FANUC Robot ARC Mate 100*i*C
FANUC Robot ARC Mate 100*i*Ce
FANUC Robot M-10*i*A
FANUC Robot M-10*i*Ae

MECHANICAL UNIT

OPERATOR'S MANUAL

B-82754EN/15

- **Original Instructions**

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

SAFETY PRECAUTIONS

This chapter 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 user can be defined as follows.

Operator:
- Turns ON/OFF power to the robot
- Starts the robot program from the operator's panel

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

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

- Operator is not allowed to work in the safety fence.
- Programmers and maintenance engineers are allowed to work in the safety fence. The work inside the safety fence includes lifting, setting, teaching, adjustment, maintenance, etc.
- To work inside the safety fence, the person must receive a professional training for the robot.

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.

(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.

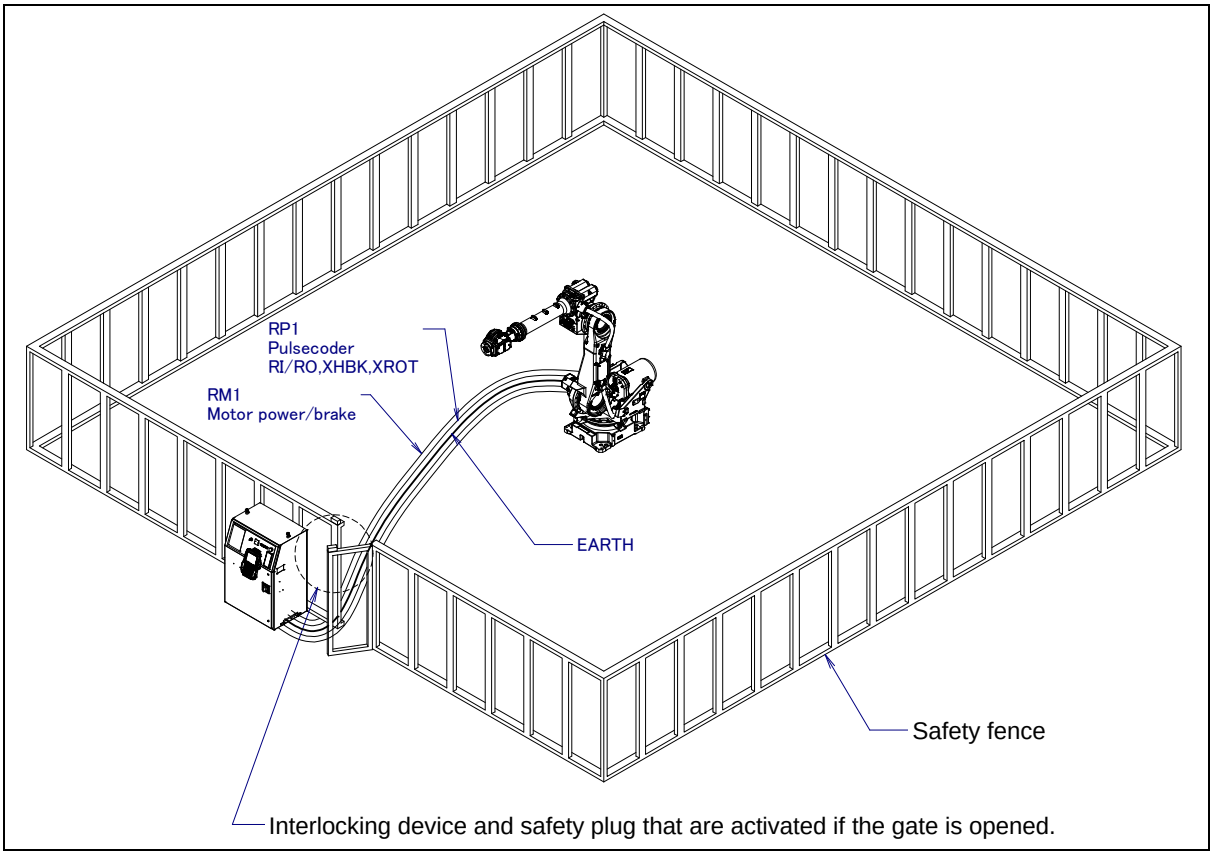


Fig. 3 (a) Safety fence and safety gate

⚠ WARNING
When you close a fence, please confirm that there is not a person from all directions of the robot.

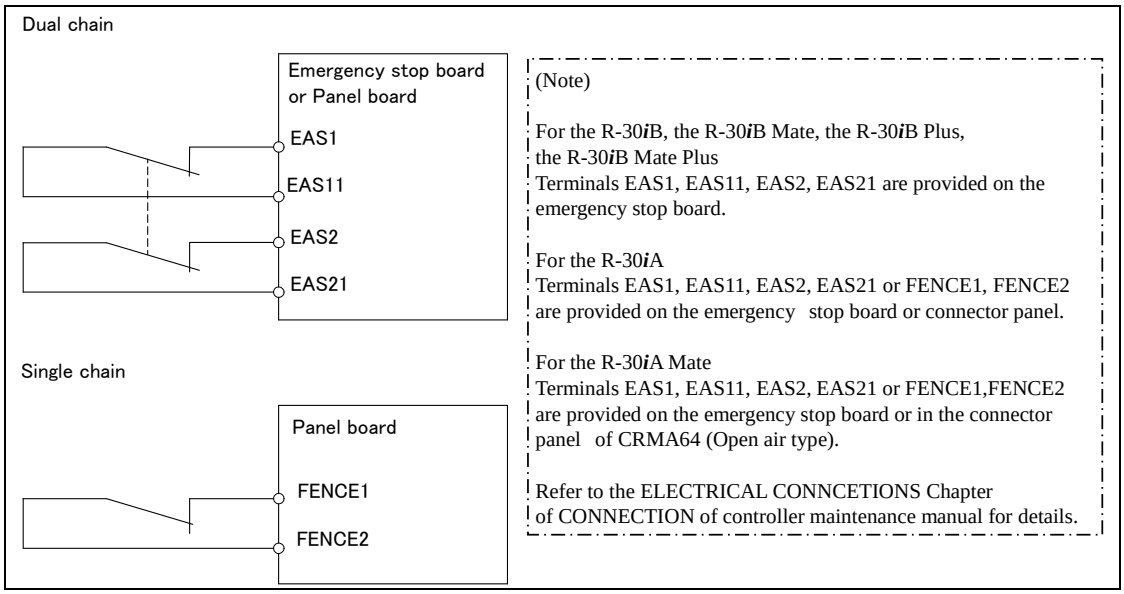


Fig. 3 (b) Connection diagram for the signal of safety fence

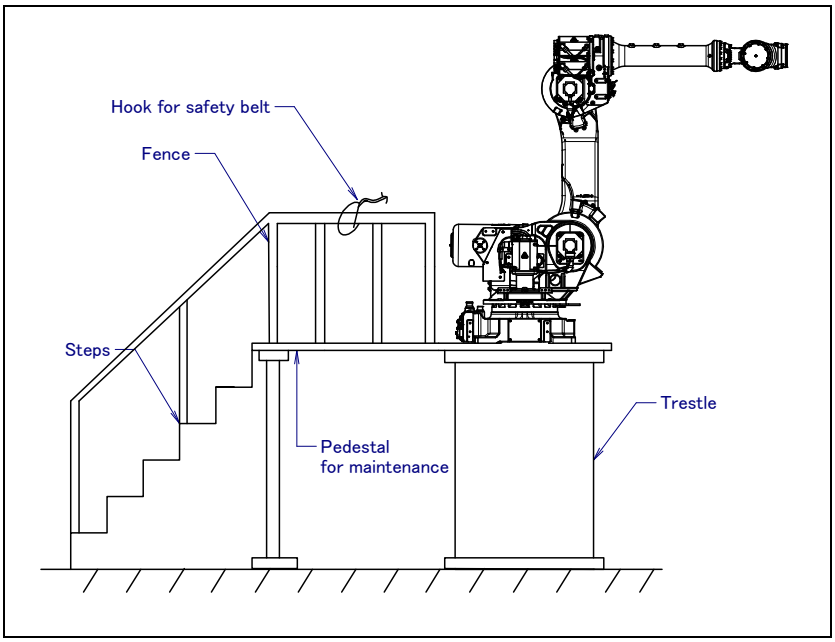


Fig. 3 (c) Pedestal for maintenance

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 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.

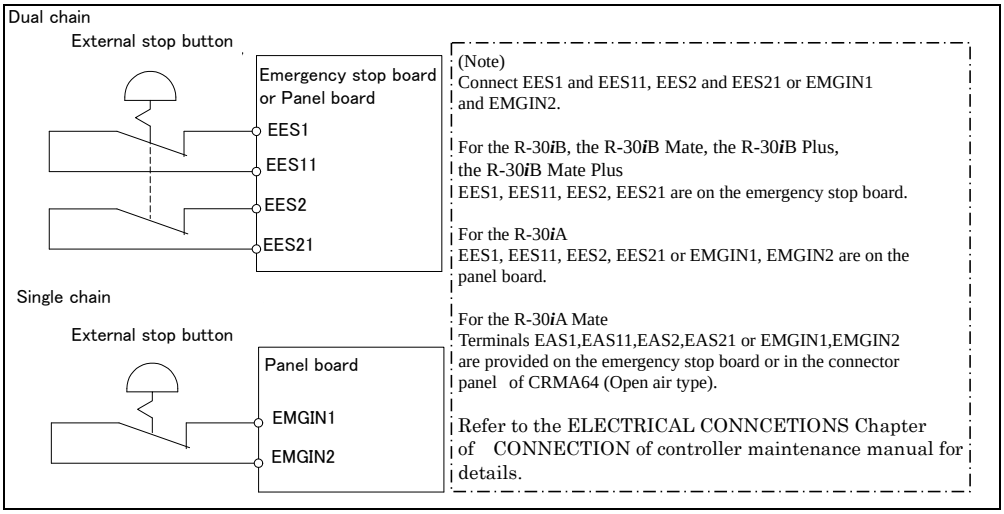


Fig. 3.1 Connection diagram for external emergency stop button

3.2 SAFETY OF THE PROGRAMMER

While teaching the robot, the operator may need to 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. (In case of R-30*i*A Mate Controller standard specification, there is no mode switch. The automatic operation mode and the teach mode is selected by teach pendant enable switch.)

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-30*i*B Plus/R-30*i*B Mate Plus /R-30*i*B/R-30*i*B Mate/R-30*i*A/R-30*i*A 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-30*i*B Plus/R-30*i*B Mate Plus/R-30*i*B/R-30*i*B Mate/R-30*i*A Controller or CE or RIA specification of the R-30*i*A 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-30*i*A 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-30*i*B Plus/R-30*i*B Mate Plus/R-30***i***B/R-30*i*B Mate /R-30*i*A Controller or CE or RIA specification of R-30*i*A 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-2450-J350 (Input voltage AC100-115V single phase) A05B-2450-J351 (Input voltage AC200-240V single phase)
Robot connection cable	A05B-2525-J047(5 m) A05B-2525-J048(10m)
Power cable	A05B-2525-J010(5 m) (AC100-115V Power plug) (*) A05B-2525-J011(10m) (AC100-115V Power plug) (*) A05B-2450-J364(5 m) (AC100-115V or AC200-240V No power plug) A05B-2450-J365(10m) (AC100-115V or AC200-240V No power plug)

(*) These do not support CE marking.

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

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

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

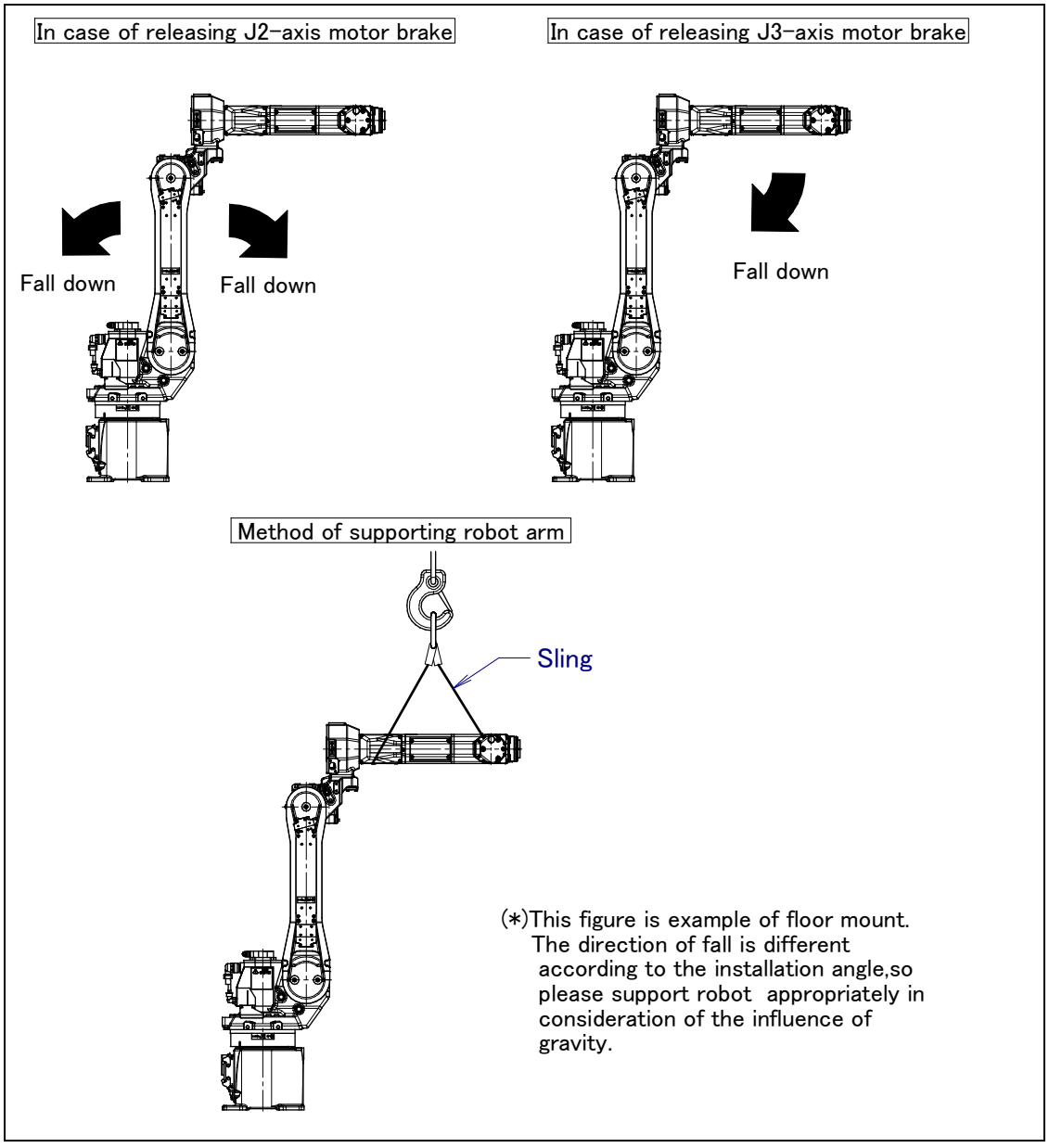


Fig. 5.4 Arm operation by the release of J2/J3-axis motor brake and measures

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 (R-30*i*A, R-30*i*A Mate)

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 motion 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 mechanical problems 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

1 The stopping distance and time of Controlled stop is 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 Controlled stop is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.
2 In multi arm system, the longest stopping distance and time of Controlled Stop among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.
3 In the system which has extended axis, the longer stopping distance and time of Controlled Stop among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator’s manual for considering the stopping distance and time of the extended axis.
4 In case of Controlled stop, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

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-30*i*A				R-30*i*A 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-30*i*A standard (single) does not have servo disconnect.
(**) R-30*i*A 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 "Stop type set (Stop pattern C) (A05B-2500-J570) option 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-30*i*A controller)
SRVO-194 Servo disconnect	Servo disconnect input (SD4-SD41, SD5-SD51) is open. (R-30*i*A controller)
SRVO-218 Ext.E-stop/Servo Disconnect	External emergency stop input (EES1-EES11, EES2-EES21) is open. (R-30*i*A 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 stopping time of Controlled stop is longer than the stopping distance and stopping time 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 stopping 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 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 this option is loaded.

8 STOP TYPE OF ROBOT (R-30*i*B, R-30*i*B Mate)

There are following four types of Stopping Robot.

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 motion path of the deceleration is uncontrolled.
"**Power-Off stop**" performs following processing.

- An alarm is generated, and then the servo power turns off. Instantly the robot stops.
- Execution of the program is paused.

Frequent Power-Off stop of the robot during operation can cause mechanical problems 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.
"**Controlled stop**" performs following processing.

- The alarm "**SRVO-199 Controlled stop**" occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

Smooth stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.
"**Smooth stop**" performs following processing.

- The alarm "**SRVO-289 Smooth Stop**" occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.
- In Smooth stop, the robot decelerates until it stops with the deceleration time shorter than Controlled stop.

Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.
"**Hold**" performs following processing.

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

⚠ WARNING

1 The stopping distance and time of Controlled stop and Smooth 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 Controlled stop or Smooth Stop is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.
2 In multi arm system, the longest stopping distance and time of Controlled Stop or Smooth Stop among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.
3 In the system which has extended axis, the longer stopping distance and time of Controlled Stop or Smooth Stop among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator's manual for considering the stopping distance and time of the extended axis.
4 When Smooth stop occurs during deceleration by Controlled stop, the stop type of robot is changed to Power-Off Stop.
When Smooth stop occurs during deceleration by Hold, the stop type of robot is changed to Power-Off Stop.
5 In case of Controlled stop or Smooth Stop, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

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

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Deadman switch (*)
A	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	-
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
C	AUTO	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
D	AUTO	S-Stop	S-Stop	C-Stop	C-Stop	-
	T1	S-Stop	S-Stop	-	C-Stop	S-Stop
	T2	S-Stop	S-Stop	-	C-Stop	S-Stop

P-Stop: Power-Off stop
C-Stop: Controlled stop
S-Stop: Smooth stop
-: Disable
(*) The stop pattern of NTED input is same as Deadman switch.

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

Option	R-30*i*B/R-30*i*B Mate
Standard	A (**)
Controlled stop by E-Stop (A05B-2600-J570)	C (**)
Smooth E-Stop (A05B-2600-J651)	D (**)

(**) R-30*i*B Mate does not have SVOFF input.

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 is specified, the stop type of the following alarms become 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.
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 those of Power-Off stop, depending on the robot model and axis.

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.

"Smooth E-Stop Function" option

When "**Smooth E-Stop Function**" (A05B-2600-J651) option is specified, the stop type of the following alarms becomes Smooth stop in all operation modes (AUTO, T1 and T2 mode).

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-003 Deadman switch released	Both deadman switches on Teach pendant are released.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-037 IMSTP input (Group: %d)	IMSTP input (*IMSTP signal for a peripheral device interface) is OFF.
SRVO-232 NTED input	NTED input (NTED1-NTED11, NTED2-NTED21) is open.
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.
SRVO-410 DCS SSO NTED input	In DCS Safe I/O connect function, SSO[5] is OFF.
SRVO-419 DCS PROFIsafe comm. error	PROFINET Safety communication error occurs.

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

- In Smooth stop, the robot is stopped along 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 Smooth 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 Smooth stop is longer than those of Power-Off stop, depending on the robot model and axis.

Smooth stop is different from **Controlled stop** as follows:

- The stopping distance and time of Smooth stop is normally shorter than those of Controlled stop, depending on the robot model and axis.

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 Smooth 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.

9 STOP TYPE OF ROBOT (R-30*i*B Plus, R-30*i*B Mate Plus)

There are following three types of Stop Category.

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

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

"**Stop Category 0**" performs following processing.

- An alarm is generated, and then the servo power turns off. Instantly the robot stops.
- Execution of the program is paused.

Frequent Category 0 Stop of the robot during operation can cause mechanical problems of the robot. Avoid system designs that require routine or frequent Category 0 Stop conditions.

Stop Category 1 following IEC 60204-1 (Controlled Stop, Smooth Stop)

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

"**Stop Category 1**" performs following processing.

- The alarm "**SRVO-199 Controlled stop**" or "**SRVO-289 Smooth Stop**" occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

In Smooth stop, the robot decelerates until it stops with the deceleration time shorter than Controlled stop. The stop type of Stop Category 1 is different according to the robot model or option configuration. Please refer to the operator's manual of a particular robot model.

Stop Category 2 following IEC 60204-1 (Hold)

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

"**Stop Category 2**" performs following processing.

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

⚠ WARNING

1 The stopping distance and time of Stop Category 1 are longer than those of Stop Category 0. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time is necessary when Stop Category 1 is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.
2 In multi arm system, the longest stopping distance and time of Stop Category 1 among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.
3 In the system which has extended axis, the longer stopping distance and time of Stop Category 1 among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator's manual for considering the stopping distance and time of the extended axis.
4 When Stop Category 1 occurs during deceleration by Stop Category 2, the stop type of robot is changed to Stop Category 0.
5 In case of Stop Category 1, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Stop Category 0 or Stop Category 1. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Deadman switch (*)
A	AUTO	Category 0	Category 0	Category 1	Category 1	-
	T1	Category 0	Category 0	-	Category 1	Category 0
	T2	Category 0	Category 0	-	Category 1	Category 0
C	AUTO	Category 1	Category 1	Category 1	Category 1	-
	T1	Category 0	Category 0	-	Category 1	Category 0
	T2	Category 0	Category 0	-	Category 1	Category 0
D	AUTO	Category 1	Category 1	Category 1	Category 1	-
	T1	Category 1	Category 1	-	Category 1	Category 1
	T2	Category 1	Category 1	-	Category 1	Category 1

Category 0: Stop Category 0
Category 1: Stop Category 1
-: Disable
(*) The stop pattern of NTED input is same as Deadman switch.

The following table indicates the Stop pattern according to the controller type or option configuration.
The case R651 is specified.

Option	R-30*i*B Plus/ R-30*i*B Mate Plus
Standard	C (**)
Old Stop Function (A05B-2670-J680)	A (**)
All Smooth Stop Function (A05B-2670-J651)	D (**)

The case R650 is specified.

Option	R-30*i*B Plus/ R-30*i*B Mate Plus
Standard	A (**)
Stop Category 1 by E-Stop (A05B-2670-J521)	C (**)
All Smooth Stop Function (A05B-2670-J651)	D (**)

(**) R-30*i*B Mate Plus does not have SVOFF input.

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.

"Old Stop Function" option

When "**Old Stop Function**" (A05B-2670-J680) option is specified, the stop type of the following alarms becomes Stop Category 0 in AUTO mode.

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.
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.

Stop Category 0 is different from **Stop Category 1** as follows:

- In Stop Category 0, servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.
- The stopping distance and time of Stop Category 0 is shorter than those of Stop Category 1, depending on the robot model and axis.

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.

"All Smooth Stop Function" option

When "**All Smooth Stop Function**" (A05B-2670-J651) option is specified, the stop type of the following alarms becomes Stop Category 1 in all operation modes (AUTO, T1 and T2 mode).

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-003 Deadman switch released	Both deadman switches on Teach pendant are released.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-037 IMSTP input (Group: %d)	IMSTP input (*IMSTP signal for a peripheral device interface) is ON.
SRVO-232 NTED input	NTED input (NTED1-NTED11, NTED2-NTED21) is open.
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.
SRVO-410 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[5] is OFF.
SRVO-419 DCS PROFIsafe comm. error	PROFINET Safety communication error occurs.

Stop Category 1 is different from **Stop Category 0** as follows:

- In Stop Category 1, the robot is stopped along 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 Stop Category 1, physical impact is less than Stop Category 0. 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 Stop Category 1 is longer than those of Stop Category 0, depending on the robot model and axis.

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 Stop Category 1 are longer than those of Stop Category 0. 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.

"Stop Category 1 by E-Stop" option

When "**Stop Category 1 by E-Stop**" (A05B-2670-J521) option is specified, the stop type of the following alarms become Category 1 Stop but only in AUTO mode. In T1 or T2 mode, the stop type is Category 0 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.
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.

Stop Category 1 is different from **Stop Category 0** as follows:

- In Stop Category 1, the robot is stopped along 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 Stop Category 1, physical impact is less than Stop Category 0. 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 Stop Category 1 is longer than those of Stop Category 0, depending on the robot model and axis.

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 Stop Category 1 are longer than those of Stop Category 0. 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.

10 WARNING & CAUTION LABEL

(1) Greasing and degreasing label

Fig. 10 (a) Greasing and degreasing label

Description

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

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

> ⚠ **CAUTION**
> See Section 7.3 or 8.3 for explanations about specified grease, grease amount, and the locations of grease and degrease outlets for individual models.

(2) Step-on prohibitive label

Fig. 10 (b) Step-on prohibitive label

Description

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

(3) High-temperature warning label

Fig. 10 (c) High-temperature warning label

Description

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

(4) Transportation label

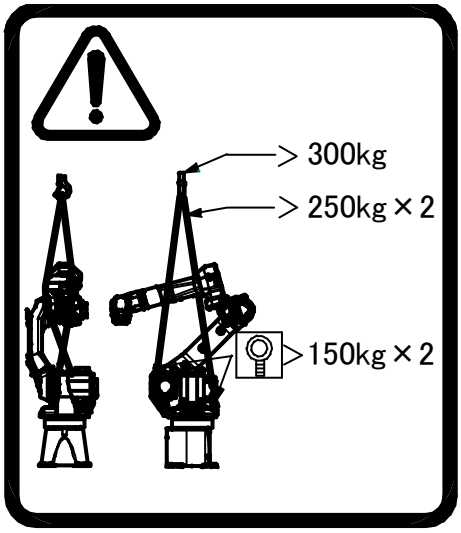


Fig. 10 (d) Transportation label

Description

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

(1) Using a crane

- Use a crane with a load capacity of 300kg or greater.
- Use two slings with each load capacity of 250kg or greater, sling the robot as shown Chapter 1 of operator's manual.
- Use two M10 eyebolts with each allowable load of 1470N (150kgf) or greater.

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

(5) Transportation caution label (When transport equipment option A05B-1221-H072 is specified.)

Fig. 10 (e) Transportation caution label

Description

Keep the following in mind when transporting the robot.

(1) Prevent the forks of the forklift from having impact on a transport equipment
(2) Do not thread a chain or the like through transport equipment.

(6) High current attention label

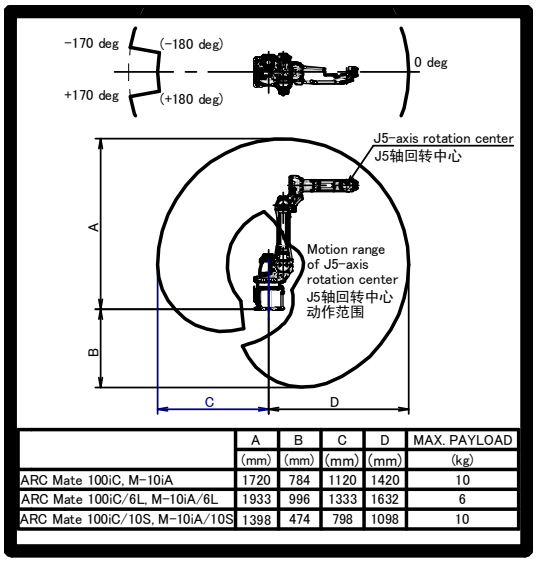
Fig. 10 (f) High current attention Label

Description

Do not access during energized high current inside.

(7) Operating space and payload mark label

Below label is added when CE specification is specified.



	A	B	C	D	MAX. PAYLOAD
	(mm)	(mm)	(mm)	(mm)	(kg)
ARC Mate 100iC, M-10iA	1720	784	1120	1420	10
ARC Mate 100iC/6L, M-10iA/6L	1933	996	1333	1632	6
ARC Mate 100iC/10S, M-10iA/10S	1398	474	798	1098	10

Fig. 10 (g) Operating space and payload mark label

170802

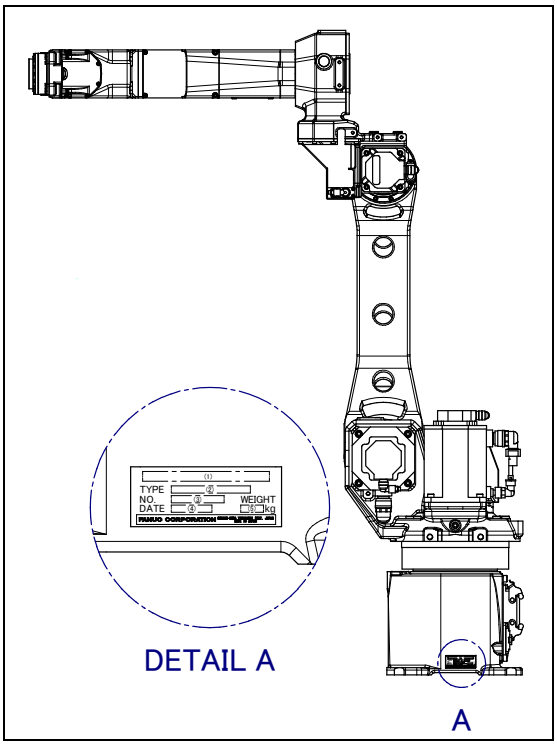
PREFACE

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

Model name	Mechanical unit specification No.	Max. payload
FANUC Robot ARC Mate 100*i*C (With all axes brakes)	A05B-1221-B201	3kg or 6kg or 10kg
	A05B-1221-B401	
FANUC Robot M-10*i*A (With all axes brakes)	A05B-1221-B202	3kg or 6kg or 10kg
	A05B-1221-B402	
FANUC Robot ARC Mate 100*i*C/6L (With all axes brakes)	A05B-1221-B301	3kg or 6kg
	A05B-1221-B501	
FANUC Robot M-10*i*A/6L (With all axes brakes)	A05B-1221-B302	3kg or 6kg
	A05B-1221-B502	
FANUC Robot ARC Mate 100*i*C/10S (With all axes brakes)	A05B-1221-B601	3kg or 10kg
FANUC Robot M-10*i*A/10S (With all axes brakes)	A05B-1221-B602	
FANUC Robot ARC Mate 100*i*Ce (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B451	3kg or 6kg or 10kg
FANUC Robot M-10*i*Ae (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B452	3kg or 6kg or 10kg
FANUC Robot ARC Mate 100*i*Ce/6L (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B551	3kg or 6kg
FANUC Robot M-10*i*Ae/6L (NOTE) (With J2 and J3-axis brakes)	A05B-1221-B552	3kg or 6kg
FANUC Robot M-10*i*A/10M (With all axes brakes)	A05B-1221-B702	10kg
FANUC Robot M-10*i*A/10MS (With all axes brakes)	A05B-1221-B902	10kg

NOTE
These robot cannot support Wall & Angle mount.

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



Position of label indicating mechanical unit specification number

TABLE 1)

	(1)	(2)	(3)	(4)	(5)
CONTENTS	**Model name**	**TYPE**	**No.**	**DATE**	**WEIGHT kg (Without controller)**
LETTERS	FANUC Robot ARC Mate 100*i*C	A05B-1221-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	130
		A05B-1221-B401			
	FANUC Robot M-10*i*A	A05B-1221-B202			130
		A05B-1221-B402			
	FANUC Robot ARC Mate 100*i*C/6L	A05B-1221-B301			135
		A05B-1221-B501			
	FANUC Robot M-10*i*A/6L	A05B-1221-B302			135
		A05B-1221-B502			
	FANUC Robot ARC Mate 100*i*C/10S	A05B-1221-B601			130
	FANUC Robot M-10*i*A/10S	A05B-1221-B602			130
	FANUC Robot ARC Mate 100*i*Ce	A05B-1221-B451			130
	FANUC Robot M-10*i*Ae	A05B-1221-B452			130
	FANUC Robot ARC Mate 100*i*Ce/6L	A05B-1221-B551			135
	FANUC Robot M-10*i*Ae/6L	A05B-1221-B552			135
	FANUC Robot M-10*i*A/10M	A05B-1221-B702			130
	FANUC Robot M-10*i*A/10MS	A05B-1221-B902			130

RELATED MANUALS

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

SAFETY HANDBOOK B-80687EN All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers: Operator, system designer Topics: Safety items for robot system design, operation, maintenance
R-30*i*A controller	Operator's Manual HANDLING TOOL **B-83124EN-2** ARC TOOL **B-83124EN-3** DISPENSE TOOL **B-83124EN-4** ALARM CODE LIST **B-83124EN-6**	Intended readers: Operator, programmer, maintenance engineer, system designer Topics: Robot functions, operations, programming, setup, interfaces, alarms Use: Robot operation, teaching, system design
	Maintenance Manual **B-82595EN** **B-82595EN-1 (For Europe)** **B-82595EN-2 (For RIA)**	Intended readers: Maintenance engineer, system designer Topics: Installation, connection to peripheral equipment, maintenance Use: Installation, start-up, connection, maintenance
R-30*i*A Mate controller	Operator's Manual LR HANDLING TOOL **B-83134EN-1** LR ARC TOOL **B-83134EN-2** ALARM CODE LIST **B-83124EN-6**	Intended readers: Operator, programmer, maintenance engineer, system designer Topics: Robot functions, operations, programming, setup, interfaces, alarms Use: Robot operation, teaching, system design
	Maintenance Manual **B-82725EN** **B-82725EN-1 (For Europe)** **B-82725EN-2 (For RIA)**	Intended readers: Maintenance engineer, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance

R-30*i*B/ **R-30*i*B Mate/** **R-30*i*B Plus/** **R-30*i*B Mate Plus** **controller**	Operations manual (Basic Operation) **B-83284EN** Operations manual (Alarm Code List) **B-83284EN-1** Operations manual (Optional Function) **B-83284EN-2** ARC WELDING FUNCTION Operations manual **B-83284EN-3** Spot WELDING FUNCTION Operations manual **B-83284EN-4** DISPENSE FUNCTION Operations manual **B-83284EN-5**	Intended readers: Operator, programmer, maintenance engineer, system designer Topics: Robot functions, operations, programming, setup, interfaces, alarms Use: Robot operation, teaching, system design
	Maintenance manual **R-30*i*B, R-30*i*B Plus :** **B-83195EN** **R-30*i*B Mate, R-30*i*B Mate Plus:** **B-83525EN**	Intended readers: Maintenance engineer, system designer Topics: Installation, start-up, connection, maintenance Use: Installation, start-up, connection, maintenance

NOTE

ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L is not applied to the R-30*i*B controller. M-10*i*A/10M, M-10*i*A/10MS is not applied to the R-30*i*A/R-30*i*A Mate controller.

Following words is used in this manual.

Name	Words in this manual
Connection cable between the robot and the 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 7
1.2.1 Installation Method 8
1.2.2 Angle of Mounting Surface Setting 10
1.3 MAINTENANCE AREA 12
1.4 INSTALLATION CONDITIONS 12

2 CONNECTION WITH THE CONTROLLER 13
2.1 CONNECTION WITH THE CONTROLLER 13

3 BASIC SPECIFICATIONS 14
3.1 ROBOT CONFIGURATION 14
3.2 MECHANICAL UNIT OPERATING SPACE AND OPERATING SPACE 20
3.3 ZERO POINT POSITION AND MOTION LIMIT 25
3.4 MOTION RANGE ACCORDING TO CABLE INTEGRATION 32
3.5 WRIST LOAD CONDITIONS 33

4 EQUIPMENT INSTALLATION TO THE ROBOT 38
4.1 END EFFECTOR INSTALLATION TO WRIST 38
4.2 EQUIPMENT MOUNTING FACE 40
4.3 LOAD SETTING 46
4.4 MAX PAYLOAD SHIFT FUNCTION 48
4.4.1 Method of Executing KAREL Program by Using “Call program” 50
4.4.2 Method of Executing KAREL Program Directly 52

5 PIPING AND WIRING TO THE END EFFECTOR 54
5.1 AIR SUPPLY (OPTION) 55
5.2 AIR PIPING (OPTION) 56
5.3 INTERFACE FOR OPTION CABLE (OPTION) 57

6 AXIS LIMIT SETUP 70
6.1 CHANGE AXIS LIMIT BY DCS (OPTION) 71
6.2 ADJUSTABLE MECHANICAL STOPPER SETTING (OPTION) 74
6.2.1 Installing the Adjustable Mechanical Stopper 74
6.2.2 Changing the Parameter Setting 76

7 CHECKS AND MAINTENANCE (EXCEPT M-10*i*A/10M/10MS) 77
7.1 CHECKS AND MAINTENANCE 77

7.1.1 Daily Checks 77
7.1.2 Periodic Check and Maintenance 78
7.2 CHECK POINTS 81
7.2.1 Confirmation of Oil Seepage 81
7.2.2 Confirmation of the Air Control Set 82
7.2.3 Check the Oil Sight Glasses 82
7.2.4 Check the Failure of the Wrist Part Fluoric Resin Ring 83
7.2.5 Check the Mechanical Unit Cables and Connectors 84
7.2.6 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper 86
7.3 MAINTENANCE 87
7.3.1 Replacing the Batteries (1 year (3840 hours) or (1.5 year (5760 hours) checks) 87
7.3.2 Replacing the Grease and Oil of the Drive Mechanism (3-Year (11520 Hours) Checks) 89
7.3.2.1 Grease replacement procedure for J1 to J3-axis reducer 89
7.3.2.2 Procedure for releasing remaining pressure from the grease bath (J1 to J3-axis) 92
7.3.2.3 Oil replacement procedure for J4-axis gearbox 92
7.3.2.4 Oil replacement procedure for J5/J6-axis gearbox 96
7.3.2.5 Procedure for releasing remaining pressure from oil bath (J4 to J6-axis) 100
7.4 STORAGE 100

8 CHECKS AND MAINTENANCE (M-10*i*A/10M/10MS) 101

8.1 CHECKS AND MAINTENANCE 101
8.1.1 Daily Checks 101
8.1.2 Periodic Checks and Maintenance 102
8.2 CHECK POINTS 104
8.2.1 Confirmation of Oil Seepage 104
8.2.2 Confirmation of the Air Control Set 105
8.2.3 Check the Mechanical Unit Cables and Connectors 106
8.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper 108
8.3 MAINTENANCE 109
8.3.1 Replacing the Batteries (1-Year Checks) 109
8.3.2 Greasing 110
8.3.3 Replacing the Grease of the Drive Mechanism (3-Year (11520 Hours) Checks) 111
8.3.3.1 Grease replacement procedure for J1 to J3-axis reducer 112
8.3.3.2 Procedure for releasing remaining pressure from the grease bath (J1 to J3-axis) 114
8.3.3.3 Grease replacement procedure for J4/J5-axis gearbox 114
8.3.3.4 Procedure for releasing remaining pressure from the grease bath (J4 to J6-axis) 116
8.4 STORAGE 116

9 MASTERING 117

9.1 OVERVIEW 117
9.2 RESETTING ALARMS AND PREPARING FOR MASTERING 121
9.3 ZERO POSITION MASTERING 122
9.4 QUICK MASTERING 128
9.5 QUICK MASTERING FOR SINGLE AXIS 130
9.6 SINGLE AXIS MASTERING 132
9.7 MASTERING DATA ENTRY 134
9.8 VERIFYING MASTERING 136

10 TROUBLESHOOTING 137
10.1 TROUBLESHOOTING 137
10.2 CHANGE THE COLLISION DETECTION PARAMETER 144

11 M/H CONDUIT (OPTION) 145
11.1 NOTES FOR ASSEMBLING CABLES TO M/H CONDUIT 145
11.2 WRIST CABLE KIT 146
11.3 OTHER NOTES 149

12 NO DUST M/H CONDUIT (OPTION) 150

13 TIG WELDING OPTION 154

APPENDIX

A PERIODIC MAINTENANCE TABLE 157

B STRENGTH OF BOLT AND BOLT TORQUE LIST 162

C INSULATION ABOUT ARC WELDING ROBOT 163
C.1 INSULATION AT THE WRIST 163

D CONTROL OF MULTIPLE ROBOTS 164

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

Use a crane or a forklift to transport the robot. When transporting the robot, be sure to change the posture of the robot to that shown in the following and lift it by using the eyebolts and the transport equipment properly.

> ⚠ **WARNING**
> 1 When hoisting or lowering the robot with a crane, move it slowly and with great care. When placing the robot on the floor, exercise care to prevent the installation surface of the robot from striking the floor with too much force.
> 2 The robot becomes unstable when it is transported with the end effector or equipment is installed. Make sure to remove the end effector when the robot is transported. (Except light cargo such as welding torch or wire feeder).
> 3 Use the forklift pockets only to transport the robot with a forklift. Do not use the forklift pockets to secure the robot.
> 4 Before moving the robot by using crane, check and tighten any loose bolts on the forklift pockets.
> 5 Do not pull eyebolts sideways.

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

> **NOTE**
> If an over travel alarm is issued at 1, hold down the shift key and press the alarm reset key. Then, while holding down the shift key, feed the J2 and J3-axis sections to such a position, using JOINT, that the over travel condition is released.

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

2) Transportation using a crane (Fig. 1.1 (a) to (e))
Fasten the M10 eyebolts to the two points of the robot base and lift the robot by the two slings. In this case, please intersect and hang two slings as shown in figure.

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

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

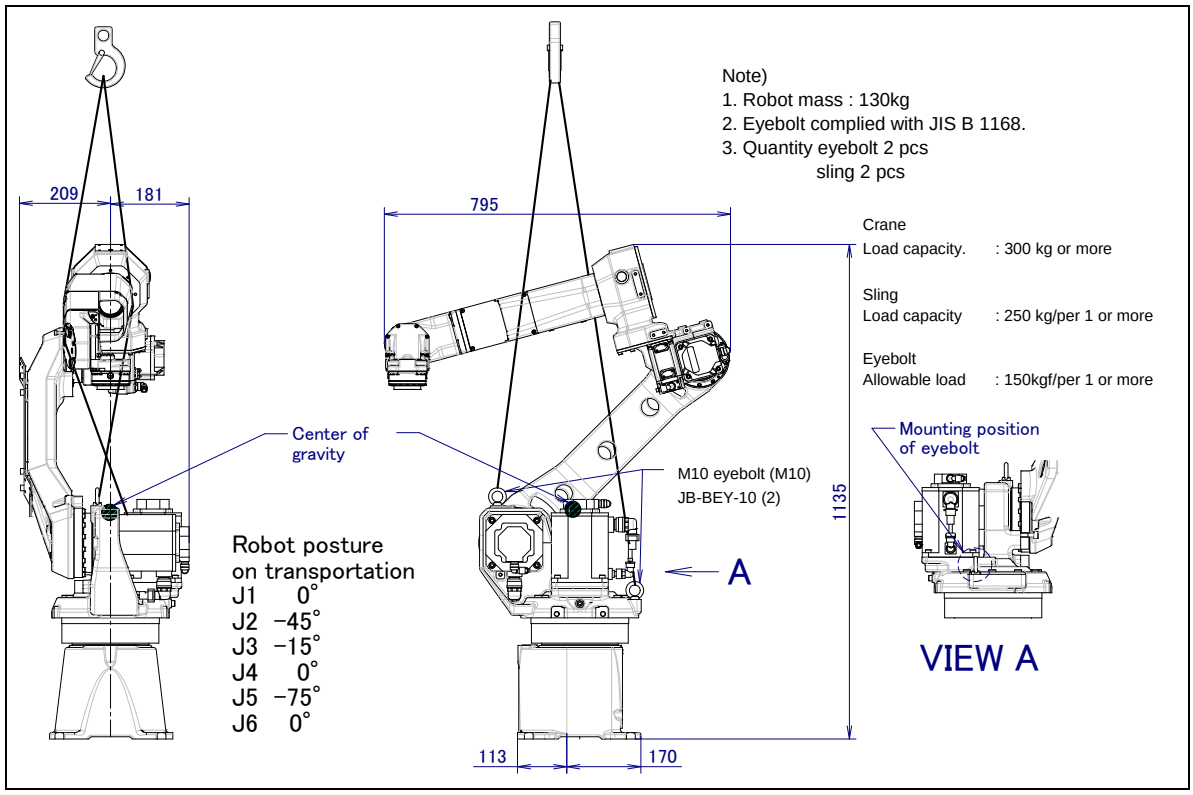


Fig. 1.1 (a) Transportation using a crane (ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*Ce, M-10*i*Ae)

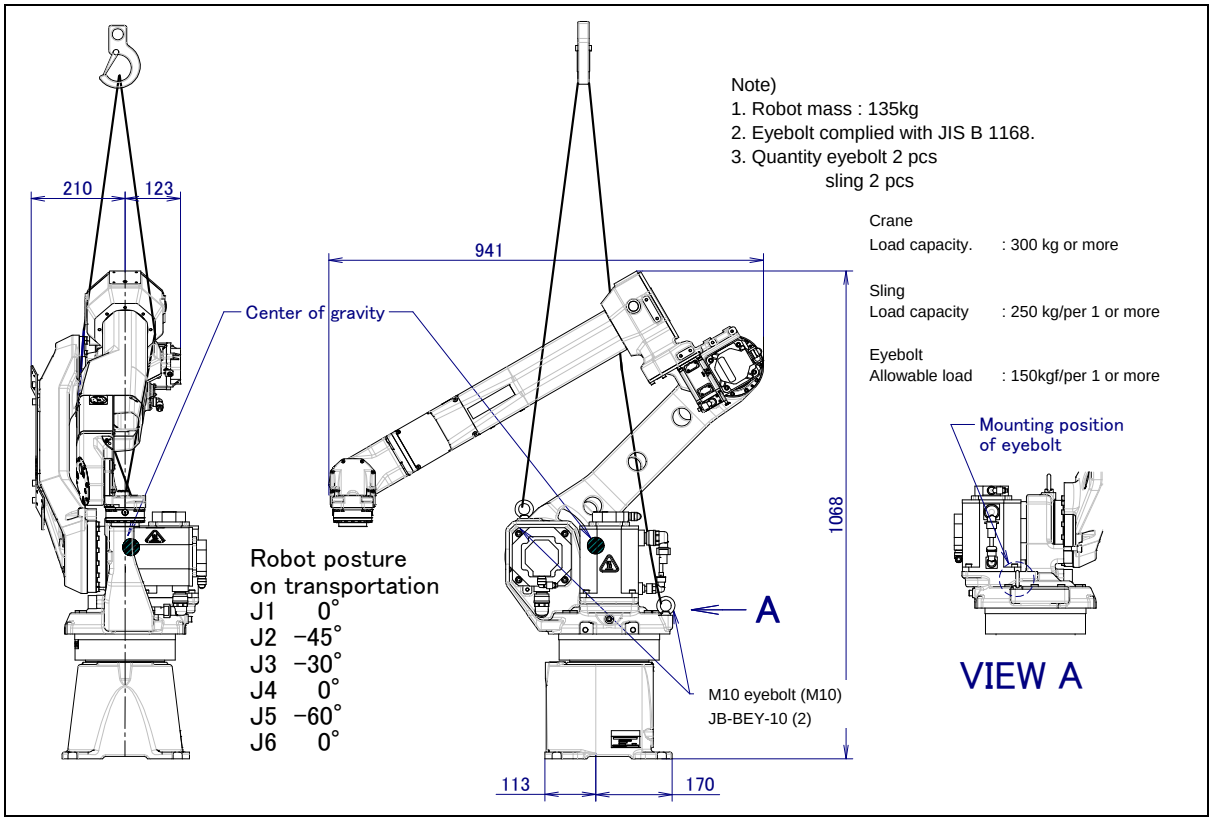


Fig. 1.1 (b) Transportation using a crane (ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

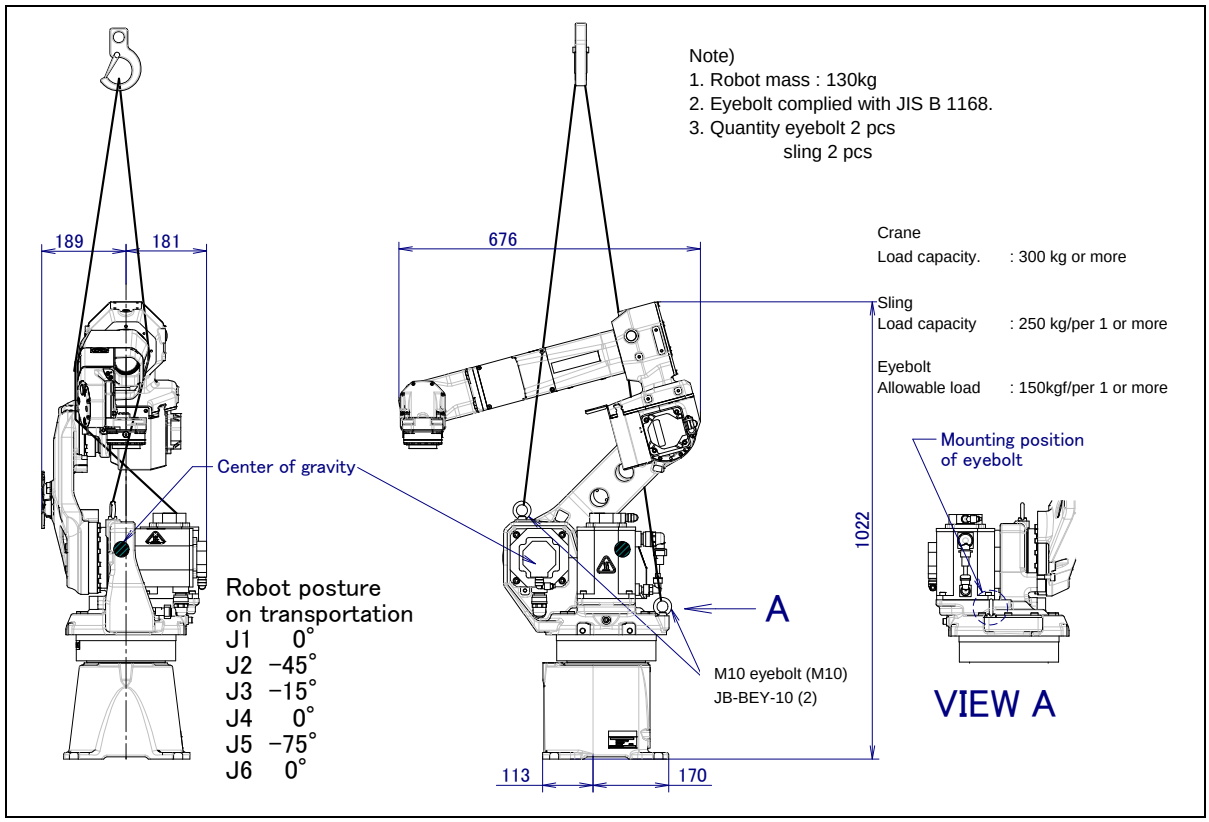


Fig. 1.1 (c) Transportation using a crane (ARC Mate 100*i*C/10S, M-10*i*A/10S)

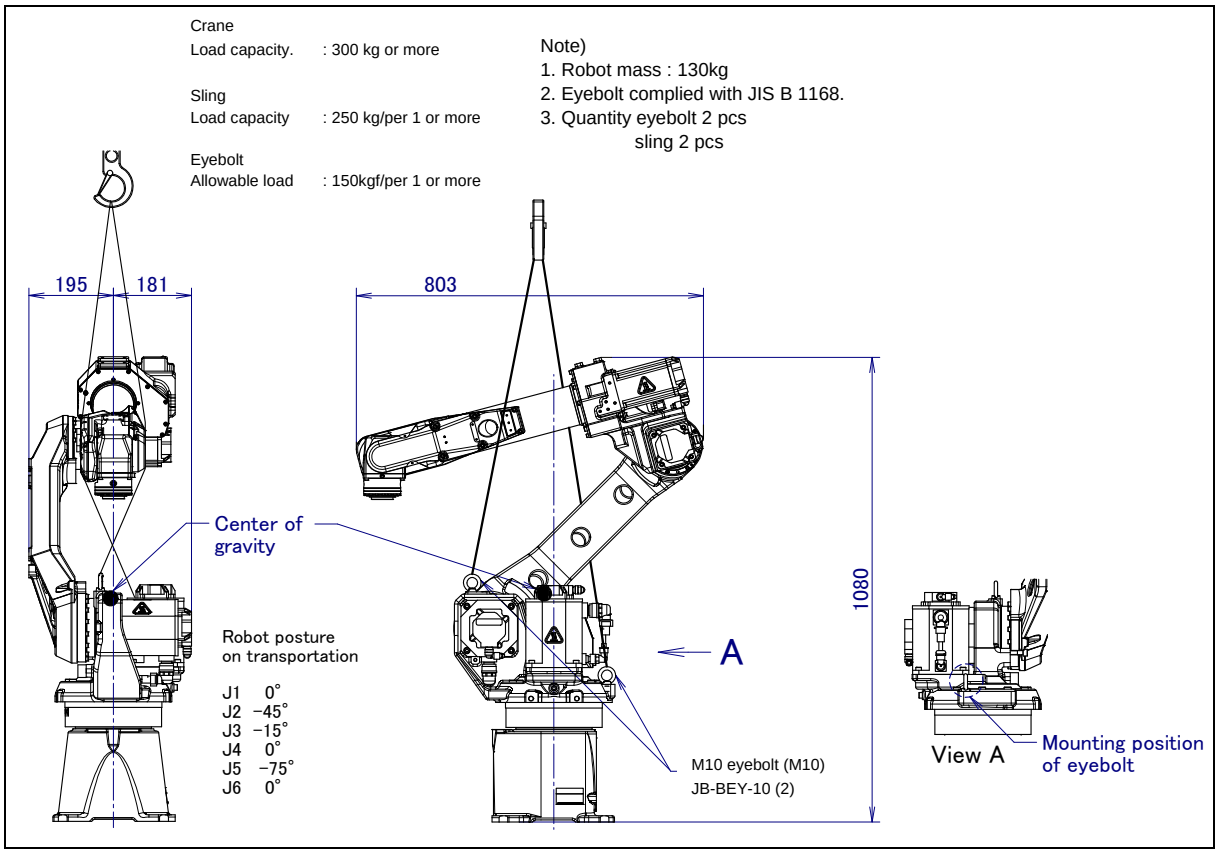


Fig. 1.1 (d) Transportation using a crane (M-10*i*A/10M)

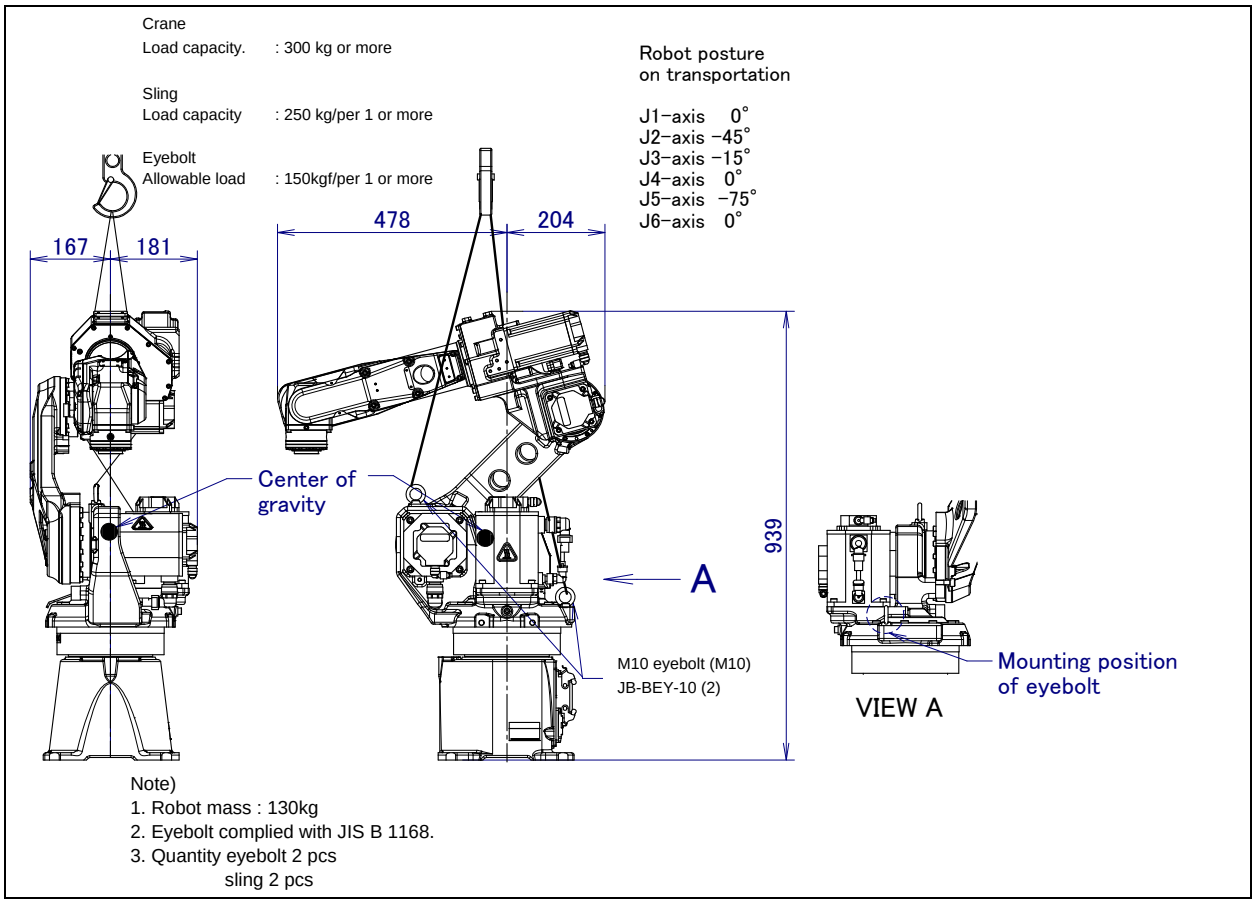


Fig. 1.1 (e) Transportation using a crane (M-10*i*A/10MS)

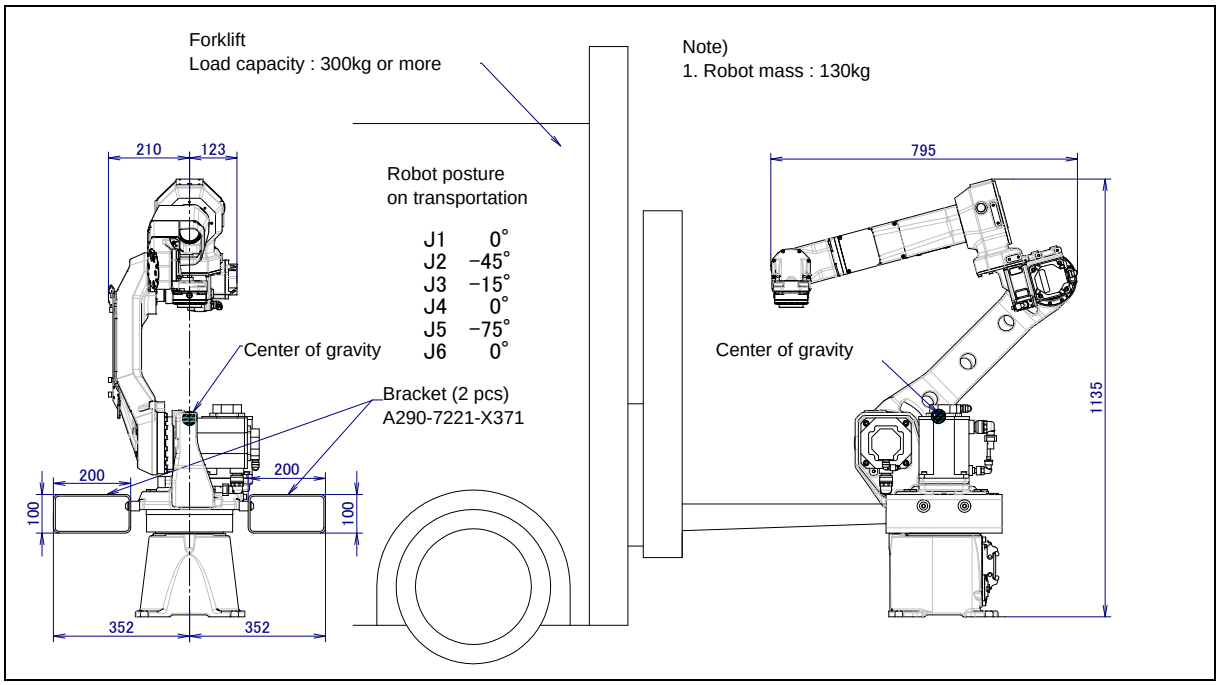


Fig. 1.1 (f) Transportation using a forklift (ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*Ce, M-10*i*Ae)

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

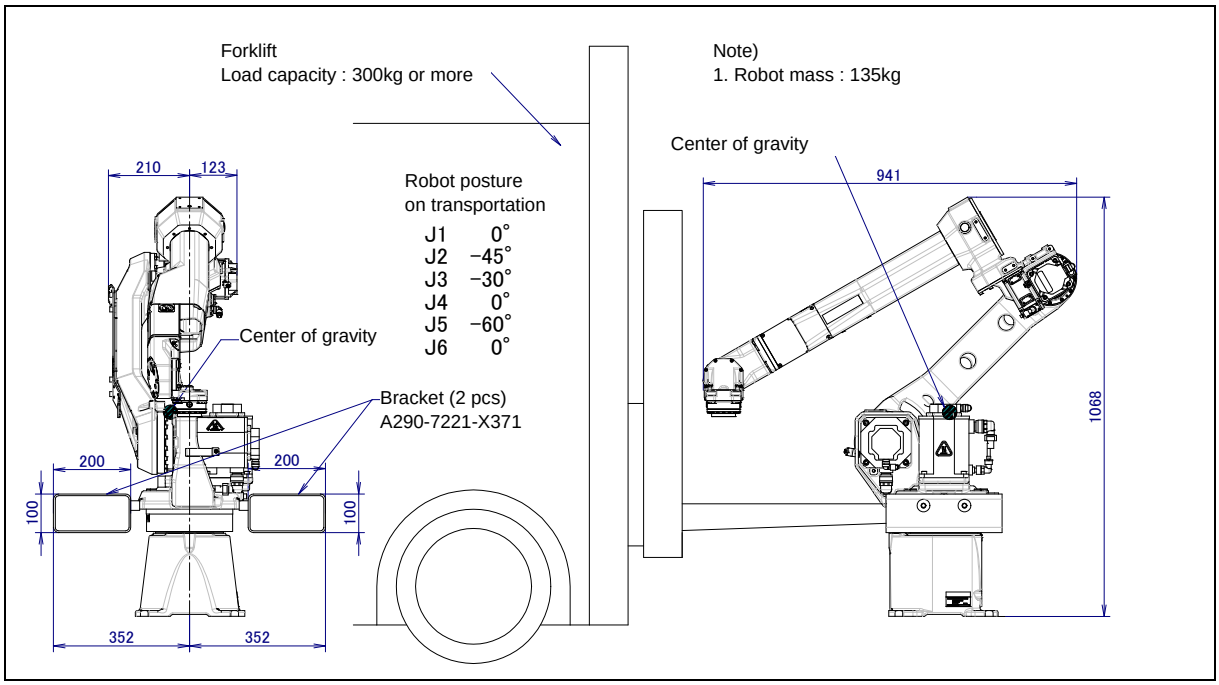


Fig. 1.1 (g) Transportation using a forklift (ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

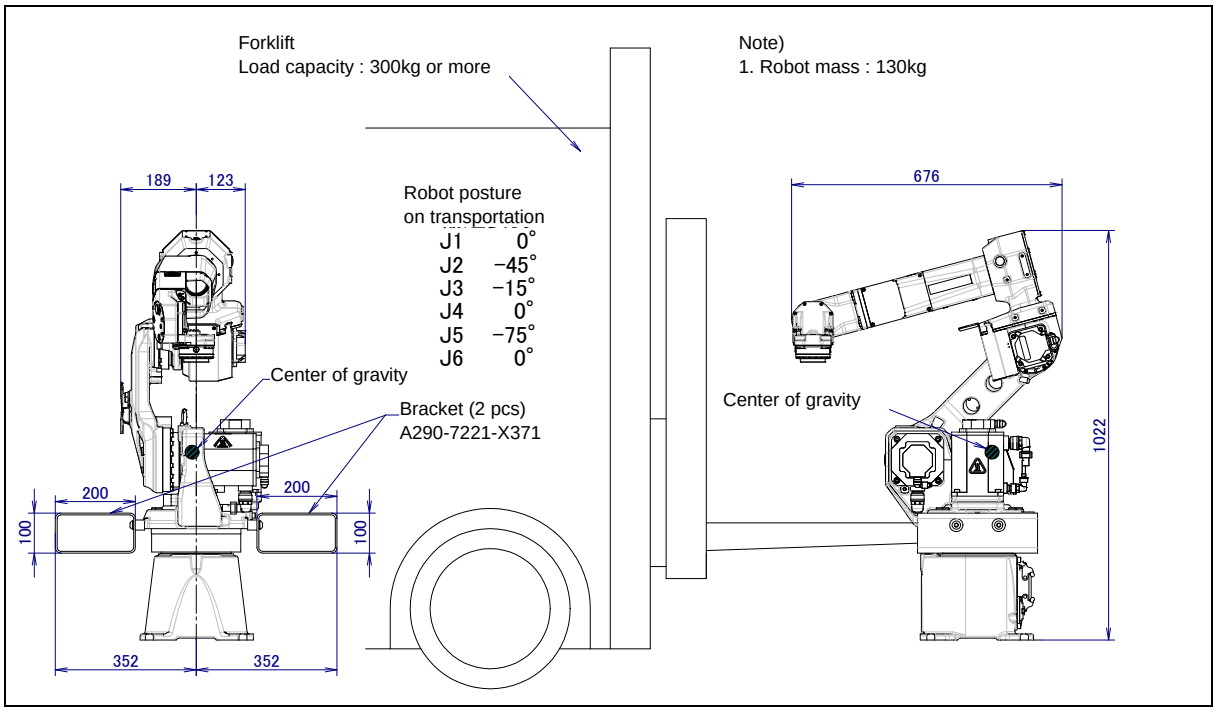


Fig. 1.1 (h) Transportation using a forklift (ARC Mate 100*i*C/10S, M-10*i*A/10S)

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

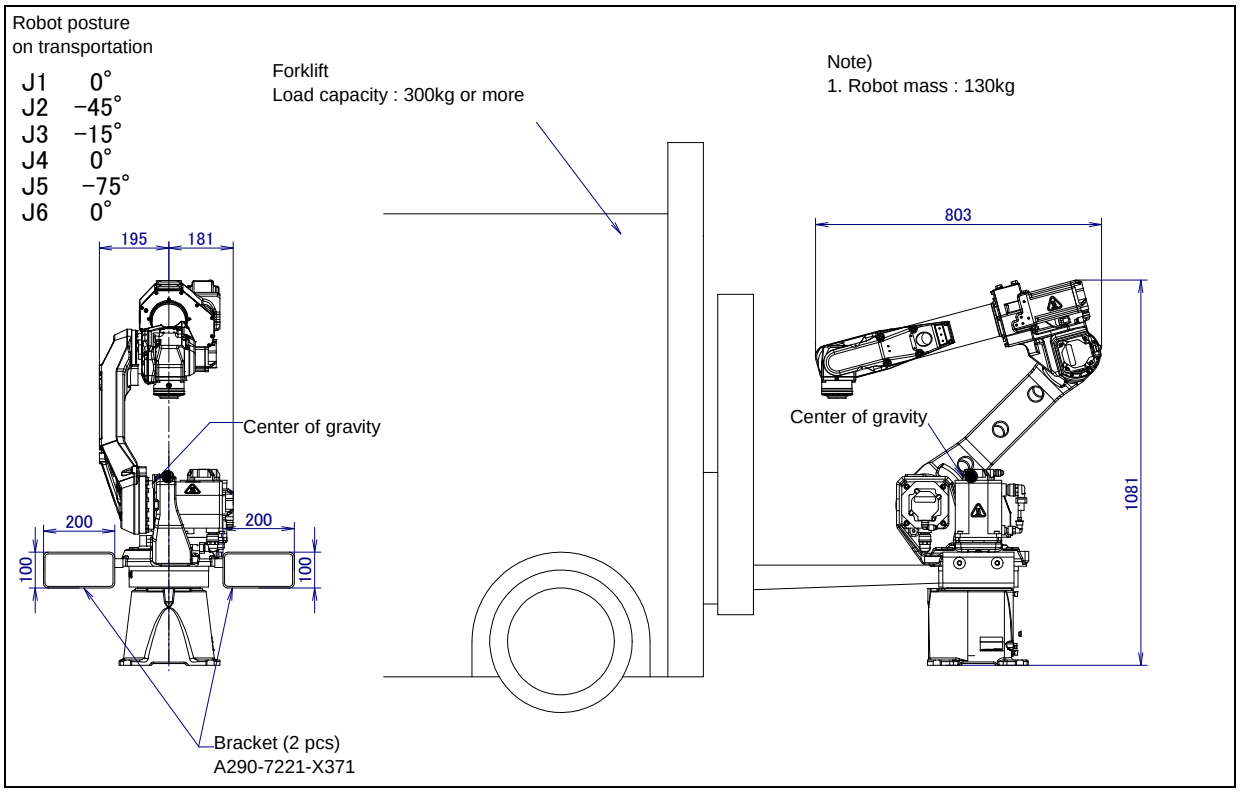


Fig. 1.1 (i) Transportation using a forklift (M-10*i*A/10M)

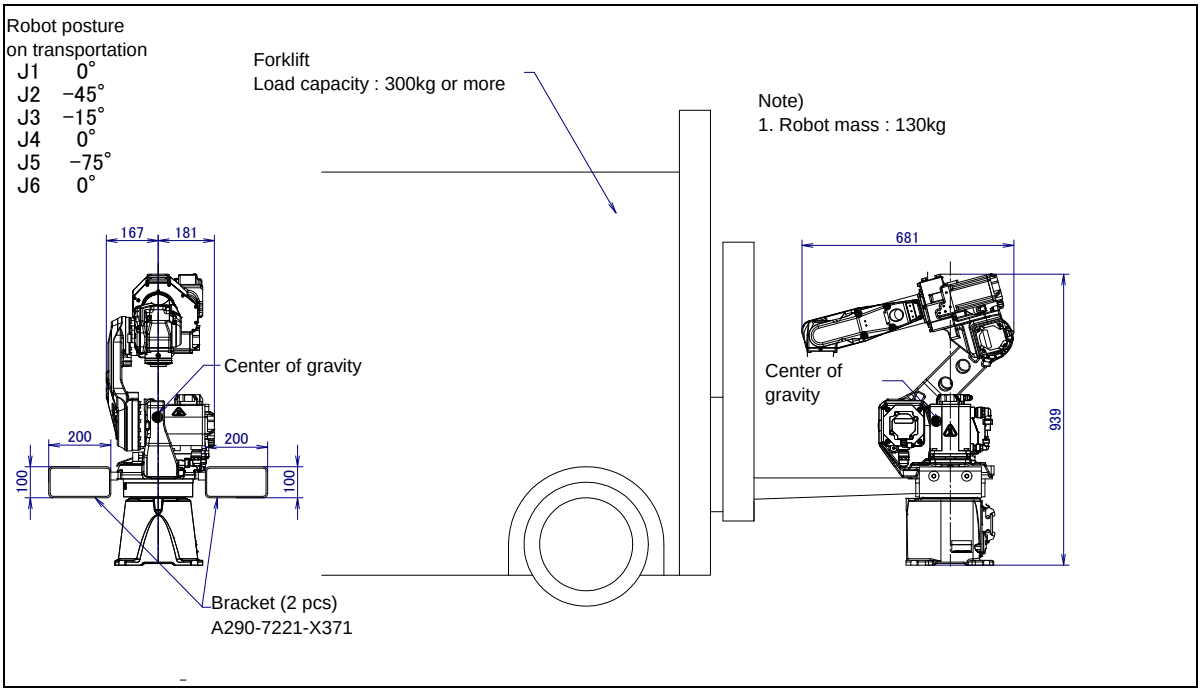


Fig. 1.1 (j) Transportation using a forklift (M-10*i*A/10MS)

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

1.2 INSTALLATION

Fig. 1.2 shows the robot base dimensions. Avoid placing any object in front of the robot on the locating surface to facilitate the installation of the mastering fixture.

