FANUC Robot ARC Mate 100*i*B
FANUC Robot ARC Mate 100*i*B/6S
FANUC Robot M-6*i*B
FANUC Robot M-6*i*B/6S
FANUC Robot M-6*i*B/2HS

MECHANICAL UNIT

OPERATOR'S MANUAL

B-81544EN/01

- **Original Instructions**

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

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

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

SAFETY PRECAUTIONS

This chapter must be read before using the robot.

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

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

1 DEFINITION OF USER

The personnel can be classified as follows.

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

Programmer or Teaching operator:
- Operates the robot
- Teaches the robot inside the safety fence

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

- Operator is not allowed to work in the safety fence.
- Programmer/Teaching operator and maintenance technician are allowed to work in the safety fence. Works carried out in the safety fence include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safety fence, the person must be trained on proper robot operation.

Table 1 (a) lists the work outside the safety fence. In this table, the symbol "O" means the work allowed to be carried out by the worker.

Table 1 (a) List of work outside the fence

	Operator	Programmer or Teaching operator	Maintenance technician
Turn power ON/OFF to Robot controller	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

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

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

2 DEFINITION OF SAFETY NOTATIONS

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

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

- Check this manual thoroughly, and keep it handy for the future reference.

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

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

Name	Specification
Brake release unit	A05B-2450-J350 (Input voltage AC100-115V single phase) A05B-2450-J351 (Input voltage AC200-240V single phase)
Robot connection cable	A05B-2450-J370 (5m) A05B-2450-J371 (10m)
Power cable	A05B-2525-J010 (5m) (AC100-115V Power plug) (*) A05B-2525-J011 (10m) (AC100-115V Power plug) (*) A05B-2450-J364 (5m) (No power plug) A05B-2450-J365 (10m) (No power plug)

(*) These do not support CE marking.

(2) Prepare and store adequate numbers of brake release units which are ready and readily accessible for robot system before installation.
(3) Regarding how to use brake release unit, please refer to "**Robot controller maintenance manual**".

> ⚠ **CAUTION**
> Robot systems installed without adequate number of brake release units or similar means are neither in compliance with **EN ISO 10218-1** nor with the Machinery Directive and therefore cannot bear the CE marking.

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

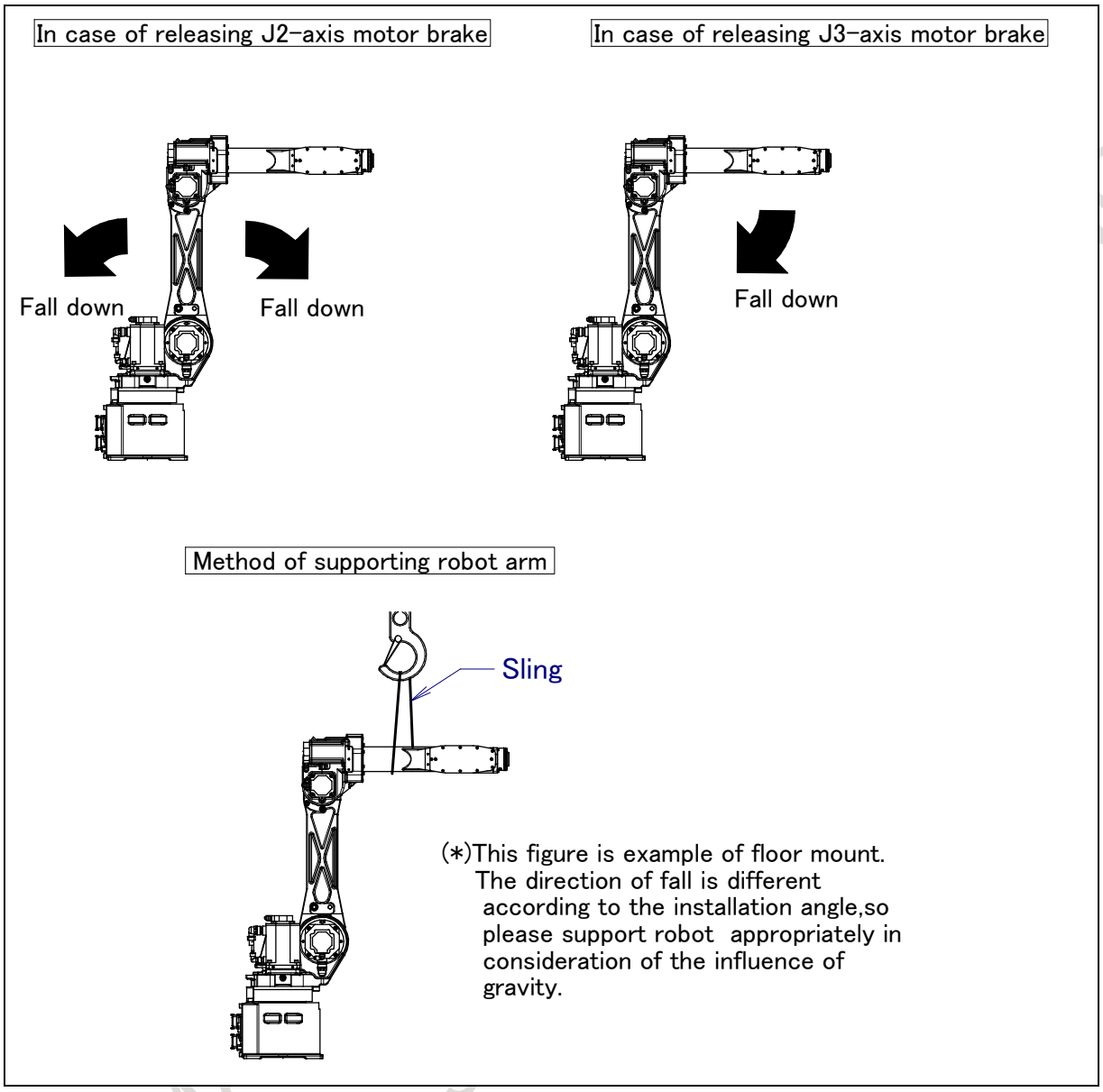


Fig. 3 (a) Releasing J2 and J3 motor brake and measures

4 WARNING LABEL

(1) Greasing and degreasing label

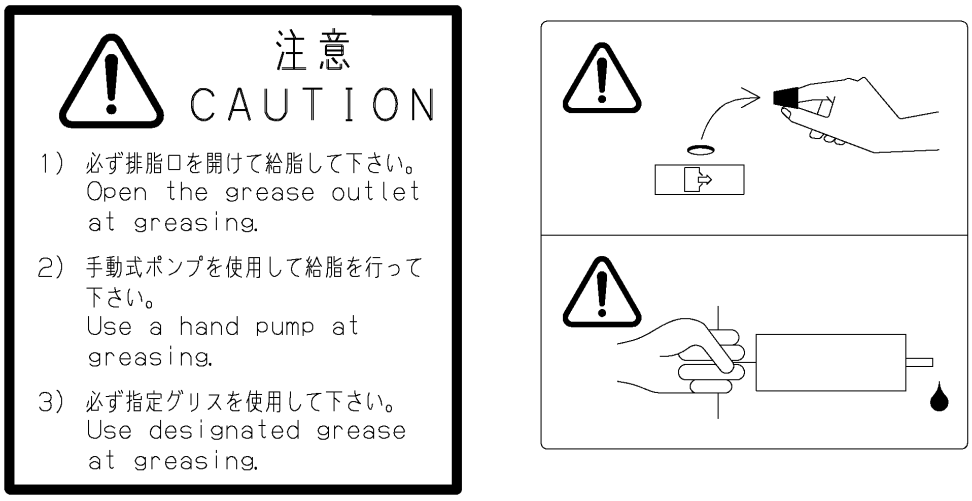


Fig. 4 (a) Greasing and Degreasing Label

Description

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

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

> **⚠CAUTION**
> See Chapter 3″ PERIODIC MAINTENANCE” for explanations about specified greases, the amount of grease to be supplied, and the locations of grease and degrease outlets for individual models.

(2) Step-on prohibitive label

Fig. 4 (b) Step-on Prohibitive Label

Description

Do not step on or climb the robot or controller as it may adversely affect the robot or controller and you may get hurt if you lose your footing as well.

(3) High-temperature warning label

Fig. 4 (c) High-temperature warning label

Description

Be cautious about a section where this label is affixed, as the section generates heat. If you have to inevitably touch such a section when it is hot, use a protective provision such as heat-resistant gloves.

(4) Transportation label

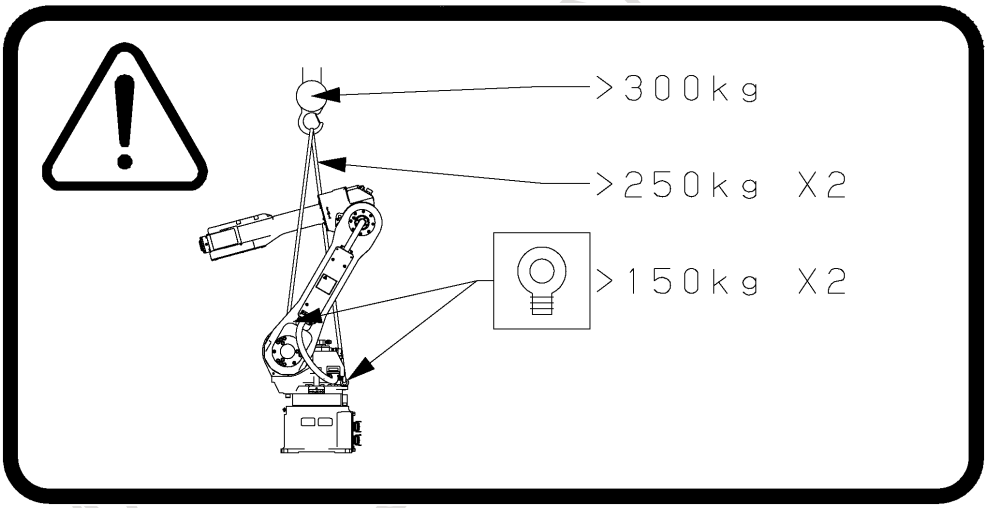


Fig. 4 (d) Transportation label

Description

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

1) Using a crane
   - Use a crane having a load capacity of 300 kg or greater.
   - Use at least two slings each having a withstand load of 2450 N (250 kgf) or greater.
   - Use at least two eyebolts each having a withstand load of 1470 N (150 kgf) or greater.

> ⚠ **CAUTION**
> See section 10.1 TRANSPORTATION for explanations about the posture a specific model should take when it is transported.

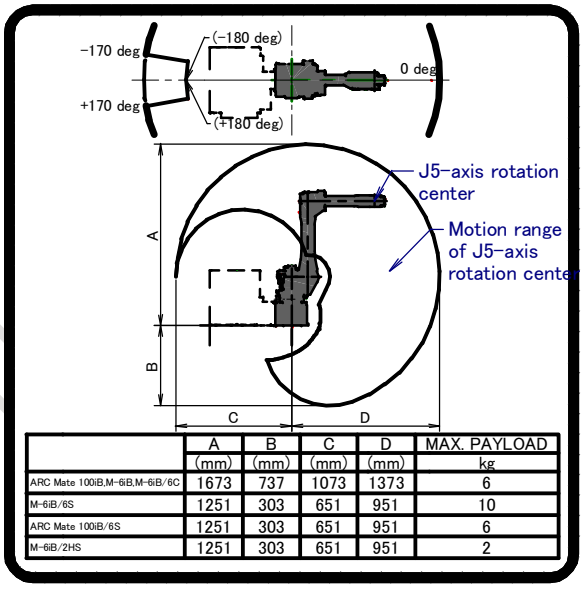
Fig. 4 (e) Transportation label

Description

When transporting the robot, observe the instructions indicated on this label.
Do not pull eyebolts sideways.

(5) Operating space and payload mark label

Below label is added when CE specification is specified. (only for 6-axis brake type)



	A (mm)	B (mm)	C (mm)	D (mm)	MAX. PAYLOAD kg
ARC Mate 100iB,M-6iB,M-6iB/6C	1673	737	1073	1373	6
M-6iB/6S	1251	303	651	951	10
ARC Mate 100iB/6S	1251	303	651	951	6
M-6iB/2HS	1251	303	651	951	2

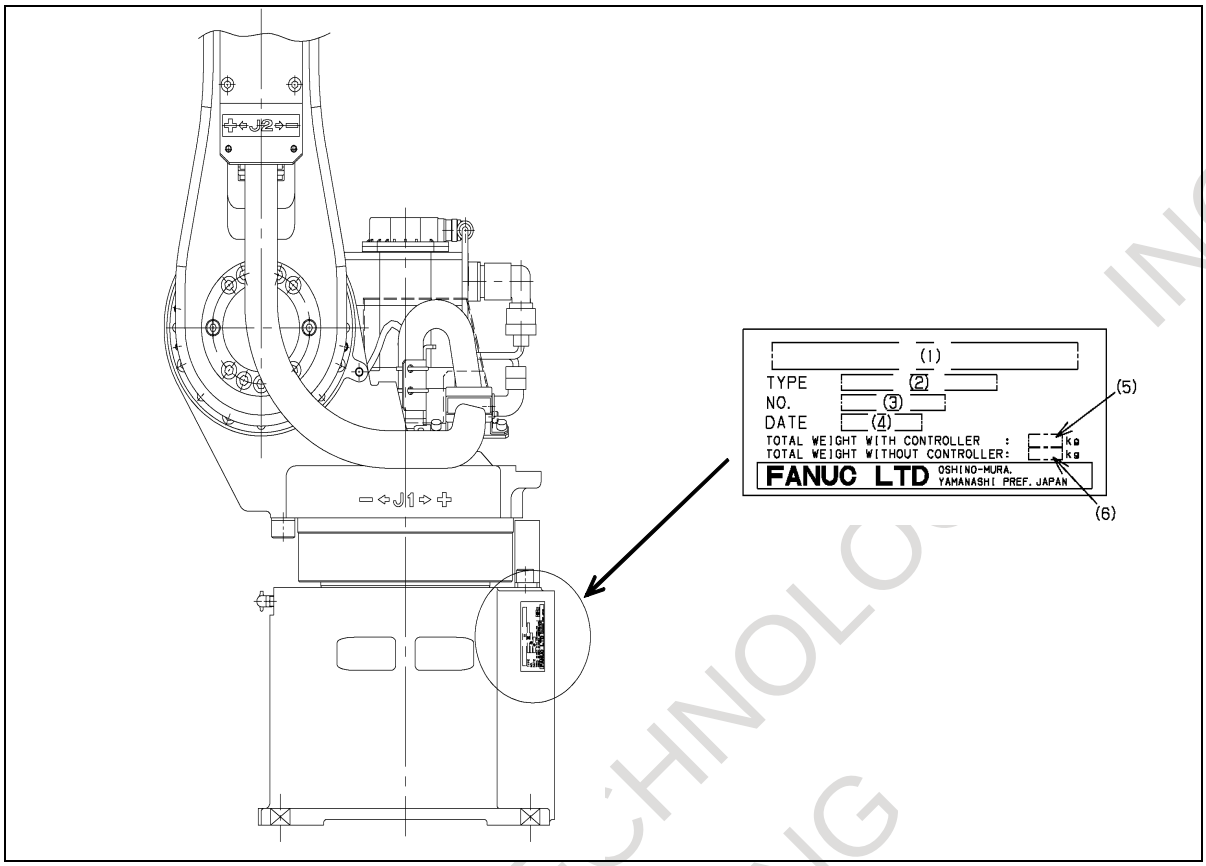
Fig.4 (f) Operating space and payload mark label

PREFACE

This manual explains the operation procedures for the mechanical units (R-J3*i*B and R-30*i*A controller) of the following robots. Before replacing the parts, determine the specification number of the mechanical unit.:

Model name	Abbreviation	Mechanical unit specification No.	Controller
FANUC Robot ARC Mate 100*i*B (With J2 and J3-axis brakes)	ARC Mate 100*i*B	A05B-1215-B201	R-J3*i*B
FANUC Robot ARC Mate 100*i*B (With all axes brakes)		A05B-1215-B601	
FANUC Robot ARC Mate 100*i*B/6S (With all axes brakes)	ARC Mate 100*i*B/6S	A05B-1215-B611	
FANUC Robot M-6*i*B (With J2 and J3-axis brakes)	M-6*i*B	A05B-1215-B202	
FANUC Robot M-6*i*B (With all axes brakes)		A05B-1215-B602	
FANUC Robot M-6*i*B/6S (With all axes brakes)	M-6*i*B/6S	A05B-1215-B612	
FANUC Robot M-6*i*B/2HS (With all axes brakes)	M-6*i*B/2HS	A05B-1215-B632	
FANUC Robot ARC Mate 100*i*B (with J2 and J3-axis brakes)	ARC Mate 100*i*B	A05B-1215-B401	R-30*i*A
FANUC Robot ARC Mate 100*i*B (with all axes brakes)		A05B-1215-B801	
FANUC Robot ARC Mate 100*i*B/6S (with all axes brakes)	ARC Mate 100*i*B/6S	A05B-1215-B811	
FANUC Robot M-6*i*B (with J2 and J3-axis brakes)	M-6*i*B	A05B-1215-B402	
FANUC Robot M-6*i*B (with all axes brakes)		A05B-1215-B802	
FANUC Robot M-6*i*B/6S (with all axes brakes)	M-6*i*B/6S	A05B-1215-B812	
FANUC Robot M-6*i*B/2HS (with all axes brakes)	M-6*i*B/2HS	A05B-1215-B832	

> ⚠ **CAUTION**
> Note that the models for the R-J3*i*B controller and those for the R-30*i*A controller partly differ in the specifications of mechanical unit cables and motors.



No.	(1)	(2)	(3)	(4)	(5)	(6)
CONTENTS	MODEL	TYPE	No.	DATE	WEIGHT (With controller)	WEIGHT (Without controller)
LETTERS	FANUC Robot ARC Mate 100*i*B (With J2,J3-axis brakes)	A05B-1215-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	222 kg	134 kg
	FANUC Robot ARC Mate 100*i*B (With all axes brakes)	A05B-1215-B601			226 kg	138 kg
	FANUC Robot ARC Mate 100*i*B/6S (With all axes brakes)	A05B-1215-B611			-	135 kg
	FANUC Robot M-6*i*B (With J2,J3-axis brakes)	A05B-1215-B202			222 kg	134 kg
	FANUC Robot M-6*i*B (With all axes brakes)	A05B-1215-B602			226 kg	138 kg
	FANUC Robot M-6*i*B/6S (With all axes brakes)	A05B-1215-B612			-	135 kg
	FANUC Robot M-6*i*B/2HS (With all axes brakes)	A05B-1215-B632			-	135 kg

Position of label indicating mechanical unit specification number (R-J3*i*B controller)

No.	(1)	(2)	(3)	(4)	(5)	(6)
CONTENTS	**MODEL**	**TYPE**	**No.**	**DATE**	**WEIGHT (With controller)**	**WEIGHT (Without controller)**
LETTERS	FANUC Robot ARC Mate 100*i*B (With J2,J3-axis brakes)	A05B-1215-B401	PRINT SERIAL NO.	PRINT PRODUCTION YEAR AND MONTH	222 kg	134 kg
	FANUC Robot ARC Mate 100*i*B (With all axes brakes)	A05B-1215-B801			226 kg	138 kg
	FANUC Robot ARC Mate 100*i*B/6S (With all axes brakes)	A05B-1215-B811			-	135 kg
	FANUC Robot M-6*i*B (With J2,J3-axis brakes)	A05B-1215-B402			222 kg	134 kg
	FANUC Robot M-6*i*B (With all axes brakes)	A05B-1215-B802			226 kg	138 kg
	FANUC Robot M-6*i*B/6S (With all axes brakes)	A05B-1215-B812			-	135 kg
	FANUC Robot M-6*i*B/2HS (With all axes brakes)	A05B-1215-B832			-	135 kg

Position of label indicating mechanical unit specification number (R-30*i*A controller)

Specification

Item		Specifications	Specifications	Specifications
Model		ARC Mate 100*i*B M-6*i*B	ARC Mate 100*i*B/6S M-6*i*B/6S (NOTE 1)	M-6*i*B/2HS
Type		Articulated type		
Controlled axes		6 axes (J1, J2, J3, J4, J5, J6)		
Installation		Floor, Upside-dowm (Wall & Angle mount) (NOTE 2)		
Motion range	J1 axis	340° (5.93rad)		
	J2 axis	250° (4.36rad)		
	J3 axis	340° (5.93rad)	310° (5.41rad)	
	J4 axis	380° (6.63rad)		
	J5 axis	280° (4.89rad)		
	J6 axis	720° (12.57rad)		
Maximum speed (NOTE 3)	J1 axis	150°/s (2.62rad/s)	200°/s (3.49rad/s)	
	J2 axis	160°/s (2.79rad/s)	200°/s (3.49rad/s)	
	J3 axis	170°/s (2.97rad/s)	260°/s (4.54rad/s)	
	J4 axis	400°/s (6.98rad/s)		
	J5 axis	400°/s (6.98rad/s)		
	J6 axis	520°/s (9.08rad/s)	720°/s (12.57rad/s)	1200°/s (20.94rad/s)
Max. load capacity at wrist		6kg		2kg
Max. load capacity on J3 arm		12kg		
Allowable load moment at wrist	J4 axis	15.7N·m (1.6kgf·m)		
	J5 axis	9.8N·m (1.0kgf·m)		
	J6 axis	5.9N·m (0.6kgf·m)		2.0N·m (0.2kgf·m)
Allowable load inertia at wrist	J4 axis	0.63kg·m^2 (6.4kgf·cm·s^2)		
	J5 axis	0.22kg·m^2 (2.2kgf·cm·s^2)		
	J6 axis	0.061kg·m^2 (0.62kgf·cm·s^2)		0.035kg·m^2 (0.36kgf·cm·s^2)
Drive method		Electric servo drive by AC servo motor		
Repeatability		±0.08mm		
Weight of mechanical unit		134kg (2-axis brake type without controller) 138kg (6-axis brake type without controller)	135kg (6-axis brake type without controller)	
		222kg (2-axis brake type with controller) 226kg (6-axis brake type with controller)		
Installation environment		Ambient temperature : 0 - 45°C Ambient humidity : Normally :75%RH or less : Short time 95%RH or less (within 1 month) (No dew or frost allowed) Vibration : 0.5G (4.9m/s^2) or less		
Requirement		Average power consumption : 1.0kW Input power source capacity : 2.5kVA		
Acoustic noise level		less than 70dB NOTE This value is equivalent continuous A-weighted sound pressure level which applied with ISO11201 (EN31201). This value is measured with the following conditions. - Maximum load and speed - Operating mode is AUTO		

NOTE

1) You can make a parameter change to switch to the 10 kg wrist payload specification. For details, see Section 9.5."
2) Under the installation condition given in parentheses, the motion ranges of the J1 and J2 axes are limited.
3) It does not arrive at each axial maximum speed at the short movement distance.

Severe dust/liquid protection performance of ARC Mate 100*i*B, M-6*i*B, ARC Mate 100*i*B/6S, M-6*i*B/6S and M-6*i*B/2HS

	Normal specification	Severe dust/liquid protection option
Wrist+J3 arm	IP67	IP67
Other part	IP54	IP55

NOTE
Definition of IP code
- Definition of IP 67
  - 6=Dust-tight
  - 7=Protection from water immersion
- Definition of IP 55
  - 5=Dust-protected
  - 5=Protection from water jet
- Definition of IP 54
  - 5=Dust-protected
  - 4=Protection from splashing water

Performance of resistant chemicals and resistant solvents

(1) The robot (including severe dust/liquid protection model) cannot be used with the following liquids because there is fear that rubber parts (packing, oil seal, O ring etc.) will corrode.
   (a) Organic solvents
   (b) Coolant including chlorine / gasoline
   (c) Amine type detergent
   (d) Acid, alkali and liquid causing rust
   (e) Other liquids or solutions, that will harm NBR

(2) When the robots work in the environment, using water or liquid, complete draining of J1 base must be done. Incomplete draining of J1 base will make the robot break down.

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 : All persons who use FANUC Robot, system designer Topics : Safety items for robot system design, operation, maintenance
R-J3*i*B controller	Operator's manual HANDLING TOOL **B-81464EN-2** ARC TOOL **B-81464EN-3** SEALING TOOL **B-81464EN-4**	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-81465EN** **B-81465EN-1** (For Europe)	Intended readers : Maintenance technician, system designer Topics : Installation, connection to peripheral equipment, maintenance Use : Installation, start-up, connection, maintenance
R-30*i*A controller	Operator's manual HANDLING TOOL **B-82594EN-2** ARC TOOL **B-82594EN-3** DISPENSE TOOL **B-82594EN-4**	Intended readers : Operator, programmer, maintenance technician, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	Maintenance manual Standard : **B-82595EN** RIA : **B-82595EN-2** CE : **B-82595EN-1** (European specification)	Intended readers : Maintenance technician, system designer Topics : Installation, connection to peripheral equipment, maintenance Use : Installation, start-up, connection, maintenance

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APPENDIX

1 CONFIGURATION

Fig. 1 (a) shows the configuration of the mechanical unit.

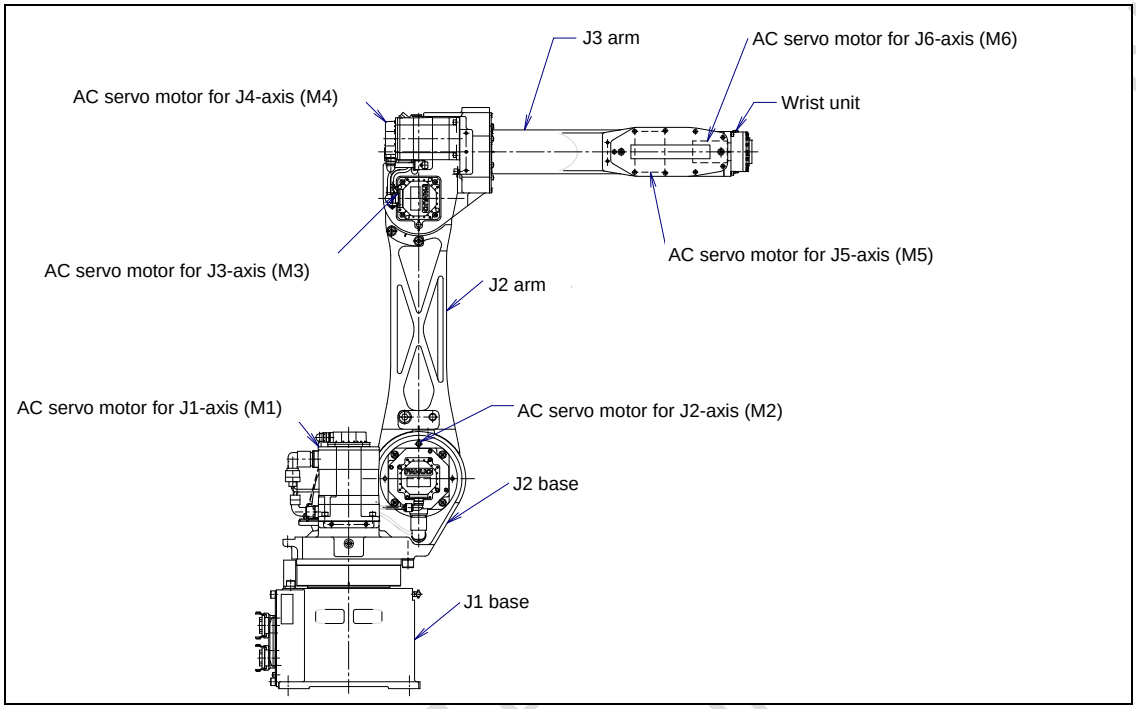


Fig. 1 (a) Mechanical unit configuration

2 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.

2.1 DAILY INSPECTION

Clean and maintain each robot component during everyday system operations. At the same time, check the components to see if there is a crack or break in them. Also check and maintain the following items as required.

(a) Before the power is turned on

No.	Inspection item		Inspection procedure
1	For machines with a three-piece pneumatic option	Pneumatic pressure check	Make a pneumatic pressure check, using the three-piece pneumatic option shown in Fig. 2.1 (a). If the measured pneumatic pressure does not fall in the range between 0.5 and 0.7 MPa (5 and 7 kg/cm^2), make adjustments, using the regulator pressure setting handle.
2		Check on the amount of oil mist	Put the pneumatic pressure system in operation and check the amount of oil dripping. If the measured amount of oil dripping does not meet the rating (one drop/10 to 20 seconds), make adjustments, using the oil adjustment knob. The oiler becomes empty after 10 to 20 days of normal operation.
3		Check on the amount of oil	Check to see if the amount of oil in the three-piece option is within the rated level shown in Fig. 2.1 (a).
4		Check for leakage from the piping	Check to see if a joint or hose leaks. If you find a problem, tighten the joint or replace any defective component.
5	Whether cables are abnormal Mechanical unit		See Chapter 6.
6	Battery voltage check		Make sure that when the power is turned on, the BLAL alarm has not been raised. If the BLAL alarm has been raised, replace the battery as directed in Section 3.4.
7	Component cleaning and inspection		Clean and maintain each component. At the same time, check the components to see if there is a crack or break in them.

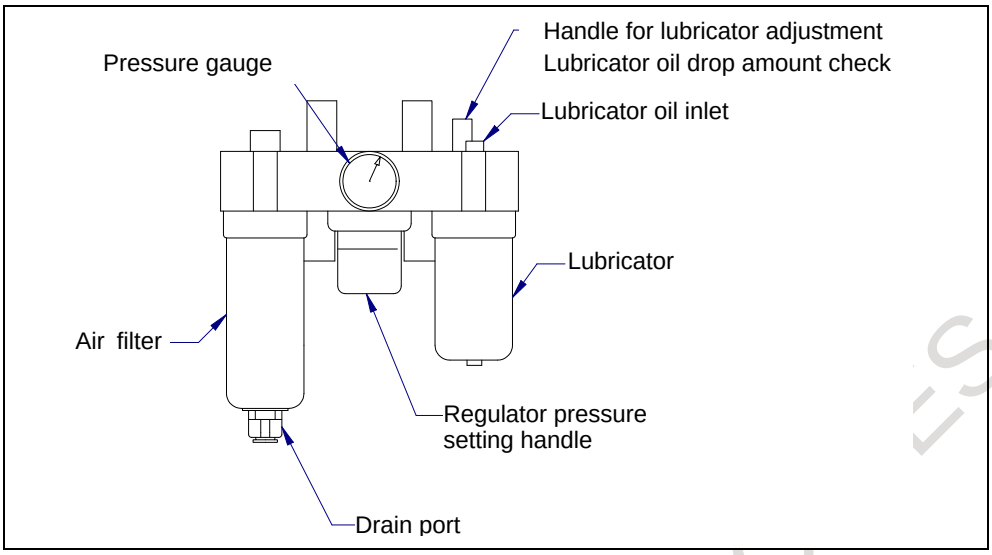


Fig. 2.1 (a) Air control set (option)

(b) After turning on power

No.	Check items	Check points
1	Vibration, abnormal noises, and motor heating	Check whether the robot moves along and about the axes smoothly without unusual vibration or sounds. Also check whether the temperature of the motors are excessively high.
2	Changing repeatability	Check to see that the stop positions of the robot have not deviated from the previous stop positions.
3	Peripheral devices for proper operation	Check whether the peripheral devices operate properly according to commands from the robot.
4	Brakes for each axis	Check that the end effector drops within 5 mm when the power is cut off.

2.2 1-MONTH (320 HOURS) CHECKS

Inspect the following items at regular intervals of every months. Increase the locations and the frequency of inspection if necessary).

No.	Inspection item	Inspection procedure
1	Ventilation portion of control unit	Check whether the cable connected to the teach pendant and robot is unevenly twisted.

2.3 QUARTERLY INSPECTION (960 HOURS)

Check the following items at the first quarterly inspection, then every year thereafter. (See the Section 2.4.)

Item	Check items	Check points
1	Mechanical unit cable and welding cable	Check whether the jackets of the mechanical unit cables and welding are damaged. Also, check whether the cables are excessively bent or unevenly twisted. Check that the connectors of the motors and connector panels are securely engaged. (NOTE1)
2	Cleaning and checking each part	Clean each part (remove chips, etc.) and check component parts for cracks and flaws. (NOTE2)
3	Further tightening external main bolts	Further, tighten the end-effecter mounting bolts and external main bolts. (NOTE3)
4	Check the hand cable, etc.	Confirm whether there is wound in the cable
5	Control unit cable and robot connecting cable	Check whether the cable connected to the teach pendant and robot is unevenly twisted.

Note 1) Inspection points and check items of the mechanical unit cables and connectors

Inspection points of the mechanical unit cables and welding cable

Check the cable for damage that has been exposed.
Clean it when the spatter adheres.

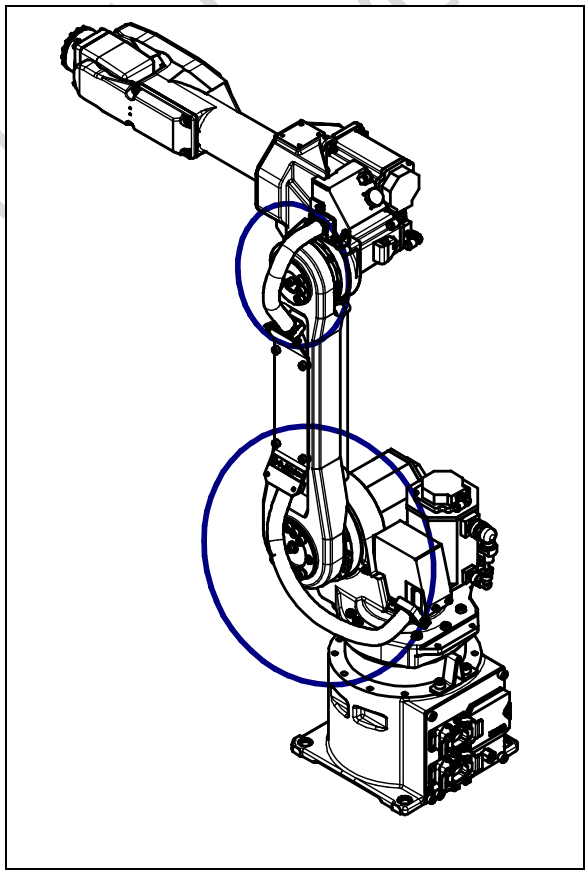


Fig. 2.3(a) Inspection points of the mechanical unit cables

Inspection points of the connectors

- Power/brake connectors of the motor exposed externally
- Robot connection cables, earth terminal and user cables

Check items

- Circular connector : Check the connector for looseness by turning it manually.
- Square connector : Check the connector for disengagement of its lever.
- Earth terminal : Check the terminal for looseness.

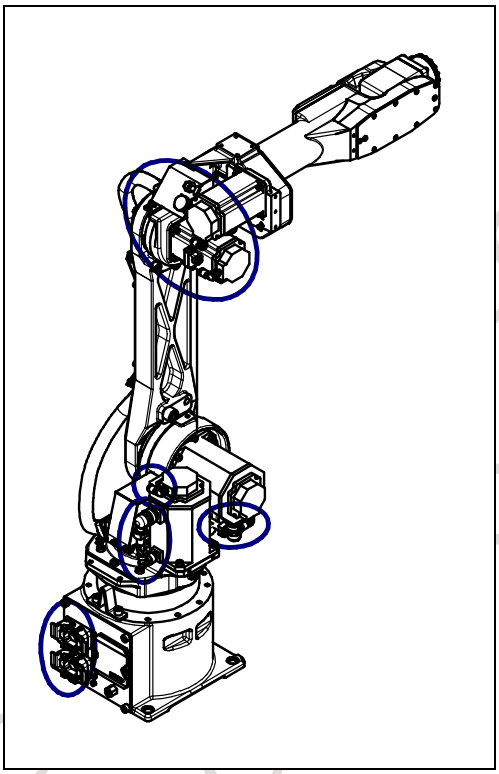


Fig. 2.3(b) Inspection points of connectors

Note 2) Cleaning

- Necessary cleaning points, dust on the flat part, sedimentation of spatters
  Clean sediments periodically.
  In particular, clean the following points carefully.

  Vicinity of the wrist axis and oil seal
  → If chippings or spatters are attached to the oil seal, an oil leak may be caused.

  Vicinity of the welding torch and the wrist flange
  → The insulation failure occurs when the spatter has collected around the wrist flange or welding torch, and there is a possibility of damaging the robot mechanism by the welding current. (See Section 9.9)

- Check if the vicinity of the necessary inspection points, wrist part, and J3 arm significantly wears due to rubbing against the welding cable or hand cable.
- Check if there is a trace of a collision around the gun or hand.
- Check the reducer or grease bath for an oil leak.
  → If oil can be found a day after wiping oil, an oil leak may be caused.

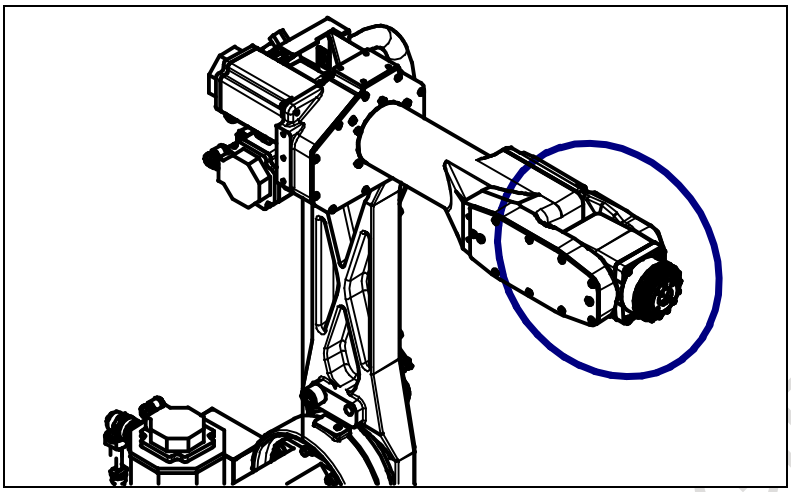


Fig. 2.3(c) Cleaning points

Note 3) Points to be retightened

- The end effecter mounting bolts, robot installation bolts, and bolts to be removed for inspection need to be retightened.
- The bolts exposed to the outside of the robot need to be retightened.
  For the tightening torque, see the recommended bolt tightening torque shown in the Appendix.
  A loose prevention agent (adhesive) is applied to some bolts. If the bolts are tightened with greater than the recommended torque, the loose prevention agent may be removed. So, follow the recommended tightening torque when retightening them.

2.4 YEARLY INSPECTION (3840 HOURS)

Inspect the following item at the intervals based on every 1 year or 3840 hours, whichever comes first.

Item	Check items	Check points
1	Mechanical unit cable and welding cable	See Section 2.3.
2	Cleaning each parts and inspection	See Section 2.3.
3	Tightness of major external bolts	See Section 2.3.
4	Check the hand cable, etc	See Section 2.3.
5	Control unit cable and robot connecting cable	See Section 2.3.
6	J6 Greasing	See Section 3.1

2.5 ONE-AND HALF-YEAR PERIODIC INSPECTION (5760 HOURS)

Perform the following inspection/maintenance item at regular intervals of about one year and half.

No.	Inspection item	Inspection procedure
1	Battery replacement	Replace the battery in the mechanical unit. (See Section 3.4.)

2.6 THREE-YEAR PERIODIC INSPECTION (11520 HOURS)

Perform the following inspection/maintenance item at the intervals based on every 3 years or 11520 hours, whichever comes first.

No.	Inspection item	Inspection procedure
1	J1 to J5 Grease replacement	See Section 3.2.

3 PERIODIC MAINTENANCE

3.1 GREASING

Following is greasing for J6-axis reducer.
When greasing the robot, keep its power turned off.

i) Replenish the robot with grease every 12 months under normal operating condition (or 3840 hours operating).
ii) See Fig. 3.1(a) and Table 3.1 (a) for greasing points and the method.
iii) After applying grease, release the remaining pressure within the grease bath as described in the procedure in Section 3.3.

Table 3.1 (a) Greasing points

No.	Greasing point	Specified grease	Amount of grease	Gun tip pressure	Greasing method
1	J6-axis reducer	Harmonic drive systems SK-3 (Specification: A98L-0040-0110)	40 ml	0.1 MPa or less (NOTE)	Replace the flat-head bolts and sealing washers of the J6-axis grease inlet and outlet, and attach the supplied grease nipple to the grease inlet of the J6-axis. After greasing, remove the grease nipple, and attach the flat-head bolts and sealing washers to the grease inlet and outlet.

NOTE
When a manual pump is used for greasing, the standard rate is one pumping cycles per two seconds.

⚠ CAUTION
If you grease incorrectly, the pressure in the grease bath may increase steeply, leading to a broken seal, which will eventually cause grease leakage or malfunction. When greasing, be sure to follow the cautions stated in Section 3.2.

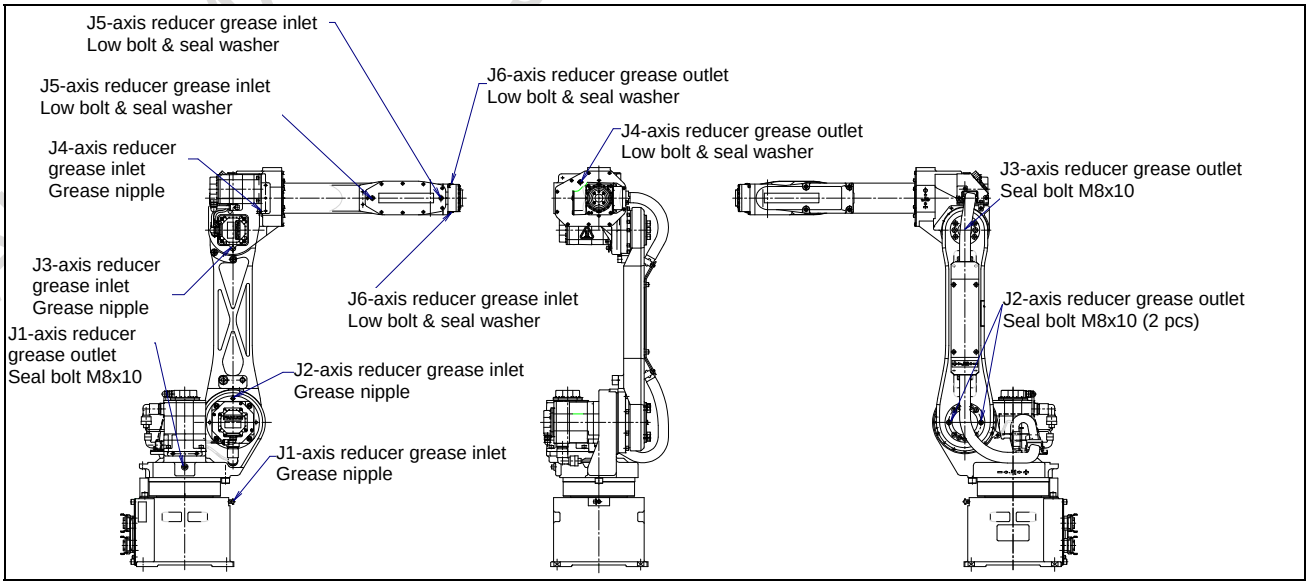


Fig. 3.1 (a) Greasing points

Table 3.1 (b) Specification of grease nipple, seal bolt and seal washer

Parts name	Specification
Grease nipple (J1)	A97L-0218-0013#C110
Grease nipple (J2 to J4)	A97L-0218-0013#A610
Seal bolt (M8)	A97L-0218-0417#081010
seal washer (M6)	A30L-0001-0048#6M

3.2 GREASE REPLACEMENT

Follow the procedure stated below to replace the grease in the J1, J2, and J3-axis reducers and the J4 and J5-axis gearboxes at the intervals based on every 3 years or 11520 hours, whichever comes first. See Fig. 3.1(a) for greasing points.

1) Remove the seal bolts from the J1, J2, and J3-axis grease outlets shown in Fig. 3.1(a). Also remove the flat-bolts and sealing washers from the J4 and J5-axis grease outlets.
2) Uncap the grease nipples at the J1, J2, J3, and J4-axis grease inlets. When the J5-axis grease is supplied remove the flat-head bolt from the J5-axis grease inlet and attach the grease nipple to the J3-axis or J4-axis grease inlet.
3) Attach a grease nipple delivered with the robot.
   Note that the grease nipple for the J5/J6-axis is shared for the axes.
4) Supply the grease specified in Table 3.2 (a) to the J1, J2, J3, J4, and J5 axes through their respective grease nipples. For the J1, J2, J3, and J4 axes, keep greasing until the new grease pushes out the old grease and comes out of each grease outlet. Ensure that the amount of the drained grease is equal to the amount specified in the table so that the grease bath will not become full. For the J5 axis, the grease may not come out of the grease outlet because the specified grease amount is small. If a larger amount of grease is supplied, however, the gearbox performance may be adversely affected. Do not supply a larger amount of grease than specified.
5) After applying grease, release the remaining pressure within the grease bath as described in the procedure in Section 3.3.
6) Wind sealing tape around the J1, J2, and J3-axis seal bolts you removed, and attach them to the respective grease outlets.
7) Attach the J4 and J5-axis flat-head bolts and the J4 and J5-axis sealing washers to the respective grease inlets and outlets.
8) Be sure to cap the grease nipple for each axis.

⚠ CAUTION
When reusing a grease nipple once used, wind sealing tape around the screw.

Table 3.2 (a) Grease to be replaced at regular intervals of three years (11,520 hours)

	Specified grease Kyodo Yushi	Amount of grease to be applied (ml)	Gun tip pressure	Robot posture when greased
J1-axis reducer	VIGOGREASE RE0 (Specification: A98L-0040-0174)	About 1100	0.1 MPa or less (NOTE)	-
J2-axis reducer		About 570		-
J3-axis reducer		About 300		-
J4-axis gearbox		About 700		-
J5-axis gearbox		About 290		J4=+90°

NOTE
When a manual pump is used for greasing, the standard rate is one pumping cycles per two seconds.

⚠ CAUTION

If you grease incorrectly, the pressure in the grease bath will increase, leading to a broken seal, which will eventually cause grease leakage or malfunction.
When greasing, be sure to follow the cautions stated below.

1 Before starting greasing, open the bolts to allow the grease to come out.
2 A grease inlet may optionally have a plug. Replace the plug with the attached grease nipple and then start greasing.
3 Using a manual greasing pump, grease gently and slowly.
4 Avoid using a pneumatic pump driven from a factory pneumatic line as much as possible. Even when using a of Table 3.1 (a), 3.2 (a) or less during application of grease.
5 Be sure to use the specified grease. Otherwise, damage to reducers or a similar abnormality may occur.
6 After applying grease, release the remaining pressure within the grease bath as described in the procedure in Section 3.3.
7 To prevent the accident like fall, fire, remove all the excess grease from the floor and robot.

When replacing or supplying grease, we suggest keeping the robot in the posture shown in Fig. 3.2 (a).

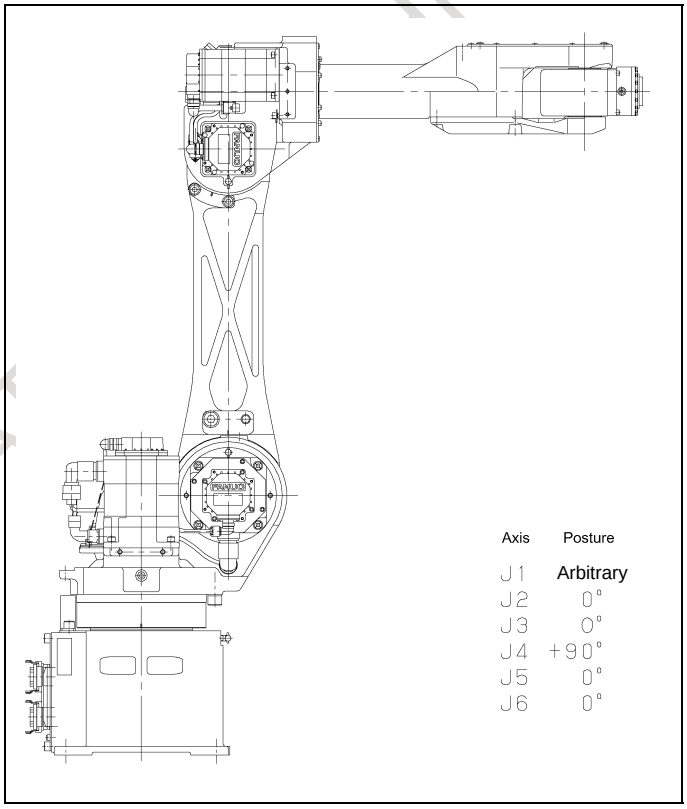


Fig. 3.2 (a) Robot posture for greasing

3.3 PROCEDURE FOR RELEASING THE GREASE REMAINING PRESSURE

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

Table 3.3 (a) Releasing the remaining pressure of the axis

Axis name					
J1	J2	J3	J4	J5	J6
A	A	A	B	B	A

A

Perform program operation for the time specified below leave the grease inlet and outlet open in order to release the remaining pressure. (When there are two outlets, uncap both of the two outlets.) Perform repetitive operation with an axis angle of at least 60 degrees and OVR100% for 10 minutes or more

B

To release remaining pressure, leave the grease inlets and outlets open for three minutes. Install the bolts or seal bolts in the grease inlets and outlets, and perform repetitive operation with an axis angle of at least 60 degrees and OVR100% for 10 minutes or more. After the operation is completed, remove the plugs or bolts from the grease inlets and outlets, and leave the grease inlets and outlets open for three minutes to release internal pressure.

If the above operation cannot be performed due to the environment, adjust the operating time according to the operating angle. (When the maximum allowable axis angle is 30 degrees, perform the twice operation for 20 minutes or more.) Upon completion of the above operation, attach the grease nipple or the seal bolt to each the grease inlet and outlet. When reusing the grease nipple and the seal bolt, be sure to seal it with seal tape.

3.4 BATTERY REPLACEMENT

A backup battery is used to keep the reference-position data for each axis of the robot.
The battery needs to be replaced at regular intervals of one year and half. Follow this procedure for battery replacement.

1 Press the EMERGENCY STOP button to prohibit the robot motion.

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

2 Remove the battery case cap. (Fig. 3.4 (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.

> **⚠ CAUTION**
> When using a robot with the severe dust/liquid protection option, remove the cover from the battery case as shown in Fig. 3.4 (b) to replace the battery. After replacing the battery, reinstall the cover.

