

FANUC Robot R-2000*i*C/210WE

MECHANICAL UNIT OPERATOR'S MANUAL

B-84014EN/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.
- All specifications and designs are subject to change without notice.

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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-2450-J360 (5m)
	A05B-2450-J361(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 not in compliance with EN ISO 10218-1 and 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.

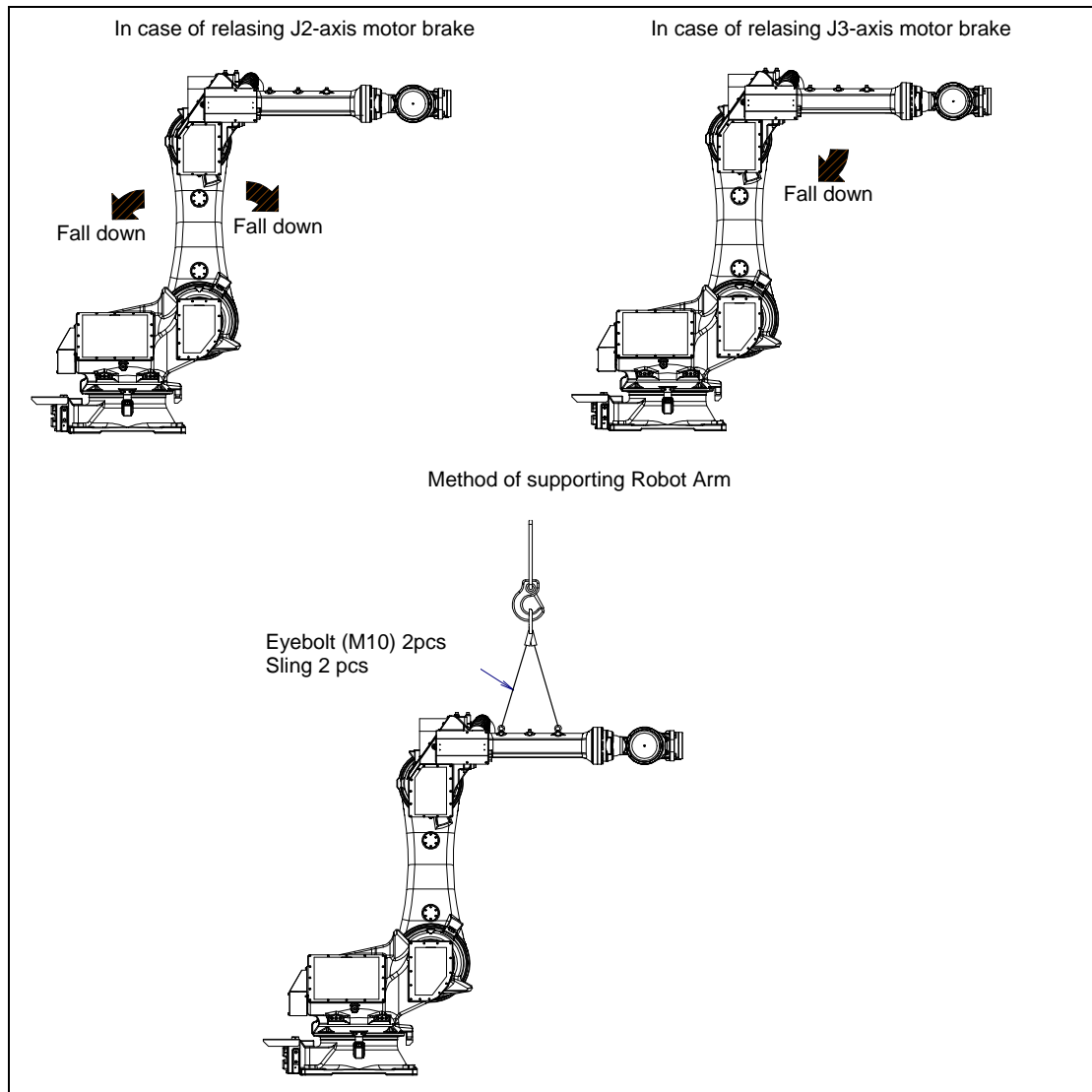


Fig. 3 (a) Arm operation by the release of J2, J3-axis motor brake and measures

4 PRECAUTIONS FOR MECHANISMS

In case of washing robot, perform air purge constantly when robot is in washing booth. Please refer to piping and wiring to the end effector chapter of mechanical unit operator's manual (B-84014EN) about purge air inlet and purge pressure.

5 WARNING & CAUTION LABEL

(1) Oiling label



Fig. 5 (a) Oiling label

Description

When oiling, observe the instructions indicated on this label.

- 1) Open the ventilator hole at oiling.
- 2) Use a manual pump at oiling.
- 3) Be sure to use a specified oil.



CAUTION

See Chapter 7 "CHECKS AND MAINTENANCE" for explanations about specified oil, the oil amount, and the locations of oil inlet, outlet and ventilator hole.

(2) Step-on prohibitive label



Fig. 5 (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. 5 (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

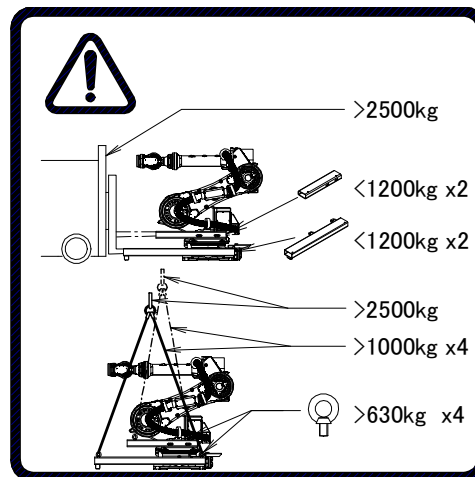


Fig. 5 (d) Transportation label

Description

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

- 1) Using a forklift
 - Use a forklift having a load capacity of 2500 kg or greater.
 - Keep the total mass of the robot to be transported to within 2400 kg, because the load capacity of the forklift bracket (option) is 11760 N (1200 kgf).
- 2) Using a crane
 - Use a crane with a load capacity of 2500 kg or greater.
 - Use four slings each with each load capacity of 1000 kg or greater.
 - Use at least four eyebolts with each allowable load of 6174 N (630 kgf) or greater.



CAUTION

Transportation labels are model-specific. Before transporting the robot, see the transportation label affixed to the J2 arm side.

See Subsection 1.1 TRANSPORTATION for explanations about the posture a specific model should take when it is transported.

(5) Operating space and payload capacity label

In the case of CE specification, the following label is added:

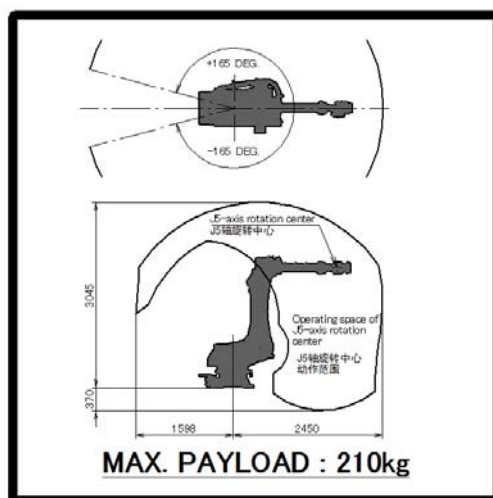


Fig. 5 (e) Operating space and payload label

(6) Transportation caution label

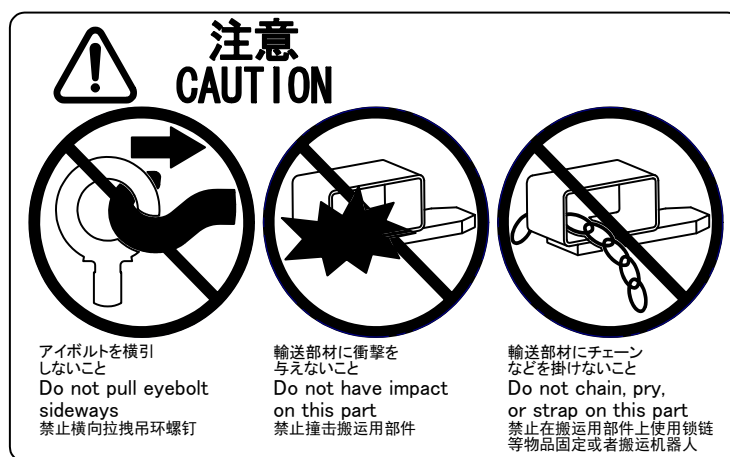
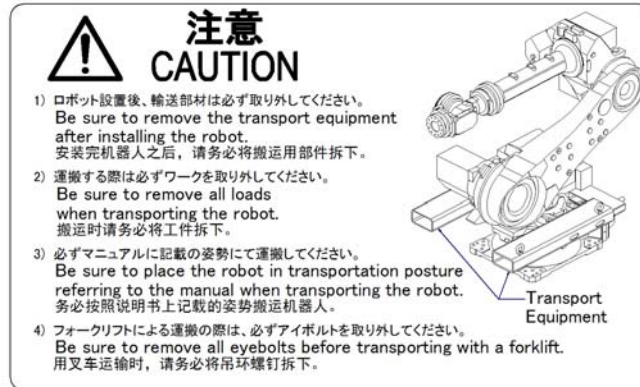


Fig. 5 (f) Transportation prohibitive label
(Transport equipment option)

Description

Keep the following in mind when transporting the robot.

- 1) Do not pull eyebolts sideways.
- 2) Prevent the forks of the forklift from having impact on a transport equipment.
- 3) Do not thread a chain or the like through a transport equipment.



**Fig. 5 (g) Transportation caution label
(for transport equipment option)**

Description

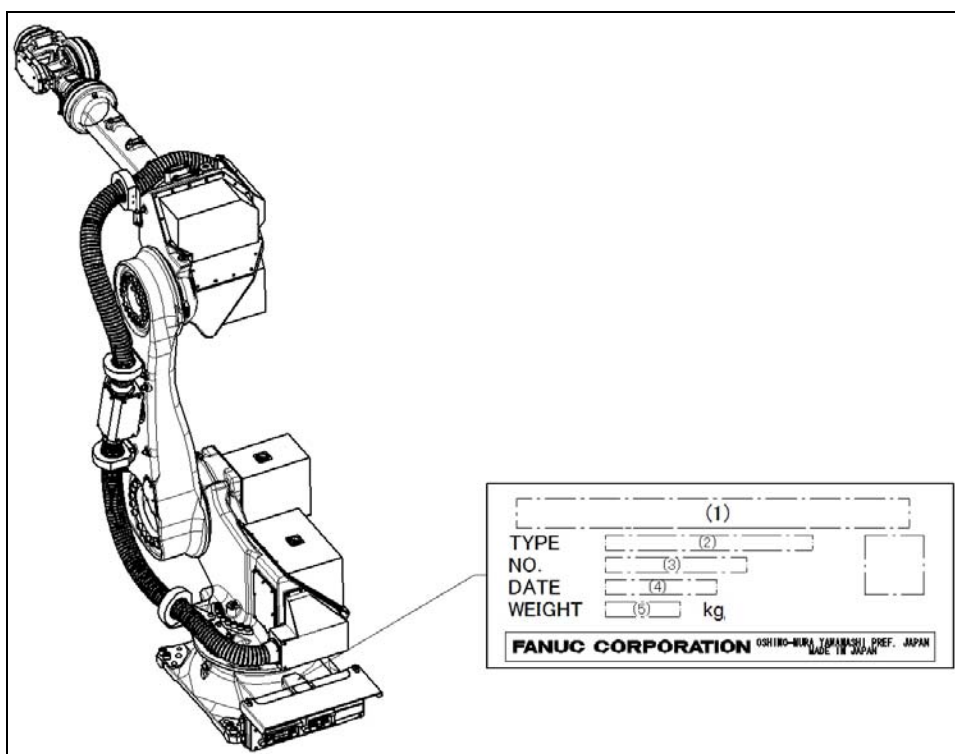
- 1) Remove the transport equipment after installing the robot.
- 2) Remove all loads when transporting the robot. (Wrist and arm)
- 3) Always place the robot in shipping position (refer to the manual) when transporting the robot.
- 4) Be sure to remove all eyebolts before transporting with a forklift.

PREFACE

This manual explains about the operation procedures for the following robot mechanical units:

Model name	Mechanical unit specification No.	Max. payload
FANUC Robot R-2000iC/210WE	A05B-1338-B201	210kg

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



Position of label indicating mechanical unit specification number

TABLE 1

	(1)	(2)	(3)	(4)	(5)
CONTENTS	MODEL NAME	TYPE	No.	DATE	WEIGHT kg (Without controller)
LETTERS	FANUC Robot R-2000iC/210WE	A05B-1338-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	1180

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, R-30iB Plus controller	OPERATOR'S MANUAL (Basic Operation) B-83284EN OPERATOR'S MANUAL (Alarm Code List) B-83284EN-1 Optional Function OPERATOR'S MANUAL B-83284EN-2 Spot Welding Function OPERATOR'S MANUAL B-83284EN-4 Dispense Function OPERATOR'S MANUAL B-83284EN-5 Servo Gun Function OPERATOR'S MANUAL B-83264EN	Intended readers : Operator, Programmer, Maintenance technician, System designer Topics : Robot functions, Operations, Programming, Start-up, Interfaces, Alarms Use : Robot operation, Teaching, System design
	MAINTENANCE MANUAL R-30iB, R-30iB Plus : B-83195EN	Intended readers : Maintenance technician, System designer Topics : Installation, Start-up, Connection, Maintenance Use : Installation, Start-up, Connection, Maintenance

This manual uses following terms.

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

TABLE OF CONTENTS

SAFETY PRECAUTIONS	s-1
PREFACE	p-1
1 TRANSPORTATION AND INSTALLATION	1
1.1 TRANSPORTATION.....	1
1.1.1 Transportation with an End Effector Attached.....	4
1.2 INSTALLATION	5
1.2.1 Installation Method.....	6
1.3 MAINTENANCE AREA.....	11
1.4 INSTALLATION CONDITIONS.....	11
2 CONNECTION WITH THE CONTROLLER	12
2.1 CONNECTION WITH THE CONTROLLER	12
3 BASIC SPECIFICATIONS.....	13
3.1 ROBOT CONFIGURATION.....	13
3.2 MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE	17
3.3 ZERO POINT POSITION AND MOTION LIMIT	18
3.4 WRIST LOAD CONDITIONS	22
3.5 LOAD CONDITIONS ON J2 BASE AND J3 CASING	23
4 EQUIPMENT INSTALLATION TO THE ROBOT	24
4.1 END EFFECTOR INSTALLATION TO WRIST	24
4.2 EQUIPMENT MOUNTING FACE	25
4.3 LOAD SETTING	26
5 PIPING AND WIRING TO THE END EFFECTOR.....	28
5.1 AIR SUPPLY (OPTION)	29
5.2 AIR PIPING (OPTION)	30
5.3 INTERFACE FOR OPTION CABLE (OPTION)	31
5.4 INSTALLING THE AIR PURGE KIT	32
6 AXIS LIMITS SETUP.....	33
6.1 CHANGE AXIS LIMIT BY DCS (OPTION).....	34
6.2 ADJUSTABLE MECHANICAL STOPPER AND LIMIT SWITCH SETTING (OPTION)	37
6.2.1 Installing Adjustable Mechanical Stopper Option	38
6.2.2 Changing the Parameter Setting	42
6.2.3 The Maximum Stopping Distance (Position) of Adjustable Mechanical Stopper	43
7 CHECKS AND MAINTENANCE	44

7.1	CHECKS AND MAINTENANCE	44
7.1.1	Daily Checks	44
7.1.2	Periodic Checks and Maintenance.....	45
7.2	CHECK POINTS.....	47
7.2.1	Confirmation of Oil Seepage.....	47
7.2.2	Confirmation of the Air Control Set or Air Purge Kit (option).....	48
7.2.3	Check the Mechanical Unit Cables and Connectors	49
7.2.4	Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper	50
7.2.5	Check of Purge Piping and Drain Holes.....	51
7.2.6	Check of Debris Cover	52
7.3	MAINTENANCE.....	53
7.3.1	Replacing the Batteries (1.5 year Periodic Maintenance)	53
7.3.2	Replacing the Oil of the Drive Mechanism (1 year (3840 hours) Periodic Maintenance)	54
7.4	STORAGE	59
8	MASTERING	60
8.1	OVERVIEW	60
8.2	RESETTING ALARMS AND PREPARING FOR MASTERING	61
8.3	ZERO POSITION MASTERING	62
8.4	QUICK MASTERING.....	65
8.5	QUICK MASTERING FOR SINGLE AXIS	68
8.6	SINGLE AXIS MASTERING	71
8.7	MASTERING DATA ENTRY	74
8.8	VERIFYING MASTERING	76
9	TROUBLESHOOTING	77
9.1	TROUBLESHOOTING.....	77
 APPENDIX		
A	PERIODIC MAINTENANCE TABLE	85
B	STRENGTH OF BOLT AND BOLT TORQUE LIST.....	88

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

Use a crane or a forklift to transport the robot. When transporting the robot, be sure to change the posture of the robot to that shown below and lift by using the eyebolts and the transport equipment at their points.

(1) Transportation using a crane (Fig. 1.1 (a))

The robot is transported with the specific transport equipment attached. Fasten the M20 eyebolts at the four points and lift the robot by the four slings.



CAUTION

When lifting the robot, be careful not to damage conduits of the robot by slings.

(2) Transportation using a forklift (Fig. 1.1 (b))

The robot is transported with the specific transport equipment attached.



WARNING

- 1 When hoisting or lowering the robot with a crane or forklift, move it slowly with great care. When placing the robot on the floor, exercise care to prevent the installation surface of the robot from striking the floor.
- 2 Detach the end effectors and the floor plate before transporting the robot. If the robot need to be transported with the floor plate or end effectors attached, take the following precautions:
 - The entire position of center of gravity is changed by installing the end effector and the floor plate. Please note the balance enough.
 - The end effector swings by the vibration when transported, and there is a possibility that an excessive load acts on the robot. Secure the end effector firmly according to Subsection 1.1.1.
 - When you lift robot with the floor plate installed, please lift up not the robot but the floor plate.
- 3 Use the forklift transport equipment only to transport the robot with a forklift. Do not use the forklift transport equipment to secure the robot.
- 4 Before moving the robot by using transport equipment, check the bolts on the transport equipment and tighten any loose bolts if any.

Crane
Load capacity.: 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling

Eyebolt
Allowable load. : 630kgf/each or more

Note)

1 Machine mass 1180 kg

2 Eyebolt complied with JIS B 1168.

3 Quantity eyebolt 4 pcs, sling 4 pcs

Robot posture on transportation

J1	Arbitrary
J2	-65°
J3	0°
J4	0°
J5	0°
J6	0°

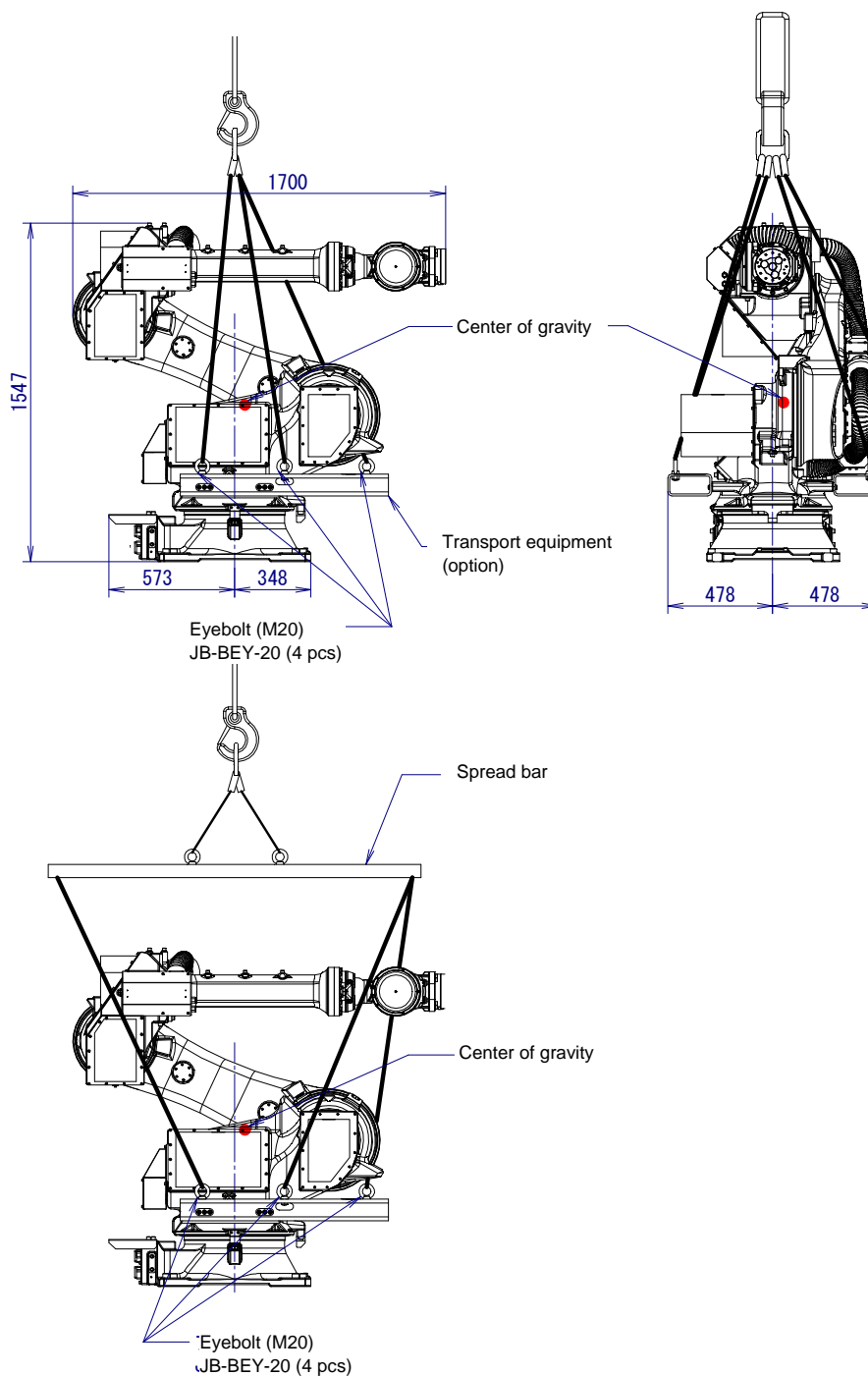


Fig. 1.1 (a) Transportation using a crane

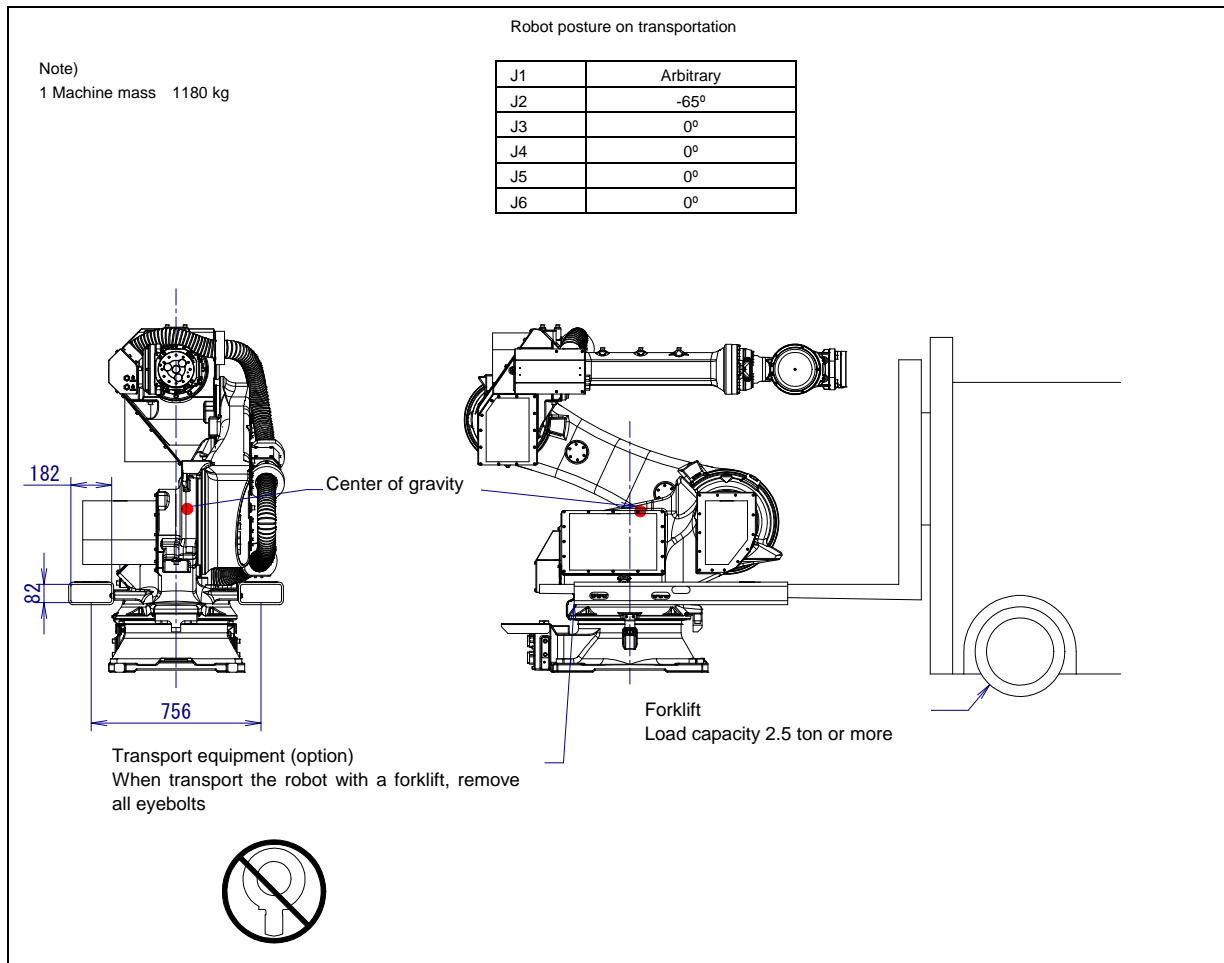


Fig. 1.1 (b) Transportation using a forklift

**CAUTION**

Be careful not to strike the transport equipment with the forklift forks.

1.1.1 Transportation with an End Effector Attached

When transporting a robot with an end effector such as a hand attached, secure the arm with wood. If the arm is not secured, the end effector may oscillate for a cause such as vibration during transportation, as a result, a large impact load, imposes on the reducer of the robot, cause premature failure of the reducer.

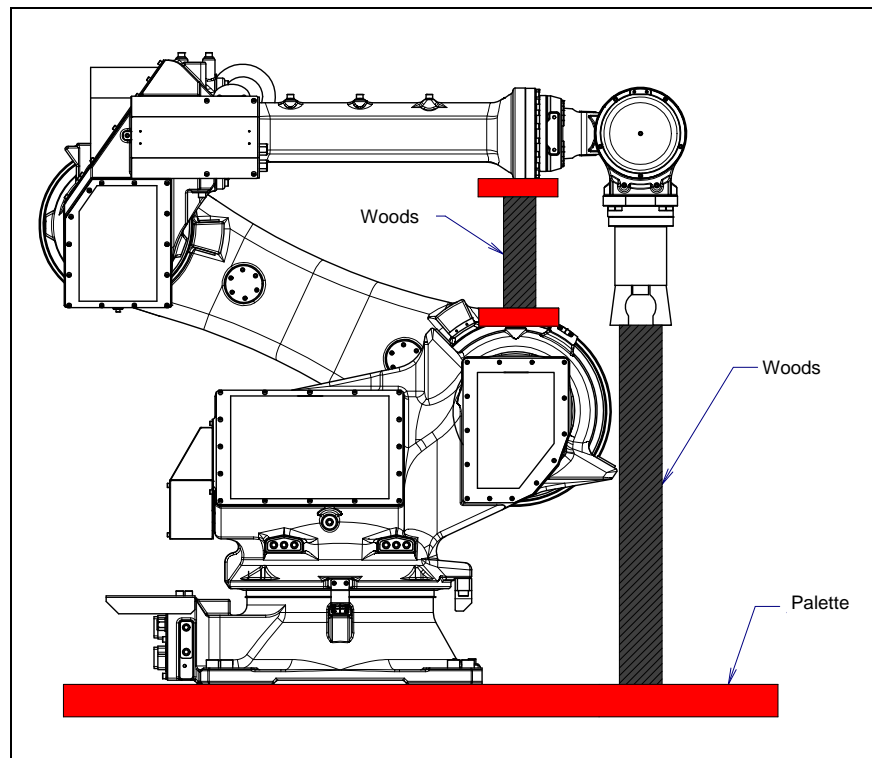


Fig. 1.1.1 (a) Example of securing the arm during transportation when an end effector is attached

1.2 INSTALLATION

Fig. 1.2 (a) shows the robot base dimensions. Avoid placing any object in front of the robot on the locating surface to facilitate the installation of the mastering fixture. (Shaded portion)

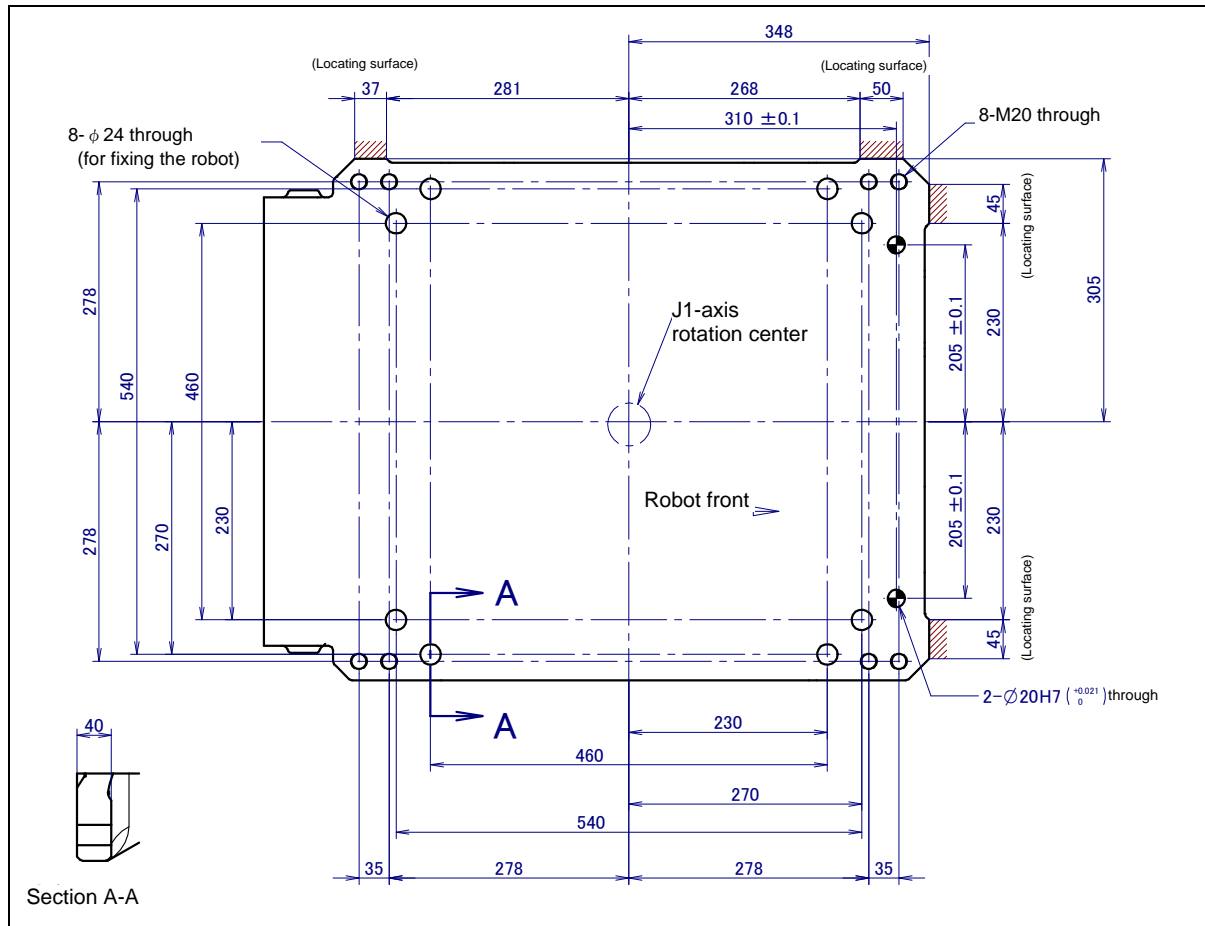


Fig. 1.2 (a) Dimensions of the robot base

1.2.1 Installation Method

There are three methods for installation of the robot as given below. Select a method according to the customer's installation environment, and install the robot.