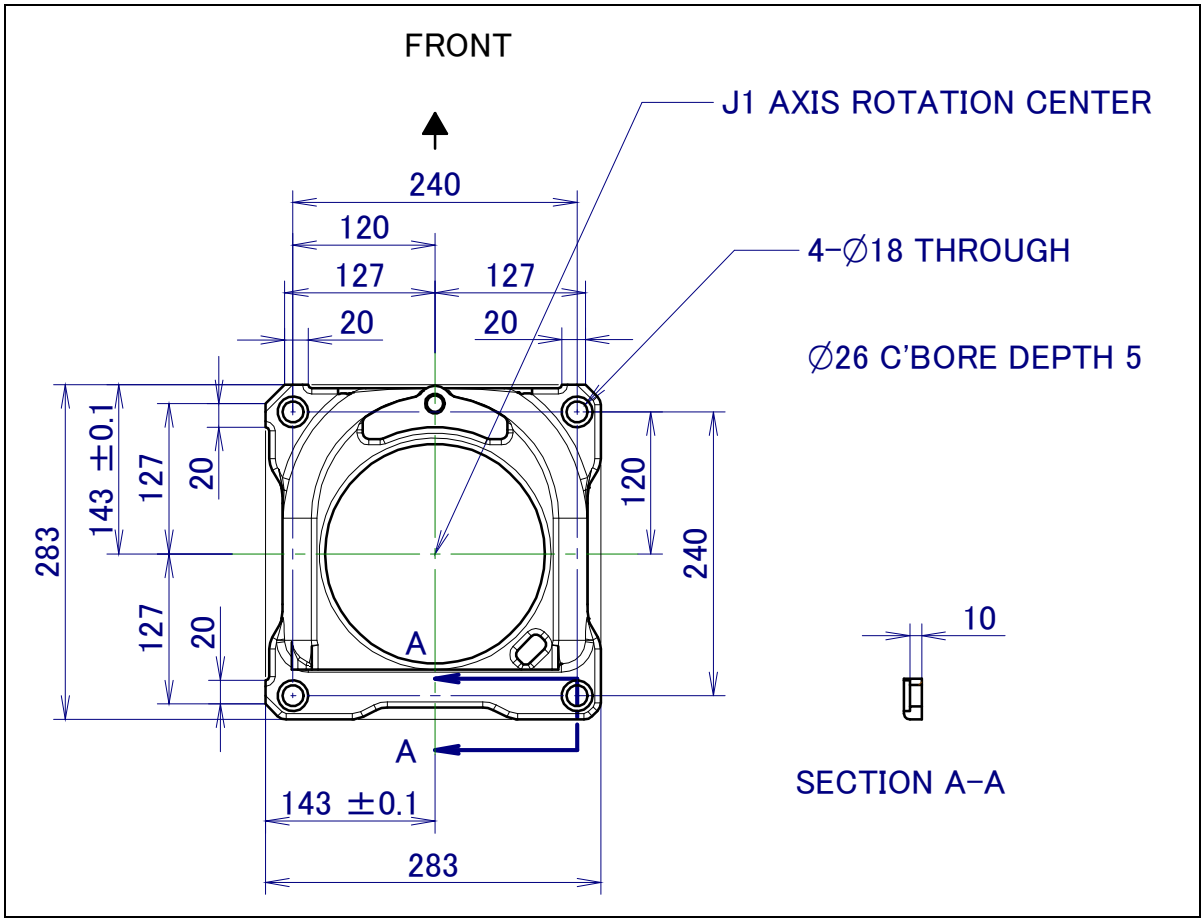


Fig. 1.2 Dimensions of the robot base

1.2.1 Installation Method

Fig. 1.2.1 (a) shows an example of installing the robot. In this example, the floor plate is fixed with four M20 chemical anchors (tensile strength 400N/mm^2 or more), and the robot base is fastened to the floor plate with four M16 x 35 bolts (tensile strength 1200N/mm^2 or more). If compatibility must be maintained in teaching the robot after the robot mechanical unit is replaced, use the locating surface.

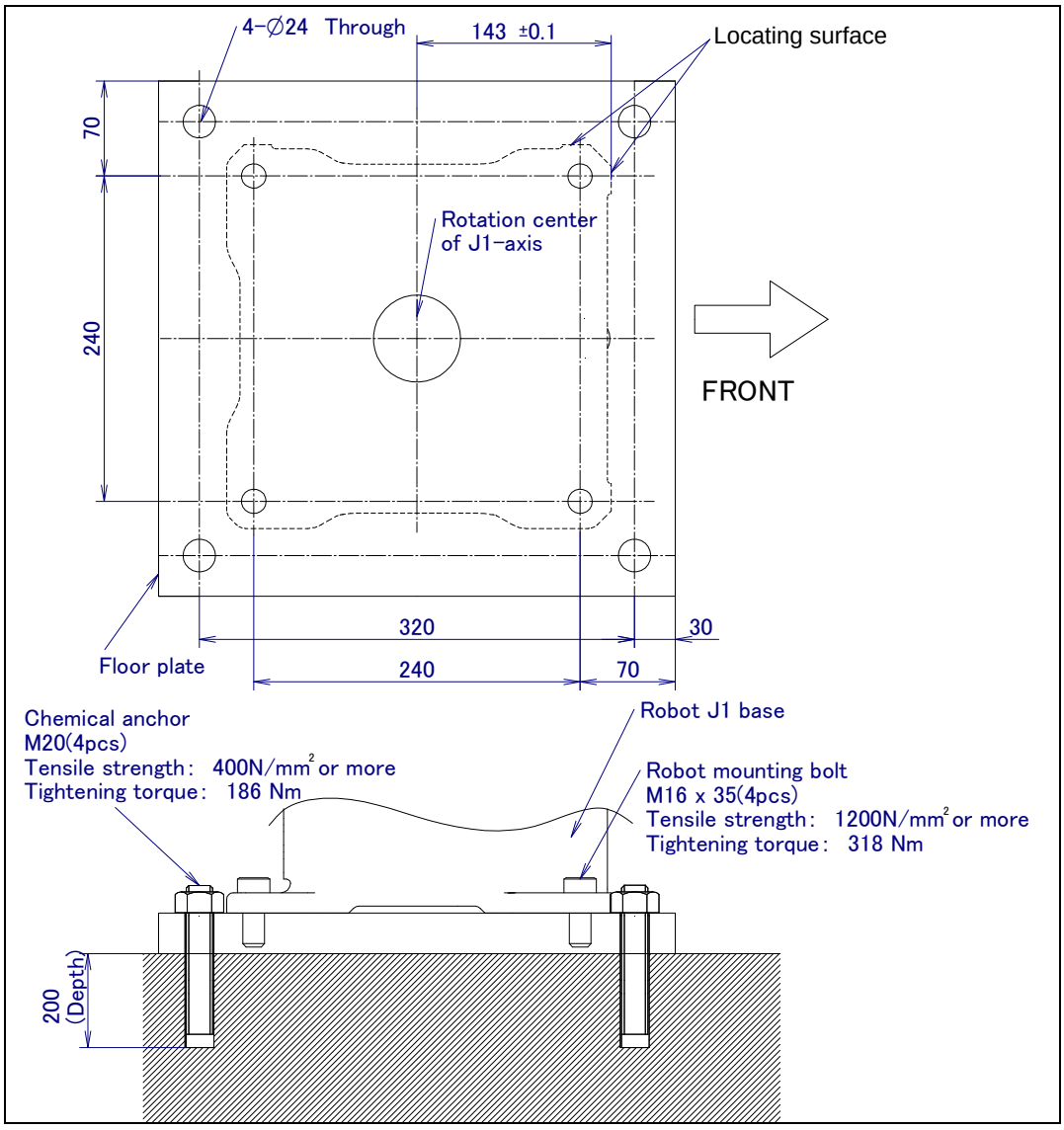


Fig. 1.2.1 (a) Example of installing the robot

NOTE

The customer shall arrange for the positioning pin, anchor bolts, and floor plate. Don't perform leveling at the robot base directly using a push bolt or a wedge. To secure the robot base, use four hexagon socket head bolt M16 x 35 (tensile strength 1200N/mm^2 or more) and tighten them with regulated tightening torque 318Nm.
The strength of the chemical anchor depends on the concrete strength. See the design guideline of the manufacturer for the execution of the chemical anchor and consider the safety ratio sufficiently before use.
Flatness of robot installation surface must be less than or equal to 0.5mm.
Inclination of robot installation surface must be less than or equal to 0.5º.
If robot base is placed on uneven ground, it may result in the base breakage or low performance of the robot.

Fig. 1.2. (b) and Table 1.2.1 (a) show the force and moment applied to the Robot base. Table 1.2.1 (b), (c) indicates the stopping distance and time of the J1 through J3 axes until the robot stops 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 1.2.1 (a) Force and moment that act on J1 base (Common to all models)

	Vertical moment MV [Nm](kgfm)	Force in vertical direction FV [N] (kgf)	Horizontal moment MH [Nm] (kgfm)	Force in horizontal direction FH [N] (kgf)
During stillness	679 (69)	1470 (150)	0 (0)	0(0)
During acceleration or deceleration	3116 (318)	2481 (253)	1083 (110)	2285 (233)
During Power-Off stop	9718 (992)	6840 (698)	3910 (399)	4289 (438)

Table 1.2.1 (b) Stopping time and distance until the robot stopping by Power-Off stop after input of stop signal

Model		J1-axis	J2-axis	J3-axis
ARC Mate 100*i*C, M-10*i*A ARC Mate 100*i*Ce, M-10*i*Ae	Stopping time [ms]	148	108	96
	Stopping distance [deg] (rad)	15.5 (0.27)	8.7 (0.15)	10.7 (0.19)
ARC Mate 100*i*C/6L, M-10*i*A/6L ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L	Stopping time [ms]	158	128	106
	Stopping distance [deg] (rad)	15.8 (0.28)	8.9 (0.16)	13.3 (0.23)
ARC Mate 100*i*C/10S, M-10*i*A/10S	Stopping time [ms]	98	90	132
	Stopping distance [deg] (rad)	12.1 (0.21)	8.0 (0.14)	22.8 (0.40)
M-10*i*A/10M	Stopping time [ms]	140	92	116
	Stopping distance [deg] (rad)	10.7 (0.19)	7.0 (0.12)	15.1(0.26)
M-10*i*A/10MS	Stopping time [ms]	108	132	164
	Stopping distance [deg] (rad)	16.2 (0.28)	15.4 (0.27)	28.5 (0.50)

* Max payload and max speed

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

Model		J1-axis	J2-axis	J3-axis
ARC Mate 100*i*C, M-10*i*A ARC Mate 100*i*Ce, M-10*i*Ae	Stopping time [ms]	510	510	502
	Stopping distance [deg] (rad)	53.9 (0.94)	52.0 (0.91)	56.9 (0.99)
ARC Mate 100*i*C/6L, M-10*i*A/6L ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L	Stopping time [ms]	486	470	486
	Stopping distance [deg] (rad)	48.4 (0.84)	49.4 (0.86)	50.8 (0.89)
ARC Mate 100*i*C/10S, M-10*i*A/10S	Stopping time [ms]	540	548	564
	Stopping distance [deg] (rad)	67.9 (1.18)	51.3 (0.89)	78.7 (1.37)
M-10*i*A/10M	Stopping time [ms]	468	468	468
	Stopping distance [deg] (rad)	39.0 (0.68)	41.5 (0.72)	36.3 (0.63)
M-10*i*A/10MS	Stopping time [ms]	684	684	468
	Stopping distance [deg] (rad)	103.6 (1.81)	76.9 (1.34)	58.0 (1.01)

* Max payload and max speed

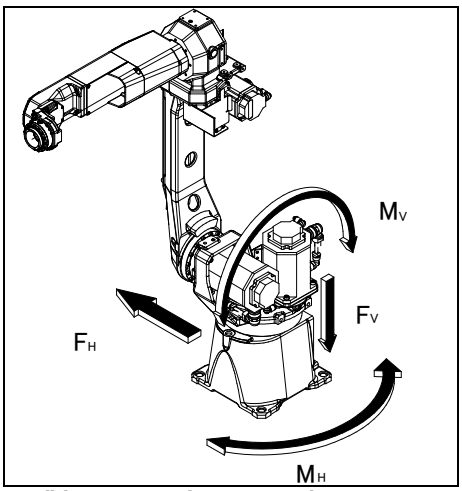
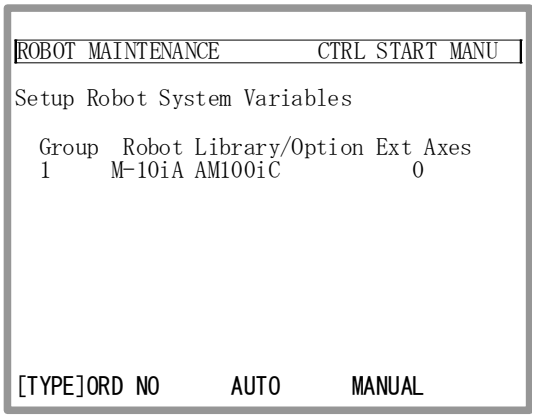


Fig. 1.2.1 (b) Force and moment that acts on J1 base

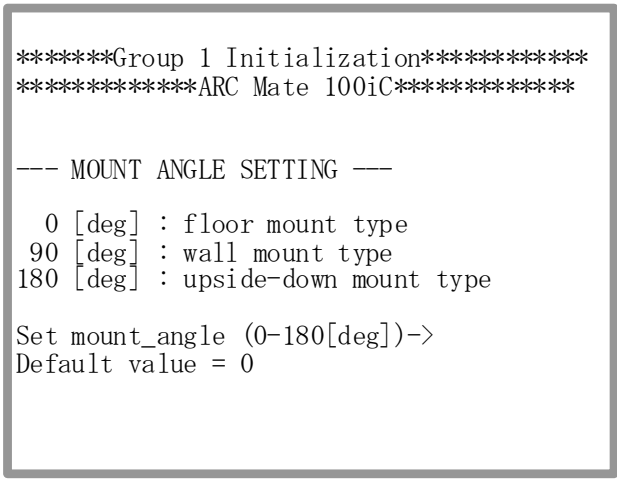
1.2.2 Angle of Mounting Surface Setting

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

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



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



6 Input the mount angle referring to Fig.1.2.2.

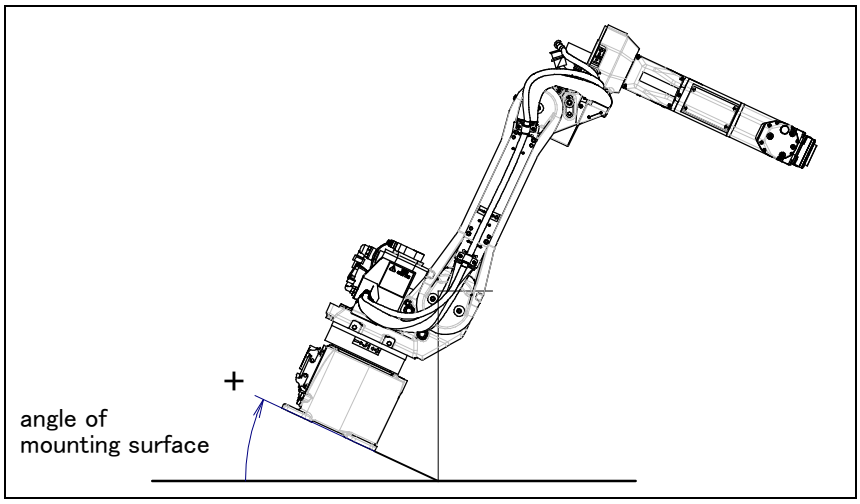
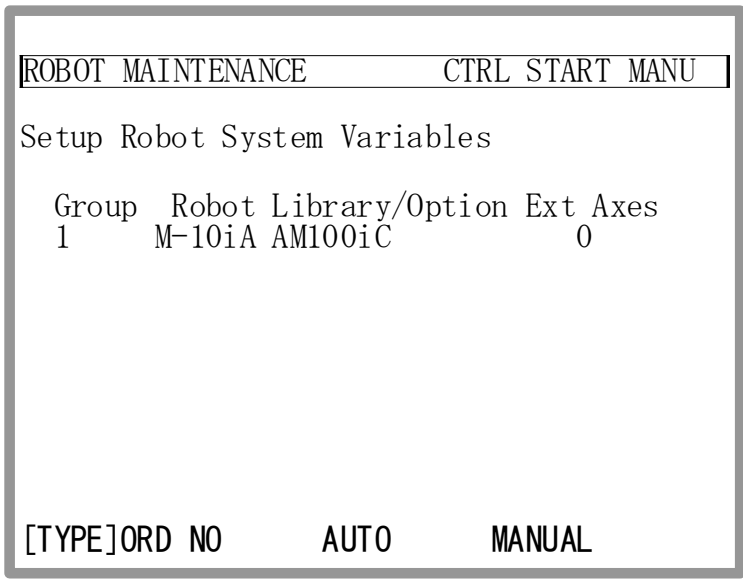


Fig. 1.2.2 Mounting angle

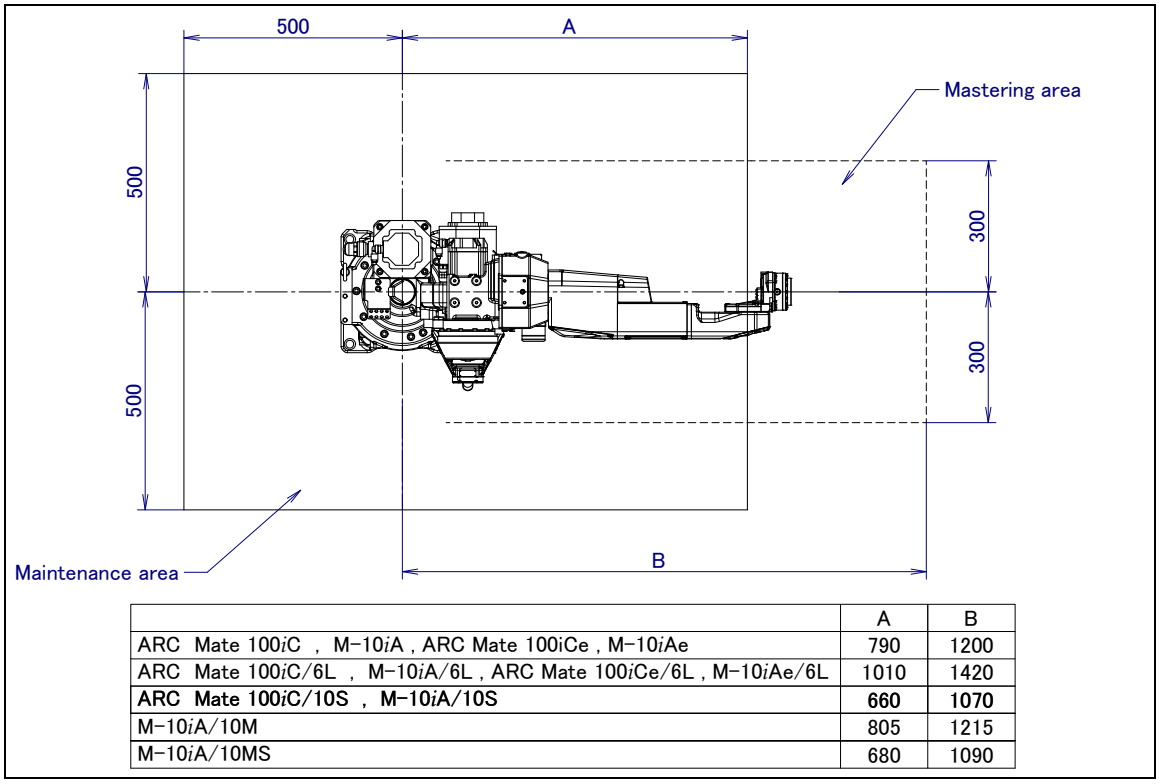
7 Press the [ENTER] key until screen below is displayed again.



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

1.3 MAINTENANCE AREA

Fig. 1.3 shows the maintenance area of the mechanical unit. Be sure to leave enough room for the robot to be mastered. See Chapter 9 for mastering information.



	A	B
ARC Mate 100*i*C , M-10*i*A , ARC Mate 100iCe , M-10*i*Ae	790	1200
ARC Mate 100*i*C/6L , M-10*i*A/6L , ARC Mate 100*i*Ce/6L , M-10*i*Ae/6L	1010	1420
ARC Mate 100*i*C/10S , M-10*i*A/10S	**660**	**1070**
M-10*i*A/10M	805	1215
M-10*i*A/10MS	680	1090

Fig. 1.3 Maintenance area

1.4 INSTALLATION CONDITIONS

Refer to specification of Section 3.1 about installation conditions.

2 CONNECTION WITH THE CONTROLLER

2.1 CONNECTION WITH THE CONTROLLER

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

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

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

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

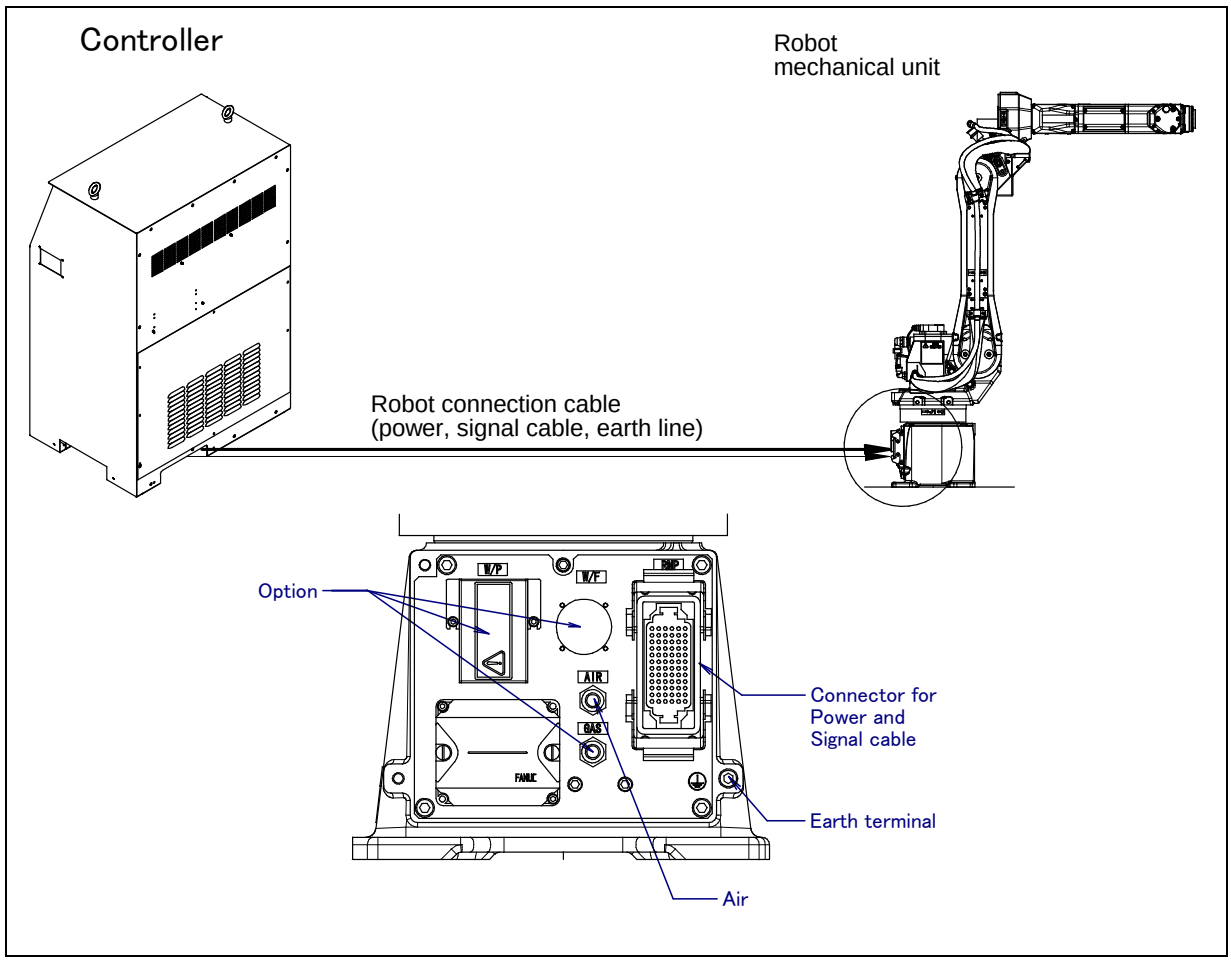


Fig. 2.1 Cable connection

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

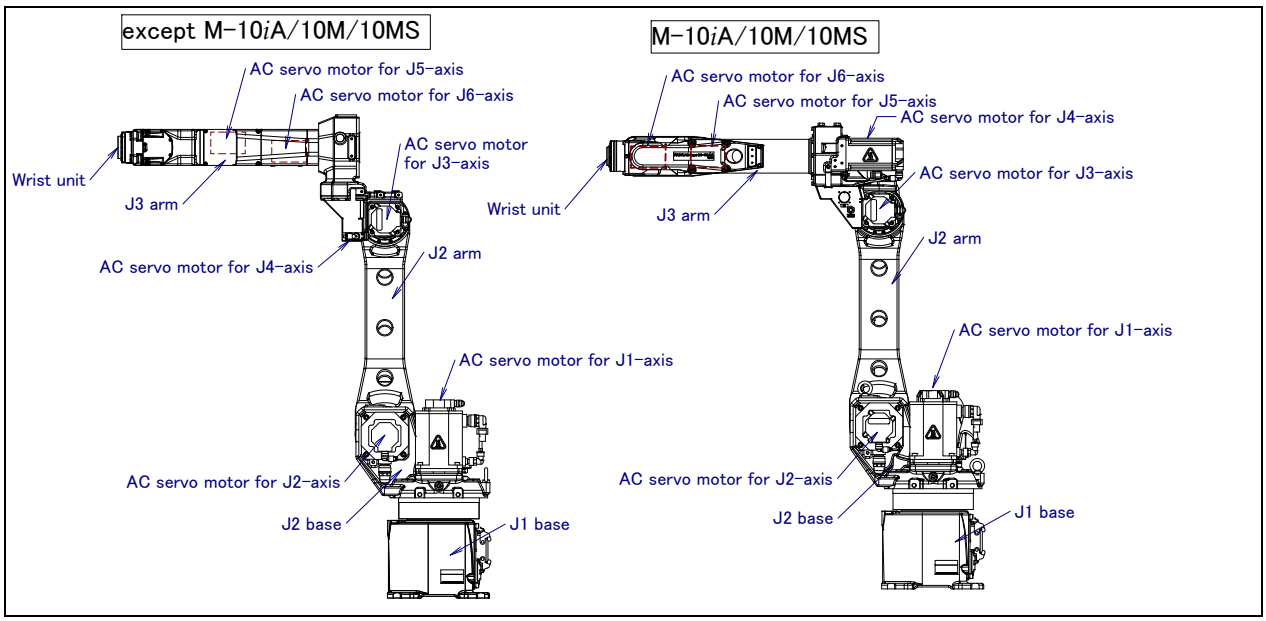


Fig. 3.1 (a) Mechanical unit configuration

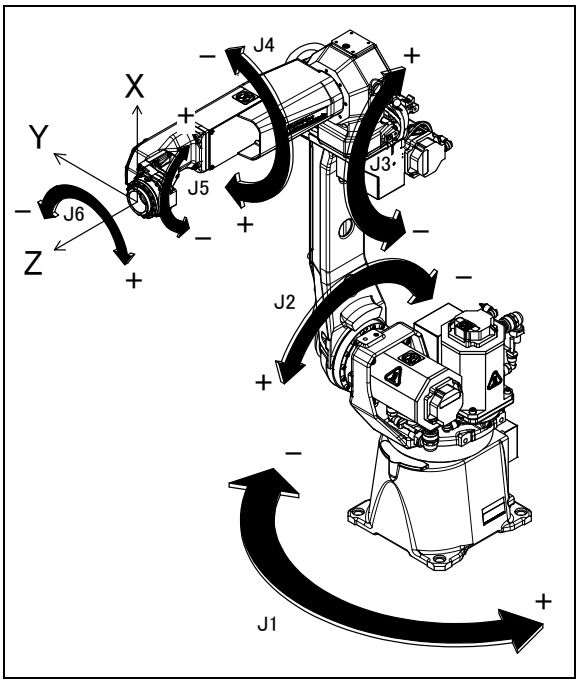


Fig. 3.1 (b) Each axes coordinates and mechanical interface coordinates

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

Table 3.1 Specifications (1/4)

Item		Specification			
Model		ARC Mate 100*i*C M-10*i*A ARC Mate 100*i*Ce M-10*i*Ae			
Type		Articulated type			
Controlled axes		6axes (J1, J2, J3, J4, J5, J6)			
Installation		Floor, Upside-down, Wall & Angle mount (NOTE 1)			
Load setting		3 kg (Standard welding torch) mode	6 kg (Standard inertia) mode		10 kg (High inertia) mode
Motion range	J1-axis	Upper limit /Lower limit	170° (2.97rad)/-170° (-2.97rad) 180° (3.14rad)/-180° (-3.14rad) (option)		
	J2-axis	Upper limit /Lower limit	160° (2.79rad)/ - 90° (-1.57rad)		
	J3-axis	Upper limit /Lower limit	264.5° (4.61rad)/-180° (-3.14rad)		
	J4-axis	Upper limit /Lower limit	190° (3.31rad)/-190° (-3.31rad)		
	J5-axis	Upper limit /Lower limit	Cable integrated J3 arm (NOTE 2)	140° (2.44rad)/-140° (-2.44rad)	
			Conventional dress-out	190° (3.31rad)/-190° (-3.31rad)	
	J6-axis	Upper limit /Lower limit	Cable integrated J3 arm (NOTE 2)	270° (4.71rad)/-270° (-4.71rad)	
			Conventional dress-out	360° (6.28rad)/-360° (-6.28rad)	
Maximum speed (NOTE 3)	J1-axis	210°/s (3.67rad/s)			
	J2-axis	190°/s (3.32rad/s)			
	J3-axis	210°/s (3.67rad/s)			
	J4-axis	400°/s (6.98rad/s)			
	J5-axis	400°/s (6.98rad/s)			
	J6-axis	600°/s(10.47rad/s)			
Maximum load	At wrist	3 kg	6 kg		10 kg
	On J3 arm (NOTE 4)	12 kg			
Allowable load moment at wrist	J4-axis	7.7 N·m (0.79 kgf·m)	15.7 N·m (1.6kgf·m)		22.0 N·m (2.24 kgf·m)
	J5-axis	7.7 N·m (0.79 kgf·m)	9.8 N·m (1.0kgf·m)		22.0 N·m (2.24 kgf·m)
	J6-axis	0.2 N·m (0.02 kgf·m)	5.9 N·m (0.6 kgf·m)		9.8 N·m (1.0 kgf·m)
Allowable load inertia at wrist	J4-axis	0.24 kg·m^2 (2.5 kgf·cm·s^2)	0.63 kg·m^2 (6.4 kgf·cm·s^2)		0.63 kg·m^2 (6.4 kgf·cm·s^2)
	J5-axis	0.24 kg·m^2 (2.5 kgf·cm·s^2)	0.22 kg·m^2 (2.2kgf·cm·s^2)		0.63 kg·m^2 (6.4 kgf·cm·s^2)
	J6-axis	0.0027 kg·m^2 (0.028 kgf·cm·s^2)	0.061 kg·m^2 (0.62kgf·cm·s^2		0.15 kg·m^2 (1.5 kgf·cm·s^2)
Repeatability (NOTE 5)		±0.03 mm			
Mass		130 kg			
Acoustic noise level		Less than 70dB (NOTE 6)			
Installation environment		Ambient temperature: 0 to 45℃ (NOTE 7) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%RH or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 8)			

Table 3.1 Specifications (2/4)

Item		Specification		
Model		ARC Mate 100*i*C/6L M-10*i*A/6L ARC Mate 100*i*Ce/6L M-10*i*Ae/6L		
Type		Articulated type		
Controlled axes		6axes (J1, J2, J3, J4, J5, J6)		
Installation		Floor, Upside-down, Wall & Angle mount (NOTE 1)		
Load setting		3 kg (Standard welding torch) mode		6 kg (Standard inertia) mode
Motion range	J1-axis	Upper limit /Lower limit	170° (2.97rad)/-170° (-2.97rad) 180° (3.14rad)/-180° (-3.14rad) (option)	
	J2-axis	Upper limit /Lower limit	160° (2.79rad)/ - 90° (-1.57rad)	
	J3-axis	Upper limit /Lower limit	267° (4.66rad)/-180° (-1.57rad)	
	J4-axis	Upper limit /Lower limit	190° (3.31rad)/-190° (-3.31rad)	
	J5-axis	Upper limit /Lower limit	Cable integrated J3 arm (NOTE 2)	140° (2.44rad)/-140° (-2.44rad)
			Conventional dress-out	190° (3.31rad)/-190° (-3.31rad)
	J6-axis	Upper limit /Lower limit	Cable integrated J3 arm (NOTE 2)	270° (4.71rad)/-270° (-4.71rad)
			Conventional dress-out	360° (6.28rad)/-360° (-6.28rad)
Maximum speed (NOTE 3)	J1-axis	210°/s (3.67rad/s)		
	J2-axis	190°/s (3.32rad/s)		
	J3-axis	210°/s (3.67rad/s)		
	J4-axis	400°/s (6.98rad/s)		
	J5-axis	400°/s (6.98rad/s)		
	J6-axis	600°/s(10.47rad/s)		
Maximum load	At wrist	3 kg		6 kg
	On J3 arm (NOTE 4)	12 kg		
Allowable load moment at wrist	J4-axis	7.7 N·m (0.79 kgf·m)		15.7 N·m (1.6kgf·m)
	J5-axis	7.7 N·m (0.79 kgf·m)		10.1N·m (1.0kgf·m)
	J6-axis	0.2 N·m (0.02 kgf·m)		5.9 N·m (0.6 kgf·m)
Allowable load inertia at wrist	J4-axis	0.24 kg·m^2 (2.5 kgf·cm·s^2)		0.63 kg·m^2 (6.4 kgf·cm·s^2)
	J5-axis	0.24 kg·m^2 (2.5 kgf·cm·s^2)		0.38 kg·m^2 (3.9 kgf·cm·s^2)
	J6-axis	0.0027 kg·m^2 (0.028 kgf·cm·s^2)		0.061 kg·m^2 (0.62 kgf·cm·s^2
Repeatability (NOTE 5)		±0.03 mm		
Mass		135 kg		
Acoustic noise level		Less than 70dB (NOTE 6)		
Installation environment		Ambient temperature: 0 to 45°C (NOTE 7) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%RH or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 8)		

Table 3.1 Specifications (3/4)

Item		Specification		
Model		ARC Mate 100*i*C/10S, M-10*i*A/10S		
Type		Articulated type		
Controlled axes		6 axes(J1, J2, J3, J4, J5, J6)		
Installation		Floor, Upside-down, Wall & Angle mount (NOTE 1)		
Load setting		3 kg (Standard welding torch) mode		10 kg (High inertia) mode
Motion range	J1-axis	Upper limit /Lower limit	170° (2.97rad)/-170° (-2.97rad) 180° (3.14rad)/-180° (-3.14rad) (option)	
	J2-axis	Upper limit /Lower limit	160° (2.79rad)/ - 90° (-1.57rad)	
	J3-axis	Upper limit /Lower limit	180° (3.14rad)/-160° (-2.79rad)	
	J4-axis	Upper limit /Lower limit	190° (3.31rad)/-190° (-3.31rad)	
	J5-axis	Upper limit /Lower limit	Cable integrated J3 arm	140° (2.44rad)/-140° (-2.44rad)
			Conventional dress-out	190° (3.31rad)/-190° (-3.31rad)
	J6-axis	Upper limit /Lower limit	Cable integrated J3 arm	270° (4.71rad)/-270° (-4.71rad)
			Conventional dress-out	360° (6.28rad)/-360° (-6.28rad)
Maximum speed (NOTE 3)	J1-axis	220°/s (3.83rad/s)		
	J2-axis	230°/s (4.01rad/s)		
	J3-axis	270°/s (4.71rad/s)		
	J4-axis	410°/s (7.15rad/s)		
	J5-axis	410°/s (7.15rad/s)		
	J6-axis	610°/s(10.64rad/s)		
Maximum load	At wrist	3 kg		10 kg
	On J3 arm (NOTE 4)	12 kg		
Allowable load moment at wrist	J4-axis	7.7 N·m (0.79 kgf·m)		22.0 N·m (2.24 kgf·m)
	J5-axis	7.7 N·m (0.79 kgf·m)		22.0 N·m (2.24 kgf·m)
	J6-axis	0.2 N·m (0.02 kgf·m)		9.8 N·m (1.0 kgf·m)
Allowable load inertia at wrist	J4-axis	0.24 kg·m^2 (2.5 kgf·cm·s^2)		0.63 kg·m^2 (6.4 kgf·cm·s^2)
	J5-axis	0.24 kg·m^2 (2.5 kgf·cm·s^2)		0.63 kg·m^2 (6.4 kgf·cm·s^2)
	J6-axis	0.0027 kg·m^2 (0.028 kgf·cm·s^2)		0.15 kg·m^2 (1.5 kgf·cm·s^2)
Repeatability (NOTE 5)		±0.03 mm		
Mass		130 kg		
Acoustic noise level		Less than 70dB (NOTE 6)		
Installation environment		Ambient temperature: 0 to 45℃ (NOTE 7) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%RH or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 8)		

Table 3.1 Specifications (4/4)

Item		Specification		
Model		M-10*i*A/10M		M-10*i*A/10MS
Model		Articulated type		
Controlled axes		6 axes(J1, J2, J3, J4, J5, J6)		
Installation		Floor, Upside-down, Wall & Angle mount (NOTE 1)		
Load setting		10kg payload specification		
Motion range	J1-axis	Upper limit /Lower limit	170° (2.97rad)/-170° (-2.97rad) 180° (3.14rad)/-180° (-3.14rad) (option)	
	J2-axis	Upper limit /Lower limit	160° (2.79rad)/ - 90° (-1.57rad)	
	J3-axis	Upper limit /Lower limit	264.5° (4.61rad)/ -180° (-3.14rad)	186° (3.25rad)/ -155° (-2.70rad)
	J4-axis	Upper limit /Lower limit	190° (3.31rad)/-190° (-3.31rad)	
	J5-axis	Upper limit /Lower limit	140° (2.44rad)/-140° (-2.44rad)	
	J6-axis	Upper limit /Lower limit	360° (6.28rad)/-360° (-6.28rad)	
Maximum speed (NOTE 3)	J1-axis	225°/sec (3.93rad/s)		290°/sec (5.06rad/s)
	J2-axis	205°/sec (3.58rad/s)		280°/sec (4.89rad/s)
	J3-axis	225°/sec (3.93rad/s)		315°/sec (5.50rad/s)
	J4-axis	420°/sec (7.33rad/s)		420°/sec (7.33rad/s)
	J5-axis	420°/sec (7.33rad/s)		420°/sec (7.33rad/s)
	J6-axis	700°/sec(12.22rad/s)		720°/sec(12.57rad/s)
Maximum load	At wrist	10kg		
	On J3 arm (NOTE 4)	12kg		
Allowable load moment at wrist	J4-axis	26.0Nm (2.7kgf･m)		
	J5-axis	26.0Nm (2.7kgf･m)		
	J6-axis	11.0Nm (1.1kgf･m)		
Allowable load inertia at wrist	J4-axis	0.90kg.m^2 (9.38 kgf･cm･s^2)		
	J5-axis	0.90kg.m^2 (9.38 kgf･cm･s^2)		
	J6-axis	0.30kg.m^2 (3.13 kgf･cm･s^2)		
Repeatability (NOTE 5)		±0.03 mm		
Mass		130kg		
Acoustic noise level		Less than 70dB (NOTE 6)		
Installation environment		Ambient temperature: 0 to 45℃ (NOTE 7) Ambient humidity: Normally 75%RH or less (No dew or frost allowed) Short time 95%RH or less (Within 1 month) Permissible altitude: Above the sea 1000m or less Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases (NOTE 8)		

NOTE

1 There is no limit of motion range for all the installation types. ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L cannot support Wall & Angle mount.
2 Cable integrated J3 arm is cannot be selected for ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/ 6L, M-10*i*Ae/6L.
3 During short distance motions, the axis speed may not reach the maximum value stated.
4 Maximum load on J3 arm is influenced by load of wrist. See Section 4.2 for detail.
5 Compliant with ISO 9283.
6 This value is equivalent continuous A-weighted sound pressure level, which applied with ISO11201 (EN31201). This value is measured with the following conditions.
- Maximum load and speed
- Operating mode is AUTO

7 When the robot is used in a low temperature environment that is near to 0ºC, or not operated for a long time in the environment that is less than 0ºC (during a holiday or during the night), a collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.
8 Contact the service representative, if the robot is to be used in an environment or a place subjected to severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

The following table lists the IEC60529-based severe dust/liquid protection characteristics of this robot.

Table 3.1 (a) The dustproof and waterproof characteristics of ARC Mate 100*i*C, ARC Mate 100*i*C/6L, ARC Mate 100*i*C/10S, ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/ 6L, M-10*i*Ae/6L

	Normal specification
Wrist (*) +J3 arm	IP54
Other part	IP54

Table 3.1 (b) The dustproof and waterproof characteristics of M-10*i*A, M-10*i*A/6L, M-10*i*A/10S, M-10*i*A/10M, M-10*i*A/10MS

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

⚠ CAUTION
It does not include conduit part. There is no dustproof and waterproof characteristic for M/H conduit. IP level of NO DUST M/H conduit is 65. Refer to chapter 11 and 12 for details.

NOTE
Definition of IP code
Definition of IP 67
6=Dust-tight
7=Protection from water immersion
Definition of IP 65
6=Dust-tight
5=Protection from water jet
Definition of IP 55
5=Dust-protected
5=Protection from water jet
Definition of IP 54
5=Dust-protected
4=Protection from splashing water

Performance of resistant chemicals and resistant solvents

(1) The robot (including severe dust/liquid protection model) cannot be used with the following liquids. Potentially these liquids will cause irreversible damage to the rubber parts (such as: gaskets, oil seals, O-rings etc.). (As exception to this only liquids tested and approved by FANUC can be used with the robot.)
   (a) Organic solvents
   (b) Cutting fluid including chlorine / gasoline
   (c) Amine type detergent
   (d) Acid, alkali and liquid causing rust
   (e) Other liquids or solutions, that will harm NBR
(2) When the robots work in the environment, using water or liquid, complete draining of J1 base must be done. Incomplete draining of J1 base will make the robot break down.
(3) Don’t use unconfirmed liquid.
(4) Do not use the robot immersed in water, neither temporary nor permanent. Robot must not be wet permanently.
   *Example : in case motor surface is exposed to water for a long time, liquid may invade inside the motor and cause failure.

3.2 MECHANICAL UNIT OPERATING SPACE AND OPERATING SPACE

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

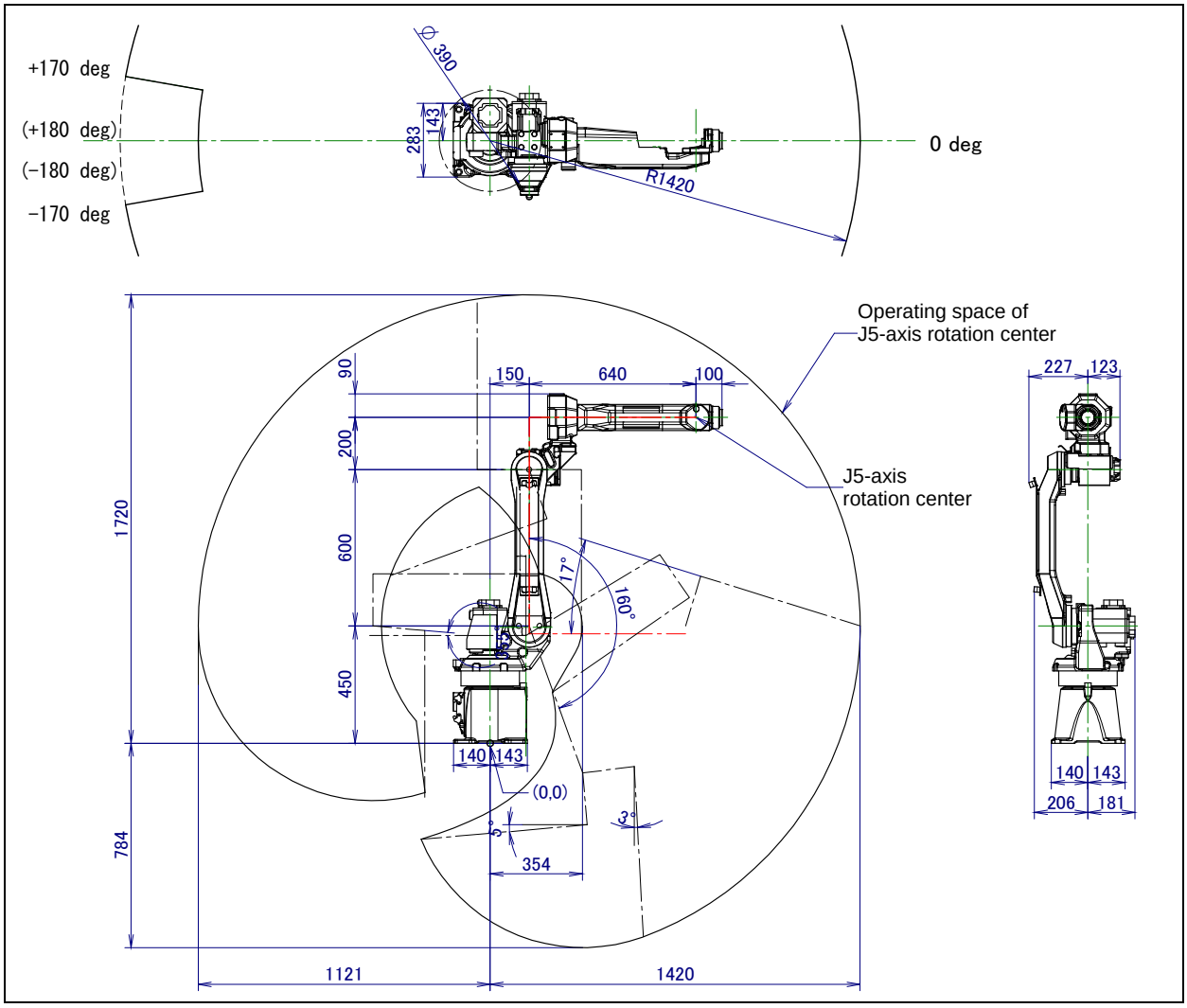


Fig. 3.2 (a) Operating space (ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*Ce, M-10*i*Ae)

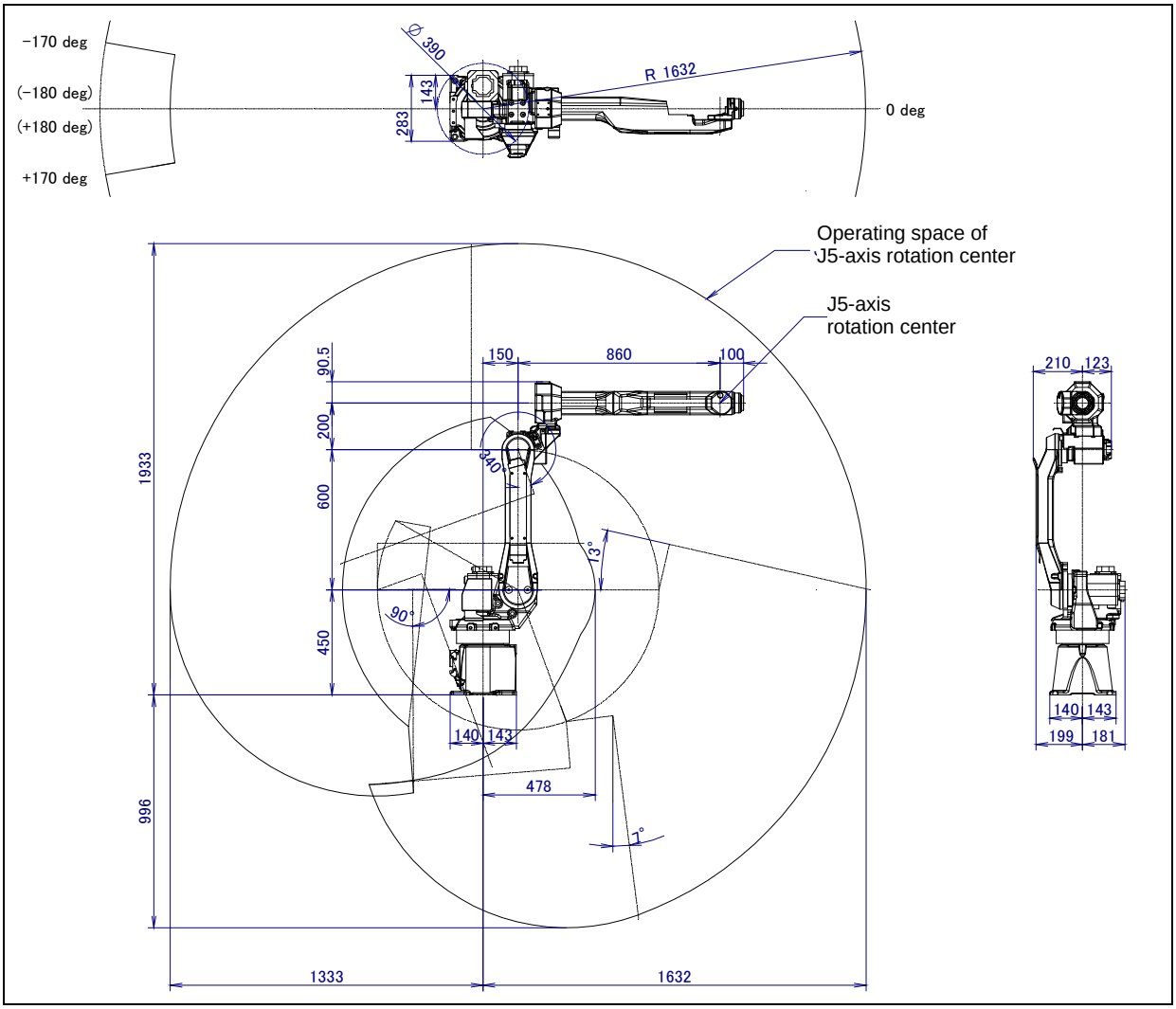


Fig. 3.2 (b) Operating space (ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/ 6L, M-10*i*Ae/6L)

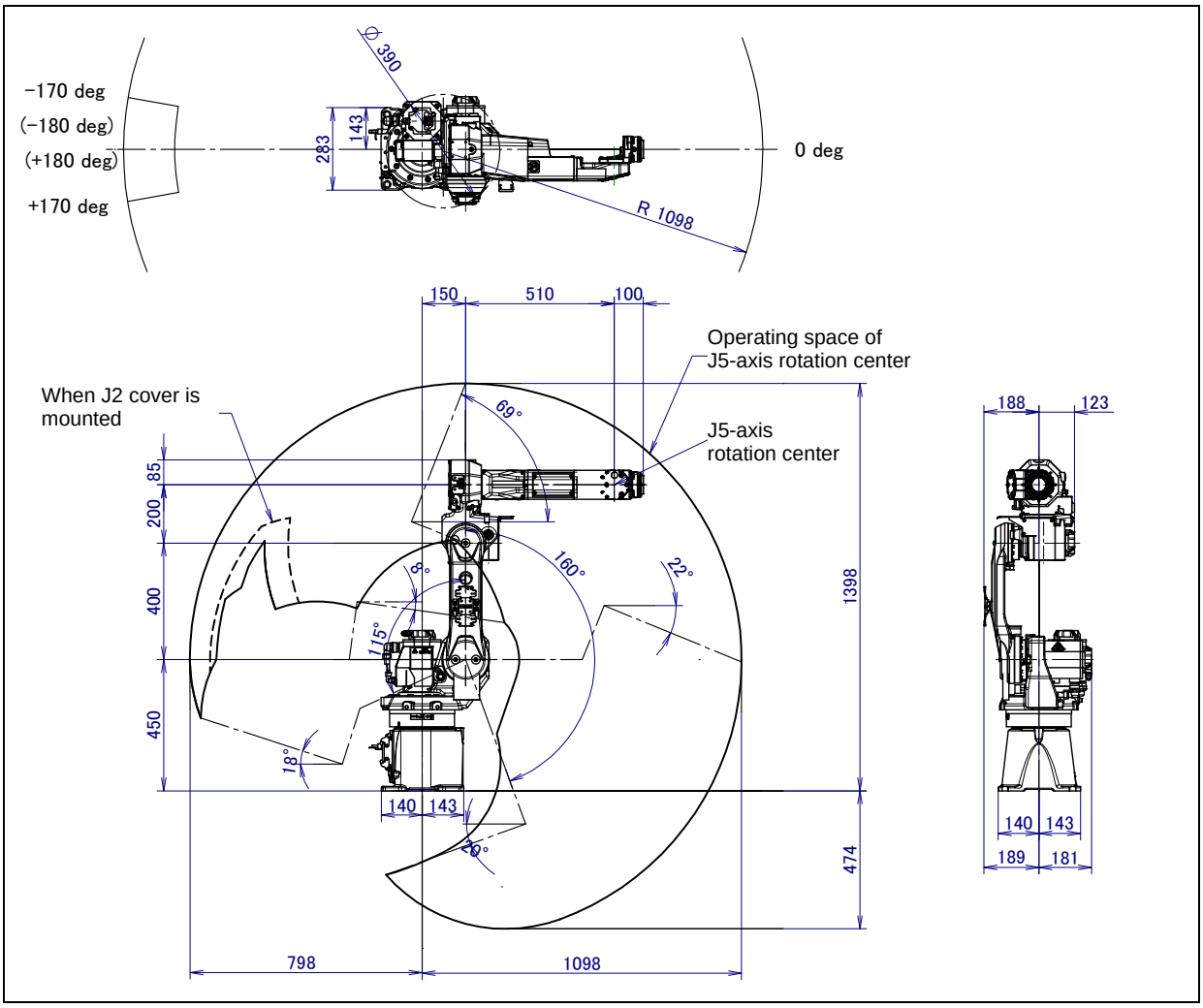


Fig. 3.2 (c) Operating space (ARC Mate 100*i*C/10S, M-10*i*A/10S)

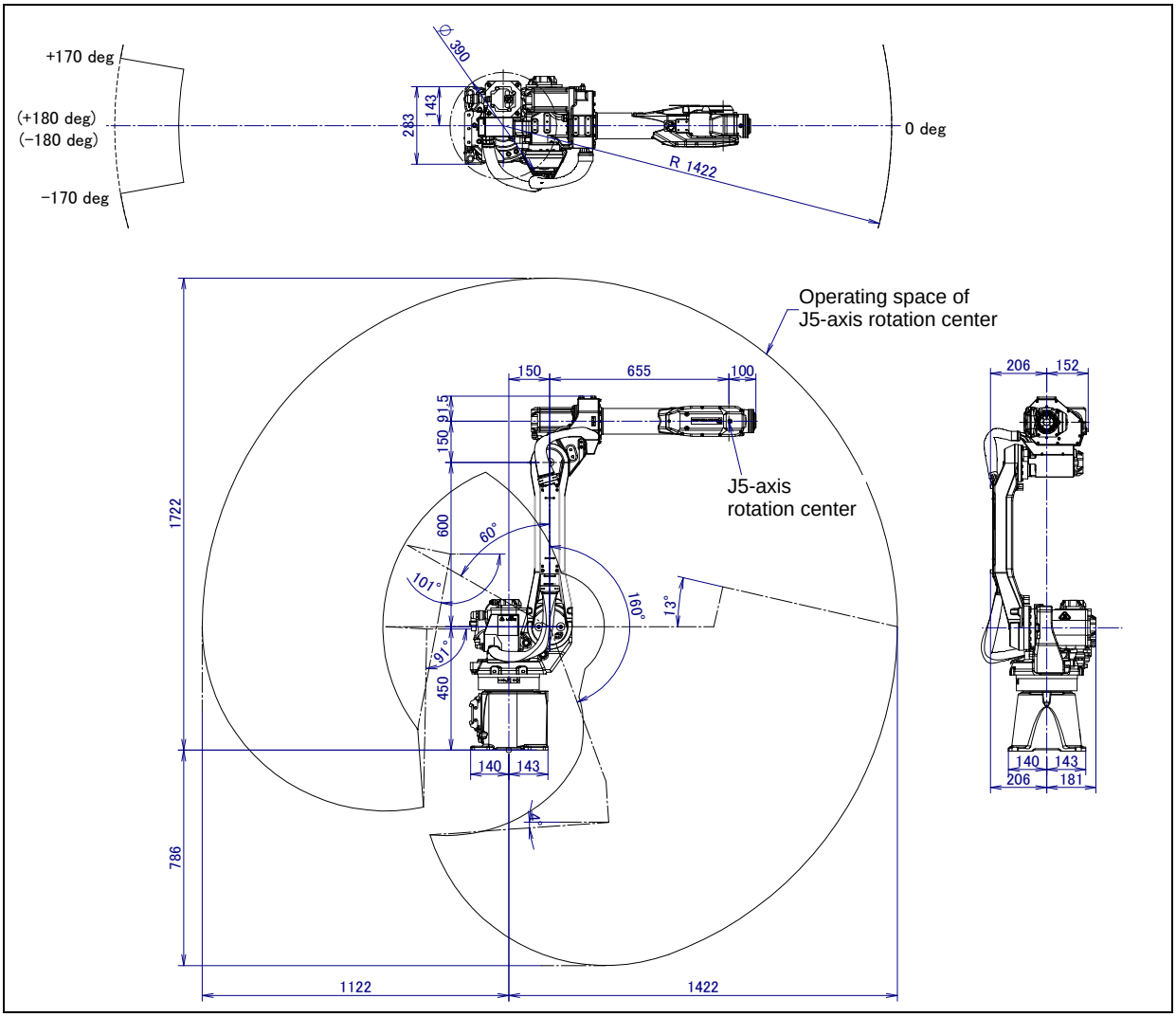


Fig. 3.2 (d) Operating space (M-10*i*A/10M)

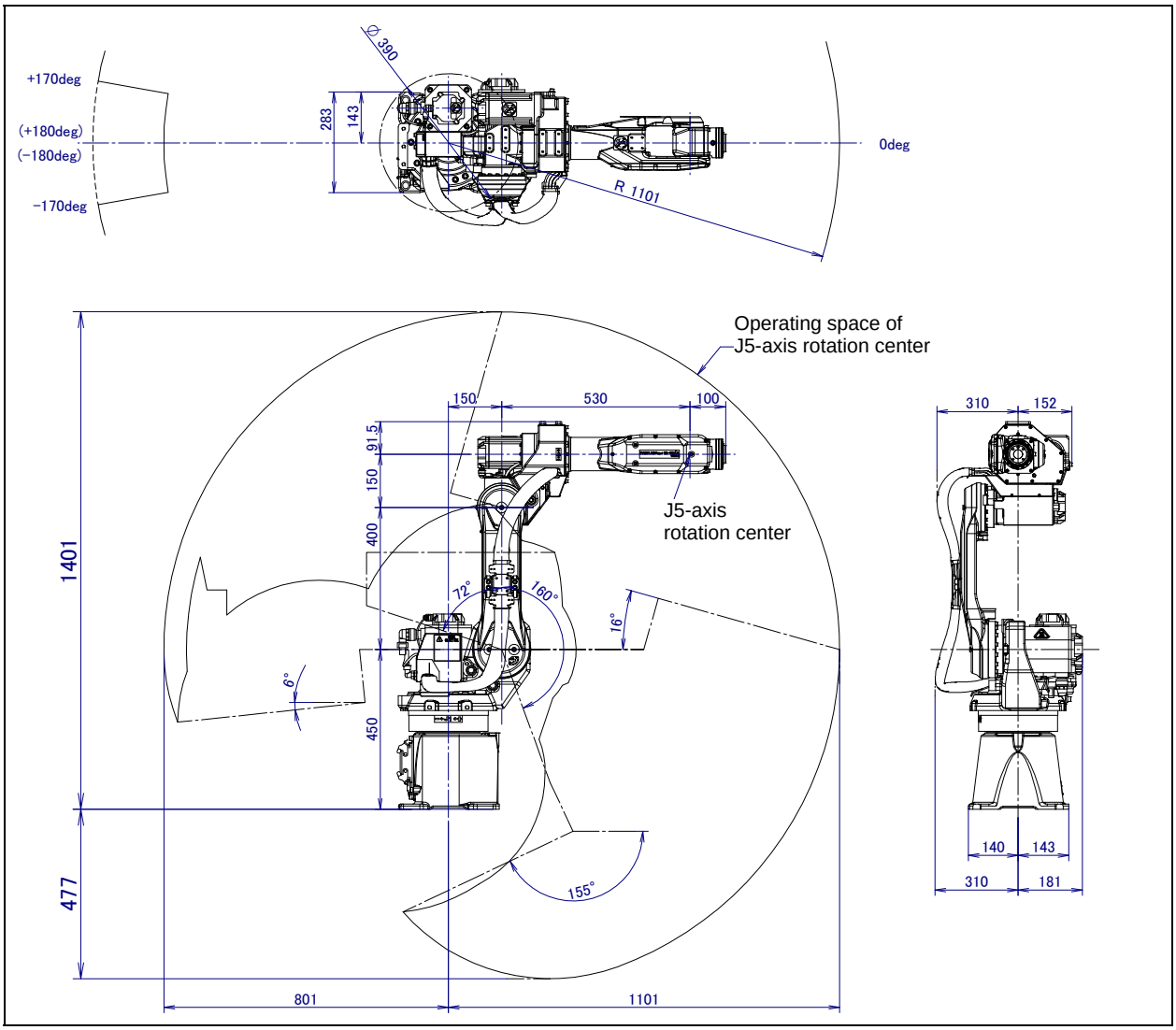


Fig. 3.2 (e) Operating space (M-10*i*A/10MS)

3.3 ZERO POINT POSITION AND MOTION LIMIT

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

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

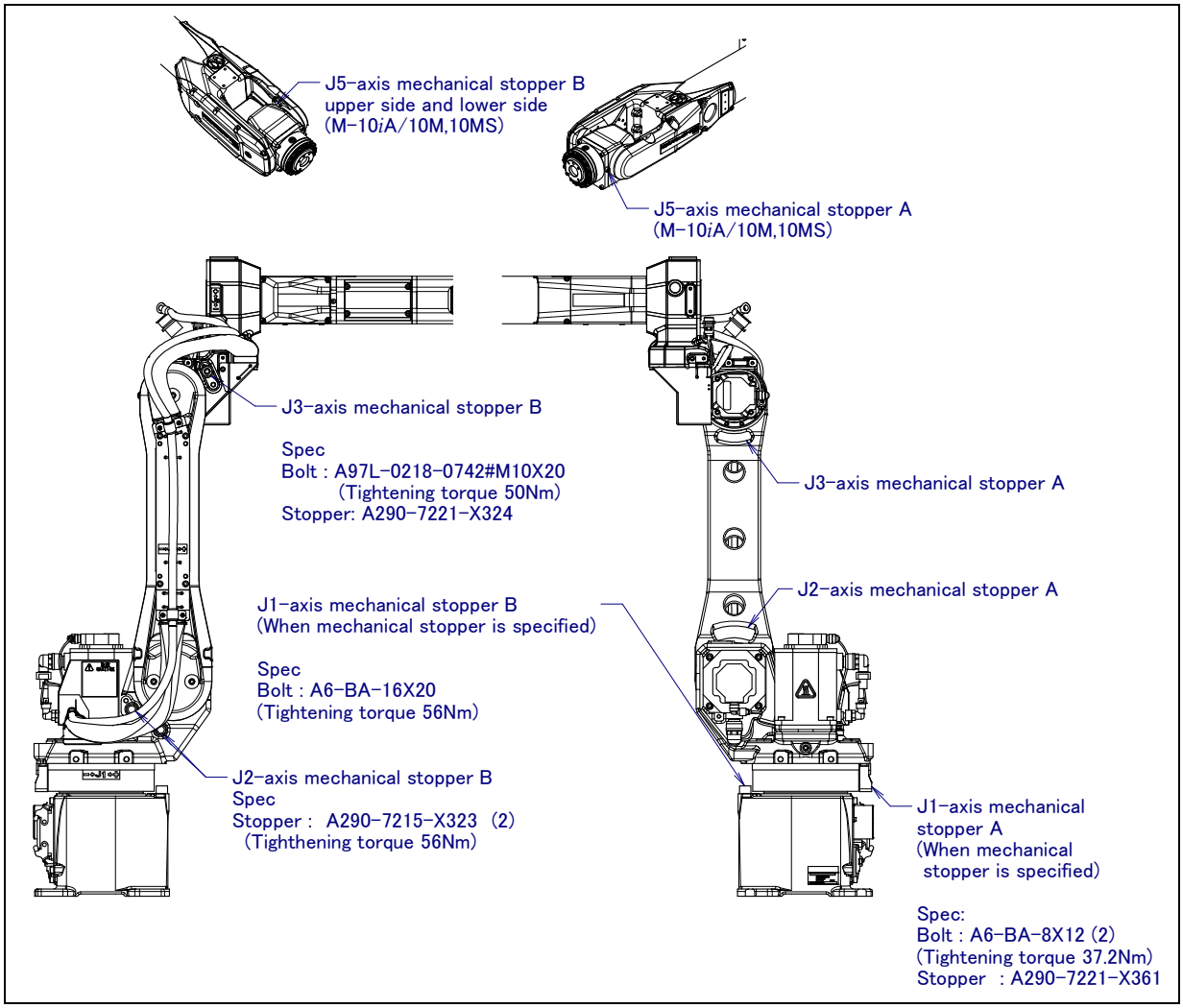


Fig. 3.3 (a) Position of mechanical stopper

Fig.3.3 (b) to (l) show the zero point and mechanical stopper position of each axis.
*The motion range can be changed. For information on how to change the motion range, see Chapter 6, "AXIS LIMIT SETUP".

