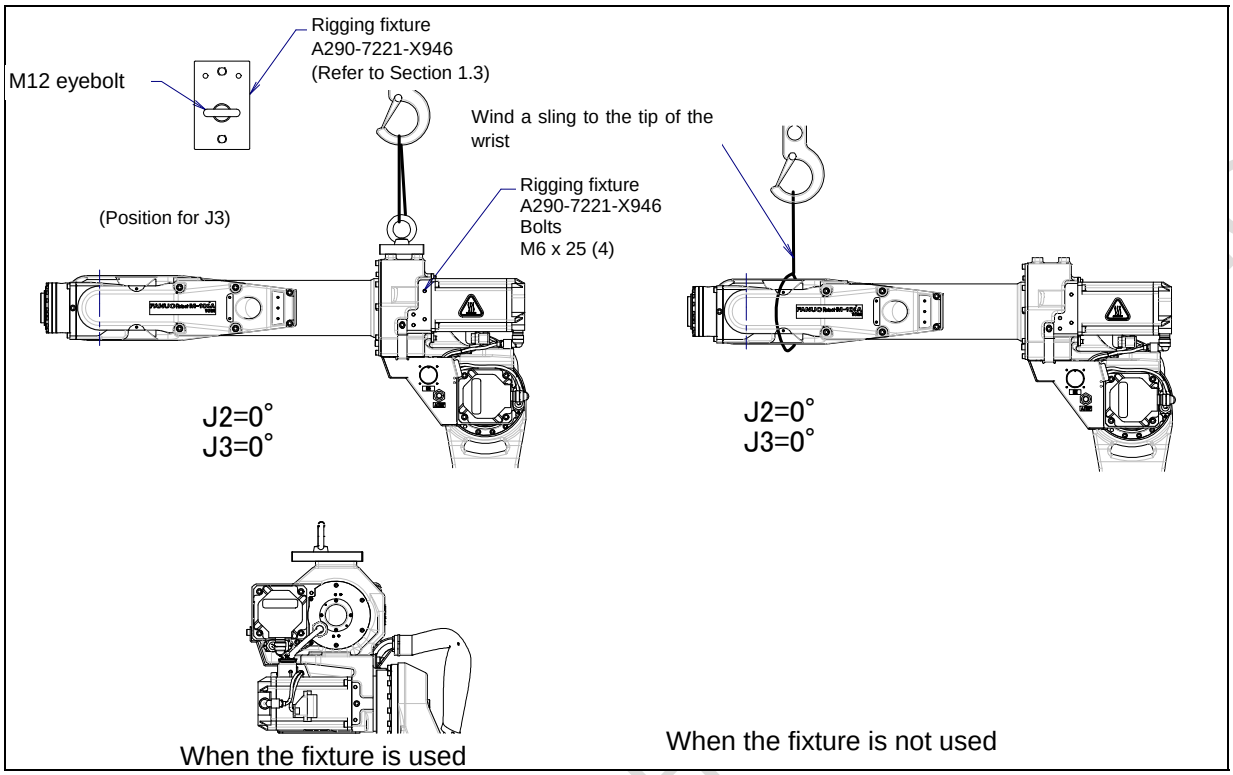


Fig. 7.6 (a) Hanging method of the J3 arm

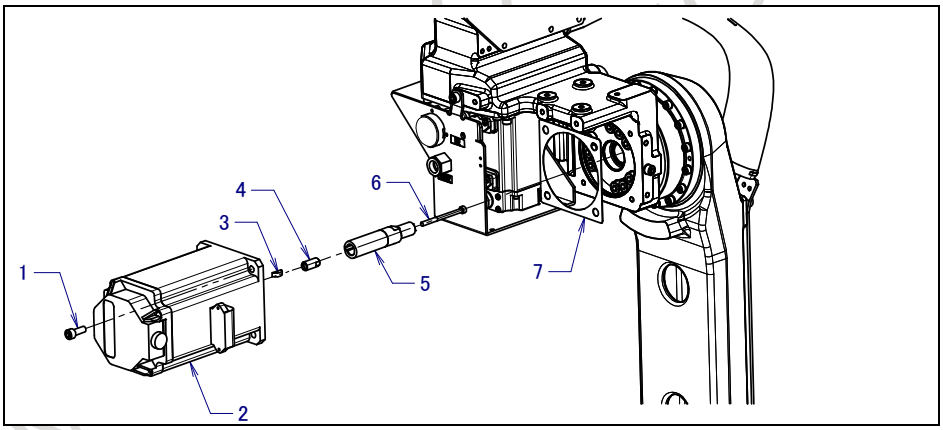


Fig. 7.6 (b) Replacing the J3-axis motor

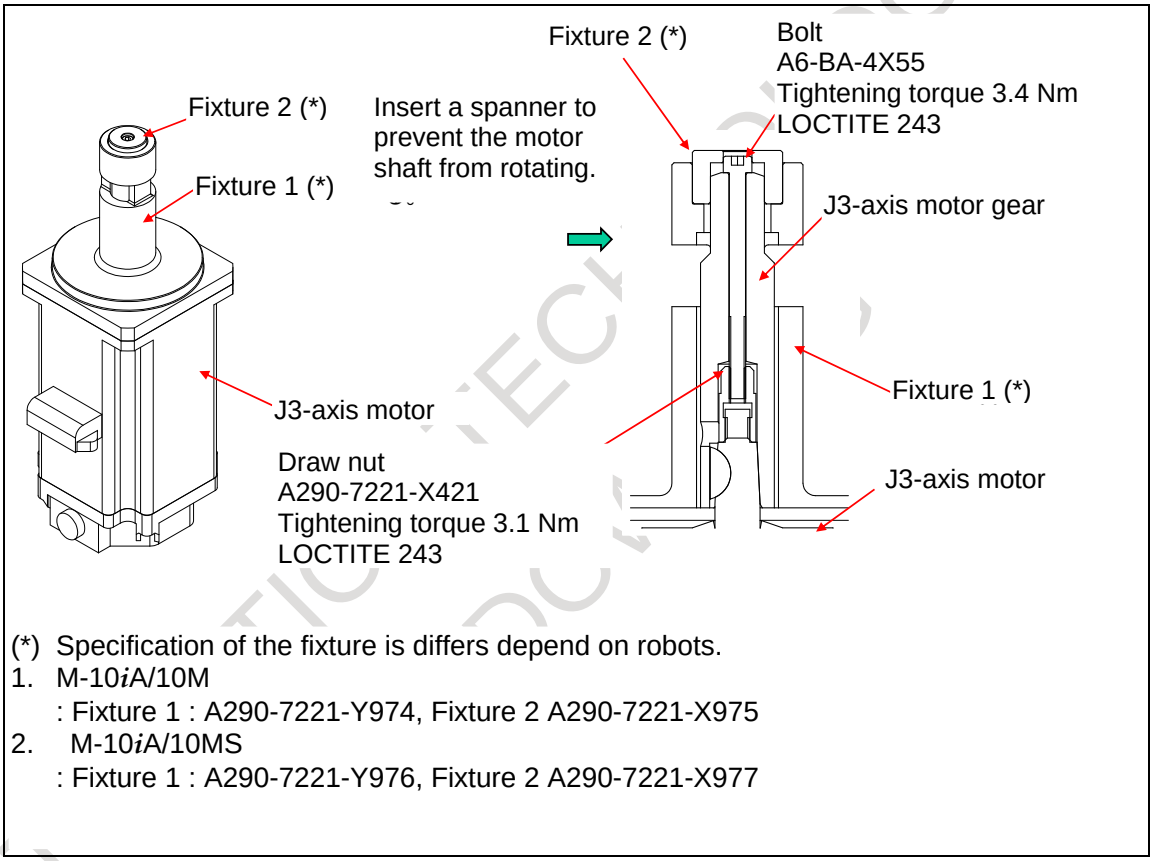
	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X16	4		
2	MOTOR (NOTE)	A06B-0212-B605#S000 (*1)	1		
		A06B-2212-B605 (*2)			
3	KEY (Attached to motor)	JB-HGKYA-4X13	1		
4	DRAW NUT	A290-7221-X421	1	LT243	3.1
5	GEAR	A290-7221-Y411 (*3)	1		
		A290-7221-Y415 (*4)			
6	BOLT	A6-BA-4X55	1	LT243	3.4
7	GASKET	A98L-0040-0042#03	1		

NOTE
Both of (*1), (*2) motors can be used. However, we recommend (*2) when ordering motors.

(*3) M-10*i*A/10M
(*4) M-10*i*A/10MS

7.7 NOTES OF ATTACHING J3-AXIS MOTOR TO REDUCER

1 Apply LOCTITE 243 to thread the Draw Nut (A290-7221-X421) and mount it to the motor shaft by using torque wrench with regulated torque set at 3.1Nm.
2 Attach the woodruff key to motor shaft, confirm there is no dust on taper shaft of motor and insert gear to motor shaft.
3 Mount fixture to motor as Fig. 7.7 (a) for centering.
4 According to Fig. 7.7 (a), apply LOCTITE 243 to thread and tighten bolt (M4 x 55) with regulated torque 3.4Nm while supporting gear with spanner wrench preventing the gear from rotating. (To prevent motor brake slips) Turn the torque wrench until you hear the ratchet sound. This completes setting of the gear on the motor taper shaft. Without this work might cause motor shaft failure. Be careful.
5 Remove the Fixture from the Motor Shaft.



(*) Specification of the fixture is differs depend on robots.
1. M-10*i*A/10M
: Fixture 1 : A290-7221-Y974, Fixture 2 A290-7221-X975
2. M-10*i*A/10MS
: Fixture 1 : A290-7221-Y976, Fixture 2 A290-7221-X977

Fig. 7.7 (a) Attaching the gear on the J3-axis motor

7.8 REPLACING THE J3-AXIS REDUCER

1 Set a dial gauge at the J3-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Put the robot in such a posture that the J3-axis section and the components on it can be suspended with a crane, (If there is the fixture shown in Fig. 7.8 (a), work improves.)
3 Turn off controller power.
4 While referencing Section 8.4, remove the cable from the J2 arm section. While referencing Fig. 7.8 (a), suspend the J3-axis section and the components on it with a crane so that they will not drop when the reducer is dismounted from the J2 arm. Be careful not to allow an excessive load to be put on the cable assembly (because the cables are left attached when the reducer is dismounted).
5 While referencing Section 7.6, dismount the J3-axis motor from the J3 arm unit.
6 Suction the grease with a vacuum cleaner to prevent grease from splattering.
7 Remove bolt (1) that fasten J3-axis reducer to J3 casing via the guide pin (A290-7221-X925 2 pcs) (Fig. 1.3 (b)). In addition, remove J3-axis reducer from J3 casing. (See Fig. 7.8 (c))
8 As shown in Fig. 7.8 (b), remove bolts (4) that fasten the J3-axis reducer to the J2 arm and dismount the J3 arm unit that reducer attaches from the J2 arm.
9 Remove the O-ring (7) and attach new O-ring (7) to the J3-axis reducer installation part of J2 arm. Refer to Fig. 7.8 (d).
10 Suspend the J3-axis section and the components on it with a crane, and fasten the J2 arm and J3-axis reducer with bolts (4) (by applying LOCTITE 263 and tightening with a torque of [9.0 Nm]).
11 Degrease both the J3-axis reducer and the J3 casing surfaces that are to meet each other, and as shown in Fig. 7.8 (e), apply sealant (LOCTITE 518) to the J3-axis reducer surface on which the J3 casing is to be mounted. Attach new reducer to J3 casing, fix it with bolt (1) (by applying LOCTITE 263 and tightening with a torque of [37.2Nm]) via the guide pin (A290-7221-X925 2 pcs) (Fig. 1.3 (b)).
12 While referencing Section 7.6, mount the J3-axis motor on the J3 arm unit.
13 While referencing Section 8.4, dress the cable into the previous form.
14 According to Section 4.3, supply the J3-axis reducer with the specified grease.
15 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator’s manual (B-82754EN).

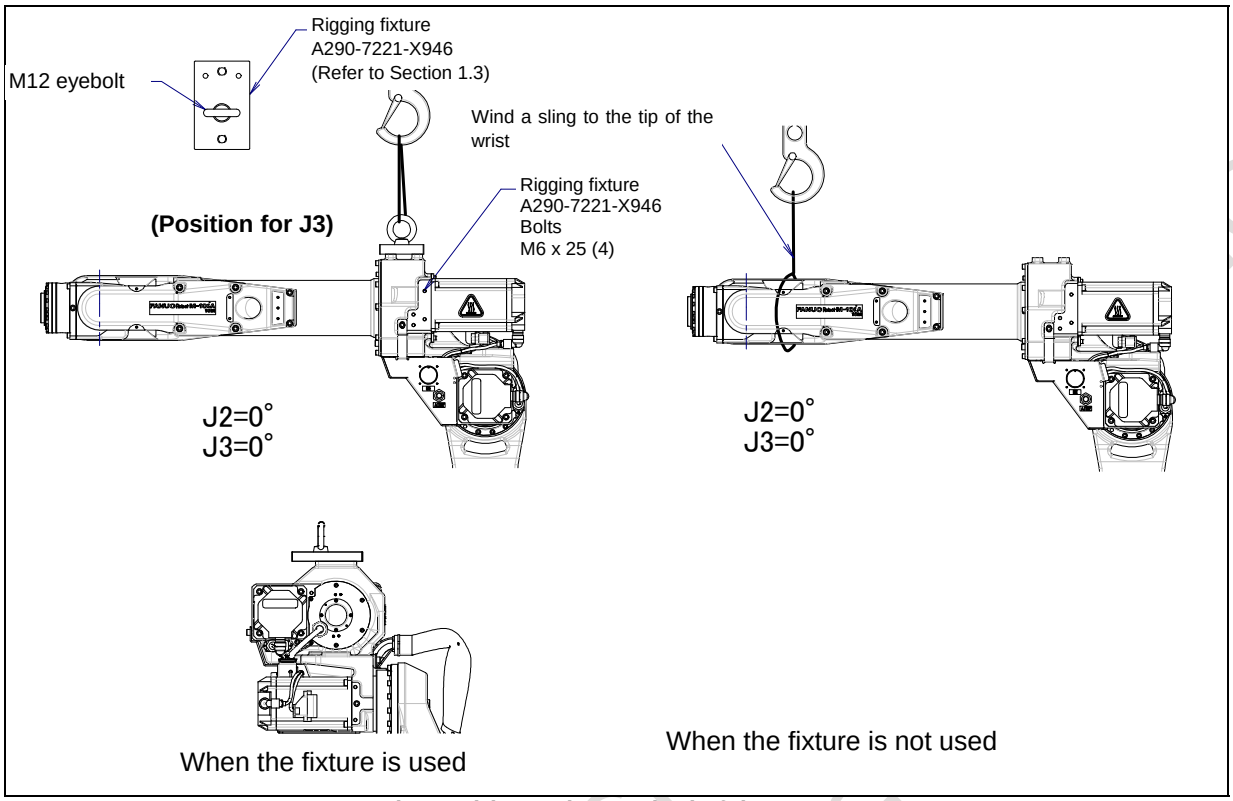


Fig. 7.8 (a) Hanging method of the J3 arm

NOTE
When the influence of the damaged pieces generated from broken reducer is concerned about, replace gear of J3-axis motor shaft.

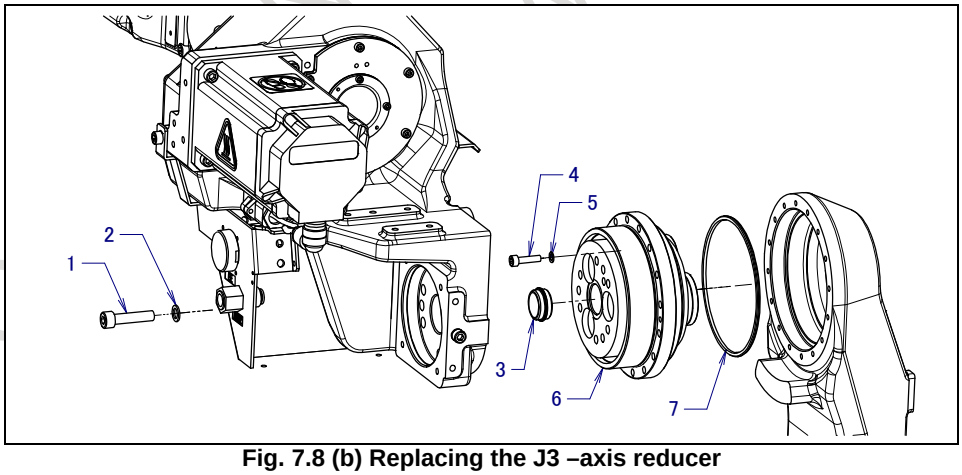


Fig. 7.8 (b) Replacing the J3 –axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-8X25	8	LT263	37.2
2	WASHER	A97L-0001-0823#M8H	8		
3	ADAPTER	A290-7221-X422	1		
4	BOLT	A6-BA-5X20	12	LT263	9.0
5	WASHER	A97L-0001-0823#M5L	12		
6	J3 REDUCER	A97L-0218-0887#150 (*1)	1		
		A97L-0218-0887#108 (*2)			
7	O-RING	JB-OR1A-G108	1		

(*1) M-10*i*A/10M
(*2) M-10*i*A/10MS

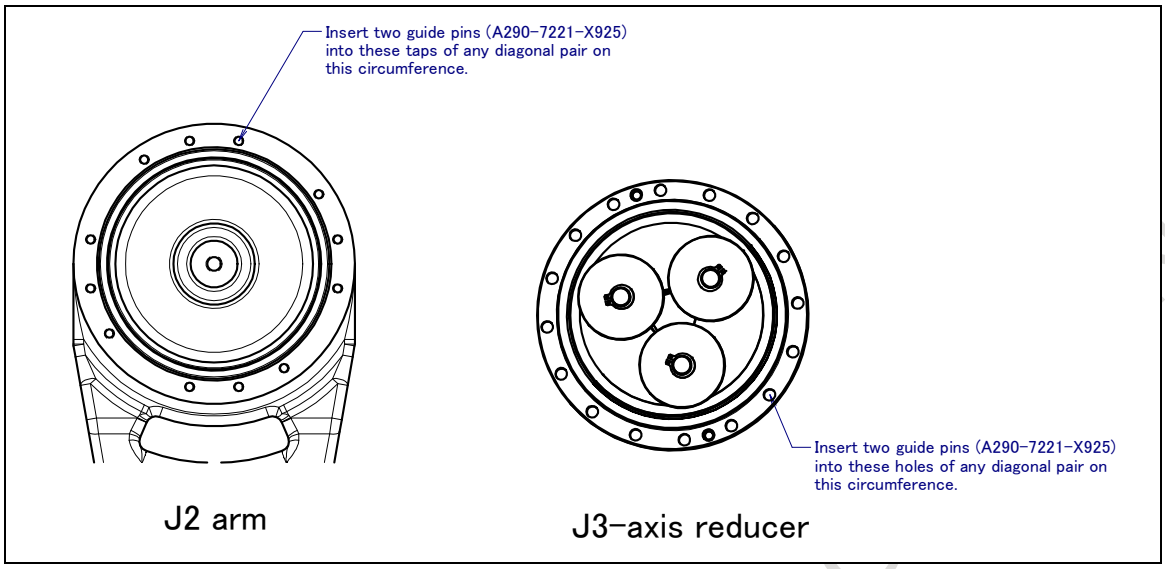


Fig. 7.8 (c) Guide pin inserting position

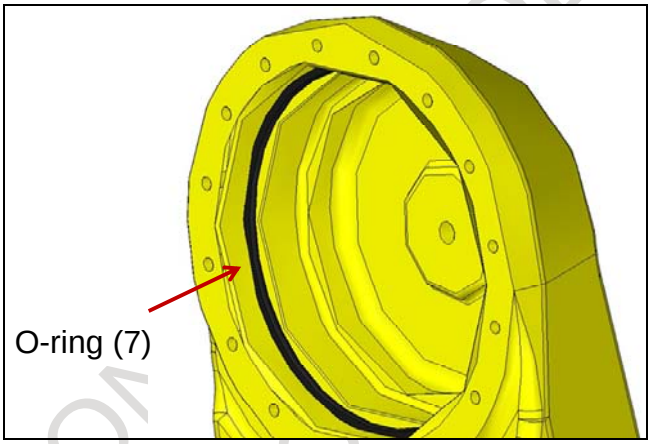


Fig. 7.8 (d) Inserting position of the O-ring (7)

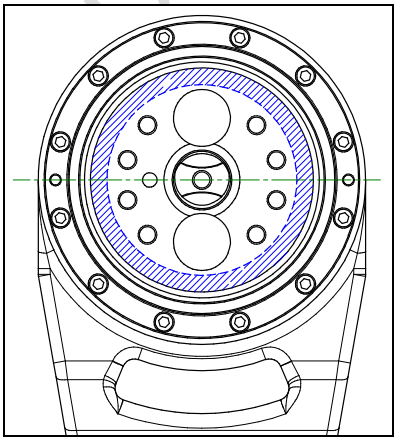


Fig. 7.8 (e) Applying sealant to the J3-axis reducer

NOTE
Refer to Section 7.16 about applying sealant (LOCTITE 518).

7.9 REPLACING THE J4-AXIS MOTOR (M4)

1 Place the robot in a posture of J3 = -90°.
2 Set dial gauges at the J4-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
3 Turn off controller power.
4 When the J4 cover (option) is attached, remove it referring to Section 7.15.
5 Remove the connector of a cable leading to the motor (2).
6 Remove the three bolts (1) that fasten the motor (2) to the J3 casing, and dismount the motor (2).
7 Remove the bolts (6) which fasten the gear (5) on the motor shaft, Remove the gear (5) and the key (3). Then remove the draw nut (4) which is fastened on the motor shaft.
8 Apply LOCTITE 243 on the thread part of the new motor (2) shaft, then tighten the draw nut (4) with a torque of [3.1 Nm]. In this time, attach the key (3), too.
9 Apply LOCTITE 243 on the M4 thread part of the draw nut (4), mount the gear (5) over the draw nut (4), tighten the bolt (6) with a torque of [3.4 Nm]. (When torque is smaller than the specified torque, the J4-axis may get out of place.)
10 If the bearing (7) is broken when removing the gear (5), remove the C ring (8) and replace the bearing by new one.
11 Replace the O-ring (9) by new one and attach it on the motor mounting part of the J3 casing. Fix the motor (2) on the J3 casing with seal bolts (1). Replace the seal bolts by new articles. When reusing them, be sure to wind them with seal tapes.
12 Attach the cable connector to the J4-axis motor.
13 When the J4 cover (option) was attached, attach it referring to Section 7.15.
14 According to Section 4.3, supply the J4-axis gearbox with the specified grease.
15 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

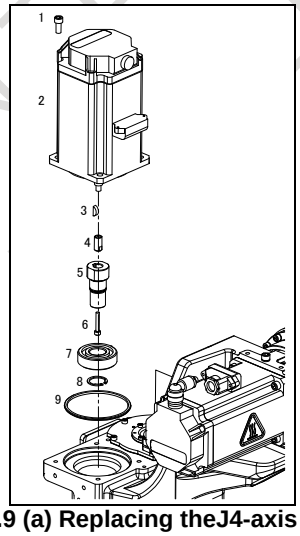


Fig. 7.9 (a) Replacing theJ4-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X14	4		6.8
2	MOTOR (NOTE)	A06B-0212-B605#S000 (*1) A06B-2212-B605 (*2)	1		
3	KEY	JB-HGKYA-4X13	1		
4	DRAW NUT	A290-7221-X421	1	LT243	3.1
5	GEAR J4-1	A290-7221-Z416	1		
6	BOLT	A6-BA-4X25	1	LT243	3.4
7	BEARING	A97L-0001-0195#04Z000A	1		
8	C RING	A97L-0118-0520#GV-20	1		
9	O-RING	JB-OR1A-G75	1		

NOTE
Both of (*1), (*2) motors can be used. However, we recommend (*2) when ordering motors.

7.10 REPLACING THE J4-AXIS GEARBOX

1 Make the robot to the posture of J3= 0° to hang it with a crane.
2 Set dial gauges at the J3/J4-axes, and prepare for single axis mastering after replacement. Refer to Section 9.5.
3 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
4 Turn off controller power.
5 Remove the option cables referring to Section 8.4.
6 Remove bolts (1) and remove the pipe (2).
7 Remove bolts (3) then remove the plate (4).
8 Referring to Section 8.4, remove the J3/J4-axis motor connector, clamp part in the J3 casing, the clamp part in the J3 arm and cable of the J5/J6-axis motor, and pull out cable from the J3 arm unit.

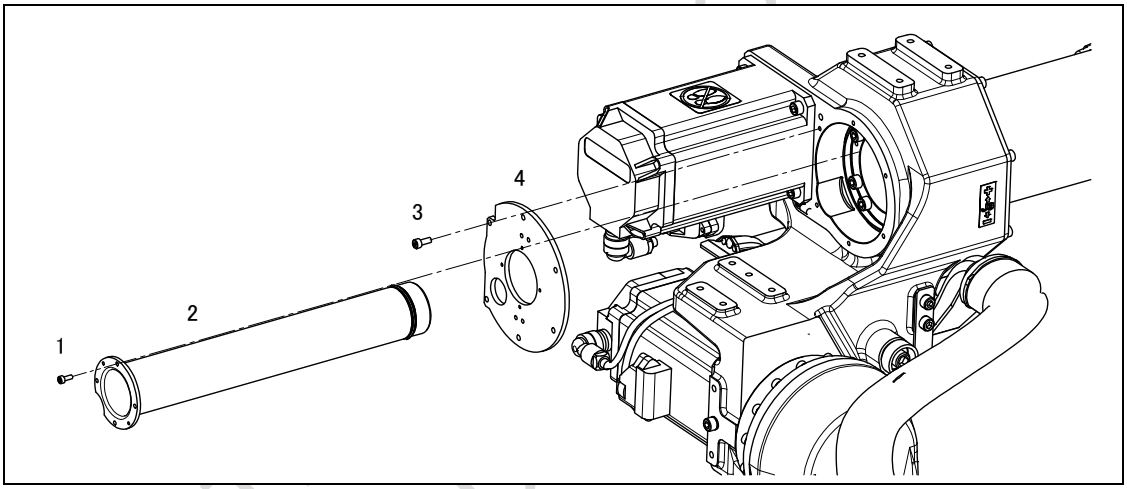


Fig. 7.10 (a) Replacing the J4-axis gearbox unit

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	SEAL BOLT	A97L-0218-0423#053016	4		9.0
2	PIPE	A290-7221-Z435 (M-10*i*A/10M)	1		
		A290-7221-Z436 (M-10*i*A/10MS)			
3	SEAL BOLT	A97L-0218-0423#052016	3		9.0
4	PLATE	A290-7221-Z437	1		

9 Remove bolts (5), then remove the wrist unit (7) from the J3 casing. Remove the O-ring (6).

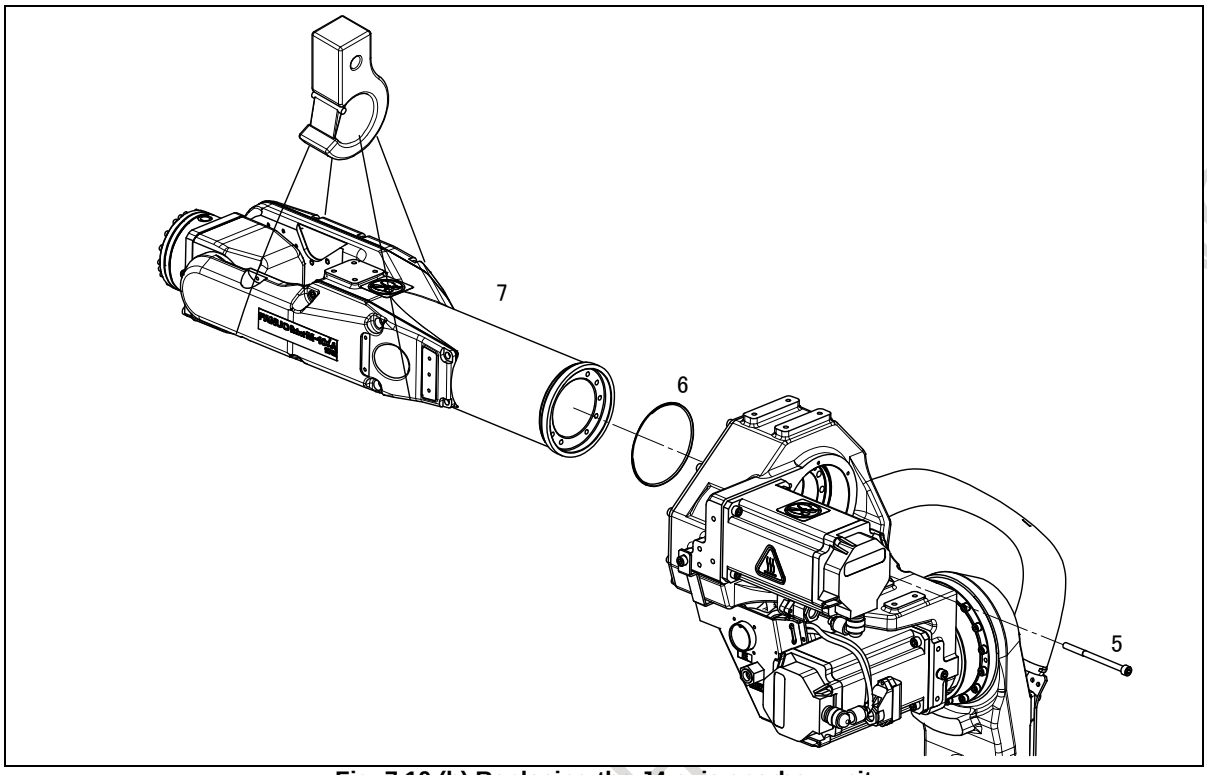


Fig. 7.10 (b) Replacing the J4-axis gearbox unit

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
5	BOLT	A6-BA-6X85	9		15.7
6	O-RING	A290-7221-X444	1		
7	WRIST ASSY	A290-7221-T551 (M-10*i*A/10M)	1		
		A290-7221-T553 (M-10*i*A/10MS)			

10 Remove the J3-axis motor referring to Section 7.6.
11 Wind the sling around the J3 casing as shown in Fig. 7.10 (c), and hang it with a crane.

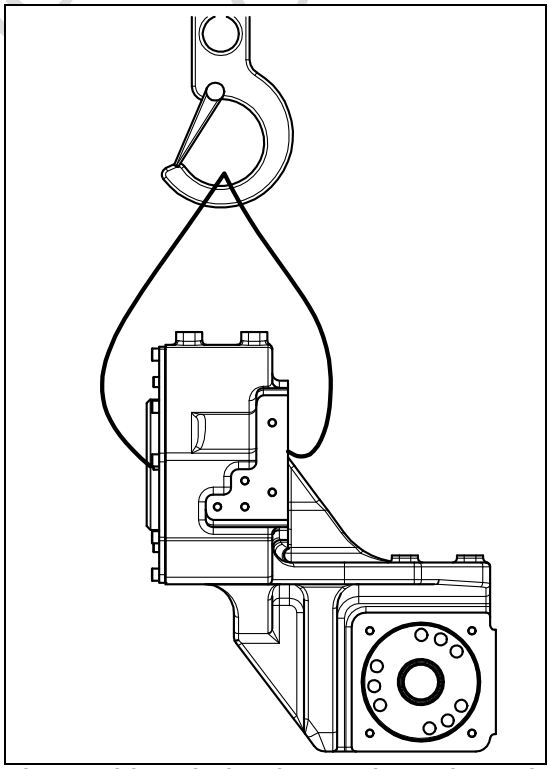


Fig. 7.10 (c) Replacing the J4-axis gearbox unit

12 Remove the bolts (8) and washers (9), the remove the J4casing (10) from theJ3-axis reducer.
13 Remove the adapter (11).
14 Remove the J4-axis motor referring to Section 7.9.

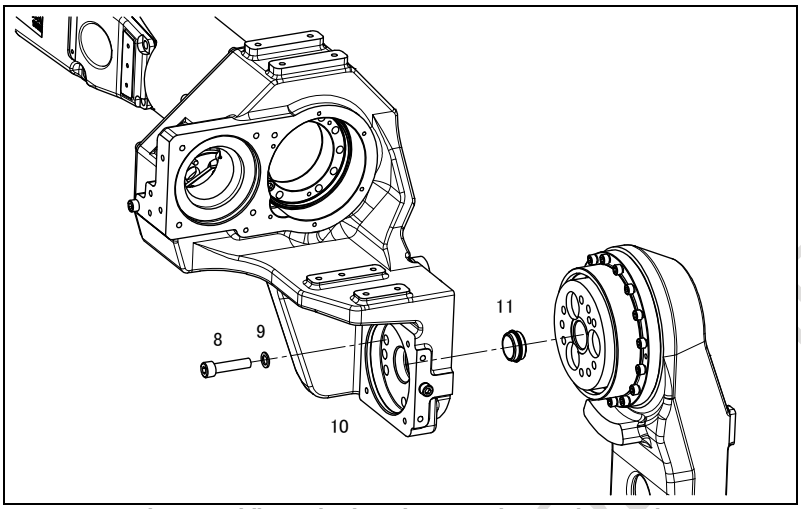


Fig. 7.10 (d) Replacing the J4-axis gearbox unit

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
8	BOLT	A6-BA-8X35	9	LT263	37.2
9	WASHER	A97L-0001-0823#M8H	9		
10	J4-AXIS GEARBOX	A05B-1221-K451 (M-10*i*A/10M)	1		
		A05B-1221-K453 (M-10*i*A/10MS)			
11	ADAPTER	A290-7221-X422	1		

15 Attached removed adapter (11) on the new J4-axis gearbox (A05B-1221-K451, K453).
16 Apply the sealant on the J3 casing side of the J3-axis reducer referring to Section 7.7.
17 Attach the J casing on the J3-axis reducer with bolts (8) (LOCTITE 263 is applied on the thread hole and tightening torque is 37.2Nm) and washers (9).
18 Replace the O-ring (6) by new one, then mount the wrist unit (7) on the J3 casing with bolts (5).
19 Attach the plate (4) with bolts (3).
20 Attach the pipe (2) with bolts (1). If Alvania grease S2 is applied on the wrist side tip of the pipe, inserting becomes easy.
21 Perform the cable forming of the J3 arm and the J3 casing referring to Section. 8.4.
22 Mount the J3-axis motor and the J4-axis motor. Refer to Section 7.6 and 7.9. At this time, replace seal bolts and the O-ring by new one.
23 According to Section 4.3, supply grease to J3-axis reducer and J4-axis gearbox with specified grease.
24 Perform quick mastering and perform single axis mastering of J3 and J4-axis. Refer to the QUICK MASTERING and SINGLE AXIS MASTERING of the mechanical unit operator's manual (B-82754EN).

The following service parts are appended to J4-axis gearbox (A05B-1221-K451, A05B-1221-K453) for maintenance. Please replace these with the J4-axis gearbox.

