FANUC Robot SR-3*i*A/U

MECHANICAL UNIT
OPERATOR'S MANUAL

B-84424EN/01

- **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

	Operator	Programmer or Teaching operator	Maintenance technician
Teaching with teach pendant		○	○
Emergency stop with operator's panel	○	○	○
Emergency stop with teach pendant	○	○	○
Operator's panel maintenance			○
Teach pendant maintenance			○

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

For emergency or abnormal situations (e.g. persons trapped in or pinched by the robot), turn off the robot controller immediately, change robot posture by directly pressing robot arm and release the worker. In case of J3-axis, to release the brake, press the brake release button as shown in Figure during turning on the controller power. If J3-axis brake cannot be released even if turning on controller power, open the cover, loosen the J3 unit mounting bolts, and release engagement between the belt and the pulley.

⚠ WARNING
If the belt was released from pulley, J3-axis will fall and may cause injury of the personnel. Therefore, it is strongly recommended to take adequate measures such as supporting the J3-axis by a block etc. before releasing a brake.

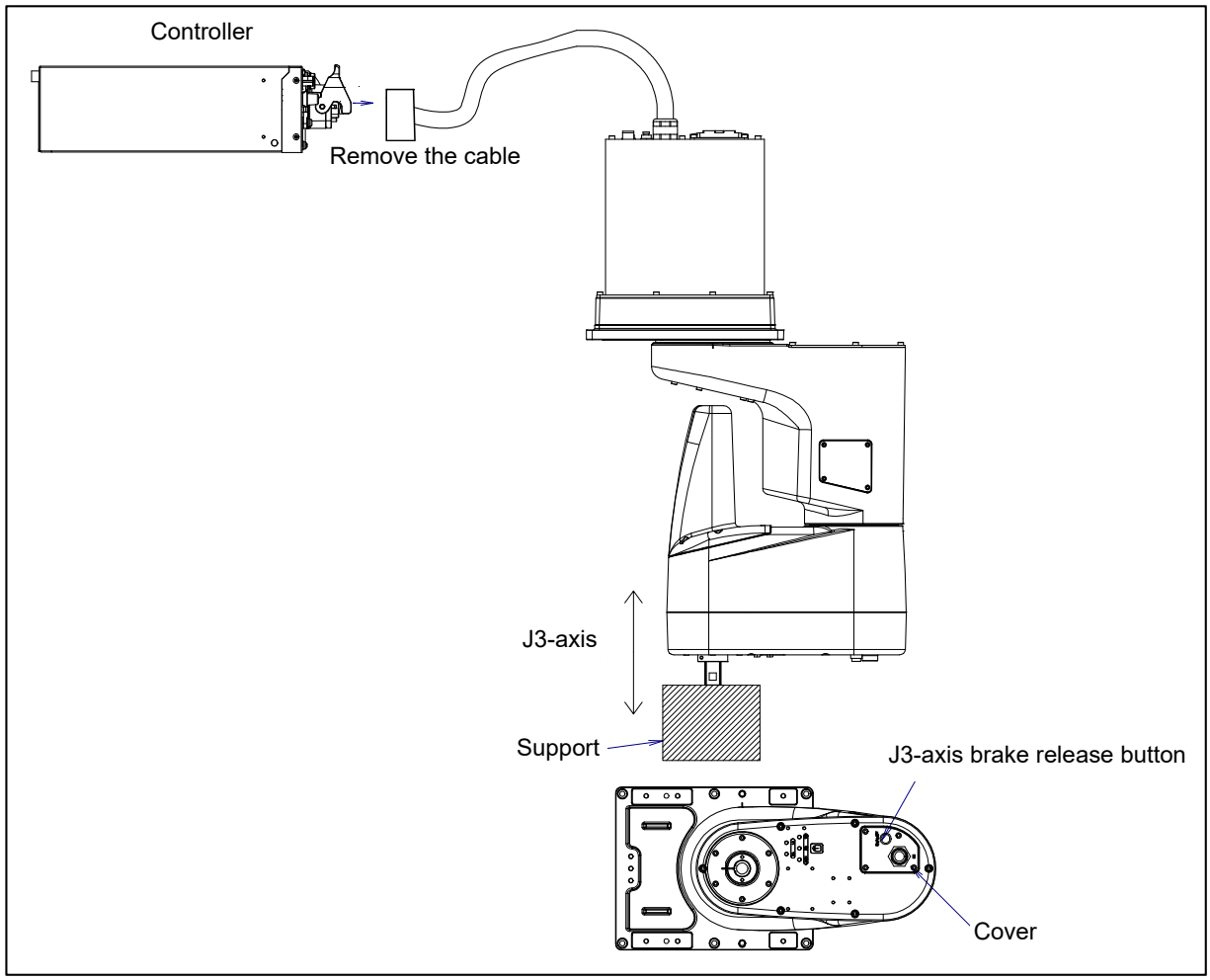


Fig. 3 (a) J3-axis brake release button

NOTE
Contact your local FANUC representative for method of adjusting belt tension when restoring.

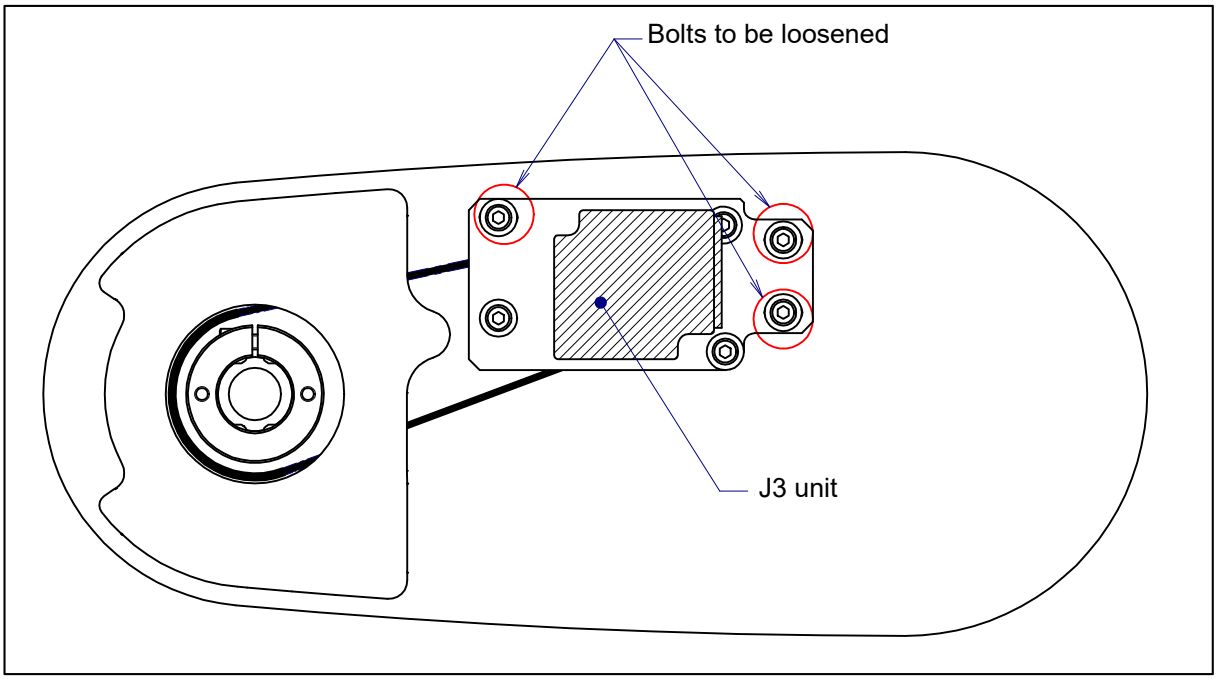


Fig. 3 (b) Bolt position to be loosened

4 PRECAUTIONS FOR MECHANISMS

NOTE
1 Never move J1 or J2 by applying pressure to the ball-screw spline.
2 Please do not wipe out the grease on the ball screw spline.

5 BEHAVIOR OF MOTION AT SINGULARITIES

In SR-3*i*A/U, the posture where the center of rotation of the J1 axis and the center of rotation of the J4 axis overlap is the singular point (singular posture).
The singular point is the boundary of the configuration (LEFT / RIGHT) that represents the left or right of the arm.
The behavior at and near the singular point is as follows.

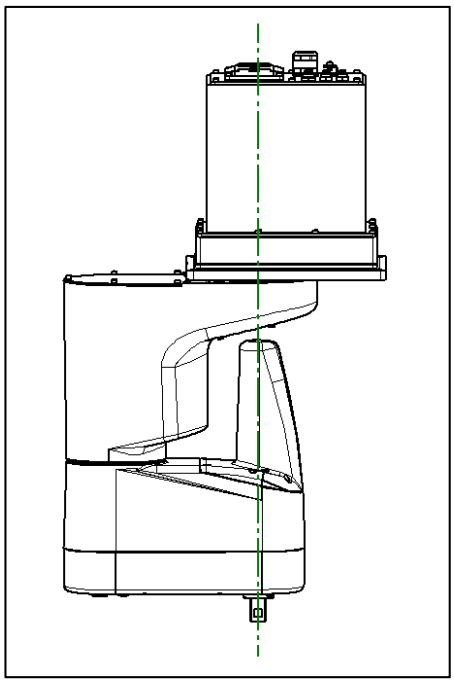


Fig. 5 (a) Posture at the singularity

Motion to singular point

If the taught position is a singular point, or if the robot's current position is a singular point, the robot cannot execute the motion except for Joint motion or Joint jog feed.

Motion that passes near the singular point

Even if the taught position is not a singular point, J1-axis may rotate at high speed if the motion passes near the singular point in the middle of the motion (except for Joint motion).
In T1/T2/AUTO mode, to prevent such behavior, the “SRVO-114 Singularity Detected” alarm or the “MOTN-018 Position not reachable (G:xx)” alarm will be posted when attempting to execute a motion that passes through an area within 5 mm of the singular point. No alarm is generated for movements exceeding 5 mm from the singularity, but the closer the trajectory is to the singularity, the more the movement may vibrate or the elbow of the arm may rotate at high speed.

Singularity avoidance function

When the singularity avoidance function is enabled, a Linear motion that passes near the singular point is automatically executed as Joint motion. In this case, the Linear motion that passes near the singular point can be executed. However, in case of tracking motion, singularity avoidance function is not available.
When using the tracking motion, set the robot and the conveyor position so that the robot does not pass the singular point.
For details on general settings and functions related to the singularity avoidance function, please refer to the Optional Function OPERATOR'S MANUAL (B-83284EN-2).

6 WARNING & CAUTION LABEL

(1) Operating space and payload label

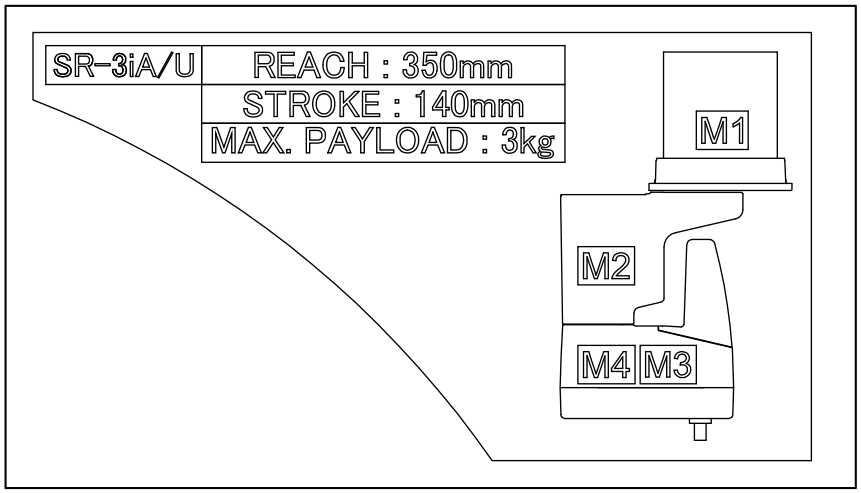


Fig. 6 (a) Operating space and payload label

(2) Grease caution label

Fig. 6 (b) Caution label

Description

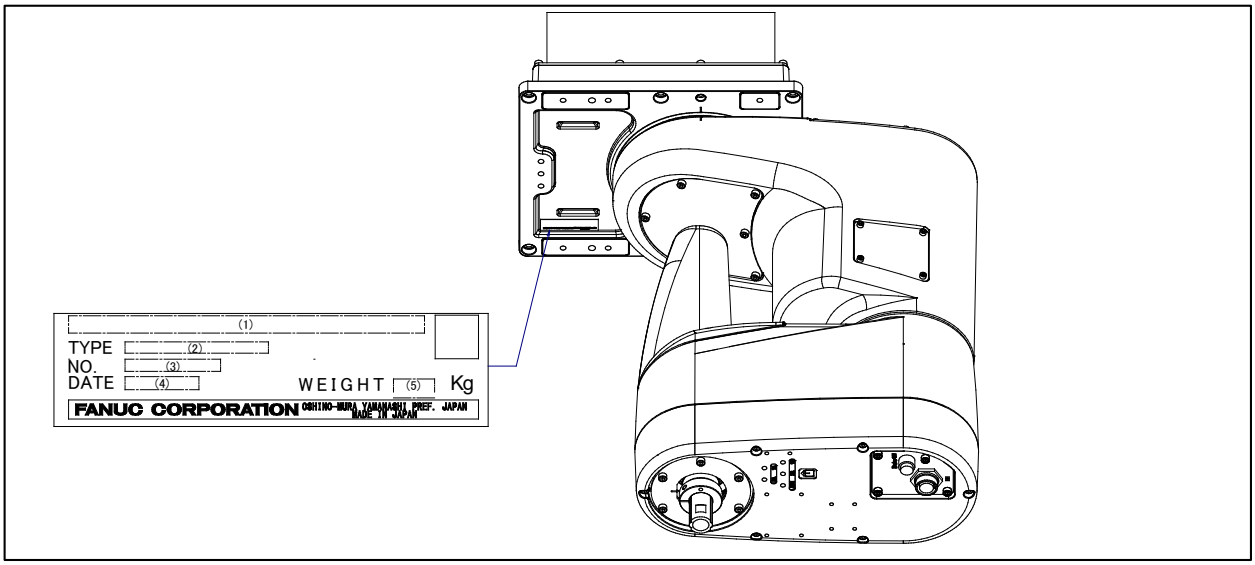
Do not wipe out the grease applied to the ball screw spline.

PREFACE

This manual explains operation procedures for the following mechanical units:

Model name	Mechanical unit specification No.	Maximum load
FANUC Robot SR-3*i*A/U	A05B-1541-B201	3kg

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



Position of label indicating mechanical unit specification number

TABLE 1）

	(1)	(2)	(3)	(4)	(5)
CONTENTS	**Model name**	**TYPE**	**No.**	**DATE**	**WEIGHT kg (Without controller)**
LETTERS	FANUC Robot SR-3*i*A/U	A05B-1541-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	27

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 Compact 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 **B-84035EN**	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

When transporting the robot, sure to change the posture of the robot to that shown below. Lay down the robot and perform works by two or more people.

> **⚠ CAUTION**
> 1 Do not move the robot the posture as shown in the following figure. Grease may drop.
> 2 Do not support the robot by holding the resin cover or the spline shaft for ball screw. It may cause failure.

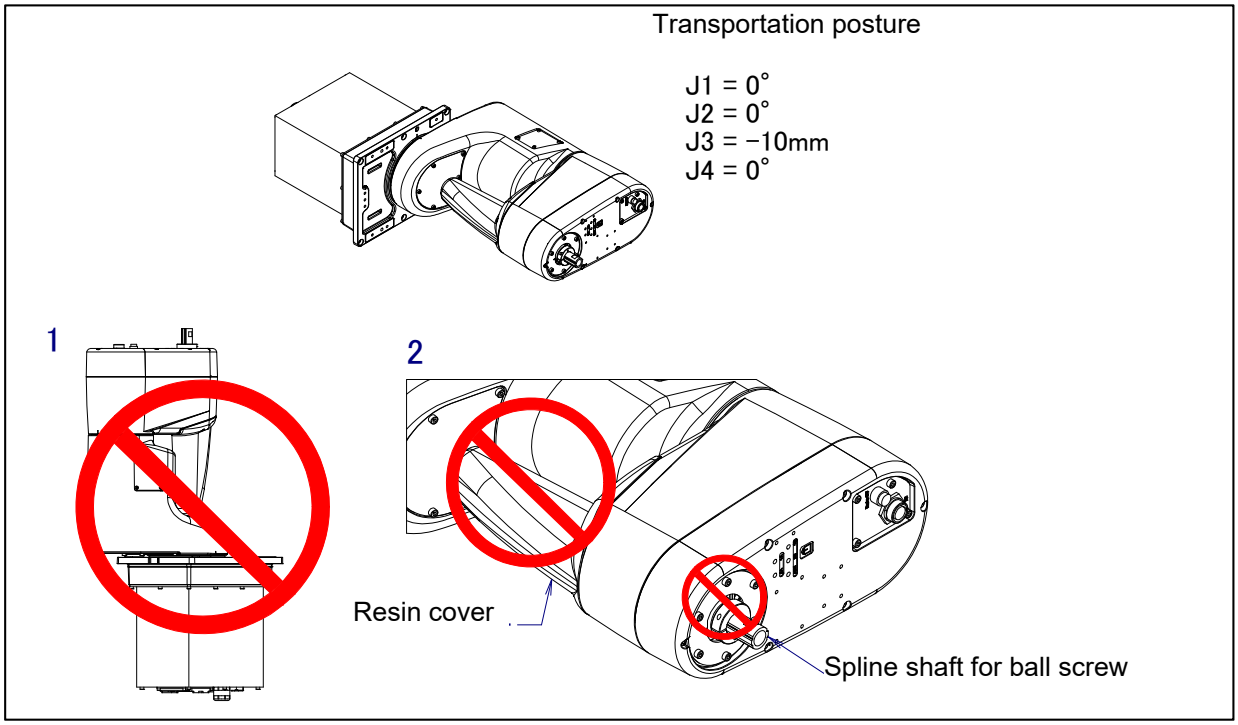


Fig.1.1 (a) Status for transportation

Unpack and install the robot by 3 or more people. Fig. 1.1 (b) shows the installation method.

