FANUC 2-axis SERVO POSITIONER

MECHANICAL UNIT

OPERATOR'S MANUAL

B-82534EN/01

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- **Original Instructions**

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

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

- No part of this manual may be reproduced in any form.
- The appearance and specifications of this product are subject to change without notice.

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

SAFETY PRECAUTIONS

This chapter must be read before using the robot.

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

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

1 DEFINITION OF USER

The personnel can be classified as follows.

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

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

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

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

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

Table 1 (a) List of work outside the fence

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

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

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

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

2 DEFINITION OF SAFETY NOTATIONS

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

Symbol	Definitions
⚠ **WARNING**	Indicates a hazard could occur resulting in the death or serious injury of the user if he or she fails to follow the approved procedure.
⚠ **CAUTION**	Indicates 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	Indicates a supplementary explanation not related to any of WARNING and CAUTION.

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

3 PRECAUTIONS FOR USAGE

⚠ WARNING

The 2-axis servo positioner has a built-in earth cable. Operate the positioner within the service factor corresponding to the current, referencing Section 8.6, "SERVICE FACTOR (DUTY) OF EARCH CABLE". If the service factor is exceeded during operation, the cable temperature may exceed the maximum allowable temperature, resulting in deterioration or burning of the cable.

4 WARNING & CAUTION LABEL

(1) Greasing and degreasing label

Fig. 4 (a) Greasing and Degreasing Label

Description

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

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

> ⚠ **CAUTION**
> See Section 3.1 ″GREASE REPLACEMENT″ for explanations about specified greases, the amount of grease to be supplied, and the locations of grease and degrease outlets for individual models.

(2) Step-on prohibitive label

Fig. 4 (b) Step-on Prohibitive Label

Description

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

(3) High-temperature warning label

Fig. 4 (c) High-temperature warning label

Description

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

(4) High-current warning label

Fig. 4 (d) High-current warning label

Description

A large current flows through the positioner during welding.
Do not touch the terminal block or conductor under the cover.

(5) Transportation label

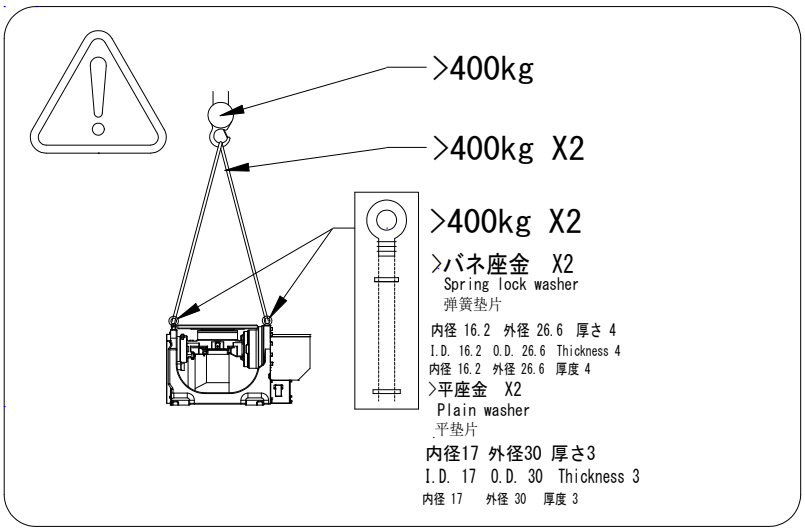


Fig. 4 (e) Transportation label

Description

When transporting the positioner, observe the instruction on the transportation label. The above label includes the following instructions.

Using a crane

- Use a crane having a load capacity of 400 kg or greater.
- Use at least two slings each having a load capacity of 400 kg or greater.
- Use two M16 eyebolts with an allowable load of 3920 N (400 kgf) or greater. (The eyebolts are attached during shipment.)

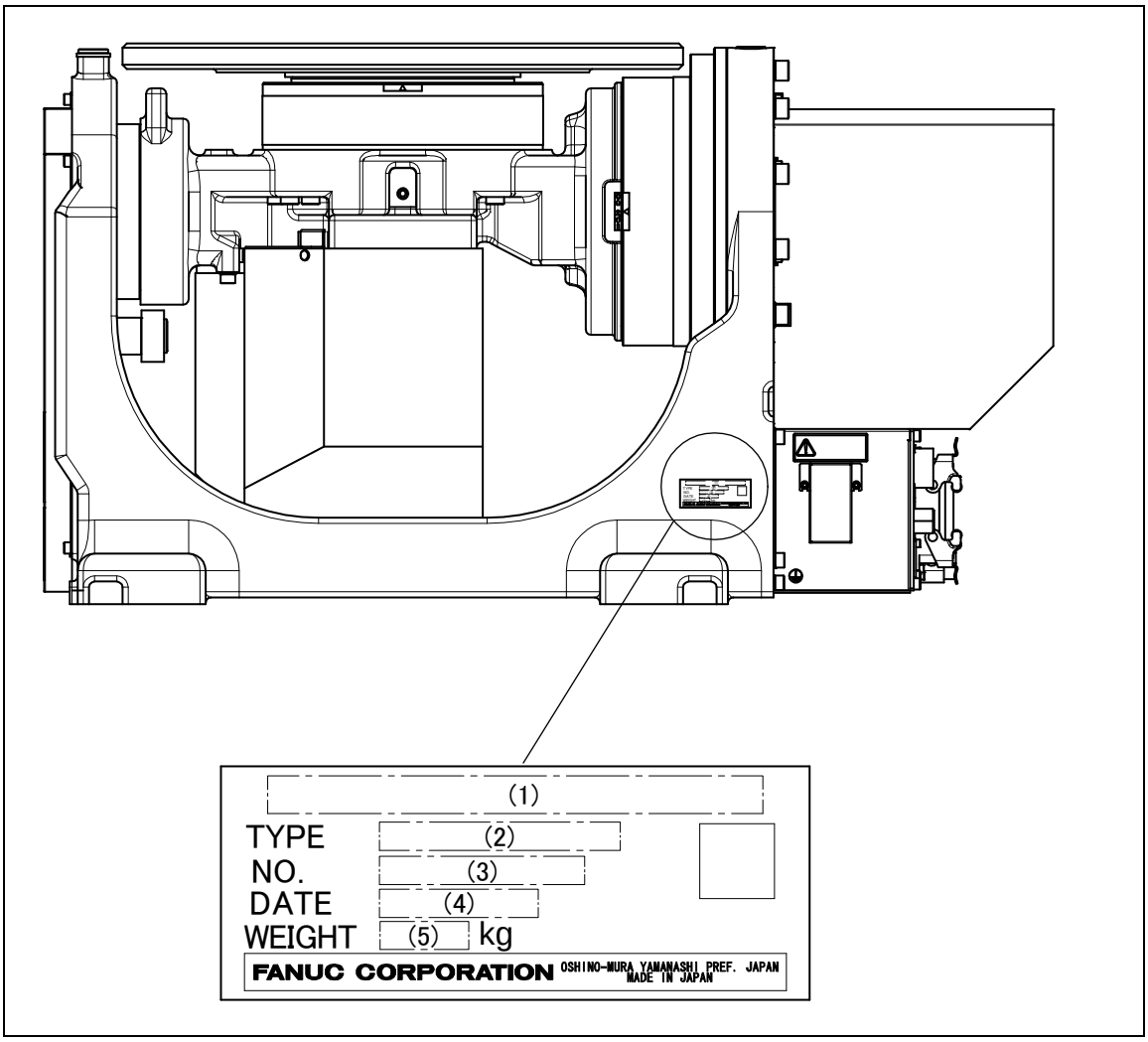
> ⚠ **CAUTION**
> See Section 9.1 TRANSPORTATION for explanations about the posture should take when it is transported.

PREFACE

This manual describes operation work for the servo positioner. Before replacing parts, check the specifications of the mechanical unit.

Model name	Mechanical unit specification No.
2-axis Servo Positioner	A05B-1220-J201
2-axis Servo Positioner	A05B-1220-J203

NOTE
Air tubes, the user cable and the welding cable do not exist for A05B-1220-J203.



No.	(1)	(2)	(3)	(4)	(5)
CONTENTS	MODEL	TYPE	No.	DATE	WEIGHT kg
LETTERS	2-axis Servo Positioner	A05B-1220-J201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	295
	2-axis Servo Positioner	A05B-1220-J203			295

Specification

Item		Specifications
Controlled axes		2 axes (J1, J2)
Installation		Floor, Wall mount, Upside-down
Motion range	J1-axis	270°(-135° to +135°) 4.72 rad (-2.36 rad - +2.36 rad)
	J2-axis	480°(-240° to +240°) 8.38 rad (-4.19 rad - +4.19 rad) (NOTE1)
Maximum speed (NOTE2)	J1-axis	120°/sec 2.09 rad/sec
	J2-axis	190°/sec 3.32 rad/sec
Max payload		500 kg
Allowable load Moment	J1-axis	180 kgf·m 1764 N·m
	J2-axis	70 kgf·m 686 N·m
Allowable load Inertia	J1-axis	3061 kgf·cm·s^2 300 kg·m^2
	J2-axis	1020 kgf·cm·s^2 100 kg·m^2
Repeatability		±0.05mm (R=500)
Drive method		Electric servo drive by AC servo motor
Weight		About 295 kg
Required facilities		Average power consumption : 1.0 kW Input power supply capacity : 2.0 kVA
Installation environment		Ambient temperature : 0 to 45℃ (NOTE 3) Ambient humidity : Normally 75%RH or less (No dew or frost allowed) Short time 95%Rh or less (Within 1 month) Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 4)

NOTE 1) In case of A05B-1220-J203, motion range can be set to unlimited by option.
NOTE 2) During short distance motions, the axis speed may not reach the maximum value stated.
NOTE 3) When positioner is used in low temperature environment that is near to 0ºC, or robot is not operated for a long time in the environment that is less than 0ºC in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO-050) etc. In this case, we recommend performing the warm up operation for several minutes.
NOTE 4) 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.

Dust-proof/drip performance

	Normal specification
MECHANICAL UNIT	IP54

NOTE
Definition of IP 54
5= Dust-tight: Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory of the equipment.
4= Protection from water immersion : Water splashing against the enclosure from any direction shall have no harmful effect.

Integrated air hose

Max air pressure	0.49MPa (5kgf/cm^2)
Max air flow	0.12Nm^3/min (120Nl/min)

Performance of resistant chemicals and resistant solvents

(1) The positioner (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) Coolant including chlorine / gasoline
   (c) Amine type detergent
   (d) Acid, alkali and liquid causing rust
   (e) Other liquids or solutions, that will harm NBR
(2) When the positioner work in the environment, using water or liquid, complete draining of J1 base must be done. Incomplete draining of J1 base will make the positioner break down.
(3) Don not use unconfirmed liquid.
(4) Do not use the positioner immersed in water, neither temporary nor permanent. Positioner must not be wet permanently.
   * Example : in case motor surface is exposed to water for a long time, liquid may invade inside the motor and cause failure.

RELATED MANUALS

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

Safety handbook B-80687EN All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers : Operator, system designer Topics : Safety items for robot system design, operation, maintenance
R-J3*i*B Mate controller	Operator's manual LR ARC TOOL **B-82094EN** LR HANDLING TOOL **B-81524EN**	Intended readers: Operator, programmer, maintenance technician, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	Maintenance manual **B-81525EN** **B-81525EN-1** (for Europe)	Intended readers : Maintenance person, system designer Topics : Installation, set-up, connection, maintenance Use : Installation, start-up, connection, maintenance
R-J3*i*B controller	Setup and Operations manual SPOT TOOL **B-81464EN-1** HANDLING TOOL **B-81464EN-2** ARC TOOL **B-81464EN-3**	Intended readers : Operator, programmer, maintenance technician, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	Maintenance manual **B-81465EN** **B-81465EN-1** (European specification)	Intended readers : Maintenance technician, system designer Topics : Installation : start-up, connection, maintenance Use : Installation, start-up, connection, maintenance

R-30*i*A Mate controller	Operator's manual LR HANDLING TOOL **B-83134EN-1** LR ARC TOOL **B-83134EN-2** Alarm code list **B-83124EN-6**	Intended readers : Operator, programmer, maintenance technician, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	Maintenance manual Standard: **B-82725EN** **B-82725EN-1** (For Europe) **B-82725EN-2** (For RIA) Open air type **B-82965EN-1**	Intended readers : Maintenance technician, system designer Topics : Installation, start-up, connection, maintenance Use : Installation, start-up, connection, maintenance
R-30*i*A controller	Operator's manual SPOT TOOL+ **B-83124EN-1** HANDLING TOOL **B-83124EN-2** ARC TOOL **B-83124EN-3**	Intended readers : Operator, programmer, maintenance technician, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	Maintenance manual **B-82595EN** **B-82595EN-1** (European specification) **B-82595EN-2** (RIA)	Intended readers : Maintenance technician, system designer Topics : Installation, start-up, connection, maintenance Use : Installation, start-up, connection, maintenance
R-30*i*B/ R-30*i*B 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 technician, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	MAINTENANCE MANUAL R-30*i*B : **B-83195EN** R-30*i*B Mate : **B-83525EN**	Intended readers : Maintenance technician, system designer Topics : Installation, start-up, connection, maintenance Use : Installation, start-up, connection, maintenance
Robot mechanical unit	For the robot mechanical unit, refer to the manual of each robot.	

This manual uses following terms.

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

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1 CONFIGURATION

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

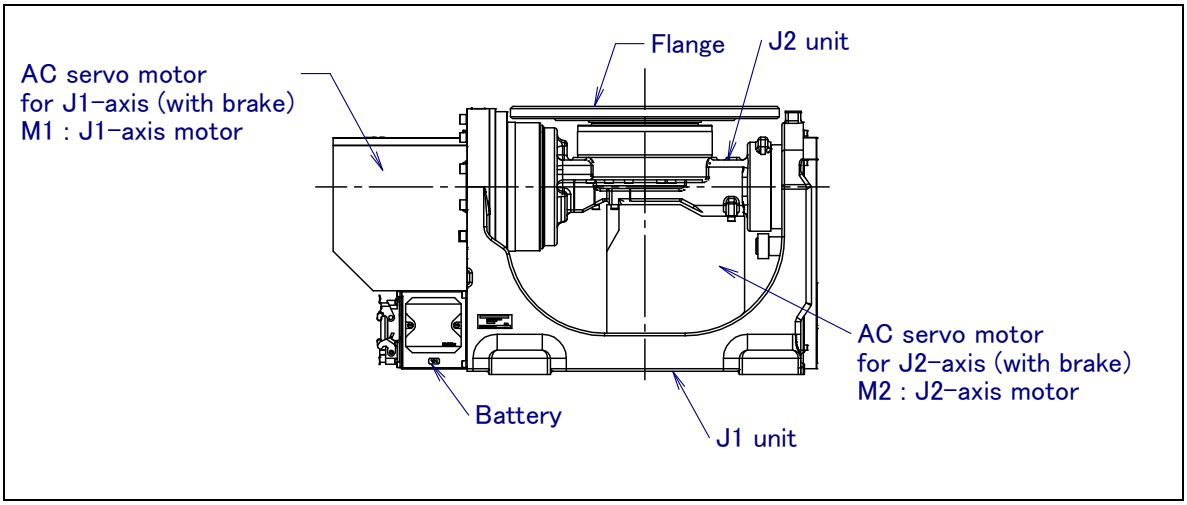


Fig. 1 (a) Mechanical unit configuration

2 CHECKS AND MAINTENANCE

Optimum performance of the positioner 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 operation time/year vs. the 3840 hours/year should be used to calculate the new (higher) frequencies. For example, when using the robot 7680 hours a year with a recommended maintenance interval of 3 years or 11520 hours, use the following calculation to determine the maintenance frequency: 3 years / 2 = perform maintenance every 1.5 years.