⚠ CAUTION
In case of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L, brake is not installed for J1/J4/J5/J6-axes. In case of J4/J5/J6-axes If you turn off the controller power at wait position, robot may move greatly by weight or exceeds stroke limit depend on the posture of robot or wrist load condition. Adjust the wait position so that axis does not move greatly when controller power is turned off.

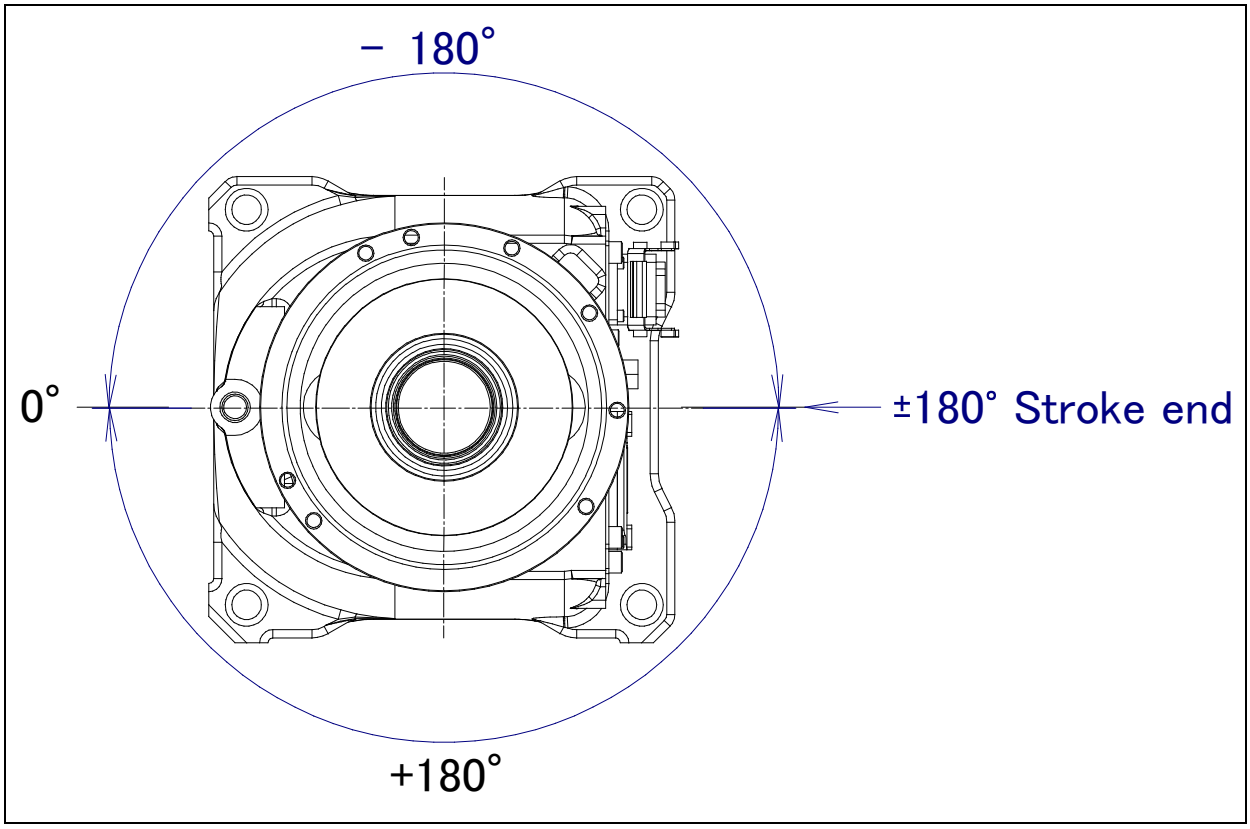


Fig. 3.3 (b) J1-axis motion limit (When mechanical stopper option is not selected)

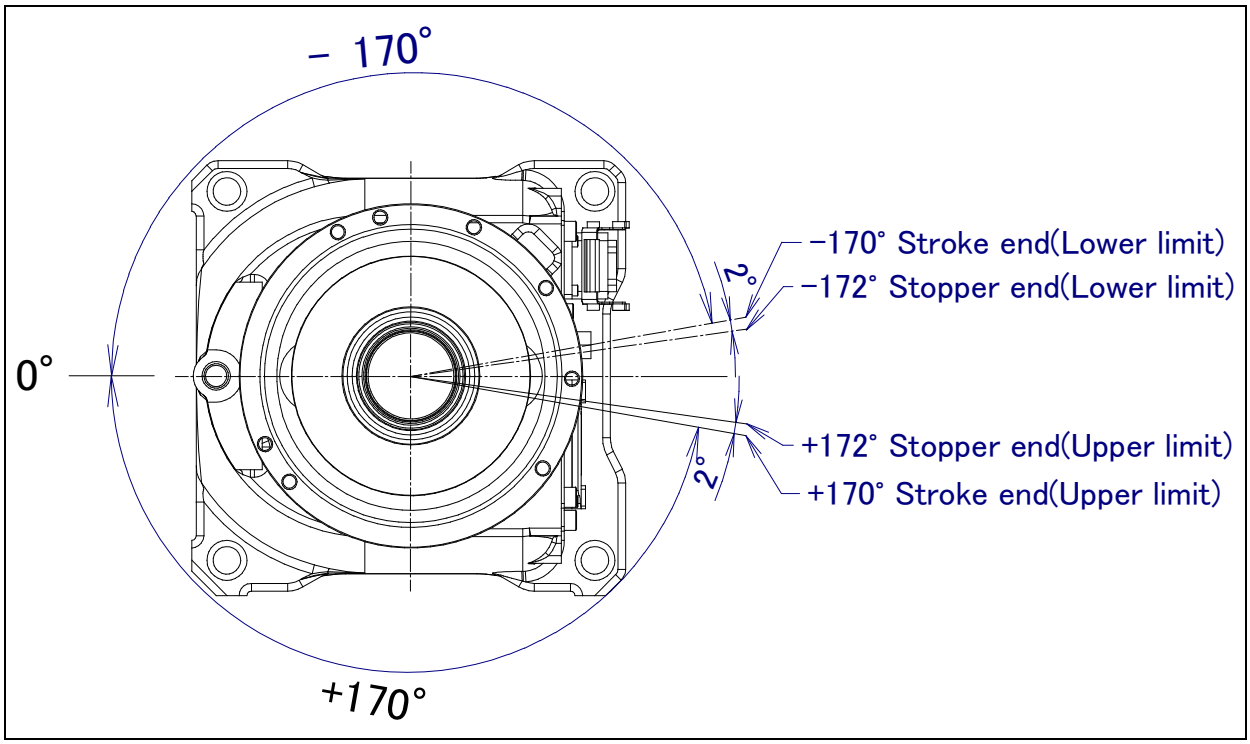


Fig. 3.3 (c) J1-axis motion limit (When mechanical stopper is selected)

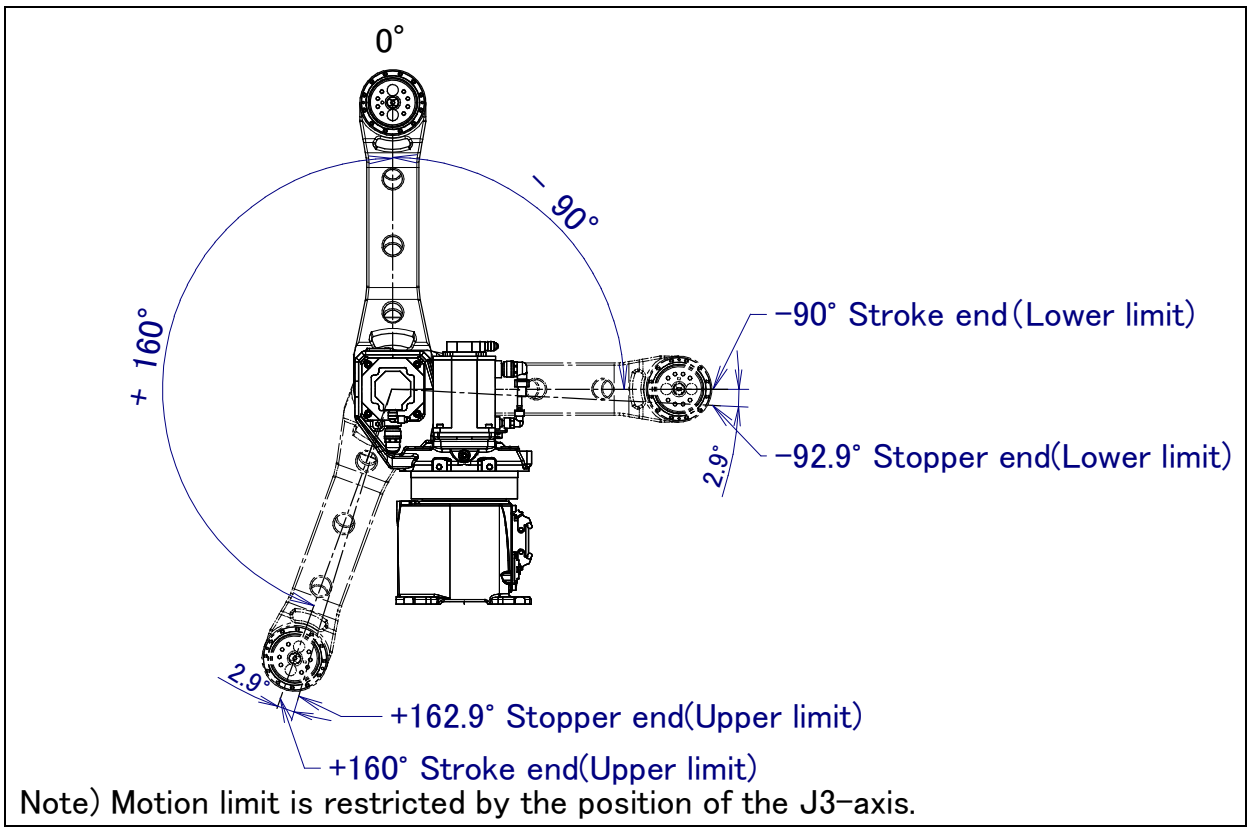


Fig. 3.3 (d) J2-axis motion limit

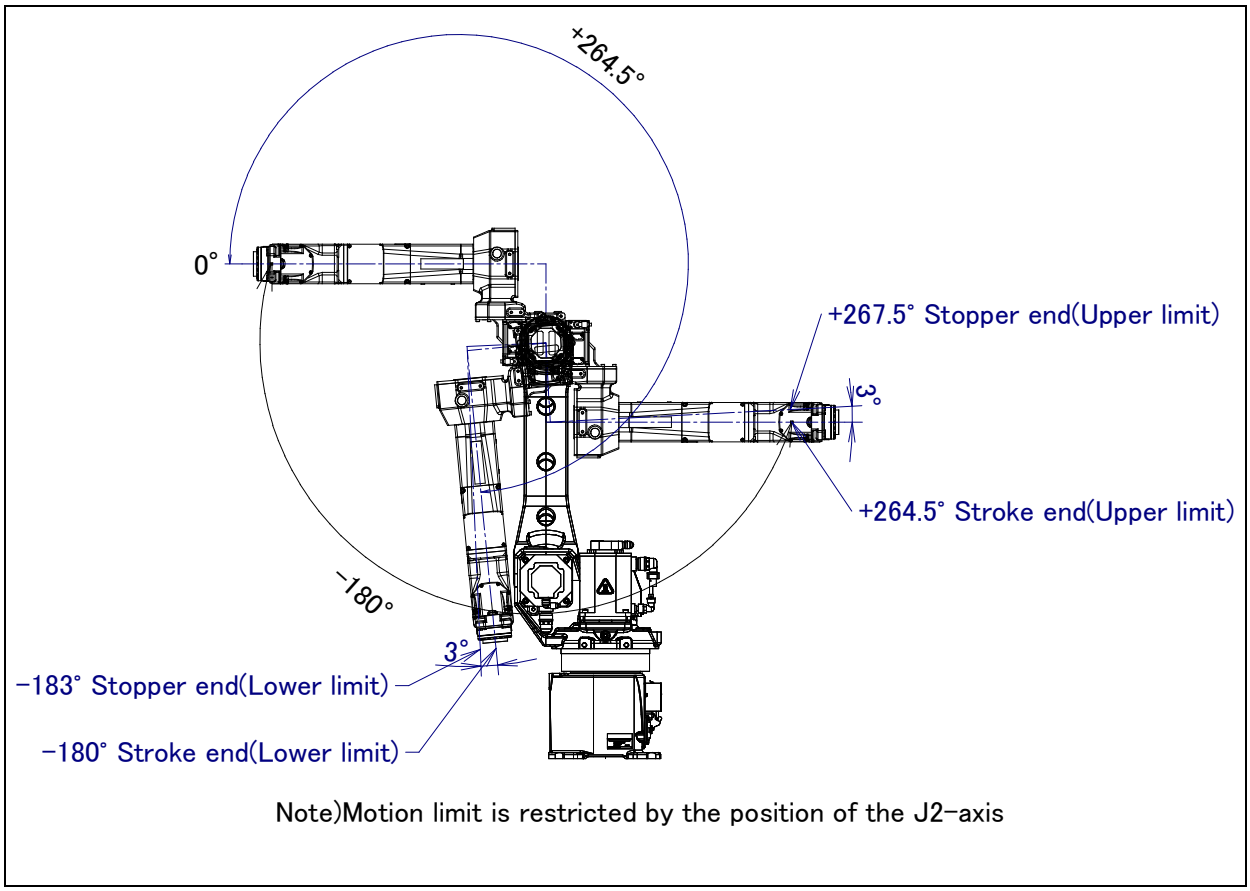


Fig. 3.3 (e) J3-axis motion limit (ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*Ce, M-10*i*Ae, M-10*i*A/10M)

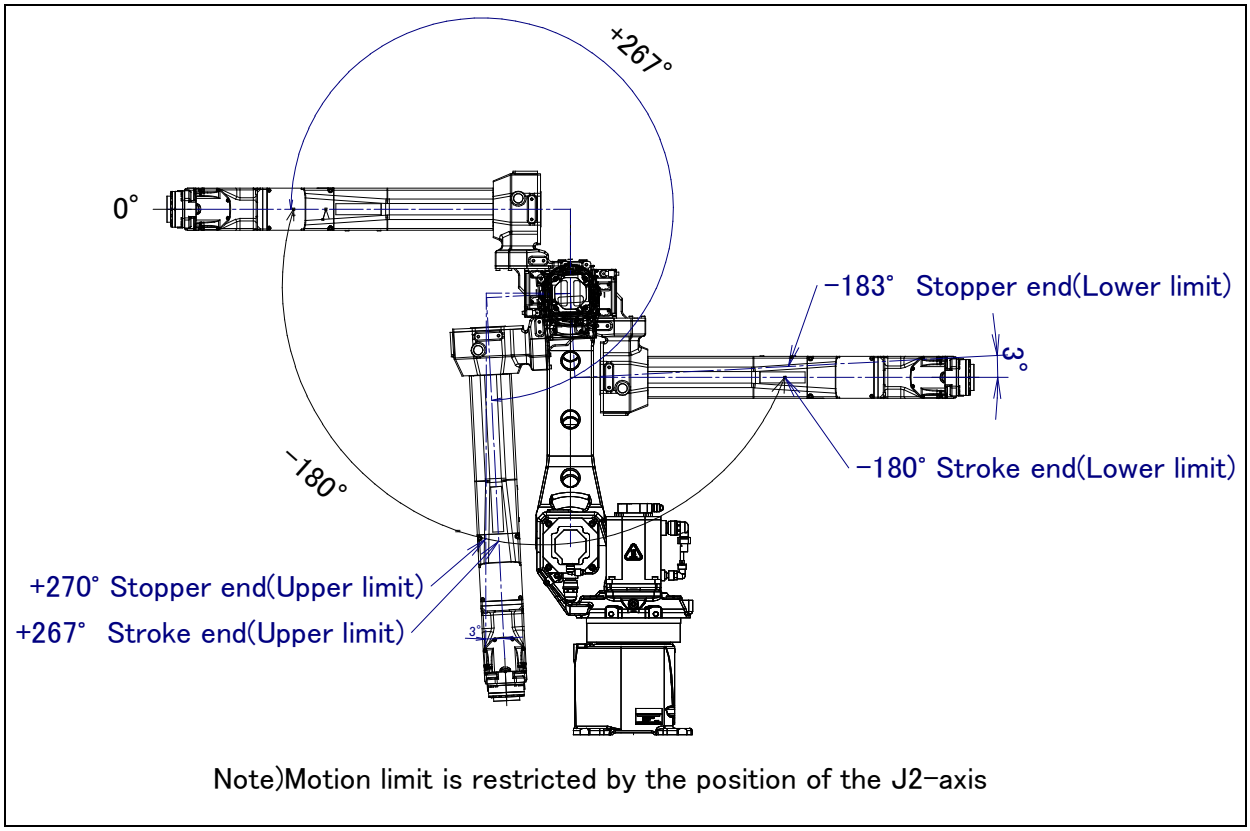


Fig. 3.3 (f) J3-axis motion limit (ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

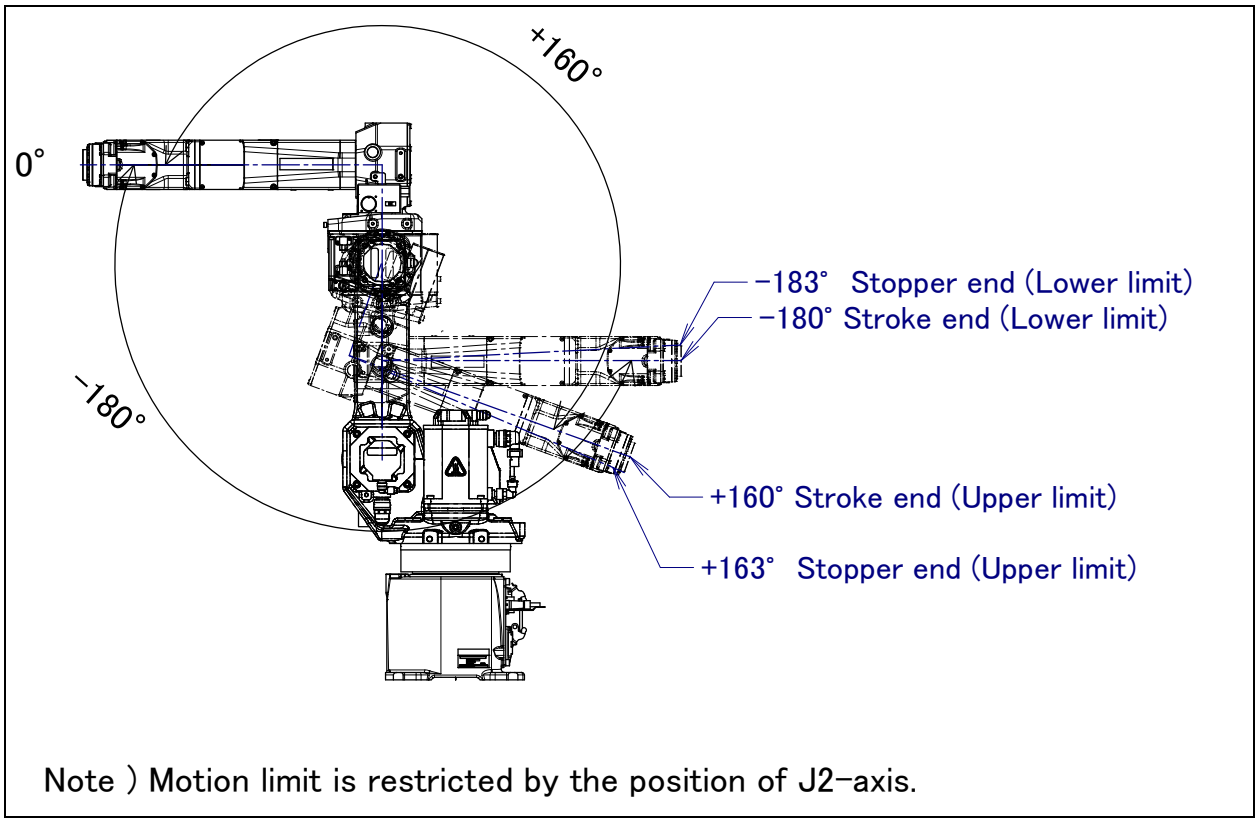


Fig. 3.3 (g) J3-axis motion limit (ARC Mate 100*i*C/10S, M-10*i*A/10S)

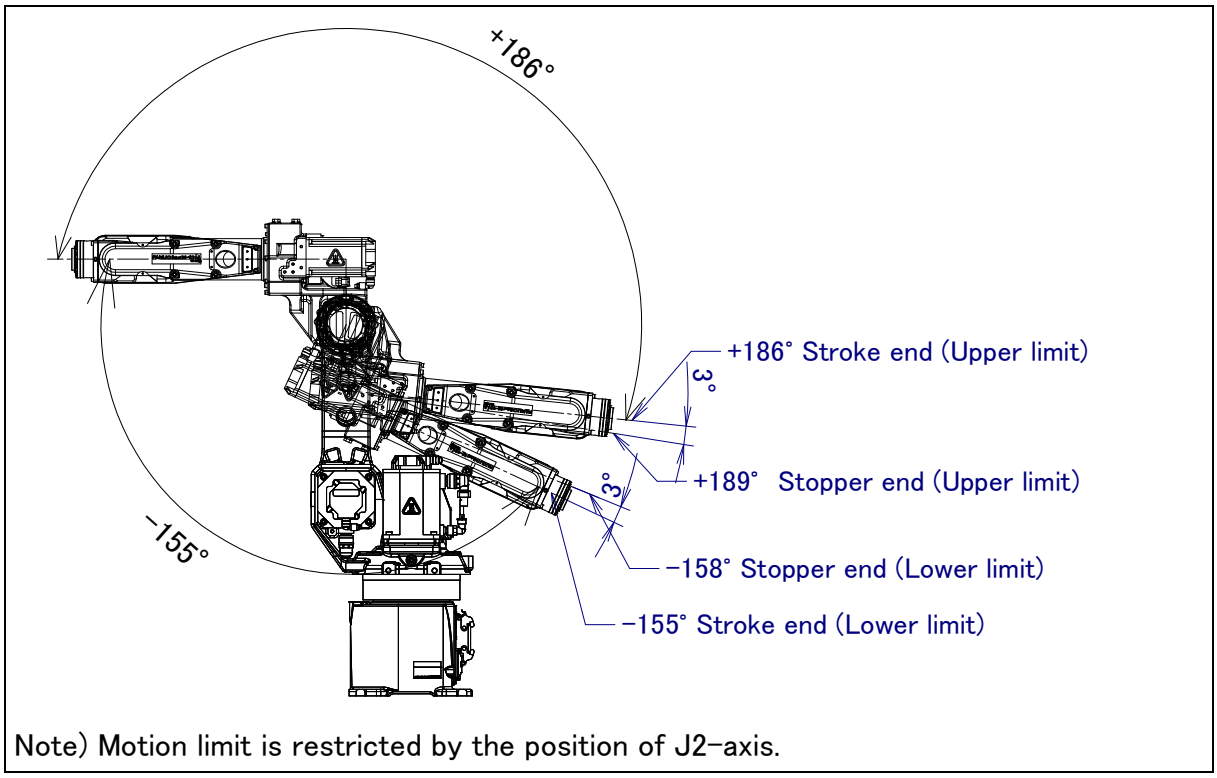


Fig. 3.3 (h) J3-axis motion limit (M-10*i*A/10MS)

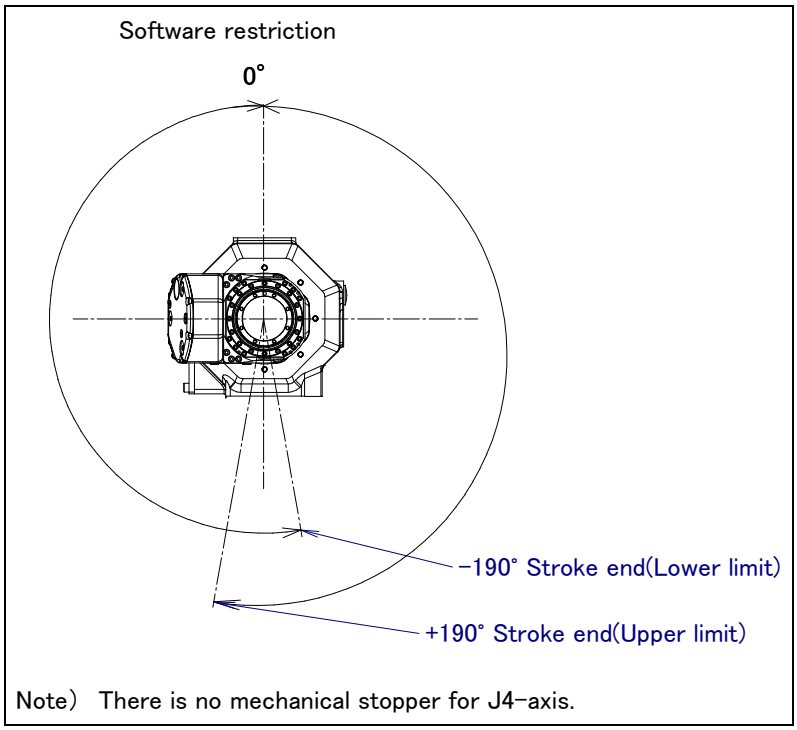


Fig. 3.3 (i) J4-axis motion limit

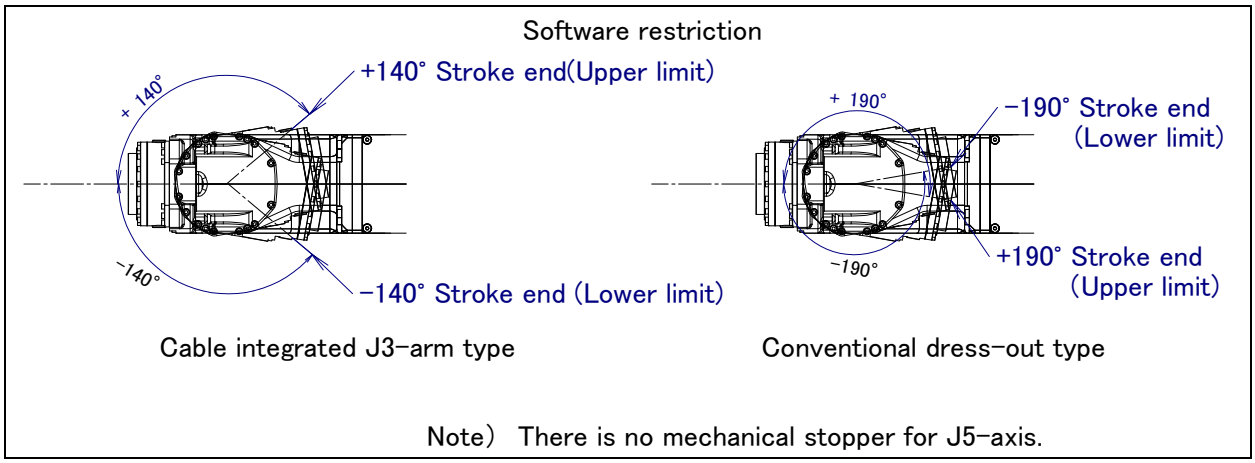


Fig. 3.3 (j) J5-axis motion limit (except M-10*i*A/10M/10MS)

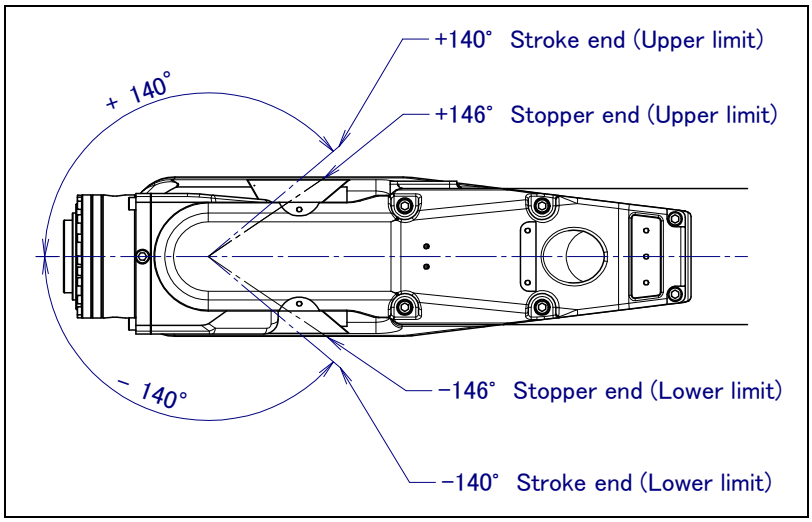


Fig. 3.3 (k) J5-axis motion limit (M-10*i*A/10M/10MS)

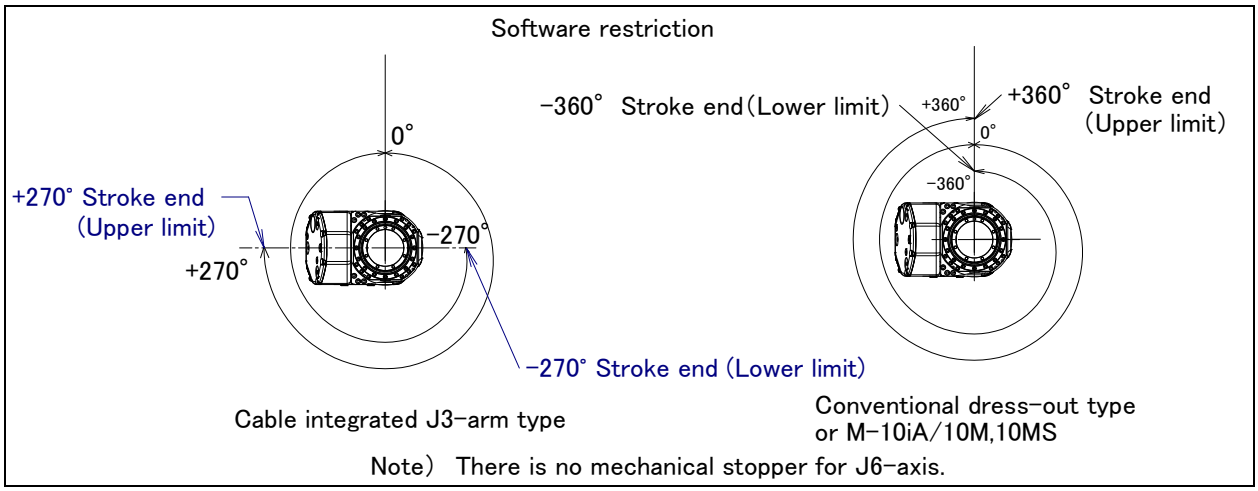


Fig. 3.3 (l) J6-axis motion limit

3.4 MOTION RANGE ACCORDING TO CABLE INTEGRATION

In ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, cable is integrated hollow part of J3 arm is standard. (It is “Cable integrated J3 Arm type” in the following). When the robot is shipped, is set to the range of motion of “Cable integrated J3 arm type”. The case where conduit is inserted in the J3 arm hollow part, and the cable is passed as shown in Fig. 3.4 is defined as "Cable integrated J3 arm".
Other than the above-mentioned, the case where the cable is passed outside of the J3 arm is defined as "Conventional dress-out” and the case of where the option of no dust M/H conduit is defined as "No dust M/H conduit”.

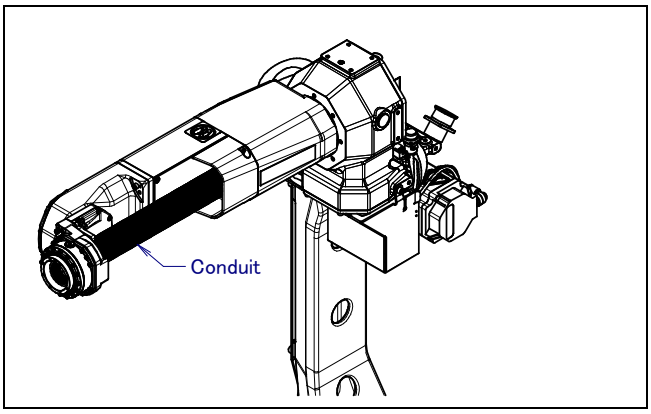


Fig. 3.4 Example of “Cable integrated J3 arm”

When robot is used with “Conventional dress-out” or "No dust M/H conduit”, its motion range needs to be reset. Set the motion range by the following methods.

1 Perform a Controlled Start.
2 Set “Conventional dress-out” or "No dust M/H conduit” on the robot initialization screen
3 Perform a Cold Start.

```
1: Cable integrated J3 arm
   (J5:-140  .. 140, J6:-270  ..  270[deg])
2: Conventional dress-out
   (J5:-190  ..  190, J6:-360  ..  360[deg])
3: No dust M/H conduit
   (J5:-120  ..  120, J6:-270  ..  270[deg])

Select cable dress-out type (1 or 2 or 3) ->
```

1) Note about “Cable integrate J3 arm” type
   The range of motion of “1” is a set value when the hand (torch and tool) cable which FANUC recommends is integrated in J3 arm. (Handling specification. M/H conduit option [A05B-1221-J701, J702] is needed. Refer to Section 11.3 about exchange cycle.) For other cases, set motion range and the regular replacement cycle of the wrist axis according to the specification of installed hand (torch and tool) cable, just like with conventional dress out type.
2) Note about “Conventional dress out” type
   The range of motion of “2” is the one of the dress out type. Set the motion range and the regular exchange cycle of the wrist axis according to installing hand (torch and tool) cable as usual.
3) Note about “No dust M/H conduit” type
   The range of motion of “3” is the motion range when the no dust M/H conduit option [A05B-1222-J721, J722] is specified. Set the motion range and the regular exchange cycle of the wrist axis according to the installing hand (tool) cable. (Refer to Chapter 12 about exchange cycle.)

3.5 WRIST LOAD CONDITIONS

- Fig. 3.5 (a) to (e) are diagrams showing the allowable load that can be applied to the wrist section.
- Apply a load within the region indicated in the graph.
- Apply the conditions of the allowable load moment and the allowable load inertia. See Section 3.1 about the allowable load moment and the allowable load inertia.
- See Section 4.1 about mounting of end effector.

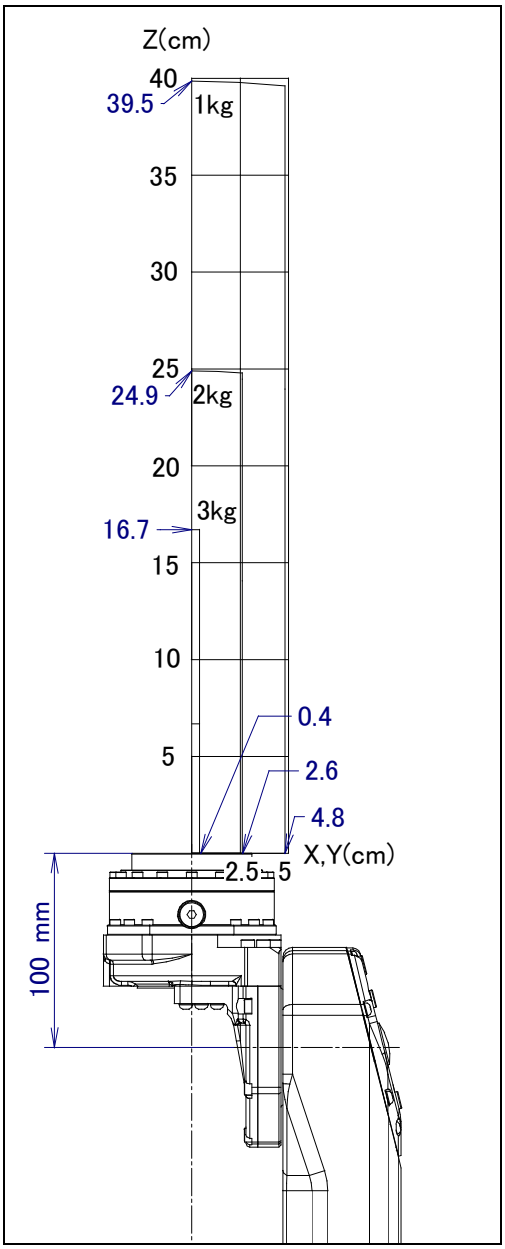


Fig. 3.5 (a) Wrist load diagram
ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S, ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L
(3kg payload Standard welding torch mode)

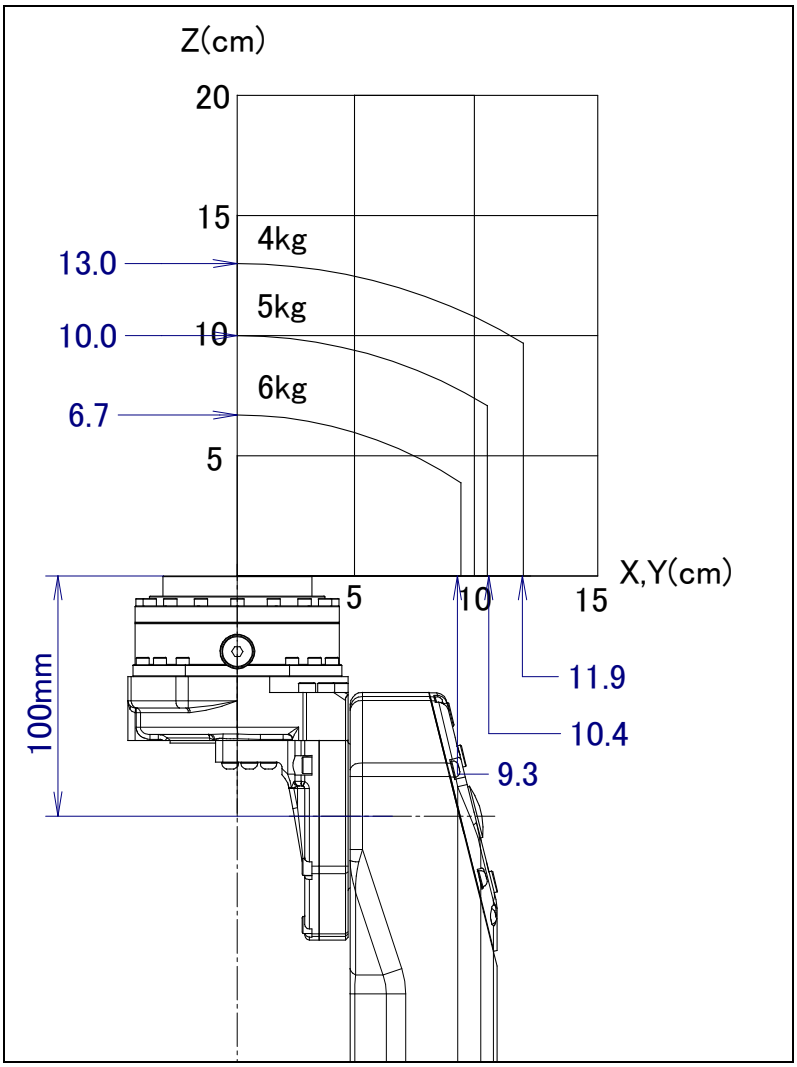


Fig. 3.5 (b) Wrist load diagram
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*Ce, M-10*i*Ae
6kg payload Standard inertia mode)

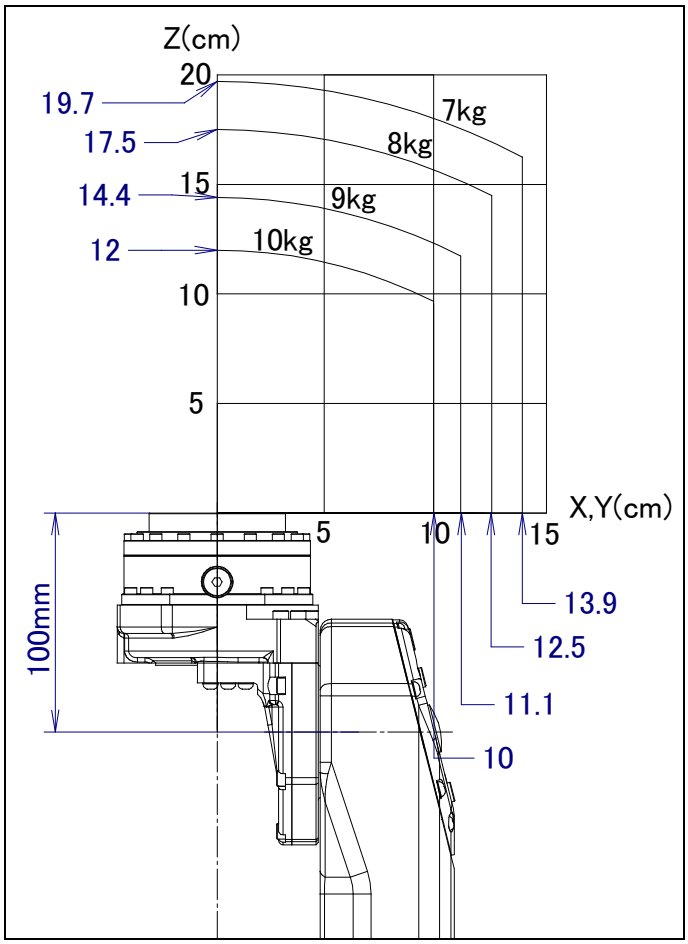


Fig. 3.5 (c) Wrist load diagram
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/10S, M-10*i*A/10S, ARC Mate 100*i*Ce, M-10*i*Ae
10kg payload High inertia mode)

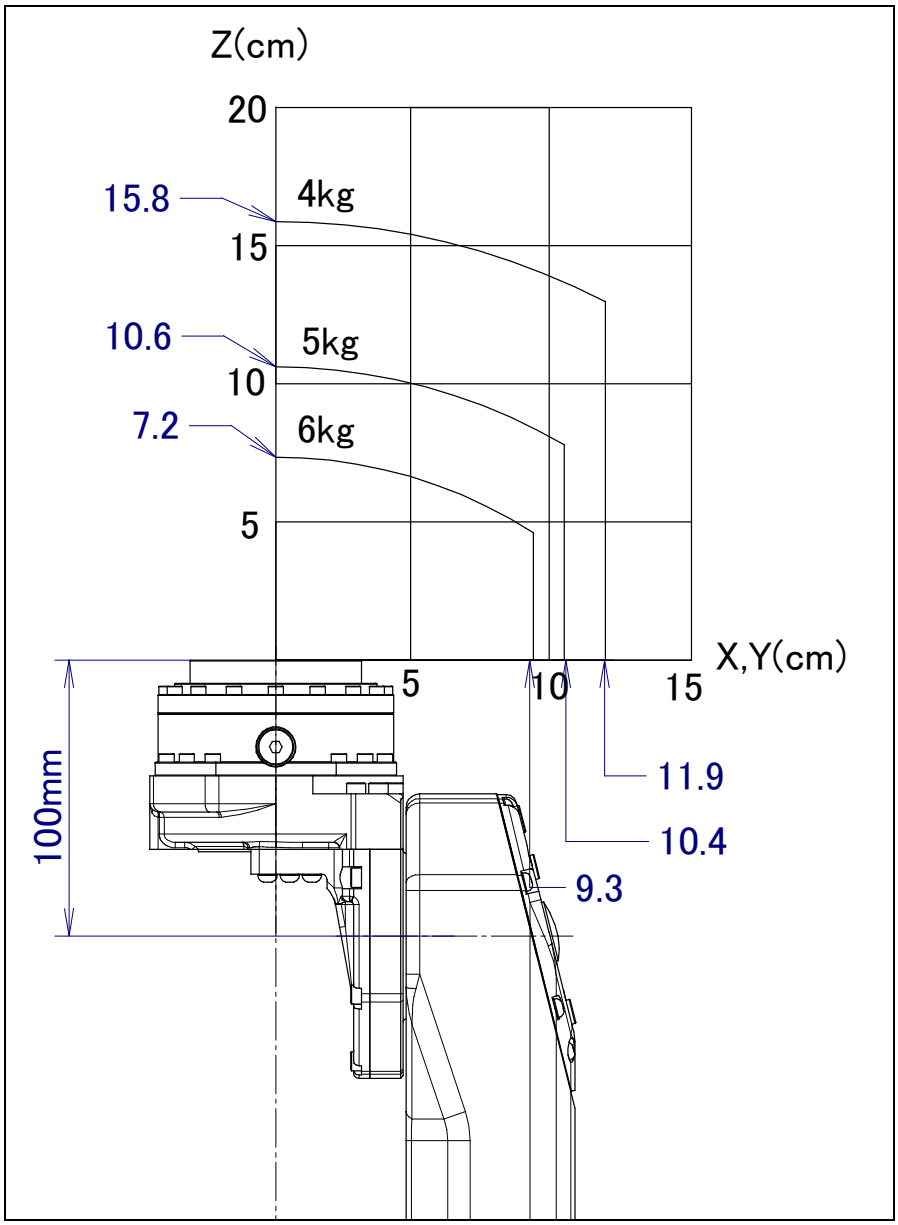


Fig. 3.5 (d) Wrist load diagram (ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L 6kg payload Standard inertia mode)

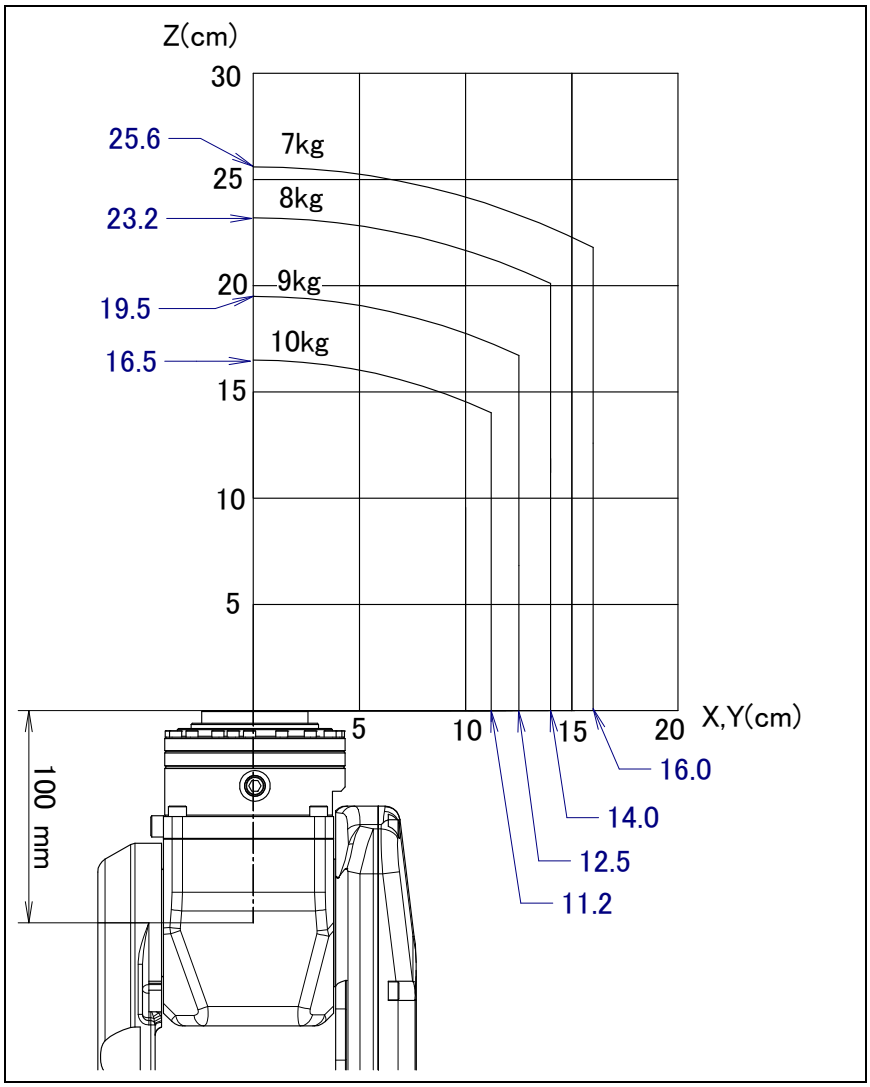


Fig. 3.5 (e) Wrist load diagram (M-10*i*A/10M/10MS)

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) to (c) are the diagram for installing end effectors on the wrist. Select screws and positioning pins of a length that matches the depth of the tapped holes and pinholes. See Appendix B "STRENGTH OF BOLT AND BOLT TORQUE LIST" for tightening torque specifications.

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

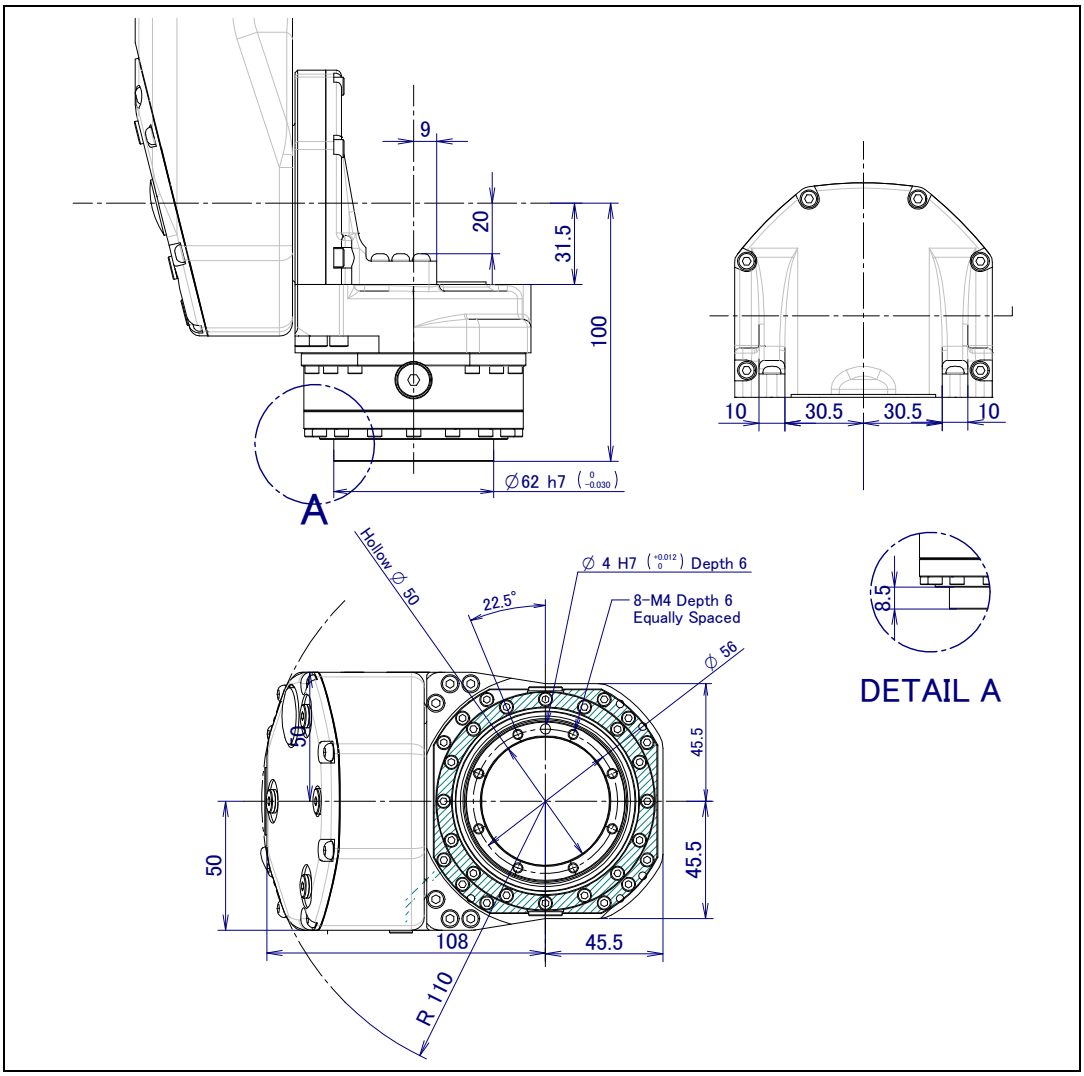


Fig. 4.1 (a) End effector interface
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

> ⚠ **CAUTION**
> Do not remove the M3 bolts of shaped area. If they are removed, the robot does not return to the original state.

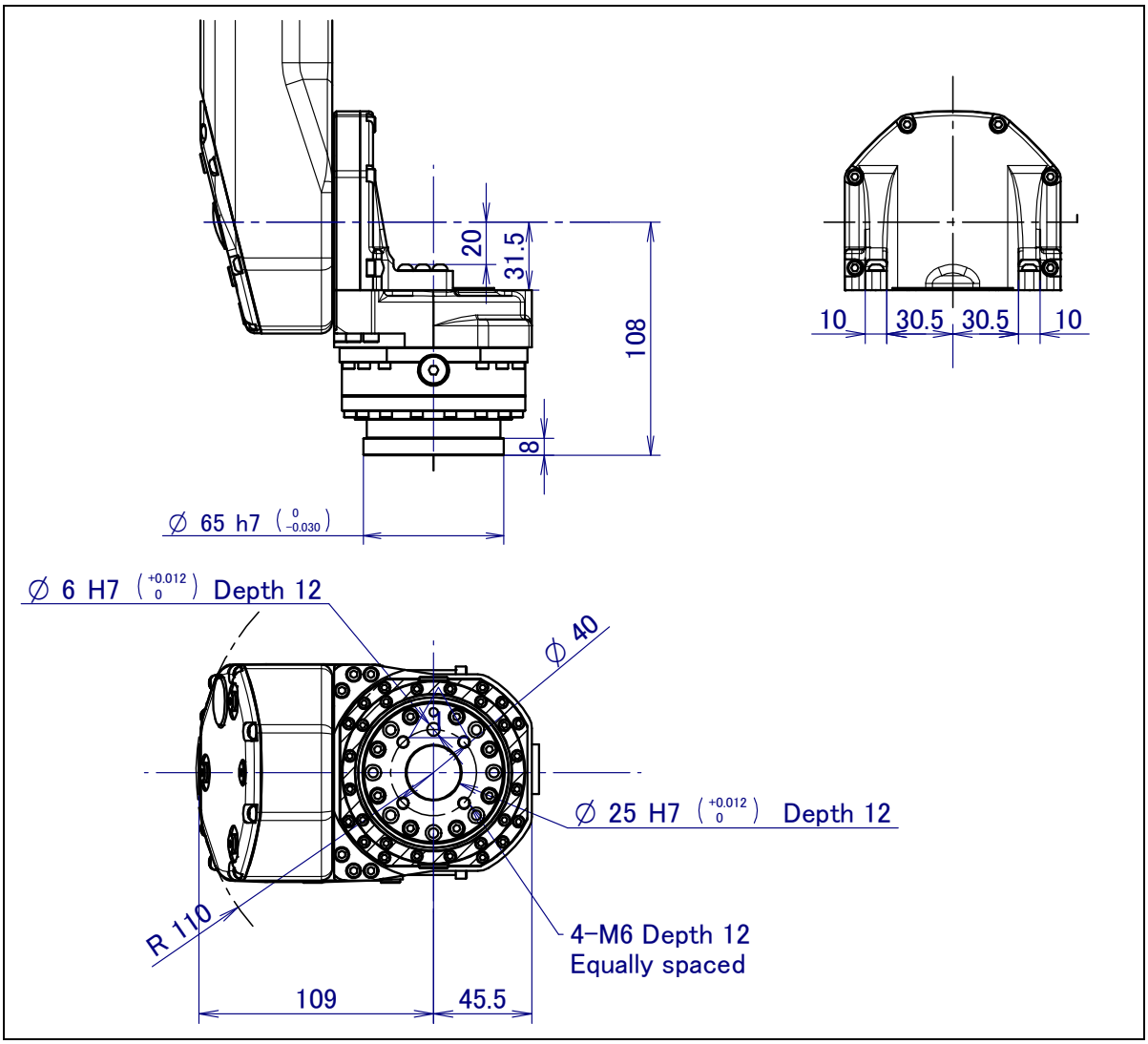


Fig. 4.1 (b) End effector interface (ISO flange adapter is specified)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

> ⚠ **CAUTION**
> Do not remove the M3 bolts of shaped area. If they are removed, the robot does not return to the original state.

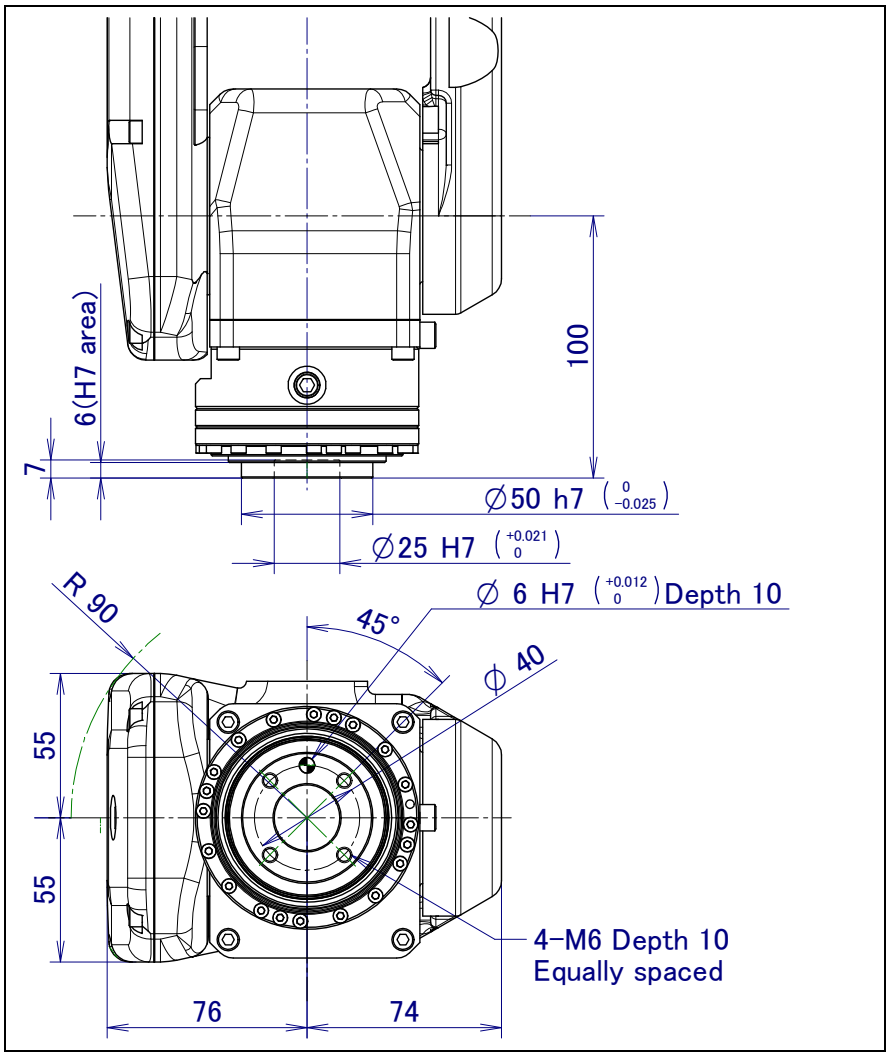


Fig. 4.1 (c) End effector interface (M-10*i*A/10M/10MS)

4.2 EQUIPMENT MOUNTING FACE

As shown in Fig. 4.2 (a) to (c) tapped holes are provided to install equipment to the robot.