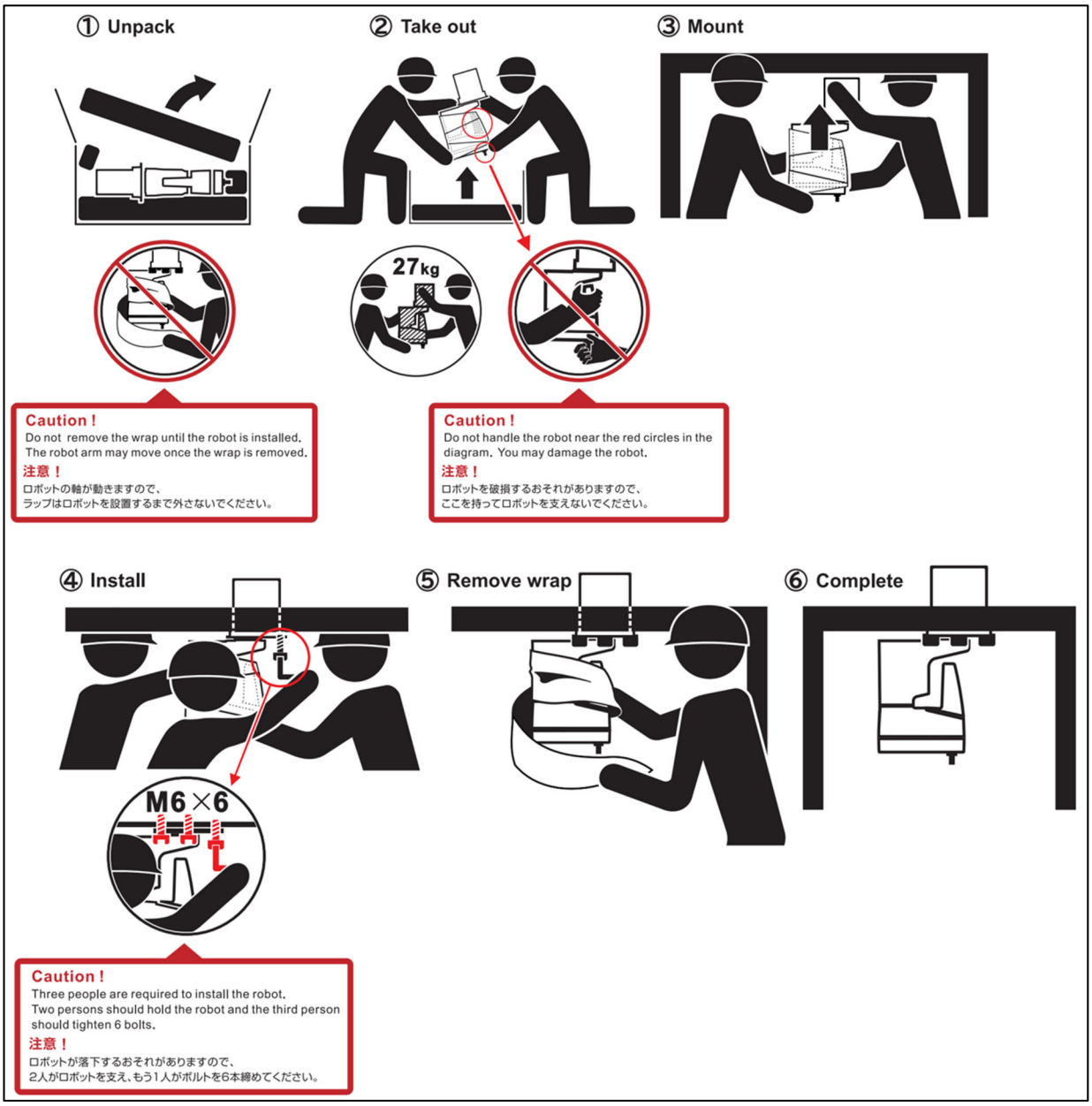


Fig. 1.1 (b) Installing method

1.2 INSTALLATION

Fig. 1.2 (a) shows the robot base dimensions.

> **⚠ 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.

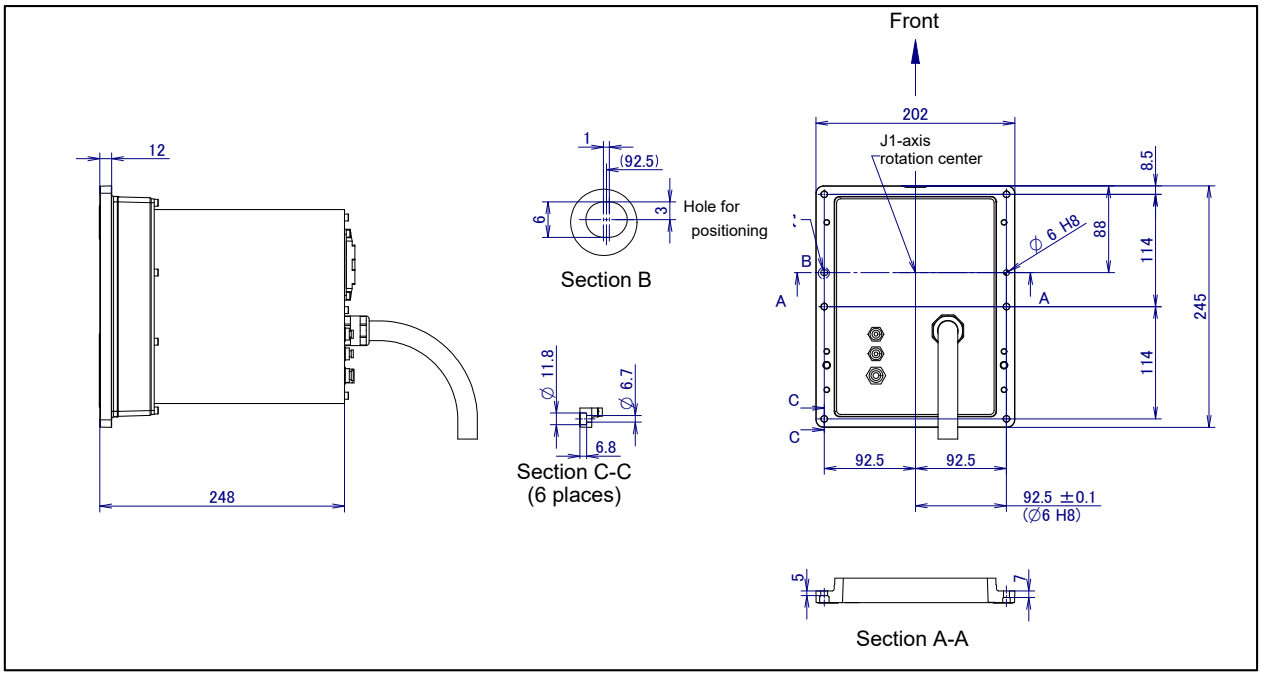


Fig. 1.2 (a) Dimensions of the robot base

1.2.1 Actual Installation Example

Fig. 1.2.1 (a) show three actual examples of the robot installation. Fasten the robot base with four M6 x 15 (Tensile strength 1200N/mm^2 or more) with regulated torque 12Nm. If compatibility must be maintained in teaching the robot after the robot mechanical unit is replaced, use the locating surface.

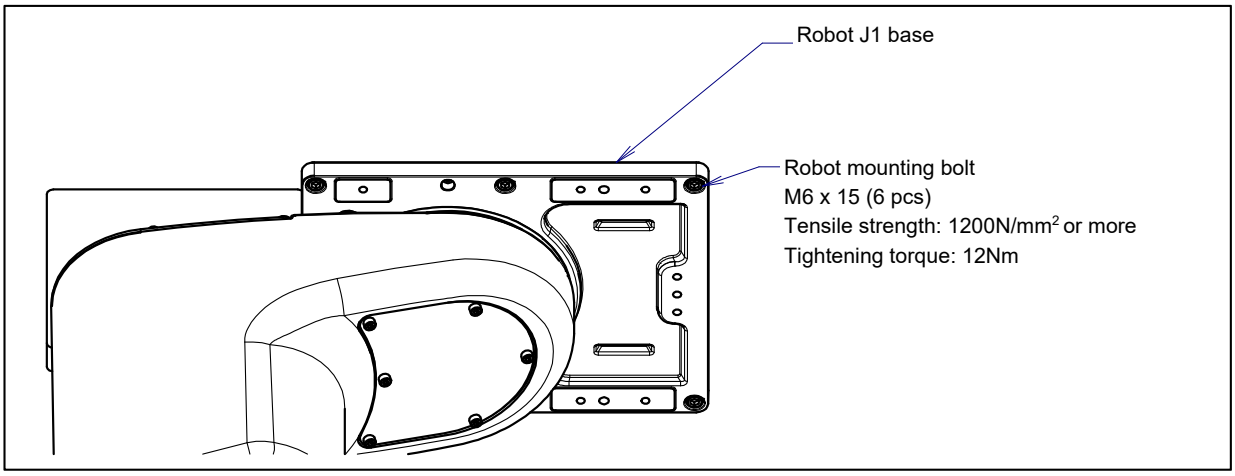


Fig. 1.2.1 (a) Actual Installation Example

Fig. 1.2.1 (b) shows example of design dimension of pedestal. Fig 1.2.1 (c) shows the caution for designing the pedestal.

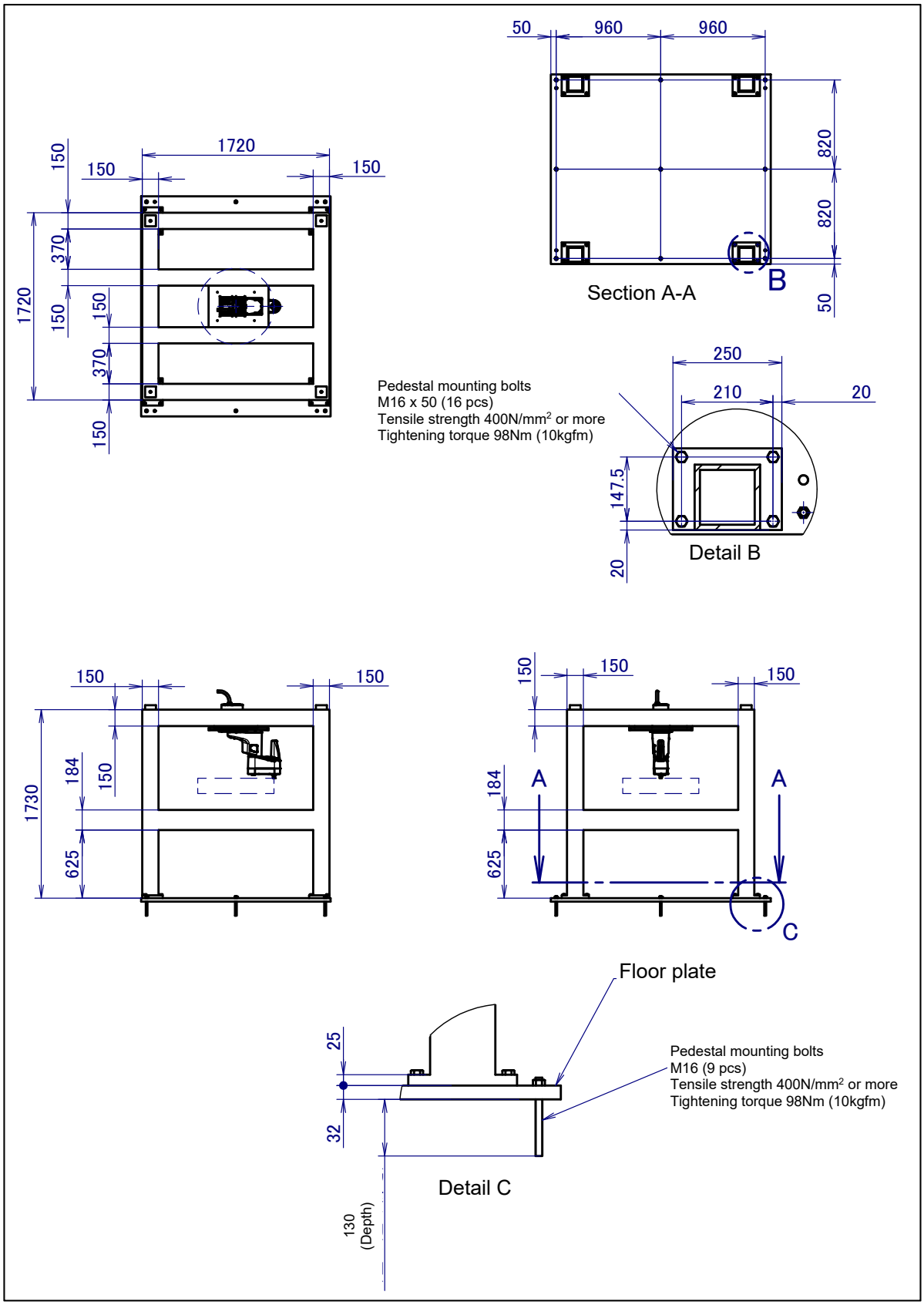


Fig. 1.2.1 (b) Example of design dimension of pedestal

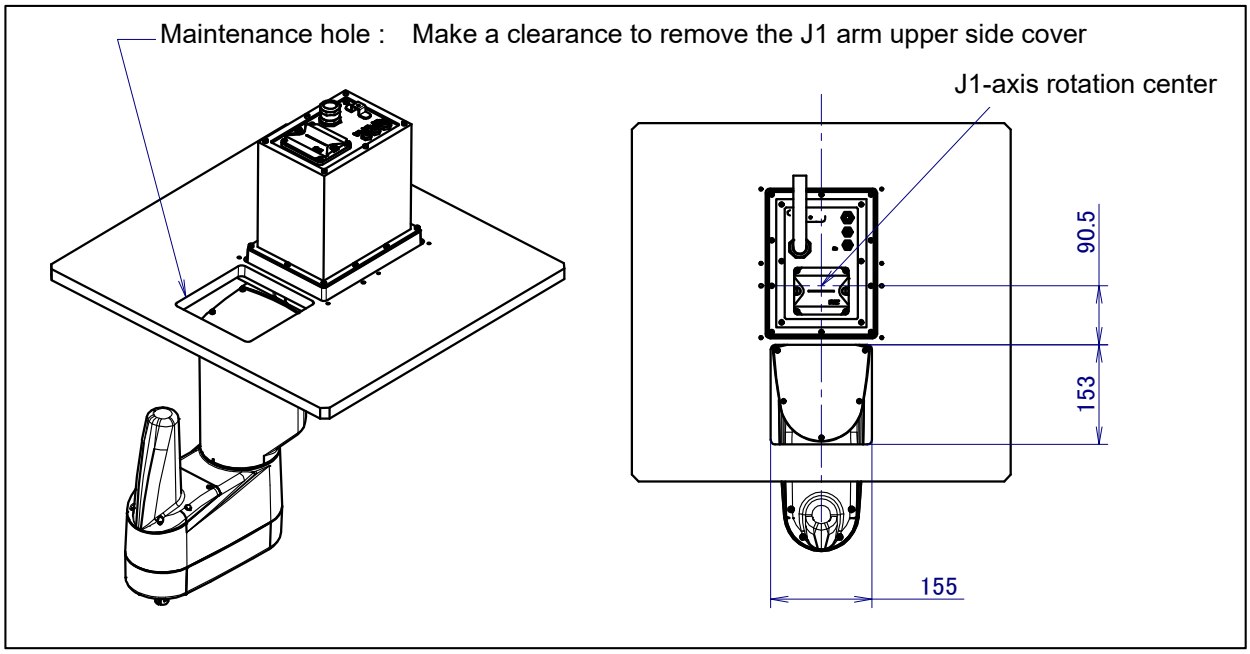


Fig. 1.2.1 (c) Caution for pedestal design

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

NOTE

Stopping times and distances in Table 1.2.1 (b) and (c) are reference values measured in accordance with ISO 10218-1. Please measure and check the actual values, since it varies depending on robot individual, load condition and operation program. Stopping times and distances in Table 1.2.1 (b) are affected by the robot's operating status and the number of servo-off stops. Please measure and check the actual values periodically.

Table 1.2.1 (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	39.4	294.0	0	0
During acceleration or deceleration	211.9	323.8	205.3	664.5
During Power-Off stop	335.7	394.6	217.6	1019.4

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

		J1	J2	J3
SR-3*i*A/U	Stopping time [ms]	151	85	66
	Stopping angle [deg] (rad) (J1, J2-axis) Stopping distance [mm] (J3-axis)	52.6 (0.92)	36.7 (0.64)	47.9

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

		J1	J2	J3
SR-3*i*A/U	Stopping time [ms]	154	122	120
	Stopping angle [deg] (rad) (J1, J2-axis) Stopping distance [mm] (J3-axis)	53.5 (0.93)	59.9 (1.05)	64.9

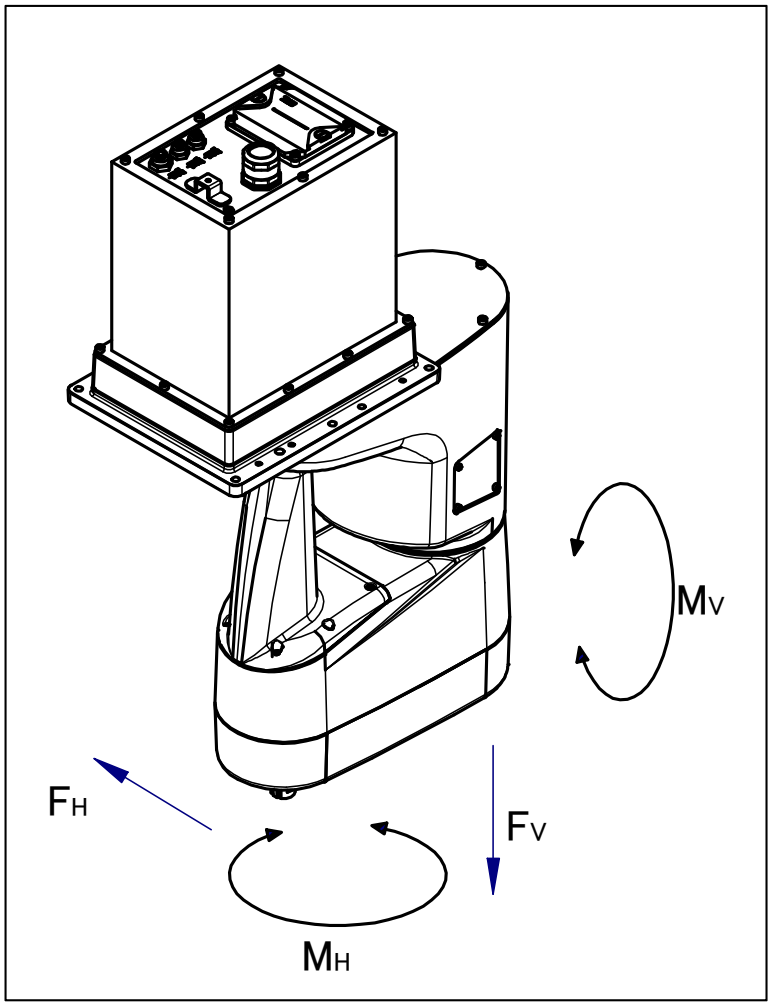


Fig. 1.2.1 (d) Force and moment that acts on J1 base

1.3 MAINTENANCE AREA

Fig.1.3 (a) shows the maintenance area of the mechanical unit. If maintenance space is no secured, maintenance work may not be possible. Please consider installation layout of equipment. See Chapter 8 for the mastering.

