

FANUC Robot ARC Mate OiB

MECHANICAL UNIT MAINTENANCE MANUAL

B-83615EN/02

- **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.

- No part of this manual may be reproduced in any form.
- The appearance and specifications of this product are subject to change without notice.

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 is 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)

(*) These do not support CE marking.

- (2) Please make sure that adequate numbers of brake release units are available and readily accessible for robot system before installation.
- (3) Regarding how to use brake release unit, please refer to Robot controller maintenance manual.

CAUTION

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 gravity. Therefore, it is strongly recommended to take adequate measures such as hanging Robot arm by a crane before releasing a brake.

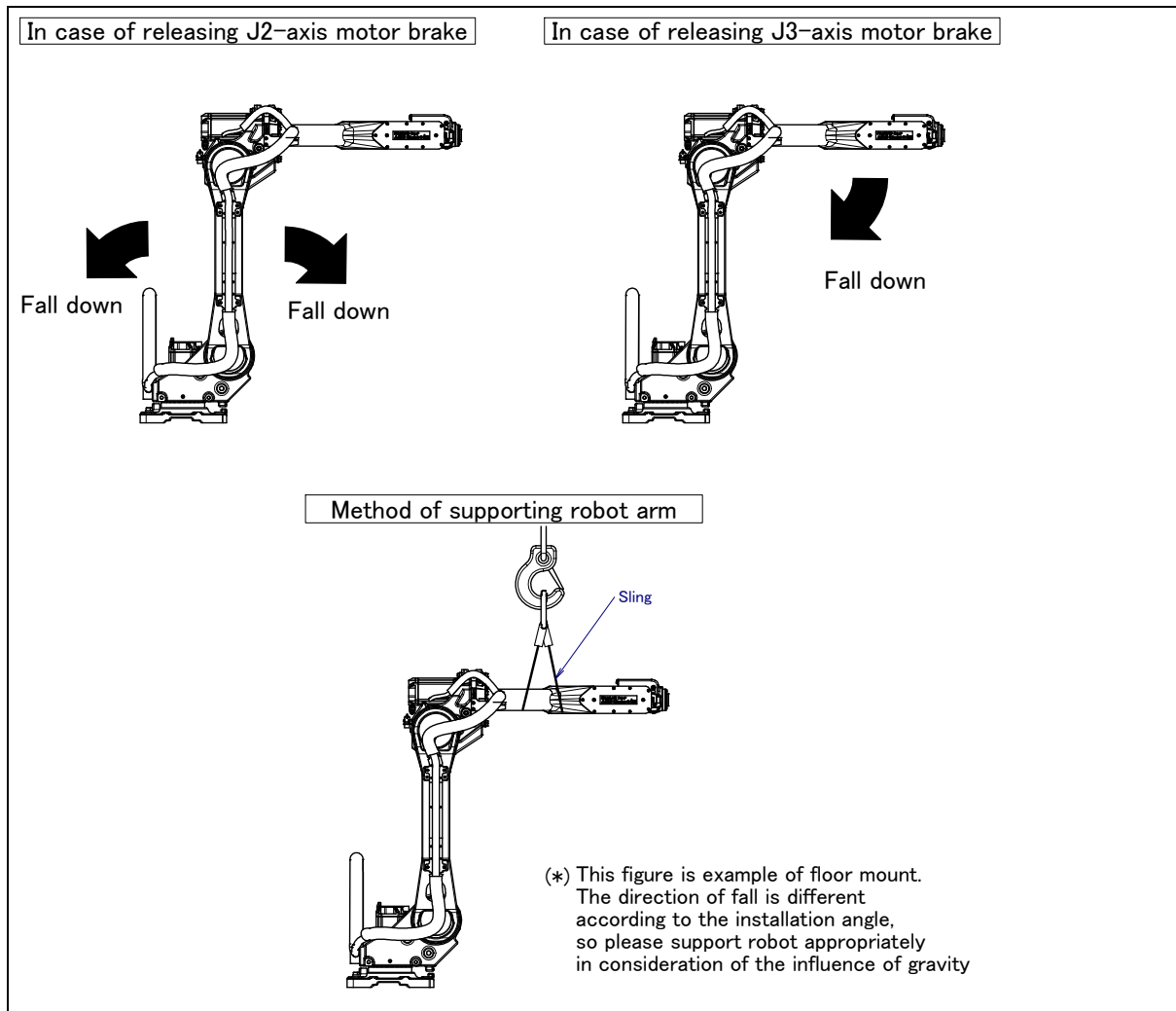


Fig. 3 (a) Releasing J2 and J3 motor brake and measures

4 WARNING 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 Section 2.2 Replacing the Grease of the Drive Mechanism (3 years (11520 hours) checks) for explanations about specified greases, the amount of grease to be supplied, and the locations of grease and degrease outlets.

(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.

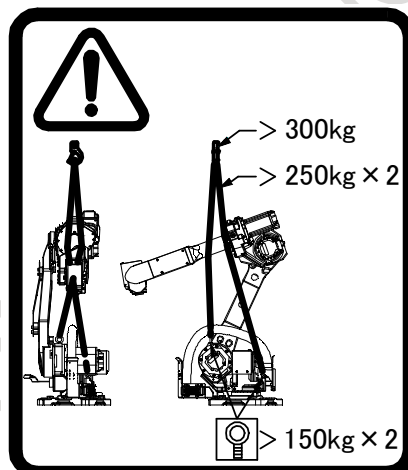
(4) Transportation label

Fig. 4 (d) Transportation label

Description

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

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

⚠ CAUTION

See Section 1.1 TRANSPORTATION of operator's manual (B-83614EN) for explanations about the posture should take when it is transported.

(5) Disassembly prohibitive label (for robot with pedestal)



Fig.4 (e) Disassembly prohibitive label

Descriptions

Do not remove J1 base.

(6) Operating space and payload mark label

Below label is added when CE specification is specified.

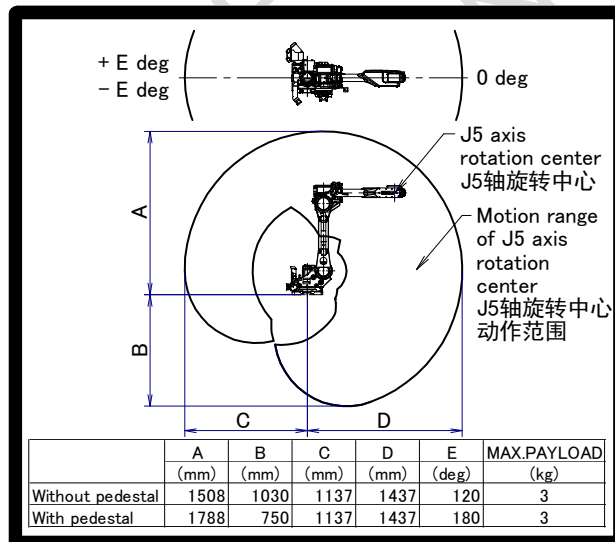


Fig.4 (f) Operating space and payload mark label

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PREFACE

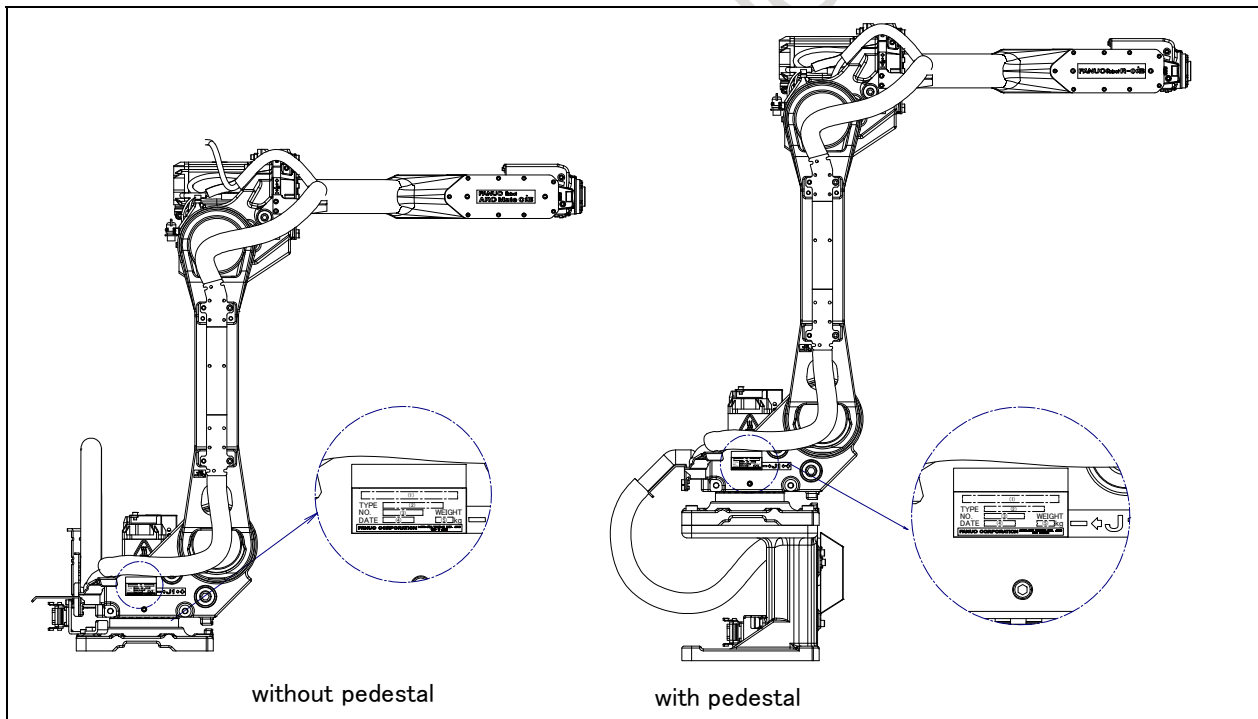
This manual explains the maintenance procedures for the mechanical units of the following robots:

Model name	Mechanical unit specification No.	Maximum load
FANUC Robot ARC Mate 0iB	A05B-1223-B301	3kg

NOTE

- 1 Use of this robot is strictly limited to arc welding applications. Any other use is prohibited.
- 2 This robot cannot be used in environments where it could be subject to water or oil splashing.
- 3 Wrist load and moment and inertia limits must be strictly observed. Exceeding the allowable values will cause premature mechanical unit breakdown.

The label stating the mechanical unit specification number is affixed in the position shown below. 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)	(5)
CON TENTS	Model name	TYPE	No.	DATE	WEIGHT kg (WITHOUT PEDESTAL)	WEIGHT kg (WITH PEDESTAL)
LETTERS	FANUC Robot ARC Mate 0iB	A05B-1223-B301	SERIAL NO IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	99	145

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-30iB Mate 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	Intended readers: Operator, programmer, maintenance technician, system designer Topics: Robot functions, operations, programming, setup, interfaces, alarms Use: Robot operation, teaching, system design
	MAINTENANCE MANUAL B-83525EN	Intended readers: Maintenance technician, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance
FANUC Robot ARC Mate 0iB Mechanical unit	OPERATOR'S MANUAL B-83614EN	Intended readers: System designer, Maintenance technician Topics: Installation, connection to the 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

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1 CHECKS AND MAINTENANCE

Optimum performance of the robot can be maintained by performing the checks and maintenance procedures presented in this chapter. (See 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: $3 \text{ years} / 2 = \text{perform maintenance every 1.5 years}$.

1.1 CHECKS AND MAINTENANCE

1.1.1 Daily Checks

Clean each part, and visually check component parts for damage before daily system operation. Check the following items when necessary.

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"
Vibration, abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: ⇒"3.1 TROUBLESHOOTING"(symptom : Vibration, Noise)
Repeatability	Check to see that the taught positions of the robot have not deviated from the previous taught positions. When displacement occurs, perform the measures as described in the following section: ⇒"3.1 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 end effector drops within 5 mm when servo power is turned off. If the end effector (hand) drops, perform the measures as described in the following section: ⇒"3.1 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: ⇒" CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)"

1.1.2 Periodic Checks and Maintenance

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

Check and maintenance intervals (Operating time, 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	1.5 years 5760h	2 years 7680h	3 years 11520h	4 years 15360h			
○ Only 1st check	○						Cleaning the controller ventilation system	Confirm the controller ventilation system is not dusty. If dust has accumulated, remove it.	18
	○						Check for external damage or peeling paint	Check whether the robot has external damage or peeling paint due to the interference with the peripheral devices. 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 sleeves	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. ⇒"1.2.2 Check the Mechanical Unit Cables and Connectors"	2
	○						Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.	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.	17
	○ 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. ⇒"1.2.2 Check the Mechanical Unit Cables and Connectors"	4
	○ 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. ⇒"1.2.2 Check the Mechanical Unit Cables and Connectors"	5
	○ Only 1st check	○					Retightening the end effector mounting bolts	Retighten the welding torch mounting bolts. Refer to the following section for tightening torque information: ⇒"4.1 WELDING TORCH MOUNTING FACE TO WRIST TIP" of the operator's manual (B-83614EN).	6

Check and maintenance intervals (Operating time, 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	1.5 years 5760h	2 years 7680h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○					Retightening the external main bolts	Retighten the robot installation bolts, bolts to be removed for inspection, and bolts exposed to the outside. Refer to the recommended bolt tightening torque guidelines at the end of the manual. An adhesive to prevent bolts from loosening is applied to some bolts. 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.	7
	○ Only 1st check	○					Check the fixed mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the fixed mechanical stopper, the adjustable mechanical stopper, and check the tightness of the stopper mounting bolts. ⇒"1.2.3 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"	8
	○ 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, wrist flange). 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)	9
	○ Only 1st check	○					Check the cable for equipment	Check whether the cables for equipment are unevenly twisted or damaged. If damage is found, replace the damaged cables.	10
			○				Replacing the mechanical unit batteries	Replace the mechanical unit batteries. Regardless of operating time, replace batteries at 1.5 years. ⇒"2.1 Replacing the Batteries"	11
					○		Replacing the grease of J4 to J6-axis gearbox	Replace the grease of J4 to J6-axis gearbox. ⇒"2.2 Replacing the Grease of the Drive Mechanism"	12 to 14
						○	Replacing the mechanical unit cable	Replace the mechanical unit cable. ⇒"5.1 REPLACING CABLES"	15
				○			Replacing the J1-axis cable protective sleeve.	Replace the J1-axis cable protective sleeve. ⇒"1.2.2 Check the Mechanical Unit Cables and Connectors"	16
						○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. ⇒Chapter 7 Replacing batteries of CONTROLLER MAINTENANCE MANUAL (B-83525EN)"	19

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.

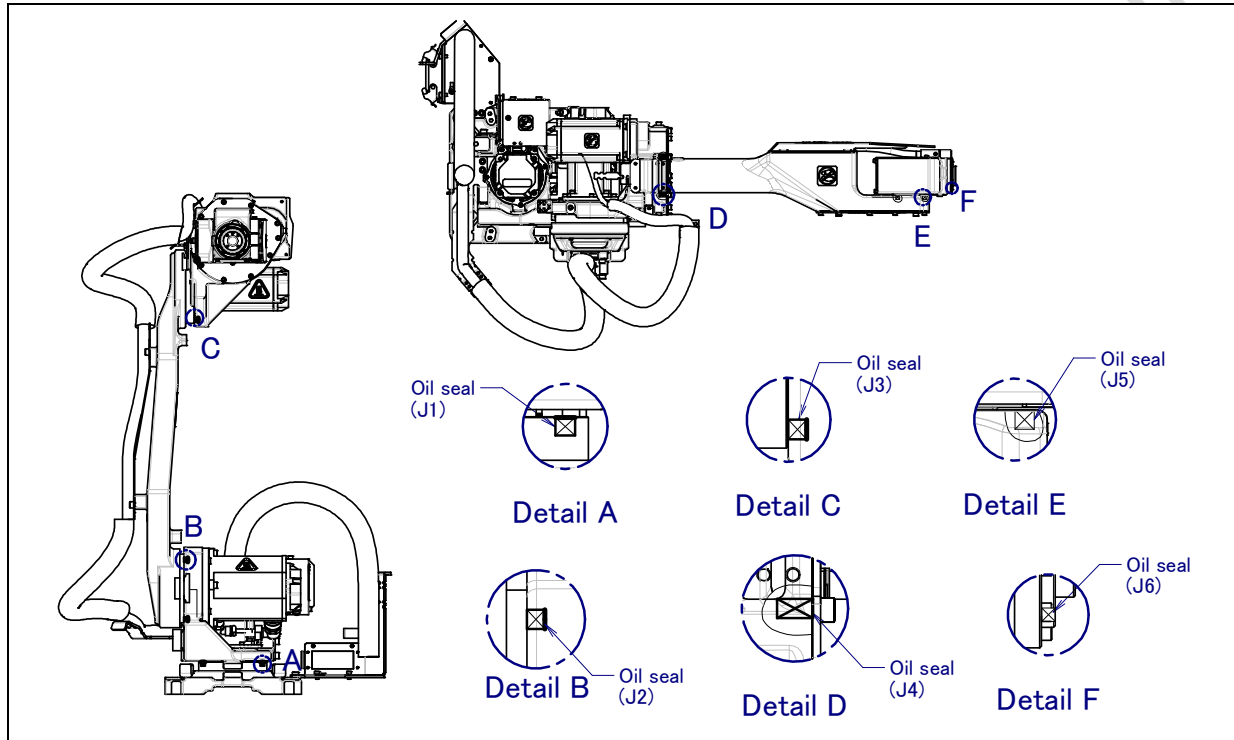


Fig. 1.2.1 (a) Check parts of oil seepage

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil changes to a state of liquid, the oil might fall depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components 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, motors might become hot and the internal pressure of the grease bath or oil bath might rise by frequent repetitive movement and use in high temperature environments. In these cases, normal internal can be achieved by venting the grease outlet. (When opening the grease outlet, and ensure that grease is not expelled onto the machine or tooling.)



WARNING

Grease may come out suddenly when opening the grease outlet. Attach bags for collecting grease.

- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.
⇒ "3.1 TROUBLESHOOTING" (symptom : Grease leakage)

1.2.2 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. Replace those when those are damaged.

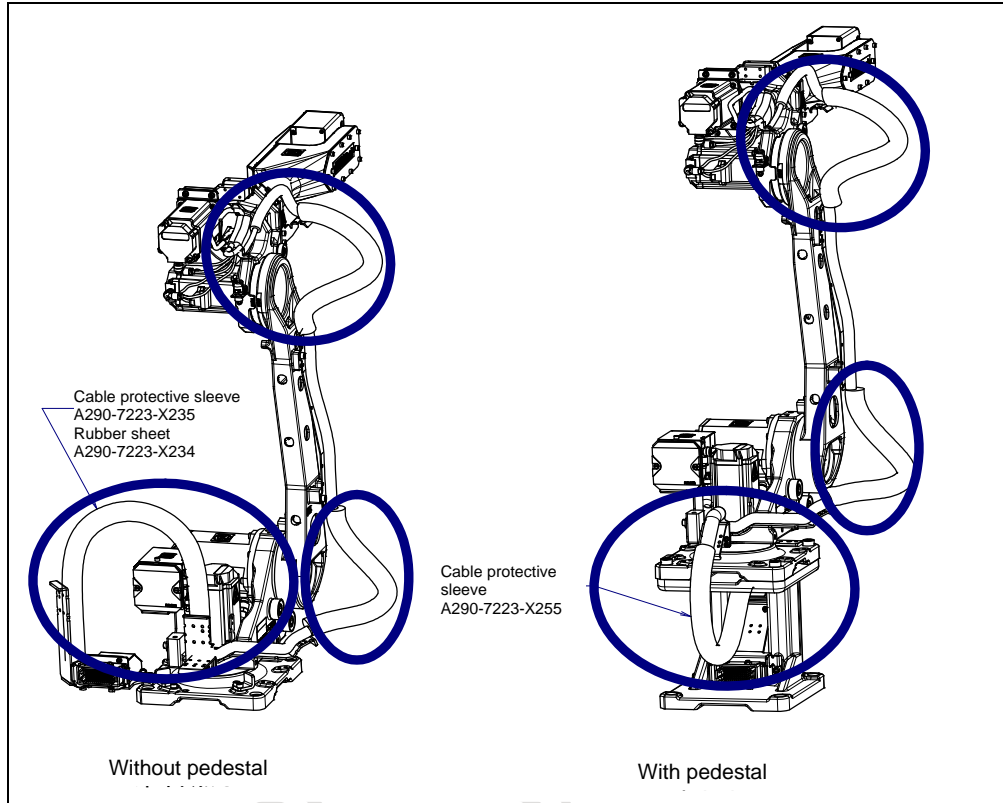


Fig. 1.2.2 (a) Inspection points of the mechanical unit cables

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. 1.2.2 (b), replace the cable protective sleeves.



Fig. 1.2.2 (b) Damages on the cable protective sleeve

<Cables>

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

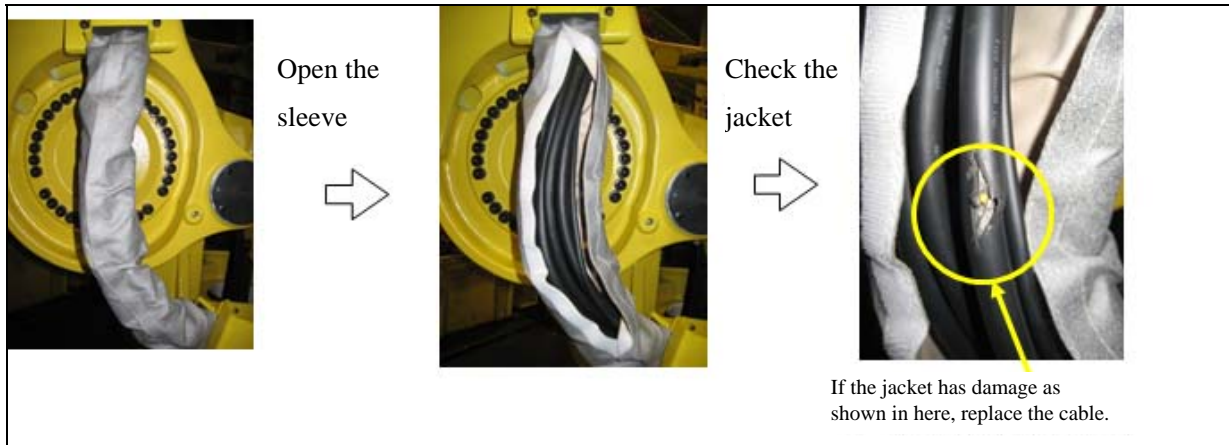


Fig. 1.2.2 (c) Cable check method

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.

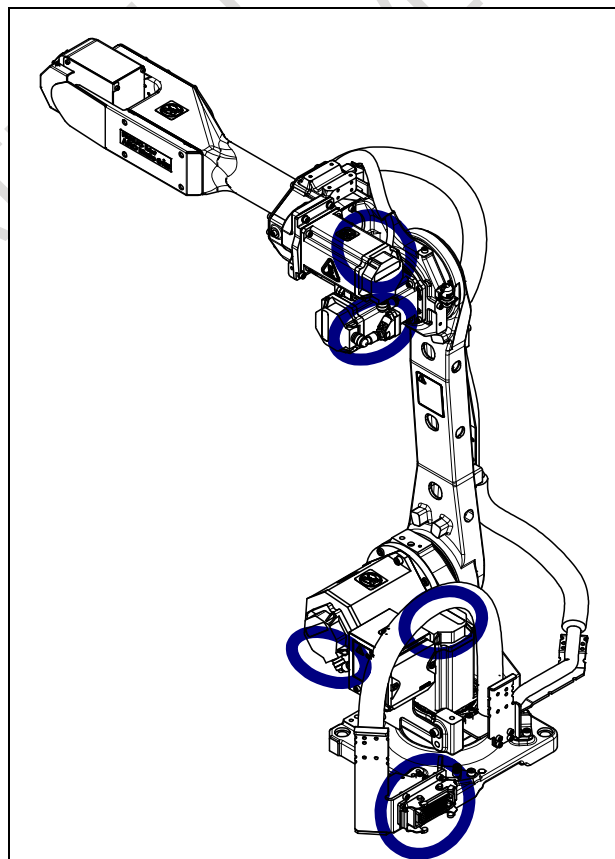


Fig. 1.2.2 (d) Connector Inspection points

1.2.3 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check that there is no evidence of a collision on the fixed mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace the parts.
- Check the tightness 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 (B-83614EN) for details regarding the adjustable mechanical stopper.