2.1 PERIODIC MAINTENANCE

2.1.1 Daily Checks

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

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is an oil seepage, clean it. **⇒"2.2.1 Confirmation of Oil Seepage"**
Air control set	(When an air control set is used) **⇒"2.2.2 Confirmation of the Air Control Set"**
Vibration, abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: **⇒" 4.1 TROUBLESHOOTING"(symptom：Vibration, Noise)**
Positioning accuracy	Check that the taught positions of the positioner have not deviated from the previously taught positions. If displacement occurs, perform the measures as described in the following section: **⇒" 4.1 TROUBLESHOOTING"(symptom：Displacement)**
Peripheral devices for proper operation	Check whether the peripheral devices operate properly according to commands from the positioner and the peripheral devices.
Brakes for each axis	Check that the flange mounting surface drops 5 mm or less when servo power is turned off. If the flange mounting surface drops, perform the measures as described in the following section: **⇒"4.1 TROUBLESHOOTING"(symptom：Dropping axis)**
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: **⇒"R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)etc."**

2.1.2 Periodic Check and Maintenance

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

Check and maintenance intervals (Period, Accumulated Operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 months 320h	3 months 960h	1 year 3840h	1.5 year 5760h	3 years 11520h	4 years 15360h			
○ Only 1st check	○					Cleaning the controller ventilation system	Confirm that the controller ventilation system is not dusty. If dust has accumulated, remove it.	13
	○					Check for external damage or peeling paint	Check whether the positioner has external damage or peeling paint due to contact with the peripheral equipment. If unintended contact has occurred, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check for water	Check whether the positioner 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, the operation box and the positioner are unevenly twisted or damaged. If damage is found, replace the damaged cables.	12
	○ Only 1st Check	○				Check for damage to the mechanical unit cable (movable part)	Observe the movable part of the mechanical unit cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted.	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.	4
	○ Only 1st check	○				Retightening the cover bolts and external main bolts	Retighten the cover bolts, bolts fixing fixtures to the flange surface, positioner mounting bolts, J2-axis motor cover bolts, bolts to be removed for inspection. Refer to the recommended bolt tightening torque guidelines at the end of the manual. An adhesive to prevent bolts from loosening is applied to some bolts. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	6

Check and maintenance intervals (Period, Accumulated Operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 months 320h	3 months 960h	1 year 3840h	1.5 year 5760h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Clean spatters, sawdust and dust	Check that spatters, sawdust, or dust does not exist on the positioner main body. If dust has accumulated, remove it. Especially, clean the positioner movable parts well (each joint).	7
			○			Replacing the mechanical unit batteries	Replace the mechanical unit batteries. Regardless of operating time, replace batteries at 1.5 years. **⇒" 3.3 BATTERY REPLACEMENT"**	8
				○		Replacing the grease and oil of J1, J2- axis reducer	Replace the grease of each axis reducer and gearbox **⇒"3.1 GREASE REPLACEMENT"**	9 to 10
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	11
					○	Replacing the controller batteries	Replace the controller batteries. Regardless of operating time, replace batteries at 4 years. **⇒Chapter 7 Replacing batteries of R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) etc."**	14

2.2 CHECK POINTS

2.2.1 Confirmation of Oil Seepage

Check items

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

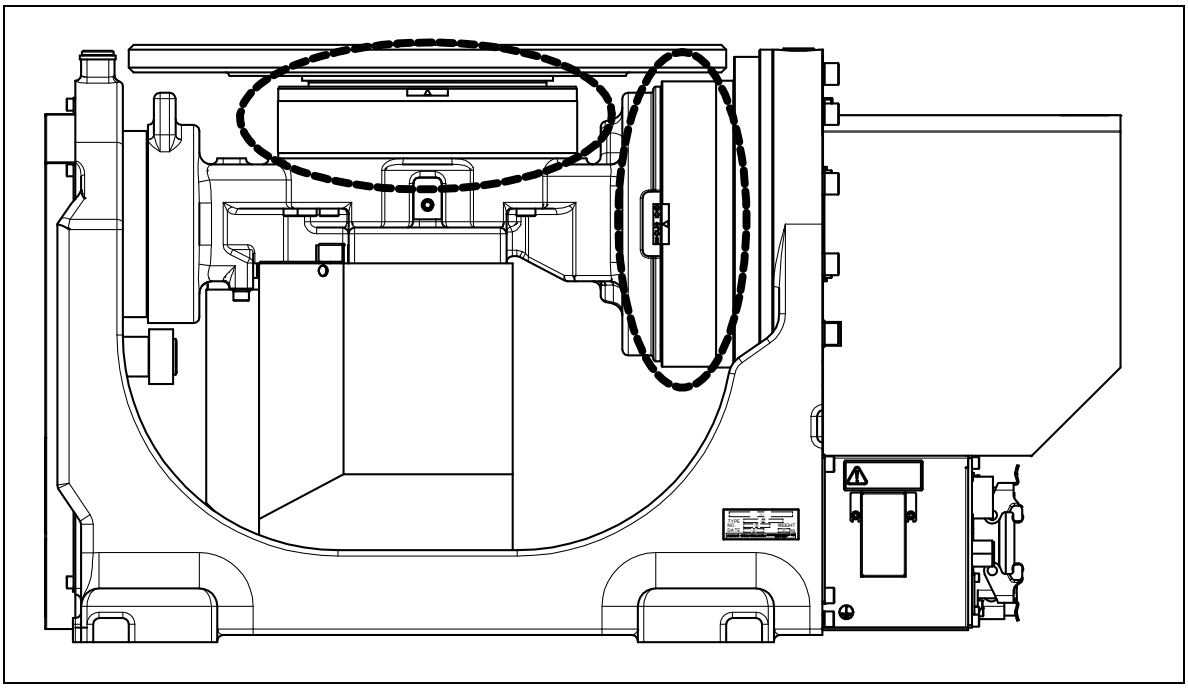


Fig. 2.2.1 (a) Check points of oil seepage

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil 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. 2.2.1 (a) before you operate the positioner.
- In case of oil seepage, please consider replacing the grease. This replacement potentially can help improving the seepage situation.

> ⚠ **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.

- Also, motors might become hot and the internal pressure of the grease bath might rise by frequent repetitive movement and use in high temperature environments. In these cases, normal internal can be restored by venting the grease outlet. (When opening the grease outlet, refer to Section 3.1 of "MAINTENANCE" and ensure that grease is not expelled onto the machine or tooling.)
- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.

  ⇒" 4.1 TROUBLESHOOTING"(symptom : Grease leakage)

2.2.2 Confirmation of the Air Control Set

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

Item	Check items	Check points
1	Air pressure	Check the air pressure using the pressure gauge on the air regulator as shown in Fig. 2.2.2 (a). If it does not meet the specified pressure of 0.49 to 0.69 MPa (5 to 7 kgf/cm^2), adjust it using the regulator pressure-setting handle.
2	Lubricator oil mist quantity	Check the number of oil drops during wrist or hand motion. If it does not meet the specified value (1 drop/10 to 20 sec), adjust it using the lubricator control knob. Under normal usage, the lubricator will be empty in about 10 to 20 days.
3	Lubricator oil level	Check to see that the air control set oil level is within the specified level.
4	Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts as required.
5	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.

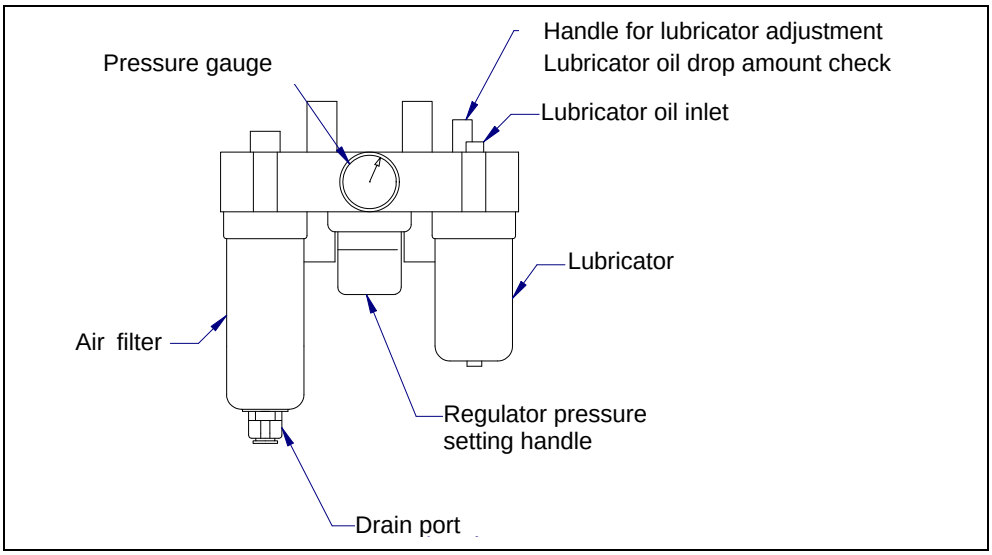


Fig. 2.2.2 (a) Air control set (option)

3 PERIODIC MAINTENANCE

3.1 GREASE REPLACEMENT

According to below, replace the grease of the reducers of J1, J2 axis, at the intervals based on every 3 years or 11520 hours, which ever comes first. For greasing points, see Figs. 3.1 (a) and (b).

1 Remove the seal bolts and taper plugs of the J1-axis and J2-axis grease outlets shown in Figs. 3.1 (a) and (b). Use grease outlet 1 in Fig. 3.1 (b) as the J2-axis grease outlet. Only when outlet 1 cannot be used because of the installation state of the fixture, use grease outlet 2.
2 Attach the grease nipple supplied with the positioner. Note that the grease nipple is provided for multipurpose use.
3 Apply the grease specified in Table 3.1 (a) to the J1-axis and J2-axis grease nipples until the old grease is replaced and the new grease is output from the grease outlets. At this time, confirm that the same amount of the old grease as that of applied grease has been output to prevent the grease bath from overflowing.
4 After applying grease, release the remaining pressure in the grease bath as instructed by the procedure in Section 3.2.
5 Wind seal tape around the removed J1-axis and J-2 axis seal bolts and attach them to the J1-axis and J2-axis grease outlets.
6 Attach the taper plugs to the J1-axis and J2-axis grease inlets. Wind seal tape around the taper plugs.

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

Table 3.1 (a) Grease to be replaced at regular intervals of three years (11520 hours)

	Specified grease	Amount of grease to be applied	Gun tip pressure
	Kyodo Yushi		
J1-axis reducer	VIGOGREASE RE0 (Specification: A98L-0040-0174)	About 1180 ml	0.1 MPa or less (NOTE)
J2-axis reducer		About 980 ml	

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

Set the posture specified below during replacement of grease.

Table 3.1 (b) Greasing posture

Greasing point	Posture	
	J1	J2
J1-axis	0°	Free
J2-axis	0° (*-90°)	Free

* Set this posture when using grease outlet 2.

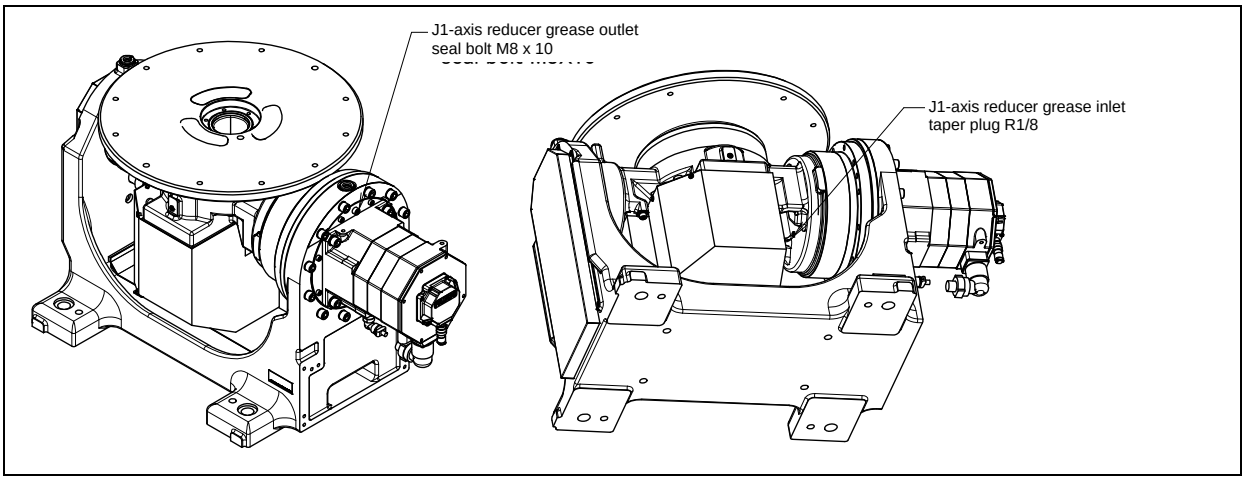


Fig. 3.1 (a) Grease inlet and outlet of the J1-axis reducer

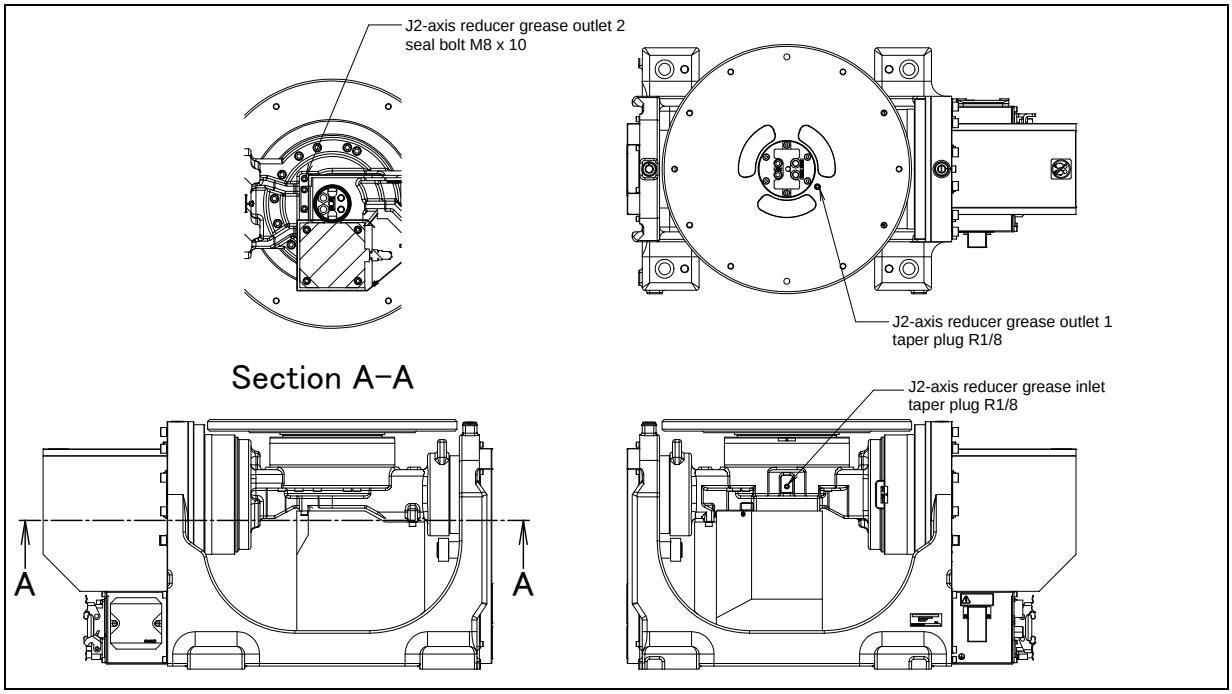


Fig. 3.1 (b) Grease inlet and outlet of the J2-axis reducer

Table 3.1 (c) Spec. of the seal bolt, the taper plug and the grease nipple

Parts name	Specification
Seal bolt (M8)	A97L-0218-0417#081010
Taper plug (R1/8)	A97L-0001-0436#2-1D
Grease nipple	A97L-0218-0013#B110

⚠ CAUTION

Failure to follow proper lubrication procedures may cause the suddenly increase of the grease bath internal pressure and the damage to the seal, which could lead to grease leakage and abnormal operation. When greasing, observe the following cautions.

1 Before starting to grease, open the grease outlet (remove the plug or bolt from the grease outlet).
2 Supply grease slowly, using a manual pump.
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply. If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 3.1 (a)).
4 Use specified grease. Use of non-approved grease may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Section 3.2, and then close the grease outlet.
6 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.

3.2 PROCEDURE FOR RELEASING THE GREASE REMAINING PRESSURE

After applying grease, operate the J1-axis for 20 minutes or more or the J2-axis for 10 minutes or more with the plug of the grease inlet and the seal bolt of the grease outlet removed in a state in which an axis angle of 60^{o} or more and OVR100% are satisfied and to release the remaining pressure in the grease bath. At this time, attach a recovery bag to prevent output grease from splattering.

