FANUC Robot M-900*i*A/350/260L/150P

MECHANICAL UNIT

OPERATOR'S MANUAL

B-82134EN/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.

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

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Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government.
Should you wish to export or re-export these products, please contact FANUC for advice.

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

SAFETY PRECAUTIONS

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

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

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

1 PERSONNEL

Personnel can be classified as follows.

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

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

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

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

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

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

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

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

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

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

2 DEFINITION OF SAFETY NOTATIONS

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

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

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

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

Name	Specification
Brake release unit	A05B-2450-J350 (Input Voltage AC100-115V single-phase) A05B-2450-J351 (Input Voltage AC200-240V single-phase)
Robot connection cable	A05B-2450-J360 (5m) A05B-2450-J361 (10m)
Power cable	A05B-2525-J010 (5m) (AC100-115V Power plug) (*) A05B-2525-J011 (10m) (AC100-115V Power plug) (*) A05B-2450-J364 (5m) (AC100-115V or AC200-240V No power plug) A05B-2450-J365 (10m) (AC100-115V or AC200-240V No power plug)

(*) These do not support CE marking.

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

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

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

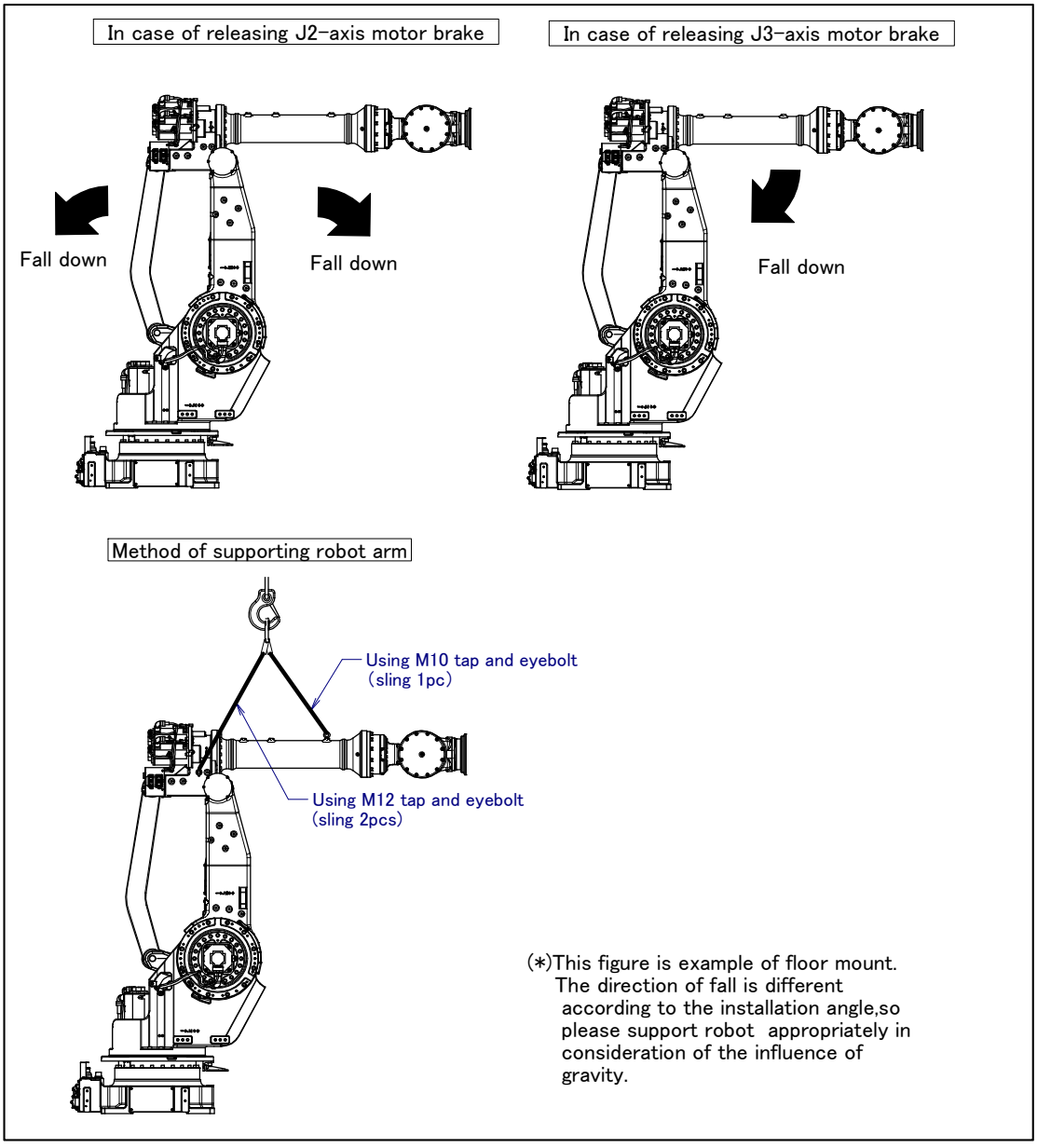

Fig. 3 (a) Arm operation by the release of J2, J3-axis motor brakes and measures

4 WARNING & CAUTION LABEL

(1) Greasing and degreasing label

Fig. 4 (a) Greasing and Degreasing Label

Description

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

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

> ⚠ **CAUTION**
> See Section 3.1 REPLACING GREASE OF THE DRIVE MECHANISM for explanations about specified grease, the grease amount, 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 tool such as heat-resistant gloves.

(4) Transportation label

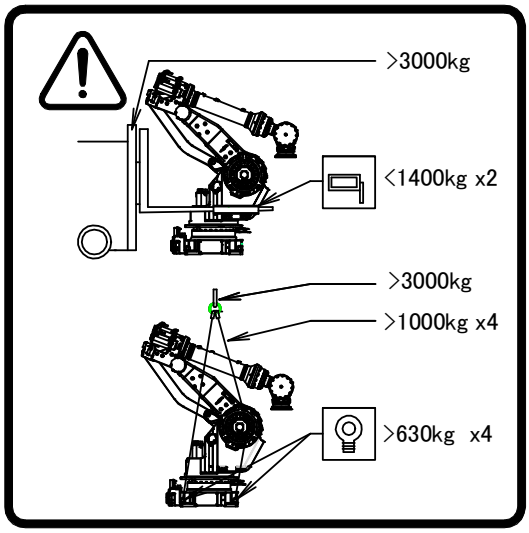

Fig. 4 (d) Transportation label (M-900*i*A/350/260L)

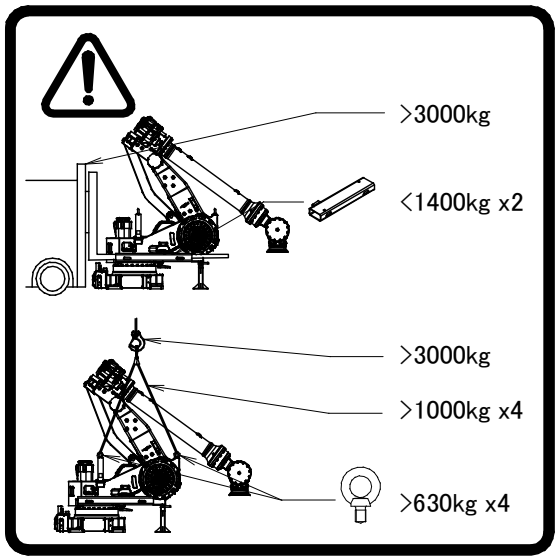

Fig. 4 (e) Transportation label (M-900*i*A/150P)

Description

When transporting the robot, observe the instructions indicated on this label. The above label indicates the following:

1 Using a forklift
- Use a forklift having a load capacity of 3000 kg or greater.
- Keep the total mass of the robot to be transported to within 2800 kg, because the allowable load of the forklift bracket (option) is 13720 N (1400 kgf).

2 Using a crane
- Use a crane having a load capacity of 3000 kg or greater.
- Use at least four slings each having a load capacity of 1000 kg or greater.
- Use at least four eyebolts each having an allowable load of 6174 N (630 kgf) or greater.

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

(5) Operating space and payload capacity label

When CE specification is specified, following label is added.

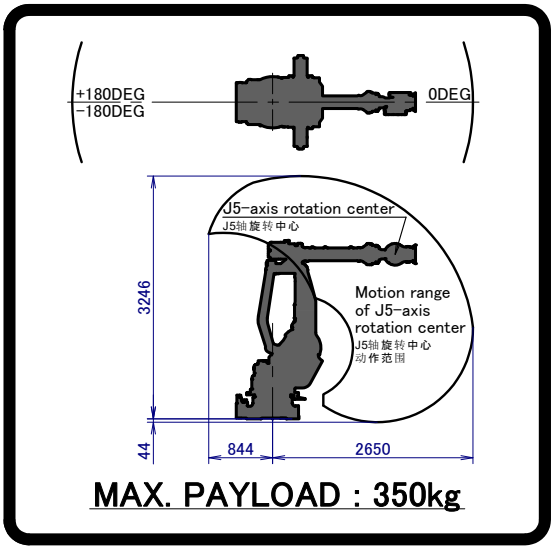

Fig. 4 (f) Operating space and payload capacity label (Example of M-900*i*A/350)

(6) Transportation prohibitive label (When transportation equipment option is specified.)

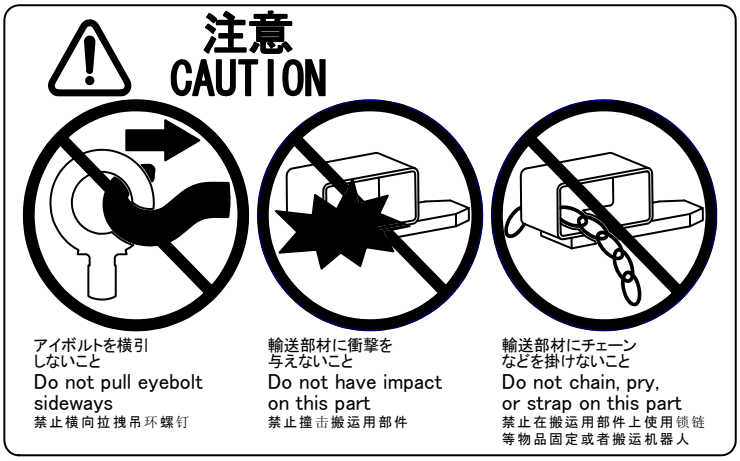

Fig. 4 (g) Transportation prohibitive label

Description

Keep the following in mind when transporting the robot.

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

(7) Fall prevention label (M-900*i*A/150P)

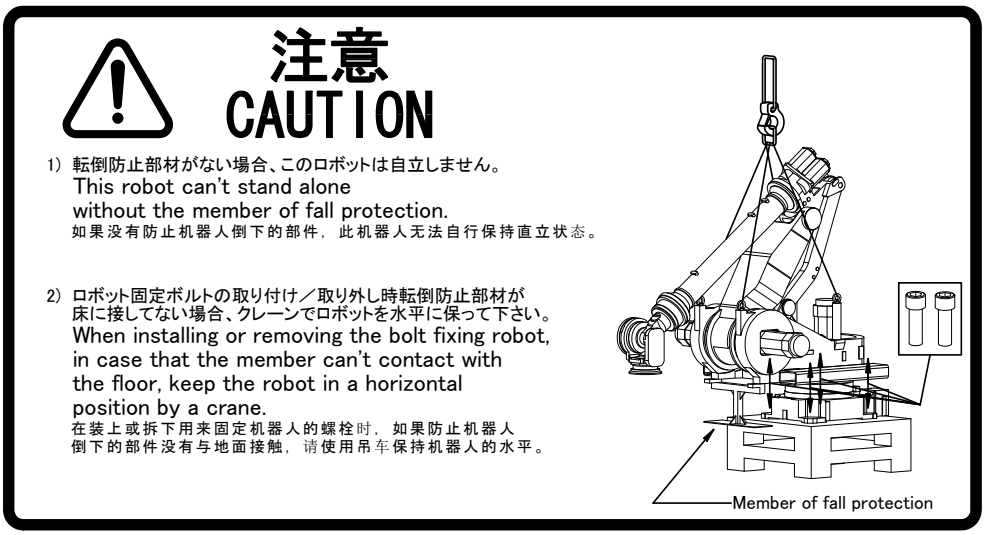

Fig. 4 (h) Fall prevention label

Description

1) This robot can't stand alone without the member of fall protection.
2) When installing or removing the bolt fixing robot, in case that the member can't contact with the floor, keep the robot in a horizontal position by a crane.

(8) Transportation caution label (M-900*i*A/150P)

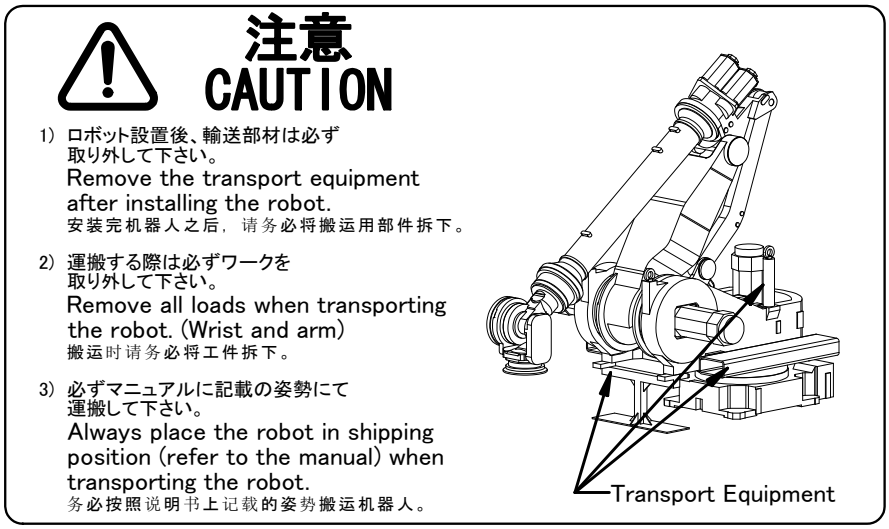

Fig. 4 (i) Transportation caution label

Description

1) Remove the transport equipment after installing the robot.
2) Remove all loads when transporting the robot. (Wrist and arm)
3) Always place the robot in shipping position (refer to the manual) when transporting the robot.

PREFACE

This manual explains the operation procedures for the following robots:

Model name	Mechanical unit specification No.	Maximum load	Controller
FANUC Robot M-900*i*A/350	A05B-1327-B201	350kg	R-J3*i*B
FANUC Robot M-900*i*A/260L	A05B-1327-B203	260kg	
FANUC Robot M-900*i*A/350	A05B-1327-B501	350kg	R-30*i*A/ R-30*i*B
FANUC Robot M-900*i*A/260L	A05B-1327-B503	260kg	
FANUC Robot M-900*i*A/150P	A05B-1327-B511	150kg	R-30*i*A/ R-30*i*B/ R-30*i*B Plus

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

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

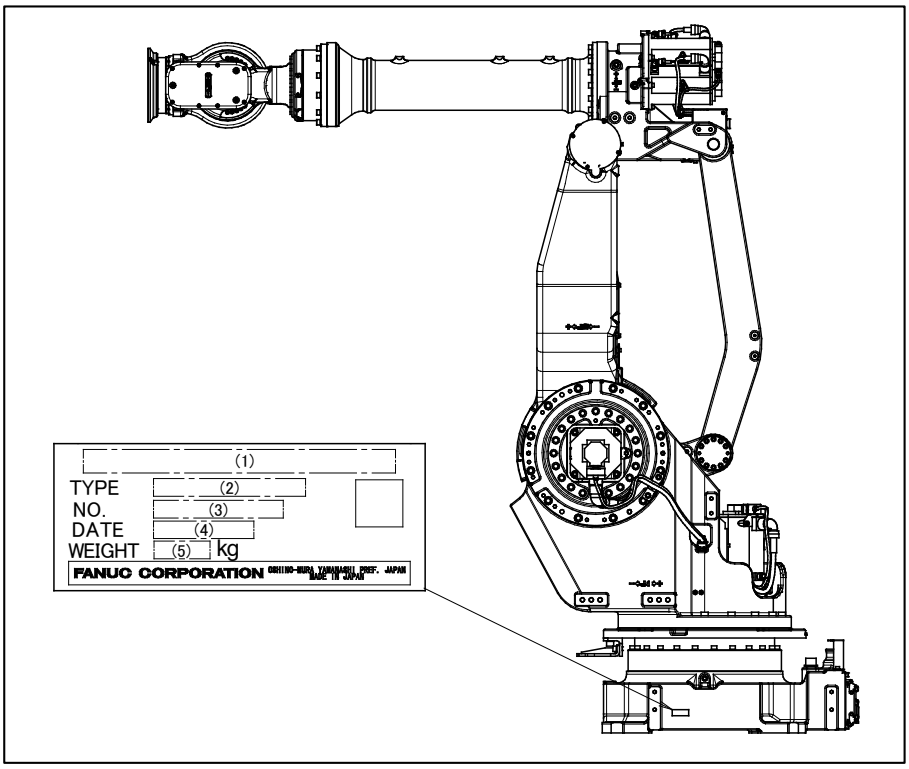

TABLE 1

No.	(1)	(2)	(3)	(4)	(5)
CONTENTS	MODEL NAME	TYPE	No.	DATE	WEIGHT (Without controller)
LETTERS	FANUC Robot M-900*i*A/350	A05B-1327-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	1720 kg
	FANUC Robot M-900*i*A/260L	A05B-1327-B203			1800 kg
	FANUC Robot M-900*i*A/350	A05B-1327-B501			1720 kg
	FANUC Robot M-900*i*A/260L	A05B-1327-B503			1800 kg
	FANUC Robot M-900*i*A/150P	A05B-1327-B511			1860 kg

Position of label indicating mechanical unit specification number

Specifications (NOTE 1)

Item			M-900*i*A/350	M-900*i*A/260L	M-900*i*A/150P
Type			Articulated Type		
Controlled axes			6 axes (J1, J2, J3, J4, J5, J6)		
Installation (NOTE 2)			Floor mount, Upside-down (Angle mount)		Rack mount
Motion range	J1-axis		360° (6.28rad)	360° (6.28rad)	360° (6.28rad)
	J2-axis		150° (2.62rad)	150° (2.62rad)	180° (3.14 rad)
	J3-axis		223.4° (3.90rad)	211.28° (3.69rad)	180° (3.14 rad)
	J4-axis		720° (12.57rad)	720° (12.57rad)	720° (12.57rad)
	J5-axis		250° (4.36rad)	250° (4.36rad)	250° (4.36rad)
	J6-axis		720° (12.57rad)	720° (12.57rad)	720° (12.57rad)
Max. Motion speed (NOTE 3)	J1-axis		100°/s (1.75rad/s)	100°/s (1.75rad/s)	110°/s (1.92rad/s)
	J2-axis		95°/s (1.66rad/s)	105°/s (1.83rad/s)	95°/s (1.66 rad/s)
	J3-axis		95°/s (1.66rad/s)	95°/s (1.66rad/s)	95°/s (1.66 rad/s)
	J4-axis		105°/s (1.83rad/s)	120°/s (2.09rad/s)	120°/s (2.09rad/s)
	J5-axis		105°/s (1.83rad/s)	120°/s (2.09rad/s)	120°/s (2.09rad/s)
	J6-axis		170°/s (2.97rad/s)	200°/s (3.49rad/s)	200°/s (3.49rad/s)
Max. load capacity	At wrist		350kg	260kg	150kg
	On J3 arm		25kg	25kg	25kg
	On J2 base		550kg	550kg	
Allowable load moment at wrist	J4		1960N·m (200kgf·m)	1666N·m (170kgf·m)	1666N·m (170kgf·m)
	J5		1960N·m (200kgf·m)	1666N·m (170kgf·m)	1666N·m (170kgf·m)
	J6		891.8N·m (91kgf·m)	715.4N·m (73kgf·m)	715.4N·m (73kgf·m)
Allowable load inertia at wrist	J4	standard inertia mode	235.2kg·m^2 (2400kgf·cm·s^2)	188.2kg·m^2 (1920kgf·cm·s^2)	313.6kg·m^2 (3200kgf·cm·s^2)
		high inertia mode	392kg·m^2 (4000kgf·cm·s^2)	313.6kg·m^2 (3200kgf·cm·s^2)	
	J5	standard inertia mode	235.2kg·m^2 (2400kgf·cm·s^2)	188.2kg·m^2 (1920kgf·cm·s^2)	313.6kg·m^2 (3200kgf·cm·s^2)
		high inertia mode	392kg·m^2 (4000kgf·cm·s^2)	313.6kg·m^2 (3200kgf·cm·s^2)	
	J6	standard inertia mode	156.8kg·m^2 (1600kgf·cm·s^2)	117.6kg·m^2 (1200kgf·cm·s^2)	225.4kg·m^2 (2300kgf·cm·s^2)
		high inertia mode	352.8kg·m^2 (3600kgf·cm·s^2)	225.4kg·m^2 (2300kgf·cm·s^2)	
Drive method			Electric servo drive by AC servo motor		
Repeatability (NOTE 4)			±0.1mm		±0.3mm
Mass (NOTE 5)			Approx.1720kg	Approx.1800kg	Approx.1860kg
Acoustic noise level (NOTE 6)			76.3dB		
Installation environment			Ambient temperature: 0 - 45°C (Note 7) Ambient humidity: Normally 75%RH or less No dew, nor frost allowed. Short time (within one month) Max 95%RH Height: Up to 1000 meters above the sea level required, no particular provision for attitude. Vibration acceleration: 4.9m/s^2 (0.5G) or less Free of corrosive gases (Note 8)		

NOTE 1) Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat. Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.
NOTE 2) The operation range of the J1-axis and J2-axis are limited to the installation condition.
NOTE 3) During short distance motions, the axis speed may not reach the maximum value stated.
NOTE 4) Compliant with ISO 9283.
NOTE 5) It doesn't contain the mass of the control part.
NOTE 6) This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.
- Maximum load and speed
- Operating mode is AUTO

NOTE 7) When robot is used in low temperature environment that is near to 0ºC, or robot is not operated for a long time in the environment that is less than 0ºC in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing the warm up operation for several minute.
NOTE 8) Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, water, water vapor, cutting oil, cleaning fluid splash and or other foreign materials.

RELATED MANUALS

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

Safety handbook B-80687EN All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers: Operator, system designer Topics: Safety items for robot system design, operation, maintenance
R-J3*i*B controller	Operator's manual SPOT TOOL **B-81464EN-1** HANDLING TOOL **B-81464EN-2** 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) **B-81505EN** (For RIA)	Intended readers: Maintenance technician, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance
R-30*i*A controller	Operator's manual SPOT TOOL+ **B-83124EN-1** HANDLING TOOL **B-83124EN-2** DISPENSE TOOL **B-83124EN-4** ALARM CODE LIST **B-83124EN-6** SERVO GUN FUNCTION **B-82634EN**	Intended readers: Operator, programmer, maintenance technician, system designer Topics: Robot functions, operations, programming, setup, interfaces, alarms Use: Robot operation, teaching, system design
	Maintenance manual **B-82595EN** **B-82595EN-1** (For Europe) **B-82595EN-2** (For RIA)	Intended readers: Maintenance technician, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance
R-30*i*B, R-30*i*B Plus controller	Operator's manual (Basic Operation) **B-83284EN** (Alarm Code List) **B-83284EN-1** Optional Function **B-83284EN-2** Spot Welding Function **B-83284EN-4** Dispense Function **B-83284EN-5** Servo Gun Function **B-83264EN**	Intended readers: Operator, programmer, maintenance technician, system designer Topics: Robot functions, operations, programming, setup, interfaces, alarms Use: Robot operation, teaching, system design
	Maintenance manual **B-83195EN**	Intended readers: Maintenance technician, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance

This manual uses following terms.

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

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1 CONFIGURATION

The configuration of the mechanical unit is shown in Fig. 1 (a).

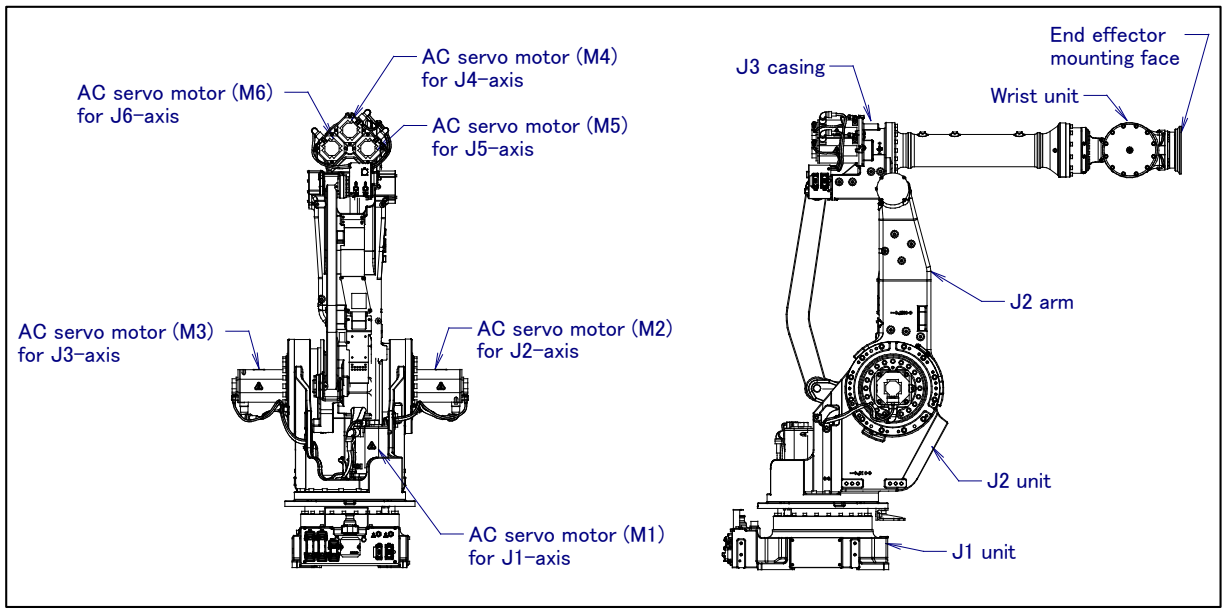


Fig. 1 (a) Mechanical unit configuration

2 CHECKS AND MAINTENANCE

Optimum performance of the robot can be maintained by performing the checks and maintenance procedures presented in this chapter. (See the APPENDIX C 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 CHECKS AND MAINTENANCE

2.1.1 Daily Checks

Check the following items when necessary before daily system operation.

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is an oil seepage, clean it. **⇒"2.2.1 Confirmation of Oil Seepage"**
Air control set	(When air control set is used) **⇒"2.2.2 Confirmation of the Air Control Set"**
Vibration, Abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: **⇒"4.1 TROUBLESHOOTING"(symptom : Vibration, Noise)**
Positioning accuracy	Check that the taught positions of the robot have not deviated from the previously taught positions. If displacement occurs, perform the measures as described in the following section: **⇒"4.1 TROUBLESHOOTING"(Symptom : Displacement)**
Peripheral equipment for proper operation	Check whether the peripheral equipment operate properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the droppage of the end effector mounting face is within 0.2 mm when the servo power turned off. If the end effector (hand) drops, perform the measures as described in the following section: **⇒"4.1 TROUBLESHOOTING"(symptom : Dropping axis)**
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: **⇒"R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)** **or R-30*i*A/R-30*i*A Mate CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83124EN-6)** **or R-J3*i*B CONTROLLER SPOT TOOL OPERATOR'S MANUAL(B-81464EN-1)** **or R-J3*i*B CONTROLLER HANDLING TOOL OPERATOR'S MANUAL(B-81464EN-2)** **or R-J3*i*B CONTROLLER SEALING TOOL OPERATOR'S MANUAL(B-81464EN-3)"**

2.1.2 Periodic Checks and Maintenance

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

Check and maintenance intervals (Period, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	3 years 11520h	4 years 15360h			
○ Only 1st check	○					Cleaning the controller ventilation system	Check whether dust is accumulated in the controller ventilation system. Remove them if any.	21
	○					Check the external damage or peeling paint	Check whether the robot has external damage or peeling paint due to the interference with the peripheral equipment. If an interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check damages of the cable protective sleeves	Check whether the cable protective sleeves of the mechanical unit cable have holes or tears. If damage is found, replace the cable protective sleeve. If the cable protective sleeve is damaged due to the interference with peripheral equipment, eliminate the cause. **⇒"2.2.3 Check the Mechanical Unit Cables and Connectors"**	2
	○					Check wear debris of the J1-axis swing stopper	Check whether wear debris is generated on the J1-axis swing stopper rotation part. If serious wear occurs on the part that generated the wear debris, replace the part.	3
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.	4
	○ Only 1st check	○				Check for damages to the teach pendant cable, the operation box connection cable or the robot connection cable	Check whether the cables connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.	22
	○ Only 1st check	○				Check for damage to the mechanical unit cable (movable part)	Observe the movable part of the mechanical unit cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted. **⇒"2.2.3 Check the Mechanical Unit Cable and Connectors"**	5
	○ Only 1st check	○				Check for damage to the end effector (hand) cable	Check whether the end effector cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.	6
	○ Only 1st check	○				Check the connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"2.2.3 Check the Mechanical Unit Cable and Connectors"**	7

Check and maintenance intervals (Period, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Retightening the end effector mounting bolts	Retighten the end effector mounting bolts. Refer to the following section for tightening torque information: **⇒"9.3 END EFFECTOR INSTALLATION TO WRIST"**	8
	○ Only 1st check	○				Retightening the external main bolts	Retighten the bolts which are installed, removed in the inspection, and exposed. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with torque greater than the recommended one, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	9
	○ Only 1st check	○				Check the fixed mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the fixed mechanical stopper, the adjustable mechanical stopper, and check that the stopper mounting bolts are not loose. Check that the J1-axis swing stopper rotates smoothly. **⇒"2.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"**	10
	○ Only 1st check	○				Clean spatters, sawdust and dust	Check that spatters, sawdust, or dust does not exist on the robot main body. If dust has accumulated, remove it. Especially, clean the robot movable parts well (each joint, and the cable protective sleeve).	11
	○ Only 1st check	○				Check the operation of the cooling fan	(When cooling fans are installed on the each axis motor) Check whether the cooling fans are operating correctly. If the cooling fans do not operate, replace them.	12
			○			Replacing the mechanical unit batteries	Replace the mechanical unit batteries. Regardless of operating time, replace batteries at 1.5 years. **⇒"3.3 REPLACING THE BATTERIES"**	13
		○ (*)		○ (*)		Supply grease to J2/J3-axis connection part bearing	Supply grease to J2/J3-axis connection part bearing (*) Periodic interval differs according to the model. 150P :1 year (3840 hours) 350/260L : 3 years (11520 hours) **⇒"3.2 GREASING OF J2/J3-AXIS CONNECTION PART BEARING"**	14
		○ (*)		○ (*)		Replacing the grease of drive mechanism	Replace the grease of each axis reducer and gearbox (*) Periodic interval differs according to the model. 150P :1 year (3840 hours) 350/260L : 3 years (11520 hours) **⇒"3.1 REPLACING THE GREASE OF THE DRIVE MECHANISM"**	15 to 19
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	20

Check and maintenance intervals (Period, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	3 years 11520h	4 years 15360h			
					○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. **⇒Refer to "Chapter 7 Replacing batteries of R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) R-30*i*A CONTROLLER MAINTENANCE MANUAL (B-82595EN) R-30*i*A CONTROLLER MAINTENANCE MANUAL (CE specification) (B-82595EN-1) R-30*i*A CONTROLLER MAINTENANCE MANUAL (RIA specification) (B-82595EN-2) R-J3*i*B CONTROLLER MAINTENANCE MANUAL (B-81465EN) R-J3*i*B CONTROLLER MAINTENANCE MANUAL (CE specification) (B-81465EN-1) R-J3*i*B CONTROLLER MAINTENANCE MANUAL (RIA specification) (B-81505EN)"**	23

2.2 CHECK POINTS

2.2.1 Confirmation of Oil Seepage

Check items

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

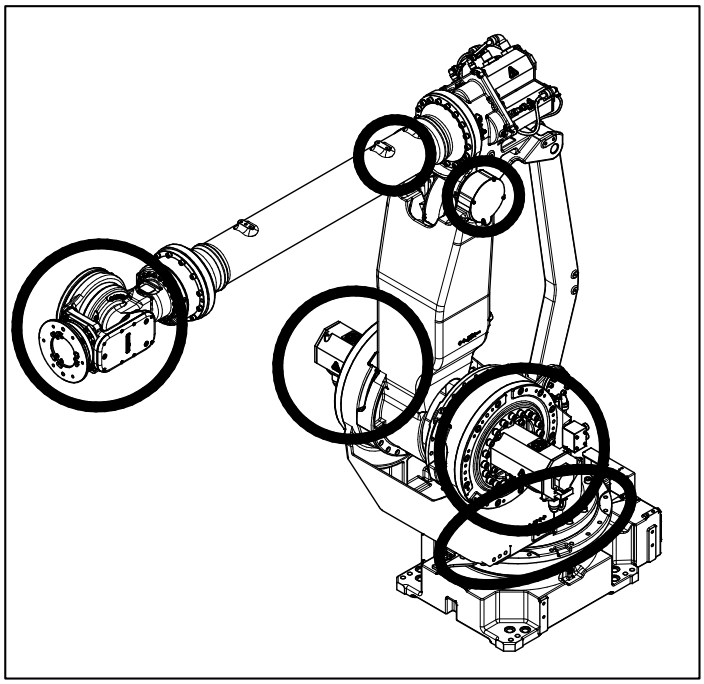


Fig. 2.2.1 (a) Check parts of oil seepage

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil changes to a state of liquid, the oil might fall depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components before you operate the robot.
- Also, motors might become hot and the internal pressure of the grease bath might rise by frequent repetitive movement and use in high temperature environments. In these cases, normal internal pressure can be restored by venting the grease outlet. (When opening the grease outlet, refer to Subsection 3.1 and ensure that grease is not expelled onto the machine or tooling.)

> ⚠ **WARNING**
> Hot grease might eject suddenly when you open the grease outlet. Attach bags for collecting grease, and use appropriate protective equipment such as heat-resistant gloves, protective glasses, a face shield, or a body suit if necessary.

- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.
  ⇒" 4.1 TROUBLESHOOTING" (Symptom : Grease leakage)

2.2.2 Confirmation of the Air Control Set (option)

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

Item	Check items	Check points
1	Air pressure	Check the air pressure using the pressure gauge on the air regulator as shown in Fig. 2.2.2 (a). If it does not meet the specified pressure of 0.49 to 0.69 MPa (5-7 kgf/cm^2), adjust it using the regulator pressure-setting handle.
2	Lubricator oil mist quantity	Check the number of oil drops during operation. If it does not meet the specified value (1 drop/10-20 sec), adjust it using the lubricator control knob. The lubricator becomes empty in about 10 to 20 days under normal operation.
3	Lubricator oil level	Check to see that the air control set oil level is within the specified level.
4	Leakage from hose	Check the joints, tubes, etc. for leaks. Retighten the joints or replace parts, as required.
5	Drain	Check the drain and release it. When quantity of the drain is remarkable, examine the setting of the air dryer to the air supply side.

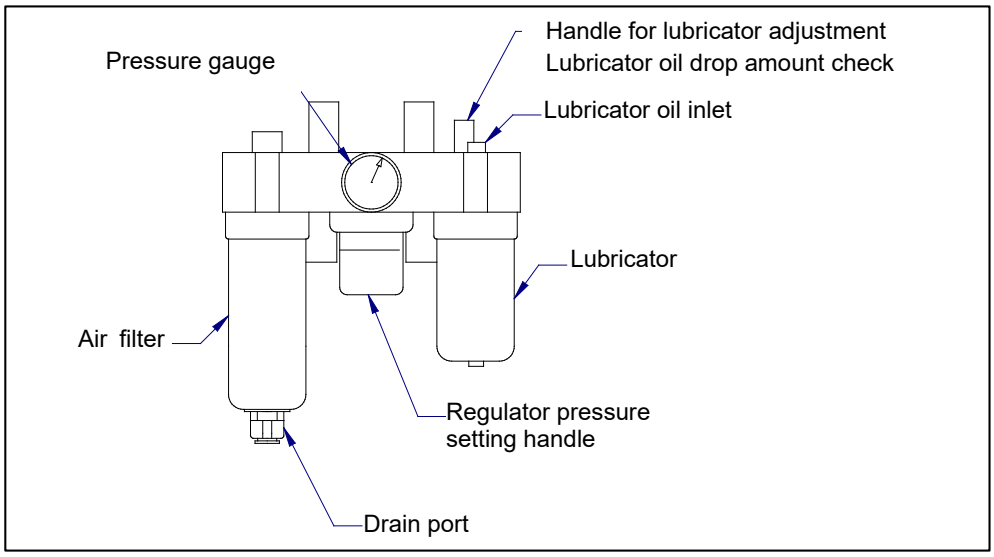


Fig. 2.2.2 (a) Air control set (option)

2.2.3 Check the Mechanical Unit Cables and Connectors

Check points of the mechanical unit cables

Fixed part cables can interfere with the J1, J2, and J3 movable parts and peripheral equipment.

* For the J1-axis, inspect the cables from above the J2 base and from the side by removing the metal plate on the side of the J1 base.

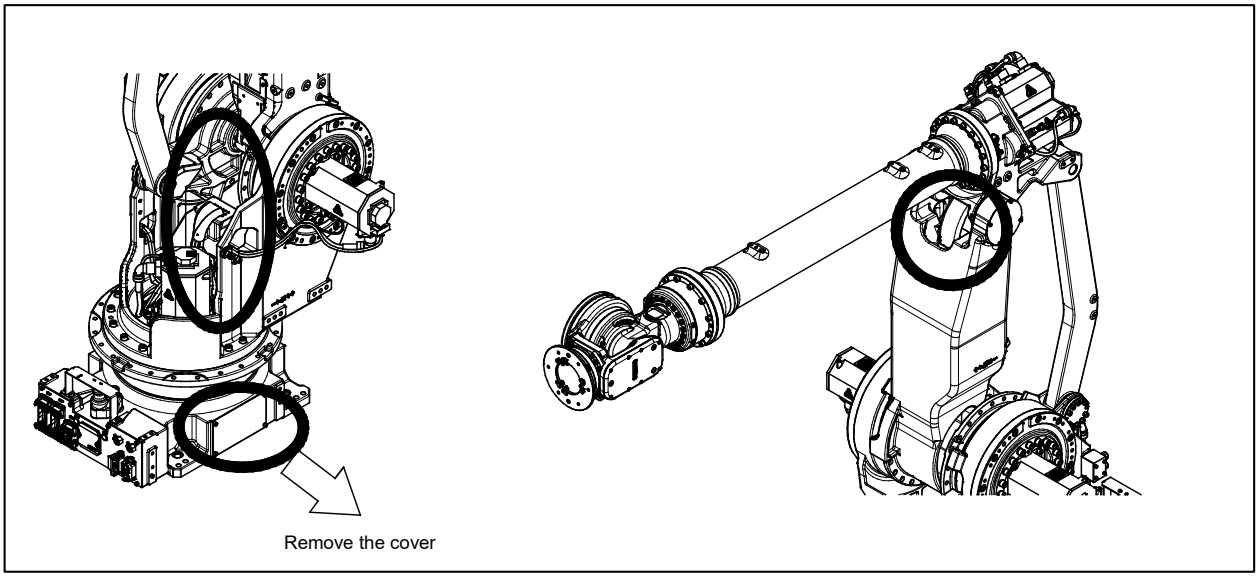


Fig. 2.2.3 (a) Inspection points of the mechanical unit cables

Check items

＜Cable protective sleeve＞

- Check that no holes or tears exist on the cable protective sleeve.
- If there is damage as shown in Fig. 2.2.3 (b), replace the cable protective sleeves.

Fig. 2.2.3 (b) Damage on the cable protective sleeve

＜Cables＞

- Check that there is no wear or damage on the coating.
- If the inside wire strands are exposed due to wear or damage, replace the cables.

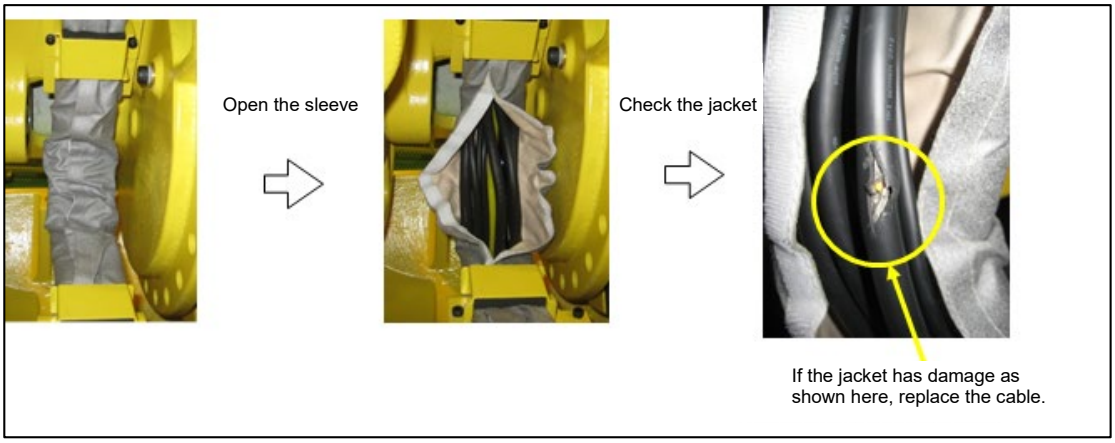


Fig. 2.2.3 (c) Cable check method

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

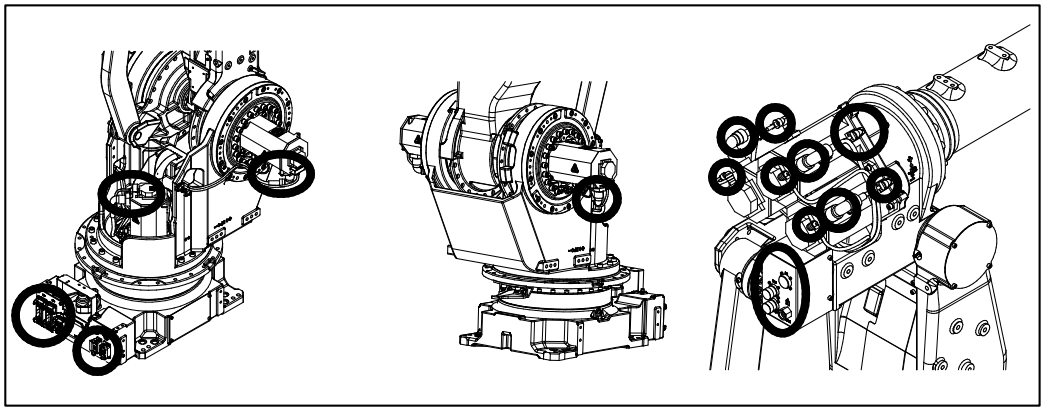


Fig. 2.2.3 (d) Connector Inspection points

2.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check that there is no evidence of a collision on the mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace the parts.
- Check the tightness of the stopper mounting bolts. If they are loose, retighten them. Be sure to check the tightness of the mounting bolts of the J1-axis swing stopper.
- Check that the J1-axis swing stopper rotates smoothly.
- Refer to Subsection 5.1.3 for details regarding the adjustable mechanical stopper.

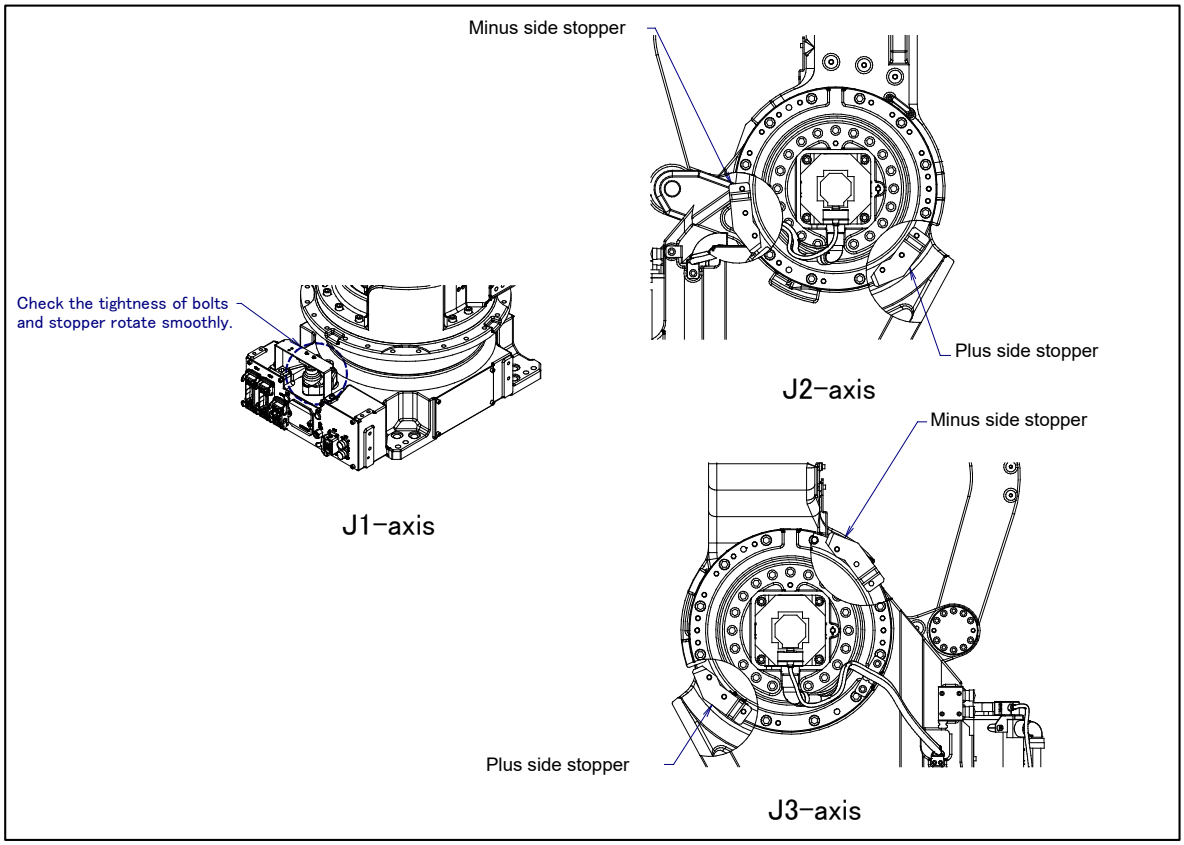


Fig. 2.2.4 (a) Check of fixed mechanical stopper and adjustable mechanical stopper

3 PERIODIC MAINTENANCE

3.1 REPLACING GREASE OF THE DRIVE MECHANISM (3 YEARS CHECK (11520 HOURS) OR 1 YEAR CHECK (3840 HOURS) PERIODIC MAINTENANCE)

In case of M-900*i*A/350/260L, according to below, replace the grease of J1, J2, and J3 axes, J4-axis gearbox, and the wrist at the intervals based on every 3 years or 11520 hours, whichever comes first.
In case of M-900*i*A/150P, according to below, replace the grease of J1, J2, and J3 axes, J4-axis gearbox, and the wrist at the intervals based on every year or 3840 hours, whichever comes first. Refer to Table 3.1 (a) for the specified grease and the quantity.

Table 3.1 (a) Grease for 3-year (1-year) periodical replacement

Models	Supply position	Quantity	Gun tip pressure	Grease name
M-900*i*A/350/260L	J1-axis reducer	7000g (8000ml)	0.15MPa or less (NOTE)	Spec. : A98L-0040-0174
	J2-axis reducer	3000g (3400ml)		
	J3-axis reducer	2700g (3100ml)		
	J4-axis gearbox	1900g (2200ml)		
	Wrist	5000g (5750ml)		
M-900*i*A/150P	J1-axis reducer	7000g (8000ml)		
	J2-axis reducer	2700g (3100ml)		
	J3-axis reducer	2700g (3100ml)		
	J4-axis gearbox	1900g (2200ml)		
	Wrist	5000g (5750ml)		

NOTE
When using a hand pump, apply grease approximately twice per 3 seconds.

⚠ WARNING
Hot grease might eject suddenly when you open the grease outlet. Attach bags for collecting grease, and use appropriate protective equipment such as heat-resistant gloves, protective glasses, a face shield, or a body suit if necessary.

For grease replacement or replenishment, use the postures indicated below.

Table 3.1 (b) Postures for greasing (for floor mount) (M-900*i*A/350/260L)

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

Table 3.1 (c) Postures for greasing (M-900*i*A/150P))

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

For ceiling-hung installation, see Table 3.1 (d).

