FANUC Robot LR Mate 200*i*D/4S/4SH/4SC

FANUC Robot ER-4*i*A

MECHANICAL UNIT

OPERATOR'S MANUAL

B-83574EN/06

- **Original Instructions**

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

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

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

SAFETY PRECAUTIONS

This chapter describes the precautions which must be followed to enable the safe use of the robot. Before using the robot, be sure to read this chapter thoroughly.

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 series SAFETY HANDBOOK (**B-80687EN)**”.

1 PERSONNEL

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 safeguarded space

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

- The operator is not allowed to work in the safeguarded space.
- The programmer or teaching operator and maintenance technician are allowed to work in the safeguarded space. Works carried out in the safeguarded space include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safeguarded space, the person must be trained on proper robot operation.

Table 1 (a) lists the work outside the safeguarded space. In this table, the symbol "O" means the work allowed to be carried out by the specified personnel.

Table 1 (a) List of work outside the Safeguarded Space

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

During robot operation, 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.

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

Please drop the power supply of the robot control system at once when the worker is placed by the robot by any chance or it is confined, push the robot arm directly, change posture, and liberate the worker.

4 WARNING & CAUTION LABEL

(1) Transportation label

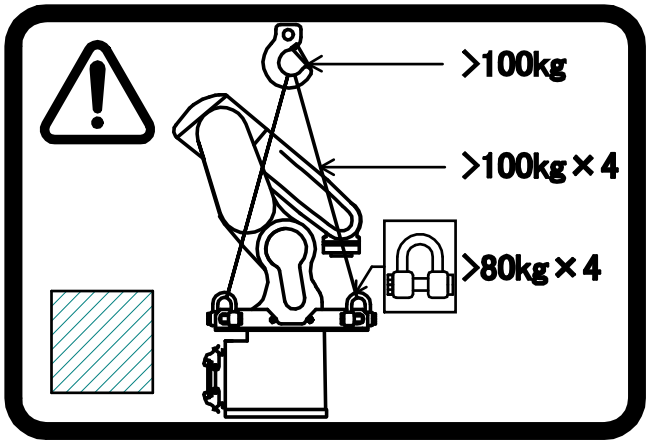


Fig. 4 (a) Transportation label

Description

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

1) Use a crane with a load capacity of 100 kg or greater.
2) Use four slings with each load capacity of 100 kg or greater.
3) Use four shackles with each load capacity of 784 N (80 kgf) or greater.

(2) Greasing label
(if greasing kit A05B-1142-K021, A05B-1142-K026, A05B-1143-K021 are specified)

(4S/4SH/ER-4*i*A) (4SC)

Fig. 4 (b) Greasing label

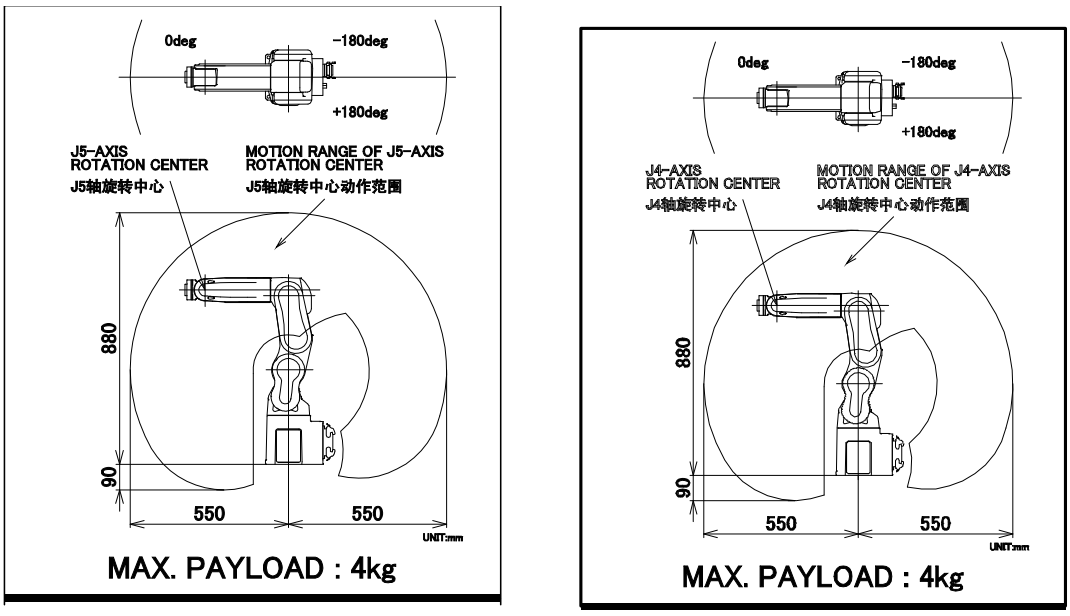
Description

When using a grease kit, observe the instructions indicated on this label.

1) Before filling the cylinder with grease from tube, squeeze the tube to make the grease in it soft.
2) Pushing in the plunger by 2.5 mm causes a grease of 1 ml to be pushed out.

(3) Operating space and payload label

The following label is added if the CE specification is requested.



(4S/4SC/ER-4*i*A) (4SH)

Fig. 4 (c) Operating space and payload label

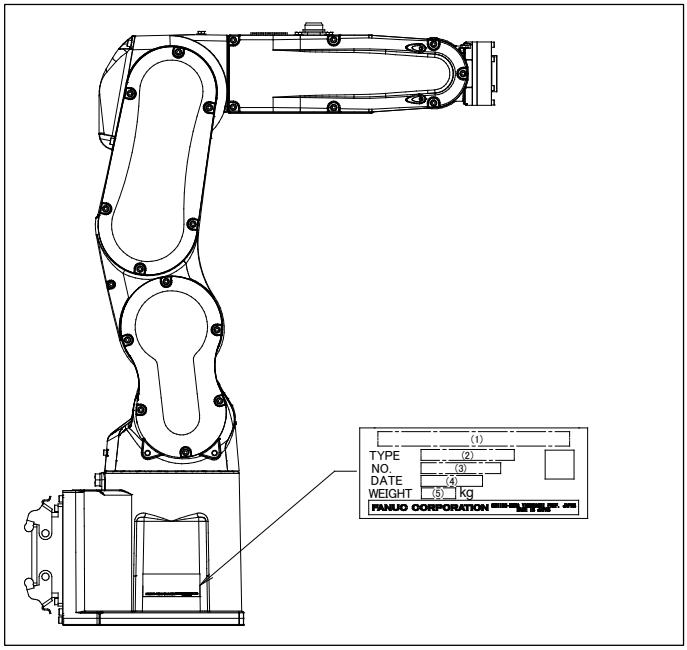
PREFACE

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

Model name	Mechanical unit specification No.	Maximum load	Remarks
FANUC Robot LR Mate 200*i*D/4S	A05B-1143-B201	4kg	
FANUC Robot LR Mate 200*i*D/4SH	A05B-1143-B211	4kg	
FANUC Robot LR Mate 200*i*D/4SC	A05B-1143-B221	4kg	
FANUC Robot ER-4*i*A	A05B-1143-B261	4kg	

NOTE
The following abbreviations are used herein.
4S : LR Mate 200*i*D/4S
4SH : LR Mate 200*i*D/4SH
4SC : LR Mate 200*i*D/4SC

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 LR Mate 200*i*D/4S	A05B-1143-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	20
	FANUC Robot LR Mate 200*i*D/4SH	A05B-1143-B211			19
	FANUC Robot LR Mate 200*i*D/4SC	A05B-1143-B221			20
	FANUC Robot ER-4*i*A	A05B-1143-B261			20

RELATED MANUALS

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

SAFETY HANDBOOK **B-80687EN** All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers : Operator, system designer Topics : Safety items for robot system design, operation, maintenance
R-30*i*B Mate, **R-30*i*B Mate Plus controller**	OPERATOR'S MANUAL Basic Operation **B-83284EN** Alarm Code List **B-83284EN-1** Optional Function **B-83284EN-2**	Intended readers : Operator, programmer, maintenance technician, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	MAINTENANCE MANUAL **Standard : B-83525EN** **Open air : B-83555EN**	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

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

The robot can be transported with a crane. 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.

⚠ WARNING
1 The robot becomes unstable when it is transported with the end effector applied to wrist. Please be sure to remove the end effector when the robot is transported.
2 Before moving the robot with a crane, check and tighten any loose bolts on the transport equipment on the robot.
3 Do not pull eyebolts sideways.

Transportation using a crane (Fig. 1.1 (a) to (c))
Fasten the transport equipment to the robot base and lift the robot with the four slings.

⚠ CAUTION
Note that a sling with insufficient length may break the J2 base or J2 arm cover.

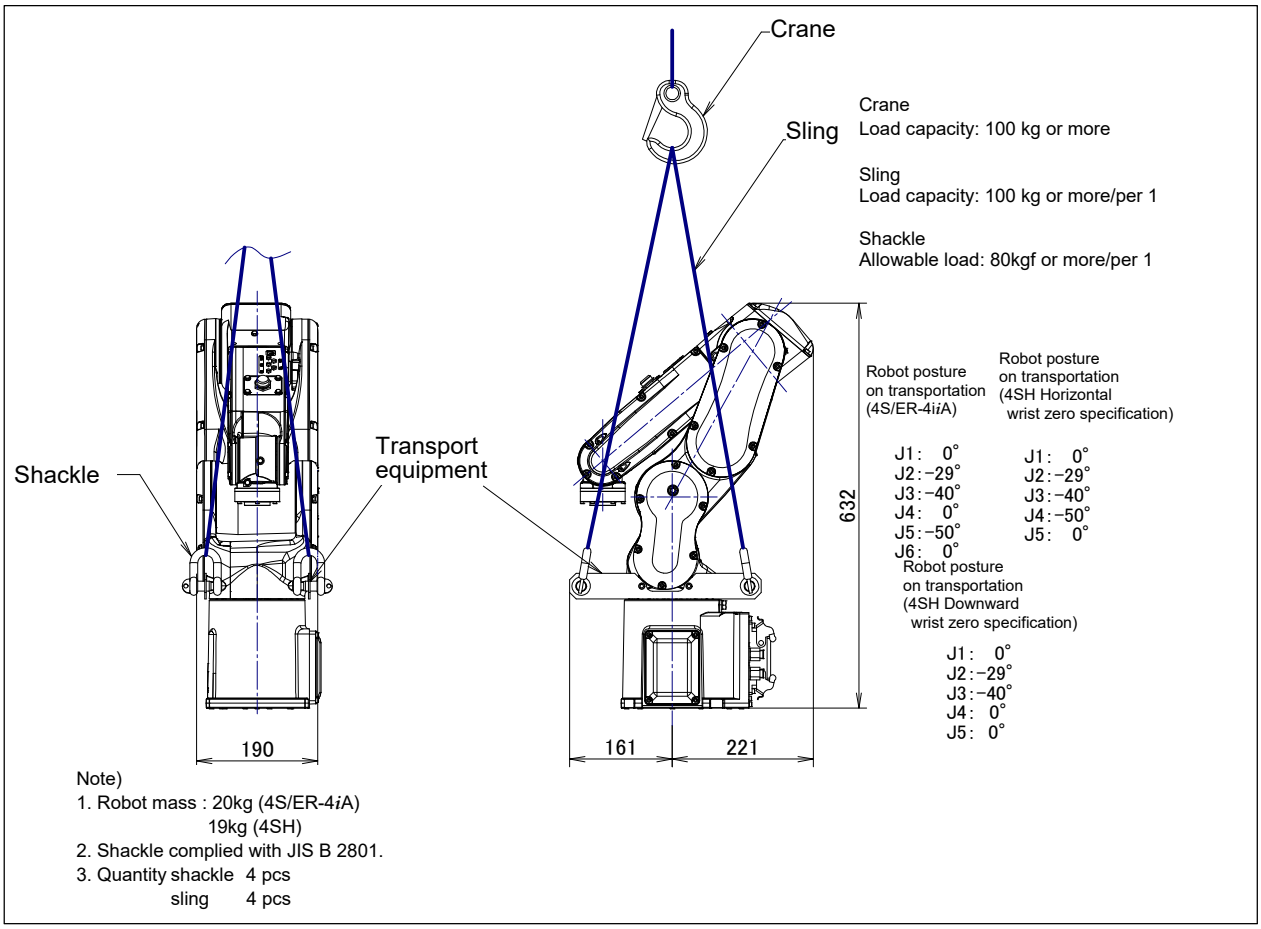


Fig. 1.1 (a) Transportation using a crane (4S/4SH/ER-4*i*A) (back side connector plate)

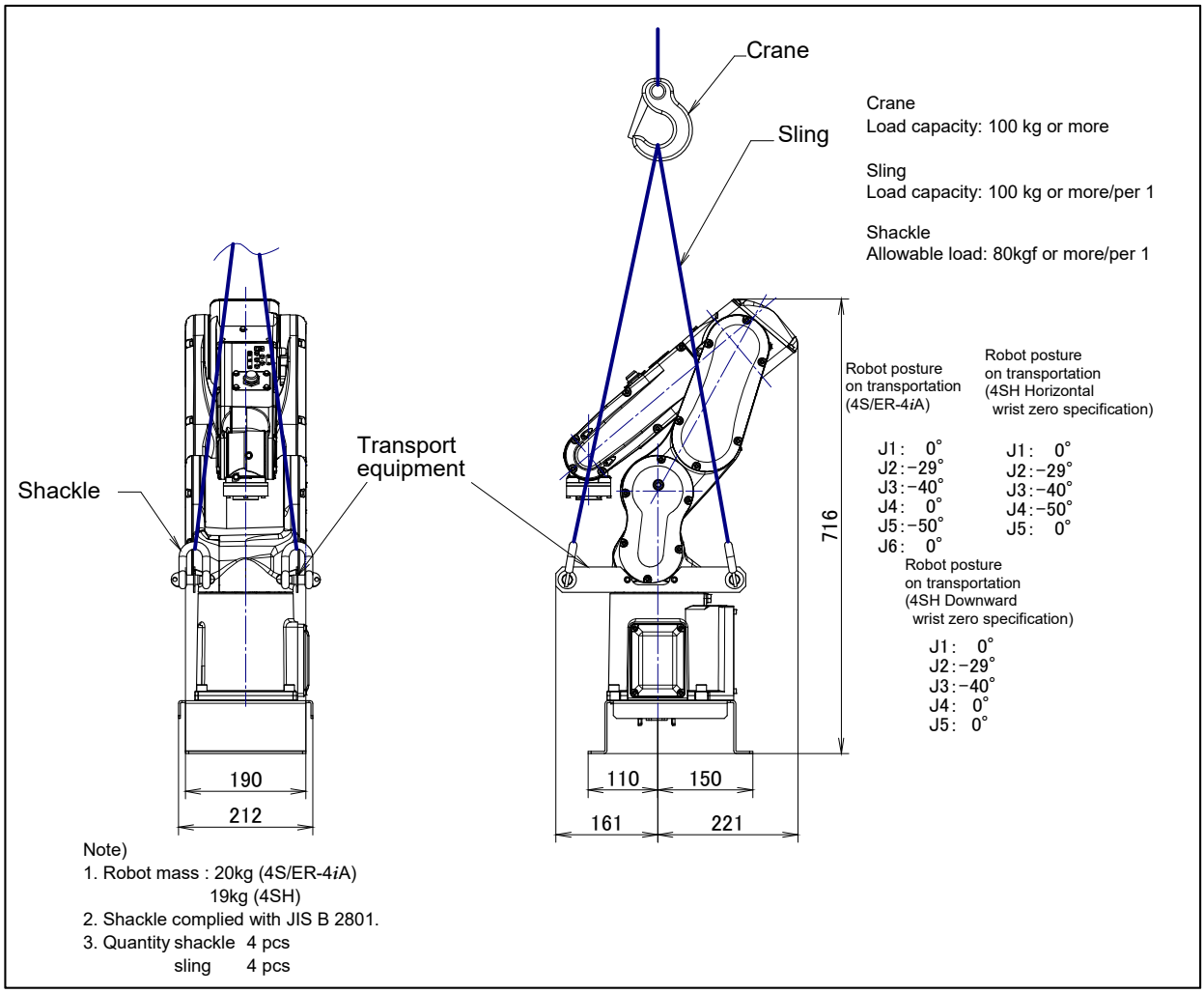


Fig. 1.1 (b) Transportation using a crane (4S/4SH) (bottom side connector plate)

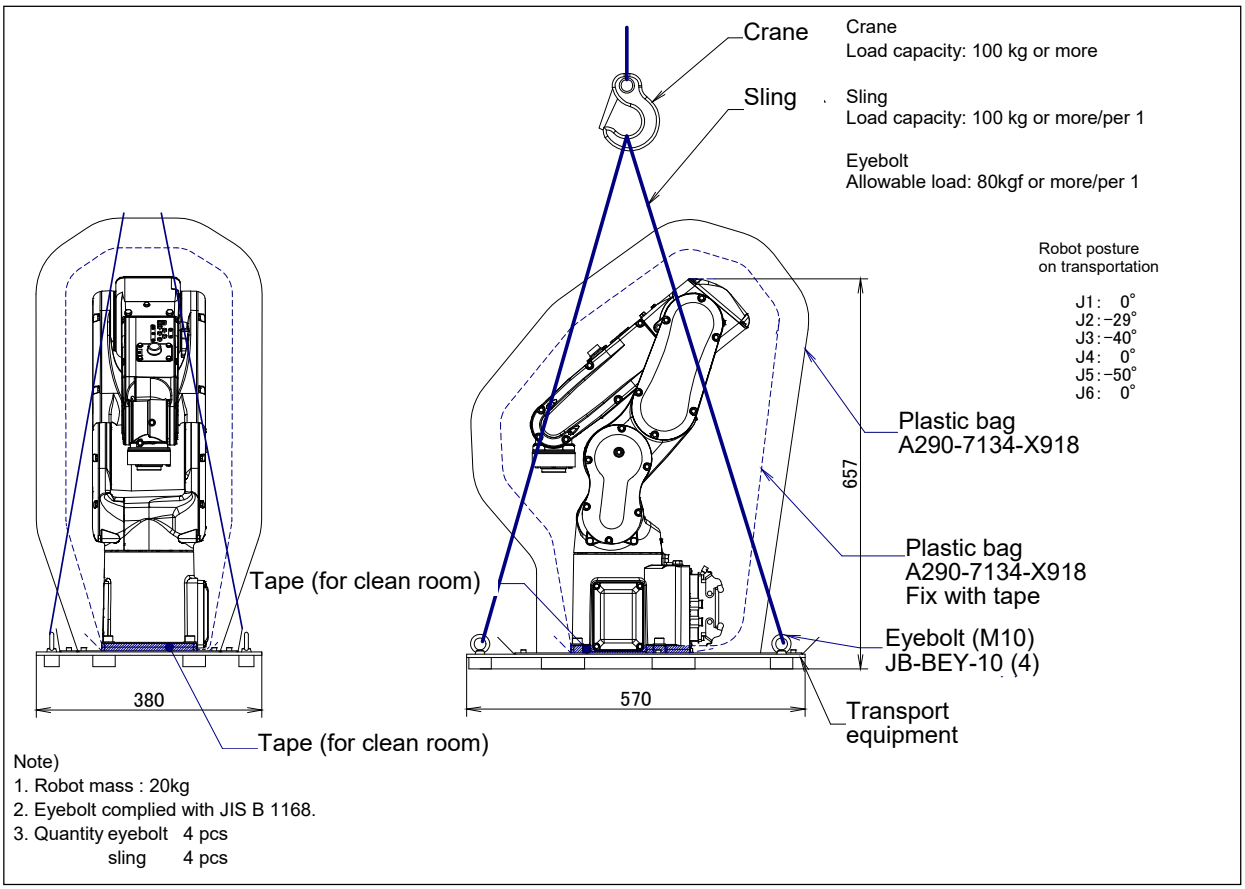


Fig. 1.1 (c) Transportation using a crane (4SC) (back side connector plate)

NOTE

About the LR Mate 200*i*D/4SC

1 Before shipment of the LR Mate 200*i*D/4SC, it is cleaned in a clean room, covered with an antistatic sheet, then packed as shown in Fig. 1.1 (c).
2 The transport plate can be used as a roll–over prevention plate in a clean room. If the plate is cleaned before being carried in a clean room, it can be carried in the room together with the robot.
3 The antistatic sheet can be removed in a clean room.
4 When installing the robot, use the eyebolts to lift it as shown Fig. 1.1 (c).
5 Once the robot has been installed, remove the eyebolts from it.
6 After transportation, be sure to fix it as described in Section 1.2.

1.2 INSTALLATION

Fig. 1.2 (a), (b) show 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.

> **⚠ CAUTION**
> 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.

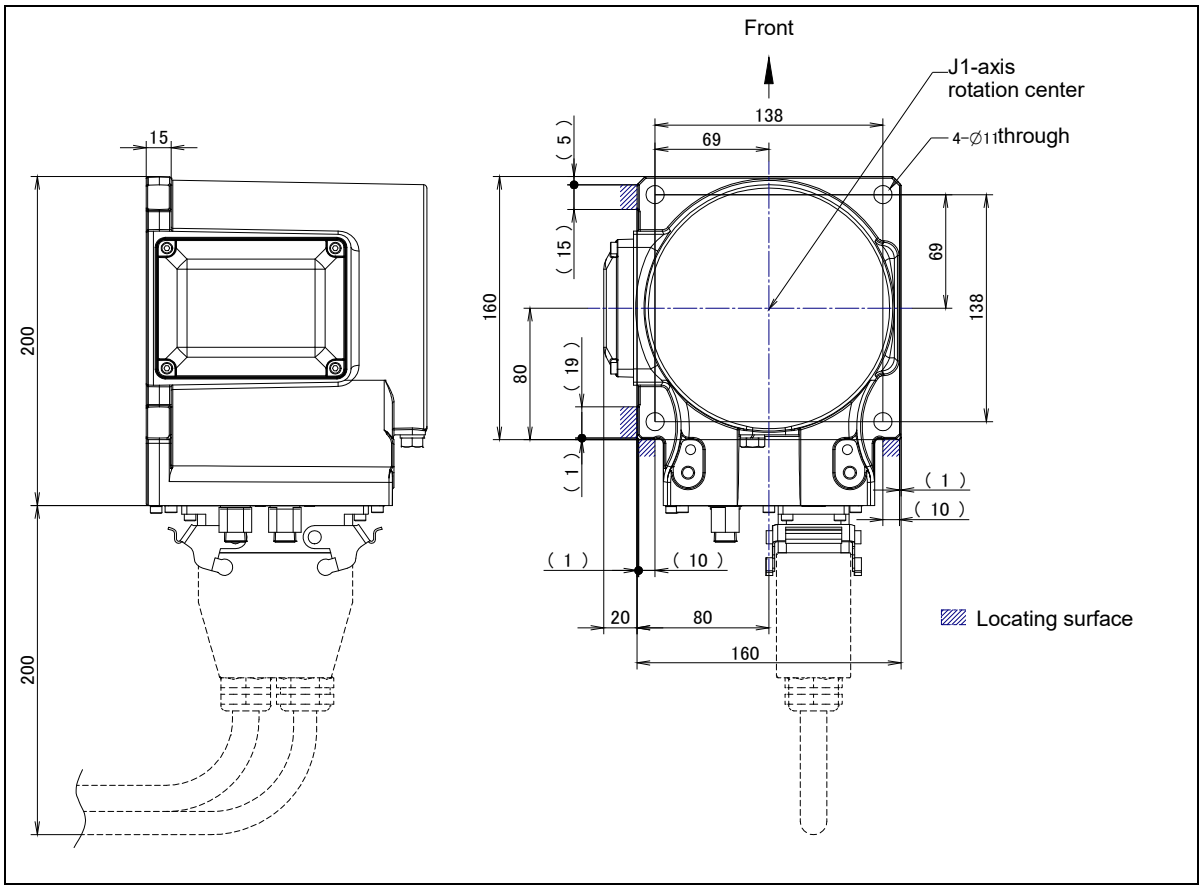


Fig. 1.2 (a) Dimensions of the robot base (back side connector plate)

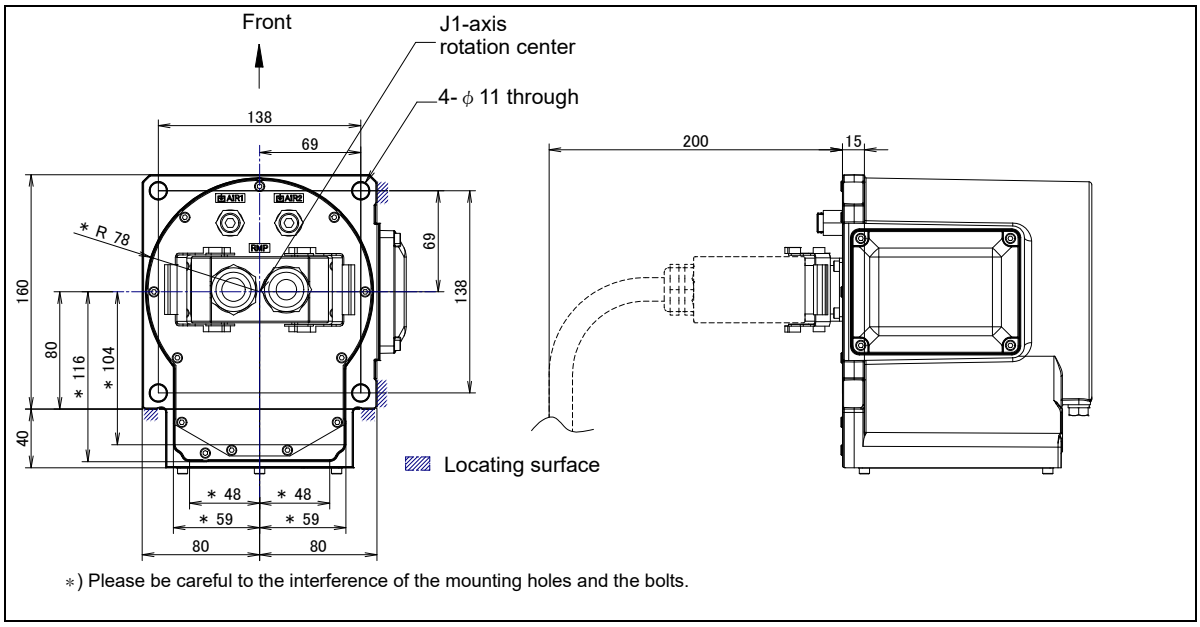


Fig. 1.2 (b) Dimensions of the robot base (bottom side connector plate)

Fig. 1.2 (c), Table 1.2 (a) indicate the force and moment applied to the robot base.
Table 1.2 (b) to (d) indicate the stopping distance and time of the J1 through J3 axes until the robot stopping by Power-Off stop or by Controlled stop or Smooth stop after input of the stop signal.
Refer to the data when considering the strength of the installation face.