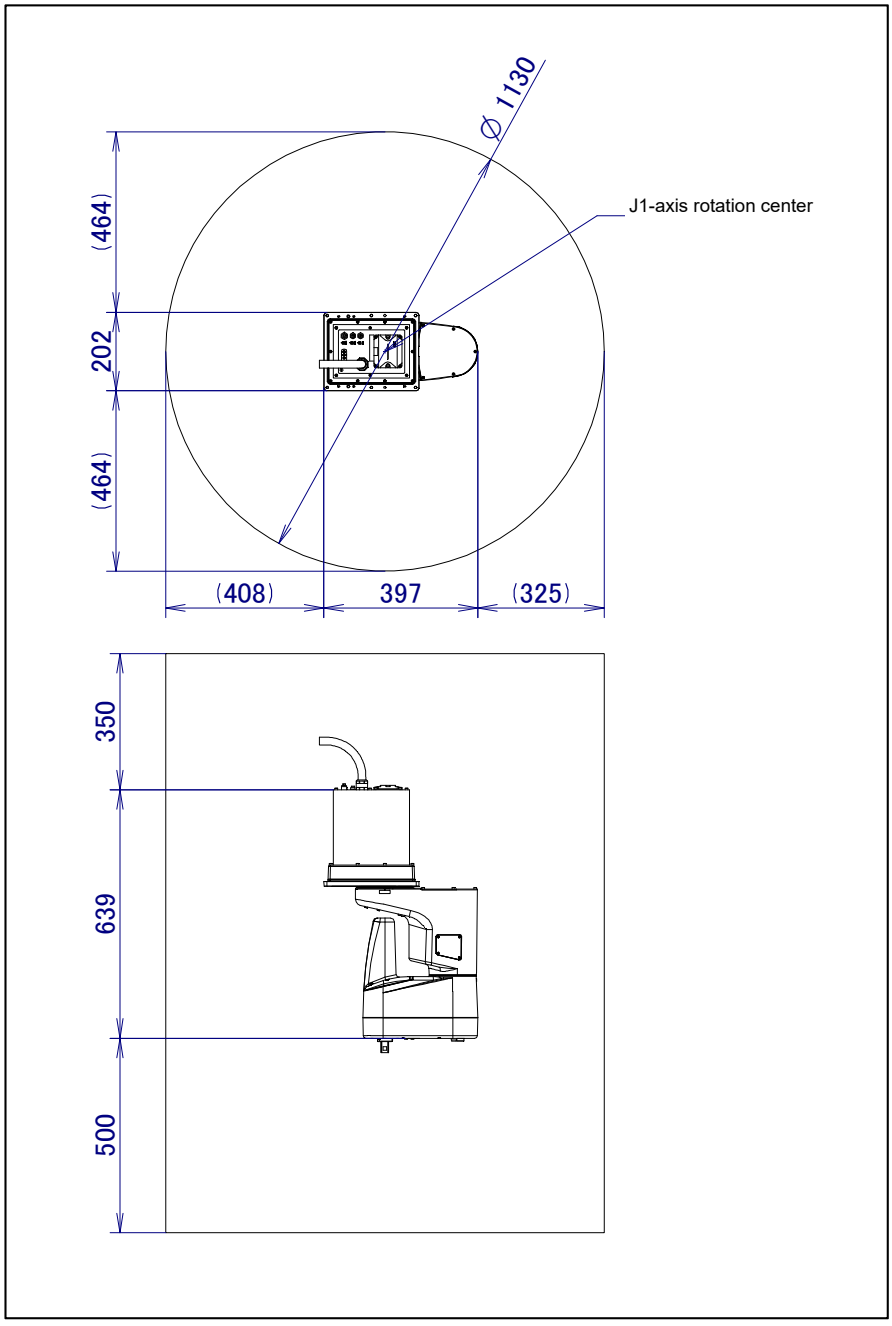


Fig. 1.3 (a) Maintenance area

1.4 INSTALLATION CONDITIONS

Refer to the specifications found in Section 3.1.

2 CONNECTION WITH THE CONTROLLER

The robot is connected with the controller via the power cable and signal cable. Connect each cables to the controller 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 will heat up and become damaged.

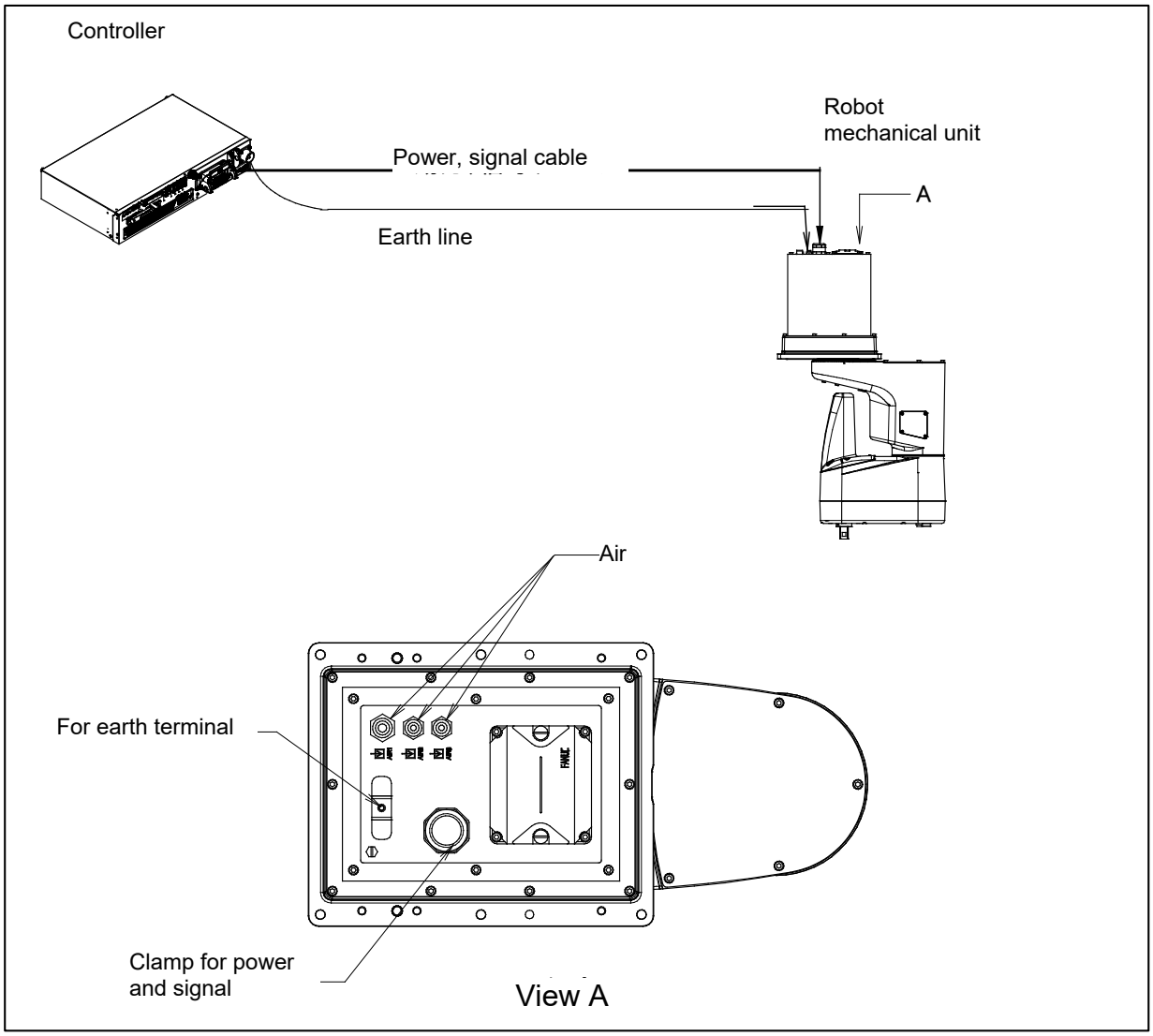


Fig. 2 (a) Cable connection

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

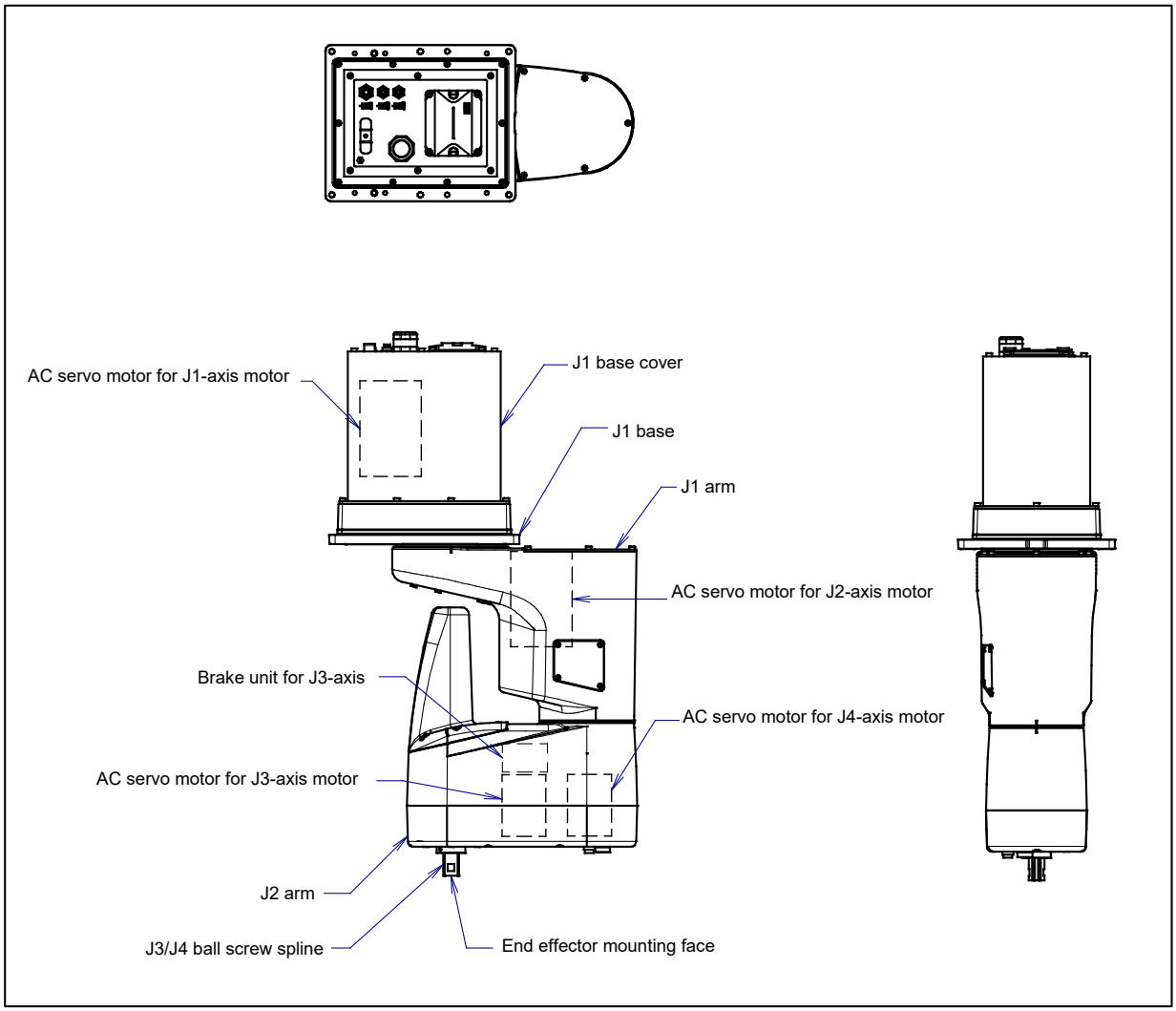


Fig. 3.1 (a) Mechanical unit configuration

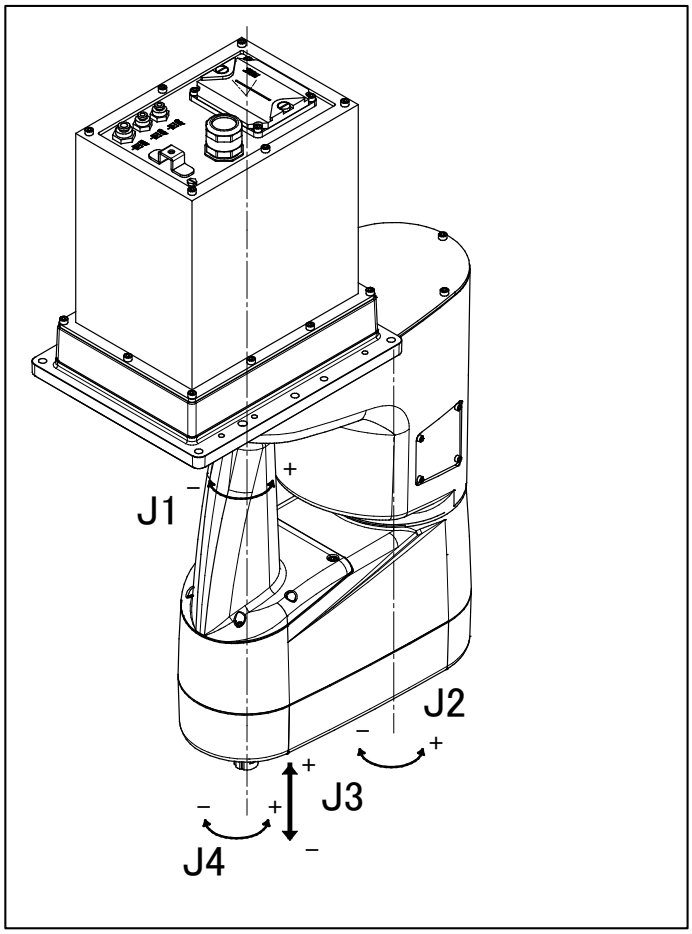


Fig. 3.1 (b) Each axis coordinates

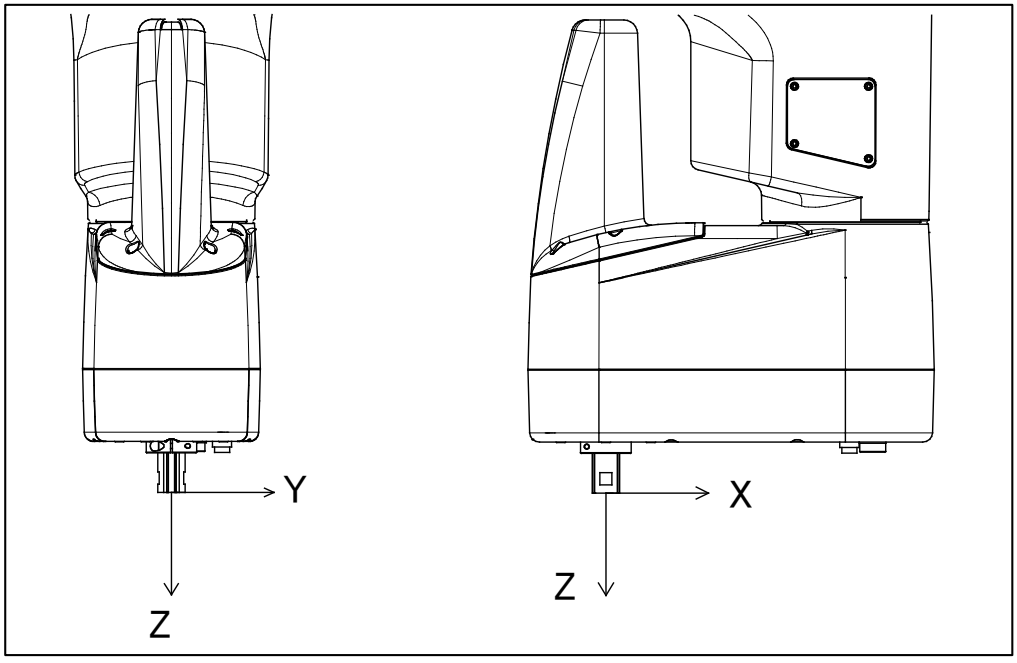


Fig. 3.1 (c) Mechanical interface coordinates

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

Specifications (NOTE 1)

		SR-3*i*A/U
Type		Scara type
Controlled axis		4-axis (J1, J2, J3, J4)
Installation		Ceiling
Motion range (Maximum speed) (NOTE 2)	J1	±225° (610°/s) ±3.93 rad (10.65rad/s)
	J2	±225° (840°/s) ±3.93 rad (14.66rad/s)
	J3	140mm (1500mm/s)
	J4	±720° (3000°/s) ±12.57 rad (52.36rad/s) Continuous rotation is available. (NOTE 3)
Max. load capacity at wrist		3kg
Allowable inertia At wrist	J4-axis	0.06 kg m^2
Repeatability	J1+J2-axis	±0.01mm
	J3-axis	±0.01mm
	J4-axis	±0.004deg
Cables and air for user	Standard	RI x 4/RO x 4, ϕ 6mm x 1,ϕ 4mm x 2
	Option	RI x 4, ϕ 6mm x 1 ,Solenoid valve x 2
Drive method		Electric servo drive by AC servo motor
Mass		27kg
Dust proof and drip proof mechanism		Conform to IP20
Acoustic noise level		70dB or less (NOTE 4)
Installation environment		Ambient temperature: 0 to 45°C (NOTE 5) Ambient humidity: Normally 75%RH or less. (No condensation allowed.) Short time (within one month) Max 95%RH (No condensation allowed.) Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 6)

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 for further evaluation before running production.
2 During short distance motions, the axis speed may not reach the maximum value stated.
3 This is an option. Refer to Section 6.2.
4 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

5 When robot is used in low temperature environment that is near to 0ºC, or robot is not operated for a long time in the environment that is less than 0ºC in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO-050) etc. In this case, we recommend performing the warm up operation for several minutes.
6 Contact the service representative, if the robot is to be used in an environment or a place subjected to severe vibrations, heavy dust, cutting oil splash and or other contaminations.

3.1.1 Tool flange option

A tool flange (A05B-1116-K113) is prepared as an option for installation to the wrist.

- Mass of the tool flange is 0.16kg.
- Refer to Section 3.2 and 4.2 for the operating space and the equipment mounting surface when installing the tool flange.
- Refer to Section 4.3 for load information of the tool flange.
- The wrist load condition (Section 3.4) is same without the flange.

3.2 MECHANICAL UNIT OPERATING SPACE AND INTERFERENCE AREA

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

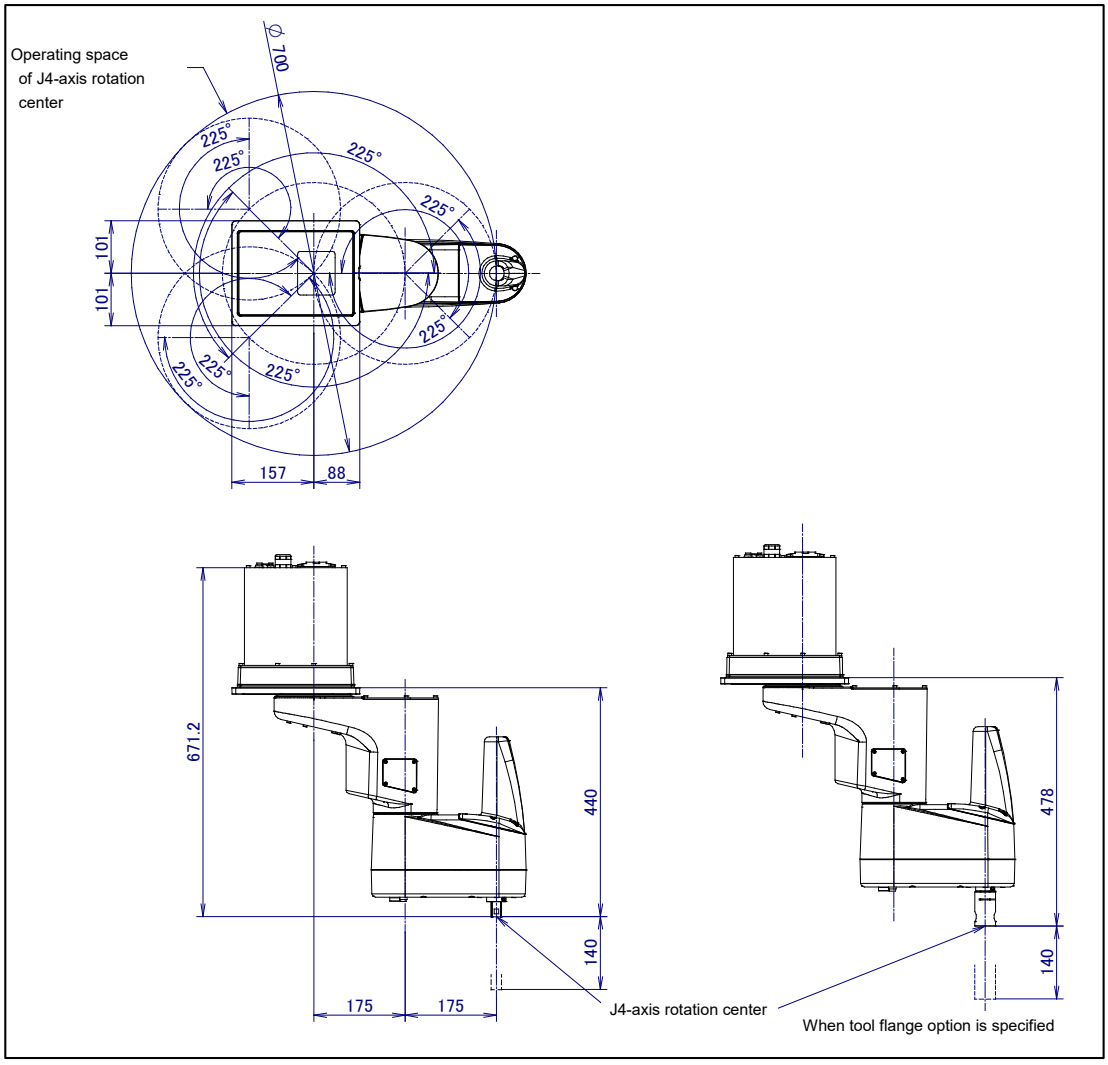


Fig. 3.2 (a) Operating space

3.3 ZERO POINT POSITION AND MOTION LIMIT

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

Fig. 3.3 (a) shows the position of the mechanical stopper. Don't reconstruct the mechanical stopper. If you do, there is a possibility that the robot will not stop normally.