Table 3.1 (d) Postures for greasing (for upside-down mount) (M-900*i*A/350/260L)

Supply position	Posture					
	J1	J2	J3	J4	J5	J6
J1-axis reducer	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
J2-axis reducer		-75°				
J3-axis reducer		Arbitrary	+76°			
J4-axis gearbox			-96°			
Wrist			0°	180° or -180°	0°	0°

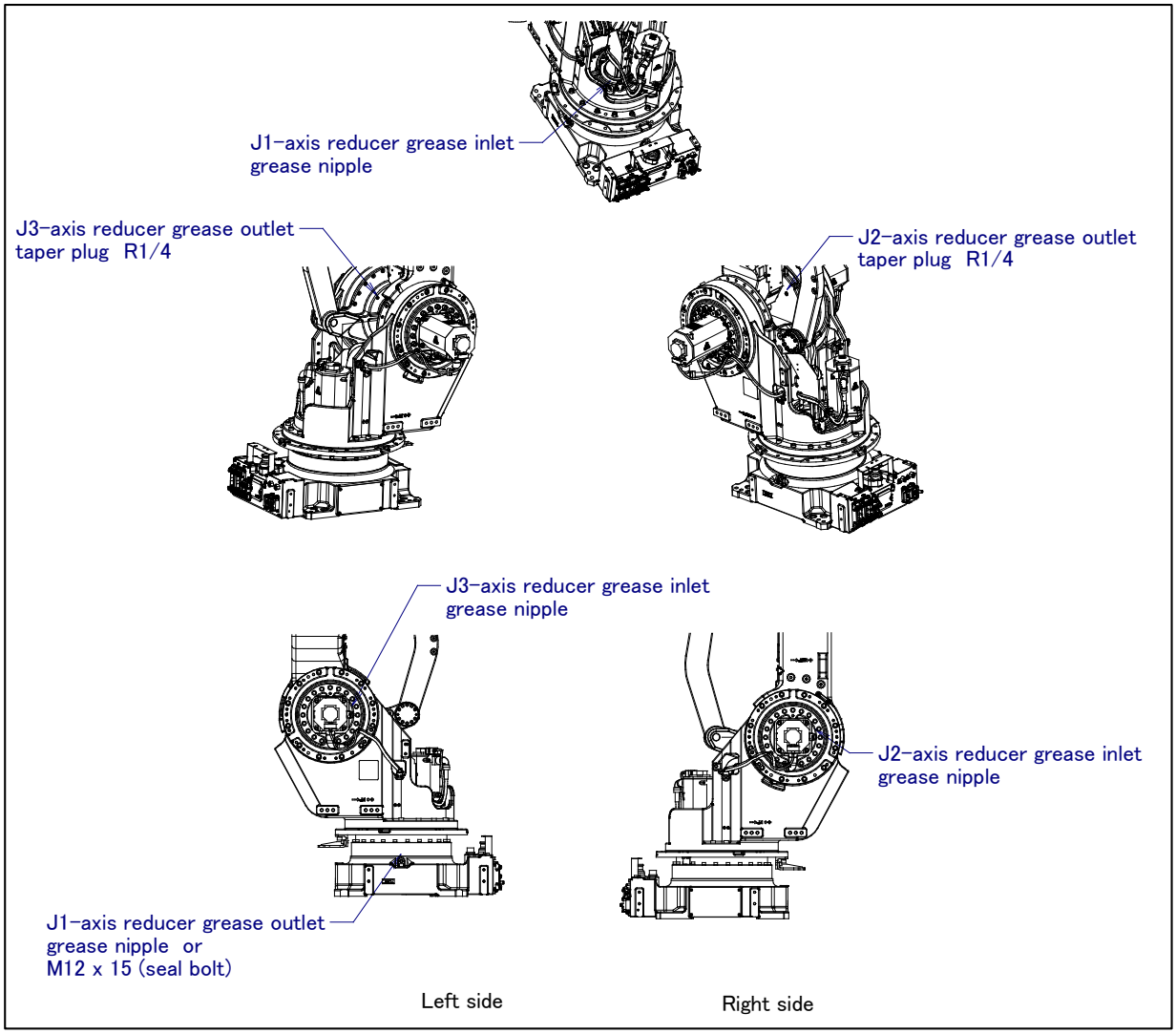


Fig. 3.1 (a) Replacing grease of J1/J2/J3-axis reducer (M-900*i*A/350/260L)

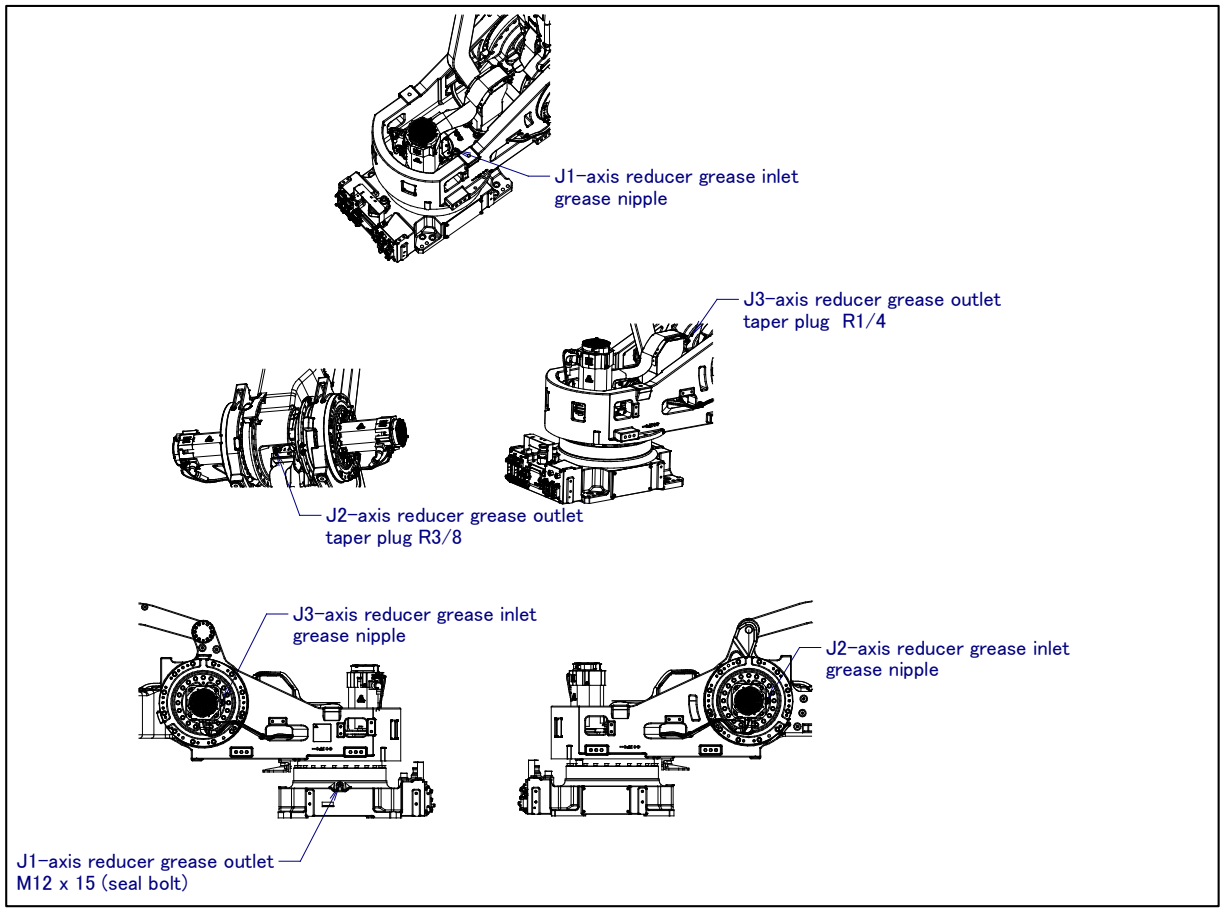


Fig. 3.1 (b) Replacing grease of J1/J2/J3-axis reducer (M-900*i*A/150P)

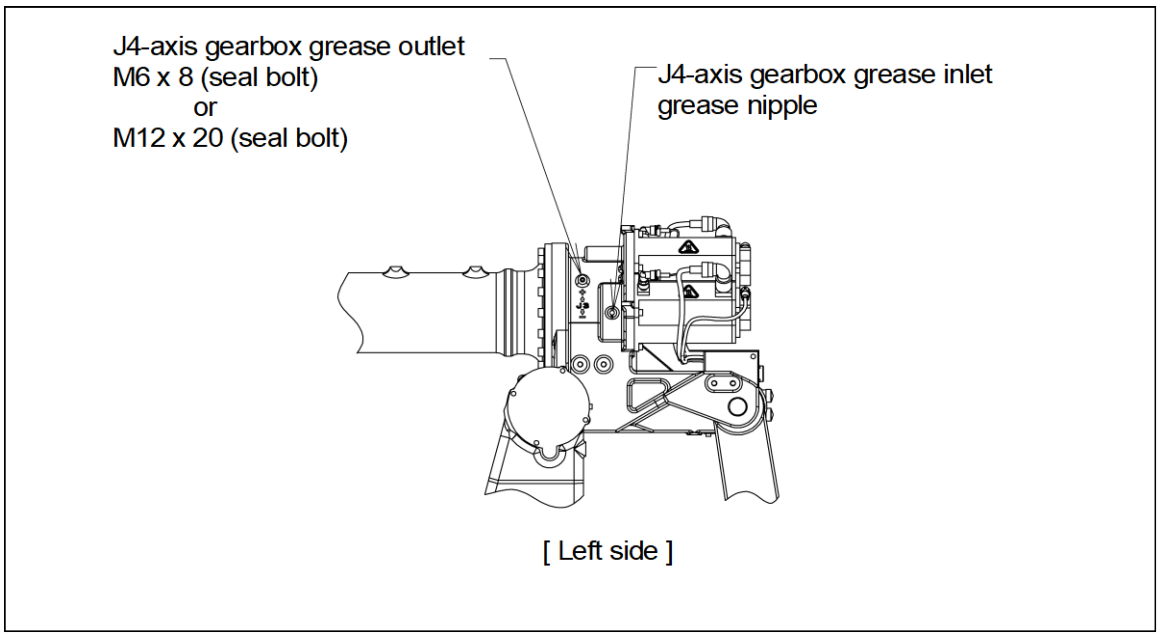


Fig. 3.1 (c) Replacing grease of J4-axis gearbox

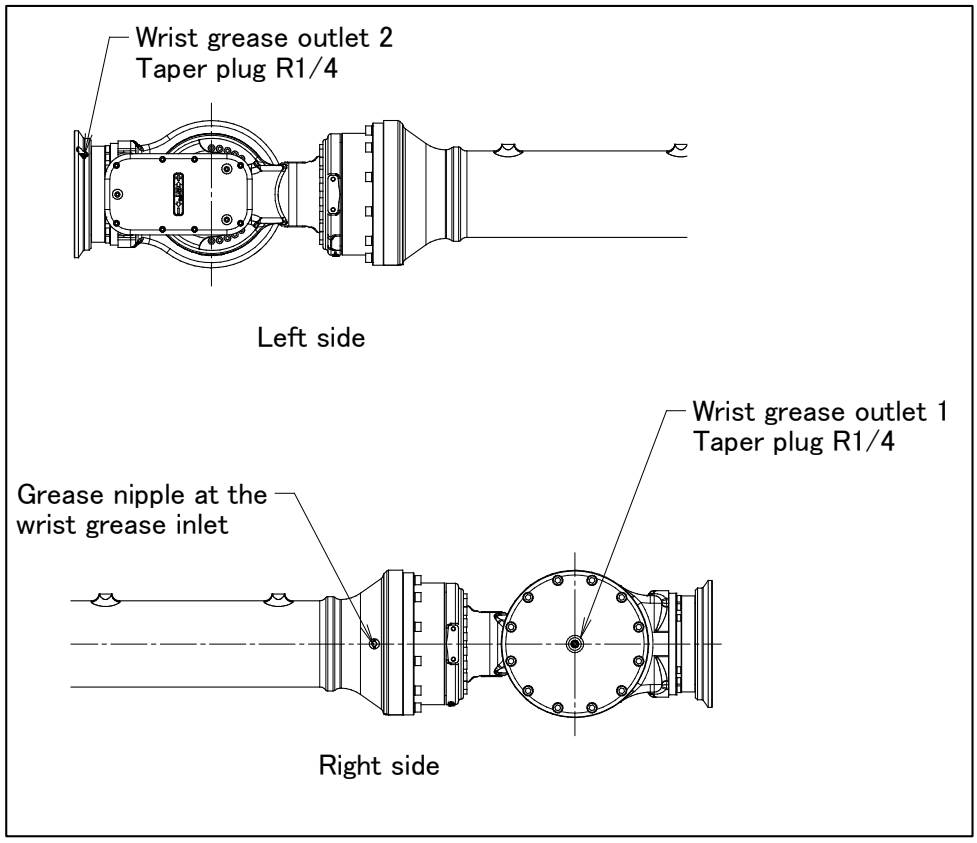


Fig. 3.1 (d) Replacing grease of wrist

Table 3.1 (e) Spec. of seal bolts, taper plugs and grease nipples

Parts name	Specifications
Seal bolt (M6 x 8)	A97L-0218-0417#060808
Seal bolt (M12 x 15)	A97L-0218-0417#121515
Seal bolt (M12 x 20)	A97L-0218-0417#122020
Taper plug (R1/4)	A97L-0001-0436#2-2D
Taper plug (R3/8)	A97L-0001-0436#2-3D
Grease nipple	A97L-0218-0013#A610

3.1.1 Grease Replacement Procedure for the J1-Axis/J2- Axis/J3-Axis and J4-Axis Gearbox

1 Move the robot to the greasing posture described in Section 3.1.
2 Turn off controller power.
3 Remove the plug or the seal bolt from the grease outlet.
4 Supply new grease until new grease is output from the grease outlet.
5 After applying grease, release the remaining pressure within the grease bath as described in the procedure in Subsection 3.1.3.

3.1.2 Grease Replacement Procedure for the Wrist

1 Move the robot to the greasing posture described in Section 3.1.
2 Turn off controller power.
3 Remove the plug from wrist grease outlet 1.
4 Supply new grease through the wrist grease inlet until new grease is output from wrist grease outlet 1.
5 Attach the plug onto wrist grease outlet 1. When reusing the plug, be sure to seal the plug with seal tape.
6 Remove the plug from wrist grease outlet 2.
7 Supply new grease through the wrist grease inlet until new grease is output from wrist grease outlet 2.
8 After applying grease, release the remaining pressure within the grease bath as described in the procedure in Subsection 3.1.3.

> **⚠ CAUTION**
> Failure to follow proper greasing procedures may cause a sudden increase of the grease bath internal pressure and damage to the seal. This could lead to grease leakage and abnormal operation. When greasing, observe the following cautions.
> (1) Before starting to grease, remove the plug or bolt from the grease outlet and the ventilator hole to allow the grease to come out.
> (2) Supply grease slowly, using a manual pump.
> (3) Whenever possible, avoid using an air pump, which is powered by the factory air supply.
> If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (Table 3.1 (a)).
> (4) Use specified grease. Use of non-approved grease may damage the reducer or lead to other problems.
> (5) After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 3.1.3, and then close the grease inlet, the grease outlet and the ventilator hole.
> (6) To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.

3.1.3 Procedure for Releasing the Grease Remaining Pressure

Release the remaining pressure as described below.
Attach the recovery bag under the grease inlet and outlet to prevent drained grease from splattering.

Table 3.1.3 (a) Movement for releasing remaining pressure

Grease replacement position	Operation angle	OVR	Operation time	Release position
J1-axis reducer	80° or more	50%	20minutes	A
J2-axis reducer	90° or more	50%	20minutes	A
J3-axis reducer	70° or more	50%	20minutes	A
J4-axis gearbox	J4=60° or more J5=120° or more J6=60° or more	100%	20minutes	B
Wrist	J4=60° or more J5=120° or more J6=60° or more	100%	10minutes	C

For A: Make a continuous operation with the grease inlet and outlet open.
For B: Make a continuous operation with only the grease outlet open.
For C: Make a continuous operation with all of the grease inlets and outlets in the following figure open.

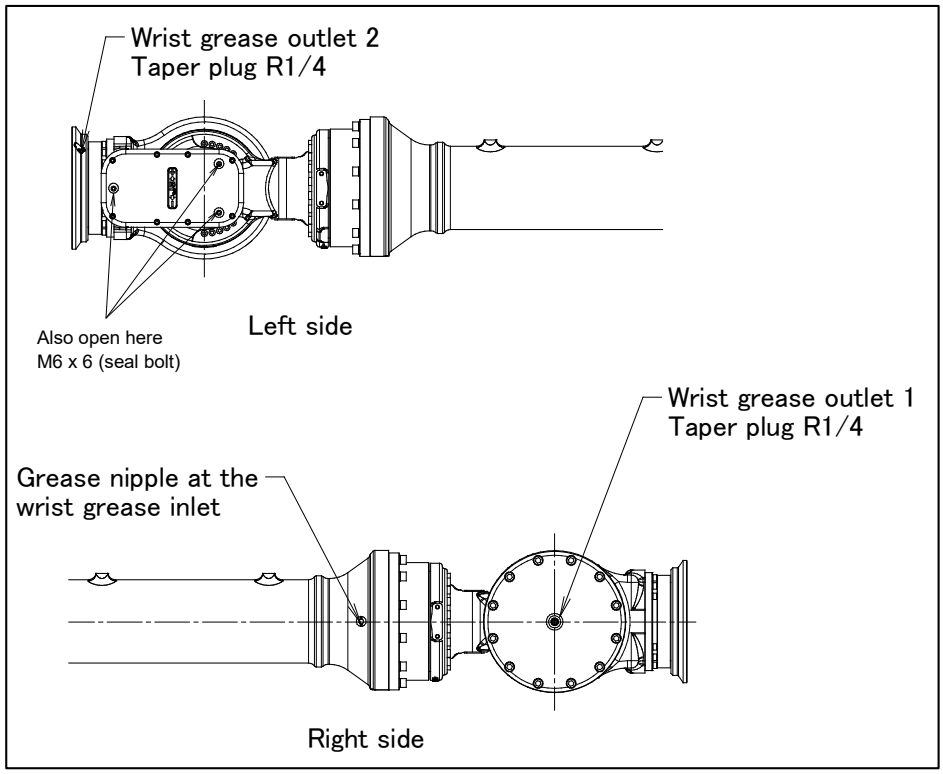


Fig. 3.1.3 (a) Positions to be released when the wrist remaining pressure is released

When the above operation is impossible due to ambient conditions, perform the program operation for a time equivalent to the above. (When the maximum allowable axis angle is half the specified angle, run the program for twice the specified time.) If you grease multiple axes, you can exercise multiple axes at the same time. 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.

3.2 GREASING OF J2/J3-AXIS CONNECTION PART BEARING (3 YEARS CHECK (11520 HOURS) OR 1 YEAR CHECK (3840 HOURS) PERIODIC MAINTENANCE)

Fig. 3.2 (a) shows the greasing points. In case of M-900*i*A/350/260L, apply grease at the intervals based on every 3 years or 11520 hours, whichever comes first. In case of M-900*i*A/150P, apply grease at the intervals based on every 1 year or 3840 hours, whichever comes first. If the robot is installed in a severe environment, apply grease whenever necessary. If water splashes on the robot, apply grease immediately. Table 3.2 (b) shows the substitute table grease.

Table 3.2 (a) Greasing points

Greasing points	Grease	Amount	Way
Bearing at J2/J3-axis connection	SHELL ALVANIA GREASE S2 (Spec.: A98L-0004-0602#CTG)	20 ml each (2 locations)	Apply grease from the grease nipple.

Table 3.2 (b) Substitutes for SHELL ALVANIA GREASE S2

MOBIL	MOBILACKS EP2
JXTG Nippon Oil & Energy Corporation	MULTINOC 2
JXTG Nippon Oil & Energy Corporation	EPNOC AP-2
IDEMITSU KOHSAN	EPONEX GREASE NO.2
COSMO OIL	DYNAMAX NO.2
Showa Shell Sekiyu K.K.	Shell Gadus S2 V100 2

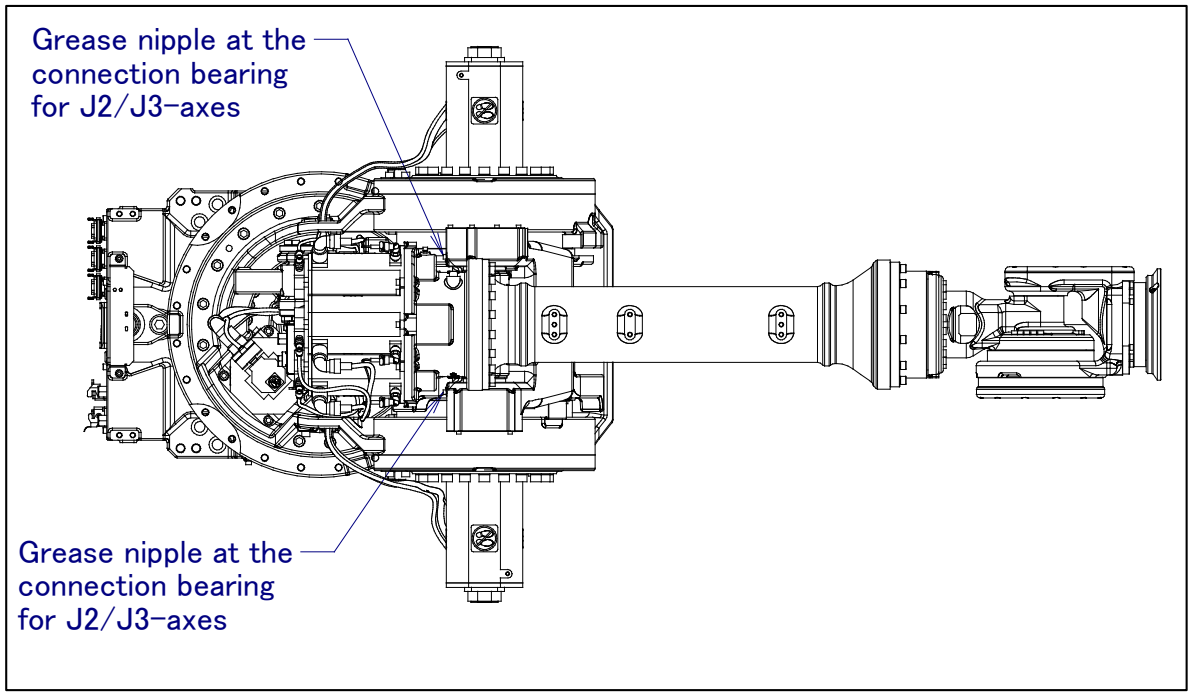


Fig. 3.2 (a) Greasing points

Table 3.2 (c) Spec. of the grease nipples

Parts name	Specifications
Grease nipple	A97L-0218-0013#A610

3.3 REPLACING THE BATTERIES (1.5 YEARS PERIODIC MAINTENANCE)

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1.5 year. Also, use the following procedure to replace when the backup battery voltage drop alarm occurs.

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

> ⚠ **CAUTION**
> Be sure to keep the power supply turning 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.
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.3.3 (b) to replace the battery. After replacing the battery, reinstall the cover. In this time, please be sure to replace gasket to new one for effects of severe dust/liquid protection.

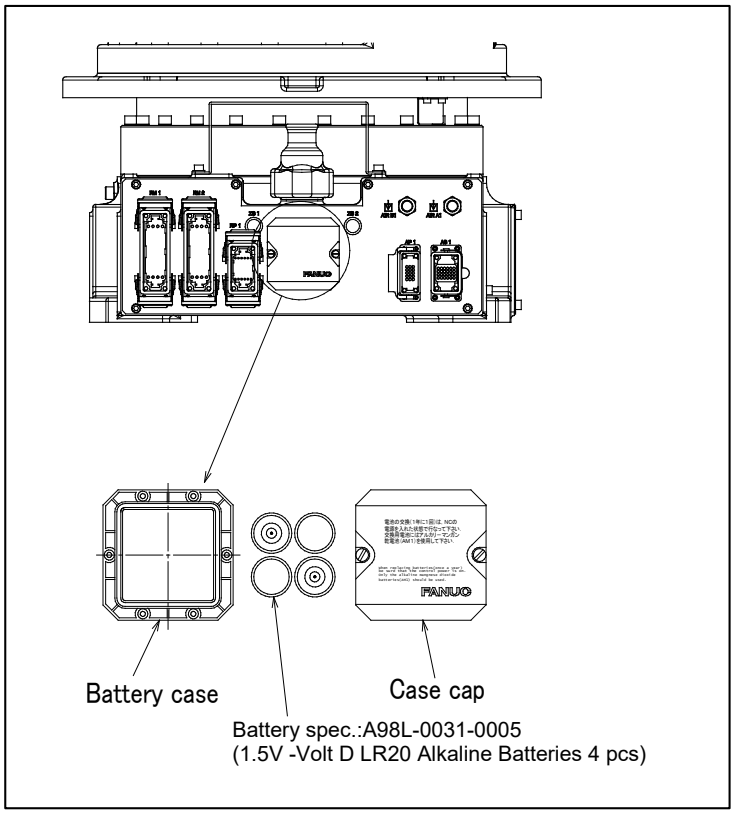


Fig. 3.3 (a) Replacing Batteries

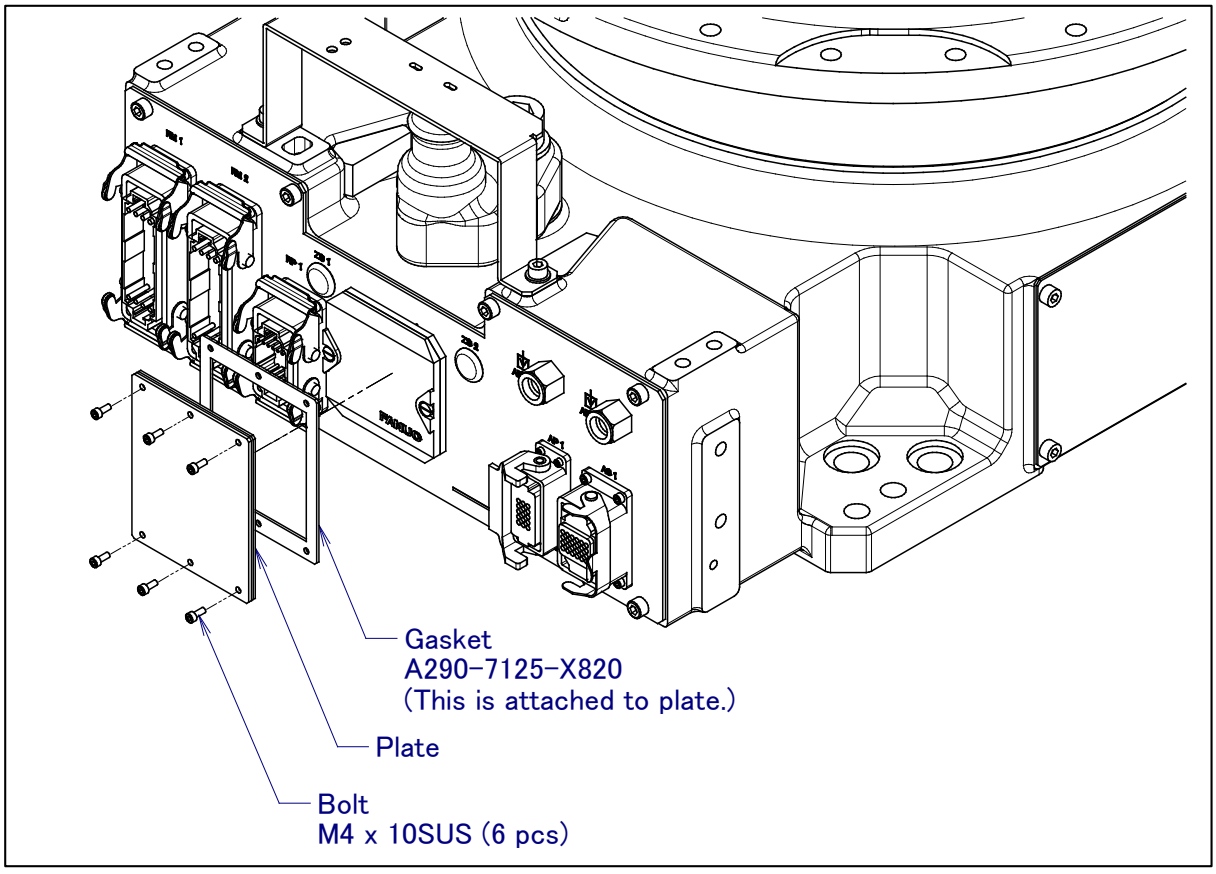


Fig. 3.3 (b) Removing the battery cover plate (When severe dust/liquid protection option is specified)

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, you must keep an accurate record of problems and take proper corrective actions.

4.1 TROUBLESHOOTING

Table 4.1 (a) shows the major troubleshooting symptoms that may occur in the mechanical unit and their probable causes. If you cannot pinpoint a failure cause or which measures to take, contact your local FANUC representative.

Table 4.1 (a) Troubleshooting

Symptom	Description	Cause	Measure
Vibration Noise	- As the robot operates, its base plate lifts off the floor plate. - There is a gap between the base plate and the floor plate. - There is a crack in the weld that fastens the base plate to the floor plate.	[Base plate and floor plate fastening] - It is likely that the base plate is not securely fastened to the floor plate because of poor welding. - If the base plate is not securely fastened to the floor plate, it lifts as the robot operates, allowing the base and floor plates to strike each other, which, in turn, leads to vibration.	- Re-weld the base plate to the floor plate. - If the weld is not strong enough, increase its width and length.
	- The J1 base lifts off the base plate as the robot operates. - There is a gap between the J1 base and base plate. - The J1 base retaining bolt is loose.	[J1 base fastening] - It is likely that the robot J1 base is not securely fastened to the base plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or abrasive contamination caught between the base plate and floor plate. - If the robot is not securely fastened to the floor plate, the J1 base lifts the floor plate as the robot operates, allowing the base and floor plates to strike each other. That, in turn, leads to vibration.	- If a bolt is loose, apply LOCTITE and tighten it to the appropriate torque. - Adjust the base plate surface flatness to within the specified tolerance. - If there is any abrasive contamination, remove it. - Apply adhesive between the J1 base and base plate.
	- The rack or floor plate vibrates during operation of the robot.	[Rack or floor] - It is likely that the rack or floor is not rigid enough. - If they are not rigid enough, counterforce can deform the rack or floor, and cause 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.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- Vibration becomes more serious when the robot adopts a specific posture. - If the operating speed of the robot is reduced, vibration stops. - Vibration is most noticeable when the robot is accelerating. - Vibration occurs when two or more axes operate at the same time.	[Overload] - It is likely that the load on the robot is greater than the maximum rating. - It is likely that the robot control program is too demanding for the robot hardware. - It is likely that the ACCELERATION value is excessive.	- Check the maximum load that the robot can handle once more. If the robot is found to be overloaded, reduce the load, or modify the robot control program. - Vibration in a specific portion can be reduced by modifying the robot control program while slowing the robot and reducing its acceleration (to minimize the influence on the entire cycle time).
	- Vibration or noise was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating or noise occurring axis has not been replaced for a long period. - Cyclical vibration and noise occur.	[Gear, bearing, or reducer] - 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 the rolling surface of bearing and reducer. - It is likely that abrasive contamination caught in a gear, bearing, or within a reducer caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that abrasive contamination 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.	- 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. - Using the specified grease at the recommended interval will prevent problems.

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

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

Symptom	Description	Cause	Measure
Motor Overheating	- The motor overheated due to the temperature in the installation area rose. - After a cover was attached to the motor, the motor overheated. - After changing the Robot control program or the load, the motor overheat.	[Ambient temperature] - It is likely that the motor overheated along with the ambient temperature rose, and could not dissipate the heat. [Operating condition] - It is likely that the overcurrent above the specified permissive average current.	- Reducing the ambient temperature is the most effective means of preventing overheat. - Having the surroundings of the motor well ventilated enables the motor to release heat efficiently, thus preventing overheating. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is effective to reduce the average current. Thus, prevent overheating. - The teach pendant can monitor the average current. Check the average current when the robot control program launched.
	- After a robot control parameter (load setting etc.) was changed, the motor overheated.	[Parameter] - If data input for a workpiece is invalid, the robot cannot be accelerated or decelerated normally, so the average current increases, leading to overheat.	- As for load setting, Input an appropriate parameter referring to Section 9.5.
	- Symptom other than stated above	[Mechanical unit problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor operating 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 while referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - If the average current falls after the motor is replaced, it indicates that the first motor was faulty. - If the fan is broken, replace it by new one.

Symptom	Description	Cause	Measure

Grease Leakage	- Grease is leaking from the mechanical unit.	[Poor sealing]
		- Probable causes are a crack in the casting, a broken O-ring, a damaged oil seal, or a loose seal bolt.
		- A crack in a casting can occur due to excessive force that might be caused in 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 or a plug might allow grease to leak along the threads.
		- Problems with the grease nipple.
			- If a crack develops in the casting, sealant can be used as a quick-fix to prevent further grease leakage. However, the component should be replaced as soon as possible, because the crack might extend.
			- O-rings are used in the locations listed below.
			  - Motor coupling section
			  - Reducer (case and shaft) coupling section
			  - Wrist coupling section
			  - J3 arm coupling section
			  - Inside the wrist
			- Oil seals are used in the locations stated below.
			  - Inside the reducer
			  - Inside the wrist
			- Seal bolts are used in the locations stated below.
			  - Grease 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 relays 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 stuck each other or not. If they are found to be stuck, replace the relay.
			- Replace the motor confirmed following symptoms.
			  - Brake shoe is worn out
			  - Brake main body is damaged
			  - Oil soak through the motor

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

5 ADJUSTMENTS

Each part of the mechanical unit is carefully adjusted at the factory before shipment. Therefore, it is usually unnecessary for the customer to make adjustments at the time of delivery. However, after a long period of use or after parts are replaced, adjustments may be required.

5.1 AXIS LIMITS SETUP

Axis limits define the motion range of the robot. The operating range of the robot axes can be restricted because of:

- Used motion range of the robot is limited.
- Tooling and fixture interference points
- Cable and hose lengths

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 adjustable mechanical stopper ((J1, J2, J3 axis) option)
- Axis limit switches ((J1, J2, J3 axis) option)

⚠CAUTION

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

Upper Limits

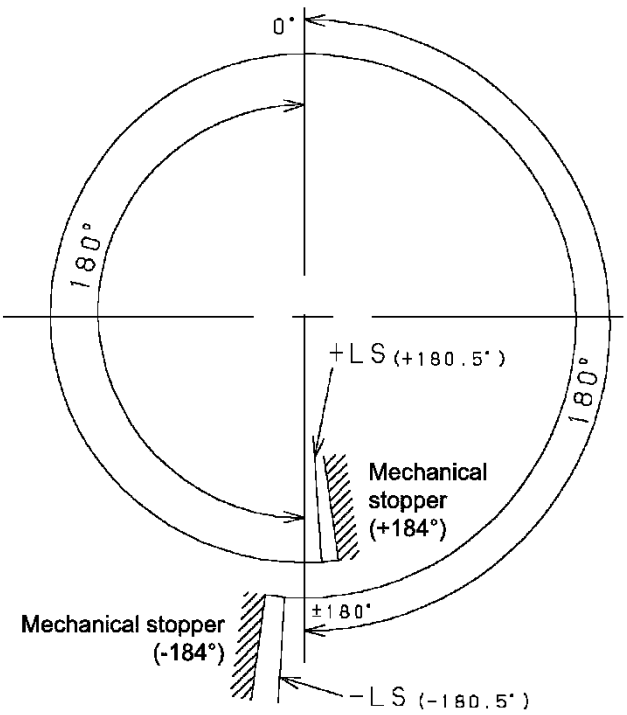
Displays the upper limits of each axis, or the axis limits in a positive direction.

Lower Limits

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

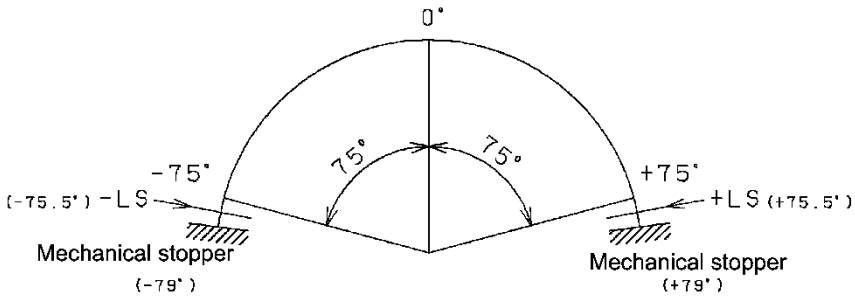
5.1.1 Zero Point Position and Motion Limit

Zero point and software motion limit are provided for each controlled axis. Exceeding the software motion limit of a controlled axis is called overtravel (OT). Overtravel is detected at both ends of the motion limit for each axis. The robot cannot exceed the software motion limit unless there is a failure of the system causing loss of zero point position or there is a system error.
Fig. 5.1.1 (a) to (j) show the zero point and motion limit, LS detection position, and mechanical stopper position of each axis.



Note) The limit switch (LS) of J1-axis is an option.

Fig. 5.1.1 (a) J1-axis



Note) The limit switch (LS) of J2-axis is an option.
Motion limit is restricted by the position of the J3-axis.

Fig. 5.1.1 (b) J2-axis (M-900*i*A/350/260L)

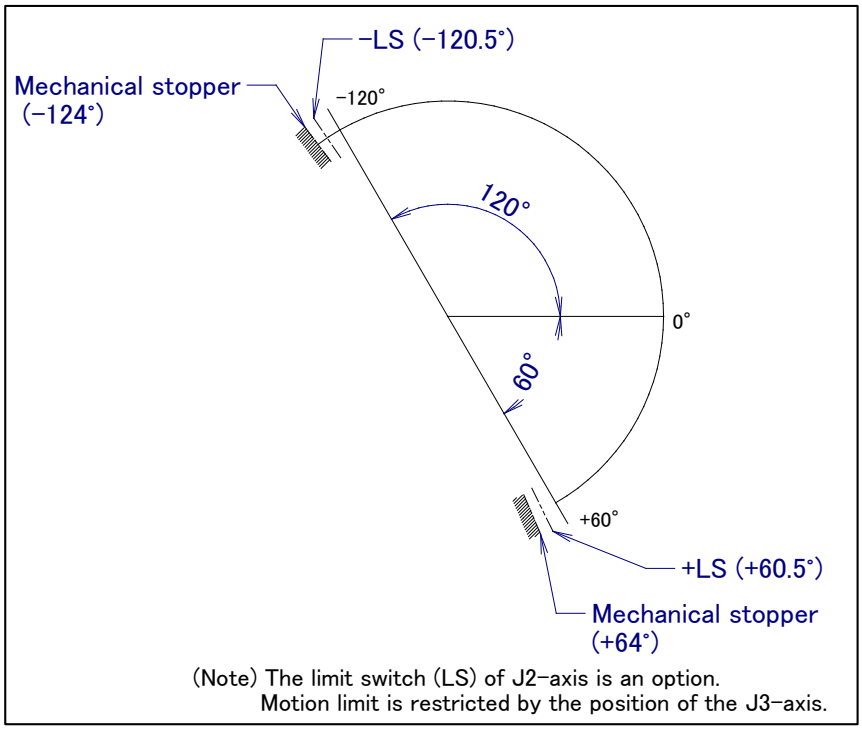
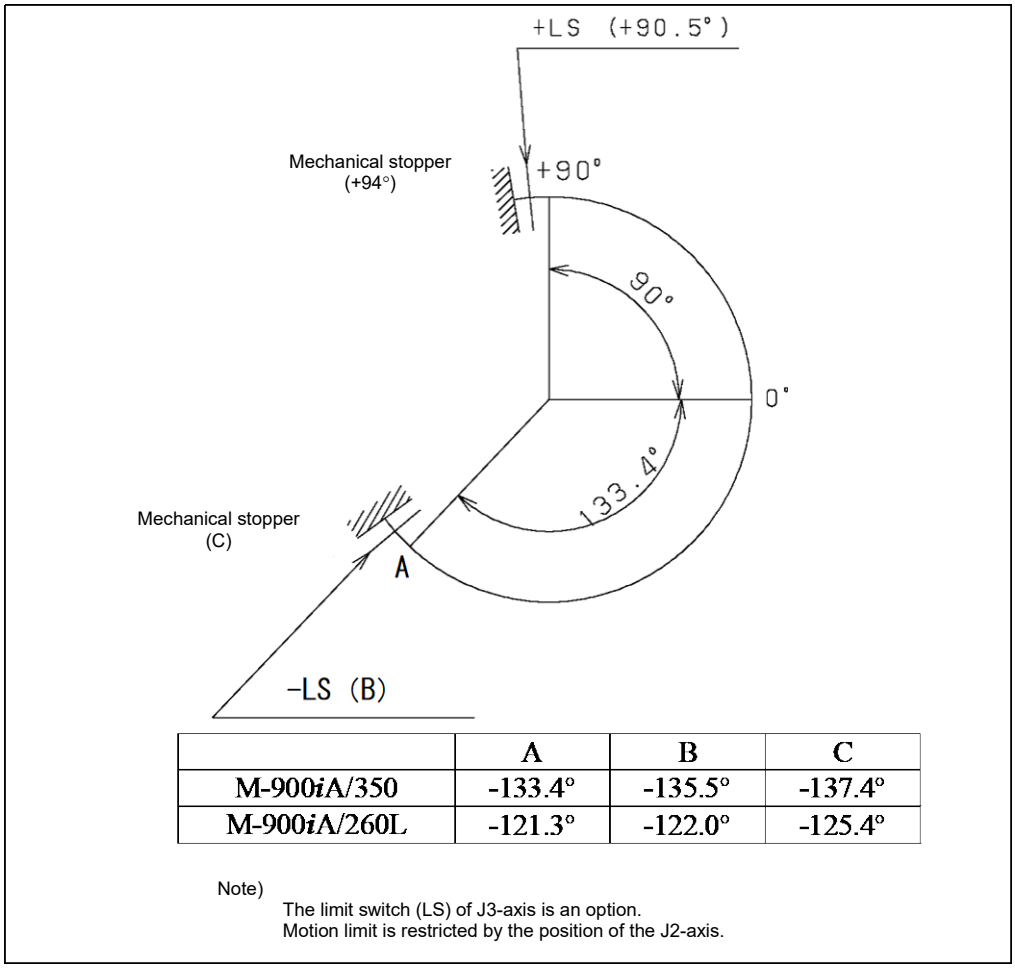


Fig. 5.1.1 (c) J2-axis (M-900*i*A/150P)



	A	B	C
M-900*i*A/350	-133.4°	-135.5°	-137.4°
M-900*i*A/260L	-121.3°	-122.0°	-125.4°

Note)
The limit switch (LS) of J3-axis is an option.
Motion limit is restricted by the position of the J2-axis.

Fig. 5.1.1 (d) J3-axis (M-900*i*A/350/260L)

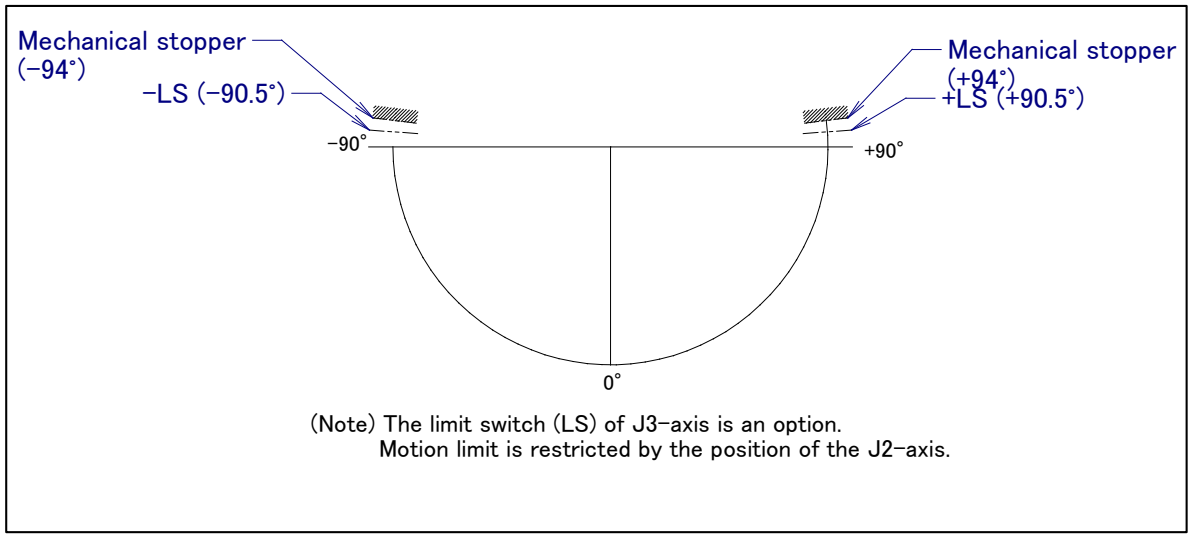
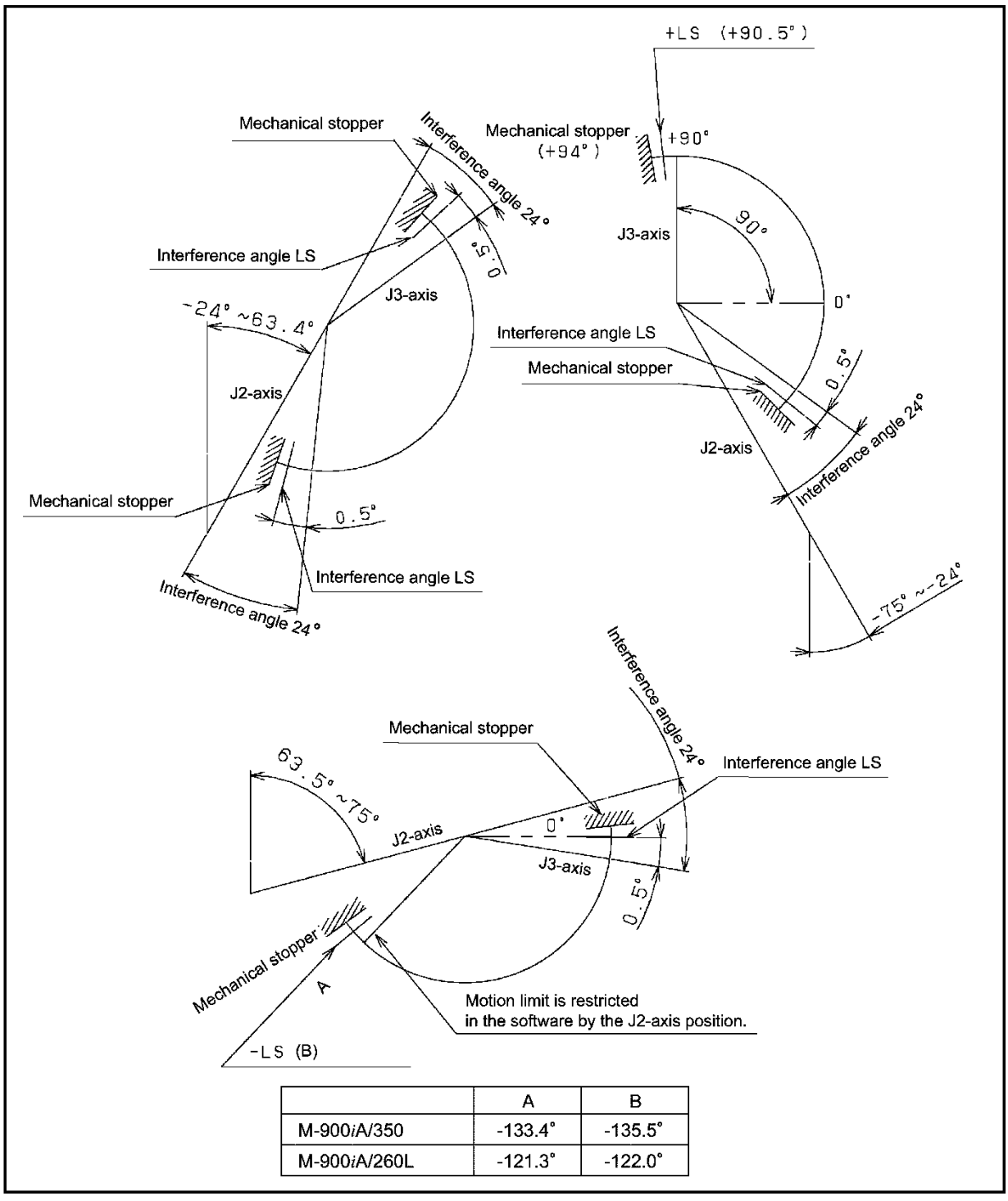


Fig. 5.1.1 (e) J3-axis (M-900*i*A/150P)



	A	B
M-900*i*A/350	-133.4°	-135.5°
M-900*i*A/260L	-121.3°	-122.0°

Fig. 5.1.1 (f) J2/J3-axis interference angle (M-900*i*A/350/260L)

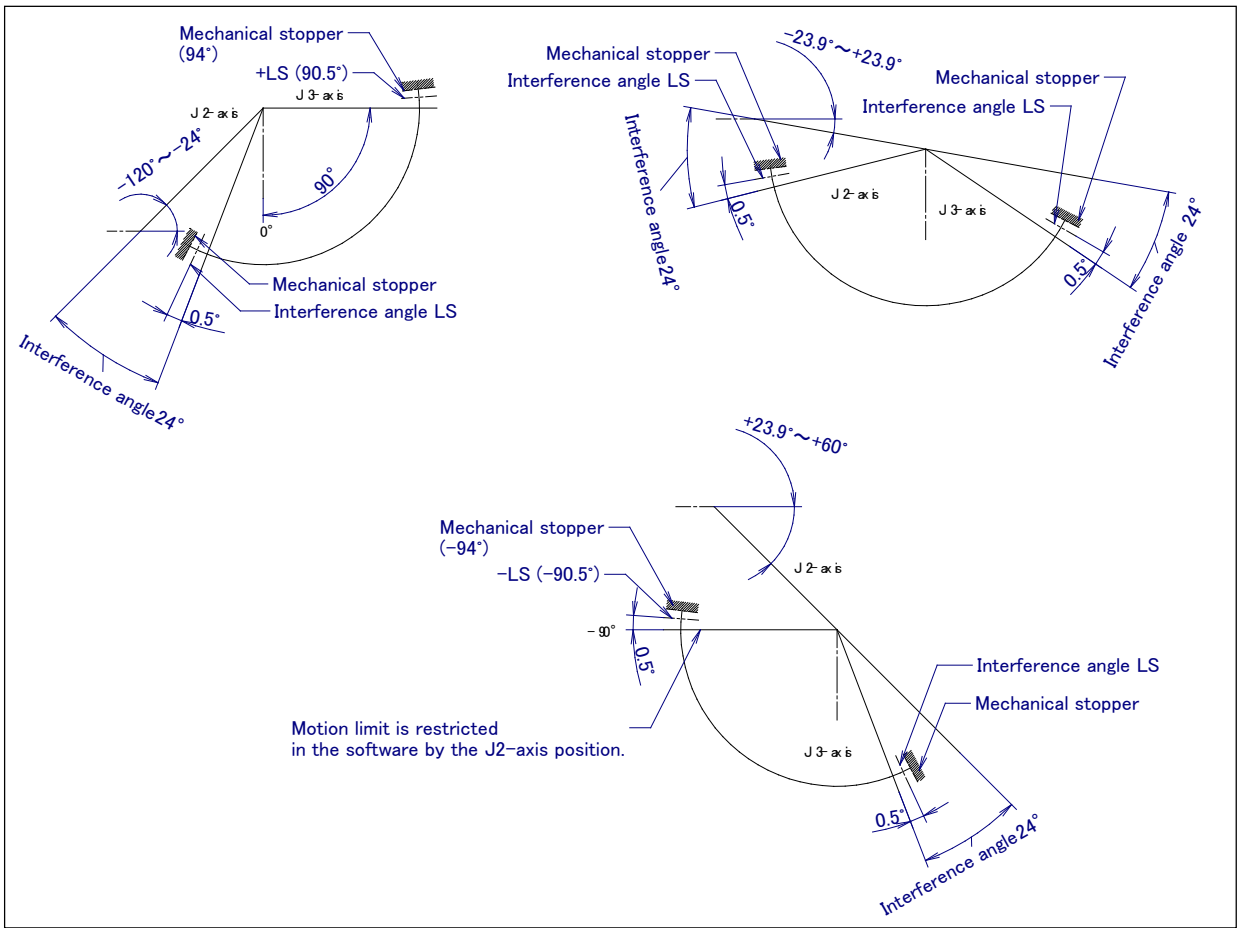


Fig. 5.1.1 (g) J2/J3-axis interference angle (M-900*i*A/150P)

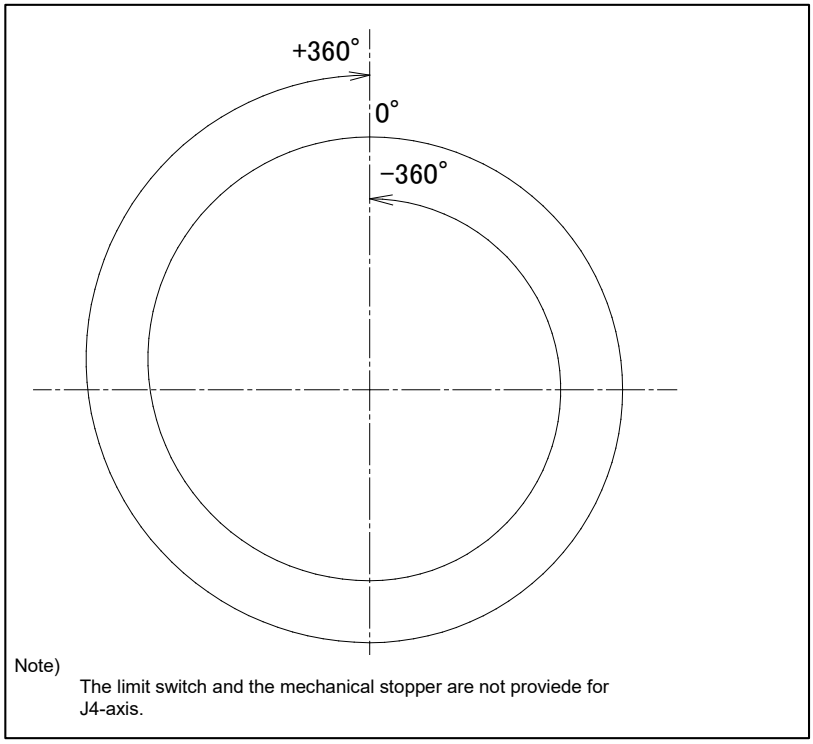


Fig. 5.1.1 (h) J4-axis

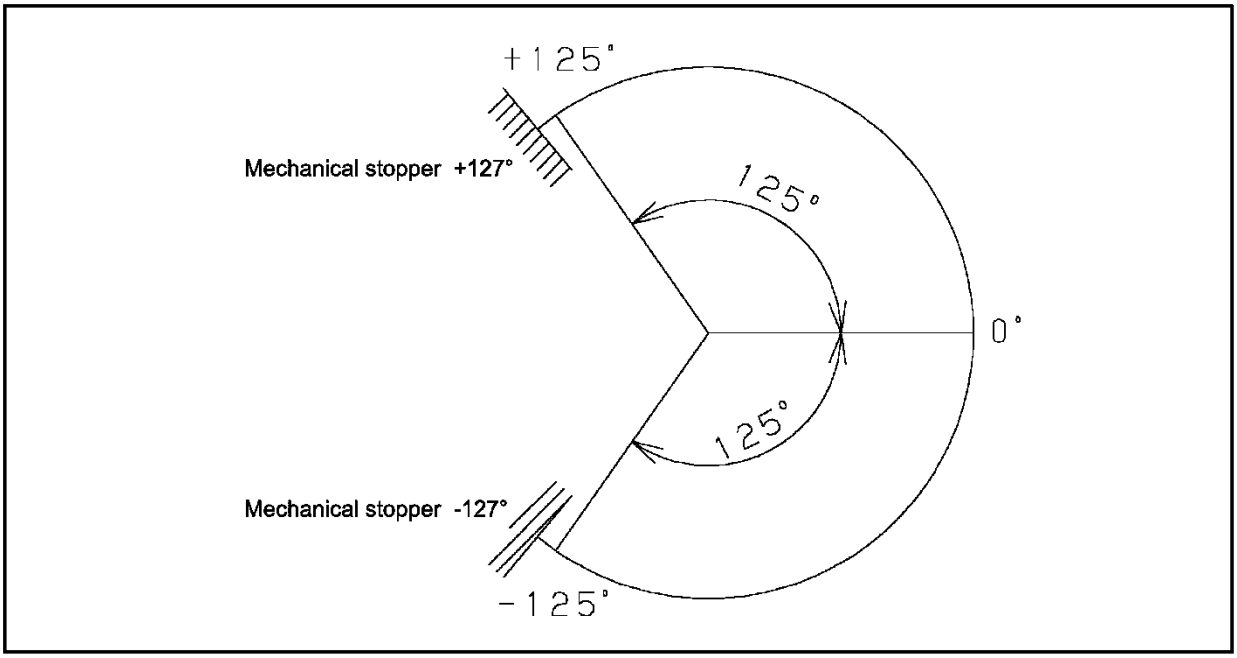


Fig. 5.1.1 (i) J5-axis

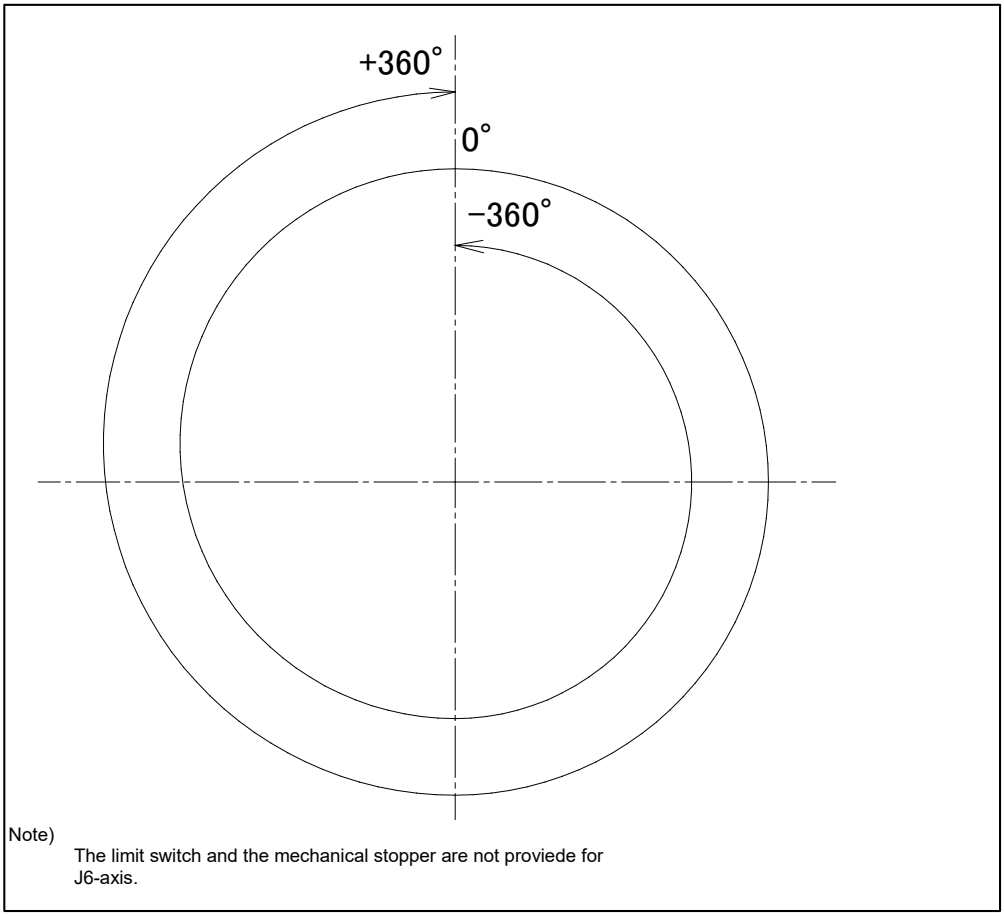


Fig. 5.1.1 (j) J6-axis

5.1.2 Motion limit change by software

Upper and lower axis limits about motion range can be changed by software settings. The limits can be set for all axes. The robot stops the motion if the robot reaches to the limits.

