# FANUC Robot LR Mate 200*i*C
# FANUC Robot ARC Mate 50*i*C

## MECHANICAL UNIT

# OPERATOR'S MANUAL

MAROTLR2006071E REV. G



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**B-82584EN/07**

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

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FANUC Robotics conducts courses on its systems and products on a regularly scheduled basis at the company's world headquarters in Rochester Hills, Michigan. For additional information contact

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For customer assistance, including Technical Support, Service, Parts & Part Repair, and Marketing Requests, contact the Customer Resource Center, 24 hours a day, at 1-800-47-ROBOT (1-800-477-6268). International customers should call 011-1-248-377-7159.

Send your comments and suggestions about this manual to:
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## Patents

One or more of the following U.S. patents might be related to the FANUC Robotics products described in this manual.

FRA Patent List
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## Conventions

**WARNING**

**Information appearing under the "WARNING" caption concerns the protection of personnel. It is boxed and bolded to set it apart from the surrounding text.**

**CAUTION**

Information appearing under the "CAUTION" caption concerns the protection of equipment, software, and data. It is boxed and bolded to set it apart from the surrounding text.

**Note** Information appearing next to NOTE concerns related information or useful hints.

- **Original Instructions**

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



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Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

# SAFETY

# Safety

FANUC Robotics is not and does not represent itself as an expert in safety systems, safety equipment, or the specific safety aspects of your company and/or its work force. It is the responsibility of the owner, employer, or user to take all necessary steps to guarantee the safety of all personnel in the workplace.

The appropriate level of safety for your application and installation can be best determined by safety system professionals. FANUC Robotics therefore, recommends that each customer consult with such professionals in order to provide a workplace that allows for the safe application, use, and operation of FANUC Robotics systems.

According to the industry standard ANSI/RIA R15-06, the owner or user is advised to consult the standards to ensure compliance with its requests for Robotics System design, usability, operation, maintenance, and service. Additionally, as the owner, employer, or user of a robotic system, it is your responsibility to arrange for the training of the operator of a robot system to recognize and respond to known hazards associated with your robotic system and to be aware of the recommended operating procedures for your particular application and robot installation.

Ensure that the robot being used is appropriate for the application. Robots used in classified (hazardous) locations must be certified for this use.

FANUC Robotics therefore, recommends that all personnel who intend to operate, program, repair, or otherwise use the robotics system be trained in an approved FANUC Robotics training course and become familiar with the proper operation of the system. Persons responsible for programming the system–including the design, implementation, and debugging of application programs–must be familiar with the recommended programming procedures for your application and robot installation.

The following guidelines are provided to emphasize the importance of safety in the workplace.

## CONSIDERING SAFETY FOR YOUR ROBOT INSTALLATION

Safety is essential whenever robots are used. Keep in mind the following factors with regard to safety:

- The safety of people and equipment
- Use of safety enhancing devices
- Techniques for safe teaching and manual operation of the robot(s)
- Techniques for safe automatic operation of the robot(s)
- Regular scheduled inspection of the robot and workcell
- Proper maintenance of the robot

## Keeping People and Equipment Safe

The safety of people is always of primary importance in any situation. However, equipment must be kept safe, too. When prioritizing how to apply safety to your robotic system, consider the following:

- People
- External devices
- Robot(s)
- Tooling
- Workpiece

## Using Safety Enhancing Devices

Always give appropriate attention to the work area that surrounds the robot. The safety of the work area can be enhanced by the installation of some or all of the following devices:

- Safety fences, barriers, or chains
- Light curtains
- Interlocks
- Pressure mats
- Floor markings
- Warning lights
- Mechanical stops
- EMERGENCY STOP buttons
- DEADMAN switches

## Setting Up a Safe Workcell

A safe workcell is essential to protect people and equipment. Observe the following guidelines to ensure that the workcell is set up safely. These suggestions are intended to supplement and not replace existing federal, state, and local laws, regulations, and guidelines that pertain to safety.

- Sponsor your personnel for training in approved FANUC Robotics training course(s) related to your application. Never permit untrained personnel to operate the robots.
- Install a lockout device that uses an access code to prevent unauthorized persons from operating the robot.
- Use anti–tie–down logic to prevent the operator from bypassing safety measures.
- Arrange the workcell so the operator faces the workcell and can see what is going on inside the cell.
- Clearly identify the work envelope of each robot in the system with floor markings, signs, and special barriers. The work envelope is the area defined by the maximum

motion range of the robot, including any tooling attached to the wrist flange that extend this range.

- Position all controllers outside the robot work envelope.
- Never rely on software or firmware based controllers as the primary safety element unless they comply with applicable current robot safety standards.
- Mount an adequate number of EMERGENCY STOP buttons or switches within easy reach of the operator and at critical points inside and around the outside of the workcell.
- Install flashing lights and/or audible warning devices that activate whenever the robot is operating, that is, whenever power is applied to the servo drive system. Audible warning devices shall exceed the ambient noise level at the end–use application.
- Wherever possible, install safety fences to protect against unauthorized entry by personnel into the work envelope.
- Install special guarding that prevents the operator from reaching into restricted areas of the work envelope.
- Use interlocks.
- Use presence or proximity sensing devices such as light curtains, mats, and capacitance and vision systems to enhance safety.
- Periodically check the safety joints or safety clutches that can be optionally installed between the robot wrist flange and tooling. If the tooling strikes an object, these devices dislodge, remove power from the system, and help to minimize damage to the tooling and robot.
- Make sure all external devices are properly filtered, grounded, shielded, and suppressed to prevent hazardous motion due to the effects of electro–magnetic interference (EMI), radio frequency interference (RFI), and electro–static discharge (ESD).
- Make provisions for power lockout/tagout at the controller.
- Eliminate *pinch points*. Pinch points are areas where personnel could get trapped between a moving robot and other equipment.
- Provide enough room inside the workcell to permit personnel to teach the robot and perform maintenance safely.
- Program the robot to load and unload material safely.
- If high voltage electrostatics are present, be sure to provide appropriate interlocks, warning, and beacons.
- If materials are being applied at dangerously high pressure, provide electrical interlocks for lockout of material flow and pressure.

## Staying Safe While Teaching or Manually Operating the Robot

Advise all personnel who must teach the robot or otherwise manually operate the robot to observe the following rules:

- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.

- Know whether or not you are using an intrinsically safe teach pendant if you are working in a hazardous environment.
- Before teaching, visually inspect the robot and work envelope to make sure that no potentially hazardous conditions exist. The work envelope is the area defined by the maximum motion range of the robot. These include tooling attached to the wrist flange that extends this range.
- The area near the robot must be clean and free of oil, water, or debris. Immediately report unsafe working conditions to the supervisor or safety department.
- FANUC Robotics recommends that no one enter the work envelope of a robot that is on, except for robot teaching operations. However, if you must enter the work envelope, be sure all safeguards are in place, check the teach pendant DEADMAN switch for proper operation, and place the robot in teach mode. Take the teach pendant with you, turn it on, and be prepared to release the DEADMAN switch. Only the person with the teach pendant should be in the work envelope.

**WARNING**

**Never bypass, strap, or otherwise deactivate a safety device, such as a limit switch, for any operational convenience. Deactivating a safety device is known to have resulted in serious injury and death.**

- Know the path that can be used to escape from a moving robot; make sure the escape path is never blocked.
- Isolate the robot from all remote control signals that can cause motion while data is being taught.
- Test any program being run for the first time in the following manner:

**WARNING**

**Stay outside the robot work envelope whenever a program is being run. Failure to do so can result in injury.**

  - Using a low motion speed, single step the program for at least one full cycle.
  - Using a low motion speed, test run the program continuously for at least one full cycle.
  - Using the programmed speed, test run the program continuously for at least one full cycle.
- Make sure all personnel are outside the work envelope before running production.

## Staying Safe During Automatic Operation

Advise all personnel who operate the robot during production to observe the following rules:

- Make sure all safety provisions are present and active.
- Know the entire workcell area. The workcell includes the robot and its work envelope, plus the area occupied by all external devices and other equipment with which the robot interacts.
- Understand the complete task the robot is programmed to perform before initiating automatic operation.
- Make sure all personnel are outside the work envelope before operating the robot.
- Never enter or allow others to enter the work envelope during automatic operation of the robot.
- Know the location and status of all switches, sensors, and control signals that could cause the robot to move.
- Know where the EMERGENCY STOP buttons are located on both the robot control and external control devices. Be prepared to press these buttons in an emergency.
- Never assume that a program is complete if the robot is not moving. The robot could be waiting for an input signal that will permit it to continue its activity.
- If the robot is running in a pattern, do not assume it will continue to run in the same pattern.
- Never try to stop the robot, or break its motion, with your body. The only way to stop robot motion immediately is to press an EMERGENCY STOP button located on the controller panel, teach pendant, or emergency stop stations around the workcell.

## Staying Safe During Inspection

When inspecting the robot, be sure to

- Turn off power at the controller.
- Lock out and tag out the power source at the controller according to the policies of your plant.
- Turn off the compressed air source and relieve the air pressure.
- If robot motion is not needed for inspecting the electrical circuits, press the EMERGENCY STOP button on the operator panel.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- If power is needed to check the robot motion or electrical circuits, be prepared to press the EMERGENCY STOP button, in an emergency.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.

## Staying Safe During Maintenance

When performing maintenance on your robot system, observe the following rules:

- Never enter the work envelope while the robot or a program is in operation.
- Before entering the work envelope, visually inspect the workcell to make sure no potentially hazardous conditions exist.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Consider all or any overlapping work envelopes of adjoining robots when standing in a work envelope.
- Test the teach pendant for proper operation before entering the work envelope.
- If it is necessary for you to enter the robot work envelope while power is turned on, you must be sure that you are in control of the robot. Be sure to take the teach pendant with you, press the DEADMAN switch, and turn the teach pendant on. Be prepared to release the DEADMAN switch to turn off servo power to the robot immediately.
- Whenever possible, perform maintenance with the power turned off. Before you open the controller front panel or enter the work envelope, turn off and lock out the 3–phase power source at the controller.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.