Parts name	Specifications	Q'ty	Used place
Seal washer	A30L-0001-0048#6M	1	J3-axis grease inlet
Gasket	A98L-0040-0042#03	1	J3-axis motor
Bolt	A6-BA-6X8	1	J3-axis grease inlet
Bolt	A6-BA-6X85	9	Between the J3 casing and the wrist unit
Bolt	A6-BA-8X35	9	Between J3 casing and J3-axis reducer
Washer	A97L-0001-0823#M8H	9	Between J3 casing and J3-axis reducer
Seal bolt	A97L-0218-0546#030808BC	4	Pipe
Seal bolt	A97L-0218-0417#060808	2	J4-axis grease inlet, outlet
O-RING	A290-7221-X444	1	Between the J3 arm and the J3 casing
O-RING	JB-OR1A-G75	1	J4-axis motor

7.11 REPLACING THE J5-AXIS MOTOR (M5)

1 Place the robot in a posture of J3 = -90°.
2 Set a dial gauge at the J5-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
3 Turn off controller power.
4 Remove the pipe referring to Section 7.9.
5 Remove the bolts (1), move the cover assembly (2) so that J5-axis motor can be seen. Then remove the gasket (3) (Remove adhesive tape completely.)
6 Remove the cables which are attached to the motor.
7 Remove bolts (4), then remove the motor (5) which the gear (7) etc. are attached. Replace the motor by new one, attach the gear to the new motor. Then assemble the motor applying the steps above in reversed sequence. Replace the gasket (6) by new one, too. Apply LOCTITE 675 on the key (9). Replace the gasket (3) by new one.
8 Supply the J5-axis gearbox with the specified grease. (Refer to Section 4.3.)
9 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

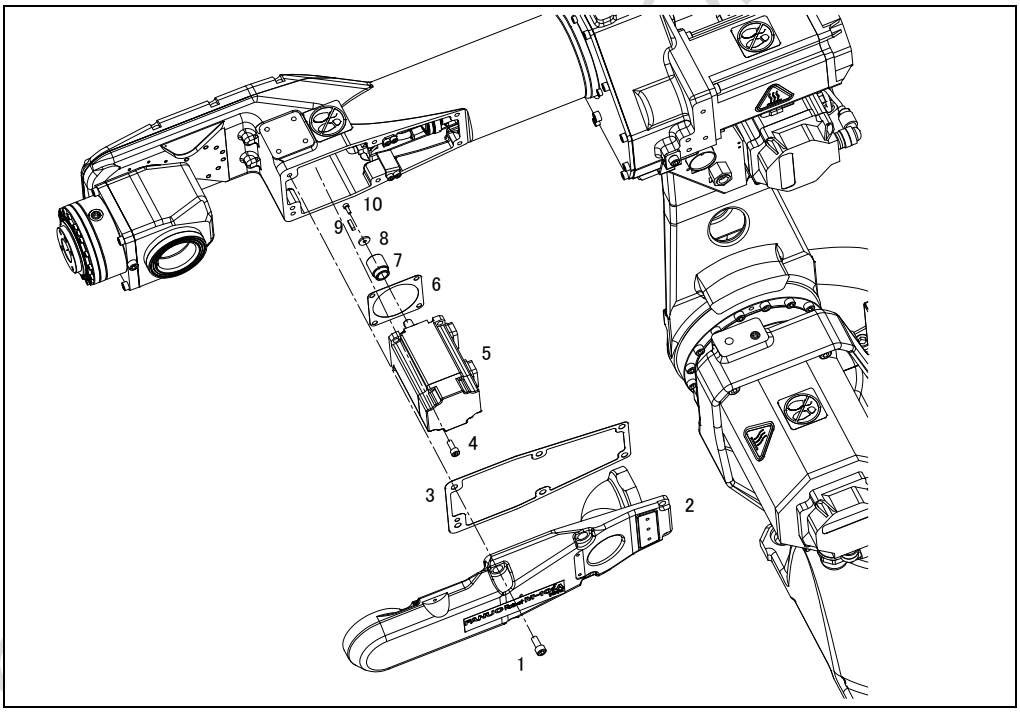


Fig. 7.11 (a) Replacing the J5-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	SEAL BOLT	A97L-0218-0423#061414	6	LT263	15.6
2	COVER ASS'Y	A290-7221-V554	1		
3	GASKET	A290-7221-Z531	1		
4	SEAL BOLT	A97L-0218-0423#051212	4		7.0
5	MOTOR	A06B-0115-B855#0048	1		
6	GASKET	A98L-0040-0042#07	1		
7	GEAR J5-1	A290-7222-Z511	1		
8	WASHER	A290-7210-X532	1		
9	KEY	A97L-0118-0402#3X3X12BN	1	LT675	
10	BOLT	A6-BA-3X8	1	LT243	2.0

7.12 REPLACING THE J6-AXIS MOTOR (M6) AND THE REDUCER

1 Set dial gauges at the J6-axis, and prepare for single axis mastering after replacement. Refer to Section 9.5.
2 Turn off controller power.
3 Remove bolts (6), then remove the unit which the reducer (1) and the motor (12) are attached.
4 Remove bolts (8), then remove the reducer (1).
5 Remove the bolt (2) and the washer (3).
6 Pull out the wave generator (4).
7 Remove the motor mounting bolts (13), then remove the adapter (7), the gasket (9), (10) and the key (11).
8 Replace the reducer, the motor, the O-ring and the gasket by new one. And assemble them applying the steps above in reversed sequence. Apply LOCTITE 675 on the key (11).
9 Supply the J6-axis reducer with the specified grease. (Refer to Section 4.2)
10 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

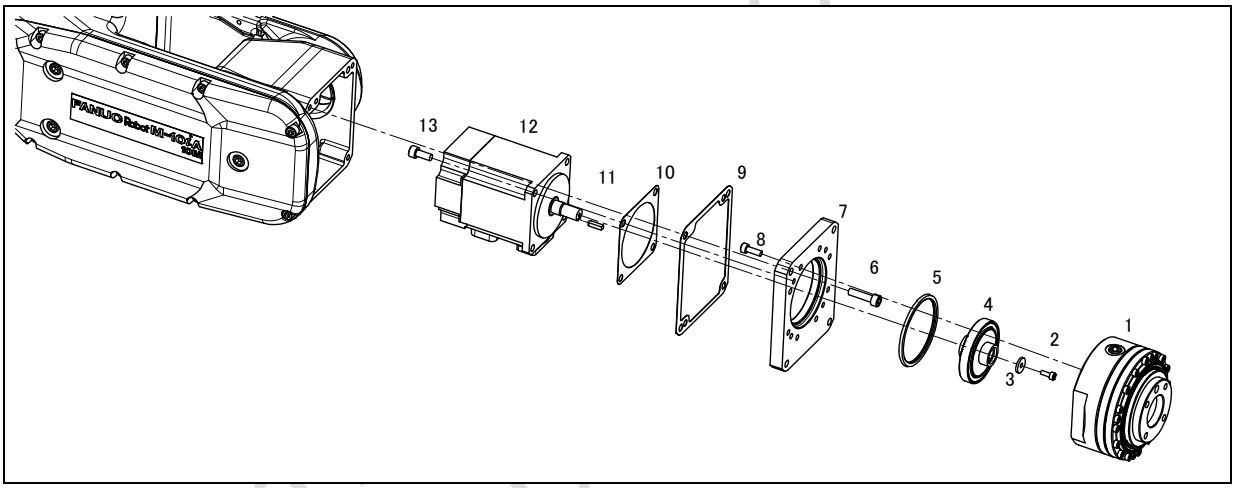


Fig. 7.12 (a) Replacing the J6-axis motor and the reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	REDUCER	A97L-0218-0978	1		
2	BOLT	A6-BA-3X8	1	LT243	2.0
3	WASHER	A290-7210-X532	1		
4	WAVE GENERATOR	(It is attached to the reducer)	1		
5	O-RING	(It is attached to the reducer)	1		
6	BOLT	A6-BA-5X20	4	LT263	9.0
7	ADAPTER	A290-7221-Z543	1		
8	BOLT	A6-BA-4X12	8	LT243	8.0
9	GASKET	A290-7221-Z533	1		
10	GASKET	A98L-0040-0042#07	1		
11	KEY	A97L-0118-0402#3X3X12BN	1	LT675	
12	MOTOR	A06B-0114-B855#0048	1		
13	BOLT	A6-BA-5X12	4		7.0

7.13 REPLACING WRIST UNIT

1 Make the robot to the posture of J3= 0° to hang it with a crane.
2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
3 Set dial gauges at the J3/J4-axes, and prepare for single axis mastering after replacement. Refer to Section 9.5.
4 Turn off controller power.
5 Remove the option cables referring to Section 8.4.
6 Remove bolts (1) and remove the pipe (2).
7 Remove bolts (3) then remove the plate (4).
8 Referring to Section 8.4,remove the J3/J4-axis motor connector, clamp part in the J3 casing, the clamp part in the J3 arm and cable of the J5/J6-axis motor, and pull out cable from the J3 arm unit.

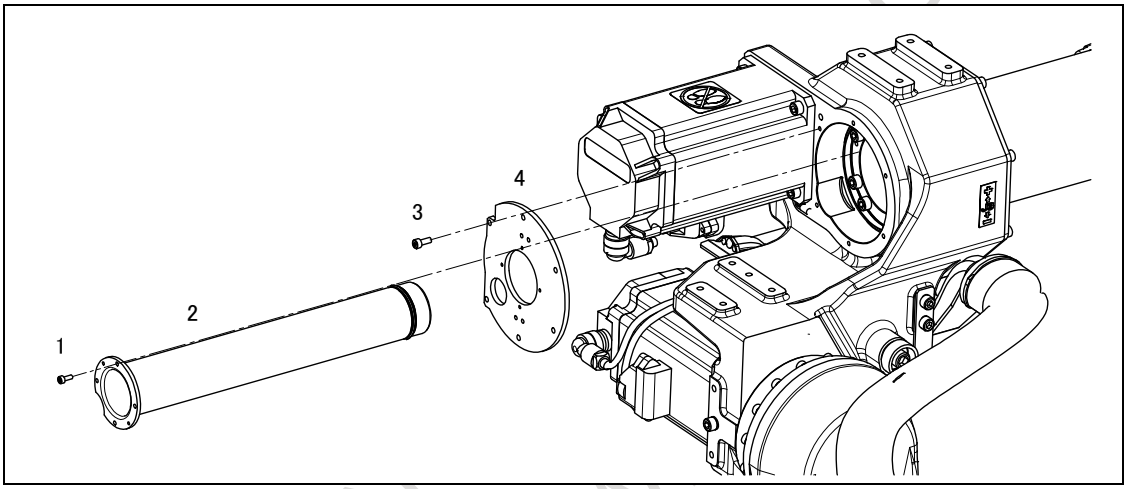


Fig. 7.13 (a) Replacing the wrist unit

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A97L-0218-0423#030808	4		2.0
2	PIPE	A290-7221-Z435	1		
3	BOLT	A6-BA-4X10	6		
4	PLATE	A290-7221-Z437	1		

9 Remove bolts (5), then remove the wrist unit (7) from the J3 casing. Remove the O-ring (6).

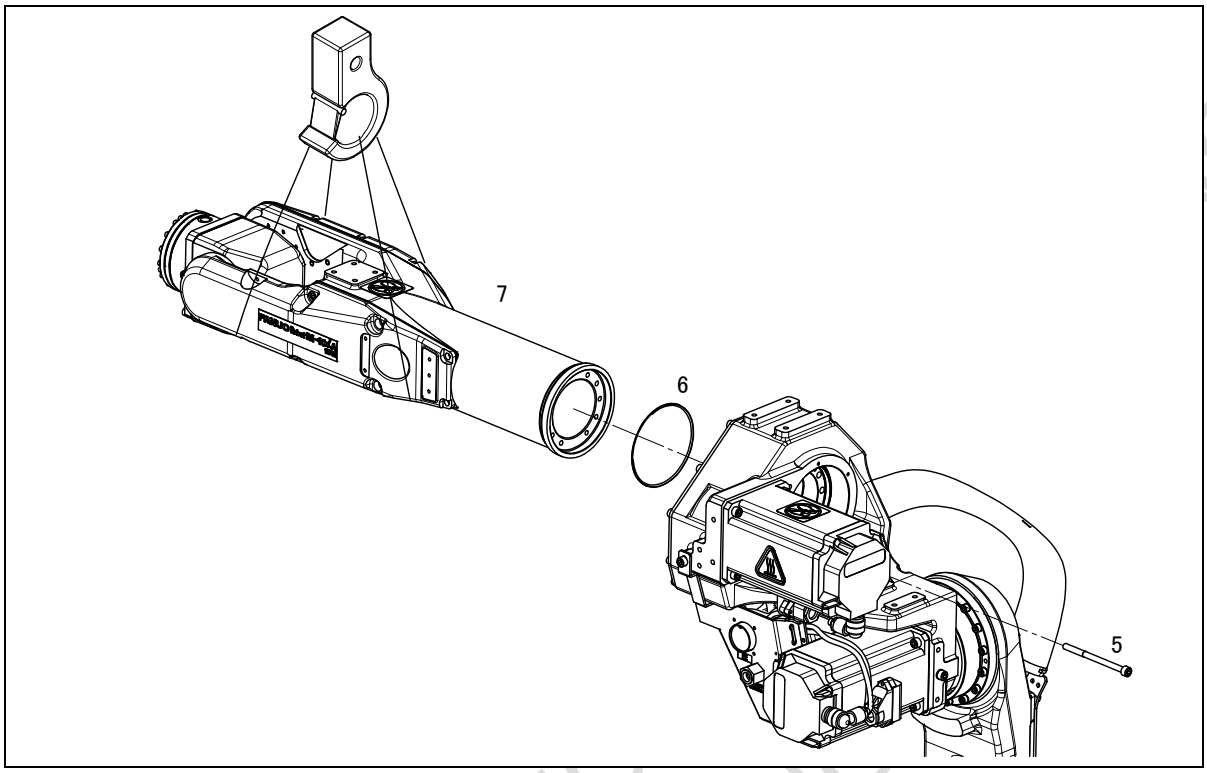


Fig. 7.13 (b) Replacing the wrist unit.

10 Mount the J5/J6-axis motors in the new wrist unit referring to Section 7.11 and 7.12.
11 Attach the new wrist unit. For its assembly, please apply the steps above in reversed sequence.
12 Perform the cable forming of between the J3 arm and the wrist referring to Section. 8.4.
13 According to Section 4.2 and 4.3, supply grease to J5-axis gearbox and J6-axis reducer with specified grease.
14 Perform quick mastering and perform single axis mastering of J3 and J4-axis. Refer to the QUICK MASTERING and SINGLE AXIS MASTERING of the mechanical unit operator's manual (B-82754EN).

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
5	BOLT	A6-BA-6X85	9		15.7
6	O-RING	A290-7221-X444	1		
7	WRIST ASSY	A290-7221-T551 (M-10*i*A/10M)	1		
		A290-7221-T553 (M-10*i*A/10MS)			

7.14 REPLACING THE J2 COVER (OPTION)

1 Remove bolts (1) and washers (2).
2 Remove the J2 cover (3). When replacing only the J2 cover, omit the procedure 3 to 5.
3 Remove bolts (5) and washers (6).
4 Remove the base support (4).
5 Remove bolts (8) and support (7).
6 Replace J2 cover by new one. For its assembly, please apply the steps above in reversed sequence.

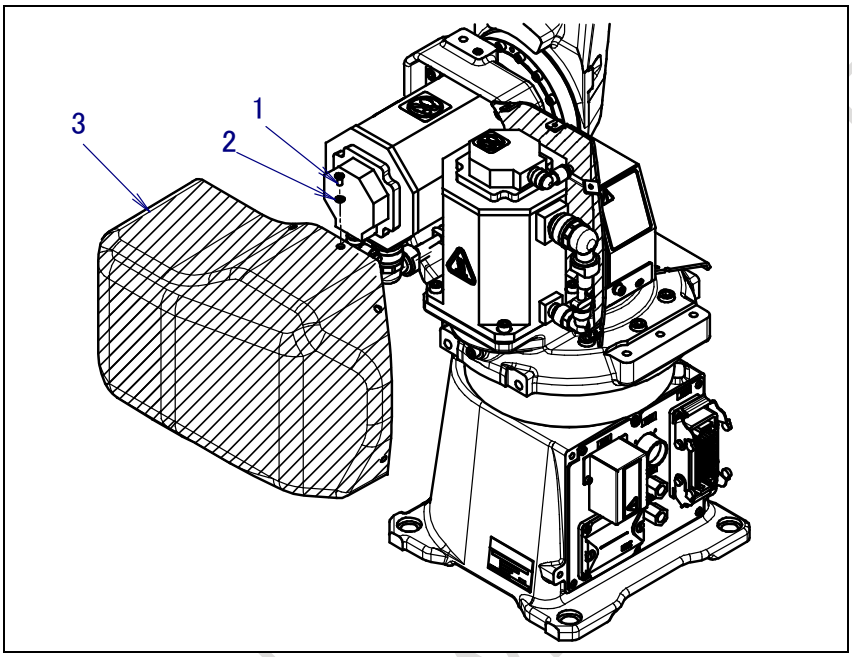


Fig. 7.14 (a) Replacing the J2 cover (1/3)

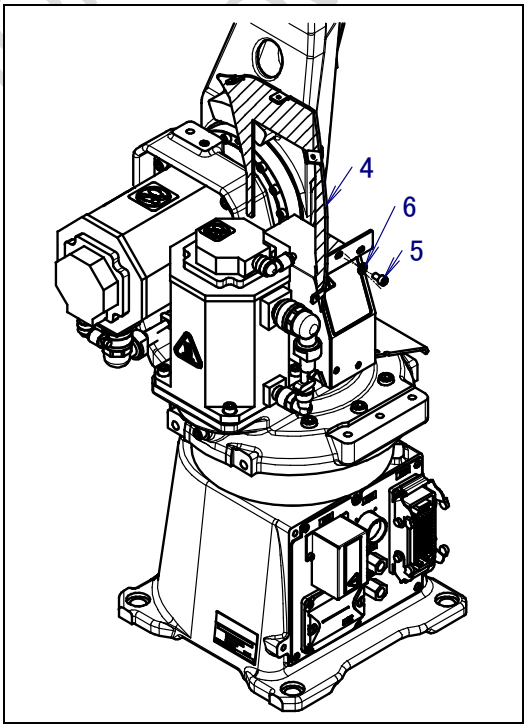


Fig. 7.14 (b) Replacing the J2 cover (2/3)

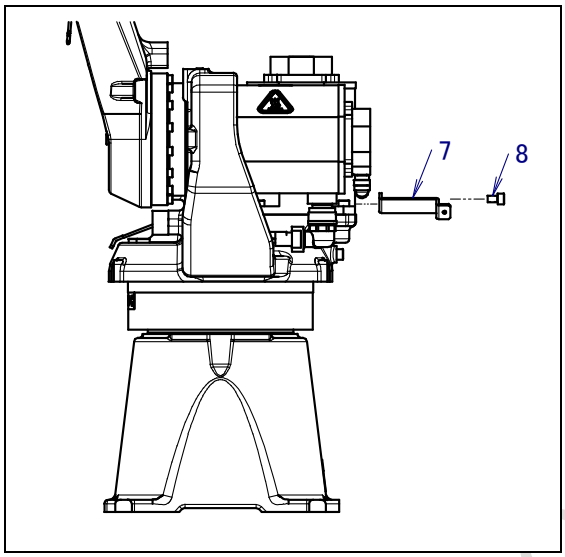


Fig. 7.14 (c) Replacing the J2 cover (3/3)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A97L-0218-0502#M5X10	5		
2	WASHER	A6-WM-5S	5		
3	J2 COVER	A290-7221-X381	1		
4	BASE SUPPORT	A290-7221-X382	1		
5	SEAL BOLT	A97L-0218-0736#050808	2		
6	WASHER	A6-WM-6S	2		
7	SUPPORT	A290-7221-X383	1		
8	BOLT	A6-BA-8X12	1		

7.15 REPLACING THE J3/J4 COVER (OPTION)

Replacing the J3 cover

1 Remove the bolts (1) and the washers (2).
2 Remove the J3 cover (3). If replacing only the J3 cover, omit the procedure 3 and 4.
3 Remove the bolts (4), then remove the plate (5).
4 Remove the bolts (6), then remove the support (7).
5 Replace the J3 cover (3) by new one. For its assembly, please apply the steps above in reversed sequence.

Replacing the J4 cover

1 Remove bolts (8).
2 Replace the J4 cover (9) by new one. For its assembly, please apply the steps above in reversed sequence.

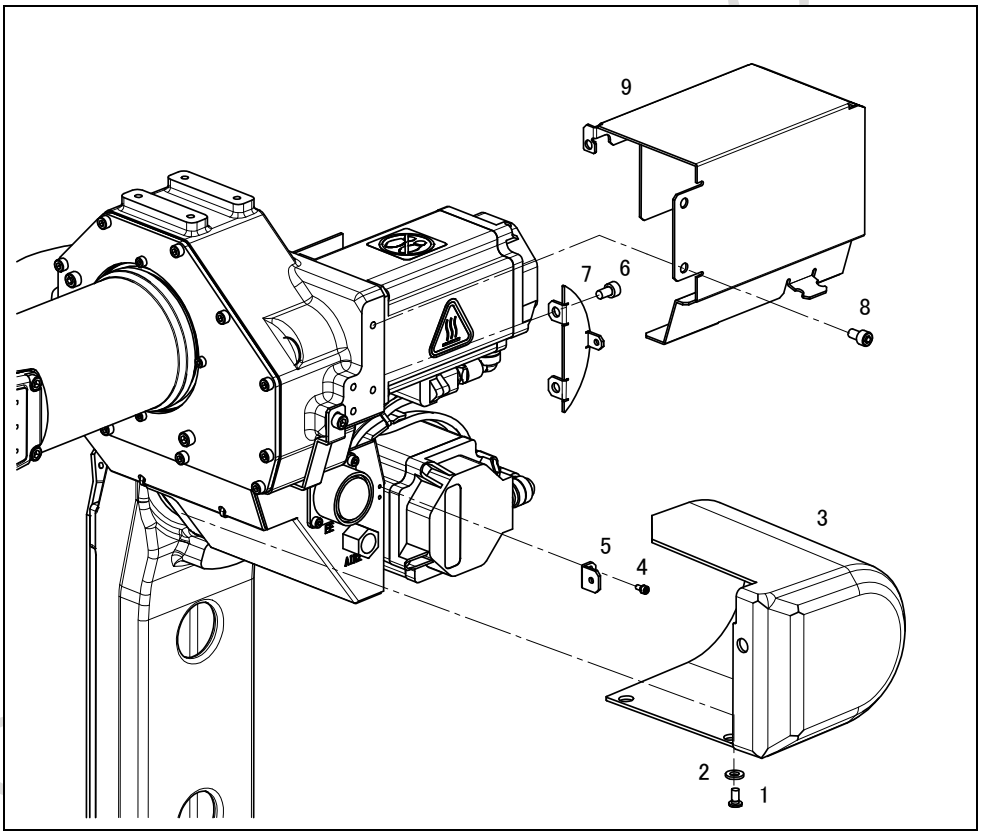


Fig. 7.15 (a) Replacing the J3/J4 cover

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A97L-0218-0502#M5X10	3		
2	WASHER	A6-WM-6S	3		
3	J3 COVER	A290-7221-X481	1		
4	BOLT	A97L-0218-0606#M3X6	2		
5	PLATE	A290-7221-X483	1		
6	BOLT	A6-BA-6X10	2		
7	SUPPORT	A290-7221-Z484	1		
8	BOLT	A6-BA-6X10	2		
9	J4 COVER	A290-7221-Z489	1		

7.16 SEALANT APPLICATION

Washing and degreasing the surfaces to be sealed

1 After removing the reducer, the surfaces that were sealed with LOCTITE 518 must be cleaned and all old LOCTITE 518 must be removed. Apply LOCTITE Gasket Remover to the surface to be cleaned. Allow 10 minutes to soften the old LOCTITE 518. After the LOCTITE has softened it can be removed using a scraper.
2 Blow air onto the surface to be sealed to remove dust from the tapped holes.
3 Sufficiently degrease the reducer's surface to be sealed and the arm's surface to be sealed, using a cloth dampened with solvent. Do not spray solvent directly onto the surface.
4 Polish the surfaces of the reducer to be sealed with an oil stone, and degrease them with removal and cleaner again.

> ⚠ **CAUTION**
> Oil may drip from inside of the reducer. Check that there are no oil drips thoroughly after you have finished degreasing.

Applying sealant

5 Make sure that the reducer and surfaces of the items to be sealed are dry (with no oil and grease remover remaining). If they are still wet with oil and grease remover, wipe them dry. Always use a new surface of a cloth so that the grease once wiped up with the cloth will not get on the degreased surface. Make sure that no wet solvent exists in the threaded holes or on any sealing surfaces. If solvent is still present, it can prevent the LOCTITE from curing.
6 Apply sealant (LOCTITE 518) to the surfaces.

> ⚠ **CAUTION**
> See descriptions of reducer replacement and check the areas to which sealant is to be applied to be sure they are clean and dry. Otherwise, the sealant will not adhere properly.

Assembly

7 To prevent dust from sticking to the areas to which sealant was applied, mount the reducer as quickly as possible after sealant application. Be careful not to touch the applied sealant. If sealant was wiped off, apply again.
8 After installing the reducer, fasten it with bolts and washers quickly so that the mated surfaces are pressed together.
9 After attaching the reducer, wipe off any excessive sealant that comes out from the sealed section with a cloth or spatula. Do not use oil and grease remover.

> ⚠ **CAUTION**
> Do not grease or move the reducer before the sealant sets, as it may allow grease to leak. Before greasing or moving, wait for at least one hour after the reducer is mounted.

8 REPLACING CABLES

Replace the welding power cables of the mechanical unit in the cycle that is shorter among every about two years and 7680 hours operating. Replace the other cables of the robot in the cycle that is shorter among every four years and 15360 hours operating. If a cable is broken or damaged, replace it according to the procedure described in this chapter.

Cautions in handling the Pulsecoder cable

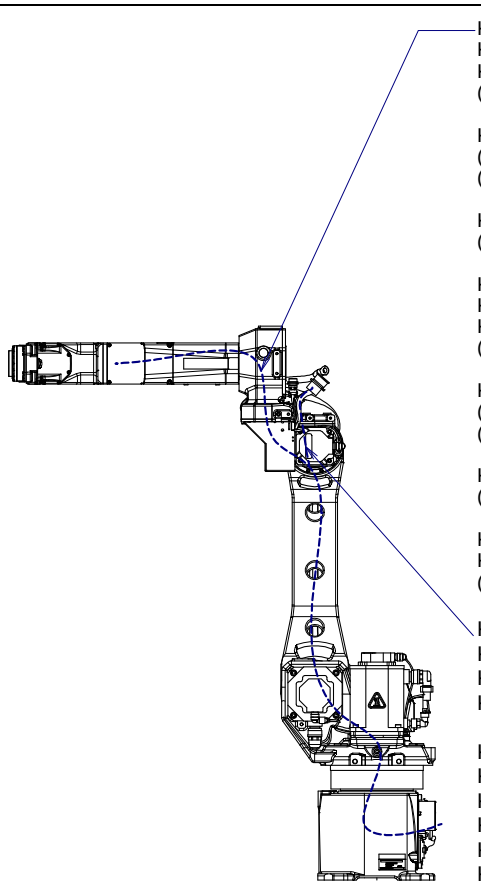
When transporting, installing, or maintaining the robot, do not detach the Pulsecoder cables carelessly. The cables are provided with the marking tie shown below. If you detached any cable with the marking tie, you need to perform mastering for the robot.
Do not detach any connector unless you replace a motor, Pulsecoder, reducer, gearbox or cable.

Fig. 8 (a) Wire mark

If there is a break in or any other damage to a cable, replace the cable according to the procedure described in this chapter. If the connector of a motor cable is detached, the data about the absolute position of the robot is lost. Once any of these cables is replaced, perform quick mastering while referencing Chapter 8 of the Operator's Manual. If the data is lost because of a break in a cable, also perform mastering to calibrate the robot into the previous absolute position.

8.1 CABLE WIRING

Fig. 8.1 (a), (b) are the routing of the robot cables. See Chapter 5 of the Operator's Manual for option cable interface.



K101 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*8))
K102 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*1)) (Non correspondence to CE)
K103 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*1))
(ARC Mate 100*i*C, M-10*i*A)

K111 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*8))
(for severe dust/liquid protection option)
(M-10*i*A)

K121 (M1 to M6 Pulsecoder,power,brake(only J2/J3))
(ARC Mate 100*i*Ce, M-10*i*Ae)

K131 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*8))
K132 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*1))(Non correspondence to CE)
K133 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*1))
(ARC Mate 100*i*C/6L, M-10*i*A/6L)

K141 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*8))
(for severe dust/liquid protection option)
(M-10*i*A/6L)

K151(M1 to M6 Pulsecoder,power,brake(only J2/J3))
(ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

K161 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*8))
K162 (M1 to M6 Pulsecoder,power,brake, EE (RI/RO*1)) (Non correspondence to CE)
(ARC Mate 100*i*C/10S M-10*i*A/10S

K301 Wire feeder cable
K311 User cable (signal)
K312 User cable (power)
K315 User cable (signal usable to force sensor
and 3D Laser Vision senro)
K321 Welding power cable 38SQ
K323 Welding power cable 60SQ
K331 Earth cable for camera
K351 Camera and 3D Laser Vision Sensor cable
K701 Camera cable (non water proof type)
K802 Camera cable (water proof type)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L)

K314 User cable (signal usable to force sensor
And 3D Laser Vision senro)
K331 Earth cable for camera
K803 Camera cable (water proof type)
(ARC Mate 100*i*C/10S, M-10*i*A/10S)

Fig. 8.1 (a) Routing of the robot (except 10M/10MS)

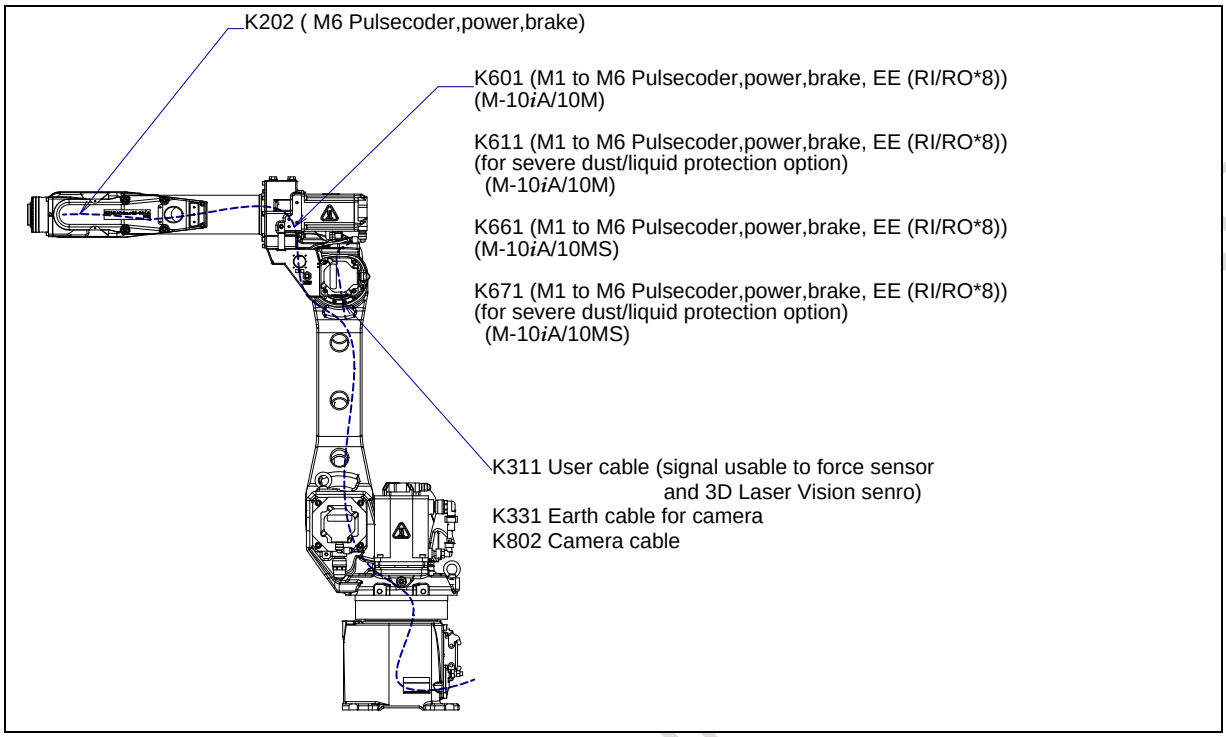


Fig. 8.1 (b) Routing of the robot (10M/10MS)

8.2 CABLE DRESSING

After a cable is replaced individually rather than in a bundle, clamp it with nylon ties (cable ties) at the specified positions listed in Table 8.2 (a) to (i). Otherwise, the cable might sag or become too tight, leading to a break in the cable.

Clamp position of Table 8.2 (a) to (i) mean position in Fig.8.2 (a), (b).

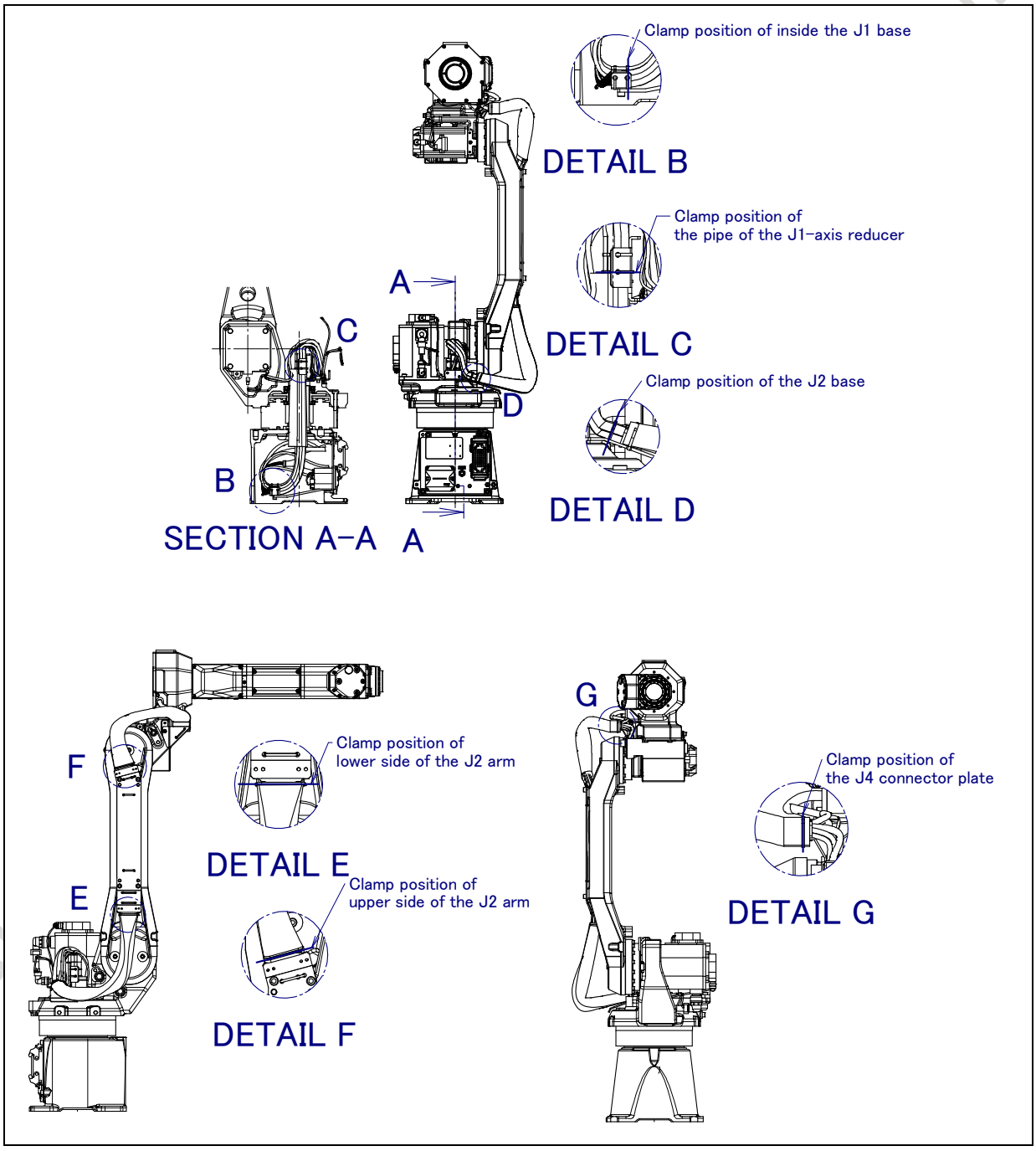


Fig. 8.2 (a) Clamp position of motor cable
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce, M-10*i*Ae)

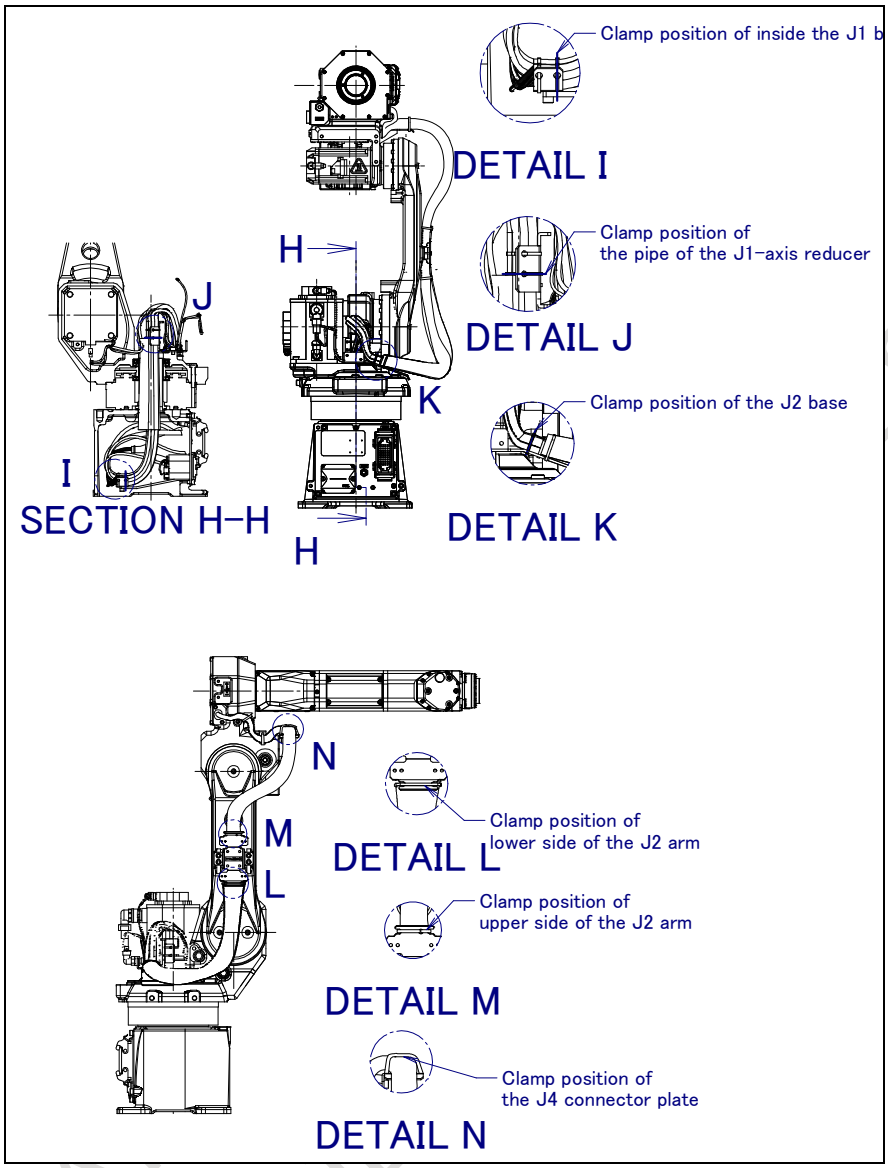


Fig. 8.2 (b) Clamp position of motor cable (ARC Mate 100*i*C/10S, M-10*i*A/10S)

