

FANUC Robot **M-1*i*A**

MECHANICAL UNIT OPERATOR'S MANUAL

B-83084EN/08

- **Original Instructions**

Thank you very much for purchasing FANUC Robot.

Before using the Robot, be sure to read the "FANUC Robot SAFETY HANDBOOK (B-80687EN)" and understand the content.

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

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

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral equipment installed in a work cell.

In addition, refer to the "FANUC Robot SAFETY HANDBOOK (B-80687EN)".

1 DEFINITION OF USER

The personnel can be classified as follows.

Operator:

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

Programmer:

- Operates the robot
- Teaches the robot inside the safety fence

Maintenance engineer:

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

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

During the operation, programming, and maintenance of your robotic system, the programmer, operator, and maintenance engineer should take additional care of their safety by wearing the following safety items.

- Adequate clothes for the operation
- Safety shoes
- A helmet

2 DEFINITION OF SAFETY NOTATIONS

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

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

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

3 SAFETY OF THE USER

User safety is the primary safety consideration. Because it is very dangerous to enter the operating space of the robot during automatic operation, adequate safety precautions must be observed. The following lists the general safety precautions. Careful consideration must be made to ensure user safety.

- (1) Have the robot system users attend the training courses held by FANUC.

FANUC provides various training courses. Contact our sales office for details.
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- (2) Even when the robot is stationary, it is possible that the robot is still in a ready to move state, and is waiting for a signal. In this state, the robot is regarded as still in motion. To ensure user safety, provide the system with an alarm to indicate visually or aurally that the robot is in motion.
- (3) Install a safety fence with a gate so that no user can enter the work area without passing through the gate. Install an interlocking device, a safety plug, and so forth in the safety gate so that the robot is stopped as the safety gate is opened.

The controller is designed to receive this interlocking signal of the door switch. When the gate is opened and this signal received, the controller stops the robot (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type). For connection, see Fig. 3 (b).

- (4) Provide the peripheral equipment with appropriate earth (Class A, Class B, Class C, and Class D).
- (5) Try to install the peripheral equipment outside the robot operating space.
- (6) Draw an outline on the floor, clearly indicating the range of the robot operating space, including the tools such as a hand.
- (7) Install a mat switch or photoelectric switch on the floor with an interlock to a visual or aural alarm that stops the robot when a user enters the work area.
- (8) If necessary, install a safety lock so that no one except the user in charge can turn on the power of the robot.

The circuit breaker installed in the controller is designed to disable anyone from turning it on when it is locked with a padlock.

- (9) When adjusting each peripheral equipment independently, be sure to turn off the power of the robot.
- (10) Operators should be ungloved while manipulating the operator panel or teach pendant. Operation with gloved fingers could cause an operation error.
- (11) Programs, system variables, and other information can be saved on memory card or USB memories. Be sure to save the data periodically in case the data is lost in an accident. (refer to Controller OPERATOR'S MANUAL.)
- (12) The robot should be transported and installed by accurately following the procedures recommended by FANUC. Wrong transportation or installation may cause the robot to fall, resulting in severe injury to workers.
- (13) In the first operation of the robot after installation, the operation should be restricted to low speeds. Then, the speed should be gradually increased to check the operation of the robot.
- (14) Before the robot is started, it should be checked that no one is inside the safety fence. At the same time, a check must be made to ensure that there is no risk of hazardous situations. If detected, such a situation should be eliminated before the operation.
- (15) When the robot is used, the following precautions should be taken. Otherwise, the robot and peripheral equipment can be adversely affected, or workers can be severely injured.
 - Avoid using the robot in a flammable environment.
 - Avoid using the robot in an explosive environment.
 - Avoid using the robot in an environment full of radiation.
 - Avoid using the robot under water or at high humidity.
 - Avoid using the robot to carry a person or animal.
 - Avoid using the robot as a stepladder. (Never climb up on or hang from the robot.)
 - Outdoor
- (16) When connecting the peripheral equipment related to stop (safety fence etc.) and each signal (external emergency, fence etc.) of robot, be sure to confirm the stop movement and do not take the wrong connection.
- (17) When preparing footstep, please consider security for installation and maintenance work in high place according to Fig. 3 (c). Please consider footstep and safety belt mounting position.

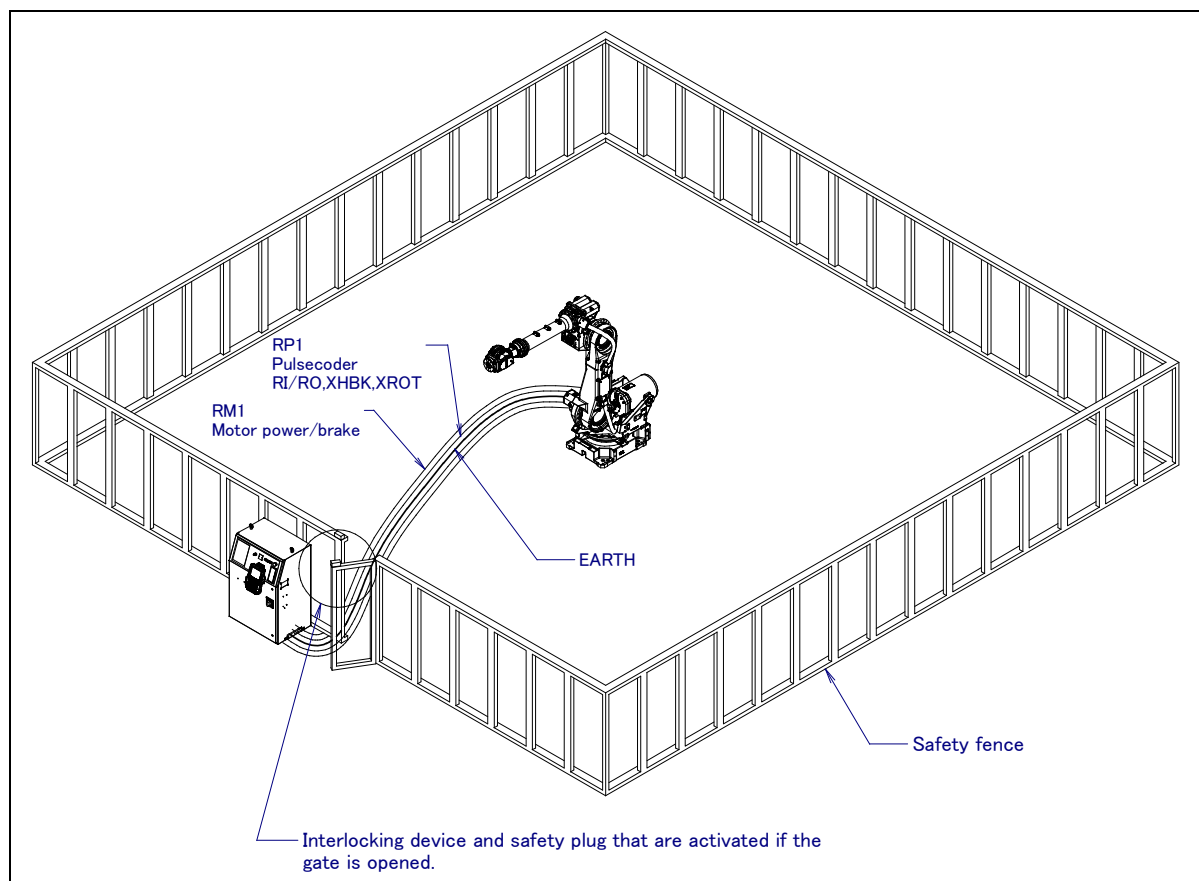


Fig. 3 (a) Safety fence and safety gate

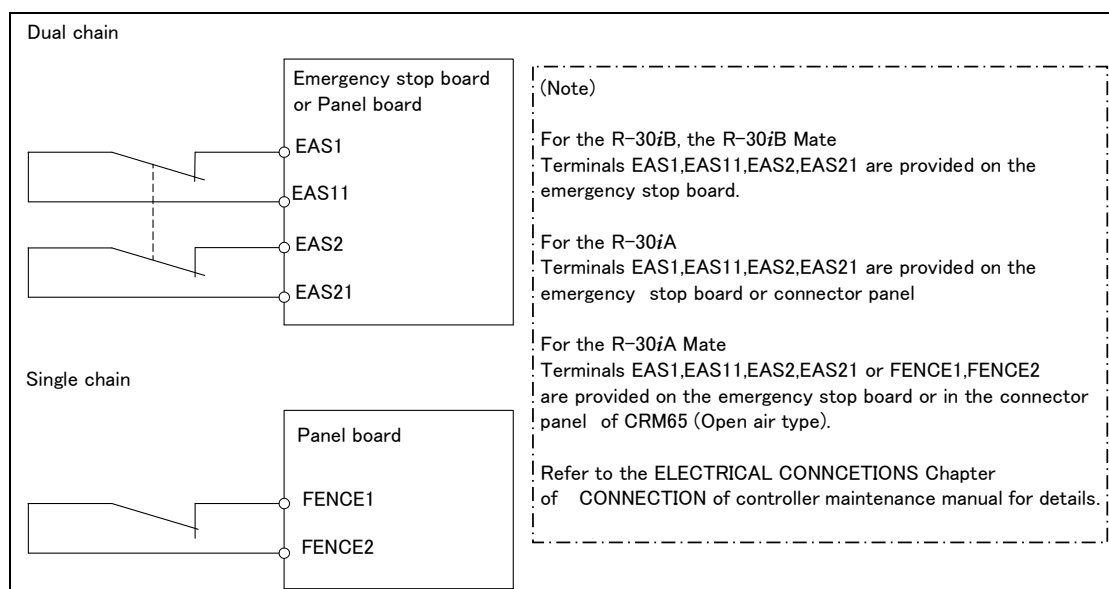


Fig. 3 (b) Connection diagram for the signal of safety fence

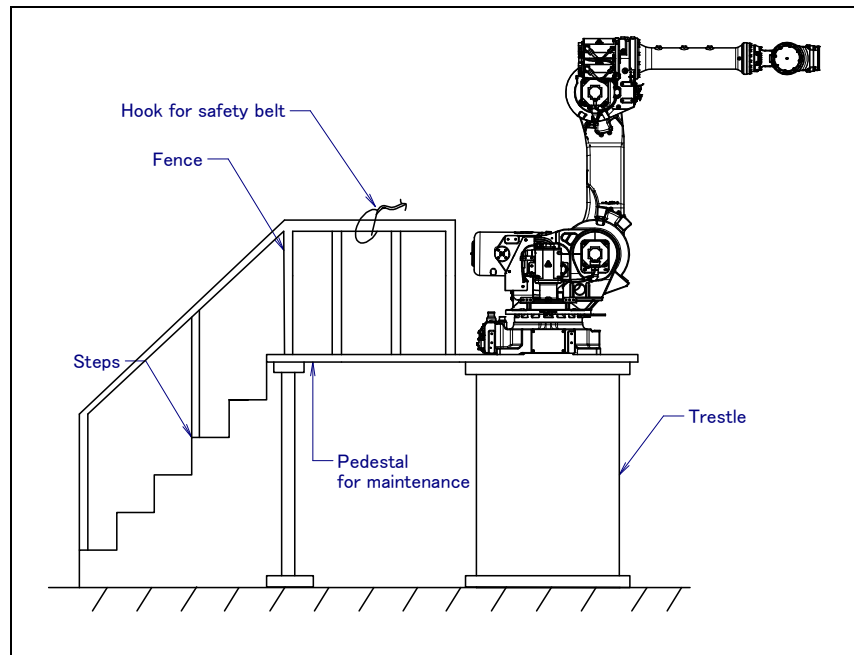


Fig. 3 (c) Pedestal for maintenance

3.1 SAFETY OF THE OPERATOR

An operator refers to a person who turns on and off the robot system and starts a robot program from, for example, the operator panel during daily operation. Operators cannot work in the inside of the safety fence.

- (1) If the robot does not need to be operated, turn off the robot controller power or press the EMERGENCY STOP button during working.
- (2) Operate the robot system outside the operating space of the robot.
- (3) Install a safety fence or safety door to avoid the accidental entry of a person other than an operator in charge or keep operator out from the hazardous place.
- (4) Install the EMERGENCY STOP button within the operator's reach.

The robot controller is designed to be connected to an external EMERGENCY STOP button. With this connection, the controller stops the robot operation (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type) when the external EMERGENCY STOP button is pressed. See the diagram below for connection.

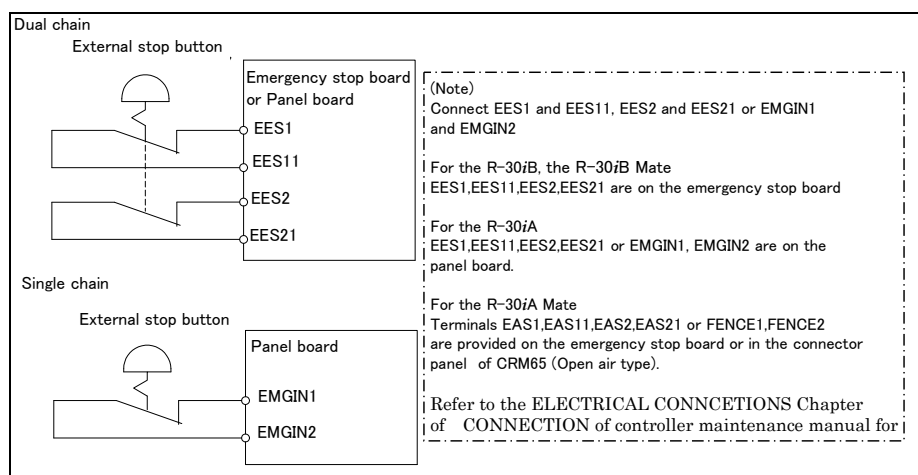


Fig. 3.1 Connection diagram for external emergency stop button

3.2 SAFETY OF THE PROGRAMMER

While teaching the robot, the operator must enter the robot operation area. The programmer must ensure the safety especially.

- (1) Unless it is specifically necessary to enter the robot operating space, carry out all tasks outside the operating space.
- (2) Before teaching the robot, check that the robot and its peripheral equipment are all in the normal operating condition.
- (3) If it is inevitable to enter the robot operating space to teach the robot, check the locations, settings, and other conditions of the safety devices (such as the EMERGENCY STOP button, the DEADMAN switch on the teach pendant) before entering the area.
- (4) The programmer must be extremely careful not to let anyone else enter the robot operating space.
- (5) Programming should be done outside the area of the safety fence as far as possible. If programming needs to be done inside the safety fence, the programmer should take the following precautions:
 - Before entering the area of the safety fence, ensure that there is no risk of dangerous situations in the area.
 - Be prepared to press the emergency stop button whenever necessary.
 - Robot motions should be made at low speeds.
 - Before starting programming, check the whole robot system status to ensure that no remote instruction to the peripheral equipment or motion would be dangerous to the user.

Our operator panel is provided with an emergency stop button and a key switch (mode switch) for selecting the automatic operation mode (AUTO) and the teach modes (T1 and T2). Before entering the inside of the safety fence for the purpose of teaching, set the switch to a teach mode, remove the key from the mode switch to prevent other people from changing the operation mode carelessly, then open the safety gate. If the safety gate is opened with the automatic operation mode set, the robot stops (Please refer to "**STOP TYPE OF ROBOT**" in SAFETY PRECAUTIONS for detail of stop type). After the switch is set to a teach mode, the safety gate is disabled. The programmer should understand that the safety gate is disabled and is responsible for keeping other people from entering the inside of the safety fence.

Teach pendant is provided with a switch to enable/disable robot operation from teach pendant and DEADMAN switch as well as emergency stop button. These button and switch function as follows:

- (1) Emergency stop button: Causes the stop of the robot (Please refer to "**STOP TYPE OF ROBOT**" in SAFETY PRECAUTIONS for detail of stop type) when pressed.
- (2) DEADMAN switch: Functions are different depending on the teach pendant enable/disable switch setting status.
 - (a) **Enable:** Servo power is turned off and robot stops when the operator releases the DEADMAN switch or when the operator presses the switch strongly.
 - (b) **Disable:** The DEADMAN switch is disabled.

(Note) The DEADMAN switch is provided to stop the robot when the operator releases the teach pendant or presses the pendant strongly in case of emergency. The R-30iB/R-30iB Mate/R-30iA/R-30iA Mate employs a 3-position DEADMAN switch, which allows the robot to operate when the 3-position DEADMAN switch is pressed to its intermediate point. When the operator releases the DEADMAN switch or presses the switch strongly, the robot stops immediately.

The operator's intention of starting teaching is determined by the controller through the dual operation of setting the teach pendant enable/disable switch to the enable position and pressing the DEADMAN switch. The operator should make sure that the robot could operate in such conditions and be responsible in carrying out tasks safely.

Based on the risk assessment by FANUC, number of operation of DEADMAN switch should not exceed about 10000 times per year.

The teach pendant, operator panel, and peripheral device interface send each robot start signal. However the validity of each signal changes as follows depending on the mode switch and the DEADMAN switch of the operator panel, the teach pendant enable switch and the remote condition on the software.

For the R-30iB/R-30iB Mate/R-30iA Controller or CE or RIA specification of the R-30iA Mate Controller

Mode	Teach pendant enable switch	Software remote condition	Teach pendant	Operator panel	Peripheral device
AUTO mode	On	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed
	Off	Local	Not allowed	Allowed to start	Not allowed
		Remote	Not allowed	Not allowed	Allowed to start
T1, T2 mode	On	Local	Allowed to start	Not allowed	Not allowed
		Remote	Allowed to start	Not allowed	Not allowed
	Off	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed

T1,T2 mode: DEADMAN switch is effective.

For the standard specification of R-30iA Mate Controller

Teach pendant enable switch	Software remote condition	Teach pendant	Peripheral device
On	Ignored	Allowed to start	Not allowed
Off	Local	Not allowed	Not allowed
	Remote	Not allowed	Allowed to start

- (6) (Only when R-30iB/R-30iB Mate /R-30iA Controller or CE or RIA specification of R-30iA Mate controller is selected.) To start the system using the operator panel, make certain that nobody is in the robot operating space and that there are no abnormal conditions in the robot operating space.
- (7) When a program is completed, be sure to carry out the test operation according to the following procedure.
 - (a) Run the program for at least one operation cycle in the single step mode at low speed.
 - (b) Run the program for at least one operation cycle in the continuous operation mode at low speed.
 - (c) Run the program for one operation cycle in the continuous operation mode at the intermediate speed and check that no abnormalities occur due to a delay in timing.
 - (d) Run the program for one operation cycle in the continuous operation mode at the normal operating speed, and check that the system operates automatically without trouble.
 - (e) After checking the completeness of the program through the test operation above, execute it in the automatic operation mode.
- (8) While operating the system in the automatic operation mode, the teach pendant operator must leave the safety fence.

3.3 SAFETY OF THE MAINTENANCE ENGINEER

For the safety of maintenance engineer personnel, pay utmost attention to the following.

- (1) During operation, never enter the robot operating space.
- (2) A hazardous situation may arise when the robot or the system, are kept with their power-on during maintenance operations. Therefore, for any maintenance operation, the robot and the system should be put into the power-off state. If necessary, a lock should be in place in order to prevent any other person from turning on the robot and/or the system. In case maintenance needs to be executed in the power-on state, the emergency stop button must be pressed.

- (3) If it becomes necessary to enter the robot operating space while the power is on, press the emergency stop button on the operator box or operator panel, or the teach pendant before entering the range. The maintenance worker must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.
- (4) When entering the area enclosed by the safety fence, the worker must check the whole robot system in order to make sure no dangerous situations exist. In case the worker needs to enter the safety area whilst a dangerous situation exists, extreme care must be taken, and whole robot system status must be carefully monitored.
- (5) Before the maintenance of the pneumatic system is started, the supply pressure should be shut off and the pressure in the piping should be reduced to zero.
- (6) Before the start of maintenance work, check that the robot and its peripheral equipment are all in the normal operating condition.
- (7) Do not operate the robot in the automatic operation while anybody is in the robot operating space.
- (8) When you maintain the robot alongside a wall or instrument, or when multiple users are working nearby, make certain that their escape path is not obstructed.
- (9) When a tool is mounted on the robot, or when any movable device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.
- (10) If necessary, have a user who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the user should be ready to press the EMERGENCY STOP button at any time.
- (11) When replacing a part, please contact your local FANUC representative. If a wrong procedure is followed, an accident may occur, causing damage to the robot and injury to the user.
- (12) When replacing or reinstalling components, take care to prevent foreign material from entering the system.
- (13) When handling each unit or printed circuit board in the controller during inspection, turn off the circuit breaker to protect against electric shock.
If there are two cabinets, turn off the both circuit breaker.
- (14) A part should be replaced with a part recommended by FANUC. If other parts are used, malfunction or damage would occur. Especially, a fuse that is not recommended by FANUC should not be used. Such a fuse may cause a fire.
- (15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the operating space and that the robot and the peripheral equipment are not abnormal.
- (16) When a motor or brake is removed, the robot arm should be supported with a crane or other equipment beforehand so that the arm would not fall during the removal.
- (17) Whenever grease is spilled on the floor, it should be removed as quickly as possible to prevent dangerous falls.
- (18) The following parts are heated. If a maintenance user needs to touch such a part in the heated state, the user should wear heat-resistant gloves or use other protective tools.
 - Servo motor
 - Inside the controller
 - Reducer
 - Gearbox
 - Wrist unit
- (19) Maintenance should be done under suitable light. Care must be taken that the light would not cause any danger.
- (20) When a motor, reducer, or other heavy load is handled, a crane or other equipment should be used to protect maintenance workers from excessive load. Otherwise, the maintenance workers would be severely injured.
- (21) The robot should not be stepped on or climbed up during maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.
- (22) When performing maintenance work in high place, secure a footstep and wear safety belt.
- (23) After the maintenance is completed, spilled oil or water and metal chips should be removed from the floor around the robot and within the safety fence.

- (24) When a part is replaced, all bolts and other related components should put back into their original places. A careful check must be given to ensure that no components are missing or left not mounted.
- (25) In case robot motion is required during maintenance, the following precautions should be taken :
 - Foresee an escape route. And during the maintenance motion itself, monitor continuously the whole robot system so that your escape route will not become blocked by the robot, or by peripheral equipment.
 - Always pay attention to potentially dangerous situations, and be prepared to press the emergency stop button whenever necessary.
- (26) The robot should be periodically inspected. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can adversely affect the performance or service life of the robot and may cause an accident
- (27) After a part is replaced, a test execution should be given for the robot according to a predetermined method. (See TESTING section of “Controller operator’s manual”.) During the test execution, the maintenance worker should work outside the safety fence.

4 SAFETY OF THE TOOLS AND PERIPHERAL EQUIPMENT

4.1 PRECAUTIONS IN PROGRAMMING

- (1) Use a limit switch or other sensor to detect a dangerous condition and, if necessary, design the program to stop the robot when the sensor signal is received.
- (2) Design the program to stop the robot when an abnormality occurs in any other robots or peripheral equipment, even though the robot itself is normal.
- (3) For a system in which the robot and its peripheral equipment are in synchronous motion, particular care must be taken in programming so that they do not interfere with each other.
- (4) Provide a suitable interface between the robot and its peripheral equipment so that the robot can detect the states of all devices in the system and can be stopped according to the states.

4.2 PRECAUTIONS FOR MECHANISM

- (1) Keep the component cells of the robot system clean, operate the robot where insulated from the influence of oil, water, and dust.
- (2) Don't use unconfirmed liquid for cutting fluid and cleaning fluid.
- (3) Adopt limit switches or mechanical stoppers to limit the robot motion, and avoid the robot from collisions against peripheral equipment or tools.
- (4) Observe the following precautions about the mechanical unit cables. Failure to follow precautions may cause problems.
 - Use mechanical unit cable that have required user interface.
 - Do not add user cable or hose to inside of the mechanical unit.
 - Please do not obstruct the movement of the mechanical unit when cables are added to outside of mechanical unit.
 - In the case of the model that a cable is exposed, please do not perform remodeling (Adding a protective cover and fix an outside cable more) obstructing the behavior of the outcrop of the cable.
 - When installing user peripheral equipment on the robot mechanical unit, please pay attention that the device does not interfere with the robot itself.

- (5) The frequent power-off stop for the robot during operation causes the trouble of the robot. Please avoid the system construction that power-off stop would be operated routinely. (Refer to bad case example.) Please perform power-off stop after reducing the speed of the robot and stopping it by hold stop or cycle stop when it is not urgent. (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type.)

(Bad case example)

- Whenever poor product is generated, a line stops by emergency stop and power-off of the robot is incurred.
 - When alteration is necessary, safety switch is operated by opening safety fence and power-off stop is incurred for the robot during operation.
 - An operator pushes the emergency stop button frequently, and a line stops.
 - An area sensor or a mat switch connected to safety signal operates routinely and power-off stop is incurred for the robot.
 - Power-off stop is regularly incurred due to an inappropriate setting for Dual Check Safety (DCS).
- (6) Power-off stop of Robot is executed when collision detection alarm (SRVO-050) etc. occurs. Please try to avoid unnecessary power-off stops. It may cause the trouble of the robot, too. So remove the causes of the alarm.

5 SAFETY OF THE ROBOT MECHANICAL UNIT

5.1 PRECAUTIONS IN OPERATION

- (1) When operating the robot in the jog mode, set it at an appropriate speed so that the operator can manage the robot in any eventuality.
- (2) Before pressing the jog key, be sure you know in advance what motion the robot will perform in the jog mode.

5.2 PRECAUTIONS IN PROGRAMMING

- (1) When the operating spaces of robots overlap, make certain that the motions of the robots do not interfere with each other.
- (2) Be sure to specify the predetermined work origin in a motion program for the robot and program the motion so that it starts from the origin and terminates at the origin. Make it possible for the operator to easily distinguish at a glance that the robot motion has terminated.

5.3 PRECAUTIONS FOR MECHANISMS

Keep the robot operation area clean, and operate the robot in an environment free of grease, water, and dust.

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

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

Name	Specification
Brake release unit	A05B-2560-J460 (Input voltage AC100-115V single phase) A05B-2560-J461 (Input voltage AC200-240V single phase)
Robot connection cable	A05B-2560-J480 (5m) A05B-2560-J481 (10m)
Power cable	A05B-2560-J470 (5m) (AC100-115V Power plug) (*) A05B-2560-J471 (10m) (AC100-115V Power plug) (*) A05B-2560-J472 (5m) (AC100-115V or AC200-240V No power plug) A05B-2560-J473 (10m) (AC100-115V or AC200-240V No power plug)

(*) These do not support CE marking.

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



CAUTION

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



WARNING

Robot arm would fall down by releasing its brake because of gravity. Therefore, it is strongly recommended to take adequate measures such as supporting Robot arm by a block etc. before releasing a brake.

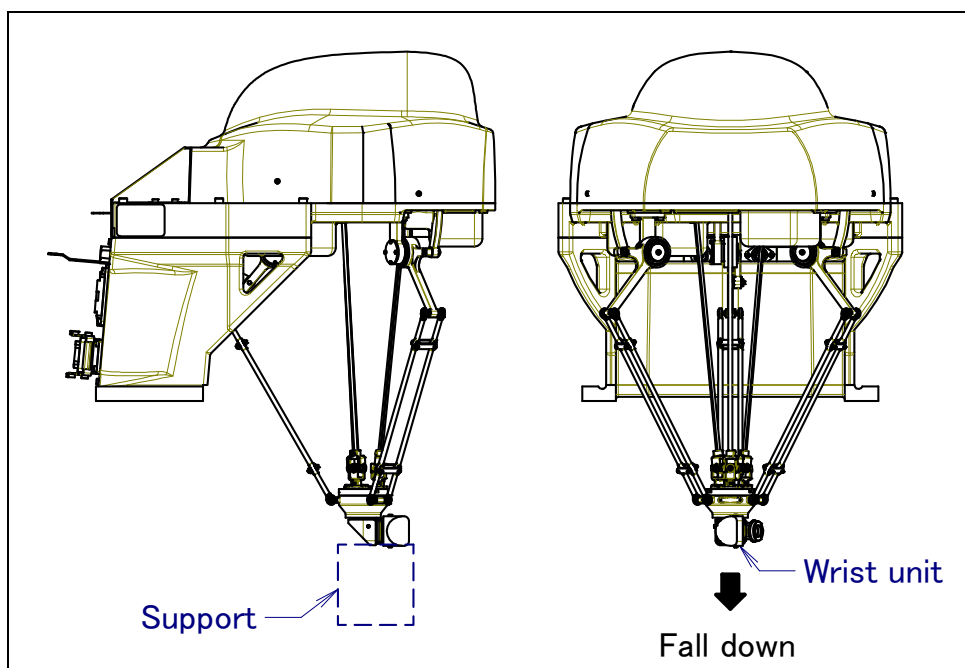


Fig. 5.4 Arm operation by the release of motor brake and measures

6 SAFETY OF THE END EFFECTOR

6.1 PRECAUTIONS IN PROGRAMMING

- (1) To control the pneumatic, hydraulic and electric actuators, carefully consider the necessary time delay after issuing each control command up to actual motion and ensure safe control.
- (2) Provide the end effector with a limit switch, and control the robot system by monitoring the state of the end effector.

7 STOP TYPE OF ROBOT

The following three robot stop types exist:

Power-Off Stop (Category 0 following IEC 60204-1)

Servo power is turned off and the robot stops immediately. Servo power is turned off when the robot is moving, and the path of the deceleration is uncontrolled.

The following processing is performed at Power-Off stop.

- An alarm is generated and servo power is turned off.
- The robot operation is stopped immediately. Execution of the program is paused.

Frequent Power-Off stop of the robot during operation can cause failures of the robot.

Avoid system designs that require routine or frequent Power-Off stop conditions.

Controlled stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.

The following processing is performed at Controlled stop.

- The alarm "SRVO-199 Controlled stop" occurs along with a decelerated stop. Execution of the program is paused.
- An alarm is generated and servo power is turned off.

Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.

The following processing is performed at Hold.

- The robot operation is decelerated until it stops. Execution of the program is paused.



WARNING

The stopping distance and stopping time of Controlled stop are longer than the stopping distance and stopping time of Power-Off stop. A risk assessment for the whole robot system, which takes into consideration the increased stopping distance and stopping time, is necessary when Controlled stop is used.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Power-Off stop or Controlled stop. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the controller type or option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Servo disconnect
A	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	P-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
B	AUTO	P-Stop	P-Stop	P-Stop	P-Stop	P-Stop
	T1	P-Stop	P-Stop	-	P-Stop	P-Stop
	T2	P-Stop	P-Stop	-	P-Stop	P-Stop
C	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	C-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop

P-Stop: Power-Off stop

C-Stop: Controlled stop

-: Disable

The following table indicates the Stop pattern according to the controller type or option configuration.

Option	R-30iB/R-30iB Mate
Standard	A (*)
Controlled stop by E-Stop (A05B-2600-J570)	C (*)

(*) R-30iB/R-30iB Mate does not have servo disconnect. R-30iB Mate does not have SVOFF input.

Option	R-30iA				R-30iA Mate		
	Standard (Single)	Standard (Dual)	RIA type	CE type	Standard	RIA type	CE type
Standard	B (*)	A	A	A	A (**)	A	A
Stop type set (Stop pattern C) (A05B-2500-J570)	N/A	N/A	C	C	N/A	C	C

(*) R-30iA standard (single) does not have servo disconnect.

(**) R-30iA Mate Standard does not have servo disconnect, and the stop type of SVOFF input is Power-Off stop.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer to "Software version" in operator's manual of controller for the detail of software version screen.

"Controlled stop by E-Stop" option

When "Controlled stop by E-Stop" (A05B-2600-J570) option (For the R-30iA/R-30iA Mate, it is Stop type set (Stop pattern C) (A05B-2500-J570)) is specified, the stop type of the following alarms becomes Controlled stop but only in AUTO mode. In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open. (R-30iA/R-30iB/R-30iB Mate controller)
SRVO-194 Servo disconnect	Servo disconnect input (SD4-SD41, SD5-SD51) is open. (R-30iA controller)
SRVO-218 Ext.E-stop/Servo Disconnect	External emergency stop input (EES1-EES11, EES2-EES21) is open. (R-30iA Mate controller)
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Controlled stop is different from **Power-Off stop** as follows:

- In Controlled stop, the robot is stopped on the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Controlled stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and time of Controlled stop is longer than the those of Power-Off stop, depending on the robot model and axis. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.

For the R-30*i*A or R-30*i*A Mate, this function is available only in CE or RIA type hardware.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

**WARNING**

The stopping distance and time of Controlled stop are longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

151112

8 WARNING & CAUTION LABEL

(1) Transportation attention label

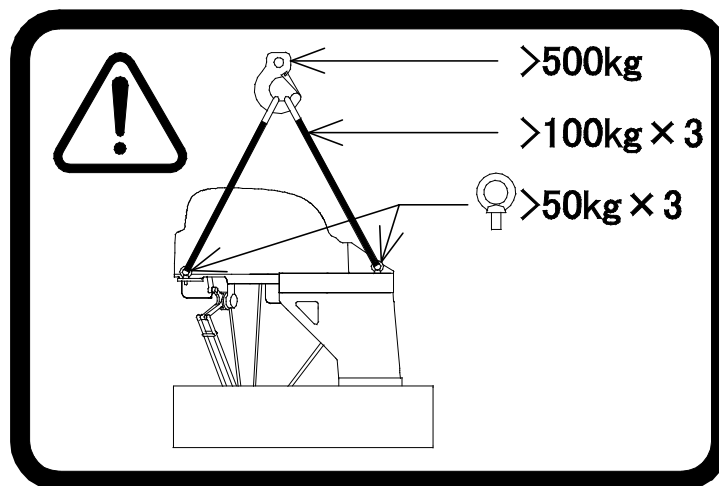


Fig. 8 (a) Transportation attention label

Description

- 1) Use a crane having a load capacity of 500 kg or greater.
- 2) Use at least four slings each having a load capacity of 980 N (100 kgf) or greater.
- 3) Use at least four eyebolts each having a load capacity of 490 N (50 kgf) or greater.

(2) Operating space and payload label

Below label is added when CE specification is specified.

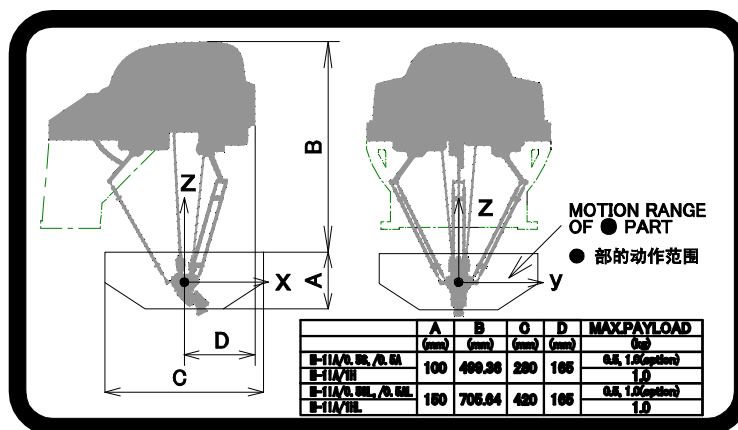


Fig. 8 (b) Operating space and payload label

PREFACE

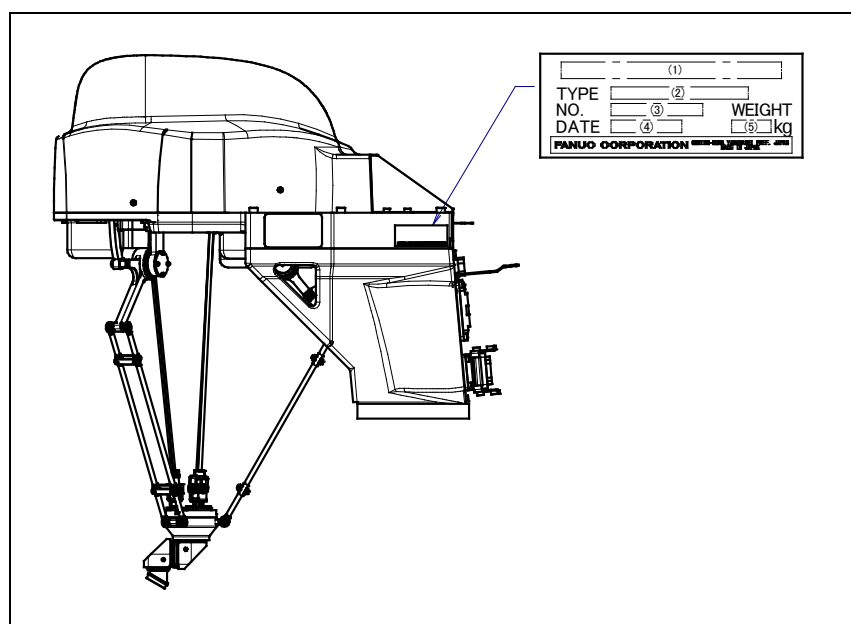
This manual explains operation procedures for the mechanical units of the following robots:

Model name	Mechanical unit specification No.	Maximum load
FANUC Robot M-1iA/0.5S	A05B-1522-B201	0.5kg
FANUC Robot M-1iA/0.5A	A05B-1522-B202	1kg (Note)
FANUC Robot M-1iA/1H	A05B-1522-B203	1kg
FANUC Robot M-1iA/0.5SL	A05B-1522-B204	0.5kg
FANUC Robot M-1iA/0.5AL	A05B-1522-B205	1kg (Note)
FANUC Robot M-1iA/1HL	A05B-1522-B206	1kg

NOTE

When 1 kg payload option is specified.

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



Position of label indicating mechanical unit specification number

TABLE 1)

	(1)	(2)	(3)	(4)	(5)
CON TENTS	MODEL NAME	TYPE	No.	DATE	WEIGHT kg (without controller)
LETTERS	FANUC Robot M-1iA/0.5S	A05B-1522-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	14
	FANUC Robot M-1iA/0.5A	A05B-1522-B202			17
	FANUC Robot M-1iA/1H	A05B-1522-B203			12
	FANUC Robot M-1iA/0.5SL	A05B-1522-B204			17
	FANUC Robot M-1iA/0.5AL	A05B-1522-B205			20
	FANUC Robot M-1iA/1HL	A05B-1522-B206			15

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-30iA Mate controller	OPERATOR'S MANUAL LR HANDLING TOOL B-83134EN-1 ALARM CODE LIST B-83124EN-6	Intended readers : Operator, programmer, Teaching operator, Maintenance engineer, 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 engineer, System designer Topics : Installation, Connection, Maintenance Use : Installation, Start-up, Connection, Maintenance
R-30iB Mate controller	OPERATOR'S MANUAL Basic Operation B-83284EN Alarm Code List B-83284EN-1 Optional Function B-83284EN-2	Intended readers : Operator, programmer, Teaching operator, Maintenance engineer, System designer Topics : Robot functions, Operations, Programming, Setup, Interfaces, Alarms Use : Robot operation, Teaching, System design
	MAINTENANCE MANUAL B-83525EN R-30iB Mate (Open Air): B-83555EN	Intended readers : Maintenance engineer, System designer Topics : Installation, Connection, Maintenance Use : Installation, Start-up, Connection, Maintenance

This manual uses following terms.