**⚠WARNING**

**Lethal voltage is present in the controller WHENEVER IT IS CONNECTED to a power source. Be extremely careful to avoid electrical shock. HIGH VOLTAGE IS PRESENT at the input side whenever the controller is connected to a power source. Turning the disconnect or circuit breaker to the OFF position removes power from the output side of the device only.**

- Release or block all stored energy. Before working on the pneumatic system, shut off the system air supply and purge the air lines.
- Isolate the robot from all remote control signals. If maintenance must be done when the power is on, make sure the person inside the work envelope has sole control of the robot. The teach pendant must be held by this person.
- Make sure personnel cannot get trapped between the moving robot and other equipment. Know the path that can be used to escape from a moving robot. Make sure the escape route is never blocked.

- Use blocks, mechanical stops, and pins to prevent hazardous movement by the robot. Make sure that such devices do not create pinch points that could trap personnel.

**⚠WARNING**

**Do not try to remove any mechanical component from the robot before thoroughly reading and understanding the procedures in the appropriate manual. Doing so can result in serious personal injury and component destruction.**

- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.
- When replacing or installing components, make sure dirt and debris do not enter the system.
- Use only specified parts for replacement. To avoid fires and damage to parts in the controller, never use nonspecified fuses.
- Before restarting a robot, make sure no one is inside the work envelope; be sure that the robot and all external devices are operating normally.

## KEEPING MACHINE TOOLS AND EXTERNAL DEVICES SAFE

Certain programming and mechanical measures are useful in keeping the machine tools and other external devices safe. Some of these measures are outlined below. Make sure you know all associated measures for safe use of such devices.

### Programming Safety Precautions

Implement the following programming safety measures to prevent damage to machine tools and other external devices.

- Back–check limit switches in the workcell to make sure they do not fail.
- Implement ‘‘failure routines” in programs that will provide appropriate robot actions if an external device or another robot in the workcell fails.
- Use *handshaking* protocol to synchronize robot and external device operations.
- Program the robot to check the condition of all external devices during an operating cycle.

### Mechanical Safety Precautions

Implement the following mechanical safety measures to prevent damage to machine tools and other external devices.

- Make sure the workcell is clean and free of oil, water, and debris.
- Use software limits, limit switches, and mechanical hardstops to prevent undesired movement of the robot into the work area of machine tools and external devices.

# KEEPING THE ROBOT SAFE

Observe the following operating and programming guidelines to prevent damage to the robot.

## Operating Safety Precautions

The following measures are designed to prevent damage to the robot during operation.

- Use a low override speed to increase your control over the robot when jogging the robot.
- Visualize the movement the robot will make before you press the jog keys on the teach pendant.
- Make sure the work envelope is clean and free of oil, water, or debris.
- Use circuit breakers to guard against electrical overload.

## Programming Safety Precautions

The following safety measures are designed to prevent damage to the robot during programming:

- Establish *interference zones* to prevent collisions when two or more robots share a work area.
- Make sure that the program ends with the robot near or at the home position.
- Be aware of signals or other operations that could trigger operation of tooling resulting in personal injury or equipment damage.
- In dispensing applications, be aware of all safety guidelines with respect to the dispensing materials.

**NOTE**: Any deviation from the methods and safety practices described in this manual must conform to the approved standards of your company. If you have questions, see your supervisor.

# ADDITIONAL SAFETY CONSIDERATIONS FOR PAINT ROBOT INSTALLATIONS

Process technicians are sometimes required to enter the paint booth, for example, during daily or routine calibration or while teaching new paths to a robot. Maintenance personnel also must work inside the paint booth periodically.

Whenever personnel are working inside the paint booth, ventilation equipment must be used. Instruction on the proper use of ventilating equipment usually is provided by the paint shop supervisor.

Although paint booth hazards have been minimized, potential dangers still exist. Therefore, today's highly automated paint booth requires that process and maintenance personnel have full awareness of the system and its capabilities. They must understand

the interaction that occurs between the vehicle moving along the conveyor and the robot(s), hood/deck and door opening devices, and high–voltage electrostatic tools.

**⚠ CAUTION**

**Ensure that all ground cables remain connected. Never operate the paint robot with ground provisions disconnected. Otherwise, you could injure personnel or damage equipment.**

Paint robots are operated in three modes:

- Teach or manual mode
- Automatic mode, including automatic and exercise operation
- Diagnostic mode

During both teach and automatic modes, the robots in the paint booth will follow a predetermined pattern of movements. In teach mode, the process technician teaches (programs) paint paths using the teach pendant.

In automatic mode, robot operation is initiated at the System Operator Console (SOC) or Manual Control Panel (MCP), if available, and can be monitored from outside the paint booth. All personnel must remain outside of the booth or in a designated safe area within the booth whenever automatic mode is initiated at the SOC or MCP.

In automatic mode, the robots will execute the path movements they were taught during teach mode, but generally at production speeds.

When process and maintenance personnel run diagnostic routines that require them to remain in the paint booth, they must stay in a designated safe area.

## Paint System Safety Features

Process technicians and maintenance personnel must become totally familiar with the equipment and its capabilities. To minimize the risk of injury when working near robots and related equipment, personnel must comply strictly with the procedures in the manuals.

This section provides information about the safety features that are included in the paint system and also explains the way the robot interacts with other equipment in the system.

The paint system includes the following safety features:

- Most paint booths have red warning beacons that illuminate when the robots are armed and ready to paint. Your booth might have other kinds of indicators. Learn what these are.
- Some paint booths have a blue beacon that, when illuminated, indicates that the electrostatic devices are enabled. Your booth might have other kinds of indicators. Learn what these are.
- EMERGENCY STOP buttons are located on the robot controller and teach pendant. Become familiar with the locations of all E–STOP buttons.

- An intrinsically safe teach pendant is used when teaching in hazardous paint atmospheres.
- A DEADMAN switch is located on each teach pendant. When this switch is held in, and the teach pendant is on, power is applied to the robot servo system. If the engaged DEADMAN switch is released or pressed harder during robot operation, power is removed from the servo system, all axis brakes are applied, and the robot comes to an EMERGENCY STOP. Safety interlocks within the system might also E–STOP other robots.

**WARNING**

**An EMERGENCY STOP will occur if the DEADMAN switch is released on a bypassed robot.**

- Overtravel by robot axes is prevented by software limits. All of the major and minor axes are governed by software limits. Limit switches and hardstops also limit travel by the major axes.
- EMERGENCY STOP limit switches and photoelectric eyes might be part of your system. Limit switches, located on the entrance/exit doors of each booth, will EMERGENCY STOP all equipment in the booth if a door is opened while the system is operating in automatic or manual mode. For some systems, signals to these switches are inactive when the switch on the SOC is in teach mode.
- When present, photoelectric eyes are sometimes used to monitor unauthorized intrusion through the entrance/exit silhouette openings.
- System status is monitored by computer. Severe conditions result in automatic system shutdown.

## Staying Safe While Operating the Paint Robot

When you work in or near the paint booth, observe the following rules, in addition to all rules for safe operation that apply to all robot systems.

**WARNING**

**Observe all safety rules and guidelines to avoid injury.**

**WARNING**

**Never bypass, strap, or otherwise deactivate a safety device, such as a limit switch, for any operational convenience. Deactivating a safety device is known to have resulted in serious injury and death.**

**WARNING**

**Enclosures shall not be opened unless the area is known to be nonhazardous or all power has been removed from devices within the enclosure. Power shall not be restored after the enclosure has been opened until all combustible dusts have been removed from the interior of the enclosure and the enclosure purged. Refer to the Purge chapter for the required purge time.**

- Know the work area of the entire paint station (workcell).
- Know the work envelope of the robot and hood/deck and door opening devices.
- Be aware of overlapping work envelopes of adjacent robots.
- Know where all red, mushroom–shaped EMERGENCY STOP buttons are located.
- Know the location and status of all switches, sensors, and/or control signals that might cause the robot, conveyor, and opening devices to move.
- Make sure that the work area near the robot is clean and free of water, oil, and debris. Report unsafe conditions to your supervisor.
- Become familiar with the complete task the robot will perform BEFORE starting automatic mode.
- Make sure all personnel are outside the paint booth before you turn on power to the robot servo system.
- Never enter the work envelope or paint booth before you turn off power to the robot servo system.
- Never enter the work envelope during automatic operation unless a safe area has been designated.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Remove all metallic objects, such as rings, watches, and belts, before entering a booth when the electrostatic devices are enabled.
- Stay out of areas where you might get trapped between a moving robot, conveyor, or opening device and another object.
- Be aware of signals and/or operations that could result in the triggering of guns or bells.
- Be aware of all safety precautions when dispensing of paint is required.
- Follow the procedures described in this manual.

## Special Precautions for Combustible Dusts (Powder Paint)

When the robot is used in a location where combustible dusts are found, such as the application of powder paint, the following special precautions are required to insure that there are no combustible dusts inside the robot.

- Purge maintenance air should be maintained at all times, even when the robot power is off. This will insure that dust can not enter the robot.
- A purge cycle will not remove accumulated dusts. Therefore, if the robot is exposed to dust when maintenance air is not present, it will be necessary to remove the covers

and clean out any accumulated dust. Do not energize the robot until you have performed the following steps.

1. Before covers are removed, the exterior of the robot should be cleaned to remove accumulated dust.
2. When cleaning and removing accumulated dust, either on the outside or inside of the robot, be sure to use methods appropriate for the type of dust that exists. Usually lint free rags dampened with water are acceptable. Do not use a vacuum cleaner to remove dust as it can generate static electricity and cause an explosion unless special precautions are taken.
3. Thoroughly clean the interior of the robot with a lint free rag to remove any accumulated dust.
4. When the dust has been removed, the covers must be replaced immediately.
5. Immediately after the covers are replaced, run a complete purge cycle. The robot can now be energized.

## Staying Safe While Operating Paint Application Equipment

When you work with paint application equipment, observe the following rules, in addition to all rules for safe operation that apply to all robot systems.