Setting procedure

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

System Axis Limits JOINT 100%
Group1 1/16

AXIS	GROUP	LOWER	UPPER	
1	1	-180.00	180.00	deg
2	1	-75.00	75.00	deg
3	1	-133.70	90.00	deg
4	1	-360.00	360.00	deg
5	1	-125.00	125.00	deg
6	1	-360.00	360.00	deg
7	1	0.00	0.00	mm
8	1	0.00	0.00	mm
9	1	0.00	0.00	mm

[TYPE]

> ⚠ **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.

System Axis Limits 2/16

AXIS	GROUP	LOWER	UPPER	
2	1	-75.00	75.00	deg

[TYPE]

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 cycle power of the controller to use the new information; otherwise injury to personnel or damage to equipment could occur.

5.1.3 Motion limit change by the Adjustable Mechanical Stopper and the Limit Switch

For the J1, J2, and J3 axes, Adjustable mechanical stopper (option) can be installed in addition to standard mechanical stopper. It is possible to re-position adjustable mechanical stoppers. The limit switch-based movable range can be changed by changing the dog positions. The dog for the J1 axis is placed in the same position as the mechanical stopper.

Item		M-900*i*A/350	M-900*i*A/260L
J1-axis mechanical stopper, limit switch	Upper limit	Settable in steps of 7.5° degrees in a range of -135° to +180° degrees	
	Lower limit	Settable in steps of 7.5° degrees in the range of -180° to +135° degrees	
	Space between the upper and lower limits	A space of 45° degrees or more is required.	
J2-axis mechanical stopper	Upper limit	Settable in steps of 15° degrees in the range of -60° to +60° degrees. A mechanical stopper is also provided at the upper limit +75° degrees of the standard movable range.	
	Lower limit	Settable in steps of 15° degrees in the range of -60° to +60° degrees. A mechanical stopper is also provided at the lower limit -75° degrees of the standard movable range.	
	Space between the upper and lower limits	A space of 15° degrees or more is required.	
J2-axis limit switch	Upper limit	Settable in steps of 15° degrees in the range of -60° to +60° degrees. Also settable to the upper limit +75° degrees of the standard movable range.	
	Lower limit	Settable in steps of 15° degrees in the range of -60° to +60° degrees. Also settable to the lower limit -75° degrees of the standard movable range.	
	Space between the upper and lower limits	A space of 15° degrees or more is required.	
J3-axis mechanical stopper	Upper limit	Settable in steps of 15° degrees in the range of -120° to +75° degrees. A mechanical stopper is also provided at the upper limit +90° degrees of the standard movable range.	
	Lower limit	Settable in steps of 15° degrees in the range of -120° to +75° degrees. A mechanical stopper is also provided at the lower limit -133.4° degrees of the standard movable range.	Settable in steps of 15° degrees in the range of -120° to +75° degrees. A mechanical stopper is also provided at the lower limit -121.3° degrees of the standard movable range.
	Space between the upper and lower limits	A space of 15° degrees or more is required.	
J3-axis limit switch	Upper limit	Settable in steps of 15° degrees in the range of -120° to +75° degrees. Also settable to the upper limit +90° degrees of the standard movable range.	
	Lower limit	Settable in steps of 15° degrees in the range of -120° to +75° degrees. Also settable to the lower limit - 133.4° degrees of the standard movable range.	Settable in steps of 15° degrees in the range of -120° to +75° degrees. Also settable to the lower limit - 121.3° degrees of the standard movable range.
	Space between the upper and lower limits	A space of 15° degrees or more is required.	

Item		M-900*i*A/150P
J1-axis mechanical stopper, limit switch	Upper limit	Settable in steps of 7.5° degrees in a range of -135° to +180° degrees
	Lower limit	Settable in steps of 7.5° degrees in the range of -180° to +135° degrees
	Space between the upper and lower limits	A space of 45° degrees or more is required.
J2-axis mechanical stopper	Upper limit	Settable in steps of 15° degrees in the range of -105° to +45° degrees. A mechanical stopper is also provided at the upper limit +60° degrees of the standard movable range.
	Lower limit	Settable in steps of 15° degrees in the range of -105° to +45° degrees. A mechanical stopper is also provided at the lower limit -120° degrees of the standard movable range.
	Space between the upper and lower limits	A space of 15° degrees or more is required.
J2-axis limit switch	Upper limit	Settable in steps of 15° degrees in the range of -120° to +60° degrees. Also settable to the upper limit +60° degrees of the standard movable range.
	Lower limit	Settable in steps of 15° degrees in the range of -120° to +60° degrees. Also settable to the lower limit -120° degrees of the standard movable range.
	Space between the upper and lower limits	A space of 15° degrees or more is required.
J3-axis mechanical stopper	Upper limit	Settable in steps of 15° degrees in the range of -75° to +75° degrees. A mechanical stopper is also provided at the upper limit +90° degrees of the standard movable range.
	Lower limit	Settable in steps of 15° degrees in the range of -75° to +75° degrees. A mechanical stopper is also provided at the lower limit -90° degrees of the standard movable range.
	Space between the upper and lower limits	A space of 15° degrees or more is required.
J3-axis limit switch	Upper limit	Settable in steps of 15° degrees in the range of -90° to +90° degrees. Also settable to the upper limit +90° degrees of the standard movable range.
	Lower limit	Settable in steps of 15° degrees in the range of -90° to +90° degrees. Also settable to the lower limit -90° degrees of the standard movable range.
	Space between the upper and lower limits	A space of 15° degrees or more is required.

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.

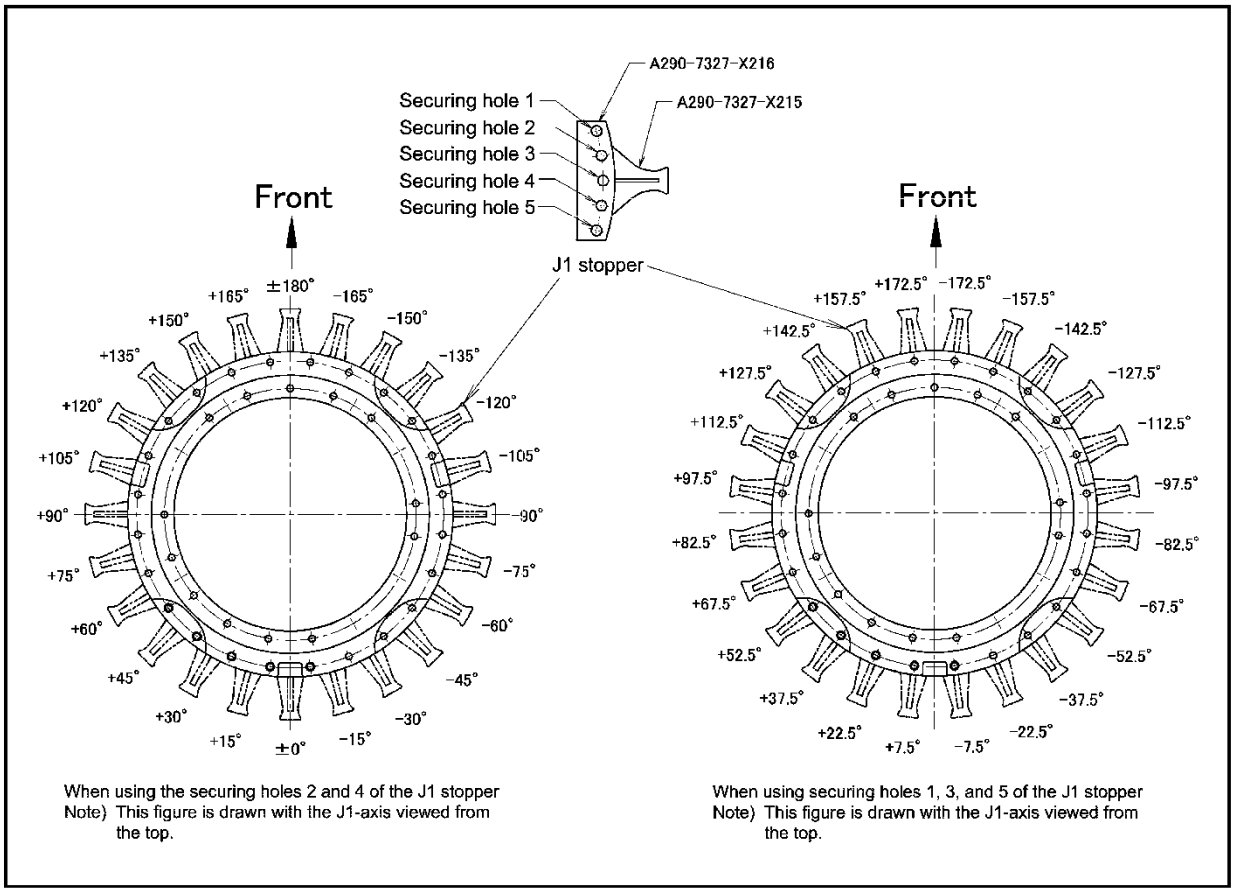


Fig. 5.1.3 (a) J1-axis mechanical stopper change (option)

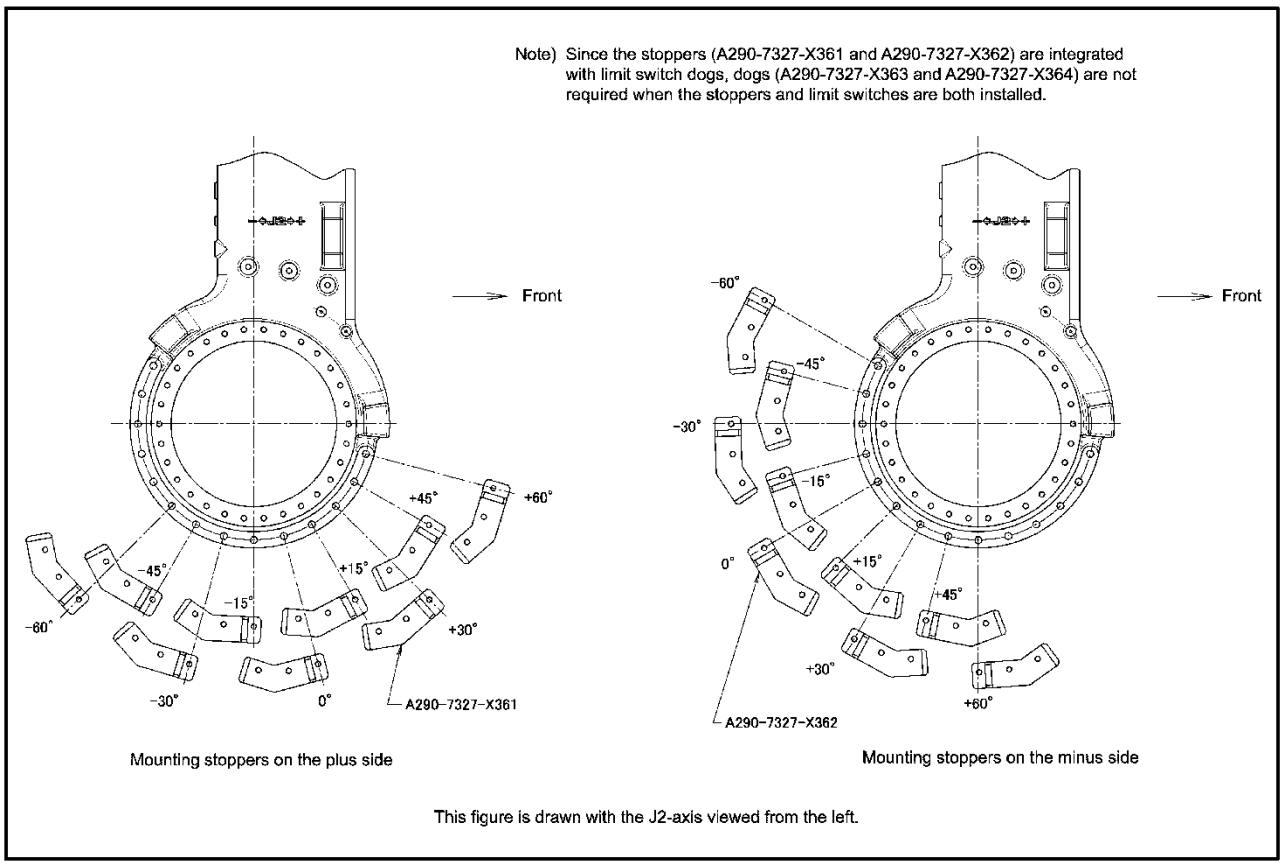


Fig. 5.1.3 (b) J2-axis mechanical stopper change (M-900*i*A/350/260L) (option)

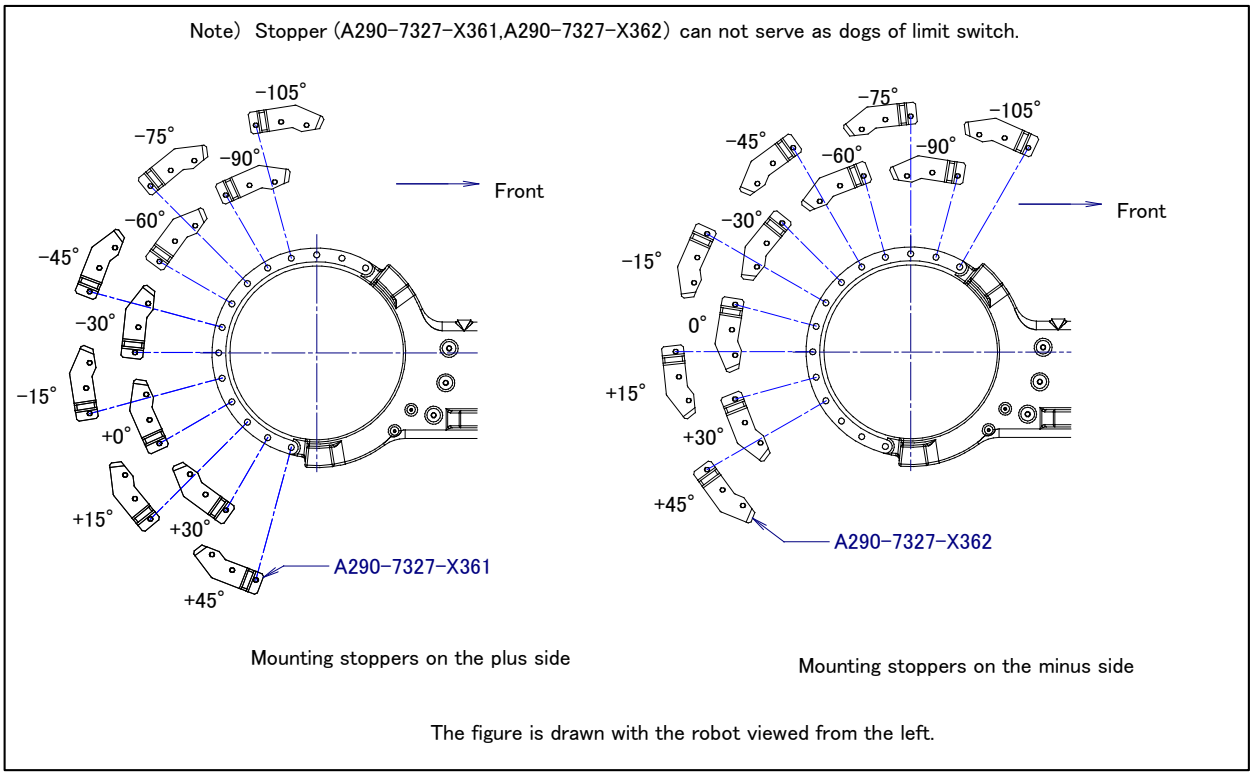


Fig. 5.1.3 (c) J3-axis mechanical stopper change (M-900*i*A/150P) (option)

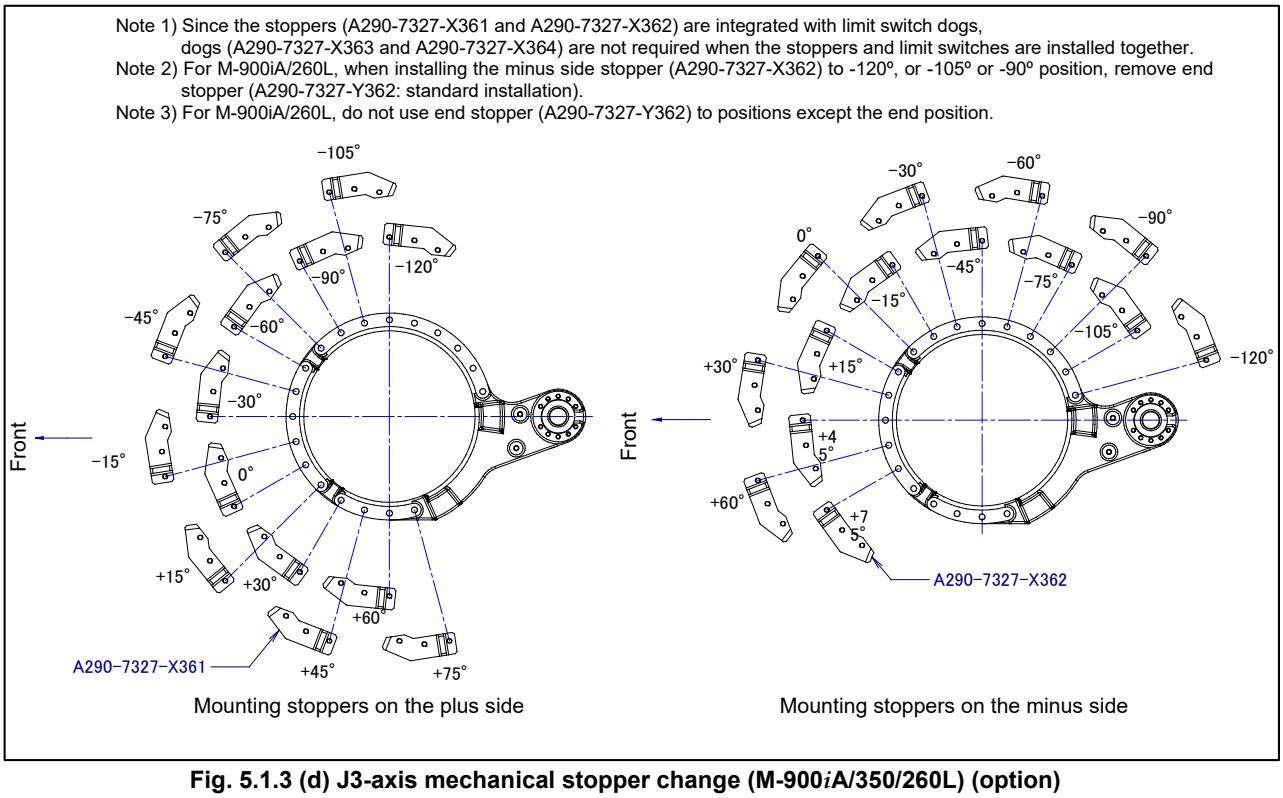


Fig. 5.1.3 (d) J3-axis mechanical stopper change (M-900*i*A/350/260L) (option)

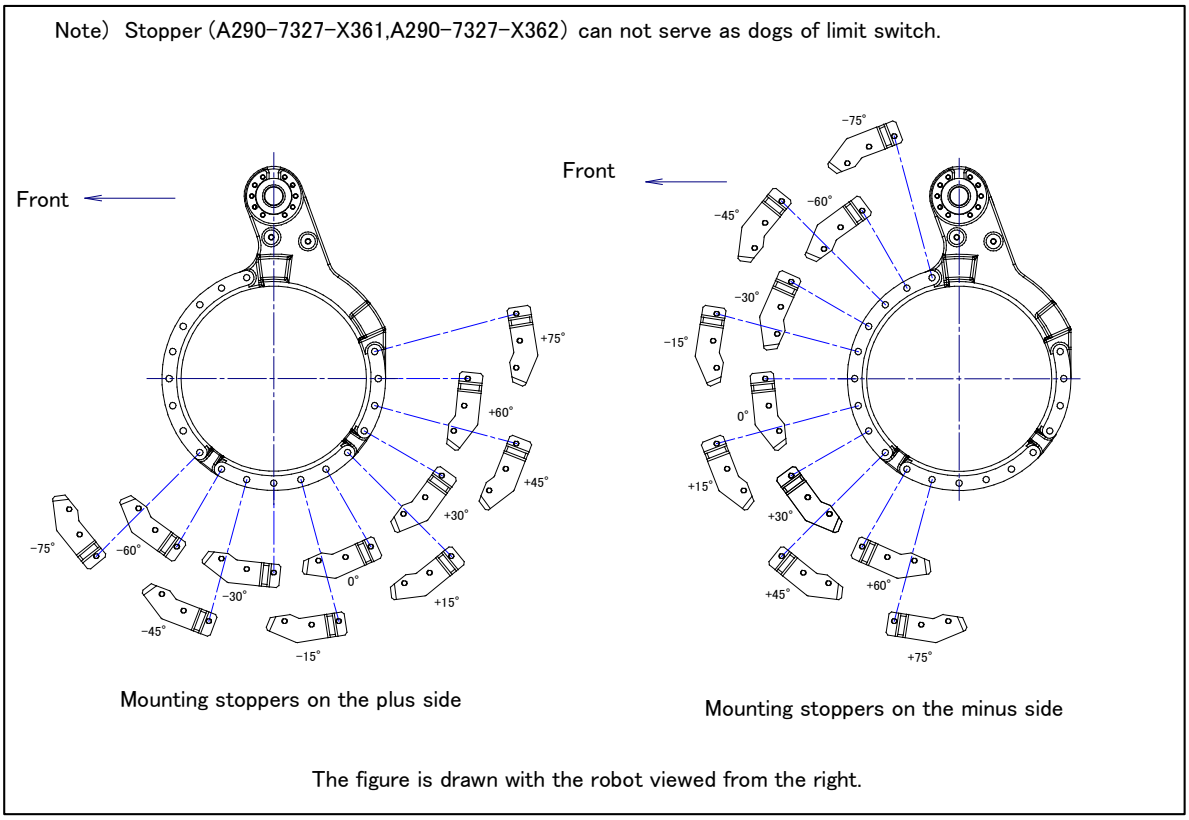


Fig. 5.1.3 (e) J3-axis mechanical stopper change (M-900*i*A/150P) (option)

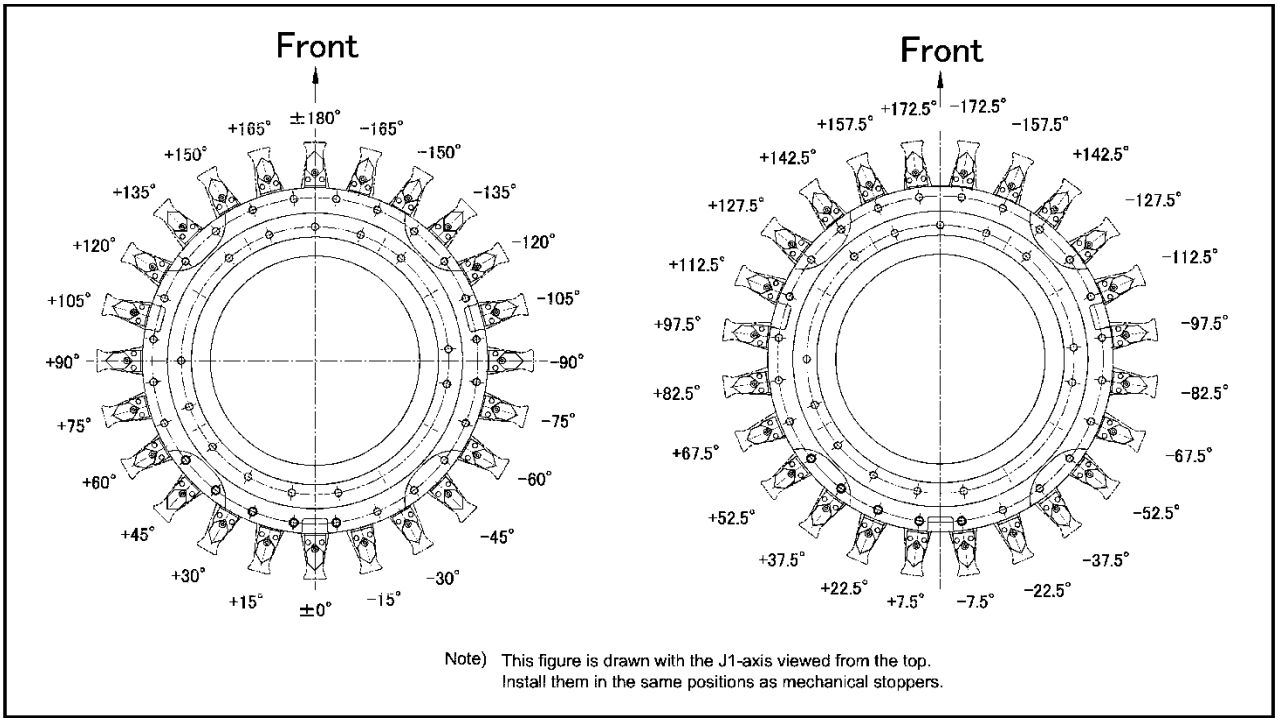


Fig. 5.1.3 (f) J1-axis dog (option) change

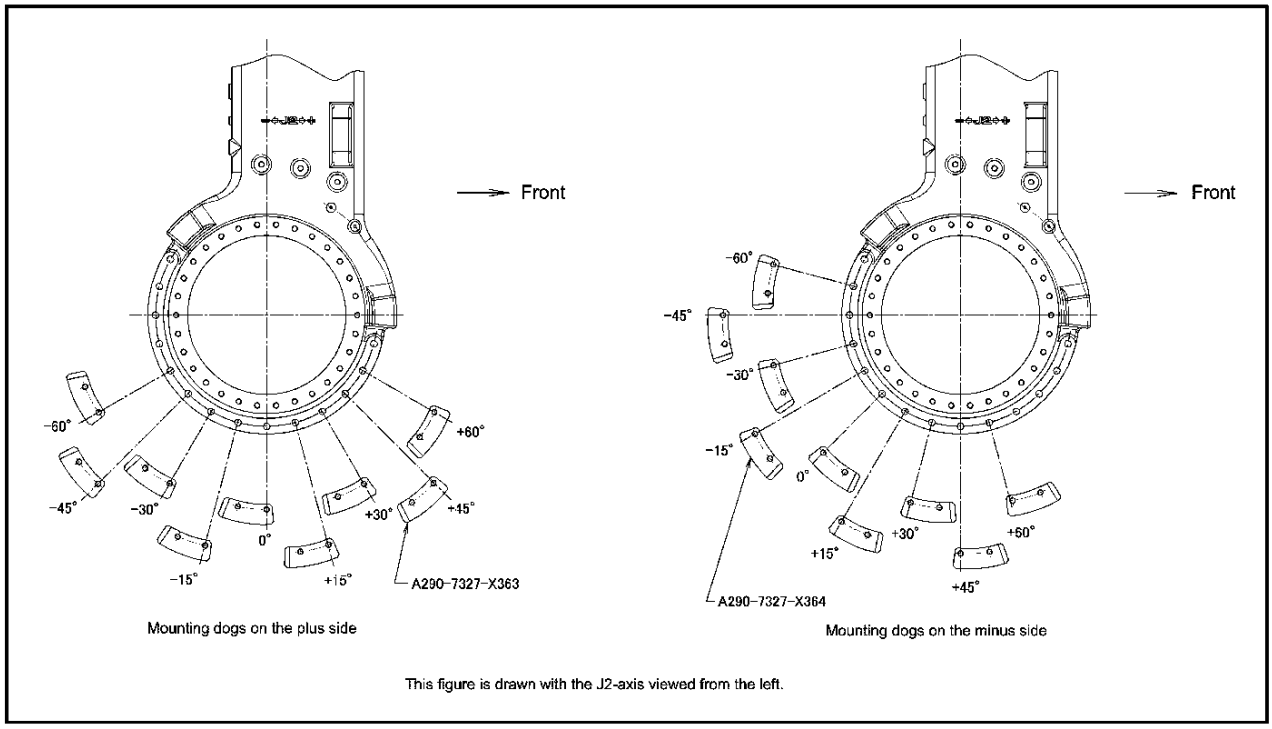


Fig. 5.1.3 (g) J2-axis dog (option) change (M-900*i*A/350/260L)

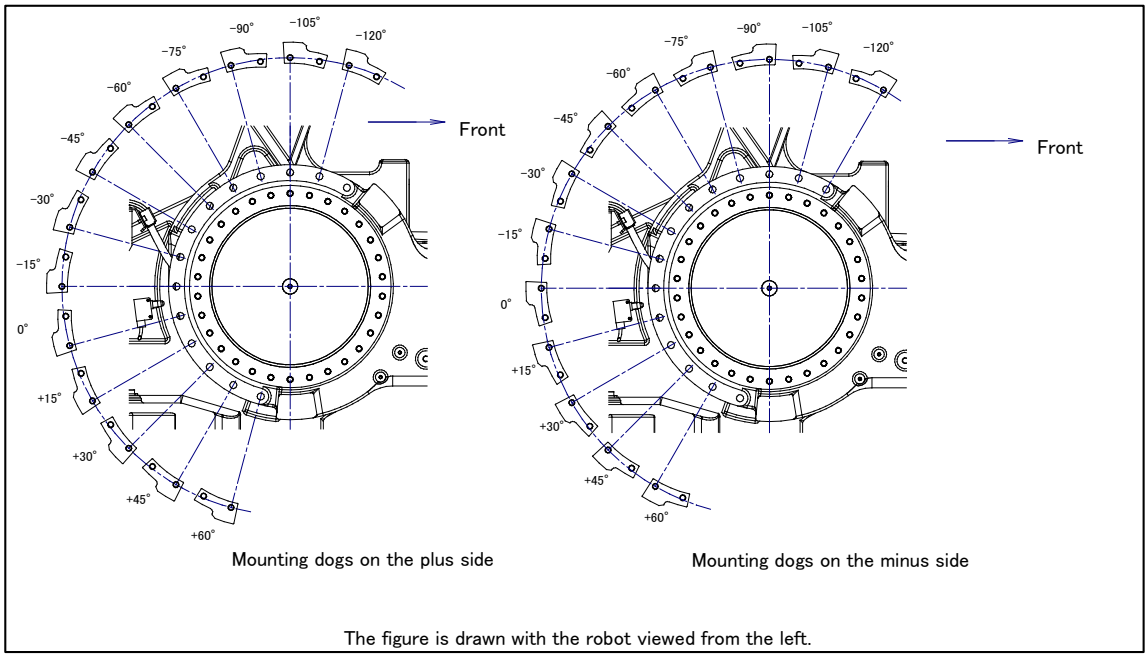


Fig. 5.1.3 (h) J2-axis dog (option) change (M-900*i*A/150P)

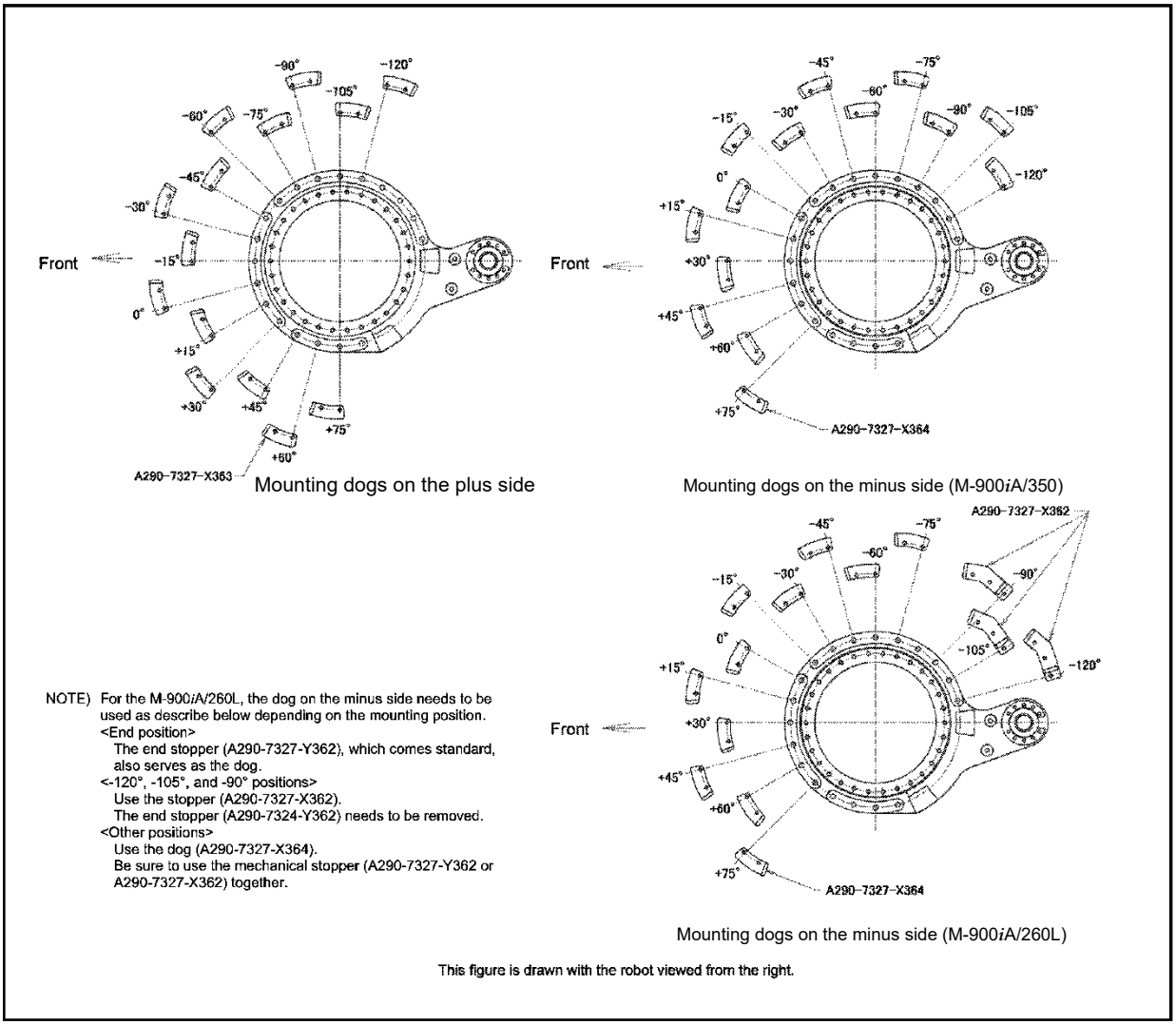


Fig. 5.1.3 (i) J3-axis dog (option) change (M-900*i*A/350/260L)

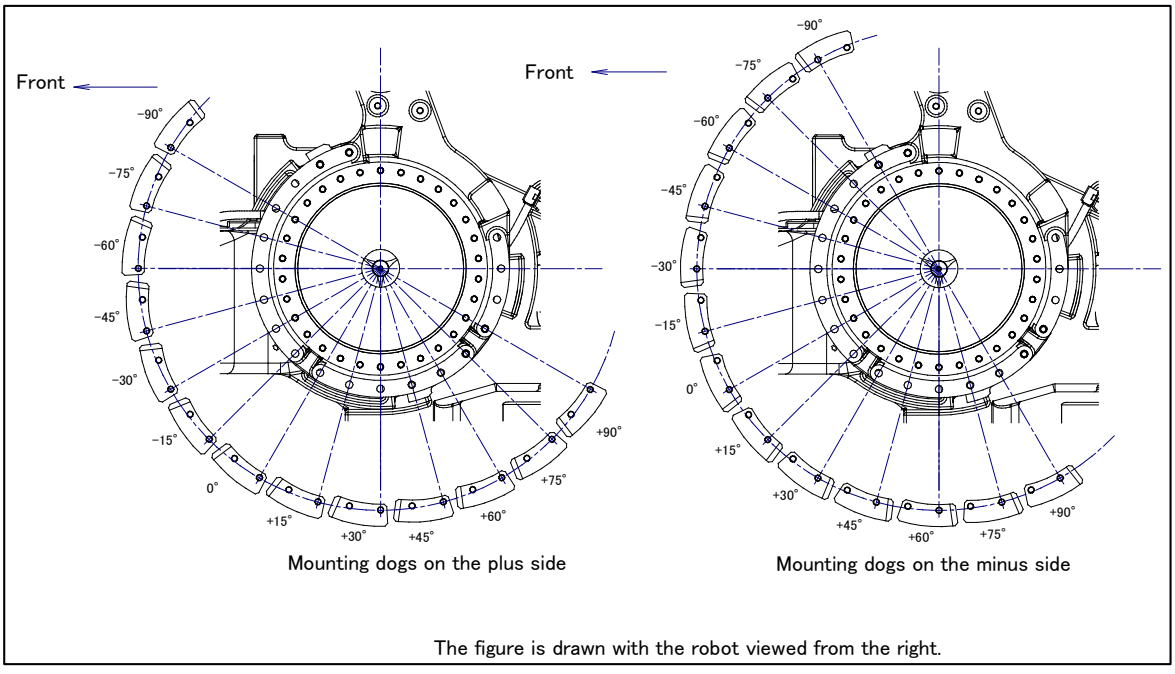


Fig. 5.1.3 (j) J3-axis dog (option) change (M-900*i*A/150P)

5.2 ADJUSTING LIMIT SWITCH (OPTION)

Axis limit switches are overtravel switches that, when tripped, cut power to the servo motors and an operation is stopped. Overtravel switches for J1-axis, J2-axis and J3-axis and J2/J3 interference angle are optional.

ADJUSTING PROCEDURE

1 Set the $MOR_GRP.$CAL_DONE system parameter to FALSE. This disables the motion limit specified by the software. As a result, the operator can rotate the robot by a jog feed which goes beyond the motion limit.
2 Loosen the following bolts.
Bolts secure the J1-axis: two M8 x 12, two M4 x 25
Bolts secure the J2-axis: two M12 x 20, two M6 x 10
Bolts secure the J3-axis: two M12 x 20, two M6 x 10
Bolt secure the J2/J3 interference angle : four M4 x 6
3 Move the limit switch so that the robot activates it at about 0.5 degrees before the stroke end. Step on the dog, and position the limit switch in such a place that only one of the step-on allowance indication lines at the tip of the switch is hidden.
4 When the limit switch operates and detects overtravel (OT), the robot stops, and an error message, “OVERTRAVEL”, is displayed. To restart the robot, hold on the SHIFT key and press the RESET key. Then, while holding on the SHIFT key, move the adjusting axis off the OT limit switch by jogging in joint mode.
5 Check that the robot also activates the limit switch when the robot is approx. 0.5 degrees from the opposite stroke end in the same way as above. If the limit switch does not operate at the position, adjust the position of the switch again.
6 Set the $MOR_GRP.$CAL_DONE system parameter to TRUE.
7 Cycle power of the controller.

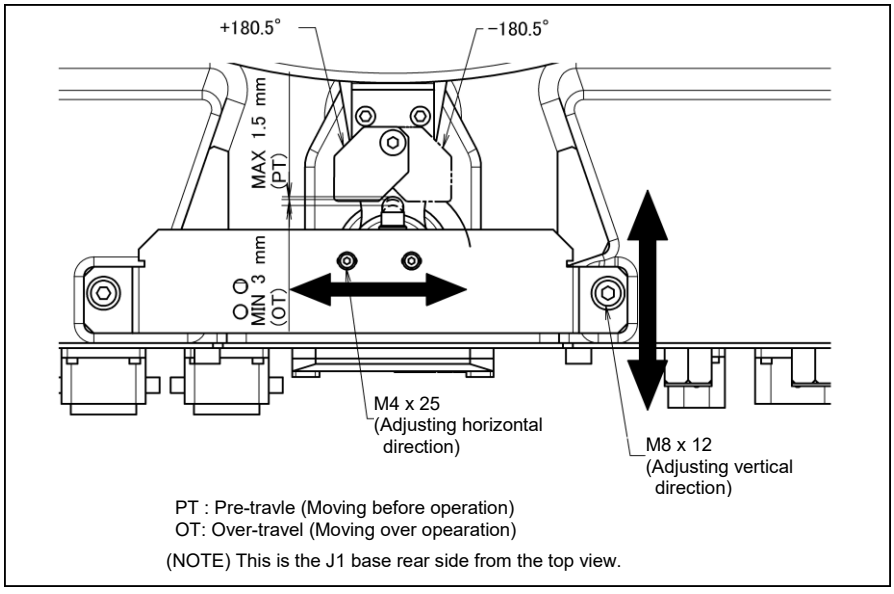


Fig. 5.2 (a) Adjusting J1-axis limit switch (option)

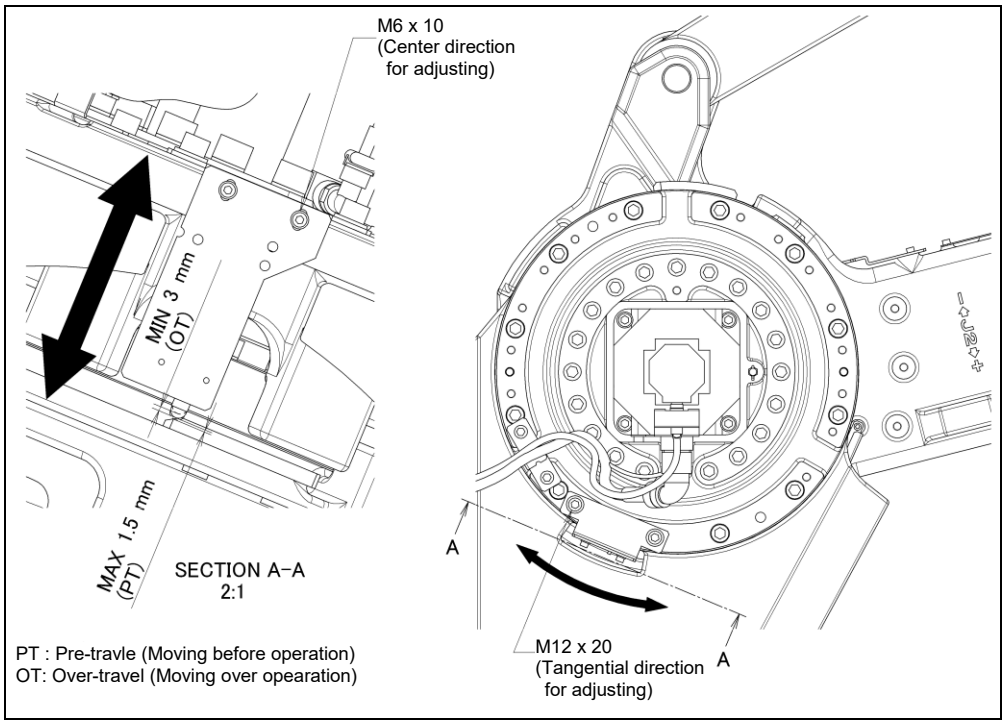


Fig. 5.2 (b) Adjusting J2-axis limit switch (option) (M-900*i*A/350/260L)

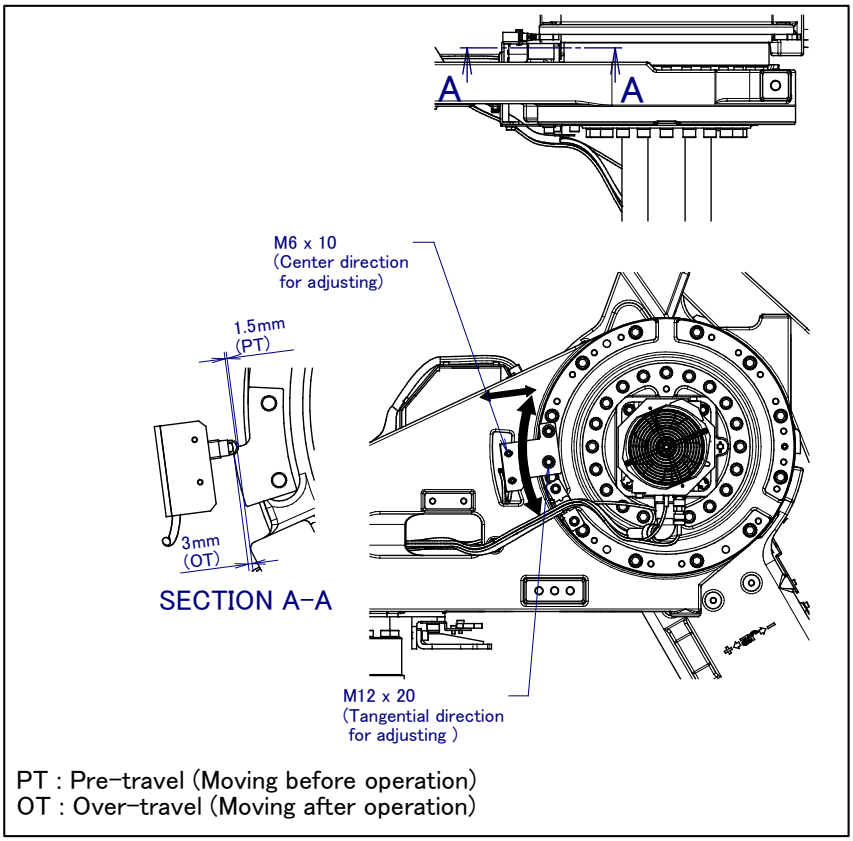


Fig. 5.2 (c) Adjusting J2-axis limit switch (option) (M-900*i*A/150P)

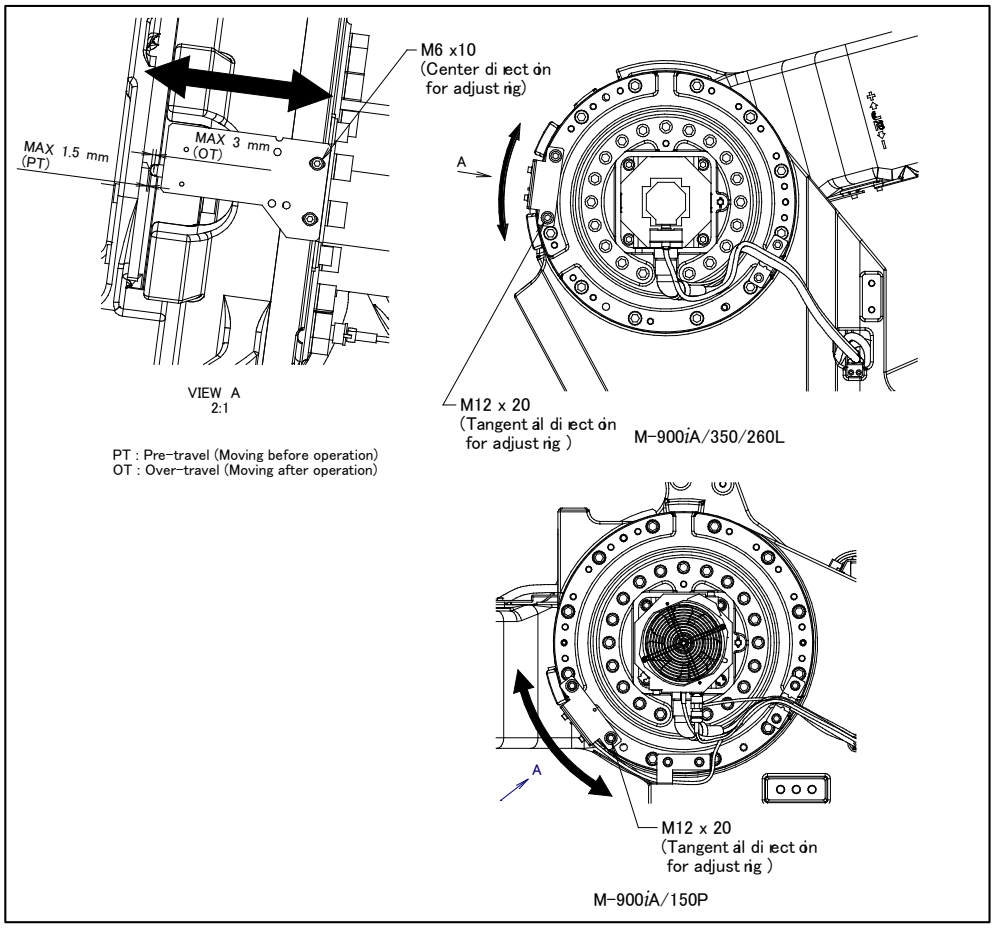


Fig. 5.2 (d) Adjusting J3-axis limit switch (option)

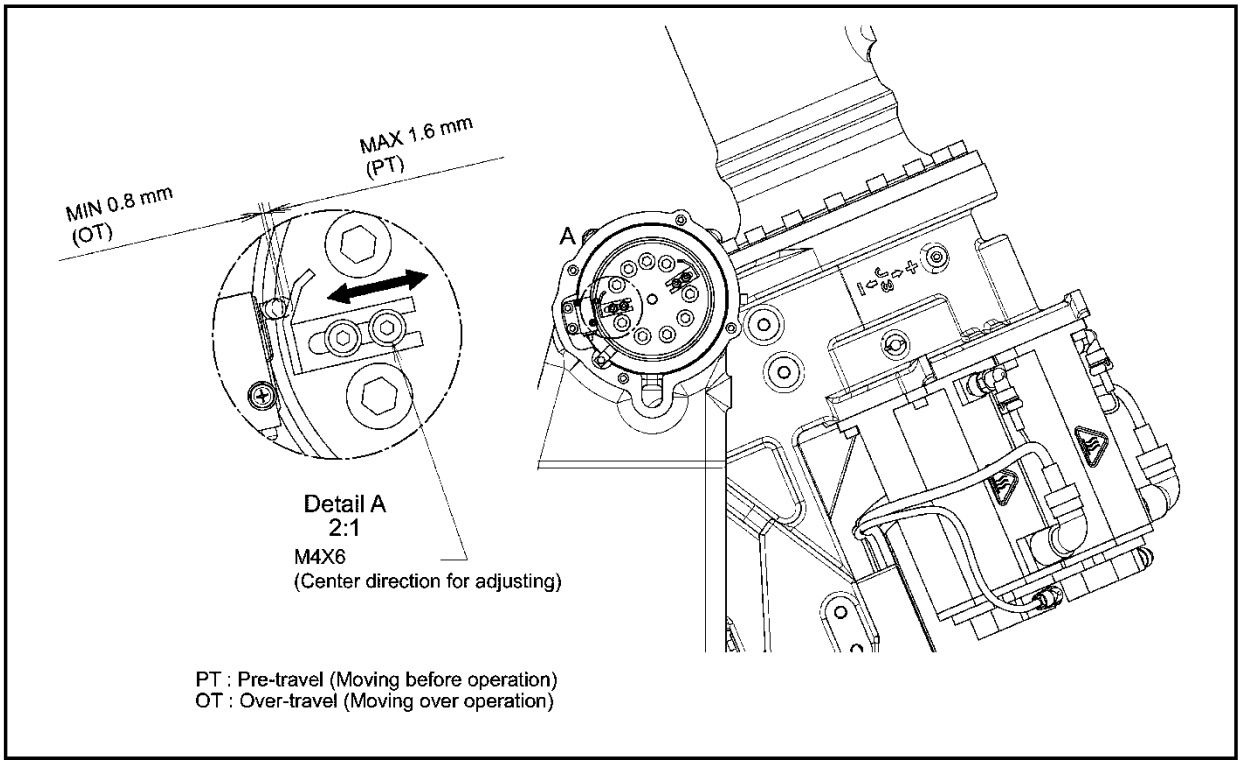


Fig. 5.2 (e) Adjusting J2/J3-axis interference angle limit switch (option)

5.3 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.