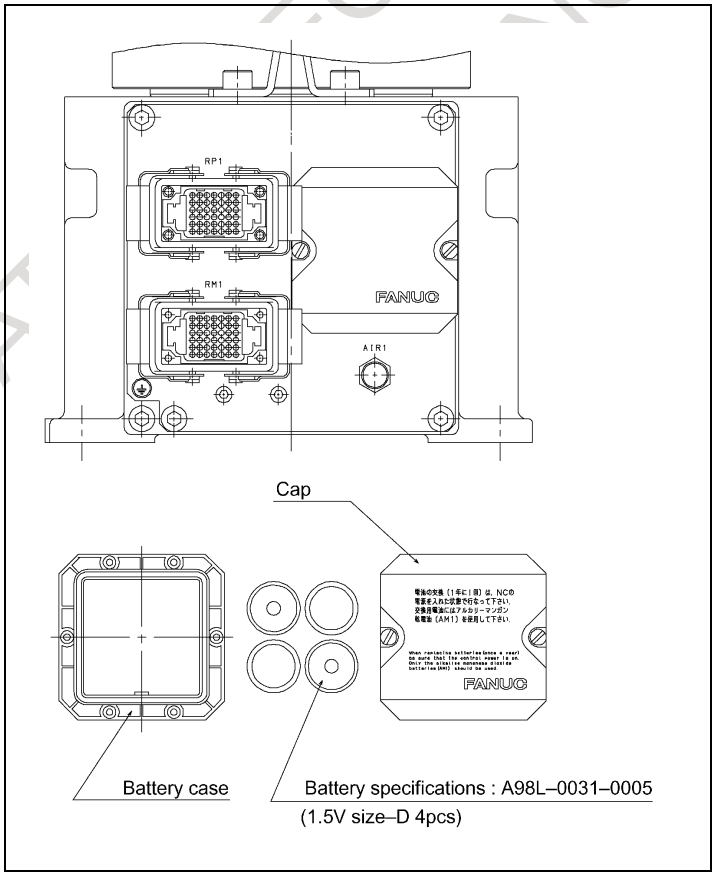


Fig. 3.4 (a) Battery replacement (Standard)

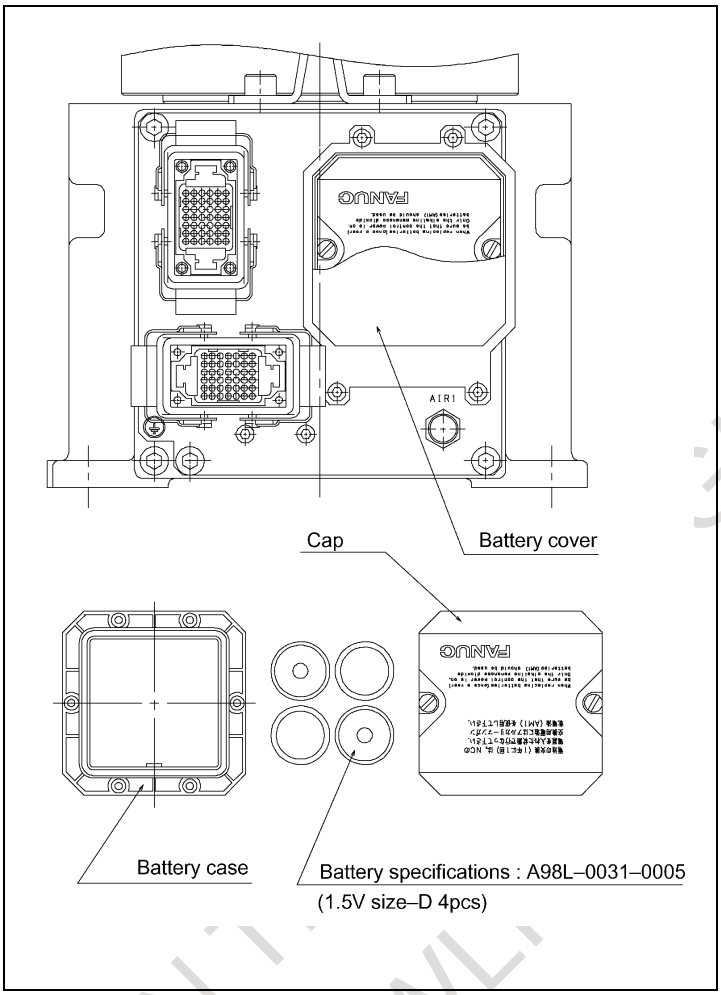


Fig. 3.4 (b) Battery replacement (With severe dust/liquid protection option)

4 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, it is necessary to keep an accurate record of problems and to take proper corrective actions.

4.1 TROUBLESHOOTING

Table 4.1(a) shows the troubleshooting. If a cause of remedy is unclear, please contact your local FANUC service representative.

Table 4.1 (a) Troubleshooting

Symptom	Descriptions	Causes	Measures
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 foreign material caught between the J1 base and floor plate. - If the robot is not securely fastened to the floor plate, the J1 base lifts the floor plate as the robot operates, allowing the base and floor plates to strike each other which, in turn, leads to vibration.	- 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 foreign matter between the J1 base and floor plate, remove it.
	- The rack or floor plate vibrates during operation of the robot.	[Rack or floor] - It is likely that the rack or floor is not sufficiently rigid. - If the rack or floor is not sufficiently rigid, reaction from the robot deforms the rack or floor, leading to vibration.	- Reinforce the rack or floor to make it more rigid. - If it is impossible to reinforce the rack or floor, modify the robot control program; doing so might reduce the amount of vibration.
	- Vibration becomes more serious when the robot adopts a specific posture. - If the operating speed of the robot is reduced, vibration stops. - Vibration is most noticeable when the robot is accelerating. - Vibration occurs when two or more axes operate at the same time.	[Overload] - It is likely that the load on the robot is greater than the maximum rating. - It is likely that the robot control program is too demanding for the robot hardware. - It is likely that the ACCELERATION value is excessive.	- Check the maximum load that the robot can handle once more. If the robot is found to be overloaded, reduce the load, or modify the robot control program. - Vibration in a specific portion can be reduced by modifying the robot control program while slowing the robot and reducing its acceleration (to minimize the influence on the entire cycle time).

Symptom	Descriptions	Causes	Measures
Vibration Noise (Continued)	- Vibration was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating axis has not been exchanged for a long period. - Periodic vibration and noise occur.	[Gear, bearing, or reducer, belt] - It is likely that collision or overload applied an excessive force on the drive mechanism, thus damaging the gear tooth surface or rolling surface of a bearing, or reducer. - Prolonged overloaded use may cause fretting fatigue on the gear tooth surface or rolling surface of the bearing and reducer. - It is likely that a foreign material caught in a gear, bearing, or within a reducer has damaged the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that a foreign material caught in a gear, bearing, or within a reducer is causing 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 or inadequate lubrication.	- Operate one axis at a time to determine which axis is vibrating. - Remove the motor, and replace the gear, the bearing, and the reducer. For the spec. of parts and the method of replacement, contact your local FANUC representative. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Regularly greasing with the specified grease can help prevent problems.

Symptom	Descriptions	Causes	Measures
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. - If the pulsecoder develops a fault, vibration might occur because information about the motor position cannot be transferred to the controller accurately. - 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 section 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 section has an intermittent break, vibration might occur because commands cannot be sent to the motor accurately. - If a connection cable between them has an intermittent break, vibration might occur. - If the power cable has an intermittent break, vibration might occur. - If the power source voltage drops below the rating, vibration might occur. - If a robot control parameter is set to an invalid value, vibration might occur.	- Refer to the controller Maintenance Manual for troubleshooting related to the controller and amplifier. - Replace the pulsecoder for the motor of the axis that is vibrating, and check whether the vibration still occurs. - Also, replace the motor of the axis that is vibrating, and check whether vibration still occurs. For the method of replacement, contact FANUC. - Check that the robot is supplied with the rated voltage. - Check whether the sheath of the power cord is damaged. If so, replace the power cord, and check whether vibration still occurs. - Check whether the sheath of the cable connecting the mechanical section and controller is damaged. If so, replace the connection cable, and check whether vibration still occurs. - If vibration occurs only when the robot assumes a specific posture, it is likely that a cable in the mechanical unit is broken. - Shake the movable part cable while the robot is at rest, and check whether an alarm occurs. If an alarm or any other abnormal condition occurs, replace the mechanical unit cable. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct it. Contact FANUC for further information if necessary.

Symptom	Descriptions	Causes	Measures
Vibration Noise (Continued)	- There is some relationship between the vibration of the robot and the operation of a machine near the robot.	[Noise from a nearby machine] - If the robot is not grounded properly, electrical noise is induced on the grounding wire, preventing commands from being transferred accurately, thus leading to vibration. - If the robot is grounded at an unsuitable point, its grounding potential becomes unstable, and noise is likely to be induced on the grounding line, thus leading to vibration.	- Connect the grounding wire firmly to ensure a reliable ground potential and prevent extraneous electrical noise.
	- There is an unusual sound after replacement of grease. - There is an unusual sound after a long period of time. - There is an unusual sound during operation at low speed.	- There may be an unusual sound when using other than the specified grease. - Even for the specified grease, there may be an unusual sound during operation at low speed immediately after replacement or after a long period of time.	- Use the specified grease. - When there is an unusual sound even for specified grease, perform operation for one or two days on an experiment. Generally, an usual sound will disappear.
Rattling	- While the robot is not supplied with power, pushing it with the hand causes part of the mechanical unit to wobble. - There is a gap on the mounting face of the mechanical unit.	[Mechanical section coupling bolt] - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical section.	- Check that the following bolts for each axis are tight. If any of these bolts is loose, apply loctite and tighten it to the appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Reducer shaft retaining bolt - Base retaining bolt - Arm retaining bolt - Casting retaining bolt - End effecter retaining bolt

Symptom	Descriptions	Causes	Measures
Motor overheating	- The ambient temperature of the installation location increases, causing the motor to overheat. - After a cover was attached to the motor, the motor overheated. - After the robot control program or the load was changed, the motor overheated.	[Ambient temperature] - It is likely that a rise in the ambient temperature or attaching the motor cover prevented the motor from releasing heat efficiently, thus leading to overheating. [Operating condition] - It is likely that the robot was operated with the maximum average current exceeded.	- The teach pendant can be used to monitor the average current. Check the average current when the robot control program is running. The allowable average current is specified for the robot according to its ambient temperature. Contact FANUC for further information. - Relaxing the robot control program and conditions can reduce the average current, thus preventing overheating. - Reducing the ambient temperature is the most effective means of preventing overheating. - Having the surroundings of the motor well ventilated enables the motor to release heat efficiently, thus preventing overheating. Using a fan to direct air at the motor is also effective. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation.
	- After a control parameter was changed, the motor overheated.	[Parameter] - If data input for a workpiece is invalid, the robot cannot be accelerate or decelerate normally, so the average current increases, leading to the motor overheating.	- As for load setting, Input an appropriate parameter referring to Section 9.3.
	- Symptom other than stated above	[Mechanical section problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor running with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor. - It is likely that cooling fan is broken.	- Repair the mechanical unit referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - Judgment is possible if the average current decreased after replacing the motor, the former motor had been defected. - If the cooling fan is broken, replace it with a new one.

Symptom	Descriptions	Causes	Measures

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 collision.
		- An O-ring can be damaged if it is trapped or cut during disassembling or re-assembling.
		- An oil seal might be damaged if extraneous dust scratches the lip of the oil seal.
		- A loose seal bolt might allow grease to leak along the threads.
		- Problems with the grease nipple or threads.
			- If the casting cracks, sealant can be used as a quick-fix to prevent further grease leakage. However, the component must be replaced as soon as possible, as the crack will widen.
			- O-rings are used in the locations listed below.
			  - 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
			  - Inside the wrist
			- Seal bolts are used in the locations stated below.
			  - Grease drain outlet
			- Replace the grease nipple.

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

Displace-ment	- The robot moves to a point other than the taught position. - The repeatability is not within the tolerance.	[Mechanical unit problems] - If the 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.

Symptom	Descriptions	Causes	Measures
Displace-ment (Continued)	- 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 peripheral equipment position. - Correct the taught program.
	- Displacement occurred after a parameter was changed.	[Parameter] - It is likely that the mastering data was overwritten moving the robot's origin.	- Re-enter the previous optimal mastering data. - If correct mastering data is unavailable, perform mastering again.
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.

Table 4.1 (b) Allowable drop

At power off	5mm
At emergency stop	5mm

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

4.2 COMPONENT REPLACEMENT AND ADJUSTMENT ITEMS

Adjustments are needed after a component is replaced.
The following table lists components and the adjustment items that must be made after their replacement. After replacing a component, make necessary adjustments according to this table.

Component replacement or function change	Adjustment item
Cable replacement	(a) Cable dressing (b) Quick mastering
Change to J1-axis stroke	(a) Change to stopper position (b) Change to parameter
Battery replacement (The battery should be replaced once 1.5 years.)	Replace the battery with the power kept on. No adjustment is needed.

5 ADJUSTMENTS

Each part of the mechanical units of a robot is set to the best condition before the robot is shipped to the customer. The customer does not need to make adjustments on the robot when it is delivered.
If a mechanical unit of the robot has a large backlash because of a long-term use or component replacement, make adjustments according to this section.

5.1 REFERENCE POSITION AND MOVING RANGE

Zero point and software motion limits 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.
Fig. 5.1 (a) to (i) show the zero point and motion limit (stroke), and max stop distance (stopping distance in condition of max speed and max load) of each axis.
Fig. 5.1 (j) shows the motion direction (+ and - direction).

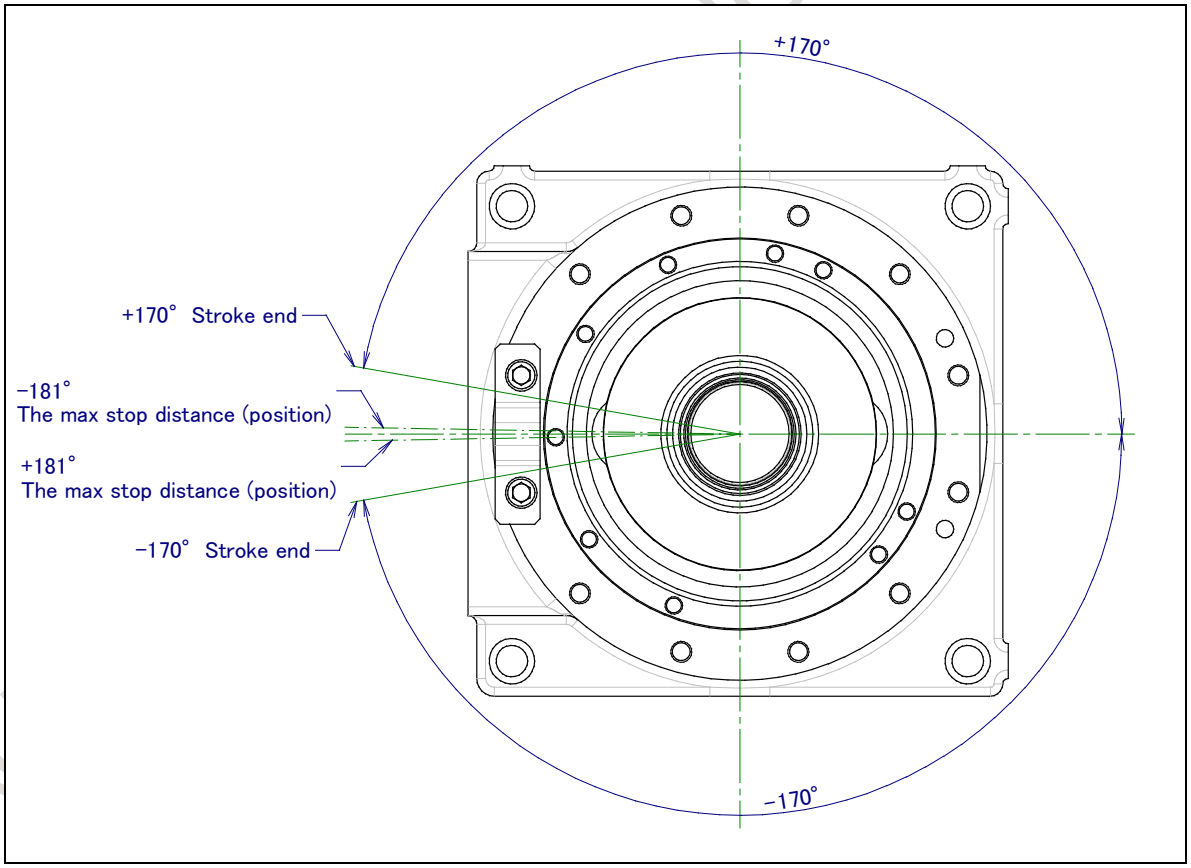


Fig. 5.1 (a) J1-axis swiveling (typically 340°)

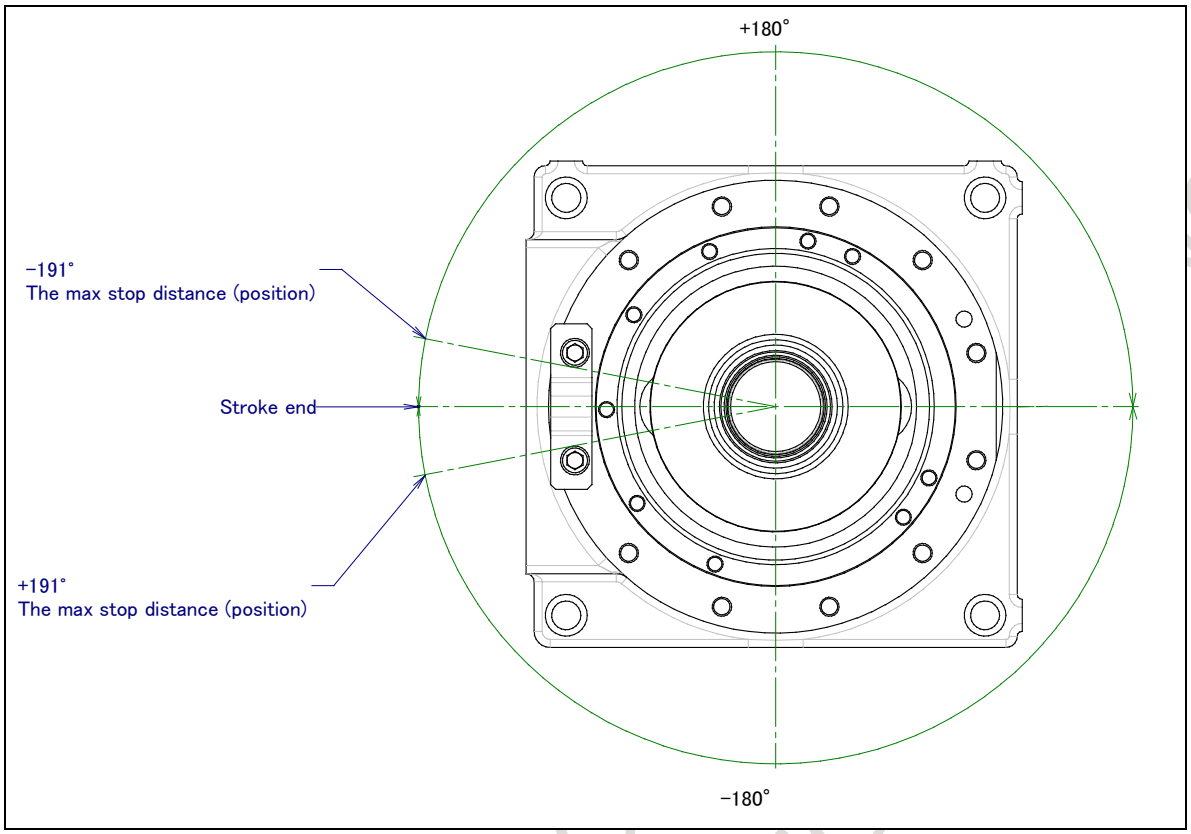


Fig. 5.1 (b) J1-axis swiveling (option 360°) (Only the remote type controller can install.)

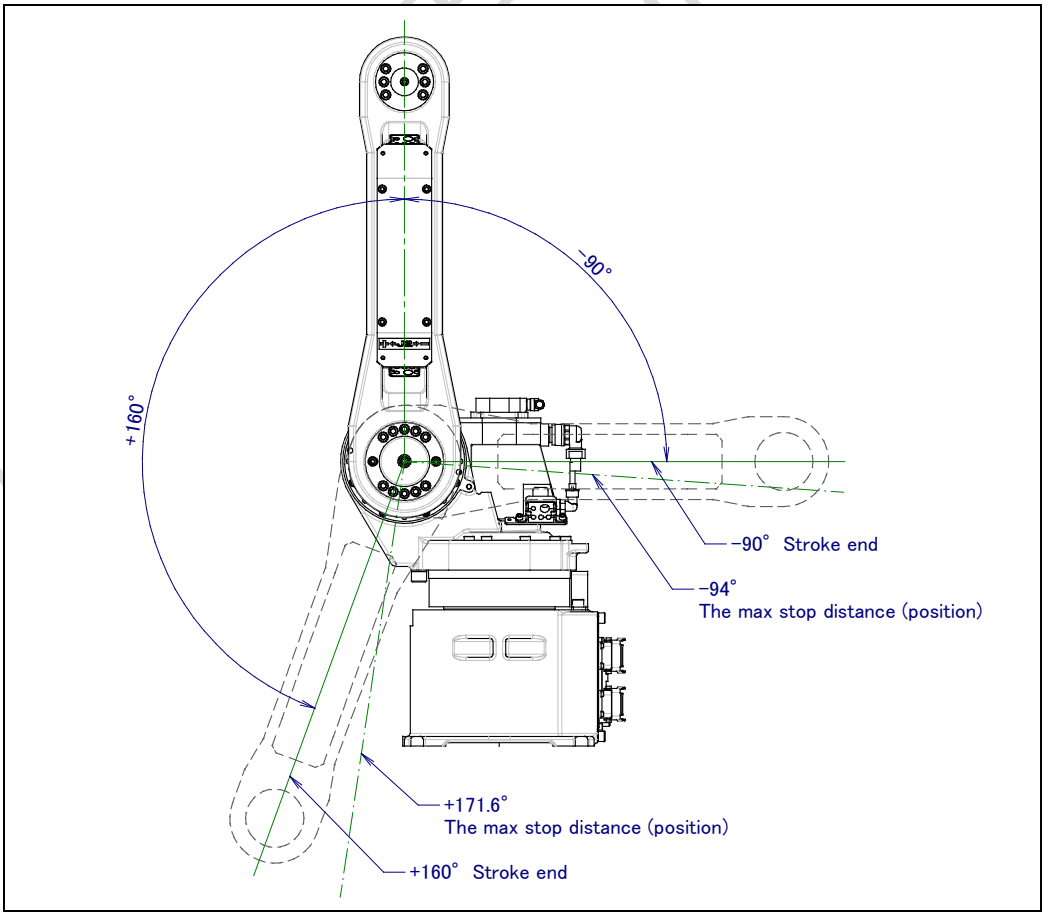


Fig. 5.1 (c) J2-axis rotation

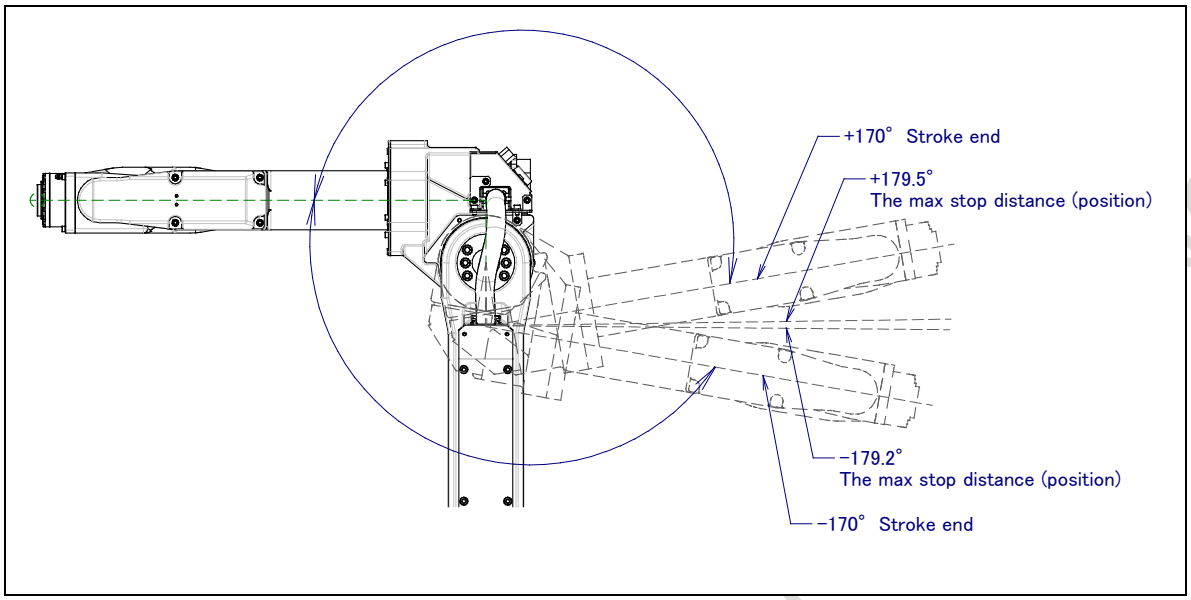


Fig. 5.1 (d) J3-axis rotation ARC Mate 100*i*B, M-6*i*B

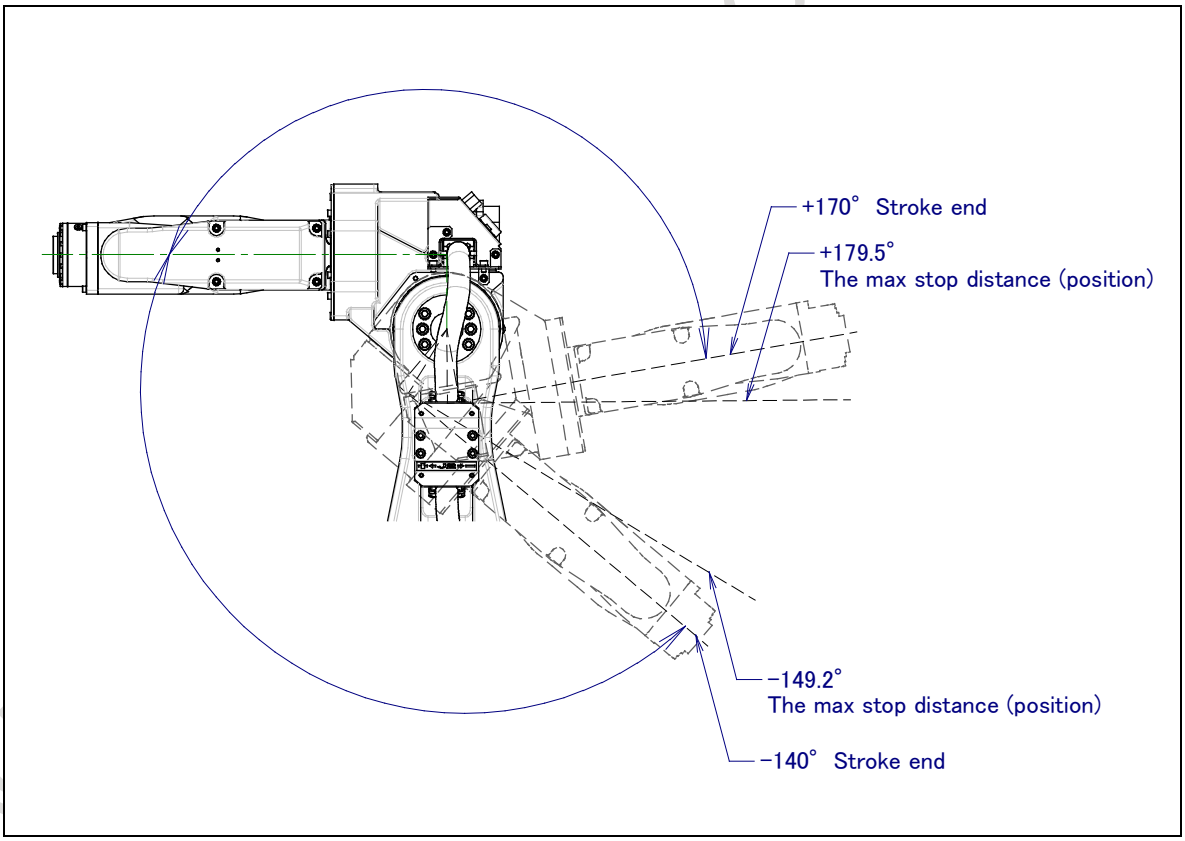


Fig. 5.1 (e) J3-axis rotation ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

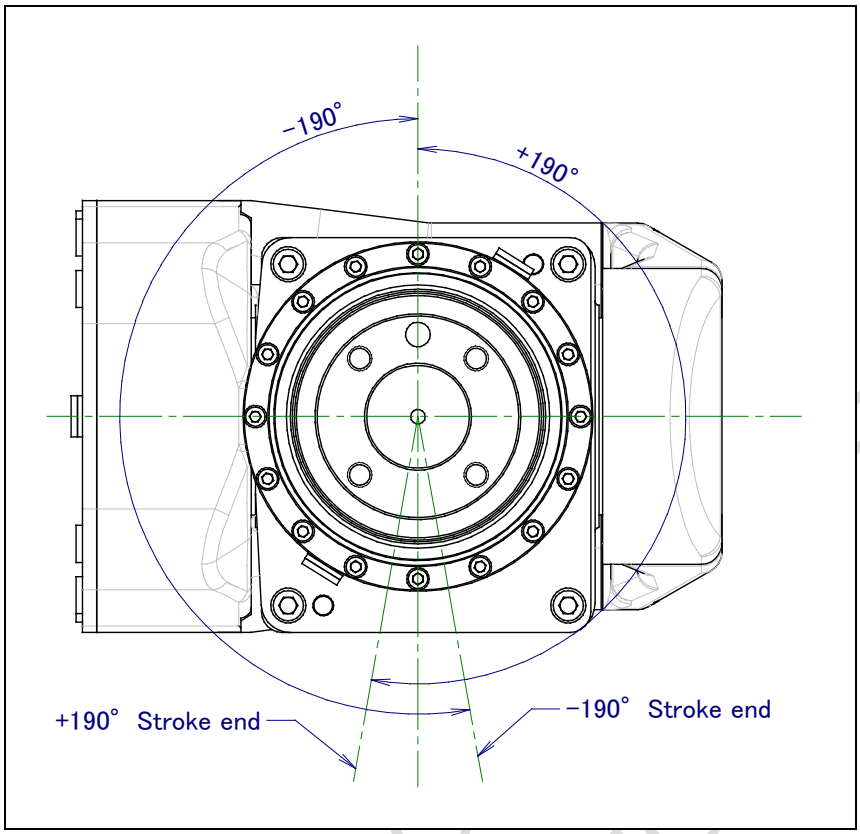


Fig. 5.1 (f) J4-axis rotation

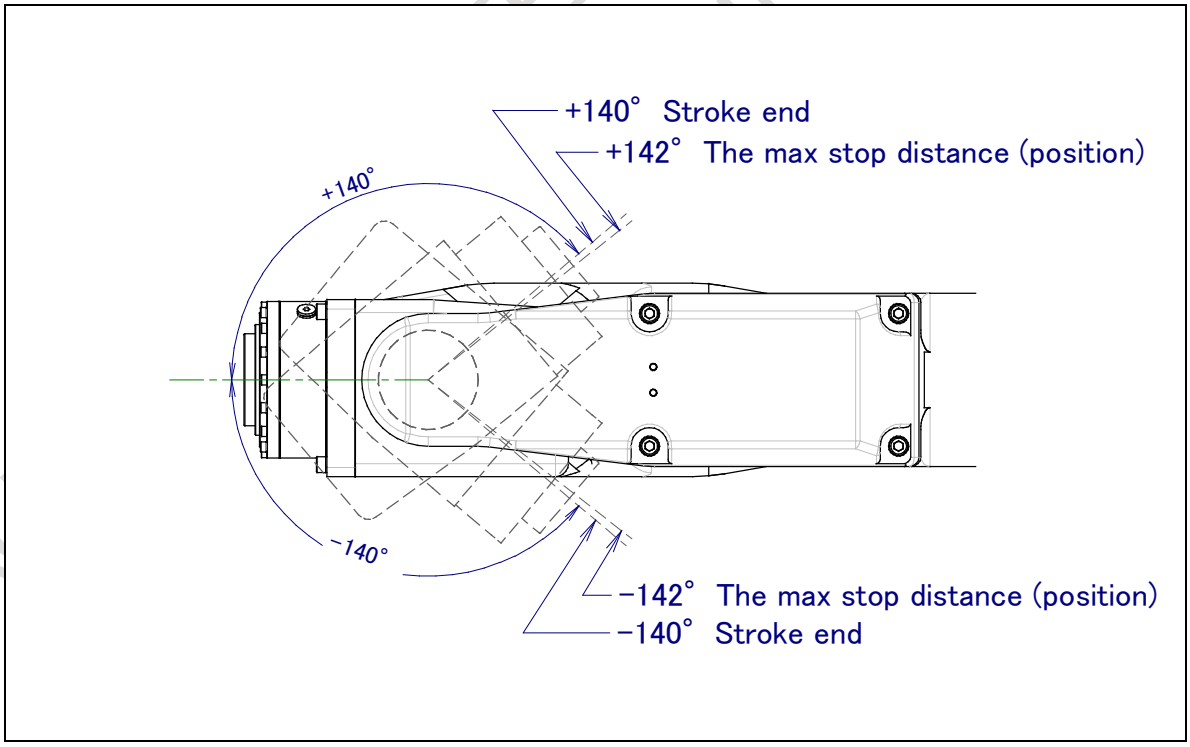


Fig. 5.1 (g) J5-axis wrist rotation

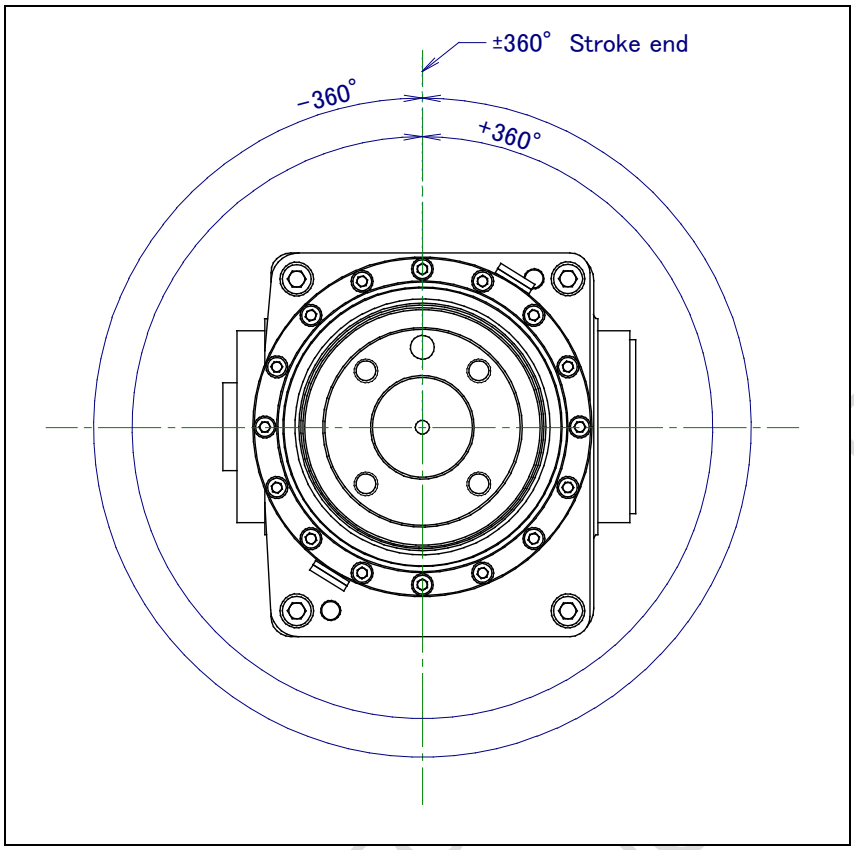


Fig. 5.1 (h) J6-axis wrist rotation

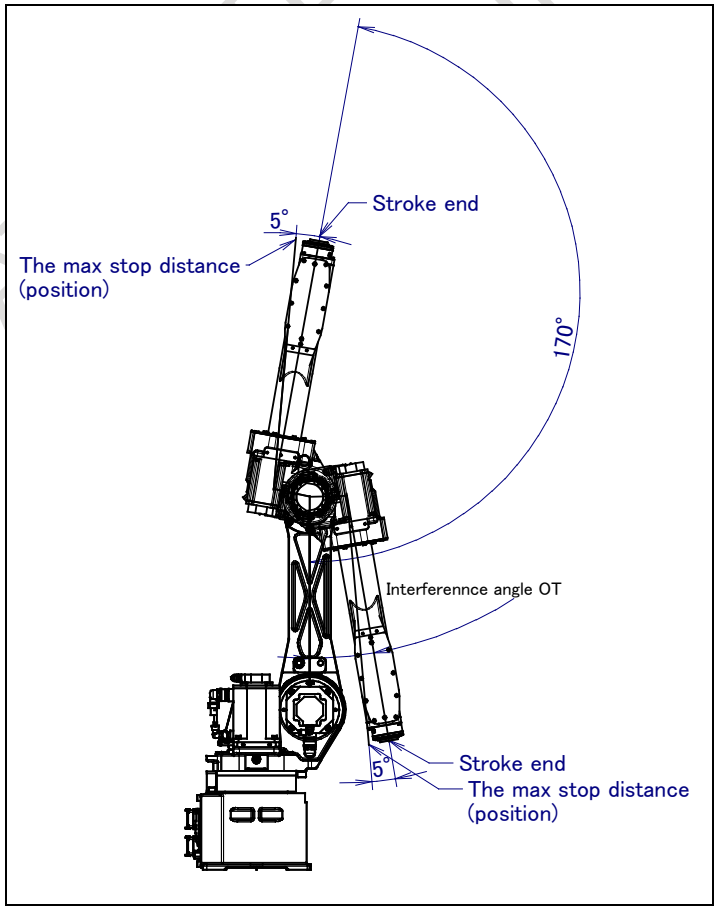


Fig. 5.1 (i) J2/J3 limit interference angle

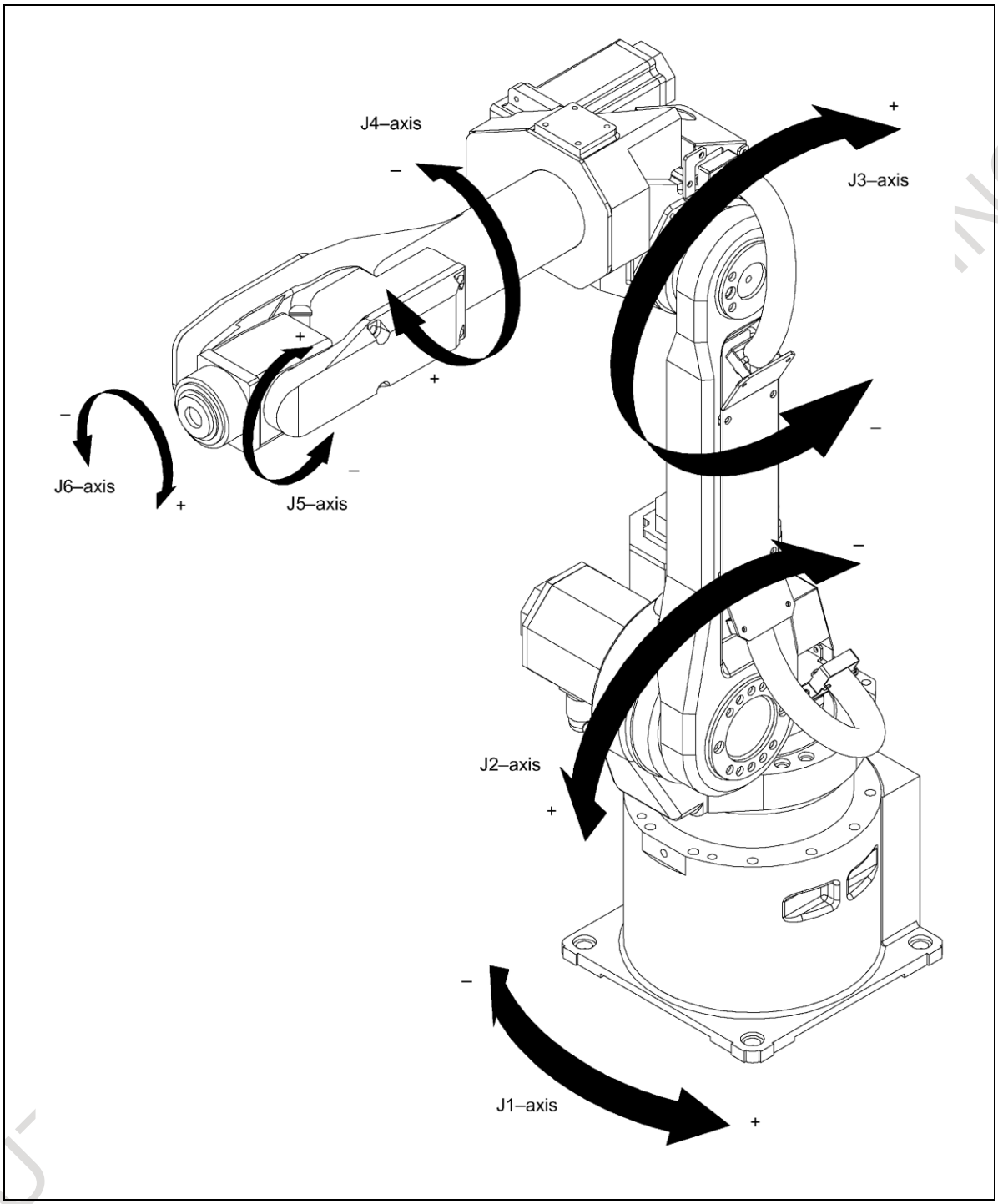


Fig. 5.1 (j) Operation directions of each axis

5.2 AXIS LIMITS SETUP

By setting the movable range of each axis, the movable range of the robot can be changed from the standard values.
In the following environments, changing the movable range of the robot is useful:

- The movable range of the robot at run time is limited.
- The robot may interfere with tools or peripheral equipment in an area.
- The length of a cable or hose attached for an application is limited.

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

- Axis limit software settings (All axes)
- Axis limit mechanical stopper (J1, J2, J3 axis (option))
- Axis limit switches ((J1 axis) (option))

⚠ WARNING

1 Changing the movable range of any axis affects the operation range of the robot. To avoid trouble, carefully consider a possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition occurs; for example, an alarm may occur in a previous taught position.
2 For the J1 axis, do not count merely on software-based limits to the movable range when changing the movable range of the robot. Use 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 mechanical stoppers.
3 Mechanical stoppers are physical obstacles. The robot cannot move beyond them. For the J1 axis, it is possible to re-position the mechanical stoppers. For J2, J3 and J5 axis, the mechanical stoppers are fixed. For the J4 and J6 axes, only software-specified limits are available.
4 Adjustable mechanical stoppers (J1 to J3 axis) is deformed in a collision to stop the robot. Once a stopper is subject to a collision, it can no longer assure its original strength and, therefore, may not stop the robot. When this happens, replace it with a new one.

Upper Limits

Displays the upper limits of each axis, or the axis limits in a positive direction.

Lower Limits

Displays the lower limits of each axis, or the axis limits in a negative direction.

5.2.1 Software Setting

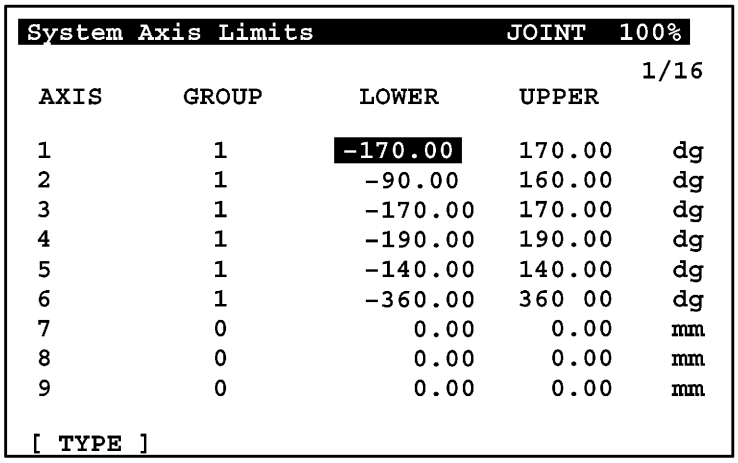
Axis limit software settings are upper and lower motion degree limitations. The limits can be set for all robot axes and will stop robot motion if the robot is calibrated.

Procedure

Setting Up Axis Limits

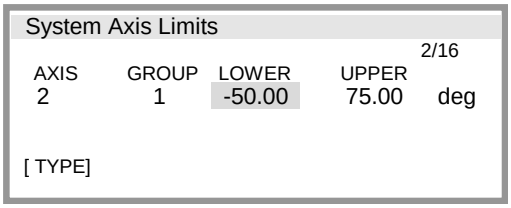
Step

1 Press the [MENUS] key.
2 Select SYSTEM.
3 Press F1, [TYPE].
4 Select Axis Limits. The following screen will be displayed.



> ⚠ **WARNING**
> 1 The setting value 0.00 indicates that the robot does not have the axis.
> 2 Do not depend on J1,J2,J3 -axis limit software settings to control the motion range of your robot. Use the axis limit switches or adjustable mechanical stopper also; otherwise injury to personnel or damage to equipment could occur.

5 Move the cursor to the desired axis range and type the new value using the numeric keys on the teach pendant.



6 Perform the setting for all axes.
7 Cycle the power of the controller in the cold start mode so the new settings are enabled.

> ⚠ **WARNING**
> You must turn off the controller and then turn it back on to use the new information; otherwise injury to personnel or damage to equipment could occur.

5.2.2 ADJUSTABLE MECHANICAL STOPPER SETTING (OPTION)

For the J1 to J3 axis, it is possible to re-position mechanical stopper.
Change the position of the mechanical stopper according to the desired movable range.

Item		Movable range
J1 axis adjustable mechanical stopper	Upper limit	Settable in steps of 30° degrees in a range of +20° to +170° degrees
	Lower limit	Settable in steps of 30° degrees in the range of -170° to -20° degrees
J2 axis adjustable mechanical stopper	Upper limit	Settable in steps of 20° degrees in the range of 0° to +100° degrees A mechanical stopper is also provided at the upper limit +160° of the standard movable range.
	Lower limit	Settable in steps of 20° degrees in the range of -60° to 0° degrees A mechanical stopper is also provided at the upper limit -90° of the standard movable range.
J3 (J2+J3)axis adjustable mechanical stopper	Upper limit	Settable in steps of 20° degrees in a range of 0° to +180° degrees
	Lower limit	Settable in steps of 20° degrees in a range of -60° to +180° degrees

NOTE
If the newly set operation range does not include 0°, it is necessary to change it by zero degree mastering so that 0° is included.

Change of the J1-axis stroke

A stroke modification can be performed at an arbitrary position in steps of 30° within the range -170° to +170°.
J1 axis operation range modification option specification (A05B-1215-H314)

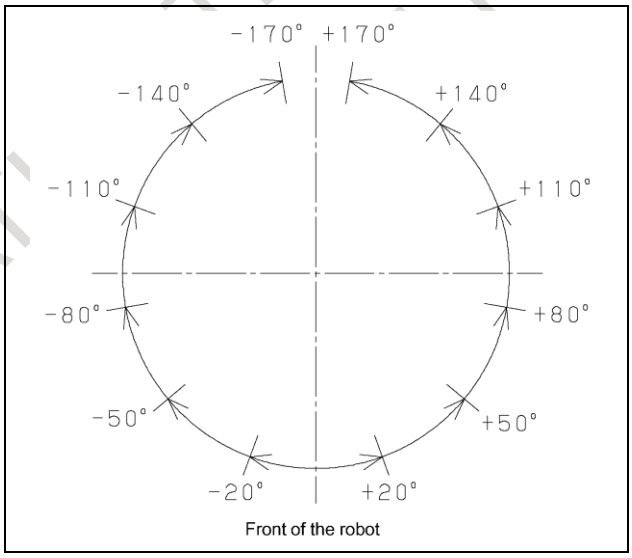


Fig. 5.2.2 (a) J1 axis stroke modification

⚠ CAUTION
If 0° is not included in a modified operation range, a re-modification is required to include 0° when zero-position mastering is performed.

2) Changing the lower and upper limits of the J1 axis stroke
After changing the mechanical stopper positions of the J1 axis, modify the movable range by software according to Table 5.2.2 (a) and the procedure described in Section 5.2.1.

Table 5.2.2 (a) Lower and upper stroke limits of the J1 axis

Stroke end position	Lower stroke limit value	Upper stroke limit value
-170°	-170°	
-140°	-140°	
-110°	-110°	
-80°	-80°	
-50°	-50°	
-20°	-20°	
+20°		+20°
+50°		+50°
+80°		+80°
+110°		+110°
+140°		+140°
+170°		+170°

J2 AXIS STROKE MODIFICATION

Spec of change of J2 axis motion range : (A05B-1215-J033)

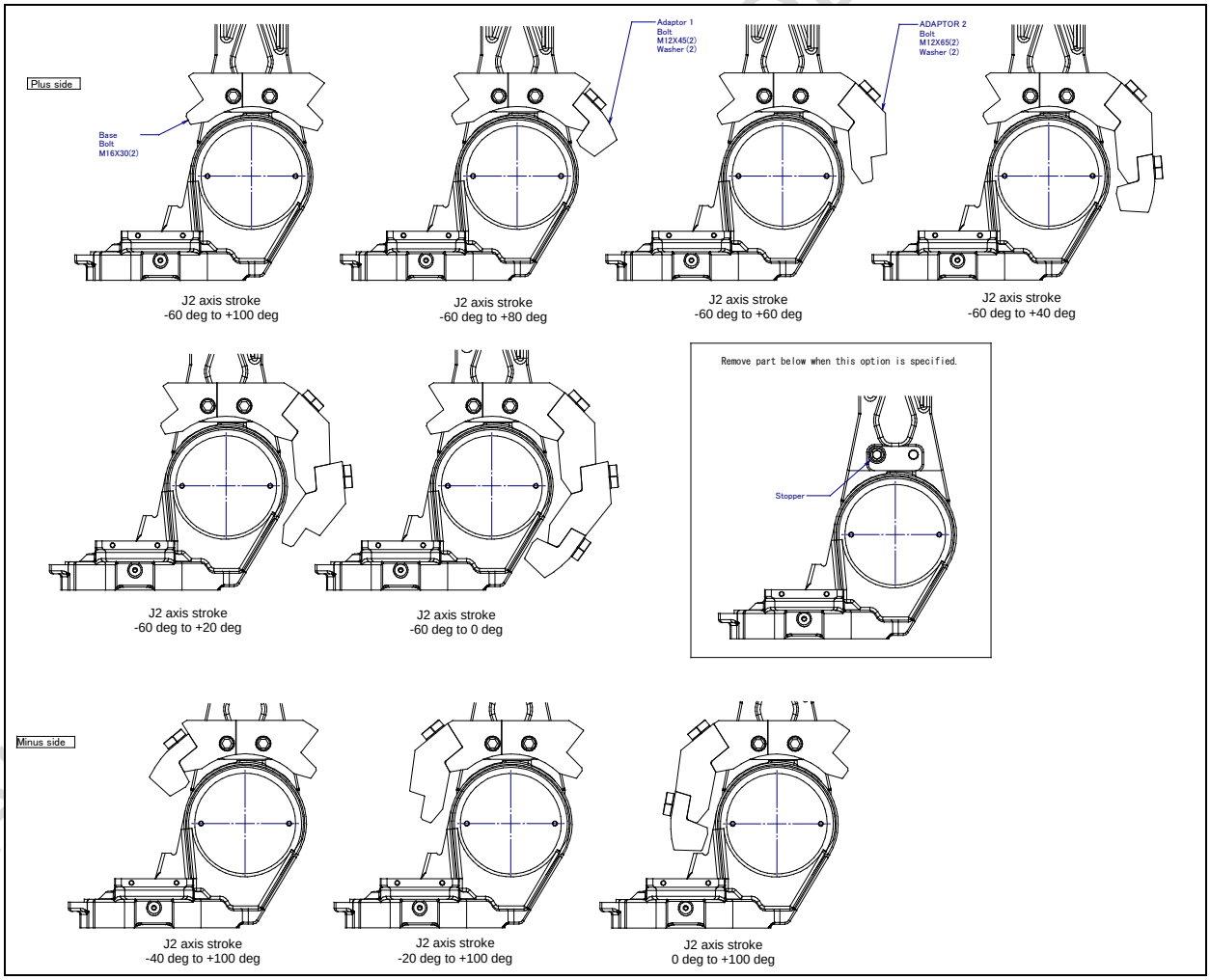
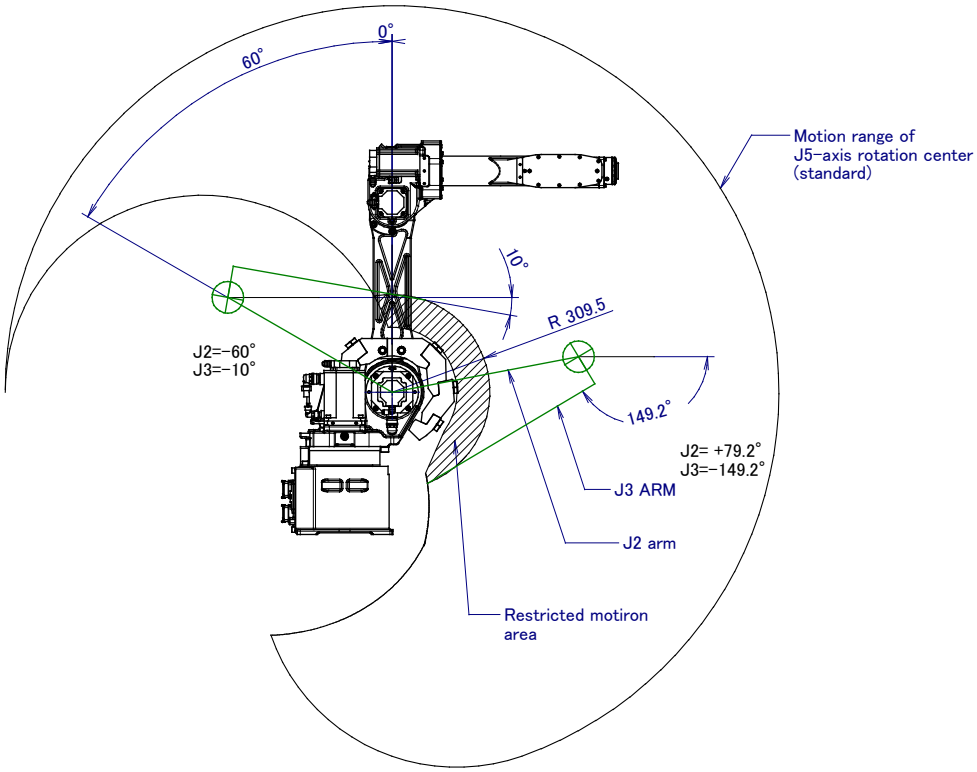


Fig. 5.2.2(b) J2 axis stroke change (option)

⚠ CAUTION

1 High sensitive collision detection is required when using this option.
2 Stroke of J2-axis depends on the angle of J3-axis.
3 Assemble the mechanical stopper without a gap between the base and the adapter and between adapters.
4 Assemble mechanical stopper as figure. The operation of the mechanical stopper cannot be secured at the installations other than figure.
5 Setting the stopper, robot can not reach to hatched area. Please do not access hatched area.