If the above operation cannot be performed due to the environment of the positioner, adjust the operating time according to the operating angle. (If only a motion angle of 30 degrees can be set, perform an operation for 20 minutes or more.) After completion of the operation, attach the plugs and seal bolts to the grease inlets and outlets. When reusing the taper plugs and seal bolts, be sure to seal them with seal tape.

3.3 BATTERY REPLACEMENT

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

1 Press the EMERGENCY STOP button of the robot to keep robot and positioner from moving.

> **⚠ CAUTION**
> Be sure to turn on the power. If the battery is replaced when the power is off, the current position information is lost, so that mastering becomes necessary.

2 Uncap the battery case.
3 Take out the battery from the battery case.
4 Insert a new battery into the battery case while paying attention to the polarity of the battery.
5 Cap the battery case.

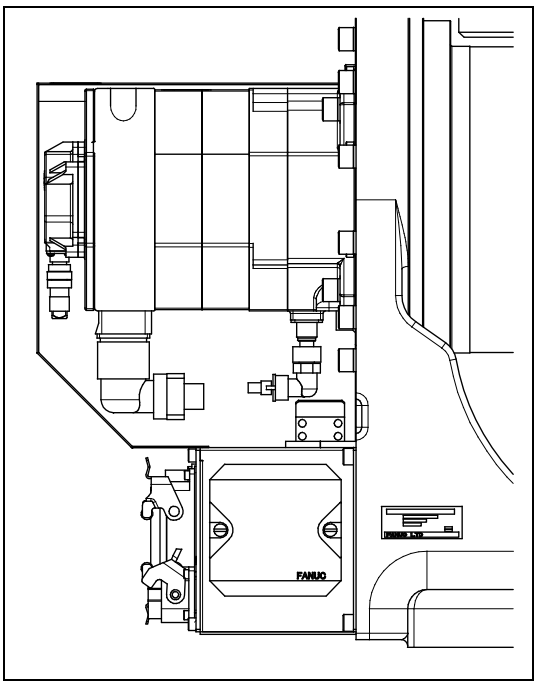


Fig. 3.3 (a) Battery replacement 1

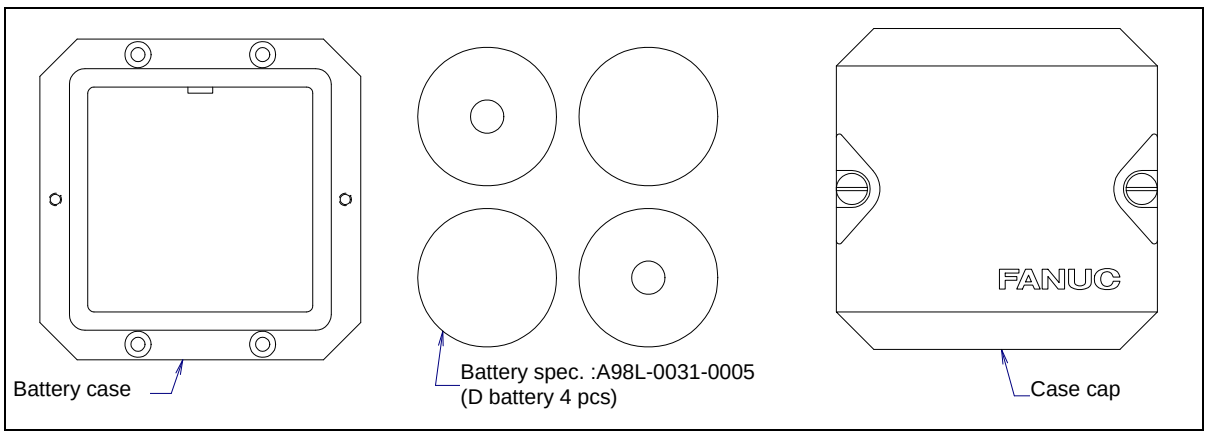


Fig. 3.3 (b) Battery replacement 2

4 TROUBLESHOOTING

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

4.1 TROUBLESHOOTING

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

Table 4.1 (a) Troubleshooting

Symptom	Description	Cause	Measure
Vibration Noise	- The J1 base lifts off the base plate as the positioner operates. - There is a gap between the J1 base and base plate. - A J1 base retaining bolt is loose.	[J1 base fastening] - It is likely that the positioner J1 base is not securely fastened to the base plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or foreign material caught between the base plate and floor plate. - If the positioner is not securely fastened to the base plate, the J1 base lifts the base plate as the positioner 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 base plate surface flatness to within the specified tolerance. - If there is any foreign material between the J1 base and base plate, remove it.
	- The rack or floor vibrates during operation of the positioner.	[Rack or floor] - It is likely that the rack or floor is not sufficiently rigid. - If the rack or floor is not sufficiently rigid, reaction from the positioner deforms the rack or floor, leading to vibration.	- Reinforce the rack or floor to make it more rigid. - If it is impossible to reinforce the rack or floor, modify the robot control program; doing so might reduce the amount of vibration.
	- Vibration becomes more serious when the positioner adopts a specific posture. - If the operating speed of the positioner is reduced, vibration stops. - Vibration is most noticeable when the positioner is accelerating. - Vibration occurs when two or more axes operate at the same time.	[Overload] - It is likely that the load on the positioner is greater than the maximum rating. - It is likely that the positioner control program is too demanding for the positioner hardware. - It is likely that the ACCELERATION value is excessive.	- Check the maximum load that the positioner can handle once more. If the positioner is found to be overloaded, reduce the load, or modify the positioner control program. - Vibration in a specific portion can be reduced by modifying the robot control program while slowing the positioner 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 positioner collided with an object or the positioner was overloaded for a long period. - The grease of the vibrating or noise occurring axis has not been exchanged for a long period. - Cyclical vibration and noise occur.	[Gear, bearing, or reducer] - It is likely that the collision or overload applied an excessive force on the drive mechanism, thus damaging the gear tooth surface or rolling surface of a bearing, or reducer. - Prolonged overloaded use may cause fretting fatigue on the gear tooth surface or the rolling surface of bearing and reducer. - It is likely that foreign material which was caught in a gear, bearing, or within a reducer caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that foreign material which was caught in a gear, bearing, or within a reducer cause vibration. - It is likely that, because the grease has not been changed for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue.	- Operate one axis at a time to determine which axis is vibrating. - Remove the motor, and replace the gear , the bearing, and the reducer. For the spec. of parts and the method of replacement, contact FANUC. - Using the positioner within its maximum rating prevents problems with the drive mechanism. - Using the specified grease at the recommended interval will prevent problems.

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

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

Symptom	Description	Cause	Measure
Motor overheating	- The ambient temperature of the installation location increases, causing the motor to overheat. - After a cover was attached to the motor, the motor overheated. - After changing the Robot control program or the load, the motor overheats.	[Ambient temperature] - It is likely that a rise in the ambient temperature or attaching the motor cover prevented the motor from releasing heat efficiently, thus leading to overheating. [Operating condition] - It is likely that the positioner was operated with the maximum average current exceeded.	- The teach pendant can be used to monitor the average current. Check the average current when the robot control program is running. The allowable average current is specified for the positioner according to its ambient temperature. Contact FANUC for further information. - Relaxing the positioner control program and conditions can reduce the average current, thus preventing overheating. - Reducing the ambient temperature is the most effective means of preventing overheating. - Having the surroundings of the motor well ventilated enables the motor to release heat efficiently, thus preventing overheating. Using a fan to direct air at the motor is also effective. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation.
	- After a 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 8.3.
	- Symptom other than stated above	[Mechanical section problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor running with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor.	- 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 is leaking from the mechanical unit.	[Poor sealing]
		- Probable causes are a crack in the casting, a broken O-ring, a damaged oil seal, or a loose seal bolt.
		- A crack in a casting can occur due to excessive force that might be caused in a collision.
		- An O-ring can be damaged if it is pinched or cut during disassembling or re-assembling.
		- An oil seal might be damaged if extraneous dust scratches the lip of the oil seal.
		- A loose seal bolt or taper plug might 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 leakage. However, the component should be replaced as soon as possible, because the crack might extend.
			- O-rings are used in the locations listed below.
			  - Motor coupling section
			  - Reducer (case and shaft) coupling section
			- Oil seals are used in the locations stated below.
			  - Inside the reducer
			- Seal bolts and taper plugs are used in the locations stated below.
			  - Grease inlet, outlet

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

Symptom	Description	Cause	Measure
Displace-ment	- The positioner moves to a point other than the taught position. - The repeatability is not within the tolerance.	[Mechanical section problems] - If the repeatability is unstable, probable causes are a failure in the drive mechanism or a loose bolt. - If the repeatability becomes stable it is likely that a collision imposed an excessive load, leading to slipping on the base surface or the mating surface of the reducer. - It is likely that the Pulsecoder is faulty.	- If the repeatability is unstable, repair the mechanical section by referring to the above descriptions of vibration, noise, and rattling. - If the repeatability is stable, correct the taught program. The problem will not reoccur unless another collision occurs. - If the Pulsecoder is faulty, replace the motor.
	- Displacement occurs only in a specific peripheral unit.	[Peripheral unit displacement] - It is likely that an external force was applied to the peripheral unit, thus shifting its position relative to the positioner.	- Correct the setting of the peripheral unit position. - Correct the taught program.
	- Displacement occurred after a parameter was changed.	[Parameter] - It is likely that the mastering data was rewritten in such a way that the positioner 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.	- The voltage of the memory backup battery is low. - The Pulsecoder cable is defective.	- Replace the battery. - Replace the cable.
Troubles related to arc welding	- Starting of an arc is not good. - An arc is unstable. - Beads are irregular.	- The welding earth cable may be loosened or broken (NOTE).	- Tighten the connection part of the earth cable. - Replace the earth cable.

NOTE
Arc welding troubles may be caused by a welding unit such as a welding power supply or torch. When a trouble occurs, see the manual of each unit to find the cause.

4.2 COMPONENT REPLACEMENT AND ADJUSTMENT ITEMS

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

Component replacement or function change	Adjustment item
Cable replacement	(a) Cable dressing (b) Quick mastering
Battery replacement (The battery should be replaced once 1.5 years.)	Replace the battery with the power kept on. No adjustment is needed.

5 ADJUSTMENTS

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

5.1 AXIS LIMITS SETUP

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

- Used work area limitations
- The robot may interfere with tools or peripheral equipment in an area.
- The length of a cable or hose attached for an application is limited.

There are two methods used to prevent the positioner from going beyond the necessary motion range. These are

- Axis limit software settings (J1/J2-axis)
- Axis limit mechanical stopper (J1 axis)

⚠ CAUTION

1 Changing the movable range of any axis affects the operation range of the positioner. To avoid trouble, carefully consider a possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition occurs; for example, an alarm may occur in a previous taught position.
2 For the J1-axis, do not count merely on software-based limits to the movable range when changing the movable range of the positioner. When changing the movable range, use mechanical stoppers together so that damage to peripheral equipment and injuries to human bodies can be avoided. In this case, make the software-specified limits match the limits based on the mechanical stoppers.
3 Mechanical stoppers are physical obstacles. The positioner cannot move beyond them. For the J1-axis, it is possible to re-position the mechanical stoppers. The J2-axis has no mechanical stopper.
4 Movable mechanical stoppers (J1-axis) is deformed in a collision to stop the positioner. Once a stopper is subject to a collision, it can no longer assure its original strength and, therefore, may not stop the positioner. When this happens, replace it with a new one.

Upper Limits

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

Lower Limits

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

5.2 REFERENCE POSITION AND MOVING RANGE

Zero point and software motion limits are provided for each controlled axis. Exceeding the software motion limit of a controlled axis is called overtravel (OT). Overtravel is detected at both ends of the motion limit for each axis. The positioner cannot exceed the software motion limit unless there is a failure of the system causing loss of zero point position or there is a system error.
Fig. 5.2 (a) and (b) show the zero point and motion limit (stroke), and mechanical stopper position of each axis.

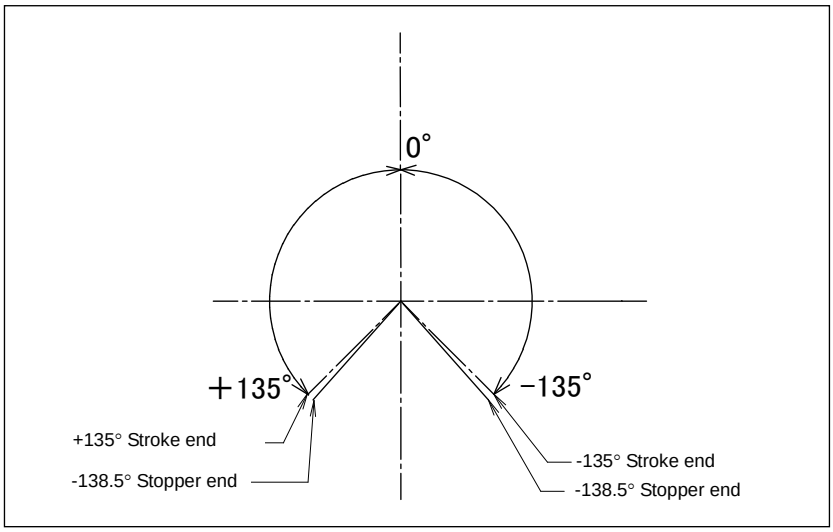


Fig. 5.2 (a) J1-axis rotation

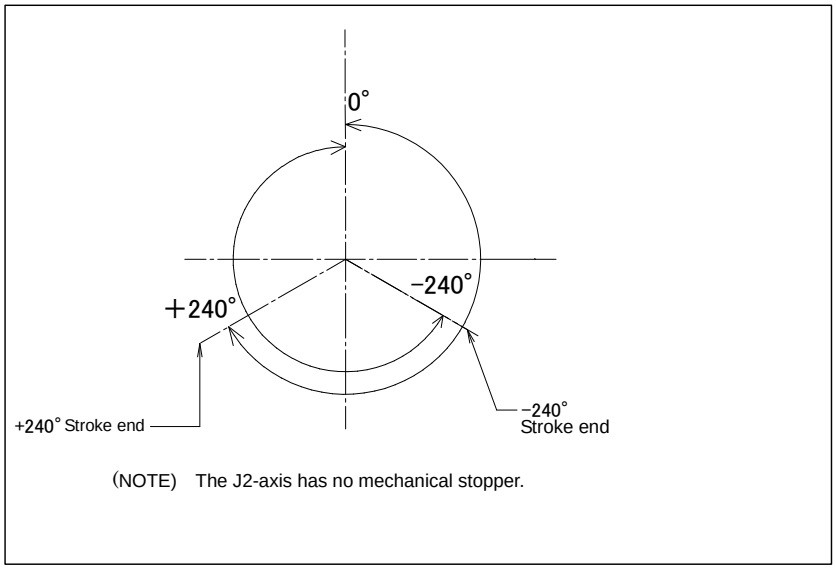


Fig. 5.2 (b) J2-axis rotation

5.3 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.

Mastering method

Table 5.3 (a) describes the following mastering methods. If 7DC2 (V8.20P) or former software is installed, "Quick Mastering for Single Axis" has not been supported.

Table 5.3 (a) Type of mastering

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

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

If the backup batteries for the Pulsecoder go dead during cable replacement, quick mastering can be performed, resetting the positioner exactly to its initial position by calibration.
If replacement of the motors, reducers, or other parts causes mechanical changes in the phases of the Pulsecoder, quick mastering cannot be performed. In this case, perform fixture position mastering for accurate position calibration.

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

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

5.3.1 Resetting Alarms and Preparing for Mastering

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

Alarm displayed

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

Procedure

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

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

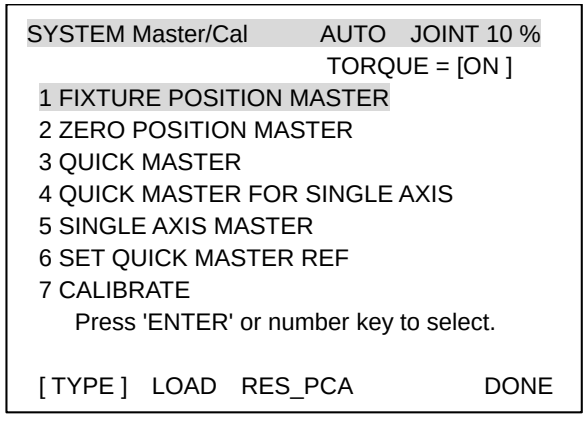
3 To reset the "SRVO-075 Pulse not established" alarm, follow the steps 1 to 2.
   1 After cycling controller power, the message "SRVO-075 Pulse not established" appears again.
   2 Move the axis for which the message mentioned above has appeared in either direction till the alarm disappears when you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

5.3.2 Zero Position Mastering

Zero-position mastering is performed with axes set at the 0-degree position. A zero-position mark (witness mark) is attached to each positioner axis. (Fig.5.3.2 (a)) This mastering is performed with all axes set at the 0-degree position using their respective witness marks.
Zero-position mastering involves a visual check. It cannot be so accurate. It should be used only as a quick-fix method.