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

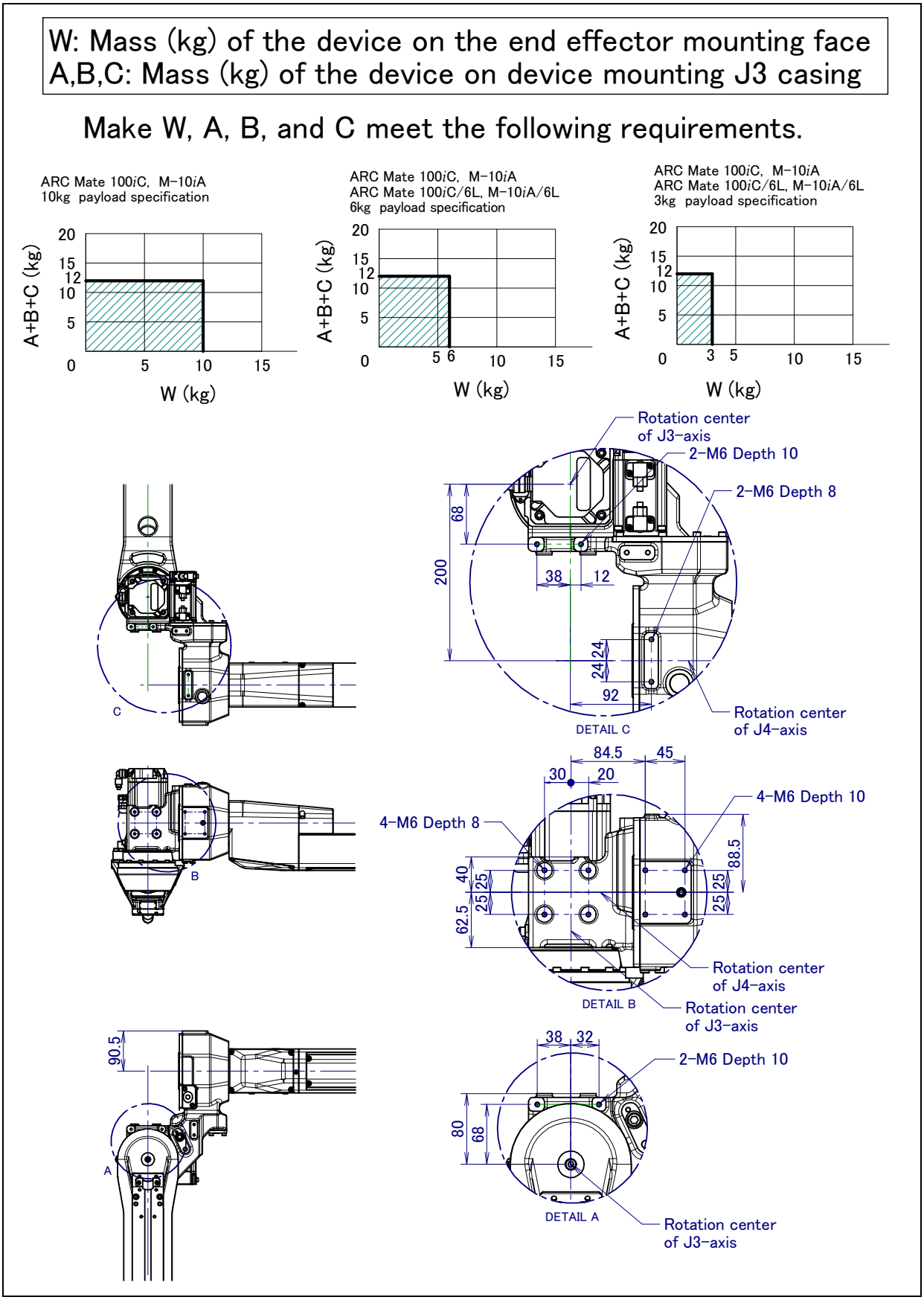


Fig. 4.2 (a) Equipment mounting faces
ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L,
ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L

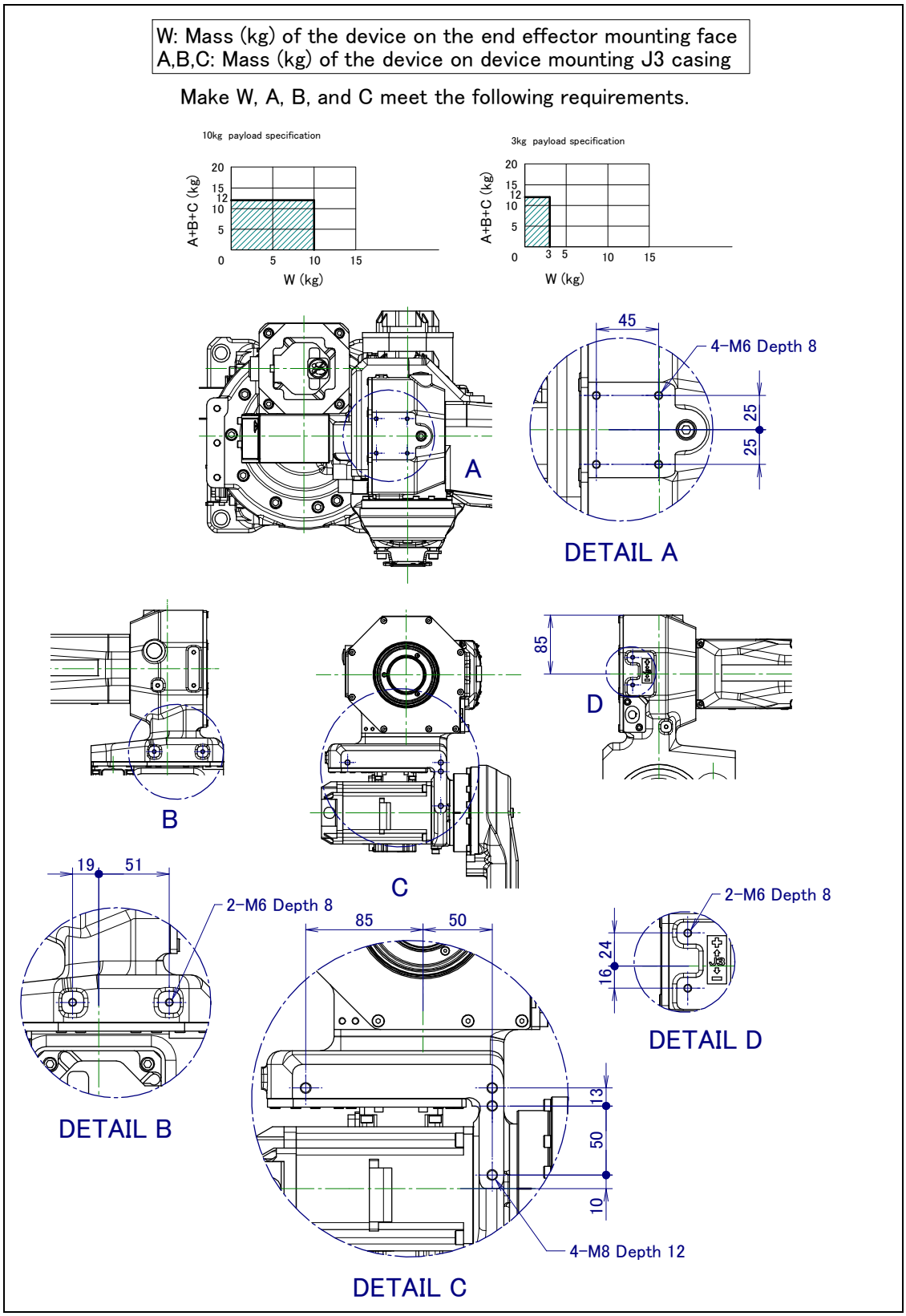


Fig. 4.2 (b) Equipment mounting faces (ARC Mate 100*i*C/10S, M-10*i*A/10S)

> ⚠ **CAUTION**
> Be careful not to spoil the M6 tap of top of J3 casing when you tighten bolts. Confirm bolts are seated and tighten them with tightening torque written in Appendix.

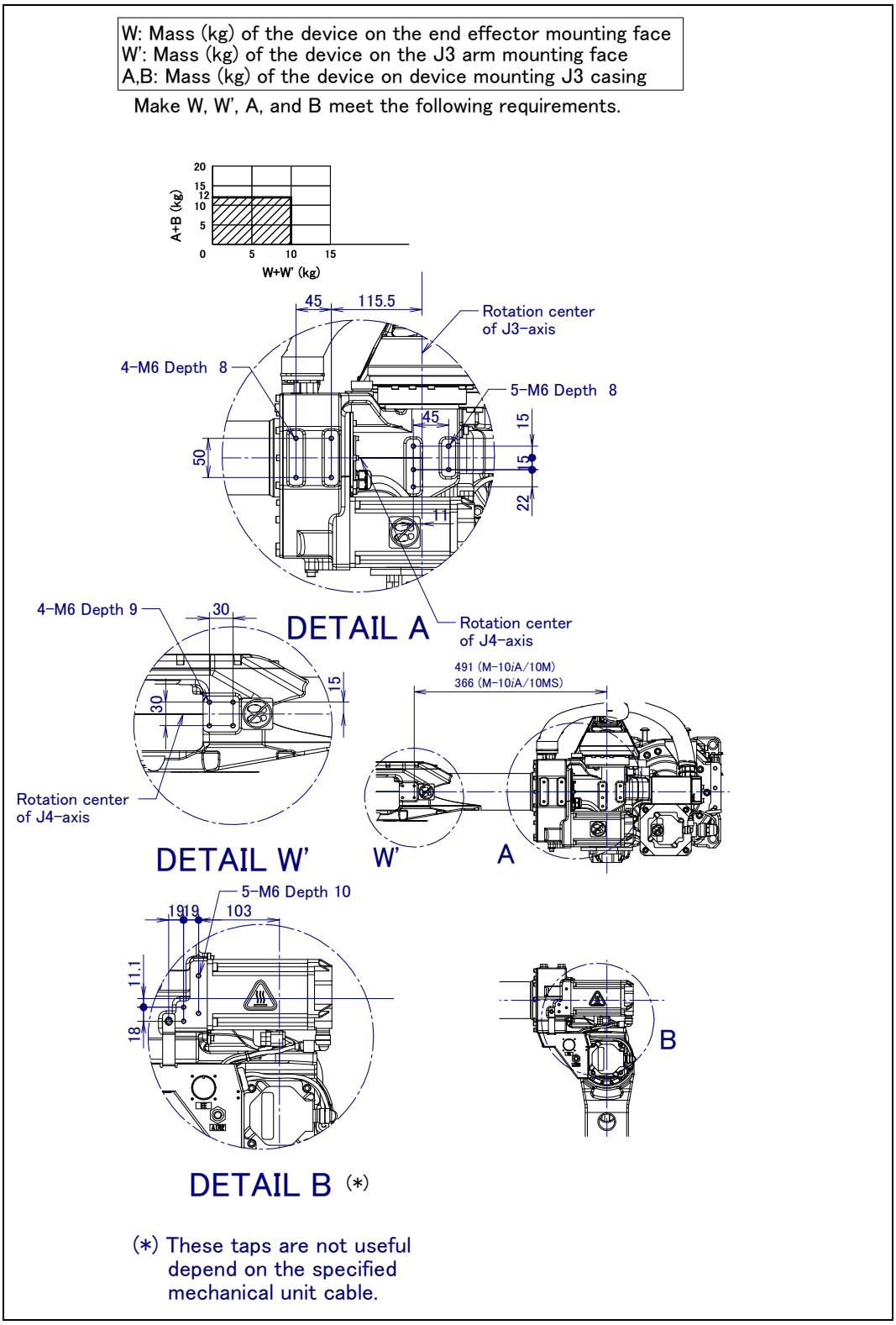


Fig. 4.2 (c) Equipment mounting faces (M-10*i*A/10M/10MS)

Fig. 4.2 (d) shows taps for the cable clamp of M-10*i*A/10M/10MS.

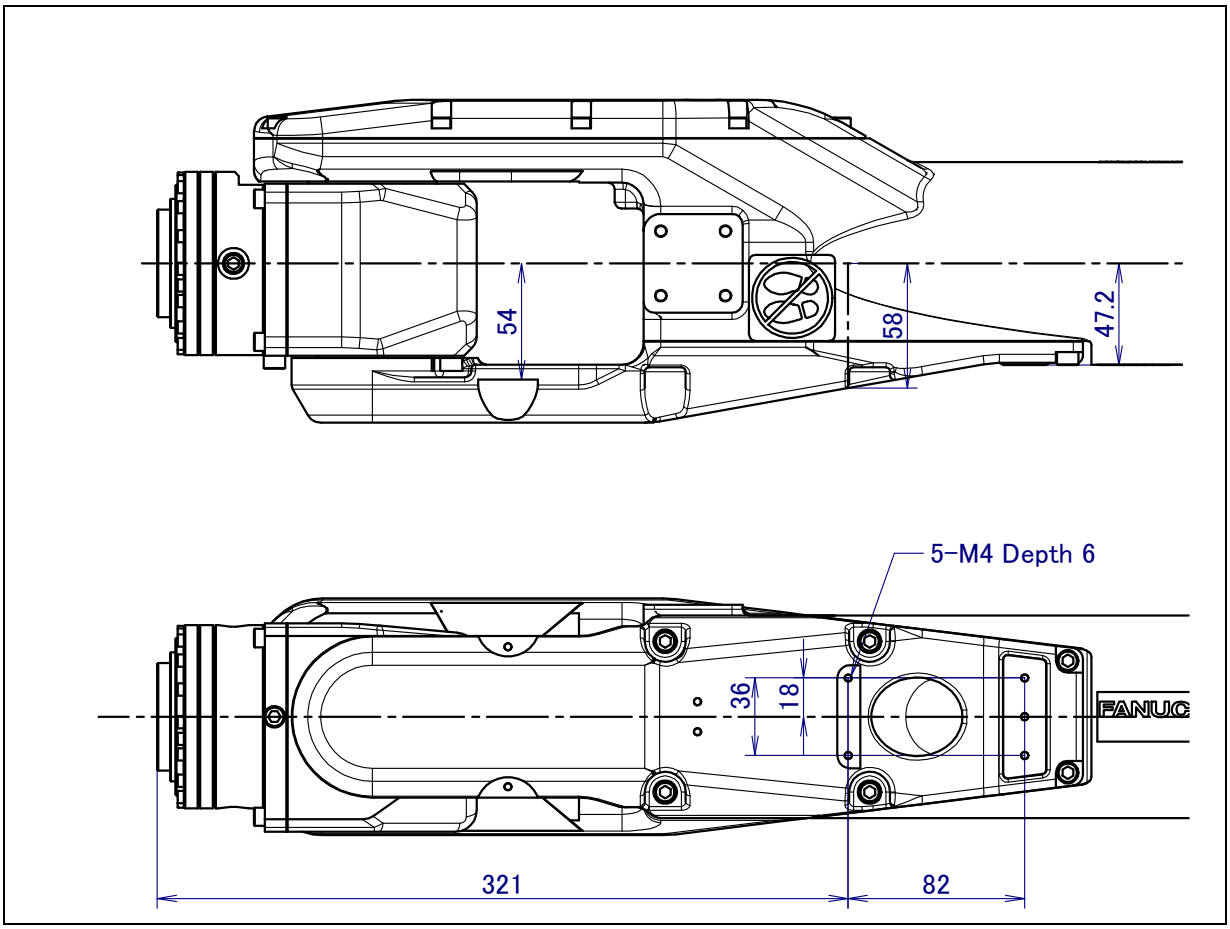


Fig. 4.2 (d) Equipment mounting faces (for the cable clamp) (M-10*i*A/10M/10MS)

NOTE
When the clamp option is specified, the taps of Fig. 4.2 (d) cannot be used.

Fig. 4.2 (e) shows tap positions for the cable clamp option of M-10*i*A/10M/10MS.

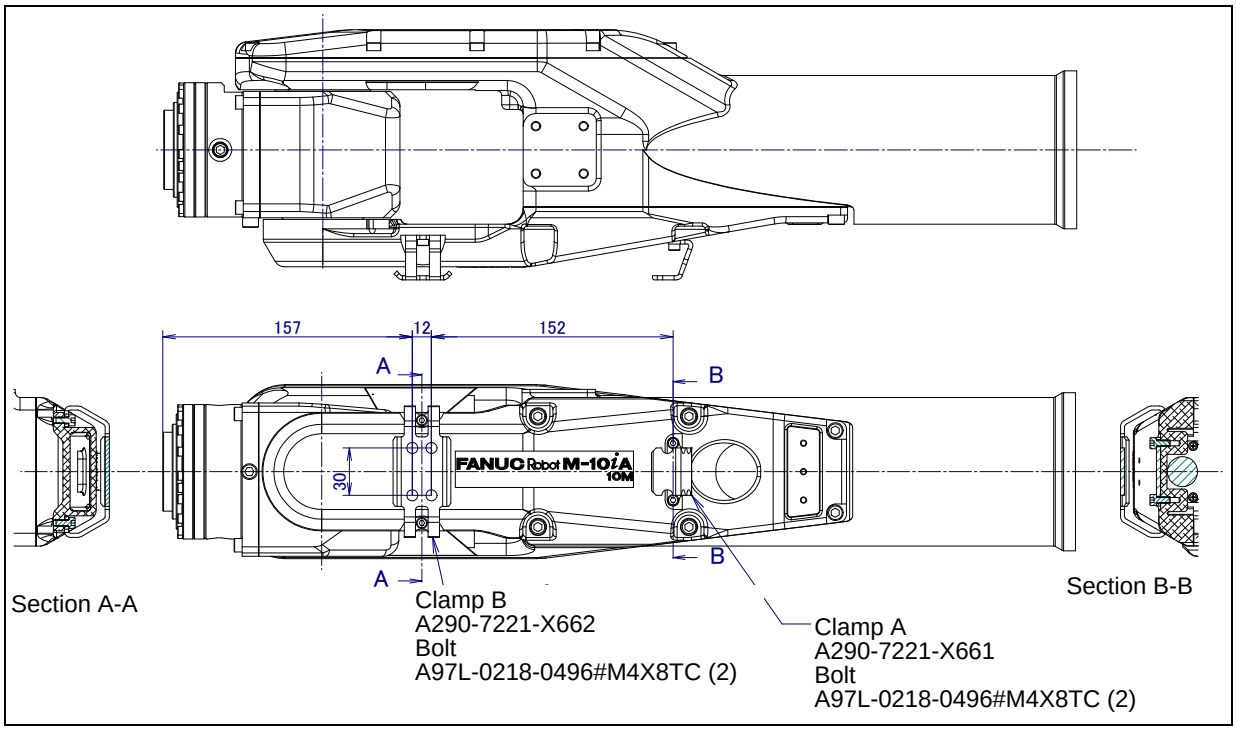


Fig. 4.2 (e) Cable clamp (M-10*i*A/10M/10MS)

4.3 LOAD SETTING

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

> **NOTE**
> Wrist payload specification cannot be changed with the setting described in this section. Refer to Section 4.4, please.

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

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

```
MOTION PERFORMANCE                    JOINT 10%
    Group1
No.   PAYLOAD[kg]          Comment
 1          10.00    [                    ]
 2           0.00    [                    ]
 3           0.00    [                    ]
 4           0.00    [                    ]
 5           0.00    [                    ]
 6           0.00    [                    ]
 7           0.00    [                    ]
 8           0.00    [                    ]
 9           0.00    [                    ]
10           0.00    [                    ]


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

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

```
MOTION PAYLOAD SET                    JOINT 10%

    Group 1
 1 Schedule No[          1]:[Comment          ]
 2 PAYLOAD                [kg]            10.00
 3 PAYLOAD CENTER  X [cm]                 -7.99
 4 PAYLOAD CENTER  Y [cm]                  0.00
 5 PAYLOAD CENTER  Z [cm]                  6.44
 6 PAYLOAD INERTIA X [kgfcms^2]            0.13
 7 PAYLOAD INERTIA Y [kgfcms^2]            0.14
 8 PAYLOAD INERTIA Z [kgfcms^2]            0.07

 [TYPE] GROUP NUMBER  DEFAULT  HELP
```

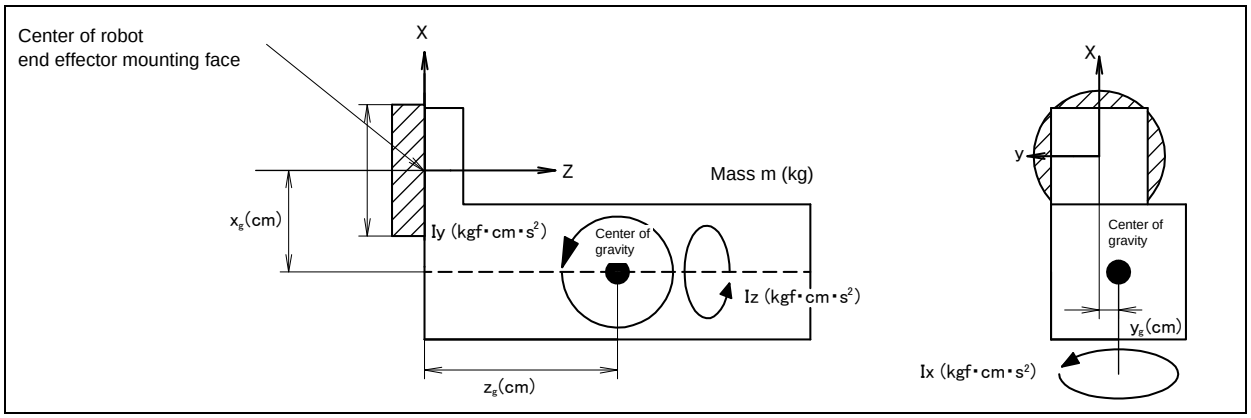


Fig. 4.3 Standard tool coordinate

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

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

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

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

```
MOTION ARMLOAD SET          JOINT   100%

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

[ TYPE ]    GROUP          DEFAULT  HELP
```

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

4.4 MAX PAYLOAD SHIFT FUNCTION

About Max payload shift function

In ARC Mate100*i*C/M-10*i*A, the best three servo motion parameters are prepared respectively when the wrist payload specification is 3kg, 6kg, and 10kg. The best acceleration and deceleration operation can be achieved by setting the parameter matched to the wrist payload specification. The parameter is changed by executing the following KAREL programs (It is abbreviated as KAREL for Changing method of wrist payload specification thereafter.)

ARC Mate100*i*C, M-10*i*A (A05B-1221-B201, B202)
- M10SET03.PC: 3kg wrist payload specification
- M10SET06.PC: 6kg wrist payload specification
- M10SET10.PC: 10kg wrist payload specification

ARC Mate100*i*C, M-10*i*A (A05B-1221-B401, B402)
ARC Mate100*i*Ce, M-10*i*Ae (A05B-1221-B451, B452)
- MTCSET03.PC: 3kg wrist payload specification
- MTCSET06.PC: 6kg wrist payload specification
- MTCSET10.PC: 10kg wrist payload specification

ARC Mate100*i*C/6L, M-10*i*A/6L (A05B-1221-B301, B302)
- A6LSET03.PC: 3kg wrist payload specification
- A6LSET06.PC: 6kg wrist payload specification

ARC Mate100*i*C/10S, M-10*i*A/10S (A05B-1221-B601, B602)
- A66SET03.PC: 3kg wrist payload specification
- A66SET10.PC: 6kg wrist payload specification

ARC Mate100*i*C/6L, M-10*i*A/6L (A05B-1221-B501, B502)
ARC Mate100*i*Ce/6L, M-10*i*Ae/6L (A05B-1221-B551, B552)
- A6CSET03.PC: 3kg wrist payload specification
- A6CSET06.PC: 6kg wrist payload specification

The following procedure is based on an example of ARCMate100*i*C, M-10*i*A (A05B-1221-B201, B202).

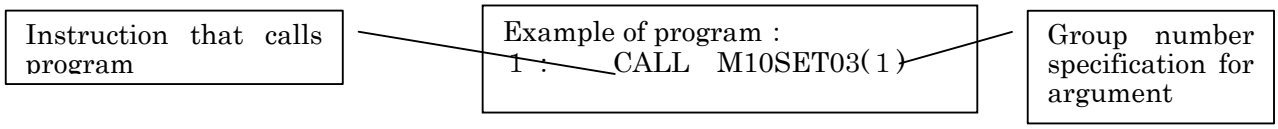
M-10*i*A, M-10*i*Ae is set in 10kg wrist payload specification. M-10*i*A/6L, M-10*i*Ae/6L is set in 6kg wrist payload specification. ARC Mate 100*i*C, ARC Mate 100*i*C/6L, ARCMate100*i*Ce, and ARCMate100*i*Ce/6L is set to an acceptable 3kg wrist payload specification when robot is shipped.
In case of servo torch (option) is specified, ARC Mate 100*i*C is set to 10kg wrist payload specification and ARC Mate 100*i*C/6L is set to 6kg wrist payload specification.

> ⚠ **CAUTION**
> Please set the moderate payload specification referring to specification table in Section 3.1 and Section 3.5., If the robot is operated with wrong setting, the function and the lifetime of the robot would deteriorate.
> In case of M-10*i*A/10M and 10MS, it is impossible to change payload.

Method of shifting

There are the following two in the method of executing KAREL for changing method of wrist payload specification. Please use it properly according to the purpose.

1) Method of executing KAREL program by using "Call program" →Section 4.4.1
   - The KAREL program is set in the program call instruction of the TP program and the parameter is set by specifying with the argument that shows the group number, and executing it. The parameter of M-10*i*A of a specific group can be switched in this method.



2) Method of executing KAREL program directly→Section 4.4.2
   - Select and execute the KAREL program in program select screen.
   - To set same load parameter to multiple M-10*i*A in the multi group system, use this method to switch the parameter at once.

> ⚠ **CAUTION**
> Execute KAREL for Changing method of wrist payload specification in the state of cold start mode. Be careful that the paths and the cycle time of an existing teach program change if KAREL for changing method of wrist payload specification is executed

Below section explains the method of executing KAREL for changing wrist payload specification.

4.4.1 Method of Executing KAREL Program by Using “Call program”

* The following procedures assume the thing of changing M-10*i*A of the first group to the 3kg wrist payload specification.

Execution procedure

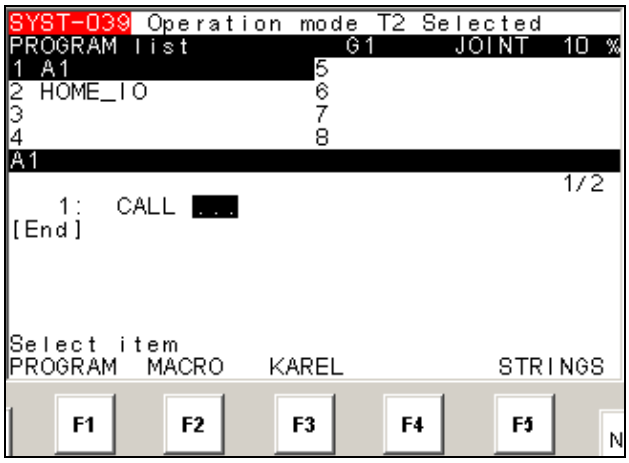
1 Call the system variable screen.

MENU key → Select “System” and press F1 key(screen) → Select “System variables”

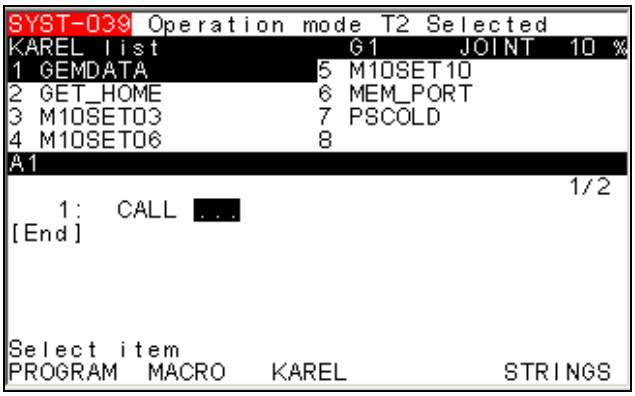
2 Set system variables $KAREL_ENB to 1.
3 Open TP program edit screen.
4 Select “call program” from among the program instruction

F1 key (INST) →Select “CALL” →Select “CALL program”

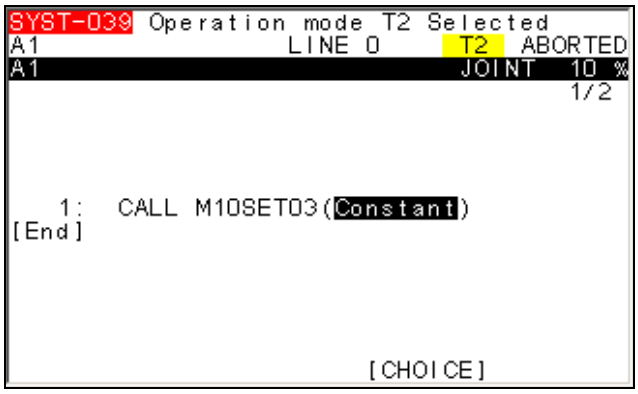
Then, the following screens are displayed.



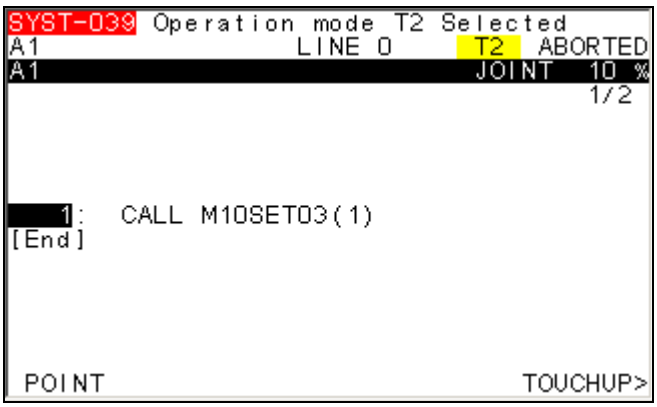
5 Press F3 key (KAREL). Then, select KAREL. The following screen will be displayed. Then select M10SET03 of 3kg wrist payload specification from among that.



6 Press F4 key (CHOICE). Choose “CONSTANT” from there. Then, it becomes the following screens.



7 Enter group number (1 in this case) while the cursor is at “Constant”.

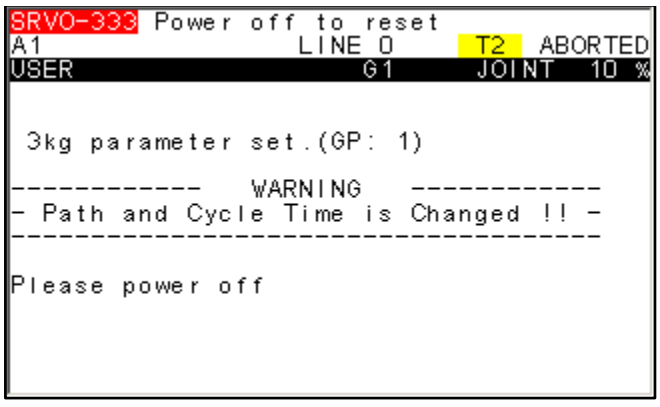


8 Execute this program.
9 Cycle power of the controller

Press [FWD] key while pressing [SHIFT]

Then, the following screens are displayed. This indicates that KAREL M10SET03.PC of 3kg wrist payload specification is executed.

This means specification is changed to wrist payload 3kg specification.



Please turn off the power supply and turn it on.

This completes the parameter switching.

4.4.2 Method of Executing KAREL Program Directly

Use scene

For instance, it is assumed that the following multi group systems exist.
1st group: M-10*i*A
2nd group: M-10*i*A
3rd group: positioner A
To set M-10***i***A in 1st and 2nd group to 3kg wrist payload specification, the method explained below will allow you to do it at once.

> ⚠ **CAUTION**
> If you want to M-10*i*A of 1st group to 3kg wrist payload specification and M-10*i*A of 2nd group to 6kg wrist payload specification, Method of this chapter cannot be used.
> In that case, please make two programs as follows, and do the parameter change by the method of Chapter 1.

1 Turn on the controller power again after executing the program 1.
2 Turn on the controller power again after executing the program 2.

Example of program

Program 1:

```
1:    call  M10SET03(1)
```

Program 2:

```
1:    call  M10SET06(2)
```

1st group is Max payload 3kg specification

2nd group is Max payload 6kg specification

Execution procedure

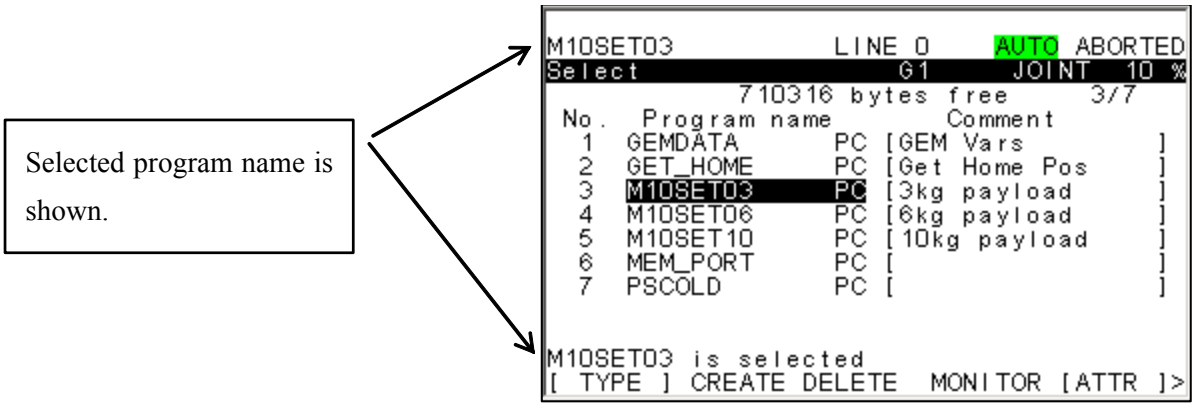
1 Call the system variable screen.

MENU key ?	Press F1 key (screen) after selecting “system”?	Select system variables

2 Set system variables $KAREL_ENB to 1.
3 Call program select screen and select “

```
TPIF-005 Program is not selected
                                    AUTO
Select                    G1      JOINT   10 %
              710316 bytes free       1/7
 No.   Program name        Comment
  1   GEMDATA       PC [GEM Vars          ]
  2   GET_HOME      PC [Get Home Pos      ]
  3   M10SET03      PC [3kg payload       ]
  4   M10SET06      PC [6kg payload       ]
  5   M10SET10      PC [10kg payload      ]
  6   MEM_PORT      PC [                  ]
  7   PSCOLD        PC [                  ]