Table 8.2 (a) Cable pattern diagram (1)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

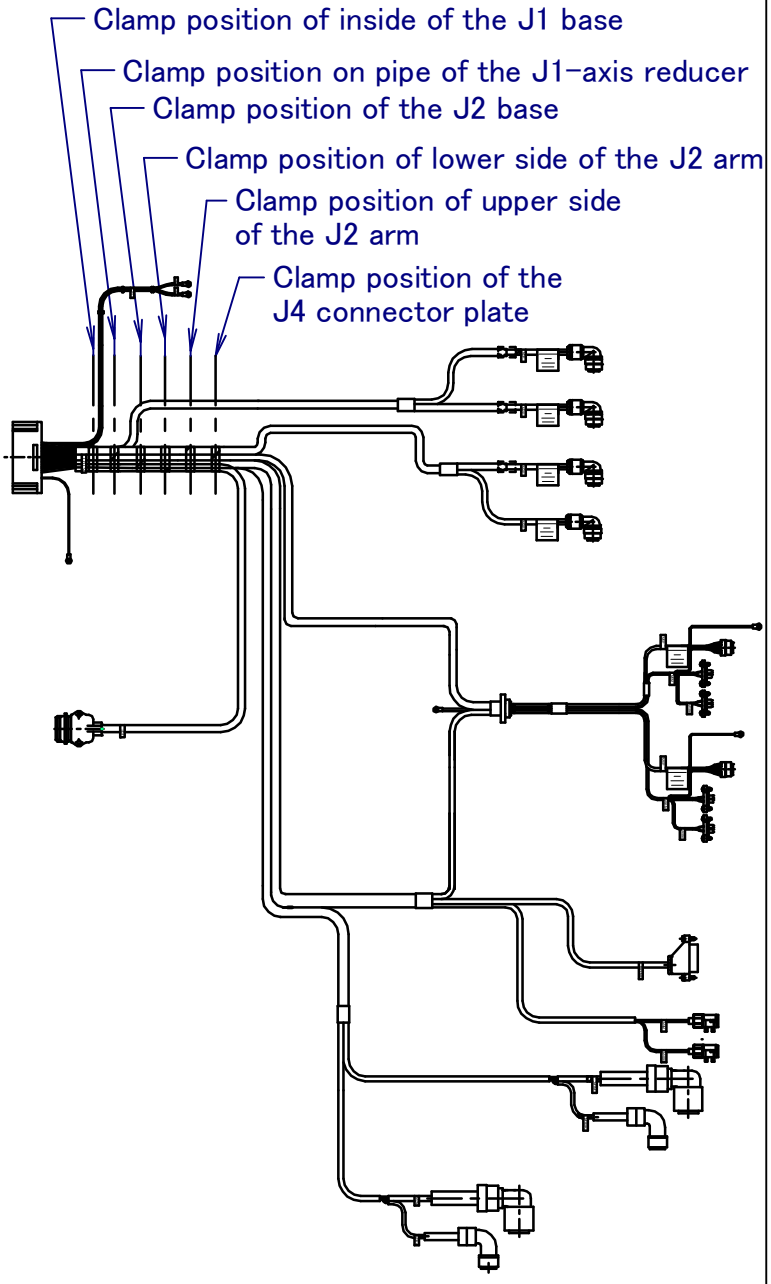
Stamp	Cable pattern diagram	Stamp	Cable No.
EE		+ - M1P M2P M3P M4P M5P M5M M5BK M6P M6M M6BK M3M M4M M4BK M1M M1BK M2M M2BK	K101, K131, K161

Table 8.2 (b) Cable pattern diagram (2)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L)

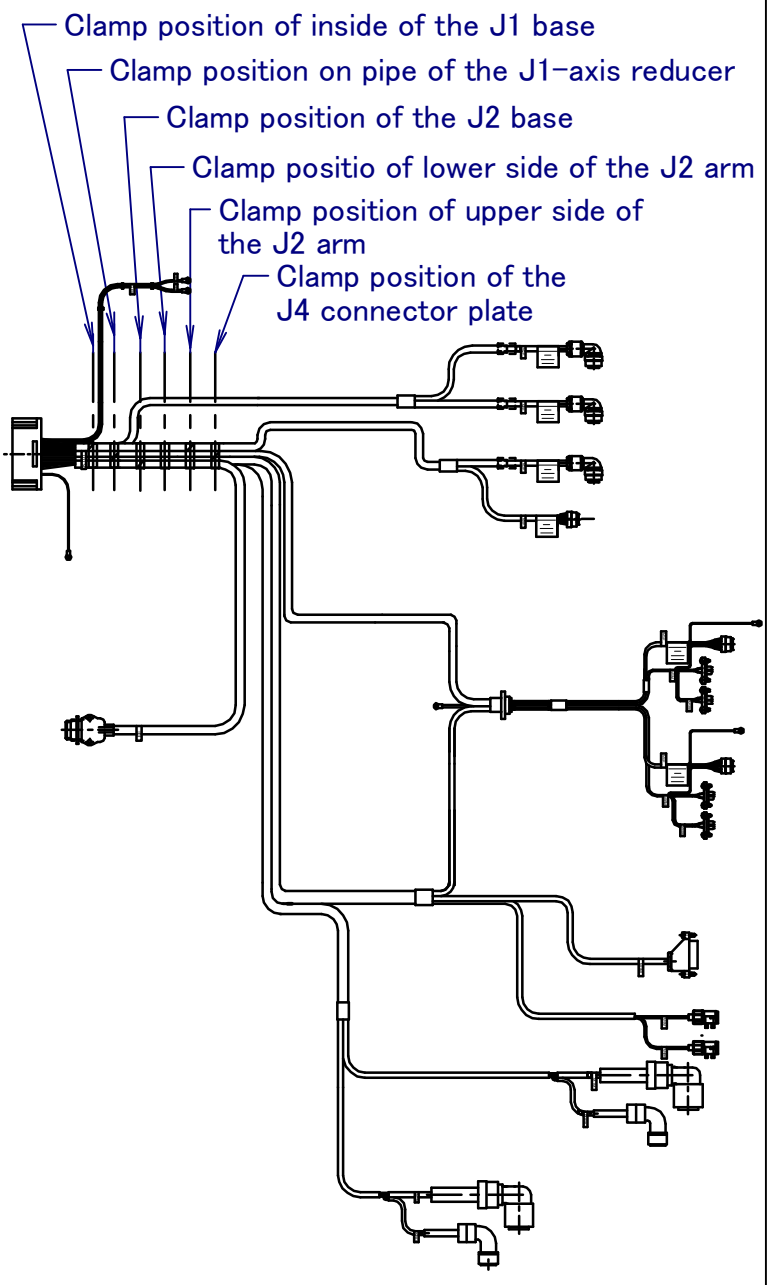
Stamp	Cable pattern diagram	Stamp	Cable No.
EE		+ − M1P M2P M3P M4P M5P M5M M5BK M6P M6M M6BK M3M M4M M4BK M1M M1BK M2M M2BK	K102, K132, K162

Table 8.2 (c) Cable pattern diagram (3)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L)

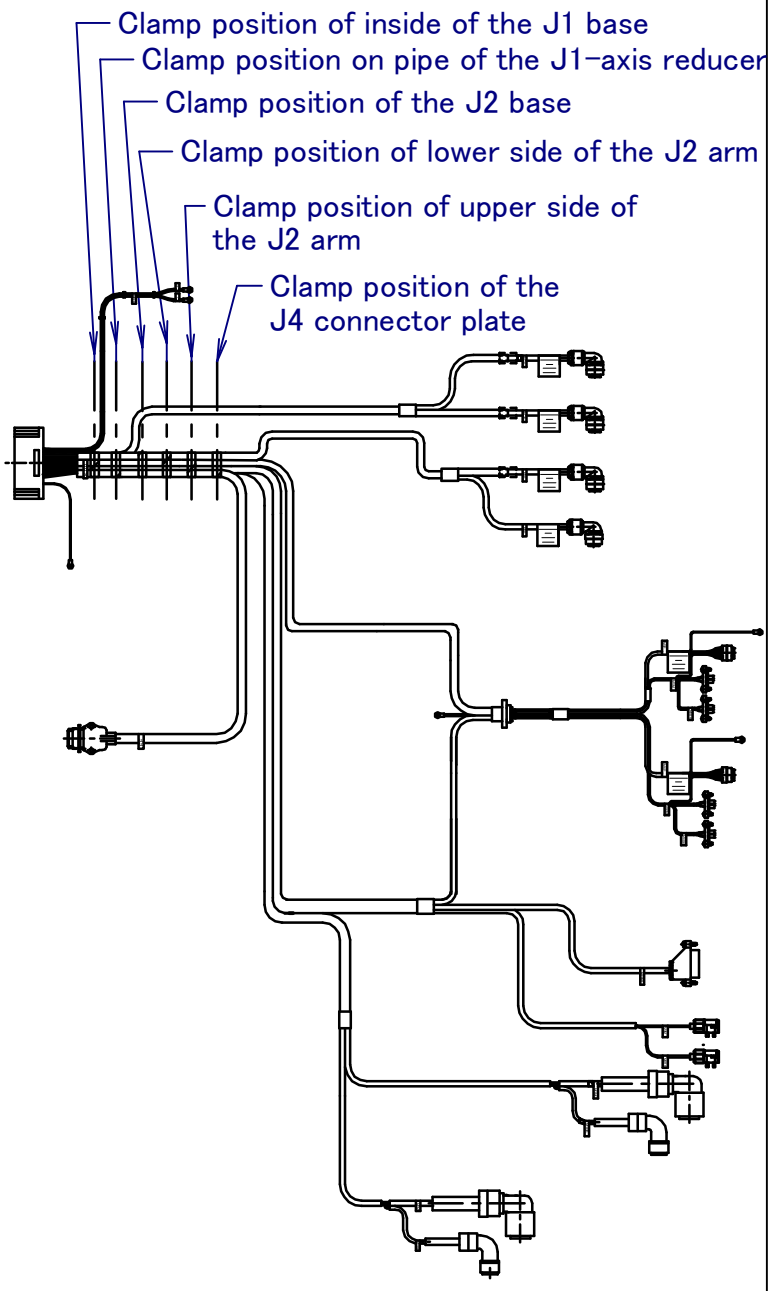
Stamp	Cable pattern diagram	Stamp	Cable No.
EE		+ − M1P M2P M3P M4P M5P M5M M5BK M6P M6M M6BK M3M M4M M4BK M1M M1BK M2M M2BK	K103, K133

Table 8.2 (d) Cable pattern diagram (4)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L)

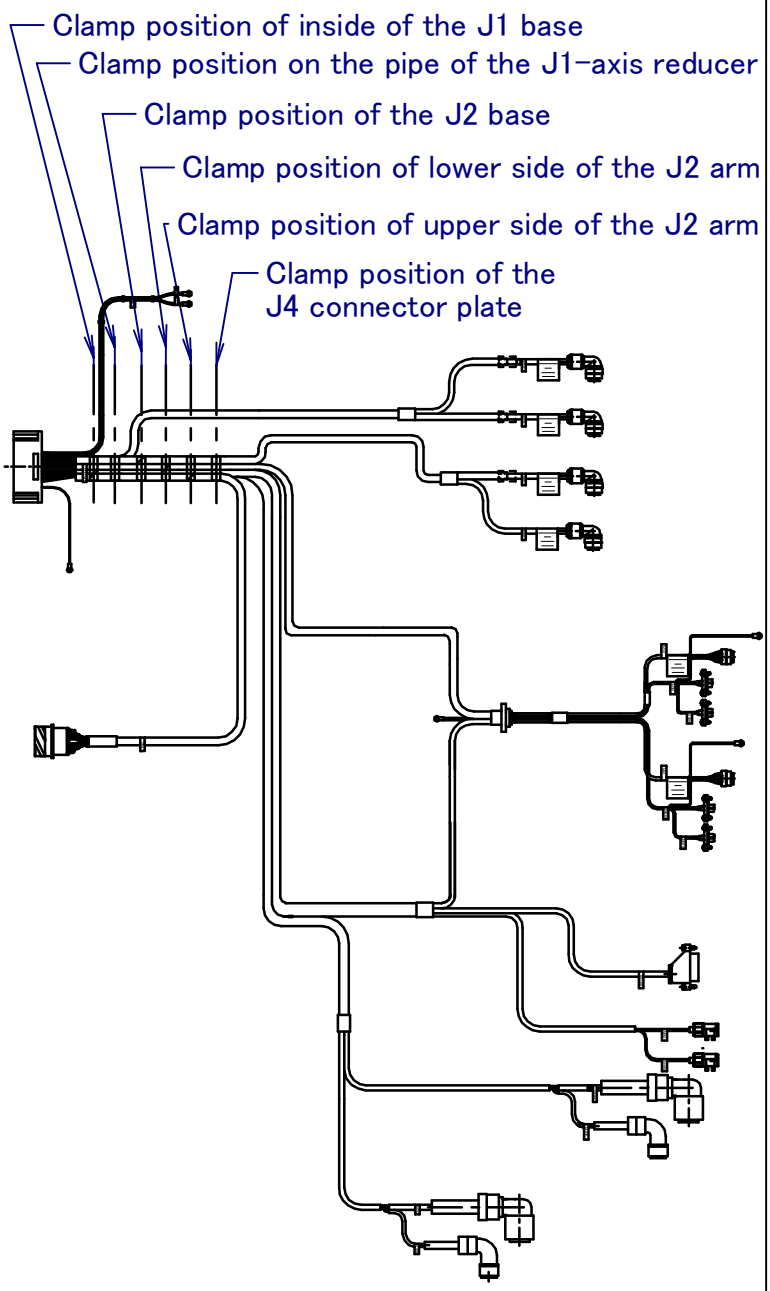
Stamp	Cable pattern diagram	Stamp	Cable No.
EE		+ − M1P M2P M3P M4P M5P M5M M5BK M6P M6M M6BK M3M M4M M4BK M1M M1BK M2M M2BK	K111, K141

Table 8.2 (e) Cable pattern diagram (5)
(ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

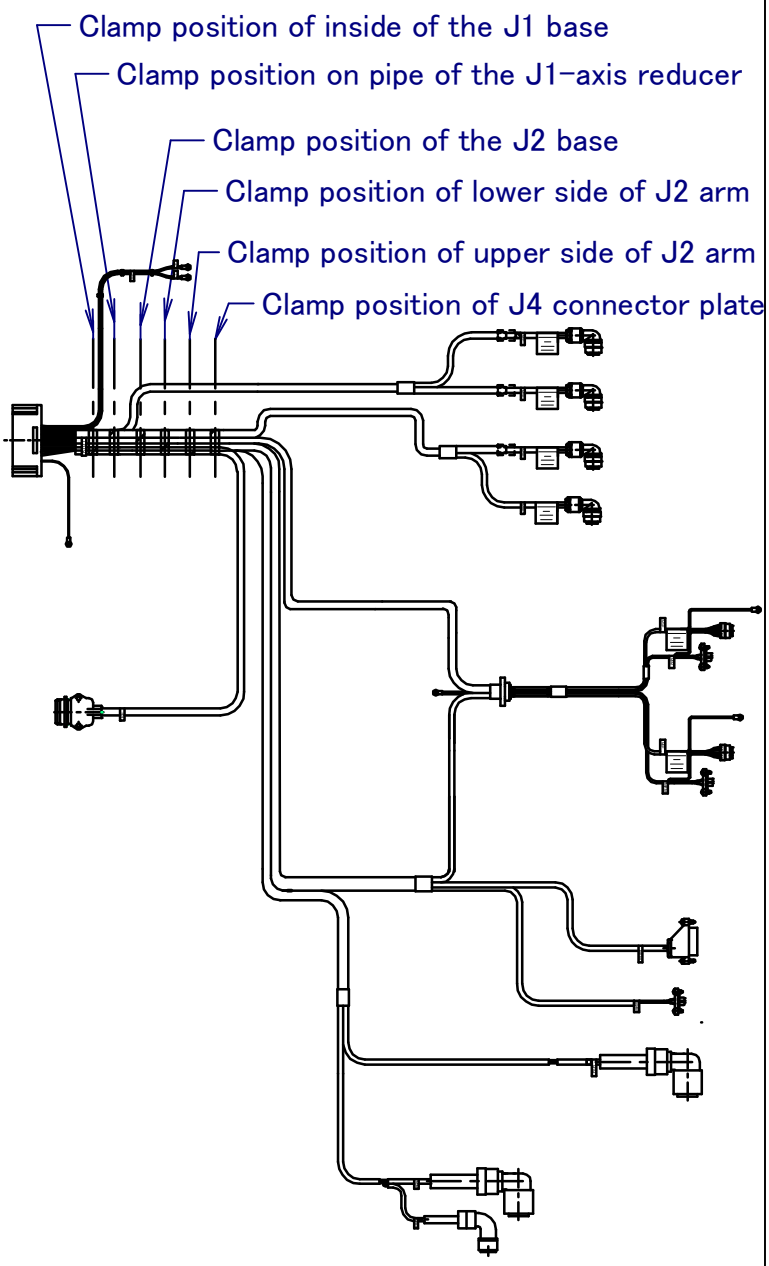
Stamp	Cable pattern diagram	Stamp	Cable No.
EE		+ − M1P M2P M3P M4P M5P M5M M6P M6M M3M M4M M1M M2M M2BK	K121, K151

Table 8.2 (f) Cable pattern diagram (6)
(10M/10MS)

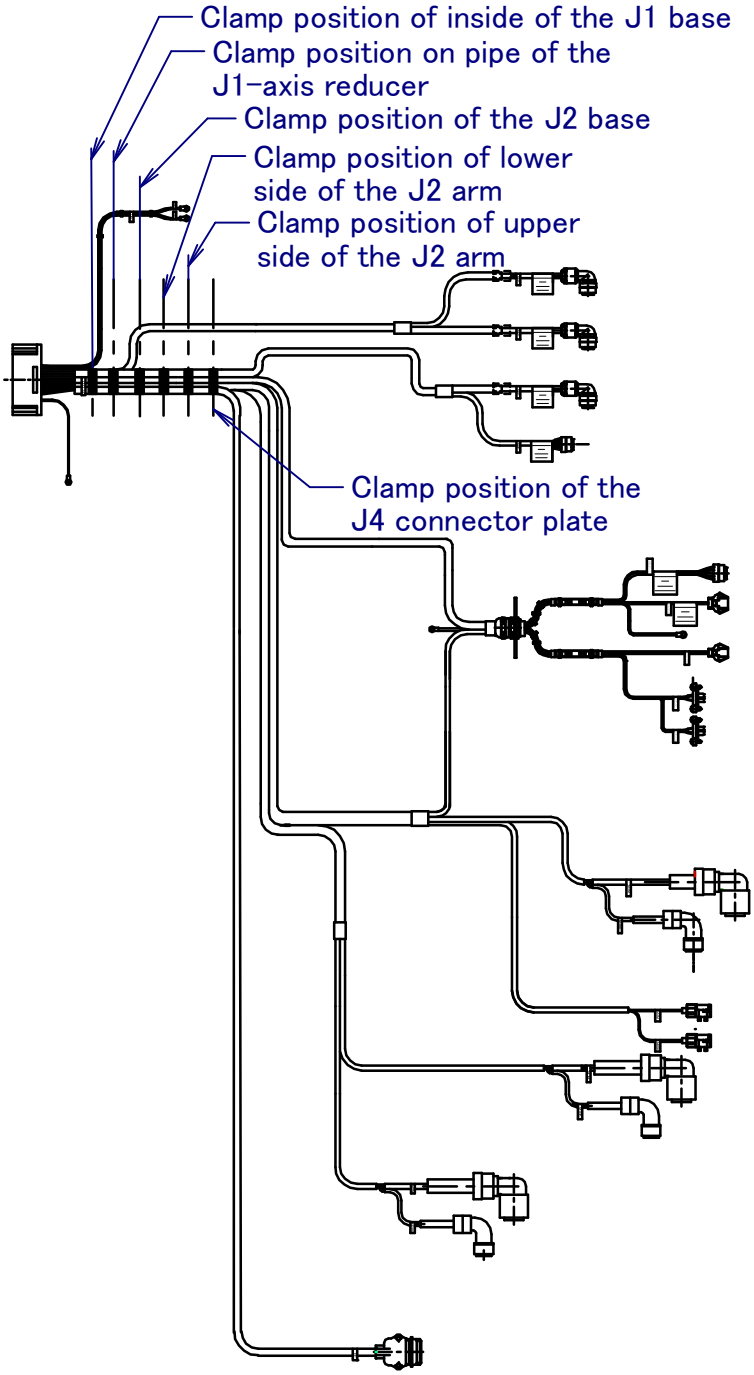
Stamp	Cable pattern diagram	Stamp	Cable No.
RMP		+ − M1P M2P M3P M4P M5P M6P1 M6M1 M5M M5BK M3M M3BK M4M M4BK M1M M1BK M2M M2BK EE	K601, K661

Table 8.2 (g) Cable pattern diagram (7)
(10M/10MS)

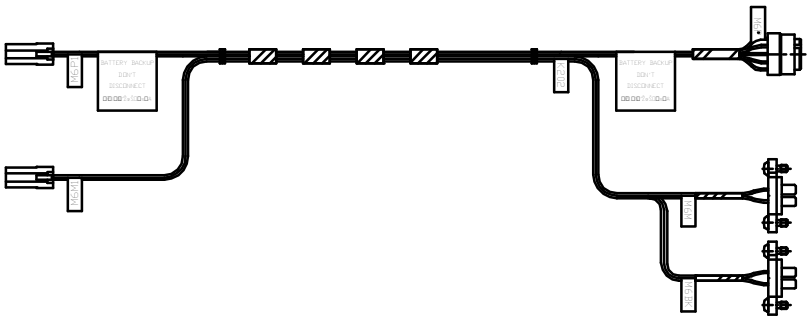
Stamp	Cable pattern diagram	Stamp	Cable No.
M6P1		M6P	K202
M6M1		M6M	
		M6BK	

Table 8.2 (h) Cable pattern diagram (8)

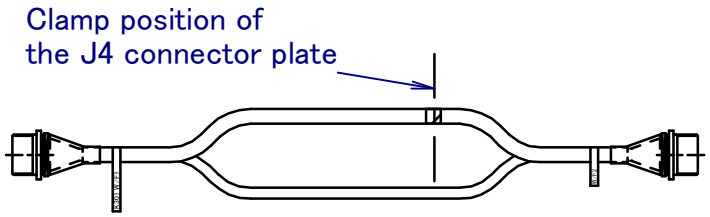
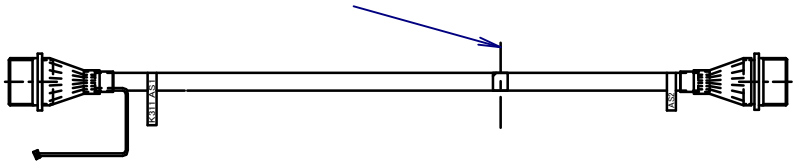
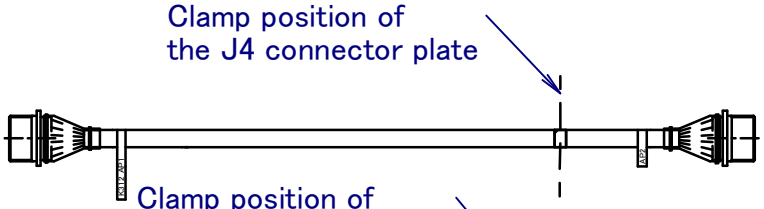
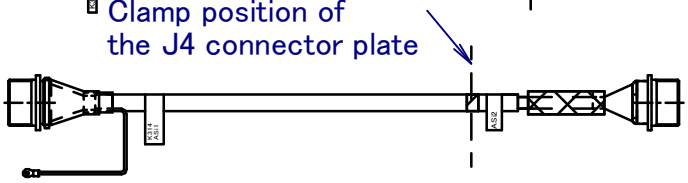
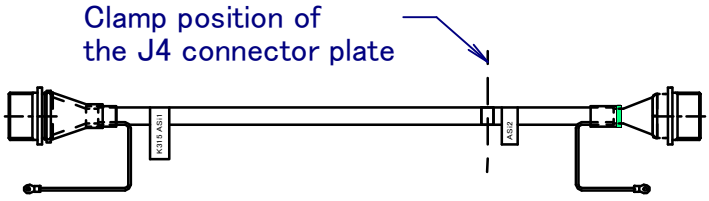
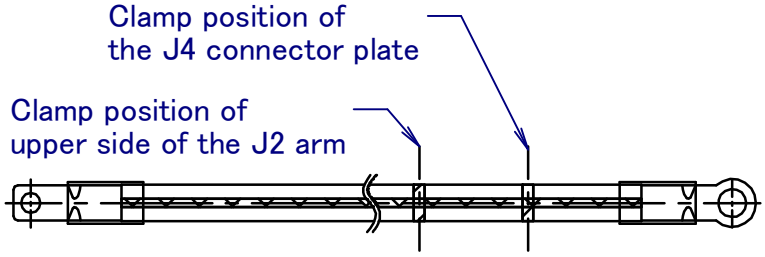
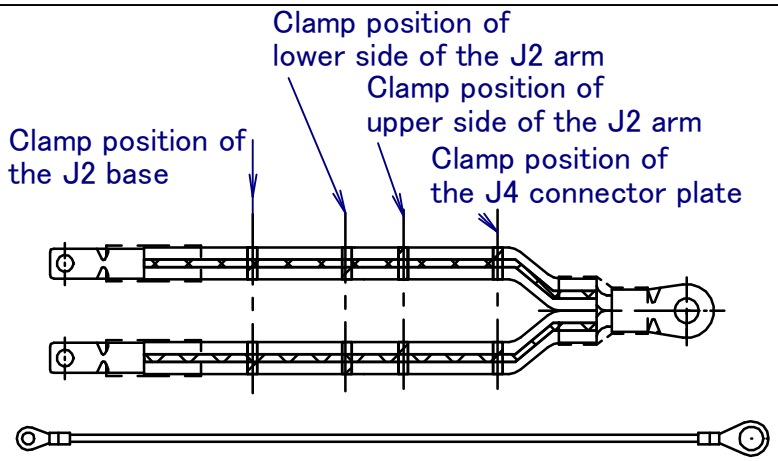
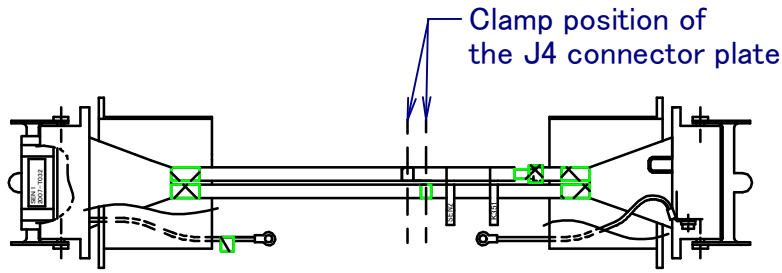
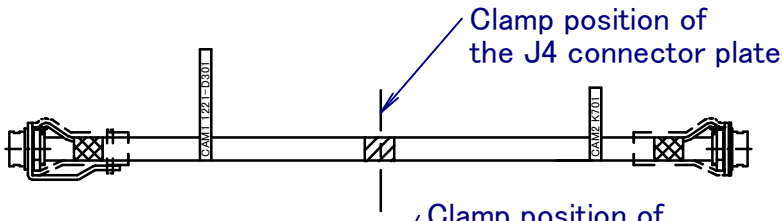
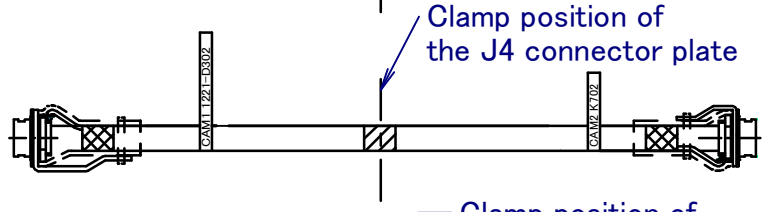
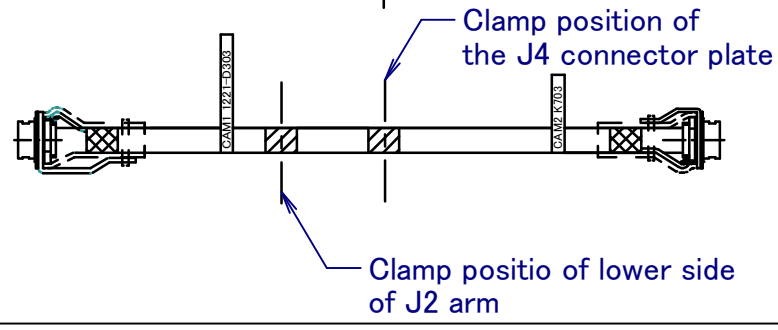
Stamp	Cable pattern diagram	Stamp	Cable No.
W/F1		W/F2	K301
AS1		AS2	K311
AP1		AP2	K312
ASi1		ASi2	K314
ASi1		ASi2	K315
			K321

Table 8.2 (i) Cable pattern diagram (9)

Stamp	Cable pattern diagram	Stamp	Cable No.
			K323 K331
SEN1		SEN2	K351
CAM1		CAM2	K701
CAM1		CAM2	K802
CAM1		CAM2	K803

8.3 REPLACING CABLE KIT (EXCEPT 10M/10MS)

1) Replacing the cable kit
When you have special tool (A290-7221-X971) for remove connector of J6-axis, place the robot in a posture of J1 to J4 = 0°
When you don't have special tool, place the robot in a posture of J1, J2 and J4 =0° and J3=-90° (Refer to Section 6.14.)

1 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (The Quick Master Reference is set with all axes at 0º before shipment.)
2 Before replacing cables, turn off controller power and remove all cables between robot and controller from the robot.
3 Cut the cable tie for the J2-/J3-axis cable protective sleeve, and remove the cable protective sleeve from the cable kit. (Refer to Fig. 8.3 (a)).
(There is no cable protective sleeve for ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L.)

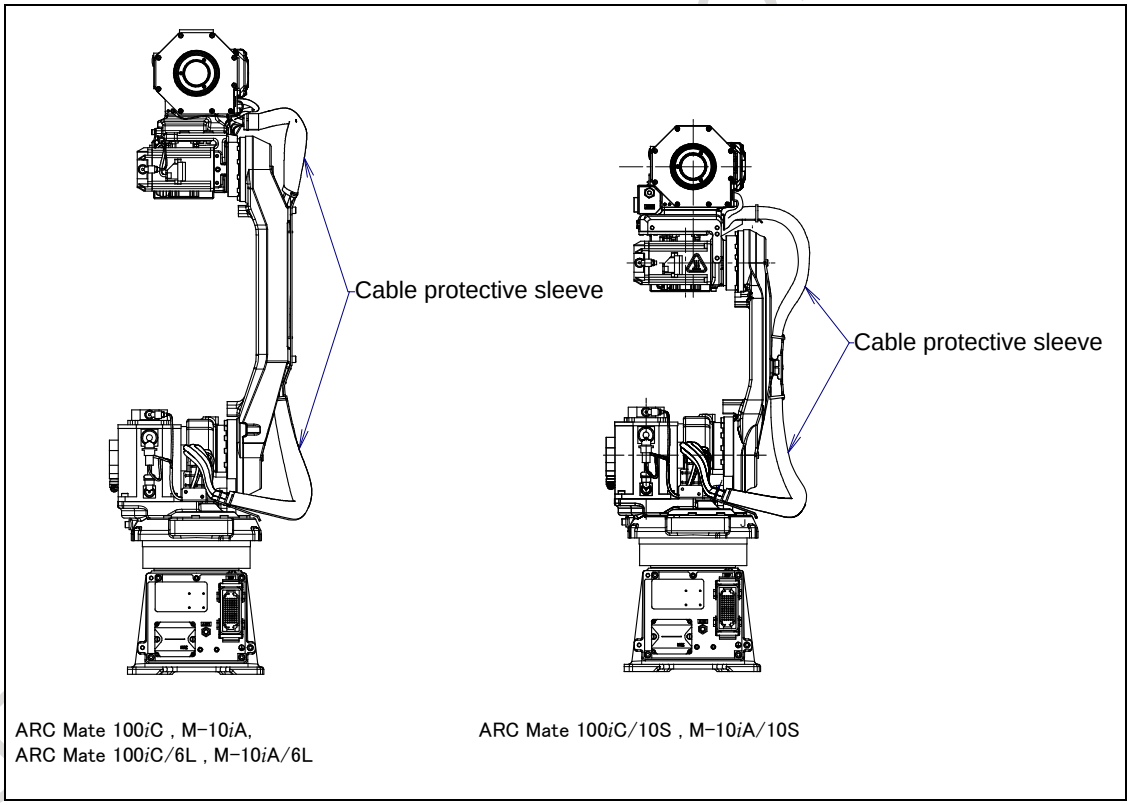


Fig. 8.3 (a) Replacing cable kit (J2/J3-axis cable protective sleeve)

4 Remove extra low bolt and button seal bolt, J6 motor cover and J5 motor cover. (Refer to Fig. 8.3 (b)). In case of M-10*i*A or M-10*i*A/6L or M-10*i*A/10S, replace gasket. (Remove adhesive tape completely.)
5 Remove duct cover and plate cover 1 (Refer to Fig. 8.3 (b)). In case of M-10*i*A or M-10*i*A/6L or M-10*i*A/10S, replace gasket. (Remove adhesive tape completely.)
6 Cut the cable tie of plate cover 1. Remove the earth terminal (M3) of upper side of J5-axis motor. (Refer to Fig. 8.3 (b))
7 Remove connector of J5/J6-axis motor, when connector of J6-axis motor is removed, use special tool (A290-7221-X971). If special tool cannot be prepared, remove J6-axis motor referring to Section 6.14 and remove connector.