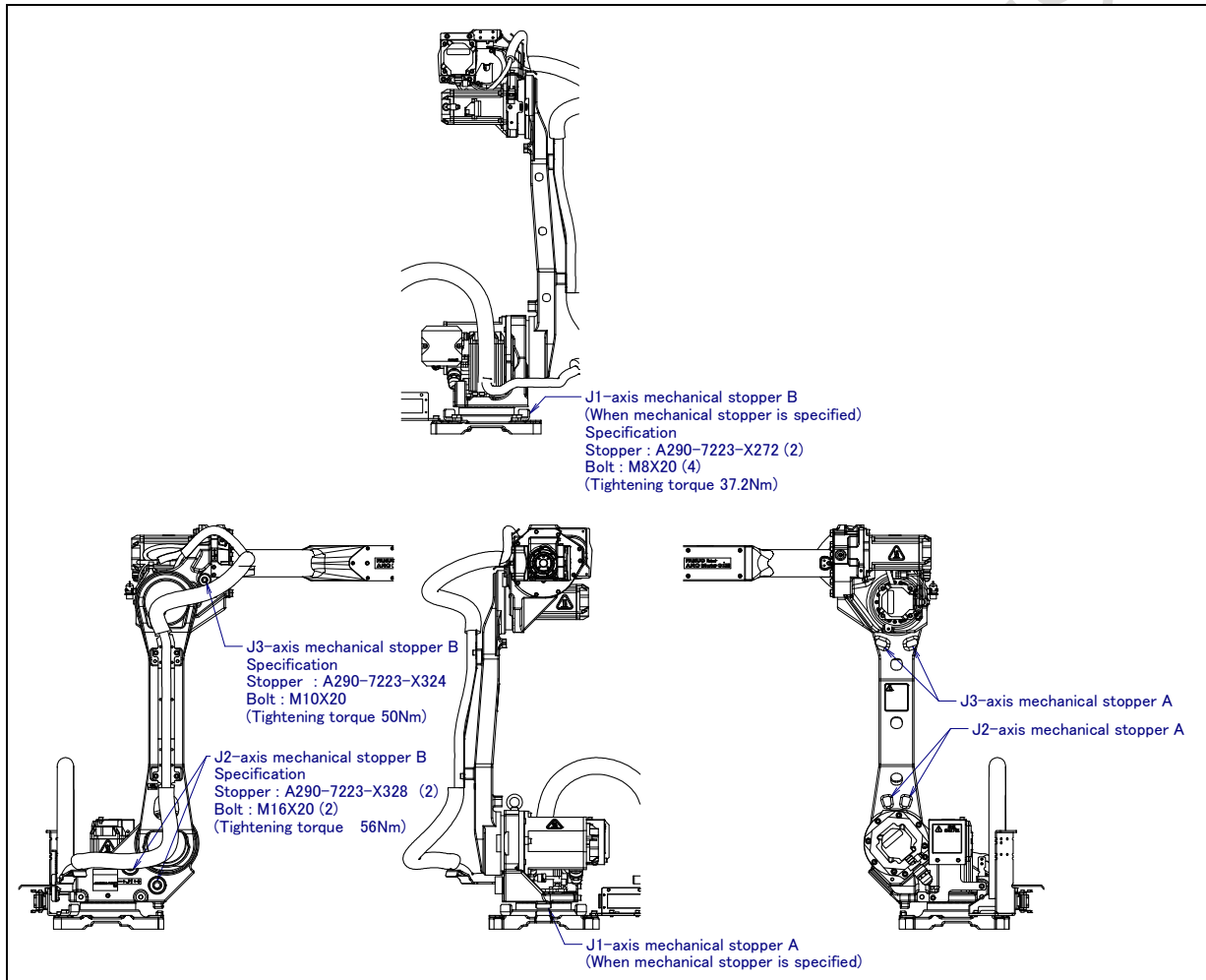


Fig. 1.2.3 (a) Check of fixed mechanical stopper and adjustable mechanical stopper

1.3 MAINTENANCE

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
Hexagonal wrench sets	Width across flats 2.5, 3, 4, 5, 6,8 (for replacing parts)
Torque wrench	Width across flats 2.5, 3, 4, 5, 6,8 (for replacing parts)
Long T wrenches	Width across flats 2.5, 3, 4, 5, 6,8 (for replacing parts)
Adjustable wrenches	(Medium and small sizes)
Pliers	
Needle nose pliers	
Nipper	
Offset wrench	
Grease gun	
C-ring pliers	
J1/J2/J3-axis reducer hanging fixture	A290-7223-X950 (Fig.1.3 (a))
Guide pin for replacing J1/J2/J3-axes reducer	A290-7223-X994 (Fig.1.3 (b))
Shaft J6-axis wave generator disassembly fixture	A290-7223-X995 (Fig.4.2 (b))
Plate J6-axis wave generator disassembly fixture	A290-7223-X996 (Fig.4.2 (b))
Shaft J6-axis wave generator disassembly fixture	A290-7223-X997 (Fig.4.2 (b))
Flashlight	
LOCTITE 243,263,518,638	

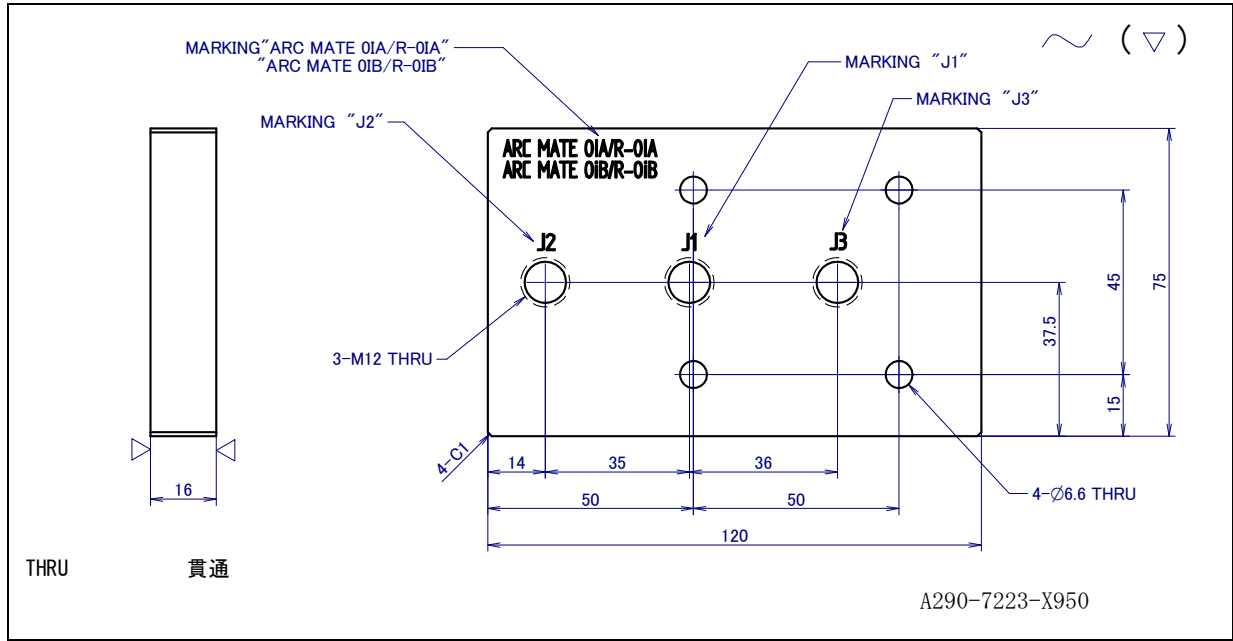


Fig.1.3 (a) J1/J2/J3-axis reducer hanging fixture (A290-7223-X950)

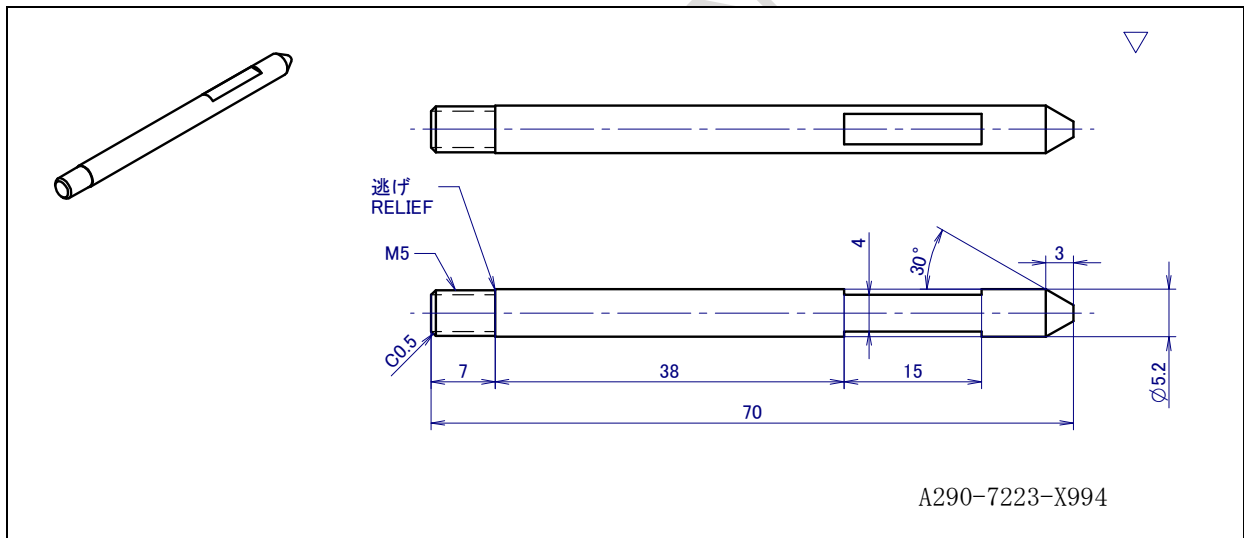


Fig.1.3 (b) Guide pin for replacing J1/J2/J3-axis reducer (M8) (A290-7223-X994)

2 PERIODIC MAINTENANCE

2.1 REPLACING THE BATTERIES (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 1.5 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 controller 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. 2.1 (a))
- 3 Take out the old batteries from the battery case.
- 4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
- 5 Close the battery case cap.

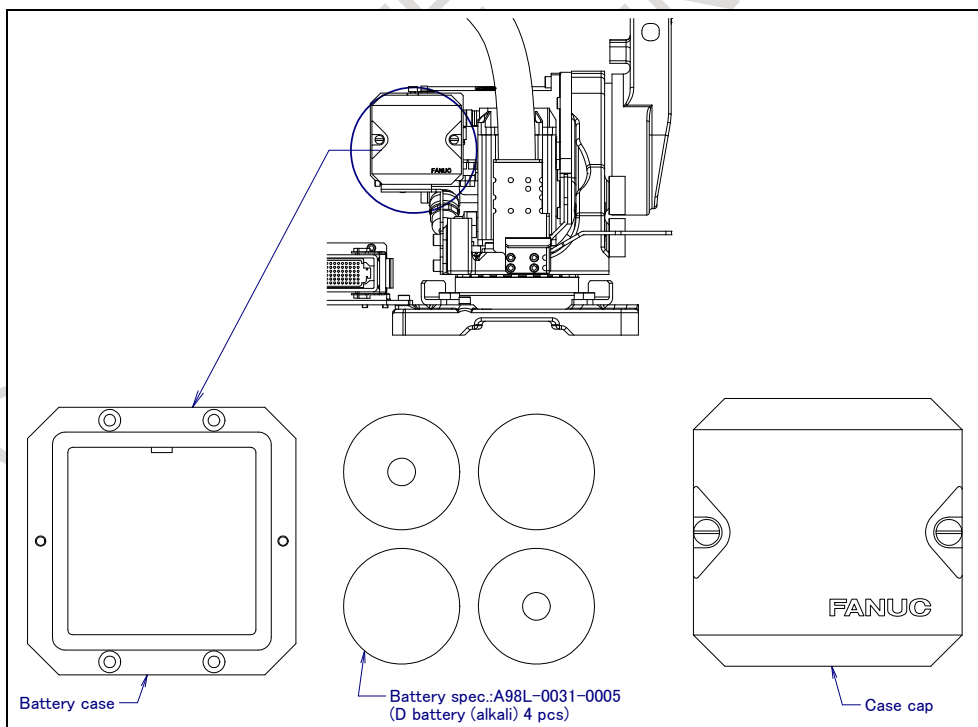


Fig. 2.1 (a) Replacing the battery

2.2 REPLACING THE GREASE OF THE DRIVE MECHANISM (3 YEARS (11520 HOURS) CHECKS)

2.2.1 Grease replacement procedure for the reducer

Replace the grease of the reducers of J4/J5/J6-axis gearbox in cycle that is shorter among every three years and 11520 hours by using the following procedures. For J1 to J3-axes, greasing may be necessary when robot is overhaul period at 8 years, so contact your local FANUC representative. (If robot is under environment of the high temperature, shortening the interval is recommended.)

CAUTION

Failure to follow proper lubrication procedures may cause damage to the seal, which could lead to grease leakage and abnormal operation.

When greasing, observe the following cautions.

- 1 Before starting to grease, open the seal bolt of the grease outlet.
- 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 2.2.1 (a)).
- 4 Use specified grease. Use of non-approved grease 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 2.2.2, 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 2.2.1 (a) Grease name and amount to be replaced at regular intervals of three years (11520 hours)

Greasing points	Amount of grease to be applied	Gun tip pressure	Specified grease
J4-axis gearbox	400g(450ml)	0.1MPa or less (NOTE)	Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174)
J5-axis gearbox	180g(200ml)		
J6-axis gearbox	75g(85ml)		

NOTE

When using a hand pump, supply grease at a rate of approximately once 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, move the robot to the posture below.
 Consider relative angle of from posture of floor mount when robot is angle mount.

Table 2.2.1 (b) Grease supplying posture

Supply position		Posture							
		J1	J2	J3	J4	J5	J6		
J4-axis gearbox supply posture	Floor mount	Arbitrary	Arbitrary	0°	Arbitrary	Arbitrary	Arbitrary		
	Top mount			180°					
	Wall mount -90°	0°		-90°					
	Wall mount +90°			90°					
J5-axis gearbox supply posture	Floor mount	Arbitrary		0°	0°			Arbitrary	Arbitrary
	Top mount			180°					
	Wall mount -90°	0°		-90°					
	Wall mount +90°			90°					
J6-axis gearbox supply posture	Floor mount	Arbitrary	0°	0°	0°	Arbitrary			
	Top mount		180°						
	Wall mount -90°	0°	-90°						
	Wall mount +90°		90°						

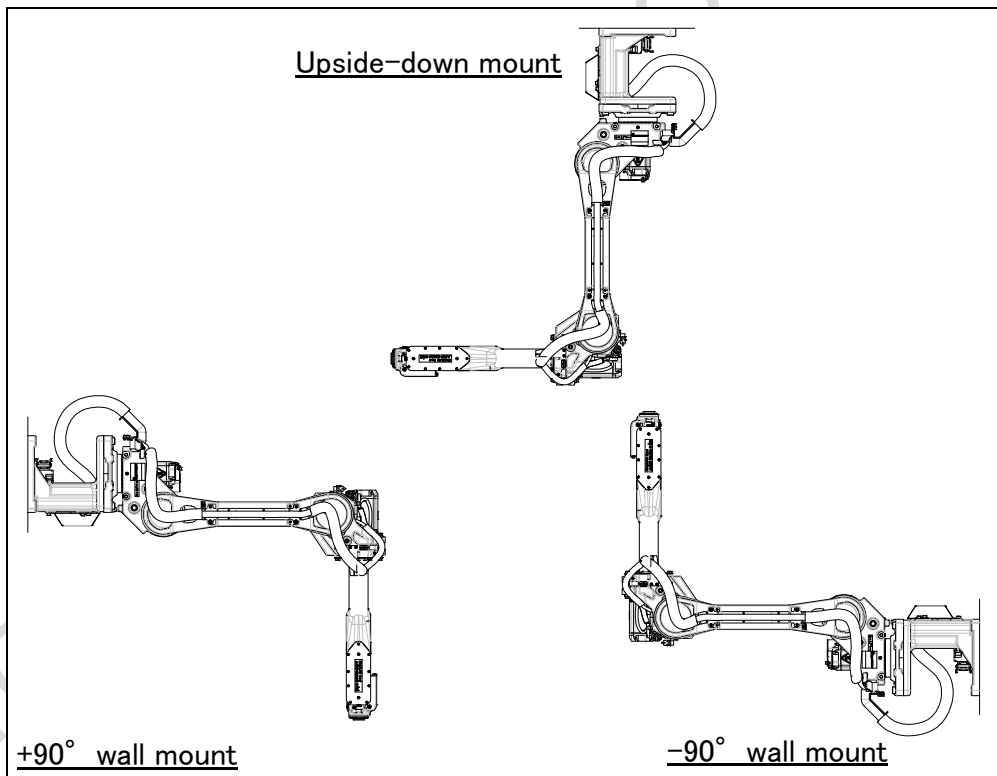


Fig. 2.2.1 (a) Installation method

- 1 Move the robot to the greasing Posture described in Table.2.2.1 (b).
- 2 Turn off controller power.
- 3 Remove the taper plug or the seal bolt or the bolt and the seal washer from grease outlet. (Fig.2.2.1 (b))
 J4-axis: seal bolt M6 x 8
 J5-axis: bolt M6 x 8 + seal washer
 J6-axis: taper plug R1/8
- 4 Remove the seal bolt or the bolt or taper plug from grease inlet and attach grease nipple.
- 5 Supply new grease until new grease is discharged from the grease outlet.
- 6 After supplying grease, release the remaining pressure within the grease bath as described in the procedure in Subsection 2.2.2.

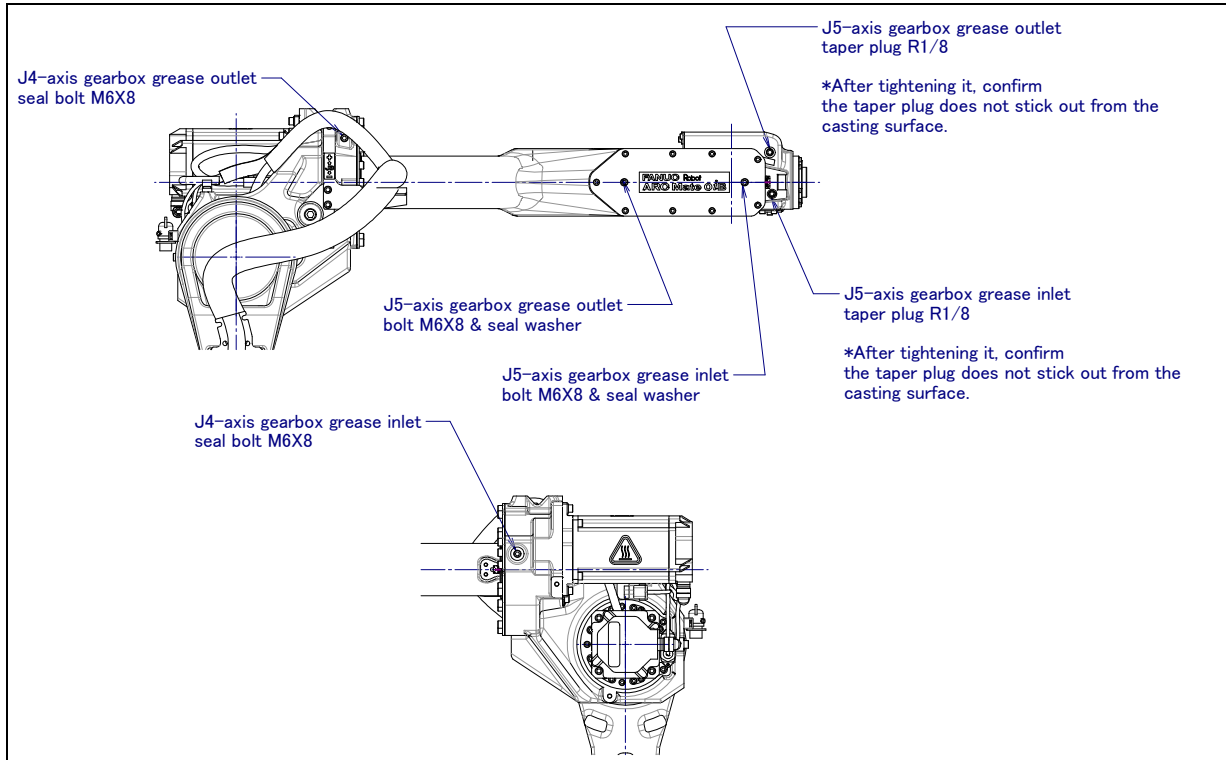


Fig. 2.2.1 (b) Greasing points of gearboxes

Table 2.2.1 (c) Specification of seal bolt , taper plug and seal washer

Parts name	Specification
Seal bolt (M6X8)	A97L-0218-0417#060808
Taper plug (R1/8)	A97L-0001-0436#1-1D
Seal washer (M6)	A30L-0001-0048#6M

2.2.2 Procedure for releasing remaining pressure from the grease bath

After applying grease, operate the robot as instructed below with the taper plug or seal bolt or bolt of the grease inlet and the taper plug or seal bolt or bolt and seal washer of the grease outlet uncapped to release the remaining pressure within the grease bath. Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

To release remaining pressure, after remove the tube for applying grease leave the grease inlets and outlets open for three minutes. Install the bolts or seal bolts in the grease inlets and outlets, and perform repetitive operation with an axis angle of at least 60 degrees and OVR100% for 10 minutes or more.

In case of J5-axis, move the robot so that tip of J3 arm face floor.

After the operation is completed, remove the taper plugs or bolts from the grease inlets and outlets, and leave the grease inlets and outlets open for three minutes to release internal pressure.

When the above operation is impossible due to ambient conditions, adjust the operating time according to the operating angle. (When the maximum allowable axis angle is 30 degrees, perform the twice operation for 20 minutes or more.) Upon completion of the above operation, attach the taper plug or the seal bolt or bolt and seal washer to each the grease inlet and outlet. When reusing the seal bolt or taper plug, be sure to seal it with seal tape.

3 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.

3.1 TROUBLESHOOTING

Table 3.1 (a) shows the major troubleshooting that may occur in the mechanical unit and their probable causes. If you cannot pinpoint a failure cause or which measures to take, contact your local FANUC representative.

Table 3.1 (a) Troubleshooting

Symptom	Description	Cause	Measure
Vibration Noise	<ul style="list-style-type: none"> - 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] <ul style="list-style-type: none"> - 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, which, in turn, leads to vibration. 	<ul style="list-style-type: none"> - If a bolt is loose, apply LOCTITE and tighten it with the appropriate torque. - Adjust the floor plate surface flatness to within the specified tolerance. - If there is any foreign material between the J1 base and floor plate, remove it.
	<ul style="list-style-type: none"> - The rack or floor plate vibrates during operation of the robot. 	[Rack or floor] <ul style="list-style-type: none"> - It is likely that the rack or floor is not sufficiently rigid. - If the rack or floor is not sufficiently rigid, reaction from the robot deforms the rack or floor, leading to vibration. 	<ul style="list-style-type: none"> - Reinforce the rack or floor to make it more rigid. - If it is impossible to reinforce the rack or floor, modify the robot control program; doing so will reduce the amount of vibration.
	<ul style="list-style-type: none"> - 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] <ul style="list-style-type: none"> - 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. 	<ul style="list-style-type: none"> - 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).

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	<ul style="list-style-type: none"> - Vibration or noise was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating or noise occurring axis has not been replaced for a long period. - Periodic vibration and noise occur. 	<p>[Broken gear, bearing, or reducer]</p> <ul style="list-style-type: none"> - 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. - Prolonged overloaded use may cause fretting fatigue on the gear tooth surface or the rolling surface of bearing and reducer. - 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 replaced for a long period, fretting occurred on the tooth surface or rolling contact surface of a bearing, or reducer due to metal fatigue. For J1 to J3 –axis, grease replacing is not necessary if robot is used normally. But in case of temperature is very high, or posture is almost constant and Motion angle is very small. It is necessary to add grease. About greasing method of J1 to J3 axes, please contact your local FANUC representative. 	<ul style="list-style-type: none"> - Operate one axis at a time to determine which axis is vibrating. - 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, Perform continuous operation before replacing grease, then it may be improved.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical section.	<p>[Controller, cable, and motor]</p> <ul style="list-style-type: none"> - 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 connection cable between the mechanical unit and the controller 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 the invalid value parameter was set. 	<ul style="list-style-type: none"> - 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 cable jacket connecting the mechanical unit and controller 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 them. Contact FANUC for further information if necessary.

Symptom	Description	Cause	Measure
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 unusual sound even for specified grease, perform operation for one or two days on an experiment. Generally, a usual sound will disappear.
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

Symptom	Description	Cause	Measure
Rattling	<ul style="list-style-type: none"> - Backlash is larger than the permitted value stated in the maintenance manual. (See Section 3.2.) 	<p>[Increase in backlash]</p> <ul style="list-style-type: none"> - 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. - Increased backlash, resulting from prolonged overloaded use, has caused gear and reducer wear. - 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. 	<ul style="list-style-type: none"> - 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 from the gearbox and wash the inside of the gearbox. - After replacing the gear or reducer, add an appropriate amount of grease. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Regularly changing the grease at the specified interval with a specified type can help prevent problems.

Symptom	Description	Cause	Measure
Motor overheating	<ul style="list-style-type: none"> - 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. 	<p>[Ambient temperature]</p> <ul style="list-style-type: none"> - 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. <p>[Operating condition]</p> <ul style="list-style-type: none"> - It is likely that the condition is above the robot's operating performance. 	<ul style="list-style-type: none"> - The teach pendant can be used to monitor the average current. Check the average current when the robot control program is running. The allowable average current is specified for the robot according to its ambient temperature. Contact your local FANUC representative for further information. - Relaxing the robot control program and conditions can reduce the average current, thus preventing overheating. - 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. Using a fan to direct air at the motor is also effective. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation.
	<ul style="list-style-type: none"> - After a control parameter (load setting etc.) was changed, the motor overheated. 	<p>[Parameter]</p> <ul style="list-style-type: none"> - If data input for a workpiece is invalid, the robot cannot be accelerated or decelerated normally, so the average current increases, leading to overheat. 	<ul style="list-style-type: none"> - As for load setting, Input an appropriate parameter referring to Section 4.3 of the operator's manual (B-83614EN).
	<ul style="list-style-type: none"> - Symptom other than stated above 	<p>[Mechanical section problems]</p> <ul style="list-style-type: none"> - It is likely that problems occurred in the mechanical drive system, thus placing an excessive load on the motor. <p>[Motor problems]</p> <ul style="list-style-type: none"> - It is likely that a failure of the motor brake resulted in the motor running 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. 	<ul style="list-style-type: none"> - 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.

Symptom	Description	Cause	Measure
Grease leakage	<ul style="list-style-type: none"> - Grease is leaking from the mechanical unit. 	<p>[Poor sealing]</p> <ul style="list-style-type: none"> - 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 or a taper plug might allow grease to leak along the threads. 	<ul style="list-style-type: none"> - 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. <ul style="list-style-type: none"> - Motor coupling section - Reducer (case and shaft) coupling section - Wrist connection part - J3 arm coupling section - Inside the wrist - Oil seals are used in the locations stated below. <ul style="list-style-type: none"> - Inside the reducer - Inside the wrist - Seal bolts and taper plugs are used in the locations stated below. <ul style="list-style-type: none"> - Grease inlet or outlet - Cover for fixation
Dropping axis	<ul style="list-style-type: none"> - An axis drops because the brake does not function. - An axis drops gradually when it should be at rest. 	<p>[Brake drive relay and motor]</p> <ul style="list-style-type: none"> - 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 grease has entered the motor, causing the brake to slip. 	<ul style="list-style-type: none"> - Check whether the brake drive relay contacts are stuck to each other. If they are found to be stuck, replace the relay. - If the brake shoe is worn out, if the brake main body is damaged, or if grease has entered the motor, replace the motor. - J1/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 8.1).

Symptom	Description	Cause	Measure
Displacement	<ul style="list-style-type: none"> - The robot operates at a point other than the taught position. - The repeatability is not within the tolerance. 	[Mechanical section problems] <ul style="list-style-type: none"> - 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. 	<ul style="list-style-type: none"> - 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 or the Pulsecoder.
	<ul style="list-style-type: none"> - Displacement occurs only in a specific peripheral unit. 	[Peripheral unit displacement] <ul style="list-style-type: none"> - It is likely that an external force was applied to the peripheral unit, thus shifting its position relative to the robot. 	<ul style="list-style-type: none"> - Correct the setting of the peripheral unit position. - Correct the taught program.
	<ul style="list-style-type: none"> - Displacement occurred after a parameter was changed. 	[Parameter] <ul style="list-style-type: none"> - It is likely that the mastering data was rewritten in such a way that the robot origin was shifted. 	<ul style="list-style-type: none"> - Re-enter the previous mastering data, which is known to be correct. - If correct mastering data is unavailable, perform mastering again.
BZAL alarm occurred.	<ul style="list-style-type: none"> - BZAL is displayed on the controller screen. 	<ul style="list-style-type: none"> - It is likely that the voltage of the memory backup battery is low. - It is likely that the Pulsecoder cable is defective. 	<ul style="list-style-type: none"> - Replace the battery. - Replace the cable.

Table 3.1 (b) Allowable drops

At power off	5mm
At emergency stop	5mm

NOTE

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

3.2 BACKLASH MEASUREMENT

Measurement method

- 1 Put the robot in a specified posture. (See Fig. 3.2 (b) to (c).)
- 2 Apply positive and negative loads to each axis as shown in Fig.3.2 (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.