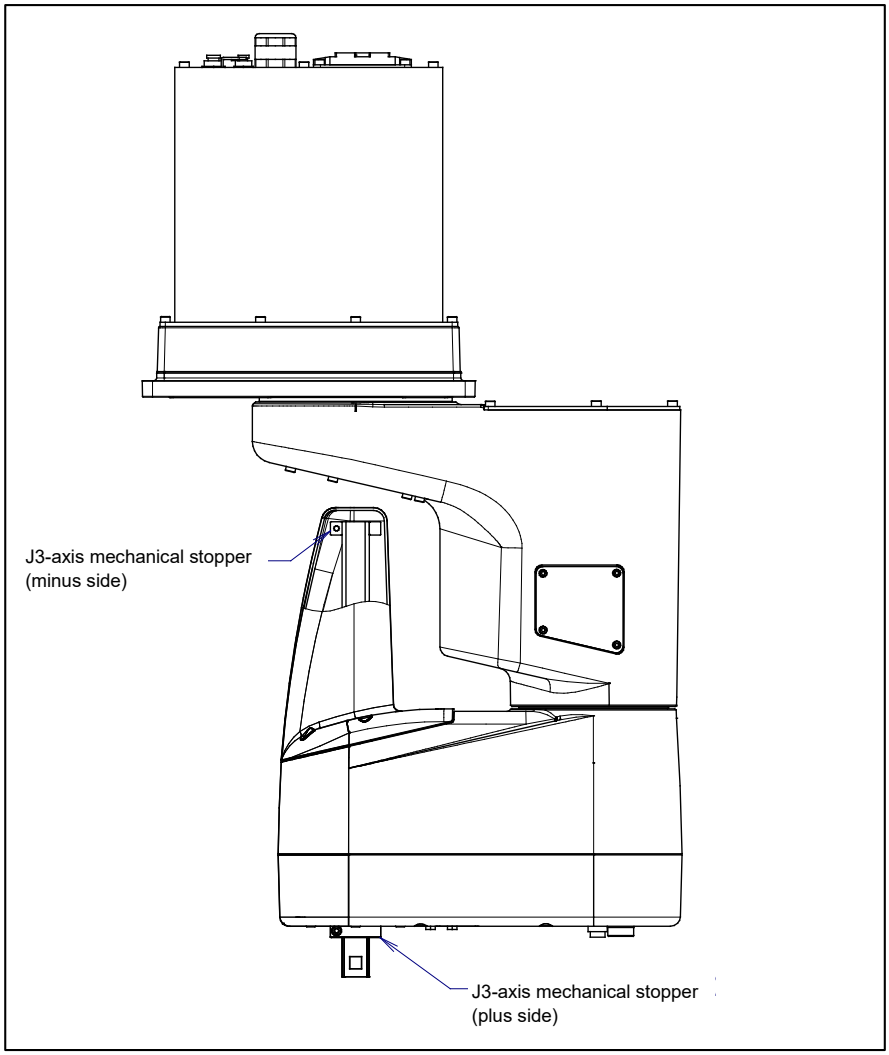


Fig. 3.3 (a) Position of mechanical stopper

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

When J1-axis mechanical stopper is necessary, contact your local FANUC representative.

Only in case of the J3-axis, when the robot comes in contact with the mechanical stopper, it may deform. When the mechanical stopper is deformed, replacement is needed. Contact FANUC about replacing J3-axis mechanical stopper.

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

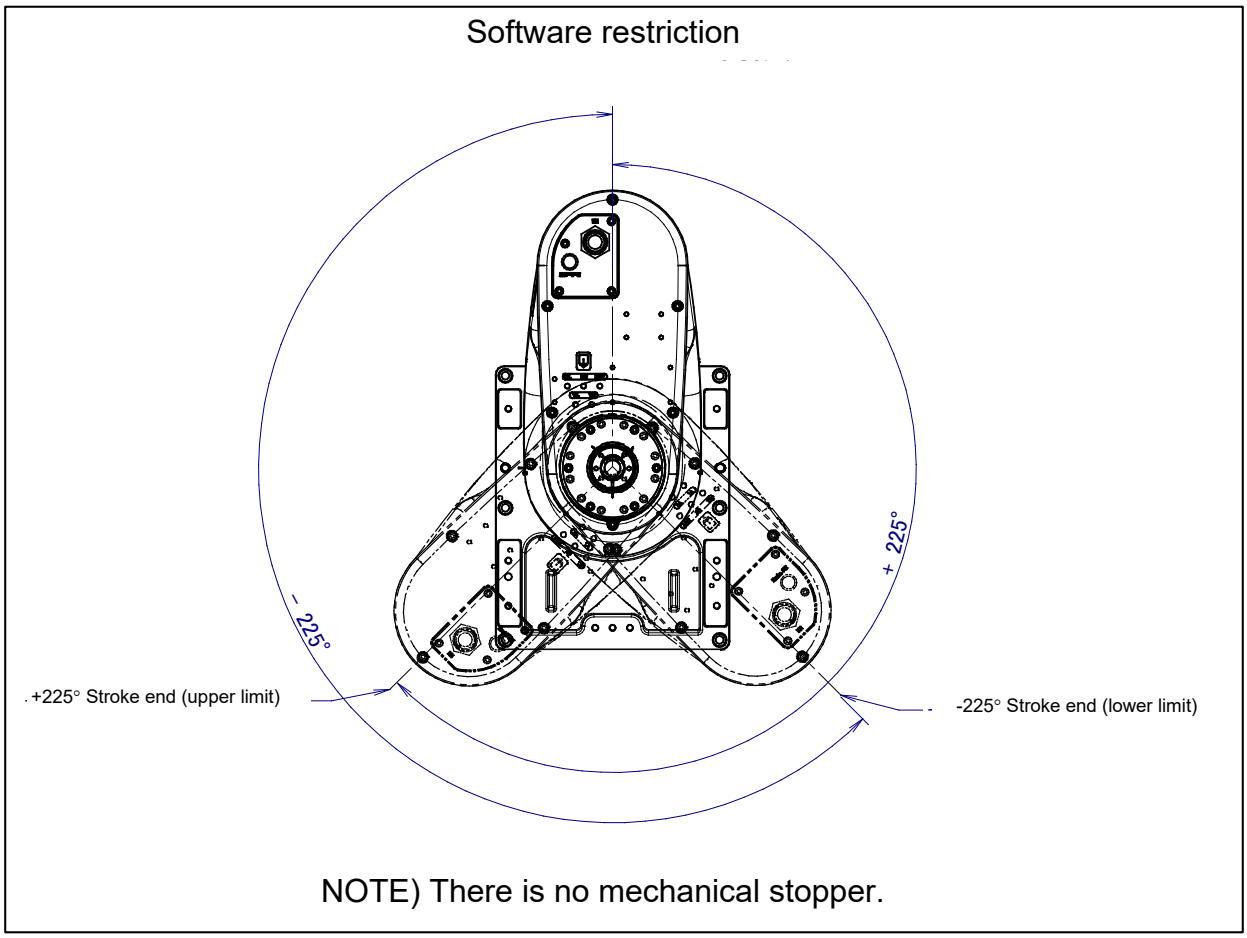


Fig. 3.3 (b) J1-axis motion limit

NOTE
If the arm is pushed by hand J1-axis moved to the outside of the motion area, it might cause cable twisted and cable failure. Do not change the J1-axis position when the present position is unknown.

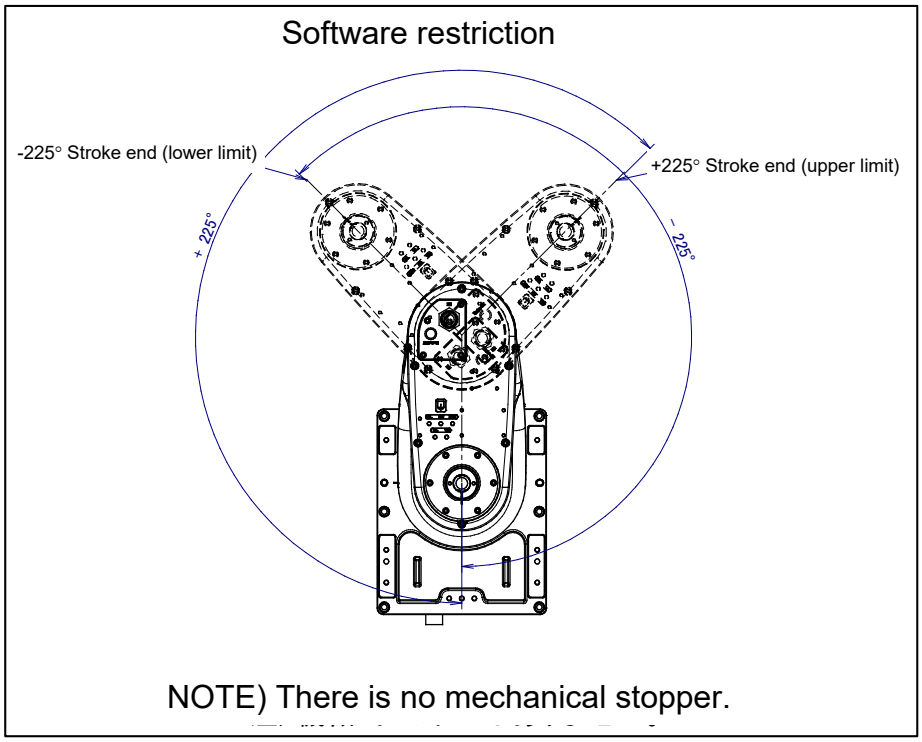


Fig. 3.3 (c) J2-axis motion limit

NOTE
If the arm is pushed by hand J2-axis moved to the outside of the motion area, it might cause cable twisted and cable failure. Do not change the J2-axis position when the present position is unknown.

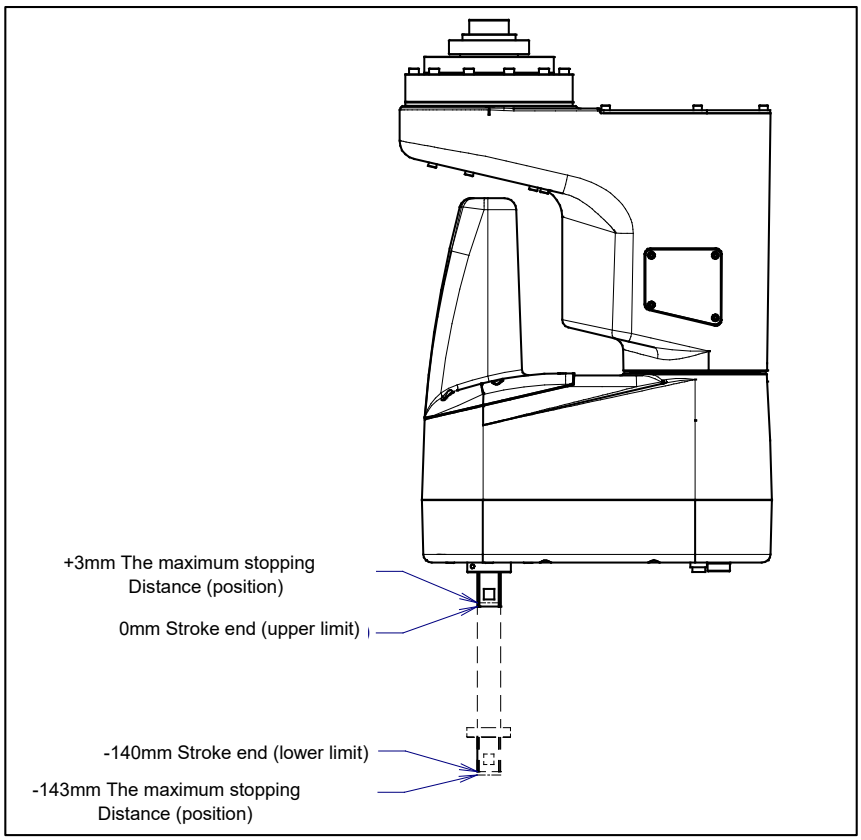


Fig. 3.3 (d) J3-axis motion limit

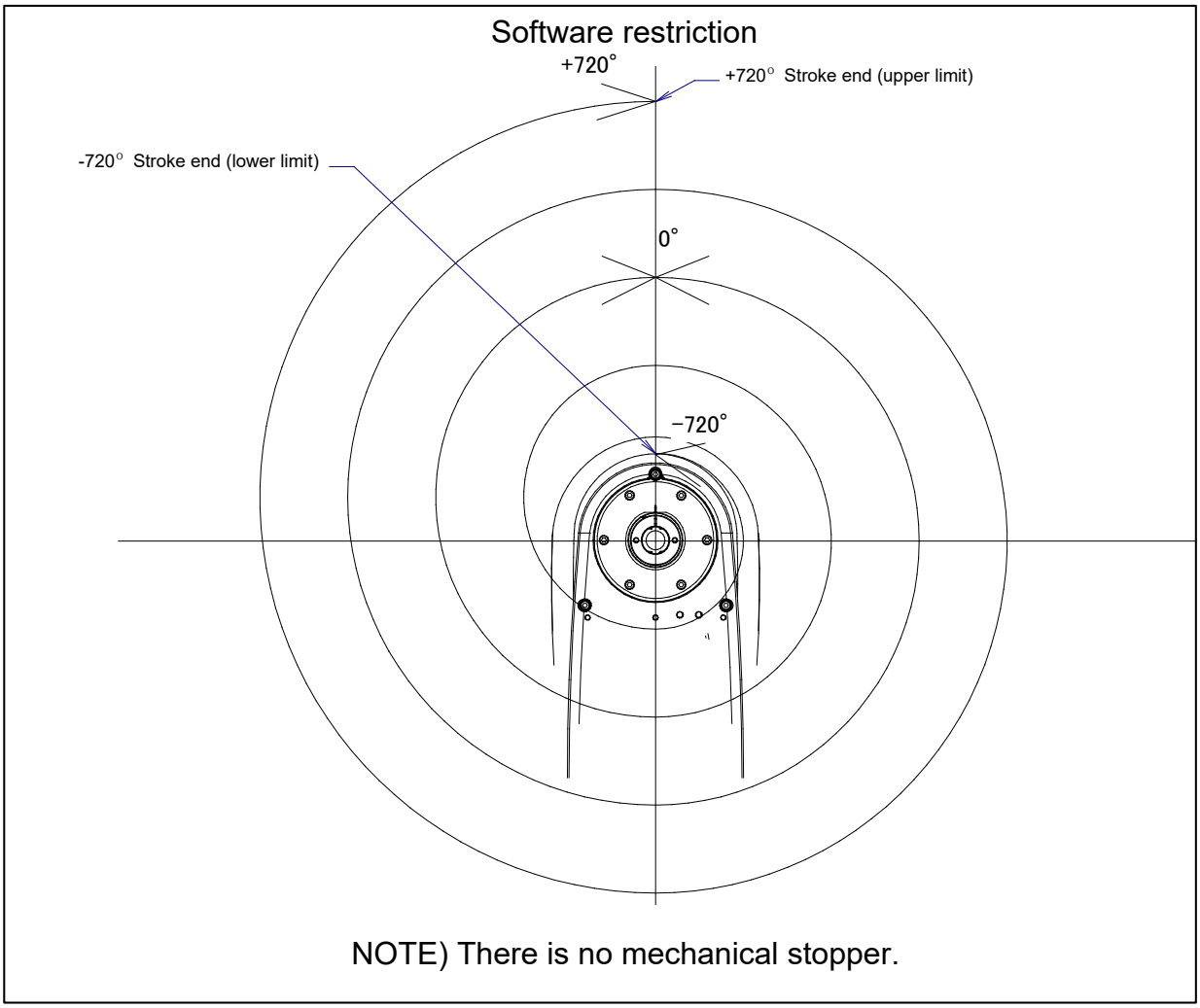


Fig. 3.3 (e) J4-axis motion limit

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (a) shows diagram to limit loads applied to the wrist. The robot might vibrate even if wrist load in in wrist load diagram. At this time, reduce the acceleration.

- Apply a load within the region indicated in the graph.
- For the zero point and the motion range of the J3-axis, refer to Fig.3.3 (d) in Section 3.3.
- See Section 4.1 about the mounting of an end effector.

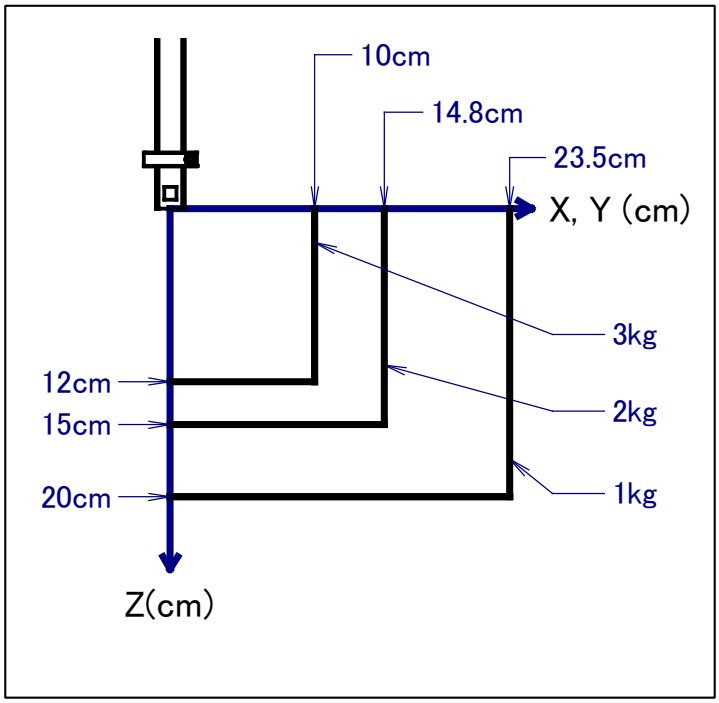


Fig. 3.4 (a) Wrist load diagram

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) is the diagrams for installing end effectors on the wrist. Fasten the bolt for attaching the end effector referring to Appendix B for the tightening torque.

> ⚠ **CAUTION**
> Notice the tooling coupling depth to wrist flange should be shorter than the flange coupling length.