**⚠ WARNING**

**When working with electrostatic paint equipment, follow all national and local codes as well as all safety guidelines within your organization. Also reference the following standards: NFPA 33 Standards for Spray Application Using Flammable or Combustible Materials, and NFPA 70 National Electrical Code.**

- **Grounding**: All electrically conductive objects in the spray area must be grounded. This includes the spray booth, robots, conveyors, workstations, part carriers, hooks, paint pressure pots, as well as solvent containers. Grounding is defined as the object or objects shall be electrically connected to ground with a resistance of not more than 1 megohms.
- **High Voltage**: High voltage should only be on during actual spray operations. Voltage should be off when the painting process is completed. Never leave high voltage on during a cap cleaning process.
- Avoid any accumulation of combustible vapors or coating matter.
- Follow all manufacturer recommended cleaning procedures.
- Make sure all interlocks are operational.
- No smoking.
- Post all warning signs regarding the electrostatic equipment and operation of electrostatic equipment according to NFPA 33 Standard for Spray Application Using Flammable or Combustible Material.
- Disable all air and paint pressure to bell.
- Verify that the lines are not under pressure.

## Staying Safe During Maintenance

When you perform maintenance on the painter system, observe the following rules, and all other maintenance safety rules that apply to all robot installations. Only qualified, trained service or maintenance personnel should perform repair work on a robot.

- Paint robots operate in a potentially explosive environment. Use caution when working with electric tools.
- When a maintenance technician is repairing or adjusting a robot, the work area is under the control of that technician. All personnel not participating in the maintenance must stay out of the area.
- For some maintenance procedures, station a second person at the control panel within reach of the EMERGENCY STOP button. This person must understand the robot and associated potential hazards.
- Be sure all covers and inspection plates are in good repair and in place.
- Always return the robot to the ‘‘home’’ position before you disarm it.
- Never use machine power to aid in removing any component from the robot.
- During robot operations, be aware of the robot’s movements. Excess vibration, unusual sounds, and so forth, can alert you to potential problems.
- Whenever possible, turn off the main electrical disconnect before you clean the robot.
- When using vinyl resin observe the following:
  - Wear eye protection and protective gloves during application and removal.
  - Adequate ventilation is required. Overexposure could cause drowsiness or skin and eye irritation.
  - If there is contact with the skin, wash with water.
  - Follow the Original Equipment Manufacturer’s Material Safety Data Sheets.
- When using paint remover observe the following:
  - Eye protection, protective rubber gloves, boots, and apron are required during booth cleaning.
  - Adequate ventilation is required. Overexposure could cause drowsiness.
  - If there is contact with the skin or eyes, rinse with water for at least 15 minutes. Then seek medical attention as soon as possible.
  - Follow the Original Equipment Manufacturer’s Material Safety Data Sheets

# 1 SAFETY PRECAUTIONS

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral devices installed in a work cell.
In addition, refer to the "FANUC Robot SAFETY HANDBOOK (B-80687EN)".

## 1.1 WORKING PERSON

The personnel can be classified as follows.

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

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

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

- An operator cannot work inside the safety fence.
- A programmer, teaching operator, and maintenance engineer can work inside the safety fence. The working activities inside the safety fence include lifting, setting, teaching, adjusting, maintenance, etc..
- To work inside the fence, the person must be trained on proper robot operation.

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

- Use adequate clothing or uniforms during system operation
- Wear safety shoes
- Use helmet

## 1.2 WORKING PERSON SAFETY

Working person 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 working person safety.

(1) Have the robot system working persons 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 working

person 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 working person 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 in an emergency. For connection, see Fig.1.2 (a) and Fig.1.2 (b).

(4) Provide the peripheral devices with appropriate grounding (Class A, Class B, Class C, and Class D).
(5) Try to install the peripheral devices outside the work area.
(6) Draw an outline on the floor, clearly indicating the range of the robot motion, 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 working person enters the work area.
(8) If necessary, install a safety lock so that no one except the working person 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 device independently, be sure to turn off the power of the robot.

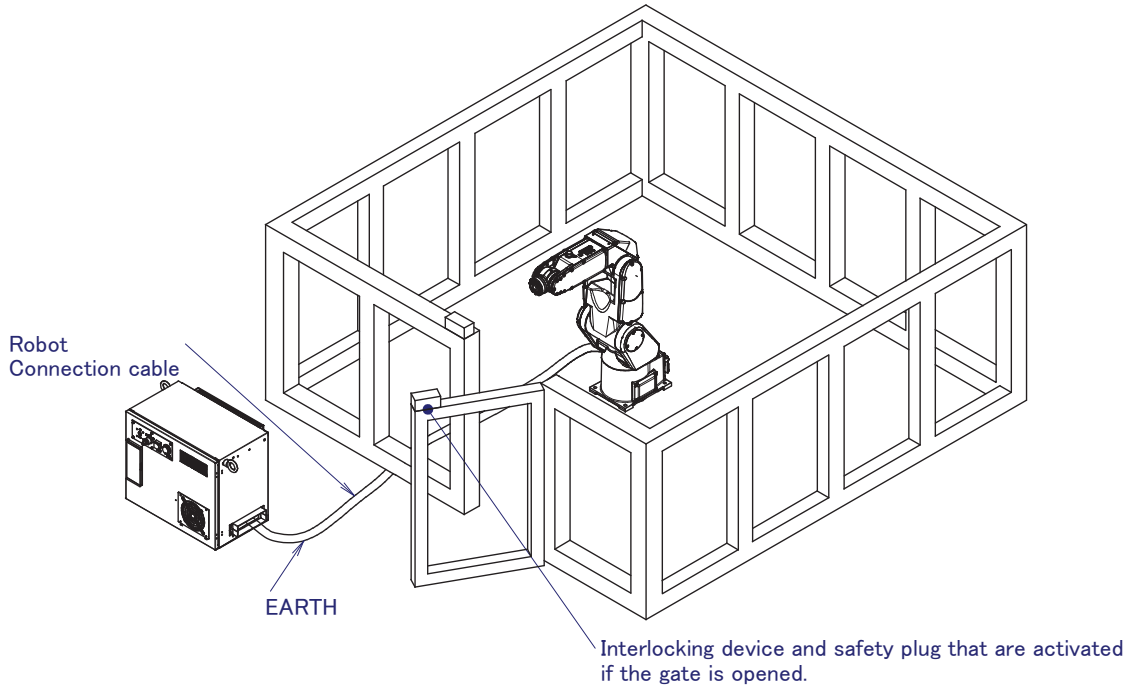



**Fig.1.2 (a) Safety fence and safety gate**

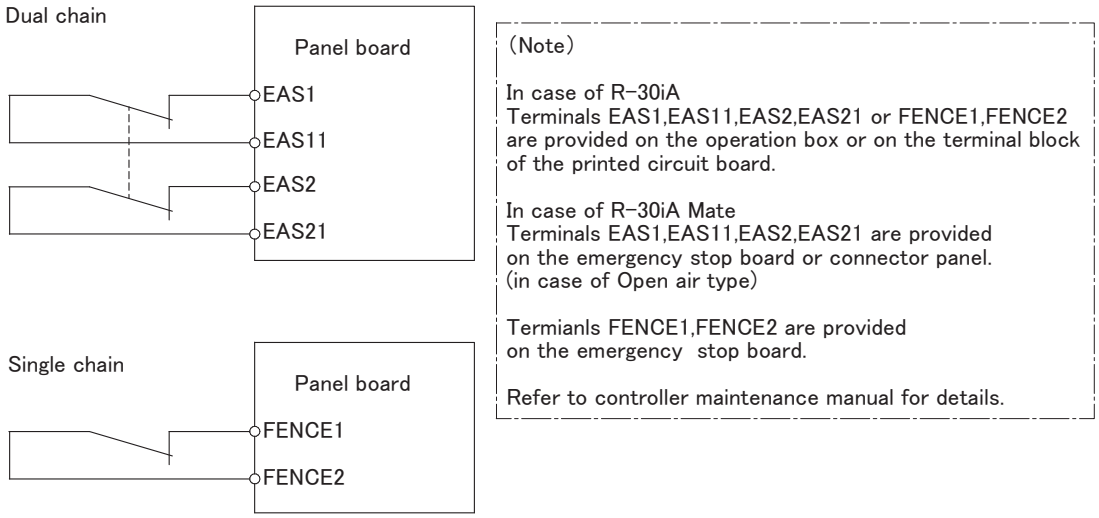



**Fig.1.2 (b) Connection Diagram for Safety Fence**

## 1.2.1 General Person Safety

The operator is a person who operates the robot system. In this sense, a worker who operates the teach pendant is also an operator. However, this section does not apply to teach pendant operators.

(1) If you do not have to operate the robot, turn off the power of the robot controller or press the EMERGENCY STOP button, and then proceed with necessary work.
(2) Operate the robot system at a location outside of the safety fence
(3) Install a safety fence with a safety gate to prevent any worker other than the operator from entering the work area unexpectedly and to prevent the worker from entering a dangerous area.
(4) Install an 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 when the external EMERGENCY STOP button is pressed. See the diagram below for connection.