Zero-position Mastering Procedure

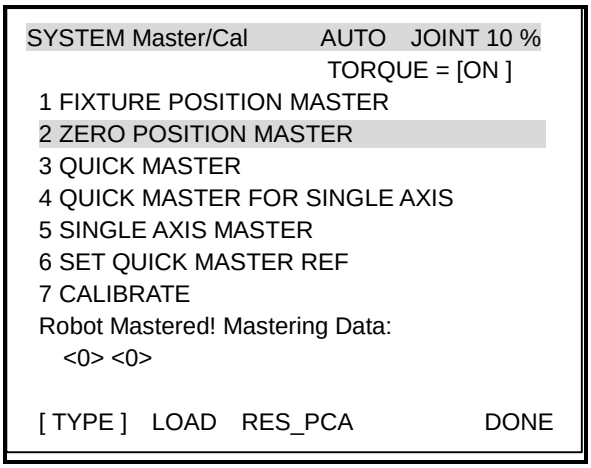
1 Press the [MENU] key to display the screen menu.
2 Select [0 NEXT] and press [6 SYSTEM].
3 Press F1 [TYPE], display the screen change menu.
4 Select [Master/Cal]. The positioning screen will be displayed.



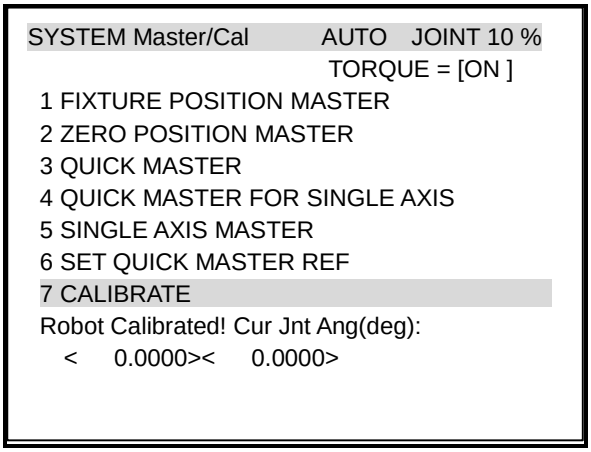
5 Release brake control, and jog the robot into a posture for mastering.

NOTE
Brake control can be released by setting the system variables as follows:
$PARAM_GROUP.SSV_OFF_ALL : FALSE
$PARAM GROUP.SSV OFF ENB[*] : FALSE (for all axes)
After changing the system variables, turn off the controller power and on again.
([*] is the axis number of the positioner.)

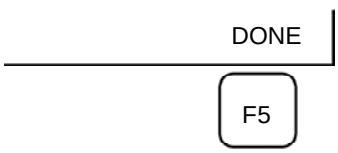
6 Select “2 ZERO POSITION MASTER”.



7 Select [7 CALIBLATE] and press F4, YES. Mastering will be performed automatically.
Alternatively, turn the power off and then back on. Mastering is performed.
When the power is turned off and then back on, mastering is always performed.



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



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

Table 5.3.2 (a) Posture with position marks aligned

Axis	Position
J1-axis	0 deg
J2-axis	0 deg

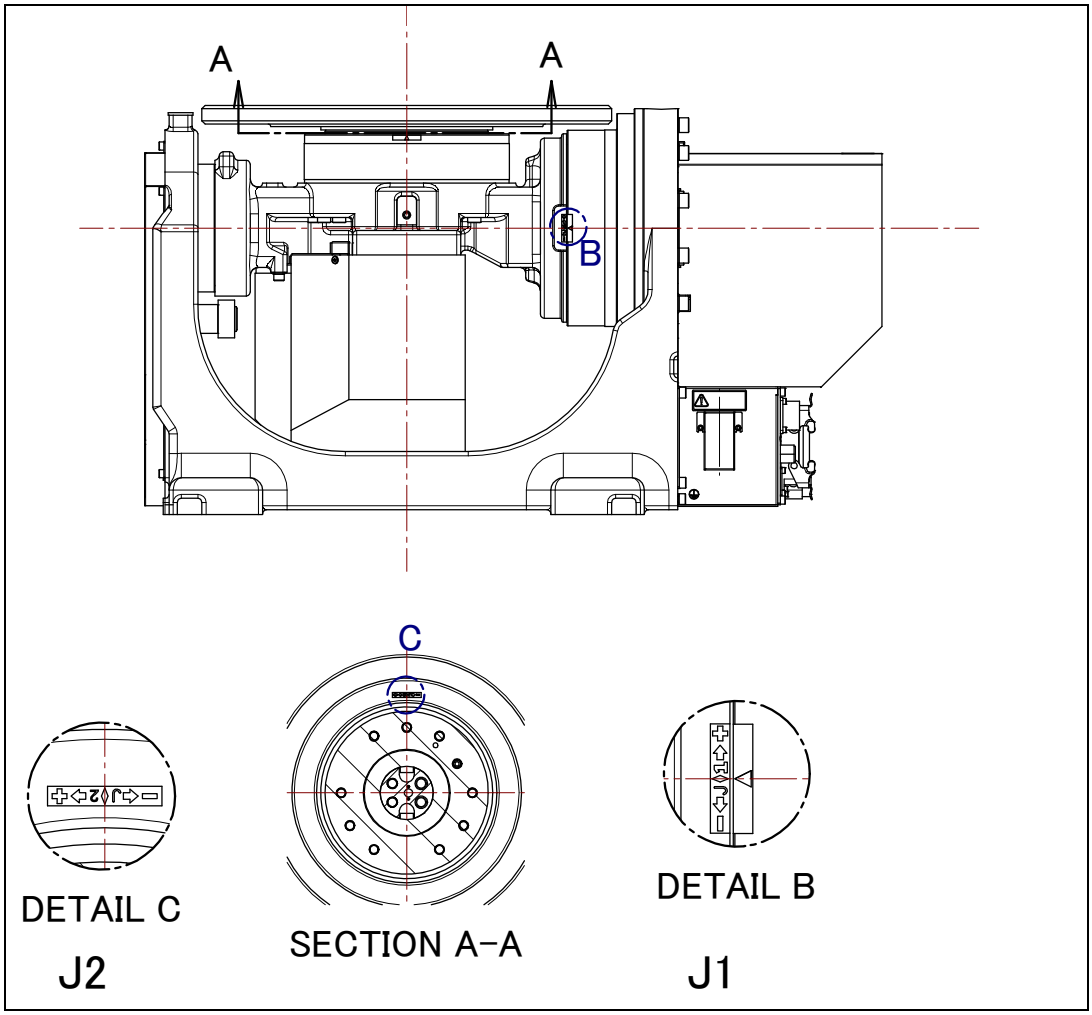


Fig. 5.3.2 (a) Marking of the zero-degree for each axis (witness mark)

5.3.3 Quick Mastering

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

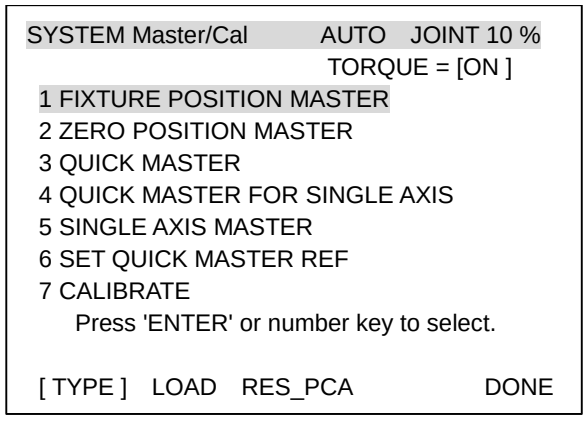
Quick mastering is factory-performed at the zero-degree position. Do not change the setting unless there is a problem.
If it is impossible to set the positioner at the position mentioned above, it is necessary to re-set the quick mastering reference position using the following method. (It would be convenient to set up a marker that can work in place of the position mark.)

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

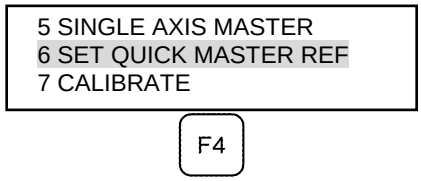
Procedure for Recording the Quick Master Reference Position

Step

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



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

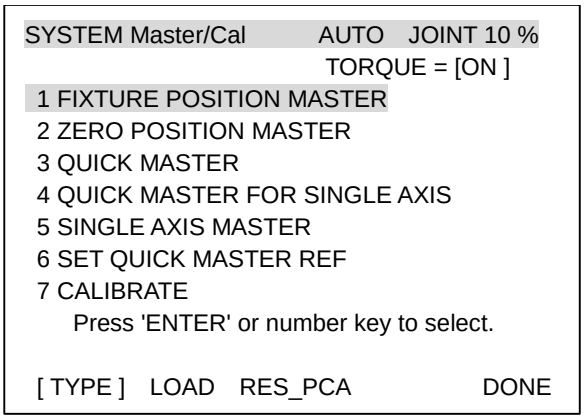


⚠ CAUTION
If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or zero –position mastering to restore mastering data.

Procedure Quick Mastering

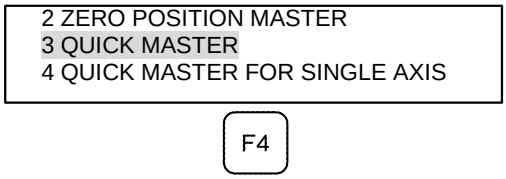
Step

1 Display the Master/Cal screen



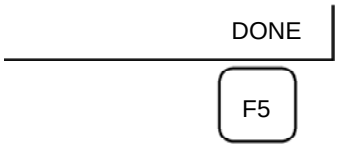
2 Release brake control, and jog the robot to the quick mastering reference position.

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



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

5 After completing the calibration, press F5 Done.



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

7 After mastering, update the mastering data listed in the factory-supplied data sheet with new mastering data ($DMR_GROUP[*].$MASTER_COUN [*]).
([*] is the group number of the positioner.)

5.3.4 QUICK MASTERING FOR SINGLE AXIS

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

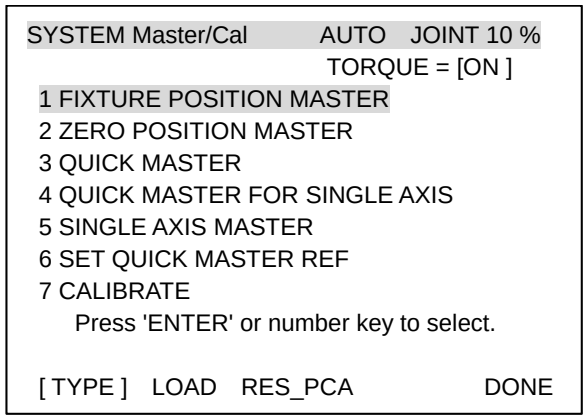
Quick mastering is factory-performed at the position indicated in Table 5.3.2 (a). Do not change the setting unless there is any problem.

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

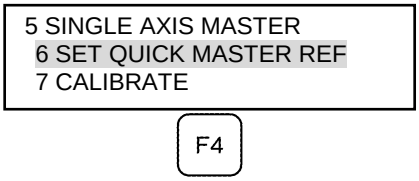
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure for Recording the Quick Mastering Reference Position

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



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



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

Procedure of Quick Mastering for single axis

1 Display the Master/Cal screen.

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

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

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

                                                EXEC
```

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

```
SINGLE AXIS MASTER              AUTO    JOINT 10%
                                                1/9
    ACTUAL   POS    (MSTR POS)      (SEL)   [ST]
J1          0.000   (       0.000)  (0)     [2]
J2          0.000   (       0.000)  (0)     [2]

                                                EXEC
```

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

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

5.3.5 Single Axis Mastering

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

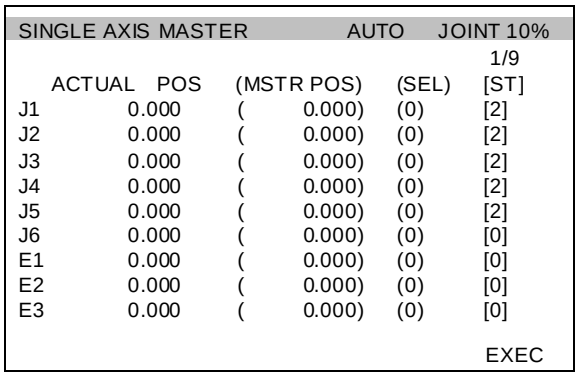


Table 5.3.5 (a) Items set in single axis mastering

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

Procedure of Single axis mastering

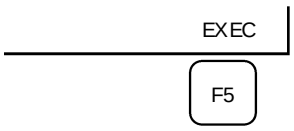
1 Select [6 SYSTEM].
2 Select [Master/Cal]. The positioning screen will be displayed.

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

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

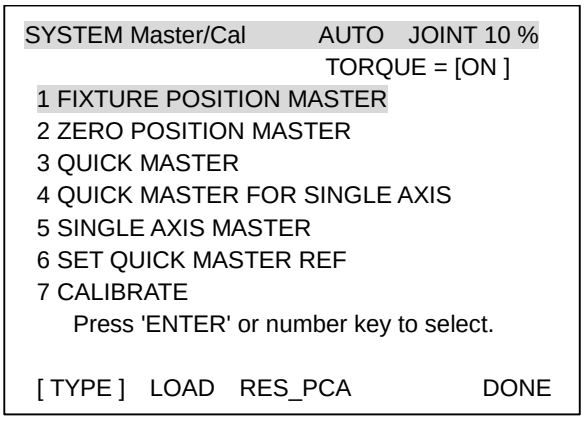
```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                          1/9
    ACTUAL   POS    (MSTR POS)    (SEL)   [ST]
J1          0.000   (     0.000)  (0)     [2]
J2          0.000   (     0.000)  (0)     [2]
J3          0.000   (     0.000)  (0)     [2]
J4          0.000  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

                                          EXEC
```

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



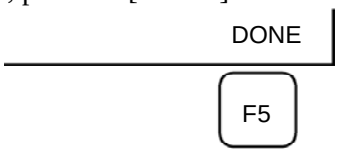

```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                          6/9
    ACTUAL   POS    (MSTR POS)    (SEL)   [ST]
J1          0.000   (     0.000)  (0)     [2]
J2          0.000   (     0.000)  (0)     [2]
J3          0.000   (     0.000)  (0)     [2]
J4          0.000  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