When installing the equipment using the friction type fastening fixture, make the surface pressure on the friction surface less than 150N/mm^2.
(reference)
Allowable maximum thrust force at the end effector tip
: 150N
Allowable maximum torque at the end effector tip
: 16Nm

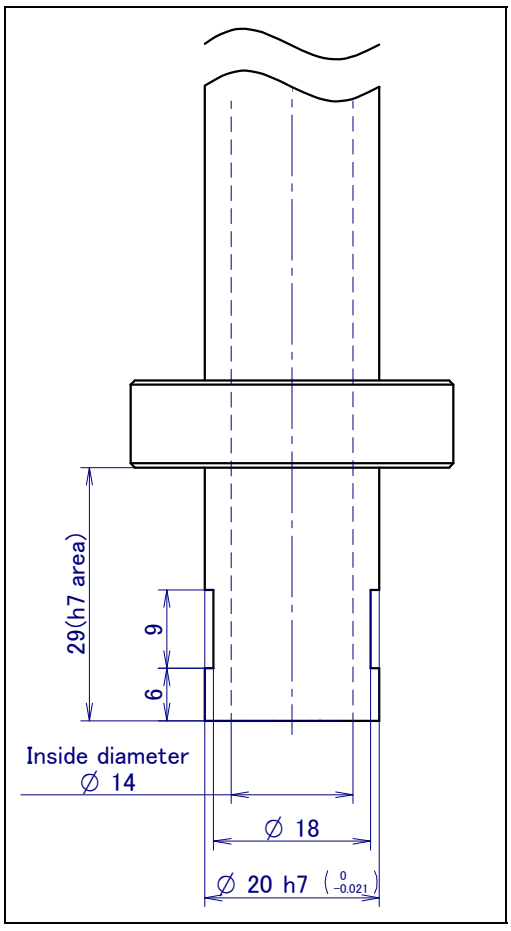


Fig. 4.1 (a) Surface for installing the end effector

4.2 EQUIPMENT MOUNTING FACE

As shown in Fig. 4.2 (a) and (b), 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.

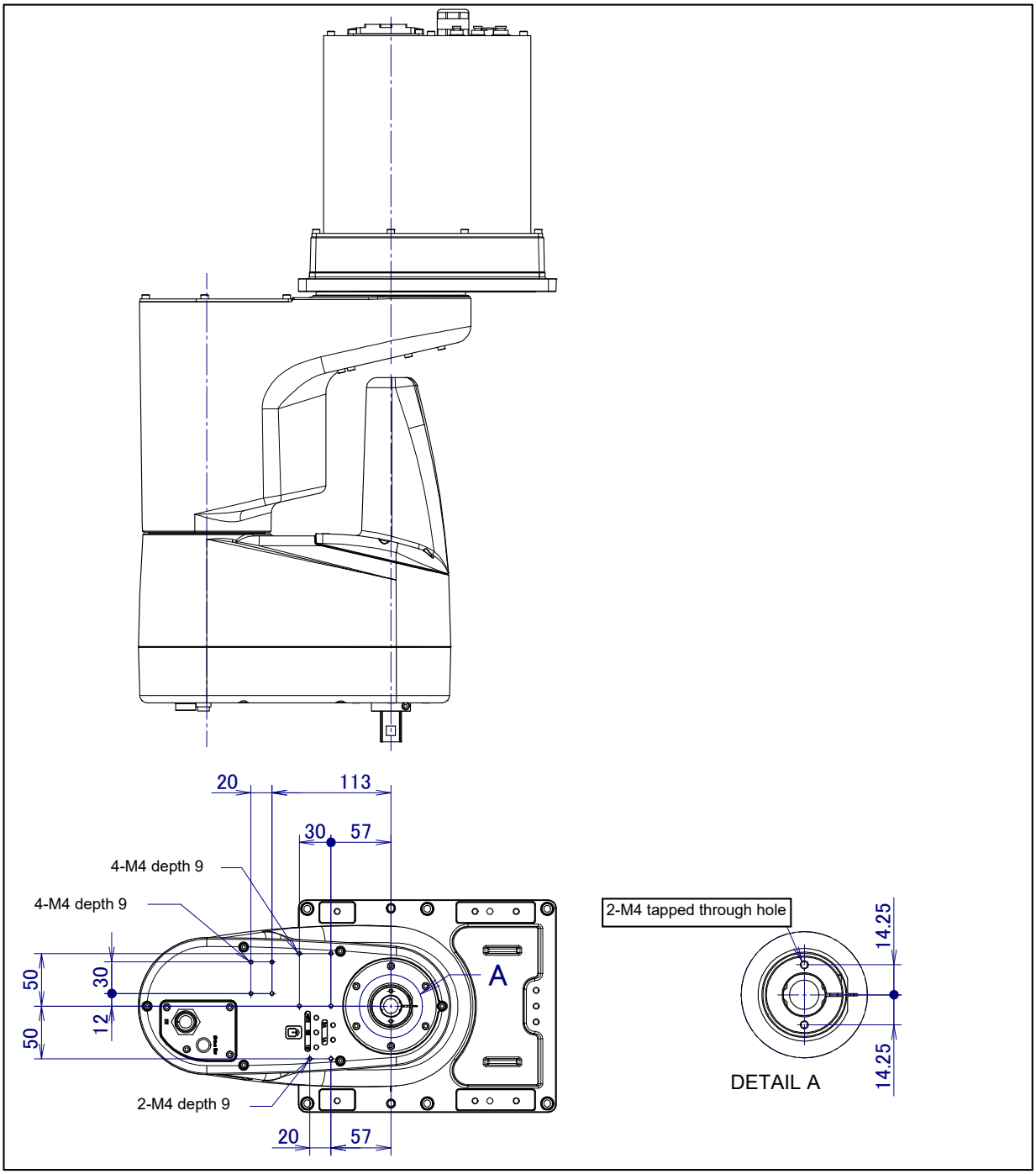


Fig. 4.2 (a) Equipment mounting faces

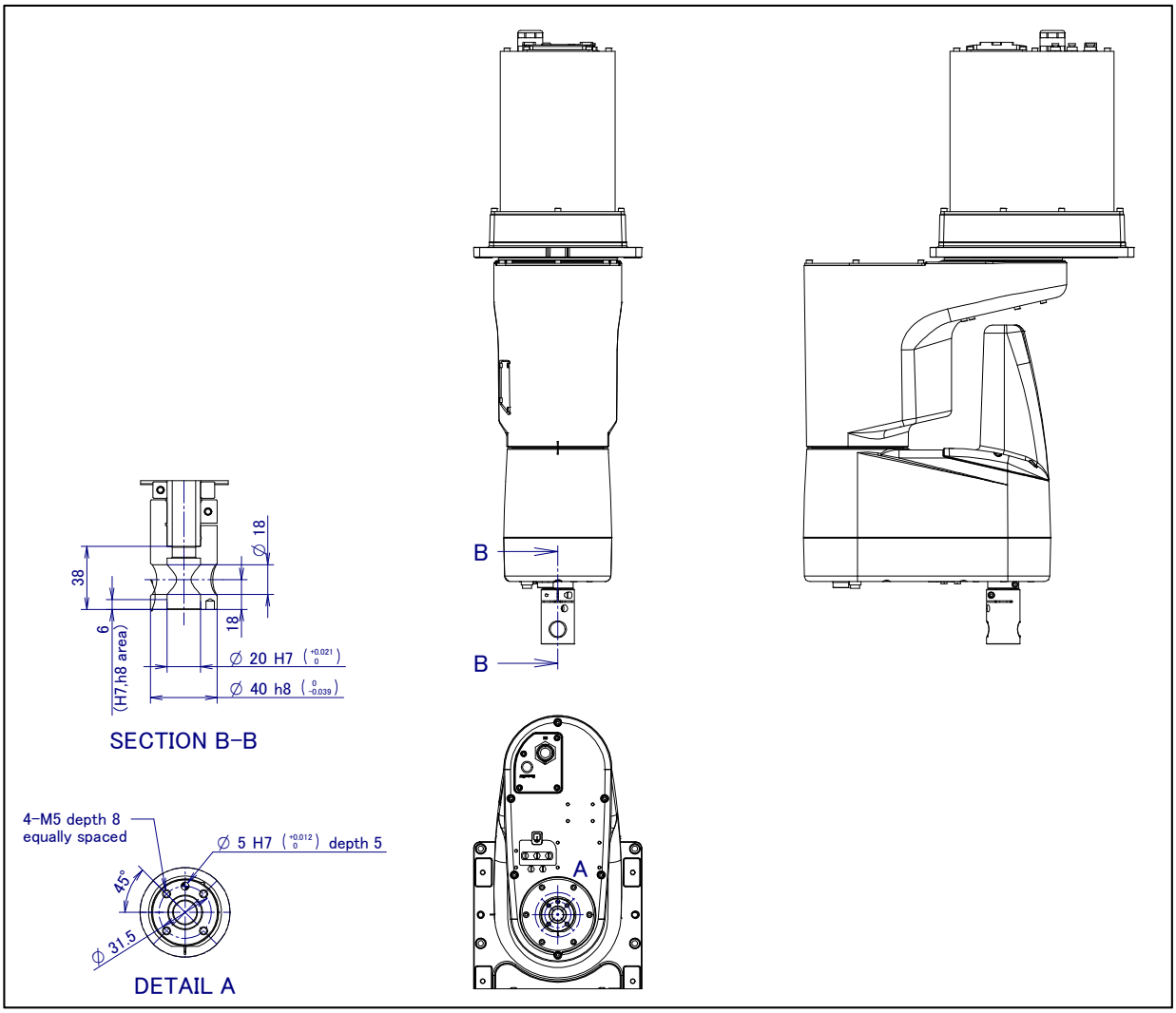


Fig. 4.2 (b) Equipment mounting faces (tool flange option)

4.3 LOAD SETTING

⚠ CAUTION
Set the correct load condition parameter before the robot runs. Do not operate the robot when its payload is exceeded or incorrect. Do not exceed the allowable payload including connection cables and its swing. Operation in with the robot over payload may result in troubles such as reducer life reduction.

NOTE
Explanation in this chapter is for when teach pendant (option) is selected.

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          3.00   [                    ]
 2          0.00   [                    ]
 3          0.00   [                    ]
 4          0.00   [                    ]
 5          0.00   [                    ]
 6          0.00   [                    ]
 7          0.00   [                    ]
 8          0.00   [                    ]
 9          0.00   [                    ]
10          0.00   [                    ]


  Active PAYLOAD number =0
[ TYPE]  GROUP  DETAIL  ARMLOAD  SETIND >
```

5 Ten different pieces of payload information can be set using condition Nos. 1 to 10 on this screen. Place the cursor on one of the numbers, and click F3 (DETAIL). The MOTION PAYLOAD SET screen appears.

```
MOTION PAYLOAD SET                    JOINT 10%

    Group 1
 1 Schedule No[          1]:[Comment           ]
 2 PAYLOAD                [kg]            3.00
 3 PAYLOAD CENTER  X [cm]                 0.00
 4 PAYLOAD CENTER  Y [cm]                 0.00
 5 PAYLOAD CENTER  Z [cm]                 1.50
 6 PAYLOAD INERTIA X [kgfcms^2]           0.10
 7 PAYLOAD INERTIA Y [kgfcms^2]           0.01
 8 PAYLOAD INERTIA Z [kgfcms^2]           0.10