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

TABLE OF CONTENTS

SAFETY PRECAUTIONS	s-1
PREFACE	p-1
1 TRANSPORTATION AND INSTALLATION	1
1.1 TRANSPORTATION	1
1.2 INSTALLATION	3
1.2.1 Angle of Mounting Surface Setting	8
1.3 MAINTENANCE AREA	10
1.4 INSTALLATION SPECIFICATIONS	10
2 CONNECTION WITH THE CONTROLLER	11
2.1 CONNECTION WITH THE CONTROLLER	11
3 BASIC SPECIFICATIONS.....	14
3.1 ROBOT CONFIGURATION	14
3.2 A MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE	20
3.3 WRIST LOAD CONDITIONS	44
4 EQUIPMENT INSTALLATION TO THE ROBOT	47
4.1 END EFFECTOR INSTALLATION TO WRIST	47
4.2 LOAD SETTING	49
4.3 JOINT COVER (OPTION) (M-1iA/0.5S, 0.5A, 1H)	51
5 PIPING AND WIRING TO THE END EFFECTOR.....	52
5.1 AIR SUPPLY AND EE(RI) INTERFACE (OPTION)	53
5.2 CAMERA CABLE (OPTION).....	57
6 CHECKS AND MAINTENANCE	58
6.1 PERIODIC MAINTENANCE	58
6.1.1 Daily Checks	58
6.1.2 Periodic Check and Maintenance	59
6.2 CHECK POINTS.....	62
6.2.1 Confirmation of Oil Seepage and Oil Accumulation	62
6.2.2 Confirmation of the Air Control Set.....	63
6.2.3 Retightening the Link B	63
6.2.4 Check the joint cover (OPTION)	64
6.2.5 Cleaning the Wrist Axis Rotation Parts and the Wrist Gears (M-1iA/0.5S,0.5A,0.5SL,0.5AL)	64
6.2.6 Check the Connectors.....	65
6.3 MAINTENANCE.....	66
6.3.1 REPLACING THE BATTERIES (1-YEAR (3840 Hours) CHECKS (with stand/no stand B)) (1.5-YEAR (5760 Hours) CHECKS (no stand A)).....	66
6.3.2 Applying the Grease of the Wrist Input Gear and Drive Shaft (M-1iA/0.5S,0.5A,0.5SL,0.5AL) (6 months (1920 Hours) Checks).....	69
6.4 STORAGE	70

7 MASTERING 71

7.1 OVERVIEW 71

7.2 RESETTING ALARMS AND PREPARING FOR MASTERING 72

7.3 ZERO POSITION MASTERING 73

7.4 QUICK MASTERING 77

7.5 QUICK MASTERING FOR SINGLE AXIS 79

7.6 SINGLE AXIS MASTERING 81

7.7 MASTERING DATA ENTRY 83

7.8 CHECKING THE MASTERING 85

8 TROUBLESHOOTING 86

8.1 TROUBLESHOOTING..... 86

APPENDIX

A PERIODIC MAINTENANCE TABLE 95

B MOUNTING BOLT TORQUE LIST 98

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

Use a crane to transport the robot. When transporting the robot, be sure to change the posture of the robot to that shown Fig. 1.1 (a), (b), (c) and lift by using the eyebolts and the transport equipment at their points.

Transportation using a crane (Fig. 1.1 (a), (b), (c))

Fasten the M6 eyebolts of special transport equipment and lift the robot by the four slings.

NOTE

- 1 When lifting the robot, notice so that the motor, connectors or cables of the robot are not damaged by slings.
- 2 When hoisting or lowering the robot with a crane, move it slowly with great care. When placing the robot on the floor, exercise care to prevent the installation surface of the robot from striking the floor strongly.
- 3 Be sure to remove end effector before transporting robot.
- 4 When transporting or installing the robot, please be careful not to touch the drive shaft, the links and the wrist.



WARNING

Use the transport equipment only to transport the robot. Do not use the transport equipment to secure the robot.

Before moving the robot by using transport equipment, check and tighten any loose bolts on the transport equipment.

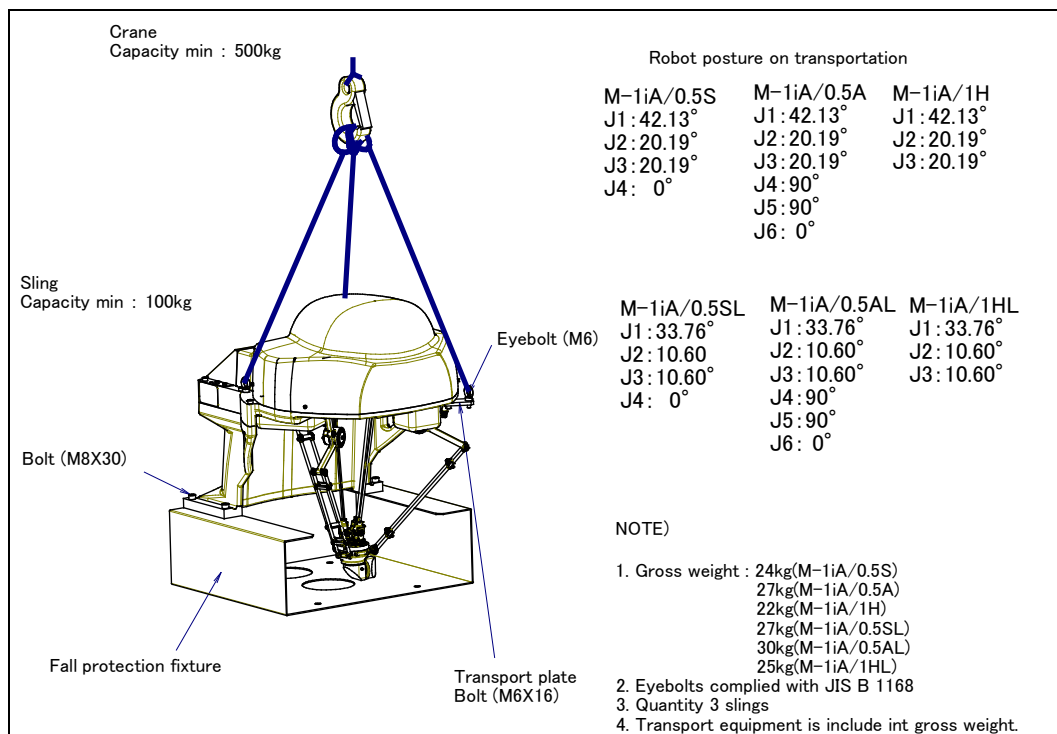


Fig. 1.1 (a) Transportation using a crane (with stand)

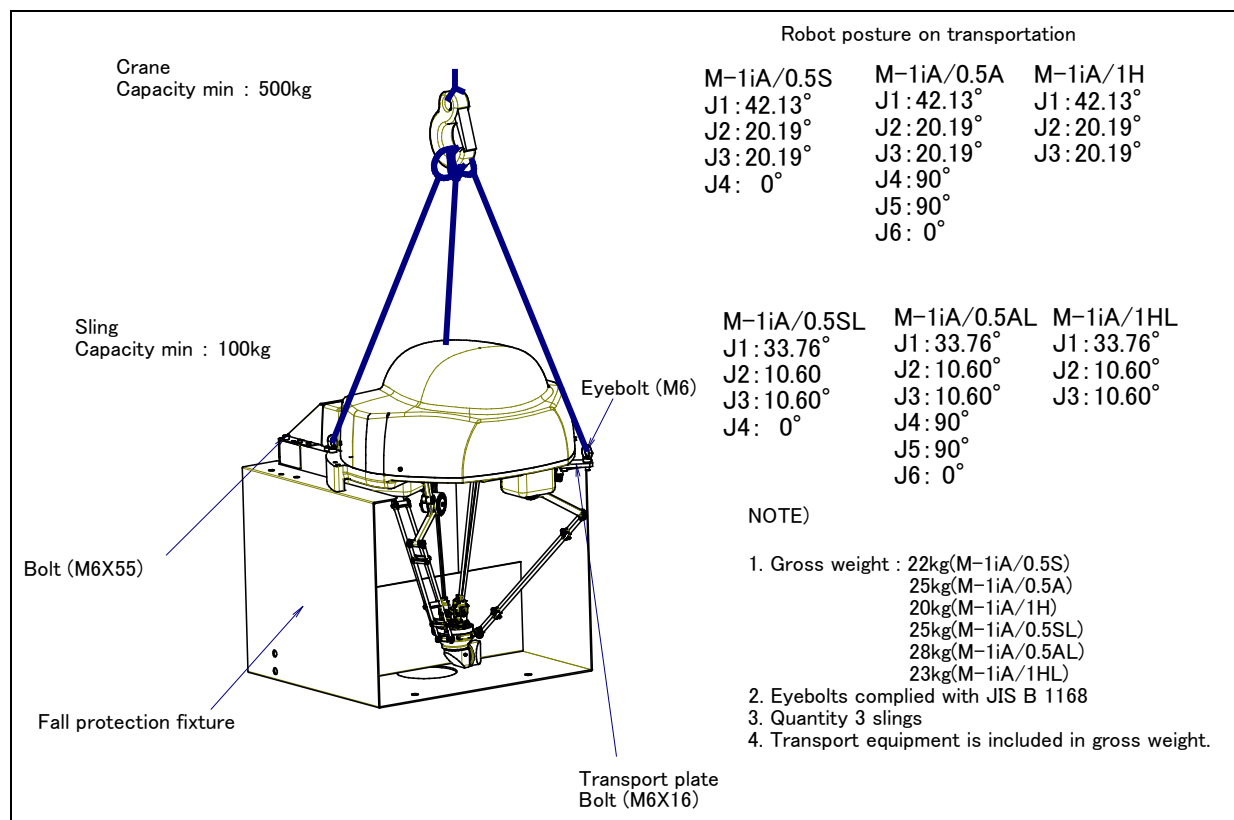


Fig. 1.1 (b) Transportation using a crane (no stand A and no stand B)

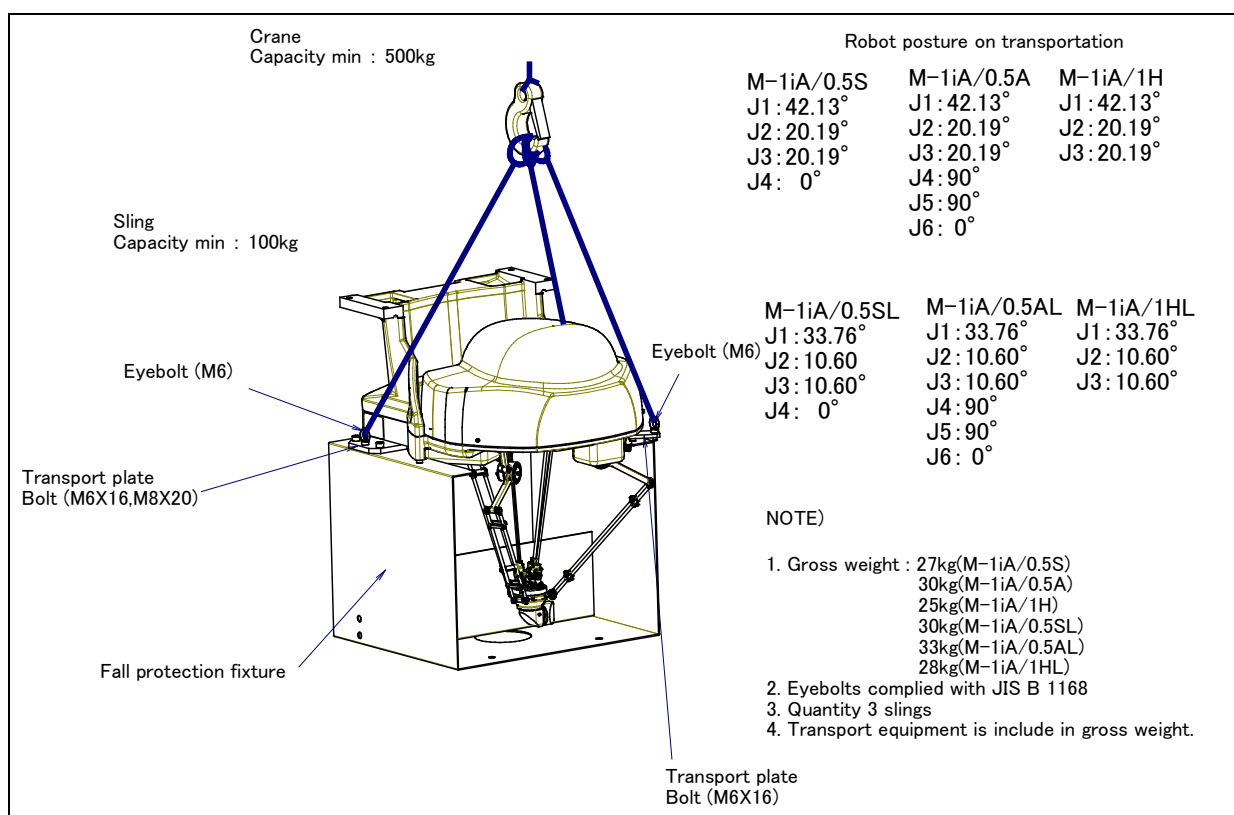


Fig. 1.1 (c) Transportation using a crane (ceiling mount)

1.2 INSTALLATION

Fig. 1.2 (a) to (f) show the robot base dimensions.

Meet the following requirements about the character frequency of robot pedestal.

Character frequency > 50Hz



CAUTION

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

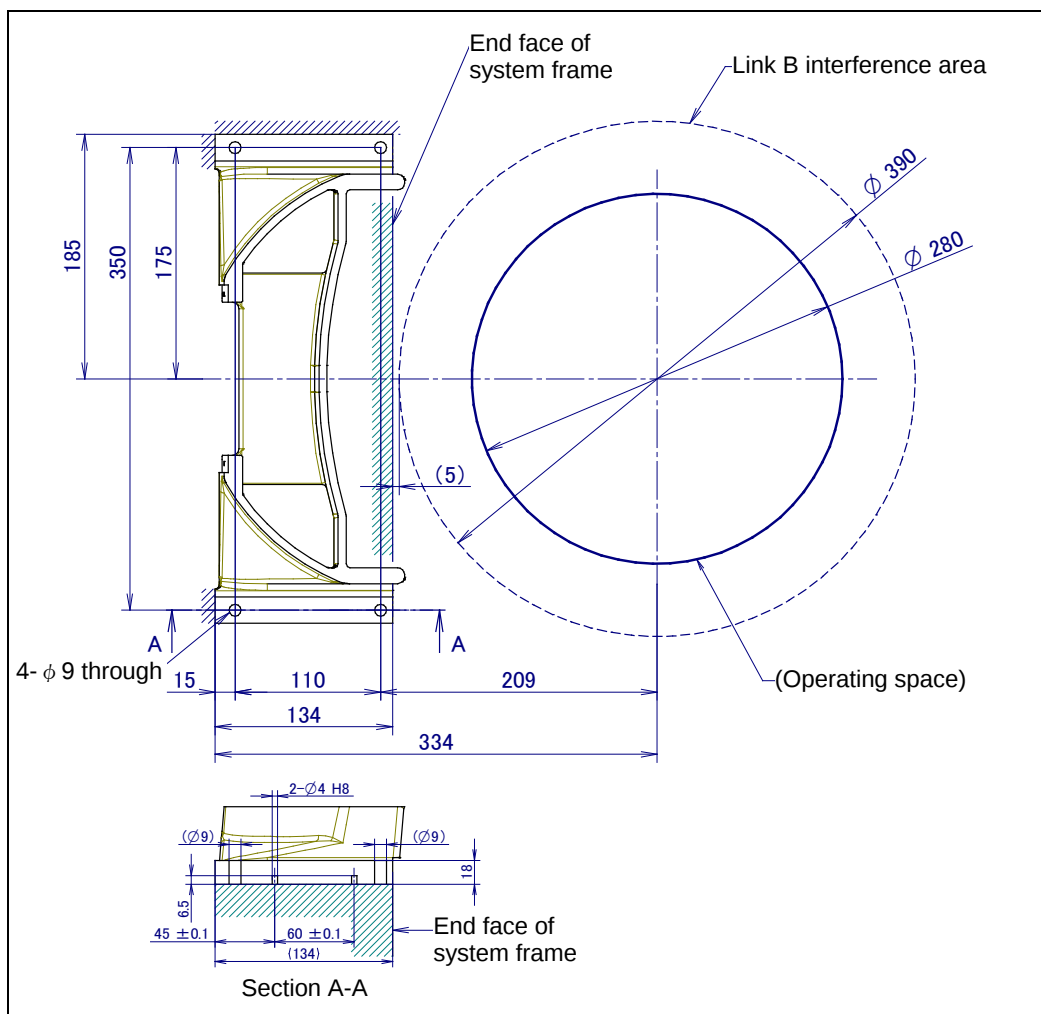


Fig. 1.2 (a) Dimension of robot base (with stand) (M-1iA/0.5S, 0.5A, 1H)

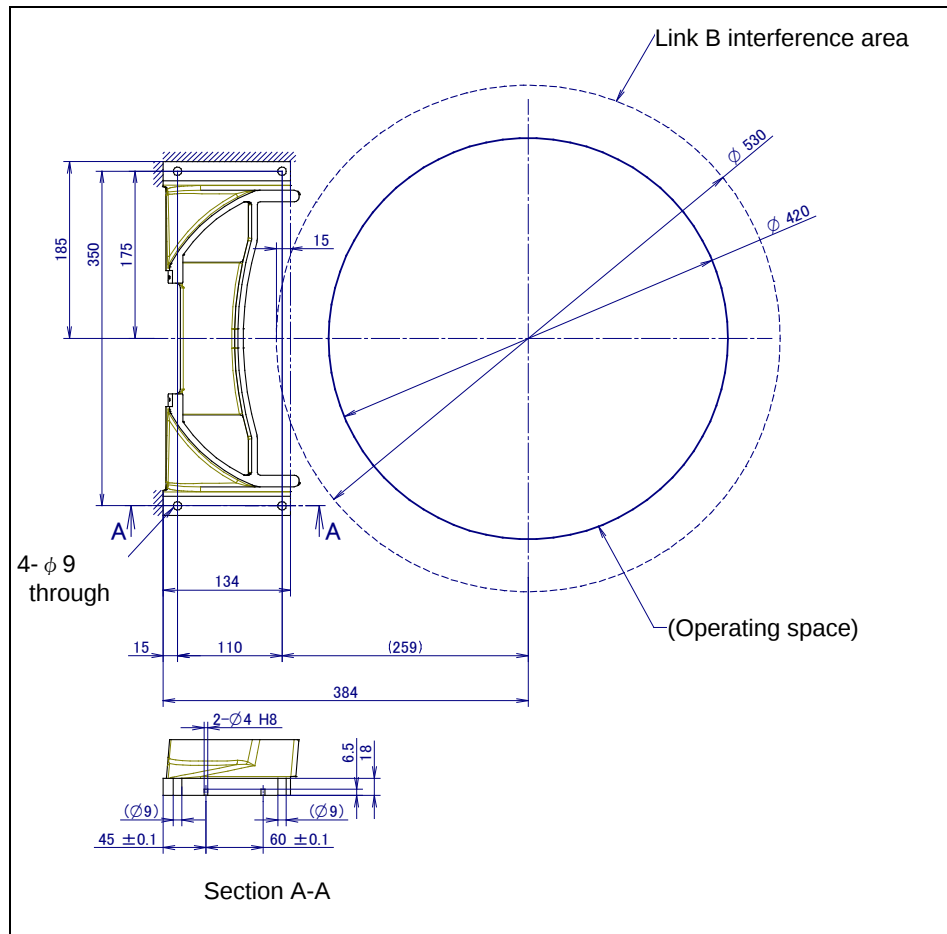


Fig. 1.2 (b) Dimension of robot base (with stand) (M-1iA/0.5SL, 0.5AL, 1HL)

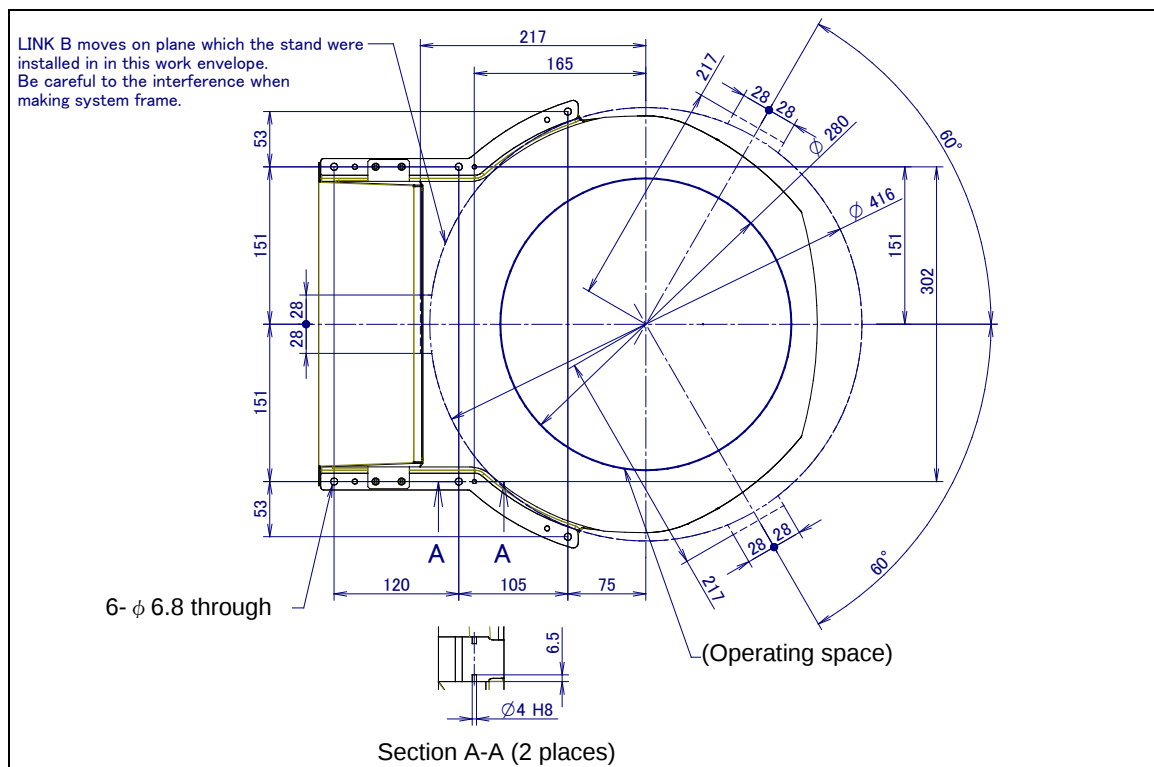


Fig. 1.2 (c) Dimension of robot base (no stand A and no stand B) (M-1iA/0.5S, 0.5A, 1H)

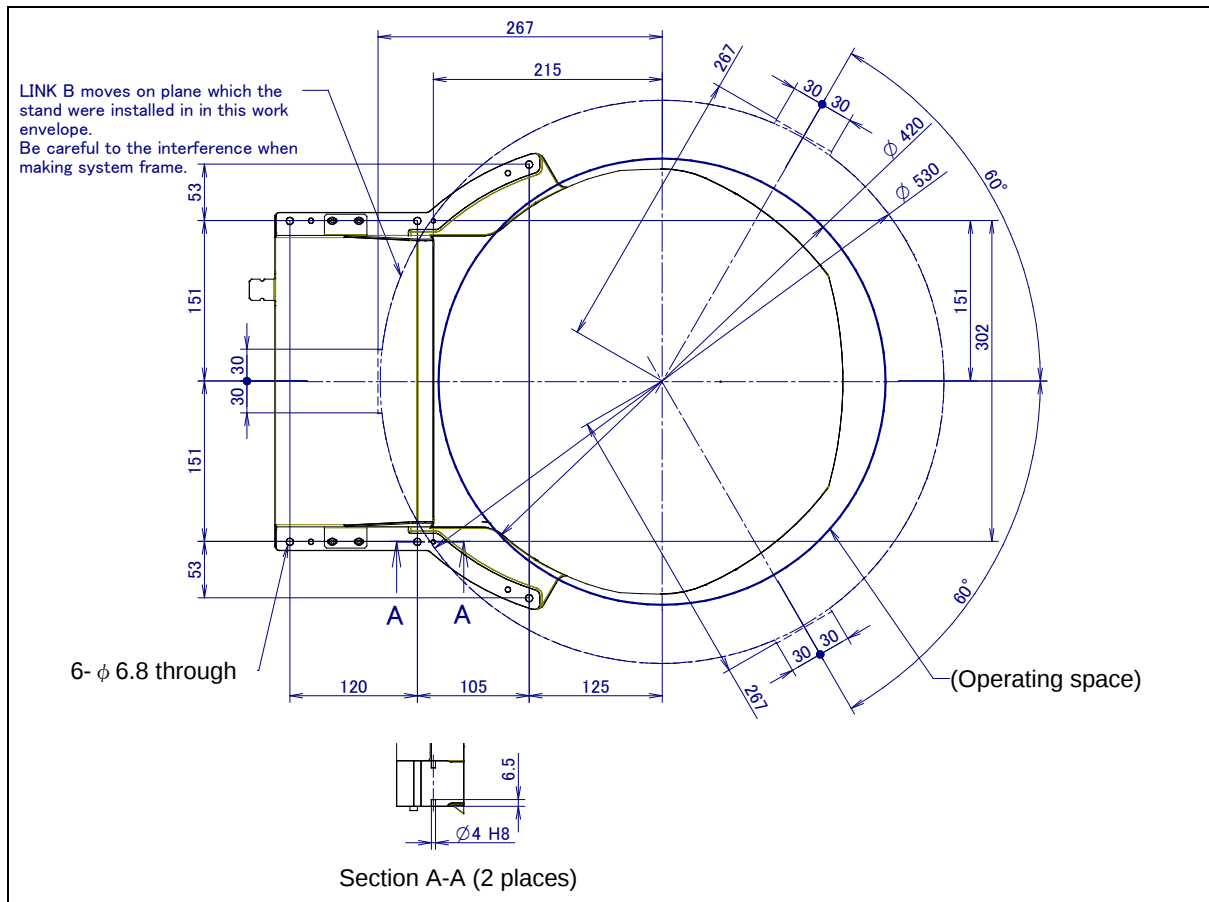


Fig. 1.2 (d) Dimension of robot base (no stand A and no stand B) (M-1iA/0.5SL, 0.5AL, 1HL)

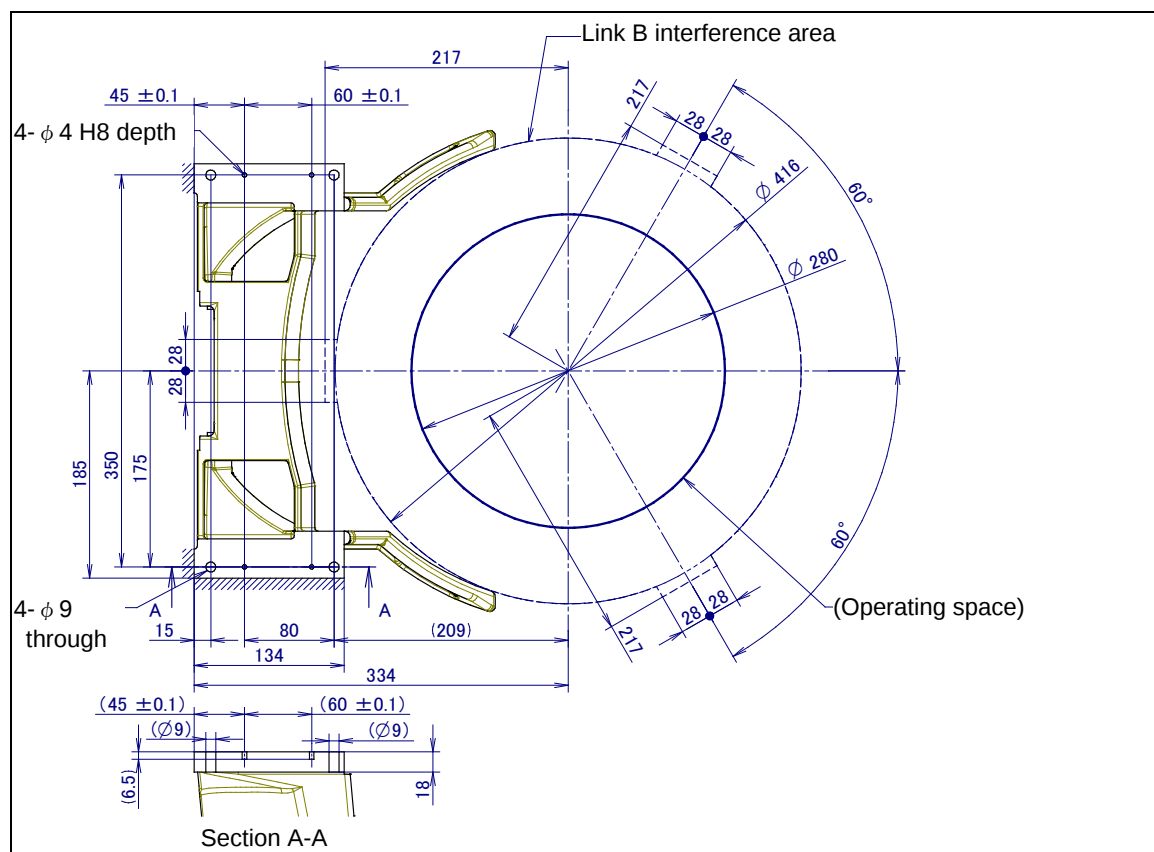


Fig. 1.2 (e) Dimension of robot base (ceiling mount) (M-1iA/0.5S, 0.5A, 1H)

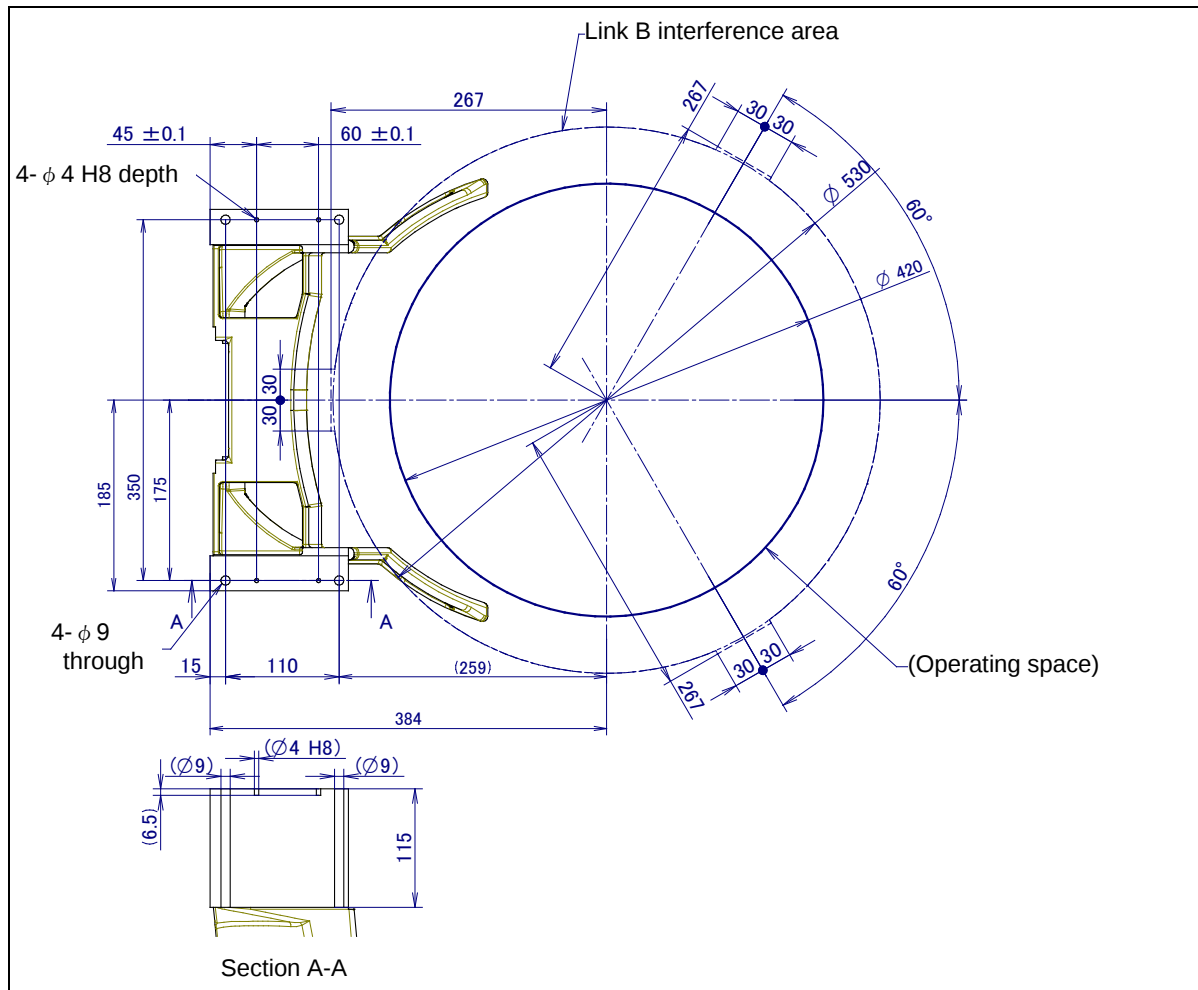


Fig. 1.2 (f) Dimension of robot base (ceiling mount) (M-1iA/0.5SL, 0.5AL, 1HL)

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

Table 1.2 (a) Force and moment that acts on robot base (M-1iA/0.5SL, 0.5AL, 1HL)

	Bending moment Mv (Nm)	Force in vertical condition Fv (N)	Twisting moment Mh (Nm)	Force in horizontal direction Fh (N)
Static	58.2	220.5	0	0
Acceleration/ Deceleration	77.7	269.0	11.0	44.8
Power-Off stop	119.7	450.7	42.8	208.6

Table 1.2 (b) Force and moment that acts on robot base (M-1iA/0.5SL, 0.5AL, 1HL)

	Bending moment Mv (Nm)	Force in vertical condition Fv (N)	Twisting moment Mh (Nm)	Force in horizontal direction Fh (N)
Static	58.2	263.8	0	0
Acceleration/ Deceleration	89.5	282.8	18.2	42.2
Power-Off stop	288.0	466.8	73.6	298.0

Table1.2 (c) Stopping time and distance until the robot stopping by Power-Off stop after input of stop signal

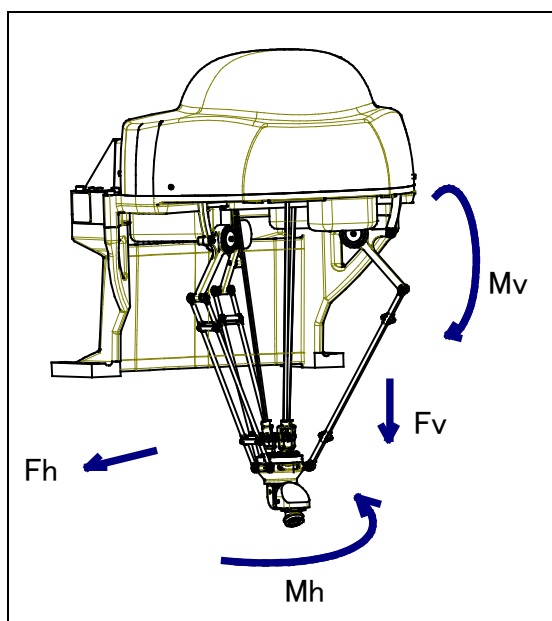
Model		X	Y	Z
M-1iA/0.5A	Stopping time [msec]	31	31	22
M-1iA/0.5S	Stopping distance [mm]	48	48	21
M-1iA/1H	Stopping time [msec]	33	33	24
	Stopping distance [mm]	42	42	18
M-1iA/0.5AL	Stopping time [msec]	47	47	31
M-1iA/0.5SL	Stopping distance [mm]	150	150	28
M-1iA/1HL	Stopping time [msec]	36	36	25
	Stopping distance [mm]	107	107	25

*Max payload and max speed

Table1.2 (d) Stopping time and distance until the robot stopping by Controlled stop after input of stop signal

Model		X	Y	Z
M-1iA/0.5A	Stopping time [msec]	95	95	60
M-1iA/0.5S	Stopping distance [mm]	171	171	61
M-1iA/1H	Stopping time [msec]	322	322	214
	Stopping distance [mm]	138	138	45
M-1iA/0.5AL	Stopping time [msec]	346	346	314
M-1iA/0.5SL	Stopping distance [mm]	235	235	67
M-1iA/1HL	Stopping time [msec]	285	285	290
	Stopping distance [mm]	193	193	68

*Max payload and max speed

**Fig. 1.2 (g) Force and moment that acts on robot base**

1.2.1 Angle of Mounting Surface Setting

If robot is used except floor mount, be sure to set the mounting angle referring to the procedure below.
Refer to specification of Section 3.1 about installation specifications.

1. When performing a robot initial start

- 1 With the F1 key and the F5 key held down on the teach pendant, set the power breaker on the controller to ON. Next, Select 3, Init start.
- 2 Input the angle of mounting surface to floor surface setting and the angle of robot to mounting surface setting as shown in Fig. 1.2 .1.

```
*****Group 1 Initialization*****
*****M-iA/0.5S*****

--Angle of Mounting Surface --
--to Floor Surface setting --

Enter angle (-180 - +180[deg])->

Default value = 0
```

```
*****Group 1 Initialization*****
*****M-iA/0.5S*****

--Angle of Robot to --
--Mounting Surface setting --

Enter angle (-180 - +180[deg])->

Default value = 0
```

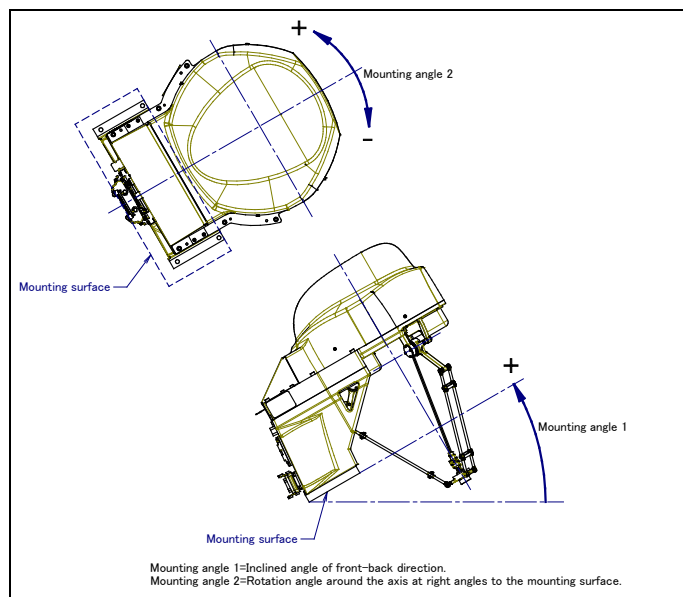


Fig. 1.2.1 Robot mounting angle

2. When changing the setting angle

To change the setting angle, perform the procedure below.

Refer to specification of Section 3.1 about installation specifications.

- 1 Turn on the controller with [PREV] and [NEXT] key pressed. Then select "3. Controlled start".
- 2 Press "TYPE" key and select "MAINTENANCE".
- 3 Select the robot which you would like to change the setting angle and press F4 "AUTO".