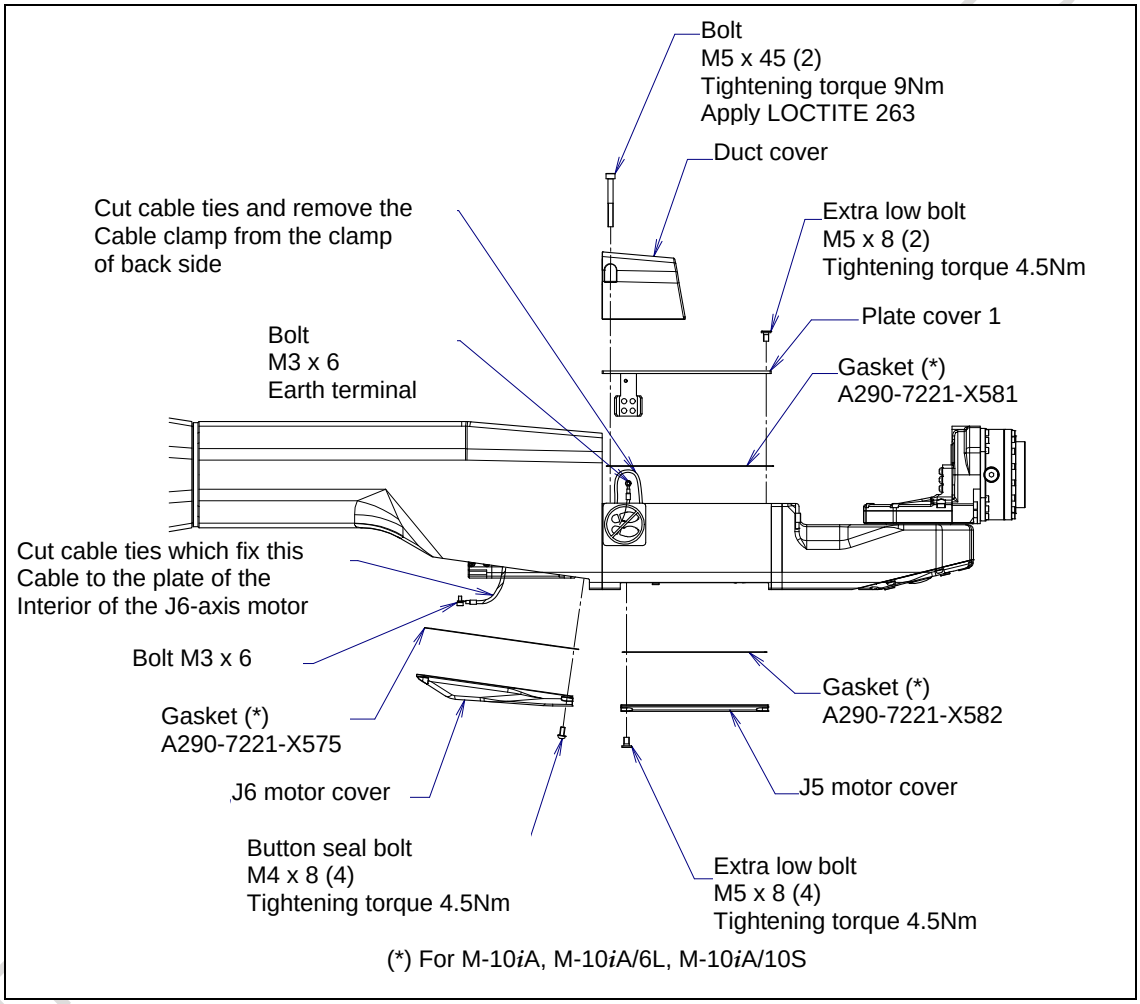


Fig. 8.3 (b) Replacing cable kit (J3 arm part 1)

8 Remove earth terminal (M3) above J6-axis motor. (Refer to Fig. 8.3 (c))

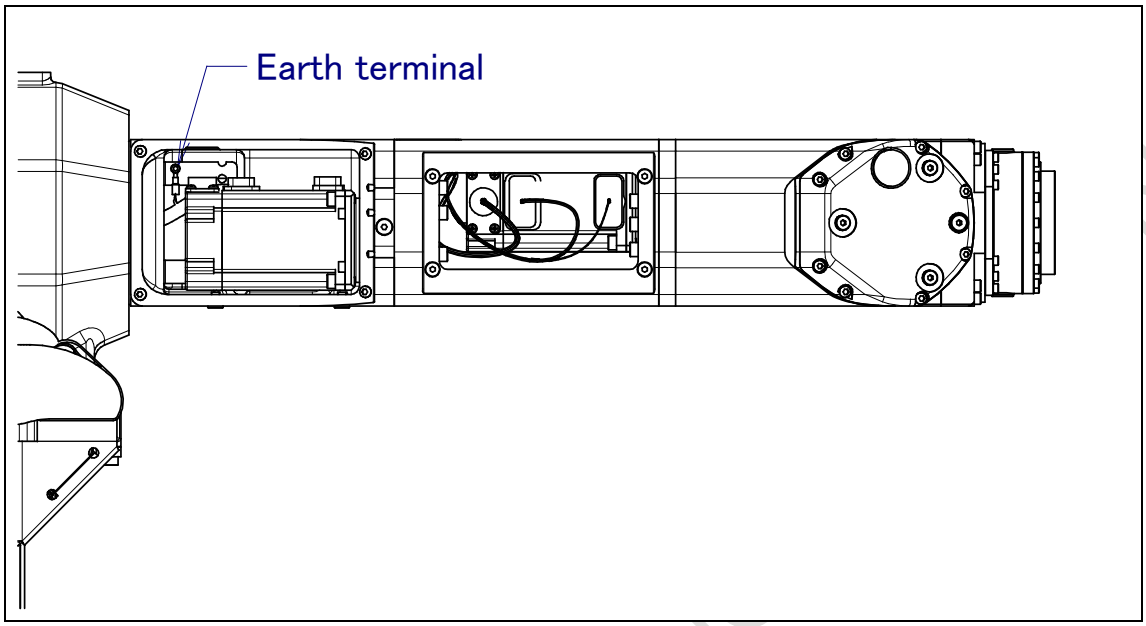


Fig. 8.3 (c) Replacing cable kit (J3 arm part 2)

9 Remove bolts M5 x 12 (9 pcs) or M5 x 8 (9 pcs), cover, gasket (A290-7221-X441). (Refer to Fig. 8.3 (d), (e)) (Remove adhesive tape completely.)
10 Remove bolts M3 x 35 (3 pcs) or M3 x 30 (3 pcs) and pulled out pipe. (Refer to Fig. 8.3 (d), (e))
11 Cut the cable tie of the back of the J6-axis motor.
12 Remove seal bolts M6 x 16 (2 pcs). (Refer to Fig. 8.3 (d), (e))

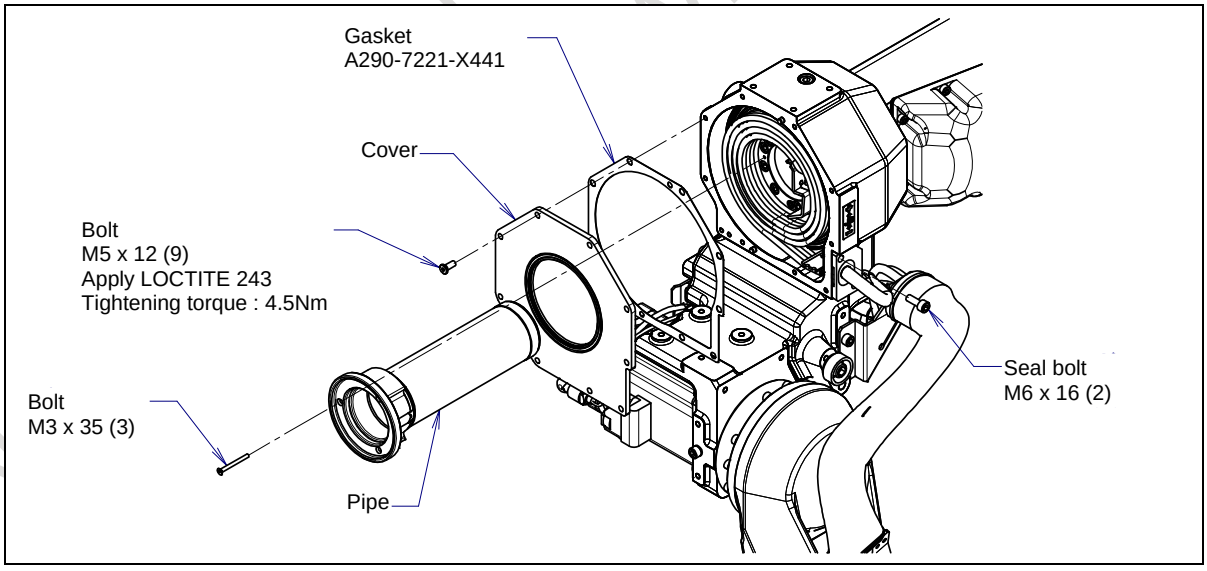


Fig. 8.3 (d) Replacing cable kit (J3 casing part 1)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

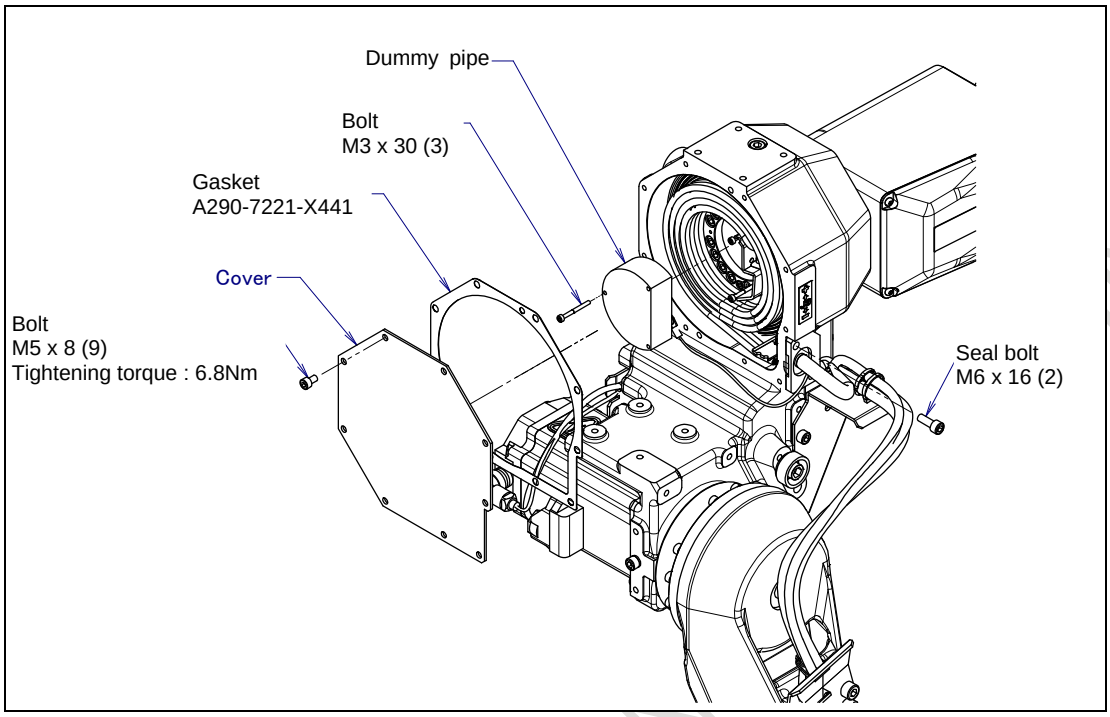


Fig. 8.3 (e) Replacing cable kit (J3 casing part 1)
(ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

13 Remove bolt that fasten clamp (2 places) of J3 casing. Then cut cable tie. (Refer to Fig. 8.3 (f))

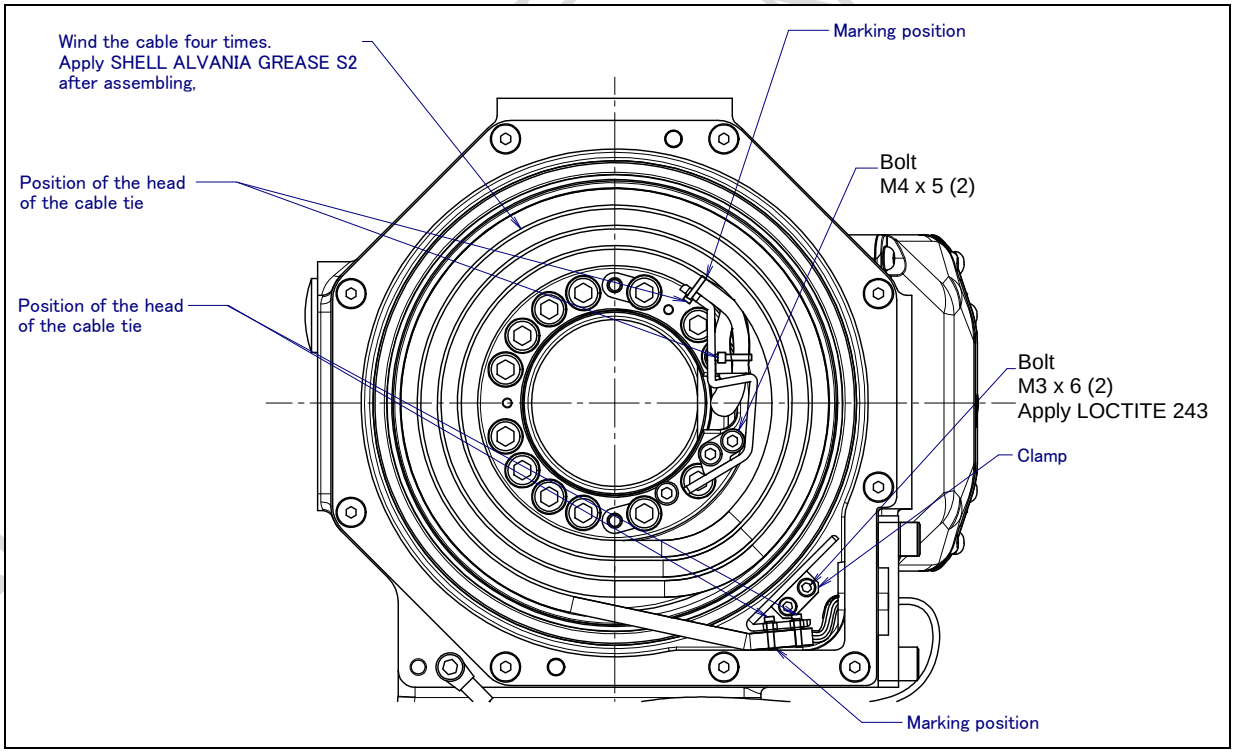


Fig. 8.3 (f) Replacing cable kit (J3 casing part 2)

14 Pull out cable that is in J3 arm to the J3 casing. When Pulsecoder cable passes between cable clamps that is read side of J6-axis motor and J3 arm base. Pass it carefully so as not to damage it by using the space referring to Fig. 8.3 (g).

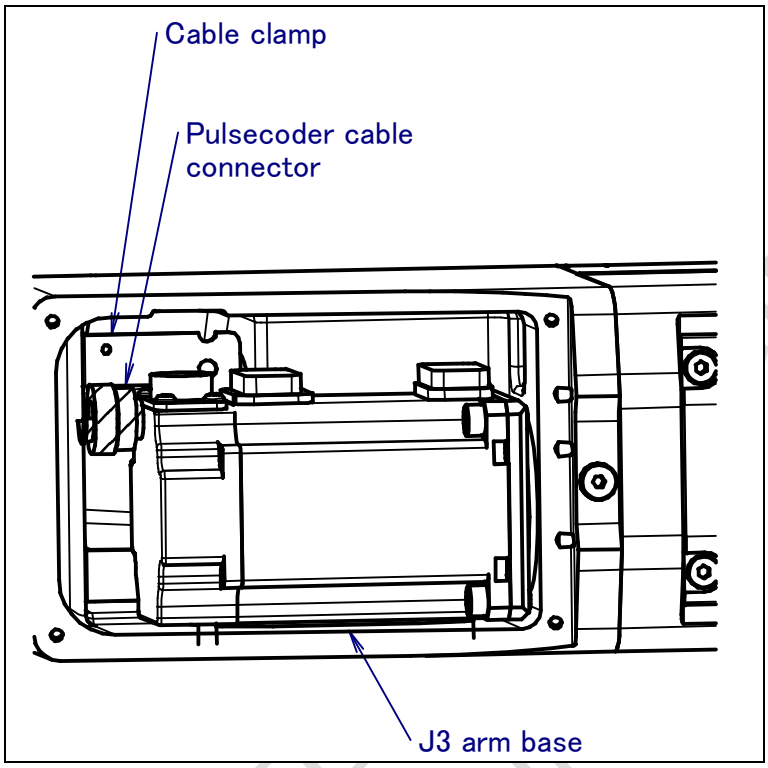


Fig. 8.3 (g) Replacing cable kit (J3 arm part 3)

15 Pull out the cable from the side of the J3 casing. In this time, if power cable and Pulsecoder cable is pulled beforehand. Work becomes easy.

16 Remove bolt and J4 connector plate. (Refer to Fig. 8.3 (h).) In this time, do not put it into the state to hang the cable of J4 connector plate. The cable might be hurt. If the J4 connector box is attached, remove it.

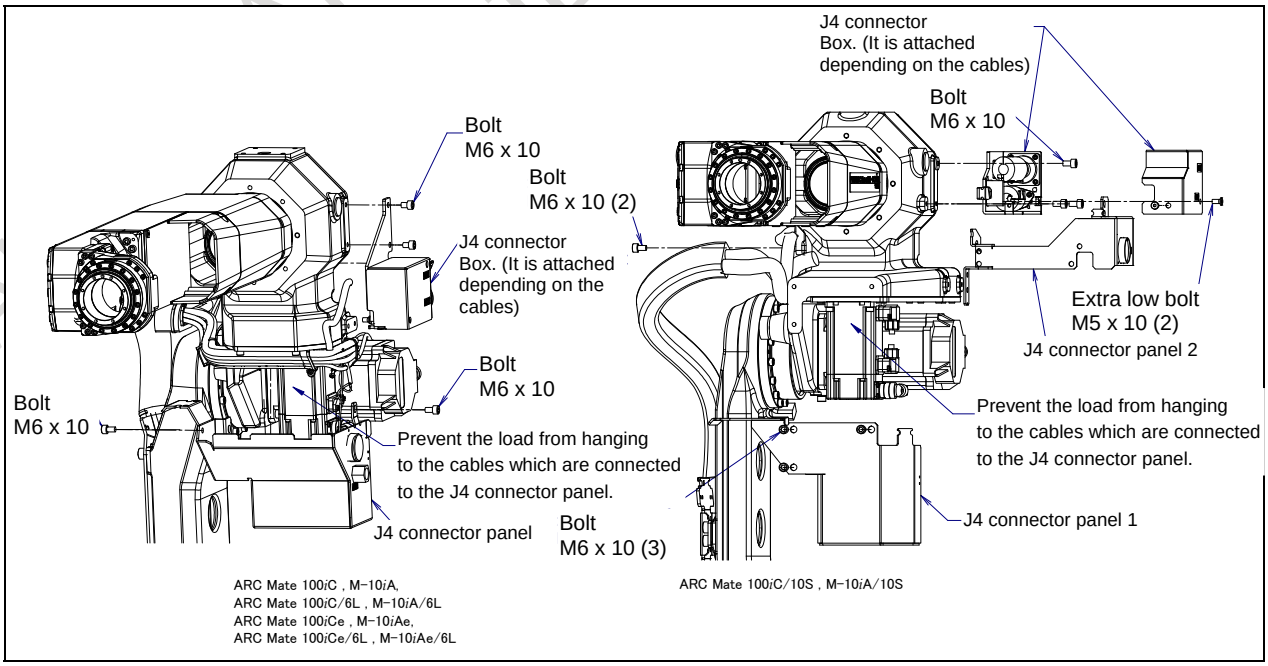


Fig. 8.3 (h) Replacing cable kit (J4 connector plate part)

17 Remove connector and lead line of J3/J4-axis motor. In this time, do not put it into the state to hang the cable of J4 connector plate. The cable might be hurt.
18 Remove cable cover and bolt. (Refer to Fig. 8.3 (i)).

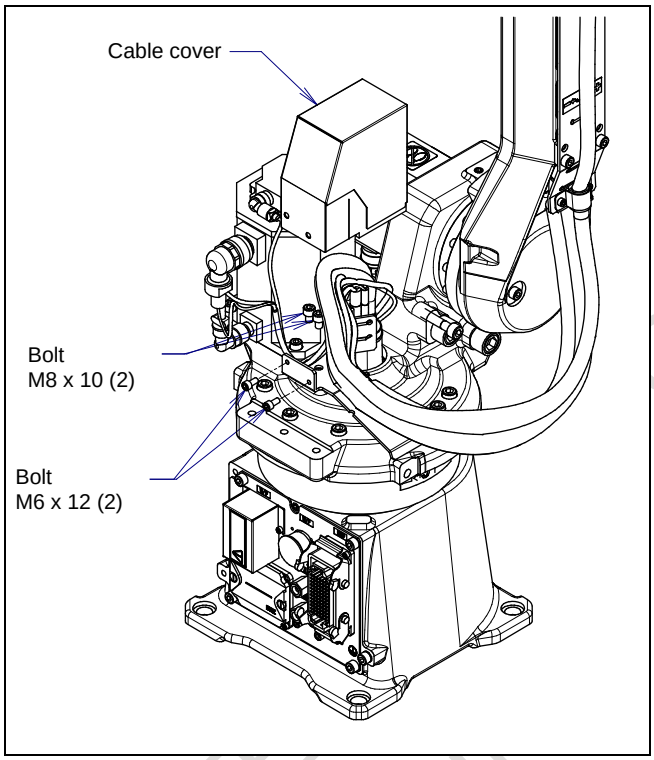


Fig. 8.3 (i) Replacing cable kit (J2 base part)

19 Remove connector of J1/J2-axis motor.
20 Remove M8 x 10 bolts (4 pcs) that fasten J1 connector plate to J1 base and remove J1connector plate from J1 base (Refer to Fig. 8.3 (j)).
21 Cut the cable tie that fastens rubber boots.
22 Remove M4 x 10 bolts (4 pcs) that fasten connector housing and bolt M6 x 10 bolts (2 pcs) that fasten support. (Refer to Fig. 8.3 (j)).
23 Remove connector insert from connector housing and remove connector insert and rubber boot from J1 connector plate. (Refer to Fig. 8.3 (j), (k)).
24 Remove the terminal from battery box.
25 Remove the two earth terminals secured to the J1 base.
26 Pull out the air tube from the panel union.
27 When option cable attached, remove them from J1 connector plate and J1 base.
28 Remove rubber boot from the cable.
29 Remove the plate, which is attached to support. (Refer to Fig. 8.3 (j)).

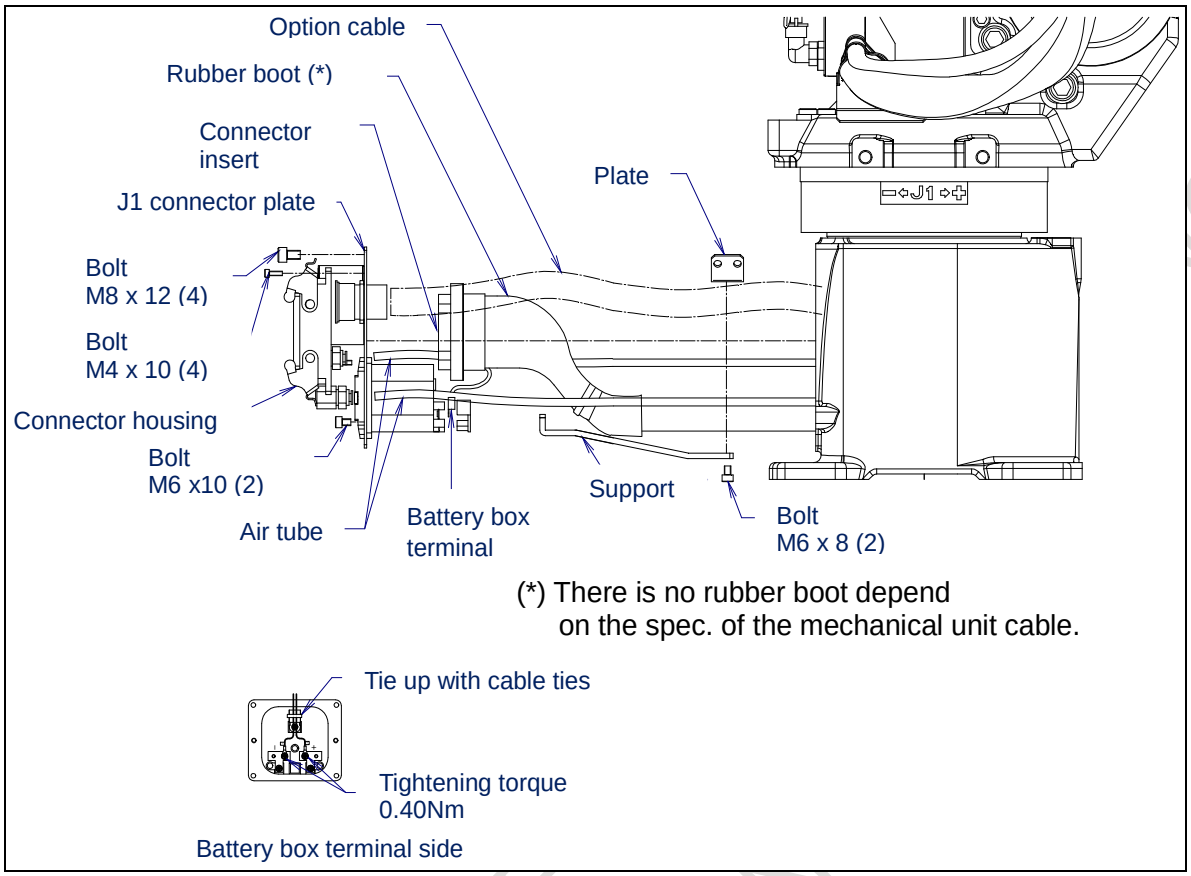


Fig. 8.3 (j) Replacing cable kit (J1 connector plate part 1)

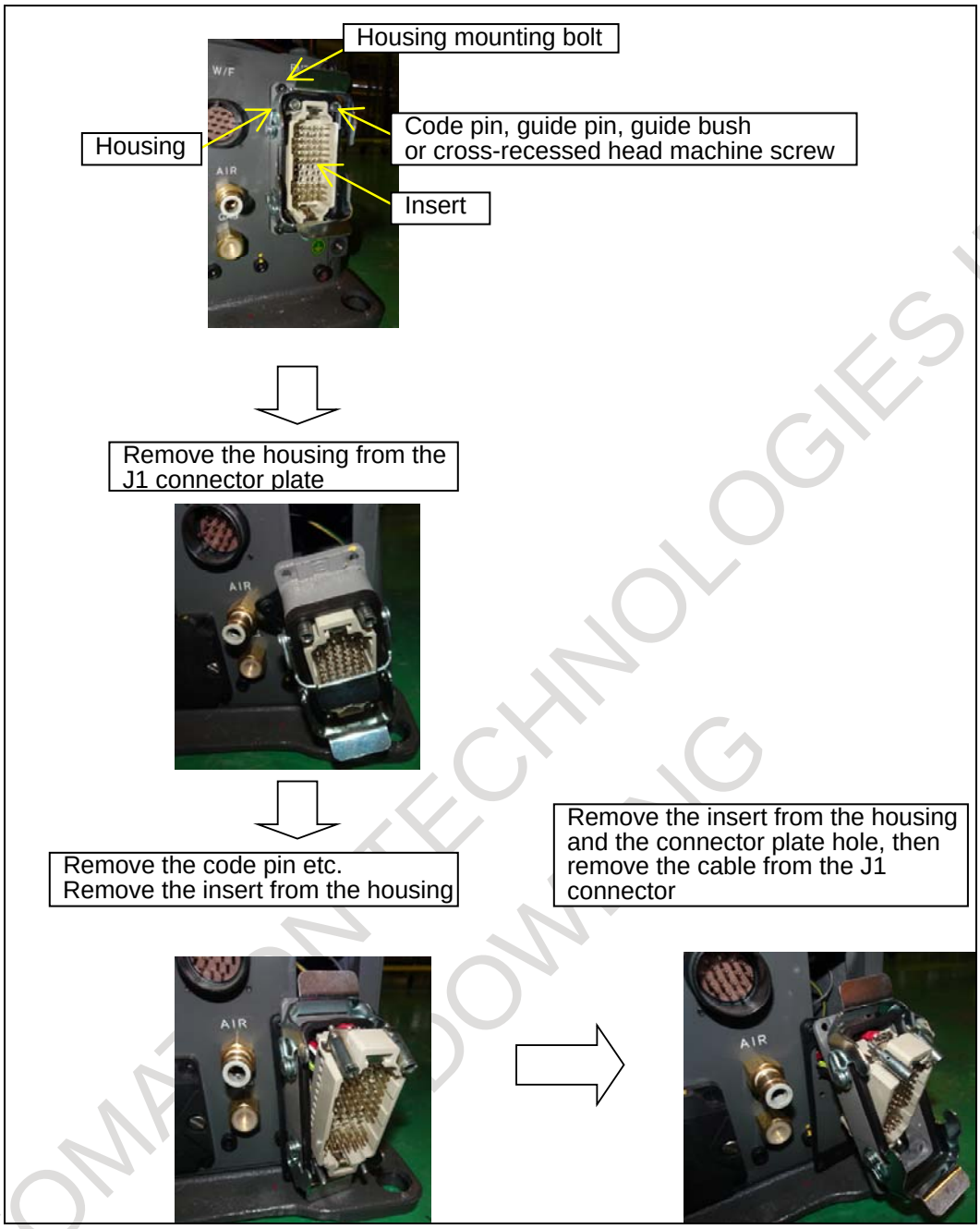


Fig. 8.3 (k) Removal method of the Harting connector (J1 connector plate part 2)

30 Pull out cables from the J1-axis reducer hollow part. When cable pass hollow part of J1-axis reducer, be careful connector insert don't caught in it. If cable is pulled forcibly, it causes the disconnection.
31 Remove J2 arm plate fixation M8 bolts (4) and the cable. (Refer to Fig. 8.3 (m))
32 Replace the cable kit by new one. Do 29 to 31 in reversed sequence. Pay attention cable don't twist in the J1 base. (Refer to Fig. 8.3 (l))

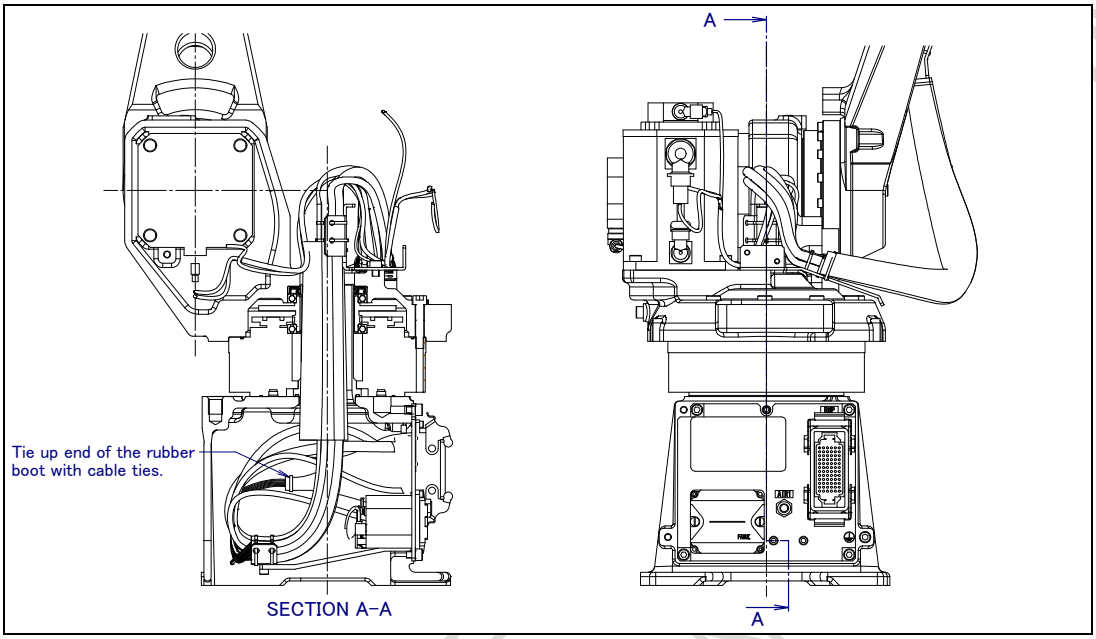


Fig. 8.3 (l) Replacing cable kit (J1 connector plate part 2)

33 Do 23 to 28 in reversed sequence. Pay attention rubber boot come between J1 connector plate and connector housing.
34 Do 16 to 22 in reversed sequence. In this time, do not put it into the state to hang the cable of J4 connector plate. The cable might be hurt. (See Fig. 8.3 (g))
35 Do 12 to 15 in reversed sequence. Wind the cable to J3 casing 4 times, and apply shell Alvania grease S2 referring to Fig. 8.3 (f). When reuse seal bolt, be sure to seal them with seal tape. At this time, please connect it to come to the position in which the head of the cable tie is shown in Fig. 8.3 (f). The cable might be hurt when differing from the shown in the figure position.
36 Do 11 in reversed sequence. Clamp cables while pulling it to the J6 motor side at this time. If pull is insufficient, when the pipe is inserted, cable might be hurt.
37 Do 9 to 10 in reversed sequence. In this time, be sure to replace gasket by new one.
38 Do 2 to 8 in reversed sequence. In this time, be sure to replace gasket by new article. Install the cable protective sleeve onto the cable kit as originally done, and then secure the cover with cable tie. (Secure the cable tie to such an extent that the cable protective sleeve does not get out of position when the robot operates. If the cable tie is tightened excessively, the cables in the movable section are confined and the cables can be broken at an earlier time.)
39 Perform quick mastering. Refer to the QUICK MASTERING section of the mechanical unit operator's manual (B-82754EN). If motor is removed, perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

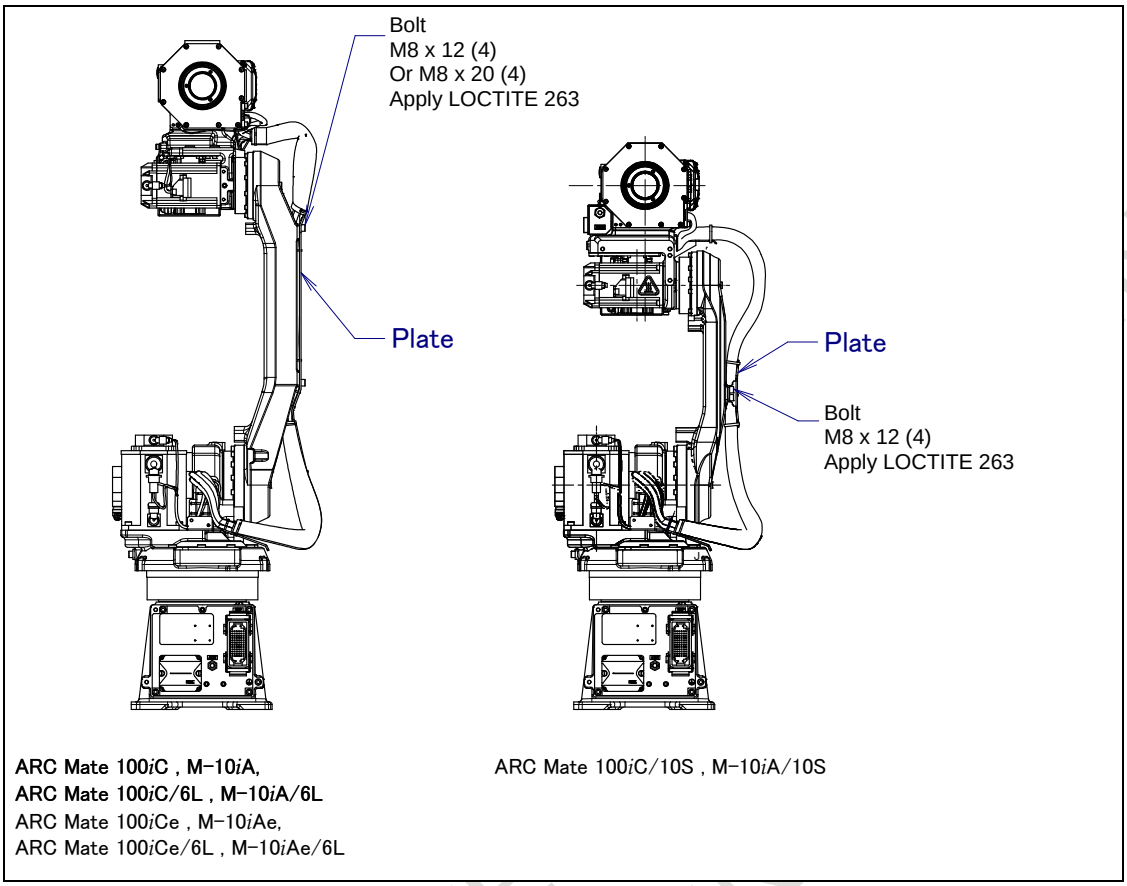


Fig. 8.3 (m) Replacing cable kit (J2 arm part)

8.4 REPLACING CABLE KIT (10M/10MS)

1 Place the robot in a posture of J1 to J4 = 0° and J5 =5°
2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
3 Before replacing cables, turn off controller power and remove all cables between robot and controller from the robot.
4 Cut the cable tie for the J2-/J3-axis cable protective sleeve, and remove the cable protective sleeve from the cable kit. (Refer to Fig. 8.4 (a)).

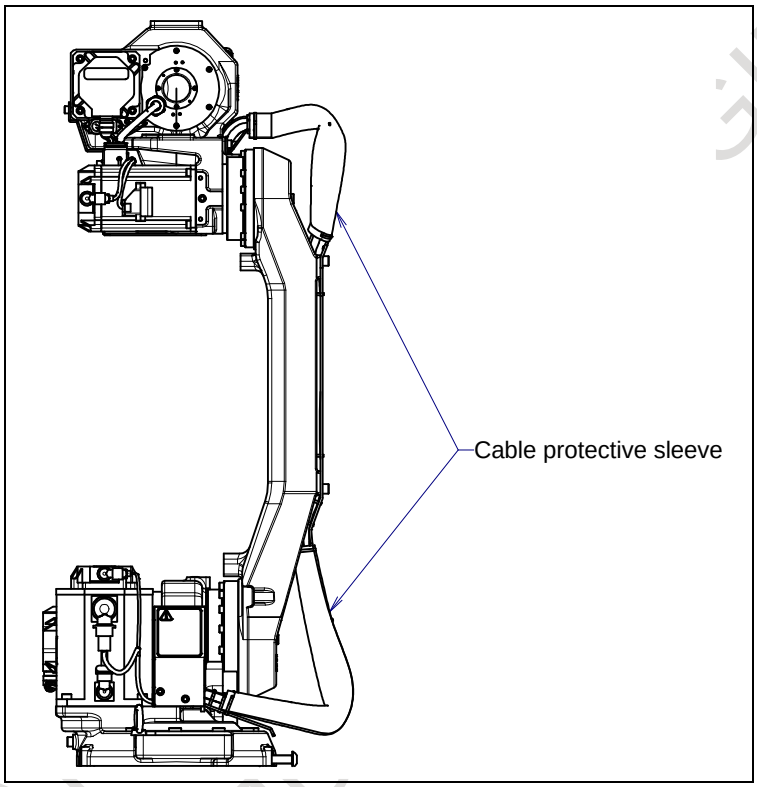


Fig. 8.4 (a) Replacing cable kit (J2/J3-axis cable protective sleeve)

5 Remove the pipe mounting seal bolt of J3 casing back side, then pull out the pipe. (Refer to Fig. 8.4 (b).)
6 Remove bolts M5 x 12, then remove the plate. (Refer to Fig. 8.4 (b).)

