FANUC Robot M-20*i*B

MECHANICAL UNIT
OPERATOR'S MANUAL

B-83754EN/03

- **Original Instructions**

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

SAFETY PRECAUTIONS

This chapter must be read before using the robot.

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

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

1 DEFINITION OF USER

The personnel can be classified as follows.

Operator:
- Turns the robot controller power on/off
- Starts the robot program from operator panel

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

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

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

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

Table 1 List of work outside the fence

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

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

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

2 DEFINITION OF SAFETY NOTATIONS

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

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

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

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

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

Name	Specification
Brake release unit	A05B-2450-J350 (Input voltage AC100-115V single phase) A05B-2450-J351 (Input voltage AC200-240V single phase)
Robot connection cable	A05B-2525-J047 (5m) A05B-2525-J048 (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 neither in compliance with EN ISO 10218-1 nor with the Machinery Directive and therefore cannot bear the CE marking.

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

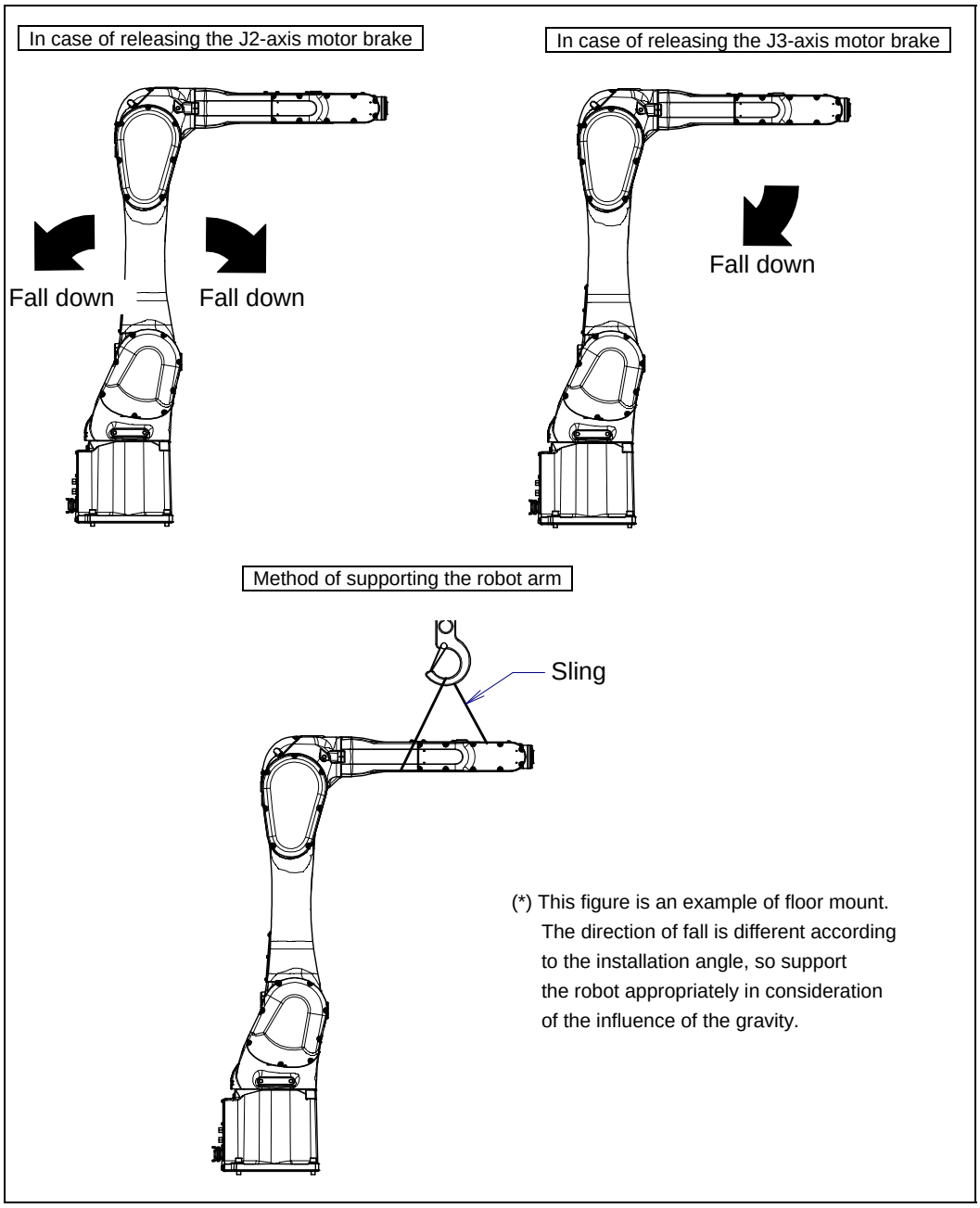


Fig. 3 Arm operation by the release of J2/J3-axis motor brake and measures

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) Open the grease outlet at greasing.
(2) Use a hand pump at greasing.
(3) Use designated grease at greasing.

> ⚠ **CAUTION**
> See Subsection 7.3.2 and 7.3.3 for explanations about specified grease, the grease amount, and the locations of grease inlets and outlets for individual models.

(2) Step-on prohibitive label

Fig. 4 (b) Step-on prohibitive label

Description

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

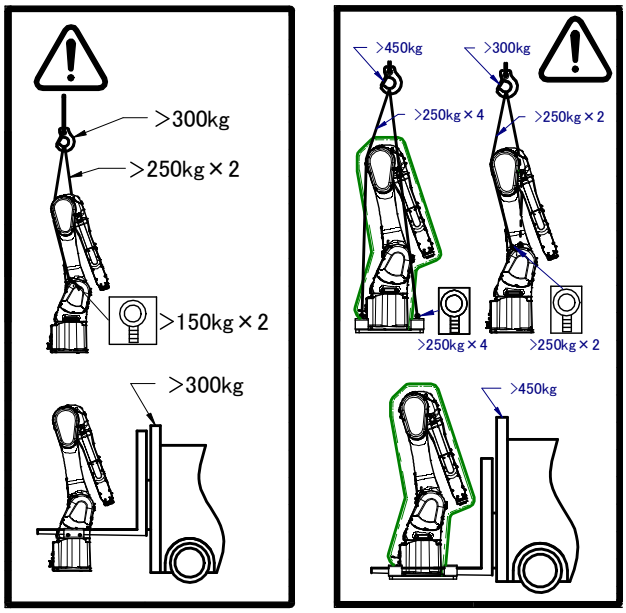
(3) High-temperature warning label

Fig. 4 (c) High-temperature warning label

Description

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

(4) Transportation label



M-20*i*B/25/35S **M-20*i*B/25C**

Fig. 4 (d) Transportation label

Description

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

For M-20*i*B/25/35S

(1) Using a crane
- Use a crane with a load capacity of 300kg or greater.
- Use two slings with each load capacity of 250 kg or greater. In this case, please intersect and hang two slings as shown in figure.
- Use two M12 eyebolts with each load capacity of 1470 N (150 kgf) or greater.

(2) Using a forklift
- Use a forklift with a load capacity of 300kg or greater.

For M-20*i*B/25C

(1) Using a crane

With an antistatic sheet
- Use a crane with a load capacity of 450kg or greater.
- Use four slings with each load capacity 250 kg or greater, sling the robot as shown Chapter 1 of operator's manual.
- Use four M12 eyebolts with each allowable load of 2450 N (250 kgf) or greater.

Without an antistatic sheet
- Use a crane with a load capacity of 300kg or greater.
- Use two slings with each load capacity of 250 kg or greater. In this case, please intersect and hang two slings as shown in figure.
- Use two M12 eyebolts with each allowable load of 1470 N (150 kgf) or greater.

(2) Using a forklift
- Use a forklift with a load capacity of 450kg or greater.

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

(5) Transportation prohibitive label (When transport equipment option A05B-1226-H072 is specified.)

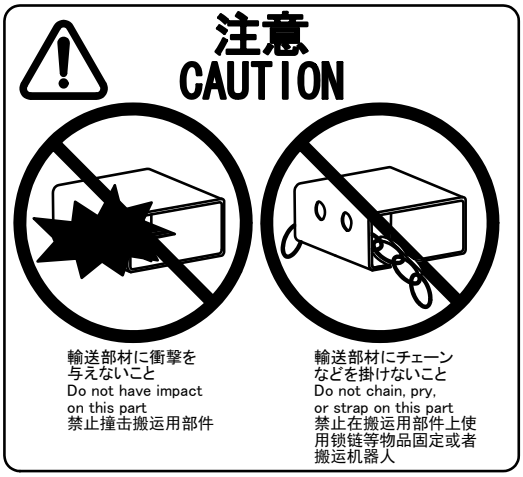


Fig. 4 (e) Transportation prohibitive label

Description

Keep the following in mind when transporting the robot.

(1) Prevent the forks of the forklift from having impact on a transport equipment

(2) Do not thread a chain or the like through transport equipment.

(6) Greasing label (if greasing kit A05B-1226-K031, K033 are specified)

M-20*i*B/25/35S M-20*i*B/25C

Fig. 4 (f) Greasing label

Description

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

1) Before filling the cylinder with grease from tube, squeeze the tube to make the grease in it soft.

2) Pushing in the plunger by 2.5 mm causes a grease of 1 ml to be pushed out.

(7) Installation label

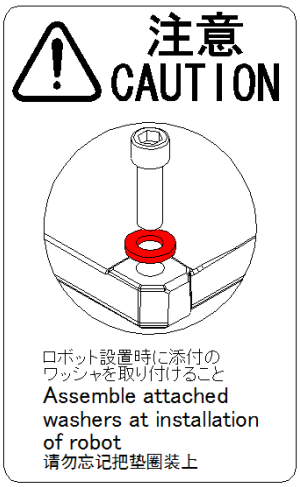


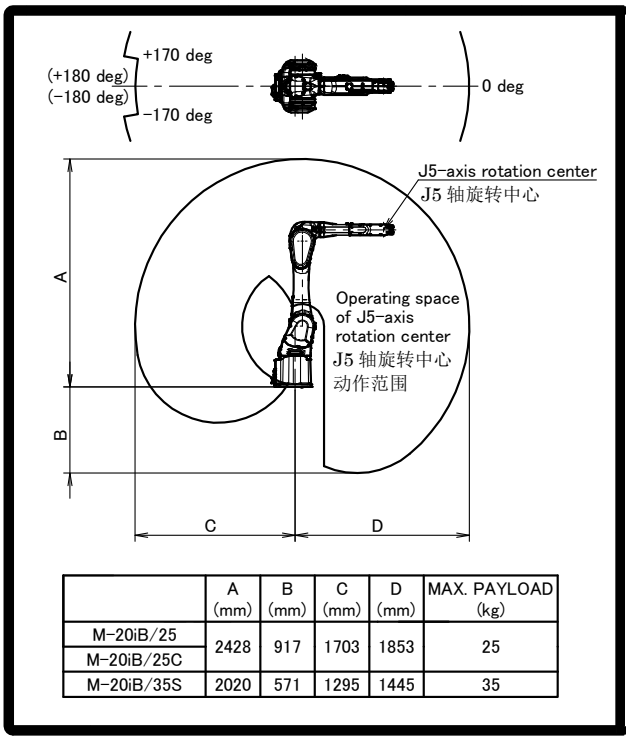
Fig. 4 (g) Installation label

Description

Assemble attached washers at installation of robot.

(8) Operating space and payload label

Below label is added when CE specification is specified.



	A (mm)	B (mm)	C (mm)	D (mm)	MAX. PAYLOAD (kg)
M−20iB/25	2428	917	1703	1853	25
M−20iB/25C					
M−20iB/35S	2020	571	1295	1445	35

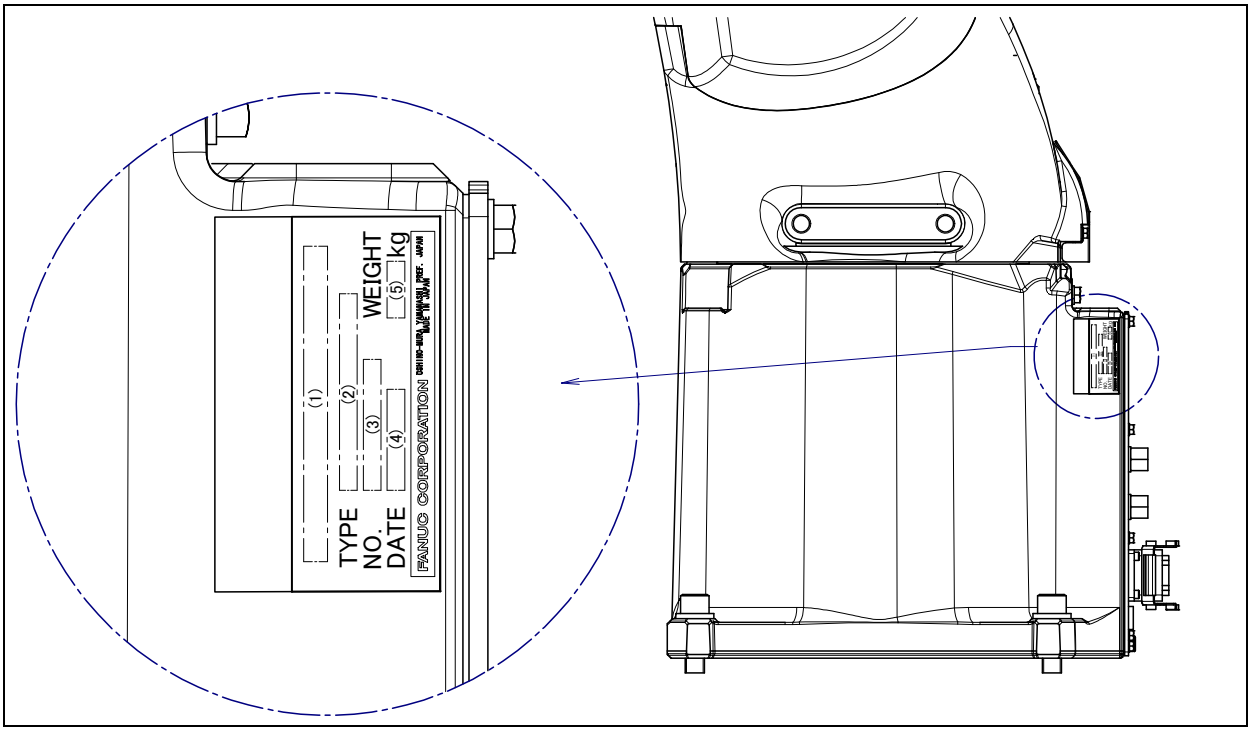
Fig. 4 (h) Operating space and payload label

PREFACE

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

Model name	Mechanical unit specification No.	Maximum load
FANUC Robot M-20*i*B/25	A05B-1226-B201	25kg
FANUC Robot M-20*i*B/35S	A05B-1226-B211	35kg
FANUC Robot M-20*i*B/25C	A05B-1226-B221	25kg

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



Position of label indicating mechanical unit specification number

TABLE 1)

	(1)	(2)	(3)	(4)	(5)
CONTENTS	**Model name**	**TYPE**	**No.**	**DATE**	**WEIGHT kg (Without controller)**
LETTERS	FANUC Robot M-20*i*B/25	A05B-1226-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	210
	FANUC Robot M-20*i*B/35S	A05B-1226-B211			205
	FANUC Robot M-20*i*B/25C	A05B-1226-B221			210

RELATED MANUALS

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

SAFETY HANDBOOK **B-80687EN** All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers: Operator ,system designer Topics: Safety items for robot system design, operation, maintenance
R-30*i*B/ **R-30*i*B Mate/** **R-30*i*B Plus/** **R-30*i*B Mate Plus** **controller**	OPERATOR'S MANUAL (Basic Operation) **B-83284EN** OPERATOR'S MANUAL (Alarm Code List) **B-83284EN-1** OPERATOR'S MANUAL (Optional Function) **B-83284EN-2** ARC WELDING FUNCTION OPERATOR'S MANUAL **B-83284EN-3** Spot WELDING FUNCTION OPERATOR'S MANUAL **B-83284EN-4** DISPENSE FUNCTION OPERATOR'S MANUAL **B-83284EN-5**	Intended readers: Operator, programmer, maintenance engineer, system designer Topics: Robot functions, operations, programming, setup, interfaces, alarms Use: Robot operation, teaching, system design
	MAINTENANCE MANUAL **R-30*i*B, R-30*i*B Plus:** **B-83195EN** **R-30*i*B Mate, R-30*i*B Mate Plus:** **B-83525EN**	Intended readers: Maintenance engineer, system designer Topics: Installation, connection to peripheral equipment, maintenance Use: Installation, start-up, connection, maintenance

This manual uses following terms.

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

TABLE OF CONTENTS

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

Use a crane or a forklift to transport the robot. When transporting the robot, be sure to change the posture of the robot to that shown below and lift by using the eyebolts and the transport equipment at their points.

> ⚠ **CAUTION**
> When hoisting or lowering the robot with a crane or forklift, move it slowly, and with great care. When placing the robot on the floor, exercise care to prevent the installation surface of the robot from striking the floor.

> ⚠ **WARNING**
> 1 Robot becomes unstable when it is transported with the end effector or equipment is installed, and it is dangerous. Make sure to remove end effector when robot is transported. (Except light cargo such as welding torch or wire feeder)
> 2 Employ the transport equipment only for the transportation means. Fixing the robot with the transport equipment is prohibited.
> 3 Before moving the robot by using crane, check and tighten any loose bolts on the forklift pockets.
> 4 Do not pull eyebolts sideways.

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

1) Transportation using a crane (Fig. 1.1 (a) to (e))
Fasten the M12 eyebolts to the two points of the robot base and lift the robot by the two slings. In this case, please intersect and hang two Slings as shown in figure.

> ⚠ **CAUTION**
> When lifting the robot, be careful not to damage motors, connectors, or cables of the robot by slings.

2) Transporting the robot with a forklift (Fig. 1.1 (f) to (j))
When transporting a robot with a forklift, use special transport equipment. Transport equipment is prepared as the option.

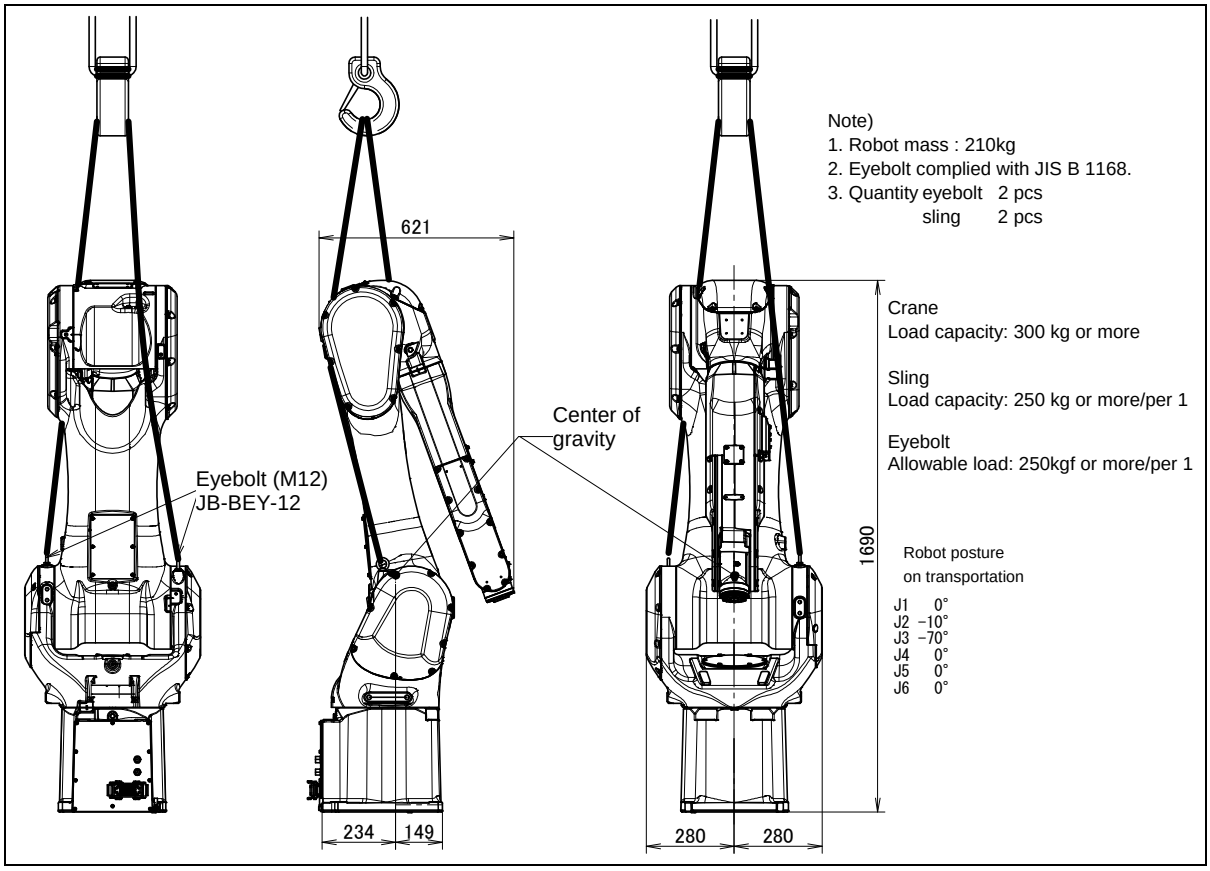


Fig. 1.1 (a) Transportation using a crane (M-20*i*B/25 back side connector plate)

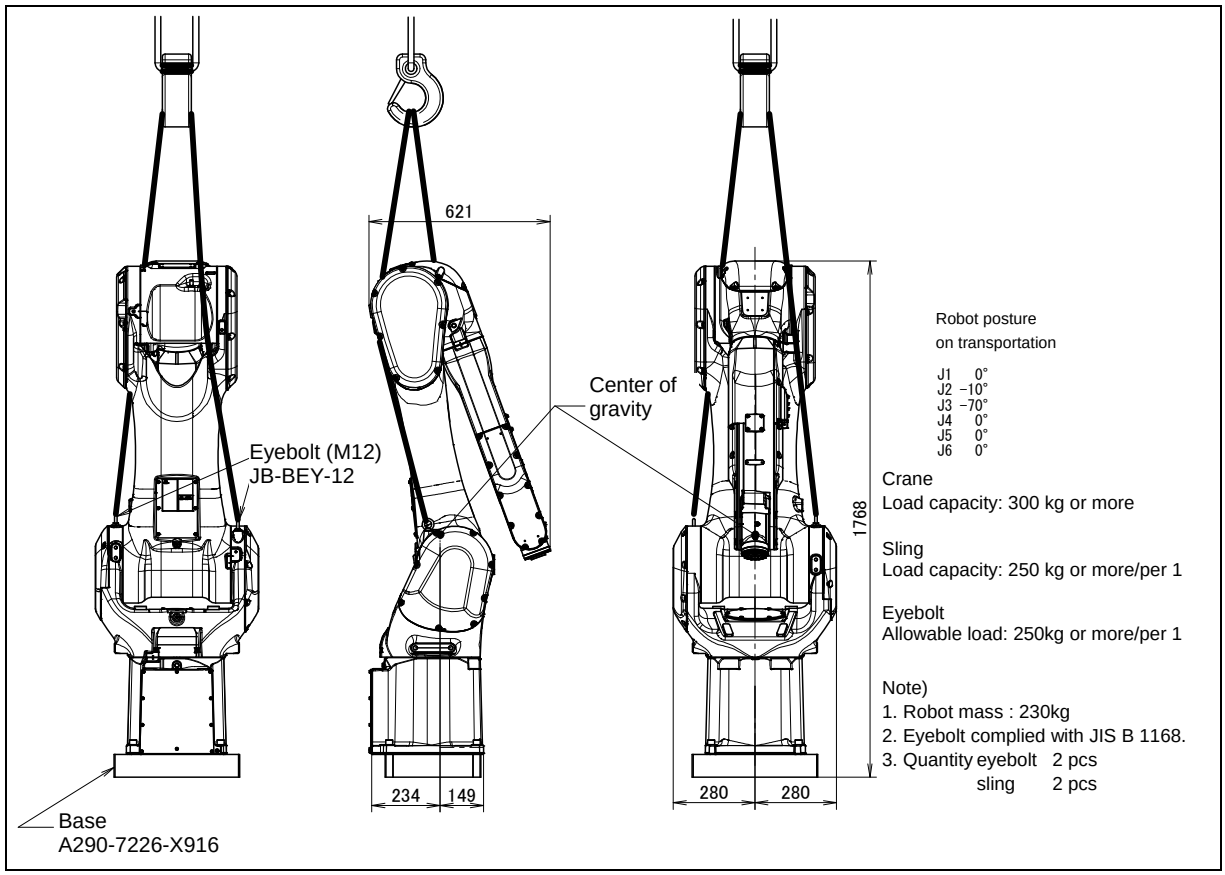


Fig. 1.1 (b) Transportation using a crane (M-20*i*B/25 bottom connector plate)

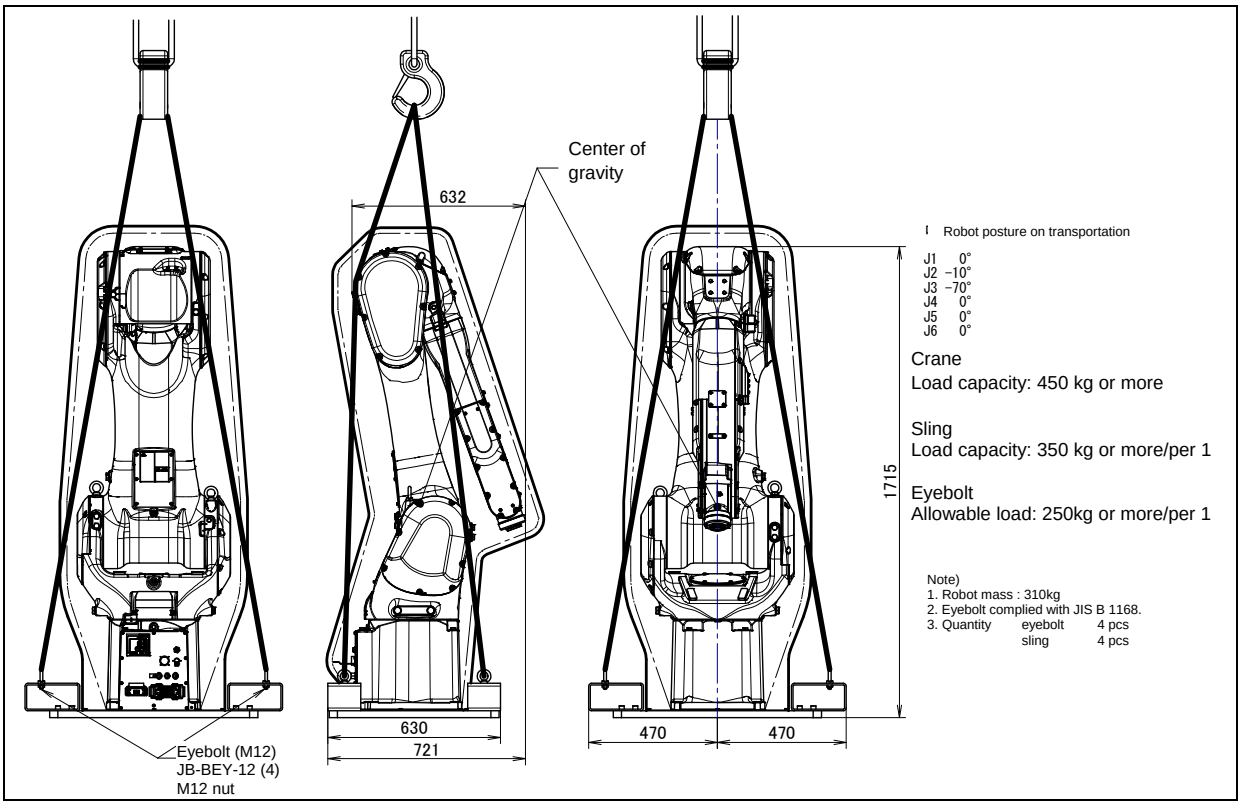


Fig. 1.1 (c) Transportation using a crane (M-20*i*B/25C)

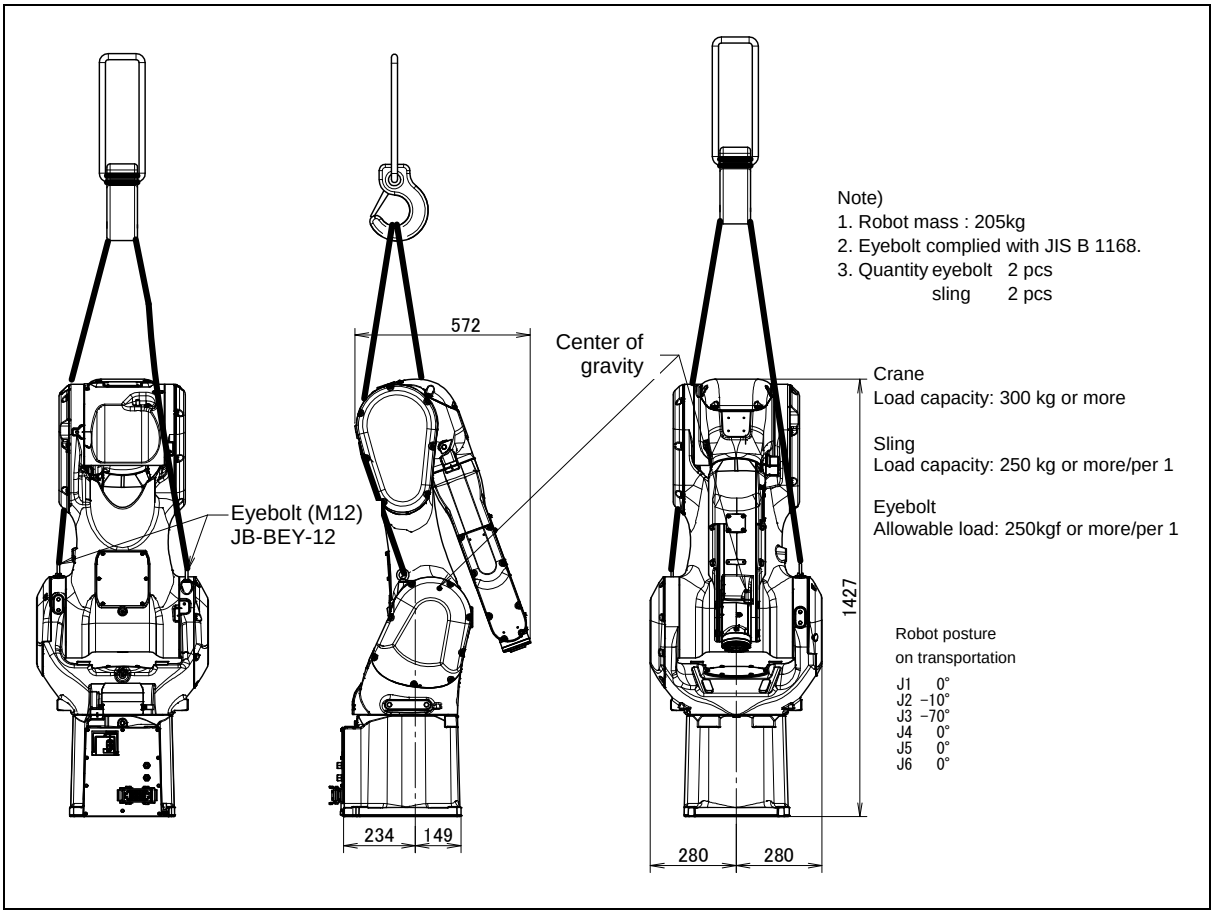


Fig. 1.1 (d) Transportation using a crane (M-20*i*B/35S back side connector plate)

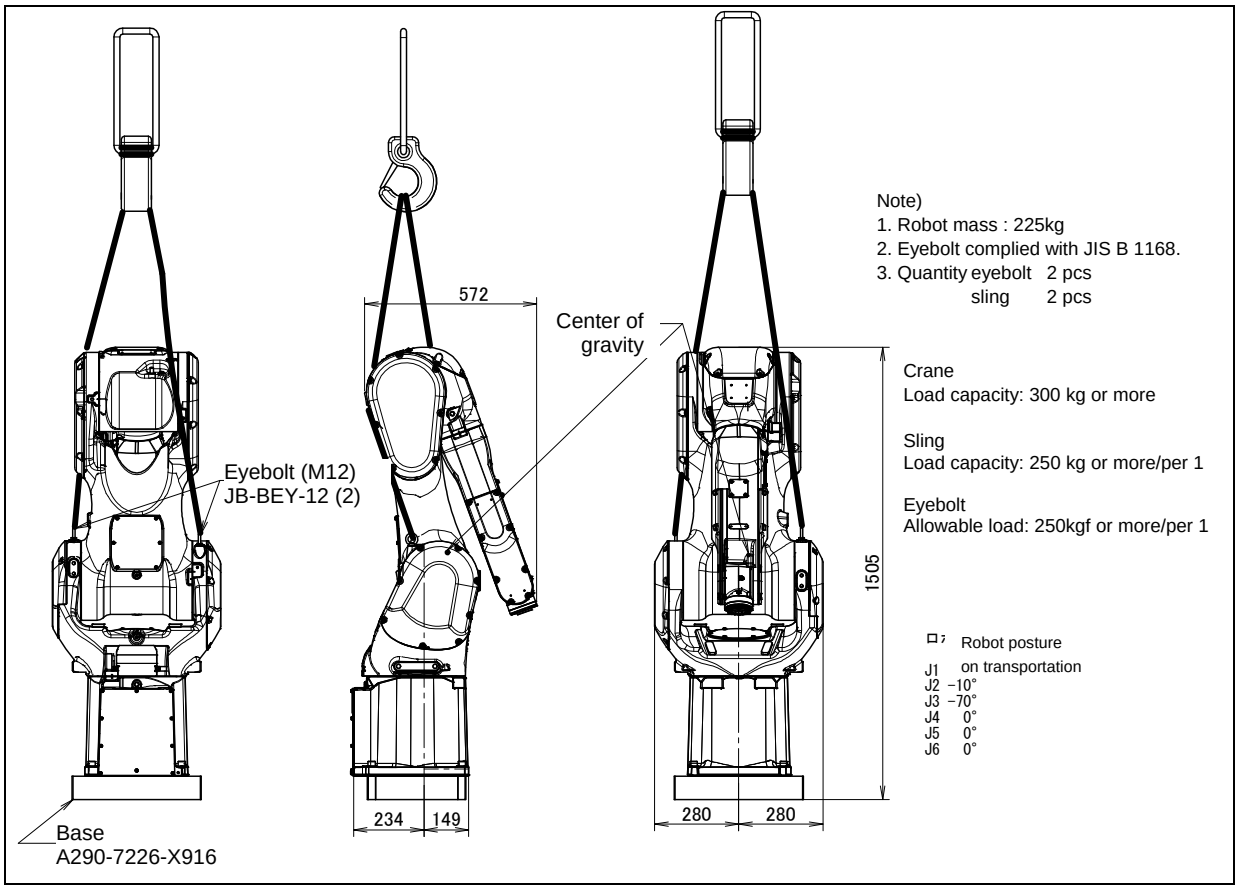


Fig. 1.1 (e) Transportation using a crane (M-20*i*B/35S bottom side connector plate)

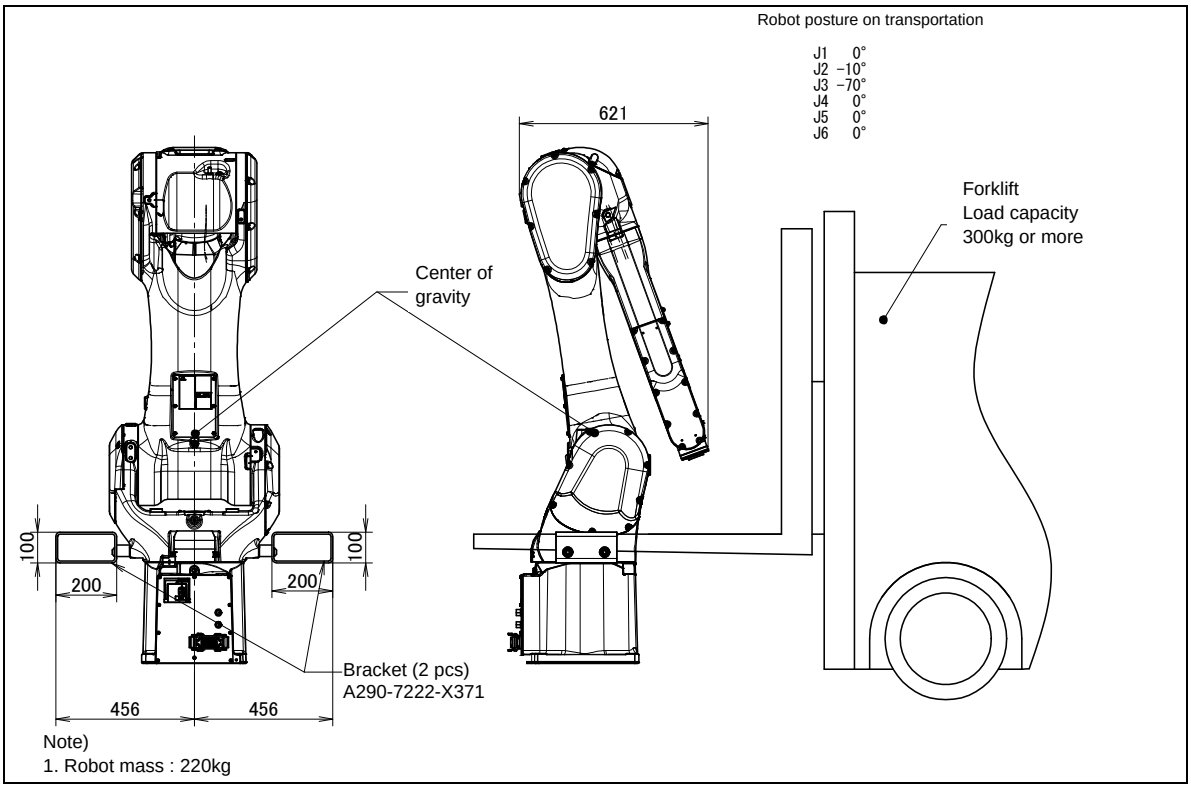


Fig. 1.1 (f) Transportation using a forklift (M-20*i*B/25 back side connector plate)