- Installation method I Fig. 1.2.1 (a)
The floor plate is imbedded in concrete and fastened with twelve M20 (Tensile strength 400N/mm² or more) chemical anchors. Also fasten the base plate to the robot base using eight M20 x 75 bolts (Tensile strength 1200N/mm² or more). Next, position the robot, and weld the base plate to the floor plate. (Floor length is 10 to 15mm.) (The base plate is prepared as the option.)
- Installation method II Fig. 1.2.1 (b)
The floor plate is not imbedded in concrete. The floor plate is fastened at the twelve points with M20 chemical anchors (Tensile strength 400N/mm² or more) and the inclination of the floor plate is adjusted with the four fixing screws. The robot is positioned with the robot base pushed against the three ϕ 20 parallel pins inserted into the floor plate and the robot base is fastened on the floor plate with eight M20 x 75 bolts (Tensile strength 1200N/mm² or more).
- Installation method III Fig. 1.2.1 (c)
The installation method is generally the same as described above except that the parallel pins for pushing the robot base are not used.

The strength of the chemical anchor depends on the concrete strength. See the design guideline of the manufacturer for the execution of the chemical anchor and consider the safety ratio sufficiently before use.

The following parts are required to install the robot.

(○ : Parts needs to be prepared.)

Required parts	Remarks	Methods I	Methods II	Methods III
Robot mounting bolts	M20 x 75 (Tensile strength 1200N/mm ² or more) 8 pcs	○	○	○
Plain washers	For M20 (HRC 35 or more, thickness between 4 and 5 mm) 8 pcs	○	○	○
Chemical anchors	M20 (Tensile strength 400N/mm ² or more) 12 pcs	○	○	○
Floor plate	Thickness 32t 1 pc	○	○	○
Base plates	Thickness 32t 4 pcs	○		
Fixing screws	M20 4 pcs		○	○
Nuts	M20 4 pcs		○	○
Parallel pins	ϕ 20 3 pcs		○	

NOTE

- Damage to robot will occur in case the mechanical unit is installed by a method other than one of those 3 methods validated by FANUC.
- Customer must provide all necessary arrangements for the actual installation work (such as welding and anchoring).
- Flatness of robot installation surface must be less than or equal to 0.5mm.
Inclination of robot installation surface must be less than or equal to 0.5°.
If robot base is placed on uneven ground, it may result in the base breakage or low performance of the robot.

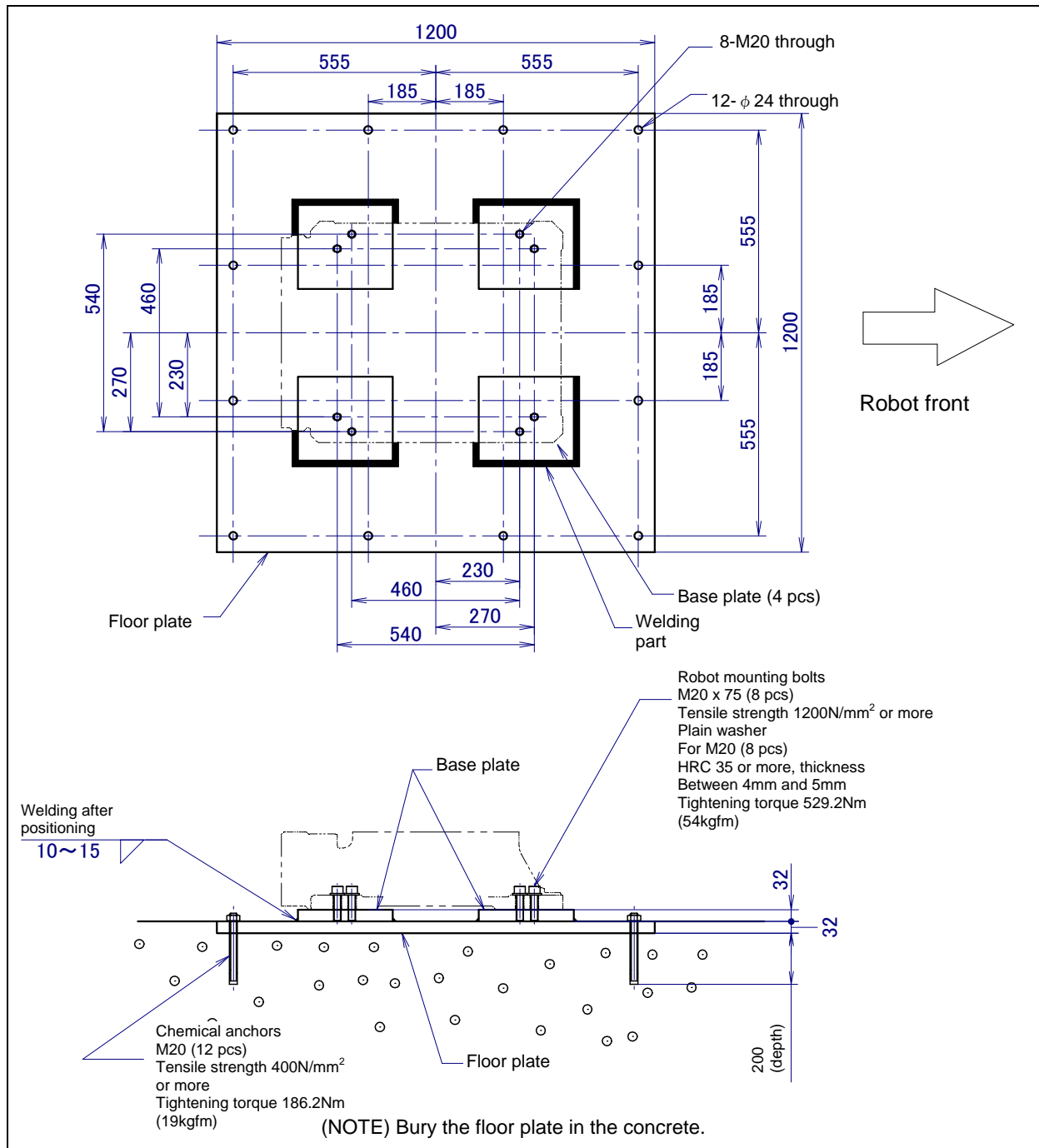


Fig. 1.2.1 (a) Installation method I

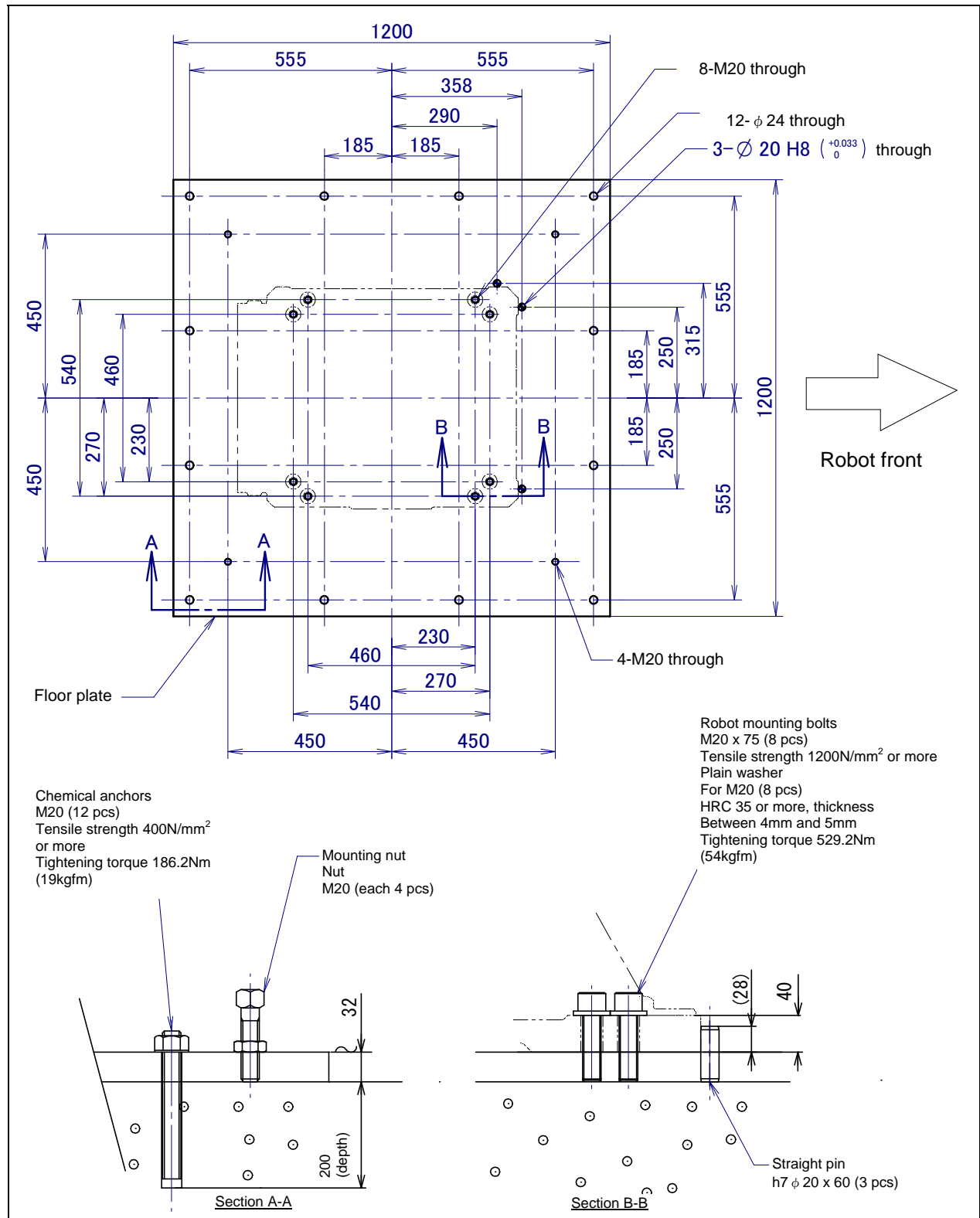


Fig. 1.2.1 (b) Installation method II

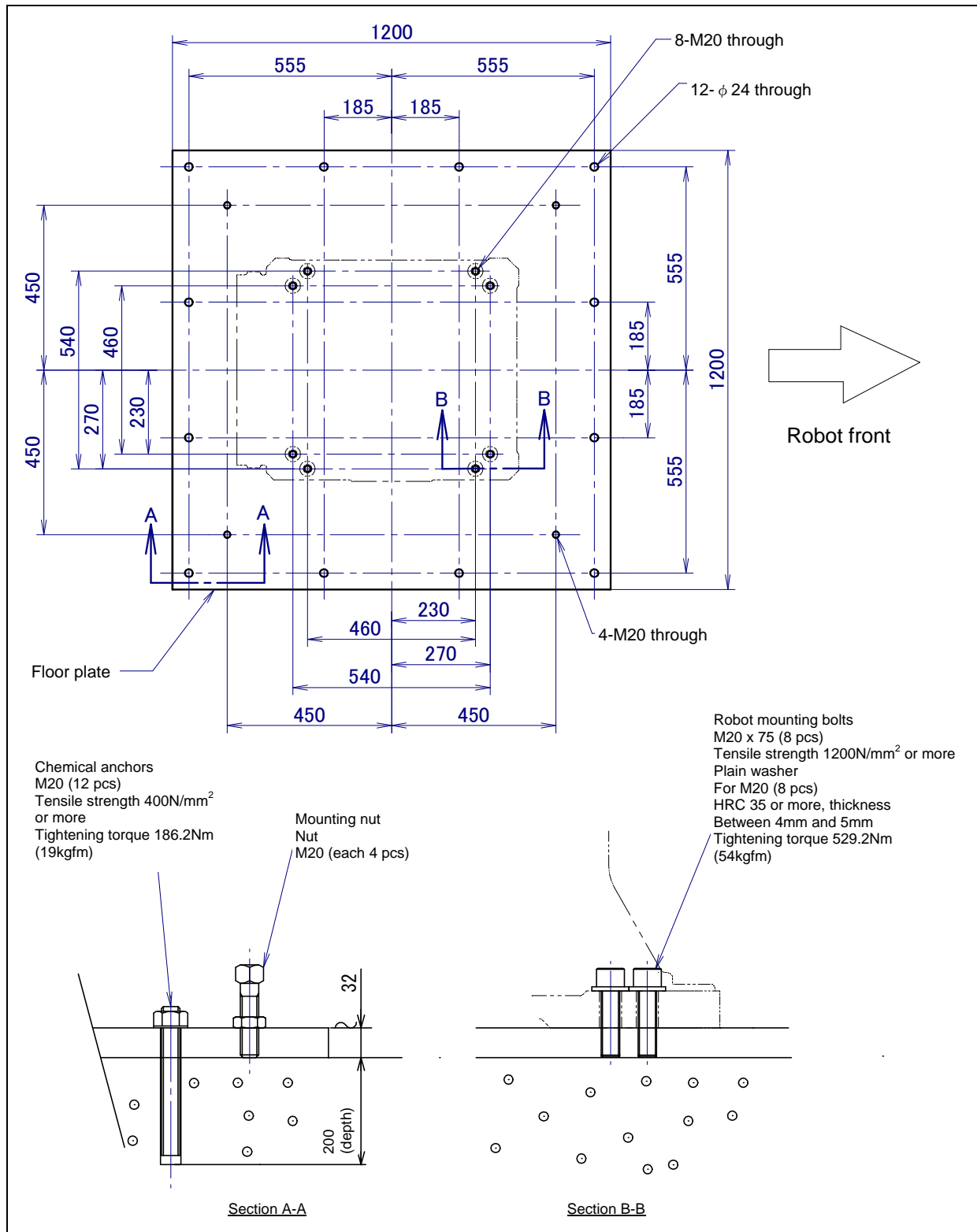


Fig. 1.2.1 (c) Installation method III

Fig. 1.2.1 (d) and Table 1.2.1 (a) indicate the force and moment applied to the base plate at the time of Power-off stop of the robot. Table 1.2.1 (b) to (d) indicate the stopping distance and time of the J1 to J3 axis until the robot stopping by Power-Off stop, by Smooth stop or by Controlled stop after input of the stop signal. Refer to the data when considering the strength of the installation face.

NOTE

Table 1.2.1 (b) to (d) are measured reference value complied with ISO10218-1. Values differs depending on each robot individual difference, payload and the program. So confirm the real value by measurement. Values in Table 1.2.1 (b) is affected by the robot operating status and number of times of the servo-off stop. Periodically measure the real values and confirm those.

Table 1.2.1 (a) Force and moment during Power-Off stop

Model	Vertical moment MV [kNm(kgfm)]	Force in vertical direction FV [kN(kgf)]	Horizontal moment MH [kNm(kgfm)]	Force in horizontal direction FH [kN(kgf)]
R-2000iC/210WE	69.58 (7100)	40.18 (4100)	25.48 (2600)	27.44 (2800)

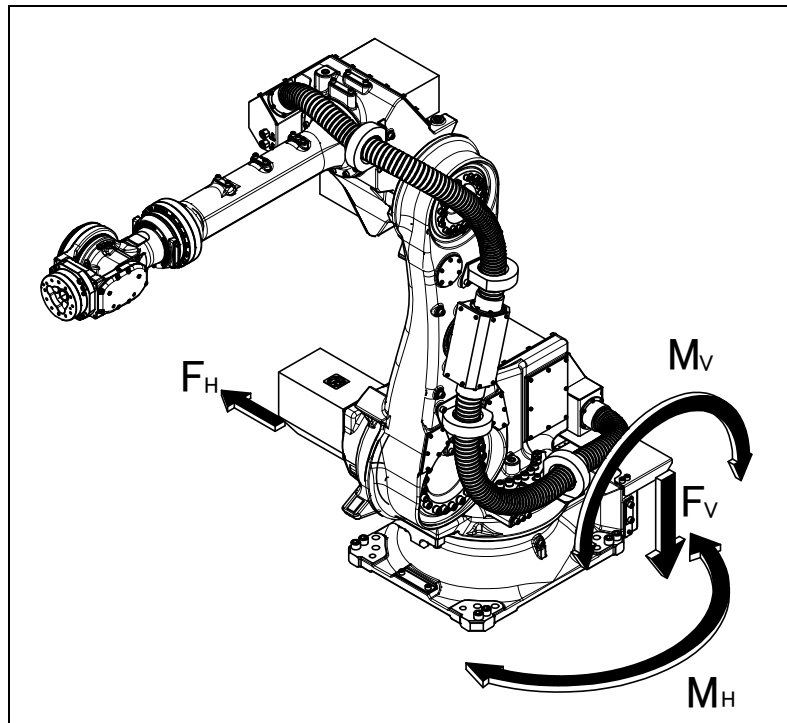


Fig. 1.2.1 (d) Force and moment during Power-Off stop

Table 1.2.1 (b) Stopping time and distance until the robot stopping by Power-Off stop after input of stop signal

Model		J1-axis	J2-axis	J3-axis
R-2000iC/210WE	Stopping time [ms]	374	305	163
	Stopping distance [deg] (rad)	17.8 (0.31)	12.0 (0.21)	7.2 (0.13)

Table 1.2.1 (c) Stopping time and distance until the robot stopping by Smooth stop after input of stop signal

Model		J1-axis	J2-axis	J3-axis
R-2000iC/210WE	Stopping time [ms]	706	690	756
	Stopping distance [deg] (rad)	32.1 (0.56)	28.7 (0.50)	31.7 (0.55)

Table 1.2.1 (d) Stopping time and distance until the robot stopping by Controlled stop after input of stop signal

Model		J1-axis	J2-axis	J3-axis
R-2000iC/210WE	Stopping time [ms]	868	848	960
	Stopping distance [deg] (rad)	42.4 (0.74)	37.2 (0.65)	43.0 (0.75)

1.3 MAINTENANCE AREA

Fig. 1.3 (a) shows the maintenance area of the mechanical unit. Dotted line area is necessary for mastering. Be sure to leave enough room for the robot to be mastered. See Chapter 8 for mastering.

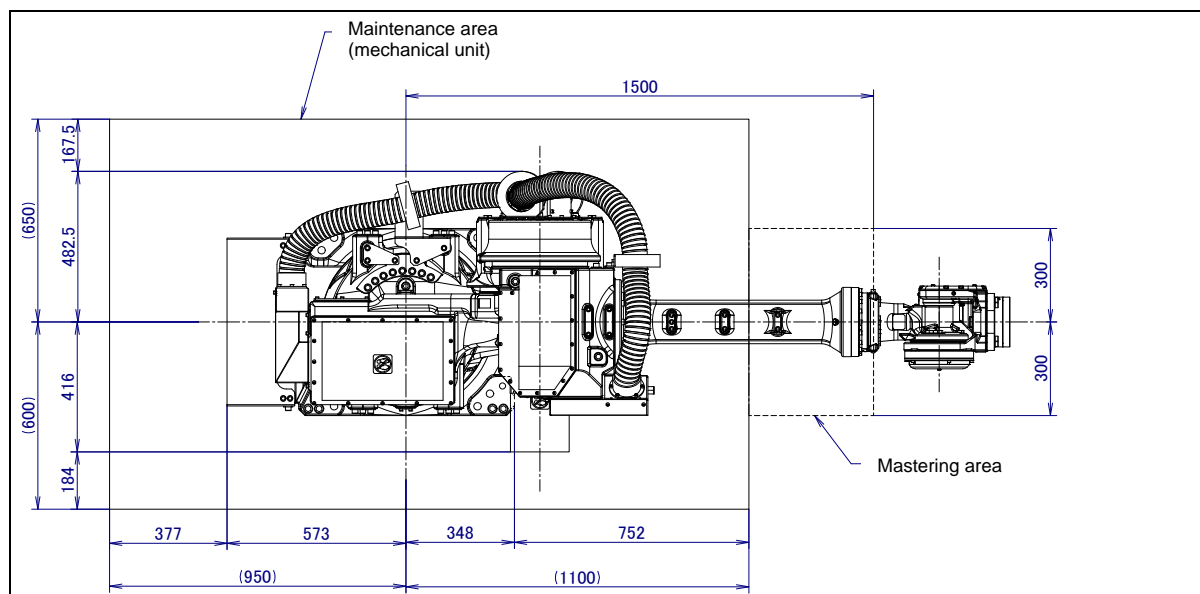


Fig. 1.3 (a) Maintenance area

1.4 INSTALLATION CONDITIONS

Refer to the caution below concerning installation conditions. Refer to also to the specifications found in Section 3.1.



CAUTION

Damage to the cable jacket can cause water intrusion. Take care not to damage the cable jacket when installing the robot. Replace the cable if it is damaged.

2 CONNECTION WITH THE CONTROLLER

2.1 CONNECTION WITH THE CONTROLLER

The robot is connected with the controller via the power cable, the signal cable and the earth cable. Connect these cables to the connectors on the back of the robot base. For details on air, see Chapter 5.



WARNING

Before turning on controller power, be sure to connect the robot and controller with the earth line (ground). Otherwise, there is the risk of electrical shock.



CAUTION

- 1 Before connecting the cables, be sure to turn off the controller power.
- 2 Don't use 10m or longer coiled cable without first untying it. The long coiled cable will heat up and become damaged.

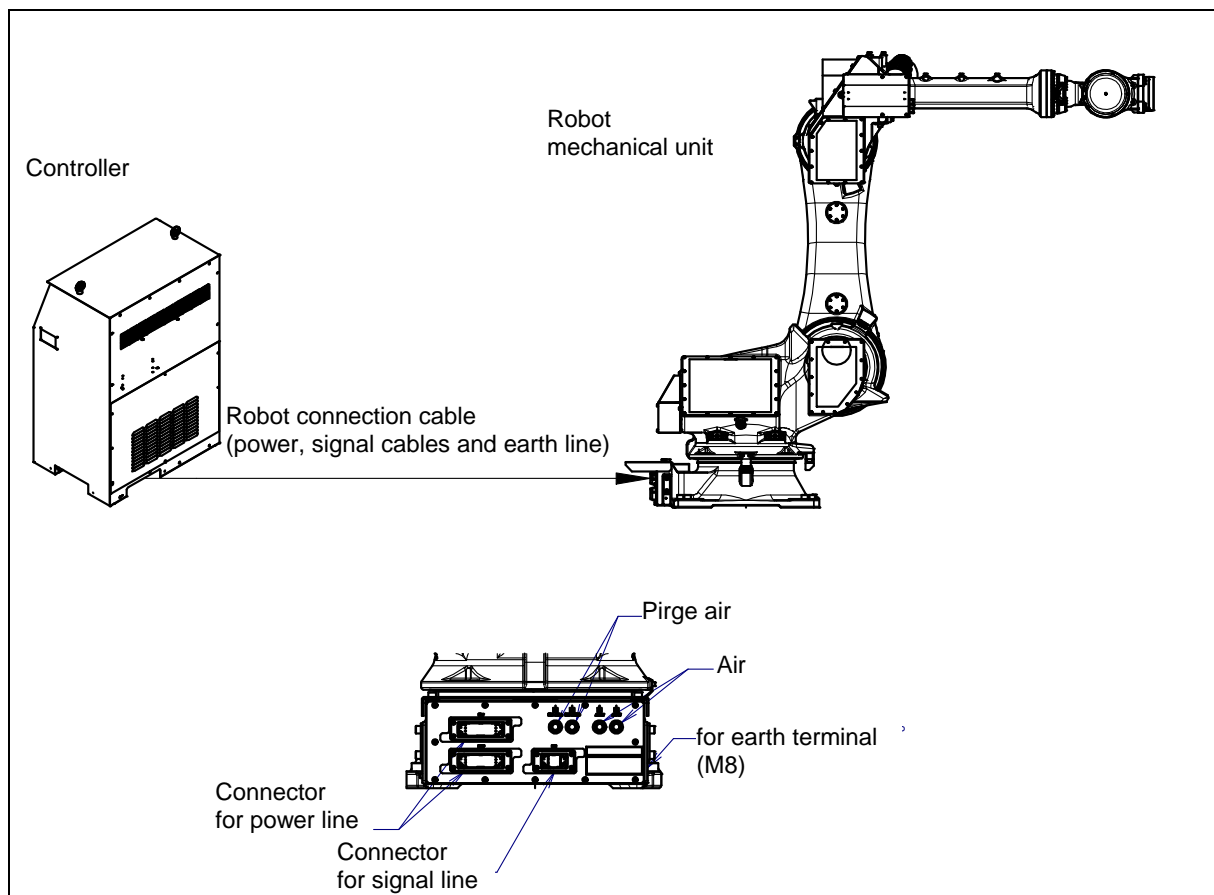


Fig. 2.1 (a) Cable connection

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

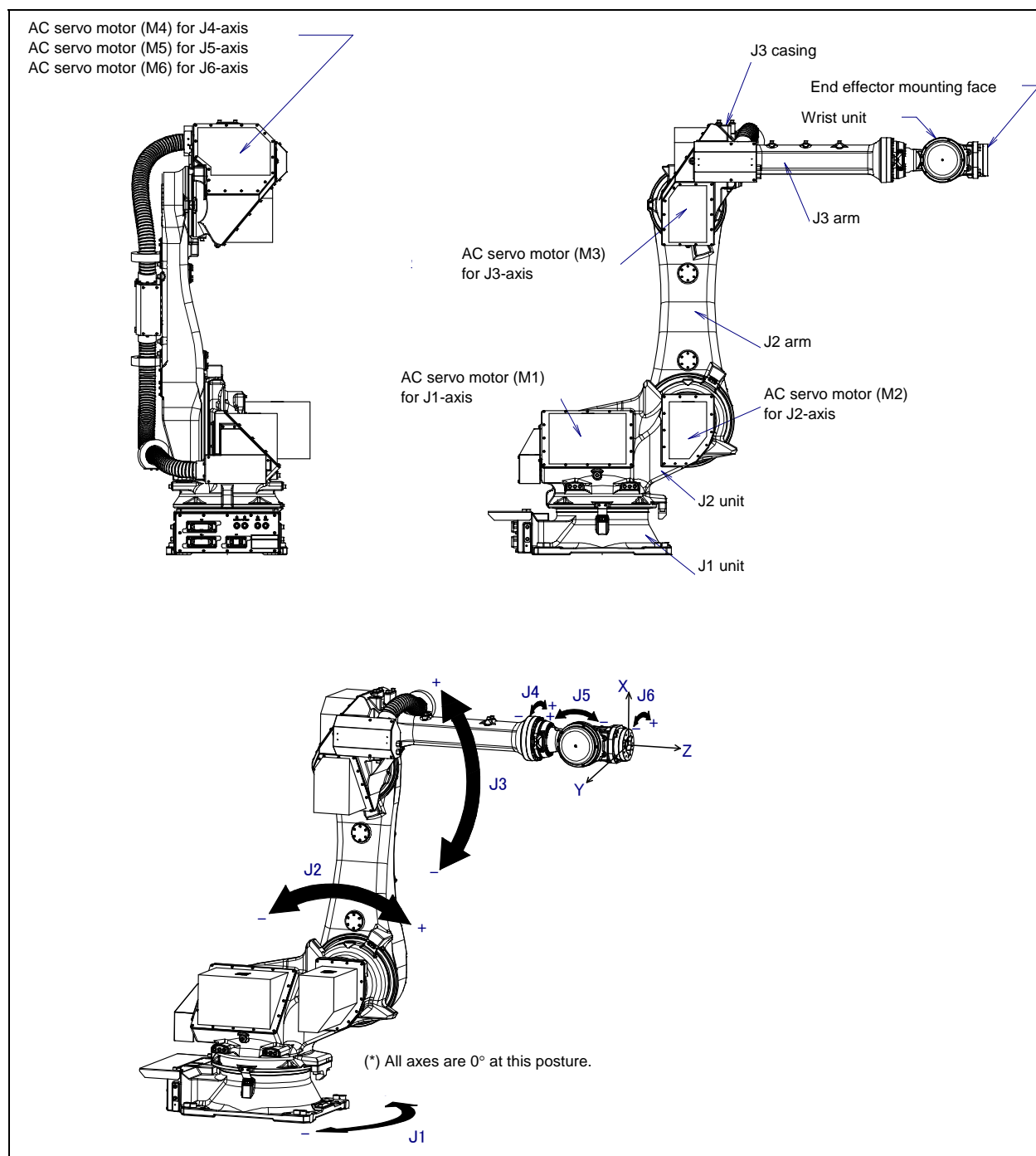


Fig. 3.1 (a) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates

NOTE

The end effector mounting face center is 0, 0, 0 of the mechanical interface coordinates.

