FANUC Robot M-430*i*A

MECHANICAL UNIT
OPERATOR'S MANUAL

B-82554EN/08

- **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.

This manual can be used with controllers labeled R-30*i*A or R-J3*i*C. If you have a controller labeled R-J3*i*C, you should read R-30*i*A as R-J3*i*C throughout this manual.

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

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

SAFETY PRECAUTIONS

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

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

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

1 PERSONNEL

Personnel can be classified as follows.

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

Programmer or Teaching operator:
- Operates the robot
- Teaches the robot inside the safeguarded space

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

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

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

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

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

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

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

2 DEFINITION OF SAFETY NOTATIONS

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

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

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

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

Name	Specification
Brake release unit	A05B-2450-J350 (Input voltage AC100-115V single phase) A05B-2450-J351 (Input voltage AC200-240V single phase)
Robot connection cable	A05B-2525-J049 (M-430*i*A/2P 5m) A05B-2525-J050 (M-430*i*A/2P 10m) A05B-2525-J051 (M-430*i*A/2F/2FH/4FH/2PH 5m) A05B-2525-J052 (M-430*i*A/2F/2FH/4FH/2PH 10m)
Power cable	A05B-2525-J010 (5m) (AC100-115V Power plug) (*) A05B-2525-J011(10m) (AC100-115V Power plug) (*) A05B-2450-J364 (5m) (AC100-115V or AC200-240V No power plug) A05B-2450-J365(10m) (AC100-115V or AC200-240V No power plug)

(*) These do not support CE marking.

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

⚠ CAUTION
Robot systems installed without adequate number of brake release units or similar means are not in compliance with EN ISO 10218-1 and the Machinery Directive and therefore cannot bear the CE marking.

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

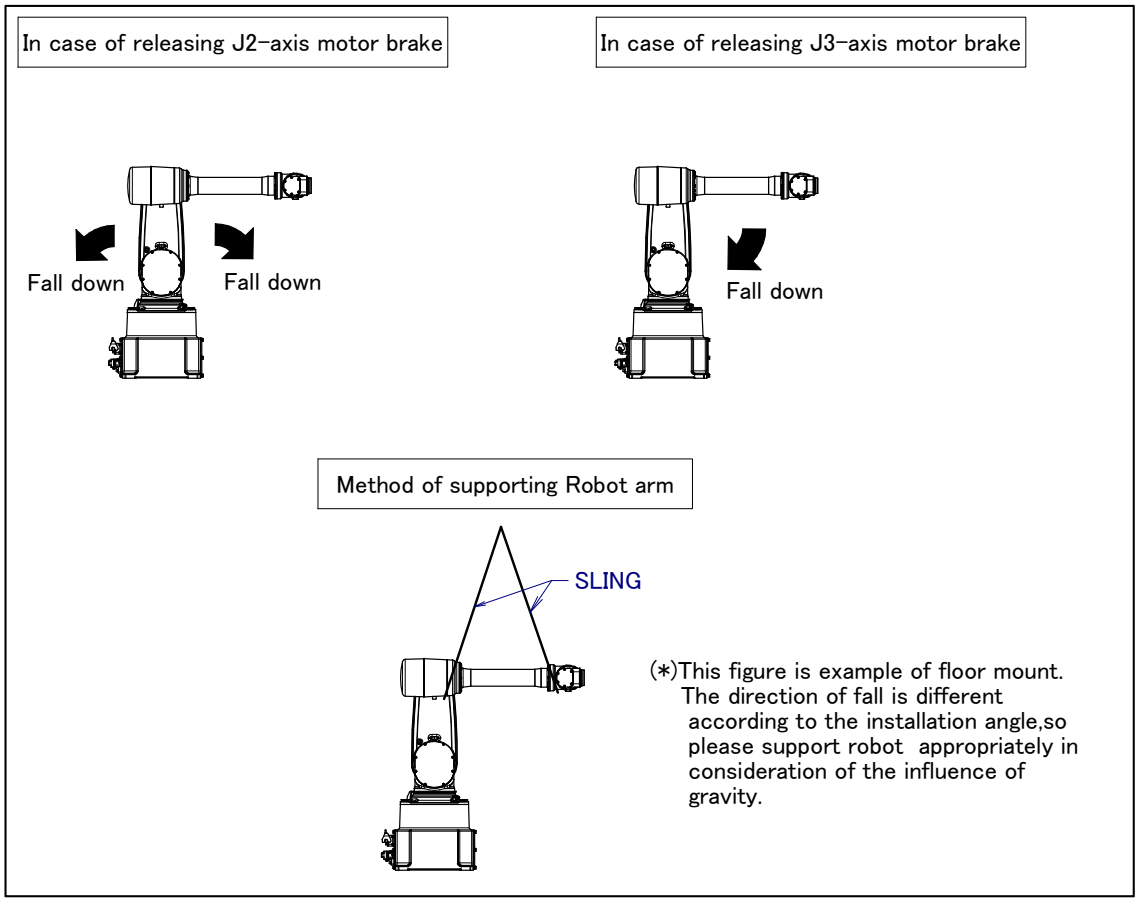


Fig. 3 (a) Arm operation by the release of J2, J3-axis motor brakes and measures

4 WARNING & CAUTION LABEL

(1) Greasing and degreasing label

Fig. 4 (a) Greasing and degreasing label

Description

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

1) When greasing, be sure to keep the grease outlet open.
2) Use a manual pump to grease.
3) Be sure to use specified grease.

> ⚠ **CAUTION**
> See Section 7 ″CHECKS AND MAINTENANCE″ for explanations about specified grease, the grease amount, and the locations of grease and degrease outlets for individual models.

(2) Transportation label

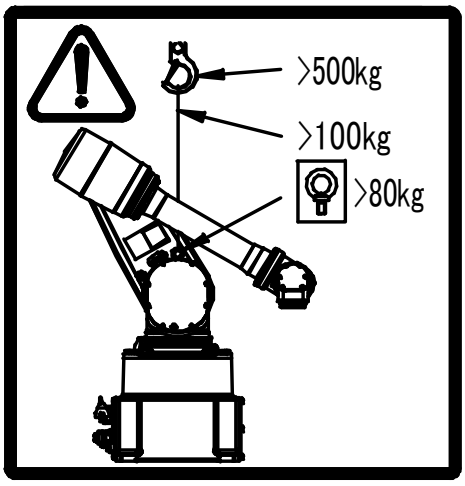


Fig. 4 (b) Transportation label

Description

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

- Use a crane having a load capacity of 500 kg or greater.
- Use at least one slings each having a load capacity of 100 kg or greater.
- Use at least one M8 eyebolt each having an allowable load of 784 N (80 kgf) or greater.

> ⚠ **CAUTION**
> See 1.1 TRANSPORTATION for explanations about the posture a specific model should take when it is transported.

(3) Operating space and payload label

Below label is added when CE specification is specified.

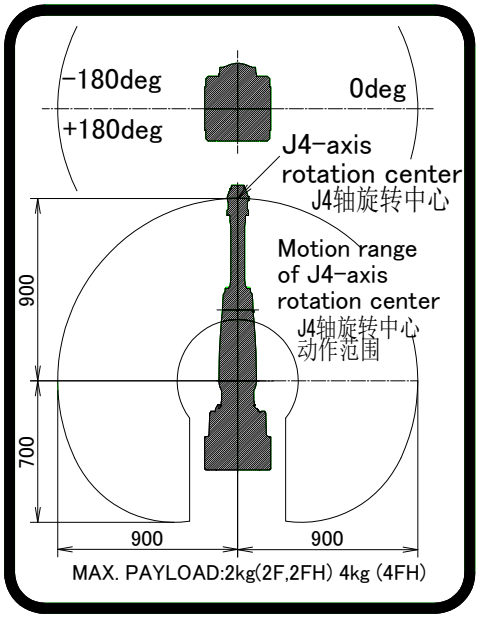


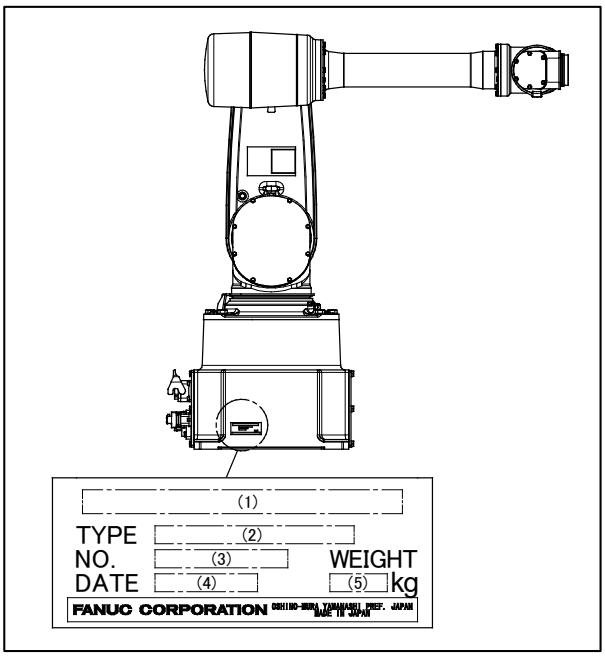
Fig. 4 (c) Operating space and payload label

PREFACE

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

Model name	Mechanical unit specification No.	Maximum load
FANUC Robot M-430*i*A/2F	A05B-1521-B201	2kg
	A05B-1521-B211	
FANUC Robot M-430*i*A/2FH	A05B-1521-B202	
	A05B-1521-B212	
FANUC Robot M-430*i*A/4FH	A05B-1521-B213	4kg
FANUC Robot M-430*i*A/2PH	A05B-1521-B222	2kg
FANUC Robot M-430*i*A/2P	A05B-1521-B241	
	A05B-1521-B251	

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



Position of label indicating mechanical unit specification number

TABLE 1 (a)

	(1)	(2)	(3)	(4)	(5)
CONTENTS	**Model name**	**TYPE**	**No.**	**DATE**	**WEIGHT kg (Without controller)**
LETTERS	FANUC Robot M-430*i*A/2F	A05B-1521-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	55
		A05B-1521-B211			
	FANUC Robot M-430*i*A/2FH	A05B-1521-B202			55
		A05B-1521-B212			
	FANUC Robot M-430*i*A/4FH	A05B-1521-B213			55
	FANUC Robot M-430*i*A/2PH	A05B-1521-B222			57
	FANUC Robot M-430*i*A/2P	A05B-1521-B241			45
		A05B-1521-B251			

RELATED MANUALS

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

SAFETY HANDBOOK **B-80687EN** All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers: Operator, system designer Topics: Safety items for robot system design, operation, maintenance
R-30*i*A CONTROLLER	OPERATOR'S MANUAL HANDLING TOOL **B-83124EN-2** ALARM CODE LIST **B-83124EN-6**	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-82595EN** **B-82595EN-1 (For Europe)** **B-82595EN-2 (For RIA)**	Intended readers: Maintenance technician, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance
R-30*i*B 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-83195EN**	Intended readers: Maintenance technician, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance

This manual uses following terms.

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

TABLE OF CONTENTS

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

Use a crane to transport the robot. When transport the robot, it makes to the posture of Fig. 1.1 (c), (d), and fasten the M8 eyebolt referring to Fig.1.1 (a), and use and lift up by a sling.

⚠ WARNING
1 Before moving the robot by using the transport equipment, check and tighten any loose bolts on the transport equipment.
2 Do not pull an eyebolt sideways.

⚠ CAUTION
When lifting the robot, take notice so that the motor, connectors, or cables of the robot are not damaged by slings.

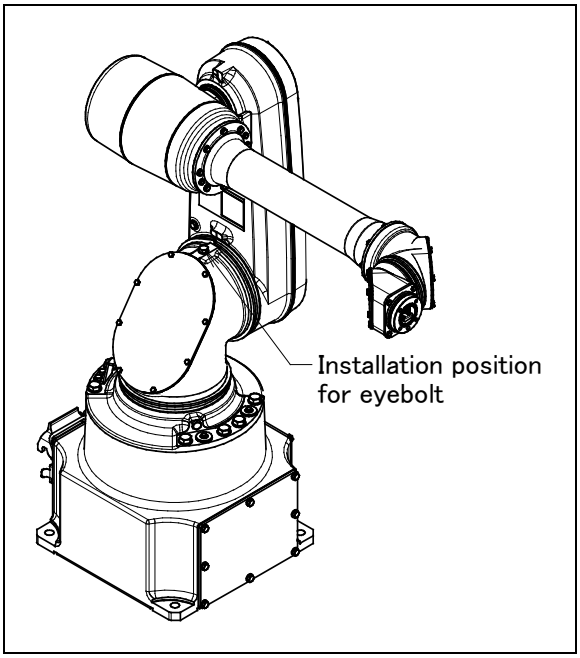


Fig. 1.1 (a) Position of the eyebolts installation

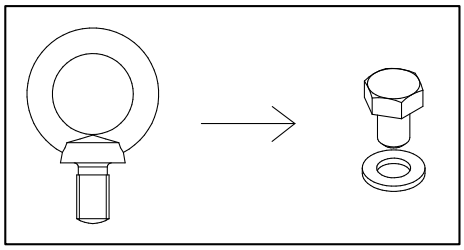


Fig.1.1 (b) Mounting bolt after transportation

If transport task is finished, remove M8 eyebolt which is installed to J2 base unit and tighten resin washer and hexagon head seal bolt to the same place.

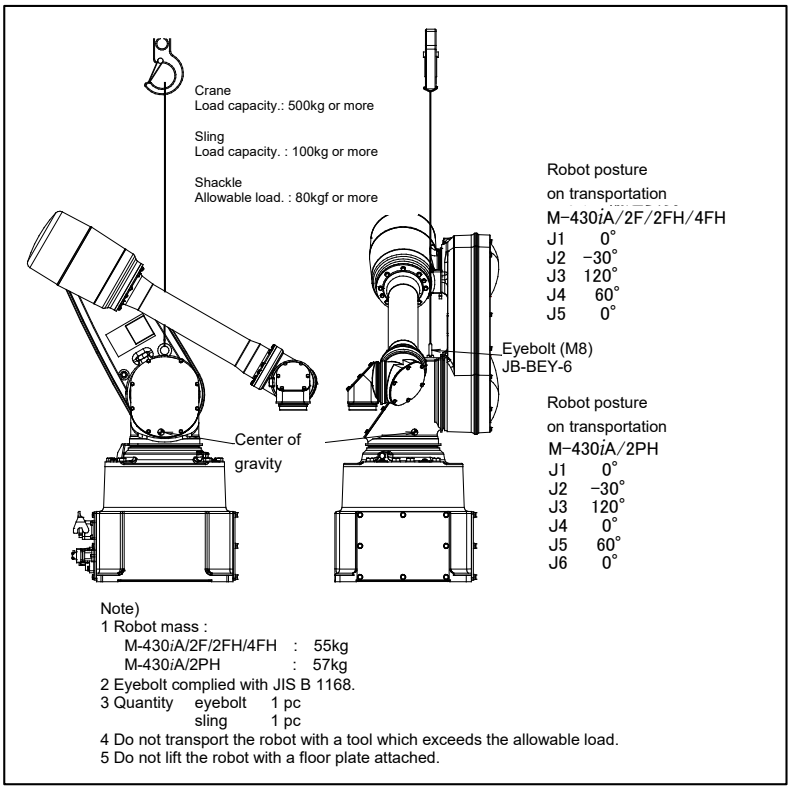


Fig. 1.1 (c) Transportation using a crane (M-430*i*A/2F/2FH/4FH/2PH)

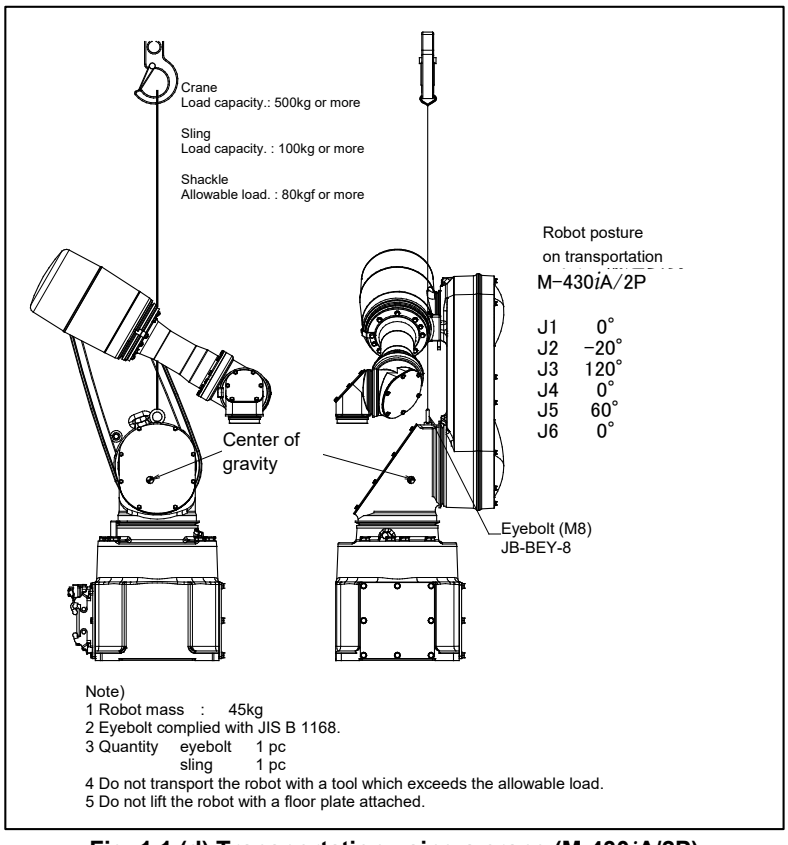


Fig. 1.1 (d) Transportation using a crane (M-430*i*A/2P)

1.2 INSTALLATION

Fig. 1.2 (a) and (b) show the robot base dimensions. Avoid placing any object in front of the robot on the mounting surface to facilitate the installation of the mastering fixture.

> **⚠ CAUTION**
> Flatness of robot installation surface must be less than or equal to 0.5mm.
> Inclination of robot installation surface must be less than or equal to 0.5°.
> If robot base is placed on uneven ground, it may result in the base breakage or low performance of the robot.

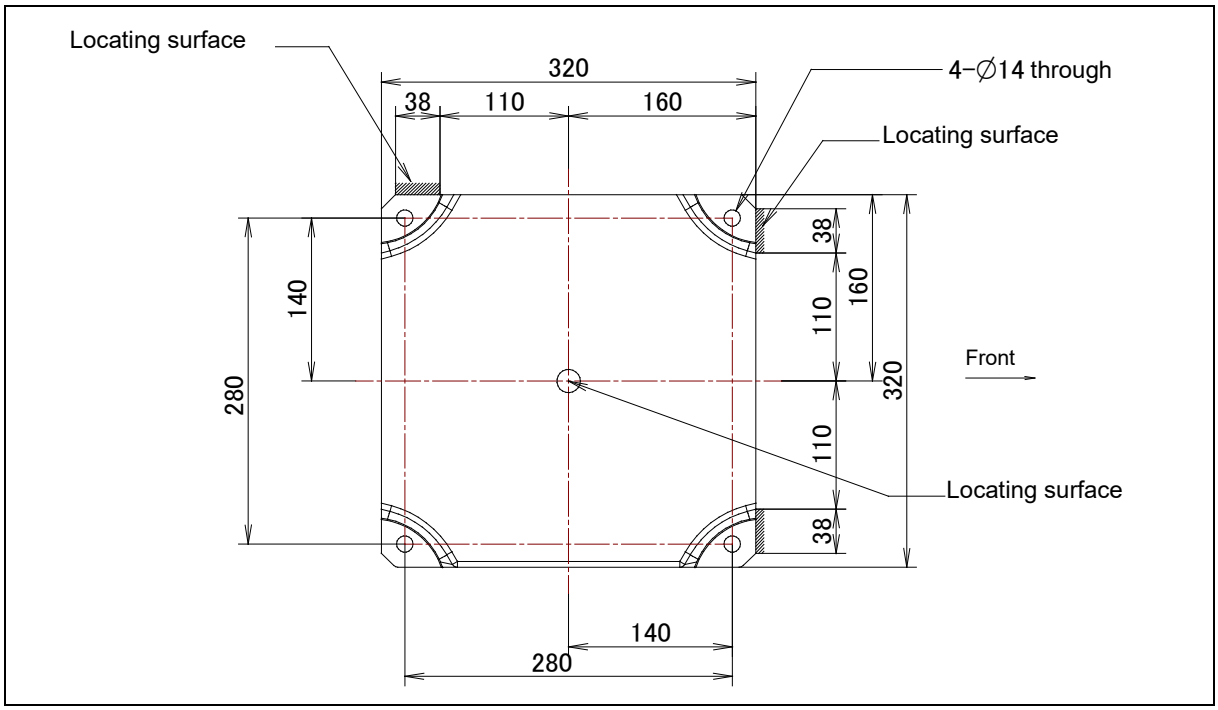


Fig. 1.2 (a) Dimensions of the robot base (M-430*i*A/2F/2FH/4FH/2PH)

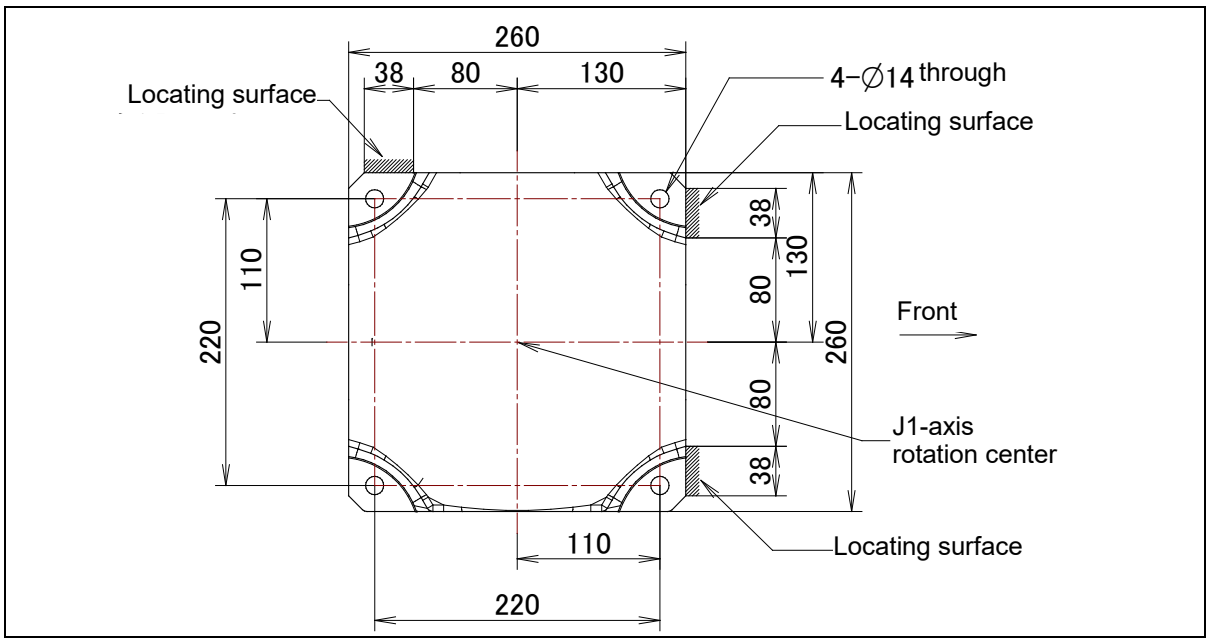


Fig. 1.2 (b) Dimensions of the robot base (M-430*i*A/2P)

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

NOTE
Table 1.2 (b) and (c) are measured reference value complied with ISO10218-1. values differ depending on each robot individual difference, payload and the program. So confirm the real value by measurement. Values in Table 1.2 (b) are affected by the robot operating status and number of times of the servo-off stop. Periodically measure the real values and confirm those.