ROBOT MAINTENANCE	CTRL START MANU
Setup Robot System Variables	
Group	Robot Library/Option Ext Axes
1	M-1iA/0.5S 0
[TYPE] ORD NO AUTO MANUAL	

- 4 Press [F4] key.
- 5 Press [ENTER] key until the screen below will be displayed.
- 6 Input the angle of mounting surface to floor surface setting and the angle of robot to mounting surface setting as shown in Fig.1.2.1.

```
*****Group 1 Initialization*****
*****M-1iA/0.5S*****

--Angle of Mounting Surface  --
--to Floor Surface setting --

Enter angle (-180 - +180[deg])->

Default value = 0
```

```
*****Group 1 Initialization*****
*****M-1iA/0.5S*****

--Angle of Robot to  --
--Mounting Surface setting --

Enter angle (-180 - +180[deg])->

Default value = 0
```

- 7 Press [ENTER] key until screen below will be displayed again.

ROBOT MAINTENANCE		CTRL START MANU	
Setup Robot System Variables			
Group	Robot Library/Option	Ext	Axes
1	M-1iA/0.5S		0
[TYPE] ORD NO		AUTO	MANUAL

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

1.3 MAINTENANCE AREA

Fig. 1.3 shows the maintenance area of the mechanical unit. See Chapter 8 for the mastering.

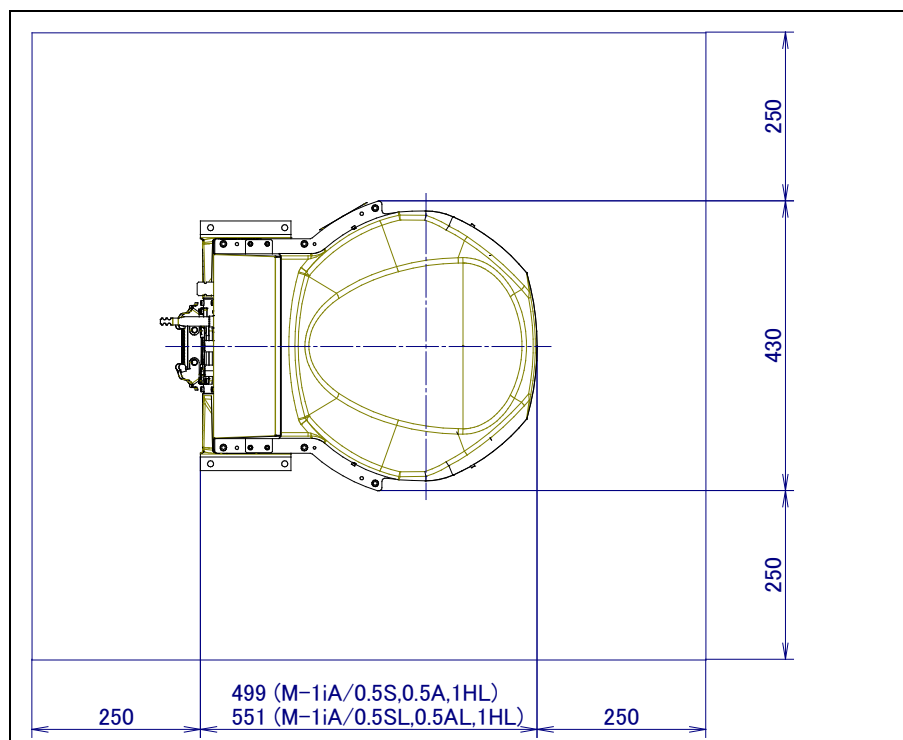


Fig. 1.3 Maintenance area

1.4 INSTALLATION SPECIFICATIONS

Refer to specification of Section 3.1 about installation specifications.

2 CONNECTION WITH THE CONTROLLER

2.1 CONNECTION WITH THE CONTROLLER

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

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



WARNING

Before turning on controller power, be sure to connect robot mechanical unit and controller with the earth line. Otherwise, there is the risk of electrical shock.



CAUTION

- 1 Before connecting the cables, be sure to turn off the controller power.
- 2 Don not use 10m or longer coiled cable without untying. The long coiled cable will heat and damage itself.

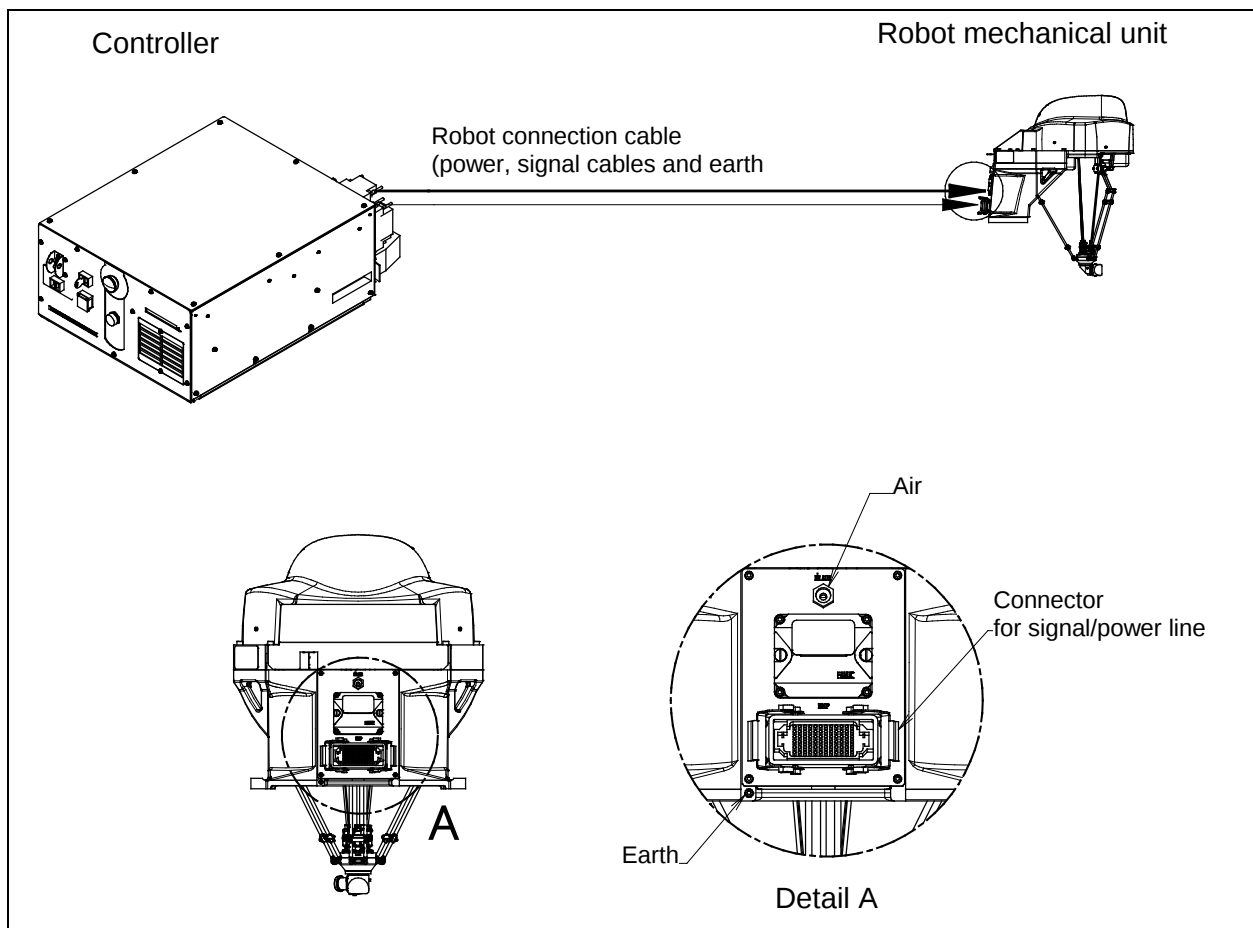


Fig. 2.1 (a) Cable connection (with stand)

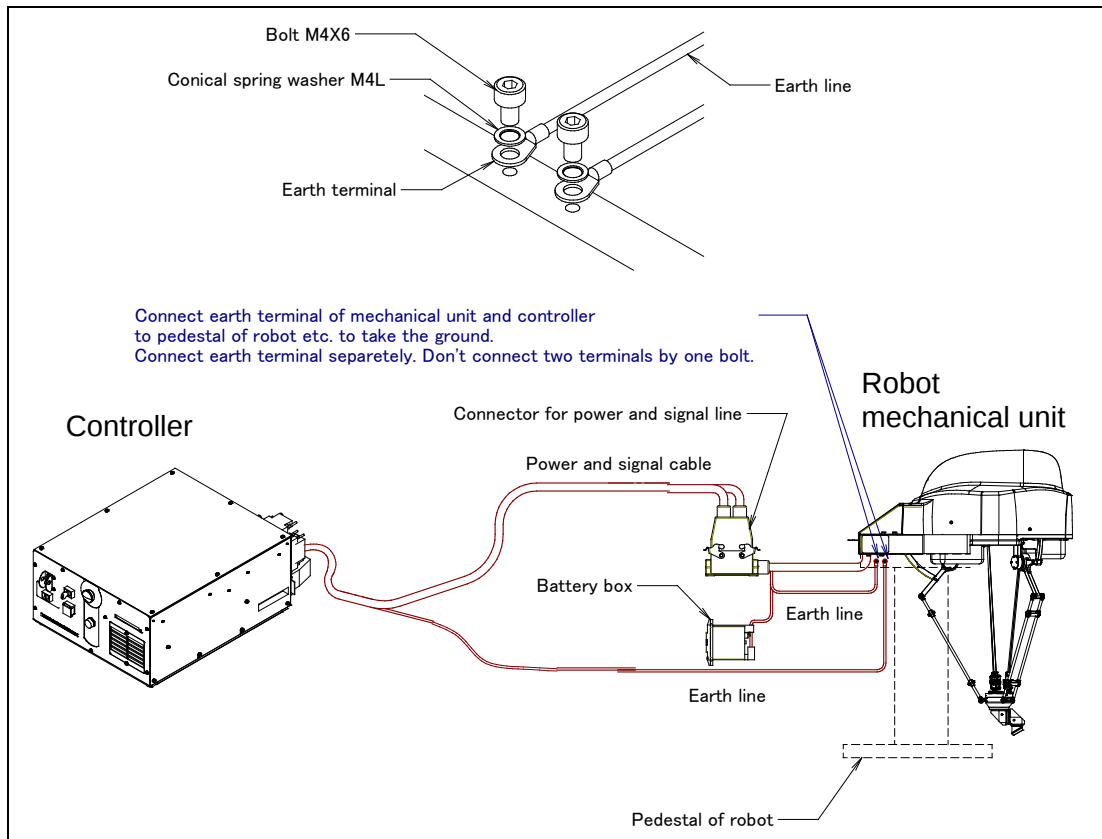


Fig. 2.1 (b) Cable connection (no stand A)

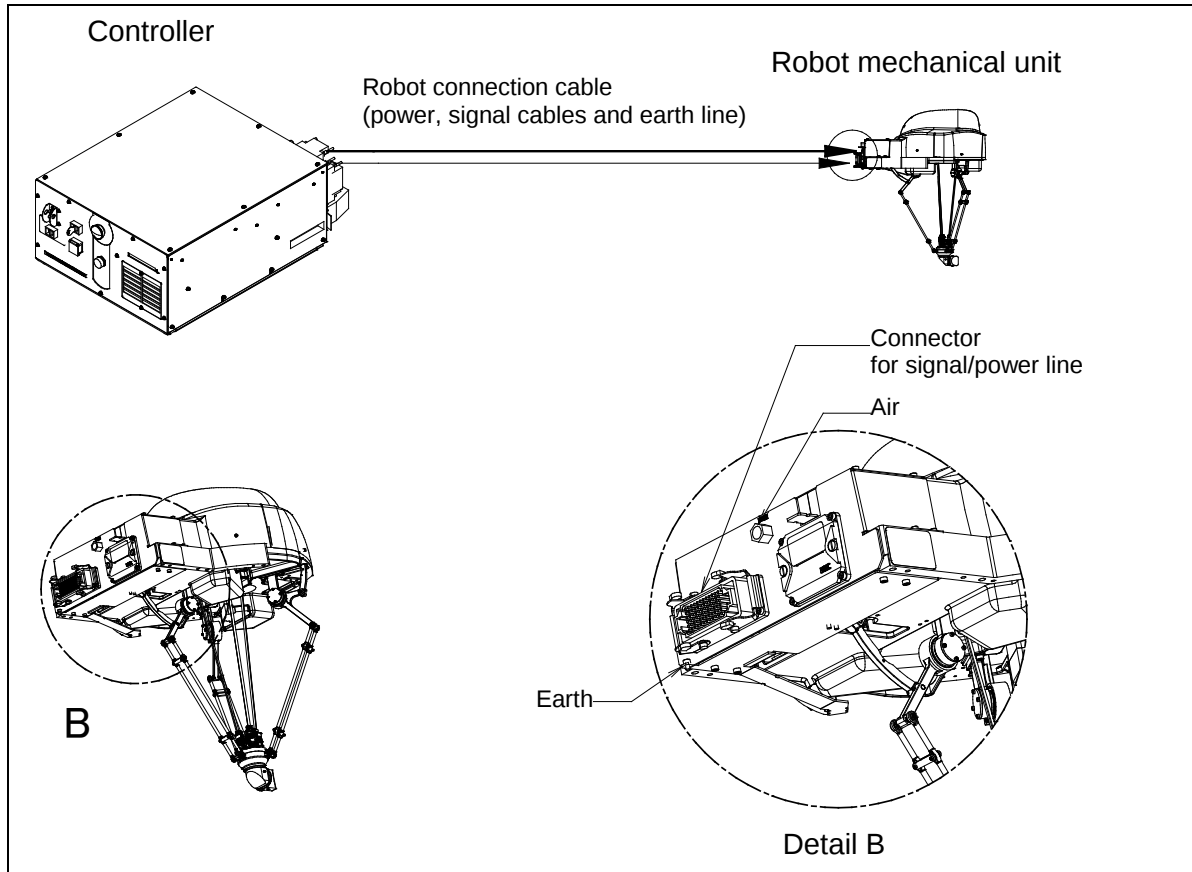


Fig. 2.1 (c) Cable connection (no stand B)

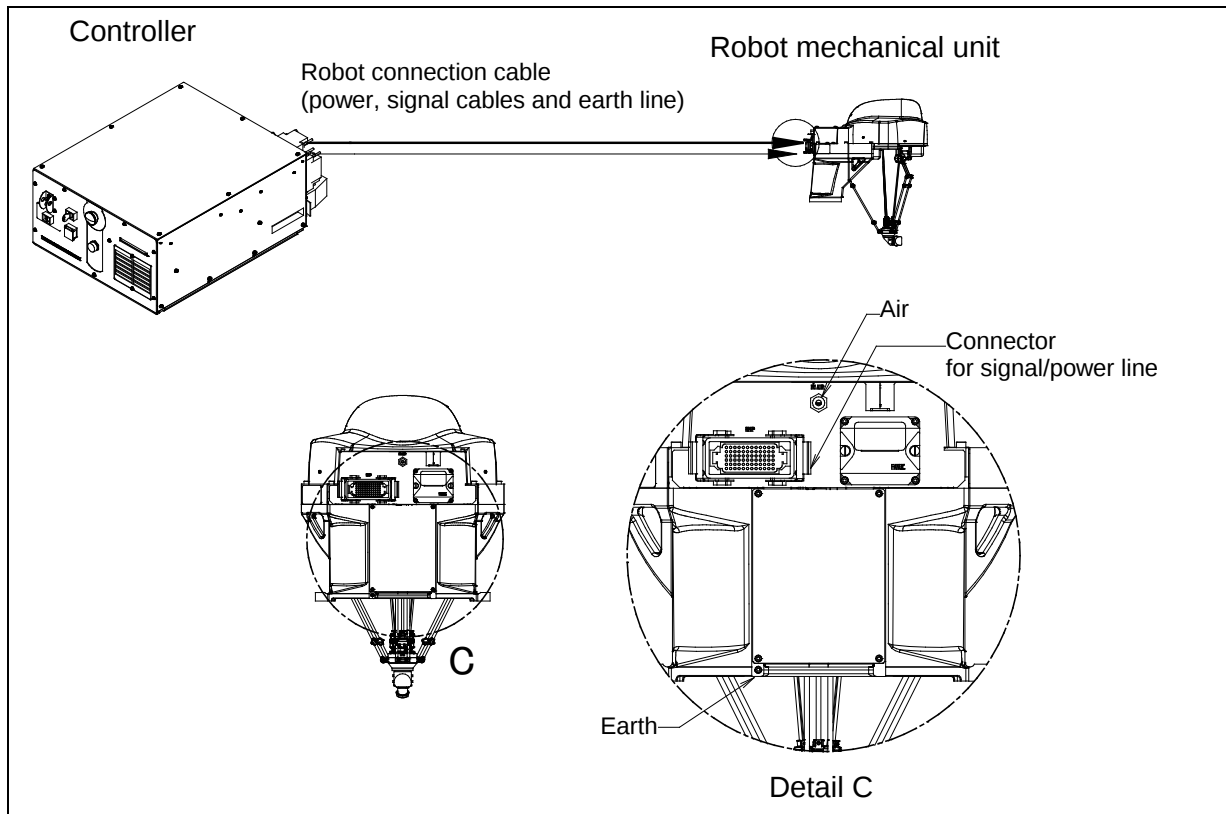


Fig. 2.1 (d) Cable connection (no stand B) (additional stand option)

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

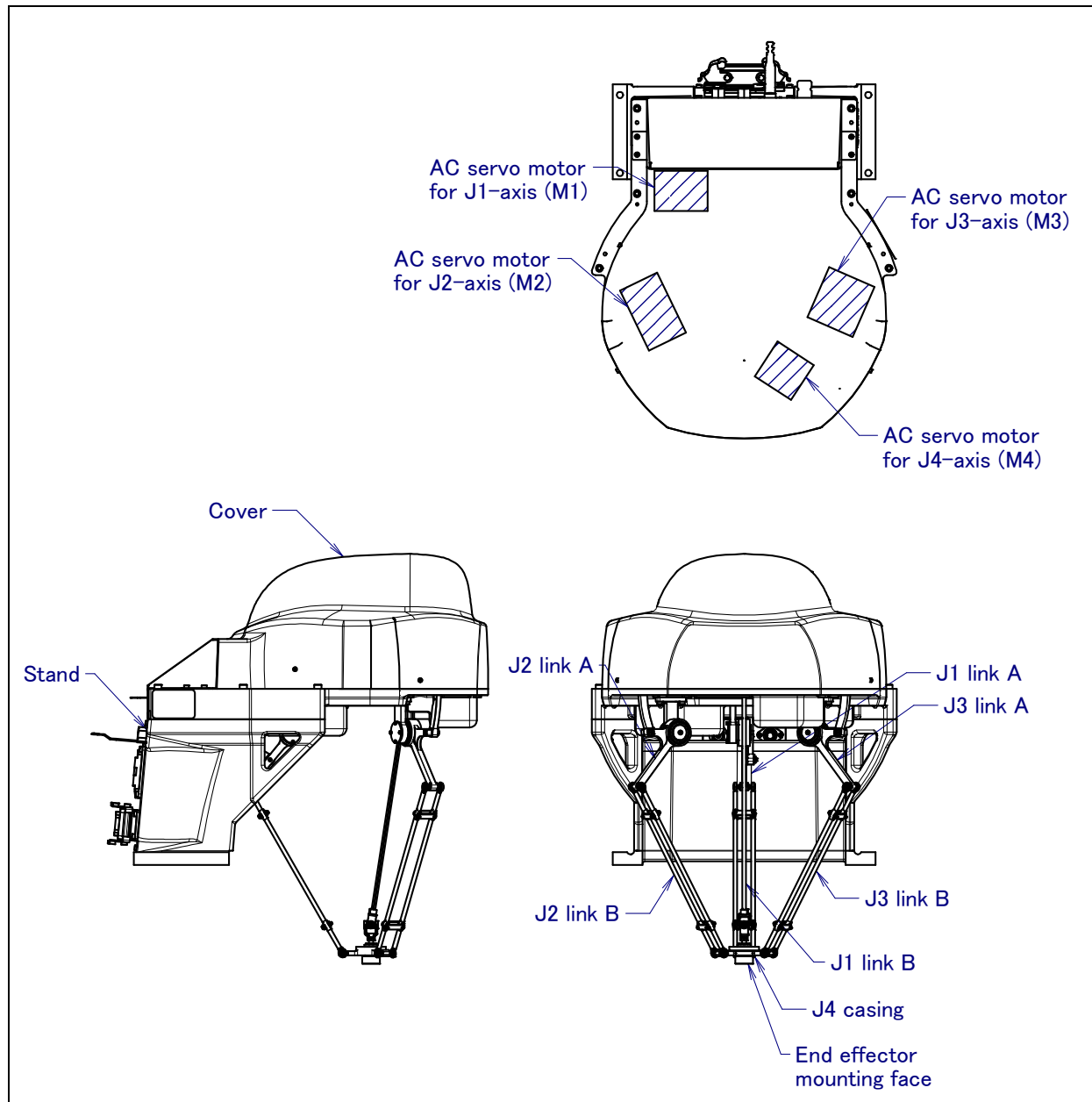


Fig. 3.1 (a) Mechanical unit configuration (M-1iA/0.5S,0.5SL)

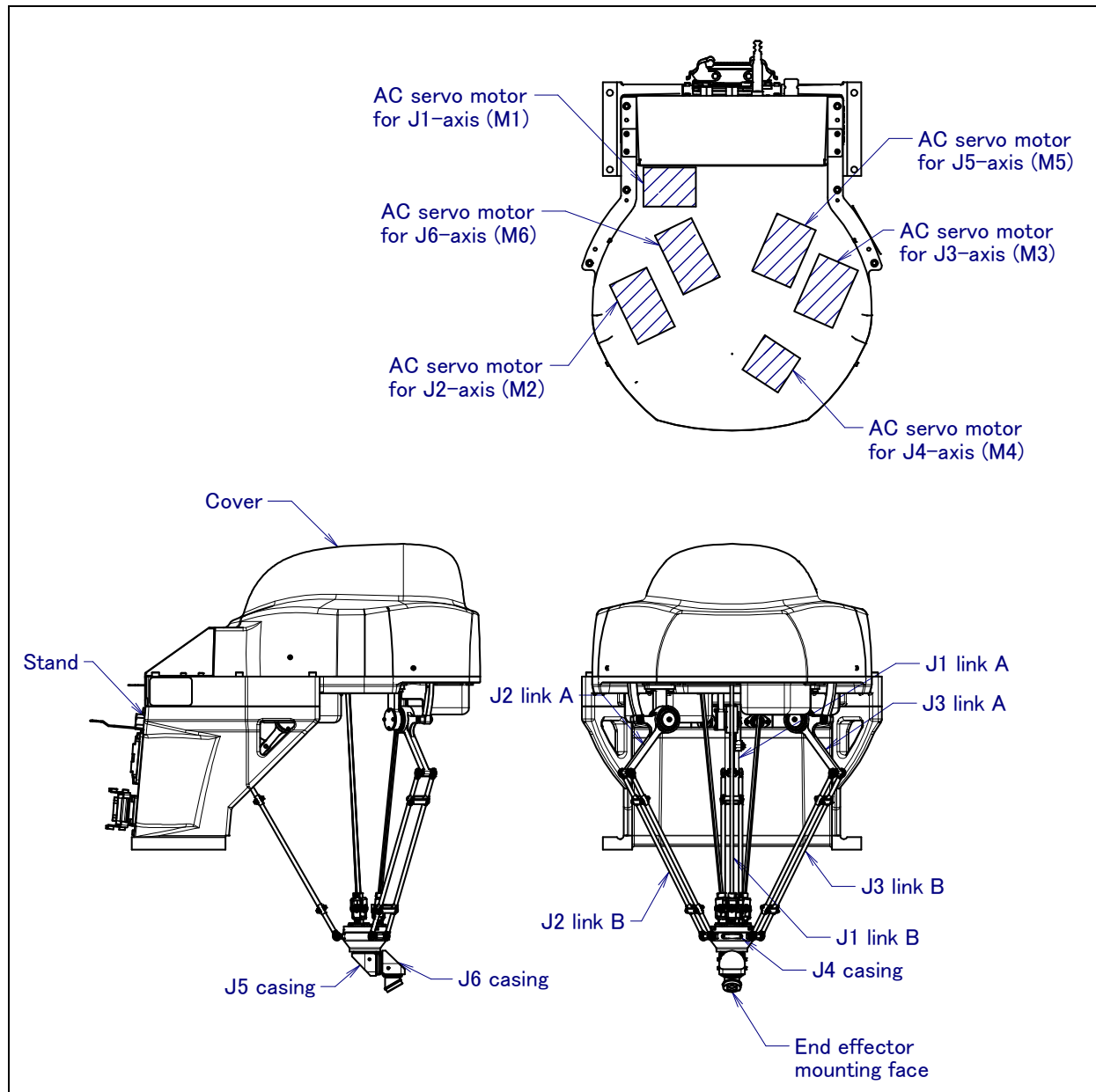


Fig. 3.1 (b) Mechanical unit configuration (M-1iA/0.5A,0.5AL)

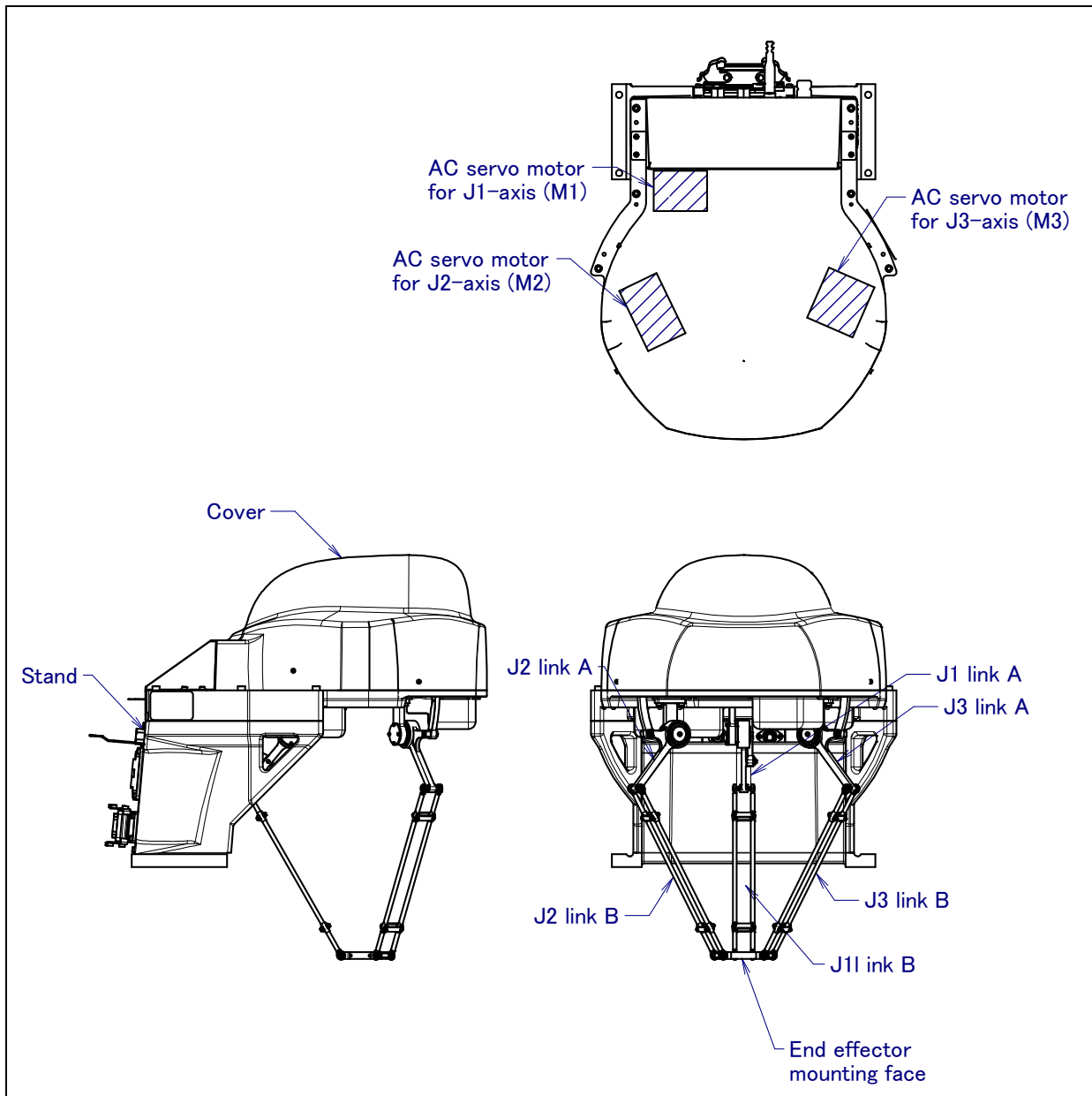


Fig. 3.1 (c) Mechanical unit configuration (M-1iA/1H,1HL)

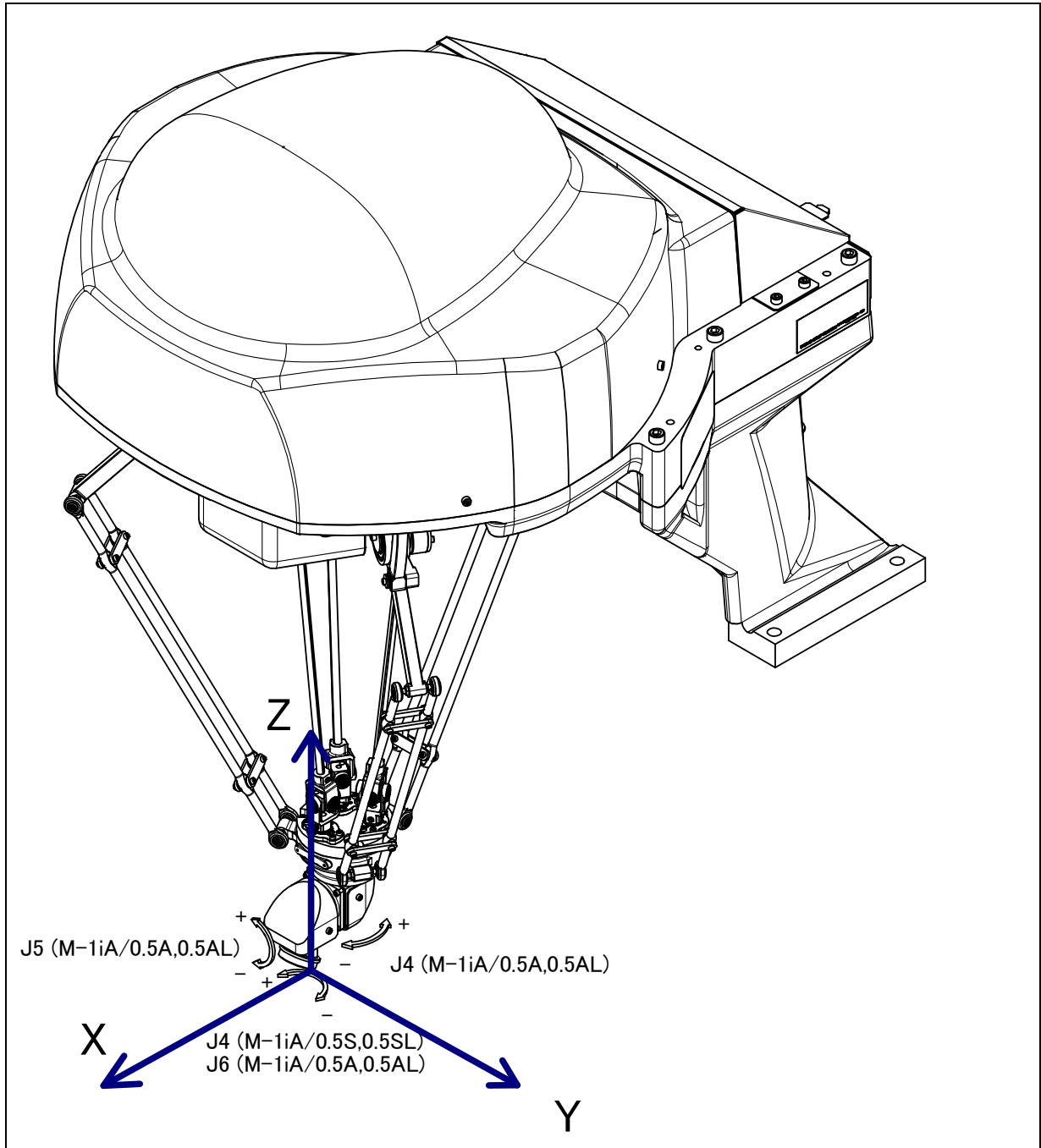


Fig. 3.1 (d) Each axes coordinates

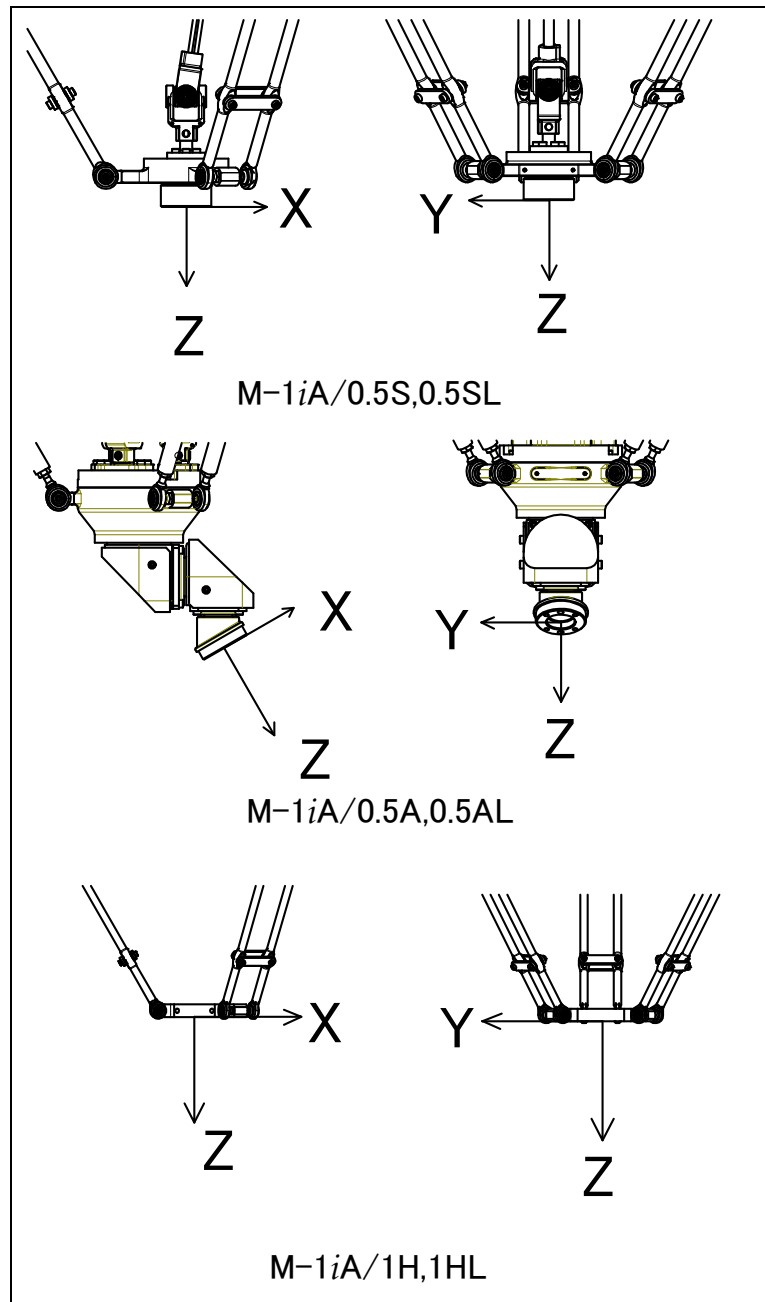


Fig. 3.1 (e) Mechanical interface coordinates

NOTE

Zero point of mechanical interface coordinates is the end effector mounting face center.

Table 3.1 (a) Specifications (1/2)

	M-1iA/0.5S	M-1iA/0.5A	M-1iA/1H
Type	Parallel link mechanism robot		
Controlled axes	4-axes (J1, J2, J3, J4)	6-axes (J1, J2, J3, J4, J5, J6)	3-axes (J1, J2, J3)
Installation	Floor, Ceiling	Floor, Ceiling (Angle mount)	Floor, Ceiling
Work envelope	Diameter 280 mm, Height 100 mm		
Max.payload	0.5kg (option : 1kg)		1kg
Drive method	Electric servo drive by AC servo motor		
Wrist maximum speed (Note 1)	3000 deg/sec (J4)	1440 deg/sec (J4,J5,J6)	
Repeatability	±0.02mm		
Dust.proof and drip.proof mechanism	Conform to IP20		
Mass	20kg (with stand)	23kg (with stand)	18kg (with stand)
	14kg (without stand)	17kg (without stand)	12kg (without stand)
Acoustic noise level	61.2dB (Note 2)		
Installation environment	Ambient temperature: 0 to 45°C (Note 3) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%RH or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s ² (0.5G) or less Free of corrosive gases (Note 4)		

Table 3.1 (b) Specifications (2/2)

	M-1iA/0.5SL	M-1iA/0.5AL	M-1iA/1HL
Type	Parallel link mechanism robot		
Controlled axes	4-axes (J1, J2, J3, J4)	6-axes (J1, J2, J3, J4, J5, J6)	3-axes (J1, J2, J3)
Installation	Floor, Ceiling	Floor, Ceiling (Angle mount)	Floor, Ceiling
Work envelope	Diameter 420 mm, Height 150 mm		
Max.payload	0.5kg (option : 1kg)		1kg
Drive method	Electric servo drive by AC servo motor		
Wrist maximum speed (Note 1)	3000 deg/sec (J4)	1440 deg/sec (J4,J5,J6)	
Repeatability	±0.03mm		
Dust.proof and drip.proof mechanism	Conform to IP20		
Mass	23kg (with stand)	26kg (with stand)	21kg (with stand)
	17kg (without stand)	20kg (without stand)	15kg (without stand)
Acoustic noise level	57.6dB (Note 2)		
Installation environment	Ambient temperature: 0 to 45°C (Note 3) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%RH or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s ² (0.5G) or less Free of corrosive gases (Note 4)		

NOTE

- 1 In case of short distance motion, the axis speed may not reach the maximum value stated.
- 2 This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.
 - Maximum load and speed
 - Operating mode is AUTO
- 3 When robot is used in low temperature environment that is near to 0°C, or not operated for a long time in the environment that is less than 0°C in a holiday or the night, collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.
- 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.

**CAUTION**

They should be installed in the environment of "Pollution degree 2" regulated in IEC 60664-1 (JIS C 0664). "Pollution degree 2" means cleanly environment like an office.