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

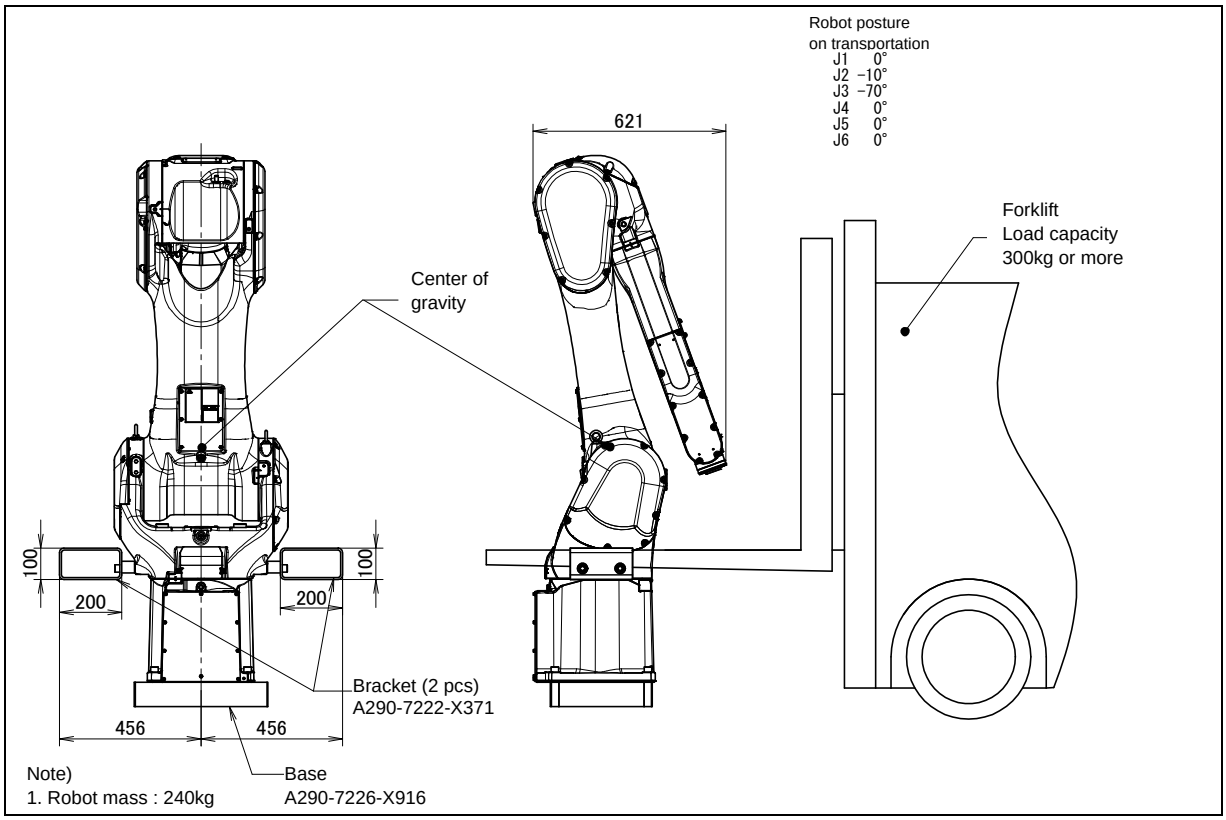


Fig. 1.1 (g) Transportation using a forklift (M-20*i*B/25 bottom side connector plate)

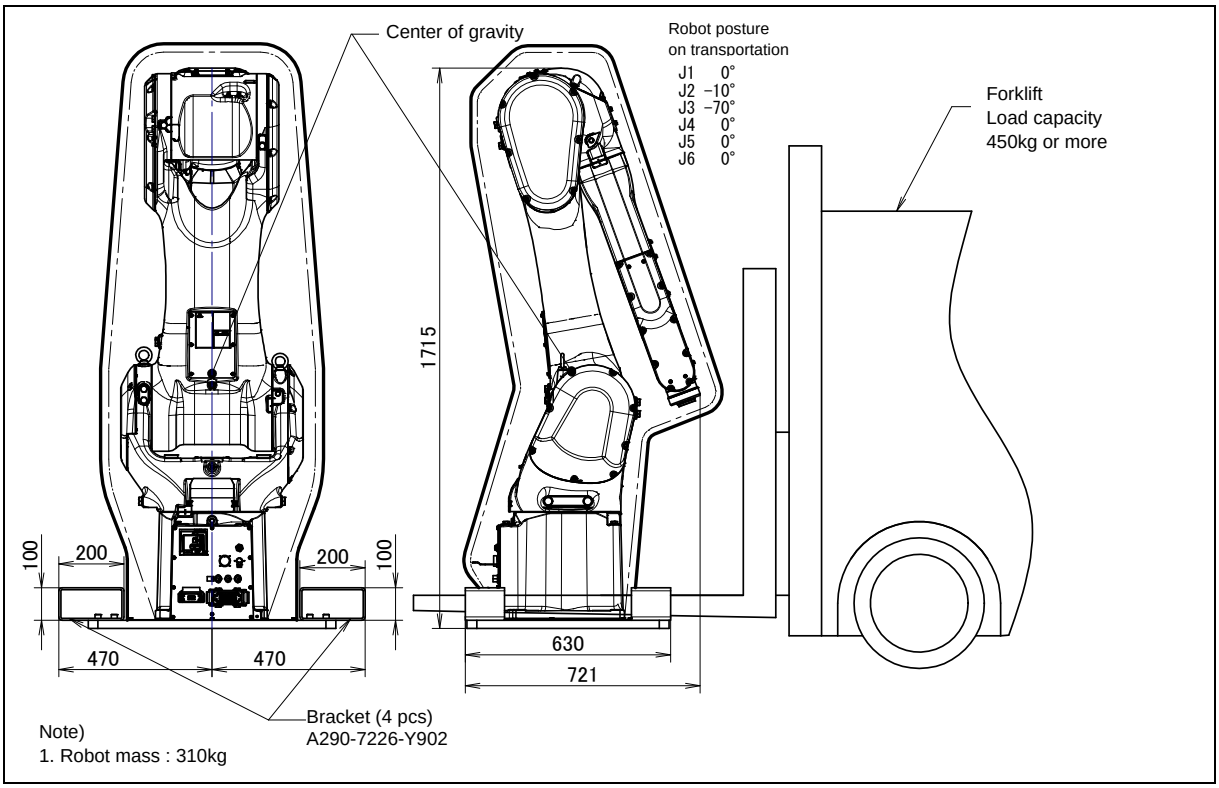


Fig. 1.1 (h) Transportation using a forklift (M-20*i*B/25C)

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

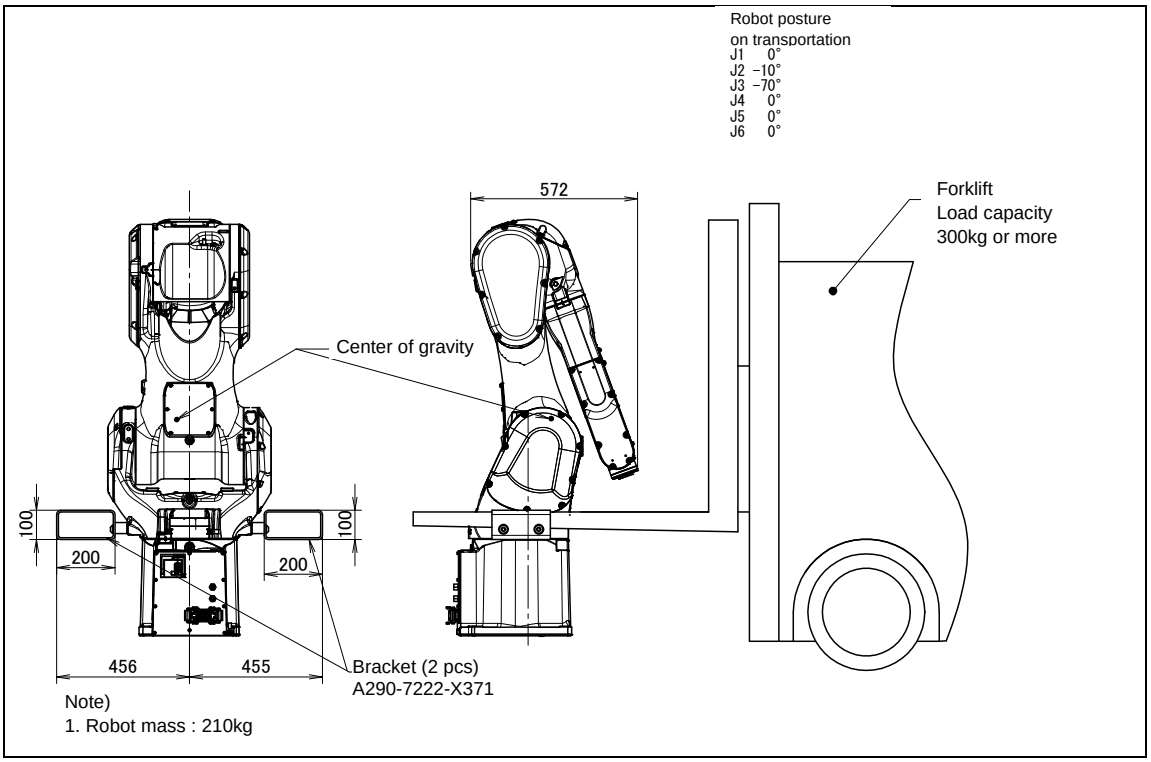


Fig. 1.1 (i) Transportation using a forklift (M-20*i*B/35S back side connector plate)

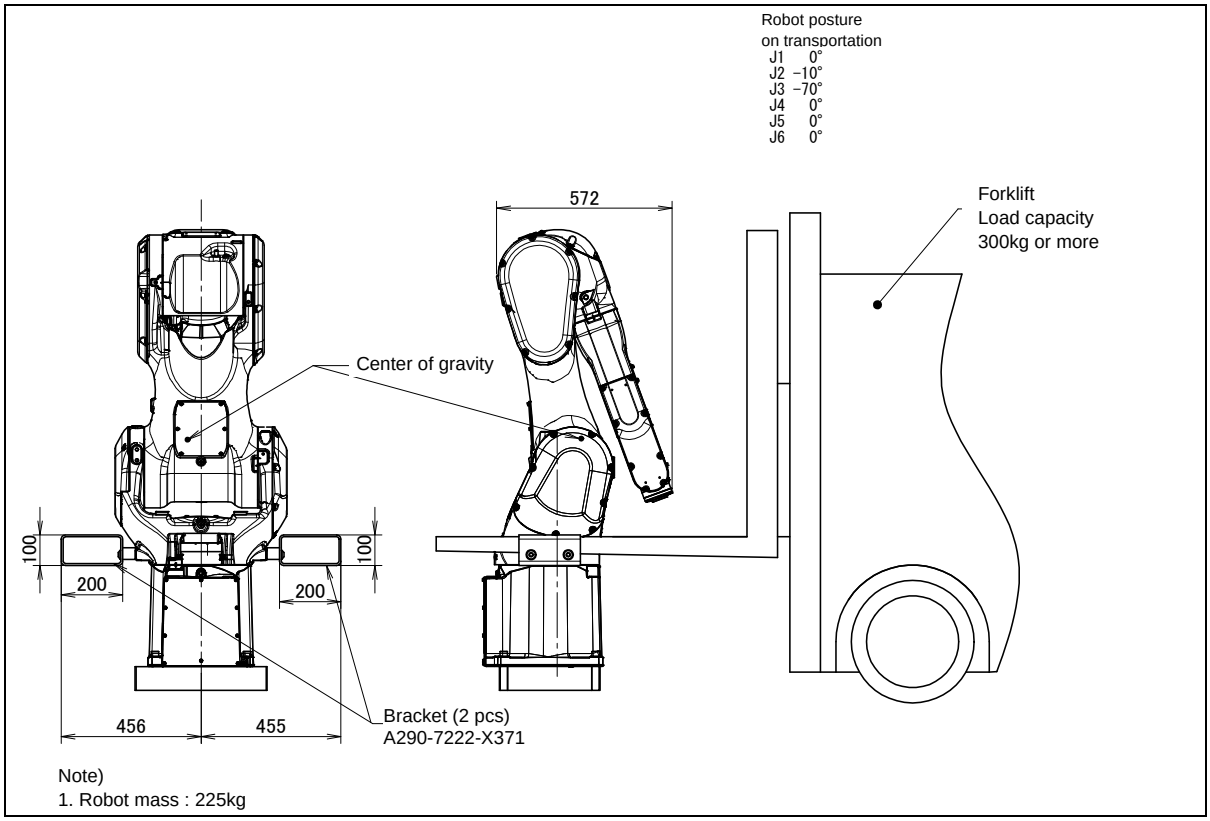


Fig. 1.1 (j) Transportation using a forklift (M-20*i*B/35S bottom side connector plate)

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

NOTE
About the M-20*i*B/25C
1 Before shipment of the M-20*i*B/25C, it is cleaned in a clean room, covered with an antistatic sheet, then packed as shown in Fig. 1.1 (c).
2 The transport plate can be used as a roll–over prevention plate in a clean room. If the plate is cleaned before being carried in a clean room, it can be carried in the room together with the robot.
3 The antistatic sheet can be removed in a clean room.
4 When installing the robot, use the eyebolts to lift it as shown Fig. 1.1 (c).
5 Once the robot has been installed, remove the eyebolts from it.
6 After transportation, be sure to fix it as described in Section 1.2.

1.2 INSTALLATION

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

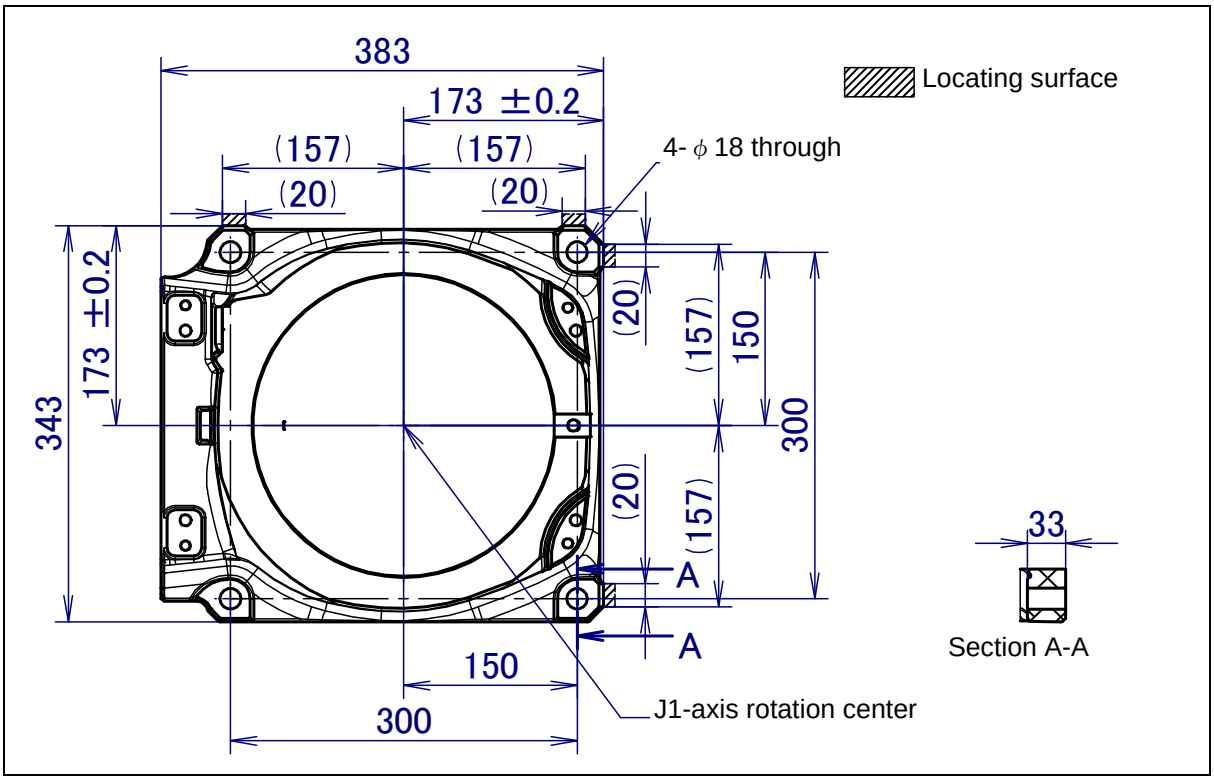


Fig. 1.2 (a) Dimensions of the robot base (back side connector plate)

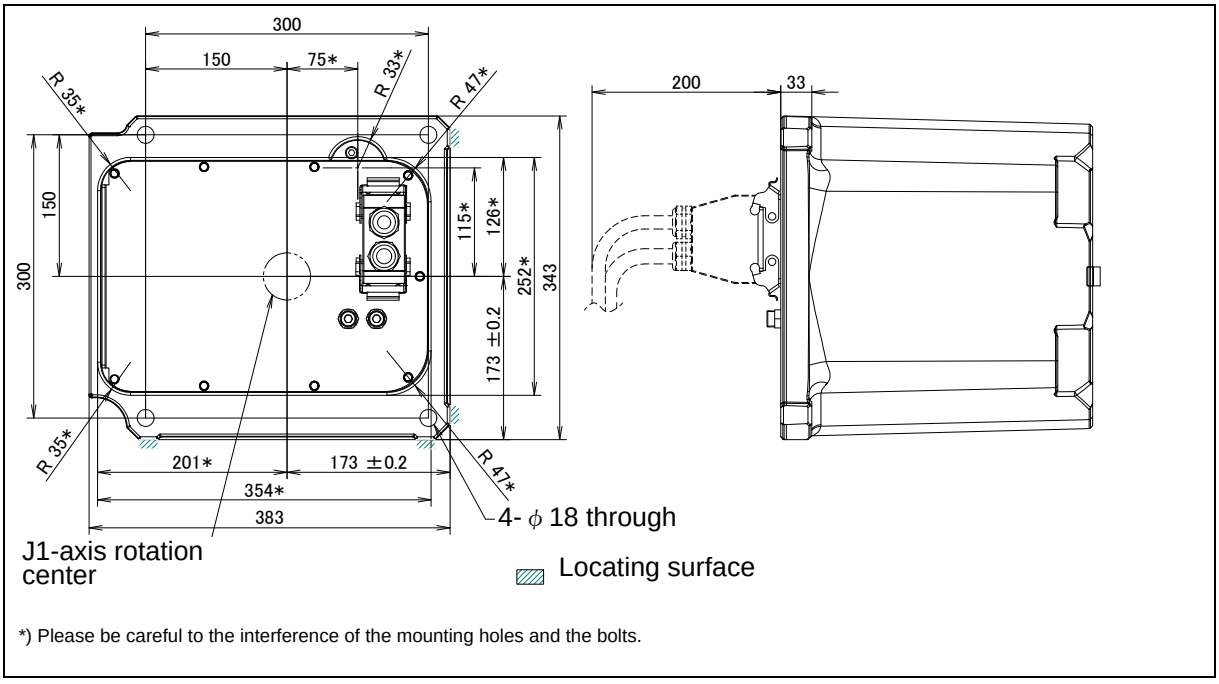


Fig. 1.2 (b) Dimensions of the robot base (bottom connector plate)

1.2.1 Installation Method

Fig. 1.2.1 (a) shows an example of installing the robot. In this example, the floor plate is fixed with four M20 chemical anchors (tensile strength 400N/mm^2 or more), and the robot base is fastened to the floor plate with four M16 x 65 bolts (tensile strength 1200N/mm^2 or more). If compatibility must be maintained in teaching the robot after the robot mechanical unit is replaced, use the locating surface.

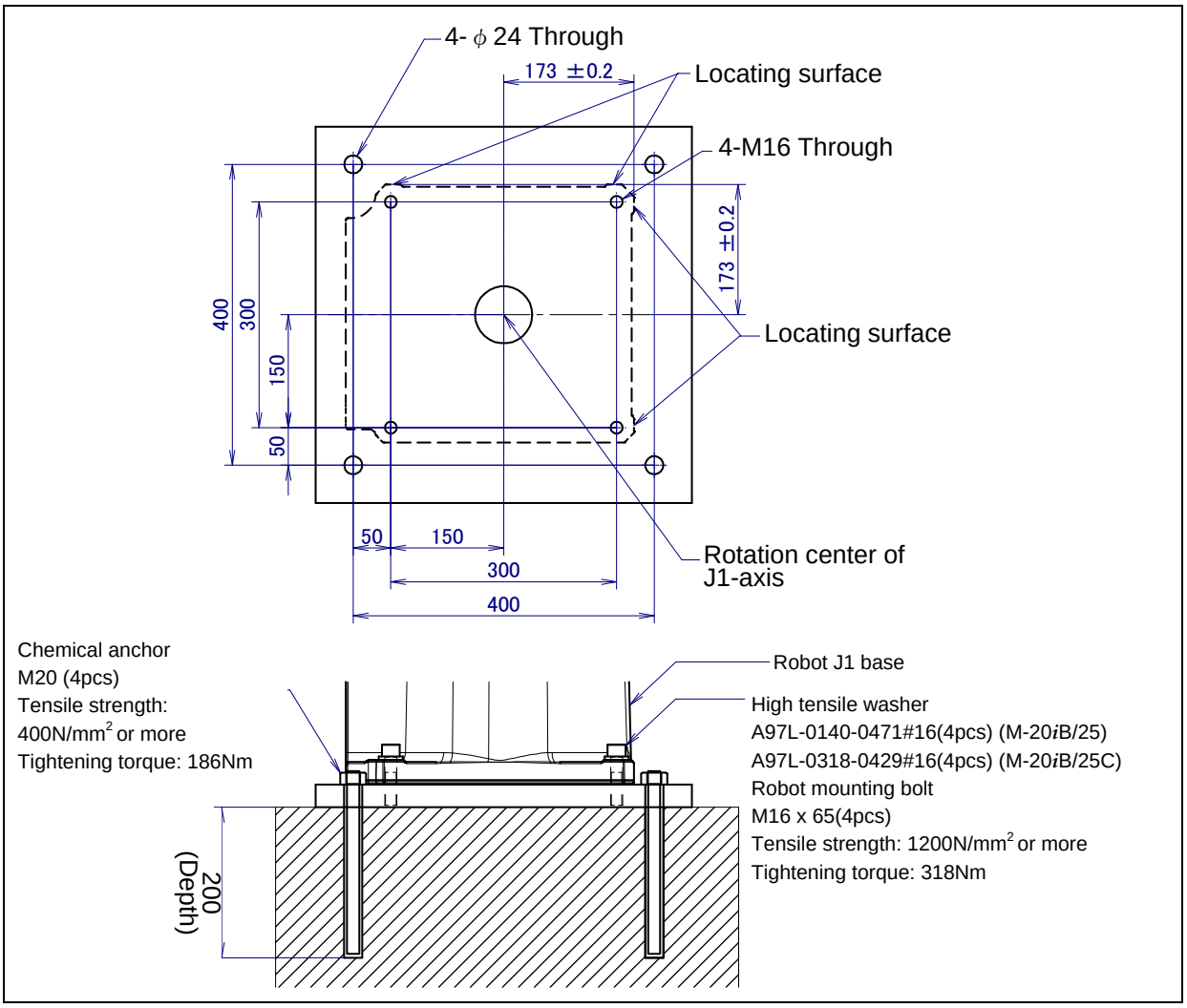


Fig. 1.2.1 (a) Example of installing the robot

> ⚠ **WARNING**
> The customer shall arrange for the positioning pin, anchor bolts, and floor plate. Don't perform leveling at the robot base directly using a push bolt or a wedge. For fixing the robot base, use four hexagon socket head bolt M16 x 65 (tensile strength 1200N/mm^2 or more) and tighten them with regulated tightening torque 318Nm.
> 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. 1.2.1 (b) and Table 1.2.1 (a), (b) show the force and moment applied to the Robot base. Table 1.2.1 (c) to (e) indicate the stopping distance and time of the J1 through J3 axes until the robot stopping by Power-Off stop or by Controlled stop or Smooth stop after input of the stop signal. Refer to the data when considering the strength of the installation face.

NOTE

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

Table 1.2.1 (a) Force and moment that act on J1 base (M-20*i*B/25/25C)

	Vertical moment MV [Nm](kgfm)	Force in vertical direction FV [N] (kgf)	Horizontal moment MH [Nm] (kgfm)	Force in horizontal direction FH [N] (kgf)
During stillness	1526 (156)	2605 (266)	0 (0)	0(0)
During acceleration or deceleration	5760 (588)	5204 (531)	1803 (184)	3436 (351)
During Power-Off stop	7811 (797)	7069 (721)	6626 (676)	4028 (411)

Table 1.2.1 (b) Force and moment that act on J1 base (M-20*i*B/35S)

	Vertical moment MV [Nm](kgfm)	Force in vertical direction FV [N] (kgf)	Horizontal moment MH [Nm] (kgfm)	Force in horizontal direction FH [N] (kgf)
During stillness	1181 (121)	2412 (246)	0 (0)	0(0)
During acceleration or deceleration	3913 (399)	5040 (514)	2006 (205)	3707 (378)
During Power-Off stop	5696 (581)	7268 (742)	5370 (548)	4350 (444)

Table 1.2.1 (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-20*i*B/25/25C	Stopping time [ms]	268	300	228
	Stopping distance [deg] (rad)	27.5(0.48)	29.8(0.52)	29.4(0.51)
M-20*i*B/35S	Stopping time [ms]	192	196	196
	Stopping distance [deg] (rad)	19.7(0.34)	18.7(0.33)	23.8(0.42)

Table 1.2.1 (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-20*i*B/25/35S/25C	Stopping time [ms]	532	492	556
	Stopping distance [deg] (rad)	56.7(0.99)	54.2(0.96)	71.6(1.25)

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

Model		J1-axis	J2-axis	J3-axis
M-20*i*B/25/25C	Stopping time [ms]	516	412	316
	Stopping distance [deg] (rad)	42.0(0.96)	41.4(0.72)	42.3(0.74)
M-20*i*B/35S	Stopping time [ms]	488	376	384
	Stopping distance [deg] (rad)	38.1(0.66)	38.0(0.66)	45.9(0.80)

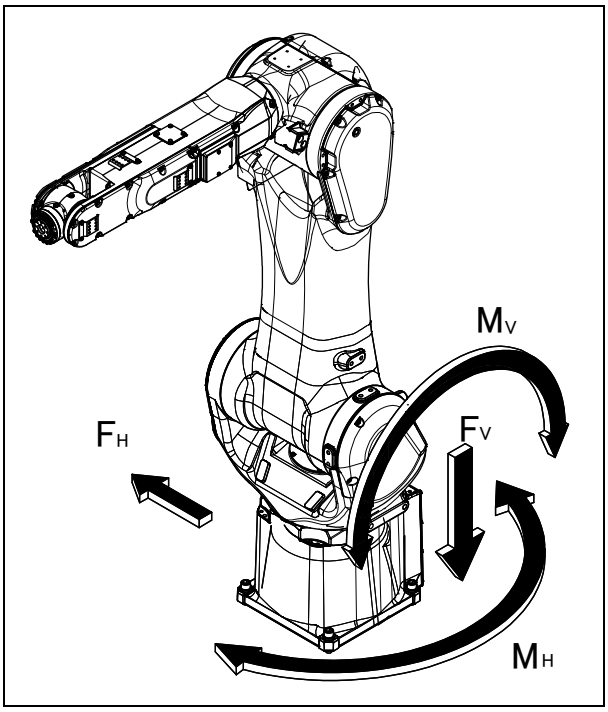
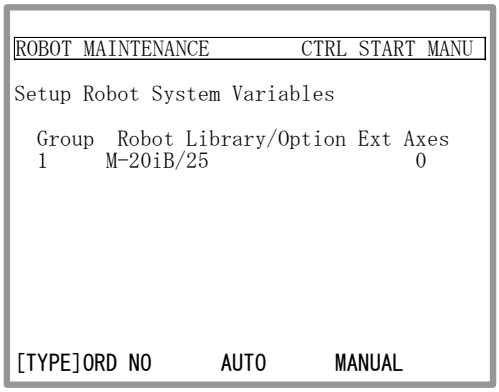


Fig. 1.2.1 (b) Force and moment that acts on robot base

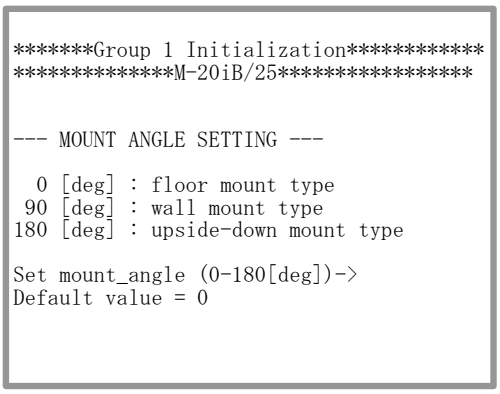
1.2.2 Angle of Mounting Surface Setting

If robot is used except floor mount, be sure to set the mounting angle referring to the procedure below. Refer to specification of Section 3.1 about 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 which you set mount angle and press the [ENTER] key.



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



6 Input mount angle referring to Fig.1.2.2.

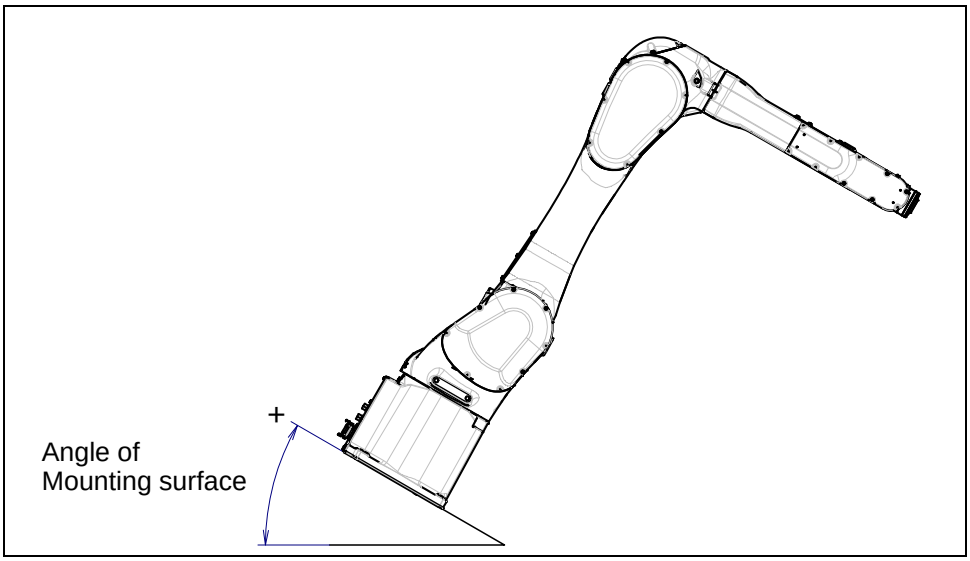
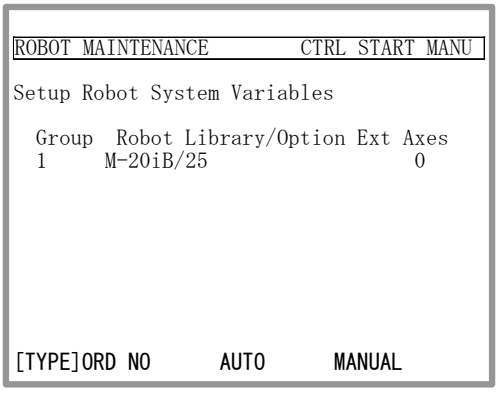


Fig.1.2.2 Mounting angle

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



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

1.3 MAINTENANCE AREA

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

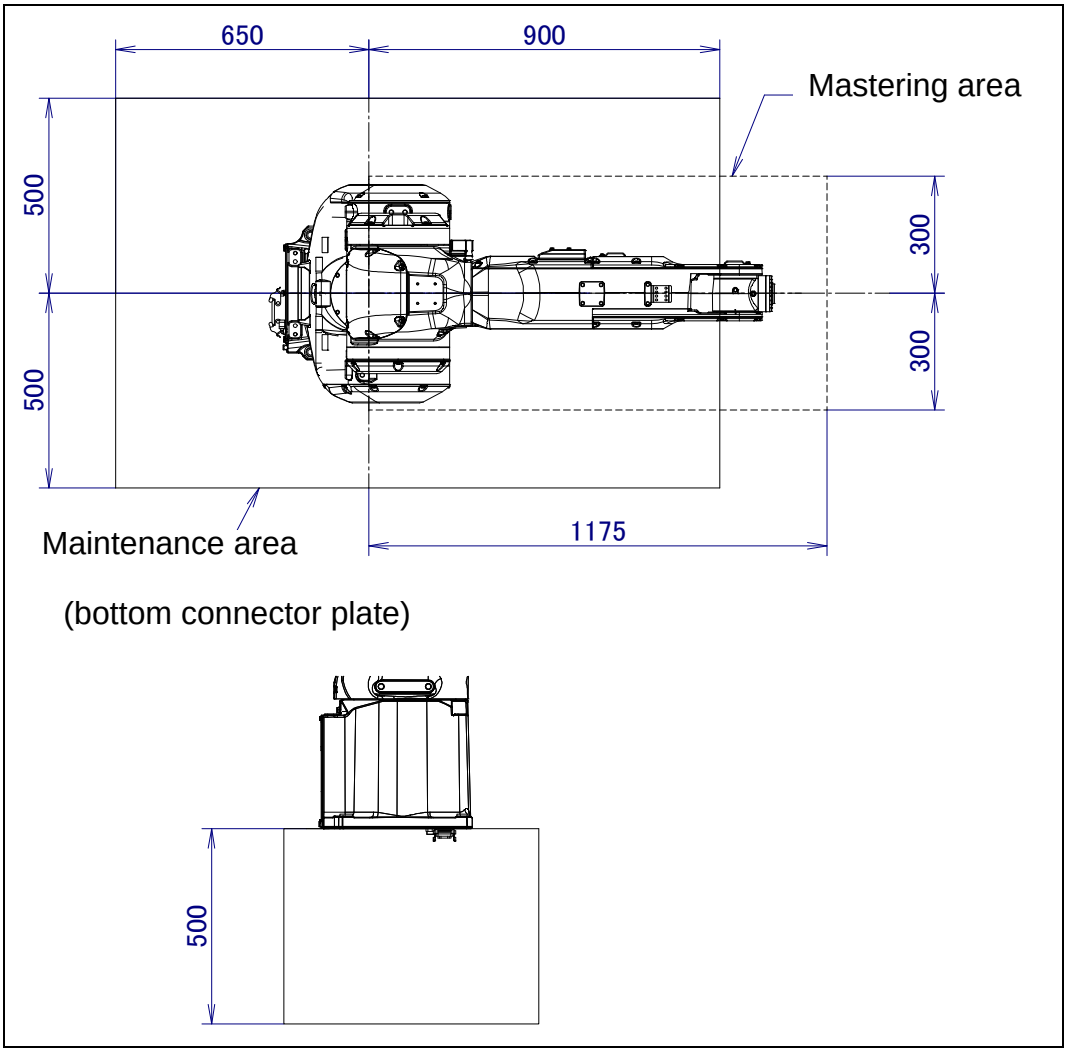


Fig. 1.3 Maintenance area

1.4 INSTALLATION CONDITIONS

Refer to Section 3.1 for installation conditions.

2 CONNECTION WITH THE CONTROLLER

2.1 CONNECTION WITH THE CONTROLLER

The robot is connected with the controller via the power and signal cable and earth cable. Connect these cables to the connectors on the back of the base.
For details on air and option cables, see Chapter 5.