Table 1.2 (a) Force and moment during Power-Off stop

Model	Vertical moment M_V [kNm(kgfm)]	Force in vertical direction F_V [kN(kgf)]	Horizontal moment M_H [kNm(kgfm)]	Force in horizontal direction F_H [kN(kgf)]
M-430*i*A/2F/2FH/4FH/2PH	0.63 (64.3)	0.98 (100.0)	0.74 (75.5)	1.10 (112.2)
M-430*i*A/2P	0.23 (23.5)	0.79 (80.6)	0.32 (32.7)	0.56 (57.1)

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

Model		J1-axis	J2-axis	J3-axis
M-430*i*A/2F/2FH/4FH/2PH	Stopping time [ms]	200	330	160
	Stopping distance [deg] (rad)	30.0 (0.52)	45.9 (0.80)	26.8 (0.47)
M-430*i*A/2P	Stopping time [ms]	205	154	80
	Stopping distance [deg] (rad)	22.1 (0.39)	20.5 (0.36)	12.9 (0.22)

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

Model		J1-axis	J2-axis	J3-axis
M-430*i*A/2F/2FH/4FH/2PH	Stopping time [ms]	260	260	260
	Stopping distance [deg] (rad)	51.0 (0.89)	56.0 (0.98)	54.5 (0.95)
M-430*i*A/2P	Stopping time [ms]	450	460	450
	Stopping distance [deg] (rad)	74.7 (1.3)	66.6 (1.16)	73.9 (1.29)

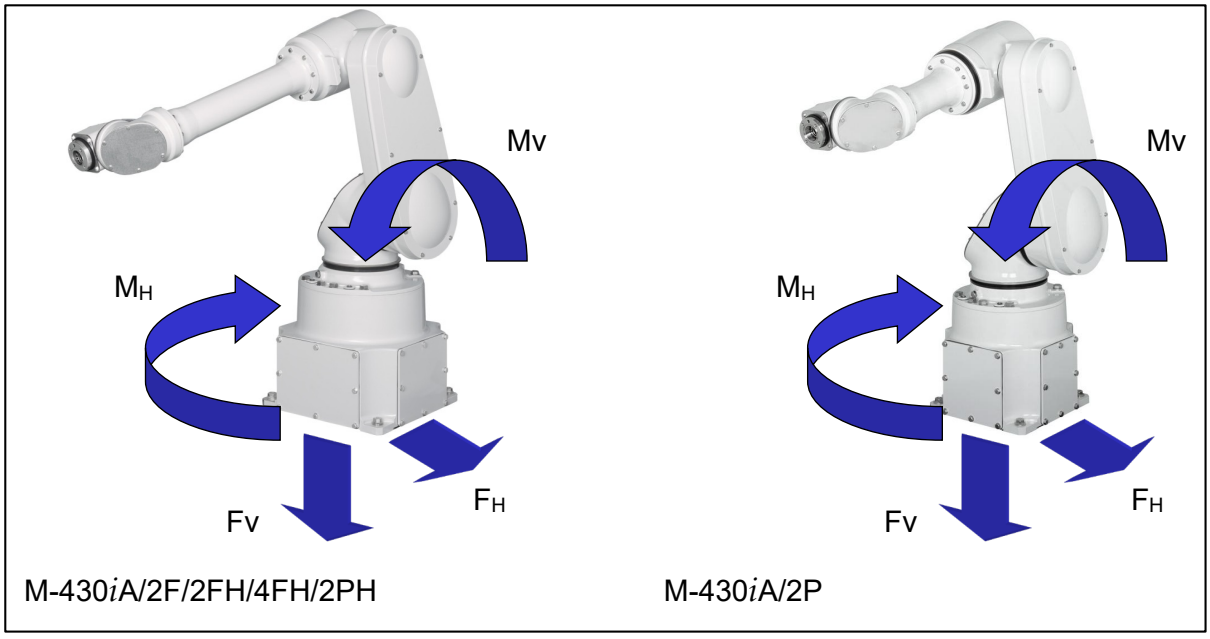


Fig. 1.2 (c) Force during Power-Off Stop

1.3 MAINTENANCE AREA

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

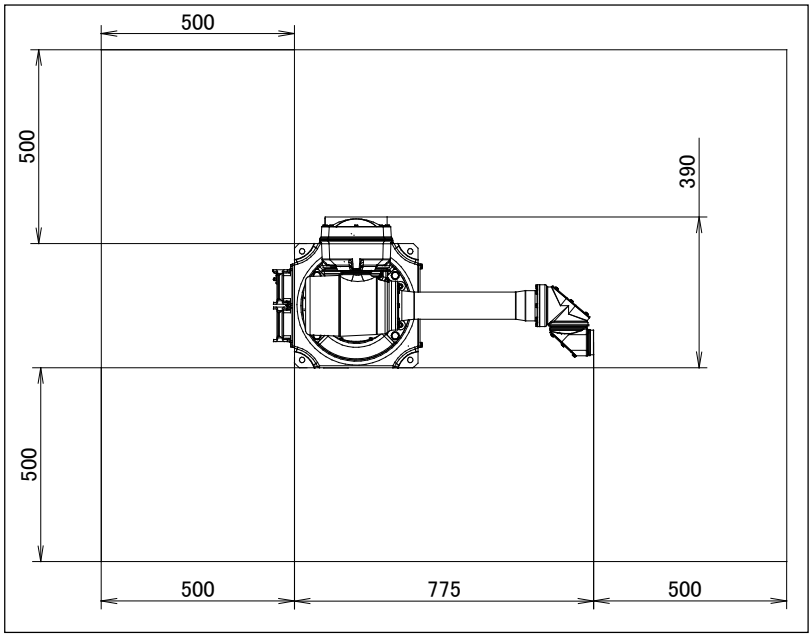


Fig. 1.3 (a) Maintenance area (M-430*i*A/2F/2FH/4FH/2PH)

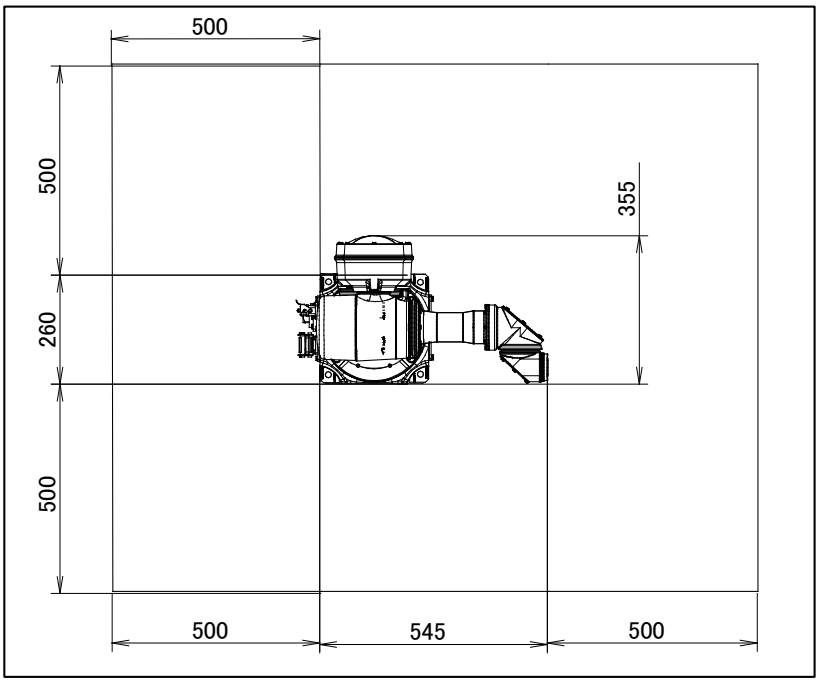


Fig. 1.3 (b) Maintenance area (M-430*i*A/2P)

1.4 INSTALLATION CONDITIONS

Refer to specification of Section 3.1 about installation conditions.

2 CONNECTION WITH THE CONTROLLER

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

For details on air and option cables, see Chapter 5.

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

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

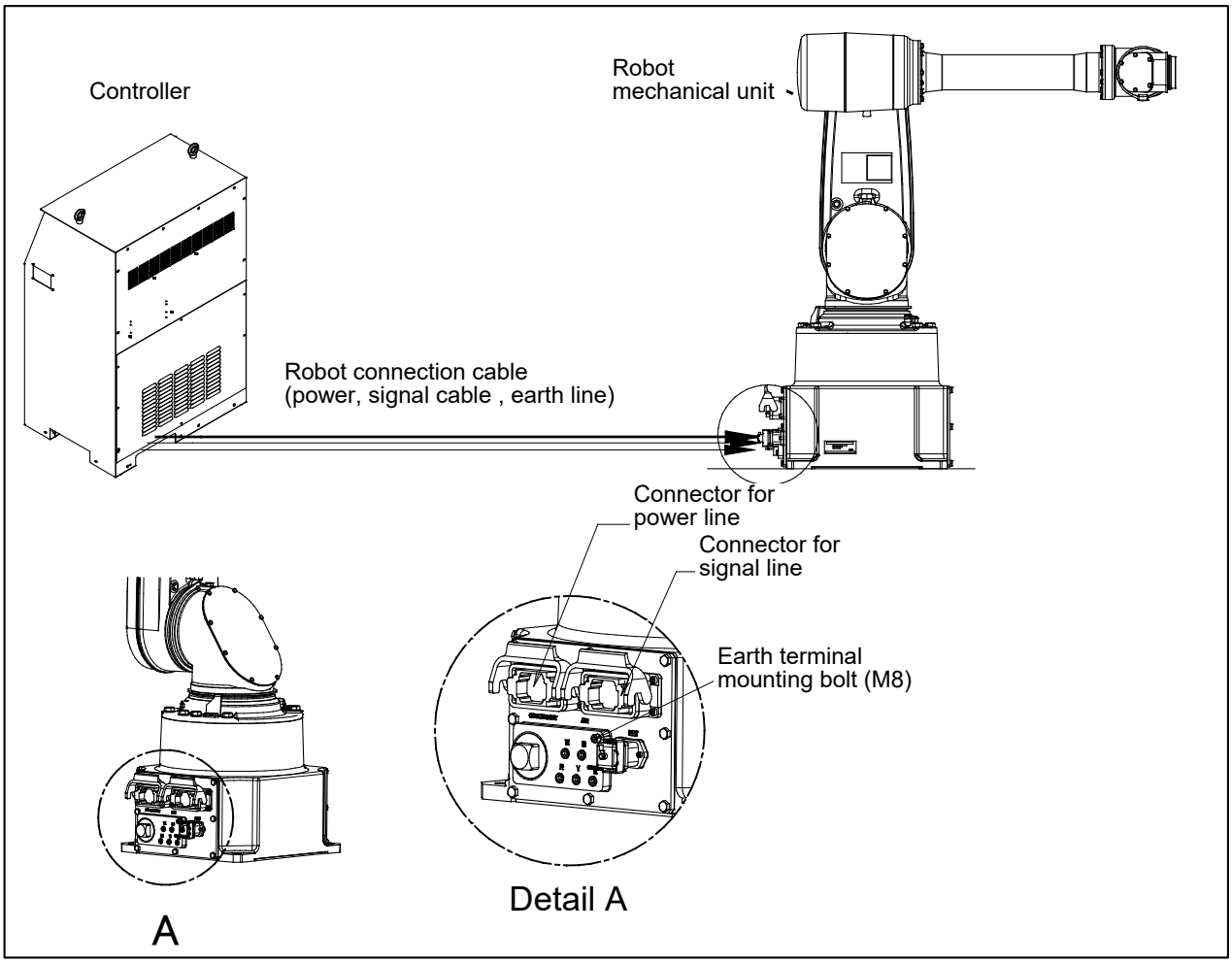


Fig. 2 (a) Cable connection

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

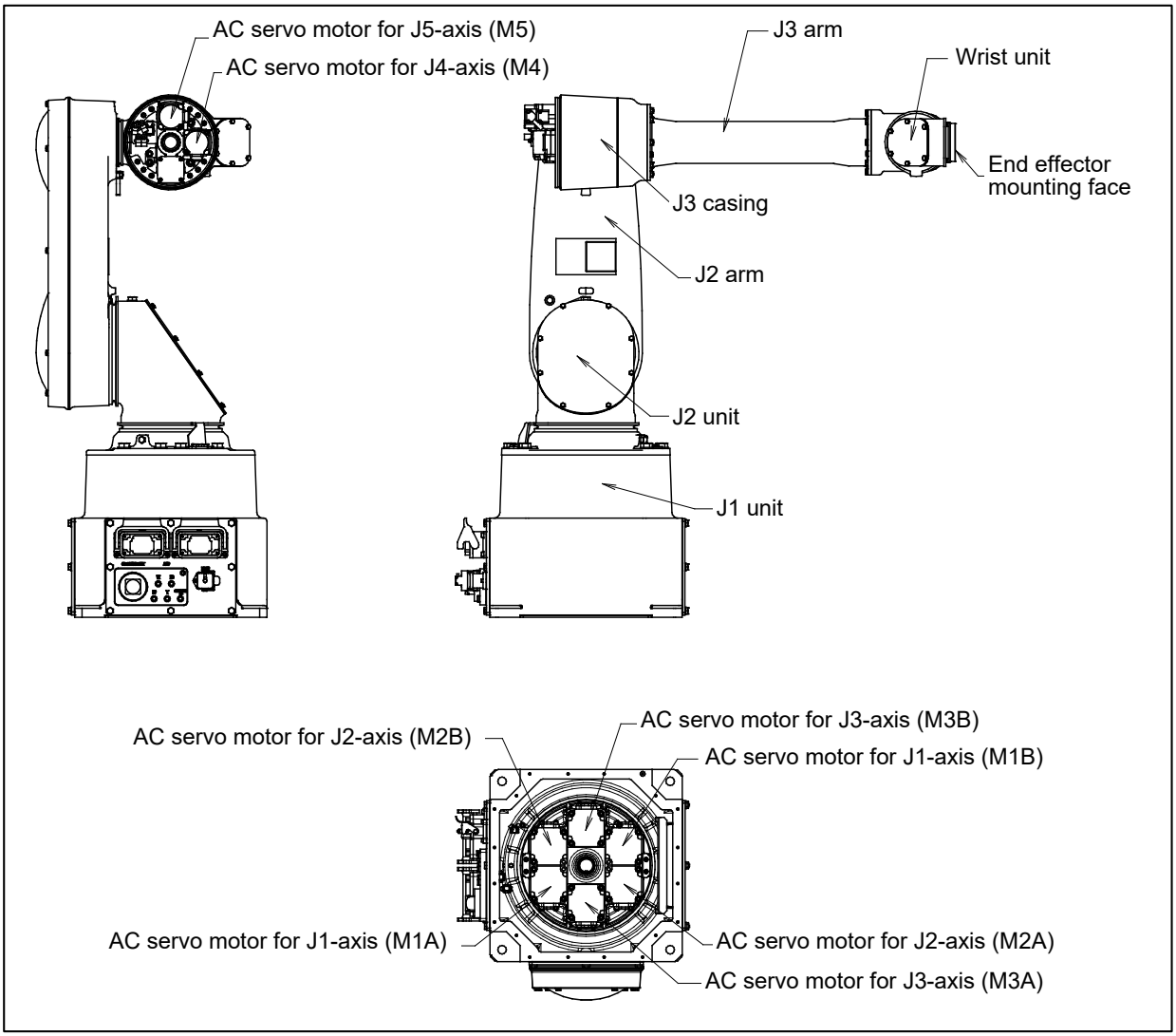


Fig. 3.1 (a) Mechanical unit configuration (M-430*i*A/2F/2FH/4FH)

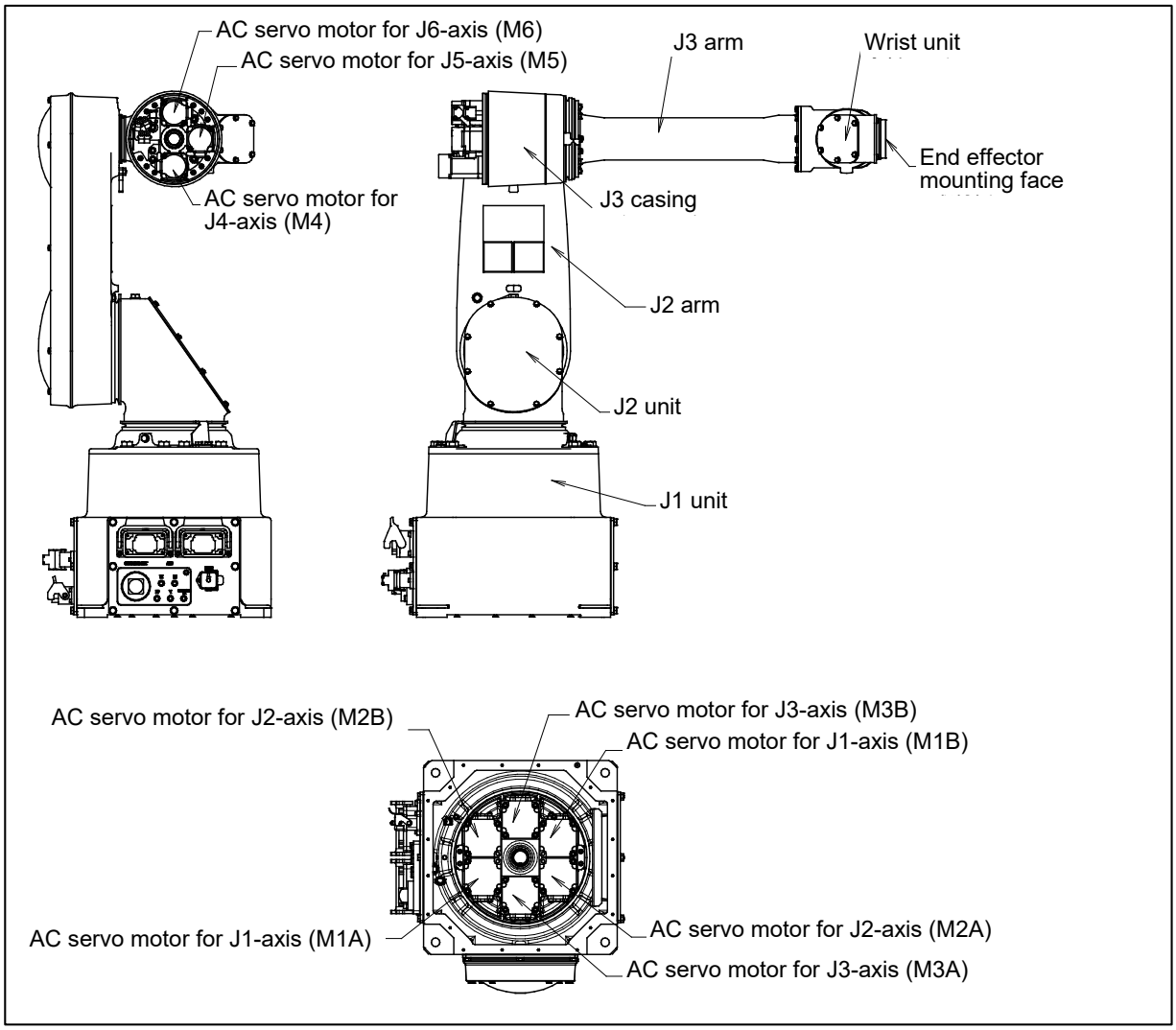


Fig. 3.1 (b) Mechanical unit configuration (M-430*i*A/2PH)

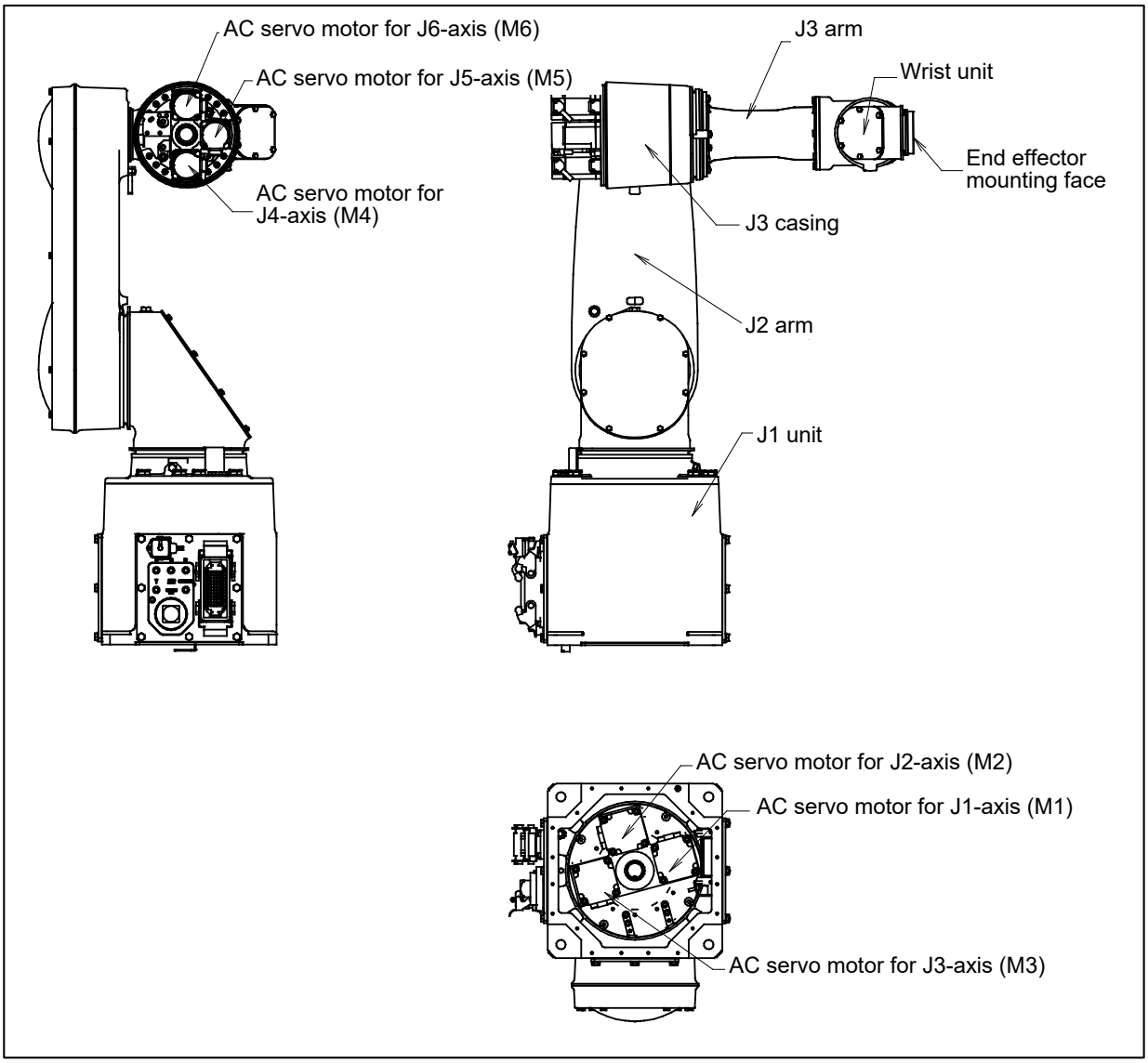


Fig. 3.1 (c) Mechanical unit configuration (M-430*i*A/2P)

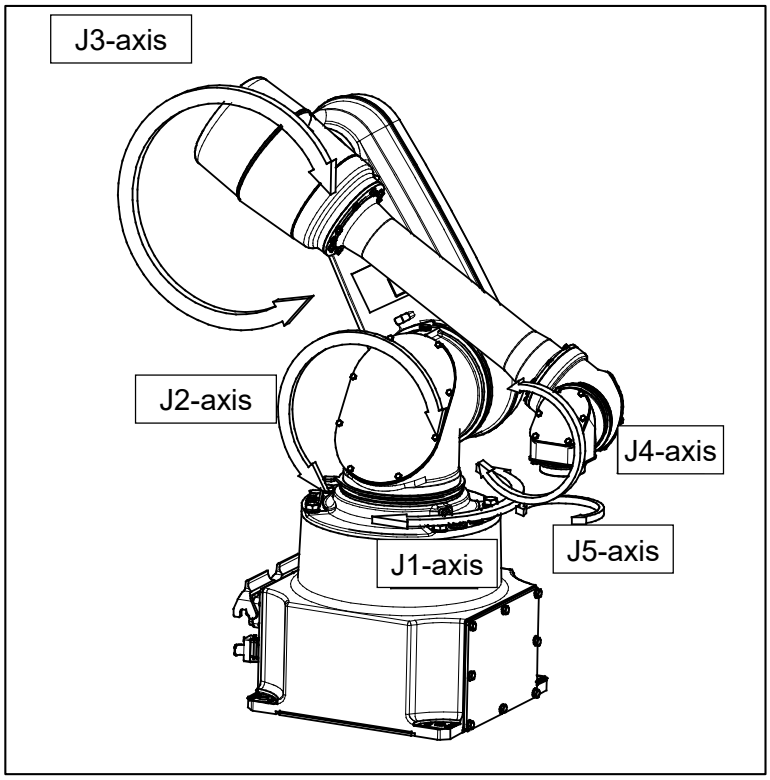


Fig. 3.1 (d) Coordinates for each axis (M-430*i*A/2F/2FH/4FH)