[ TYPE ] CREATE DELETE  MONITOR [ATTR ]>
```

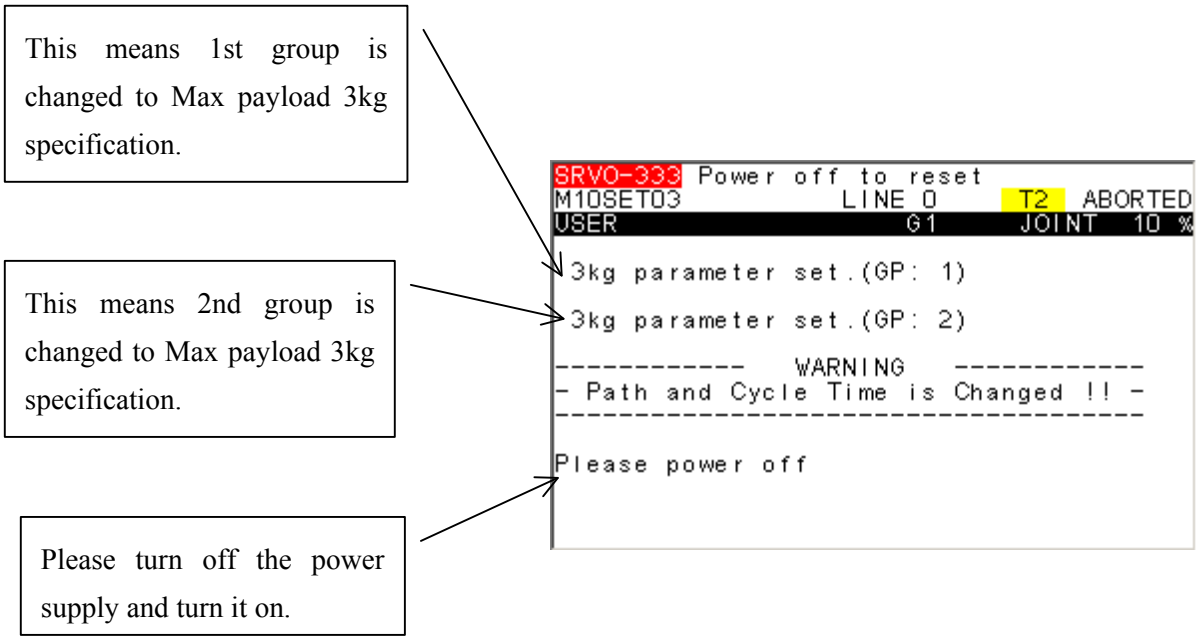
4 Place the cursor to the KAREL program of the load to be set, and press [ENTER] key. M10SET03.PC KAREL of 3kg wrist payload specification is selected in below screen. The selected program name is displayed to two places as follows.



5 Execute the program.

Press [FWD] key while pressing [SHIFT] key.

Then, the following screens are displayed. This is case of executing KAREL M10SET03.PC of Max payload 3kg specification.



6 Turn on the controller power again.

This completes the parameter switching.

5 PIPING AND WIRING TO THE END EFFECTOR

⚠ WARNING

- Only use appropriately-specified mechanical unit cables.
- Do not add user cables or hoses inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit cable when cables are added to outside of mechanical unit.
- Please do not perform remodeling (adding a protective cover, or secure an additional outside cable) that obstructs the behavior of the outcrop of the cable.
- When external equipment is installed in the robot, make sure that it does not interfere with other parts of the robot.
- Cut and discard any unnecessary length of wire strand of the end effector (hand) cable. Insulate the cable with seal tape. (See Fig. 5)
- If you have end effector wiring and a process that develops static electricity, keep the end effector wiring as far away from the process as possible. If the end effector and process must remain close, be sure to insulate the cable.
- Be sure to seal the connectors of the user cable and terminal parts of all cables to prevent water from entering the mechanical unit. Also, attach the cover to the unused connector.
- Frequently check that connectors are tight and cable jackets are not damaged.
- When precautions are not followed, damage to cables might occur. Cable failure may result in incorrect function of end effector, robot faults, or damage to robot electrical hardware. In addition, electric shock could occur when touching the power cables.

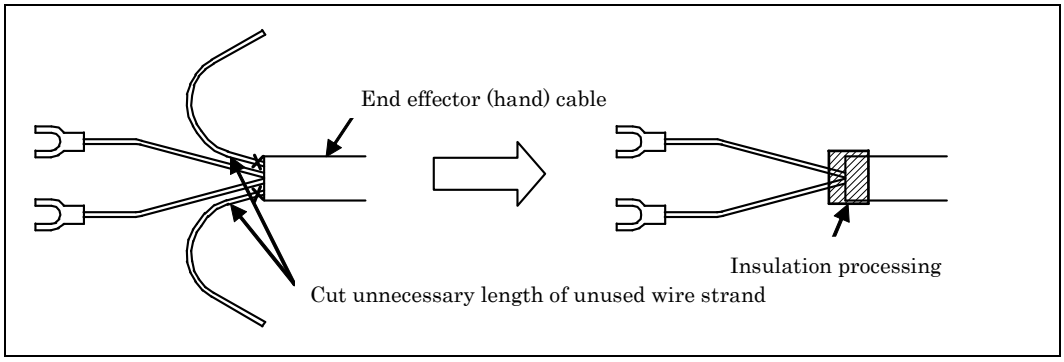


Fig. 5 Treatment method of end effector (hand) cable

5.1 AIR SUPPLY (OPTION)

Robot has air inlet and air outlet on the back of the J1 base and the J3 casing used to supply air pressure to the end effector. As couplings are not supplied, it will be necessary to prepare couplings, which suit to the hose size. Please refer to the table below about panel union and inside and outside diameter of air tube.

Spec. of Mechanical unit cable		Panel union (Input side)	Panel union (Output side)	Outer, inner and number of air tube
A05B-1221-H201	A05B-1221-H505	Rc3/8 Female x 1	Rc3/8 Female x 1	Outer 8mm Inner 5mm x 1pc
A05B-1221-H204	A05B-1221-H507			
A05B-1221-H221	A05B-1221-H525			
A05B-1221-H231	A05B-1221-H535			
A05B-1221-H234	A05B-1221-H537			
A05B-1221-H251	A05B-1221-H601			
A05B-1221-H261	A05B-1221-H605			
A05B-1221-H265	A05B-1221-H661			
A05B-1221-H281	A05B-1221-H665			
A05B-1221-H202 A05B-1221-H203 A05B-1221-H206 A05B-1221-H232 A05B-1221-H233 A05B-1221-H236		1/4NPT Female x 2 (*)	None	Outer 6.35mm Inner 4.23mm X 2pcs(*)
A05B-1221-H214 A05B-1221-H614		Rc3/8 Female x 2	Rc3/8 Female x 2	Outer 10mm Inner 6.5mm x 2pcs
A05B-1221-H401 A05B-1221-H431		None	None	None

(*) There is two hose. One is for the welding gas.

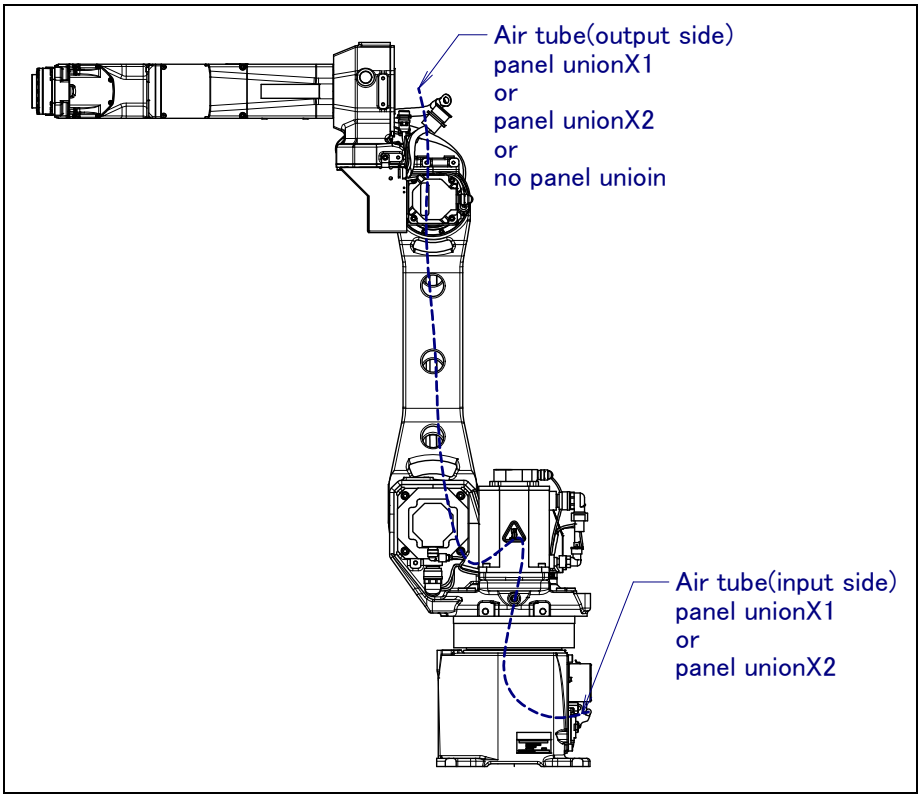


Fig. 5.1 Air supply (option)

5.2 AIR PIPING (OPTION)

Fig. 5.2 (a) shows how to connect air hose to the robot. If the air control set is specified as an option, the air hose between the mechanical unit and the air control set is provided. Mount the air control set using the information in Fig. 5.2 (b). This is outside FANUC delivery scope.

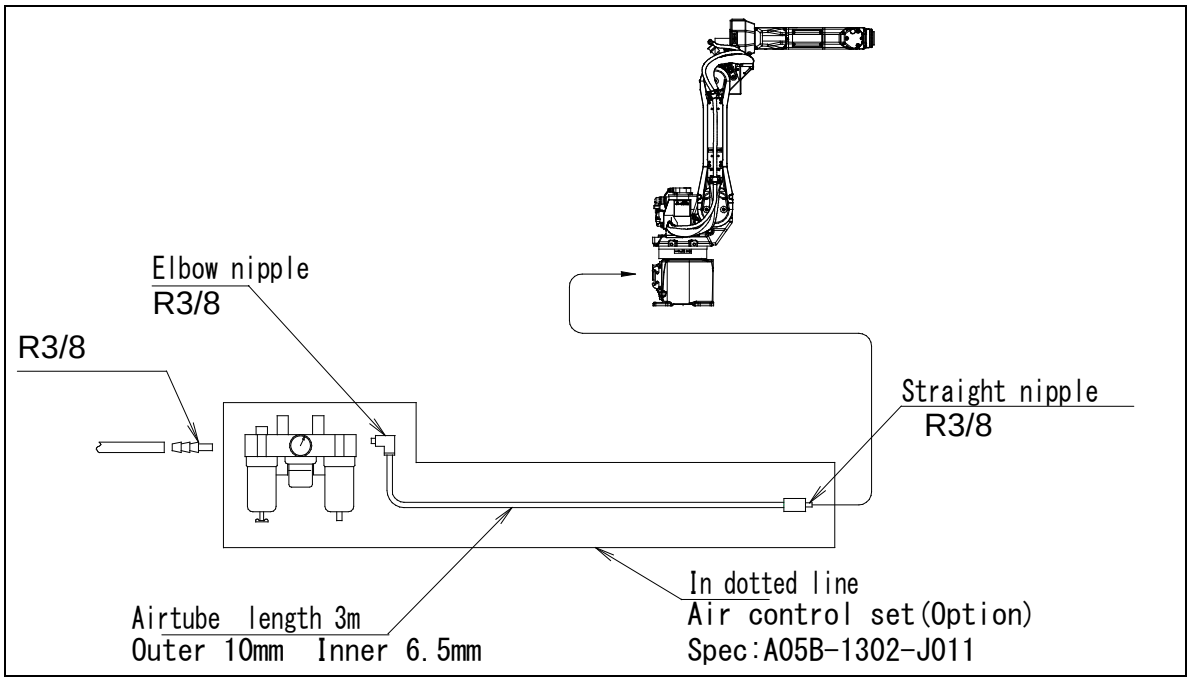


Fig. 5.2 (a) Air piping (option)

Air control set

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

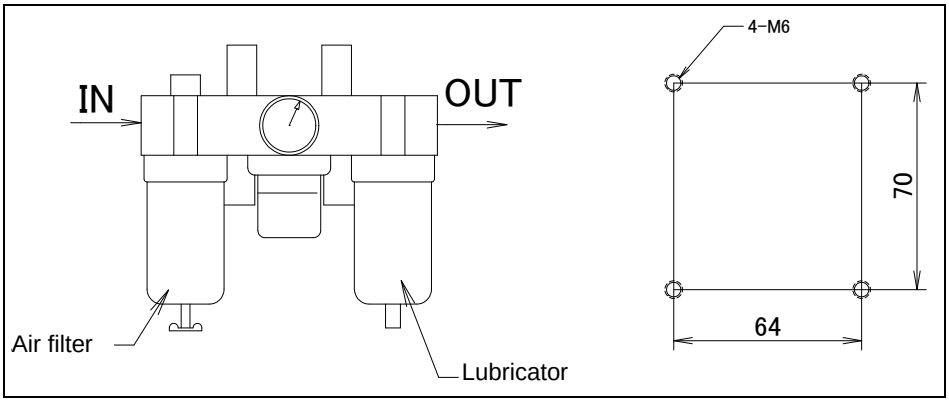


Fig. 5.2 (b) Air control set (option)

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

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

5.3 INTERFACE FOR OPTION CABLE (OPTION)

Fig. 5.3 (a) to (l) show the position of the option cable interface. EE interface (RI/RO), Wire feeder power supply interface, welding power supply, user cable (signal lines/signal line usable to 3D Laser Vision sensor and force sensor/power line), 3DL cable and Camera cable are prepared as options.

NOTE

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

EE(RI/RO) interface	: EE
User cable (signal)	: AS
User cable (power)	: AP
Wire feeder cable	: W/F
Welding power cable	: W/P
User cable (signal line usable to 3D Laser Vision sensor and force sensor	: ASi
Camera cable	: CAM
Sensor cable	: SEN

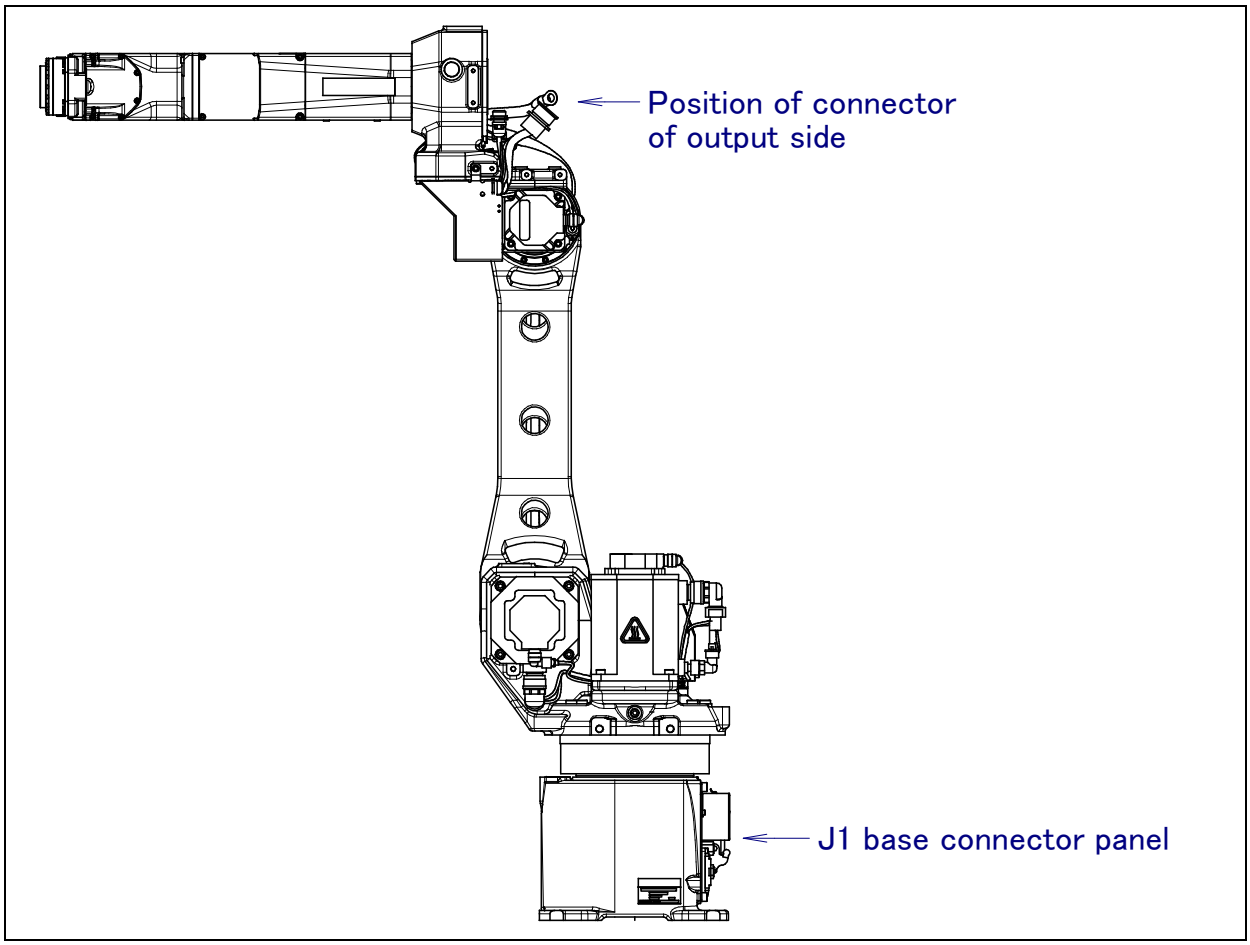


Fig. 5.3 (a) Interface for option cable (OPTION)

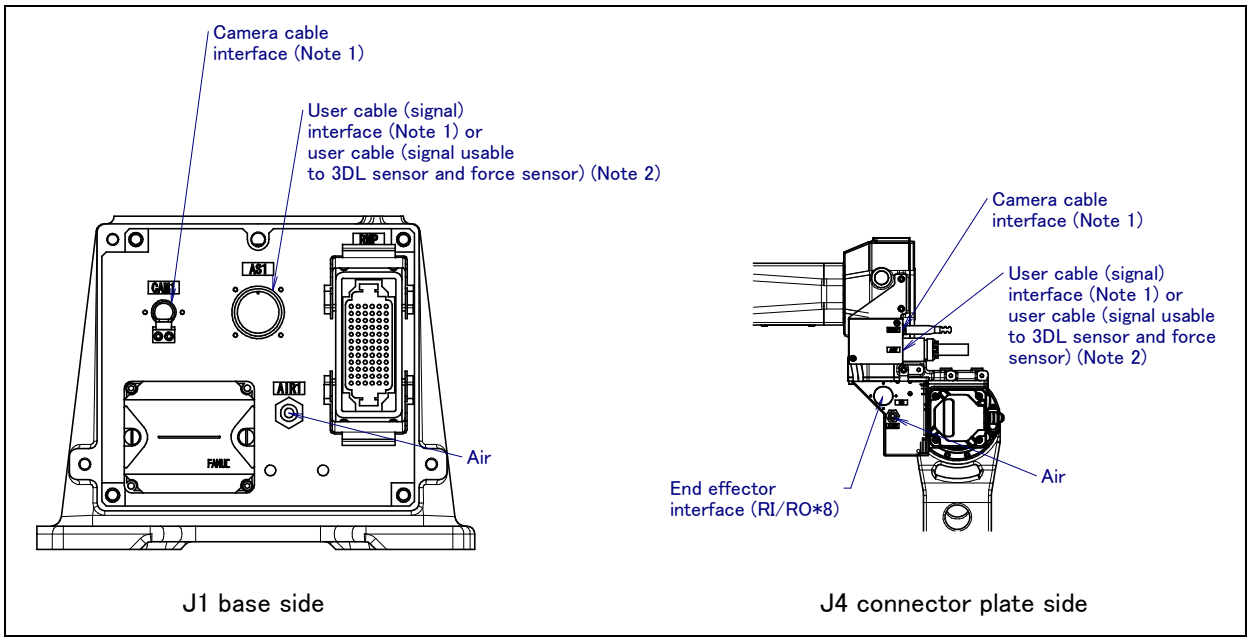


Fig. 5.3 (b) Interface for option cable ((A05B-1221-H201, H204, H231, H505, H535 is specified)

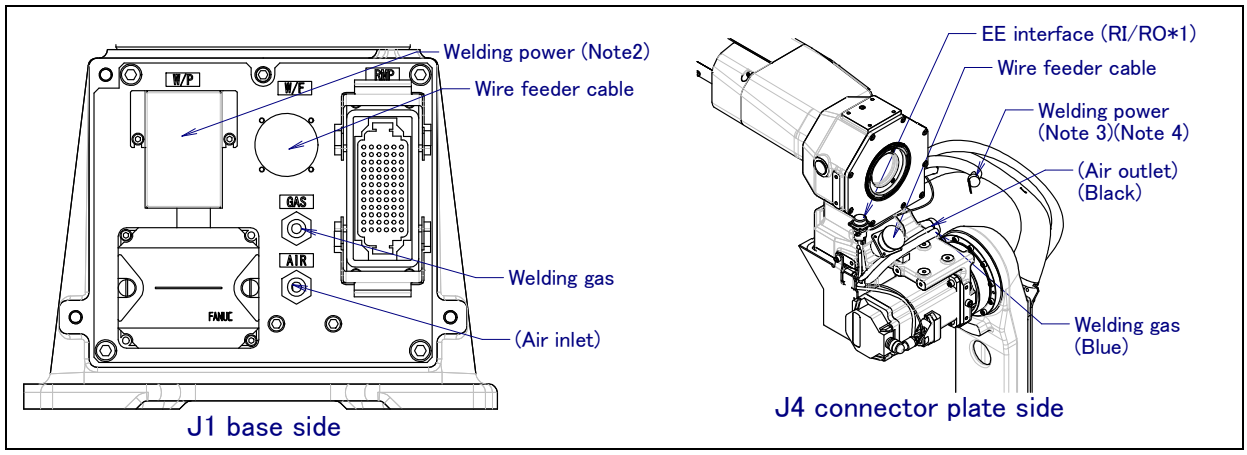


Fig. 5.3 (c) Interface for option cable (A05B-1221-H202, H203, H206, H232, H233, H236 is specified)

NOTE

1 They are attached only when mechanical unit cable A05B-1221-H204, H505.
2 They are attached only when mechanical unit cable A05B-1221-H505, H535.
3 They are attached only when mechanical unit cable A05B-1221-H203, H206, H233, H236.
4 Allowable current of welding power cable is 5A/mm^2.
Welding cable of A05B-1221-H203, H233 is 38mm^2 x 1 and regulated current is 190A.
Welding cable of A05B-1221-H206, H236 is 38mm^2 x 2 and regulated current is 300A.

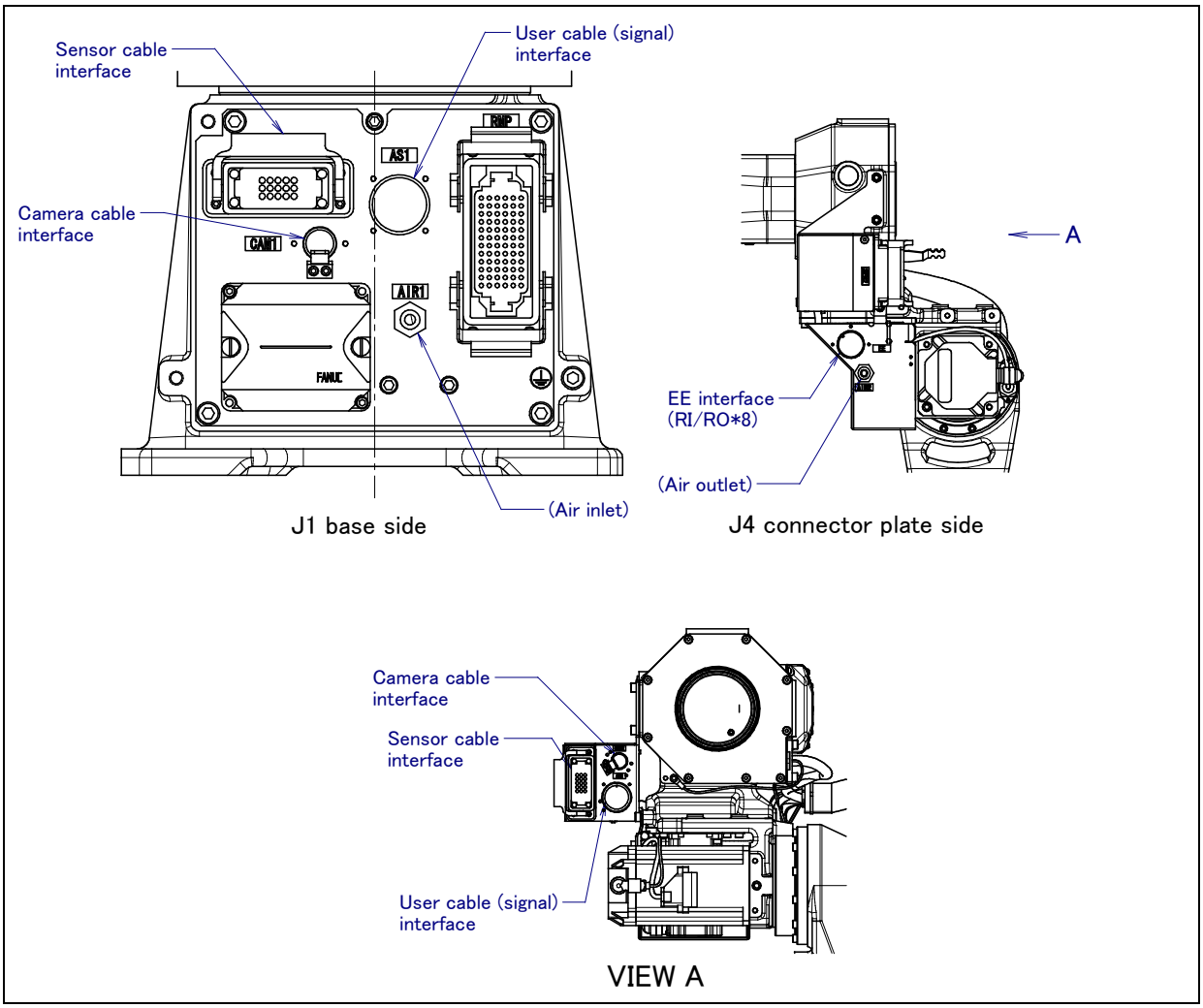


Fig. 5.3 (d) Interface for option cable (A05B-1221-H507, H537 is specified)

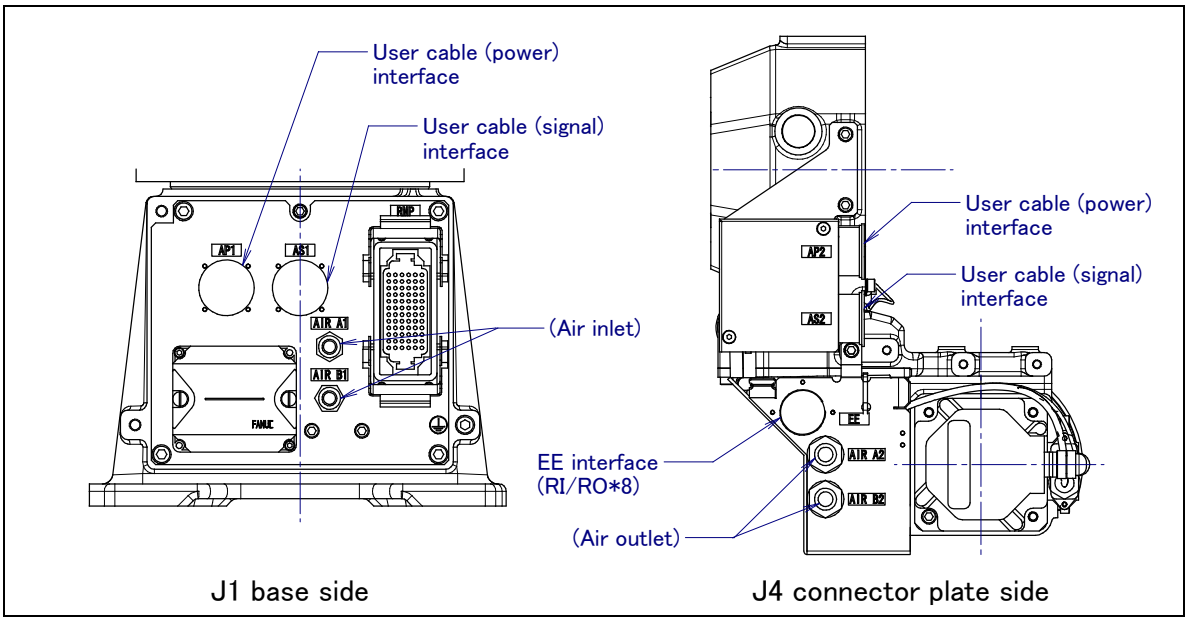


Fig. 5.3 (e) Interface for option cable (A05B-1221-H214 is specified)

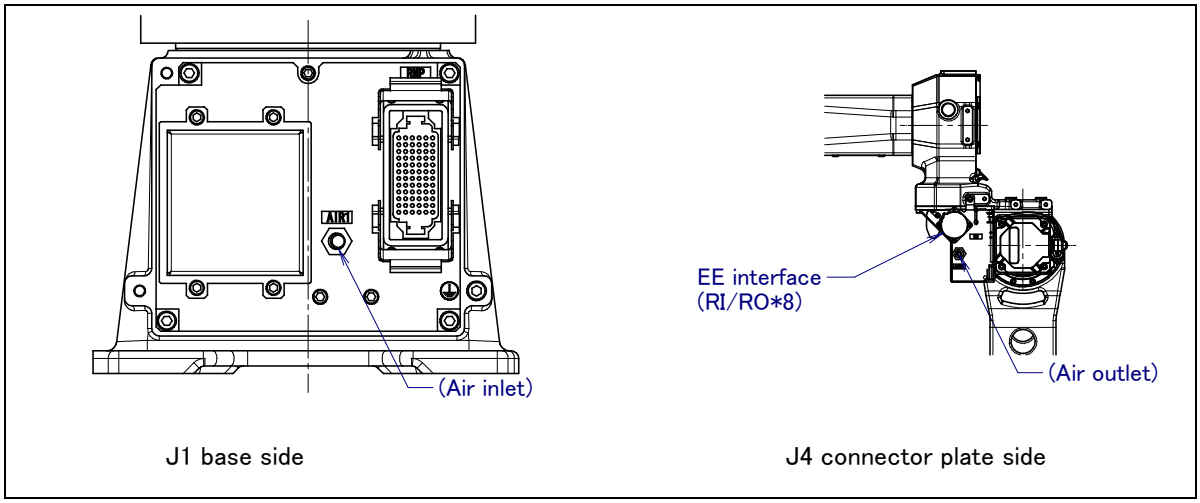


Fig. 5.3 (f) Interface for option cable (A05B-1221-H221, H251 are specified)

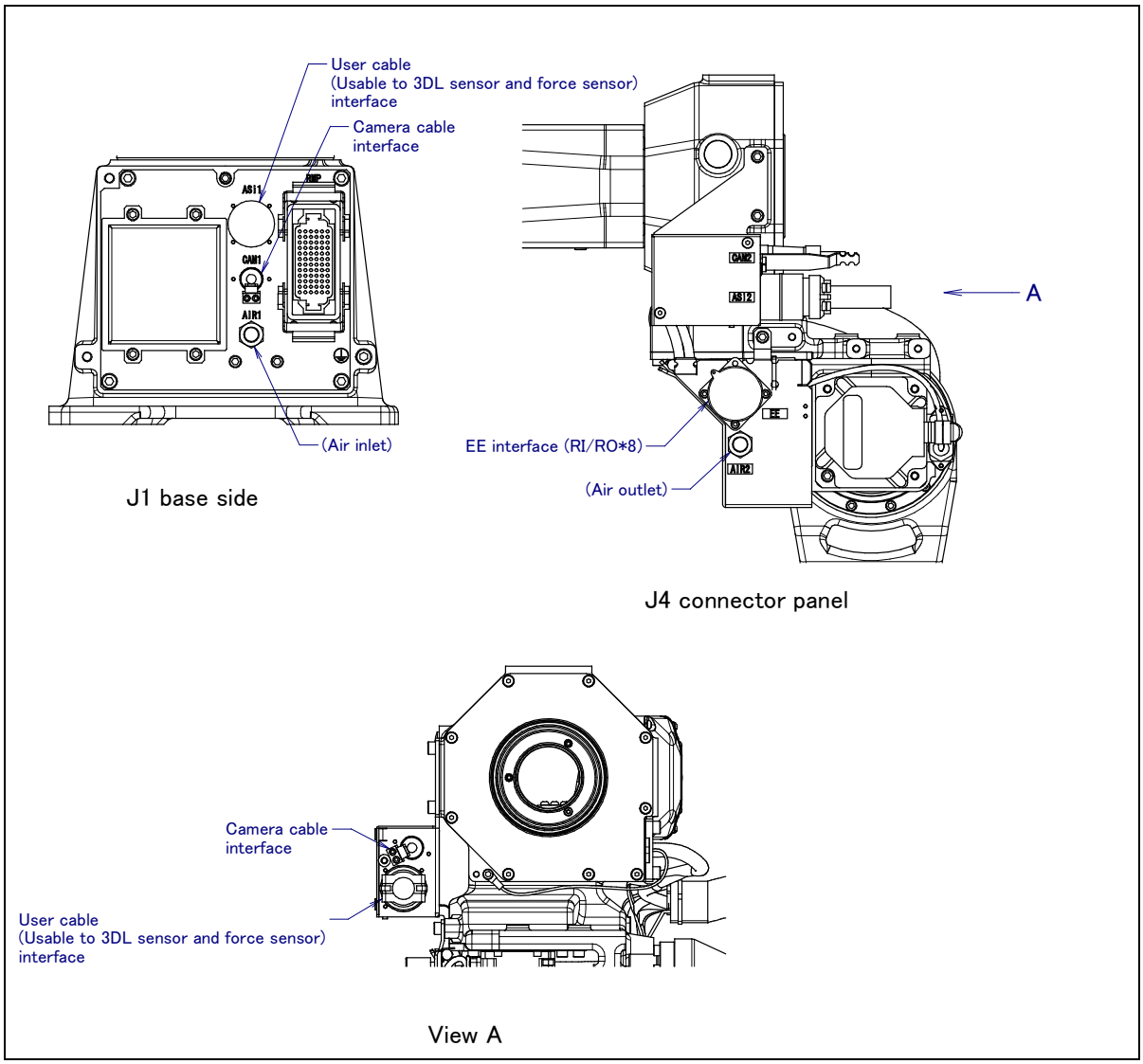


Fig. 5.3 (g) Interface for option cable (A05B-1221-H525 is specified)

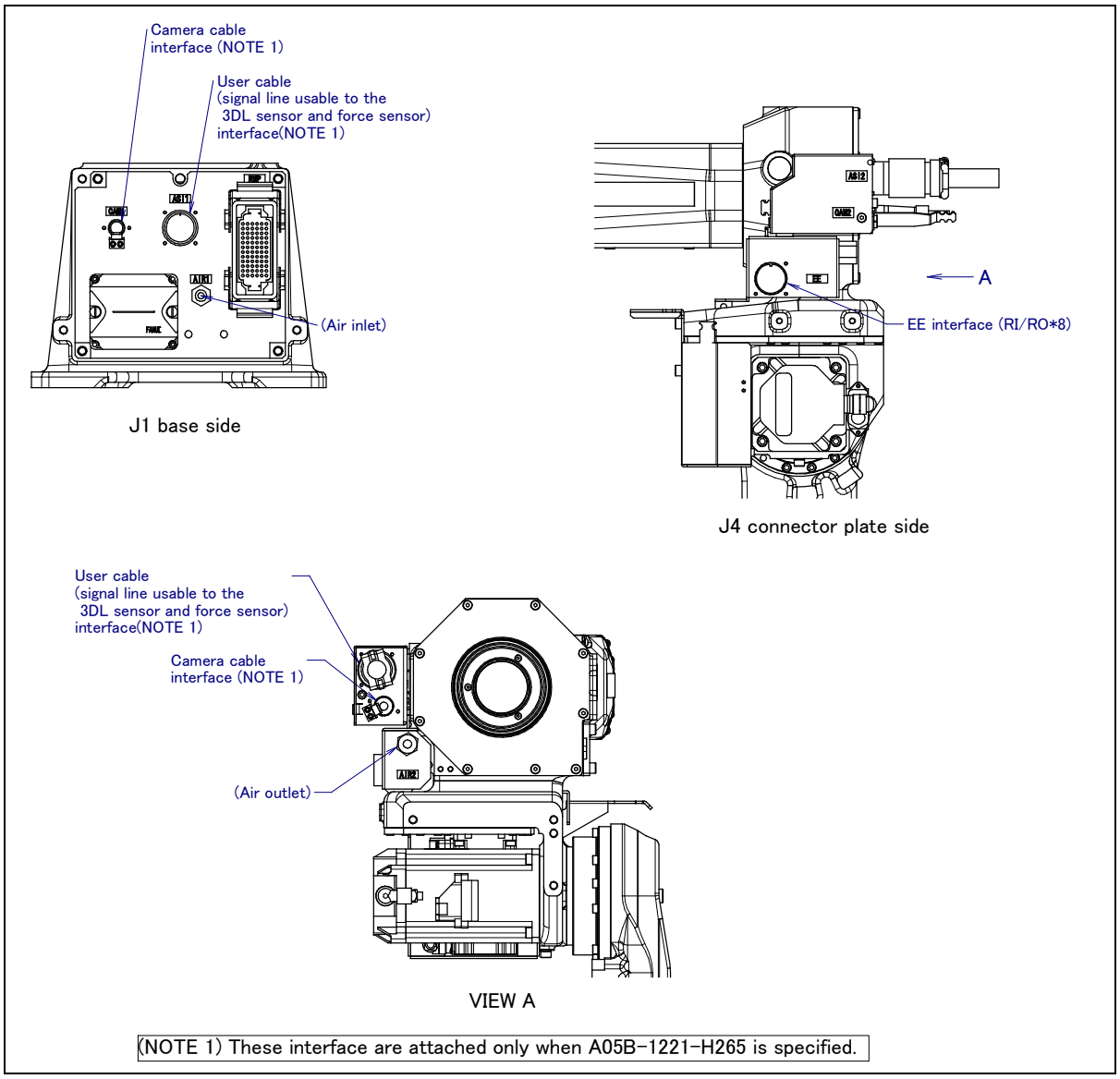


Fig. 5.3 (h) Interface for option cable (A05B-1221-H261, H265 is specified)

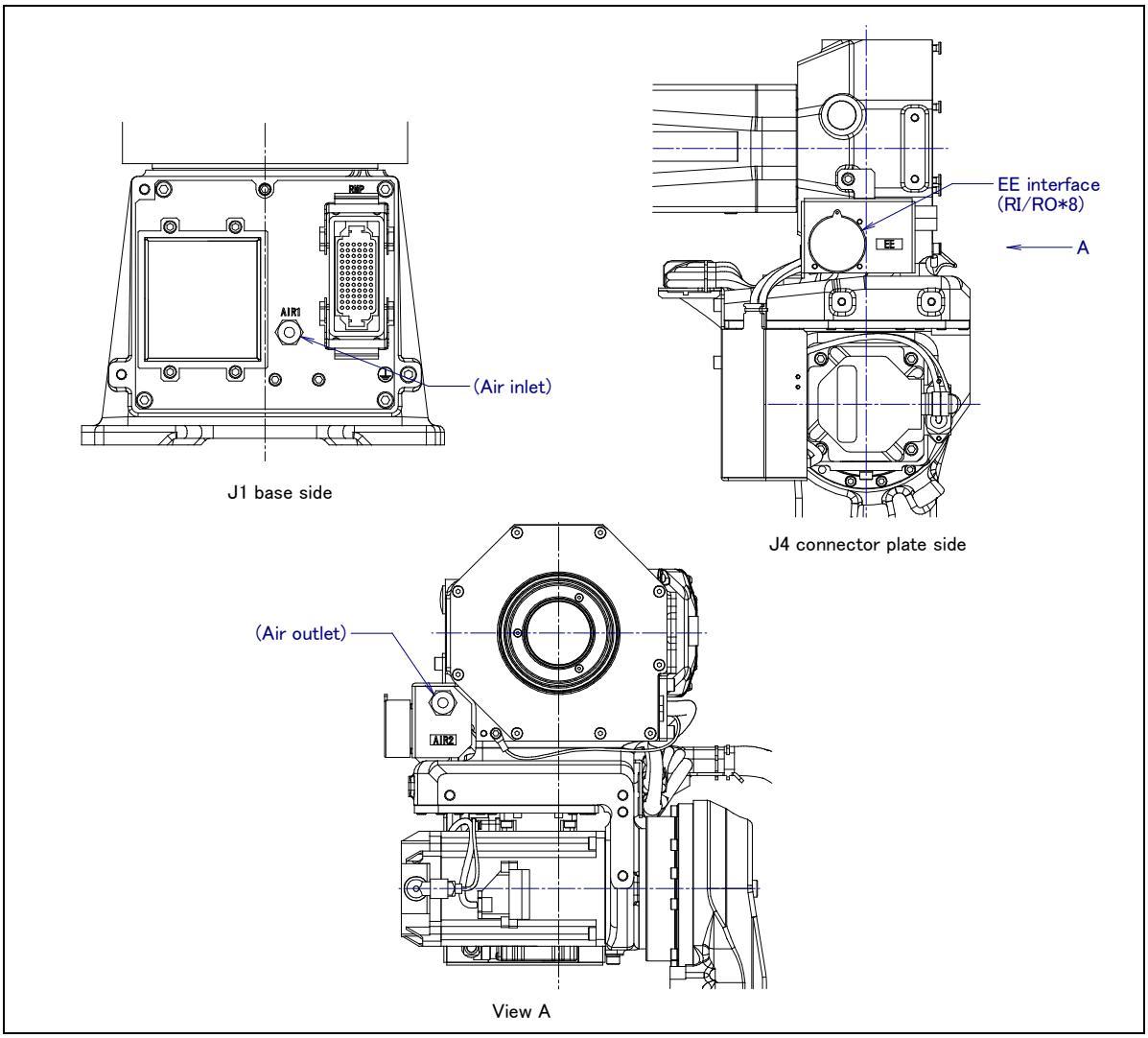


Fig. 5.3 (i) Interface for option cable (A05B-1221-H281 is specified)

NOTE
There is no option cable for A05B-1221-H401 and A05B-1221-H431.

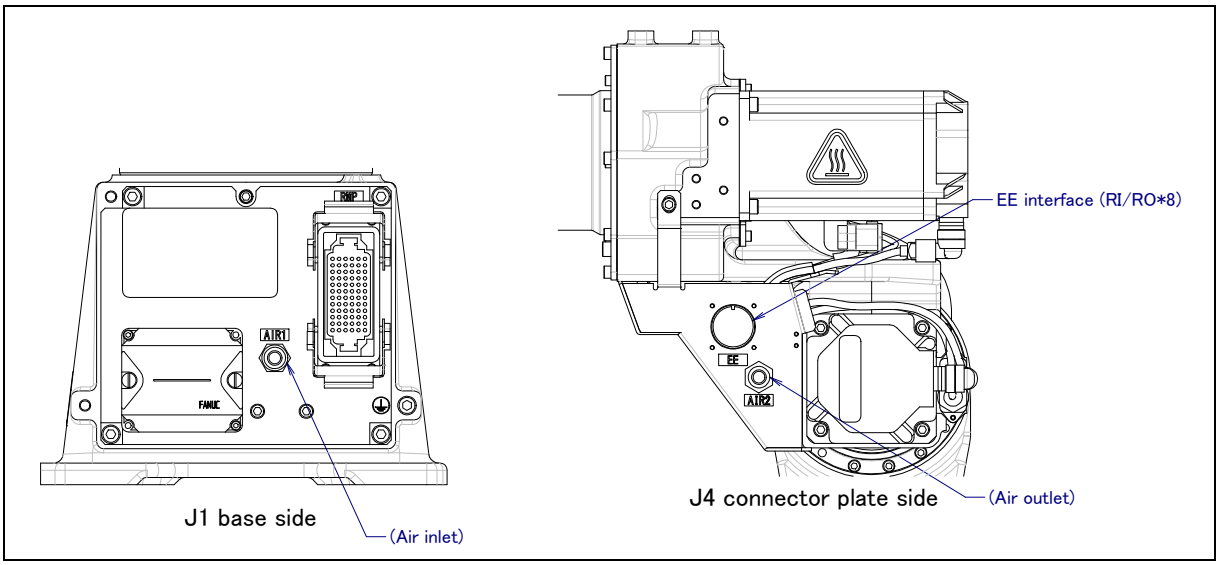


Fig. 5.3 (j) Interface for option cable (A05B-1221-H601, H661 is specified)

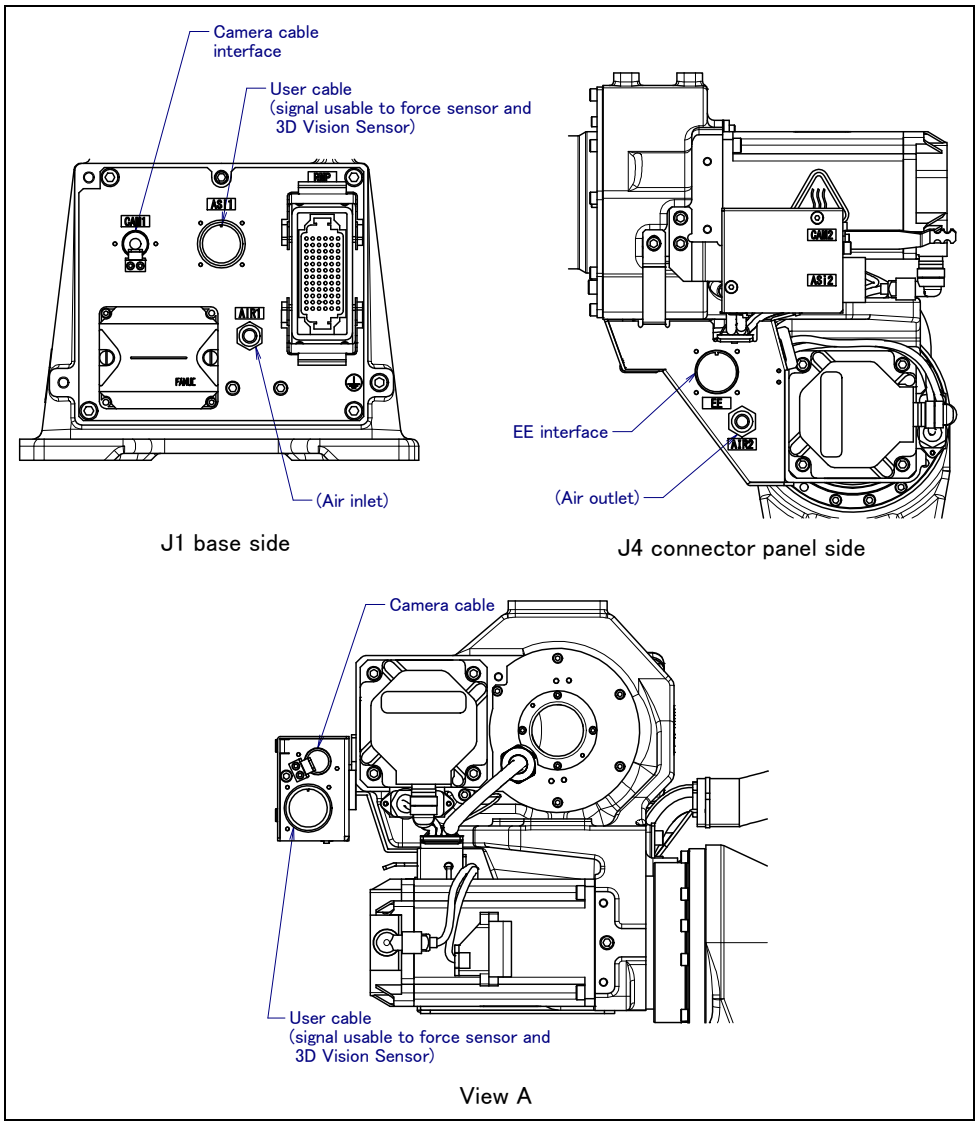


Fig. 5.3 (k) Interface for option cable (A05B-1221-H605, H665 is specified)

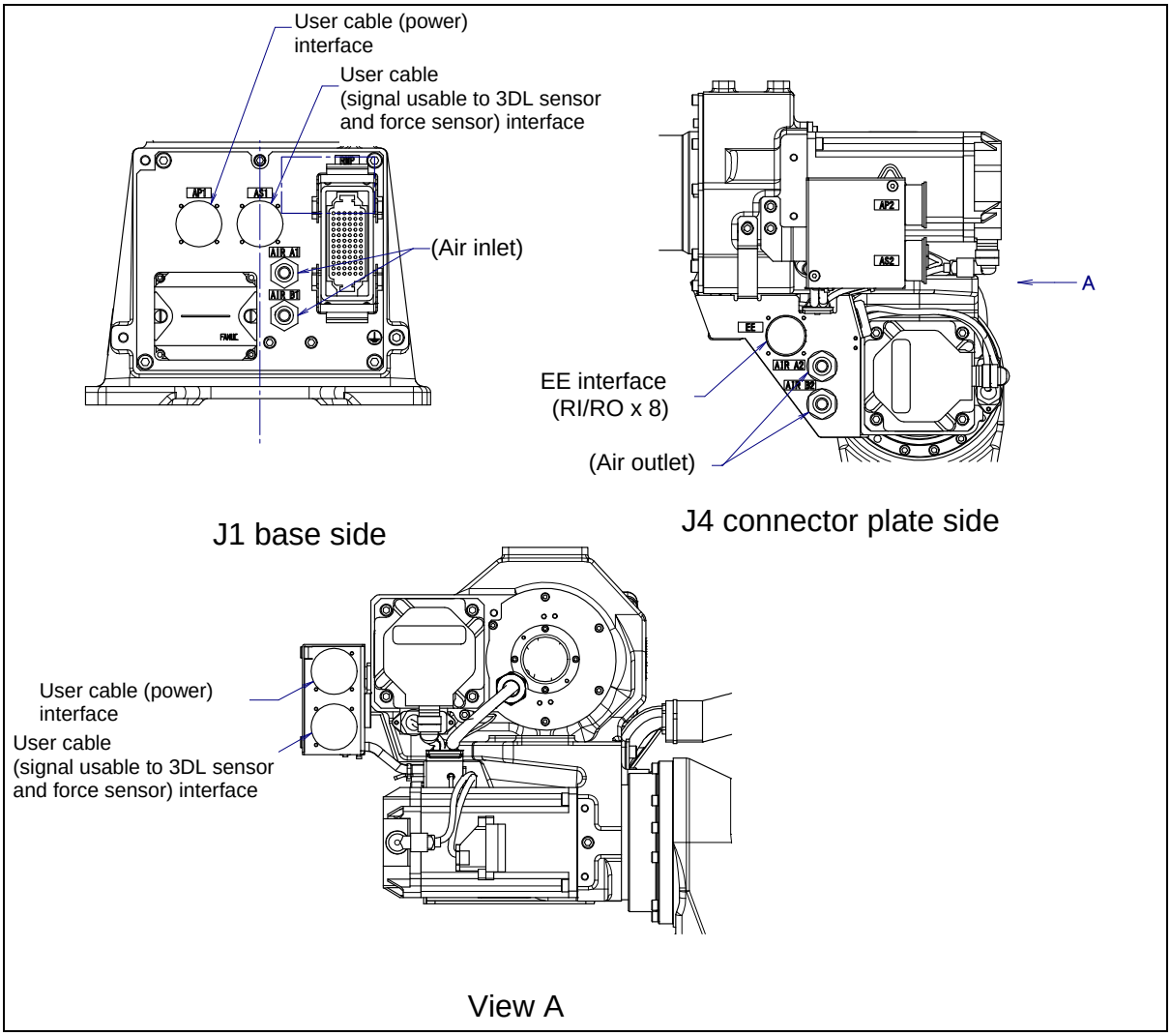


Fig. 5.3 (l) Interface for option cable (A05B-1221-H614 is specified)

1 EE interface (RI/RO) (option) Fig. 5.3 (m) to (o) show pin layout for EE interface (RI/RO).

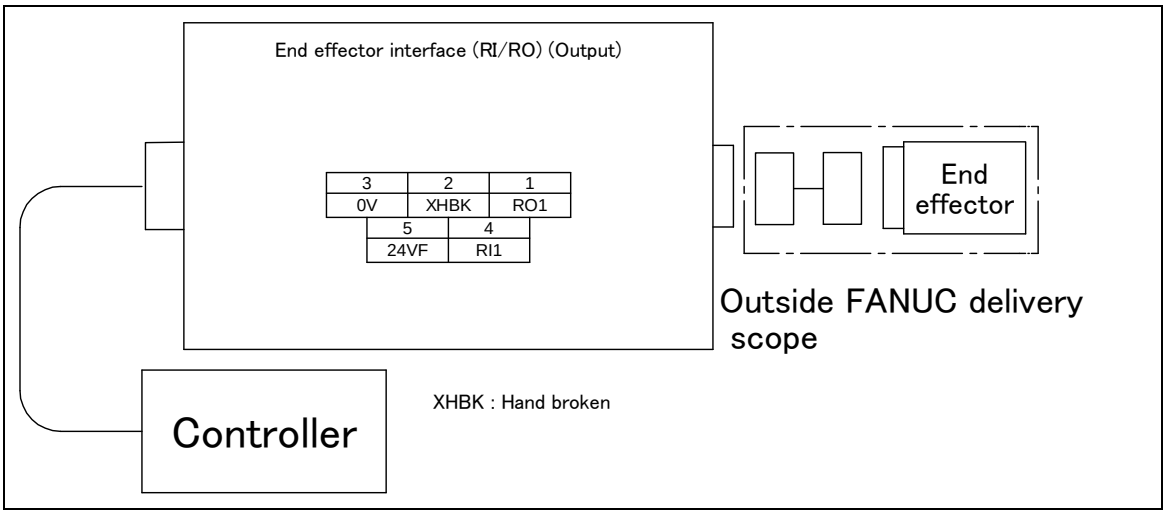


Fig. 5.3 (m) Pin layout for EE interface (RI/RO) RI/ROx1 (option)

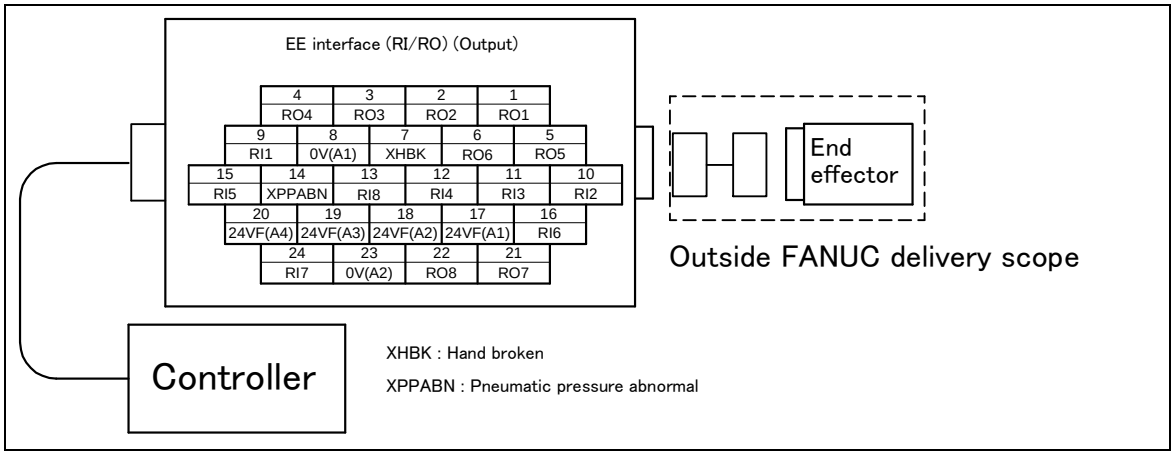


Fig. 5.3 (n) Pin layout for EE interface (RI/RO) RI/ROX8 (option)

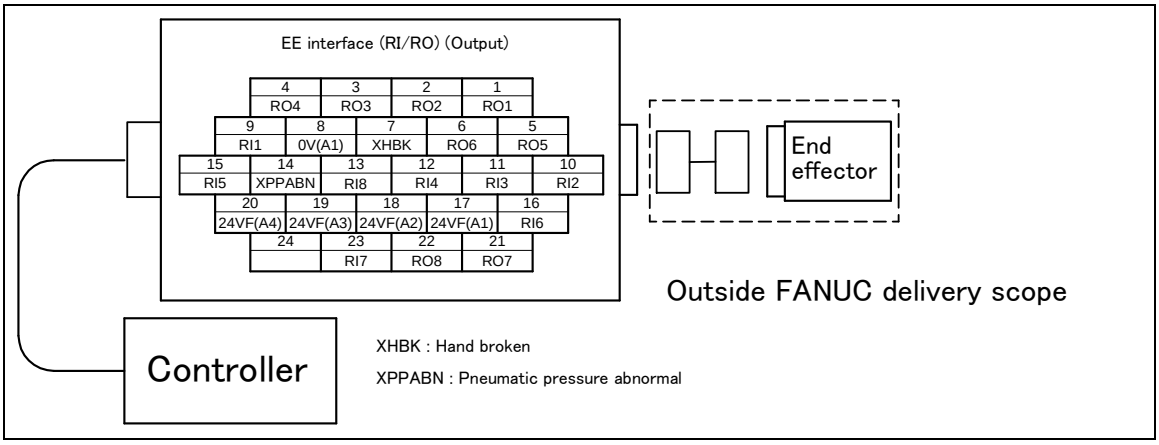


Fig. 5.3 (o) Pin layout for EE interface
(when the M-10*i*A, M-10*i*A/6L severe dust/liquid protection option is specified) RI/ROX8 (option)

2 Wire feeder power supply Interface (option)
Fig. 5.3 (p) shows pin layout for wire feeder power supply interface.

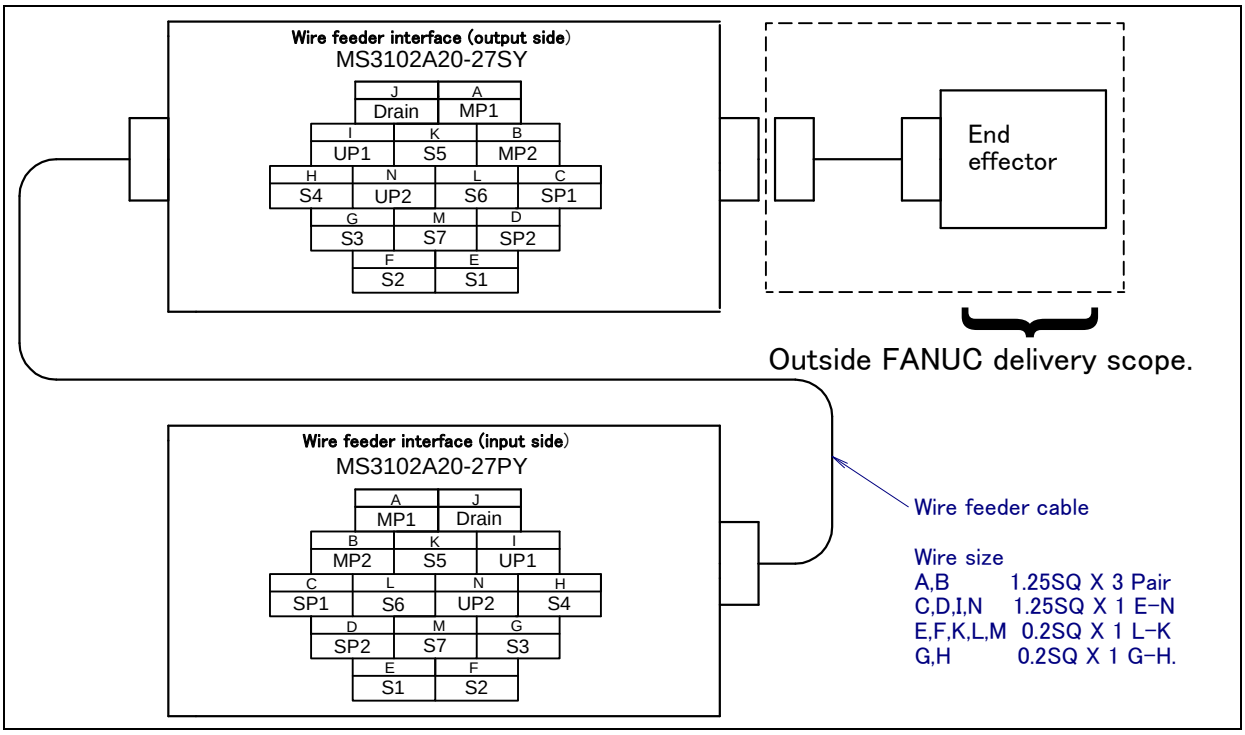


Fig. 5.3 (p) Pin layout for wire feeder power supply interface (option)
(A05B-1221-H202, H203, H206, H232, H233, H236 are specified.)

3 User cable (signal line, signal line usable to 3D Laser Vision Sensor and Force Sensor) (AS) (ASi) Interface (option)
Fig. 5.3 (q) shows pin layout for user cable (signal line, signal line usable to 3D Laser Vision Sensor and Force Sensor) interface.

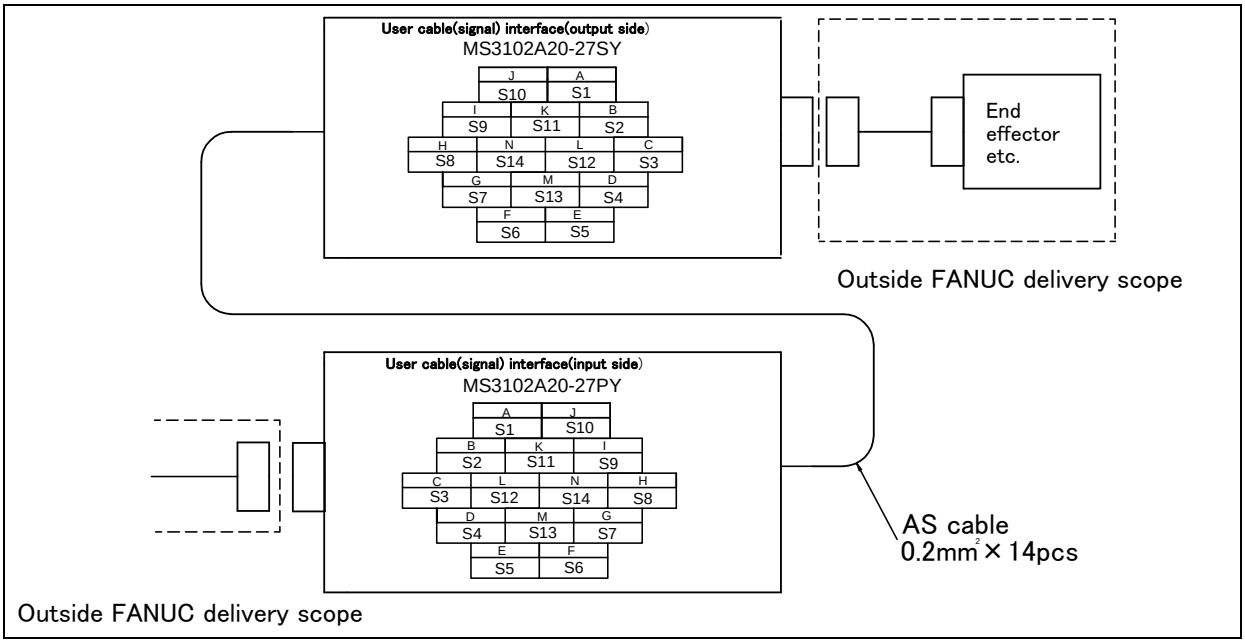


Fig. 5.3 (q) Pin layout for user cable
(signal usable to 3D Laser Vision Sensor and Force Sensor) (AS) (ASi) interface (option)
(A05B-1221-H207, H214, H265 are specified.)

4 User cable (power line) interface (option)
Fig. 5.3 (r) shows pin layout for user cable (power line) interface.

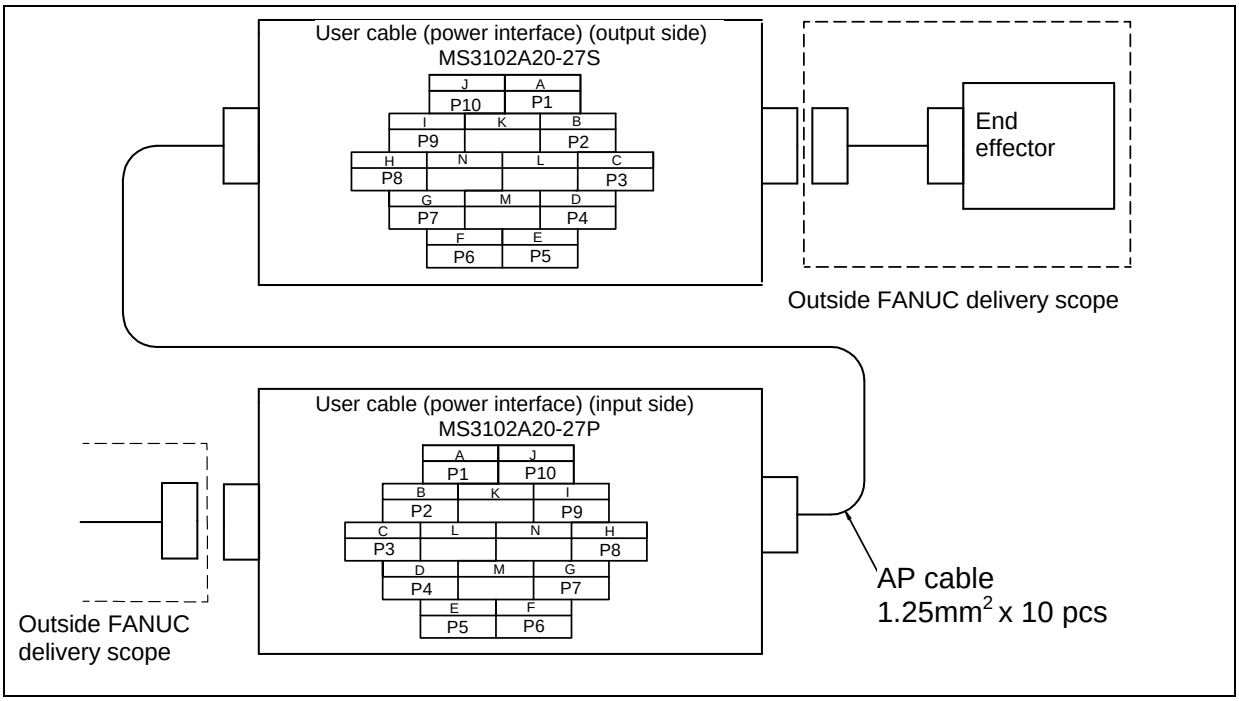


Fig. 5.3 (r) Pin layout for user cable (power line) interface (option) (A05B-1221-H214 is specified)

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

Connector specifications

Table 5.3 (a) Connector specifications (User side)

Cable name	Input side (J1 base)	Output side (J3 casing)	Maker /dealer
EE (RI/RO x 1)	————	JMSP1305M Straight plug (FANUC Spec: A05B-1221-K845) JMLP1305M Angle plug	Fujikura.Ltd
EE (RI/RO x 8)	————	JMSP2524M Straight plug (Attached) (FANUC Spec: A63L-0001-0234#S2524M) JMLP2524M Angle plug	
EE (RI/RO x 8) For severe dust/liquid protection package	————	Plug : JL05-6A24-28PC-F0-R (FANUC spec. : A63L-0001-0463#P2424P) End bell (elbow) : JL04-24EBH-R (FANUC spec. : A63L-0001-0463#24EBL) Clamp : JL04-2428CK(20)-R (FANUC spec. : A63L-0001-0463#2428CK20) Pin contact : ST-JL05-16P-C3-100 (FANUC spec. : A63L-0001-0463#16PC3)	Japan Aviation Electronics Industry, Ltd.
W/F, AS, ASi	Straight plug : MS3106B20-27SY (*1) Elbow plug : MS3108B20-27SY or a compatible product Clamp : MS3057-12A (*1) (FANUC spec. : A05B-1221-K843 Straight plug (*1) and clamp (*1) are included)	Straight plug : MS3106B20-27PY (*2) Elbow plug : MS3108B20-27PY or a compatible produce Clamp : MS3057-12A (*2) (FANUC spec. : A05B-1221-K841 Straight plug (*2) and clamp (*2) are included)	Fujikura.Ltd Japan Aviation Electronics Industry, Ltd.
W/F, AS, ASi For severe dust/liquid protection package	Plug : JA06A-20-27SY-J1-R End bell (straight) : JL04-20EB-R End bell (elbow) : JL04-20EBH-R Cable clamp (cable diameter) ϕ 6.5 to 9.5 : JL04-2022CK(09)-CR-R ϕ 9.5 to 13 : JL04-2022CK(12)-CR-R ϕ 12.9 to 16 : JL04-2022CK(14)-CR-R	Plug : JA06A-20-27PY-J1-R End bell (straight) : JL04-20EB-R End bell (elbow) : JL04-20EBH-R Cable clamp (cable diameter) ϕ 6.5 to 9.5 : JL04-2022CK(09)-CR-R ϕ 9.5 to 13 : JL04-2022CK(12)-CR-R ϕ 12.9 to 16 : JL04-2022CK(14)-CR-R	Japan Aviation Electronics Industry, Ltd.

(Note) The voltage to which the wire feeder connector can be input is a direct current 40V.

Table 5.3 (b) Connector specifications (Mechanical unit side・reference)

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

Table 5.3 (c) Connector specifications (on the Mechanical unit side when the M-10*i*A, M-10*i*A/6L, M-10*i*A/10M severe dust/liquid protection option is specified reference)

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

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

6 AXIS LIMIT SETUP

By setting the motion range of each axes, you can change the robot's motion range from the standard values. Changing the motion range of the robot is effective under following circumstances:

- Used motion range of the robot is limited.
- There's an area where tool and peripheral devices interfere with robot.
- The length of cables and hoses attached for application is limited.

The two methods used to prevent the robot from going beyond the necessary motion range.

- Axis limit by DCS (All axes)
- Axis limit adjustable mechanical stopper ((J1-axis) option)

⚠ WARNING

1 Changing the motion range of any axis affects the operating range of the robot. To avoid trouble, carefully consider the possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition will occur; for example, an alarm may occur when the robot tries to reach a previously taught position.
2 For J1-axis, use adjustable mechanical stoppers, for J2/J3-axis, use the DCS function so that damage to peripheral equipment and injuries to human bodies can be avoided.
3 Mechanical stoppers are physical obstacles. For J1-axis, it is possible to re-position the adjustable mechanical stoppers. But the robot cannot move beyond them. For J2, J3-axis, the mechanical stoppers are fixed. For the J4, J5 and J6-axis, only DCS-specified limits are available. (In case of /10M/10MS, J5-axis fixed mechanical stopper exists.)
4 Adjustable mechanical stoppers (J1-axis) are damaged in any collision to stop the robot. Once a stopper is subjected to a collision, it can no longer assure its original strength and, therefore, might not stop the robot. When this happens, replace the mechanical stopper with a new one.

6.1 CHANGE AXIS LIMIT BY DCS (OPTION)

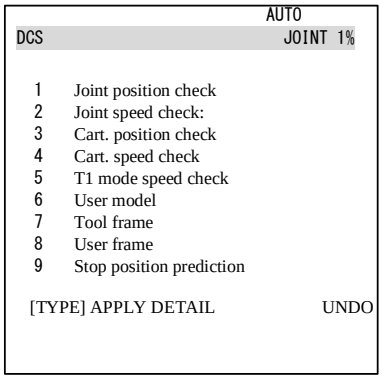
The robot motion can be restricted with DCS (Dual check safety) function by using the following software. For J2/J3-axis, the same effect as J1-axis adjustable mechanical stopper can be obtained.
The robot motion can be restricted at any angle and position if it is in robot motion area. DCS functions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

- DCS position/speed check function (J567)

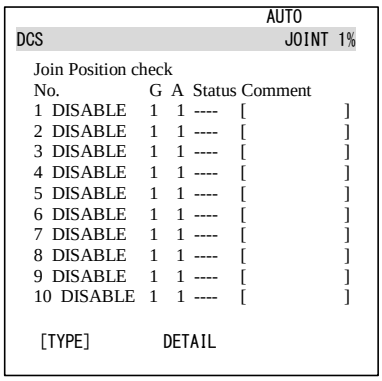
As an example, we shows the procedure to set $\pm 30^{o}$ for J2-axis in here. Refer to R-30*i*B/R-30*i*B Mate /R-30*i*B Plus Controller Dual check safety function Operator's Manual (B-83184EN) or R-30*i*A/ R-30*i*A Mate Controller Dual check safety function Operator's Manual (B-83104EN) for details of other setting, function and DCS stop position prediction.

Setting procedure

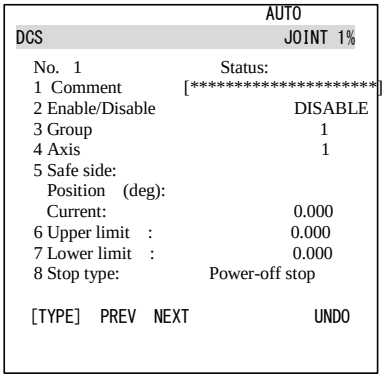
1 Press the [MENU] key to display the screen menu.
2 Press [0 NEXT] and press [6 SYSTEM].
3 Press the F1 (]TYPE]).
4 Select [DCS]. The following screen will be displayed.



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

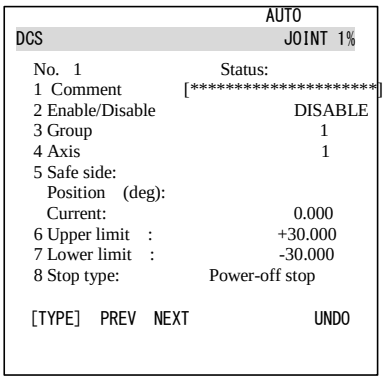


6 Move the cursor to [1], then press the [DETAIL].

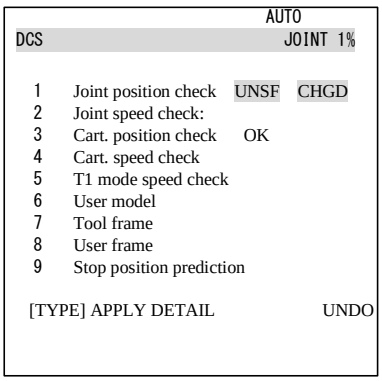


7 Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
8 Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
9 Move the cursor to [Axis], then input “2”, then press the [ENTER] key.
10 Move the cursor to [Upper limit] right side, then input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

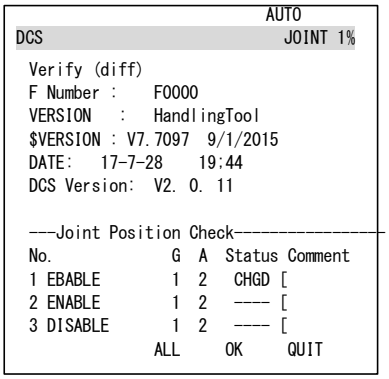
> ⚠ **WARNING**
> If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot’s momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the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



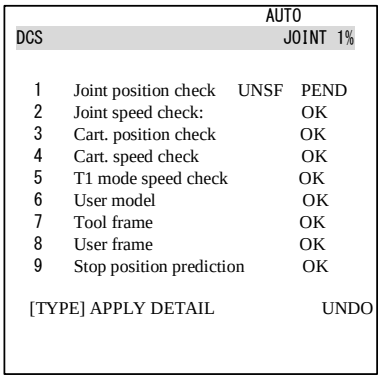
12 Press the [PREV] key two times, back to the first screen.



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



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



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

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

6.2 ADJUSTABLE MECHANICAL STOPPER SETTING (OPTION)

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

Item		Movable range
J1-axis adjustable mechanical stopper	Upper limit	Settable in steps of 30° degrees in a range of +20° to +170° degrees
	Lower limit	Settable in steps of 30° degrees in the range of -170° to -20° degrees

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

6.2.1 Installing the Adjustable Mechanical Stopper

J1-AXIS STROKE MODIFICATION

A stroke modification can be performed at an arbitrary position in steps of 30° within the range -170° to +170°.

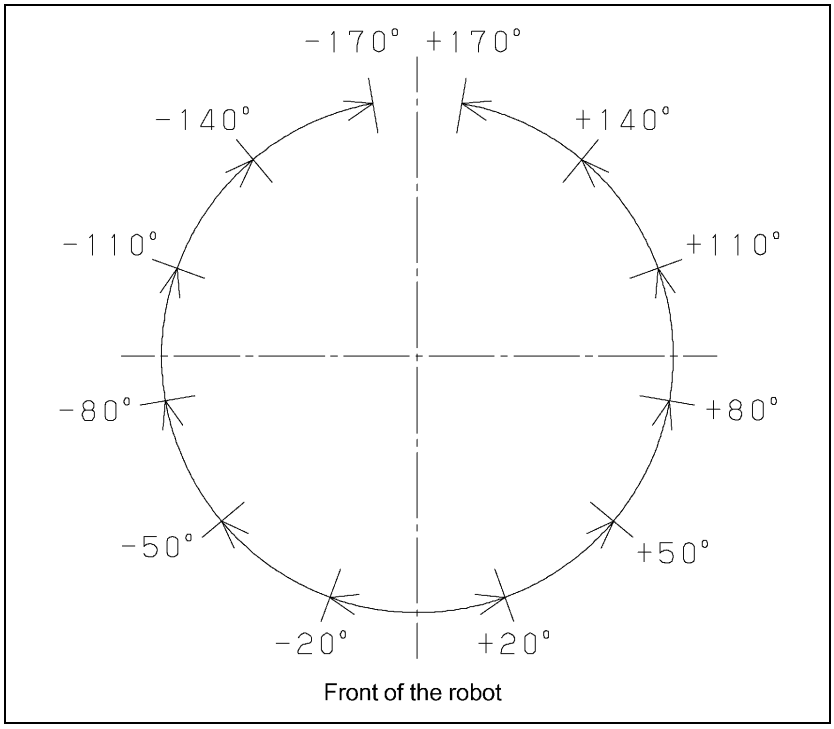


Fig. 6.2.1 (a) J1-axis stroke modification

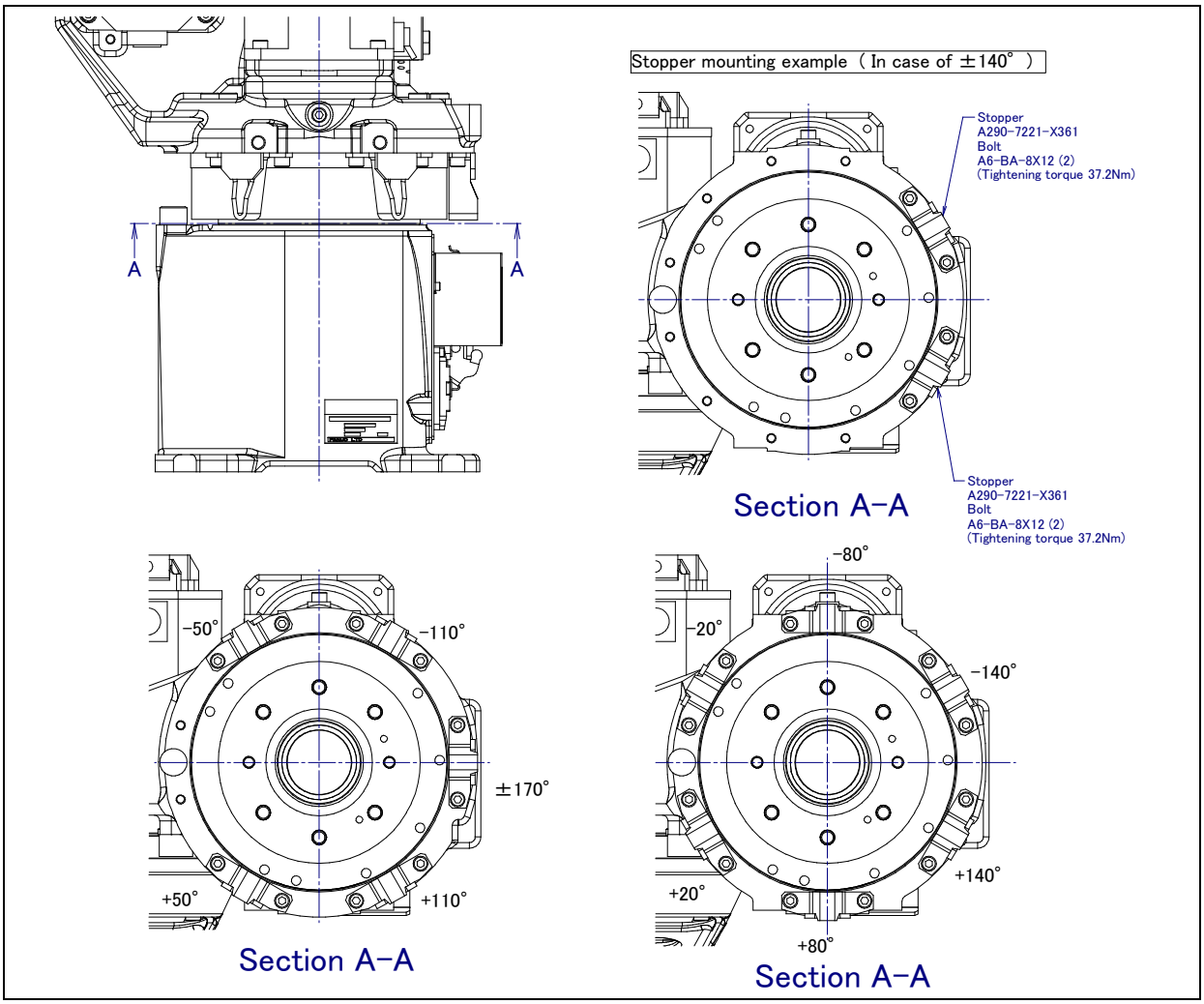


Fig. 6.2.1 (b) Installing of J1-axis adjustable stopper

6.2.2 Changing the Parameter Setting

Setting procedure

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

System Axis Limits JOINT 100%
Group1 1/16

AXIS	GROUP	LOWER	UPPER	
1	1	-180.00	180.00	deg
2	1	-90.00	160.00	deg
3	1	-180.00	267.00	deg
4	1	-190.00	190.00	deg
5	1	-140.00	140.00	deg
6	1	-270.00	270.00	deg
7	1	0.00	0.00	mm
8	1	0.00	0.00	mm
9	1	0.00	0.00	mm

[TYPE]

NOTE
0.00 indicates the robot does not have these axes.

5 Move the cursor to J1-axis. Type the new value using the numeric keys on the teach pendant. In this time, set the axial upper limit and the lower limit at the position same as adjustable mechanical stoppers are attached.

System Axis Limits JOINT 100%
Group1 1/16

AXIS	GROUP	LOWER	UPPER	
1	1	-180.0	180.00	deg

[TYPE]

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

⚠ WARNING
1 You must turn off the controller and then turn it back on to use the new information; otherwise, the old settings remain valid and could cause personnel injury or equipment damage.
2 After changing system variables, be sure to run the robot at a low speed and make sure that the robot stops at the ends of the stroke.
3 If a collision should occur, the J1-axis adjustable mechanical stopper becomes deformed to absorb energy, so that the robot can stop safely. If the stopper is deformed by mistake, replace it. An exchange method and the part are the same as a J1-axis mechanical stopper. Refer to Section 3.3.

7 CHECKS AND MAINTENANCE (EXCEPT M-10*i*A/10M/10MS)

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

NOTE
The periodic maintenance procedures described in this chapter assume that the FANUC robot is used for up to 3840 hours a year. In cases where robot use exceeds 3840 hours/year, adjust the given maintenance frequencies accordingly. The ratio of actual 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 interval should be divided by 2.

7.1 CHECKS AND MAINTENANCE

7.1.1 Daily Checks

Check the following items when necessary before daily system operation.

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is an oil seepage, clean it. **⇒"7.2.1 Confirmation of Oil Seepage"**
Air control set	(When air control set is used) **⇒"7.2.2 Confirmation of the Air Control Set"**
Vibration, Abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: **⇒"10.1 TROUBLESHOOTING"(symptom：Vibration, Noise)**
Positioning accuracy	Check that the taught positions of the robot have not deviated from the previously taught positions. When the displacement occurs, perform the measures as described in the following section: **⇒"10.1 TROUBLESHOOTING"(Symptom：Displacement)**
Peripheral equipment for proper operation	Check whether the peripheral equipment operates properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the droppage of the end effector is 5 mm or less when the servo power turned off. If the end effector (hand) drops, perform the measures as described in the following section: **⇒"10.1 TROUBLESHOOTING"(symptom：Dropping axis)**
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: **⇒"R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1) or R-30*i*A/R-30*i*A Mate CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83124EN-6)"**

7.1.2 Periodic Check and Maintenance

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

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
○ Only 1st check	○					Check the oil sight glasses of J4/J5/J6-axes gearboxes	Please confirm whether the amount of oil of the oil sight glass of J4/J5/J6-axes gearboxes has come above the 3/4 of total height. **⇒"7.2.3 Check the Oil Sight Glasses"**	11
○ Only 1st check	○					Check the failure of the wrist part fluoric resin ring	Check to see whether there is failure on the wrist part fluoric resin ring. If it is broken, replace it with a new one. **⇒"7.2.4 Check the Failure of the Wrist Part Fluoric Resin Ring"**	21
○ Only 1st check	○					Cleaning the controller ventilation system	If the controller ventilation system is dusty, turn the power off, and clean the unit.	23
	○					Check the external damage or peeling paint	Check whether the robot has external damage due to the interference with the peripheral devices or peeled paint. If it interferes, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check damages of the cable protective sleeves	Check whether the cable protective sleeves of the mechanical unit cable have holes or tears. If damage is found, replace the cable protective sleeve. If the cable protective sleeve is damaged due to the interference with peripheral devices, eliminate the cause. **⇒"7.2.5 Check the Mechanical Unit Cables and Connectors"**	2
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If liquid was found, remove the cause, and wipe the liquid off.	3
	○ 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 them.	22
	○ Only 1st check	○				Check for damage to the mechanical unit cable (movable part) and welding cable	Observe the movable part of the mechanical unit cable and welding cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted. **⇒"7.2.5 Check the Mechanical Unit Cables and Connectors"**	4

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Check for damage to the end effector (hand) connection cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace them.	5
	○ Only 1st check	○				Check the connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"7.2.5 Check the Mechanical Unit Cables and Connectors"**	6
	○ 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"**	7
	○ Only 1st check	○				Retightening the external main bolts	Retighten the bolts which are installed, removed in the inspection, and exposed. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	8
	○ Only 1st check	○				Check the mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the mechanical stopper, the adjustable mechanical stopper, and check the looseness of the stopper mounting bolts. **⇒"7.2.6 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"**	9
	○ Only 1st check	○				Clean spatters, sawdust and dust	Check that spatters, sawdust, or dust does not exist on the robot main body. If dust has accumulated, remove it. Especially, clean the robot movable parts well (each joint, around the welding torch, conduit part, wrist axis hollow part and the cable protective sleeve). The insulation failure occurs when the spatter has collected around the wrist flange or welding torch, and there is a possibility of damaging the robot mechanism by the welding current. (See Appendix E)	10
		○				Replacing the mechanical unit batteries	Replace the mechanical unit batteries **⇒"7.3.1 Replacing the Batteries"**	12
			○			Replace the wrist part fluoric resin ring	Replace the wrist part fluoric resin ring. Contact your local FANUC representative for information regarding replacing the fluoric resin ring. **⇒"7.2.4 Check the Failure of the Wrist Part Fluoric Resin Ring"**	21

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
			○			Replacing cable of Mechanical unit welding power	Replace the cable of Mechanical unit welding Refer to Chapter 8 for information regarding replacing the cable.	19
			○			Replacing the Material handling (M/H) conduit or No dust material handling conduit	Replace the Material handling (M/H) conduit Refer to Chapter 6 regarding replacing the Material handling (M/H) conduit or No dust material handling conduit	20
				○		Replacing the grease and oil of J1- to J3- axis reducer and J4 to J6-axis gearbox	Replace the grease and oil of each axis reducer and gearbox **⇒"7.3.2 Replacing the Grease and Oil of the Drive Mechanism"**	13 to 17
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	18
					○	Replacing the controller batteries	Replace the controller batteries **⇒"Chapter 7 Replacing batteries of R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) or R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN) or R-30*i*A CONTROLLER MAINTENANCE MANUAL (B-82595EN) or R-30*i*A Mate CONTROLLER MAINTENANCE MANUAL (B-82725EN)"**	24

7.2 CHECK POINTS

7.2.1 Confirmation of Oil Seepage

Check items

Check there is oil on sealed part of each joint parts. If there is oil seepage, clean them.

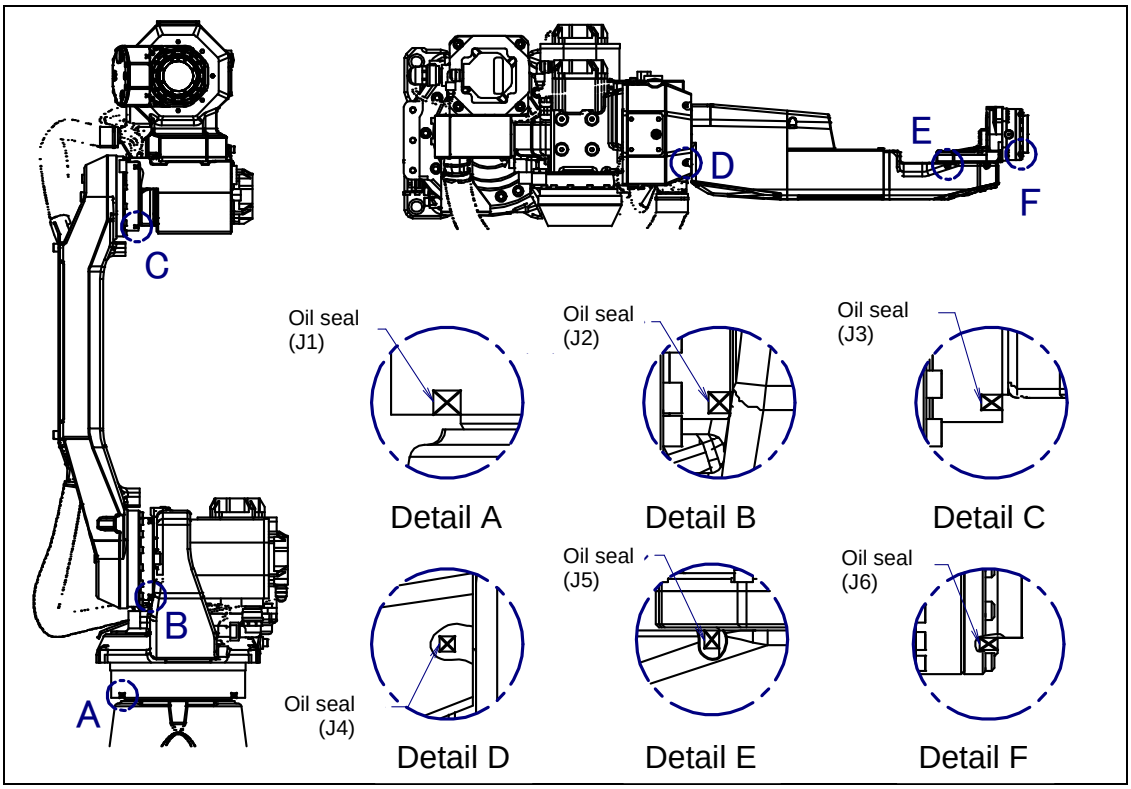


Fig. 7.2.1 Check parts of oil seal

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil changes to a state of liquid, the oil might fall depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components before you operate the robot.
- In case of oil seepage, please consider replacing the grease and the oil altogether. This replacement potentially can help improving the seepage situation.
- Also, drive mechanism might become hot and the internal pressure of the grease bath or oil bath might rise. In these cases, normal internal can be achieved by venting the grease outlet. (When opening the grease outlet, refer to Subsection 7.3.2 and ensure that grease is not expelled onto the machine or tooling. When opening the oil outlet, refer to Subsection 7.3.2, put a oil pan under the oil outlet or place the oil outlet at the upper side.)

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

- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.

  ⇒" 10.1 TROUBLESHOOTING"(Symptom : Grease leakage, Oil leakage)

7.2.2 Confirmation of the Air Control Set

When adopting an air control set, check the items below.

Item	Check items	Check points
1	Air pressure	Check the air pressure using the pressure gauge on the air control set as shown in Fig.7.2.2. If it does not meet the specified pressure of 0.49 to 0.69 MPa (5-7 kgf/cm^2), adjust it using the regulator pressure-setting handle.
2	Lubricator oil mist quantity	Check the number of oil drops during wrist or hand motion. If it does not meet the specified value (1 drop/10-20 sec), adjust it using the lubricator control knob. Under normal usage, the lubricator will be empty in about 10 to 20 days.
3	Lubricator oil level	Check to see that the air control set oil level is within the specified level.
4	Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts as required.
5	Drain	Check the drain and release it. When volume of the drain is remarkable, examine the setting of the air dryer to the air supply side.

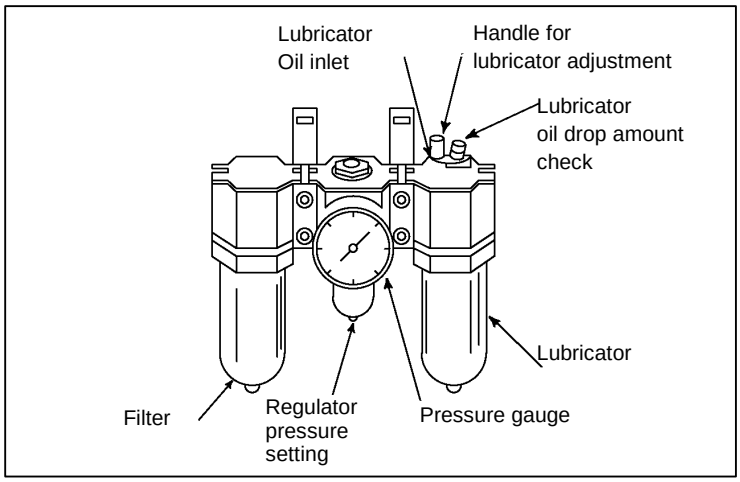


Fig. 7.2.2 Air control set (option)

7.2.3 Check the Oil Sight Glasses

Please confirm whether the amount of oil of the oil sight glass of J4/J5/J6-axes gearboxes has come above the 3/4 of total height. Please replenish it in case of the shortage. Through the oil sight glass might not have air part, but this is not trouble. When oil does not fill enough, the red index of the oil sight glass shows the reflected heat of the light, and the outline of the index is seen clearly. When oil fills enough, it does not show this reflected heat, and the outline of the index is not clear. When the oil sight glass cannot be read at all because of the oil discoloration due to deterioration, like a right edge of Fig.7.2.3, exchange oil referring to Section 7.3.2.

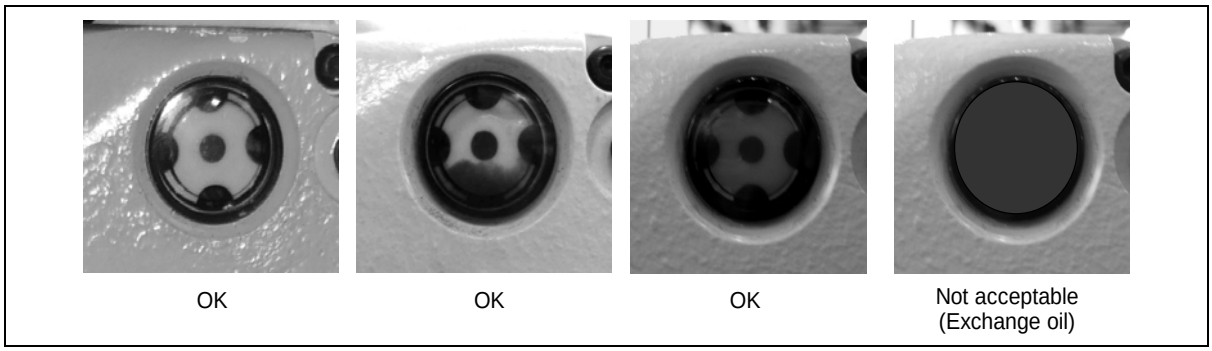


Fig. 7.2.3 The extent of oil deterioration

> **⚠ CAUTION**
> If you continue using the oil in the dirty state, it reduces the seal performance of oil seal and cause the sludge outbreak, and cause vibration of robot.
> If operation condition is severe, oil is stained early, in that case we recommend early oil exchange.

7.2.4 Check the Failure of the Wrist Part Fluoric Resin Ring

Check to see whether there is failure on the wrist part fluoric resin ring. If is broken, replace it by new one. Two years are aims in an exchange period. If you operate robot with the state that hard mine dust is attached to rotated part, exchange period may shorten.
(Spec. of fluoric resin ring: A290-7221-X571)

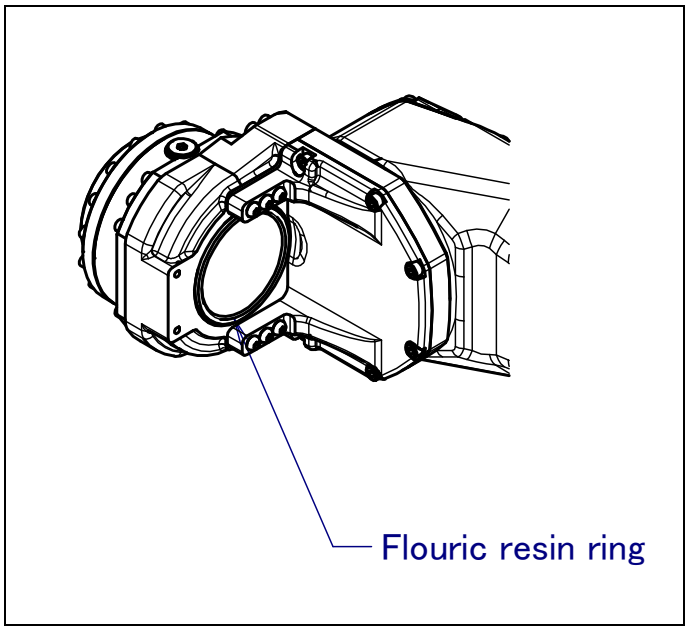


Fig. 7.2.4 (a) Fluoric resin ring

If the fluoric resin rig is broken as shown in Fig. 7.2.4 (b), replace it.

Fig .7.2.4 (b) Failure of the fluoric resin ring

7.2.5 Check the Mechanical Unit Cables and Connectors

Inspection points of the mechanical unit cables and welding cables
Check the cable for damage that has been exposed. Take special care for movable parts.
Clean it when the spatter adheres.

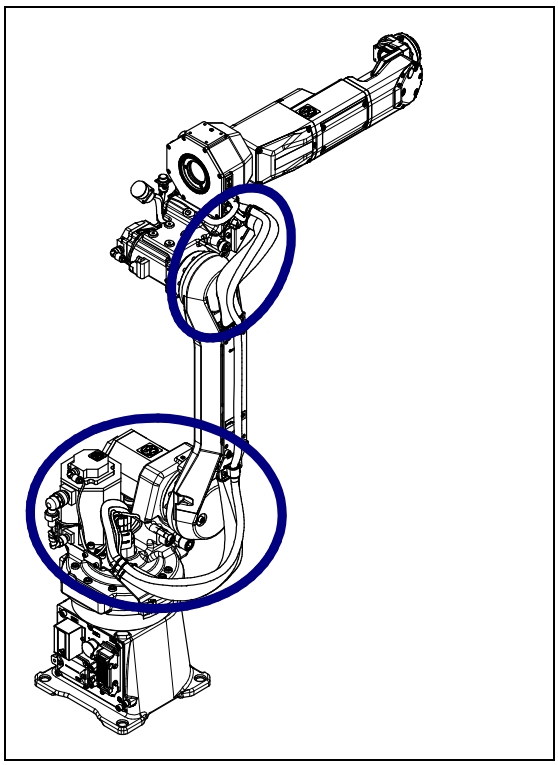


Fig. 7.2.5 (a) Inspection points of the mechanical unit cables

Check points
＜Cable protective sleeve＞
- Check that no holes or tears exist on the cable protective sleeves.
- If there is damage as shown in Fig. 7.2.5 (b), replace the cable protective sleeves.

Fig. 7.2.5 (b) Damage on the cable protective sleeve

＜Cables＞

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

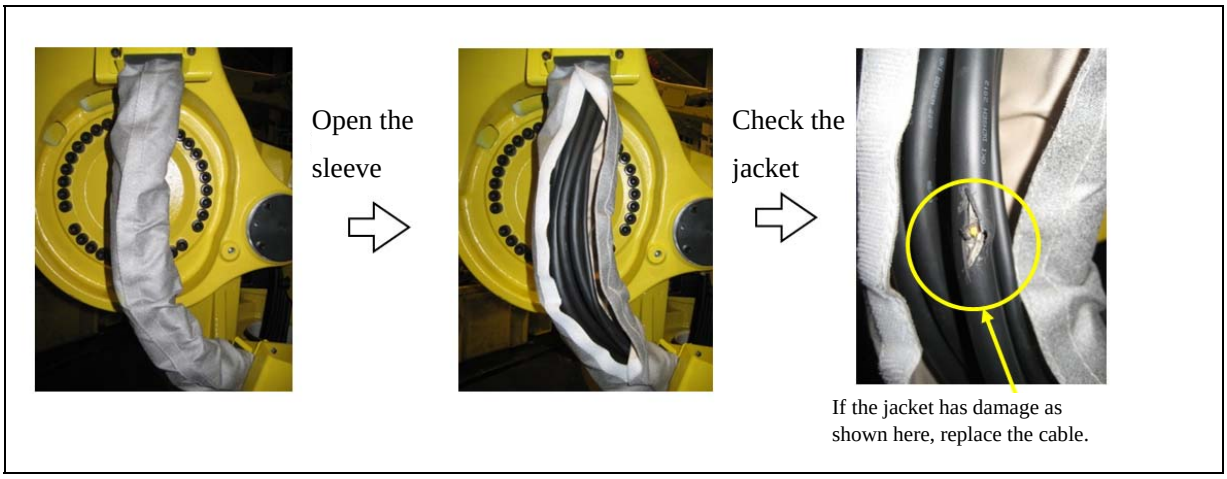


Fig. 7.2.5 (c) Cable check method

Inspection points of the connectors

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

Check items

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

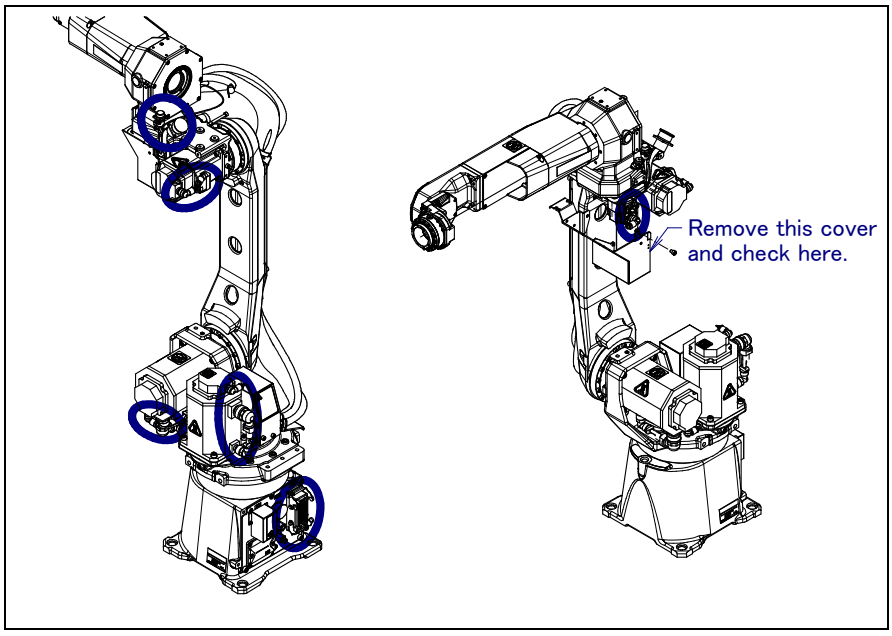


Fig. 7.2.5 (d) Connector Inspection points

7.2.6 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check that there is no evidence of a collision on the mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace the parts.
- Check the tightness of the stopper mounting bolts. If they are loose, retighten them.
  Be sure to check the tightness of the mounting bolts of the J1-axis swing stopper.
- Refer to Section 6.2 of the operator's manual for details regarding the adjustable mechanical stopper.

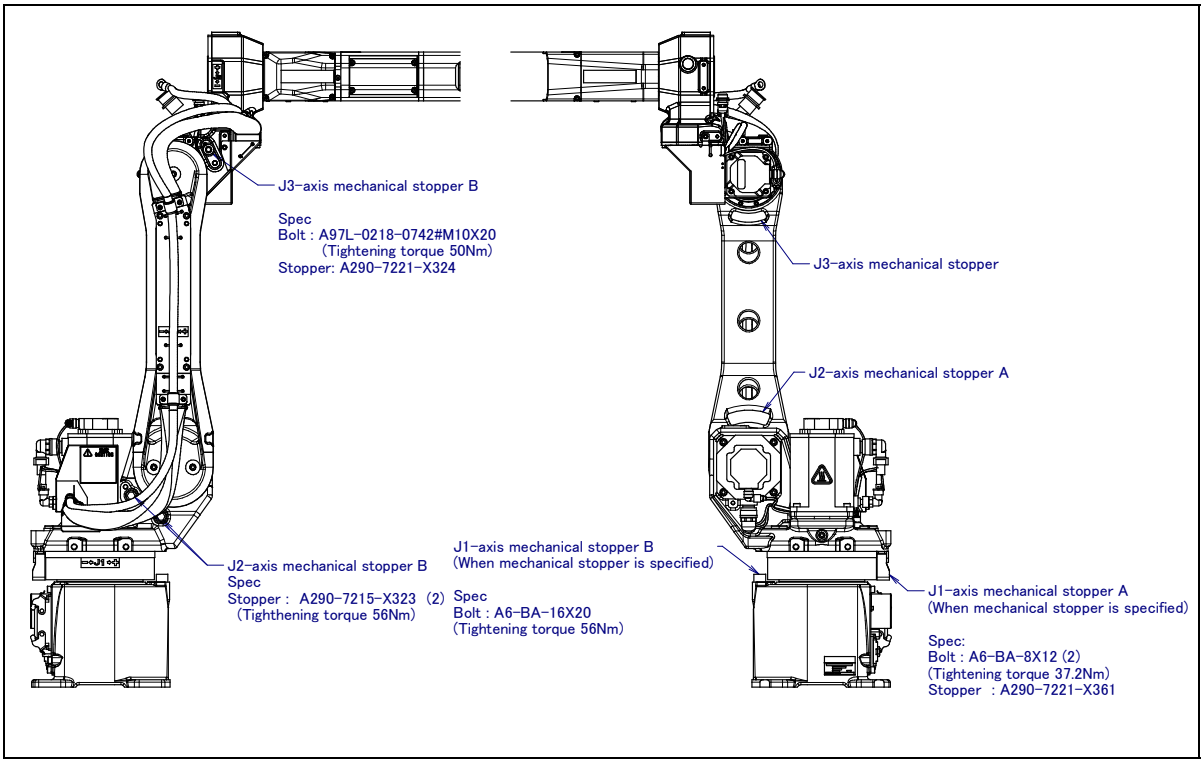


Fig. 7.2.6 Check of mechanical stopper and adjustable mechanical stopper

7.3 MAINTENANCE

7.3.1 Replacing the Batteries (1 year (3840 hours) or (1.5 year (5760 hours) checks)

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1 year in case of ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S and 1.5 year in case of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L. Also, use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery

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

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

2 Remove the battery case cap. (Fig. 7.3.1 (a) to (c)) If it cannot be removed, tap it to side direction with a plastic hammer.
3 Take out the old batteries from the battery case. In this time, battery can be taken out by pulling the stick of the center of the battery box.
4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
5 Close the battery case cap.

> ⚠ **CAUTION**
> When using a robot with the severe dust/liquid protection option, remove the cover from the battery case as shown in Fig. 7.3.1 (b) to replace the battery. After replacing the battery, reinstall the cover. At this time, please be sure to replace gasket with new one for severe dust/liquid protection. When sticking a packing on a battery cover, please stick it not to have gaps between them.

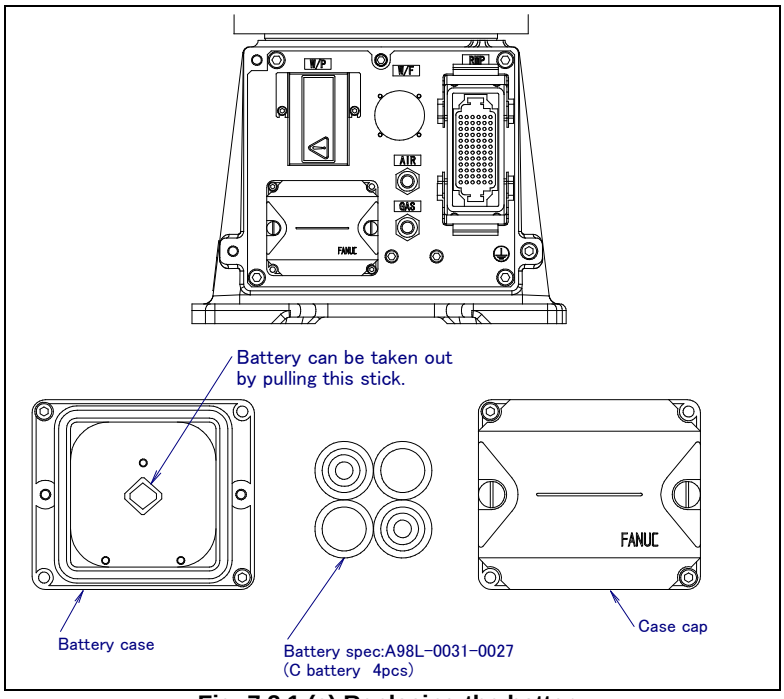


Fig. 7.3.1 (a) Replacing the battery
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L ARC Mate 100*i*C/10S, M-10*i*A/10S)

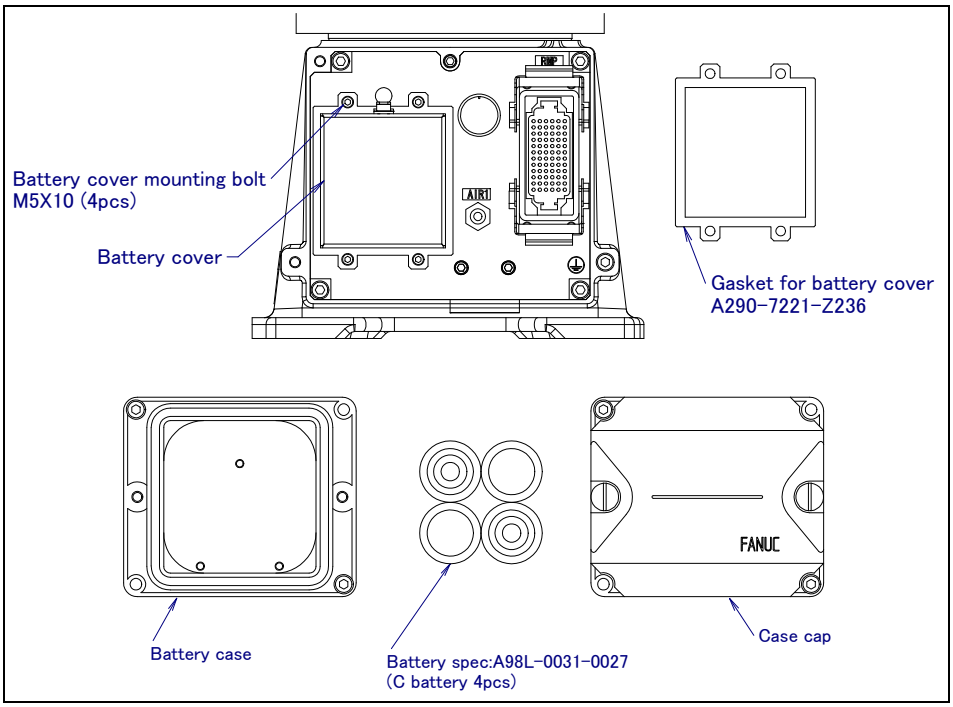


Fig. 7.3.1 (b) Replacing the battery (When severe dust/liquid protection option is specified)

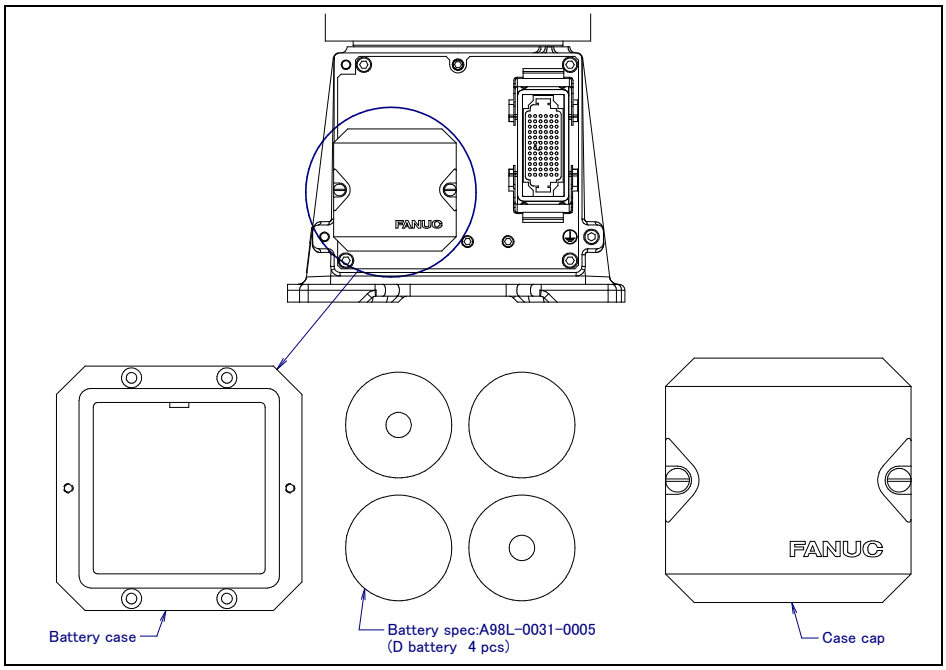


Fig. 7.3.1 (c) Replacing the battery
(ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

7.3.2 Replacing the Grease and Oil of the Drive Mechanism (3-Year (11520 Hours) Checks)

According to below, replace the grease and of the reducers of J1/J2/J3-axes and J4/J5/J6-axis gearbox at the intervals based on every 3 years or 11520 hours, whichever comes first.

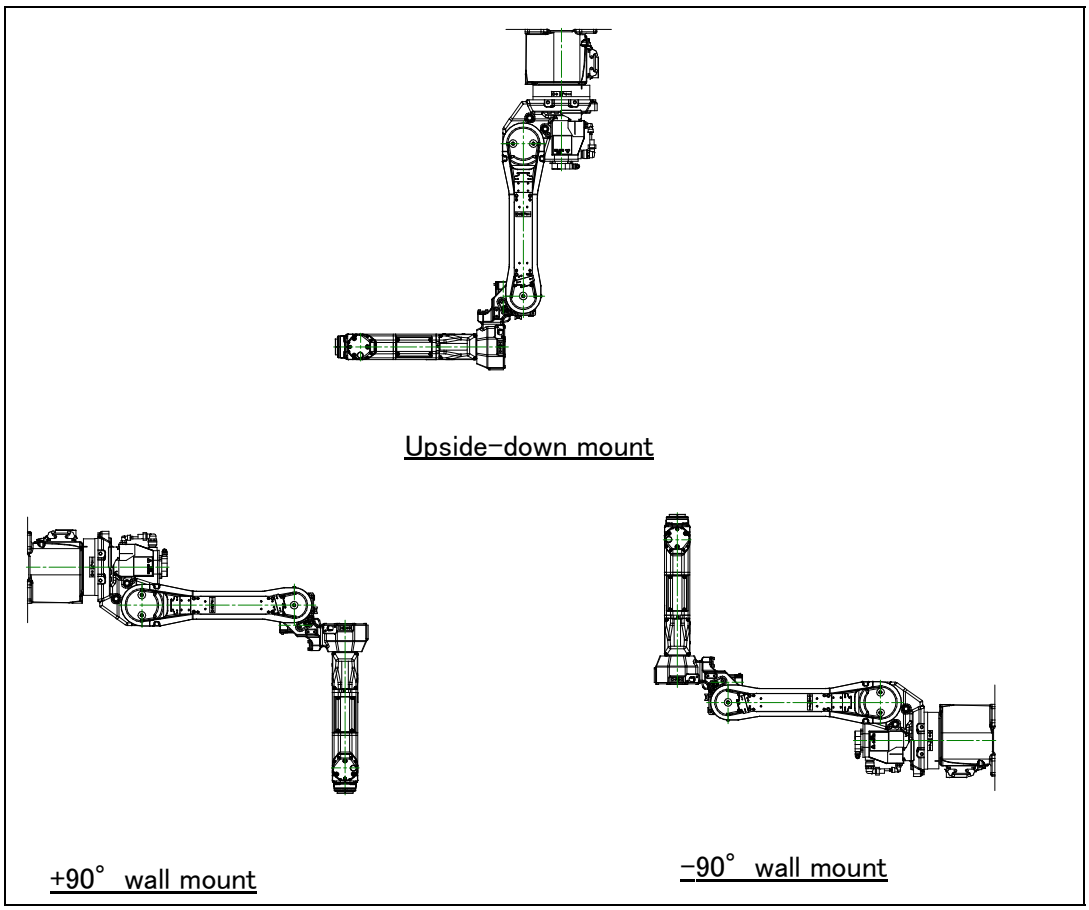


Fig. 7.3.2 Installation method

7.3.2.1 Grease replacement procedure for J1 to J3-axis reducer

⚠ CAUTION

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

1 Before starting to grease, remove the seal bolt or the taper plug grease out.
2 Supply grease slowly, using a manual pump. (once per two seconds)
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply. If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 7.3.2.1 (a)).
4 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 7.3.2.2, and then close the grease outlet.
6 To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.

Table 7.3.2.1 (a) Grease name and amount to be replaced at regular intervals of three years (11520 hours)

Grease supplying position	Amount of grease to be applied	Gun tip pressure	Specified grease
J1-axis reducer	790 g (870ml)	0.1MPa or less (NOTE)	Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174)
J2-axis reducer	300 g (330ml)		
J3-axis reducer	170 g (190ml)		

NOTE
When using a hand pump, apply grease approximately once per two seconds.

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

Table 7.3.2.1 (b) Postures for greasing (J1/J2/J3-axis reducer)

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

1 Move the robot to the greasing posture described in Table 7.3.2.1 (b).
2 Turn off the controller power.
3 Remove the seal bolt or taper plug from grease outlet. (Fig. 7.3.2.1)
  J1-axis : 1 location (seal bolt M8 x 10)
  J2-axis : 2 locations (seal bolt M8 x 10)
  J3-axis : 1 location (seal bolt M8 x 10)
4 Remove the seal bolt or taper plug from grease inlet and attach grease nipple.
5 Keep greasing until the new grease pushes out the old grease and comes out from each grease outlet.
6 Release remaining pressure using the procedure given in Subsection 7.3.2.5. In case of upside-down mount, pull out about 100ml grease to make space of grease bath.

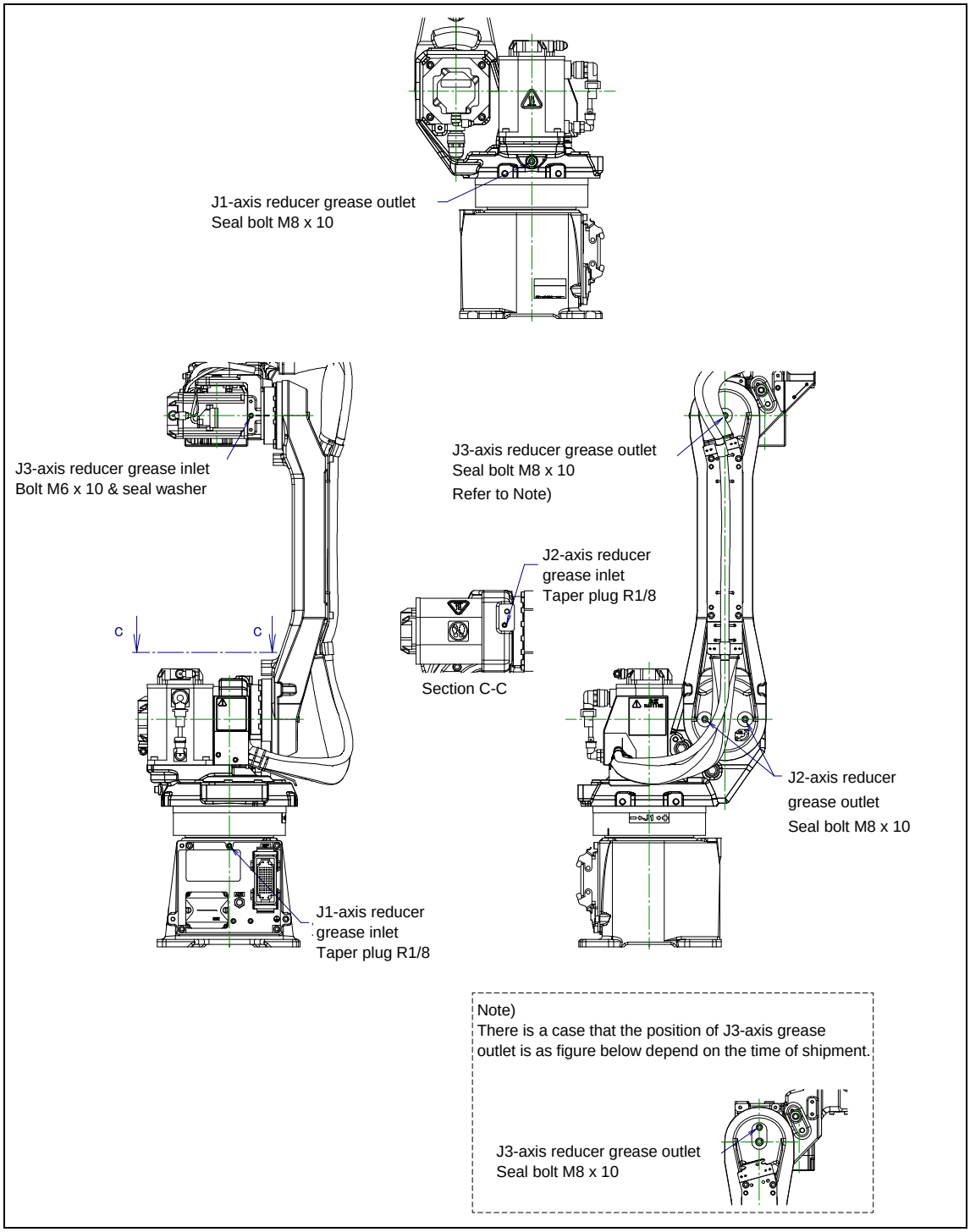


Fig. 7.3.2.1 Greasing points of J1 to J3-axis reducer

Table 7.3.2.1 (c) Specification of the seal bolts, the taper plug and the seal washer

Parts name		Specification
Seal bolt	(M8 x 10)	A97L-0218-0417#081010
Taper plug	(R1/8)	A97L-0001-0436#1-1D
Seal washer	(M6)	A30L-0001-0048#6M

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

After applying grease, operate the robot more than 10 minutes as instructed below with the taper plug and seal bolt of the grease inlet and outlet uncapped to release the remaining pressure within the grease bath. In case of J2-axis, there are two seal bolts for grease outlet, so uncap both of them.
Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

Operating axis / Grease replacement part	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
J1-axis reducer	Axis angle of 60° or more OVR 100%	Arbitrary				
J2-axis reducer	Arbitrary	Axis angle of 60° or more OVR 100%	Arbitrary			
J3-axis reducer	Arbitrary		Axis angle of 60° or more OVR 100%	Arbitrary		

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

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

7.3.2.3 Oil replacement procedure for J4-axis gearbox

⚠ CAUTION
Failure to supply oil correctly may cause damage to the seal, which would in turn lead to oil leakage and abnormal operation. When performing oiling, therefore, observe the following cautions.
1 Use specified oil. Use of non-approved oil may damage the reducer or lead to other problems.
2 After oiling, release remaining pressure from the grease bath using the procedure given in Subsection 7.3.2.5, and then close the grease outlet.
3 To prevent slipping accidents and catching fire, completely remove any excess oil from the floor or robot.

Table 7.3.2.3 (a) Oil name and amount of oiling of standard to be replaced at regular intervals of three years (11520 hours)

Oiling points	Amount of oil to be applied (NOTE)	Gun tip pressure	Specified oil
J4-axis gearbox	410g (480ml)	0.1MPa or less	JXTG Nippon Oil & Energy Corporation BONNOC AX68 (Specification: A98L-0040-0233)

NOTE) It is not a regulated amount injection. Please confirm height of oil sight glass oil surface is 3/4 or more of all heights. Refer to Fig. 7.3.2.3 (a).

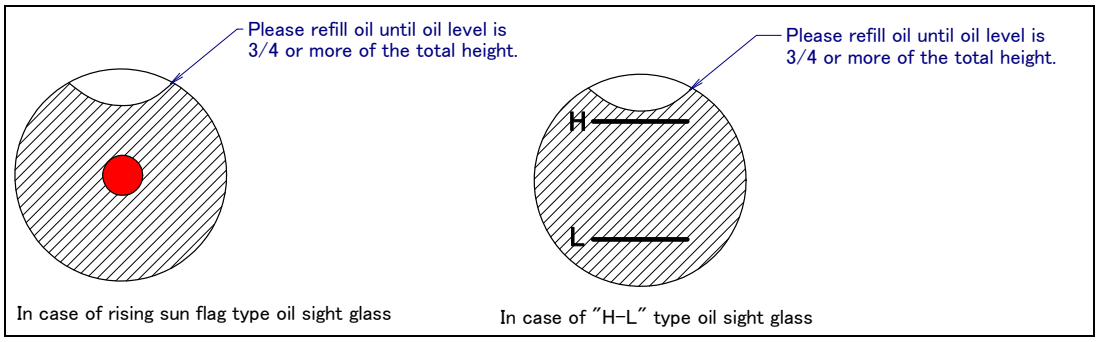


Fig. 7.3.2.3 (a) Oil sight glass

For oil replacement or replenishment, use the Postures indicated below.
Consider relative angle of from posture of floor mount when robot is angle mount.

Table 7.3.2.3 (b) Postures for oiling (J4-axis gearbox)