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

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

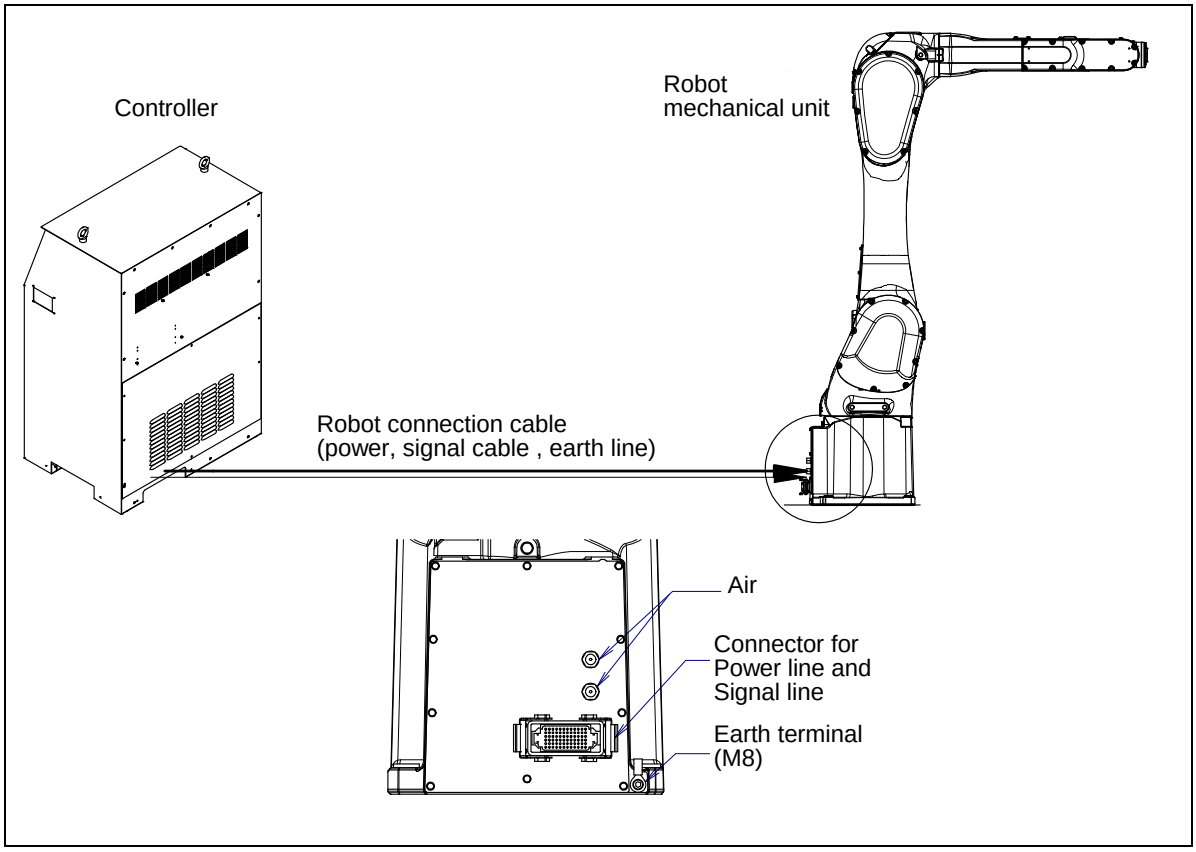


Fig. 2.1 (a) Cable connection (back side connector plate)

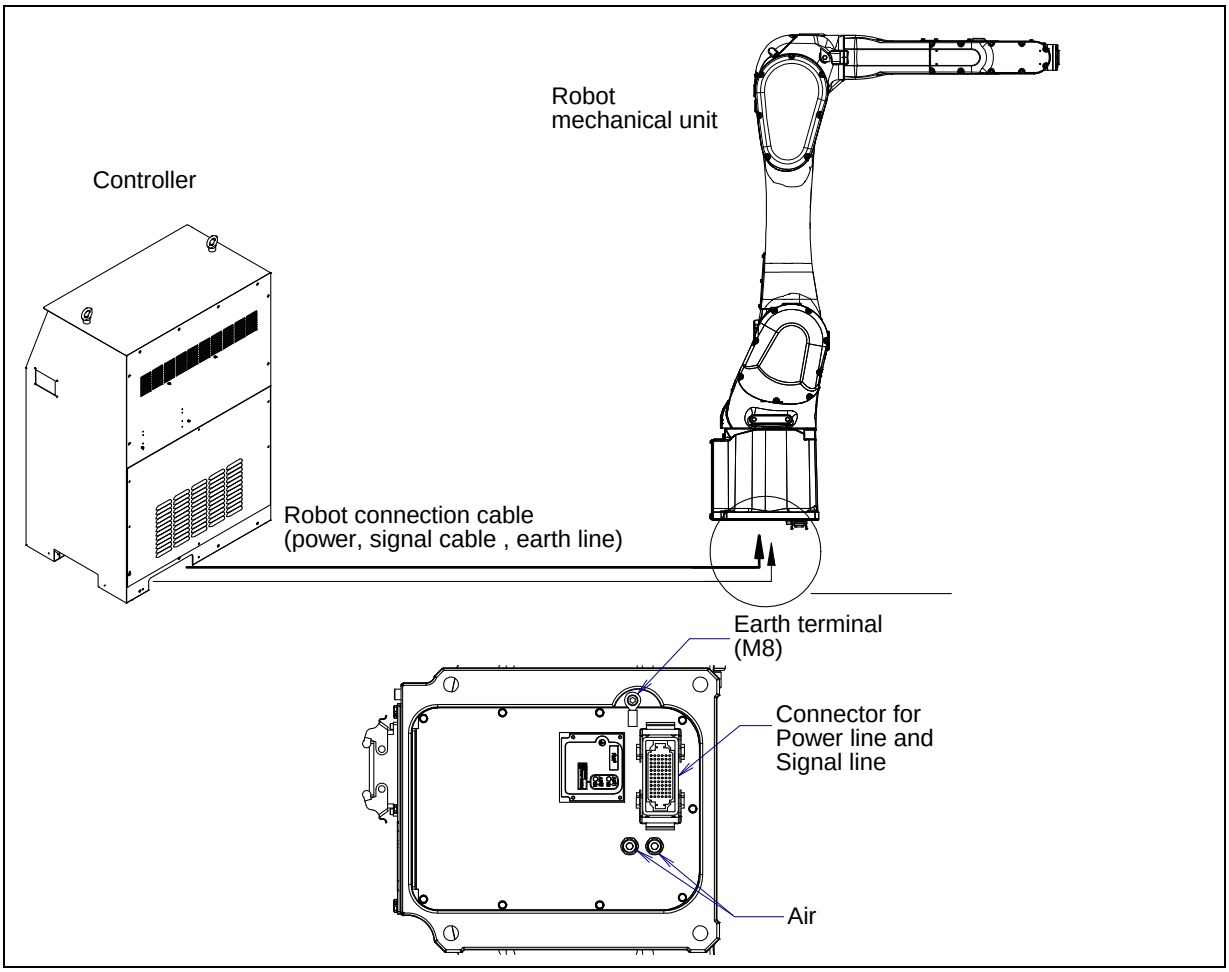


Fig. 2.1 (b) Cable connection (bottom connector plate)

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

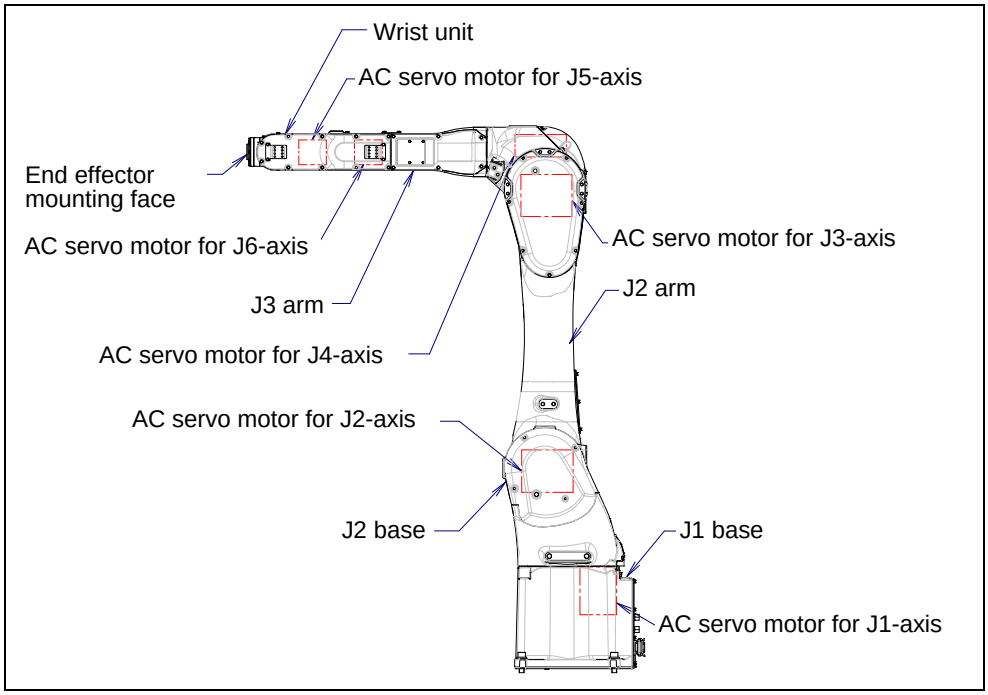


Fig. 3.1 (a) Mechanical unit configuration

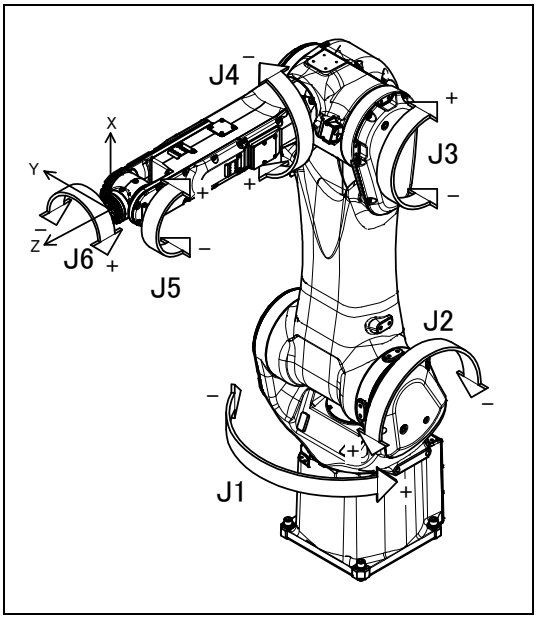


Fig. 3.1 (b) Each axes coordinates and mechanical interface coordinates

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

Table 3.1 Specifications

Item		Specification	
Model		M-20*i*B/25/25C	M-20*i*B/35S
Type		Articulated type	
Controlled axes		6 axes(J1, J2, J3, J4, J5, J6)	
Installation		Floor, Upside-down, Wall & Angle mount (NOTE 1)	
Motion range	J1-axis	180°(3.14rad) / -180°(-3.14rad)	
	J2-axis	140°(2.44rad) / -100°(-1.74rad)	
	J3-axis	320°(2.53rad)/ -149°(-2.60rad)	320°(2.53rad)/ -132.8°(-2.32rad)
	J4-axis	200°(3.49rad) / -200°(-3.49rad)	
	J5-axis	145°(2.53rad)/ -145°(-2.53rad)	130°(2.27rad)/ -130°(-2.27rad)
	J6-axis	270°(4.71rad) / -270°(-4.71rad)	
Maximum speed (NOTE 2)	J1-axis	205°/sec (3.58rad/s)	
	J2-axis	205°/sec (3.58rad/s)	
	J3-axis	260°/sec (4.54rad/s)	
	J4-axis	415°/sec (7.24rad/s)	
	J5-axis	415°/sec (7.24rad/s)	
	J6-axis	880°/sec (15.36rad/s)	
Maximum load	At wrist	25kg	35kg
	On J3 arm(NOTE 3)	12kg	
Allowable load moment at wrist	J4-axis	51.0Nm	
	J5-axis	51.0Nm	
	J6-axis	31.0Nm	
Allowable load inertia at wrist	J4-axis	2.20kg.m^2	
	J5-axis	2.20kg.m^2	
	J6-axis	1.20kg.m^2	
Repeatability		±0.02mm	
Mass		210kg	205kg
Dust proof and drip proof mechanism (NOTE 4)		Conform to IP67	
Clean class (NOTE 5)		ISO class 4	
Acoustic noise level		73.3dB (NOTE 6)	
Installation environment		Ambient temperature: 0 to 45℃ (NOTE 7) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%Rh or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 8)	

NOTE

1 Under the installation condition within ( ), the motion range will be limited. See Section 3.5.
2 During of short distance motions, the axis speed may not reach the maximum value stated.
3 Maximum load on J3 arm is influenced by load of wrist. See Section 4.2 for detail.
4 Definition of IP(Dust proof and drip proof mechanism)
  Definition of IP67
  6→Dust-tight
  7→Protection from water immersion
5 Only for M-20*i*B/25C
6 This value is equivalent continuous A-weighted sound pressure level, which applied with ISO11201 (EN31201). This value is measured with the following conditions.
  - Maximum load and speed
  - Operating mode is AUTO
7 When the robot is used in a low temperature environment that is near to 0ºC, or not operated for a long time in the environment that is less than 0ºC (during a holiday or during the night), a collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.
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, cutting oil splash and or other foreign substances.

3.1.1 Note of Severe Dust /Liquid Specification

1 The robot (including severe dust/liquid protection model) cannot be used with the following liquids. Potentially these liquids will cause irreversible damage to the rubber parts (such as: gaskets, oil seals, O-rings etc.). (As exception to this only liquids tested and approved by FANUC can be used with the robot.)
   (a) Organic solvents
   (b) Cutting fluid including chlorine / gasoline
   (c) Amine type detergent
   (d) Acid, alkali and liquid causing rust
   (e) Other liquids or solutions, that will harm NBR or CR rubber
2 When the robots work in a water or liquid environment, completely drain the J1 base. Incomplete draining of the J1 base will make the robot break down.
3 Do not use unconfirmed cutting fluid and cleaning fluid.
4 Do not use the robot immersed in water, neither temporary nor permanent. The robot must not be wet permanently.

3.1.2 Cautions for 25C

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

3.2 MECHANICAL UNIT EXTERNAL DIMENSIONS AND WORK ENVELOPE

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

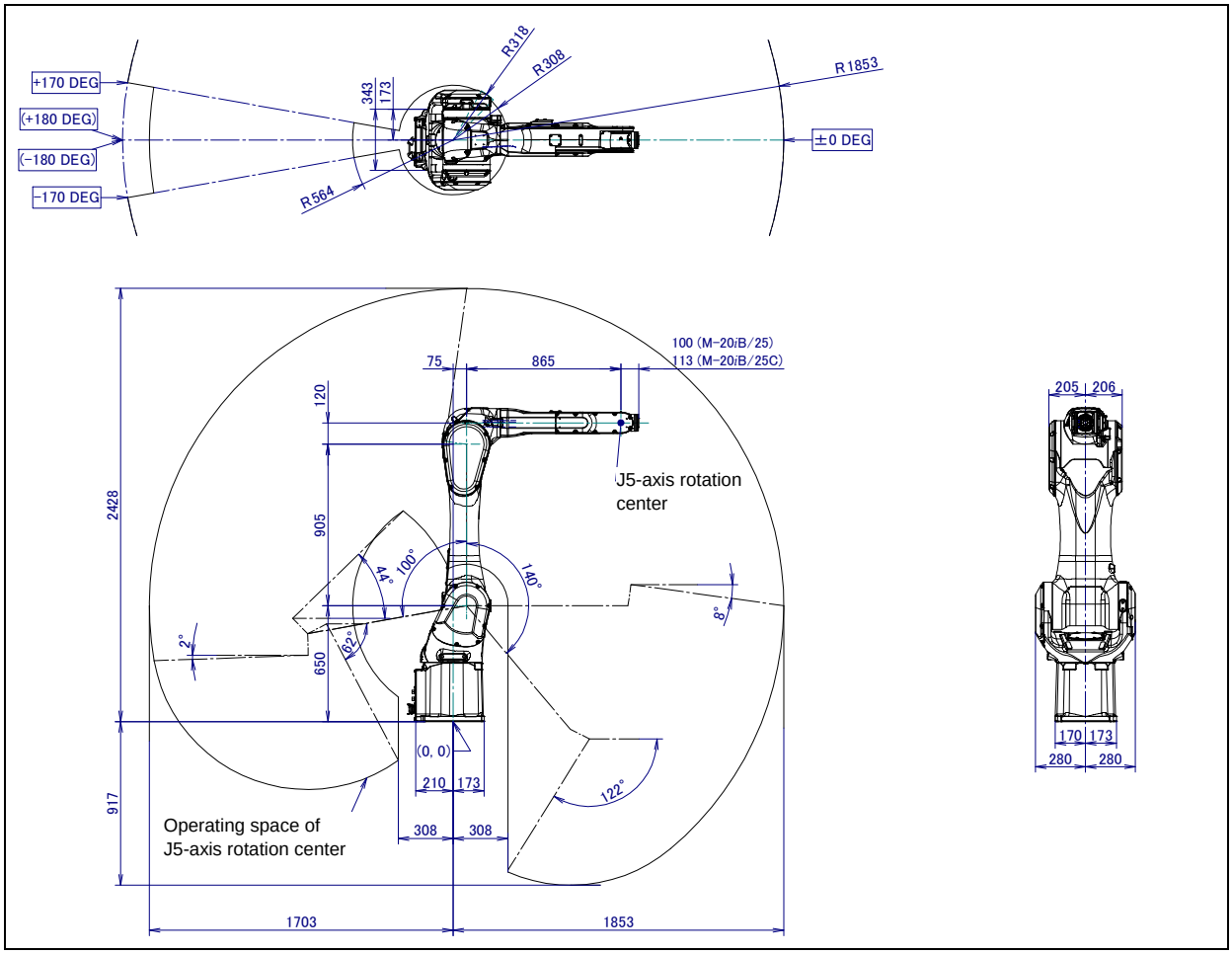


Fig. 3.2 (a) Operating space (M-20*i*B/25/25C)

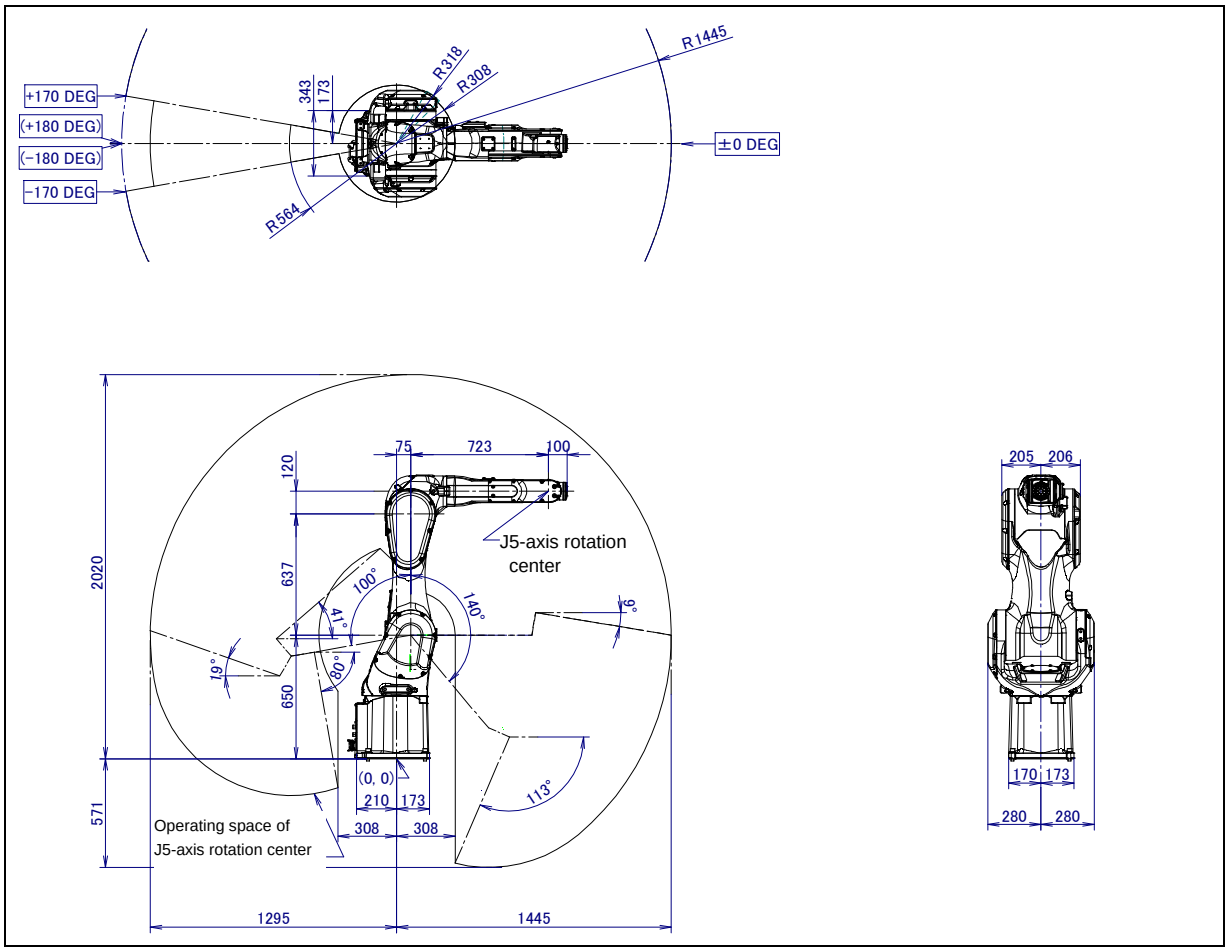


Fig. 3.2 (b) Operating space (M-20*i*B/35S)

3.3 ZERO POINT POSITION AND MOTION LIMIT

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

Fig. 3.3 (a) shows the position of the mechanical stopper. For the J1 to J3-axis, stopping by overtravel damages the mechanical stopper. If this occurs, replace the stopper with a new one. Don't reconstruct the mechanical stopper. There is a possibility that the robot doesn't stop normally.

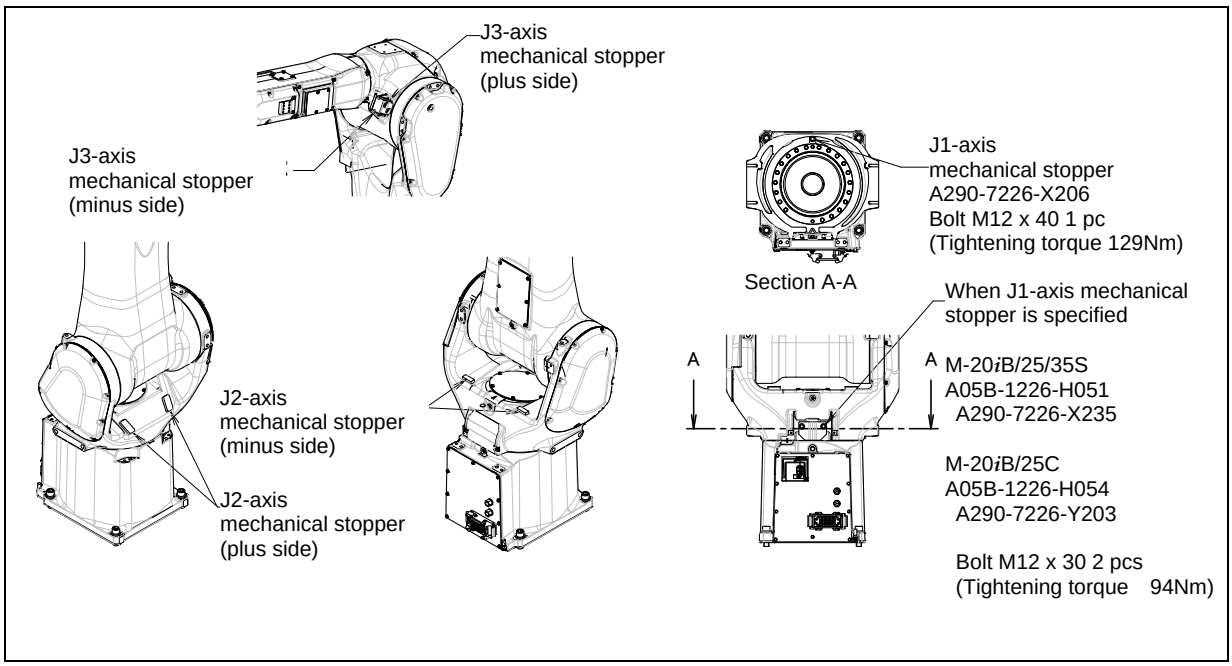


Fig. 3.3 (a) Position of mechanical stopper

Fig.3.3 (b) to (i) show the zero point and mechanical stopper position of each axis.

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

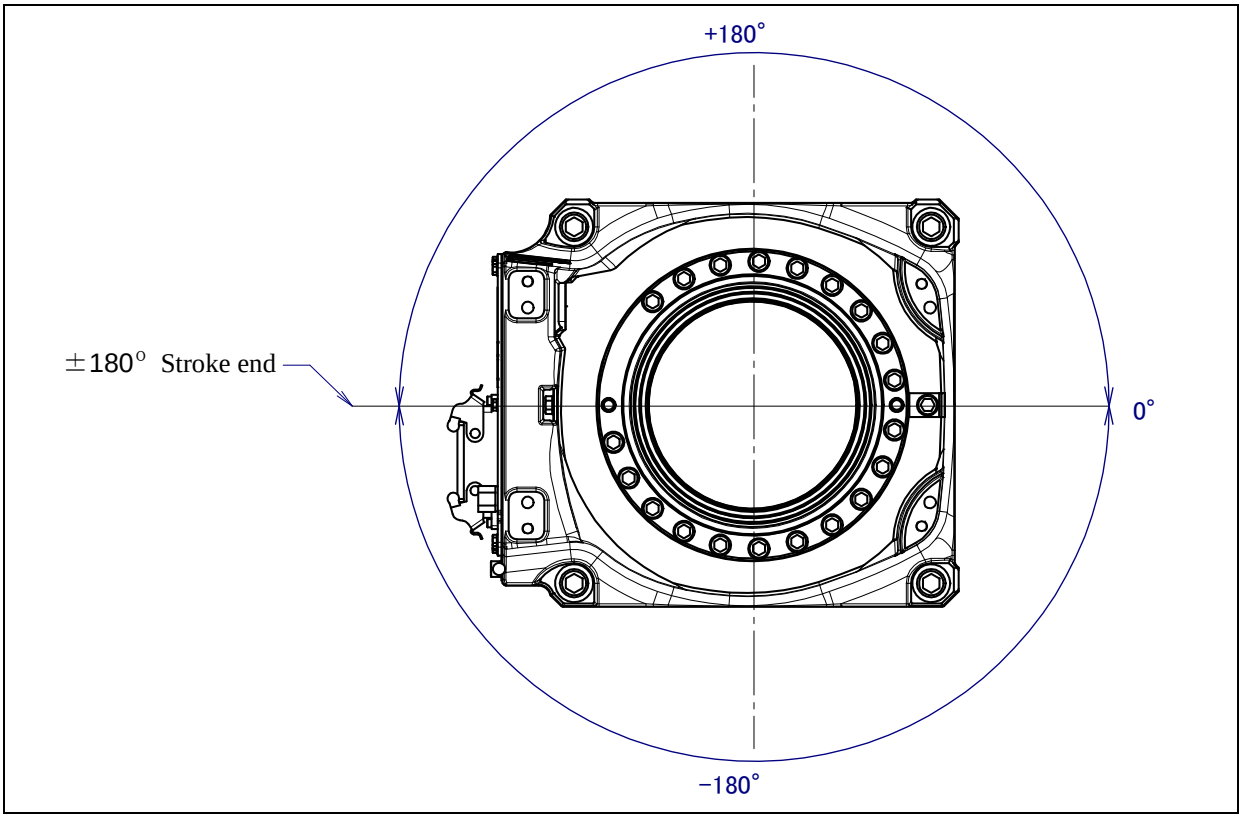


Fig. 3.3 (b) J1-axis motion limit (When mechanical stopper option is not selected)

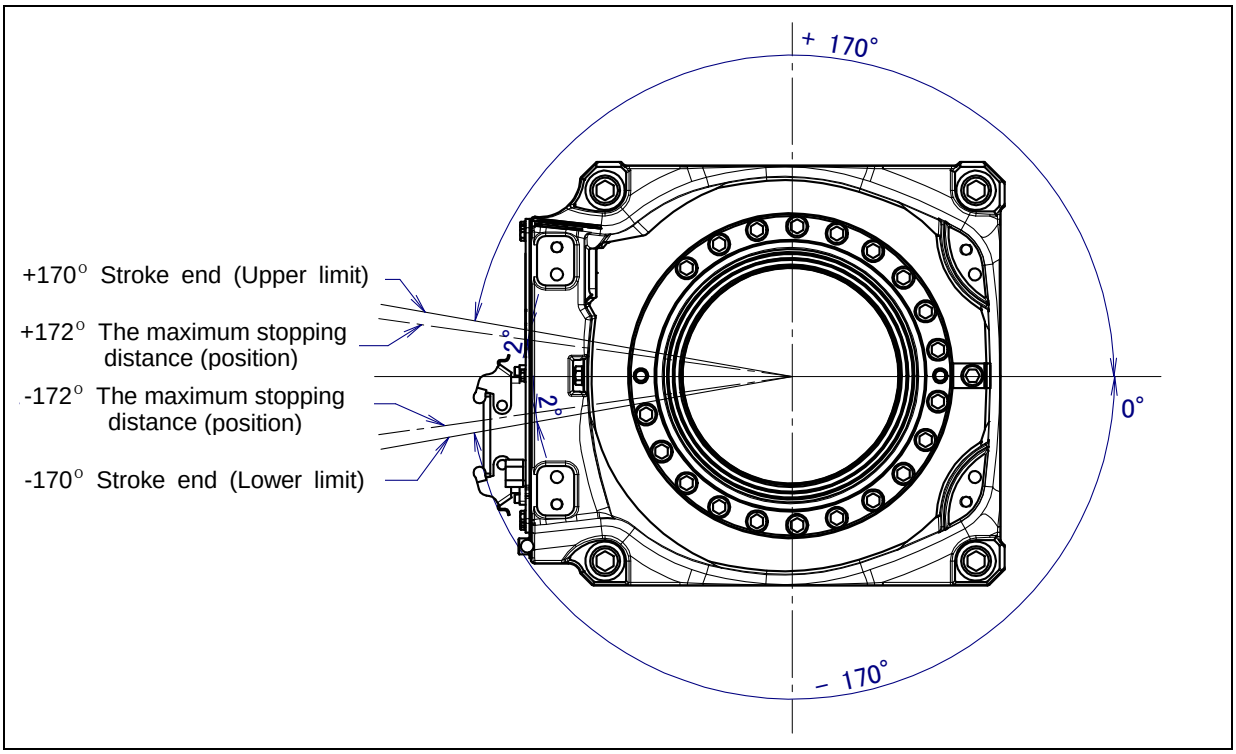


Fig. 3.3 (c) J1-axis motion limit (When mechanical stopper is selected)

Note) Motion limit is restricted by the position of the J3-axis.

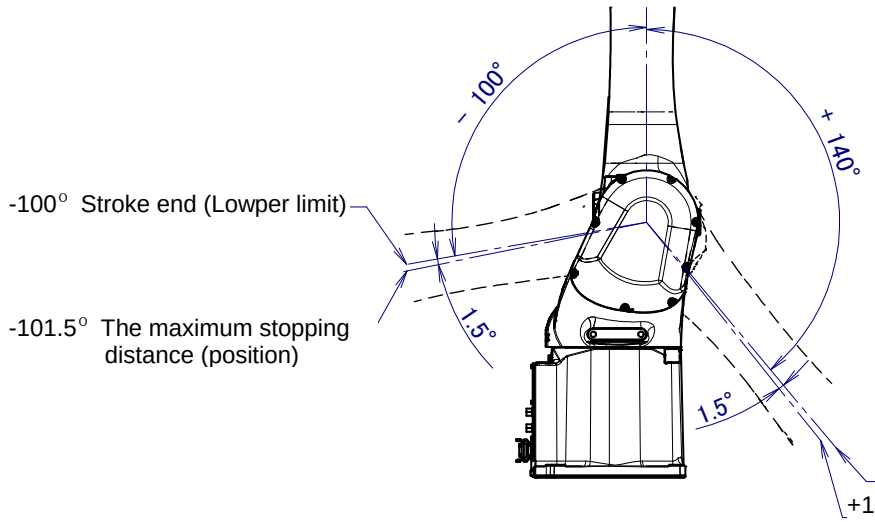
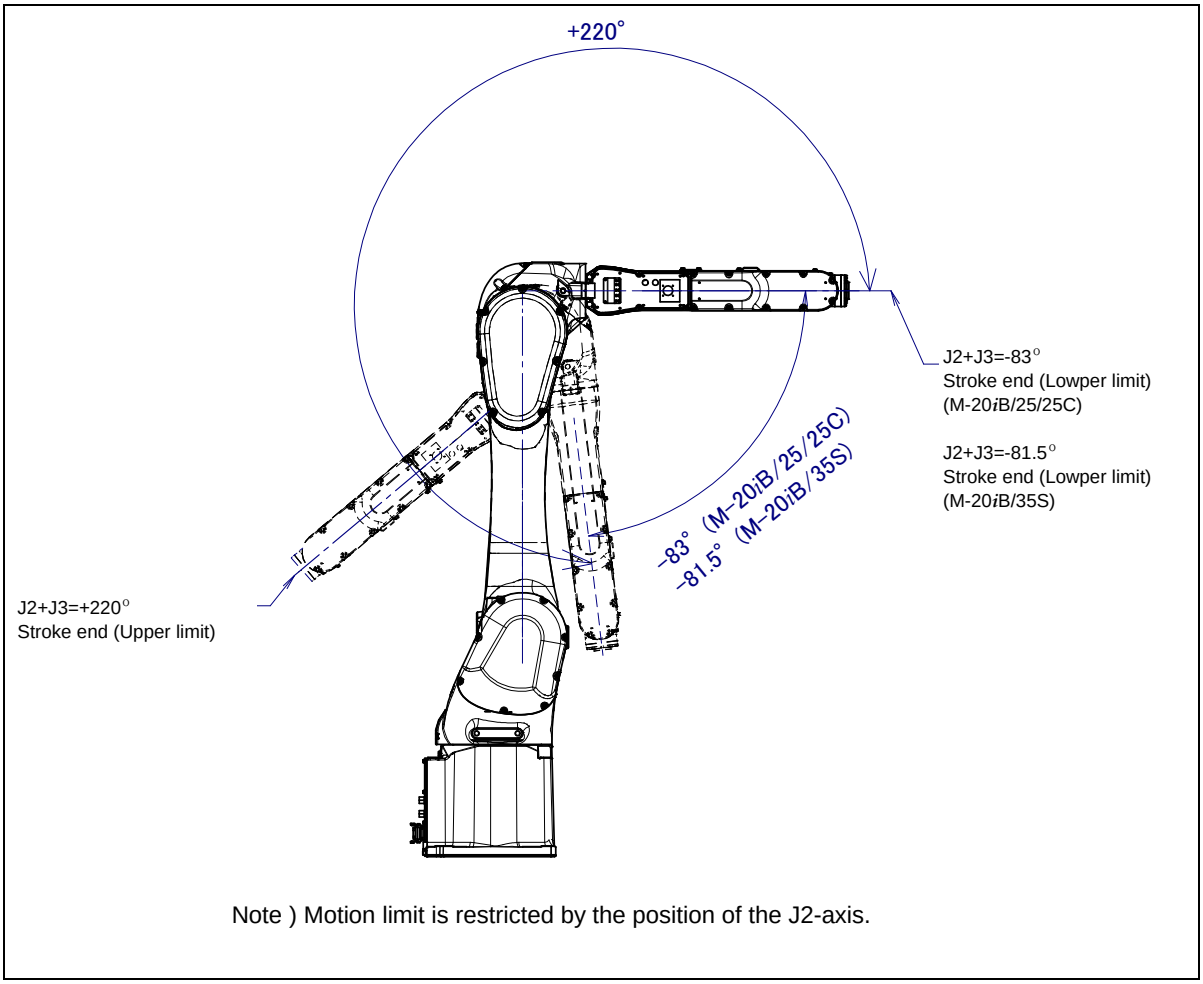


Fig. 3.3 (d) J2-axis motion limit



Note) Motion limit is restricted by the position of the J2-axis.

Fig. 3.3 (e) J3-axis motion limit

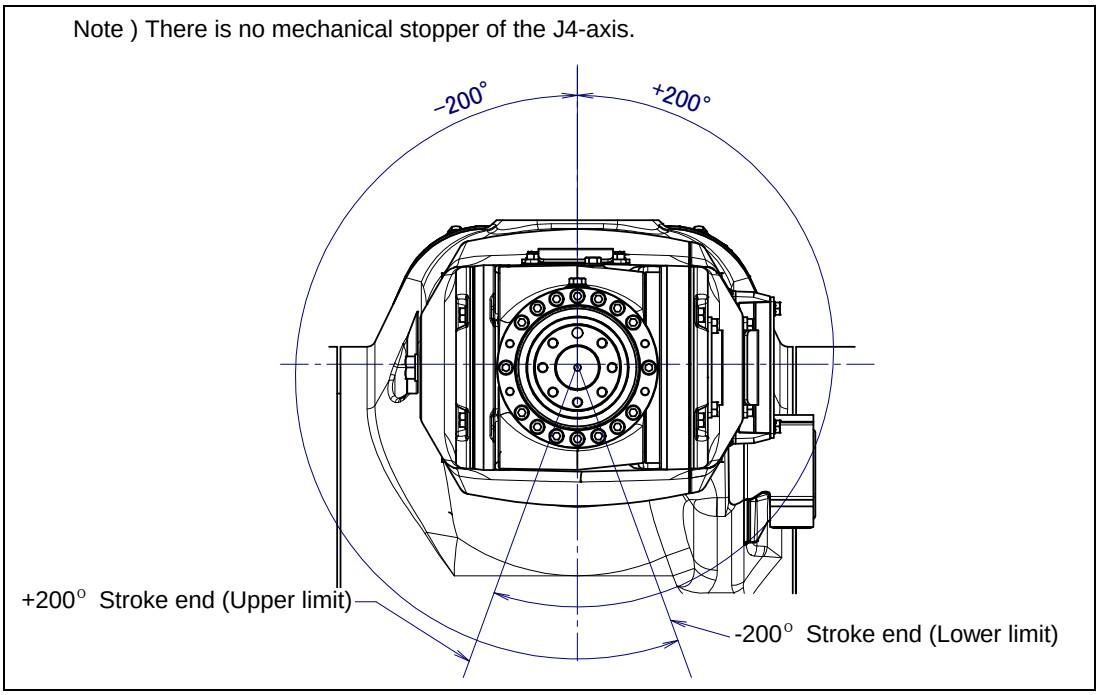


Fig. 3.3 (f) J4-axis motion limit

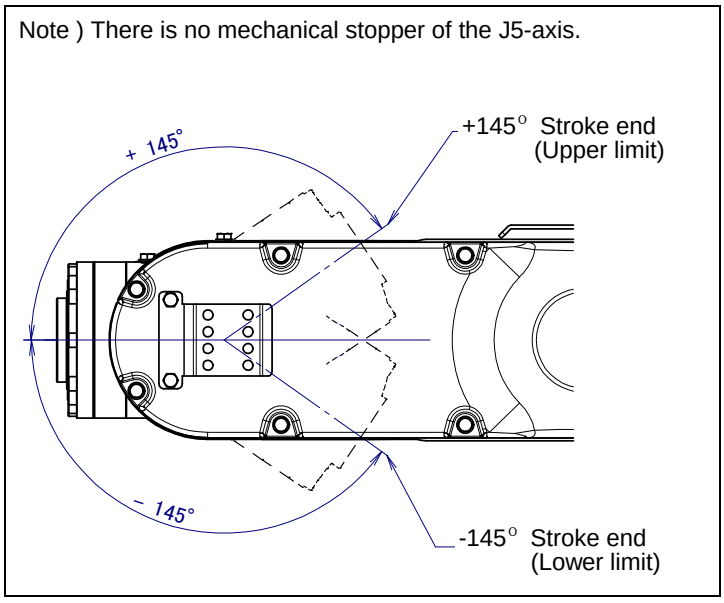


Fig. 3.3 (g) J5-axis motion limit (M-20*i*B/25/25C)

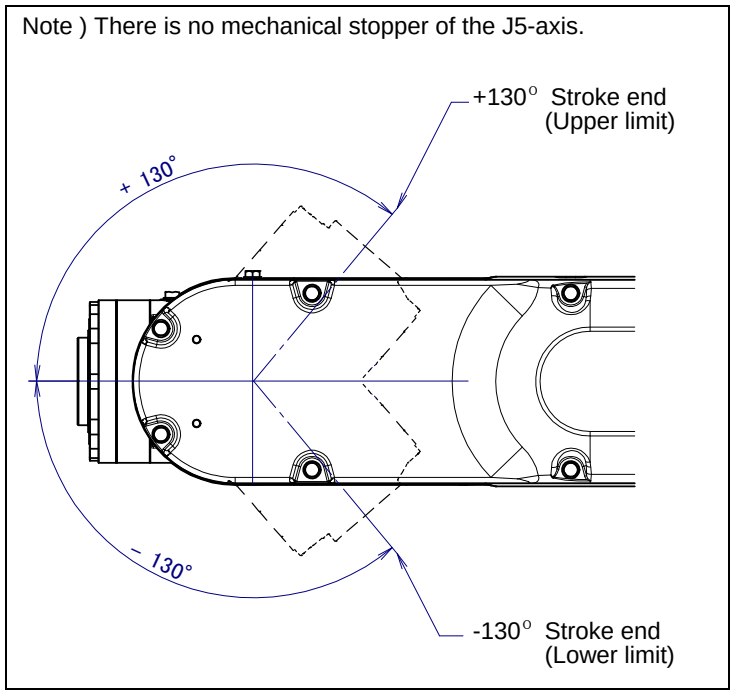


Fig. 3.3 (h) J5-axis motion limit (M-20*i*B/35S)

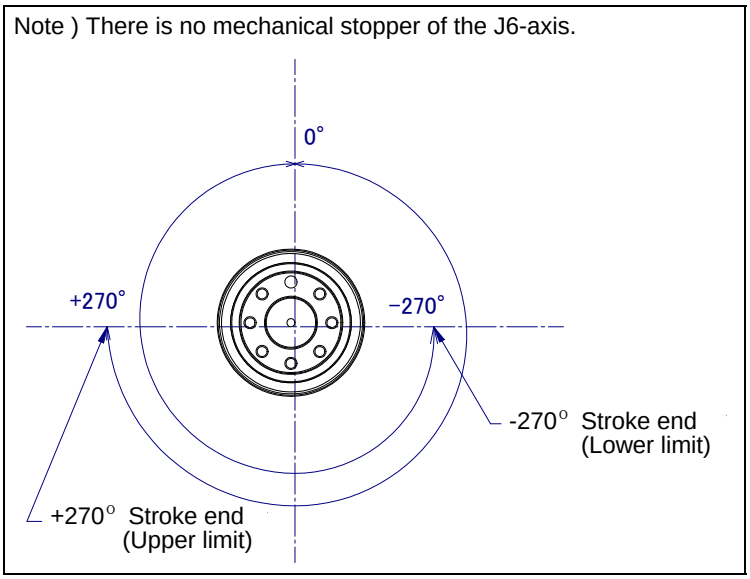


Fig. 3.3 (i) J6-axis motion limit

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (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. See Section 3.1 about the allowable load moment and the allowable load inertia.
- See Section 4.1 about mounting of end effector.