NOTE
Table 1.2 (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 (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 (a) Force and moment that acts on J1 base

	Vertical moment M_V(Nm)	Force in Vertical direction F_V(N)	Horizontal moment M_H(Nm)	Force in Horizontal direction F_H(N)
During stillness	58.9	235.2	0	0
During acceleration or deceleration	308.9	520.9	135.0	570.6
During Power-Off stop	426.5	675.7	236.5	1445.0

Table 1.2 (b) Stopping time and distance until the robot stopping by Power-Off stop after input of stop signal

		J1	J2	J3
4S/4SC	Stopping time [ms]	284	148	244
	Stopping angle [deg] (rad)	67.5 (1.18)	23.5 (0.41)	59.9 (1.04)
4SH	Stopping time [ms]	252	372	252
	Stopping angle [deg] (rad)	59.2 (1.03)	57.2 (1.00)	59.1 (1.03)
ER-4*i*A	Stopping time [ms]	300	268	196
	Stopping angle [deg] (rad)	66.4(1.15)	45.9(0.80)	47.0(0.82)

Table 1.2 (c) Stopping time and distance until the robot stopping by Controlled stop after input of stop signal

		J1	J2	J3
4S/4SC	Stopping time [ms]	636	636	636
	Stopping angle [deg] (rad)	155.1 (2.71)	84.5 (1.47)	118.7 (2.07)
4SH	Stopping time [ms]	628	628	580
	Stopping angle [deg] (rad)	157.0 (2.74)	85.9 (1.50)	124.7 (2.18)

Table 1.2 (d) Stopping time and distance until the robot stopping by Smooth stop after input of stop signal

		J1	J2	J3
4S/4SC	Stopping time [ms]	264	408	264
	Stopping angle [deg] (rad)	63.2 (1.10)	55.4 (0.97)	66.2 (1.16)
ER-4*i*A	Stopping time [ms]	476	468	480
	Stopping angle [deg] (rad)	102.6 (1.79)	74.4 (1.30)	103.2 (1.80)

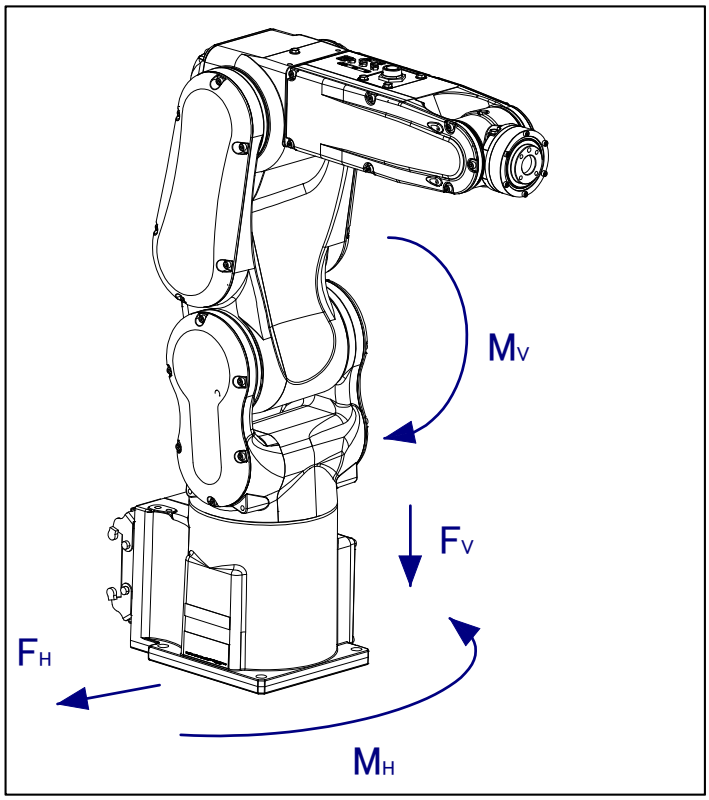
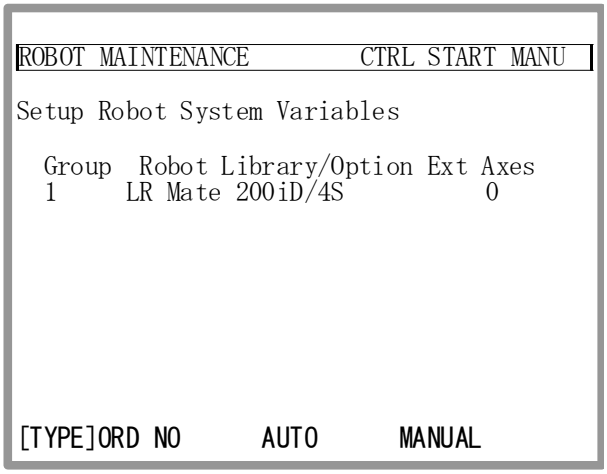


Fig. 1.2 (c) Force and moment that acts on J1 base

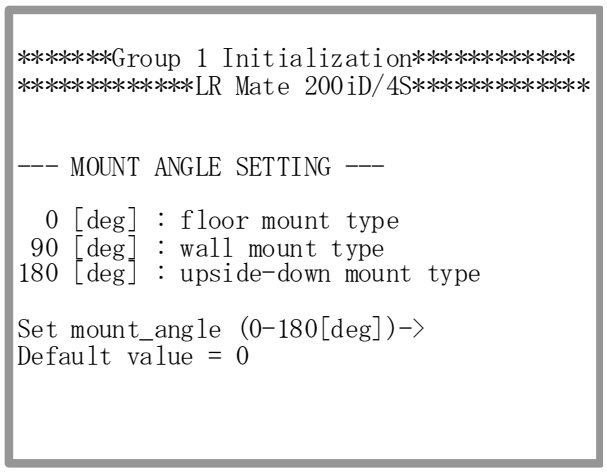
1.2.1 Angle of Mounting Surface Setting

If robot is used except floor mount, be sure to set the mounting angle referring to the procedure below. Refer to specifications in Section 3.1 for installation type.

1 Turn on the controller with the [PREV] and the [NEXT] key pressed. Then select [3 Controlled start].
2 Press the [MENU] key and select “9 MAINTENANCE”.
3 Select the robot for which you want to set the mount angle and press the [ENTER] key.



4 Press the [F4] key.
5 Press the [ENTER] key until screen below is displayed.



6 Input the mount angle referring to Fig. 1.2.1 (a). 4SH Downward wrist zero specification is restricted to floor mount and upside-down mount.

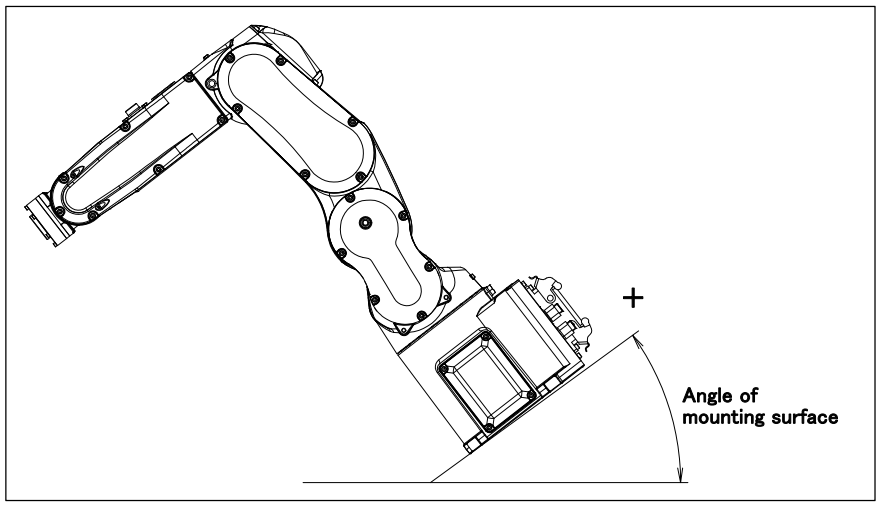
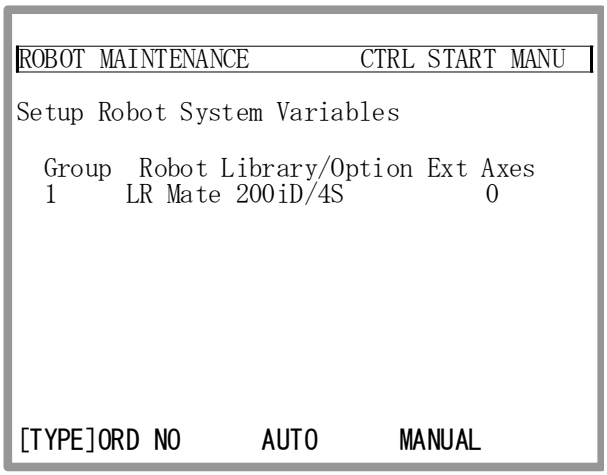


Fig. 1.2.1 (a) Robot mounting angle

7 Press the [ENTER] key until the screen below is displayed again.



8 Press the [FCTN] key and select ”1 START (COLD)”.

1.3 MAINTENANCE AREA

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

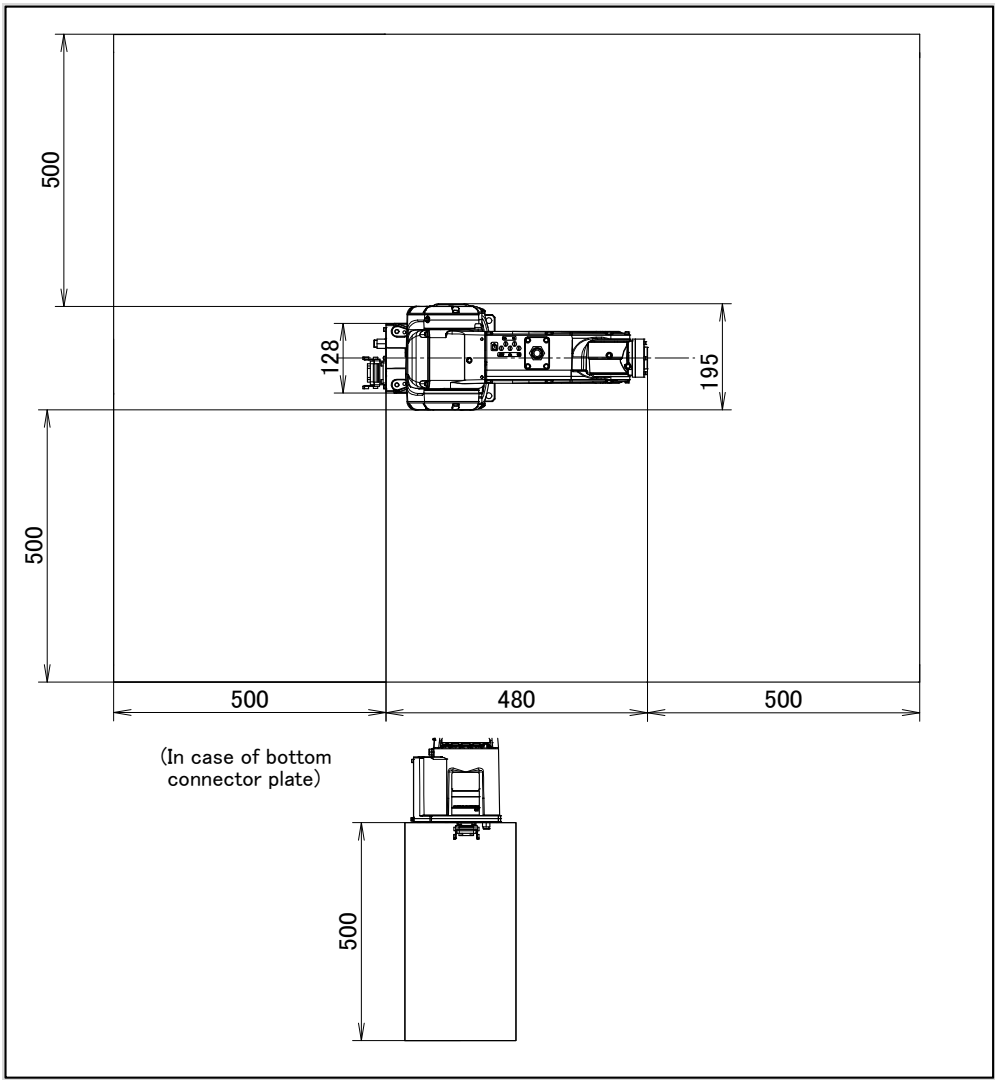


Fig. 1.3 (a) Maintenance area

1.4 INSTALLATION CONDITIONS

Refer to the caution below concerning installation conditions.
Refer to also to the specifications found in Section 3.1 and Section 3.2.

> ⚠ **CAUTION**
> Damage of the cable jacket can cause water intrusion. Take care when installing the cable and exchange it if it is damaged.

2 CONNECTION WITH THE CONTROLLER

The robot is connected with the controller via the power cable and signal cable. Connect these cables to the connectors on the back of the robot base. Please be sure to connect the earth cable.
For details on air and option cables, 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 could heat up and become damaged.

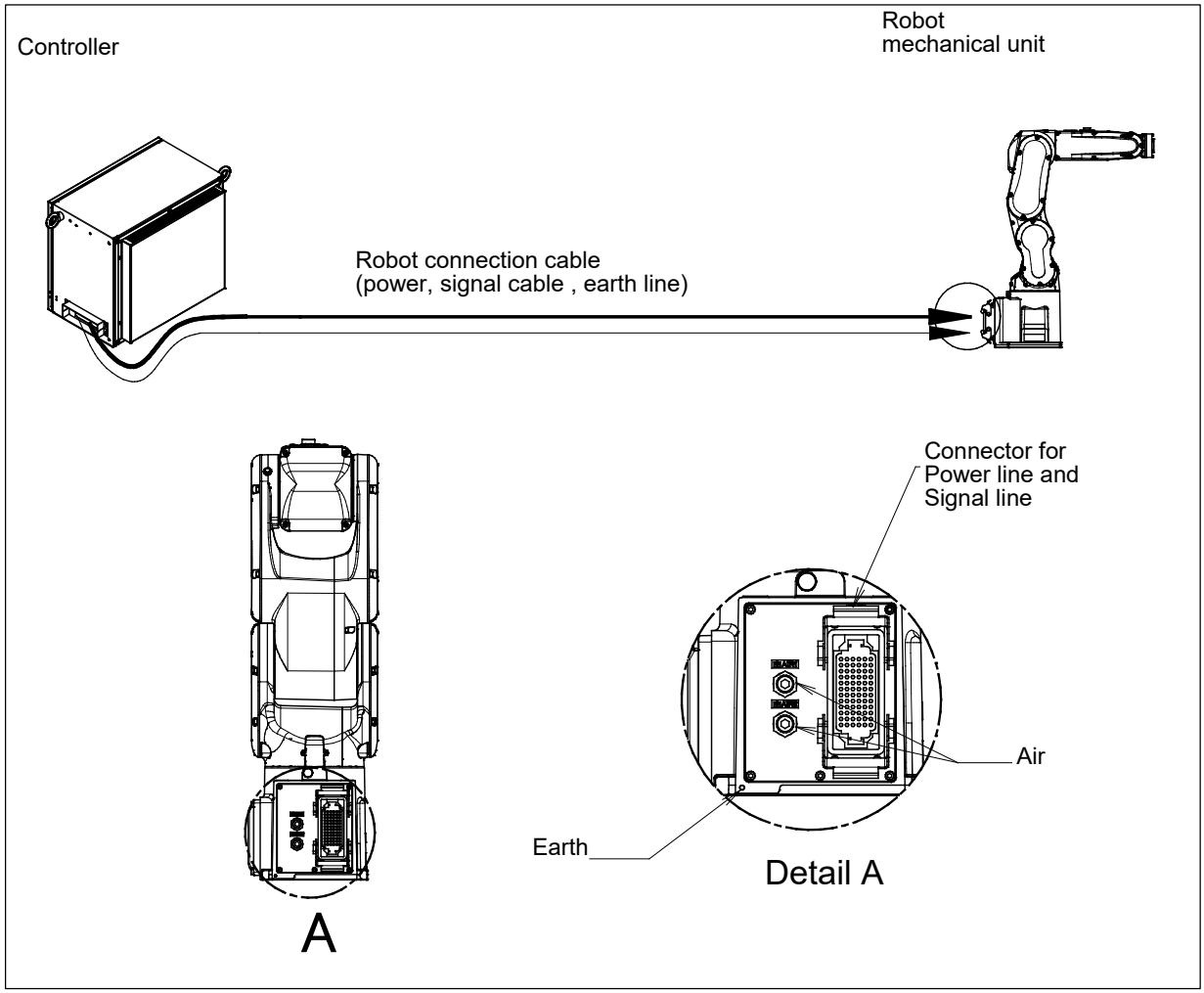


Fig. 2 (a) Cable connection (back side connector plate)

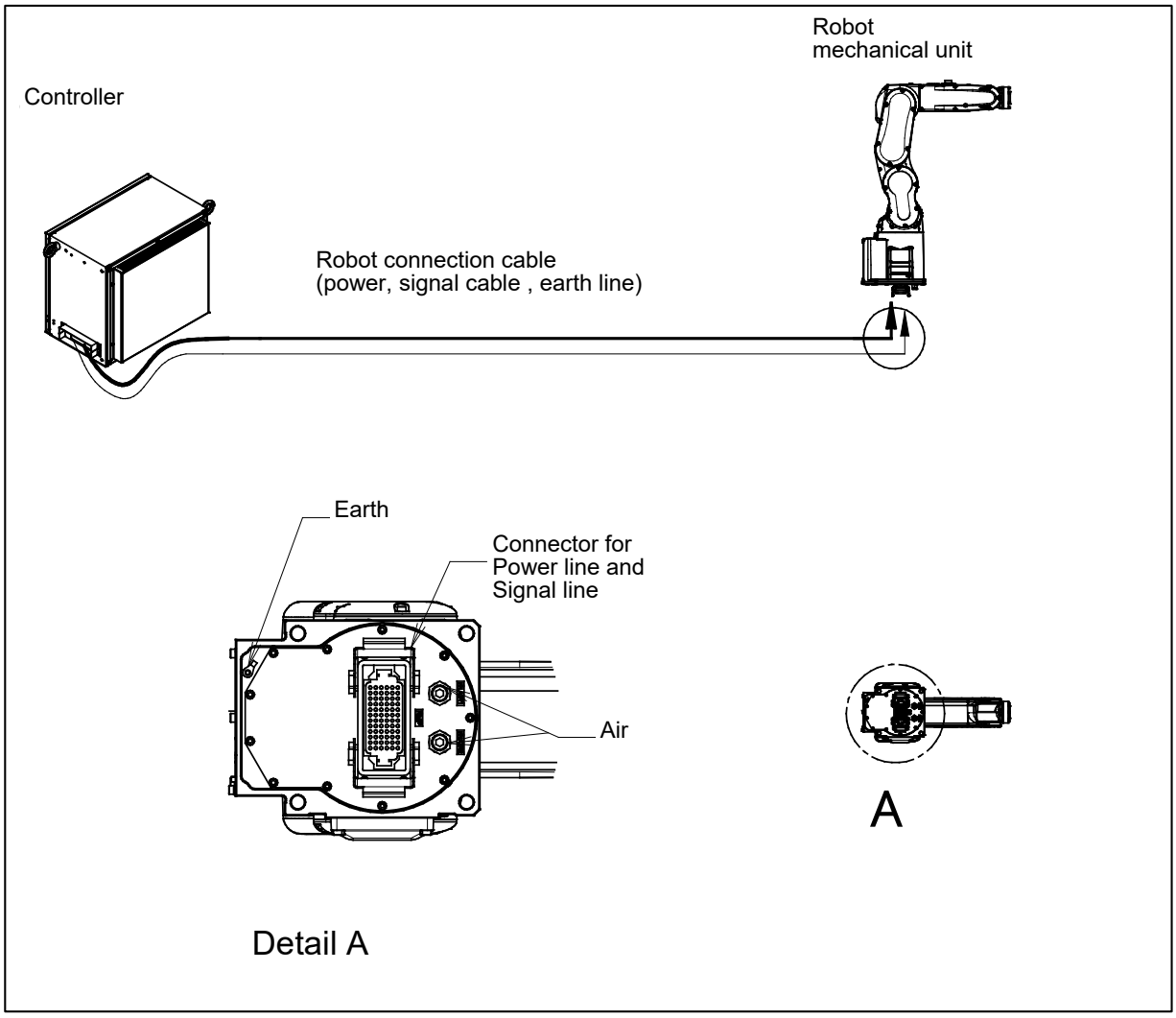


Fig. 2 (b) Cable connection (bottom side connector plate)

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

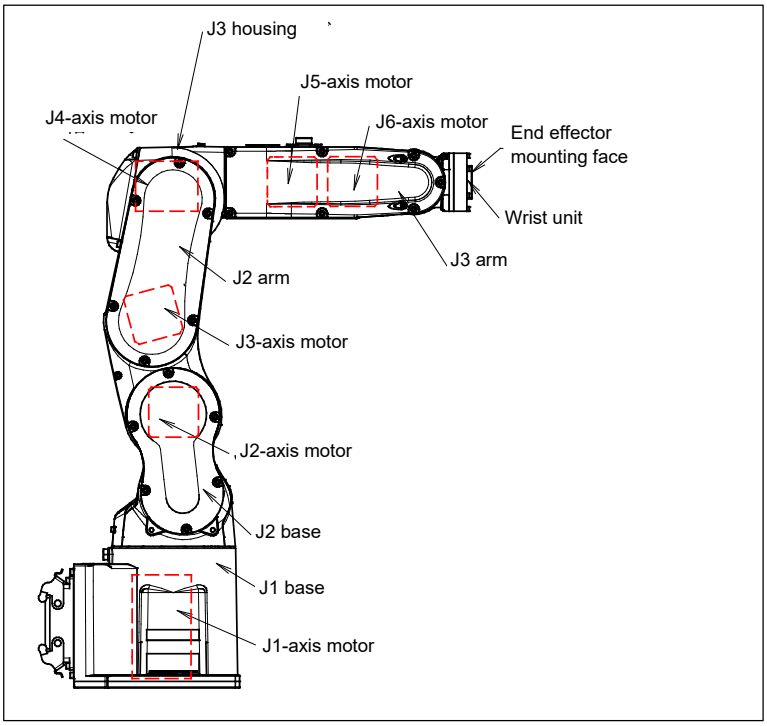


Fig. 3.1 (a) Mechanical unit configuration (4S/4SC/ER-4*i*A)

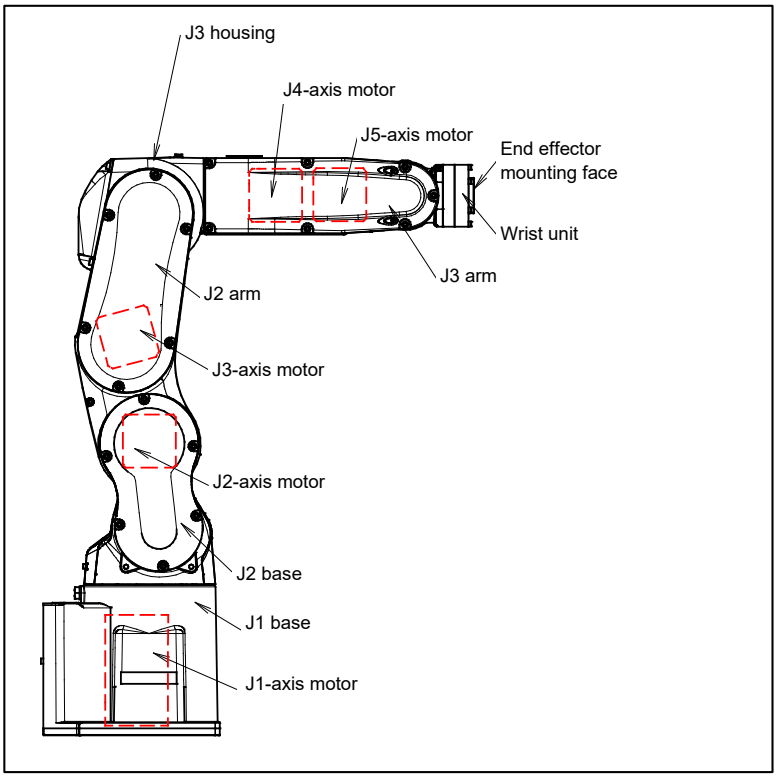


Fig. 3.1 (b) Mechanical unit configuration (4SH)

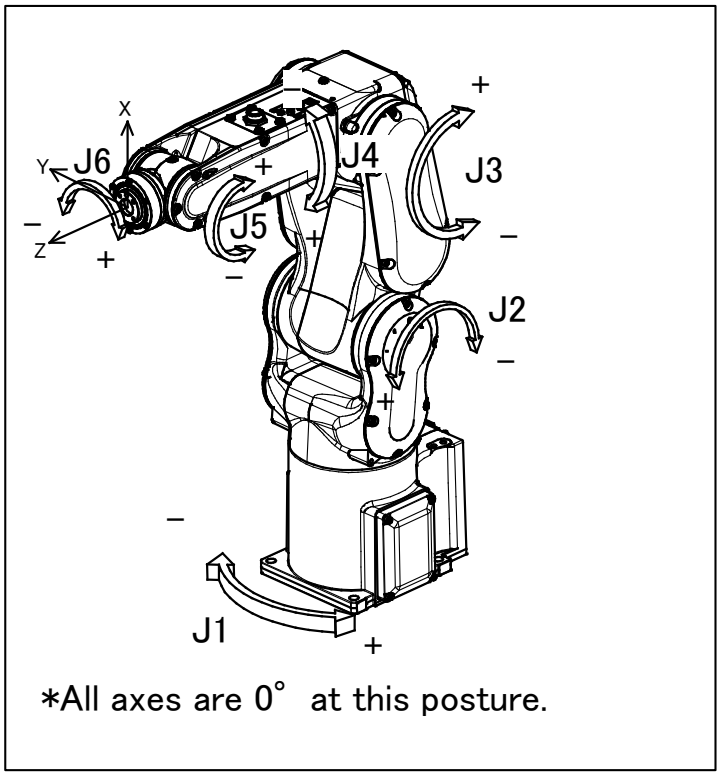


Fig. 3.1 (c) Each axis coordinates and mechanical interface coordinates (4S/4SC/ER-4*i*A)

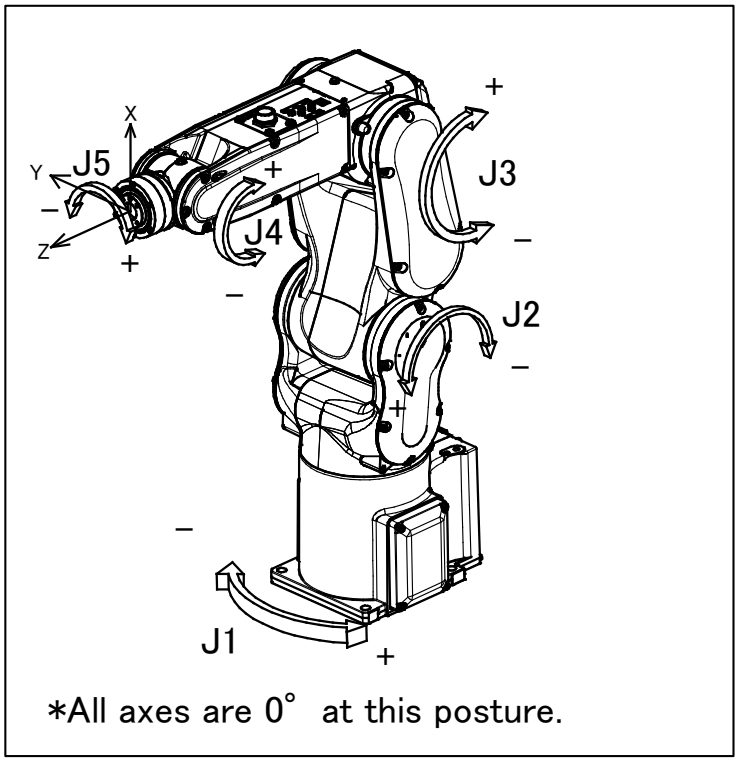


Fig. 3.1 (d) Each axis coordinates and mechanical interface coordinates (4SH Horizontal wrist zero specification)