Supply position		Posture					
		J1	J2	J3	J4	J5	J6
J4-axis gearbox	Floor mount	Arbitrary	Arbitrary	0°	Arbitrary	Arbitrary	Arbitrary
	Upside-down mount			180°			
	-90° wall mount	0°		-90°			
	+90°wall mount			90°			

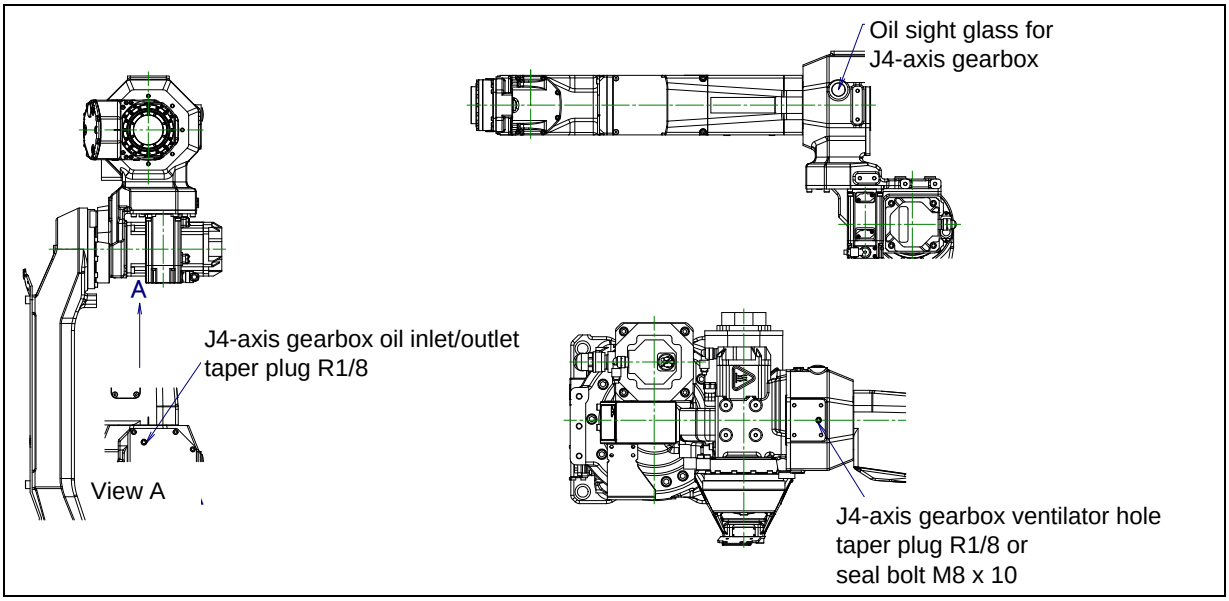


Fig. 7.3.2.3 (b) Greasing point of J4-axis gearbox
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L,
ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L)

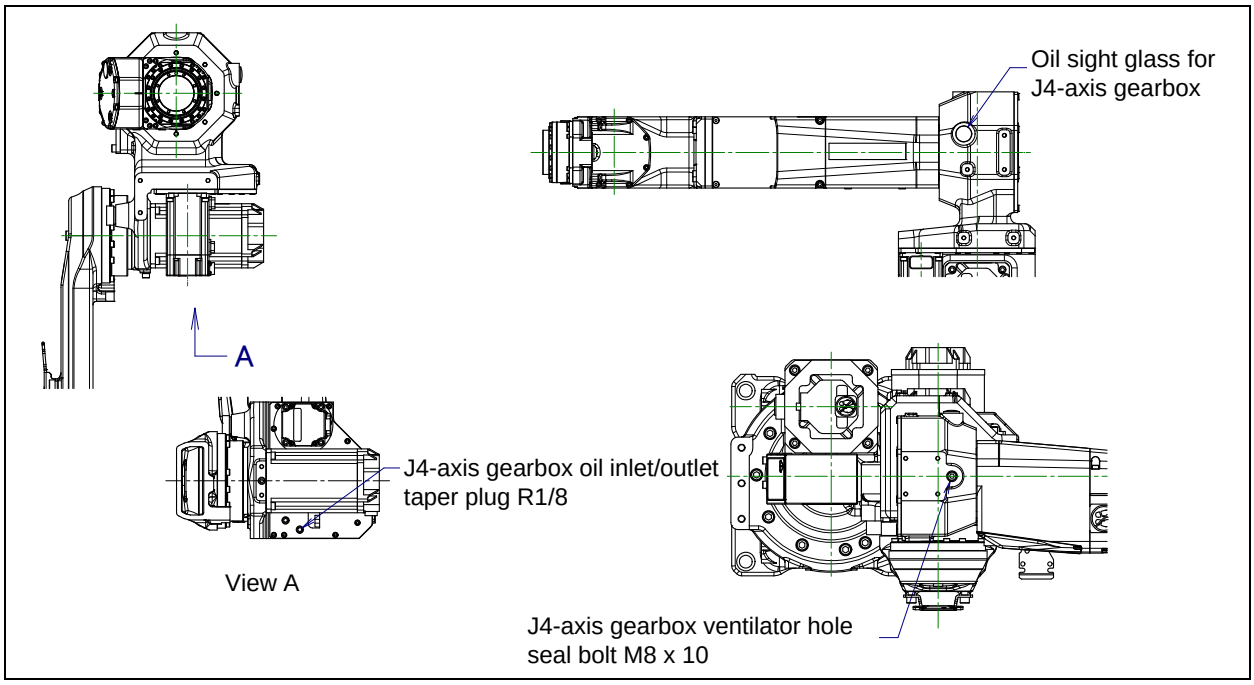


Fig. 7.3.2.3 (c) Greasing point of J4-axis gearbox
(ARC Mate 100*i*C/10S, M-10*i*A/10S)

Table 7.3.2.3 (c) Specification of the seal bolts and the taper plug

Parts name	Specification
Seal bolt (M8 x 10)	A97L-0218-0417#081010
Taper plug (R1/8)	A97L-0001-0436#1-1D

Exhausting oil method

1 Move the robot to the oil discharge Posture for J4-axis gearbox described in Table 7.3.2.3 (b).
2 Turn off the controller power.
3 Put the oil pan under the oil outlet. For oil inlet/outlet, remove J4 connector panel mounting bolts and make it so that the plug of oil inlet/outlet can be seen. When moving the connector, remove user side connector and air joint if necessary. If equipment is installed on the ventilator hole, remove it. Then remove plug or seal bolt of oil inlet/outlet and ventilator hole.

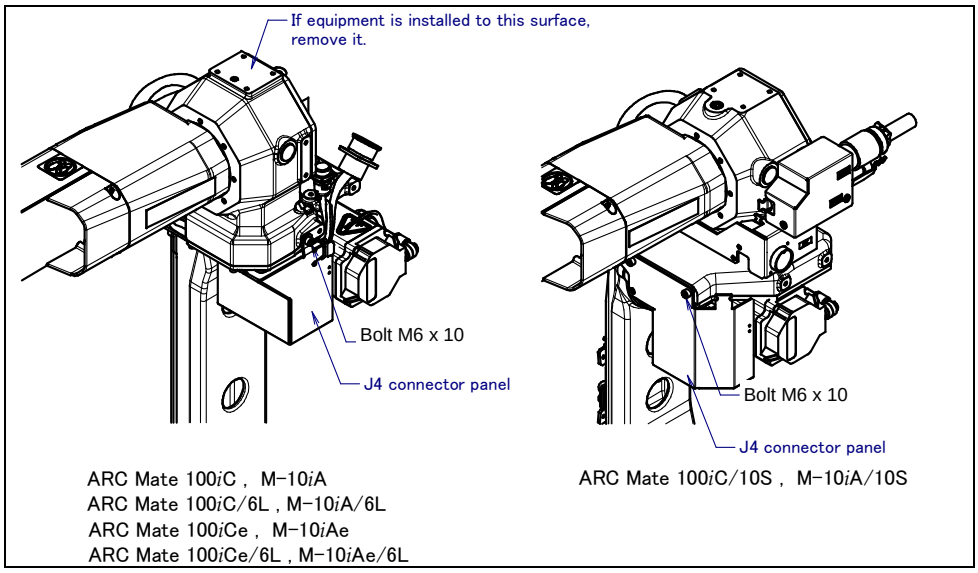


Fig. 7.3.2.3 (d) Removing the J4 connector panel

Injecting oil method

According to description below, inject oil.

(1) Install the oil injection nipple with valve (A05B-1221-K008) to the oil inlet.
(2) Confirm the valve is open, Perform oiling using the oil gun (A05B-1221-K005). In this time, install adapter for keeping of oiling posture. (It is appendix of A05B-1221-K005) If the oil sight glass is filled with oil, push the oil gun about 2 to 3 cm (about 50ml).
(3) Close the valve of oil injection nipple, then remove the oil gun.
(4) Attach the seal bolt to the ventilator hole. Replace the seal bolt by new one. When reusing it, be sure to wind it with a seal tape.
(5) Remove oil injection nipple, and attach seal bolt to oil inlet. Replace seal bolt by new one. When reusing it, be sure to wind it with seal tape.
(6) Release remaining pressure of oil bath referring to Subsection 7.3.2.5 and confirm oil quantity with oil sight glass.

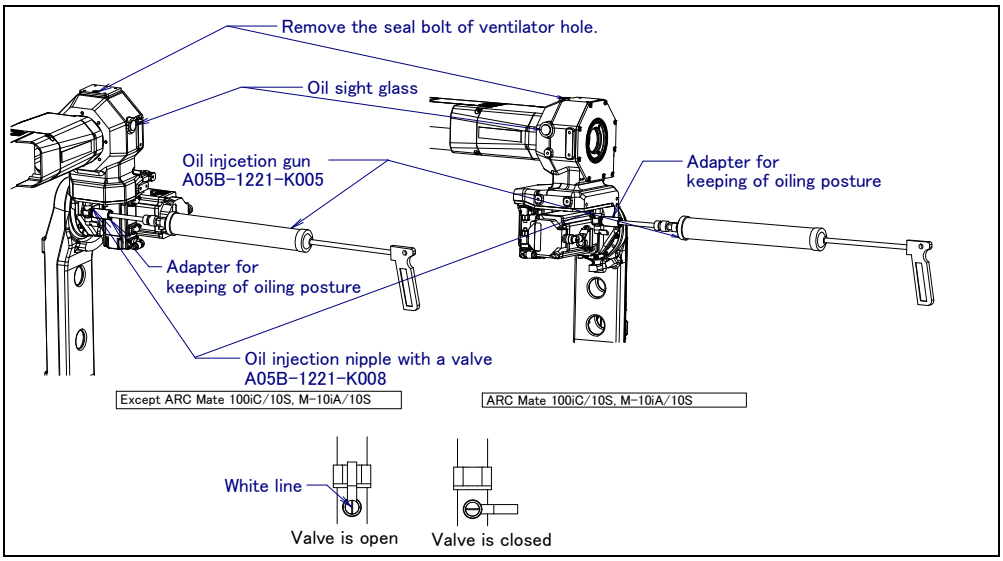


Fig. 7.3.2.3 (e) Oiling by oil gun (supplying oil J4-axis gearbox)

7.3.2.4 Oil replacement procedure for J5/J6-axis gearbox

⚠ CAUTION

1 There is severe risk of gear damage in case robot is operated with oil shortage. Please make sure the gearbox is always filled with correct amount of oil.
2 Failure to supply oil correctly may cause damage to the seal, which would in turn lead to oil leakage and abnormal operation. When performing oiling, therefore, observe the following cautions.
   (1) Use specified oil. Use of non-approved oil may damage the reducer or lead to other problems.
   (2) After oiling, release remaining pressure from the oil bath using the procedure given in Subsection 7.3.2.5, and then close the oil outlet.
   (3) To prevent slipping accidents and catching fire, completely remove any excess oil from the floor or robot.

Table 7.3.2.4 (a) Oil name and amount (J5/J6-axis gearbox)

Oiling points	Amount of oil to be applied (NOTE)	Gun tip pressure	Specified oil
J5/J6-axis gearbox	340g (400ml)	0.1MPa or less	JXTG Nippon Oil & Energy Corporation BONNOC AX68 (Specification: A98L-0040-0233)

NOTE

It is not a regulated amount injection. Be sure to confirm the amount of oil with the oil sight glass.

There is no brake for wrist axes of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L, so be careful not to drop the axes.

Table 7.3.2.4 (b) Postures for oiling (J5/J6-axis gearbox)

Supply position		Posture					
		J1	J2	J3	J4	J5	J6
J5/J6-axis gearbox (Oiling posture) (When oil gun is used)	Floor mount	Arbitrary	Arbitrary	18°	-40°	0°	Arbitrary
	Upside-down mount			-18°	140°		
	-90°wall mount	0°		-72°	-40°		
	+90°wall mount			108°	-40°		
J5/J6-axis gearbox (Oiling posture) (When oil gun is not used)	Floor mount	Arbitrary		18°	90°		
	Upside-down mount			-18°	-90°		
	-90°wall mount	0°		-72°	90°		
	+90°wall mount			108°	90°		
J5/J6-axis gearbox (replenishing oil)	Floor mount	Arbitrary		90°	0°		
	Upside-down mount			-90°	0°		
	-90°wall mount	0°		0°	0°		
	+90°wall mount			180°	0°		
J5/J6-axis gearbox (discharging oil)	Floor mount	Arbitrary		-30°	-70°		
	Upside-down mount			30°	110°		
	-90°wall mount	0°		-210°	-70°		
	+90°wall mount			150°	-70°		
J5/J6-axis gearbox (confirm oiling)	Floor mount	Arbitrary		0°	0°		
	Upside-down mount			180°	0°		
	-90°wall mount	0°		-90°	0°		
	+90°wall mount			90°	0°		
J5/J6-axis gearbox (release remaining pressure)	Floor mount	Arbitrary		20° to 90°	90°		
	Upside-down mount			-20° to-90°	-90°		
	-90°wall mount	0°		0° to 70°	-90°		
	+90°wall mount			110° to 180	90°		

NOTE) Choose the one of the posture taken easily when there is two or more posture.

Exhausting oil method

1 Move the robot to the posture of J5/J6-axis (oil discharge) described in Table 7.3.2.4 (b).
2 Turn off the controller power.
3 Put the oil pan under the oil outlet. Remove the extra low bolt and seal washer of first oil inlet and seal washer. (See Fig. 7.3.2.4 (a)) (In this time, if you remove bolt of oil outlet firstly, you can prevent spilling oil on surroundings.)

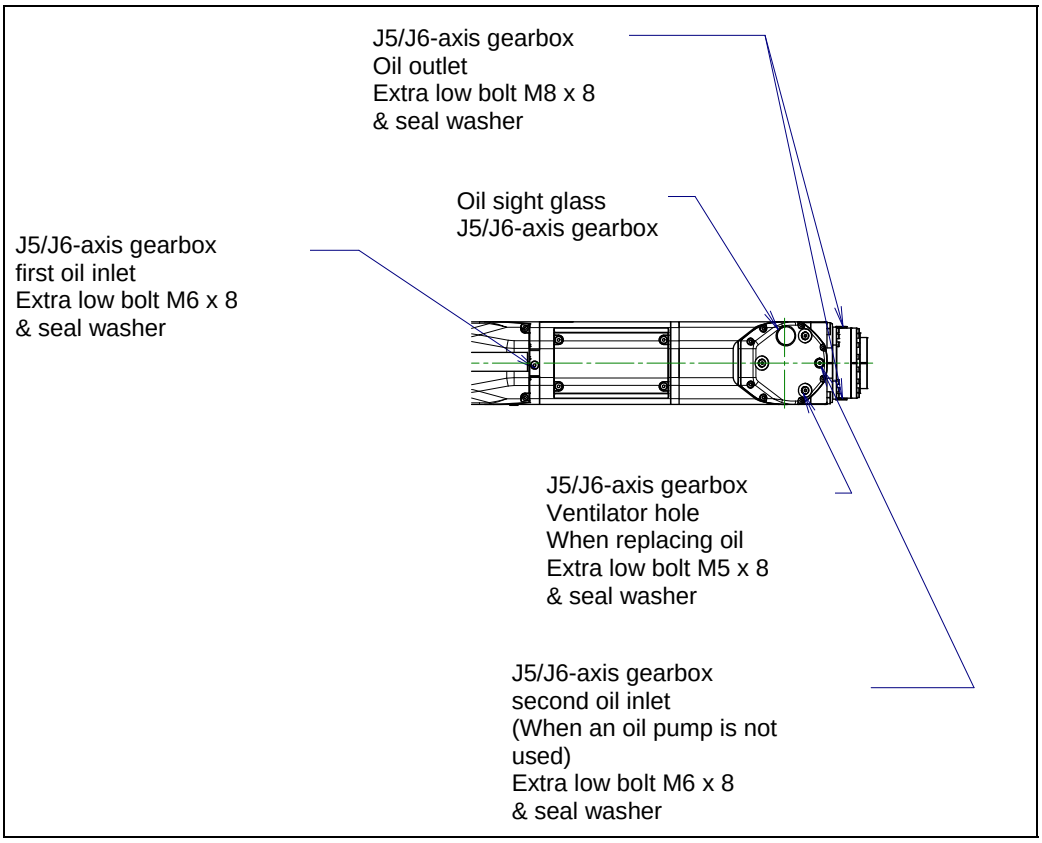


Fig .7.3.2.4 (a) Oil inlet and outlet

Table 7.3.2.4 (c) Spec. of the seal washers

Parts name	Specification
Seal washer (M6)	A30L-0001-0048#6M
Seal washer (M8)	A30L-0001-0048#8M

4 Install the taper plug or extra low bolt and seal washer to the first oil outlet and oil outlet after all oil is exhausted.
5 Turn on the controller power.

Injecting oil method

A When oil gun is used

(1) Install oil injection nipple with valve to J5/J6-axis gearbox first oil inlet (A05B-1221-K006) (Fig. 7.3.2.4 (c)) referring to Fig. 7.3.2.4 (b).
(2) Attach oil tray with valve (A05B-1221-K007) to J5/J6-axis gearbox oil outlet (J6-axis bearing part).
(3) Confirm valve of oil inlet and oil outlet are open referring to Fig. 7.3.2.4 (b). Supply oil to J5/J6-axis gearbox by oil injection gun (A05B-1221-K005). If oil comes out in oil tray from oil outlet, stop supplying oil, close the valve oil injection nipple, and remove oil gun.
(4) Close the valve of oil tray, remove tray and close the oil outlet.
(5) Remove the oil injection nipple, then attach extra low bolt and seal washer to first oil inlet.
(6) Move robot to the posture for J5/J6-axis gearbox (replenishment) of Table 7.3.2.4 (b) and add oil from second oil inlet (M5) by a syringe fountain pen filler. If about 15ml of oil is added, oil comes out from oil inlet. Then close the oil inlet.
(7) Move robot to the posture for J5/J6-axis gearbox (confirm oiling) of Table 7.3.2.4 (b) and confirm the quantity of oil. (See Fig. 7.3.2.4 (d).)
(8) Turn J4-axis 90 degree by each axis jog, back to the original posture, confirm oil amount height is 3/4 or more. If oil is insufficient, add oil by a syringe fountain pen filler.
(9) Release remaining pressure using the procedure given in Subsection 7.3.2.5 and confirm the oil sight glass again.

⚠ CAUTION
If supplying oil forcibly when valve is closed, internal pressure of oil bath rise abnormally and cause oil leak from seal part or oil seal falling out. Be careful.

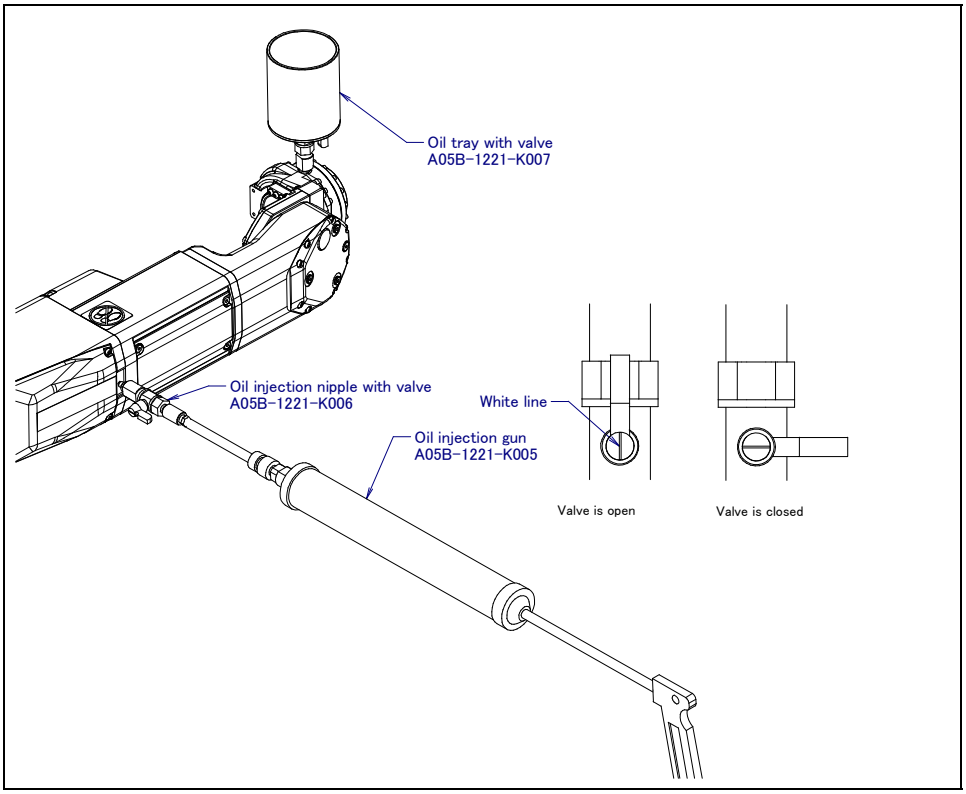


Fig .7.3.2.4 (b) Oil injection with a oil gun

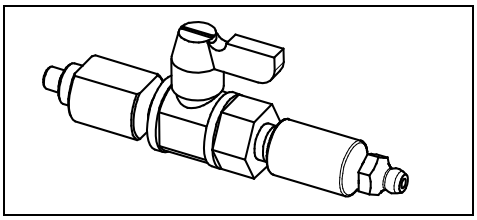


Fig .7.3.2.4 (c) Oil injection nipple with valve (A05B-1221-K006)

B When oil gun is not used

(1) Remove extra low bolt and seal washer of ventilator hole and second oil inlet of Fig. 7.3.2.4 (a) and supply oil. When the adaptor for oiling (A290-7221-X591) is used, oiling is easy. (Fig. 7.3.2.4 (e)). In case of using adaptor for oiling, install it to second oil inlet, remove J5/J6-axis gearbox ventilator hole and supply oil. The amounts of oiling are about as many as two adaptors. It takes about five minutes to supply one cup of oil.

(2) When oil comes out from ventilator hole, in case of using adapter for oiling ,remove it, close the ventilator hole, move robot to the posture (confirm oiling) and confirm amount of oil sight glass. (See Fig. 7.3.2.4 (d)) If oil is not sufficient, replenish it by a syringe fountain pen filler.

(3) Move the robot to the posture (replenishment) and add oil from second oil inlet (M6). If about 15ml of oil is added, oil comes out from oil inlet. Then close the oil inlet.

(4) Move robot to the posture of (confirm oiling) of Table 7.3.2.4 (b).In this time, rotate the J4-axis to +/- direction and confirm oil does not decrease. If it decreased, move the robot to the posture of (confirm oiling). And add oil from second oil inlet (M6) by a syringe fountain pen filler.

(5) Release remaining pressure using the procedure given in Subsection 7.3.2.5.

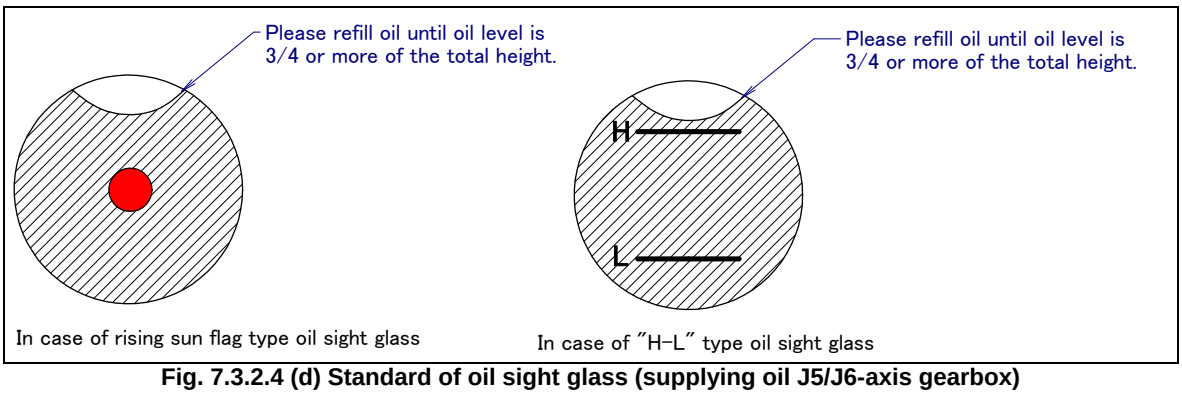


Fig. 7.3.2.4 (d) Standard of oil sight glass (supplying oil J5/J6-axis gearbox)

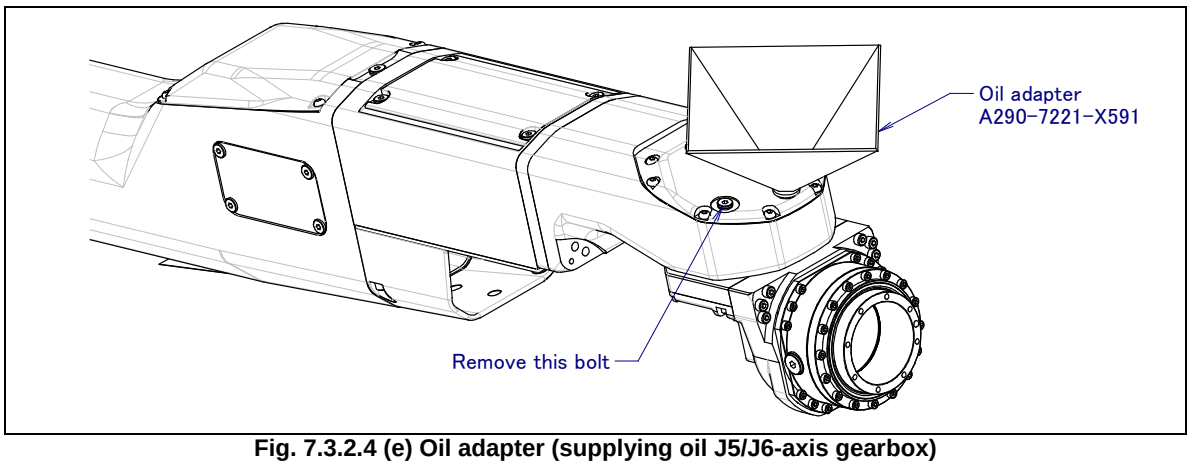


Fig. 7.3.2.4 (e) Oil adapter (supplying oil J5/J6-axis gearbox)

7.3.2.5 Procedure for releasing remaining pressure from oil bath (J4 to J6-axis)

After replacing oil, please do the following operation to adjust the amount of oil properly.

In case of J4-axis gearbox

Confirm that oil level seen in oil sight glass is as per Fig. 7.3.2.3 (a). If confirmed then please operate robot J4 axis during 10 minutes, at 100% override, making ±90° motion (or more). Keep oil inlet and oil outlet closed during this operation. When completed, move the robot to the posture outlet comes to right above position (In case of floor mount, J3=0^{o}.) and remove seal bolt of J4-axis gearbox oil outlet. Remaining pressure is released at once if it is removed. After operation, confirm whether the oil side of the oil sight glass has come above 3/4 of the total height, and attach plug of the oil inlet. In case oil level is insufficient, please add oil from the oil outlet with the syringe etc. Wipe off the oil that adhered to the surface of the robot and attach the taper plug on the oil inlet, the seal bolt on the oil outlet completely then attach seal bolt of oil outlet.

In case of J5/J6-axis gearbox

Confirm that oil level seen in oil sight glass is as Fig. 7.3.2.4 (d). Then move the robot to the posture J5/J6-axis (release remaining pressure), attach extra low bolt and seal washer to second oil inlet but keep them loose. Operate robot J5 and J6 axis during 10 minutes, at 100% override, making ±90° motion (or more) on both axes. In this time, make program that move both of J5-axis and J6-axis.
When completed, move the robot to the posture (replenishing oil). Remaining pressure is released at once if the second oil inlet (M5) is opened. Move the robot to the posture (confirm oiling), then confirm that oil level is 3/4 or more. At this time, please rotate the J4 axis in the direction of +/-, and confirm that the amount of oil doesn't decrease. If oil decreases, move robot to the posture J5/J6-axis gearbox (replenish oil) and add oil from the second oil inlet with the syringe etc. After it is confirmed, wipe off the oil that adhered to the surface of the robot and attach the extra low bolt on the oil inlet completely.

If the above operation cannot be performed due to the environment of the robot, prolong the operating time so that an equivalent operation can be performed. (When the maximum allowable axis angle is 45 degrees, perform the twice operation for 20 minutes or more.). If you grease or oil multiple axes, you can exercise multiple axes at the same time.

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

> ⚠ **CAUTION**
> When reusing seal bolt and taper plug, be sure to seal t thread part with seal tape. As for the seal washer, one side, rubber sticks to the entire and the other side, rubber sticks to only around hole and rubber sticks is incomplete state, Attach later face to bolt side. Confirm seal washer by viewing. If it is damaged obviously, replace it by new one.
> See Table 7.3.2.3 (c), Table 7.3.2.4 (c) about specification of seal bolts and seal washer.

7.4 STORAGE

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

8 CHECKS AND MAINTENANCE (M-10*i*A/10M/10MS)

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

NOTE
The periodic maintenance procedures described in this chapter assume that the FANUC robot is used for up to 3840 hours a year. In cases where robot use exceeds 3840 hours/year, adjust the given maintenance frequencies accordingly. The ratio of actual 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 interval should be divided by 2.

8.1 CHECKS AND MAINTENANCE

8.1.1 Daily Checks

Check the following items when necessary before daily system operation.

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is an oil seepage, clean it. **⇒"8.2.1 Confirmation of Oil Seepage"**
Air control set	(When air control set is used) **⇒"8.2.2 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: **⇒"10.1 TROUBLESHOOTING"(symptom : Vibration, Noise)**
Positioning accuracy	Check that the taught positions of the robot have not deviated from the previously taught positions. When the displacement occurs, perform the measures as described in the following section: **⇒"10.1 TROUBLESHOOTING"(Symptom : Displacement)**
Peripheral equipment for proper operation	Check whether the peripheral equipment operates properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the droppage of the end effector is 5 mm or less when the servo power turned off. If the end effector (hand) drops, perform the measures as described in the following section: **⇒"10.1 TROUBLESHOOTING"(symptom : Dropping axis)**
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: **⇒"OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)"**

8.1.2 Periodic Checks and Maintenance

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

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
○ Only 1st check	○					Cleaning the controller ventilation system	If the controller ventilation system is dusty, turn the power off, and clean the unit.	20
	○					Check the external damage or peeling paint	Check whether the robot has external damage due to the interference with the peripheral devices or peeled paint. If an interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check damages of the cable protective sleeves	Check whether the cable protective sleeves of the mechanical unit cable have holes or tears. If damage is found, replace the cable protective sleeve. If the cable protective sleeve is damaged due to the interference with peripheral devices, eliminate the cause. **⇒"8.2.3 Check the Mechanical Unit Cables and Connectors"**	2
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If liquid was found, remove the cause, and wipe the liquid off.	3
	○ 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.	19
	○ Only 1st check	○				Check for damage to the mechanical unit cable (movable part) cable	Observe the movable part of the mechanical unit cable and welding cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted. **⇒"8.2.3 Check the Mechanical Unit Cables and Connectors"**	4
	○ Only 1st Check	○				Check for damage to the end effector (hand) connection cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.	5
	○ Only 1st check	○				Check the connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"8.2.3 Check the Mechanical Unit Cables and Connectors"**	6

Check and maintenance intervals (Period, Accumulated operating time)						Check and Maintenance item	Check points, Management and Maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	2 years 7680h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Retightening the 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"**	7
	○ Only 1st check	○				Retightening the external main bolts	Retighten the bolts which are installed, removed in the inspection, and exposed. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	8
	○ Only 1st check	○				Check the mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the mechanical stopper, the adjustable mechanical stopper, and check the looseness of the stopper mounting bolts. **⇒"8.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"**	9
	○ Only 1st check	○				Clean spatters, sawdust and dust	Check that spatters, sawdust, or dust does not exist on the robot main body. If dust has accumulated, remove it. Especially, clean the robot movable parts well (each joint, around the welding torch, conduit part, wrist axis hollow part and the cable protective sleeve).	10
		○				Replacing the mechanical unit batteries	Replace the mechanical unit batteries **⇒"8.3.1 Replacing the Batteries"**	11
		○				Apply grease	Apply grease to the J6-axis reducer **⇒"8.3.2 Greasing**	17
				○		Replacing the grease of J1 to J3- axis reducer and J4 to J5-axis gearbox	Replace the grease of each axis reducer and gearbox **⇒"8.3.3 Replacing the Grease of the Drive Mechanism"**	12 to 16
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Please refer to Chapter 8 about the replacing the cable.	18
					○	Replacing the controller batteries	Replace the controller batteries **⇒Chapter 7 Replacing batteries of R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) or R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)"**	21

8.2 CHECK POINTS

8.2.1 Confirmation of Oil Seepage

Check items

Check there is oil on sealed part of each joint parts. If there is oil seepage, clean them.

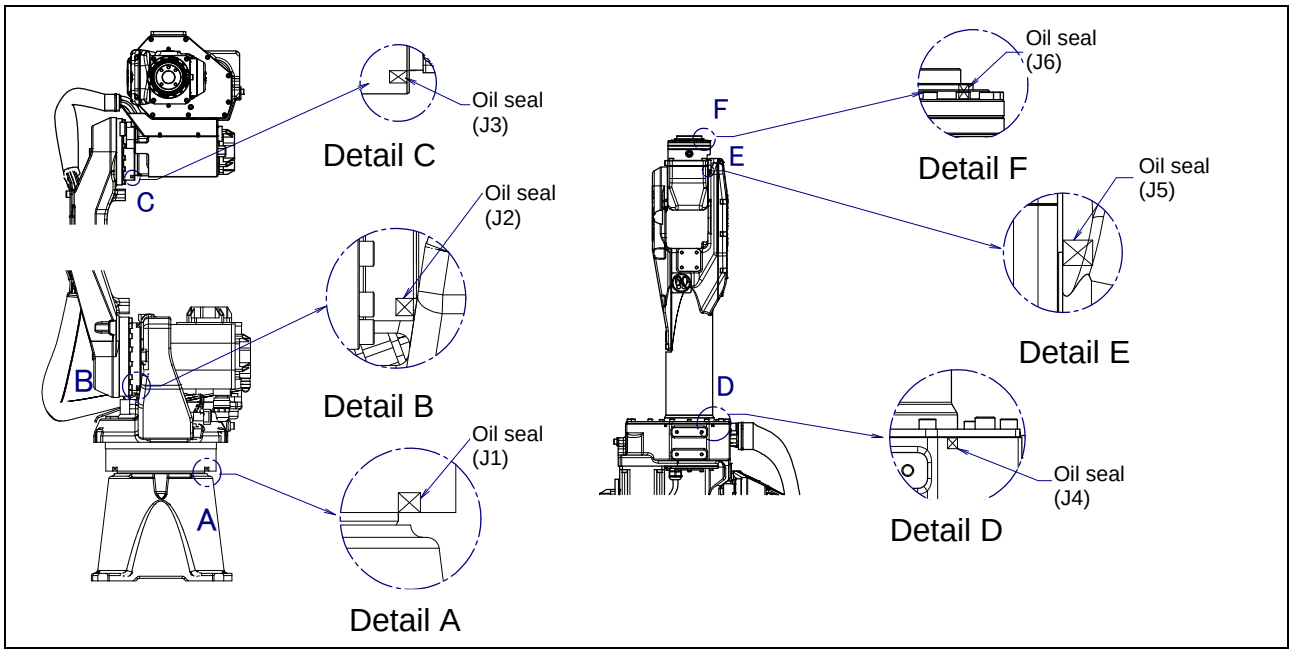


Fig. 8.2.1 Check parts of oil seal

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil changes to a state of liquid, the oil might spill depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components before you operate the robot.
- In case of oil seepage, please consider replacing the grease. This replacement potentially can help improving the seepage situation.
- Also, drive mechanism might become hot and the internal pressure of the grease bath or oil bath might rise. In these cases, normal internal can be achieved by venting the grease outlet. (When opening the grease outlet, refer to Section 8.3.2, 8.3.3.3 and ensure that grease is not expelled onto the machine or tooling.)

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

- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.

  ⇒" 10.1 TROUBLESHOOTING"(symptom : Grease leakage , Oil leakage)

8.2.2 Confirmation of the Air Control Set

When adopting an air control set, check the items below.

Item	Check items	Check points
1	Air pressure	Check the air pressure using the pressure gauge on the air control set as shown in Fig. 8.2.2. If it does not meet the specified pressure of 0.49 to 0.69 MPa (5 to 7 kgf/cm^2), adjust it using the regulator pressure-setting handle.
2	Lubricator oil mist quantity	Check the number of oil drops during wrist or hand motion. If it does not meet the specified value (1 drop/10 to 20 sec), adjust it using the lubricator control knob. Under normal usage, the lubricator will be empty in about 10 to 20 days.
3	Lubricator oil level	Check to see that the air control set oil level is within the specified level.
4	Leakage from hose	Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts as required.
5	Drain	Check the drain and release it. When volume of the drain is remarkable, examine the setting of the air dryer to the air supply side.

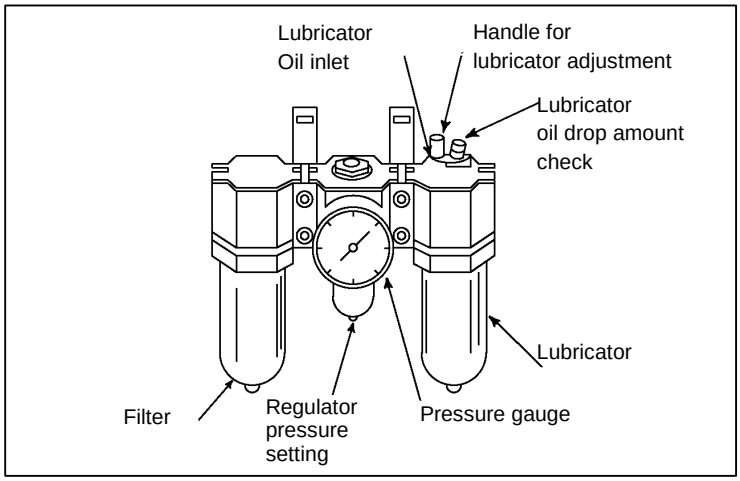


Fig. 8.2.2 Air control set (option)

8.2.3 Check the Mechanical Unit Cables and Connectors

Inspection points of the mechanical unit cables and welding cables
Check the cable for damage that has been exposed. Take special care for movable parts.
Clean it when the spatter adheres.

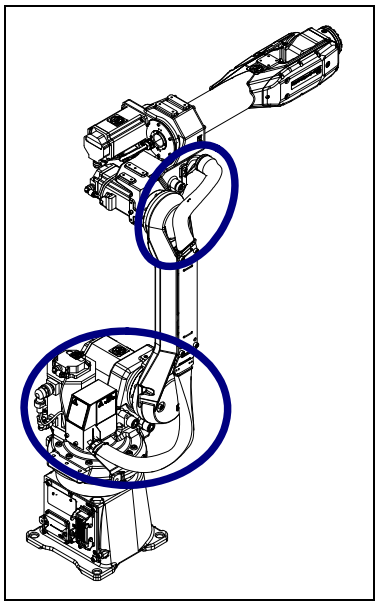


Fig. 8.2.3 (a) Inspection points of the mechanical unit cables

Check points
＜Cable protective sleeve＞
- Check that no holes or tears exist on the cable protective sleeves.
- If there is damage as shown in Fig. 8.2.3 (b), replace the cable protective sleeves.

Fig. 8.2.3 (b) Damage on the cable protective sleeve

＜Cables＞

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

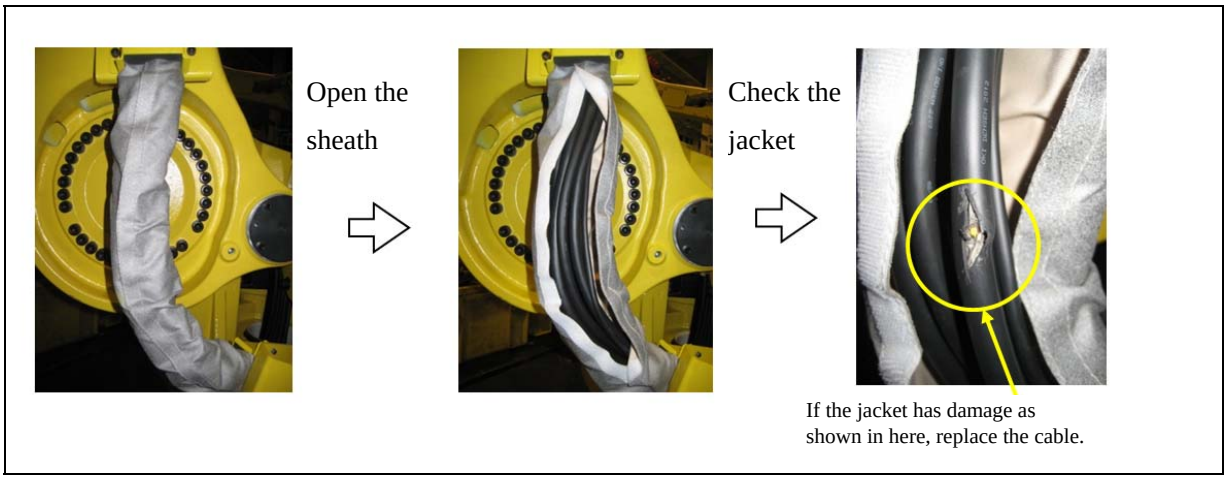


Fig. 8.2.3 (c) Cable check method

Inspection points of the connectors

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

Check items

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

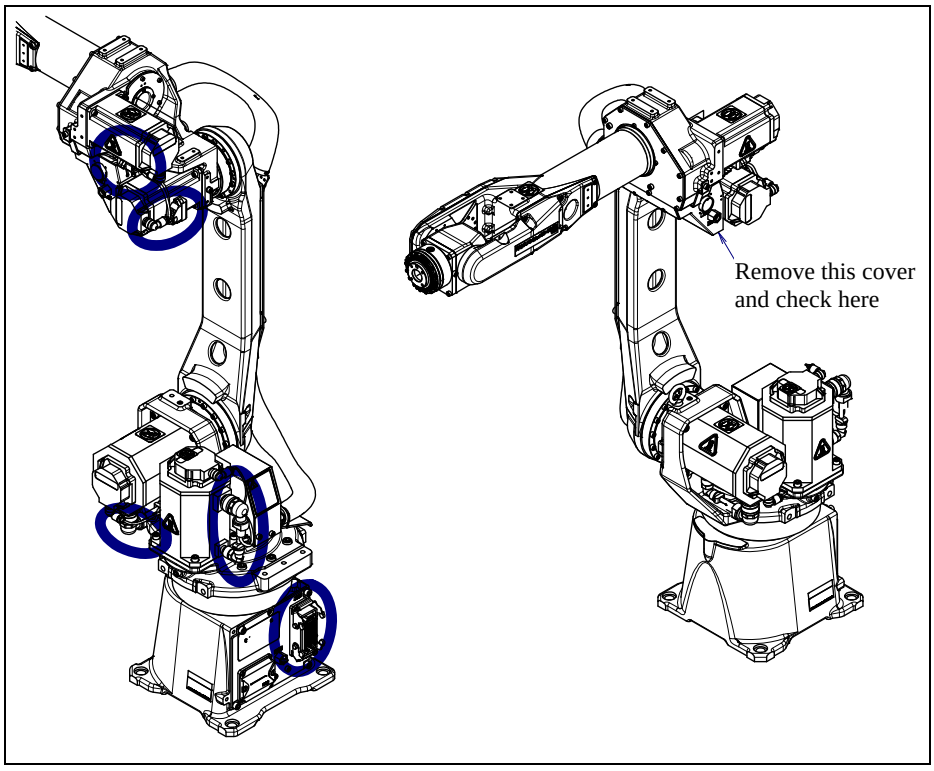


Fig. 8.2.3 (d) Connector Inspection points

8.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

- Check that there is no evidence of a collision on the mechanical stopper and the adjustable mechanical stopper. If there is evidence of a collision on the stopper, replace the parts.
- Check the tightness of the stopper mounting bolts. If they are loose, retighten them.
  Be sure to check the tightness of the mounting bolts of the J1-axis swing stopper.
- Refer to Section 6.2 of the operator's manual for details regarding the adjustable mechanical stopper.

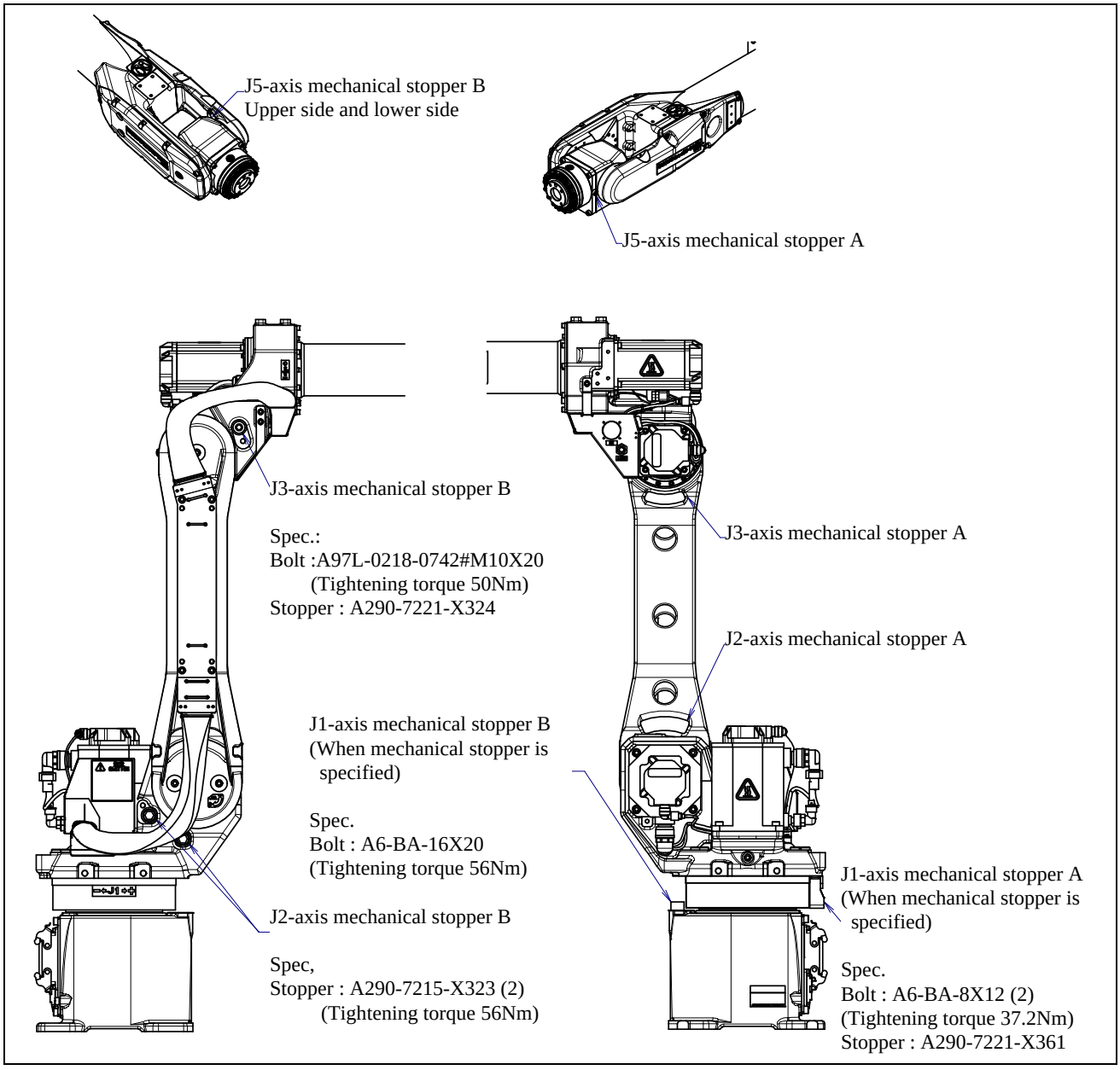


Fig. 8.2.4 Check of mechanical stopper and adjustable mechanical stopper

8.3 MAINTENANCE

8.3.1 Replacing the Batteries (1-Year Checks)

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1 year. Also, use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery

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

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

2 Remove the battery case cap. (Fig. 8.3.1 (a), (b)) If it cannot be removed, tap it to side direction with a plastic hammer.
3 Take out the old batteries from the battery case. In this time, battery can be taken out by pulling the stick of the center of the battery box.
4 Insert new batteries into the battery case. Pay attention to the direction of batteries.
5 Close the battery case cap.

> **⚠ CAUTION**
> When using a robot with the severe dust/liquid protection option, remove the cover from the battery case as shown in Fig. 8.3.1 (b) to replace the battery. After replacing the battery, reinstall the cover. At this time, please be sure to replace gasket with new one for severe dust/liquid protection. When sticking a gasket on a battery cover, please stick it not to have gaps between them.

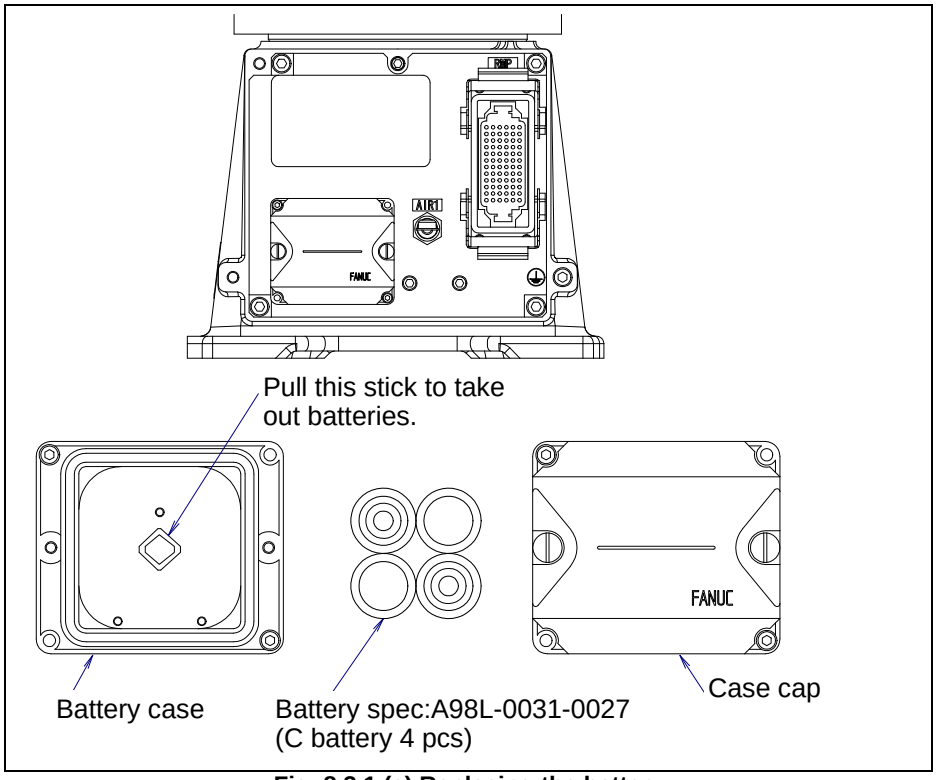


Fig. 8.3.1 (a) Replacing the battery

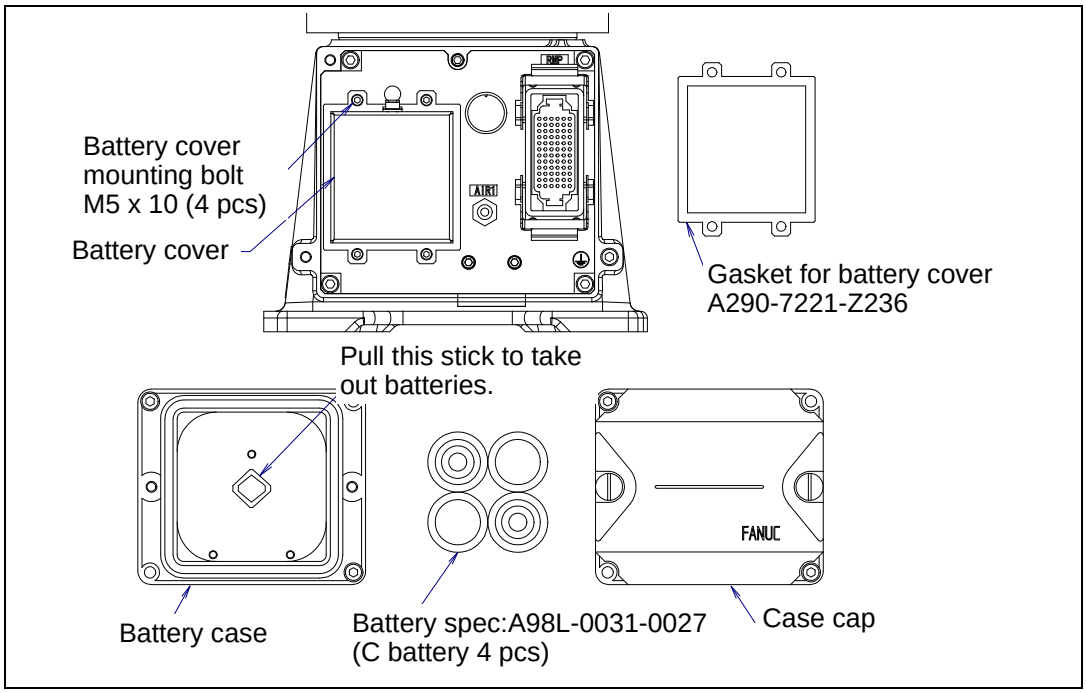


Fig. 8.3.1 (b) Replacing the battery (When severe dust/liquid protection option is specified)

8.3.2 Greasing

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

1 Replenish the reducer with grease about every 12 months or after 3840 hours of operation.
2 See Fig. 8.3.2 and Table 8.3.2 for greasing points and the method.
3 After applying grease, release the remaining pressure within the grease bath as described in the procedure in Subsection 8.3.3.4.

Table 8.3.2 Greasing points

Greasing point	Specified grease	Amount of grease	Gun tip pressure	Greasing method
J6-axis reducer	Harmonic grease 4BNo.2 Specification : A98L-0040-0230	35ml (31g)	0.1 MPa or less (NOTE)	Remove the Extra low bolts and sealing washers of the J6-axis grease inlet and outlet, and attach the supplied grease nipple of the J6-axis to the grease inlet of the J6-axis. After greasing, remove the grease nipple, and attach the extra low bolts and sealing washers to the grease inlet and outlet.

NOTE
When using a hand pump, apply grease approximately once per two seconds.

⚠ CAUTION
Failure to follow proper greasing procedures may cause a sudden increase of the grease bath internal pressure and damage to the seal. This could lead to grease leakage and abnormal operation. When greasing, observe the following cautions.

1 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems. Do no use Harmonic grease SK-3.
2 To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.

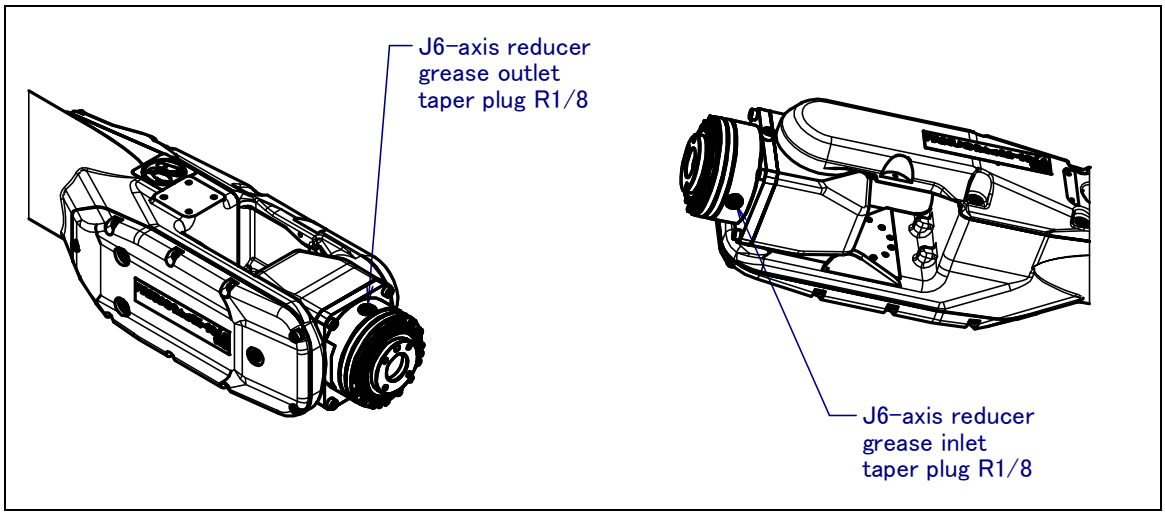


Fig. 8.3.2 J6-axis grease supply position

8.3.3 Replacing the Grease of the Drive Mechanism (3-Year (11520 Hours) Checks)

According to below, replace the grease of the reducers of J1, J2, and J3 axes and J4/J5-axis gearbox at the intervals based on every 3 years or 11520 hours, whichever comes first.

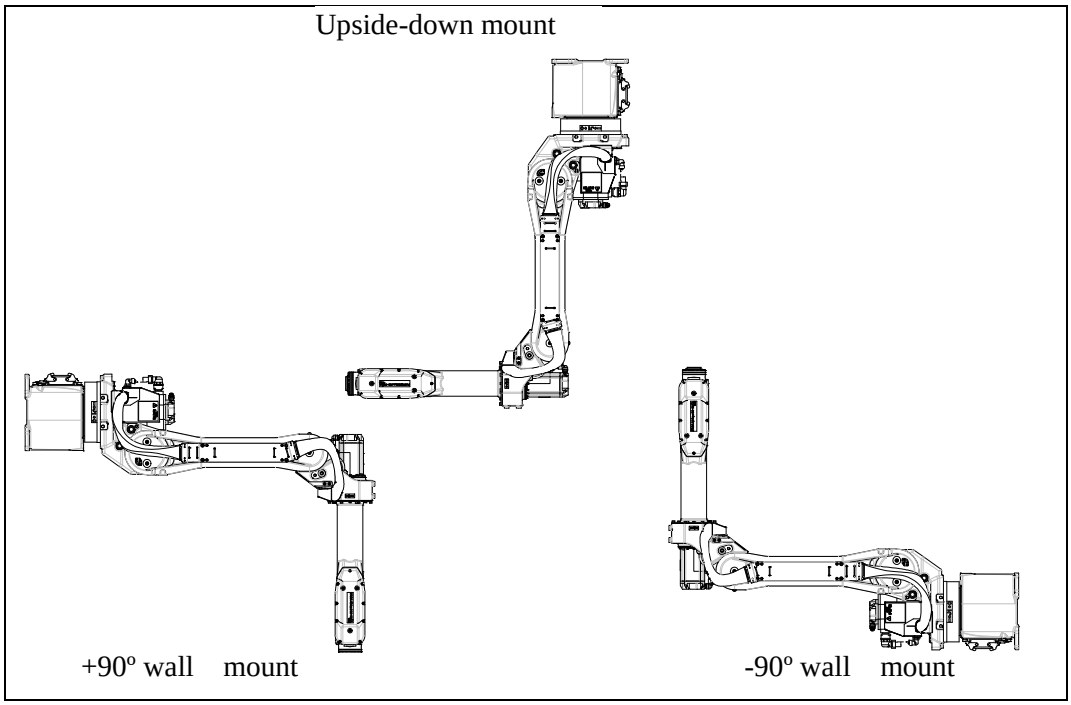


Fig. 8.3.3 Installation method

8.3.3.1 Grease replacement procedure for J1 to J3-axis reducer

⚠ CAUTION

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

1 Before starting to grease, remove the seal bolt or the taper plug grease out.
2 Supply grease slowly, using a manual pump. (once per two seconds)
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply. If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 8.3.3.1 (a)).
4 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 8.3.3.2, and then close the grease outlet.
6 To prevent an accident such as a fall or fire, remove all the excess grease from the floor and robot.

Table 8.3.3.1 (a) Grease name and amount to be replaced at regular intervals of three years (11520 hours)

Grease supplying position	Amount of grease to be applied	Gun tip pressure	Specified grease
J1-axis reducer	790g (870ml)	0.1MPa or less (NOTE)	Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174)
J2-axis reducer	300g (330ml)		
J3-axis reducer	170g (190ml)		

NOTE

When using a hand pump, apply grease approximately once per two seconds.

⚠ WARNING

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

For grease replacement or replenishment, use the Postures indicated below.
Consider relative angle of from posture of floor mount when robot is angle mount.

Table 8.3.3.1 (b) Postures for greasing (J1/J2/J3-axis reducer)

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

1 Move the robot to the greasing posture described in Table 8.3.3.1 (b).
2 Turn off the controller power.
3 Remove the seal bolt or taper plug from grease outlet. (Fig. 8.3.3.1)
J1-axis : 1 location (seal bolt M8 x 10)
J2-axis : 2 locations (seal bolt M8 x 10)
J3-axis : 1 location (seal bolt M8 x 10)
(*Robot has 2 grease outlet. Remove only first grease outlet.)
4 Remove the seal bolt or taper plug from grease inlet and attach grease nipple.
5 Keep greasing until the new grease pushes out the old grease and comes out from each grease outlet.
6 Release remaining pressure using the procedure given in Subsection 8.3.3.2. In case of upside-down mount, pull out about 100ml grease to make space of grease bath.

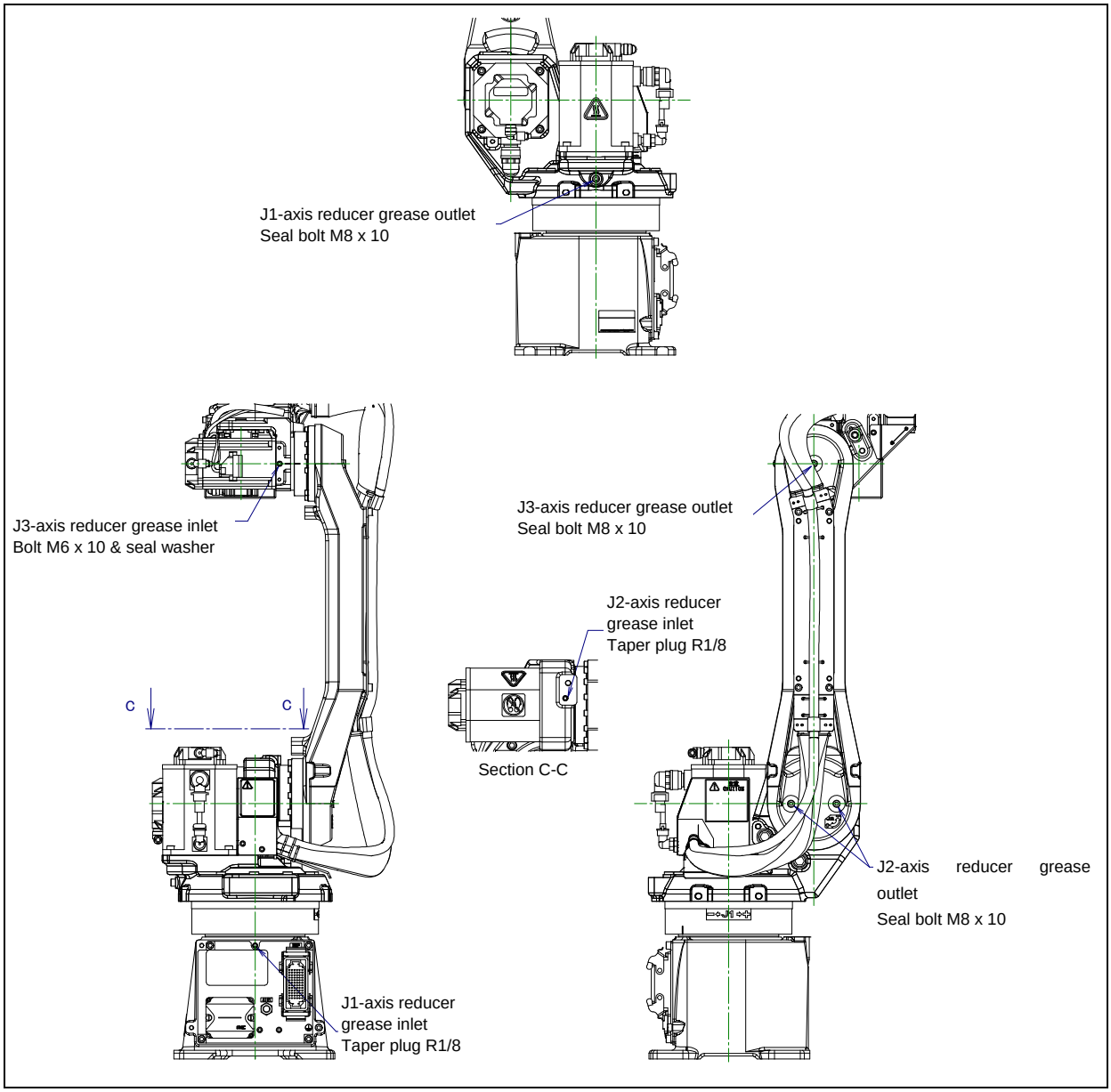


Fig. 8.3.3.1 Greasing points of J1 to J3-axis reducer

Table 8.3.3.1 (c) Specification of the seal bolts, the taper plug and the seal washer

Parts name	Specification
Seal bolt (M6 x 8)	A97L-0218-0417#060808
Seal bolt (M8 x 10)	A97L-0218-0417#081010
Taper plug (R1/8)	A97L-0001-0436#1-1D

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

After applying grease, operate the robot as instructed below with the plug and seal bolt of the grease inlet and outlet uncapped to release the remaining pressure within the grease bath. In case of J2-axis, there are three seal bolts for grease outlet. So uncap all of them.
Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

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

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

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

8.3.3.3 Grease replacement procedure for J4/J5-axis gearbox

⚠ CAUTION
Failure to supply grease correctly may cause an increase of the internal pressure of the grease bath. Such pressure increase will then damage the seal, which in turn leads to grease leakage and abnormal robot operation.
When performing greasing, therefore, observe the following precautions.

1 Before starting to grease, remove the seal bolt or the taper plug grease out.
2 Supply grease slowly, using a manual pump. (once per two seconds)
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply.
If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 8.3.3.3 (a)).
4 Use grease only of the specified type. Grease of a type other than that specified may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 8.3.3.4, and then close the grease outlet.
6 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.

Table 8.3.3.3 (a) Grease name and amount (J4/J5-axis gearbox)

Greasing points	Amount of grease to be applied	Gun tip pressure	Specified grease
J4-axis gearbox	340 g (390ml)	0.1MPa or less (NOTE)	Kyodo Yushi VIGOGREASE RE0 (Specification: A98L-0040-0174)
J5-axis gearbox	220 g (250ml)		

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

Table 8.3.3.3 (b) Grease supplying posture (J4/J5-axis gearbox)

Greasing points		Posture					
		J1	J2	J3	J4	J5	J6
J4-axis gearbox Greasing posture	Floor mount	Arbitrary	Arbitrary	0°	Arbitrary	Arbitrary	Arbitrary
	Upside-down mount			0°			
	-90° wall mount			90°			
	+90° wall mount			90°			
J5-axis gearbox Greasing posture	Floor mount	Arbitrary	Arbitrary	-90°			
	Upside-down mount			90°			
	-90° wall mount	0°	0°	180°			
	+90° wall mount			0°			

1 Move the robot to the greasing posture described in Table 8.3.3.3 (b).
2 Turn off the controller power.
3 Remove the seal bolt. (Fig. 8.3.3.3)
J4-axis : 1 location (seal bolt M6 x 8)
J5-axis : 1 location (bolt M8 x 12 + seal washer)
4 Remove the seal bolt or taper plug from grease inlet and attach grease nipple.
5 Keep greasing until the new grease pushes out the old grease and comes out from each grease outlet.
6 Release remaining pressure using the procedure given in Subsection 8.3.3.4.

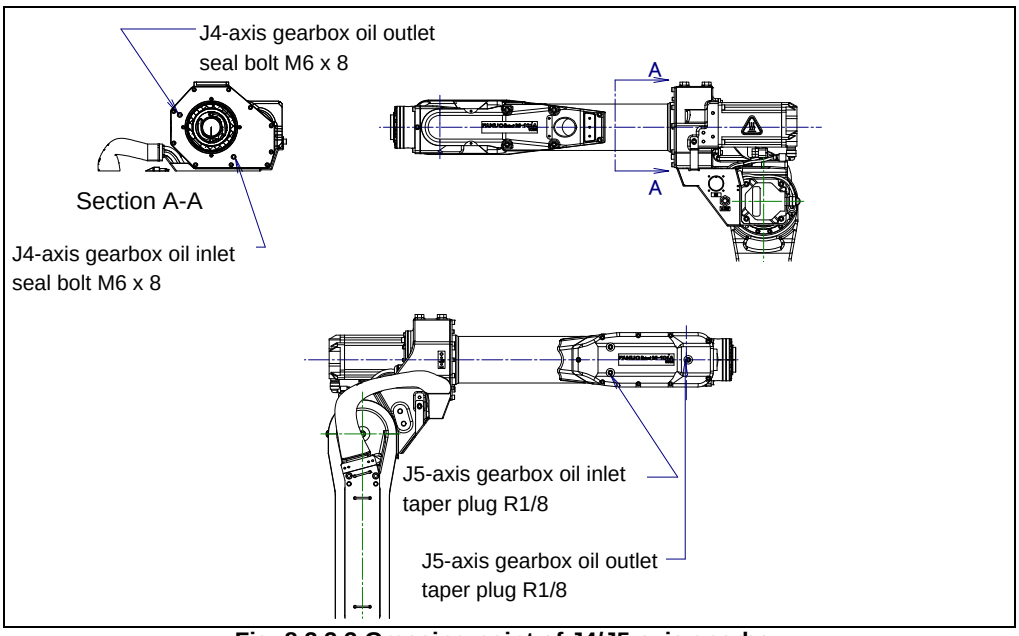


Fig. 8.3.3.3 Greasing point of J4/J5-axis gearbox

Table 8.3.3.3 (c) Spec. of the seal bolt and the taper plug

Parts name	Specification
Seal bolt (M6 x 8)	A97L-0218-0417#060808
Taper plug (R1/8)	A97L-0001-0436#1-1D

8.3.3.4 Procedure for releasing remaining pressure from the grease bath (J4 to J6-axis)

To release remaining pressure, perform the procedure below.

(For the J4-axis)
Operate the robot as described in the table below for at least 10 minutes, with the seal bolts removed from the grease inlet and outlet.

(For the J5-axis gearbox)
- After greasing, remove the grease nipple from the grease inlet.
- Move the robot to J3=-90°, perform ±90° repeating operation during 5 minutes for only J5-axis. Make wait time between 2 points 0, perform the continuous operation with position pass is fine.
- After 5 minutes, confirm about 50ml grease is pulled out. (just as volume of 2 golf balls.)
- Attach the bolts and seal washers of grease inlet and outlet.

(For the J6-axis)
Operate the robot as described in the table below for at least 10 minutes, with the extra low bolts and seal washers removed from the grease inlet and outlet.

Attach a recovery bag below the grease inlet and outlet to prevent output grease from splattering.

Operating axis / Grease replacement part	J1-axis	J2-axis	J3-axis	J4-axis	J5-axis	J6-axis
J4-axis gearbox	Arbitrary			Axis angle of 60° or more OVR 100%	Arbitrary	
J5-axis gearbox	Arbitrary				Axis angle of 180° or more OVR 100%	Arbitrary
J6-axis reducer	Arbitrary					Axis angle of 60° or more OVR 100%

If the above operation cannot be performed due to the environment of the robot, prolong the operating time so that an equivalent operation can be performed. (When the maximum allowable axis angle is 30 degrees, perform the twice operation for 20 minutes or more.) If you grease multiple axes, you can exercise multiple axes at the same time. (Except J5-axis) After completion of the operation, attach the taper plug, seal bolts or bolts and seal washers to the grease inlets and outlets. When reusing the seal bolts or the taper plug, be sure to seal them with seal tape.

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

8.4 STORAGE

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

9 MASTERING

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

> ⚠ **CAUTION**
> In case of R-30*i*B/R-30*i*B Plus controller, when arc tool (3kg payload specification) is specified for ARC Mate *i*C series, mastering is performed with gravity compensation function enabled in our factory before shipment. Please refer to Chapter 11 of optional function operator's manual (B-83284EN-2) for details of the gravity compensation function.

9.1 OVERVIEW

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

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

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

Types of Mastering

Table 9.1 describes the following mastering methods. Note that "Quick Mastering for Single Axis" is not supported in software version 7DC2 (V8.20P) or earlier.

Table 9.1 Type of mastering

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

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

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

⚠ CAUTION

1 If mastering is performed incorrectly, the robot may behave unexpectedly. This is very dangerous. For this reason, the Master/Cal screen is designed to appear only when the $MASTER_ENB system variable is 1 or 2. After performing positioning, press F5, ([DONE]) on the Master/Cal screen. The $MASTER_ENB system variable is reset to 0 automatically, and the Master/Cal screen will disappear.
2 Before mastering is performed, it is recommended that the current mastering data be backed up.
3 When the motion range is mechanically 360 degrees or more, if any of the axes (J1-axis and J4-axis) to which the cables are connected is turned one turn beyond the correct mastering position when mastering occurs, the cables in the mechanical unit may be damaged. If the correct rotation position is not clear because the axis is moved too much during mastering, remove the connector panel or cover, check the states of the internal cables, and perform mastering in the correct position. For the checking procedure, see Fig. 9.1 (a) and 9.1 (d).

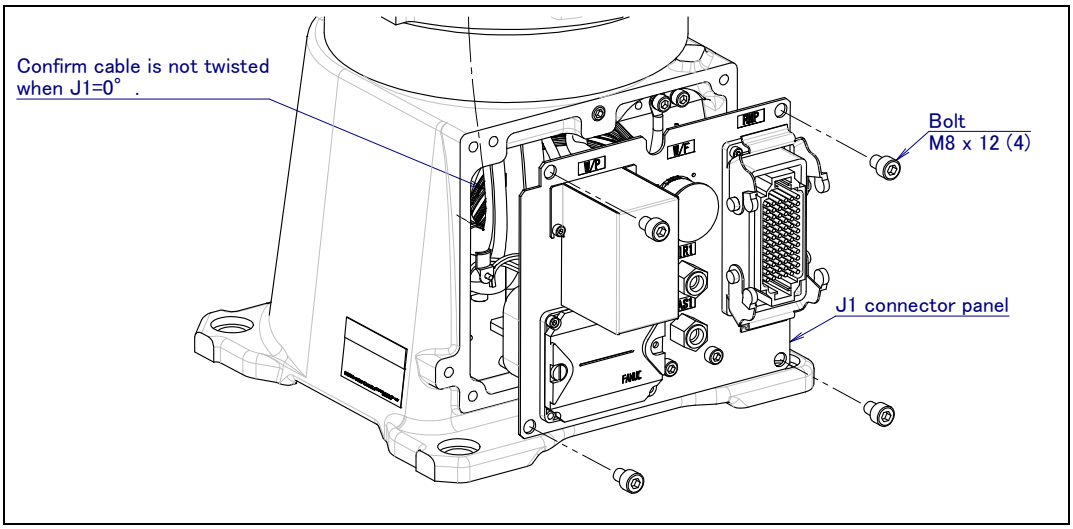


Fig. 9.1 (a) Confirming the state of cable (J1-axis)

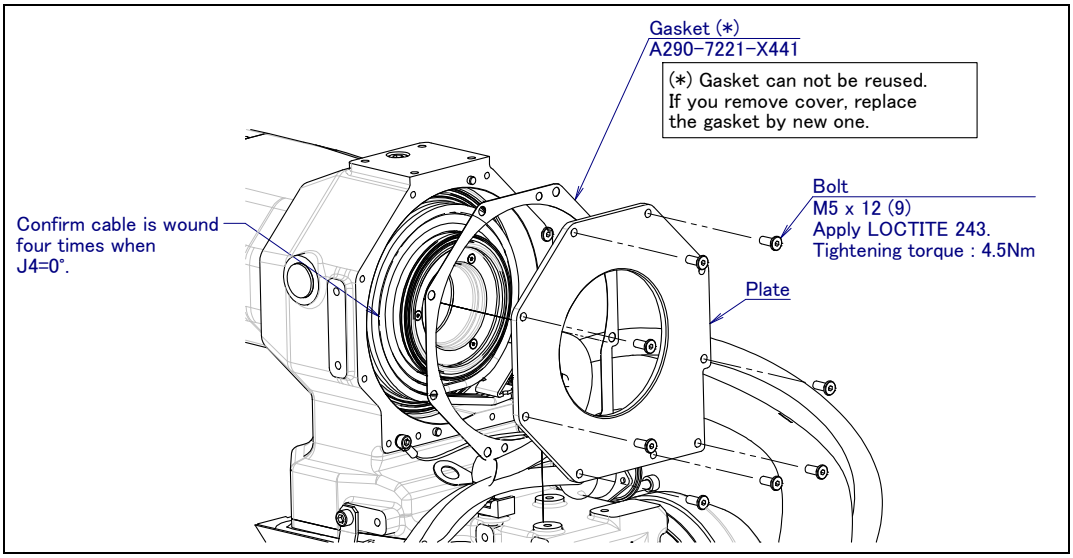


Fig. 9.1 (b) Confirming the state of cable (J4-axis) (1/2)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

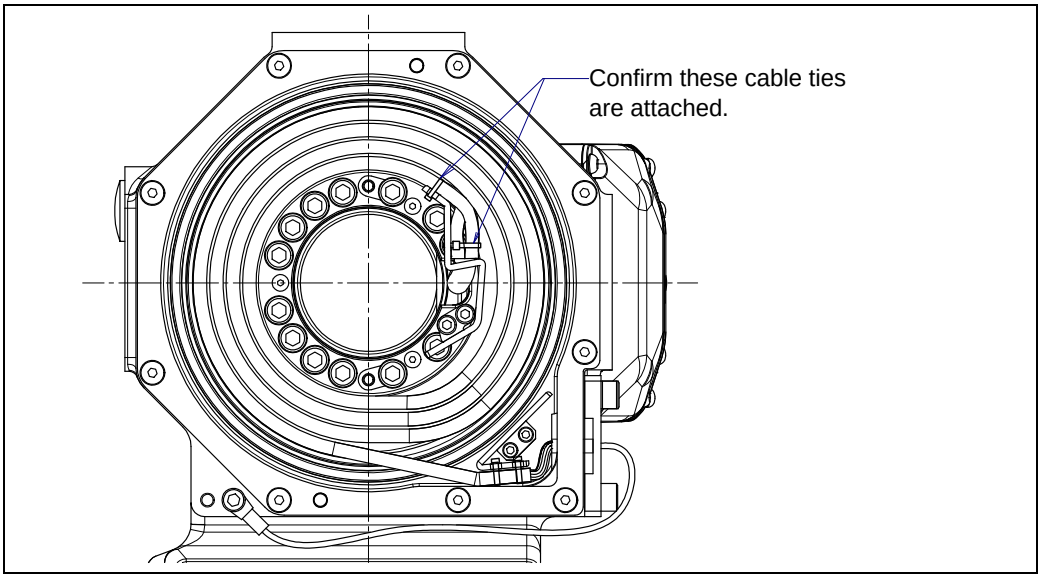


Fig. 9.1 (c) Confirming the state of cable (J4-axis) (2/2)
(ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S)

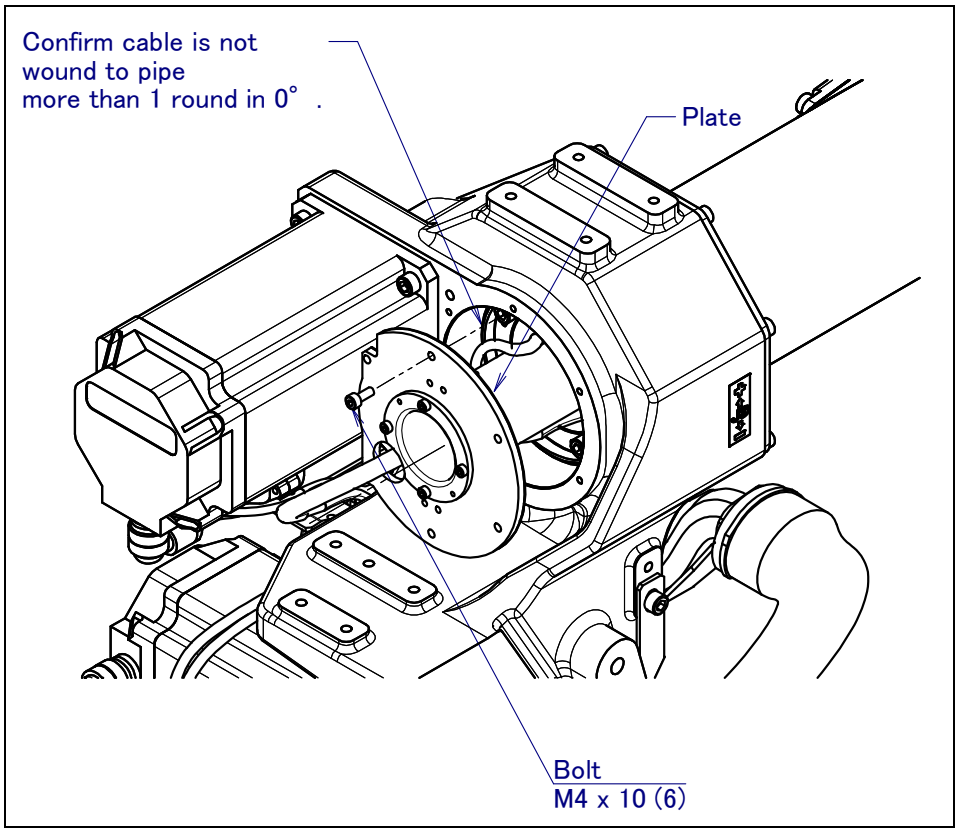


Fig. 9.1 (d) Confirming the state of cable (J4-axis)
(M-10*i*A/10M/10MS)

9.2 RESETTING ALARMS AND PREPARING FOR MASTERING

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

Alarm displayed

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

Procedure

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

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

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

9.3 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. 9.3 (a) to (d)). This mastering is performed with all axes set at the 0-degree position using their respective witness marks.

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

Zero-position Mastering Procedure

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

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

[ TYPE ]   LOAD   RES_PCA                DONE
```