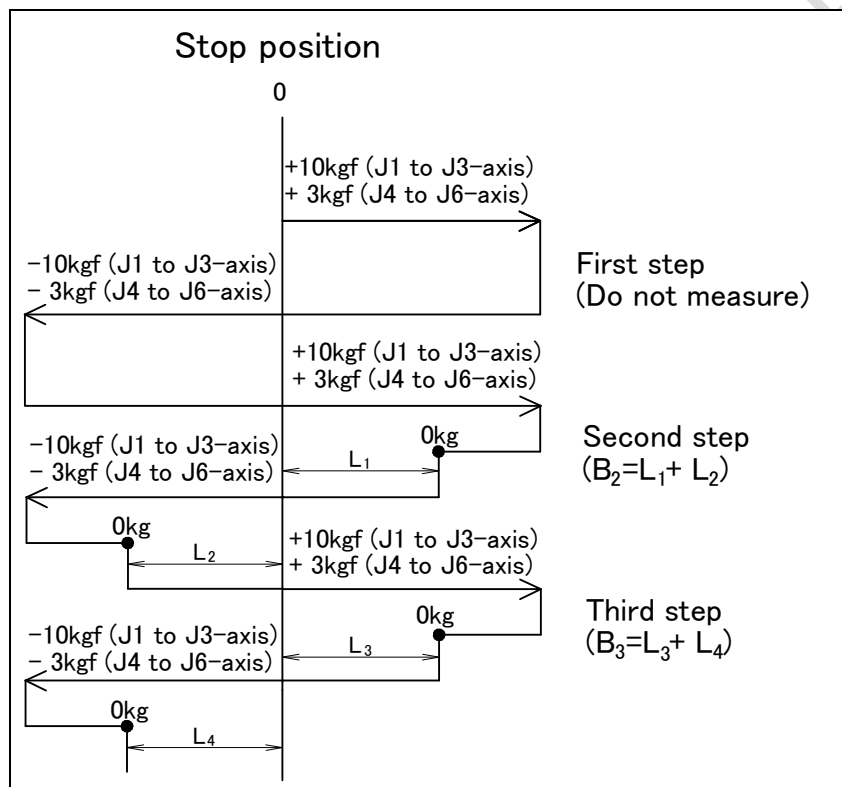


Fig.3.2 (a) Backlash measurement method

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

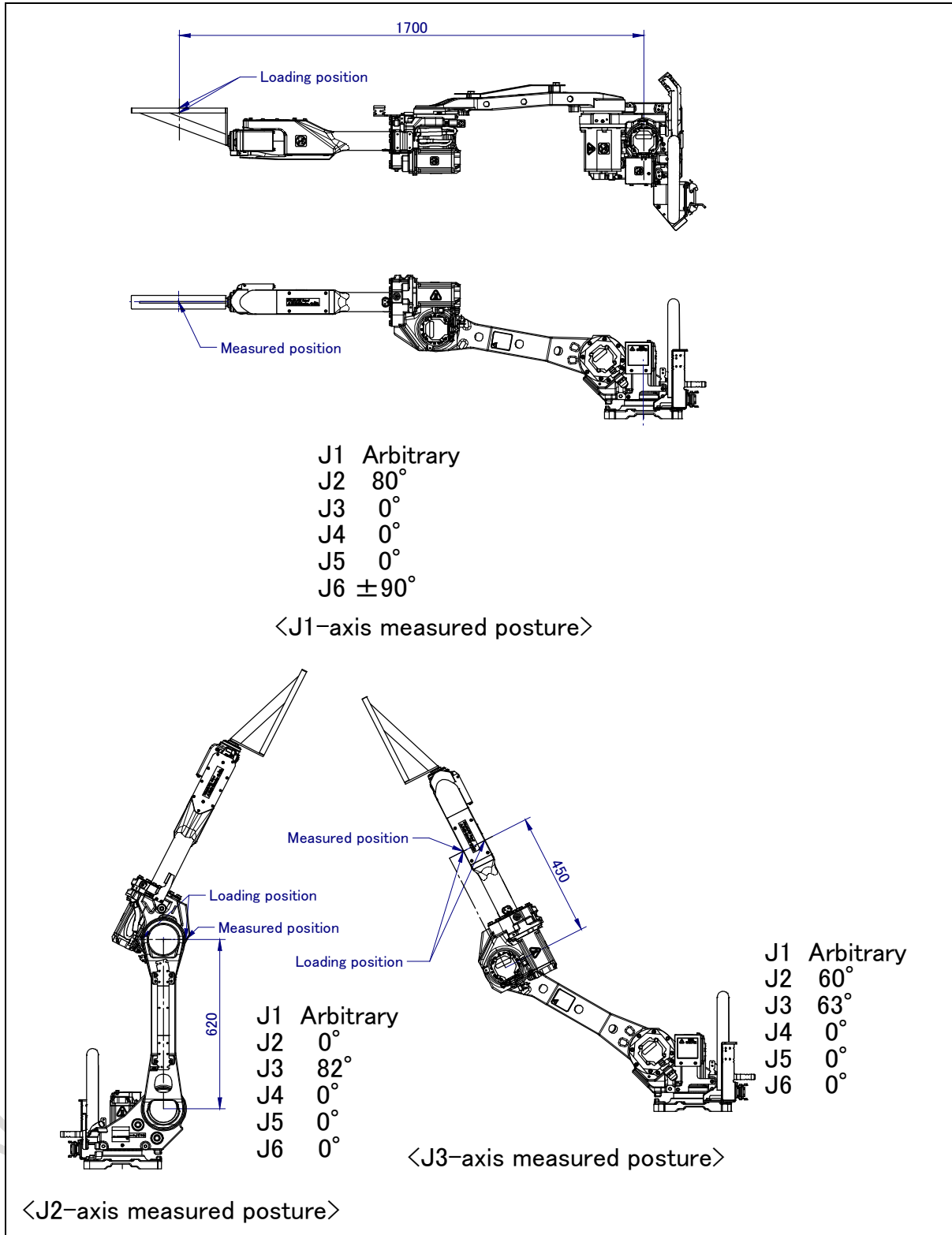


Fig.3.2 (b) Backlash measured posture (1/2)

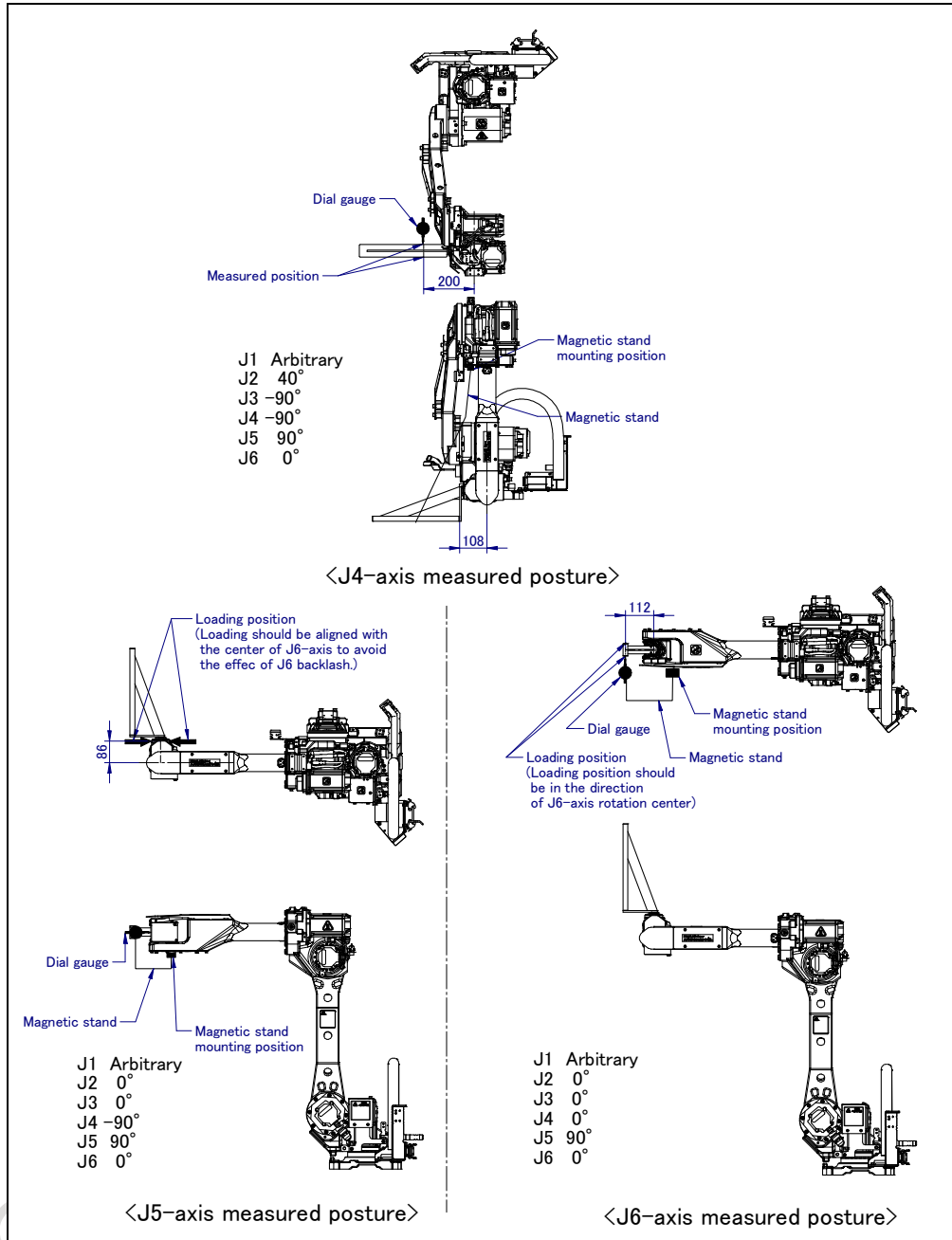


Fig.3.2 (c) Backlash measured posture (2/2)

Table.3.2 (a) Permissible backlash value

	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
Angle conversion (arc-min)	2.5	2.5	2.5	3.0	4.5	3.0
Displacement conversion (mm)	1.24	0.45	0.33	0.17	0.11	0.10
Distance between the rotation center and dial gauge (mm)	1700	620	450	200	86	112

NOTE

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

4 REPLACING PARTS

Once motors, reducers, the gearbox and the wrist unit are replaced, mastering becomes necessary, perform mastering according to Chapter 6 after any of these components are replaced.

NOTE

Be very careful when dismounting and mounting the heavy components that are listed below.

Component	Mass (approximate)
J3 arm to wrist unit (Refer to Fig.4.9 (a))	15 kg
J3 casing to wrist unit (Refer to Fig.4.7 (a).)	25 kg
J2arm to wrist unit (Refer to Fig.4.5 (a).)	50 kg
J2 base to wrist unit (Refer to Fig.4.3 (a).)	80 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. After you screw the bolts into the threaded holes, remove any excess LOCTITE.
- 2 Description of [LT243] means LOCTITE 243.
- 3 Description of [LT263] means LOCTITE 263.
- 4 Description of [LT518] means LOCTITE 518.
- 5 Description of [LT638] means LOCTITE 638.

4.1 DRIVE MECHANISM

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

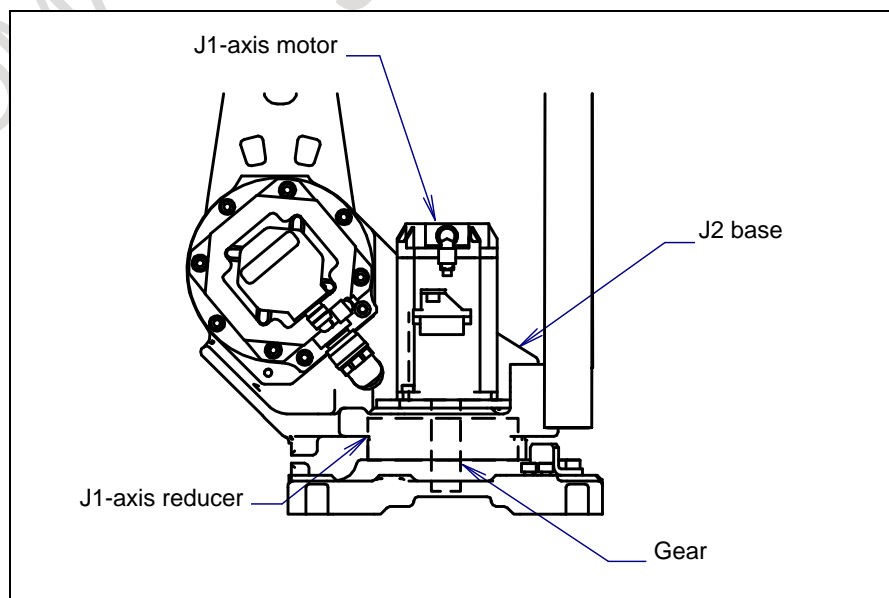


Fig.4.1 (a) Drive mechanism of J1-axis

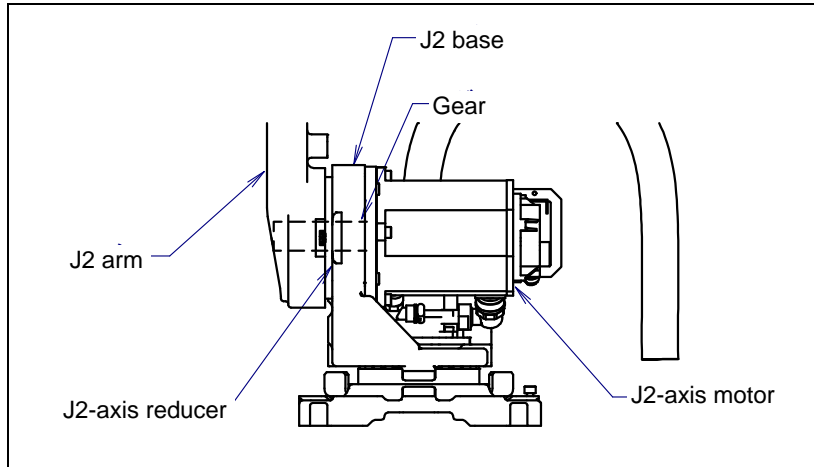


Fig.4.1 (b) Drive mechanism of J2-axis

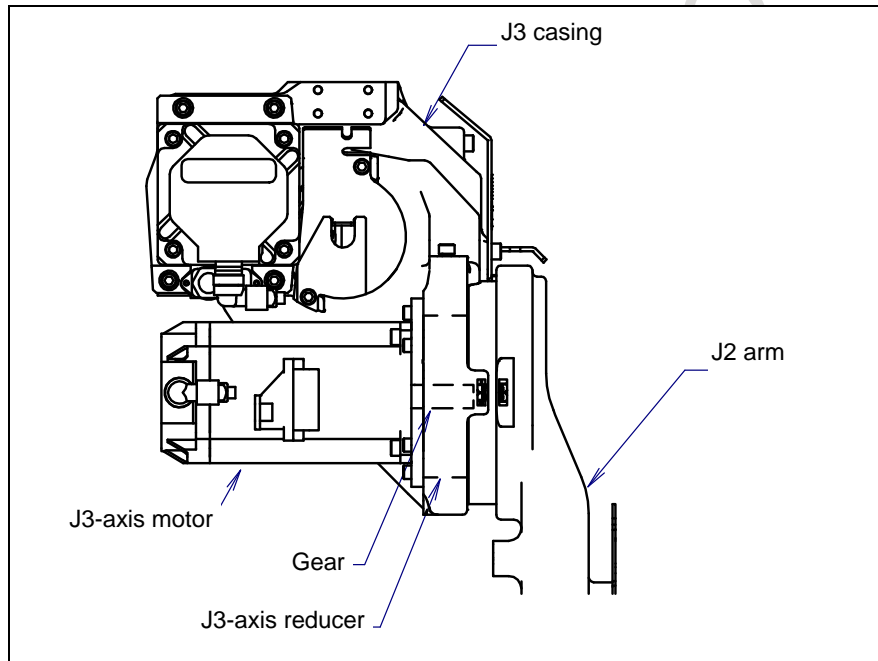


Fig.4.1 (c) Drive mechanism of J3-axis

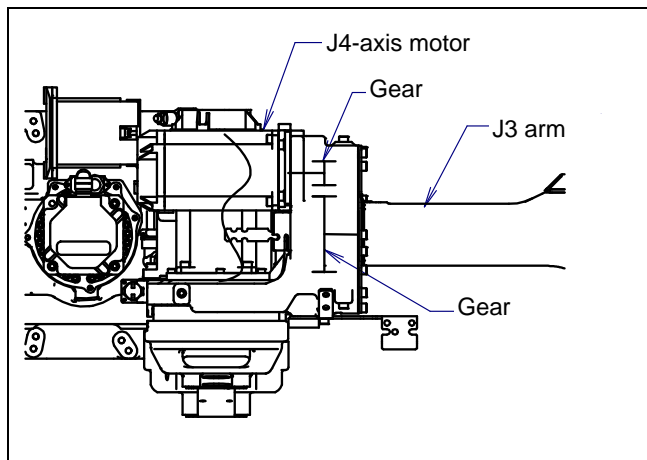


Fig.4.1 (d) Drive mechanism of J4-axis

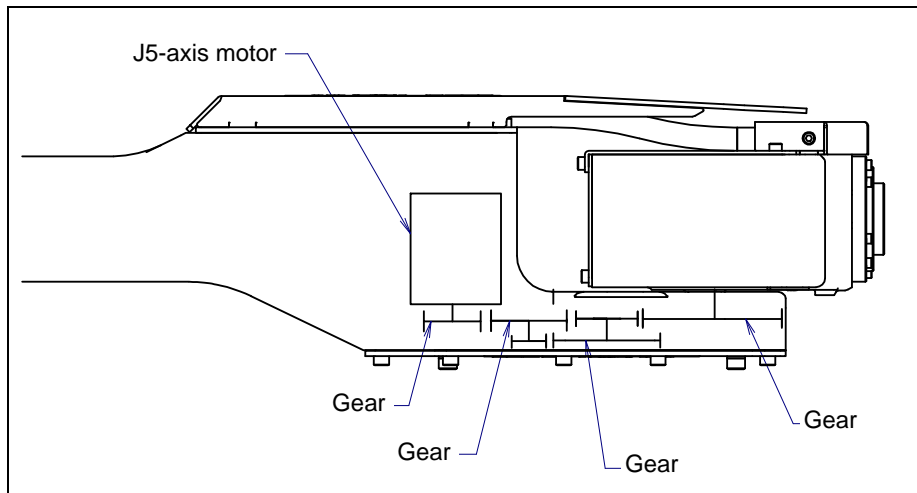


Fig.4.1 (e) Drive mechanism of J5-axis

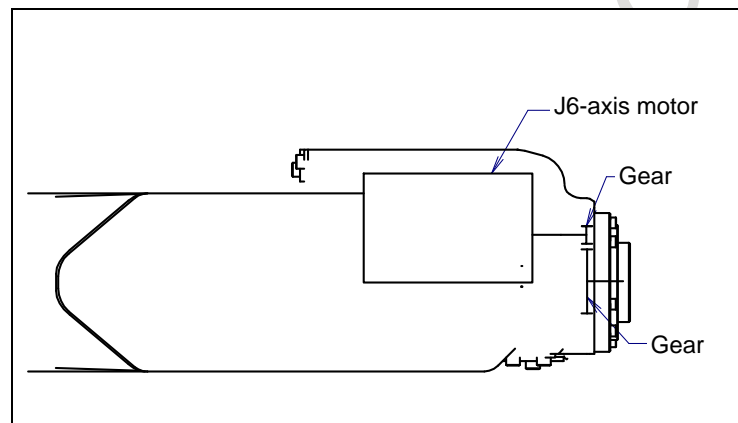


Fig.4.1 (f) Drive mechanism of J6-axis

4.2 REPLACING THE J1-AXIS MOTOR (M1)

- 1 Set a dial gauge at J1-axis, and prepare for single axis mastering after replacement. Refer to Section 6.4.
- 2 Turn off the controller power.
- 3 Remove the J1-axis motor connectors.
- 4 Remove bolts (5) then remove the adapter (7) which the motor (2) is attached.
- 5 Remove bolts (1), then dismount the motor (2) from the motor adapter (7).
- 6 Remove the bolt (13) and the seal washer (12), then remove the cover (11), the gasket (10), the wave generator (9) from the motor shaft. When removing the wave generator (9), use the fixture as shown in Fig.4.2 (b).
- 7 Remove the draw nut (4) which is fasten on the motor shaft.
- 8 Apply LOCTITE 243 on the new motor (2) shaft thread part, then tighten the draw nut with a torque of [3.1Nm].
- 9 Apply LOCTITE 243 on the M4 thread part of the draw nut (4), attach the seal washer (12), the cover (11), the gasket (10) and the wave generator (9) over the draw nut (4), tighten the bolt (13) with a torque of [3.4Nm]. At this time, replace the O-ring (6), (8) and the gasket (10) by new one.
- 10 Mount the motor adapter (7) which the motor (2) is attached on the robot main body.
- 11 Connect cable connectors to the J1-axis motor.
- 12 Supply the gear part bath 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-83614EN).

NOTE

- 1 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.
- 2 If excessive grease is applied to the motor shaft root, or to the flange surface, the oil seal between the motor and the oil seal may be damaged. If damaged this seal must be replaced.
In case oil seal replacement is required (due to the problem of excessive grease mentioned before; or due to any other failure during maintenance), please consult with your local FANUC representative.

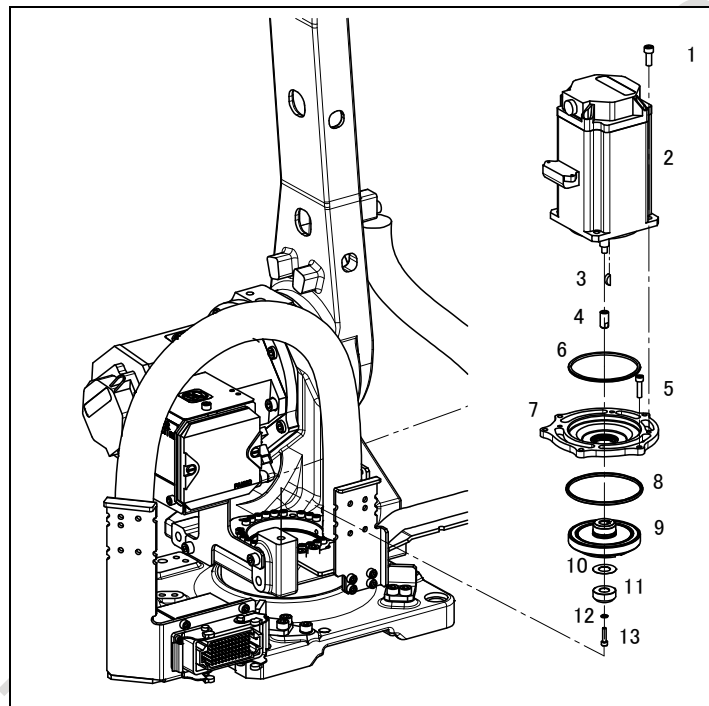


Fig.4.2 (a) Replacing the J1-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X16	3		
2	MOTOR	A06B-0202-B608#S000	1		
3	KEY	(It is attached to the J1-axis motor)	1		
4	DRAW NUT	A290-7221-X421	1	LT243	3.1
5	BOLT	A6-BA-5X35	26	LT263	10.8
6	O RING	JB-OR1A-G75	1		
7	ADAPTER	A290-7223-X241	1		
8	O RING	JB-OR1A-G80	1		
9	WAVE GENERATOR	(It is attached to the reducer)	1		
10	GASKET	A290-7223-X325	1		
11	COVER	A290-7223-X242	1		
12	SEAL WASHER	A30L-0001-0048#4M	1		
13	BOLT	A6-BA-4X16	1	LT243	3.4

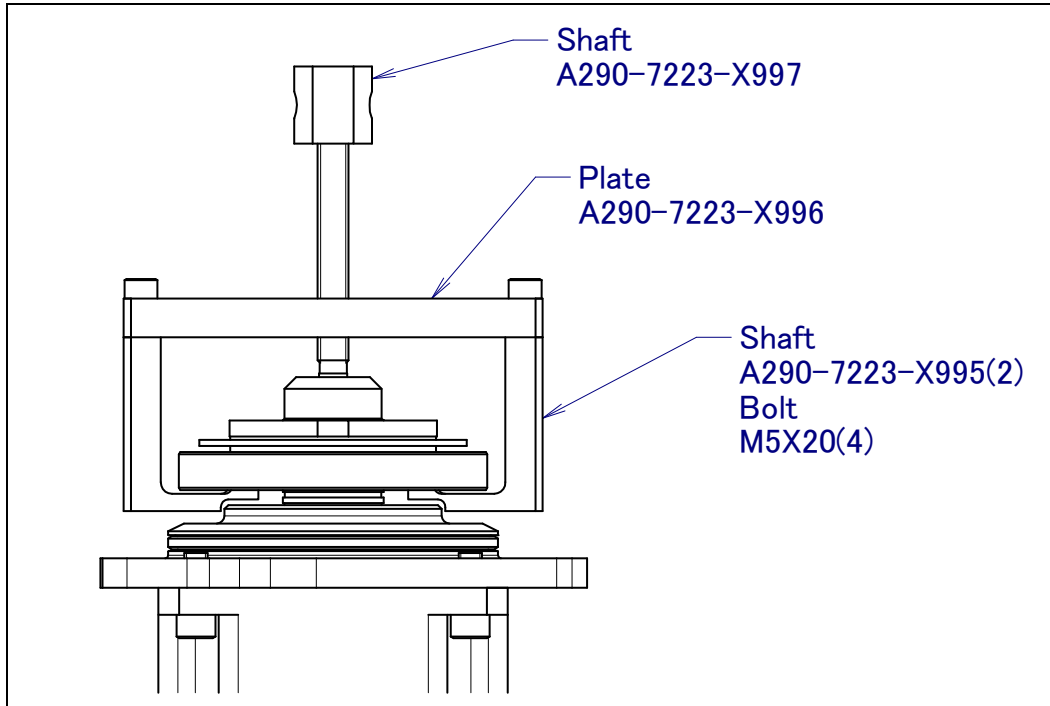


Fig.4.2 (b) Disassembling wave generator fixture (common to J1 to J3-axes)

4.3 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 6.4.
- 2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-83614EN). (All the axes are set to 0° before shipment.)
- 3 Remove the wire feeder and the torch.
- 4 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 the controller power. (See Fig. 4.3 (a)) (If there is the fixture shown in Fig. 4.3 (a), workability improves.)
- 5 While referencing Section 5.1, pull out the cables below the J2 base.
- 6 While referencing Section 4.2, dismantle the J1-axis motor unit from the J2 base.
- 7 As shown in Fig. 4.3 (b), remove the bolts (1) that fasten the J2 base to the J1-axis reducer.
- 8 While referencing Section 4.3 (a), hoist the J2 base and portions above it slowly.
- 9 Remove bolts (2) which fasten the J1-axis reducer to the J1 base via the guide pins (A290-7223-X994 2pcs) (Refer to Fig.4.3 (c).) Then dismantle the reducer (4).
- 10 Remove grease inside the robot completely.
- 11 Replace the O ring (5) by new one and attach it to the J1 base correctly.
- 12 Fix the reducer (4) to the J1 base with bolts (2) (LOCTITE 263 is applied, and tightening torque of [10.8Nm]). Match the "I" marking of the J1 base and the scribe mark on the reducer referring to Fig.4.3 (d).
- 13 Fix the J2 base to the reducer with bolts (1) (LOCTITE 263 is applied, and tightening torque of [10.8Nm]) via the guide pins (A290-7223-X994 2 pcs).
- 14 Apply Harmonic grease 4B No.2 on the gear of the J3-axis reducer. Then apply 35g in the center. At this chance, make grease is applied equally to the center part.
- 15 According to Section 4.2, mount the J1-axis motor unit on the J2 base.
- 16 According to Section 5.1, mount the cables.
- 17 Perform quick mastering and perform single axis mastering of J1-axis. Refer to the QUICK MASTERING and SINGLE AXIS MASTERING of the mechanical unit operator's Manual (B-83614EN).

NOTE

If excessive grease is applied to the motor shaft root, or to the flange surface, the oil seal between the motor and the oil seal may be damaged. If damaged this seal must be replaced.

In case oil seal replacement is required (due to the problem of excessive grease mentioned before; damage of the oil seal is confirmed during maintenance or due to any other failure during maintenance), please consult with your local FANUC representative.