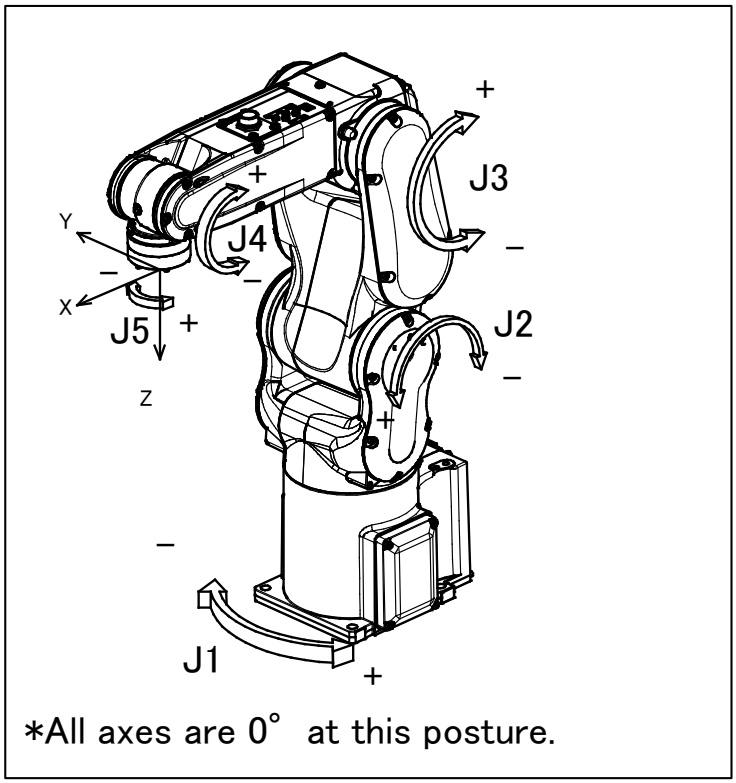


Fig. 3.1 (e) Each axis coordinates and mechanical interface coordinates
(4SH Downward wrist zero specification)

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

Table 3.1 (a) Specifications (NOTE 1) (1/2)

Item		Specification	
Model		LR Mate 200*i*D/4S/4SC	LR Mate 200*i*D/4SH
Type		Articulated Type	
Controlled axis		6-axes (J1, J2, J3, J4, J5, J6)	5-axes (J1, J2, J3, J4, J5)
Reach		550mm	
Installation NOTE 2)		Floor, Upside-down, Angle mount	
Motion range (Max. speed) NOTE 3)	J1-axis	340° /360°(option) (460°/s) 5.93rad/6.28rad(option) (8.03rad/s)	
	J2-axis	230° (460°/s) 4.01rad (8.03rad/s)	
	J3-axis	402° (520°/s) 7.02rad (9.08rad/s)	
	J4-axis	380° (560°/s) 6.63rad (9.77rad/s)	240° (560°/s) 4.19rad (9.77rad/s)
	J5-axis	NOTE 4) 240° (560°/s) 4.19rad (9.77rad/s)	720° (1500°/s) 12.57rad (26.18rad/s)
	J6-axis	720° (900°/s) 12.57rad (15.71rad/s)	
Max. load Capacity NOTE 5)	Wrist	Max.4 kg	
Allowable load moment at wrist	J4-axis	8.86Nm	
	J5-axis	8.86Nm	4.00Nm 5.50Nm NOTE 6)
	J6-axis	4.90Nm	
Allowable load inertia at wrist	J4-axis	0.20 kg·m^2	
	J5-axis	0.20 kg·m^2	0.046 kg·m^2 0.083 kg·m^2 NOTE 6)
	J6-axis	0.067kg·m^2	
Drive method		Electric servo drive by AC servo motor	
Repeatability NOTE 7)		±0.01mm	
Mass NOTE 8)		20kg	19kg
Dust proof and drip proof mechanism NOTE 9)		Conform to IP67 (4S/4SH) Conform to IP67, Class 10 (ISO class 4) (4SC)	
Acoustic noise level		Less than 70dB NOTE 10)	
Installation environment		Ambient temperature: 0 to 45°C (NOTE 11) Ambient humidity: Normally 75%RH or less. No dew, nor frost allowed. Short time (within one month) Max 95%RH Height: Up to 1000 meters above the sea level required, no particular provision for posture. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases NOTE 12)	

NOTE

1 Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat. Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.

2 There is no limit in the motion range in all installation. 4SH Downward wrist zero specification is restricted to floor mount and upside-down mount.

3 During short distance motions, the axis speed may not reach the maximum value stated.

4 In case of 4SC, J5 motion range is restricted to 236°(4.11rad).

5 The all up weight including the equipment and connection cables and its swing must not exceed this value when you install the equipment, see Section 3.5.

6 This value is for high inertia mode. Please refer to Section 4.4 about change method.

7 Compliant with ISO 9283.

8 It doesn't contain the mass of the control part.

9 The liquid that is the deterioration of the seal material such as Organic solvent, acid, alkali and chlorine system, cutting liquid cannot be use. (See Subsection 3.1.1.)

10 This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.
- Maximum load and speed
- Operating mode is AUTO

11 When the robot is used in a low temperature environment that is near to 0ºC, or not operated for a long time in the environment that is less than 0ºC (during a holiday or during the night), a collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.

12 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, water, water vapor, cutting oil, cleaning fluid splash and or other contaminations.

Table 3.1 (b) Specifications (NOTE 1) (2/2)

Item		Specification
Model		ER-4*i*A
Type		Articulated Type
Controlled axis		6-axes (J1, J2, J3, J4, J5, J6)
Reach		550mm
Installation NOTE 2)		Floor, Upside-down
Motion range (Max. speed) NOTE 3)	J1-axis	340° (option) (460°/s) 5.93rad (option) (8.03rad/s)
	J2-axis	230° (360°/s) 4.01rad (6.28rad/s)
	J3-axis	402° (520°/s) 7.02rad (9.08rad/s)
	J4-axis	380° (560°/s) 6.63rad (9.77rad/s)
	J5-axis	NOTE 3) 240° (560°/s) 4.19rad (9.77rad/s)
	J6-axis	720° (900°/s) 12.57rad (15.71rad/s)
Max. load Capacity NOTE 4)	Wrist	Max.4 kg
Allowable load moment at wrist	J4-axis	8.86Nm
	J5-axis	8.86Nm
	J6-axis	4.90Nm
Allowable load inertia at wrist	J4-axis	0.20 kg·m^2
	J5-axis	0.20 kg·m^2
	J6-axis	0.067kg·m^2
Drive method		Electric servo drive by AC servo motor
Repeatability NOTE 5)		±0.01mm
Mass NOTE 6)		20kg
Dust proof and drip proof mechanism		Conform to IP50 NOTE 7)
Acoustic noise level		Less than 70dB NOTE 8)
Installation environment		Ambient temperature: 0 to 45°C (NOTE 9) Ambient humidity: Normally 75%RH or less. No dew, nor frost allowed. Short time (within one month) Max 95%RH Height: Up to 1000 meters above the sea level required, no particular provision for posture. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases NOTE 10)

NOTE

1 Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat. Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.
2 There is no limit in the motion range in all installation.
3 During short distance motions, the axis speed may not reach the maximum value stated.
4 The all up weight including the equipment and connection cables and its swing must not exceed this value when you install the equipment, see Section 3.5.
5 Compliant with ISO 9283.
6 It doesn't contain the mass of the control part.
7 This is a level of protection that can be used in environments where only non-conductive pollution occurs (for example, the environment in which non-waterproof home electronics and office equipment are used). If this restriction is not followed, it may cause a death or serious accident due to the electric shock.
8 This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.
   - Maximum load and speed
   - Operating mode is AUTO
9 When the robot is used in a low temperature environment that is near to 0ºC, or not operated for a long time in the environment that is less than 0ºC (during a holiday or during the night), a collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.
10 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, water, water vapor, cutting oil, cleaning fluid splash and or other contaminations.

3.1.1 Note of Severe Dust /Liquid Specification

1 The liquids below cannot be applied because they may cause deterioration or corrosion of the rubber parts (such as gaskets, oil seals, and O-rings) used in the robot.
   (a) Organic solvents
   (b) Cutting fluid or cleaning fluid including chlorine / gasoline
   (c) Amine type cutting fluid or cleaning fluid
   (d) Acid, alkali and liquid causing rust
   (e) Other liquids or solutions, that will harm NBR or CR rubber
2 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.
3 Please exchange it absolutely for the new article when you remove the gaskets by the component replacement and the check.
4 Do not use unconfirmed liquid.

3.1.2 Cautions for 4SC

1 As for the clean specification, only the robot mechanical unit satisfies clean class 10. Note that none of the controller, the cables between the controller and robot, and teach pendant does not meet the clean specification.
2 When using liquids in cleaning, see 1 and 4 in Subsection 3.1.1.
3 If gaskets are dismounted during parts replacement or inspection, replace them by new ones.

3.1.3 Cautions for ER-4*i*A

1 ER-4*i*A stops by the Smooth stop function when the emergency stop button is pushed or an external emergency stop signal is entered.

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.

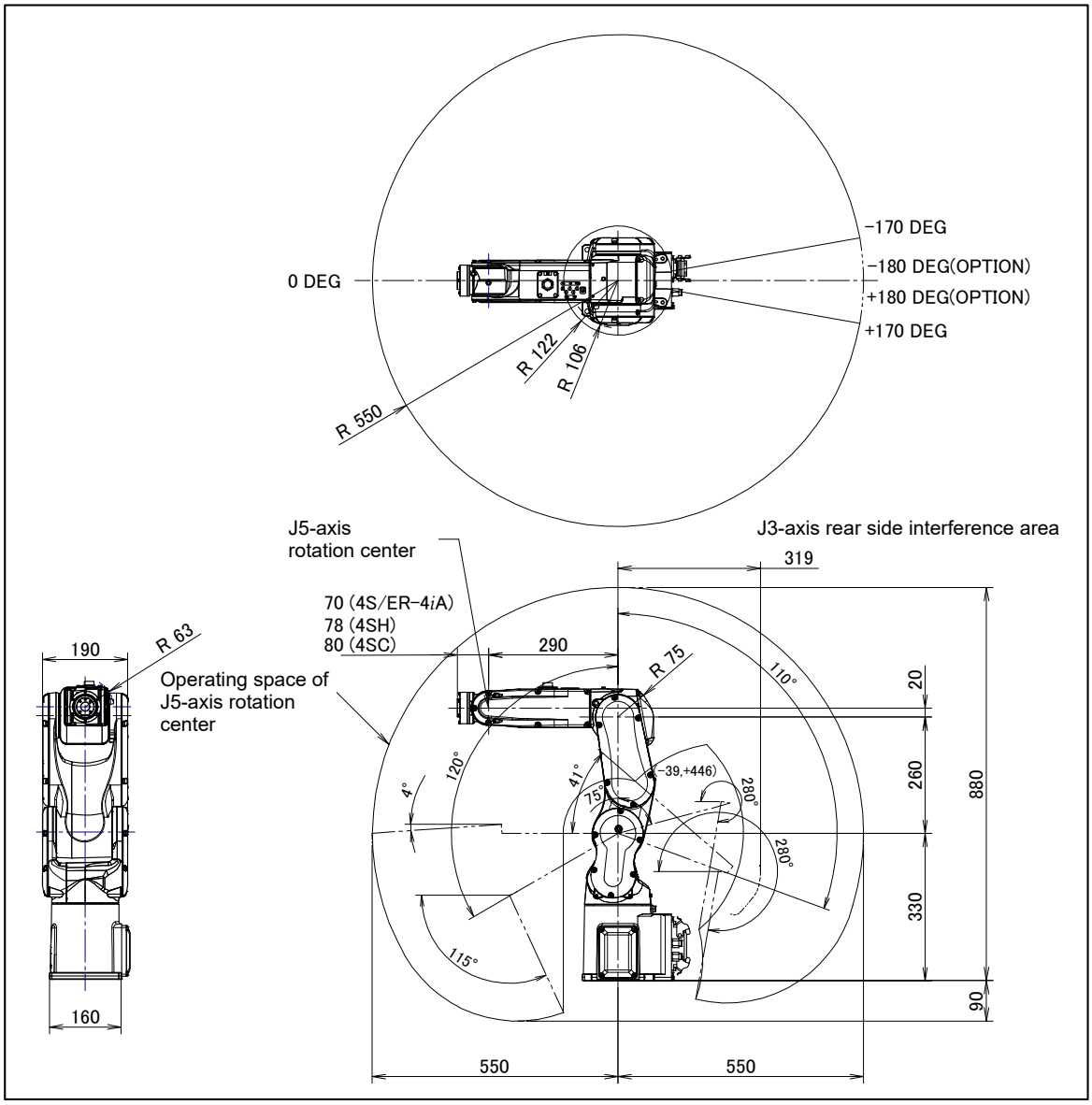


Fig. 3.2 (a) Operating space

NOTE

Fig. 3.2 (a) is an examples of 4S/ER-4*i*A, please read J5-axis as J4-axis throughout this figures in case of 4SH.

3.3 ZERO POINT POSITION AND MOTION LIMIT

Zero point and software motion limit are provided for each controlled axis. The robot cannot exceed the software motion limit unless there is a failure of the system causing loss of zero point position or there is a system error.

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.
In addition, the motion range limit by a mechanical stopper is also prepared to improve safety.

Fig.3.3 (a) shows position of mechanical stopper. Don't reconstruct the mechanical stopper. There is a possibility that the robot doesn't stop normally.

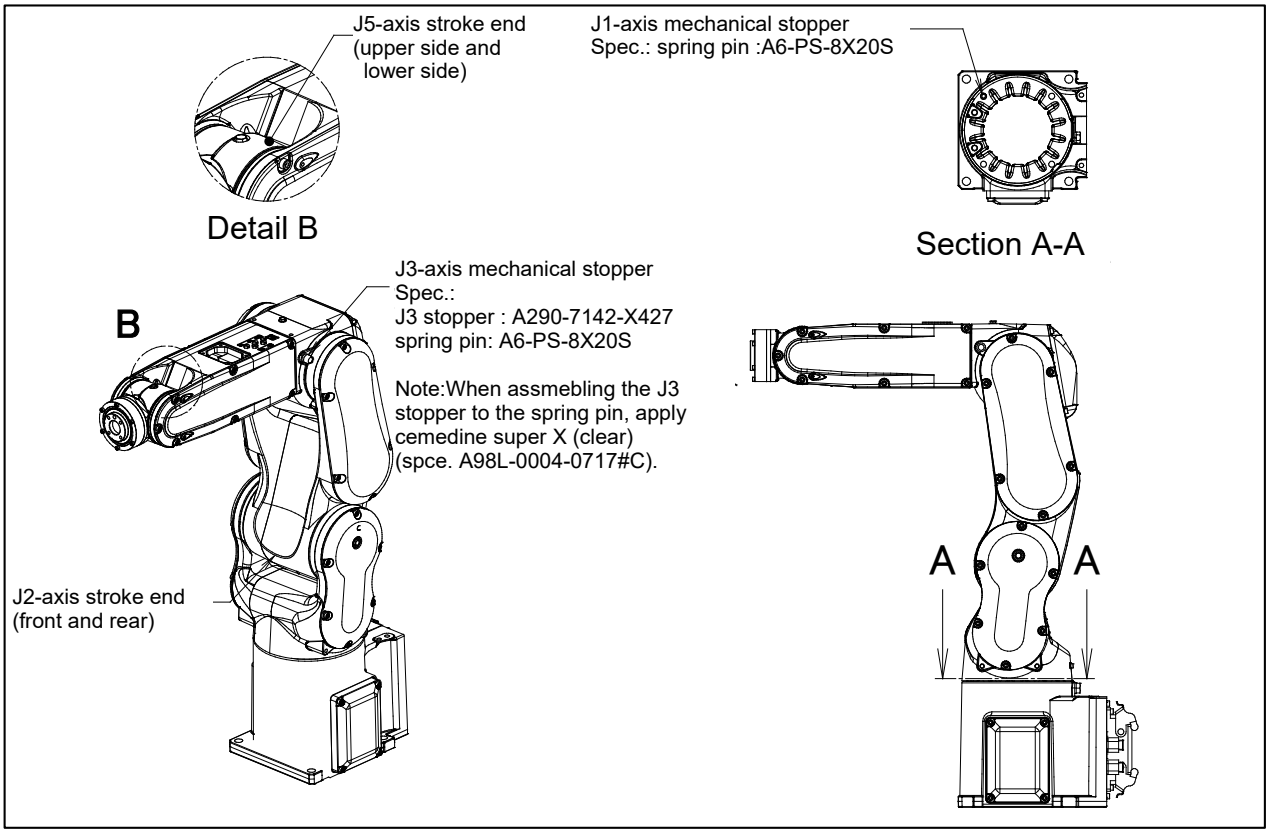


Fig. 3.3 (a) Position of mechanical stopper

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

Only in case of J1-axis and J3-axis, robot stops by transforming mechanical stopper. When the mechanical stopper is transformed, the exchange is needed. See Fig.3.3 (a) about replacing J3-axis mechanical stopper. Contact FANUC about replacing J1-axis mechanical stopper.

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

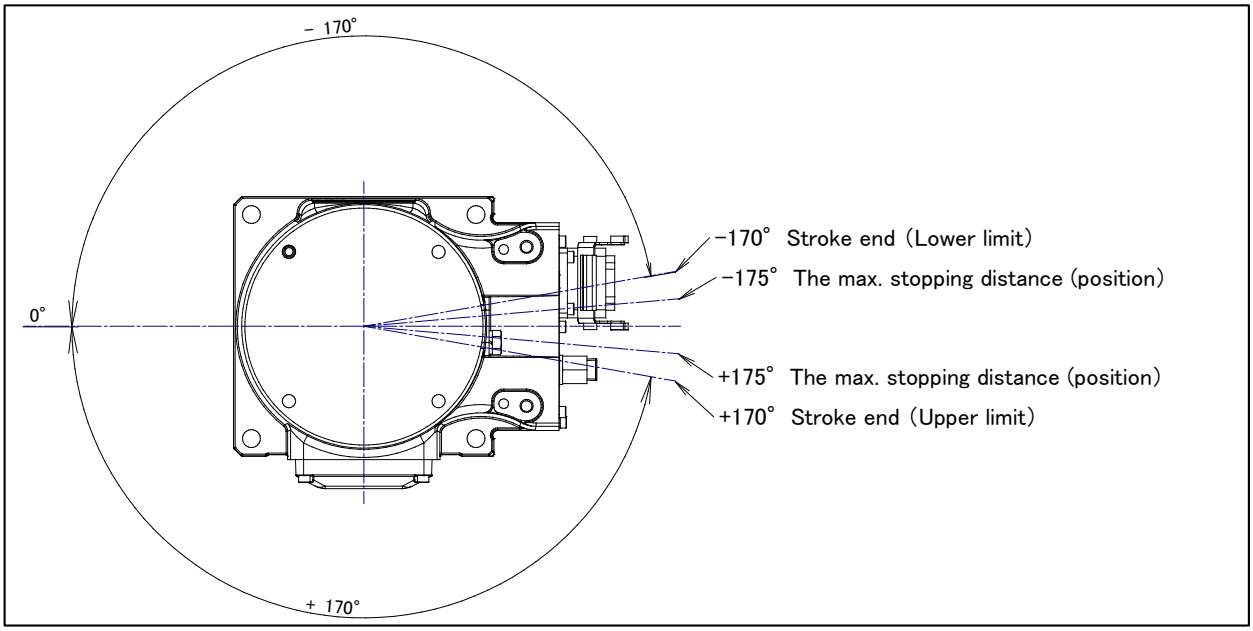


Fig. 3.3 (b) J1-axis motion limit (J1-axis 340°turn specification)

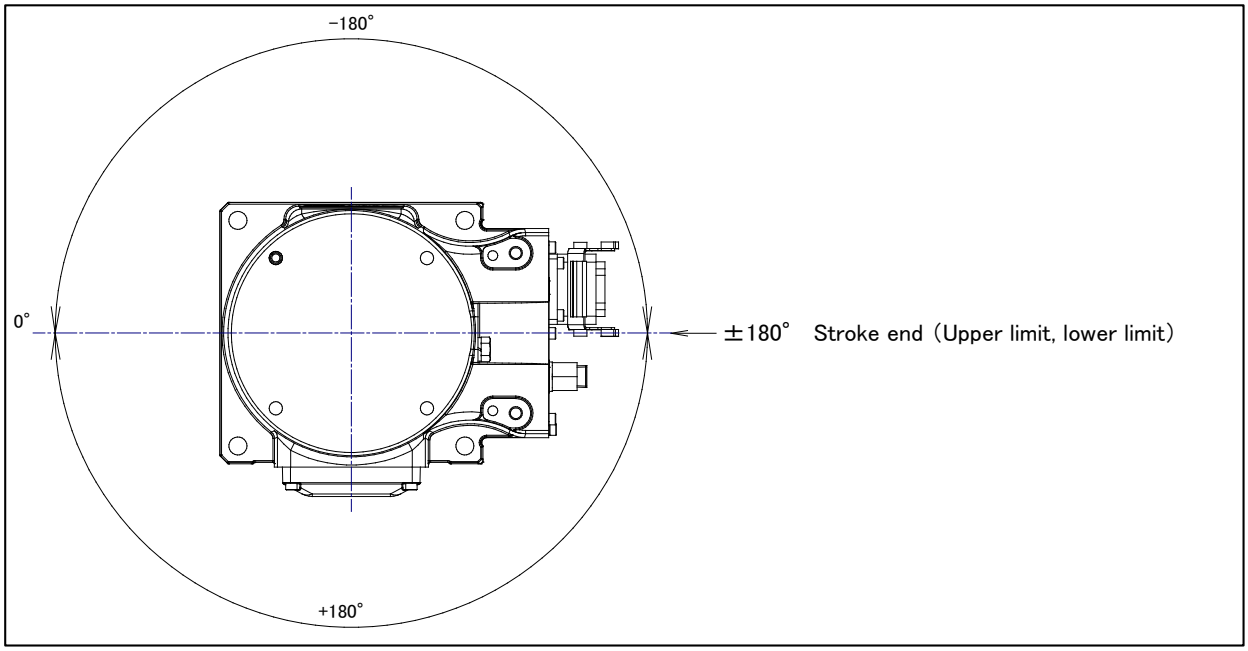


Fig. 3.3 (c) J1-axis motion limit (J1-axis 360°turn specification)