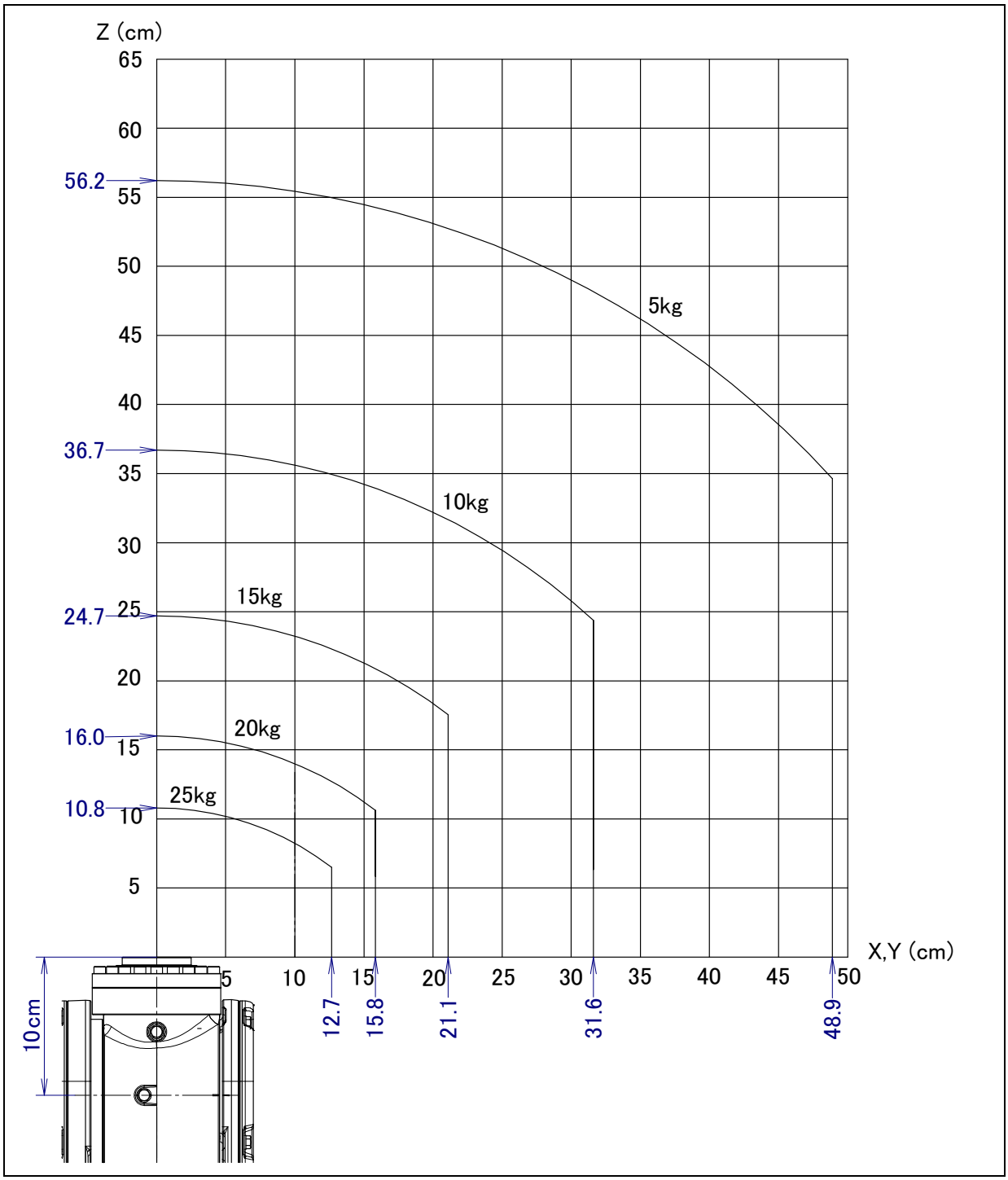


Fig. 3.4 (a) Wrist load diagram (M-20*i*B/25)

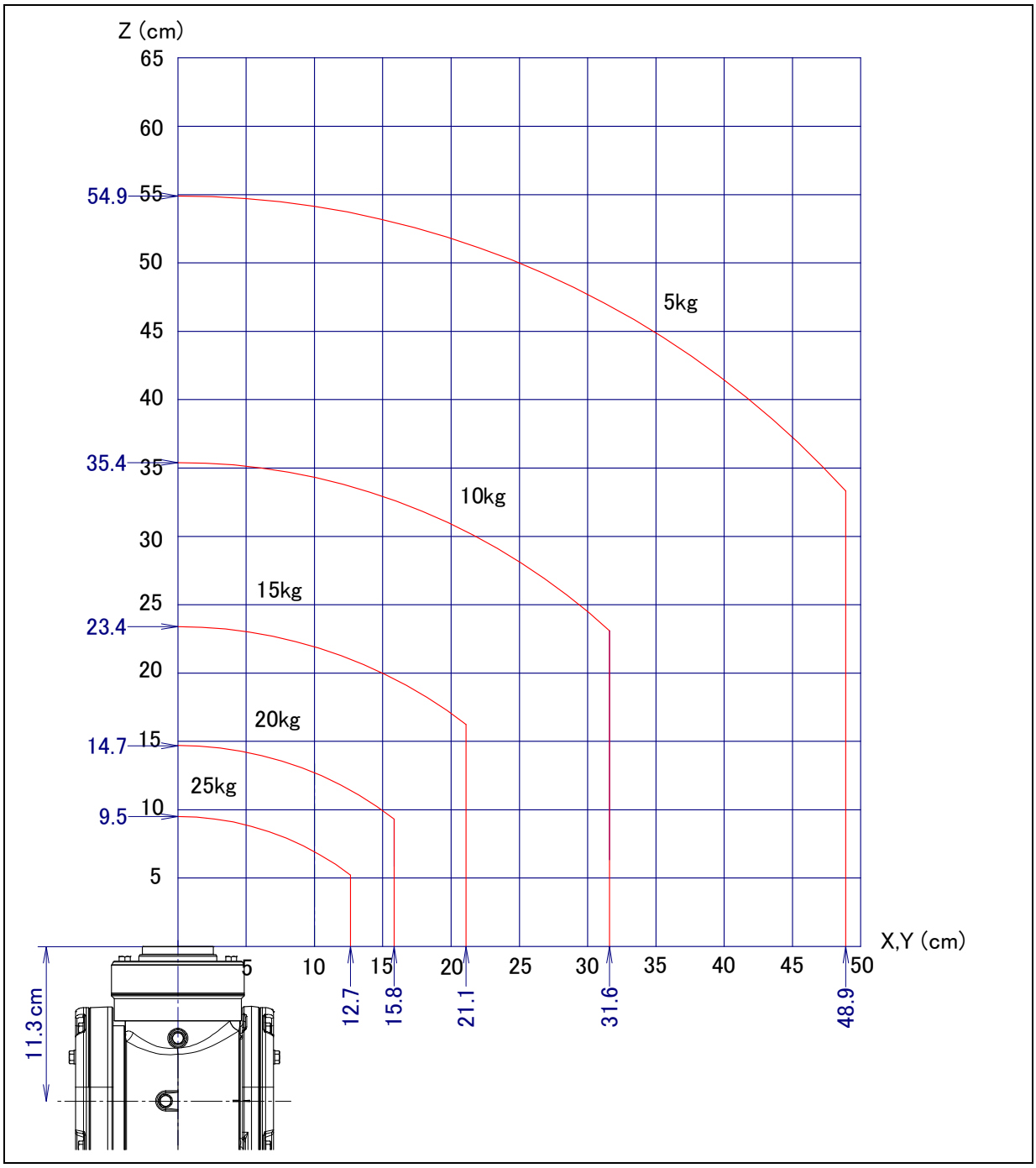


Fig. 3.4 (b) Wrist load diagram (M-20*i*B/25C)

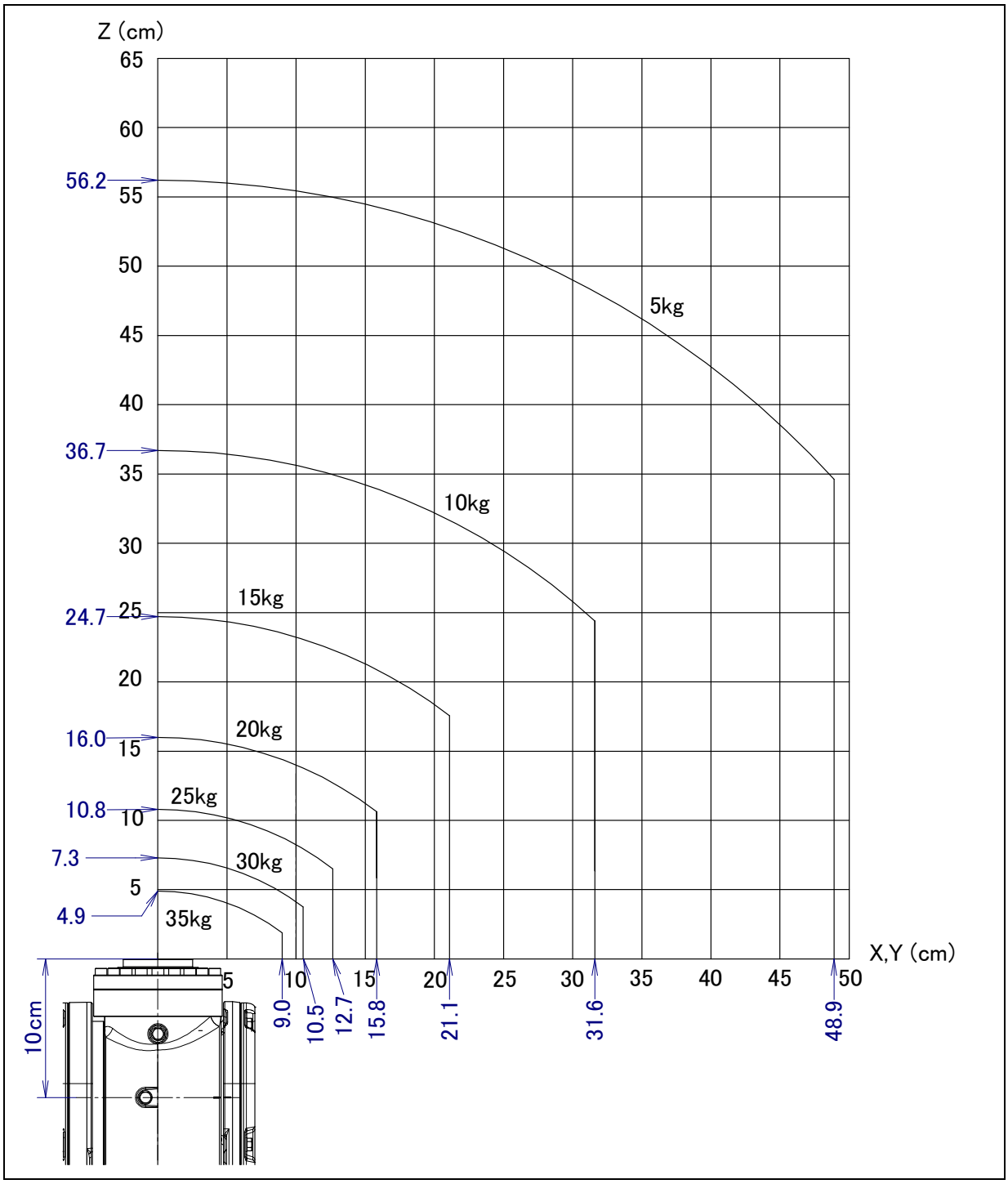


Fig. 3.4 (c) Wrist load diagram (M-20*i*B/35S)

3.5 OPERATING AREA FOR INCLINATION INSTALLATION

When the robot is installed on an angle, the operating area is limited to that angle. The robot can't rest except for within the ranges that are shown in the Fig. 3.5 (a) to (e).

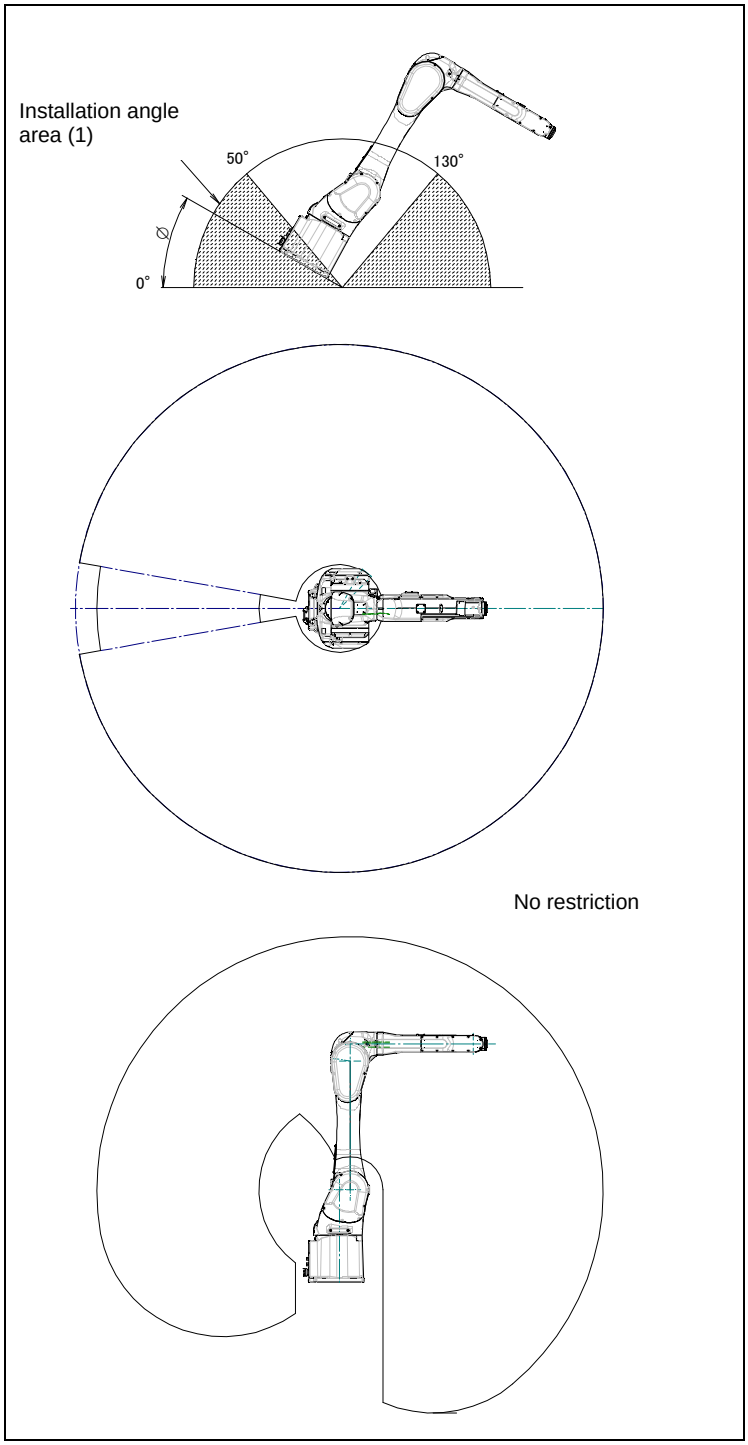


Fig. 3.5 (a) Installation area (1) operating area (M-20*i*B/25/25C)
(0°≦ϕ≦50°, 130°≦ϕ≦180°)

NOTE
In case of a mounted angle (1), there is no operating area restriction.

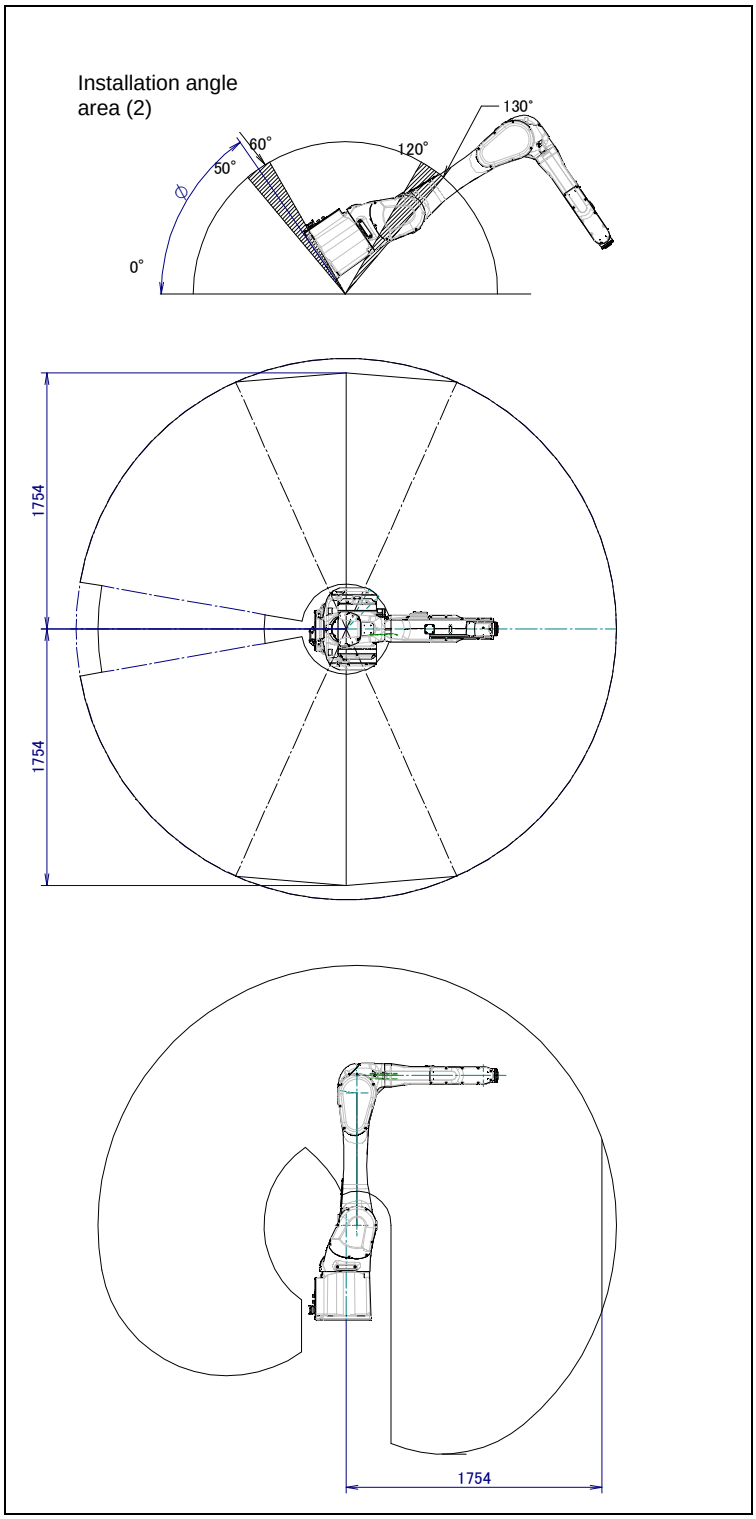


Fig. 3.5 (b) Installation area (2) operating area (M-20*i*B/25/25C)
(50°< ϕ ≦60°, 120°≦ ϕ <130°)

NOTE
Robot can rest or invert in a solid line range. The operation to a dotted line range becomes possible when not resting and not inverting.

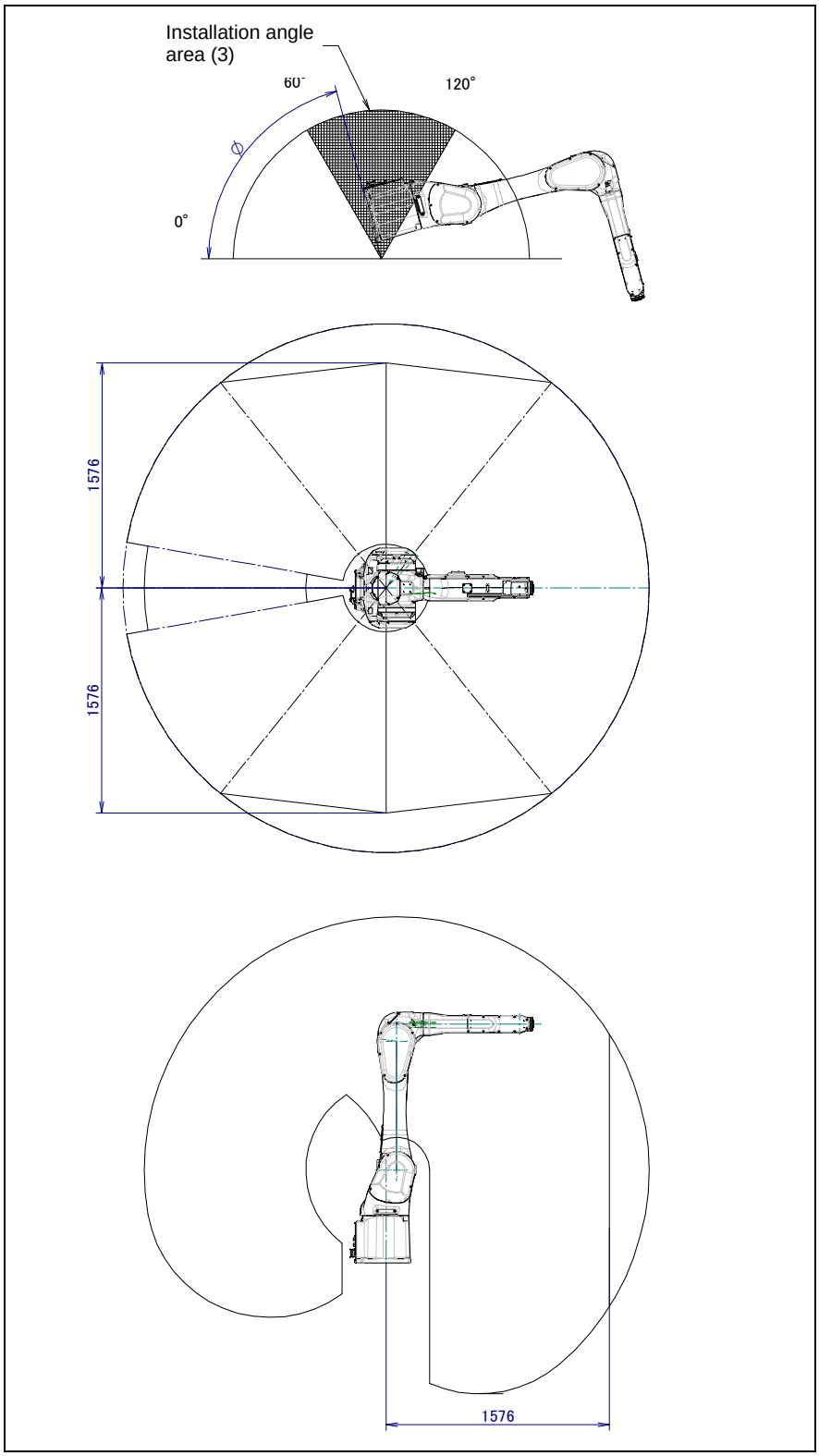


Fig. 3.5 (c) Installation area (3) operating area (M-20*i*B/25/25C)
(60°< ϕ <120°)

NOTE
Robot can rest or invert in a solid line range. The operation to a dotted line range becomes possible when not resting and not inverting.

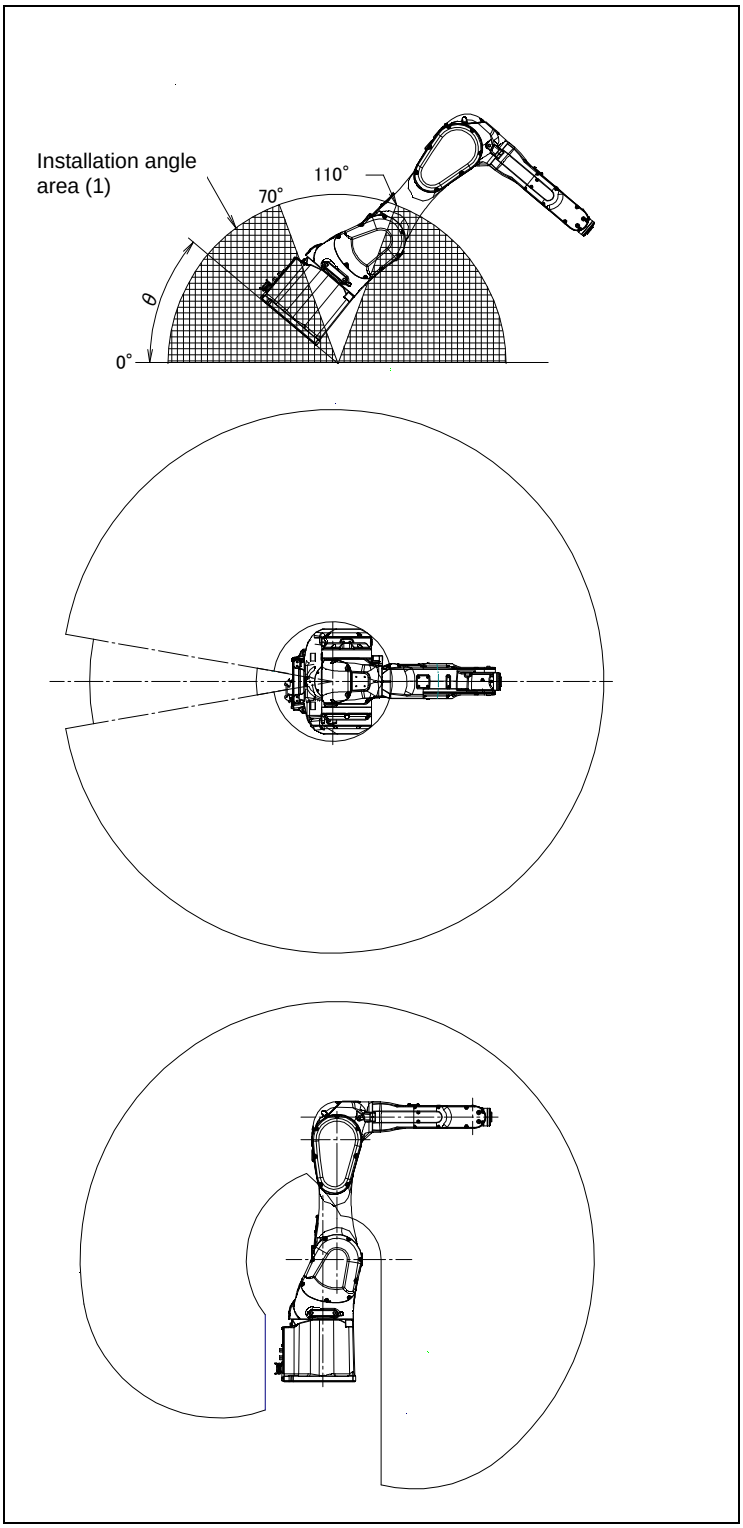


Fig. 3.5 (d) Installation area (1) operating area (M-20*i*B/35S)
(0°<ϕ≦70°, 110°≦ϕ<180°)

NOTE
In case of a mounted angle (1), there is no operating area restriction.

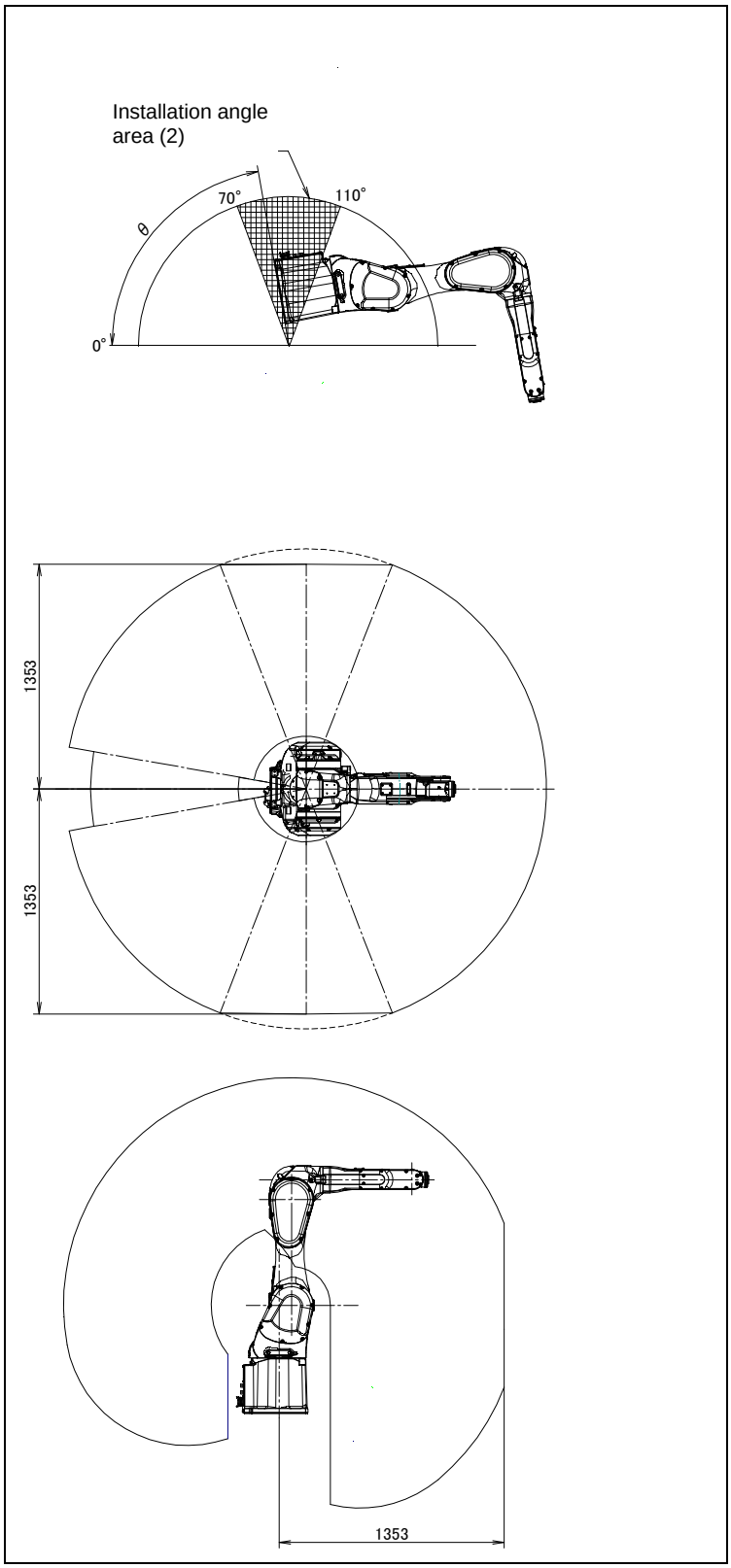


Fig. 3.5 (e) Installation area (2) operating area (M-20*i*B/35S)
(70°< ϕ <110°)

NOTE
Robot can rest or invert in a solid line range. The operation to a dotted line range becomes possible when not resting and not inverting.

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a), (b) show the figures for installing end effectors on the wrist. Select screws and positioning pins of a length that matches the depth of the tapped holes and pinholes. See Appendix B “STRENGTH OF BOLT AND BOLT TORQUE LIST” for tightening torque specifications.

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

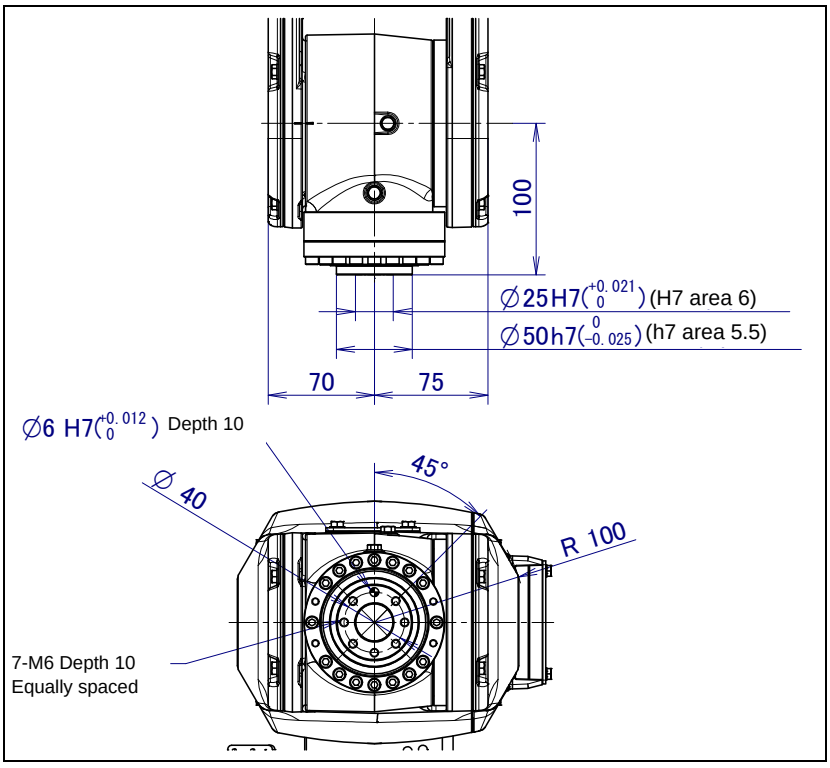


Fig. 4.1 (a) End effector interface (M-20*i*B/25/35S)

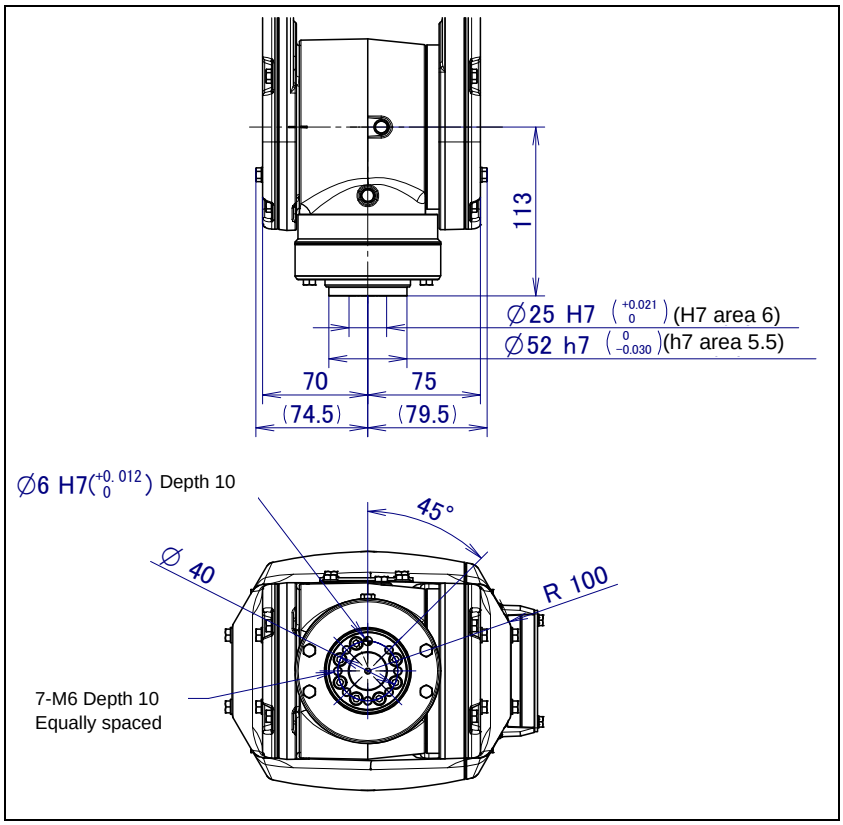


Fig. 4.1 (b) End effector interface (M-20*i*B/25C)

4.2 EQUIPMENT MOUNTING FACE

As shown in Fig. 4.2 (a) to (d), tapped holes are provided to install equipment to the robot. Refer to Fig. 4.2 (c) and (d) about load condition of the J3 casing and the J3 arm.