B-84014EN/02

Model			R-2000iC/210WE
Type			Articulated Type
Controlled axis			6 axes (J1,J2,J3,J4,J5,J6)
Installation			Floor mount
Motion range	J1-axis	Upper limit	165° (2.88rad)
		Lower limit	-165° (-2.88rad)
	J2-axis	Upper limit	76° (1.33rad)
		Lower limit	-65° (-1.13rad)
	J3-axis	Upper limit	180° (3.14rad)
		Lower limit	-138° (-2.41rad)
	J4-axis	Upper limit	360° (6.28rad)
		Lower limit	-360° (-6.28rad)
	J5-axis	Upper limit	125° (2.18rad)
		Lower limit	-125° (-2.18rad)
J6-axis	Upper limit	360° (6.28rad)	
	Lower limit	-360° (-6.28rad)	
Max. speed Note 2)	J1-axis		95°/s (1.66rad/s)
	J2-axis		85°/s (1.48rad/s)
	J3-axis		95°/s (1.66rad/s)
	J4-axis		120°/s (2.09rad/s)
	J5-axis		120°/s (2.09rad/s)
	J6-axis		190°/s (3.32rad/s)
Max. payload	At wrist		210kg
	On J3 arm		-
	On J3 casing		10kg
	On J2 base		550kg
Allowable load moment at wrist	J4-axis		1333N·m (136kgf·m)
	J5-axis		1333N·m (136kgf·m)
	J6-axis		706N·m (72kgf·m)
Allowable load inertia at wrist	J4-axis		141.1kg·m ² (1440kgf·cm·s ²)
	J5-axis		141.1kg·m ² (1440kgf·cm·s ²)
	J6-axis		78.4kg·m ² (800kgf·cm·s ²)
Drive method			Electric servo drive by AC servo motor
Repeatability			±0.1mm Note 3)
Mass			1180kg
Acoustic noise level			70.5dB Note 4)
Installation environment Note 5)			Ambient temperature: 0 to 55°C (Robot), 0 to 45°C (Controller) Note 6) Cleaning fluid temperature: 60°C or less Height: Up to 1000 meters above the sea level required, no particular provision for attitude. Vibration acceleration : 4.9m/s ² (0.5G) or less Free of corrosive gases Note 7)

Note 7) Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

The following table lists the IEC60529-based Severe dust/liquid protection characteristics of the R-2000iC/210WE.

	Standard
J3 arm and wrist section	IPX7
Drive unit of the main body	
Main body	

NOTE

Definition of IP code

Definition of IP X7

7=Protection from water immersion: Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time.

Performance of resistant chemicals and resistant solvents

- The liquids below cannot be applied because they may cause deterioration or corrosion of the rubber parts (such as gasket, oil seals, and O-rings) used in the robot. (As exception to this only liquids tested and approved by FANUC can be used with the robot.)
 - Organic solvent
 - Chlorine- or gasoline-based cutting fluid
 - Amine-based cleaning fluid
 - Liquid or solution that includes a corrosive such as an acid or alkali or causes rust
 - Some other liquid or solution to which nitrile rubber (NBR) does not have resistance
- When the robot is used in an environment where a liquid such as water is dashed over the robot, great attention should be given to drainage under the J1 base.
A failure may be caused if the J1 base is kept immersed in water due to poor drainage.
- Replace gaskets by new one when it is removed when replacing part and check.
- Don't use unconfirmed liquid for cutting fluid and cleaning fluid. The following shows usable cleaning fluid. Please don't use the cleaning fluid under the condition over the allowable concentration or temperature. Keep cleaning fluid temperature less than 60°C.

Cleaning fluid type	Manufacturer name	Permissible concentration	Reference pH
Yushiro cleaner W80	YUSHIRO CHEMICAL INDUSTRY CO.,LTD.	5.0% Diluted to 20 times with water	9.0
Techniclean XHP	BP Lubricants USA Inc.	2.0% Diluted to 50 times with water	8.3
PRODUCTO SP-735	CIMCOOL Industrial Products LLC	5.0% Diluted to 20 times with water	9.5
CIMCLEAN SP-787FN	CIMCOOL Industrial Products LLC	3.0% Diluted to 33 times with water	10.7
QUAKERCLEAN 624 CP	Quaker Chemical Corporation	8.0% Diluted to 12.5 times with water	9.7
QUAKERCLEAN 680 VDA	Quaker Chemical Corporation	4.0% Diluted to 25 times with water	10.6

- 5 Insufficient management of cleaning fluid causes bad effects such as corrosion on the robot. Please manage it carefully in accordance with the following description. For (a) to (e), FANUC recommends making a management check sheet and recording a management history.
 - (a) Management of pH
Please monitor pH by using pH test paper, etc., and keep appropriate pH. PH decrease causes deterioration of cleaning fluid, and it makes the robot parts corroded.
 - (b) Concentration management
Cleaning fluid is perishable when concentration is decreased, and the robot is also damaged when cleaning fluid is too much concentrated. Keep the appropriate concentration in reference to the manual of cleaning fluid.
 - (c) Refilling of diluted solution
Cleaning fluid is likely to be reduced by splashing or evaporation and carried out with workpiece and chips. Please refill diluted solution regularly. Refilling before holidays will help to prevent decay of cleaning fluid and maintain pH and antirust effect.
 - (d) Appearance check
Please check the followings of cleaning fluid on a daily basis and find the abnormality beforehand.
Cleanliness / Discoloration / Occurrence of film and sludge
 - (e) Bad smell check
Bad smell occurs when microorganisms are bred. Please check the smell of cleaning fluid on a daily basis. Examples of typical bad smell are as follows.
Rotten egg smell / Acidulous smell / Moldy smell / Other putrid smell
 - (f) Removing foreign materials
Removing chips and foreign materials with a high efficiency filter, etc. The more chloride ions from diluted solution accumulate, the more cleaning fluid becomes harmful to the robot. In cases that the chloride ions may enter from tap water, please take measures such as installation of some removing filter.
 - (g) Removing oil from other processes
FANUC recommends installing oil skimmer or oil removal equipment. Other simple ways are as below.
 - Absorbing floating ingredients of the oil with non-woven fabric, etc.
 - Scooping floating ingredients of the oil by a dedicated container (please use a dedicated one to prevent other contaminations).
- 6 Using a unapproved cleaning liquid not included in the specification or one using an approved cleaning liquid beyond its permissible concentration or temperature may result in serious damage to the robot. If a different cleaning fluid or concentration of an approved solution is required, contact your local FANUC representative in advance for details regarding performing an evaluation test.
- 7 Be sure to maintain air purge at the recommended regulated pressure.(See Section 5.4.) Continue applying the air purge even when the robot is stopping or the power supply is cut. Failure to maintain the recommended air purge pressure either when robot is in operation or stopped can may allow water to intrude inside of the robot and/or allow dew to form inside of the robot, causing serious damage to the robot. The air supply requires that a filter, dryer and oil filter be used and properly maintained. An optional air purge kit is available.
- 8 Avoid direct spray of cleaning liquid on the robot from nozzle.
- 9 Do not allow the robot to be immersed in water, neither temporary nor permanent.

3.2 MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE

Fig. 3.2 (a) shows the robot operating space. When installing peripheral devices, be careful not to interfere with the robot and its operating space.

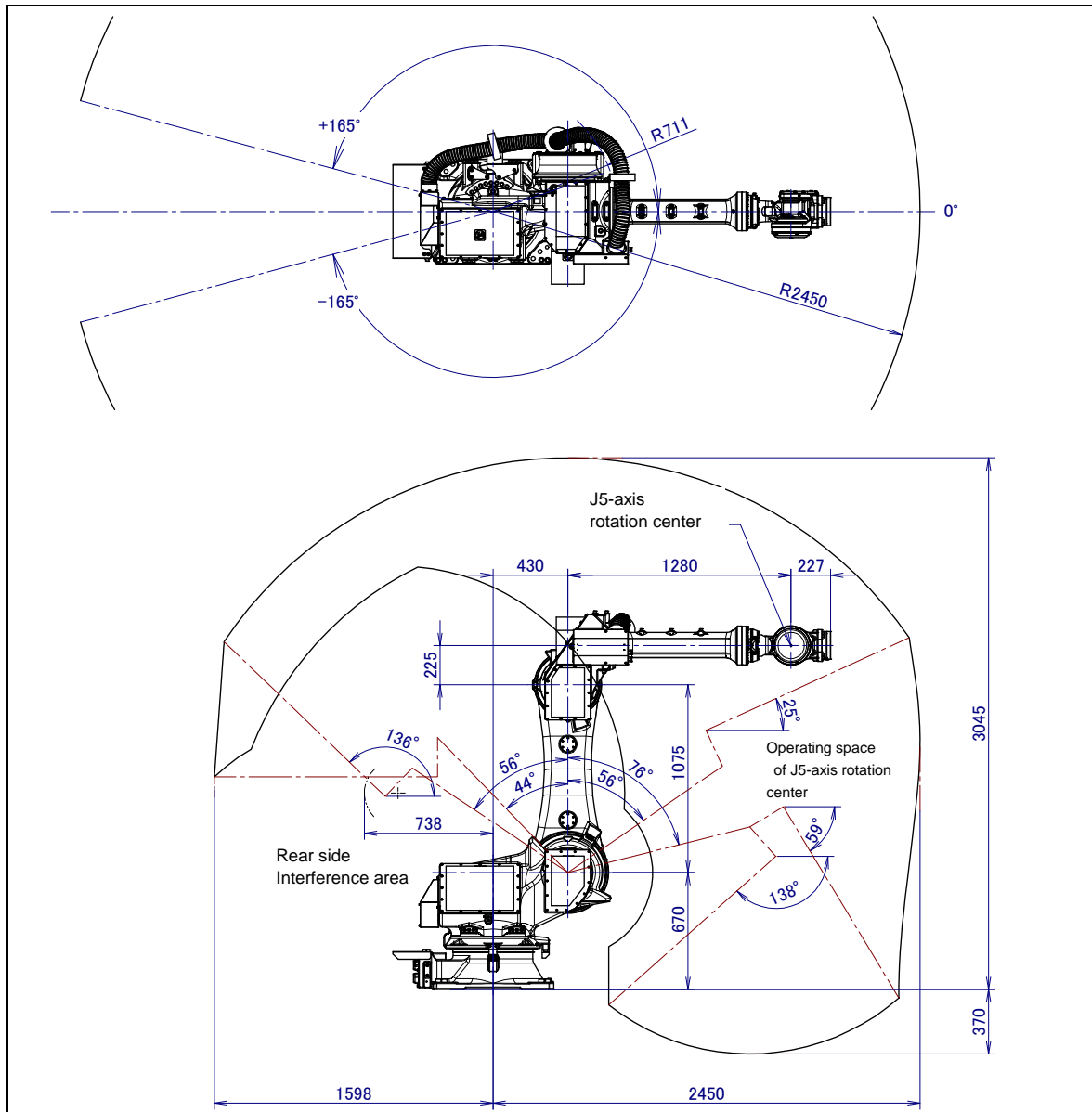


Fig. 3.2 (a) Operating space

3.3 ZERO POINT POSITION AND MOTION LIMIT

Zero point and motion range are provided for each controlled axis. Exceeding the software motion limit of a controlled axis is called overtravel (OT). Overtravel is detected at both ends of the motion limit for each axis. The robot cannot exceed the motion range unless there is a loss of zero point position due to abnormalities in servo system or system error. In addition, the motion range limit by a fixed mechanical stopper is also prepared to improve safety.

Fig. 3.3 (a) shows the position of fixed mechanical stopper.

Only in case of J1, robot stops by transforming fixed mechanical stopper (option).

Be sure to replace transformed stopper to new one. Tighten bolts with regulated torque referring to Appendix B [MOUNTING BOLT TORQUE LIST].

Replace mechanical stopper of J1-axis referring to Section 6.2.



WARNING

Do not reconstruct the fixed mechanical stopper. There is a possibility that the robot doesn't stop normally.

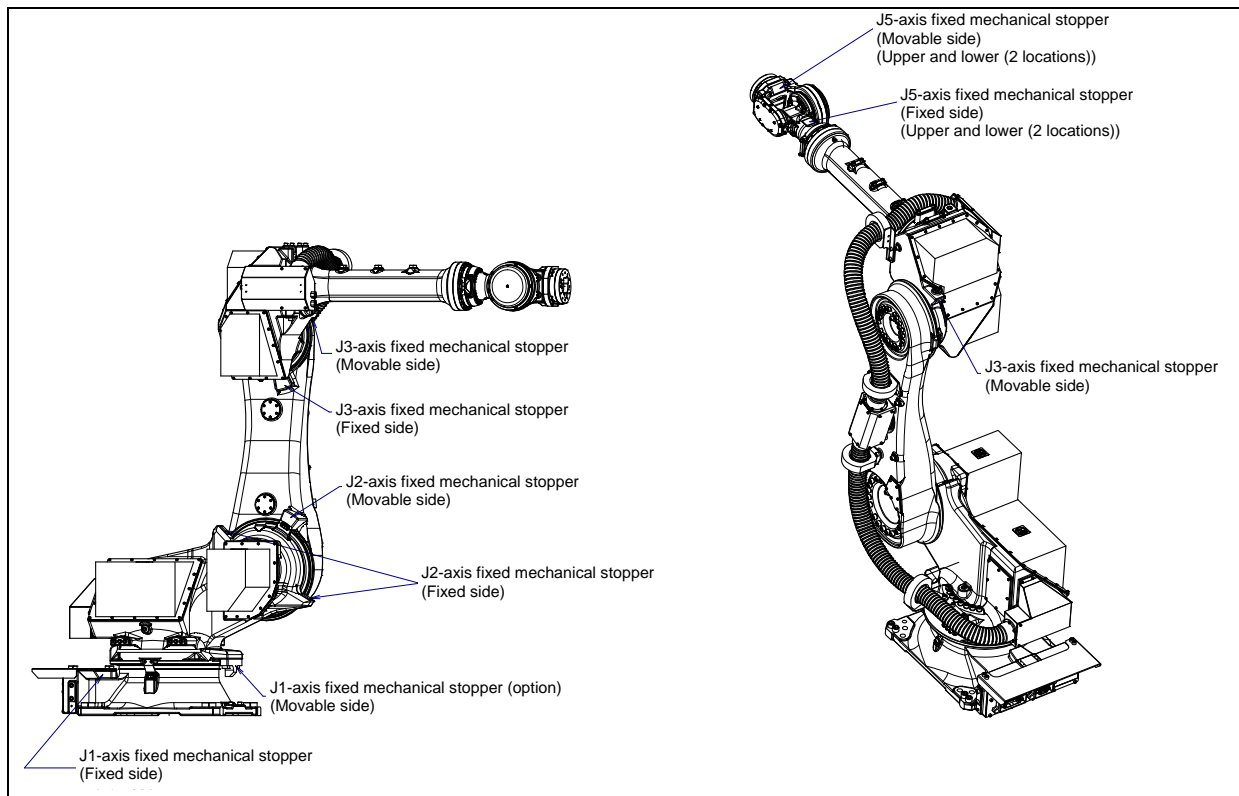


Fig. 3.3 (a) Position of fixed mechanical stopper

Fig. 3.3 (b) to (g) show the zero point, motion limit and maximum stopping distance (stopping distance in condition of maximum speed and maximum load) of each axis.

* The motion range can be changed. For information on how to change the motion range, see Chapter 6, "AXIS LIMIT SETUP".

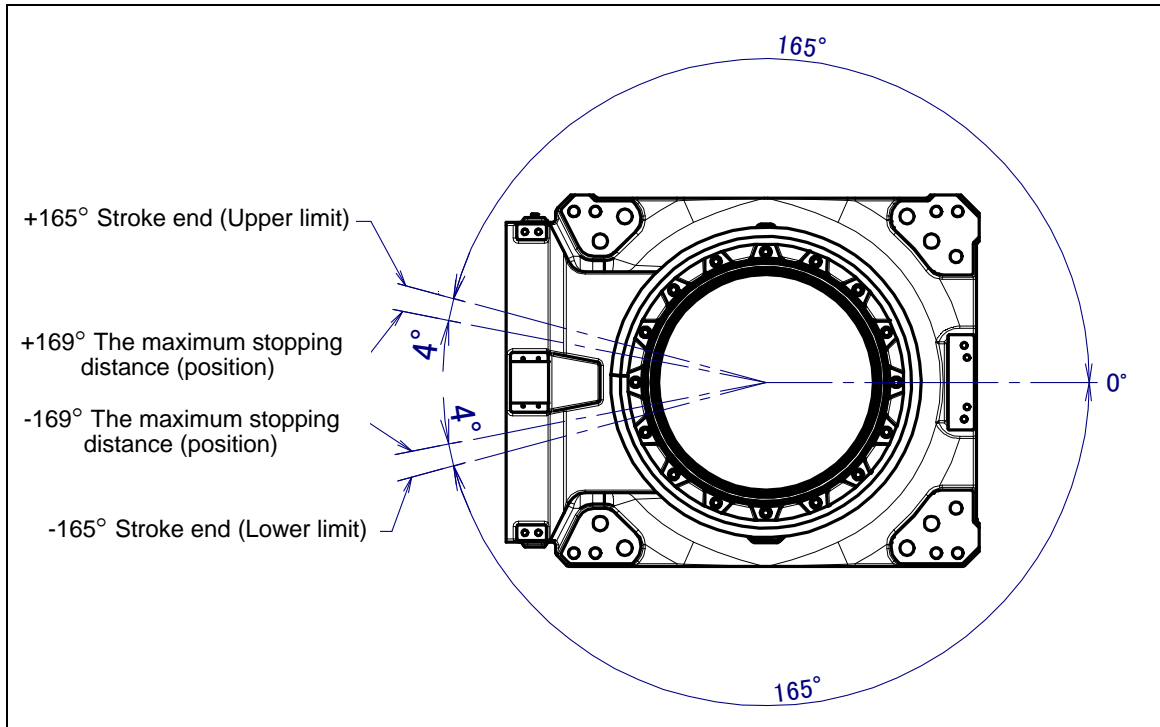


Fig. 3.3 (b) J1-axis motion limit

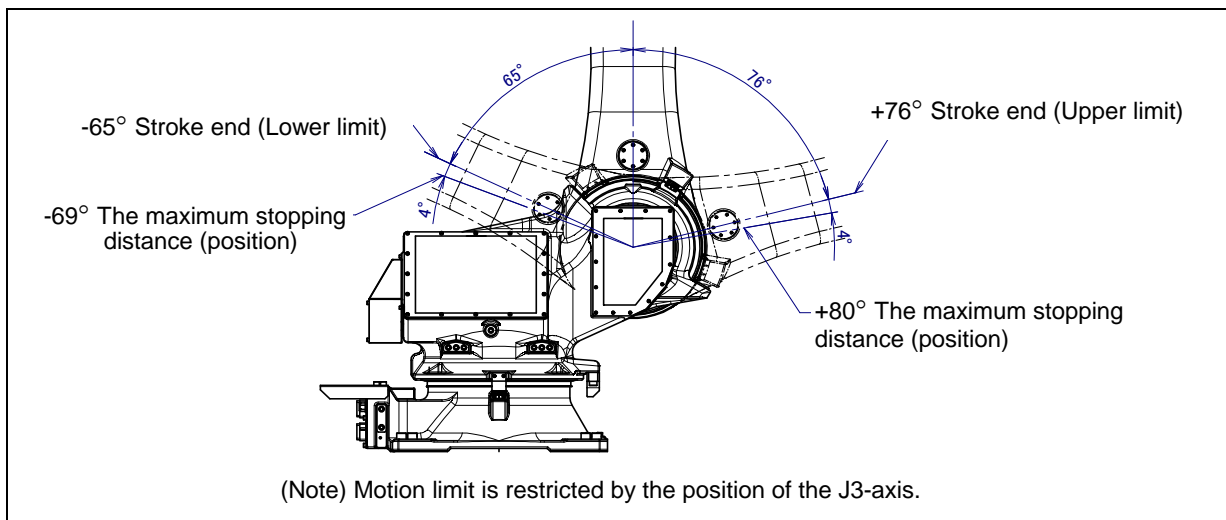


Fig. 3.3 (c) J2-axis motion limit

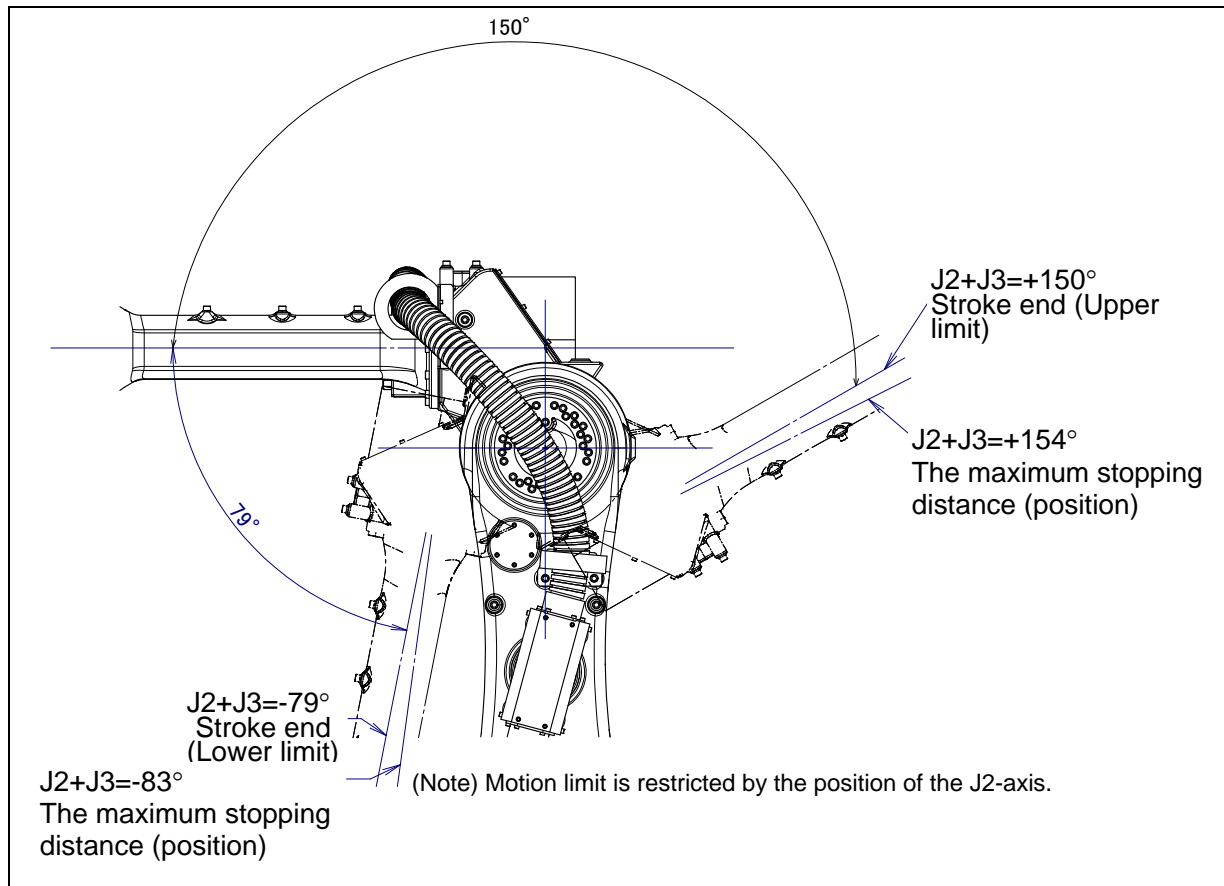


Fig. 3.3 (d) J3-axis motion limit

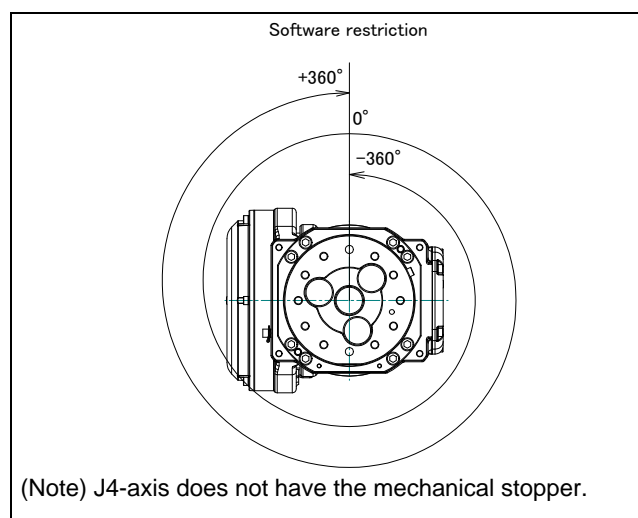


Fig. 3.3 (e) J4-axis motion limit

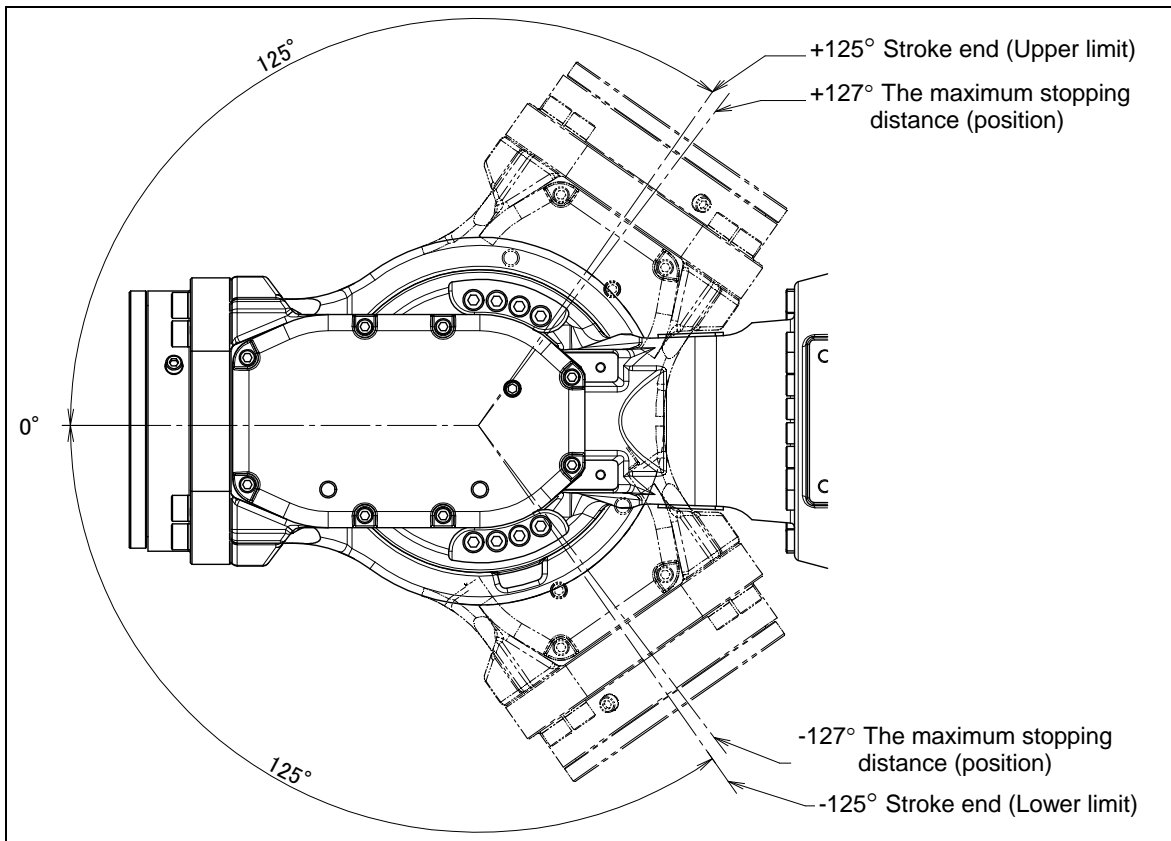


Fig. 3.3 (f) J5-axis motion limit

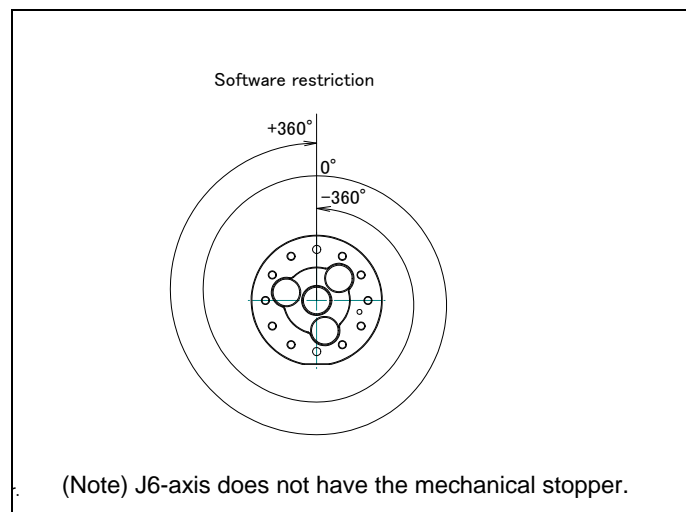


Fig. 3.3 (g) J6-axis motion limit

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (a) is a diagram to limit loads applied to the wrist.