5.3.1 Overview

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

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

> **⚠CAUTION**
> Robot data (including mastering data) and Pulsecoder data are backed up by their respective backup batteries. Data will be lost if the batteries go dead. Replace the batteries in the control and mechanical units periodically. An alarm will be issued to warn the user of a low battery voltage.

Mastering method

Table 5.3.1 (a) describes the following mastering methods. If 7DC2 (V8.20P) or former software is installed, "Quick Mastering for Single Axis" has not been supported.

Table 5.3.1 (a) Types of Mastering

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

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

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

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

5.3.2 Resetting Alarms and Preparing for Mastering

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

Alarm displayed

"SRVO-062 BZAL" or "SRVO-075 Pulse not established"

Procedure

1 Display the positioning menu by following the steps 1 to 6.
   1 Press the [MENU] key.
   2 Press [0 NEXT] and select [6 SYSTEM].
   3 Press F1 ([TYPE]), and select [Variable] from the menu.
   4 Place the cursor on $MASTER_ENB, then key in "1" and press the [ENTER] key.
   5 Press F1 ([TYPE]), and select [Master/Cal] from the menu.
   6 Select the desired mastering type from the [Master/Cal] menu.

2 To reset the "SRVO-062 BZAL" alarm, follow steps 1 to 5.
   1 Press the [MENU] key.
   2 Press [0 NEXT] and select [6 SYSTEM].
   3 Press F1 ([TYPE]), and select [Master/Cal] from the menu.
   4 Press F3 ([RES_PCA]), then press F4 ([YES]).
   5 Cycle power of the controller.

3 To reset the "SRVO-075 Pulse not established" alarm, follow the steps 1 to 2.
   1 After cycling controller power, the message "SRVO-075 Pulse not established" appears again.
   2 Move the axis for which the message mentioned above has appeared in either direction till the alarm disappears when you press the [RESET] key.

5.3.3 Zero Position Mastering

Zero position mastering (witness mark mastering) is performed with all axes set at the 0-degree position. A zero-position mark (witness mark) is attached to each robot axis (Fig. 5.3.3 (a)). This mastering is performed with all axes set at the 0-degree position using their respective witness marks.

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

Zero position Mastering Procedure

1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE].
4 Select [Master/Cal].

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

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

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

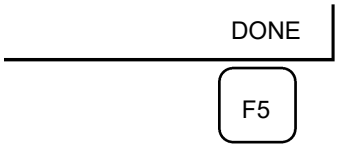
6 Select [2 ZERO POSITION MASTER]. Press F4 [YES].

```
SYSTEM Master/Cal          AUTO   JOINT 10 %
                                  TORQUE = [ON ]
 1 FIXTURE POSITION MASTER
 2 ZERO POSITION MASTER
 3 QUICK MASTER
 4 QUICK MASTER FOR SINGLE AXIS
 5 SINGLE AXIS MASTER
 6 SET QUICK MASTER REF
 7 CALIBRATE
 Robot Mastered! Mastering Data:
    <0> <11808249> <38767856>
    <9873638> <12200039> <2000319>
 [ TYPE ]   LOAD   RES_PCA                DONE
```

7 Select [7 CALIBRATE] and press F4 [YES]. Mastering will be performed automatically. Alternatively, cycle power of the controller to perform mastering.

```
SYSTEM Master/Cal          AUTO   JOINT 10 %
                                  TORQUE = [ON ]
 1 FIXTURE POSITION MASTER
 2 ZERO POSITION MASTER
 3 QUICK MASTER
 4 QUICK MASTER FOR SINGLE AXIS
 5 SINGLE AXIS MASTER
 6 SET QUICK MASTER REF
 7 CALIBRATE
 Robot Calibrated! Cur Jnt Ang(deg):
   <    0.0000> <    0.0000> <    0.0000>
   <    0.0000> <    0.0000> <    0.0000>
```

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



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

Table 5.3.3 (a) Posture with position marks aligned

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

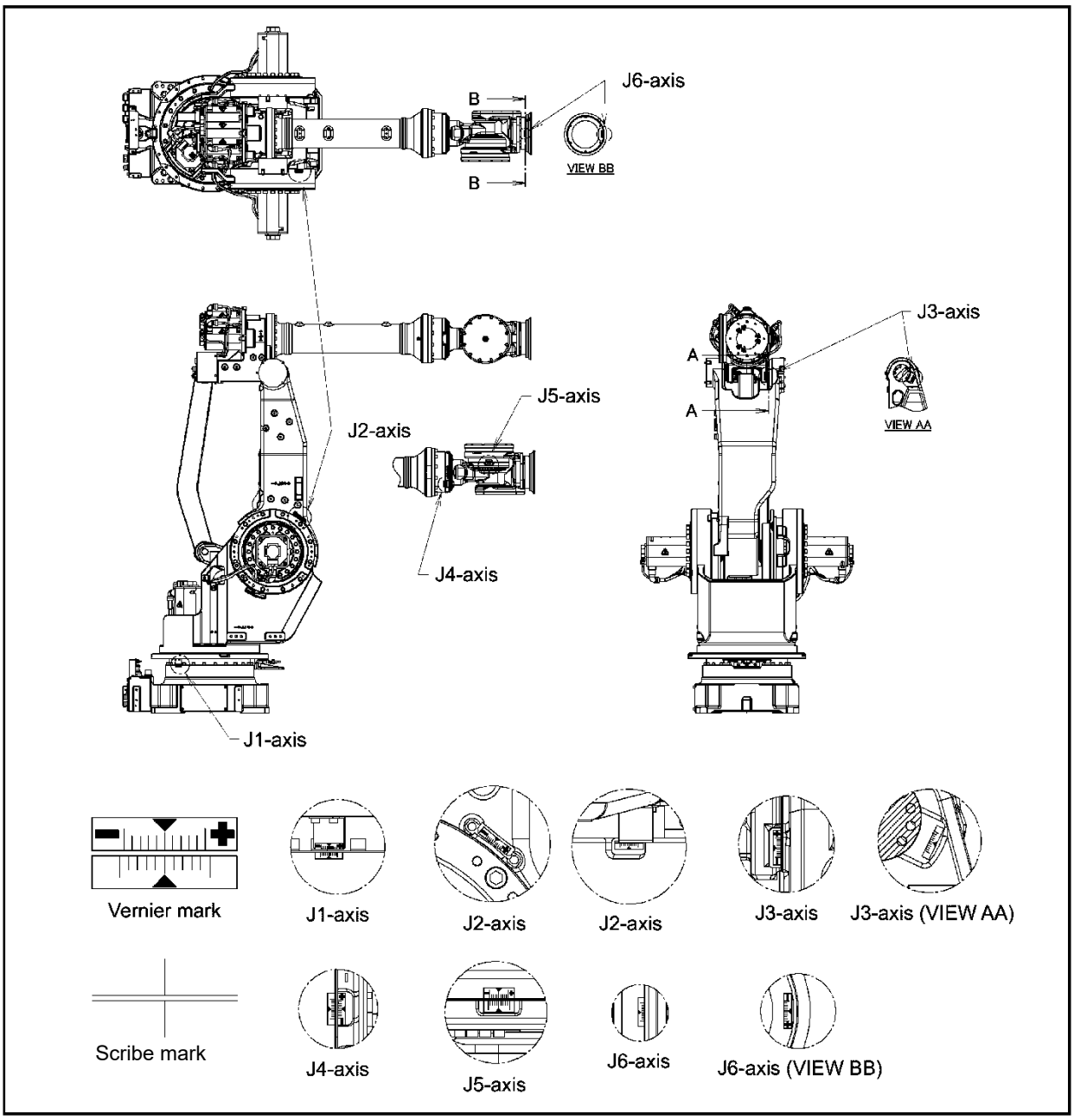


Fig. 5.3.3 (a) Zero degree position arrow mark for each axis

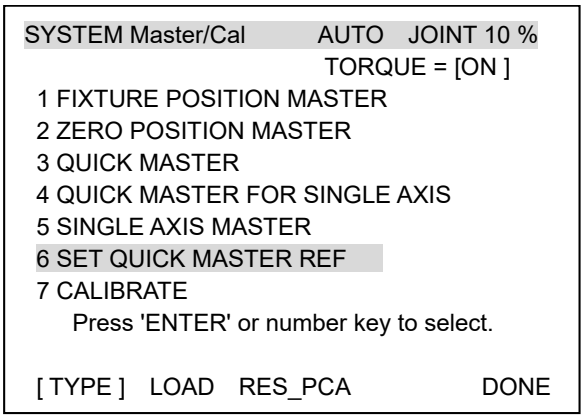
5.3.4 Quick Mastering

Quick mastering is performed at a user-specified position. The corresponding count value is obtained from the rotation times of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the character that the absolute value of a rotation angle within one rotation will not be lost.
Quick mastering is factory-performed at the position indicated in Table. 5.3.3 (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.)

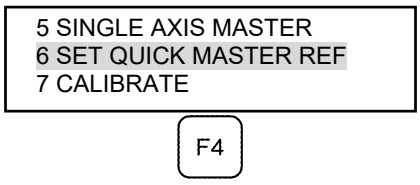
⚠CAUTION
1. Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2. Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

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 [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position is saved.

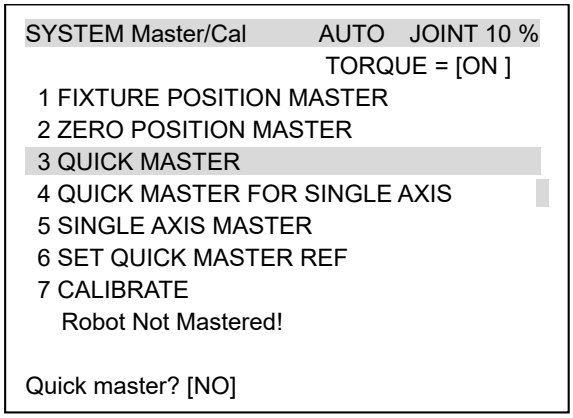


⚠ CAUTION
If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or zero –position mastering is required to restore mastering data.

Procedure of Quick Mastering

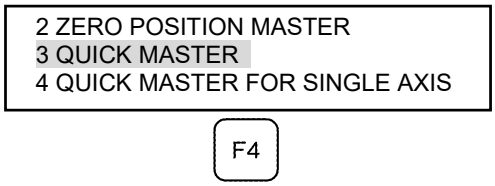
Step

1 Display the Master/Cal screen.



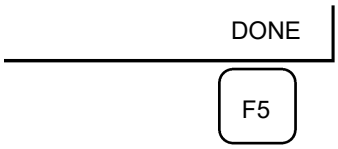
2 Release brake control, and jog the robot to the quick mastering reference position.

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 [CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration is executed by cycling power on again.

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



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

5.3.5 Quick Mastering for Single Axis

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

Quick mastering is factory-performed at the position indicated in Table 5.3.3 (a). Do not change the setting unless there is any problem.

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

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

Procedure Recording the Quick Mastering Reference Position

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

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

[ TYPE ]   LOAD   RES_PCA                DONE
```

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

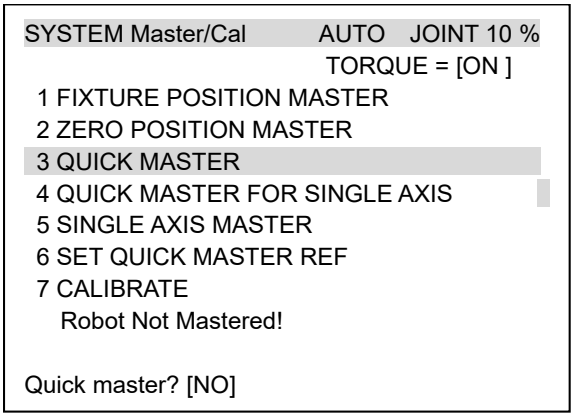
```
 5 SINGLE AXIS MASTER
 6 SET QUICK MASTER REF
 7 CALIBRATE
```

F4

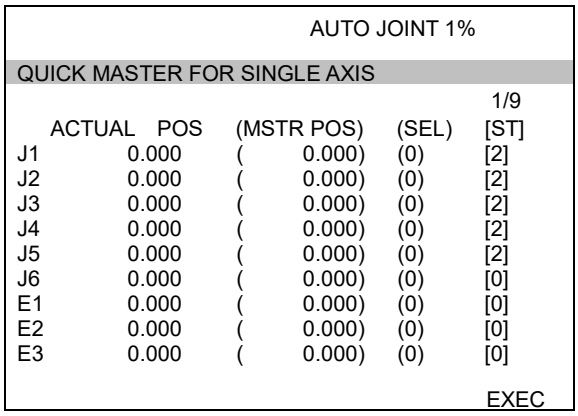
> **⚠ CAUTION**
> If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or zero –position mastering is required to restore mastering data.

Procedure of Quick Mastering for single axis

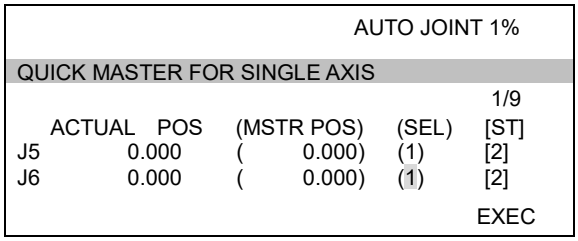
1 Display the Master/Cal screen.



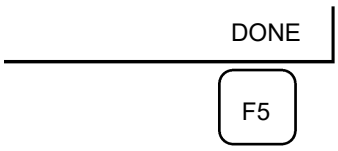
2 Select [4 QUICK MASTER FOR SINGLE AXIS]. You will see the quick master for single axis screen.



3 Move the cursor to the [SEL] column for the unmastered axis and press the numeric key [1]. Setting of [SEL] is available for one or more axes.



4 Turn off brake control, then jog the robot to the quick mastering reference position.
5 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2.
6 Select [7 CALIBRATE] and press F4 [YES]. Calibration will be executed. Calibration is executed by cycling power.
7 After completing the calibration, press F5 Done.



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

5.3.6 Single Axis Mastering

Single axis mastering is performed for one axis at a time. The mastering position for each axis can be specified by the user.
Single axis mastering can be used, if mastering data for a specific axis is lost, for example, because a low voltage has been detected on the pulse counter backup battery or because the Pulsecoder has been replaced.

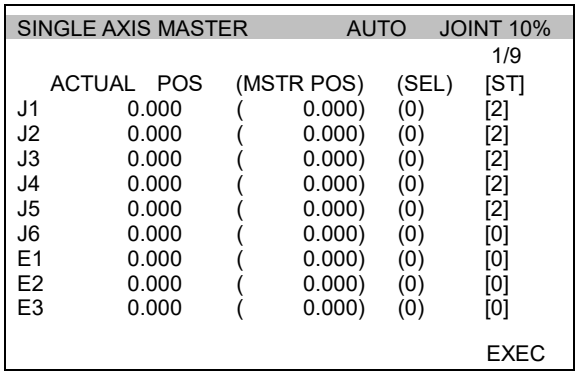
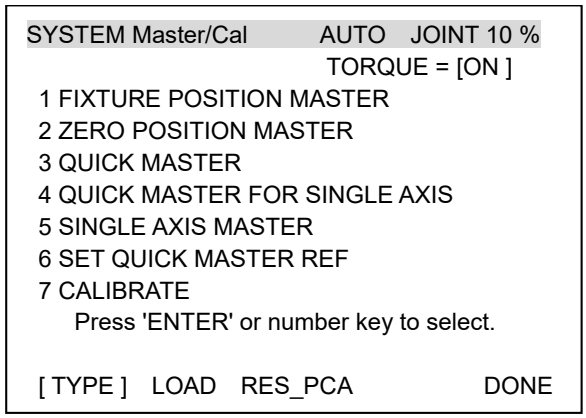


Table 5.3.7 (a) Items set in single axis mastering

Item	Description
Current position (ACTUAL AXIS)	The current position of the robot is displayed for each axis in degree units.
Mastering position (MSTR POS)	A mastering position is specified for an axis to be subjected to single axis mastering. It would be convenient if it is set to 0 degree position.
SEL	This item is set to 1 for an axis to be subjected to single axis mastering. Usually, it is 0.
ST	This item indicates whether single axis mastering has been completed for the corresponding axis. It cannot be changed directly by the user. The value of the item is reflected in $EACHMST_DON (1 to 9). 0 : Mastering data has been lost. Single axis mastering is necessary. 1 : Mastering data has been lost. (Mastering has been performed only for the other interactive axes.) Single axis mastering is necessary. 2 : Mastering has been completed.

Procedure of Single axis mastering

1 Select [6 SYSTEM].
2 Select [Master/Cal].



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

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

                                          EXEC
```

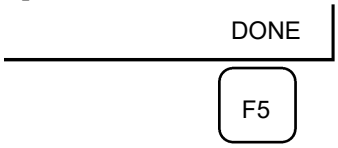
4 For the axis to which to perform single axis mastering, set (SEL) to "1." Setting of [SEL] is available for one or more axes.
5 Turn off brake control, then jog the robot to the mastering position.
6 Enter axis data for the mastering position.
7 Press F5 [EXEC]. Mastering is performed. So, [SEL] is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

```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                            6/9
    ACTUAL   POS   (MSTR POS)    (SEL)   [ST]
J1          0.000  (     0.000)  (0)     [2]
J2          0.000  (     0.000)  (0)     [2]
J3          0.000  (     0.000)  (0)     [2]
J4          0.000  (     0.000)  (0)     [2]
J5          0.000  (     0.000)  (0)     [2]
J6         90.000  (     0.000)  (1)     [0]
E1          0.000  (     0.000)  (0)     [0]
E2          0.000  (     0.000)  (0)     [0]
E3          0.000  (     0.000)  (0)     [0]

                                          EXEC
```