⚠ CAUTION

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

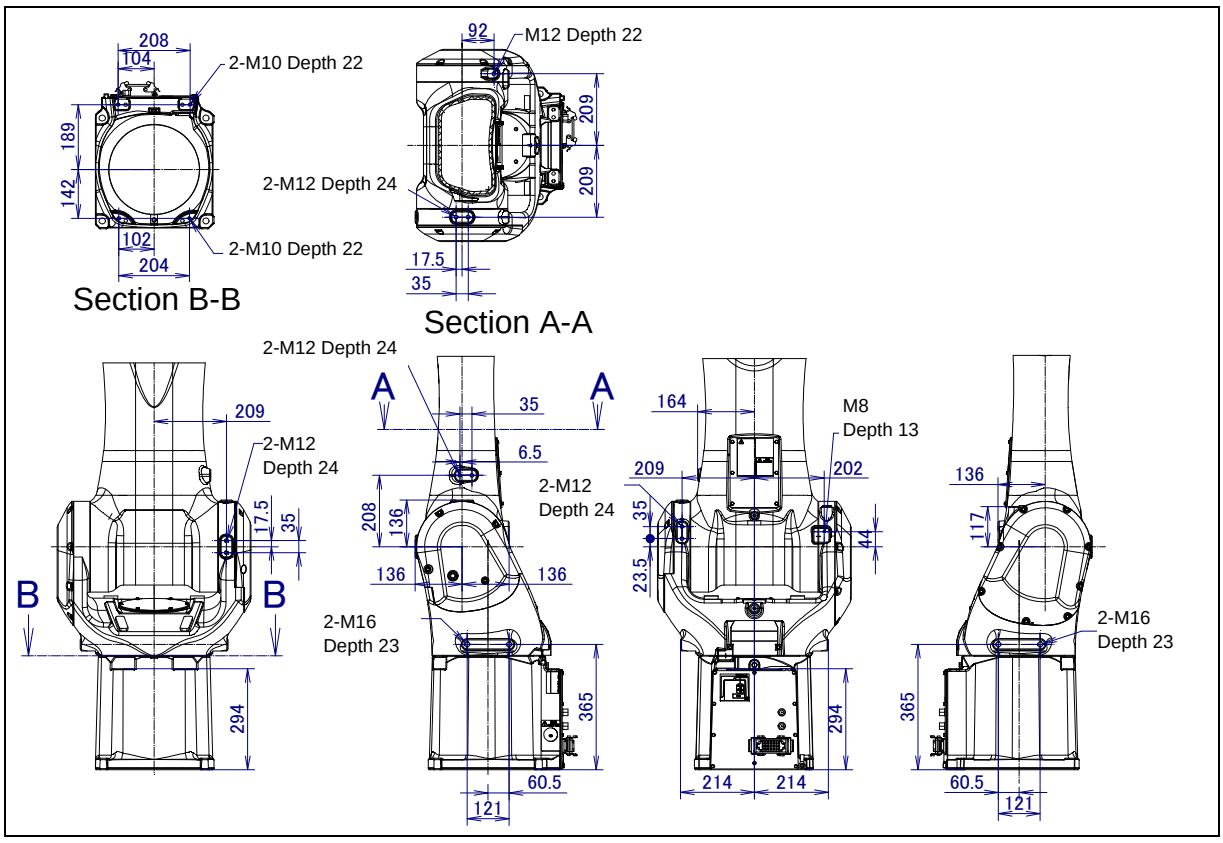


Fig. 4.2 (a) Equipment mounting faces (1/3)

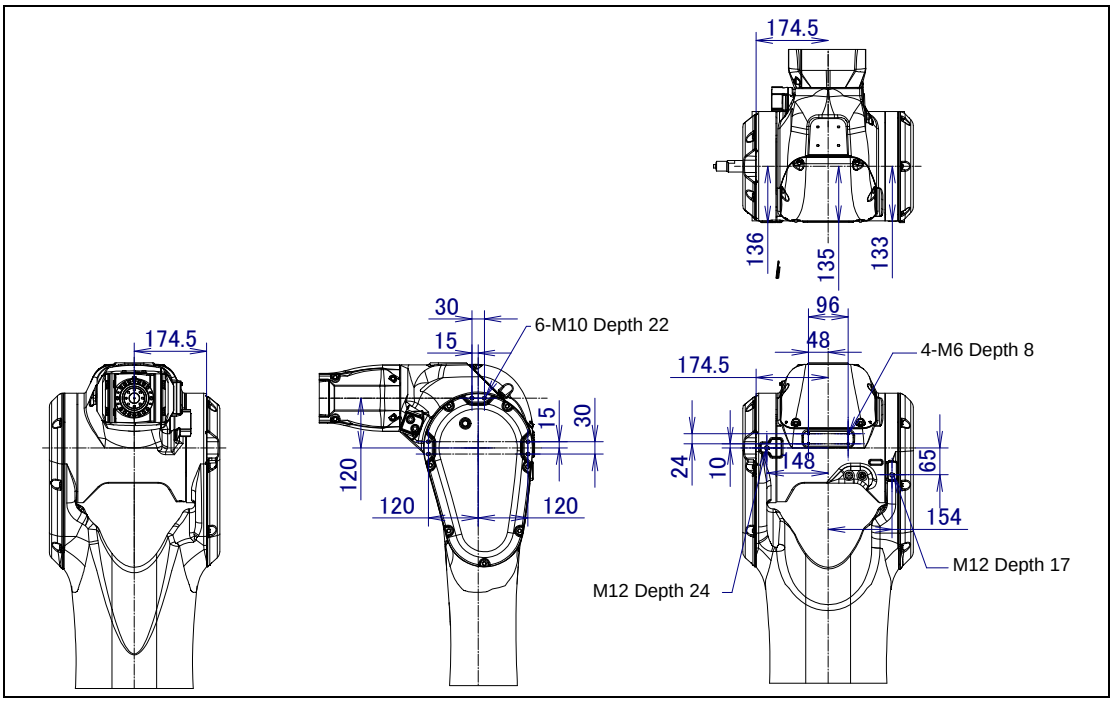


Fig. 4.2 (b) Equipment mounting faces (2/3)

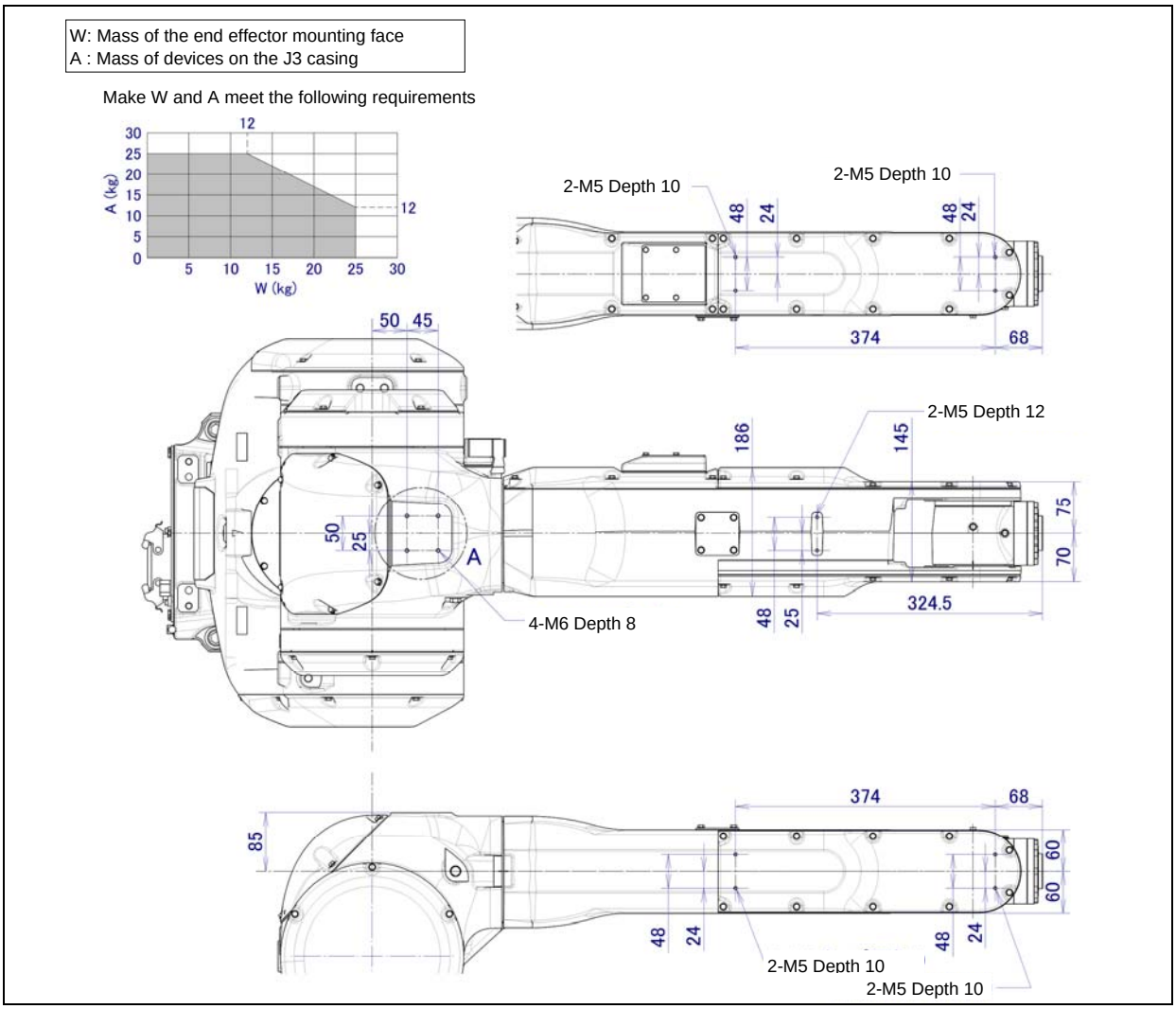


Fig. 4.2 (c) Equipment mounting faces (3/3) (M-20*i*B/25/25C)

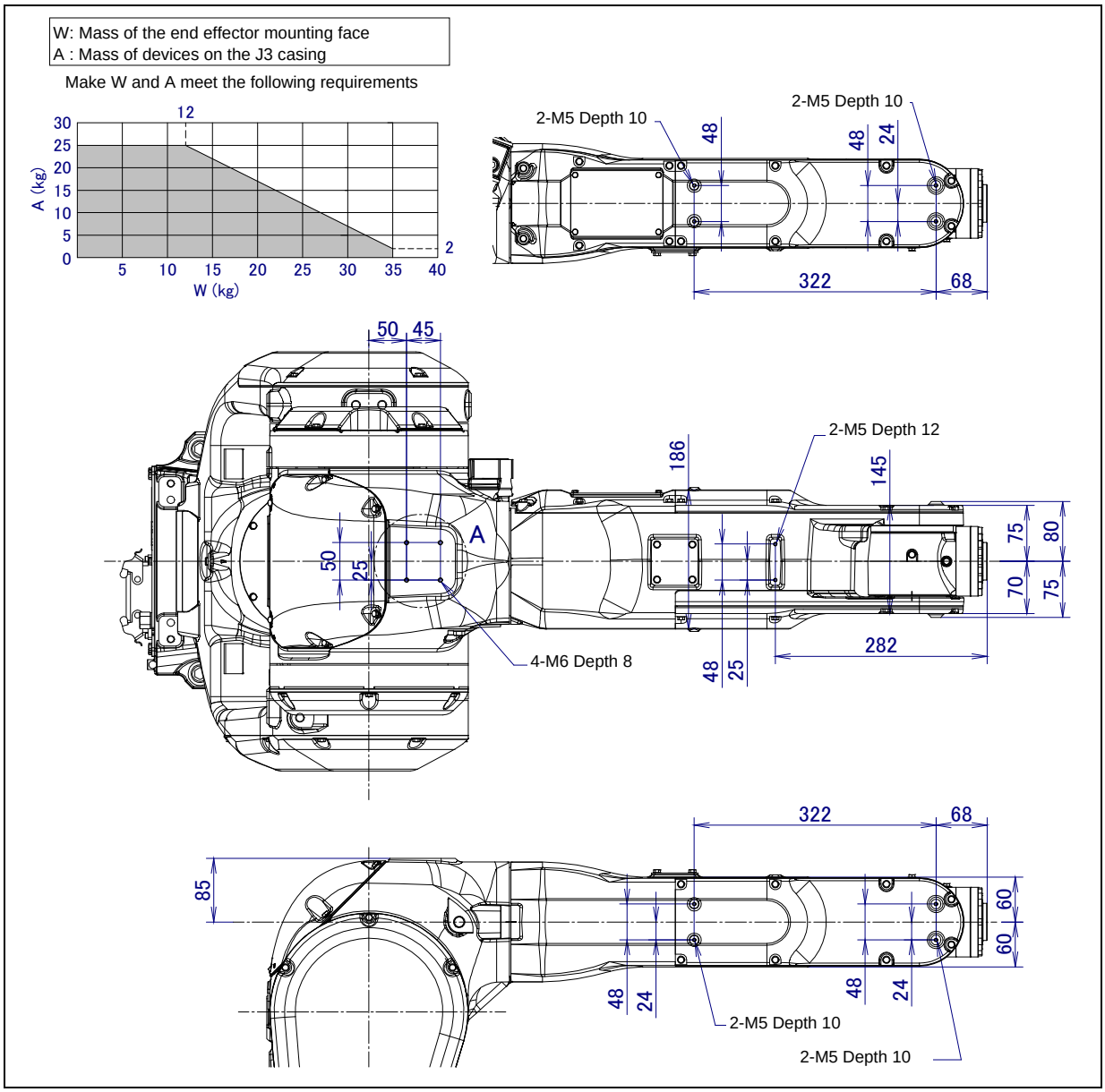


Fig. 4.2 (d) Equipment mounting faces (3/3) (M-20*i*B/35S)

4.3 LOAD SETTING

⚠ CAUTION

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

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.
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.

```
MOTION PERFORMANCE                    JOINT 10%
    Group1
No.   PAYLOAD[kg]          Comment
 1          25.00    [                    ]
 2           0.00    [                    ]
 3           0.00    [                    ]
 4           0.00    [                    ]
 5           0.00    [                    ]
 6           0.00    [                    ]
 7           0.00    [                    ]
 8           0.00    [                    ]
 9           0.00    [                    ]
10           0.00    [                    ]


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

5 Ten different pieces of payload information can be set using condition No.1 to No.10 on this screen. Place the cursor on one of the numbers, and click F3 (DETAIL). The MOTION PAYLOAD SET screen appears.

```
MOTION PAYLOAD SET                    JOINT 10%

    Group 1
 1 Schedule No[         1]:[Comment          ]
 2 PAYLOAD                [kg]          25.00
 3 PAYLOAD CENTER  X [cm]              -7.99
 4 PAYLOAD CENTER  Y [cm]               0.00
 5 PAYLOAD CENTER  Z [cm]               6.44
 6 PAYLOAD INERTIA X [kgfcms^2]         0.13
 7 PAYLOAD INERTIA Y [kgfcms^2]         0.14
 8 PAYLOAD INERTIA Z [kgfcms^2]         0.07

 [TYPE] GROUP NUMBER  DEFAULT  HELP
```

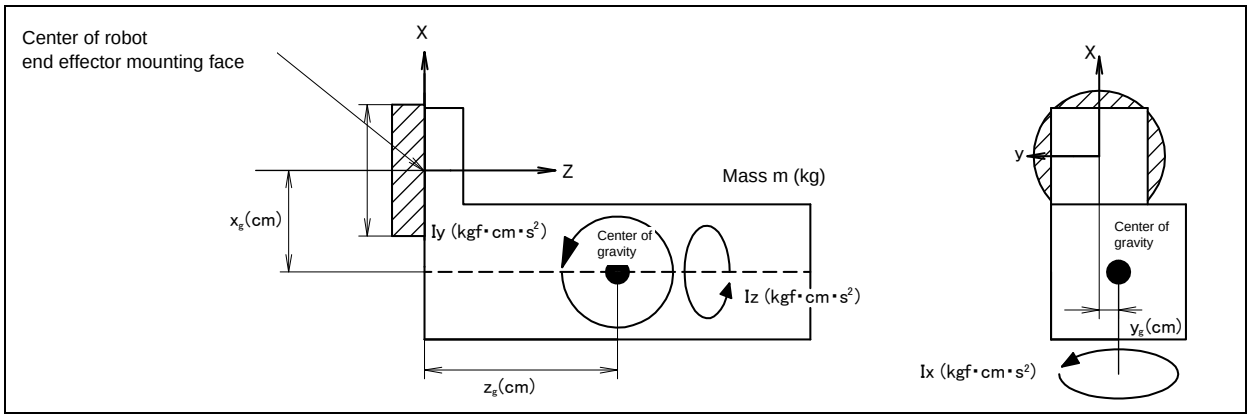


Fig. 4.3 Standard tool coordinate

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 Cycle time will change. Set it?” Respond to the message with F4 ([YES]) or F5 ([NO]).

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

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

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

```
MOTION ARMLOAD SET              JOINT   100%

   Group 1
 1 ARM LOAD AXIS #1 [kg]              0.00
 2 ARM LOAD AXIS #3 [kg]             12.00