3.2 A MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE

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

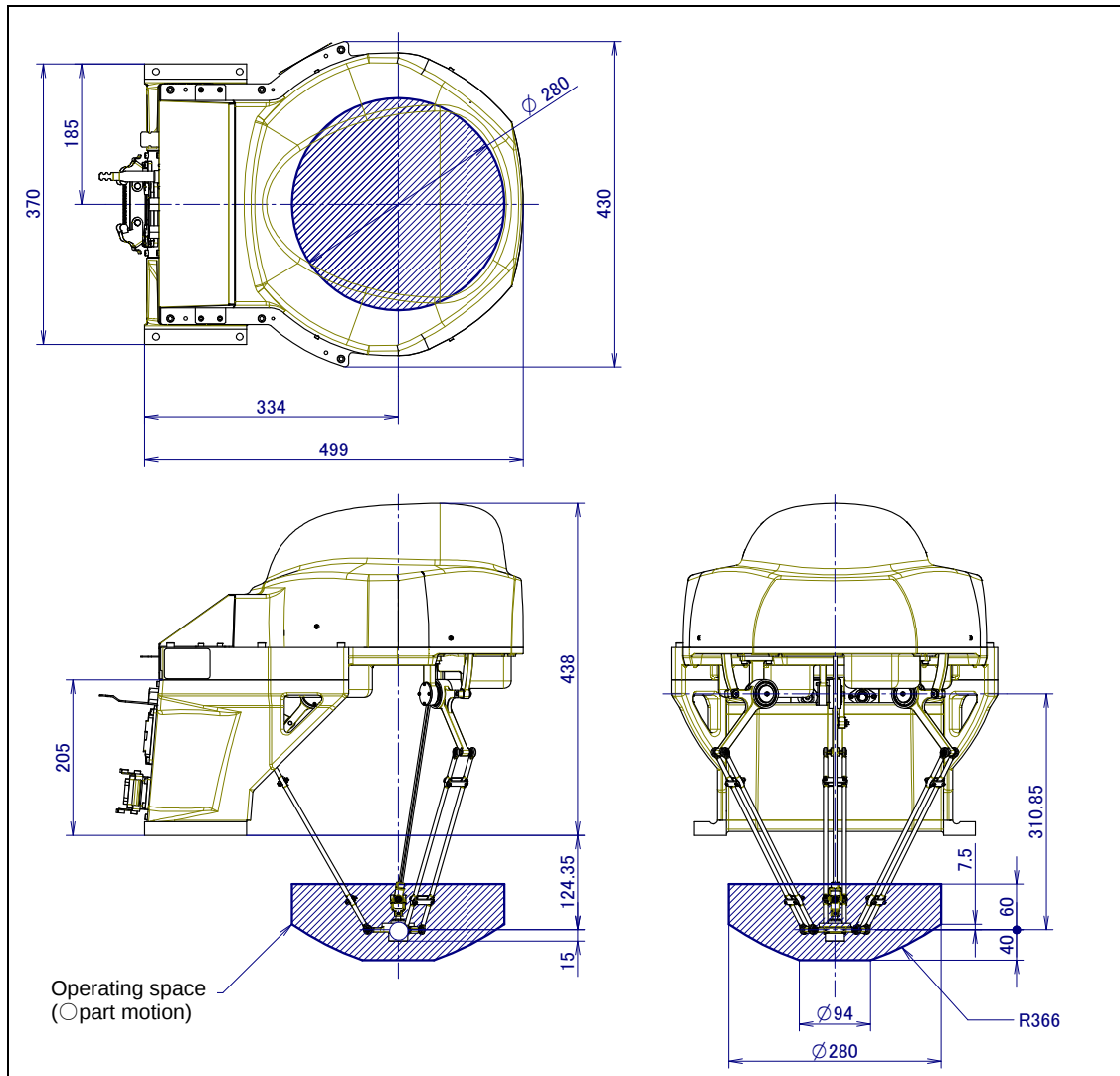


Fig. 3.2 (a) Operating space (M-1iA/0.5S) (with stand)

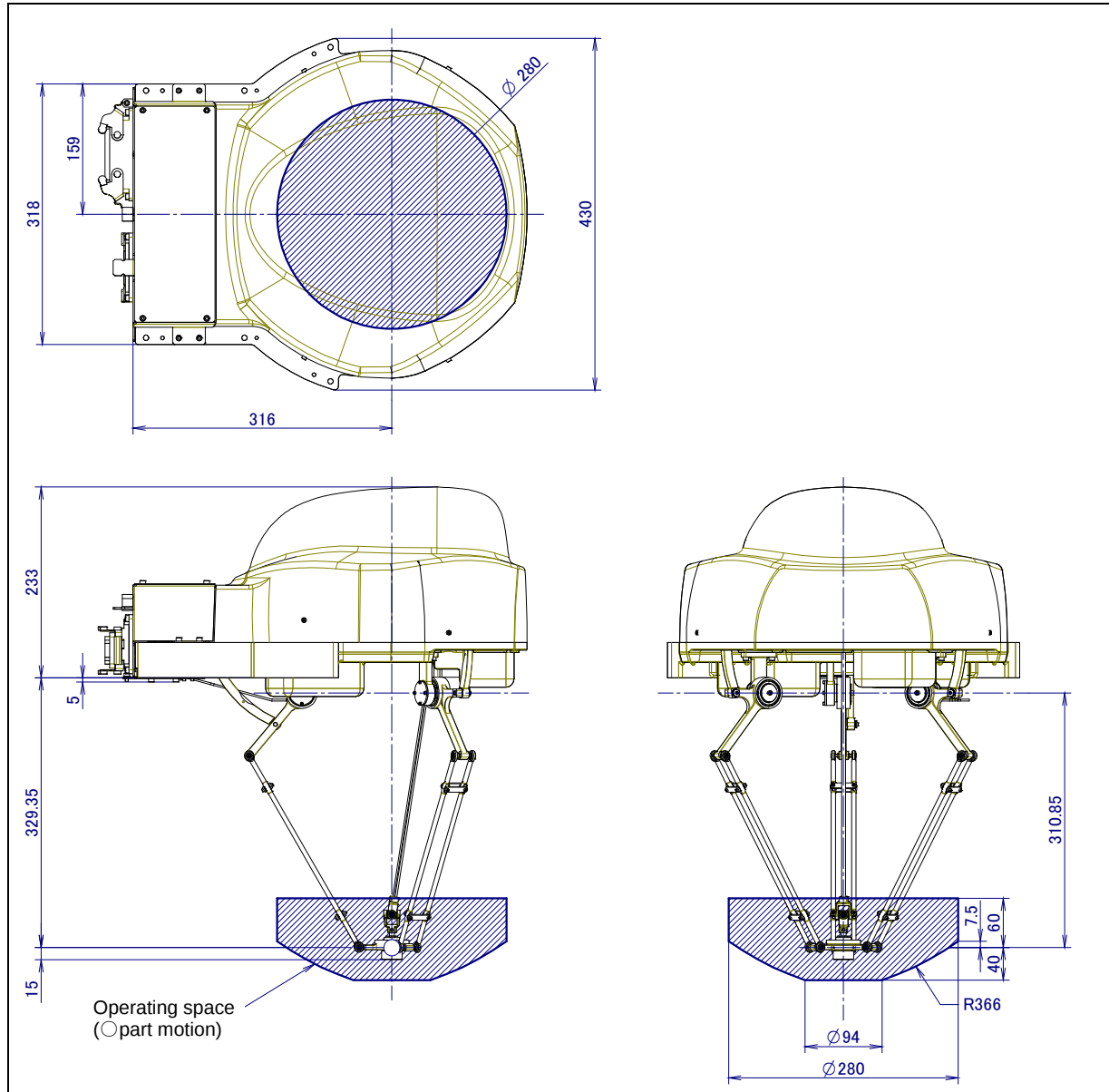


Fig. 3.2 (d) Operating space (M-1iA/0.5S) (no stand B)

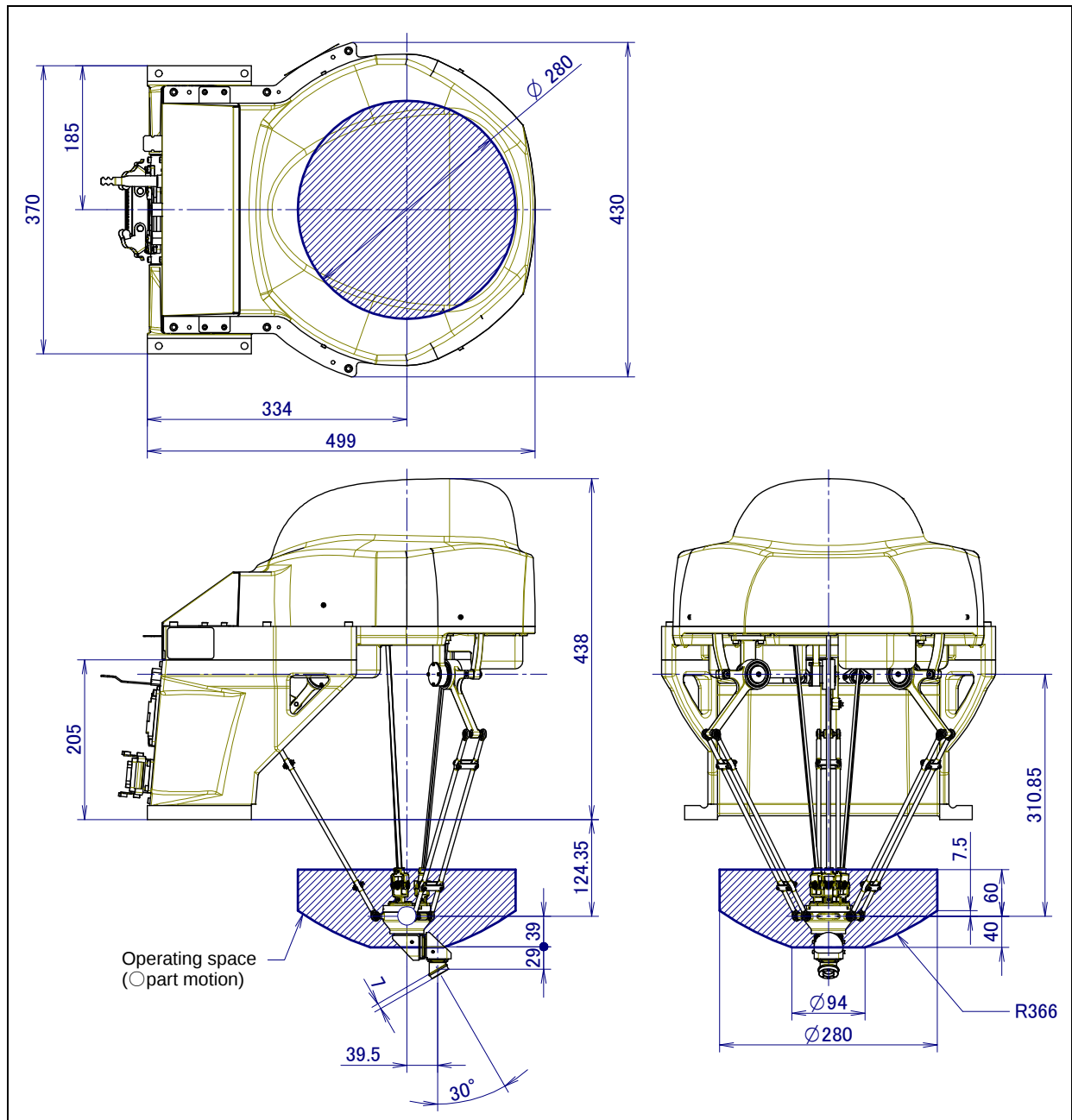


Fig. 3.2 (e) Operating space (M-1iA/0.5A) (with stand)

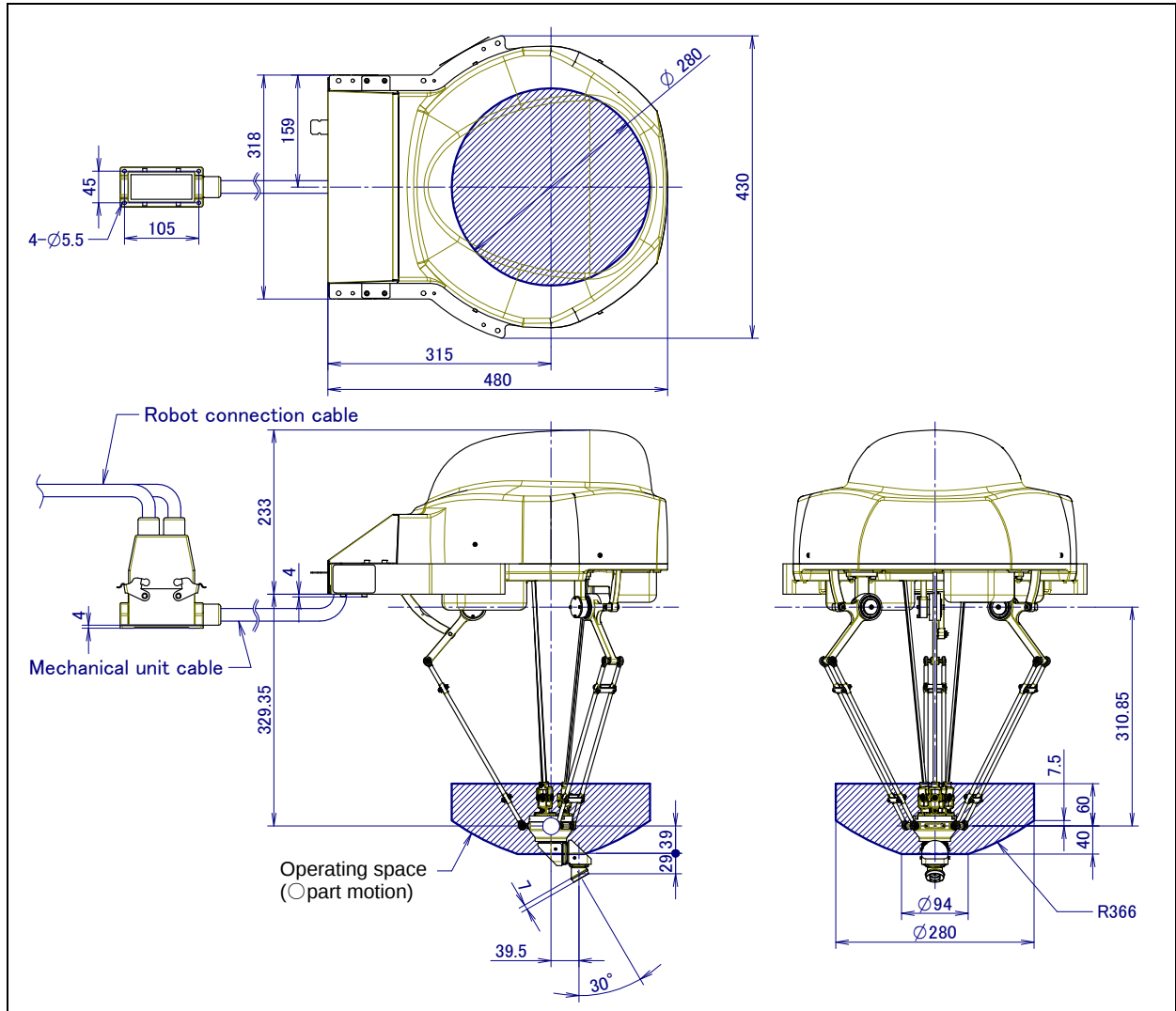


Fig. 3.2 (f) Operating space (M-1iA/0.5A) (no stand A)

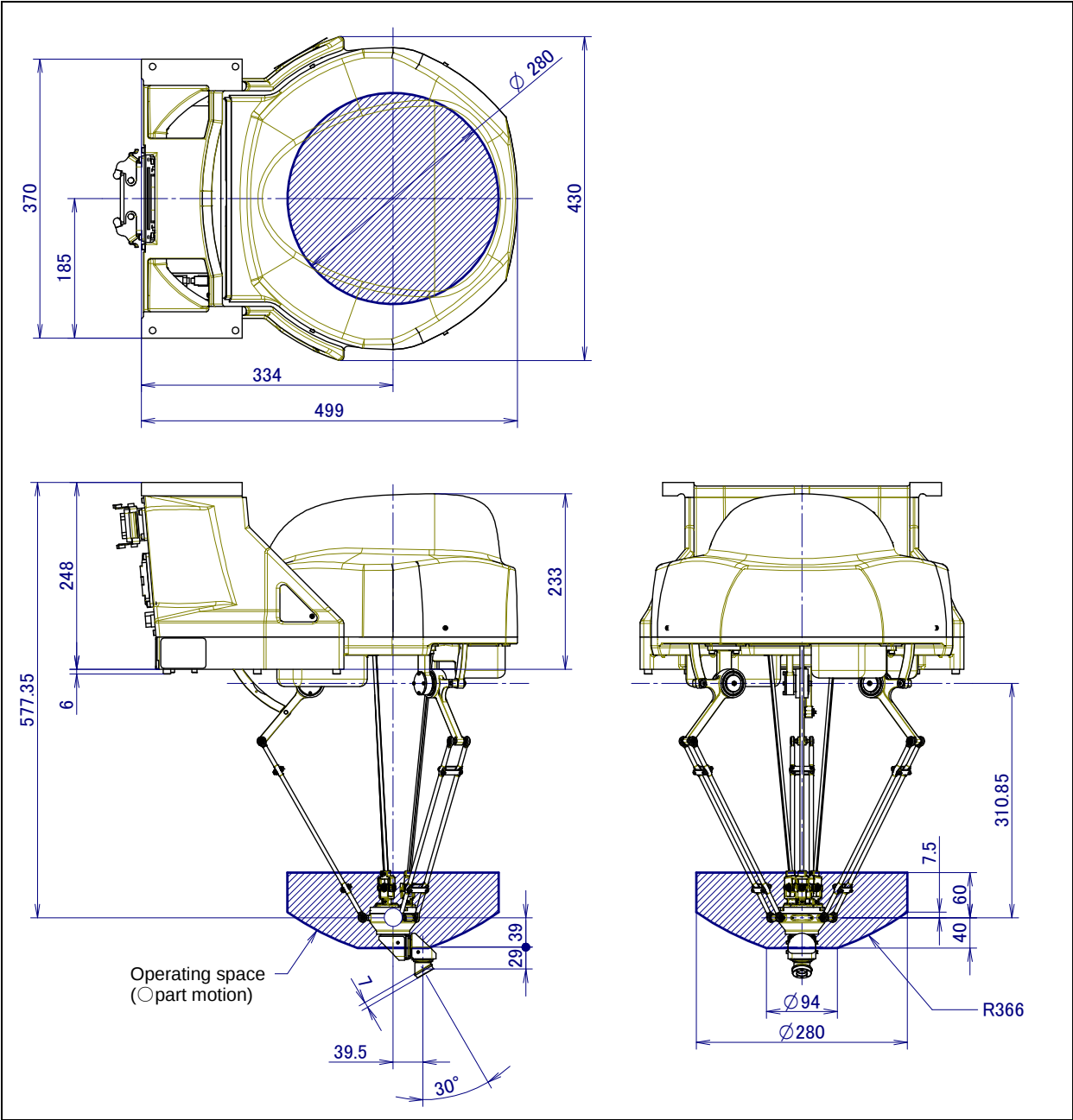


Fig. 3.2 (g) Operating space (M-1iA/0.5A) (ceiling mount)

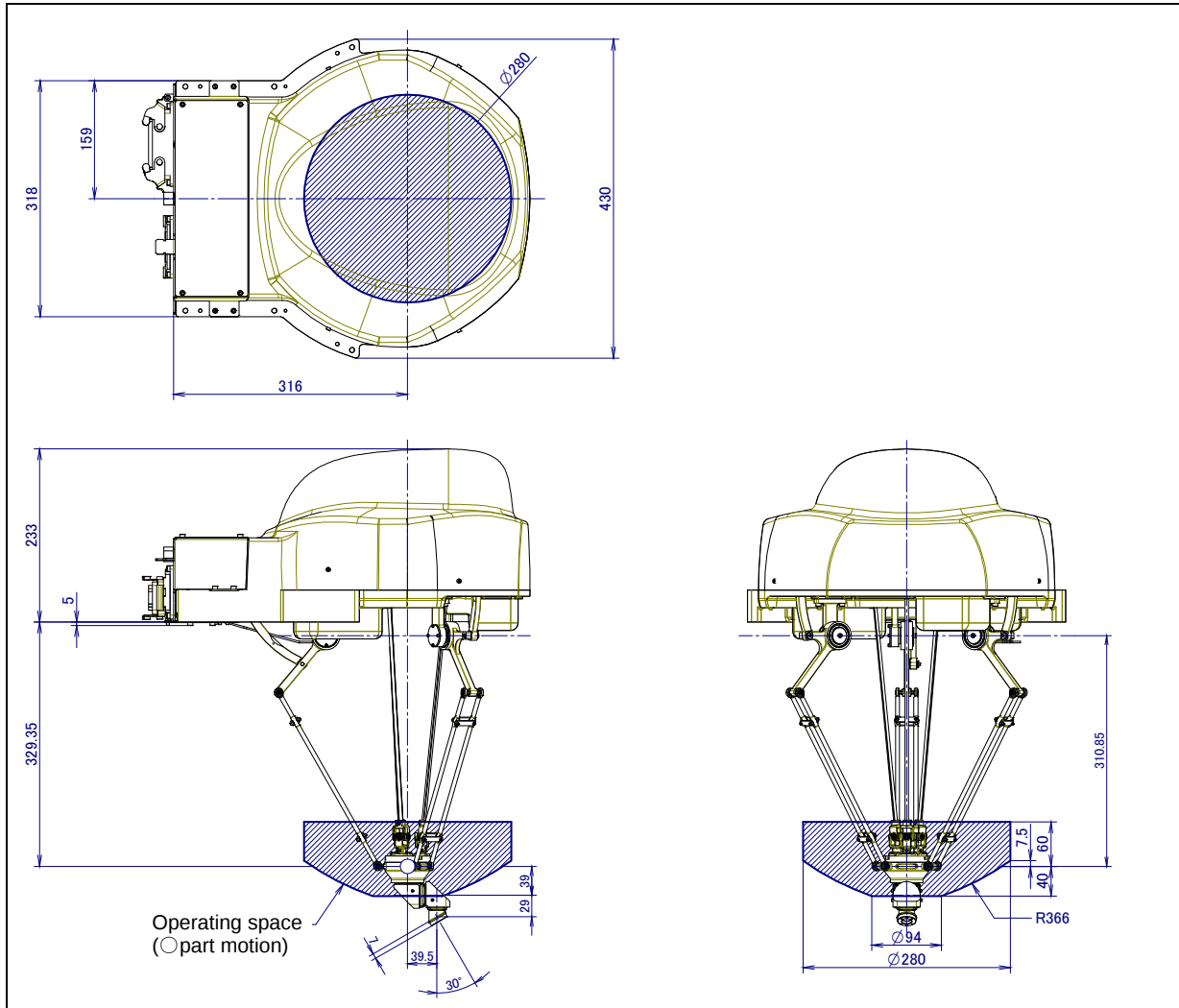


Fig. 3.2 (h) Operating space (M-1iA/0.5A) (no stand B)

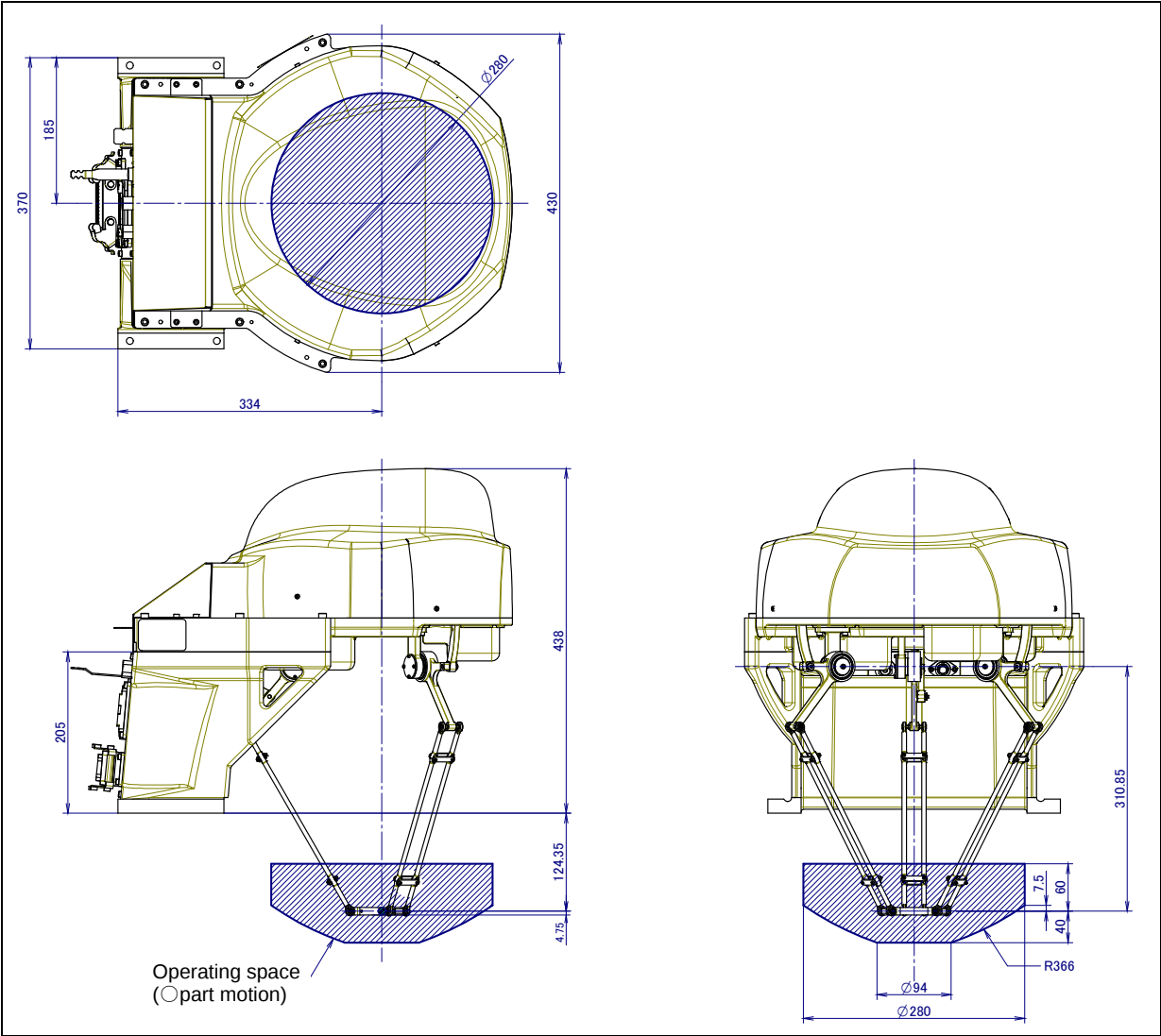


Fig. 3.2 (i) Operating space (M-1iA/1H) (with stand)

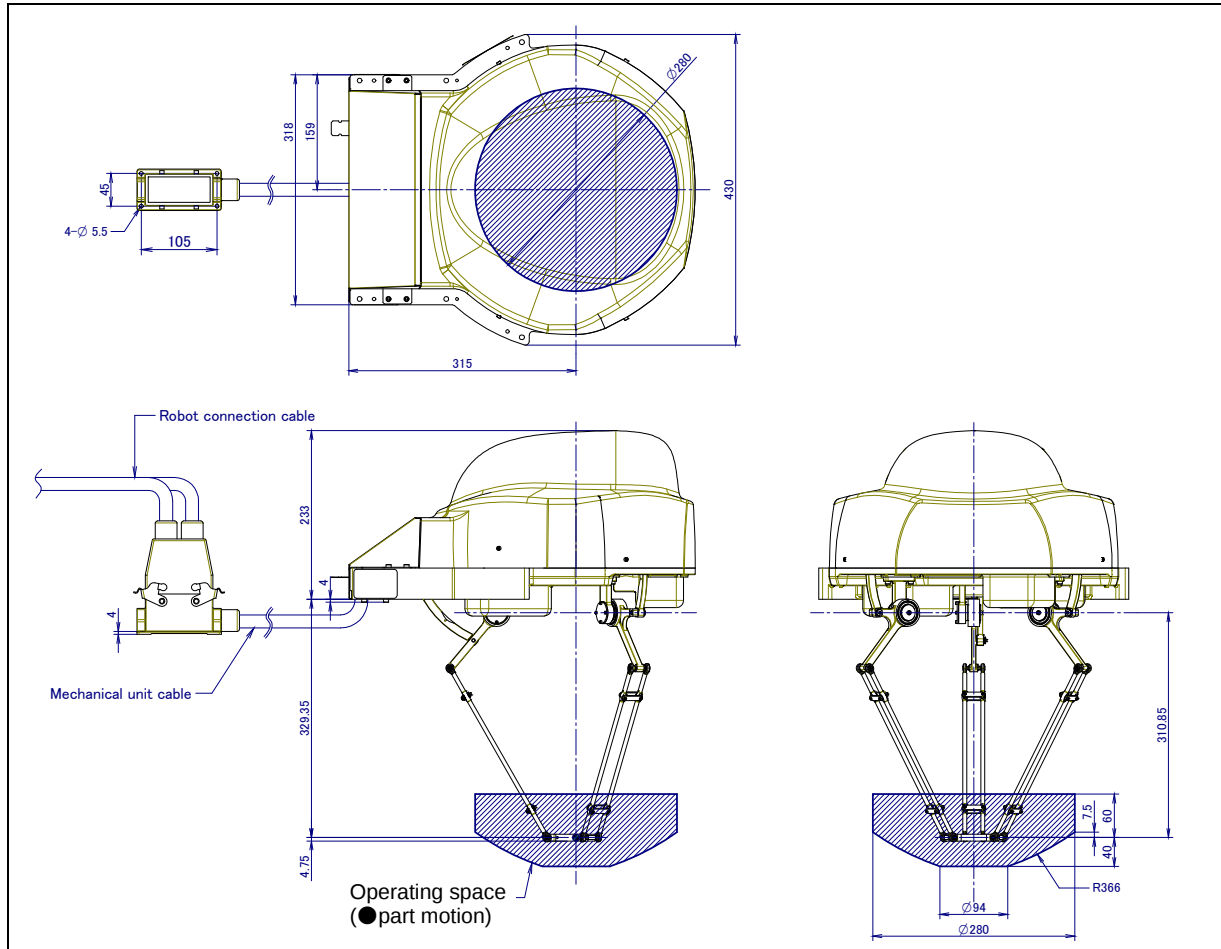


Fig. 3.2 (j) Operating space (M-1iA/1H) (no stand A)

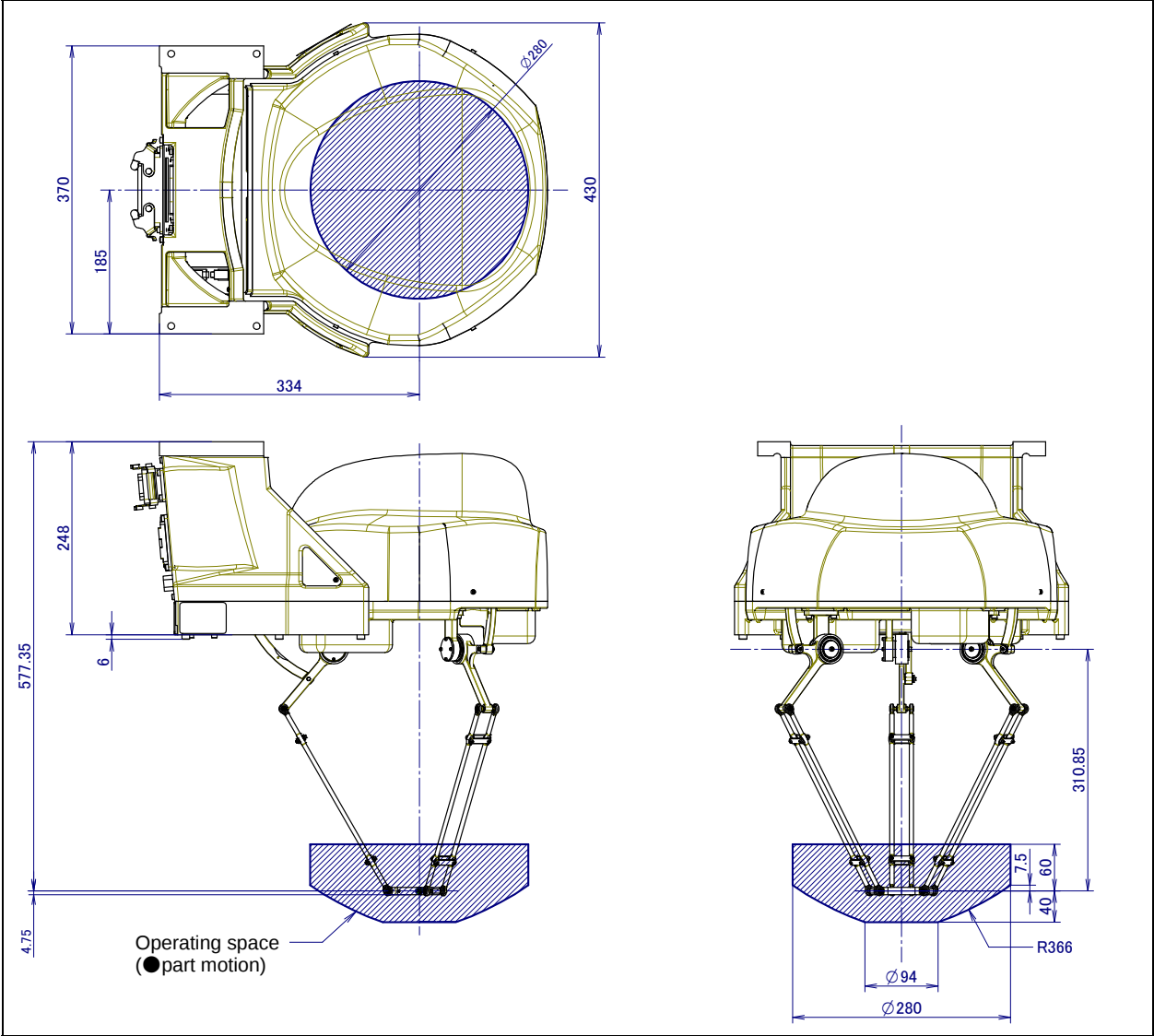


Fig. 3.2 (k) Operating space (M-1i/A/1H) (ceiling mount)

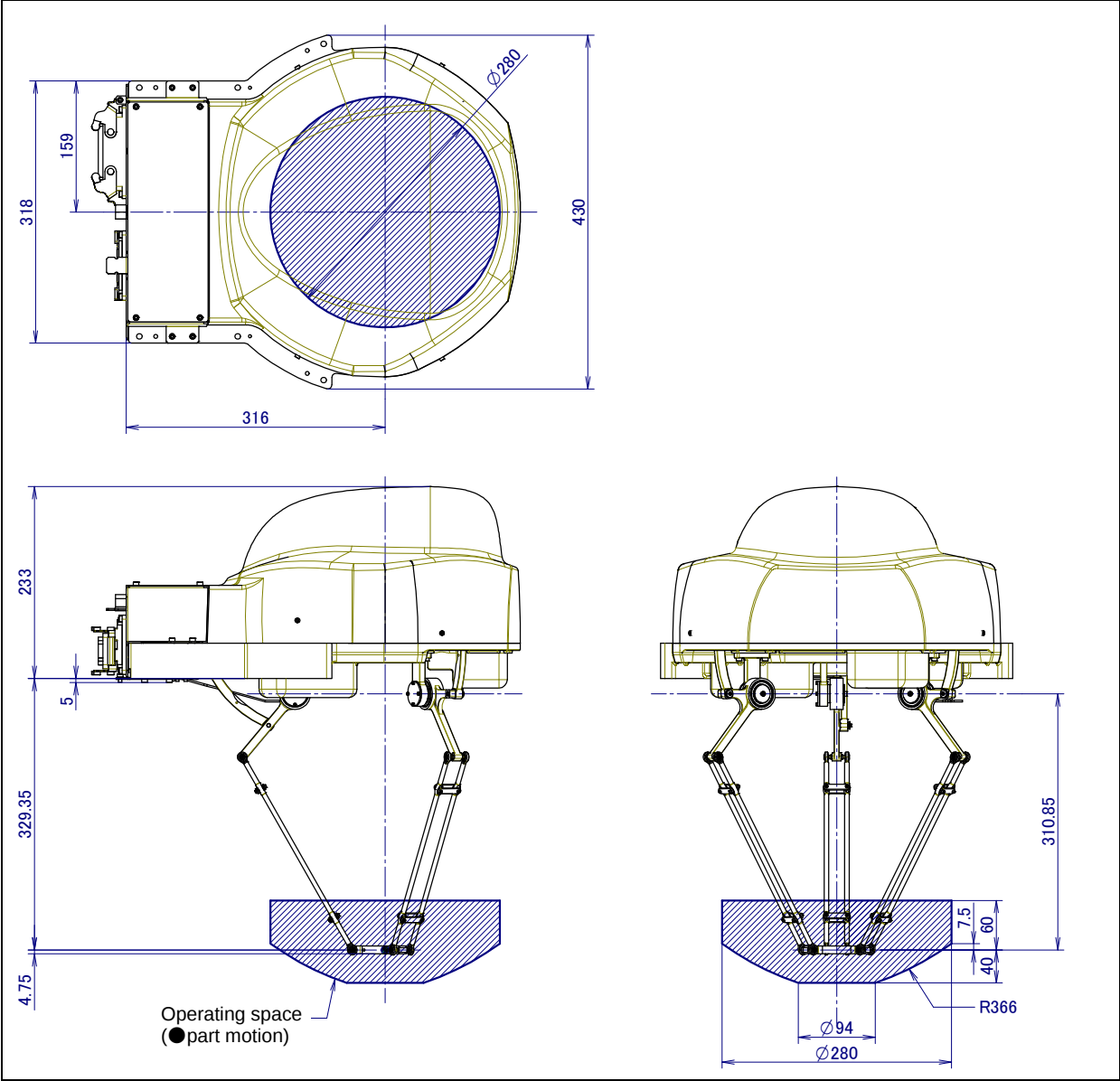


Fig. 3.2 (I) Operating space (M-1iA/1H) (no stand B)