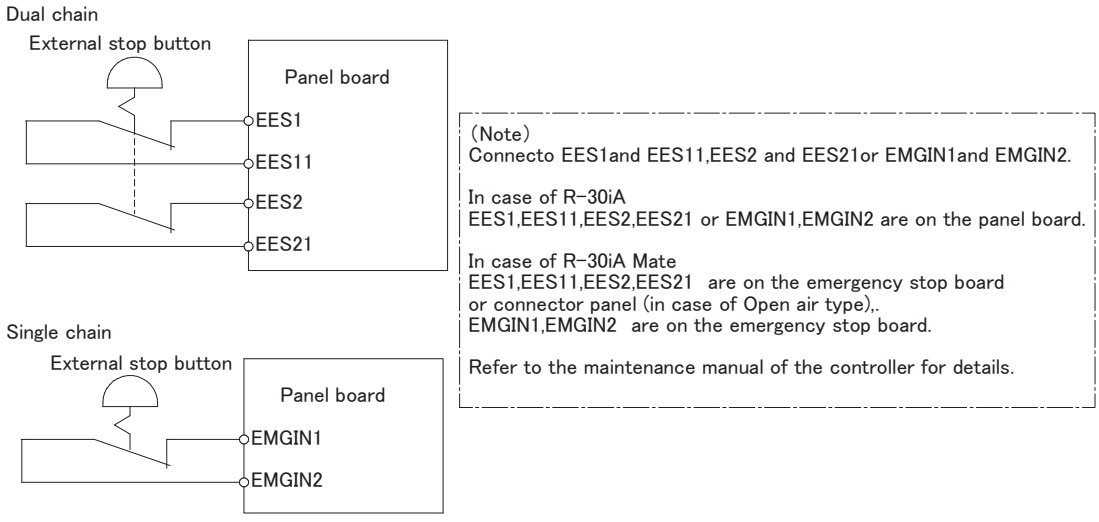



**Fig.1.2.1 Circuit diagram for external emergency stop button**

## 1.2.2 Safety of the Teaching Operator

While teaching the robot, the operator must enter the work area of the robot. The operator must ensure the safety of the teach pendant operator especially.

(1) Unless it is specifically necessary to enter the robot work area, carry out all tasks outside the area.
(2) Before teaching the robot, check that the robot and its peripheral devices are all in the normal operating condition.
(3) If it is inevitable to enter the robot work area 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 work area.

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 enters the emergency stop state. 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.)

Our teach pendant is provided with a DEADMAN switch as well as an emergency stop button. These button and switch function as follows:
(1) Emergency stop button: Causes an emergency stop when pressed.
(2) DEADMAN switch: Functions differently depending on the mode switch setting status.
  (a) Automatic operation mode: The DEADMAN switch is disabled.
  (b) Teach mode: Causes an emergency stop when the operator releases the DEADMAN switch or when the operator presses the switch strongly.

Note) The DEADMAN switch is provided to place the robot in the emergency stop state when the operator releases the teach pendant or presses the pendant strongly in case of emergency. The 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 enters the emergency stop state.

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.

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.

**In case of R-30iA Controller or CE or RIA specification of R-30iA Mate Controller**

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

**In case of 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 |

(5) (Only when 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's panel, make certain that nobody is the robot work area and that there are no abnormal conditions in the robot work area.
(6) When a program is completed, be sure to carry out a test run according to the procedure below.
  (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 run above, execute it in the automatic operation mode.
(7) While operating the system in the automatic operation mode, the teach pendant operator should leave the robot work area.

## 1.2.3 Safety During Maintenance

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

(1) During operation, never enter the robot work area.
(2) Except when specifically necessary, turn off the power of the controller while carrying out maintenance. Lock the power switch, if necessary, so that no other person can turn it on.
(3) If it becomes necessary to enter the robot operation range while the power is on, press the emergency stop button on the operator panel, or the teach pendant before entering the range. The maintenance personnel must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.
(4) When disconnecting the pneumatic system, be sure to reduce the supply pressure.
(5) Before the start of teaching, check that the robot and its peripheral devices are all in the normal operating condition.
(6) Do not operate the robot in the automatic mode while anybody is in the robot work area.
(7) When you maintain the robot alongside a wall or instrument, or when multiple workers are working nearby, make certain that their escape path is not obstructed.
(8) When a tool is mounted on the robot, or when any moving device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.

(9) If necessary, have a worker who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the worker should be ready to press the EMERGENCY STOP button at any time.
(10) When replacing or reinstalling components, take care to prevent foreign matter from entering the system.
(11) 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.
(12) When replacing parts, be sure to use those specified by FANUC.
In particular, never use fuses or other parts of non-specified ratings. They may cause a fire or result in damage to the components in the controller.
(13) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the work area and that the robot and the peripheral devices are not abnormal.

# 1.3 SAFETY OF THE TOOLS AND PERIPHERAL DEVICES

## 1.3.1 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 abnormal condition occurs in any other robots or peripheral devices, even though the robot itself is normal.
(3) For a system in which the robot and its peripheral devices 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 devices so that the robot can detect the states of all devices in the system and can stop them according to the their states.

## 1.3.2 Precautions for Mechanism

(1) Keep the component cells of the robot system clean, and operate the robot in an environment free of grease, water, and dust.
(2) Employ a limit switch or mechanical stopper to limit the robot motion so that the robot or cable does not strike against its peripheral devices or tools.
(3) Observe the following precautions about the mechanical unit cables. When theses attentions are not kept, unexpected troubles might occur.
- Use mechanical unit cable that have required user interface.
- Don’t add user cable or hose to inside of mechanical unit.
- Please do not obstruct the movement of the mechanical unit cable 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.
- Please do not interfere with the other parts of mechanical unit when install equipments in the robot.

# 1.4 SAFETY OF THE ROBOT MECHANISM

## 1.4.1 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.

### 1.4.2 Precautions in Programming

(1) When the work areas 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.

### 1.4.3 Precautions for Mechanisms

(1) Keep the work areas of the robot clean, and operate the robot in an environment free of grease, water, and dust.

## 1.5 SAFETY OF THE END EFFECTOR

### 1.5.1 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.

## 1.6 WARNING LABEL

(1) Transportation label 1

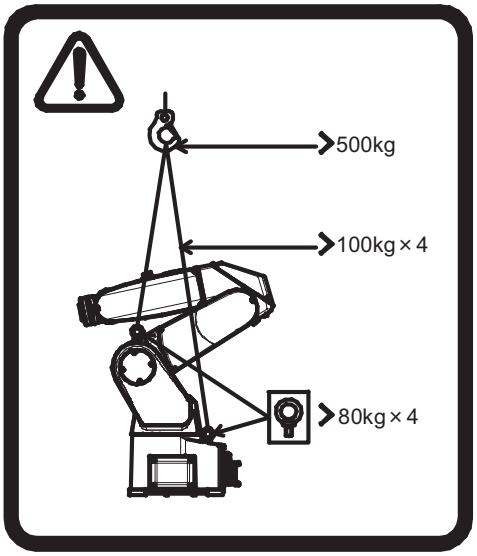



**Fig. 1.6 (a) Transportation label 1**

## Description

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

1) Use a crane having a load capacity of 500 kg or greater.
2) Use at least four slings each having a withstand load of 980 N (100 kgf) or greater.
3) Use at least four eyebolts each having a withstand load of 784 N (80 kgf) or greater.

(2) Transportation label 2


**Fig. 1.6 (b) Transportation label 2**

## Description

When using eyebolts, observe the instructions indicated on this label.

1) Do not pull eyebolts sideways.
2) Before starting to use the robot, remove the eyebolts from it.

(3) Greasing label (if greasing kit A05B-1139-K021,K022 is specified)

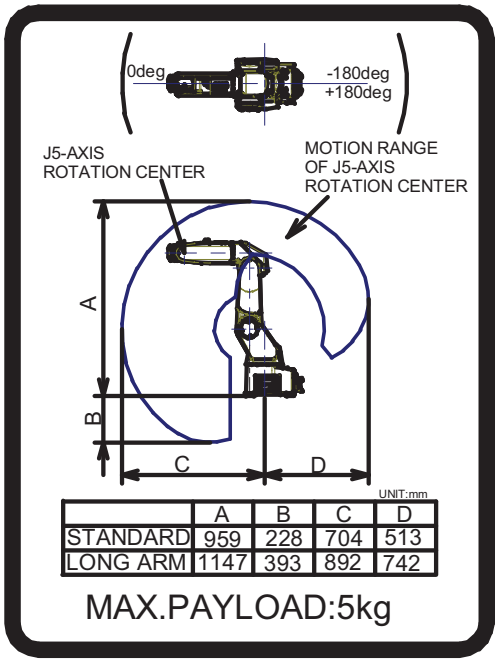

**Fig. 1.6 (c) Greasing label**

## Description

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

1) Before filling the cylinder with grease from tube, squeeze the tube to make the grease in it soft.
2) Pushing in the plunger by 2.5 mm causes a grease of 1 cc to be pushed out.

(4) Motion range and payload label
The following label is added if the CE specification is requested.




| | A | B | C | D |
|---|---|---|---|---|
| STANDARD | 959 | 228 | 704 | 513 |
| LONG ARM | 1147 | 393 | 892 | 742 |

**Fig 1.6 (d) Motion range and payload label**

# PREFACE

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

| Model name | Mechanical unit specification No. | Maximum load | Remarks |
|---|---|---|---|
| FANUC Robot LR Mate 200*i*C | A05B-1139-B201 | 5kg | 3-axes brake type<br>Non-severe dust/liquid protection specification |
| FANUC Robot LR Mate 200*i*C | A05B-1139-B202 | | 6-axes brake type<br>Non-severe dust/liquid protection specification |
| FANUC Robot LR Mate 200*i*C | A05B-1139-B203 | | 3-axes brake type<br>severe dust/liquid protection specification |
| FANUC Robot LR Mate 200*i*C | A05B-1139-B204 | | 6-axes brake type<br>severe dust/liquid protection specification |
| FANUC Robot LR Mate 200*i*C/5L | A05B-1139-B211 | | 6-axes brake type Non-severe dust/liquid protection specification |
| | A05B-1139-B212 | | 6-axes brake type<br>severe dust/liquid protection specification |
| FANUC Robot LR Mate 200*i*C/5LC | A05B-1139-B213 | | 6-axes brake type<br>Clean class 100 (ISO class 5) specification |
| | A05B-1139-B214 | | 6-axes brake type<br>Clean class 10 (ISO class 4) specification |
| FANUC Robot LR Mate 200*i*C/5C | A05B-1139-B221 | | 6-axes brake type<br>Clean class 100 (ISO class 5) specification |
| | A05B-1139-B222 | | 6-axes brake type<br>Clean class 10 (ISO class 4) specification |
| FANUC Robot LR Mate 200*i*C/5WP | A05B-1139-B231 | | 6-axes brake type<br>Washing specification |
| FANUC Robot LR Mate 200*i*C/5H | A05B-1139-B101 | | 3-axes brake type<br>Non-severe dust/liquid protection specification |
| | A05B-1139-B102 | | 5-axes brake type<br>Non-severe dust/liquid protection specification |
| | A05B-1139-B103 | | 3-axes brake type<br>severe dust/liquid protection specification |
| | A05B-1139-B104 | | 5-axes brake type<br>severe dust/liquid protection specification |
| | A05B-1139-B107 | | 3-axes brake type<br>Non-severe dust/liquid protection specification<br>(High spped wrist) |
| | A05B-1139-B108 | | 5-axes brake type<br>Non-severe dust/liquid protection specification<br>(High spped wrist) |
| | A05B-1139-B109 | | 3-axes brake type<br>severe dust/liquid protection specification<br>(High spped wrist) |