J3 AXIS STROKE MODIFICATION
Spec of change of J3 axis motion range : (A05B-1215-J032)

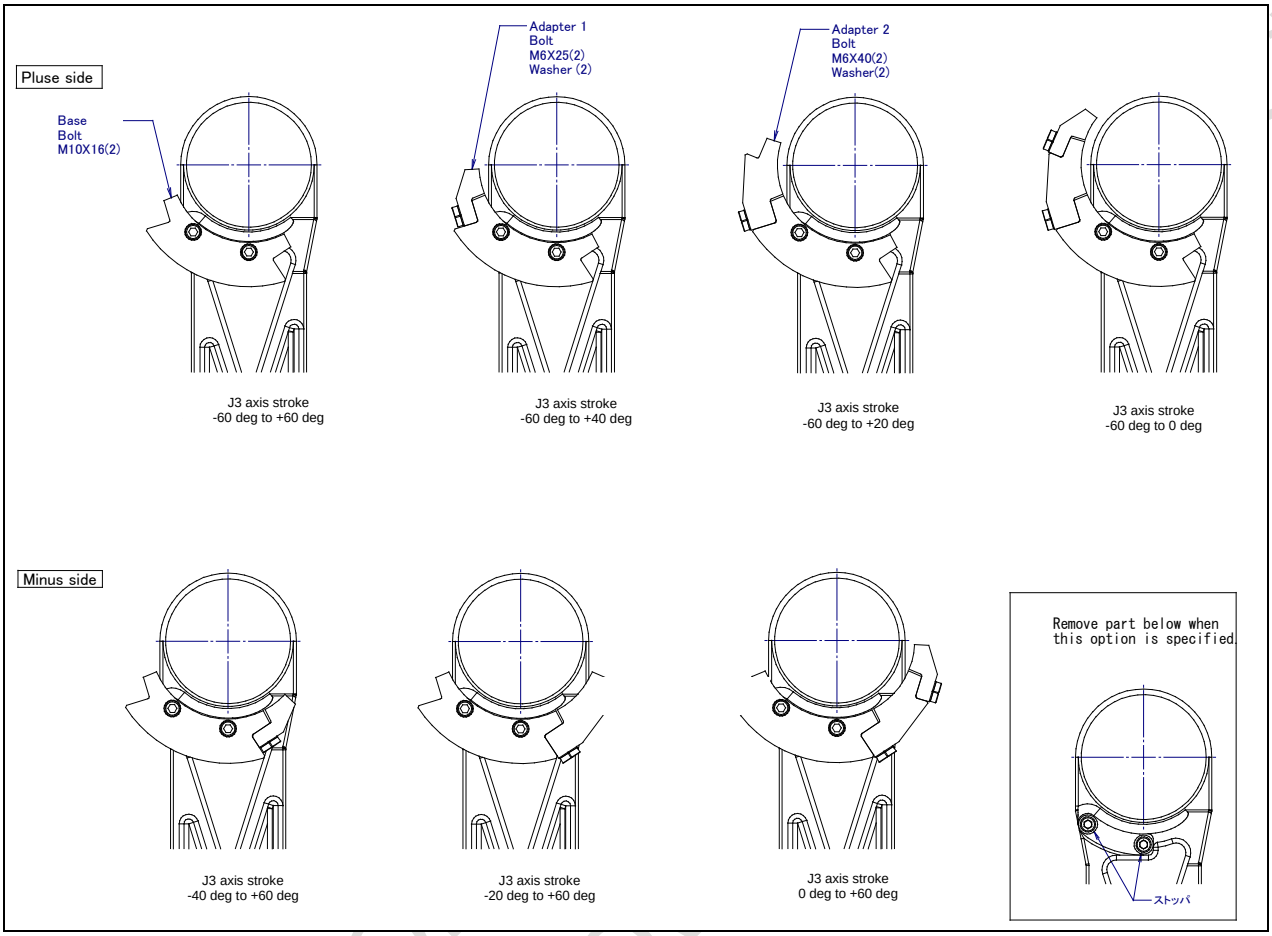


Fig. 5.2.2(c) J3 axis stroke change (option)

⚠ CAUTION

1 These figures show the case of J2 = 0 deg. Stroke limit of J3-axis depends on the J2-axis angle.
2 Assemble the mechanical stopper without a gap between the base and the adapter and between adapters.
3 Assemble mechanical stopper as figure. The operation of the mechanical stopper cannot be secured at the installations other than figure.

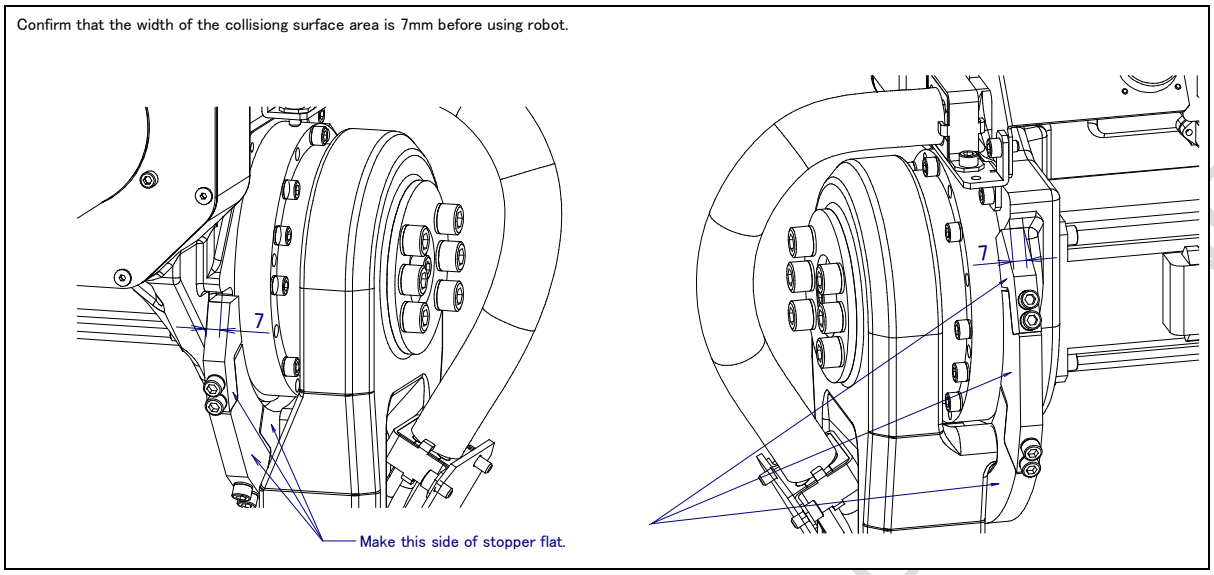


Fig. 5.2.2(d) J3 axis stroke change (option)

The adjustable mechanical stopper is a thing that the stopper is transformed, a mechanism that the robot is stopped, and the robot works up to the stopping distance shown in Table 5.2.2(b) in the maximum compared with the set range of motion when the stopper collides.

Table.5.2.2(b) Max. stopping distance (position) of adjustable mechanical stopper

Item		Plus side	Minus side
All models	J1	+11°	-11°
	J2	+11.6°	-4°
	J3	+9.5°	-9.2°

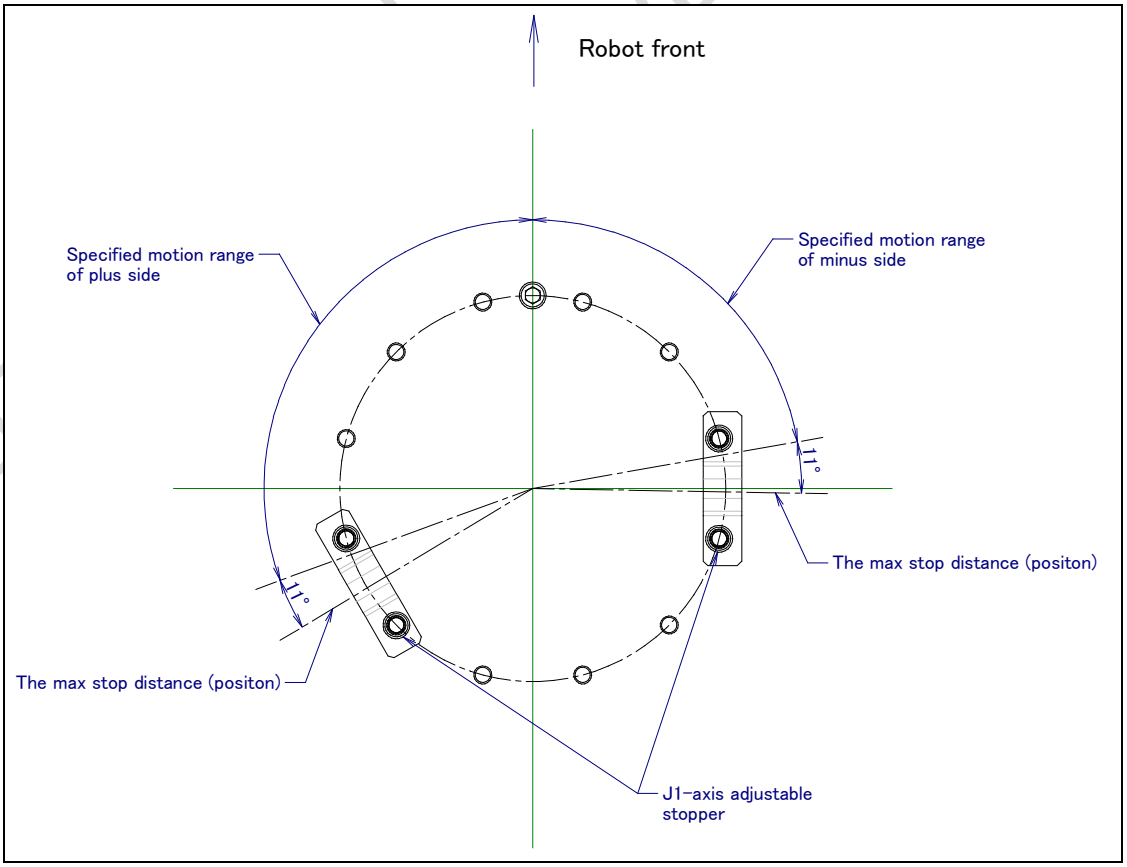


Fig.5.2.2 (e) Max. stopping distance (position) of adjustable mechanical stopper (J1-axis)

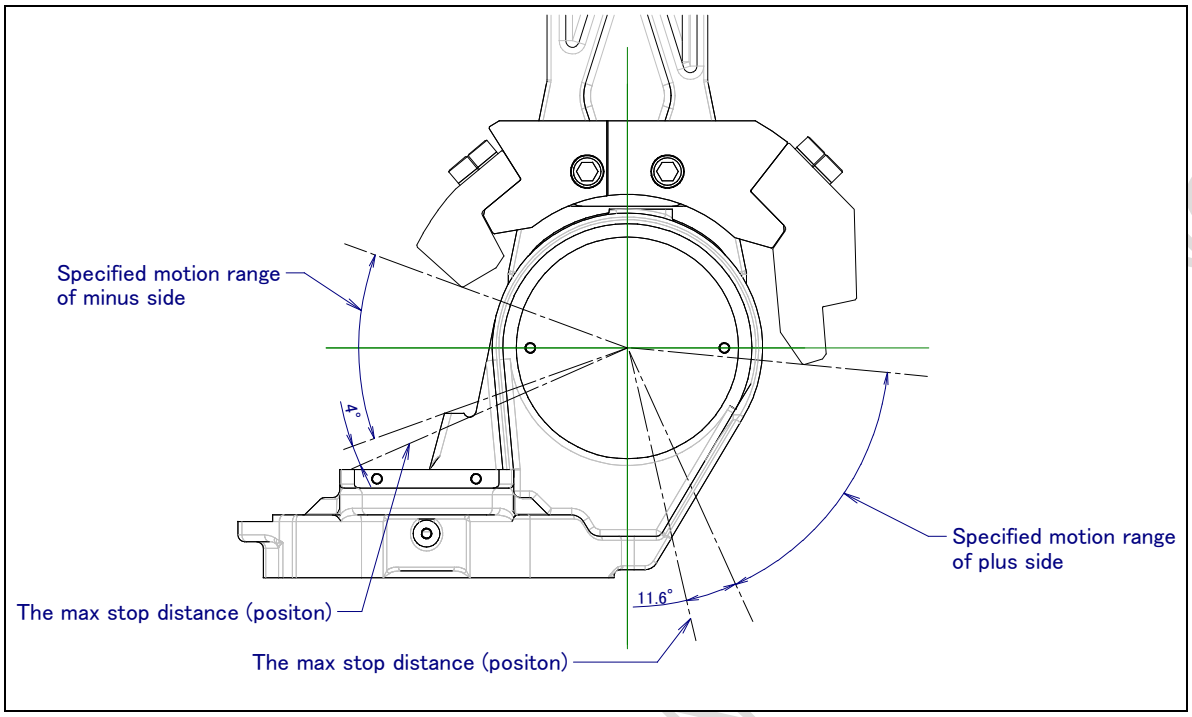


Fig.5.2.2 (f) Max. stopping distance (position) of adjustable mechanical stopper (J2-axis)

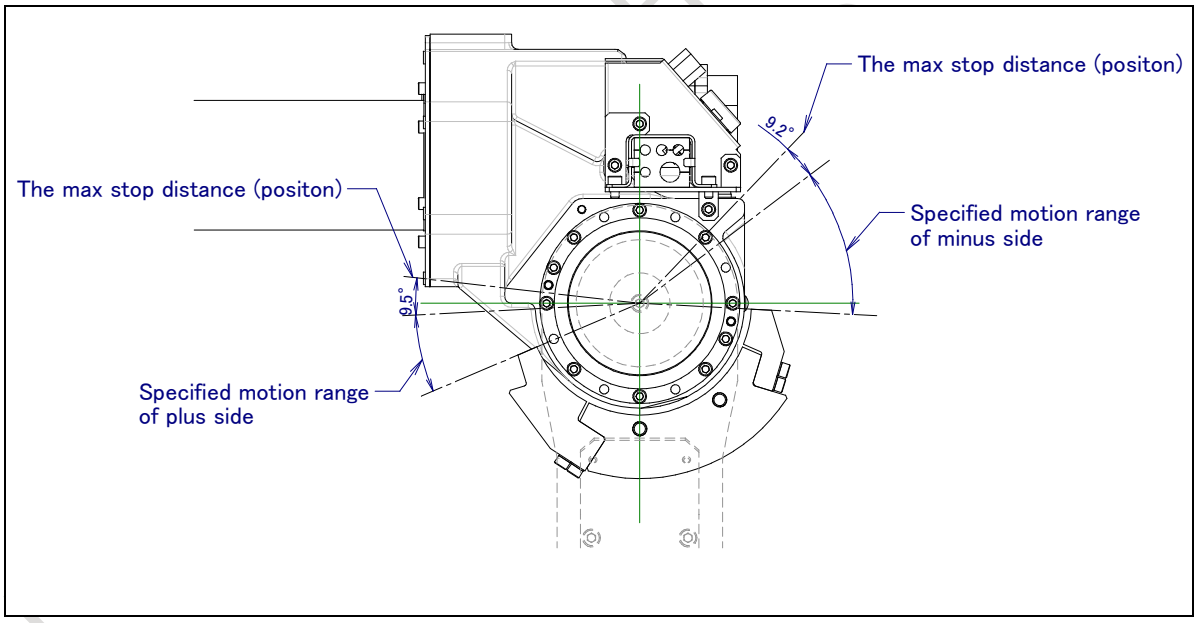


Fig.5.2.2 (g) Max. stopping distance (position) of adjustable mechanical stopper (J3-axis)

5.3 J1-AXIS LIMIT SWITCH ADJUSTMENT (OPTION)

A limit switch is an overtravel switch. When a limit switch is actuated, the power to the servo motor is turned off to stop the robot. Two types of limit switches are available as options for the J1 axis only:

- Specification of the option for the operation range 340° (+/- 170°): A05B-1215-H312
- Specification of the option for the operation range 360° (+/- 180°): A05B-1215-H313

Adjustment procedure

1 Set the system variable $MOR_GRP.$CAL_DONE to FALSE. This setting cancels the software-based stroke end limits, and enables axis operation to be performed by jogging beyond each stroke end.
2 Loosen the two M4×8 bolts used to secure a dog (block).
3 Adjust the position of the limit switch so that the limit switch is actuated at a position about 1° from the stroke end.
4 When an OT is detected with the switch actuated, the robot stops, and the error message "OVERTRAVEL" is displayed. To move the robot again, press "RESET" while holding down "SHIFT". Furthermore, while holding down "SHIFT", move the axis under adjustment away from the limit by jogging.
5 If the adjustment allowance of 2 is insufficient, loosen the following bolts on the J1 base used for securing the limit switch and adjust the position of the limit switch itself in order to facilitate adjustment:
   - For the operation range 340°: Two M4×20 bolts, two M4×8 bolts, or two M12×20 bolts
   - For the operation range 360°: Two M4×20 bolts or two M4×6 bolts
6 Check that the switch on the opposite side is also actuated normally at a position about 1° from the stroke end. If the switch is not actuated normally, readjust the position of the switch.
7 Reset the system variable $MOR_GRP.$CAL_DONE to TRUE.
8 Turn off the power, then turn on the controller again.

NOTE
The J1-axis limit switch option cannot be used with the integrated type controller.

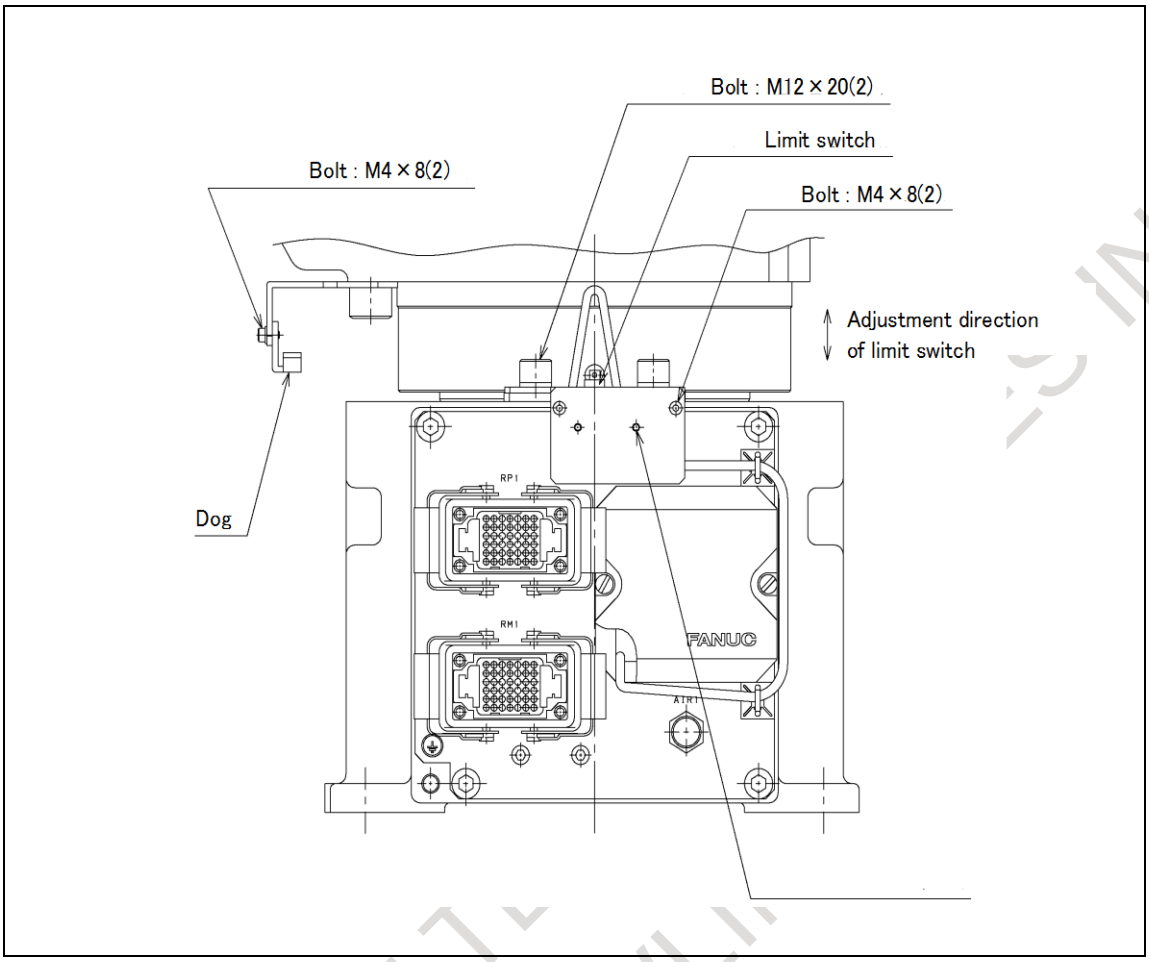


Fig.5.3 (a) J1-axis limit switch adjustment (operation range 340º)

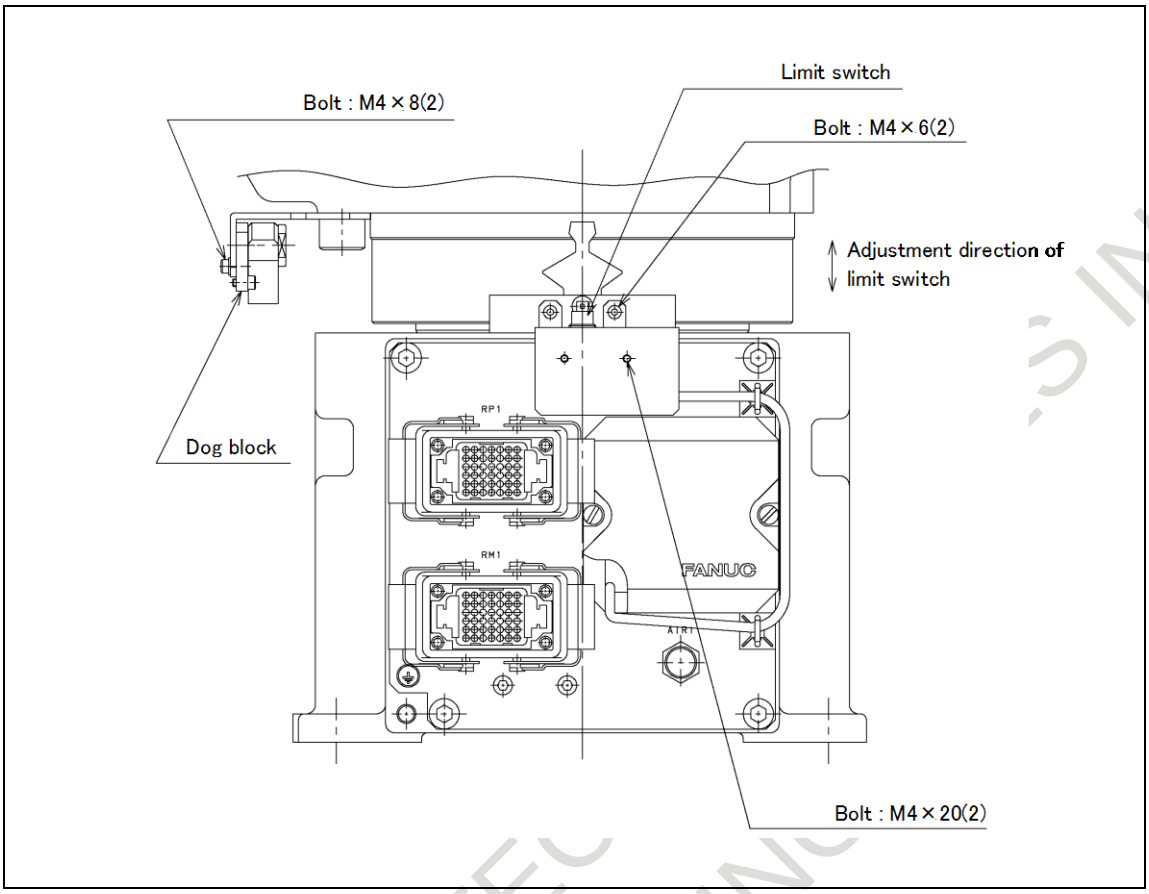


Fig.5.3 (b) J1-axis limit switch adjustment (operation range 360º)

5.4 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.

5.4.1 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.

NOTE
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 control and mechanical units periodically. An alarm will be issued to warn the user of a low battery voltage.

Mastering method

There are following five methods of mastering.

Table 5.4.1 (a) Mastering method

Fixture position mastering	This is performed using a mastering fixture before the machine is shipped from the factory.
Zero-position mastering (eye mark mastering)	This is performed with all axes set at the 0-degree position. A zero-position mark (eye mark) is attached to each robot axis. This mastering is performed with all axes aligned to their respective eye marks.
Quick mastering	This is performed at a user-specified position. The corresponding count value is obtained from the rotation speed of the pulsecoder connected to the relevant motor and the rotation angel within one rotation. Quick mastering uses the fact that the absolute value of a rotation angel 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 performing the mastering, the positioning (calibration) is indispensable. The Positioning is an operation which recognizes the robot current position loading the pulse count value.

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

> ⚠ **CAUTION**
> 1 If mastering is performed incorrectly, the robot may behave unexpectedly. This is very dangerous. For this reason, the Master/Cal screen is designed to appear only when the $MASTER_ENB system variable is 1 or 2. After performing positioning, press F5, ([DONE]) on the Master/Cal screen. The $MASTER_ENB system variable is then reset to 0 automatically, and the Master/Cal screen will disappear.
> 2 Before performing mastering, it is recommended that you back up the current mastering data.

5.4.2 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 "Servo 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.

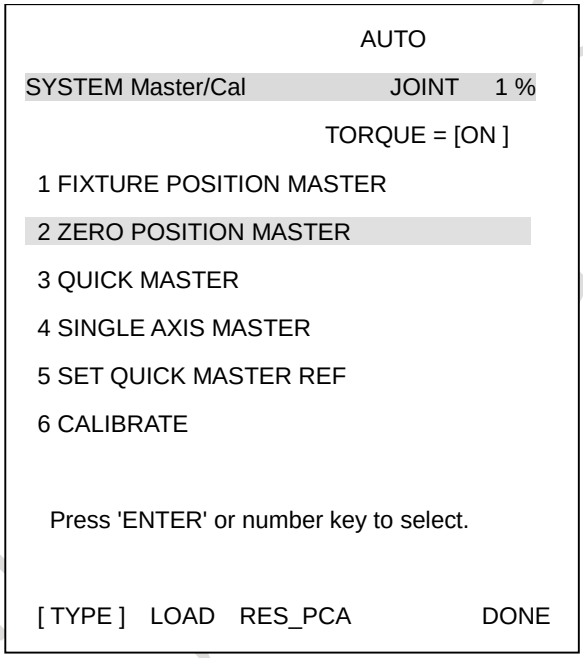
5.4.3 Zero Position Mastering

Zero-position mastering (eye mark mastering) is performed with all axes set at the 0-degree position. A zero-position mark (eye mark) is attached to each robot axis. This mastering is performed with all axes set at the 0-degree position using their respective eye marks.
Zero-position mastering involves a visual check. It cannot be so accurate. It should be used only as a quick-fix method.

Procedure Mastering to Zero Degrees

Step

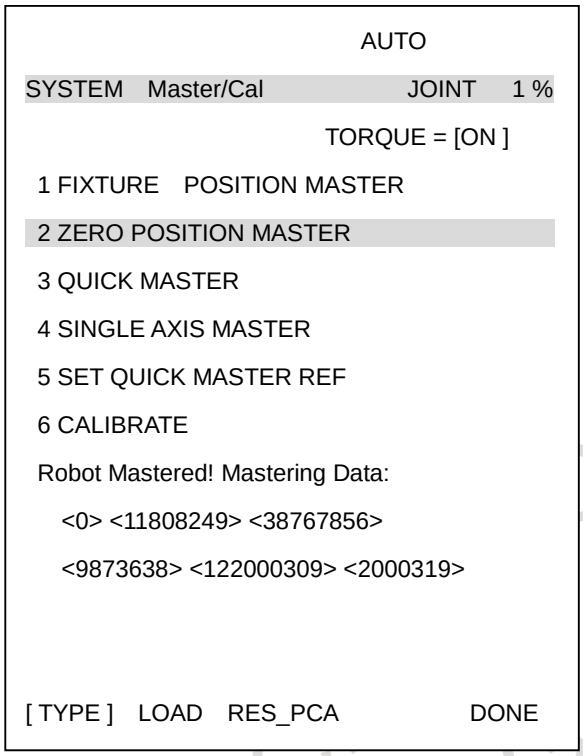
1 Press the [MENUS] key.
2 Select NEXT and press SYSTEM.
3 Press F1, [TYPE].
4 Select Master/Cal.



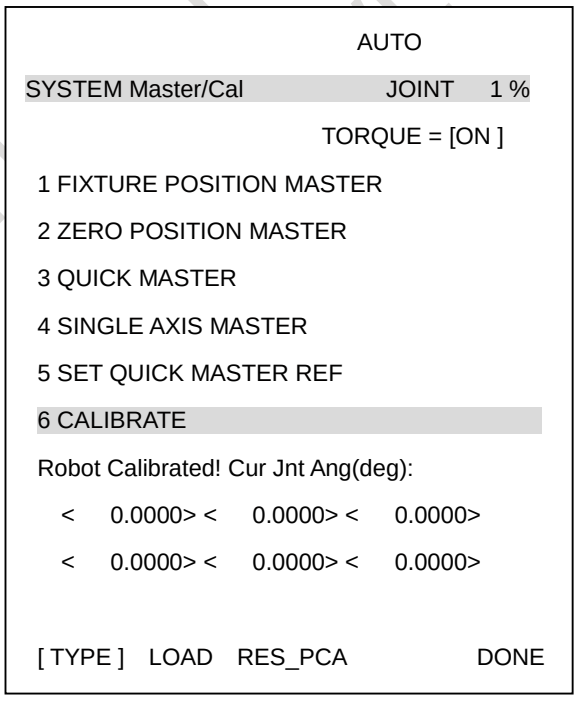
5 Release brake control, and jog the robot into a posture for mastering.

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, switch the controller power off and on again.

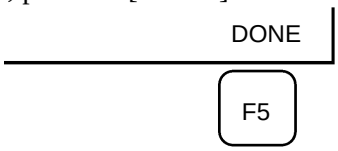
6 Select Zero Position Master.



7 Press F4, YES. Mastering will be performed automatically. Alternatively, switch the power off and on again. Switching the power on always causes positioning to be performed.



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



9 Reset the brake control release settings to the original state. Set system variables $PARAM_GROUP, $SV_OFF_ALL, and $SV_OFF_ENB to their original values, then turn off then back on the power.

Table 5.4.3 (a) Witness mark position

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

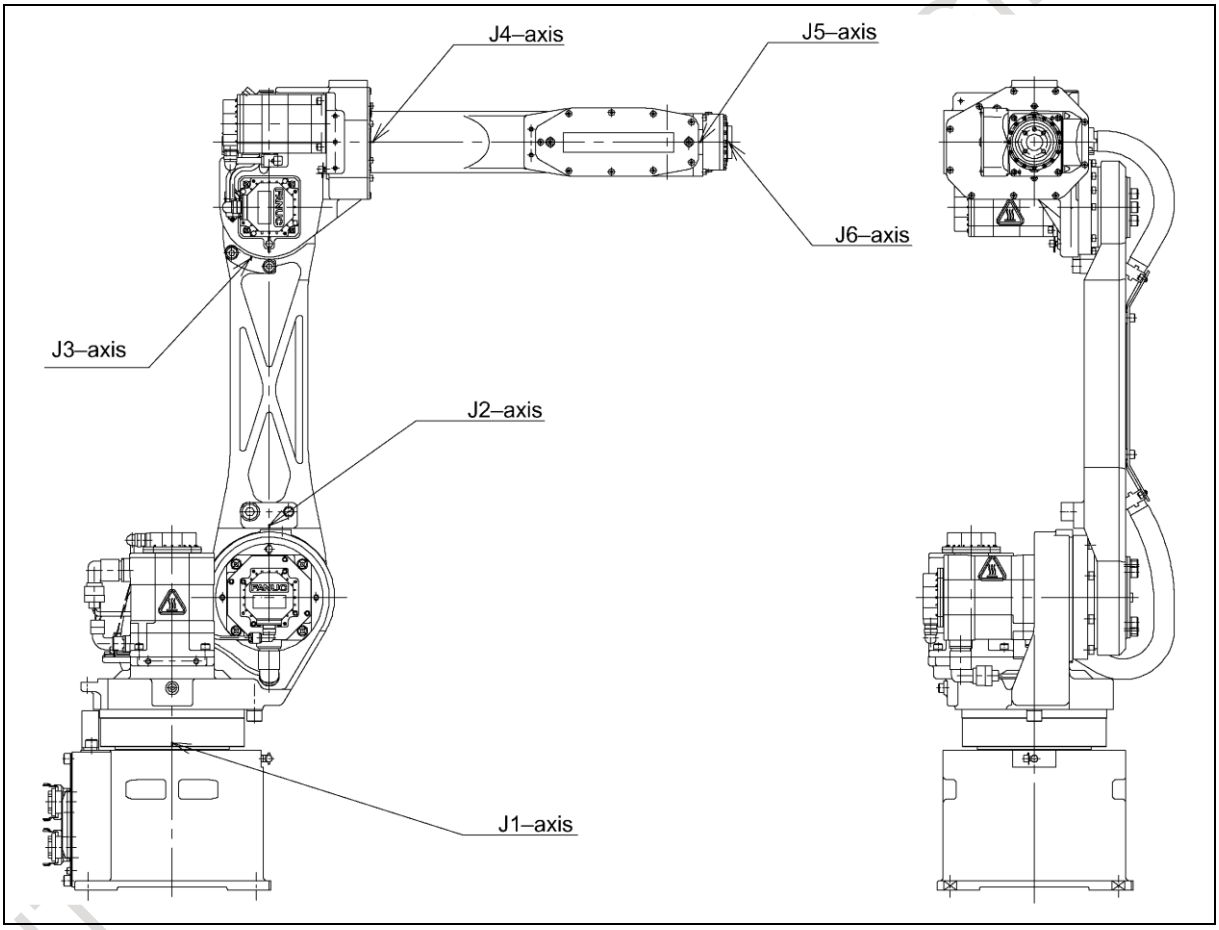


Fig. 5.4.3 (a) Scribe mark of the zero-degree for each axis

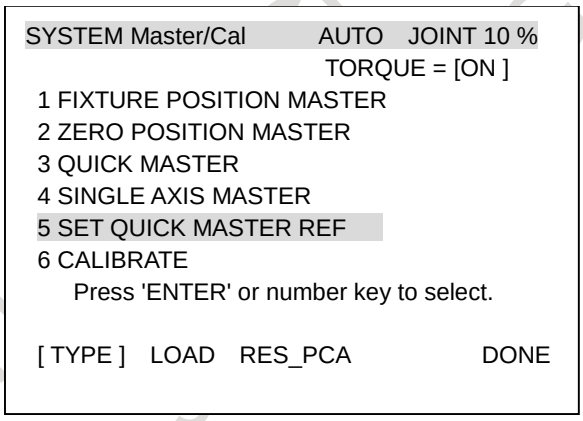
5.4.4 Quick Mastering

Quick mastering is performed at a user-specified position. The corresponding count value is obtained from the rotation speed of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the fact that the absolute value of a rotation angle within one rotation will not be lost.
Quick mastering is factory-performed at the position indicated in Table. 5.4.4 (a). Do not change the setting unless there is any problem. If it is impossible to set the robot at the position mentioned above, it is necessary to re-set the quick mastering reference position using the following method. (It would be convenient to set up a marker that can work in place of the witness mark.)

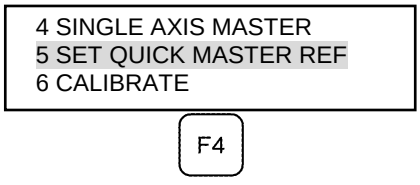
⚠ CAUTION
1. Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2. Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

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



3 Release brake control, and jog the robot to the quick mastering reference position.
4 Select [5 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position is saved.

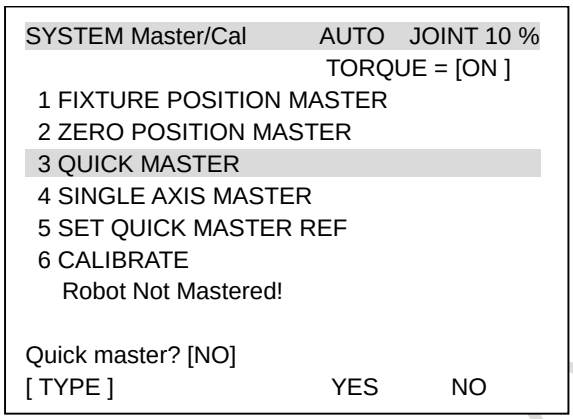


⚠ CAUTION
If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or zero –position mastering is required to restore mastering data.

Procedure of Quick Mastering

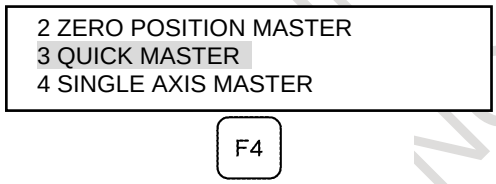
Step

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 [QUICK MASTER] and press the [ENTER] key. Press F4, [YES]. Quick mastering data is memorized.



4 Move the cursor to [6 CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration is executed by power on again.

5 After completing the calibration, press F5, DONE.

6 Reset the brake control release settings to the original state. Set system variables $PARAM_GROUP, $SV_OFF_ALL, and $SV_OFF_ENB to their original values, then turn off then back on the power.

7 After mastering, update the mastering data listed in the factory-supplied data sheet with new mastering data ($DMR_GROUP.$MASTER_COUN [1] to [6]).

5.4.5 Single Axis Mastering

Single-axis mastering is performed for one axis at a time. When mastering is required only for a specific axis, perform single axis mastering as described below. New position information is then stored only for that axis, and the previous position information is preserved for the other axes. The mastering position for each axis can be specified by the user.
Single 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.
Note that mastering of the J2 and J3 axes must always be performed simultaneously because there is an interaction between the two axes.

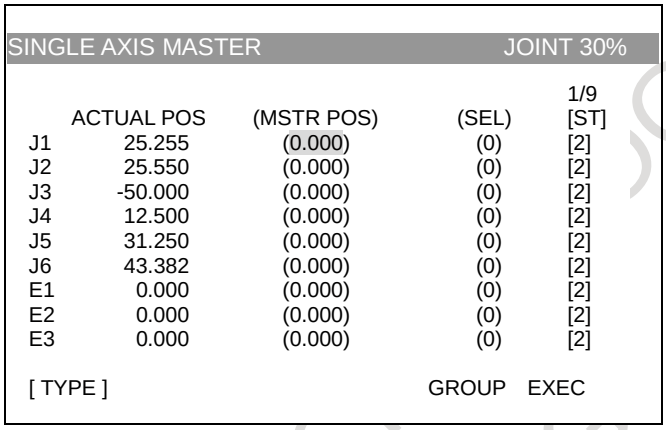
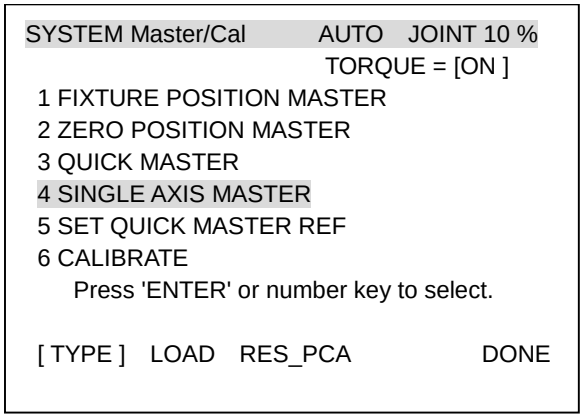


Table 5.4.5 (a) Items Set in single axis Mastering

Item	Description
Current position	The current position of the robot is displayed for each axis in degree units.
Mastering position	A mastering position is specified for an axis to be subjected to single axis mastering. It is typically useful to specify a 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 one-axis mastering has been completed for the corresponding axis. It cannot be rewritten directly by the user. The value of the item is reflected in 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].



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

```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                            1/9
    ACTUAL   POS    (MSTR POS)    (SEL)   [ST]
J1        25.255    (    0.000)   (0)     [2]
J2        25.255    (    0.000)   (0)     [2]
J3       -50.000    (    0.000)   (0)     [2]
J4        12.500    (    0.000)   (0)     [2]
J5        31.250    (    0.000)   (0)     [2]
J6        43.382    (    0.000)   (0)     [0]
E1         0.000    (    0.000)   (0)     [0]
E2         0.000    (    0.000)   (0)     [0]
E3         0.000    (    0.000)   (0)     [0]

                                           EXEC
```

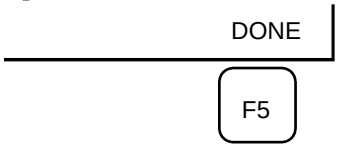
4 For the axis to which to perform single axis mastering, set (SEL) to "1." Setting of [SEL] is available for one or more axes.
5 Turn off brake control, then jog the robot to the mastering position.
6 Enter axis data for the mastering position.
7 Press F5 [EXEC]. Mastering is performed. So, [SEL] is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

```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                            1/9
    ACTUAL   POS    (MSTR POS)    (SEL)   [ST]
J1        25.255    (    0.000)   (0)     [2]
J2        25.255    (    0.000)   (0)     [2]
J3        50.000    (    0.000)   (0)     [2]
J4        12.500    (    0.000)   (0)     [2]
J5         0.000    (    0.000)   (0)     [2]
J6        90.000    (   90.000)   (0)     [0]
E1         0.000    (    0.000)   (0)     [0]
E2         0.000    (    0.000)   (0)     [0]
E3         0.000    (    0.000)   (0)     [0]

                                           EXEC
```