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

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

 [ TYPE ]   LOAD   RES_PCA              DONE
```

9 Select [7 CALIBRATE], then press F4 [YES]. Positioning is performed. Alternatively, cycle power of the controller to perform mastering.
10 After positioning is completed, press F5 [DONE].



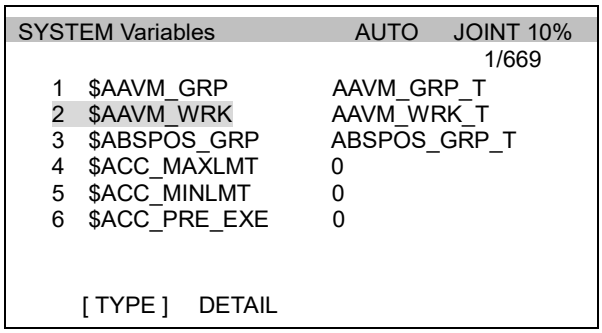
11 Return brake control to original setting, and cycle power of the controller.

5.3.7 Mastering Data Entry

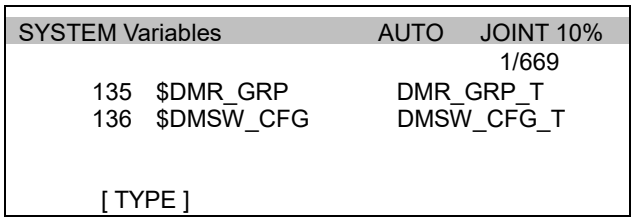
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

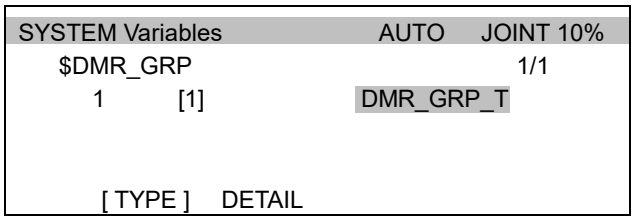
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen will be displayed.

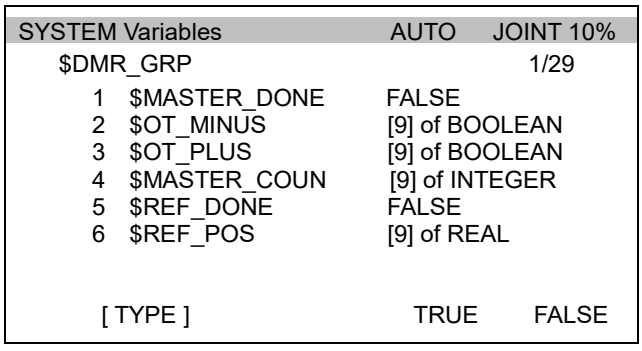


3 Change the mastering data. The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

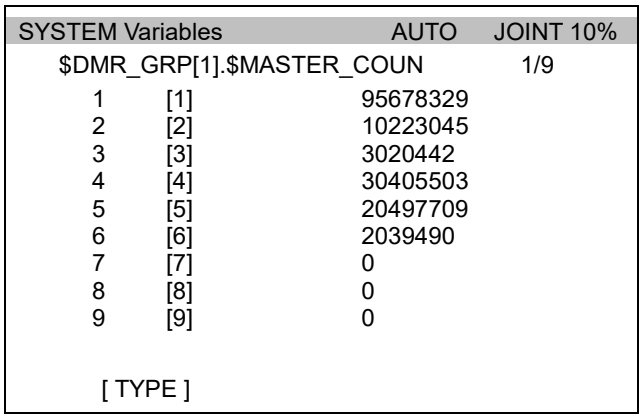


4 Select $DMR_GRP.

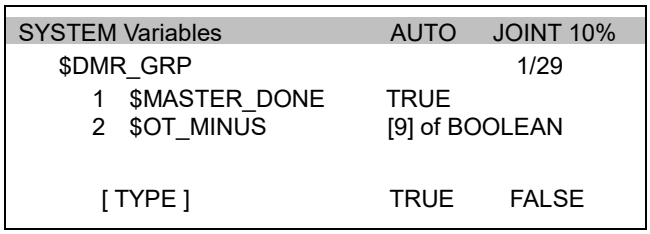




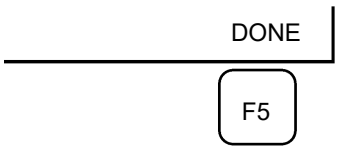
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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 VERIFYING MASTERING

1 How to verify that the robot is mastered properly:

Usually, positioning is performed automatically when the power is turned on. To check whether mastering has been performed correctly, examine if the current displayed position matches the actual robot position by using the procedure described below:

(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the zero-degree position marks indicated in Subsection 5.3.3 are aligned. There is no need to use any visual aid.

If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described below 2 in this Subsection. Alternatively, the mastering data in system variable $DMR_GRP.$MASTER_COUN may have been overwritten as a result of an operation error or some other reasons.
Compare the data with the values indicated on the supplied data sheet. This system variable is overwritten whenever mastering is performed. Whenever mastering is performed, record the value of the system variable on the data sheet.

2 Alarms that may be output during mastering and remedy for it
(1) BZAL alarm
This alarm is output if the voltage of the Pulsecoder's backup battery falls to 0 V while the power to the controller is disconnected. Also, if Pulsecoder connector is removed for replacing cables etc. this alarm is output because voltage becomes to 0. To clear the alarm, fit a new battery, execute the pulse reset (See Subsection 5.3.2.), Then, cycle power of the controller to check if the alarm disappears or not.
The battery might be weak if you can’t reset alarm, then replace battery to new one , perform pulse reset , turn off and on the controller power. Note that, if this alarm occurs, all data originally held by the Pulsecoder will have been lost. Mastering must be performed again.
(2) BLAL alarm
This alarm is output if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is output, fit a new battery immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1 in this Subsection.
(3) CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL, alarms
Contact the FANUC because the Pulsecoder may be defective.

6 PIPING AND WIRING

6.1 WIRING DIAGRAM

Fig 6.1 (a) to (d) are the routing of the robot cables and the connector wiring. For piping in the mechanical unit, refer to Section 9.7.

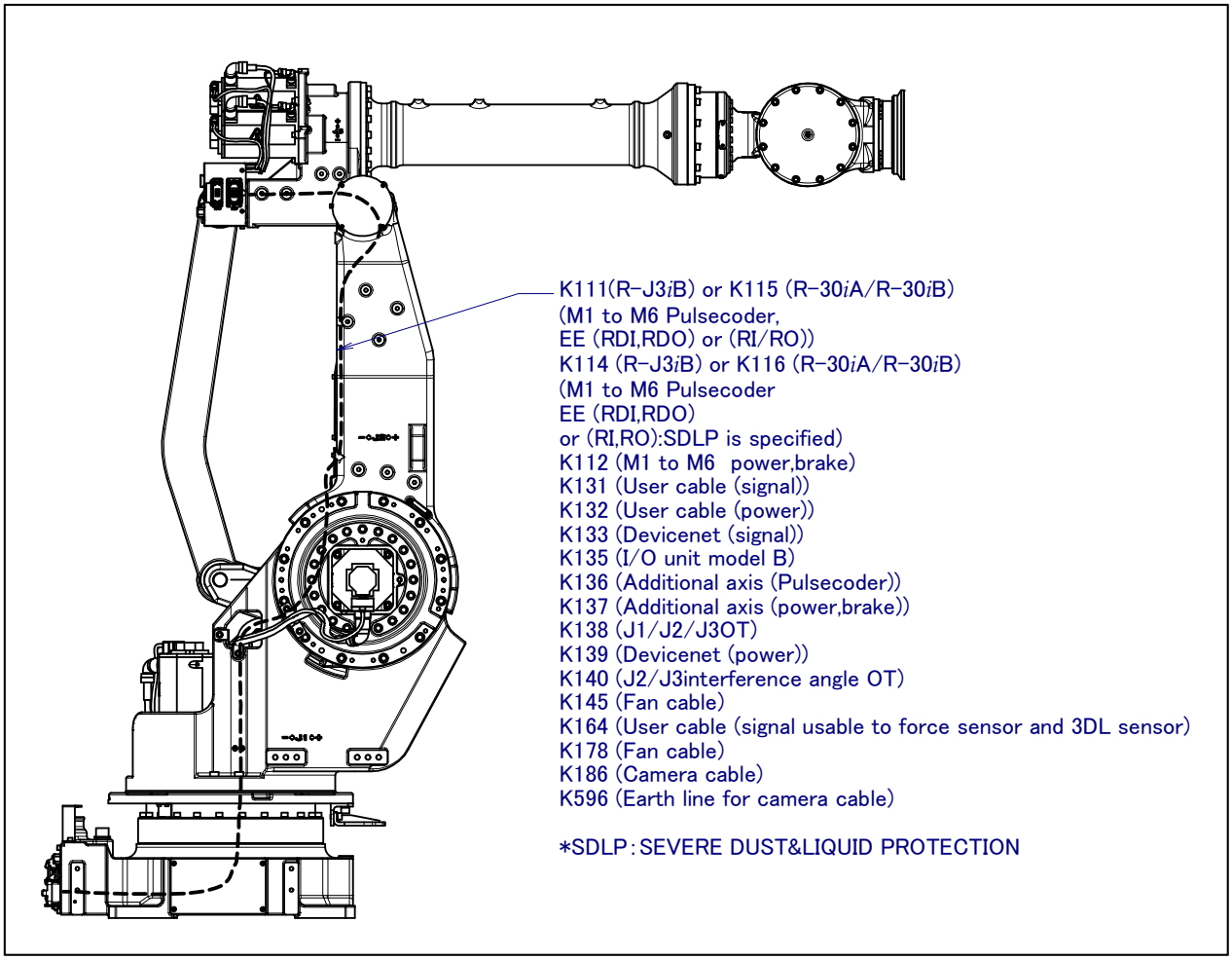


Fig. 6.1 (a) Wiring diagram (M-900*i*A/350/260L)

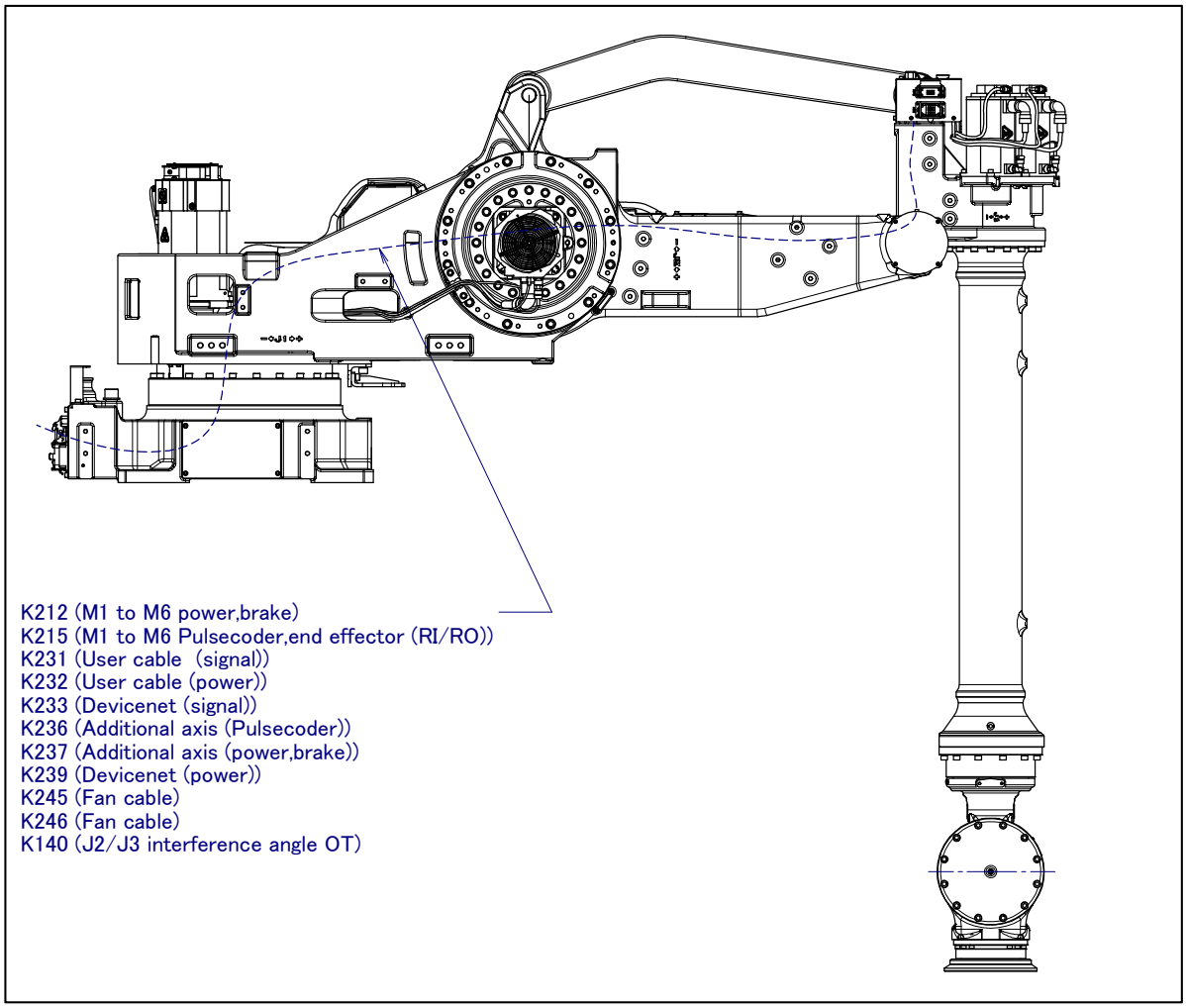


Fig. 6.1 (b) Wiring diagram (M-900*i*A/150P)

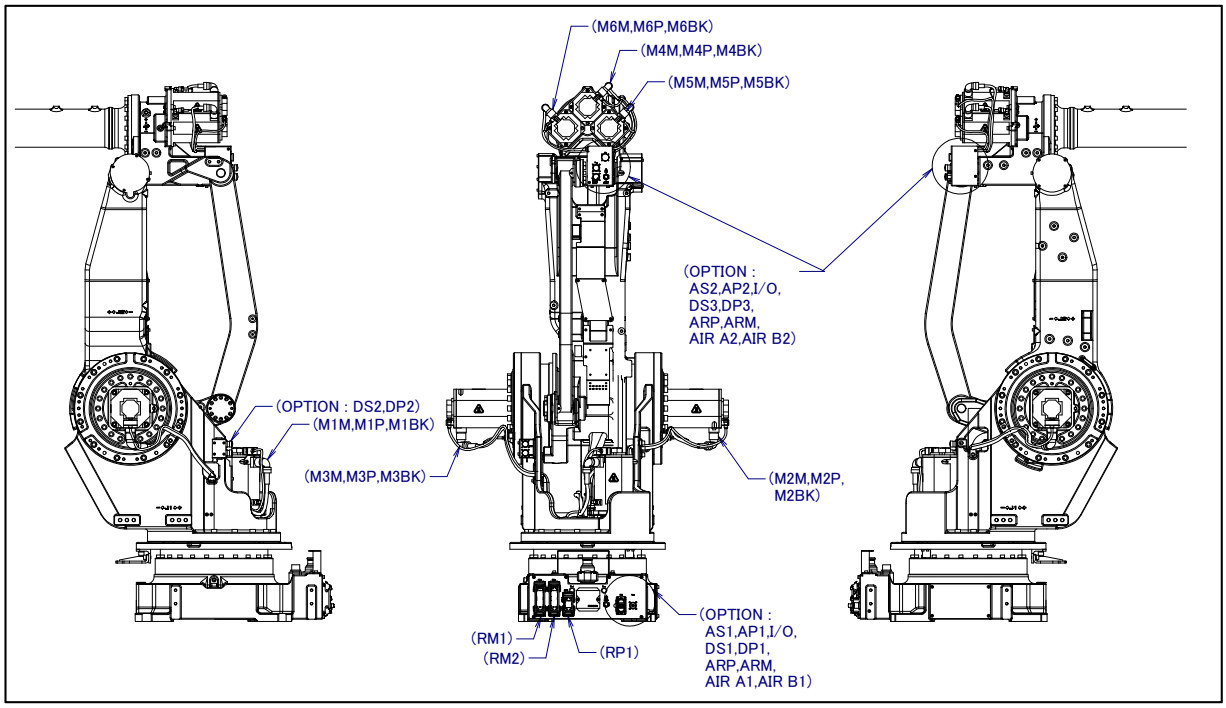


Fig. 6.1 (c) Connector locations (M-900*i*A/350/260L)

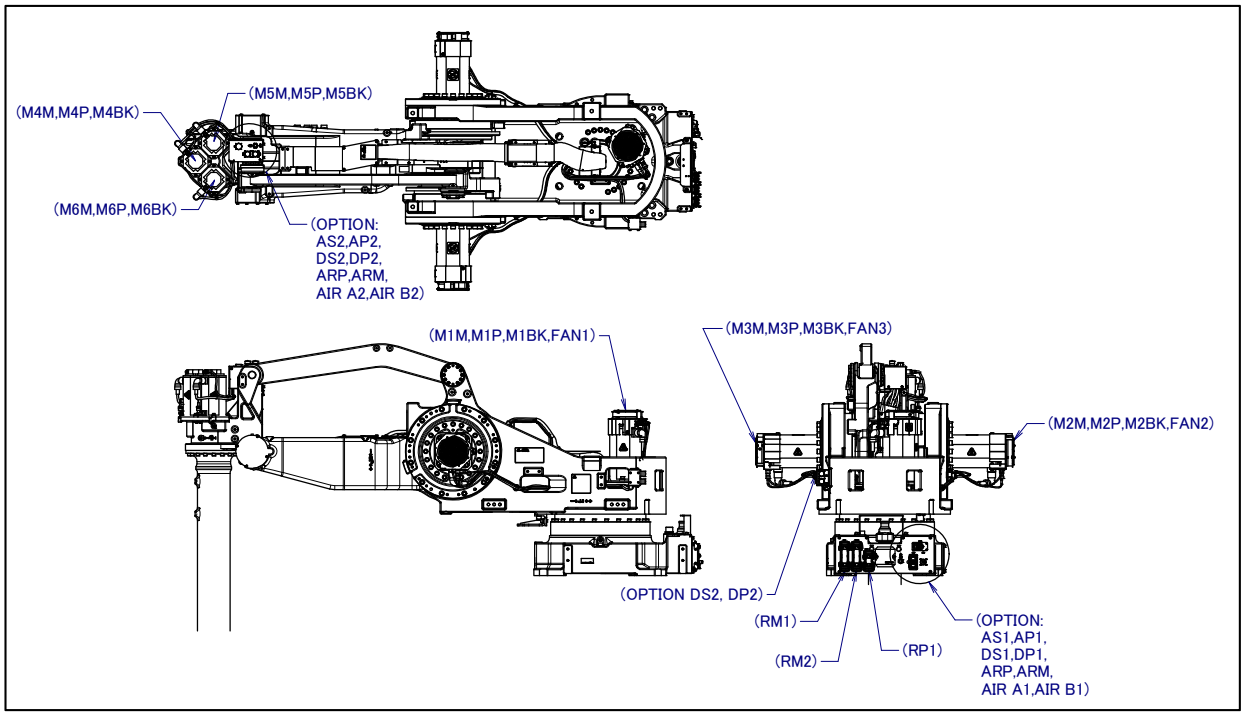


Fig. 6.1 (d) Connector locations (M-900*i*A/150P)

7 SEVERE DUST/LIQUID PROTECTION OPTION

7.1 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.

Model	Severe dust/liquid protection specification
M-900*i*A/350/260L	A05B-1327-J801

NOTE
Contact your FANUC representative for confirmation that the severe dust/liquid protection package is suitable for your environment.

7.1.1 Severe dust/liquid protection characteristics

The following table lists the IEC60529-based Severe dust/liquid protection characteristics of the M-900*i*A.

	Standard	Severe dust/liquid protection package
J3 arm and wrist section	IP67	IP67
Driving unit of the body	IP66	IP66
Main body	IP54	IP56

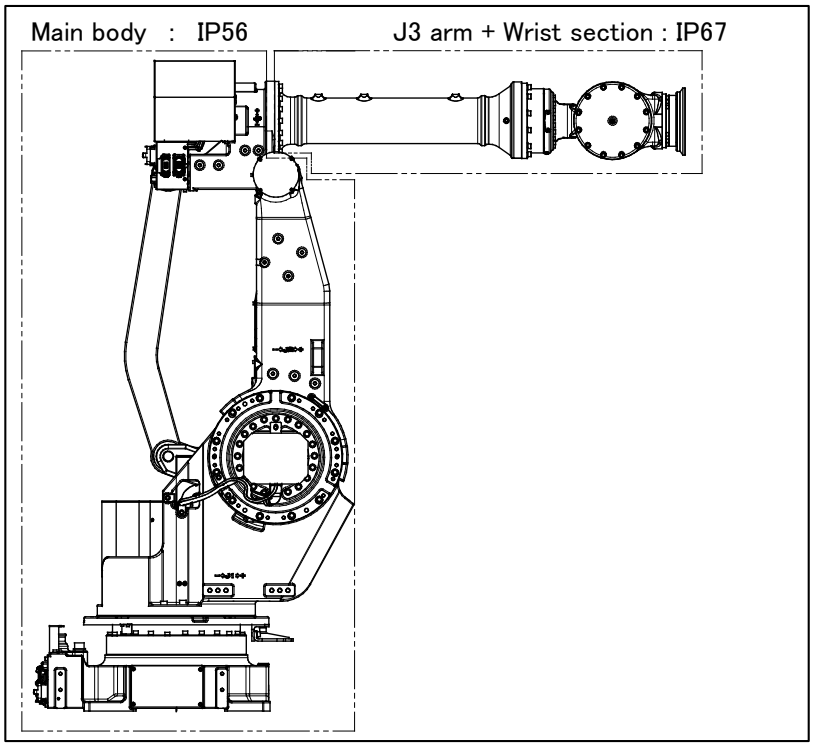


Fig. 7.1.1 (a) Severe dust/Liquid protection characteristics of the M-900*i*A

7.1.2 Configuration of the severe dust/liquid protection option

The following table lists the major differences between the M-900*i*A/350/260L standard specification and severe dust/liquid protection package.

	Standard specification	**Severe dust/liquid protection package**	
	Whole mechanical unit	**Main body**	**J3 arm and wrist section**
Bolts	Black steel bolt Black washer	FR coating bolt Black chrome plated washer Stainless bolt Black steel bolt	FR coating bolt Black chrome plated washer Stainless bolt
Cover		J1-axis motor cover J2-axis motor cover J3-axis motor cover J4, 5, 6-axis motor cover Battery box cover Mechanical unit cable protective sleeve (for all exposed cable sections)	
J3 connector panel EE(RI/RO), I/O connector	Non-waterproof connector	Waterproof connector	

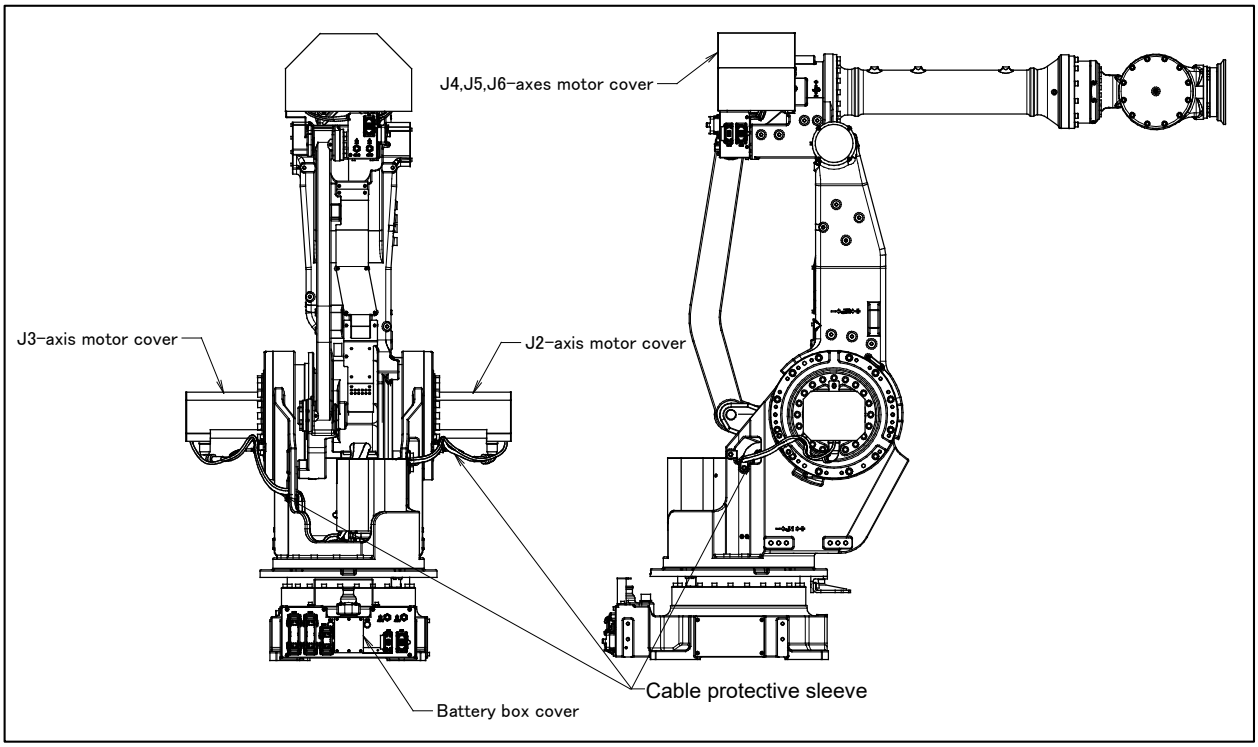


Fig. 7.1.2 (a) Configuration of the severe dust/liquid protection

7.1.3 Notes on Specifying severe dust/liquid protection option

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. (As exception to this, only liquids tested and approved by FANUC can be used with the robot.)
   (1) Organic solvents
   (2) Cutting fluid or detergent including chlorine / gasoline
   (3) Amine type cutting fluid or detergent
   (4) Acid, alkali and liquid causing rust
   (5) Other liquids or solutions, that will harm NBR or CR rubber

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

8 ROBOT OPERATING SPACE

8.1 OPERATING SPACE

Fig. 8.1 (a) to (c) shows the operating space of the robot. When installing peripheral equipment, be careful to clear away any objects that are in the robot's motion path in normal operation.

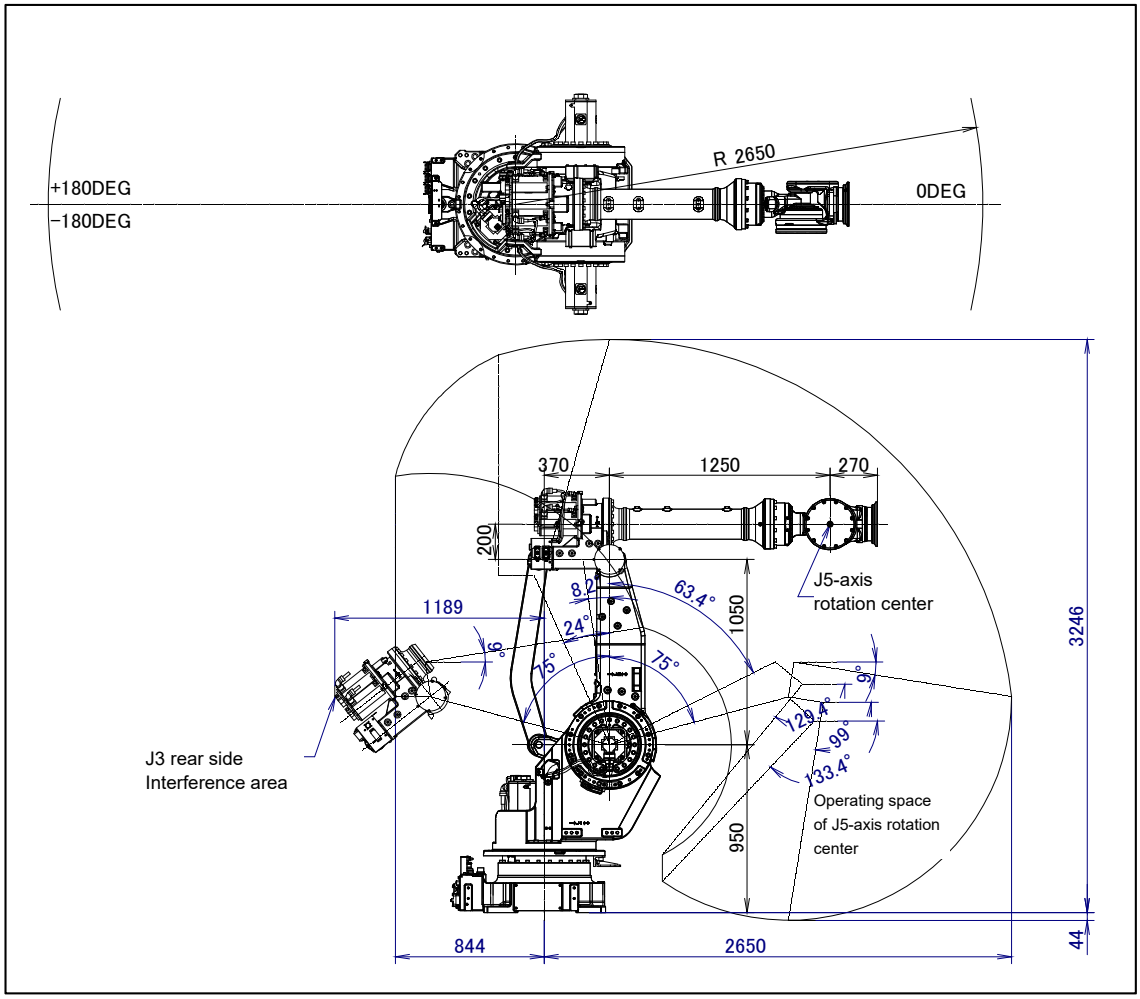


Fig. 8.1 (a) Operating space (M-900*i*A/350)

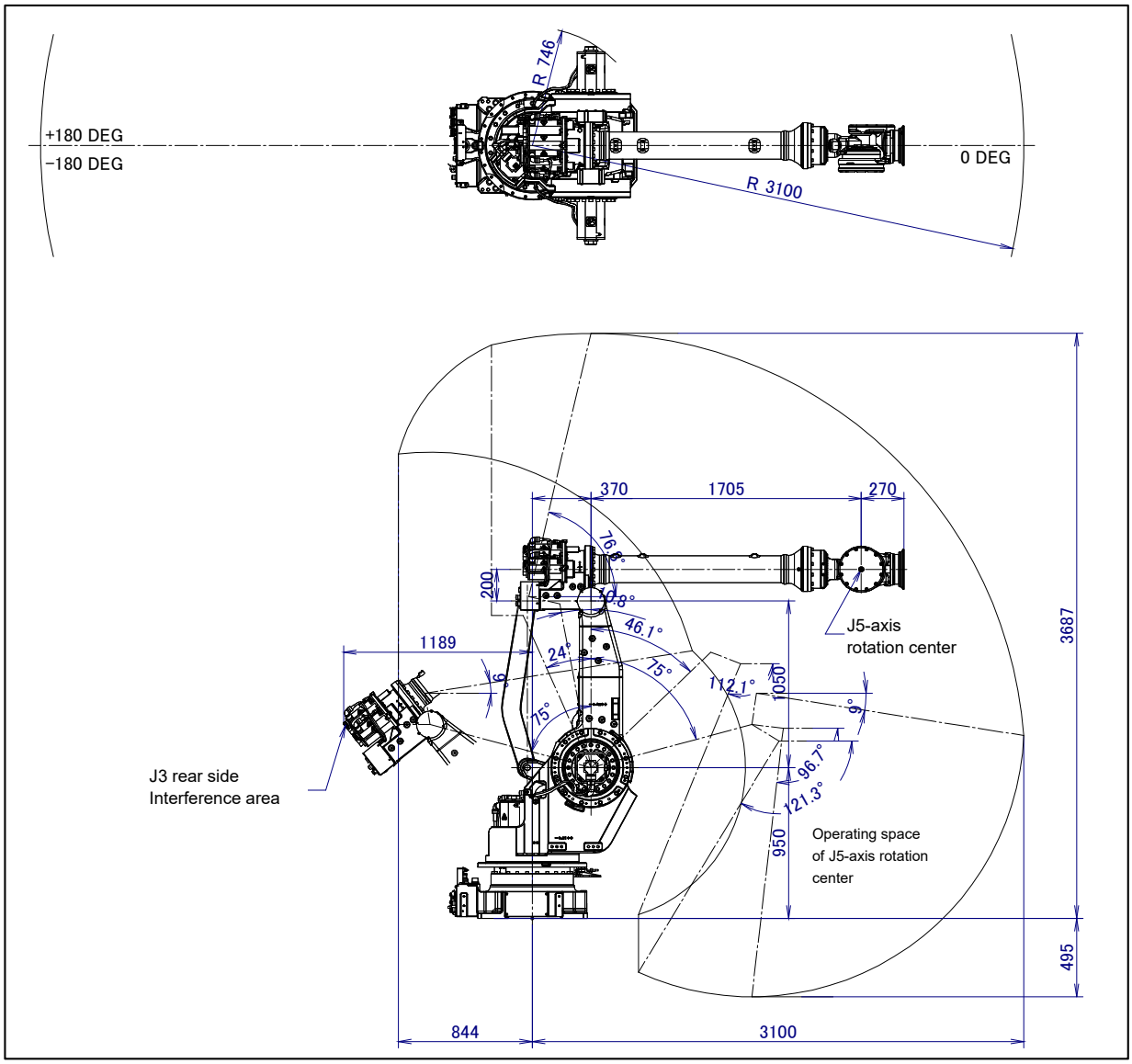


Fig. 8.1 (b) Operating space (M-900*i*A/260L)

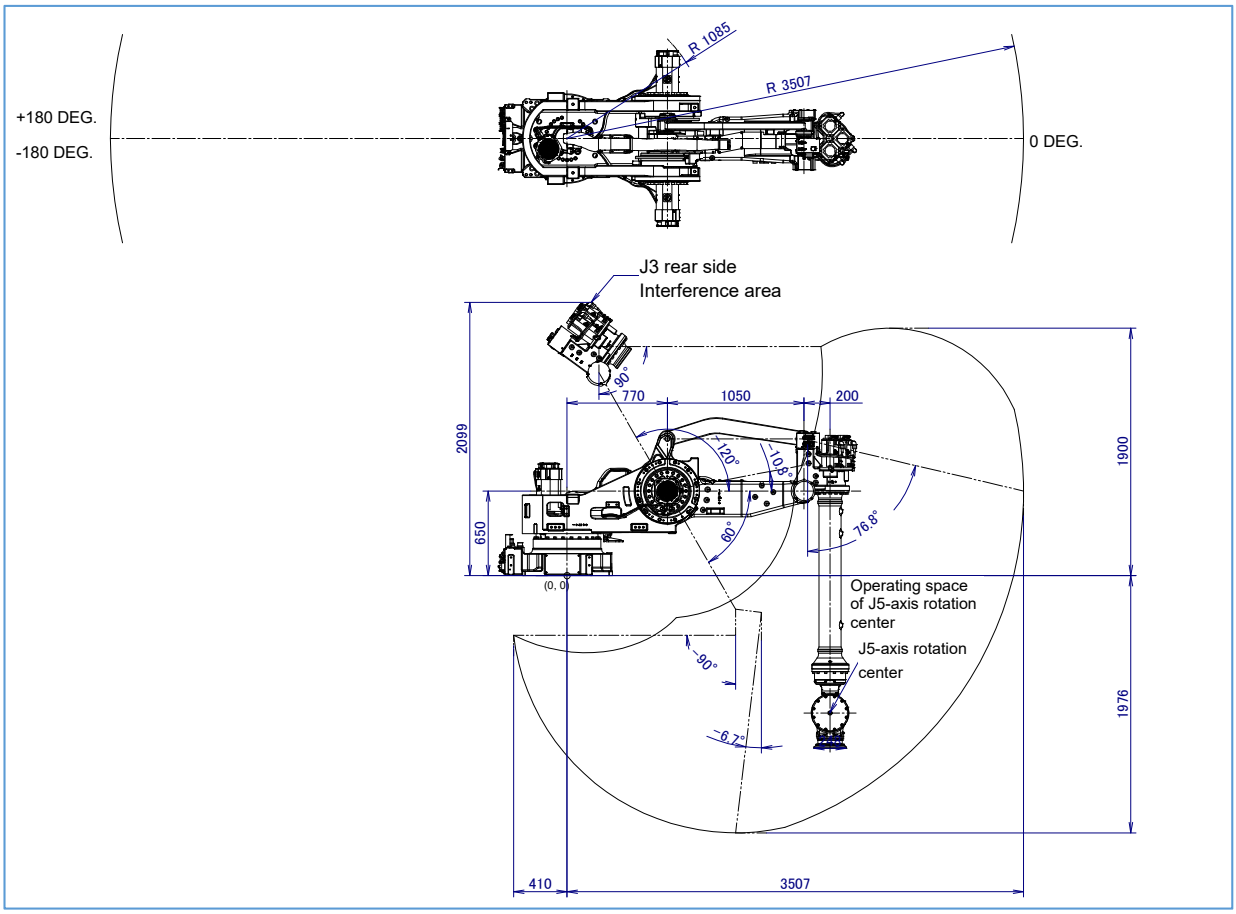


Fig. 8.1 (c) Operating space (M-900*i*A/150P)

8.2 OPERATING SPACE RESTRICTION AT WALL OR ANGLE MOUNTING

When M-900*i*A/350/260L is mounted on wall or inclined surface, the operating space has restriction depending on its mounted angle.
The following Fig 8.2 (a) to (h) show the Operating space restriction on these conditions.
Robot can't keep its posture in the hatching area on Fig. 8.2 (a) to (h).

In order to mount on wall or inclined surface, the adapted software is required.
In case of M-900*i*A/350, refer to table below about support status of software.

Software series	Software version
V6.10P (7D80)	Edition A4 or later
V6.20P (7D81)	Edition 53 or later
V6.30P (7D82)	Edition 62 or later
V7.10P (7DA0) or later	All edition

In case of M-900*i*A/260L, all software versions support it.

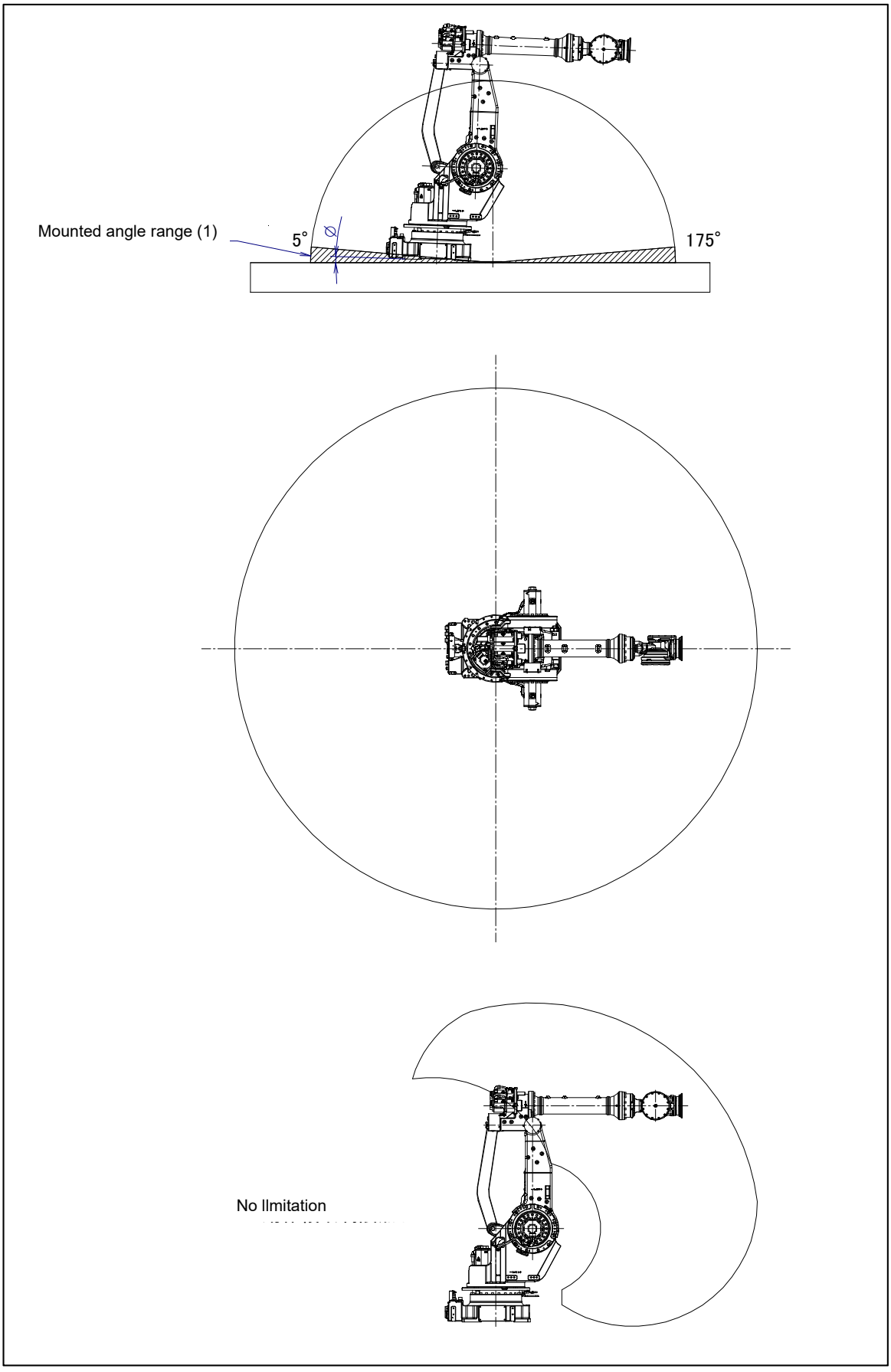


Fig. 8.2 (a) Operating space of Mount angle range (1) (M-900*i*A/350)

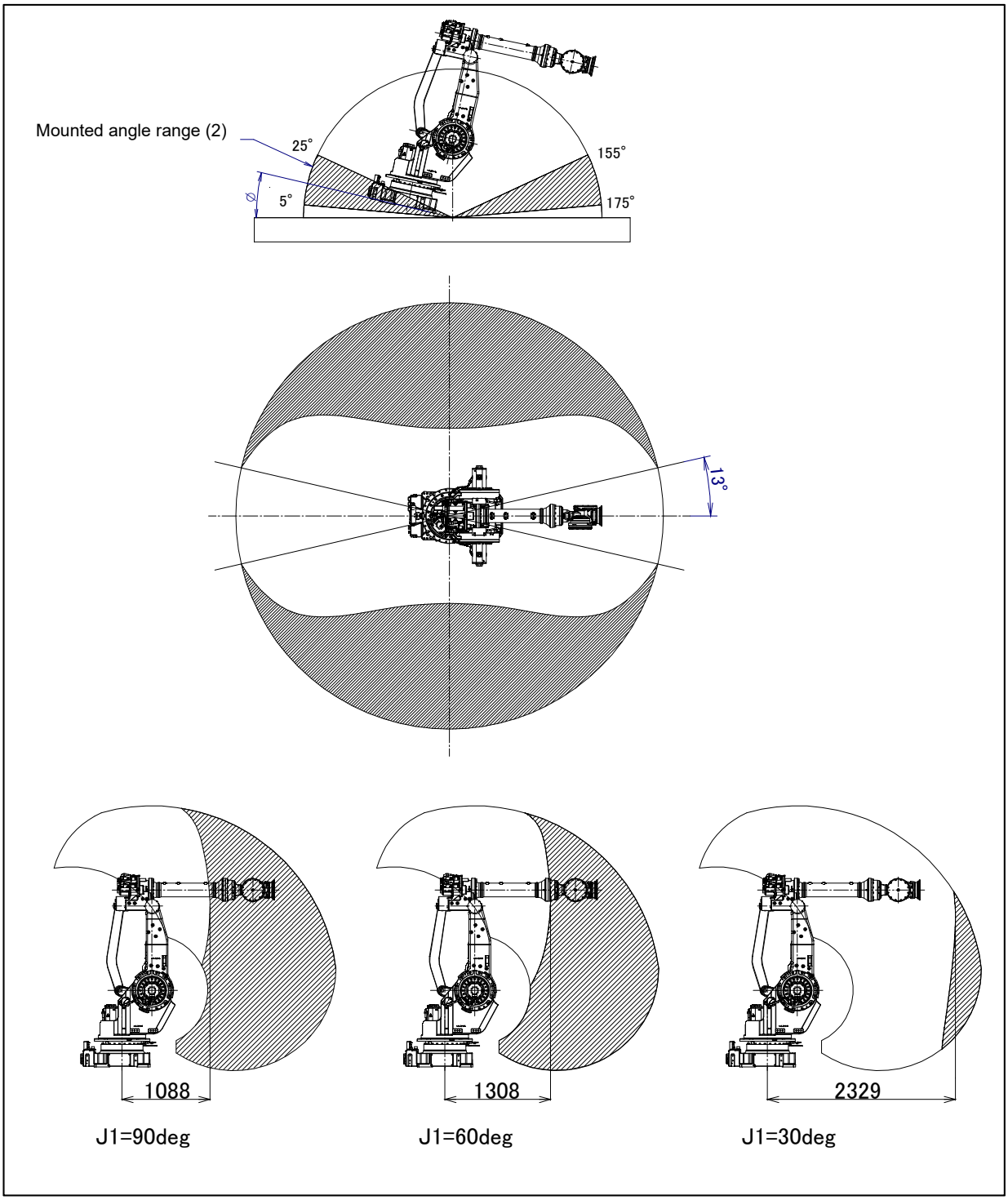


Fig. 8.2 (b) Operating space of Mount angle range (2) (M-900*i*A/350)

NOTE
Robot can not stop in dotted area.

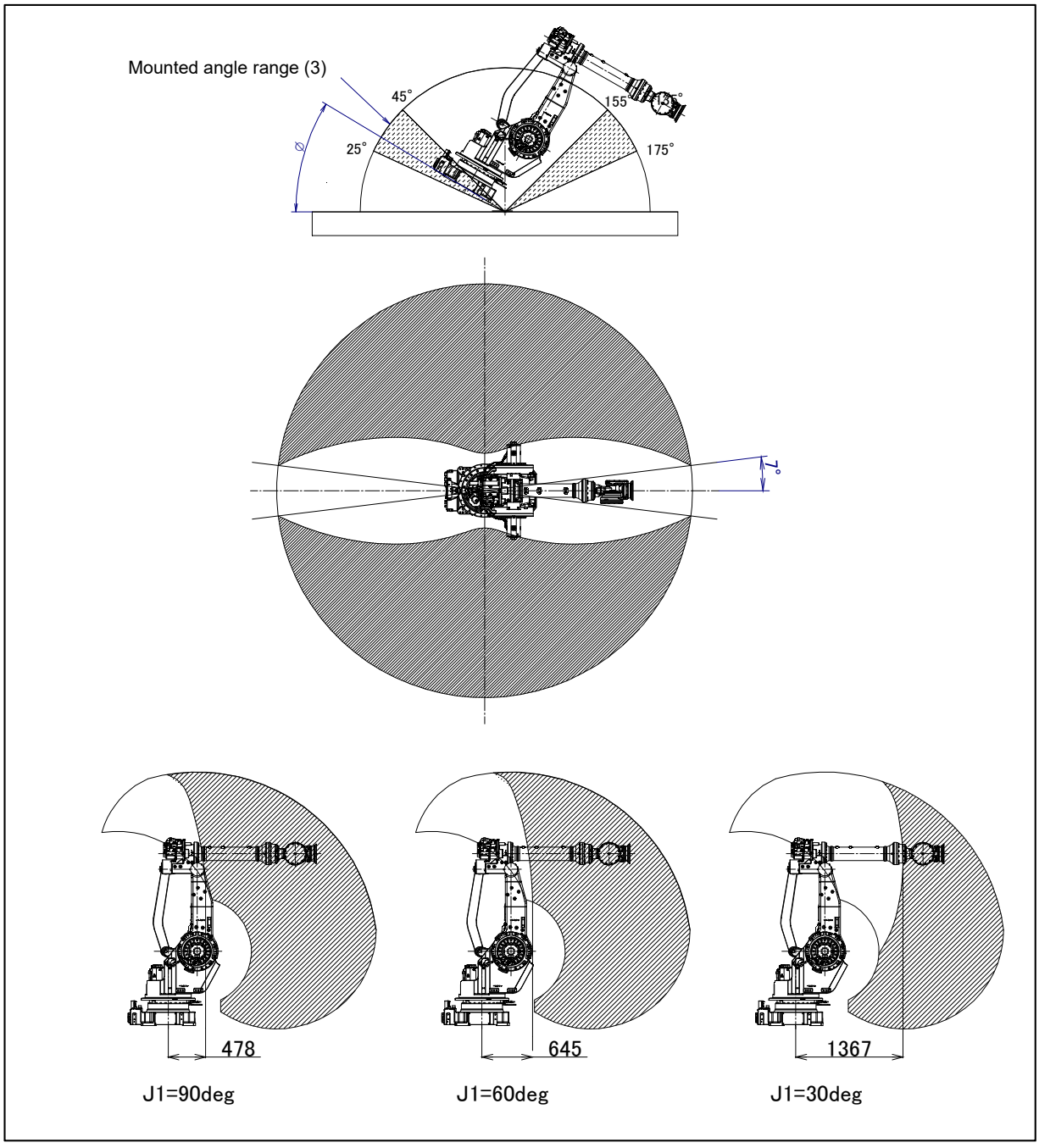


Fig. 8.2 (c) Operating space of mount angle range (3) (M-900*i*A/350)

NOTE
Robot can not stop in dotted area.

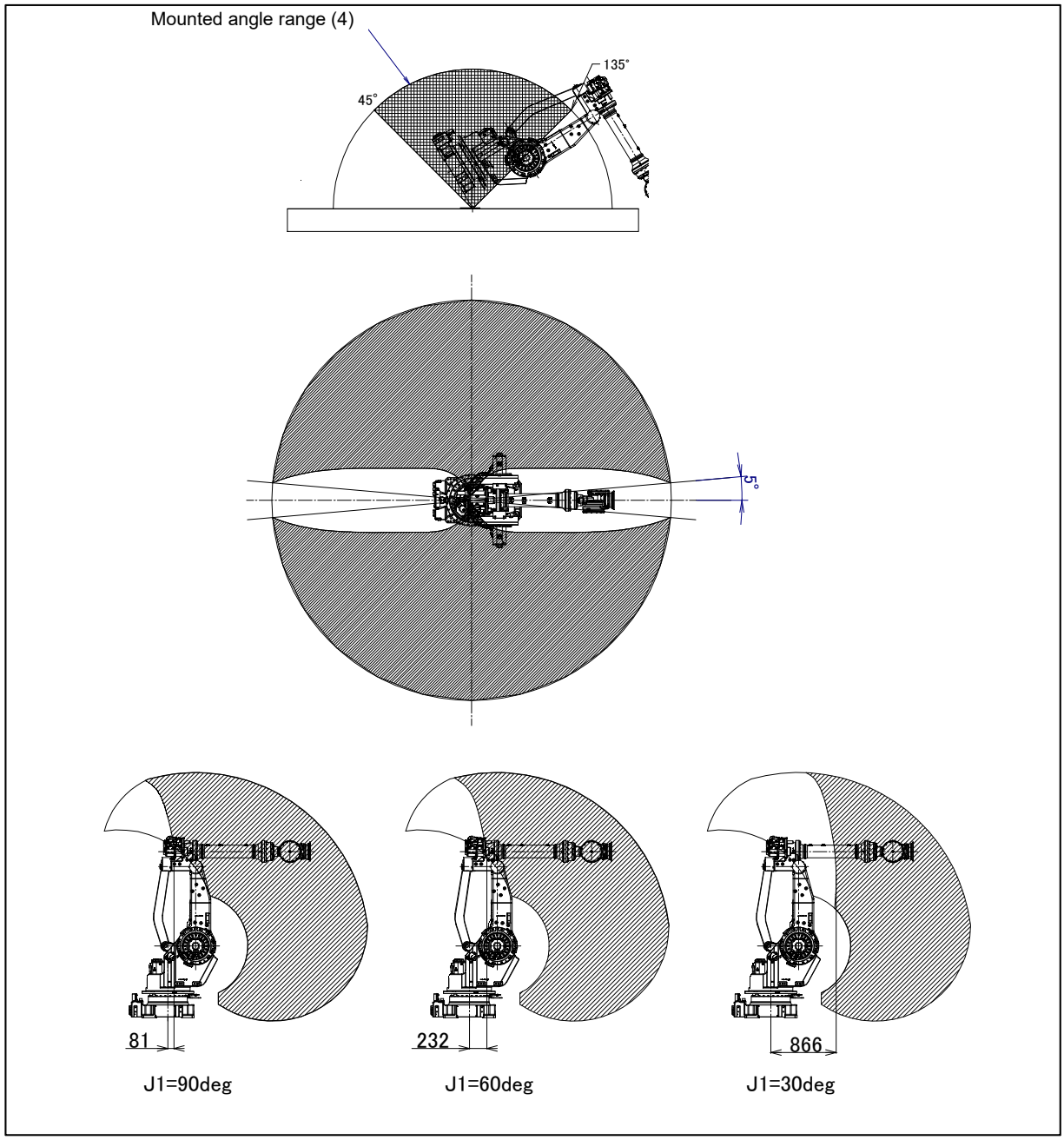


Fig. 8.2 (d) Operating space of mount angle range (4) (M-900*i*A/350)

NOTE
Robot can not stop in dotted area.

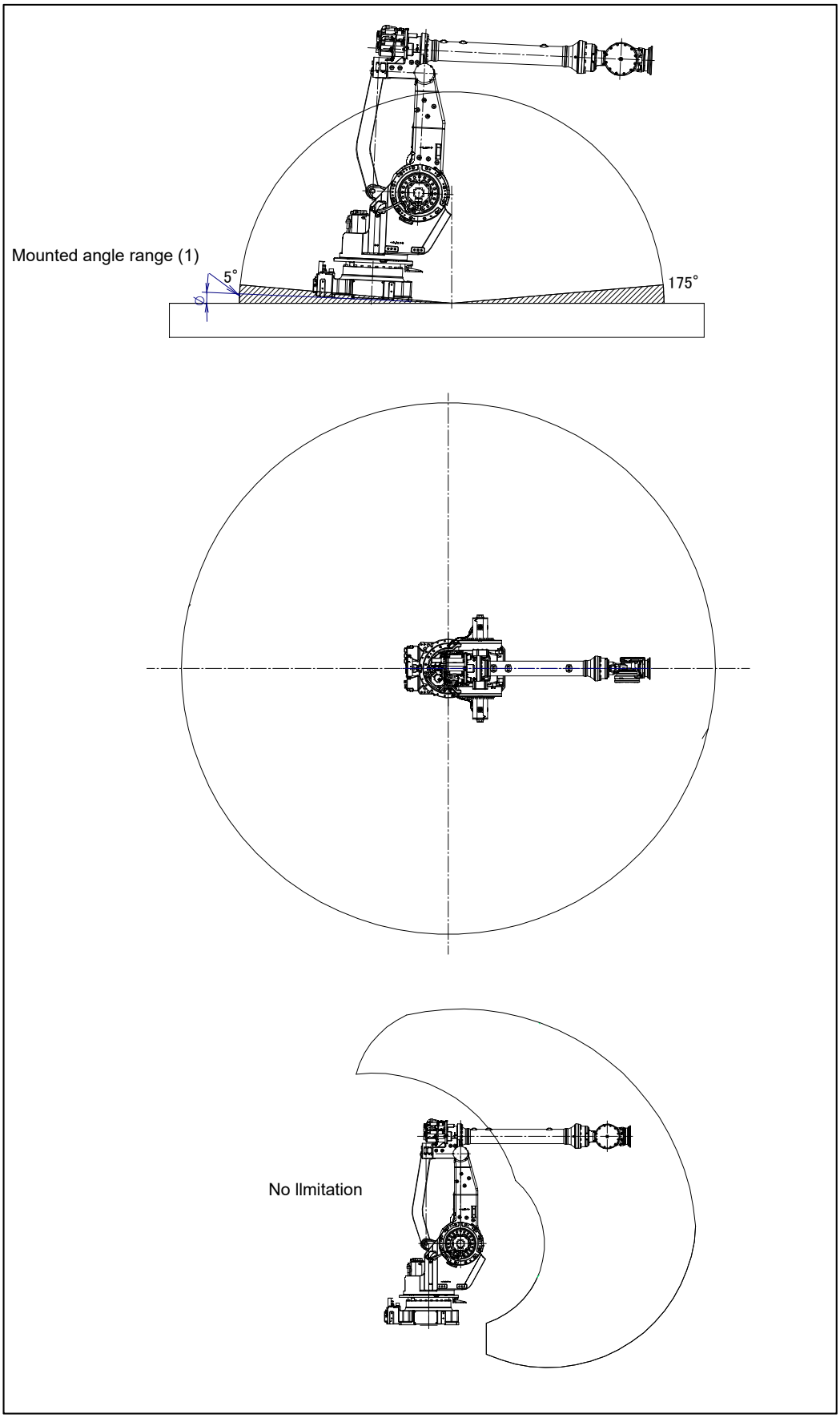


Fig. 8.2 (e) Operating space of mount angle range (1) (M-900*i*A/260L)

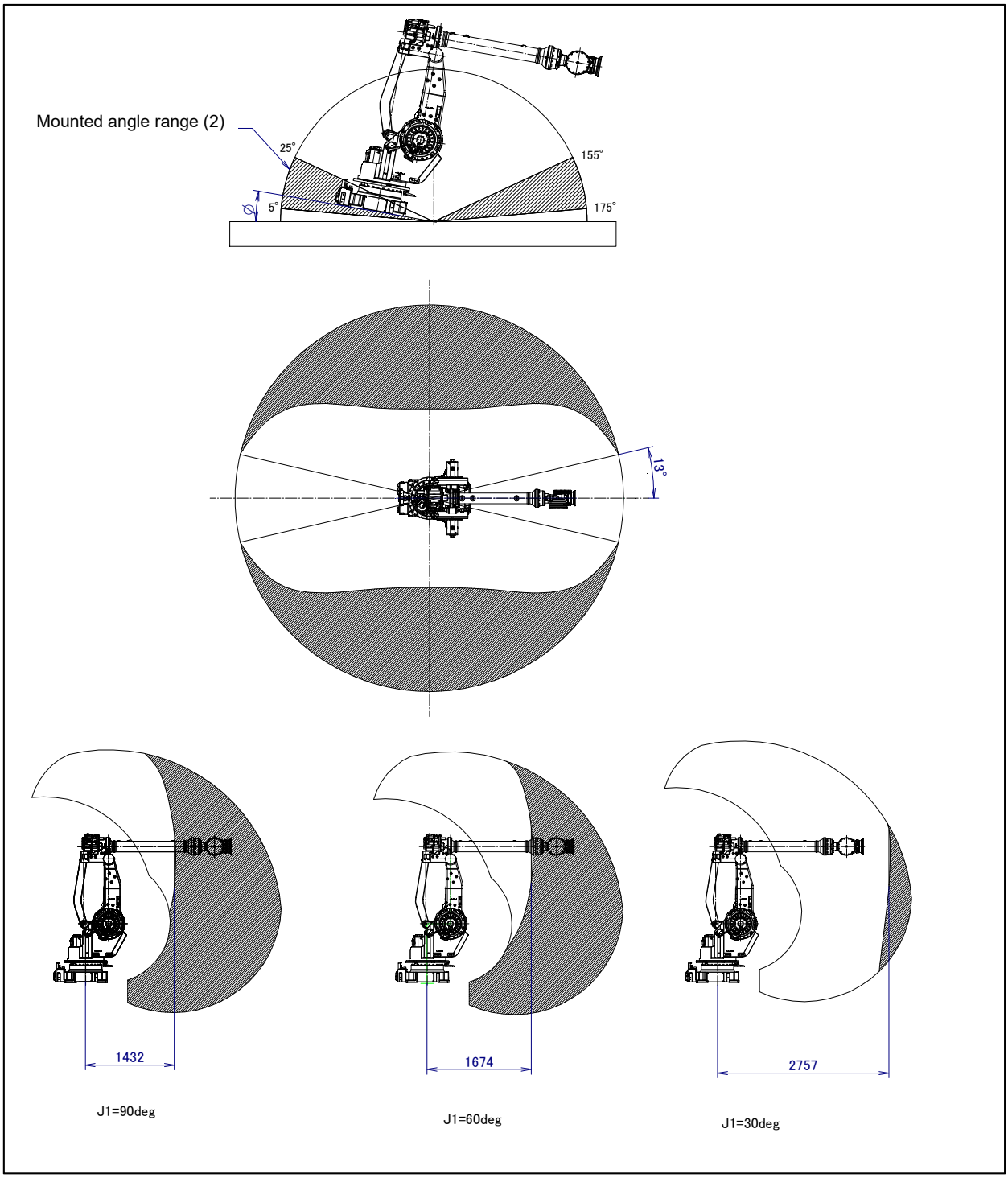


Fig. 8.2 (f) Operating space of mount angle range (2) (M-900*i*A/260L)

NOTE
Robot can not stop in dotted area.

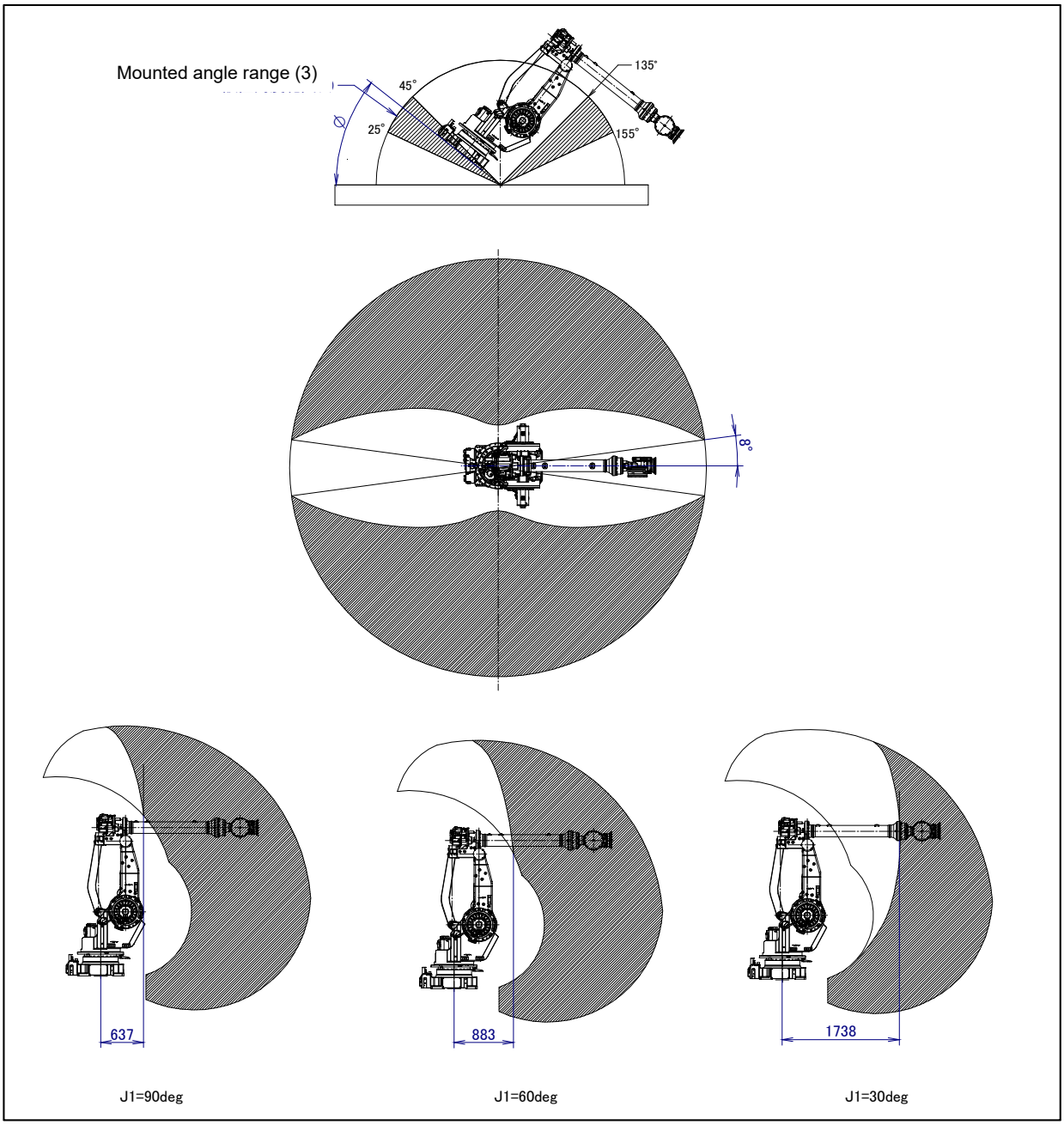


Fig. 8.2 (g) Operating space of mount angle range (3) (M-900*i*A/260L)

NOTE
Robot can not stop in dotted area.

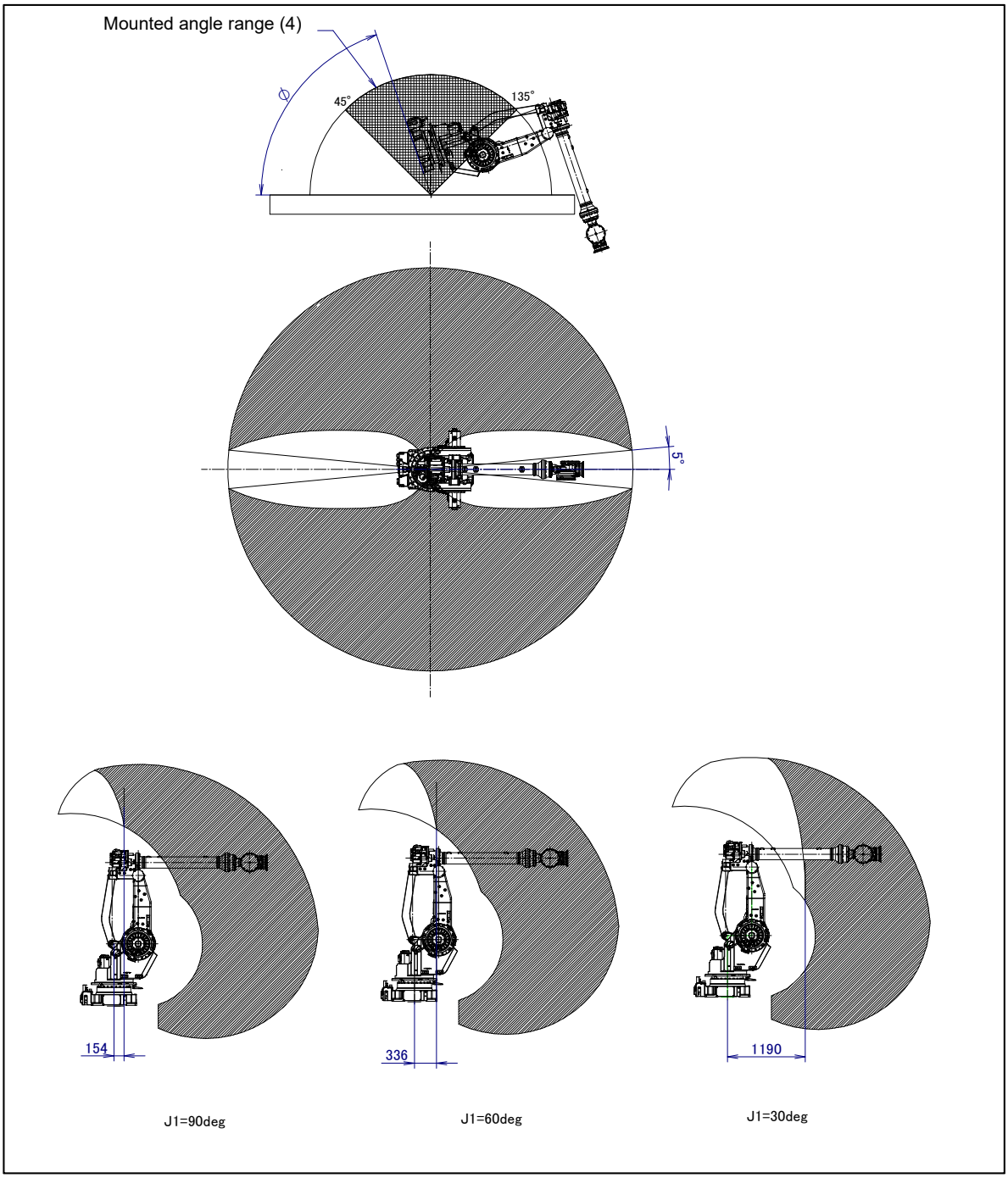


Fig. 8.2 (h) Operating space of mount angle range (4) (M-900*i*A/260L)

NOTE
Robot can not stop in dotted area.

9 EQUIPMENT INSTALLATION TO THE ROBOT

9.1 WRIST LOAD CONDITIONS

Fig. 9.1 (a) to (c) are diagrams showing the allowable load that can be applied to the wrist section. Apply a load within the region indicated in the graph. Apply the conditions of the allowable load moment and the allowable load inertia.

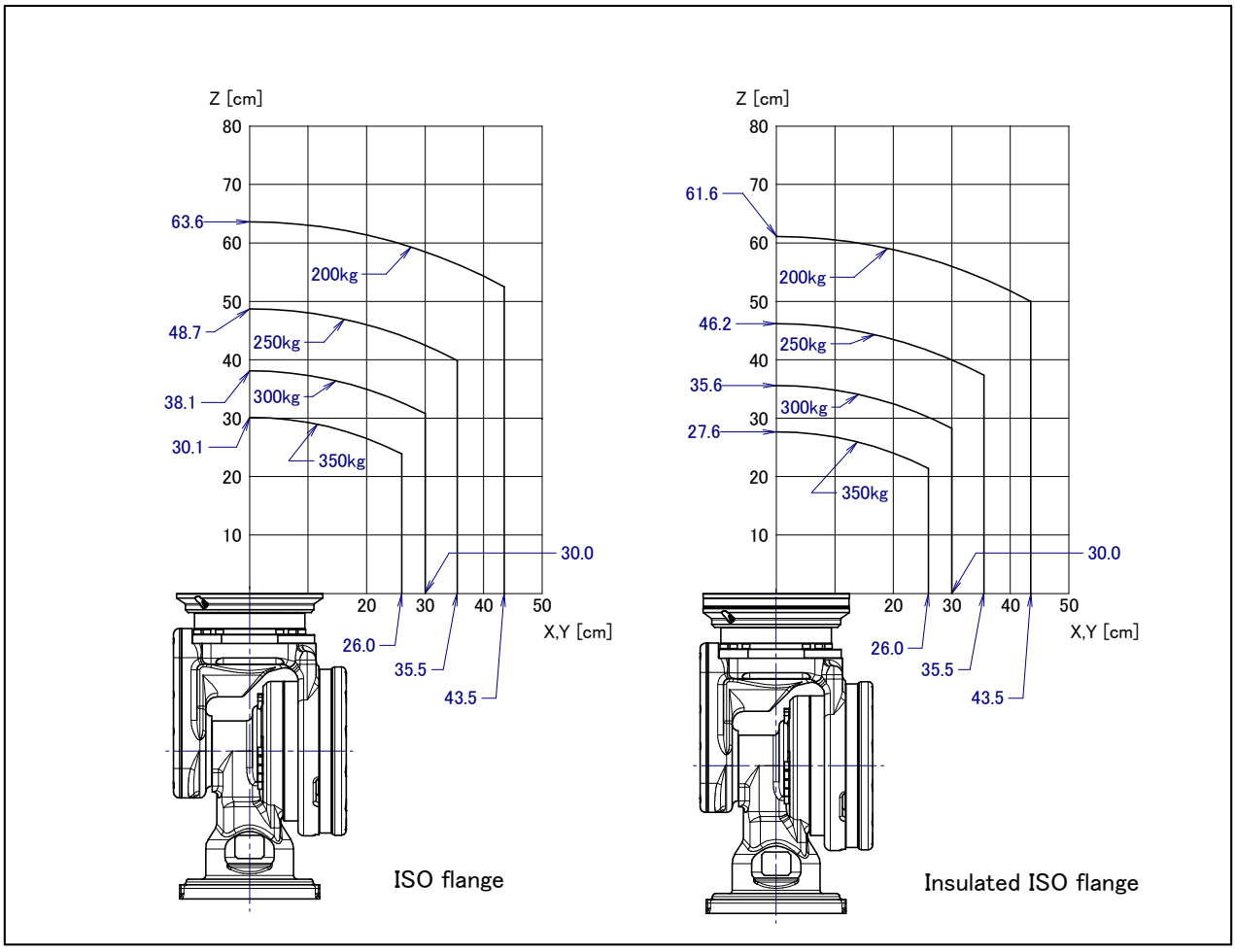


Fig. 9.1 (a) Wrist Load Diagram (M-900*i*A/350)

NOTE
The FANUC and special flange options cannot be selected.

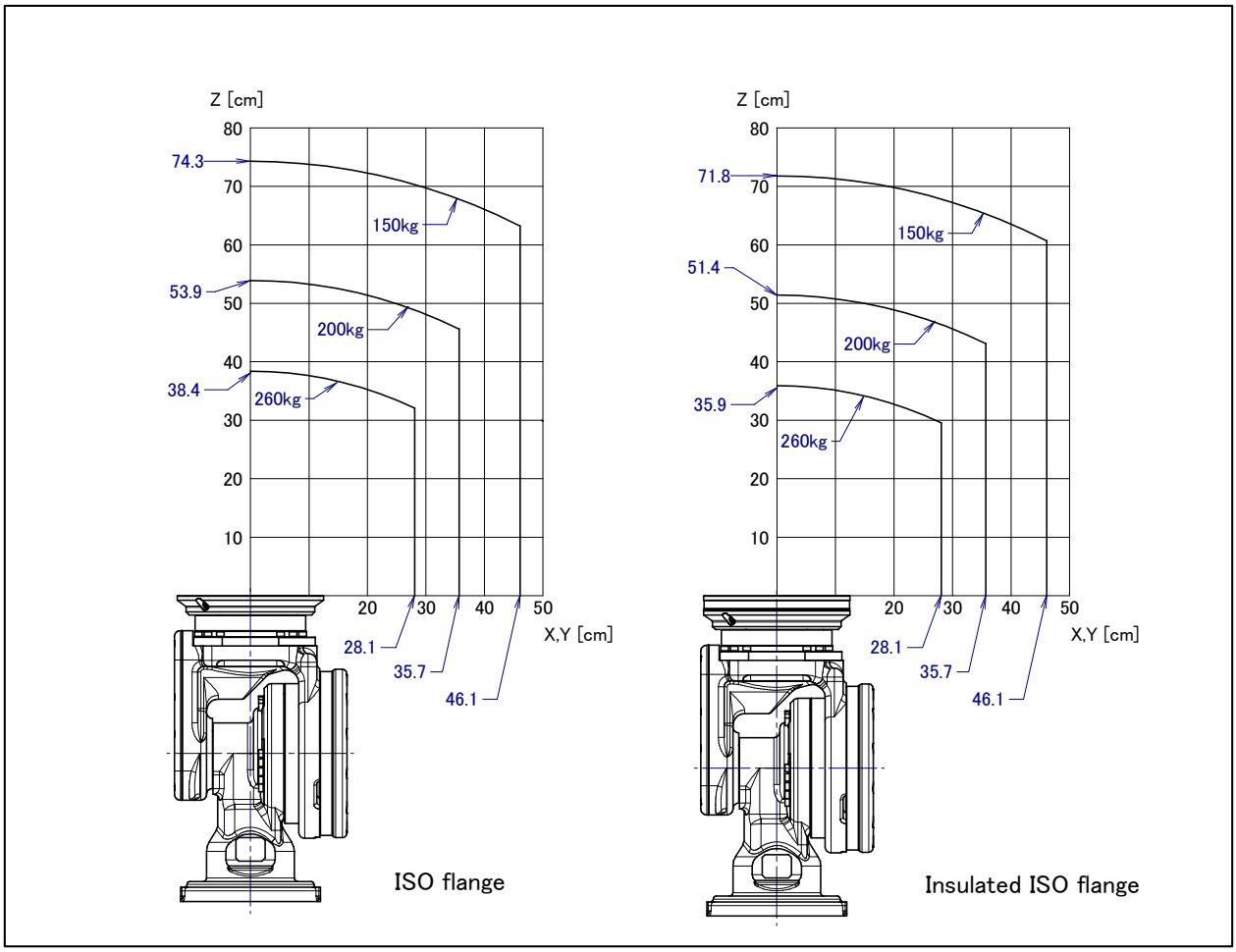


Fig. 9.1 (b) Wrist Load Diagram (M-900*i*A/260L)

NOTE
The FANUC and special flange options cannot be selected.

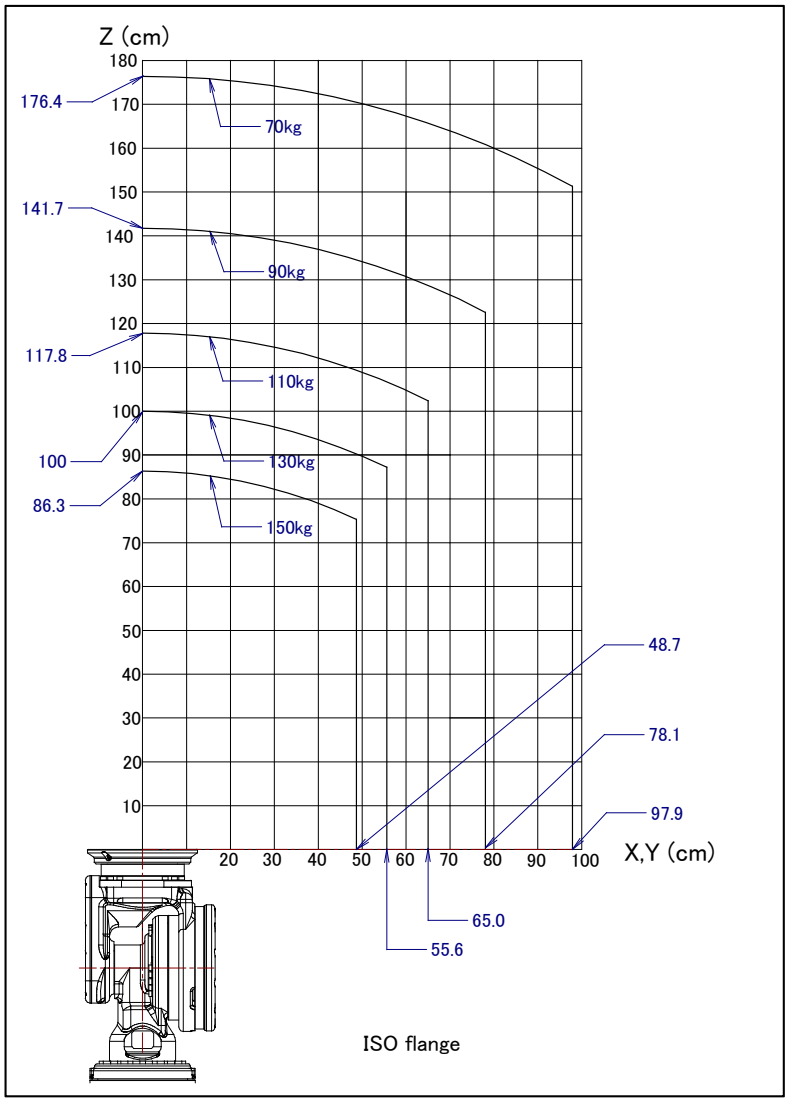


Fig. 9.1 (c) Wrist Load Diagram (M-900*i*A/150P)

NOTE
The FANUC , special flange and Insulated ISO flange options cannot be selected.

9.2 LOAD CONDITIONS ON J2 BASE AND J3 ARM

Table 9.2 (a) and Fig. 9.2 (a), (b) show the J2 base and J3 arm load conditions.

Table 9.2 (a) Installation conditions of loads to be added

Installation site	Model	Loads	Condition
J2 base	M-900*i*A/350/260L	550kg	The center of gravity must lie within a radius of 500 mm from the rotation center of the J1 axis.
	M-900*i*A/150P	-	The load cannot be put.
J3 arm	All model	25kg	See Fig. 9.2 (a),(b) for the positional condition of the center of gravity.

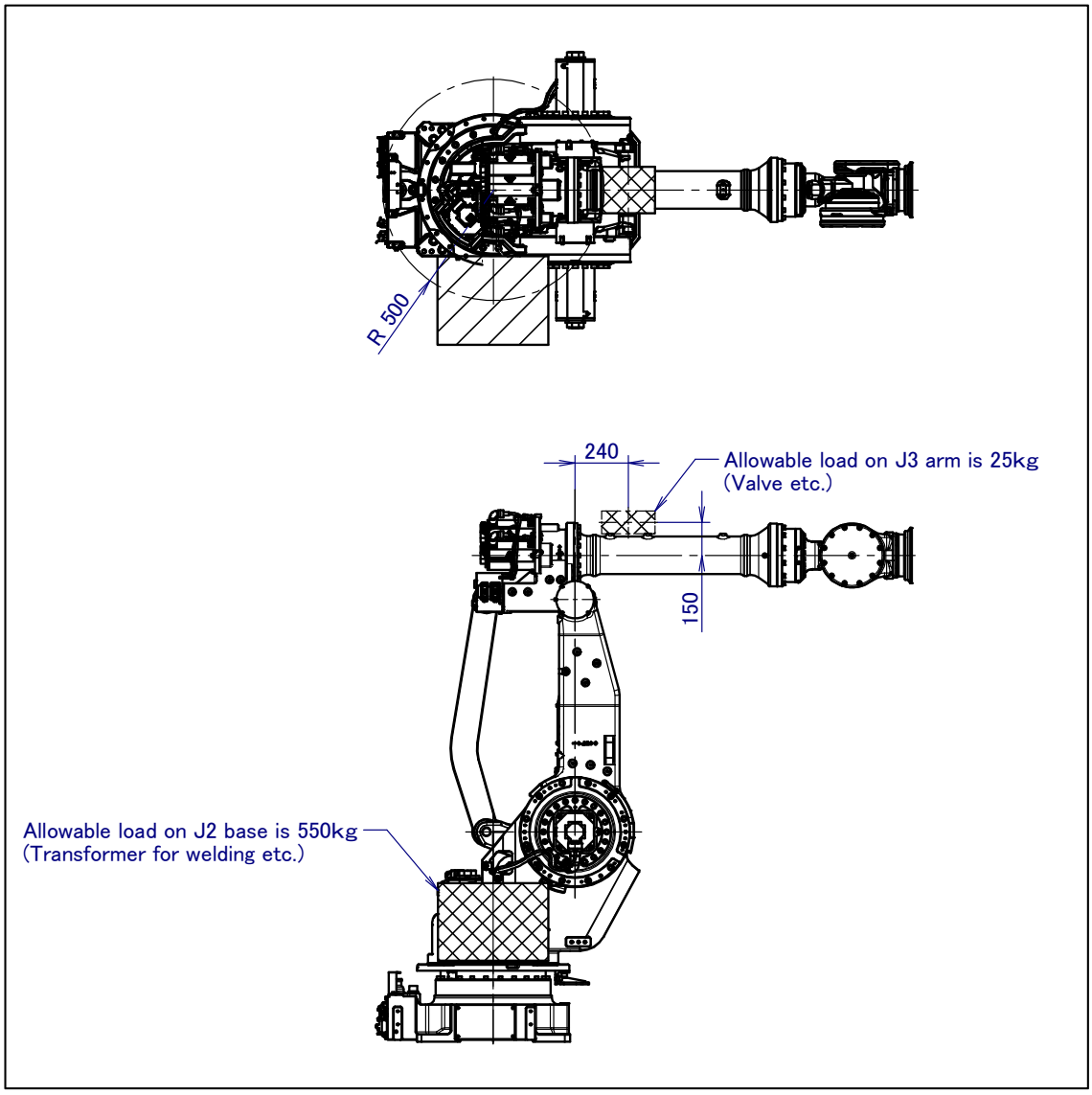


Fig. 9.2 (a) Load Conditions on J2 base and J3 arm (M-900*i*A/350/260L)

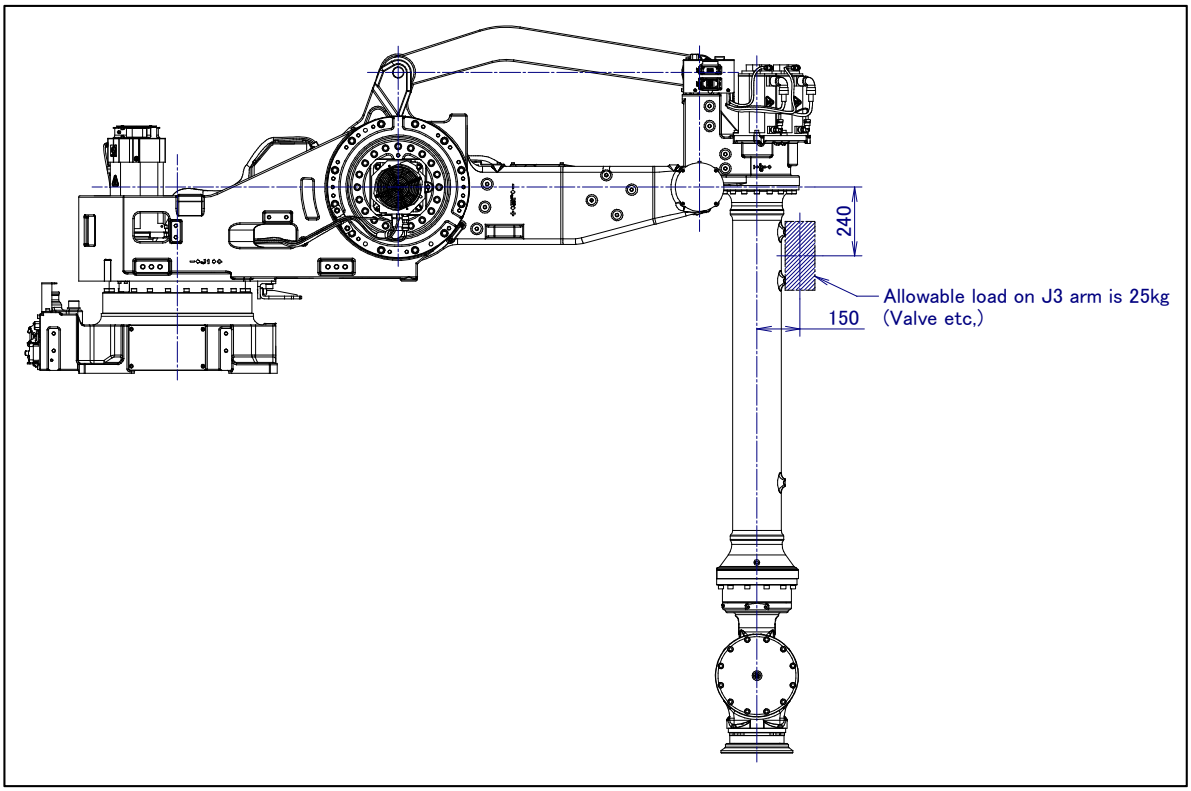


Fig. 9.2 (b) Load Conditions on J3 arm (M-900*i*A/150P)

9.3 END EFFECTOR INSTALLATION TO WRIST

Fig. 9.3 (a) and (b) are the diagrams for installing end effectors on the wrist. To fasten the end effector, firstly position it with two pin holes at [D] using fitting [B] or [C], then lock it using screws at [E]. Select screws and positioning pins of a length that matches the depth of the tapped holes and pin holes. Fasten the bolt for fixing the end effector with following torque: 128.4 ± 6.4 Nm (1310 ± 65kg fcm)

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

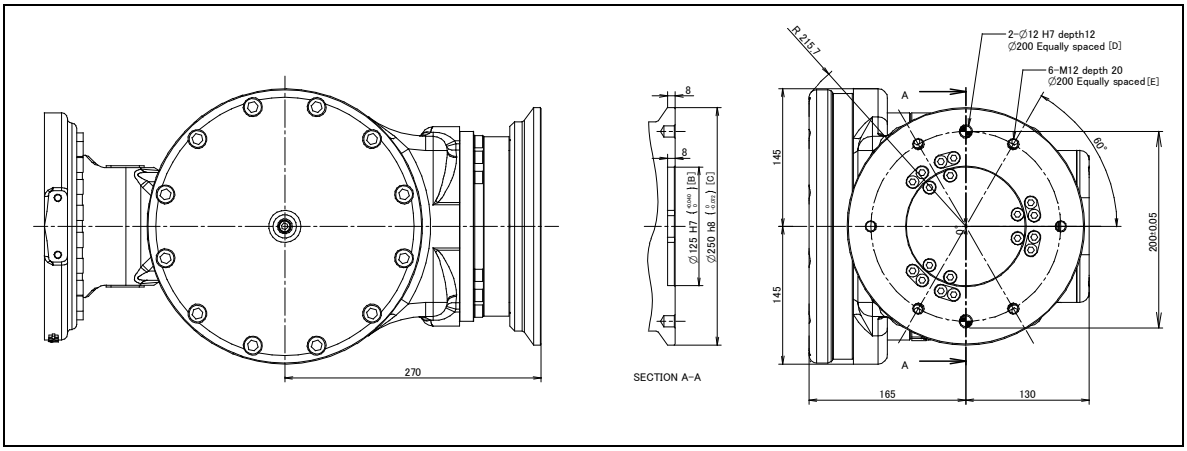


Fig. 9.3 (a) End effector mounting face (ISO flange)

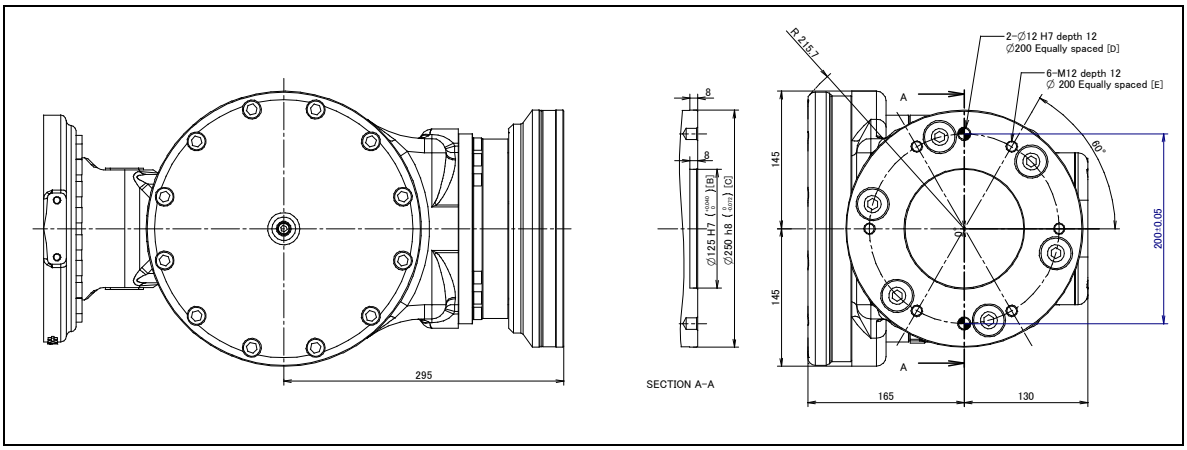


Fig. 9.3 (b) End effector mounting face (Insulated flange)

NOTE
The FANUC and special flange options cannot be selected.

9.4 EQUIPMENT MOUNTING FACE

As shown in Fig. 9.4 (a) and (b), tapped holes are provided to install equipment to the robot.

⚠ CAUTION

1 Never perform additional machining operations such as drilling or tapping on the robot body. This can seriously affect the safety and functions of the robot.
2 When using a user tap shown in Fig. 9.4 (a) and (b), please keep the center of gravity position of the equipment as shown in Section 9.2.
3 Equipment should be installed on robot in a way it does not interfere with the mechanical unit cables. If equipment interferes, the mechanical unit cable might be disconnected, and unexpected troubles might occur.
4 Note that the use of a tapped hole not shown in the following figure is not assured. Please do not tighten both with the tightening bolts used for mechanical unit.

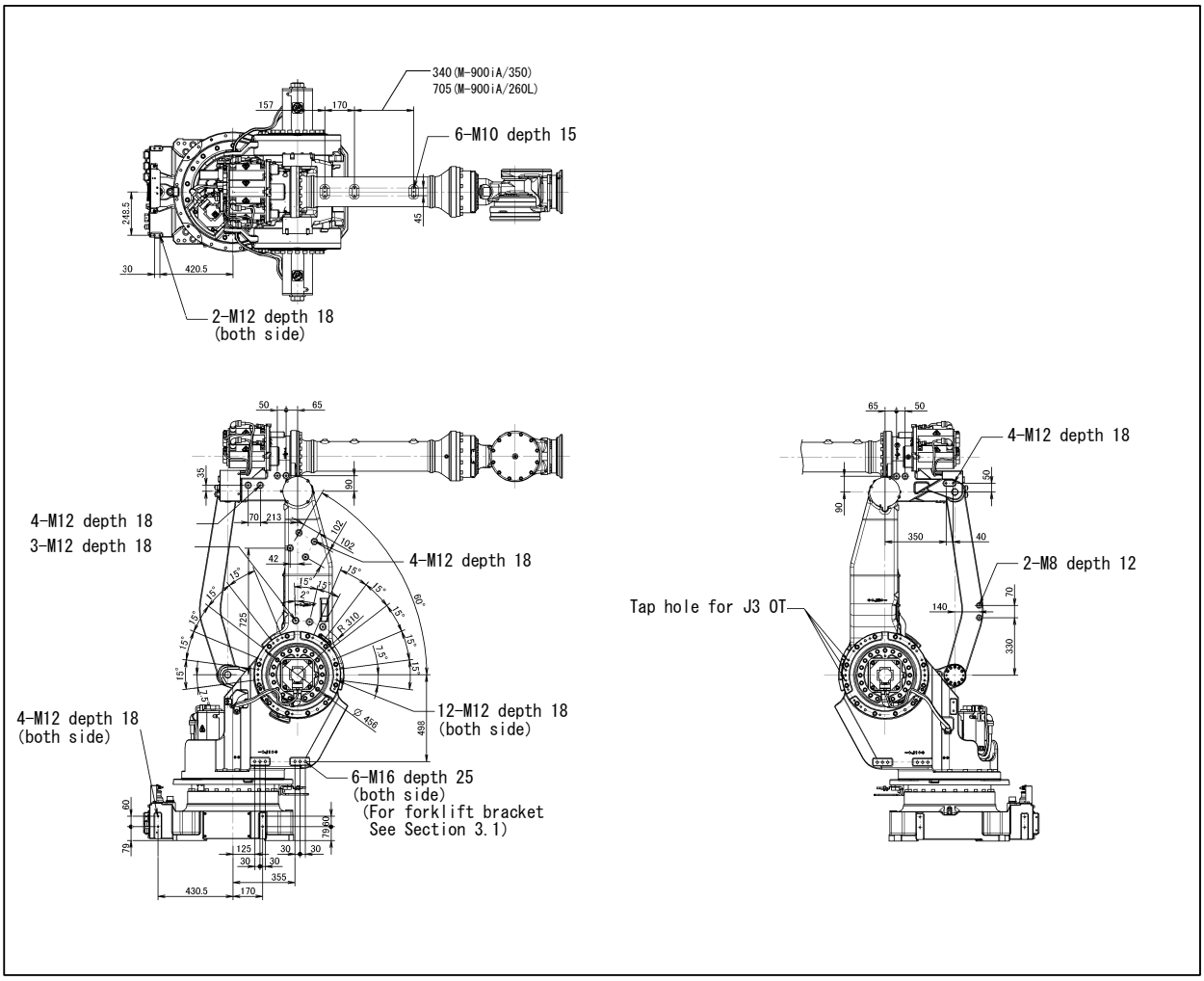


Fig. 9.4 (a) Equipment mounting faces (M-900*i*A/350/260L)

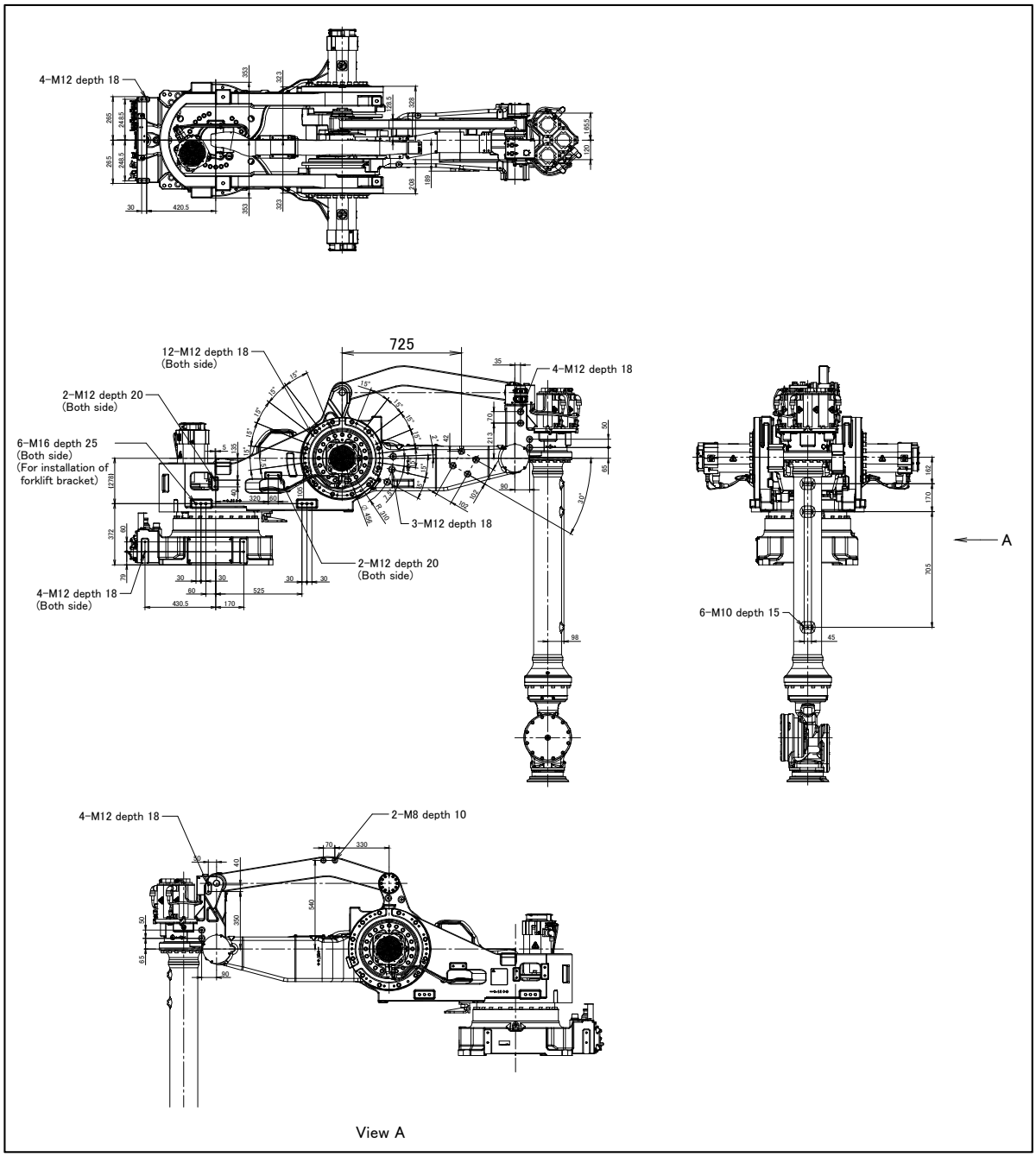


Fig. 9.4 (b) Equipment mounting faces (M-900*i*A/150P)

9.5 LOAD SETTING

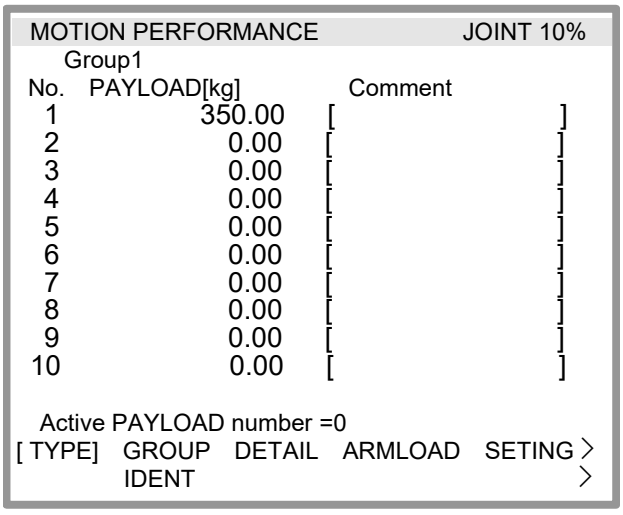
⚠ CAUTION

1 Set load condition parameter before operating the robot. Do not operate the robot in over payload condition. Do not exceed allowable payload including connection cables and its swing. Otherwise troubles such as degradation of reducer life may occur.

2 WHEN PERFORMING LOAD ESTIMATION AFTER PARTS REPLACEMENT
If wrist axis motors (J5/J6-axis) or reducers are replaced, payload estimation accuracy may decrease. Perform calibration of load estimation without the load such as hand before performing load estimation.
Section 9.15 “LOAD ESTIMATION” in R-30*i*A Controller Spot tool+ OPERATOR’S MANUAL (B-83124EN-1).
Section 9.15 “LOAD ESTIMATION” in R-30*i*A Controller Handling tool OPERATOR’S MANUAL (B-83124EN-2).
Section 9.15 “LOAD ESTIMATION” in R-30*i*A Controller Dispense tool OPERATOR’S MANUAL (B-83124EN-3).
Chapter 9 “LOAD ESTIMATION” in R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus Controller Optional Function OPERATOR’S MANUAL (B-83284EN-2).

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

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



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   100%

  Group 1
  Schedule No[   1]:[Comment              ]
1 PAYLOAD                [kg]        350.00
2 PAYLOAD CENTER  X      [cm]        -28.33
3 PAYLOAD CENTER  Y      [cm]          0.00
4 PAYLOAD CENTER  Z      [cm]         27.78
5 PAYLOAD INERTIA X [kgfcms^2]        56.84
6 PAYLOAD INERTIA Y [kgfcms^2]        59.39
7 PAYLOAD INERTIA Z [kgfcms^2]        15.10

 [TYPE]  GROUP  NUMBER  DEFAULT  HELP
```