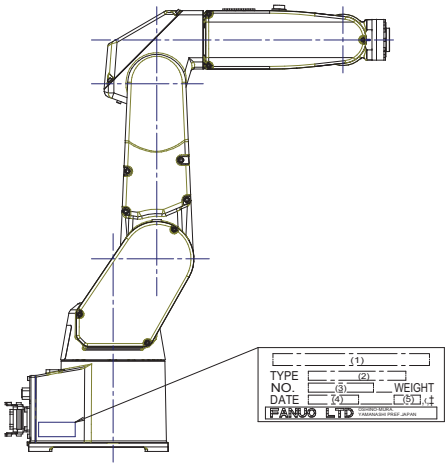
| Model name | Mechanical unit specification No. | Maximum load | Remarks |
|---|---|---|---|
| FANUC Robot LR Mate 200*i*C/5H | A05B-1139-B110 | 5kg | 5-axes brake type<br>severe dust/liquid protection specification<br>(High spped wrist) |
| FANUC Robot LR Mate 200*i*C/5F | A05B-1139-B105 | | 3-axes brake type<br>(2nd food specification) |
| | A05B-1139-B106 | | 5-axes brake type<br>(2nd food specification) |
| FANUC Robot ARC Mate 50*i*C | A05B-1139-B251 | | 3-axes brake type<br>Non-severe dust/liquid protection specification |
| | A05B-1139-B252 | | 6-axes brake type<br>Non-severe dust/liquid protection specification |
| | A05B-1139-B253 | | 3-axes brake type<br>severe dust/liquid protection specification |
| | A05B-1139-B254 | | 6-axes brake type<br>severe dust/liquid protection specification |
| FANUC Robot ARC Mate 50*i*C/5L | A05B-1139-B261 | | 6-axes brake type<br>Non-severe dust/liquid protection specification |
| | A05B-1139-B262 | | 6-axes brake type<br>severe dust/liquid protection specification |

**NOTE**

The following abbreviations are used herein.

| | |
|---|---|
| STANDARD | : LR Mate 200*i*C, ARC Mate 50*i*C |
| 5L | : LR Mate 200*i*C/5L, ARC Mate 50*i*C/5L |
| 5LC | : LR Mate 200*i*C/5LC |
| 5C | : LR Mate 200*i*C/5C |
| 5WP | : LR Mate 200*i*C/5WP |
| 5H | : LR Mate 200*i*C/5H |
| 5F | : LR Mate 200*i*C/5F |

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




**Position of label indicating mechanical unit specification number**

**TABLE 1)**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **CONTENTS** | **-** | **TYPE** | **No.** | **DATE** | **WEIGHT (Without controller)** |
| LETTERS | FANUC Robot LR Mate 200*i*C | A05B-1139-B201 | PRINT SERIAL NO. | PRINT PRODUCTION YEAR AND MONTH | 27kg |
| | | A05B-1139-B202 | | | |
| | | A05B-1139-B203 | | | |
| | | A05B-1139-B204 | | | |
| | FANUC Robot LR Mate 200*i*C/5L | A05B-1139-B211 | | | 29kg |
| | | A05B-1139-B212 | | | |
| | FANUC Robot LR Mate 200*i*C/5LC | A05B-1139-B213 | | | |
| | | A05B-1139-B214 | | | |
| | FANUC Robot LR Mate 200*i*C/5C | A05B-1139-B221 | | | 27kg |
| | | A05B-1139-B222 | | | |
| | FANUC Robot LR Mate 200*i*C/5WP | A05B-1139-B231 | | | |
| | FANUC Robot LR Mate 200*i*C/5H | A05B-1139-B101 | | | 26kg |
| | | A05B-1139-B102 | | | |
| | | A05B-1139-B103 | | | |
| | | A05B-1139-B104 | | | |
| | | A05B-1139-B107 | | | |
| | | A05B-1139-B108 | | | |
| | | A05B-1139-B109 | | | |
| | | A05B-1139-B110 | | | |
| | FANUC Robot LR Mate 200*i*C/5F | A05B-1139-B105 | | | |
| | | A05B-1139-B106 | | | |
| | ARC Mate 50*i*C | A05B-1139-B251 | | | 27kg |
| | | A05B-1139-B252 | | | |
| | | A05B-1139-B253 | | | |
| | | A05B-1139-B254 | | | |
| | ARC Mate 50*i*C/5L | A05B-1139-B261 | | | 29kg |
| | | A05B-1139-B262 | | | |

**Positon of label indicating mechanical unit specification number**

## RELATED MANUALS

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

| | | |
|---|---|---|
| Safety handbook B-80687EN<br>All persons who use the FANUC Robot and system designer must read and understand<br>thoroughly this handbook | | Intended readers :<br>All persons who use FANUC Robot, system designer<br>Topics :<br>Safety items for robot system design, operation, maintenance |
| R-30*i*A Mate controller | Operations manual<br><br>LR HANDLING TOOL<br>B-82724EN-1<br>ALARM CODE LIST<br>B-82594EN-6<br>ALARM CODE LIST<br>(for series 7DA4/7DA5)<br>B-83124EN-6 | Intended readers :<br>Operator, programmer, maintenance person, system designer<br>Topics :<br>Robot functions, operations, programming, setup, interfaces, alarms<br>Use :<br>Robot operation, teaching, system design |
| | Maintenance manual<br><br>Standard:<br>B-82725EN<br>B-82725EN-1<br>(For Europe)<br>B-82725EN-2<br>(For RIA)<br><br>Open air type:<br>B-82965EN<br>B-82965EN-1<br>(For Europe and RIA ) | Intended readers :<br>Maintenance person, system designer<br>Topics :<br>Installation, connection to peripheral equipment, maintenance<br>Use :<br>Installation, start-up, connection, maintenance |

# TABLE OF CONTENTS

# 1 TRANSPORTATION AND INSTALLATION

## 1.1 TRANSPORTATION

The robot can be transported by a crane. When transporting the robot, be sure to change the attitude of the robot to that shown below and lift by using the eyebolts and the transport equipment at their points.

**⚠WARNING**
1 Robot becomes unstable when it is transported with the end effector applied to wrist ,and it is dangerous. Please be sure to remove end effector when robot is transported.
2 Before moving the robot by using crane, check and tighten any loose bolts on the forklift pockets.
3 Do not pull eyebolts sideways.

Transportation using a crane (Fig. 1.1 (a),(b),(c),(d))
Fasten the M8 eyebolts to the four points of the robot base and lift the robot by the four slings.