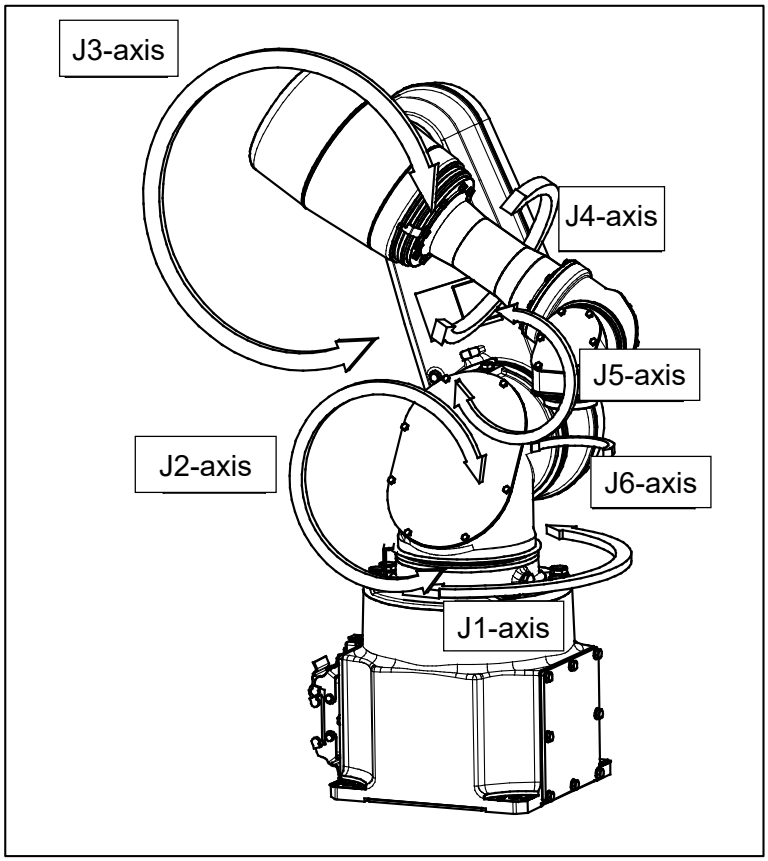


Fig. 3.1 (e) Coordinates for each axis (M-430*i*A/2PH/2P)

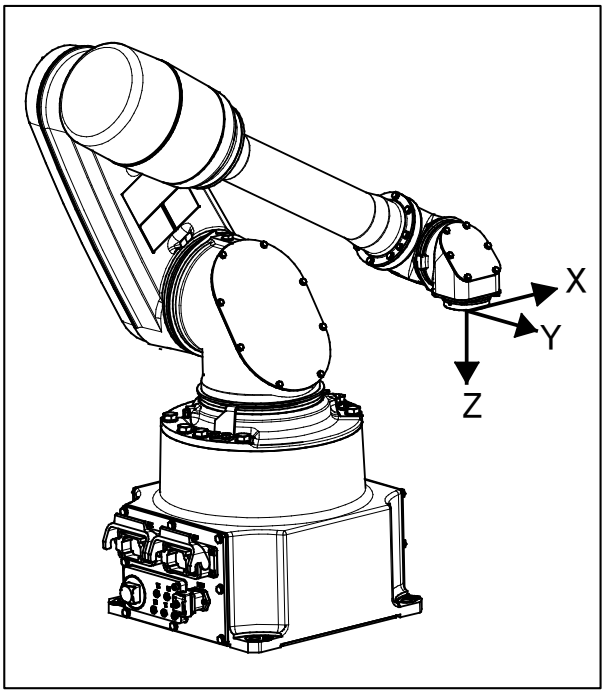


Fig. 3.1 (f) Mechanical interface coordinates (M-430*i*A/2F/2FH/4FH)

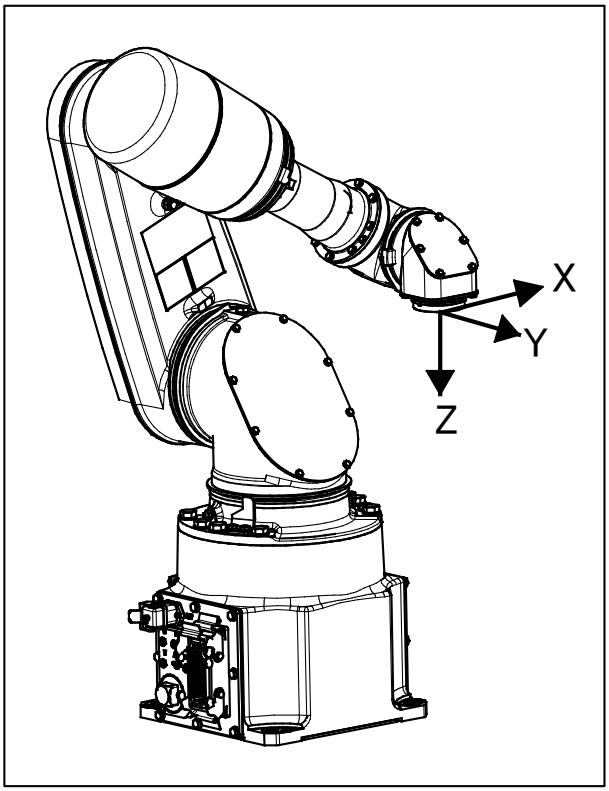


Fig. 3.1 (g) Mechanical interface coordinates (M-430*i*A/2PH/2P)

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

Table 3.1 (a) Specifications (NOTE 1)

		M-430*i*A/2F	M-430*i*A/2FH (NOTE 2)	M-430*i*A/4FH (NOTE 2)	M-430*i*A/2PH	M-430*i*A/2P
Controlled axis		5-axes			6-axes	
Max. load capacity		2kg		4kg	2kg	
Installation		Floor, upside-down, wall mount				
Motion range (Max. speed) (NOTE 3)	J1	360° (300°/s)	360° (300°/s)	360° (300°/s)	360° (300°/s)	360° (300°/s)
	J2	230° (320°/s)	230° (320°/s)	230° (320°/s)	230° (320°/s)	230° (320°/s)
	J3	383° (320°/s)	383° (320°/s)	383° (320°/s)	383° (320°/s)	400° (340°/s)
	J4	300° (360°/s)	300° (360°/s)	300° (360°/s)	380° (500°/s)	380° (300°/s)
	J5	540° (1200°/s)	540° (2000°/s)	540°(2000°/s)	300° (500°/s)	300° (300°/s)
	J6				540° (1700°/s)	540° (720°/s)
Reach		900 mm	900 mm	900 mm	900 mm	700 mm
Allowable load moment at wrist	J4	3.5 N·m	3.5 N·m	3.5 N·m	3.5 N·m	3.5 N·m
	J5	1.5 N·m	0 N·m	0 N·m	3.5 N·m	3.5 N·m
	J6				1.5 N·m	1.5 N·m
Allowable load inertia at wrist	J4	0.032 kgm^2	0.032 kgm^2	0.064 kgm^2	0.032 kgm^2	0.032 kgm^2
	J5	0.0065 kgm^2	0.0050 kgm^2	0.010 kgm^2	0.032 kgm^2	0.032 kgm^2
	J6				0.0050 kgm^2	0.0065 kgm^2
Repeatability		± 0.5 mm				
Protection		Conform to IP67 (NOTE 4)				
Mass		55 kg	55 kg	55 kg	57 kg	45 kg
Acoustic noise level		73.3dB (Note 5)				
Installation environment		Ambient temperature : 0 - 45°C (NOTE 6) Ambient humidity : Normally 75%RH or less. No dew, nor frost allowed. Short time (within one month) Max 95%RH Height: Up to 1,000 meters above the sea level required, no particular provision for attitude. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 7)				

NOTE

1) Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat. Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.
2) The wrist must always be pointed upward or downward when the M-430*i*A/2FH/4FH model is used.
3) During short distance motions, the axis speed may not reach the maximum value stated.
4) Don't use unconfirmed liquid.
5) 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
6) 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, for example during a holiday or overnight, viscous resistance of the drive train may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing a warm up operation for several minutes.
7) Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, water, water vapor, cutting oil, cleaning fluid splash and or other contaminations.

3.2 MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE

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

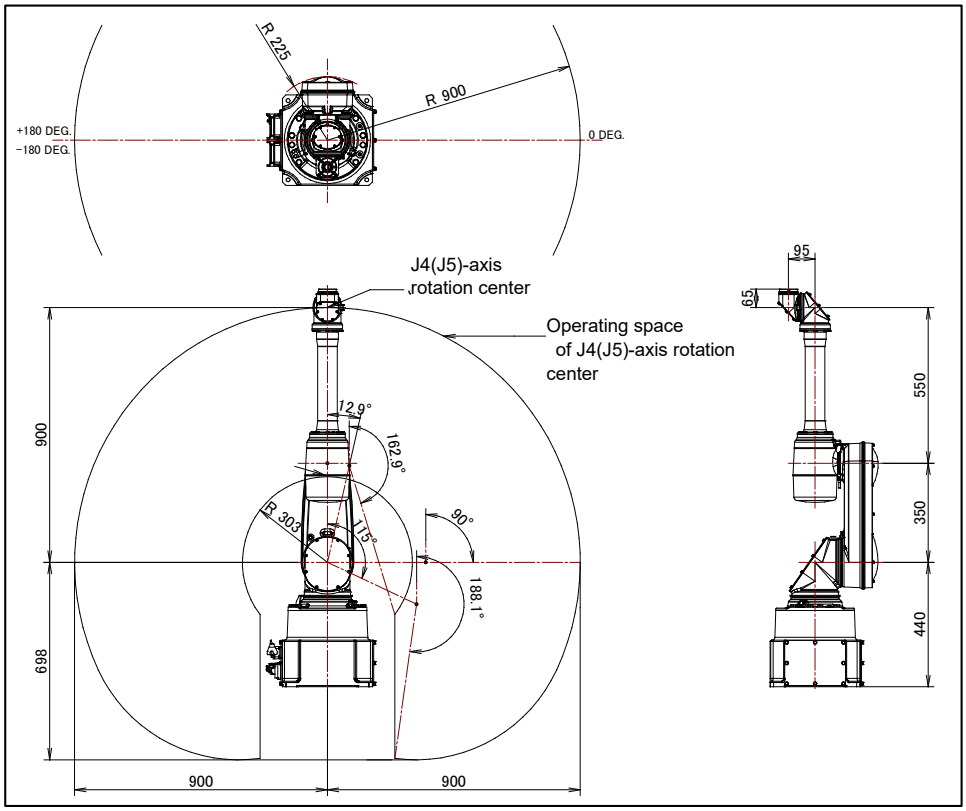


Fig. 3.2 (a) Operating space (M-430*i*A/2F/2FH/4FH/2PH)

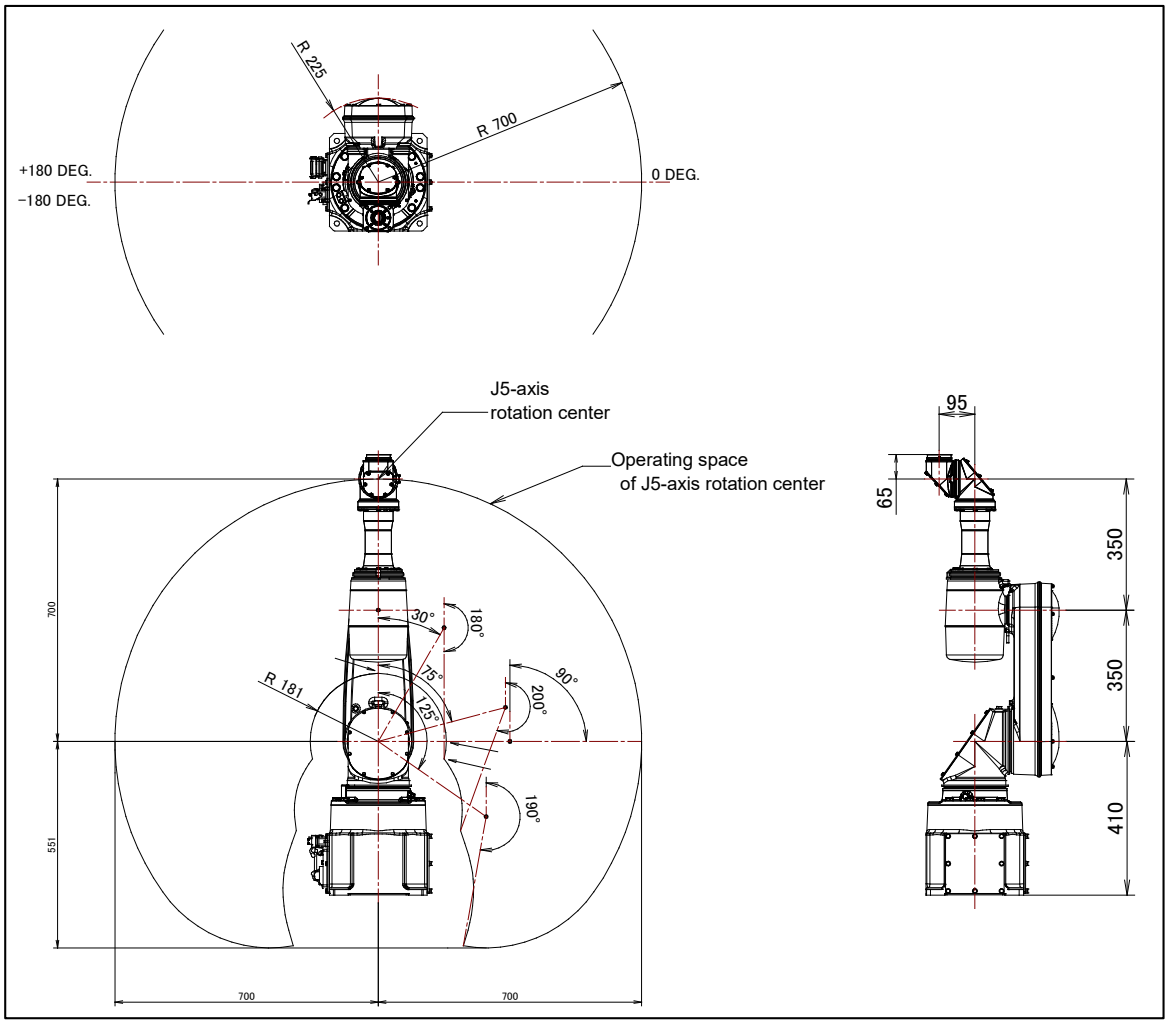


Fig. 3.2 (b) Operating space (M-430*i*A/2P)

3.3 ZERO POINT POSITION AND MOTION LIMIT

A zero point and software motion limit 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 software motion limit unless there is a failure of the system causing loss of zero point position or there is 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 mechanical stopper. In case of J1 to J3 axis, robot stops by transforming mechanical stopper. See Fig.3.3 (a) about J3-axis mechanical stopper. Contact FANUC about replacing method of J1 and J2 –axis mechanical stopper. Be sure to exchange transformed stopper to new one. Don't reconstruct the mechanical stopper. There is a possibility that the robot doesn't stop normally.

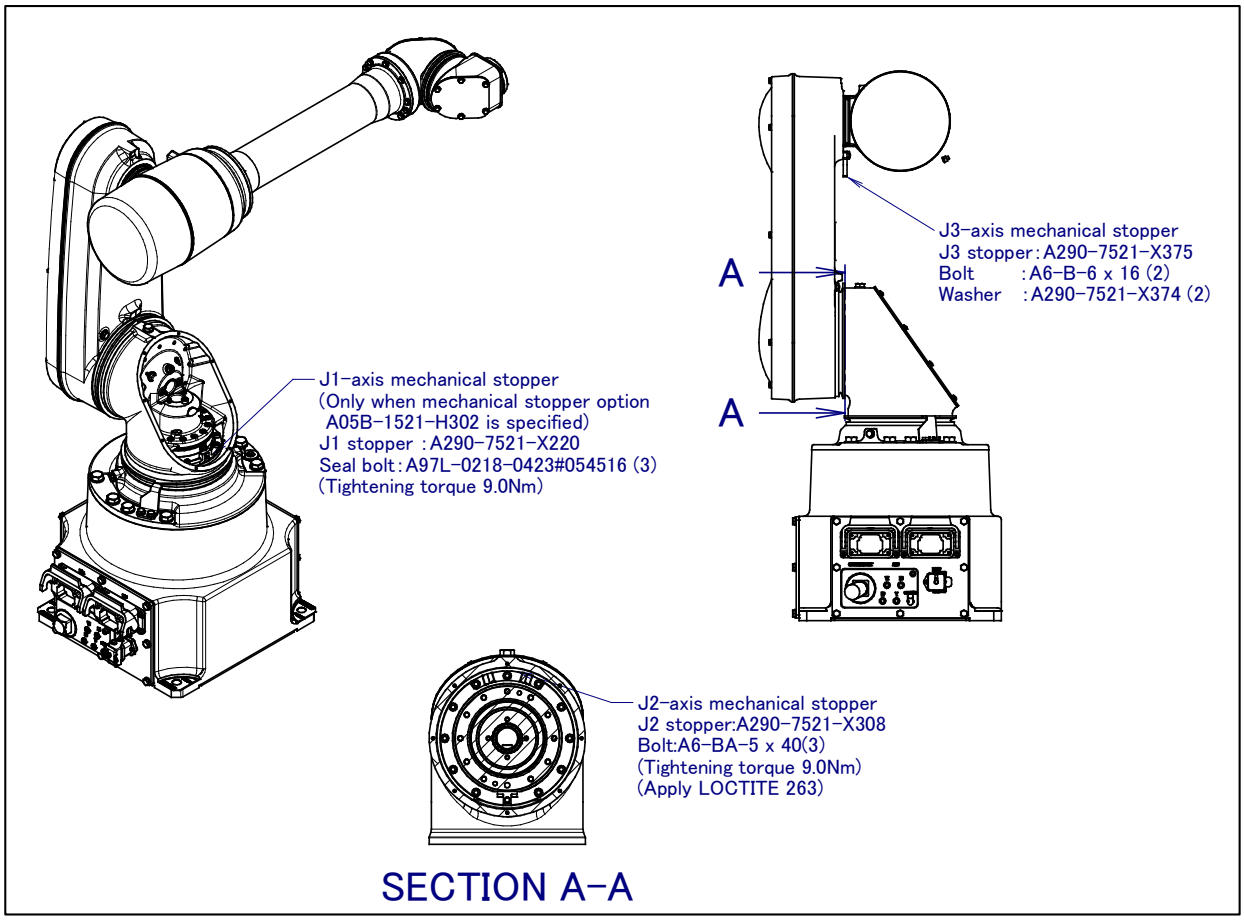


Fig. 3.3 (a) Position of mechanical stopper

Fig. 3.3 (b) to (l) show the zero point, motion limit, and mechanical stopper position of each axis.

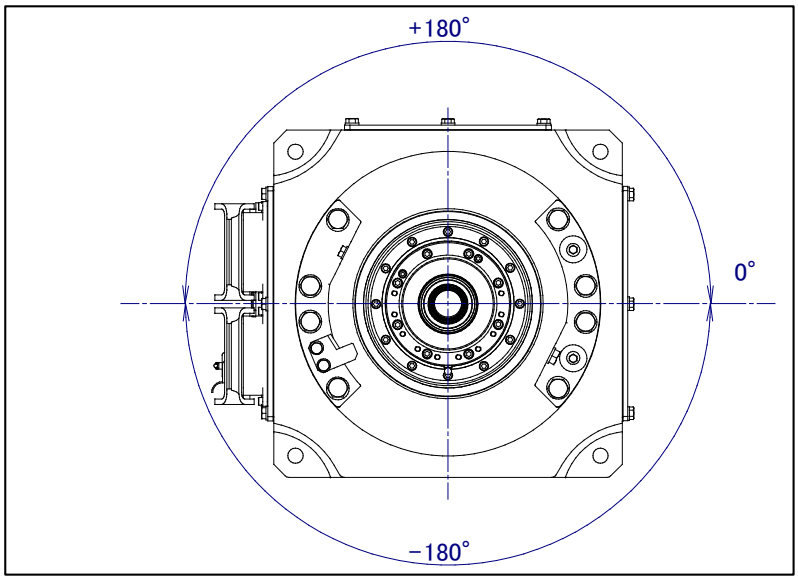


Fig. 3.3 (b) J1-axis motion limit (M-430*i*A/2F/2FH/4FH/2PH/2P when A05B-1521-H301 is selected)

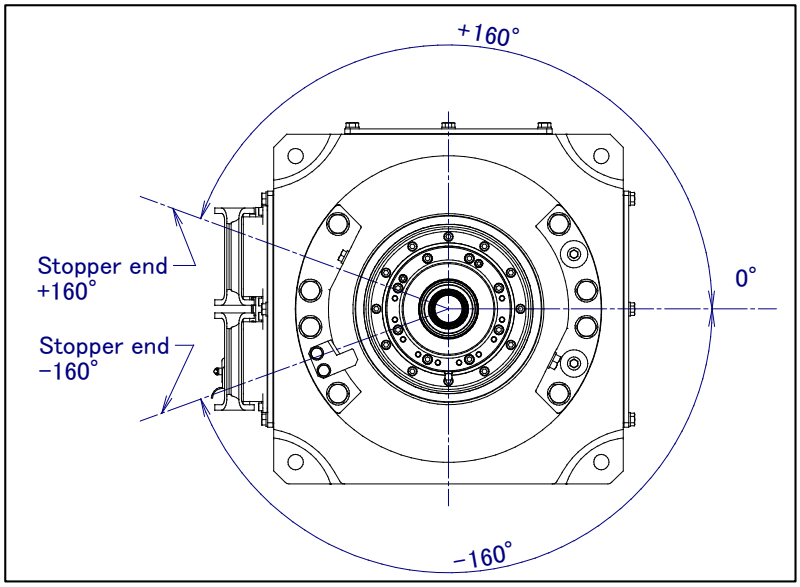


Fig. 3.3 (c) J1-axis motion limit (M-430*i*A/2F/2FH/4FH/2PH/2P when A05B-1521-H302 is selected)

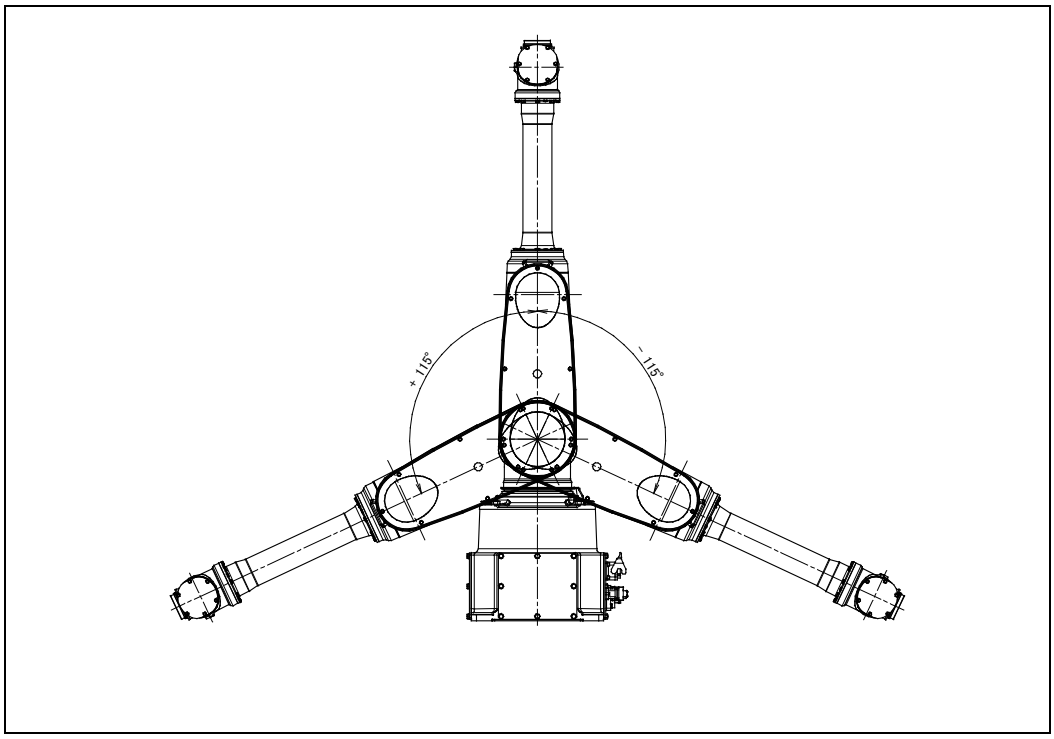


Fig. 3.3 (d) J2-axis motion limit (M-430*i*A/2F/2FH/4FH/2PH)