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

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

 [ TYPE ]   LOAD   RES_PCA              DONE
```

9 Select [6 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].



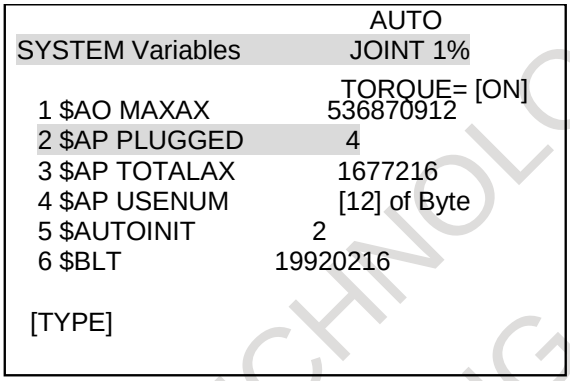
11 Restore brake control. Reset system variables $PARAM_GROUP.$SV_OFF_ALL and $PARAM_GROUP.$SV_OFF_ENB to their original values, and turn the power off and then back on.

5.4.6 Mastering Data Entry

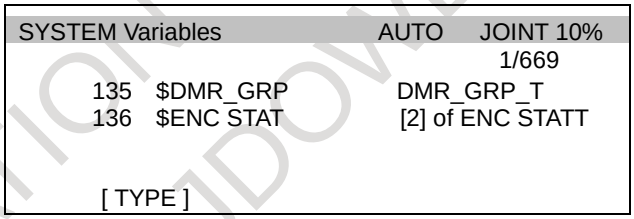
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

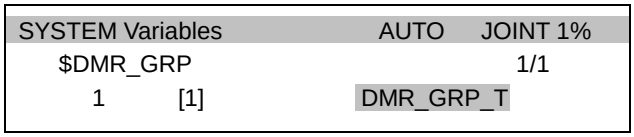
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen will be displayed.

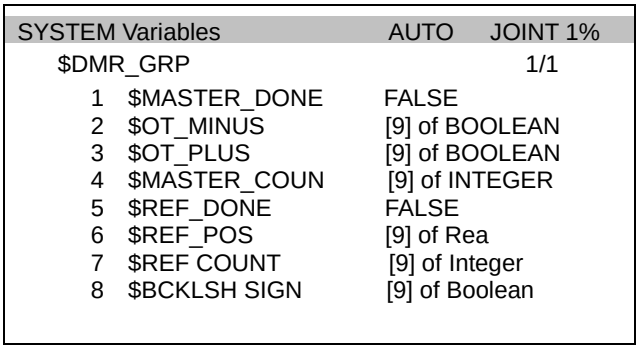


3 Change the mastering data. The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

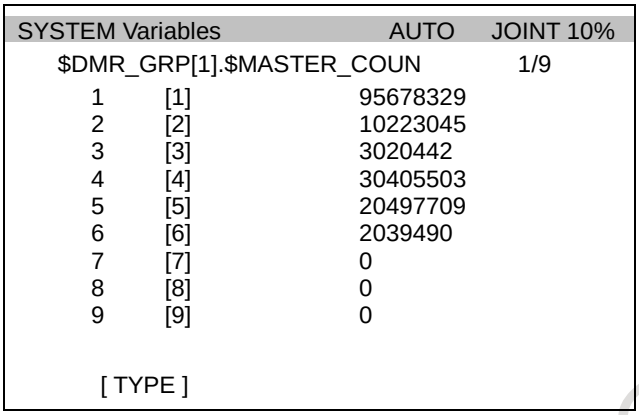


4 Select $DMR_GRP.

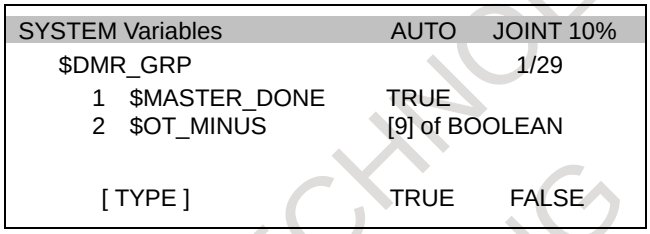




5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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].

5.4.7 CONFIRMING MASTERING

1) Confirming that mastering was performed normally
   Usually, positioning is performed automatically when the power is turned on. To confirm that mastering was performed normally, check that the current-position display matches the actual position of the robot, using this procedure.
   a) Replay the taught operation of the robot to set each axis to zero degrees, and visually check that the zero-degree position marks shown in Fig. 5.4.4(a) and (b) are aligned.
   b) Replay a specific portion of the program, and check that the robot has moved to the taught position.
2) Possible alarms in positioning
   The following paragraphs describe alarms that may occur in positioning and explain how to handle them.
   a) BZAL alarm
      This alarm is raised if the voltage of the pulsecoder backup battery becomes 0V when the controller power is off. Mastering must be performed again because the counter has already lost data.
   b) BLAL alarm
      This alarm indicates that the voltage of the pulsecoder backup battery is too low to run the pulsecoder. If this alarm is issued, replace the backup battery soon while keeping the power on, and check whether the current-position data is correct, using a method described in item (1).
   c) CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL alarms
      If any of these alarms is issued, contact your FANUC service representative. A motor may have to be replaced.

5.5 BRAKE RELEASE

When the robot power is off, the brakes of the robot can be released using the brake release unit (option). In this case, the robot can be put in a different position. Observe Notes 1 to 4 given below.

NOTE
1 When releasing the brakes of the J2-axis or J3-axis motor (M2 or M3), support the robot with a crane as shown in Fig. 5.6(a).
2 When releasing the brakes of the J4-axis to J6-axis motor (M4 to M6), support the end effector with a crane so that it will not fall.
3 When releasing the brakes of motors, use slings having a sufficient tensile strength.
4 Do not release the brakes of more than one motor simultaneously.

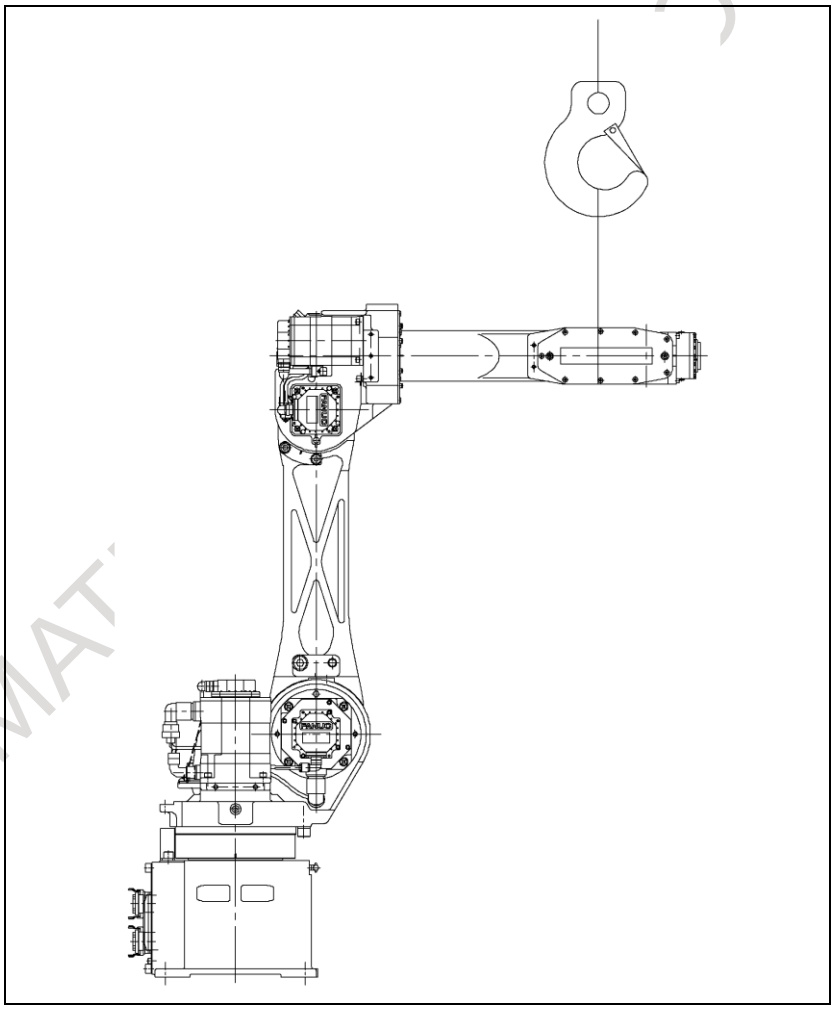


Fig. 5.5 (a) Releasing the brakes of the J2-axis motor

6 PIPING AND WIRING

6.1 PIPING DRAWING

Fig. 6.1 (a), (b), (c) shows the diagram of piping in the mechanical unit.
The basic configuration employed when the servo torch option is specified is equivalent to the one defined in the standard specification. When the MIG EYE option is specified, air is blown into the air three-item set placed at the backward portion of the J1 base, then air output from the air three-item set is input to the panel union on the J1-axis connector board. The basic configuration in the mechanical unit is equivalent to the one defined in the standard specification.

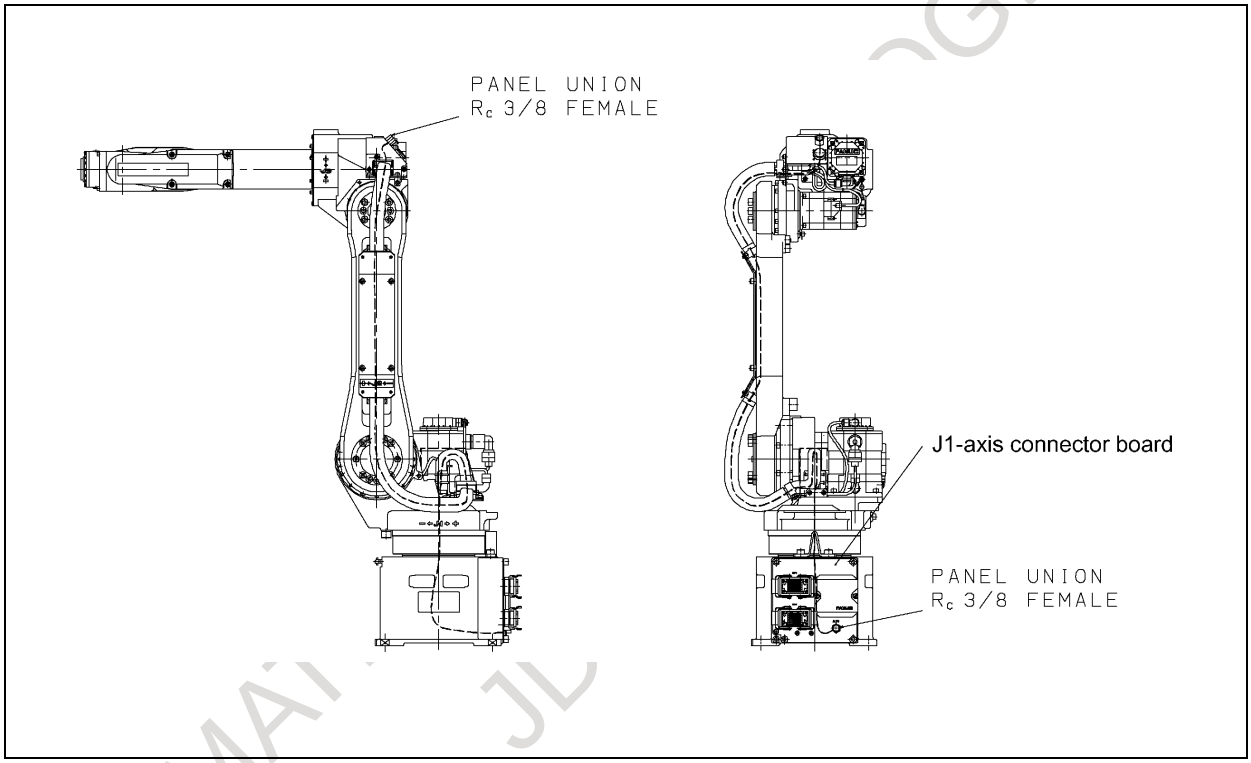


Fig. 6.1 (a) Piping diagram ARC Mate 100*i*B, M-6*i*B

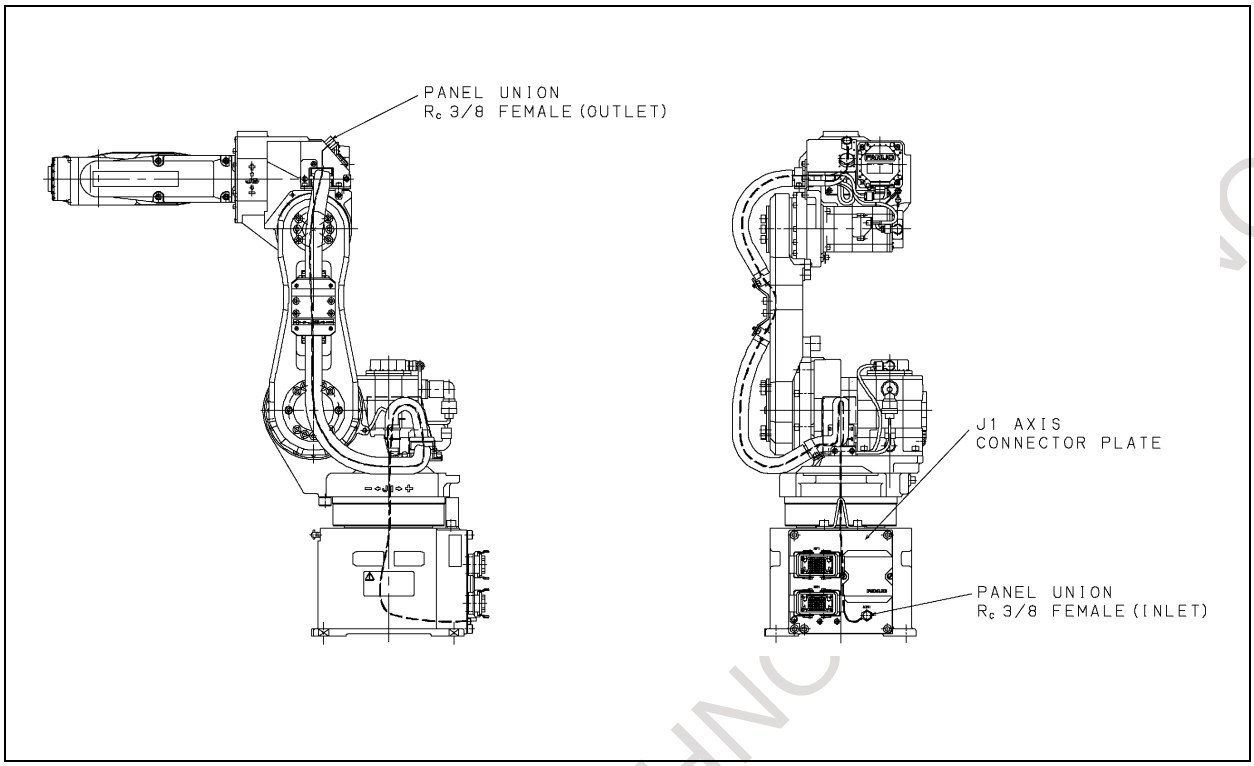


Fig. 6.1 (b) Piping diagram ARC Mate 100*i*B/6S, M-6*i*B/6S

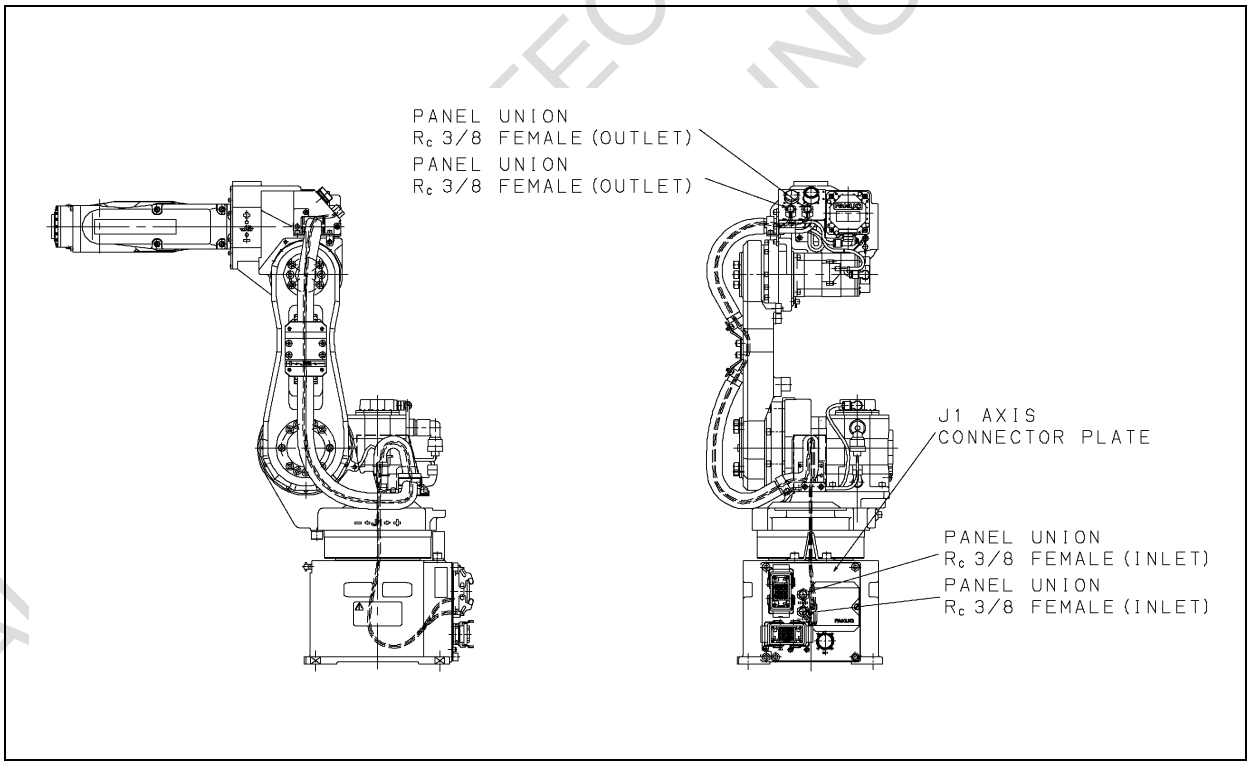


Fig. 6.1 (c) Piping diagram ARC Mate 100*i*B/6S, M-6*i*B/6S

6.2 CABLE MOUNTING DIAGRAM

Make the following visual checks to see if there are any cable abnormalties:

1) Whether the swiveling motion of the robot has caused any tension or bending in the swiveling section.
2) Whether the cables leading to the J2 or J3-axis sections have worn each other during operation.
3) Whether the route of cables leading to the end effector is appropriate for the operation of the wrist and the service operation of the robot. Fig. 6.2 (a) to (c) are the mounting diagram of cables in the mechanical unit.
   For the wiring diagram when the servo torch option or MIG EYE option is specified, see the relevant maintenance manual.

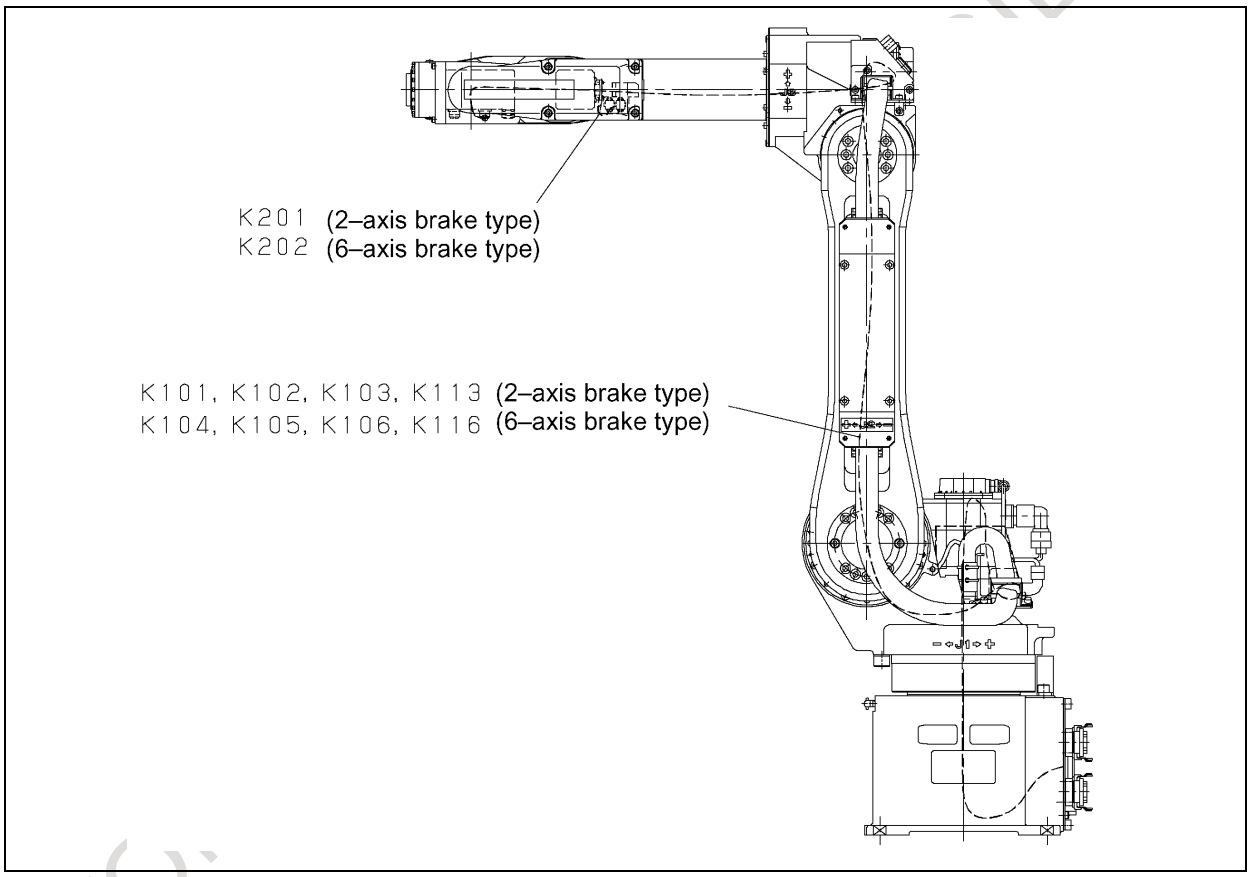


Fig. 6.2 (a) Cables in the mechanical unit (Remote type controller) ARC Mate 100*i*B, M-6*i*B

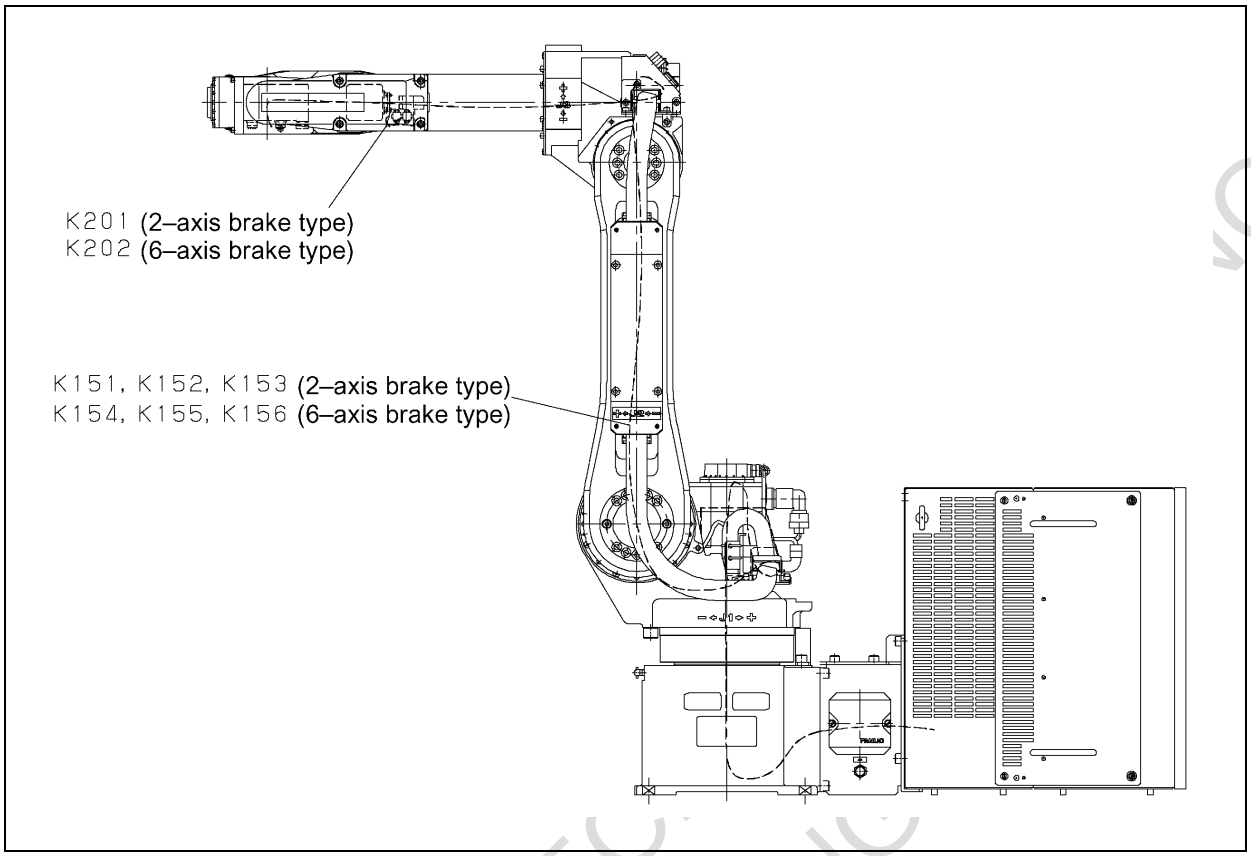


Fig. 6.2 (b) Cables in the mechanical unit (Integrated type controller) ARC Mate 100*i*B, M-6*i*B

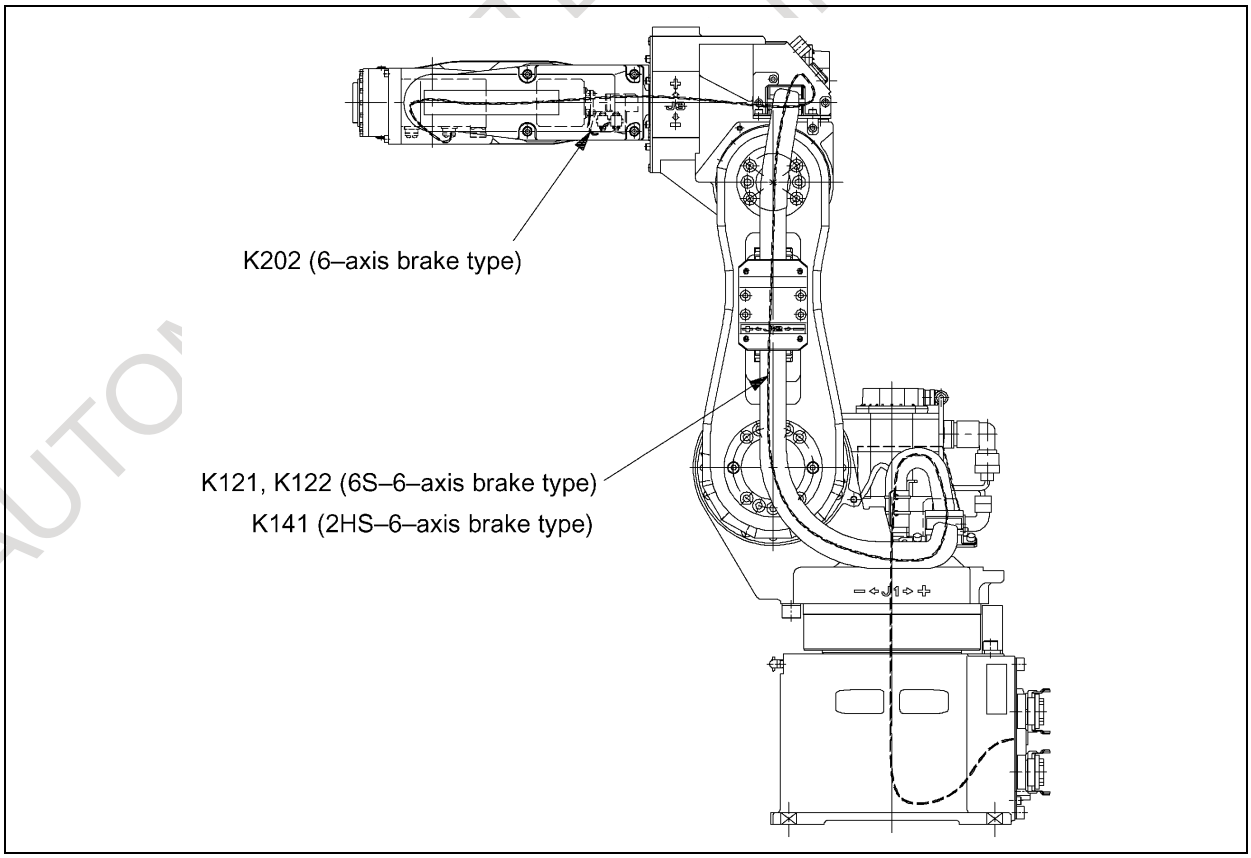


Fig. 6.2 (c) Cables in the mechanical unit (Remote type controller) ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

7 SEVERE DUST/LIQUID PROTECTION PACKAGE (OPTION)

The package is intended to improve the severe dust/Liquid protection characteristics of the robot so that it can be used in a severe environment. It is also intended to improve the rust resistance of the robot so that it can be used for a longer time.

> ⚠ **CAUTION**
> The severe dust/liquid protection package(option) is supported for M-6*i*B and M-6*i*B/6S only, and is not supported for ARC Mate 100*i*B, ARC Mate 100*i*B/6S and M-6*i*B/2HS. Note also that this option cannot be modified by addition to the standard specification.

7.1 SEVERE DUST/LIQUID PROTECTION OPTION CHARACTERISTICS

The following table lists the IEC60529-based severe dust/liquid protection option characteristics of the M-6*i*B, M-6*i*B/6S. See the Preface for additional information.

	Severe dust/liquid protection package
J3 arm and wrist section	IP67
Main body	IP55

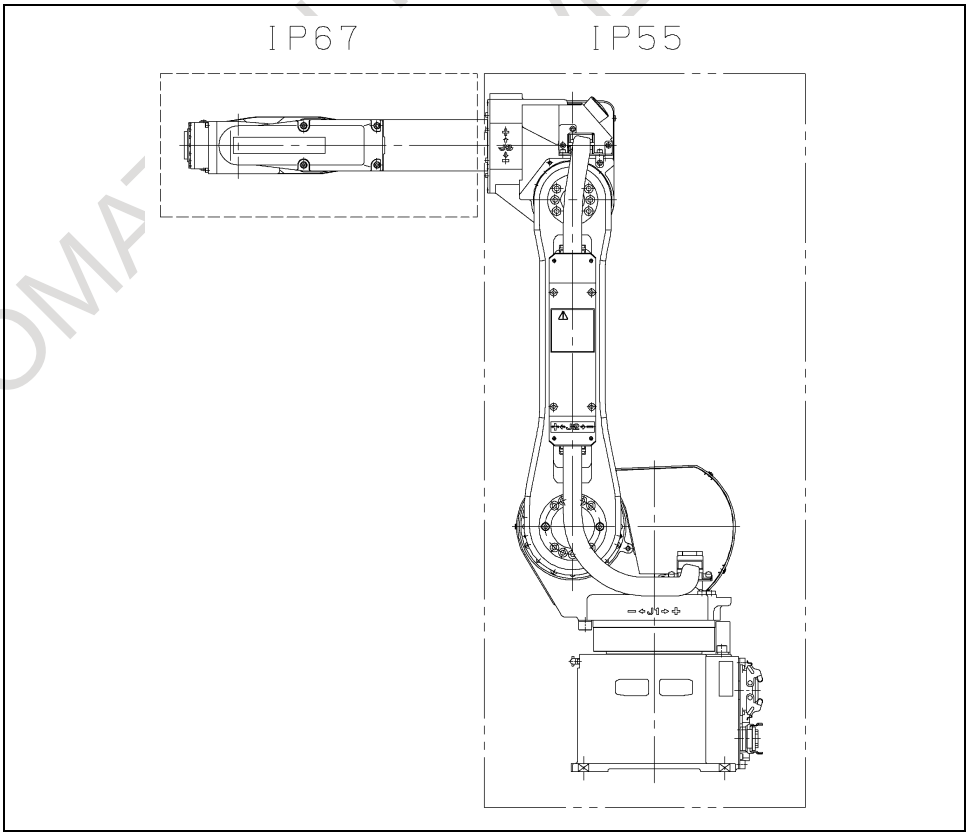


Fig. 7.1 (a) Severe dust/liquid protection option characteristics

7.2 CONFIGURATION OF THE SEVERE DUST/LIQUID PROTECTION OPTION PACKAGE

The following table lists the major differences between the M-6*i*B, M-6*i*B/6S standard specification and severe dust/liquid protection option package.

	Standard specification	Severe dust/liquid protection option
Painting	Polyurethane resin enamel painting or melamine resin enamel painting	Polyurethane resin enamel painting
Bolts	Black oxide coating	FR coating bolt Stainless steel bolt Black chrome plated washer
Cover	Option	With a J2 cover With a J4 cover With a battery box cover
EE connector	Non-waterproof connector	Waterproof connector
Others		Tap seal

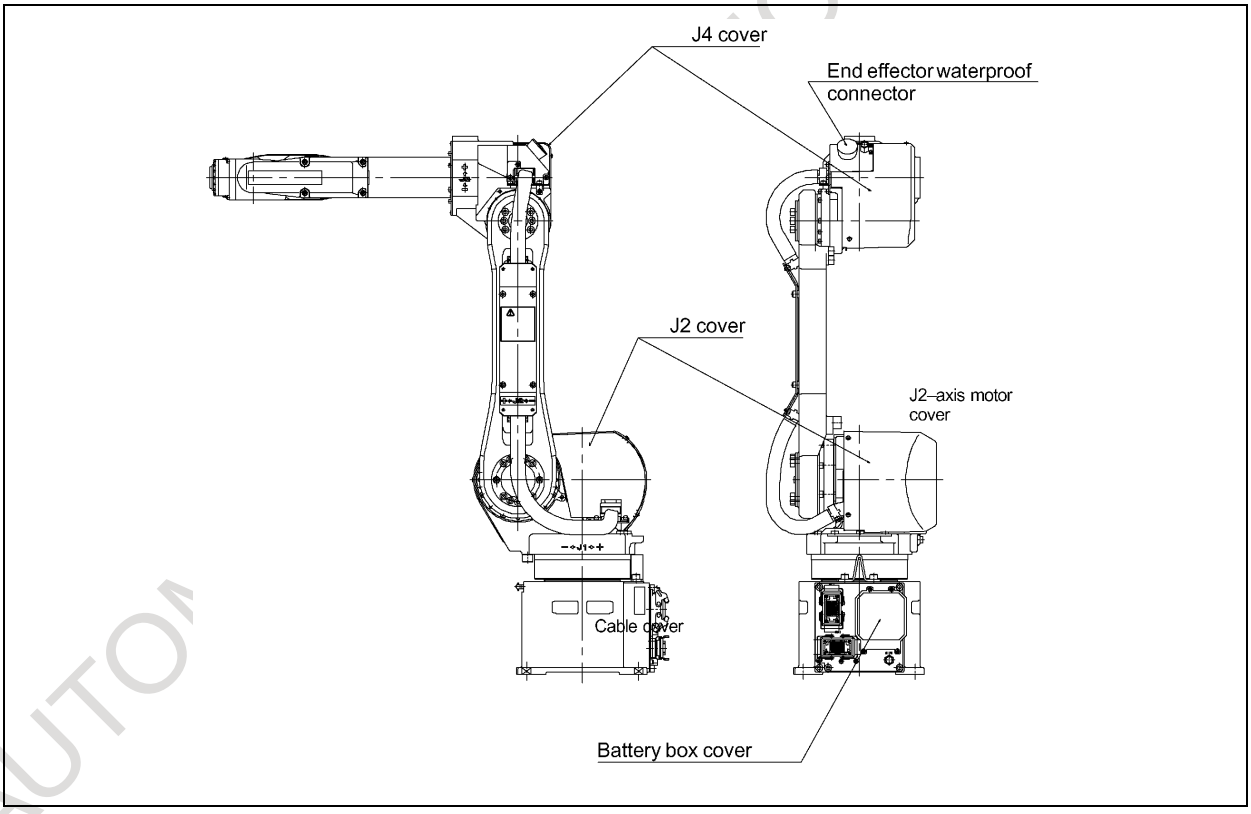


Fig. 7.2 (a) Configuration of the severe dust/liquid protection option package

7.3 REPLACING THE CABLE IN THE MECHANICAL UNIT FOR THE SEVERE DUST/LIQUID PROTECTION OPTION

For the basic procedure, see (1) and (2) in Section 8.2.
This section describes only the procedure associated with the J1 connector board differing from the standard specification (only the procedure associated with the battery box described in step 9 of (1) in Section 8.2).

1 Remove the battery cover according to Fig. 10.3 (a).
2 Remove the cap from the battery box.