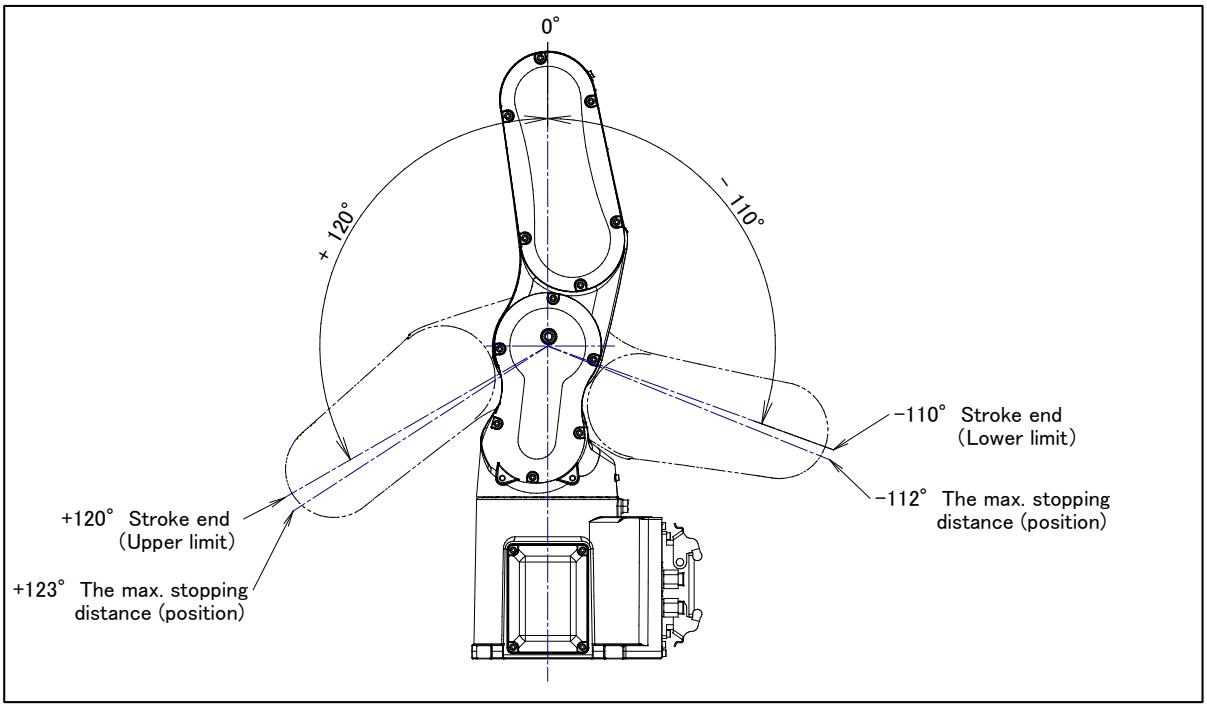


Fig. 3.3 (d) J2-axis motion limit

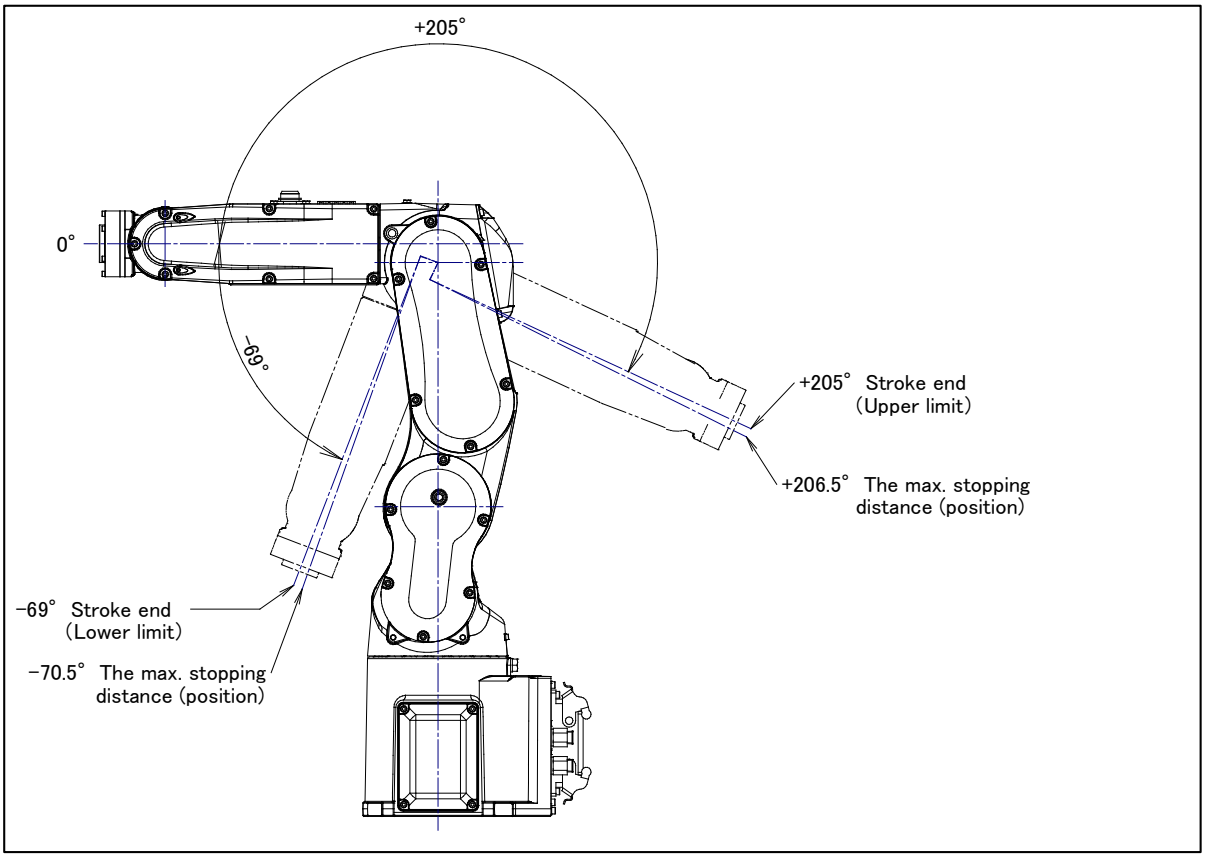


Fig. 3.3 (e) J3-axis motion limit

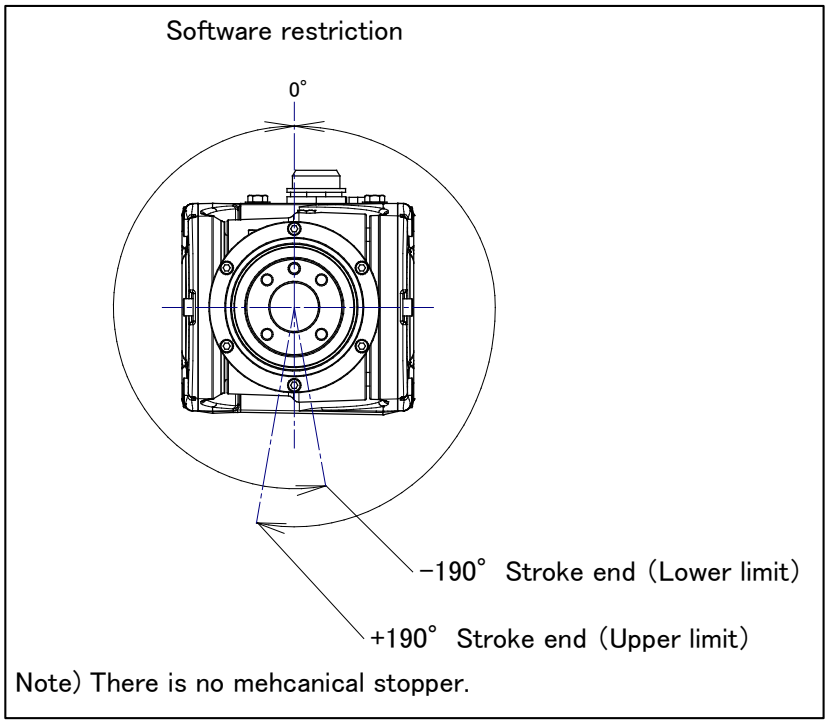


Fig. 3.3 (f) J4-axis motion limit (4S/4SC/ER-4*i*A)

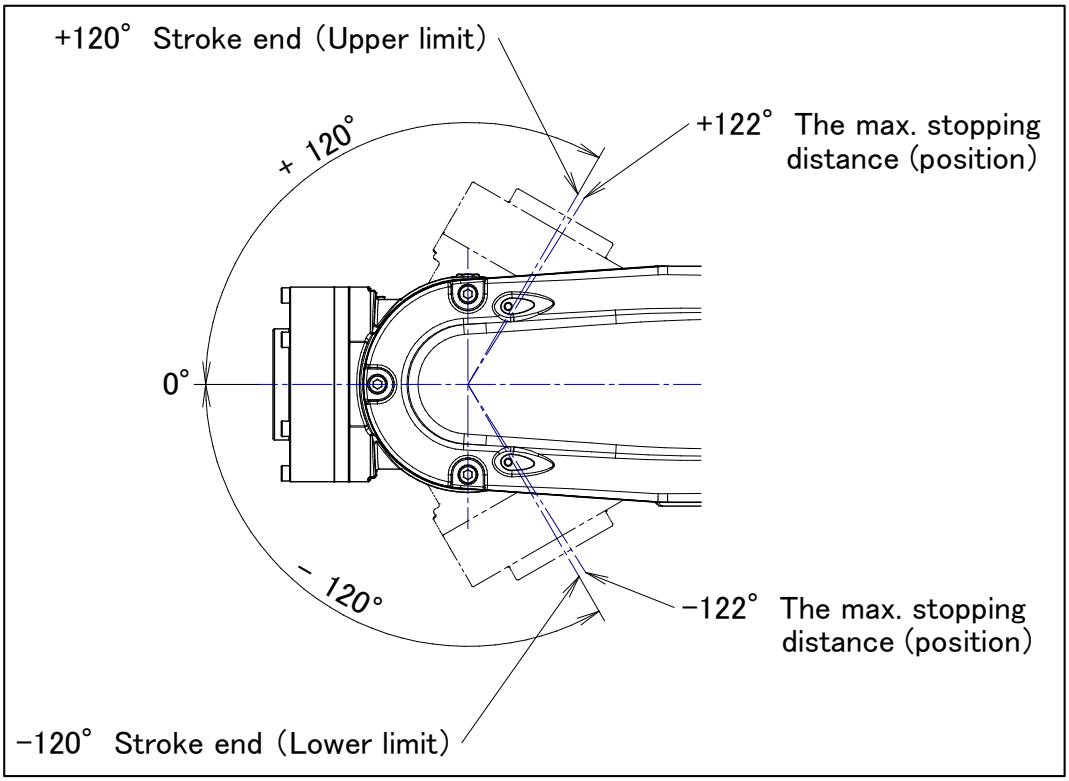


Fig. 3.3 (g) J5-axis motion limit (4S/ER-4*i*A)
J4-axis motion limit (4SH Horizontal wrist zero specification)

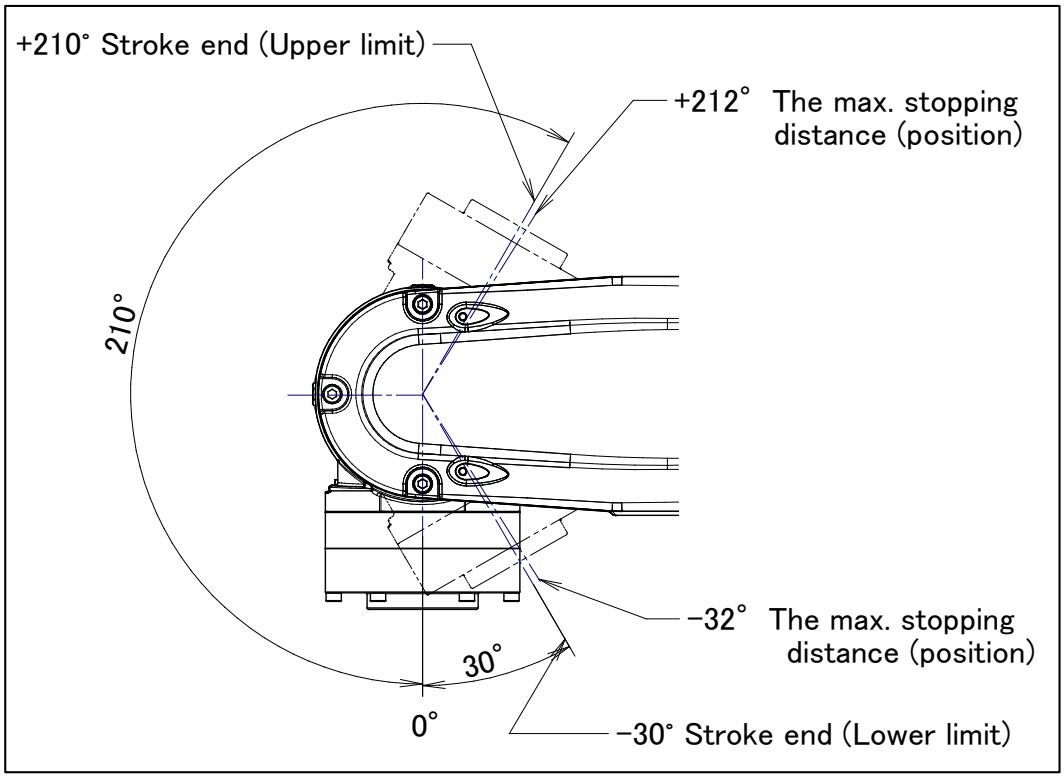


Fig. 3.3 (h) J4-axis motion limit (4SH Downward wrist zero specification)

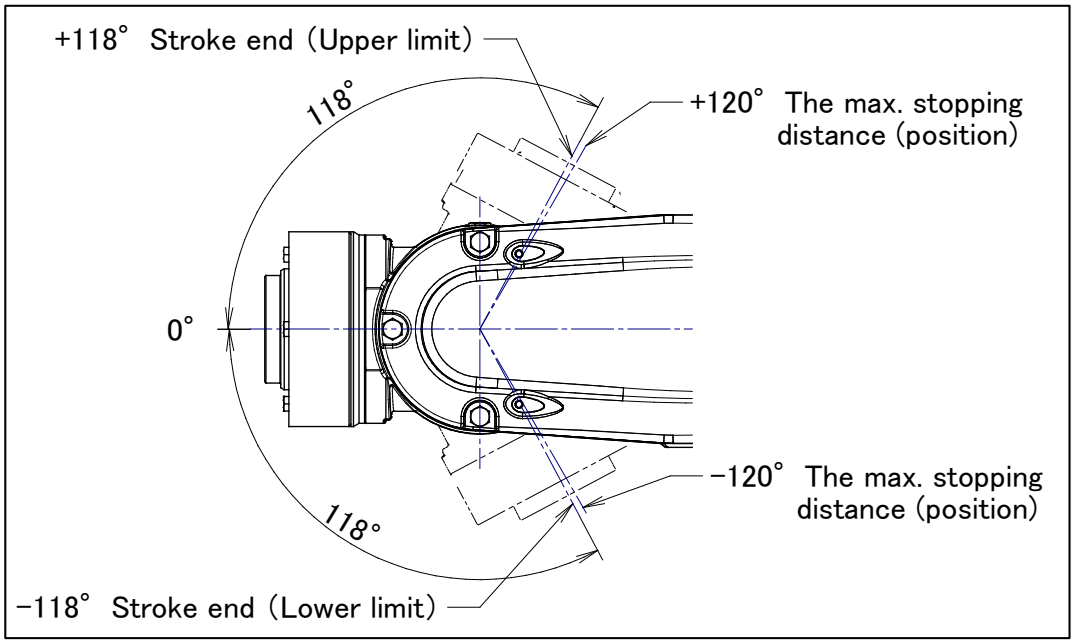


Fig. 3.3 (i) J5-axis motion limit (4SC)

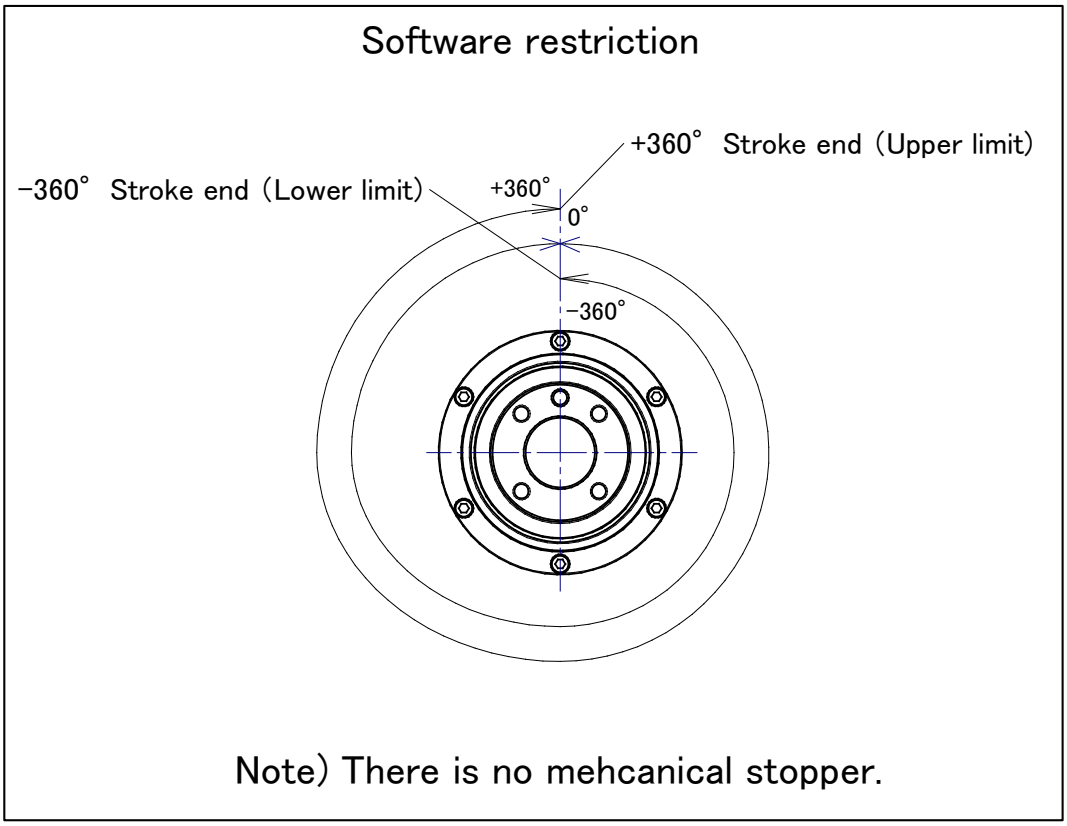


Fig. 3.3 (j) J6-axis motion limit (Except 4SH)
J5-axis motion limit (4SH)

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (a) to (d) are diagrams showing the allowable load that can be applied to the wrist section.

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

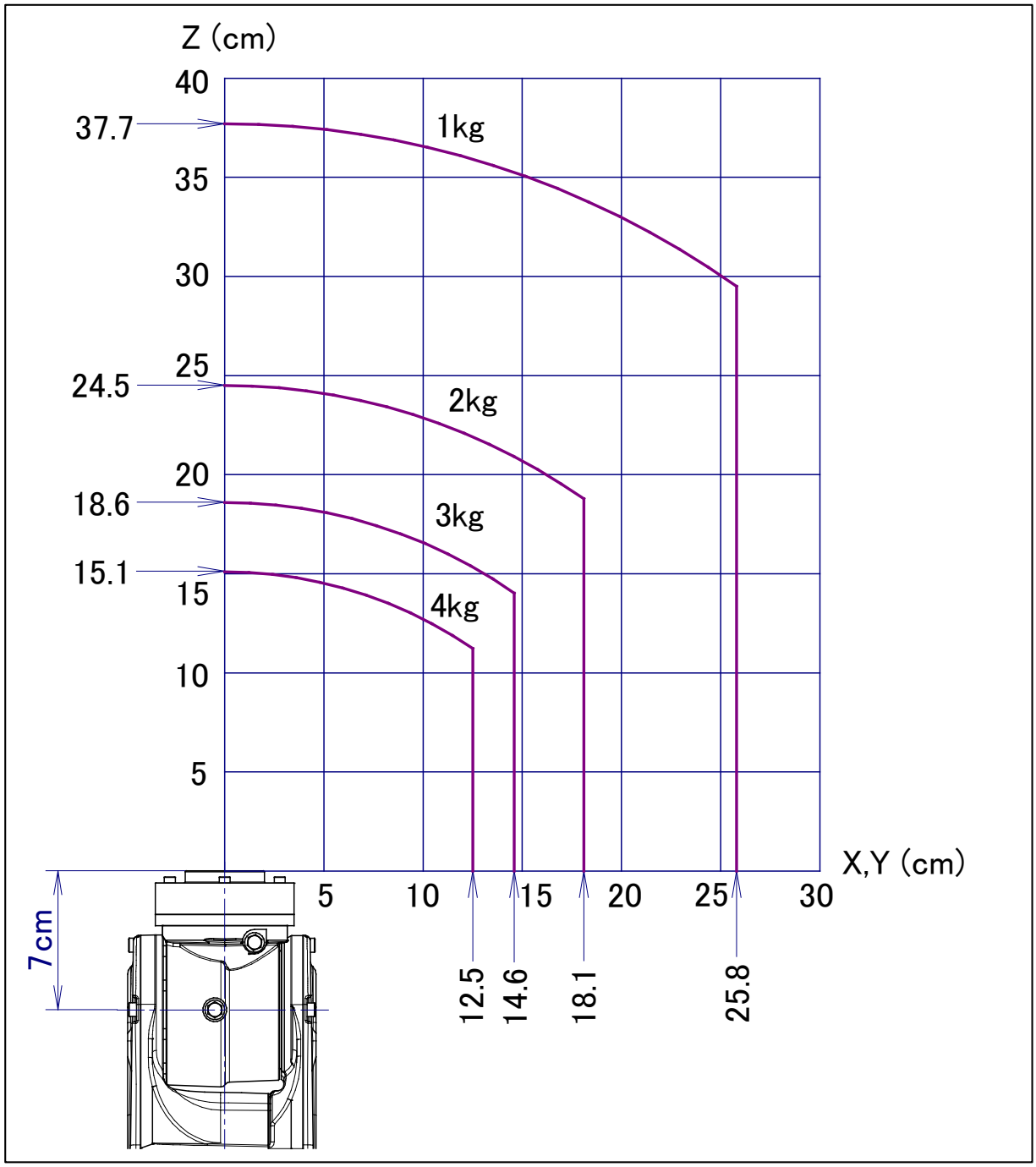


Fig. 3.4 (a) Wrist load diagram (4S/ER-4*i*A)

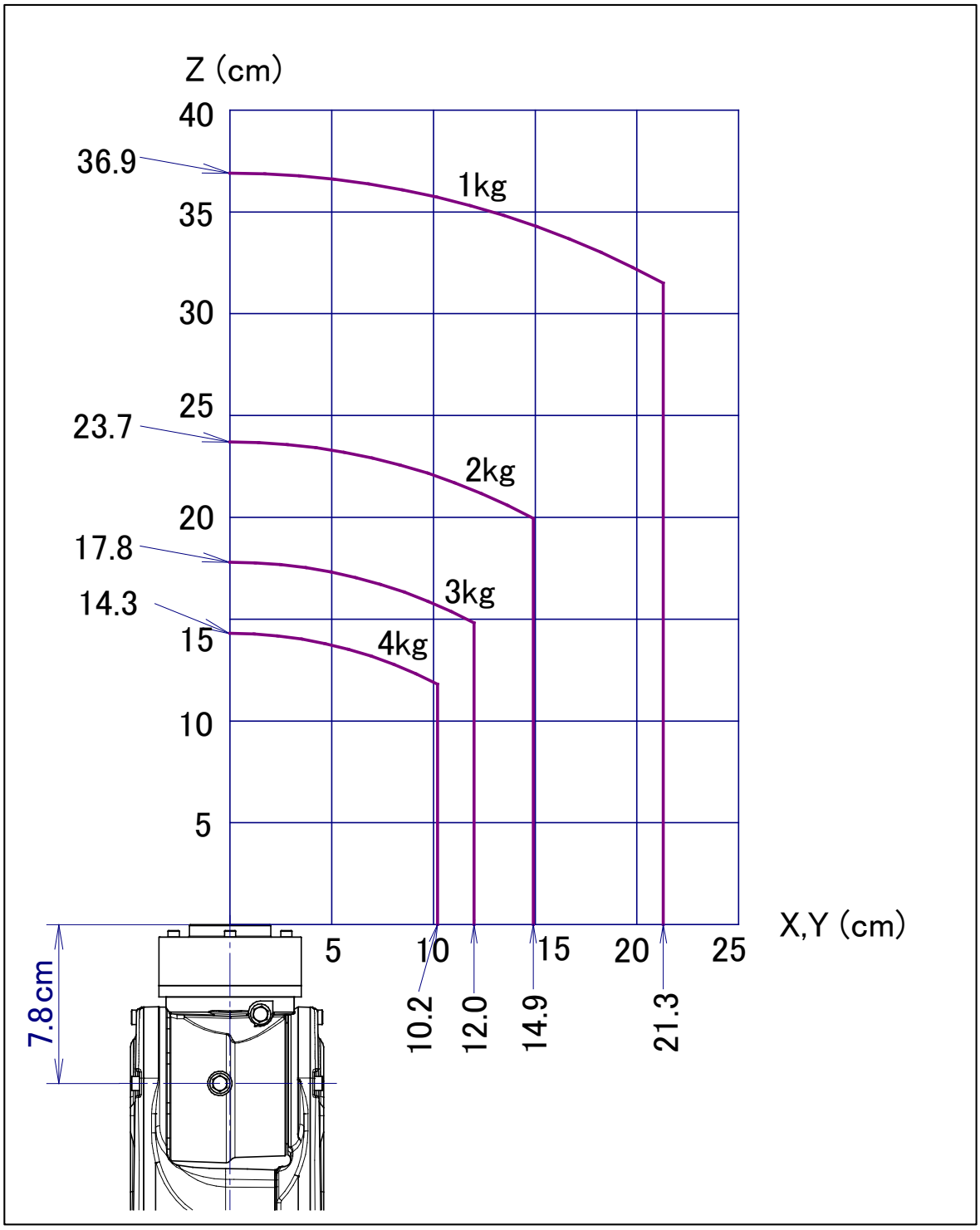


Fig. 3.4 (b) Wrist load diagram (4SH Standard inertia mode)

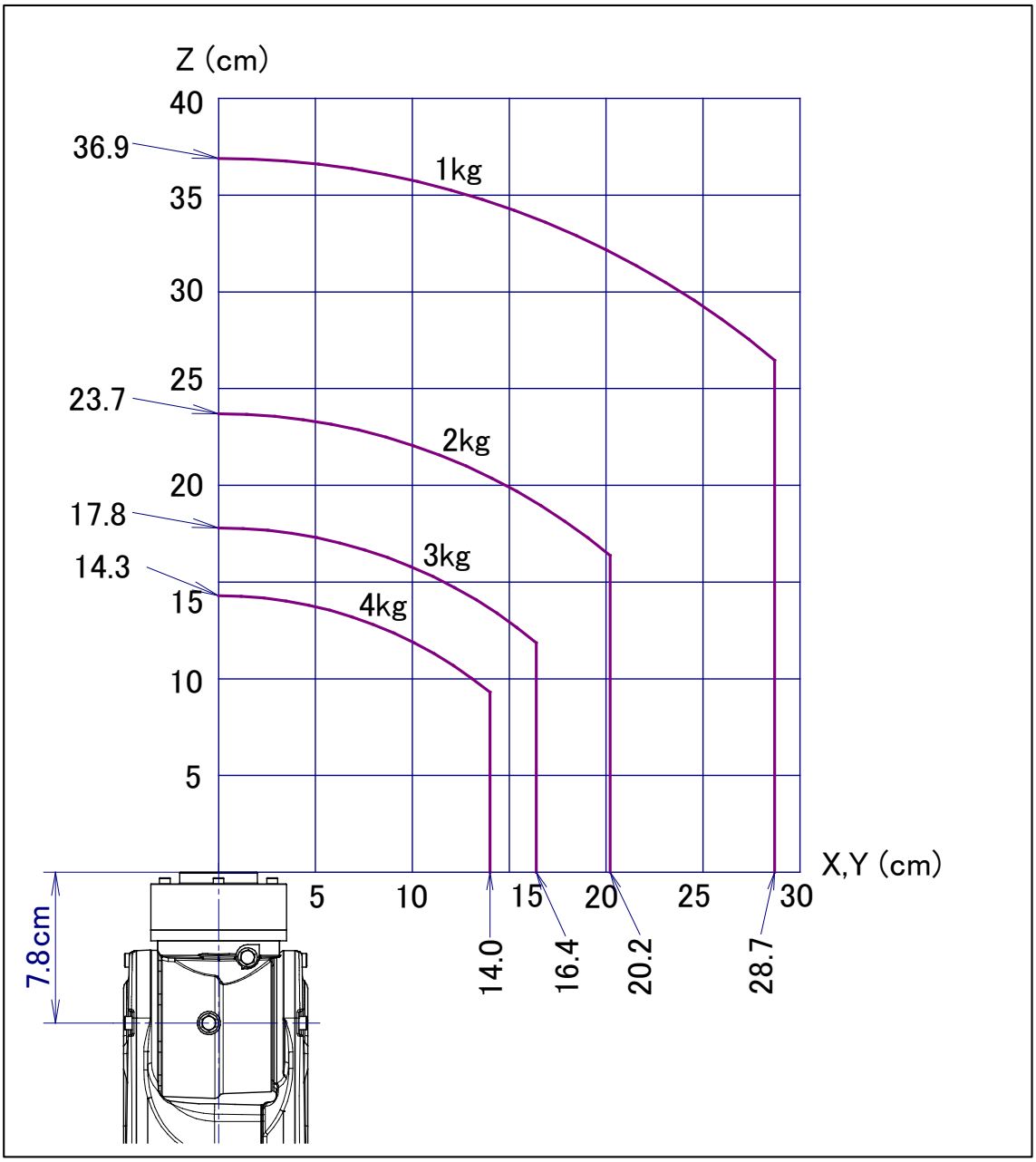


Fig. 3.4 (c) Wrist load diagram (4SH High inertia mode)

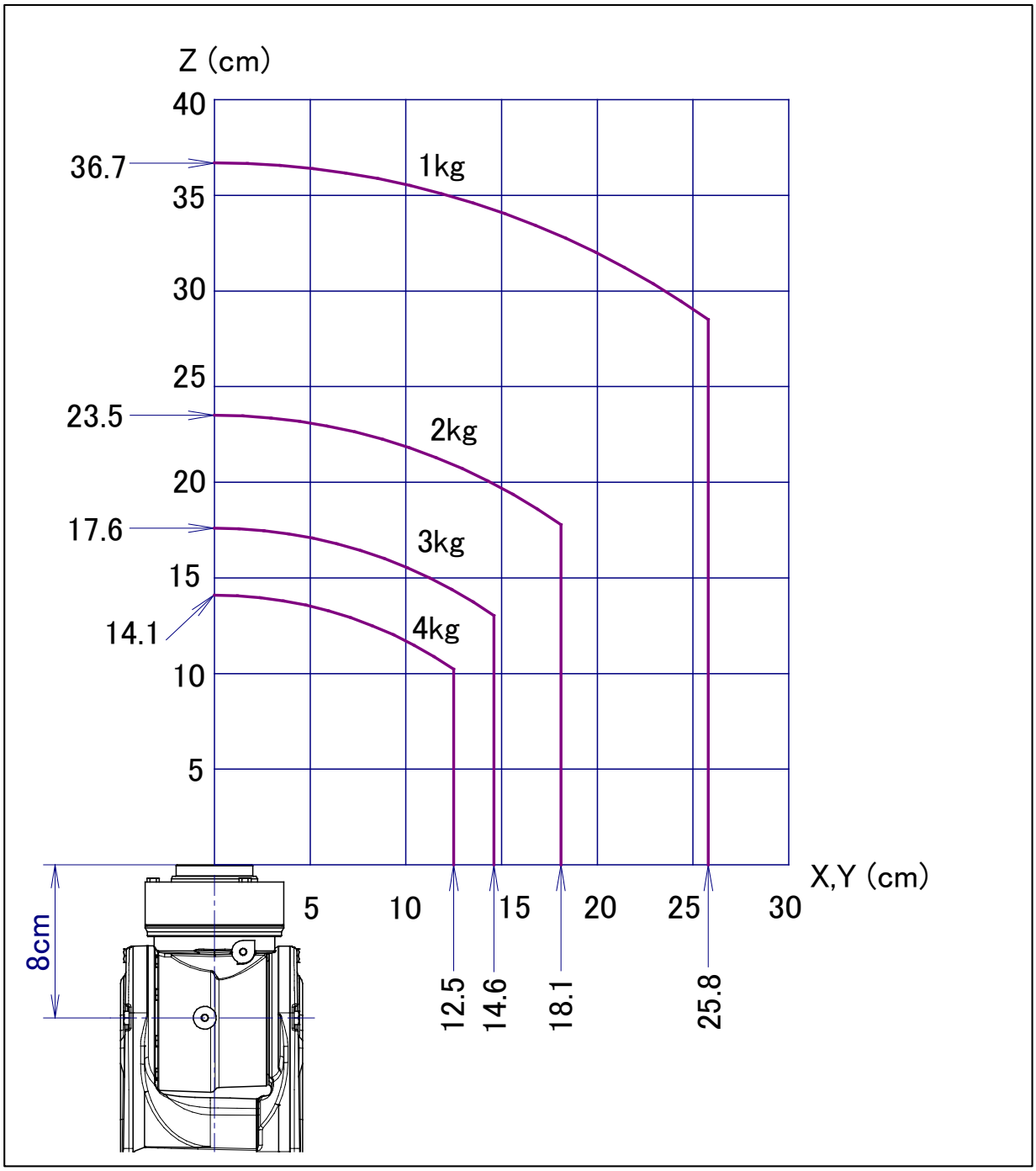


Fig. 3.4 (d) Wrist load diagram (4SC)

3.5 LOAD CONDITION ON EQUIPMENT MOUNTING FACE

The equipment can be installed as shown in Fig.3.5 (a). When equipment is installed, total weight of installed equipment, hand and work must not exceed 4kg. Please refer to Chapter 4 for the size on the equipment installation side.