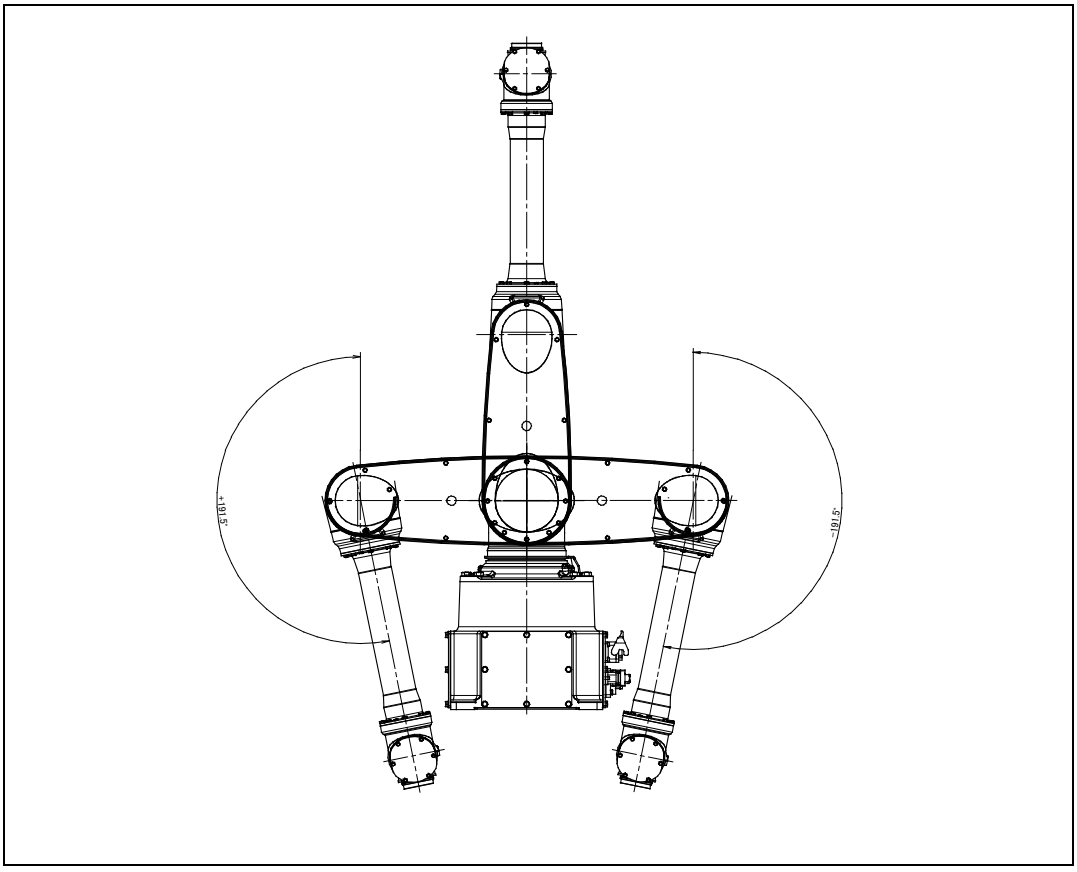


Fig. 3.3 (e) J3-axis motion limit (M-430*i*A/2F/2FH/4FH/2PH)

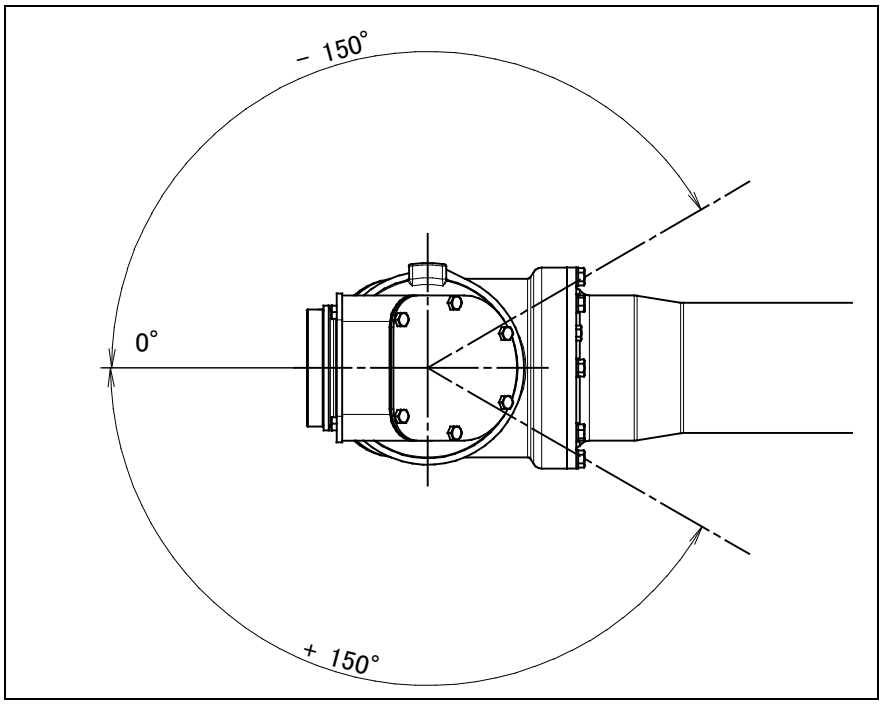


Fig. 3.3 (f) J4-axis motion limit (M-430*i*A/2F/2FH/4FH)

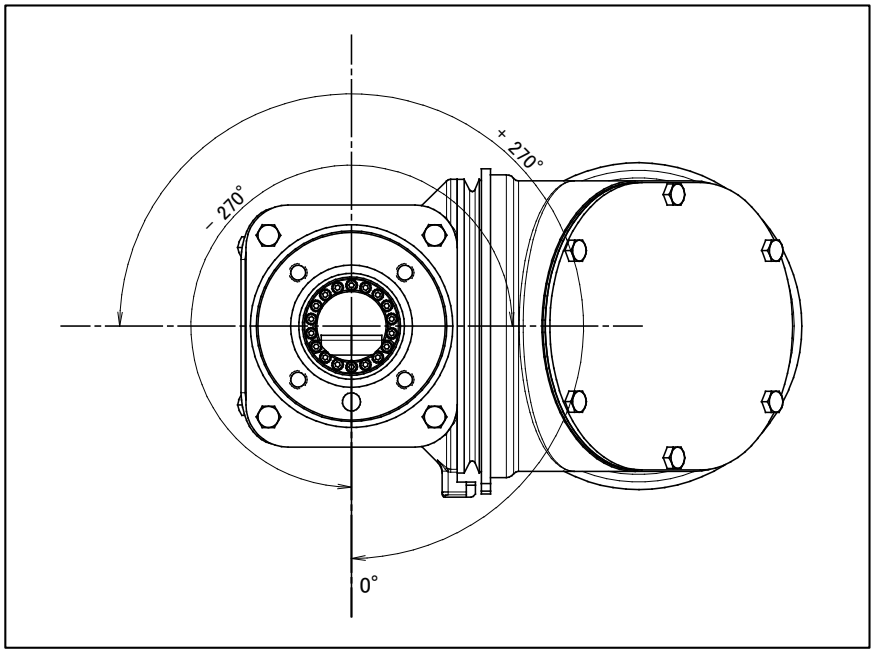


Fig. 3.3 (g) J5-axis motion limit (M-430*i*A/2F/2FH/4FH)

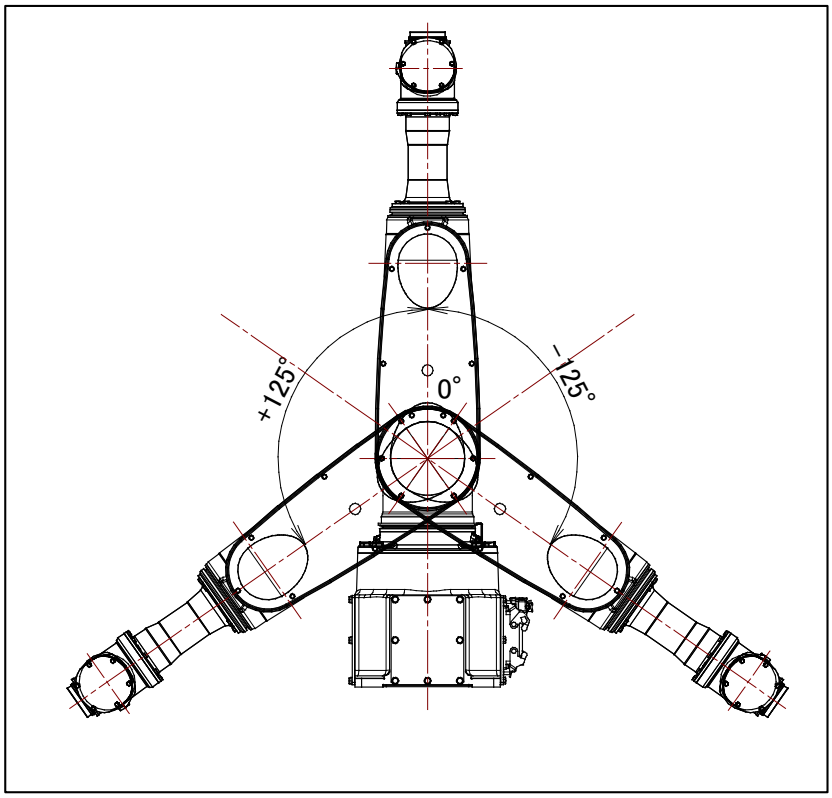


Fig. 3.3 (h) J2-axis motion limit (M-430*i*A/2P)

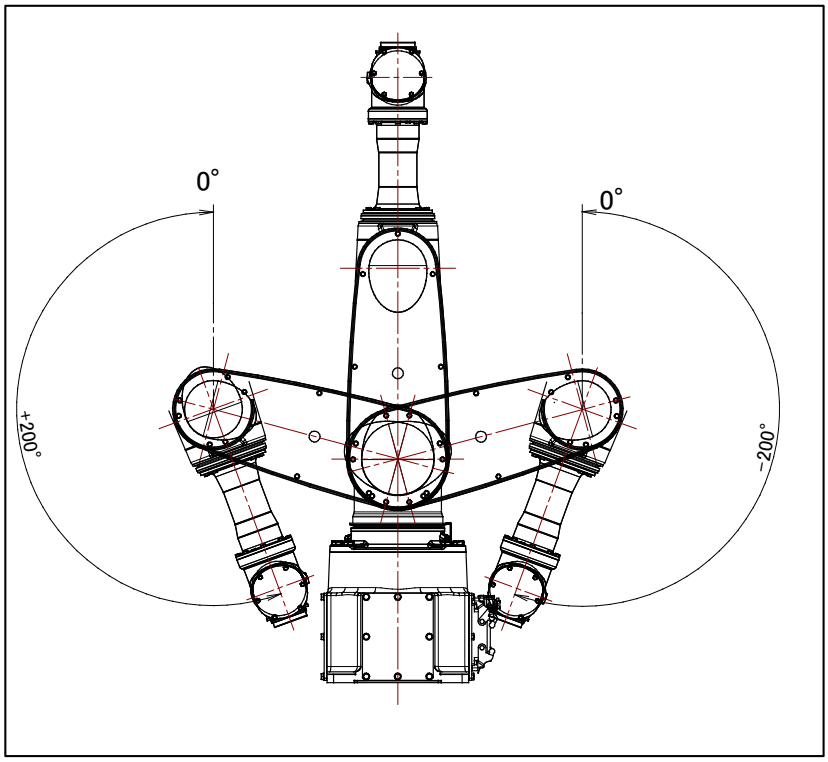


Fig. 3.3 (i) J3-axis motion limit (M-430*i*A/2P)

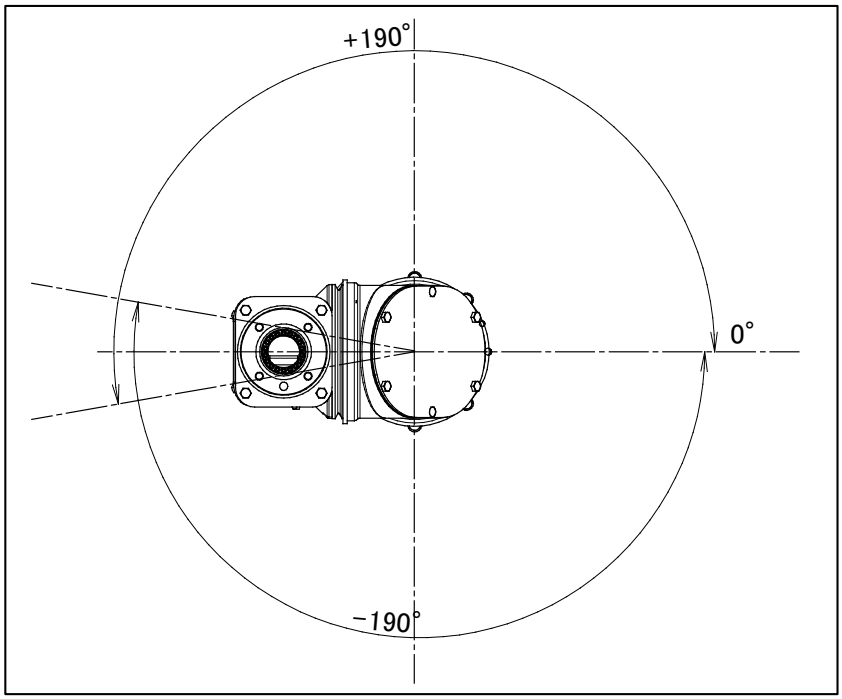


Fig. 3.3 (j) J4-axis motion limit (M-430*i*A/2PH/2P)

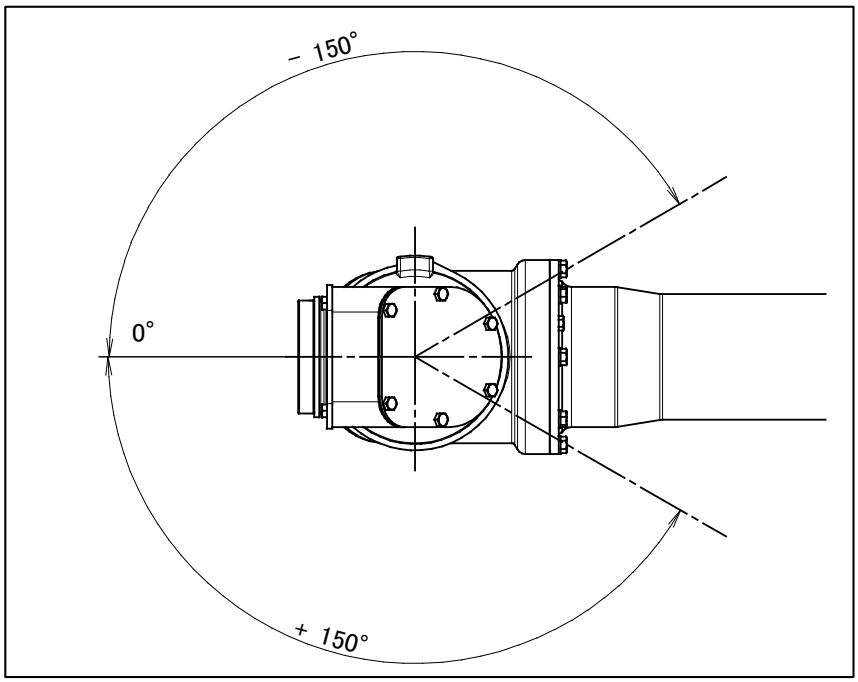


Fig. 3.3 (k) J5-axis motion limit (M-430*i*A/2PH/2P)

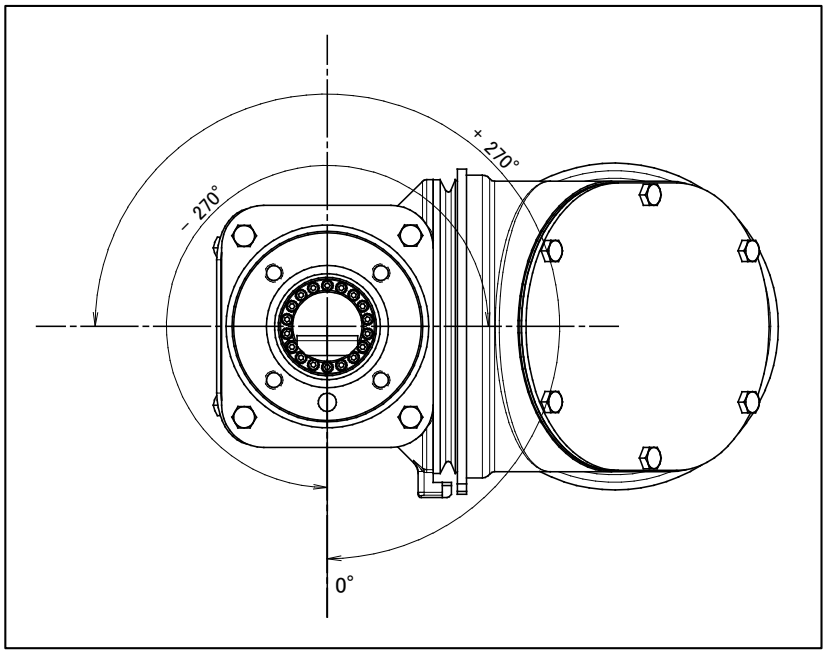


Fig. 3.3 (l) J6-axis motion limit (M-430*i*A/2PH/2P)

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (a) to Fig. 3.4 (c) are allowable wrist load diagrams. Apply a load within the region indicated in the graph.
Apply the conditions of the allowable load moment and the allowable load inertia. See Table 3.1 (a) about allowable load moment and inertia at wrist.

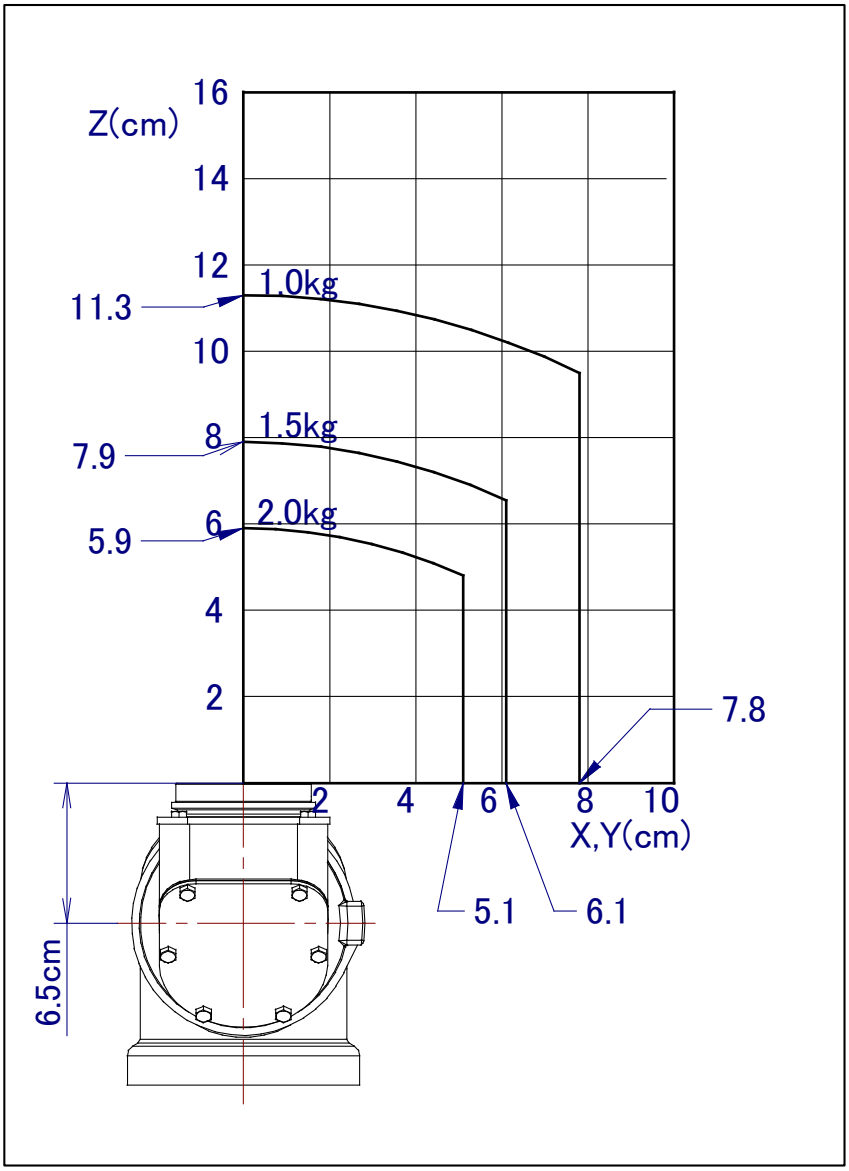


Fig. 3.4 (a) Allowable wrist load diagram (M-430*i*A/2F/2P)

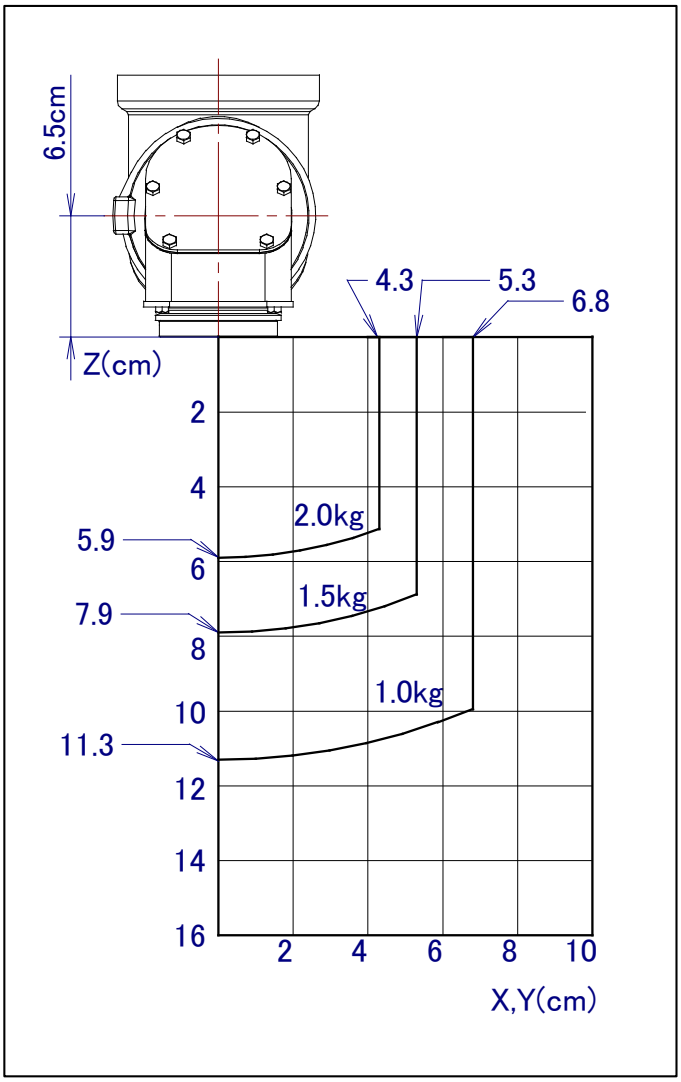


Fig. 3.4 (b) Allowable wrist load diagram (M-430*i*A/2FH/2PH)

NOTE
The wrist must always be pointed upward or downward when the M-430*i*A/2FH model is used.