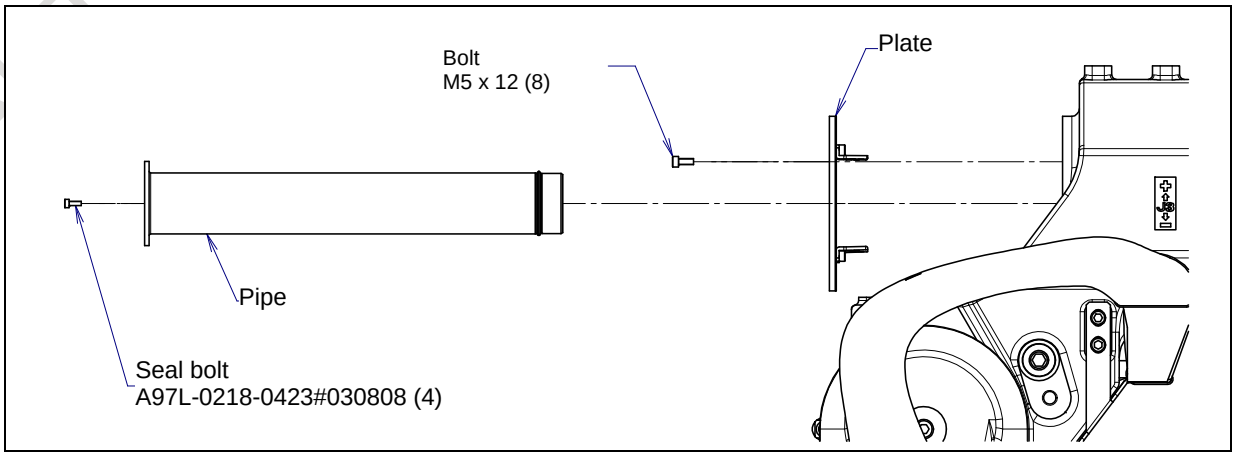


Fig. 8.4 (b) Replacing cable kit (J3 casing part) (10M/10MS)

7 Remove seal bolts M6 x 14, the remove the cover. (Refer to Fig. 8.4 (c).)

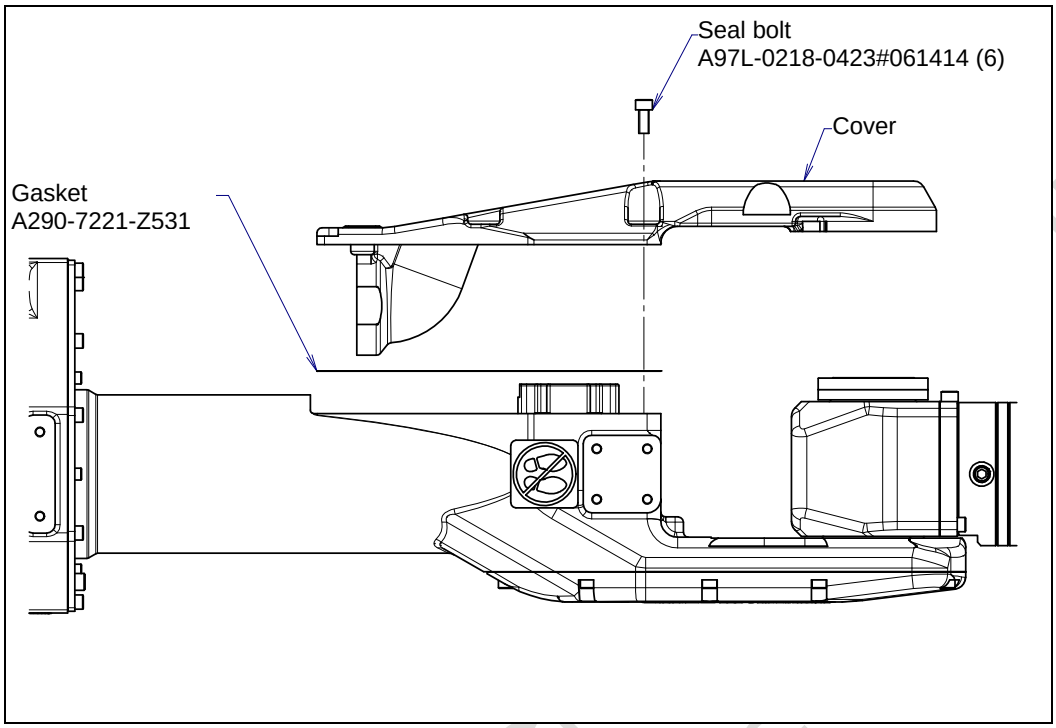


Fig. 8.4 (c) Replacing cable kit (J3 arm part) (10M/10MS)

8 Remove the bolts M5 x 20, the J6-axis reducer which the motor is attached. (Refer to Fig. 8.4 (d).)
9 Remove the seal bolts M6 x 14, the remove the cover. (Refer to Fig. 8.4 (d).)

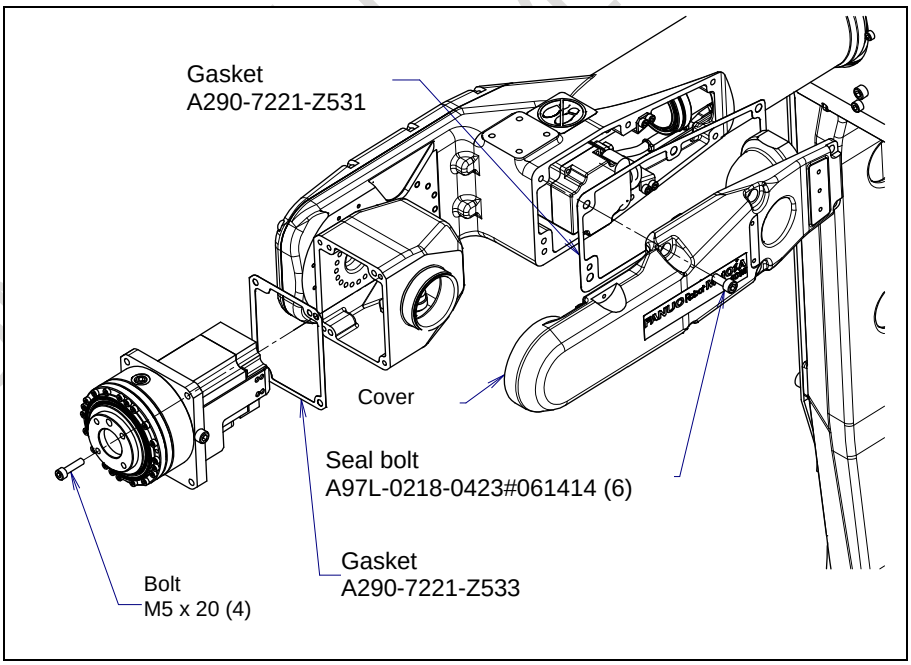


Fig. 8.4 (d) Replacing cable kit (J3 arm to wrist part) (10M/10MS)

10 Remove the cable forming of inside the J3 arm referring to Fig. 8.4 (e).

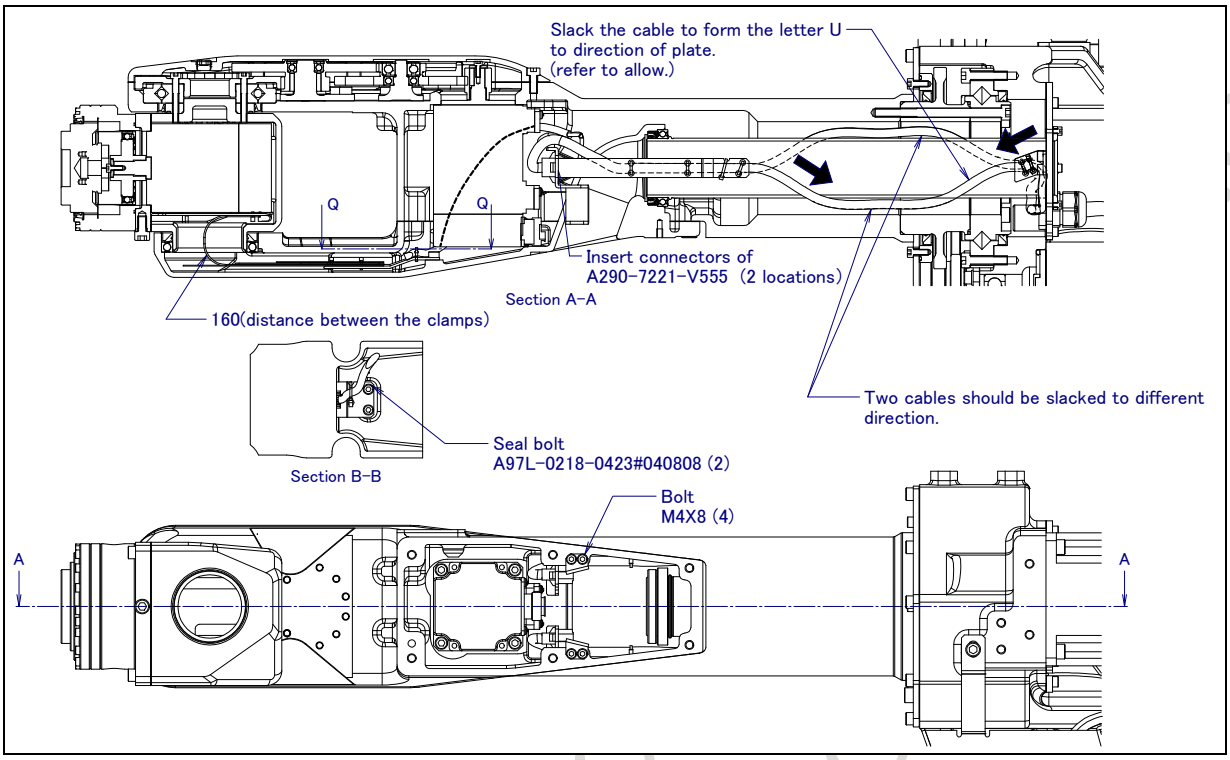


Fig. 8.4 (e) Replacing cable kit (J3 arm part 2) (10M/10MS)

11 Pull out the cable inside the J3 arm from the J3 casing back side.
12 Pull out the cable from the side of the J3 casing. In this time, if power cable and Pulsecoder cable is pulled beforehand. Work becomes easy.
13 Remove bolts M6 x 10 (3 pcs) and J4 connector plate. (Refer to Fig. 8.4 (f)) In this time, do not put it into the state to hang the cable of J4 connector plate. The cable might be hurt.

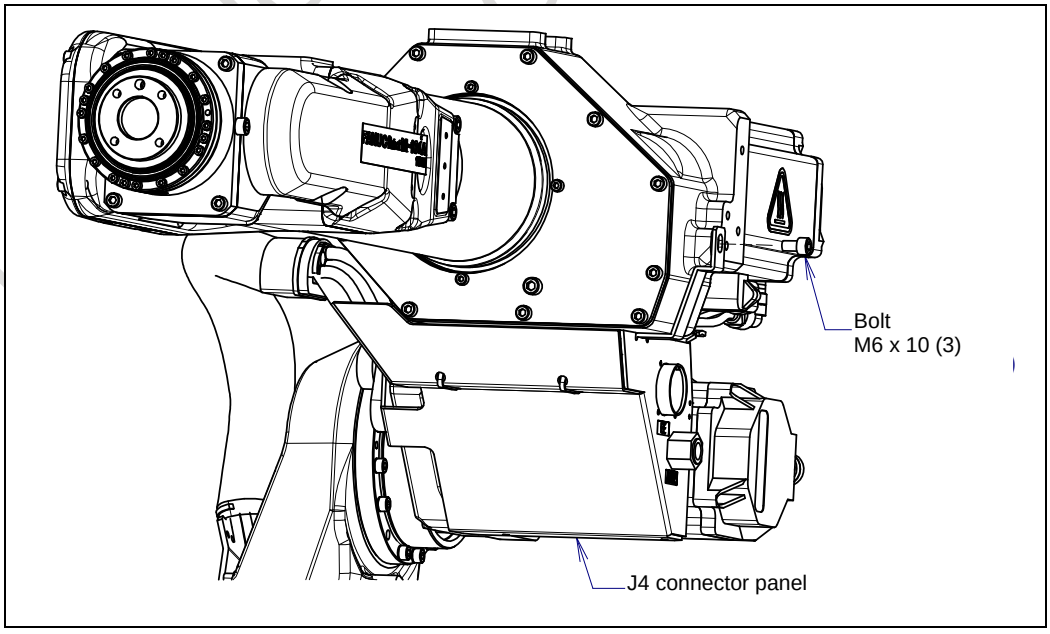


Fig. 8.4 (f) Replacing cable kit (J4 connector panel part 1) (10M/10MS)

14 Remove the connectors which are attached to the J3-axis motor and the J4-axis motor.
15 Remove the earth terminal of the J4 connector panel. (Refer to Fig. 8.4 (g))

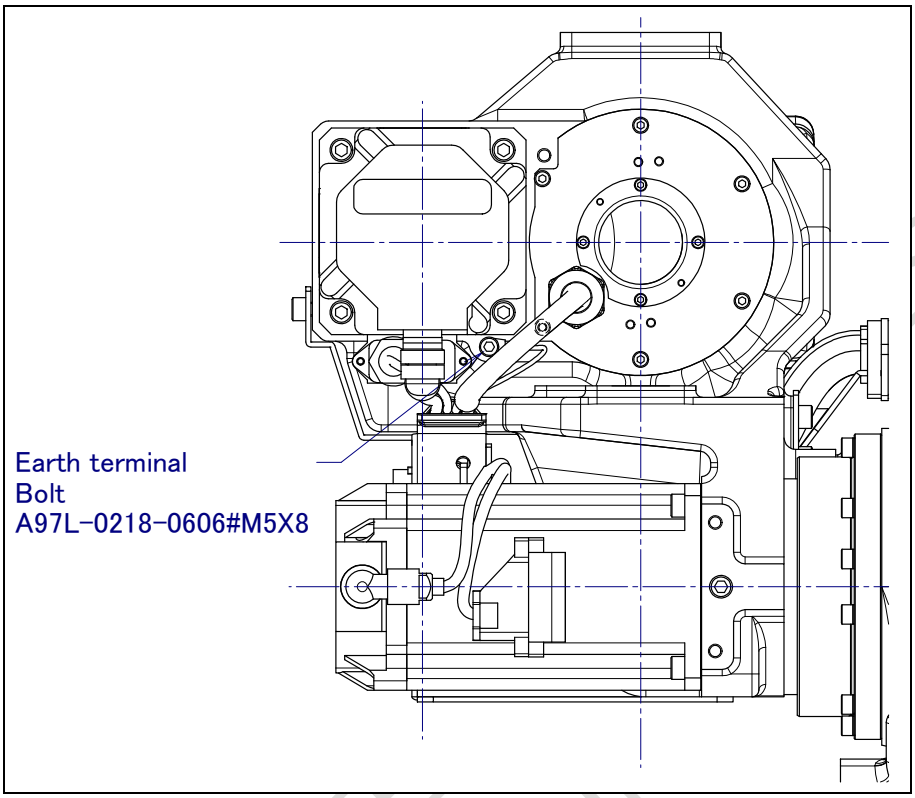


Fig. 8.4 (g) Replacing cable kit (J4 connector panel part 2) (10M/10MS)

16 Remove the cable cover and bolts M6 x 10 (2) and M8 x 10 (2). (Refer to Fig. 8.4 (h).)

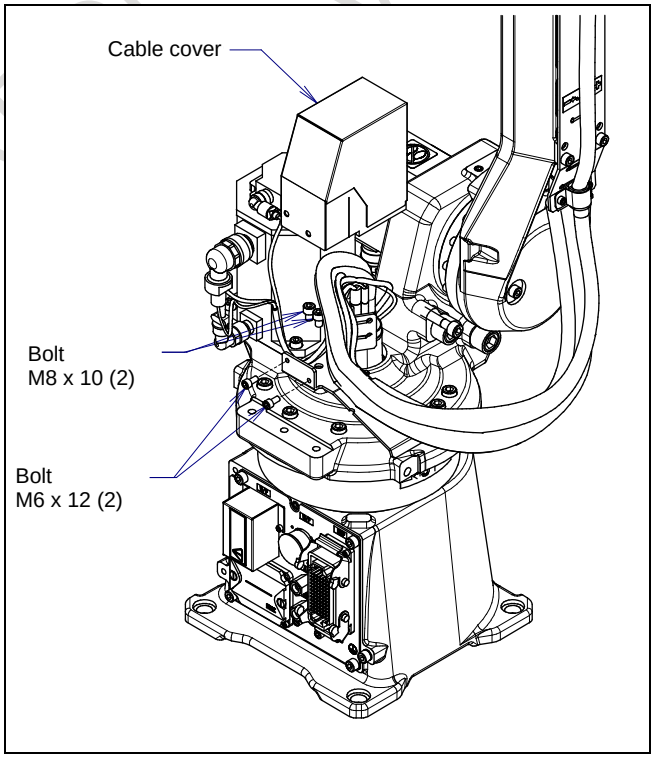


Fig. 8.4 (h) Replacing cable kit (J2 base part) (10M/10MS)

17 Remove connector of J1/J2-axis motor.
18 Remove M8 x 12 bolts (4 pcs) that fasten J1 connector plate to J1 base and remove J1connector plate from J1 base (Refer to Fig. 8.4 (i)).
19 Cut the cable tie that fastens rubber boots.
20 Remove M4 x 10 bolts (4pcs) that fasten connector housing and bolt M6 x 10 bolts (2pcs) that fasten support. (Refer to Fig. 8.4 (i)).
21 Remove connector insert from connector housing and remove connector insert and rubber boot from J1 connector plate. (Refer to Fig. 8.4 (i), (j))
22 Remove the terminal from battery box. (Refer to Fig. 8.4 (i))
23 Remove the two earth terminals secured to the J1 base.
24 Pull out the air tube from the panel union.
25 When option cable attached, remove them from J1 connector plate and J1 base.
26 If the rubber boot is attached, remove rubber boot from the cable.

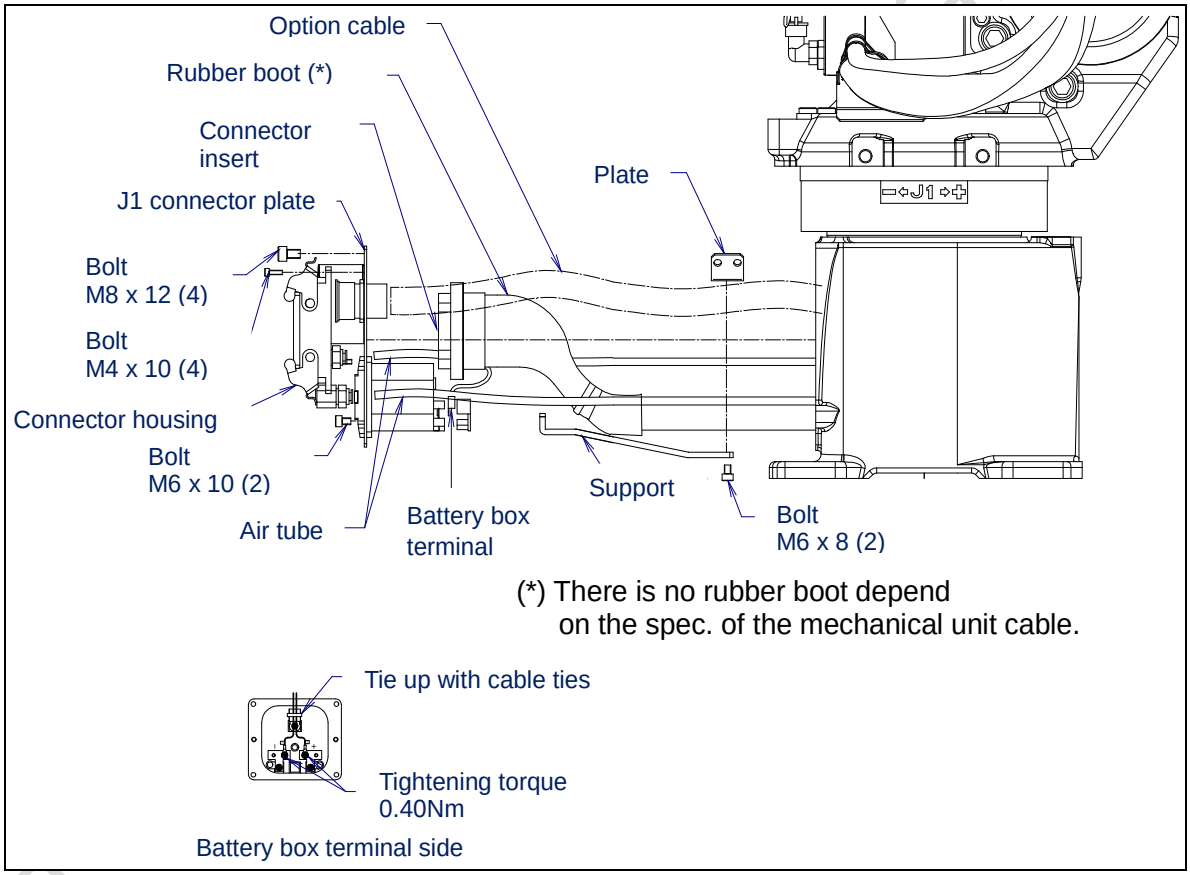


Fig. 8.4 (i) Replacing cable kit (J1 connector plate part 1)

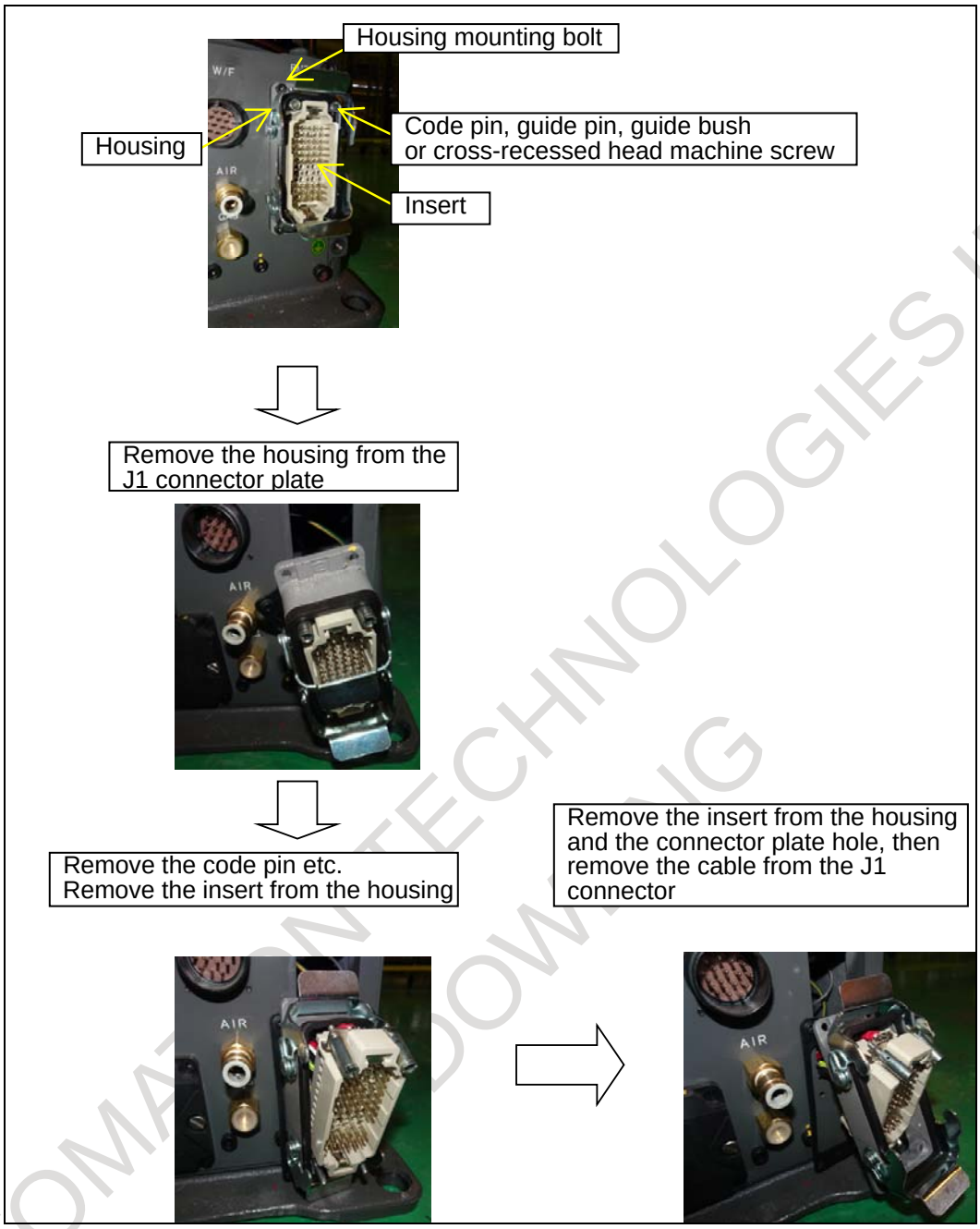


Fig. 8.4 (j) Removal method of the Harting connector (J1 connector plate part 2)

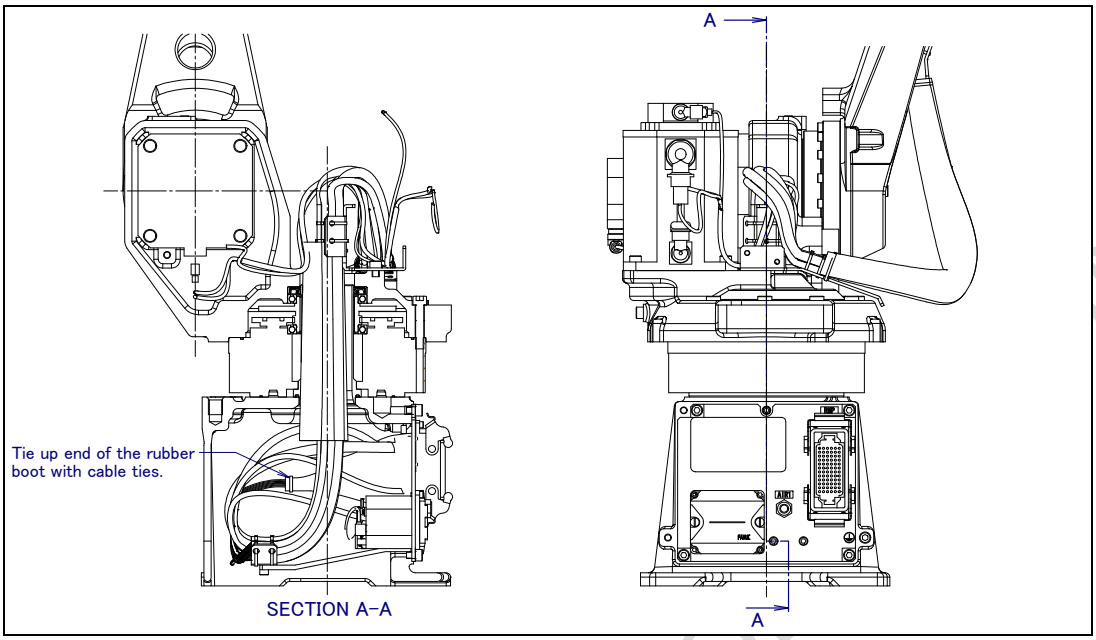


Fig. 8.4 (k) Replacing cable kit (J1 connector plate part 2)

27 Pull out cables from the J1-axis reducer. When cable pass hollow part of J1-axis reducer, be careful connector insert don't caught in it. If cable is pulled forcibly, it causes the disconnection.
28 Remove J2 arm plate fixation M8 x 12 (4) bolts and the cable. (Refer to Fig. 8.4 (l)).

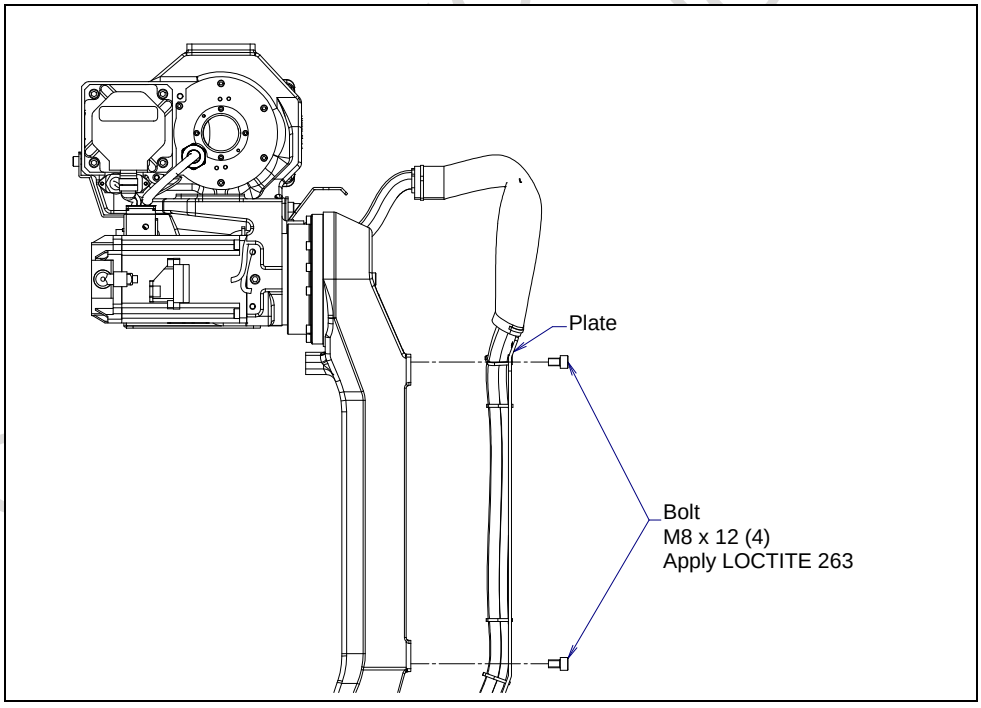


Fig. 8.4 (l) Replacing cable kit (J2 arm part)

29 Replace the cable kit by new one .Do 24 to 28 in reversed sequence. Pay attention cable don't twist in the J1 base. (Refer to Fig. 8.4 (k).)
30 Do 20 to 23 in reversed sequence. Pay attention rubber boot come between J1 connector plate and connector housing.
31 Assemble cable in reversed sequence at 11 to 22. Note that the cable doesn't come in contact with J3-axis and the J4-axis motor when the cable is fix to J4 connector panel with the cable tie. When J4 connector panel is assembled, support heavy goods by hand so that load does not depend on a cable. When load depends on a cable, a cable might be damaged. (refer to Fig. 8.4 (f))
32 Do 7 to 9 in reversed sequence. When reusing seal bolts, be sure to wind them with seal tape.
33 Do 3 to 6 in reversed sequence. In this time, be sure to replace gasket by new article.
34 Install the J2-/J3-axis cable protective sleeve onto the cable kit as originally done, and then secure the cover with cable tie. (Secure the cable tie to such an extent that the cable protective sleeve does not get out of position when the robot operates. If the cable tie is tightened excessively, the cables in the movable section are confined and the cables can be broken at an earlier time.)
35 Perform quick mastering. Refer to the QUICK MASTERING section of the mechanical unit operator's manual (B-82754EN). If motor is removed, perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-82754EN).

8.5 REPLACING SINGLE CABLES

1) Replacing only motor cable
   1 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
   2 Remove cable kit from robot referring to Section 8.3 and 8.4.
   3 Replace the motor cable by new one and assemble it to cable kit. Clamp cables as the clamping position that the marking position shown in Table 8.2 (a) to (i) and in Figure 8.2 (a), (b) are corresponding. If cable is clamped in not specified position, slack and an impossible pull are caused in the cable, and it causes the cable disconnection. There are cables that don't have marking on all position. First, set the cable with the marking position to a specified position. The cable without marking is formed along it and do so as not to twist along it.
   4 Attach the cable kit onto the robot body. (See Section 8.3 and 8.4.) Retighten the mounting bolts.
   5 Install the J2/J3-axis cable protective sleeve as originally done. (Secure the cable tie to such an extent that the cable protective sleeve does not get out of position when the robot operates. If the cable tie is tightened excessively, the cables in the movable section are confined and the cables can be broken at an earlier time.) (There is no cable protective sleeve for ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L.)
   6 Perform quick mastering. Refer to the QUICK MASTERING section of the mechanical unit operator's manual (B-82754EN).

2) Replacing only option cables (K301 etc.)
   (There is no option cable for ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L.)
   1 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-82754EN). (All the axes are set to 0º before shipment.)
   2 Cut the cable tie that fastens J2/J3-axis cable protective sleeve and remove it from cable kit.
   3 Remove cables that is between J1 base and J4 connector plate from robot referring to (1) of Section 8.2, 8.3 and 8.4.
   4 Replace the option cable by new one and fasten it in reversed sequence. Retighten the mounting bolts. Clamp cables as the clamping position that the marking position shown in Table 8.2 (a) to (i) and in Figure 8.2 (a), (b) are corresponding. If cable is clamped in not specified position, slack and an impossible pull are caused in the cable, and it causes the cable disconnection. There are cables that don't have marking on all position. First, set the cable with the marking position to a specified position. The cable without marking is formed along it and do so as not to twist along it.
   5 Install the J2-/J3-axis cable protective sleeve as originally done. (Secure the cable tie to such an extent that the J2/J3-axis cable protective sleeve does not get out of position when the robot operates. If the cable tie is tightened excessively, the cables in the movable section are confined and the cables can be broken at an earlier time.)
   6 Perform quick mastering. Refer to the QUICK MASTERING section of the mechanical unit operator's manual (B-82754EN).

9 MASTERING

Mastering is an operation performed to associate the angle of each robot axis with the pulse count value supplied from the absolute Pulsecoder connected to the corresponding axis motor. To be specific, mastering is an operation for obtaining the pulse count value corresponding to the zero position.

> ⚠ **CAUTION**
> In case of R-30*i*B/R-30*i*B Plus controller, when arc tool (3kg payload specification) is specified for ARC Mate *i*C series, mastering is performed with gravity compensation function enabled in our factory before shipment. Please refer to Chapter 11 of R-30*i*B/R-30*i*B Mate/R-30*i*B Plus /R-30*i*B Mate Plus controller optional function operator's manual (B-83284EN-2) for details of the gravity compensation function.

9.1 OVERVIEW

The current position of the robot is determined according to the pulse count value supplied from the Pulsecoder on each axis.
Mastering is factory-performed. It is unnecessary to perform mastering in daily operations. However, mastering becomes necessary after:

- Motor replacement
- Pulsecoder replacement
- Reducer replacement
- Cable replacement
- Batteries for pulse count backup in the mechanical unit have gone dead.

> ⚠ **WARNING**
> Robot data (including mastering data) and Pulsecoder data are backed up by their respective backup batteries. Data will be lost if the batteries go dead. Replace the batteries in the controller and mechanical units periodically. An alarm will be issued to warn the user of a low battery voltage.

Mastering method

Table 9.1 (a) describes the following mastering methods. Note that "Quick Mastering for Single Axis" is not supported in software version 7DC2 (V8.20P) or earlier.

Table 9.1 (a) Type of mastering

Fixture position mastering	This is performed using a mastering fixture before the machine is shipped from the factory.
Zero-position mastering (witness mark mastering)	This is performed with all axes set at the 0-degree position. A zero-position mark (witness mark) is attached to each robot axis. This mastering is performed with all axes aligned to their respective witness marks.
Quick mastering	This is performed at a user-specified position. The corresponding count value is obtained from the rotation count of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the fact that the absolute value of a rotation angle within one rotation will not be lost. (All axes at the same time)
Quick mastering for single axis	This is performed at a user-specified position for one axis. The corresponding count value is obtained from the rotation count of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the fact that the absolute value of a rotation angle within one rotation will not be lost.
Single-axis mastering	This is performed for one axis at a time. The mastering position for each axis can be specified by the user. This is useful in performing mastering on a specific axis.
Mastering data entry	Mastering data is entered directly.