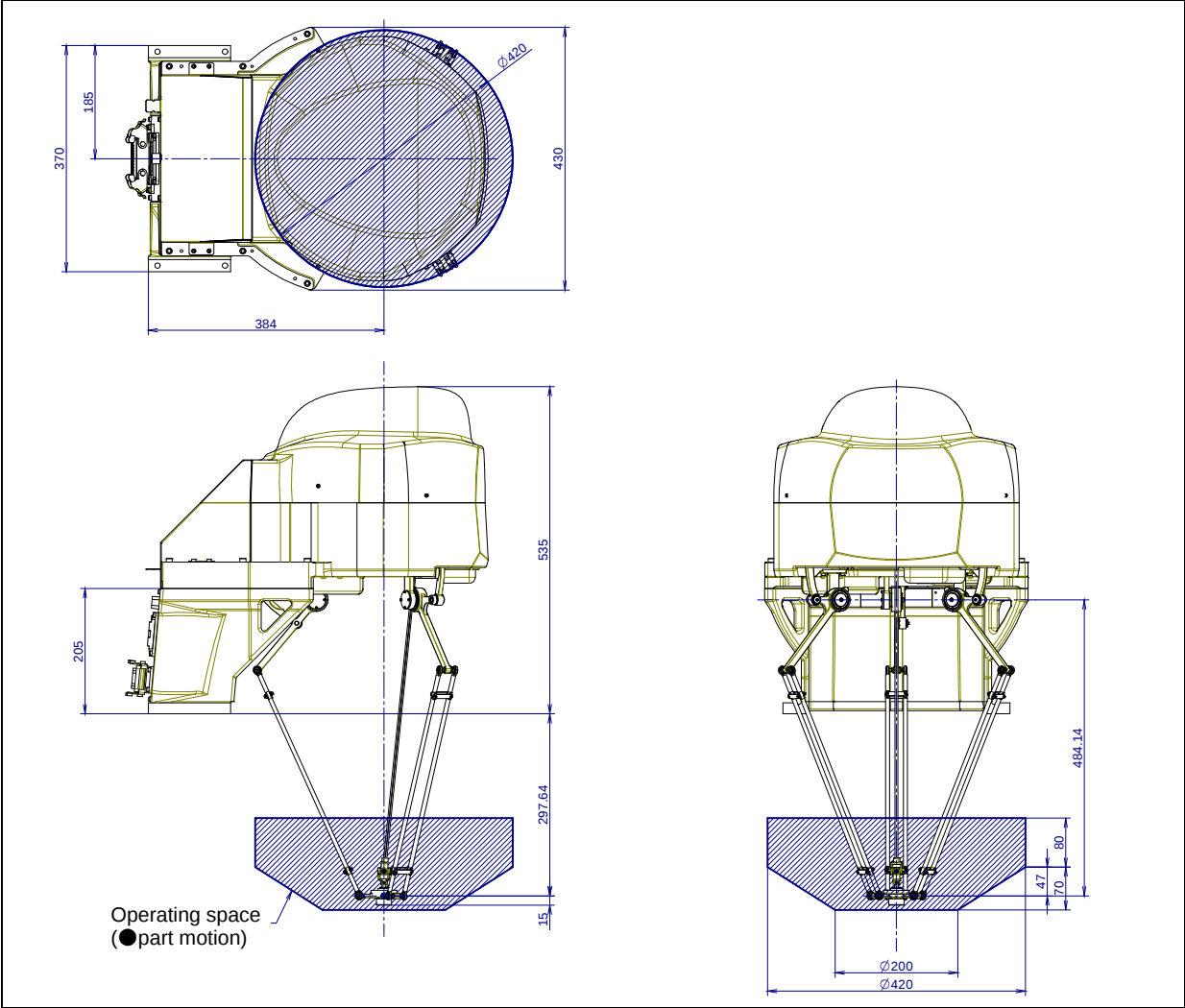


Fig. 3.2 (m) Operating space (M-1iA/0.5SL) (with stand)

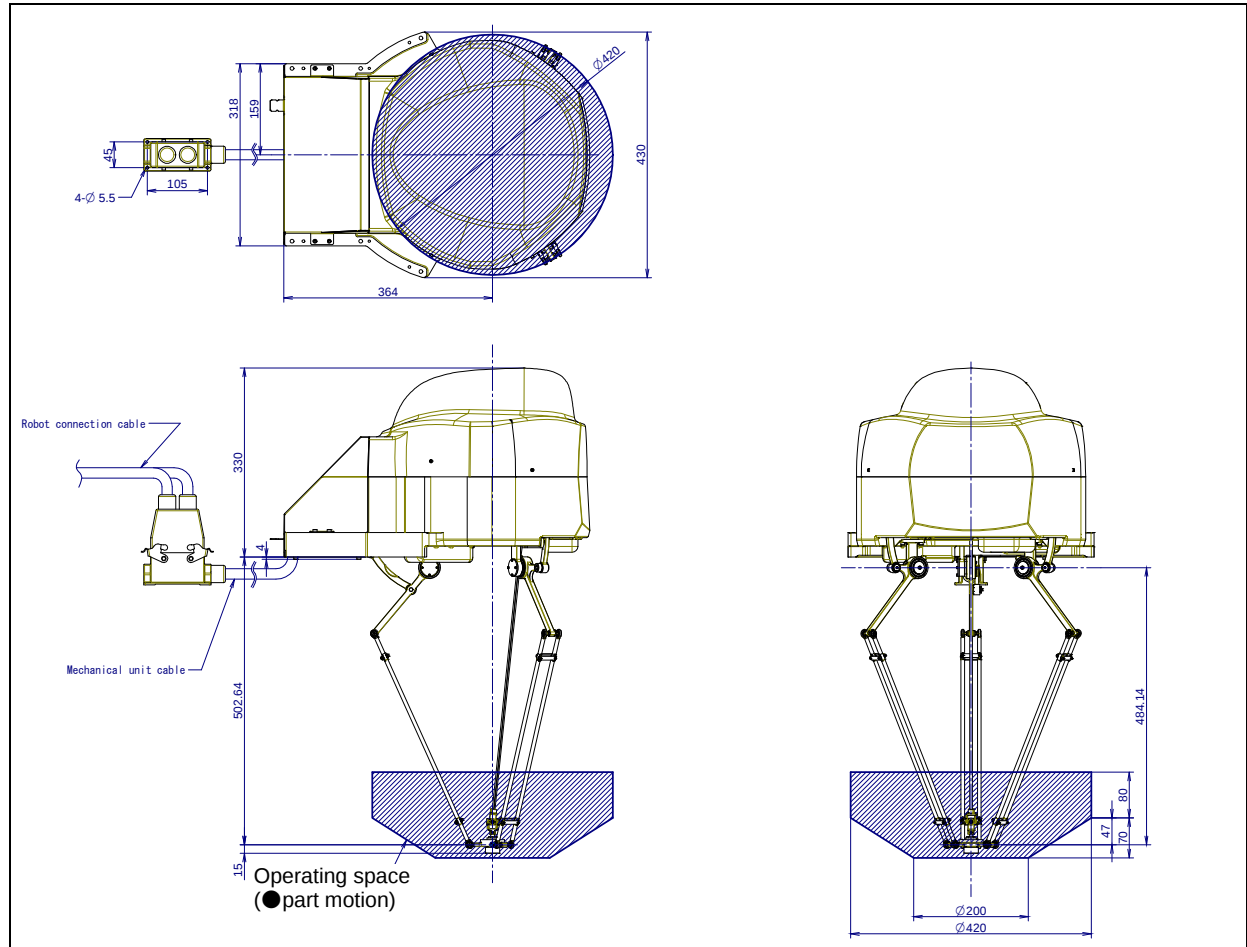


Fig. 3.2 (n) Operating space (M-1iA/0.5SL) (no stand A)

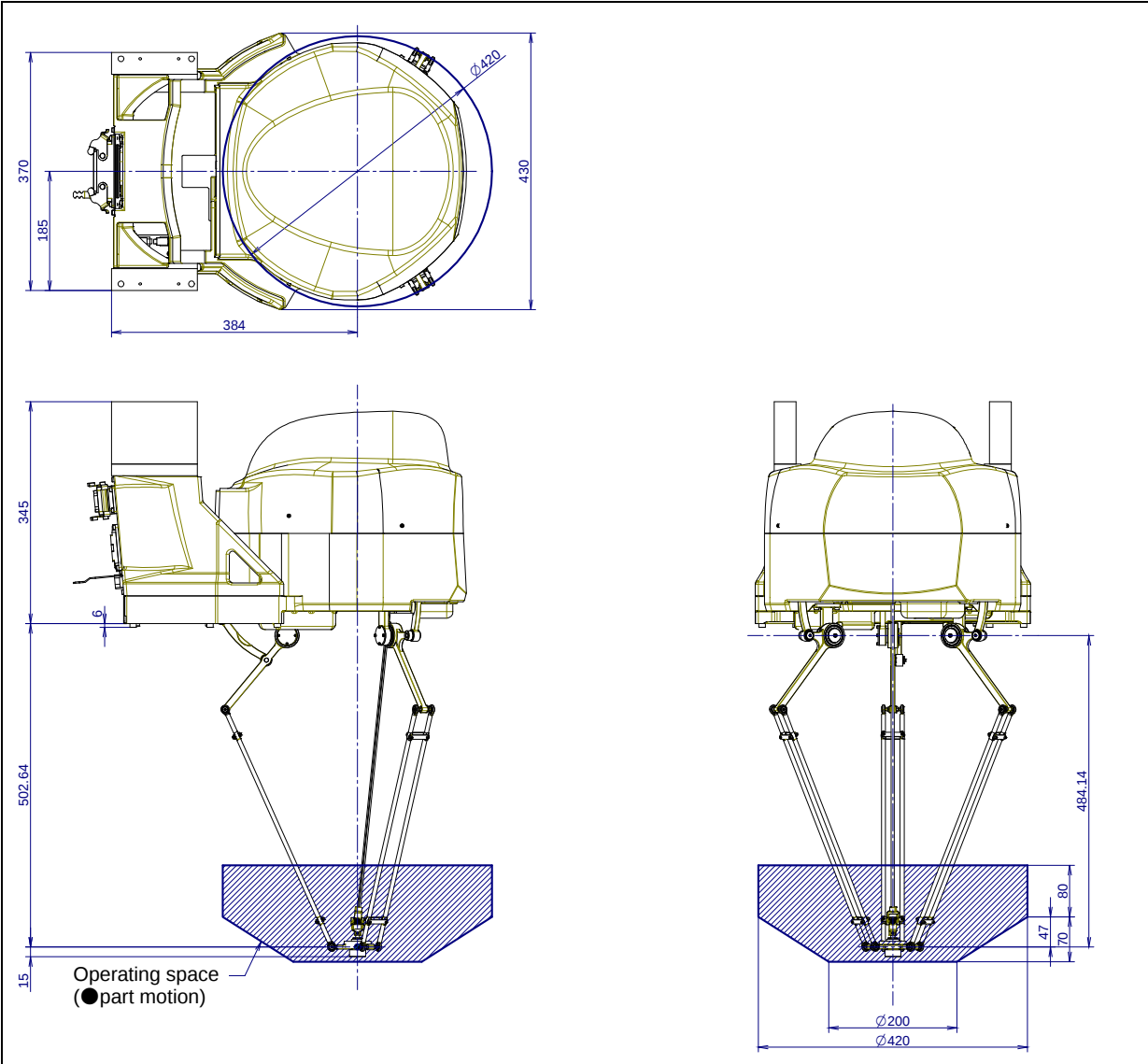


Fig. 3.2 (o) Operating space (M-1iA/0.5SL) (ceiling mount)

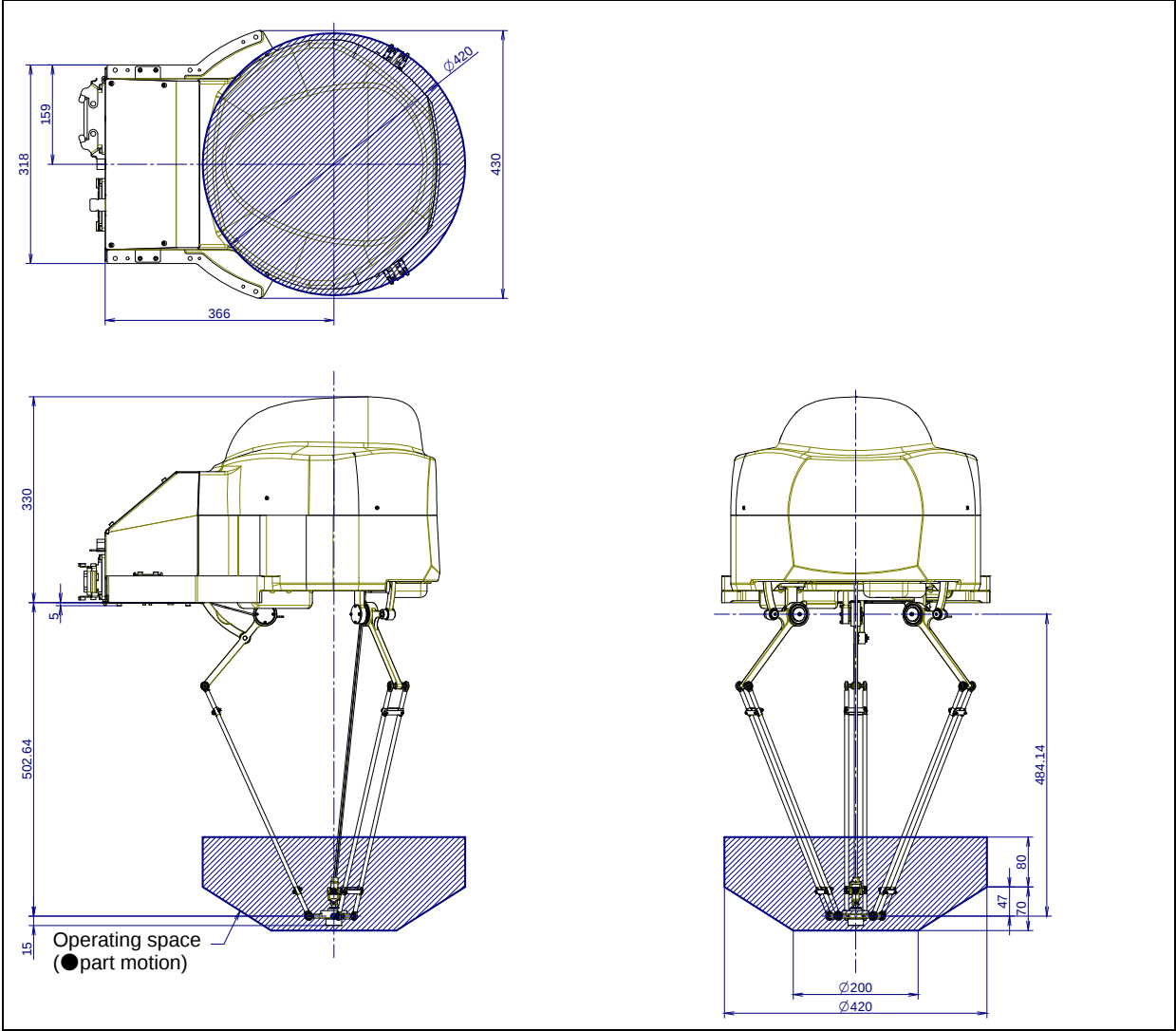


Fig. 3.2 (p) Operating space (M-1iA/0.5SL) (no stand B)

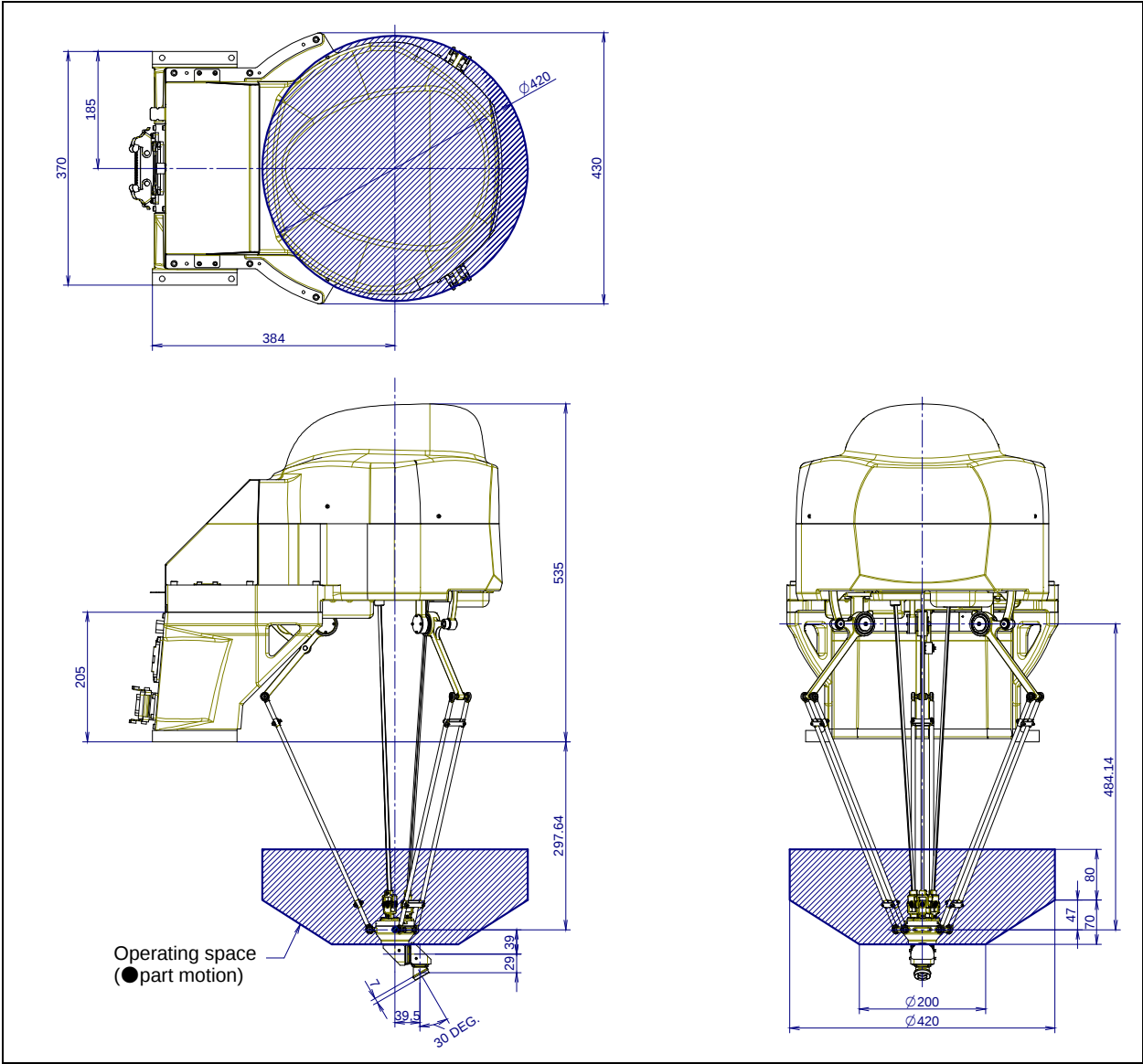


Fig. 3.2 (q) Operating space (M-1iA/0.5AL) (with stand)

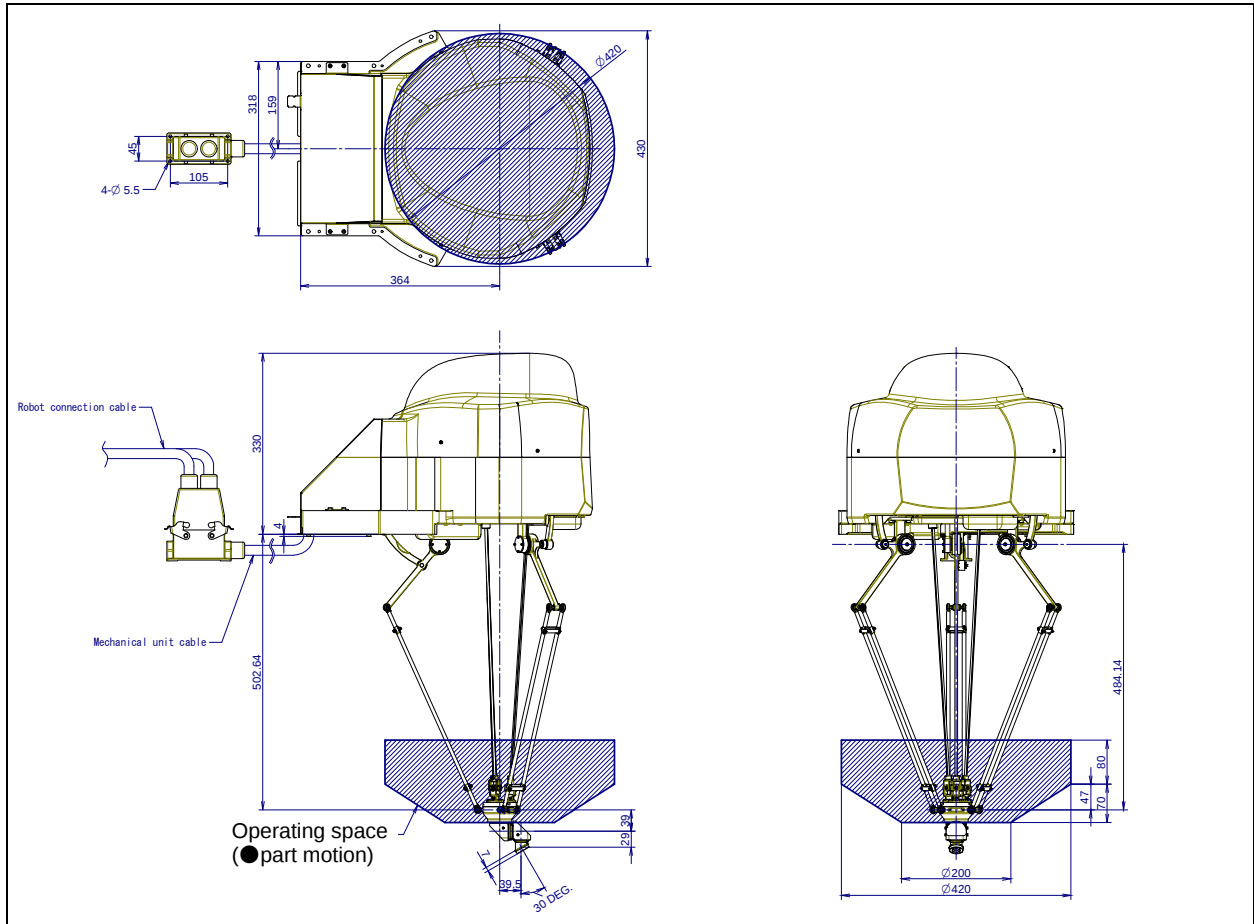


Fig. 3.2 (r) Operating space (M-1iA/0.5AL) (no stand A)

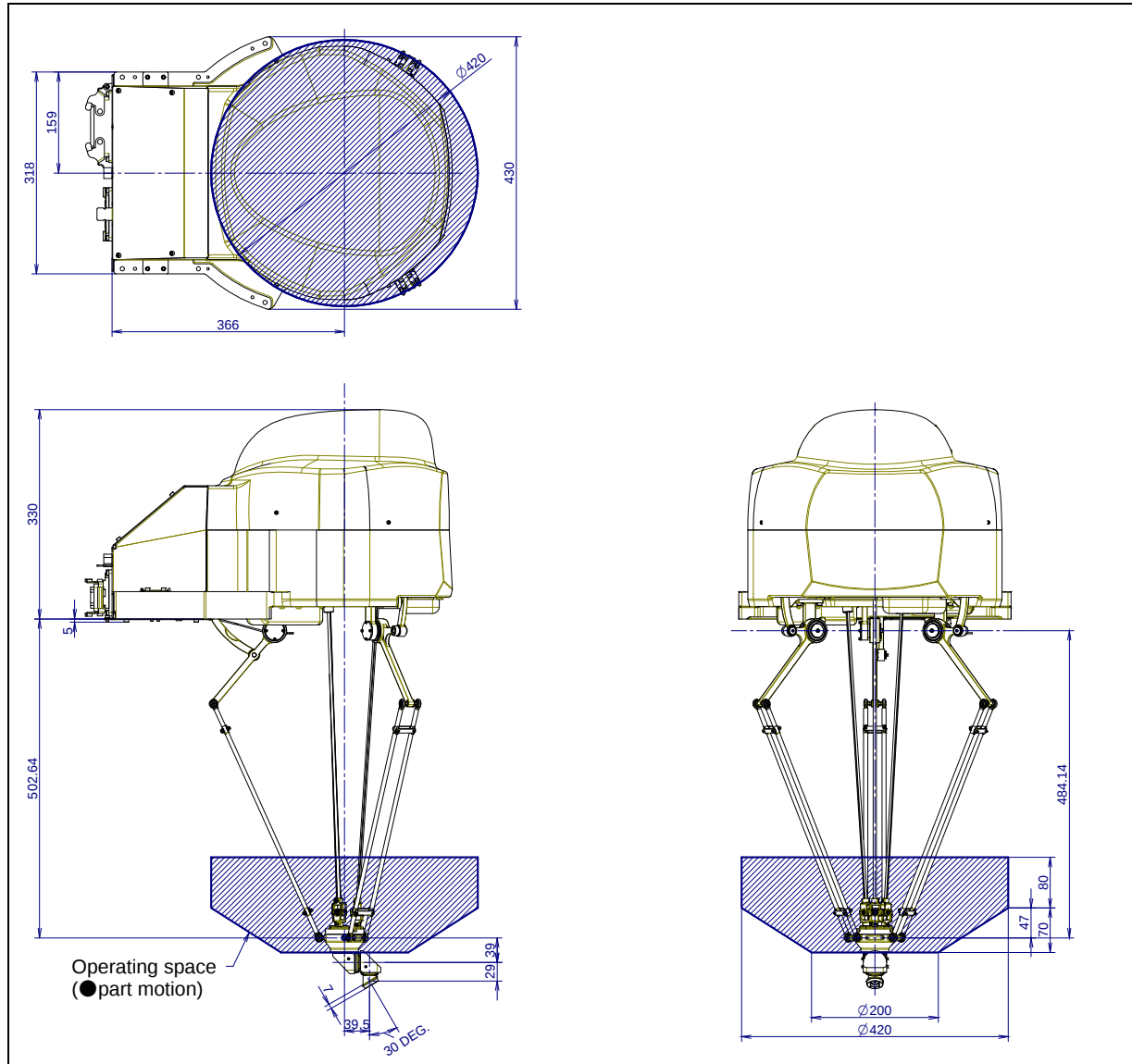


Fig. 3.2 (t) Operating space (M-1i/A/0.5AL) (no stand B)

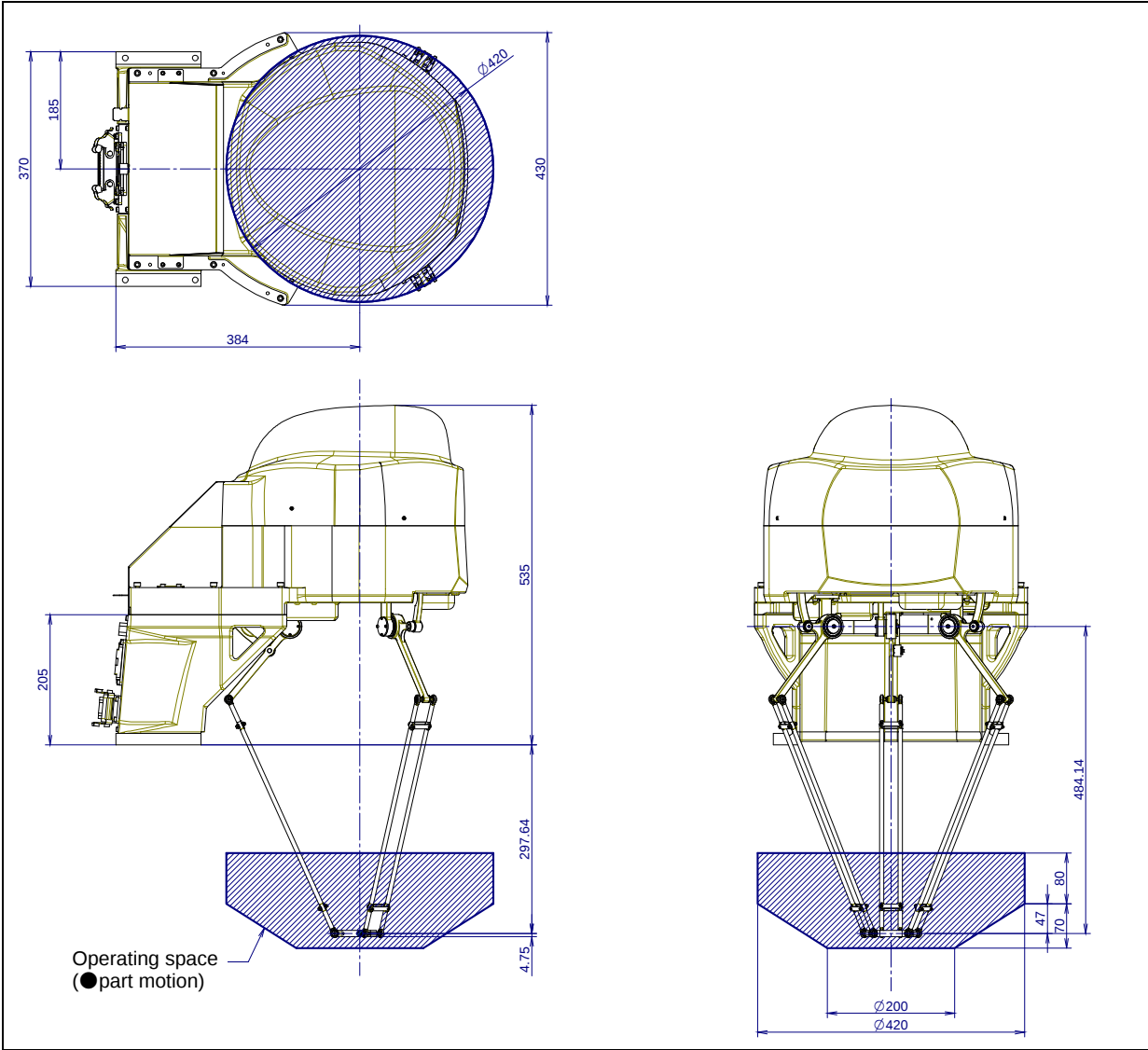


Fig. 3.2 (u) Operating space (M-1i/A/1HL) (with stand)

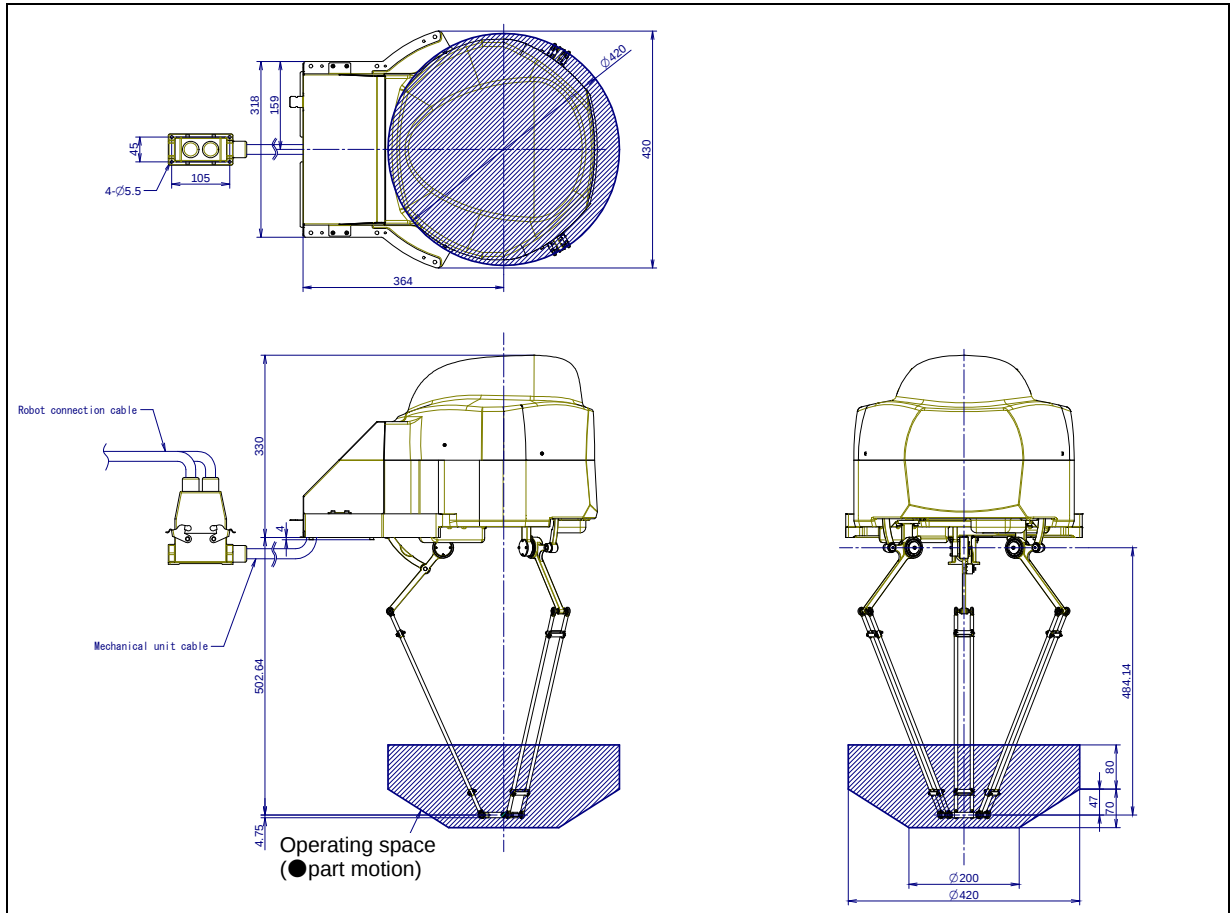


Fig. 3.2 (v) Operating space (M-1iA/1HL) (no stand A)

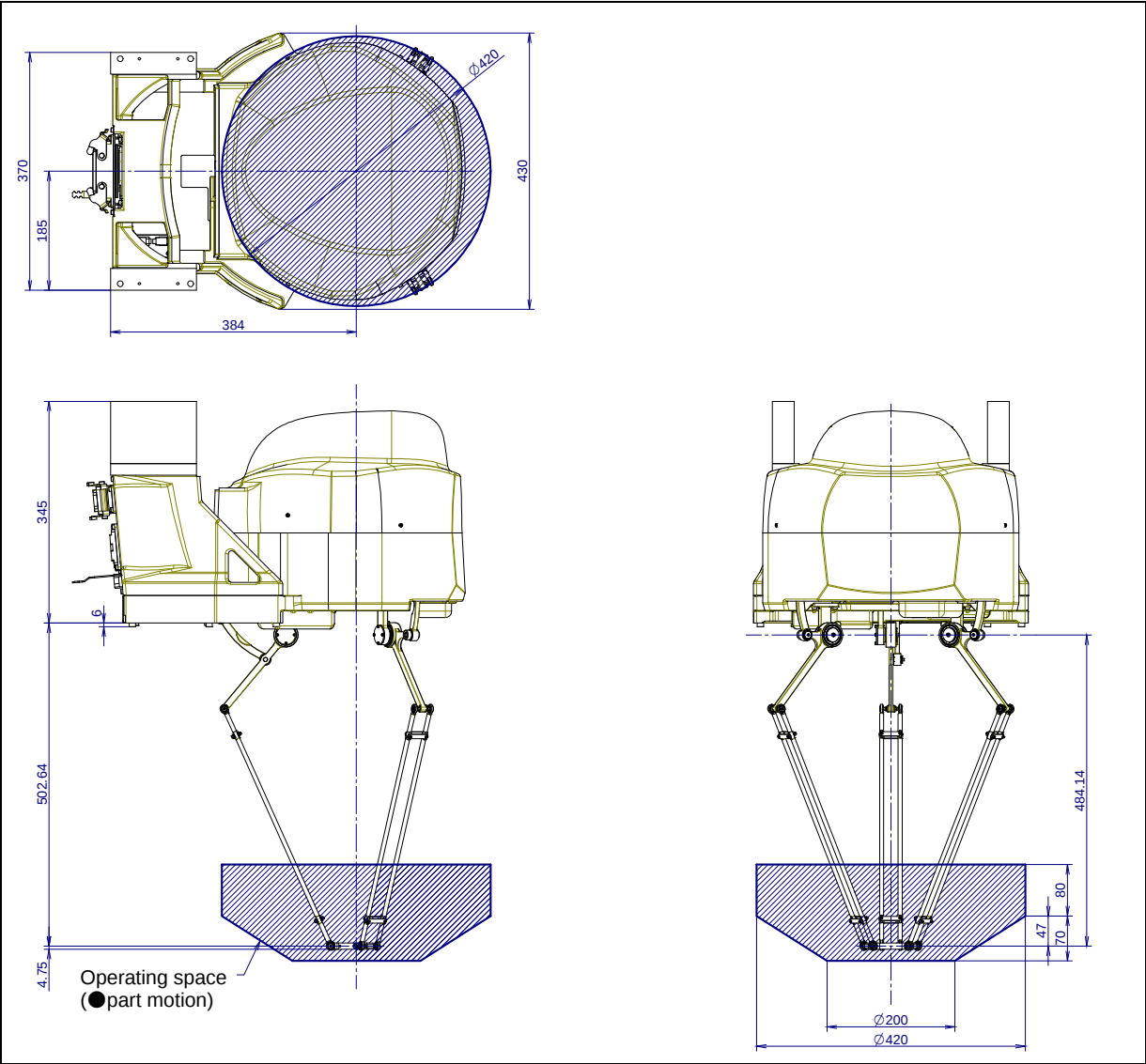


Fig. 3.2 (w) Operating space (M-1iA/1HL) (ceiling mount)

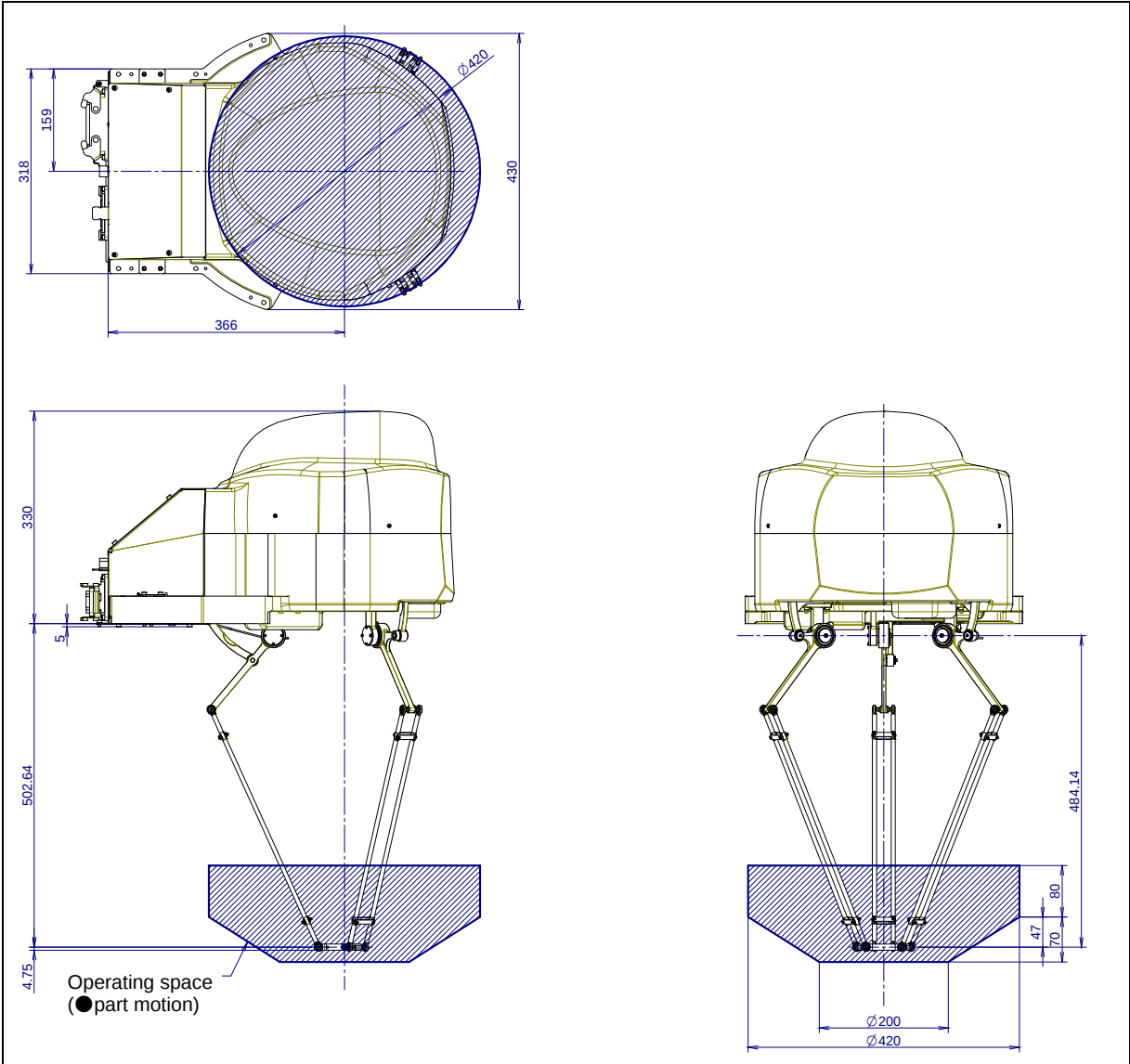


Fig. 3.2 (x) Operating space (M-1i/A/1HL) (no stand B)

3.3 WRIST LOAD CONDITIONS

Fig. 3.3 (a) to (c) are diagrams showing the allowable load that can be applied to the wrist section.