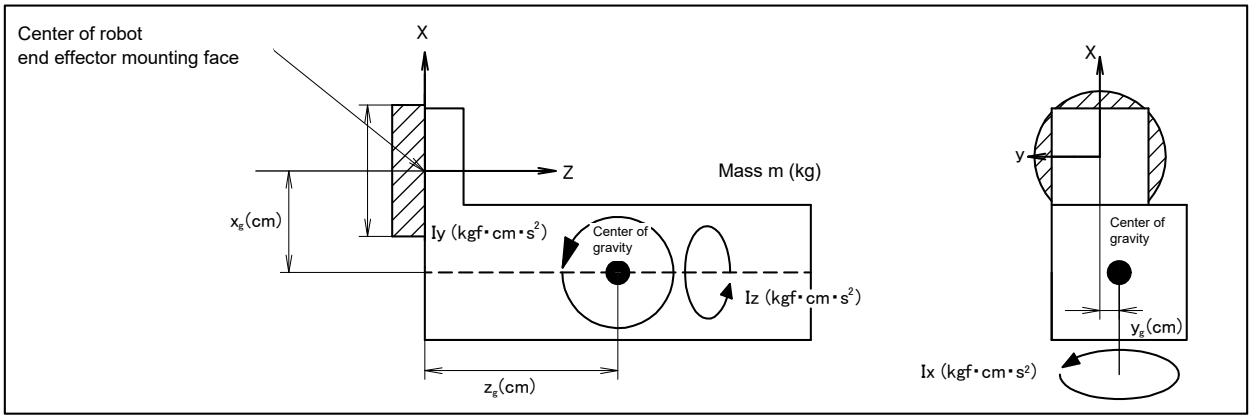


Fig. 9.5 (a) Standard tool coordinate

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

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

```
MOTION ARMLOAD SET                JOINT   100%

  Group 1
1 ARM LOAD AXIS #1 [kg]              550.00
2 ARM LOAD AXIS #3 [kg]               25.00

[ TYPE ]    GROUP          DEFAULT  HELP
```

10 Specify the weight of the load on the J2 base and J3 arm as follows:
ARMLOAD AXIS #1[kg]: Weight of the load on the J2 base
ARMLOAD AXIS #3[kg]: Weight of the load on the J3 arm
The following message appears: “Path and Cycletime will change. Set it?” Respond to the message with F4 [YES] or F5 [NO]. Once the arm payload is set up, the settings are completed by switching the power off and on again.

9.6 INERTIA LOAD SETTINGS

For the M-900*i*A/350 and 260L, there are two parameter settings depending on the magnitude of load inertia. (By default, the parameter settings for the standard inertia mode are set.)

			Standard inertia mode	High inertia mode
Wrist unit allowable load inertia	J4-axis	350	235.2kg·m^2 (2400kgf·cm·s^2)	392kg·m^2 (4000kgf·cm·s^2)
		260L	188.2kg·m^2 (1920kgf·cm·s^2)	313.6kg·m^2 (3200kgf·cm·s^2)
	J5-axis	350	235.2kg·m^2 (2400kgf·cm·s^2)	392kg·m^2 (4000kgf·cm·s^2)
		260L	188.2kg·m^2 (1920kgf·cm·s^2)	313.6kg·m^2 (3200kgf·cm·s^2)
	J6-axis	350	156.8kg·m^2 (1600kgf·cm·s^2)	352.8kg·m^2 (3600kgf·cm·s^2)
		260L	117.6kg·m^2 (1200kgf·cm·s^2)	225.4kg·m^2 (2300kgf·cm·s^2)

⚠CAUTION
When a workpiece with inertia exceeding the allowable inertia of the standard inertia mode is used in the standard inertia mode, components of the mechanical unit may be degraded earlier.
In case of M-900*i*A/260L with solution arm, it does not support high inertia mode.

In case of the software versions listed below, since the high inertia mode is not supported, make use within the allowable range of the standard inertial mode.

Software system	Software version	Mechanical unit
V6.10P (7D80)	92 or earlier	M-900*i*A/350 M-900*i*A/260L
V6.20P (7D81)	44 or earlier	
V6.30P (7D82)	41 or earlier	

In case of the software versions listed below, following the setting method described in Subsection 9.6.1, make parameter settings depending on the load. (By default, the parameter settings for the standard inertia mode are made.)

Software system	Software version	Mechanical unit
V6.10P (7D80)	94 or earlier	M-900*i*A/350 M-900*i*A/260L
V6.20P (7D81)	46 or earlier	
V6.30P (7D82)	44 or earlier	

In case of the software versions listed below, parameters are set automatically based on the load settings made in Section 9.5.

Software system	Software version	Mechanical unit
V6.10P (7D80)	95 or earlier	M-900*i*A/350 M-900*i*A/260L
V6.20P (7D81)	47 or earlier	
V6.30P (7D82)	45 or earlier	
V7.10P (7DA0) or later	All versions	

> ⚠ **CAUTION**
> Set the load inertia correctly as described in Section 9.5. When a workpiece with inertia exceeding the allowable inertia of the standard inertia mode is used in the standard inertia mode, components of the mechanical unit may be degraded earlier.

9.6.1 Setting

In the M-900*i*A/350, when the software edition is:
V6.10P (7D80) and the versions is 93 or 94
V6.20P (7D81) and the versions is 45 or 46
V6.30P (7D82) and the versions is any of 42 to 44

Follow the procedure below to change settings manually.

To make parameter settings, execute the factory-stored setting program, PAYLD350.PC. This program sets parameters based on the magnitude of the currently used load inertia of the load settings made in Section 9.5.

Call the setting program within the operation program. In particular, when changing the load setting with the PAYLOAD SET command, execute this program.

[Example of the operation program]
1: PAYLOAD SET [1]
2: CALL PAYLD350 (i)
Enter the robot group number in input parameter i of PAYLD350. If input parameter i is not specified, set group 1.

Exception processing

In the following cases, exception processing is performed and a message describing exception processing appears on the user screen without changing the parameter.

1 When the load setting condition number (1 to 10) on the operation performance screen is not selected

[User screen display]
Payload number 0 is invalid. (GP: x)

When this message appears, select a load setting condition on the operation performance screen or set the load setting condition with the PAYLOAD SET command.

2 When the group specified by input parameter i of PAYLD350 is not present

[User screen display]
Incorrect group number

When this message appears, specify a correct group number.

3 When the group specified by input parameter i of PAYLD350 is not M-900*i*A/350

[User screen display]
This group is not M-900*i*A/350

When this message appears, specify a correct group number.

9.6.2 Checking the Settings

Settings can be checked on the user screen. To display the user screen, press the [MENU] key and select [9 USER].

[User screen display]
For the standard inertia load setting:
Standard payload set. (GP: x, Payload: y)

For the high inertia load setting:
High payload set. (GP: x, Payload: y)

"x" indicates the group number for which the parameter was set and "y" indicates the load setting number used for evaluation.

To check only the current settings without switching the parameter, enter the value obtained by adding 100 to the group number in input parameter i of PAYLD350 and then perform execution. The current parameter settings of the group are displayed on the user screen.

[User screen display]
For the standard inertia load setting:
Standard payload type now (GP: x)

For the high inertia load setting:
High payload type now (GP: x)

"x" indicates the group number for which the parameter was checked.

9.7 AIR SUPPLY (OPTION)

There is an air-pressure supply opening on the side of the J1 base and the front of J3 casing. The connector is a Rc1/2 female (ISO). As couplings are not supplied, it will be necessary to prepare couplings, which suit to the hose size.

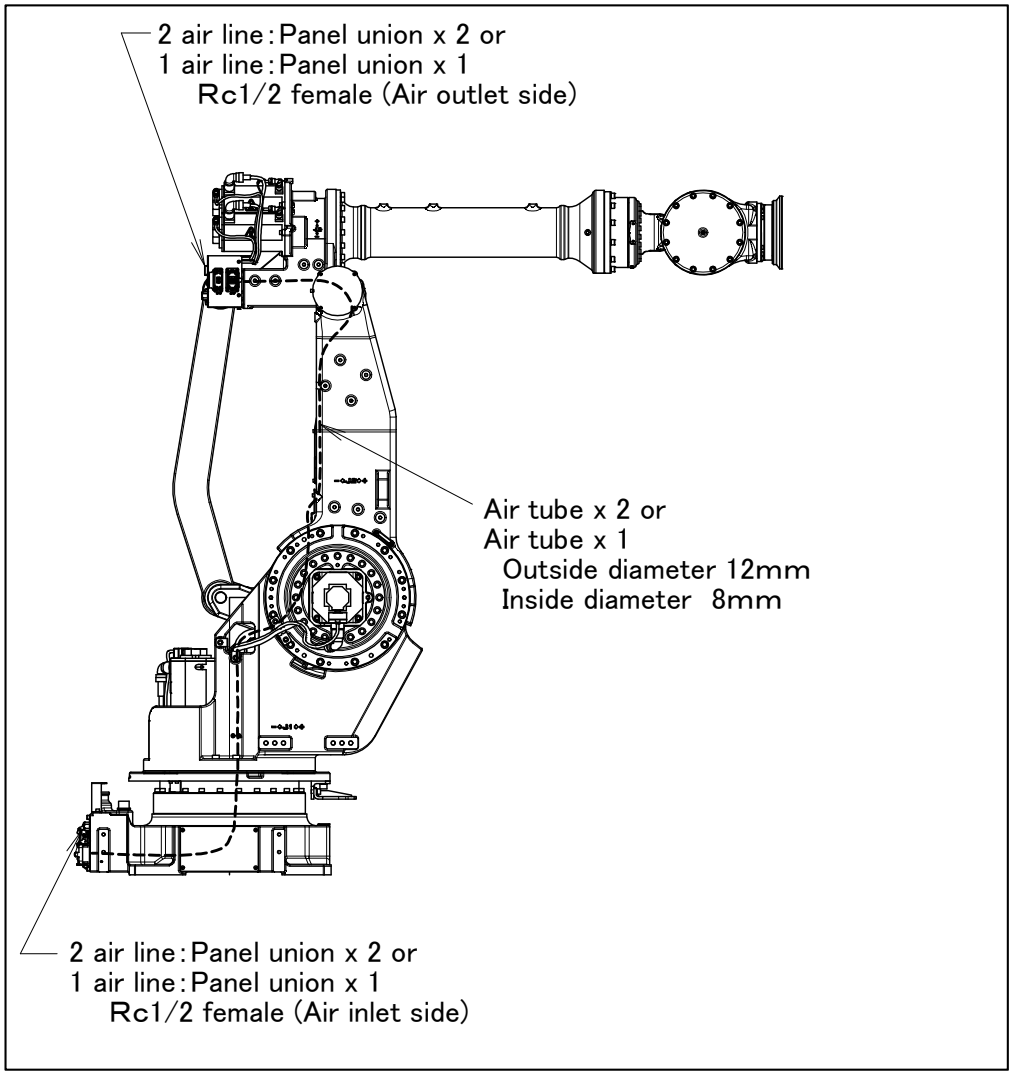


Fig. 9.7 (a) Air-pressure supply connection (M-900*i*A/350/260L) (option)

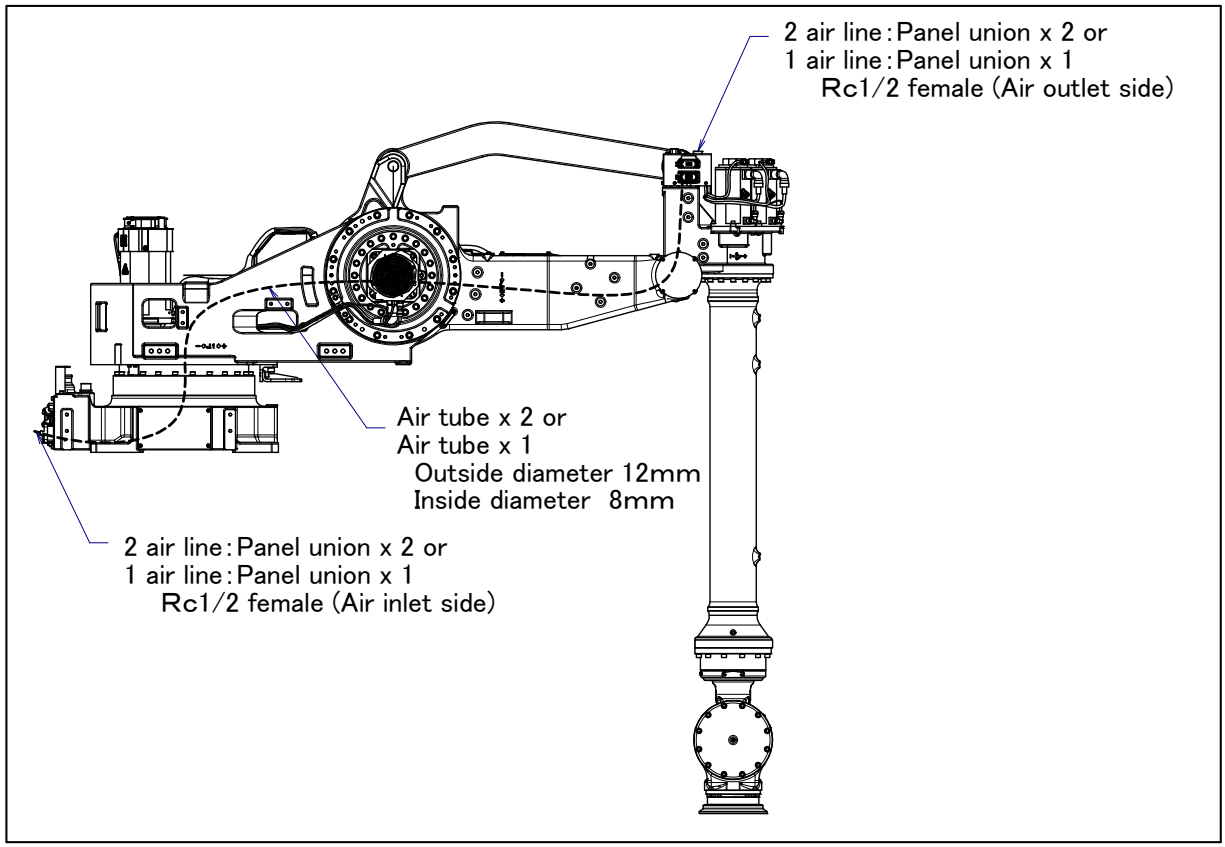


Fig. 9.7 (b) Air-pressure supply connection (M-900*i*A/150P) (option)

9.8 INTERFACE FOR OPTION CABLE (OPTION)

⚠ WARNING

- Only use appropriately-specified mechanical unit cables.
- Do not add user cables or hoses inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit when cables are added to outside of mechanical unit.
- Please do not perform remodeling (adding a protective cover, or secure an additional outside cable) that obstructs the behavior of the outcrop of the cable.
- When external equipment is installed in the robot, make sure that it does not interfere with other parts of the robot.
- Cut and discard any unnecessary length of wire strand of the end effector (hand) cable. Insulate the cable with seal tape. (See Fig. 9.8 (a))
- If you have end effector wiring and a process that develops static electricity, keep the end effector wiring as far away from the process as possible. If the end effector and process must remain close, be sure to insulate the cable.
- Be sure to seal the connectors of the user cable and terminal parts of all cables to prevent water from entering the mechanical unit. Also, attach the cover to the unused connector.
- Frequently check that connectors are tight and cable jackets are not damaged.
- When precautions are not followed, damage to cables might occur. Cable failure may result in incorrect function of end effector, robot faults, or damage to robot electrical hardware. In addition, electric shock could occur when touching the power cables.

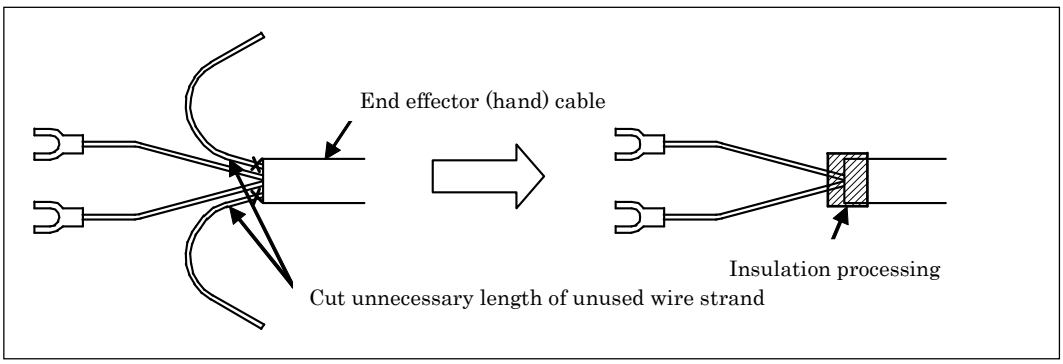


Fig.9.8 (a) Treatment method of end effector (hand) cable

Fig. 9.8 (b) to (f) show the position of the option cable interface. EE interface (RDI/RDO or RI/RO), I/O Unit-MODEL B interface, user cable (signal lines, power lines) and DeviceNet cable (signal lines, signal line usable to the force sensor, signal line usable to force sensor and 3DL sensor, power lines), additional axis motor cable (Pulsecoder line) ,additional axis motor cable(power and brake), camera cable and 3DL sensor cable are prepared as options.

NOTE
Each option cable is written like below on connector panel
EE(RI/RO) interface : EE
I/O Unit Model B : I/O
User cable (signal) : AS
User cable (signal usable to force sensor) : ASH
User cable (signal usable to force sensor and 3DL sensor) : ASi
User cable (power) : AP
Devicenet cable (signal) : DS
Devicenet cable (power) : DP
Additional axis motor cable (Pulsecoder) : ARP
Additional axis motor cable (power,brake) : ARM
3DL sensor cable : SEN
Camera cable : CAM

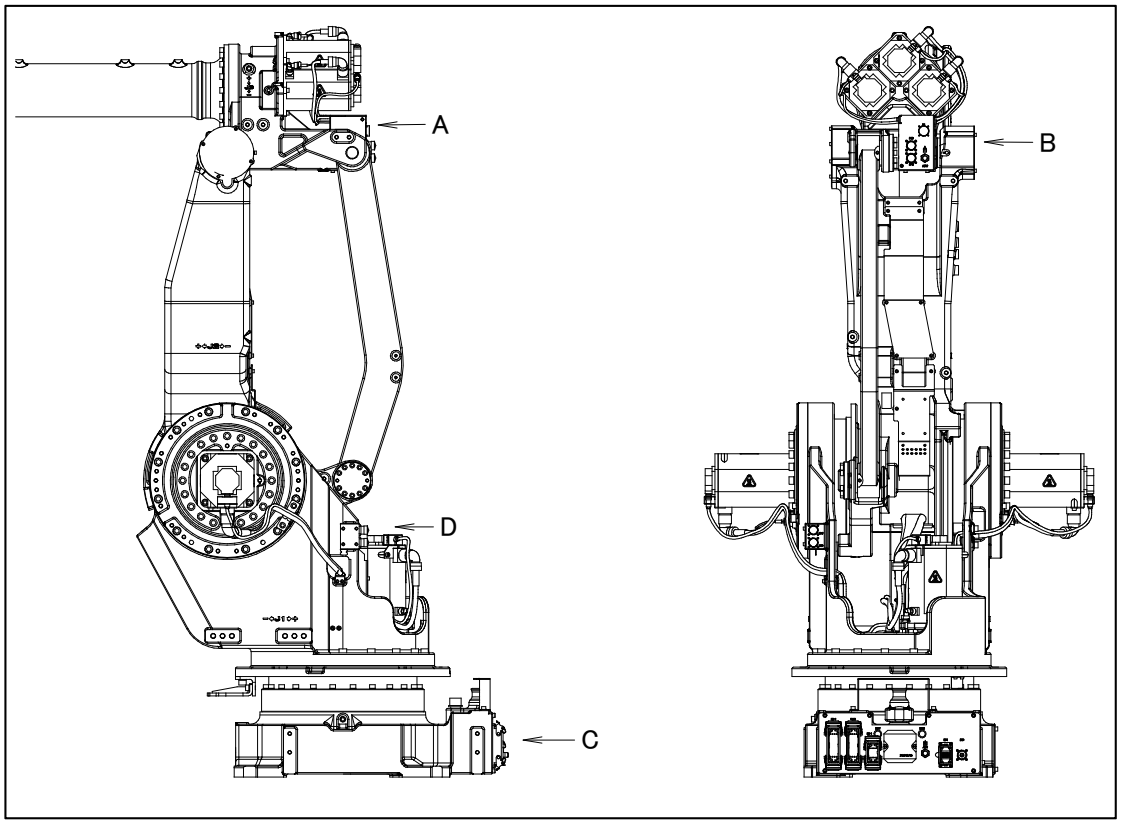


Fig. 9.8 (b) Interface for optional cable (M-900*i*A/350/260L) (Option)

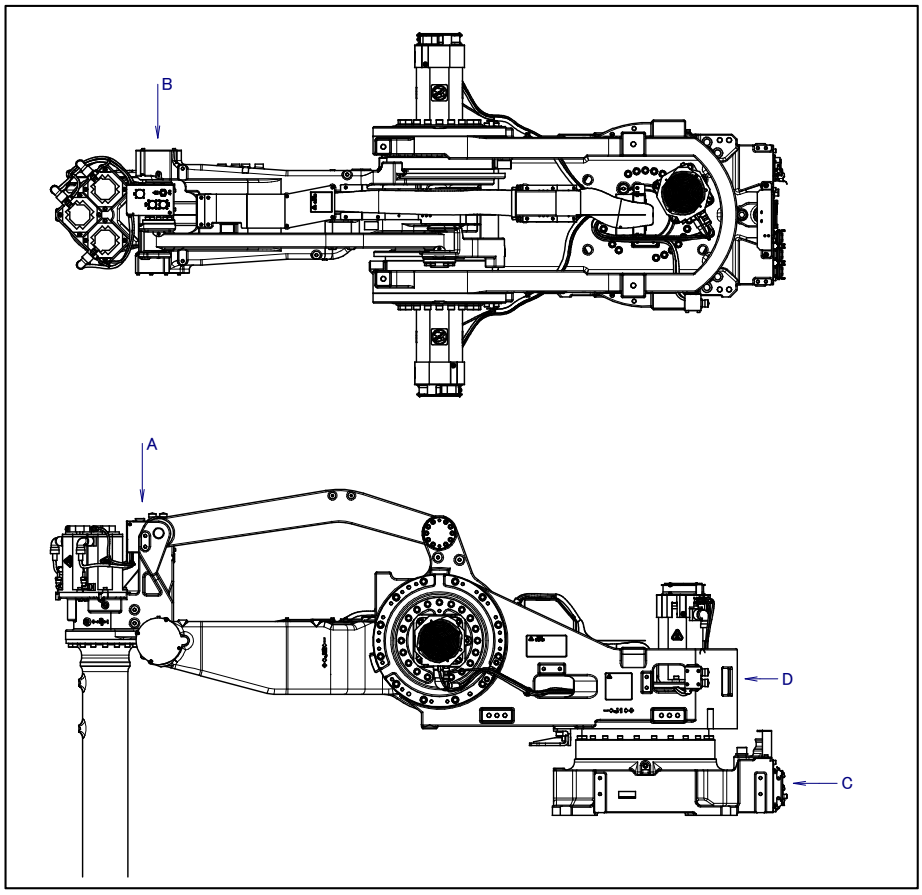


Fig. 9.8 (c) Interface for optional cable (M-900*i*A/150P) (Option)

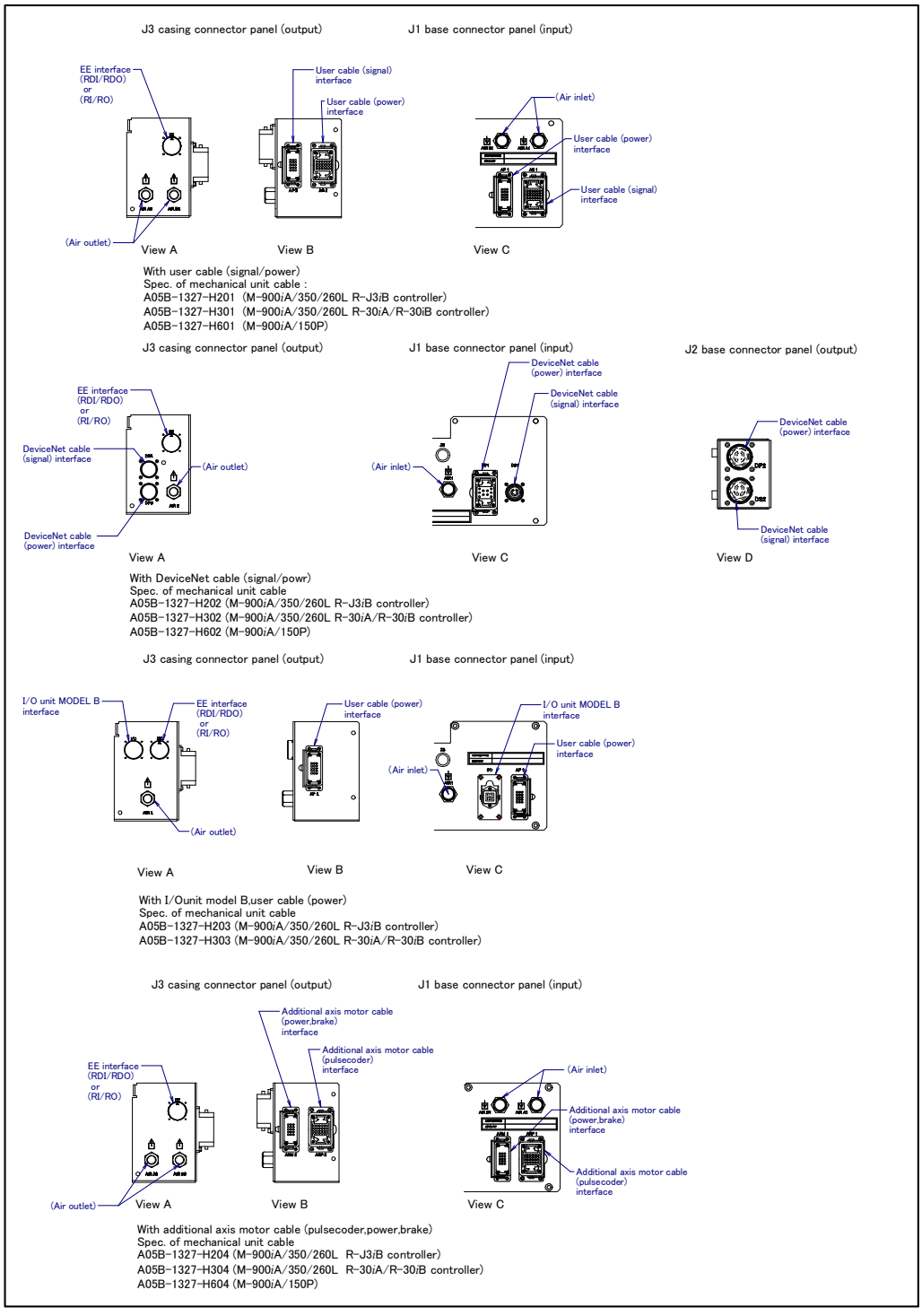


Fig. 9.8 (d) Interface for optional cable 1

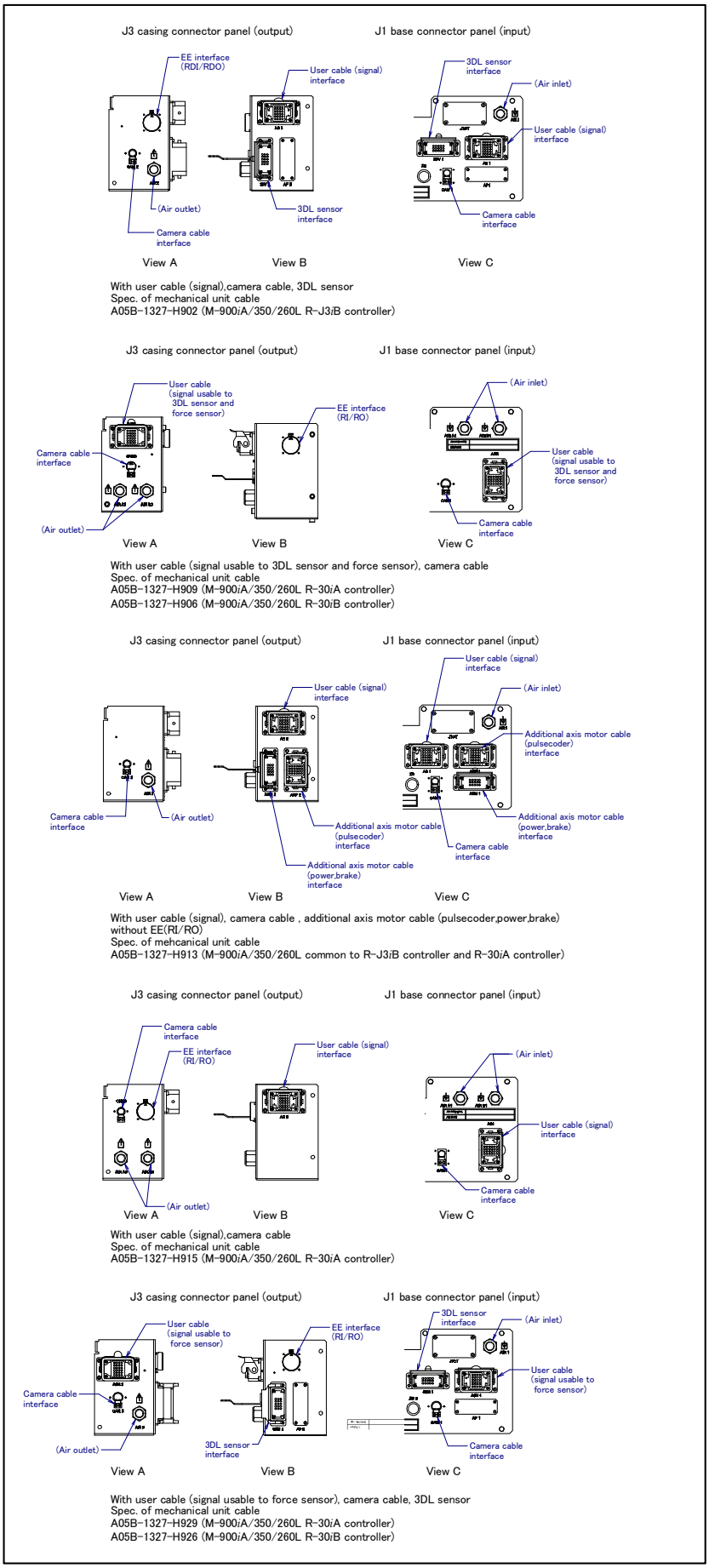


Fig. 9.8 (e) Interface for optional cable 2

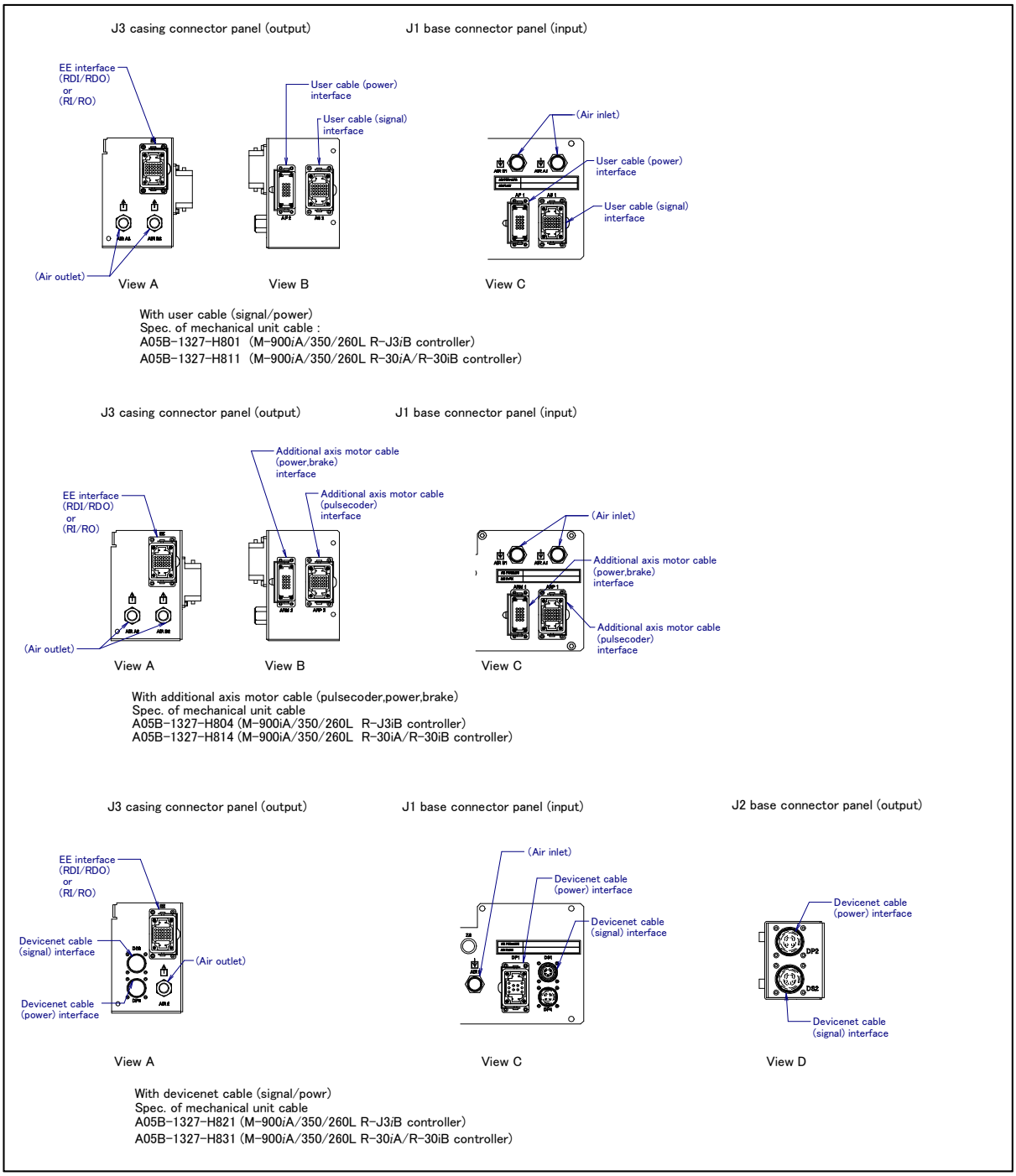


Fig. 9.8 (f) Interface for optional cable 3 (for severe dust/liquid protection option)

1. EE interface (RDI/RDO or RI/RO) (option)
Fig. 9.8 (g), (h), (i), (j) show pin layout for EE interface (RDI/RDO or RI/RO). When severe dust/liquid protection package is specified, the connector has guide pins and bushes for preventing improper insertion. For cables prepared by the user, use these guide pins and bushes.

⚠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 maintenance manuals for the controllers.