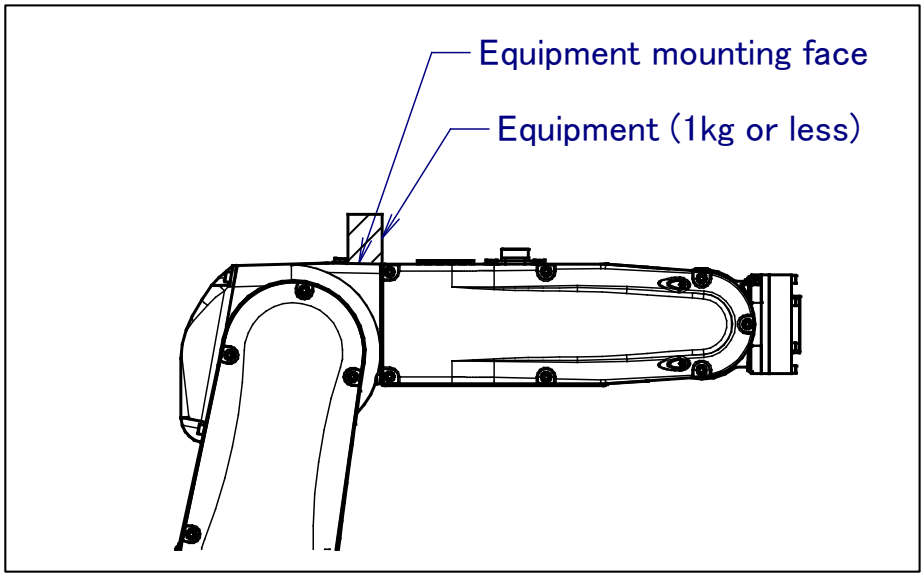


Fig. 3.5 (a) Load condition of equipment mounting face

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) and (b) are the diagrams for installing end effectors on the wrist. 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 referring to Appendix B for the tightening torque.

⚠ CAUTION
1 Notice the tooling coupling depth to wrist flange should be shorter than the flange coupling length.
2 Don't use a pin without tap for removal at wrist flange.

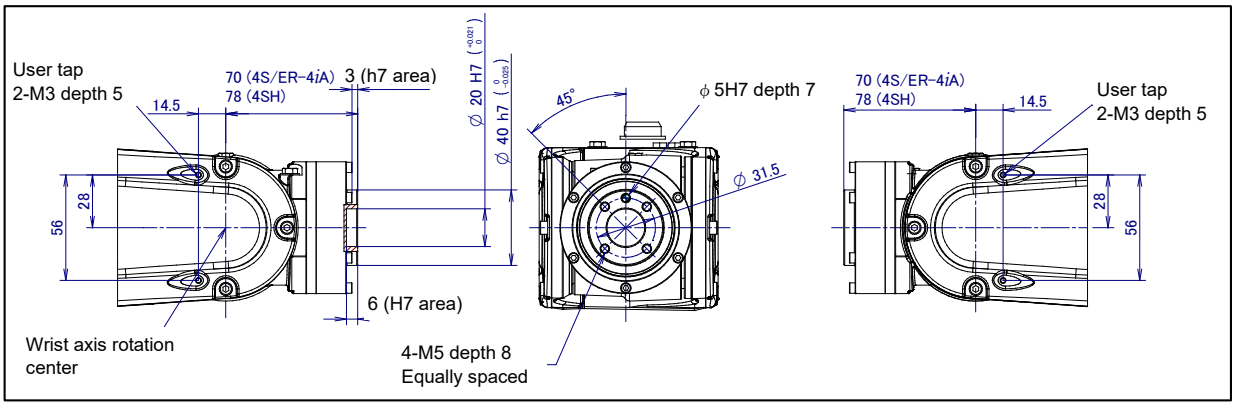


Fig. 4.1 (a) Surface for installing the end effector (4S/4SH/ER-4iA)

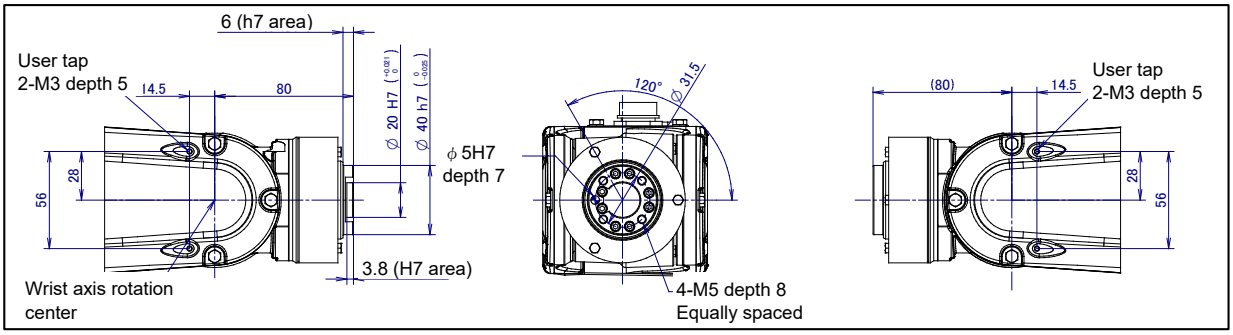


Fig. 4.1 (b) Surface for installing the end effector (4SC)

NOTE : User tap (2-M3) is for piping and wiring to the end effector

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 operations such as drilling or tapping on the robot body. This can seriously affect the safety and functions of the robot.
2 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.
3 Equipment should be installed so that mechanical unit cable does not interfere. If equipment interferes, the mechanical unit cable might be disconnected, and unexpected troubles might occur.

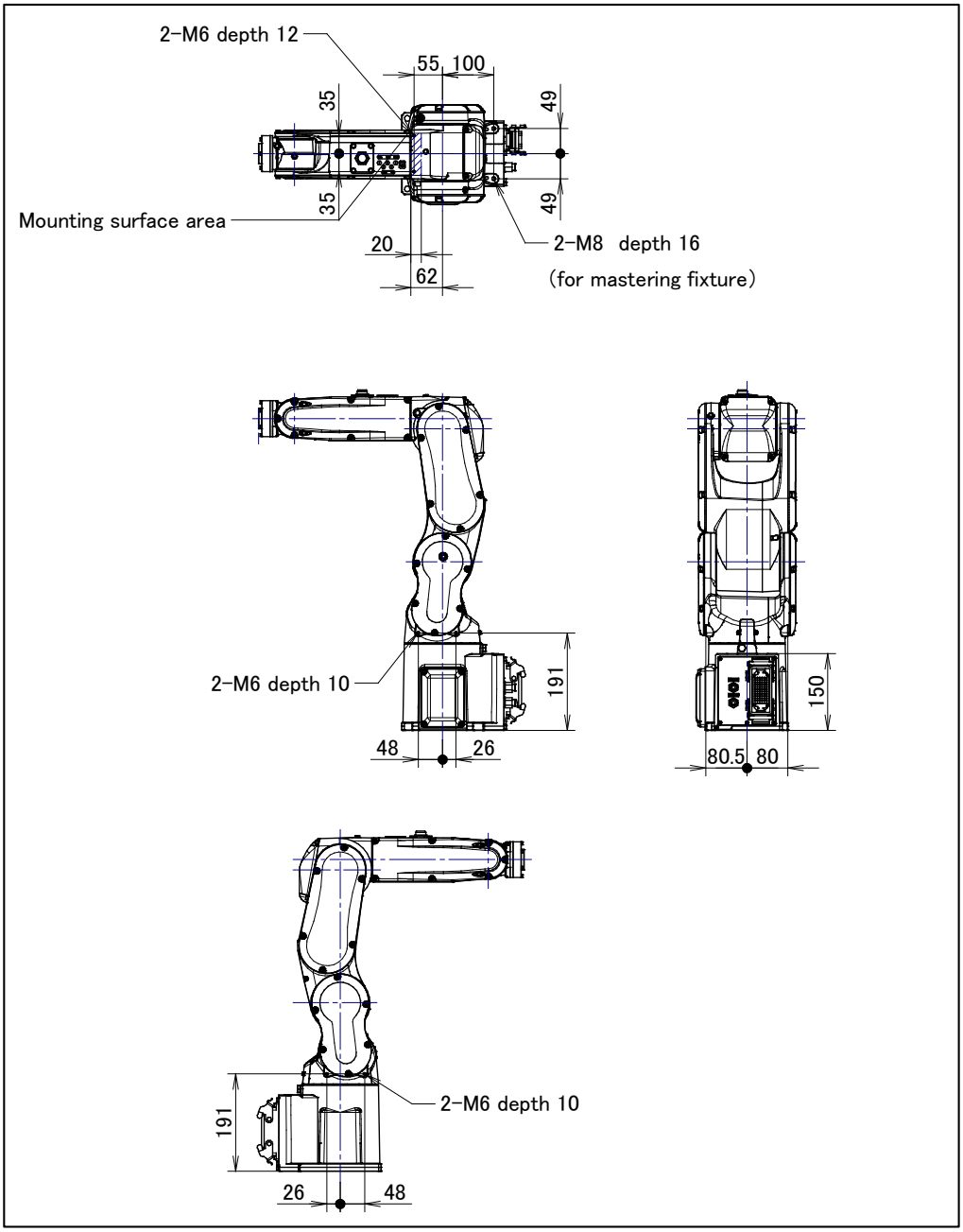


Fig. 4.2 (a) Equipment mounting faces

4.3 LOAD SETTING

⚠ CAUTION

1 Set load condition parameter before robot runs. Do not operate the robot in over payload. Don't exceed allowable payload including connection cables and its swing. Operation in over payload may occur troubles such as reducer life reduction.

2 When performing load estimation after parts replacement
If wrist axes (J5/J6-axis) motors or reducers are replaced, estimation accuracy may go down. Perform the calibration for load estimation before performing load estimation. Refer to Chapter 9 "LOAD ESTIMATION" in 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          4.00  [                    ]
 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  SETING >
         IDENT                          >
```

5 Ten different pieces of payload information can be set using condition Nos. 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      100 %

      Group1
1   Schedule No [     1]:   [ Comment          ]
2   PAYLOAD                 [ kg ]          4.00
3   PAYLOAD  CENTER  X      [ cm ]          0.10
4   PAYLOAD  CENTER  Y      [ cm ]          0.00
5   PAYLOAD  CENTER  Z      [ cm ]         11.95
6   PAYLOAD  INERTIA  X     [kgfcms^2]     10.00
7   PAYLOAD  INERTIA  Y     [kgfcms^2]     10.00
8   PAYLOAD  INERTIA  Z     [kgfcms^2]     10.00

 [ TYPE ]  GROUP  NUMBER  DEFAULT  HELP
```

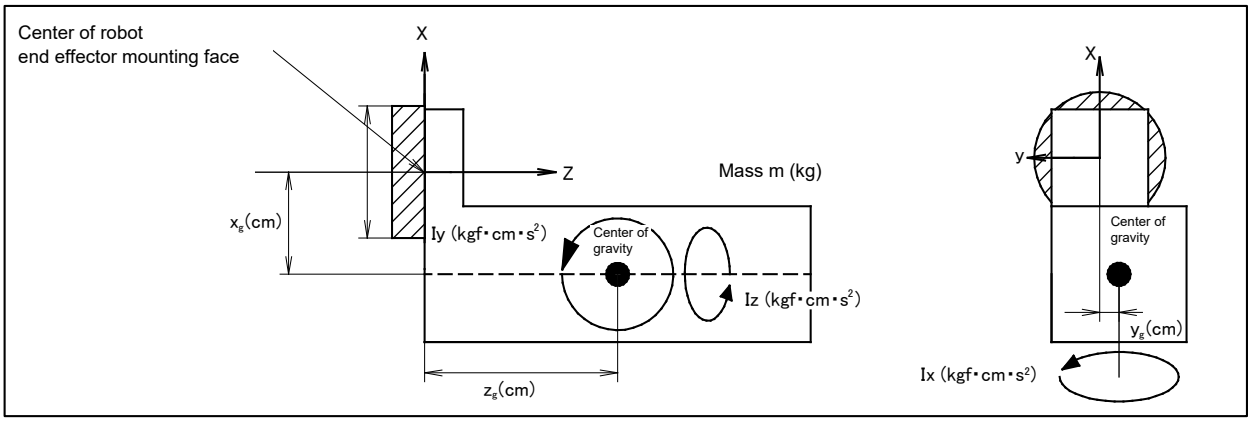


Fig. 4.3 (a) Standard tool coordinate

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 Press the F3 ([NUMBER]) will bring you to the MOTION PAYLOAD SET screen for another condition number. For a multigroup system, clicking 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. Click F5 ([SETIND]), and enter the desired payload setting condition number.

9 On the list screen, pressing F4 ARMLOAD brings you to the device-setting screen.

```
MOTION ARMLOAD SET              JOINT   100%

   Group 1
 1 ARM LOAD AXIS #1 [kg]              0.00
 2 ARM LOAD AXIS #3 [kg]              1.00

[ TYPE  ]    GROUP          DEFAULT   HELP
```

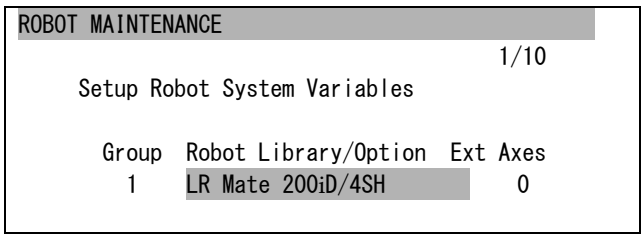
10 Specify the mass of the loads on the J2 base and J3 housing. When you enter ARMLOAD AXIS #1[kg]: Mass of the load on the J2 base and ARMLOAD AXIS #3[kg]: Mass of the load on the J3 housing, the confirmation message “Path and Cycle time will change. Set it?” appears. Select F4 YES or F5 NO. Once the mass of a device is entered, it is put in effect by turning the power off and on again.

4.4 HIGH INERTIA MODE (OPTION) (LR Mate 200*i*D/4SH)

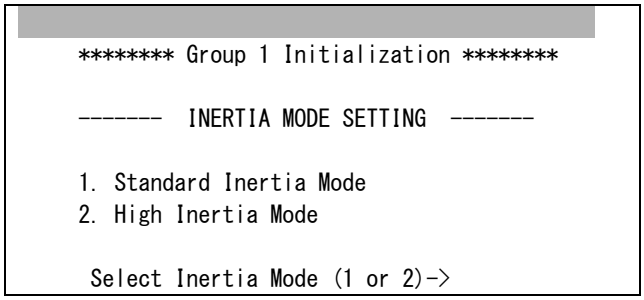
High Inertia Option

Two servo motion parameters are prepared depending on the magnitude of load inertia. The best addition and subtraction velocity operation can be achieved by setting the parameter matched to the load inertia mode. The parameter is changed by the following methods.

1 Turn on the controller with the [PREV] key and the [NEXT] key pressed.
Then select "3. Controlled start".
2 Press the [MENU] key and select "9. MAINTENANCE".
3 The following screen will be displayed.
Press arrow (↑ , ↓) keys and move the cursor to "LR Mate 200*i*D/4SH". Then press F4, MANUAL.



4 Set "Standard Inertia Mode" or "High Inertia Mode" on the INERTIA MODE SETTING screen.



5 Press the [FCTN] key and select "1. START (COLD)".

Robot is set in standard inertia mode when robot is shipped.

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 cable 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.

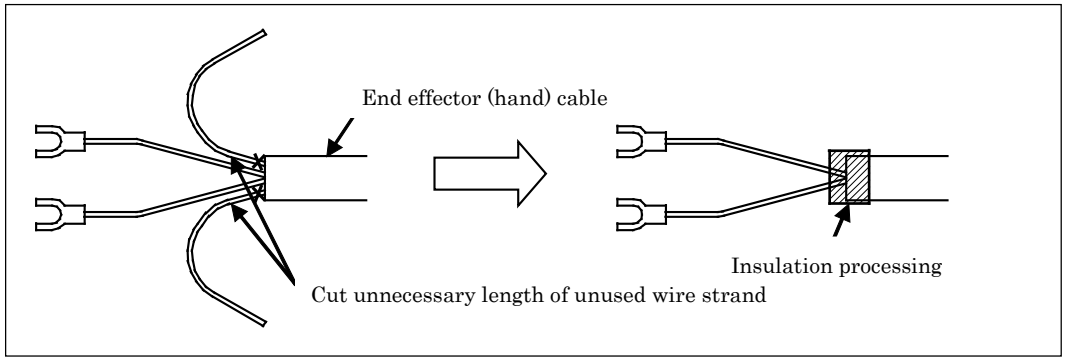


Fig. 5 (a) Treatment method of end effector (hand) cable

5.1 AIR SUPPLY

Air supply holes (Rc1/4) exist on the J1–axis connector panel to supply air to the end effector as shown in Fig. 5.1 (b). Optional solenoid valves can be mounted as shown in Tables 5.1 (a). Plugs are inserted in all of the ports used for supplying air before the robot is shipped. To use the air circuit, you must remove the plugs and connect couplings to the ports.
When the solenoid valve is replaced, the entire manifold should be replaced.

Table 5.1 (a) Optional solenoid valves

Option spec.	Model	Description	Solenoid (Manifold) spec	Remarks	RO
A05B-1143-H001	Except ER-4*i*A	Path 2 air piping, RO connector output (without solenoid valve)	—	—	—
A05B-1143-H002	4S/4SH	Double solenoids x 1	A97L-0218-0130#D1L (manufactured by SMC)	2 position x 1	RO1 to 2
A05B-1143-H003	4S/4SH /ER-4*i*A	Double solenoids x 2	A97L-0218-0130#D2L (manufactured by SMC)	2 position x 2	RO1 to 4
A05B-1143-H022	4SC	Double solenoids x 1	A97L-0218-0130#D1L (manufactured by SMC)	2 position x 1	RO1 to 2
A05B-1143-H023	4SC	Double solenoids x 2	A97L-0218-0130#D2L (manufactured by SMC)	2 position x 2	RO1 to 4

Available section area of the solenoid valve : 1.98mm^2 (CV value : 0.11)

NOTE
1 When the air circuit is not used, reinstall the plugs as originally installed for the purpose of dust and water protection.
2 Attach an air filter with a mesh size of 5μm or better on the upstream side near the robot. Compressed air including much moisture causes valve malfunctions. Take action to prevent the entry of moisture, and also drain the air filter periodically.
3 For 4SC, remove the exhaust port plug before using it. (Fig.5.1 (a)) Air of the built-in solenoid valve exhaust port is exhausted from here. So connect the piping and exhaust it to outer of the clean room.

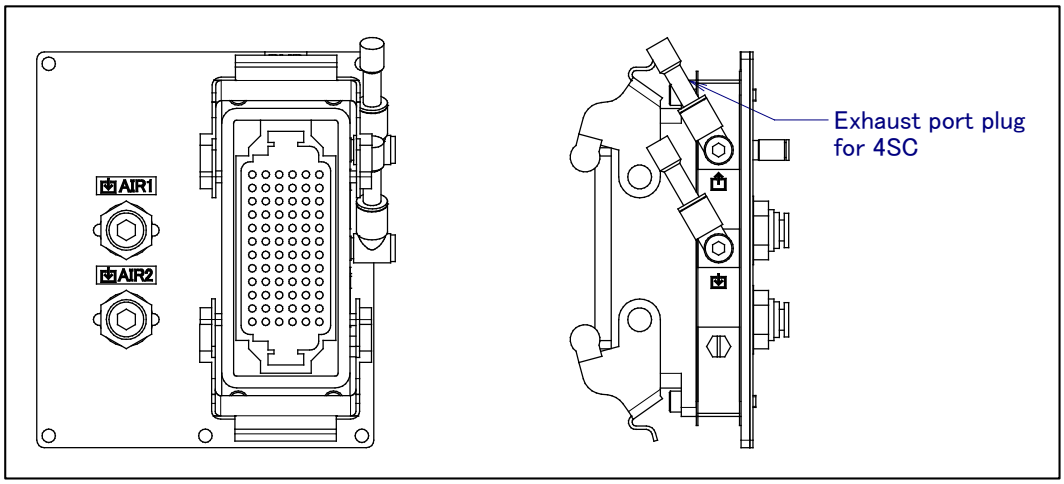


Fig. 5.1 (a) Exhaust port plug for 4SC

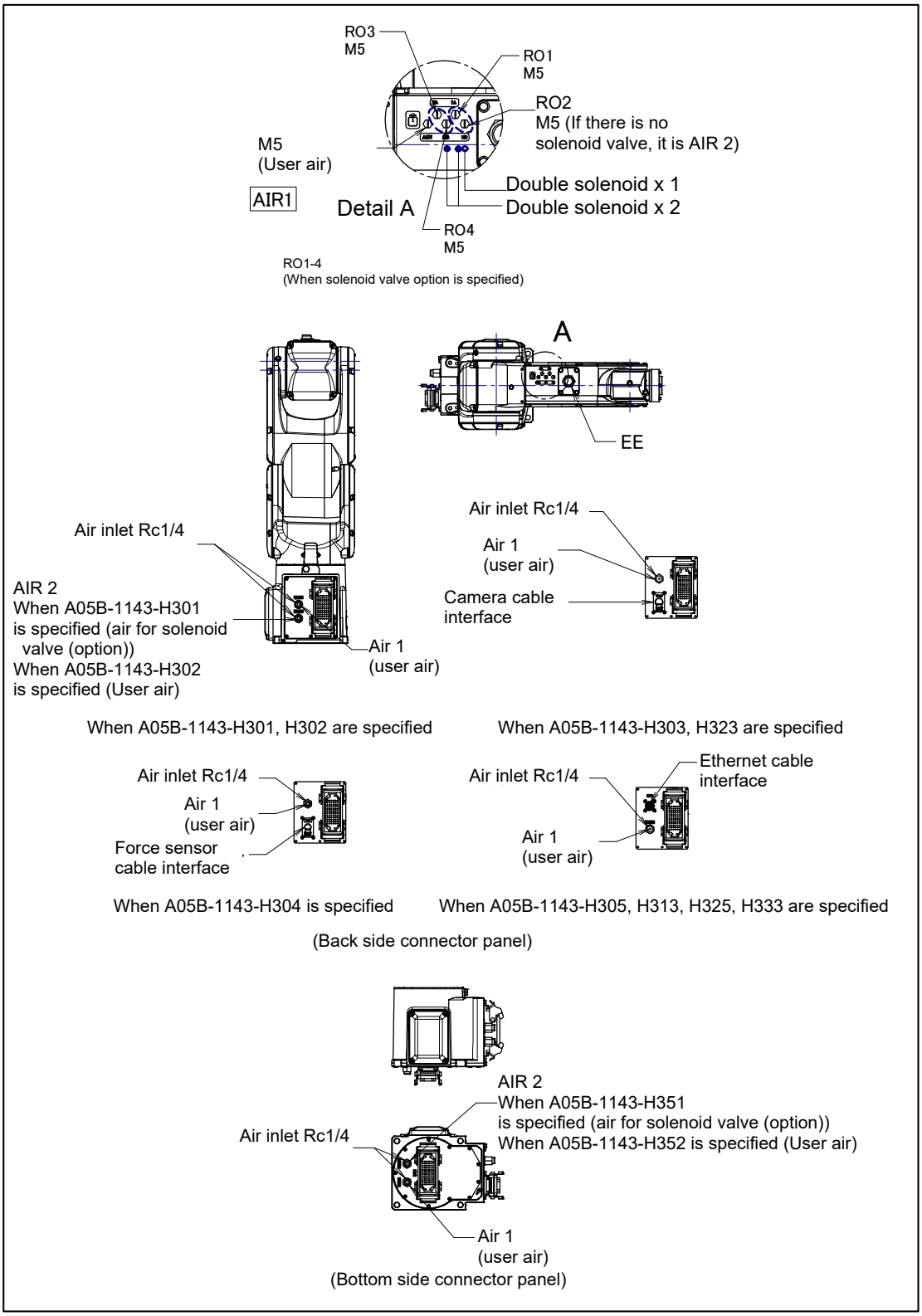


Fig. 5.1 (b) Air supply

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 120Nl/min (0.12Nm^3/min)

* The air should be dry. Do not use oiled compressed air.