**⚠CAUTION**
Note that a sling with insufficient length may break the J2 base or J2 arm cover.

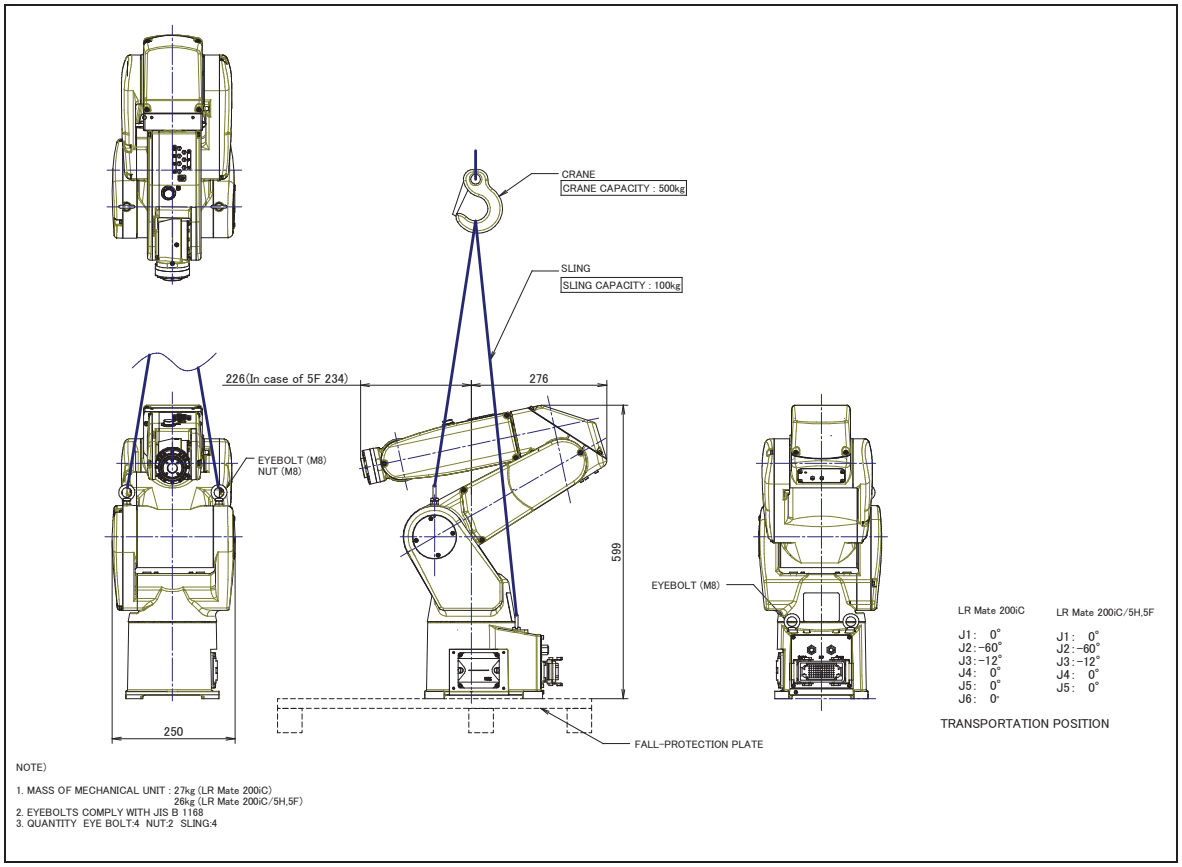



**Fig. 1.1 (a) Transportation using a crane(LR Mate 200*i*C,LR Mate 200*i*C/5WP,5H,5F, ARC Mate 50*i*C)**

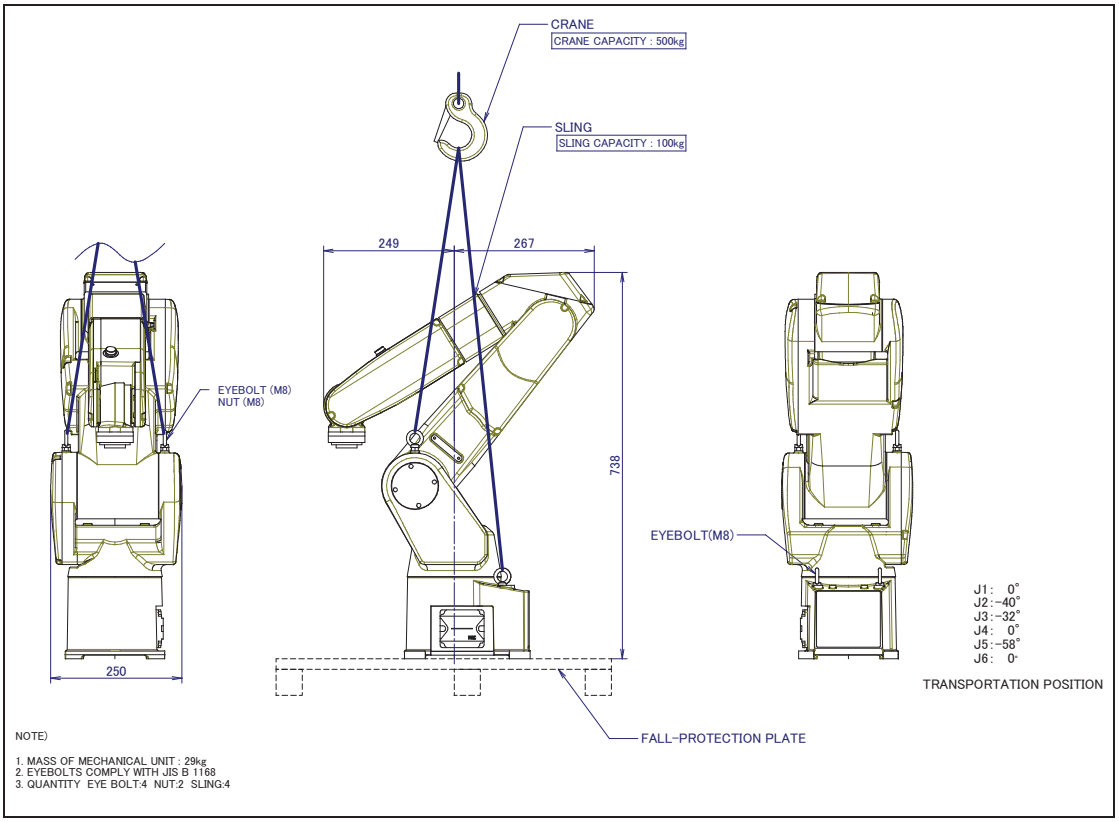



**Fig. 1.1 (b) Transportation using a crane (LR Mate 200*i*C/5L5L , ARC Mate 50*i*C/5L)**

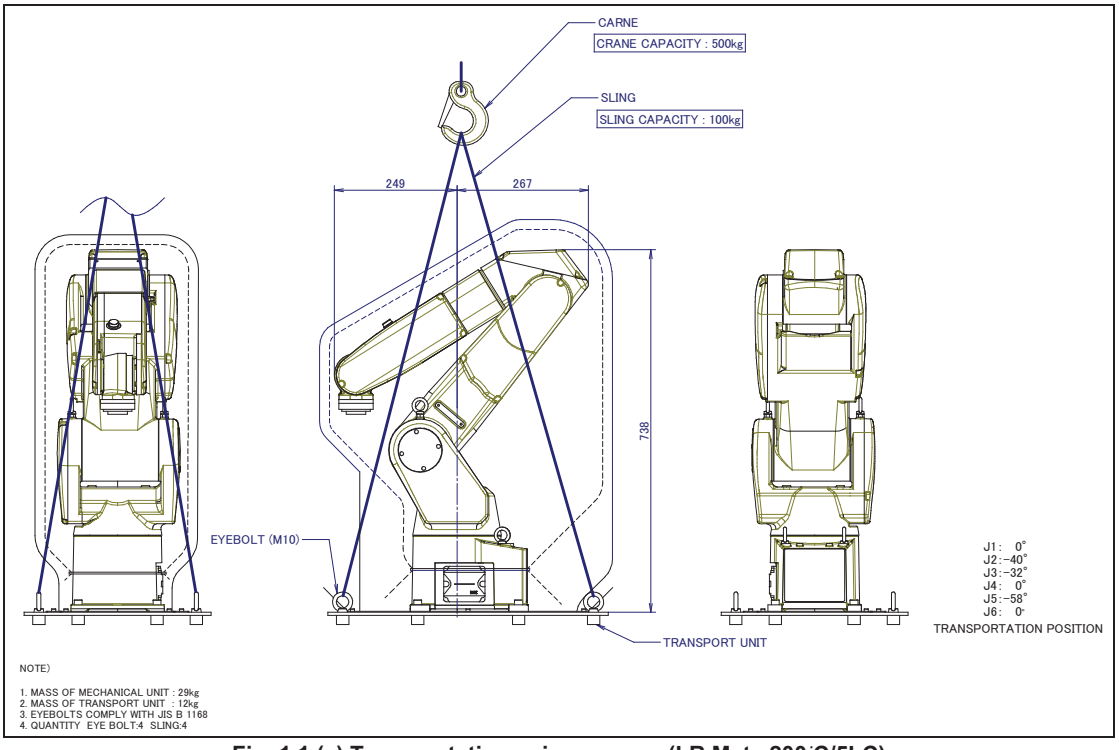



**Fig. 1.1 (c) Transportation using a crane (LR Mate 200*i*C/5LC)**

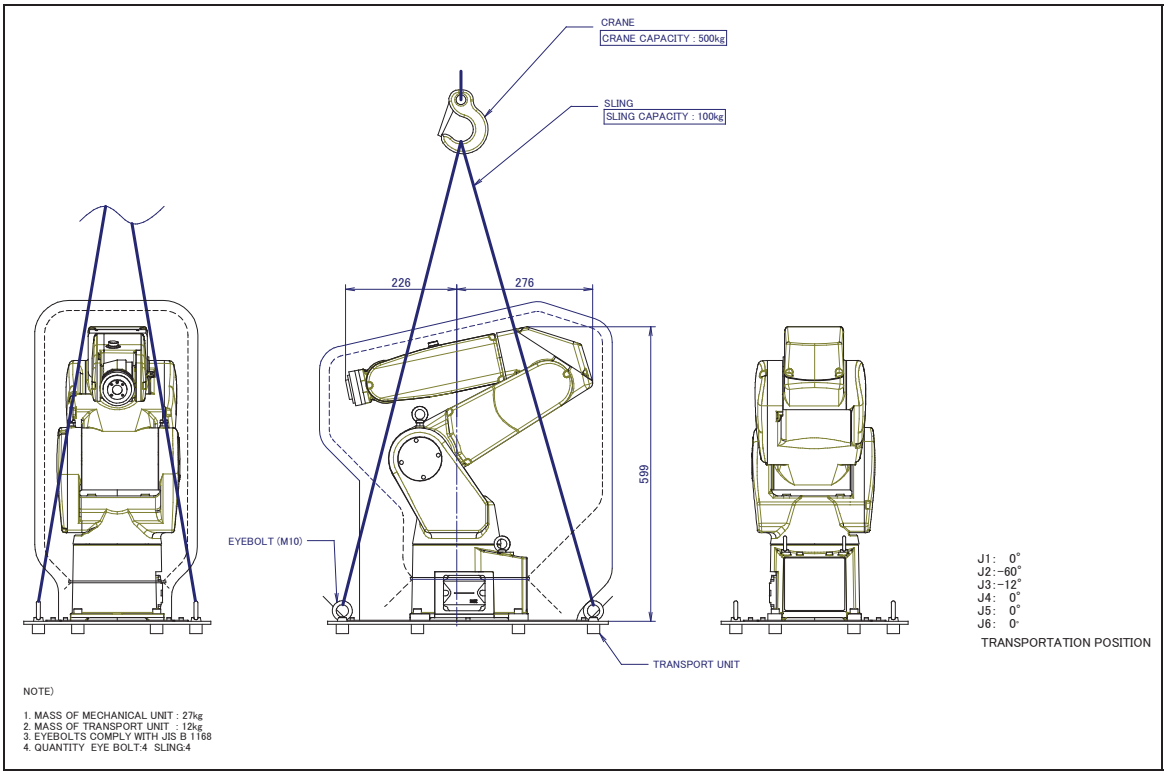



**Fig. 1.1 (d) Transportation using a crane (LR Mate 200*i*C/5C)**

**NOTE**
About the LR Mate 200*i*C/5LC,5C
1 Before shipment of the LR Mate 200*i*B/5C, it is cleaned in a clean room, covered with an antistatic sheet, then packed as shown in Fig. 1.1 (c) and (d).
2 The transport plate can be used as a roll–over prevention plate in a clean room. If the plate is cleaned before being carried in a clean room, it can be carried in the room together with the robot.
3 The antistatic sheet can be removed in a clean room.
4 When installing the robot, use the eyebolts to lift it as shown Figs 1.1 (c) and (d).
5 Once the robot has been installed, remove the eyebolts from it.
6 After transportation, be sure to fix it as described in Section 1.2.