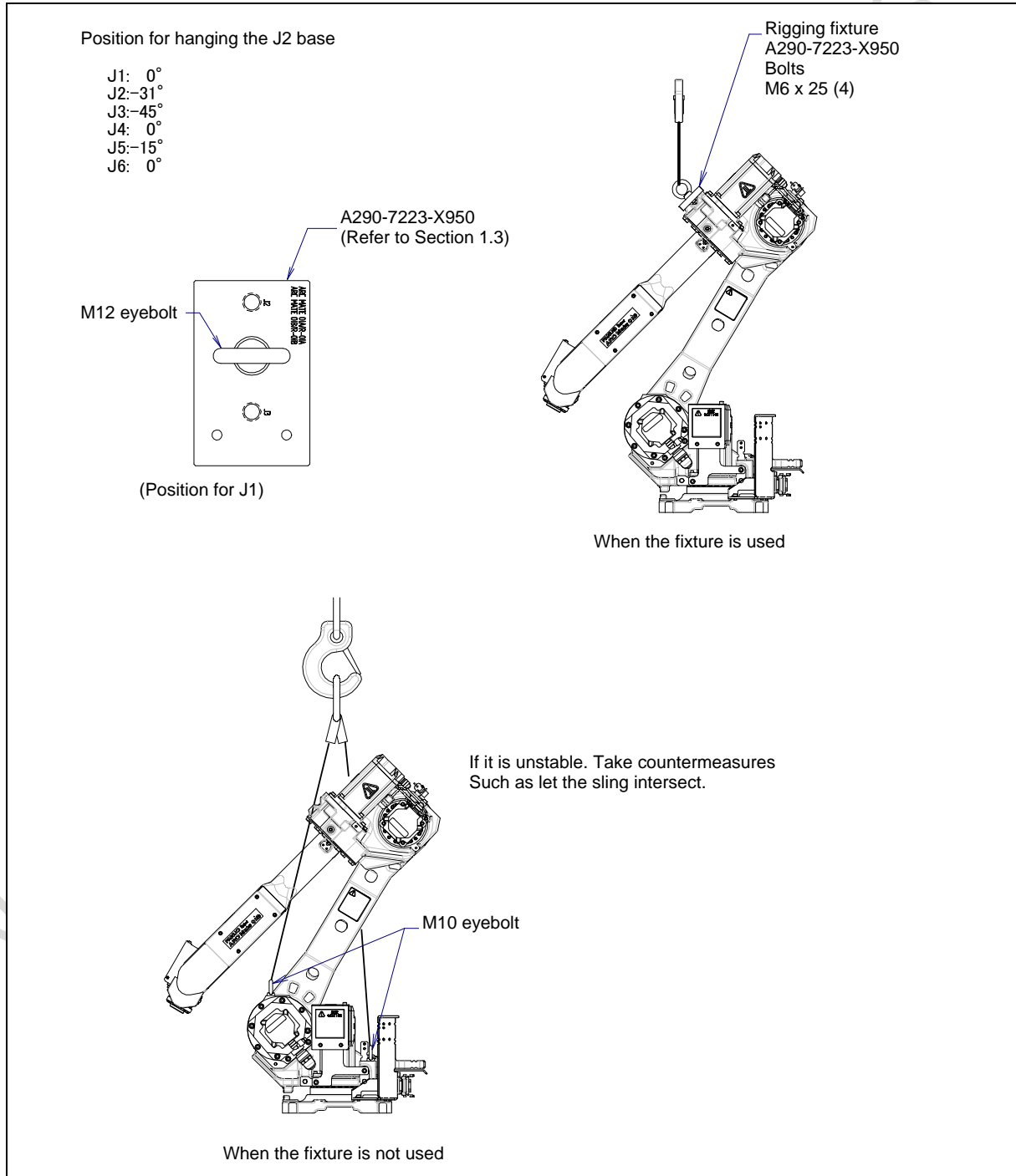


Fig.4.3 (a) Hanging method of the J2 base unit

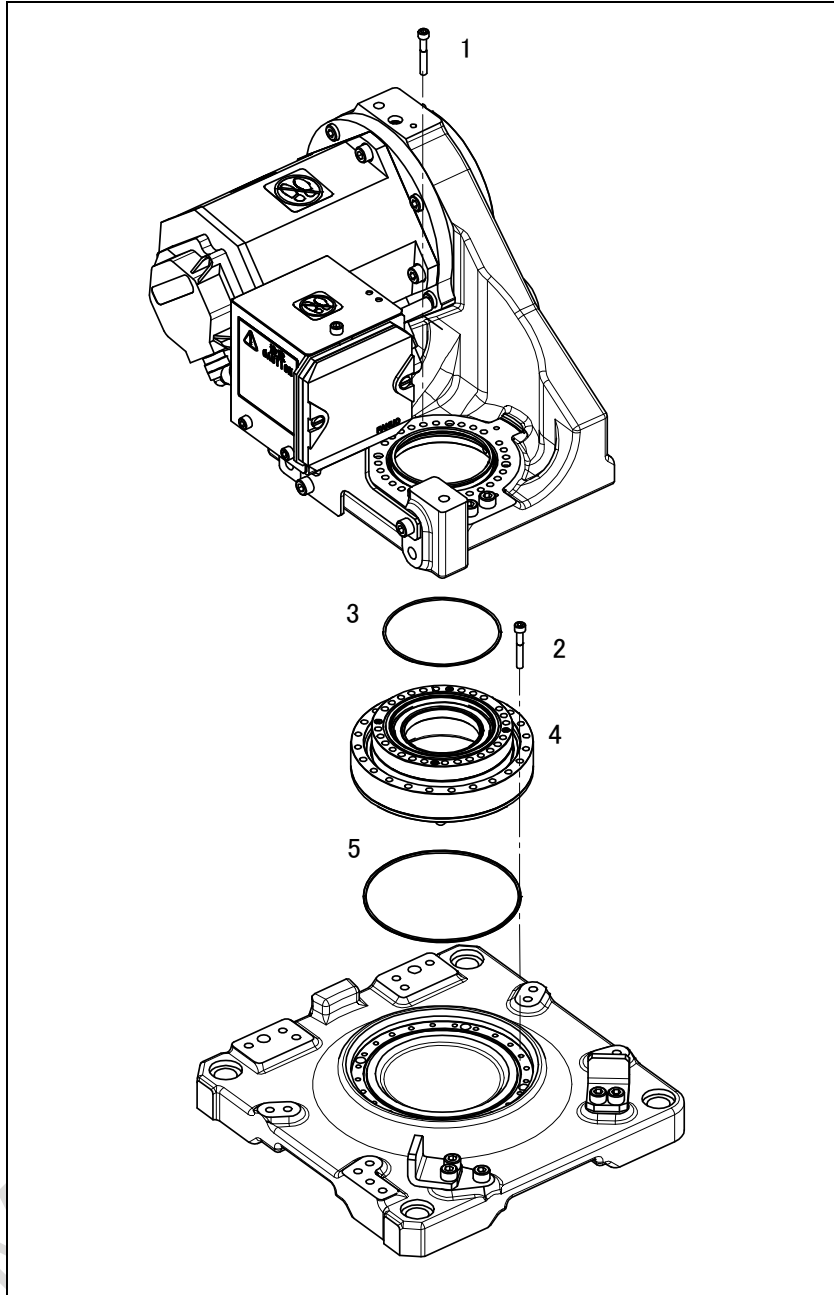


Fig.4.3 (b) Replacing the J1-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-5X35	26	LT263	10.8
2	BOLT	A6-BA-5X35	24	LT263	10.8
3	O RING	(It is attached to the reducer)	1		
4	REDUCER	A97L-0218-0993	1		
5	O RING	(It is attached to the reducer)	1		

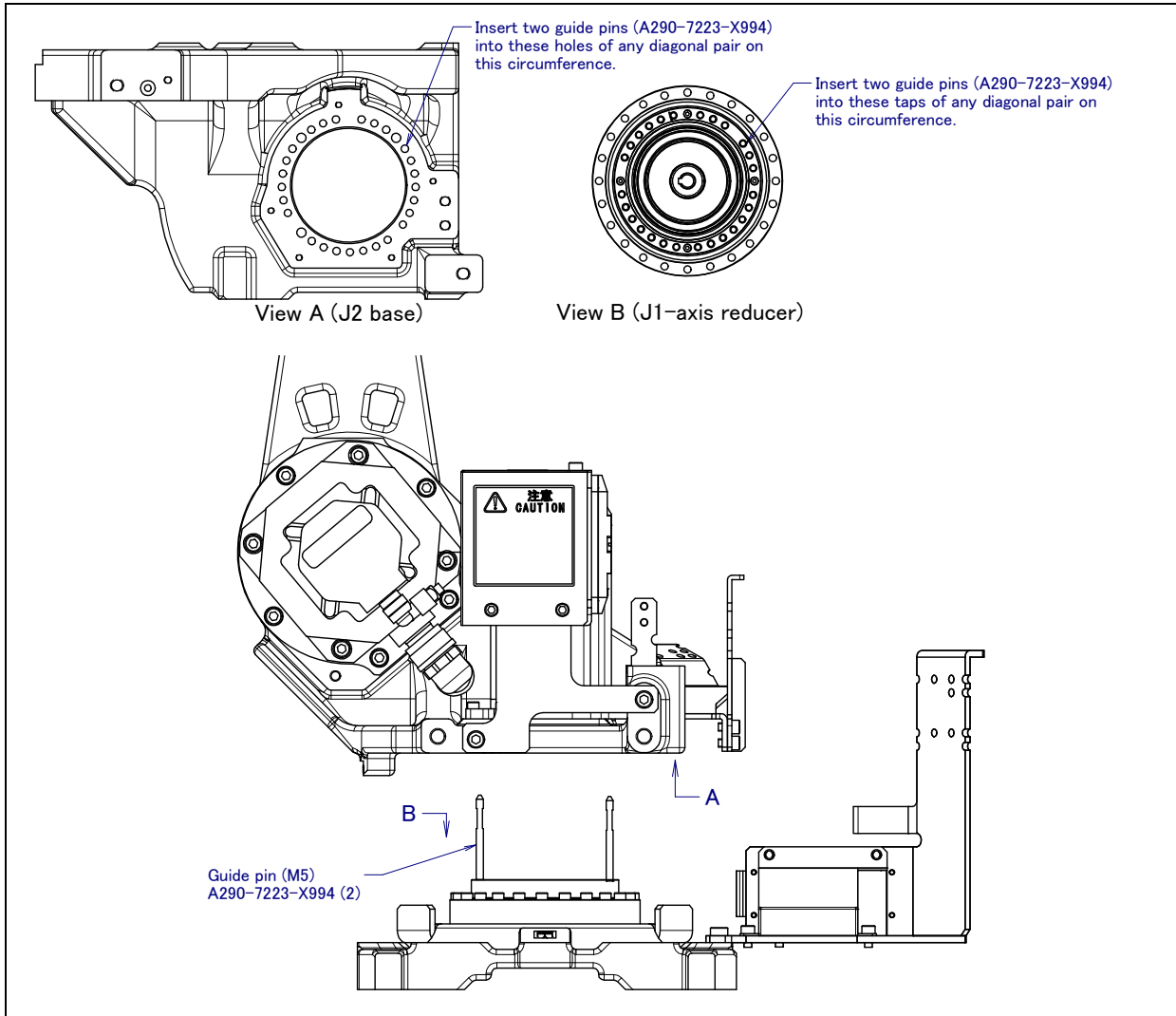


Fig.4.3 (c) Guide pins inserting position

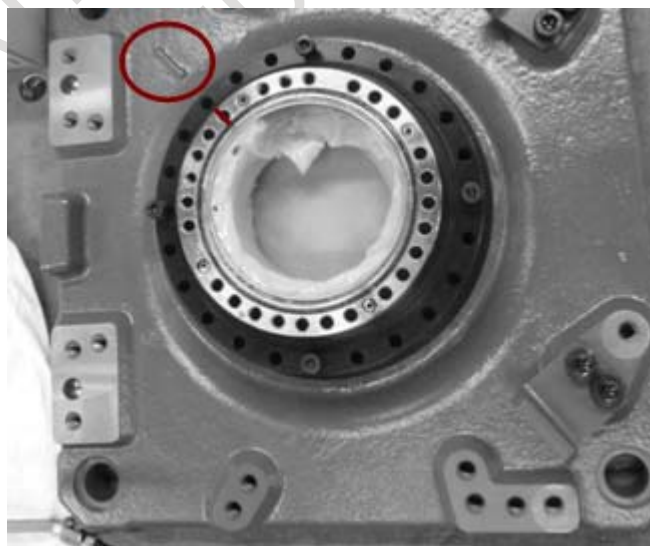


Fig.4.3 (d) Phase of the reducer

4.4 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 6.4.
- 2 Push the J2-axis section against the mechanical stopper, or fix it in such a way that it will not swivel when the motor is dismantled, for example, by placing it in the direction of gravity.

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 Remove the J2-axis motor connectors.
- 5 Remove bolts (6) then remove the adapter (7) which the motor (2) is attached.
- 6 Remove bolts (1), then dismount the motor (2) from the motor adapter (7).
- 7 Remove the bolt (12) and the seal washer (11), then remove the wave generator (10) from the motor shaft. When removing the wave generator (10), use the fixture as shown in Fig.4.2 (b).
- 8 Remove the draw nut (4) which is fasten on the motor shaft.
- 9 Apply LOCTITE 243 on the new motor (2) shaft thread part, then tighten the draw nut with a torque of [20.0Nm].
- 10 Apply LOCTITE 243 on the M4 thread part of the draw nut (4), attach the seal washer (11), the gasket (5) and the wave generator (10) over the draw nut (4), tighten the bolt (12) with a torque of [6.8Nm]. At this time, replace the gasket (5),(8) by new one.
- 11 Mount the motor adapter (7) which the motor (2) is attached on the robot main body.
- 12 Connect cable connectors to the J2-axis motor.
- 13 If grease overflowed, supply the J2-axis grease bath with the specified grease.
- 14 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-83614EN).

NOTE

If excessive grease is applied to the motor shaft root, or to the flange surface, the oil seal between the motor and the oil seal may be damaged. If damaged this seal must be replaced.

In case oil seal replacement is required (due to the problem of excessive grease mentioned before; or due to any other failure during maintenance), please consult with your local FANUC representative.

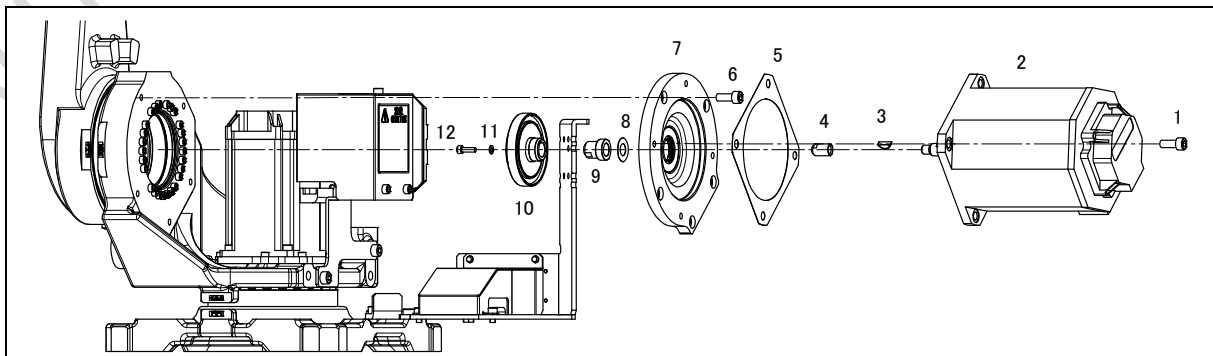


Fig.4.4 (a) Replacing the J2-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-8X20	4		
2	MOTOR	A06B-0223-B608#S000	1		
3	KEY	(It is attached to the motor)	1		
4	DRAW NUT	A290-7221-X321	1	LT243	20.0
5	GASKET	A290-7223-X326	1		
6	BOLT	A6-BA-8X20	5		
7	ADAPTER	A290-7223-X322	1		
8	GASKET	A290-7223-X325	1		
9	COVER	A290-7223-X323	1		
10	WAVE GENERATOR	(It is attached to the reducer)	1		
11	SEAL WASHER	A30L-0001-0048#5M	1		
12	BOLT	A6-BA-5X16	1	LT243	6.8

4.5 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 6.4.
- 2 Remove the wire feeder and the torch.
- 3 Put the robot in such a posture that the J2 arm and the components on it can be suspended with a crane.
- 4 Turn off controller power.
- 5 Suspend the J2 arm and the components on it as shown Fig. 4.5 (a) with a crane so that they will not drop when the J2 arm is dismantled. (If there is the fixture shown in Fig. 4.5 (a), workability improves.)
- 6 Dismount the J2-axis motor unit as described in Section 4.4.
- 7 Remove the bolts (1) that fasten the reducer (4) to J2 base. Be careful not to allow an excessive load to be put on the cables (because the cables are left attached when the reducer is dismantled). Then remove the bolts (2) which fasten the reducer (4) on the J2 arm via the guide pins (A290-7223-X994 2 pcs).
- 8 Remove the grease inside the robot and the grease which is attached to the oil seal between the motor and the reducer completely.
- 9 Replace the O ring (3) by a new one and attach it to a new reducer (4), insert the reducer (4) into the J2 arm, and fasten them with bolts (2) (by applying LOCTITE 263 and tightening with a torque of [10.3 Nm]) via the guide pins (A290-7223-X994 2 pcs). Match the "I" marking of the J2 arm and the scribe mark on the reducer referring to Fig.4.5 (d).
- 10 Mount the reducer (4) to the J2 base with bolts (1) (by applying LOCTITE 263 and tightening with a torque of [10.8 Nm]) via the guide pin (A290-7223-X994 2pcs) (Fig.1.3 (b)) and fix the reducer (4). (Grease is applied in the reducer in advance. So it is not necessary to apply grease.)
- 11 Mount the J2-axis motor unit as described in Section 4.4.
- 12 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-83614EN).

NOTE

If excessive grease is applied to the motor shaft root, or to the flange surface, the oil seal between the motor and the oil seal may be damaged. If damaged this seal must be replaced.

In case oil seal replacement is required (due to the problem of excessive grease mentioned before; damage of the oil seal is confirmed during maintenance or due to any other failure during maintenance), please consult with your local FANUC representative.

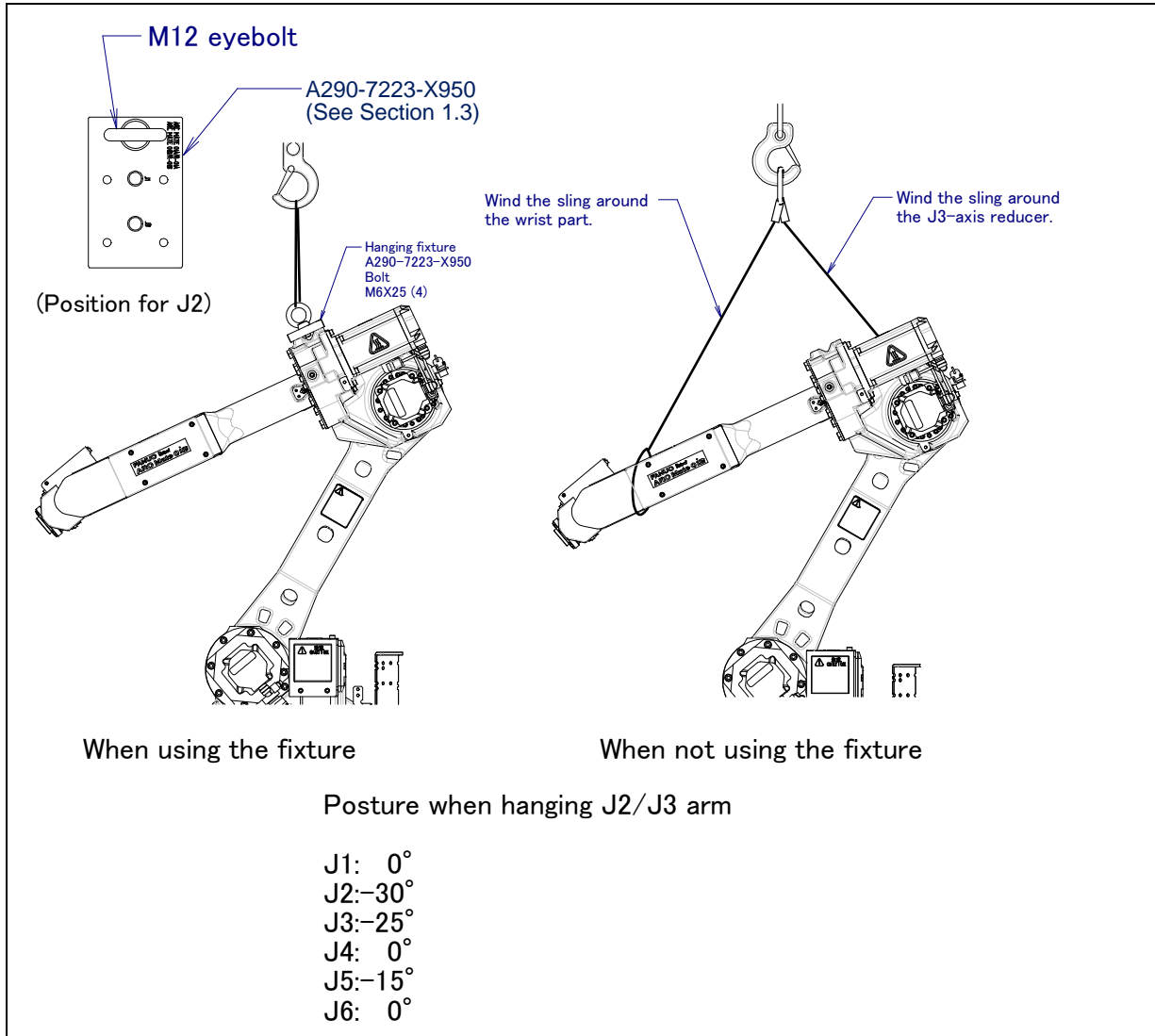


Fig.4.5 (a) Hanging method of the J2 and J3 arms

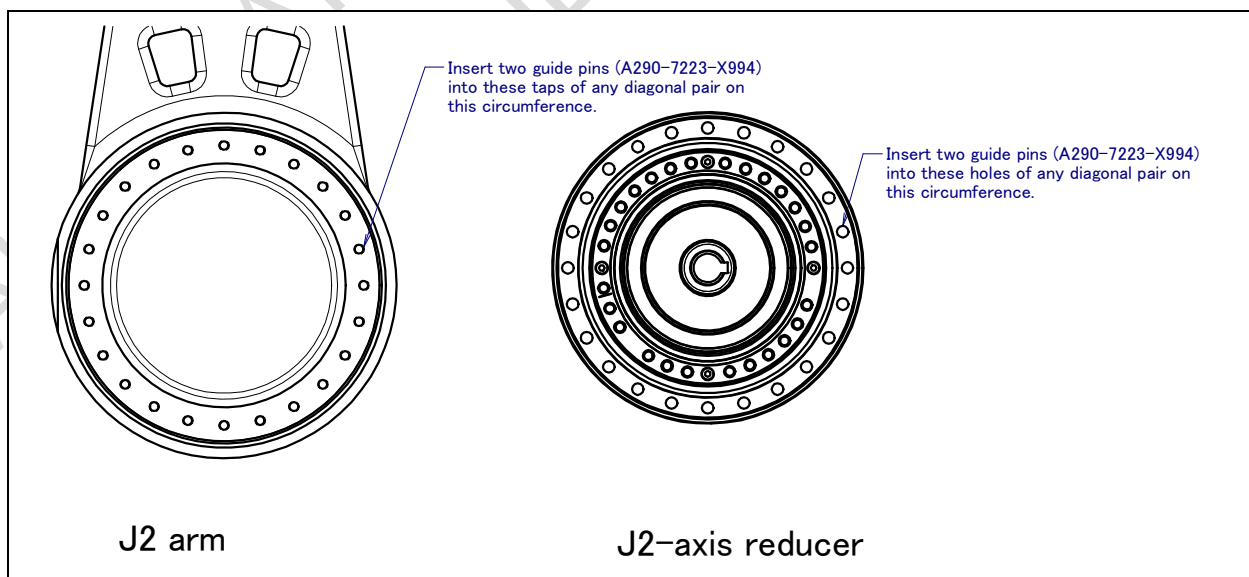


Fig.4.5 (b) Guide pin inserting position

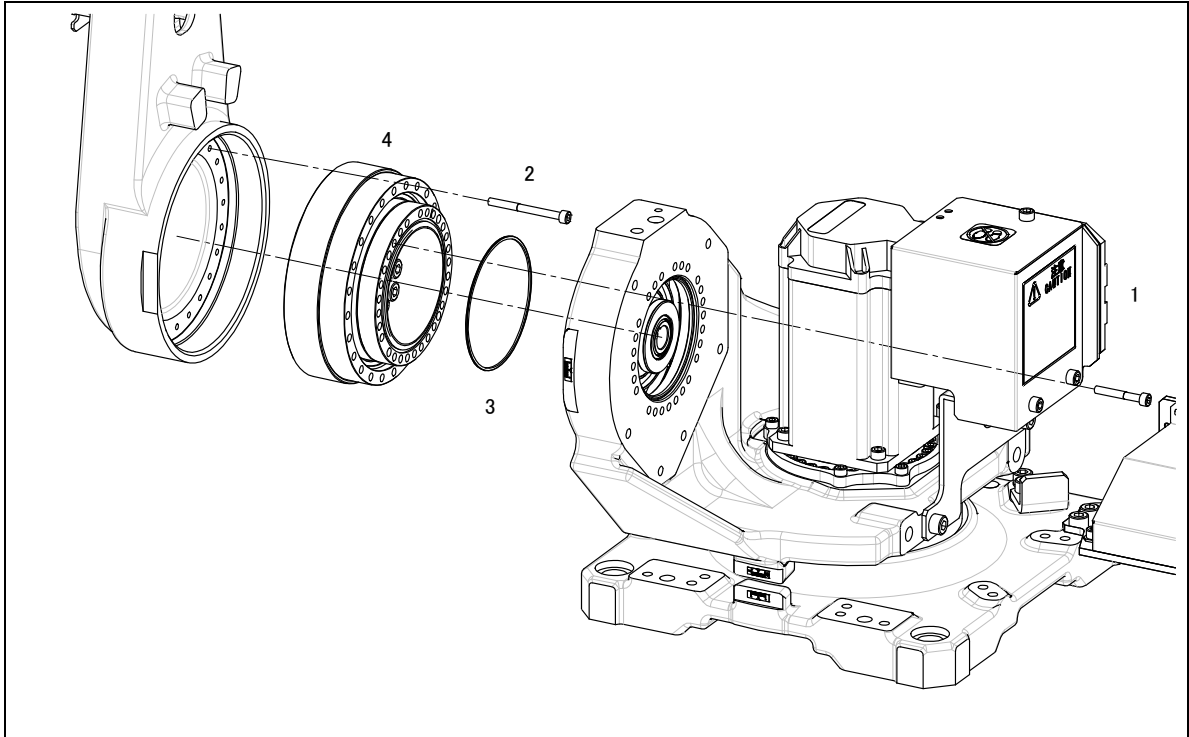


Fig.4.5 (c) Replacing the J2-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-5X35	26	LT263	10.8
2	BOLT	A6-BA-5X55	24	LT263	10.8
3	O RING	(It is attached to the reducer)	1		
4	REDUCER	A97L-0218-0994	1		



Fig.4.5 (d) Phase of the reducer

4.6 REPLACING THE J3-AXIS MOTOR (M3)

- 1 Set a dial gauge at the J3-axis, and prepare for single axis mastering after replacement. Refer to Section 6.4.
- 2 Fix the J3 arm such as hanging with a crane.
- 3 Turn off controller power.
- 4 Remove the connectors of the J3-axis motor.
- 5 Remove bolts (6) then remove the adapter (7) which the motor (2) is attached.
- 6 Remove the bolt (13) and the seal washer (12), then remove the cover (11), the gasket (10), the wave generator (9) from the motor shaft. When removing the wave generator (9), use the fixture as shown in Fig.4.2 (b).
- 7 Remove bolts (1), then dismount the motor (2) from the motor adapter (7).
- 8 Remove the draw nut (4) which is fasten on the motor shaft.
- 9 Apply LOCTITE 243 on the new motor (2) shaft thread part, then tighten the draw nut with a torque of [3.1Nm].
- 10 Apply LOCTITE 243 on the M4 thread part of the draw nut (4), attach the seal washer (12), the cover (11), the gasket (10) and the wave generator (9) over the draw nut (4), tighten the bolt (13) with a torque of [3.4Nm]. At this time, replace the O-ring (5), (8) and the gasket (10) by new one.
- 11 Mount the motor adapter (7) which the motor (2) is attached on the robot main body.
- 12 Connect cable connectors to the J3-axis motor.
- 13 If grease overflowed, supply the J3-axis reducer with Harmonic grease 4B No.2.
- 14 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-83614EN).