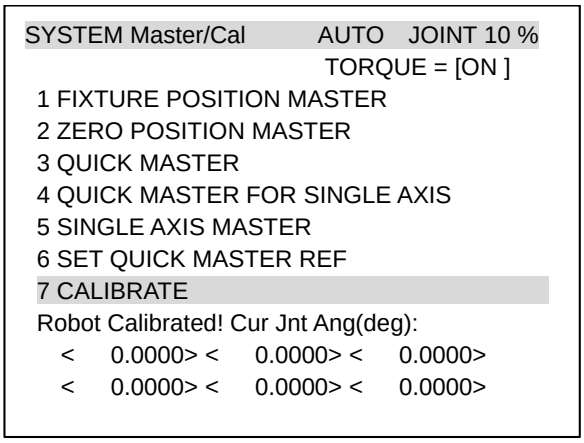
5 Release brake control, and jog the robot into a posture for mastering.

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

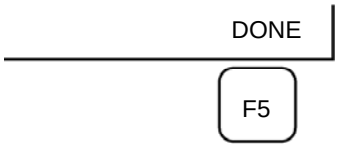
6 Select [2 ZERO POSITION MASTER]. Press F4 [YES].

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

7 Select [7 CALIBRATE] and press F4 [YES]. Mastering will be performed automatically. Alternatively, 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 9.3 Posture with position marks (witness mark) aligned

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

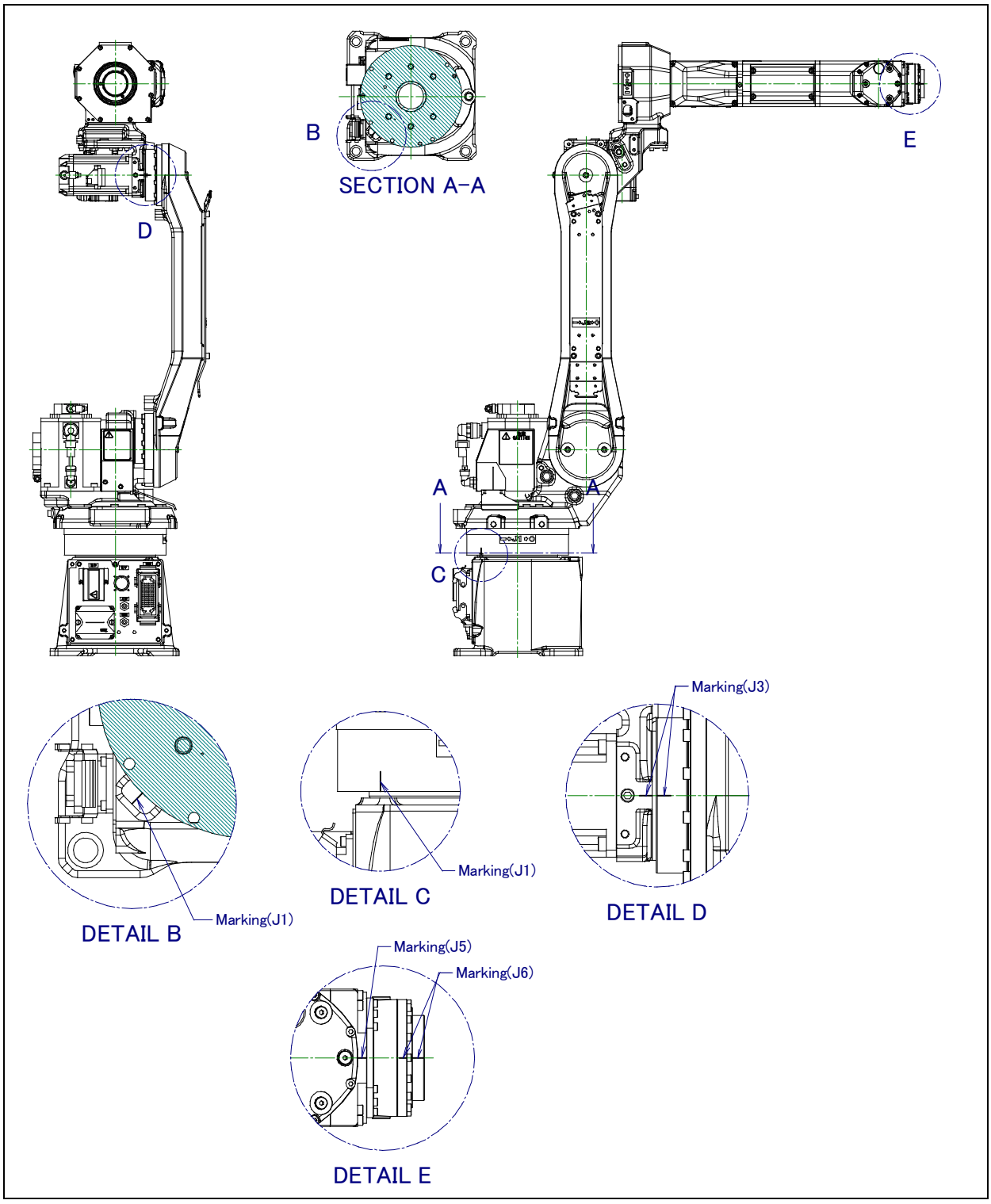


Fig. 9.3 (a) Marking position (witness mark) for each axis (except M-10*i*A/10M/10MS)

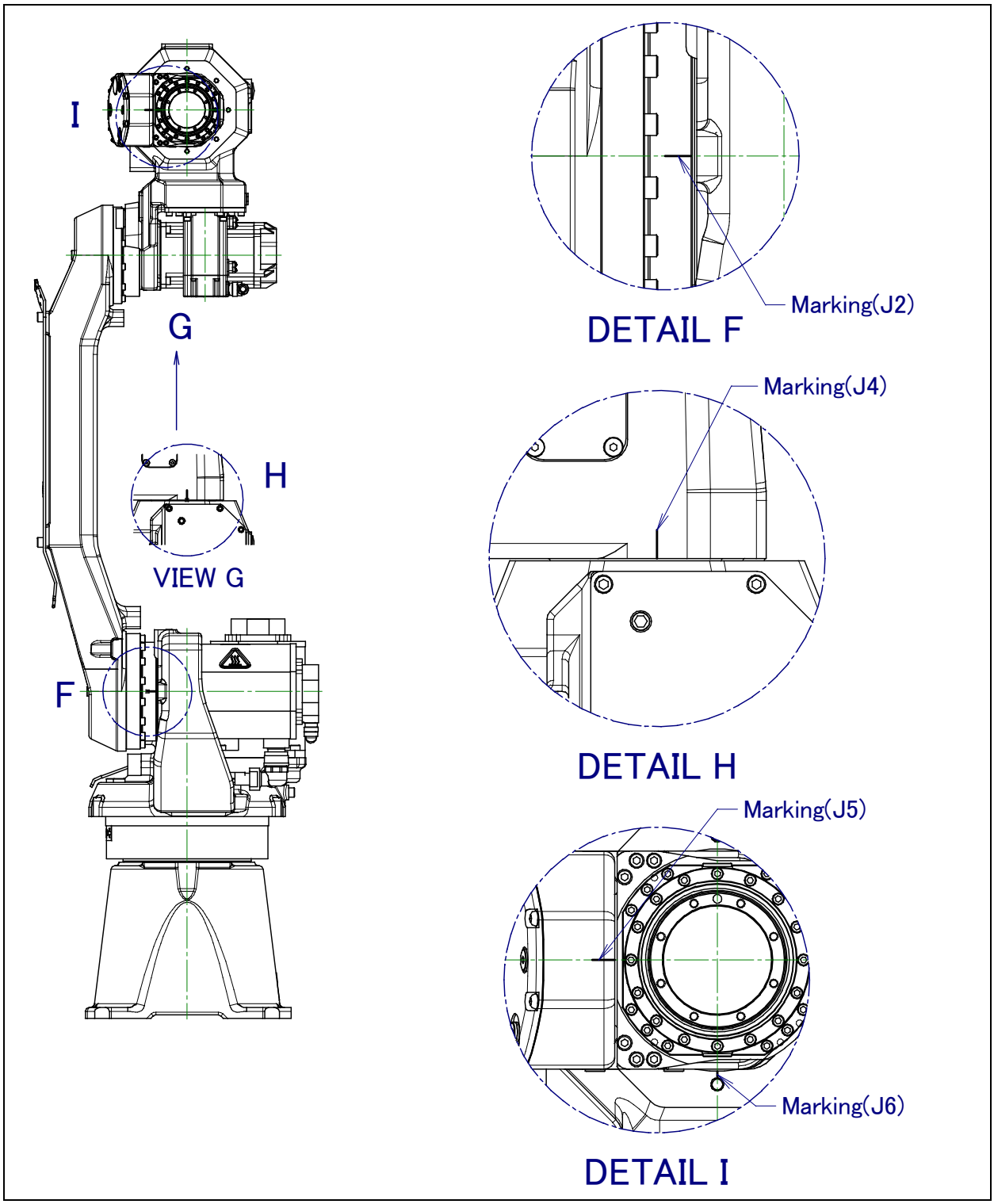


Fig. 9.3 (b) zero-position mark (witness mark) for each axis (except M-10*i*A/10M/10MS)

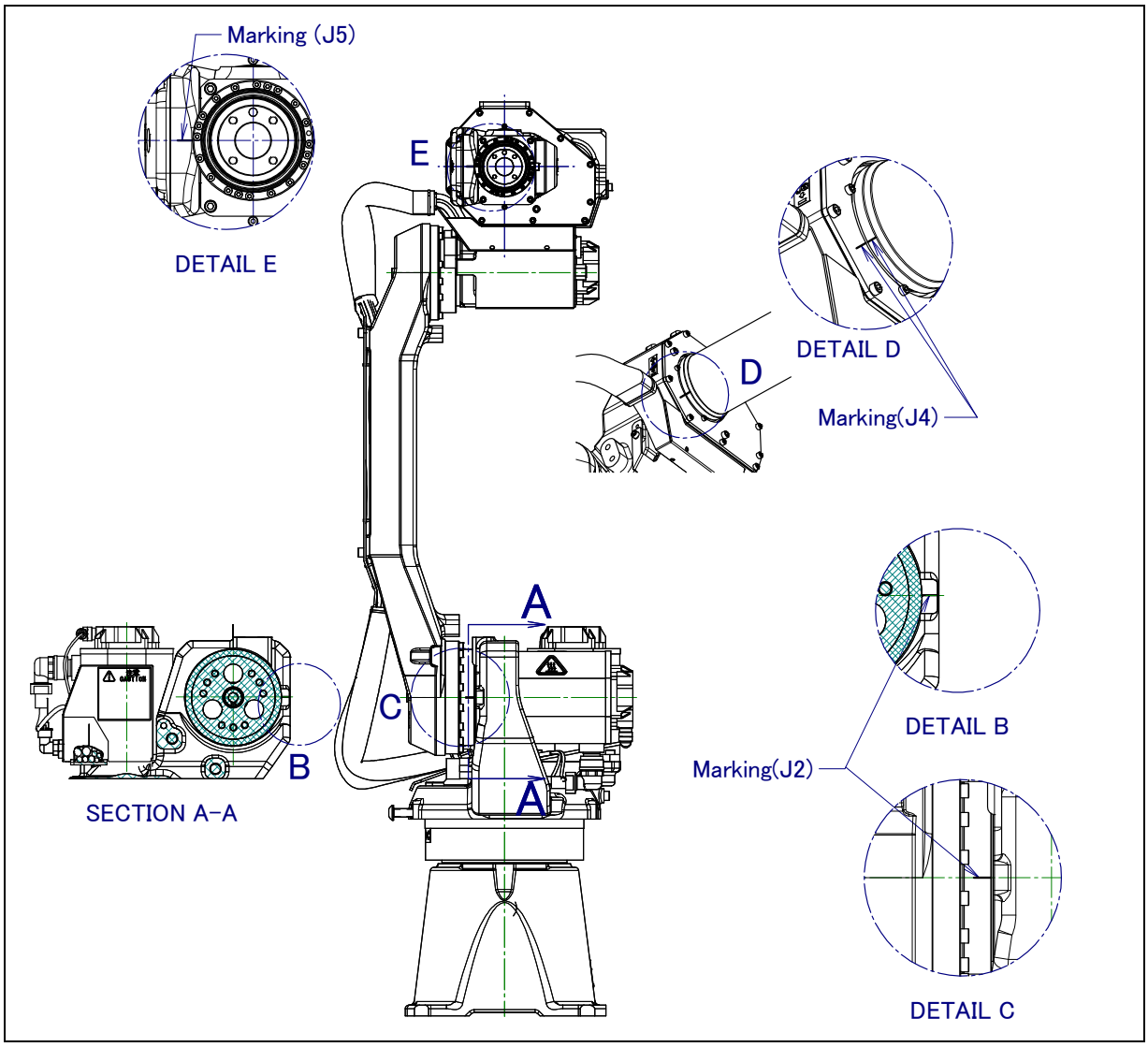


Fig. 9.3 (c) zero-position mark (witness mark) for each axis (M-10*i*A/10M/10MS)

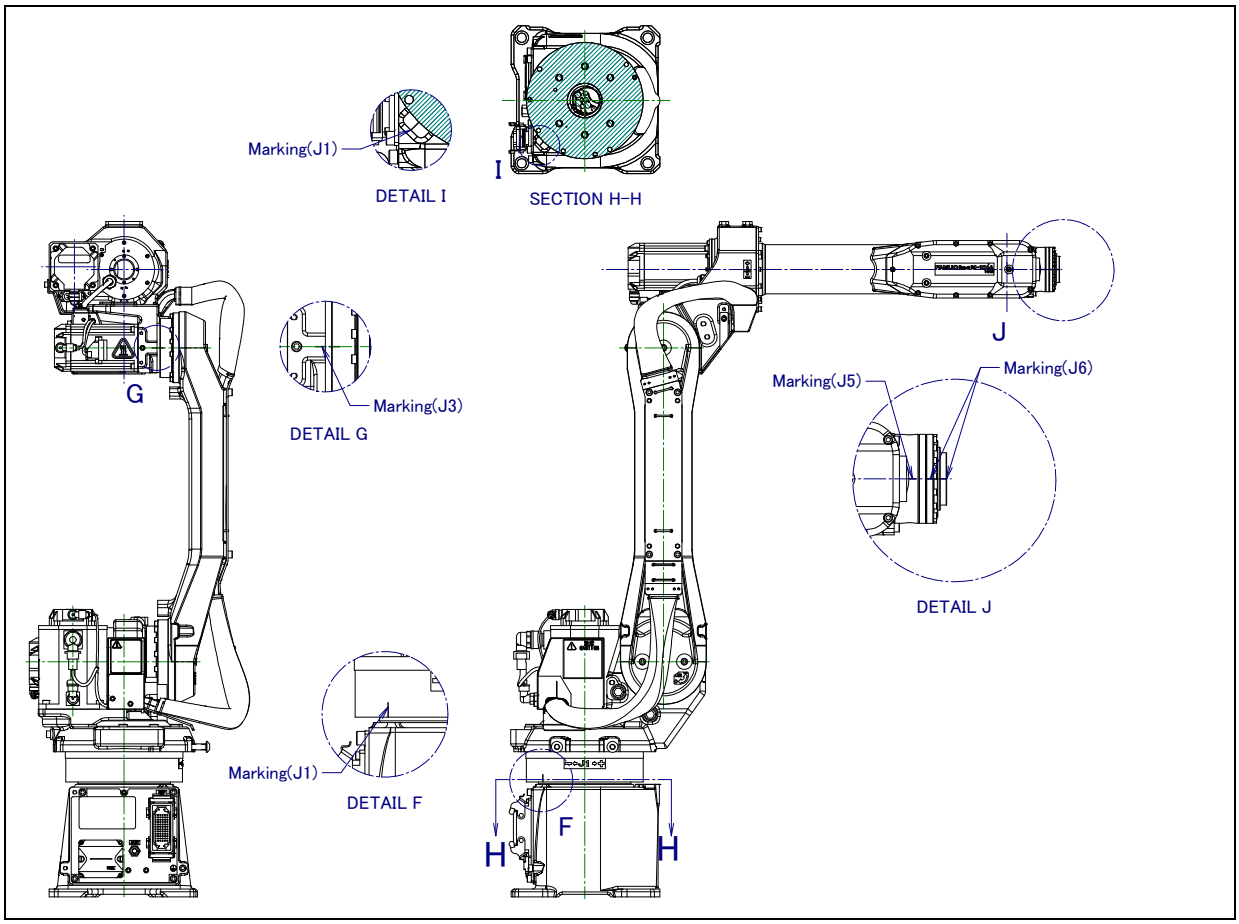


Fig. 9.3 (d) zero-position mark (witness mark) for each axis (M-10*i*A/10M/10MS)

9.4 QUICK MASTERING

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

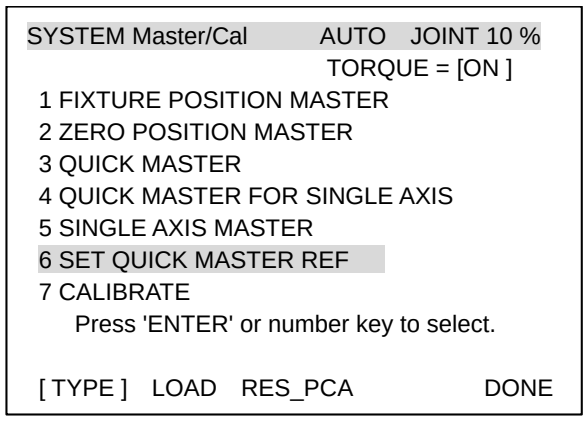
Quick mastering is factory-performed at the position indicated in Table 9.3. If possible, do not change the setting.

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

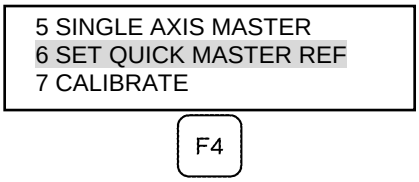
> ⚠ **CAUTION**
> 1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
> 2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot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

Procedure for Recording the Quick Mastering Reference Position

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



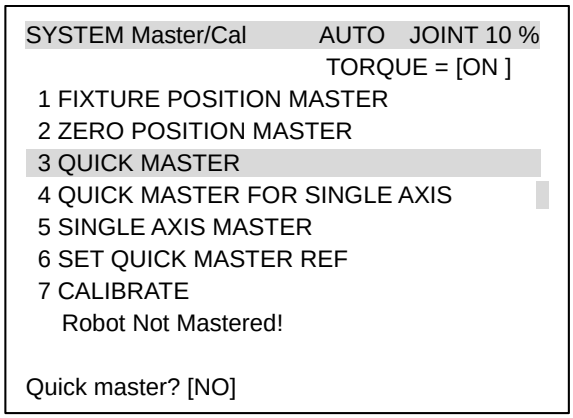
3 Release brake control, and jog the robot to the quick mastering reference position.
4 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position will be set.



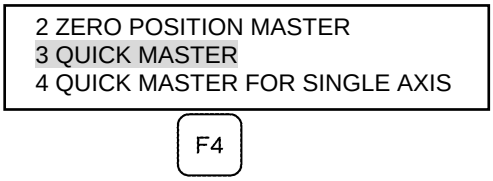
> ⚠ **CAUTION**
> If the robot has lost mastering data due to mechanical disassembly or repair, you cannot perform this procedure. In this case, perform Fixture position mastering or Zero position mastering to restore mastering data.

Procedure of Quick Mastering

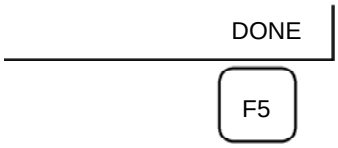
1 Display the Master/Cal screen.



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 the [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.

9.5 QUICK MASTERING FOR SINGLE AXIS

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

Quick mastering is factory-performed at the position indicated in Table 9.3. If possible, do not change the setting.

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

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

Procedure for 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 to restore mastering data.

Procedure of Quick Mastering for single axis

1 Display the Master/Cal screen.

```
SYSTEM Master/Cal          AUTO   JOINT 10 %
                                  TORQUE = [ON ]
 1 FIXTURE POSITION MASTER
 2 ZERO POSITION MASTER
 3 QUICK MASTER
 4 QUICK MASTER FOR SINGLE AXIS
 5 SINGLE AXIS MASTER
 6 SET QUICK MASTER REF
 7 CALIBRATE
   Robot Not Mastered!

Quick master? [NO]
```

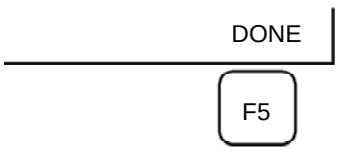
2 Select [4 QUICK MASTER FOR SINGLE AXIS]. The quick master for single axis screen will be displayed.

```
QUICK  MASTER  FOR  SINGLE  AXIS                AUTO
                                                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)        [2]
E1          0.000     (     0.000)   (0)        [2]
E2          0.000     (     0.000)   (0)        [2]
E3          0.000     (     0.000)   (0)        [2]

                                                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.