- Apply a load within the region indicated in the graph.
- See Section 4.1 about mounting of end effector.

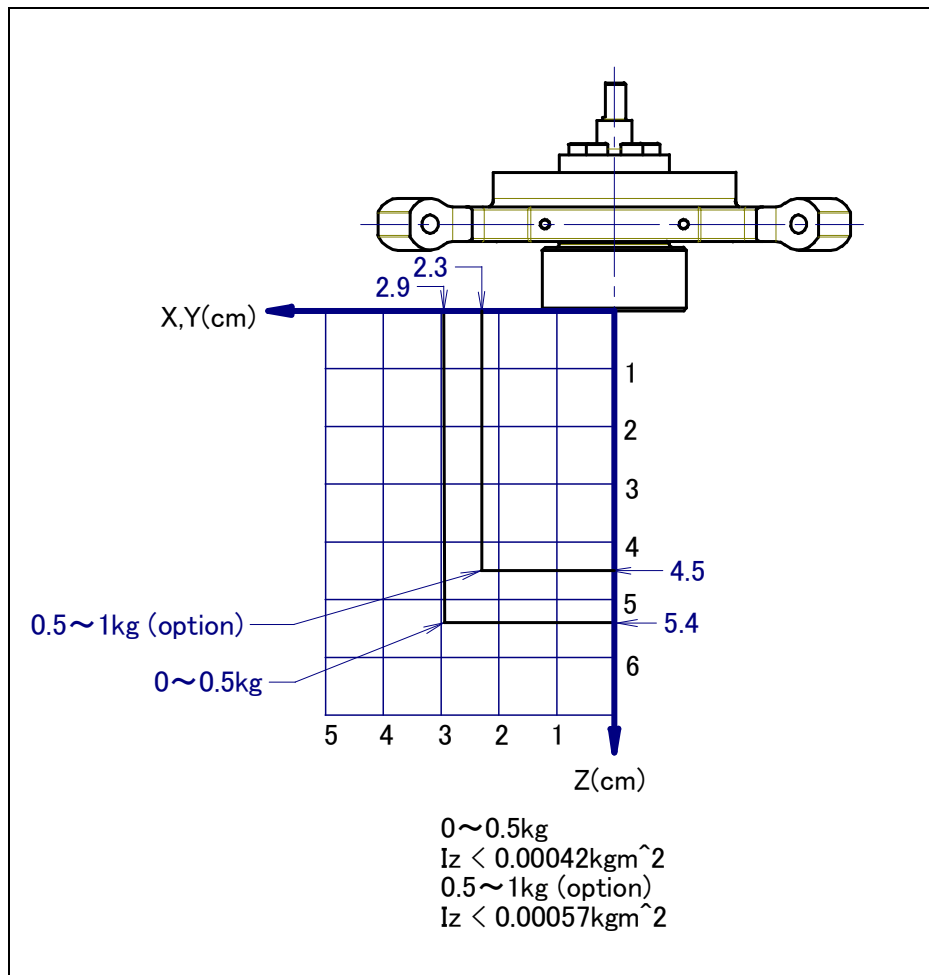


Fig. 3.3 (a) Wrist load diagram (M-1iA/0.5S,0.5SL)

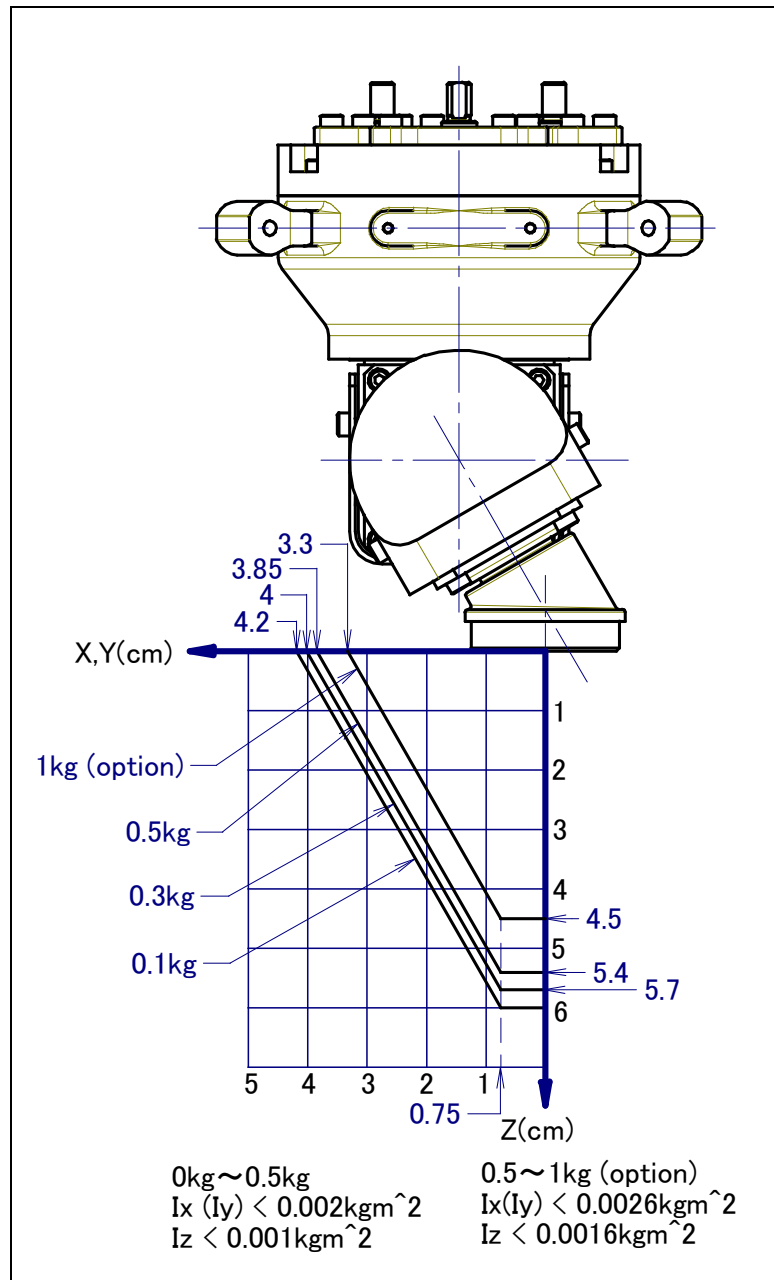


Fig. 3.3 (b) Wrist load diagram (M-1iA/0.5A,0.5AL)

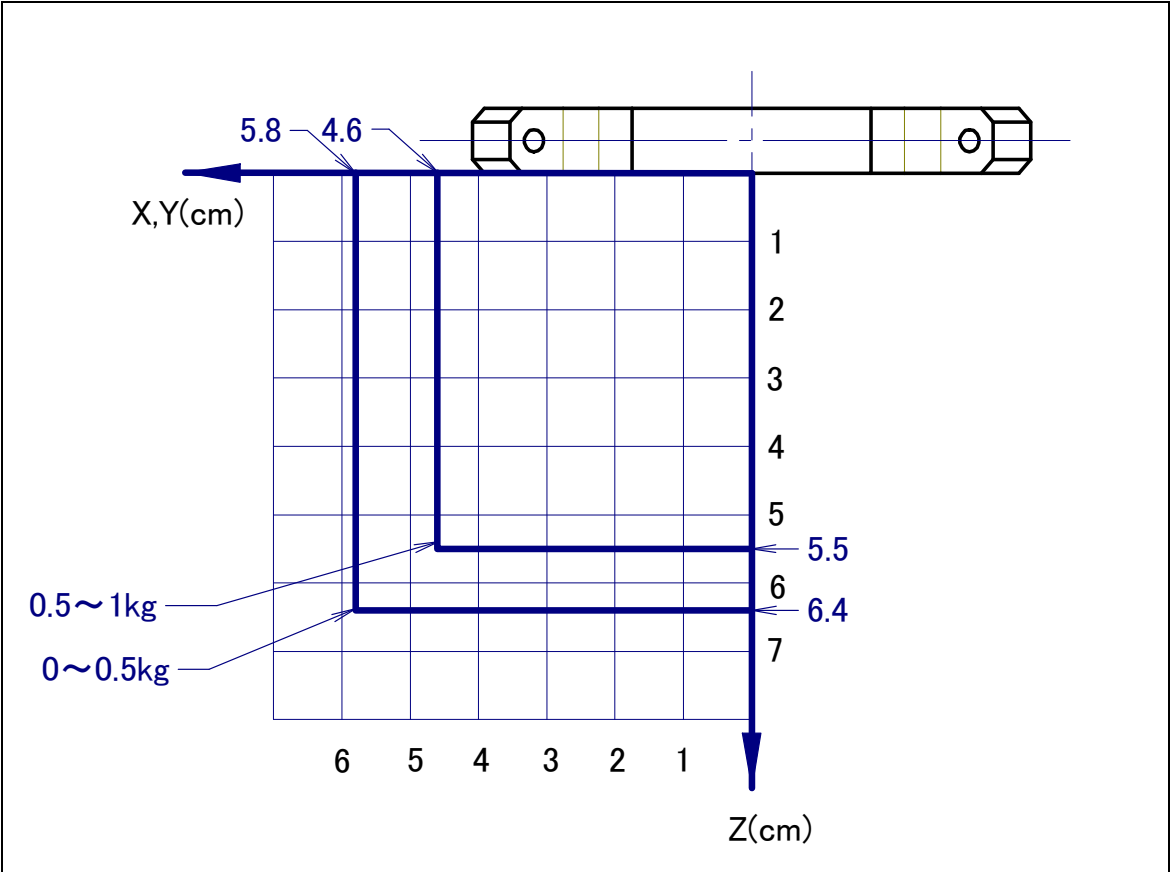


Fig. 3.3 (c) Wrist load diagram (M-1iA/1H,1HL)

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) - (c) are the diagrams for end effector interface dimension. Select screws and positioning pins of a length that matches the depth of the tapped and pin holes. See Appendix B “Bolt tightening torque” about tightening torque.

⚠ CAUTION

- 1 Notice the tooling coupling depth to wrist flange should be shorter than the flange coupling length.
- 2 When installing the end effector or performing maintenance after the installation, take care not to put large moment and load on the wrist.

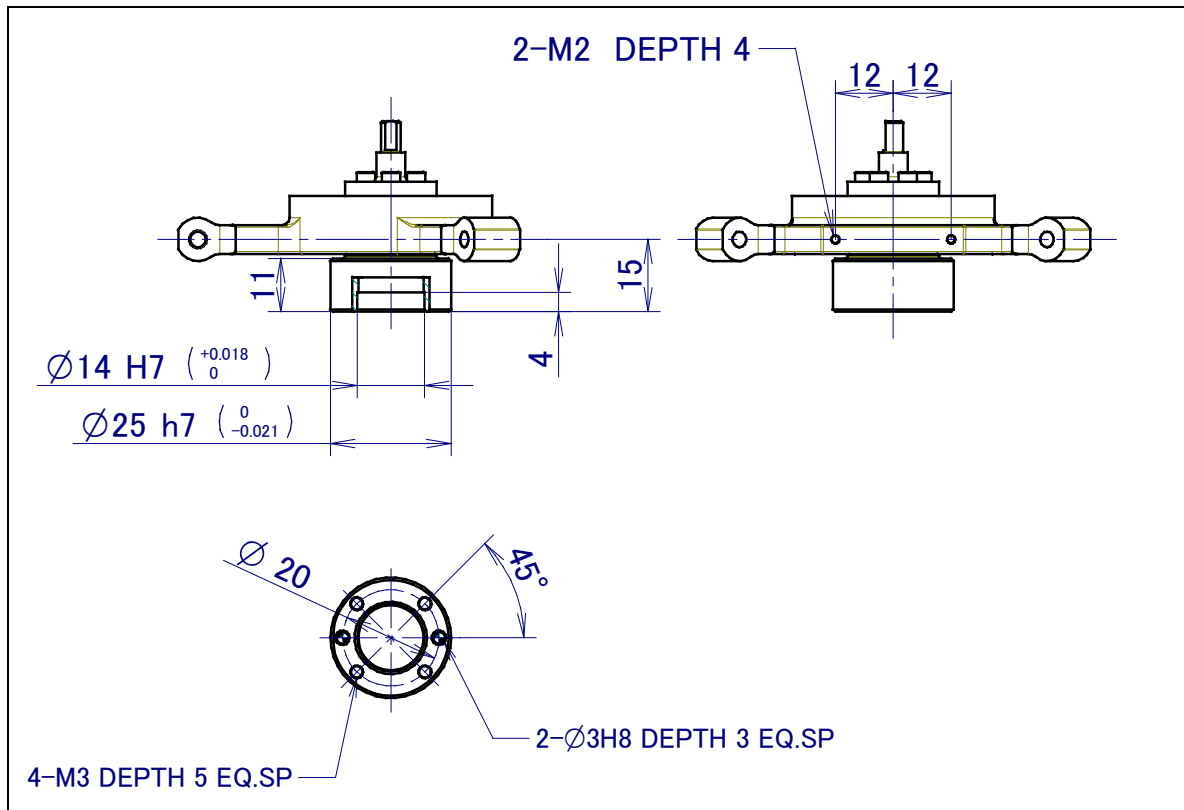


Fig. 4.1 (a) End effector interface dimension (M-1i/A/0.5S,0.5SL)

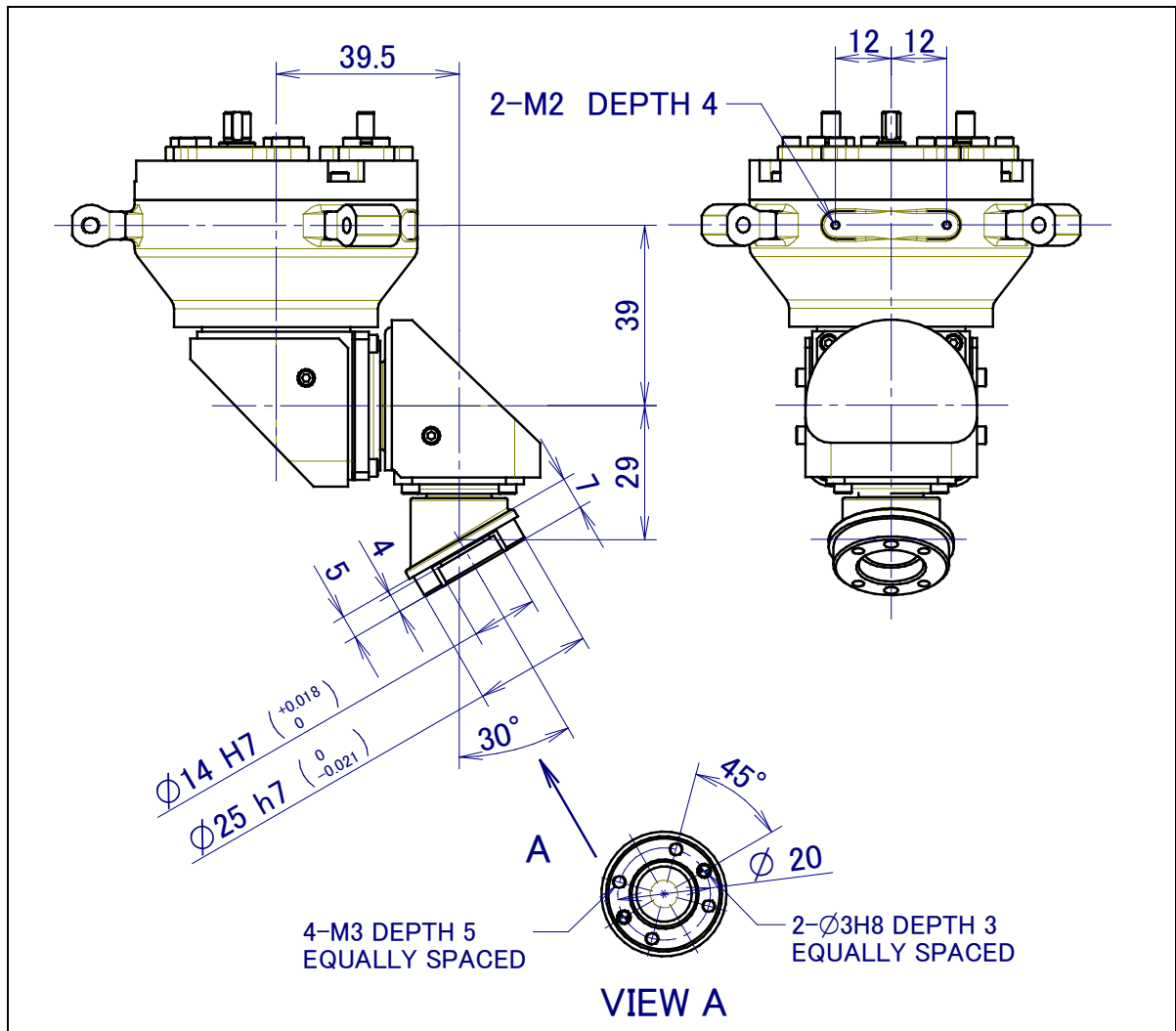


Fig. 4.1 (b) End effector interface dimension (M-1iA/0.5A,0.5AL)

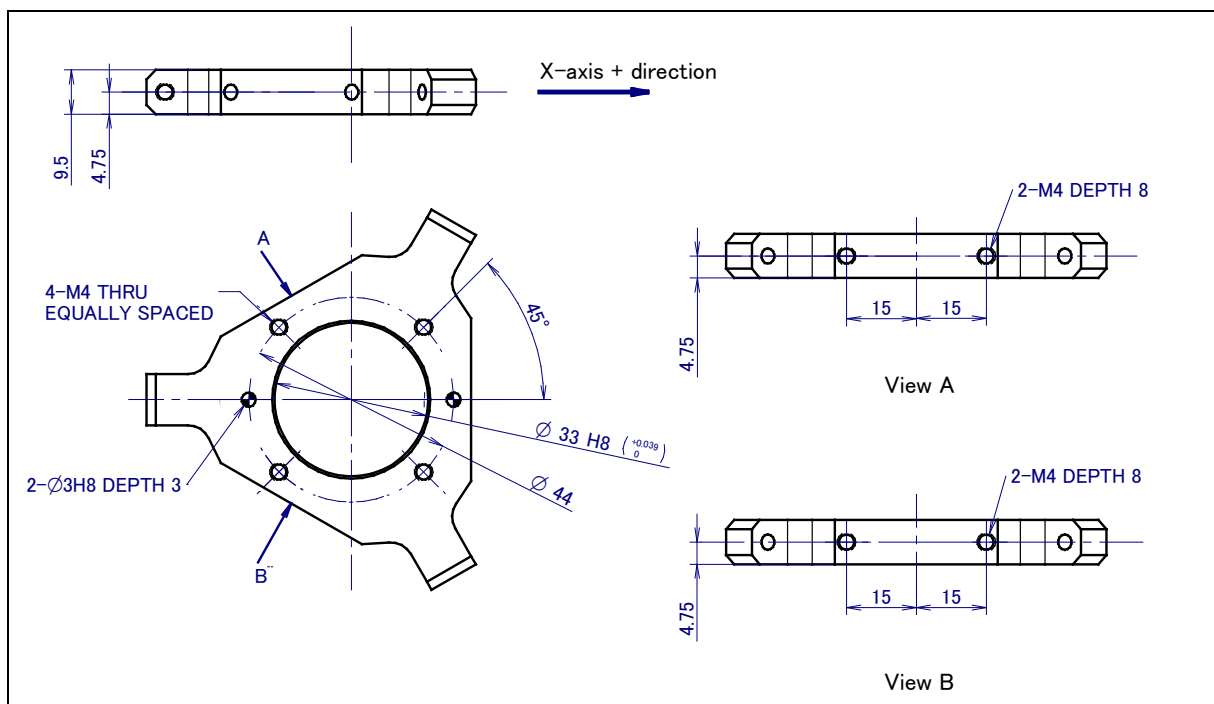


Fig. 4.1 (c) End effector interface dimension (M-1iA/1H,1HL)

4.2 LOAD SETTING

NOTE

Remember to set load condition parameter. Otherwise, there is a possibility that trouble occurs such as reducer life reduction. Don't exceed allowable payload including connection cables and its swing.

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

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

MOTION PERFORMANCE		JOINT	10 %
Group1			
No.	PAYLOAD[kg]	Comment	
1	0.50	[	]
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	DETIAL	ARMLOAD SETTND>
IDENT		>	

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

MOTION PAYLOAD SET			JOINT	100 %
Group1				
1	Schedule No [1]:	[Comment]		
2	PAYLOAD	[kg]		0.50
3	PAYLOAD CENTER X	[cm]		0.7654
4	PAYLOAD CENTER Y	[cm]		0.00
5	PAYLOAD CENTER Z	[cm]		5.4484
6	PAYLOAD INERTIA X	[kgfcms ²]		2.0972
7	PAYLOAD INERTIA Y	[kgfcms ²]		2.3716
8	PAYLOAD INERTIA Z	[kgfcms ²]		1.421
[TYPE] GROUP NUMBER DEFAULT HELP				

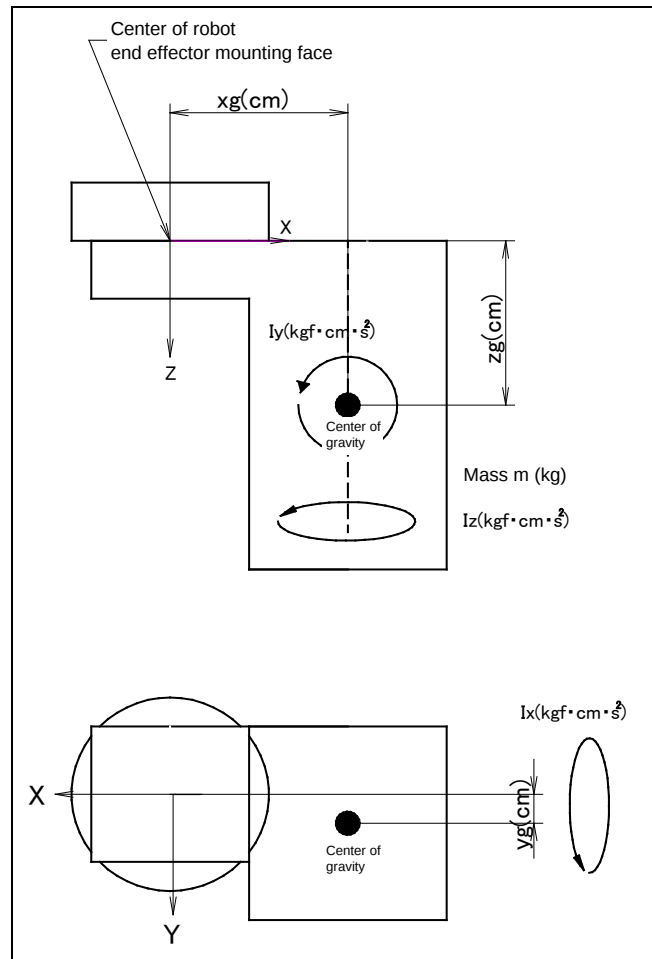


Fig. 4.2 Standard tool coordinate

- 6 Set the payload, gravity center position, and inertia around the gravity center on the MOTION PAYLOAD SET screen. The X, Y, and Z directions displayed on this screen correspond to the respective standard tool coordinates (with no tool coordinate system set up). When values are entered, the following message appears: “Path and Cycletime will change. Set it?” Respond to the message with F4 ([YES]) or F5 ([NO]).
- 7 Press F3 ([NUMBER]) will bring you to the MOTION PAYLOAD SET screen for another condition
- 8 Press [PREV] key to return to the list screen. Press F5 SETIND, and enter a desired load setting condition number.

4.3 JOINT COVER (OPTION) (M-1iA/0.5S, 0.5A, 1H)

It is possible to diminish the generation of the abrasion powder by installing the joint cover (option) as shown in Fig.4.3. This option is not for server dust/liquid protection. Please be careful.

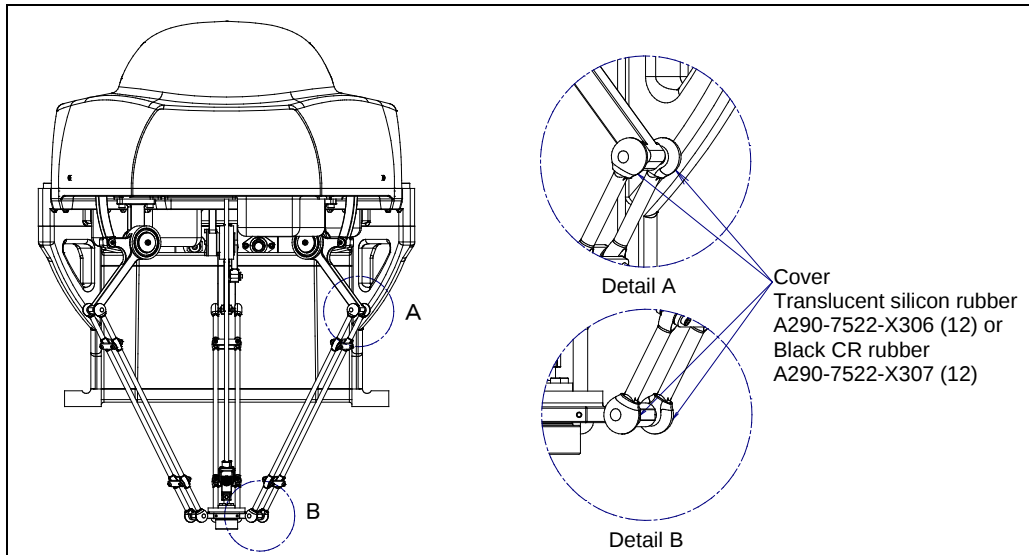


Fig. 4.3 Joint cover

5 PIPING AND WIRING TO THE END EFFECTOR



WARNING

- Use mechanical unit cables that have required user interface.
- Do not add user cable or hose to inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit cable when cables are added to outside of mechanical unit.
- Please do not perform remodeling (adding a protective cover, or fixing an additional outside cable) that obstructs the behavior of the outcrop of the cable.
- When an external equipment is installed in the robot, make sure that it does not interfere with other parts of the robot.
- Cut unnecessary length of wire rod of end effector (hand) cable. Make insulation processing like winding acetate tape.
- If you cannot prevent electrostatic charge of work and end effector, keep away an end effector (a hand) cable from an end effector and a work as much as possible, when wiring it. When they come too close unavoidably, insulate the cable from the end effector and work.
- Be sure to seal the connectors of hand side and robot side and terminal parts of cables, to prevent water from entering the mechanical unit. Also, attach the cover to unused connector.
- Check that connectors are tight and cable jackets are not damaged routinely.
- When precautions are not followed, damage to cables might occur. Cable failure may result in incorrect function of end effector, robot faults, or damage to robot electrical hardware. In addition, electric shock could occur when touching the power cables.

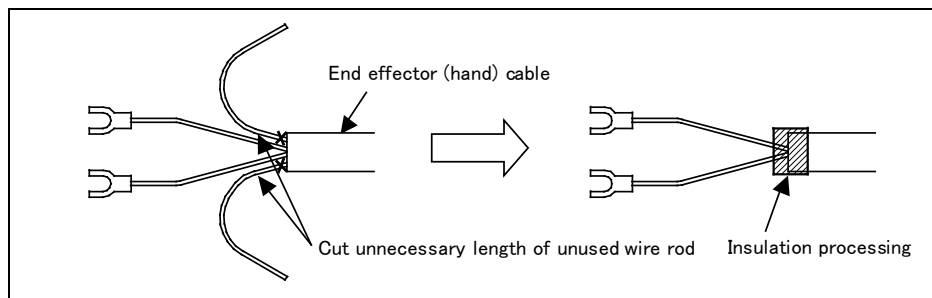


Fig.5 Treatment method of end effector (hand) cable

5.1 AIR SUPPLY AND EE(RI) INTERFACE (OPTION)

Fig.5.1 shows the position of air supply and EE interface position and pin layout.

Optional solenoid valves can be mounted as shown in Table 5.1(a). Plugs are inserted in all the ports used for supplying air before the robot is shipped. To use the air circuit, you must remove the plugs and connect the couplings with the ports.

When the solenoid valve is to be replaced, the entire manifold should be replaced.

Table 5.1(a) Optional solenoid valves

Option spec.	Description	Solenoid (Manifold) spec	Remarks	RO
A05B-1522-J001	Double solenoids X1	A97L-0218-0121#D1 (manufactured by SMC)	2 positionX1	RO1 to 2
A05B-1522-J002	Double solenoids X2	A97L-0218-0121#D2 (manufactured by SMC)	2 positionX2	RO1 to 4
A05B-1522-J003	Double solenoids X3	A97L-0218-0121#D3 (manufactured by SMC)	2 positionX3	RO1 to 6

Available section area of the solenoid valve : 1.98mm² (CV value : 0.11)

NOTE

- 1 The connector to be plugged into the interface and the cable attached to that connector should be prepared by the customer.
- 2 When the robot is shipped, a cap is mounted on the end effector interface. When the interface is not used, mount the cap on the interface.

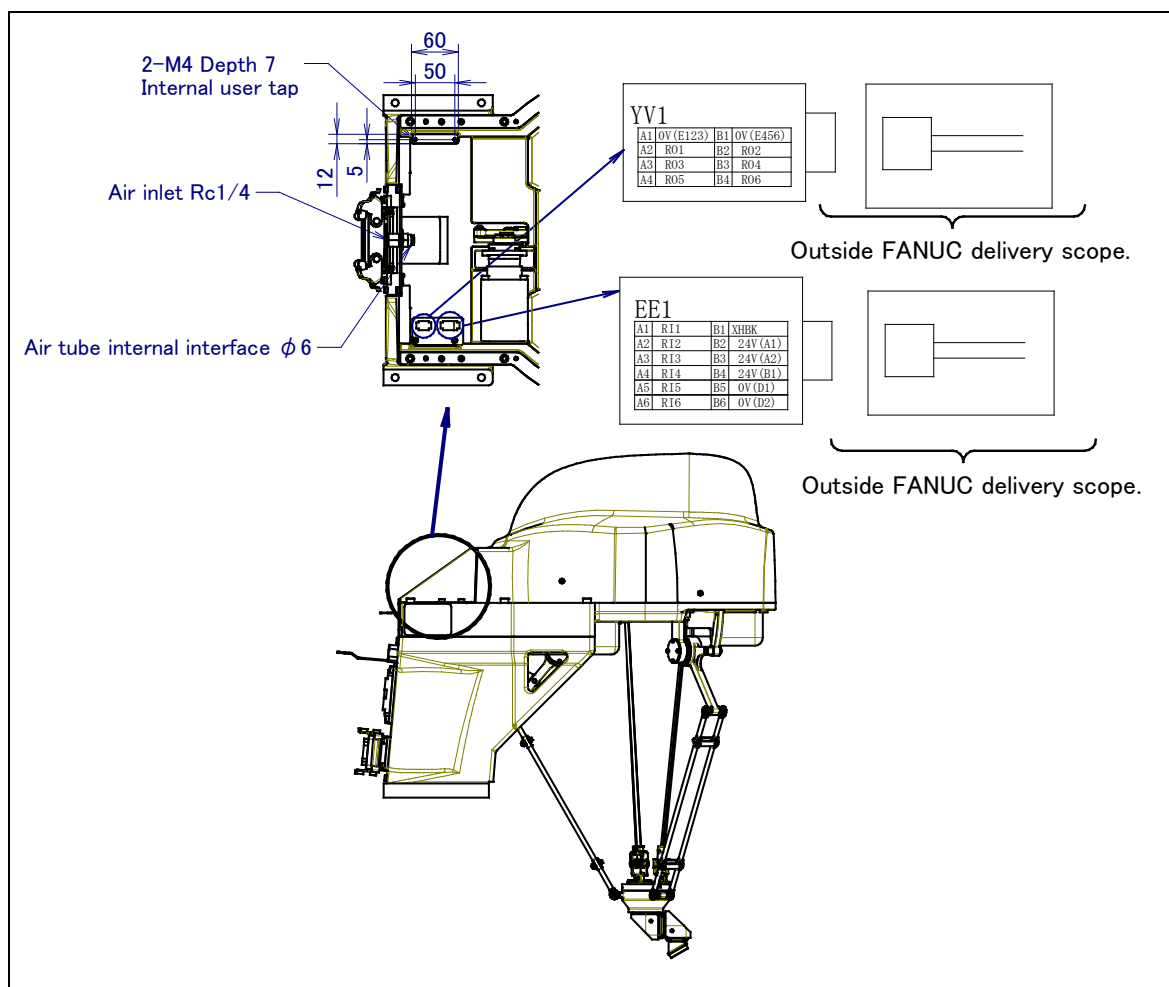


Fig. 5.1 (a) Air supply and EE (RI) interface

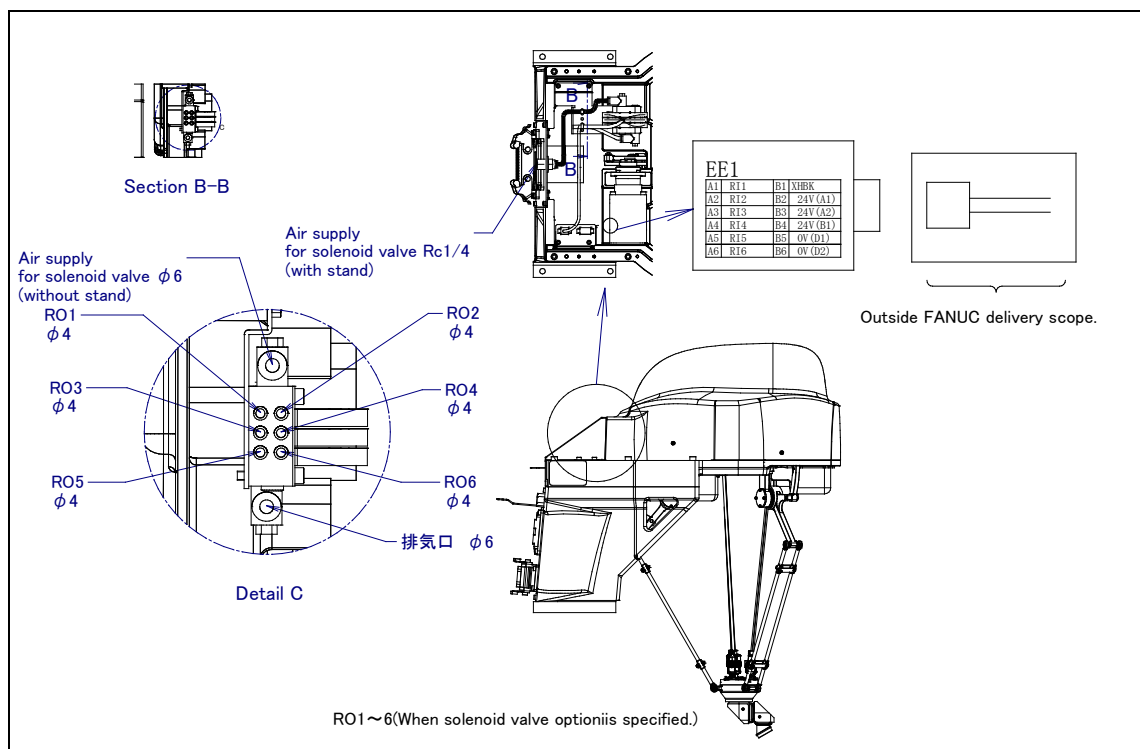


Fig. 5.1 (b) Air supply and EE (RI) interface (When solenoid valve option is specified.)

**CAUTION**

For wiring of the peripheral device to the EE interface, refer to the Chapter 4 of manuals below, too.

R-30iA Mate Controller Maintenance Manual B-82725EN

R-30iA Mate Controller Maintenance Manual B-82965EN-1

R-30iB Mate Controller Maintenance Manual B-83525EN

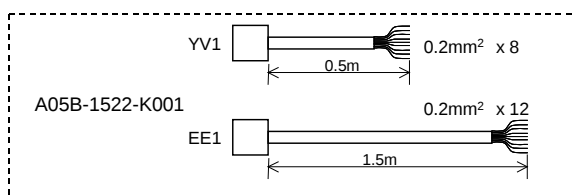
R-30iB Mate Controller Maintenance Manual B-83555EN

Connector specifications

Table 5.1(b) Supported connectors (user side)

Maker/Dealer	MAKER SPEC			FANUC SPEC	Q'tt
TYCO ELETORONICS AMP CO. Ltd	YV1	CONNECTOR	1-1827864-4	A63L-0002-0066#R08DX	1
		CONTACT	1827587-2	A63L-0002-0066#CRMB	8
	EE1	CONNECTOR	1-1827864-6	A63L-0002-0066#R12DX	1
		CONTACT	1827587-2	A63L-0002-0066#CRMB	12

Below is prepared as option cable kit.

**NOTE**

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

Fig. 5.1 (c) shows window for user free cabling.

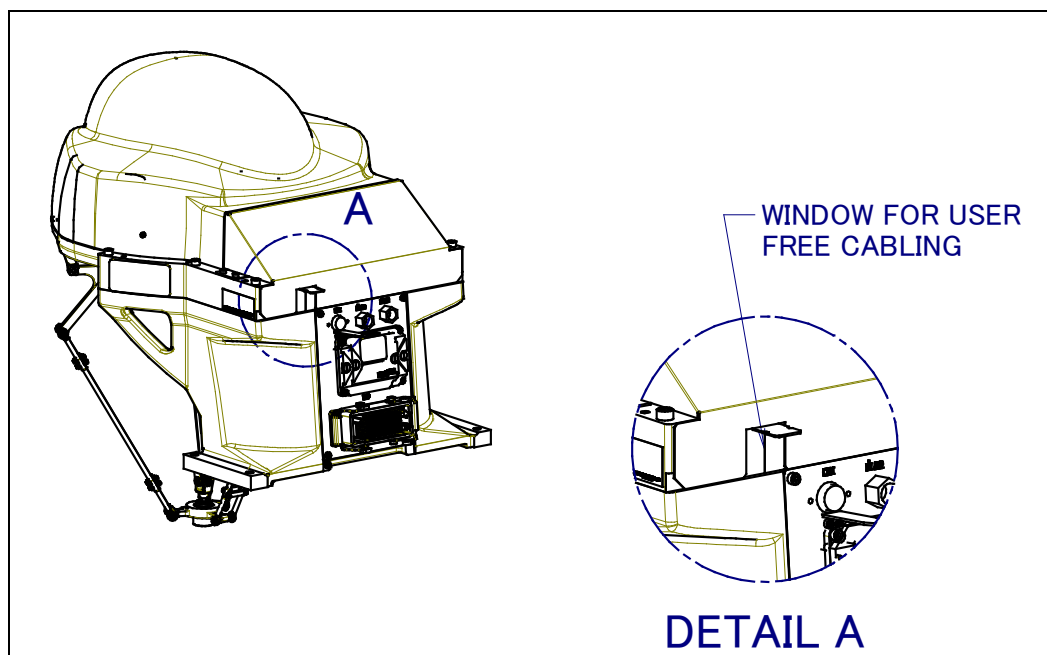


Fig. 5.1 (c) Window for user free cabling

Fig. 5.1 (d) shows wiring method of wiring along user piping and wiring tag.