- Apply a load within the region indicated in the graph.
- Apply the conditions of the allowable load moment and the allowable load inertia. See Section 3.1 about the allowable load moment and the allowable load inertia.
- See Section 4.1 about the mounting of the end effector.

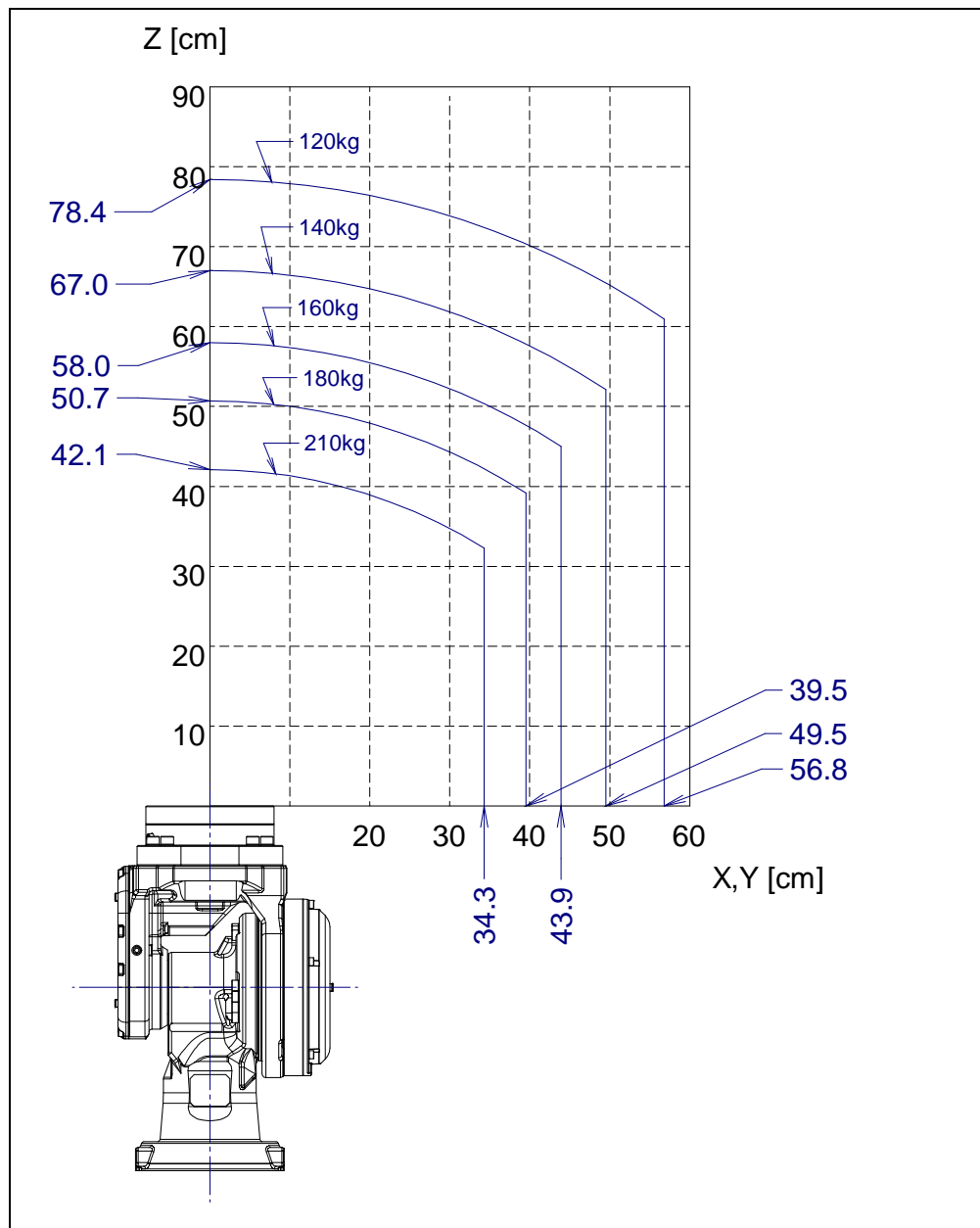


Fig. 3.4 (a) Wrist load diagram (ISO flange)

3.5 LOAD CONDITIONS ON J2 BASE AND J3 CASING

Fig. 3.5 (a) shows J2 base and J3 casing load condition.

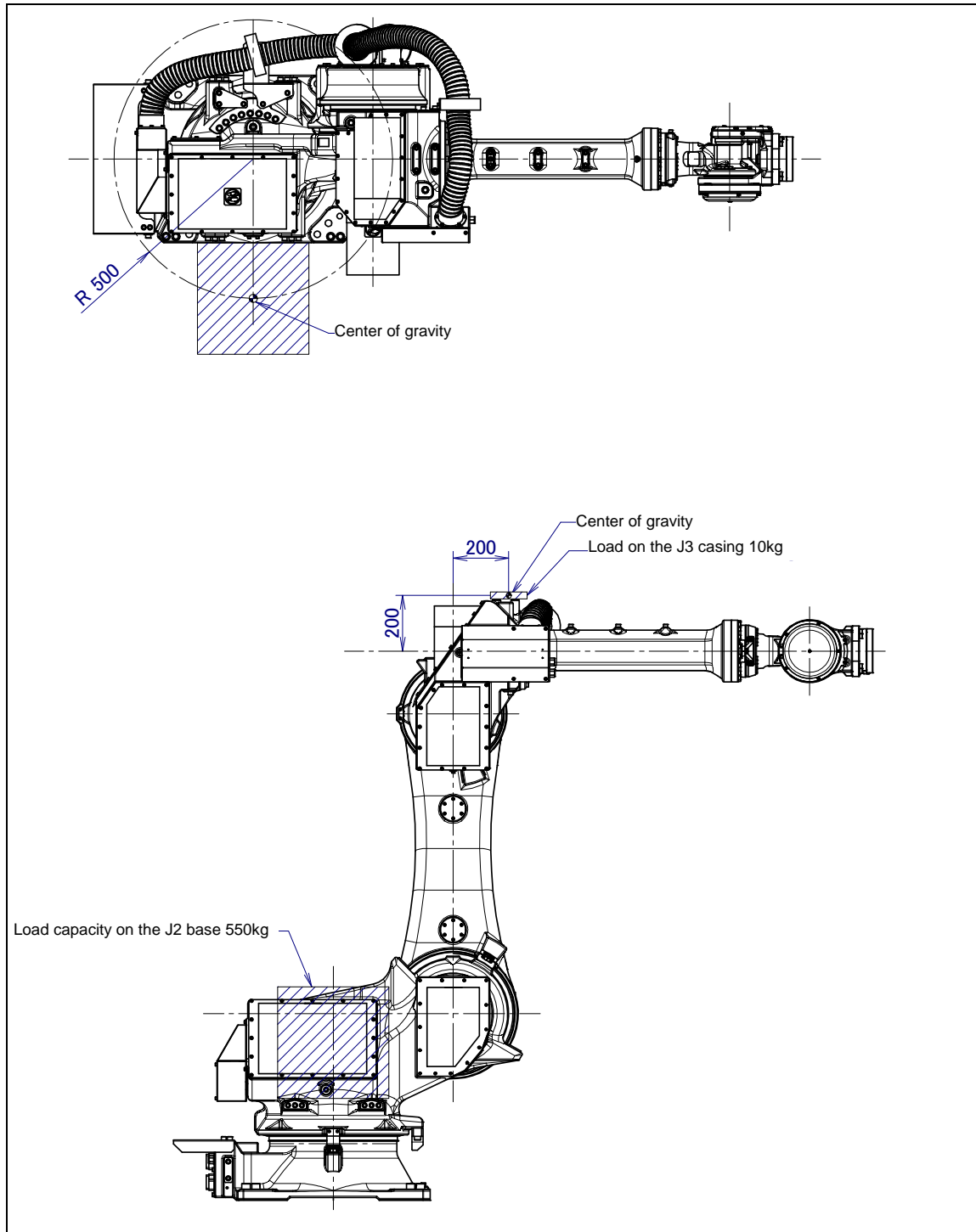


Fig. 3.5 (a) J2 base/J3 casing load condition



CAUTION

You cannot bet load on J3 arm.

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) is the diagrams for installing end effectors on the wrist. To fasten the end effector, first position it by two pin holes, then lock it using screws. Select screws and positioning pins of a length that matches the depth of the tapped and pin holes. Fasten the bolt for fixing the end effector with following torque.

$73.5 \pm 3.4 \text{ Nm}$ ($750 \pm 35 \text{ kgfcm}$)



CAUTION

Notice the tooling coupling depth to wrist flange should be shorter than the flange coupling length.

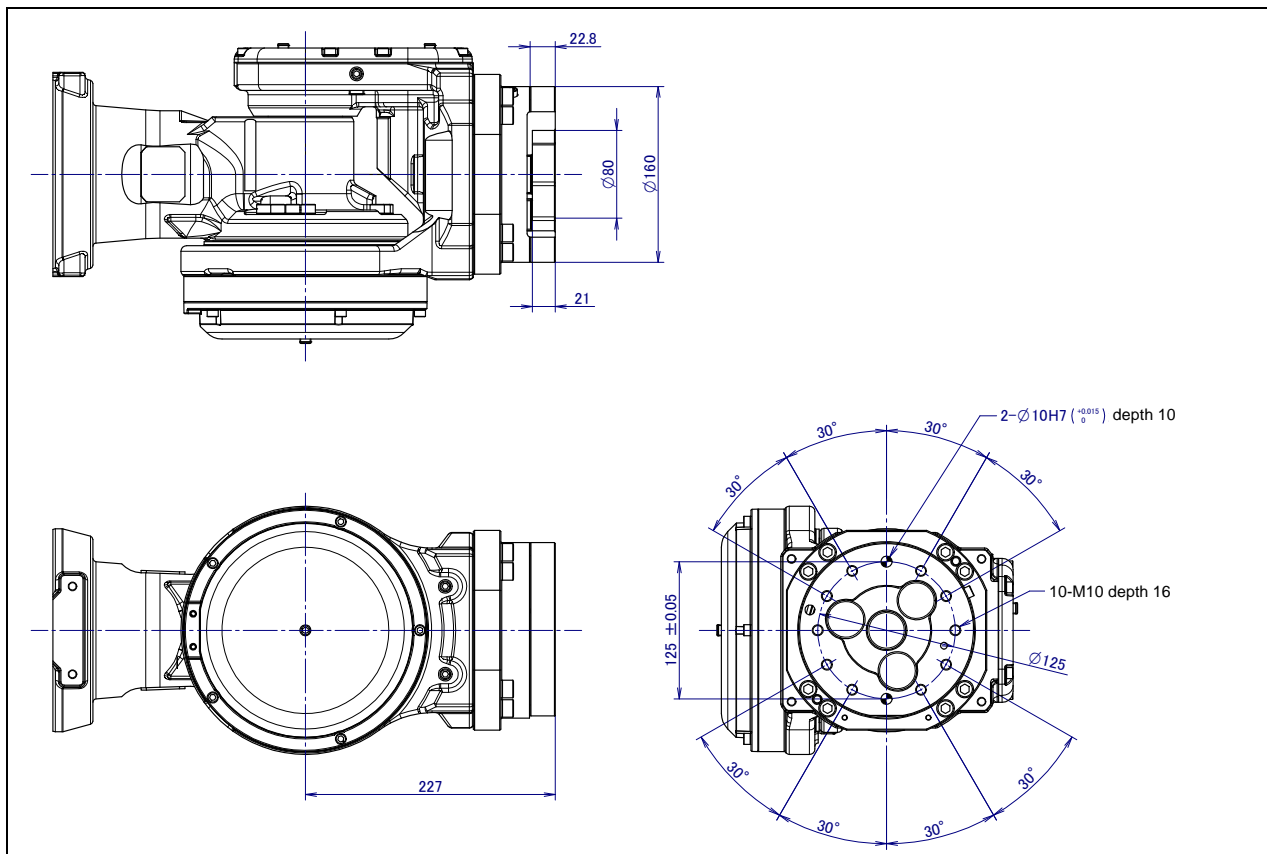


Fig. 4.1 (a) End effector mounting face (ISO flange)

4.2 EQUIPMENT MOUNTING FACE

As shown in Fig. 4.2 (a), tapped holes are provided to install equipment to the robot.



CAUTION

- 1 Never perform additional machining operation such as drilling or tapping on the robot body. This can seriously affect the safety and function of the robot.
- 2 When using a user tap shown in Fig. 4.2 (a), keep the center of gravity position of the equipment according to Section 3.5.
- 3 Equipment should be installed so that mechanical unit cable does not interfere. If equipment interfere, the mechanical unit cable might be disconnected, and unexpected troubles might occur.
- 4 Note that the use of a tapped hole not shown in the following figure is not assured. Please do not tighten both with the tightening bolts used for mechanical unit.
- 5 Bolts and covers are installed to these taps when this robot is shipped for anti-rust. Be sure to install those when taps are not used.

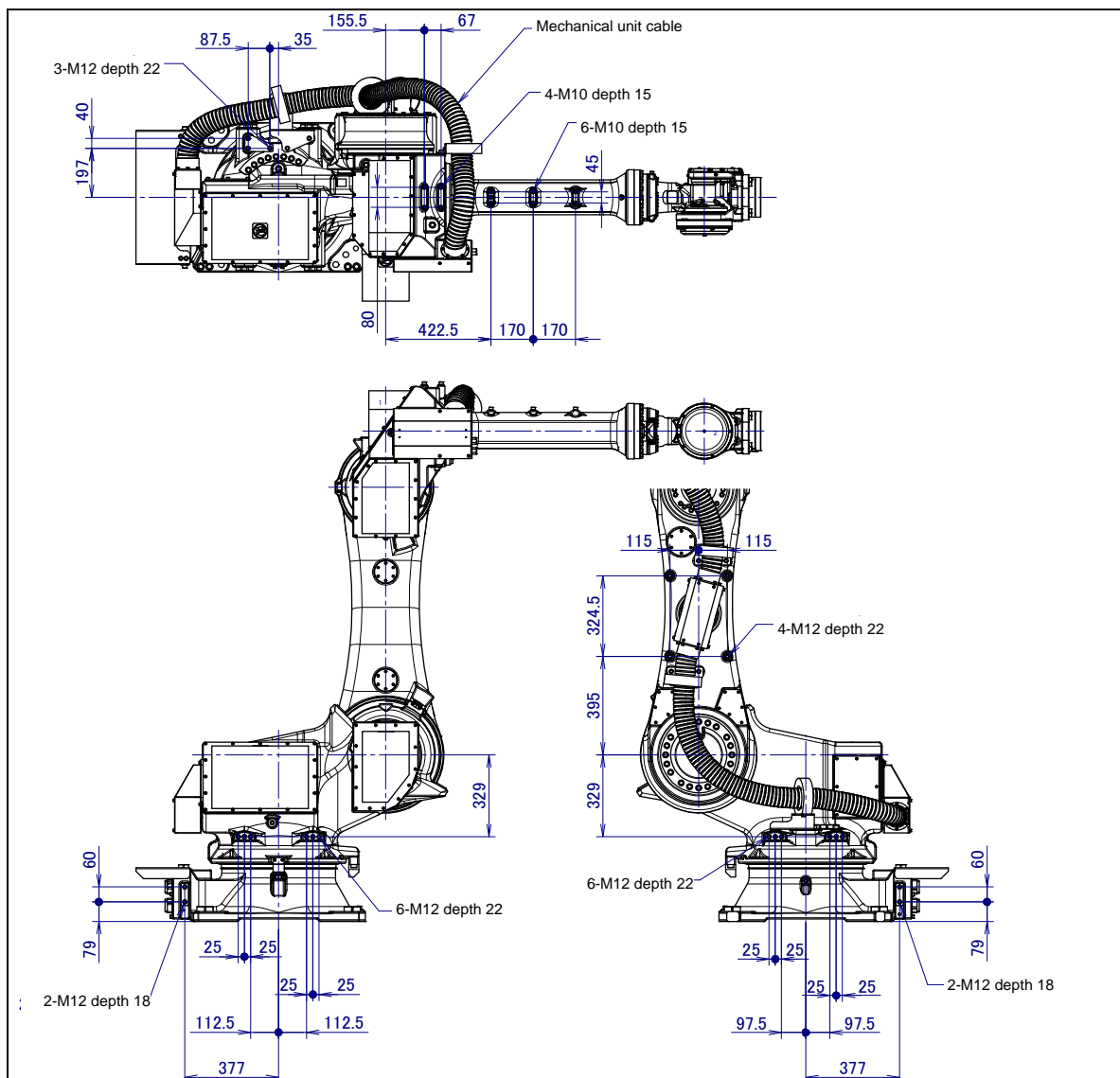


Fig. 4.2 (a) Equipment mounting faces

4.3 LOAD SETTING



CAUTION

- 1 Set the load condition parameter before the robot runs. Do not operate the robot in over when its payload is exceeded. Do not exceed the allowable payload including connection cables. Operation in with the robot over payload may occur result in troubles such as reducer life reduction.
- 2 **WHEN PERFORMING LOAD ESTIMATION AFTER PARTS REPLACEMENT**
If wrist axis motors (J5/J6-axis) or reducers are replaced, payload estimation accuracy may decrease. Perform calibration of load estimation without the load such as hand before performing load estimation.
Refer to Chapter 9 "LOAD ESTIMATION"
in the Optional Function OPERATOR'S MANUAL (B-83284EN-2)

The operation motion performance screens include the MOTION PERFORMANCE screen, MOTION PAYLOAD SET screen, and payload information and equipment information on the robot.

- 1 Press the [MENU] key to display the screen menu.
- 2 Select [6 SYSTEM] on the next page.
- 3 Press the F1 ([TYPE]) key to display the screen switch menu.
- 4 Select "MOTION." The MOTION PERFORMANCE screen will be displayed.

MOTION PERFORMANCE			JOINT 10%	
Group1				
No.	PAYLOAD[kg]	Comment		
1	210.00	[]
2	0.00	[]
3	0.00	[]
4	0.00	[]
5	0.00	[]
6	0.00	[]
7	0.00	[]
8	0.00	[]
9	0.00	[]
10	0.00	[]
Active PAYLOAD number =0				
[TYPE]	GROUP	DETAIL	ARMLoad	SETIND >

- 5 Ten different pieces of payload information can be set using condition No. 1 to 10 on this screen. Place the cursor on one of the numbers, and press F3 [DETAIL]. The MOTION PAYLOAD SET screen will be displayed.

MOTION PAYLOAD SET		JOINT 10%
Group 1		
1	Schedule No[1]:[Comment]	
2	PAYLOAD	

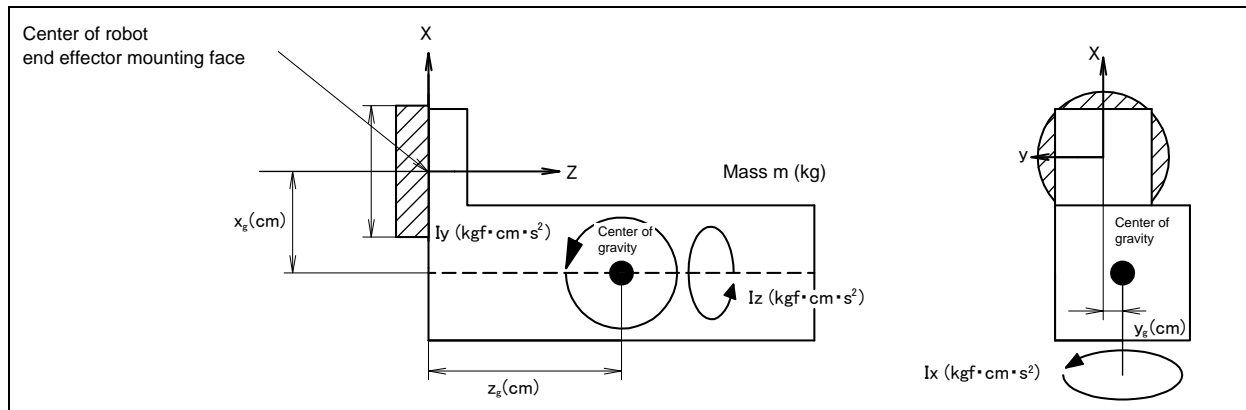


Fig. 4.3 (a) Standard tool coordinate

- 6 Set the payload, gravity center position, and inertia around the gravity center on the MOTION PAYLOAD SET screen. The X, Y, and Z directions displayed on this screen correspond to the respective standard tool coordinates (with no tool coordinate system set up). When values are entered, the following message appears: “Path and Cycletime will change. Set it?” Respond to the message with F4 [YES] or F5 [NO].
- 7 Pressing F3 [NUMBER] will bring you to the MOTION PAYLOAD SET screen for another condition number. For a multigroup system, pressing F2 [GROUP] will bring you to the MOTION PAYLOAD SET screen for another group
- 8 Press the [PREV] key to return to the MOTION PERFORMANCE screen. Press F5 [SETIND], and enter the desired payload setting condition number.
- 9 On the MOTION PERFORMANCE screen, press F4 [ARMLOAD] to display the MOTION ARMLoad SET screen.
(* This screen differs depending on the robot model.)

MOTION ARMLoad SET		JOINT	100%
Group 1			
1	J2 BASE LOAD [kg]	550.00	
2	J3 ARM LOAD [kg]	0.00	
3	J3 CASING LOAD [kg]	10.00	
[TYPE]	GROUP	DEFAULT	HELP

- 10 Specify the weight of the load on the J2 base and J3 arm as follows:
 - (*) Load mounting face differs depending on the robot model. Refer to “3.5 LOAD CONDITIONS ON J2 BASE AND J3 CASING”.
 - J2 BASE LOAD[kg]: Weight of the load on the J2 base
 - J3 ARM LOAD[kg]: Weight of the load on the J3 arm (Load cannot be applied to here)
 - J3 CASING LOAD[kg]: Weight of the load on the J3 casing
- The following message appears: “Path and Cycletime will change. Set it?” Select F4 [YES] or F5 [NO]. Once the loads are set up, the settings are completed by switching the power off and on again.

5 PIPING AND WIRING TO THE END EFFECTOR



WARNING

- Only use appropriately-specified mechanical unit cables.
- Do not add user cables or hoses inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit when cables are added to the outside of the mechanical unit.
- Please do not perform remodeling (adding a protective cover, or secure an additional outside cable) that obstructs the behavior of the cable.
- When external equipment is installed on the robot, make sure that it does not interfere with other parts of the robot.
- Cut and discard any unnecessary length of wire strand of the end effector (hand) cable. Insulate the cable with seal tape. (See Fig. 5 (a))
- If you have end effector wiring and a process that develops static electricity, keep the end effector wiring as far away from the process as possible. If the end effector and process must remain close, be sure to insulate the cable.
- Be sure to seal the connectors of the user cable and terminal parts of all cables to prevent water from entering the mechanical unit. Also, attach the cover to the unused connector.
- Frequently check that connectors are tight and cable jackets are not damaged.
- When precautions are not followed, damage to cables might occur. Cable failure may result in incorrect function of the end effector, robot faults, or damage to robot electrical hardware. In addition, electric shock could occur when touching the power cables.

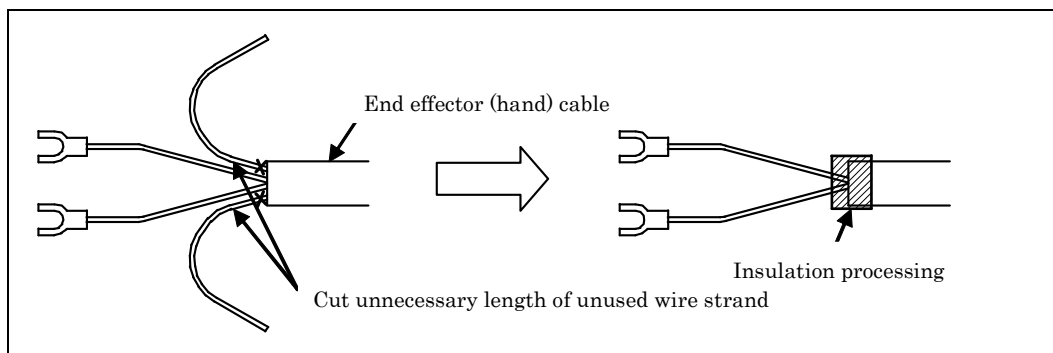


Fig. 5 (a) Treatment method of end effector (hand) cable

5.1 AIR SUPPLY (OPTION)

Robot has air inlets and air outlets openings on the back of the J1 base and the side of the J3 casing used to supply air pressure to the end effector. The connector is a Rc1/2 female (ISO).

As coupling are not supplied, it will be necessary to prepare couplings which suit to the hose size.

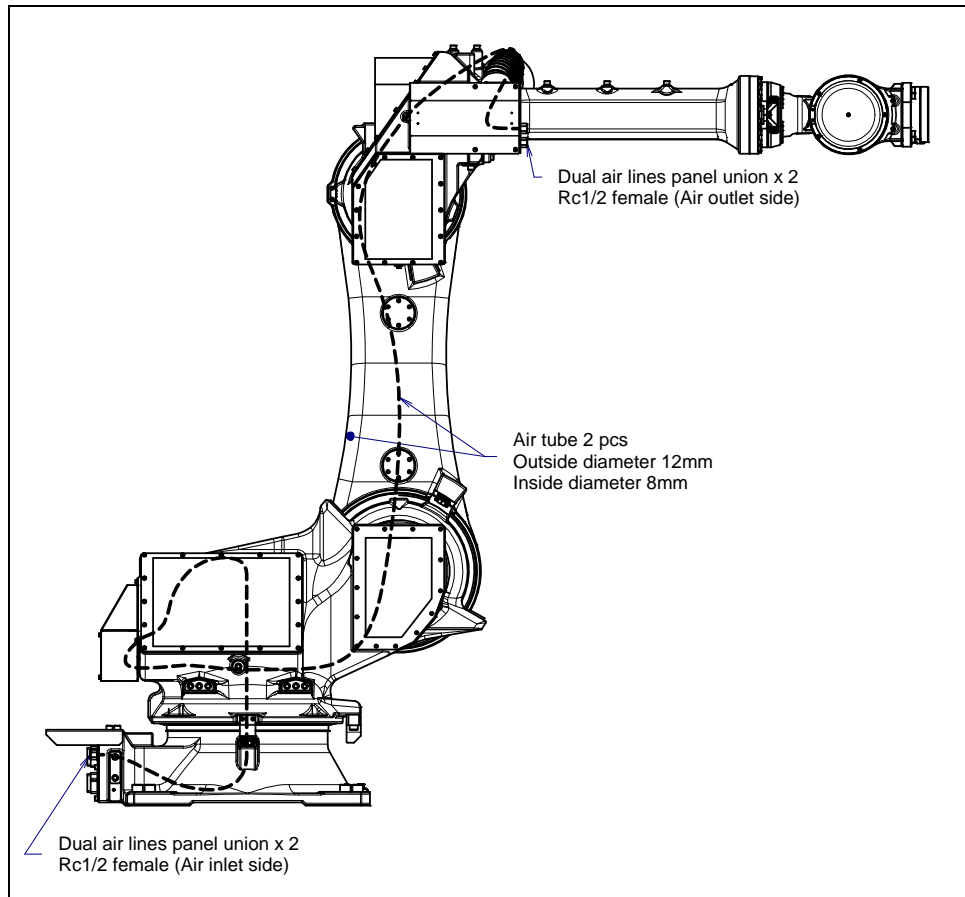


Fig. 5.1 (a) Air supply (option)

5.2 AIR PIPING (OPTION)

Fig. 5.2 (a) shows how to connect air hose to the robot. If the air control set is specified as an option, the air hose between the mechanical unit and the air control set is provided. Mount the air control set using the information in Fig. 5.2 (b). This is outside FANUC delivery scope.

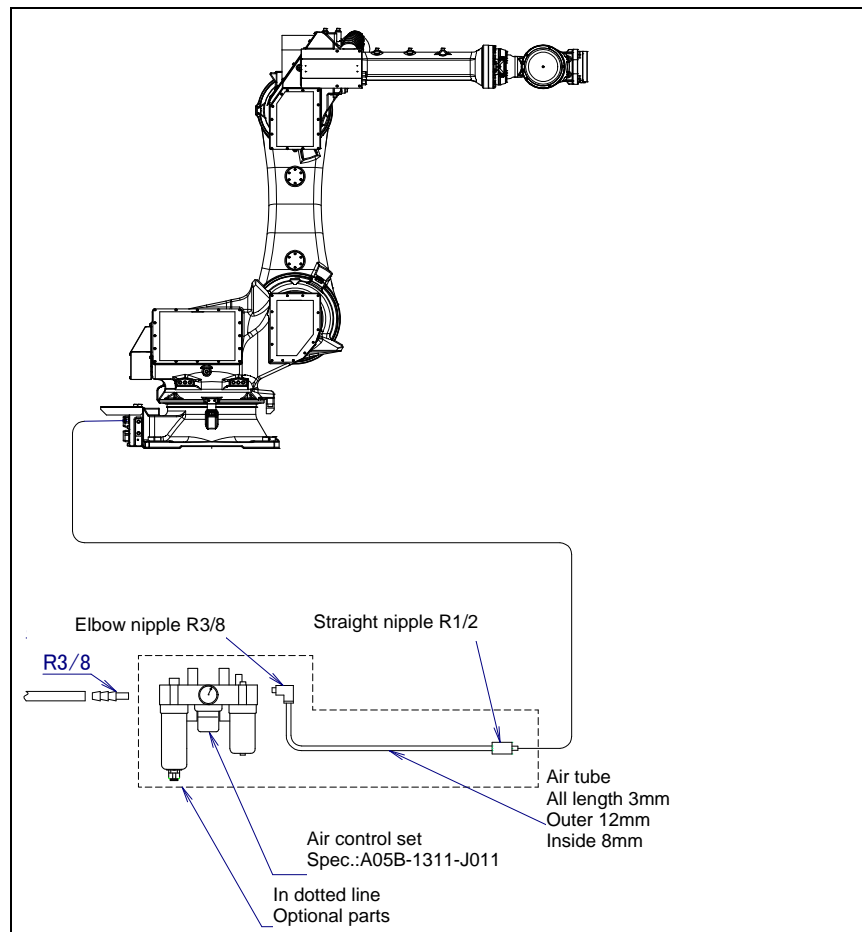


Fig. 5.2 (a) Air piping (option)

Air control set

Fill the lubricator having air control set to the specified level with turbine oil #90 to # 140. The machine tool builder is required to prepare mounting bolts.