5.2 INSTALLING THE AIR PURGE KIT (OPTION)

Air purge kit is preparatory as the option, and use it, please. Use the prepared air purge kit.

・ Air purge kit (A05B-1142-J061)

Set the air purge pressure to 15 kPa (0.015 MPa, 0.15 kgf/cm^2) or less. Air purge regulator kit (A05B-1138-J062) is appropriate for controlling the purge pressure.

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 operating, an air purge is required if it is placed in a bad condition. Intermittent purge sometimes causes liquid entrance or internal dew.
3 When removing the air tube from the air inlet of the J1 connector panel, replace the joint together. Be careful to prevent cleaning fluids from entering into the joint. Otherwise, rubbers in the joint are degraded and the robot may be damaged.
4 Air purge kit cannot be used when using 4SC in the clean room. It causes particle generation. Except for clean room, such as food environment is acceptable.

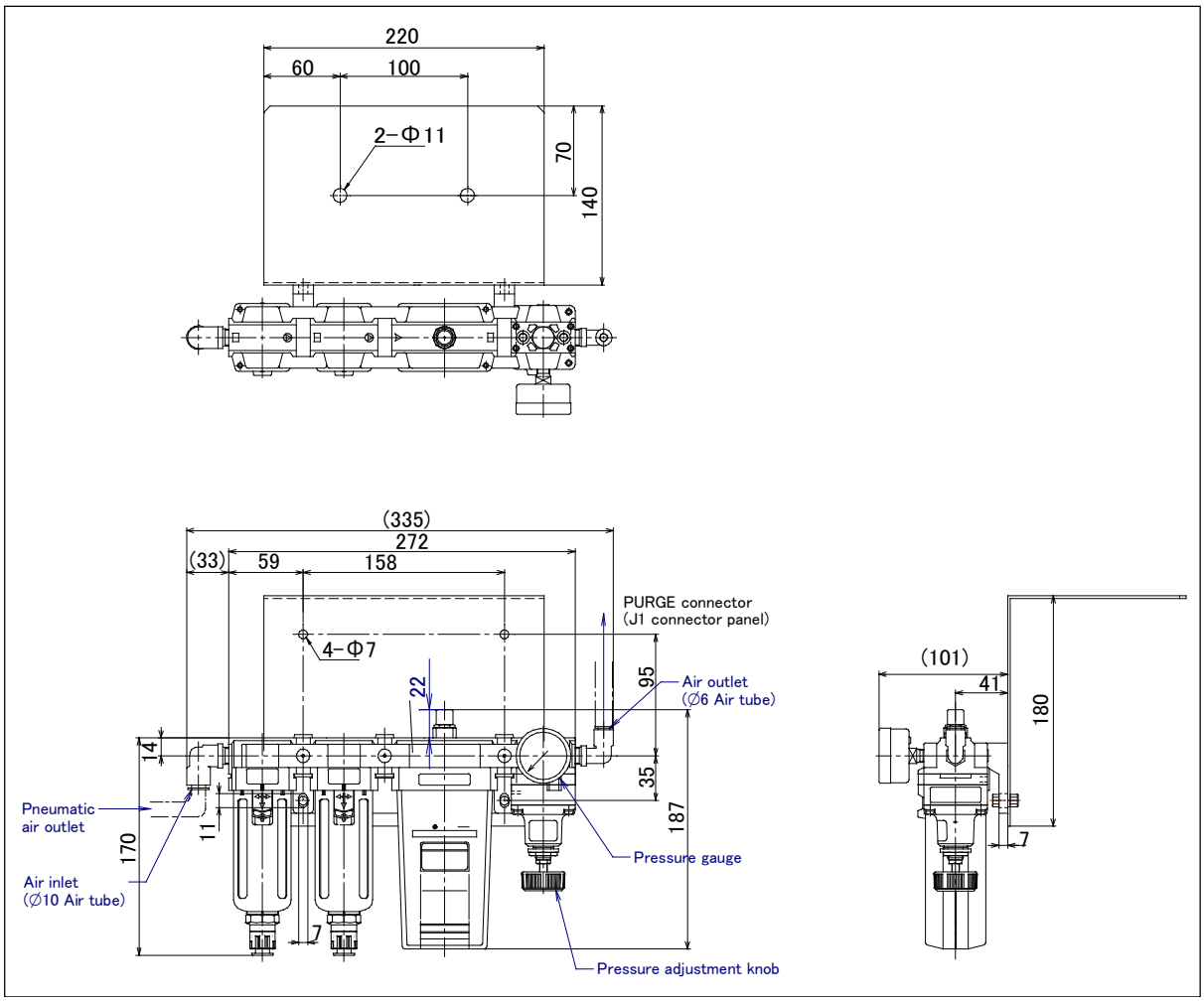


Fig 5.2 (a) Regulator kit for air purge external dimensions

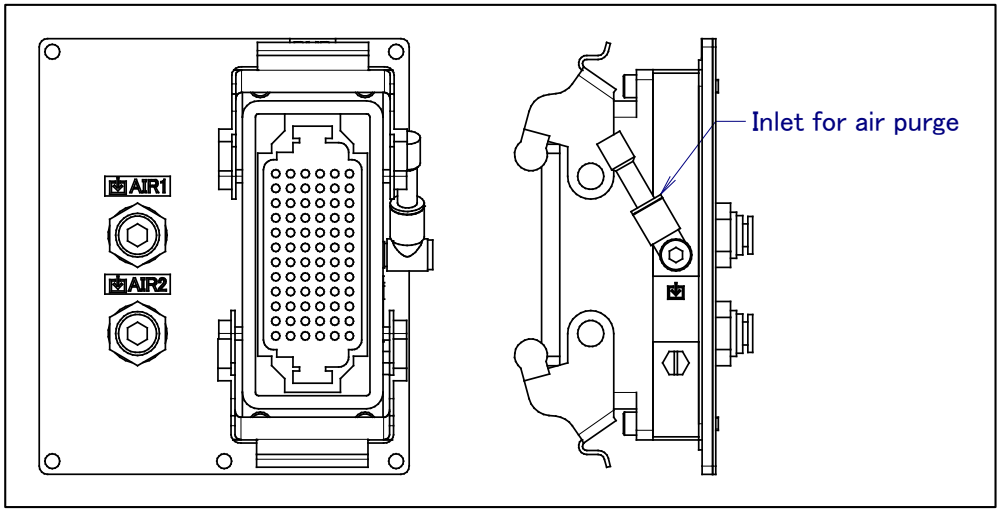


Fig 5.2 (b) Inlet for air purge

5.3 INTERFACE FOR OPTION CABLE (OPTION)

This Section shows the position of the EE interface.

⚠ CAUTION

1 The connector to be plugged into the interface and the cable attached to that connector should be supplied by the customer.
2 Please cover the unused connector and air port using a metal cap (option) and a plug. If the covering is loose, unexpected substances will enter the robot and cause trouble. When leaving the factory, the interfaces are covered by easy caps in order to avoid dust during transportation. Please keep in mind that this factory installed cap doesn't work well enough to provide protection in a factory environment.
3 Please waterproof the cable controlling the tooling to prevent moisture from entering the robot. Moreover, a damaged cable jacket might allow liquids into the robot, so replace it if it gets damaged.

(1) EE interface (RI/RO signal)

Fig. 5.3 (a) shows the pin layout for the EE interface (RI/RO signal).

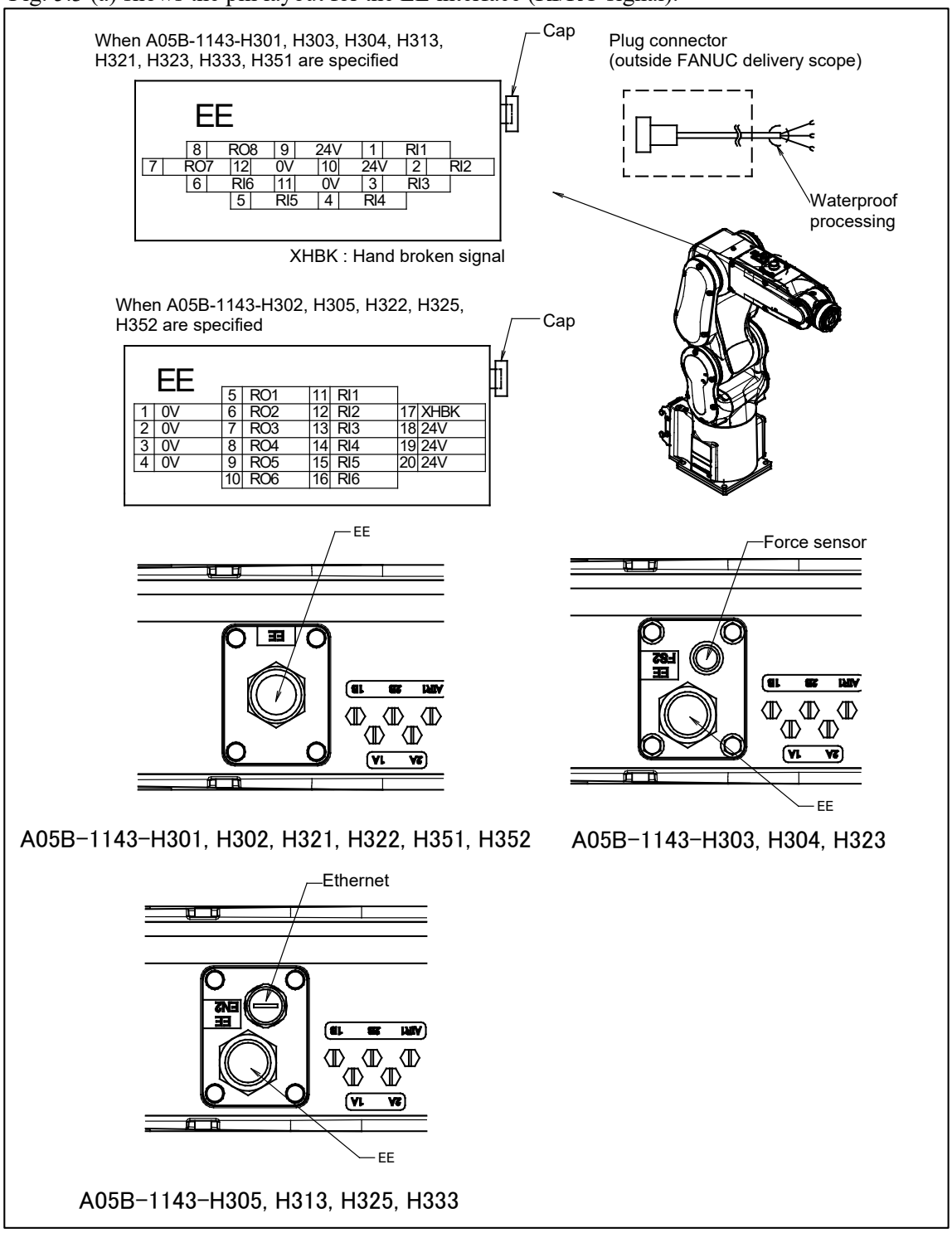


Fig. 5.3 (a) EE interface (RI/RO signal)

> ⚠ **CAUTION**
> For wiring of the peripheral device to the EE interface, refer to below, too.
> - Chapter “ELECTRICAL CONNECTIONS” of R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN).
> - Chapter “ELECTRICAL CONNECTIONS” of R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER (Open Air) MAINTENANCE MANUAL (B-83555EN).

Connector specifications

Table 5.3 (a) shows the connector parts supported by the end effector interface. Some of these parts are available as an option from FANUC. (Table 5.3 (b))

Table 5.3 (a) Supported connector (user side)

Maker	Manufacturer specification	Remarks
Hirose Electric Co. Ltd.	Plug: RM15WTPZ-12P(71) Clamp: JR13WCC-*(72)	Straight type connector (12 pins) ∗ indicates an applicable cable diameter selected from the following: ∗ : ϕ5, 6, 7, 8, 9, 10mm For A05B-1143-H301, H321 (EE12P)
	Plug: RM15WTLP-12P(71) Clamp: JR13WCC-*(72)	Elbow type connector (12 pins) ∗ indicates an applicable cable diameter selected from the following: ∗ : ϕ5, 6, 7, 8, 9, 10mm For A05B-1143-H301, H321 (EE12P)
	Plug: RM15WTLP-20P (31) Clamp: JR13WCC-*(72)	Elbow type connector (20 pins) * indicates an applicable cable diameter selected from the following: * : ϕ5, 6, 7, 8, 9, 10mm For A05B-1143-H302, H322 (EE20P)

NOTE
For details, such as the dimensions, refer to the related catalogs offered by the respective manufacturers, or contact your local FANUC representative.

Table 5.3 (b) Supported option

Option specification	Remarks
A05B-1137-J057	Straight type (12-pins) Applicable cable diameter : 8mm
A05B-1137-J058	Elbow type (12-pins) Applicable cable diameter : 9mm
A05B-1139-J059	Elbow type (20-pins) Applicable cable diameter : 9mm

Table 5.3 (c) shows the connector parts supported by the Ethernet cable (ES) interface.

Table 5.3 (c) Connector specifications (user side)

Cable name	Input side (J1 base)	Maker/ dealer	Output side (J3 arm)	Maker/ dealer
ES	2103 881 1405 2103 881 1415 2103 281 1405 2103 282 1405 Many other types are available.	HARTING K.K	←The same	HARTING K.K

NOTE
See Appendix C, "OPTIONAL CONNECTOR WIRING PROCEDURE" for explanations about how to wire optional connectors.

6 AXIS LIMIT SETUP

When axis limits are defined, the motion range of the robot can be changed from the standard value. The motion range of the robot axes can be restricted because of:

- Used motion range of the robot is limited.
- Tools and peripheral equipment interfere each other in some areas.
- Length of the cable or hose attached to the application is limited.
  The following method used to prevent the robot from going beyond the necessary motion range.
- Axis limit by DCS (All axes (option))

> ⚠ **WARNING**
> 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.

6.1 SOFTWARE SETTING CHANGE AXIS LIMIT BY DCS (OPTION)

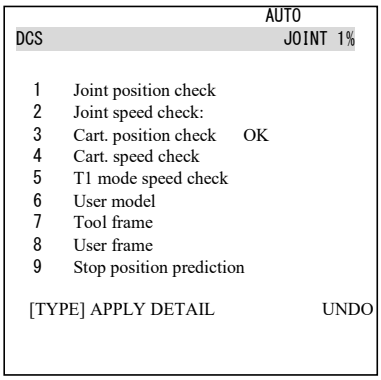
The robot motion can be restricted with DCS (Dual check safety) function by using the following software. For J2/J3-axis, the same effect as an adjustable mechanical stopper can be obtained.
The robot motion can be restricted at any angle and position if it is in robot motion area. DCS functions are 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)

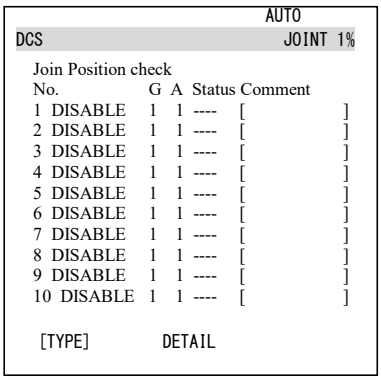
As an example, we shows the procedure to set $\pm 90^{o}$ for J2-axis in here. Refer to R-30*i*B/R-30*i*B Mate /R-30*i*B Plus Controller Dual check safety function Operator's Manual (B-83184EN) for details of other setting, function and DCS stop position prediction.

Setting procedure

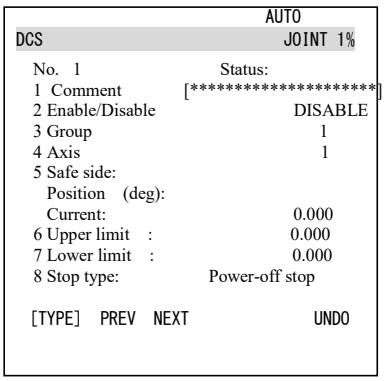
1 Press the [MENU] key to display the screen menu.
2 Press [0 NEXT] and press [6 SYSTEM].
3 Press the F1 ([TYPE]).
4 Select [DCS]. The following screen will be displayed.



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

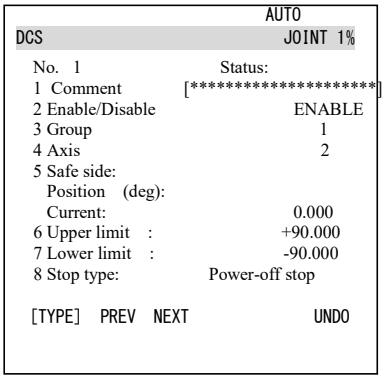


6 Move the cursor to [1], then press the [DETAIL].

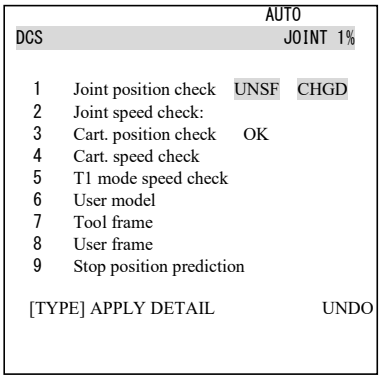


7 Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
8 Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
9 Move the cursor to [Axis], then input “2”, then press the [ENTER] key.
10 Move the cursor to [Upper limit] right side, then input “90”, then press the [ENTER] key.
11 Move the cursor to [Lower limit] right side, then input “-90”, then press the [ENTER] key.

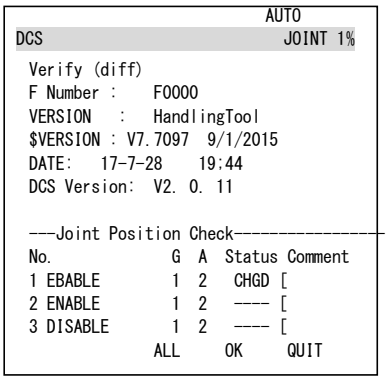
⚠ WARNING
If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot's momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the workspace.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



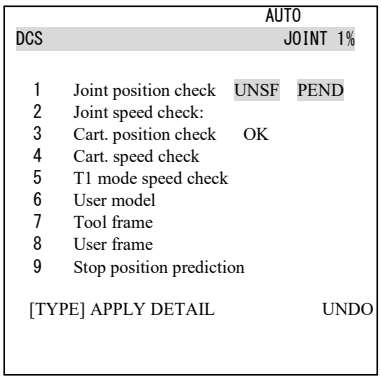
12 Press the [PREV] key two times, back to the first screen.



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].



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



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.

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 years / 2 = 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 Air purge kit	(When air control set or air purge kit is used) **⇒"7.2.2 Confirmation of the Air Control Set and Air Purge kit"**
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 operates properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the end effector drops 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)**
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 Check and Maintenance

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

Check and maintenance intervals (Period, Accumulated operating time)					Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	4 years 15360h			
○ Only 1st check	○				Cleaning the controller ventilation system	Confirm that the controller ventilation system is not dusty. If dust has accumulated, remove it.	13
	○				Check for external damage or peeling paint	Check whether the robot has external damage or peeling paint due to contact with the peripheral equipment. If unintended contact has occurred, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○				Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.	2
	○ 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.	12
	○ Only 1st Check	○			Check for damage to the end effector (hand) cable and external batteries cable	Check whether the end effector cables and external batteries cable are unevenly twisted or damaged. If damage is found, replace the damaged cables.	8
	○ Only 1st check	○			Check the exposed connectors	Check the exposed connectors. **⇒"7.2.3 Check the Connectors"**	3
	○ 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"**	4

Check and maintenance intervals (Period, Accumulated operating time)					Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	4 years 15360h			
	○ Only 1st check	○			Retightening the external main bolts	Retighten the robot installation bolts, bolts that have been removed for inspection, and bolts exposed to the outside. Refer to the recommended bolt tightening torque guidelines at the end of the manual. An adhesive to prevent bolts from loosening is applied to some bolts. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	5
	○ Only 1st check	○			Check the mechanical stopper	Check that the spring pin of J1/J3-axis mechanical stopper is not deformed, if it is deformed, replace it with a new one. **⇒"7.2.4 Check of Mechanical Stopper "**	6
	○ 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).	7
		○			Replacing the mechanical unit batteries	Replace the mechanical unit batteries. Regardless of operating time, replace batteries at 1 year. **⇒"7.3.1 Replacing the Batteries"**	9
			○ (*)	○ (*)	Replenish grease to each axis reducer	Replenish grease to each axis reducer (*) Periodic interval differs according to the model. 4SC : 2 years (7680 hours) 4S/4SH/ER-4*i*A : 4 years (15360 hours) **⇒"7.3.2 Replenish the Grease of the Drive Mechanism"**	10
				○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	11
				○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. **⇒Chapter 7 Replacing batteries of R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN) or R-30*i*B MATE CONTROLLER Open Air MAINTENANCE MANUAL (B-83555EN)"**	14

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.

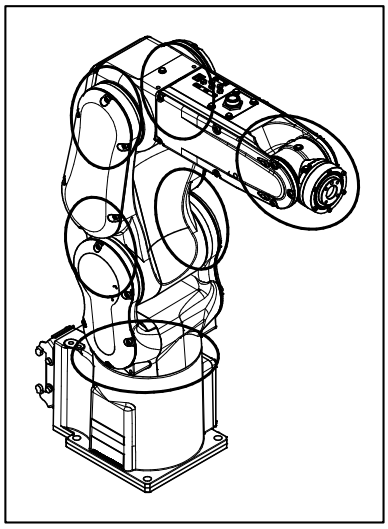


Fig. 7.2.1 (a) Check points of oil seepage

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If there is a change in oil viscosity, the oil might drip depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components before you operate the robot.
- Also, motors might become hot and the internal pressure of the grease bath might rise by frequent repetitive movement and use in high temperature environments. In these cases, normal internal can be restored by venting the grease inlet. (When opening the grease inlet, refer to Subsection .7.3.2 and ensure that grease is not expelled onto the machine or tooling.)
- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.

  ⇒"9.1 TROUBLESHOOTING"(symptom : Grease leakage)

7.2.2 Confirmation of the Air Control Set and Air Purge Kit (Option)

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

Item	Check items		Check points
1	When air control set is provided.	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 0.49MPa (5 kg/cm²), adjust it using the regulator pressure setting handle.
2		Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts, as required.
3		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.
4	When air purge kit is provided.	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 15 kPa (0.15 kgf/cm²), adjust it using the regulator pressure setting handle.
5		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.
6		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.

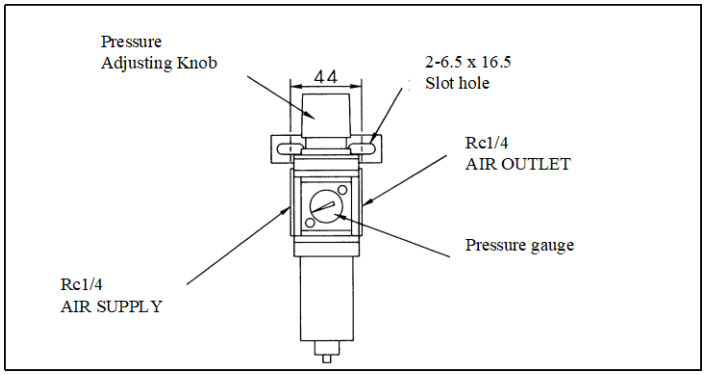


Fig. 7.2.2 (a) Air control set (option)

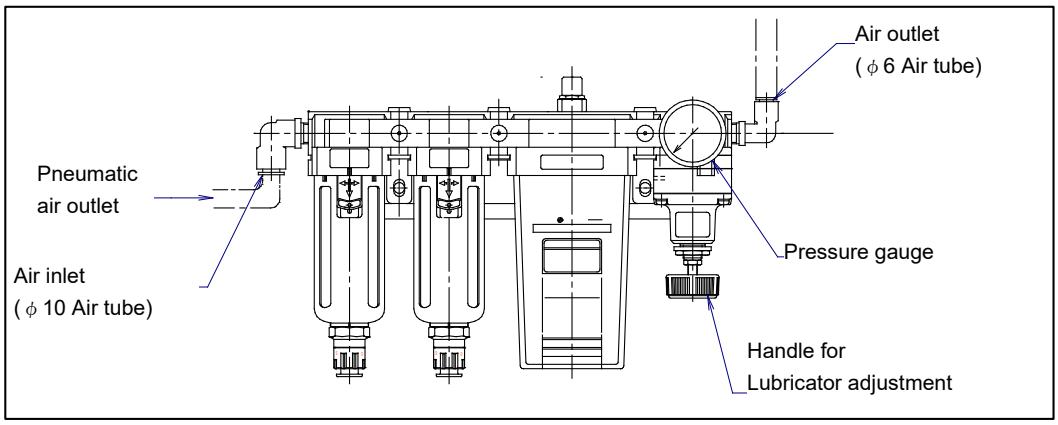


Fig. 7.2.2 (b) Regulator kit for air purge (option)

7.2.3 Check the Connectors

Inspection points of the connectors

- Robot connection cables, earth terminal and user cables

Check items

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

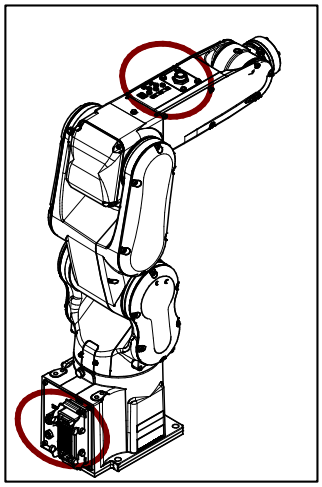


Fig. 7.2.3 (a) Connector Inspection points

7.2.4 Check of Mechanical Stopper

- Check that the spring pin of the J1/J3 -axis mechanical stopper is not deformed, if it is deformed, replace it with a new one.