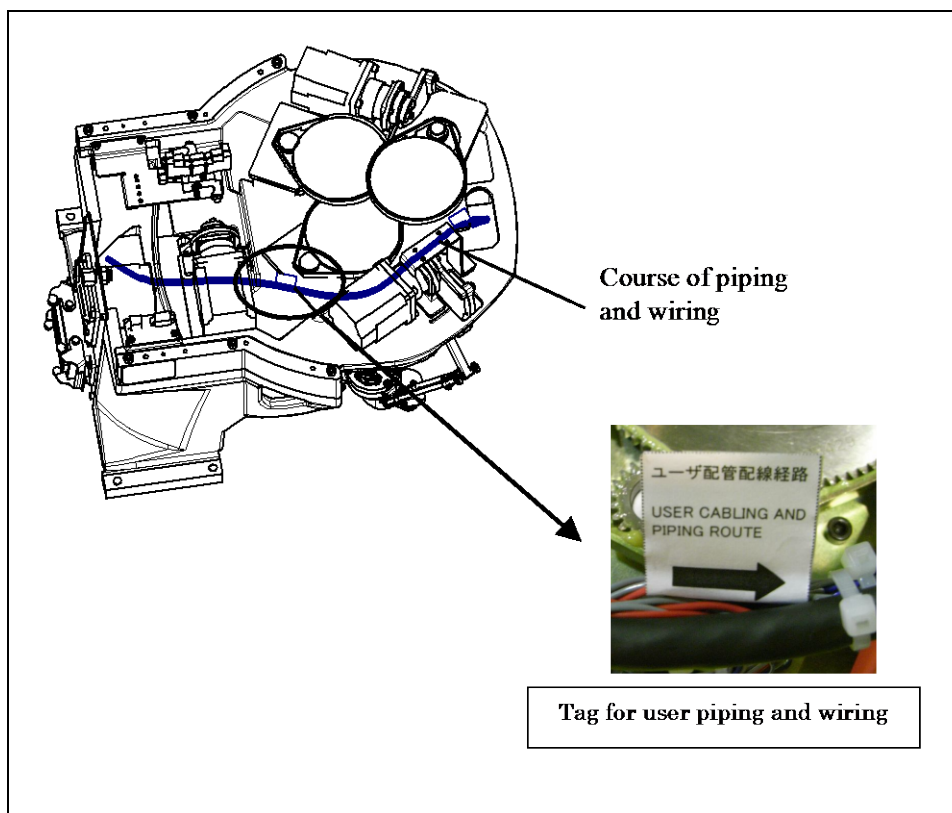


Fig. 5.1 (d) wiring method of wiring along user piping and wiring tag

Fig. 5.1 (e) shows method of using cable clamp option.

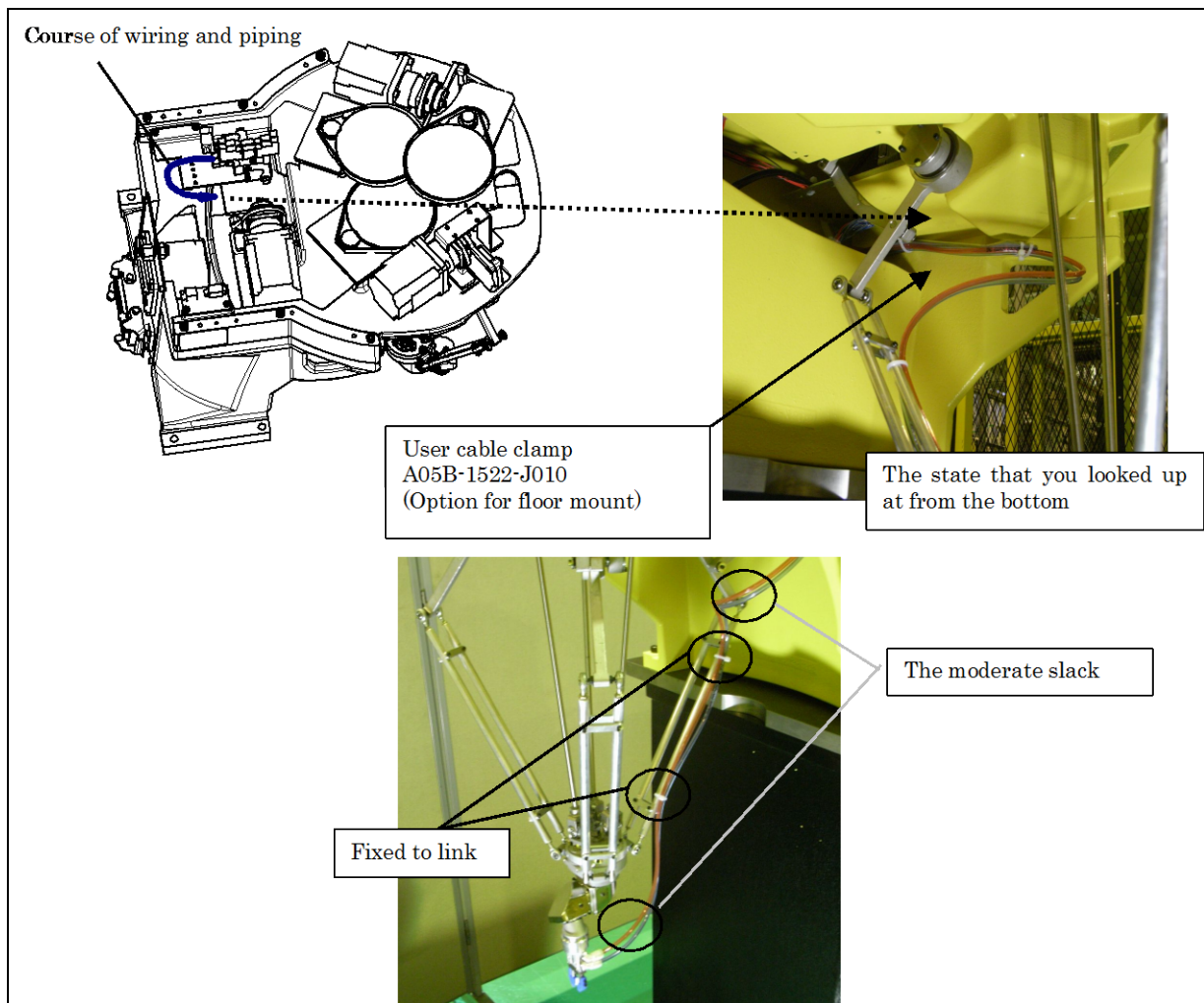


Fig. 5.1 (e) method of using cable clamp option

5.2 CAMERA CABLE (OPTION)

Fig. 5.2 (a),(b) show the camera cable interface.

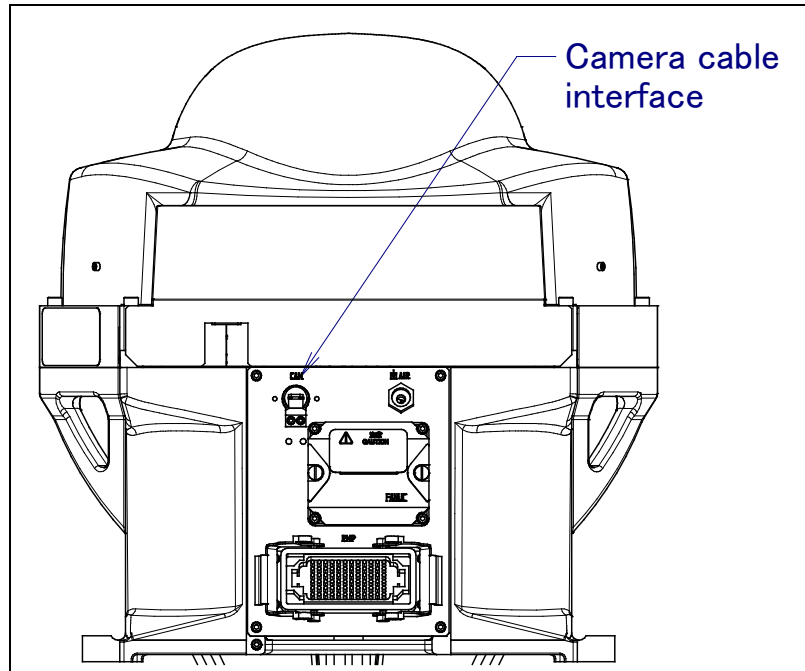


Fig. 5.2 (a) Camera cable interface (With stand, ceiling)

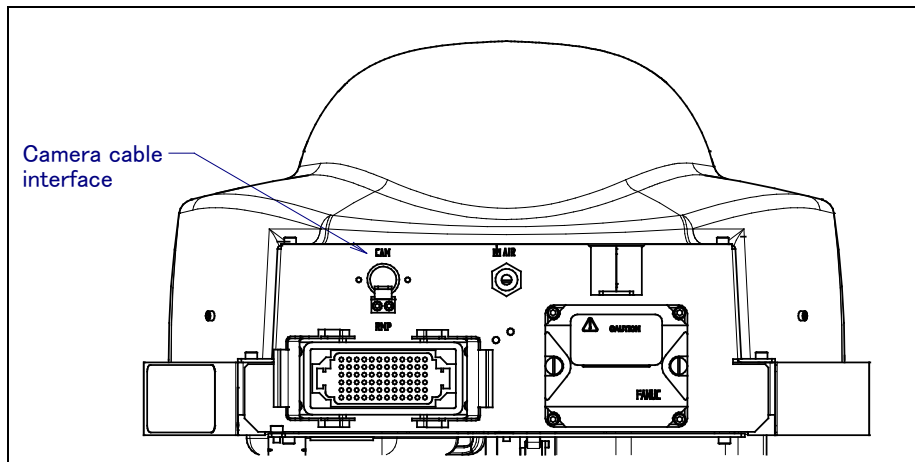


Fig. 5.2 (b) Camera cable interface (no stand B)

6 CHECKS AND MAINTENANCE

Optimum performance of the robot can be maintained by performing the periodic maintenance procedures presented in this chapter.

(See the APPENDIX A PERIODIC MAINTENANCE TABLE.)

NOTE

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

6.1 PERIODIC MAINTENANCE

6.1.1 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 Oil accumulation	Check there is oil on the sealed part of each joint. If there is an oil seepage, clean them. Clean the accumulated oil on the lower side of the drive shaft (upper side of the universal joints). (There is no drive shaft for M-1iA/1H,1HL.) ⇒"6.2.1 Confirmation of Oil Seepage and Oil Accumulation"
Air control set	(When air control set is used) ⇒"6.2.2 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: ⇒"8.1 TROUBLESHOOTING"(symptom : Vibration, Noise)
Repeatability	Check to see that the taught positions of the robot have not deviated from the previous taught positions. When displacement occurs, perform the measures as described in the following section: ⇒"8.1 TROUBLESHOOTING"(symptom : Displacement)
Peripheral devices for proper operation	Check whether the peripheral devices operate properly according to commands from the robot and the peripheral devices.
Brakes for each axis	Check that the end effector drops within 0.2 mm when servo power is turned off. If the end effector (hand) drops, perform the measures as described in the following section: ⇒"8.1 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-30iB/R-30iB Mate CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1) or R-30iA/R-30iA Mate CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83124EN-6)"

6.1.2 Periodic Check and Maintenance

Check the following items at the intervals recommended below based on the total operating time or the accumulated operating time, which ever comes first.

Check and maintenance intervals (Operating time, Operating accumulated time)							Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 month 320h	3 months 960h	6 months 1920h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
○ Only 1st check	○						Retightening LINK B mounting par	Check the looseness of LINK B part (12 places), if they are loosened, remove the LOCTITE 243, then apply LOCTITE 243 on the thread and retighten them. ⇒"6.2.3 Retightening the Link B"	6
○ Only 1st check	○						Check the wear of the LINK B ball joint part	Check the wear of the LINK B ball joint part. If looseness is large and it cause a bad influence on the robot accuracy, replace it. (See Fig. 6.2.3.)	7
○ Only 1st check	○						Cleaning the controller Ventilation system	If the controller ventilation system is dusty, turn off power and clean the unit.	16
	○						Check for external damage or peeling paint	Check whether the robot has external damage or peeling paint due to the interference with the peripheral devices. If an interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○						Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.	2
	○ Only 1st check		○				Check the exposed connectors	Check the exposed connectors. ⇒"6.2.6 Check the Connectors"	3
	○ Only 1st check		○				Retightening the end effector mounting bolts	Retighten the end effector mounting bolts. Refer to the following section for tightening torque information: ⇒"4.1 END EFFECTOR INSTALLATION TO WRIST"	4

Check and maintenance intervals (Operating time, Operating accumulated time)							Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 month 320h	3 months 960h	6 months 1920h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
	○ Only 1st check		○				Retightening the cover bolts and external main bolts	Retighten the cover bolts , robot installation bolts, bolts to be removed for inspection, and bolts exposed to the outside. 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	5
	○ Only 1st check		○				Clean foreign material s such as dust , powder	Check that foreign materials such as dust , powder does not exist on the robot main body. If foreign materials have accumulated, remove them. Especially, clean the robot movable parts well (each joint the gear cover, and the wrist axis rotation parts). When checking and cleaning the drive shafts, please be careful no to push the shaft on the drive shaft. ⇒"6.2.5 Cleaning the wrist axis rotation part and the wrist gears"	8
	○ Only 1st Check		○				Check for damage to the end effector (hand) cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.	9
○	○						Check the joint cover (option)	If joint covers (option) are installed, clean them. Confirm there is no abrasion or the breakage. If they are broken, replace them by new articles. ⇒"6.2.4 Check the joint cover (option)"	10
	○ Only 1st Check		○				Cleaning the grease around the wrist input gear	Clean the grease of the around of wrist input gear after removing cover. ⇒"6.2.5 Cleaning the wrist axis rotation part and the wrist gears"	14
	○ Only 1st check		○				Check for damages to the teach pendant cable, the operation box connection cable or the robot connection cable	Check whether the cable connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.	15
		○					Supply grease to wrist input gears (M-1iA/0.5S,0.5A, 0.5SL,0.5AL)	Supply grease to wrist input gear. ⇒"6.3.2 Applying the Grease of the Wrist Input Gears and Drive Shafts"	12

Check and maintenance intervals (Operating time, Operating accumulated time)							Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 month 320h	3 months 960h	6 months 1920h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
		○					Supply grease to Drive shafts (M-1iA/0.5S,0.5A, 0.5SL,0.5AL)	Supply grease to drive shafts. ⇒ "6.3.2 Applying the Grease of the Wrist Input Gears and Drive Shafts"	13
			○ (*)	○ (*)			Replacing the batteries	Replace the mechanical unit batteries (*) Replacing interval differs depend on the mounting types. ⇒ "6.3.1 Replacing the batteries"	11
						○	Replacing the controller batteries	Replace the controller batteries ⇒ Chapter 7 Replacing batteries of • R-30iB MATE CONTROLLER MAINTENANCE MANUAL (B-83525EN) • R-30iB MATE CONTROLLER Open Air MAINTENANCE MANUAL B-83555EN) • R-30iA MATE CONTROLLER MAINTENANCE MANUAL (B-83725EN) • For Europe R-30iA MATE CONTROLLER MAINTENANCE MANUAL (B-83725EN-1) • RIA R15.06-19999 COMPLIANT R-30iA MATE CONTROLLER MAINTENANCE MANUAL (B-83725EN-2) • R-30iA MATE CONTROLLER Open Air MAINTENANCE MANUAL B-83555EN)	17

6.2 CHECK POINTS

6.2.1 Confirmation of Oil Seepage and Oil Accumulation

Check items

Check to see whether there is an oil seepage on the bearings. If there are oil contents, clean them.
Clean the accumulated oil on the lower side of the drive shaft (upper side of the universal joints).

(1 point for M-1*i*A/0.5S,0.5SL , 3 points for M-1*i*A/0.5A,0.5AL) (There is no drive shaft for M-1*i*A/1H,1HL.)

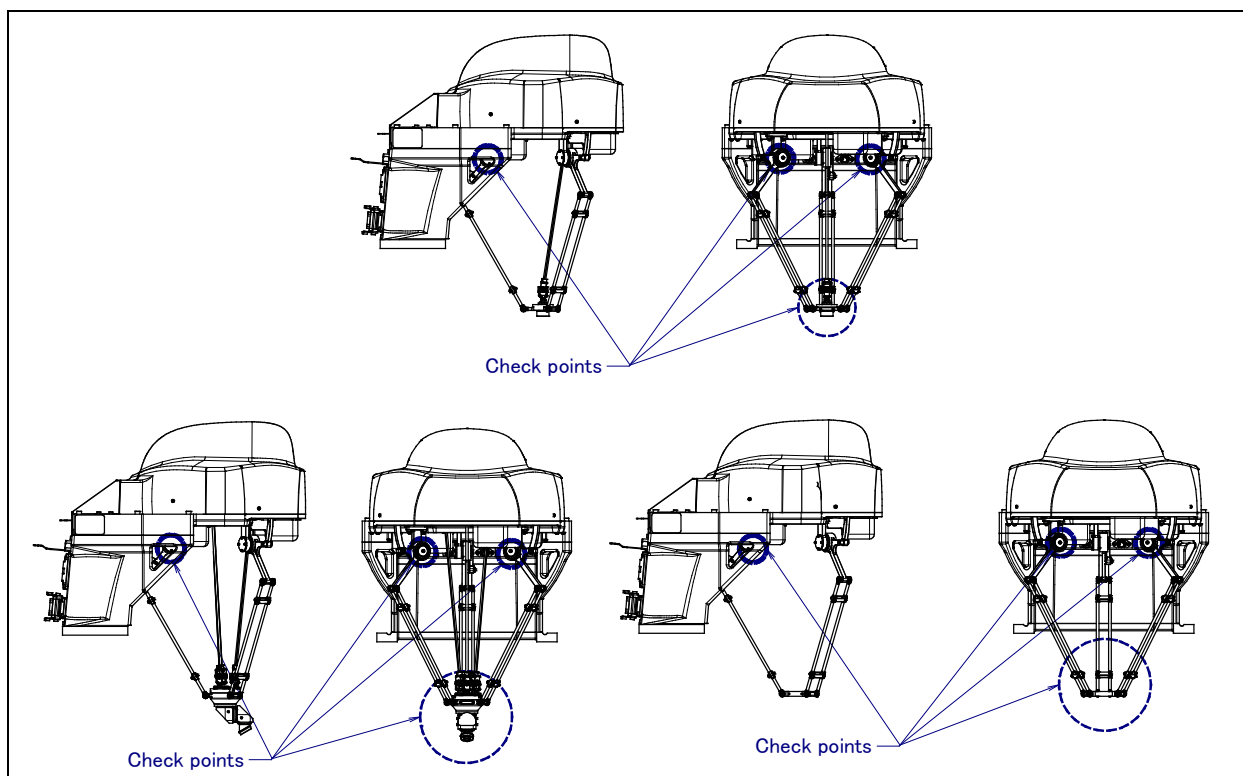


Fig. 6.2.1 (a) Check points of oil seepage

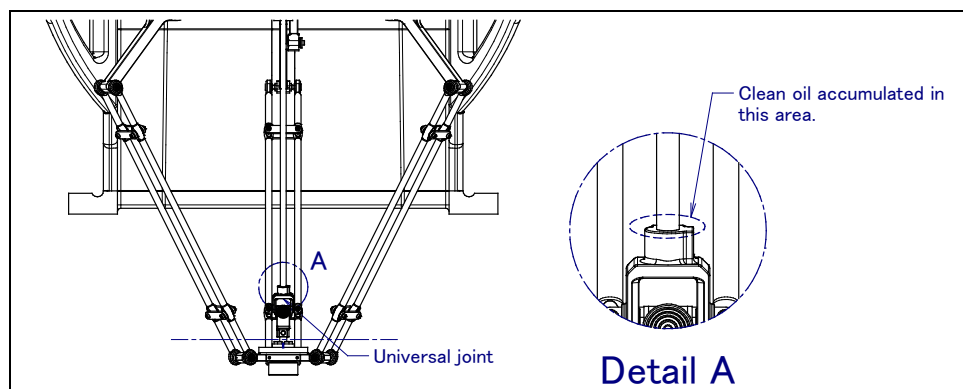


Fig. 6.2.1 (b) Cleaning parts of accumulated oil (example of M-1*i*A/0.5S J4-axis)

6.2.2 Confirmation of the Air Control Set

Item	Check items		Check points
1	When air control set is provided.	Air pressure	Check air pressure using the pressure gauge on the air control set as shown in Fig. 6.2.2. If it does not meet the specified pressure of 0.49MPa (5 kg/cm ²), adjust it using the regulator pressure setting handle.
2		Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts, as required.
3		Drain	Check drain and release it. When quantity of the drain is remarkable, examine the setting of the air dryer to the air supply side.

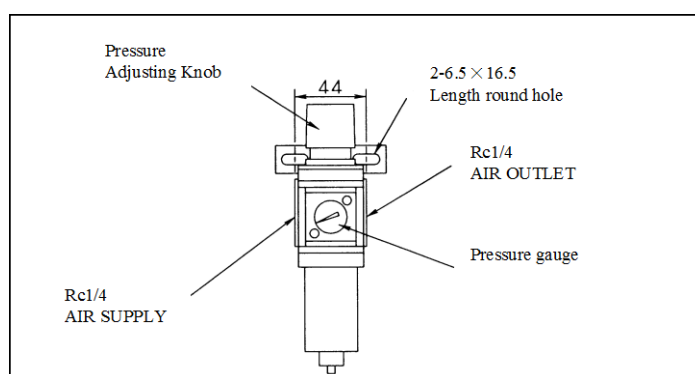


Fig. 6.2.2 Air control set (option)

6.2.3 Retightening the Link B

Check the tightness of LINK B part (12 places), if they are loosened, remove the LOCTITE 243, then apply LOCTITE 243 on the thread and retighten them.

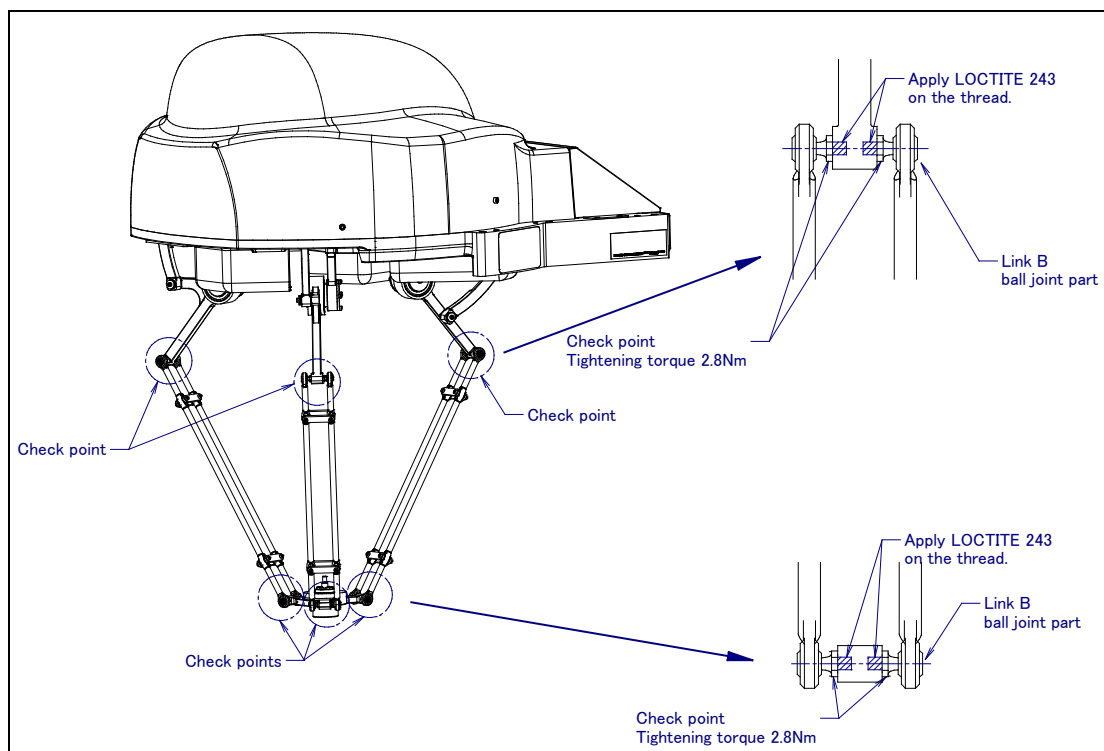


Fig. 6.2.3 Checking points of LINK B

6.2.4 Check the joint cover (OPTION)

If joint covers (option) are installed, clean them. Confirm there is no abrasion or the breakage. If they are broken, replace them by new articulated.

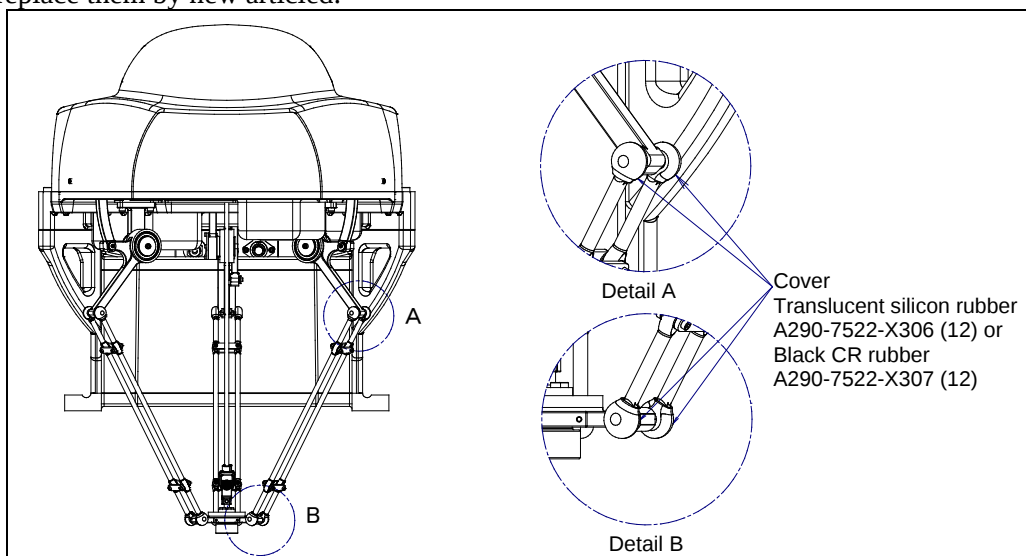


Fig. 6.2.4 Check the joint cover (option)

6.2.5 Cleaning the Wrist Axis Rotation Parts and the Wrist Gears (M-1iA/0.5S,0.5A,0.5SL,0.5AL)

Cleaning points

Clean up the dirty splattered grease around the wrist axis rotation parts , gears and the gear cover.

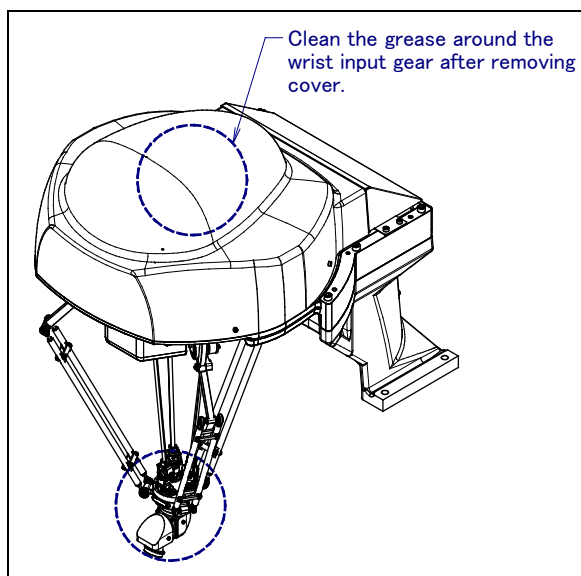


Fig. 6.2.5 Cleaning points of the wrist axis rotation parts and the wrist gear

NOTE

When checking and cleaning the drive shafts, please be careful no to push the shaft on the drive shaft.

6.2.6 Check the Connectors

Inspection points of the connectors

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

Check items

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

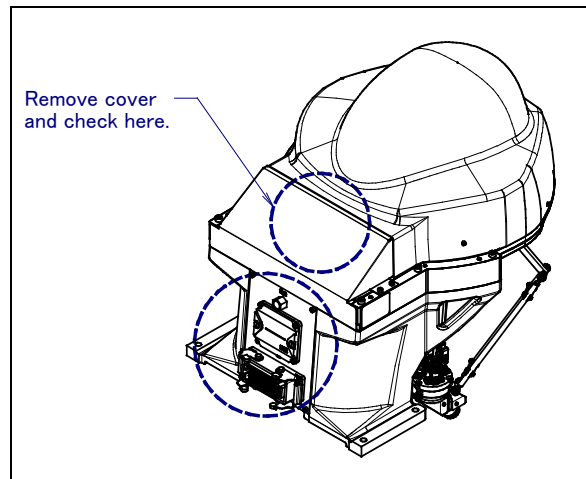


Fig. 6.2.6 Connector Inspection points

6.3 MAINTENANCE

6.3.1 REPLACING THE BATTERIES (1-YEAR (3840 Hours) CHECKS (with stand/no stand B)) (1.5-YEAR (5760 Hours) CHECKS (no stand A))

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1 year in case of with stand/no stand B 1.5 years in case of no stand A. Also, use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery (with stand /no stand B)

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



CAUTION

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

- 2 Remove the battery case cap. (Fig. 6.3.1 (a))
- 3 Take out the old batteries from the battery case.
- 4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
- 5 Close the battery case cap.

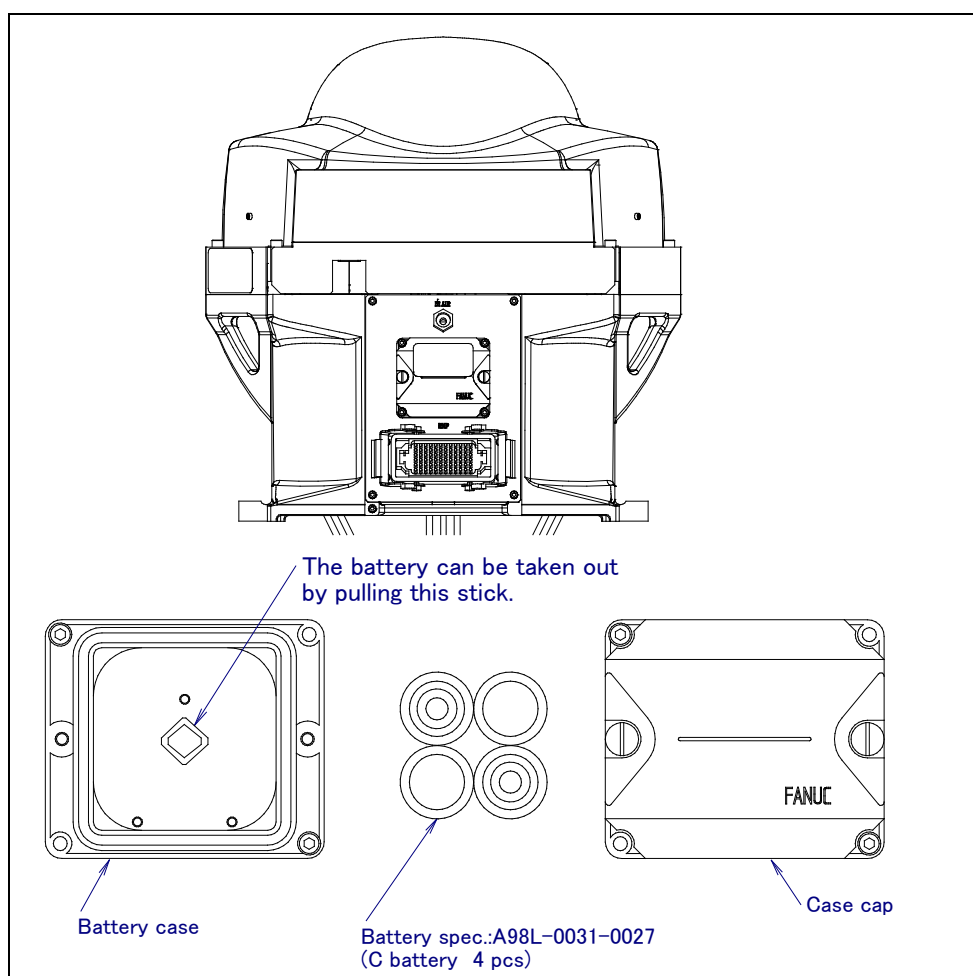


Fig. 6.3.1 (a) Replacing Batteries (with stand/no stand B)

Procedure of replacing the battery (no stand A)

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



CAUTION

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

- 2 Remove the battery case cap. (Fig. 6.3.1 (b))
- 3 Take out the old batteries from the battery case.
- 4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
- 5 Close the battery case cap.

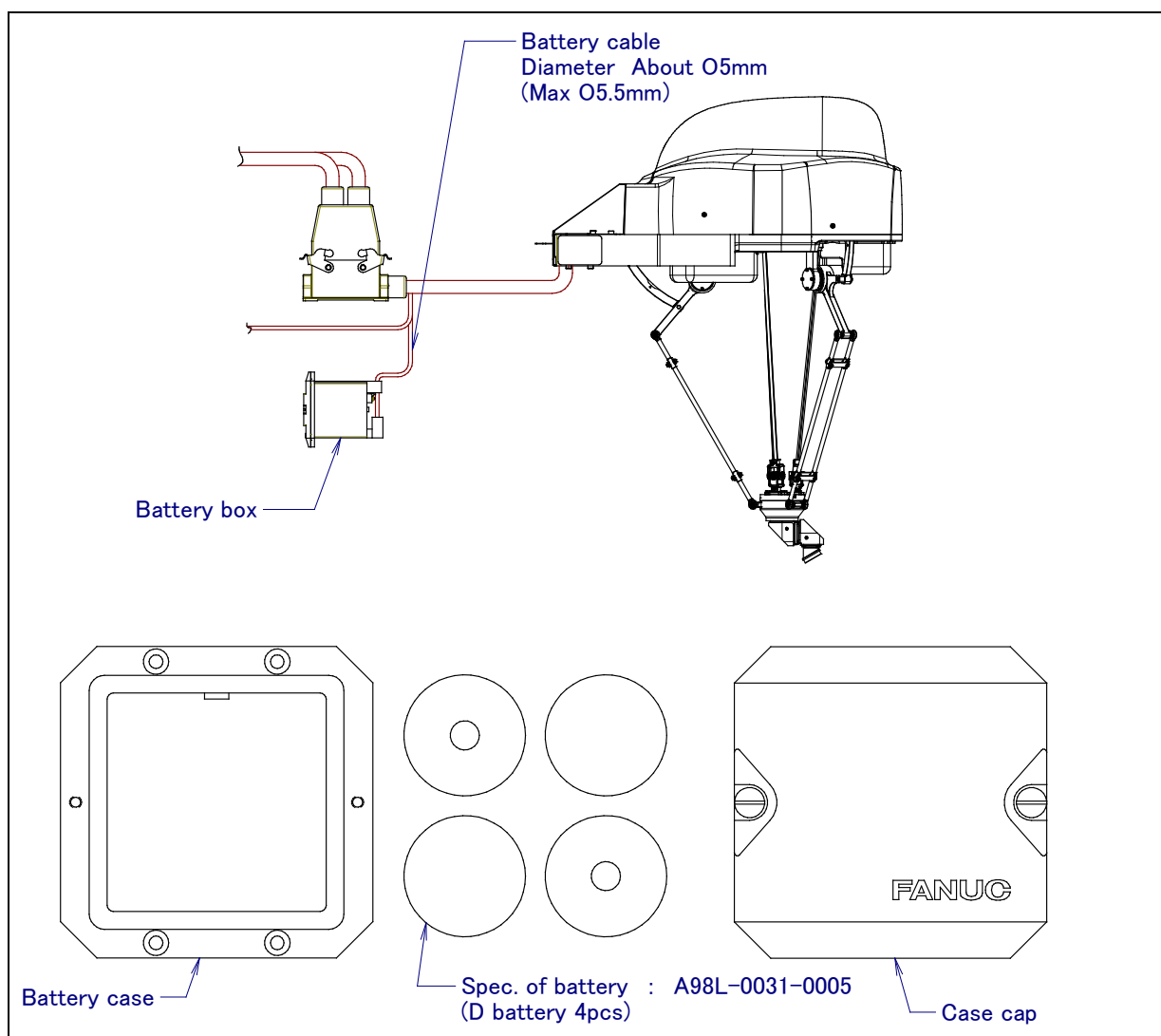


Fig. 6.3.1 (b) Replacing Batteries (no stand A)

Fig. 6.3.1 (c) shows the external size of external battery box.

When the battery box needs to be built into the controller or other internal units, refer to the external dimensions shown in Fig. 6.3.1 (c)

The battery box can be fixed by using M4 flat-head screws. (The bolts do not come with the system.)

A maximum of six terminals can be attached to the backplane of the battery box.