[ TYPE ]    GROUP          DEFAULT   HELP
```

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

5 PIPING AND WIRING TO THE END EFFECTOR

⚠ WARNING

- Only use appropriately-specified mechanical unit cables.
- Do not add user cables or hoses inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit 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. 5)
- 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.

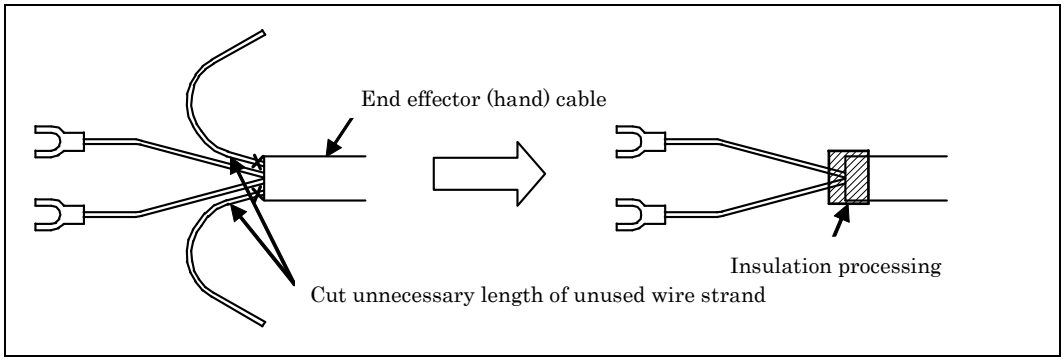


Fig. 5 Treatment method of end effector (hand) cable

5.1 AIR SUPPLY (OPTION)

Robot has air inlet and air outlet openings on the J1 base and the J3 casing used to supply air pressure to the end effector. As couplings are not supplied, it will be necessary to prepare couplings that fit the hose size. Cable clamp option (A05B-1226-K021) is prepared. Replace hexagon bolts with new ones when they are removed. When reusing hexagon bolts, be sure to wind them with seal tape.

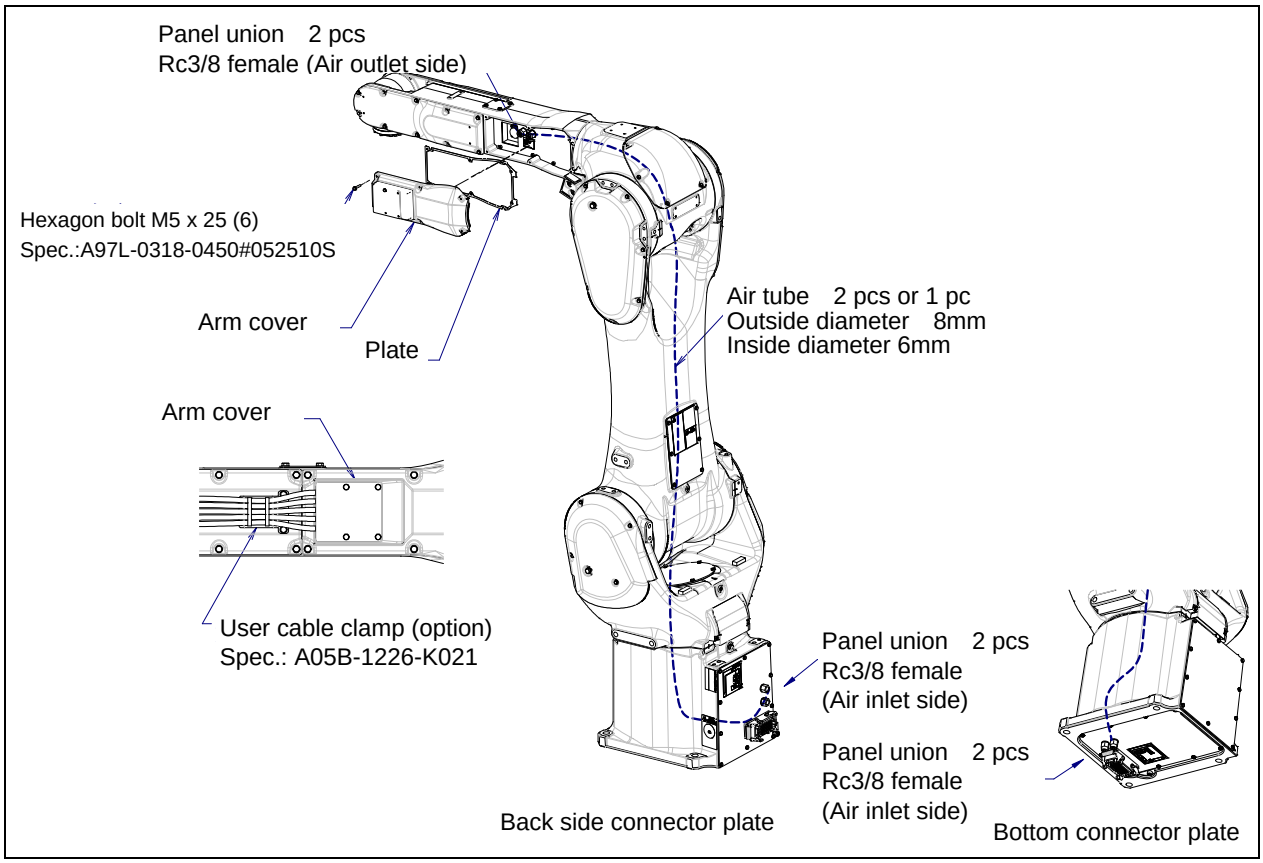


Fig. 5.1 Air supply (option)

Table 5.1 shows solenoid option. When the solenoid valve is to be replaced, the entire manifold should be replaced.

Table 5.1 Optional solenoid valves

Option spec.	Model	Description	Solenoid (Manifold) spec.	Remarks	RO
A05B-1226-H001	25/35S	Path 2 air piping, RO connector output (without solenoid valve)	—	—	—
A05B-1226-H002	25	Double solenoids x 1	A97L-0218-0137#D1 (Made by SMC)	2 position x 1	RO1 to 2
A05B-1226-H003	25	Double solenoids x 2	A97L-0218-0137#D2 (Made by SMC)	2 position x 2	RO1 to 4
A05B-1226-H004	25	Double solenoids x 3	A97L-0218-0137#D3 (Made by SMC)	2 position x 3	RO1 to 6
A05B-1226-H021	25C	Path 2 air piping, RO connector output (without solenoid valve)	—	—	—
A05B-1226-H022	25C	Double solenoids x 1	A97L-0218-0137#D1 (Made by SMC)	2 position x 1	RO1 to 2
A05B-1226-H023	25C	Double solenoids x 2	A97L-0218-0137#D2 (Made by SMC)	2 position x 2	RO1 to 4
A05B-1226-H024	25C	Double solenoids x 3	A97L-0218-0137#D3 (Made by SMC)	2 position x 3	RO1 to 6

Available section area of the solenoid valve : 11.52mm^2 (CV value : 0.64)

NOTE
1 When the air circuit is not used, reinstall the plugs as originally installed for the purpose of dust and water protection.
2 Attach an air filter with a mesh size of 5μm or better on the upstream side near the robot. Compressed air including much drainage causes valve malfunctions. Take action to prevent the entry of drainage, and also drain the air filter periodically.

5.2 AIR PIPING (OPTION)

Fig. 5.2 (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. 5.2 (b). This is outside FANUC delivery scope.

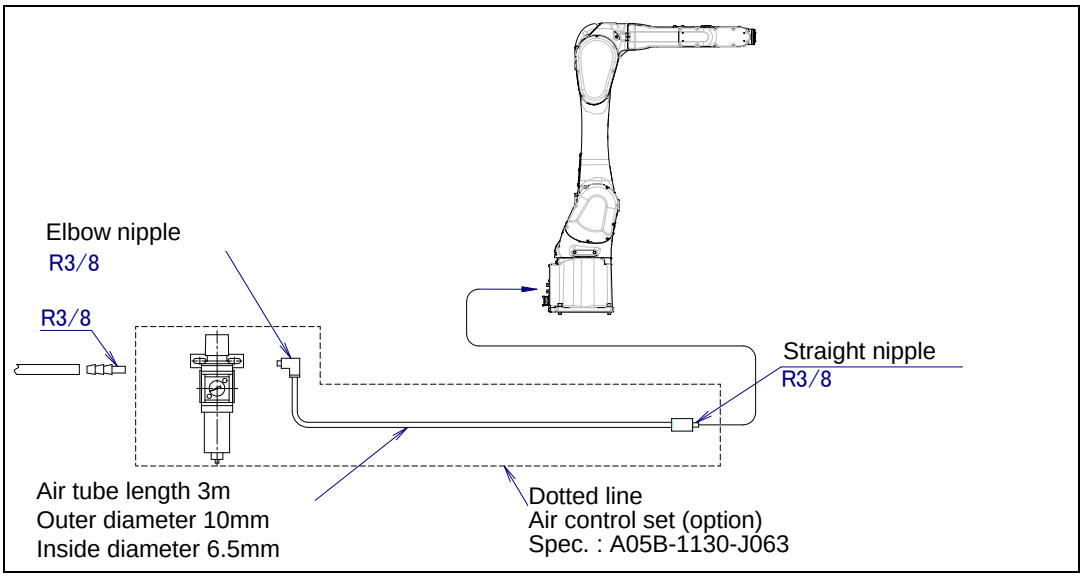


Fig. 5.2 (a) Air piping (option)

Air control set

The machine tool builder is required to prepare mounting bolts.

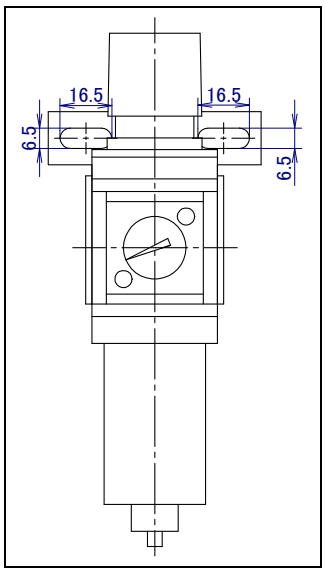


Fig. 5.2 (b) Air control set (option)

NOTE
The capacity values of the air control set are determined as follows. These values must not be exceeded.

Air pressure	Supply air pressure	0.49 to 0.69MPa(5 to 7kgf/cm^2) Setting: 0.49MPa(5kgf/cm^2)
	Amount of consumption	Maximum instantaneous amount 150Nl/min (0.15Nm^3/min)

5.3 INTERFACE FOR OPTION CABLE (OPTION)

Fig. 5.3 (a) shows the position of the option cable interface. Fig. 5.3 (b) to (d) show the option cable interface. EE interface (RI/RO), user cable (signal line usable to 3D Laser Vision sensor and force sensor), camera cable, force sensor cable, 3D Laser vision sensor cable and Ethernet cable are optional. Be sure to fix the tubes around the arm cover inlet. Cable clamp option (A05B-1226-K021) is prepared. Replace the hexagon bolts with new ones when they are removed. When reusing hexagon bolts, be sure to wind them with seal tape.

NOTE

Each option cable is written as shown below on the connector panel.

EE(RI/RO) interface	: EE
User cable usable to 3D Laser Vision sensor and force sensor	: ASi
Camera cable	: CAM
Force sensor cable	: FS
3D Laser Vision sensor cable	: 3DL
Ethernet cable	: EN

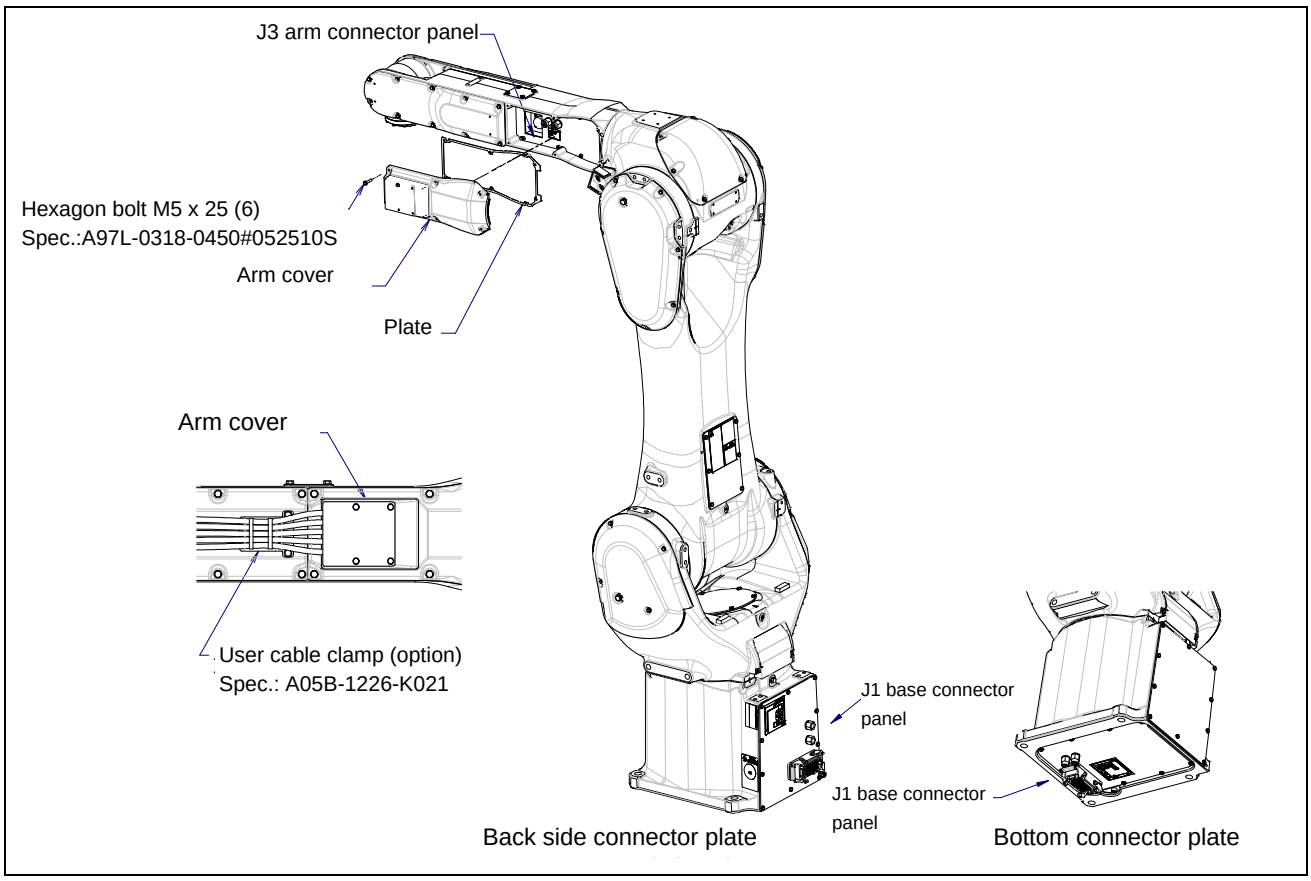


Fig. 5.3 (a) Interface for option cable (option)

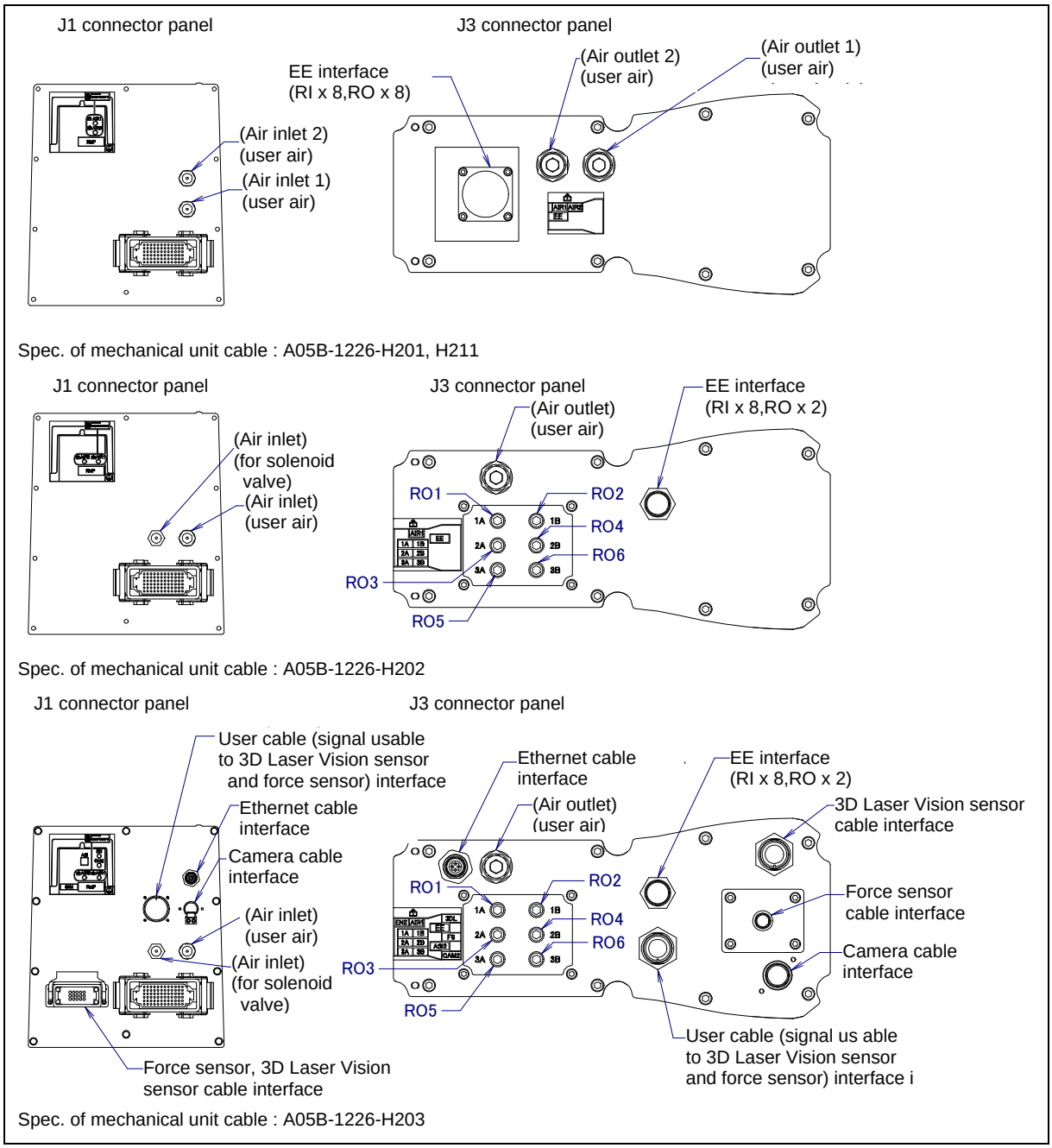


Fig. 5.3 (b) Interface for option cable (M-20*i*B/25/35S back side connector plate)

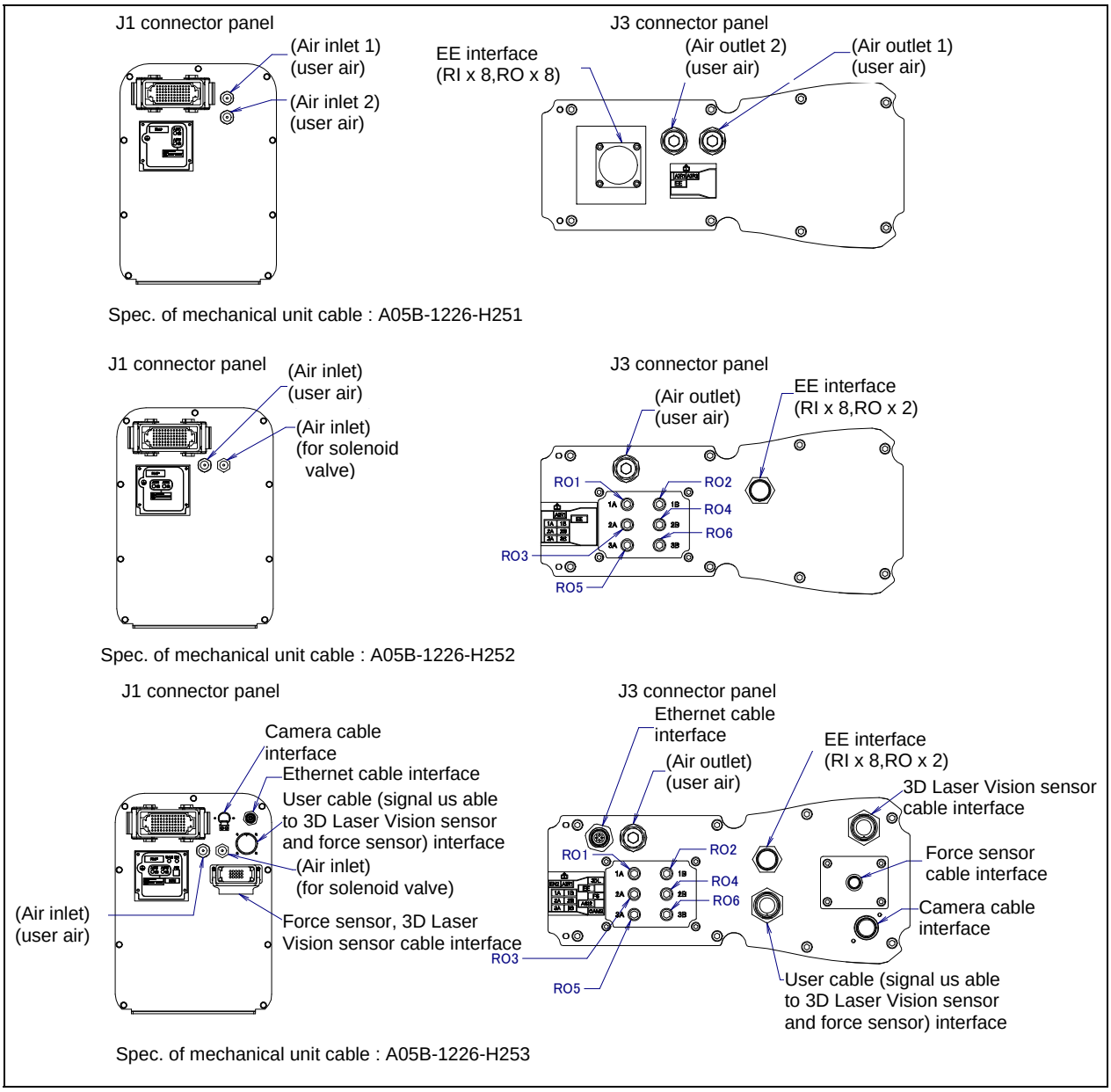


Fig. 5.3 (c) Interface for option cable (M-20*i*B/25 bottom connector plate)

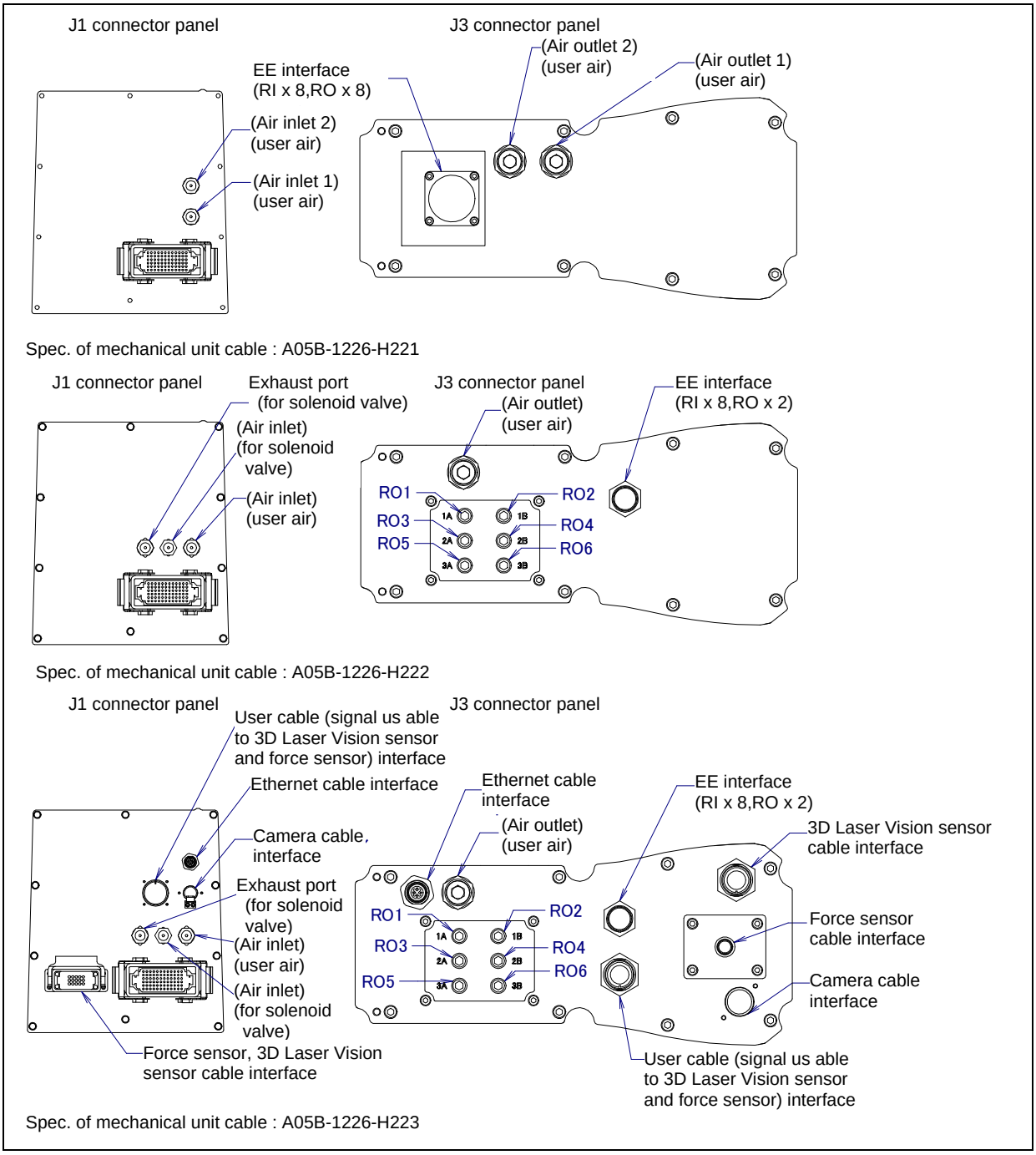


Fig. 5.3 (d) Interface for option cable (M-20*i*B/25C)

1 EE interface (RI/RO) (option)
Fig. 5.3 (e) and (f) show the pin layout for the EE interface (RI/RO).

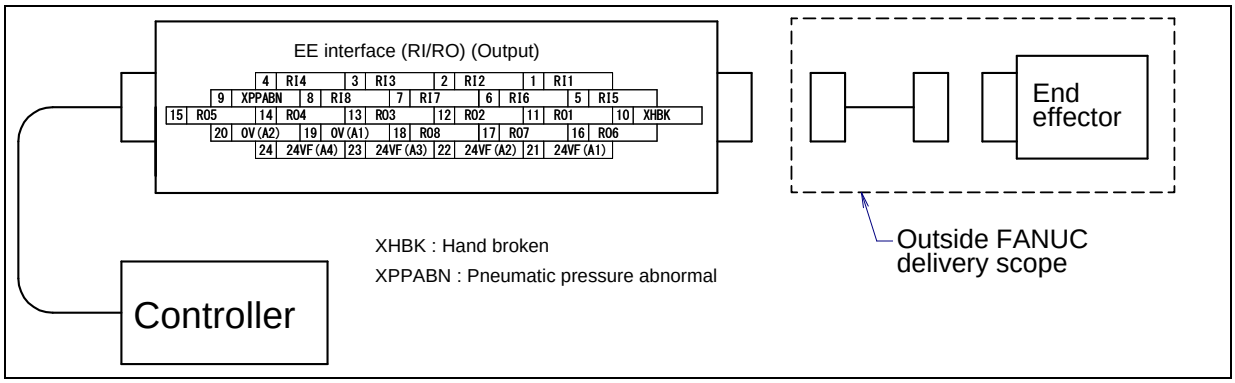


Fig. 5.3 (e) Pin layout for EE interface (RI/RO) RI/RO x 8 (option)

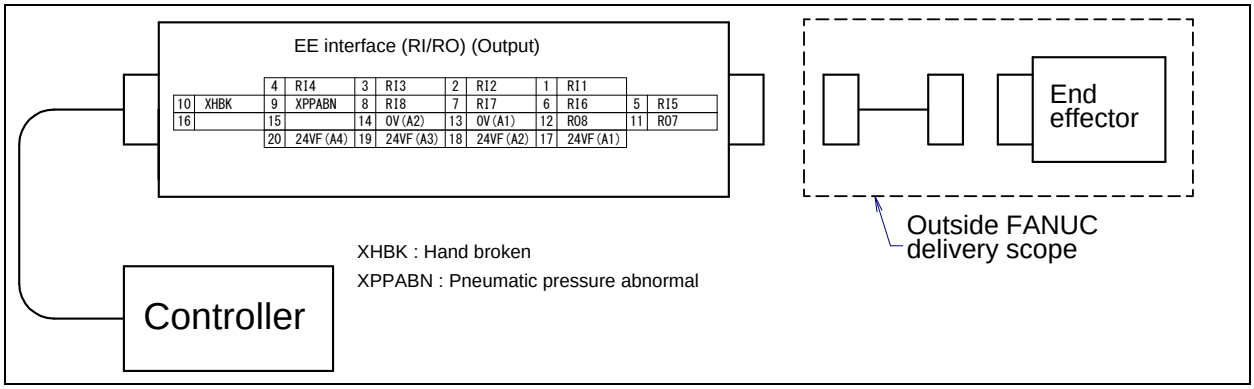


Fig. 5.3 (f) Pin layout for EE interface (RI/RO) RI x 8 /RO x 2 (option)

> ⚠ **CAUTION**
> To wire the peripheral device to the EE interface, refer to the ELECTRICAL CONNECTIONS Chapter of the CONTROLLER MAINTENANCE MANUAL.

2 User cable (signal usable to force sensor and 3D Laser Vision sensor) cable (ASi) Interface (option)
Fig. 5.3 (g) shows the pin layout for the Eternet cable interface.

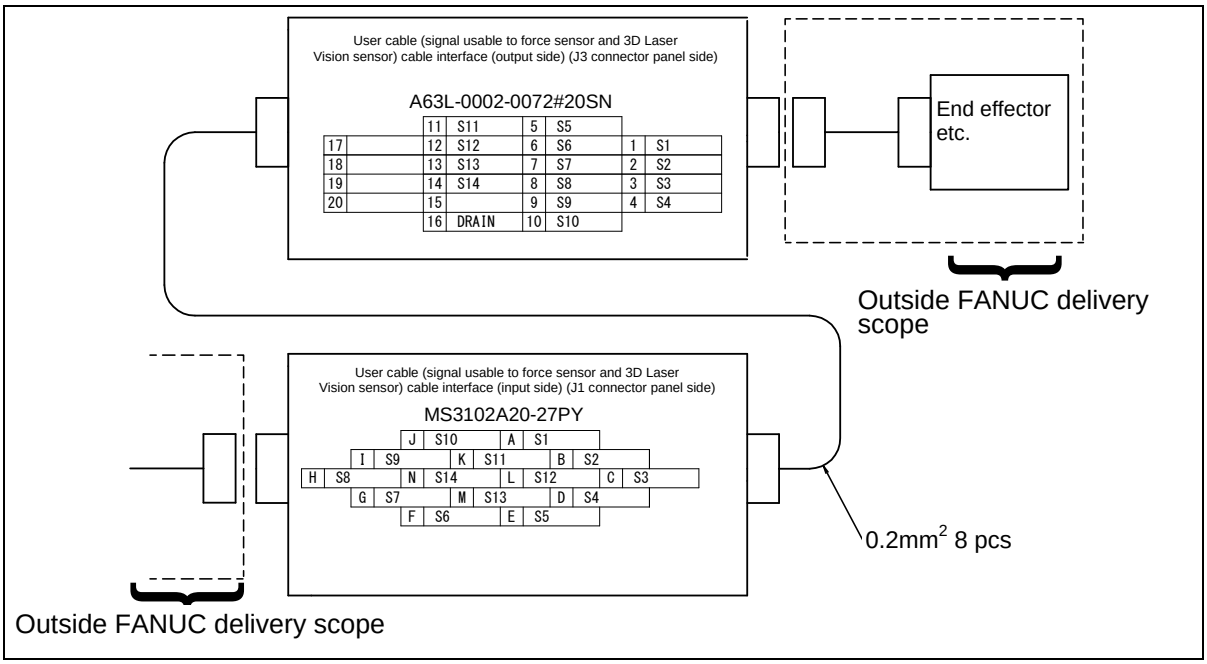


Fig. 5.3 (g) Pin layout for User cable
(signal usable to force sensor and 3D Laser Vision sensor) cable (ASi) interface (option)

3 Camera cable Interface (CAM) (option)
Fig. 5.3 (h) shows the pin layout for the camera cable interface.

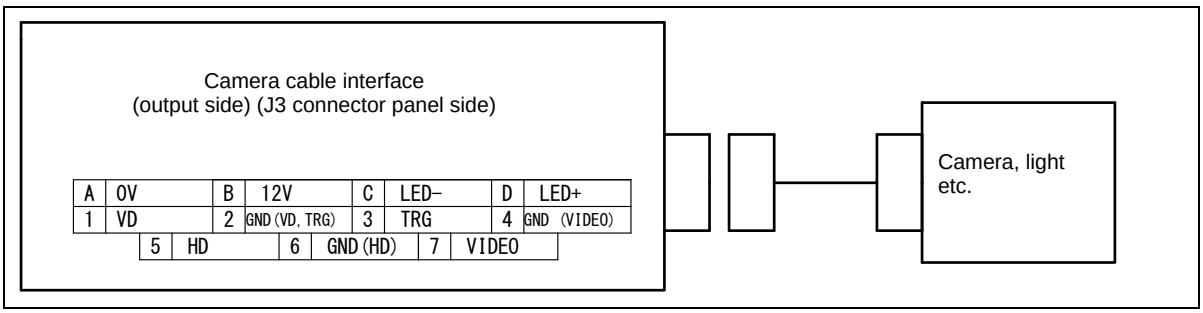


Fig. 5.3 (h) Pin layout for Camera cable interface (option)

4 3D Laser Vision sensor cable (3DL) and force sensor cable (FS) Interface (option)
Fig. 5.3 (i) shows the pin layout for the 3D Laser Vision sensor cable and force sensor cable interface.

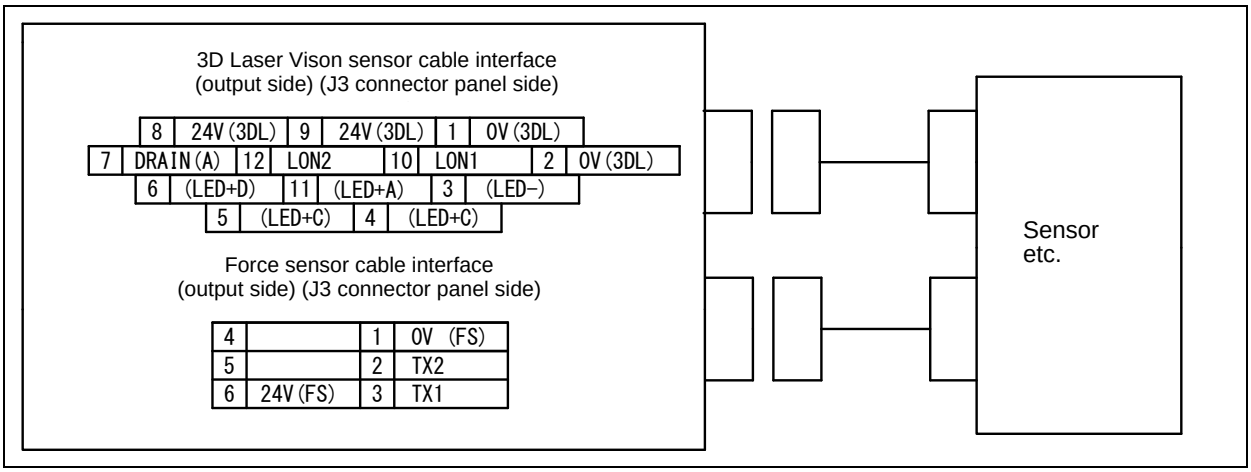


Fig. 5.3 (i) Pin layout for 3D Laser Vision sensor cable (3DL) and force sensor cable (FS) interface (option)

5 Eternet cable Interface (EN)(option)
Fig. 5.3 (j) shows the pin layout for the Eternet cable interface.

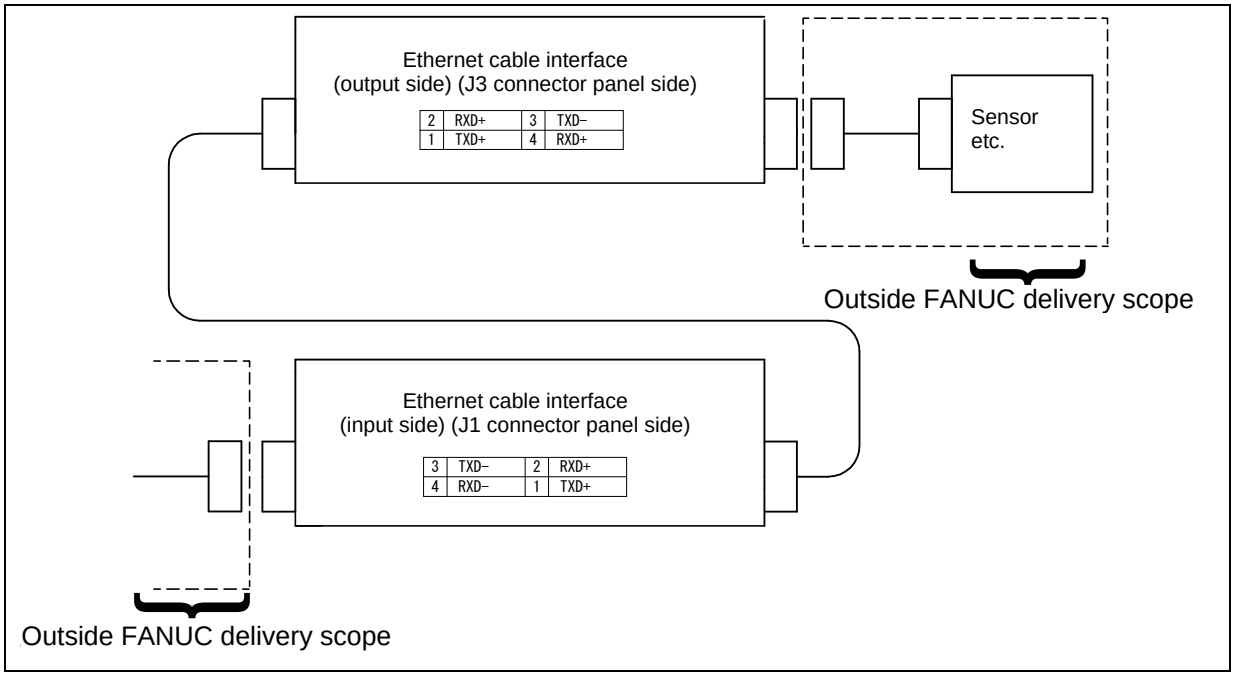


Fig. 5.3 (j) Pin layout for Eternet (EN) cable interface (option)

Connector specifications

Table 5.3 (a) Connector specifications (User side)

Cable name	Input side (J1 connector panel)		Output side (J3 connector panel)	
EE (RI/RO x 8)	————		Connector: A05B-1226-K003 Connector & cable (2m) : A05B-1226-K001 Maker (Hirose Electric Co., Ltd.) spec. Connector : JR25WP-24P(71) Clamp : JR25WCC-8(71)	
EE (RI x 8, RO x 2)	————		Connector : A05B-1226-K004 Connector & cable (2m) : A05B-1226-K002 Maker (Hirose Electric Co., Ltd.) spec. Connector : HR22-12WTLP-20P(73) Clamp : JR13WCCA-8(72)	
ASi	Connector: A05B-1226-K005 Metal cap for connector: A05B-1226-K061 (set for J1 &J3) Maker (Fujikura) spec. Connector : D/MS3106A20-27SY(D190) Bush : CE02-20BS-S-D Clamp : CE3057-12A-3-D		Connector : A05B-1226-K006 Maker (Hirose Electric Co., Ltd.) spec. Connector : RM15WTLP-20P Clamp : JR13WCCA-9(72)	
CAM	————		Camera cable (2m) : A05B-1226-K041 Camera cable (2m, with LED) : A05B-1226-K046 Metal cap for connector : A05B-1226-K062 (set for J1&J3)	
FS	————		Force sensor cable (2m) : A05B-1226-K051 Metal cap for connector : A05B-1226-K063 (set for J1&J3)	
3DL	————		3DL sensor cable (2m) : A05B-1226-K056 Metal cap for connector : A05B-1226-K063 (set for J1&J3)	
EN	Connector	Maker (HARTING) spec. 21 03 882 1415	Connector	Maker (HARTING) spec. 21 03 882 1415
	Contact	Maker (HARTING) spec. 09 67 000 7576 AWG 28-24 5576 AWG 26-22 8576 AWG 24-20 3576 AWG 22-18	Contact	Maker (HARTING) spec. 09 67 000 7576 AWG 28-24 5576 AWG 26-22 8576 AWG 24-20 3576 AWG 22-18

Table 5.3 (b) Connector specifications

Cable name	Input side (J1 connector panel)	Output side (J3 connector panel)	Maker/dealer
EE (RI/RO x 8)	———	A63L-0002-0210#25WR24S	Hirose Electric Co. Ltd.
EE (RI x 8,RO x 2)	———	A63L-0001-0509#200S	
ASi	MS3102A20-27PY	A63L-0002-0072#20SN	Fujikura.Ltd, Japan Aviation Electronics Industry, Ltd. etc

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

User side cable specification

Table 5.3 (c) User cable specifications

Cable name	Specifications	Remarks
EE (RI/RO x 8)	A05B-1226-K001	Between J3 arm and hand length 2000mm
EE (RI x 8,RO x 2)	A05B-1226-K002	
CAM	A05B-1226-K041	
	A05B-1226-K046	Between J3 arm and hand length 2000mm with LED
FS	A05B-1226-K051	Between J3 arm and hand length 2000mm
3DL	A05B-1226-K056	

6 AXIS LIMIT SETUP

When axis limits are defined, the motion range of the robot can be changed from the standard value. The motion range of the robot axes can be restricted because of:
- Used motion range limitations
- Tools and peripheral equipment interfere each other in some areas.
- Length of the cable or hose attached to the application is limited.

Two methods are provided not to exceed the motion range of the robot:
- Axis limit software settings (All axes)
- Axis limit adjustable mechanical stopper (J1-axis (option))

⚠ WARNING
1 Changing the motion range of any axis affects the operating range of the robot. To avoid trouble, carefully consider any possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition will occur; for example, an alarm may occur in a previously taught position.
2 To limit the motion range, for J1-axis, use adjustable mechanical stoppers, for J2/J3-axis, use DCS function so that damage to peripheral equipment and injuries to human bodies can be avoided.
3 Mechanical stoppers are physical obstacles. For J1 -axis, it is possible to re-position the adjustable mechanical stoppers. But the robot cannot move beyond them. For J2/J3-axis, the mechanical stoppers are fixed. For the J4/J5/J6-axes, only DCS-specified limits are available.
4 Adjustable mechanical stoppers (J1-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.

6.1 CHANGE AXIS LIMIT BY DCS (OPTION)

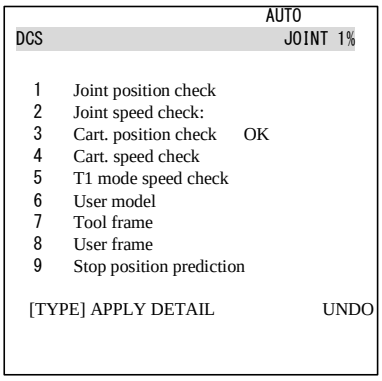
The robot motion can be restricted with DCS (Dual check safety) function by using the following software. For J2/J3-axis, the same effect as J1-axis adjustable mechanical stopper can be obtained.
The robot motion can be restricted at any angle and position if it is in robot motion area. DCS functions are certified to meet the requirements of International Standard ISO13849-1 and IEC61508 approved by certificate authority. If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot's momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the workspace. To stop the robot within the robot workspace, use the DCS Stop Position Prediction function. The stop position prediction is disabled by default.

・ DCS position/speed check function (J567)

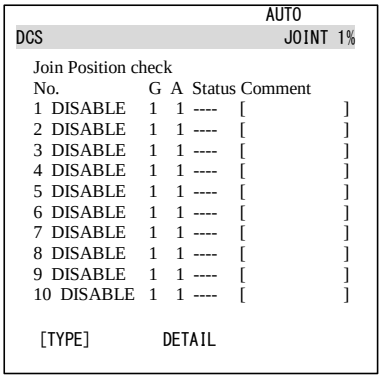
As an example, we shows the procedure to set $\pm 30^{\circ}$ for J2-axis in here. Refer to R-30*i*B/ R-30*i*B Mate Controller Dual check safety function Operator's Manual (B-83184EN) for details of other setting, function and DCS stop position prediction.

Setting procedure

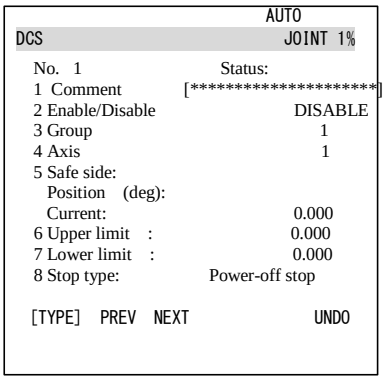
1 Press the [MENU] key to display the screen menu.
2 Press [0 NEXT] and press [6 SYSTEM].
3 Press the F1 (]TYPE]).
4 Select [DCS]. The following screen will be displayed.



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

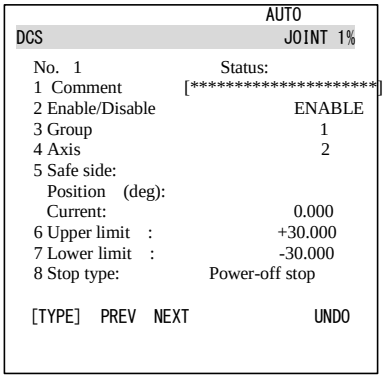


6 Move the cursor to [1], then press the [DETAIL].

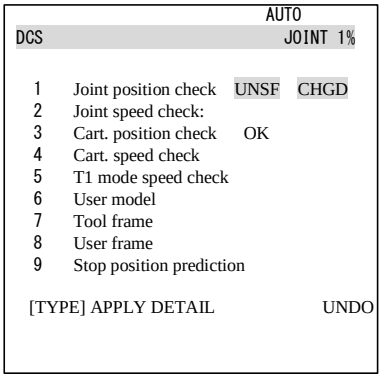


7 Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
8 Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
9 Move the cursor to [Axis], then input “2”, then press the [ENTER] key.
10 Move the cursor to [Upper limit] right side, then input “30”, then press the [ENTER] key.
11 Move the cursor to [Lower limit] right side, then input “-30”, then press the [ENTER] key.

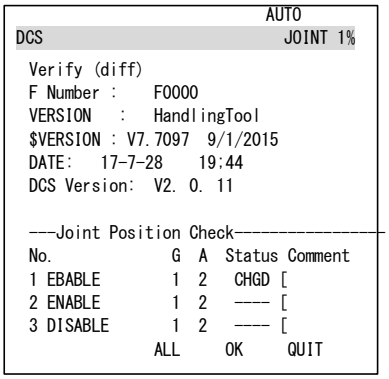
> ⚠ **WARNING**
> If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot’s momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the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



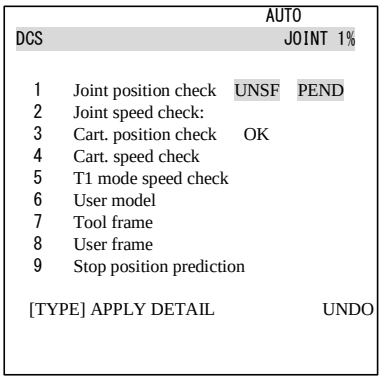
12 Press the [PREV] key two times, back to the first screen.



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



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



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

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

6.2 ADJUSTABLE MECHANICAL STOPPER SETTING (OPTION)

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

Item		Movable range
J1-axis adjustable mechanical stopper	Upper limit	Settable in steps of 15° degrees in a range of +15° to +165° degrees
	Lower limit	Settable in steps of 15° degrees in the range of -165° to -15° degrees

NOTE
1 If the newly set operation range does not include 0°, you must change it by zero degree mastering so that 0° is included.
2 When adjustable mechanical stopper is ordered, mounting bolt is attached.
3 When motion range is changed by movable mechanical stopper, be sure to set the motion range of soft same refer to Subsection 6.2.2.

6.2.1 Installing adjustable mechanical stopper option

J1-AXIS STROKE MODIFICATION

A stroke modification can be performed at an arbitrary position in steps of 15° within the range -165° to +165°.
Install the adjustable mechanical stopper referring to Fig. 6.2.1 (a), (b).

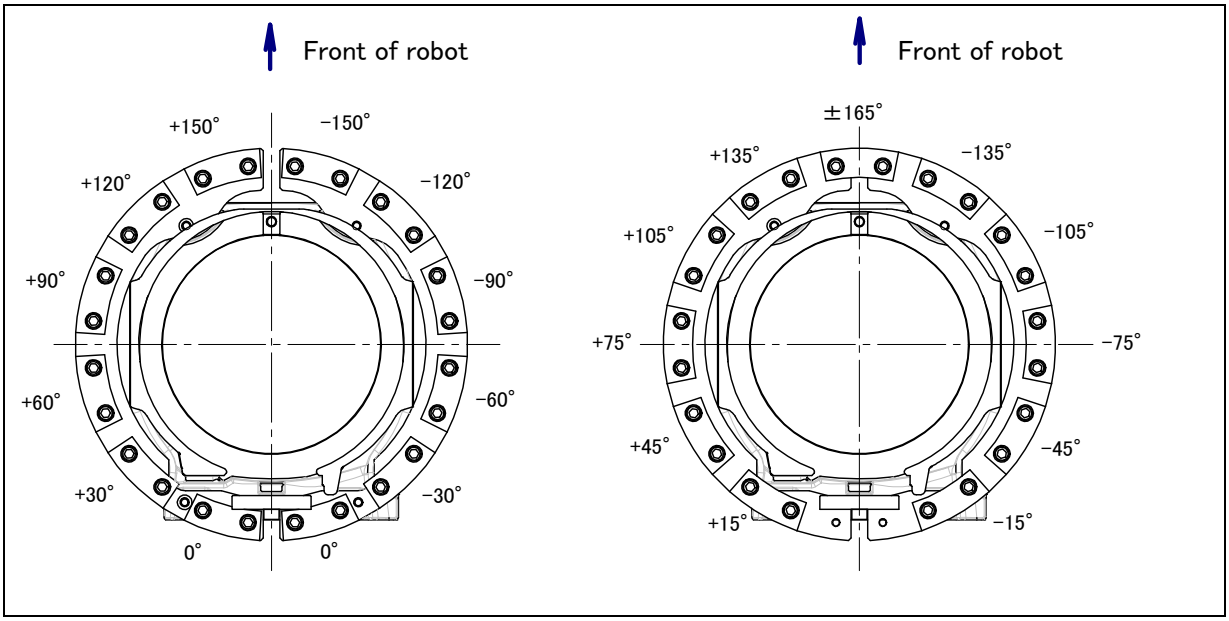


Fig. 6.2.1 (a) Changing the J1-axis stroke

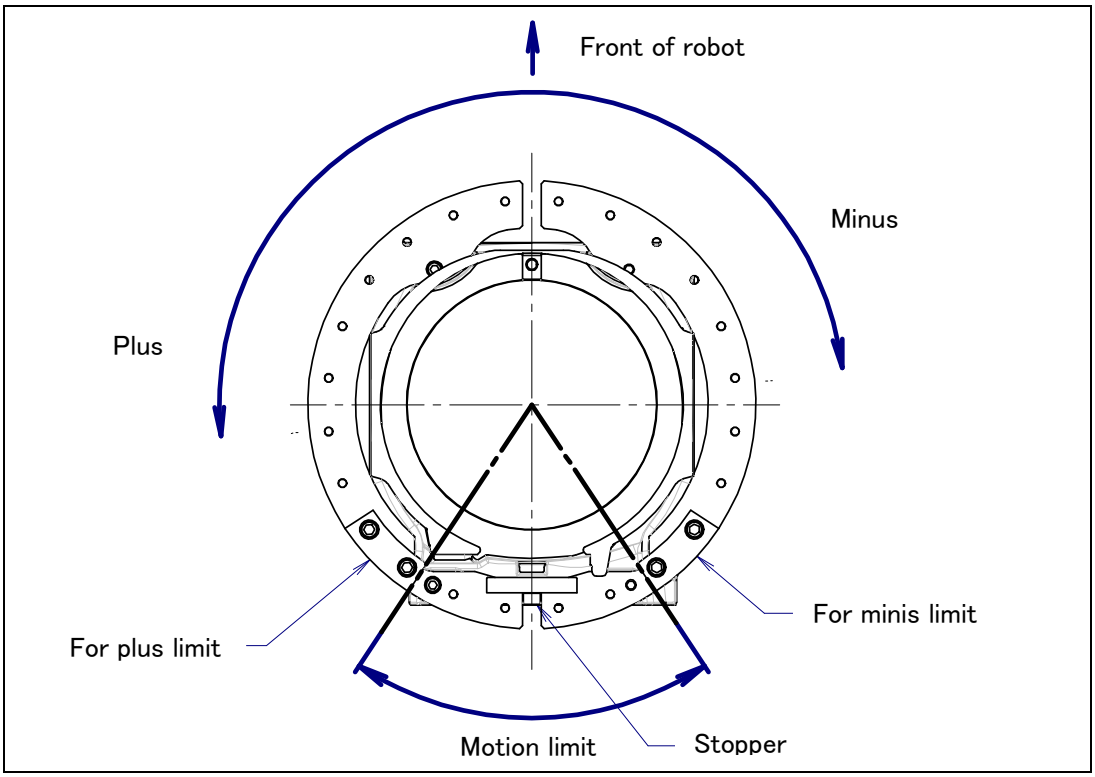
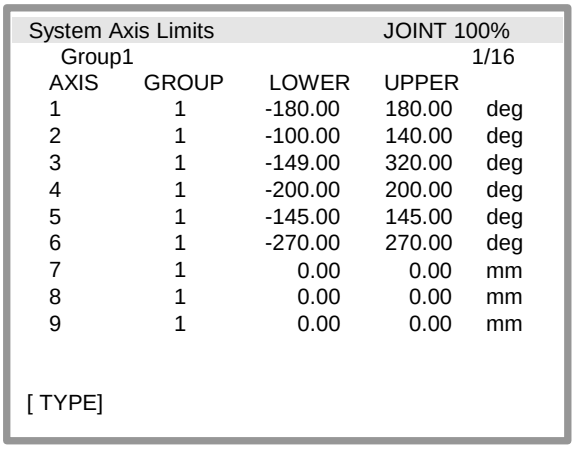


Fig. 6.2.1 (b) Mechanical stopper and motion limit of J1-axis

6.2.2 Changing the parameter setting

Setting 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 [Axis Limits]. The following screen will be displayed.



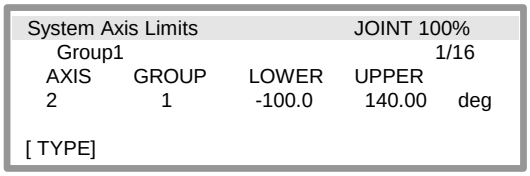
System Axis Limits JOINT 100%
Group1 1/16

AXIS	GROUP	LOWER	UPPER	
1	1	-180.00	180.00	deg
2	1	-100.00	140.00	deg
3	1	-149.00	320.00	deg
4	1	-200.00	200.00	deg
5	1	-145.00	145.00	deg
6	1	-270.00	270.00	deg
7	1	0.00	0.00	mm
8	1	0.00	0.00	mm
9	1	0.00	0.00	mm

[TYPE]

NOTE
0.00 indicates the robot does not have these axes.

5 Move the cursor to the axis limit to be set. Type the new value using the numeric keys on the teach pendant. In this time, set the axial upper limit and the lower limit at the position same as adjustable mechanical stoppers are attached.



System Axis Limits JOINT 100%
Group1 1/16

AXIS	GROUP	LOWER	UPPER	
2	1	-100.0	140.00	deg

[TYPE]

6 Turn off the controller and then turn it back on again in the cold start mode so the new information can be used.

⚠ WARNING
1 You must turn off the controller and then turn it back on to use the new information; otherwise, the old settings remain valid and could cause personnel injury or equipment damage.
2 After changing system variables, be sure to run the robot at a low speed and make sure that the robot stops at the ends of the stroke.
3 If a collision should occur, the adjustable mechanical stopper becomes deformed to absorb energy, so that the robot can stop safely. If the stopper is deformed by mistake, replace it.
4 Do not depend on parameter settings to control the motion range of your robot.

7 CHECKS AND MAINTENANCE

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

NOTE
The periodic maintenance procedures described in this chapter assume that the FANUC robot is used for up to 3840 hours a year. In cases where robot use exceeds 3840 hours/year, adjust the given maintenance frequencies accordingly. The ratio of actual operating time/year vs. the 3840 hours/year should be used to calculate the new (higher) frequencies. For example, when using the robot 7680 hours a year, the maintenance frequency should be doubled – i.e. the time interval should be divided by 2.

7.1 PERIODIC MAINTENANCE

7.1.1 Daily Checks

Clean each part, and visually check component parts for damage before daily system operation. Check the following items when necessary.

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is oil seepage, clean it. **⇒"7.2.1 Confirmation of Oil Seepage"**
Air control set	(When air control set is used) **⇒"7.2.2 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: **⇒"9.1 TROUBLESHOOTING"(symptom : Vibration, Noise)**
Positioning accuracy	Check that the taught positions of the robot have not deviated from the previously taught positions. If displacement occurs, perform the measures as described in the following section: **⇒"9.1 TROUBLESHOOTING"(symptom: Displacement)**
Peripheral devices for proper operation	Check whether the peripheral devices operate properly according to commands from the robot and the peripheral devices.
Brakes for each axis	Check that the end effector drops 5 mm or less when the servo power is turned off. If the end effector (hand) drops more than the prescribed amount, perform the measures as described in the following section: **⇒"9.1 TROUBLESHOOTING"(symptom : Dropping axis)**
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: **⇒" OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)"**

7.1.2 Periodic Checks and Maintenance

Check the following items at the intervals recommended below based on 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	2 years 7680h	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 the dust if it exists.	18
	○					Check for external damage or peeling paint	Check whether the robot has external damage or peeling paint due to interference with the peripheral devices. If an interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.	2
	○ Only 1st check	○				Check for damages to the teach pendant cable, the operation box connection cable or the robot connection cable	Check whether the cable connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.	17