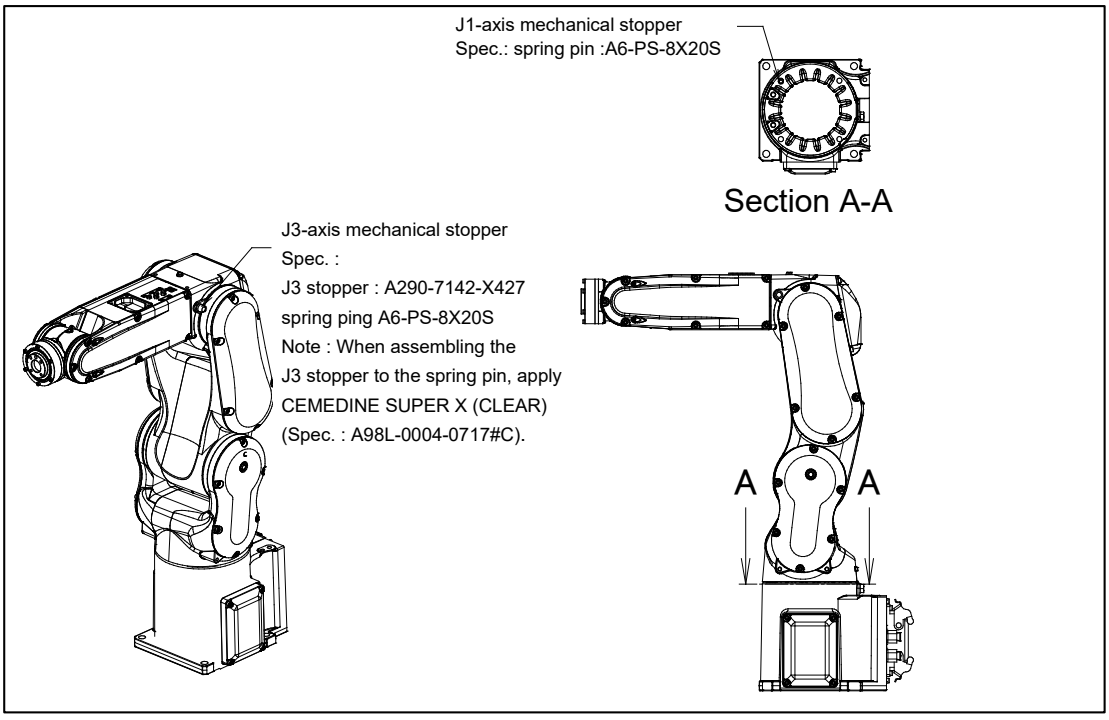


Fig. 7.2.4 (a) Check of mechanical stopper

7.3 MAINTENANCE

7.3.1 Replacing the Batteries (1-Year Periodic Inspection)

The position data of each axis is preserved by the backup batteries. If built-in batteries are in use, replace them every year. If external batteries are in use, replace them every year. Also use the following procedure to replace them when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery (if built-in batteries are specified)

1 Keep the power on. Press the EMERGENCY STOP button to prohibit the robot motion.

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

2 Remove the battery case cap. (Fig. 7.3.1 (a)) If it cannot be removed, tap it on the side with a plastic hammer.
3 Loosen the plate screw and take off the lid of the battery box and replace the battery. The battery can be taken out by pulling the stick which is in the center of the battery box.
4 Assemble them by reversing the sequence. Pay attention to the direction of batteries.
It is necessary to replace the gasket.

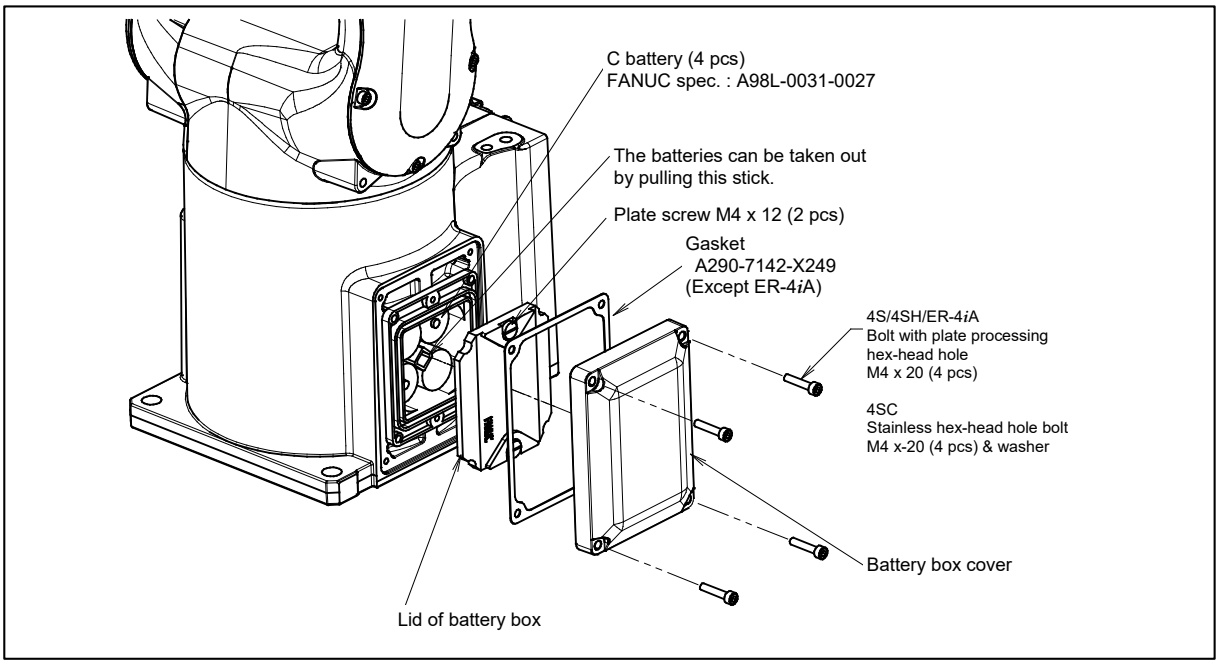


Fig. 7.3.1 (a) Replacing the battery (if built-in batteries are specified)

7.3.2 Replenish the Grease of the Drive Mechanism (4 years (15360 hours) or 2 years (7680 hours)checks)

For 4S/4SH/ER-4*i*A, supply reducer grease at the intervals based on every 4 years or 15360 hours, whichever comes first by using the following procedures.
For 4SC, supply reducer grease at the intervals based on every 2 years or 7680 hours, whichever comes first by using the following procedures.

For the grease name and quantity, see the Table 7.3.2 (a).

Table 7.3.2 (a) Grease for 4-year (15360 hours) or 2-year (7680 hours) periodical greasing

Greasing points	Greasing amount	Models	Specified grease
J1-axis reducer	2.7g (3ml)	4S/4SH	Spec: A98L-0040-0230
J2-axis reducer	2.7g (3ml)		
J3-axis reducer	1.8g (2ml)		
J4-axis reducer	1.8g (2ml)		
J5-axis reducer	1.8g (2ml)		
J6-axis reducer	1.8g (2ml)		
J1-axis reducer	0.9g (1ml)	4SC	Spec: A98L-0040-0320
J2-axis reducer	0.9g (1ml)		
J3-axis reducer	0.9g (1ml)		
J4-axis reducer	0.9g (1ml)		
J5-axis reducer	0.9g (1ml)		
J6-axis reducer	0.9g (1ml)		
J1-axis reducer	2.7g (3ml)	ER-4*i*A	Spec: A98L-0040-0330
J2-axis reducer	2.7g (3ml)		
J3-axis reducer	1.8g (2ml)		
J4-axis reducer	1.8g (2ml)		
J5-axis reducer	1.8g (2ml)		
J6-axis reducer	1.8g (2ml)		

For greasing use the arbitrary postures.

⚠ CAUTION
The following maintenance kits are prepared for the greasing.
- Greasing kit (for 4S/4SH) : A05B-1142-K021
  (This is a set of greasing syringe and grease in tube. (90g))
- Greasing kit (for 4SC) : A05B-1142-K026
  (This is a set of greasing syringe and grease in tube. (90g))
- Greasing kit (for ER-4*i*A) : A05B-1143-K021
  (This is a set of greasing syringe and grease in tube. (90g))
- Grease in tube: A05B-1139-K022 (for 4S/4SH) (grease in tube. (90g))
- Grease in tube: A05B-1142-K027 (for 4SC) (grease in tube. (90g))
- Grease in tube: A05B-1143-K022 (for ER-4*i*A) (grease in tube. (90g))
  LR Mate 200*i*D/4SH does not have J6-axis.

⚠ CAUTION

Failure to follow proper lubrication procedures may cause the suddenly increase of the grease bath internal pressure and the damage to the seal, which could lead to grease leakage and abnormal operation. When greasing, observe the following cautions.

1 Use specified grease. Use of non-approved grease may damage the reducer or lead to other problems.
2 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.
3 Please When you use the grease kit, fill a necessary amount to the injection syringe with the necessary amount of grease after softening the grease in the tube by massaging it by the hand when you use the grease greasing kit. Please install the nozzle in the point of the injection syringe. Please remove the nozzle and do the cap when you do not use the injection syringe.

1 Turn off the controller power.
2 Remove the seal bolts from the grease inlet.
3 Supply a regulated amount of grease by using the injection syringe. Please note that grease might come out immediately after the grease has been supplied, or during the greasing. Even in this case, please do not supply grease beyond the regulated amount specified.
4 Replace the seal bolts with new ones. When reusing a seal bolt, be sure to seal it with seal tape.

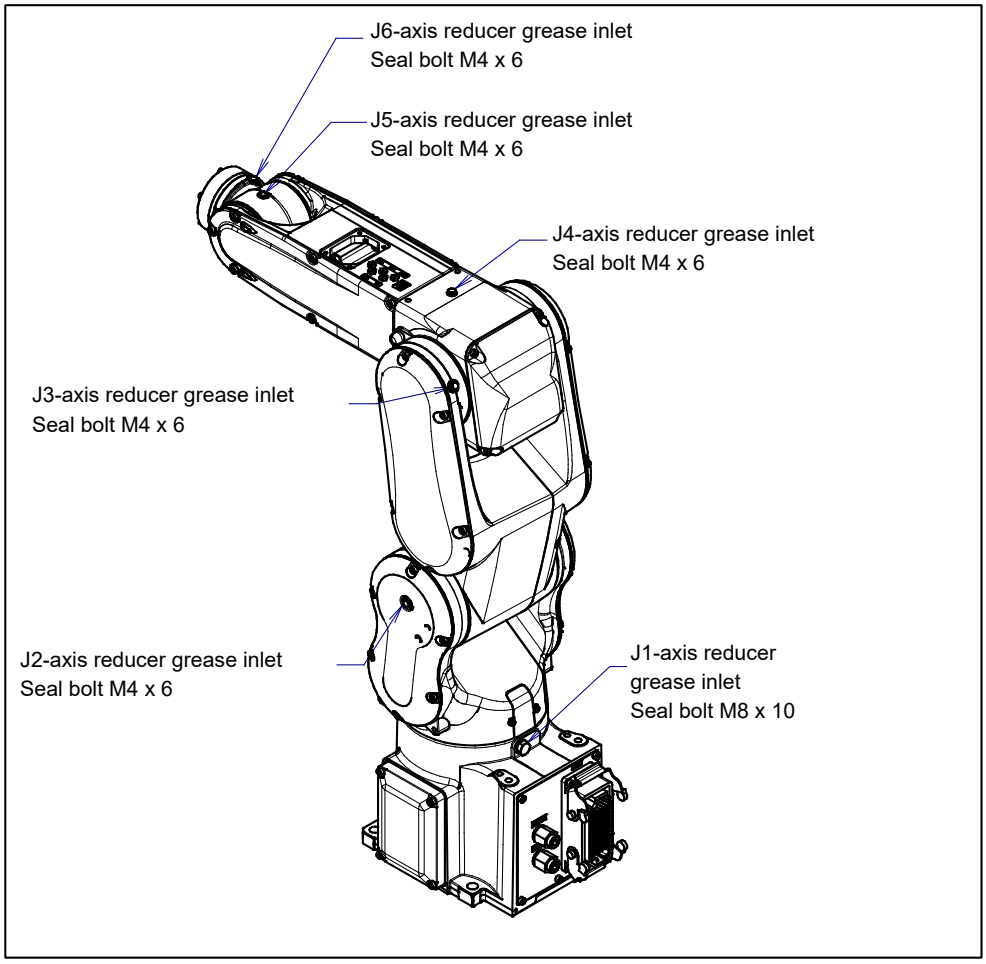


Fig. 7.3.2 (a) Applying grease of the reducer

Table 7.3.2 (b) Spec. of seal bolts

Parts name	Specifications	Remarks	Model
Seal bolt	A97L-0318-0410#040606EN	J2 to J6-axis grease inlet 5 pcs/1 robot	4S/4SC/4SH
Seal bolt	A97L-0218-0417#040606BC	J2 to J6-axis grease inlet 5 pcs/1 robot	ER-4*i*A
Seal bolt	A97L-0318-0406#081010EN	J1-axis grease inlet	4S/4SC/4SH
Seal bolt	A97L-0318-0417#081010BC	J1-axis grease inlet	ER-4*i*A

7.4 CLEANING TH ROBOT (4SC)

The appropriate treatment and material is adopted for robot LR Mate 200*i*D/4SC, which the treatment and material have enough chemical resistance. It is possible to spray cleaners directly on the robot surface, and the robot can be kept in sanitary condition by daily cleaning.

The cleaners written in the Table 7.4 (a) is confirmed that they are not affect the robot LR Mate 200*i*D/4SC surface. Other cleaner has to be checked the impact to robot surface, please contact FANUC for them.

Use cleaner whose dilution rate is correct. If dilution rate is not correct, it may cause bad influence to the robot surface. Use the water and cleaner equal to or less than 50 degrees.
Alcohol and organic solvent may have a bad influence on the robot surface. Do not use them to cleaning robot.

Table 7.4 (a) Cleaners whose harmlessness for the robot surface is confirmed

NAME	MAKER	TYPE	MAIN INGREDIENT	DILUTION RATE (NOTE 1)
Geron IV	ANDERSON	Sanitizer	Quaternary ammonium chloride	0.2%
Reg13	ANDERSON	Sanitizer	Sodium hypochloride	0.15%
FOMENT	ANDERSON	Alkali cleaner	Potassium hydroxide Sodium hypochlorite	1.5%
P3-topax 99	ECOLAB	Sanitizer	N-3(-Aminopropyl)-N-Dodecylpropan -1,3-diamin	2%
P3-topax 91	ECOLAB	Sanitizer	Benzalkonium chloride	0.5%
P3-topax 66	ECOLAB	Sanitizer	Sodium hydroxide Sodium hypochlorite Alkylamine oxide	5%
P3-topactive 200	ECOLAB	Alkali cleaner	Ethanol Potassium hydroxide Sodium hydroxide	4%
Hypofoam VF6	JohsonDiversey	Sanitizer	Sodium hydroxide Sodium hypochlorite Amine	10%
DIVOSAN EXTRA VT55	JohsonDiversey	Sanitizer	Quaternary ammonium chloride	1%
Vesphene IIse	STERIS	Sanitizer	Sulfonic acids, C14-16-alkane hydroxy and C14-16-alkene, sodium salts 2-Phenylphenol 4-tert-Pentylphenol Potassium hydroxide Phosphoric acid Sodium hydroxide Sodium xylene sulfonate	0.8%
CIDEX Activated Dialdehyde Solution ASP	Advanced Sterilization Products	Cleaner	Pentane	1%

NOTE
1 DILUTION RATE = STOCK SOLUTION / (STOCK SOLUTION+WATER)
2 Acid cleaner have to be rinsed diligently and it should never remain on the robot surface. Robot surface cannot contact with acid cleaner continuously for over 15 minute.
3 The use of cleaner in above might be restricted by the law of the country or the region, and obtaining is difficult.

7.5 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.

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. Note that "Quick Mastering for Single Axis" is not supported in software version 7DC2 (V8.20P) or earlier.

Table 8.1 (a) Type of mastering

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

Once mastering is performed, you must carry out positioning (calibration). Positioning is an operation in which the controller reads the 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 accurate mastering (fixture position mastering), contact your local FANUC representative.

⚠ CAUTION

1 If mastering is performed incorrectly, the robot may behave unexpectedly. This is very dangerous. For this reason, the Master/Cal screen is designed to appear only when the $MASTER_ENB system variable is 1 or 2. After performing positioning, press F5, ([DONE]) on the Master/Cal screen. The $MASTER_ENB system variable is then reset to 0 automatically, and the Master/Cal screen will disappear.
2 Before performing mastering, it is recommended that you back up the current mastering data.
3 When the motion range is mechanically 360 degrees or more, if any of the axes (J1-axis and J4-axis) to which the cables are connected is turned one turn beyond the correct mastering position when mastering occurs, the cables in the mechanical unit are may be damaged. If the correct rotation position is not clear because the axis is moved too much during mastering, remove the connector panel or cover, check the states of the internal cables, and perform mastering in the correct position. For the checking procedure, see Fig. 8.1 (a) and 8.1 (b).

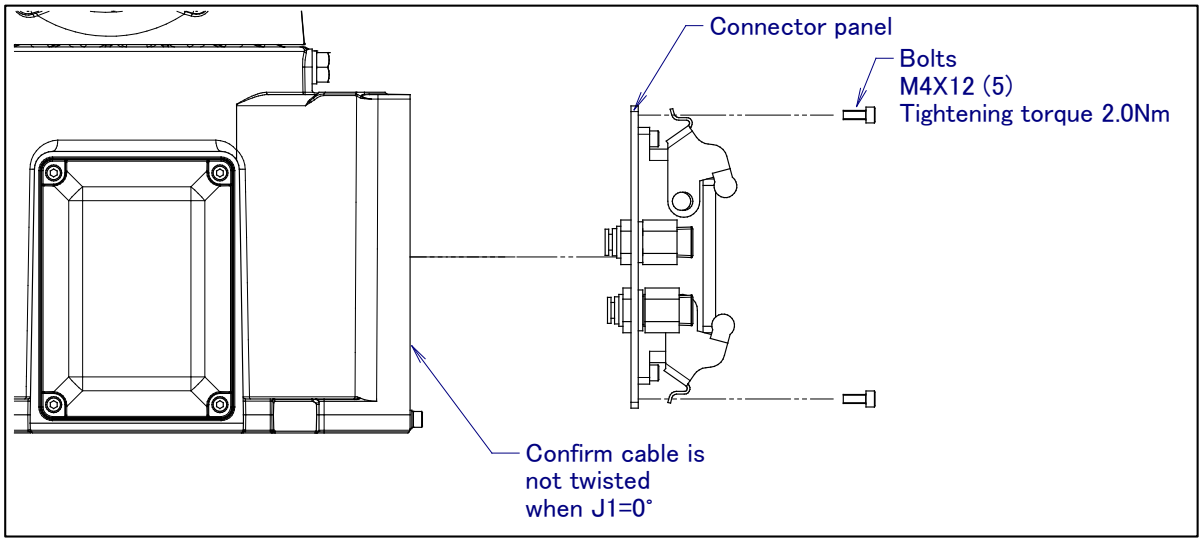


Fig. 8.1 (a) Confirming the state of cable (J1-axis)

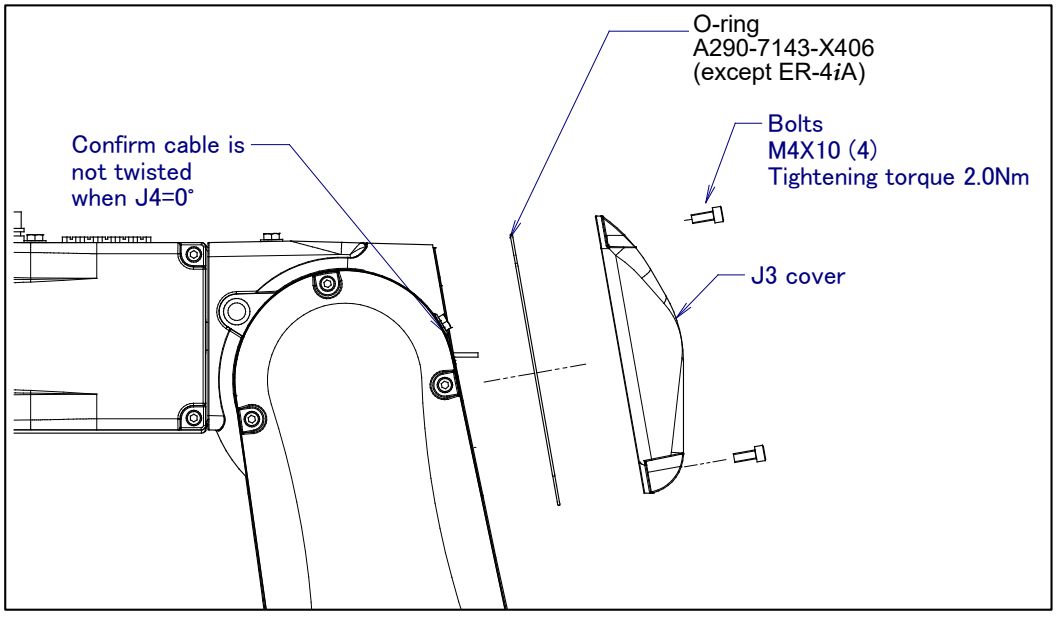


Fig. 8.1 (b) Confirming the state of cable (J4-axis) (except 4SH)

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].
4 Select [Master/Cal]. Master/Cal 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
```

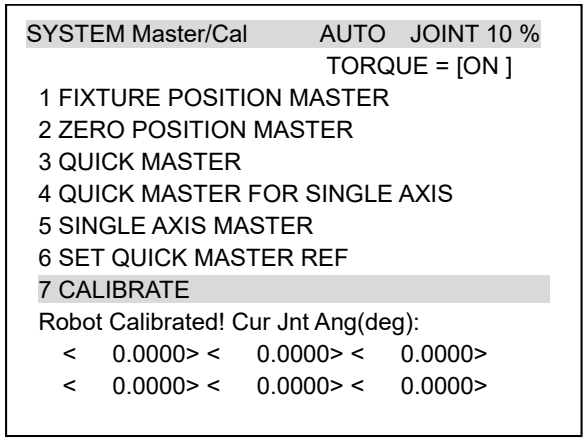
5 Release brake control, and jog the robot into a posture for mastering.

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

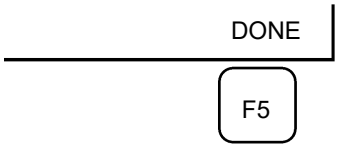
6 Select [2 ZERO POSITION MASTER]. Press F4 [YES].

```
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
```

7 Select [7 CALIBRATE] and press F4 [YES]. Mastering will be performed automatically. Alternatively, turn off the controller power and on again. Turning on the power always causes positioning to be performed.



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



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

Table 8.3 (a) Posture with position marks aligned

Axis	Position
J1-axis	0 deg
J2-axis	0 deg
J3-axis	0 deg (When J2-axis is 0 deg.)
J4-axis	0 deg (Note 1) 90 deg (When J3-axis is 0 deg.) (Note 2)
J5-axis	0 deg
J6-axis	0 deg

(Note 1) Except 4SH Downward wrist zero specification
(Note 2) 4SH Downward wrist zero specification

NOTE
There is no J6-axis for LR Mate 200*i*D/4SH.

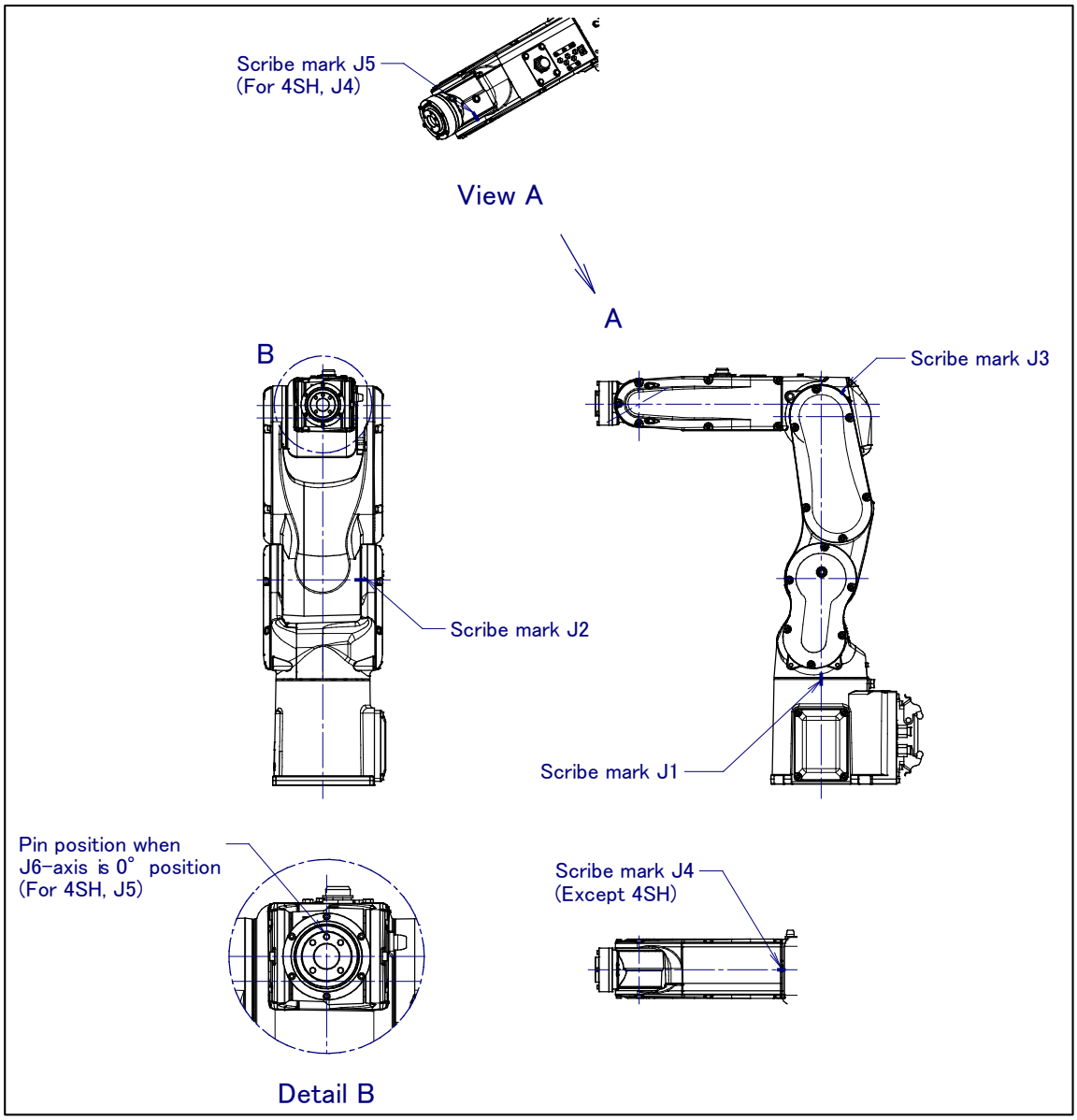


Fig. 8.3 (a) Marking position

8.4 QUICK MASTERING

Quick mastering is performed at a user-specified position. The pulse count value is obtained from the rotation speed 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.

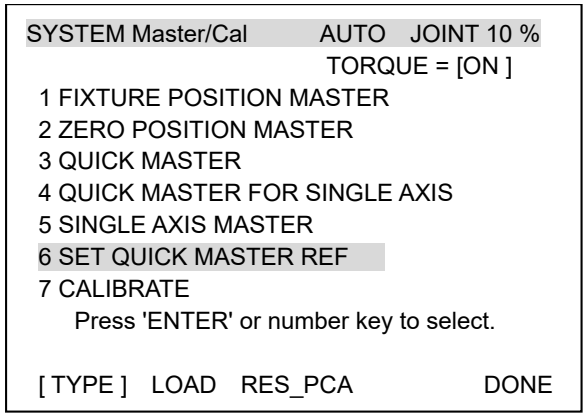
Quick mastering is factory-performed at the position indicated in Table 8.3 (a). Do not change the setting unless there is any problem.

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.)

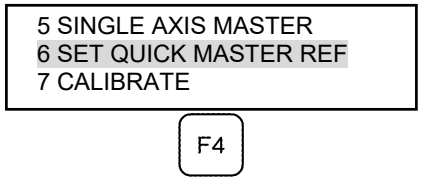
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

1 Select SYSTEM.
2 Select Master/Cal. Master/Cal screen will be displayed.



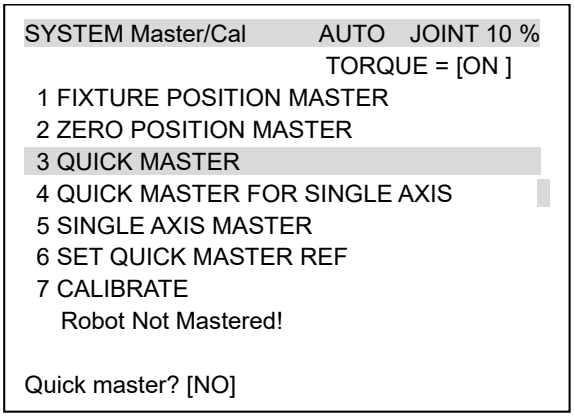
3 Release brake control, and jog the robot to the quick mastering reference position.
4 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position will be set.



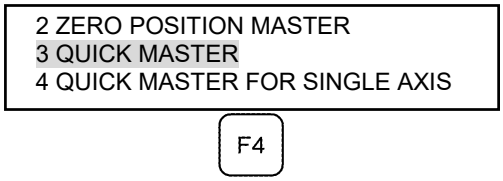
⚠ CAUTION
If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or Zero position mastering to restore mastering data.

Procedure of Quick Mastering

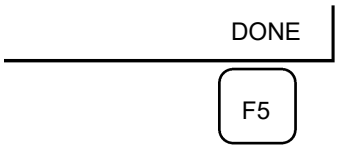
1 Display the Master/Cal screen.



2 Release brake control, and jog the robot to the quick mastering reference position.
3 Select [3 QUICK MASTER] and press F4 [YES]. Quick mastering reference position will be set.



4 Select [7 CALIBRATE] and press [ENTER] key. Calibration is executed. Calibration is executed by cycling power.
5 After completing the calibration, press F5 [Done].



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

8.5 QUICK MASTERING FOR SINGLE AXIS

Quick mastering 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 character that the absolute value of a rotation angle within one rotation will not be lost.

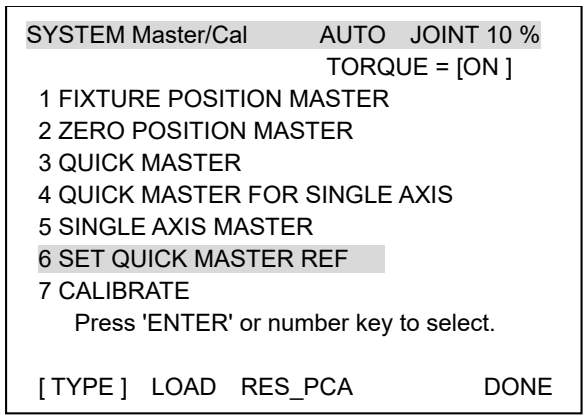
Quick mastering is factory-performed at the position indicated in Table 8.3 (a). Do not change the setting unless there is any problem.

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.)

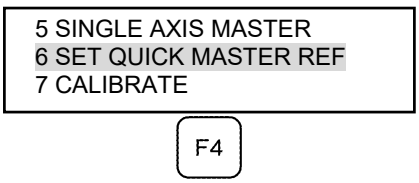
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

1 Select [6 SYSTEM].
2 Select [Master/Cal]. The positioning screen will be displayed.



3 Release brake control, and jog the robot to the quick mastering reference position.
4 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position will be set.



⚠ 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 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
   Robot Not Mastered!

Quick master? [NO]
```