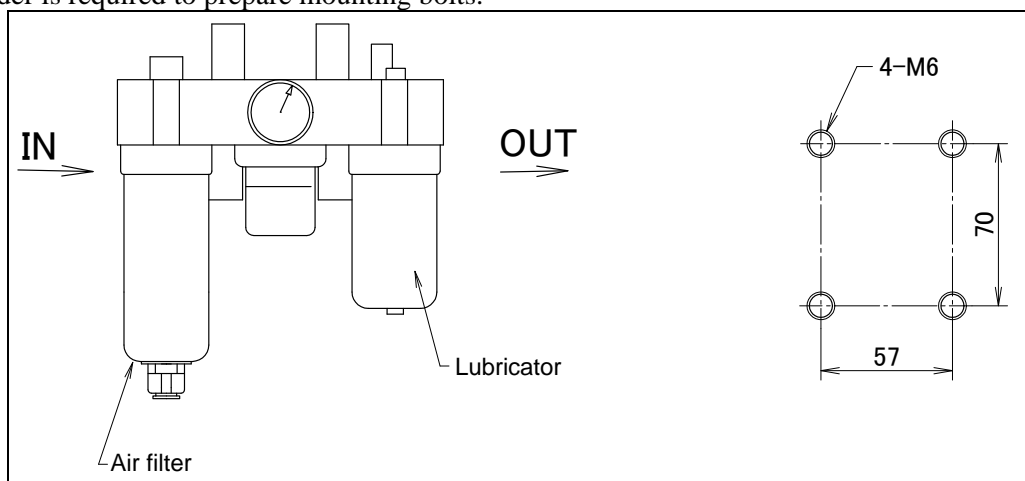


Fig. 5.2 (b) Air control set option (option)

NOTE

The capacity values of the three air components are determined as follows.
These values must not be exceeded.

Air pressure	Supply air pressure	0.49 to 0.69MPa(5 to 7kgf/cm ²), Setting: 0.49MPa(5kgf/cm ²)
	Amount of consumption	Maximum instantaneous amount 150NI/min(0.15Nm ³ /min)

5.3 INTERFACE FOR OPTION CABLE (OPTION)

Fig. 5.3 (a) shows the position of the connector panel. Fig. 5.3 (b) shows the air interface.

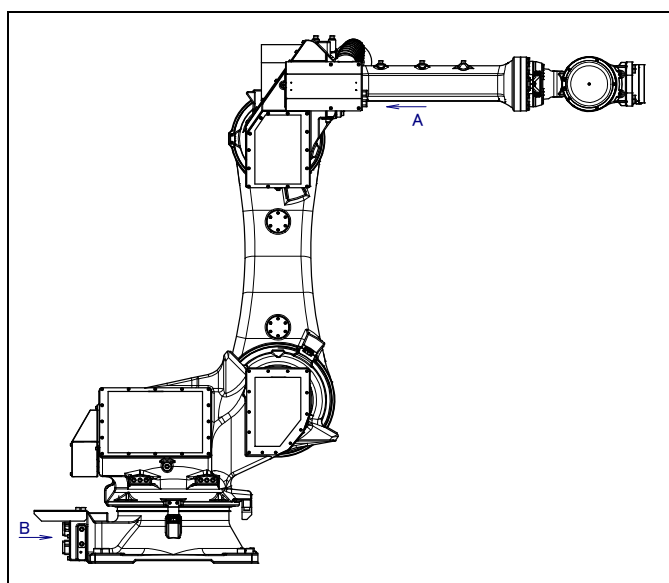


Fig. 5.3 (a) Interface for air (OPTION)

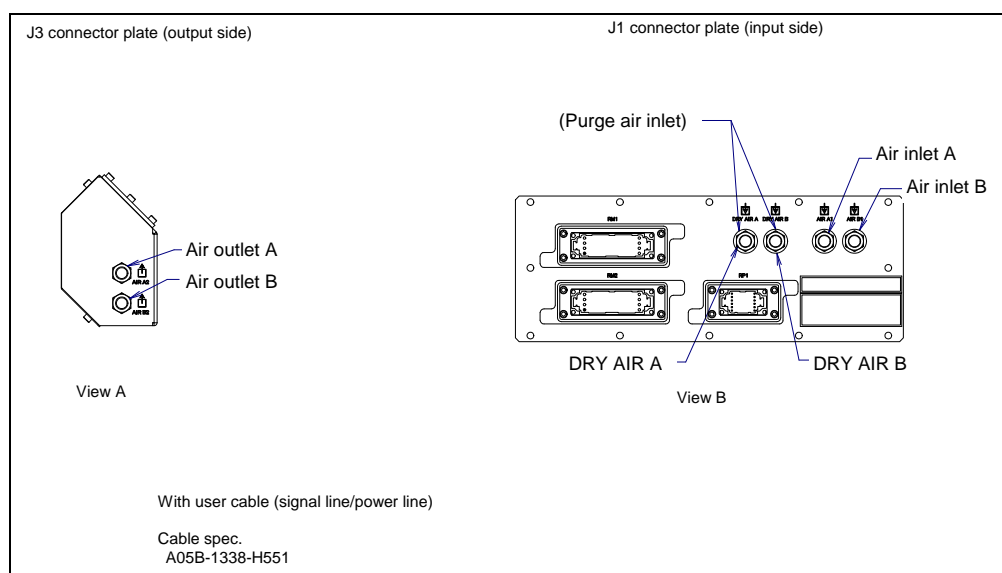


Fig. 5.3 (b) Interface for option cable

5.4 INSTALLING THE AIR PURGE KIT

In case of R-2000iC/210WE, be sure to use air purge kit. Air purge kit (A05B-1338-K801) is preparatory as the option, and use it, please. Set the air purge pressure to 20 to 30kPa (0.02 to 0.03 MPa, 0.2 to 0.3 kgf/cm²).

NOTE

- 1 It is recommended that a dedicated air pressure source be used for an air purge. Do not use the same air pressure source for both the air purge kit and others. Otherwise, the dryer capacity is exceeded and water or oil remains in air, causing serious damage to the robot.
- 2 After installing the robot, perform an air purge at all times. Even when the robot is not operated, an air purge is required if it is placed in a bad condition such as water splash on the robot or its humid in washing booth.

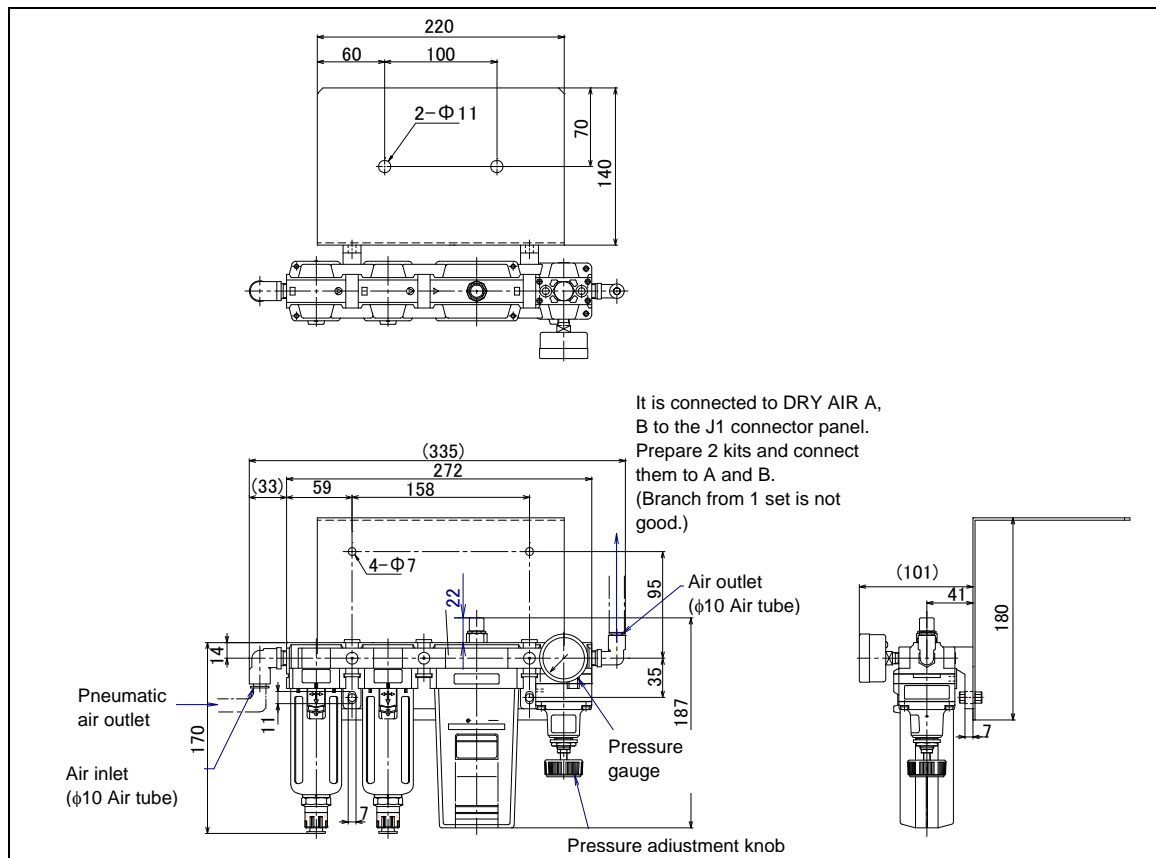


Fig. 5.4 (a) Regulator kit for air purge external dimensions

6

AXIS LIMITS SETUP

By setting the motion range of each axes, you can change the robot's motion range from the standard values. Changing the motion range of the robot is effective under following circumstances:

- Used motion range of the robot is limited.
- There's an area where tool and peripheral devices interfere with the robot.
- The length of cables and hoses attached for application is limited.

There are two methods used to prevent the robot from going beyond the necessary motion range. These are

- Axis limit by DCS (All axes (option))
- Axis limit adjustable mechanical stopper (J1 -axis (option))

WARNING

- 1 Changing the motion range of any axis affects the operating range of the robot. To avoid trouble, carefully consider any possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition will occur; for example, an alarm may occur in a previously taught position.
- 2 For J1-axis, use adjustable mechanical stoppers, for J2/J3-axis, use the DCS function so that damage to peripheral equipment and injuries to human bodies can be avoided.
- 3 Mechanical stoppers are physical obstacles. For J1-axis, it is possible to re-position the adjustable mechanical stoppers. But the robot cannot move beyond them. For J2/J3/J5-axis, the mechanical stoppers are fixed. For the J4 and J6-axes, only DCS-specified limits are available.
- 4 J2 and J3-axes interference angles cannot be changed.
- 5 Adjustable mechanical stoppers (J1-axis) is deformed in a collision to stop the robot. Once a stopper is subject to a collision, it can no longer assure its original strength and, therefore, may not stop the robot. When this happens, replace it with a new one.

6.1 CHANGE AXIS LIMIT BY DCS (OPTION)

The robot motion can be restricted with DCS (Dual check safety) function by using the following software. For J2/J3-axis, the same effect as adjustable mechanical stopper described in Section 6.2 can be obtained. The robot motion can be restricted at any angle and position if it is in robot motion area. DCS functions are certified to meet the requirements of International Standard ISO13849-1 and IEC61508 approved by certificate authority. If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot's momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the workspace. To stop the robot within the robot workspace, use the DCS Stop Position Prediction function. The stop position prediction is disabled by default.

- DCS position/speed check function (J567)

As an example, we shows the procedure to set $\pm 30^\circ$ for J2-axis in here. Refer to Dual check safety function Operator's Manual (B-83184EN) for details of other setting, function and DCS stop position prediction.

Setting procedure

- 1 Press the [MENU] key to display the screen menu.
- 2 Press [0 NEXT] and press [6 SYSTEM].
- 3 Press the F1 ([TYPE]).
- 4 Select [DCS]. The following screen will be displayed.

AUTO	
DCS	JOINT 1%
1	Joint position check
2	Joint speed check:
3	Cart. position check OK
4	Cart. speed check
5	T1 mode speed check
6	User model
7	Tool frame
8	User frame
9	Stop position prediction
[TYPE] APPLY DETAIL UNDO	

- 5 Move the cursor to [1 Joint position check], then press the [DETAIL].

AUTO	
DCS	JOINT 1%
Join Position check	
No.	G A Status Comment
1	DISABLE 1 1 ---- []
2	DISABLE 1 1 ---- []
3	DISABLE 1 1 ---- []
4	DISABLE 1 1 ---- []
5	DISABLE 1 1 ---- []
6	DISABLE 1 1 ---- []
7	DISABLE 1 1 ---- []
8	DISABLE 1 1 ---- []
9	DISABLE 1 1 ---- []
10	DISABLE 1 1 ---- []
[TYPE] DETAIL	

- 6 Move the cursor to [1], then press the [DETAIL].

DCS		AUTO
		JOINT 1%
No. 1	Status:	
1 Comment	[*****]	
2 Enable/Disable		DISABLE
3 Group		1
4 Axis		2
5 Safe side		
Position (deg):		
Current		0.000
6 Upper limit:		0.000
7 Lower limit:		0.000
8 Stop type:		Power-off stop
[TYPE]	PREV NEXT	UNDO

- 7 Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
 8 Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
 9 Move the cursor to [Axis], then input "2", then press the [ENTER] key.
 10 Move the cursor to [Upper limit] right side, then input "30", then press the [ENTER] key.
 11 Move the cursor to [Lower limit] right side, then input "-30", then press the [ENTER] key.



WARNING

If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot's momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the workspace. To stop the robot within the robot workspace, use the DCS Stop Position Prediction function. The stop position prediction is disabled by default.

DCS		AUTO
		JOINT 1%
No. 1	Status:	
1 Comment	[*****]	
2 Enable/Disable		ENABLE
3 Group		1
4 Axis		2
5 Safe side		
Position (deg):		
Current		0.000
6 Upper limit:		+30.000
7 Lower limit:		-30.000
8 Stop type:		Power-off stop
[TYPE]	PREV NEXT	UNDO

- 12 Press the [PREV] key two times, back to the first screen.

DCS		AUTO
		JOINT 1%
1	Joint position check	UNSF CHGD
2	Joint speed check:	
3	Cart. position check	OK
4	Cart. speed check	
5	T1 mode speed check	
6	User model	
7	Tool frame	
8	User frame	
9	Stop position prediction	
[TYPE]	APPLY DETAIL	UNDO

- 13 Press the [APPLY].
- 14 Input 4-digit password, then press the [ENTER] key. (Password default setting is “1111”.)
- 15 The following screen will be displayed, then press the [OK].

DCS		AUTO	
		JOINT 1%	
Verify (diff)			
F Number : F000			
VERSION : HandlingTool			
&VERSION : V7.7097 9/1/2015			
DATE: 17-7-28 19:44			
DCS Version V2. 0. 11			
--Joint Position Check-----			
No.	G	A	Status Comment
1	ENABLE	1	2 CHGD [
2	ENABLE	1	2 ---- [
3	DISABLE	1	2 ---- [
		ALL	OK QUIT

[CHGD] on the right side of [1 Joint position check] will change to [PEND].

DCS		AUTO	
		JOINT 1%	
1	Joint position check	UNSF	PEND
2	Joint speed check:		
3	Cart. position check	OK	
4	Cart. speed check		
5	T1 mode speed check		
6	User model		
7	Tool frame		
8	User frame		
9	Stop position prediction		
[TYPE] APPLY DETAIL		UNDO	

- 16 Cycle the power of the controller in the cold start mode so the new settings are enabled.



WARNING

You must cycle the power of the controller to enable the new setting. If you fail to do so, the robot does not work normally and it may injure personnel or damage the equipment.

6.2 ADJUSTABLE MECHANICAL STOPPER AND LIMIT SWITCH SETTING (OPTION)

For the J1-axis, adjustable mechanical stopper (option) can be installed. It is possible to re-position adjustable mechanical stoppers. Change the position of the adjustable mechanical stoppers according to the desired movable range.

Table 6.2 (a) Motion range that can be set by the adjustable mechanical stopper and space between the upper and lower limits

Item		Settable motion range
J1-axis adjustable mechanical stopper,	Upper limit	Settable in steps of 7.5° in the range of -150° to -60° and +30° to +120°.
	Lower limit	Settable in steps of 7.5° in the range of -120° to -30° and +60° to +150°.
	Space between the upper and lower limits	Combination of upper limit and lower limit has restriction. See Table 6.2 (b) for details.

Table 6.2 (b) Combination of upper limit and lower limit

Lower limit [deg]	Upper limit [deg]
Standard stopper (-165°)	Settable in steps of 7.5° in the range of -150° to -60° and +30° to +120°.
-120°	Settable in steps of 7.5° in the range of -112.5° to -60° and +30° to +120°.
-112.5°	Settable in steps of 7.5° in the range of -105° to -60° and +30° to +120°.
-105°	Settable in steps of 7.5° in the range of -97.5° to -60° and +30° to +120°.
-97.5°	Settable in steps of 7.5° in the range of -90° to -60° and +30° to +120°.
-90°	Settable in steps of 7.5° in the range of -82.5° to -60° and +30° to +120°.
-82.5°	Settable in steps of 7.5° in the range of -75° to -60° and +30° to +120°.
-75°	Settable in steps of 7.5° in the range of -67.5° to -60° and +30° to +120°.
-67.5°	Settable in steps of 7.5° in the range of -60° and +30° to +120°.
-60°, -52.5°, -45°, -37.5°, -30°	Settable in steps of 7.5° in the range of +30° to +120°.
+60°	Settable in steps of 7.5° in the range of +67.5° to +120°.
+67.5°	Settable in steps of 7.5° in the range of +75° to +120°.
+75°	Settable in steps of 7.5° in the range of +82.5° to +120°.
+82.5°	Settable in steps of 7.5° in the range of +90° to +120°.
+90°	Settable in steps of 7.5° in the range of +97.5° to +120°.
+97.5°	Settable in steps of 7.5° in the range of +105° to +120°.
+105°	Settable in steps of 7.5° in the range of +112.5° to +120°.
+112.5°	Settable in +120°.
+120°, +127.5°, +135°, +142.5°, +150°	Only standard stopper (+165°) can be used.

NOTE

- 1 If the newly set operation range does not include 0°, you must change it by zero degree mastering so that 0° is included.
- 2 When adjustable mechanical stopper is ordered, mounting bolt is attached.
- 3 When motion range is changed by adjustable mechanical stopper, be sure to set the motion range of soft same refer to Subsection 6.2.2.

6.2.1 Installing Adjustable Mechanical Stopper Option

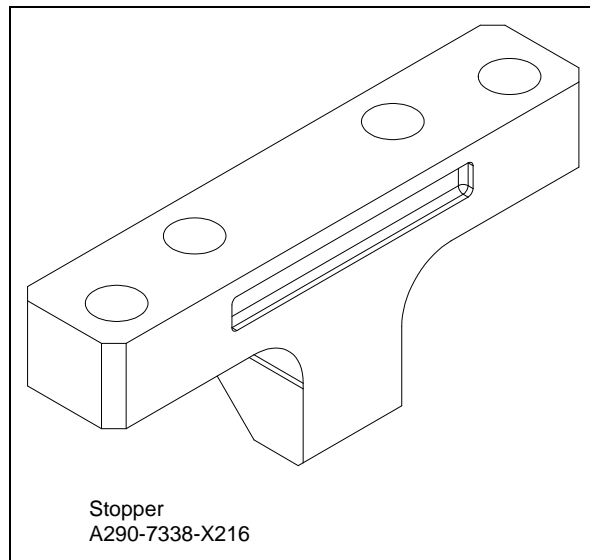


Fig. 6.2.1 (a) J1-axis adjustable mechanical stopper (option)

- 1 Remove bolts and plate shown in Fig .6.2.1 (b).

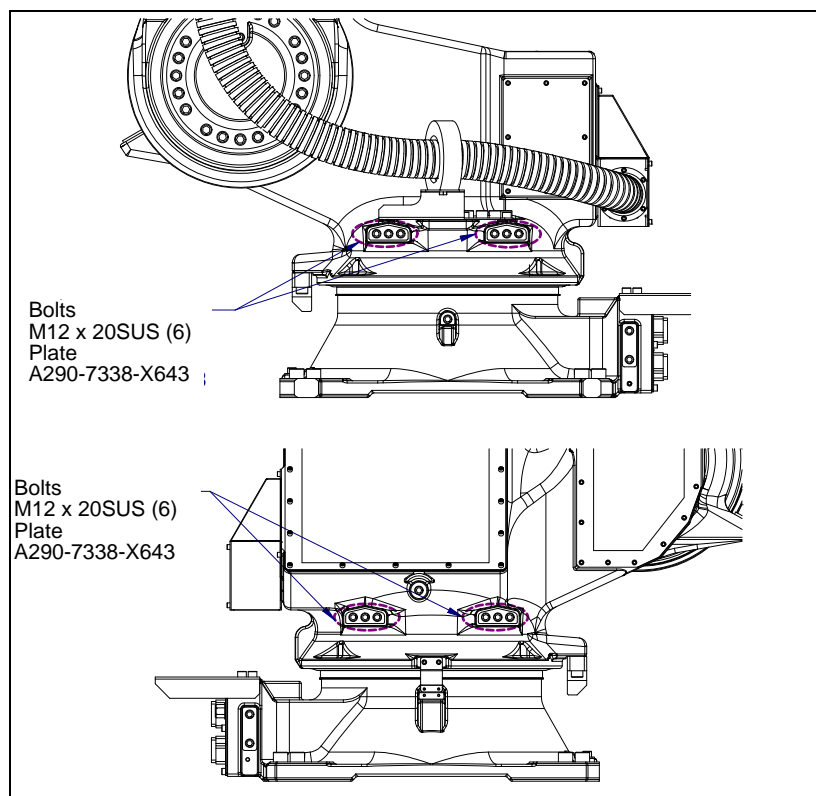


Fig. 6.2.1 (b) Mounting the J1-axis adjustable mechanical stopper (1/7)

- 2 Assemble the adapter and the plate referring to Fig. 6.2.1 (c).

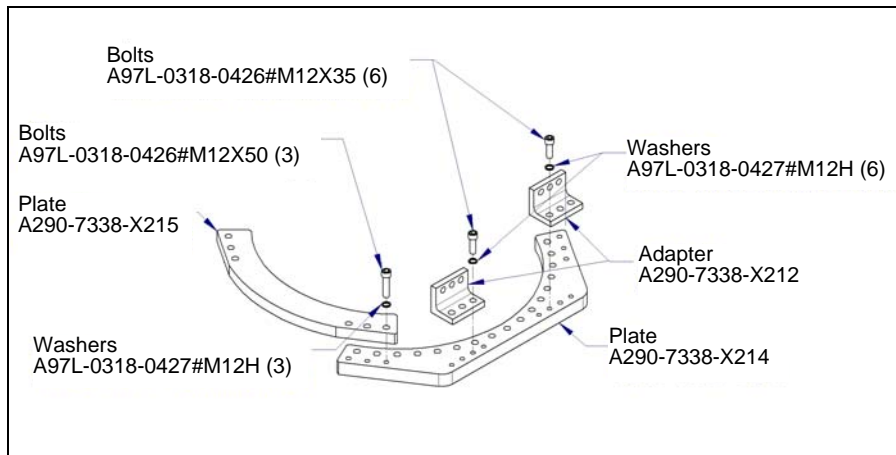


Fig. 6.2.1 (c) Mounting the J1-axis adjustable mechanical stopper (2/7)

- 3 Assemble parts assembled in step 2 to the robot.
 4 Attach the stopper to the plate lower side.

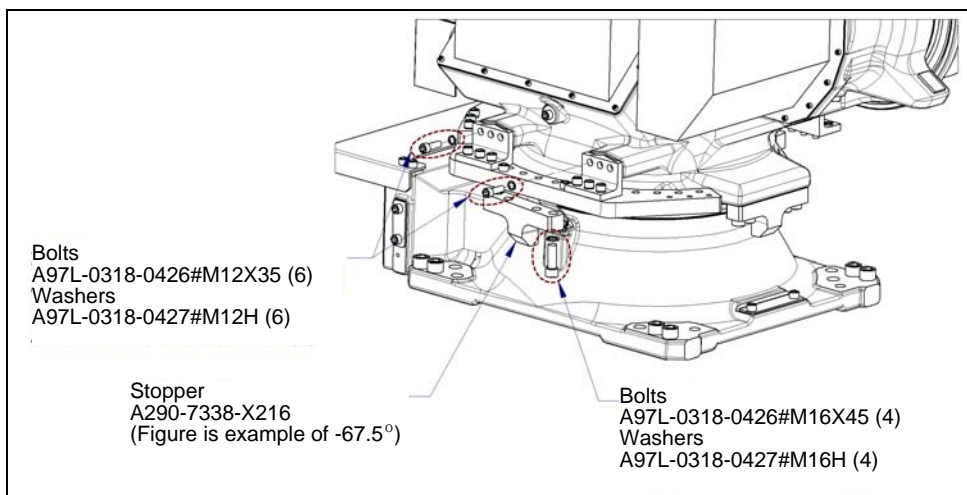


Fig. 6.2.1 (d) Mounting the J1-axis adjustable mechanical stopper (3/7)

- 5 Assemble the adapter and the plate referring to Fig. 6.2.1 (e).

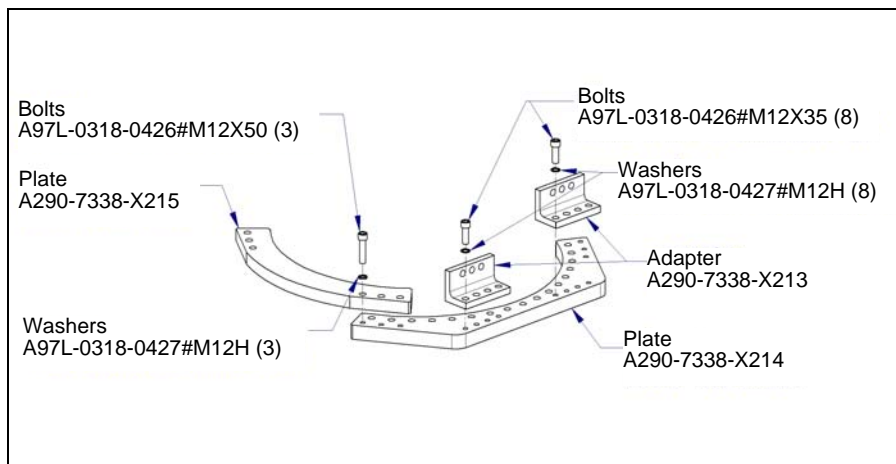


Fig. 6.2.1 (e) Mounting the J1-axis adjustable mechanical stopper (4/7)

- 6 Assemble parts assembled in step 5 to the robot.
- 7 Attach the stopper to the plate lower side.

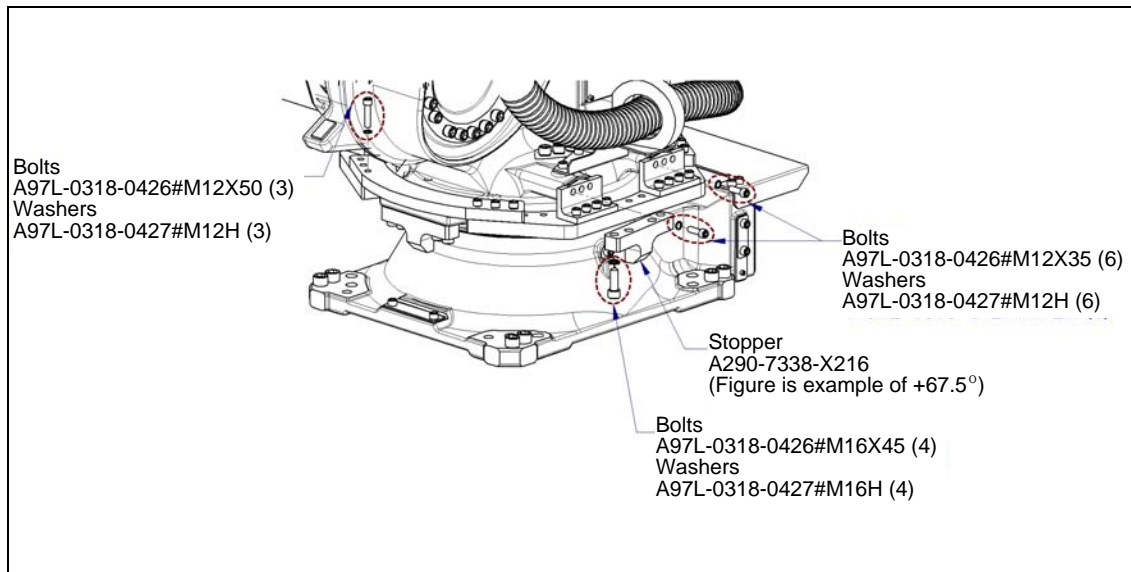


Fig. 6.2.1 (f) Mounting the J1-axis adjustable mechanical stopper (5/7)

- 8 Attach parts assembled in step 3 and step 6 with bolts and washers.