                                          EXEC
```

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



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

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



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

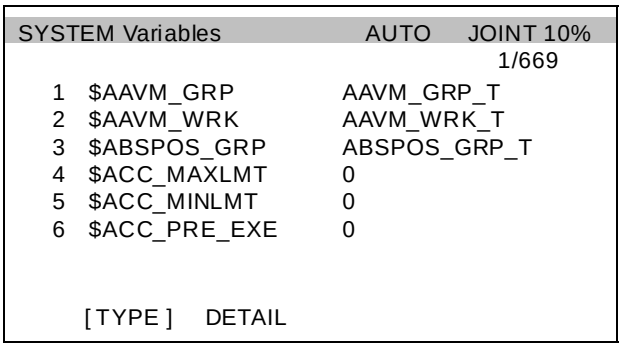
5.3.6 Mastering Data Entry

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

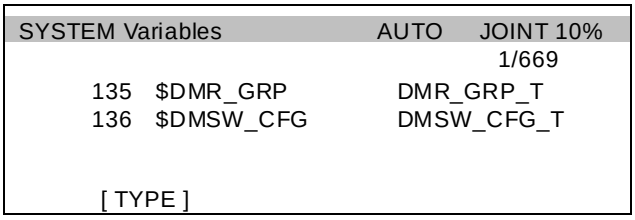
Mastering data entry method

1 Press the [MENU] key, then select the [6 SYSTEM]. .

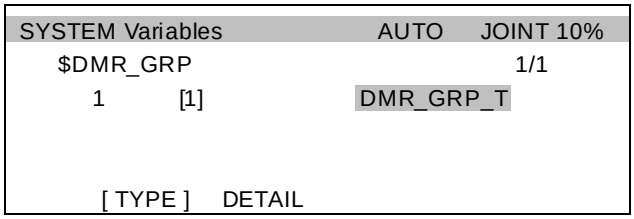
2 Press F1 [TYPE]. Select [Variables]. The system variable screen will be displayed.

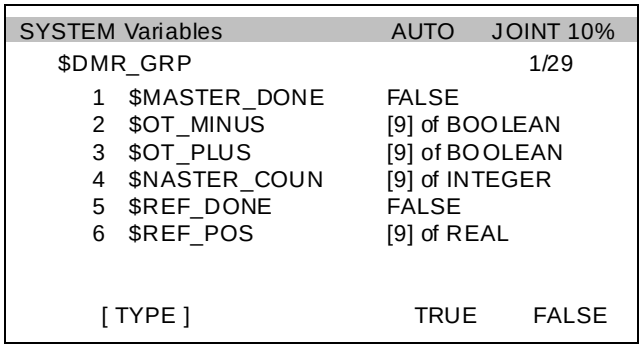


3 Change the mastering data.
The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

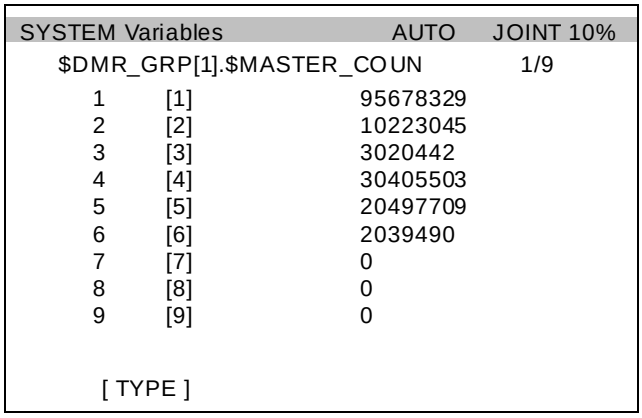


4 Select $DMR_GRP.

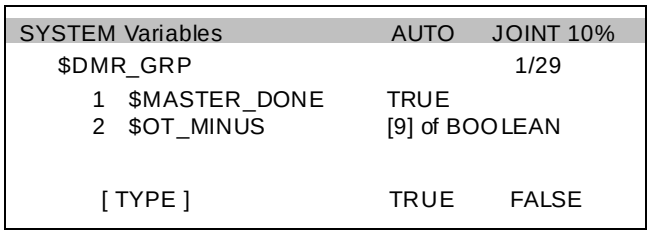




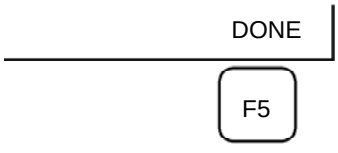
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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



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



5.3.7 Confirming Mastering

1 Checking whether mastering has been made correctly
Usually, positioning is performed automatically at power-on. To check whether mastering has been made correctly, note whether the displayed current position agrees with the actual robot position. Use the procedure described below:
(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the zero-degree position marks indicated in Fig.5.3.2 (a) are aligned. There is no need to use any visual aid.
(3) Using fixtures, set the robot to the mastering position in the same way as when performing mastering. Check that the displayed current position agrees with the actual mastering position.

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

2 Alarms that may be output during mastering and remedy for it
(1) BZAL alarm
This alarm is output if the voltage of the Pulsecoder's backup battery falls to 0 V while the power to the controller is disconnected. Also, if Pulsecoder connector is removed for replacing cables etc. this alarm is output because voltage becomes to 0. To clear the alarm, fit a new battery, execute the pulse reset (See Subsection 5.3.1.), then turn off the controller power then on again and confirm alarm is not output.
Battery might be weak if you can’t reset alarm, then replace battery to new one, perform pulse reset, turn off and on the controller power. Note that, if this alarm occurs, all data originally held by the Pulsecoder will have been lost. Mastering must be performed again.
(2) BLAL alarm
This alarm is output if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is output, fit a new battery immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
(3) CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL, alarms
Contact your local FANUC representative because the Pulsecoder may be defective.

6 PIPING AND WIRING

6.1 PIPING DRAWING (Only for A05B-1220-J201)

Fig. 6.1 (a) shows the diagram of piping in the mechanical unit.

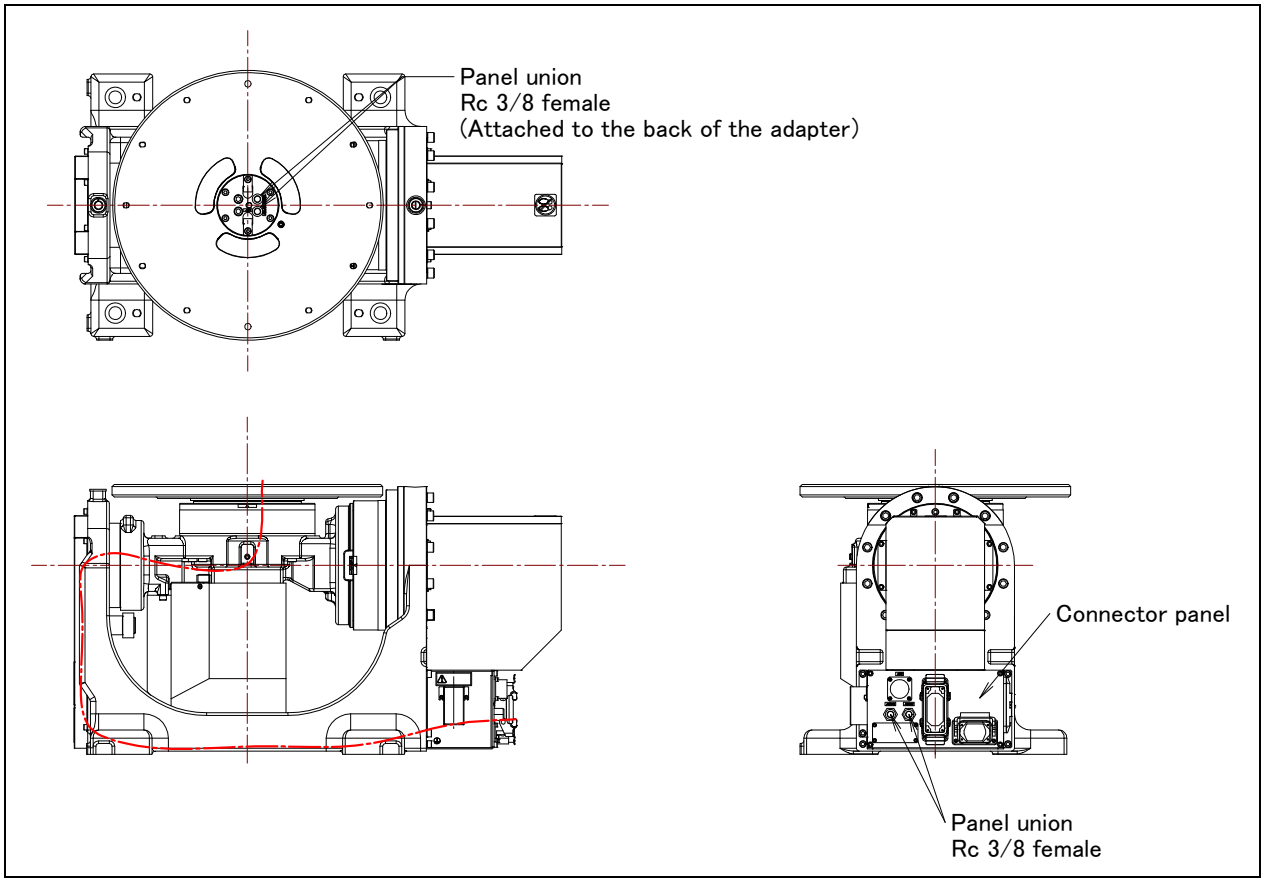


Fig. 6.1 (a) Piping diagram

6.2 CABLE MOUNTING DIAGRAM

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

1) Whether the swiveling motion of the positioner has caused any tension or bending in the swiveling section.
2) Confirm that cables do not rub against each other due to the operation of each axis.
3) In particular, confirm that the pipe portion from the J2-axis shaft to the J2-axis reducer pipe is not damaged.

Fig. 6.2 (a) shows the wiring of the cables in the mechanical unit.

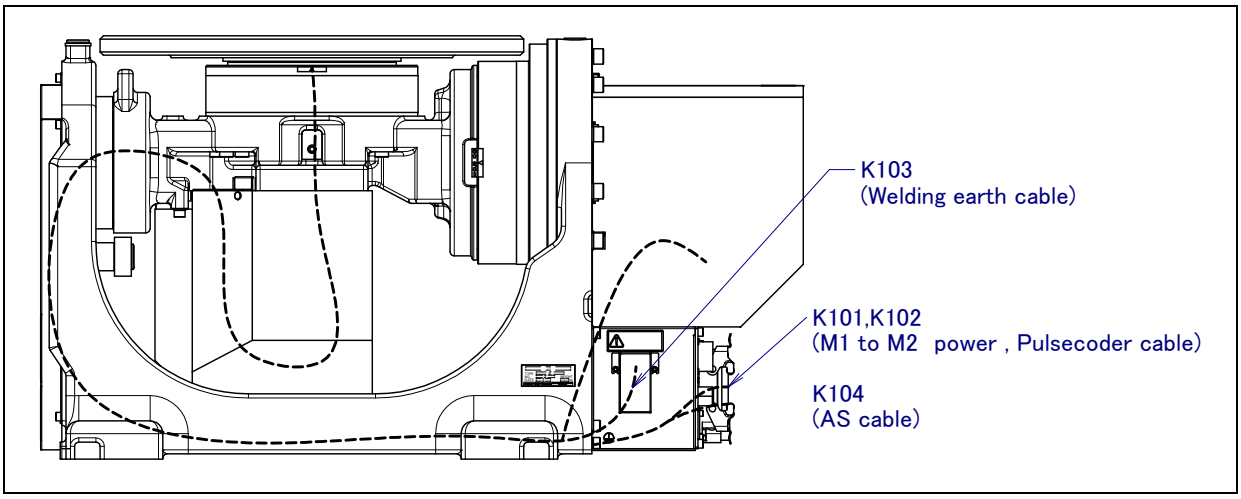


Fig. 6.2 (a) Cables in the mechanical unit

NOTE
K103 and K104 cable do not exist for A05B-1220-J203.

7 POSITIONER OUTLINE DRAWING AND OPERATION AREA DIAGRAM

When installing peripheral equipments, be careful not to cause interference with the positioner body. For installation, see Section 9.3 and use 4-ϕ24 through holes provided on the base.

7.1 OUTLINE DRAWING AND OPERATION AREA DIAGRAM

Figs. 7.1 (a) and (b) show the outer dimensions and the operation area of the positioner, respectively. This operation area does not depend on the installation type: floor mount, wall mount, or upside-down mount.

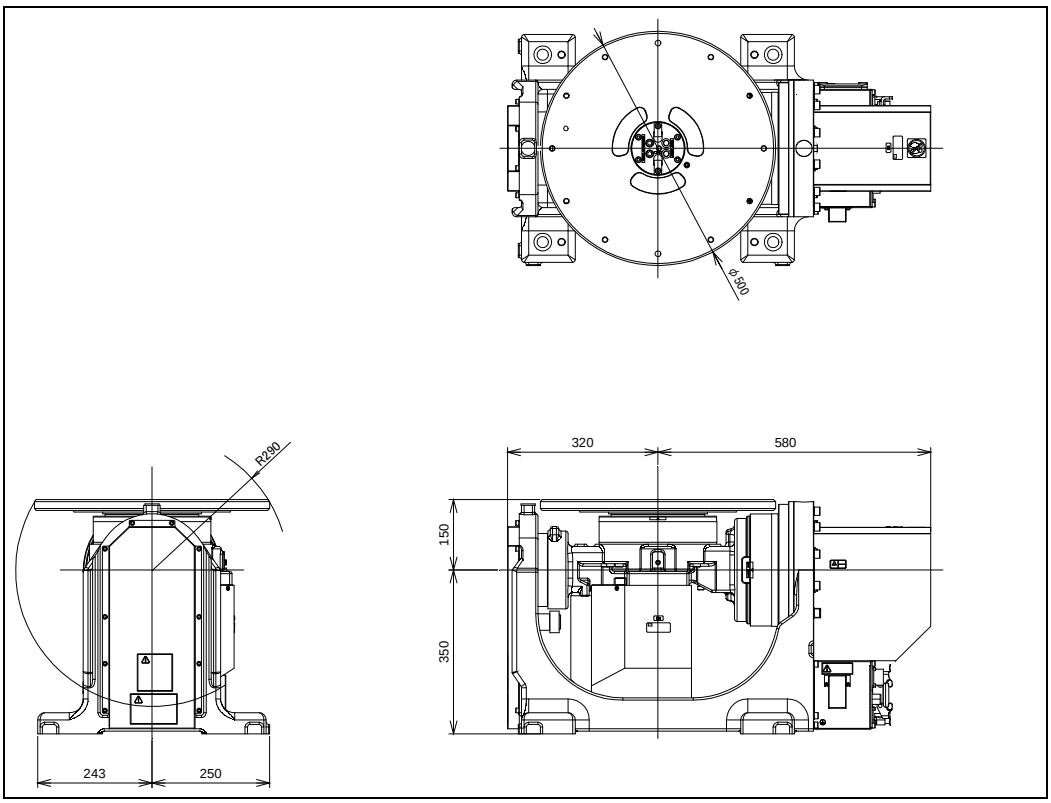


Fig. 7.1 (a) Outline

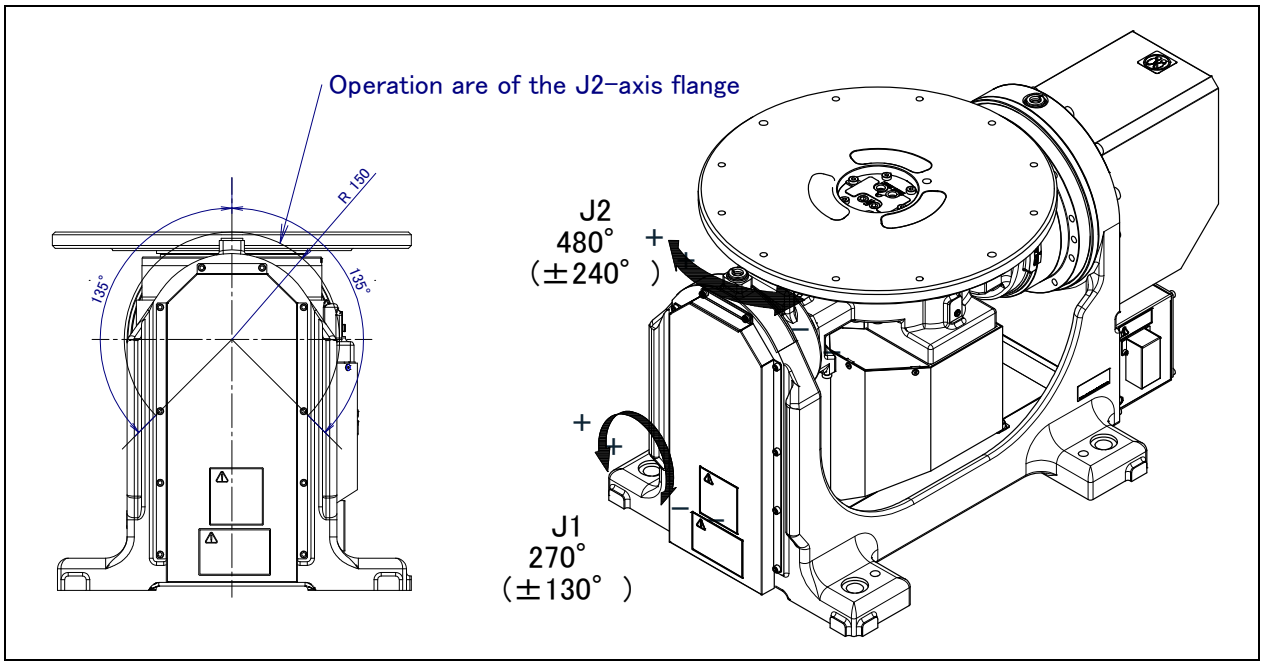


Fig. 7.1 (b) Operation area diagram

8 MOUNTING DEVICES ON THE POSITIONER

NOTE
Before mounting a device, wipe oil off the flange surface well. If not, the position of the device may be deviated.

8.1 FLANGE MOUNTING SURFACE

(1) Flange mounting surface
The flange mounting surface is shown in Fig. 8.1 (a).

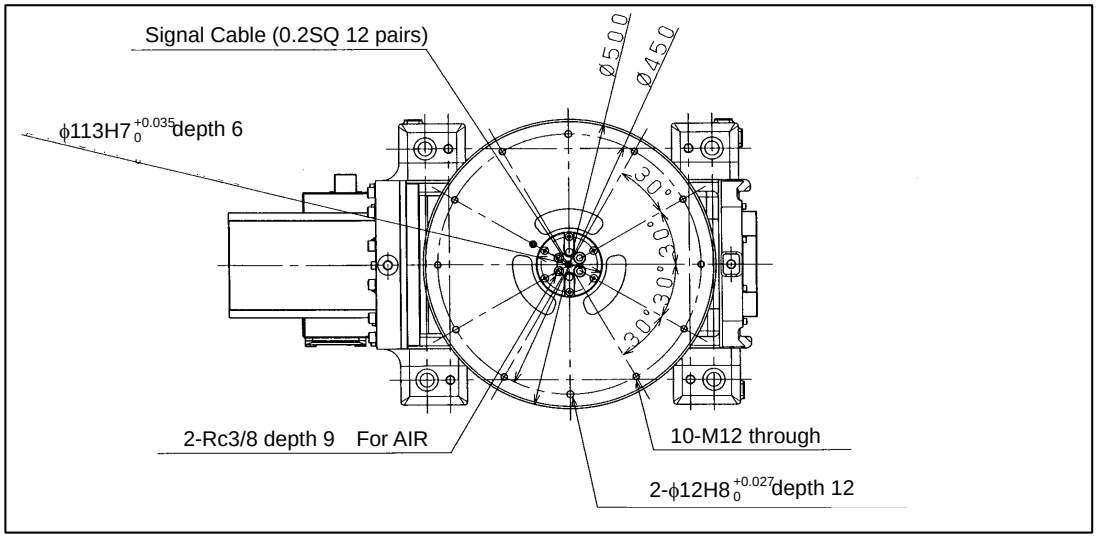


Fig. 8.1 (a) Flange fixture mounting surface

8.2 POSITIONER LOAD CONDITION

Fig. 8.2 (a) is diagram to limit loads applied to the wrist. Apply a load within the region indicated in the graph. Apply the conditions of the allowable load moment and the allowable load inertia, too.

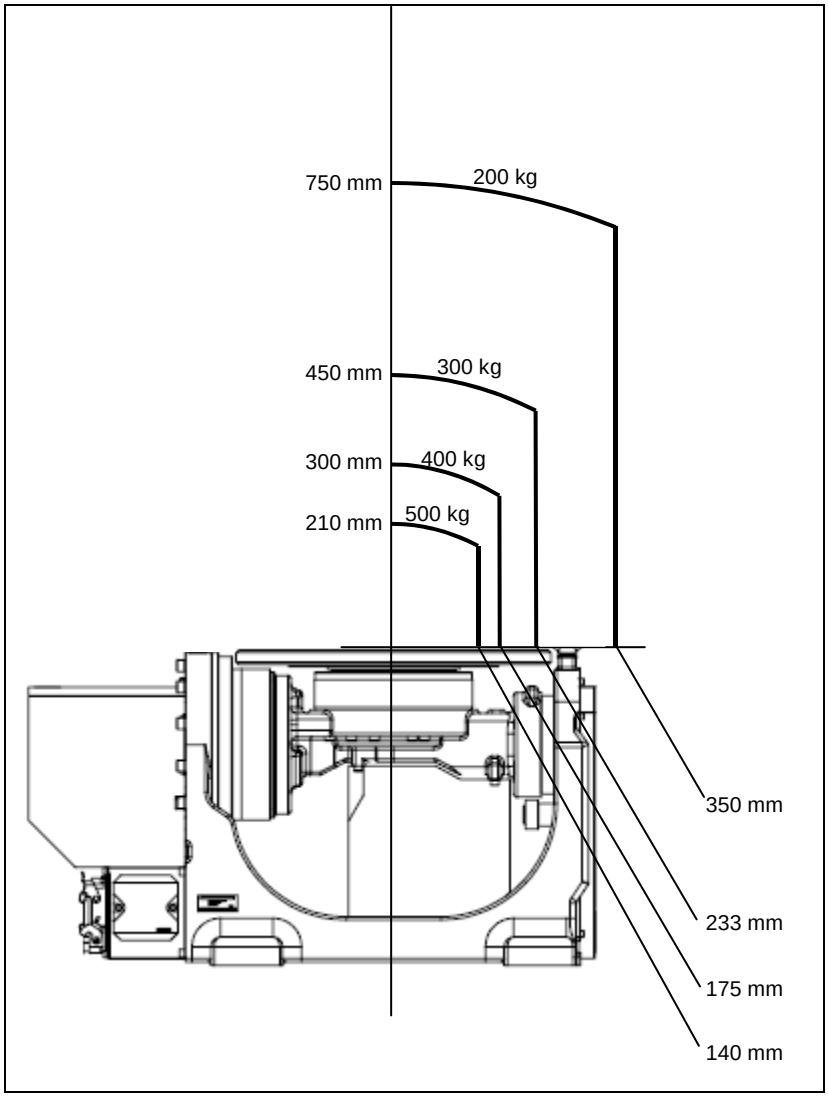


Fig. 8.2 (a) Positioner allowable load condition

Allowable load moment	J1-axis	180 kgf·m (1764 N·m)
	J2-axis	70 kgf·m (686 N·m)
Allowable load inertia	J1-axis	3061 kgf·cm·s^2 (300 kg·m^2)
	J2axis	1020 kgf·cm·s^2 (100 kg·m^2)

8.3 LOAD SETTING

> ⚠ **CAUTION**
> Set load condition parameter before operating the robot. Do not operate the robot in over payload reduction. Don't exceed allowable payload including connection cables and its swing. Otherwise troubles such as degradation of reducer life may occur.

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 [MENU] key to display the screen menu.
2 Select [6 SYSTEM] on the next page,
3 Press the F1 ([TYPE]) key to display the screen switch menu.
4 Select "MOTION." The MOTION PERFORMANCE screen will be displayed.
5 Press the [GROUP], then input group number of the 2-axis positioner.