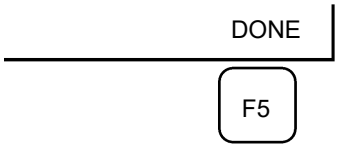
2 Select [4 QUICK MASTER FOR SINGLE AXIS]. The quick master for single axis screen will be displayed.

```
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
```

3 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.

```
SINGLE AXIS MASTER                AUTO   JOINT 10%
                                                1/9
    ACTUAL   POS    (MSTR POS)      (SEL)    [ST]
J5          0.000   (     0.000)    (0)      [2]
J6          0.000   (     0.000)    (0)      [0]

                                              EXEC
```

4 Turn off brake control, then jog the robot to the quick mastering reference position.
5 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2.
6 Select [7 CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration is executed by cycling power.
7 After completing the calibration, press F5 Done.



8 Return brake control to 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.

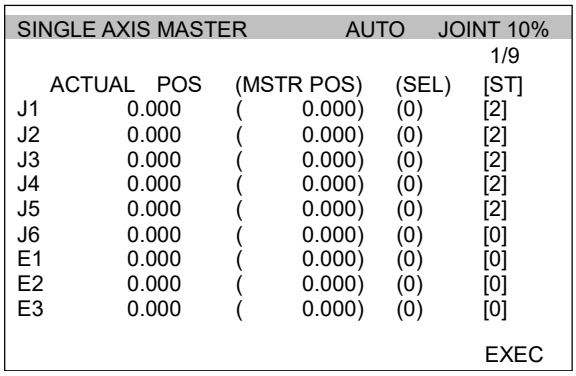


Table 8.6 (a) Items set in single axis mastering

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

Procedure of Single axis mastering

1 Select [6 SYSTEM].
2 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
```

3 Select [5 SINGLE AXIS MASTER]. You will see a screen similar to the following.

```
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
```

4 For the axis to which to perform single axis mastering, set (SEL) to “1.” Setting of [SEL] is available for one or more axes.
5 Turn off brake control, then jog the robot to the mastering position.
6 Enter axis data for the mastering position.
7 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2 or 1.

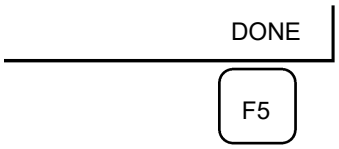
```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                            6/9
    ACTUAL   POS    (MSTR POS)    (SEL)   [ST]
J1          0.000   (     0.000)  (0)     [2]
J2          0.000   (     0.000)  (0)     [2]
J3          0.000   (     0.000)  (0)     [2]
J4          0.000   (     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
```

8 When single axis mastering is completed, press the [PREV] key to resume the previous 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
```

9 Select [7 CALIBRATE], then press F4 [YES]. Positioning is performed. Alternatively, turn off the controller power and on again. Positioning is performed.

10 After positioning is completed, press F5 [DONE].



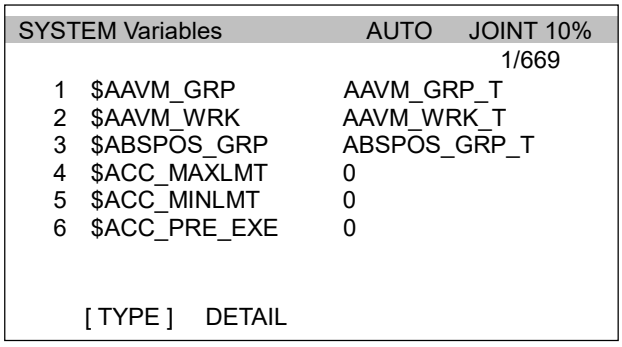
11 Return brake control to original setting, and cycle power of the controller.

8.7 MASTERING DATA ENTRY

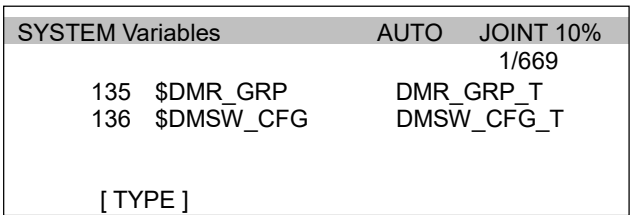
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

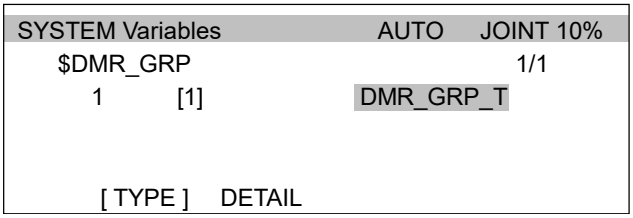
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen appears.

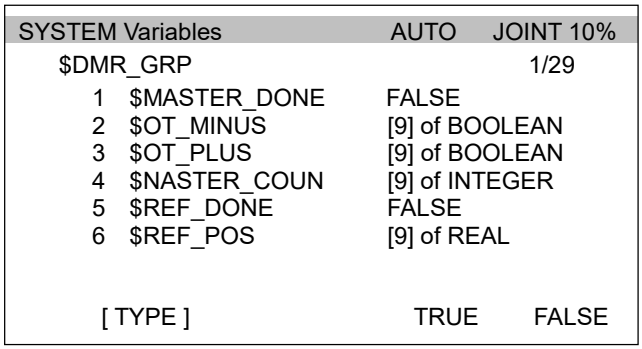


3 Change the mastering data. The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

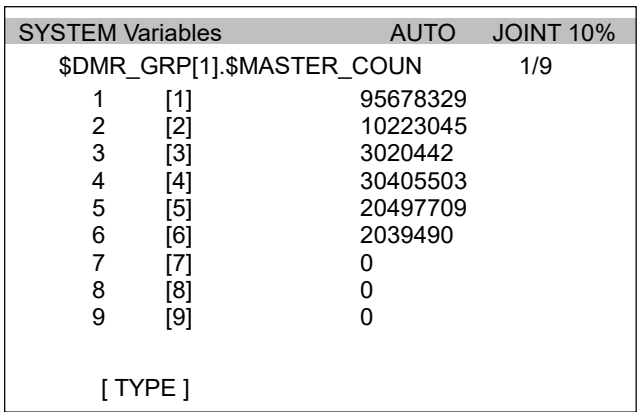


4 Select $DMR_GRP.

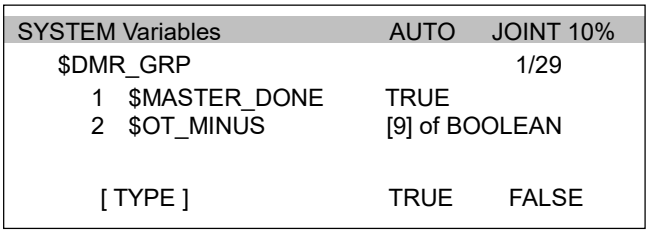




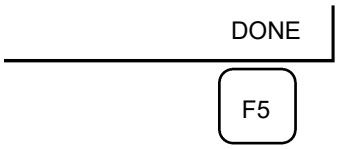
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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



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 problems 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. For troubleshooting except the mechanical unit, refer to "CONTROLLER MAINTENANCE MANUAL (B-83525EN etc.)" and Alarm Code List (B-83284EN-1).

Table 9.1 (a) TROUBLESHOOTING

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

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- Vibration or noise was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating or noise occurring axis has not been replaced for a long period. - Periodic vibration and noise occur.	[Gear, bearing, or reducer] - It is likely that the collision or overload applied an excessive force to the drive system, thus damaged the geartooth surface or rolling surface of a bearing, or reducer. - It is likely that prolonged use of the robot while overloaded caused fretting of the gear tooth surface or rolling surface of a bearing, or reducer due to resulting metal fatigue. - It is likely that contamination caught in a gear, bearing, or within a reducer caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that contamination caught in a gear, bearing, or within a reducer caused vibration. - It is likely that, because the grease has not been replaced for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue.	- Operate one axis at a time to determine which axis is vibrating. - Remove the motor, and replace the gear, the bearing, and the reducer. For the spec. of parts and the method of replacement, contact your local FANUC representative. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Supplying the specified grease at the recommended interval will prevent problems.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical section.	[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. - Pulse coder defect may be the cause of the vibration as the motor cannot propagate the accurate position. - If the motor becomes defective, vibration might occur because the motor cannot deliver its rated performance. - If a power line in a movable cable of the mechanical unit has an intermittent break, vibration might occur because the motor cannot accurately respond to commands. - If a Pulsecoder wire in a movable part of the mechanical unit has an intermittent break, vibration might occur because commands cannot be sent to the motor accurately. - If a connection cable between them has an intermittent break, vibration might occur. - If the power cable between them has an intermittent break, vibration might occur. - If the power source voltage drops below the rating, vibration might occur. - The robot may vibrate when the invalid value parameter was set. - If the noise occurs on a belt driving axis, damage of the belt may cause the noise.	- 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 FANUC representative. - Check that the robot is supplied with the rated voltage. - Check whether the power cord jacket is damaged. If so, replace the power cord, and check whether vibration still occurs. - Check whether the cable jacket connecting the mechanical unit and controller is damaged. If so, replace the connection cable, and check whether vibration still occurs. - If vibration occurs only when the robot assumes a specific posture, it is likely that the cable in the mechanical unit is broken. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct them. Contact your local FANUC representative for further information if necessary. - Contact your local FANUC representative if performing the belt check.
	- 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 may 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 leading to vibration.	- Connect the grounding wire firmly to ensure a reliable ground potential and prevent extraneous electrical noise.

Symptom	Description	Cause	Measure
Rattling	- While the robot is not supplied with power, pushing it with the hand causes part of the mechanical unit to wobble. - There is a gap on the mounting face of the mechanical unit.	[Mechanical section coupling bolt] - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical section.	- Check that the following bolts for each axis are tight. If any of these bolts is loose, apply LOCTITE and tighten it to the appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Base retaining bolt - Arm retaining bolt - Casting retaining bolt - End effector retaining bolt
Motor overheating	- The ambient temperature of the installation location increases, causing the motor to overheat. - After the robot control program or the load was changed, the motor overheated.	[Ambient temperature] - It is likely that a rise in the ambient temperature prevented the motor from releasing heat efficiently, thus leading to overheating. [Operating condition] - It is likely that the robot was operated with the maximum average current exceeded.	- Reducing the ambient temperature is the most effective means of preventing overheating. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and conditions can reduce the average current, thus preventing overheating. - The teach pendant can be used to monitor the average current. Check the average current when the robot control program is running.
	- After a control parameter (load setting etc.) was changed, the motor overheated.	[Parameter] - If data input for a workpiece is invalid, the robot cannot be accelerated or decelerated normally, so the average current increases, leading to overheating.	- As for load setting, Input an appropriate parameter referring to Section 4.3.
	- Symptom other than stated above	[Mechanical section problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - 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.	- Repair the mechanical unit while referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - If the average current falls after the motor is replaced, it indicates that the first motor was faulty.

Symptom	Description	Cause	Measure

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

Dropping axis	- An axis drops because the brake does not function. - An axis drops gradually when it should be at rest.	[Brake drive relay and motor] - It is likely that brake drive relay contacts are stuck to each other to keep the brake current flowing, thus preventing the brake from operating when the motor is deenergized. - It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently. - It is likely that oil or grease has entered the motor, causing the brake to slip.	- Check whether the brake drive relay contacts are stuck to each other. If they are found to be stuck, replace the relay. - If the brake shoe is worn out, if the brake main body is damaged, or if oil or grease has entered the motor, replace the motor.

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

Symptom	Description	Cause	Measure
CLALM alarm occurred. Move error excess alarm occurred.	- Ambient temperature of the robot installation location is low, CLALM alarm is displayed on the teach pendant screen. - Ambient temperature of the robot installation position is low, "Move error excess" alarm is displayed on the teach pendant screen.	[Peripheral temperature] - When the robot is used in a low temperature environment that is near to 0ºC, or the robot is not operated for a long time in an environment that is less than 0ºC, there will be a large viscous resistance of the drive train immediately after starting which will cause the alarm.	- Perform a warm up operation or a low speed operation for several minutes.
	- After changing the motion program or the load condition, the CLALM alarm is displayed. - After changing the motion program or the load condition, the "Move error excess" alarm is displayed.	- It is likely that a robot collision occurred.	- If a robot collision has occurred, press the [RESET] key while pressing the [SHIFT] key. Then, jog the robot in the opposite direction while pressing the [SHIFT] key. - Check the motion program.

		[Overload]
		- It is likely that load exceeded the permissible value.
		- It is likely that the motion program is too severe for the robot.
		  - Excessive motion due to a large acceleration.
		  - Tight motion such as reverse motion using "CNT".
		  - Linear motion occurs near singularity point where axes revolve in high speed.
			- Check the permissible value of the robot payload. If the load exceeds the permissible value, reduce the load or change the motion program.
			- Consider minimizing the cycle time by reducing the speed or acceleration, and changing the motion program.
			- Check that the load setting is performed correctly.

	- None of the symptoms stated above are the problem.	- It is likely the vibration occurred.	- Refer to the Symptoms: Vibration, Noise section of this troubleshooting for more information.
		- It is likely that rated voltage is not supplied due to the voltage drop.	- Check that the robot is supplied with the proper rated voltage.
BZAL alarm occurred.	- BZAL is displayed on the teach pendant screen.	- It is likely that the voltage of the memory backup battery is low. - It is likely that the Pulsecoder cable is defected.	- Replace the battery. - Replace the cable.

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot LR Mate 200*i*D/4S/4SH/ER-4*i*A **Periodic Maintenance Table**

Items			Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 years 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check the exposed connector (loosening)	0.2H	—		○			○				○			
	4	Tighten the end effector bolt	0.2H	—		○			○				○			
	5	Tighten the cover and main bolt	2.0H	—		○			○				○			
	6	Check the mechanical stopper	0.1H	—		○			○				○			
	7	Clean spatters, sawdust and dust	1.0H	—		○	○	○	○	○	○	○	○	○	○	○
	8	Check hand cable and external battery cable (option)	0.1H	—		○			○				○			
	9	Replacing battery. (if built-in batteries are specified) *5	0.1H	—					●				●			
	10	Greasing the reducers	0.5H	14ml (*1) 12ml (*2)												
	11	Replacing cable of mechanical unit	4.0H	—												
Controller	12	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○				○			
	13	Cleaning the controller ventilator system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	14	Replacing battery *3 *5	0.1H	—												

*1 LR Mate 200*i*D/4S, ER-4*i*A

*2 LR Mate 200*i*D/4SH

*3 Refer to the "REPLACING UNITS Chapter of "MAINTENANCE" in the following manuals.
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER Open Air MAINTENANCE MANUAL (B-83555EN)

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

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

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	Overhaul	1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○				○				○				○				○					3
○				○				○				○				○					4
○				○				○				○				○					5
○				○				○				○				○					6
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		7
○				○				○				○				○					8
●				●				●				●				●					9
				●																	10
				●																	11
○				○				○				○				○					12
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		13
				●																	14

FANUC Robot LR Mate 200*i*D/4SC **Periodic Maintenance Table**

Items			Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 years 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check the exposed connector.(loosening)	0.2H	—		○			○				○			
	4	Tighten the end effector bolt.	0.2H	—		○			○				○			
	5	Tighten the cover and main bolt.	2.0H	—		○			○				○			
	6	Check the mechanical stopper.	0.1H	—		○			○				○			
	7	Remove spatter and dust etc.	1.0H	—		○	○	○	○	○	○	○	○	○	○	○
	8	Check hand cable and external battery cable (option)	0.1H	—		○			○				○			
	9	Replacing battery. (if built-in batteries are specified) *3	0.1H	—					●				●			
	10	Greasing the reducers.	0.5H	6ml									●			
	11	Replacing cable of mechanical unit	4.0H	—												
Controller	12	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○				○			
	13	Cleaning the controller ventilator system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	14	Replacing battery *1 *3	0.1H	—												

*1 Refer to the “REPLACING UNITS Chapter of “MAINTENANCE” in the following manuals.
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER Open Air MAINTENANCE MANUAL (B-83555EN)

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

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

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	Overhaul	1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○				○				○				○				○					3
○				○				○				○				○					4
○				○				○				○				○					5
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○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		7
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○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		13
				●																	14

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.

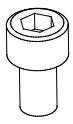
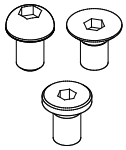
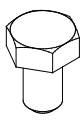
Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:

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

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

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

Recommended bolt tightening torques **Unit: Nm**

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

C OPTIONAL CONNECTOR WIRING PROCEDURE

Source of information: Hirose Electric Co., Ltd.
NOTE1) Corresponds to A05B-1137-J057.
NOTE2) Corresponds to A05B-1137-J058 and A05B-1139-J059.

Plug – Disassembly / Assembly

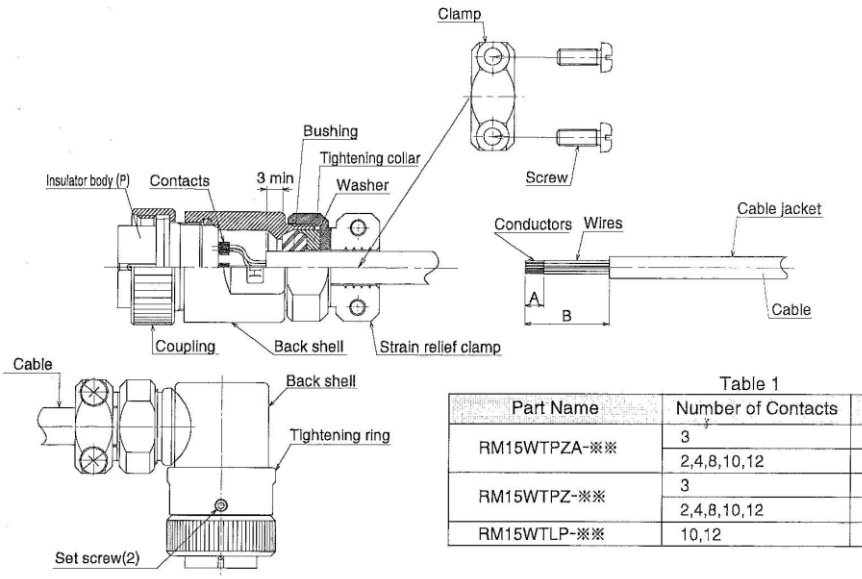


Table 1

Part Name	Number of Contacts	A	B	
RM15WTPZA-※※	3	6mm	21mm	
	2,4,8,10,12	3mm	21mm	
RM15WTPZ-※※	3	6mm	12mm	
	2,4,8,10,12	3mm	12mm	NOTE1
RM15WTLP-※※	10,12	3mm	25mm	NOTE2

1. Disassembly

① Fix the plug in the assembly fixture (RM15TP-T01 (CL150-0098-0)), then remove the insulator body (P) and the back shell. Right-angle plugs have set screws in the tightening ring at 2 locations. Loosen the set screws before removing the back shell.
② Remove the 2 screws of the strain relief clamp, and then remove the clamp from the tightening collar.

2. Wiring

① Assure that the cable outer diameter will fit the strain relief clamp, and is prepared as recommended in Table 1. It is recommended that the exposed conductors be pre-soldered, to assure easier insertion in the soldering cup.
② Pass the parts over the cable in the order of: tightening collar, washer, bushing, back shell, and coupling. Refer to the drawings (above) for assembly orientation of all components.
③ Solder the wires to the contacts of the insulator body (P).
Use of heat-shrink tubing or another insulating media between the soldered contacts is suggested.

3. Connector Assembly

Straight Plugs
① Place the completely wired insulator body (P) in the assembly fixture secured in a vise. Insert in the coupling, then back shell. The back shell should be tightened to a torque of 3 N·m.
Right-angle Plugs
① Place the completely wired insulator body (P) in an assembly fixture secured by a vise. Insert in the coupling, then back shell (with tightening ring). When attaching the back shell, orient the cable in the desired direction and fasten the tightening ring to the insulator body (P) with a torque of 3 N·m. After this, tighten and fix the 2 sets crews with a torque of 0.2 to 0.3 N·m.
Additional assembly recommendations:
In applications where continuous extremely high vibrations may be encountered it is recommended that a thread locking compound be applied to male threads prior to assembly (Loctite 271 , manufactured by Henkel Japan K.K. or equivalent)

4. Waterproof verification - plug assembly

Apply air pressure of 17.6 kPa for 30 seconds from the mating side of the plug assembly. There shall not be any air leakage from inside the connector when submerged in the water tank.

5. Precautions

① Follow the correct assembly sequence, cable preparation and tightening torques.
② Assure that the applicable cable outer surfaces are free of scratches, oil, grease or any other contamination.
③ Do not use excessive forces or improper tools when assembling or mounting the connectors.

ADDITIONAL INFORMATION

FANUC Robot LR Mate 200*i*D/4S/4SH/4SC, ER-4*i*A
MECHANICAL UNIT OPERATOR'S MANUAL
Correction of mistakes

1.Type of applied technical documents

Name	FANUC Robot LR Mate 200*i*D/4S/4SH/4SC, ER-4*i*A MECHANICAL UNIT OPERATOR'S MANUAL
Spec.No./Ed.	B-83574EN/06

2.Summary of Change

Group	Name/Outline	New, Add, Correct, Delete	Applicable Date
Basic			
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction	Correction of mistakes	Correction	Immediately
Another			

We corrected the Table 5.3 (a).

Table 5.3 (a) Supported connector (user side)

Maker	Manufacturer specification	Remarks
Hirose Electric Co. Ltd.	Plug: RM15WTPZ-12P(76) Clamp: JR13WCC-*(72)	Straight type connector (12 pins) * indicates an applicable cable diameter selected from the following: * : ϕ5, 6, 7, 8, 9, 10mm For A05B-1143-H301, H321 (EE12P)
	Plug: RM15WTLP-12P(33) Clamp: JR13WCC-*(72)	Elbow type connector (12 pins) * indicates an applicable cable diameter selected from the following: * : ϕ5, 6, 7, 8, 9, 10mm For A05B-1143-H301, H321 (EE12P)
	Plug: RM15WTLP-20P (31) Clamp: JR13WCC-*(72)	Elbow type connector (20 pins) * indicates an applicable cable diameter selected from the following: * : ϕ5, 6, 7, 8, 9, 10mm For A05B-1143-H302, H322 (EE20P)

Correction

Correction

【Version history】

Ed	Date	Description
01	2021/12/7	The first edition registration

INDEX

REVISION RECORD

Edition	Date	Contents
06	July, 2021	• Correction of errors
05	June, 2019	• Addition of ER-4*i*A • Change grease for 4SC • Correction of errors
04	Dec., 2017	• Addition of 4SC washing method • Addition of R-30*i*B Mate Plus Controller • Correction of errors
03	Feb., 2016	• Addition of quick master for single axis • Correction of errors
02	Dec., 2013	• Addition of LR Mate 200*i*D/4SH/4SC • Correction of errors
01	May, 2013	

B-83574EN/06

B-83574EN/06.01