This MAINTENANCE MANUAL describes fixture position mastering that is mainly required during replacement of parts. For other mastering methods, refer to OPERATOR'S MANUAL.
Once mastering is performed, it is necessary to carry out positioning, or calibration. Positioning is an operation is which the controller reads the current pulse count value to sense the current position of the robot.

⚠ CAUTION

1 If mastering is performed incorrectly, the robot may behave unexpectedly. This is very dangerous. So, the Master/Cal screen is designed to appear only when the $MASTER_ENB system variable is 1 or 2. After performing positioning, press F5 [DONE] on the Master/Cal screen. The $MASTER_ENB system variable is reset to 0 automatically, thus hiding the Master/Cal screen.
2 Before mastering is performed, it is recommended that the current mastering data be backed up.
3 When the motion range is mechanically 360 degrees or more, if any of the axes (J1-axis and J4-axis) to which the cables are connected is turned one turn in the correct mastering position, the cables in the mechanical unit are damaged. If the correct rotation position is not clear because the axis is moved too much during mastering, remove the connector panel or cover, check the states of the internal cables, and perform mastering in the correct position. For the checking procedure, See Fig. 9.1 (a) to 9.1 (d).

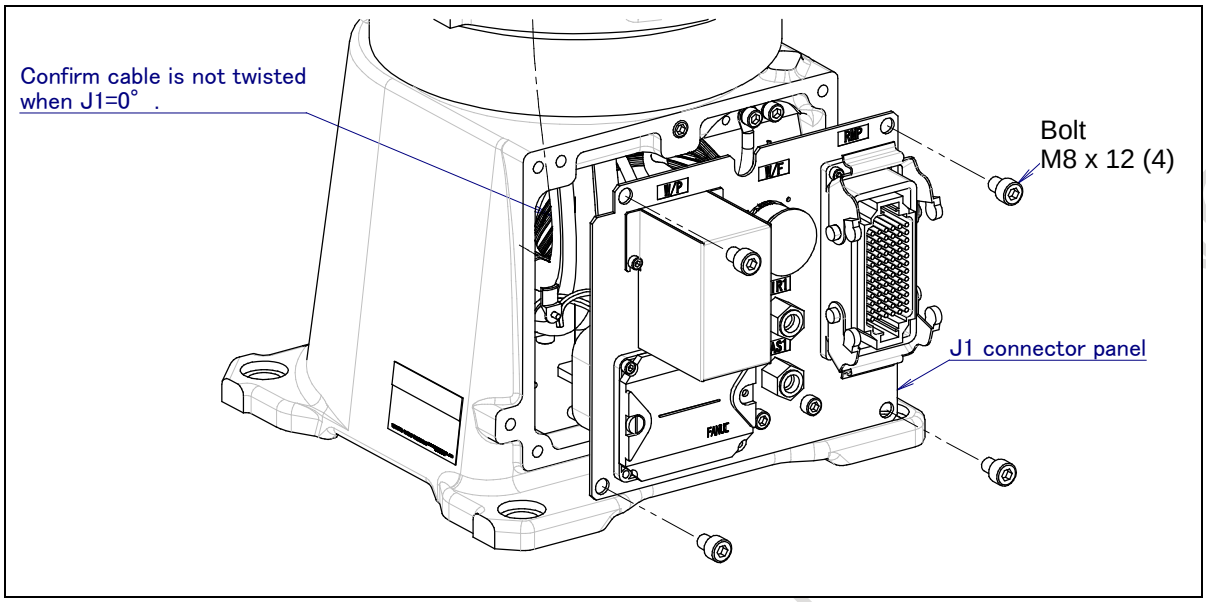


Fig. 9.1 (a) Confirming the state of cable (J1-axis)

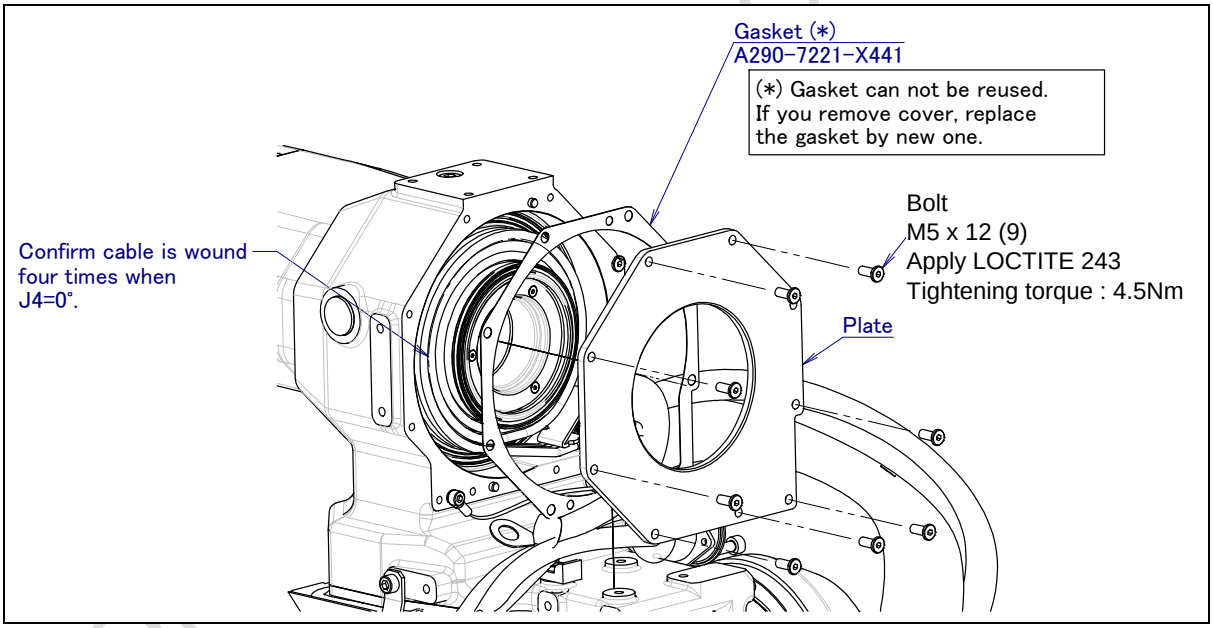


Fig. 9.1 (b) Confirming the state of cable (J4-axis) (1/2)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

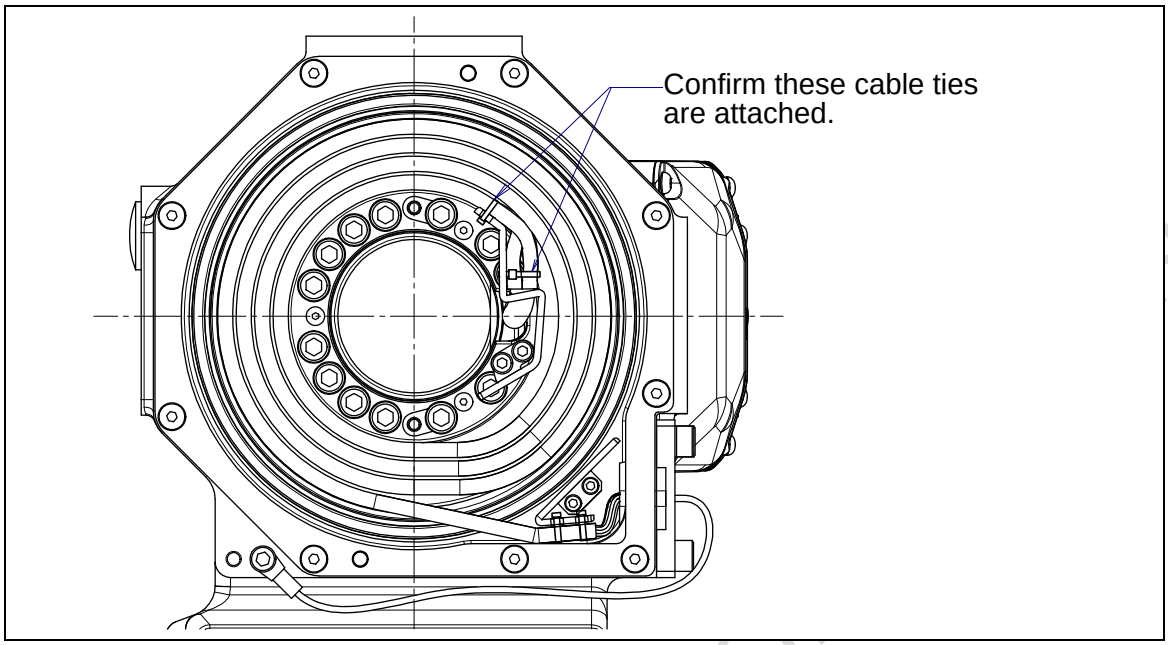


Fig. 9.1 (c) Confirming the state of cable (J4-axis) (2/2)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

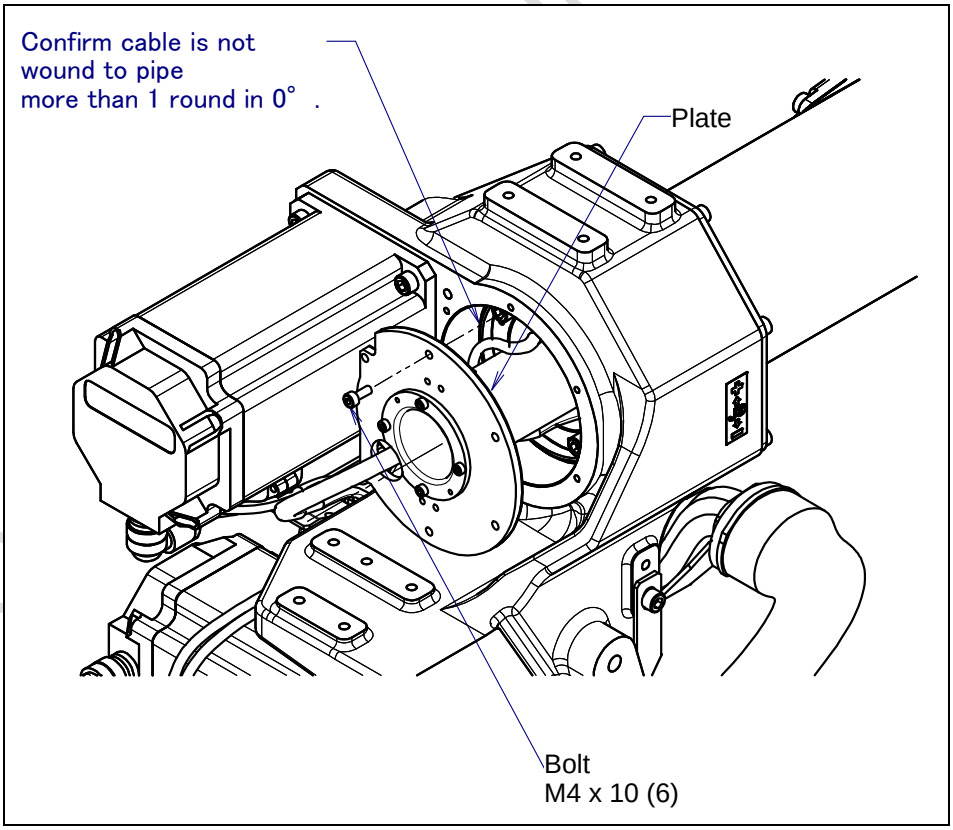


Fig. 9.1 (d) Confirming the state of cable (J4-axis)
(10M/10MS)

9.2 REGISTER OF MASTERING POSTURE

If the number of soft versions is Edition 24 or earlier of the 7DA3.
When FIXTURE POSITION MASTER is done for the first time.
It is necessary to input the mastering posture according to the following procedure beforehand.
(It is not necessary when FIXTURE POSITION MASTER is done for the second time or more.)

Procedure

1 Press the [MENU] key.
2 Press [0 NEXT] and Select [6 SYSTEM].
3 Press F1 [TYPE], and select [SYSTEM Variable] from the menu.
4 Place the cursor on $PARAM_GRP, then press [ENTER] key.
5 [$MRR_GRP_T] is displayed then press [ENTER].
6 Place the cursor on $MASTER _POS, then press [ENTER] key.
7 Input MASTERING POSTURE in Fig. 9.4 (f), (g).
8 Turn off the power of the controller and turn on it.
(If the power supply of the controller is never turned on again, the value of the mastering posture is not updated.

9.3 RESETTING ALARMS AND PREPARING FOR MASTERING

Before performing mastering because a motor has been replaced, it is necessary to release the relevant alarm and display the positioning menu.

Alarm displayed

"SRVO-062 BZAL" or "SRVO-075 Pulse not established"

Procedure

1 Display the positioning menu by following the steps 1 to 6.
  1 Press the [MENU] key.
  2 Press [0 NEXT] and select [6 SYSTEM].
  3 Press F1 ([TYPE]), and select [Variable] from the menu.
  4 Place the cursor on $MASTER_ENB, then key in "1" and press the [ENTER] key.
  5 Press F1 ([TYPE]), and select [Master/Cal] from the menu.
  6 Select the desired mastering type from the [Master/Cal] menu.

2 To reset the "SRVO-062 BZAL" alarm, follow steps 1 to 5.
  1 Press the [MENU] key.
  2 Press [0 NEXT] and select [6 SYSTEM].
  3 Press F1 ([TYPE]), and select [Master/Cal] from the menu.
  4 Press F3 ([RES_PCA]), then press F4 ([YES]).
  5 Cycle power of the controller.

3 To reset the "SRVO-075 Pulse not established" alarm, follow the steps 1 to 2.
  1 After cycling controller power, the message "SRVO-075 Pulse not established" appears again.
  2 Move the axis for which the message mentioned above has appeared in either direction till the alarm disappears when you press the [RESET] key.

9.4 FIXTURE POSITION MASTER

Fixture position mastering is performed using a mastering fixture. This mastering is carried out in the predetermined fixture position.
Fixture position mastering is accurate because a dedicated mastering fixture is used.
When mastering the robot, arrange the robot to meet the following conditions.

- Make the robot mounting base horizontal.
  (The overall levelness of the robot mounting surface shall be 1 mm or less.)
- Remove the hand and other parts form the wrist.
- Set the robot in the condition protected from an external force.

Assembling the fixture base

1 Assemble the fixture base as shown in Fig. 9.4 (a).

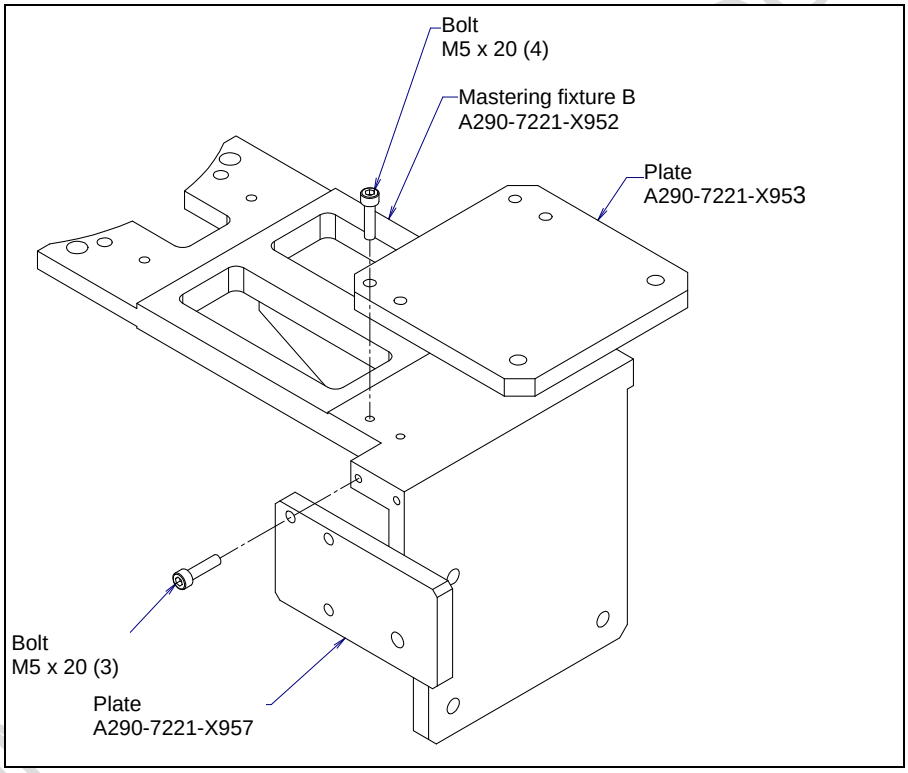


Fig. 9.4 (a) Assembling the fixture base

2 Adjust the dial gauge to 3.00 mm using the calibration block, and tighten it with M5 bolt as shown in Fig. 9.4 (b). (Do not tighten the bolt too strongly or the dial gauge will be broken.)

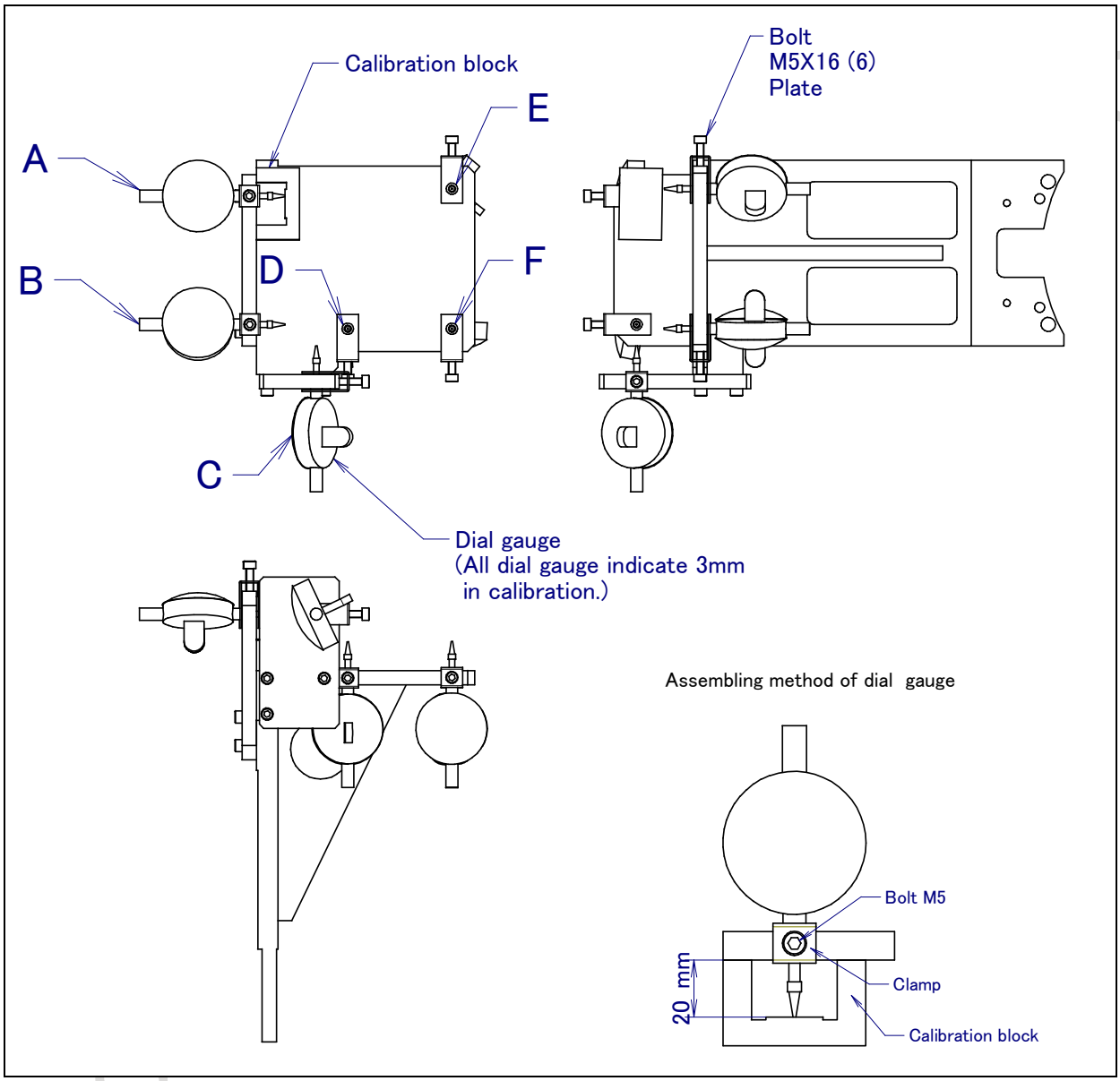


Fig. 9.4 (b) Mounting dial gauge

3 Remove the cover that protects the fixture mounting face of the J1 base. (Upon the completion of mastering, attach this cover to the original position.) Mount the fixture to the J1 base as shown Fig. 9.4 (c). When assembling pin A290-7221-X955, pay attention to the direction of the pin refer to Fig. 9.4 (c).

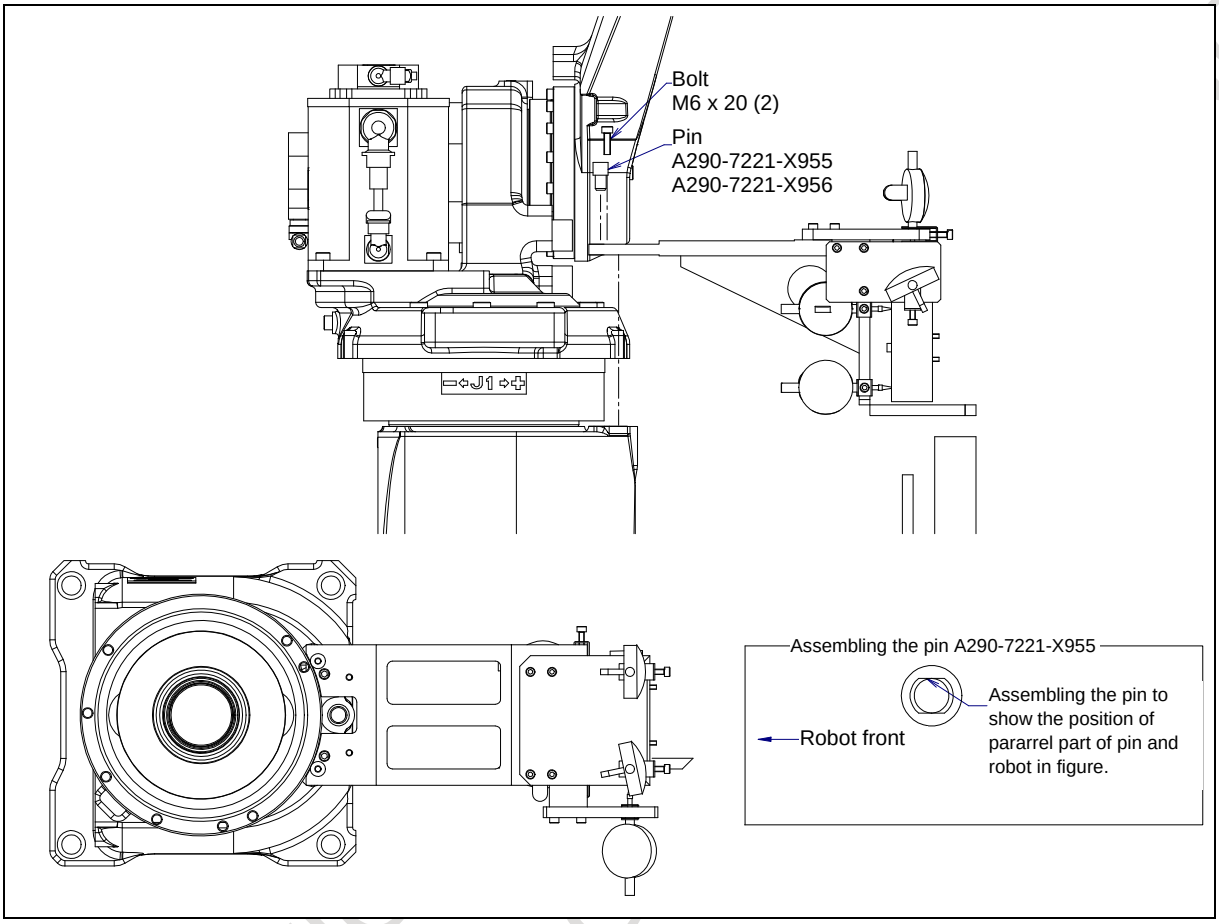


Fig. 9.4 (c) Assembling the fixture base

4 Assemble the fixture to the wrist flange as shown in Fig. 9.4 (d) and (e).
When assembling pin, pay attention the parallel pin turn to radial part of hollow flange. Refer to Fig. 9.4 (d) and (e).

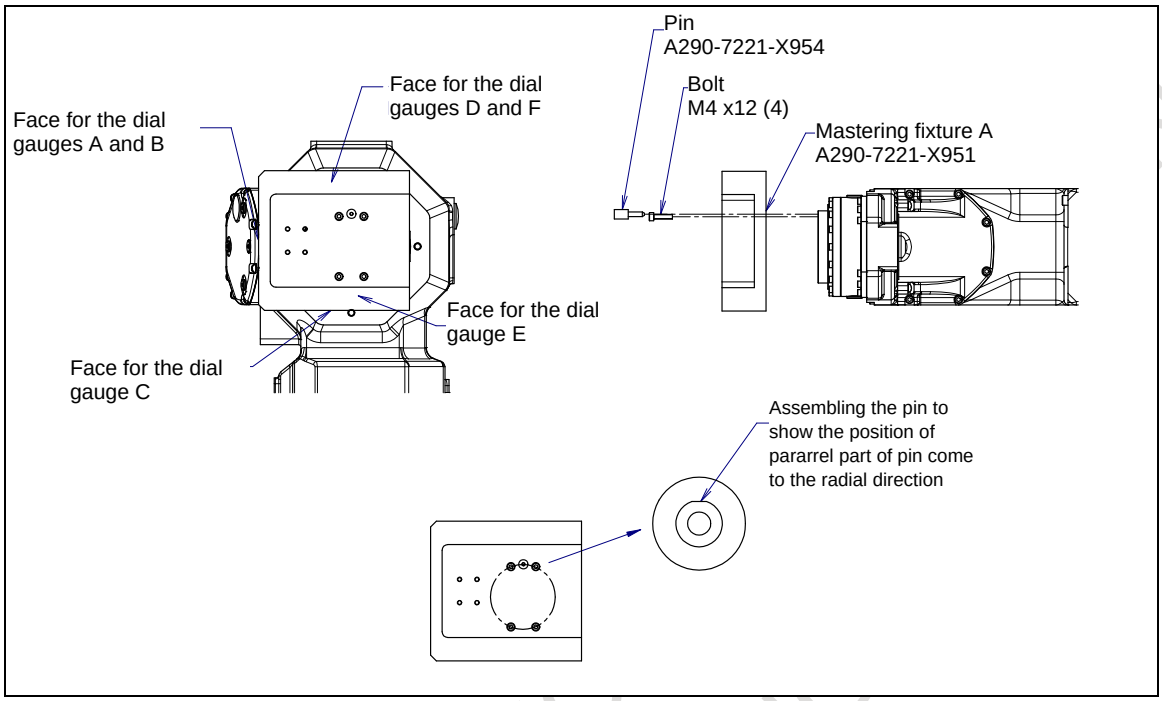


Fig. 9.4 (d) Assembling the fixture to the wrist flange (except 10M/10MS)

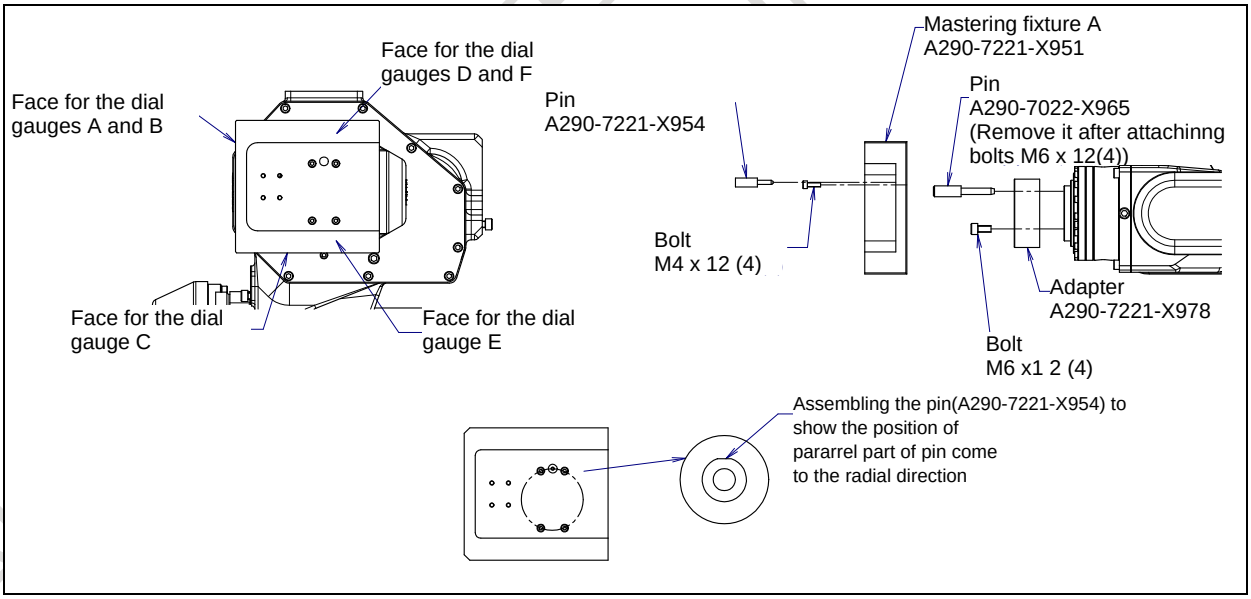


Fig. 9.4 (e) Assembling the fixture to the wrist flange (10M/10MS)

Mastering

1 Press the [MENU] key to show screen menu.
2 Press [0 NEXT] and select [6 SYSTEM].
3 Press F1 [TYPE] to show screen switch menu.
4 Select Master/Cal. Master/Cal screen will be displayed.

```
                                AUTO
SYSTEM Master/Cal                    JOINT 1%
                    TORQUE= [ON]
  1 FIXTURE POSITION MASTER
  2 ZERO POSITION MASTER
  3 QUICK MASTER
  4 QUICK MASTER FOR SINGLE AXIS
  5 SINGLE AXIS MASTER
  6 SET QUICK MASTER REF
  7 CALIBRATE

Press 'ENTER' or number key to select.

 [TYPE] LOAD RES_PCA          DONE
```

5 Release brake control, and jog the robot into a posture for mastering.
A to F (see Fig. 9.4 (b)) of the fixture attached to the wrist are dial gauges A to F (see Figs. 9.4 (d), (e)) and make adjustments so that dial gauges A to F indicate 3 mm. A posture as shown in Fig. 9.4 (f), (g) should be taken. See this figure for reference.

NOTE
Brake control can be released by setting the system variables as follows:
$PARAM_GROUP.$SV_OFF_ALL : FALSE
$PARAM_GROUP.$SV_OFF_ENB[*] : FALSE (for all axes)
After changing the system variables, switch the controller power off and on again.

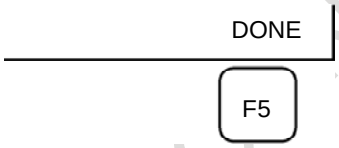
6 Select "1 FIXTURE POSITION MASTER" and Press F4, YES.
"MASTER POSITION" shown in Fig. 9.4 (f), (g) is set in this position.

```
                                AUTO
SYSTEM Master/Cal                    JOINT 1%
                    TORQUE= [ON]
  1 FIXTURE POSITION MASTER
  2 ZERO POSITION MASTER
  3 QUICK MASTER
  4 QUICK MASTER FOR SINGLE AXIS
  5 SINGLE AXIS MASTER
  6 SET QUICK MASTER REF
  7 CALIBRATE
Robot Mastered! Mastering Data:
<0><11808249><3876856>
<9873638><122000309><2000319>
  [TYPE] LOAD RES_PCA          DONE
```

7 Select “7 CALIBRATE“ and press F4 [YES]. Position arrangement will be performed Alternatively, cycle power of the controller to perform position arrangement.

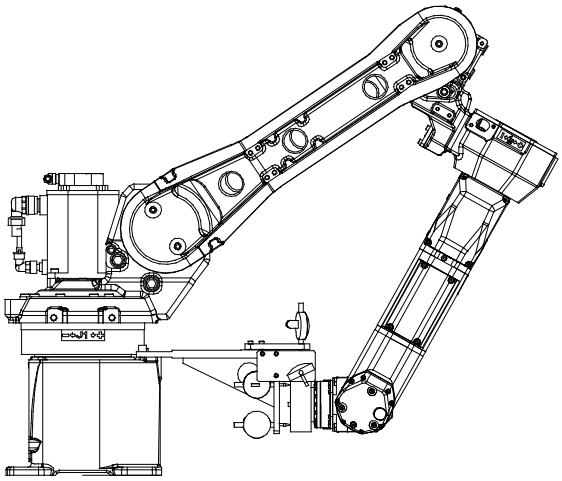
```
                                AUTO
SYSTEM Master/Cal                JOINT
                               TORQUE= [ON]
  1 FIXTURE POSITION MASTER
  2 ZERO POSITION MASTER
  3 QUICK MASTER
  4 QUICK MASTER FOR SINGLE AXIS
  5 SINGLE AXIS MASTER
  6 SET QUICK MASTER REF
  7 CALIBRATE
Robot Calibrated! Cur Jnt Ang(deg)
<0.000><55.9747><-118.993>
<0.000><-61.0069><-90.000>
  [TYPE] LOAD RES_PCA          DONE
```

8 After positioning has completed, press F5 [DONE].



9 Return brake control to the original setting, and cycle power of the controller.

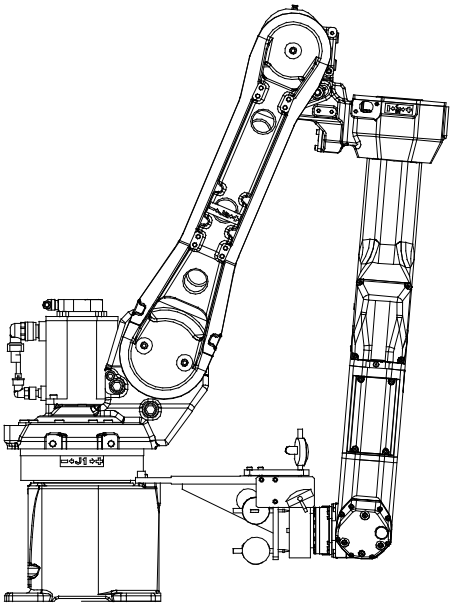
> ⚠ **CAUTION**
> No check is made on the axis movable range during mastering. Be very careful when running the robot. Continuing axis movement may bump into the mechanical stopper.