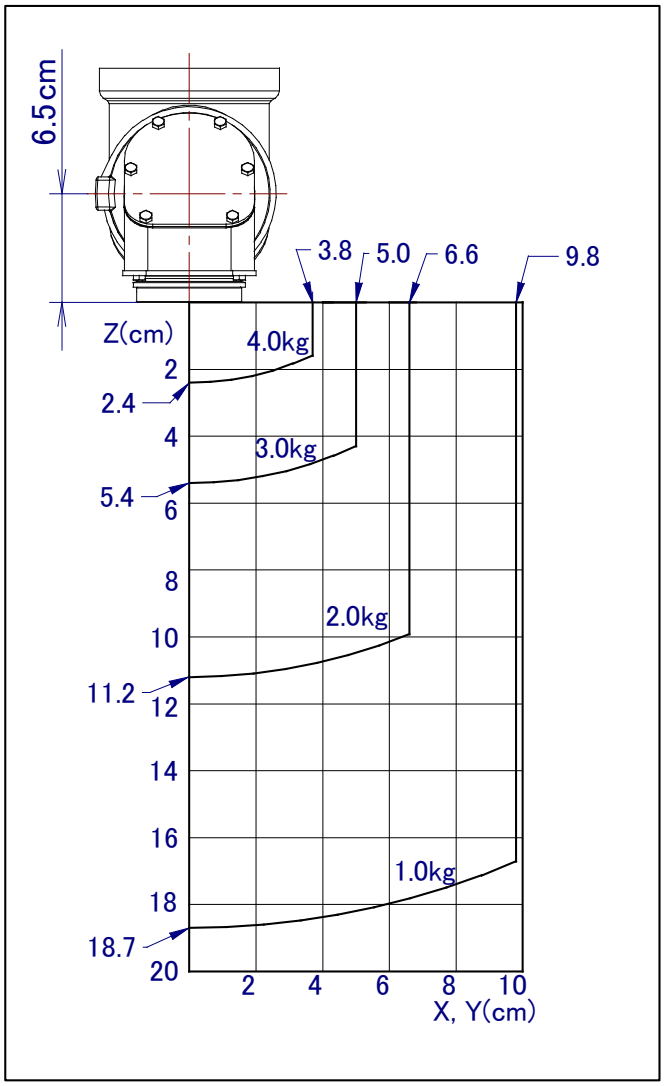


Fig. 3.4 (c) Allowable wrist load diagram (M-430*i*A/4FH)

NOTE
The wrist must always be pointed upward or downward when the M-430*i*A/4FH model is used.

3.5 APPENDIX

- O ring (A98L-0040-0225#35.5)
- Hexagon head seal bolt (A97L-0218-0539#081212S)
- Resin washer (A290-7521-X276)
- Grease nipple (A97L-0218-0013#A610)

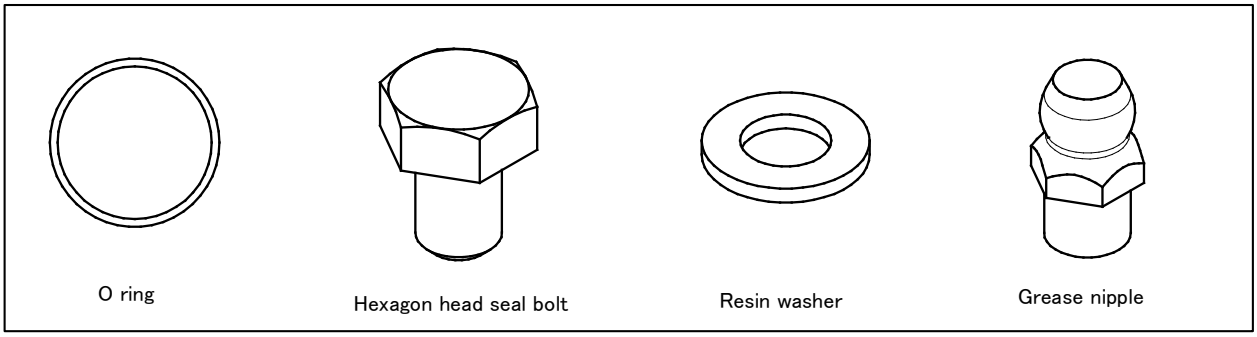


Fig.3.5 (a) Appendix

O ring is used to seal wrist flange part. (See Section 4.1.)
Hexagon head seal bolt and resin washer are tightened to tap and seal it after removing eyebolt which is attached when robot is transported. (See Section 1.1.)
Grease nipple is used for replacing grease of J3 cross roller. (See Section 7.2.)

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) is the diagram for installing end effectors on the wrist. Select screws and positioning pins of a length that matches the depth of the tapped and pin holes.
Design end effector so that space leading to the wrist hollow department is sealed to prevent to prevent invasions such as powder, cleaning fluid, the moisture from writ hollow department.
There is a groove for O ring as Fig. 4.1 (a), so design an effector referring to this dimension. Install O ring which is appendix to the groove for O ring when installing end effector.
See Appendix B BOLT TIGHTENING TORQUE TABLE about tightening torque of end effector.

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

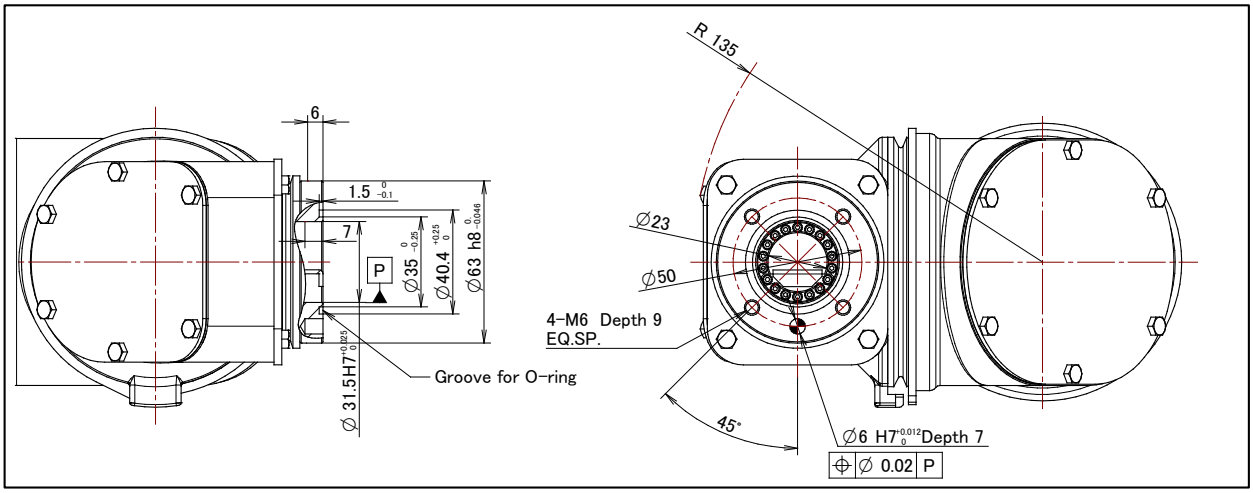


Fig. 4.1 (a) End effector interface

4.2 LOAD SETTING

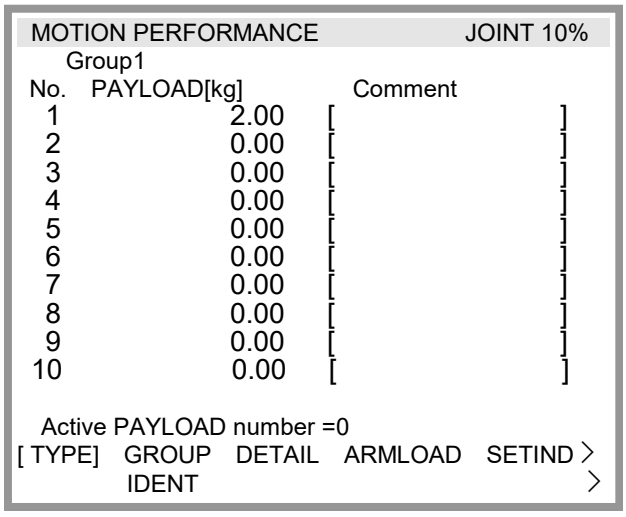
⚠ CAUTION

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

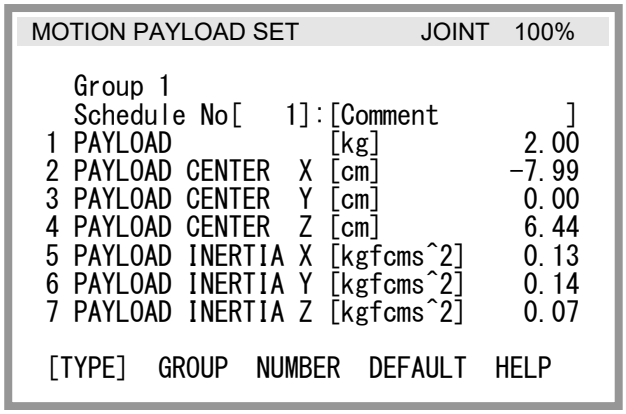
2 When performing load estimation after parts replacement
If wrist axes (J5/J6-axis) motors or reducers are replaced, estimation accuracy may go down. Perform the calibration for load estimation before performing load estimation. Refer to Chapter 9 "LOAD ESTIMATION" in R-30*i*B/R-30*i*B Mate Controller Optional Function OPERATOR'S MANUAL (B-83284EN-2).

The motion performance screens include the MOTION PERFORMANCE screen, MOTION PAYLOAD SET screen, and MOTION ARMLOAD SET screen. These screens are used to specify 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.



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 will be displayed.



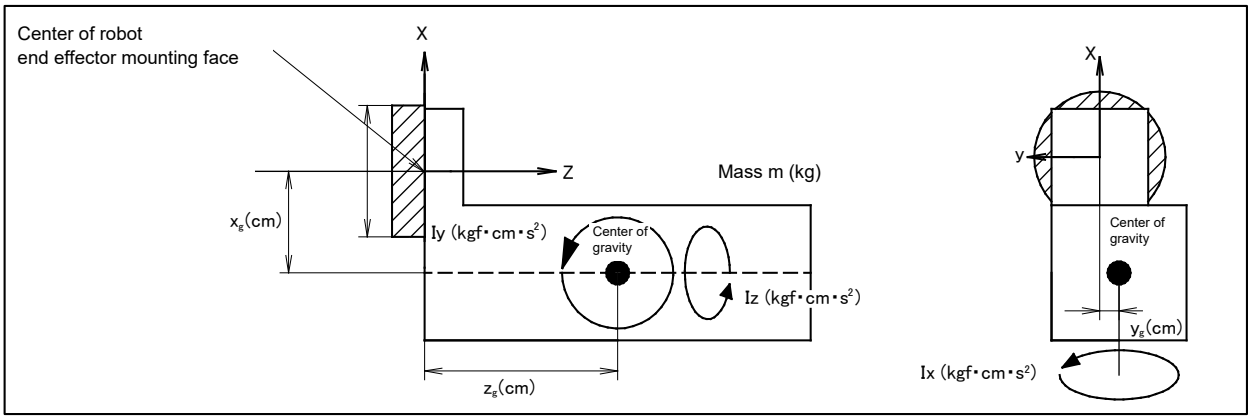


Fig. 4.2 (a) Standard tool coordinate

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 the F3 ([NUMBER]) will bring you to the MOTION PAYLOAD SET screen for another condition number. For a multigroup system, pressing F2 ([GROUP]) will bring you to the MOTION PAYLOAD SET screen for another group.

8 Press the [PREV] key to return to the MOTION PERFORMANCE screen. Press F5 ([SETIND]), and enter the desired payload setting condition number.

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.
- 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.

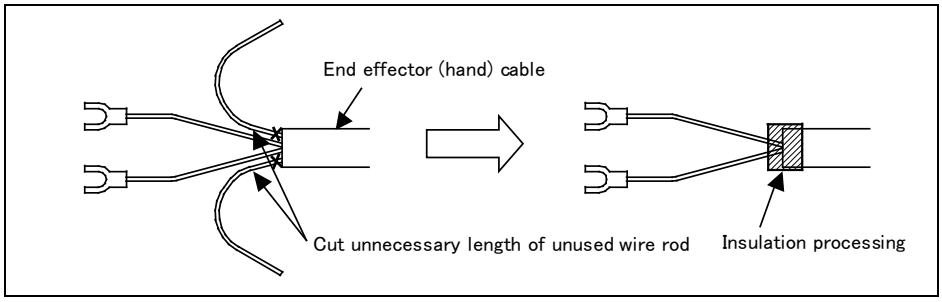


Fig. 5 (a) Treatment method example of RO1 to RO4 cable

5.1 INTERFACE FOR OPTION CABLE (OPTION)

Fig. 5.1 (a) to (c) show the position of the EE signal interface for the end effector.

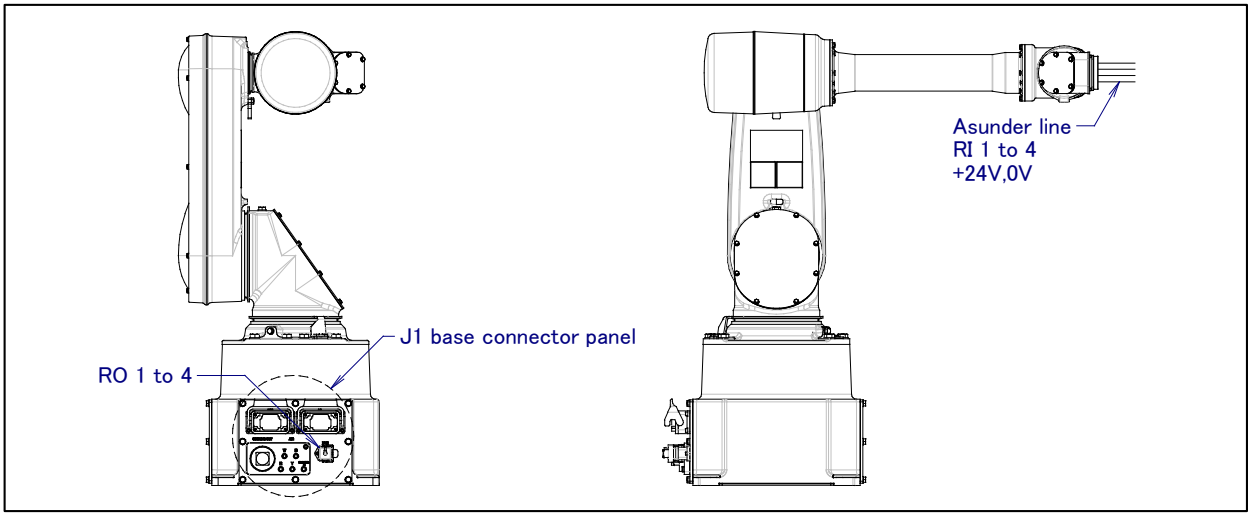


Fig. 5.1 (a) Position of EE interface (M-430*i*A/2F/2FH/4FH/2PH)

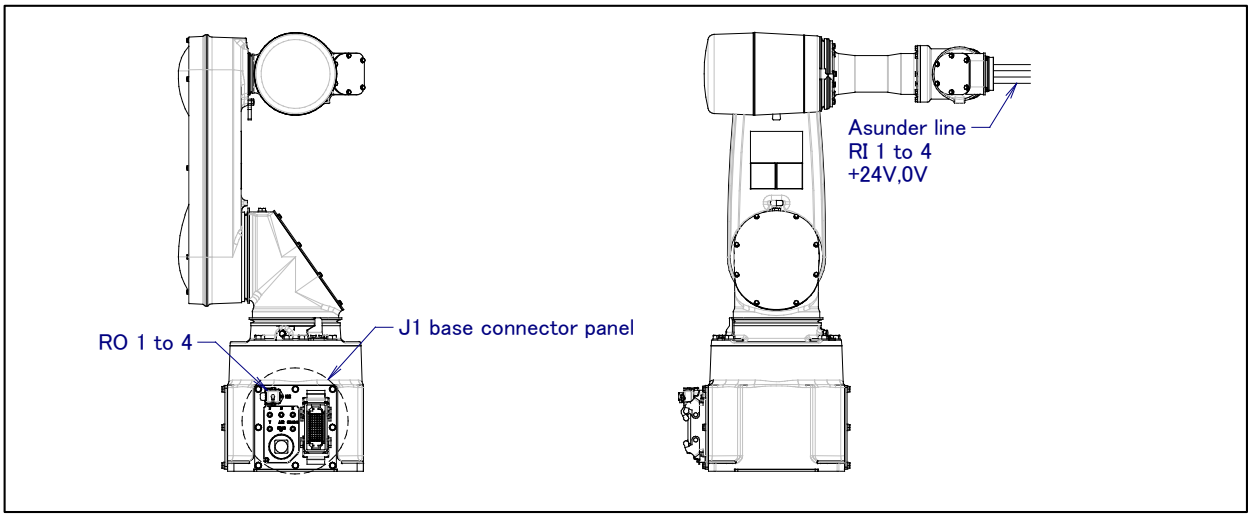


Fig. 5.1 (b) Position of EE interface (M-430*i*A/2P)

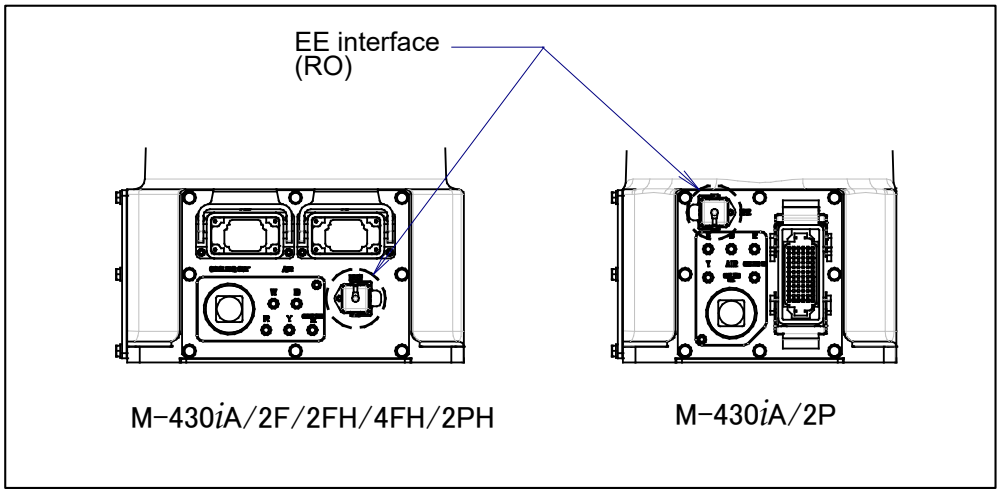


Fig. 5.1 (c) Interface for EE (RO)

(1) EE interface (RO)
Fig. 5.1 (d) shows the pin layout for the EE interface (RO).

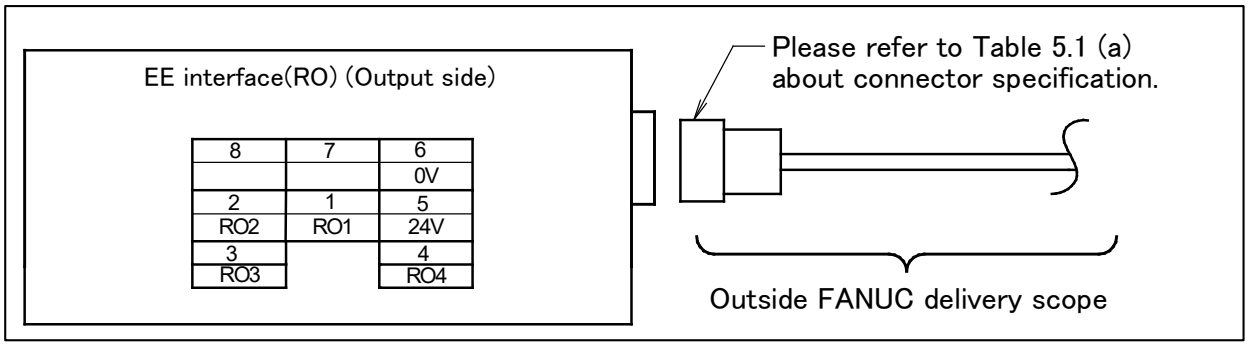


Fig. 5.1 (d) Pin layout for EE interface (RO) (option)

> **⚠ CAUTION**
> For wiring of the peripheral device to the EE interface, refer to the CONTROLLER MAINTENANCE MANUAL, too.

Connector specifications

Table 5.1 (a) Connector specifications (User side)

Name	Maker model			Maker/Dealer
Insert	09 36 008 3001			HARTING K.K.
Contact	09 15 000 6104	wire diameter	0.14-0.37mm^2	
	09 15 000 6103		0.5mm^2	
	09 15 000 6105		0.75mm^2	
	09 15 000 6102		1.0mm^2	
	09 15 000 6101		1.5mm^2	
	09 15 000 6106		2.5mm^2	
Hood	19 20 003 1640	Side entry	Screw unit M20	
	19 20 003 1440	Top entry		
	09 20 003 1640	Side entry	Screw unit PG11	
	09 20 003 1440	Top entry		
Cable clamp	19 00 000 5080	Cable out diameter 5-9mm	Screw unit M20	
	19 00 000 5082	Cable out diameter 6-12mm		
	19 00 000 5084	Cable out diameter 10-14mm		
	09 00 000 5080	Cable out diameter 5-8mm	Screw unit PG11	
	09 00 000 5081	Cable out diameter 6.5-9.5mm		
	09 00 000 5082	Cable out diameter 7-10.5mm		
Sealing screw	09 20 000 9918			

Table 5.1 (b) Connector specifications (Mechanical unit side)

Name	Maker model			Maker
Insert	09 36 008 3101			HARTING K.K.
Contact	09 15 000 6204	wire diameter	0.14-0.37mm^2	
Housing	19 20 003 0301			
Sealing screw	09 20 000 9918			

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

5.2 AIR SUPPLY (OPTION)

The robot has supply ports for supplying air pressure to the end effector. The pneumatic tubes are connected from the J1-axis base through the coupling in the J3-axis housing to the end effector.
The connector is an Rc1/2 female.
As couplings are not supplied, it will be necessary to prepare couplings, which suit to the hose size.