NOTE

If excessive grease is applied to the motor shaft root, or to the flange surface, the oil seal between the motor and the oil seal may be damaged. If damaged this seal must be replaced.

In case oil seal replacement is required (due to the problem of excessive grease mentioned before; or due to any other failure during maintenance), please consult with your local FANUC representative.

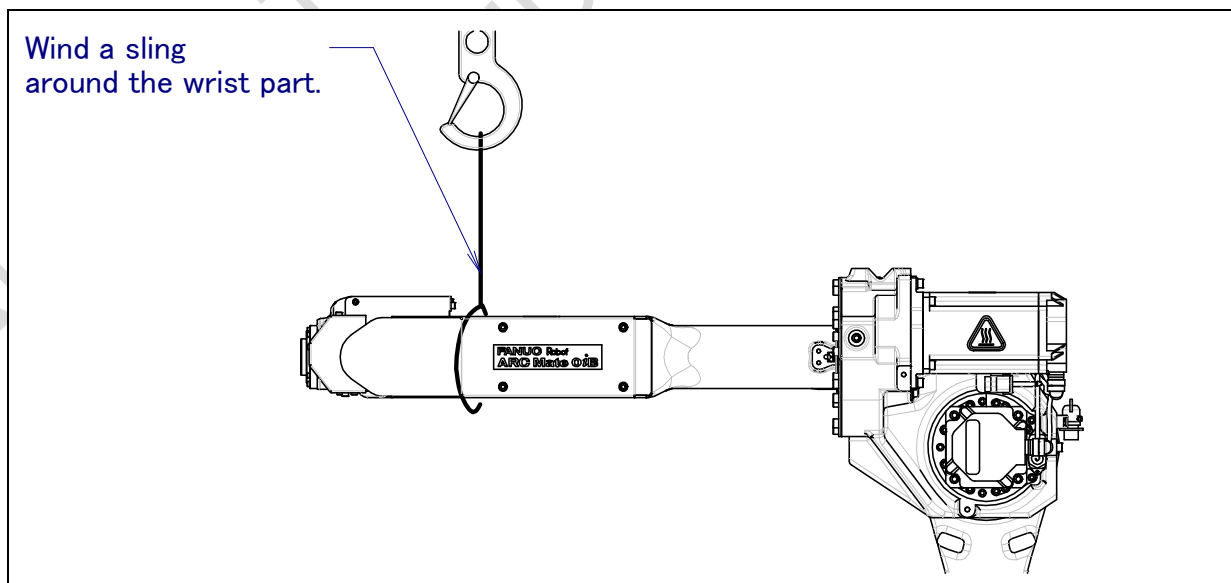


Fig.4.6 (a) Hanging method of the J3 arm

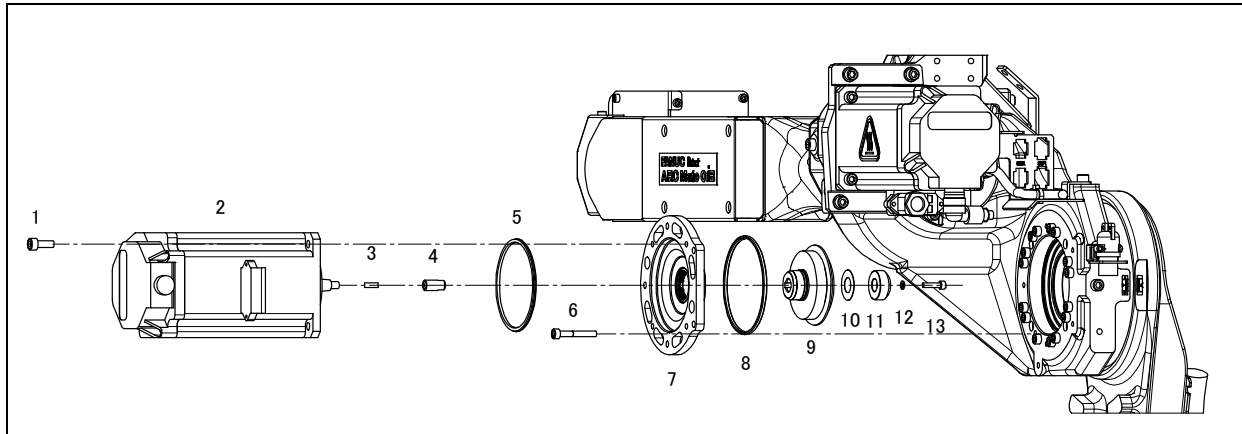


Fig.4.6 (b) Replacing the J3-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X16	4		10
2	MOTOR	A06B-0202-B608#S000	1		
3	KEY	(It is attached to the motor)	1		
4	DRAW NUT	A290-7221-X421	1	LT243	3.1
5	O RING	JB-OR1A-G75	1		
6	BOLT	A6-BA-5X20	5		10.8
7	ADAPTER	A290-7223-X327	1		
8	O RING	JB-OR1A-G80	1		
9	WAVE GENERATOR	(It is attached to the reducer)	1		
10	GASKET	A290-7223-X325	1		
11	COVER	A290-7223-X242	1		
12	SEAL WASHER	A30L-0001-0048#4M	1		
13	BOLT	A6-BA-4X16	1	LT243	3.4

4.7 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 6.4.
- 2 Remove the wire feeder and the torch.
- 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. 4.7 (a), workability improves.)
- 4 Turn off controller power.
- 5 While referencing Section 5.1, remove the cable from the J2 arm section. Suspend the J3-axis section and the components on it with a crane so that they will not drop when the reducer is dismantled from the J2 arm referring to Fig.4.7 (a). 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 dismantled).
- 6 While referencing Section 4.6, dismantle the J3-axis motor unit from the J3 arm unit.
- 7 Remove bolts (1) that fasten the J3-axis reducer (4) and the J3 casing, and dismantle the J3 arm unit from the reducer.
- 8 Remove bolts (3) that fasten the J3-axis reducer to J2 arm via the guide pins (A290-7223-X994 2 pcs) (Fig.1.3 (b)), Then remove the J3-axis reducer (4) from the J2 arm.
- 9 Remove the O ring (5) from the J2 arm and attach new O ring (5) to the J3-axis reducer installation part of the J2 arm.
- 10 Remove the grease inside the robot and the grease which is attached to the oil seal between the motor and the reducer completely.
- 11 Mount new reducer (4) on the J2 arm with bolts (3) (by applying LOCTITE 263 and tightening with a torque of [10.8Nm]). Match the "I" marking of the J2 arm and the scribe mark on the reducer referring to Fig.4.7 (d).

- 12 Attach the J3 casing on the reducer with bolts by applying LOCTITE 263 and tightening with a torque of [10.8Nm]
- 13 Apply Harmonic grease 4B No.2 on the gear of the J3-axis reducer. Then apply 35g in the center. At this chance, make grease is applied equally to the center part.
- 14 While referencing Section 4.6, mount the J3-axis motor unit on the J3 arm unit.
- 15 While referencing Section 5.1, dress the cable into the previous form.
- 16 According to Section 2.2 and 4.7, supply the J3-axis grease bath with the grease.
- 17 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-83614EN).

NOTE

If excessive grease is applied to the motor shaft root, or to the flange surface, the oil seal between the motor and the oil seal may be damaged. If damaged this seal must be replaced.

In case oil seal replacement is required (due to the problem of excessive grease mentioned before; damage of the oil seal is confirmed during maintenance or due to any other failure during maintenance), please consult with your local FANUC representative.

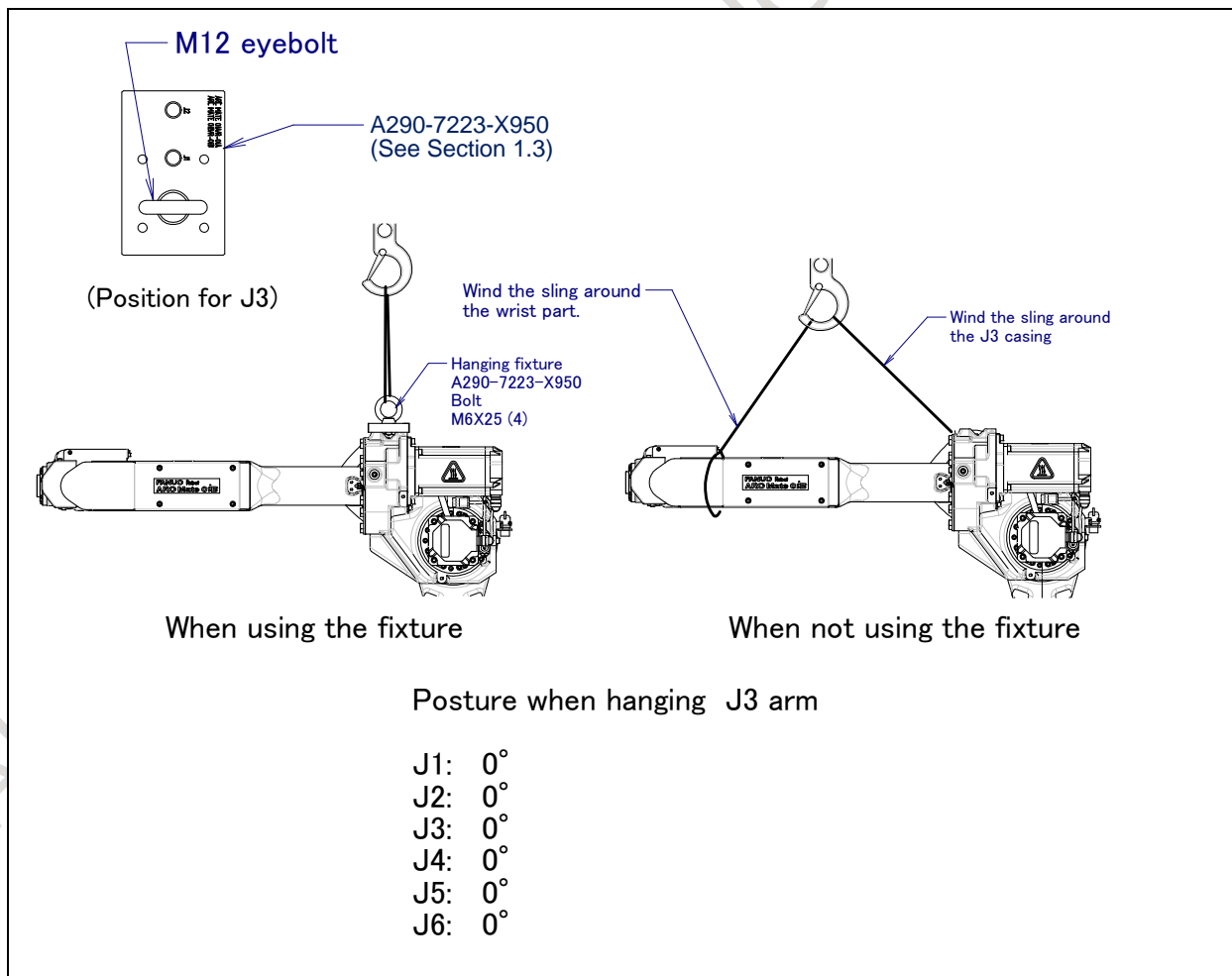


Fig.4.7 (a) Hanging method of the J3 arm

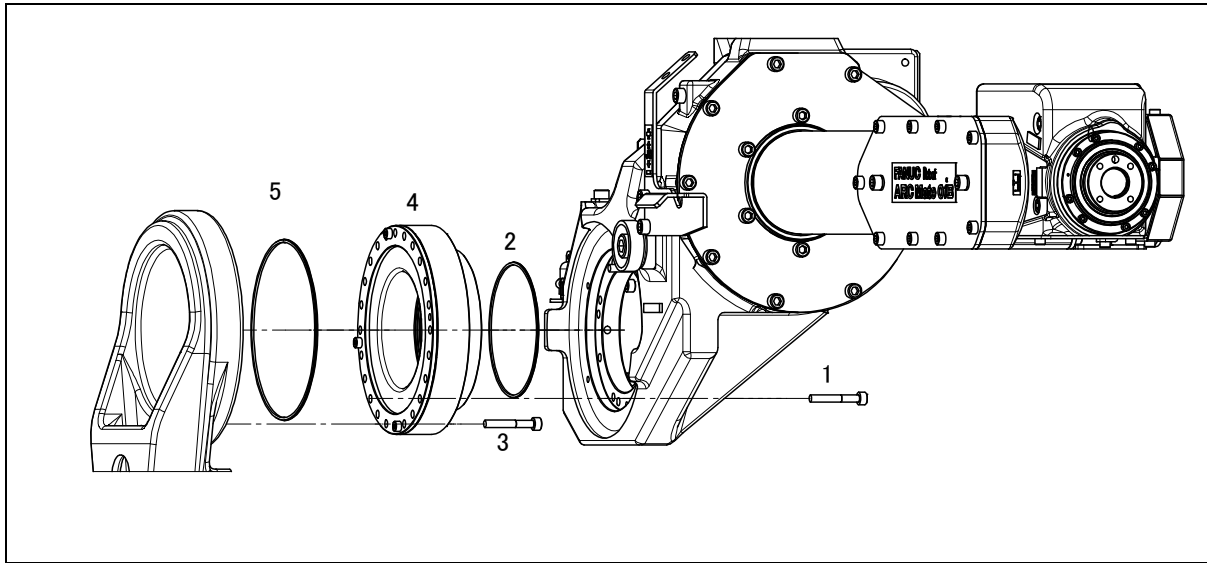


Fig.4.7 (b) Replacing the J3-axis reducer

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-5X35	14	LT263	10.8
2	O RING	(It is attached to the reducer)	1		
3	BOLT	A6-BA-5X35	10	LT263	10.8
4	REDUCER	A97L-0218-0993	1		
5	O RING	(It is attached to the reducer)	1		

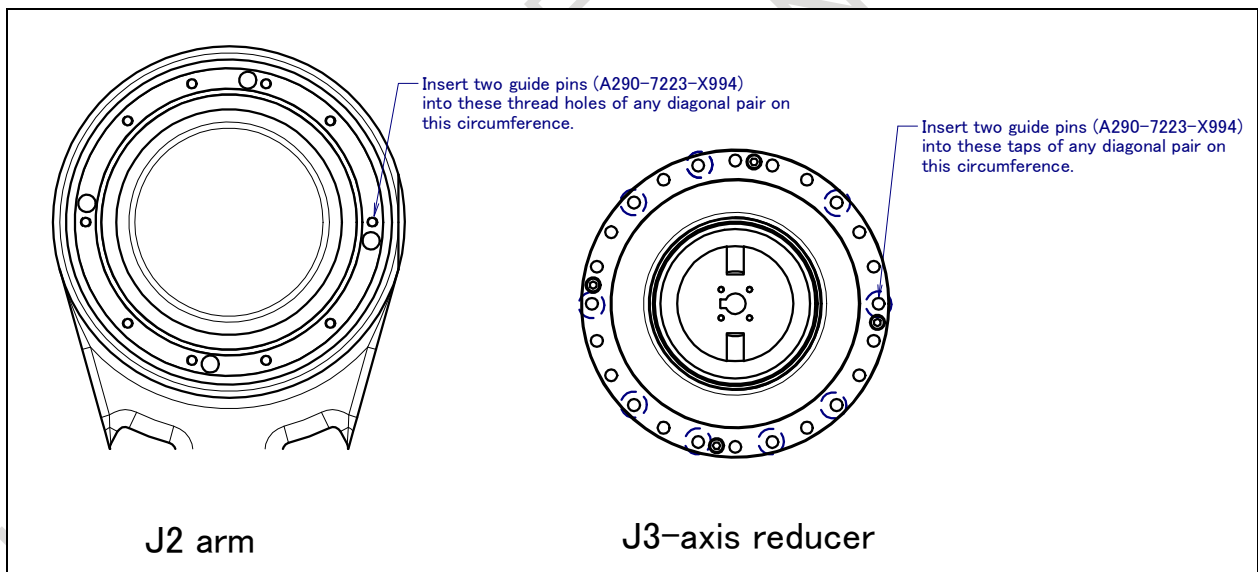


Fig.4.7 (c) Guide pin inserting position



Fig.4.7 (d) Phase of the reducer

4.8 REPLACING THE J4-AXIS MOTOR (M4)

- 1 Place the robot in a posture of $J3 = -90^\circ$.
- 2 Place the robot in a posture of $J4 = 0^\circ$. If it is impossible, record the current angle.
- 3 Set a dial gauge at the J4-axis, and prepare for single axis mastering after replacement. Refer to Section 6.4.
- 4 Turn off controller power.
- 5 Remove the connectors of the J4-axis motor.
- 6 Remove bolts (8) and washers (9) and remove the motor with the motor adapter (12) from the J3 casing.
- 7 Remove the motor mounting bolts (1) and remove the motor (2) from the motor adapter (12) using the removal tap (M6) of the motor adapter.
- 8 Remove the bolts (7) which fasten the gear (6), and remove the gear (6). Then remove the draw nut (5) which is fastened to the motor shaft.
- 9 Apply LOCTITE 243 to the thread part of a new motor (2) shaft, and tighten the draw nut (5) with a torque of 3.1Nm.
- 10 Apply LOCTITE 243 to the M4 thread part of the draw nut (5), mount the gear (6) over the draw nut (5), then tighten the bolt (7) with a torque of 3.4Nm.
- 11 Apply LOCTITE 638 to the outer ring of the bearing (10). If bearing (10) is broken when removing the gear (6), remove the C ring (11) and replace by new one.
- 12 Mount the motor (2) to the motor adapter (12) with motor mounting bolts (1). In this time, replace the gasket (3) by new one.
- 13 Temporarily attach motor adapter (12) to the J3 casing with bolts (8) and washers (9). In this time, replace the gasket (13) by new one.
- 14 Press Fig.4.8 (b)'s area to J4-axis rotation center with 3 to 5kgf.
- 15 Confirm there is no backlash in operation area which is used. If there is backlash, perform the procedure 14 in that posture.
- 16 Repeat procedure 14 and 15 until backlash is eliminated.
- 17 Tighten bolts (8) and washer (9) with a torque of 10.0Nm.
- 18 Connect cable connectors to the J4-axis motor.
- 19 According to Section 2.2, supply the J4-axis gearbox with the grease.
- 20 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-83614EN).

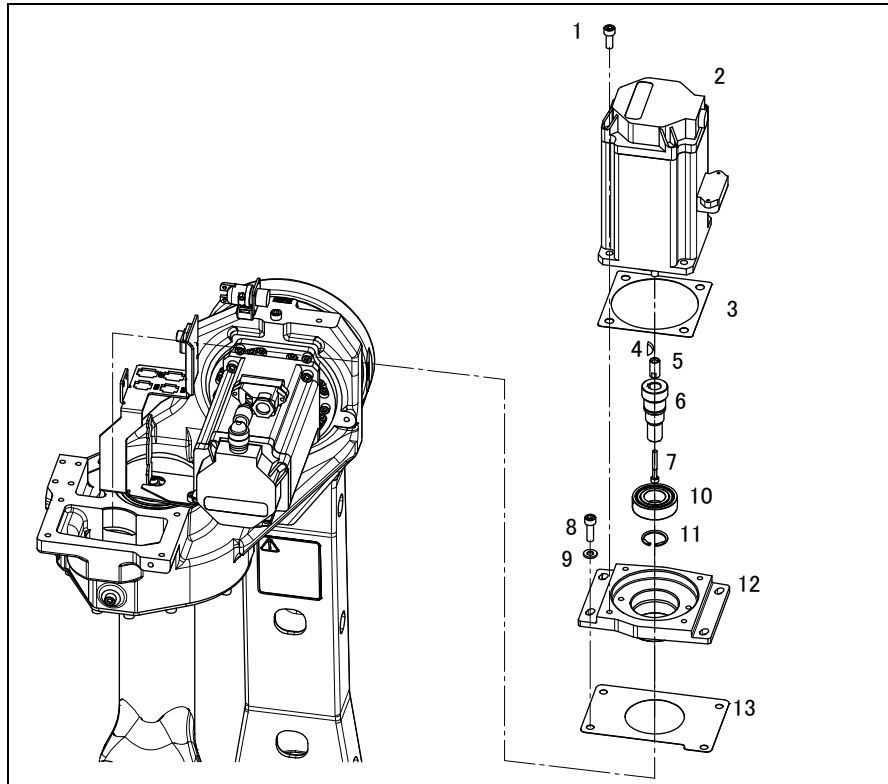


Fig.4.8 (a) Replacing the J4-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X16	4		10.0
2	MOTOR	A06B-0202-B608	1		
3	GASKET	A98L-0040-0042#03	1		
4	KEY	(It is attached to the J4-axis motor.)	1		
5	DRAW NUT	A290-7221-X421	1	LT243	3.1
6	GEAR J4-1	A290-7223-X411	1		
7	BOLT	A6-BA-4X30	1	LT243	3.4
8	BOLT	A6-BA-6X20	4		10.0
9	WASHER	A6-WM-6S	4		
10	BEARING	A97L-0001-0194#04Z000A	1	LT638	
11	C RING	A97L-0118-0520#GV-20	1		
12	MOTOR ADAPTER	A290-7223-X421	1		
13	GASKET	A290-7223-X426	1		

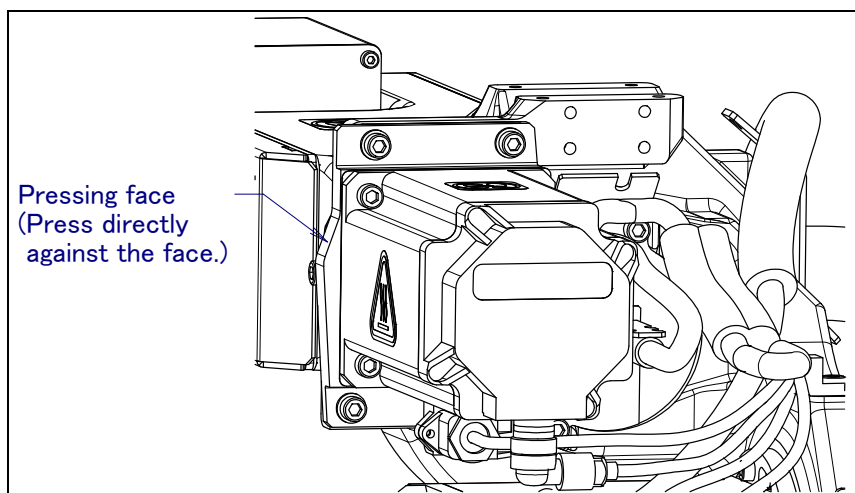


Fig.4.8 (b) Adjustment of J4-axis backlash

4.9 REPLACING THE J4-AXIS GEARBOX

- 1 Place the robot in a posture of all axes =0°.
- 2 Set dial gauges at the J3/J4-axes, and prepare for single axis mastering after replacement. Refer to Section 6.4.
- 3 Set the Quick Master Reference Position referring to Section 8.4 of operator's manual (B-83614EN). (It is set in 0° for all axes when robot is shipped.)
- 4 Turn off controller power.
- 5 Wrap and hang slings in two places of the J3 arm referring to Fig.4.9 (a).
- 6 Referring to Section 5.1, remove the wiring and piping between J3-axis and the wrist.
- 7 Referring to Section 5.1, remove J3/J4-axes motor connector, clamp part in J3 casing, clamp part in J3 arm and cable of J5/J6-axes motor, and pull out cable from the J3 arm unit.
- 8 Remove bolts (1) and the plate (2).
- 9 Remove bolts (3) and the clamp (4).
- 10 Remove bolts (5).
- 11 Remove the unit over the J3 arm from the J3 casing.

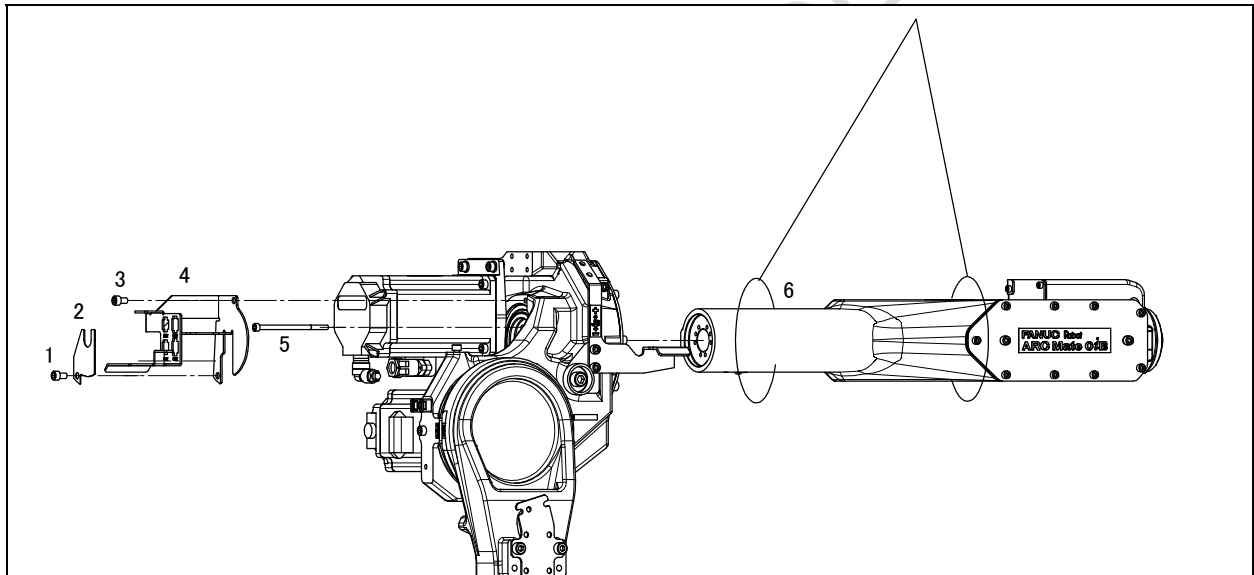


Fig.4.9 (a) Replacing the J4-axis gearbox (1/2)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X10	1		
2	PLATE	A290-7223-X433	1		
3	BOLT	A6-BA-6X10	1		
4	CLAMP	A290-7223-Y432	1		
5	BOLT	A6-BA-5X90	8	LT263	9.0
6	WRIST UNIT	A290-7223-T511	1		

- 12 Install the eyebolt to the J3 casing and hang it.
- 13 Dismount the J3-axis motor unit referring to Section 4.6.
- 14 Remove bolts (7) and remove the J3 casing from the J3-axis reducer.
- 15 Attach the J4-axis gearbox for maintenance to the J3-axis reducer with bolts (7).
- 16 Attach the unit over the J3 arm to the J3 casing with bolts (5).
- 17 Attach the clamp (4) with bolts (3).
- 18 Attach the plate (2) with bolts (1).
- 19 Mount the J3-axis motor unit referring to Section 4.6.
- 20 Perform cables wiring to the J3 arm and the J3 casing referring to Section 5.1.
- 21 According to Section 2.2, supply grease to the J3-axis reducer and the J4-axis gearbox.

- 22 Perform single axis mastering of J3/J4-axes. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator’s manual (B-83614EN).