```
QUICK  MASTER  FOR  SINGLE  AXIS                AUTO
                                                1/9
    ACTUAL   POS     (MSTR POS)     (SEL)      [ST]
J5          0.000     (     0.000)   (1)        [2]
J6          0.000     (     0.000)   (1)        [2]

                                                EXEC
```

4 Turn off brake control, then jog the robot to the quick mastering reference position.
5 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2.
6 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.

9.6 SINGLE AXIS MASTERING

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

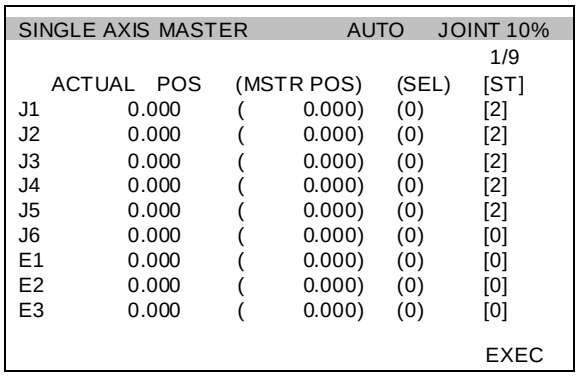
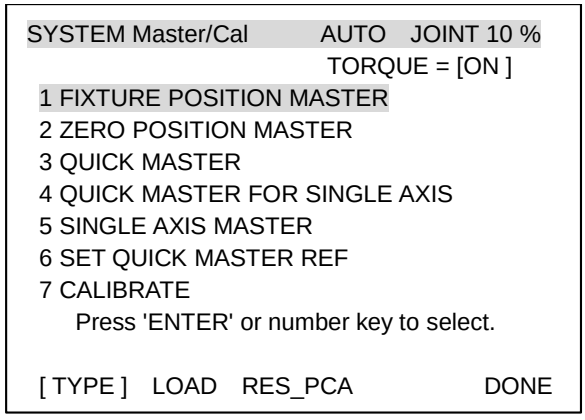


Table 9.6 Items set in single axis mastering

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].



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

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

                                            EXEC
```

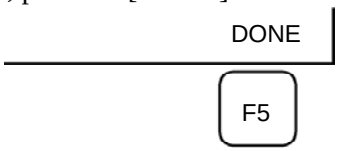
4 For the axis to which to perform single axis mastering, set (SEL) to "1." Setting of [SEL] is available for one or more axes.
5 Turn off brake control, then jog the robot to the mastering position.
6 Enter axis data for the mastering position.
7 Press F5 [EXEC]. Mastering is performed. So, [SEL] is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

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

                                            EXEC
```

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

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

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



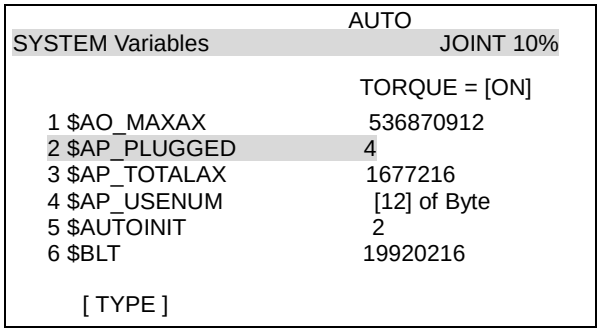
11 Return brake control to original setting, and cycle power of the controller.

9.7 MASTERING DATA ENTRY

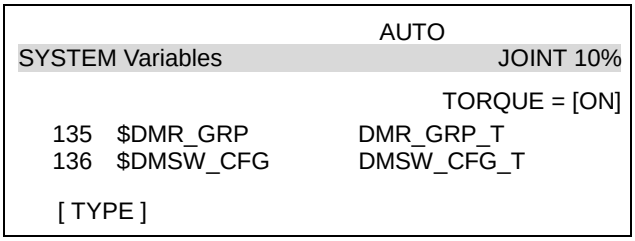
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

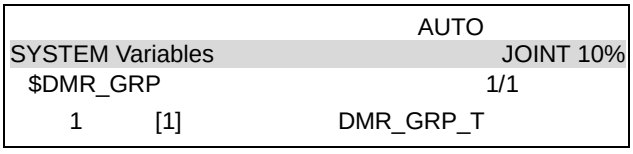
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen appears.

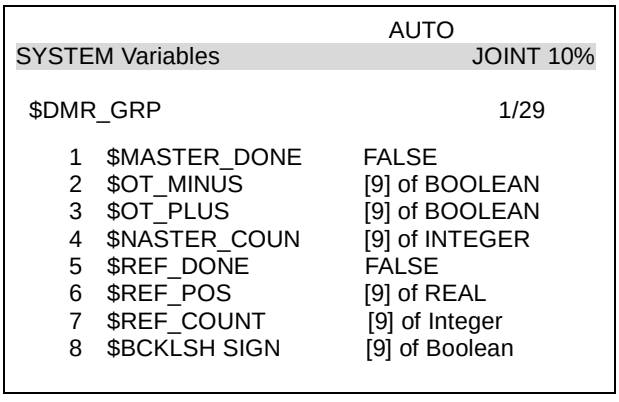


3 Change the mastering data. The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

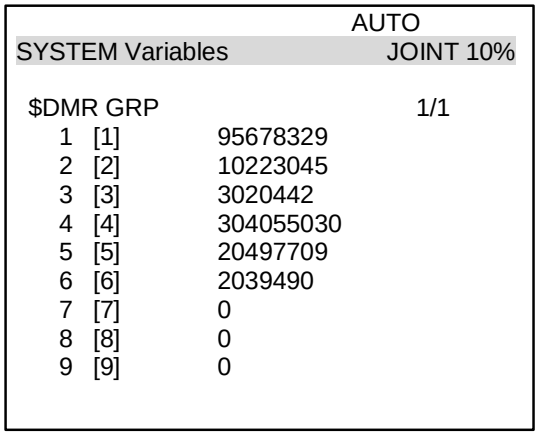


4 Select $DMR_GRP.

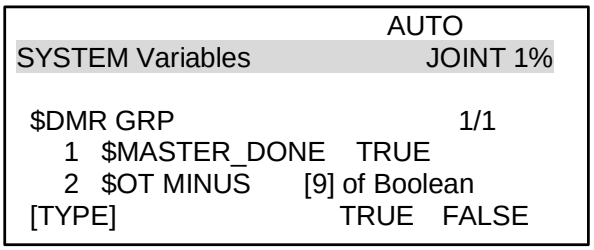




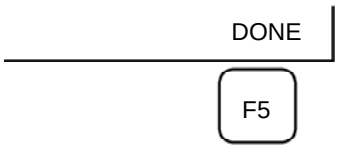
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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



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



9.8 VERIFYING MASTERING

1 How to verify that the robot is mastered properly:
Usually, positioning is performed automatically when the power is turned on. To check whether mastering has been performed correctly, examine if the current displayed position meets the actual robot position by using the procedure described below:
(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the zero-degree position marks indicated in Section 9.3 of OPERATOR'S MANUAL are aligned. There is no need to use a visual aid.

If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described in 9.2. 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 Alarm type displayed during mastering and their solution method:
(1) BZAL alarm
This alarm is displayed if the Pulsecoder's backup battery voltage decreases to 0 V while the power to the controller is disconnected. Furthermore, if the Pulsecoder connector is removed for cable replacement, etc. this alarm is displayed as the voltage decreases to 0. Confirm if the alarm will disappear by performing a pulse reset (See Section 9.2.). Then, cycle power of the controller to check if the alarm disappears or not.
The battery may be drained if the alarm is still displayed. Perform a pulse reset, and turn off and on the controller power after replacing the battery. Note that, if this alarm is displayed, all the original data held by the Pulsecoder will be lost. Mastering is required.
(2) BLAL alarm
This alarm is displayed if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is displayed, replace the battery with a new one immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
(3) Alarm notification like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may have trouble with Pulsecoder, contact your local FANUC representative.

10 TROUBLESHOOTING

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

10.1 TROUBLESHOOTING

Table 10.1 (a) shows the problems that may occur in the mechanical unit and their probable causes. If you cannot pinpoint the cause of a failure or which measures to take, contact your local FANUC representative.

Table 10.1 (a) Problems and causes and measures

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

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- Vibration was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating axis has not been exchanged for a long period. - There is vibration or unusual sound just after replacing grease or oil or parts. - Cyclical vibration and noise occur.	[Gear, bearing, or reducer] - It is likely that collision or overload applied an excessive force on the drive mechanism, thus damaging the tooth surface or rolling contact surface of a bearing, or reducer. - It is likely that prolonged use of the robot while overloaded caused fretting of the tooth surface or rolling contact surface of a bearing, or reducer due to resulting metal fatigue. - It is likely that foreign material which was caught in a gear, bearing, or within a reducer caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that foreign material which was caught in a gear, bearing, or within a reducer cause vibration. - It is likely that, because the grease has not been changed for a long period, fretting occurred on the tooth surface or rolling contact surface of a bearing, or reducer due to metal fatigue. - There is a possibility of Grease or oil has not been exchanged accurately. The amount of grease or oil may be insufficient.	- Operate one axis at a time to determine which axis is vibrating. - Confirm the oil side of the oil sight glass of J4 to J6 axis. Replenish oil when the oil side has not reached above the half. - 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 changing the grease with a specified type can help prevent problems. - If vibration can no be removed by replacing grease or oil, Perform running before replacing grease or oil, then it may be improved.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical section.	[Controller, cable, and motor] - If a failure occurs in a controller circuit, preventing control commands from being supplied to the motor normally, or preventing motor information from being sent to the controller normally, vibration might occur. - Pulsecoder defect may be the cause of the vibration as the motor cannot propagate the accurate position to the controller. - If the motor becomes defective, vibration might occur because the motor cannot deliver its rated performance. - If a power line in a movable cable of the mechanical unit has an intermittent break, vibration might occur because the motor cannot accurately respond to commands. - If a Pulsecoder wire in a movable part of the mechanical unit has an intermittent break, vibration might occur because commands cannot be sent to the motor accurately. - If a connection cable between the mechanical unit and the controller has an intermittent break, vibration might occur. - If the power supply cable is about to be snapped, vibration might occur. - If the power source voltage drops below the rating, vibration might occur. - It may vibrate when the invalid value parameter was set.	- Refer to the Controller Maintenance Manual for troubleshooting related to the controller and amplifier. - Replace the motor of the axis that is vibrating, and check whether vibration still occurs. For the method of replacement, contact your local FANUC representative. - If vibration occurs only when the robot assumes a specific posture, it is likely that a cable in the mechanical unit is broken. - Shake the movable part cable while the robot is at rest, and check whether an alarm occurs. If an alarm or any other abnormal condition occurs, replace the mechanical unit cable. - Check whether the cable jacket connecting the mechanical unit and controller is damaged. If so, replace the connection cable, and check whether vibration still occurs. - Check whether the power cable jacket is damaged. If so, replace the power cable, and check whether vibration still occurs. - Check that the robot is supplied with the rated voltage. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct them. Contact 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.
	- There is an unusual sound after replacement of grease. - There is an unusual sound after a long period. - There is an unusual sound during operation at low speed.	- There may be an unusual sound when using other than the specified grease. - Even for the specified grease, there may be an unusual sound during operation at low speed immediately after replacement or after a long period.	- Use the specified grease. - When there is an unusual sound even for specified grease, perform operation for one or two days on an experiment. Generally, an usual sound will disappear.
	- There is an unusual sound when operating right immediately the replacing part, grease or oil.	- There is a possibility of Grease or oil has not been exchanged accurately. The amount of grease or oil may be insufficient.	- Stop the robot, and confirm the damage situation at once. Replenish grease or oil when they are insufficient.
	- The movement speed of robot is not constant	- Sludge may be generated by the deterioration of the oil, and it may be attached to bearing etc.	- Perform running and destroy the sludge. Then replace oil.
Rattling	- While the robot is not supplied with power, pushing it with the hand causes part of the mechanical unit to wobble. - There is a gap on the mounting face of the mechanical unit.	[Mechanical section coupling bolt] - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical section.	- Check that the following bolts for each axis are tight. If any of these bolts is loose, apply LOCTITE and tighten it to the appropriate torque. - Motor retaining bolt - Reducer retaining bolt - Reducer shaft retaining bolt - Base retaining bolt - Arm retaining bolt - Casting retaining bolt - End effector retaining bolt

Symptom	Description	Cause	Measure
Motor overheating	- The ambient temperature of the installation location increases, causing the motor to overheat. - After a cover was attached to the motor, the motor overheated. - After 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. - Having the surroundings of the motor well ventilated enables the motor to release heat efficiently, thus preventing overheating. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is effective to reduce the average current. Thus, prevent overheating. - The teach pendant can monitor the average current. Check the average current when the robot control program launched.
	- After a 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 4.3.
	- Symptom other than stated above	[Mechanical section problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor running with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor.	- Repair the mechanical unit while referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - If the average current falls after the motor is replaced, it indicates that the first motor was faulty.

Symptom	Description	Cause	Measure
Grease leakage Oil leakage	- Grease or oil is leaking from the mechanical unit.	[Poor sealing] - Probable causes are a crack in the casting, a broken O-ring, a damaged oil seal, or a loose seal bolt. - A crack in a casting can occur due to excessive force that might be caused in collision. - An O-ring can be damaged if it is trapped or cut during disassembling or re-assembling. - An oil seal might be damaged if extraneous dust scratches the lip of the oil seal. - A loose seal bolt or a taper plug might allow grease to leak along the threads.	- If a crack develops in the casting, sealant can be used as a quick-fix to prevent further grease or oil leakage. However, the component should be replaced as soon as possible, because the crack might enlarge. - O-rings are used in the locations listed below. - Motor coupling section - Reducer (case and shaft) coupling section - Wrist connection section - J3 arm coupling section - Inside the wrist - Oil seals are used in the locations stated below. - Inside the reducer - Inside the wrist - Seal bolts and taper plugs are used in the locations stated below. - Grease inlet or outlet - Oil inlet or outlet - Cover fixation
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 reenergized. - It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently. - It is likely that oil or grease has entered the motor, causing the brake to slip. - In case of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L brake is not installed for J1/J4/J5/J6-axes. In case of J4/J5/J6-axes If you turn off the controller power at wait position, robot may move greatly by weight or exceeds stroke limit depend on the posture of robot or wrist load condition. Adjust the wait position so that axis does not move greatly when controller power is turned off.	- Check whether the brake drive relay contacts are stuck to each other. If they are found to be stuck, replace the relay. - Replace the motor confirmed following symptoms. - Brake shoe is worn out - Brake main body is damaged - Oil soak through the motor - J4-axis cable has movable part .So if robot exceeds stroke limit, load depends on cable and it may damage the f cables. If the robot exceeds the stroke limit, remove the plate on the back of J4, and return axis to motion range during checking condition of cables. If cable tie is cut, attach new articles. If you operate the robot with a cut cable tie, it will damage the cables. (See Section 9.1).

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 or the Pulsecoder.
	- 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 teach pendant 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.

Table 10.1 (b) Allowable drops

At power off	5mm
At emergency stop	5mm

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

10.2 CHANGE THE COLLISION DETECTION PARAMETER

The collision detection parameter is coordinated beforehand for every robot. You can usually use it in the state at the time of shipment if load setting is right. We recommend the use in the state of the standard setting as much as possible. When it is necessary to lower the sensitivity of the collision detection, you can change it to be hard to false detection a collision detection parameter by carrying out the following KAREL programs.

ARC Mate 100*i*C 3kg payload specification
- hi03m61c.pc (A05B-1221-B201)
- hi03mtcc.pc (A05B-1221-B401)

ARC Mate 100*i*C/6L 3kg payload specification
- hi03m66l.pc (A05B-1221-B301)
- hi03m66c.pc (A05B-1221-B501)

ARC Mate 100*i*C/10S 3kg payload specification
- hi03m61s.pc

M-10*i*A 10kg payload specification
- highm61c.pc (A05B-1221-B202)
- highmtcc.pc (A05B-1221-B402)

M-10*i*A/6L 6kg payload specification
- highm66l.pc (A05B-1221-B302)
- highm66c.pc (A05B-1221-B502)

M-10*i*A/10S 10kg payload specification
- highm6ls.pc

If you want to return it to an original parameter, execute KAREL program below.
ARC Mate 100*i*C 3kg payload specification
- no03m61c.pc (A05B-1221-B201)
- no03mtcc.pc (A05B-1221-B401)

ARC Mate 100*i*C/6L 3kg payload specification
- no03m66l.pc (A05B-1221-B301)
- no03m66c.pc (A05B-1221-B501)

ARC Mate 100*i*C/10S 3kg payload specification
- no03m61s.pc

M-10*i*A 10kg payload specification
- normm61c.pc (A05B-1221-B202)
- normmtcc.pc (A05B-1221-B402)

M-10*i*A/6L 6kg payload specification
- normm66l.pc (A05B-1221-B302)
- normm66c.pc (A05B-1221-B502)

M-10*i*A/10S 10kg payload specification
- normm6ls.pc

Practice method of KAREL program is same to KAREL for changing wrist payload specification , so refer to Section 4.4.
In the case of a following software version, these are applied.

In case of ARC Mate 100*i*C, ARC Mate 100*i*C/6L, ARC Mate 100*i*C/10S
V7.30P/36 or later, V7.40P/20 or later, V7.50P/13 or later, V7.70P/05 or later

In case of M-10*i*A, M-10*i*A/6L, M-10*i*A/10S
V7.30P/36 or later, V7.40P/20 or later, V7.50P/12 or later, V7.70P/05 or later

11 M/H CONDUIT (OPTION)

11.1 NOTES FOR ASSEMBLING CABLES TO M/H CONDUIT

(1) M/H conduit is option to protect hand cable etc. You can prevent cables interference with arm directly by installing this and can postpone life of cables. Instead conduit is expendable supplies, so replace it regularly.

(2) The cable is recommended to be clamped at a position 70mm or more away for the wrist side. A position 30mm or more away is recommended for the J3 back side. In case of M-10*i*A and M-10*i*A/10S adjust the length of the cable between clamping to 785±5mm. In case of M-10*i*A/6L, adjust the length of the cable between clamping to 1005±5mm. Please absorb extra length to Conduit. If cables are not clamped, cable and conduit may break. Be sure to clamp cables.

(3) Apply shell Alvania grease S2 to the surface of cables and air tubes inside the conduit to prevent cables and air tubes from damage. If grease is not applied, it causes early damage of cables and conduit.

Table 11.1 Recommended cables and air tube

Cable name	Maker	Spec of FANUC	Specifications
End effector cable	Oki cable co. Ltd	A66L-0001-0459	0.2mm^2 24-core Cable for moving part
Signal line 3DV sensor cable	Oki cable co. Ltd	A66L-0001-0464#1	0.2mm^2 2-core 4 pairs (8-core) Cable for moving part
Power line	Oki cable co. Ltd	A66L-0001-0401#10	1.25mm^2 10-core Cable for moving part
Force sensor cable	Okano cable co. Ltd	A66L-0001-0178#03P	0.3mm^2 2-core 3 pairs (6-core) Cable for moving part
3DV sensor camera cable	Hitachi cable co. Ltd	A66L-0001-0525	0.26mm^2 4-core 0.13mm^2 2-core 0.08mm^2 2-core Cable for moving part
LED lighting cable	Hitachi cable co. Ltd	A66L-0001-0143	0.2mm^2 6-core Cable for moving part
Air tube	SMC	A97L-0218-0010	TU0604 (Outside diameter=ϕ 6mm, Inside diameter=ϕ 4mm)

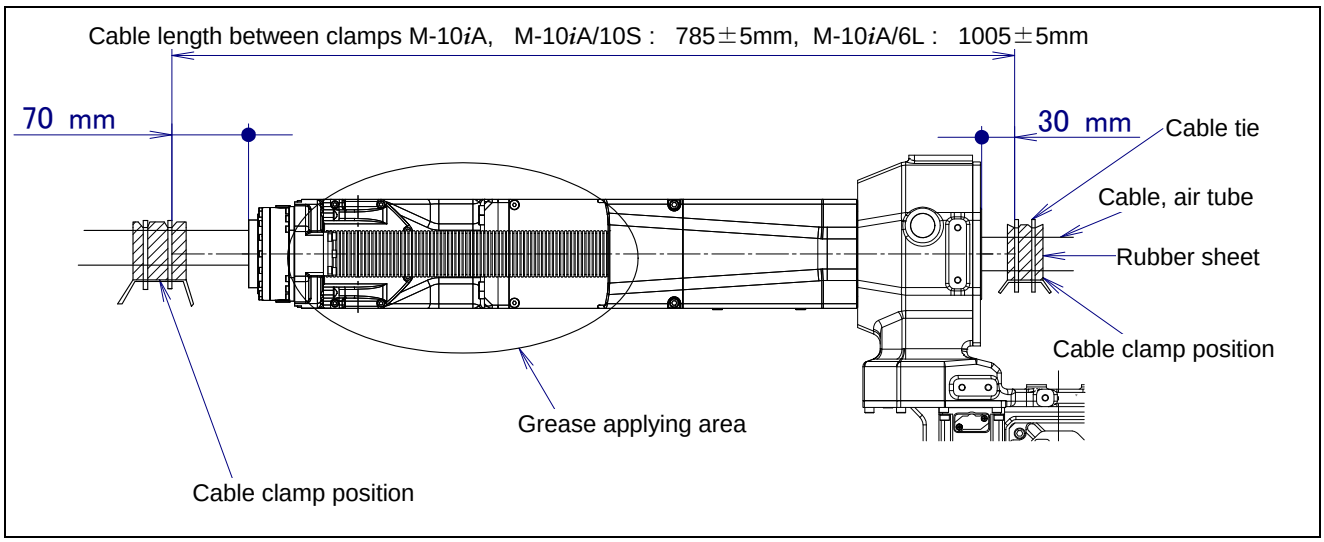


Fig. 11.1 (a) Cable length between clamp

(4) Please make sure that all cables form a bunch 30mm or less in diameter as shown in the figure so that the cables do not rub at the edge of the J6 hollow flange. If filling degree exceed the recommended value, it causes premature failure of cables and the conduit.

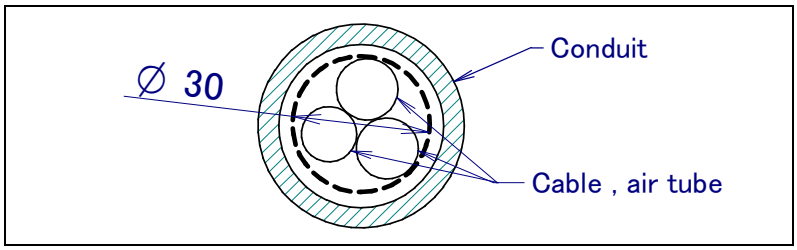


Fig. 11.1 (b) Diameter of cable and air tube in conduit

(5) It is recommended to install a protect ring, if necessary, so that neither cables nor the bolt attached to the J6 midair flange may interfere.
(6) Please roll cables in the rubber seat etc. so as not to damage the surfaces of the cables by the edge of the cable tie, and bind them with a cable tie.

11.2 WRIST CABLE KIT

Cable kits which include M/H conduit, cables and air tube between J4 connector panel to hand (recommend by FANUC) are prepared as options. When assembling them, refer to Fig. 11.2 (a), (b).
When these options are specified, these wrist cable kits are added to the normal M/H conduit when they are shipped.

Table 11.2 (a) Wrist cable kit (1/2)

Model	Name	Specification	Constitution
M-10*i*A M-10*i*A/10S	Wrist cable usable to the force sensor	A05B-1221-J737	M/H conduit, Force sensor wrist cable End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	Wrist cable usable to the 3-axes force sensor	A05B-1221-J747	M/H conduit, Force sensor wrist cable End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	Wrist cable usable to the 3DL sensor	A05B-1221-J752	M/H conduit, 3DL sensor wrist cable End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	Wrist cable usable to the 3DL sensor and force sensor	A05B-1221-J758	M/H conduit, Force sensor wrist cable 3DL sensor wrist cable End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	Wrist cable usable to the 2D vision	A05B-1221-J754	M/H conduit, Camera wrist cable. End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	EE wrist cable	A05B-1221-J735	M/H conduit, End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4

Table 11.2 (b) Wrist cable kit (2/2)

Model	Name	Specification	Constitution
M-10*i*A/6L	Wrist cable usable to the force sensor	A05B-1221-J767	M/H conduit, Force sensor wrist cable End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	Wrist cable usable to the 3DL sensor	A05B-1221-J782	M/H conduit, 3DL sensor wrist cable End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	Wrist cable usable to the 3DL sensor and force sensor	A05B-1221-J788	M/H conduit, Force sensor wrist cable 3DL sensor wrist cable End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	Wrist cable usable to the 2D vision	A05B-1221-J784	M/H conduit, Camera wrist cable. End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4
	EE wrist cable	A05B-1221-J765	M/H conduit, End effector wrist cable (RI/RO for each 8 points), Air ϕ 6 x 4

NOTE
Refer to Section 11.1 about clamp position near J4/J6 holes exist, lengths between cable clamp and notes.

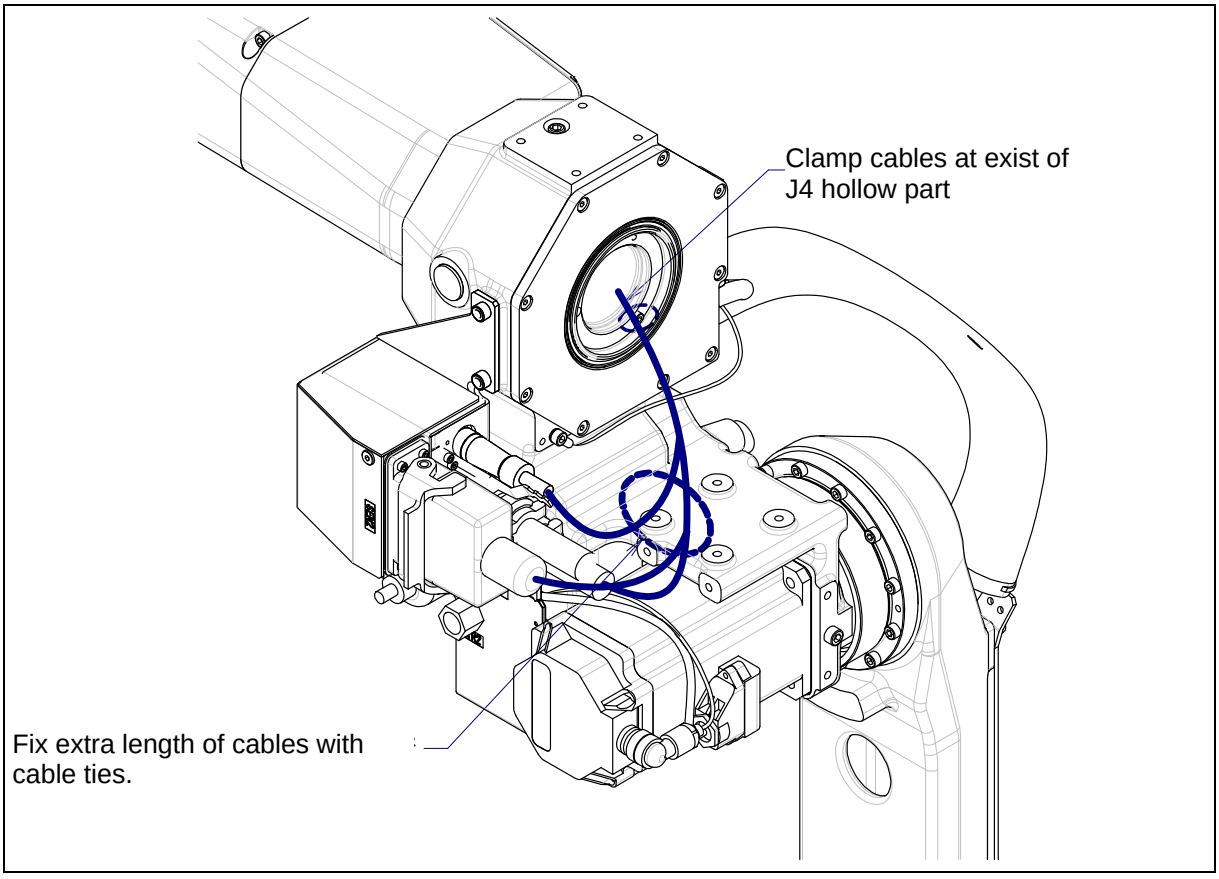


Fig. 11.2 (a) Cabling around J3 casing

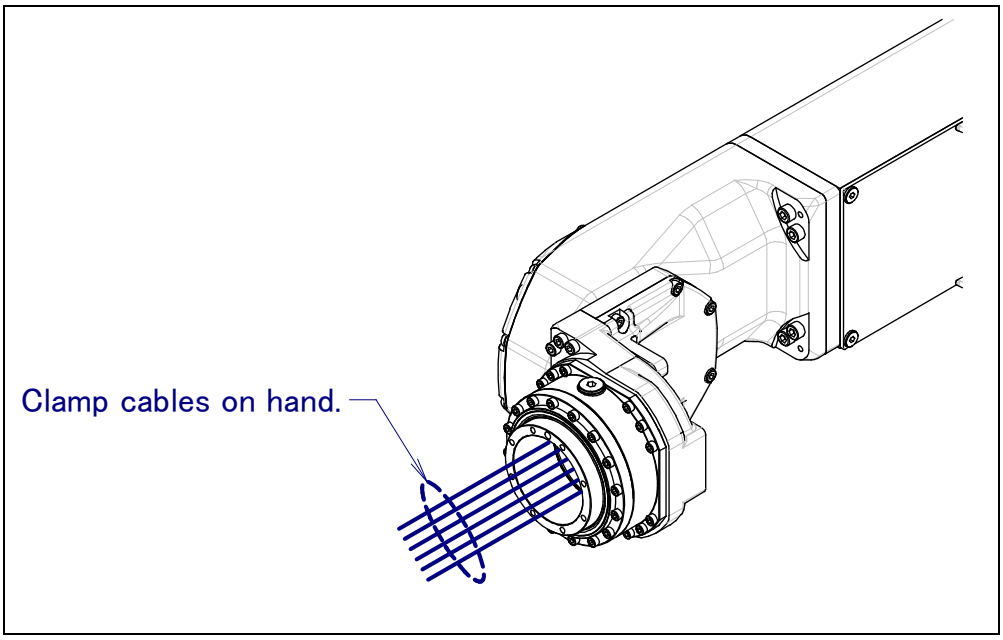


Fig. 11.2 (b) Cabling around wrist

When you set solenoid valve to J3 casing, use EE wrist cable relay kit (specification: A05B-1221-J736).

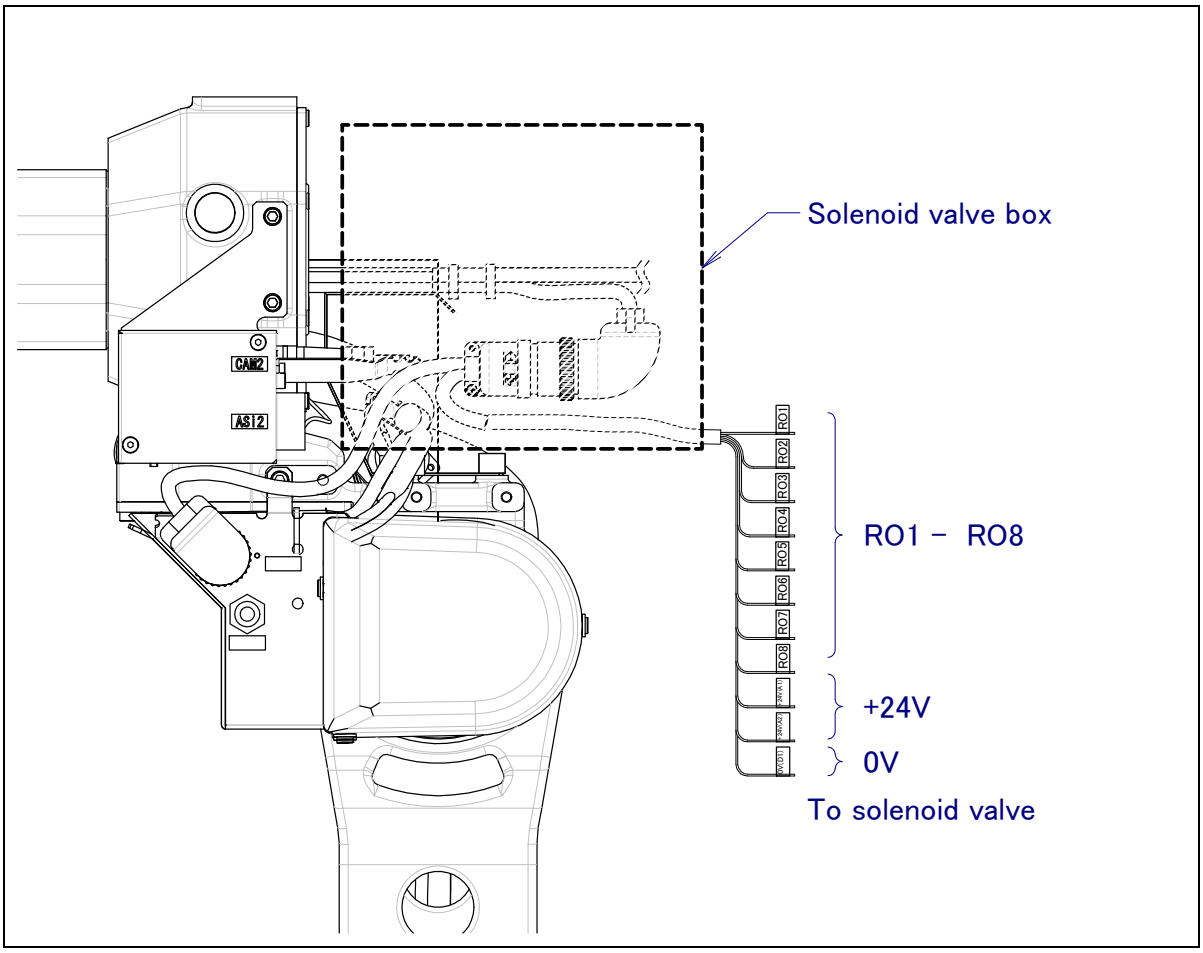


Fig. 11.2 (c) End effector wrist cable relay kit

11.3 OTHER NOTES

(1) When M/H conduit is installed, limiting J6 axis range of motion to ±190° is recommended. Cable life shortens when the range exceeds ±190° though it is possible to use a range of motion more than this (maximum ±270°).

Table 11.3 Regular exchange cycle

	Exchange cycle
J5-axis:±140°	Cycle that is shorter among 1.2 million cycles (As one cycle every 30 seconds) and 2 years
J6-axis:±190°	

> ⚠ **CAUTION**
> Please note that it is a standard at the exchange cycle when the cable wire rod and the air tube of the FANUC recommendation are used. If cable is not clamped or grease is not applied or filling degree of cable in conduit is over or robot is operated with fluoric resin ring is broken, it causes early damage of cables and conduit.

(2) Please examine the structure that the cutting powder etc. do not invade in Conduit when you specify M/H conduit and severe dust/liquid protection option simultaneously.

(3) Fluoric resin ring is installed to J6 hollow part and white powder is generated to reduce friction of rotation. This is not trouble. Fluoric resin ring is expendable supplies. (Spec:A290-7221-X571) Two years are aims in an exchange period. If you operate robot with the state that hard mine dust is attached to rotated part, exchange period may shortens. If robot is operated with fluoric resin rig is broken, it causes early damage of conduit.

12 NO DUST M/H CONDUIT (OPTION)

(1) NO DUST M/H conduit is option to protect hand cable etc. You can prevent cables interference with arm directly by installing this and can postpone life of cables. Instead conduit is expendable supplies replace it regularly.

(2) Please prepare rubber bush as figure below. Please make thickness between wrist flange and tip of rubber bush is 9mm, thickness of rubber bush is 6mm. In case of J3 casing side, please make thickness between back of J3 casing and tip of rubber bush is 11.4mm and thickness of rubber bush is 6mm.Make length of cable between rubber bush is 721±5mm(in case of M-10*i*A and M-10*i*A/10S) or 941±5mm (in case of M-10*i*A/6L) and absorb extra length to Conduit. If cables are not clamped, it cause broken of cable and conduit, be sure to clamp cables.

(3) The longevity of the cable improves by spreading grease on the surface of the cable in Conduit. Alvania grease S2 is recommended. In this case, please use the cable with performance that can endure oil. If grease is not applied, it causes early damage of cables and conduit.

(4) Confirm there is no gap in slit part of rubber bush. When there is a gap, clean degree turn worse. Please be careful.

Table 12 Recommended cables and air tube

Cable name	Maker	Spec of FANUC	Specifications
End effector cable	Oki cable co. Ltd	A66L-0001-0459	0.2mm^2 24-core Cable for moving part
Signal line 3DV sensor cable	Oki cable co. Ltd	A66L-0001-0464#1	0.2mm^2 2-core 4 pairs (8-core) Cable for moving part
Power line	Oki cable co. Ltd	A66L-0001-0401#10	1.25mm^2 10-core Cable for moving part
Force sensor cable	Okano cable co. Ltd	A66L-0001-0178#03P	0.3mm^2 2-core 3 pairs (6-core) Cable for moving part
3DV sensor camera cable	Hitachi cable co. Ltd	A66L-0001-0525	0.26mm^2 4-core 0.13mm^2 2-core 0.08mm^2 2-core Cable for moving part
LED lighting cable	Hitachi cable co. Ltd	A66L-0001-0143	0.2mm^2 6-core Cable for moving part
Air tube	SMC	A97L-0218-0010	TU0604 (Outside diameter=ϕ 6mm, Inside diameter=ϕ 4mm)

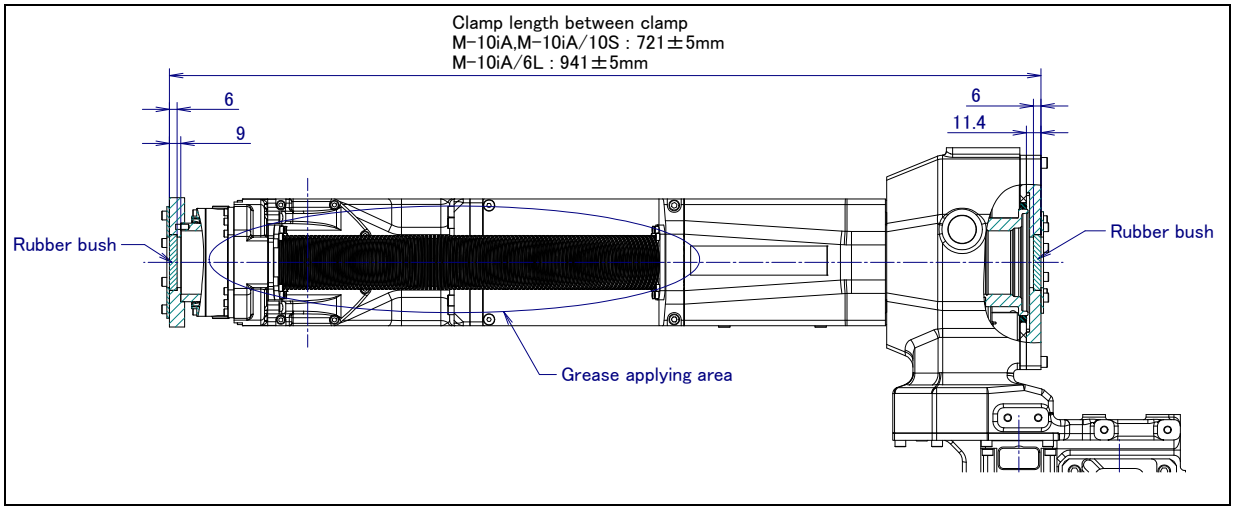


Fig. 12 (a) Cable length between clamp

(5) Please install circumscription yen of bunches of cables on 30mm or less as shown in figure so that cables should not rub at the edge of the J6 hollow flange. If filling degree is over, it causes early damage of cables and conduit.

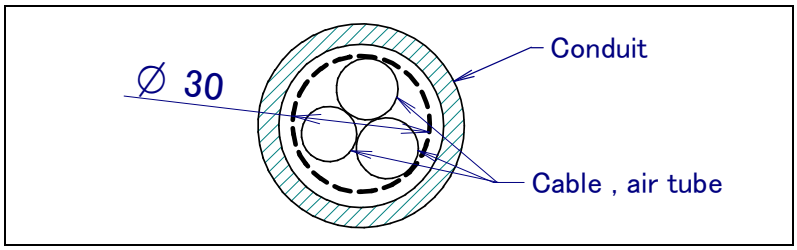


Fig. 12 (b) Diameter of cable and air tube in conduit

(6) Refer to figure below about shape of rubber bush and structure of cables in conduit.

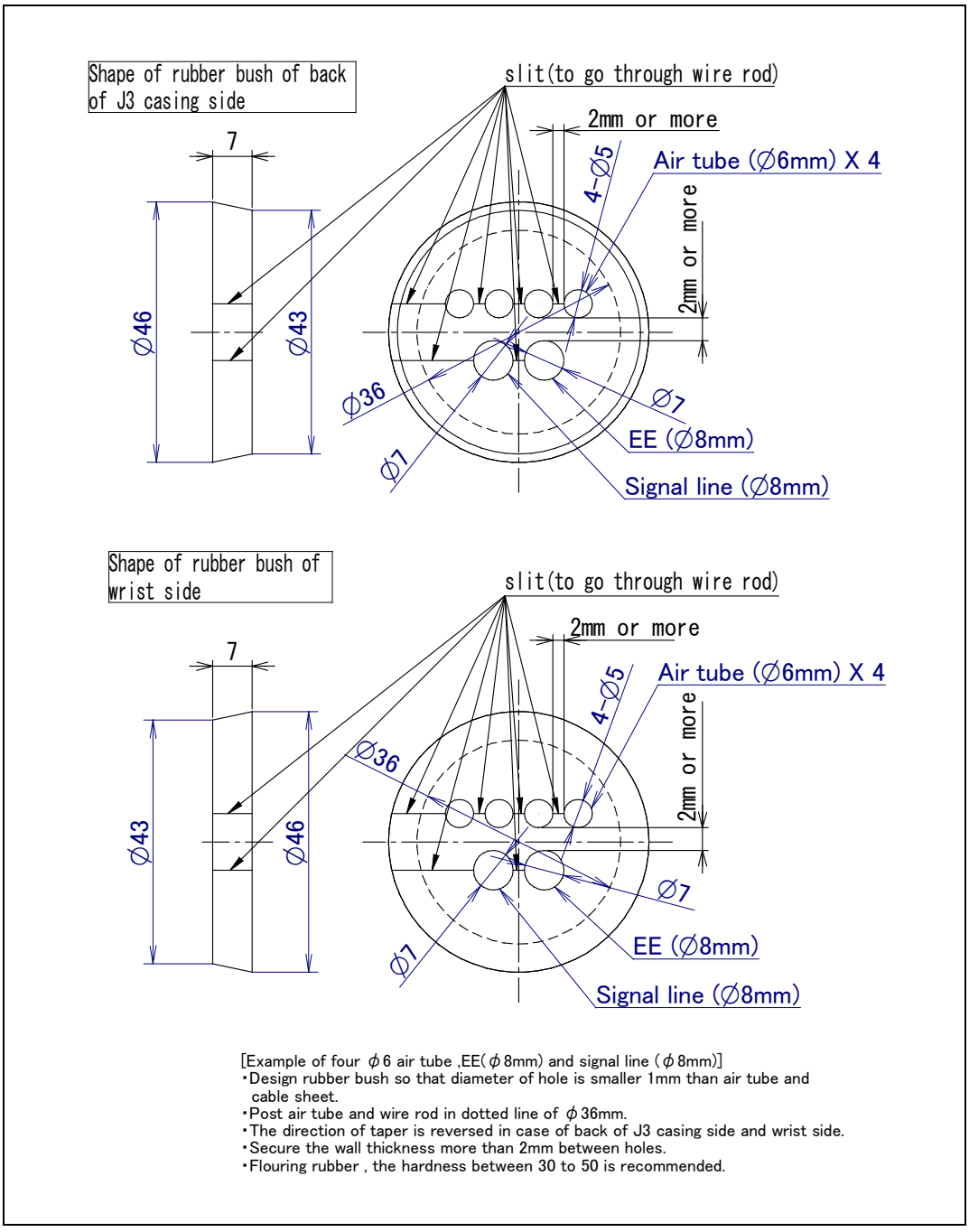


Fig. 12 (c) Shape of rubber bush (example)

(7) Refer to figure below about structure of seal of back of J3 casing.

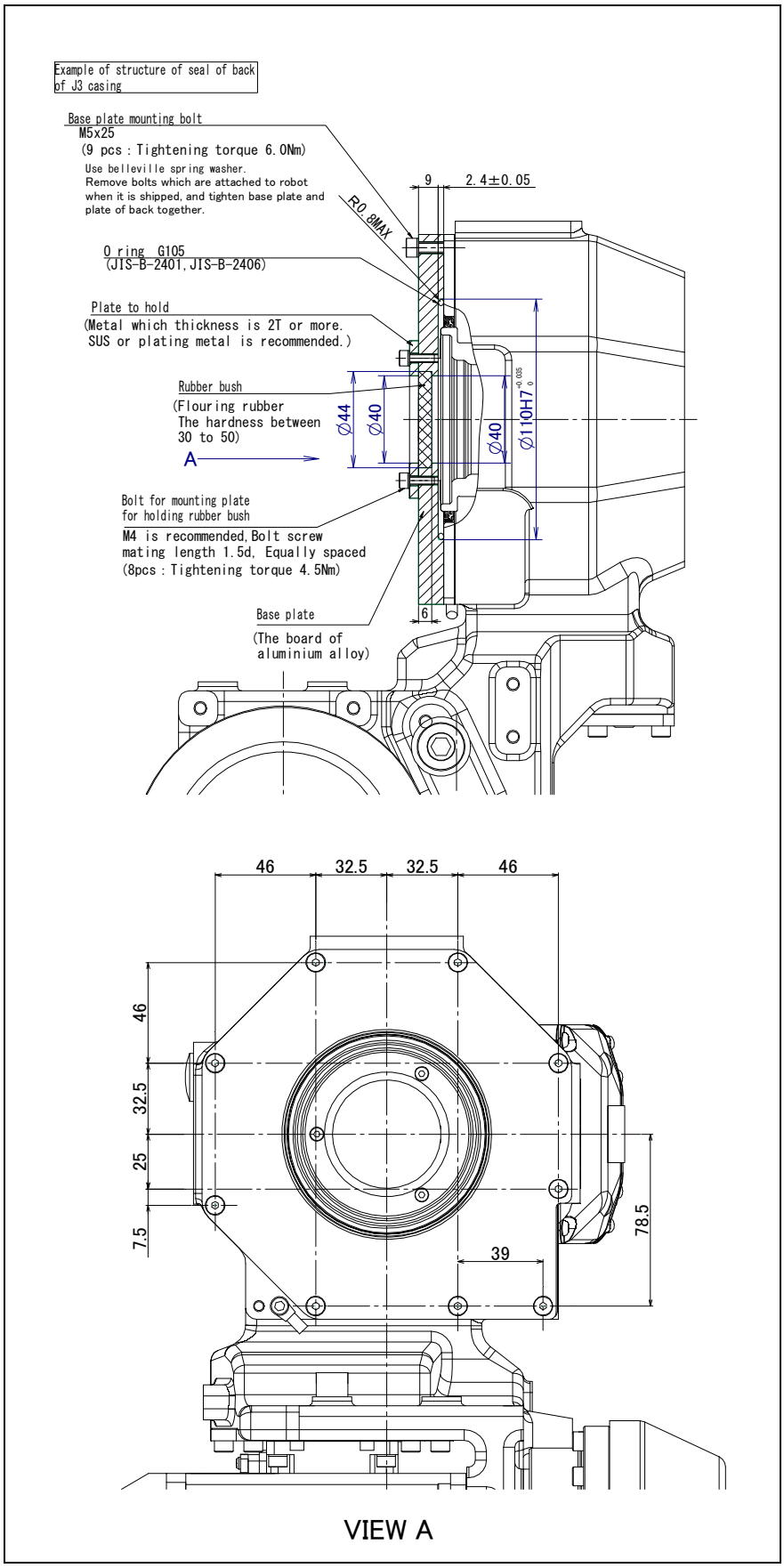


Fig. 12 (d) Structure of seal of back of J3 casing (example)

(8) Refer to figure below about structure of seal of wrist. If wrist is not sealed, dust come from hollow hole. Be sure to seal wrist.

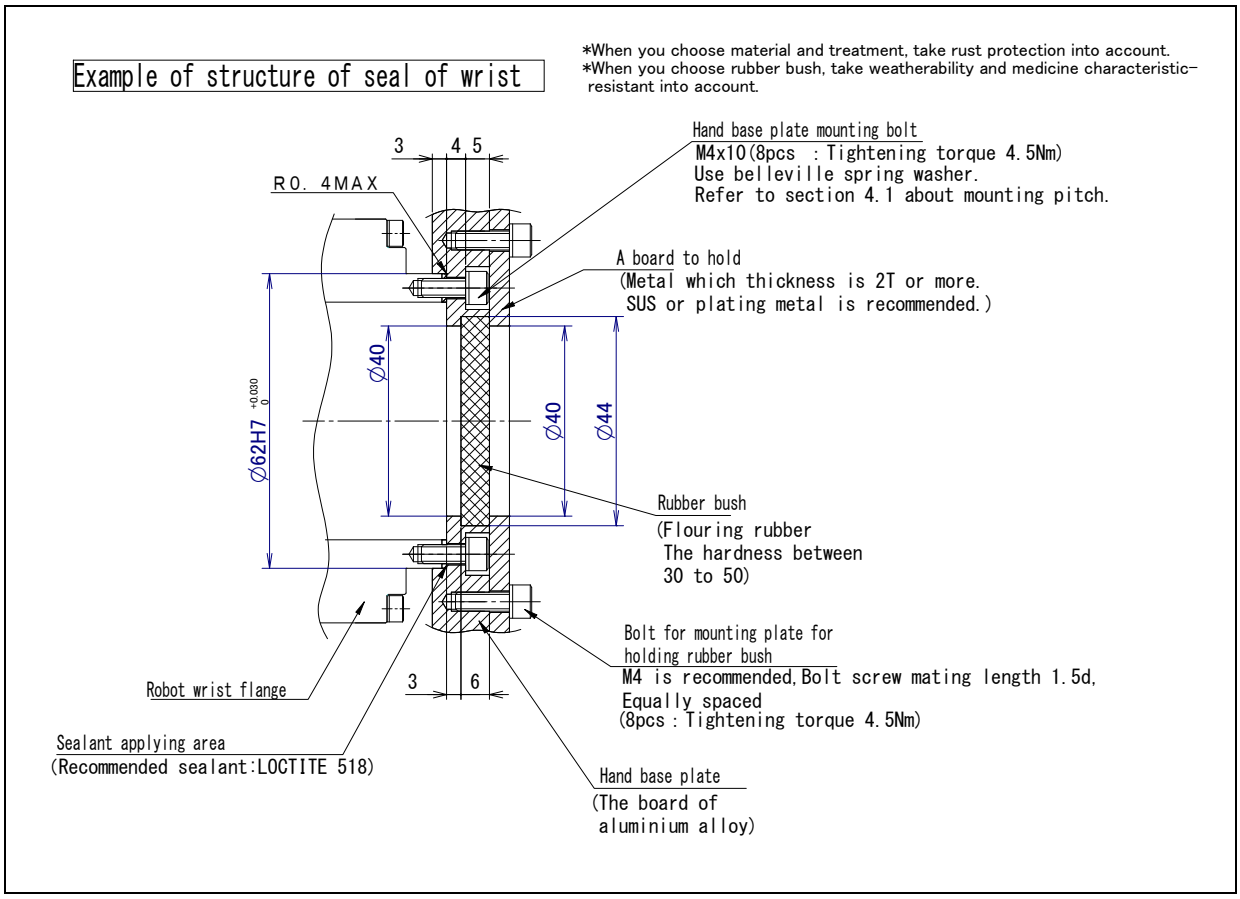


Fig. 12 (e) Structure of seal of wrist (example)

(9) When No dust M/H conduit is installed, use by the range limitation of J6 axis range of motion ±190° is recommended. The longevities of cables shortens when using it exceeding ±190° though it is possible to use even in range of motion more than this (maximum ±270°).
For J5-axis use it motion range in ±120°. If J5-axis move more than ±120°, it cause break of conduit, be careful.

> **⚠ CAUTION**
> If cable is not clamped or grease is not applied or filling degree of cable in conduit is over, it causes early damage of cables and conduit.

(10) Specification is ISO class 5 (equal to clean class 100).

13 TIG WELDING OPTION

When TIG welding option is specified, install Noise shield plate as below. (It is attached when robot is shipped.)

Fix the plate (A290-7221-X265) with the J1 connector panel. Peel the cable Jacket of the Pulsecoder cable at the clamp position, and fix Pulsecoder Cable with the cable clamp (A99L-0035-0003).

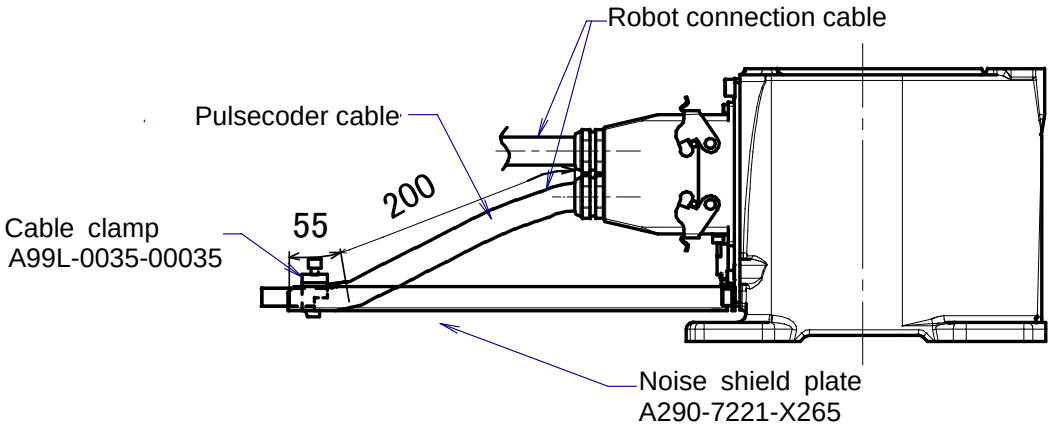


Fig. 13 Attaching of noise shield plate

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L, ARC Mate 100*i*C/10S, M-10*i*A/10S, ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L Periodic Maintenance Table

Items			Check time	Oil Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check the external damage or peeling paint	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protective sleeves	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	3	Check for water	0.1H	-		○	○	○	○	○	○	○	○	○	○	○
	4	Check the mechanical cable and welding cable (Damaged or twisted)	0.2H	-		○			○				○			
	5	Check looseness of each axis motor and other exposed connector	0.2H	-		○			○				○			
	6	Tighten the end effector bolt.	0.2H	-		○			○				○			
	7	Tighten the cover and main bolt.	2.0H	-		○			○				○			
	8	Check the mechanical stopper and adjustable mechanical stopper	0.1H	-		○			○				○			
	9	Remove spatter and dust etc.	1.0H	-		○			○				○			
	10	Check the end effector (hand) cable	0.1H			○			○				○			
	11	Check the oil sight glass of J4 to J6 axis	0.1H	-	○	○	○	○	○	○	○	○	○	○	○	○
	12	Replacing battery. *1	0.1H	-					●				●			
		Replacing battery. *2	0.1H	-							●					
	13	Replacing grease of J1-axis reducer	0.5H	870ml												
	14	Replacing grease of J2-axis reducer	0.5H	330ml												
	15	Replacing grease of J3-axis reducer	0.5H	190ml												
	16	Replacing oil of J4-axis Gearbox	0.5H	480ml (*3) 780ml (*4)												
	17	Replacing oil of J5/J6-axis gearbox	0.5H	220ml												
	18	Replacing cable of mechanical unit	4.0H	-												
	19	Replacing cable of Mechanical unit welding power	4.0H	-									●			
	20	Replacing M/H conduit /No dust M/H conduit (option)	1.0H	-									●			
	21	Check broken of fluoric resin ring.	0.1H	-	○	○	○	○	○	○	○	○	●	○	○	○
Controller	22	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	-		○			○				○			
	23	Cleaning the ventilator	0.2H	-	○	○	○	○	○	○	○	○	○	○	○	○
	24	Replacing battery *5	0.1H	-												

*1 ARC Mate 100*i*C, M-10*i*A, ARC Mate 100*i*C/6L, M-10*i*A/6L ARC Mate 100*i*C/10S, M-10*i*A/10S
*2 ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L, M-10*i*Ae/6L
*3 Except ARC Mate 100*i*C/10S, M-10*i*A/10S
*4 ARC Mate 100*i*C/10S, M-10*i*A/10S
*5 Refer to "REPLACING UNITS Chapter of MAINTENANCE" of the following manuals.
R-30*i*A CONTROLLER MAINTENANCE MANUAL (Standard) (B-82595EN),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For Europe) (B-82595EN-1),
R-30*i*A CONTROLLER MAINTENANCE MANUAL (For RIA) (B-82595EN-2),
R-30*i*A Mate CONTROLLER MAINTENANCE MANUAL (Standard) (B-82725EN),
R-30*i*A Mate CONTROLLER MAINTENANCE MANUAL (For Europe) (B-82725EN-1),
R-30*i*A Mate CONTROLLER MAINTENANCE MANUAL (For RIA) (B-82725EN-2),
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
*6 ●: requires order of parts
○: does not requires order of parts

3 years 11520	12480	13440	14400	4 years 15360	16320	17280	18240	5 years 19200	20160	21120	22080	6 years 23040	24000	24960	25920	7 years 26880	27840	28800	29760	8 years 30720	Item
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
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				●																	24

Overhaul

FANUC Robot M-10*i*A/10M/10MS Periodic Maintenance Table

Items			Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check the external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protective sleeves	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	4	Check the mechanical cable. (Damaged or twisted)	0.2H	—		○			○				○			
	5	Check looseness of each axis motor and other exposed connector	0.2H	—		○			○				○			
	6	Tighten the end effector bolt.	0.2H	—		○			○				○			
	7	Retightening external main bolts	2.0H	—		○			○				○			
	8	Check the mechanical stopper and adjustable mechanical stopper.	0.1H	—		○			○				○			
	9	Remove spatter and dust etc.	1.0H	—		○			○				○			
	10	Check the end effector (hand) cable	0.1H	—		○			○				○			
	11	Replacing battery	0.1H	—					●				●			
	12	Replacing grease of J1-axis reducer	0.5H	870ml												
	13	Replacing grease of J2-axis reducer	0.5H	330ml												
	14	Replacing grease of J3-axis reducer	0.5H	190ml												
	15	Replacing grease of J4-axis gearbox	0.5H	390ml												
	16	Replacing grease of J5-axis gearbox	0.5H	250ml												
	17	Supply grease of J6-axis reducer	0.5H	35ml					●				●			
	18	Replacing cable of mechanical unit	4.0H	—												
Controller	19	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○				○			
	20	Cleaning the ventilator	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	21	Replacing battery *1	0.1H	—												

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

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

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

B STRENGTH OF BOLT AND BOLT TORQUE LIST

NOTE

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

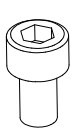
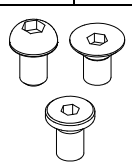
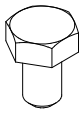
Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:

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

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

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

Recommended bolt tightening torques **Unit: Nm**

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

C INSULATION ABOUT ARC WELDING ROBOT

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

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

C.1 INSULATION AT THE WRIST

Please be careful to the following contents.

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

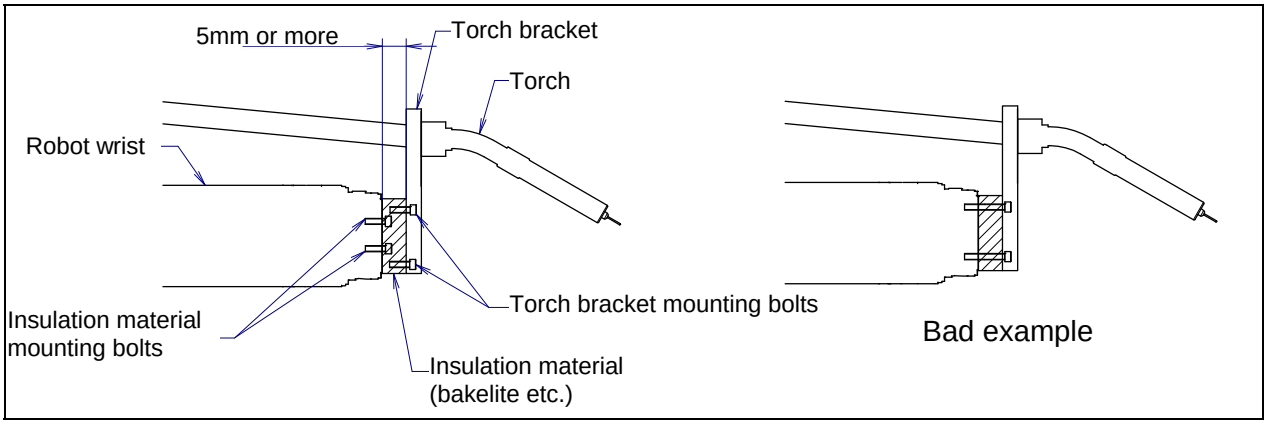


Fig. C.1 Insulation at the wrist

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

D CONTROL OF MULTIPLE ROBOTS

In case of R-30*i*A, R-30*i*A Mate, one controller can control up to four robots. Moreover, one controller can control up to eight groups, 56 axes.
In case of R-30*i*B, R-30*i*B Mate, R-30*i*B Plus, R-30*i*B Mate Plus, one controller can control up to four robots. Moreover, one controller can control up to eight groups, 72 axes.

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

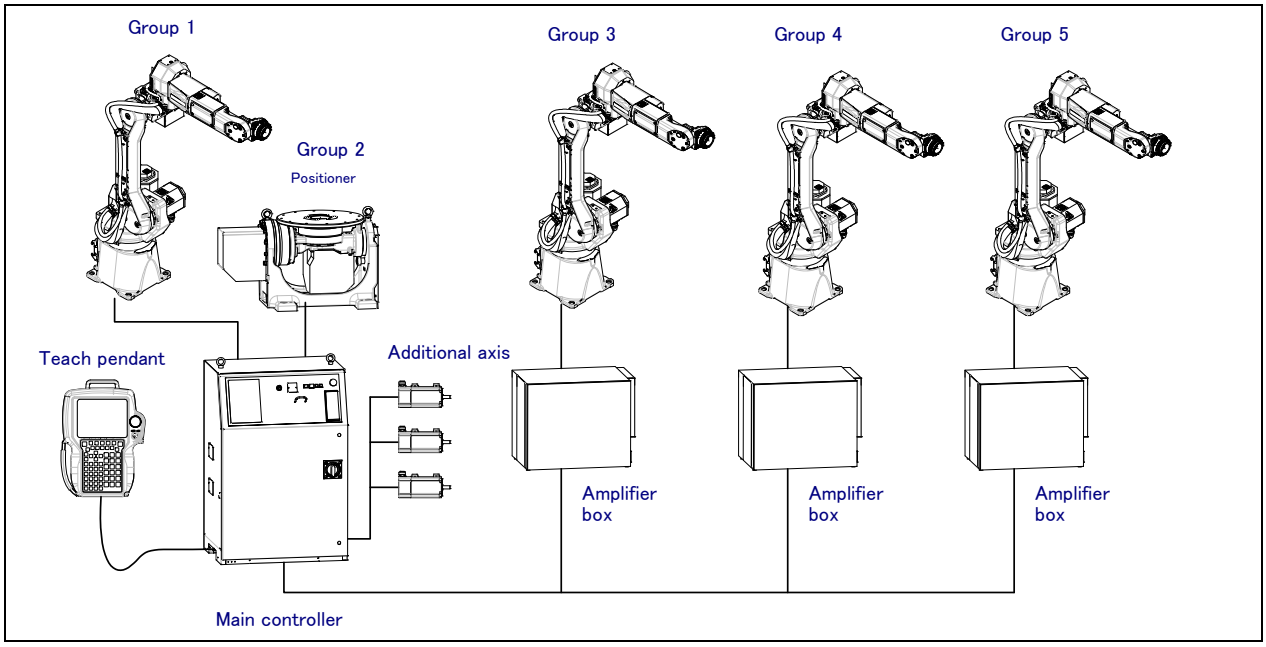


Fig. D Example of Control of multiple robots

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

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

Number of robots	Servo card and auxiliary axis board	Remarks
2 (NOTE1)	A05B-2500-H042 (16 axes)	Max. 4 auxiliary axes can be used in total of robot 1st and 2nd
3	A05B-2500-H044 (24 axes)	Max. 4 auxiliary axes can be used in total of robot 1st and 2nd Max. 2 auxiliary axes can be used in robot 3rd
4 (NOTE1)	A05B-2500-H042 (16 axes) + A05B-2500-J030 (16 axes) (NOTE 2) A05B-2550-J020 (16 axes) (NOTE 3)	Max. 4 auxiliary axes can be used in total of robot 1st and 2nd Max. 4 auxiliary axes can be used in total of robot 3rd and 4th

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

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

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

Number of robots	Servo card	Remarks
2	A05B-2670-H041 (12 axes) (NOTE 4) A05B-2670-H042 (18 axes)	Max. 6 auxiliary axes can be used in total of robot 1st and 2nd
3	A05B-2670-H042 (18 axes) (NOTE 4) A05B-2670-H043 (24 axes)	Max. 6 auxiliary axes can be used in total of robot 1st, 2nd and 3rd
4	A05B-2670-H043 (24 axes) (NOTE 4) A05B-2670-H044 (36 axes)	Max. 12 auxiliary axes can be used in total of robot 1st, 2nd, 3rd and 4th

(NOTE 1) One robot is needed to assign in 8 axes of servo card in case of Model to which high–sensitivity collision detection is supported as default like ARC Mate *i*C series etc. Therefore, A05B-2500-H040 (8 axes) cannot be used in case of two robots. Similarly, A05B-2500-H044 (24 axes) cannot be used in case of four robots.

(NOTE 2) Select this one when the controller is R-30*i*A.

(NOTE 3) Select this one when the controller is R-30*i*A Mate.

(NOTE 4) It can be used only when auxiliary axes are not specified.

INDEX

<A>

ADJUSTABLE MECHANICAL STOPPER SETTING (OPTION) 74
AIR PIPING (OPTION) 56
AIR SUPPLY (OPTION) 55
Angle of Mounting Surface Setting 10
AXIS LIMIT SETUP 70

<B>

BASIC SPECIFICATIONS 14

<C>

CHANGE AXIS LIMIT BY DCS (OPTION) 71
CHANGE THE COLLISION DETECTION PARAMETER 144
Changing the Parameter Setting 76
Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper 86,108
CHECK POINTS 81,104
Check the Failure of the Wrist Part Fluoric Resin Ring 83
Check the Mechanical Unit Cables and Connectors 84,106
Check the Oil Sight Glasses 82
CHECKS AND MAINTENANCE 77,101
CHECKS AND MAINTENANCE (EXCEPT M-10*i*A/10M/10MS) 77
CHECKS AND MAINTENANCE (M-10*i*A/10M/10MS) 101
Confirmation of Oil Seepage 81,104
Confirmation of the Air Control Set 82,105
CONNECTION WITH THE CONTROLLER 13
CONTROL OF MULTIPLE ROBOTS 164

<D>

Daily Checks 77,101

<E>

END EFFECTOR INSTALLATION TO WRIST 38
EQUIPMENT INSTALLATION TO THE ROBOT 38
EQUIPMENT MOUNTING FACE 40

<G>

Grease replacement procedure for J1 to J3-axis reducer 89,112
Grease replacement procedure for J4/J5-axis gearbox 114
Greasing 110

<I>

INSTALLATION 7
INSTALLATION CONDITIONS 12
Installation Method 8
Installing the Adjustable Mechanical Stopper 74
INSULATION ABOUT ARC WELDING ROBOT 163
INSULATION AT THE WRIST 163
INTERFACE FOR OPTION CABLE (OPTION) 57

<L>

LOAD SETTING 46

<M>

M/H CONDUIT (OPTION) 145
MAINTENANCE 87,109
MAINTENANCE AREA 12
MASTERING 117
MASTERING DATA ENTRY 134
MAX PAYLOAD SHIFT FUNCTION 48
MECHANICAL UNIT OPERATING SPACE AND OPERATING SPACE 20
Method of Executing KAREL Program by Using “Call program” 50
Method of Executing KAREL Program Directly 52
MOTION RANGE ACCORDING TO CABLE INTEGRATION 32

<N>

NO DUST M/H CONDUIT (OPTION) 150
NOTES FOR ASSEMBLING CABLES TO M/H CONDUIT 145

<O>

Oil replacement procedure for J4-axis gearbox 92
Oil replacement procedure for J5/J6-axis gearbox 96
OTHER NOTES 149
OVERVIEW 117

<P>

Periodic Check and Maintenance 78
Periodic Checks and Maintenance 102
PERIODIC MAINTENANCE TABLE 157
PIPING AND WIRING TO THE END EFFECTOR 54
PREFACE p-1
Procedure for releasing remaining pressure from oil bath (J4 to J6-axis) 100
Procedure for releasing remaining pressure from the grease bath (J1 to J3-axis) 92,114
Procedure for releasing remaining pressure from the grease bath (J4 to J6-axis) 116

<Q>

QUICK MASTERING 128
QUICK MASTERING FOR SINGLE AXIS 130

<R>

Replacing the Batteries (1 year (3840 hours) or (1.5 year (5760 hours) checks) 87

Replacing the Batteries (1-Year Checks) 109
Replacing the Grease and Oil of the Drive Mechanism (3-Year (11520 Hours) Checks).....89
Replacing the Grease of the Drive Mechanism (3-Year (11520 Hours) Checks) 111
RESETTING ALARMS AND PREPARING FOR MASTERING.....121
ROBOT CONFIGURATION.....14

<S>

SAFETY PRECAUTIONS s-1
SINGLE AXIS MASTERING 132
STORAGE 100,116
STRENGTH OF BOLT AND BOLT TORQUE LIST 162

<T>

TIG WELDING OPTION.....154
TRANSPORTATION 1
TRANSPORTATION AND INSTALLATION.....1
TROUBLESHOOTING.....137

<V>

VERIFYING MASTERING 136

<W>

WRIST CABLE KIT.....146
WRIST LOAD CONDITIONS 33

<Z>

ZERO POINT POSITION AND MOTION LIMIT.....25
ZERO POSITION MASTERING 122

REVISION RECORD

Edition	Date	Contents
15	Nov.,2017	• Addition of R-30*i*B Plus/R-30*i*B Mate Plus Controller • Correction of errors
14	May.,2016	• Addition of quick mastering for single axis • Correction of errors
13	Aug.,2013	• Addition of M-10*i*A/10MS • Correction of errors
12	June,2013	• Addition of M-10*i*A/10M • Addition of R-30*i*B Mate Controller • Correction of errors
11	June,2012	• Addition of R-30*i*B Controller • Addition of note for low temperature • Change replacing method of grease and oil • Correction of errors
10	Sep.,2011	• Addition of oil exudation check to diary check. • Addition of ISO flange adapter • Correction of oiling method • Correction of errors
09	Dec.,2010	• Addition of ARC Mate 100*i*Ce, M-10*i*Ae, ARC Mate 100*i*Ce/6L,M-10*i*Ae/6L • Addition of stop type of robot • Addition of stopping time and distance when controlled stop is executed • Addition note about end effector (hand) cable • Correction of errors
08	Apr.,2010	• Addition of ARC Mate 100*i*C/10S and M-10*i*A/10S • Addition of new specification of ARC Mate 100*i*C,ARC Mate 100*i*C/6L M-10*i*A,M-10*i*A/6L • Correction of errors
07	Feb.,2010	• Addition of wrist cable kit for M/H conduit. • Correction of errors
06	Apr., 2009	• Addition of option cables
05	Oct., 2008	• Addition of TIG welding option • Correction of errors
04	Jun., 2008	• Addition of M-10*i*A/6L • Addition of NOTE • Addition of Insulation about ARC Welding Robot
03	Mar., 2008	• Addition of load setting of ARC Mate 100*i*C/6L • Correction of errors
02	Jan., 2008	• Procedure to move arm without drive power in emergency or abnormal situations • Addition of ARC Mate 100*i*C/6L • Addition of Stopping time and distance when emergency stop • Addition of load setting • Addition of setting motion range of the robot • Addition of M/H conduit
01	Oct., 2007	

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