```
MOTION PERFORMANCE                    JOINT 10%
    Group1
 No.   PAYLOAD[kg]          Comment
  1          12.00    [                    ]
  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 >
```

6 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]          12.00
 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
```

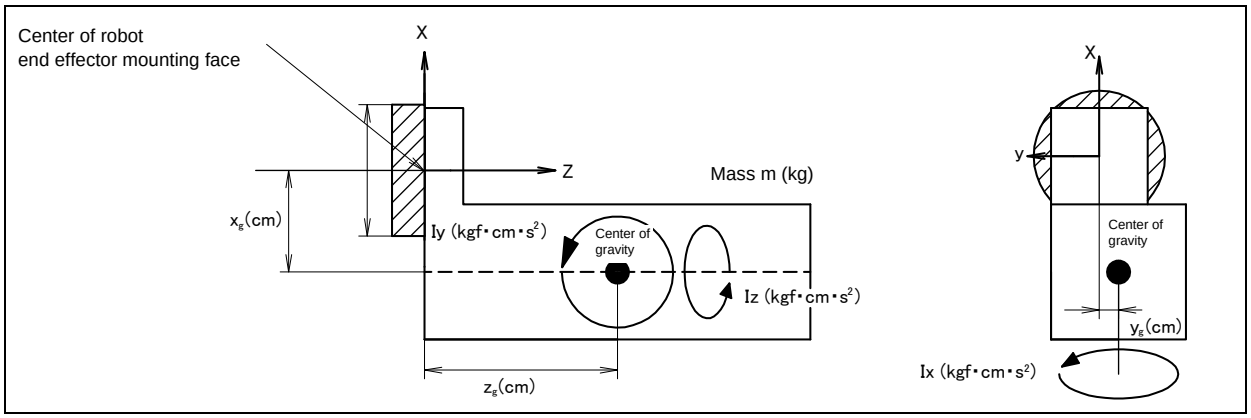


Fig. 8.3 (a) Standard tool coordinate

7 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]).

8 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.

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

8.4 AIR PIPING IN THE FLANGE (Only for A05B-1220-J201)

Air piping whose inlet is the J1-axis connector panel and outlet is the adapter within the flange is provided. For the piping route, see Fig. 6.1 (a).
The joint diameter of the inlet and outlet of the air piping is RC3/8 female. Since the joints to be connected are not supplied, acquire the joints suited to the tubes to be used.

8.5 PIN ASSIGNMENT OF THE SIGNAL LINE CONNECTOR (Only for A05B-1220-J201)

Fig. 8.5 (a) shows the pin assignment of the signal line connector.

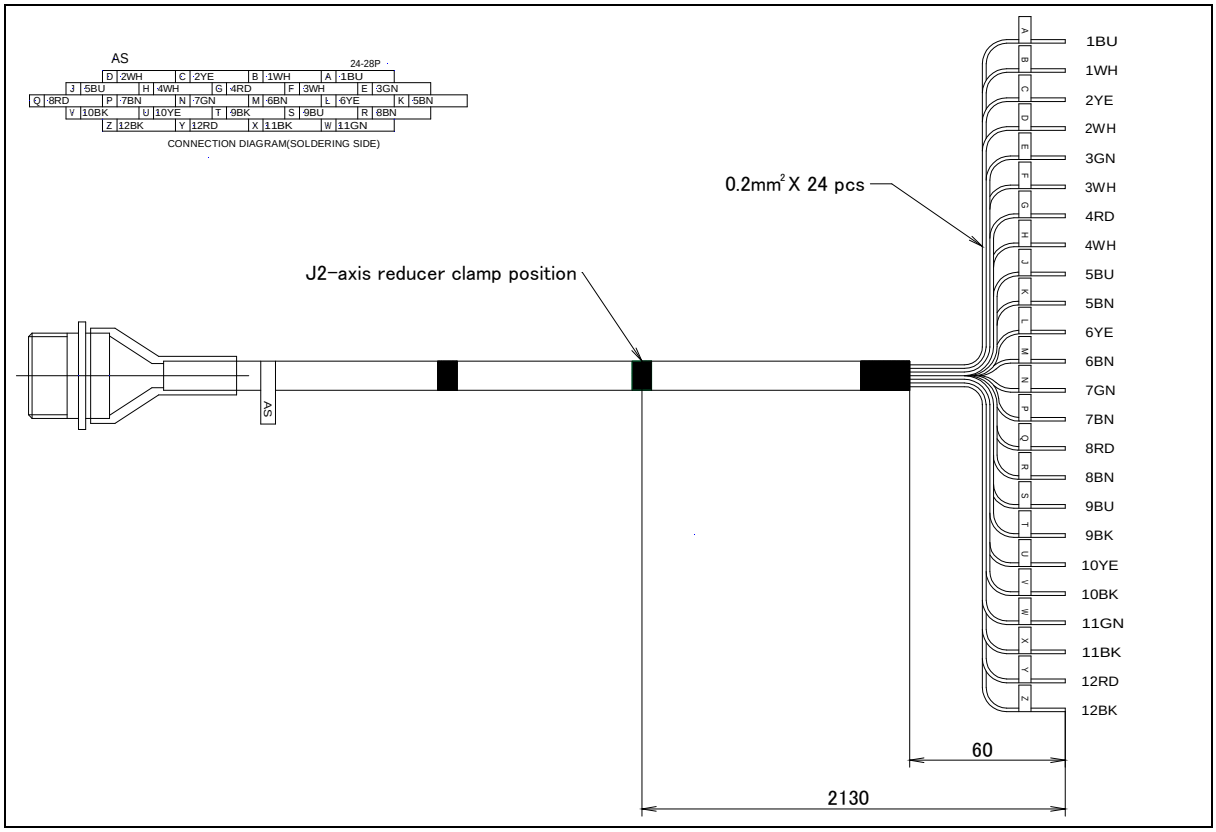


Fig. 8.5 (a) Pin assignment of the signal line connector

Table 8.5 (a) Connector specifications (on the mechanical unit side)

Cable name	Model	Maker/Dealer
Signal	MS3102A24-28P	Fujikura Ltd. Japan Aviation Electronics Industry, Ltd.

Table 8.5 (b) Connector specifications (on the user side)

Cable name	Model	Maker/Dealer
Signal	MS3106B24-28S	Fujikura Ltd. Japan Aviation Electronics Industry, Ltd.

8.6 SERVICE FACTOR (DUTY) OF EARTH CABLE (Only for A05B-1220-J201)

8.6.1 About Service Factor (Duty) of Earth Cable

When the earth cable built-in 2-axis Servo Positioner, operate within the current and the service factor shown in Fig. 8.6.1 (a). The service factor (duty) of earth cable is calculated from the following expression.

Actual welding time / total operation time per cycle (cycle time) ×100 [%]

Take care that if operation exceeded following service factor, overheating may cause deterioration or burning of the cable. And, value of Fig. 8.6.1 (a) is in the condition of ambient temperature 30℃. Refer to Subsection 8.6.2 to find permissible current in different ambient temperature

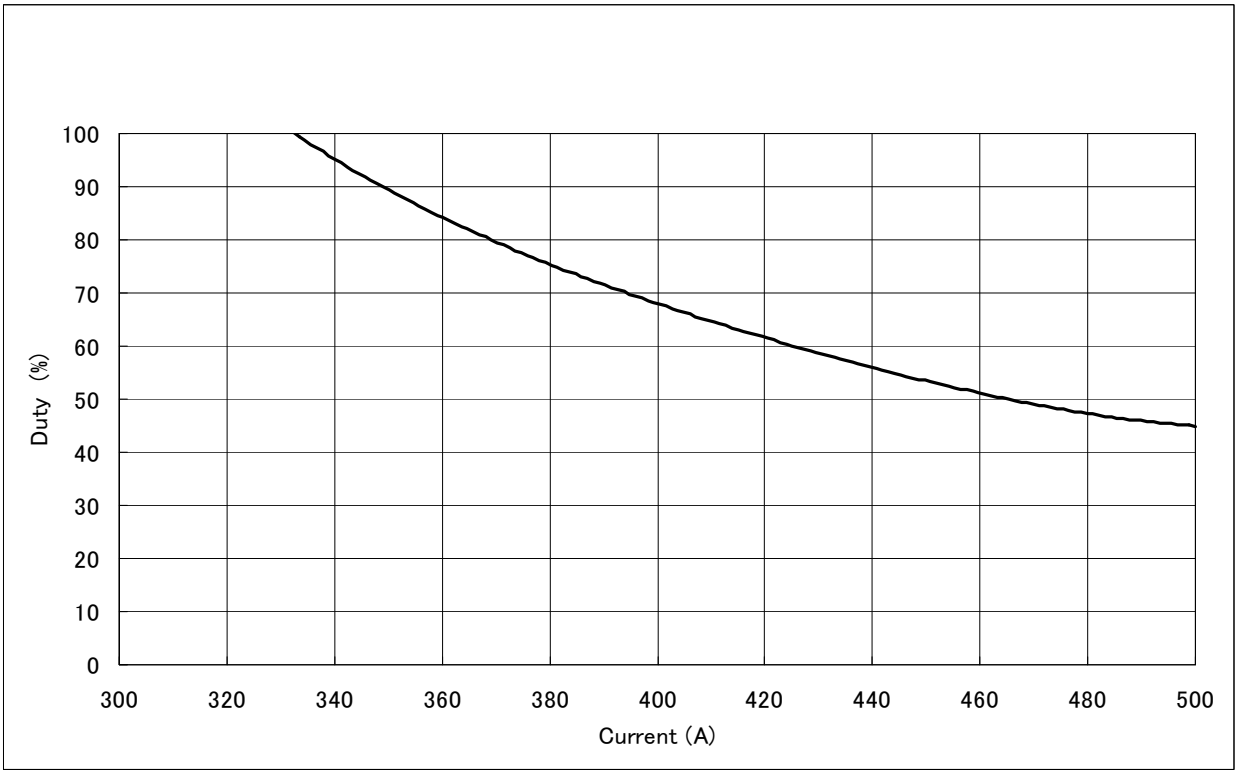


Fig. 8.6.1 (a) Relationship between current flowing through the earth cable and service factor (duty) [Ambient temperature 30℃]

NOTE
When a current exceeding the performance of cable flows, ignition or electric shock can result. So, care should be taken.