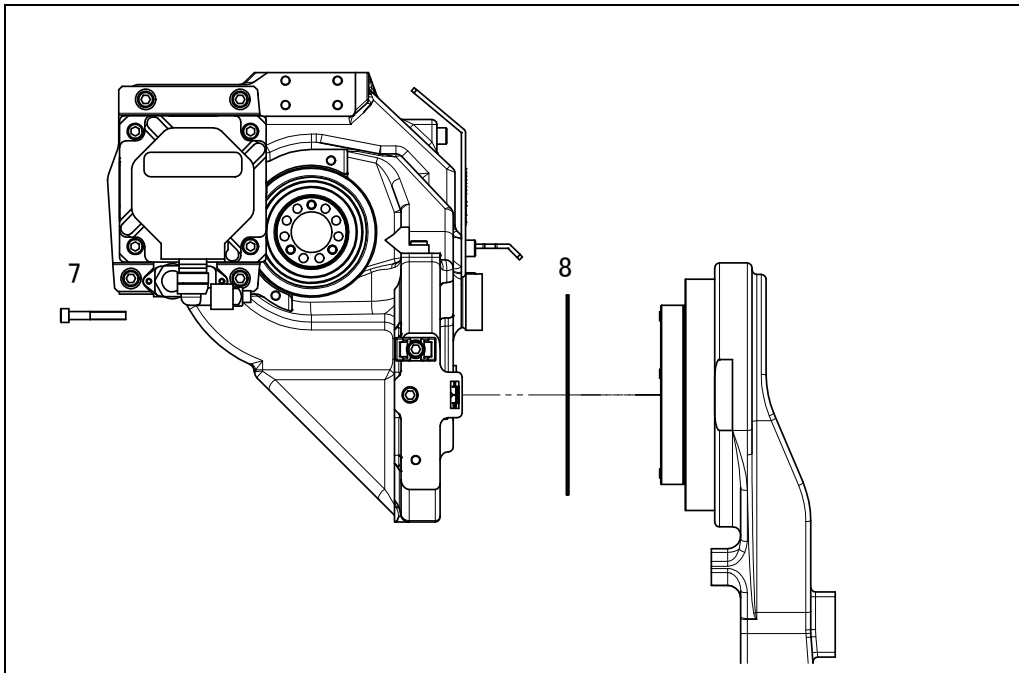


Fig.4.9 (b) Replacing the J4-axis gearbox (2/2)

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
7	BOLT	A6-BA-5X35	14	LT263	10.8
8	O RING	It is attached to the reducer	1		

4.10 REPLACING THE J5-AXIS MOTOR (M5)

- 1 Place the robot in a posture of $J3 = J5 = 0^\circ$, $J4 = -90^\circ$.
- 2 Set a dial gauge at the J5-axis, and prepare for single axis mastering after replacement. Refer to Section 6.4.
- 3 Turn off controller power.
- 4 Remove bolts (1) and the cover J5-3 (2).
- 5 Remove bolts (3) and the cover J5-1 (4).
- 6 Remove bolts (5) and the motor (6) which gear etc. are attached.
- 7 Remove the bolt (11) and the washer (10). Remove the motor (6) which gear (8) etc. are attached. Replace the motor by new one and attach the gear on the motor and assemble them applying the procedure in reverse sequence. Replace the gasket (7) by new one, too. Apply LOCTITE 675 on the key (9).
- 8 According to Section 2.2, supply the J5-axis gearbox with the grease.
- 9 Perform single axis mastering referring to Section 8.5 of operator's manual (B-83614EN).

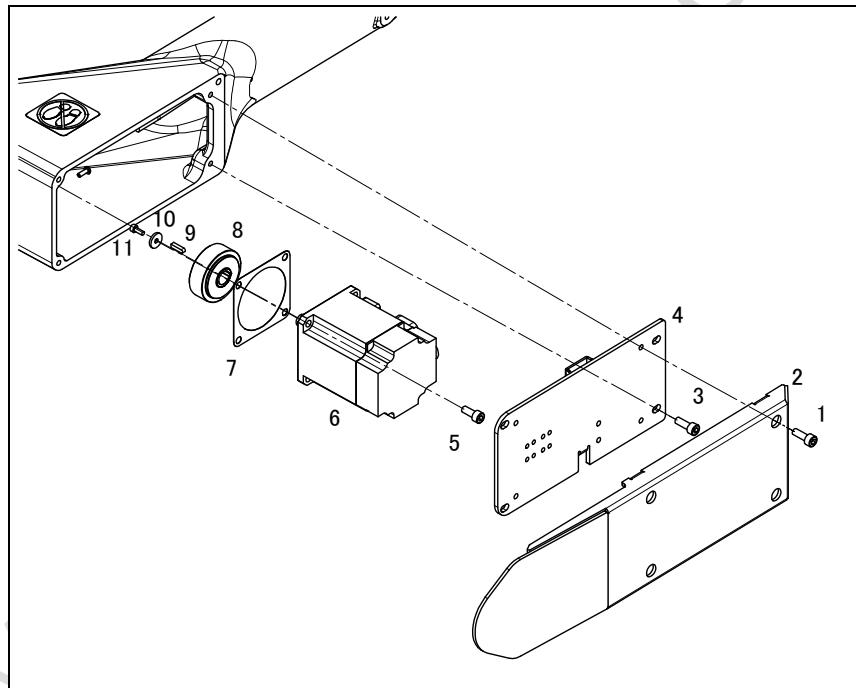


Fig.4.10 (a) Replacing the J5-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-5X14	4		
2	COVER J5-3	A290-7223-X545	1		
3	BOLT	A6-BA-5X14	4		
4	COVER J5-1	A290-7223-X543	1		
5	SEAL BOLT	A97L-0218-0423#051212	4		7.0
6	MOTOR	A06B-0114-B855#0048	1		
7	GASKET	A98L-0040-0042#07	1		
8	GEAR J5-1	A290-7223-X511	1		
9	KEY	A97L-0118-0402#3X3X12BN	1	LT675	
10	WASHER	A290-7210-X532	1		
11	BOLT	A6-BA-3X8	1	LT243	2

4.11 REPLACING THE J6-AXIS MOTOR (M6)

- 1 Place the robot in a posture of $J3 = J4 = 0^\circ$, $J5 = -90^\circ$.
- 2 Set a dial gauge at the J6-axis, and prepare for single axis mastering after replacement. Refer to Section 6.4.
- 3 Turn off controller power.
- 4 Remove bolts (1) and the cover J6 (2).
- 5 Remove bolts (3) and the motor (4) which gear etc. are attached.
- 6 Replace the motor by new one and attach the gear on the motor and assemble them applying the procedure in reverse sequence. Replace the gasket (6), too. Apply LOCTITE 675 on the key (5).
- 7 Perform single axis mastering. Refer to the SINGLE AXIS MASTERING section of the mechanical unit operator's manual (B-83614EN).

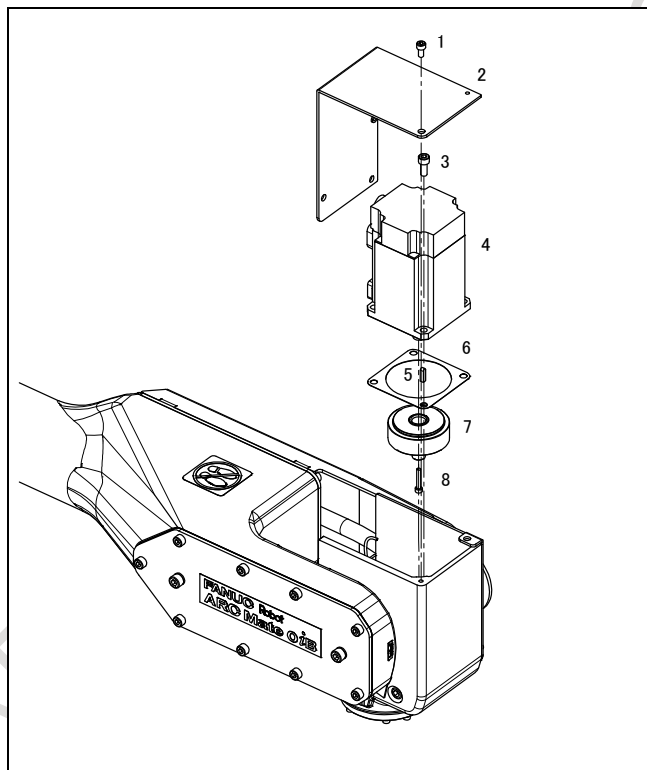


Fig.4.11 (a) Replacing the J6-axis motor

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-4X8	2		
2	COVER J6-1	A290-7223-X546	1		
3	BOLT	A6-BA-5X12	4		7
4	MOTOR	A06B-0115-B855#0048	1		
5	KEY	A97L-0118-0402#3X3X12BN	1	LT675	
6	GASKET	A98L-0040-0042#07	1		
7	GEAR	A290-7223-X515	1		
8	BOLT	A6-BA-3X18	1	LT243	2

4.12 REPLACING WRIST UNIT

- 1 Place the robot in a posture of all axes =0°.
- 2 Set dial gauges at J4/J5/J6-axes, and prepare for single axis mastering after replacement. Refer to Section 6.4.
- 3 Set the Quick Master Reference Position. Refer to the QUICK MASTERING sections of the mechanical unit operator's manual (B-83614EN). (All the axes are set to 0° before shipment.)
- 4 Turn off controller power.
- 5 Wind sling around the 2 places of J3 arm and hang it referring to Fig.4.12 (a).
- 6 Remove the wiring and the piping between J3-axis and wrist referring to Section 5.1.
- 7 Remove cables of J3/J4-axes motor connectors, clamp part in the J3 casing, clamp in the J3 arm and J5/J6-axes motor, and pull out cables form the J3 arm unit referring to Section 5.1.
- 8 Remove bolts (1) and the plate (2).
- 9 Remove bolts (3) and the clamp (4).
- 10 Remove bolts (5).
- 11 Remove the wrist unit (6) from the J3 casing.
- 12 Assemble new wrist unit. For its assembly, please apply the steps above in reverse sequence.
- 13 Attach wiring and the piping between the J3-axis and the wrist unit referring to Section 5.1.
- 14 According to Section 2.2, supply the J5-axis gearbox with the specified grease.
- 15 Perform quick mastering, then perform single axis mastering of J4/J5/J6-axes referring to Section 8.4 and 8.5 of operator's manual (B-83614EN).

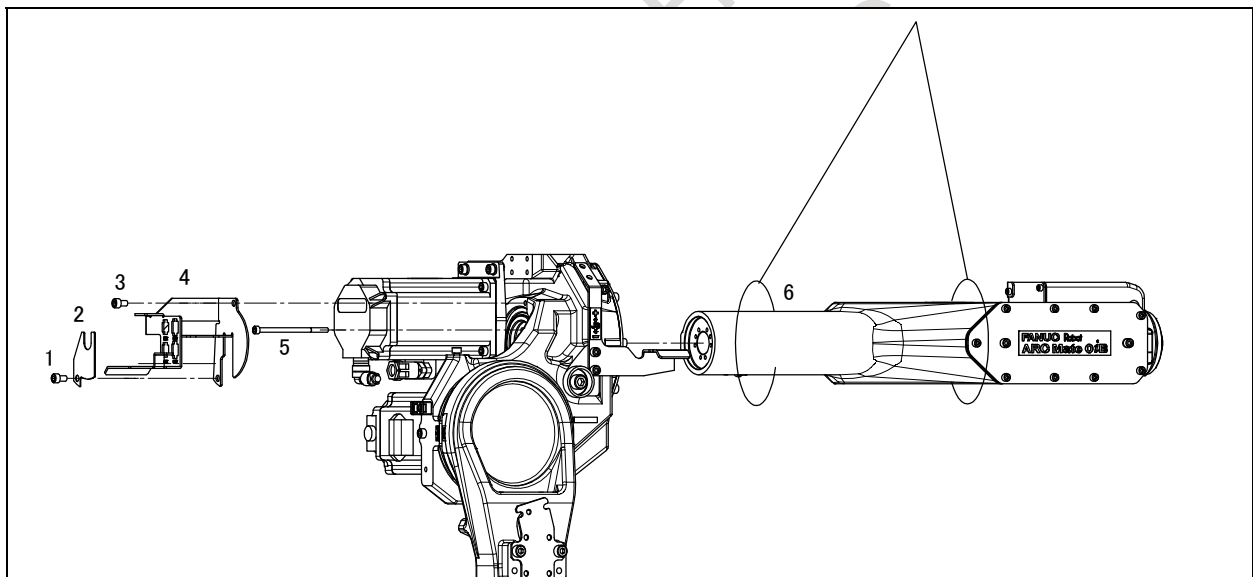


Fig.4.12 (a) Replacing the wrist unit

	Parts name	Specifications	Q'ty	Locking	Torque (N-m)
1	BOLT	A6-BA-6X10	1		
2	PLATE	A290-7223-X433	1		
3	BOLT	A6-BA-6X10	1		
4	CLAMP	A290-7223-Y432	1		
5	BOLT	A6-BA-5X90	8	LT263	9.0
6	WRIST UNIT	A290-7223-T511	1		

5 REPLACING CABLES

Replace the 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. 5 (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 Section 8 of 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.

5.1 REPLACING CABLES

Remove

- 1 Place the robot in a posture of all axes =0°.
- 2 Set the Quick Master Reference Position. Refer to the QUICK MASTERING section of the mechanical unit Operator's Manual (B-83614EN). (The Quick Master Reference is set with all axes at 0° before shipment.)
- 3 Turn off the controller power. Remove the connection cables from the controller and cables between the wire feeder and the J1 connector panel.
- 4 Turn off the welding power supply.
- 5 Remove bolts M5 x 14 (4), then remove the cover J5-3. (This cover is reused.)
- 6 Remove bolts M4 x 8 (2), then remove the cover J6-3.
- 7 Remove bolts M5 x 14 (4), then remove the cover J5-1.
- 8 Remove bolts M4 x 8 (2), then remove the cover J6-2.
- 9 Remove bolts M4 x 8 (3), then remove the cover J6-1.

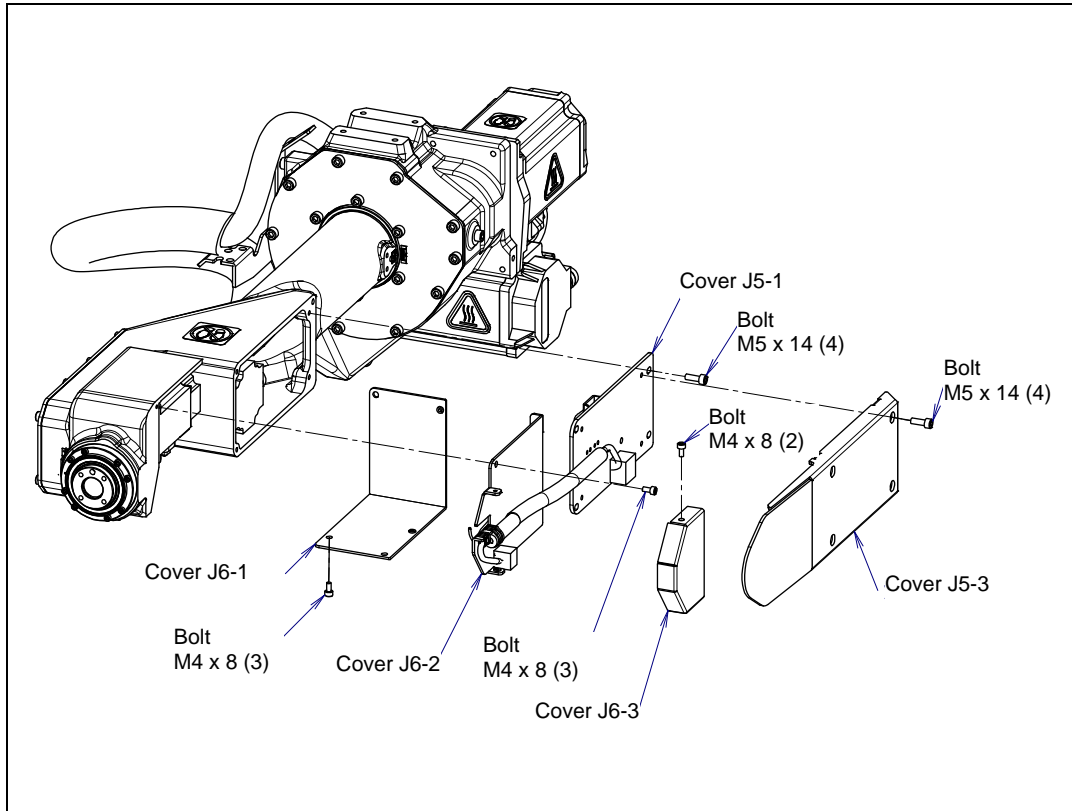


Fig. 5.1 (a) Replacing the cable kit (J5/J6-axis motor part 1)

- 10 Remove the J5/J6-axes connectors.
- 11 Remove the bolts M6 x 10 (2) which fasten the clamp J3 A290-7223-Y431 to the side of the J3 casing. Then remove the clamp J3 from the J3 casing.

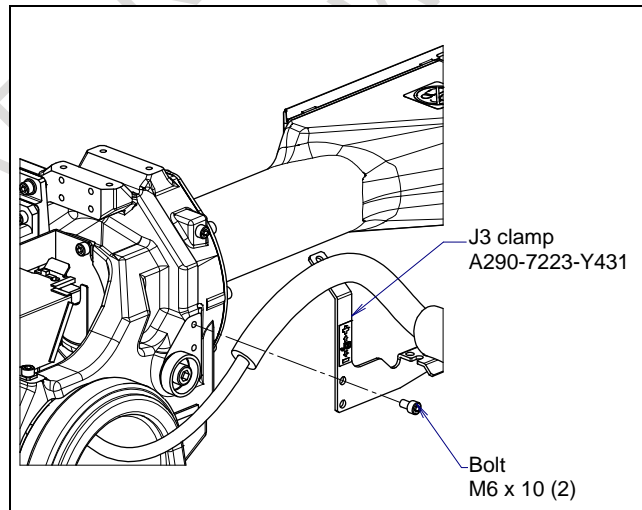


Fig. 5.1 (b) Replacing the cable kit (J3 casing side)

- 12 Remove the cables from the J3/J4-axes motors. If there is the wire feeder cable, remove it, too. Remove air/gas tubes and the EE connector, too. Cut cable ties on the tie mount of the J3 casing and remove the cables.

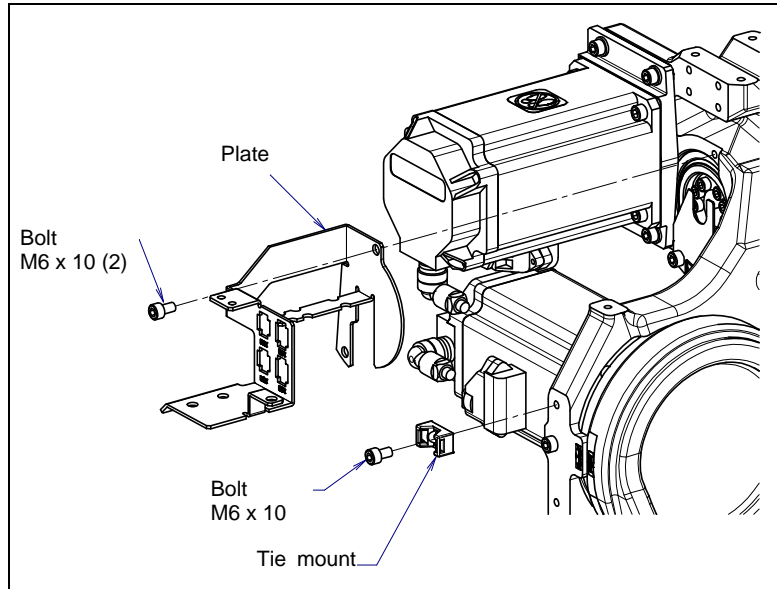


Fig. 5.1 (c) Replacing the cable kit (J3 casing side)

- 13 Remove bolts which fasten the plate A290-7223-X433, then remove the plate. Cut cable ties of the clamp A290-7223-Y432 of J3 casing back side, Remove the clamp mounting bolts M6X10 and remove the clamp with cables from the J3 casing. (This clamp is reused.)

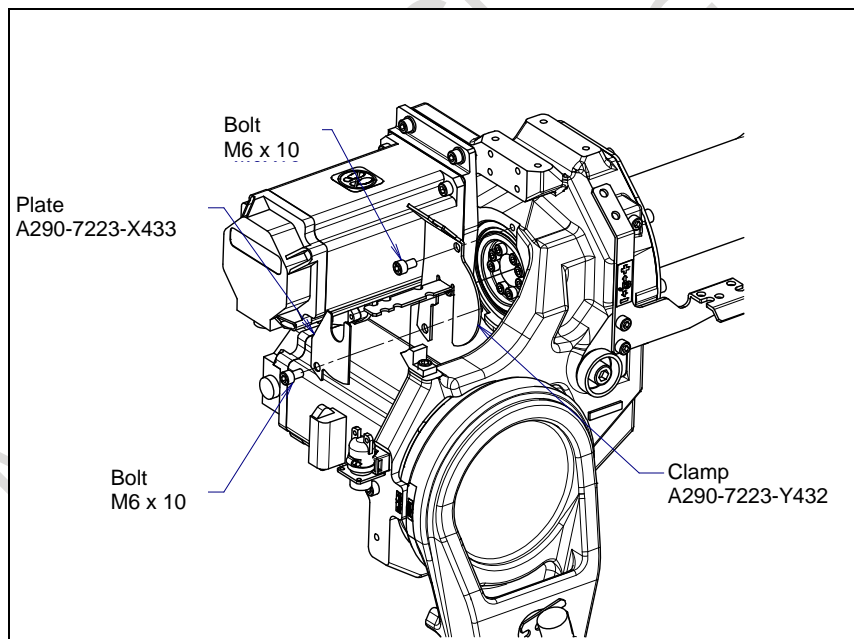


Fig. 5.1 (d) Replacing the cable kit (J3 casing back side)

- 14 Remove the relay connectors to the unit over the J3 arm, Remove wrist side cables and plate from the robot main body.
- 15 Remove bolts M8X12 (4) which fasten the plate A290-7223-Y341 to the J2 arm. Then remove the plate from the J2 arm.

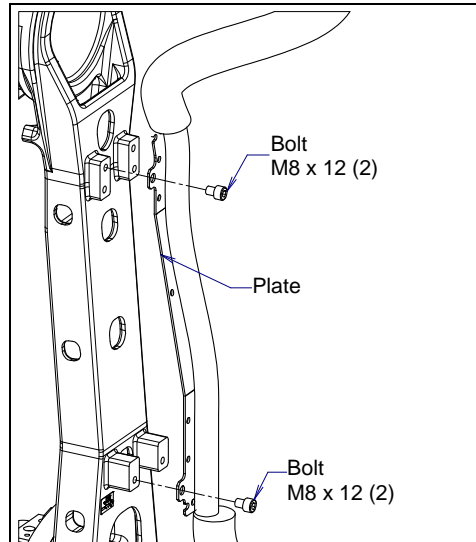


Fig. 5.1 (e) Replacing the cable kit (J2 arm)

- 16 Remove bolts M8X12 (2), then remove the battery box from the robot main body.

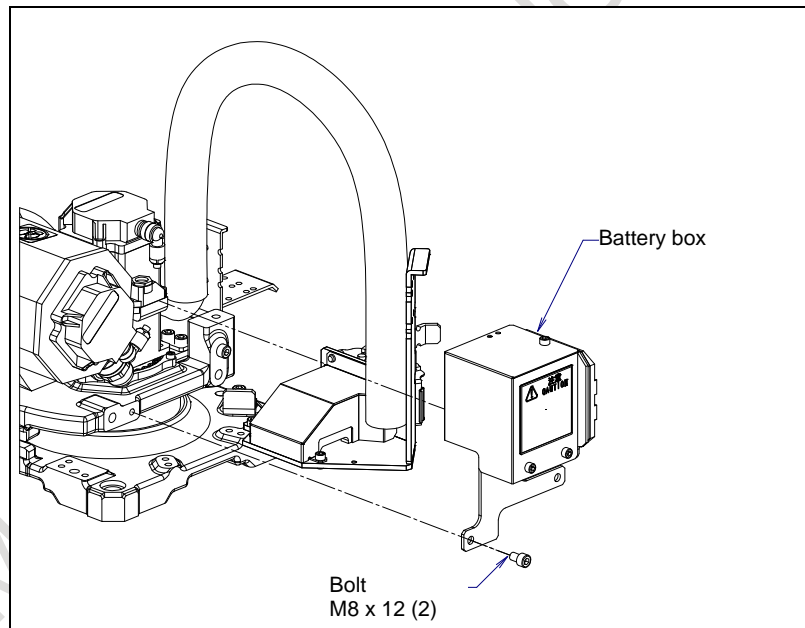


Fig. 5.1 (f) Replacing the cable kit (battery box)

- 17 (without pedestal)
Remove the bolt M8X12 for earth terminal and the washer. Remove bolts M8X12 (2) of 2 locations on the J2 base, then remove the cable kit from the robot main body.

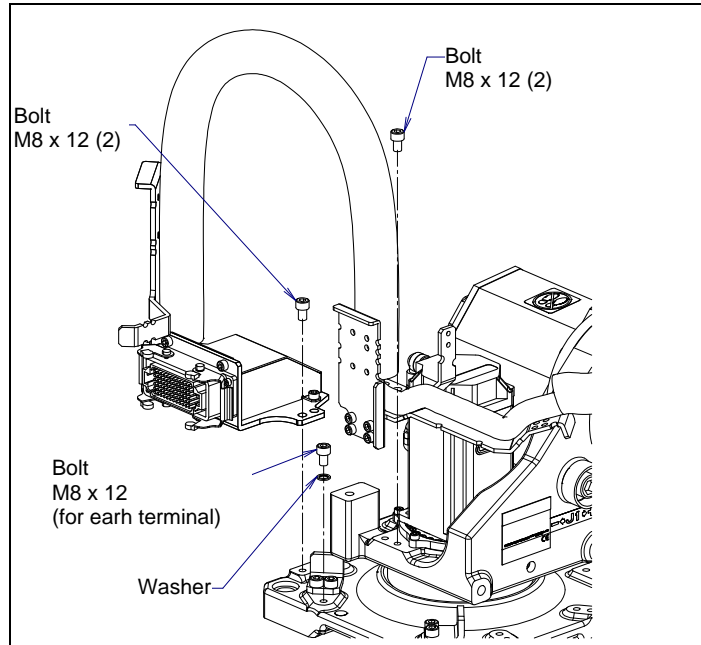


Fig. 5.1 (g) Replacing the cable kit (without pedestal J2 base)

(with pedestal)

Remove bolts M8X12 (2) of 2 locations on the J2 base, remove bolts M8X12 (4) , then remove the cover A290-7223-X256. Remove bolts M8X12 (2), then remove the plate A290-7223-X254. Remove the bolt M8X12 for earth terminal and the washer. Remove bolts M8X12 (2), then remove the cable kit from the robot main body.