 [TYPE] GROUP NUMBER  DEFAULT  HELP
```

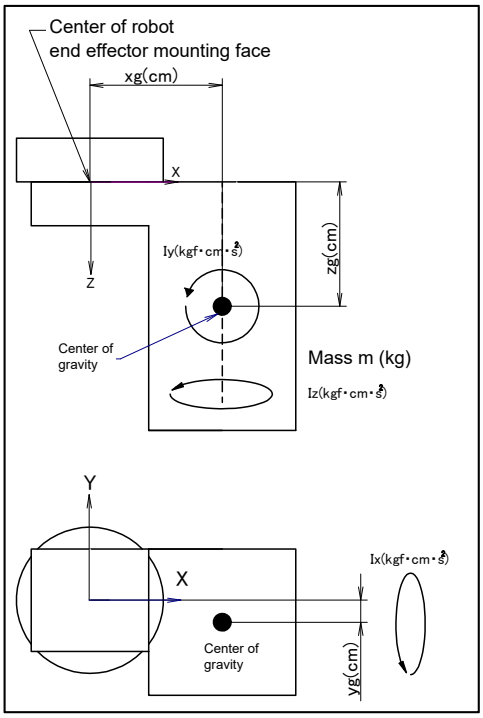


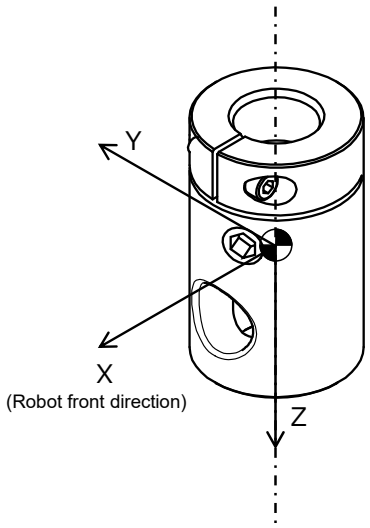
Fig. 4.3 (a) Standard tool coordinate

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 Pressing 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.

When the tool flange (option) is specified, consider the following load information.



PAYLOAD	[kg]	0.16
PAYLOAD CENTER X	[cm]	0.00
PAYLOAD CENTER Y	[cm]	0.00
PAYLOAD CENTER Z	[cm]	0.35
PAYLOAD INERTIA X	[kgfcms^2]	0.0008
PAYLOAD INERTIA Y	[kgfcms^2]	0.0008
PAYLOAD INERTIA Z	[kgfcms^2]	0.0004

Fig. 4.3 (b) Load information of the tool flange (option)

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.

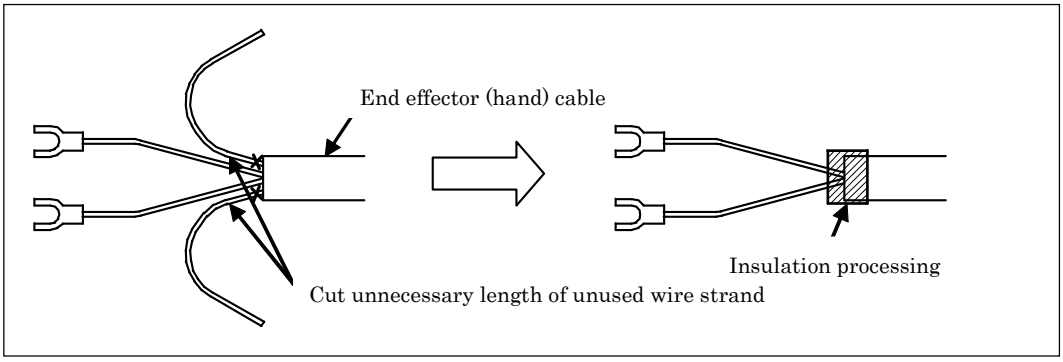


Fig. 5 (a) Treatment method of end effector (hand) cable

5.1 AIR SUPPLY

Air supply holes (φ4 and φ6) exists on the J1–axis connector panel for end effector as shown in Section 5.2.
There is a mechanical unit cable which includes solenoid valve as shown in Table 5.1 (a).
When the solenoid valve is replaced, the entire manifold should be replaced.

Table 5.1 (a) Optional solenoid valves

Mechanical unit cable spec.	Model	Description	Solenoid (Manifold) spec.	Remarks	RO
A05B-1541-H201	SR-3*i*A/U	Path 3 air piping, RO connector output (without solenoid valve)	—	—	—
A05B-1541-H202	SR-3*i*A/U	Double solenoids x 2	A97L-0218-0153#D2 (manufactured by SMC)	2 position x 2	RO1 to 4

Available section area of the solenoid valve : 1.95mm^2 (CV value : 0.11)

NOTE
Attach an air filter with a mesh size of 5μm or better on the upstream side near the robot. Compressed air including much drainage causes valve malfunctions. Take action to prevent the entry of drainage, and also drain the air filter periodically.

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 AIR SUPPLY AND EE (RI/RO) INETRFACE

Fig. 5.2 (a) and (b) show air supply and EE (RI/RO) interface position.

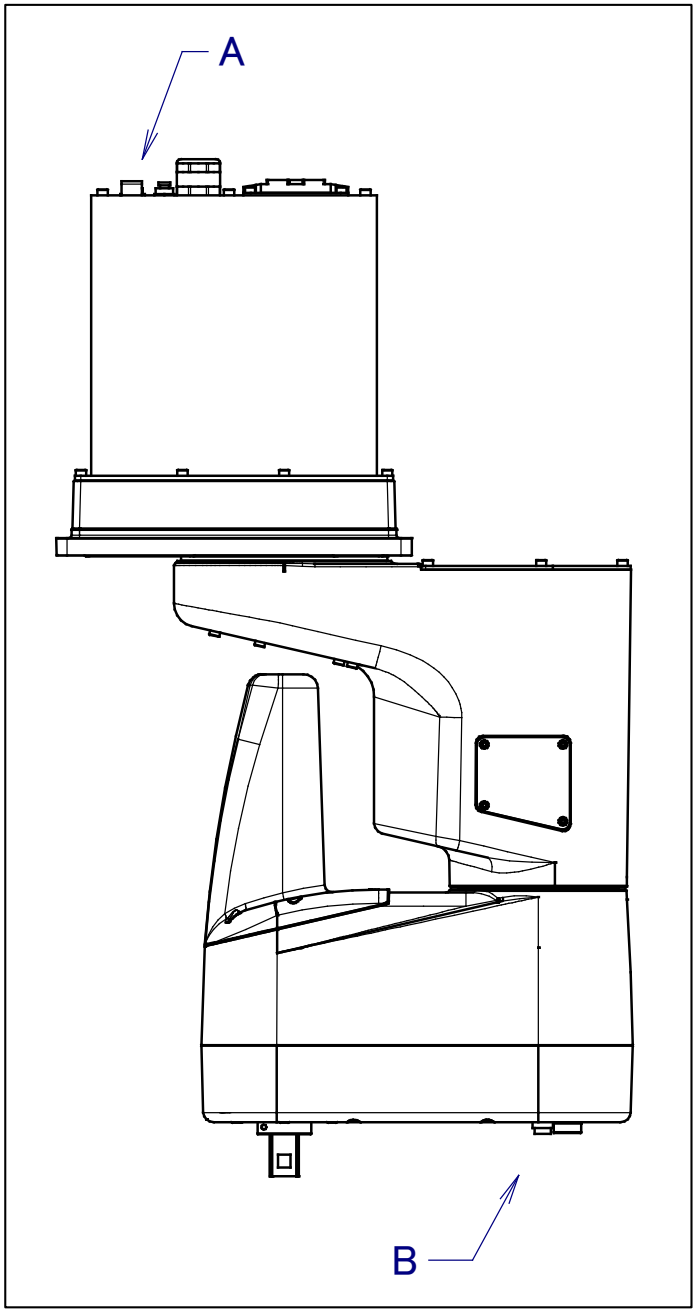


Fig. 5.2 (a) Air supply and EE (RI/RO) interface position

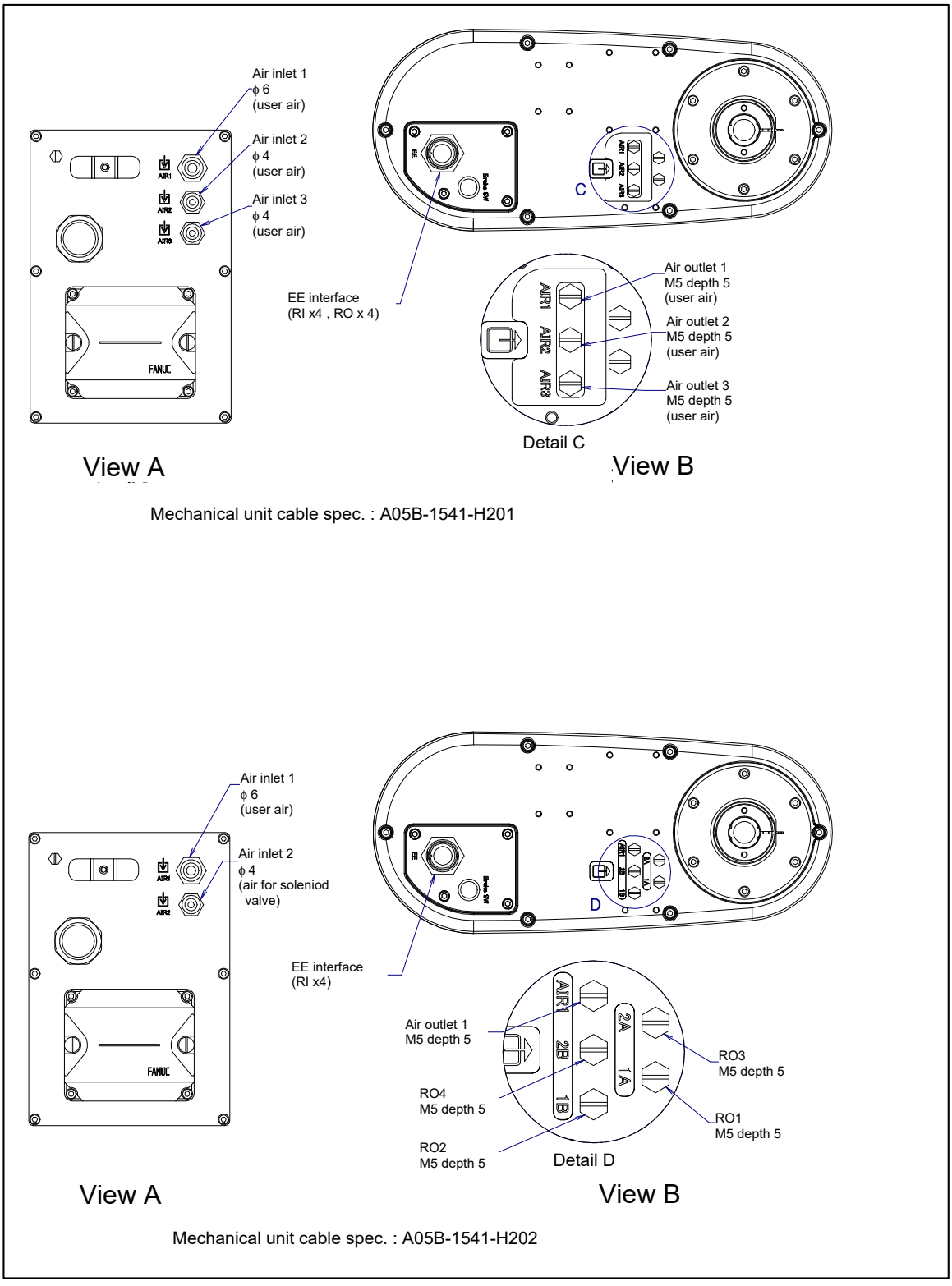


Fig. 5.2 (b) Air supply and EE (RI/RO) interface

Fig. 5.2 (c), (d) show pin layout for EE interface (RI/RO).

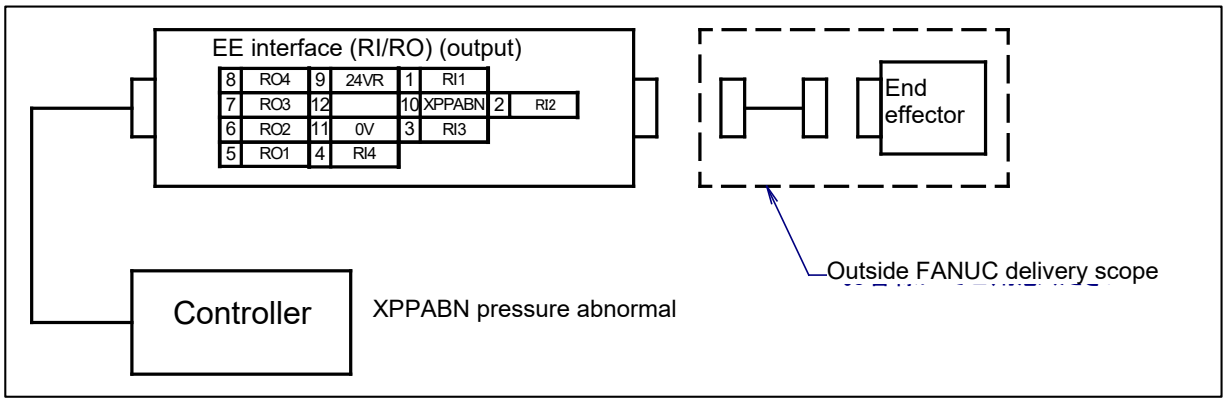


Fig. 5.2 (c) EE (RI/RO) interface (When A05B-1541-H201 is specified)

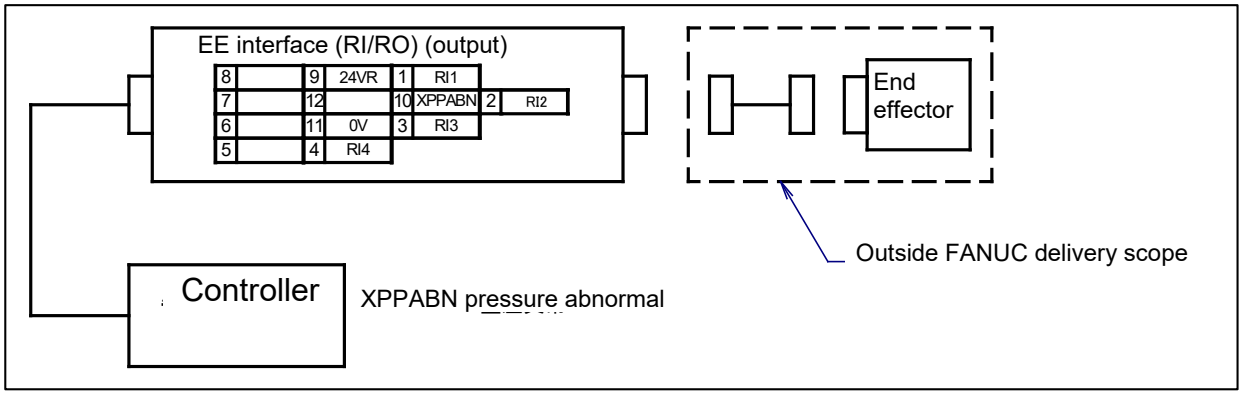


Fig. 5.2 (d) EE (RI/RO) interface
(When A05B-1541-H202 is specified)

NOTE
For wiring of the peripheral device to the EE interface, refer to -Chapter 4 “ELECTRICAL CONNECTIONS” of manuals below, too.
MAINTENANCE MANUAL (B-84035EN)

Connector specifications

Table 5.2 (a) show the connector parts supported by the EE interface. Some of these parts are available as an option from FANUC. (Table 5.2 (b))

Table 5.2 (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: * : ϕ 5, 6, 7, 8, 9, 10mm
	Plug: RM15WTLP-12P(33) Clamp: JR13WCC-*(72)	Elbow type connector (12 pins) *indicates an applicable cable diameter selected from the following: * : ϕ 5, 6, 7, 8, 9, 10mm

Table 5.2 (b) Supported option

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

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

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

> ⚠ **WARNING**
> Changing the motion range of any axis affects the operation range of the robot. To avoid trouble, carefully consider a possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition occurs; for example, an alarm may occur in a previous taught position.

> **NOTE**
> Explanation in this chapter is for when teach pendant (option) is selected.

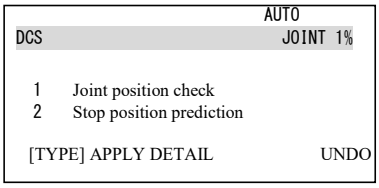
6.1 CHANGE AXIS LIMIT BY DCS (OPTION)

The robot motion can be restricted with DCS (Dual check safety) function. 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.

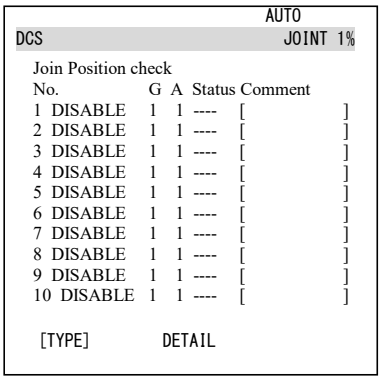
As an example, we shows the procedure to set ±90° for J2-axis in here. Refer to Dual check safety function Operator's Manual (B-83184EN) for details of other setting, function and DCS stop position prediction.

Setting procedure

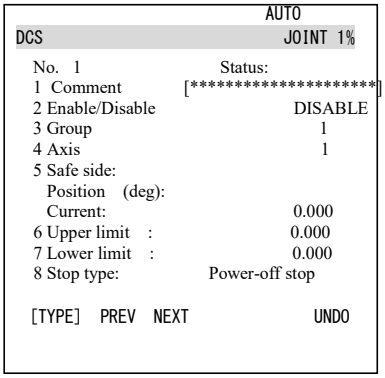
1 Press the [MENU] key to display the screen menu.
2 Press [0 NEXT] and press [6 SYSTEM].
3 Press the F1 ([TYPE]).
4 Select [DCS]. The following screen will be displayed.



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

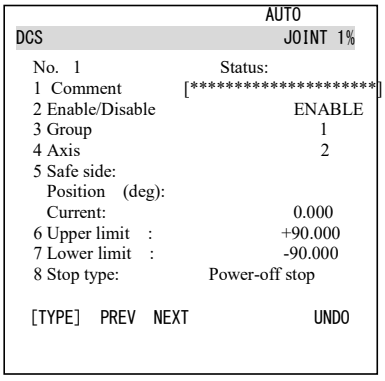


6 Move the cursor to [1], then press the [DETAIL].

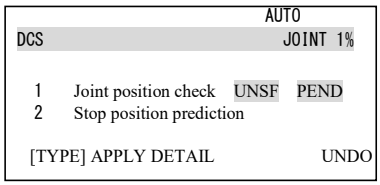


7 Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
8 Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
9 Move the cursor to [Axis], then input “2”, then press the [ENTER] key.
10 Move the cursor to [Upper limit] right side, then input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

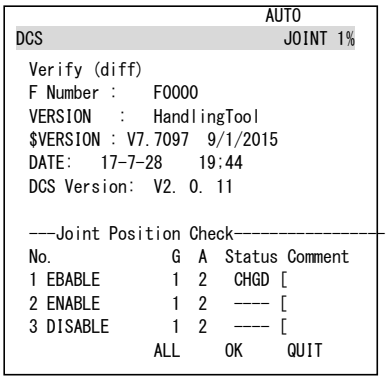
> ⚠ **WARNING**
> If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot’s momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the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



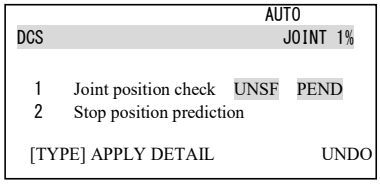
12 Press the [PREV] key two times, back to the first screen.



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.

6.2 J4-AXIS MOTION RANGE EXTENSION BY CONTINUOUS ROTATION FUNCTION

The continuous rotation function allows continuous and limitless rotation about the final axis or an additional rotation axis of the robot in one direction.
For SR-3*i*A/U, the final axis J4-axis can be the target of this function.
For the general setup and details of continuous rotation function, refer to "Optional Function OPERATOR'S MANUAL" (B-83284EN-2).
When you set up J4-axis axis of the robot as a continuous rotation axis, keep in mind the following limitation.

1 Joint Position Check of Dual Check Safety function is not available for J3 and J4-axes.
2 When you load a previous backup (all backup, etc.) including the mastering data, do it with the following procedure. During the procedure (1) to (3), do not change the position of the robot axes.
   (1) Write down the current Mastering Data ($DMR_GRP[group].$MASTER_COUN[axis]) or save a Mastering data file (SYSMAST.SV). This file is also included in all backup.
   (2) Restore the previous backup.