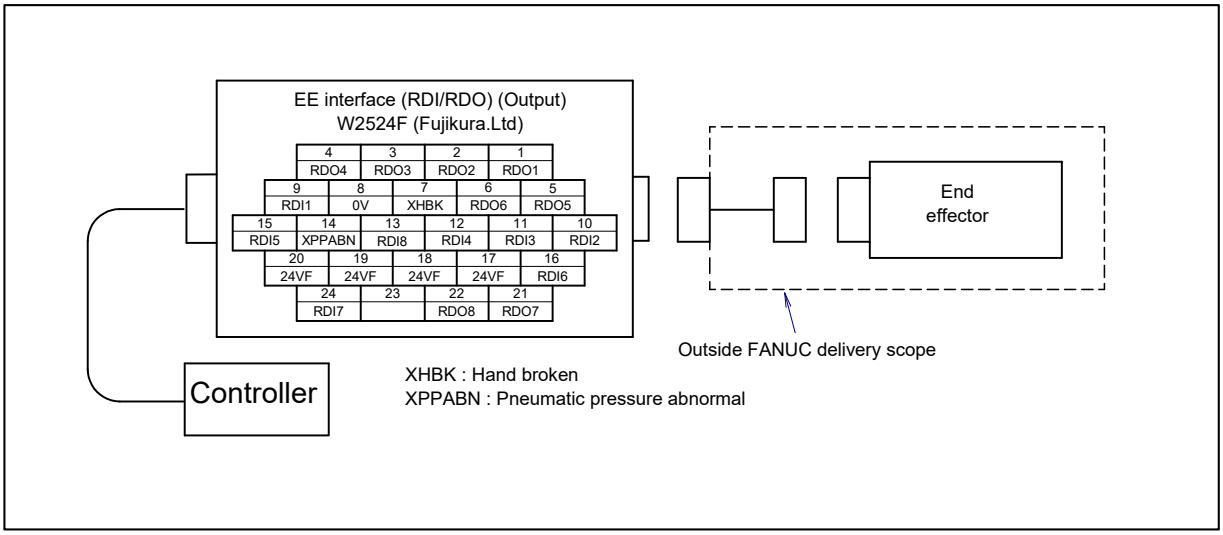


Fig. 9.8 (g) Pin layout for EE interface (RDI/RDO) (option)
(For R-J3*i*B controller)

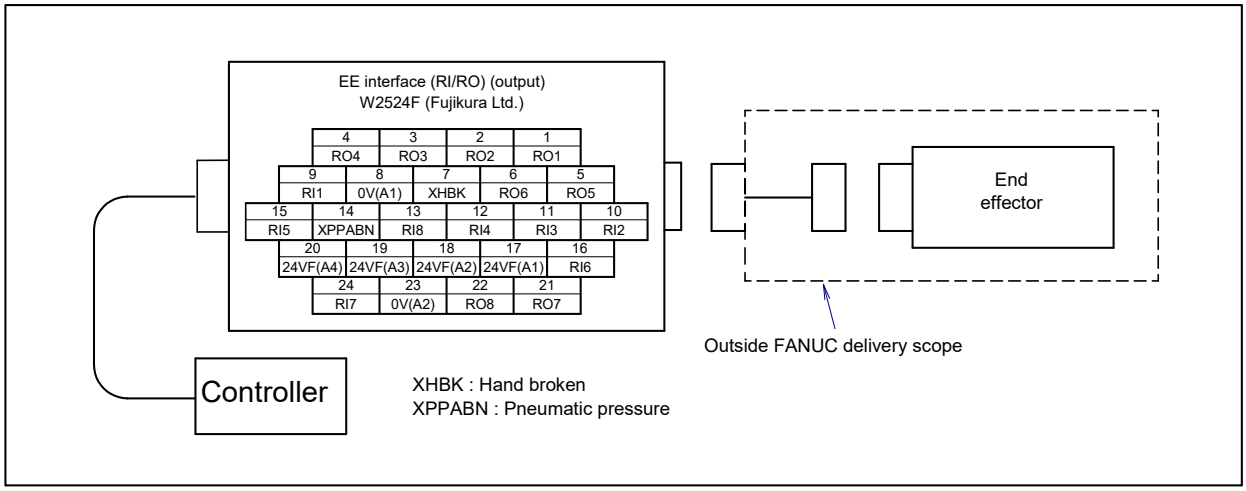


Fig. 9.8 (h) Pin layout for EE interface (RI/RO) (option)
(For R-30*i*A/R-30*i*B controller)

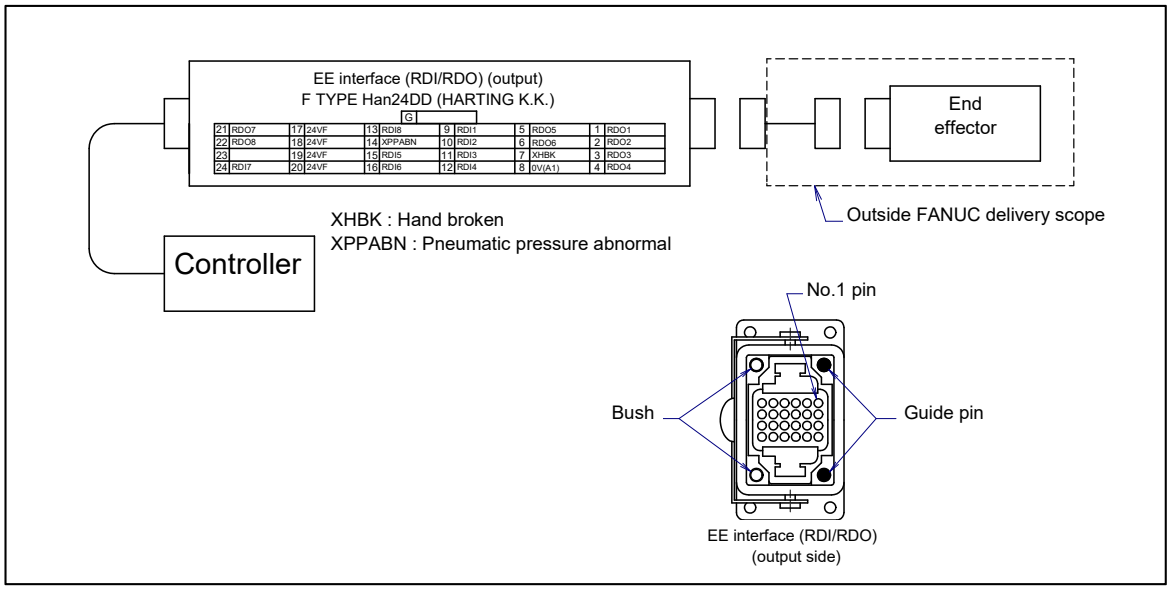


Fig. 9.8 (i) Pin layout for EE interface (RDI/RDO)
(When the severe dust/liquid protection package is selected) (Option) (For R-J3*i*B controller)

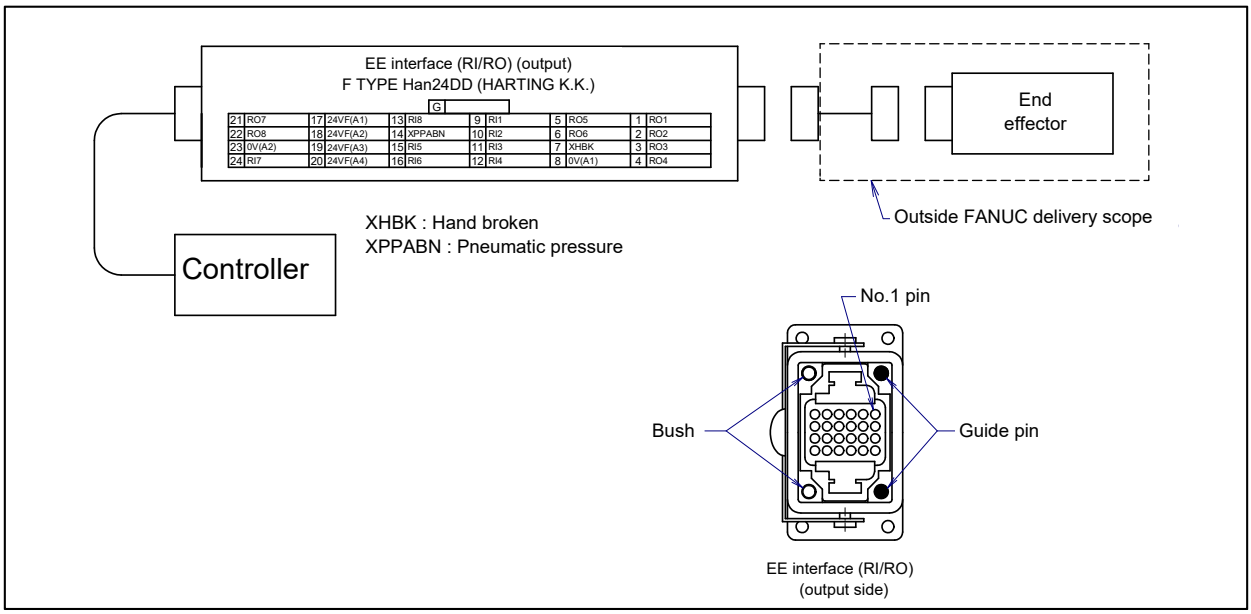


Fig. 9.8 (j) Pin layout for EE interface (RI/RO)
(When the severe dust/liquid protection package is selected) (Option) (For R-30*i*A/ R-30*i*B controller)

2. I/O Unit-MODEL B interface (option)
Fig. 9.8 (k) shows pin layout for I/O Unit-MODEL B interface.

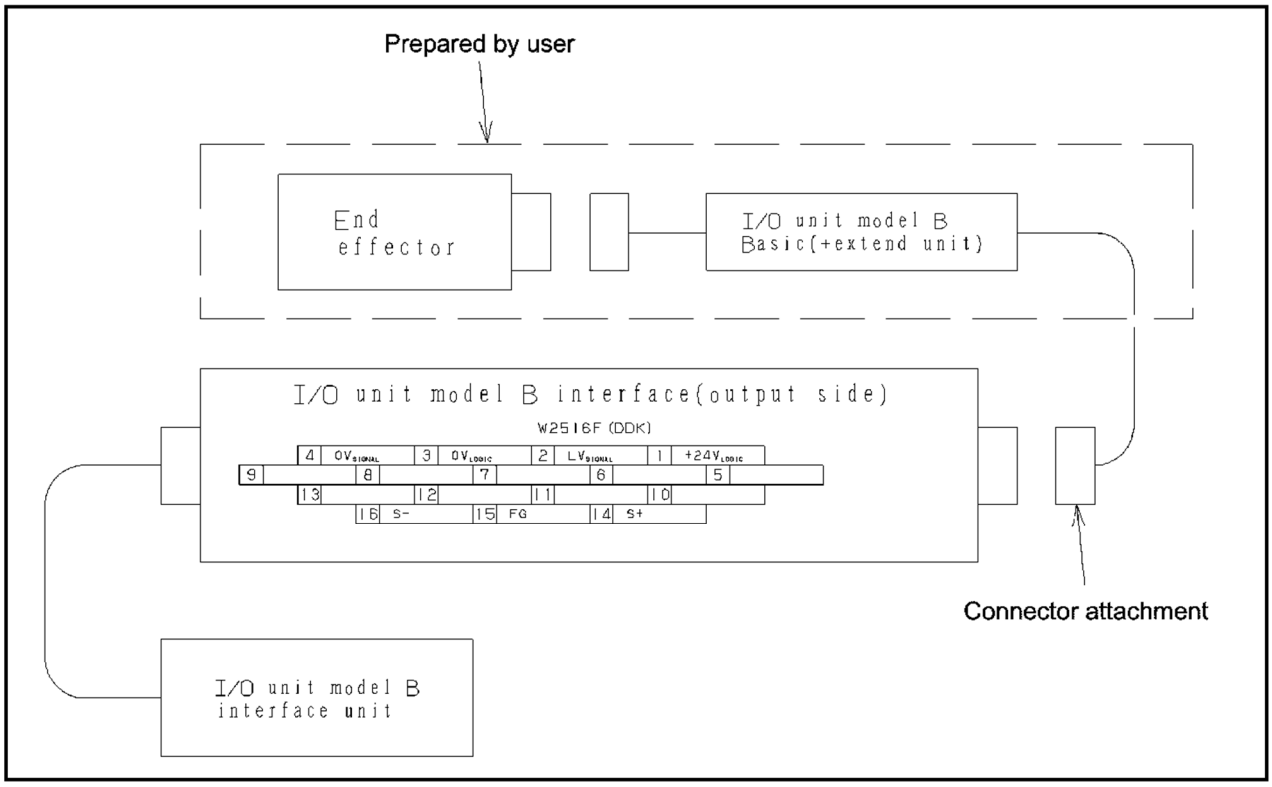


Fig. 9.8 (k) Pin layout for I/O Unit-MODEL B interface (option)

3. User cable (signal line) Interface (option)
Fig. 9.8 (l) shows pin layout for user cable (signal line) interface.
The connector has a code pin for preventing improper insertion.
For cables prepared by user, use this code pin.

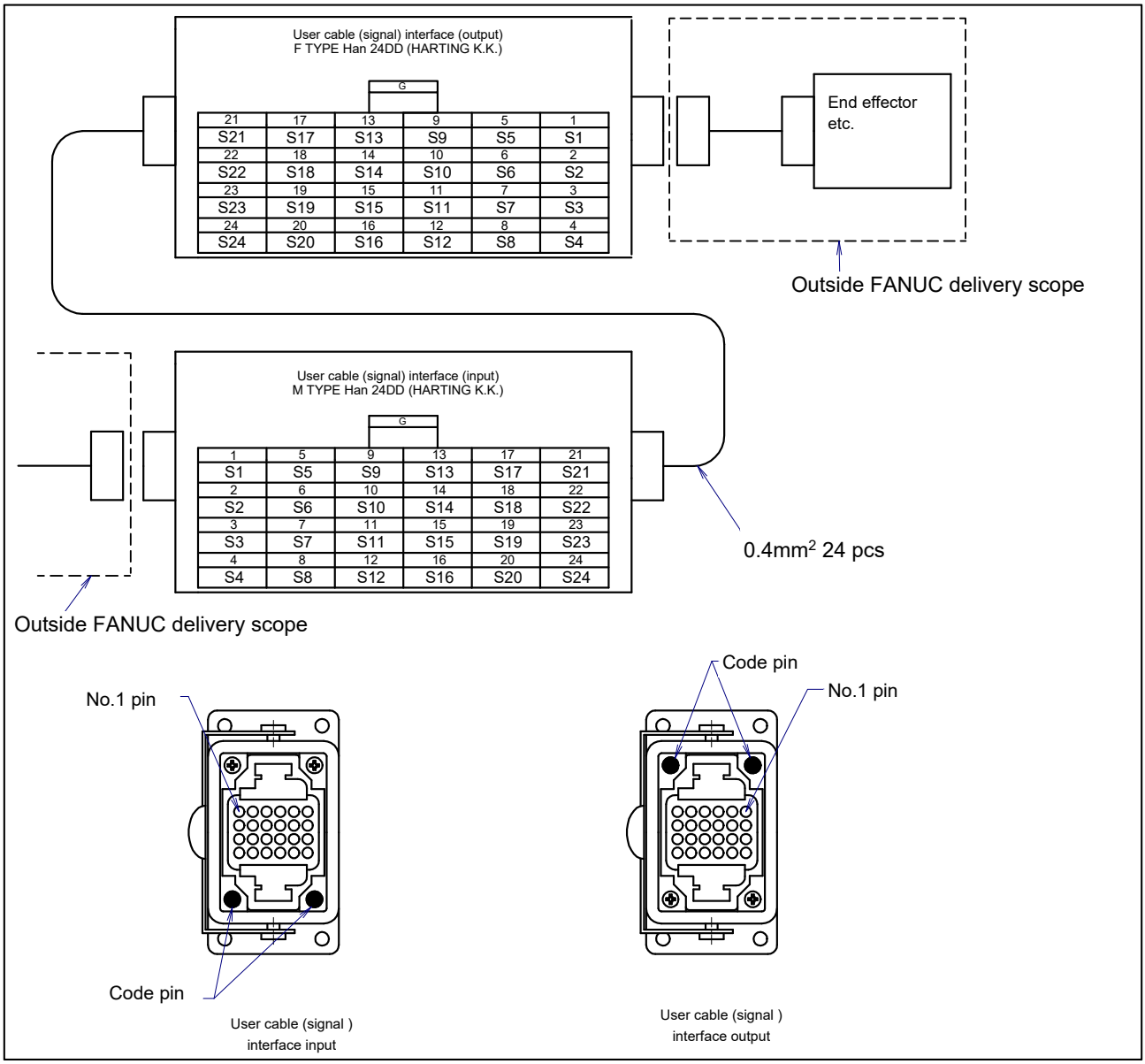


Fig. 9.8 (l) Pin layout for user cable (signal line) interface and code pin layout (option)

4 User cable (signal line usable to force sensor and 3D Laser Vision sensor) (ASi) (signal line usable to force sensor Vision sensor) (ASH)Interface (option)
Fig. 9.8 (m) shows the pin layout for the user cable (signal line usable to force sensor and 3D Laser Vision sensor)/(signal line usable to force sensor Vision sensor) (ASH) interface.
The connector has a code pin for preventing improper insertion. The code pin is required for the cable which is prepared by the user.

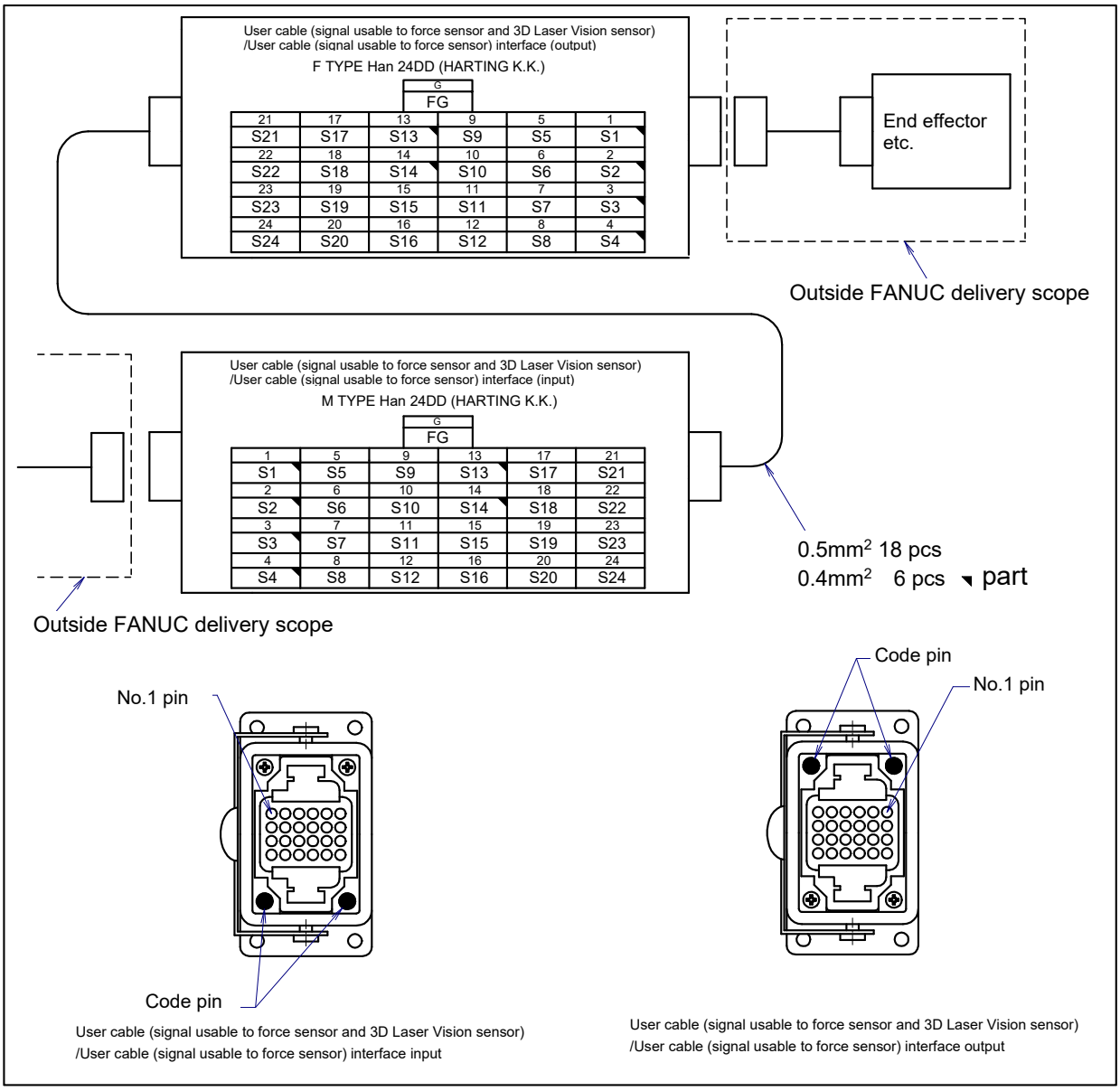


Fig. 9.8 (m) Pin layout for user cable (signal line usable to force sensor and 3D Laser Vision sensor) (ASi) (signal line usable to force sensor) (ASH)/interface and code pin layout (option)

5. User cable (power line) Interface (option)
Fig. 9.8 (n) shows pin layout for user cable (power line) interface.
The connector has a code pin for preventing improper insertion. For cables prepared by user, use this code pin.

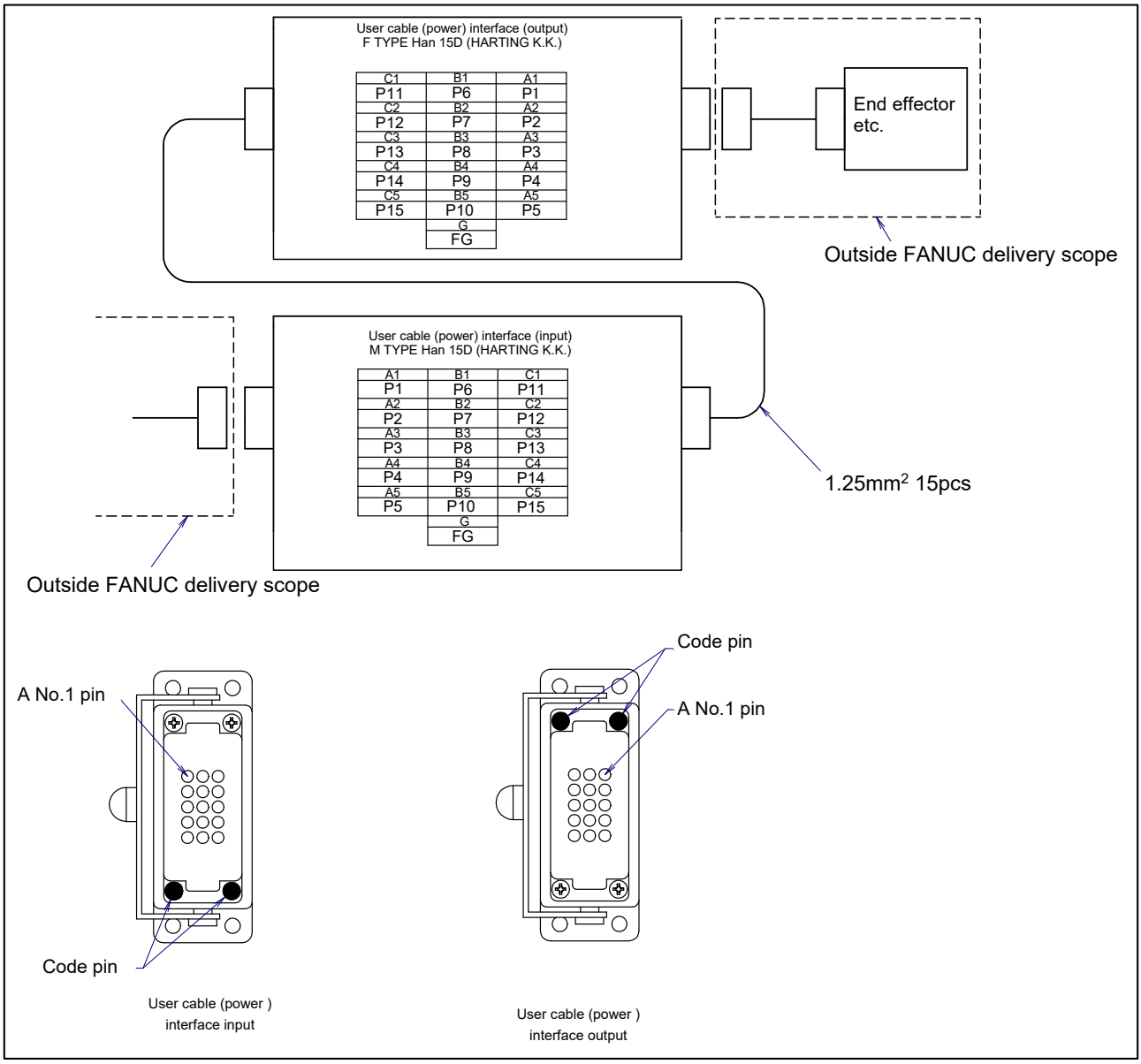


Fig. 9.8 (n) Pin layout for user cable (power line) interface and code pin layout (option)

6. DeviceNet cable (signal line) interface (option)
Fig. 9.8 (o) shows pin layout for DeviceNet cable (signal line) interface.

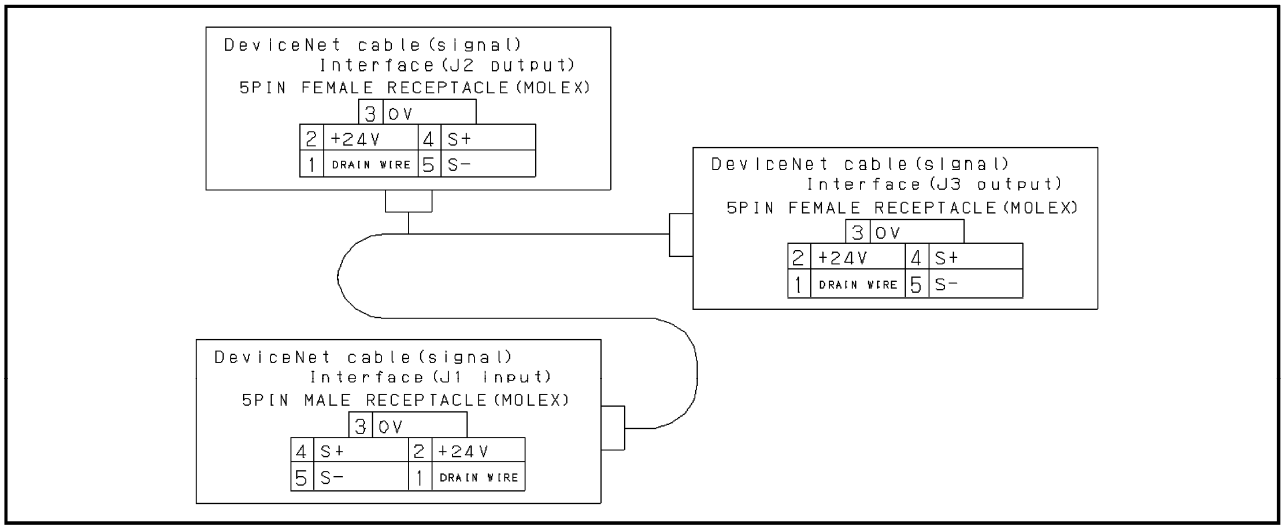


Fig. 9.8 (o) Pin layout for DeviceNet cable (signal line) interface (option)

7. DeviceNet cable (power line) interface (option)
Fig. 9.8 (p) shows pin layout for DeviceNet cable (power line) interface.

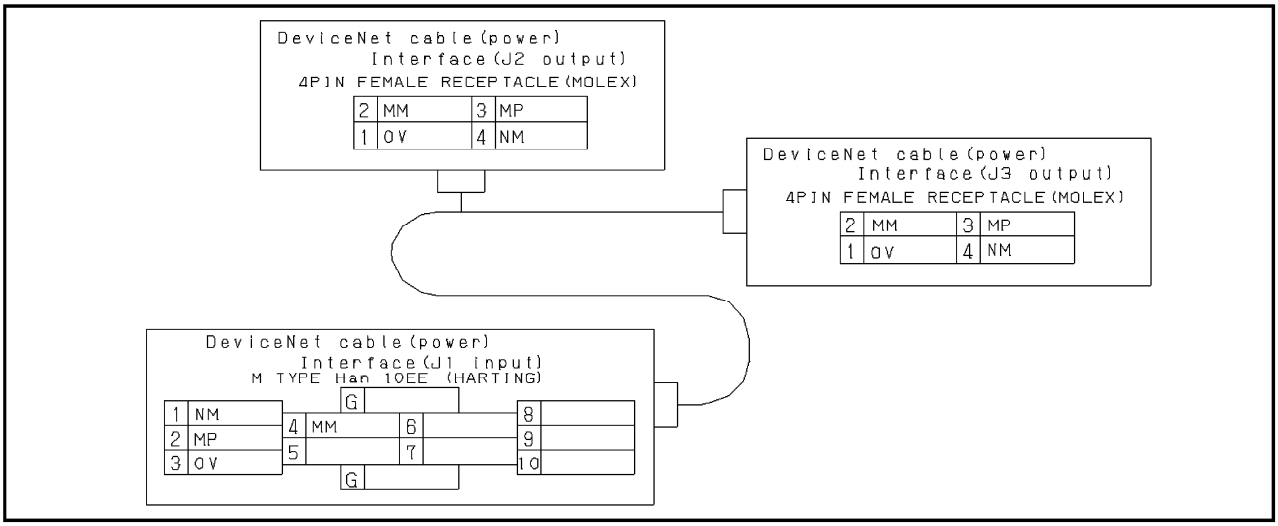


Fig. 9.8 (p) Pin layout for DeviceNet cable (power line) interface (option)

8. Additional axis motor cable (Pulsecoder cable) interface (option)
Fig. 9.8 (q) shows the pin layout of the additional axis motor cable (Pulsecoder cable) interface.
The connector has a code pin for preventing improper insertion.

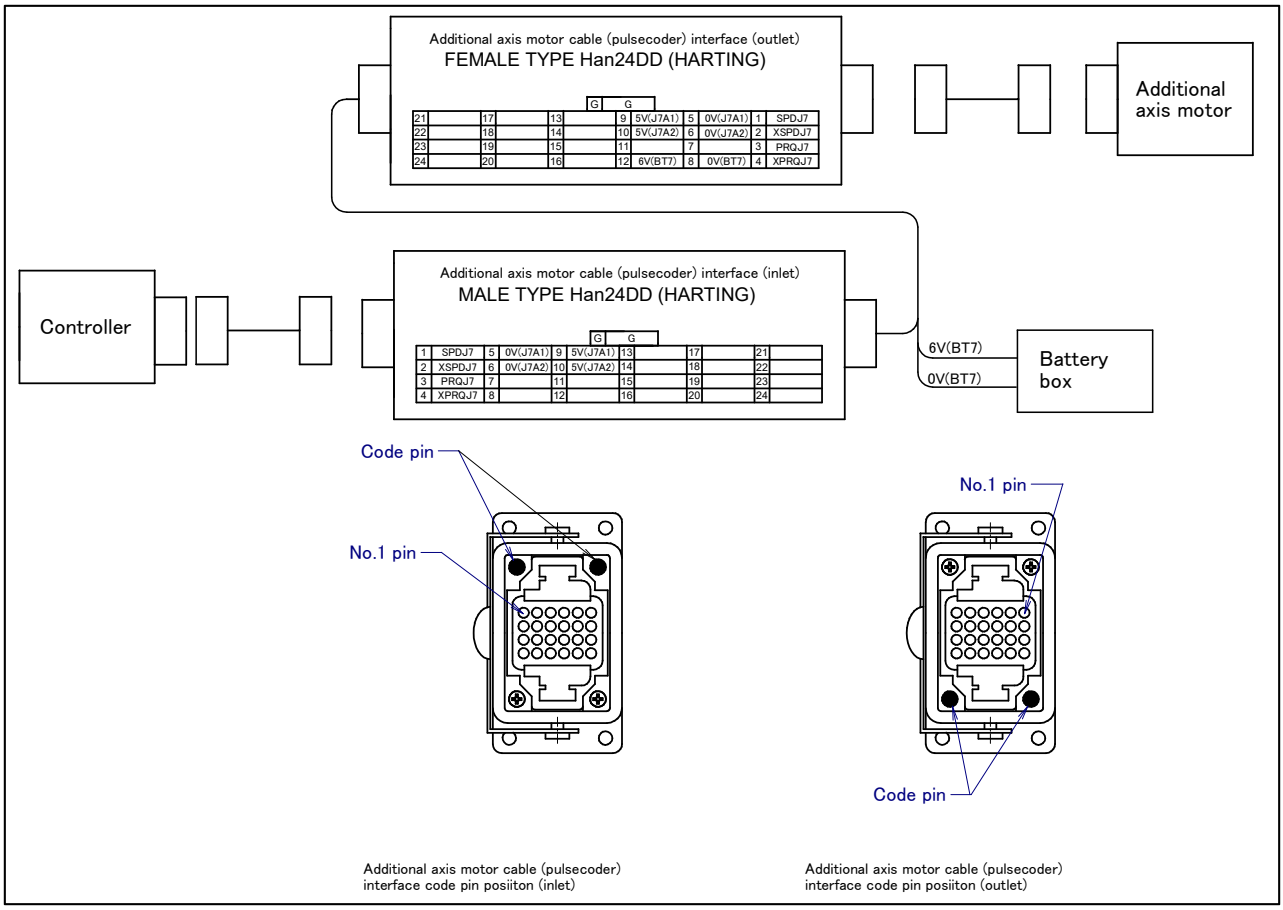


Fig. 9.8 (q) Pin layout of the additional axis motor cable (Pulsecoder cable) interface and layout position of the code pin (optional)

Table 9.8 (a) Comparative table of signal name according to the motor

ARP	α motor, β motor	*αi* , *αi* –B motor, β*i*, β*i*-B motor
SPD	SD	-
XSPD	*SD	-
PRQ	REQ	RD
XPRQ	*REQ	*RD

9. Additional axis motor cable (power and brake cables) interface (option)
Fig. 9.8 (r) shows the pin layout of the additional axis motor cable (power and brake cables) interface. The connector has a code pin for preventing improper insertion.

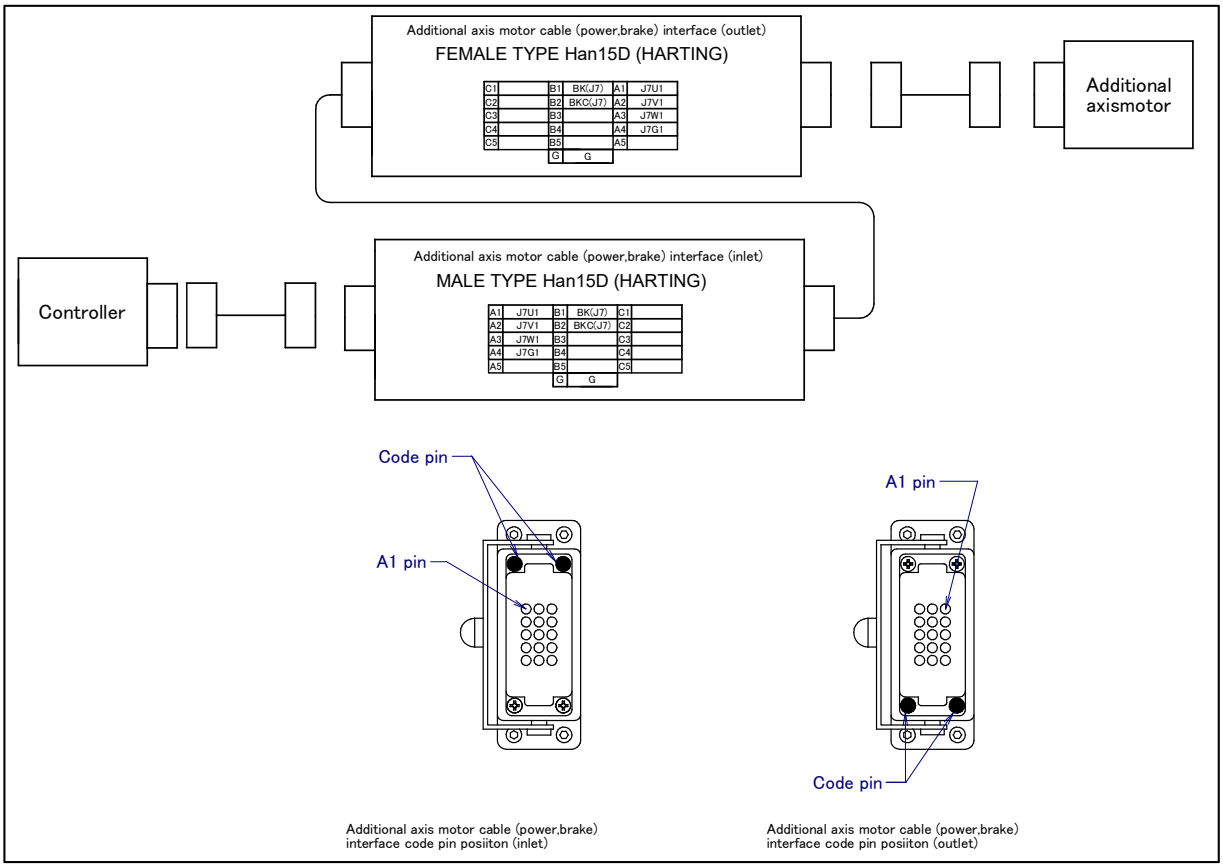


Fig. 9.8 (r) Pin layout of the additional axis motor cable (power and brake cables) interface and layout position of the code pin (optional)

Connector Specifications

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

Cable	Input side (J1 base)		Output side (J3 casing)		Maker/ Dealer
EE (RDI/RDO) or (RI/RO)	———		JMWR2524F		Fujikura Ltd
I/O	———		JMWR2516F		
AS ASH ASi	Housing Insert Contact Code pin	09 30 006 0301 09 16 024 3001 09 15 000 6103 09 30 000 9901	Housing Insert Contact Code pin	09 30 006 0301 09 16 024 3101 09 15 000 6203 09 30 000 9901	HARTING K.K.
AP	Housing Insert Contact Code pin	09 20 010 0301 09 21 015 3001 09 15 000 6101 09 30 000 9901	Housing Insert Contact Code pin	09 20 010 0301 09 21 015 3101 09 15 000 6201 09 30 000 9901	

Cable	Input side (J1 base)	Output side (J3 casing)		Maker/ Dealer
EE (RDI/RDO) or (RI/RO) When the severe dust/liquid protection package is selected	———	Housing Insert Contact Guide pin Bush	09 30 006 0301 09 16 024 3101 09 15 000 6204 09 33 000 9908 09 33 000 9909	

Table 9.8 (c) Connector specifications (user side)

Cable	Input side (J1 base)		Output side (J3 casing)		Maker/ Dealer
EE (RDI/RDO) or (RI/RO)	———		JMSP2524M (*1) JMLP2524M	Straight Angle	Fujikura Ltd
I/O	———		JMSP2516M JMLP2516M	Straight (Appendix) Angle	
AS ASH ASi	Hood (Note 2)	09 30 006 1540 1541 0542 0543 1440 1441 0442 0443 (Side entry ↓ / Top entry ↓)	Hood	← The same	HARTING K.K.
	Insert	09 16 024 3101	Insert	09 16 024 3001	
	Contact (Note 2)	09 15 000 6204 AWG 26-22 6203 AWG 20 6205 AWG 18 6202 AWG 18 6201 AWG 16 6206 AWG 14	Contact (Note 2)	09 15 000 6104 AWG 26-22 6103 AWG 20 6105 AWG 18 6102 AWG 18 6101 AWG 16 6106 AWG 14	
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094 etc	Clamp	← The same	
AP	Hood (Note 2)	09 20 010 1541 0540 0541 1440 0440 0441 (Side entry ↓ / Top entry ↓)	Hood	← The same	HARTING K.K.
	Insert	09 21 015 3101	Insert	09 21 015 3001	
	Contact (Note 2)	09 15 000 6204 AWG 26-22 6203 AWG 20 6205 AWG 18 6202 AWG 18 6201 AWG 16 6206 AWG 14	Contact (Note 2)	09 15 000 6104 AWG 26-22 6103 AWG 20 6105 AWG 18 6102 AWG 18 6101 AWG 16 6106 AWG 14	

Cable	Input side (J1 base)		Output side (J3 casing)		Maker/ Dealer
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094 Many other types are available.	Clamp	← The same	
	Code pin	09 30 000 9901	Code pin	09 30 000 9901	
EE (RDI/RDO) or (RI/RO) Severe dust/liquid protection cables which are corresponde d is specified	_____		Hood (Note 2)	09 30 006 1540 Side entry 1541 ↓ 0542 0543 1440(*2) Top entry 1441 ↓ 0442 0443	HARTING K.K.
			Insert	09 16 024 3001 (*3)	
			Contact (24 pcs)	09 15 000 6104 (*4) AWG 26-22 6103 AWG 20 6105 AWG 18 6102 AWG 18 6101 AWG 16 6106 AWG 14	
			Clamp (Note 2)	09 00 000 5085 (*5) 5086 5090 5094 Many other types are available	
			Guide pin (2 pcs)	09 33 000 9908 (*6)	
			Bush (2 pcs)	09 33 000 9909 (*7)	

NOTE 1

Underlined parts are attached. Below shows spec. to order in your local FANUC representative.

(*1)A63L-0001-0234#S2524M
(*2)A63L-0001-0453#06B1440
(*3)A63L-0001-0453#24DDM
(*4)A63L-0001-0453#CA6104
(*5)A63L-0001-0453#A-152D
(*6)A63L-0001-0453#A-9908
(*7)A63L-0001-0453#A-9909

Table 9.8 (d) Connector specifications (DeviceNet cable) (mechanical unit side)

Cable	Input side (J1 base)		Maker/ Dealer	Output side (J2 base)	Maker/ Dealer	Output side (J3 casing)	Maker/ Dealer
DS	84854-9101		MOLEX JAPAN CO., LTD.	84854-9100	MOLEX JAPAN CO., LTD.	84854-9100	MOLEX JAPAN CO., LTD.
DP	Housing Insert Contact	09 30 006 0301 09 32 010 3001 09 33 000 6104	HARTING K.K.	84854-9102	MOLEX JAPAN CO., LTD.	84854-9102	MOLEX JAPAN CO., LTD.

Table 9.8 (e) Connector specifications (DeviceNet cable) (user side)

Cable	Input side (J1 base)			Maker/ Dealer	Output side (J2 base)	Maker/ Dealer	Output side (J3 casing)	Maker/ Dealer
DS	MINI connector for use on the device net 5-pin FEMALE CM03A-R5P-P-2			Fujikura Ltd	MINI connector for use on the device net, 5-pin male CM03A-R5P-P-2	Fujikura Ltd	MINI connector for use on the device net, 5-pin male CM03A-R5P-P-2	Fujikura Ltd
DP	Hood (Note 2)	09 30 006 1540 1541 0542 0543 1440 1441 0442 0443	Side entry ↓ Top entry ↓	HARTING K.K.	MINI connector for use on the device net, 4-pin male CM03A-PR4S-P-2	Fujikura Ltd	MINI connector for use on the device net, 4-pin male CM03A-PR4S-P-2	Fujikura Ltd
	Insert	09 32 010 3101						
	Contact (Note 2)	09 33 000 6220 6214 6205 6204 6202 6207	AWG20 AWG18 AWG18 AWG16 AWG14 AWG12					
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094						
		Many other types are available.						

Table 9.8 (f) Connector specifications (additional axis motor cable, mechanical unit side)

Cable	Input side (J1 base)		Output side (J3 casing)		Maker/ Dealer
ARP	Housing	09 30 006 0301	Housing	09 30 006 0301	HARTING K.K.
	Insert	09 16 024 3001	Insert	09 16 024 3101	
	Contact	09 15 000 6103	Contact	09 15 000 6203	
	Code pin	09 30 000 9901	Code pin	09 30 000 9901	
ARM	Housing	09 20 010 0301	Housing	09 20 010 0301	
	Insert	09 21 015 3001	Insert	09 21 015 3101	
	Contact	09 15 000 6101	Contact	09 15 000 6201	
	Code pin	09 30 000 9901	Code pin	09 30 000 9901	

NOTE 2
For details, such as the dimensions, of the parts listed above, refer to the related catalogs offered by the respective manufacturers, or contact your local FANUC representative.

10 TRANSPORTATION AND INSTALLATION

10.1 TRANSPORTATION

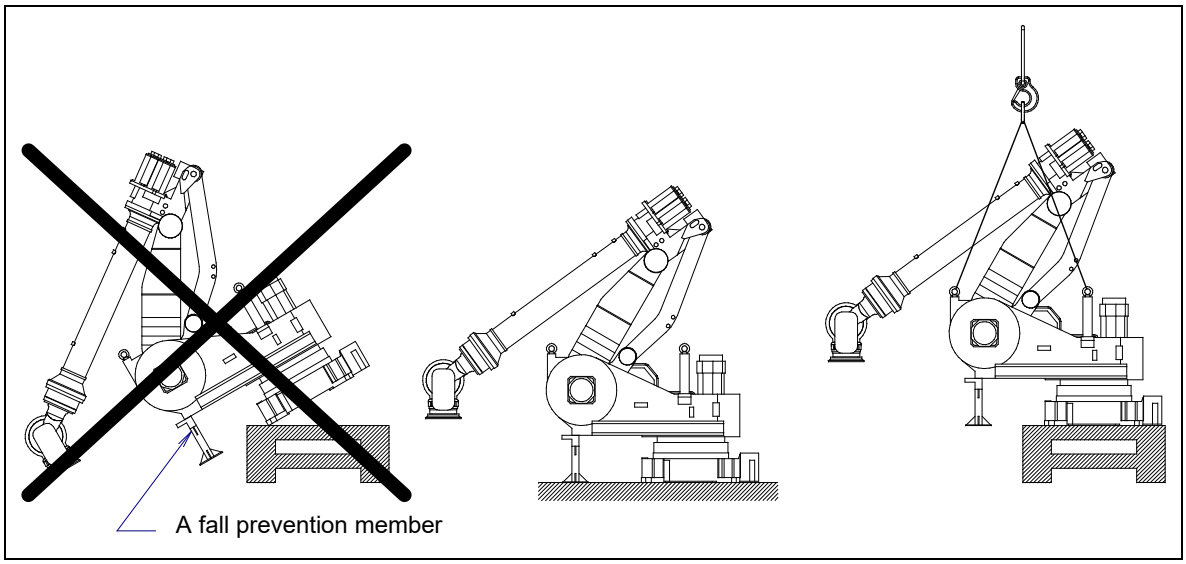
1 Transportation using a crane
The robot can be transported by lifting it. When transporting the robot, be sure to change the posture of the robot to that shown in Fig. 10.1 (a) to (c) and lift by attaching slings to the four M20 eyebolts.

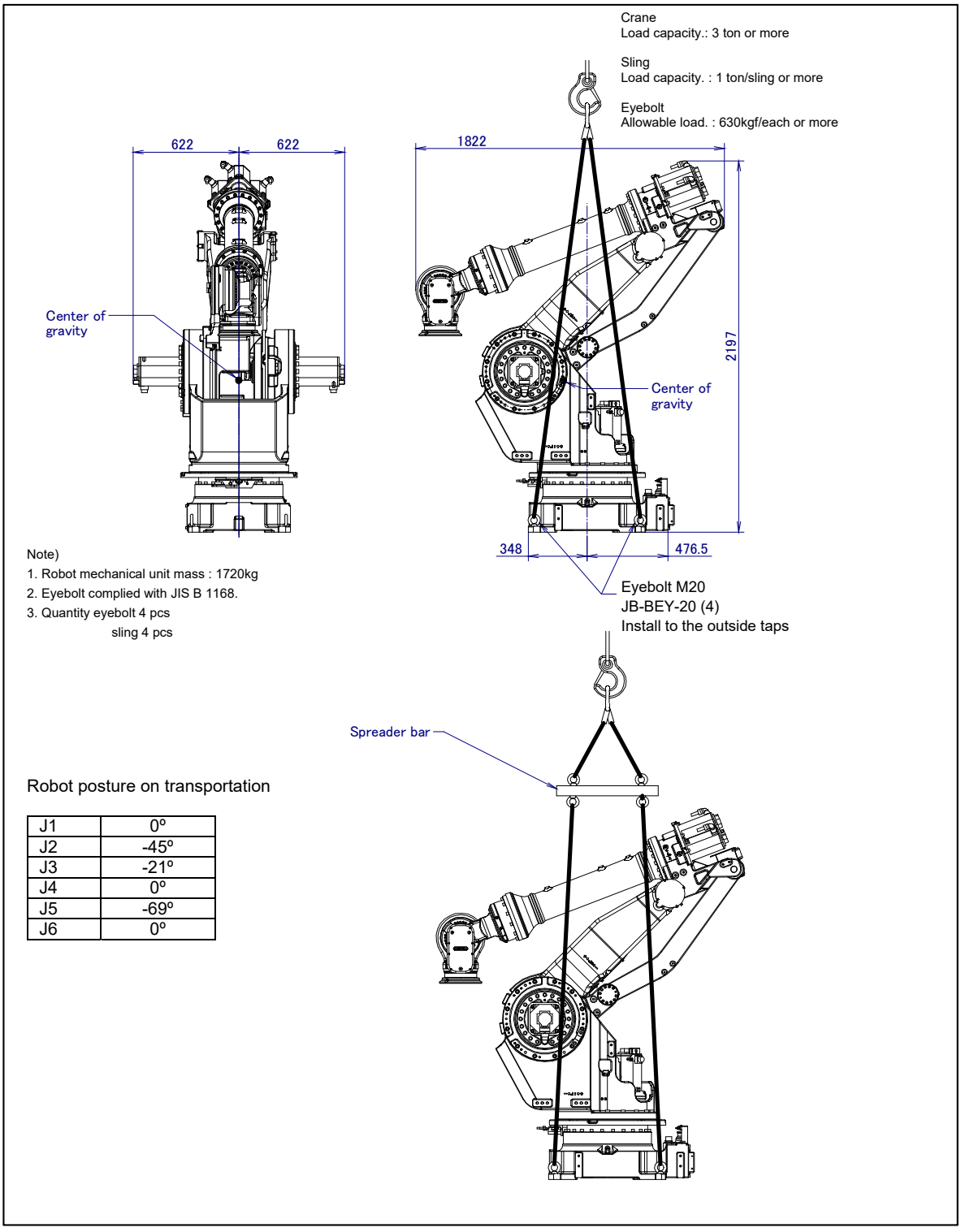
> ⚠ **CAUTION**
> When lifting the robot, take notice so that the motors, connectors, or cables of the robot are not scratched by slings.

2 Transportation using a forklift
The robots can also be transported using a forklift (refer to Fig.10.1 (d) to (f)). Transport materials are available as an option.

> ⚠ **WARNING**
> 1 When hoisting or lowering the robot with a crane or forklift, move it slowly with great care. When placing the robot on the floor, exercise care to prevent the installation surface of the robot from striking the floor.
> 2 Detach the end effectors and the floor plate before transporting the robot. If the robot must necessarily be transported with the floor plate or end effectors attached, take the following precautions:
> - The entire position of center of gravity is changed by installing the tool and the floor plate. Please note the balance enough.
> - The tool swings by the vibration etc. when transported, and there is a possibility that an excessive load acts on the robot. Secure the end effector firmly according to Subsection 10.1.1.
> - When you lift robot with the floor plate installed, please lift up not the robot but the floor plate.
>
> 3 Use the forklift transport equipment only to transport the robot with a forklift. Do not use the forklift transport equipment to secure the robot.
> Before moving the robot by using forklift transport equipment, check and tighten any loose bolts on the forklift transport equipment.
> 4 When J2/J3-axis motor covers (option) are installed, be sure to remove them before transporting robot with a crane.

> ⚠ **CAUTION**
> M-900*i*A/150P may fall down if it is not fixed when a fall prevention member is not used, because center of gravity is before of it.
> If you transport or install it, keep attention below.
> 1 Be sure to install a fall prevention member when robot is not fixed, and be sure to make all surface of a fall prevention member contact floor.
> 2 If a fall prevention member does not contact floor, hang robot by crane etc. and keep it horizontally. when you attach or remove robot mounting bolts.