	○ 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.	3
	○ Only 1st check	○				Check the connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"7.2.3 Check the Mechanical Unit Connectors"**	4
	○ Only 1st check	○				Retightening the end effector mounting bolts	Retighten the end effector mounting bolts. Refer to the following section for tightening torque information: **⇒"4.1 END EFFECTOR INSTALLATION TO WRIST"**	5

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	2 years 7680h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Retightening the external main bolts	Retighten the bolts which were installed or removed during the inspection and exposed. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. Tightening the bolts with a torque greater than what is recommended might damage the adhesive. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts. **⇒"APPENDIX B, STRENGTH OF BOLT AND BOLT TORQUE LIST"**	6
	○ 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. **⇒"7.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"**	7
	○ 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, around the welding torch, conduit part, wrist axis hollow part and the cable protective sleeve). Insulation failure might occur when spatter has collected around the wrist flange or welding torch, and there is a possibility of damaging the robot mechanism by the welding current. (See Appendix C)	8
		○				Replacing the mechanical unit batteries	Replace the mechanical unit batteries **⇒"7.3.1 Replacing the Batteries"**	9
			○ (*)	○ (*)		Replacing the grease of J1 to J3- axis reducers	Replace the grease and oil of each axis reducer and gearbox (*) Periodic interval differs according to the model. 25C : 2 years (7680 hours) 25/35S : 3 years (11520 hours) **⇒"7.3.2 Replacing the Grease of the J1 to J3 axis Reducers"**	10 to 12
			○ (*)		○ (*)	Supplying grease to J4 to J6- axis reducers	Grease J4 to J6- axis reducers (*) Periodic interval differs according to the model. 25C : 2 years (7680 hours) 25/35S : 4 years (15360 hours) **⇒"7.3.3 Grease Supplying Procedure for J4 to J6-axis Reducer"**	13 to 15
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	16
					○	Replacing the controller batteries	Replace the controller batteries **⇒Chapter 7 Replacing batteries of R-30*i*B/ R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) or R-30*i*B Mate / R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)"**	19

7.2 CHECK POINTS

7.2.1 Confirmation of Oil Seepage

Check items

Check whether there is oil on the sealed part of each joint. If there is oil seepage, clean each part.

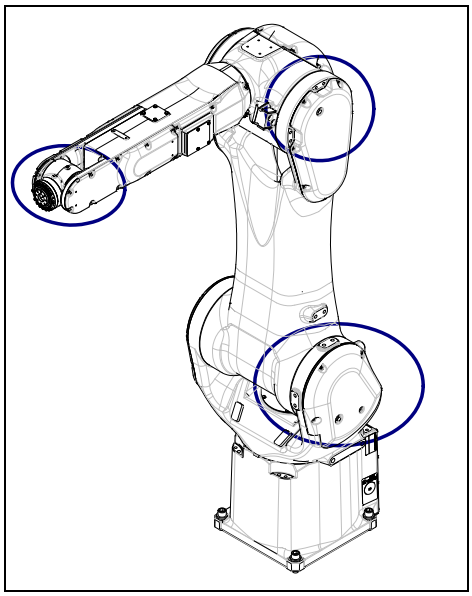


Fig. 7.2.1 Check parts for oil seepage

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil viscosity changes, the oil might drip depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components in Fig. 7.2.1 before you operate the robot.
- In case of oil seepage, please consider replacing the grease and the oil altogether. This replacement potentially can help improve the seepage situation.
- Also, motors might become hot and the internal pressure of the grease bath or oil bath may increase 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 7.3.2 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.

  ⇒"9.1 TROUBLESHOOTING"(symptom : Grease leakage)

7.2.2 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 air pressure using the pressure gauge on the air control set as shown in Fig.7.2.2. If it does not meet the specified pressure of 0.49MPa (5 kgf/cm^2), adjust it using the regulator pressure setting handle.
2	Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts, as required.
3	Drain	Check drain and release it. If the quantity of the drained liquid is significant, examine the setting of the air dryer on the air supply side.

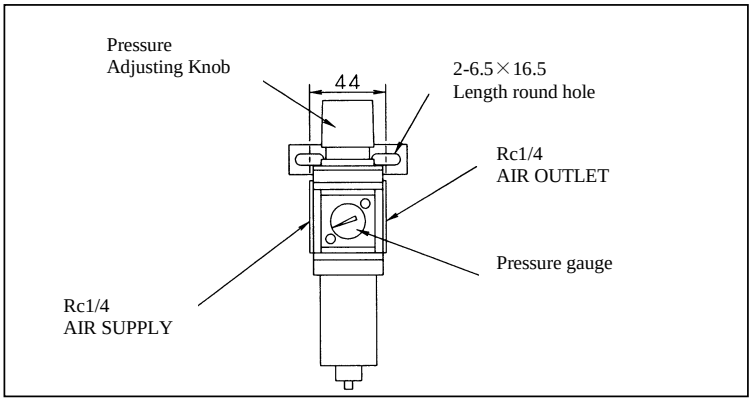


Fig. 7.2.2 Air control set (option)

7.2.3 Check the Mechanical Unit Connectors

Inspection points of the connectors

- Robot connection cables, earth terminal and user cables

Check items

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

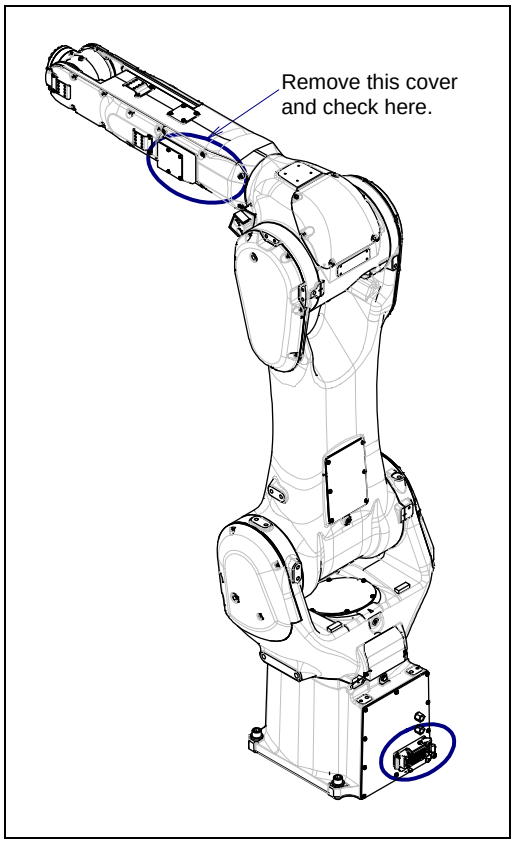


Fig. 7.2.3 Connector Inspection points

7.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check that there is no evidence of a collision on the fixed mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace it with a new one.
- Check the tightness of the stopper mounting bolts. If they are loose, retighten them.
- Refer to Section 6.2 for details regarding the adjustable mechanical stopper.

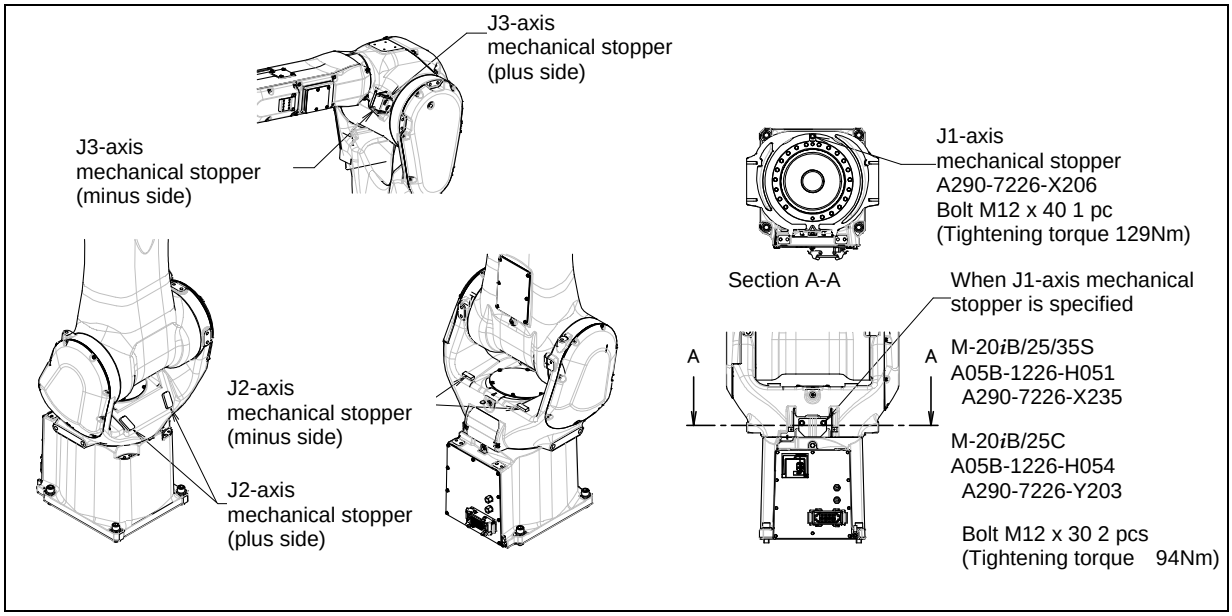


Fig. 7.2.4 Check of fixed mechanical stopper and adjustable mechanical stopper

7.3 MAINTENANCE

7.3.1 Replacing the Batteries (1.5 year checks)

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

Procedure for replacing the battery

1 Move the robot to the posture to remove the battery part cover.
2 Keep the power on. Press the EMERGENCY STOP button to stop robot motion.
3 Remove the hexagon stainless bolts (M5 x 14), then remove the cover and the gasket. If the cover could not be removed, insert a straight-head screwdriver into the arrow part, then remove it.

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

4 Remove the battery case cap. (Fig. 7.3.1)
5 Take out the old batteries from the battery case. At this time, the battery can be taken out by pulling the stick in the center of the battery box.
6 Insert new batteries into the battery case. Pay attention to the direction of the batteries.
7 Close the battery case cap.
8 Replace hexagon bolts by new article when they are removed. When reusing hexagon bolts, be sure to wind it with seal tape. Gaskets can be reused.

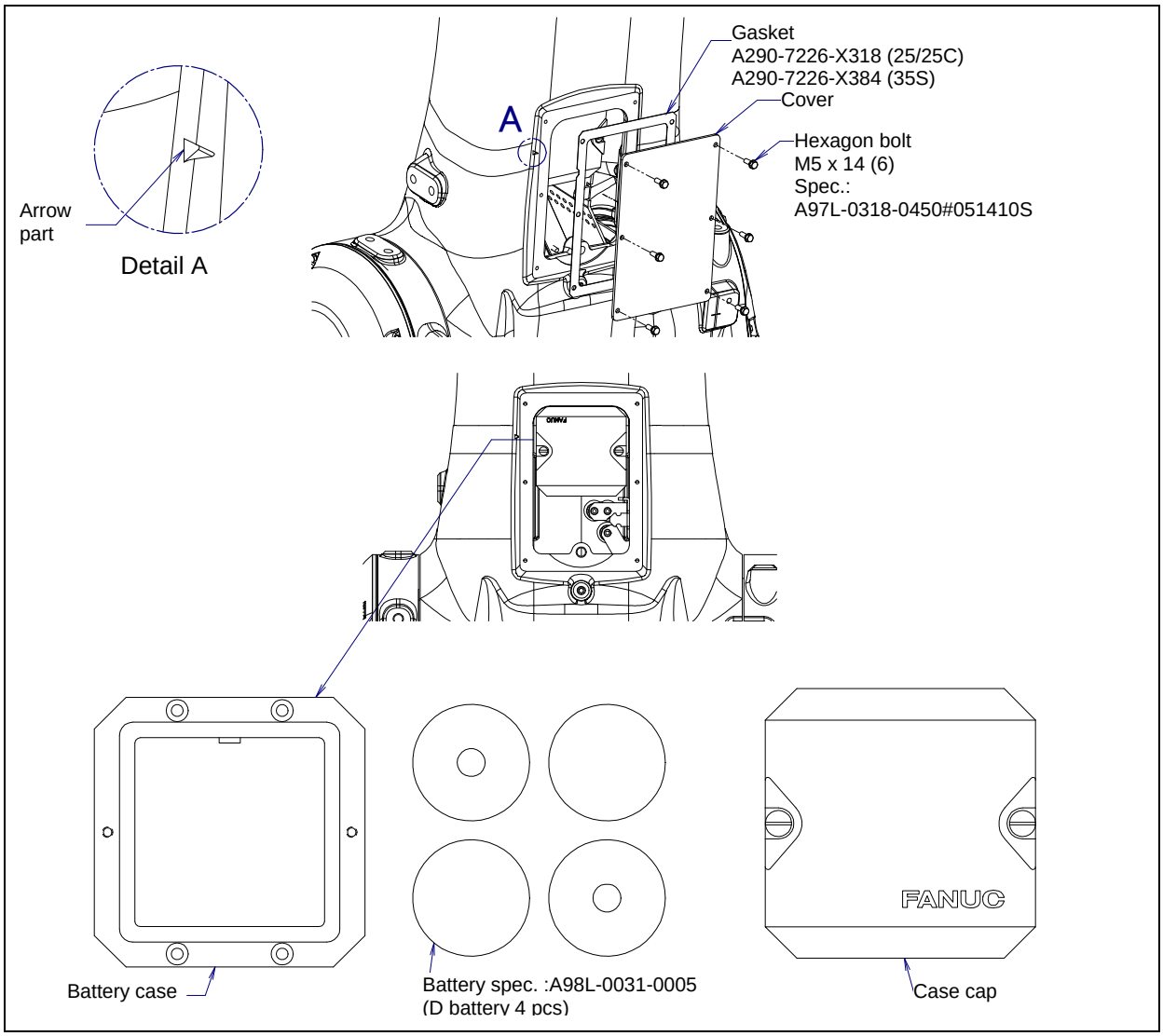


Fig. 7.3.1 Replacing the battery

7.3.2 Replacing the Grease of the J1 to J3 Axis Reducers (3 years (11520 hours) or 2 years (7680 hours) checks)

For M-20*i*B/25, according to Table 7.3.2 (a) and (b), replace the grease of the reducers of J1, J2, and J3 axes every 3 years or 11520 hours, whichever comes first.
For M-20*i*B/25C, according to Table 7.3.2 (a) and (b), replace the grease of the reducers of J1, J2, and J3 axes every 2 years or 7680 hours, whichever comes first.

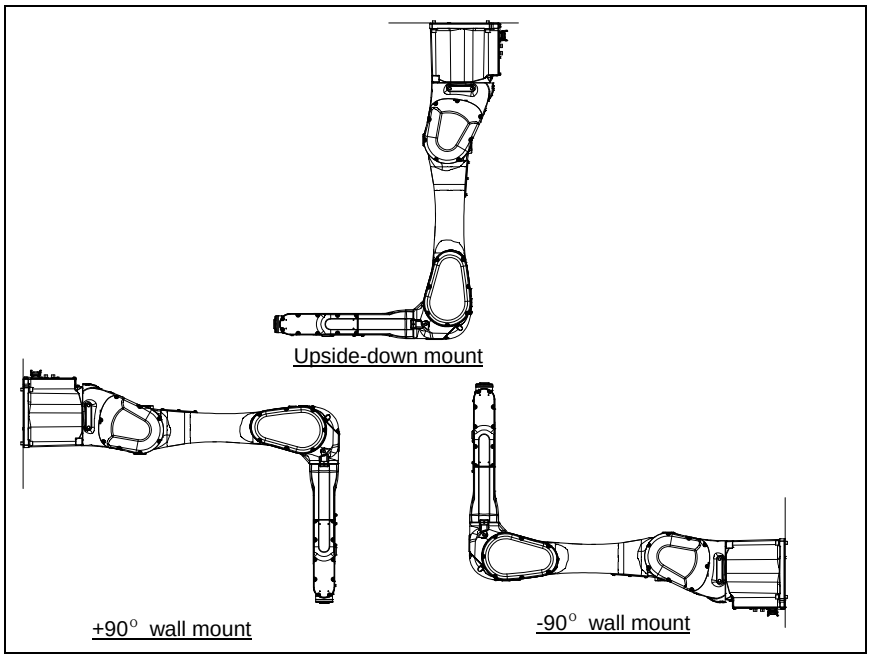


Fig. 7.3.2 (a) Installation method

Table 7.3.2 (a) Grease name and amount to be replaced at regular intervals of three years (11520 hours) or two years (7680 hours) (J1/J2/J3-axis reducer)

Grease supplying position	Amount of grease to be applied	Gun tip pressure	Specified grease
J1-axis reducer	790g (870ml)	0.1MPa or less (NOTE)	M-20*i*B/25/35S Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174) M-20*i*B/25C Shell Cassida grease EPS00 (Specification: A98L-0040-0186)
J2-axis reducer	300g (330ml)		
J3-axis reducer	170g (190ml)		

NOTE
When using a hand pump, apply grease at a rate of approximately once per two 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 in Table 7.3.2 (b).
For angle mount robots, consider the relative angle from the posture of a floor mount robot.

Table 7.3.2 (b) Grease supplying posture (J1/J2/J3-axis reducer)

Grease supplying position		Posture					
		J1	J2	J3	J4	J5	J6
J1-axis reducer grease supplying posture	Floor mount	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
	Upside-down mount						
	Wall mount -90°						
	Wall mount +90°						
J2-axis reducer grease supplying posture	Floor mount)		0°	Arbitrary			
	Upside-down mount		-90°				
	Wall mount -90°		90°				
	Wall mount +90°		-90°				
J3-axis reducer grease supplying posture	Floor mount		0°	0°			
	Upside-down mount		0°	180°			
	Wall mount -90°		0°	0°			
	Wall mount +90°		0°	0°			

1 Move the robot to the greasing posture described in Table.7.3.2 (b).
2 Turn off controller power.
3 Remove the hexagon bolt M8 x 10 from grease outlet. (Fig.7.3.2 (b))
4 Remove the taper plug from grease inlet and attach grease nipple.
5 Keep greasing until the new grease pushes out the old grease and comes out from each grease outlet.
6 Release the remaining pressure using the procedure given in Subsection 7.3.2.1. In case of Upside-down mount, pull out about 130ml grease to make space of grease bath.

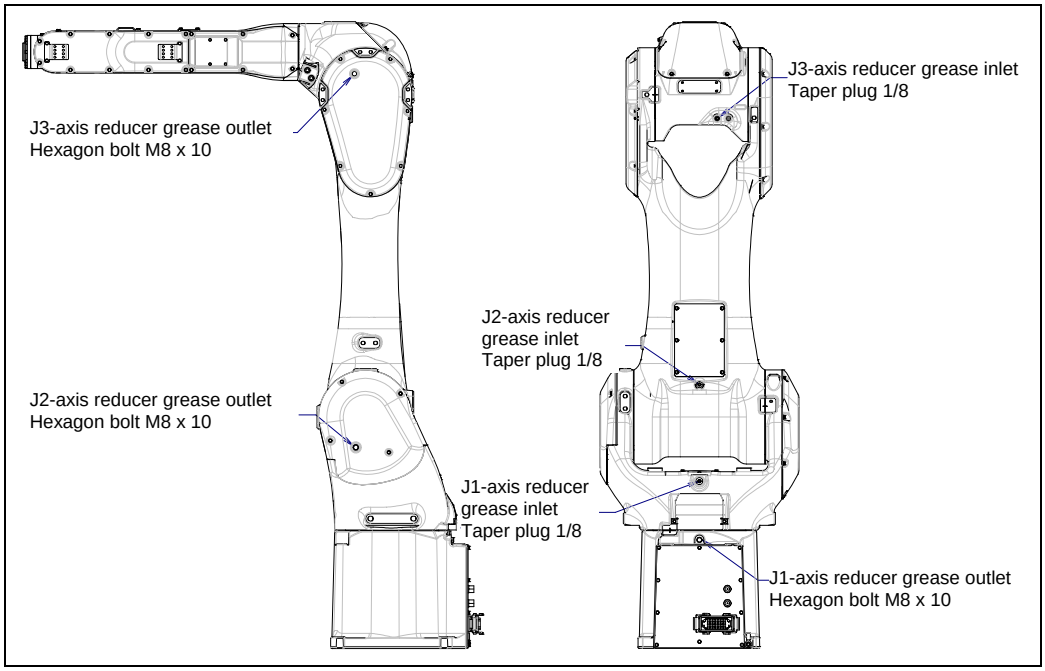


Fig. 7.3.2 (b) Greasing point of J1 to J3-axis reducer

Table 7.3.2 (c) Specification of hexagon bolts and taper plugs

Parts name	Specification	Model
Hexagon bolt (M8 x 10)	A97L-0318-0410#081010S	All models
Taper plug (R1/8)	A97L-0001-0436#2-1D	M-20*i*B/25/35S
Taper plug (R1/8)	A97L-0218-0110#01SUSS	M-20*i*B/25C

⚠ 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 precautions.

1 Before starting to grease, remove the seal bolt of the grease outlet to allow the grease to come out.
2 Supply grease slowly, using a manual pump. (once per two seconds)
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 (see Table 7.3.2 (a)).
4 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
5 After greasing, release the remaining pressure from the grease bath using the procedure given in Subsection 7.3.2.1, and then close the grease outlet.
6 To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.

7.3.2.1 Procedure for releasing remaining pressure from the grease bath (J1 to J3-axis)

After applying grease, operate the robot more than 10 minutes as instructed below with one of the taper plugs and hexagon bolts of the grease inlet and outlet which is in high position uncapped to release the remaining pressure within the grease bath.
Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

<table>
<tr><th>Operating axis / Grease replacement part</th><th>J1-axis</th><th>J2-axis</th><th>J3-axis</th><th>J4-axis</th><th>J5-axis</th><th>J6-axis</th></tr>
<tr><td>J1-axis reducer</td><td>Axis angle of 60° or more OVR 100%</td><td colspan="5">Arbitrary</td></tr>
<tr><td>J2-axis reducer</td><td>Arbitrary</td><td>Axis angle of 60° or more OVR 100%</td><td colspan="4">Arbitrary</td></tr>
<tr><td>J3-axis reducer</td><td colspan="2">Arbitrary</td><td>Axis angle of 60° or more OVR 100%</td><td colspan="3">Arbitrary</td></tr>
</table>

If the above operation cannot be performed due to the environment of the robot, prolong the operating time so that an equivalent operation can be performed. (When the maximum allowable axis angle is 30 degrees, perform the twice operation for 20 minutes or more.) If you grease multiple axes, you can exercise multiple axes at the same time. After completion of the operation, attach the taper plug and seal bolts to the grease inlets and outlets. When reusing the seal bolts, be sure to seal them with seal tape.

After replacing grease, the internal pressure of the grease bath may rise if the robot is operated again under frequent inversion movement or a high temperature environment. In these cases, you can return to normal internal pressure by releasing the grease outlet just after robot operation. (When opening grease outlet, be sure that grease or oil is not spattered.)

7.3.3 Grease Supplying Procedure for J4 to J6-axis Reducer (4 years (15360 hours) or 2 years (7680 hours) periodical check)

For M-20*i*B/25, Supply the grease of the J4/J5/J6-axis reducers every four years or 15360 hours by using the following procedures.
For M-20*i*B/25C, Supply the grease of the J4/J5/J6-axis reducers every two years or 7680 hours by using the following procedures.
For the grease name and quantity, see the Table 7.3.3 (a).

Table 7.3.3 (a) Grease for 4-year (15360 hours) or 2-year (7680 hours) periodical greasing

Greasing points	Greasing amount	Specified grease
J4-axis reducer	2.7 g (3ml)	M-20*i*B/25/35S Harmonic grease 4BNo.2 Spec: A98L-0040-0230 M-20*i*B/25C Harmonic grease HFL-1 Spec: A98L-0040-0320
J5-axis reducer	2.7 g (3ml)	
J6-axis reducer	2.7 g (3ml)	

For grease replacement, use the arbitrary postures.

⚠ CAUTION
1 The following maintenance kits are prepared for the greasing.
- Greasing kit: A05B-1226-K031 (for M-20*i*B/25/35S)
  (This a set of greasing syringe and grease in tube. (80g))
- Greasing kit: A05B-1226-K033 (for M-20*i*B/25C)
  (This a set of greasing syringe and grease in tube. (80g))
- Grease in tube: A05B-1139-K022 (for M-20*i*B/25/35S) (grease in tube. (80g))
- Grease in tube: A05B-1139-K027 (for M-20*i*B/25C) (grease in tube. (80g))

2 Failure to follow proper lubrication 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) Use specified grease. Use of non-approved grease may damage the reducer or lead to other problems. Do no use Harmonic grease SK-3
(2) To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.
(3) When you use the grease greasing kit, massage the grease tube by hand to soften the grease before you fill a necessary amount in the injection syringe. Please install the nozzle in the point of the injection syringe. Remove the nozzle and replace the cap when you are finished using the injection syringe.

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

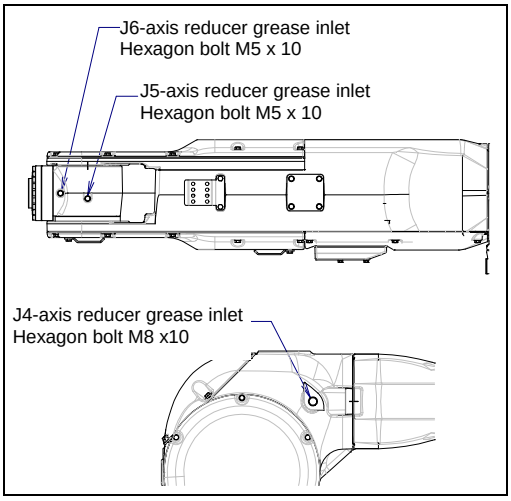


Fig. 7.3.3 Greasing point of J4/J5/J6-axis reducers

Table 7.3.3 (b) Spec. of the Hexagon bolts

Parts name	Specification
Hexagon bolt (M5 x 10)	A97L-0318-0410#051010S
Hexagon bolt (M8 x 10)	A97L-0318-0410#081010S

7.4 CLEANING THE ROBOT (25C)

The M-20*i*B/25C robot has been specially treated and materials have been used which are resistant to chemicals (Except without painting modification). It is, therefore, possible to spray some cleaners directly on the robot surface so that the robot can be kept in sanitary condition by daily cleaning.

The cleaners in Table 7.4 have been proven to have no harmful effects on the robot M-20*i*B/25C surface. Other cleaners have to be checked in order to know the impact to the robot surface. Please contact your local FANUC representative if other cleaners are to be used.

Make sure the cleaner is properly diluted. If you use cleaner whose dilution ratio is not correct, it may cause damage to the robot surface. Please use a cleaner and water at a temperature equal to or less than 50 degrees Celsius.

Alcohol and organic solvent may have a damaging effect on the robot surface. Do not use them when cleaning the robot.

Table 7.4 Cleaners whose harmlessness for the robot surface is confirmed

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

NOTE
1 DILUTION RATE = STOCK SOLUTION / (STOCK SOLUTION+WATER)
2 Acid cleaners have to be rinsed diligently and should never remain on the robot surface. The robot surface cannot stay in contact with an acid cleaner continuously for over 15 minutes.
3 The use of the cleaners in Table 7.4 might be restricted by the laws of the country or the region in which the robot is used, making them difficult to obtain.

7.5 STORAGE

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

8 MASTERING

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

> ⚠ **CAUTION**
> In case of performing mastering with gravity compensation is enabled, if load setting (See Section 4.3) is not correct, it will influence the precision of the mastering.

8.1 OVERVIEW

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

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

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

Types of Mastering

Table 8.1 describes the following mastering methods.

Table 8.1 Type of mastering

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

Once mastering is performed, you must carry out positioning (calibration). Positioning is an operation in which the controller reads the pulse count value to sense the current position of the robot.

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

⚠ CAUTION

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

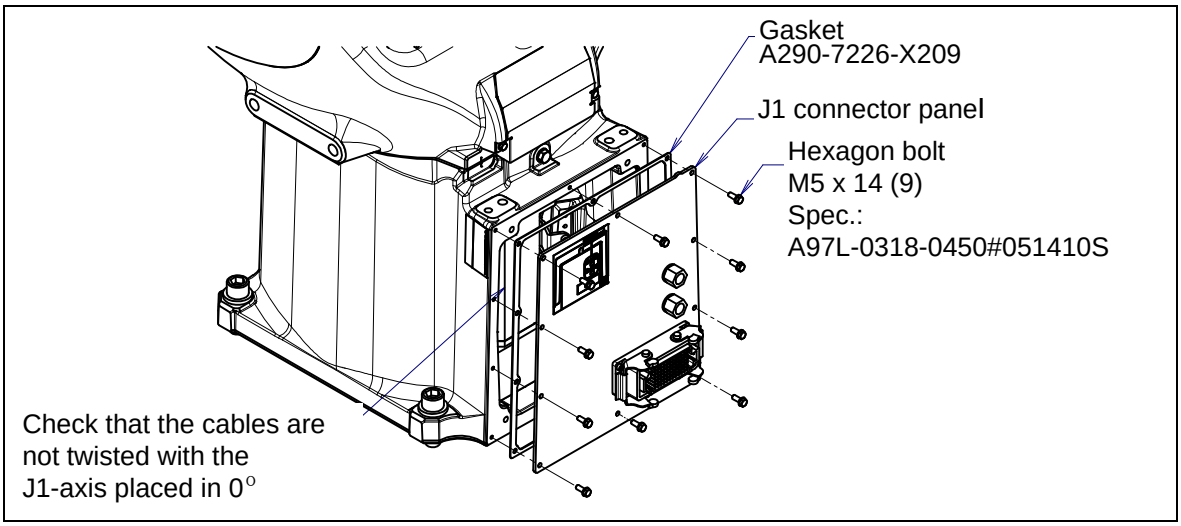


Fig. 8.1 (a) Check the cables (J1-axis) (back side connector panel)

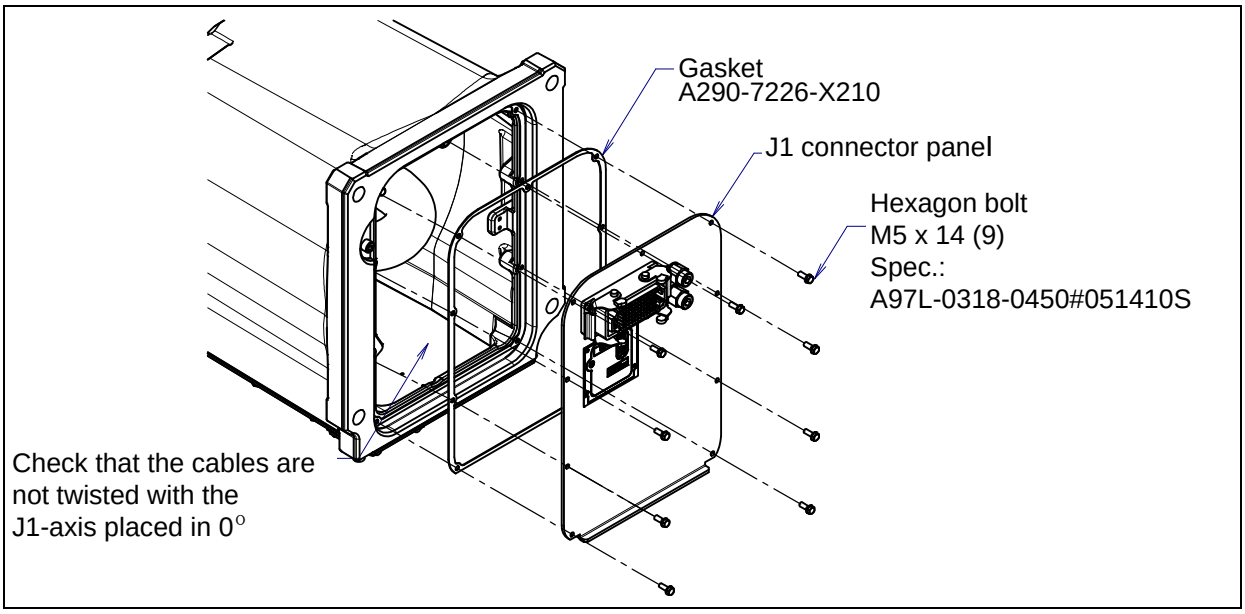


Fig. 8.1 (b) Check the cables (J1-axis) (bottom side connector panel)

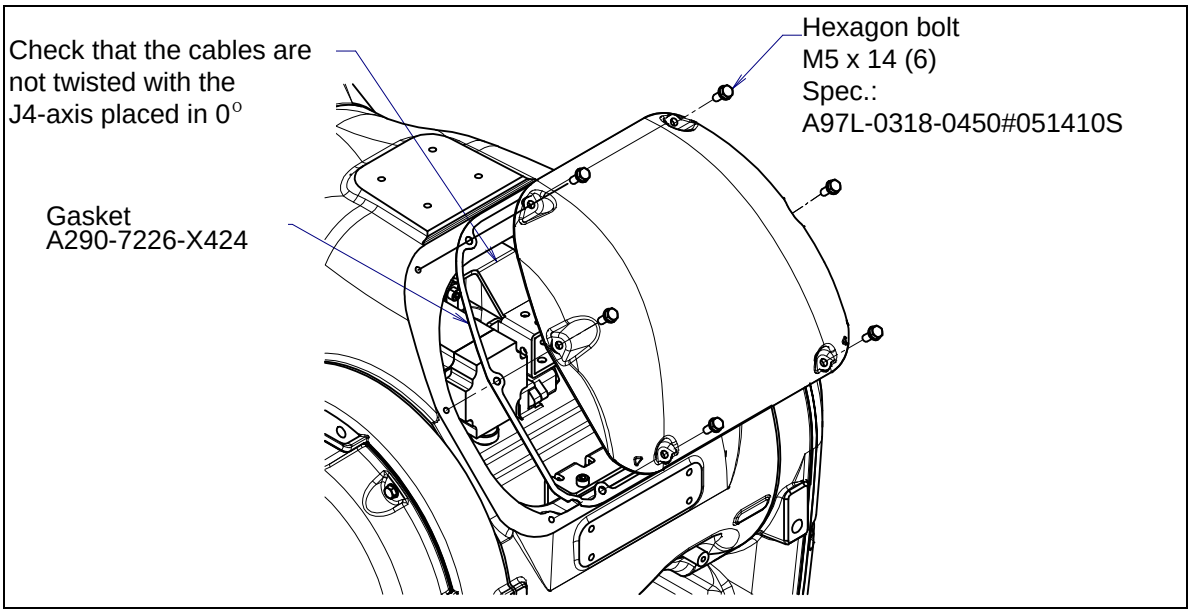


Fig. 8.1 (c) Check the cables (J4-axis)

8.2 RESETTING ALARMS AND PREPARING FOR MASTERING

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

Alarm displayed

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

Procedure

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

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

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

8.3 ZERO POSITION MASTERING

Zero-position mastering (witness mark mastering) is performed with all axes set at the 0-degree position. A zero-position mark (witness mark) is attached to each robot axis (Fig. 8.3). This mastering is performed with all axes set at the 0-degree position using their respective witness marks.

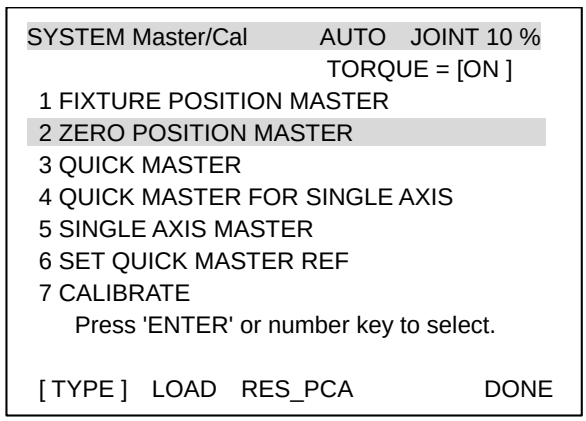
Zero-position mastering involves a visual check. It cannot be so accurate. It should be used only as a quick-fix method.

Procedure of Zero-position Mastering

1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE]. Then select [Variables] from the menu.
4 If $DMR_GRP[group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE(disabled) or TRUE (enabled)
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.
(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

5 Press the [MENU] key to display the screen menu.
6 Select [0 NEXT] and press [6 SYSTEM].
7 Press F1 [TYPE].
8 Select [Master/Cal].



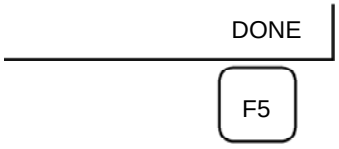
9 Jog the robot into a posture for mastering.
10 Select [2 Zero Position Master]. Press F4 [YES].