ARC Mate 100*i*C
M-10*i*A
ARC Mate 100*i*Ce
M-10*i*Ae

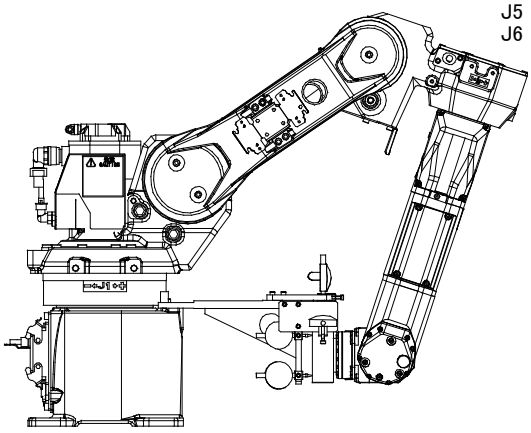
Mastering position

J1 0.00000
J2 55.9747
J3 -118.993
J4 0.00000
J5 -61.0069
J6 -90.0000



ARC Mate 100*i*C/6L
M-10*i*A/6L
ARC Mate 100*i*Ce/6L
M-10*i*Ae/6L

Mastering position
J1 0.00000
J2 22.9302
J3 -94.7411
J4 0.00000
J5 -85.2589
J6 -90.0000



ARC Mate 100*i*C/10S
M-10*i*A/10S

Mastering position

J1 0.00000
J2 55.6176
J3 -108.076
J4 0.00000
J5 -71.9238
J6 -90.0000

Fig. 9.4 (f) Mastering posture (1/2) (except 10M/10MS)

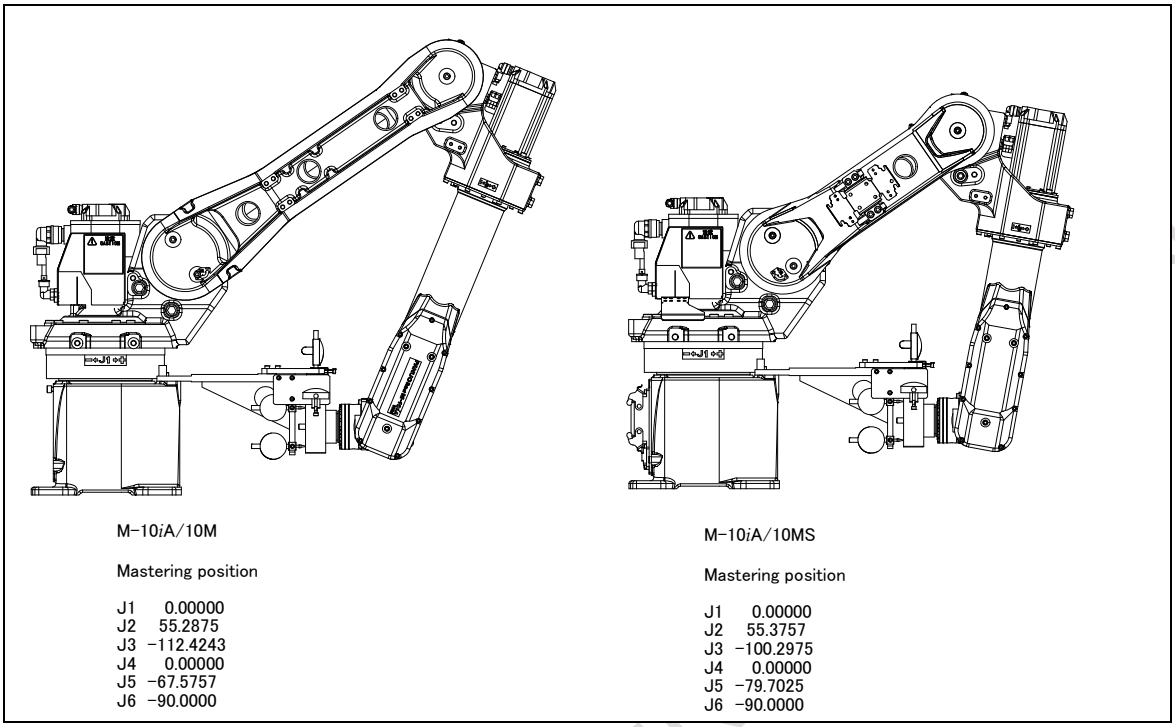


Fig. 9.4 (g) Mastering posture (2/2) (10M/10MS)

9.5 SINGLE AXIS MASTERING (FOR PARTS REPLACING)

Single axis mastering is performed for one axis at a time. The mastering position for each axis can be specified by the user. Perform single axis mastering when parts are replaced.

NOTE
There is a possibility that you cannot perform the procedure in this section due to the backlash or the motor failure. In that case, contact your local FANUC representative.

SINGLE AXIS MASTER AUTO JOINT 10%

1/9

	ACTUAL POS	(MSTR POS)	(SEL)	[ST]
J1	0.000	(0.000)	(0)	[2]
J2	0.000	(0.000)	(0)	[2]
J3	0.000	(0.000)	(0)	[2]
J4	0.000	(0.000)	(0)	[2]
J5	0.000	(0.000)	(0)	[2]
J6	0.000	(0.000)	(0)	[0]
E1	0.000	(0.000)	(0)	[0]
E2	0.000	(0.000)	(0)	[0]
E3	0.000	(0.000)	(0)	[0]

EXEC

Table 9.5 (a) Items set in single axis mastering

Item	Description
Current position (ACTUAL AXIS)	The current position of the robot is displayed for each axis in degree units.
Mastering position (MSTR POS)	A mastering position is specified for an axis to be subjected to single axis mastering. It would be convenient if it is set to 0 degree position.
SEL	This item is set to 1 for an axis to be subjected to single axis mastering. Usually, it is 0.
ST	This item indicates whether single axis mastering has been completed for the corresponding axis. It cannot be changed directly by the user. The value of the item is reflected in $EACHMST_DON (1 to 9). 0 : Mastering data has been lost. Single axis mastering is necessary. 1 : Mastering data has been lost. (Mastering has been performed only for the other interactive axes.) Single axis mastering is necessary. 2 : Mastering has been completed.

Procedure of Single axis mastering

1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE]. Then select [Variables] from the menu.
4 If $DMR_GRP[group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE(disabled) or TRUE (enabled)
Brake control can be released by setting the system variables as follows:
$PARAM_GROUP.SV_OFF_ALL : FALSE
$PARAM_GROUP.SV_OFF_ENB[*] : FALSE (for all axes)
After changing the system variables, cycle power of the controller.
(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

5 Prepare a mark (witness mark, scribe mark, point for check or temporarily set dial gauge)for single axis mastering before parts replacing, then record all axis position of this posture.
* The reproducibility after replacing parts varies depending on the mark's accuracy.
* When you can use a dial gauge, set the dial gauge as shown in the figure, then record the scale reading of the dial gauge and the angle of the axis.

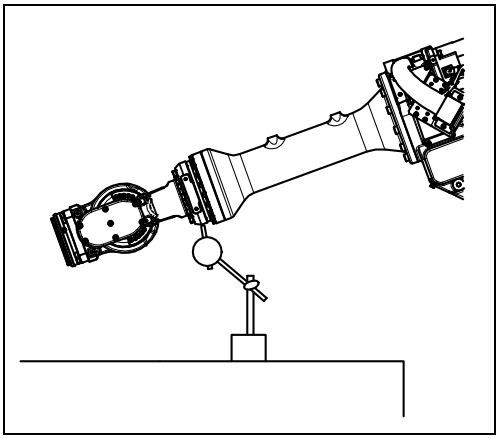


Fig. 9.5 (a) Setting of the dial gauge

6 Move the robot to the posture when the parts are replaced, so replace the parts.
7 After replacing parts, move the robot the marked position in step 5. At this time, move the axis except the replaced axis correctly, match the replaced axis to the marked positon (in case of the dial gauge : scale reading).
8 Clear an alarm that occurs as described in Section 6.2. Then prepare for the mastering.
9 Select [6 SYSTEM].
10 Select [Master/Cal]. The positioning screen will be displayed.

```
SYSTEM Master/Cal        AUTO   JOINT 10 %
                                TORQUE = [ON ]
 1 FIXTURE POSITION MASTER
 2 ZERO POSITION MASTER
 3 QUICK MASTER
 4 QUICK MASTER FOR SINGLE AXIS
 5 SINGLE AXIS MASTER
 6 SET QUICK MASTER REF
 7 CALIBRATE
    Press 'ENTER' or number key to select.

 [ TYPE ]  LOAD  RES_PCA              DONE
```

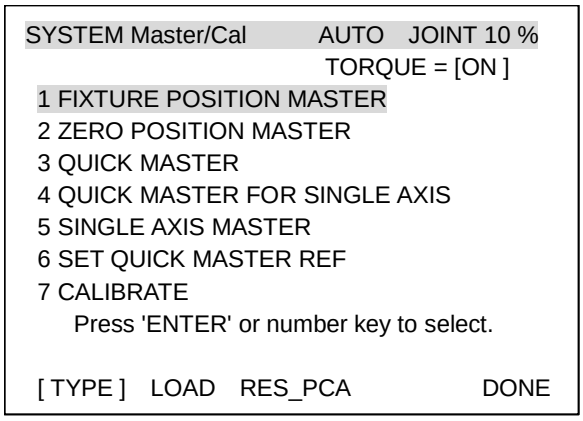
11 Select [5 SINGLE AXIS MASTER]. The following screen will be displayed.

```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                          1/9
   ACTUAL   POS   (MSTR POS)    (SEL)   [ST]
J1          0.000 (     0.000)  (0)     [2]
J2          0.000 (     0.000)  (0)     [2]
J3          0.000 (     0.000)  (0)     [2]
J4          0.000 (     0.000)  (0)     [2]
J5          0.000 (     0.000)  (0)     [2]
J6          0.000 (     0.000)  (0)     [0]
E1          0.000 (     0.000)  (0)     [0]
E2          0.000 (     0.000)  (0)     [0]
E3          0.000 (     0.000)  (0)     [0]

                                        EXEC
```

12 Move the cursor to the [SEL] column for the unmastered axis and press the numeric key [1]. Setting of [SEL] is available for one or more axes.
13 Input the position data (recorded position in step 5) of the axis mastering is done.
14 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2 or 1.

```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                          6/9
   ACTUAL   POS   (MSTR POS)    (SEL)   [ST]
J1          0.000 (     0.000)  (0)     [2]
J2          0.000 (     0.000)  (0)     [2]
J3          0.000 (     0.000)  (0)     [2]
J4          0.000 (     0.000)  (0)     [2]
J5          0.000 (     0.000)  (0)     [2]
J6         90.000 (     0.000)  (1)     [0]
E1          0.000 (     0.000)  (0)     [0]
E2          0.000 (     0.000)  (0)     [0]
E3          0.000 (     0.000)  (0)     [0]

                                        EXEC
```

15 When single axis mastering is completed, press the [PREV] key to resume the previous screen.



16 Select [7 CALIBRATE], then press F4 [YES]. Positioning is performed. Alternatively, turn off the controller power and on again. Positioning is performed.
17 After positioning is completed, press F5 [DONE].

18 Return the setting of the gravity compensation.
19 Return brake control to original setting, and cycle power of the controller.

9.6 VERIFYING MASTERING

1 How to verify that the robot is mastered properly:
Usually, positioning is performed automatically when the power is turned on. To check whether mastering has been performed correctly, examine if the current displayed position matches the actual robot position by using one or more of the procedures described below:
(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the 0-degree position marks indicated in Quick mastering section of the Operator's Manual are aligned. There is no need to use a visual aid.
(3) Using fixtures, set the robot to the mastering position in the same way as when performing mastering. Check that the displayed current position agrees with the actual mastering position.

If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described in 2. Alternatively, the mastering data in system variable $DMR_GRP.$MASTER_COUN may have been overwritten as a result of an operation error or some other reason.
Compare the data with the values indicated on the supplied data sheet. This system variable is overwritten whenever mastering is performed. Whenever mastering is performed, record the value of the system variable on the data sheet.

2 Alarm types displayed during mastering and their solution method:
(1) BZAL alarm
This alarm is displayed if the Pulsecoder's backup battery voltage decreases to 0 V while the power to the controller is disconnected. Furthermore, if the Pulsecoder connector is removed for cable replacement, etc. this alarm is displayed as the voltage decreases to 0 V. Check to see if the alarm will disappear by performing a pulse reset (RES_PCA) (See Section 6.2.). Then, cycle controller power and check if the alarm disappears or not.
The battery may be drained if the alarm is still displayed. Perform a pulse reset, and turn off and on the controller power after replacing the battery. Note that, if this alarm is displayed, all the original data held by the Pulsecoder will be lost. Mastering is required.
(2) BLAL alarm
This alarm is displayed if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is displayed, replace the battery with a new one immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
(3) Alarm notification like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may have trouble with Pulsecoder, contact your local FANUC representative.

APPENDIX

A MAINTENANCE PARTS

Table A (a) Cables (basic cable)

Cable No.	Specifications	Function	Models
K101	A05B-1221-D001	J1 to J6-AXIS MOTOR+EE(RI/O x 8)	ARC Mate 100*i*C M-10*i*A
K102	A05B-1221-D002	J1 to J6-AXIS MOTOR +EE(RI/O x 1) (Non-correspondence to CE)	
K103	A05B-1221-D003	J1 to J6-AXIS MOTOR+EE(RI/O x 1)	
K111	A05B-1221-D011	J1 to J6-AXIS MOTOR+EE(RI/O x 8) (Severe dust/liquid protection option)	
K121	A05B-1221-D021	J1 to J6-AXIS MOTOR	ARC Mate 100*i*Ce M-10*i*Ae
K131	A05B-1221-D031	J1 to J6-AXIS MOTOR+EE(RI/O x 8)	ARC Mate 100*i*C/6L M-10*i*A/6L
K132	A05B-1221-D032	J1 to J6-AXIS MOTOR+EE(RI/O x 1) (Non-correspondence to CE)	
K133	A05B-1221-D033	J1 to J6-AXIS MOTOR+EE(RI/O x 1)	
K141	A05B-1221-D041	J1 to J6-AXIS MOTOR+EE(RI/O x 8) (Severe dust/liquid protection option)	
K151	A05B-1221-D051	J1 to J6-AXIS MOTOR	ARC Mate 100*i*Ce/6L M-10*i*Ae/6L
K161	A05B-1221-D061	J1 to J6-AXIS MOTOR+EE(RI/O x 8)	ARC Mate 100*i*C/10S M-10*i*A/10S
K162	A05B-1221-D062	J1 to J6-AXIS MOTOR+EE(RI/O x 1)	
K601	A05B-1221-D201	J1 to J6-AXIS MOTOR+EE(RI/O x 8)	M-10*i*A/10M
K611	A05B-1221-D211	J1 to J6-AXIS MOTOR+EE(RI/O x 8) (Severe dust/liquid protection option)	
K202	A660-8018-T594	J6-motor wrist part	
K661	A05B-1221-D261	J1 to J6-AXIS MOTOR+EE(RI/O x 8)	M-10*i*A/10MS
K671	A05B-1221-D271	J1 to J6-AXIS MOTOR+EE(RI/O x 8) (Severe dust/liquid protection option)	
K202	A660-8018-T594	J6-AXIS MOTOR wrist part	

Table A (b) Cables (option cable)

Cable No.	Specifications	Function	Models
K301	A660-2006-T755	Wire feeder power cable	ARC Mate 100*i*C M-10*i*A ARC Mate 100*i*C/6L M-10*i*A/6L M-10*i*A/10M M-10*i*A/10MS
K311	A660-8016-T454	User cable (signal)	
K312	A660-2007-T053	User cable (power)	
K315	A660-8017-T649	User cable (signal usable to force sensor and 3D Laser Vision sensor)	
K321	A660-8040-T023	Welding power cable (38SQ)	
K323	A660-8040-T024	Welding power cable (60SQ)	
K331	A660-8016-T828	Earth cable for camera	
K351	A660-2007-T032	Force sensor, 3D Laser Vision sensor cable	
K701	A05B-1221-D301	Camera cable (Non-waterproof type)	
K802	A05B-1221-D402	Camera cable (Waterproof type)	
K314	A660-8017-T499	User cable (signal)	ARC Mate 100*i*C/10S M-10*i*A/10S
K331	A660-8016-T828	Earth cable for camera	
K803	A05B-1221-D403	Camera cable (Waterproof type)	

Table A (c) Motor

Axis	Specifications	Remarks	Models
J1, J2	A06B-0235-B605#S000	αiS8/4000	ARC Mate 100*i*C, M-10*i*A ARC Mate 100*i*C/6L, M-10*i*A/6L ARC Mate 100*i*C/10S, M-10*i*A/10S
J3	A06B-0212-B605#S000	αiS2/5000	
J4	A06B-0115-B804	βiS0.5/6000	
J5, J6	A06B-0115-B855#0048	βiSR0.5/6000	
J1	A06B-0235-B005#S000	αiS8/4000	ARC Mate 100*i*Ce, M-10*i*Ae ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L
J2	A06B-0235-B605#S000	αiS8/4000	
J3	A06B-0212-B605#S000	αiS2/5000	
J4,J5,J6	A06B-0115-B205#0048	βiSR0.5/6000	
J1,J2 (*1)	A06B-0235-B605#S000	αiS8/4000	10M/10MS
J1,J2 (*2)	A06B-2235-B605	αiS8/4000-B	
J3,J4 (*1)	A06B-0212-B605#S000	αiS2/5000	
J3,J4 (*2)	A06B-2212-B605	αiS2/5000-B	
J5	A06B-0115-B855#0048	βiSR0.5/6000	
J6	A06B-0114-B855#0048	βiSR0.4/6000	

NOTE
Both motors(1),(2) can be used. However, we recommend (*2) when ordering motors.

Table A (d) Reducer

Parts name	Specifications	Models
J1-axis reducer	A97L-0218-0822#33	(*1)
	A97L-0218-0885#33	(*2) (*3)
J2-axis reducer	A97L-0218-0886#127	(*1) (*2)
	A97L-0218-0886#93	(*3)
J3-axis reducer	A97L-0218-0824#150	(*1)
	A97L-0218-0887#150	(*2)
	A97L-0218-0887#108	(*3)
J6-axis reducer	A97L-0218-0978	(*4)

(*1) Old spec robot ARC Mate 100***i***C, M-10***i***A, ARC Mate 100***i***C/6L, M-10***i***A6L shipped before March, 2010.
(*2) New spec: robot ARC Mate 100***i***C, M-10***i***A, ARC Mate 100***i***C/6L, M-10***i***A6L shipped after April, 2010, ARC Mate 100***i***Ce, M-10***i***Ae, ARC Mate 100***i***Ce/6L, M-10***i***Ae/6L, M-10***i***A/10M
(*3) ARC Mate 100***i***C/10S, M-10***i***A/10S/10MS
(*4) 10M/10MS

NOTE
Specify the following draw nut for the J2, J3-axes reducer.

Table A (e) Gear, draw nut, gear and key

Parts name	Specifications	Used place
J1-axis gear	A290-7215-X211	J1-axis Motor
Gear	A290-7221-X311 (*1)(*2)(*3)(*4)	J2-axis Motor
	A290-7221-Y311 (*5)	
Gear	A290-7221-X411 (*1)	J3-axis Motor
	A290-7221-Y411 (*2)	
	A290-7221-Y415 (*3)	
	A290-7221-Z411 (*4)	
	A290-7221-Z415 (*5)	
Draw nut	A290-7221-X321	J2-axis Motor
Draw nut	A290-7221-X421	J3-axis Motor
Gear	A290-7221-X412	J4-axis Motor (*1)(*4)
	A290-7221-Z412	J4-axis Motor (*5)
	A290-7221-Z416	J4-axis Motor (10M/10MS)
Gear	A290-7221-X511	J5-axis Motor
Gear	A290-7221-X521	J6-axis Motor
Key	JB-HKY-3X3X8A	J5, J6-axis Motor (except M-10*i*A/10M/10MS)

(*1) Old spec. robot ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A6L shipped before March, 2010.
(*2) M-10*i*A/10M
(*3) M-10*i*A/10MS
(*4) New spec.: robot ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A6L shipped after April, 2010 or ARC Mate 100***i***Ce, M-10***i***Ae, ARC Mate 100***i***Ce/6L, M-10***i***Ae/6L.
(*5) ARC Mate 100*i*C/10S, M-10*i*A/10S

Table A (f) Other (mechanical unit)

Parts name	Specifications	Models
J4-axis gearbox	A05B-1221-K401	ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L Old specification: Robot shipped before March, 2010
	A05B-1221-K411	ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L New specification: Robot shipped after April, 2010 or ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L
	A05B-1221-K413	ARC Mate 100*i*C/10S, M-10*i*A/10S
	A05B-1221-K451	M-10*i*A/10M
	A05B-1221-K453	M-10*i*A/10MS
J5/J6-axis gearbox	A290-7221-V564	Except 10M/10MS
Wrist unit	A290-7221-T551	10M/10MS
Fluoric resin ring	A290-7221-X571	Except 10M/10MS

The following service parts are appended to J4-axis gearbox (A05B-1221-K401, K411, K413) for maintenance. Please exchange these with the J4-axis gearbox.

Parts name	Specifications	Number	Used place
Gasket	A98L-0040-0042#03	1	J3-axis Motor
Gasket	A98L-0040-0042#07	1	J4-axis Motor
Bolt	A6-BA-8X25	8 or 9	Between the J3 casing and the J3-axis reducer
Bolt	A6-BA-5X14	7	J4-axis Motor mounting part
Washer	A97L-0001-0823#M8H	8 or 9	Between the J3 casing and the J3-axis reducer
Seal bolt	A97L-0218-0502#5X10	4	J4-axis Motor
Seal bolt	A97L-0218-0417#081010	1	J4-axis oil outlet
Seal bolt	A97L-0218-0417#060808	1	J3-axis grease inlet
Gasket	A290-7221-X441	1	J4-axis Hollow part
Gasket	A290-7221-X442	1	J4-axis Motor mounting part ARC Mate 100*i*C,M-10*i*A, ARC Mate 100*i*C/6L,M-10*i*A/6L
	A290-7221-Z442		J4-axis Motor mounting part ARC Mate 100*i*C/10S,M-10*i*A/10S
O-RING	A290-7221-X444	1	Between the J3 arm and the J3 casing
PIN	JB-PH-H7A-5X10S45C	2	J4-axis Motor mounting part, J4-axis hollow part

The following service parts are appended to J4-axis gearbox (A05B-1221-K451, K453) for maintenance. Please exchange these with the J4-axis gearbox.

Parts name	Specifications	Q'ty	Used place
Seal washer	A30L-0001-0048#6M	1	J3-axis grease inlet
Gasket	A98L-0040-0042#03	1	J3-axis motor
Bolt	A6-BA-6X8	1	J3-axis grease inlet
Bolt	A6-BA-6X85	9	Between the J3 casing and the wrist unit
Bolt	A6-BA-8X35	9	Between J3 casing and J3-axis reducer
Washer	A97L-0001-0823#M8H	9	Between J3 casing and J3-axis reducer
Seal bolt	A97L-0218-0417#030808	4	Pipe
Seal bolt	A97L-0218-0417#060808	2	J4-axis grease inlet, outlet
O-RING	A290-7221-X444	1	Between the J3 arm and the J3 casing
O-RING	JB-OR1A-G75	1	J4-axis motor

Table A (g) Battery, grease, oil, and sealant

Parts name	Specifications	Remark
Battery	A98L-0031-0027	C battery 1.5V Alkali (4pcs/ per 1 robot) ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S
	A98L-0031-0005	D battery 1.5V Alkali (4pcs/ per 1 robot) ARC Mate 100***i***Ce, M-10***i***Ae, ARC Mate 100***i***Ce/6L, M-10***i***Ae/6L
Grease	A98L-0040-0174#16KG	Kyodo Yushi VIGOGREASE RE0 Refer to Section 3.2 or 4.3 for required grease amount.
Grease	A98L-0040-0230#0.08KG	10M/10MS Harmonic Drive systems Harmonic grease 4BNo.2 Refer to Section 4.2 for required grease amount.
Oil	A98L-0040-0233#20L	JXTG Nippon Oil & Energy Corporation BONNOC AX68 Refer to Section 3.2 for required grease amount.
Sealant	A98L-0040-0290#0.33KG	Musashino three bond for gearbox

Table A (h) O-ring

Parts name	Specifications	Models	Used place
O-ring	A290-7207-X342	All Models	J1-axis reducer
O-ring	A290-7221-X444	All Models	Wrist- unit
O-ring	A98L-0001-0347#S150	All Models	J1-axis reducer
O-ring	A98L-0001-0347#S39	Except 10M/10MS	J5, J6-axis Motor (2 places)
O-ring	JB-OR1A-G105	All Models	J1, J2-axis Motor (2 places)
O-ring	JB-OR1A-G65	All Models	J1-axis reducer
O-ring	JB-OR1A-G108	All Models	J3-axis reducer

Table A (i) Gasket

Parts name	Specifications	Models	Used place
Gasket	A290-7221-X441	All Models	J4-axis hollow part
Gasket	A290-7221-X442	All Models	J4-axis motor mounting part
Gasket	A98L-0040-0042#03	All Models	J3-axis Motor
Gasket	A98L-0040-0042#07	All Models	J4-axis Motor
Gasket	A290-7221-Z236	M-10*i*A, M-10*i*A/6L/10M/10MS (Severe dust/liquid protection option)	Battery cover
Gasket	A290-7221-X579	M-10*i*A, M-10*i*A/6L, M-10*i*A/10S	J5 motor cover
Gasket	A290-7221-X581	M-10*i*A, M-10*i*A/6L, M-10*i*A/10S	Plate cover 1
Gasket	A290-7221-X582	M-10*i*A, M-10*i*A/6L, M-10*i*A/10S	Plate cover 2
Gasket	A290-7221-X575	M-10*i*A, M-10*i*A/6L, M-10*i*A/10S	J6 motor cover

Table A (j) Stopper

Parts name	Specifications	Models	Used place
Stopper	A290-7215-X323	All Models	J2-axis
Stopper	A290-7221-X324	All Models	J3-axis

Table A (k) Bolt, washer

Parts name	Specifications	Qty.	Model	Used places
Bolt	A6-BA-12X80	6	All models	J1-axis reducer
Bolt	A6-BA-5X45	1		J2-axis motor
Bolt	A6-BA-10X20	9		Between J2 base and J2-axis reducer
Bolt	A6-BA-6X30	16		J2-axis reducer to J2 arm
Bolt	A6-BA-4X55	1		J3-axis motor
Bolt	A6-BA-8X25	8		Between J3 casing and J3-axis reducer
Washer	A97L-0001-0823#M8H	8		
Bolt	A6-BA-5X20	12 or16		J3-axis reducer to J2 arm
Bolt	A6-BA-3X8	1	Except 10M/10MS	J4-axis motor
Bolt	A6-BA-4X25	1	10M/10MS	
Bolt	A6-BA-6X85	9 or 14	All models	Between J3 casing and J3 arm
Bolt	A97L-0218-0496#M5X45BC	2	Except 10M/10MS	J3 arm cover
Bolt	A97L-0218-0514#M3X8	1		J5-axis motor
Bolt	A97L-0218-0514#M3X8	1		J6-axis motor
Bolt	A6-BA-3X8	1	10M/10MS	J5-axis motor
Bolt	A6-BA-3X8	1		J6-axis wave generator
Bolt	A6-BA-5X20	4		J6-axis adaptor
Bolt	A6-BA-4X12	8		J6-axis adaptor

NOTE
When a bolt with instructions to apply Loctite is removed, it is recommended to replace it with the new one. In case that a washer is attached, replace it at the same time.

Table A (l) Vernier mark seal

Parts name	Specifications	Remark	Models
Vernier mark seal	A370-3031-0155	J1 to J5-axis	Except 10M/10MS
Vernier mark seal	A370-3031-0173	J1 to J5-axis	10M/10MS
Vernier mark seal	A370-3031-0153	J6-axis	All models

Table A (m) M/H conduit (M-10*i*A, M-10*i*A/6L, M-10*i*A/10S option)

Parts name	Specifications	Models
M/H conduit	A05B-1221-J701	M-10*i*A, M-10*i*A/10S
	A05B-1221-J702	M-10*i*A/6L
Conduit	FANUC Specifications: A97L-0118-0734#E36-0062 PMA Specifications: ESDT-36B (Note)	M-10*i*A, M-10*i*A/10S
	FANUC Specifications: A97L-0118-0734#E36-0084 PMA Specifications: ESDT-36B (Note)	M-10*i*A/6L

Table A (n) No dust M/H conduit (M-10*i*A, M-10*i*A/6L, M-10*i*A/10S option)

Parts name	Specifications	Models
M/H conduit	A05B-1221-J721	M-10*i*A, M-10*i*A/10S
	A05B-1221-J722	M-10*i*A/6L
Conduit	FANUC Specifications: A97L-0118-0734#E36-0062 PMA Specifications: ESDT-36B (Note)	M-10*i*A, M-10*i*A/10S
	FANUC Specifications: A97L-0118-0734#E36-0084 PMA Specifications: ESDT-36B (Note)	M-10*i*A/6L
Gasket A	A290-7221-Z641 (4 pcs/per 1 robot)	M-10*i*A, M-10*i*A/6L, M-10*i*A/10S
Gasket B	A290-7221-Z642 (4 pcs/per 1 robot)	
Seal bolt	A97L-0218-0546#030806SC (16 pcs/per 1 robot)	

NOTE
Please cut it in the convex part when you cut Conduit. The cable might be damaged in the edge part of Conduit when cutting it in the concave portion.

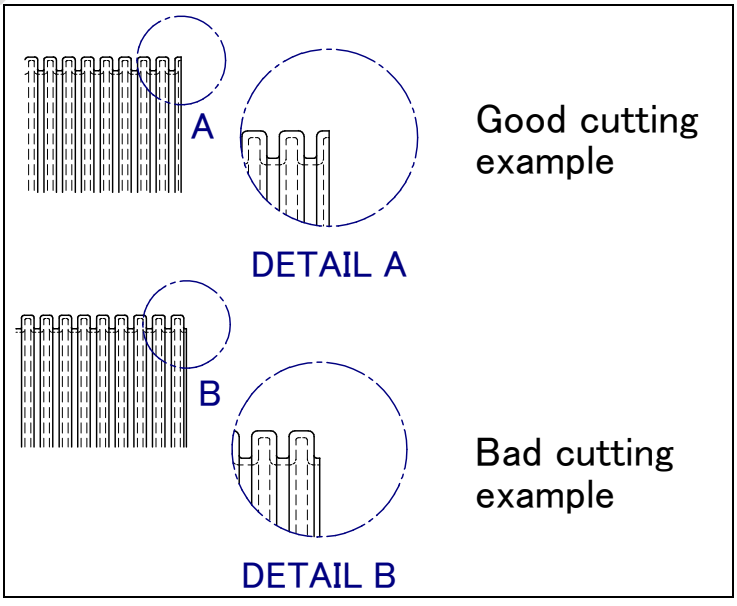
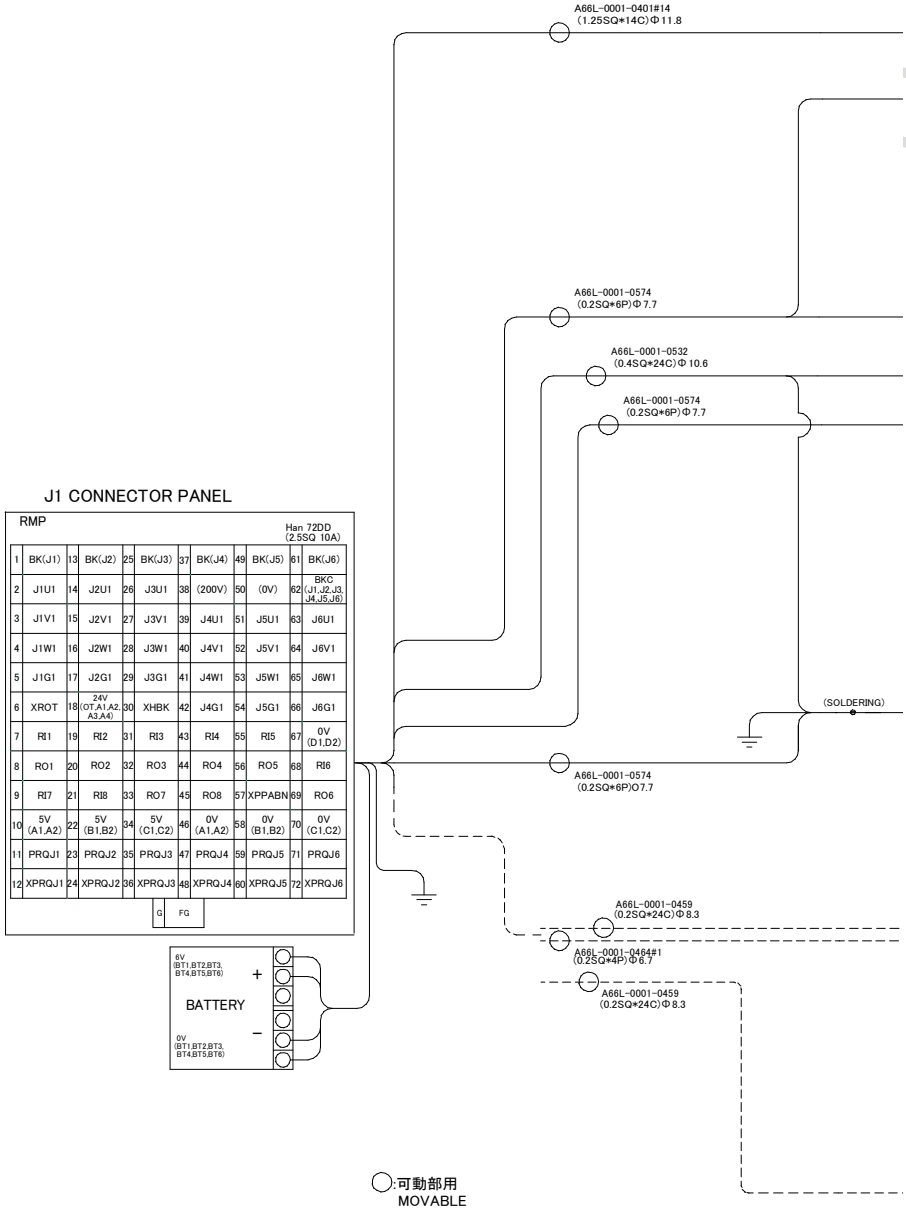


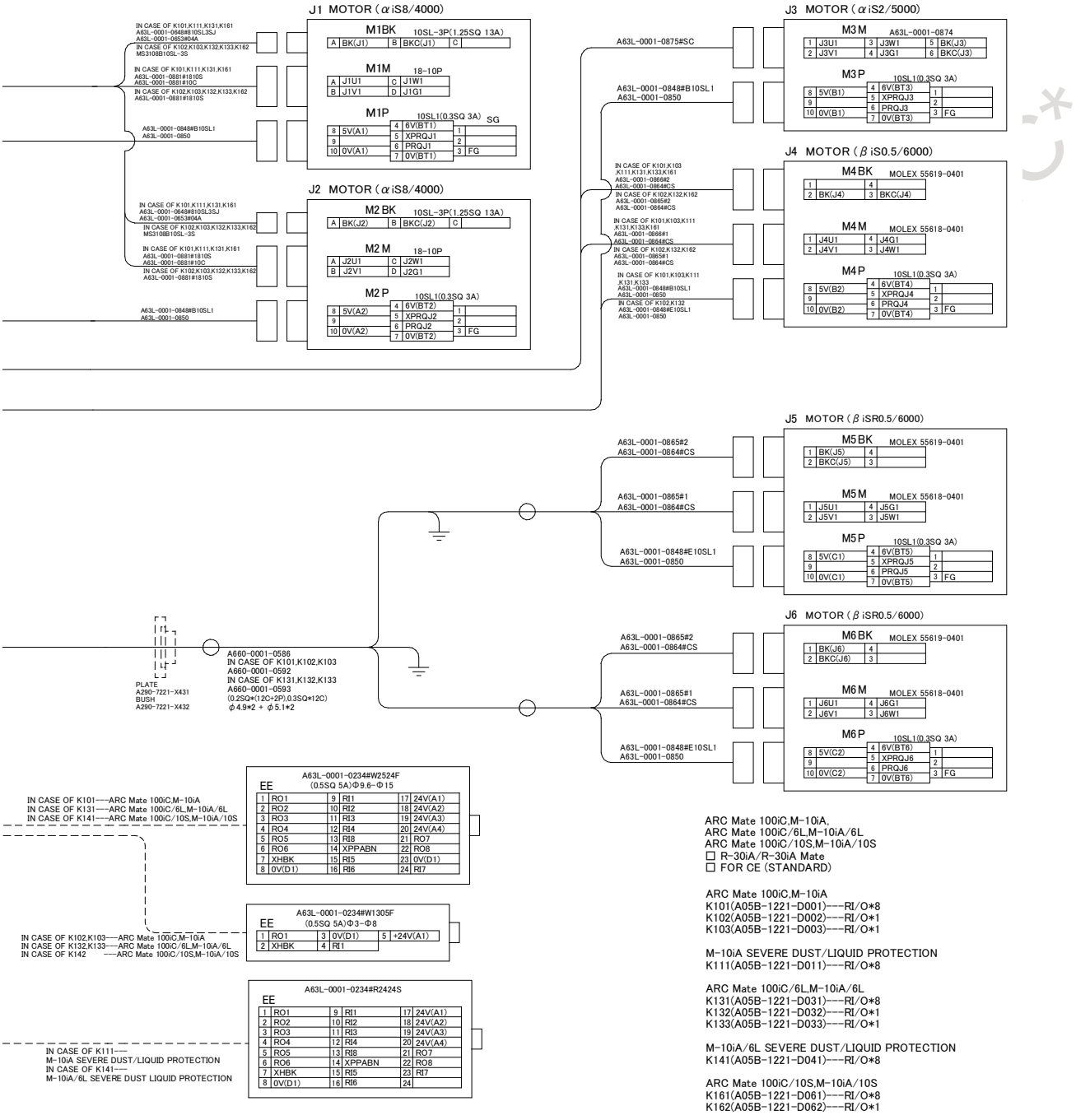
Fig. A (a) Cutting example of conduit

B MECHANICAL UNIT CIRCUIT DIAGRAM



1	BK(J1)	13	BK(J2)	25	BK(J3)	37	BK(J4)	49	BK(J5)	61	BK(J6)
2	J1U1	14	J2U1	26	J3U1	38	(200V)	50	(0V)	62	BKC (J1,J2,J3, J4,J5,J6)
3	J1V1	15	J2V1	27	J3V1	39	J4U1	51	J5U1	63	J6U1
4	J1W1	16	J2W1	28	J3W1	40	J4V1	52	J5V1	64	J6V1
5	J1G1	17	J2G1	29	J3G1	41	J4W1	53	J5W1	65	J6W1
6	XROT	18	24V (OT,A1,A2, A3,A4)	30	XHBK	42	J4G1	54	J5G1	66	J6G1
7	RI1	19	RI2	31	RI3	43	RI4	55	RI5	67	0V (D1,D2)
8	RO1	20	RO2	32	RO3	44	RO4	56	RO5	68	RI6
9	RI7	21	RI8	33	RO7	45	RO8	57	XPPABN	69	RO6
10	5V (A1,A2)	22	5V (B1,B2)	34	5V (C1,C2)	46	0V (A1,A2)	58	0V (B1,B2)	70	0V (C1,C2)
11	PRQJ1	23	PRQJ2	35	PRQJ3	47	PRQJ4	59	PRQJ5	71	PRQJ6
12	XPRQJ1	24	XPRQJ2	36	XPRQJ3	48	XPRQJ4	60	XPRQJ5	72	XPRQJ6
			G		FG						