# 1.2 INSTALLATION

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

Fig. 1.2 (b) and Table 1.2 (a),(b),(c) show the force and moment applied to the J1 base. Refer to the data when considering the strength of the installation face.

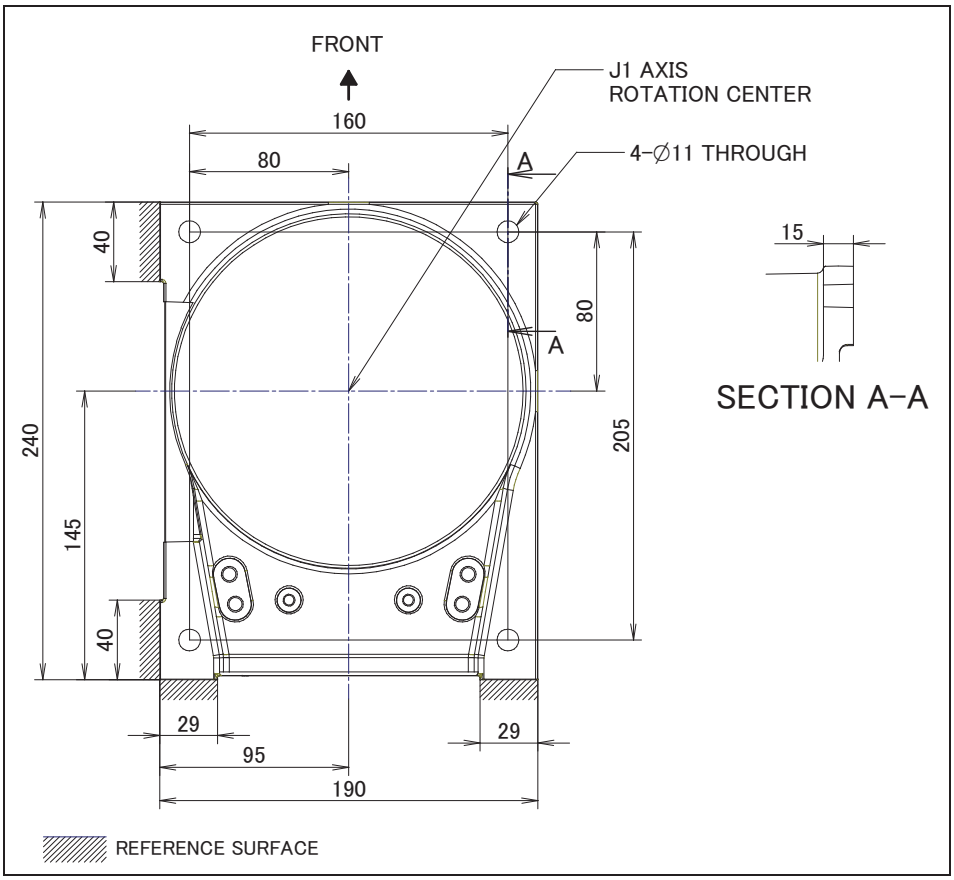



**Fig. 1.2 (a) Dimensions of the robot base**

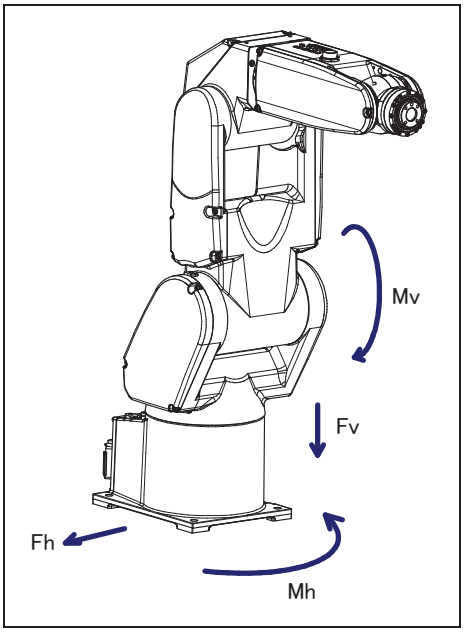



**Fig. 1.2 (b) Force and moment that acts on J1 base**

**Table 1.2 (a) Force and moment that acts on J1 base LR Mate 200*i*C, /5H, /5WP, /5C, /5F, ARC Mate 50*i*C**

| | Vertical moment Mv(Nm) | Force in Vertical direction Fv(N) | Horizontal moment Mh(Nm) | Force in Horizontal direction Fh(N) |
|---|---|---|---|---|
| During stillness | 116.3 | 321.7 | 0 | 0 |
| During acceleration or deceleration | 383.0 | 633.7 | 224.3 | 726.9 |
| During emergency stop | 635.9 | 1101.4 | 470.4 | 776.4 |

**Table 1.2 (b) Force and moment that acts on J1 base LR Mate 200*i*C /5L, /5LC, ARC Mate 50*i*C/5L**

| | Vertical moment Mv(Nm) | Force in Vertical direction Fv(N) | Horizontal moment Mh(Nm) | Force in Horizontal direction Fh(N) |
|---|---|---|---|---|
| During stillness | 138.5 | 333.2 | 0 | 0 |
| During acceleration or deceleration | 335.6 | 586.5 | 169.8 | 578.1 |
| During emergency stop | 727.8 | 992.6 | 514.5 | 720.3 |

**Table 1.2 (c) Time during which and angle through which the robot runs by inertia since the entry of an emergency stop signal**

| | J1 | J2 | J3 |
|---|---|---|---|
| Time during which the robot runs by inertia [ms] | 243 | 355 | 172 |
| Angle through which the robot runs by inertia [deg] (rad) | 44.0 (0.77) | 45.9 (0.80) | 39.4 (0.69) |

*Override: 100%
*Maximum-inertial posture with maximum load mounted

# 1.3 MAINTENANCE AREA

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

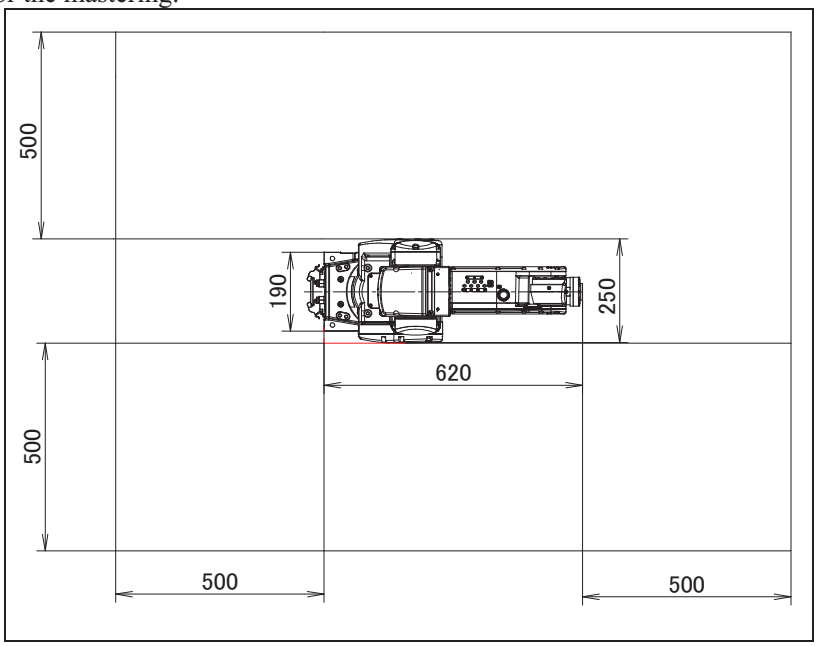



**Fig. 1.3 (a) Maintenance area (LR Mate 200*i*C ,LR Mate 200*i*C5C, 5WP,5H,5F, ARC Mate 50*i*C)**

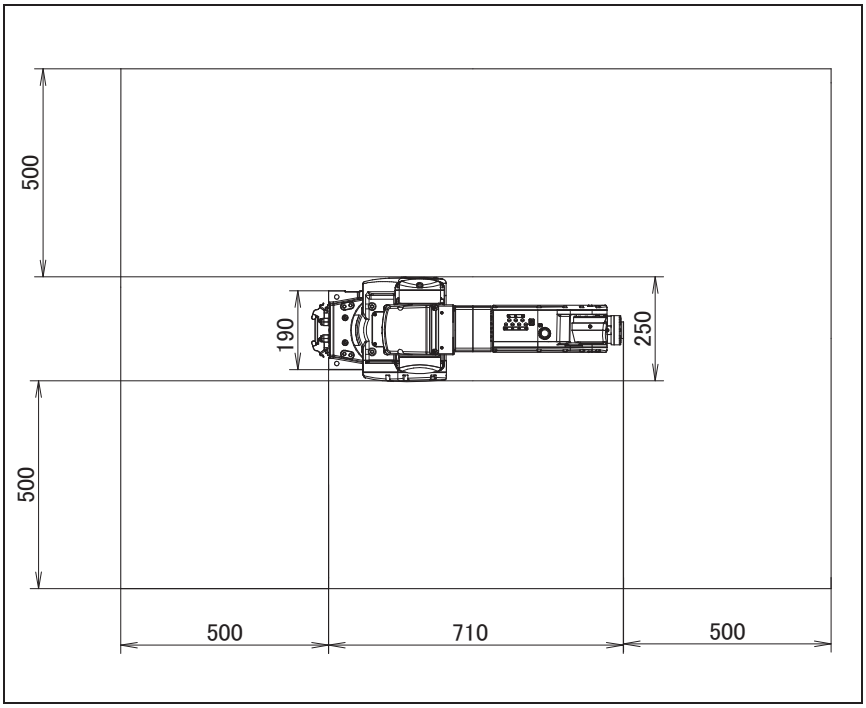



**Fig. 1.3 (b) Maintenance area (LR Mate 200*i*C/5L, LR Mate 200*i*C/5LC, ARC Mate 50*i*C/5L)**

# 1.4 INSTALLATION SPECIFICATIONS

Refer to caution below about installation specifications.
Refer to specifications of Section 3.1 and Section 3.2 ,too.