A fall prevention member

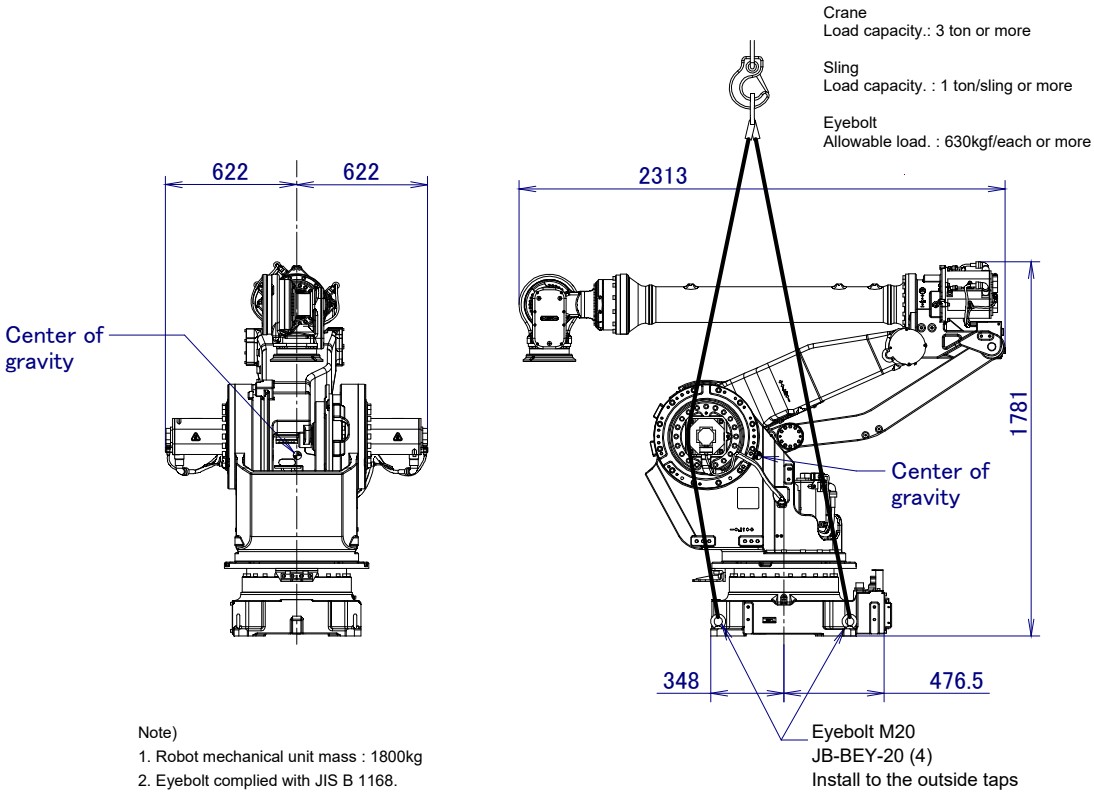


Note)
1. Robot mechanical unit mass : 1720kg
2. Eyebolt complied with JIS B 1168.
3. Quantity eyebolt 4 pcs
sling 4 pcs

Robot posture on transportation

J1	0º
J2	-45º
J3	-21º
J4	0º
J5	-69º
J6	0º

Fig. 10.1 (a) Transportation using a crane (M-900*i*A/350)



Note)
1. Robot mechanical unit mass : 1800kg
2. Eyebolt complied with JIS B 1168.
3. Quantity eyebolt 4 pcs
sling 4 pcs

Robot posture on transportation

J1	0º
J2	-66º
J3	0º
J4	0º
J5	-90º
J6	0º

Fig. 10.1 (b) Transportation using a crane (M-900*i*A/260L)

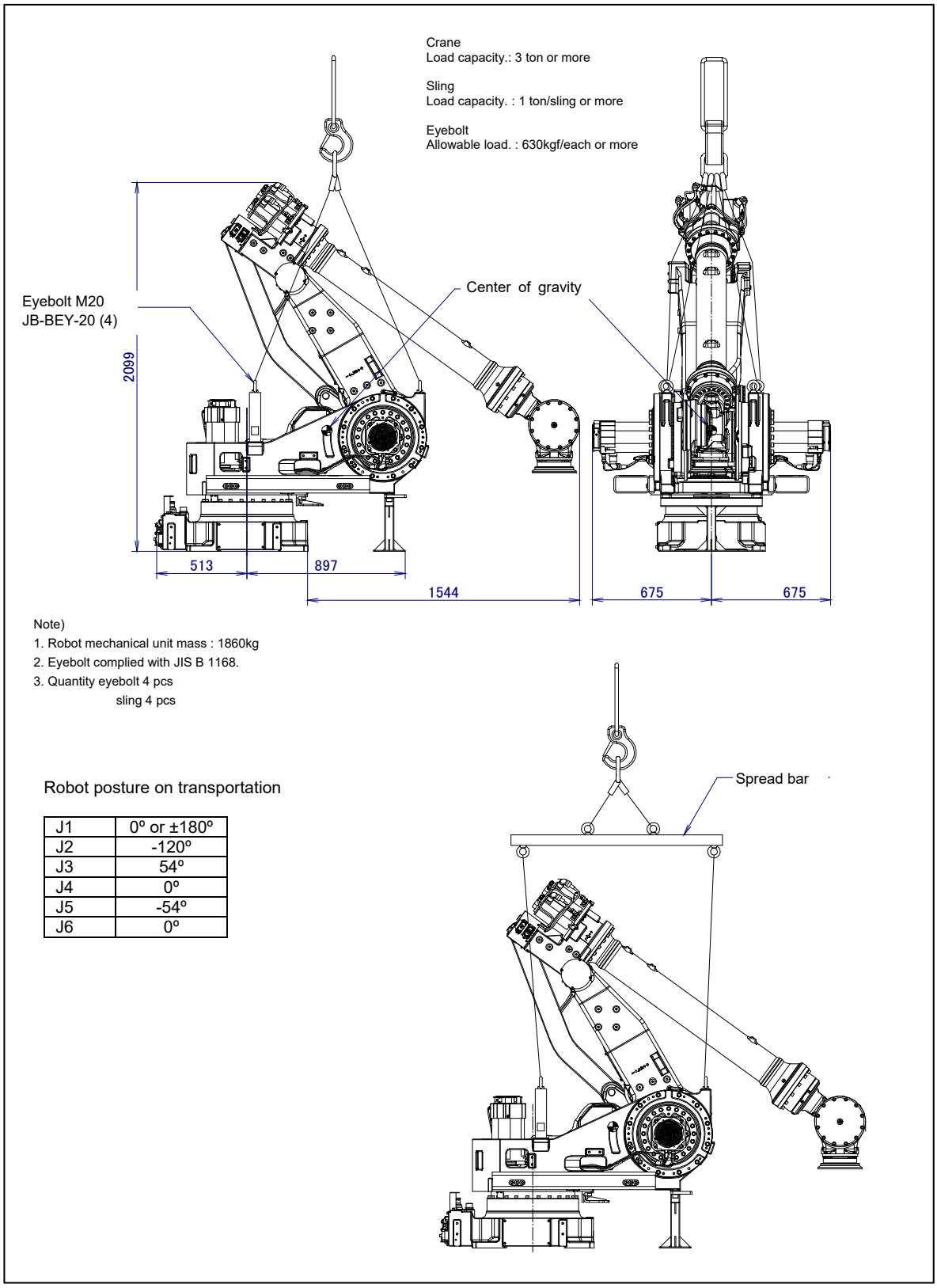


Fig. 10.1 (c) Transportation using a crane (M-900*i*A/150P)

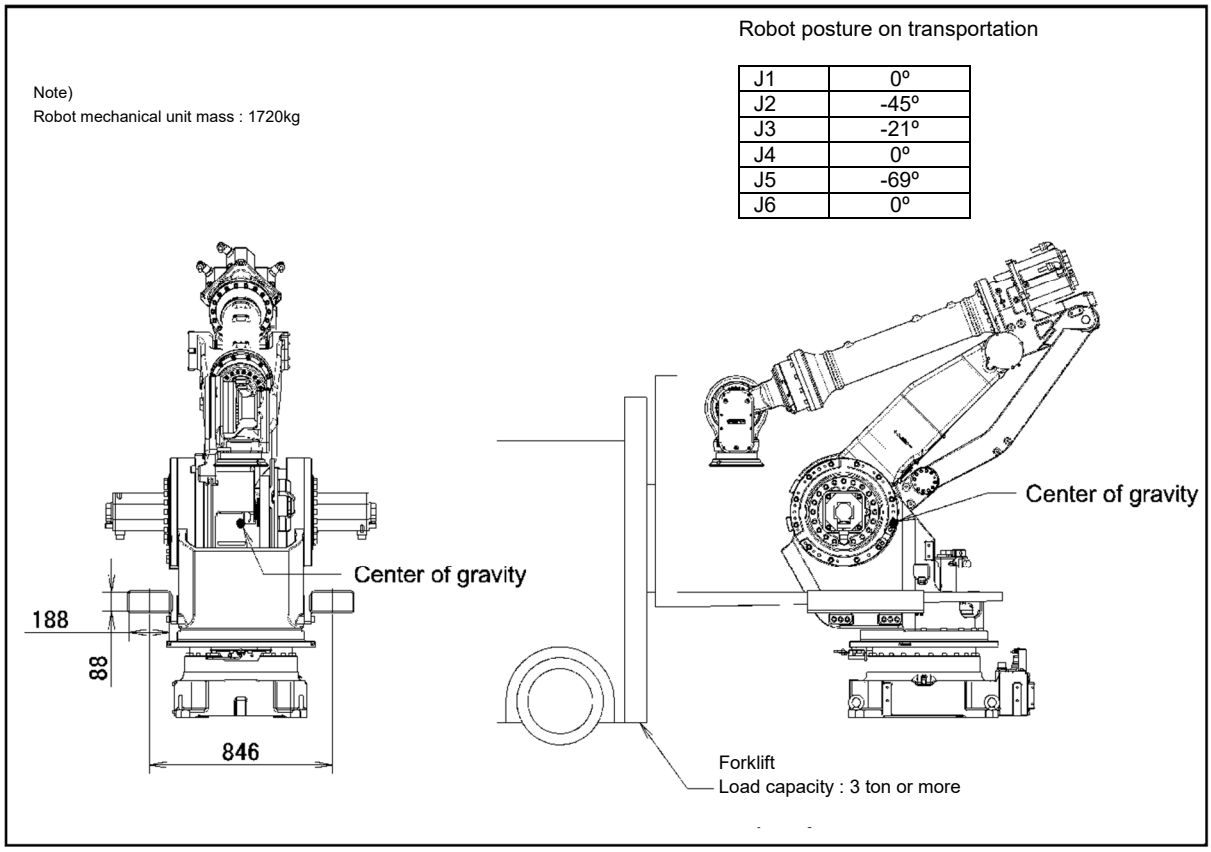


Fig. 10.1 (d) Transportation using a forklift (M-900*i*A/350)

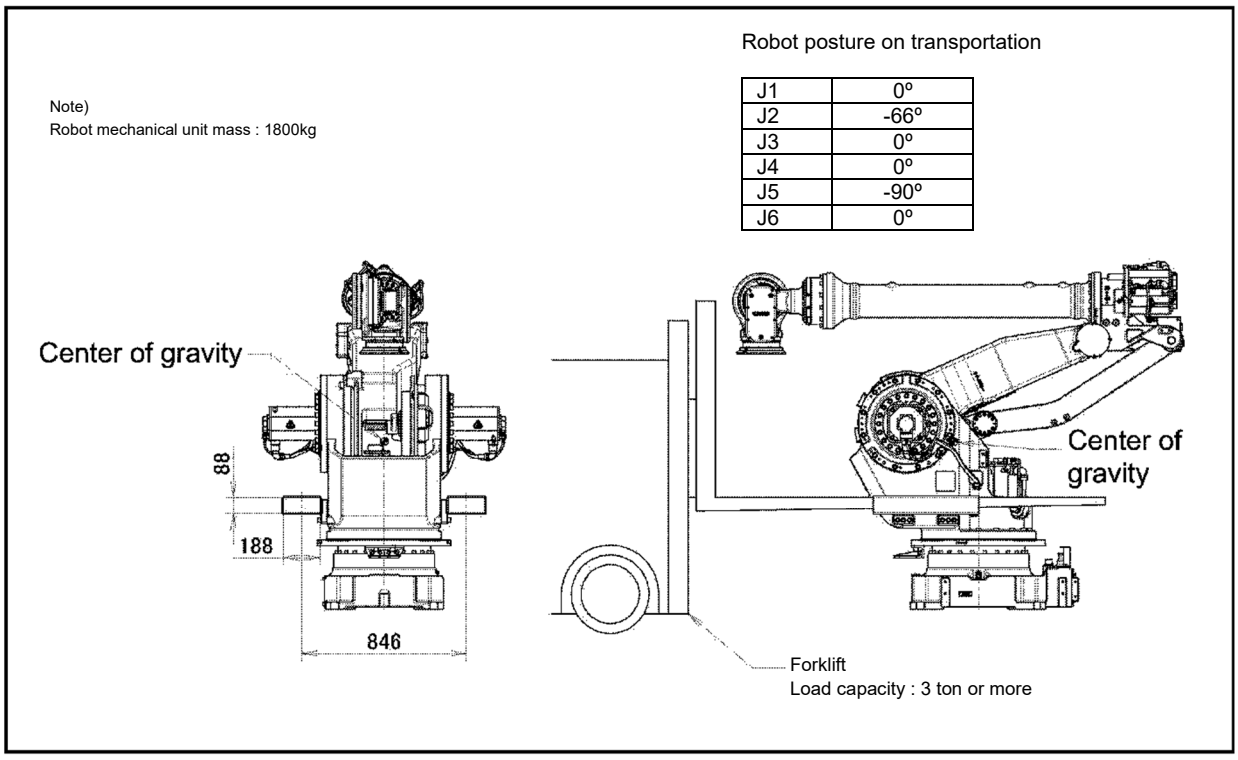


Fig. 10.1 (e) Transportation using a forklift (M-900*i*A/260L)

> ⚠ **CAUTION**
> Be careful not to strike the transport equipment with the forklift forks.

Robot posture on transportation

J1	0º or ±180º
J2	-120º
J3	54º
J4	0º
J5	-54º
J6	0º

Note)
Robot mechanical unit mass : 1860kg

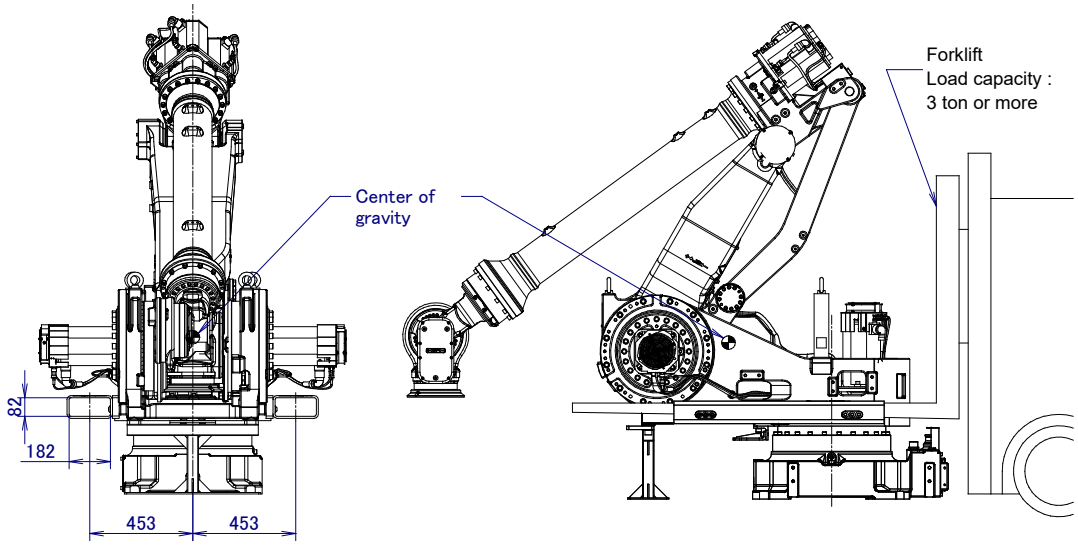


Fig. 10.1 (f) Transportation using a forklift (M-900*i*A/150P)

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

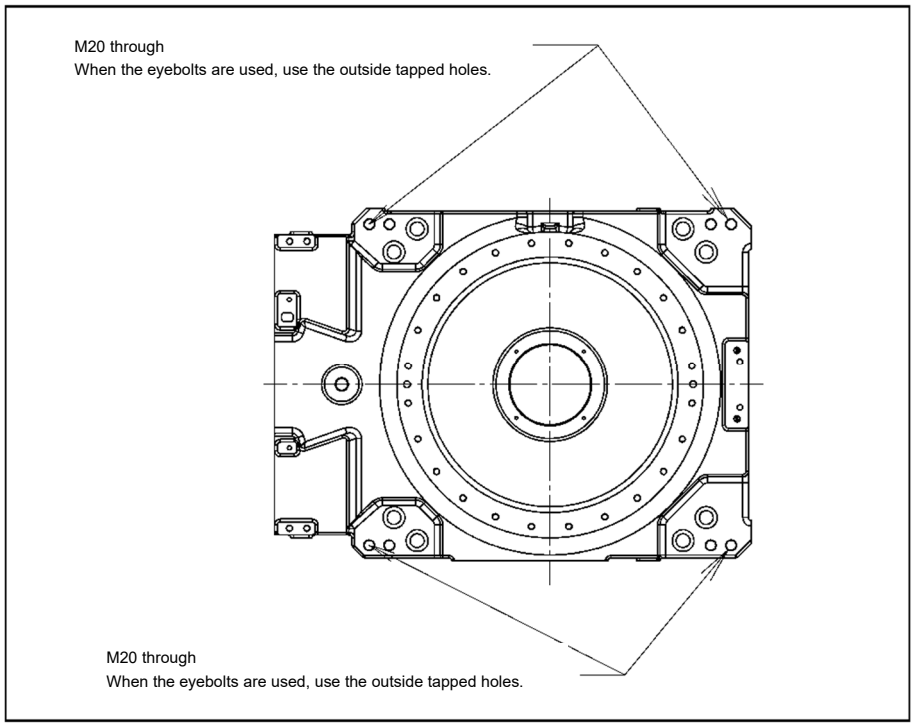


Fig. 10.1 (g) Eyebolt installation location (M-900*i*A/350/260L only)

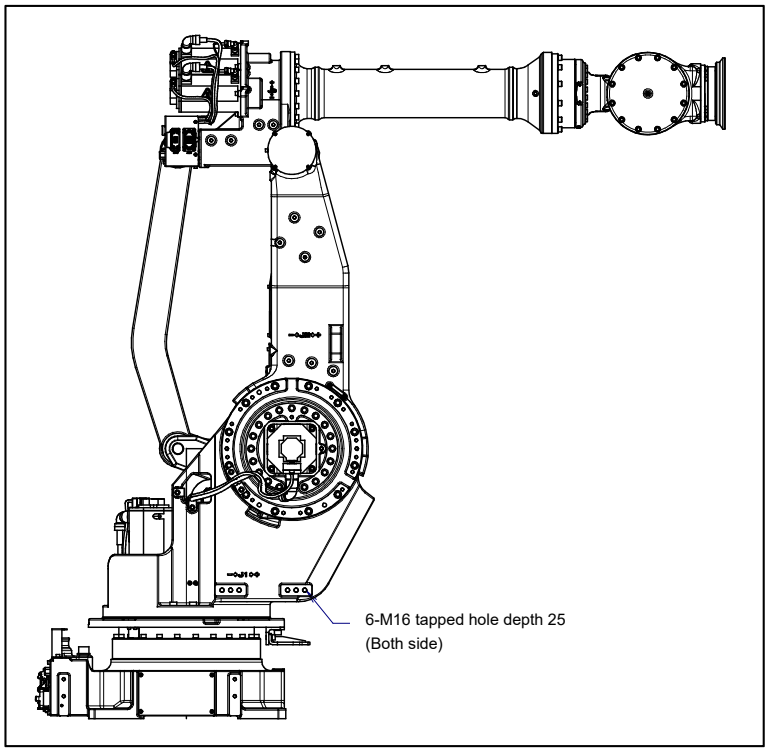


Fig. 10.1 (h) Transport equipment installation location

10.1.1 Transportation with an End Effector Attached

When transporting a robot with an end effector such as a welding gun or hand attached, secure the arm with wood. If the arm is not secured, the end effector may oscillate for a cause such as vibration during transportation, thus imposing a large impact load on the reducer of the robot and damaging the reducer at an earlier stage.

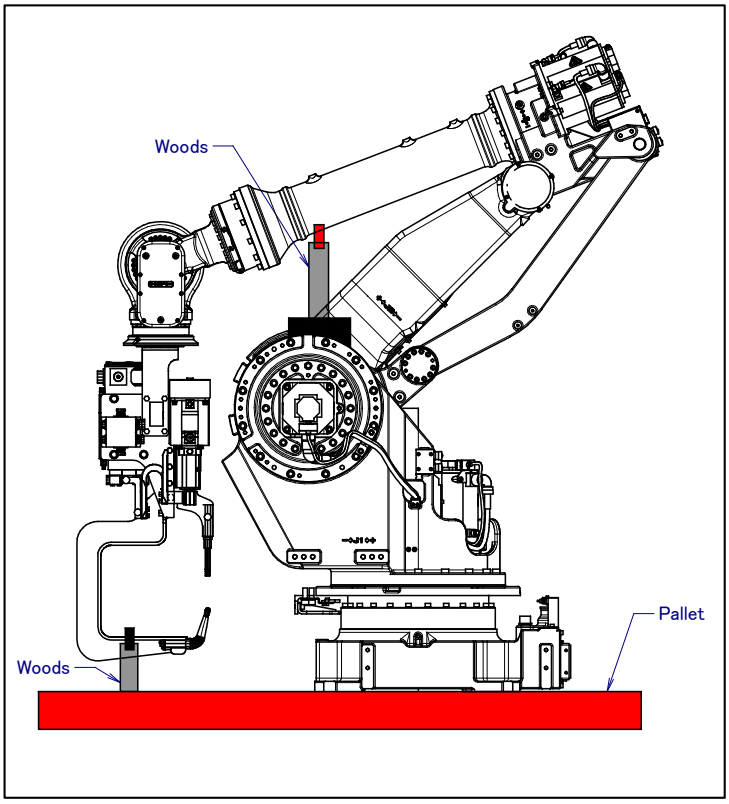


Fig. 10.1.1 (a) Example of securing the arm during transportation when an end effector is attached

10.2 INSTALLATION

Fig. 10.2 (a) shows the robot base dimensions.

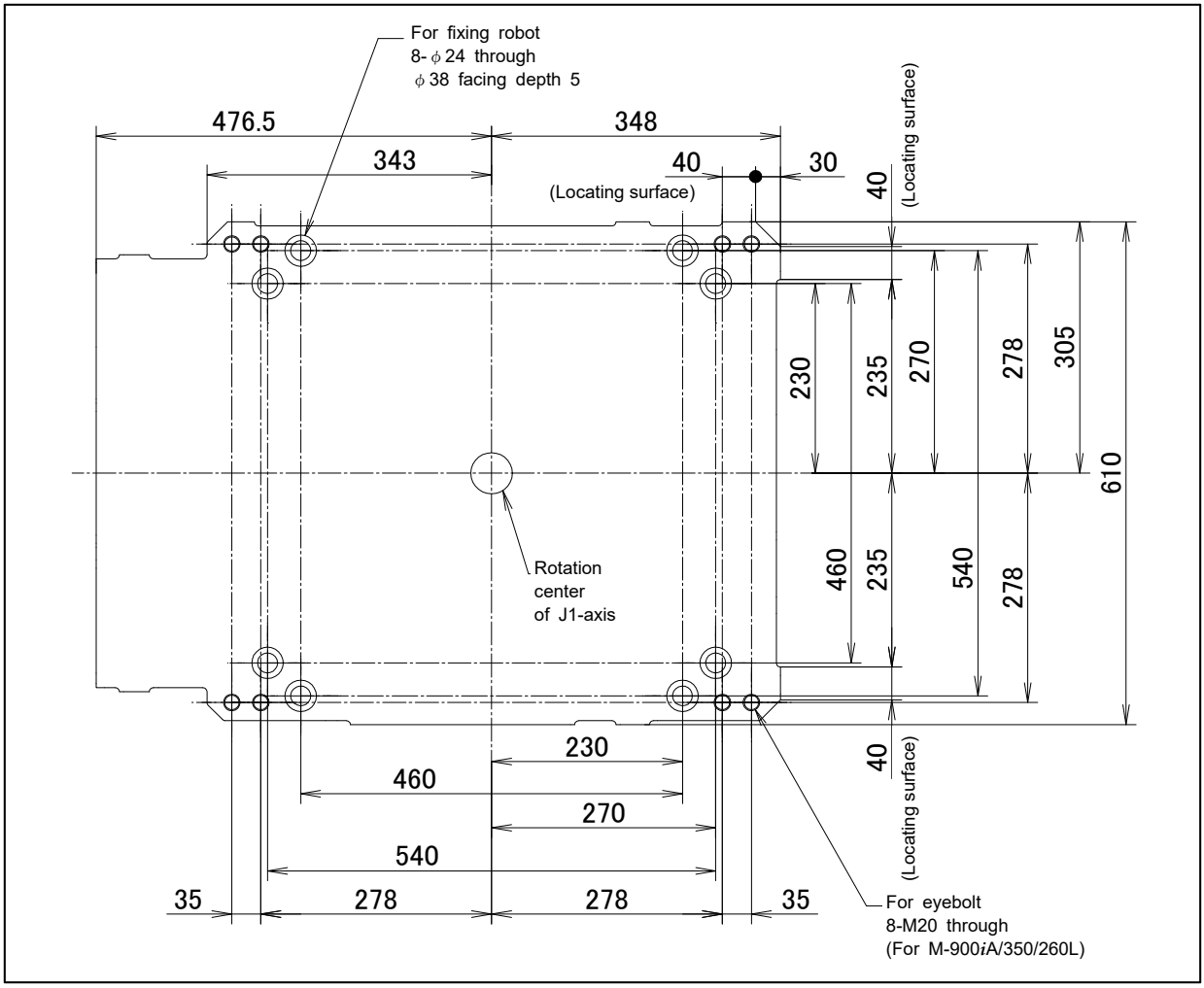


Fig. 10.2 (a) Dimensions of the robot base

10.2.1 Installation Method

Fig. 10.2.1 (a) shows actual examples of robot installations. In Fig. 10.2.1 (a), the floor plate is imbedded in concrete and fastened with twelve M20 (Tensile strength: 400N/mm^2) chemical anchors. Also, fasten the base plate to the robot base using eight M20 x 60 bolts (Tensile strength: 1200N/mm^2). Next, position the robot, and weld the base plate to the floor plate. (Foot length is 10 to 15mm.)
(The base plate is prepared as an option.)
Avoid placing any object in front of the robot on the mounting face to facilitate the installation of the mastering fixture.

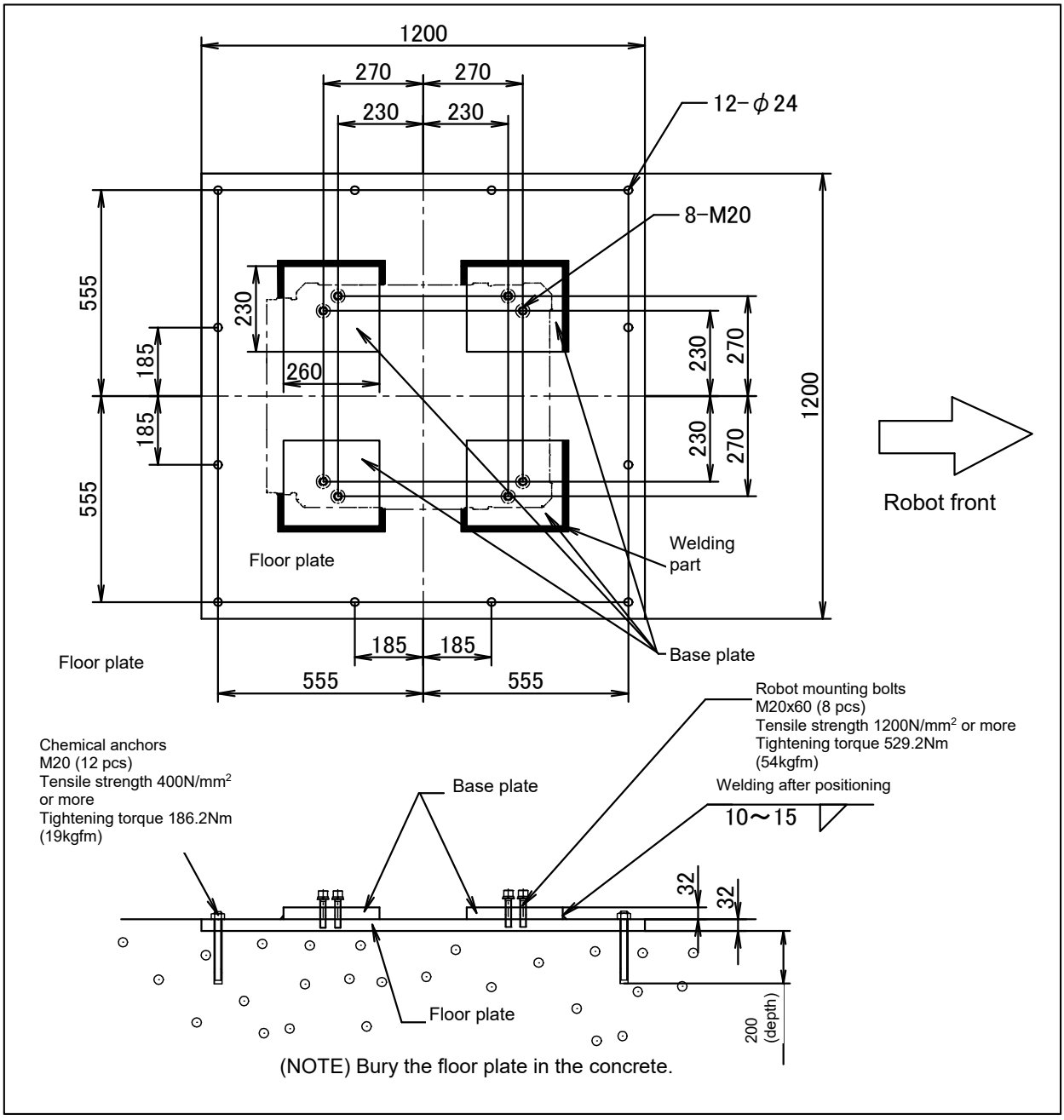


Fig. 10.2.1 (a) Actual installation example

NOTE
1 The strength of the chemical anchor depends on the concrete strength. See the design guideline of the manufacturer for the execution of the chemical anchor and consider the safety ratio sufficiently before use.
2. Parts to be provided by the customer:
   - Robot mounting bolts : M20 x 60 (Tensile strength 1200N/mm^2 or more) 8pcs.
   - Chemical anchors : M20 (Tensile strength 400N/mm^2 or more) 12pcs.
   - Base plates : Thickness 32t 4pcs.
   - Floor plate : Thickness 32t 1pcs.
3 Installation work (welding, anchoring, etc.) is prepared by the customer.
4 Flatness of robot installation surface must be less than or equal to 0.5mm.
Inclination of robot installation surface must be less than or equal to 0.5º.
If robot base is placed on uneven ground, it may result in the base breakage or low performance of the robot.

Fig. 10.2.1 (b) and Table 10.2.1 (a), (b) show the force and moment applied to the base plate at the time of emergency stop. Table 10.2.1 (c), (d) indicate the stopping distance and time of the J1 through J3 axes until the robot stopping by Power-Off stop or by Controlled stop after input of the stop signal. Refer to the data when considering the strength of the installation face.

NOTE
Stopping times and distances in Table 10.2.1 (c) and (d) are reference values measured in accordance with ISO 10218-1. Please measure and check the actual values, since it varies depending on robot individual, load condition and operation program. Stopping times and distances in Table 10.2.1 (c) are affected by the robot's operating status and the number of Servo-off stops. Please measure and check the actual values periodically.

Table 10.2.1 (a) Force and moment during emergency stop

Model	Vertical moment M_V [kNm (kgfm)]	Force in vertical direction F_V [kN (kgf)]	Horizontal moment M_H [kNm (kgfm)]	Force in horizontal direction F_H [kN (kgf)]
M-900*i*A/350	84.28 (8600)	53.90 (5500)	25.48 (2600)	32.34 (3300)
M-900*i*A/260L	94.08 (9600)	53.90 (5500)	34.30 (3500)	34.30 (3500)
M-900*i*A/150P	118.58 (12100)	49.00 (5000)	35.28 (3600)	40.18 (4100)

Table 10.2.1 (b) Force and moment applied during acceleration or deceleration

Model	Vertical moment M_V [kNm (kgfm)]	Force in vertical direction F_V [kN (kgf)]	Horizontal moment M_H [kNm (kgfm)]	Force in horizontal direction F_H [kN (kgf)]
M-900*i*A/350	34.30 (3500)	35.28 (3600)	9.80 (1000)	12.74 (1300)
M-900*i*A/260L	34.30 (3500)	33.32 (3400)	11.76 (1200)	11.76 (1200)
M-900*i*A/150P	39.20 (4000)	25.48 (2600)	10.78 (1100)	14.70 (1500)

Table 10.2.1 (c) Stopping time and distance until the robot stopping by power-off stop after input of stop signal

Model		J1-axis	J2-axis	J3-axis
M-900*i*A/350	Coasting time [ms]	739	260	251
	Coasting distance [deg] (rad)	36.0 (0.63)	13.9 (0.24)	10.8 (0.19)
M-900*i*A/260L	Coasting time [ms]	754	193	373
	Coasting distance [deg] (rad)	33.3 (0.58)	10.5 (0.18)	15.6 (0.27)
M-900*i*A/150P	Coasting time [ms]	892	188	276
	Coasting distance [deg] (rad)	43.8(0.76)	10.5(0.18)	12.8(0.22)

Table 10.2.1 (d) Stopping time and distance until the robot stopping by controlled stop after input of stop signal

Model		J1-axis	J2-axis	J3-axis
M-900*i*A/350	Coasting time [ms]	768	708	718
	Coasting distance [deg] (rad)	44.1 (0.77)	36.5 (0.64)	35.8 (0.62)
M-900*i*A/260L	Coasting time [ms]	826	432	514
	Coasting distance [deg] (rad)	46.1 (0.80)	25.0 (0.44)	20.8 (0.36)
M-900*i*A/150P	Coasting time [ms]	972	956	956
	Coasting distance [deg] (rad)	55.4 (0.97)	48.4 (0.84)	42.9 (0.75)

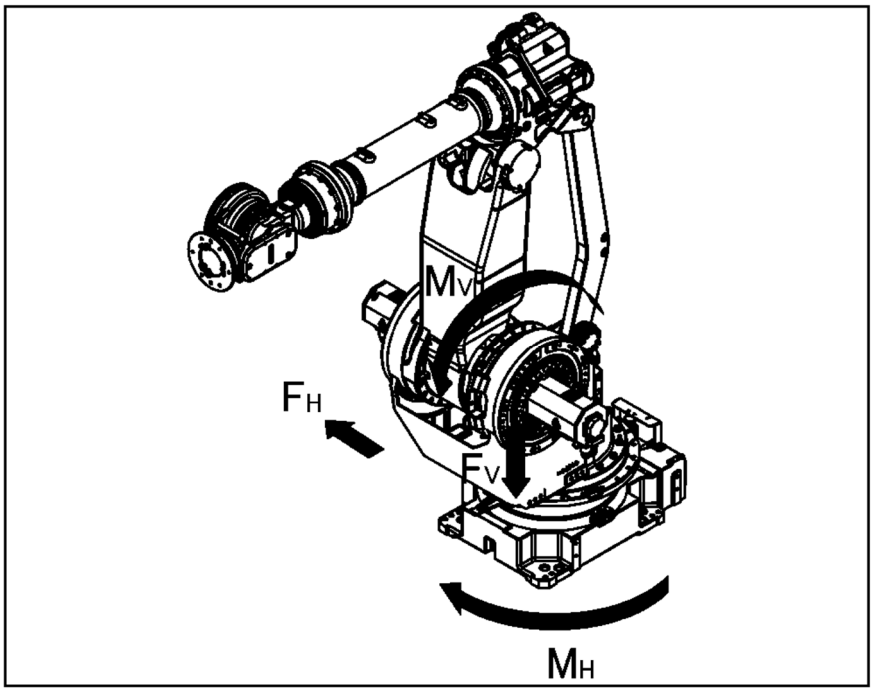
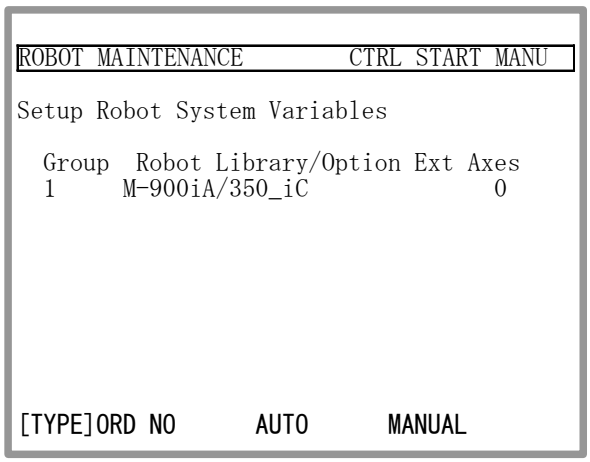


Fig. 10.2.1 (b) Force and moment to the robot base

10.2.2 Angle of Mounting Surface Setting

For all robot mounts except floor mount, be sure to set the mounting angle referring to the procedure below. Refer to Section 3.1 for installation specifications.

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



4 Press [F4] key.

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

```
*******Group 1 Initialization***********
*************M-900iA/350_iC***************


--- MOUNT ANGLE SETTING ---

  0 [deg] : floor mount type
 90 [deg] : wall mount type
180 [deg] : upside-down mount type

Set mount_angle (0-180[deg])->
Default value = 0
```

6 Input the mount angle referring to Fig. 10.2.2 (a).

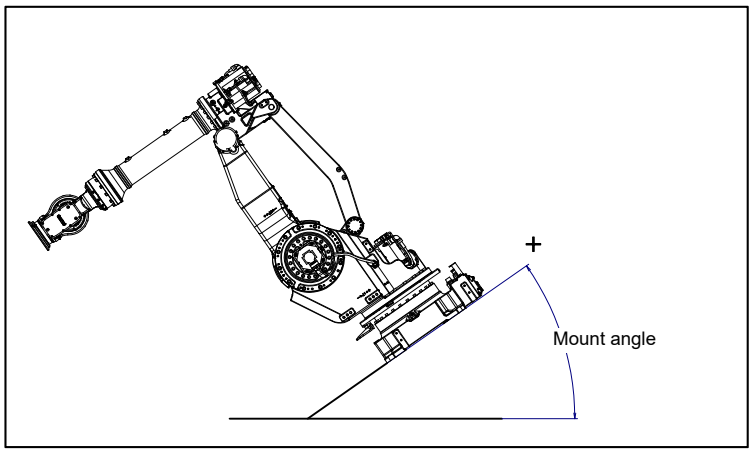


Fig. 10.2.2 (a) Mounting angle

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

```
ROBOT MAINTENANCE          CTRL START MANU

Setup Robot System Variables

  Group  Robot Library/Option Ext Axes
  1      M-900iA/350_iC              0









[TYPE]ORD NO       AUTO       MANUAL
```

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

10.3 MAINTENANCE AREA

Fig. 10.3 (a), (b) show the maintenance area of the mechanical unit. Be sure to leave enough room for the robot to be mastered.

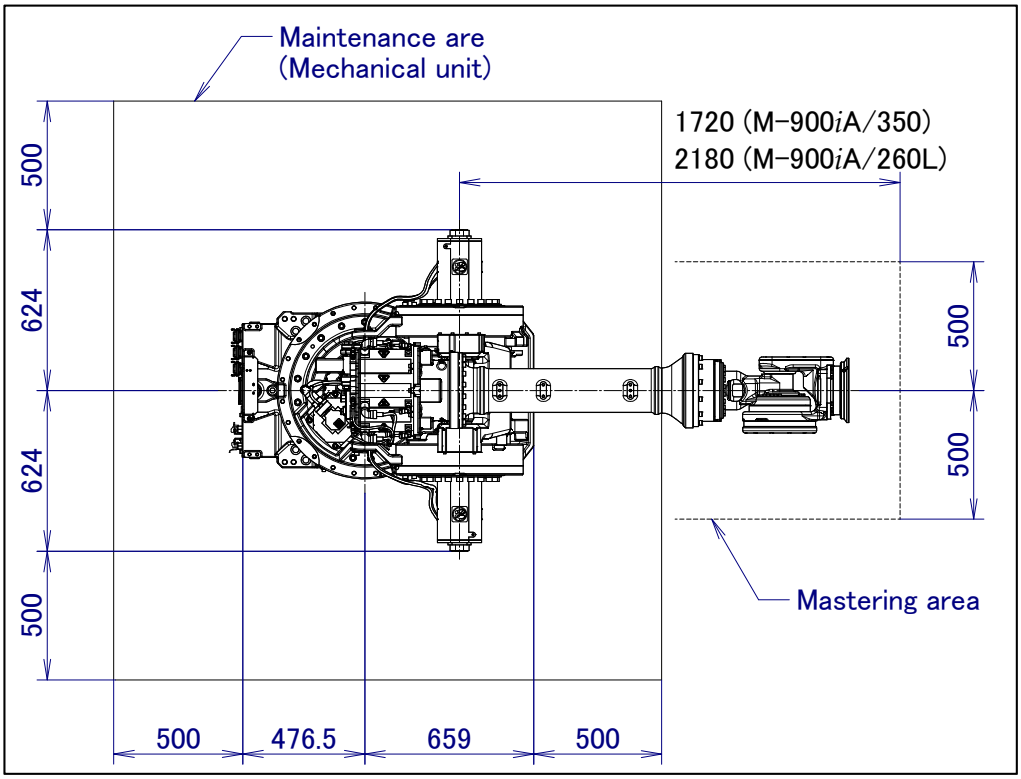


Fig. 10.3 (a) Maintenance area (M-900*i*A/350/260L)

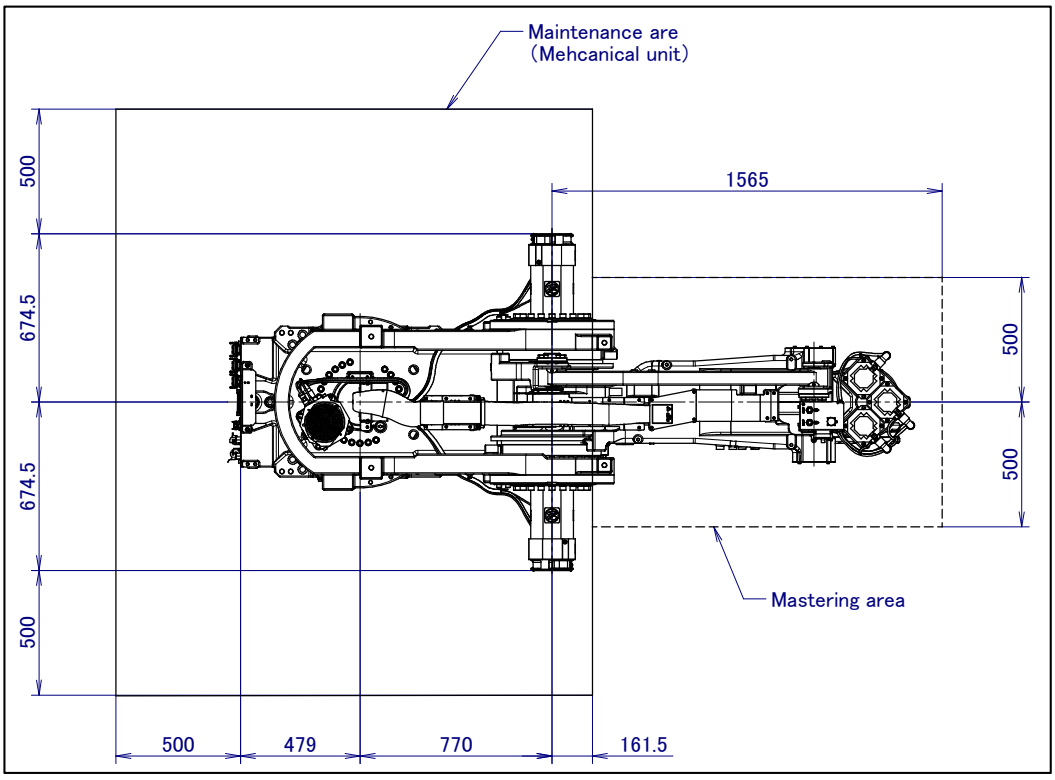


Fig. 10.3 (b) Maintenance area (M-900*i*A/150P)

10.4 AIR PIPING (OPTION)

Fig. 10.4 (a) shows how to connect air hose to the robot. If the air control set is specified as an option, the air hose between the mechanical unit and the air control set is provided. Mount the air control set using the information in Fig. 10.4 (b).

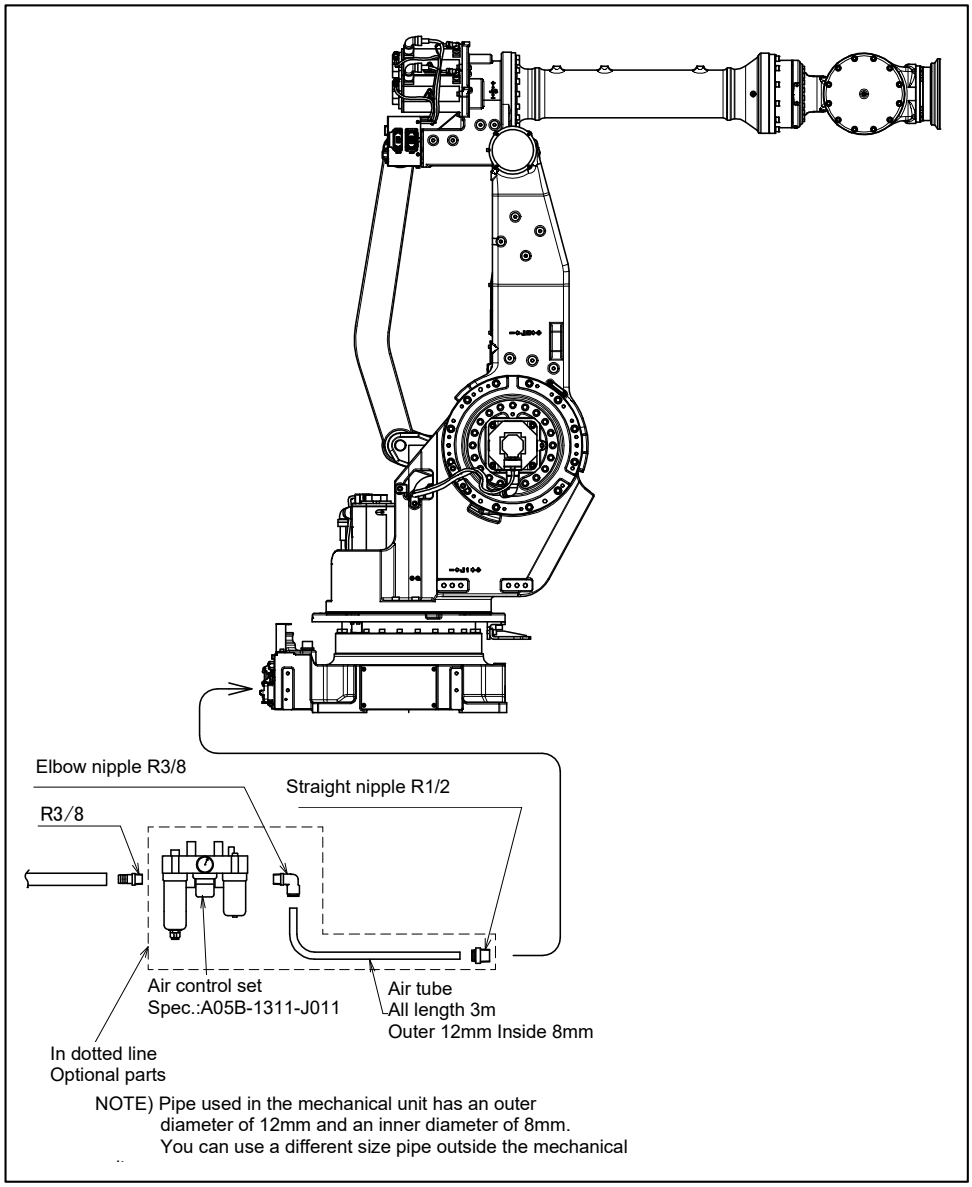


Fig. 10.4 (a) Air piping option

Air control set

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

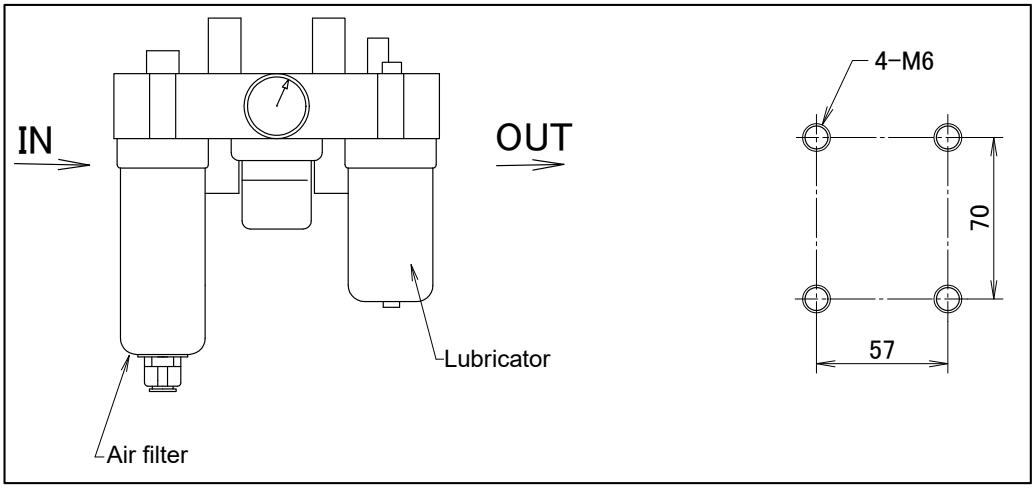


Fig. 10.4 (b) Air control set option (option)

10.5 INSTALLATION CONDITIONS

Refer to specification of “PREFACE” about installation conditions.

10.6 STORAGE

When storing the robot, place it on a level surface with the same posture that was used for transportation. (See 10.1)

11 CONNECTION WITH THE CONTROLLER

The robot is connected with the controller via the power cable, the signal cable and the earth cable. Connect these cables to the connectors on the back of the robot base. For details on air and option cables, see Chapter 9.

> ⚠ **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.

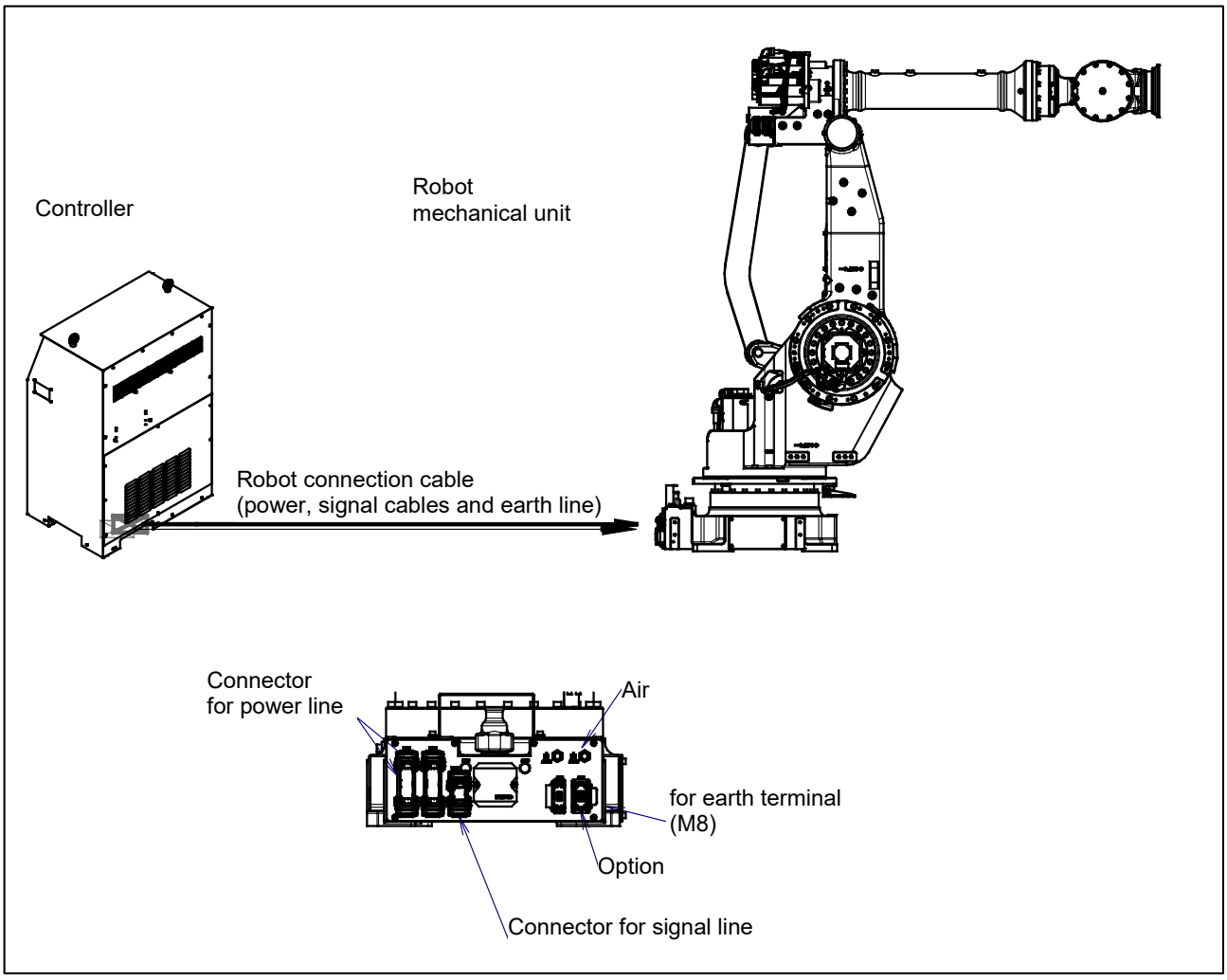


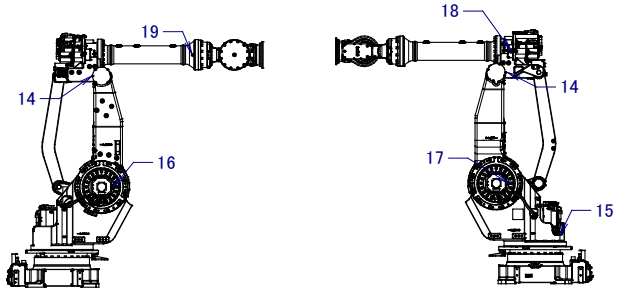
Fig. 11 (a) Cable connection

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot M-900*i*A/350/260L Periodic Maintenance Table

Items			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 for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protective sleeves	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check wear debris of J1-axis swing stopper	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	4	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	5	Check damages of the mechanical unit cable (movable part)	0.2H	—		○			○				○			
	6	Check damage of the end effector (hand) cable	0.1H	—		○			○				○			
	7	Check the motor connector (loosening)	0.2H	—		○			○				○			
	8	Retightening the end effector mounting bolts	0.2H	—		○			○				○			
	9	Retightening the External main bolts	2.0H	—		○			○				○			
	10	Check the fixed mechanical stopper and the adjustable mechanical stopper	0.1H	—		○			○				○			
	11	Clean spatters, sawdust and dust	1.0H	—		○			○				○			
	12	Check the operation of the cooling fan	0.1H	—		○			○				○			
	13	Replacing the mechanical unit Batteries *1 *3	0.1H	—							●					
	14	Greasing of J2/J3-axis connection part bearing *1	0.1H	Each 20ml												
	15	Replacing grease of J1-axis reducer *1	1.0H	8000ml												
	16	Replacing grease of J2-axis reducer *1	0.5H	3400ml												
	17	Replacing grease of J3-axis reducer *1	0.5H	3100ml												
	18	Replacing grease of J4/-axis gearbox *1	0.5H	2200ml												
	19	Replacing grease of wrist (J5/J6) axis reducer *1	1.0H	5750ml												
	20	Replacing cable of mechanical unit *1	4.0H	—												
Controller	21	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	22	Check damages of the teach pendant cable, the operation box connection cable and the robot connection cable	0.2H	—		○			○				○			
	23	Replacing battery *1 *3	0.1H	—												



Greasing point

*1 Refer to “REPLACING UNITS Chapter of MAINTENANCE ” of the following manuals.
R-J3*i*B CONTROLLER MAINTENANCE MANUAL (Standard) (B-81465EN),
R-J3*i*B CONTROLLER MAINTENANCE MANUAL (For Europe) (B-81465EN-1),
R-J3*i*B CONTROLLER MAINTENANCE MANUAL (For RIA) (B-81505EN),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (Standard) (B-82595EN),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For Europe) (B-82595EN-1),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For RIA) (B-82595EN-2),
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),

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

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

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		3
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		4
○				○				○				○				○					5
○				○				○				○				○					6
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○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		21
○				○				○				○				○					22
				●																	23

Overhaul

FANUC Robot M-900*i*A/150P Periodic Maintenance Table

Items			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 for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protective sleeves	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check wear debris of J1-axis swing stopper	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	4	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	5	Check damages of the mechanical unit cable (movable part)	0.2H	—		○			○				○			
	6	Check damage of the end effector (hand) cable	0.1H	—		○			○				○			
	7	Check the motor connector (loosening)	0.2H	—		○			○				○			
	8	Retightening the end effector mounting bolts	0.2H	—		○			○				○			
	9	Retightening the External main bolts	2.0H	—		○			○				○			
	10	Check the fixed mechanical stopper and the adjustable mechanical stopper	0.1H	—		○			○				○			
	11	Clean spatters, sawdust and dust	1.0H	—		○			○				○			
	12	Check the operation of the cooling fan	0.1H	—		○			○				○			
	13	Replacing the mechanical unit Batteries *1 *3	0.1H	—							●					
	14	Greasing of J2/J3-axis connection part bearing *1	0.1H	Each 20ml					●				●			
	15	Replacing grease of J1-axis reducer *1	1.0H	8000ml					●				●			
	16	Replacing grease of J2-axis reducer *1	0.5H	3100ml					●				●			
	17	Replacing grease of J3-axis reducer *1	0.5H	3100ml					●				●			
	18	Replacing grease of J4/-axis gearbox *1	0.5H	2200ml					●				●			
	19	Replacing grease of wrist (J5/J6) axis reducer *1	1.0H	5750ml					●				●			
	20	Replacing cable of mechanical unit *1	4.0H	—												
Controller	21	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	22	Check damages of the teach pendant cable, the operation box connection cable and the robot connection cable	0.2H	—		○			○				○			
	23	Replacing battery *1 *3	0.1H	—												

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

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

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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
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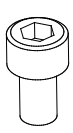
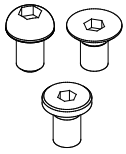
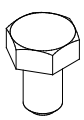
○				○				○				○				○					11
○				○				○				○				○					12
●						●						●						●		Overhaul	13
●				●				●				●				●					14
●				●				●				●				●					15
●				●				●				●				●					16
●				●				●				●				●					17
●				●				●				●				●					18
●				●				●				●				●					19
				●																	20
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		21
○				○				○				○				○					22
				●																	23

B STRENGTH OF BOLT AND BOLT TORQUE LIST

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

Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:
Size M22 or less: Tensile strength 1200N/mm^2 or more
Size M24 or more: Tensile strength 1000N/mm^2 or more
All size plated bolt: Tensile strength 1000N/mm^2 or more
Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)
Tensile strength 400N/mm^2 or more
Refer to the following tables if the bolts tightening torque is not specified.

Recommended bolt tightening torques **Unit: Nm**

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

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REVISION RECORD

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