   (3) Restore the mastering data you made in step (1). You can restore it either by directly entering the mastering data to system variable or loading SYSMAST.SV.

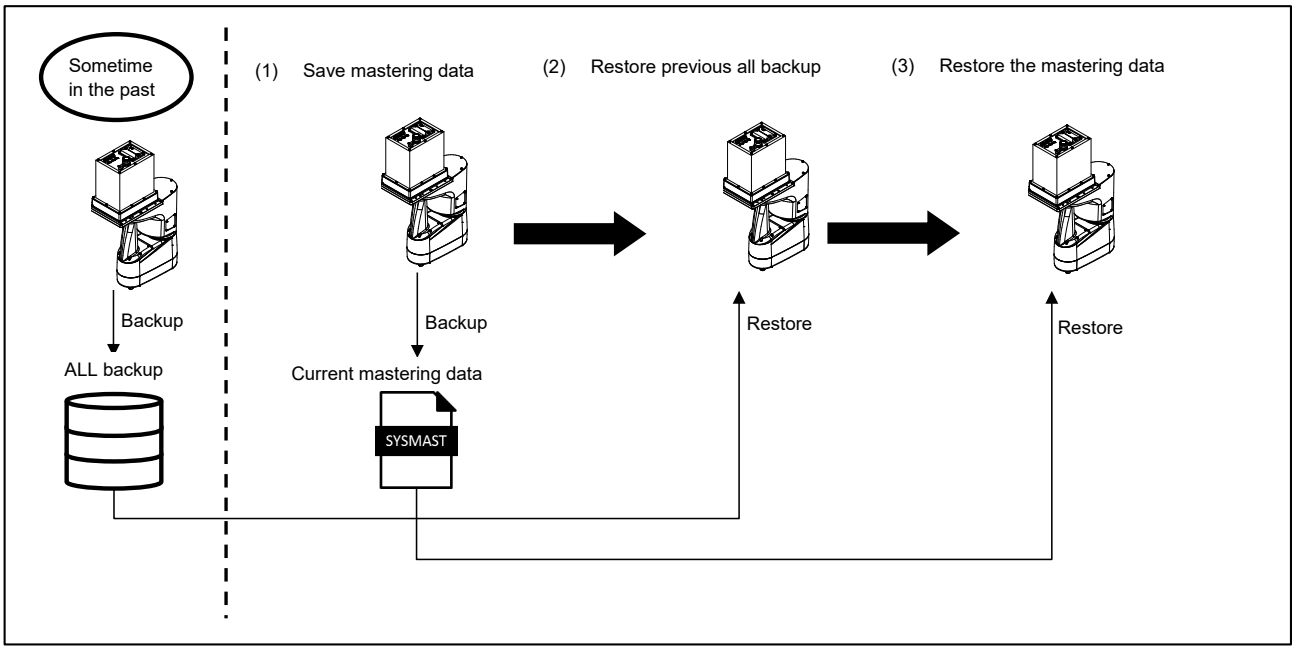


Fig. 6.2 (a) Restoration of a previous all backup after continuous rotation.

NOTE
When the continuous rotation is enabled with SR-3*i*A/U, you cannot load a previous mastering data even if you have not done a remastering since then. (see Fig. 6.2 (b))
If you load the data, the J3-axis position will become incorrect.
In such a case, remaster J3-axis.

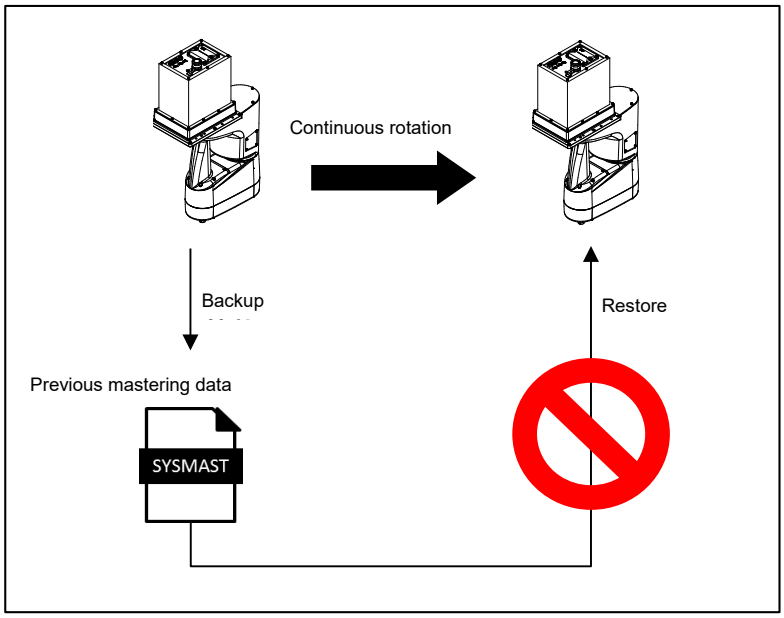


Fig. 6.2 (b) Example of wrong procedure of loading a previous mastering data

When setting the J4-axis of the robot as a continuous rotation axis, the following pop-up window is displayed.

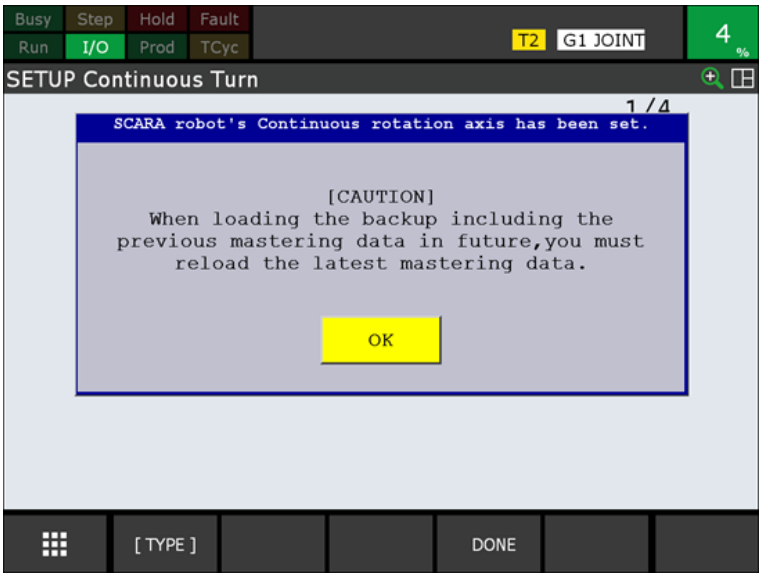


Fig.6.2 (c) Pop-up window of caution

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 operating 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, the maintenance frequency should be doubled – i.e. the time interval should be divided by 2.

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. If 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	6 months 1920h	1 year 3840h	1.5 years 5760h	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.	14
	○						Check for external damage or peeling paint	Check whether the robot has external damage or peeling paint due to contact with the peripheral devices. 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.	13
	○ Only 1st Check		○				Check for damage to the end effector (hand) cable	Check whether the end effector cables 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	6 months 1920h	1 year 3840h	1.5 years 5760h	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 fixed mechanical stopper r	Check that there is no evidence of a collision on the fixed mechanical stopper, and check that the stopper mounting bolts are not loose. **⇒"7.2.4 Check of Fixed 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 these intervals. **⇒"7.3.1 Replacing the Batteries"**	9
		○					Replenish grease to ball screw spline	Grease ball screw spline **⇒"7.3.3 Replenish the Grease of the Ball Screw Spline"**	10
			○				Confirm belt tension	Confirm the belt tension. Contact your local FANUC representative for information regarding adjusting the belt tension.	11
					○		Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	12
						○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. **⇒Chapter 7 Replacing batteries of MAINTENANCE MANUAL (B-84035EN)"**	15

7.2 CHECK POINTS

7.2.1 Confirmation of Oil Seepage

Check items

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

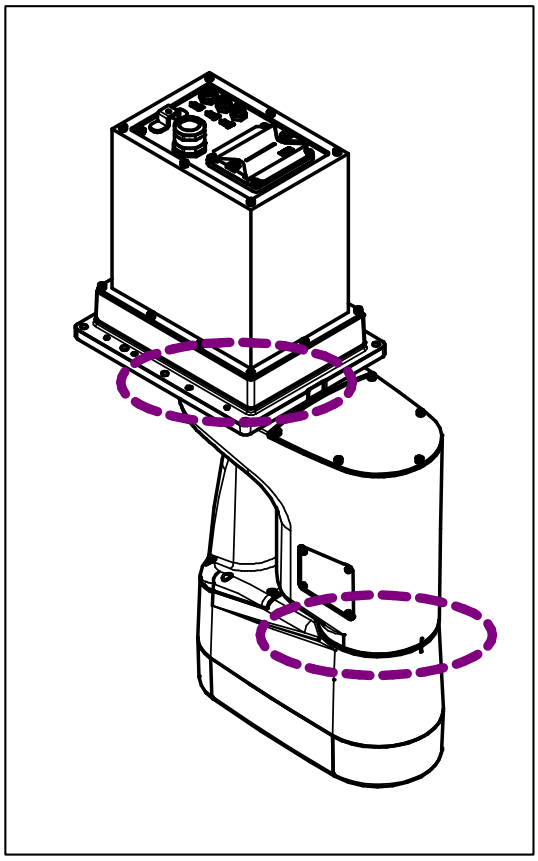


Fig. 7.2.1 (a) Check points of oil seepage

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil changes to a state of liquid, the oil might fall depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components before you operate the robot.
- If you must wipe oil frequently, 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	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 kgf/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 drain and release it. If the quantity of the drained liquid is significant, examine the setting of the air dryer on the air supply side.

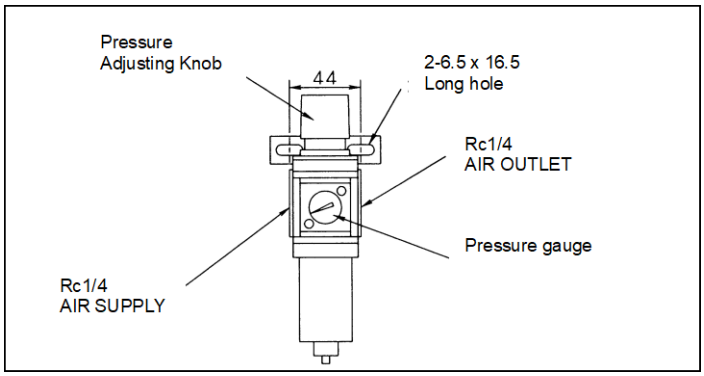


Fig. 7.2.2 (a) Air control set (option)

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 manually.
- Earth/Ground terminal : Check the terminal for tightness.

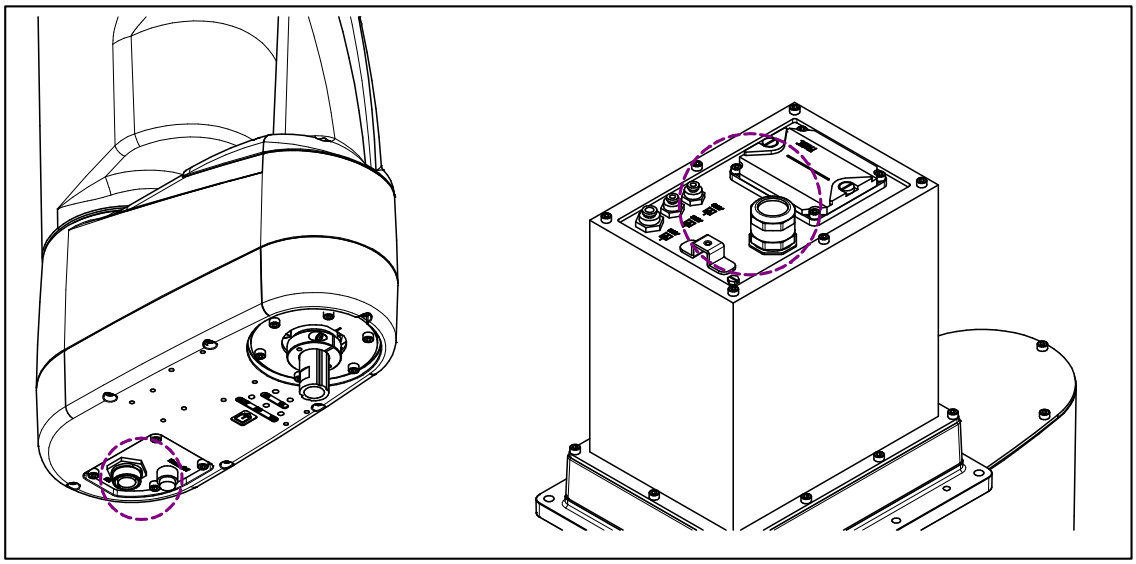


Fig. 7.2.3 (a) Cable clamp and connector Inspection points

7.2.4 Check of Mechanical Stopper

- Check that there is no evidence of a collision on the fixed mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace the parts.
- Check the tightness of the stopper mounting bolts. If they are loose, retighten them.

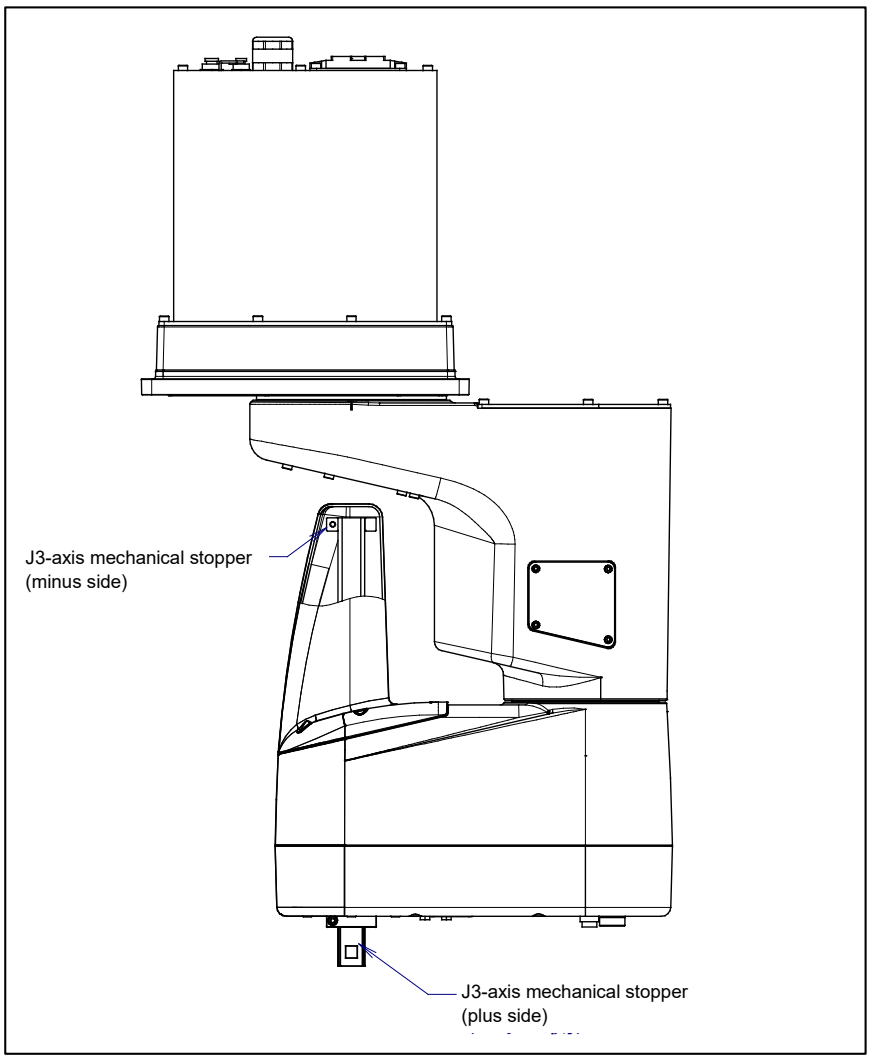


Fig. 7.2.4 (a) Position of mechanical stopper

7.3 MAINTENANCE

7.3.1 Replacing the Batteries (1-Year Periodic Maintenance)

The position data of each axis is preserved by the backup batteries. 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

1 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.

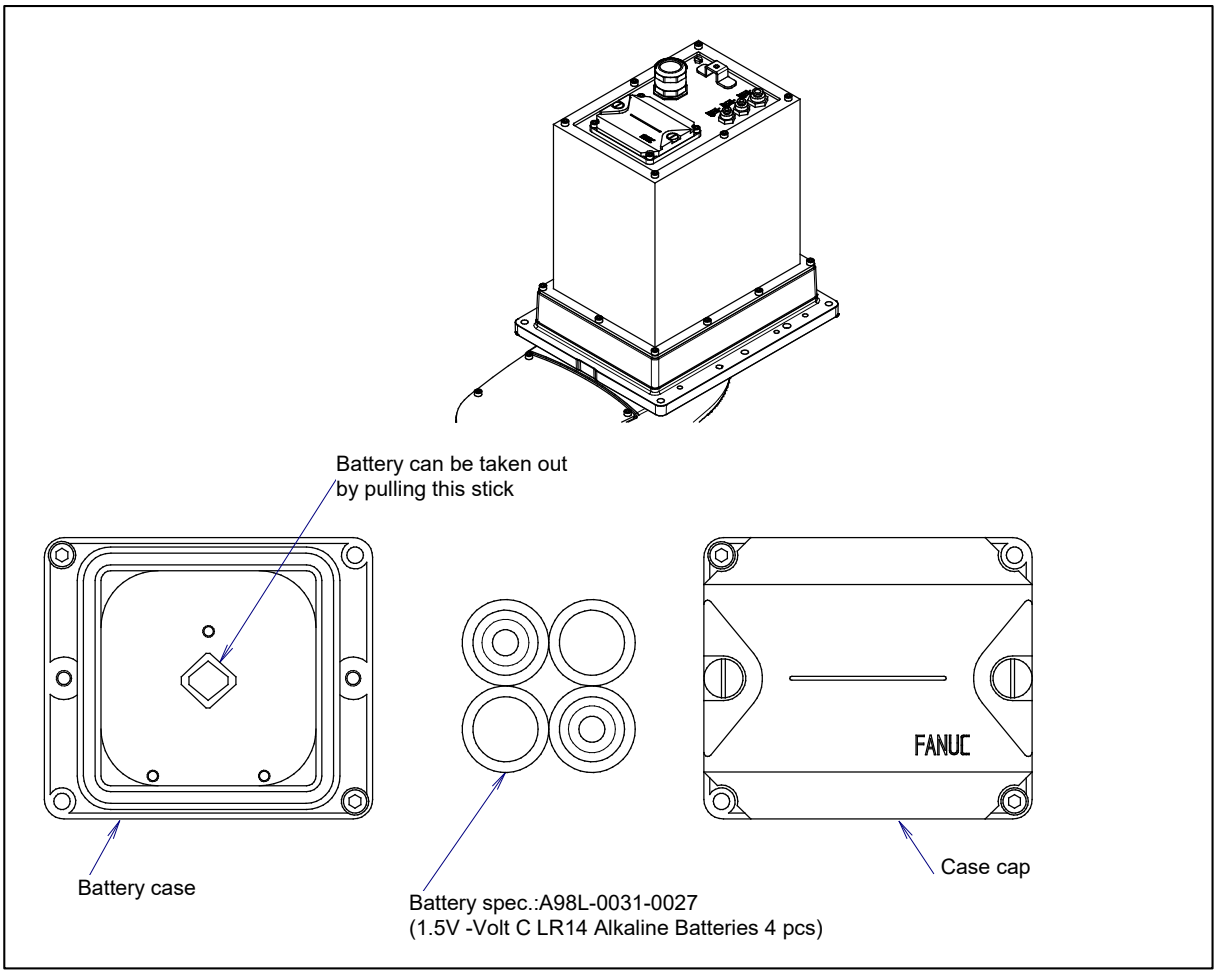


Fig. 7.3.1 (a) Replacing the battery

7.3.2 Replenish the Grease of the Ball Screw Spline (6 months (1920 hours) checks)

Supply grease to ball screw spline at the intervals recommended below based on every 6 months or 1920 hours, whichever comes first. See Table 7.3.2 (a) for the grease name and the quantity.

Table 7.3.2 (a) Grease for 6-months (1920 hours) periodical replacement

Supply position	Quantity	Grease name
Ball screw spline	Proper quantity	Spec: A98L-0040-0329

NOTE
The following maintenance kits are prepared for the greasing.
- Grease in tube: A05B-1541-K201 (grease in tube (70g))

For grease replacement or replenishment, use the arbitrary posture.

⚠ WARNING
Operate the robot without the cover is very dangerous. Be sure to fix the cover with bolts after greasing. If noise occurs, cover might be not fixed. Confirm the bolts are not loose.

1 Turn off controller power.
2 Remove the cover.
3 Supply new grease to the ball screw spline grooved with a cylinder referring to Fig. 7.3.2 (a).
4 Attach the cover.

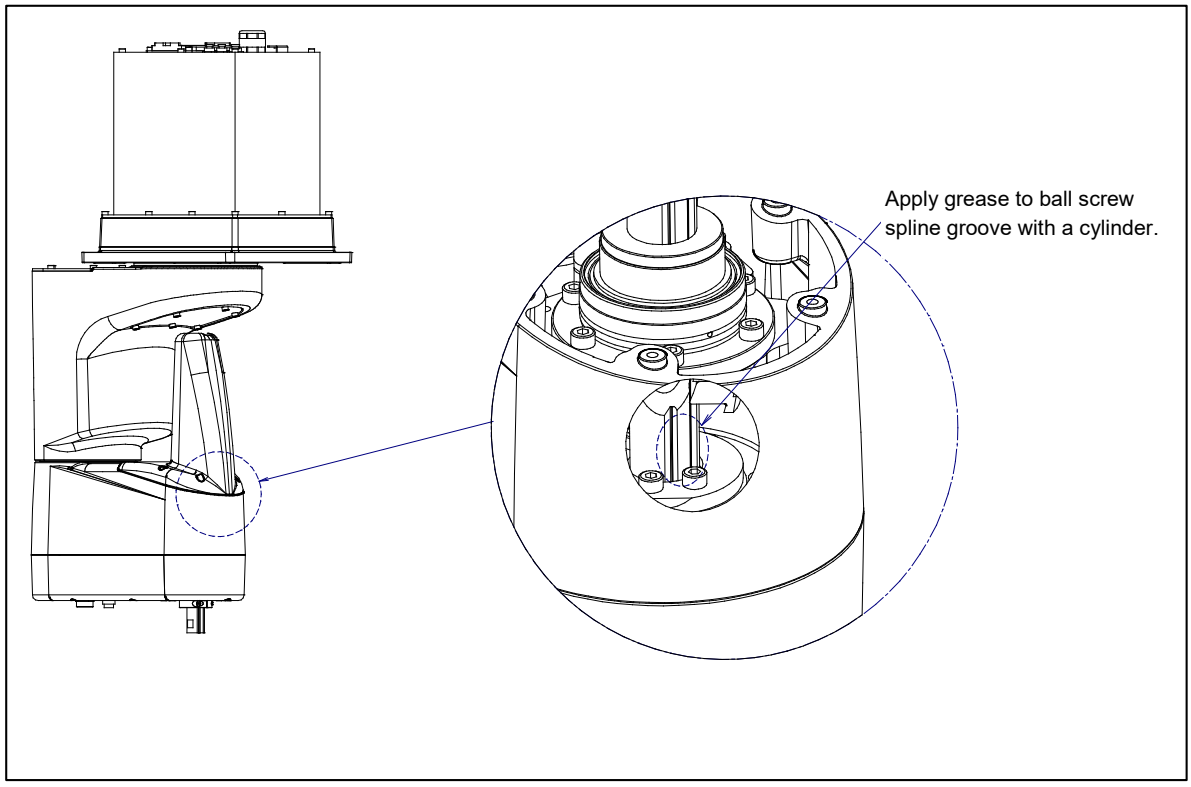


Fig. 7.3.2 (a) Applying grease of ball screw spline

7.4 STORAGE

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

8 MASTERING

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

NOTE
Explanation in this chapter is for when teach pendant (option) is selected.

8.1 OVERVIEW

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

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

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

Types of Mastering

Table 8.1 (a) describes the following mastering methods.

Table 8.1 (a) Type of mastering

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

Once mastering is performed, you must carry out positioning (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 detailed 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.

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], display the screen change menu.
4 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
```