3 Remove the two flat head screws securing the battery box body to the J1 connector board, then pull out the battery box body from the J1 connector board.
4 Detach the cable from the terminal on the battery box.
5 Loosen the nut of the Uni-Seal, then pull out the battery box cable.
6 Install a new battery box cable by reversing the procedure above.

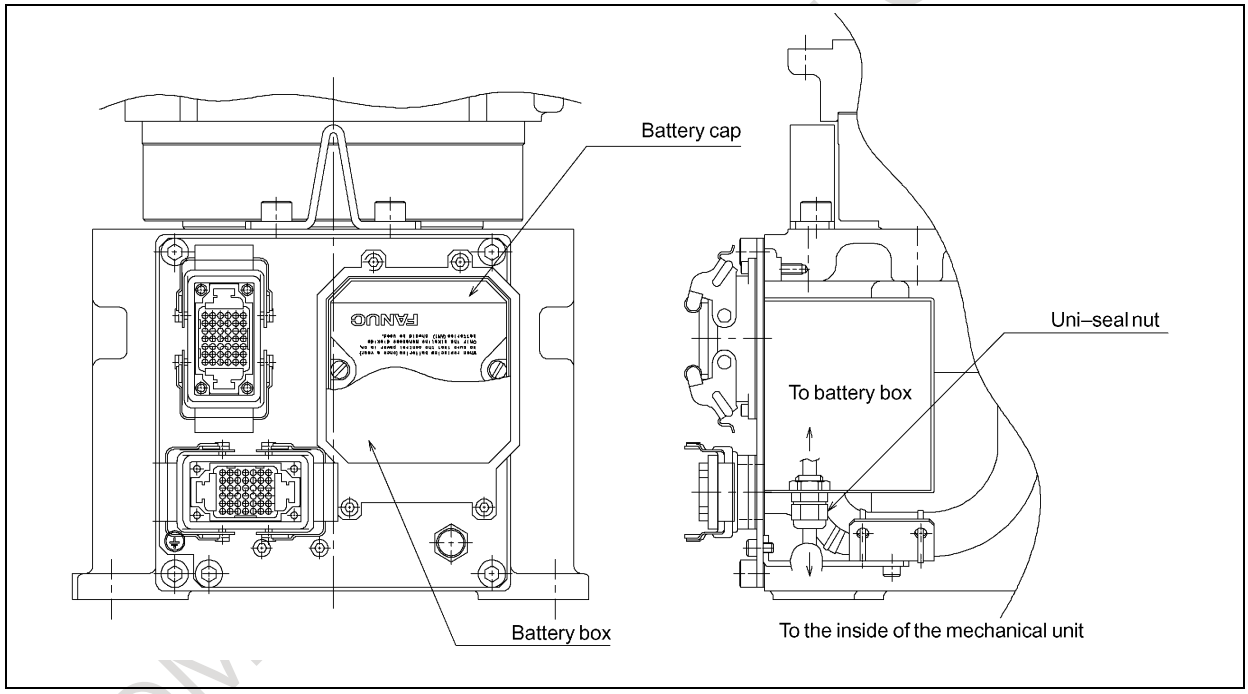


Fig. 7.3 (a) Replacing the cable in the mechanical unit for the severe dust/liquid protection option

7.4 NOTES ON SPECIFYING THE SEVERE DUST/LIQUID PROTECTION PACKAGE

(1) The liquids below cannot be applied because they may cause deterioration or corrosion of the rubber parts (such as gaskets, oil seals, and O-rings) used in the robot.
  (a) Organic solvent
  (b) Chlorine- or gasoline-based cutting fluid
  (c) Amine type detergent
  (d) Liquid or solution that includes a corrosive such as an acid or alkali or causes rust
  (e) Some other liquid or solution to which nitrile rubber (NBR) does not have resistance

(2) When the robot is used in an environment where a liquid such as water is dashed over the robot, great attention should be given to drainage under the J1 base.
  A failure may be caused if the J1 base is kept immersed in water due to poor drainage.

8 ROBOT OUTLINE DRAWING AND OPERATING AREA DIAGRAM

When installing peripheral equipment, be careful not to cause interference with the robot body. For installation, see Section 10.2 and use 4-ϕ18 through holes provided on the base.

8.1 OUTLINE DRAWING AND OPERATING AREA DIAGRAM

ARC Mate 100*i*B, M-6*i*B
Fig. 8.1 (a) shows the outline drawing and Operating area diagram of a robot of the remote type controller.
Fig. 8.1 (b) and Fig. 8.1 (c) show the operation diagrams of a robot of the remote type controller.
Fig. 8.1 (d) shows the outline drawing and Operating area diagram of a robot of the integrated type controller.
Fig. 8.1 (e), Fig. 8.1 (f), and Fig. 8.1 (g) show the operation diagrams of a robot of the integrated type controller.

ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS
Fig. 8.1 (h) shows the outline drawing and Operating area diagram of a robot of the remote type controller.
Fig. 8.1 (i), Fig. 8.1 (j) and Fig. 8.1 (k) show the operation diagrams of a robot of the remote type controller.

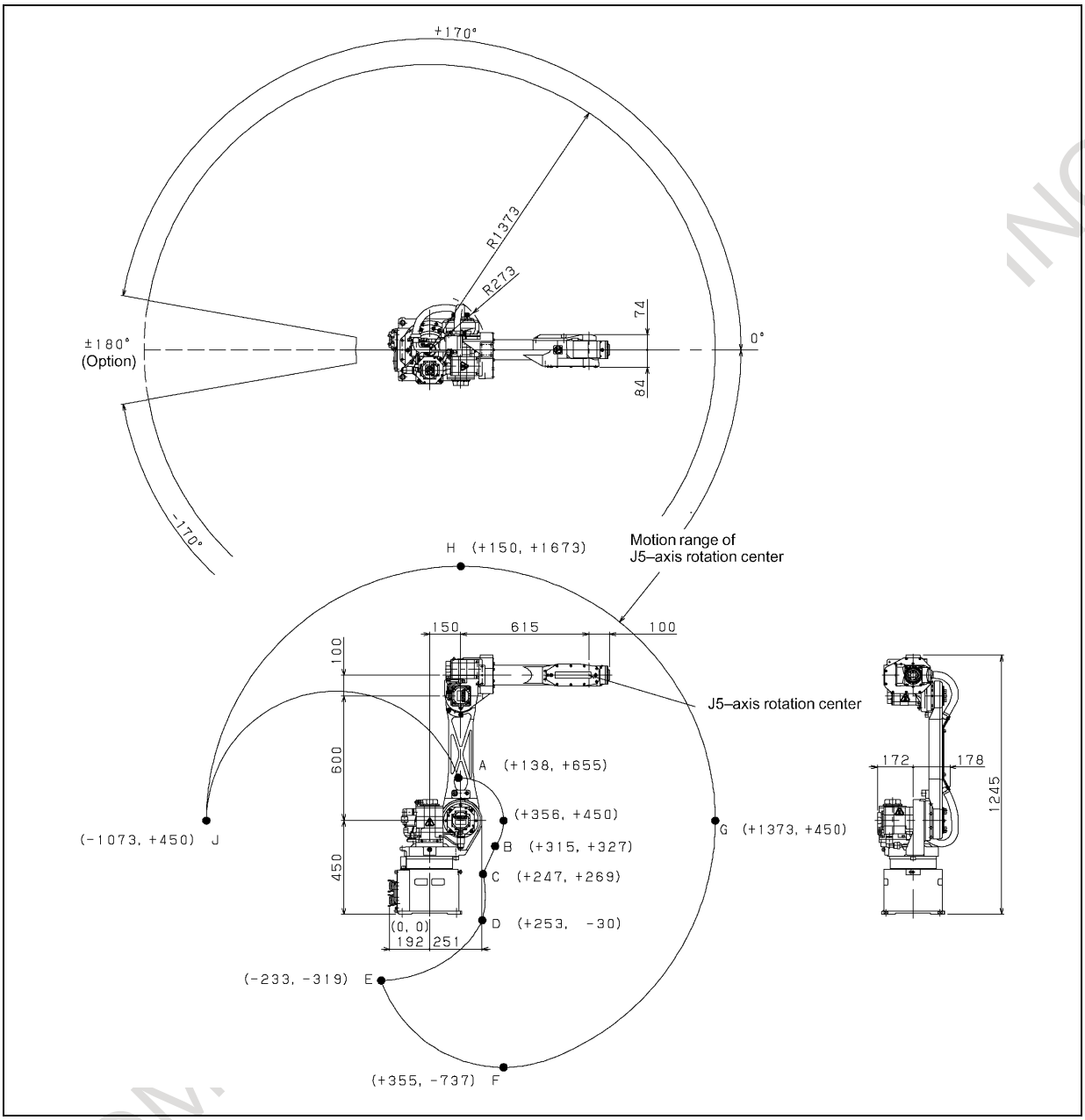


Fig. 8.1 (a) Outline drawing and Operating area diagram of the remote type controller ARC Mate 100*i*B, M-6*i*B

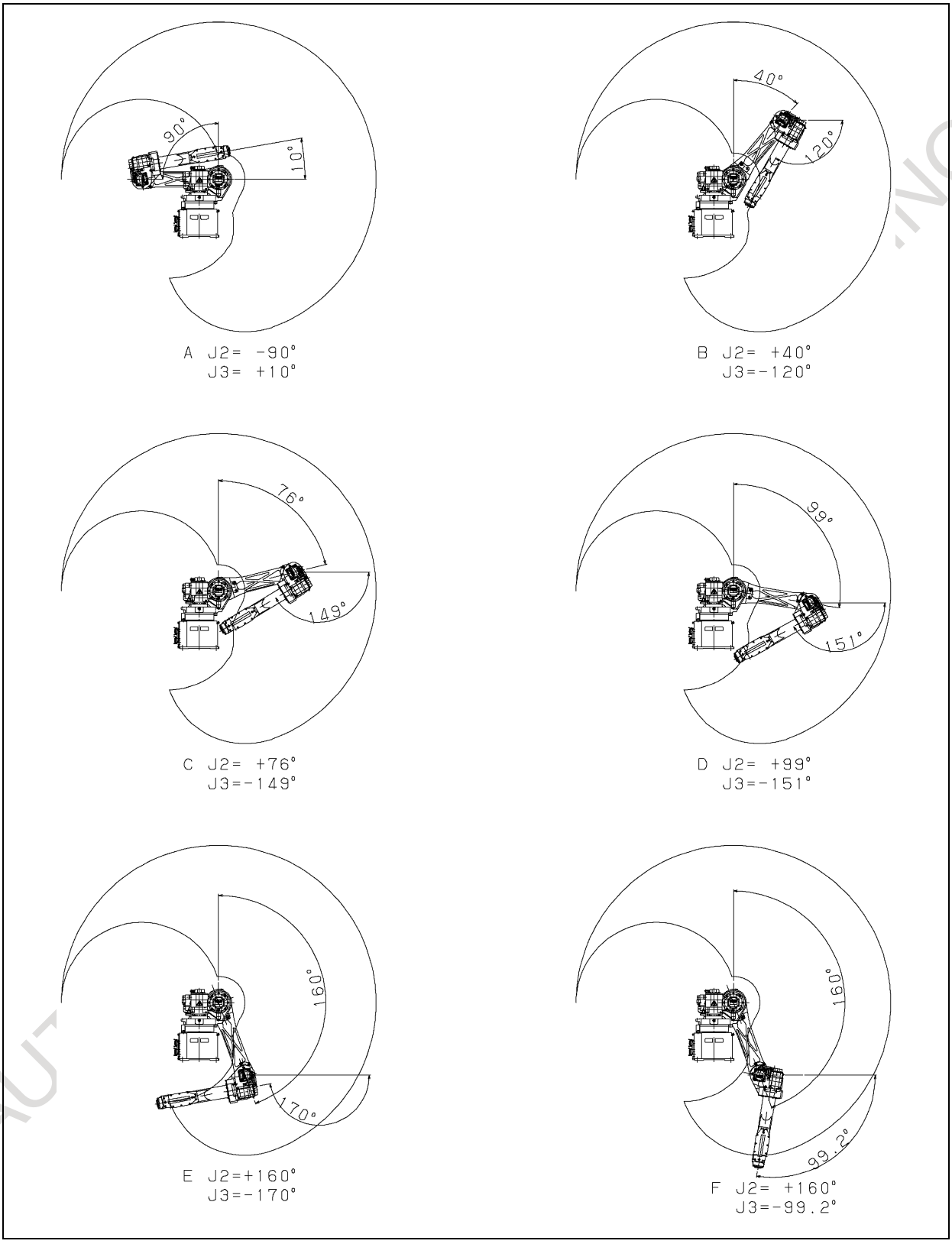


Fig. 8.1 (b) Operation diagram of a robot (Remote type controller) (No. 1)

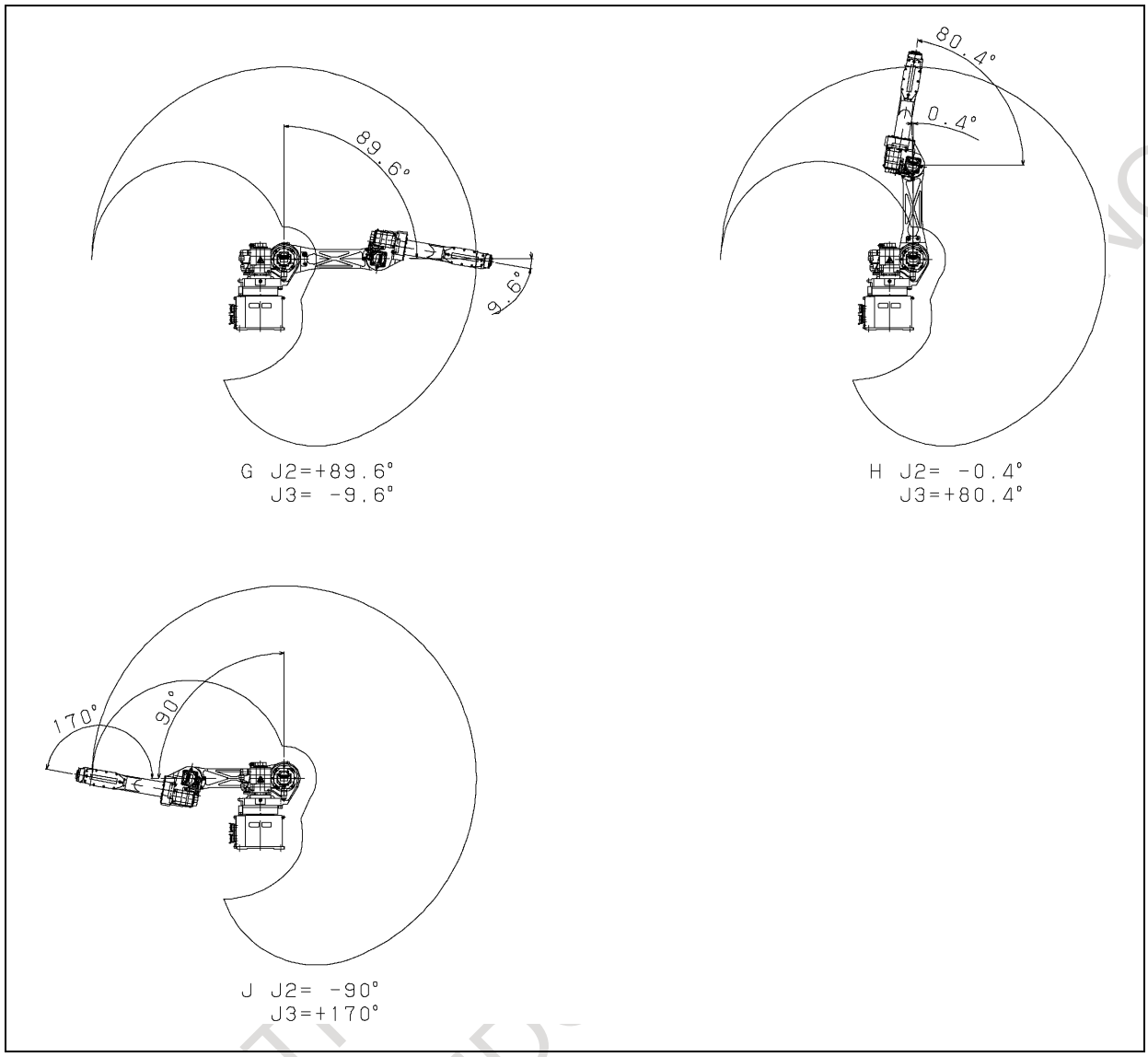


Fig. 8.1 (c) Operation diagram of a robot (Remote type controller) (No. 2)

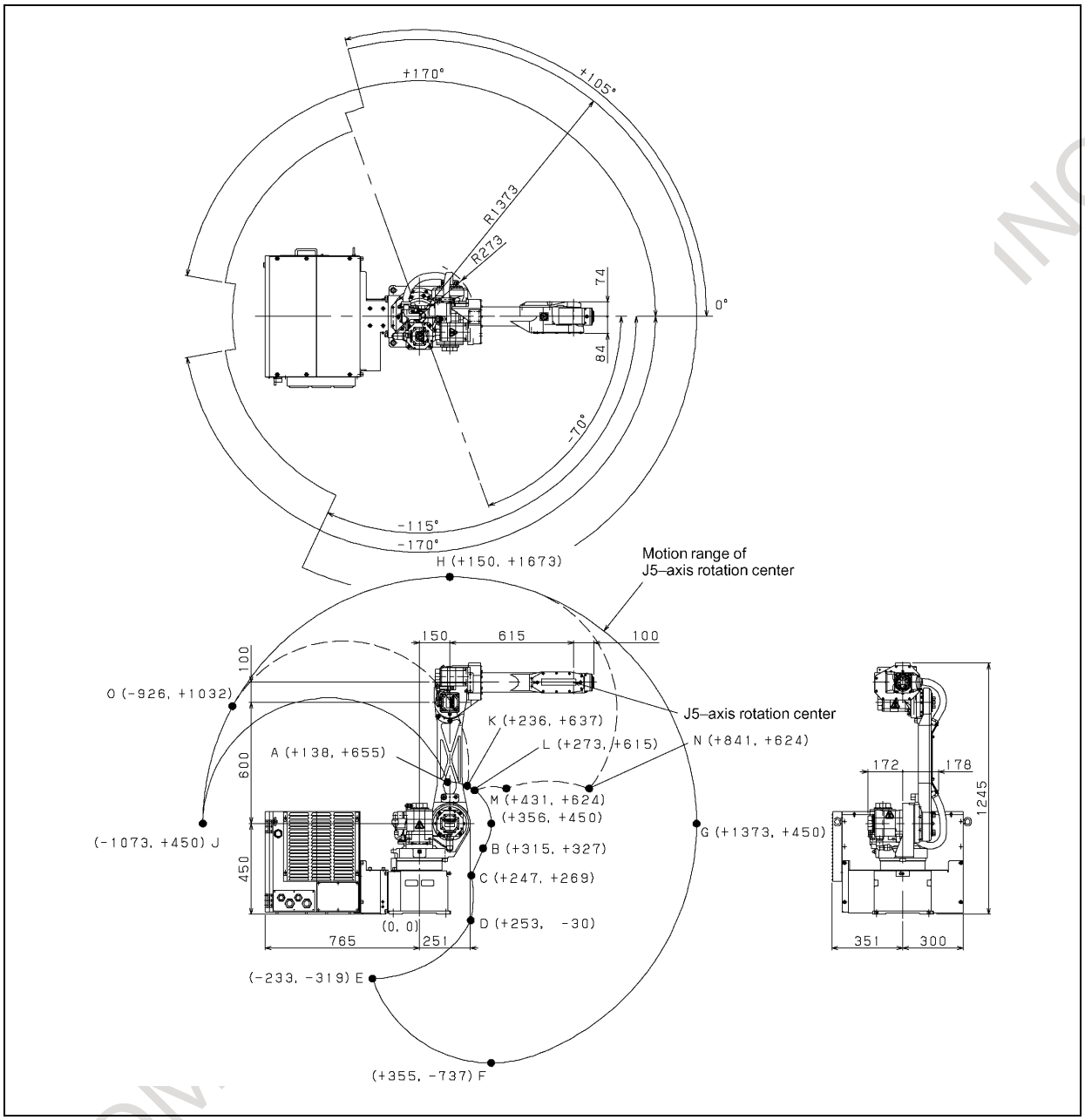


Fig. 8.1 (d) Outline drawing and Operating area diagram of a robot (Integrated type controller)

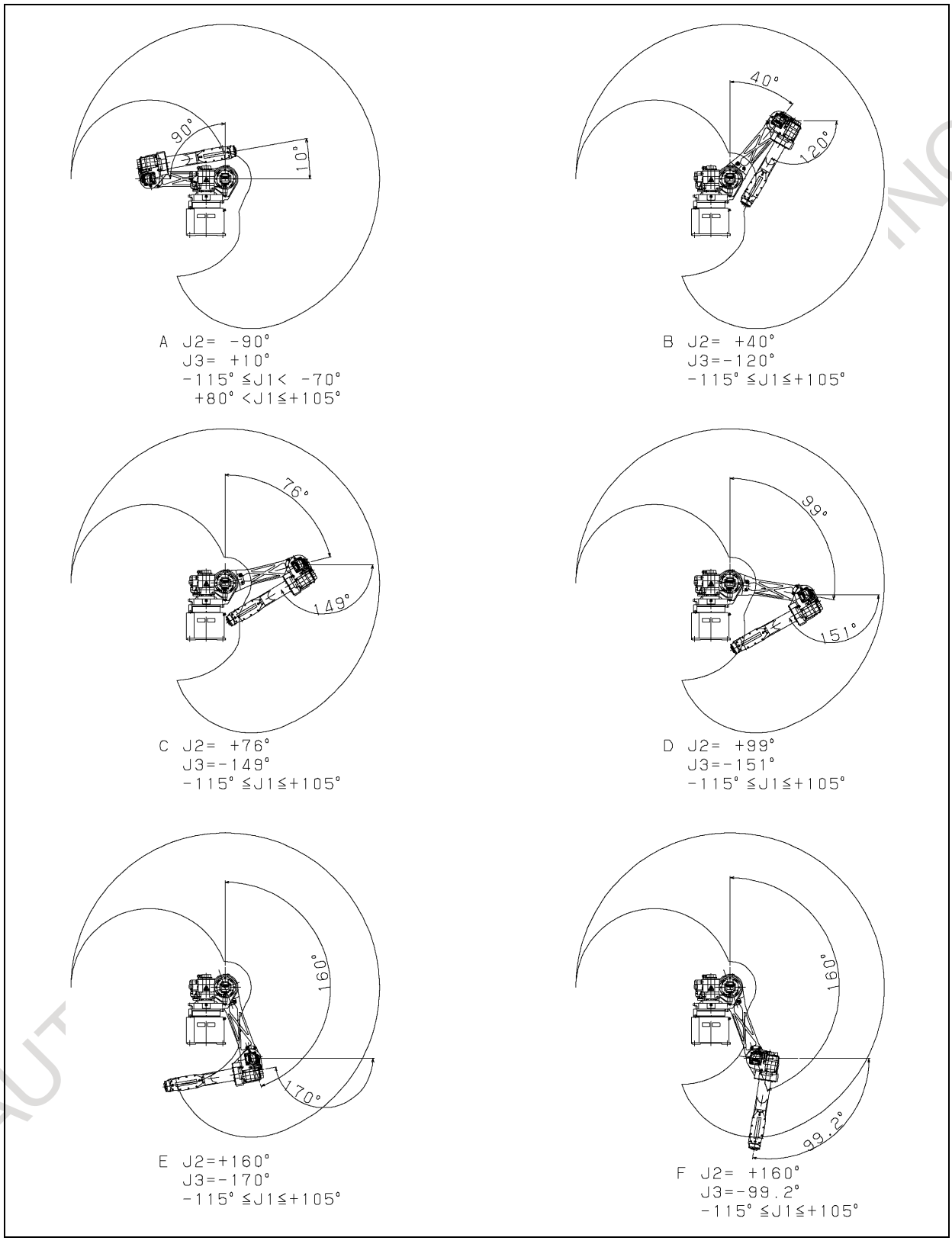


Fig. 8.1 (e) Operation diagram of a robot (integrated type controller) (1/3)

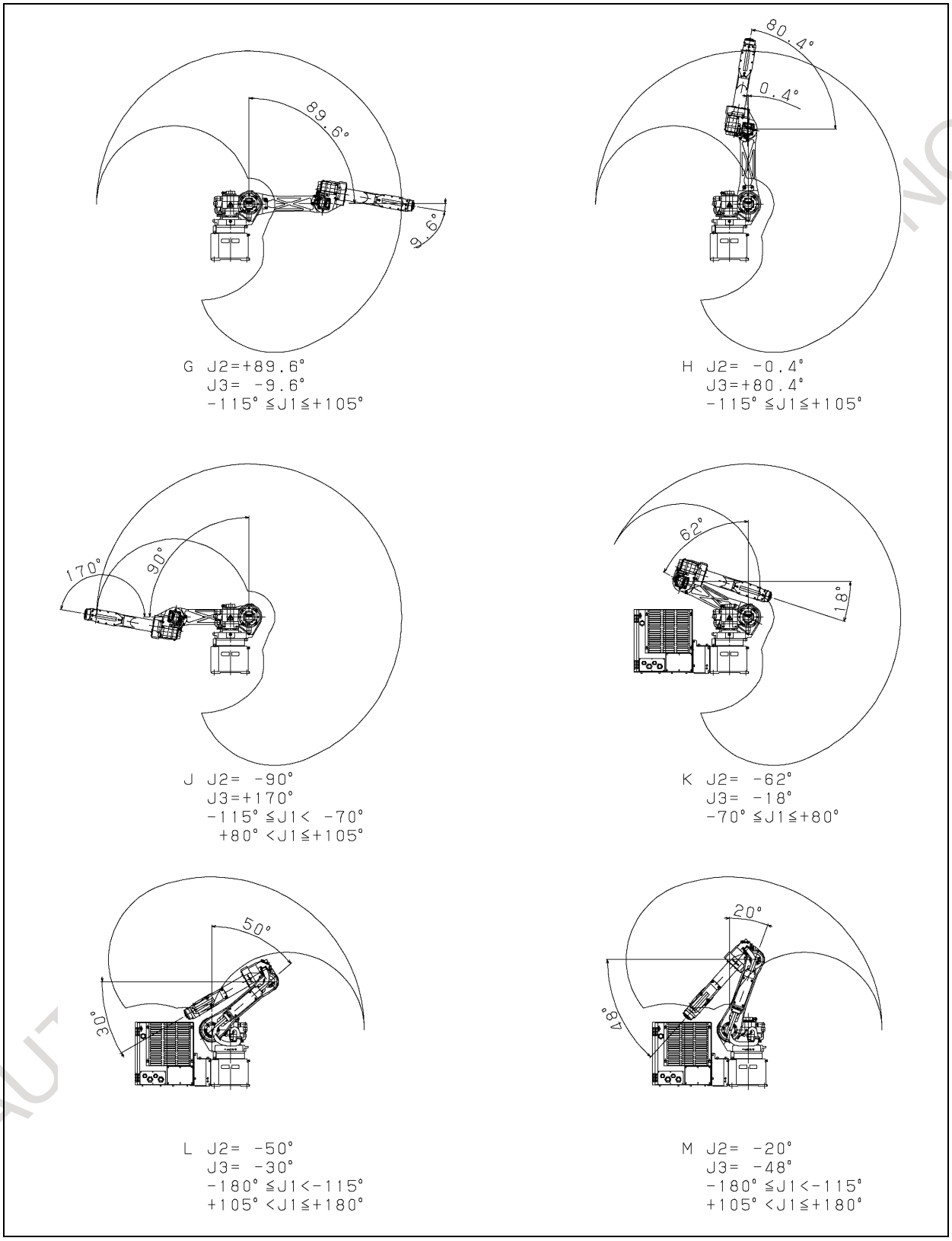


Fig. 8.1 (f) Operation diagram of a robot (integrated type controller) (2/3)

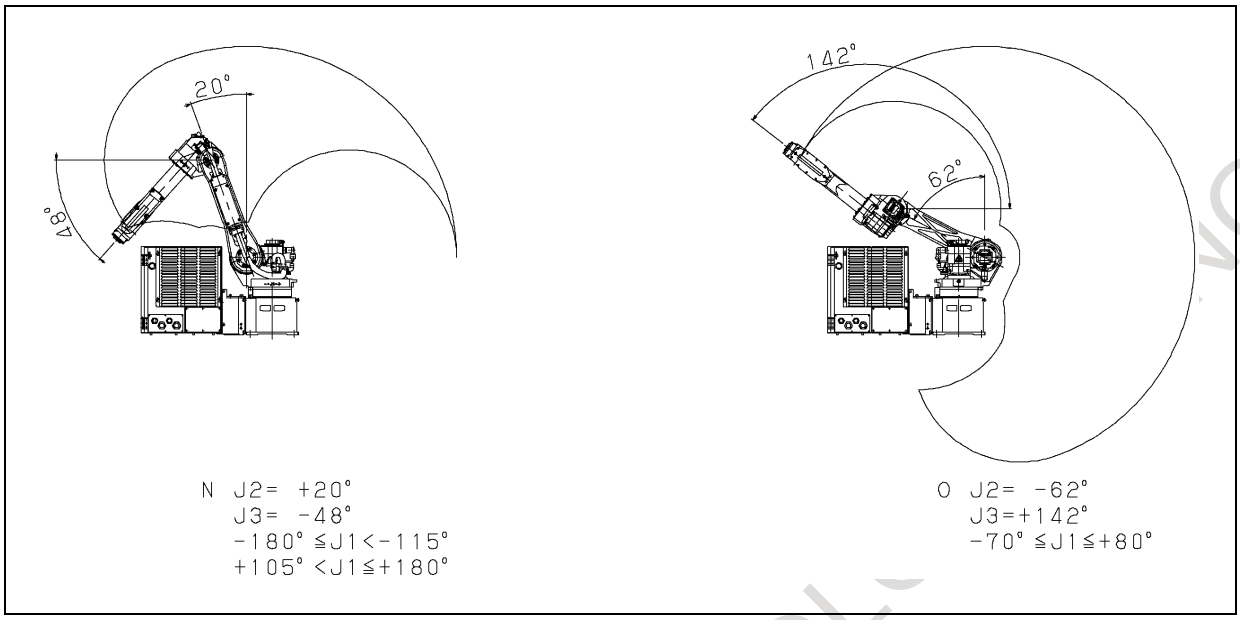


Fig. 8.1 (g) Operation diagram of a robot (integrated type controller) (3/3)

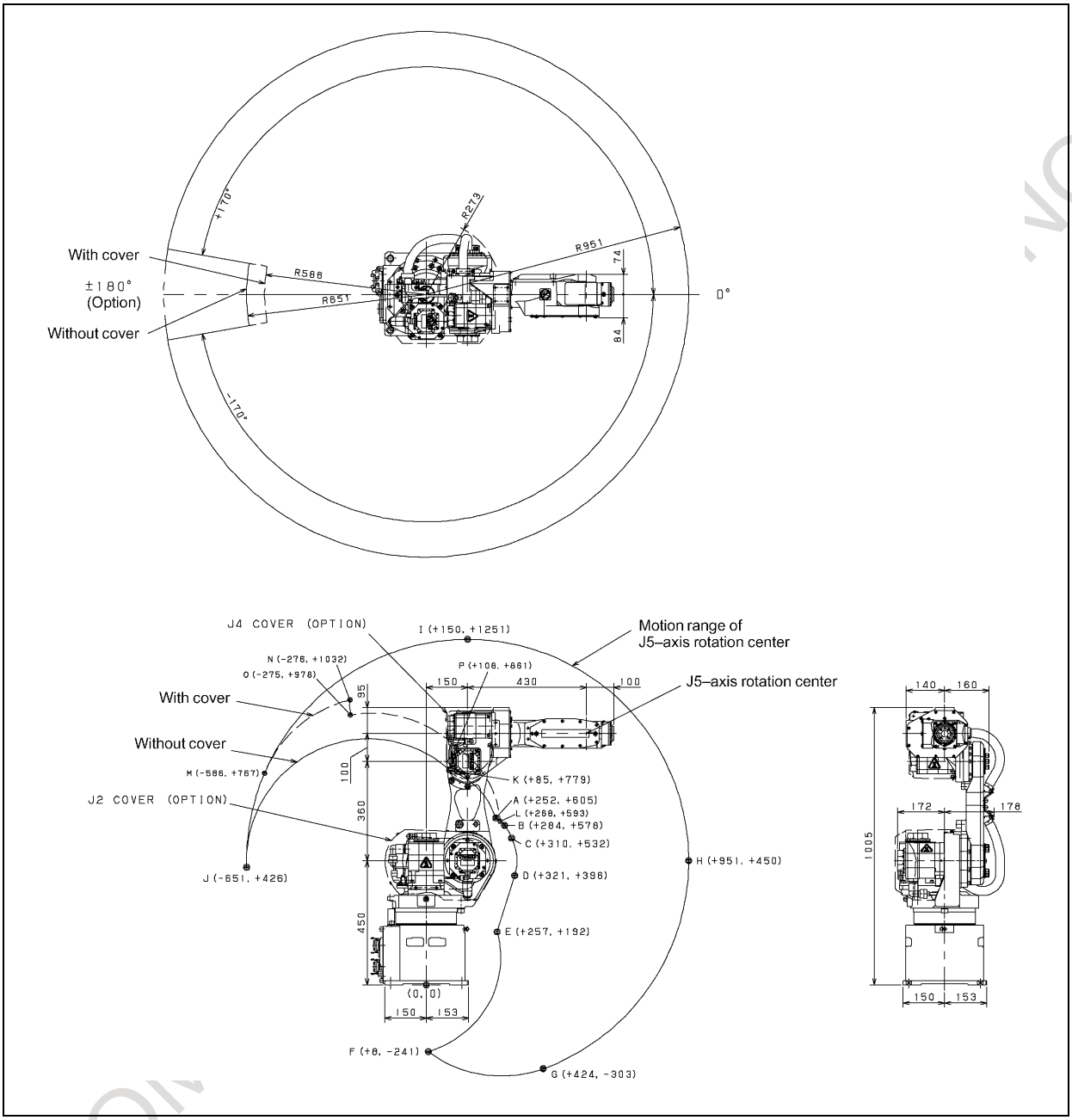


Fig. 8.1 (h) Outline drawing and Operating area diagram of the remote type controller
ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

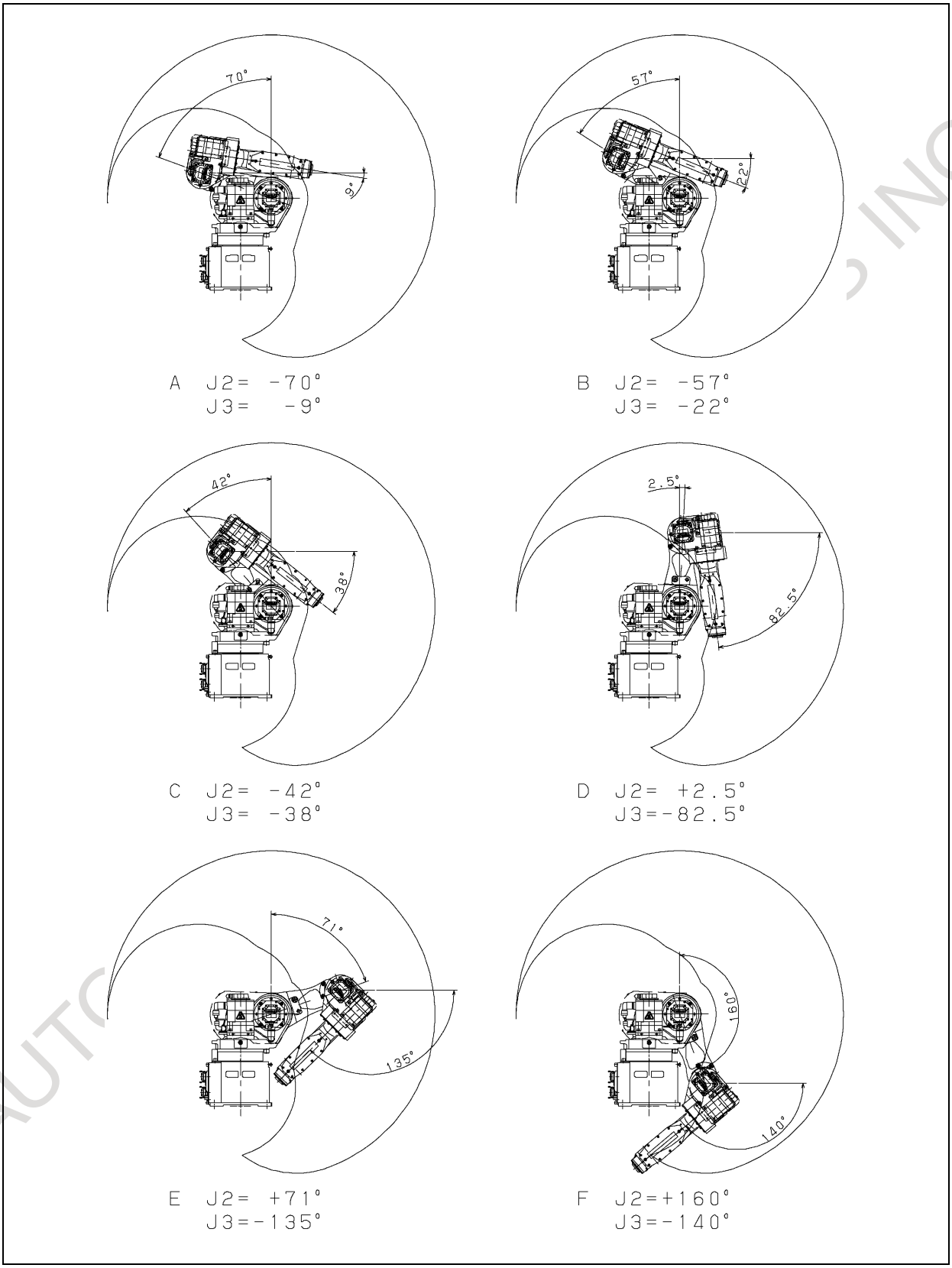


Fig. 8.1 (i) Operation diagram of a robot (remote type controller) (1/3)

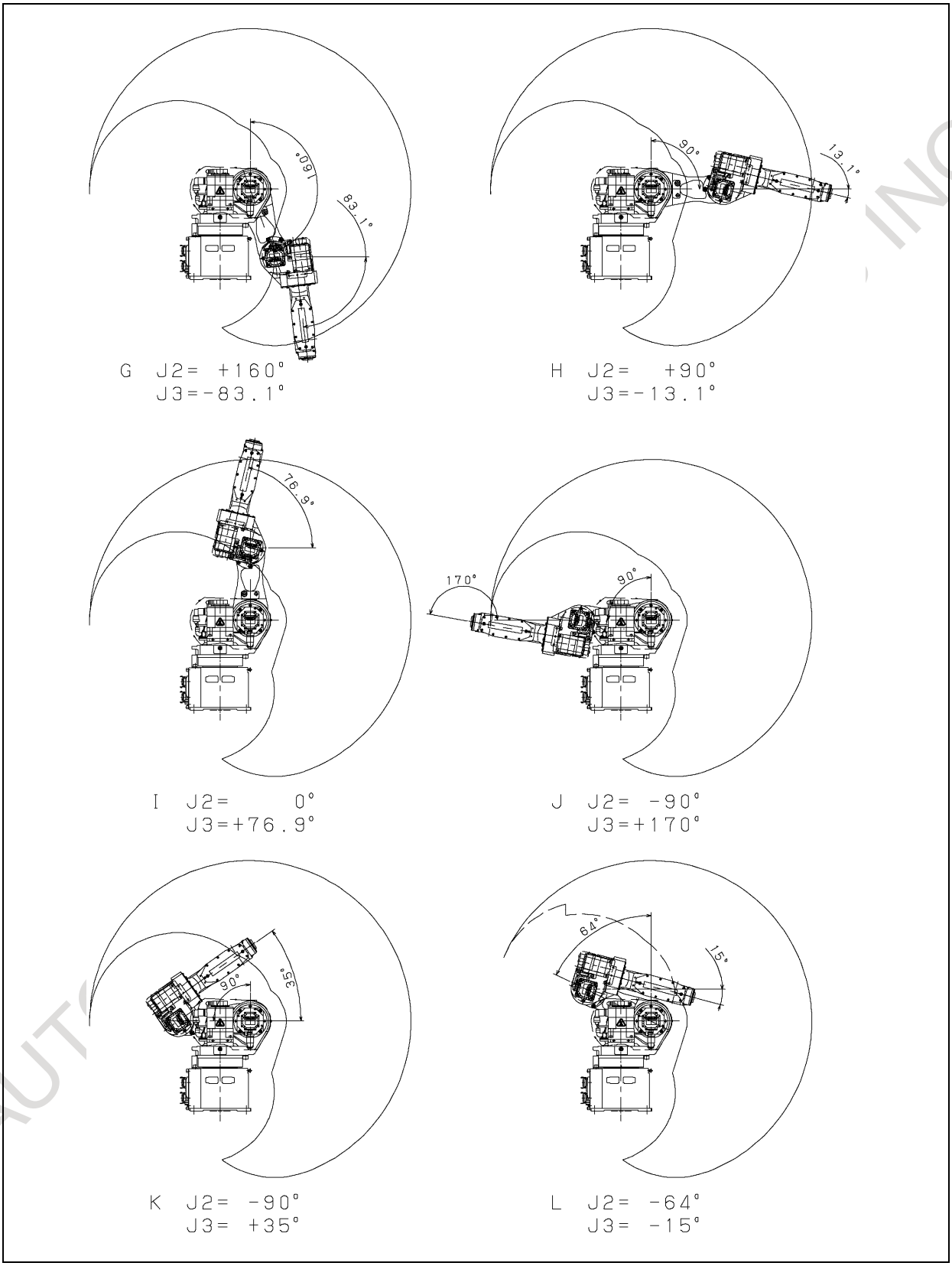


Fig. 8.1 (j) Operation diagram of a robot (remote type controller) (2/3)

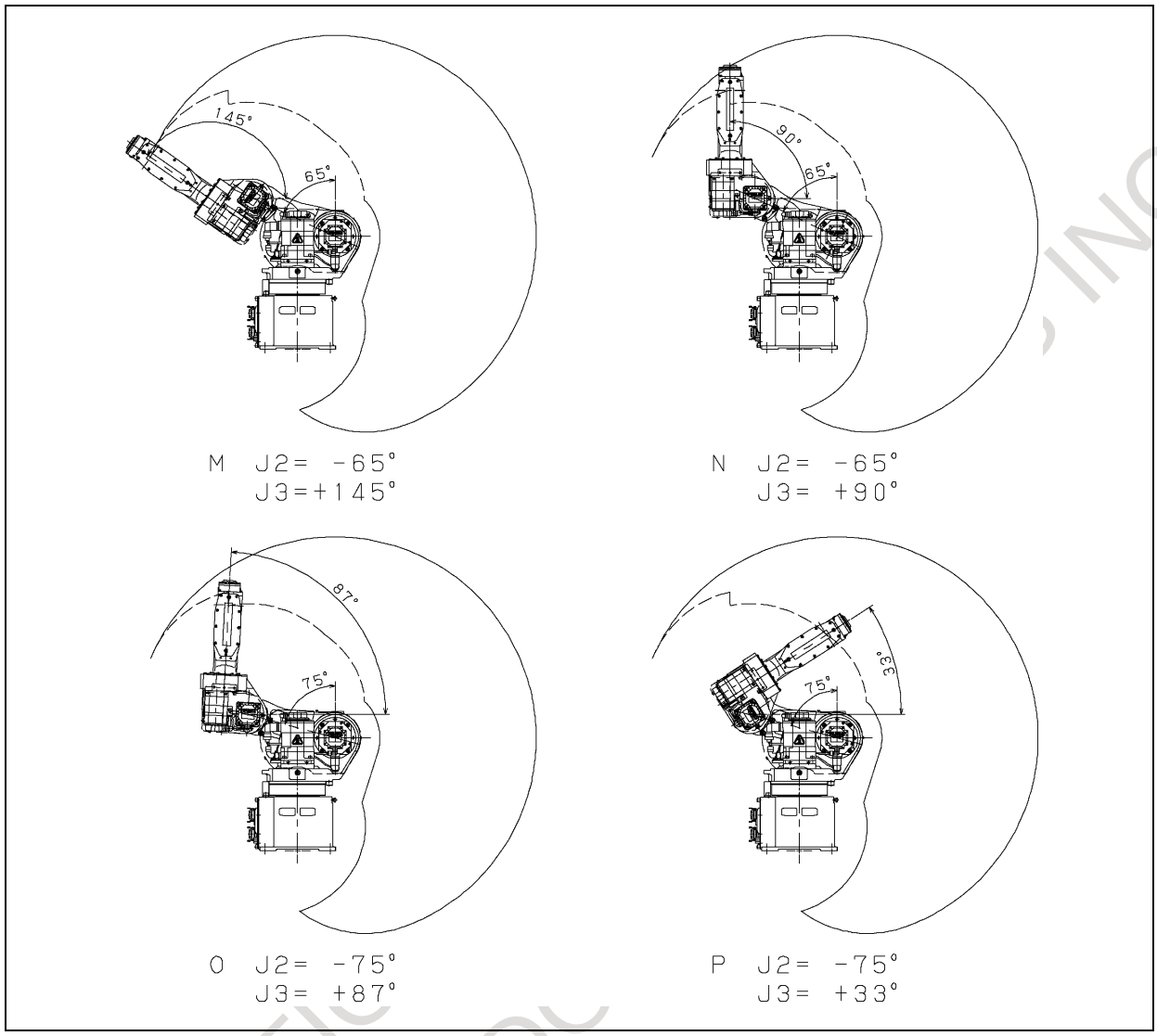


Fig. 8.1 (k) Operation diagram of a robot (Remote type controller) (3/3)

8.2 OPERATING AREA DIAGRAM WHEN A ROBOT IS INSTALLED WITH AN INCLINATION ANGLE

When a robot is installed with an inclination angle, the Operating area of the robot is restricted according to the inclination angle. (ARC Mate 100*i*B, M-6*i*B)
Fig. 8.2 (a) through Fig. 8.2 (d) show the Operating area diagrams corresponding to installation angles.
Note that the robot cannot stop outside the areas shown in Fig. 8.2 (b) through Fig. 8.2 (d).
For the ARC Mate 100*i*B/6S, M-6*i*B/6S and M-6*i*B/2HS installed at an angle, their operation is not restricted.

NOTE
Only the mechanical unit of a robot can be installed with an inclination angle. A robot of the integrated type controller can be used only when it is installed on the floor.

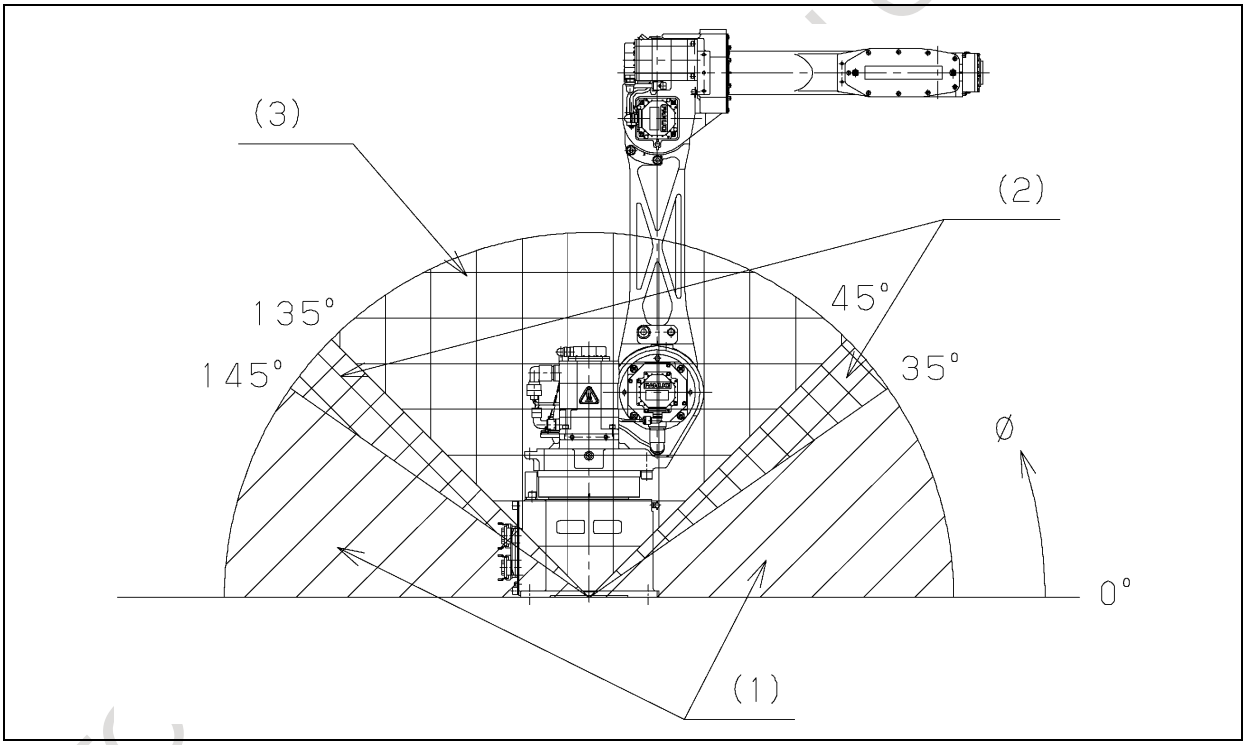


Fig. 8.2 (a) Robot installation angle ranges

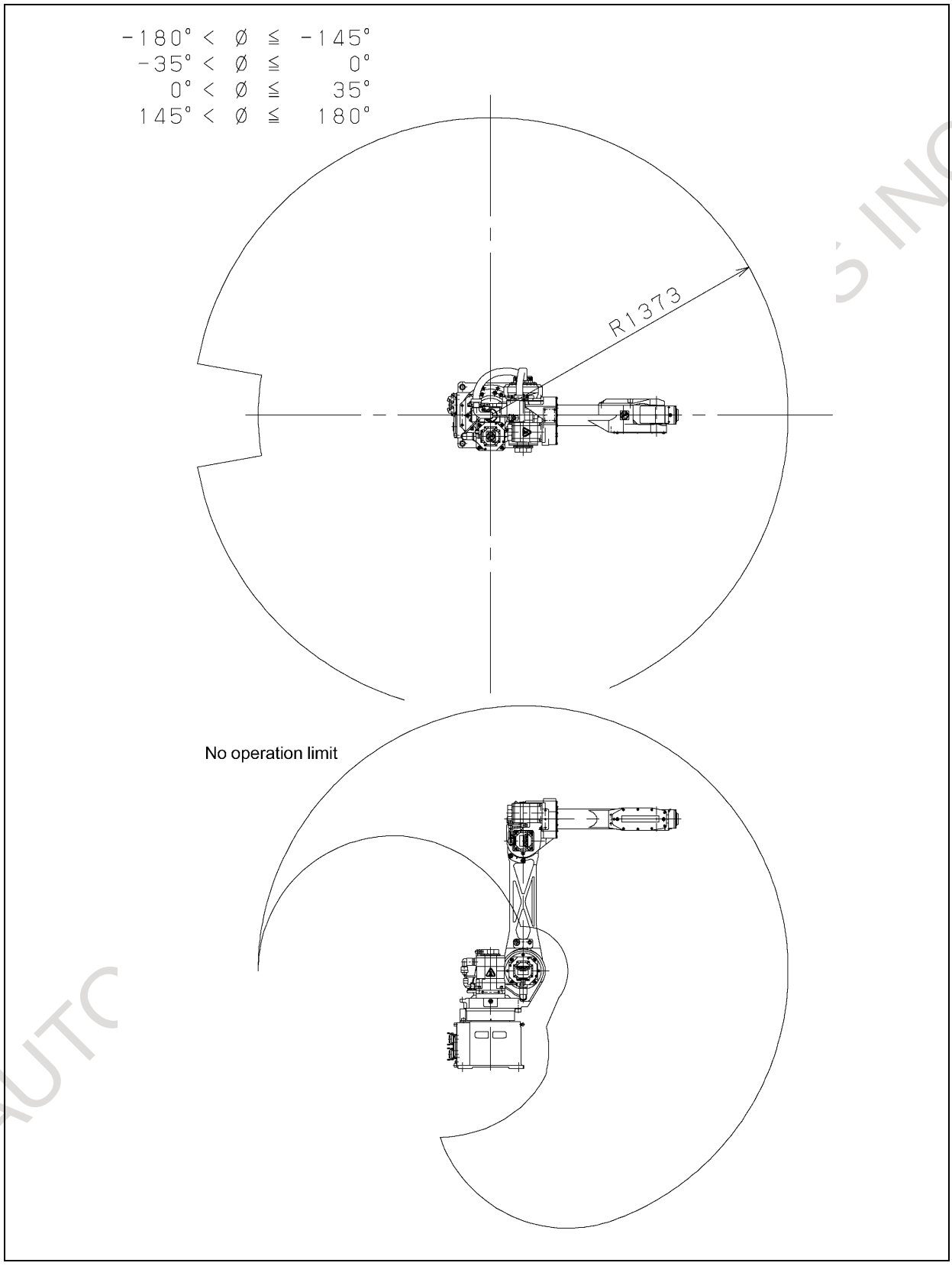


Fig. 8.2 (b) Operating area of robot installation angle range (1)

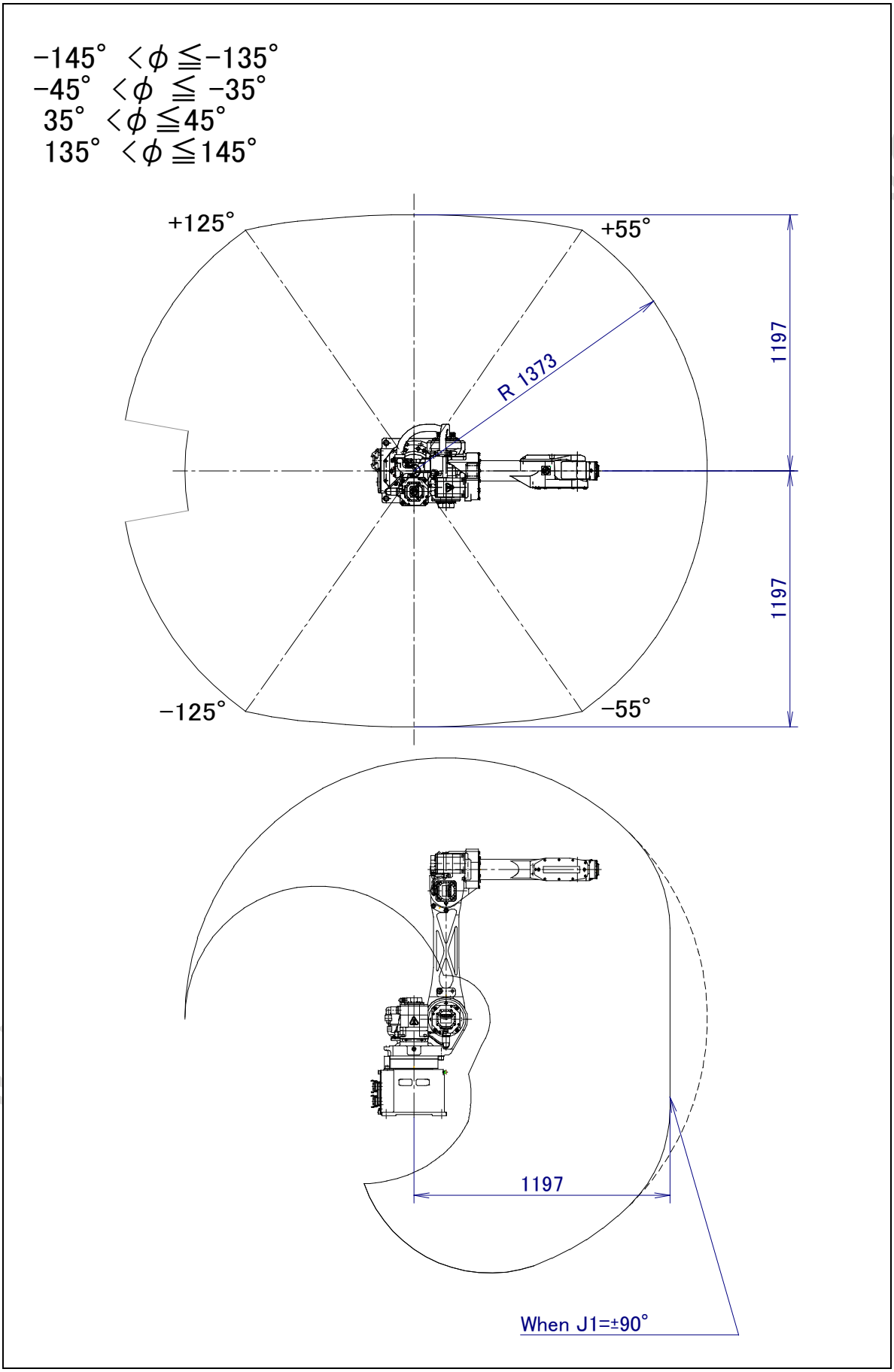


Fig. 8.2 (c) Operating area of robot installation angle range (2)

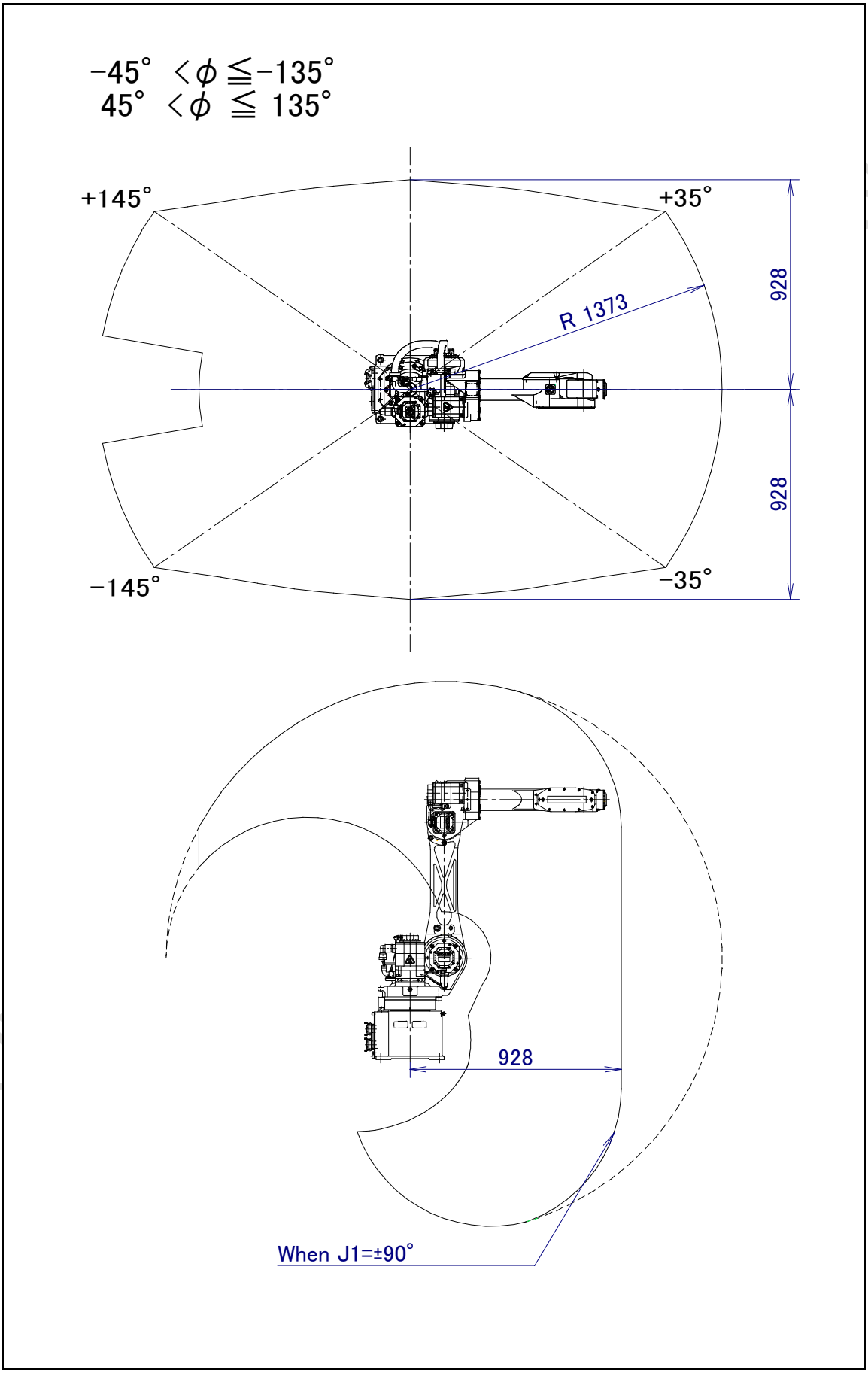


Fig. 8.2 (d) Operating area of robot installation angle range (3)

9 MOUNTING DEVICES ON THE ROBOT

9.1 WRIST SECTION END EFFECTOR MOUNTING FACE

1) Mounting face for an ISO flange-type end effector (standard)
Fig. 9.1 (a) shows the end effector mounting face at the tip of the wrist. The end effector is engaged using a ϕ50h7 spigot or ϕ25H7 socket, positioned using a 1-ϕ6H7 reamed hole, and fastened using four M6 self-tapping screws. As for the M6 self-tapping screws, select those not longer than the tapping depth (10 mm).

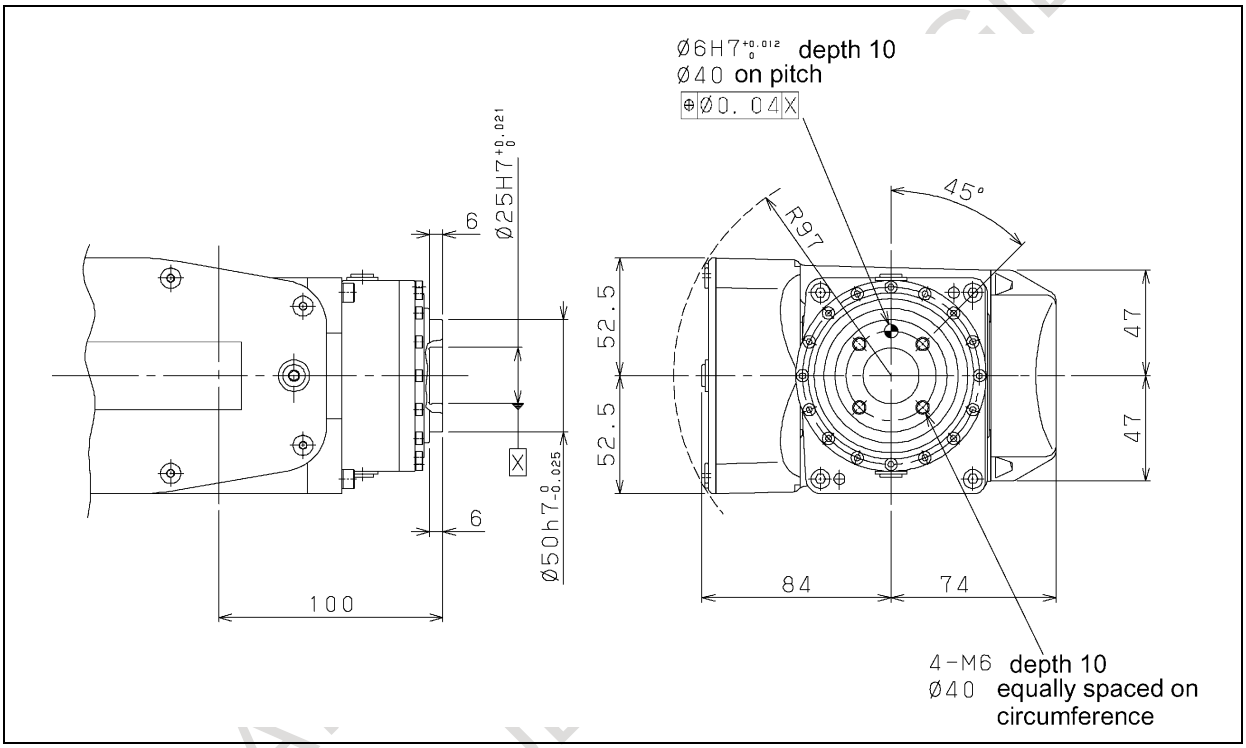


Fig. 9.1 (a) Mounting face for the ISO flange type end effector

9.2 DEVICE MOUNTING FACES

⚠ CAUTION
1 Never perform additional machining operations such as drilling or tapping on the robot body. This can seriously affect the safety and functions of the robot.
2 Note that the use of a tapped hole not shown in the following figure is not assured. Please do not tighten both with the tightening bolts used for mechanical unit.
3 Equipment should be installed so that mechanical unit cable does not interfere. If equipment interfere, the mechanical unit cable might be disconnected, and unexpected troubles might occur.

As shown in Fig. 9.2 (a) and (c), there are two device mounting faces.
1 Keep the gravity center of devices mounted on device mounting faces A and B within the area shown by hatching in Fig. 9.2 (b) and (d).
2 The mass of each device mounted on a device mounting face shall satisfy the following condition:
1) W + A + B ≤ 18 (kg) ··· ARC Mate 100*i*B, M-6*i*B,ARC Mate 100*i*B/6S, M-6*i*B/6S
W + A + B ≤ 14 (kg) ··· M-6*i*B/2HS
W + A + B ≤ 16 (kg) ··· M-6*i*B/6S when 10kg parameter is applied

W : Mass (kg) of the device on the end effector mounting face
A : Mass (kg) of the device on device mounting face A
B : Mass (kg) of the device on device mounting face B

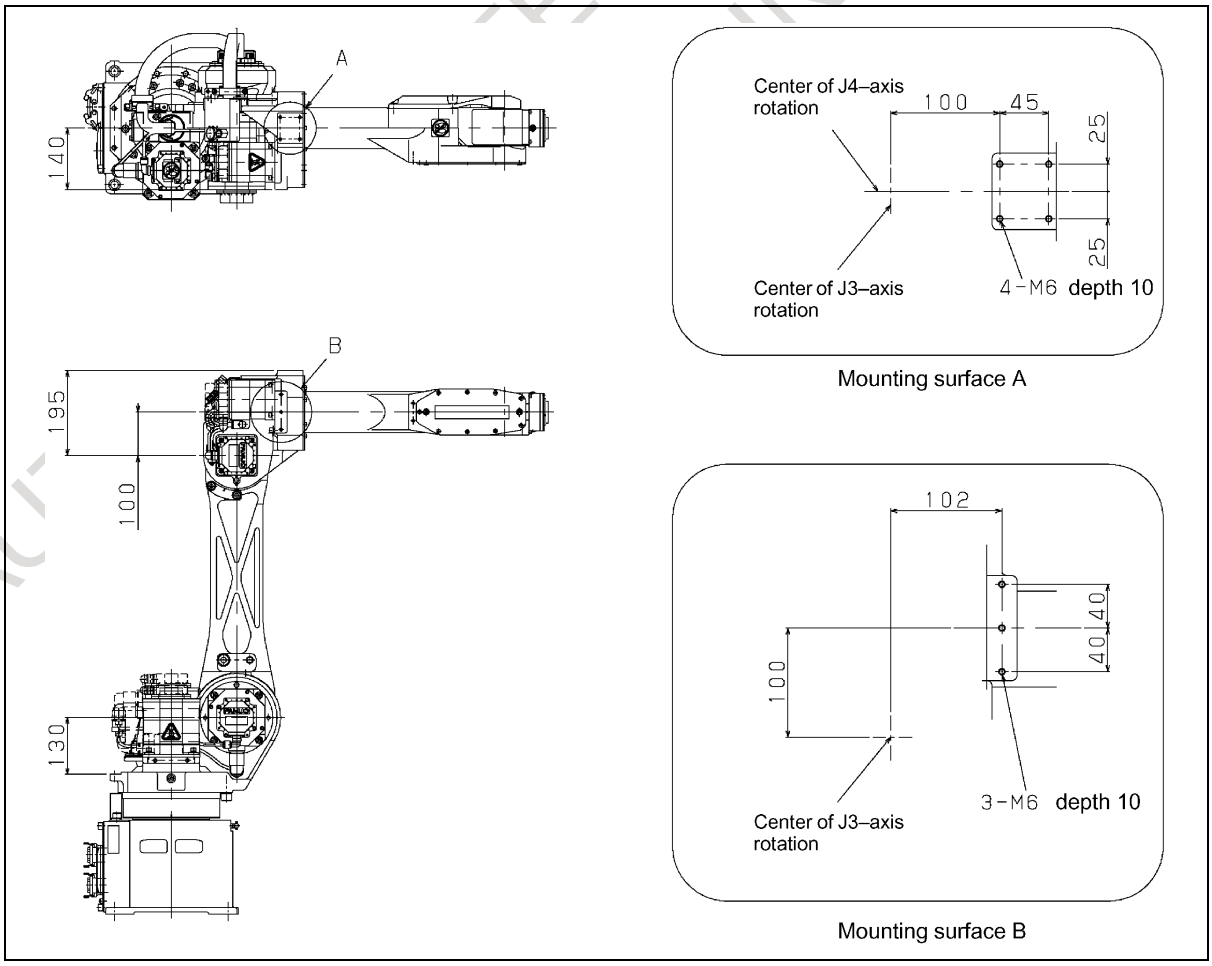


Fig. 9.2 (a) Device mounting face dimensions ARC Mate 100*i*B, M-6*i*B

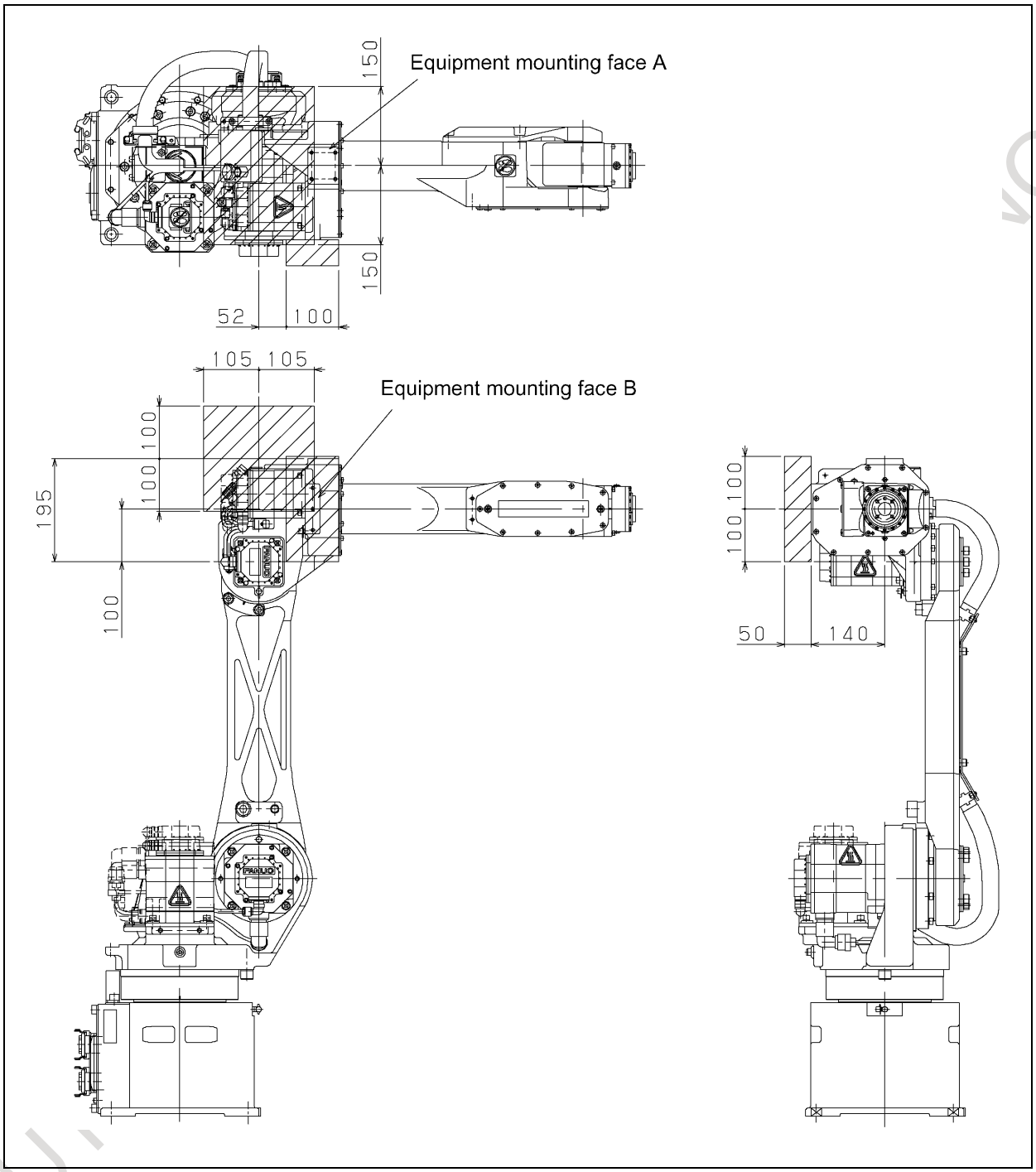


Fig. 9.2 (b) Dimensions of the gravity center position of the device on the device mounting faces
ARC Mate 100*i*B, M-6*i*B

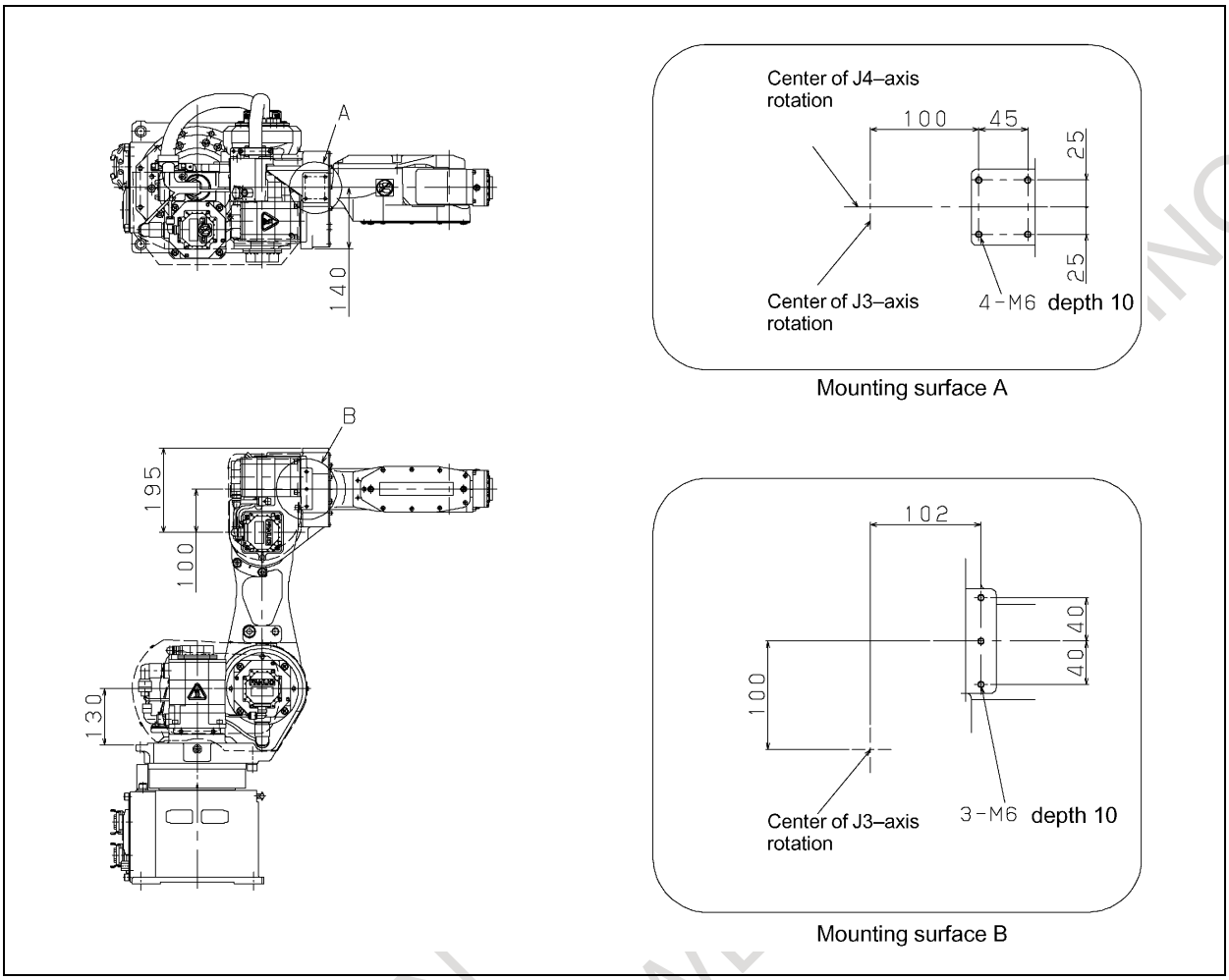


Fig. 9.2 (c) Dimensions of the device mounting faces
ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

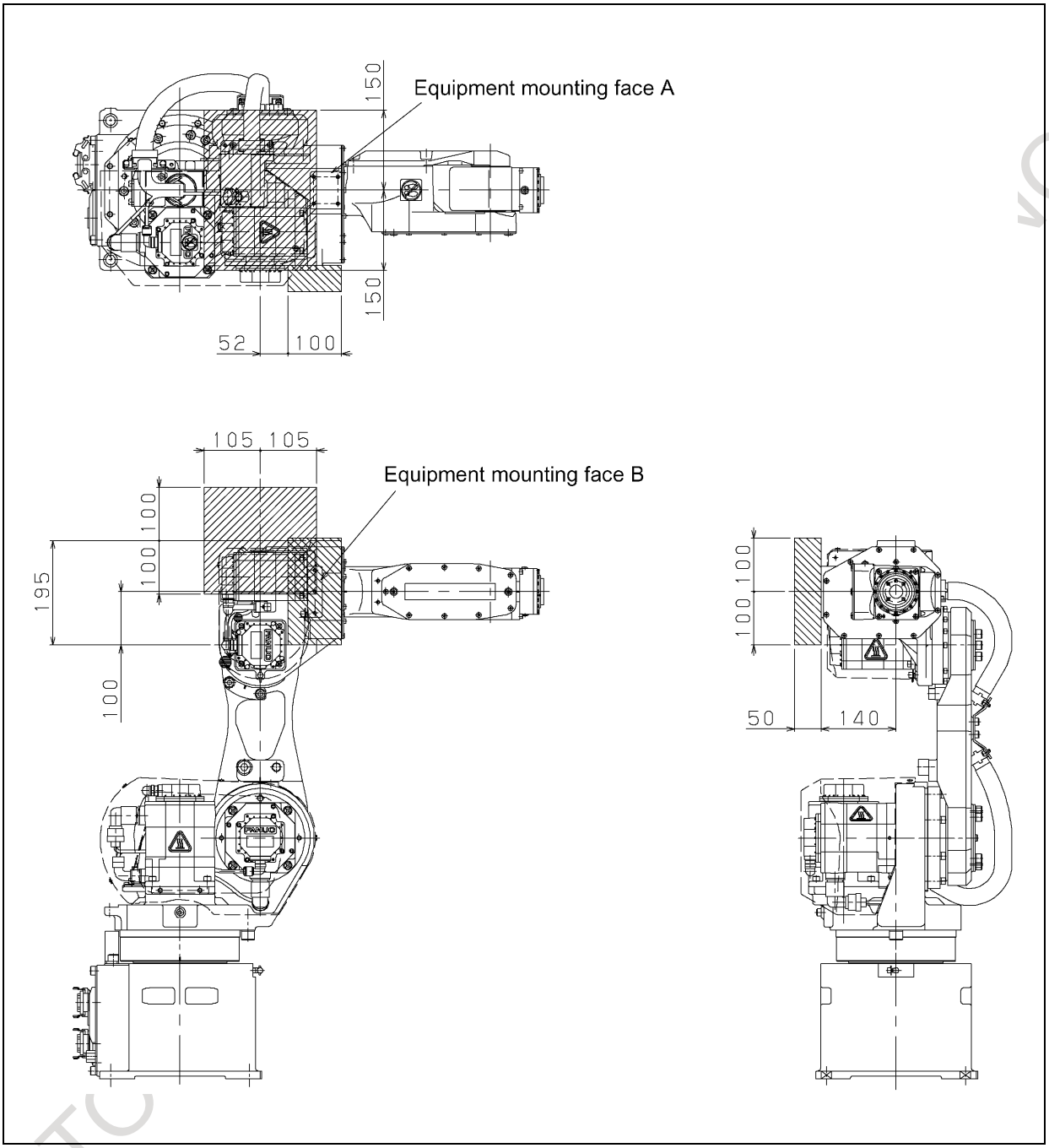


Fig. 9.2 (d) Dimensions of the gravity center position of the device on the device mounting faces
ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

9.3 LOAD SETTING

Operation performance screens

The operation performance screens include the list screen, load setting screen, and device setting screen. These screens are used to set up information about loads and that about devices on the robot.

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