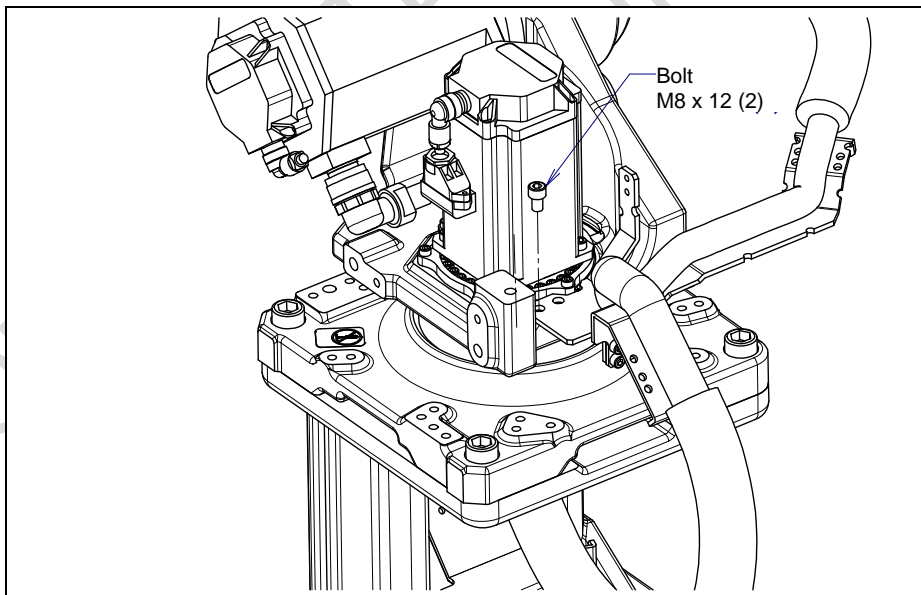


Fig. 5.1 (h) Replacing the cable kit (with pedestal J2 base)

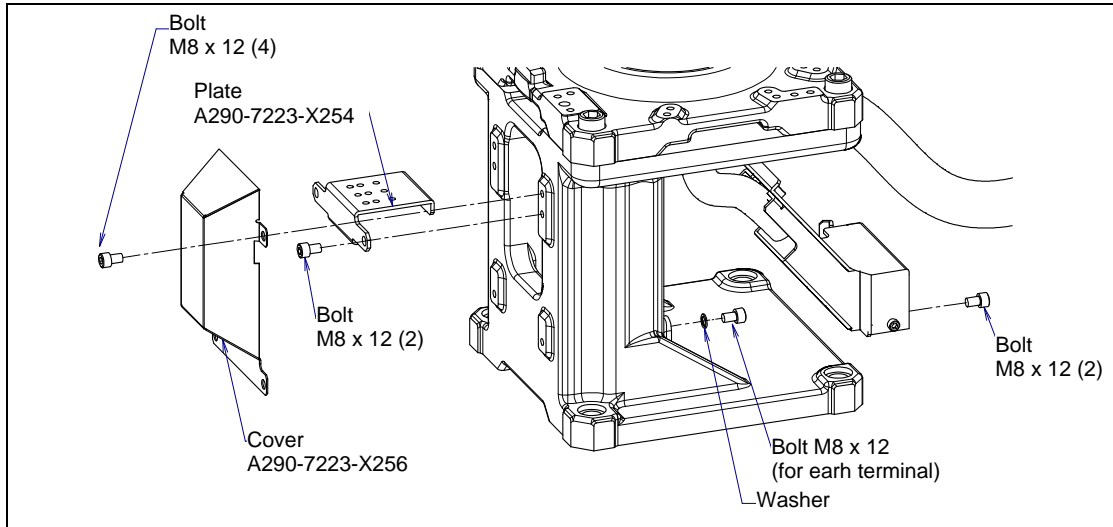


Fig. 5.1 (i) Replacing the cable kit (pedestal for with pedestal)

This completes cable kit detachment from the robot.

Attach new cable kit according to the procedure below.

Assembling

- 1 Attach J2 arm plate A290-7223-Y341 with new bolts referring to Fig.5.1 (e).
- 2 Attach the clamp J3 A290-7223-Y431 to the J3 casing referring to Fig.5.1 (b). In this time, confirm the cables in the cable protective sleeve of J3 movable part are not twisted.
- 3 (without pedestal)
Attach new cable kit on the J2 base with bolts M8X12 (2) of 2 locations. (Fig.5.1 (f))
(with pedestal)
Attach new cable kit on the pedestal with bolts of Harting connector part. Then attach the plate A290-7223-X254 and the cover A290-7223-X256, too. (Fig.5.1 (g)) Attach the cable kit on the J2 base with bolts M8X12 (2) (Fig.5.1 (g))
- 4 Attach the wrist part cable kit. (Fig.5.1 (a))
- 5 Connect the J5/J6-axes motor connectors. (Fig.5.1 (d))
- 6 Insert the wrist part cable in the J3 casing, pull them out from the backside. (Fig.5.1 (d))
- 7 Attach the tie mounts with bolts M6X10. (Fig.5.1 (c))
- 8 Connect the cables of the wrist part and the J1 base side with connectors. (Fig.5.1 (j))

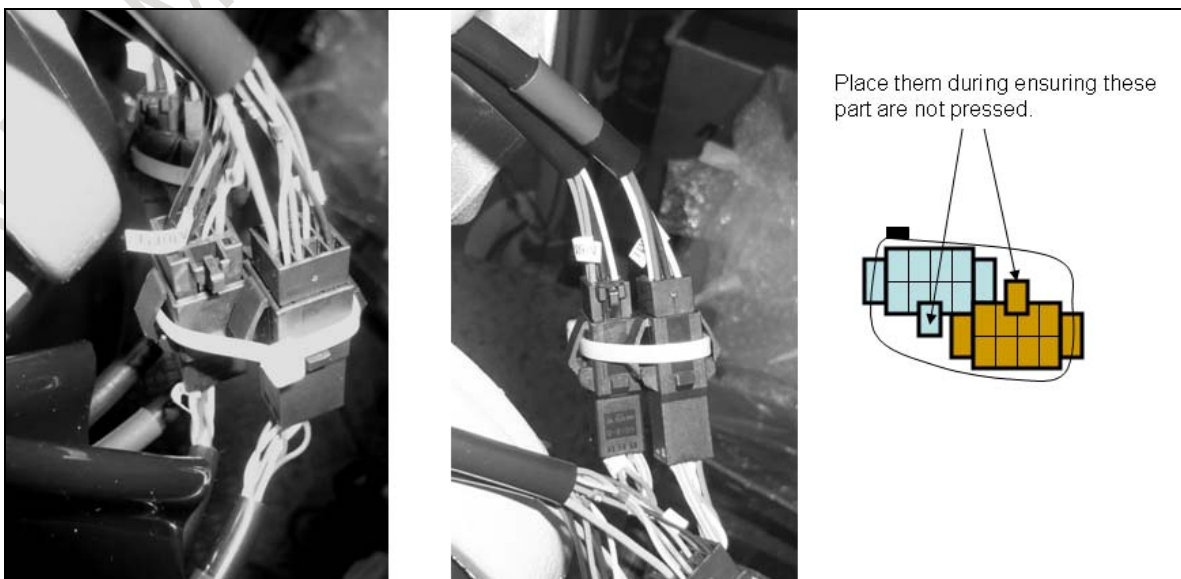


Fig. 5.1 (j) Replacing the cable kit (connector connection)

- 9 Fix 2 connectors with cable ties. At this chance, turn notch to the inside. (Fig.5.1 (k))

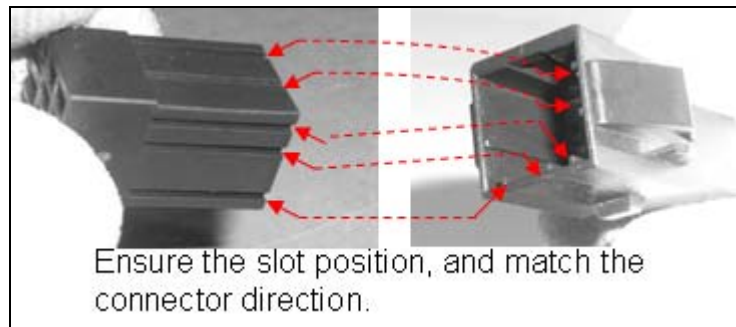


Fig.5.1 (k) Replacing the cable kit (connector connection)

- 10 Attach the clamp A290-7223-Y432 with bolts M8X12. Attach the clamp A290-7223-X433 with bolts M8X12. (Fig.5.1 (d)) Fix cables with cable ties. (Fig.5.1 (j))

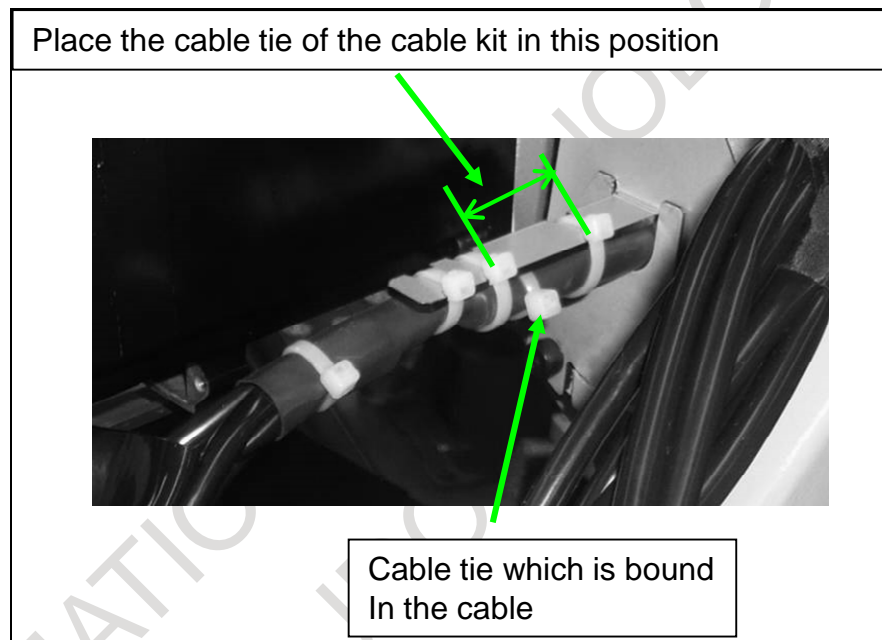


Fig. 5.1 (l) Replacing the cable kit (J3 casing back side)

- 11 Connect cables to the J3/J4-axes motor.
 12 Perform cable wiring of wire feeder (when there is it), the EE cable, air/gas tubes. Connect the wire feeder control cable to the welding power supply.
 13 Perform quick mastering. Refer to the QUICK MASTERING section of the mechanical unit Operator's Manual (B-83614EN).

6 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.

6.1 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 6.1 (a) describes the following mastering methods. If 7DC2 (V8.20P) or former software is installed, "Quick Mastering for Single Axis" has not been supported.

Table 6.1 (a) Type of mastering

Fixture position mastering	Mastering which performed with the mastering fixture before shipping.
Zero-position mastering (witness mark mastering)	Mastering which 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	Mastering which 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	Mastering which 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	Mastering which performed for one axis at a time. The mastering position for each axis can be specified by the user. Useful in performing mastering on a specific axis.
Mastering data entry	Enter the Mastering data directly.

This MAINTENANCE MANUAL describes fixture position mastering and single axis mastering those are 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 in 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. Therefore, the Master/Cal screen is designed to appear only when the \$MATER_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 positioning 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. 6.1 (a).

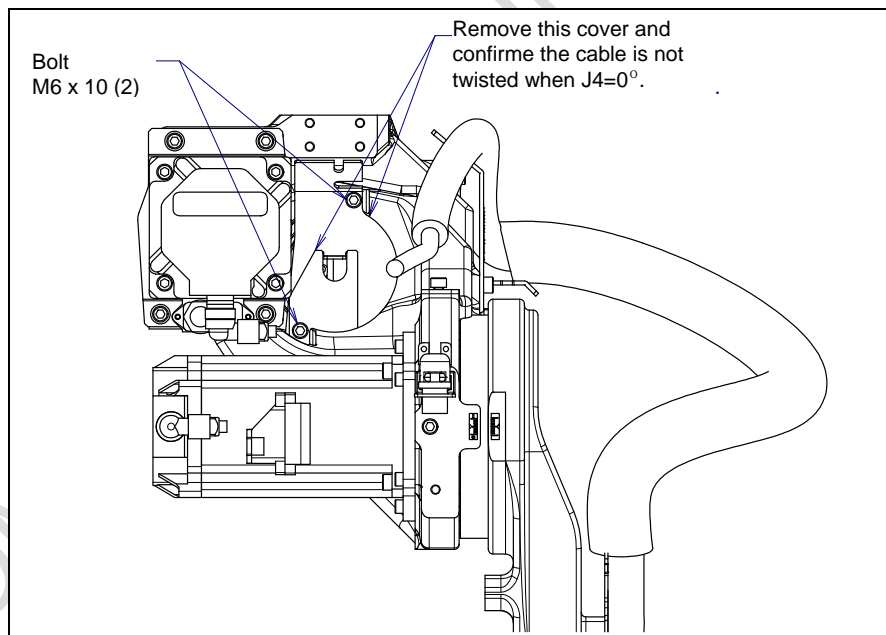


Fig. 6.1 (a) Confirming the state of cable (J4-axis)

⚠ CAUTION

When the robot is operated without J4 cover, it may cause serious trouble. Be sure to put cover back and operate the robot.

6.2 RESETTING ALARMS AND PREPARING FOR MASTERING

Before performing mastering because a motor has been replaced, it is necessary to reset 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 steps 1 to 6.
 - 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 \$MASTER_ENB, then key in “1” and press [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 Select [0 NEXT] and select [6 SYSTEM].
 - 3 Press F1 [TYPE], and select [SYSTEM Variable] from the menu.
 - 4 Place the cursor on F3 RES_PCA, then press F4 [YES].
 - 5 Turn off the controller power and on again

- 3 To reset the “SRVO-075 Pulse not established” alarm, follow 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.

6.3 FIXTURE POSITION MASTER

Fixture position mastering is performed using a mastering fixture. This mastering is carried out in the predetermined fixture position.

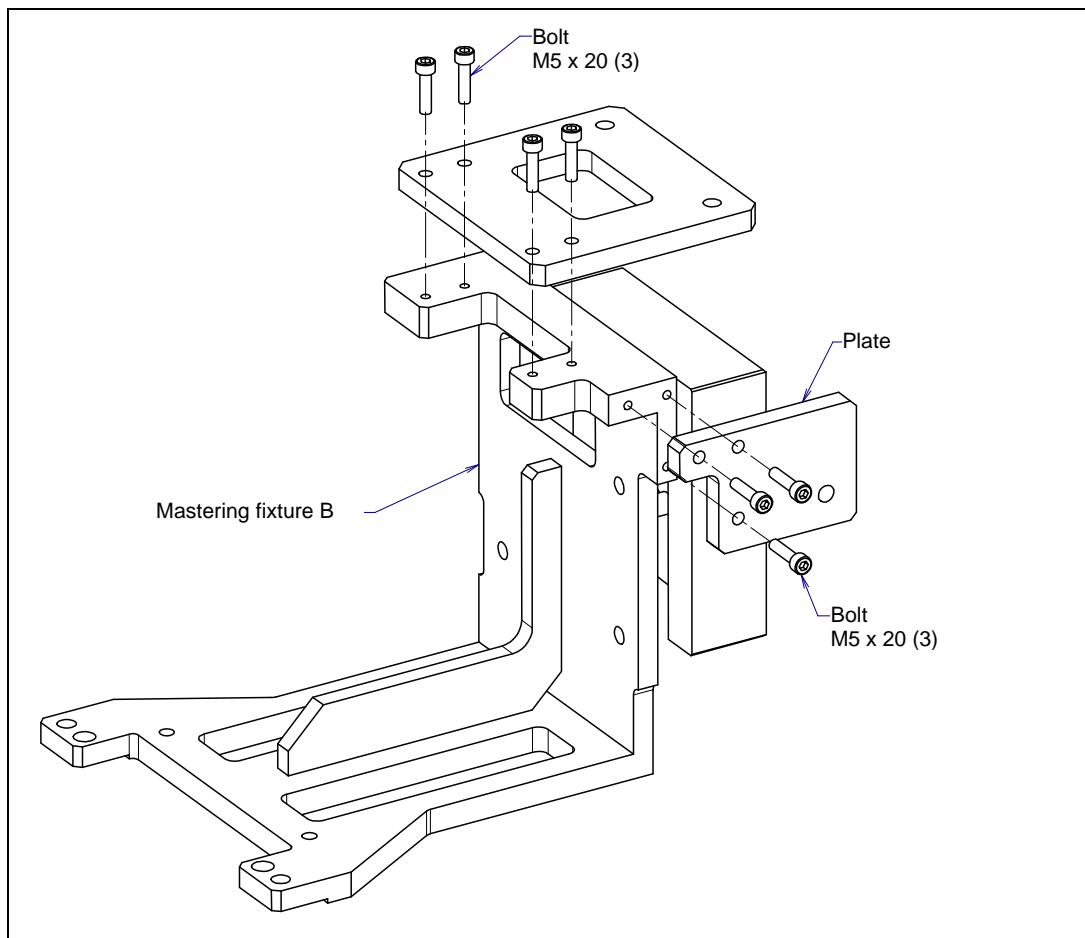
Fixture position mastering is accurate because a dedicated mastering fixture is used.

When mastering the robot, ensure that the robot meets the following conditions.

- Make sure the robot mounting base is horizontal.
(The overall levelness of the robot mounting surface shall be 1 mm or less.)
- Remove the tooling and other parts from the wrist.
- Make sure no external forces are exerted on the robot.

Assembling the fixture base

- 1 Assemble the fixture base as shown in Fig. 6.3 (a).

**Fig.6.3 (a) Assembling the fixture base**

- Adjust the dial gauge to 3.00 mm using the calibration block, and tighten it with M5 bolt as shown in Fig. 6.3 (b). (Do not tighten the bolt too strongly or the dial gauge might break.)

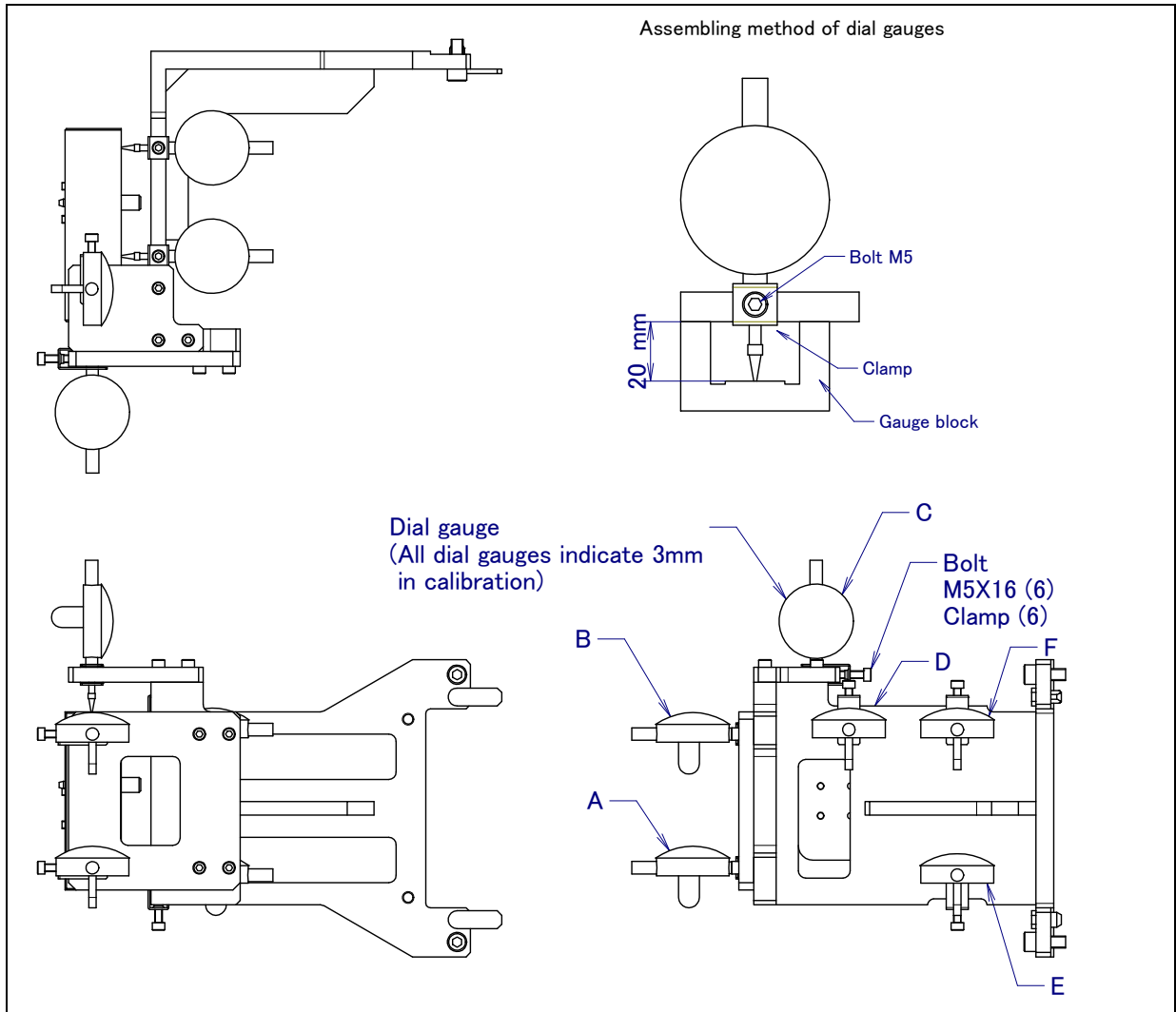


Fig.6.3 (b) Mounting dial gauges

- 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. 6.3 (c). When assembling the diamond locating pin, pay attention to the direction of the pin.

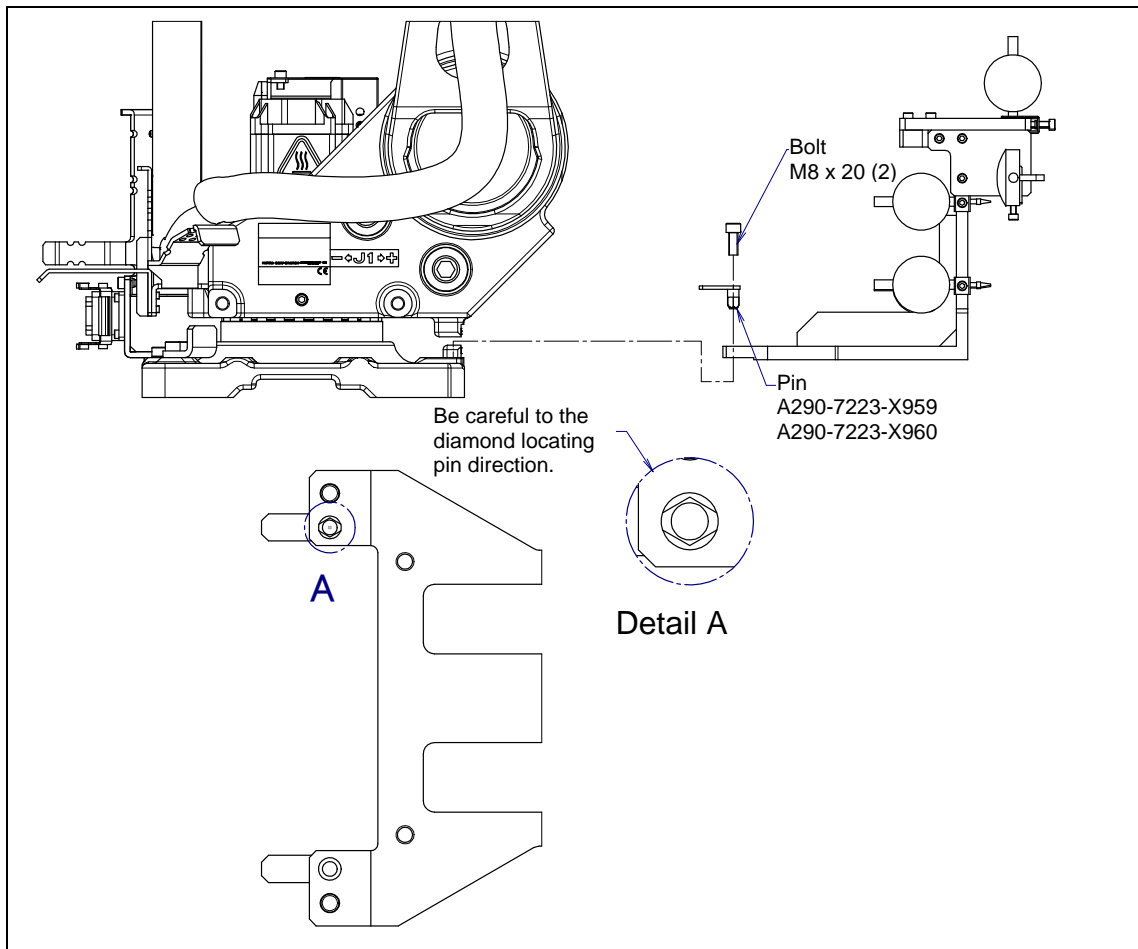


Fig.6.3 (c) Assembling the fixture base

- 4 Assemble the fixture to the wrist flange as shown in Fig. 6.3 (d).

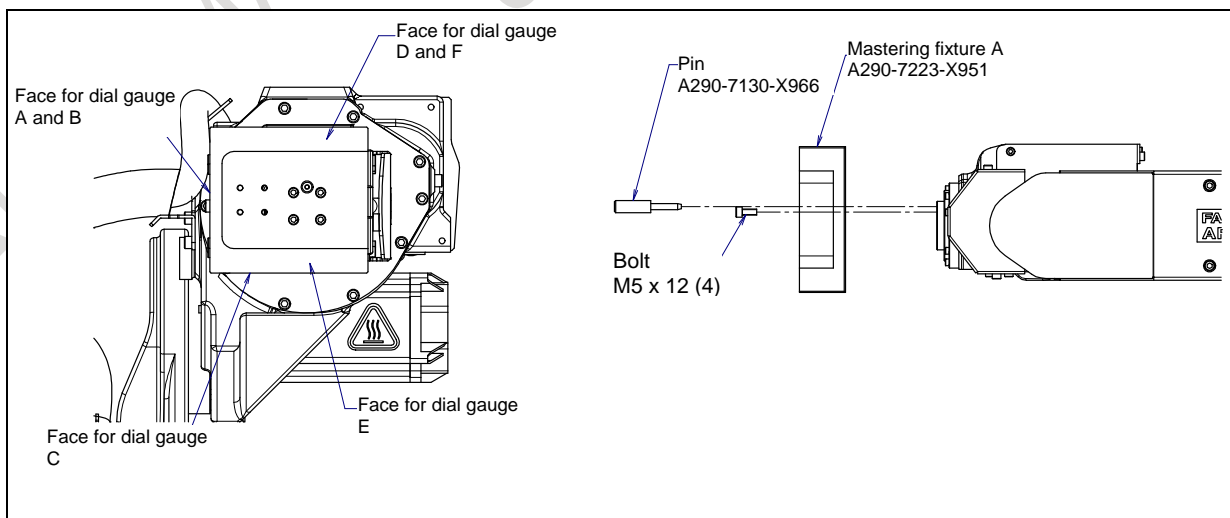
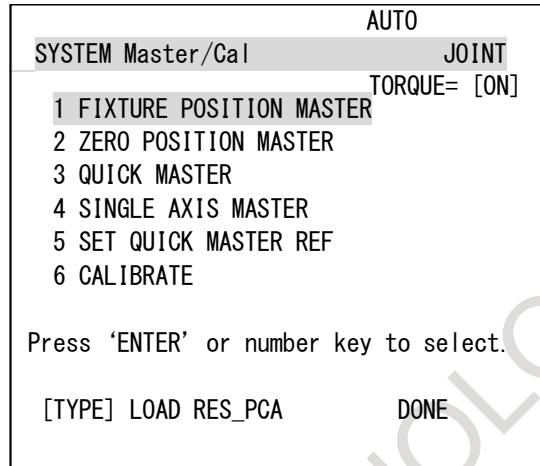


Fig.6.3 (d) Assembling the fixture to the wrist flange

Mastering

- 1 Press the [MENU] key to display the screen menu.
- 2 Select [0 NEXT] and press [6 SYSTEM].
- 3 Press F1 [TYPE].
- 4 Select [Master/Cal].



- 5 Release brake control, and jog the robot into a posture for mastering. A to F (see Fig.6.3 (b)) of the fixture attached to the wrist are dial gauges A to F (see Fig.6.3 (d)) and make adjustments so that dial gauges A to F indicate 3 mm. A posture as shown in Fig.6.3 (e) should be used. See this figure for reference.

NOTE

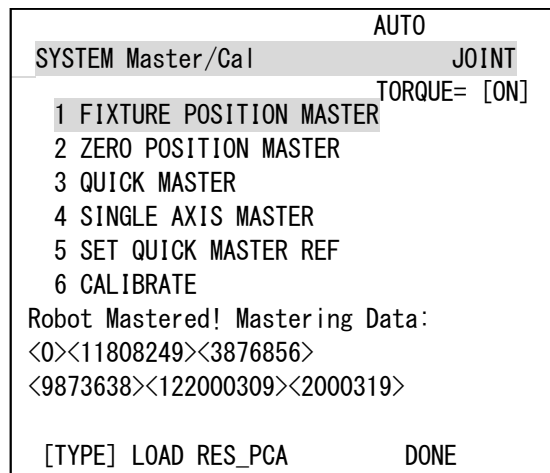
Brake control can be released by setting the system variables as follows:

\$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. 6.3 (e) is set in this position.