8.6.2 Relationship Between Ambient Temperature and Permissible Current of Earth Cable

The permissible current of earth cable is affected by ambient temperature.
The permissible current in the condition of Service factor (duty) 100% is shown in Fig. 8.6.2 (a).
Operate within the current shown in Fig. 8.6.2 (a).

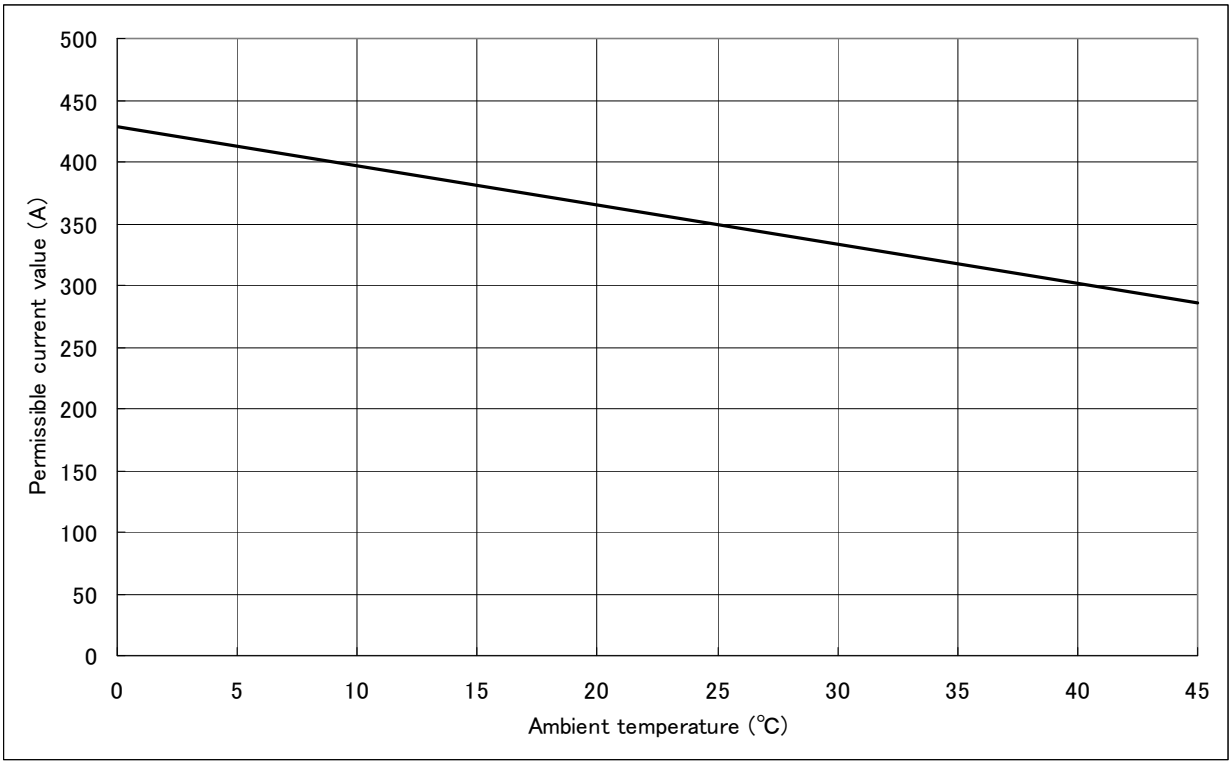


Fig. 8.6.2 (a) Relationship between ambient temperature and permissible current of earth cable [Service factor (Duty) 100%]

NOTE
When a current exceeding the performance of cable flows, ignition or electric shock can result. So, care should be taken.

9 TRANSPORTATION AND INSTALLATION

9.1 TRANSPORTATION

1) Installation procedure
   1 Oil is applied to the flange during shipment, so wipe the oil sufficiently.
   2 Remove the two M16 eyebolts attached to the J2 base.
   3 For upside-down mount, attach the drain plug to the J2-axis motor cover.

2) Carrying the positioner with a crane
   A positioner can be carried by suspending it with a crane.
   Hoist the positioner by threading a rope through the two M16 eyebolts (see Fig. 9.1 (a)).
   After installing a positioner, remove the transportation equipment.

⚠ CAUTION
When transporting a positioner, be careful not to damage a motor connector with a sling for lifting the positioner.

⚠ WARNING
When an end effector and peripherals are installed on a positioner, the center of gravity of the positioner changes and the positioner might become unstable while being transported.
If the positioner becomes unstable, remove the tooling and place the positioner into the transportation position. This will position the unit center of gravity correctly. It is recommended to transport the end effector and peripherals separately from the positioner.
Before moving the positioner by using transport equipment, check and tighten any loose bolts on the forklift pockets.

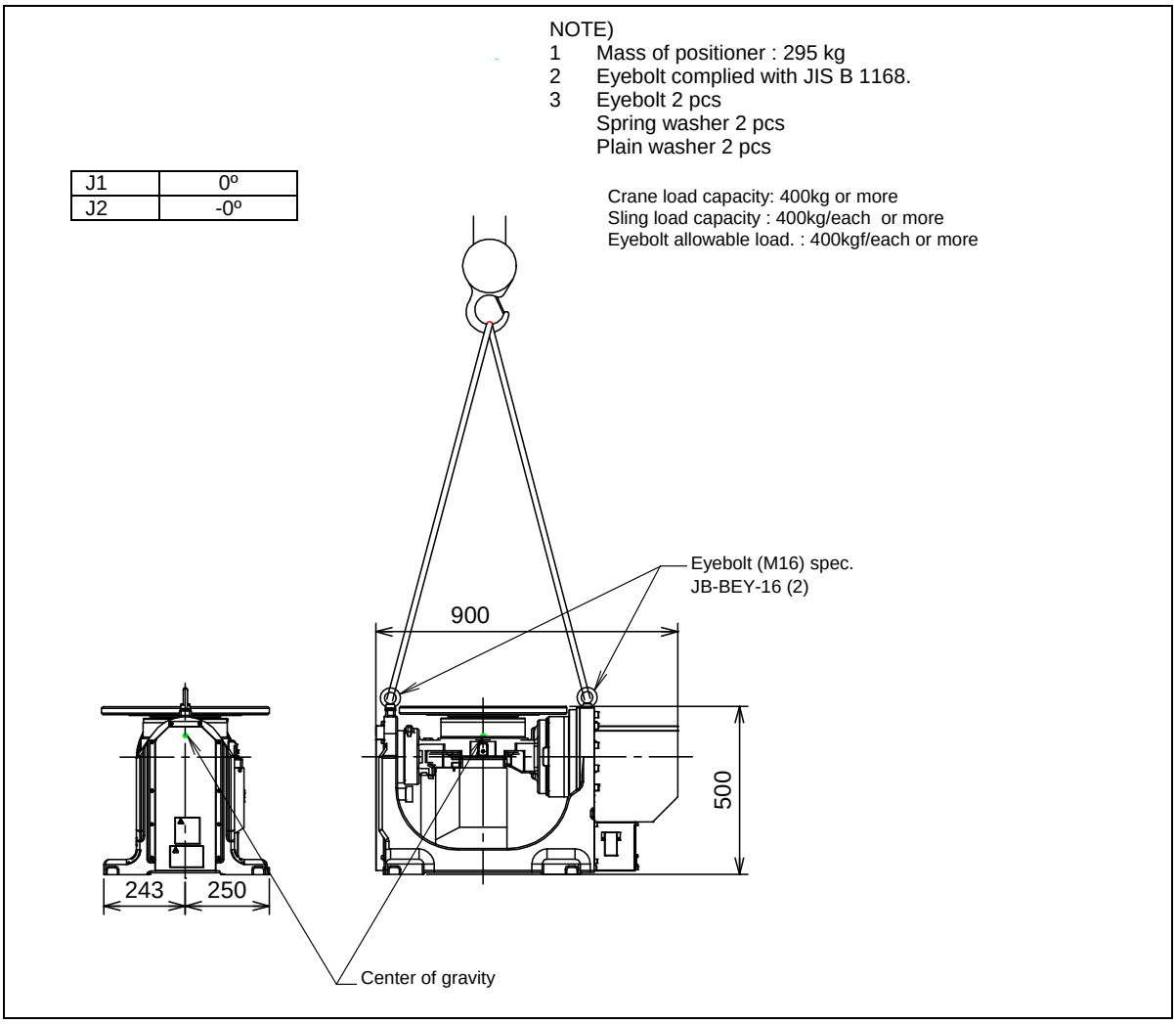


Fig. 9.1 (a) Transportation using a crane

9.2 STORING THE POSITIONER

When storing the positioner, keep it in the posture shown in Fig. 9.1 (a).

NOTE
1 A positioner assuming an attitude other than the one for transportation cannot stand by itself and can fall. Before storing a positioner for a long term, take measures for securing the positioner to prevent it from falling.
2 The flange surface is likely to rust, so apply antirust oil to the flange surface to save it for a long period of time.

9.3 INSTALLATION

Fig. 9.3 (a) shows the dimensions of the base of the positioner main body.

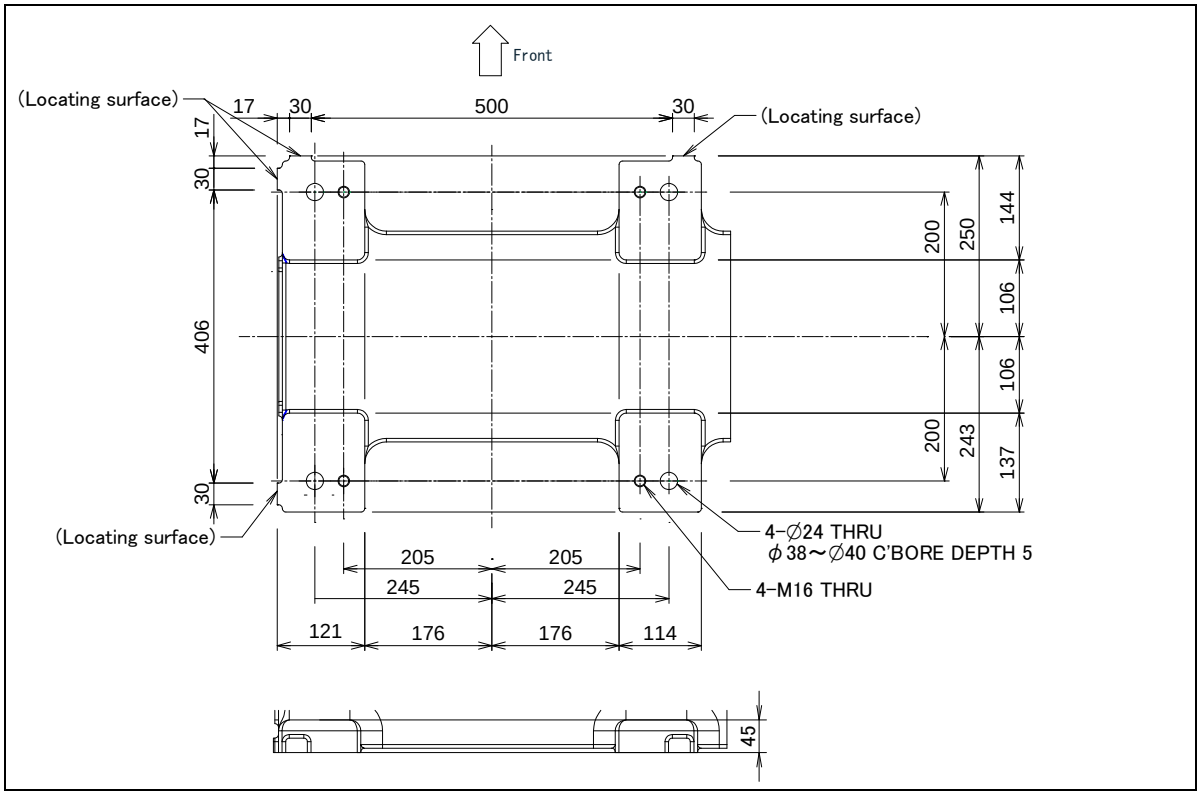


Fig. 9.3 (a) Dimensions of the base of the positioner main body

Fig. 9.3 (b) shows an example of installing the positioner. In this example, the floor plate is fixed with four M20 chemical anchors (Tensile strength 400N/mm^2 or more), and the positioner base is fastened to the floor plate with four M20 x 70 bolts (Tensile strength 1200N/mm^2 or more). If compatibility must be maintained in teaching the robot after the positioner mechanical unit is replaced, use the locating surface.

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

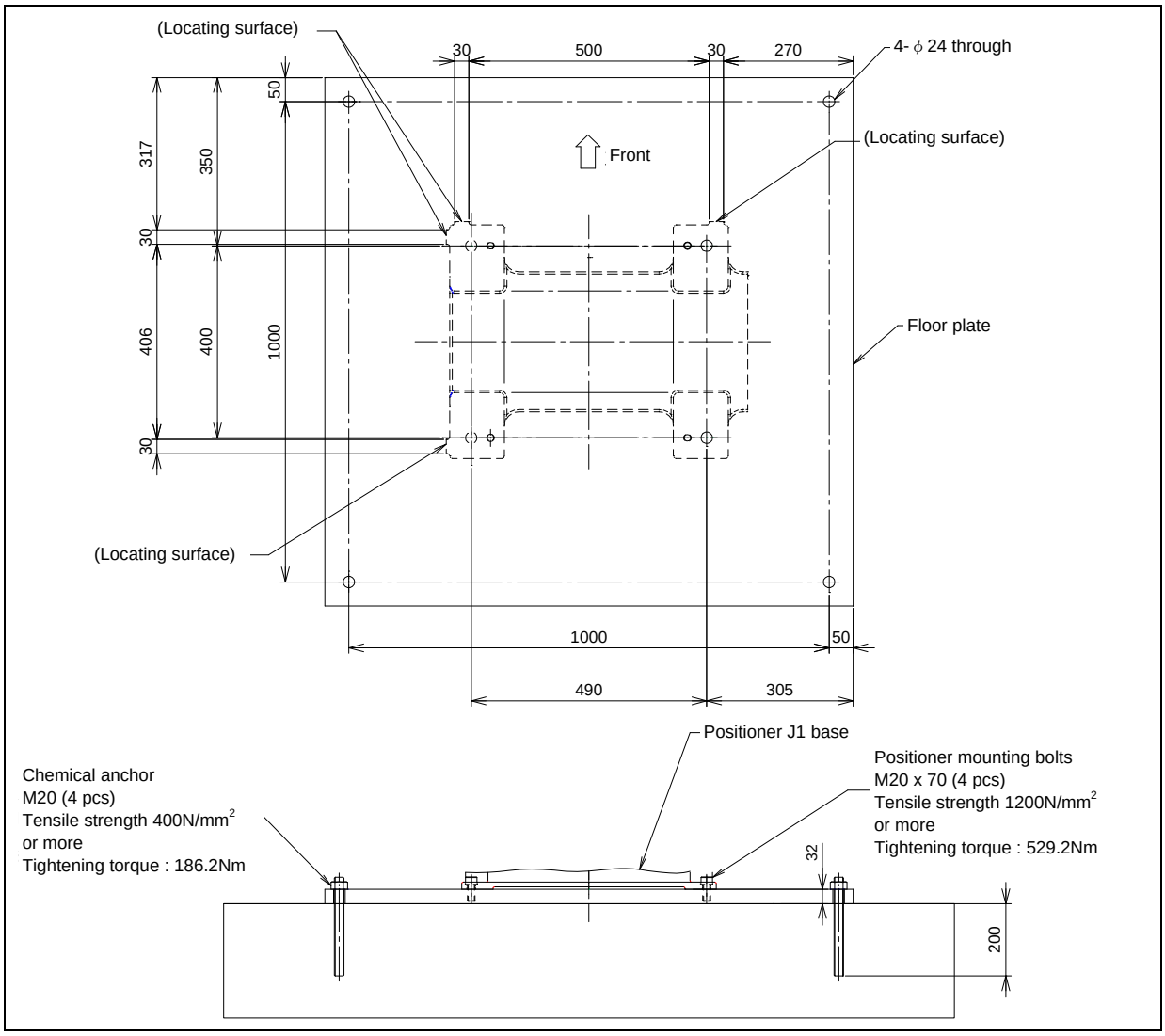


Fig. 9.3 (b) Example of installing the positioner

NOTE

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

Fig. 9.3 (c) and Table 9.3 (a) explain what load is put on the J1 base when the positioner is at a rest, accelerating or decelerating, and at an emergency stop.