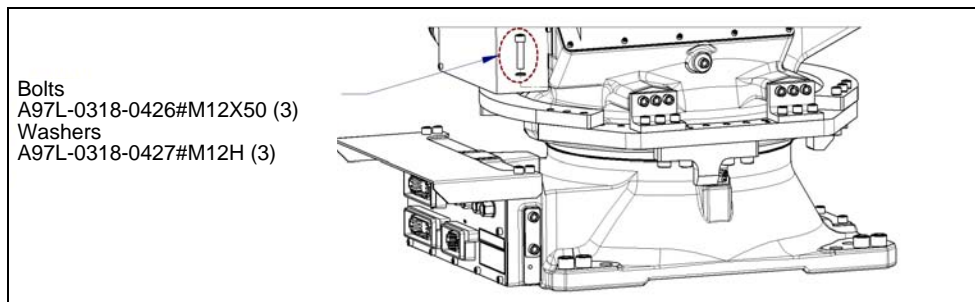


Fig. 6.2.1 (g) Mounting the J1-axis adjustable mechanical stopper (6/7)

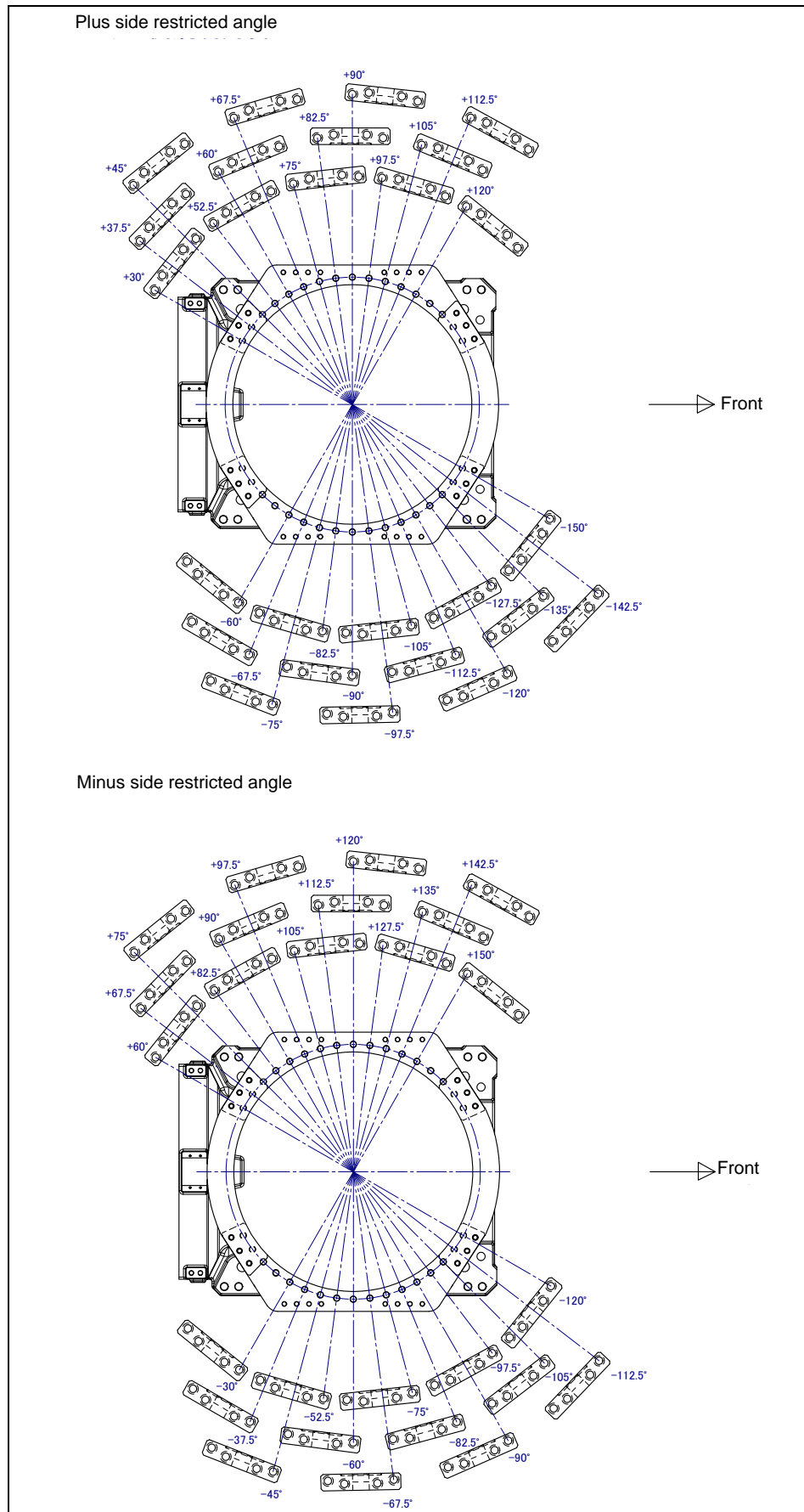


Fig. 6.2.1 (h) Mounting the J1-axis adjustable mechanical stopper (7/7)

6.2.2 Changing the Parameter Setting

Setting procedure

- 1 Press the [MENU] key to display the screen menu.
- 2 Select [0 NEXT] and press [6 SYSTEM].
- 3 Press F1 [TYPE].
- 4 Select [Axis Limits]. The following screen will be displayed.

System Axis Limits				JOINT 100%
Group1				1/16
AXIS	GROUP	LOWER	UPPER	
1	1	-165.00	165.00	deg
2	1	-65.00	76.00	deg
3	1	-132.04	180.00	deg
4	1	-360.00	360.00	deg
5	1	-125.00	125.00	deg
6	1	-360.00	360.00	deg
7	1	0.00	0.00	mm
8	1	0.00	0.00	mm
9	1	0.00	0.00	mm

[TYPE]

NOTE

0.00 indicates the robot does not have these axes.

- 5 Move the cursor to the axis limit to be set. Type the new value using the numeric keys on the teach pendant. In this time, set the axial upper limit and the lower limit at the position same as adjustable mechanical stoppers are attached.

System Axis Limits				2/16
AXIS	GROUP	LOWER	UPPER	
2	1	-65.00	76.00	deg

[TYPE]

- 6 Cycle power of controller in the cold start mode so the new information can be used.



WARNING

- 1 You must turn off the controller and then turn it back on to use the new information; otherwise, the old settings remain valid and could cause personnel injury or equipment damage.
- 2 After changing system variables, be sure to run the robot at a low speed and make sure that the robot stops at the ends of the stroke.
- 3 If a collision should occur, the adjustable mechanical stopper becomes deformed to absorb energy, so that the robot can stop safely. If the stopper is deformed by mistake, replace it.
- 4 For the J1 to J3-axis, do not count merely on changing the parameter when changing the movable range of the robot. Use the mechanical stopper (for J1-axis) or motion range restriction by DCS together. At this time, set same motion area for both. If only parameter change is used, it is very dangerous because safety is not guaranteed.

6.2.3 The Maximum Stopping Distance (Position) of Adjustable Mechanical Stopper

The adjustable mechanical stopper is a mechanism that can be adjusted in its position. The robot can work safely inside the adjusted motion range, up to the maximum range as shown in Table 6.2.3 (a) and Fig. 6.2.3 (a). A robot attempting to travel beyond this set range of motion, will be stopped by these stoppers, by collision; and therefore the robot will remain contained within the setup range.

Stopping the robot will cause the mechanical stopper to be “transformed” (means : permanently damaged). Be sure to replace the deformed stopper before using the robot again.

Table 6.2.3 (a) The maximum stopping distance (position) of adjustable mechanical stopper

	Plus side	Minus side
J1-axis	+11°	-11°

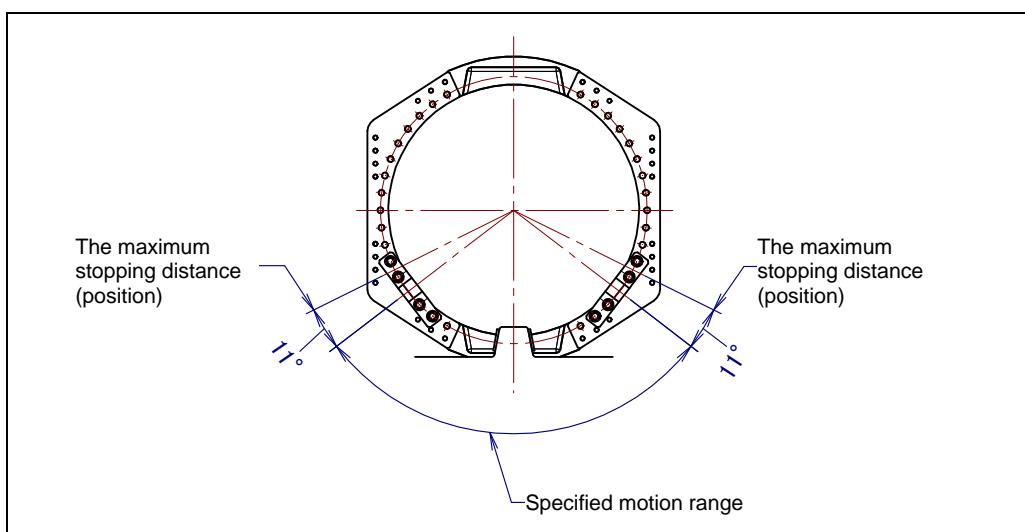


Fig. 6.2.3 (a) The maximum stopping distance of adjustable mechanical stopper of J1-axis

7 CHECKS AND MAINTENANCE

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

7.1 CHECKS AND MAINTENANCE

7.1.1 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. ⇒"7.2.1 Confirmation of Oil Seepage"
Air control set	(When air control set is used) ⇒"7.2.2 Confirmation of the Air Control or Air Purge Kit (option)"
Vibration, abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: ⇒"9.1 TROUBLESHOOTING"(symptom : Vibration, Noise)
Positioning accuracy	Check that the taught positions of the robot have not deviated from the previously taught positions. When the displacement occurs, perform the measures as described in the following section: ⇒"9.1 TROUBLESHOOTING" (Symptom : Displacement)
Peripheral equipment for proper operation	Check whether the peripheral equipment operate properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the end effector drops 0.2 mm or less when servo power is turned off. If the end effector (hand) drops, perform the measures as described in the following section: ⇒"9.1 TROUBLESHOOTING"(symptom : Dropping axis)
Purge pressure	If warning associated with purge pressure occurs, perform the following check. Confirm there is no leakage on purge piping. Remove the seal bolts of the drain holes and check there is no water inside. ⇒"7.2.5 Check of Purge Piping and Drain Holes" Confirm there is no gap and abnormal abrasion on the debris covers of the reducer outer circumference. ⇒"7.2.6 Check of Debris Cover"
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: ⇒"OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)"

7.1.2 Periodic Checks and Maintenance

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

Check and maintenance intervals (Period, Accumulated operating time)					Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	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.	20
	○				Check the external damage and appearance	Check whether the robot has external damage due to the interference with the peripheral equipment. In addition, check whether exposed parts has abnormal corrosion or deterioration. If an interference occurs, eliminate the cause. Also, if the external damage or corrosion is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○ 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.	21
	○ Only 1st check	○			Check for damage to the mechanical unit cable (movable part)	Observe the movable part of the mechanical unit cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted. ⇒"7.2.3 Check the Mechanical Unit Cables and Connectors"	2
	○ Only 1st Check	○			Check for damage to the end effector (hand) connection cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.	3
	○ Only 1st check	○			Check the exposed connectors and fittings	Check the tightness of exposed connectors and fittings. ⇒"7.2.3 Check the Mechanical Unit Cables and Connectors"	4
	○ Only 1st check	○			Retightening the end effector mounting bolts	Retighten the end effector mounting bolts. Refer to the following section for tightening torque information: ⇒"4.1 END EFFECTOR INSTALLATION TO WRIST"	5

Check and maintenance intervals (Period, Accumulated operating time)					Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	4 years 15360h			
	○ Only 1st check	○			Retightening the external main bolts	Retighten the bolts which were installed, removed, or exposed during inspection. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	6
	○ Only 1st check	○			Check the mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the mechanical stopper, the adjustable mechanical stopper, and check the looseness of the stopper mounting bolts. Check that the J1-axis swing stopper rotates smoothly. ⇒"7.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"	7
	○ 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 and the conduit of the mechanical unit cable).	8
	○ Only 1st check	○			Check the purge piping and drain holes	Confirm there is no breakage on purge piping. Remove the seal bolts of the drain holes and check there is no water inside. ⇒"7.2.5 Check of Purge Piping and Drain Holes"	9
	○ Only 1st check	○			Check of debris covers	Confirm there is no gap and abnormal abrasion on the debris covers of the reducer outer circumference. If damage was seen, replace the debris covers. ⇒"7.2.6 Check of Debris Cover"	10
		○			Replacing the oil of each axis reducer	Replace the oil of each axis reducer and gear ⇒"7.3.2 Replacing the Oil of the Drive Mechanism"	11 to 17
			○		Replacing the mechanical unit batteries	Replace the mechanical unit batteries. Regardless of operating time, replace batteries at 1.5 years. ⇒"7.3.1 Replacing the Batteries"	18
				○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	19
				○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. ⇒"Chapter 7 Replacing batteries of MAINTENANCE MANUAL (B-83195EN)"	22

7.2 CHECK POINTS

7.2.1 Confirmation of Oil Seepage

Check items

Check to see whether there is an oil seepage on the rotating parts of each joint axis.

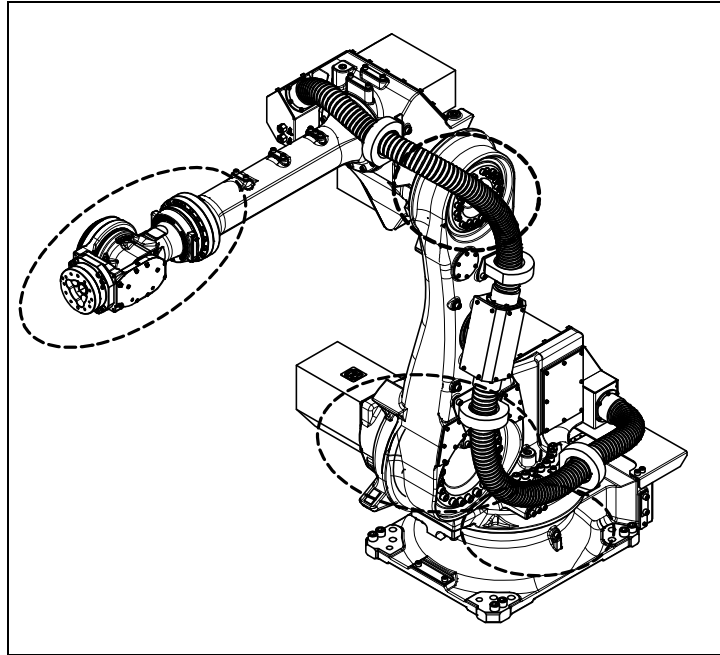


Fig. 7.2.1 (a) Check points of oil seepage

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.
- Also, drive mechanisms might become hot and the internal pressure of the oil bath might rise by frequent repetitive movement and use in high temperature environments. In these cases, normal internal pressure can be restored by venting the oil inlet. (When opening the oil outlet, refer to Subsection 7.3.2.)
- If you must wipe oil frequently, and opening the oil inlet does not stop the seepage, perform the measures below.
 - ⇒ "9.1 TROUBLESHOOTING" (symptom : Oil leakage)

7.2.2 Confirmation of the Air Control Set or Air Purge Kit (option)

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

Item	Check items		Check points
1	In case of air control set	Air pressure	Check air pressure using the pressure gauge on the air control set as shown in Fig. 7.2.2 (a). If it does not meet the specified pressure of 0.49 to 0.69 MPa (5-7 kgf/cm ²), adjust it using the regulator pressure-setting handle.
2		Lubricator oil mist quantity	Check the number of oil drops during operation. If it does not meet the specified value (1 drop/10-20 sec), adjust it using the handle for lubricator adjustment. The lubricator becomes empty in about 10 to 20 days under normal operation.
3		Lubricator oil level	Check to see that the lubricator level is within the specified level.
4		Leakage from hose	Check the joints, tubes, etc. for leaks. Retighten the joints or replace parts, as required.
5		Drain	Check the drain and empty it. When the quantity of liquid in the drain is excessive, examine the setting of the air dryer on the air supply side.
6	In case of air purge kit	Supply pressure	Check the supply pressure using the air purge kit shown in Fig. 7.2.2 (b). If it does not meet the specified pressure of 20 to 30 KPa (0.2 to 0.3kgf/cm ²), adjust it using the regulator pressure setting handle.
7		Dryer	Check whether the color of the dew point checker is blue. When it is not blue, identify the cause and replace the dryer. Maintenance for air purge kit, refer to the operator's manual attached kit.
8		Drain	Check the drain and empty it. When the quantity of liquid in the drain is excessive, examine the setting of the air dryer on the air supply side.

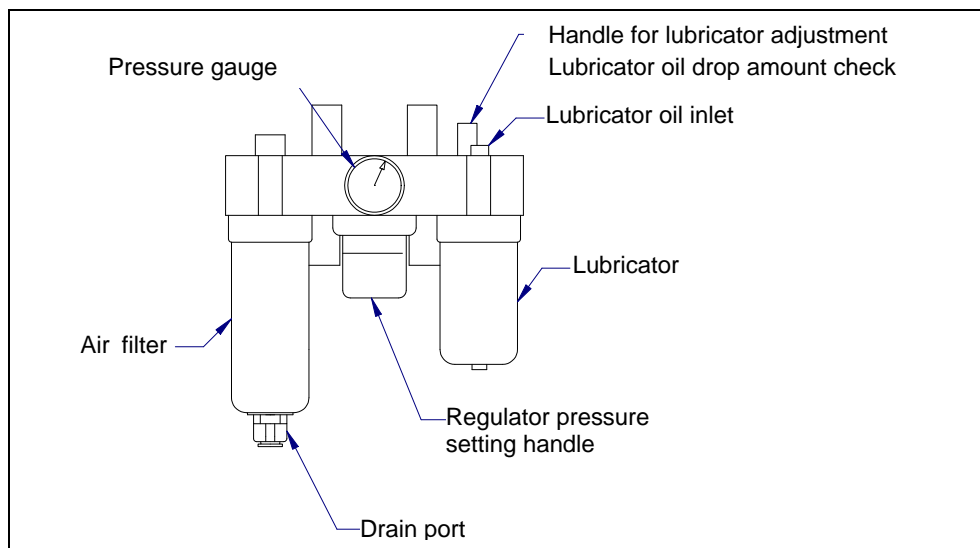


Fig. 7.2.2 (a) Air control set (option)

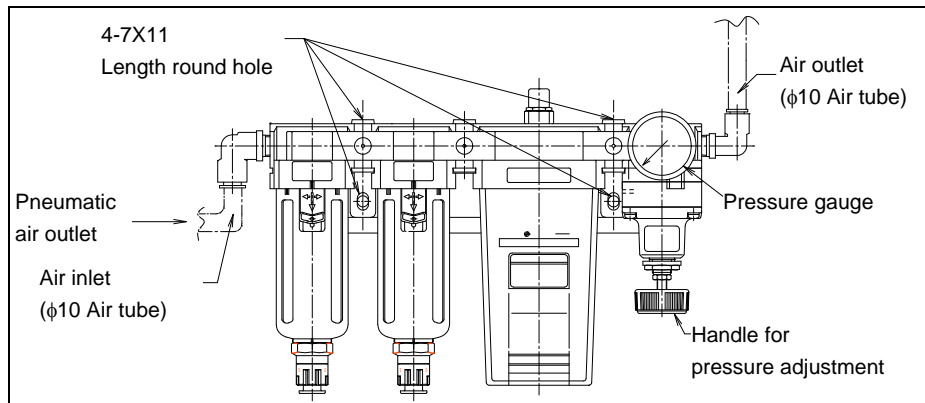


Fig. 7.2.2 (b) Air purge kit (option)

7.2.3 Check the Mechanical Unit Cables and Connectors

Check points of the mechanical unit cables

J2 and J3 movable parts, and fixed part cable which can interfere with the peripheral equipment.

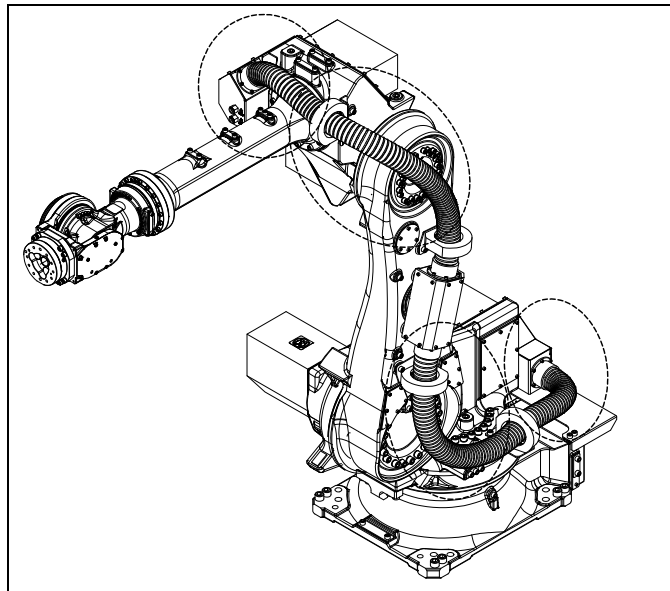


Fig. 7.2.3 (a) Check points of the mechanical unit cables

Inspection points of the connectors

- Robot connection cables, earth terminal and user cables

Check items

- Square connector: Check the connector for engagement of its lever.
- Earth terminal: Check the terminal for tightness.

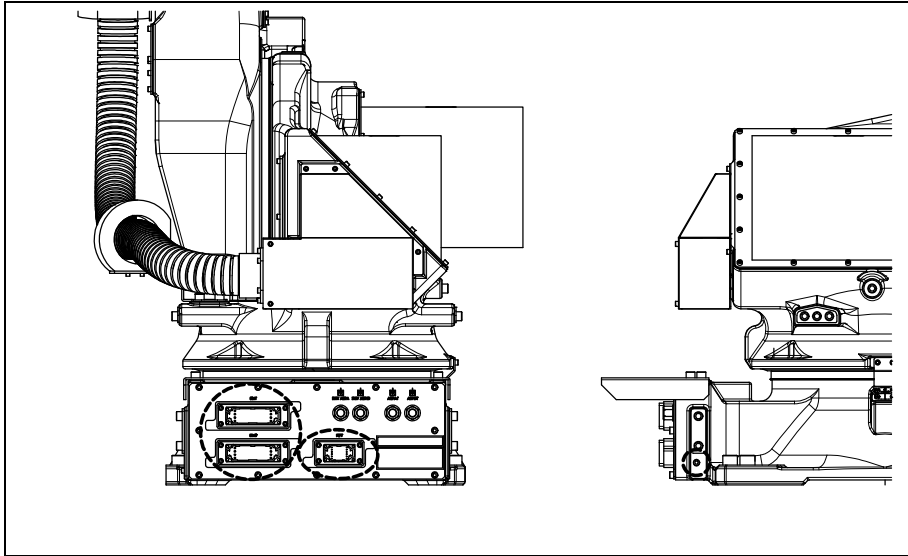


Fig. 7.2.3 (b) Connector Inspection points

7.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

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

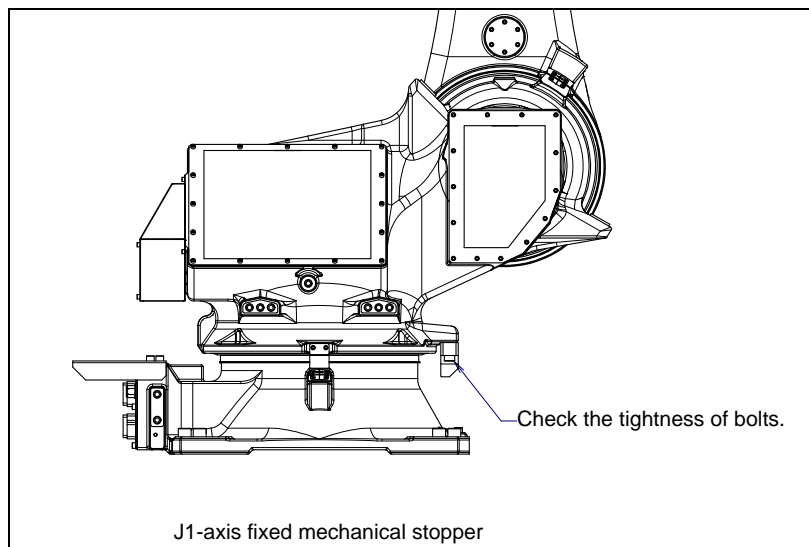


Fig. 7.2.4 (a) Check of fixed mechanical stopper and adjustable mechanical stopper

7.2.5 Check of Purge Piping and Drain Holes

Confirm there is no breakage on purge piping. Remove the seal bolts of the drain holes and check there is no water inside. Be sure to attach seal bolts after checks. When reusing seal bolts, be sure to wind those with seal tape.

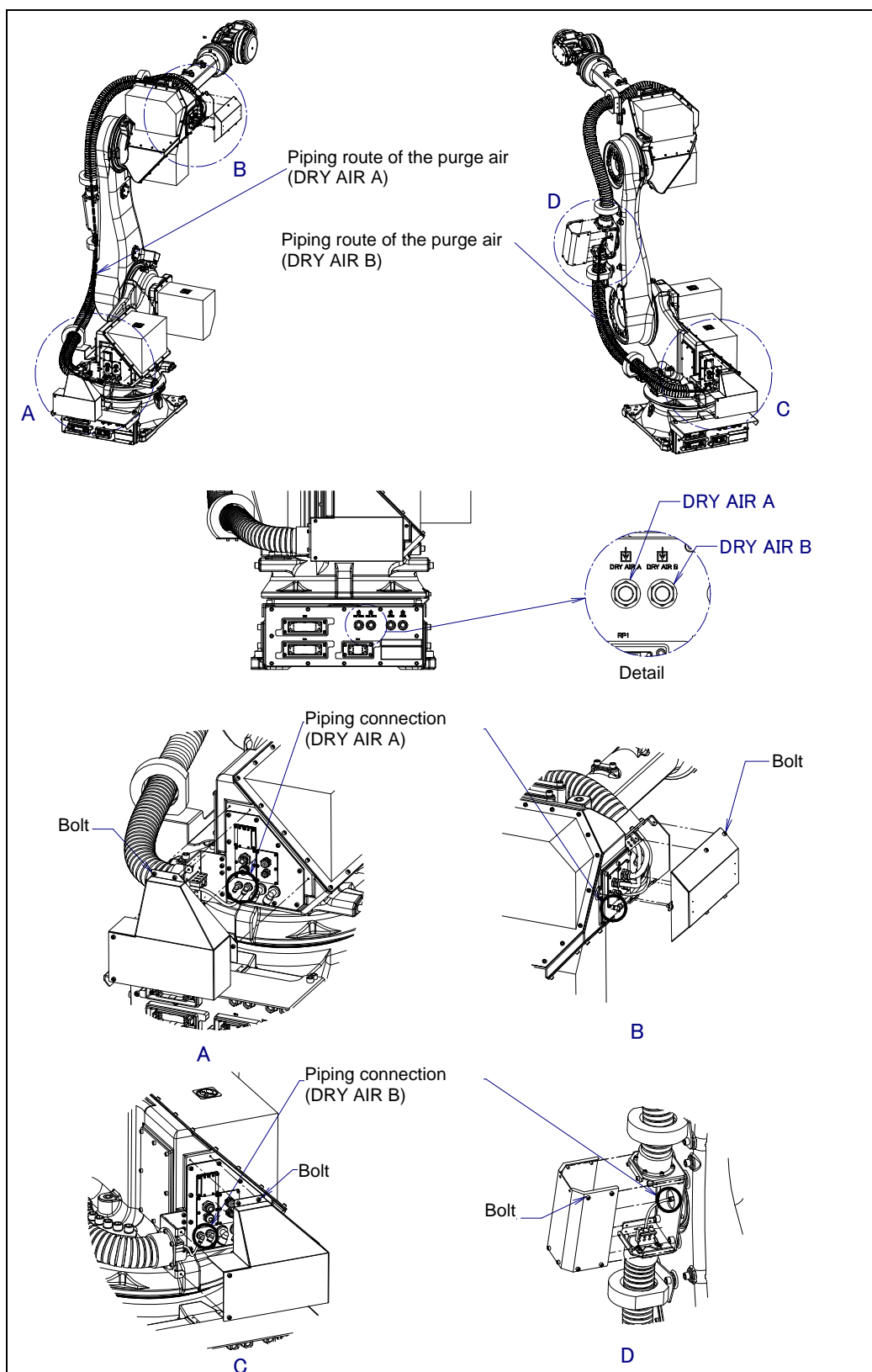


Fig. 7.2.5 (a) Check of purge piping

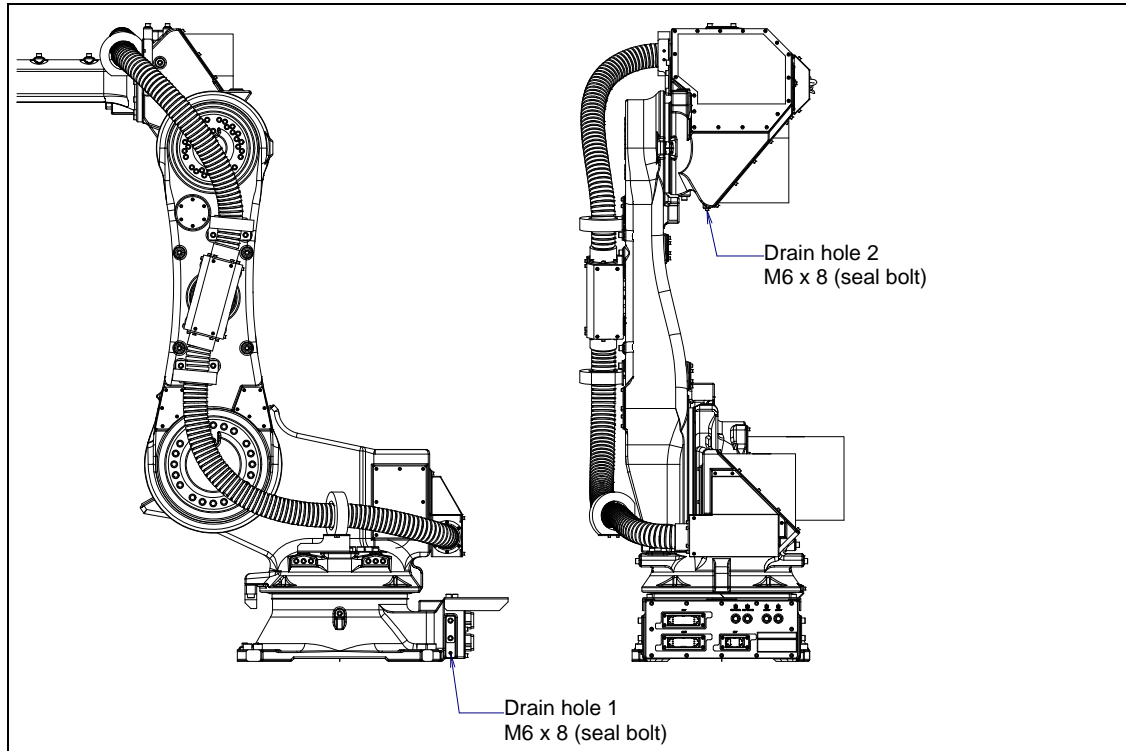


Fig. 7.2.5 (b) Check of drain holes

7.2.6 Check of Debris Cover

Confirm there is no gap and abnormal abrasion on the debris covers of the reducer outer circumference.