```
MOTION PERFORMANCE                          10%
    Group1
 No.     PAYLOAD[kg]          Comment
  1             6.34    [                 ]
  2             0.00    [                 ]
  3             0.00    [                 ]
  4             0.00    [                 ]
  5             0.00    [                 ]
  6             0.00    [                 ]
  7             0.00    [                 ]
  8             0.00    [                 ]
  9             0.00    [                 ]
 10             0.00    [                 ]

Active PAYLOAD number = 1
[ TYPE ]  GROUP  DETAIL ARMLOAD SETIND >
                                        >
```

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

```
MOTION PAYLOAD SET          JOINT    10%


   Group 1
   Schedule No[   1]:[Comment        ]
 1. PAYLOAD           [kg]          6.34
 2. PAYLOAD CENTER X  [cm]         -7.99
 3. PAYLOAD CENTER Y  [cm]          0.00
 4. PAYLOAD CENTER Z  [cm]          6.44
 5. PAYLOAD INERTIA X [kgfcms^2]    0.13
 6. PAYLOAD INERTIA Y [kgfcms^2]    0.14
 7. PAYLOAD INERTIA Z [kgfcms^2]    0.07




[ TYPE ]  GROUP  NUMBER  DEFAULT   HELP
```

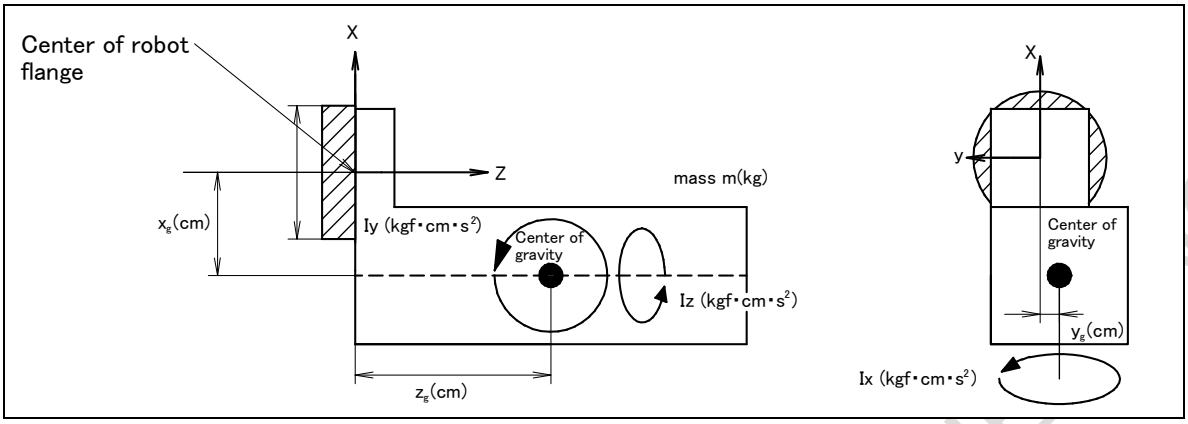


Fig. 9.3 (a) Standard tool coordinate

6 Set the payload, gravity center position, and inertia around the gravity center on the MOTION PAYLOAD SET screen. The X, Y, and Z directions displayed on this screen correspond to the respective standard tool coordinates (with no tool coordinate system set up). When values are entered, the following message appears: “Path and Cycletime will change. Set it?” Respond to the message with F4 [YES] or F5 [NO].

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

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

9 On the MOTION PERFORMANCE screen, click F4 [ARMLOAD] to display the MOTION ARMLOAD SET screen.

```
MOTION ARMLOAD SET          JOINT    10%

    Group 1
 1 ARM LOAD AXIS #1   [kg]          0.00
 2 ARM LOAD AXIS #3   [kg]         12.25