Fig. B (a) Circuit diagram
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)


J1 MOTOR (αiS8/4000)
M1BK 10SL-3P(1.25SQ 13A)
A BK(J1) B BKC(J1) C
M1M 18-10P
A J1U1 C J1W1
B J1V1 D J1G1
M1P 10SL1(0.3SQ 3A) SG
8 5V(A1) 4 6V(BT1) 1
9 5 XPRQJ1 2
10 0V(A1) 6 PRQJ1 3 FG
7 0V(BT1)
J2 MOTOR (αiS8/4000)
M2 BK 10SL-3P(1.25SQ 13A)
A BK(J2) B BKC(J2) C
M2 M 18-10P
A J2U1 C J2W1
B J2V1 D J2G1
M2 P 10SL1(0.3SQ 3A)
8 5V(A2) 4 6V(BT2) 1
9 5 XPRQJ2 2
10 0V(A2) 6 PRQJ2 3 FG
7 0V(BT2)
J3 MOTOR (αiS2/5000)
M3M A63L-0001-0874
1 J3U1 3 J3W1 5 BK(J3)
2 J3V1 4 J3G1 6 BKC(J3)
M3P 10SL1(0.3SQ 3A)
8 5V(B1) 4 6V(BT3) 1
9 5 XPRQJ3 2
10 0V(B1) 6 PRQJ3 3 FG
7 0V(BT3)
J4 MOTOR (βiS0.5/6000)
M4BK MOLEX 55619-0401
1 4
2 BK(J4) 3 BKC(J4)
M4M MOLEX 55618-0401
1 J4U1 4 J4G1
2 J4V1 3 J4W1
M4P 10SL1(0.3SQ 3A)
8 5V(B2) 4 6V(BT4) 1
9 5 XPRQJ4 2
10 0V(B2) 6 PRQJ4 3 FG
7 0V(BT4)
J5 MOTOR (βiSR0.5/6000)
M5BK MOLEX 55619-0401
1 BK(J5) 4
2 BKC(J5) 3
M5M MOLEX 55618-0401
1 J5U1 4 J5G1
2 J5V1 3 J5W1
M5P 10SL1(0.3SQ 3A)
8 5V(C1) 4 6V(BT5) 1
9 5 XPRQJ5 2
10 0V(C1) 6 PRQJ5 3 FG
7 0V(BT5)
J6 MOTOR (βiSR0.5/6000)
M6BK MOLEX 55619-0401
1 BK(J6) 4
2 BKC(J6) 3
M6M MOLEX 55618-0401
1 J6U1 4 J6G1
2 J6V1 3 J6W1
M6P 10SL1(0.3SQ 3A)
8 5V(C2) 4 6V(BT6) 1
9 5 XPRQJ6 2
10 0V(C2) 6 PRQJ6 3 FG
7 0V(BT6)
A63L-0001-0875#SC
A63L-0001-0848#B10SL1
A63L-0001-0850
A63L-0001-0865#2
A63L-0001-0864#CS
A63L-0001-0865#1
A63L-0001-0848#E10SL1
A660-0001-0586
A660-0001-0592
A660-0001-0593
PLATE A290-7221-X431
BUSH A290-7221-X432
EE A63L-0001-0234#W2524F (0.5SQ 5A)Φ9.6-Φ15
EE A63L-0001-0234#W1305F (0.5SQ 5A)Φ3-Φ8
EE A63L-0001-0234#R2424S
ARC Mate 100iC,M-10iA,
ARC Mate 100iC/6L,M-10iA/6L
ARC Mate 100iC/10S,M-10iA/10S
R-30iA/R-30iA Mate
FOR CE (STANDARD)
ARC Mate 100iC,M-10iA
K101(A05B-1221-D001)----RI/O*8
K102(A05B-1221-D002)----RI/O*1
K103(A05B-1221-D003)----RI/O*1
M-10iA SEVERE DUST/LIQUID PROTECTION
K111(A05B-1221-D011)----RI/O*8
ARC Mate 100iC/6L,M-10iA/6L
K131(A05B-1221-D031)----RI/O*8
K132(A05B-1221-D032)----RI/O*1
K133(A05B-1221-D033)----RI/O*1
M-10iA/6L SEVERE DUST/LIQUID PROTECTION
K141(A05B-1221-D041)----RI/O*8
ARC Mate 100iC/10S,M-10iA/10S
K161(A05B-1221-D061)----RI/O*8
K162(A05B-1221-D062)----RI/O*1

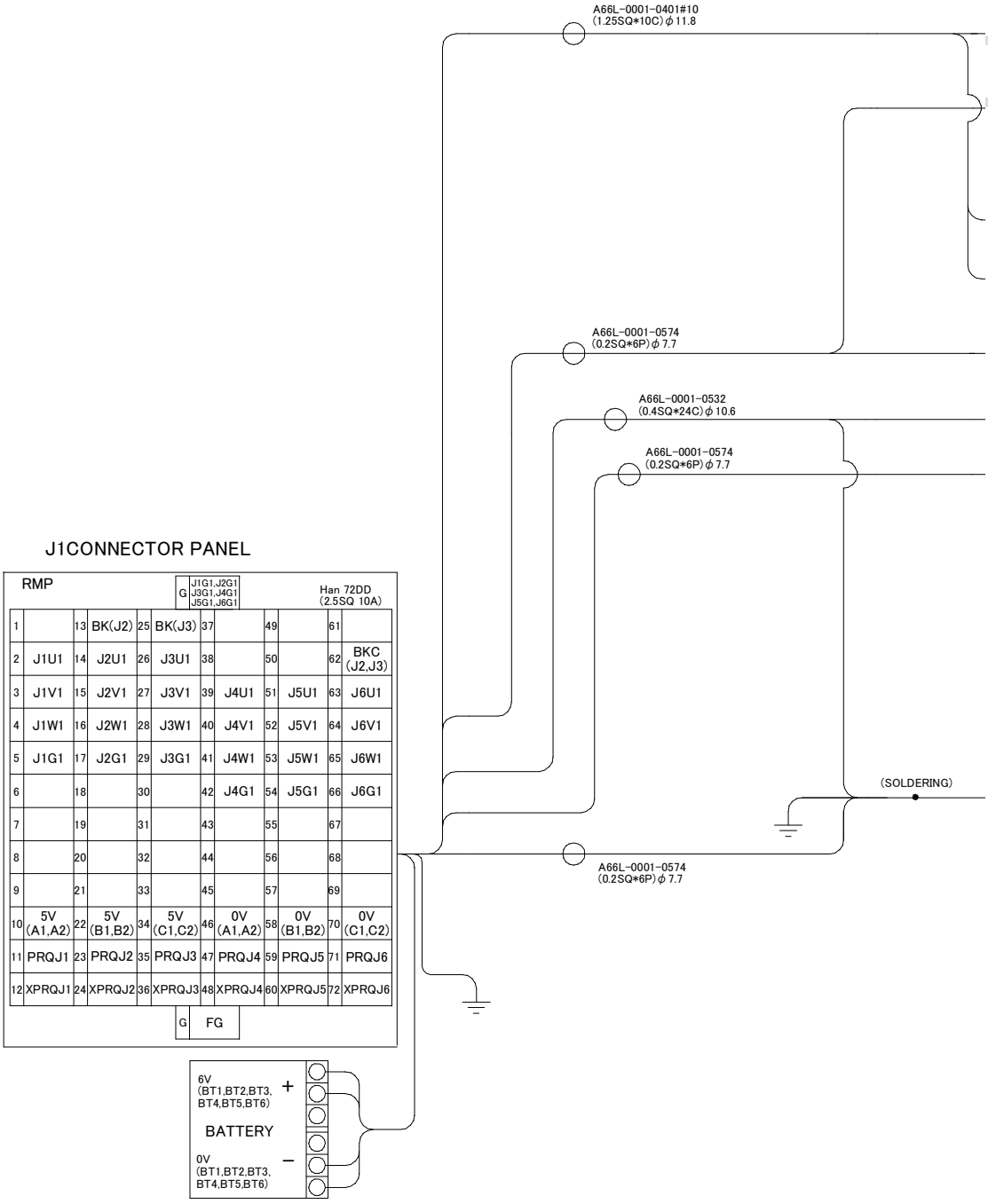
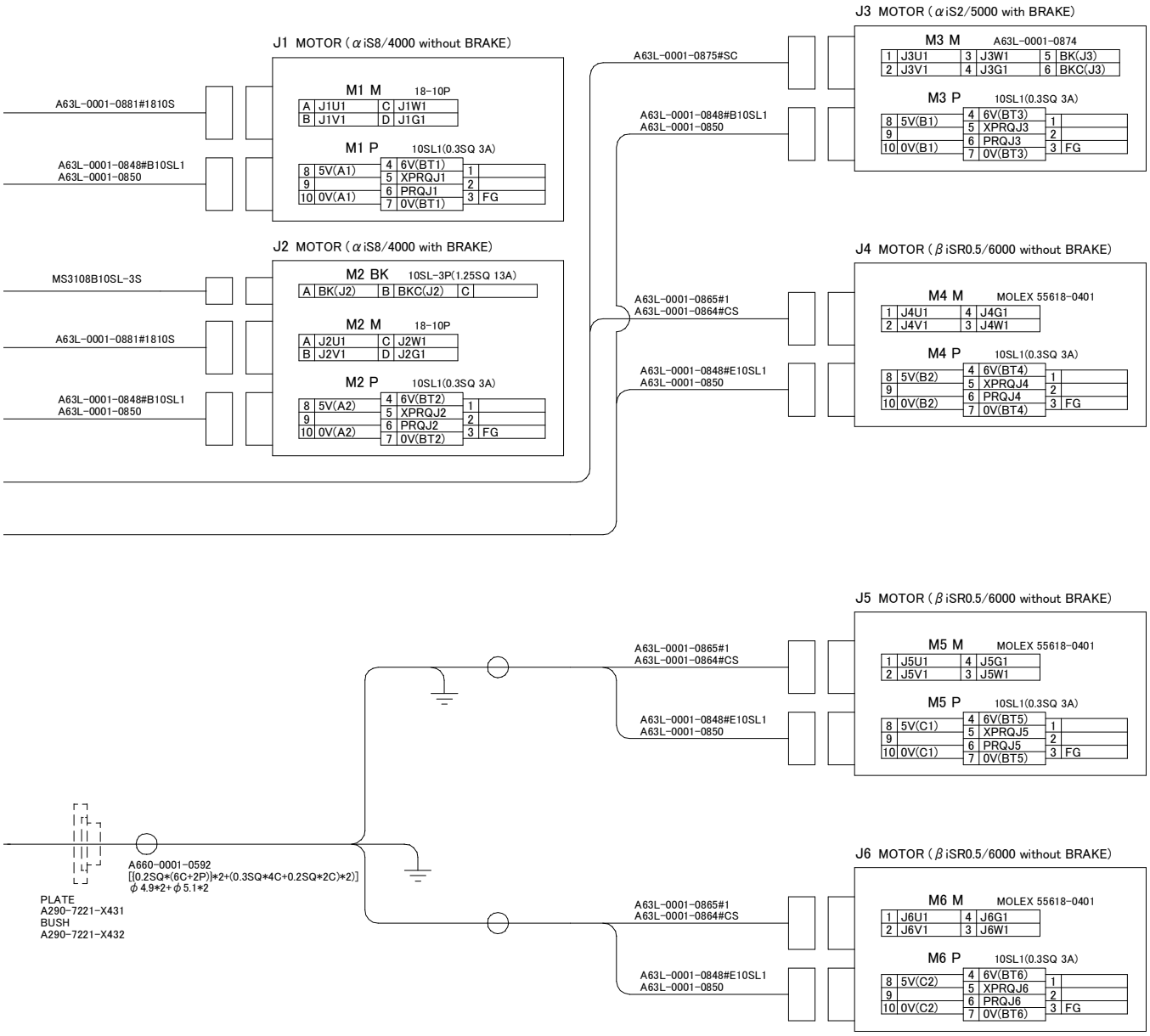


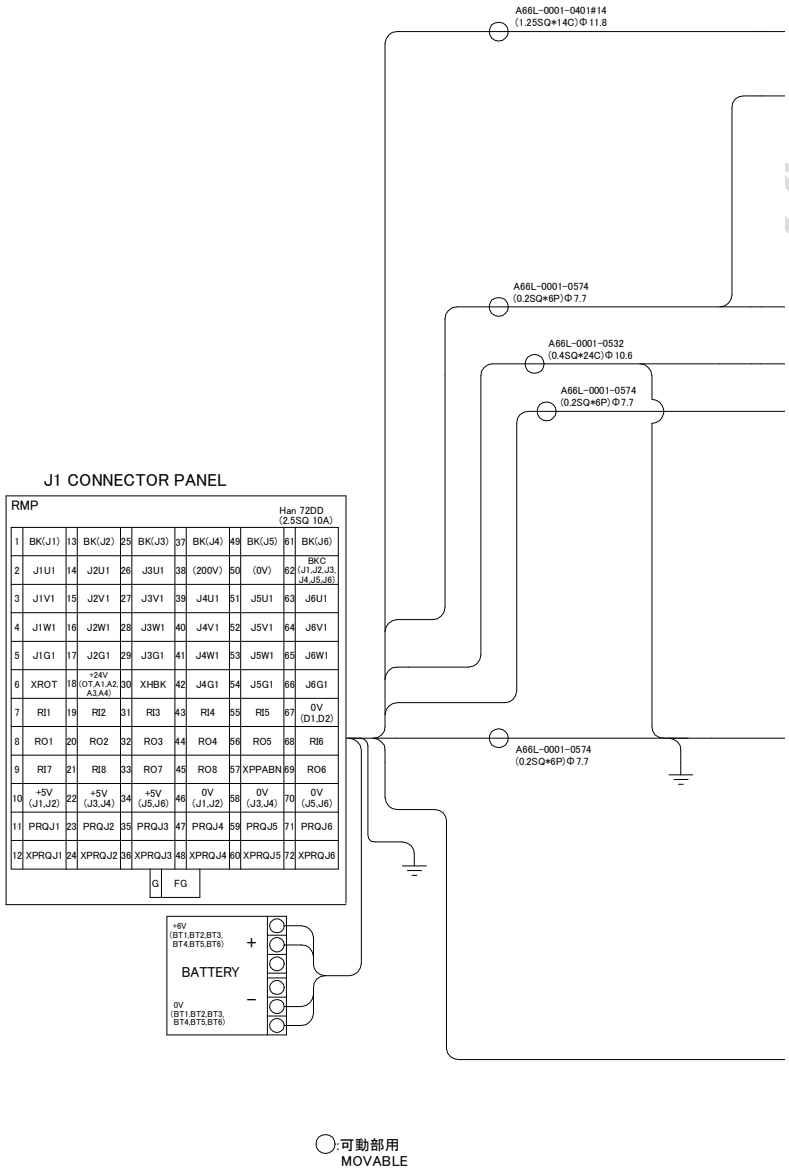
Fig. B (b) Circuit diagram
(ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)



◯ :可動部用
MOVABLE

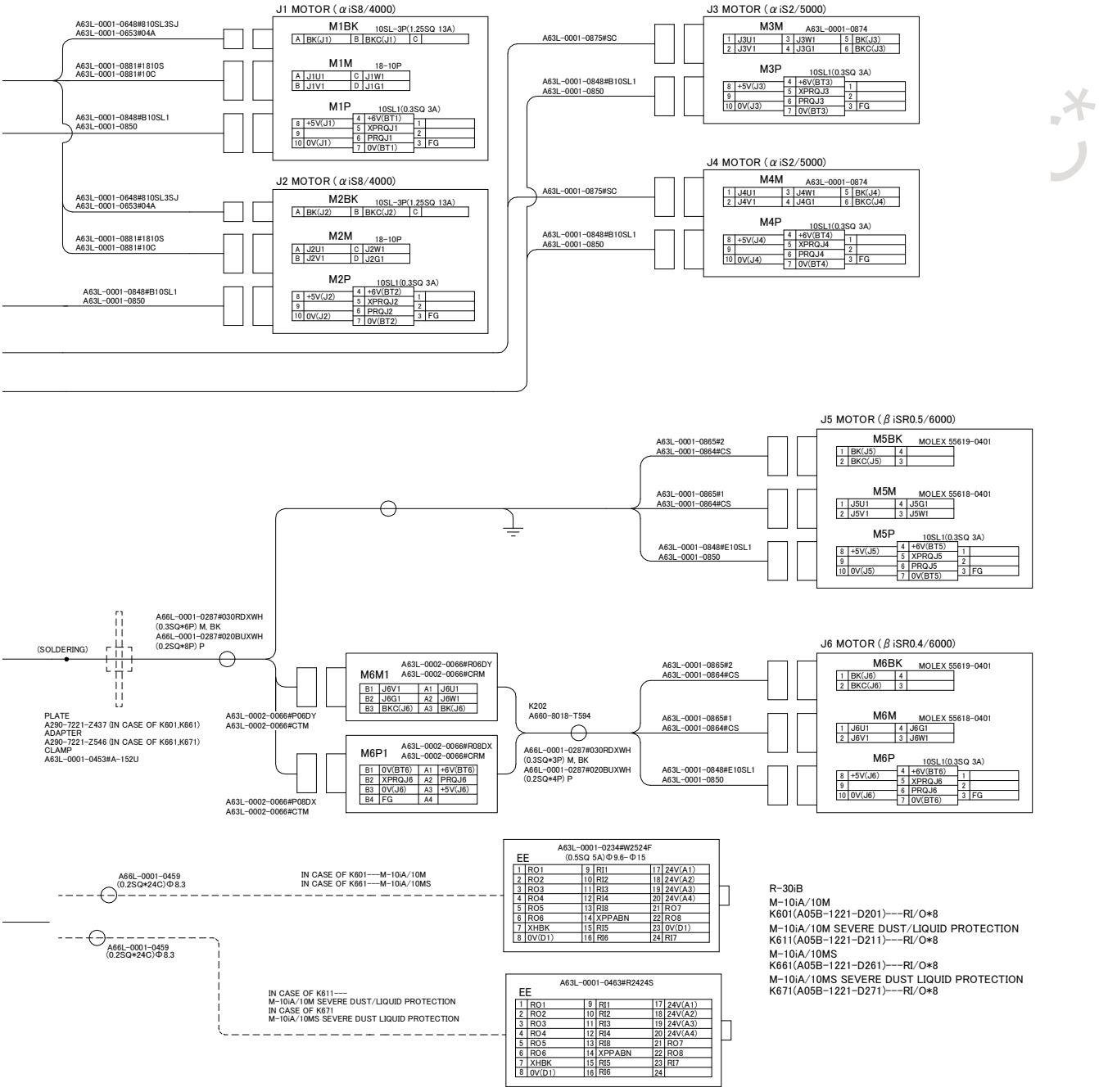
ARC Mate 100iCe , M-10iAe
ARC Mate 100iCe/6L , M-10iAe/6L
☐R-30iA Mate
☐2BK

K121(A05B-1221-D021) --- without RI /O
K151(A05B-1221-D051) --- without RI/O



1	BK(J1)	13	BK(J2)	25	BK(J3)	37	BK(J4)	49	BK(J5)	61	BK(J6)
2	J1U1	14	J2U1	26	J3U1	38	(200V)	50	(0V)	62	BKC (J1,J2,J3, J4,J5,J6)
3	J1V1	15	J2V1	27	J3V1	39	J4U1	51	J5U1	63	J6U1
4	J1W1	16	J2W1	28	J3W1	40	J4V1	52	J5V1	64	J6V1
5	J1G1	17	J2G1	29	J3G1	41	J4W1	53	J5W1	65	J6W1
6	XROT	18	+24V (OT,A1,A2, A3,A4)	30	XHBK	42	J4G1	54	J5G1	66	J6G1
7	RI1	19	RI2	31	RI3	43	RI4	55	RI5	67	0V (D1,D2)
8	RO1	20	RO2	32	RO3	44	RO4	56	RO5	68	RI6
9	RI7	21	RI8	33	RO7	45	RO8	57	XPPABN	69	RO6
10	+5V (J1,J2)	22	+5V (J3,J4)	34	+5V (J5,J6)	46	0V (J1,J2)	58	0V (J3,J4)	70	0V (J5,J6)
11	PRQJ1	23	PRQJ2	35	PRQJ3	47	PRQJ4	59	PRQJ5	71	PRQJ6
12	XPRQJ1	24	XPRQJ2	36	XPRQJ3	48	XPRQJ4	60	XPRQJ5	72	XPRQJ6
					G		FG				

Fig. B (c) Circuit diagram (10M/10MS)


J1 MOTOR (αiS8/4000)
M1BK 10SL-3P(1.25SQ 13A)
M1M 18-10P
M1P 10SL1(0.3SQ 3A)
J2 MOTOR (αiS8/4000)
M2BK 10SL-3P(1.25SQ 13A)
M2M 18-10P
M2P 10SL1(0.3SQ 3A)
J3 MOTOR (αiS2/5000)
M3M A63L-0001-0874
M3P 10SL1(0.3SQ 3A)
J4 MOTOR (αiS2/5000)
M4M A63L-0001-0874
M4P 10SL1(0.3SQ 3A)
J5 MOTOR (βiSR0.5/6000)
M5BK MOLEX 55619-0401
M5M MOLEX 55618-0401
M5P 10SL1(0.3SQ 3A)
J6 MOTOR (βiSR0.4/6000)
M6BK MOLEX 55619-0401
M6M MOLEX 55618-0401
M6P 10SL1(0.3SQ 3A)
M6M1
M6P1
K202
A660-8018-T594
PLATE
A290-7221-Z437 (IN CASE OF K601,K661)
ADAPTER
A290-7221-Z546 (IN CASE OF K661,K671)
CLAMP
A63L-0001-0453#A-152U
(SOLDERING)
A66L-0001-0459
(0.2SQ*24C)Φ8.3
IN CASE OF K601---M-10iA/10M
IN CASE OF K661---M-10iA/10MS
IN CASE OF K611---
M-10iA/10M SEVERE DUST/LIQUID PROTECTION
IN CASE OF K671
M-10iA/10MS SEVERE DUST LIQUID PROTECTION
A63L-0001-0234#W2524F
(0.5SQ 5A)Φ9.6-Φ15
A63L-0001-0463#R2424S
EE
R-30iB
M-10iA/10M
K601(A05B-1221-D201)---RI/O*8
M-10iA/10M SEVERE DUST/LIQUID PROTECTION
K611(A05B-1221-D211)---RI/O*8
M-10iA/10MS
K661(A05B-1221-D261)---RI/O*8
M-10iA/10MS SEVERE DUST LIQUID PROTECTION
K671(A05B-1221-D271)---RI/O*8

C PERIODIC MAINTENANCE TABLE

FANUC Robot ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S, ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L Periodic Maintenance Table

Items		Accumulated operating time (H)	Check time	Oil Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check the external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protective sleeves	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	4	Check the mechanical cable and welding cable (Damaged or twisted)	0.2H	-		○			○				○			
	5	Check looseness of each axis motor and other exposed connector	0.2H	-		○			○				○			
	6	Tighten the end effector bolt.	0.2H	-		○			○				○			
	7	Tighten the cover and main bolt.	2.0H	-		○			○				○			
	8	Check the mechanical stopper and adjustable mechanical stopper	0.1H	-		○			○				○			
	9	Remove spatter and dust etc.	1.0H	-		○			○				○			
	10	Check the end effector (hand) cable	0.1H			○			○				○			
	11	Check the oil sight glass of J4 to J6 axis	0.1H	-	○	○	○	○	○	○	○	○	○	○	○	○
	12	Replacing battery *1 *7	0.1H	-					●				●			
		Replacing battery *2 *7	0.1H	-							●					
	13	Replacing grease of J1-axis reducer	0.5H	870ml												
	14	Replacing grease of J2-axis reducer	0.5H	330ml												
	15	Replacing grease of J3-axis reducer	0.5H	190ml												
	16	Replacing oil of J4-axis Gearbox	0.5H	480ml(*3) 780ml(*4)												
	17	Replacing oil of J5/J6-axis gearbox	0.5H	220ml												
	18	Replacing cable of mechanical unit	4.0H	-												
	19	Replacing cable of Mechanical unit welding power	4.0H	-									●			
	20	Replacing M/H conduit /No dust M/H conduit (option)	1.0H	-									●			
	21	Check broken of fluoric resin ring.	0.1H	-	○	○	○	○	○	○	○	○	●	○	○	○
Controller	22	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	-		○			○				○			
	23	Cleaning the ventilator	0.2H	-	○	○	○	○	○	○	○	○	○	○	○	○
	24	Replacing battery *5 *7	0.1H	-												

*1 ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L ARC Mate 100*i*C/10S, M-10*i*A/10S
*2 ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L
*3 Except ARC Mate 100*i*C/10S, M-10*i*A/10S
*4 ARC Mate 100*i*C/10S, M-10*i*A/10S
*5 Refer to "REPLACING UNITS Chapter of MAINTENANCE " of the following manuals.
R-30*i*A CONTROLLER MAINTENANCE MANUAL (Standard) (B-82595EN),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For Europe) (B-82595EN-1),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For RIA) (B-82595EN-2),
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
*6 ●: requires order of parts ○: does not requires order of parts
*7 Regardless of the operating time, replace the mechanical unit batteries at 1 year, replace controller batteries at 4 years.

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		3
○				○				○				○				○					4
○				○				○				○				○					5
○				○				○				○				○					6
○				○				○				○				○					7
○				○				○				○				○					8
○				○				○				○				○					9
○				○				○				○				○					10
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		11
●				●				●				●				●					12
●						●						●						●			
●												●									13
●												●									14
●												●									15
●												●									16
●												●									17
				●																	18
				●								●									19
				●								●									20
○	○	○	○	●	○	○	○	○	○	○	○	●	○	○	○	○	○	○	○		21
○				○				○				○				○					22
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		23
				●																	24

Overhaul

FANUC Robot 10M/10MS **Periodic Maintenance Table**

Items			Accumulated operating time (H) / Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check the external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protective sleeves	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	4	Check the mechanical cable. (Damaged or twisted)	0.2H	—		○			○				○			
	5	Check looseness of each axis motor and other exposed connector	0.2H	—		○			○				○			
	6	Tighten the end effector bolt.	0.2H	—		○			○				○			
	7	Retightening external main bolts	2.0H	—		○			○				○			
	8	Check the mechanical stopper and adjustable mechanical stopper.	0.1H	—		○			○				○			
	9	Remove spatter and dust etc.	1.0H	—		○			○				○			
	10	Check the end effector (hand) cable	0.1H	—		○			○				○			
	11	Replacing battery *3	0.1H	—					●				●			
	12	Replacing grease of J1-axis reducer	0.5H	870ml												
	13	Replacing grease of J2-axis reducer	0.5H	330ml												
	14	Replacing grease of J3-axis reducer	0.5H	190ml												
	15	Replacing grease of J4-axis gearbox	0.5H	390ml												
	16	Replacing grease of J5-axis gearbox	0.5H	250ml												
	17	Supply grease of J6-axis reducer	0.5H	35ml					●				●			
	18	Replacing cable of mechanical unit	4.0H	—												
Controller	19	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○				○			
	20	Cleaning the ventilator	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	21	Replacing battery *1 *3	0.1H	—												

*1 Refer to “REPLACING UNITS Chapter of MAINTENANCE ” of the following manuals.
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)

*2 ●: requires order of parts
○: does not require order of parts

*3 Regardless of the operating time, replace the mechanical unit batteries at 1 year, replace controller batteries at 4 years.

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		3
○				○				○				○				○					4
○				○				○				○				○					5
○				○				○				○				○					6
○				○				○				○				○					7
○				○				○				○				○					8
○				○				○				○				○					9
○				○				○				○				○					10
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D STRENGTH OF BOLT AND BOLT TORQUE LIST

NOTE

When applying LOCTITE to a part, spread the LOCTITE on the entire length of the engaging part of the female thread. If applied to the male threads, poor adhesion can occur potentially loosening the bolt. Clean the bolts and the threaded holes and wipe off any oil on the engaging section. Make sure that there is no solvent left in the threaded holes. After you screw the bolts into the threaded holes, remove any excess LOCTITE.

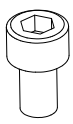
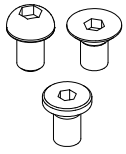
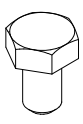
Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:

Size M22 or less: Tensile strength 1200N/mm^2 or more
Size M24 or more: Tensile strength 1000N/mm^2 or more
All size plating bolt: Tensile strength 1000N/mm^2 or more

Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)
Tensile strength 400N/mm^2 or more

Refer to the following tables if the bolts tightening torque is not specified.

Recommended bolt tightening torques **Unit: Nm**

Nominal diameter	Hexagon socket head bolt (steel)		Hexagon socket head bolt (stainless steel)		Hexagon socket head button bolt Hexagon socket head flush bolt Low-head bolt (steel)		Hexagon bolt (steel)	
	Tightening torque		Tightening torque		Tightening torque		Tightening torque	
	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit
M3	1.8	1.3	0.76	0.53	———	———	———	———
M4	4.0	2.8	1.8	1.3	1.8	1.3	1.7	1.2
M5	7.9	5.6	3.4	2.5	4.0	2.8	3.2	2.3
M6	14	9.6	5.8	4.1	7.9	5.6	5.5	3.8
M8	32	23	14	9.8	14	9.6	13	9.3
M10	66	46	27	19	32	23	26	19
M12	110	78	48	33	———	———	45	31
(M14)	180	130	76	53	———	———	73	51
M16	270	190	120	82	———	———	98	69
(M18)	380	260	160	110	———	———	140	96
M20	530	370	230	160	———	———	190	130
(M22)	730	510	———	———	———	———	———	———
M24	930	650	———	———	———	———	———	———
(M27)	1400	960	———	———	———	———	———	———
M30	1800	1300	———	———	———	———	———	———
M36	3200	2300	———	———	———	———	———	———
								

E INSULATION ABOUT ARC WELDING ROBOT

The arc welding robot performs welding, using a welding torch attached to its end effector mounting face via a bracket. Because a high welding current flows through the welding torch, the insulating material must not permit bolting directly from the welding torch bracket to mounting face plate.

If no due consideration is taken, a poor insulation caused by a pileup of spatter can allow the welding current to leak into robot mechanical units, possibly damaging the motor or melting the mechanical unit cable jackets.

E.1 INSULATION AT THE WRIST

Please be careful to the following contents.

- Insulate the end effector mounting surface. Insulation material which is inserted between the end effector mounting surface and the welding torch bracket must be different, and bolt them separately referring to Fig. E.1 (a).
- Insert the insulating material between the torch bracket and faceplate to ensure the two are electrically isolated. When installing the insulating material, be sure to set the crack in the torch holder away from that of the insulating material to prevent spatter from getting in the cracks.
- Allow a sufficient distance (at least 5 mm) at the insulating materials in case a pileup of spatter should occur.

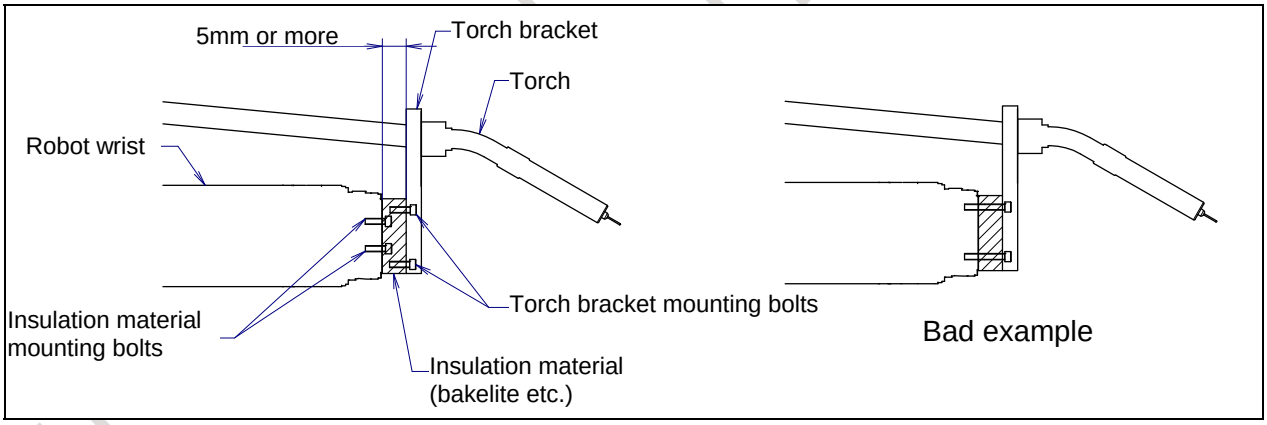


Fig. E.1 (a) Insulation at the wrist

- Even after the insulation is reinforced, it is likely that, if a pileup of spatter grows excessively, current may leak. Periodically remove the spatter.

E.2 INSULATION AT THE ADDITIONAL AXIS

If welding fixtures are installed to the additional axis, Perform insulation against between welding fixtures and the additional axis to prevent welding electric current intrusion. If the follower unit is used, perform insulation against between welding fixtures and follower unit to prevent welding electric current intrusion into the housing.

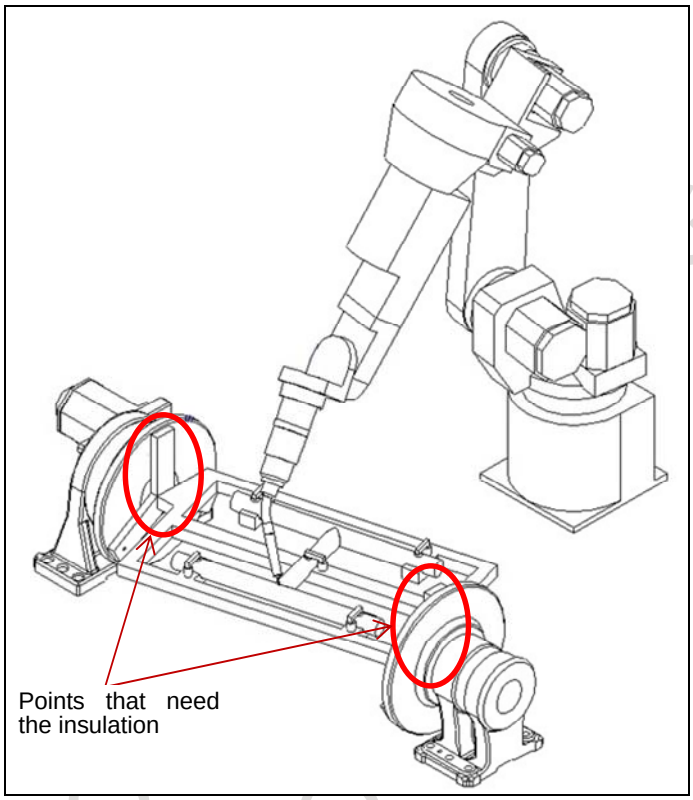


Fig. E.2 (a) Insulation at the additional axis

INDEX

REVISION RECORD

Edition	Date	Contents
11	Aug., 2020	• Addition J3-axis motor for M-10*i*A/10M/10MS • Correction of errors
10	Oct., 2019	• Change spec. of the J5/J6-axis gearbox • Correction of errors
09	May, 2017	• Addition of R-30*i*B Plus, R-30*i*B Mate Plus Controller • Correction of errors
08	Apr., 2015	• Correction of errors
07	Nov., 2013	• Addition of R-30*i*B Mate Controller • Addition of M-10*i*A/10M/10MS • Change of replacing procedure of the J4-axis gearbox • Correction of errors
06	Aug., 2012	• Addition of R-30*i*B Controller • Change of replacing method of oil and grease • Addition of reducer replacing fixture • Change of wrist unit replacing method • Correction of errors
05	May, 2011	• Addition of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L • Addition of stop type of robot • Change of replacing method of oil of J4-axis • Addition oiling method by oil injection gun • Correction of daily checks. • Correction of errors
04	Jun., 2010	• Addition of ARC Mate 100*i*C/10S and M-10*i*A/10S • Addition of new specification of ARC Mate 100*i*C, ARC Mate 100*i*C/6L, M-10*i*A, M-10*i*A/6L • Addition of replacing method of fluoric resin ring • Correction of errors
03	Jul., 2009	• Change replacing procedure of J3-axis reducer,J5,J6-axes motor and wrist unit • Addition of replacing method of grease and oil for top mount and angle mount • Addition of No dust M/H conduit • Correction of errors
02	Aug., 2008	• Addition of M-10*i*A/6L • Correction of cable replacement • Addition of Method of fixture position master • Correction of errors
01	Mar., 2008	

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