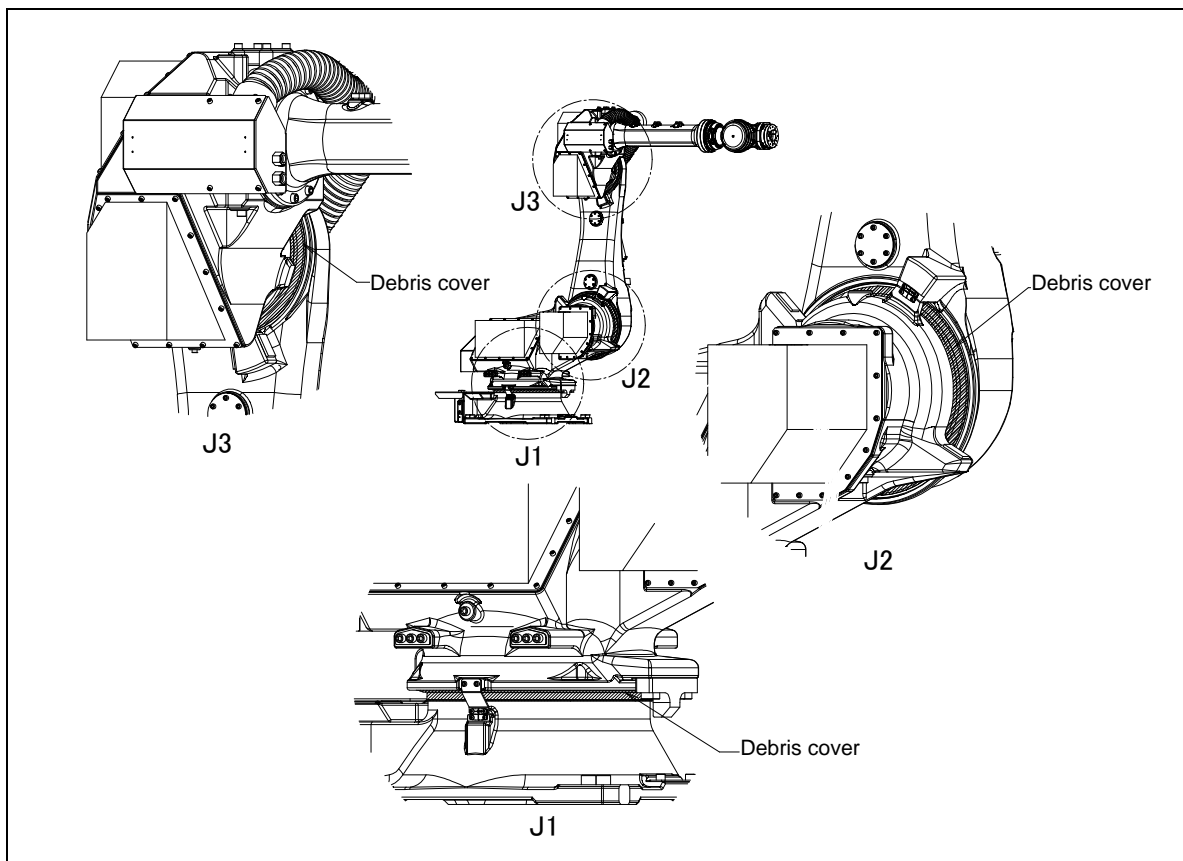


Fig. 7.2.6 (a) Check of debris covers

7.3 MAINTENANCE

7.3.1 Replacing the Batteries (1.5 year Periodic Maintenance)

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 stop the robot motion.



CAUTION

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

- 2 Stop the air purge of the DRY A.
- 3 Remove bolts M6 x 12SUS, and then removes the plate.
- 4 Remove the battery case cap. (Fig. 7.3.1 (a))
- 5 Take out the old batteries from the battery case.
- 6 Insert new batteries into the battery case while observing their correct direction.
- 7 Close the battery case cap.
- 8 Attach the plate.
- 9 Restart the air purge of the DRY A.

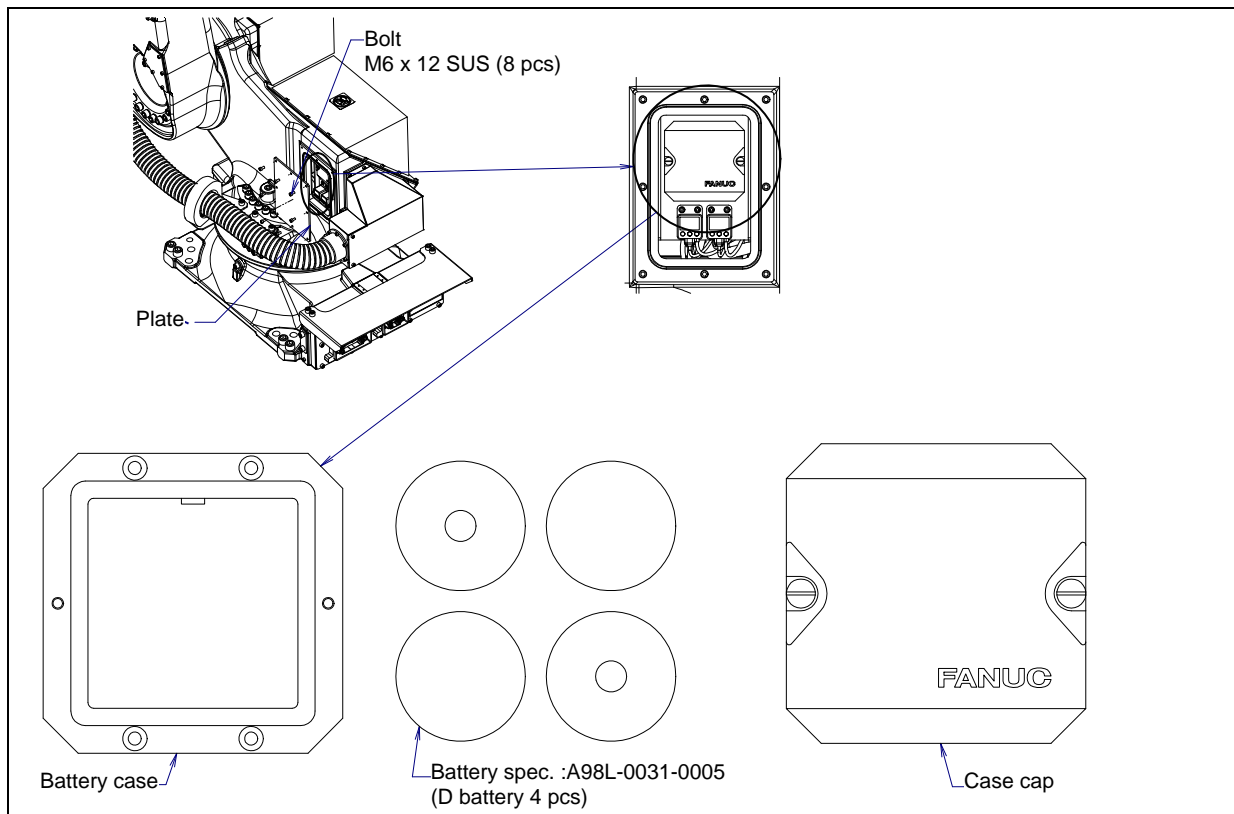


Fig. 7.3.1 (a) Replacing the battery

7.3.2 Replacing the Oil of the Drive Mechanism (1 year (3840 hours) Periodic Maintenance)

According to below, replace the oil of the reducers of J1, J2, and J3 axes, J4/J5/J6-axis gearbox and the wrist at the intervals based on every 1 year or 3840 hours, whichever comes first. See Table 7.3.2 (a) for the oil name and the quantity.

Table 7.3.2 (a) Oil for 1-year (3840 hours) periodical replacement

Models	Oiling point	Quantity	Gun tip pressure	Specified oil
R-2000iC/210WE	J1-axis reducer	4440g (5100ml)	0.15MPa or less	Kyodo yushi RV OIL SB150 Spec : A98L-0040-0323
	J2-axis reducer	3750g (4300ml)		
	J3-axis reducer	1830g (2100ml)		
	J4/J5/J6-axis gearbox	1740g (2000ml)		
	wrist 1 (J4/J5-axis reducer)	2230g (2560ml)		
	wrist 2 (J6-axis gear)	130g (140ml)		
	wrist 3 (J6-axis reducer)	350g (400ml)		

For oil replacement or replenishment, use the posture indicated below.

Table 7.3.2 (b) Postures for oiling

Supply position	Posture					
	J1	J2	J3	J4	J5	J6
J1-axis reducer	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
J2-axis reducer		0°				
J3-axis reducer		0°	0°			
J4/J5/J6-axis gearbox		Arbitrary	0°			
Wrist			0°	90°	0°	0°

Oil replacement procedure of the J1/J2/J3-axis reducer

- 1 Move the robot to the oiling posture described in Table 7.3.2 (b).
- 2 Turn off controller power.
- 3 Put an oil pan or the like under the oil outlet.
- 4 Remove seal bolts of the oil outlet and the ventilator hole, then drain all oil.
- 5 Install the seal bolt in the oil outlet. When reusing the seal bolts, be sure to seal them with seal tape.
- 6 Remove the taper plug of the oil inlet.
- 7 Add the specified oil and quantity as shown in Table 7.3.2 (a) to each axis at the oil inlet for each axis. Note: Measure the amount carefully and account for any spillage to ensure that appropriate amount is added to each axis.
- 8 Attach taper plugs in the oil inlet and ventilator hole. When reusing the taper plugs, be sure to seal them with seal tape.

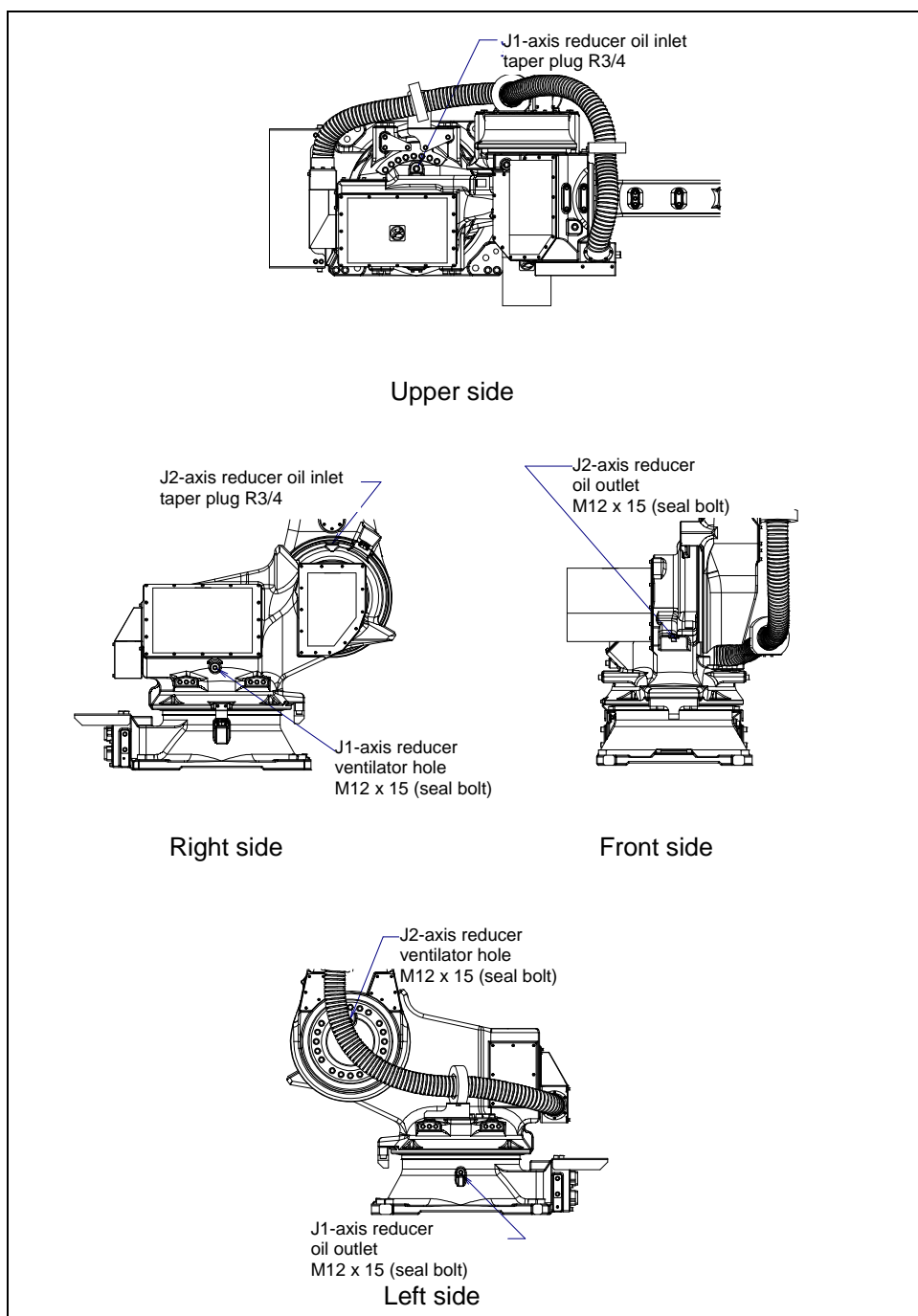
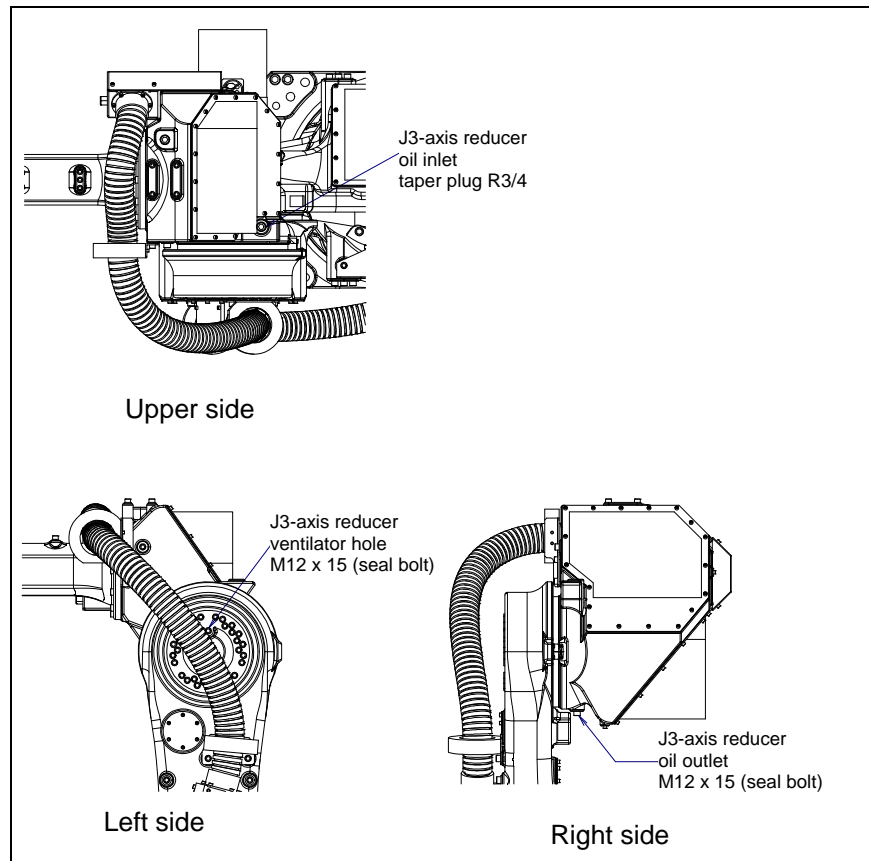


Fig. 7.3.2 (a) Replacing oil of the J1/J2-axis reducer

**Fig. 7.3.2 (b) Replacing oil of the J3-axis reducer**

Oil replacement procedure of the J4/J5/J6-axis gearbox

- 1 Move the robot to the oiling posture described in Table 7.3.2 (b).
- 2 Turn off controller power.
- 3 Put an oil pan or the like under the oil outlet.
- 4 Remove seal bolts of the oil outlet and the ventilator hole, then drain all oil.
- 5 Install the seal bolt in the oil outlet. When reusing the seal bolts, be sure to seal them with seal tape.
- 6 Remove the taper plug of the oil inlet.
- 7 Add the specified oil and quantity as shown in Table 7.3.2 (a) to the oil inlet. Note: Measure the amount carefully and account for any spillage to ensure that appropriate amount is added.
- 8 Attach taper plugs in the oil inlet and ventilator hole. When reusing the taper plugs, be sure to seal them with seal tape.

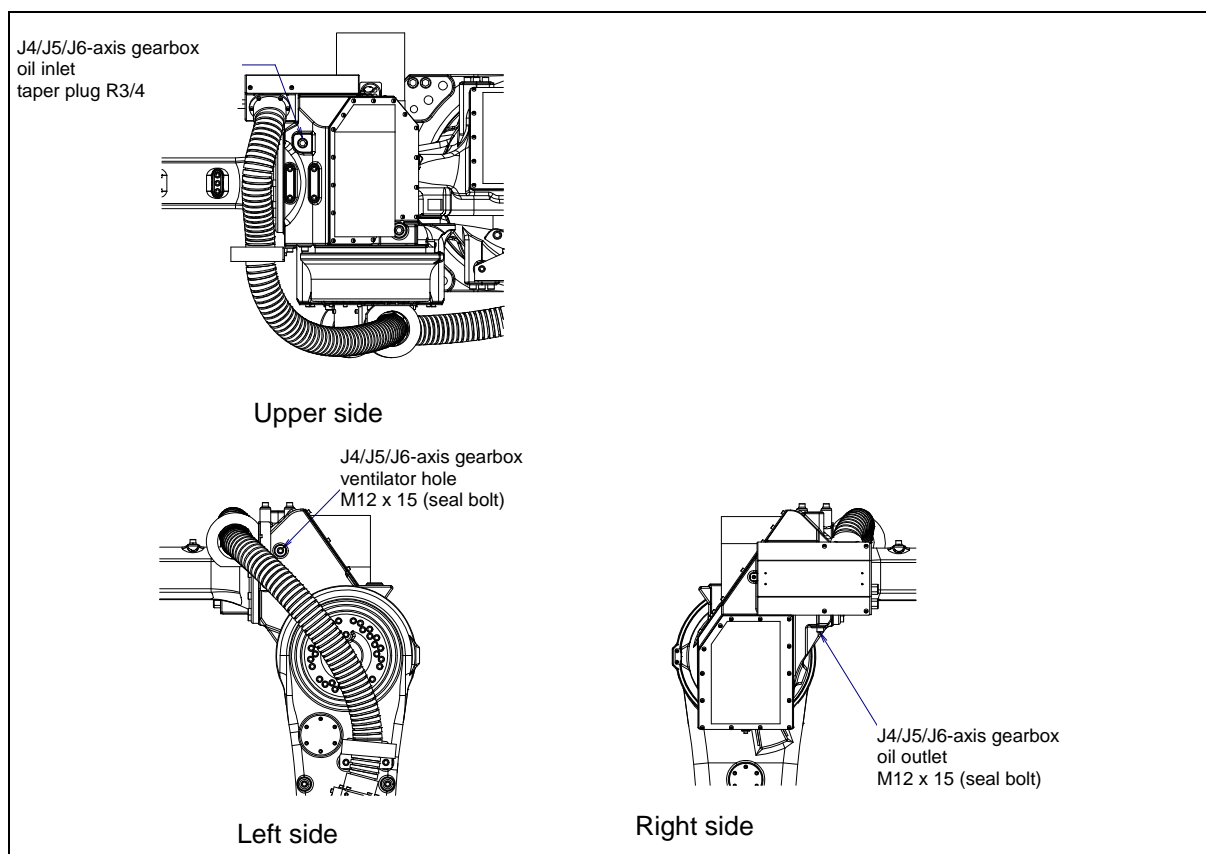


Fig. 7.3.2 (c) Replacing oil of the J4/J5/J6-axis gearbox

Oil Replacement Procedure for the Wrist

- 1 Move the robot to the oiling posture described in Table 7.3.2 (b).
- 2 Turn off controller power.
- 3 Put an oil pan or the like under the wrist oil outlet 1.
- 4 Remove seal bolts of the wrist oil outlet 1 and the wrist ventilator hole 1, then drain all oil. (Fig. 7.3.2 (d))
- 5 Install the seal bolt in the wrist oil outlet 1. When reusing the seal bolts, be sure to seal them with seal tape.
- 6 Remove the taper plug of the wrist oil inlet 1.
- 7 Add the specified oil and quantity as shown in Table 7.3.2 (a) to the wrist 1 at the wrist oil inlet 1.
Note: Measure the amount carefully and account for any spillage to ensure that appropriate amount is added.
- 8 Attach taper plugs in the wrist oil inlet 1 and wrist ventilator hole 1. When reusing the taper plugs, be sure to seal them with seal tape.
- 9 Perform same procedure for wrist oil inlet 2 and 3.

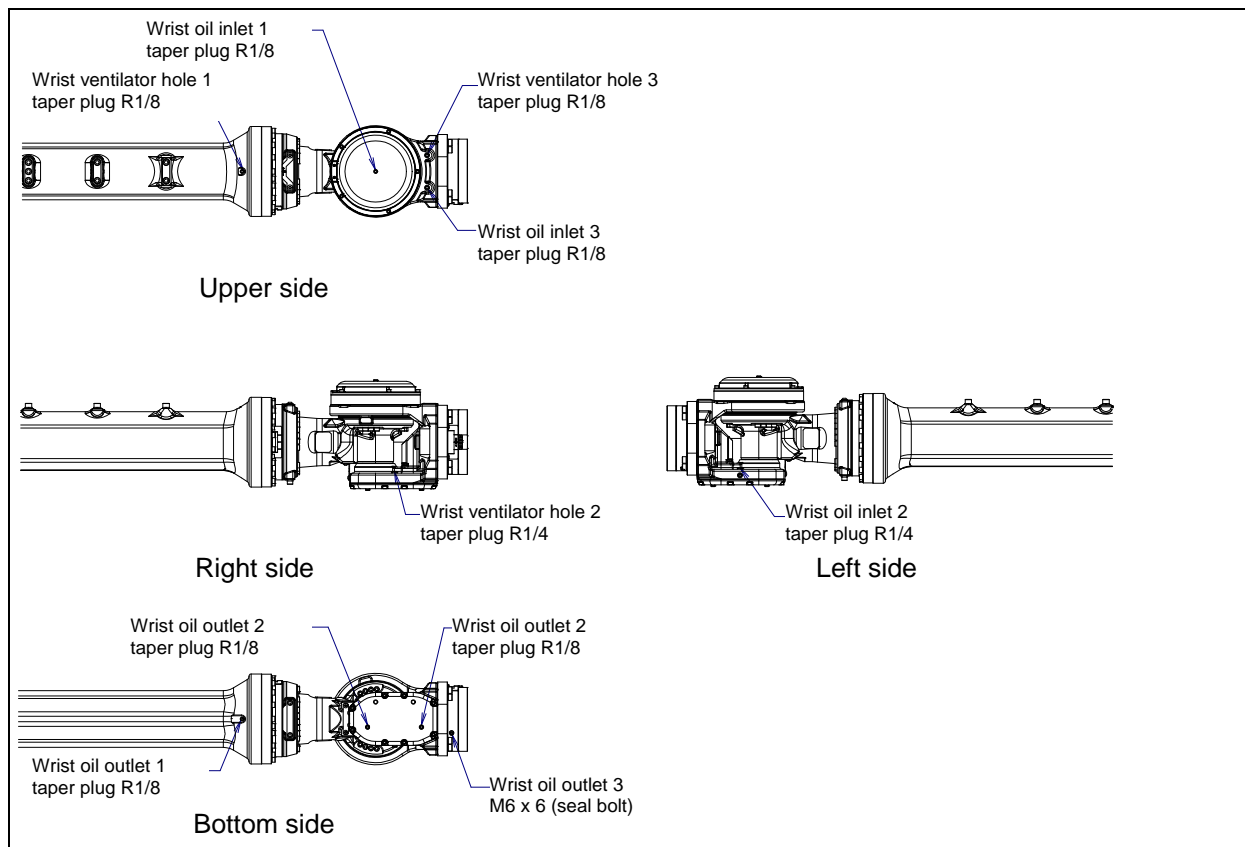


Fig. 7.3.2 (d) Replacing oil of the wrist

Table 7.3.2 (c) Specification of seal bolts and taper plugs

Parts name	Specification
Seal bolt (M6)	A97L-0218-0417#060606S
Seal bolt (M12)	A97L-0218-0417#121515S
Taper plug (R1/4)	A97L-0001-0436#2-2SUS-D
Taper plug (R3/4)	A97L-0001-0436#2-6SUD-D
Taper plug (R1/8)	A97L-0001-0436#2-1SUS-D

**CAUTION**

- 1 There is severe risk of gear damage in case robot is operated with oil shortage. Please make sure the gearbox is always filled with correct amount of oil.
- 2 Failure to supply oil correctly may cause damage to the seal, which would in turn lead to oil leakage and abnormal operation. Use specified oil. Use of non-approved oil may damage the reducer or lead to other problems.

7.4 STORAGE

When storing the robot, place it on a level surface with the same posture that was used for transportation.
(See Section 1.1.)

8 MASTERING

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



CAUTION

In case of performing mastering with gravity compensation is enabled, if load setting (See Section 4.3) is not correct, it will influence the precision of the mastering.

8.1 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



CAUTION

Robot data (including mastering data) and Pulsecoder data are backed up by their respective backup batteries. Data will be lost if the batteries die. Replace the batteries in the controller and mechanical units periodically. An alarm will alert you when battery voltage is low.

Types of Mastering

Table 8.1 (a) describes the following mastering methods.

Table 8.1 (a) Type of mastering

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

Once mastering is performed, you must 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.

This section describes zero-position mastering, quick mastering, quick mastering for single axis, single-axis mastering, and mastering data entry. For more detailed mastering (fixture position mastering), contact your local FANUC representative.



CAUTION

- 1 If mastering is performed incorrectly, the positioner may behave unexpectedly. This is very dangerous. Therefore, the positioning screen is designed to appear only when the \$MASTER_ENB system variable is 1 or 2. After performing positioning, press F5 [DONE] on the positioning screen. The \$MASTER_ENB system variable is reset to 0 automatically, thus hiding the positioning screen.
- 2 It is recommended that you back up the current mastering data before performing mastering.

8.2 RESETTING ALARMS AND PREPARING FOR MASTERING

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

Alarm displayed

“SRVO-062 BZAL” or “SRVO-075 Pulse not established”

Procedure

- 1 Display the positioning menu by following the steps 1 to 6.
 - 1 Press the [MENU] key.
 - 2 Press [0 NEXT] and select [6 SYSTEM].
 - 3 Press F1 ([TYPE]), and select [Variable] from the menu.
 - 4 Place the cursor on \$MASTER_ENB, then key in “1” and press the [ENTER] key.
 - 5 Press F1 ([TYPE]), and select [Master/Cal] from the menu.
 - 6 Select the desired mastering type from the [Master/Cal] menu.
- 2 To reset the “SRVO-062 BZAL” alarm, follow steps 1 to 5.
 - 1 Press the [MENU] key.
 - 2 Press [0 NEXT] and select [6 SYSTEM].
 - 3 Press F1 ([TYPE]), and select [Master/Cal] from the menu.
 - 4 Press F3 ([RES_PCA]), then press F4 ([YES]).
 - 5 Cycle power of the controller.
- 3 To reset the “SRVO-075 Pulse not established” alarm, follow the steps 1 to 2.
 - 1 After cycling controller power, the message “SRVO-075 Pulse not established” appears again.
 - 2 Move the axis for which the message mentioned above has appeared in either direction till the alarm disappears when you press the [RESET] key.

8.3 ZERO POSITION MASTERING

Zero-position mastering (witness mark mastering) is performed with all axes set at the 0-degree position. A zero-position mark (witness mark) is attached to each robot axis. (Fig. 8.3 (a)) This mastering is performed with all axes set at the 0-degree position using their respective witness marks.

Zero-position mastering involves a visual check, and might not be highly accurate. It should be used only as a quick-fix method.

Zero-position Mastering Procedure

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

\$PARAM_GROUP.SV_OFF_ENB[*] : FALSE (for all axes)

After changing the system variables, cycle power of the controller.