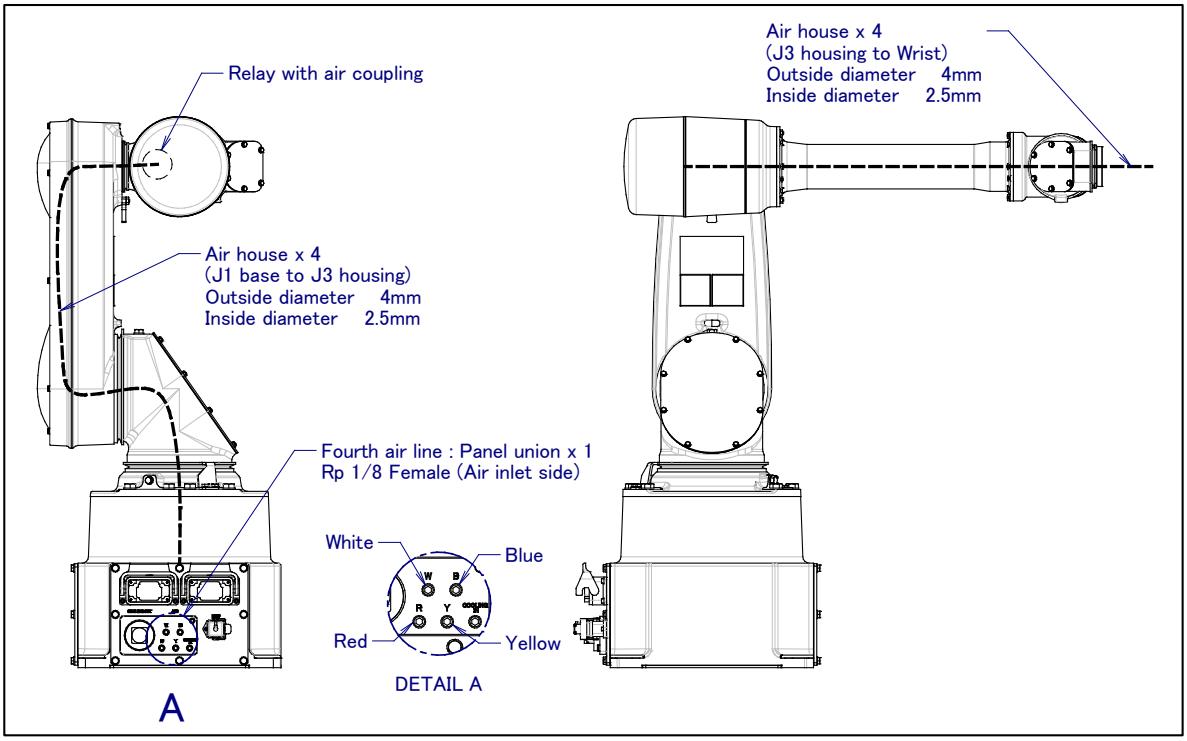


Fig. 5.2 (a) Air supply (option) (M-430*i*A/2F/2FH/4FH/2PH)

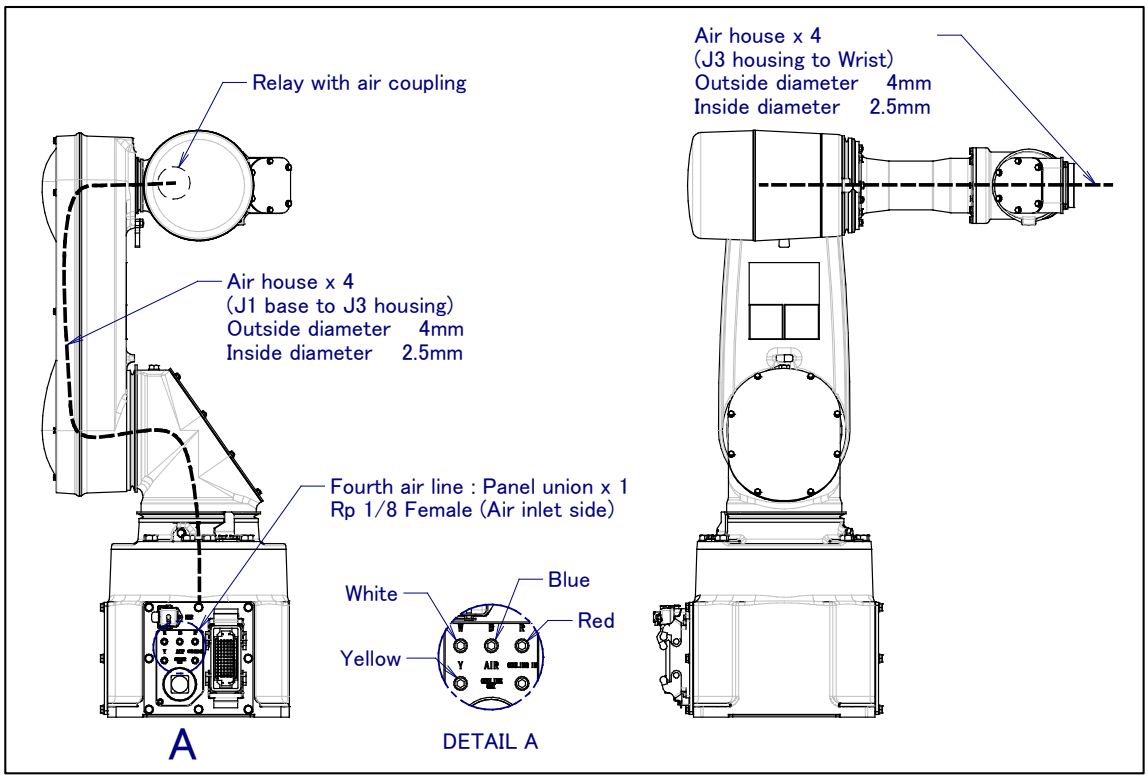


Fig. 5.2 (b) Air supply (option) (M-430*i*A/2P)

5.3 COOLING THE INTERNAL MOTOR

It is necessary to cool M-430*i*A by compressed air referring to Fig.5.3 (a).
The customer should install air supply and exhaust piping as shown in Fig. 5.3 (a) to ventilate the inside of the robot.

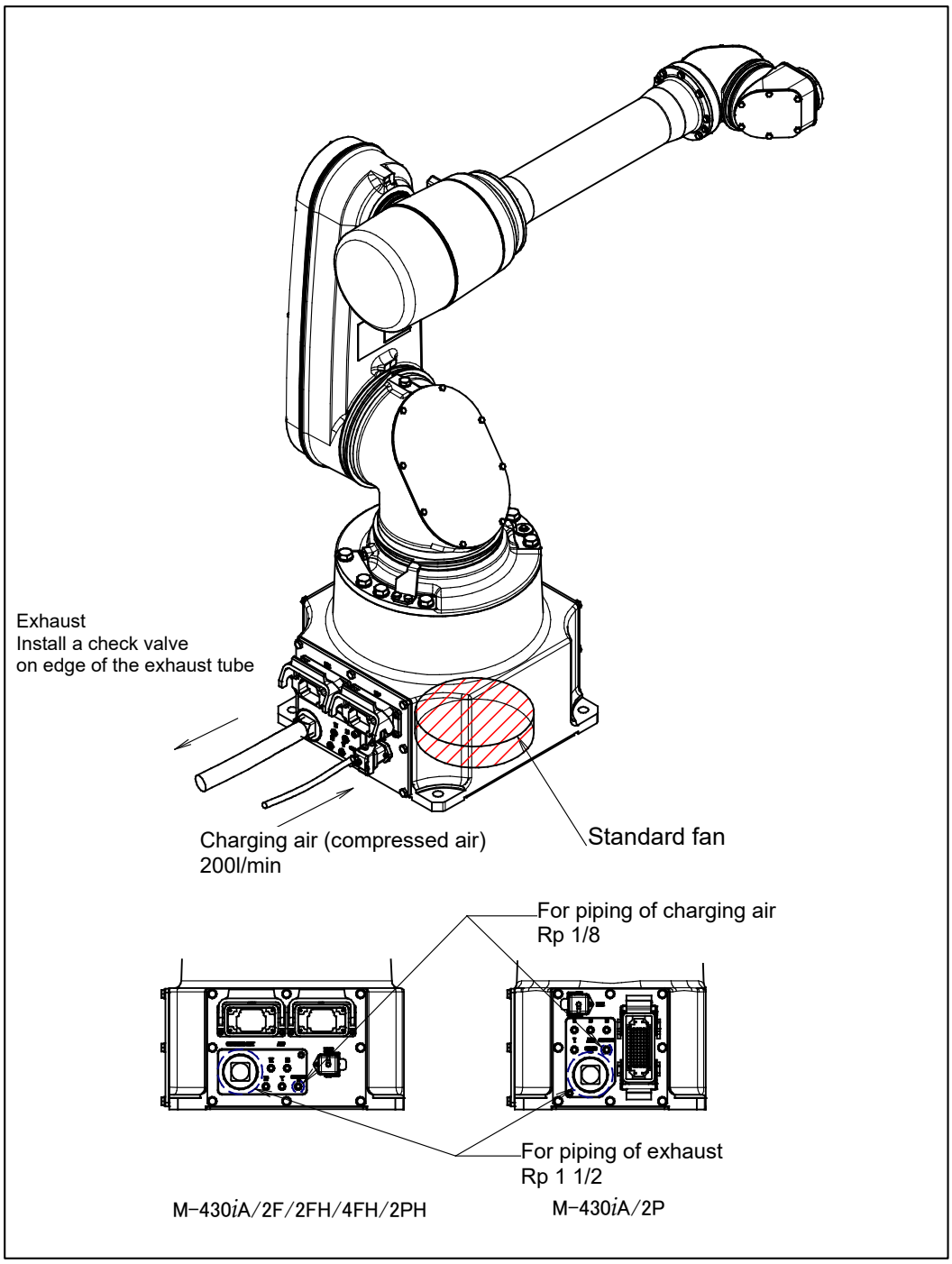


Fig. 5.3 (a) Cooling the internal motor

6 AXIS LIMIT SETUP

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

- Used motion range of the robot is limited.
- Tools and peripheral equipment interfere each other in some areas.
- Length of the cable or hose attached to the application is limited.
- When 320° J1 rotation (with stopper) A05B-1521-H302 is specified.

The following method used to prevent the robot from going beyond the necessary motion range.
- Limit axis motion range by DCS (All axes (option))
- Limit axis motion range adjustable mechanical stopper (J1/J2-axes (option))

⚠ CAUTION
1 Changing the motion range of any axis affects the operating 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 will occur; for example, an alarm may occur in a previously taught position.
2 For the J1, J2 axes, do not count merely on DCS to the movable range when changing the movable range of the robot. Use adjustable mechanical stoppers together so that damage to peripheral equipment and injuries to human bodies can be avoided. In this case, make the software-specified limits match the limits based on the adjustable mechanical stoppers.
3 Mechanical stoppers are physical obstacles. The robot cannot move beyond them.
4 Fixed mechanical stopper (J1-axis) and adjustable mechanical stoppers (J1 axis and J2 axis) are deformed in a collision to stop the robot. Once a stopper is subject to a collision, it can no longer assure its original strength and, therefore, may not stop the robot. When this happens, replace it with a new one.

6.1 SOFTWARE SETTING CHANGE AXIS LIMIT BY DCS (OPTION)

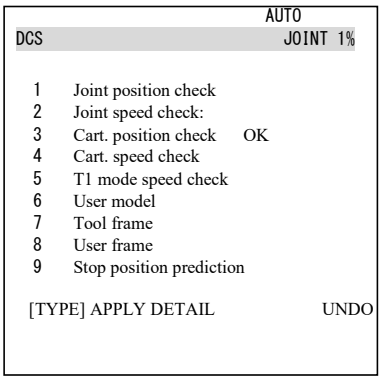
The robot motion can be restricted with DCS (Dual check safety) function by using the following software. For J2/J3-axis, the same effect as an adjustable mechanical stopper can be obtained.
The robot motion can be restricted at any angle and position if it is in robot motion area. DCS functions are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

・ DCS position/speed check function (J567)

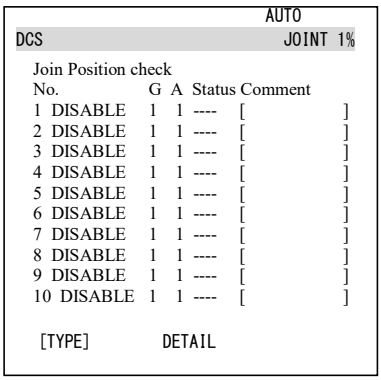
As an example, we shows the procedure to set ±90° for J2-axis in here. Refer to Controller Dual check safety function Operator's Manual (B-83184EN etc.) for details of other setting, function and DCS stop position prediction.

Setting procedure

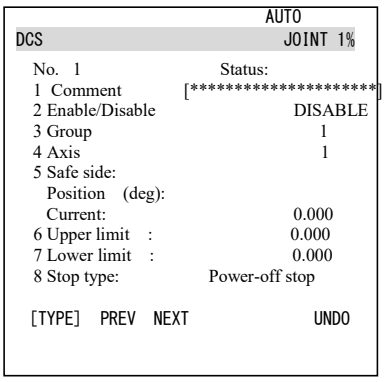
1 Press the [MENU] key to display the screen menu.
2 Press [0 NEXT] and press [6 SYSTEM].
3 Press the F1 ([TYPE]).
4 Select [DCS]. The following screen will be displayed.



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

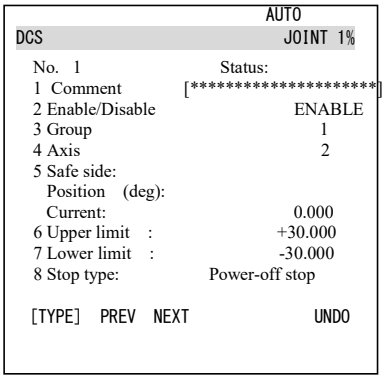


6 Move the cursor to [1], then press the [DETAIL].

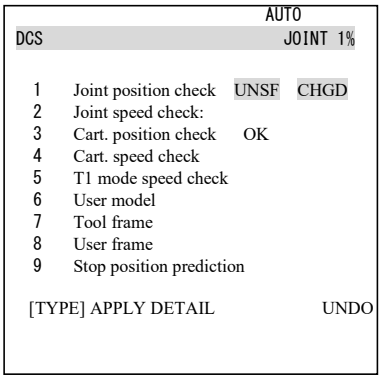


7 Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
8 Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
9 Move the cursor to [Axis], then input “2”, then press the [ENTER] key.
10 Move the cursor to [Upper limit] right side, then input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

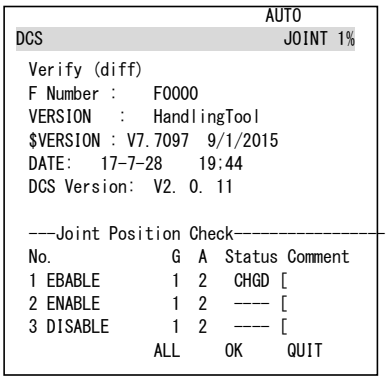
> ⚠ **WARNING**
> If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot's momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the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



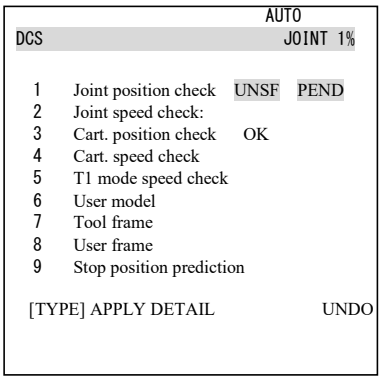
12 Press the [PREV] key two times, back to the first screen.



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



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



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

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

7 CHECKS AND MAINTENANCE

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

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

7.1 CHECKS AND MAINTENANCE

7.1.1 Daily Checks

Check the following items when necessary before daily system operation.

Check items	Check points and management
Air control set	(When air control set is used) ⇒**"7.2.1 Confirmation of the Air Control Set"**
Vibration, abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: ⇒**"9.1 TROUBLESHOOTING"(symptom : Vibration, Noise)**
Positioning accuracy	Check whether the taught positions of the robot have not deviated from the previously taught positions. When displacement occurs, perform the measures as described in the following section: ⇒**"9.1 TROUBLESHOOTING"(symptom : Displacement)**
Peripheral equipment for proper operation	Check whether the peripheral equipment operate properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the end effector drops 0.5 mm or less when the servo power is turned off. If the end effector (hand) drops more than the prescribed amount, 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: ⇒ **"R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus CONTROLLER OPERATOR'S MANUAL (Alarm Code List) (B-83284EN-1) or R-30*i*A/R-30*i*A Mate CONTROLLER OPERATOR'S MANUAL (Alarm Code List) (B-83124EN-6)"**

7.1.2 Periodic Checks and Maintenance

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

Check and maintenance intervals (Operating time, Accumulated operating time)						Check and maintenance items	Check points, management and maintenance methods	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	2 years 15360h	4 years 15360h			
○ Only 1st check	○					Cleaning the controller ventilation system	Confirm the controller ventilation system is not dusty. If dust has accumulated, remove it.	15
	○					Check the external damage or peeling paint	Check whether the robot has external damage or peeling paint due to the interference with the peripheral devices. If an interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If liquid was found, remove the cause, and wipe the liquid off.	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.	14
	○ 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 connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"7.2.2 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
	○ Only 1st check	○				Retightening the external main bolts	Retighten the bolts which were installed, removed, or exposed during inspection. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	5

Check and maintenance intervals (Operating time, Accumulated operating time)						Check and maintenance items	Check points, management and maintenance methods	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	2 years 15360h	4 years 15360h			
	○ Only 1st check	○				Check the mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the mechanical stopper, the adjustable mechanical stopper, and check the looseness of the stopper mounting bolts. Check that the J1-axis swing stopper rotates smoothly. **⇒"7.2.3 Check of Fixed Mechanical Stopper and Adjustable 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, and the cable protective sleeve).	7
		○ (*)	○ (*)			Replacing the mechanical unit batteries	Replace the mechanical unit batteries. (*) Periodic interval differs according to the batteries. 2P : 1 years (3840 hours) Except 2P : 1.5 years (5760 hours) Regardless of operating time, replace batteries at these intervals. **⇒"7.3.1 Replacing Batteries"**	9
		○				Greasing to the J1,J2,J3-axis reducer	Supply grease to the J1, J2, J3-axis reducer. **⇒"7.3.2 Replacing Grease for the Drive Mechanism"**	10,11
		○				Greasing to the J3 cross roller	Supply grease to the J3 cross roller **⇒"7.3.5 Replacing Grease of J3 Cross Roller"**	12
				○		Measure the wrist backlash	Measure the wrist backlash **⇒"9.2 METHOD OF MEASURING A BACKLASH IN THE WRIST"**	13
					○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. **⇒Chapter 7 Replacing batteries of R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) or R-30*i*A CONTROLLER MAINTENANCE MANUAL (B-82595EN) or R-30*i*A CONTROLLER MAINTENANCE MANUAL (For Europe) (B-82595EN-1) or R-30*i*A CONTROLLER MAINTENANCE MANUAL (For RIA) (B-82595EN-2)"**	16

7.2 CHECK POINTS

7.2.1 Confirmation of the Air Control Set (option)

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

Item	Check items	Check points
1	Air pressure	Check the air pressure using the pressure gauge on the air control set as shown in Fig. 7.2.1 (a). If it does not meet the specified pressure of 0.49 to 0.69 MPa (5-7 kgf/cm^2), adjust it using the regulator pressure-setting handle.
2	Lubricator oil mist quantity	Check the number of oil drops during operation. If it does not meet the specified value (1 drop/10-20 sec), adjust it using the handle for lubricator adjustment. The lubricator becomes empty in about 10 to 20 days under normal operation.
3	Lubricator oil level	Check to see that the air control set oil level is within the specified level.
4	Leakage from hose	Check the joints, tubes, etc. for leaks. Retighten the joints or replace parts, as required.
5	Drain	Check the drain and release it. If the quantity of the drained liquid is significant, examine the setting of the air dryer on the air supply side.

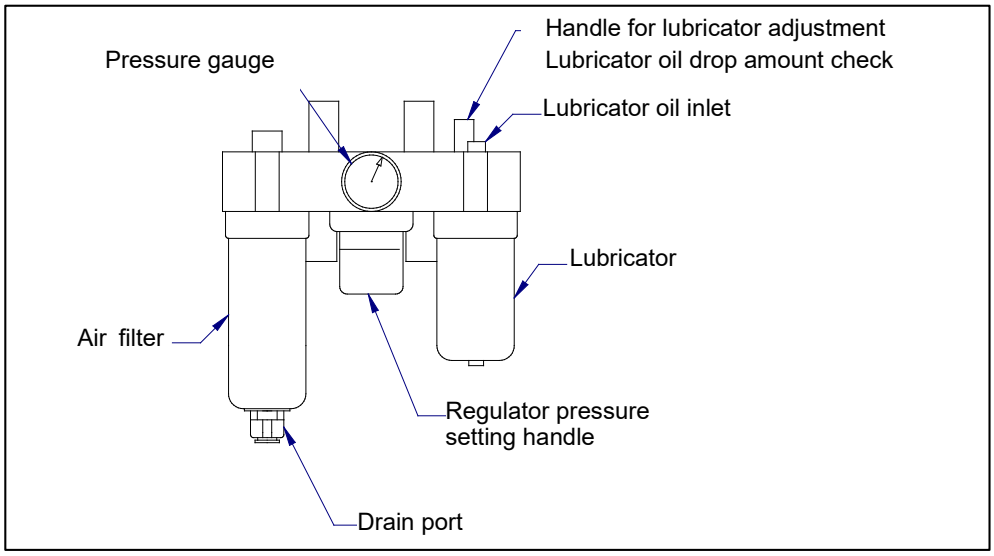


Fig. 7.2.1 (a) Air control set (option)

7.2.2 Check the Connectors

Inspection points of the connectors
- Robot connection cables, earth terminal and user cables

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

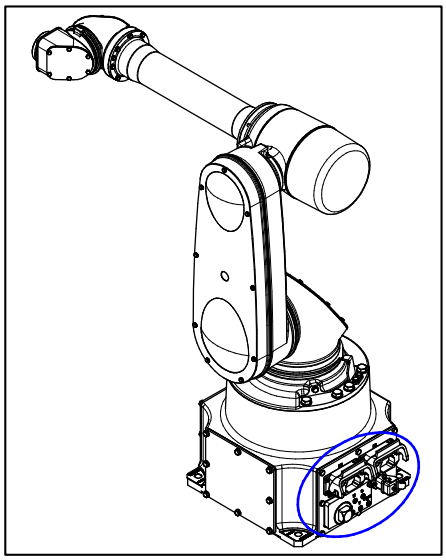


Fig. 7.2.2 (a) Connector Inspection points

7.2.3 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check the tightness of the stopper mounting bolts. If they are loose, retighten them.

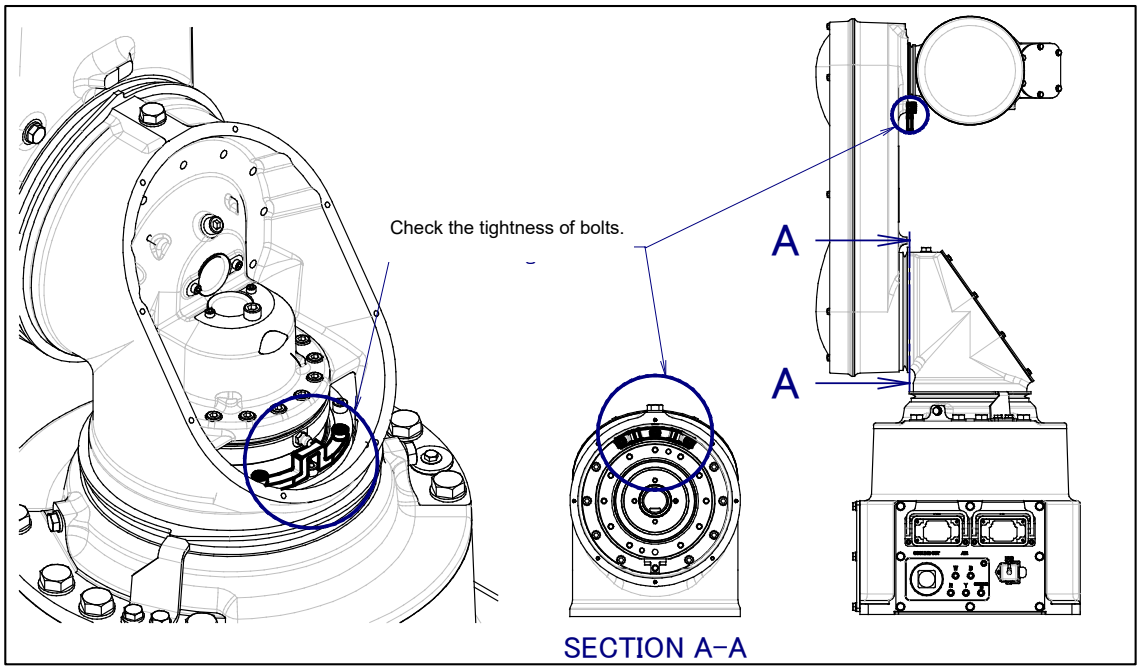


Fig. 7.2.3 (a) Check of fixed mechanical stopper and adjustable mechanical stopper

7.3 MAINTENANCE

7.3.1 Replacing Batteries (1.5-Year (5760 hours) Checks (M-430*i*A/2F/2FH/4FH/2PH)) (1-Year (3840 hours) Checks (M-430*i*A/2P))

The position data of each axis is preserved by the backup batteries. In case of M-430*i*A/2F/2FH/4FH/2PH, the batteries need to be replaced every 1.5 years. In case of M-430*i*A/2P, the batteries need to be replaced every year. Also, use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure for replacing the battery

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

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

2 Remove the battery case cap. (Fig. 7.3.1 (a))
3 Take out the old batteries from the battery case.
4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
5 Close the battery case cap.