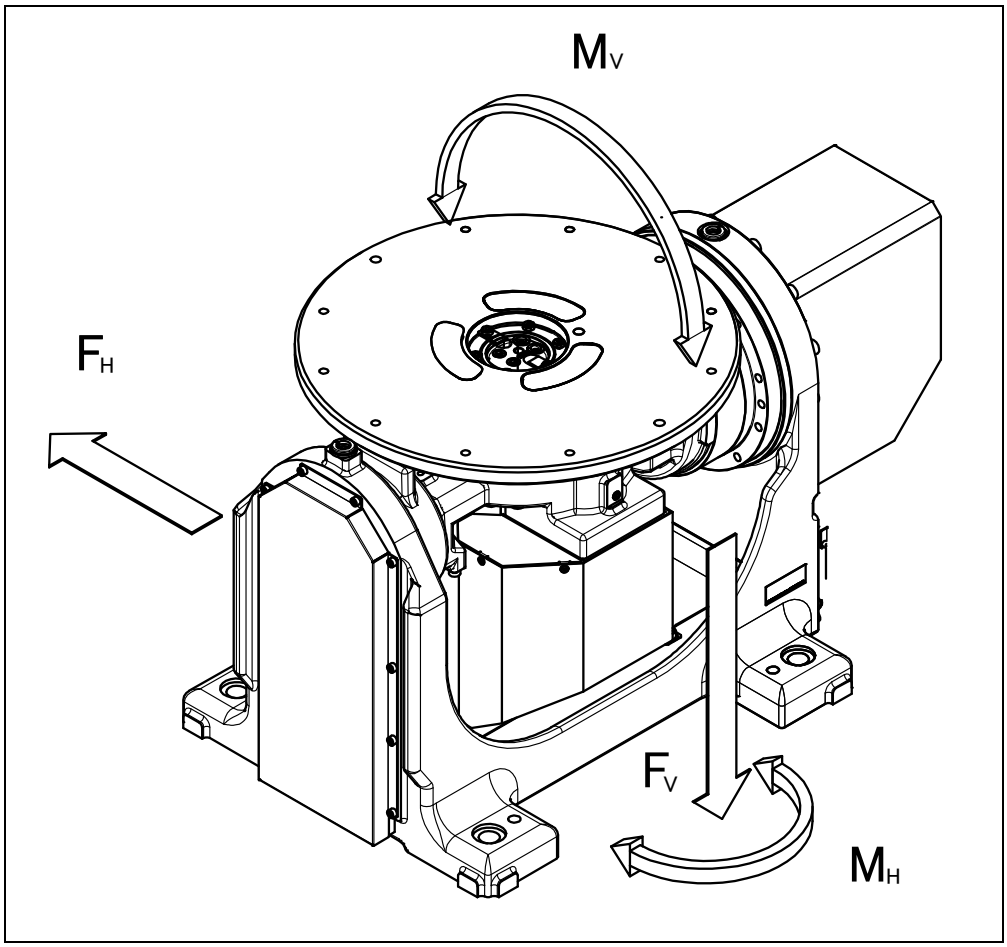


Fig. 9.3 (c) Load and moment applied to the J1 base

Table 9.3 (a) Load and moment applied to the J1 base

State	Bending moment M_V[kgfm](Nm)	Vertical load F_V[kgf](N)	Torsion moment M_H[kgfm](Nm)	Horizontal load F_H[kgf](N)
At rest	[370] (3626)	[295] (2891)	[0] (0)	[0] (0)
Accelerating or decelerating	[455] (4459)	[667] (6536.6)	[155] (1519)	[667] (6536.6)
At an Power-Off stop	[1219] (11946.2)	[1787] (17512.6)	[296] (2900.8)	[1787] (17512.6)

9.4 MAINTENANCE CLEARANCE

Fig. 9.4 (a) shows the layout of maintenance clearances.

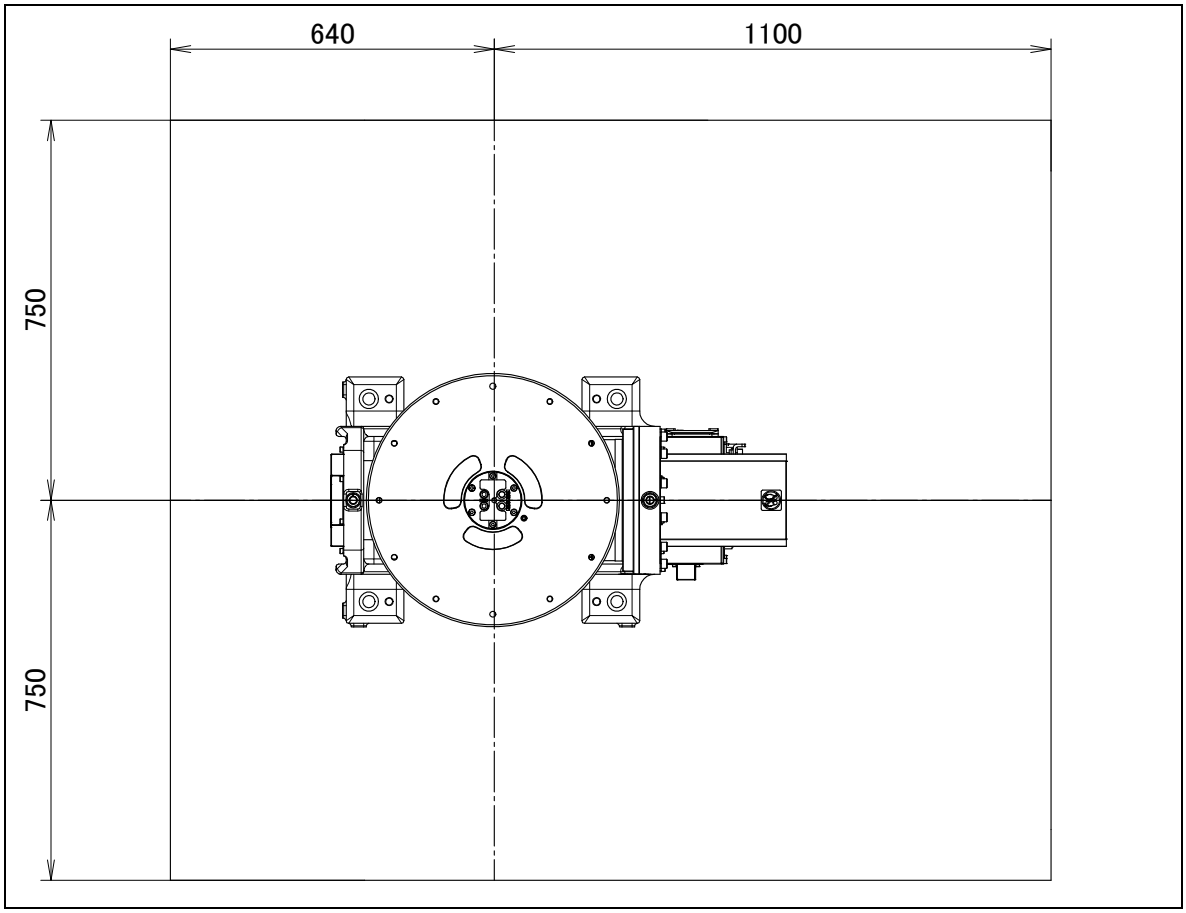


Fig. 9.4 (a) Maintenance clearance layout

9.5 ASSEMBLING THE POSITONER FOR INSTALLATION

The robot connection cables are detached from the connector panel of the mechanical unit when the positioner is shipped (the cables are connected on the controller side). Connect the cables shown in Fig. 9.5 (a) to the connector panel of the mechanical unit. During the connection, be careful not to pull the cable connected to the HARTING connector.
Insert a washer for the earth cable so that the terminal is securely fixed.
In connecting cables between the robot controller and the positioner body, the customer needs to obtain cable ducts or the like.

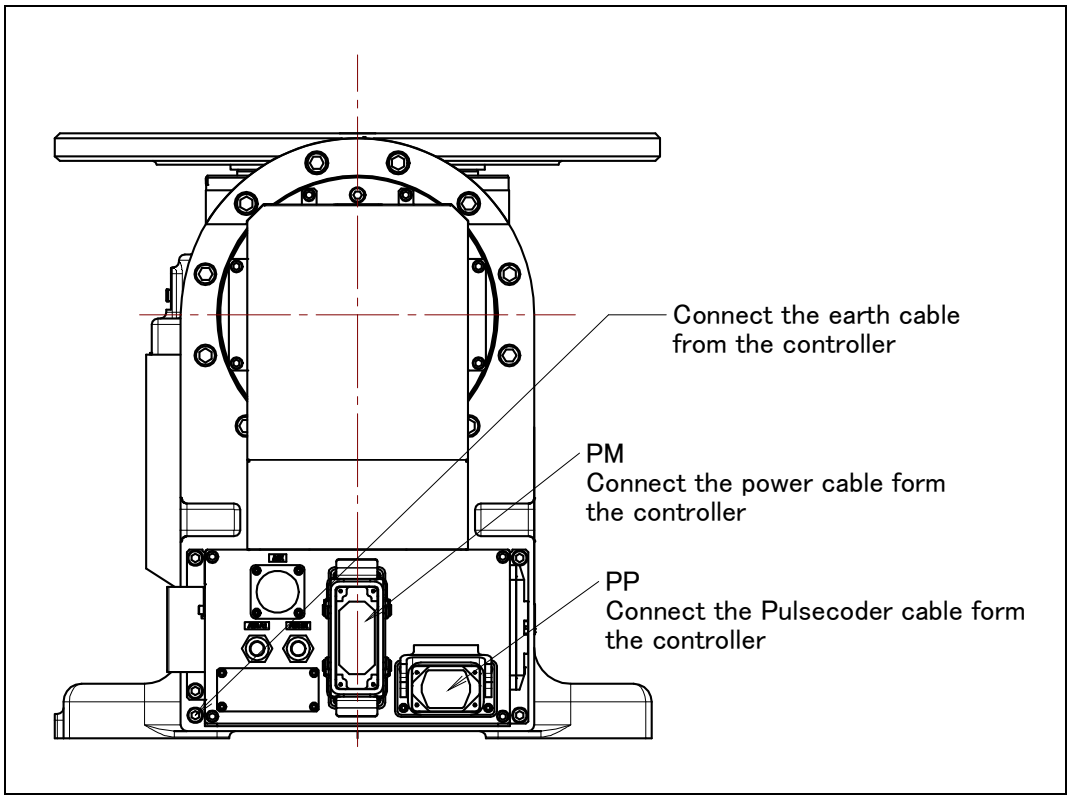


Fig. 9.5 (a) Cable connection panel for the positioner mechanical unit

9.6 AIR PIPING (Only for A05B-1220-J201)

Fig. 9.6 (a) shows the air piping of the positioner.
In the mechanical unit, two pneumatic tubes are connected. Their outside diameter is 12 mm and their inside diameter is 8 mm.
If the three-piece pneumatic option is selected, it comes with the air pipe to be installed between it and the mechanical unit. To use the option, the customer shall arrange for a three-piece pneumatic option mounting section that has the self-tapping screw holes whose dimensions and layout are specified in Fig. 9.6 (b) and for its installation.
The following figure assumes that the FANUC three-piece pneumatic option is selected. When the customer selects another option, refer to the interfaces in the following figure to prepare the required parts.

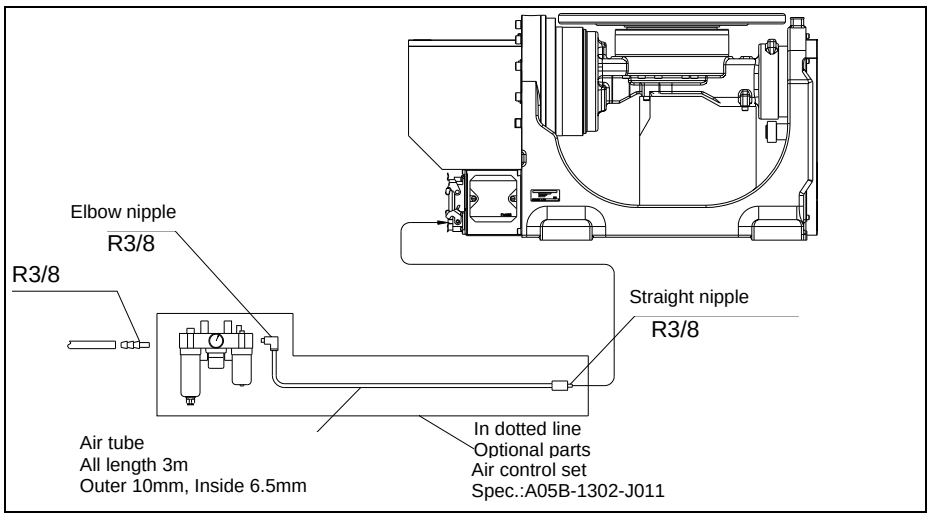


Fig. 9.6 (a) Air piping

Air control set

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

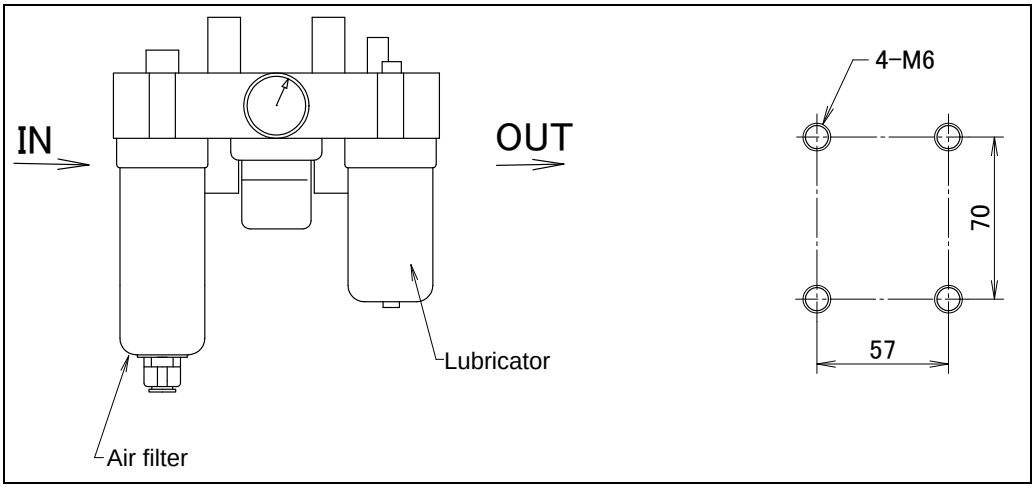


Fig. 9.6 (b) Air control set option (option)

9.7 INSTALLATION CONDITIONS

Refer to Specification of [PREFACE] about installation conditions.

APPENDIX

A PERIODIC INSPECTION TABLE

FANUC 2-axis SERVO POSITIONER **PERIODIC INSPECTION TABLE**

Item			Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check the mechanical cable. (damaged or twisted)	0.2H	—		○			○				○			
	4	Check the motor connector and exposed connector (tightness).	0.2H	—		○			○				○			
	5	Tighten the loosened flange mounting bolts.	0.2H	—		○			○				○			
	6	Tighten the cover and external main bolt.	0.5H	—		○			○				○			
	7	Clean spatters, sawdust and dust	1.0H	—		○			○				○			
	8	Replacing battery*3	0.1H	—							●					
	9	Replacing grease of J2 axis reducer.	0.3H	980ml												
	10	Replacing grease of J1 axis reducer.	0.3H	1180ml												
	11	Replacing the mechanical unit cable.	3.0H	—												
Controller	12	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○				○			
	13	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	14	Replacing battery *1 *3	0.1H	—												

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

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

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

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

B STRENGTH OF BOLT AND BOLT TORQUE LIST

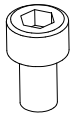
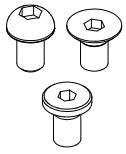
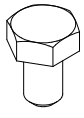
NOTE
When applying LOCTITE to a part, spread the LOCTITE on the entire length of the engaging part of the female thread. If applied to the male threads, poor adhesion can occur potentially loosening the bolt. Clean the bolts and the threaded holes and wipe off any oil on the engaging section. Make sure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

Use the following strength bolts. Comply with any bolt specification instructions as specified.

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

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