```
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
```

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

```
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>
```

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



13 Return the setting of the gravity compensation.
14 Return brake control to original setting, and cycle power of the controller.

Table 8.3 Posture with position marks (witness mark) aligned

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

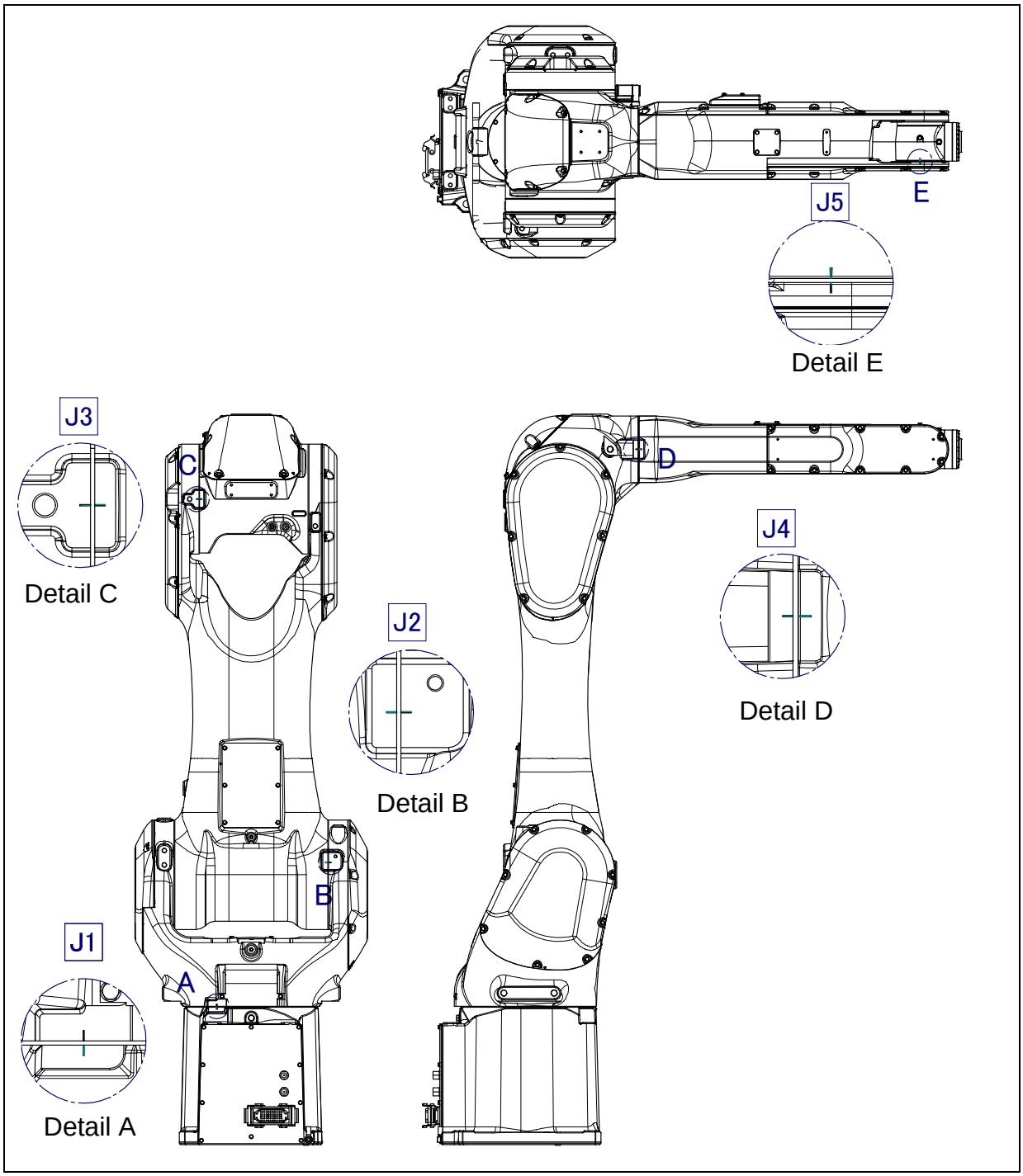


Fig. 8.3 Zero-position mark (witness mark) for each axis

8.4 QUICK MASTERING

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

Quick mastering is factory-performed at the position indicated in Table 8.3. 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.)

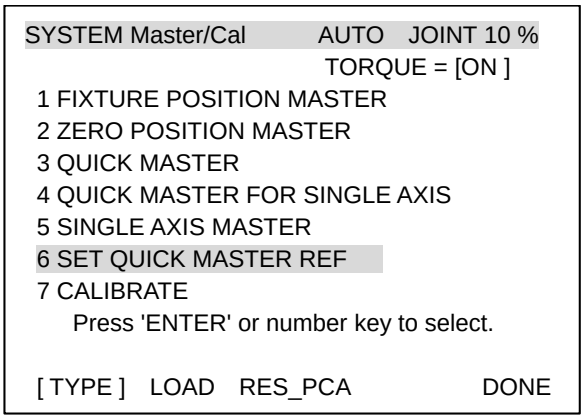
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

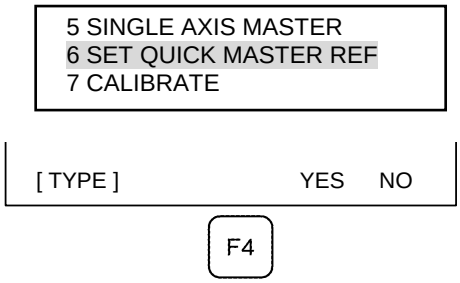
1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE]. Then select [Variables] from the menu.
4 If $DMR_GRP[group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE(disabled) or TRUE (enabled)
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.
(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

5 Select SYSTEM.
6 Select Master/Cal. Master/Cal screen will be displayed.



7 Jog the robot to the quick mastering reference position.
8 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position will be set.



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

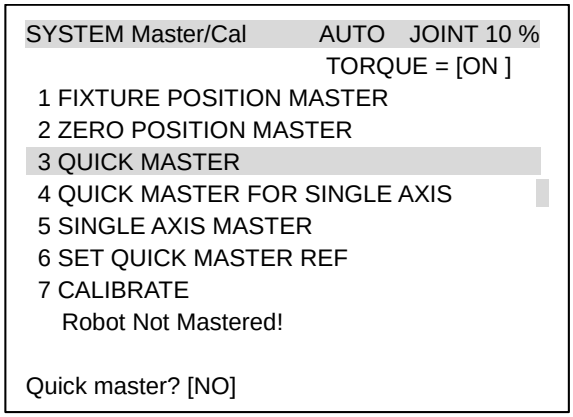
> ⚠ **CAUTION**
> If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or zero –position mastering is required to restore mastering data.

Procedure of Quick Mastering

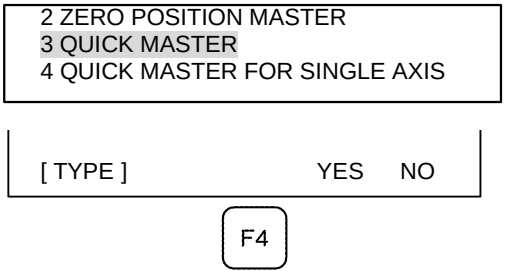
1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE]. Then select [Variables] from the menu.
4 If $DMR_GRP[group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE(disabled) or TRUE (enabled)
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.
(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

5 Display the Master/Cal screen.



6 Jog the robot to the quick mastering reference position.
7 Select [3 QUICK MASTER] and press F4 [YES]. Quick mastering reference position will be set.



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

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

8.5 QUICK MASTERING FOR SINGLE AXIS

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

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

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

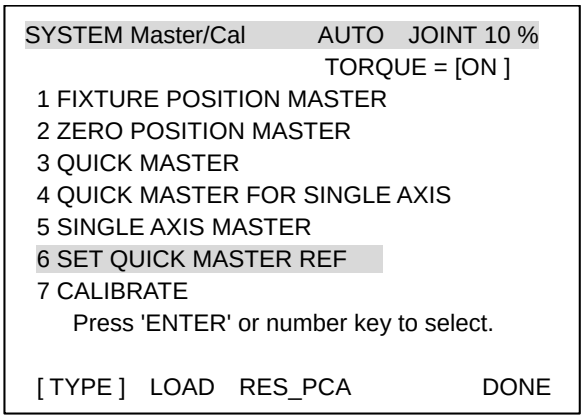
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

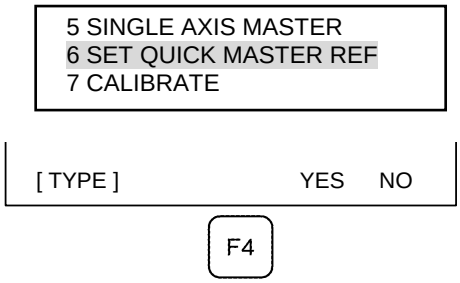
1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE]. Then select [Variables] from the menu.
4 If $DMR_GRP[group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE(disabled) or TRUE (enabled)
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.
(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

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



7 Jog the robot to the quick mastering reference position.
8 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position will be set.



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

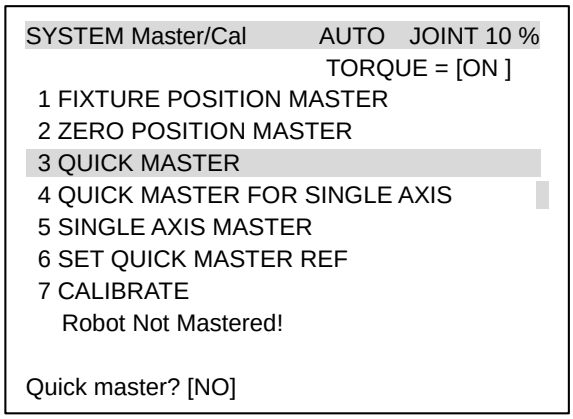
> ⚠ **CAUTION**
> If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or zero –position mastering is required to restore mastering data.

Procedure of Quick Mastering for single axis

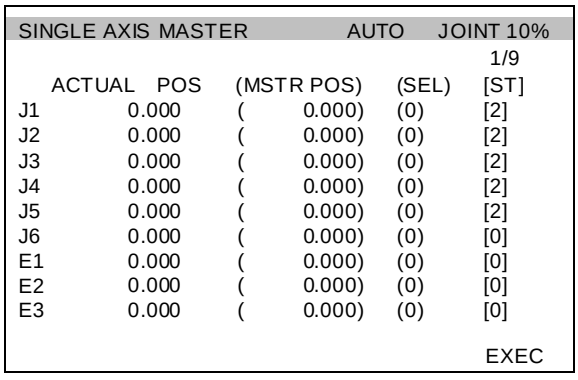
1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE]. Then select [Variables] from the menu.
4 If $DMR_GRP[group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE(disabled) or TRUE (enabled)
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.
(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

5 Display the Master/Cal screen.



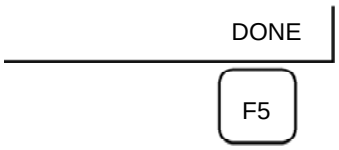
6 Select [4 QUICK MASTER FOR SINGLE AXIS]. quick master for single axis screen will be displayed.



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

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

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



12 If gravity compensation is disabled, set it to enabled.
13 Return brake control to original setting, and cycle power of the controller.

8.6 SINGLE AXIS MASTERING

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

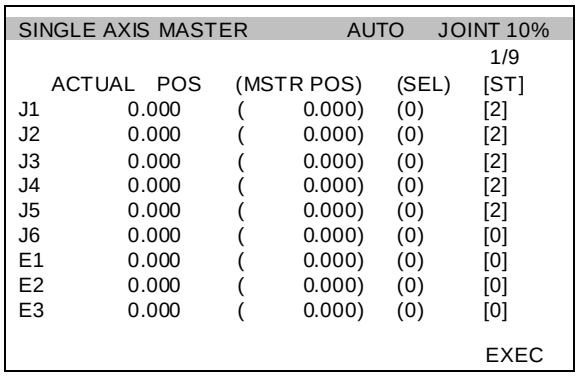


Table 8.6 Items set in single axis mastering

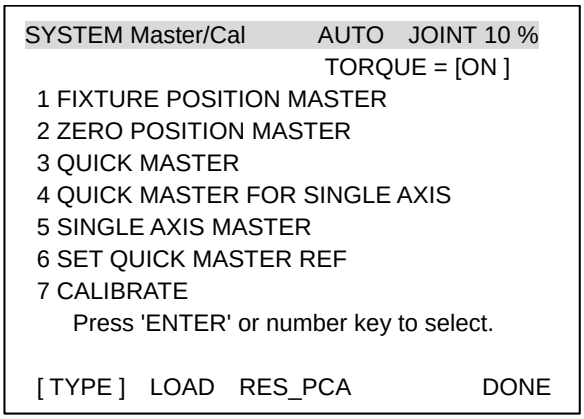
Item	Description
Current position (ACTUAL AXIS)	The current position of the robot is displayed for each axis in degree units.
Mastering position (MSTR POS)	A mastering position is specified for an axis to be subjected to single axis mastering. It would be convenient if it is set to 0 degree position.
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

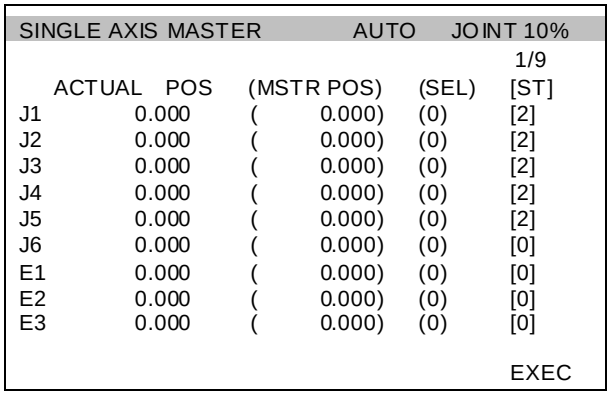
1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE]. Then select [Variables] from the menu.
4 If $DMR_GRP[group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE(disabled) or TRUE (enabled)
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.
(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

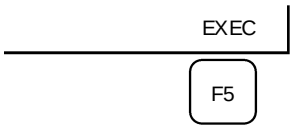
5 Select [6 SYSTEM].
6 Select [Master/Cal].



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



8 For the axis to which to perform single axis mastering, set (SEL) to “1.” Setting of [SEL] is available for one or more axes.
9 Turn off brake control, then jog the robot to the mastering position.
10 Enter axis data for the mastering position.
11 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

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

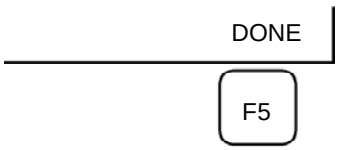
SYSTEM Master/Cal AUTO JOINT 10 %

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

13 Select [7 CALIBRATE], then press F4 [YES]. Positioning is performed. Alternatively, turn off the controller power and on again. Positioning is performed.
14 After positioning is completed, press F5 [DONE].



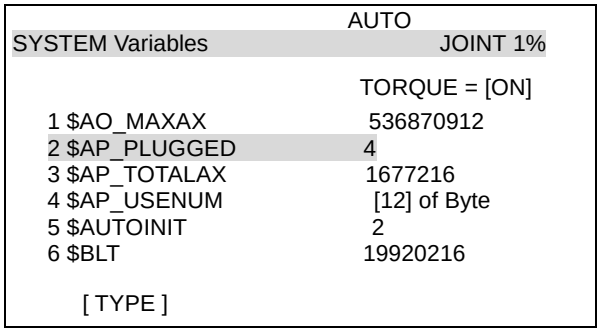
15 Return the setting of the gravity compensation.
16 Return brake control to original setting, and cycle power of the controller.

8.7 MASTERING DATA ENTRY

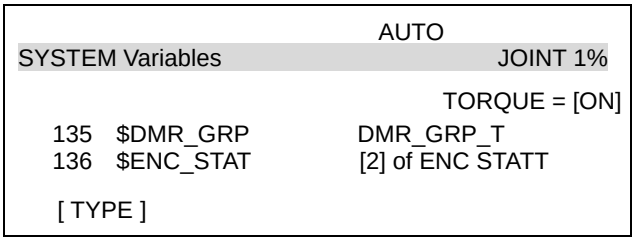
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

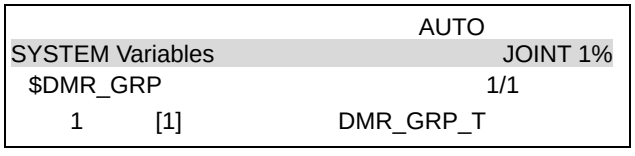
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen will be displayed.

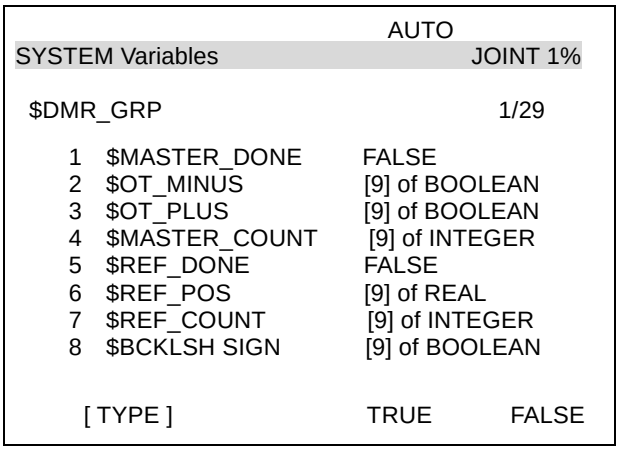


3 Change the mastering data.
The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

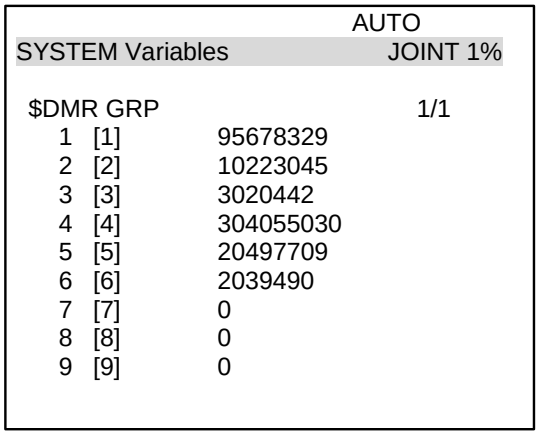


4 Select $DMR_GRP.

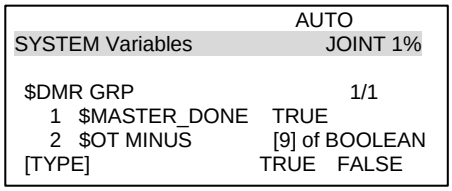




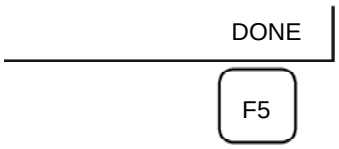
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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].



8.8 VERIFYING MASTERING

1 How to verify that the robot is mastered properly:

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

(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.

(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the zero-degree position marks indicated in Section 8.3 of the OPERATOR'S MANUAL are aligned. There is no need to use a visual aid.

If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described in 8.2. Alternatively, the mastering data in system variable $DMR_GRP.$MASTER_COUN may have been overwritten as a result of an operation error or for some other reason.

Compare the data with the values indicated on the supplied data sheet. This system variable is overwritten whenever mastering is performed. Whenever mastering is performed, record the value of the system variable on the data sheet.

2 Alarm types displayed during mastering and their solution method:

(1) BZAL alarm

This alarm is displayed if the Pulsecoder's backup battery voltage decreases to 0 V while the power to the controller is disconnected. Furthermore, if the Pulsecoder connector is removed for cable replacement, etc. this alarm is displayed as the voltage decreases to 0. Check to see if the alarm will disappear by performing a pulse reset (See Section 8.2.). Then, cycle controller power and check if the alarm disappears or not.

The battery may be drained if the alarm is still displayed. Perform a pulse reset, and turn off and on the controller power after replacing the battery. Note that, if this alarm is displayed, all the original data held by the Pulsecoder will be lost. Mastering is required.

(2) BLAL alarm

This alarm is displayed if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is displayed, replace the battery with a new one immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.

(3) Alarm notifications like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may indicate trouble with Pulsecoder; contact your local FANUC representative.

9 TROUBLESHOOTING

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

9.1 TROUBLESHOOTING

Table 9.1 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 9.1 Troubleshooting

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

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- Vibration or noise was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating or noise occurring axis has not been replaced for a long period. - Cyclical vibration and noise occur.	[Gear, bearing, or reducer] - It is likely that the collision or overload applied an excessive force to 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 gear tooth surface or rolling surface of bearing and reducer. - It is likely that foreign material caught in a gear, bearing, or inside the reducer has caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that foreign material caught in a gear, bearing, or within a reducer causes 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 by neglect greasing.	- Operate each axis individually to judge which axis has been vibrating. - Remove the motor, and replace the gear, the bearing, and the reducer. For the specification of parts and the procedure of replacement, contact your local FANUC representative. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Specific type and period of grease change will prevent troubles.
	- There is some relationship between the vibration of the robot and the operation of a machine near the robot.	[Noise from a nearby machine] - If the robot is not grounded properly, electrical noise is induced on the grounding wire, preventing commands from being transferred accurately, thus leading to vibration. - If the robot is grounded at an unsuitable point, its grounding potential becomes unstable, and noise is likely to be induced on the grounding line, thus leading to vibration.	- Connect the grounding wire firmly to ensure a reliable ground potential and prevent extraneous electrical noise.
	- There is an 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.

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 the invalid robot control parameter was set.	- Refer to the Controller Maintenance Manual for troubleshooting related to the controller and amplifier. - Also, replace the motor of the axis that is vibrating, and check whether vibration still occurs. To replace the motor, Contact your local FANUC representative. - If vibration occurs only when the robot assumes a specific posture, it is likely that a mechanical unit is broken. - Check whether the cable jacket of the robot connection cable is damaged. If so, replace the connection cable, and check whether vibration still occurs. - Check whether the power cable jacket is damaged. If so, replace the power cable, and check whether vibration still occurs. - Check that the robot is supplied with the rated voltage. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct them. Contact your local FANUC representative for further information if necessary.

Symptom	Description	Cause	Measure
Rattling	- While the robot is not supplied with power, pushing it by hand wobbles part of the mechanical unit. - There is a gap on the mounting face of the mechanical unit.	[Mechanical unit mounting bolt] - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical unit.	- Check the following retaining bolts tightness for each axis. If any of these bolts is loose, apply LOCTITE and bolt down with appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Reducer shaft retaining bolt - Base retaining bolt - Arm retaining bolt - Casing retaining bolt - End effector retaining bolt
Motor overheating	- The motor overheated due to a rise in temperature in the installation area. - After changing the Robot control program or the load, the motor overheat.	[Ambient temperature] - It is likely that the motor overheated when the ambient temperature rose, and could not release heat. [Operating condition] - It is likely that the overcurrent is above the specified permissive average current.	- Reducing the ambient temperature is the most effective means of preventing overheat. - If there is a source of heat near, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is effective to reduce the average current. Thus, prevent overheat. - The teach pendant can monitor the average current. Check the average current when the robot control program launched.
	- After a 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 4.3 of the operator's manual.
	- Symptom other than stated above	[Mechanical unit problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor running with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor.	- Repair the mechanical unit while referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - If the average current falls after the motor is replaced, it indicates that the first motor was faulty.

Symptom	Description	Cause	Measure

Grease leakage	- Grease leaks from the mechanical unit.	[Poor sealing]
		- Probable causes are a crack in the casting, a damaged O-ring, a damaged oil seal, or a loose seal bolt.
		- The casting may crack with excessive force caused in a collision.
		- An O-ring can be damaged if it is trapped or cut during disassembling or re-assembling.
		- An oil seal may be damaged if dust scratches the lip.
		- A loose hexagon bolt may allow grease to leak along the threads.
			- If a crack develops in the casting, sealant can be used as a quick-fix to prevent further grease or oil leakage. However, the component should be replaced as soon as possible, because the crack might enlarge.
			- 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
			- Hexagon bolts are used in the locations stated below.
			  - Grease drain outlet
			  - For cover attachment

Dropping axis	- An axis falls because the brake went out.
	- An axis falls in standstill.
		[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 soaked 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 soaked through the motor

Symptom	Description	Cause	Measure
Displacement	- 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 equipment.	[Peripheral equipment displacement] - It is likely that an external force was applied to the peripheral equipment, thus shifting its position relative to the robot.	- Correct the setting of the peripheral equipment position. - Correct the taught program.
	- Displacement occurred after a parameter was changed.	[Parameter] - It is likely that the mastering data was 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.

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot M-20*i*B/25/35S **Periodic Maintenance Table**

Items			Check time	Oil Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	2	Check for water	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	3	Check the end effector (hand)cable	0.1H	-		○			○				○			
	4	Check the motor connector. (Loosening)	0.1H	-		○			○				○			
	5	Tighten the end effector bolt	0.1H	-		○			○				○			
	6	Tighten the cover and main bolt	0.5H	-		○			○				○			
	7	Check the fixed mechanical stopper and adjustable mechanical stopper	0.1H	-		○			○				○			
	8	Remove spatter and dust etc.	0.1H			○			○				○			
	9	Replacing battery	0.1H	-							●					
	10	Replacing grease of J1-axis reducer	0.5H	870ml												
	11	Replacing grease of J2-axis reducer	0.5H	330ml												
	12	Replacing grease of J3-axis reducer	0.5H	190ml												
	13	Supplying grease to J4-axis reducer	0.5H	3ml												
	14	Supplying grease to J5-axis reducer	0.5H	3ml												
	15	Supplying grease to J6-axisreducer	0.5H	3ml												
	16	Replacing cable of mechanical unit	4.0H	-												
Controller	17	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	-		○			○				○			
	18	Cleaning the controller ventilation system	0.2H	-	○	○	○	○	○	○	○	○	○	○	○	○
	19	Replacing battery *1	0.1H	-												

*1 Refer to “REPLACING UNITS Chapter of MAINTENANCE ” of the following manuals.
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),
R-30*i*B Mate /R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)

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

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○				○				○				○				○					3
○				○				○				○				○					4
○				○				○				○				○					5
○				○				○				○				○					6
○				○				○				○				○					7
○				○				○				○				○					8
●						●						●						●			9
●												●									10
●												●									11
●												●									12
				●																	13
				●																	14
				●																	15
				●																	16
○				○				○				○				○					17
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		18
				●																	19

Overhaul

FANUC Robot M-20*i*B/25C **Periodic Maintenance Table**

Items		Accumulated operating time (H)	Check time	Oil Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	2	Check for water	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	3	Check the end effector (hand)cable	0.1H	-		○			○				○			
	4	Check the motor connector. (Loosening)	0.1H	-		○			○				○			
	5	Tighten the end effector bolt	0.1H	-		○			○				○			
	6	Tighten the cover and main bolt	0.5H	-		○			○				○			
	7	Check the fixed mechanical stopper and adjustable mechanical stopper	0.1H	-		○			○				○			
	8	Remove spatter and dust etc.	0.1H			○			○				○			
	9	Replacing battery	0.1H	-							●					
	10	Replacing grease of J1 axis reducer	0.5H	870ml									●			
	11	Replacing grease of J2 axis reducer	0.5H	330ml									●			
	12	Replacing grease of J3 axis reducer	0.5H	190ml									●			
	13	Supplying grease to J4-axis reducer	0.5H	3ml									●			
	14	Supplying grease to J5-axis reducer	0.5H	3ml									●			
	15	Supplying grease to J6-axis reducer	0.5H	3ml									●			
	16	Replacing cable of mechanical unit	4.0H	-												
Controller	17	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	-		○			○				○			
	18	Cleaning the controller ventilation system	0.2H	-	○	○	○	○	○	○	○	○	○	○	○	○
	19	Replacing battery *1	0.1H	-												

*1 Refer to “REPLACING UNITS Chapter of MAINTENANCE ” of the following manuals.
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),
R-30*i*B Mate /R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)

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

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○				○				○				○				○					3
○				○				○				○				○					4
○				○				○				○				○					5
○				○				○				○				○					6
○				○				○				○				○					7
○				○				○				○				○					8
●						●						●						●			9
				●								●									10
				●								●									11
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				●								●									15
				●																	16
○				○				○				○				○					17
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		18
				●																	19

Overhaul

B STRENGTH OF BOLT AND BOLT TORQUE LIST

NOTE

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

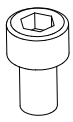
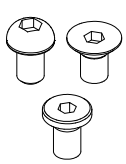
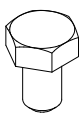
Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:

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

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

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

Recommended bolt tightening torques **Unit: Nm**

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

C INSULATION ABOUT ARC WELDING ROBOT

The arc welding robot performs welding, using a welding torch attached to its end effector mounting face via a bracket. Because a high welding current flows through the welding torch, the insulating material must not permit bolting directly from the welding torch bracket to mounting face plate.

If no due consideration is taken, a poor insulation caused by a pileup of spatter can allow the welding current to leak into robot mechanical units, possibly damaging the motor or melting the mechanical unit cable jackets.

C.1 INSULATION AT THE WRIST

Please be careful to the following contents.

- Insulate the end effector mounting surface. Insulation material which is inserted between the end effector mounting surface and the welding torch bracket must be different, and bolt them separately referring to Fig. C.1.
- Insert the insulating material between the torch bracket and faceplate to ensure the two are electrically isolated. When installing the insulating material, be sure to set the crack in the torch holder away from that of the insulating material to prevent spatter from getting in the cracks.
- Allow a sufficient distance (at least 5 mm) at the insulating materials in case a pileup of spatter should occur.

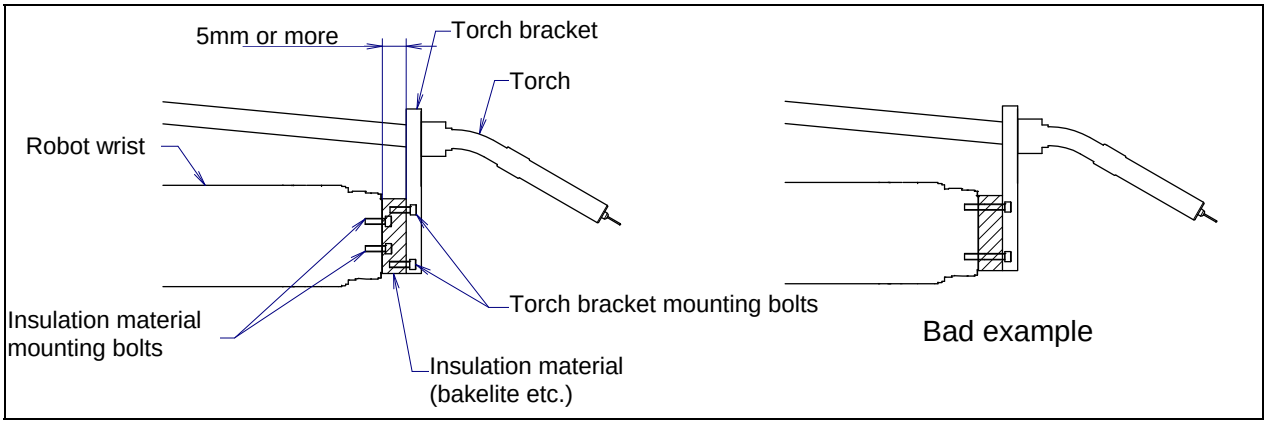


Fig. C.1 Insulation at the wrist

- Even after the insulation is reinforced, it is likely that, if a pileup of spatter grows excessively, current may leak. Periodically remove the spatter.

C.2 INSULATION AT THE ADDITIONAL AXIS

If welding fixtures are installed to the additional axis, Perform insulation against between welding fixtures and the additional axis to prevent welding electric current intrusion. If the follower unit is used, perform insulation against between welding fixtures and follower unit to prevent welding electric current intrusion into the housing.

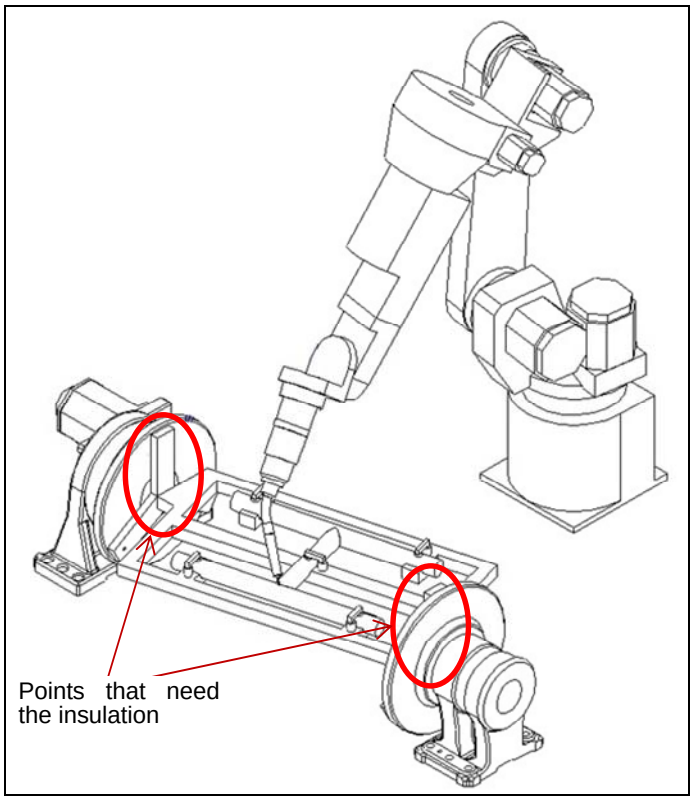


Fig. C.2 Insulation at the additional axis

D CONTROL OF MULTIPLE ROBOTS

One controller can control up to four robots. Moreover, one controller can control up to eight groups, 72 axes.

NOTE
"Group" means the gathering of independent movable axes.

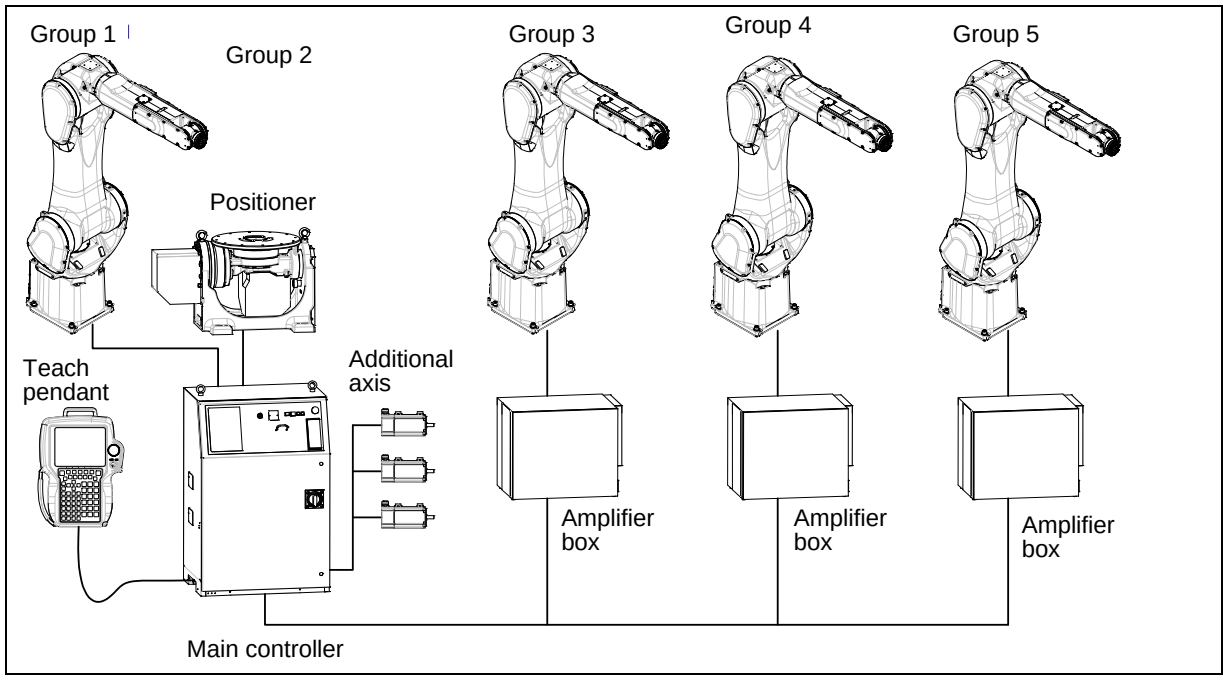


Fig. D Example of Control of multiple robots

When multiple robots are controlled with one controller, select the appropriate servo card of controller from Table D (a), (b).

Table D (a) Servo card when multiple robots are controlled (R-30*i*B, R-30*i*B Mate)

Number of robots	Servo card	Remarks
2	A05B-2600-H041 (12 axes) (Note) A05B-2600-H042 (18 axes)	Max. 6 auxiliary axes can be used in total of robot 1st and 2nd
3	A05B-2600-H042 (18 axes) (Note) A05B-2600-H043 (24 axes)	Max. 6 auxiliary axes can be used in total of robot 1st , 2nd and 3rd
4	A05B-2600-H043 (24 axes) (Note) A05B-2600-H044 (36 axes)	Max. 12 auxiliary axes can be used in total of robot 1st , 2nd, 3rd and 4th

Table D (b) Servo card when multiple robots are controlled (R-30*i*B Plus, R-30*i*B Mate Plus)

Number of robots	Servo card	Remarks
2	A05B-2600-H041 (12 axes) (Note) A05B-2600-H042 (18 axes)	Max. 6 auxiliary axes can be used in total of robot 1st and 2nd
3	A05B-2600-H042 (18 axes) (Note) A05B-2600-H043 (24 axes)	Max. 6 auxiliary axes can be used in total of robot 1st , 2nd and 3rd
4	A05B-2600-H043 (24 axes) (Note) A05B-2600-H044 (36 axes)	Max. 12 auxiliary axes can be used in total of robot 1st , 2nd, 3rd and 4th

(Note) It can be used only when auxiliary axes are not specified.

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REVISION RECORD

Edition	Date	Contents
03	Sep., 2018	・Addition of R-30*i*B Mate Plus Controller ・Addition of M-20*i*B/35S ・Correction of errors
02	Dec., 2016	・Addition of R-30*i*B Plus Controller ・Addition of M-20*i*B/25C ・Addition of bottom connector plate ・Correction of errors
01	Feb., 2016	

B-83754EN/03