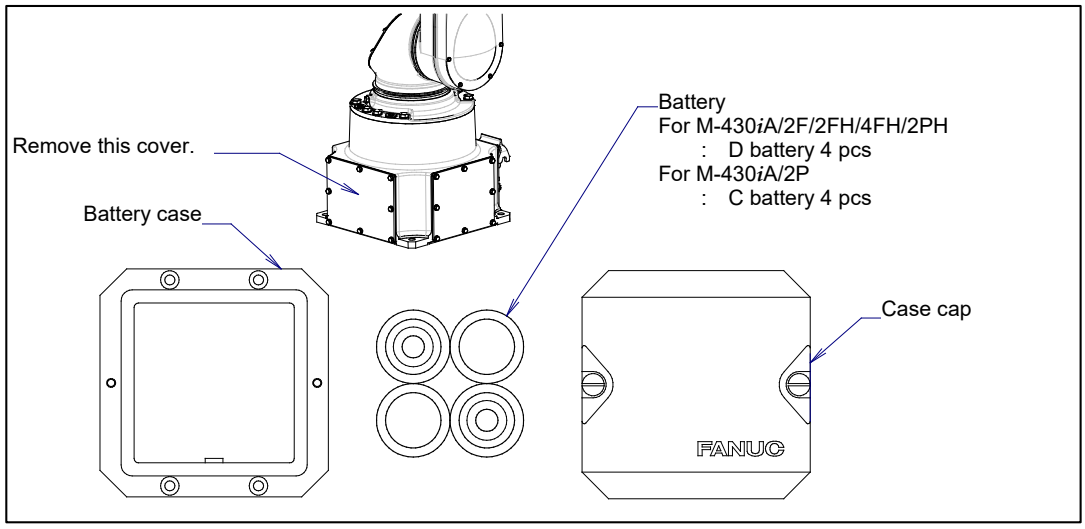


Fig. 7.3.1 (a) Replacing the battery

7.3.2 Replenishing Grease for the Drive Mechanism (1 years (3840 hours) checks)

According to below, replenish the grease of the reducers of J1, J2, and J3 axis at the intervals based on every 1 year or 3840 hours, whichever comes first. See Table 7.3.2 (a) for the grease name and the quantity.

Table 7.3.2 (a) Grease and its amount specified for periodical replenishment every 1 year (or 3840 hours)

Supply position	Quantity	Gun tip pressure	Grease name
J1-axis reducer	8.5g (10ml)	0.1MPa or less (NOTE)	Spec. : A98L-0040-0320#0.9KG
J2, J3-axis reducer	17g (20ml)		

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

For grease replenishment, use the arbitrary postures.

⚠ CAUTION
If greasing is performed incorrectly, the internal pressure of the grease bath may suddenly increase, possibly causing damage to the seal, which would in turn lead to grease leakage and abnormal operation. When performing greasing, therefore, observe the following cautions.

1 Before starting to grease, remove the seal bolt from the grease outlet to allow the grease to come out.
2 A grease inlet may have a seal bolt. Replace the seal bolt to the attached grease nipple and then start greasing.
3 Supply grease slowly without applying excessive force, using a manual pump.
4 Whenever possible, avoid using a compressed-air pump, powered by the factory air supply. Even when it is unavoidable to use a compressed-air pump, the gun tip pressure needs to be set the value of the gun tip pressure on Table 7.3.2 (a).
5 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
6 After greasing, confirm that no grease is leaking from the grease outlet and that the grease bath is not pressurized, then close the grease outlet.
7 To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.

7.3.3 Greasing Procedure of the J1, J2, J3-axis Reducer

1 Turn off controller power.
2 Remove the cover of J2 unit with a socket wrench.
3 Remove the seal bolt of grease outlet. (Fig. 7.3.3 (a))
4 See Table 7.3.2 (a) and apply a prescribed amount of grease.
5 After greasing, release remaining pressure as the Subsection 7.3.4.
6 Attach the cover after releasing remaining pressure. Apply LOCTITE 243 to bolts and tighten them with torque of 1.2Nm.

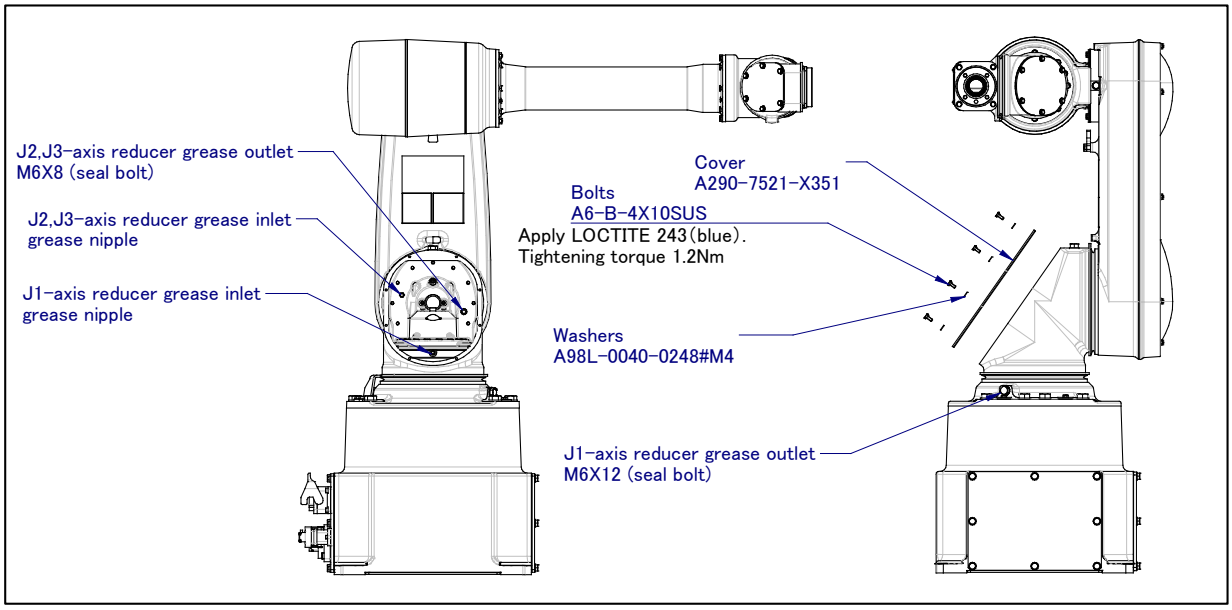


Fig. 7.3.3 (a) Greasing to the reducer

7.3.4 Procedure for Releasing Remaining Pressure from the Grease Bath

After greasing, remove the grease nipple of inlet and keep the outlet without seal bolt, then operate the robot for 20 minutes or more to release remaining pressure within the grease bath.
Attach the bags for collecting under the grease inlet and grease outlet to prevent spilled grease from splattering.

Operating axis / Grease replenish part	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
J1-axis reducer	Axis angle of 60° or more OVR 80%	Arbitrary				
J2/J3-axis reducer	Arbitrary	Axis angle of 60° or more OVR 100%	Axis angle of 60° or more OVR 100%	Arbitrary		

If the above operation cannot be performed due to the environment of the robot, adjust the operating time according to the operating angle. (When the maximum allowable axis angle is 30°, perform twice the operation for 40 minutes or more.) If you grease multiple axes, you can exercise multiple axes at the same time. After the above operation is performed, attach the grease nipple to the grease inlet and the seal bolt to the grease outlet. When the seal bolt or grease nipple is reused, be sure to seal it with seal tape.

7.3.5 Replacing Grease of J3 Cross Roller (1 years (3840 hours) checks)

If serial number of M-430*i*A is R12700446 (Made in July, 2012) or later, it is possible to replace grease of the J3 cross roller.

According to below, replace the grease of the J3 cross roller for the robot that replacing grease is possible at the intervals based on every 1 year or 3840 hours, whichever comes first. Please refer to Table 7.3.5 (a) about grease and quantity.

Table 7.3.5 (a) Grease and its amount specified for periodical replacement every 1 year (3840 hours)

Supply position	Quantity	Gun tip pressure	Specified grease
J3 cross roller	8.5g(10ml)	0.1MPa or less (NOTE)	Spec. : A98L-0040-0320#0.9KG

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

For grease replacement, use the postures of Table 7.3.5 (b).

Table 7.3.5 (b) Greasing posture

Greasing position	Posture					
	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
J3 cross roller	Arbitrary	0°	Arbitrary	Arbitrary	Arbitrary	Arbitrary

(*) M-430*i*A/2F/2FH/4FH does not have J6-axis.

⚠ CAUTION
If greasing is performed incorrectly, the internal pressure of the grease bath may suddenly increase, possibly causing damage to the seal, which would in turn lead to grease leakage and abnormal operation. When performing greasing, therefore, observe the following cautions.

1 Before starting to grease, remove the seal bolt from the grease outlet to allow the grease to come out.
2 A grease inlet may have a seal bolt. Replace the seal bolt to the attached grease nipple and then start greasing.
3 Supply grease slowly without applying excessive force, using a manual pump.
4 Whenever possible, avoid using a compressed-air pump, powered by the factory air supply. Even when it is unavoidable to use a compressed-air pump, the gun tip pressure needs to be set the value of the gun tip pressure on Table 7.3.5 (a).
5 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
6 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 7.3.7, and then close the grease outlet.
7 To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.

7.3.6 Grease Replacing Procedure of J3 Cross Roller

1 Move the robot to the posture J2=0°. (Table 7.3.5 (b))
2 Turn off controller power.
3 Remove seal bolts of grease inlet and outlet. Attach grease nipple which is attached to robot. (Fig.7.3.6 (a))
(This grease nipple and J1-axis reducer grease inlet grease nipple are common. It is possible to remove it temporally and use it instead of the attached grease nipple.)
4 Attach the bags for collecting under the grease outlet to prevent spilled grease from splattering.
5 Apply specified amount of grease referring to Table 7.3.5 (a).
6 Release remaining pressure referring to Subsection 7.3.7.

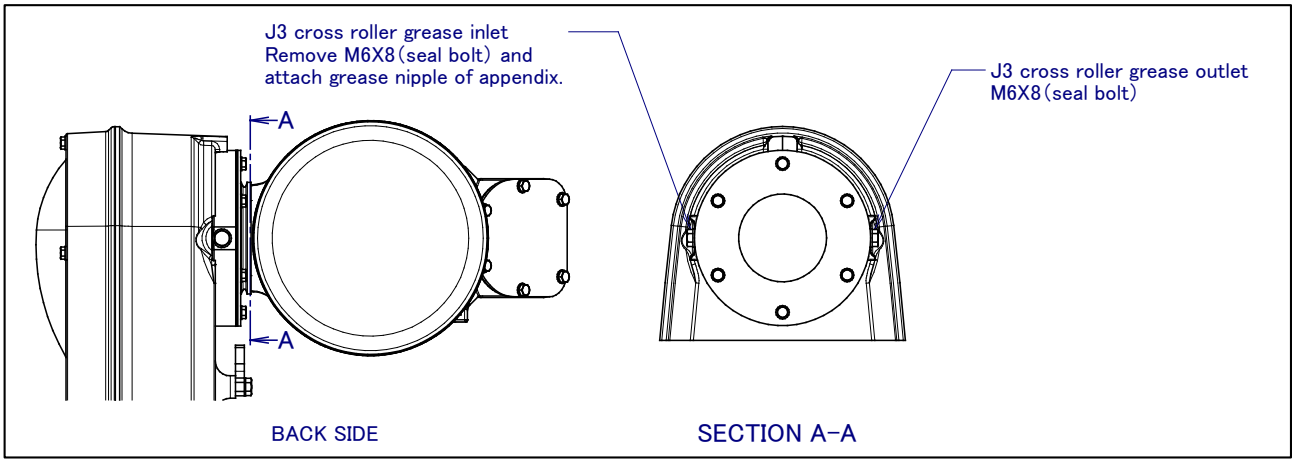


Fig.7.3.6 (a) Replacing grease of J3 cross roller

7.3.7 Procedure for Releasing Remaining Pressure of J3 Cross Roller

After greasing, remove the grease nipple of the grease inlet, and keep outlet without seal bolt, then operate the robot for 20 minutes or more to release remaining pressure within the grease bath.
Attach the bags for collecting under the grease inlet and grease outlet to prevent spilled grease from splattering.

If the above operation cannot be performed due to the environment of the robot, adjust the operating time according to the operating angle. (When the maximum allowable axis angle is 30°, perform twice the operation for 40 minutes or more.)
After the above operation is performed, attach the seal bolts to the grease inlet and the grease outlet.
Be careful not to attach the grease nipple. When the seal bolt is reused, be sure to seal it with seal tape.

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

(*) M-430*i*A/2F/2FH/4FH does not have J6-axis.

7.4 CLEANING

7.4.1 Cleaning the Robot

M-430*i*A can be washed with sprinkling water or cleaner diluted properly.

If strong water jet strike the robot, the water jet might hurt the waterproof function of robot. The water or cleaner should be sprinkled from the shower nozzle.

Stains stuck on the robot surface should be wiped with a cloth. Do not brush robot surface hard, because brushing has possibility to affect the coating on robot surface and sealing on the robot joints.

Pay special attention not to strike strong jet to V ring which seal each joint part. Don't turn lip part because it cause intrusion of an alien substance or liquid.

Do not sprinkle water or cleaner on the controller.

7.4.2 Cleaner

The appropriate treatment and material is adopted for robot M-430*i*A, which the treatment and material are resistant to chemicals (Except without painting modification). It is possible to spray cleaners directly on the robot surface, and the robot can be kept in sanitary condition by daily cleaning.

The cleaners written in the Table 7.4.2 (a) has been proven to have no harmful effects to the robot surface. Other cleaner has to be checked the impact to robot surface, please contact your local FANUC representative for them.

Use the cleaner for the rule use density of each cleaner after diluting it. If you use cleaner whose dilution ration is not correct, it may cause damage to robot surface. Please use a cleaner and the water at temperature equal to or less than 50 degrees Celsius.

Alcohol and organic solvent may have a bad influence on the robot surface. Do not use them to cleaning robot.

Table 7.4.2 Cleaners whose harmlessness for the robot surface is confirmed

NAME	MAKER	TYPE	MAIN INGREDIENT	DILUTION RATE (NOTE 1)
Geron IV	ANDERSON	Sanitizer	Quaternary ammonium chloride	0.2%
Reg13	ANDERSON	Sanitizer	Sodium hypochloride	0.15%
FOMENT	ANDERSON	Alkali cleaner	Potassium hydroxide Sodium hypochlorite	1.5%
SUPERLOX X-40	ANDERSON	Acid cleaner	Phosphoric acid	1.5%
SAN-TEC 5	ANDERSON	Acid cleaner	Hydrogen peroxide Acetic acid Peroxyacetic acid	0.2%
P3-topax 99	ECOLAB	Sanitizer	N-3(-Aminopropyl)-N- Dodecylpropan -1,3-diamin	2%
P3-topax 91	ECOLAB	Sanitizer	Benzalkonium chloride	0.5%
P3-topax 66	ECOLAB	Sanitizer	Sodium hydroxide Sodium hypochlorite Alkylamine oxide	5%
P3-topactive DES	ECOLAB	Acid cleaner	Hydrogen peroxide Acetic acid Alkylamine oxide Peroxyacetic acid	3%
P3-topactive 200	ECOLAB	Alkali cleaner	Ethanol Potassium hydroxide Sodium hydroxide	4%
ACIFOAM VF10	JohsonDiversey	Acid cleaner	Phosphoric acid Alkylbenzenesulfonic acid	10%
DIVOSAN ACTIV VT5	JohsonDiversey	Acid cleaner	Hydrogen peroxide Acetic acid Peroxyacetic acid	4%
Hypofoam VF6	JohsonDiversey	Sanitizer	Sodium hydroxide Sodium hypochlorite Amine	10%
DIVOSAN EXTRA VT55	JohsonDiversey	Sanitizer	Quaternary ammonium chloride	1%

NOTE
1 DILUTION RATE = STOCK SOLUTION / (STOCK SOLUTION+WATER)
2 Acid cleaner have to be rinsed diligently and it should never remain on the robot surface. Robot surface cannot contact with acid cleaner continuously for over 15 minute.
3 The use of cleaner in Table 7.4.2 (a) might be restricted by the law of the country or the region, and obtaining is difficult.

7.5 STORAGE

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

8 MASTERING

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

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 go dead. Replace the batteries in the controller and mechanical units periodically. An alarm will be issued to warn the user of a low battery voltage.

Types of Mastering

Table 8.1 (a) describes the following mastering methods. If 7DC2 (V8.20P) or former software is installed, "Quick mastering for single axis" has not been supported.

Table 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, it is necessary to carry out positioning, or calibration. Positioning is an operation in which the controller reads the current pulse count value to sense the current position of the robot.

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

⚠ CAUTION

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

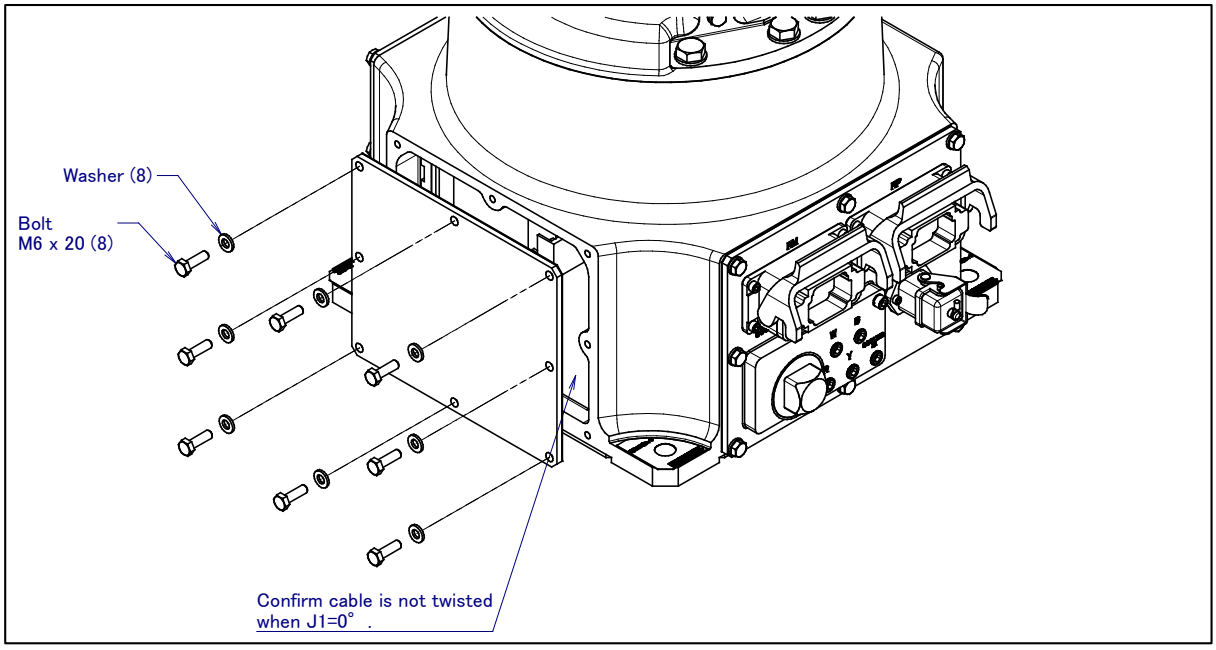


Fig. 8.1 (a) Check the cables statement (J1-axis)

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 appears.

```
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
```

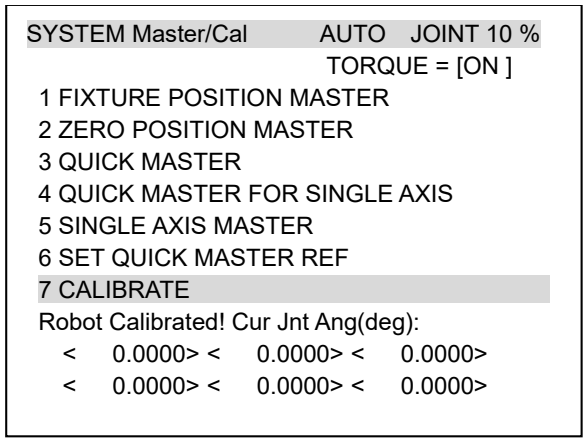
5 Release brake control, and jog the robot into a posture for mastering.

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 the controller power off and then on again.

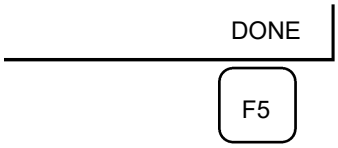
6 Select [2 Zero Position Master]. Press F4 [YES].

```
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> <12200039> <2000319>
 [ TYPE ]   LOAD   RES_PCA                DONE
```

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



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



9 Return brake control to the 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 deg
J4-axis	0 deg
J5-axis	0 deg
J6-axis	0 deg

⚠ CAUTION
The M-430*i*A/2F/2FH/4FH models do not have a J6 axis.

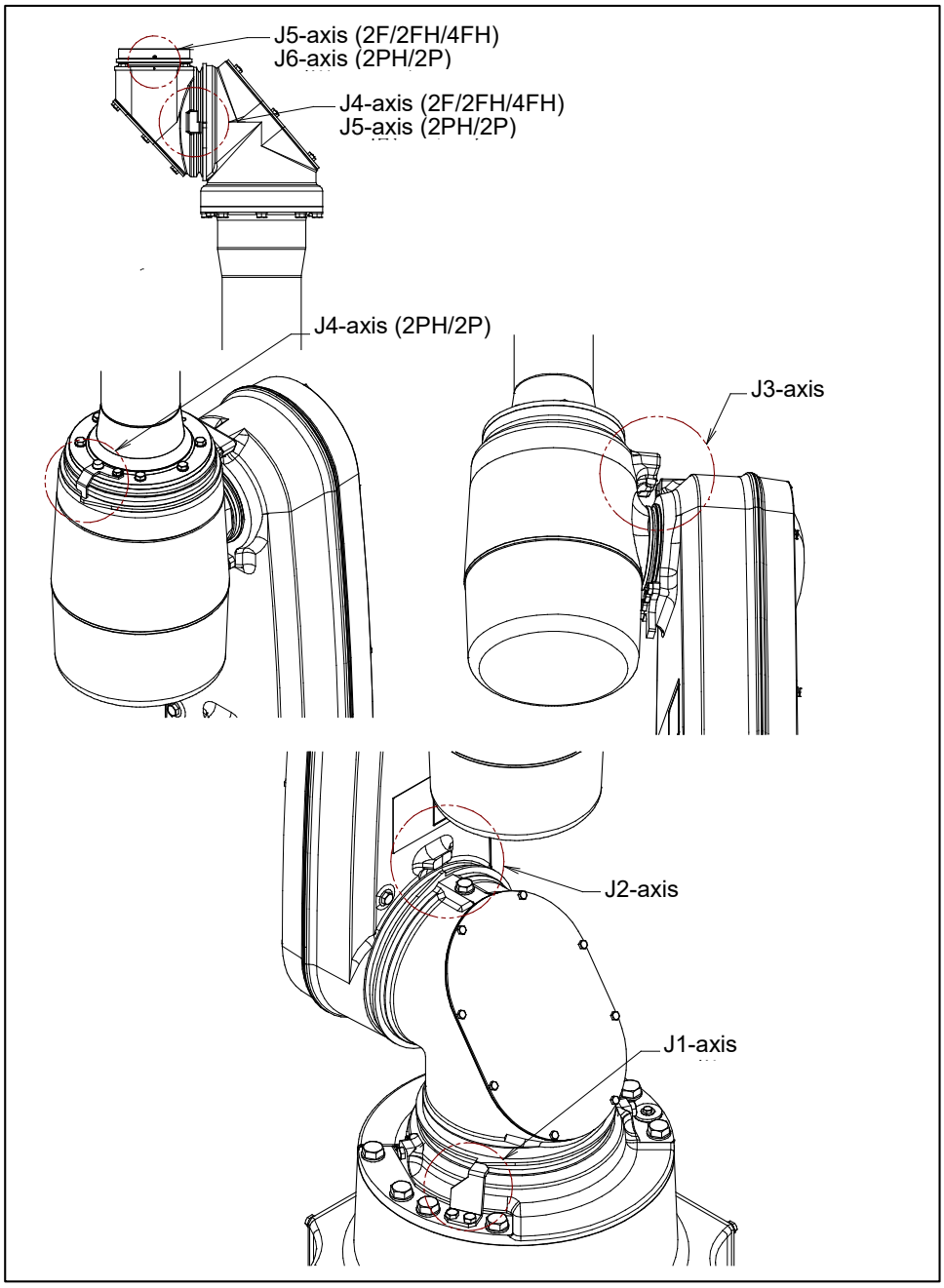


Fig. 8.3 (a) Zero degree position witness mark for each axis

8.4 QUICK MASTERING

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

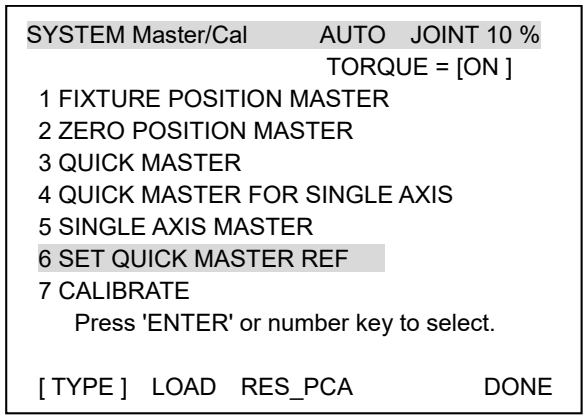
Quick mastering is factory-performed at the position indicated in Table 8.3 (a). If possible, do not change the setting.