[ TYPE ]  GROUP          DEFAULT   HELP
```

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

9.4 WRIST LOAD CONDITIONS

Fig. 9.4(a) to (c) are the allowable load curves of the wrist of the robot. Apply a load within the region indicated in the graph. Apply the conditions of the allowable load moment and the allowable load inertia. Fig. 9.4 (c) shows the payload conditions that apply when parameters for a payload of 10 kg are used on the M-6*i*B/6S. See Section 9.5 "M-6*i*B/6S 10KG WRIST PAYLOAD SPECIFICATION" for explanations about how to use the parameters.

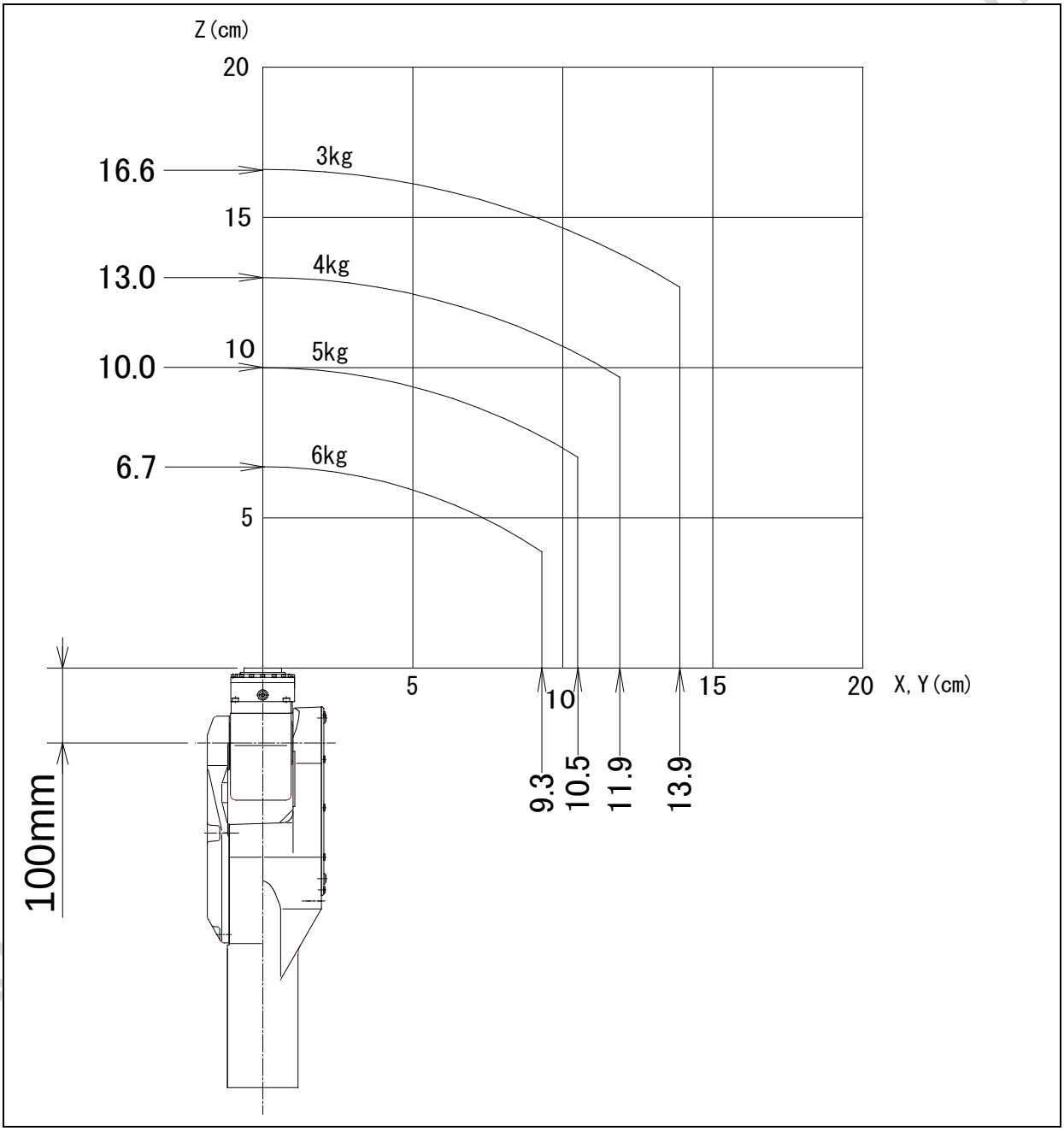


Fig. 9.4 (a) Wrist section allowable load conditions ARC Mate 100*i*B, M-6*i*B, ARC Mate 100*i*B/6S, M-6*i*B/6S

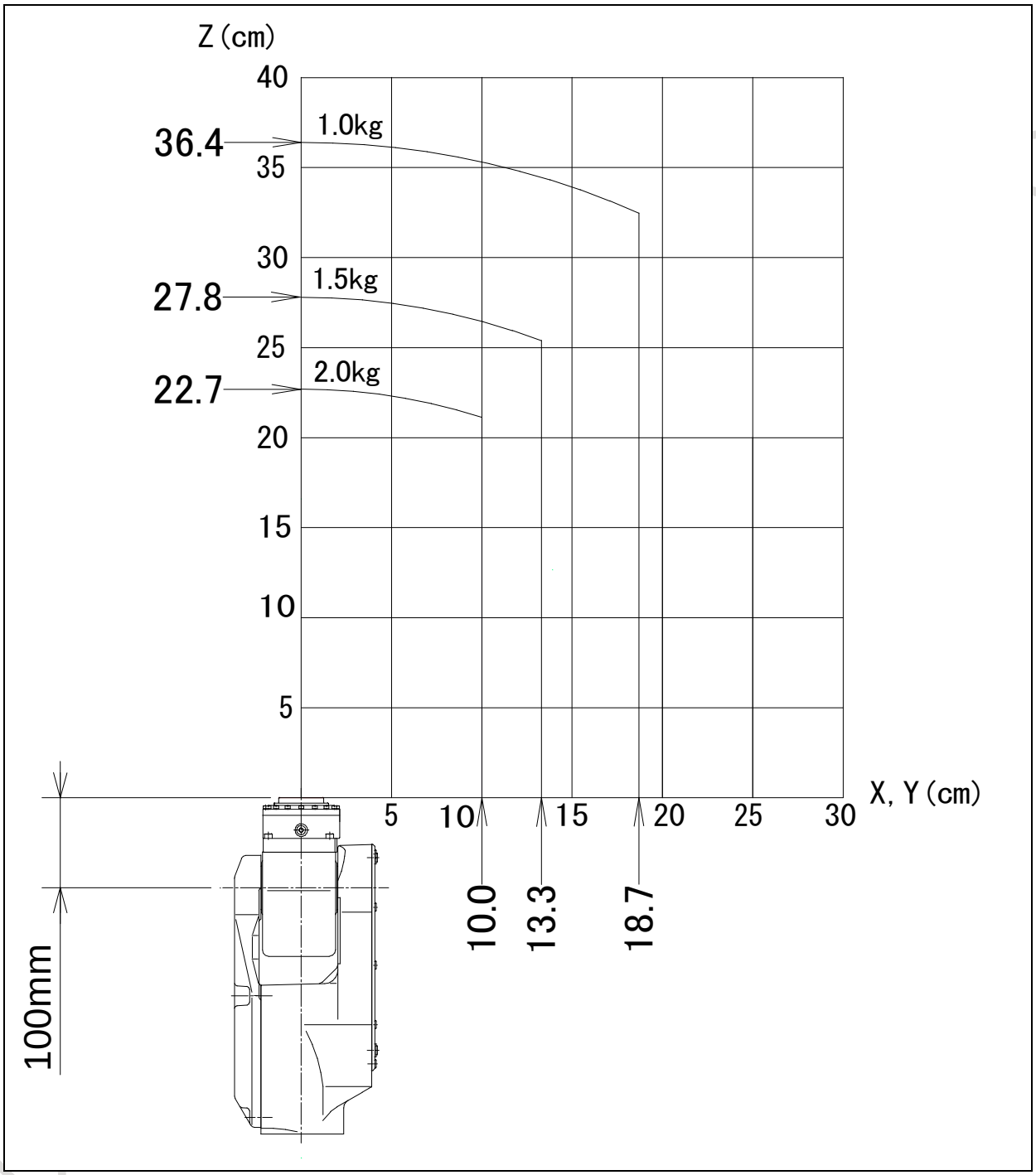


Fig. 9.4 (b) Wrist section allowable load conditions M-6*i*B/2HS

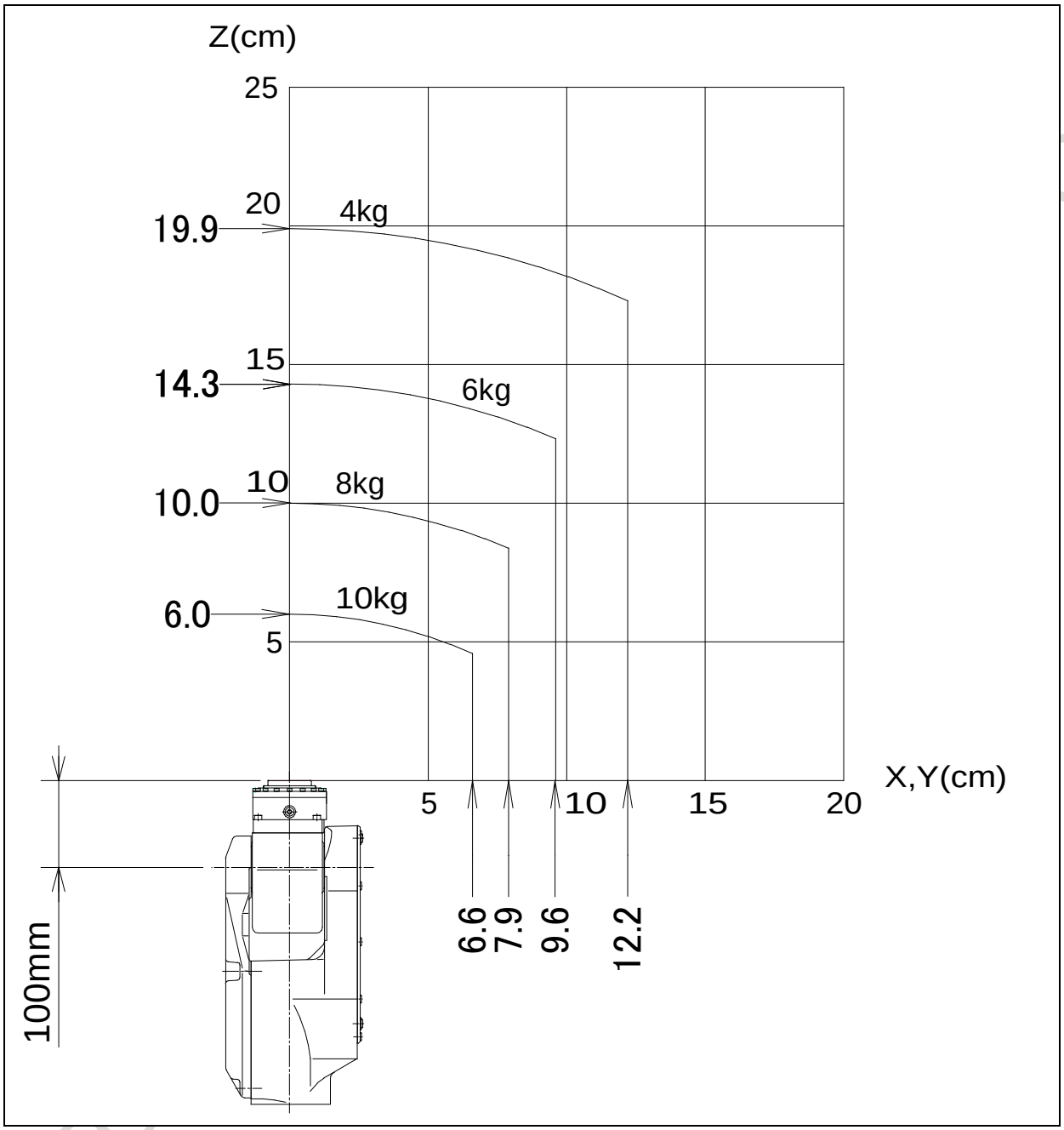


Fig. 9.4 (c) Wrist section allowable load conditions M-6*i*B/6S when Max. load capacity 10kg parameter

Item		Specifications		
Model		ARC Mate 100*i*B M-6*i*B	ARC Mate 100*i*B/6S M-6*i*B/6S	M-6*i*B/2HS
Max.load capacity at wrist		6 kg		2 kg
Allowable load moment at wrist	J4-axis	15.7 N·m (1.6 kgf·m)		
	J5-axis	9.8 N·m (1.0 kgf·m)		
	J6-axis	5.9 N·m (0.6 kgf·m)		2.0 N·m (0.2 kgf·m)
Allowable load inertia at wrist	J4-axis	0.63 kg·m^2 (6.4 kgf·cm·s^2)		
	J5-axis	0.22 kg·m^2 (2.2 kgf·cm·s^2)		
	J6-axis	0.061 kg·m^2 (0.62 kgf·cm·s^2)		0.035 kg·m^2 (0.36 kgf·cm·s^2)

Item		Specifications
Model		ARC Mate 100*i*B/6S M-6*i*B/6S (10 kg wrist payload specification)
Max. load capacity at wrist		10 kg
Allowable load moment at wrist	J4-axis	15.7 N·m (1.6 kgf·m)
	J5-axis	15.7 N·m (1.6 kgf·m)
	J6-axis	6.9 N·m (0.70 kgf·m)
Allowable load inertia at wrist	J4-axis	0.63 kg·m^2 (6.4 kgf·cm·s^2)
	J5-axis	0.36kg·m^2 (3.5 kgf·cm·s^2)
	J6-axis	0.064 kg·m^2 (6.3 kgf·cm·s^2)

9.5 M-6*i*B/6S 10KG WRIST PAYLOAD SPECIFICATION

9.5.1 Outline

10kg wrist payload specification is added to the M-6*i*B/6S (Standard 6kg wrist payload).
This material describes the specifications of the M-6*i*B/6S 10kg wrist payload specification.

9.5.2 Changing method for the M-6*i*B/6S 10kg wrist payload specification

Execute the following KAREL program pre-installed in the TP.
This KAREL program is to change the parameters to 10kg wrist payload specification.
By executing the KAREL program, we can change the parameters to chosen specification.

(For the R-J3*i*B controller)
KAREL program for writing the parameter for setting the 10 kg wrist payload specification: SET10.PC
KAREL program for writing the parameter for switching back to the standard specification: SET06.PC

(For the R-30*i*A controller)
KAREL program for writing the parameter for setting the 10 kg wrist payload specification: SET10C.PC
KAREL program for writing the parameter for switching back to the standard specification: SET06C.PC

Procedure

1 On the [SELECT] screen, select SET10.PC or SET06.PC for the R-J3*i*B controller, or select SET10C.PC or SET06C.PC for the R-30*i*A controller.
2 Press the [SHIFT] + [FWD] key to execute the KAREL program.

[Notice in execution of KAREL program]

- The KAREL program cannot be executed during robot operation.
- After executing the KAREL program, controller power ON/OFF is needed for robot re-operation. (In this case, the message to prompt controller power ON/OFF is shown up in the TP.)

9.5.3 Specifications

The following table shows the specifications of the M-6*i*B/6S 10kg wrist payload specification.
The acceleration/deceleration time of the M-6*i*B/6S 10kg wrist payload specification is about 1.2-1.5 times as length as the standard specification.

		M-6*i*B/6S Standard	M-6*i*B/6S 10kg Payload
Wrist Payload Capacity (kg)		6	10
J3 casing Payload Capacity (kg)		12	6
Reach (mm)		951	951
Stroke (mm)		622	622
Motion Speed (Deg/sec)	Axis 1	200	200
	Axis 2	200	200
	Axis 3	260	200
	Axis 4	400	400
	Axis 5	400	400
	Axis 6	720	520
Mechanical Brakes		6 axis	6 axis
Robot Weight (kg)		135	135
Wrist Moment (Nm)	Axis 4	15.7	15.7
	Axis 5	9.8	15.7
	Axis 6	5.9	6.9
Wrist Inertia (kgm^2)	Axis 4	0.63	0.63
	Axis 5	0.22	0.36
	Axis 6	0.061	0.064

9.5.4 Motion range

The motion range of the M-6*i*B/6S 10kg wrist payload is same as the standard specifications.

9.5.5 Applied software edition (FANUC software)

(For the R-J3*i*B controller)
V6.10P89 and later (Registered in July 2004)
V6.20P42 and later (Registered in July 2004)
V6.30P36 and later (Registered in July 2004)

(For the R-30*i*A controller)
V7.20P First and later editions supported
V7.30P First and later editions supported

9.5.6 INCLINATION ANGLE

It is possible to install the robot with an inclination angle (angle/wall/invert).
For the robot installed at an angle, their operation is not restricted.

9.6 END EFFECTOR AIR PIPING

If you select cables in the mechanical unit with a pneumatic option, an air pipe whose inlet is on the J1-axis connector panel or on the side of bracket for integration and outlet is behind the J3 casing is provided. See Section 7.1 for explanations about the piping routes. The joint diameter for the air pipe inlet and outlet is RC3/8 female. No joint is supplied together with the option. The customer shall arrange for the joints that match the tubes to be used. See the table below for the outside and inside diameters of the air tubes.

Mechanical unit cable specification	Outside and inside diameters and number of air tubes
A05B-1215-H205,H605,H606,H609,H806,H814	2 tubes with an outside diameter of 6.35 mm and an inside diameter of 4.23 mm
A05B-1215-H632,H661,H832,H861	2 tubes with an outside diameter of 10 mm and an inside diameter of 6.5 mm
Other than above A05B-1215-H203,H204 etc.	1 tube with an outside diameter of 8 mm and an inside diameter of 5 mm

9.7 END EFFECTOR INPUT SIGNALS (RDI/RDO OR RI/RO)

There are end effector connectors for connecting peripheral devices behind the J3 casing. Fig. 9.7 (a) to Fig. 9.7 (d) show the pin arrangement of end effector connectors. Refer to "Controller Maintenance Manual" for details of input-common settings.

⚠WARNING
The RDO signal for the R-J3*i*B controller and the RO signal for the R-30*i*A/ R-30*i*B controller are incompatible with each other because different output formats are used. For details, refer to the Chapter 4 of CONNECTION of controller maintenance manuals.

⚠CAUTION
For the R-30*i*A controller, read RDO1 and RDI1 as RO1 and RI1.

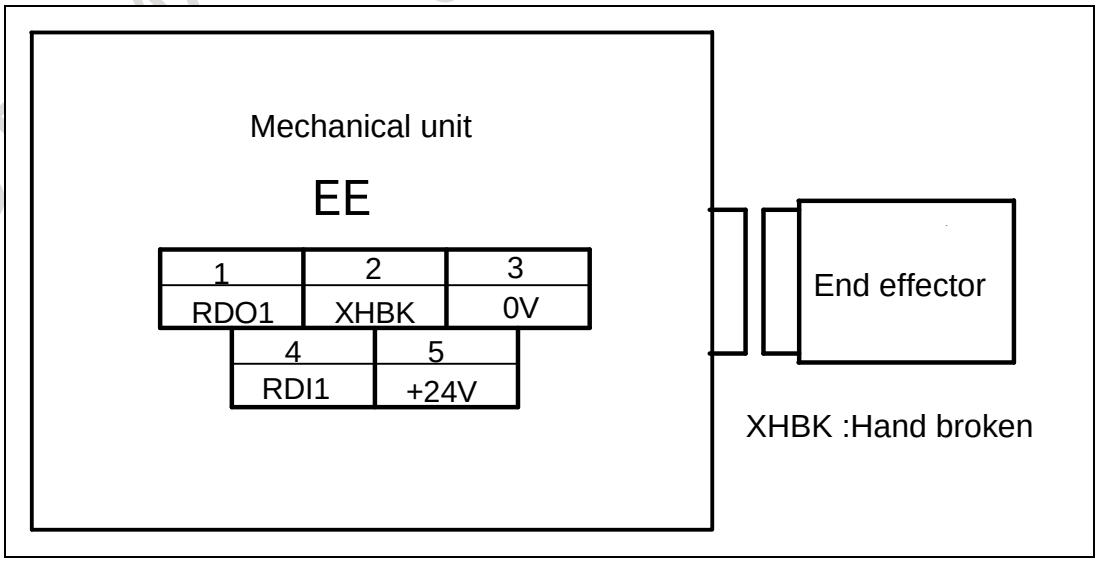


Fig. 9.7 (a) End effector signal arrangement (one RDI signal and one RDO signal) (Common to R-J3*i*B and R-30*i*A)

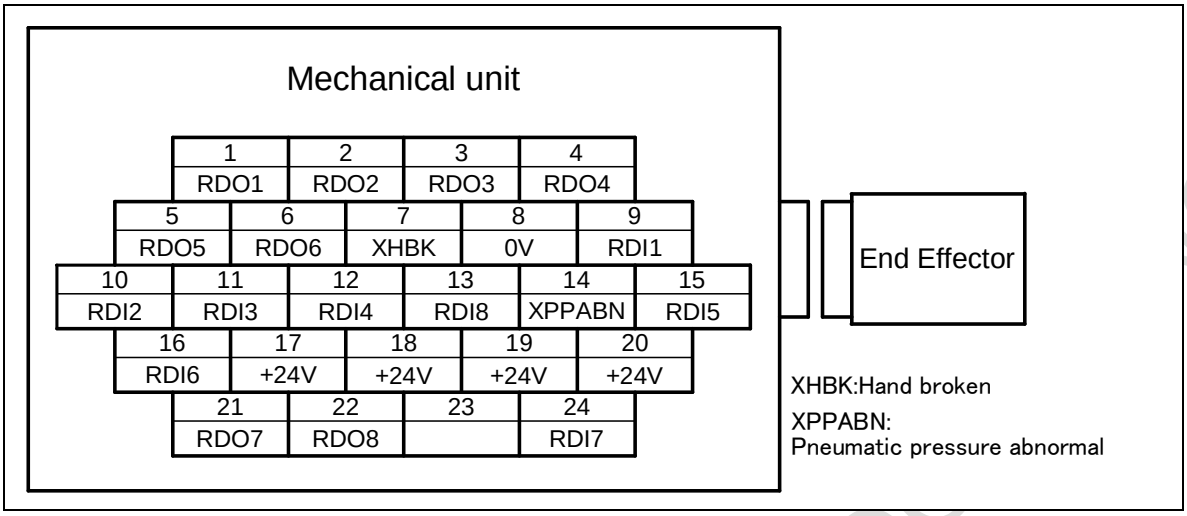


Fig. 9.7 (b) End effector signal arrangement (eight RDI signals and eight RDO signals) (For R-J3*i*B)

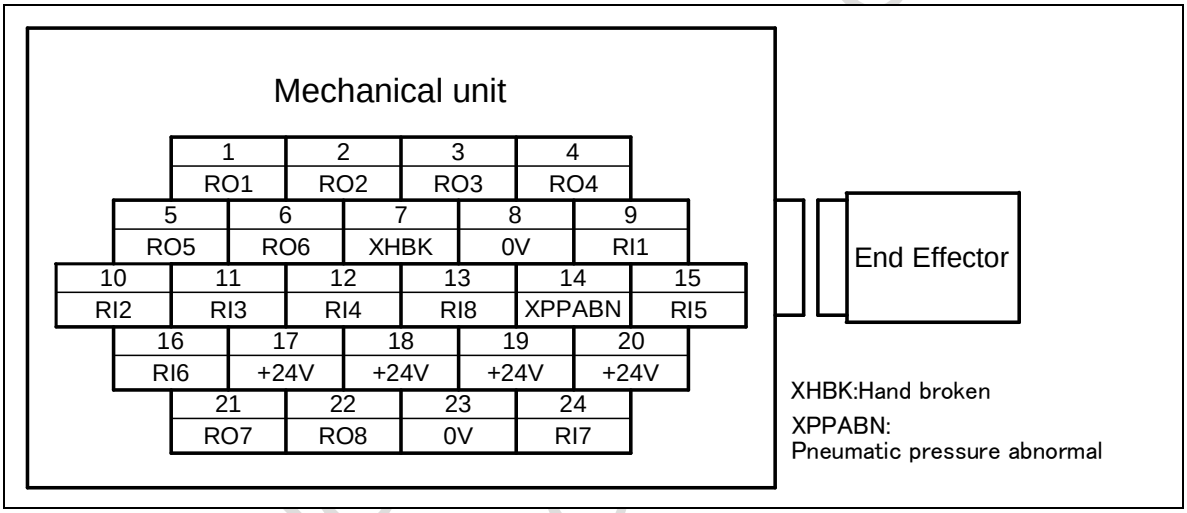


Fig. 9.7 (c) End effector signal arrangement (eight RI signals and RO signals) (For R-30*i*A)

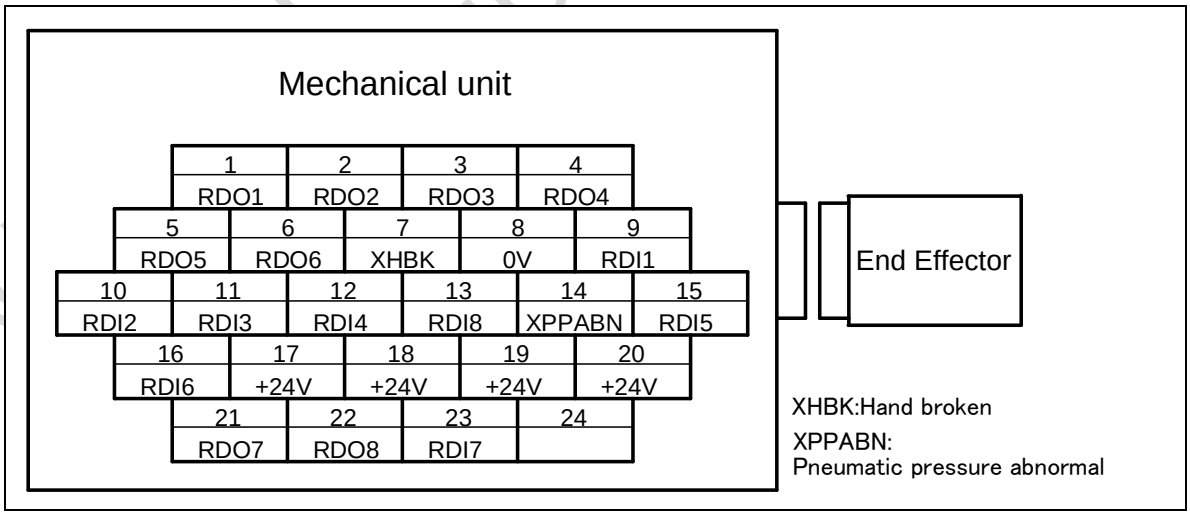


Fig. 9.7 (d) End effector signal arrangement (Severe dust/liquide protection option Eight RDI/O (Common to R-J3*i*B controller and R-30*i*A controller)

9.8 CONNECTOR SPECIFICATIONS

Table 9.8 (a) lists the makers and models of the connectors used on the robot mechanical unit. Table 9.8 (b) lists the makers and models of the connectors used on the mechanical unit of the robot with Lincoln W/F cable option. Table 9.8 (c) lists the makers and models of the connectors to be used on user-prepared devices.

Table 9.8 (d) lists the makers and models of the connectors used on the robot mechanical unit when the M-6*i*B, M-6*i*B/6S severe dust/liquid protection option is specified, and Table 9.8 (e) lists the makers and models of the connectors used on the user side.

Table 9.8 (a) Connector specifications (on the mechanical unit side)

Cable name	Input side (J1 base)	Output side (J3 casing)	Maker /dealer
RDI/O x 1 or RI/O x 1	———	JMWR1305F	Fujikura.Ltd
RDI/O x 8 or RI/O x 8	———	JMWR2524F	
AS	MS3102A20-27P	MS3102A20-27S	Fujikura.Ltd Japan Aviation Electronics Industry, Ltd.
AP	MS3102A20-27PY	MS3102A20-27SY	

Table 9.8 (b) Connector specifications (on the mechanical unit side)

Cable name	Model	Maker/dealer
Lincoln W/F cable	MS3100A20-27 SY (J1 base)	Japan Aviation Electronics Industry, LTD.
	MS3100A20-27 PY (J3 casing)	

Table 9.8 (c) Connector specifications (on the user side)

Cable name	Input side (J1 base)	Output side (J3 casing)	Maker /dealer
RDI/O x 1 or RI/O x 1	———	JMSP1305M Straight plug (Attached) (FANUC Spec: A63L-0001-0234#S1305M) JMLP1305M Angle plug	Fujikura. Ltd
RDI/O x 8 or RI/O x 8	———	JMSP2524M Straight plug (Attached) (FANUC Spec: A63L-0001-0234#S2524M) JMLP2524M Angle plug	
AS For A05B-1215-H606,H806,H814	Maker specification	Maker specification	Fujikura. Ltd, Japan Aviation Electronics Industry, Ltd. .etc
	Connector Straight plug: MS3106B20-27SY(*1) Elbow plug: MS3108B20-27SY Or, interchangeable goods. Clamp MS3057-12A (*1)	Connector Straight plug: MS3106B20-27PY (*2) Elbow plug: MS3108B20-27PY Or, interchangeable goods. Clamp MS3057-12A (*2)	
	FANUC specification	FANUC specification	
	A05B-1221-K843 (Straight plug (*1) and clamp (*1) are included)	A05B-1221-K841 (Straight plug (*2) and clamp (*2) are included)	

Cable name	Input side (J1 base)	Output side (J3 casing)	Maker /dealer
AP For A05B-1215-H606,H806,H814	Maker specification	Maker specification	Fujikura. Ltd, Japan Aviation Electronics Industry, Ltd. .etc
	Connector Straight plug : MS3106B20-27S (*3) Elbow plug : MS3108B20-27S Or a compatible model Clamp MS3057-12A (*3)	Connector Straight plug : MS3106B20-27P (*4) Elbow plug : MS3108B20-27P Or a compatible model Clamp MS3057-12A (*4)	
	FANUC specification	FANUC specification	
	A05B-1221-K844 (Straight plug (*3) and clamp (*3) are included)	A05B-1221-K842 (Straight plug (*4) and clamp (*4) are included)	

Note: Select appropriate models for the wires to be used.

Table 9.8 (d) Connector specifications
(on the mechanical unit side when the M-6*i*B severe dust/liquid protection option is specified)

Cable name	Component name	Input side (J1 base)	Output side (J3 casing)	Maker /dealer
RDI/O × 8 or RI/O × 8	Receptacle	————	JL05-2A24-28SC-F0-R	Japan Aviation Electronics Industry, Ltd.
	Socket contact	————	ST-JL05-16S-C3-100	

Table 9.8 (e) Connector specifications
(on the user side when the M-6*i*B severe dust/liquid protection option is specified)

Cable name	Component name	Input side (J1 base)	Output side (J3 casing)	Maker /dealer
RDI/O × 8 or RI/O × 8	Plug	————	JL05-6A24-28PC-F0-R (FANUC specification : A63L-0001-0463#P2424P)	Japan Aviation Electronics Industry, Ltd.
	End bell	————	JL05-24EB3B-(21)-R (FANUC specification : A63L-0001-0463#24EB3B2)	
	Pin contact	————	ST-JL05-16P-C3-100 (FANUC specification : A63L-0001-0463#16PC3)	

NOTE
For detailed descriptions of the dimensions of the connectors, contact FANUC or refer to the respective catalogs available from the maker.

User cable (signal line) interface (option)
Fig.9.8 (a) shows pin layout for user cable (signal line) interface.

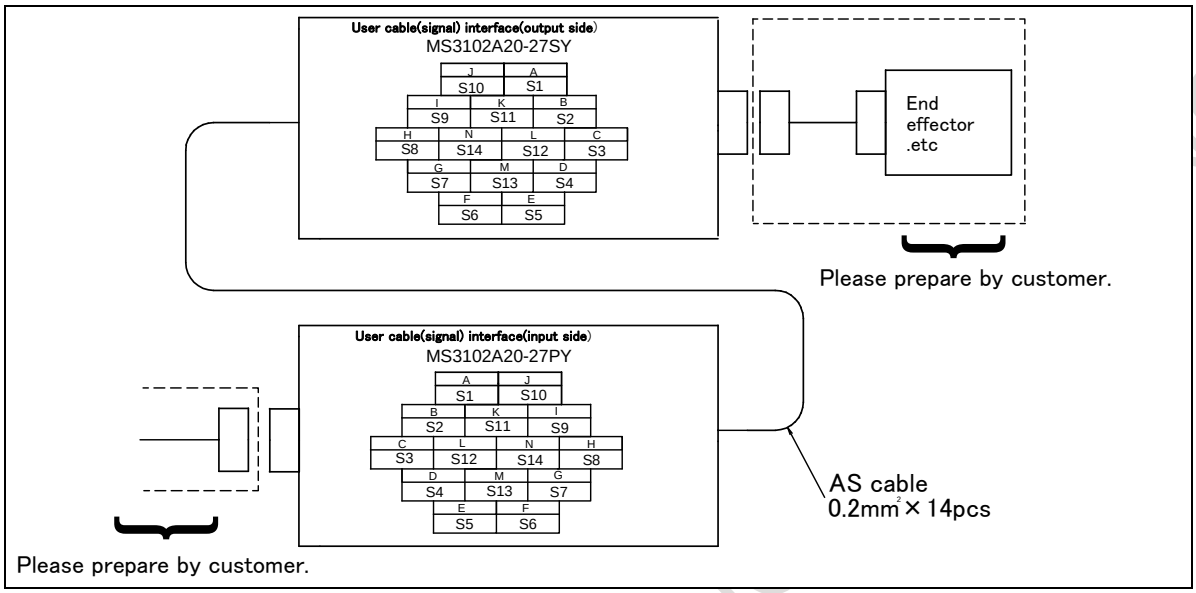


Fig.9.8 (a) Pin layout for user cable (signal line) interface (option)
(Mechanical unit cable A05B-1215-H606,H806,H814 is specified)

User cable (power line) interface (option)
Fig.9.8 (b) shows pin layout for user cable (power line) interface.

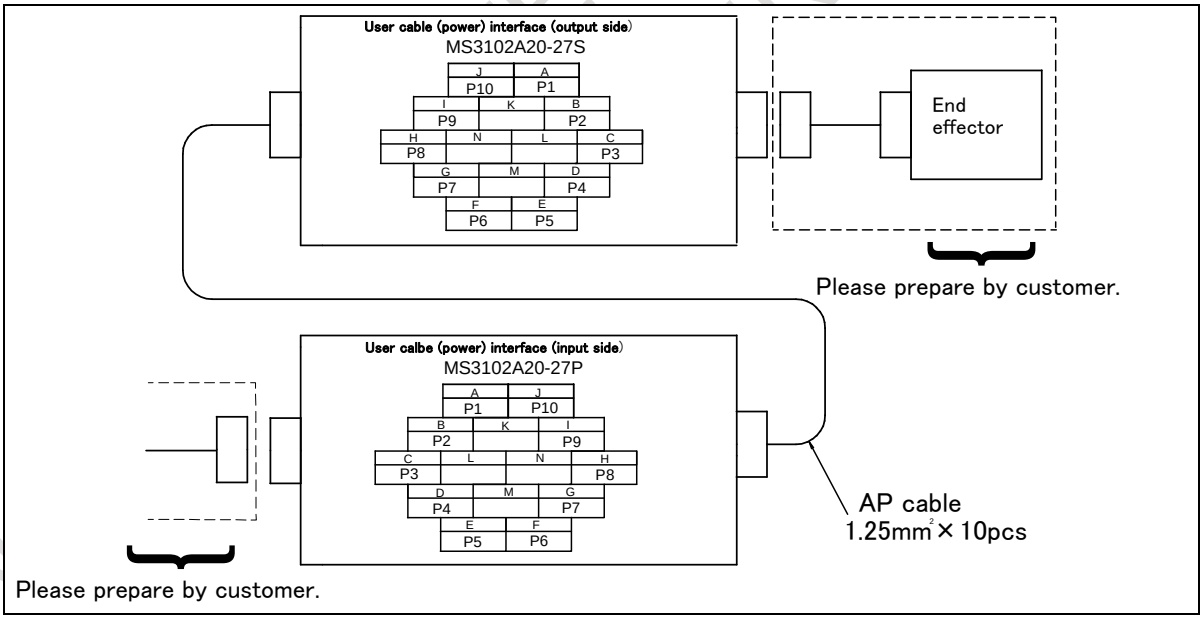


Fig.9.8 (b) Pin layout for user cable (power line) interface (option)
(Mechanical unit cable A05B-1215-H606,H806,H814 is specified)

9.9 INSULATION BETWEEN THE ARC WELDING ROBOT END EFFECTOR MOUNTING PLATE AND WELDING TORCH

9.9.1 Overview

The arc welding robot performs welding, using a welding torch attached to its end effector via a bracket. As is well known, a high welding current flows through the welding torch, so the insulation between the end effector and torch is dualized.
If no due consideration is taken, a poor insulation caused by a pileup of spatter can allow the welding current to leak into robot mechanical sections, possibly resulting in the motor being damaged or the sheaths of cables in the mechanical sections melting.
Cautions to be taken insulating between the end effector and welding torch are explicitly given below.

9.9.2 Wrist Section Insulation

Design the insulation between the end effector and welding torch so that no current will leak from the end effector. Concretely, when fastening the insulating material (A) inserted between the end effector and torch bracket, use different bolts on the insulation material and torch bracket.Insert also the insulating material (B) between the torch and torch bracket so that the insulation is dualized. When installing the insulating material (B), be sure to set the crack in the torch holder away from that of the insulating material (B) so as to prevent spatter from getting in the cracks.
Allow a sufficient distance (at least 5 mm) at the insulating materials in case a pileup of spatter should occur.
See the following example given for reference purposes.
Even after the insulation is reinforced, it is likely that, if a pileup of spatter grows excessively, current may leak. Periodically remove spatter when the robot is in service.

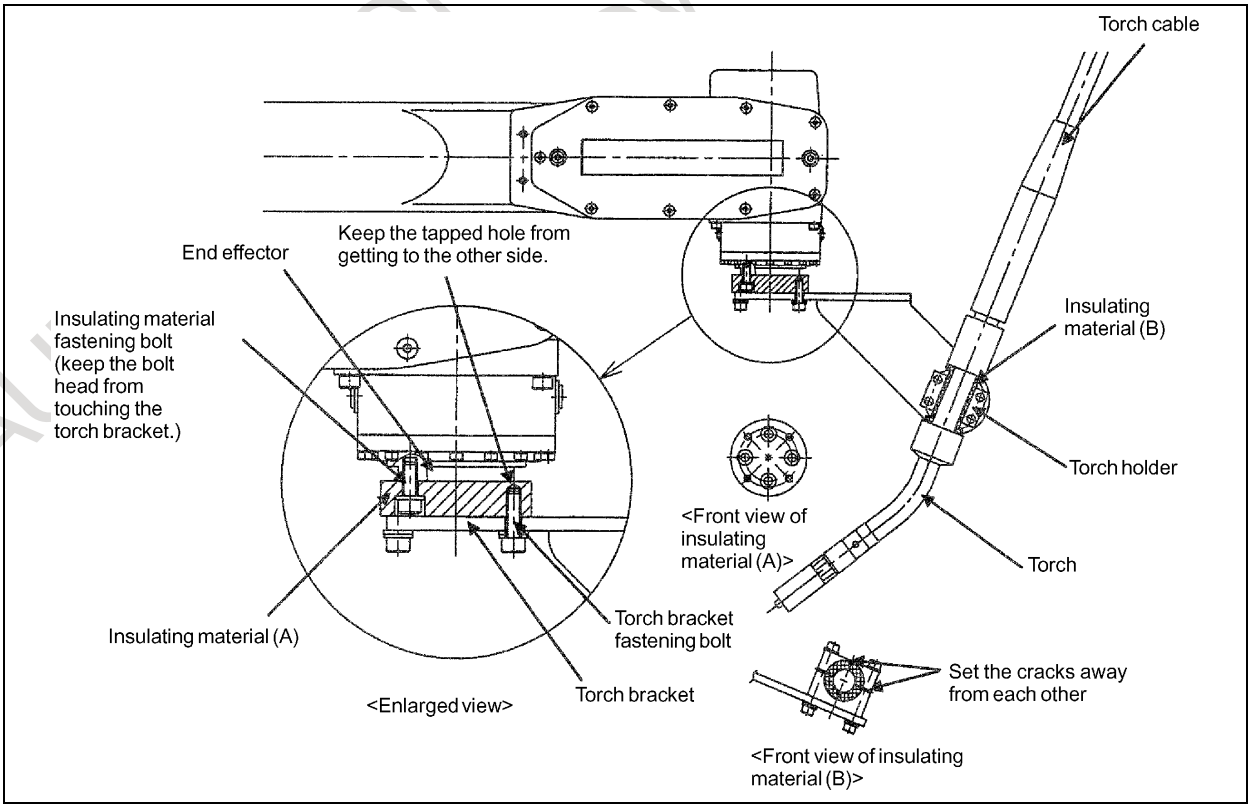


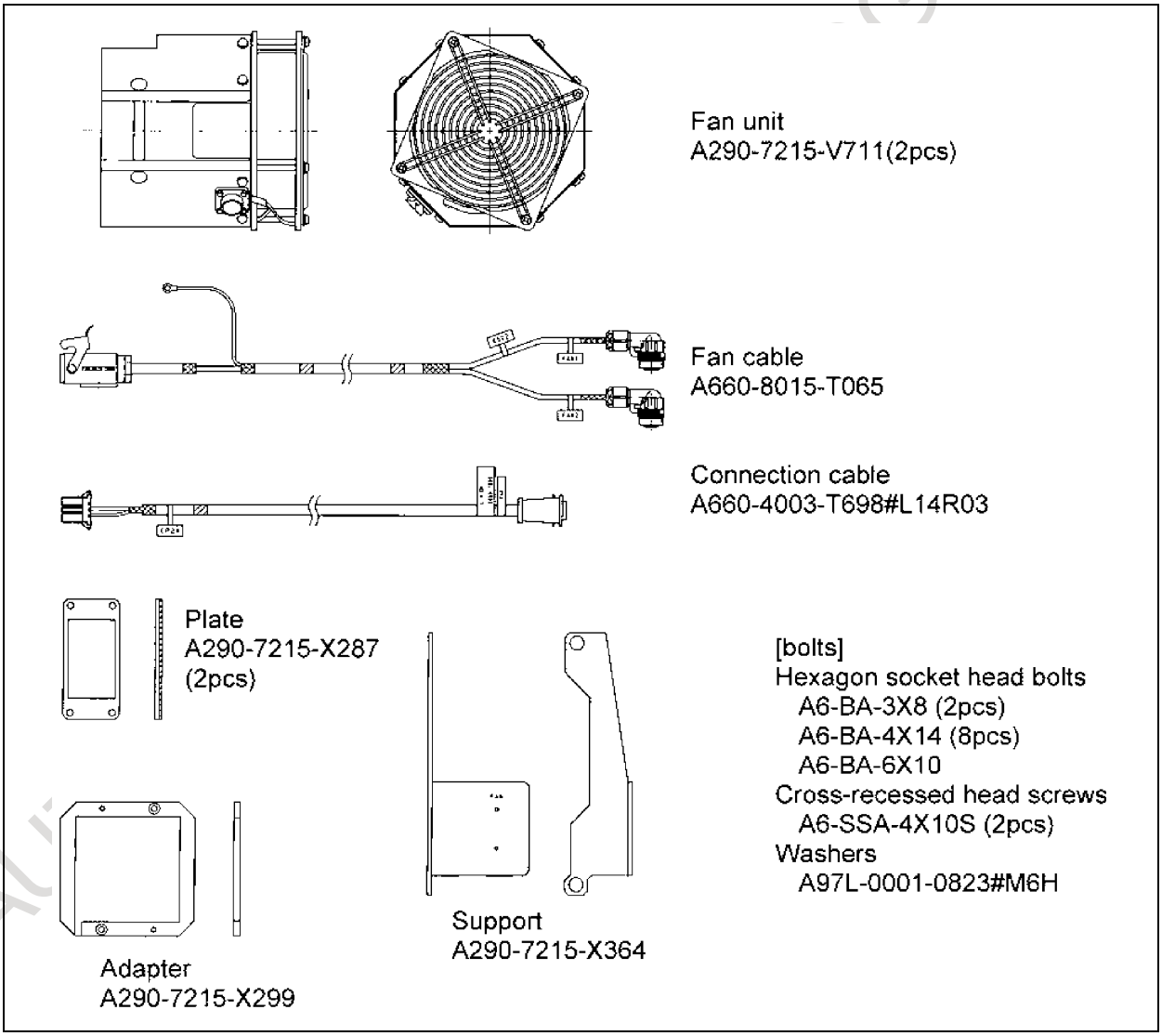
Fig. 9.9.2 (a) Insulation

9.10 M-6*i*B/6S FAN OPTION

9.10.1 Structure

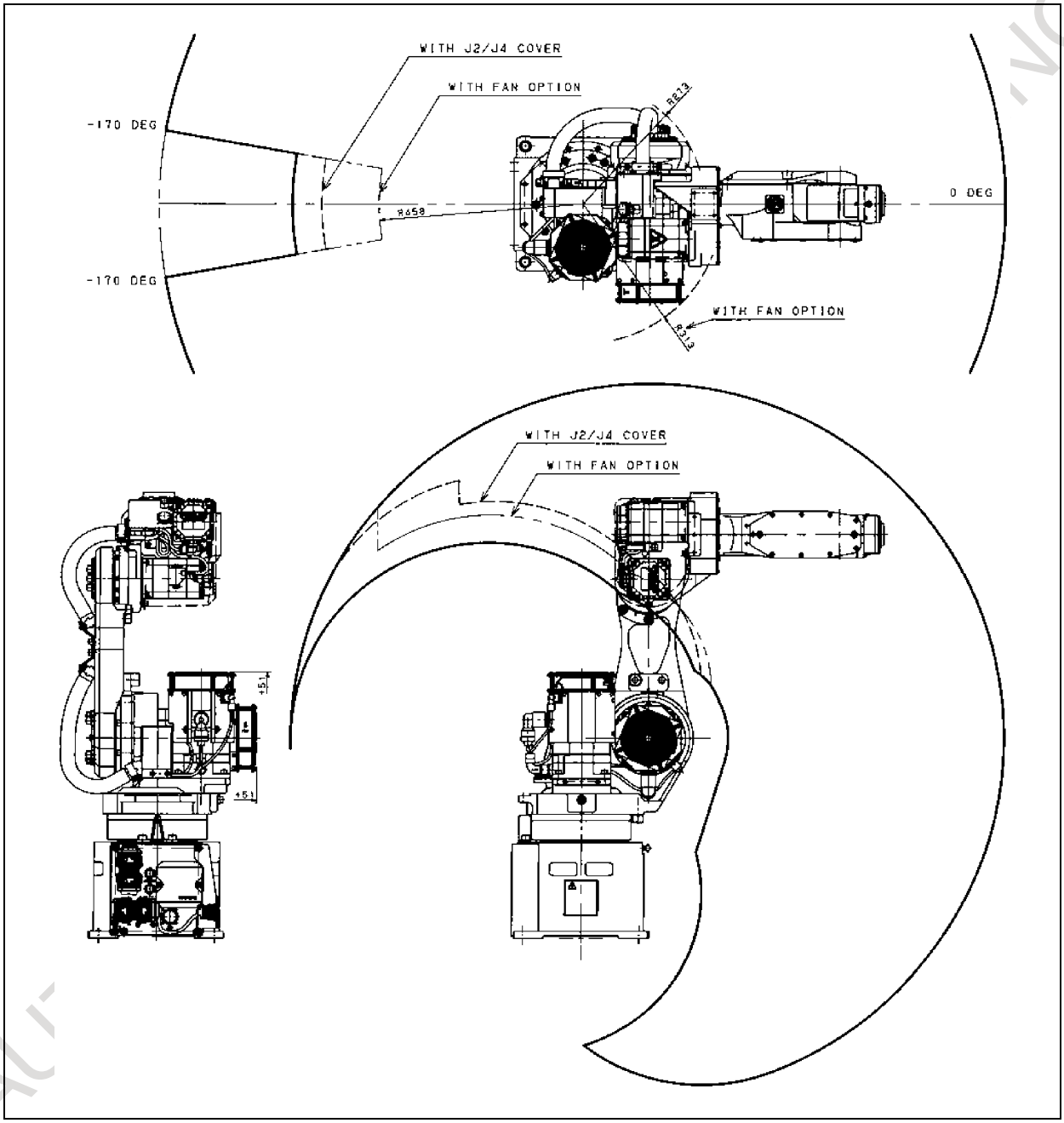
Fan option specification : A05B-1215-J711
Applicable robot specification : FANUC Robot M-6*i*B/6S

This option uses for J1/J2 motor cooling. J1/J2 motor allowable electric current is 15.2Ap (OVC level) in an ambient temperature 0 to 45 degrees C.
Not available to J2 full cover (A05B-1215-J401, -J402) and OT cable (-H312, -H313).
Designate with J2 cable cover (A05B-1215-H351, -H352).
Recommend exchange of fan units with an overhaul of a robot.



9.10.2 Outline Drawing and Motion Range

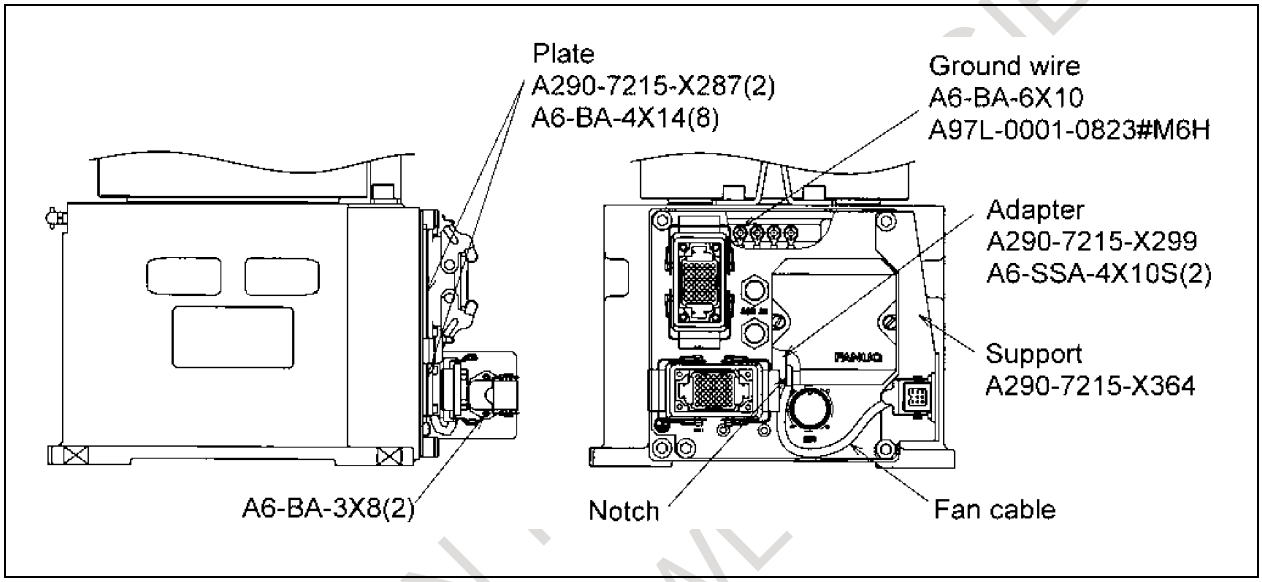
This figure shows the outline and motion range of the mechanical unit when the fan option is attached.
Please select "FAN OPTION" from motion range choices at CONTROLLED START MENU.



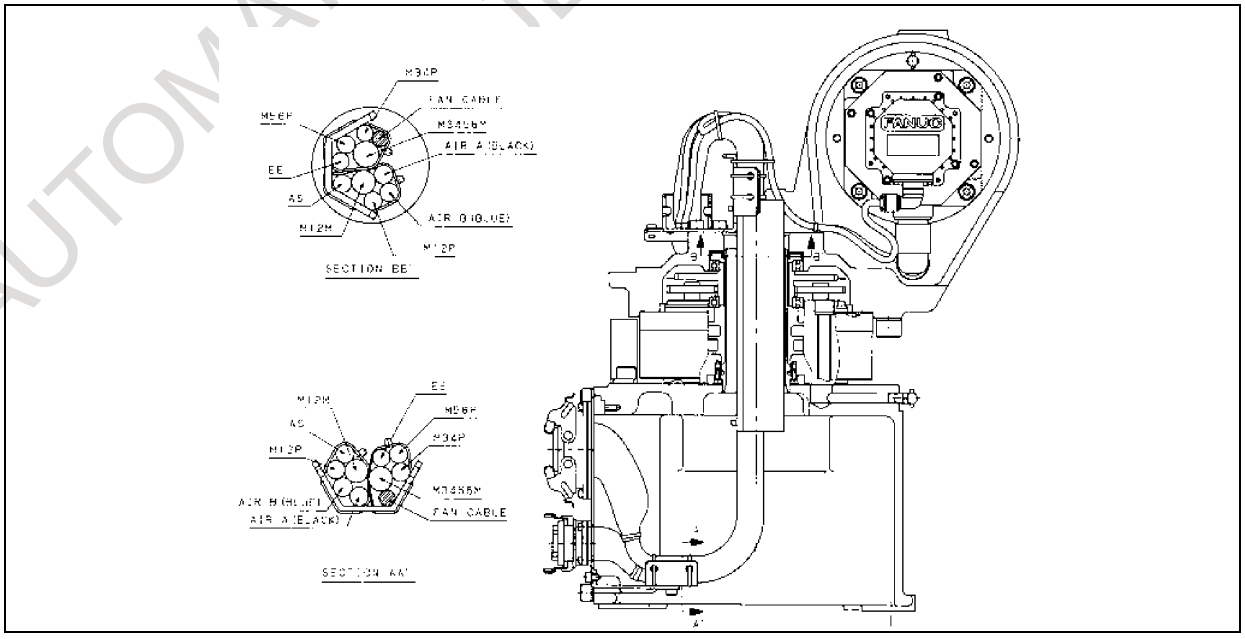
9.10.3 Installation

Please install the fan unit on condition that the robot can be supplied electric power.

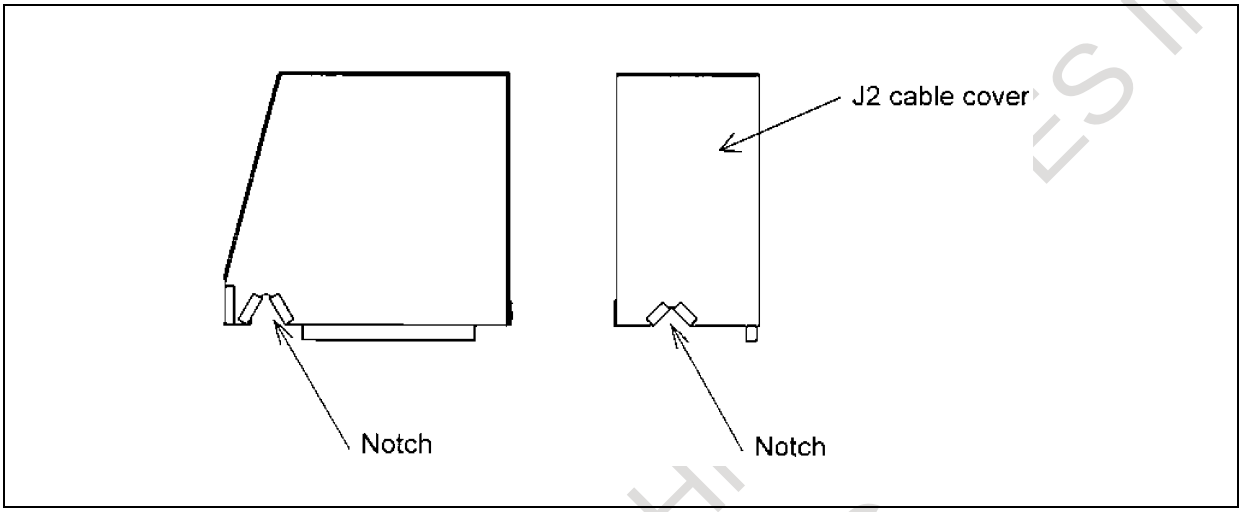
(1) Turn on the controller and place the robot in a posture of all axes = 0 deg.
(2) Press the EMERGENCY STOP button.
(3) Take off the J2 cable cover or the J2 full cover.
(4) Keep the power on and take off the battery box.
(5) Attach the adapter (A290-7215-X299) to the J1 connector board and let the fan cable pass through the notch. Mount the battery box after making sure that the cable is not caught in the battery box section.Turn off the power.



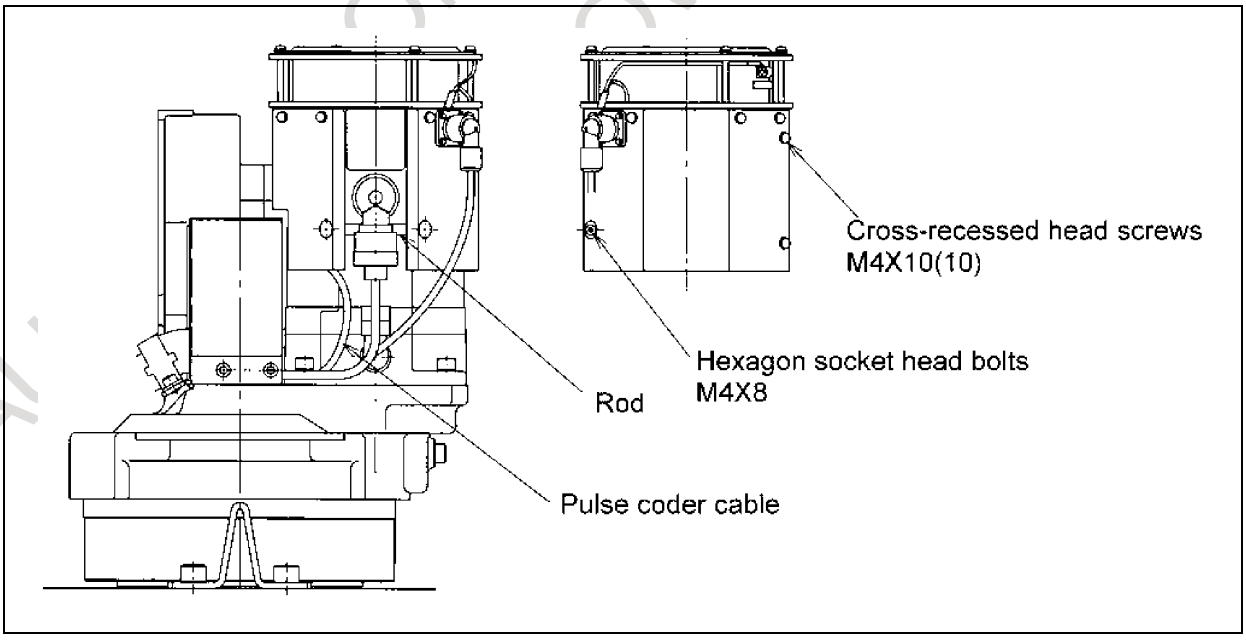
(6) Remove the J1 connector board and let the fan cable pass through the J1 hollow pipe toward the upper section. Clamp the cable upper section with the marking. And clamp the cable under section with the marking.



(7) Disconnect the robot connection cable RM1, RP1. Separate the RM1, RP1 connector inserts from the connector housings and attach the plate (A290-7215-X287) between the connector housing and the J1 connector board. Mount the ground wire terminal of the fan cable on the J1 base.
(8) Attach the J1 connector board on the J1 base and attach with the support (A290-7215-X364) in the right side. Mount the connector of fan cable on the support.
(9) Arrange the cable on the J2 base. Adjust the cable to the notch and attach the J2 cable cover. (Not available to J2 full cover.)

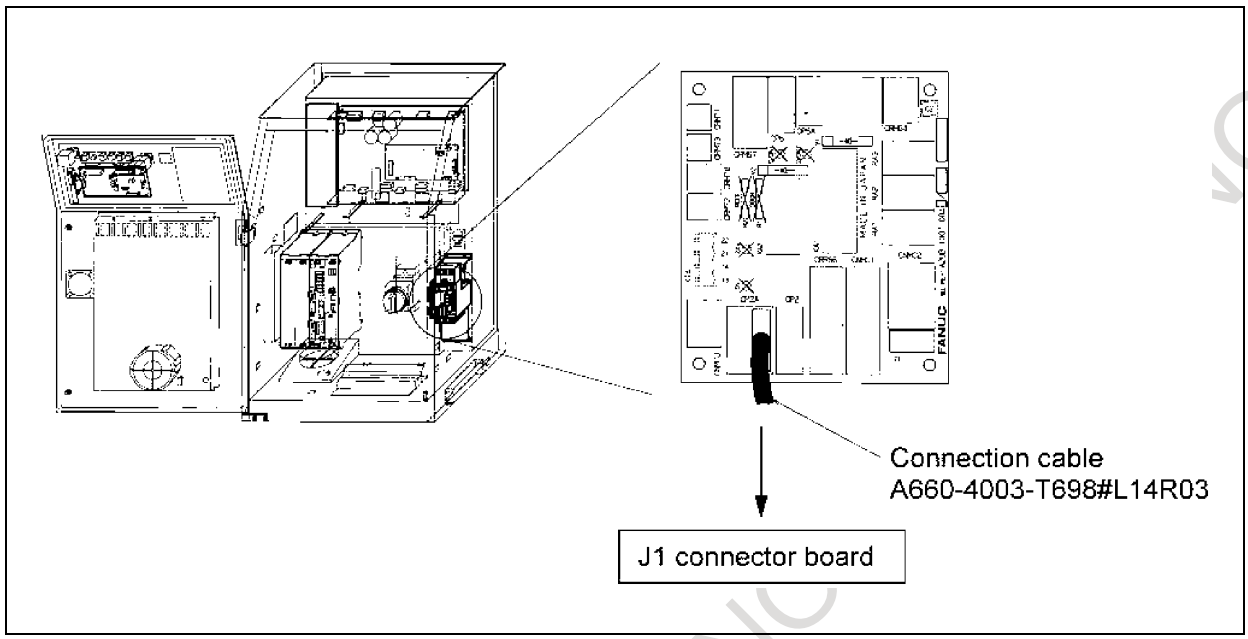


(10) Loosen the ten cross-recessed head screws M4 x 10 of the fan unit's side, remove the rod and attach the fan unit to the J1 motor. Then make sure that the pulsecoder cable is not wounded. Cut the nylon ties fixed the pulsecoder cable in case of need.
(11) Put in the fan unit to the end of the motor, fasten lightly the rod by two hexagon socket head bolts M4X8 from both side. Fasten the ten cross-recessed head screws M4 x 10 of the fan unit's side. Fasten the rod by two hexagon socket head bolts M4 x 8.