6. MASTERING

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- 7 Select " 6 CALIBRATE " and press F4, YES. Mastering will be performed.
Alternatively, switch the power off and on again. Switching the power on always causes positioning to be performed.

```

                                AUTO
SYSTEM Master/Cal                JOINT
                                TORQUE= [ON]
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Calibrated! Cur Jnt Ang(deg) :
<0.0000><22.1885><-89.4915>
<0.0000><-90.5085><-90.0000>

[TYPE] LOAD RES_PCA                DONE

```

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



CAUTION

No check is made on the axis movable range during mastering. Be very careful when running the robot. Continuing axis movement may result in the mechanical stopper being bumped.

- 9 Return brake control to original setting, and turn off the controller power and on again.

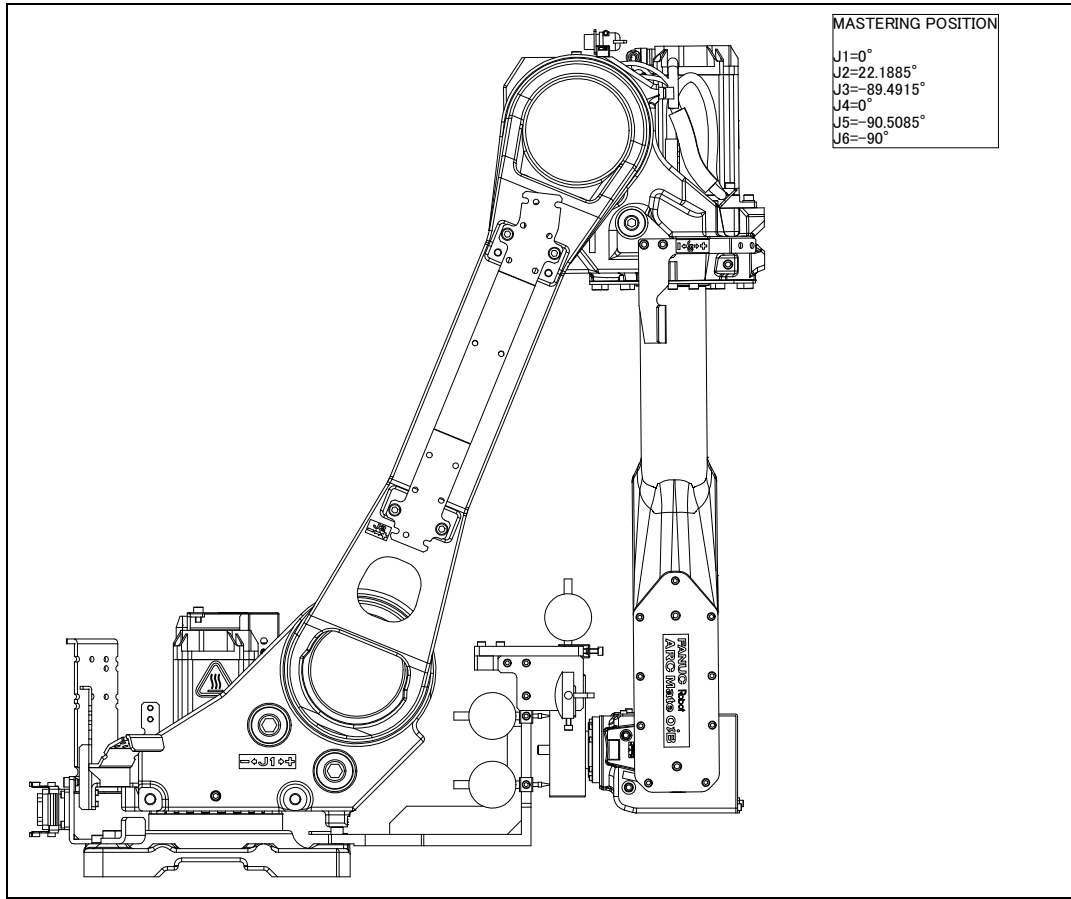


Fig.6.3 (e) Mastering posture

6.4 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 6.4 (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 Release the brake control.

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, cycle power of the controller.

(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

- 2 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.

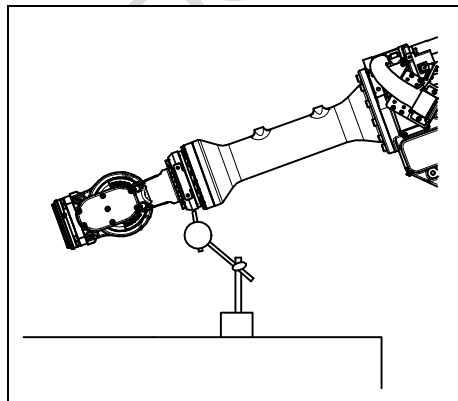


Fig. 6.4 (a) Setting of the dial gauge

- 3 Move the robot to the posture when the parts are replaced, so replace the parts.
- 4 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 position (in case of the dial gauge : scale reading).
- 5 Clear an alarm that occurs as described in Section 6.2. Then prepare for the mastering.
- 6 Select [6 SYSTEM].
- 7 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

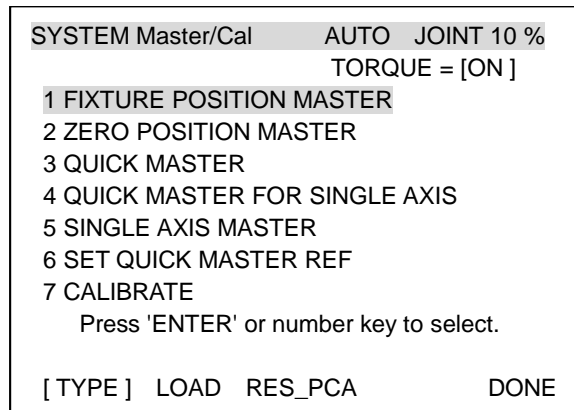
8 Select [5 SINGLE AXIS MASTER]. The following screen will be displayed.

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			

- 9 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.
- 10 Input the position data (recorded position in step 5) of the axis mastering is done.
- 11 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			

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



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



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

6.5 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 zero-degree position marks indicated in Section 8.3 of the OPERATOR'S MANUAL (B-83614EN) 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 6.2. 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 type 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. Check to see if the alarm will disappear by performing a pulse reset (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 notifications like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may indicate trouble with Pulsecoder; contact your local FANUC representative.

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APPENDIX

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A MAINTENANCE PARTS

Table A (a) Cable kit

Specifications	Models	Remarks
A05B-1223-H202	Without pedestal	Standard cable
A05B-1223-H203	Without pedestal	Standard cable with airX1,gasX1
A05B-1223-H212	Without pedestal	CE cable with airX1,gasX1
A05B-1223-H222	With pedestal	Standard cable
A05B-1223-H223	With pedestal	Standard cable with airX1,gasX1
A05B-1223-H232	With pedestal	CE cable with airX1,gasX1

Table A (b) Motor

Axis	Specifications	Remarks
J5	A06B-0114-B855#0048	β iSR0.4/6000
J6	A06B-0115-B855#0048	β iSR0.5/6000
J1/J3/J4	A06B-0202-B608#S000	α iFR1/5000
J2	A06B-0223-B608#S000	α iFR4/4000

Table A (c) Reducer

Parts name	Specifications	Remarks
J1/J3-axisreducer	A97L-0218-0993	2 pcs/1 robot
J2-axis reducer	A97L-0218-0994	

**CAUTION**

Specify the following draw nut for the J1-J4-axes motors.

Table A (d) draw nut, gear, key

Parts name	Specifications	Used places
Draw nut	A290-7221-X321	J2-axis motor
Draw nut	A290-7221-X421	J1/J3/J4-axes motor 3 pcs/1 robot
GearJ4-1	A290-7223-X411	J4-axis motor unit
Key	A97L-0118-0402#3X3X12BN	J5, J6-axes motor 2 pcs/1 robot

Table A (e) Other (Mechanical unit)

Parts name	Specifications	Remarks
J4-axis gearbox	A290-7223-T411	The J4-axis motor is included in this.
Wrist unit	A290-7223-T511	

Table A (f) Battery · Grease

Parts name	Specifications	Remarks
Battery	A98L-0031-0005	1.5V, alkali size D 4pcs per/1 robot
Grease	A98L-0040-0174#0.7KG	Kyodo yushi VIGOGREASE RE0
Grease	A98L-0040-0230#0.1KG	Harmonic grease 4BNo.2

Table A (g) O ring

Parts name	Specifications	Used places
O ring	JB-OR1A-G75	J1/J3-axes motor 2 pcs/1 robot
O ring	JB-OR1A-G80	J1/J2/J3-axes motor 3 pcs/1 robot

Table A (h) gasket

Parts name	Specifications	Used places
Gasket	A290-7223-X326	J2-axis motor
Gasket	A98L-0040-0042#03	J4-axis motor
Gasket	A98L-0040-0042#07	J5/J6-axis motor 2 pcs/1 robot

Table A (i) Stopper

Parts name	Specifications	Used places
Stopper	A290-7215-X328	J2-axis
Stopper	A290-7223-X324	J3-axis

Table A (j) Bolt, washer

Parts name	Specifications	Qty.	Location of use
Bolt	A6-BA-5X35	26	J1-axis motor adapter
Bolt	A6-BA-4X16	1	J1-axis motor
Bolt	A6-BA-5X35	26	J1-axis reducer
Bolt	A6-BA-5X35	24	J1-axis reducer
Bolt	A6-BA-5X16	1	J2-axis motor
Bolt	A6-BA-5X35	26	Between J2 arm and J2-axis reducer
Bolt	A6-BA-5X55	24	J2-axis reducer
Bolt	A6-BA-4X16	1	J3-axis motor
Bolt	A6-BA-5X35	14	Between J3casing and J3-axis reducer
Bolt	A6-BA-5X35	14	Between J3-axis reducer and J2 arm
Bolt	A6-BA-4X30	1	J4-axis motor
Washer	A6-BA-5X90	8	Between J3 arm and J3 casing
Bolt	A6-BA-3X8	1	J5-axis motor
Washer	A6-BA-3X18	1	J6-axis motor

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 (k) Vernier mark seal

Parts name	Specifications	Remarks
Vernier mark seal	A370-8017-0920	J1 to J5-axis
Vernier mark seal	A370-3031-0106	J6-axis

B **MECHANICAL UNIT CIRCUIT DIAGRAM**

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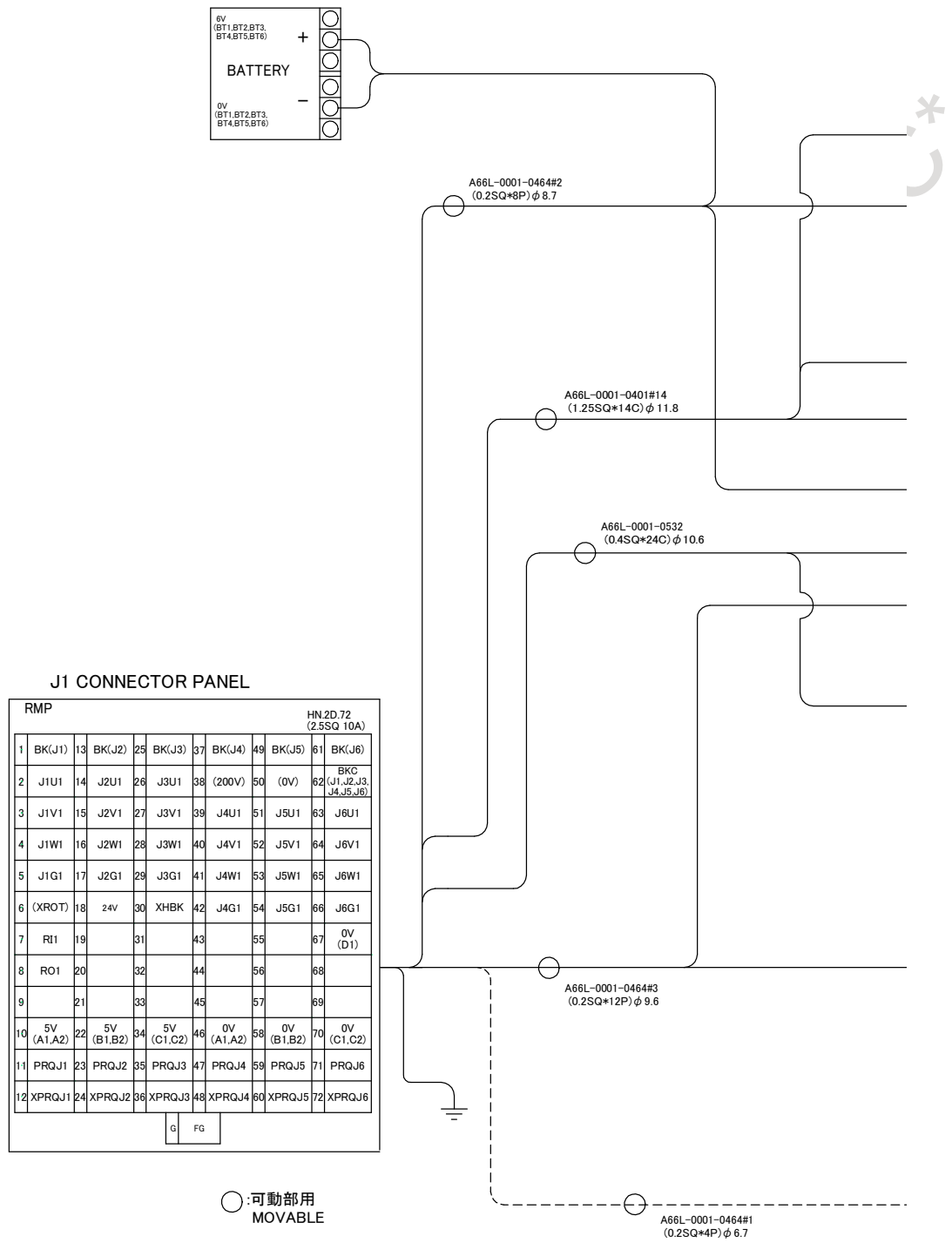
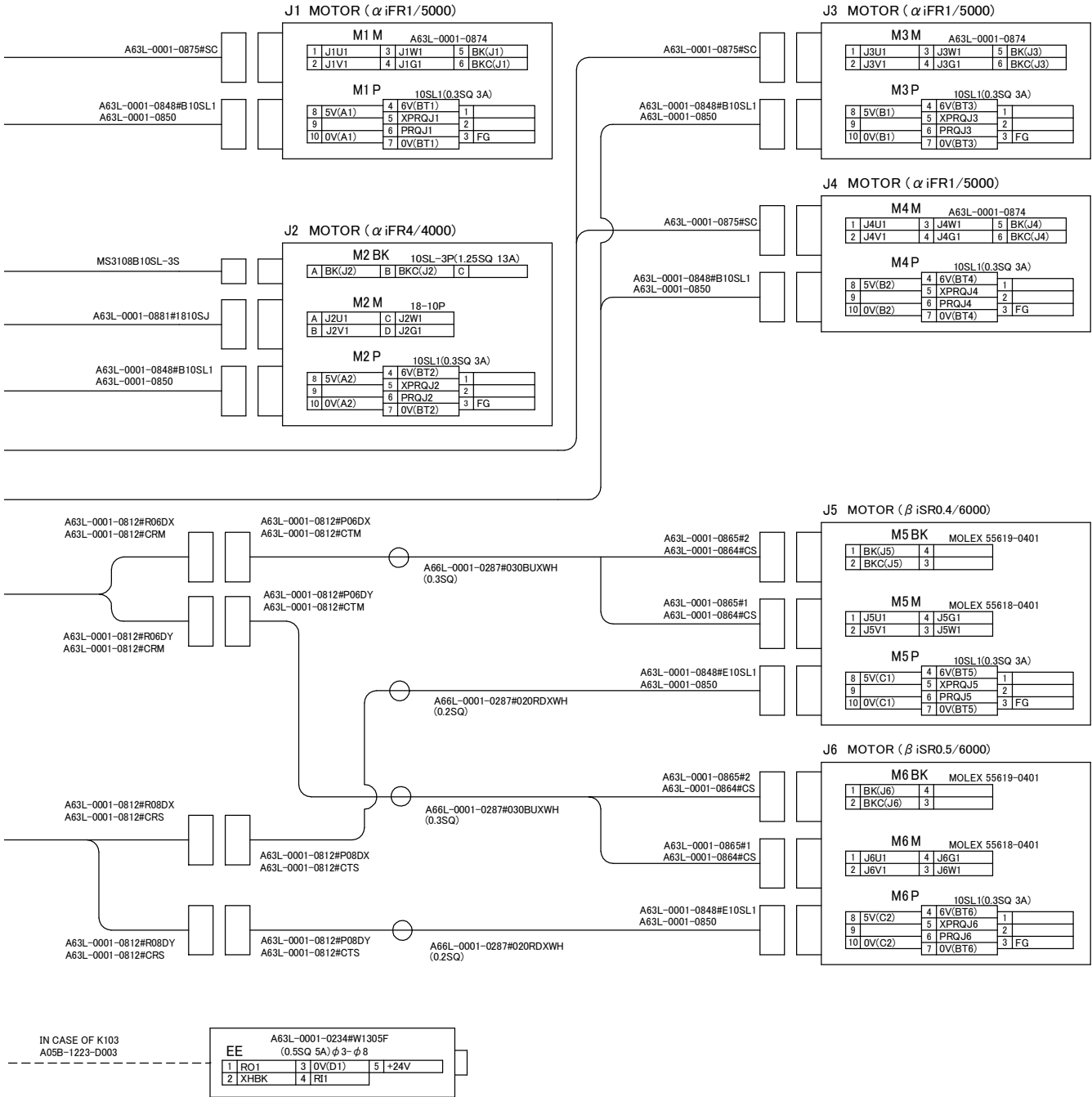


Fig.B (a) Circuit diagram (for NON-CE)

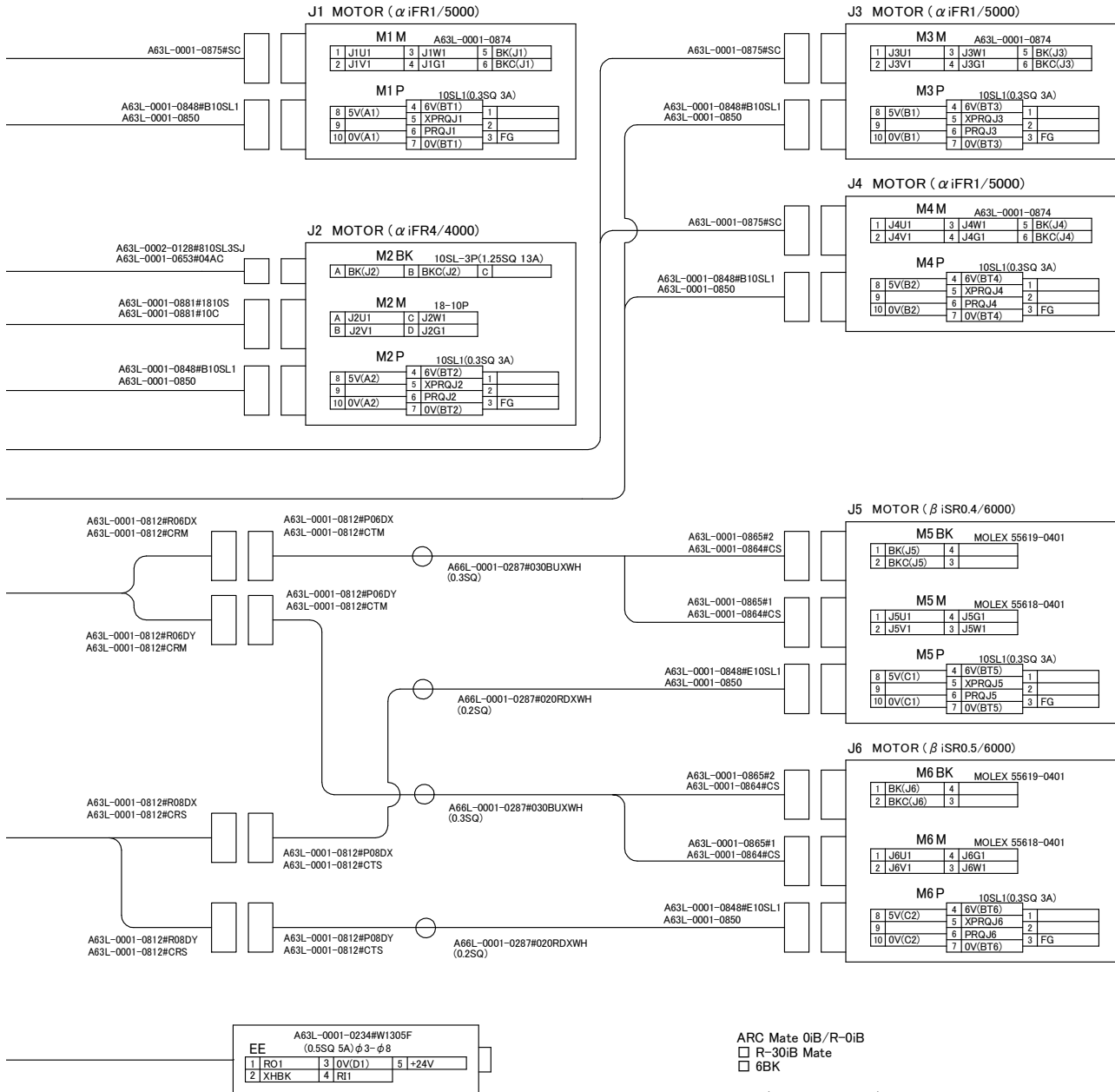
B. MECHANICAL UNIT
CIRCUIT DIAGRAM



ARC Mate 0iB/R-0iB
 R-30iB Mate
 6BK

K102(A05B-1223-D002)---without I/O FOR Non-CE
 K103(A05B-1223-D003)---RI/O*1 FOR Non-CE

B. MECHANICAL UNIT
CIRCUIT DIAGRAM



C PERIODIC MAINTENANCE TABLE

FANUC Robot ARC Mate 0iB			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		9600	10560	
												7680	8640			
Mechanical unit	1	外傷、塗装剥がれの確認	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	2	ケーブル保護シートの損傷の確認	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	3	被水の確認	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	4	Check the mechanical cable. (Damaged or twisted)	0.2H	-		○			○					○		
	5	Check the motor connector. (Loosening)	0.2H	-		○			○					○		
	6	Tighten the end effector bolt.	0.2H	-		○			○					○		
	7	Tighten the cover and main bolt.	1.0H	-		○			○					○		
	8	Check the mechanical stopper and adjustable mechanical stopper	0.1H	-		○			○					○		
	9	Remove spatter and dust etc.	1.0H	-		○			○					○		
	10	Check the cable for equipments	0.1H	-		○			○					○		
	11	Replacing batteries *3	0.1H	-									●			
	12	Replacing grease of J4 axis gearbox	0.5H	450ml												
	13	Replacing grease of J5 axis gearbox	0.5H	200ml												
	14	Replacing grease of J6 axis gearbox	0.5H	85ml												
	15	Replacing cable of mechanical unit	4.0H	-												
	16	Replace the J1 cable protection sheet	0.2H	-										●		
Controller	17	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	-		○			○					○		
	18	Cleaning the controller ventilation system	0.2H	-	○	○	○	○	○	○	○	○	○	○	○	○
	19	Replacing batteries *1 *3	0.1H	-												

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

*2 ●: requires order of parts
○: does not requires 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
●						●						●						●			11
●												●									12
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○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	18
				●																	19

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. When finished, remove all the excess LOCTITE when you are finished screwing the bolts into the threaded holes.

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/mm² or more

Size M24 or more : Tensile strength 1000N/mm² or more

All size plating bolt : Tensile strength 1000N/mm² or more

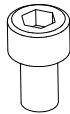
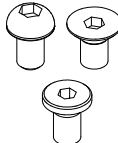
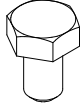
Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)

Tensile strength 400N/mm² or more

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

Recommended bolt tightening torques

Unit: Nm

Nominal diameter	Hexagon socket head bolt (steel)		Hexagon socket head bolt (stainless)		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.

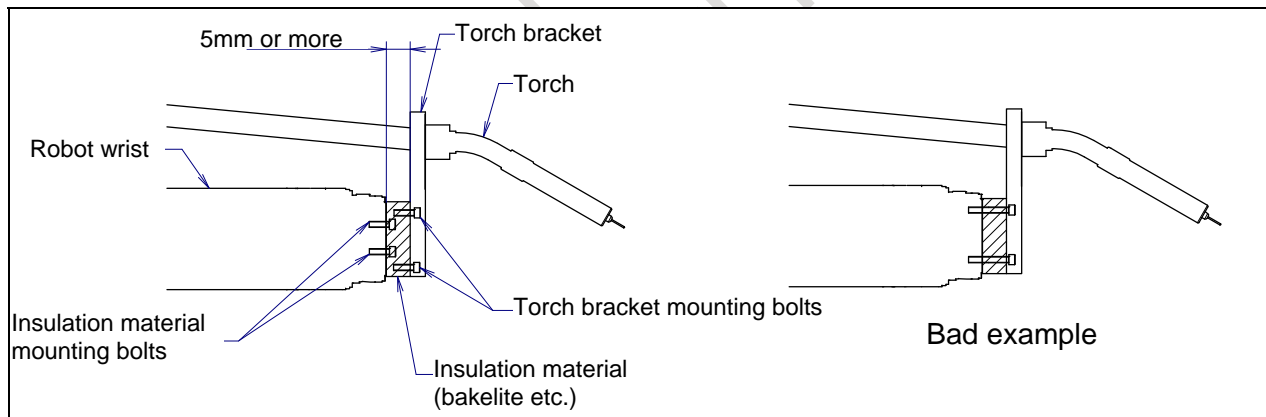


Fig.E.1 (a) Insulation at the wrist

- 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.

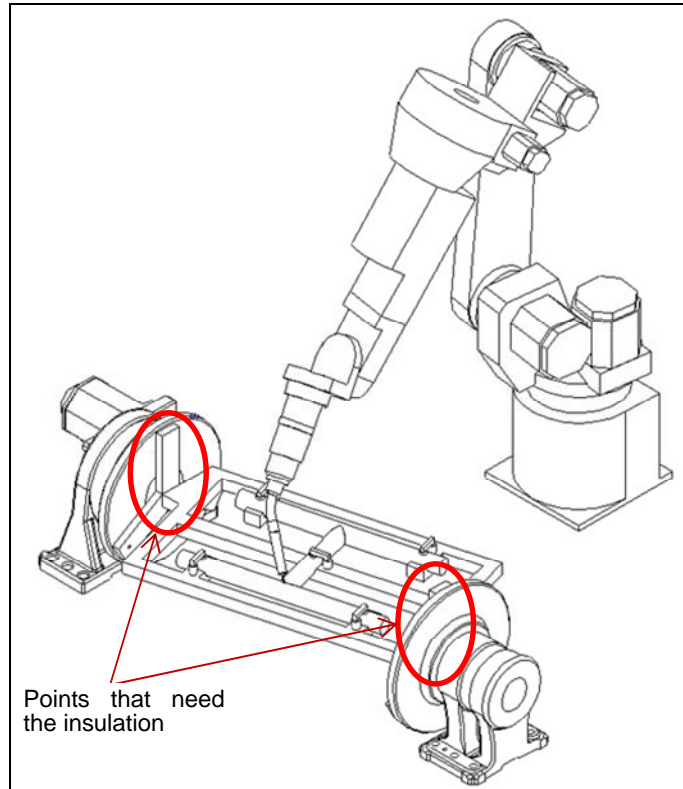


Fig. E.2 (a) Insulation at the additional axis

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REVISION RECORD

Edition	Date	Contents
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