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

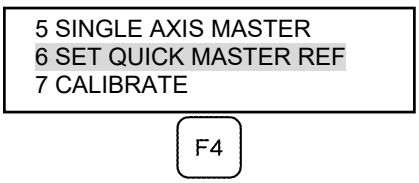
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure for Recording the Quick Mastering Reference Position

1 Select [6 SYSTEM].
2 Select [Master/Cal]. The positioning screen appears.



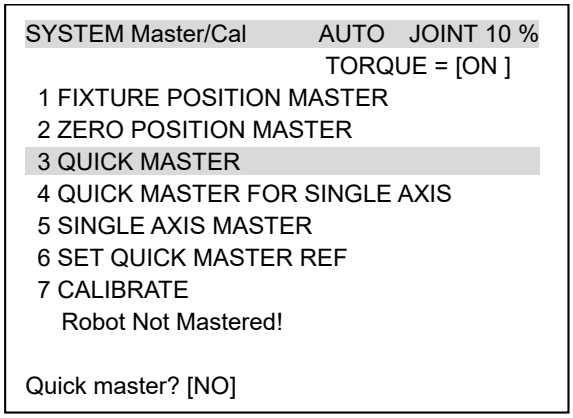
3 Release brake control, and jog the robot to the quick mastering reference position.
4 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position is saved.



⚠ 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 is required to restore mastering data.

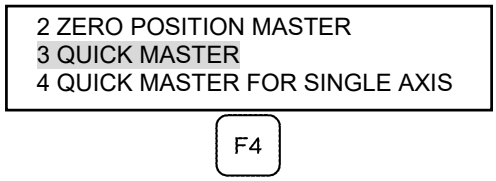
Procedure of Quick Mastering

1 Display the Master/Cal screen.



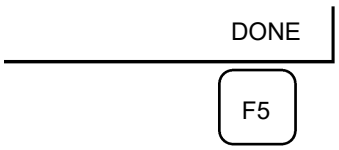
2 Release brake control, and jog the robot to the quick mastering reference position.

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



4 Select [7 CALIBRATE] and press [ENTER] key. Calibration is executed. Calibration is executed by cycling power.

5 After completing the calibration, press F5 Done.



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

8.5 QUICK MASTERING FOR SINGLE AXIS

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

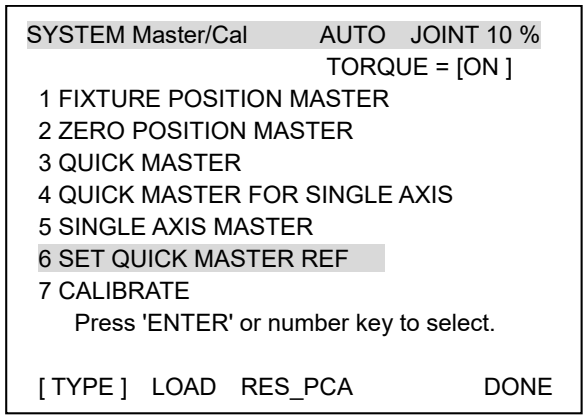
Quick mastering is factory-performed at the position indicated in Table 8.3 (a). If possible, do not change the setting.

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

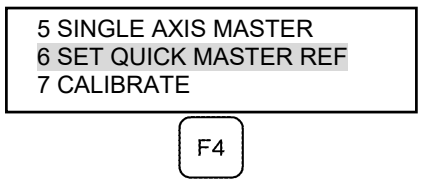
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure for Recording the Quick Mastering Reference Position

1 Select [6 SYSTEM].
2 Select [Master/Cal]. The positioning screen appears.



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]
```

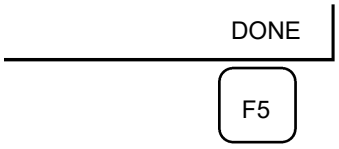
2 Select [4 QUICK MASTER FOR SINGLE AXIS]. You will see the quick master for single axis screen.

```
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)  (1)     [2]
J6          0.000   (     0.000)  (1)     [2]

                                          EXEC
```

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



8 Return brake control to original setting, and 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.

The M-430*i*A/2F/2FH/4FH has the following motors allocated to J6, E1, and E2.

J6: J1-axis sub-motor
E1: J2-axis sub-motor
E2: J3-axis sub-motor

The M-430*i*A/2PH has the following motors allocated to J6, E1, and E2.

E1: J1-axis sub-motor
E2: J2-axis sub-motor
E3: J3-axis sub-motor

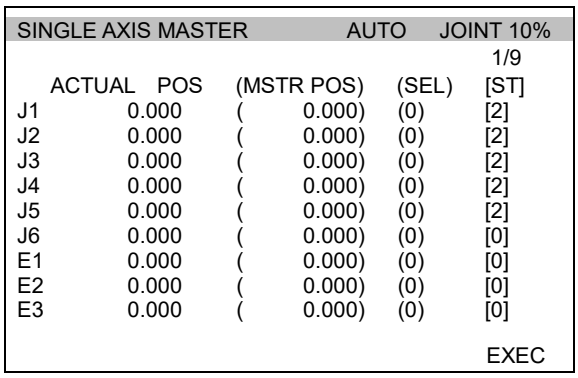


Table 8.6 (a) Items set in single axis mastering

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

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

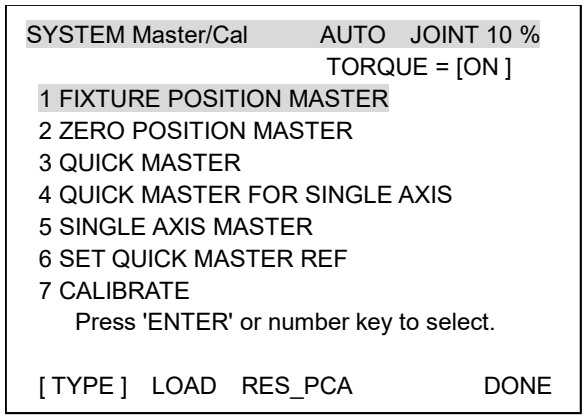
3 Select [5 SINGLE AXIS MASTER]. You will see a screen similar to the following.

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

                                          EXEC
```

4 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.

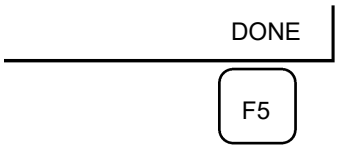
```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                          6/9
    ACTUAL   POS    (MSTR POS)    (SEL)   [ST]
J1          0.000   (     0.000)  (0)     [2]
J2          0.000   (     0.000)  (0)     [2]
J3          0.000   (     0.000)  (0)     [2]
J4          0.000  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



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

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



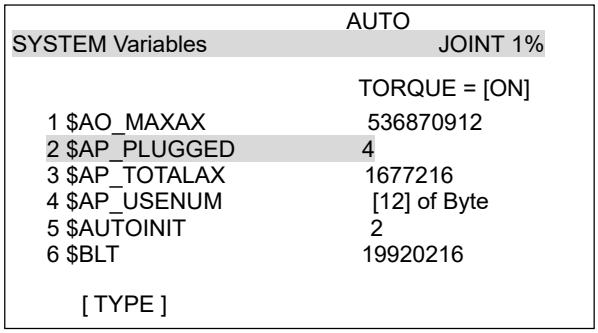
11 Return brake control to original setting, and cycle power of the controller .

8.7 MASTERING DATA ENTRY

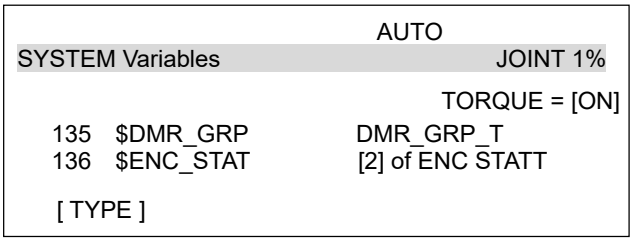
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

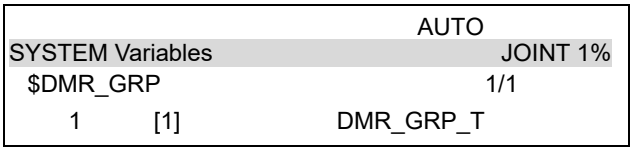
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen appears.

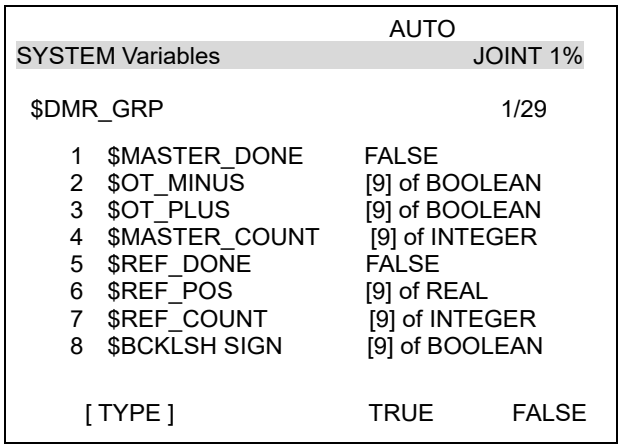


3 Change the mastering data.
The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

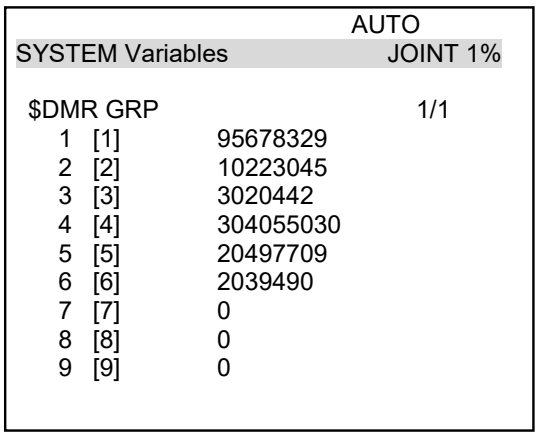


4 Select $DMR_GRP.

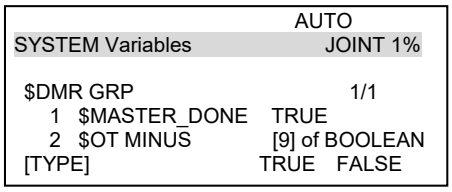




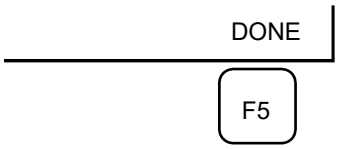
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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



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



8.8 VERIFYING MASTERING

1 How to check that the robot is mastered properly.
Usually, positioning is performed automatically at power on. To check whether mastering has been performed correctly, examine if the current displayed position matches the actual robot position by using the procedure described below:
(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the zero-degree position marks indicated in Section 8.3 are aligned. No need of any 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 below 2 in this Section. Alternatively, the mastering data in system variable $DMR_GRP.$MASTER_COUN may have been overwritten as a result of an operation error or for 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 Alarms that may be output during mastering and remedy for it
(1) BZAL alarm
This alarm occurs 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 replacing cables etc. this alarm occurs as the voltage decreased to 0. Confirm if the alarm disappears by performing pulse reset (See Section 8.2.). And then cycle power of the controller to check if the alarm disappears or not.
The battery may be drained if the alarm is still displayed. Perform pulse reset, cycle controller power after replacing the battery. Note that, if this alarm has displayed, all the original data held by the Pulsecoder will be lost. Mastering is required.
(2) BLAL alarm
This alarm occurs if the Pulsecoder's backup battery voltage has fallen to a level where backup is no longer possible. If this alarm occurs, replace the battery immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1 in this Section.
(3) Alarm notifications like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may indicate trouble with Pulsecoder, contact your local FANUC representative.

9 TROUBLESHOOTING

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

9.1 TROUBLESHOOTING

Table 9.1 (a) shows the major troubleshooting symptoms that may occur in the mechanical unit and their probable causes. If you cannot pinpoint a failure cause or which measures to take, contact your local FANUC representative. For troubleshooting except the mechanical unit, refer to "CONTROLLER MAINTENANCE MANUAL (B-83195EN etc.)" and Alarm Code List (B-83284EN-1).

Table 9.1 (a) Troubleshooting

Symptom	Description	Cause	Measure
Vibration Noise	- The J1 base lifts off the floor plate as the robot operates. - There is a gap 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 which, in turn, lead 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, remove it.
	- The rack or floor plate vibrates during operation of the robot.	[Rack or floor] - It is likely that the rack or floor is not rigid enough. - If they are not rigid enough, counterforce can deform the rack or floor, and causes 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 overloaded, reduce the load, or modify the robot control program. - Vibration can be reduced by re-modifying the robot control program; reducing speed or acceleration with minimizing the influence on the entire cycle time.
	- Vibration or noise was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating or noise occurring axis has not been exchanged for a long period. - Cyclical vibration and noise occur.	[Gear, bearing, or reducer] - It is likely that the collision or overload applied an excessive force on the drive mechanism, thus damaging the geartooth surface or rolling surface of a bearing, or reducer. - It is likely that prolonged use of the robot while overloaded caused fretting of the gear tooth surface or rolling surface of a bearing, or reducer due to resulting metal fatigue. - It is likely that contamination which was caught in a gear, bearing, or within a reducer caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that contamination which was caught in a gear, bearing, or within a reducer cause vibration. - It is likely that, because the grease has not been changed for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue.	- Operate one axis at a time to determine which axis is vibrating. - Remove the motor, and replace the gear, the bearing, and the reducer. For the spec. of parts and the method of replacement, contact FANUC. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Regularly changing the grease with a specified type can help prevent problems.

Symptom	Description	Cause	Measure
Vibration noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical section.	[Controller, cable, and motor] - If a failure occurs in a controller circuit, preventing control commands from being supplied to the motor normally, or preventing motor information from being sent to the controller normally, vibration might occur. - Pulsecoder defect may be the cause of the vibration as the motor cannot propagate the accurate position to the controller. - If the motor becomes defective, vibration might occur because the motor cannot deliver its rated performance. - If a power line in a movable cable of the mechanical unit has an intermittent break, vibration might occur because the motor cannot accurately respond to commands. - If a Pulsecoder wire in a movable part of the mechanical unit has an intermittent break, vibration might occur because commands cannot be sent to the motor accurately. - If a robot connection cable has an intermittent break, vibration might occur. - If the power supply cable is about to be snapped, vibration might occur. - If the power source voltage drops below the rating, vibration might occur. - It may vibrate when an invalid value parameter was set. - If the noise occurs on a belt driving axis, damage of the bel may cause the noise.	- Refer to CONTROLLER MAINTENANCE MANUAL for troubleshooting related to the controller and amplifier. - Replace the motor of the axis that is vibrating, and check whether vibration still occurs. For the method of replacement, contact your local FANUC representative. - If vibration occurs only when the robot assumes a specific posture, it is likely that there is a mechanical problem. - Shake the movable part cable while the robot is at rest, and check whether an alarm occurs. If an alarm or any other abnormality occurs, replace the mechanical unit cable. - Check whether the cable jacket of the robot connection cable is damaged. If so, replace the connection cable, and check whether vibration still occurs. - Check whether the power cable jacket is damaged. If so, replace the power cable, and check whether vibration still occurs. - Check that the robot is supplied with the rated voltage. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct it. Contact your local FANUC representative for further information if necessary. - 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.
	- The allophone came out when operating just after the greasing or the component replacement.	- There is a possibility of grease has not been exchanged accurately. The amount of refueling may be insufficient.	- Stop the robot, and confirm the damage situation at once. Replenish grease or oil when they are insufficient.
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 surface of the mechanical unit.	[Mechanical section coupling bolt] - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical section.	- Check that the following bolts for each axis are tight. If any of these bolts is loose, apply LOCTITE and tighten it to the appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Reducer shaft retaining bolt - Base retaining bolt - Arm retaining bolt - Casing retaining bolt - End effector retaining bolt

Symptom	Description	Cause	Measure
	- Backlash is greater than the tolerance stated in the applicable operator's manual. (See 9.2 for the wrist backlash.)	[Increase in backlash] - It is likely that excessive force applied to the drive mechanism, due to a collision or overloading, has broken a gear or the inside of the reducer, resulting in an increase in the amount of backlash. - Another possible cause is that a backlash increases because the tooth surfaces of the gear and reducer have worn due to an extended period of use under overload conditions. - It is likely that prolonged use without changing the grease has caused the tooth surfaces of a gear and the inside of the reducer to wear out, resulting in an increase in the amount of backlash.	- Operate one axis at a time to determine which axis has the increased backlash. - Remove the motor, and check whether any of its gears are broken. If any gear is broken, replace it. - Check whether any other gear of the drive mechanism is damage. If there is no damage gear, replace the reducer. - If the reducer is broken, or if a gear tooth is missing, replace the relevant component. Also, remove all the grease from the gearbox and wash the inside of the gearbox. - After replacing the gear or reducer, add an appropriate amount of grease. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Regularly changing the grease with a specified type can help prevent problems.
Motor overheating	- The ambient temperature of the installation location increases, causing the motor to overheat. - After the robot control program or the load was changed, the motor overheated.	[Ambient temperature] - It is likely that the motor overheated when the ambient temperature rose, and could not release 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 overheat. - If there is a source of heat near, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is effective to reduce the average current. Thus, prevent overheat. - The teach pendant can monitor the average current. Check the average current when the robot control program launched.
	- After a control parameter (load setting etc.) was changed, the motor overheated.	[Parameter] - If data input for a workpiece is invalid, the robot cannot be accelerated or decelerated normally, so the average current increases, leading to overheat.	- As for load setting, Input an appropriate parameter referring to Section 4.2.

Symptom	Description	Cause	Measure
	- Symptom other than stated above	[Mechanical section problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor running with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor.	- Repair the mechanical unit while referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - If the average current falls after the motor is replaced, it indicates that the first motor was faulty.

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

Symptom	Description	Cause	Measure

Dropping axis	- An axis falls because the brake went out.
	- An axis falls while standing still.
		[Brake drive relay and motor]
		- It is likely that brake drive relay contacts are stuck to each other and keep the brake current flowing, thus preventing the brake from operating when the motor is reenergized.
		- It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently.
		- It is likely that oil or grease soak through the motor, causing the brake to slip.
			- Check whether the brake drive relays are stuck to each other or not. If they are found to be stuck, replace the relays.
			- Replace the motor after confirming whether the following symptoms have occurred.
			  - Brake shoe is worn out
			  - Brake main body is damaged
			  - Oil soaked through the motor

Displacement	- The robot moves to a point other than the taught position. - The repeatability is not within the tolerance.	[Mechanical unit problems] - If the robot is not repeatable, probable causes are a failure in the drive mechanism or a loose bolt. - If the robot is repeatable, it is likely that a collision caused slip on the sting surface of each axis arm, and reducer. - It is likely that the Pulsecoder is faulty.	- If the robot is not repeatable, repair the mechanical unit by referring to the above descriptions of vibration, noise, and rattling. - If the robot is repeatable, 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 specific peripheral equipment.	[Peripheral equipment displacement] - It is likely that an external force was applied to the peripheral equipment, thus shifting its position relative to the robot.	- Correct the setting of the peripheral equipment position. - Correct the taught program.
	- Displacement occurred after a parameter was changed.	[Parameter] - It is likely that the mastering data was overwritten, and the origin had misaligned.	- Re-enter the previous optimal mastering data. - 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 occurred	- BZAL is displayed on the teach pendant screen.	- It is likely that the voltage of the memory backup battery is low. - It is likely that the Pulsecoder cable is defective.	- Replace the battery. - Replace the cable.

9.2 METHOD OF MEASURING A BACKLASH IN THE WRIST

Match the J4 and J5 alignment marks in the M-430*i*A/2F/2FH/4FH or match the J5 and J6 alignment marks in the M-430*i*A/2P/2PH and then turn off the power to the robot.
Lightly turn and match the movable alignment to the other alignment mark by hand, and measure a backlash on the surroundings of the alignment marks. The allowable value is within ±1 mm (within 2 mm in width). Replace the wrist unit if the allowable value is exceeded.

APPENDIX

A PERIODIC MAINTENANCE TABLE

Items				Check time	Oil Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint		0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	2	Check for water		0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	3	Check the tightness of exposure connector		0.2H	–		○			○				○			
	4	Tighten the end effector bolt.		0.2H	–		○			○				○			
	5	Tighten the cover and external main bolt.		2.0H	–		○			○				○			
	6	Check the mechanical stopper and adjustable mechanical stopper		0.1H			○			○				○			
	7	Remove spatter and dust etc.		1.0H	–		○			○				○			
	8	Check the end effector (hand) cable		0.1H			○			○				○			
	9	Replacing batteries (*3)	2F/2FH/ 4FH/2PH	0.1H	–							●					
			2P							●				●			
	10	Greasing to the J1 axis reducer		0.5H	10 ml					●				●			
	11	Greasing to the J2, J3 axis reducer		0.5H	20 ml					●				●			
	12	Replacing grease of J3 cross roller		0.5H	10ml					●				●			
	13	Measure the wrist backlash.		0.05H	–									○			
Controller	14	Check the robot cable and teach pendant cable.		0.2H	–		○			○				○			
	15	Cleaning the controller ventilation system		0.2H	–	○	○	○	○	○	○	○	○	○	○	○	○
	16	Replacing batteries (*1)(*3)		0.1H	–												

*1 Refer to “REPLACING UNITS Chapter of MAINTENANCE ” of the following manuals.
R-30*i*A CONTROLLER MAINTENANCE MANUAL (Standard) (B-82595EN),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For Europe)(B-82595EN-1),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For RIA) (B-82595EN-2),
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),

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

*3 Regardless of the operating time, replace the mechanical unit batteries at 1 year or 1.5 year, replace controller batteries at 4 years.

*4 The replace article when overhauling it is as follows.
J2 base unit, seal of joint, timing belt, Idler pulley, wrist unit, cable of movable part, seal for cover, grease, battery. There is an article for which the exchange is necessary when abnormality is found as a result of other checks.

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 (*3)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	Overhaul (*4)	1
○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○					○			○				○				○					3
○					○			○				○				○					4
○					○			○				○				○					5
○					○			○				○				○					6
○					○			○				○				○					7
○					○			○				○				○					8
●										●						●					9
●								●				●				●					
●								●				●				●					10
●								●				●				●					11
●								●				●				●					12
												○									13
○				○				○				○				○					14
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		15
				●																	16

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. After you screw the bolts into the threaded holes, remove any excess LOCTITE.

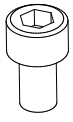
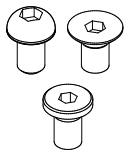
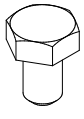
Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:

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

INDEX

REVISION RECORD

Edition	Date	Contents
08	Jun, 2021	・ Change of the grease ・ Addition of DCS option ・ Correction of errors
07	Sep.,2017	・ Correction of errors
06	Feb.,2013	・ Addition of R-30*i*B controller ・ Addition of replacing grease of J3 cross roller ・ Correction of errors
05	Sep.,2010	・ Addition of stop type of robot ・ Addition of stopping time and distance when controlled stop is executed ・ Correction of errors
04	Dec., 2008	・ Addition of M-430*i*A/4FH ・ Correction of errors
03	Aug., 2008	・ Addition of the procedure to move arm without drive power in emergency or abnormal situations. ・ Addition of stopping time and distance when emergency stop. ・ Addition of cleaning method of robot ・ Addition of M-430*i*A/2PH and High accuracy type of M-430*i*A/2F/2FH/2P
02	Oct., 2007	・ The descriptions of the M-430*i*A/2FH have been added. ・ Correction of errors
01	May, 2007	

B-82554EN/08

* B - 8 2 5 5 4 E N / 0 8 *