(12) Attach the fan unit to the J2 motor in the same way as the J1 motor.
(13) Connect the fan motor connector. Clamp the fan cable to the motor power cable by nylon ties.

(14) Connect the connection cable with the controller and with the fan cable on the J1 connector board.



(15) Connect the robot connection cable.

Fan unit installation is completed.
Please check the movement of the robot.

10 TRANSPORTATION AND INSTALLATION

10.1 TRANSPORTATION

1) Installation procedure
   1 Remove the J1 transportation stopper (red). (2-axis brake type)
   2 Using JOINT, rotate the J2- and J3-axis sections in the positive direction to such a position that the J2- and J3-axis transportation stoppers can be removed.
   3 Remove the J2- and J3-axis transportation stoppers(red).
   4 Remove the two M10 eyebolts from the J2 base. Now you are ready to install the robot.

NOTE
If an overtravel alarm is issued at step 2, hold down the shift key and press the alarm reset key. Then, while holding down the shift key, feed the J2- and J3-axis sections to such a position, using JOINT, that the overtravel condition is released.

⚠ CAUTION
Before moving the J2-axis section, be sure to remove the eyebolt from the J2 base so that the J2-axis stopper does not interfere with the eyebolt.

2) Carrying the robot with a crane
A robot can be carried by suspending it with a crane.
When lifting a robot of the remote type controller, hook a strap on the two M10 eyebolts. (See Fig. 10.1 (a) and (b).)
When lifting a robot of the remote type controller with the J2 cover installed, attach a dedicated transportation support (A05B-1215-J403) to the backward portion of the J2 base to prevent the J2 cover from being damaged. (See Fig. 10.1 (c).)
When lifting a robot of the integrated type controller, attach a dedicated transportation support (A05B-1215-H501). (See Fig. 10.1 (d).)
After installing a robot, remove any transportation stopper and transportation support.
A transportation stopper is a bolt for preventing swivel axis movement during transportation. A transportation stopper is painted or plated in red. Be sure to remove all transportation stoppers before starting robot operation.

⚠ CAUTION
1 When transporting a robot having two axes that are equipped with a brake while leaving an end effector mounted on its wrist, be sure to place soft material such as sponge rubber between the J2 and J3 arms previously so that the J4-axis section will not swing. Otherwise, the end effector or the robot main body may be damaged if the J4-axis section swings to let the end effector hit the robot main body during transportation. If the J4-axis section is caused to rotate beyond its operation range, a break may occur in the cable.
2 When transporting a robot, be careful not to damage a motor connector with a sling for lifting the robot.
3 When transporting a robot of the integrated type controller, place the teach box on the controller (because the controller and teach box are connected with each other via a cable).

⚠ WARNING

1 When an end effector and peripherals are installed on a robot, the center of gravity of the robot changes and the robot might become unstable while being transported. If the robot becomes unstable, remove the tooling and place the robot into the transportation position. This will position the unit center of gravity correctly. It is recommended to transport the end effector and peripherals separately from the robot.
2 Use the forklift pockets only to transport the robot with a forklift. Do not use the forklift pockets for any other transportation method. Do not use the forklift pockets to secure the robot.
3 Do not pull an eyebolt sideways.
4 Do not give an impact on the forklift pockets with, for example, the forks.
5 Do not put a chain or any other object on the forklift pockets.
6 Before moving the robot by using forklift pockets, check and tighten any loose bolts on the forklift pockets.

3) Carrying the robot with a forklift
When carrying a robot with a forklift, specify the following option (Fig. 10.1 (e), (f) and (g)):
Remote type controller Forklift bracket : A05B-1215-H503
Integrated type controller Forklift bracket : A05B-1215-H502
When carrying a robot, be sure to observe the cautions described in (2) above.

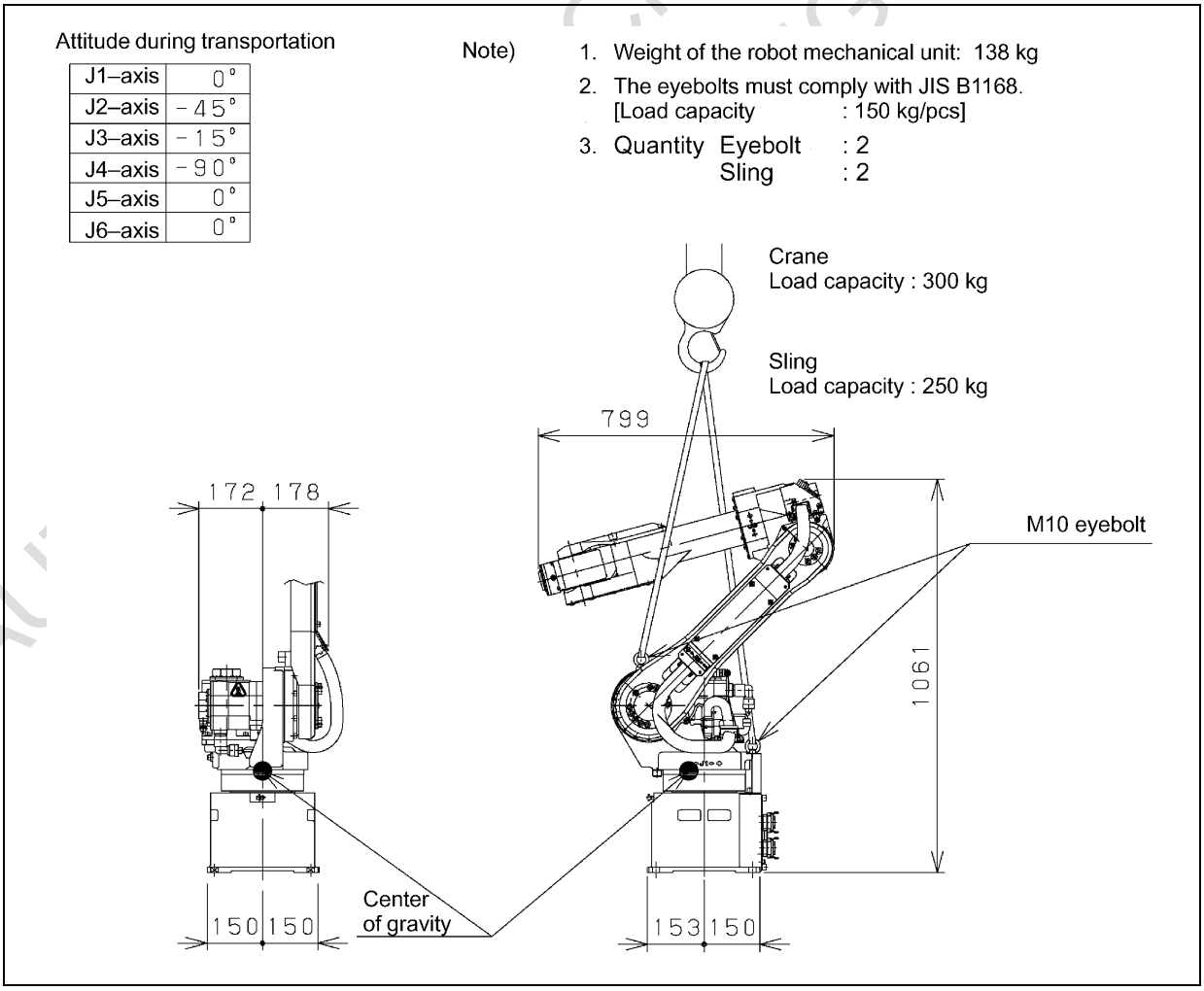


Fig. 10.1 (a) Carrying the robot with a crane ARC Mate 100*i*B, M-6*i*B

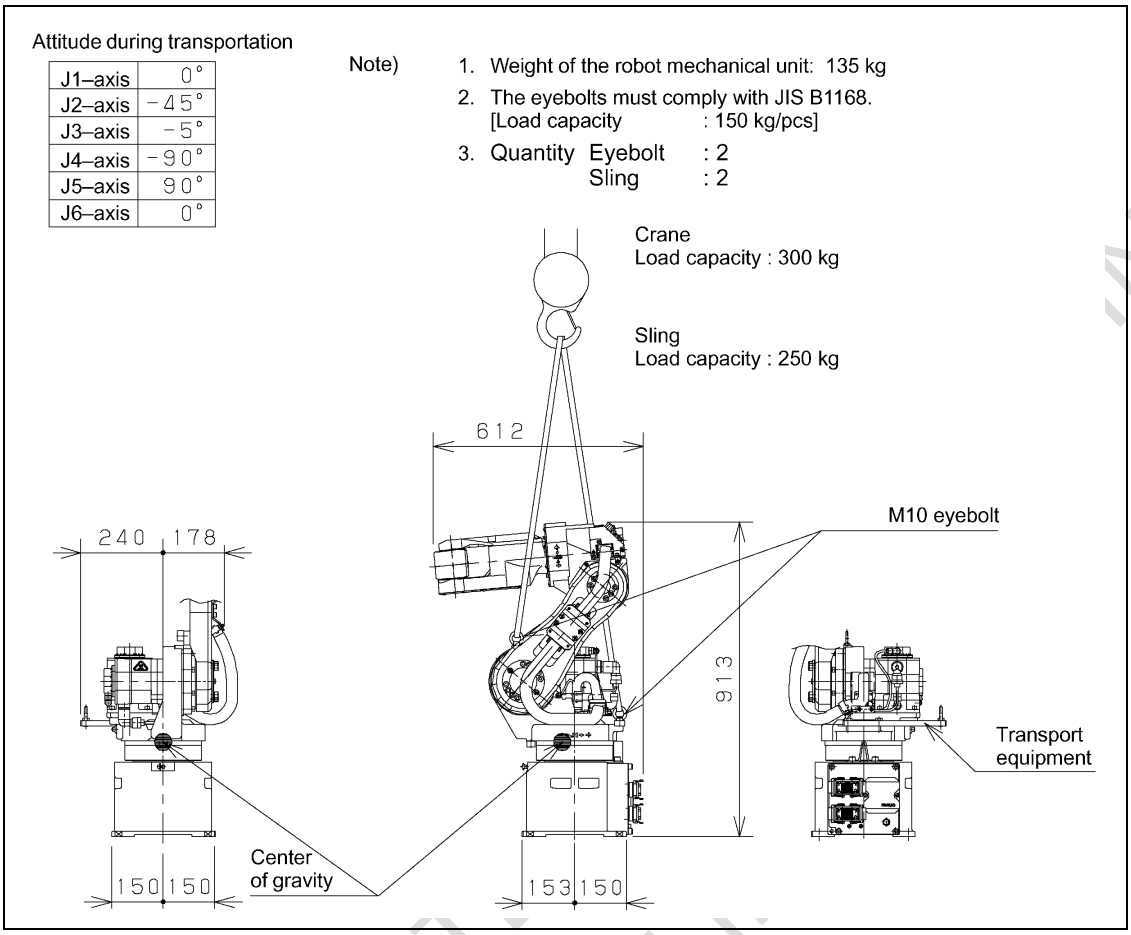


Fig. 10.1 (b) Carrying the robot with a crane ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

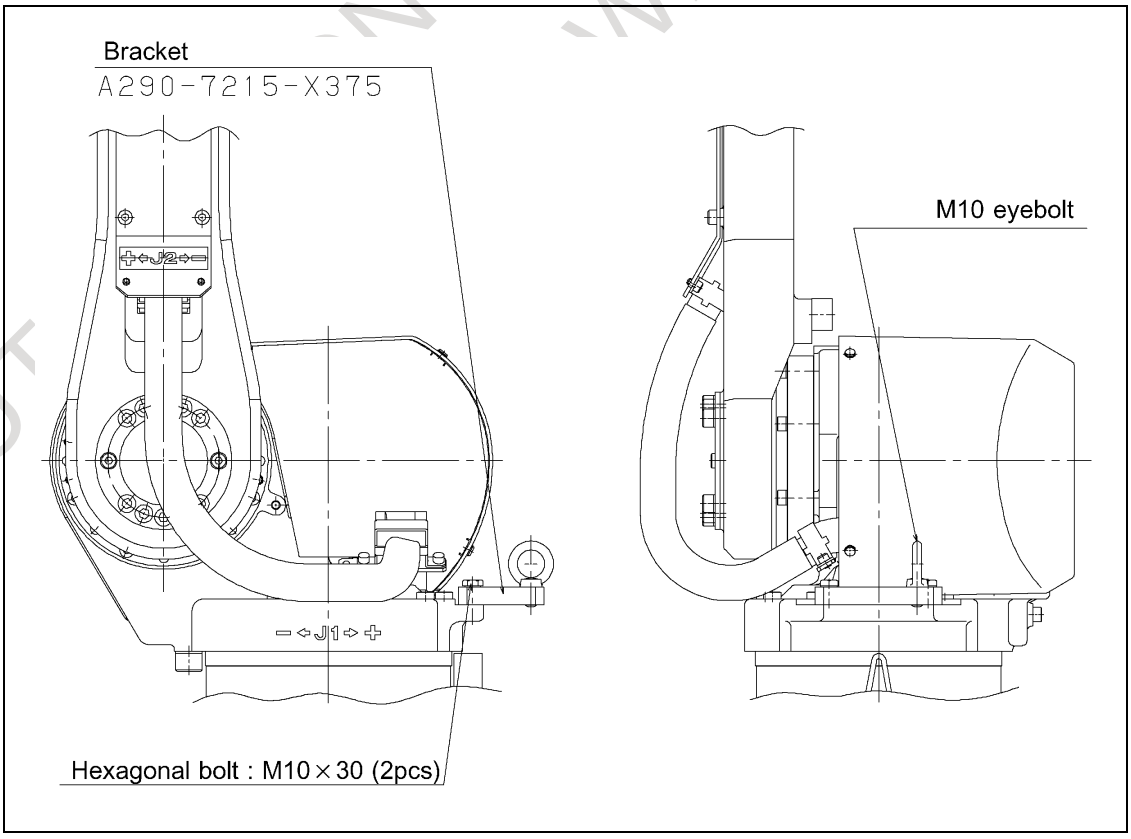


Fig. 10.1 (c) Transport equipment with J2 cover

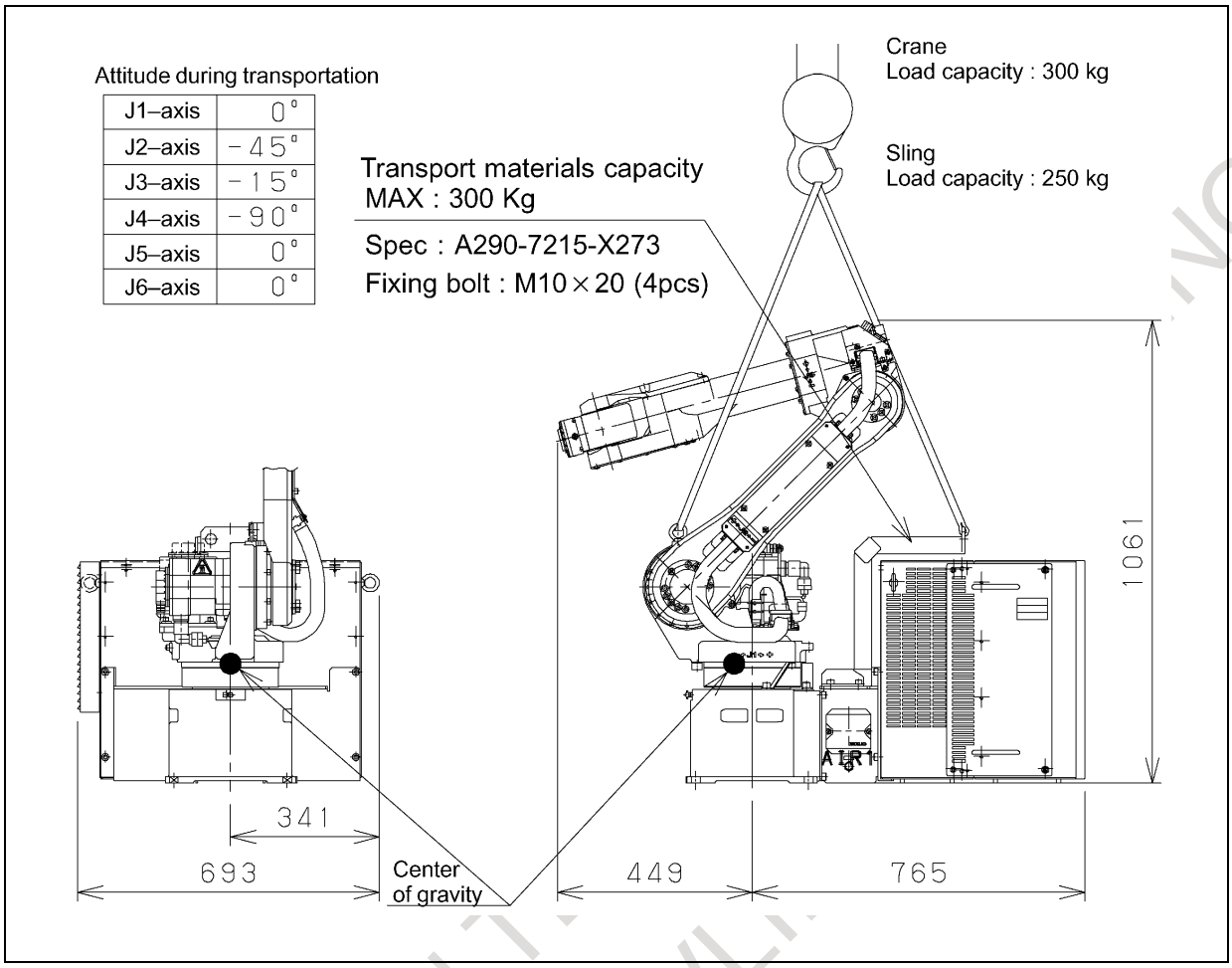


Fig. 10.1 (d) Carrying the robot with a crane ARC Mate 100*i*B, M-6*i*B integrated type controller

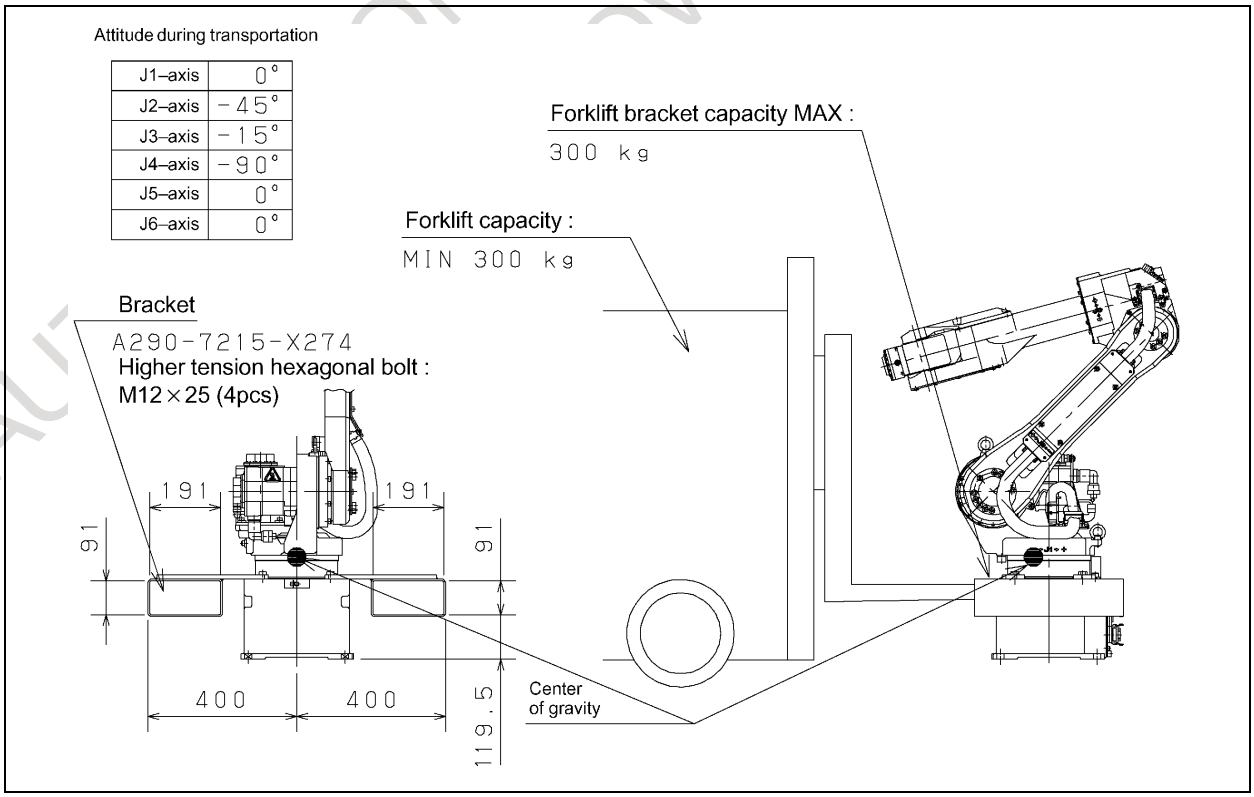


Fig. 10.1 (e) Carrying the robot with a forklift ARC Mate 100*i*B, M-6*i*B

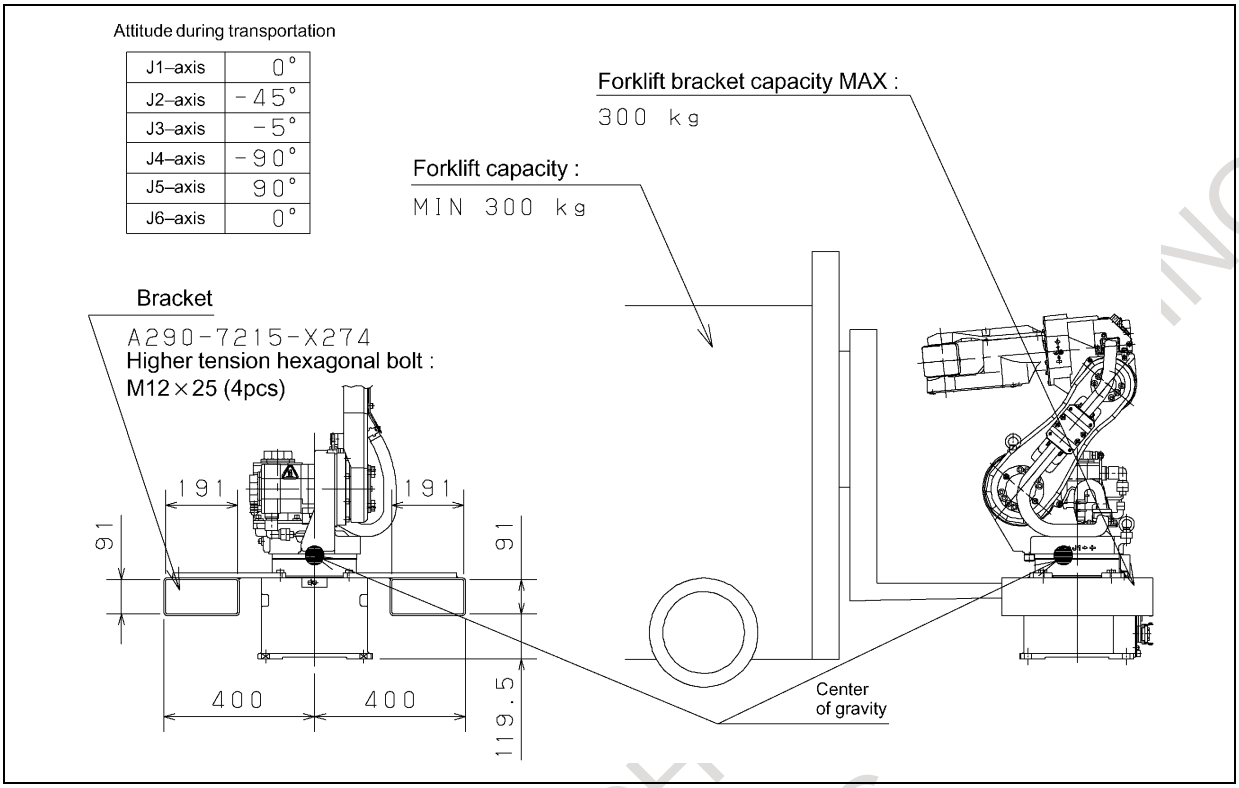


Fig. 10.1 (f) Carrying the robot with a forklift ARC Mate 100*i*iB/6S, M-6*i*B/6S, M-6*i*B/2HS

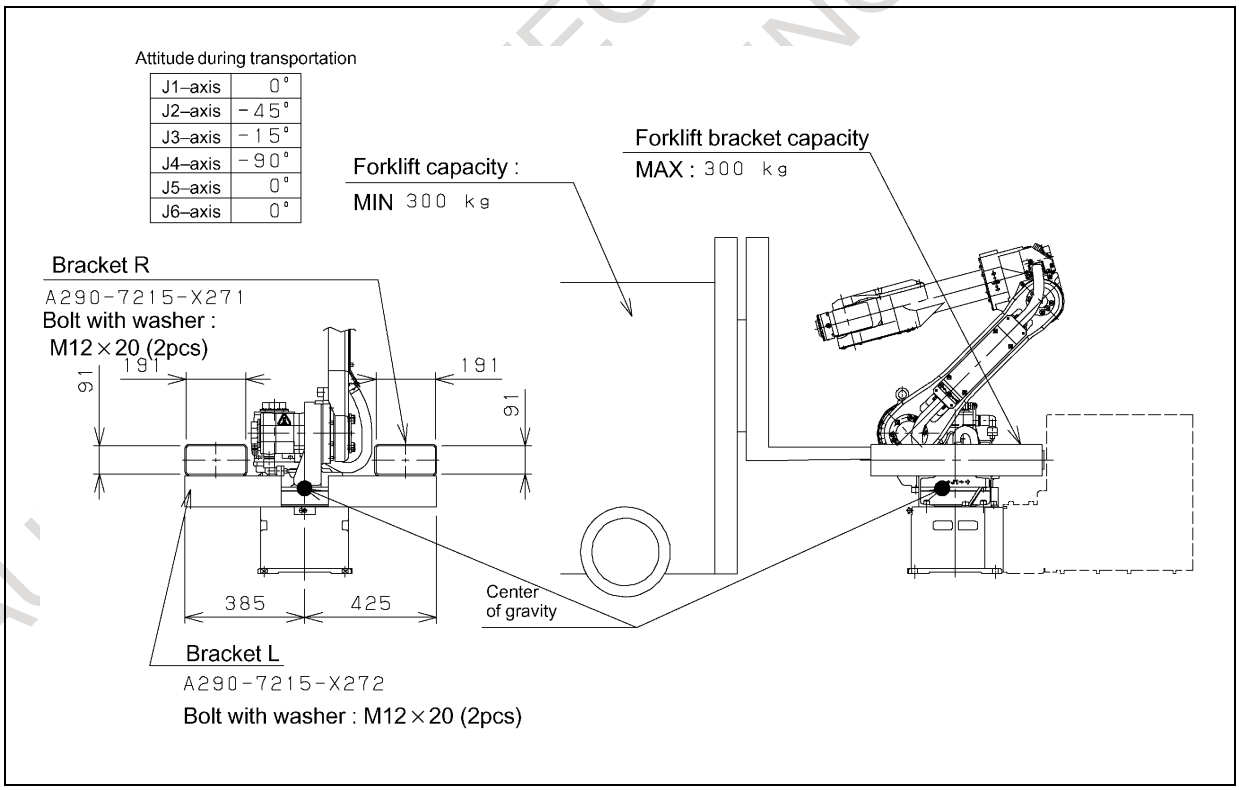


Fig. 10.1 (g) Carrying the robot with a forklift ARC Mate 100*i*B, M-6*i*B integrated type controller

10.2 STORING THE ROBOT

When storing the robot, keep it in the posture shown in Fig. 10.1 (a) and (b).

NOTE
A robot assuming an attitude other than the one for transportation cannot stand by itself and can fall. Before storing a robot for a long term, take measures for securing the robot to prevent it from falling.

10.3 INSTALLATION

Fig. 10.3 (a) shows the dimensions of the base of the robot main body.

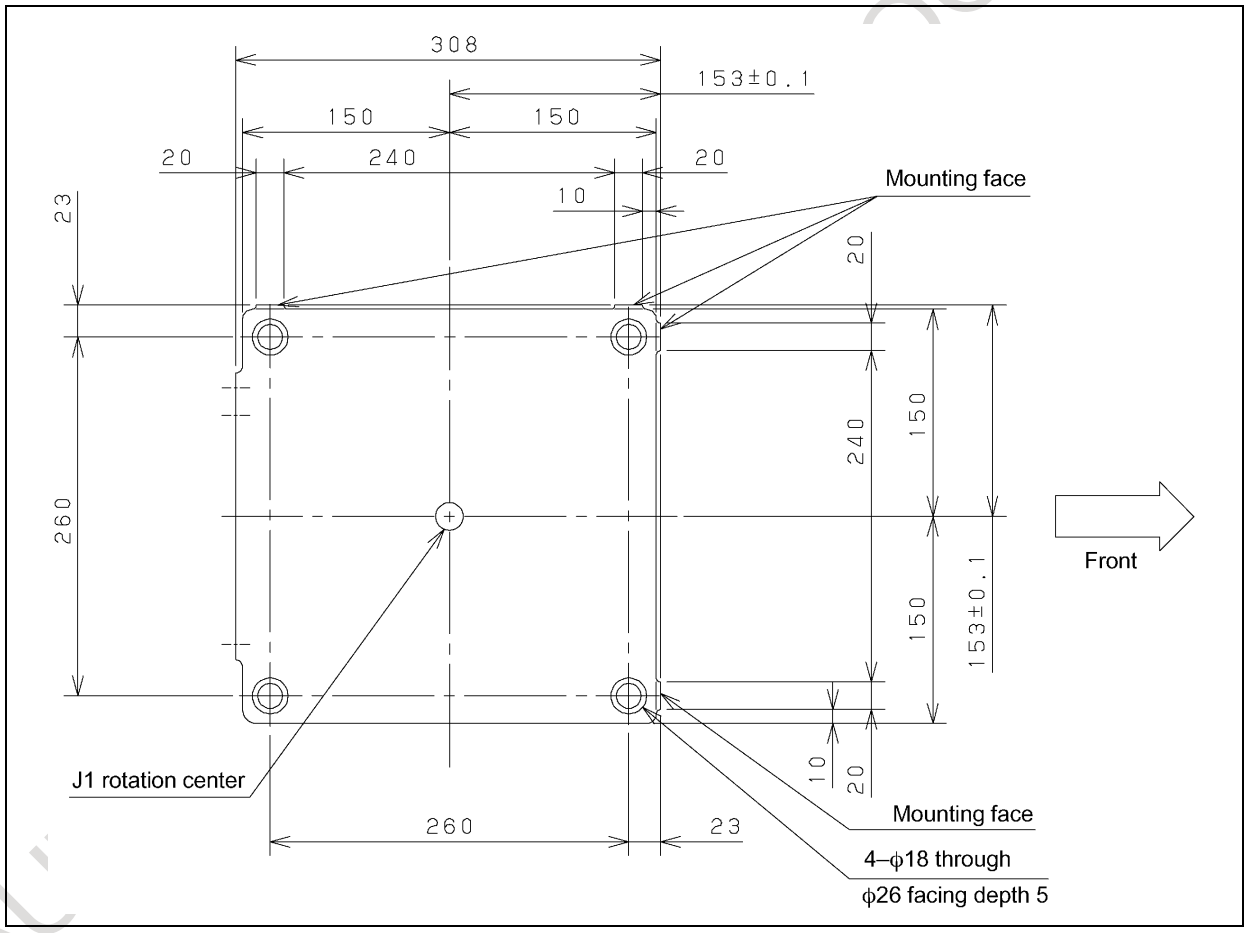


Fig. 10.3 (a) Dimensions of the base of the robot main body

Fig. 10.3 (b) shows an example of installing the robot. In this example, the sole plate is fixed with four M20 chemical anchors (in strength category 4.8), and the robot base is fastened to the sole plate with four M16×35 bolts (in strength category 12.9). If compatibility must be maintained in teaching the robot after the robot mechanical unit is replaced, use the mounting face.

NOTE
The customer shall arrange for the positioning pin, anchor bolts, and sole plate.

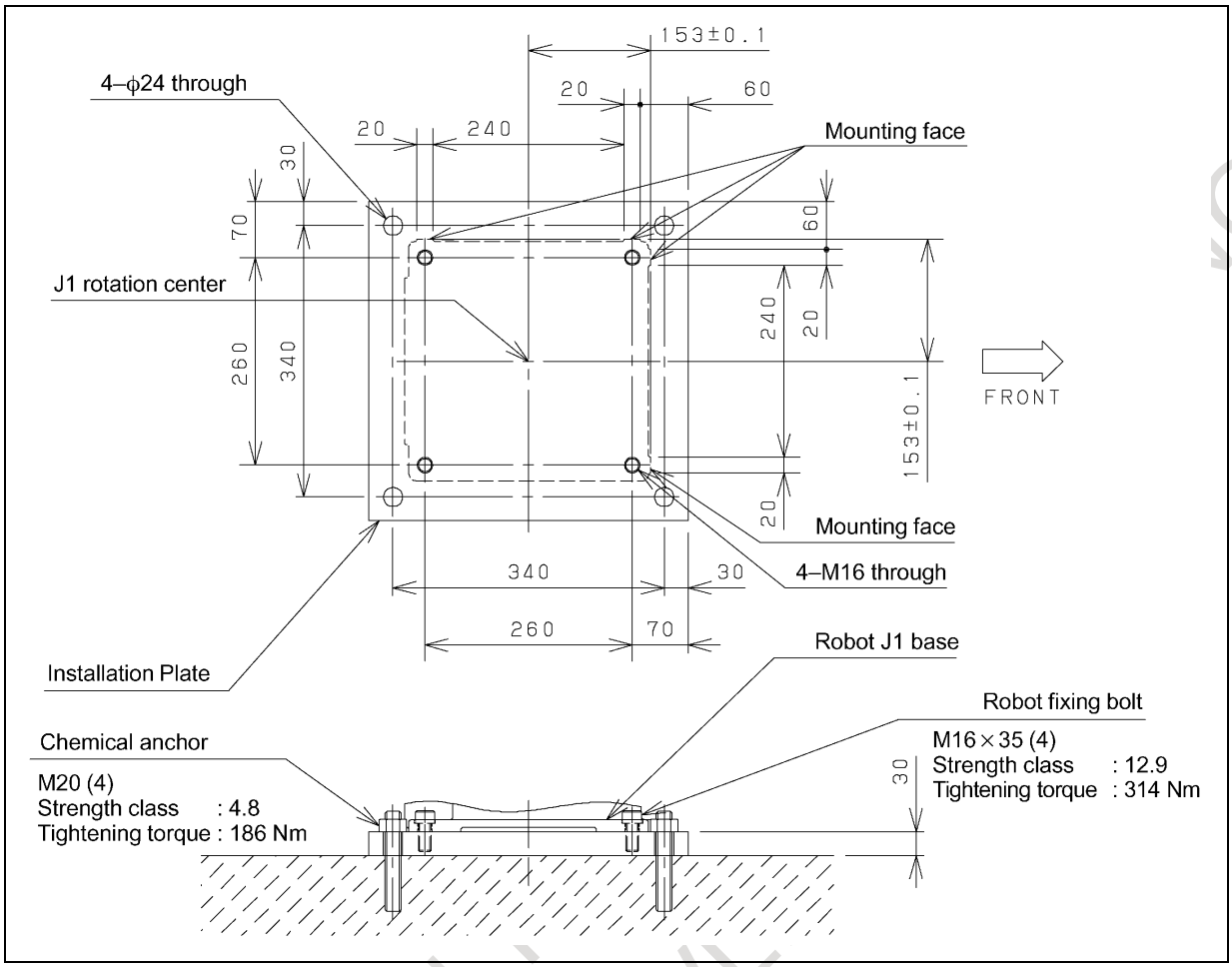


Fig. 10.3 (b) Example of installing the robot

Fig. 10.3 (c), (d) and Table 10.3 (a), (c) explain what load is put on the J1 base when the robot is at a rest, accelerating or decelerating, and at an emergency stop. Table 10.3(b),(d) indicate the coasting time and distance consumed from the pressing of the emergency stop button until the robot stops.

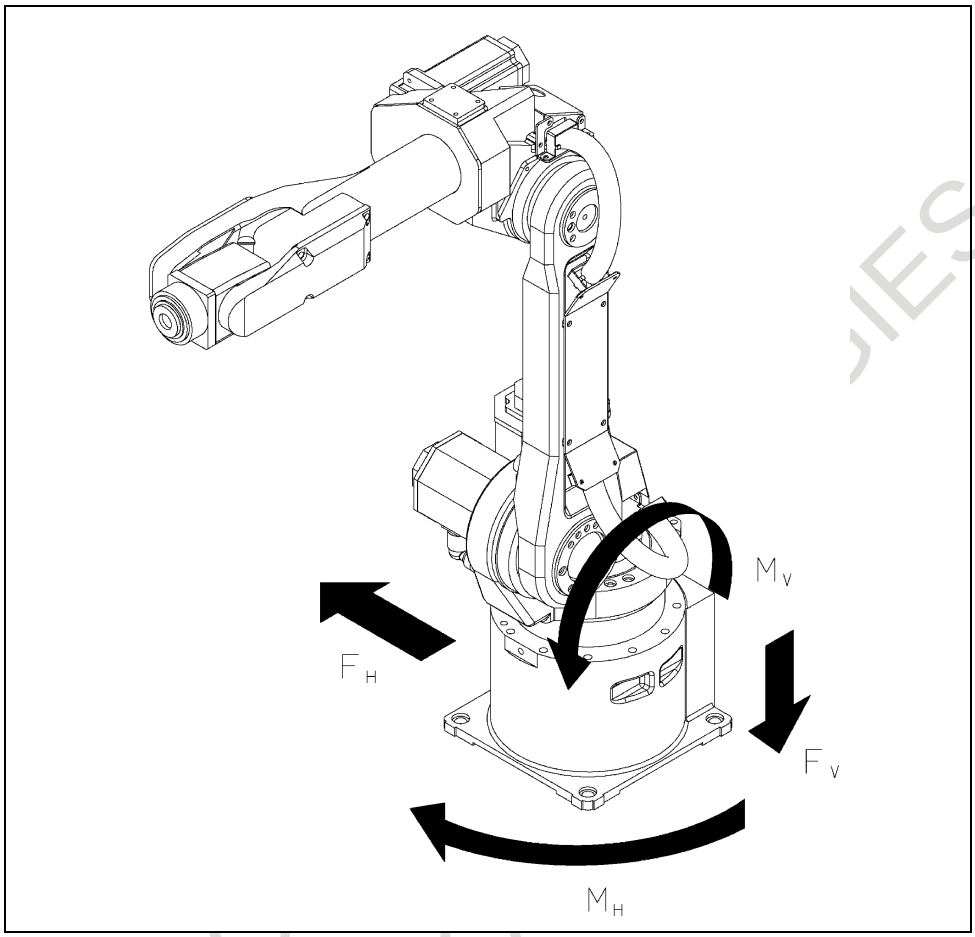


Fig. 10.3 (c) Load and moment applied to the J1 base ARC Mate 100*i*B, M-6*i*B,

Table 10.3 (a) Load and moment applied to the J1 base ARC Mate 100*i*B, M-6*i*B

State	Bending moment M_V [kgfm](Nm)	Vertical load F_V [kgf](N)	Torsion moment M_H [kgfm](Nm)	Horizontal load F_H [kgf](N)
At rest	[56] (549)	[230] (2254)	[0] (0)	[0] (0)
Accelerating or decelerating	[189] (1852)	[297] (2911)	[61] (598)	[105] (1029)
At an emergency stop	[724] (7095)	[677] (6635)	[231] (2264)	[252] (2470)

Table 10.3 (b) Stopping time and distance when emergency stop ARC Mate 100*i*B, M-6*i*B

Model		J1-axis	J2-axis	J3-axis
ARC Mate 100*i*B, M-6*i*B	Stopping time [msec]	127	69	47
	Stopping distance [deg] (rad)	7.2 (0.13)	4.9 (0.09)	4.1 (0.07)

* override : 100%

* Max payload, max speed and max inertia posture

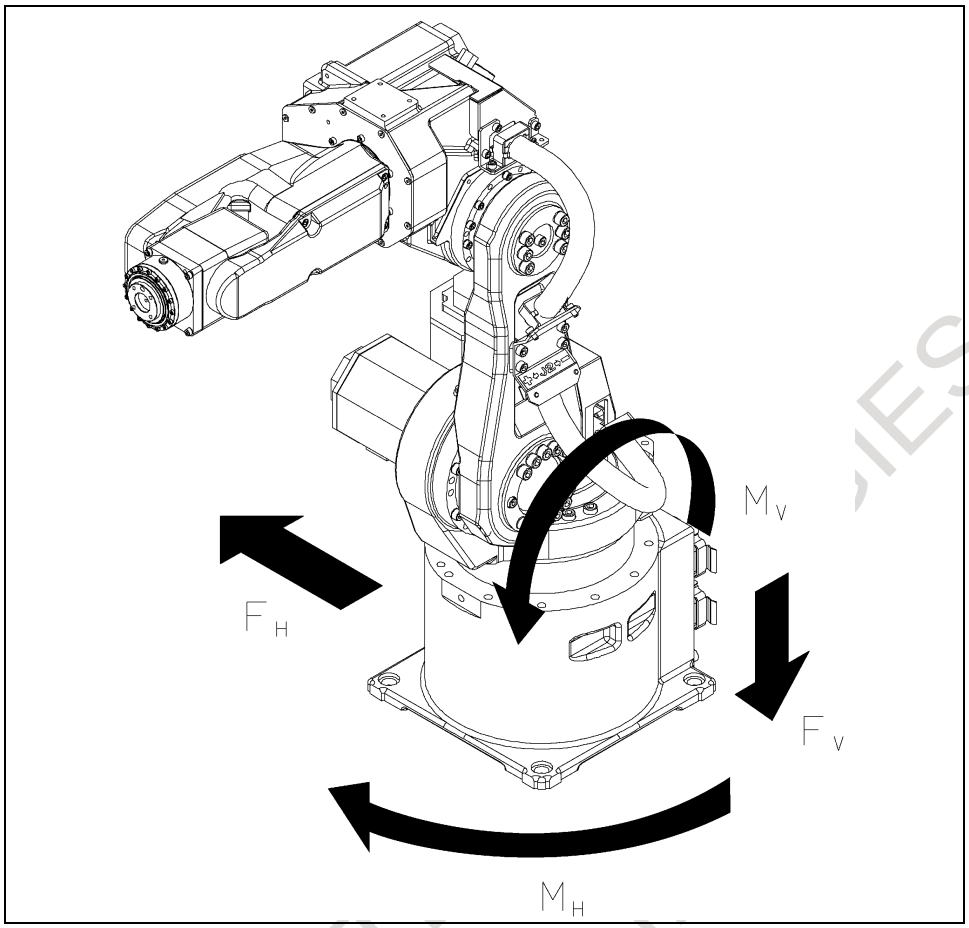


Fig. 10.3 (d) Load and moment applied to the J1 base ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

Table 10.3 (c) Load and moment applied to the J1 base ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

State	Bending moment M_V [kgfm](Nm)	Vertical load F_V [kgf](N)	Torsion moment M_H [kgfm](Nm)	Horizontal load F_H [kgf](N)
At rest	[34] (333)	[226] (2215)	[0] (0)	[0] (0)
Accelerating or decelerating	[138] (1352)	[282] (2764)	[39] (382)	[103] (1009)
At an emergency stop	[370] (3626)	[477] (4675)	[128] (1254)	[209] (2048)

Table 10.3 (d) Stopping time and distance when emergency stop ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

Model		J1-axis	J2-axis	J3-axis
ARC Mate 100*i*B/6S, M-6*i*B/6S	Stopping time [msec]	72	61	52
	Stopping distance [deg] (rad)	7.1 (0.12)	5.0 (0.09)	5.6 (0.10)
M-6*i*B/2HS	Stopping time [msec]	69	57	48
	Stopping distance [deg] (rad)	7.0(0.12)	4.7(0.08)	6.0(0.10)

* override : 100%
* Max payload, max speed and max inertia posture

10.4 MAINTENANCE CLEARANCE

Fig. 10.4 (a) and (c) show the clearance required in maintaining the robot.

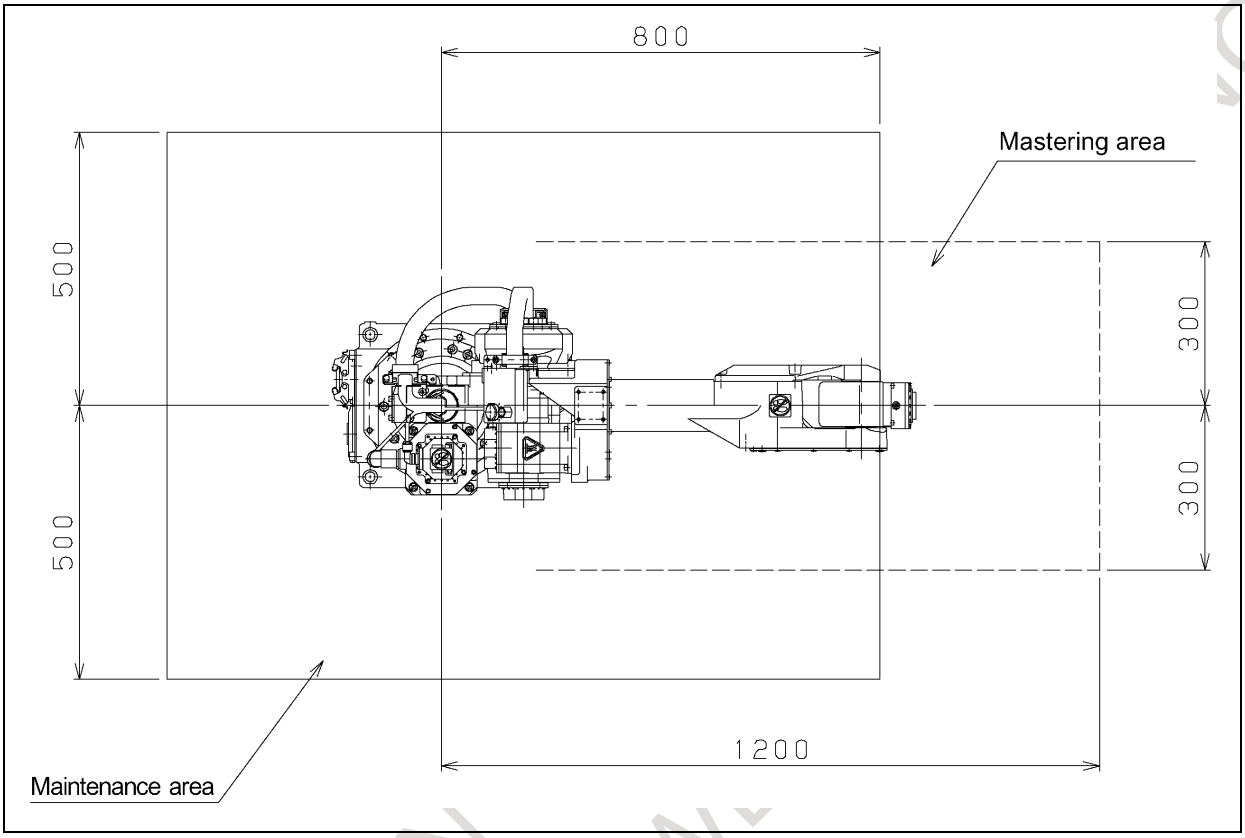


Fig. 10.4 (a) Maintenance clearance layout (Remote type controller) ARC Mate 100*i*B, M-6*i*B

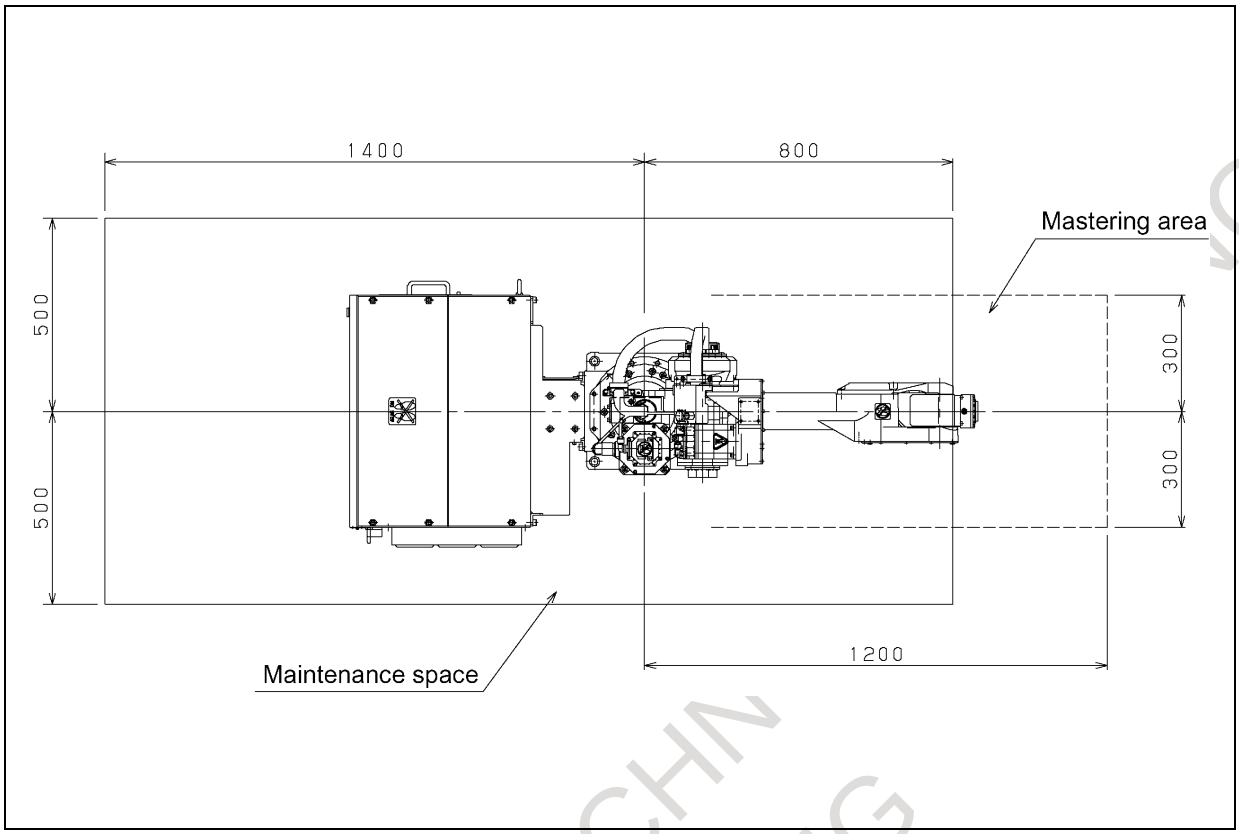


Fig. 10.4 (b) Maintenance clearance layout (integrated type controller) ARC Mate 100*i*B, M-6*i*B

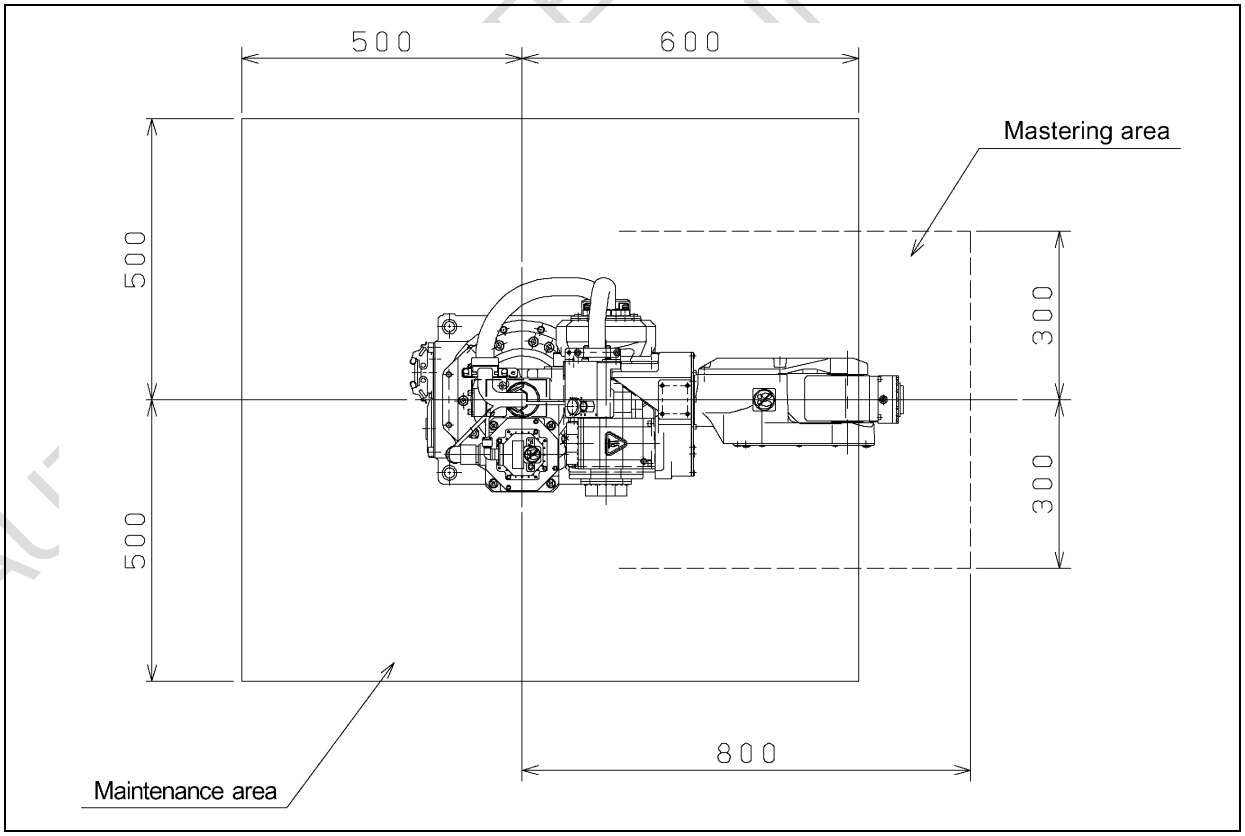


Fig. 10.4 (c) Maintenance clearance layout (Remote type controller) ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

The robot must be kept in the posture shown in Fig. 10.4 (d) and (e) during mastering. Provide such a clearance around the robot that the robot can take a posture of J1 = 0°.

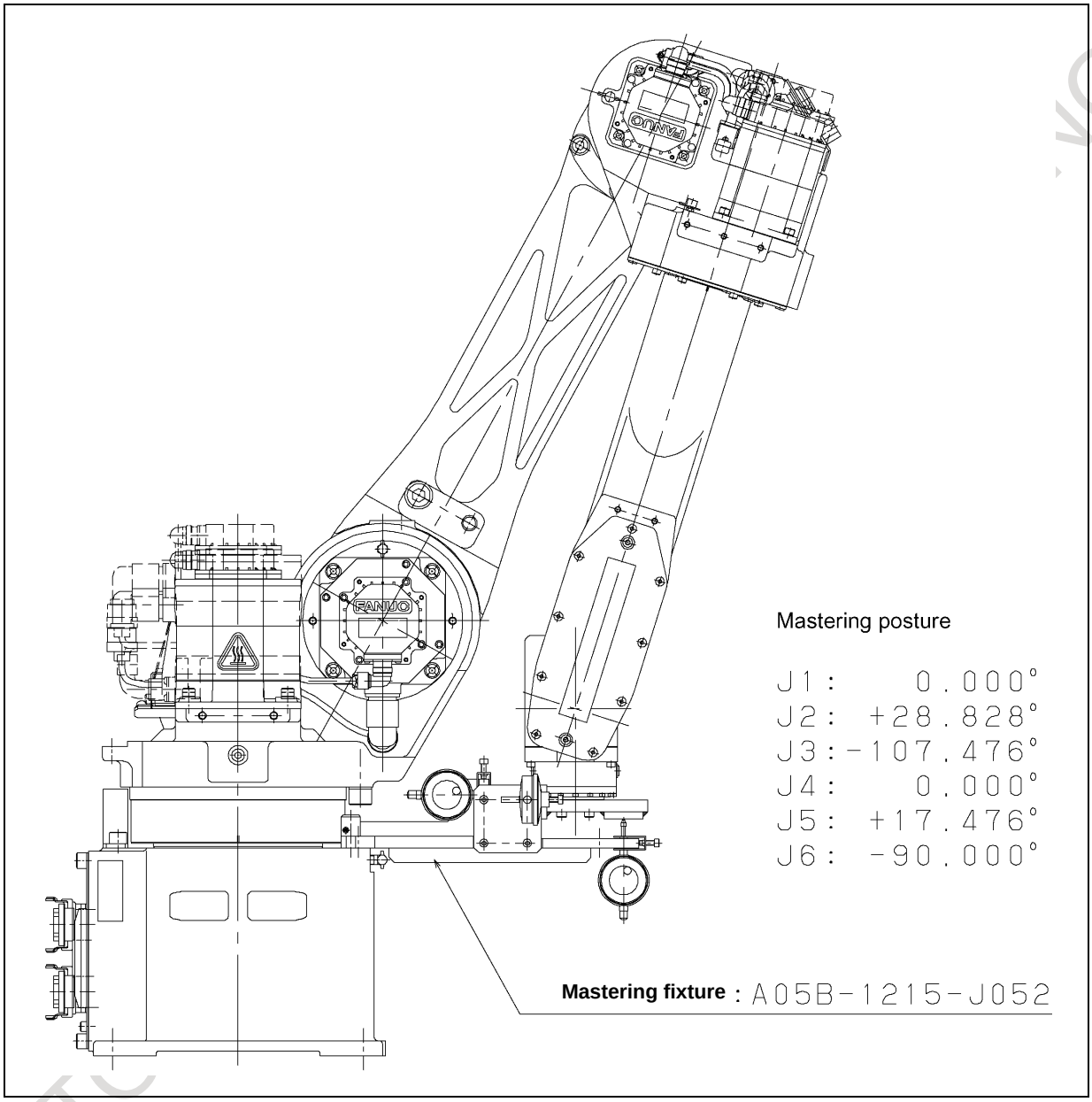


Fig. 10.4 (d) Robot posture for mastering ARC Mate 100*i*B, M-6*i*B

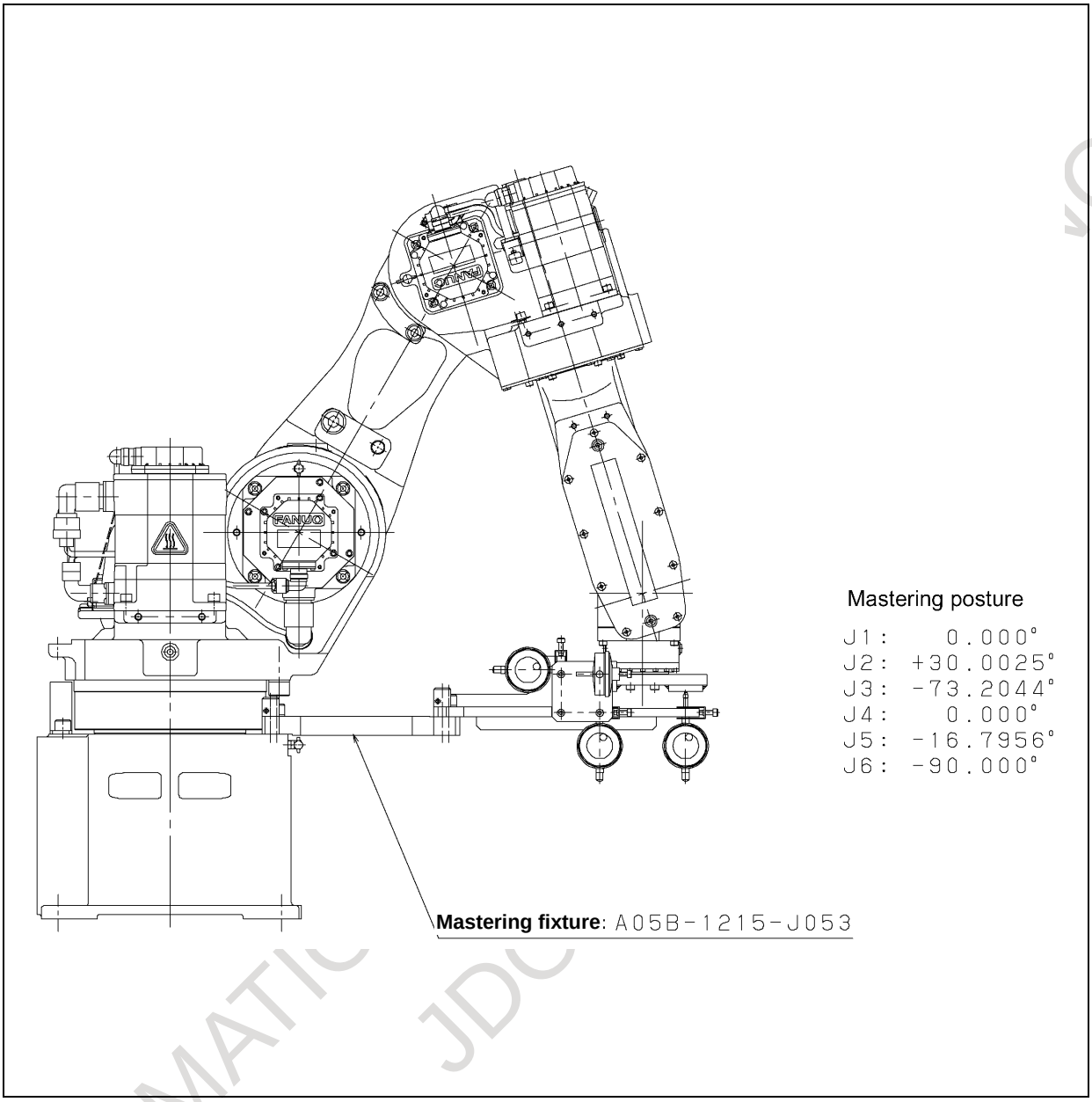


Fig. 10.4 (e) Robot posture for mastering ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS

10.5 ASSEMBLING THE ROBOT FOR INSTALLATION

If a separate controller is selected for the robot, the robot connection cables are detached from the connector board of the mechanical unit (they are left connected to the controller) when the robot is shipped. When installing the robot, attach the cables to the connector board of the mechanical unit shown in Fig. 10.5 (a).
When attaching the connectors, be careful not to pull the cables that have HARTING connectors.
Insert a washer for the ground cable so that the terminal is firmly secured.
The customer shall arrange for installation of cable ducts between the robot main body and its controller.

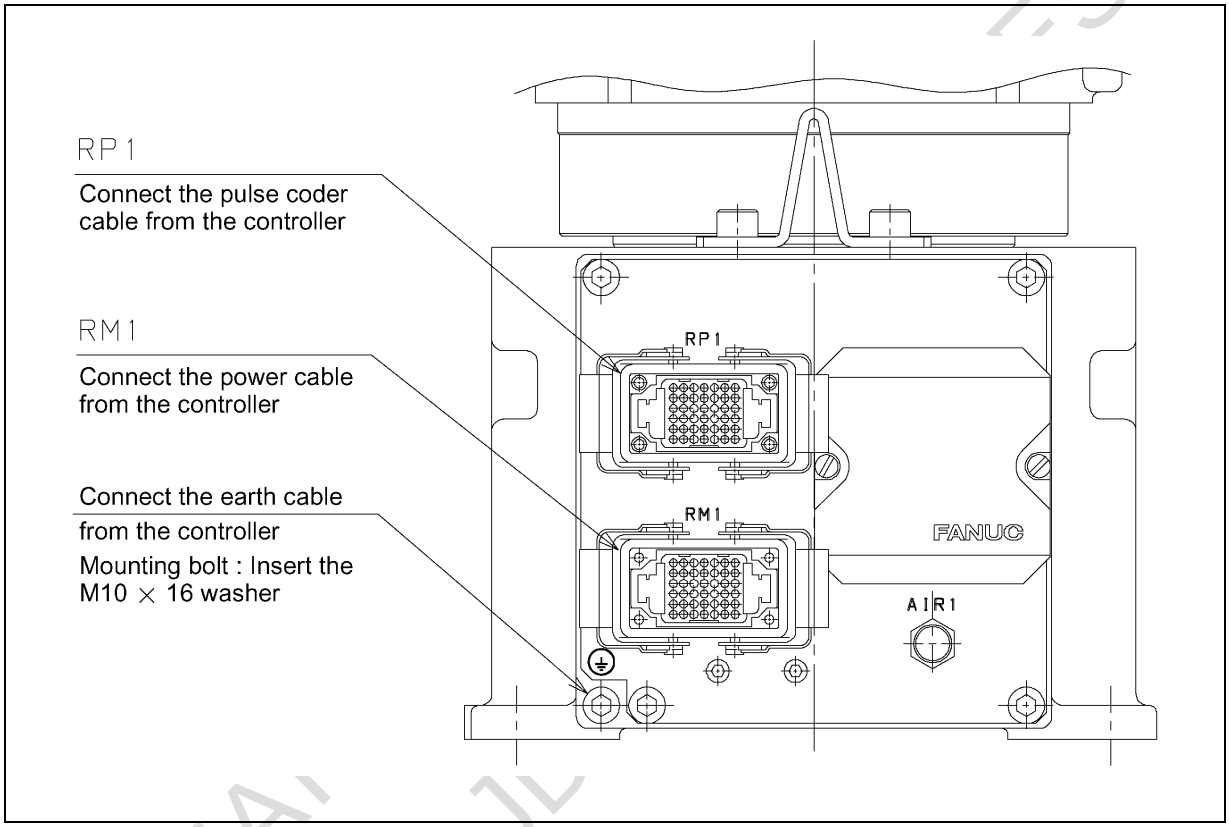


Fig. 10.5 (a) Cable connection panel for the robot mechanical unit

10.6 AIR PIPING

Fig. 10.6 (a) shows the air piping of the robot.
If the three-piece pneumatic option is selected, it comes with the air pipe to be installed between it and the mechanical unit. To use the option, the customer shall arrange for a three-piece pneumatic option mounting section that has the self-tapping screw holes whose dimensions and layout are specified in Fig. 10.6 (b) and for its installation.
The following figure assumes that the FANUC three-piece pneumatic option is selected. When the customer selects another option, refer to the interfaces in the following figure to prepare the required parts.

Cable specification	Outer (mm)	Inner (mm)
H203, H204, H224, H603, H604, H607, H624, H631, H634, H635, H636, H253, H254, H653, H654, H657	8	5
H205, H605, H606, H633	6.35	4.23
H632, H661	10	6.5

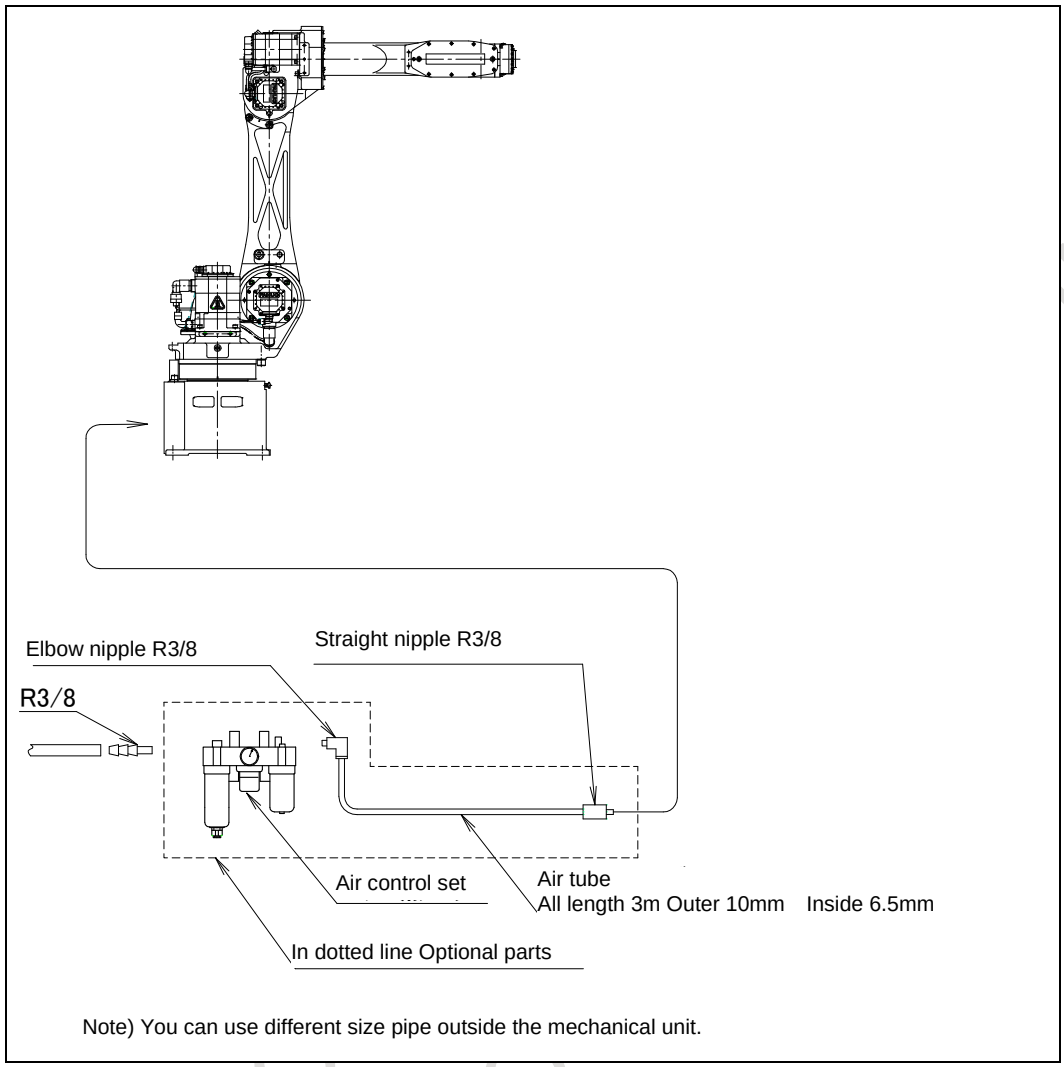


Fig. 10.6 (a) Air piping

Fill the oiler in the three-piece pneumatic option with any turbine oil between #90 and #140 to the specified level. The customer shall arrange for mounting bolts.

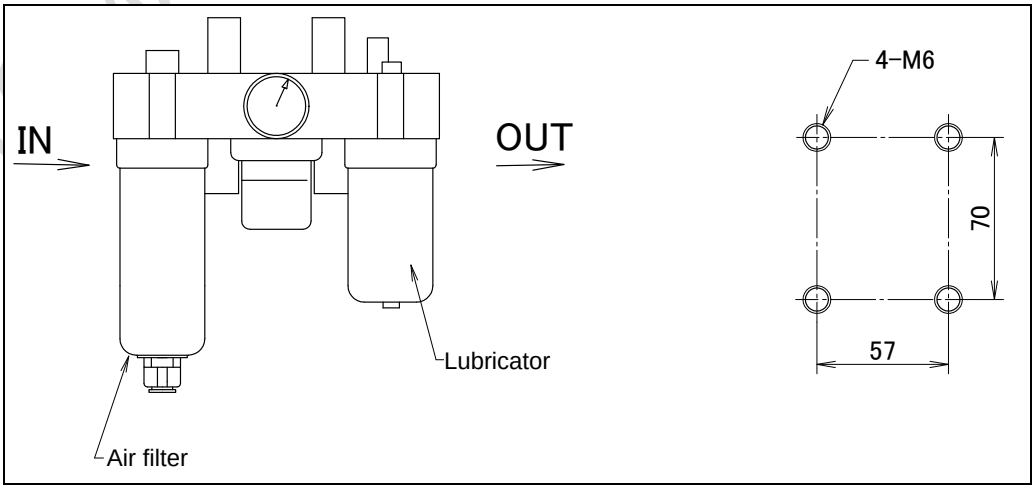


Fig. 10.6 (b) Air control set option (option)

10.7 INSTALLATION CONDITIONS

Table 10.7 (a) lists the installation conditions for the robot.

Table 10.7 (a) Installation conditions

Item		Specification
Pneumatic pressure	Supply air pressure	0.5 to 0.7 MPa (5 to 7 kg/cm^2) (set at 0.5 MPa (5 kg/cm^2))
	Consumption	Maximum instantaneous amount: 150 N*l*/min (Note 1)
Mechanical unit mass		ARC Mate 100*i*B, M-6*i*B About 134 kg: Type having two axes equipped with a brake (Remote type controller) About 138 kg: Type having six axes equipped with a brake (Remote type controller) About 222 kg: Type having two axes equipped with a brake (Integrated type controller) About 226 kg: Type having six axes equipped with a brake (Integrated type controller) ARC Mate 100*i*B/6S, M-6*i*B/6S, M-6*i*B/2HS About 135 kg: Type having six axes equipped with a brake (Remote type controller)
Allowable ambient temperature		0 to 45℃
Allowable ambient humidity		Regularly:75%RH or below Short period (within one month): 95%RH (maximum) or below : No condensation is allowed.
Atmosphere		There shall be no corrosive gas (Note 2).
Vibration		0.5 G or less

NOTE
1 This is the capacity of the three-piece pneumatic option. Use the robot at or below this value.
2 If you cannot avoid using the robot in an adverse environment with respect to vibration, dust, or coolant, contact your local FANUC representative.

11 CONNECTION WITH THE CONTROLLER

11.1 CONNECTION WITH THE CONTROLLER

The robot is connected with the controller via the power cable, the signal cable and the earth cable. In case of remote type controller, connect these cables to the connectors on the back of the robot base. For details on air and option cables, see Chapter 9. In case of integrated controller, it is not necessary.

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

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

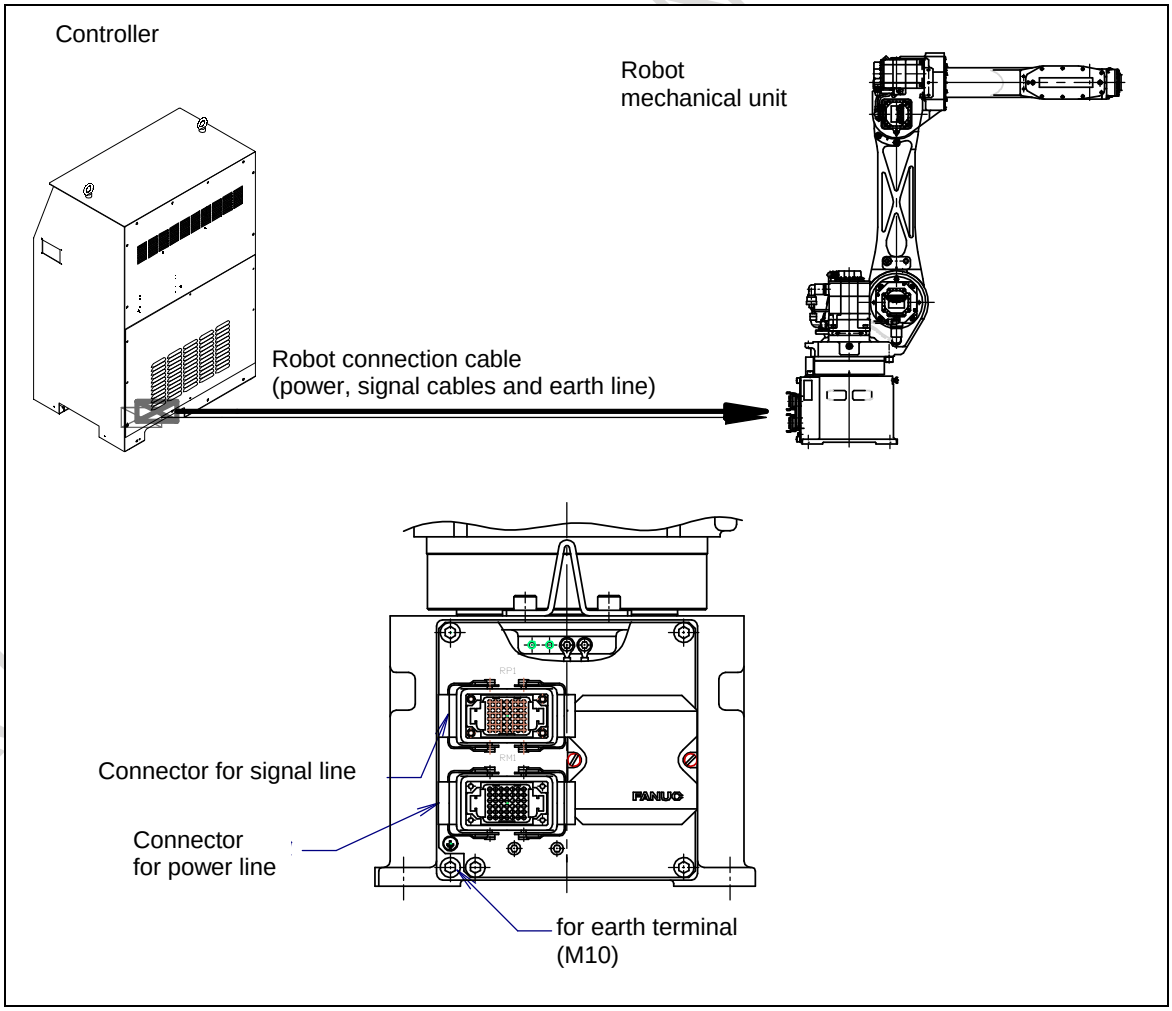


Fig. 11 (a) Cable connection

APPENDIX

A PERIODIC INSPECTION TABLE

FANUC Robot ARC Mate 100*i*B/M-6*i*B **Periodic Maintenance Table**

Items \ Accumulated operating time (H)			Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check the mechanical cable. (damaged or twisted)	0.2H	—		○			○				○			
	2	Check the motor connector. (loosening)	0.2H	—		○			○				○			
	3	Tighten the end effector bolt.	0.2H	—		○			○				○			
	4	Tighten the cover and main bolt.	2.0H	—		○			○				○			
	5	Remove spatter and dust etc.	1.0H	—		○			○				○			
	6	Check the hand cable	0.1H	—		○			○				○			
	7	Replacing battery.	0.1H	—							●					
	8	Greasing of J1 axis reducer	0.3H	1100 ml												
	9	Replacing grease of J2 axis reducer	0.3H	570ml												
	10	Replacing grease of J3 axis reducer	0.2H	300ml												
	11	Replacing grease of J4-axis gearbox reducer	0.3H	700ml												
	12	Replacing grease of J5-axis gearbox reducer	0.3H	290ml												
	13	Greasing of J6 axis reducer	0.2H	40ml					●				●			
	14	Replacing cable of mechanical unit	3.0H													
Controller	15	Check the robot cable and teach pendant cable *1	0.2H	—		○			○				○			
	16	Cleaning the ventilator *1	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	17	Replacing battery *1	0.1H	—												

*1 Refer to manual of controller

*2 ●: requires exchange of parts

○: does not require exchange of parts

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○				○				○				○				○					1
○				○				○				○				○					2
○				○				○				○				○					3
○				○				○				○				○					4
○				○				○				○				○					5
○				○				○				○				○					6
●						●						●						●			7
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○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		16
				●																	17

Overhaul

B STRENGTH OF BOLT AND BOLT TORQUE LIST

NOTE

When applying LOCTITE to a part, spread the LOCTITE on the entire length of the engaging part of the female thread. If applied to the male threads, poor adhesion can occur potentially loosening the bolt. Clean the bolts and the threaded holes and wipe off any oil on the engaging section. Make sure that there is no solvent left in the threaded holes. After you screw the bolts into the threaded holes, remove any excess LOCTITE.

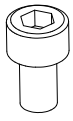
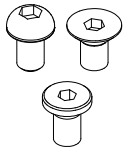
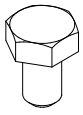
Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:

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

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

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

Recommended bolt tightening torques **Unit: Nm**

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

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