- 5 Press the [MENU] key to display the screen menu.
- 6 Select [0 NEXT] and press [6 SYSTEM].
- 7 Press F1 [TYPE], display the screen change menu.
- 8 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

```

- 9 Jog the robot into a posture for mastering.
- 10 Select [2 ZERO POSITION MASTER]. Press F4 [YES].

```

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
Robot Mastered! Mastering Data:
<0> <11808249> <38767856>
<9873638> <12200039> <2000319>
[ TYPE ]  LOAD  RES_PCA          DONE

```

- 11 Select [7 CALIBRATE] and press F4 [YES]. Mastering will be performed automatically. Alternatively, turn off the controller power and on again.

```

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
Robot Calibrated! Cur Jnt Ang(deg):
< 0.0000> < 0.0000> < 0.0000>
< 0.0000> < 0.0000> < 0.0000>

```

- 12 After positioning is completed, press F5 [DONE].



- 13 Return the setting of the gravity compensation.
- 14 Return brake control to the original setting, and cycle power of the controller.

Table 8.3 (a) Posture with position marks (witness mark) aligned

Axis	Position
J1-axis	0 deg
J2-axis	0 deg
J3-axis	0 deg (NOTE) When J2-axis is 0 deg.
J4-axis	0 deg
J5-axis	0 deg
J6-axis	0 deg

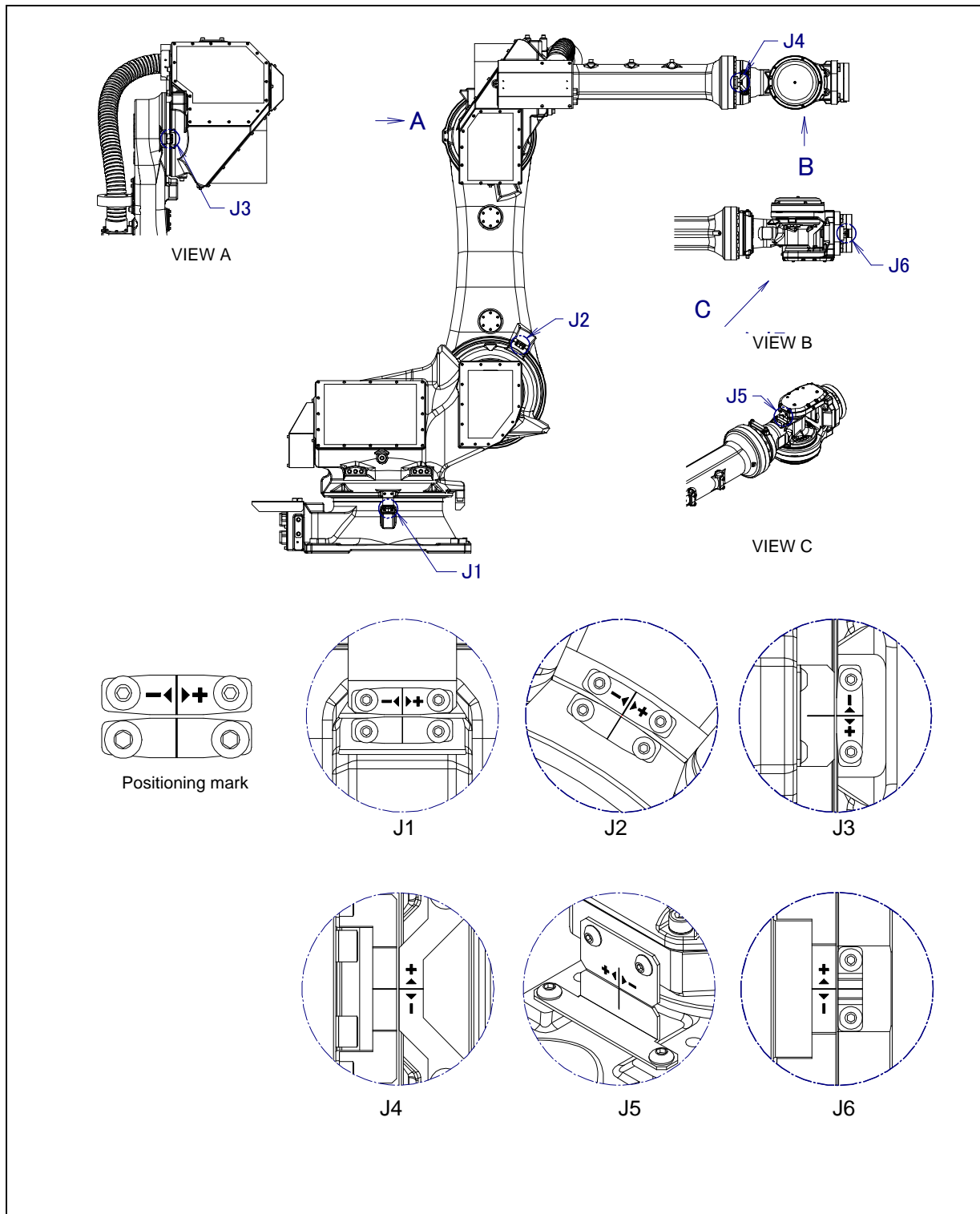


Fig. 8.3 (a) Zero-position mark (witness mark) for each axis

8.4 QUICK MASTERING

Quick mastering is performed at a user-specified position for each axis. The pulse count value is obtained from the rotation times 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.

Quick mastering is factory-performed at the position indicated in Table 8.3 (a). If possible, do not change the setting.

If setting the robot at the position mentioned above is impossible, you must re-set the quick mastering reference position using the following method. (It would be convenient to set up a marker that can work in place of the witness mark.)



CAUTION

- 1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
- 2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

\$PARAM_GROUP.SV_OFF_ENB[*] : FALSE (for all axes)

After changing the system variables, cycle power of the controller.

- 5 Select [6 SYSTEM].
- 6 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

- 7 Jog the robot to the quick mastering reference position.
- 8 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position is saved.

5 SINGLE AXIS MASTER
6 SET QUICK MASTER REF
7 CALIBRATE

[TYPE]	YES	NO
----------	-----	----

F4

- 9 Return the setting of the gravity compensation.
- 10 Return brake control to the original setting, and cycle power of the controller.

**CAUTION**

If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or Zero position mastering to restore mastering data.

Procedure of Quick Mastering

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)

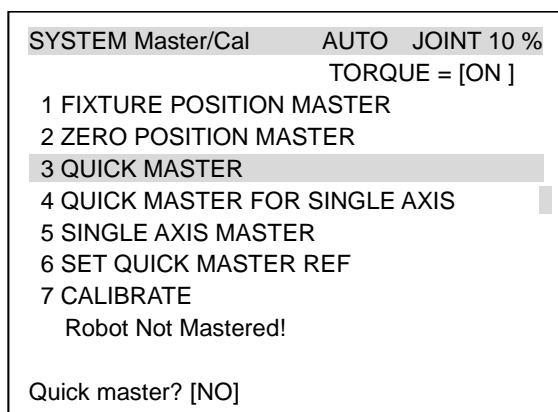
Brake control can be released by setting the system variables as follows:

\$PARAM_GROUP.SV_OFF_ALL : FALSE

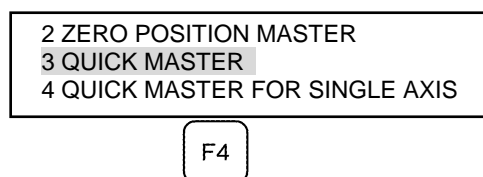
\$PARAM_GROUP.SV_OFF_ENB[*] : FALSE (for all axes)

After changing the system variables, cycle power of the controller.

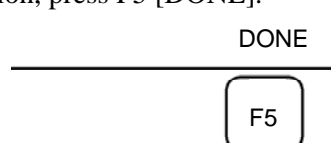
- 5 Display the Master/Cal screen.



- 6 Jog the robot to the quick mastering reference position.
- 7 Move the cursor to [3 QUICK MASTER] and press the [ENTER] key. Press F4 [YES]. Quick mastering data is saved.



- 8 Select [7 CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration is executed by cycling power.
- 9 After completing the calibration, press F5 [DONE].



- 10 Return the setting of the gravity compensation.
- 11 Return brake control to the original setting, and cycle power of the controller.

8.5 QUICK MASTERING FOR SINGLE AXIS

Quick mastering for a single axis is performed at a user-specified position for one axis. The pulse count value is obtained from the rotation times 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.

Quick mastering is factory-performed at the position indicated in Table 8.3 (a). If possible, do not change the setting.

If setting the robot at the position mentioned above is impossible, you must re-set the quick mastering reference position using the following method. (It would be convenient to set up a marker that can work in place of the witness mark.)

CAUTION

- 1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
- 2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
 \$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

\$PARAM_GROUP.SV_OFF_ENB[*] : FALSE (for all axes)

After changing the system variables, cycle power of the controller.

- 5 Select [6 SYSTEM].
- 6 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
```

- 7 Jog the robot to the quick mastering reference position.
- 8 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position is saved.

5 SINGLE AXIS MASTER 6 SET QUICK MASTER REF 7 CALIBRATE		
[TYPE]	YES	NO
<div style="border: 1px solid black; display: inline-block; padding: 5px 15px;">F4</div>		

- 9 Return the setting of the gravity compensation.
- 10 Return brake control to the original setting, and cycle power of the controller.

**CAUTION**

If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or Zero position mastering to restore mastering data.

Procedure of Quick Mastering for single axis

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

\$PARAM_GROUP.SV_OFF_ENB[*] : FALSE (for all axes)

After changing the system variables, cycle power of the controller.

- 5 Display the Master/Cal screen.

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

- 6 Select [4 QUICK MASTER FOR SINGLE AXIS]. You will see the quick master for single axis screen.

AUTO JOINT 1%					
QUICK MASTER FOR SINGLE AXIS					
	ACTUAL	POS	(MSTR POS)	(SEL)	1/9 [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					

- 7 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.

AUTO JOINT 1%					
QUICK MASTER FOR SINGLE AXIS					
	ACTUAL	POS	(MSTR POS)	(SEL)	1/9 [ST]
J5	0.000	(	0.000)	(1)	[2]
J6	0.000	(	0.000)	(1)	[2]
EXEC					

- 8 Jog the robot to the quick mastering reference position.
 9 Press F5 [EXEC]. Mastering is performed. So, (SEL) is reset to 0, and [ST] is re-set to 2.
 10 Select [7 CALIBRATE] and press F4 [YES]. Calibration is executed. Calibration is executed by cycling power.
 11 After completing the calibration, press F5 [DONE].



- 12 Return the setting of the gravity compensation.
 13 Return brake control to the original setting, and cycle power of the controller.

8.6 SINGLE AXIS MASTERING

Single axis mastering is performed for one axis at a time. The mastering position for each axis can be specified by the user.

Single axis mastering can be used, if mastering data for a specific axis is lost, for example, because a low voltage has been detected on the pulse counter backup battery or because the Pulsecoder has been replaced.

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 8.6 (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 to set to it to the 0_ position.
SEL	This item is set to 1 for an axis to be subjected to single axis mastering. Usually, it is 0.
ST	<p>This item indicates whether single axis mastering has been completed for the corresponding axis. It cannot be changed directly by the user.</p> <p>The value of the item is reflected in \$EACHMST_DON (1 to 9).</p> <p>0 : Mastering data has been lost. Single axis mastering is necessary.</p> <p>1 : Mastering data has been lost. (Mastering has been performed only for the other interactive axes.) Single axis mastering is necessary.</p> <p>2 : Mastering has been completed.</p>

Procedure of Single axis mastering

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

\$PARAM_GROUP.SV_OFF_ENB[*] : FALSE (for all axes)

After changing the system variables, cycle power of the controller.

- 5 Select [6 SYSTEM].
- 6 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

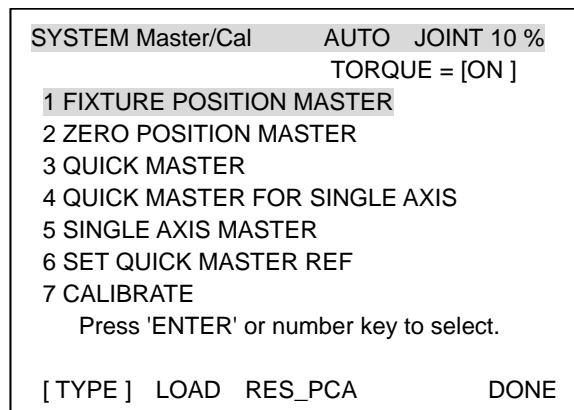
- 7 Select [5 SINGLE AXIS MASTER]. The following screen will be displayed.

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					

- 8 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.
- 9 Turn off brake control, then jog the robot to the mastering position.
- 10 Enter axis data for the mastering position.
- 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 the setting of the gravity compensation.
 16 Return brake control to the original setting, and cycle power of the controller.

8.7 MASTERING DATA ENTRY

This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

- 1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
- 2 Press F1 [TYPE]. Select [Variables]. The system variable screen appears.

SYSTEM Variables		AUTO	JOINT 1%
		TORQUE = [ON]	
1	\$AO_MAXAX	536870912	
2	\$AP_PLUGGED	4	
3	\$AP_TOTALAX	1677216	
4	\$AP_USENUM	[12] of Byte	
5	\$AUTOINIT	2	
6	\$BLT	19920216	
[TYPE]			

- 3 Change the mastering data.
The mastering data is saved to the \$DMR_GRP.\$MASTER_COUN system variable.

SYSTEM Variables		AUTO	JOINT 1%
		TORQUE = [ON]	
135	\$DMR_GRP	DMR_GRP_T	
136	\$ENC_STAT	[2] of ENC STATT	
[TYPE]			

- 4 Select \$DMR_GRP.

SYSTEM Variables		AUTO	JOINT 1%
\$DMR_GRP			1/1
1	[1]	DMR_GRP_T	

SYSTEM Variables		AUTO	JOINT 1%
\$DMR_GRP			1/29
1	\$MASTER_DONE	FALSE	
2	\$OT_MINUS	[9] of BOOLEAN	
3	\$OT_PLUS	[9] of BOOLEAN	
4	\$MASTER_COUNT	[9] of INTEGER	
5	\$REF_DONE	FALSE	
6	\$REF_POS	[9] of REAL	
7	\$REF_COUNT	[9] of INTEGER	
8	\$BCKLSH SIGN	[9] of BOOLEAN	
[TYPE]		TRUE	FALSE

- 5 Select \$MASTER_COUN, and enter the mastering data you have recorded.

SYSTEM Variables		AUTO JOINT 1%
\$DMR GRP		1/1
1 [1]	95678329	
2 [2]	10223045	
3 [3]	3020442	
4 [4]	304055030	
5 [5]	20497709	
6 [6]	2039490	
7 [7]	0	
8 [8]	0	
9 [9]	0	

- 6 Press the [PREV] key.
7 Set \$MASTER_DONE to TRUE.

SYSTEM Variables		AUTO JOINT 1%
\$DMR GRP		1/1
1 \$MASTER_DONE	TRUE	
2 \$OT MINUS	[9] of BOOLEAN	
[TYPE]	TRUE FALSE	

- 8 Display the positioning screen, and select [7 CALIBRATE], then press F4 [YES].
9 After completing positioning, press F5 [DONE].



8.8 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 meets the actual robot position by using the procedure 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 OPERATOR'S MANUAL are aligned. There is no need to use a visual aid.
If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described in 2. Alternatively, the mastering data in system variable \$DMR_GRP.\$MASTER_COUN may have been overwritten as a result of an operation error or some other reason.
Compare the data with the values indicated on the supplied data sheet. This system variable is overwritten whenever mastering is performed. Whenever mastering is performed, record the value of the system variable on the data sheet.
- 2 Alarm 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. Confirm if the alarm will disappear by performing a pulse reset (See Section 8.2.). Then, cycle power of the controller to check if the alarm disappears or not.
The battery may be drained if the alarm is still displayed. Perform a pulse reset, and turn off and on the controller power after replacing the battery. Note that, if this alarm is displayed, all the original data held by the Pulsecoder will be lost. Mastering is required.
 - (2) BLAL alarm
This alarm is displayed if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is displayed, replace the battery with a new one immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
 - (3) Alarm notification like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may have trouble with Pulsecoder, contact your local FANUC representative.

9 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.

9.1 TROUBLESHOOTING

Table 9.1 (a) shows the major troubleshooting symptoms that may occur in the mechanical unit and their probable causes. If you cannot pinpoint the cause of a failure or which measures to take, contact your local FANUC representative.

Table 9.1 (a) TROUBLESHOOTING

Symptoms	Descriptions	Causes	Measures
Vibration Noise	<ul style="list-style-type: none"> - As the robot operates, its base plate lifts off the floor plate. - There is a gap between the base plate and the floor plate. - There is a crack in the weld that fastens the base plate to the floor plate. 	[Base plate and floor plate fastening] <ul style="list-style-type: none"> - It is likely that the base plate is not securely fastened to the floor plate because of poor welding. - If the base plate is not securely fastened to the floor plate, it lifts 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"> - Re-weld the base plate to the floor plate. - If the weld is not strong enough, increase its width and length.
	<ul style="list-style-type: none"> - The J1 base lifts off the base plate as the robot operates. - There is a gap between the J1 base and base 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 base plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or foreign material caught between the base plate and floor plate. - If the robot is not securely fastened to the floor plate, the J1 base lifts the floor plate as the robot operates, allowing the base and floor plates to strike each other. That, in turn, leads to vibration. 	<ul style="list-style-type: none"> - If a bolt is loose, apply LOCTITE and tighten it to the appropriate torque. - Adjust the base plate surface flatness to within the specified tolerance. - If there is any foreign material between the J1 base and base plate, remove it. - Apply adhesive between the J1 base and base plate.
	<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 rigid enough. - If they are not rigid enough, counterforce can deform the rack or floor, and causes vibration. 	<ul style="list-style-type: none"> - Reinforce the rack or floor to make it more rigid. - If reinforcing the rack or floor is impossible, modify the robot control program; doing so might reduce the vibration.

Symptoms	Descriptions	Causes	Measures
Vibration Noise (Continued)	<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. 	<p>[Overload]</p> <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 overloaded, reduce the load, or modify the robot control program. - Vibration can be reduced by re-modifying the robot control program; reducing speed or acceleration with minimizing the influence on the entire cycle time.
	<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 oil of the vibrating or noise occurring axis has not been replaced for a long period. - Cyclical 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 gear tooth surface or rolling surface of a bearing, or reducer. - Prolonged overloaded use may cause fretting fatigue on gear tooth surface or rolling surface of bearing and reducer. - It is likely that foreign material caught in a gear, bearing, or within a reducer has caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that foreign material caught in a gear, bearing, or within a reducer is causing vibration. - It is likely that, because the oil has not been changed for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue by neglect greasing. 	<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. - Regularly greasing with the specified oil can help prevent problems.

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

Symptoms	Descriptions	Causes	Measures
Rattling	<ul style="list-style-type: none"> - While the robot is not supplied with power, pushing it by hand wobbles part of the mechanical unit. - There is a gap on the mounting face of the mechanical unit. 	<p>[Mechanical unit mounting bolt]</p> <ul style="list-style-type: none"> - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical unit. 	<ul style="list-style-type: none"> - Check the following retaining bolts tightness for each axis. If any of these bolts is loose, apply LOCTITE and bolt down with appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Reducer shaft retaining bolt - Base retaining bolt - Arm retaining bolt - Casing retaining bolt - End effector retaining bolt
Motor overheat	<ul style="list-style-type: none"> - The motor overheated due to the temperature in the installation area rose. - After changing the Robot control program or the load, the motor overheat. 	<p>[Ambient temperature]</p> <ul style="list-style-type: none"> - It is likely that the motor overheated along with the ambient temperature rose, and could not release heat. <p>[Operating condition]</p> <ul style="list-style-type: none"> - It is likely that the overcurrent is above the specified permissive average current. 	<ul style="list-style-type: none"> - Reducing the ambient temperature is the most effective means of preventing overheat. - Having the surroundings of the motor well ventilated enables the motor to release heat efficiently, thus preventing overheat. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is an effective way to reduce the average current. Thus, prevent overheat. - The teach pendant can monitor the average current. Check the average current when the robot control program launched.
	<ul style="list-style-type: none"> - After a robot 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 accelerate or decelerate normally, so the average current increases, leading to the motor overheating. 	<ul style="list-style-type: none"> - As for load setting, Input an appropriate parameter referring to Section 4.3 of the operator's manual.

Symptoms	Descriptions	Causes	Measures
Motor overheat	- 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 unit drive mechanism, 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 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. - Judgment is possible if the average current decreased after replacing the motor, the former motor had been defected.
Oil leakage	- Oil leaks from the mechanical unit.	<p>[Poor sealing]</p> <ul style="list-style-type: none"> - Probable causes are a crack in the casting, a damaged O-ring, a damaged oil seal, or a loose seal bolt. - The casting may crack with excessive force caused in collision. - An O-ring can be damaged if it is trapped or cut during disassembling or re-assembling. - An debris cover or oil seal may be damaged if dust scratches the lip. - A loose seal bolt or a taper plug may allow oil to leak along the threads. 	<ul style="list-style-type: none"> - If the casting cracks, sealant can be used as a quick-fix to prevent further oil leakage. However, the component must be replaced as soon as possible, as the crack will widen. - 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 coupling section - 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"> - Oil inlet/outlet - Oil ventilator hole - Drain hole - Debris covers are used in the locations stated below. <ul style="list-style-type: none"> - Surrounding of the J1 to J3-axis reducers

Symptoms	Descriptions	Causes	Measures
Dropping axis	<ul style="list-style-type: none"> - An axis falls because the brake went out. - An axis falls while standing still. 	<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 and keep the brake current flowing, thus preventing the brake from operating when the motor is reenergized. - It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently. - It is likely that oil soak through the motor, causing the brake to slip. 	<ul style="list-style-type: none"> - Check whether the brake drive relays are stuck to each other or not. If they are found to be stuck, replace the relays. - Replace the motor after confirming whether the following symptoms have occurred. <ul style="list-style-type: none"> - Brake shoe is worn out - Brake main body is damaged - Oil soaked through the motor
Displacement	<ul style="list-style-type: none"> - The robot moves to a point other than the taught position. - The repeatability is not within the tolerance. 	<p>[Mechanical unit problems]</p> <ul style="list-style-type: none"> - If the repeatability is unstable, probable causes are a failure in the drive mechanism or a loose bolt, and so on. - If the repeatability is stable, it is likely that collision by an excessive load caused slip on the fastening surface of each axis arm, and reducer. - It is likely that the Pulsecoder is abnormal. 	<ul style="list-style-type: none"> - If the repeatability is unstable, repair the mechanical unit 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.
	<ul style="list-style-type: none"> - Displacement occurs only in a specific peripheral equipment. 	<p>[Peripheral equipment displacement]</p> <ul style="list-style-type: none"> - It is likely that an external force was applied to the peripheral equipment, thus shifting its position relative to the robot. 	<ul style="list-style-type: none"> - Correct the setting of the peripheral equipment position. - Correct the taught program.
	<ul style="list-style-type: none"> - Displacement occurred after a parameter was changed. 	<p>[Parameter]</p> <ul style="list-style-type: none"> - It is likely that the mastering data was overwritten, and the origin had misaligned. 	<ul style="list-style-type: none"> - Re-enter the previous optimal mastering data. - If correct mastering data is unavailable, perform mastering again.
BZAL alarm displayed	<ul style="list-style-type: none"> - BZAL is displayed on the teach pendant screen 	<ul style="list-style-type: none"> - The voltage of the memory backup battery may be low. - The Pulsecoder cable may be broken. 	<ul style="list-style-type: none"> - Replace the battery. - Replace the cable.

APPENDIX

A

PERIODIC MAINTENANCE TABLE

FANUC Robot R-2000iC/210WE

Periodic Maintenance Table

Items		Accumulated operating time (H)	Check time	Oil amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the mechanical unit cable (movable part)	0.2H	—		○			○				○			
	3	Check damage of the end effector (hand) cable	0.1H	—		○			○				○			
	4	Check looseness of exposed connector	0.2H	—		○			○				○			
	5	Retightening the end effector mounting bolts	0.2H	—		○			○				○			
	6	Retightening the external main bolts	2.0H	—		○			○				○			
	7	Check the fixed mechanical stopper and the adjustable mechanical stopper	0.1H	—		○			○				○			
	8	Clean spatters, sawdust and dust	1.0H	—		○			○				○			
	9	Check of purge piping and drain holes *1	0.1H	—		○			○				○			
	10	Check of debris covers *1	0.1H	—		○			○				○			
	11	Replacing the oil of J1-axis reducer *1	1.0H	5100ml					●				●			
	12	Replacing the oil of J2-axis reducer *1	0.5H	4300ml					●				●			
	13	Replacing the oil of J3-axis reducer *1	0.5H	2100ml					●				●			
	14	Replacing the oil of J4/J5/J6-axis gearbox *1	0.5H	2000ml					●				●			
	15	Replacing oil of wrist axis 1 (J4, J5-axis) *1	0.5H	2560ml					●				●			
	16	Replacing oil of wrist axis 2 (J6 gear) *1	0.5H	140ml					●				●			
	17	Replacing oil of wrist axis 3 (J6-axis reducer) *1	0.2H	400ml					●				●			
	18	Replacing the mechanical unit Batteries *1 *3	0.1H	—							●					
	19	Replacing the mechanical unit cable*	4.0H	—												
Controller	20	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	21	Check damages of the teach pendant cable, the operation box connection cable and the robot connection cable	0.2H	—		○			○				○			
	22	Replacing battery *1 *3	0.1H	—												

1 For descriptions about the items marked with an asterisk (), refer to “REPLACING UNITS Chapter” of this manual or the following manuals.
MAINTENANCE MANUAL (B-83195EN)

*2 ●: Requires order of parts

○: Does not require order of parts

*3 Regardless of the operating time, replace the mechanical unit batteries at 1 year or 1.5 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	Items
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	1
○				○				○				○				○					2
○				○				○				○				○					3
○				○				○				○				○					4
○				○				○				○				○					5
○				○				○				○				○					6
○				○				○				○				○					7
○				○				○				○				○					8
○				○				○				○				○					9
○				○				○				○				○					10
●				●				●				●				●					11
●				●				●				●				●					12
●				●				●				●				●					13
●				●				●				●				●					14
●				●				●				●				●					15
●				●				●				●				●					16
●				●				●				●				●					17
●						●						●						●			18
				●																	19
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	20
○				○				○				○				○					21
				●																	22

Overhaul

B 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

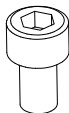
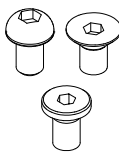
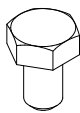
Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)

Tensile strength 400N/mm² or more

Refer to the following tables if the bolts tightening torque is 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	—	—	—	—	—	—
								

INDEX

<A>

ADJUSTABLE MECHANICAL STOPPER AND LIMIT SWITCH SETTING (OPTION).....	37
AIR PIPING (OPTION).....	30
AIR SUPPLY (OPTION).....	29
AXIS LIMITS SETUP.....	33

BASIC SPECIFICATIONS	13
----------------------------	----

<C>

CHANGE AXIS LIMIT BY DCS (OPTION).....	34
Changing the Parameter Setting.....	42
Check of Debris Cover.....	52
Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper.....	50
Check of Purge Piping and Drain Holes.....	51
CHECK POINTS	47
Check the Mechanical Unit Cables and Connectors.....	49
CHECKS AND MAINTENANCE	44
Confirmation of Oil Seepage.....	47
Confirmation of the Air Control Set or Air Purge Kit (option).....	48
CONNECTION WITH THE CONTROLLER.....	12

<D>

Daily Checks.....	44
-------------------	----

<E>

END EFFECTOR INSTALLATION TO WRIST	24
EQUIPMENT INSTALLATION TO THE ROBOT	24
EQUIPMENT MOUNTING FACE.....	25

<I>

INSTALLATION.....	5
INSTALLATION CONDITIONS.....	11
Installation Method	6
Installing Adjustable Mechanical Stopper Option.....	38
INSTALLING THE AIR PURGE KIT	32
INTERFACE FOR OPTION CABLE (OPTION).....	31

<L>

LOAD CONDITIONS ON J2 BASE AND J3 CASING	23
LOAD SETTING	26

<M>

MAINTENANCE	53
MAINTENANCE AREA.....	11
MASTERING	60
MASTERING DATA ENTRY	74
MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE	17

<O>

OVERVIEW	60
----------------	----

<P>

Periodic Checks and Maintenance	45
PERIODIC MAINTENANCE TABLE	85
PIPING AND WIRING TO THE END EFFECTOR.....	28
PREFACE.....	p-1

<Q>

QUICK MASTERING.....	65
QUICK MASTERING FOR SINGLE AXIS	68

<R>

Replacing the Batteries (1.5 year Periodic Maintenance).....	53
Replacing the Oil of the Drive Mechanism (1 year (3840 hours) Periodic Maintenance)	54
RESETTING ALARMS AND PREPARING FOR MASTERING	61
ROBOT CONFIGURATION.....	13

<S>

SAFETY PRECAUTIONS	s-1
SINGLE AXIS MASTERING	71
STORAGE	59
STRENGTH OF BOLT AND BOLT TORQUE LIST	88

<T>

The Maximum Stopping Distance (Position) of Adjustable Mechanical Stopper.....	43
TRANSPORTATION	1
TRANSPORTATION AND INSTALLATION.....	1
Transportation with an End Effector Attached.....	4
TROUBLESHOOTING	77

<V>

VERIFYING MASTERING.....	76
--------------------------	----

<W>

WRIST LOAD CONDITIONS	22
-----------------------------	----

<Z>

ZERO POINT POSITION AND MOTION LIMIT.....	18
ZERO POSITION MASTERING	62

REVISION RECORD

Edition	Date	Contents
02	Apr., 2020	<ul style="list-style-type: none">• Change of the label and specification.• Addition of caution for cleaning fluid• Correction of errors
01	Nov., 2017	

B-84014EN/02