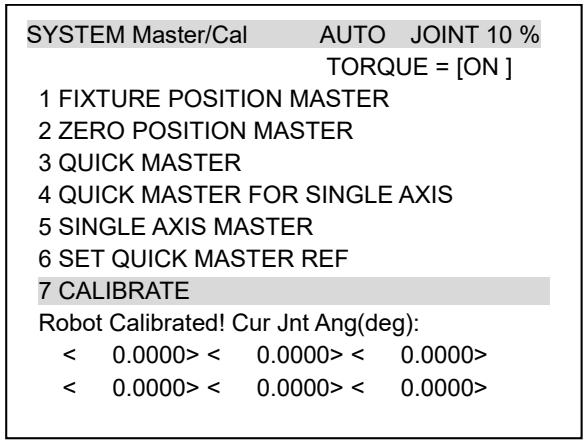
5 Release brake control, and jog the robot into a posture for mastering.

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, turn off the controller power and on again.

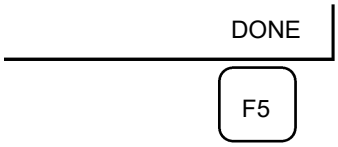
6 Select [2 ZERO POSITION MASTER]. Press F4 [YES].

```
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> <0> <0>
 [ 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 turn off the controller power and on again.

Table 8.3 (a) Posture with position marks aligned

Axis	Position
J1-axis	0 deg
J2-axis	0 deg
J3-axis	0 mm
J4-axis	0 deg

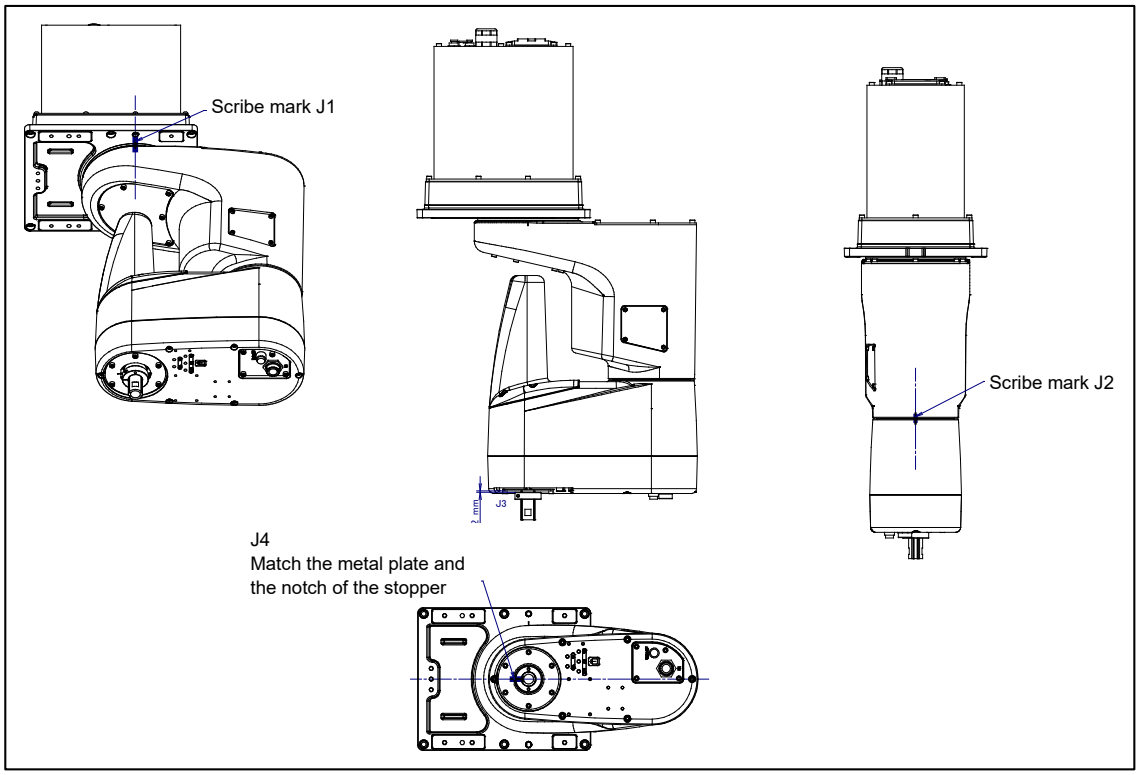


Fig. 8.3 (a) Marking position

NOTE

At J1-axis and J2-axis, 0 degree position and ±360 degree positon is same appearance. If zero position mastering is performed at the except the 0 degree positon, the mechanical unit cable is twisted and it might cause cable failure. If you cannot understand the 0 degree position, contact your local FANUC representative.

8.4 QUICK MASTERING

Quick mastering is performed at a user-specified position for each axis. The pulse count value is obtained from the rotation times of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the fact that the absolute value of a rotation angle within one rotation will not be lost.

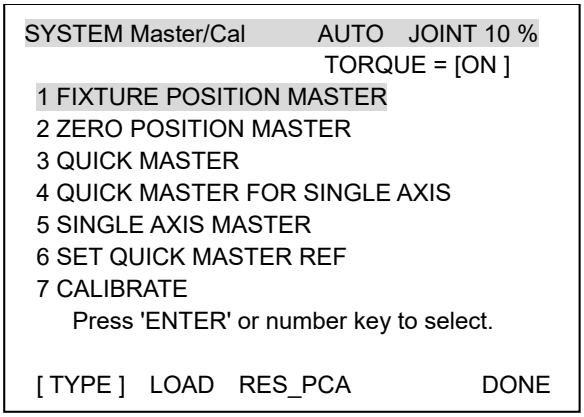
Quick mastering is factory-performed at the position indicated in Table 8.3 (a). If possible, do not change the setting.

If it is impossible to set the robot at the position mentioned above, it is necessary to 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.)

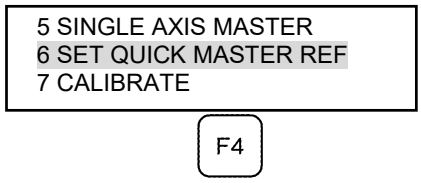
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the motor is replaced or after the mastering data is lost from the robot controller.

Procedure for Recording the Quick Mastering Reference Position

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



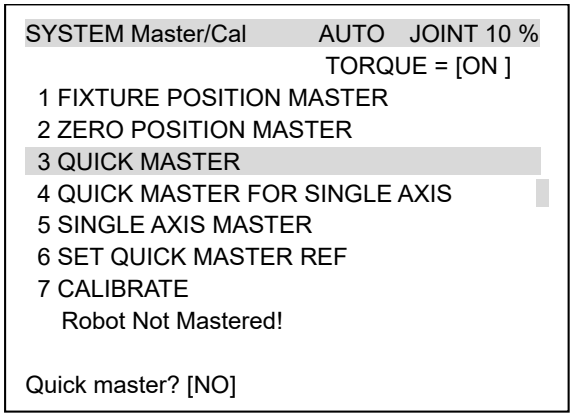
3 Release brake control, and jog the robot to the quick mastering reference position.
4 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position is saved.



⚠ 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.

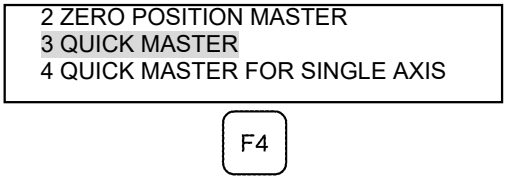
Procedure of Quick Mastering

1 Display the Master/Cal screen.



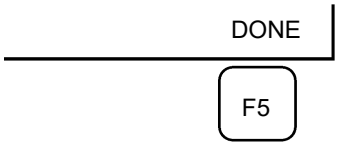
2 Release brake control, and jog the robot to the quick mastering reference position.

3 Move the cursor to [3 QUICK MASTER] and press the [ENTER] key. Press F4 [YES]. Quick mastering data is memorized.



4 Move the cursor to [7 CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration can also be executed by cycling power.

5 After completing the calibration, press F5 [DONE].



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

8.5 QUICK MASTERING FOR SINGLE AXIS

Quick mastering for a single axis is performed at a user-specified position for one axis. The pulse count value is obtained from the rotation times of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the fact that the absolute value of a rotation angle within one rotation will not be lost.

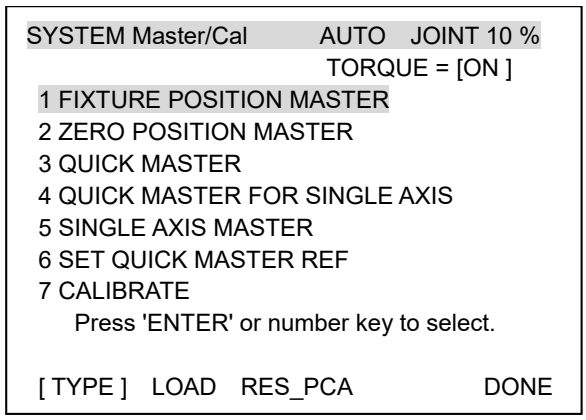
Quick mastering is factory-performed at the position indicated in Table 8.3 (a). If possible, do not change the setting.

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

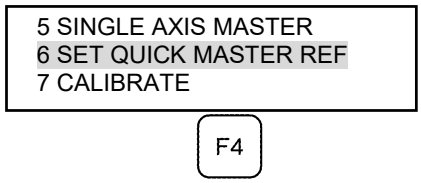
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the motor is replaced or after the mastering data is lost from the robot controller.

Procedure for 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 is saved.



⚠ 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]
```

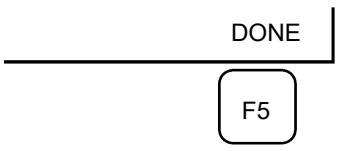
2 Select [4 QUICK MASTER FOR SINGLE AXIS]. You will see the quick master for single axis screen.

```
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 Move the cursor to [7 CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration can also be executed by cycling power.
7 After completing the calibration, press F5 [DONE].



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

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.

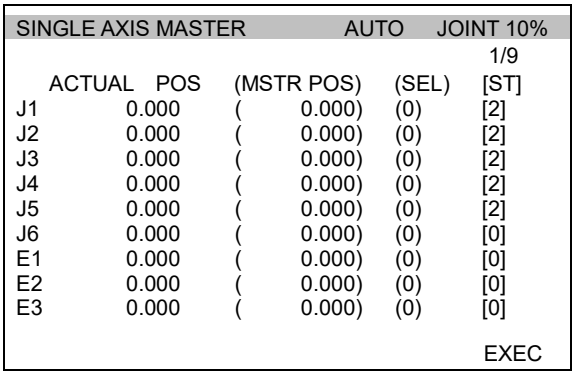


Table 8.6 (a) Items set in single axis mastering

Item	Description
Current position (ACTUAL AXIS)	The current position of the robot is displayed for each axis in degree or mm units.
Mastering position (MSTR POS)	A mastering position is specified for an axis to be subjected to single axis mastering. It would be convenient to set to it to the 0_ position.
SEL	This item is set to 1 for an axis to be subjected to single axis mastering. Usually, it is 0.
ST	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]. The following screen will be displayed.

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

                                          EXEC
```

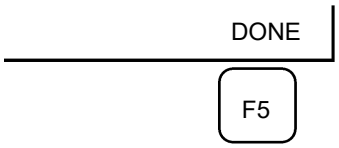
4 Move the cursor to the [SEL] column for the unmastered axis and press the numeric key [1]. Setting of [SEL] is available for one or more axes.
5 Turn off brake control, then jog the robot to the mastering position.
6 Enter axis data for the mastering position.
7 Press F5 [EXEC]. Mastering is performed. 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 turn off the controller power and on again.

8.7 MASTERING DATA ENTRY

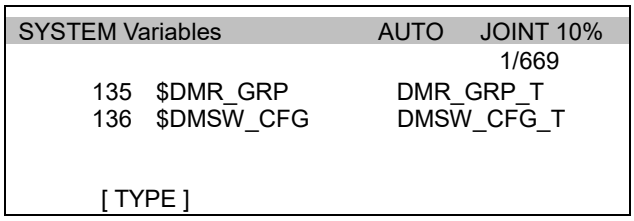
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

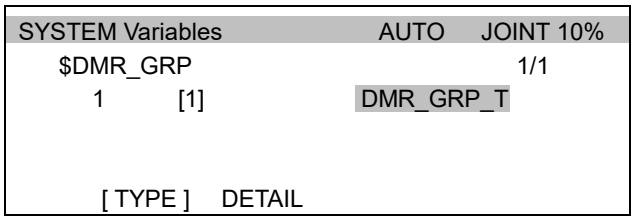
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen will be displayed.

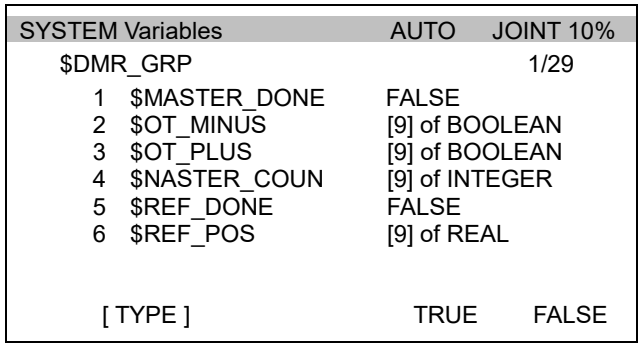
```
SYSTEM Variables              AUTO    JOINT 10%
                                        1/669
   1  $AAVM_GRP          AAVM_GRP_T
   2  $AAVM_WRK          AAVM_WRK_T
   3  $ABSPOS_GRP        ABSPOS_GRP_T
   4  $ACC_MAXLMT        0
   5  $ACC_MINLMT        0
   6  $ACC_PRE_EXE       0


     [ TYPE ]   DETAIL
```

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

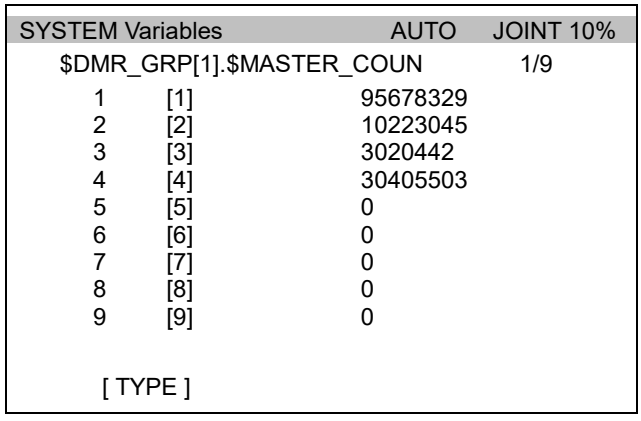


4 Select $DMR_GRP.

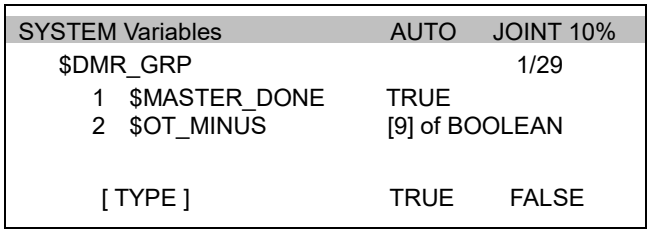




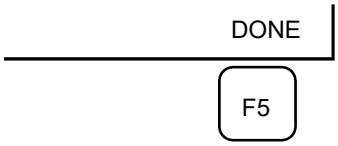
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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 matches the actual robot position by using one or more of the procedures described below:
(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the zero-degree position marks indicated in Section 8.3 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 types displayed during mastering and their solution method:
(1) BZAL alarm
This alarm is displayed if the Pulsecoder's backup battery voltage decreases to 0 V while the power to the controller is disconnected. Furthermore, if the Pulsecoder connector is removed for cable replacement, etc. this alarm is displayed as the voltage decreases to 0. Check to see if the alarm will disappear by performing a pulse reset (See Section 8.2.). Then, cycle controller power and check if the alarm disappears or not.
The battery may be drained if the alarm is still displayed. Perform a pulse reset, and turn off and on the controller power after replacing the battery. Note that, if this alarm is displayed, all the original data held by the Pulsecoder will be lost. Mastering is required.
(2) BLAL alarm
This alarm is displayed if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is displayed, replace the battery with a new one immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
(3) Alarm notification like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may have trouble with Pulsecoder, contact your local FANUC representative.

8.9 MASTERING BACKUP AND RESTORATION WHEN CONTINUOUS ROTATION ENABLED

Refer to Section 6.2 for backup and restoration of mastering data when the continuous rotation is enabled.

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-84035EN)" 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 between the J1 base and floor plate. - A J1 base retaining bolt is loose.	[J1 base fastening] - It is likely that the robot J1 base is not securely fastened to the floor plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or contamination caught between the robot and floor plate. - If the robot is not securely fastened to the floor plate, the J1 base lifts the floor plate as the robot operates, allowing the base and floor plates to strike each other. That, in turn, leads to vibration.	- If a bolt is loose, apply LOCTITE and tighten it to the appropriate torque. - Adjust the floor plate surface flatness to within the specified tolerance. - If there is any contamination between the J1 base and floor plate, remove it.
	- The rack or floor plate vibrates during operation of the robot.	[Rack or floor] - It is likely that the rack or floor is not rigid enough. - If they are not rigid enough, counterforce 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 might reduce the vibration.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- 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).
	- Vibration was first noticed after the robot collided with an object or the robot was overloaded for a long period. - Cyclical vibration and noise occur.	[Bearing, ball screw spline or reducer] - It is likely that the collision or overload applied an excessive force to the drive mechanism, thus damaging the rolling surface of a bearing, ball screw spline or reducer. - It is likely that prolonged use of the robot while overloaded caused fretting of rolling surface of a bearing, ball screw spline or reducer due to resulting metal fatigue. - It is likely that contamination which was caught in a bearing, ball screw spline or within a reducer caused damage on the rolling surface of the bearing, or reducer. - It is likely that contamination which was caught in a bearing, ball screw spline or within a reducer cause vibration. - It is likely that, because the grease has not been replenished for a long period, peeling occurred on the bearing, the ball screw spline, or 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, the ball screw spline 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.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical unit.	[Controller, cable, and motor] - If a failure occurs in a controller circuit, preventing control commands from being supplied to the motor normally, or preventing motor information from being sent to the controller normally, vibration might occur. - A Pulsecoder 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 robot connection cable 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.	- Refer to the Controller Maintenance Manual for troubleshooting related to the controller and amplifier. - Replace the motor of the axis that is vibrating, and check whether vibration still occurs. For the method of replacement, contact your local FANUC representative. - If vibration occurs only when the robot assumes a specific posture, it is likely that there is a mechanical problem. - Check whether the cable jacket of the robot connection cable is damaged. If so, replace the connection cable, and check whether vibration still occurs. - Check whether the power cable jacket is damaged. If so, replace the power cable, and check whether vibration still occurs. - Check that the robot is supplied with the rated voltage. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct them. Contact your local FANUC representative for further information if necessary. - Contact your local FANUC representative if performing the belt check.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- There is some relationship between the vibration of the robot and the operation of a machine near the robot.	[Noise from a nearby machine] - If the robot is not grounded properly, electrical noise 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.

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 unit coupling bolt]
		- It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical unit.
			- 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 motor overheated due to a rise in temperature in the installation area. - After changing the Robot control program or the load, the motor overheated.	[Ambient temperature] - It is likely that the motor overheated when the ambient temperature rose, and could not dissipate the heat. [Operating condition] - It is likely that the overcurrent is above the specified permissive average current.	- 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 load condition is an effective way to reduce the average current. Thus, prevent overheating. - The teach pendant can be used to monitor the average current. Check the average current when the robot control program is 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 accelerate or decelerate normally, so the average current increases, leading to the motor overheating.	- As for load setting, Input an appropriate parameter referring to Section 4.3.

Symptom	Description	Cause	Measure
Motor overheating	- Symptom other than stated above	[Mechanical unit 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.

Grease leakage	- Grease is leaking from the mechanical unit.	[Poor sealing]
		- Probable causes are a crack in the casting, 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 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.
		- There is a possibility that too much grease is applied to the ball screw spline.
			- 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.
			- Oil seals are used in the locations stated below.
			  - Inside the reducer
			  - Inside the wrist
			- Seal bolts are used in the locations stated below.
			  - Grease inlet
			- Wipe off grease on the ball screw spline adequately.

Dropping axis	- An axis drops because the brake failed.
	- An axis drops gradually when it should be at rest.
		[Brake drive relay and motor]
		- It is likely that the brake drive relay contacts are stuck to each other keeping the brake current flowing, thus preventing the brake from operating when the motor is de-energized.
		- 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 or not. If they are stuck, replace the relay.
			- Replace the motor after confirming the following symptoms.
			  - Brake shoe is worn out
			  - Brake main body is damaged
			  - Oil soaked through the motor

Symptom	Description	Cause	Measure
Displace-ment	- The robot moves to a point other than the taught position. - The repeatability is not within the tolerance.	[Mechanical unit 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 faulty.	- If the repeatability is unstable, repair the mechanical unit by referring to the above descriptions of vibration, noise, and rattling. - If the repeatability is stable, correct the taught program. The problem will not reoccur unless another collision occurs. - If the Pulsecoder is faulty, 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 "ACC (value)". ・ 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 influence on 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 displayed	- BZAL is displayed on the teach pendant screen.	- The voltage of the memory backup battery may be low. - The Pulsecoder cable may be broken.	- Replace the battery. - Replace the cable.

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot SR-3*i*A/U **Periodic Maintenance Table**

Items		Accumulated operating time (H) / Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 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.	1.0H	—		○			○				○			
	6	Check the fixed mechanical stopper.	0.1H	—		○			○				○			
	7	Clean spatters, sawdust and Dust	1.0H	—		○	○	○	○	○	○	○	○	○	○	○
	8	Check the end effector (hand) cable	0.1H	—		○			○				○			
	9	Replacing battery. (if built-in batteries are specified) *3	0.1H	—					●				●			
	10	Greasing the ball screw spline	0.1H	Proper quantity			●		●		●		●		●	
	11	Confirm the belt tension	0.1H						○				○			
	12	Replacing cable of mechanical unit	1.0H	—									●			
Controller	13	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○				○			
	14	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	15	Replacing batteries *1 *3	0.1H	—												

*1 Refer to the “REPLACING UNITS Chapter of “MAINTENANCE” in the following manuals.
CONTROLLER MAINTENANCE MANUAL (B-84035EN)

*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
○				○				○				○				○					6
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		7
○				○				○				○				○					8
●				●				●				●				●					9
●		●		●		●		●		●		●		●		●		●			10
○				○				○				○				○					11
				●								●									12
○				○				○				○				○					13
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		14
				●																	15

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.

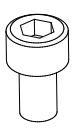
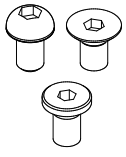
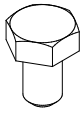
Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:

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

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