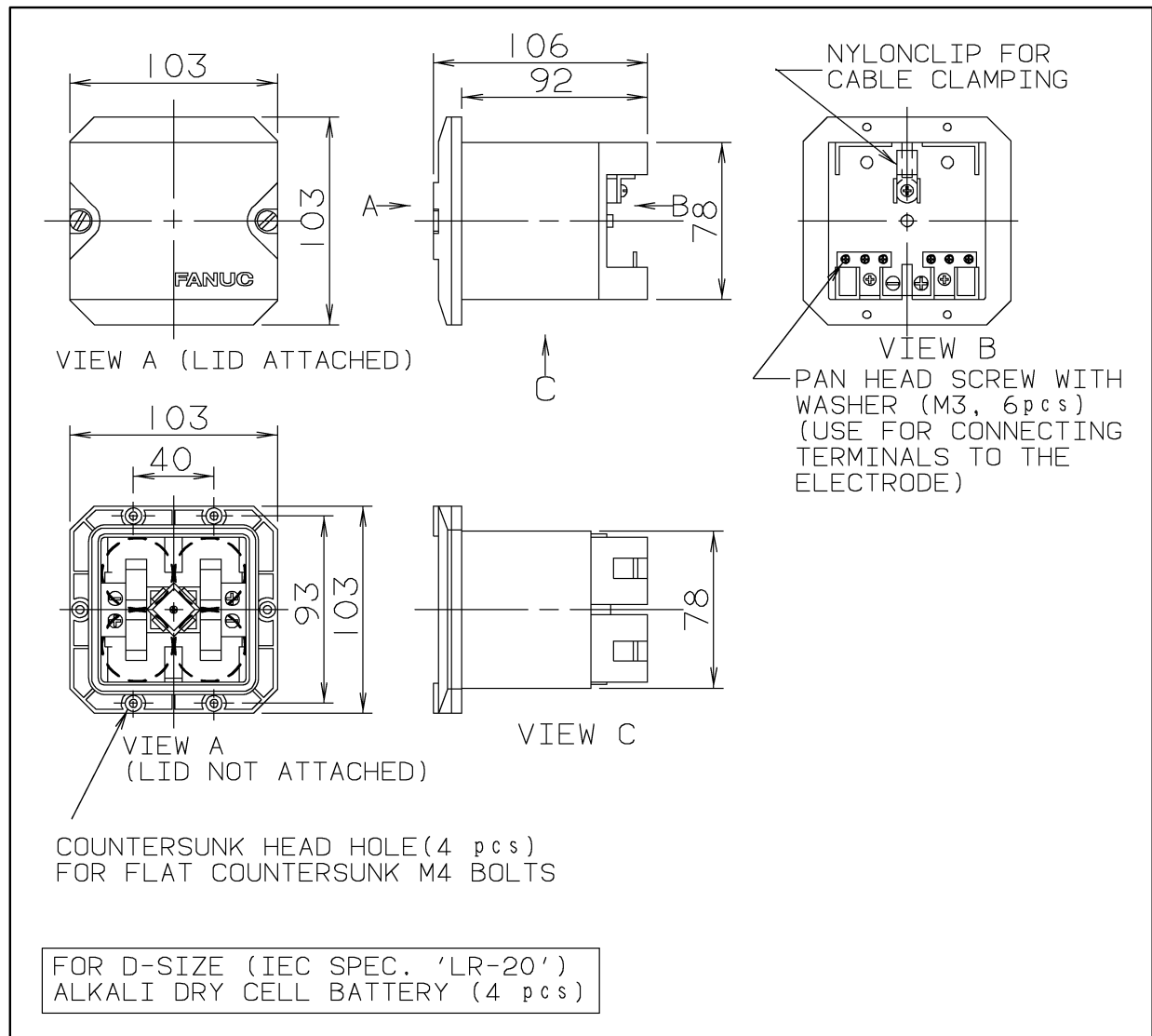


Fig. 6.3.1 (c) External dimensions of the battery box

6.3.2 Applying the Grease of the Wrist Input Gear and Drive Shaft (M-1iA/0.5S,0.5A,0.5SL,0.5AL) (6 months (1920 Hours) Checks)

Supply grease to wrist input gear and the drive shafts at the intervals recommended below based on every 6 months or 1920 hours, whichever comes first. See table 6.3.2 for the grease name and the quantity.

Table 6.3.2 Grease for 6-months (1920 hours) periodical replacement

Supply position	Quantity	Grease name
Wrist input gear	Proper quantity	JX Nippon Oil & Energy Corporation TOUGHLIX GREASE RB2 (old name: CG335) Spec: A98L-0040-0252#0.4kg
Drive shafts	Proper quantity	

For grease replacement or replenishment, move the wrist to the stroke end of the upper side.



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 Use specified grease. Use of non-approved grease may damage the gear or lead to other problems.
- 2 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.
- 3 When apply grease to the drive shaft, be careful not to push the shaft.

- 1 Turn off the controller power.
- 2 Remove the cover.
- 3 Supply new grease to the gear of J4 to J6-axes referring to Fig. 6.3.2 (a).
In case of M-1iA/0.5S,0.5SL there are two places for J4-axis.
In case of M-1iA/0.5A,0.5AL there are six places for J4 to J6-axes.
- 4 Supply new grease to the drive shafts groove with a brush or a cylinder referring to Fig. 6.3.2 (b).
In case of M-1iA/0.5S,0.5SL there is one place for J4-axis.
In case of M-1iA/0.5A,0.5AL there are three places for J4 to J6-axes.
- 5 Clean up the dirty splattered grease around the gear and gear cover.
- 6 Attach the cover.

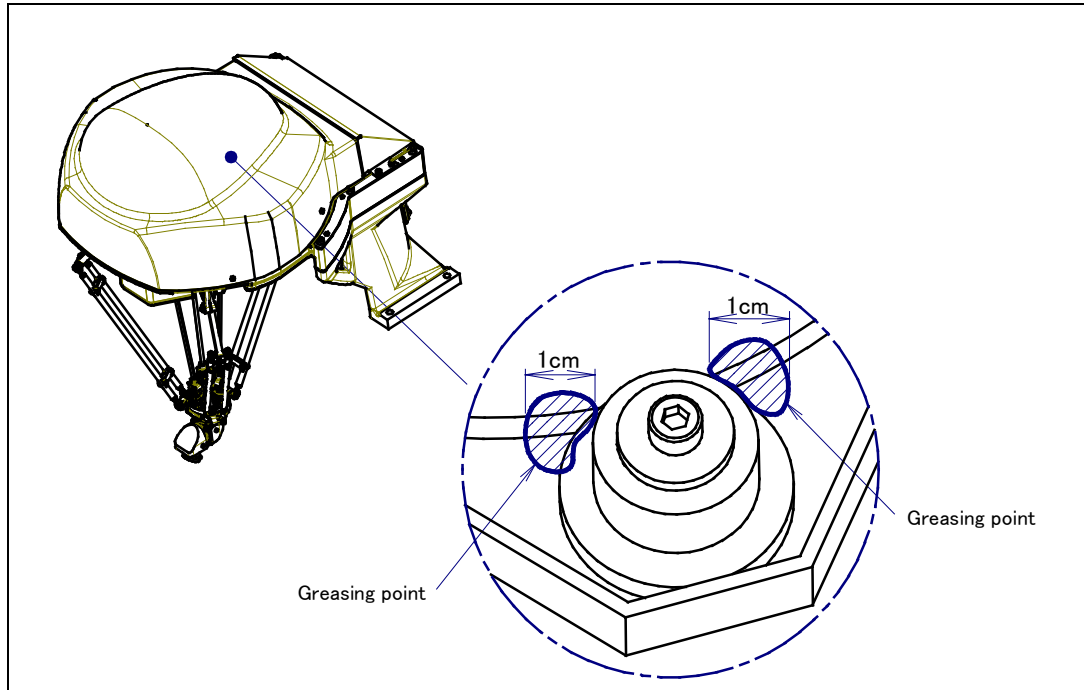


Fig. 6.3.2 (a) Supply grease to J4 to J6 gears

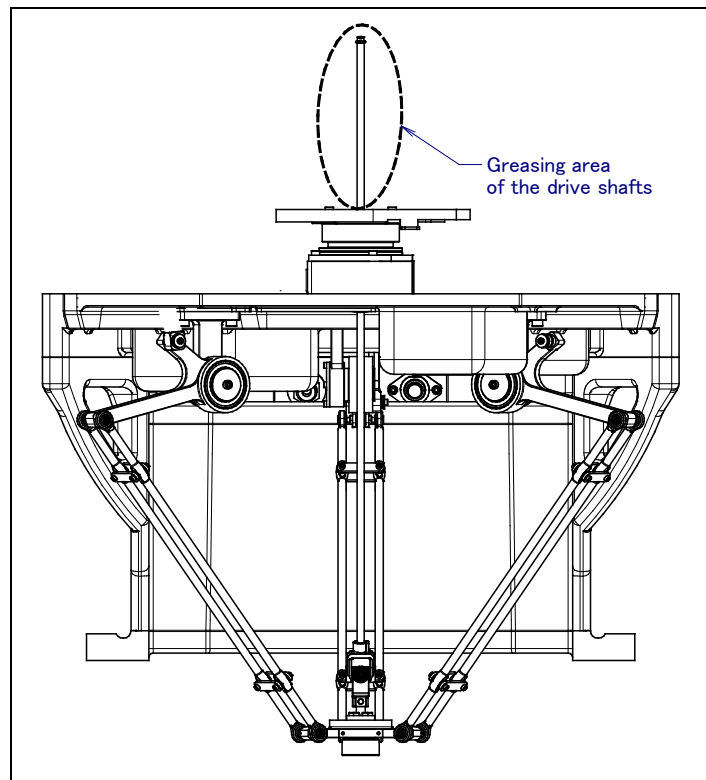


Fig. 6.3.2 (b) Supply grease to J4 to J6 drive shafts (example of J4-axis)

6.4 STORAGE

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

7 MASTERING

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

7.1 OVERVIEW

The current position of the robot is determined according to the pulse count value supplied from the Pulsecoder on each axis.

Mastering is factory-performed. It is unnecessary to perform mastering in daily operations. However, mastering becomes necessary after:

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



CAUTION

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

Types of Mastering

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

Table 7.1 Type of mastering

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

Once performing the mastering, the positioning or the calibration are indispensable. The Positioning is a manipulation which recognize the robot current position loading the current pulse count.

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

**CAUTION**

If mastering is performed incorrectly, the robot may behave unexpectedly. This is very dangerous. For the reason, the Master/Cal screen is designed to appear only when the \$MASTER_ENB system variable is 1 or 2. After performing positioning, press the F5 ([DONE]) on the Master/Cal screen. The \$MASTER_ENB system variable is reset to 0 automatically. And the Master/Cal screen will disappear.

NOTE

It is recommended that the current mastering data be backed up before mastering is performed. Use mastering data of without additional axis to with additional axis and opposite can not be done.

7.2 RESETTING ALARMS AND PREPARING FOR MASTERING

Before performing mastering because a motor is replaced, you must release the relevant alarm and display the positioning menu.

Alarm displayed

“Servo -062 BZAL” or “Servo 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 the 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 the F1 ([TYPE]), and select [Master/Cal] from the menu.
 - 6 Select the desired mastering type from the [Master/Cal] menu.
- 2 To reset the “Servo 062 BZAL” alarm, follow steps 1 to 5.
 - 1 Press the [MENU] key.
 - 2 Press [0 NEXT] and select [6 SYSTEM].
 - 3 Press the F1 ([TYPE]), and select [Master/Cal] from the menu.
 - 4 Place the cursor on the F3 ([RES_PCA]), then press the F4 ([YES]).
 - 5 Cycle power of the controller.
- 3 To reset the “Servo 075 Pulse not established” alarm, follow the steps 1 to 2.
 - 1 After cycle power of the controller, the message “Servo 075 Pulse not established” appears again.
 - 2 Move the axis for which the message mentioned above has appeared till alarm disappears when press [FAULT RESET] in either direction.

7.3 ZERO POSITION MASTERING

Zero-position mastering (witness mark mastering) is performed with all axes set at the 0-degree position. A zero-position mark (witness mark) is attached to each robot axis (Fig. 7.3 (a) to (c)). This mastering is performed with all axes set at the 0-degree position using their respective witness marks.

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

Procedure of Zero-position Mastering

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

```

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

[ TYPE ]  LOAD  RES_PCA      DONE
  
```

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

NOTE

Brake control can be released by setting the system variables as follows:

\$PARAM_GROUP.SV_OFF_ALL: FALSE

\$PARAM_GROUP.SV_OFF_ENB[*]: FALSE (for all axes)

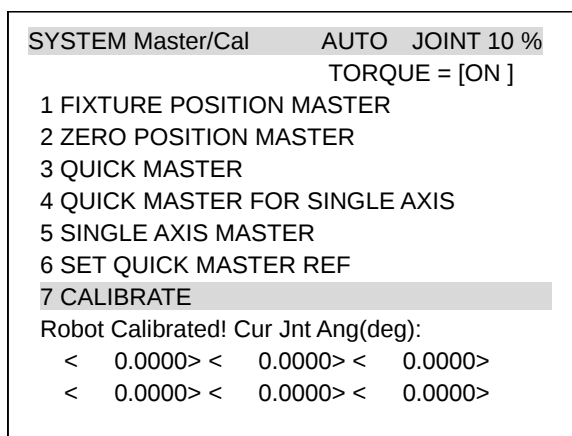
After changing the system variables, turn off the controller power and on again.

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

```

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

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



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



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

Table 7.3 Posture with zero-position marks (witness mark) aligned

Axis	Position
J1-axis	0 deg
J2-axis	0 deg
J3-axis	0 deg
J4-axis	0 deg
J5-axis	0 deg
J6-axis	0 deg



CAUTION

There is no J5, J6-axis for M-1iA/0.5S,0.5SL

There is no J4, J5, J6-axis for M-1iA/1H,1HL

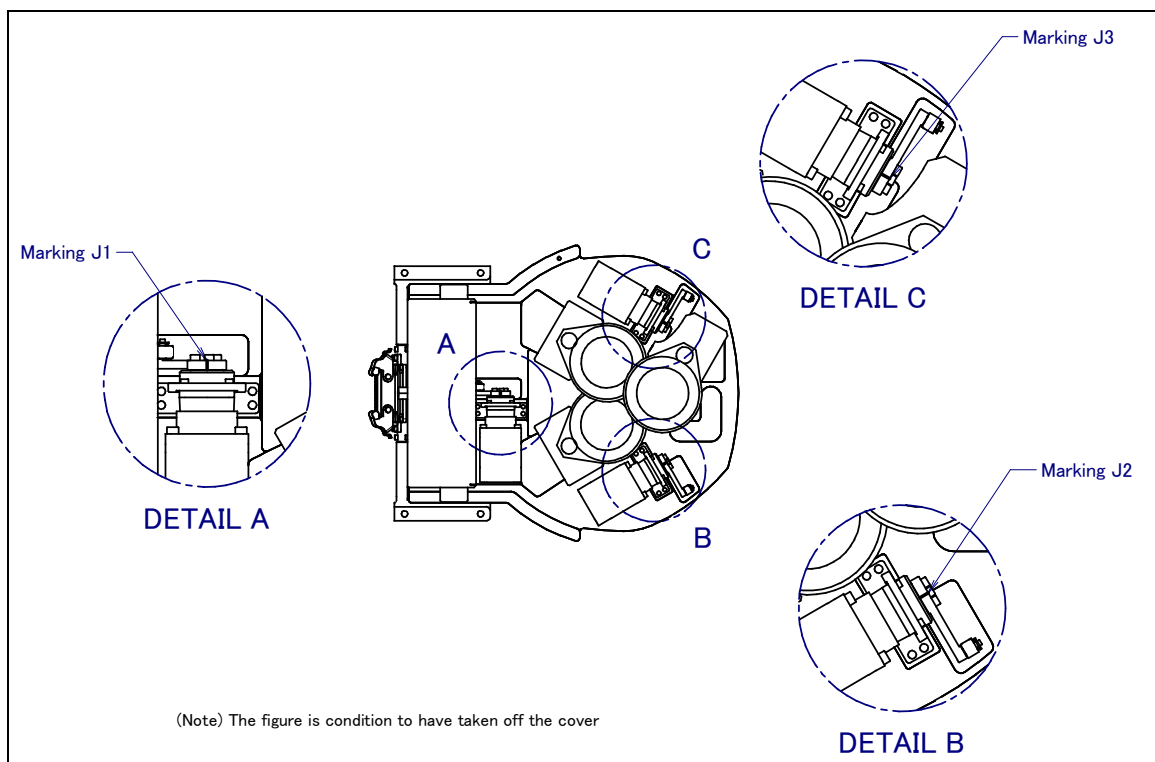


Fig. 7.3 (a) Zero-position mark (witness mark) for each axis (1/3)

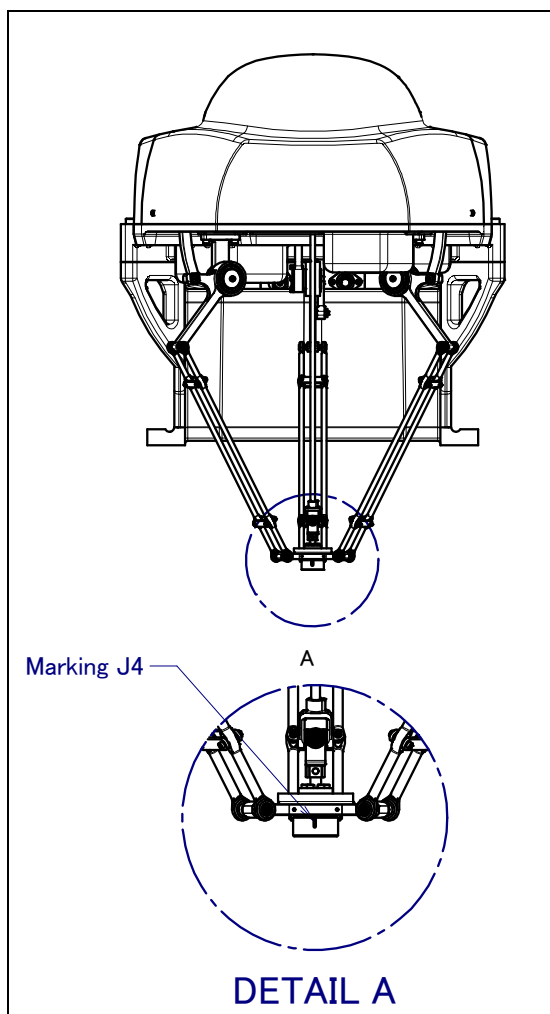


Fig. 7.3 (b) Zero-position mark (witness mark) for each axis (2/3) (M-1iA/0.5S,0.5SL)

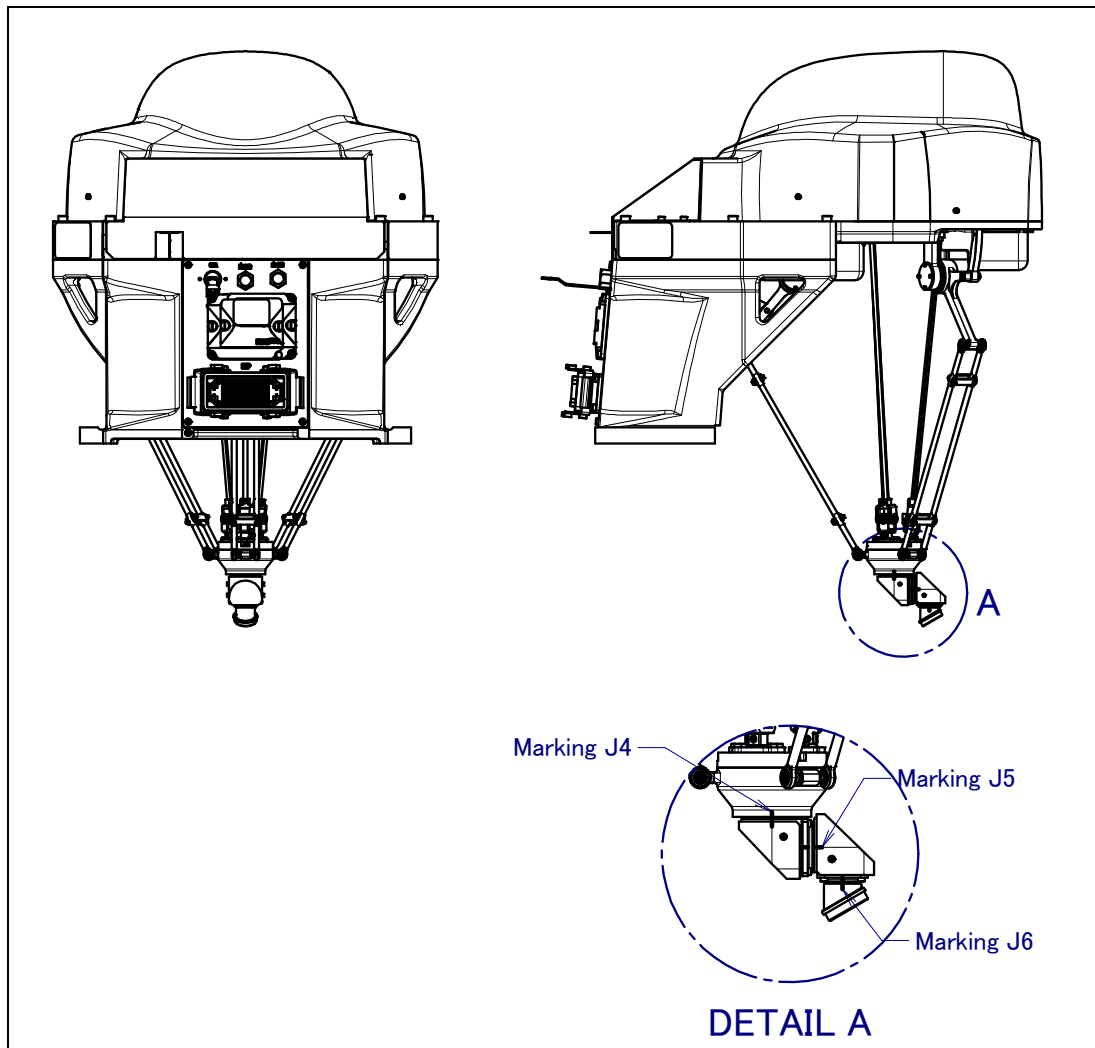


Fig. 7.3 (c) Zero-position mark (witness mark) for each axis (3/3) (M-1iA/0.5A,0.5AL)

7.4 QUICK MASTERING

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

Quick mastering is factory-performed at the position indicated in Table 8.3. Do not change the setting unless there is any problem.

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

NOTE

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

Procedure Recording the Quick Mastering Reference Position

- 1 Select SYSTEM.
- 2 Select Master/Cal. Master/Cal screen will be displayed.

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

- 3 Release brake control, and jog the robot to the quick mastering reference position.
- 4 Select [5 SINGLE AXIS MASTER] and press F4 [YES]. Quick mastering reference position will be set.

5 SINGLE AXIS MASTER
6 SET QUICK MASTER REF
7 CALIBRATE

F4

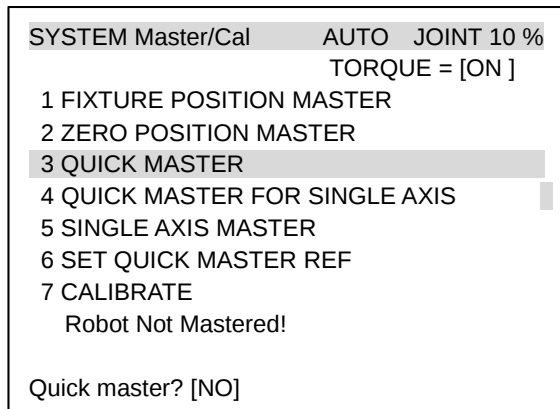


CAUTION

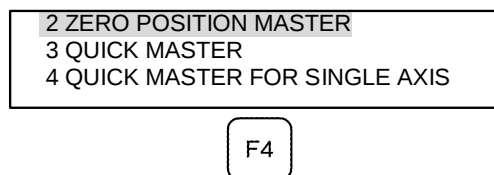
If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or zero –position mastering is required to restore mastering data.

Procedure of Quick Mastering

- 1 Display the Master/Cal screen.



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



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



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

7.5 QUICK MASTERING FOR SINGLE AXIS

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

Quick mastering is factory-performed at the position indicated in Table 7.3. Do not change the setting unless there is any problem.

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

CAUTION

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

Procedure Recording the Quick Mastering Reference Position

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

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

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

5 SINGLE AXIS MASTER
6 SET QUICK MASTER REF
7 CALIBRATE

F4

CAUTION

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

Procedure of Quick Mastering

- 1 Display the Master/Cal screen.

SYSTEM Master/Cal	AUTO	JOINT 10 %
TORQUE = [ON]		
1 FIXTURE POSITION MASTER		
2 ZERO POSITION MASTER		
3 QUICK MASTER		
4 QUICK MASTER FOR SINGLE AXIS		
5 SINGLE AXIS MASTER		
6 SET QUICK MASTER REF		
7 CALIBRATE		
Robot Not Mastered!		
Quick master? [NO]		

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

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

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

SINGLE AXIS MASTER		AUTO	JOINT 10%
			1/9
	ACTUAL POS	(MSTR POS)	(SEL) [ST]
J5	0.000	(0.000)	(0) [2]
J6	0.000	(0.000)	(0) [0]
EXEC			

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



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

7.6 SINGLE AXIS MASTERING

Single axis mastering is performed for one axis at a time. The mastering position for each axis can be specified by the user.

Single axis mastering can be used, if mastering data for a specific axis is lost, for example, because a low voltage has been detected on the pulse counter backup battery or because the Pulsecoder has been replaced.

SINGLE AXIS MASTER			AUTO	JOINT 10%
	ACTUAL POS	(MSTR POS)	(SEL)	1/9 [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				

Table 7.6 Items set in single axis mastering

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

Procedure of Single axis mastering

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

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

- 3 Select [4 SINGLE AXIS MASTER]. You will see a screen similar to the following.

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

- 4 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.

EXEC

F5

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 previous page key to resume the previous screen.

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

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

DONE

F5

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

7.7 MASTERING DATA ENTRY

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

Mastering data entry method

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

SYSTEM Variables		AUTO	JOINT 10%
			1/669
1	\$AAVM_GRP	AAVM_GRP_T	
2	\$AAVM_WRK	AAVM_WRK_T	
3	\$ABSPOS_GRP	ABSPOS_GRP_T	
4	\$ACC_MAXLMT	0	
5	\$ACC_MINLMT	0	
6	\$ACC_PRE_EXE	0	
[TYPE]		DETAIL	

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

SYSTEM Variables		AUTO	JOINT 10%
			1/669
135	\$DMR_GRP	DMR_GRP_T	
136	\$DMSW_CFG	DMSW_CFG_T	
[TYPE]			

- 4 Select \$DMR_GRP.

SYSTEM Variables		AUTO	JOINT 10%
\$DMR_GRP			1/1
1	[1]	DMR_GRP_T	
[TYPE]		DETAIL	

SYSTEM Variables		AUTO	JOINT 10%
\$DMR_GRP			1/29
1	\$MASTER_DONE	FALSE	
2	\$OT_MINUS	[9] of BOOLEAN	
3	\$OT_PLUS	[9] of BOOLEAN	
4	\$MASTER_COUN	[9] of INTEGER	
5	\$REF_DONE	FALSE	
6	\$REF_POS	[9] of REAL	
[TYPE]		TRUE	FALSE

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

SYSTEM Variables		AUTO	JOINT 10%
\$DMR_GRP[1].\$MASTER_COUN			1/9
1	[1]	95678329	
2	[2]	10223045	
3	[3]	3020442	
4	[4]	30405503	
5	[5]	20497709	
6	[6]	2039490	
7	[7]	0	
8	[8]	0	
9	[9]	0	
[TYPE]			

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

SYSTEM Variables		AUTO	JOINT 10%
\$DMR_GRP			1/29
1	\$MASTER_DONE	TRUE	
2	\$OT_MINUS	[9] of BOOLEAN	
[TYPE]		TRUE	FALSE

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



7.8 CHECKING THE 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 Section 7.3 are aligned. There is no need to use any visual aid.

If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described in 7.2. 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
This section describes those alarms related to Pulsecoders, as well as the actions required to clear them.
 - (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 Section 7.2.), then turn the power off 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 the FANUC because the Pulsecoder may be defective.

8 TROUBLESHOOTING

The cause of a failure in the mechanical unit may be difficult to localize, because failures can arise from many interrelated factors. If you fail to take the correct measures, the failure may be aggravated. Therefore, you must analyze the symptoms of the failure precisely so that the true cause can be found.

8.1 TROUBLESHOOTING

Table 8.1 shows the major troubleshooting that may occur in the mechanical unit and their probable causes. If you cannot pinpoint a failure cause or which measures to take, contact your local FANUC representative.

Table 8.1 TROUBLESHOOTING

Symptom	Description	Cause	Measure
Vibration Noise	- The base or pedestal lifts off the floor plate as the robot operates. - There is a gap between the base or pedestal and floor plate. - A base or stand retaining bolt is loose.	[Base or pedestal fastening] - It is likely that the robot base or pedestal is not securely fastened to the floor plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or foreign material caught between the floor plate and floor plate. - If the robot is not securely fastened to the floor plate, the base or pedestal lifts the floor plate as the robot operates, allowing the base or pedestal and floor plates to strike each other which, in turn, leads to vibration.	- If a bolt is loose, apply Loctite and tighten it to the appropriate torque. - Adjust the floor plate surface flatness to within the specified tolerance. - If there is any foreign matter between the base or pedestal and floor plate, remove it.
	- The rack or floor plate vibrates during operation of the robot.	[Rack or floor] - It is likely that the rack or floor is not sufficiently rigid. - If the rack or floor is not sufficiently rigid, reaction from the robot deforms the rack or floor, leading to vibration.	- Reinforce the rack or floor to make it more rigid. - If reinforcing the rack or floor is impossible, modify the robot control program; doing so might reduce the amount of vibration.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- Vibration becomes more serious when the robot adopts a specific posture. - If the operating speed of the robot is reduced, vibration stops. - Vibration is most noticeable when the robot is accelerating. - Vibration occurs when two or more axes operate at the same time.	[Overload] - It is likely that the load on the robot is greater than the maximum rating. - It is likely that the robot control program is too demanding for the robot hardware. - It is likely that the ACCELERATION value is excessive.	- Check the maximum load that the robot can handle once more. If the robot is found to be overloaded, reduce the load, or modify the robot control program. - Vibration in a specific portion can be reduced by modifying the robot control program while slowing the robot and reducing its acceleration (to minimize the influence on the entire cycle time).
	- Vibration or noise was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating axis has not been replenished for a long period.	[Broken gear, bearing, or reducer] - It is likely that collision or overload applied an excessive force on the drive mechanism, thus damaging the gear tooth surface or rolling surface of a bearing, or reducer. - It is likely that prolonged use of the robot while overloaded caused fretting of the gear tooth surface or rolling surface of a bearing, or reducer due to resulting metal fatigue. - It is likely that foreign matter 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 matter caught in a gear, bearing, or within a reducer cause vibration. - It is likely that, because the grease has not been replenished for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue. These factors all generate cyclic vibration and noise.	- Operate one axis at a time to determine which axis is vibrating. - Remove the motor, and replace the gear, the bearing, and the reducer. For the spec. of parts and the method of replacement, contact FANUC. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Regularly greasing with a specified type can help prevent problems.

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

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- There is some relationship between the vibration of the robot and the operation of a machine near the robot.	[Noise from a nearby machine] - If the robot is not grounded properly, electrical noise is induced on the grounding wire, preventing commands from being transferred accurately, thus leading to vibration. - If the robot is grounded at an unsuitable point, its grounding potential becomes unstable, and noise is likely to be induced on the grounding line, thus leading to vibration.	- Connect the grounding wire firmly to ensure a reliable ground potential and prevent extraneous electrical noise.
Rattling	- While the robot is not supplied with power, pushing it with the hand causes part of the mechanical unit to wobble. - There is a gap on the mounting face of the mechanical unit.	[Mechanical section coupling bolt] - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical section.	- Check that the following bolts for each axis are tight. If any of these bolts is loose, apply Loctite and tighten it to the appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Base retaining bolt - Arm retaining bolt - Casting retaining bolt - End effector retaining bolt
	- There is lost motion in the bearing of a joint	[Damage to the bearing, release of the pre-load] - A probable cause is that excessive force was applied to the bearing of the joint due to impact or overload, damaging the bearing or releasing the pre-load.	- Check the movement of the joints during operation to identify the faulty joint. - Remove each leg, move the top and bottom joints manually to check whether the bearings are damaged and whether there is lost motion. If a bearing is damaged or the pre-load is released, replace the unit containing the joint. - This problem can be avoided by avoiding use at overload.

Symptom	Description	Cause	Measure
Motor over-heating	- The ambient temperature of the installation location increases, causing the motor to overheat. - After the robot control program or the load was changed, the motor overheated.	[Ambient temperature] - It is likely that the motor overheated along with the ambient temperature rose, and could not dissipate the heat. [Operating condition] - It is likely that the overcurrent above the specified permissive average current.	- Reducing the ambient temperature is the most effective means of preventing overheat. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is effective to reduce the average current. Thus, prevent overheating. - The teach pendant can monitor the average current. Check the average current when the robot control program launched.
	- After a 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 overheating.	- As for load setting, Input an appropriate parameter referring to Section 4.2.
	- 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 damaged oil seal, or a loose seal bolt. - A crack in a casting can occur due to excessive force that might be caused in collision. - An oil seal might be damaged if extraneous dust scratches the lip of the oil seal.	- 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. - Oil seals are used in the locations stated below. - Inside the reducer - Inside of the wrist
Dropping axis	- An axis drops because the brake does not function. - An axis drops gradually when it should be at rest.	[Brake drive relay and motor] - It is likely that brake drive relay contacts are stuck to each other to keep the brake current flowing, thus preventing the brake from operating when the motor is deenergized. - 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. If they are found to be stuck, replace the relay. - If the brake shoe is worn out, if the brake main body is damaged, or if oil or grease has entered the motor, replace the motor.

Symptom	Description	Cause	Measure
Displacement	- The robot operates at 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 an arm or reducer. - It is likely that the Pulsecoder is abnormal.	- 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. Variation will not occur unless another collision occurs. - If the Pulsecoder is abnormal, 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 robot.	- Correct the setting of the peripheral unit position. - Correct the taught program.
	- Displacement occurred after a parameter was changed.	[Parameter] - It is likely that the mastering data was rewritten in such a way that the robot origin was shifted.	- Re-enter the previous mastering data, which is known to be correct. - If correct mastering data is unavailable, perform mastering again.
BZAL alarm occurred	- BZAL is displayed on the controller screen	- It is likely that the voltage of the memory backup battery is low. - It is likely that the Pulsecoder cable is defected.	- Replace the battery. - Replace the cable.

APPENDIX

A

PERIODIC MAINTENANCE TABLE

FANUC Robot M-1iA

Periodic Maintenance Table

Working time (H)		Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Items															
Mechanical unit	1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○
	2	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○
	3	Check the exposed connector (Loosening)	0.2H	—		○		○				○			
	4	Tighten the end effector bolt	0.2H	—		○		○				○			
	5	Tighten the cover and main bolt.	2.0H	—		○		○				○			
	6	Retighten the LINK B mounting part	0.2H	—	○	○	○	○	○	○	○	○	○	○	○
	7	Check the wear of the LINK B ball joint part	0.2H	—	○	○	○	○	○	○	○	○	○	○	○
	8	Remove dust, powder etc.	1.0H	—		○		○				○			
	9	Check the end effector (hand) cable	0.1H	—	○	○	○	○	○	○	○	○	○	○	○
	10	Check the joint cover	0.1H	—											
	11	Replacing battery. (With stand/no stand B)	0.1H	—				●				●			
		Replacing battery. (No stand A)	0.1H	—						●					
	12	Supply grease to wrist input gears	0.5H	Proper quantity			●	●		●		●		●	
	13	Supply grease to drive shafts	0.5H	Proper quantity			●	●		●		●		●	
	14	Clean the around of wrist input gear (*1)	0.1H	—		○	○	○		○		○		○	
Controller	15	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○		○				○			
	16	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○
	17	Replacing battery (*2)	0.1H	—											

*1 M-1iA/1H,1HL does not have the wrist input gear

*2 Refer to manual of controller

*3 ●: requires order of parts

○: does not require order of parts

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

B MOUNTING BOLT TORQUE LIST

NOTE

In apply the LOCTITE to designate part, spread to the entire length area of the engaging part of female thread. If applied to the male threads, poor adhesion provoke loose bolt. Clean the bolts and the threaded holes and wipe off the oil on the engaging section. Make sure that there is no solvent left in the threaded holes. In this case remove all the excess LOCTITE finished screwing.

Adopt following strength bolts.

Comply with the instruction prescribed in a manual if the bolt specified.

Hexagon socket head bolt made by steel

Size M22 or less : Tensile strength 1200N/mm² or more

Size M24 or more : Tensile strength 1000N/mm² or more

All size plating bolt : Tensile strength 1000N/mm² or more

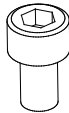
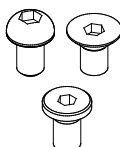
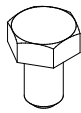
Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)

Tensile strength 400N/mm² or more

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

Recommended bolt tightening torques

Unit: Nm

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

INDEX

<A>

A MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE.....	20
AIR SUPPLY AND EE(RI) INTERFACE (OPTION) ..	53
Angle of Mounting Surface Setting.....	8
Applying the Grease of the Wrist Input Gear and Drive Shaft (M-1iA/0.5S,0.5A,0.5SL,0.5AL) (6 months (1920 Hours) Checks).....	69

BASIC SPECIFICATIONS	14
----------------------------	----

<C>

CAMERA CABLE (OPTION).....	57
CHECK POINTS	62
Check the Connectors	65
Check the joint cover (OPTION)	64
CHECKING THE MASTERING	85
CHECKS AND MAINTENANCE	58
Cleaning the Wrist Axis Rotation Parts and the Wrist Gears (M-1iA/0.5S,0.5A,0.5SL,0.5AL)	64
Confirmation of Oil Seepage and Oil Accumulation	62
Confirmation of the Air Control Set.....	63
CONNECTION WITH THE CONTROLLER.....	11

<D>

Daily Checks	58
--------------------	----

<E>

END EFFECTOR INSTALLATION TO WRIST	47
EQUIPMENT INSTALLATION TO THE ROBOT.....	47

<I>

INSTALLATION.....	3
INSTALLATION SPECIFICATIONS	10

<J>

JOINT COVER (OPTION) (M-1iA/0.5S, 0.5A, 1H).....	51
--	----

<L>

LOAD SETTING	49
--------------------	----

<M>

MAINTENANCE	66
MAINTENANCE AREA.....	10
MASTERING	71
MASTERING DATA ENTRY	83
MOUNTING BOLT TORQUE LIST	98

<O>

OVERVIEW	71
----------------	----

<P>

Periodic Check and Maintenance	59
PERIODIC MAINTENANCE	58

PERIODIC MAINTENANCE TABLE	95
PIPING AND WIRING TO THE END EFFECTOR.....	52
PREFACE	p-1

<Q>

QUICK MASTERING	77
QUICK MASTERING FOR SINGLE AXIS	79

<R>

REPLACING THE BATTERIES (1-YEAR (3840 Hours) CHECKS (with stand/no stand B)) (1.5-YEAR (5760 Hours) CHECKS (no stand A))	66
RESETTING ALARMS AND PREPARING FOR MASTERING.....	72
Retightening the Link B	63
ROBOT CONFIGURATION.....	14

<S>

SAFETY PRECAUTIONS	s-1
SINGLE AXIS MASTERING	81
STORAGE	70

<T>

TRANSPORTATION	1
TRANSPORTATION AND INSTALLATION.....	1
TROUBLESHOOTING	86

<W>

WRIST LOAD CONDITIONS	44
-----------------------------	----

<Z>

ZERO POSITION MASTERING	73
-------------------------------	----

REVISION RECORD

Edition	Date	Contents
08	Dec., 2015	• Addition of quick master for single axis • Correction of errors
07	Feb., 2014	• Addition of M-1<i>i</i>A/0.5SL,0.5AL,1HL • Correction of errors
06	Jul., 2013	• Addition of R-30<i>i</i>B Mate • Addition of M-1<i>i</i>A/1H • Addition of joint cover option • Correction of errors
05	Jan., 2012	• Addition of stand B • Addition of check of oil seepage • Correction of errors
04	Nov., 2010	• Addition of stop type of robot • Addition of stopping time and distance when controlled stop is executed • Addition of method of piping and wiring • Correction of errors
03	Mar., 2010	• Addition of 1kg payload option • Addition of solenoid valve option
02	Dec., 2009	• Addition of check of LINK B • Correction of errors
01	Aug., 2009	

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