**⚠CAUTION**
When external battery option is specified, Please fix the battery box in the part without the vibration, and do measures of a protection against dust and liquid.

**⚠CAUTION**
The wound of coating of robot connection cable and external battery cable causes the flood. Please note handling enough when setting it up, and exchange it when damaging.

# 2 CONNECTION WITH THE CONTROLLER

## 2.1 CONNECTION WITH THE CONTROLLER

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

**⚠ CAUTION**
1 Before connecting the cables, be sure to turn off the controller power.
2 Don't use 10m or longer coiled cable without untying. The long coiled cable will heat and damage itself.
3 If external batteries are in use, do not remove it with the power supply turned off. Replacing the batteries with the power supply turned off causes all current position data to be lost. Therefore, mastering will be required again.

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

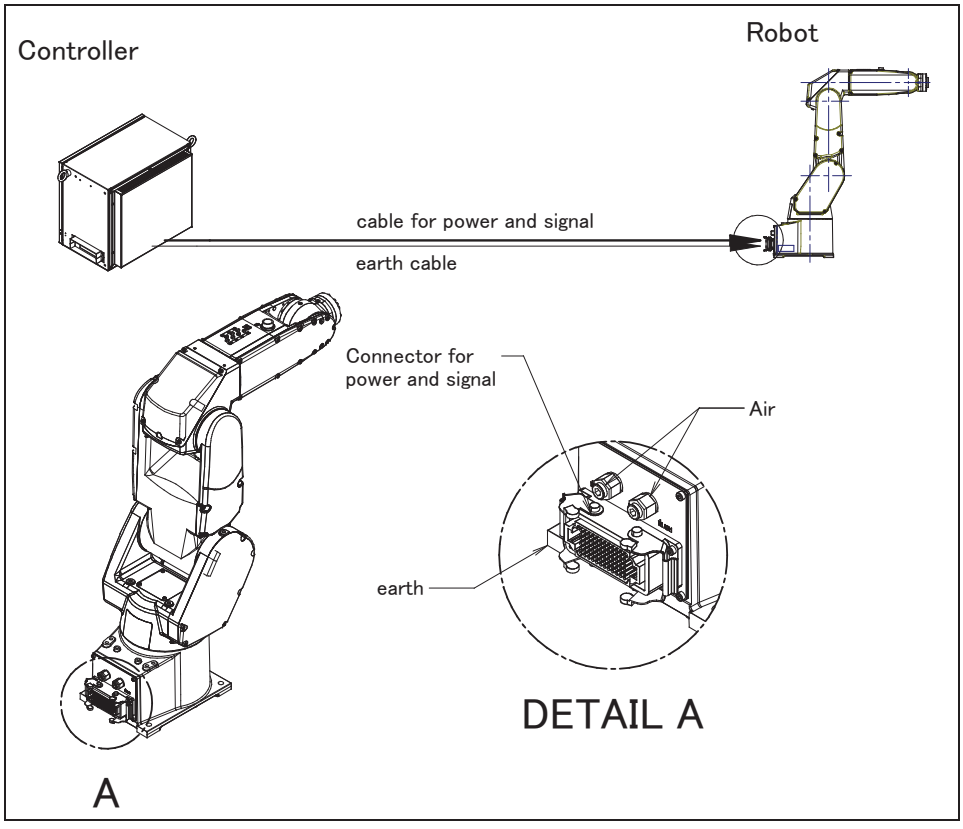



**Fig. 2.1 Cable connection**

# 3 BASIC SPECIFICATIONS

## 3.1 ROBOT CONFIGURATION

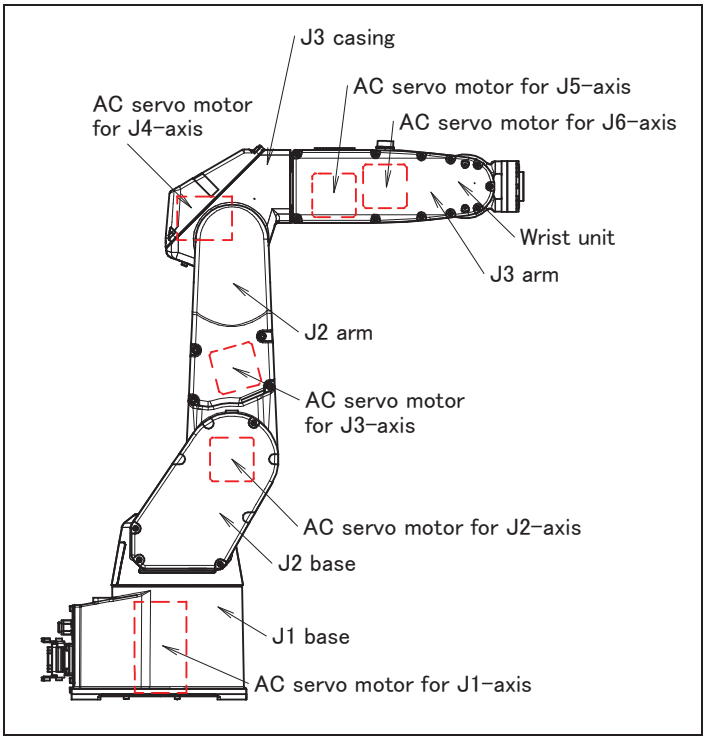



**Fig. 3.1 (a) Mechanical unit configuration**
**(LR Mate 200*i*C,LR Mate 200*i*C/5L,5LC,5C,5WP,ARC Mate 50*i*C,ARC Mate 50*i*C/5L)**

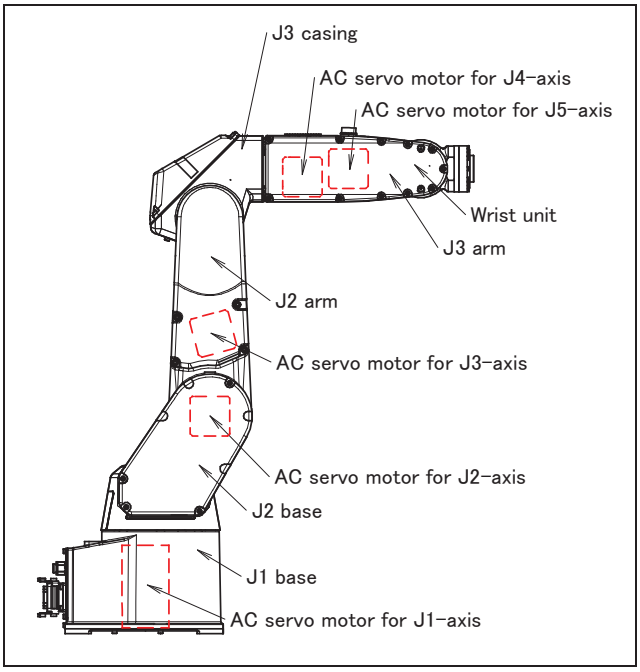



**Fig. 3.1 (b) Mechanical unit configuration (LR Mate 200*i*C/5H,5F)**

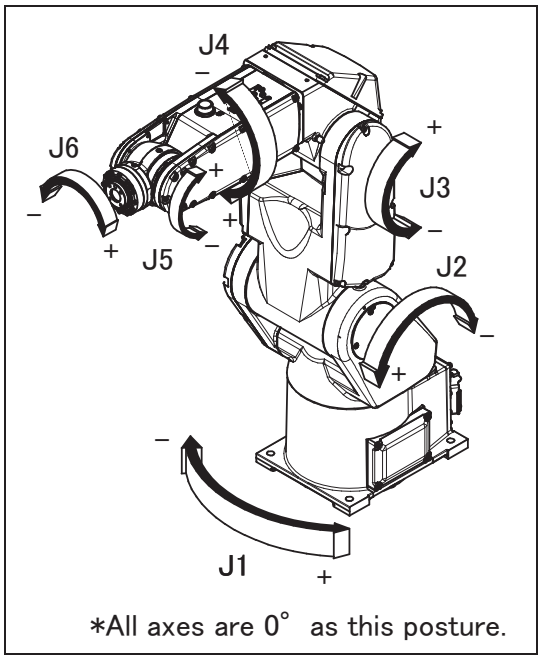



**Fig. 3.1 (c) Each axes coordinates**
**(LR Mate 200*i*C,LR Mate 200*i*C/5L,5LC,5C,5WP ,ARC Mate 50*i*C,ARC Mate 50*i*C/5L)**

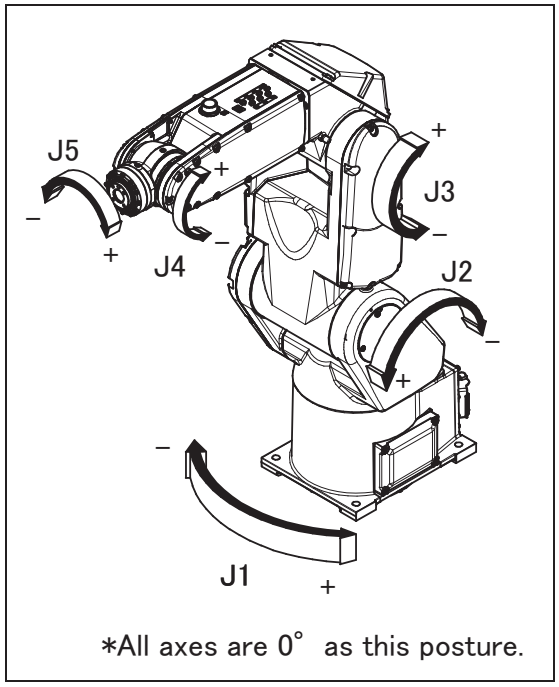



**Fig. 3.1 (d) Each axes coordinates (LR Mate 200*i*C/5H,5F)**

**Table 3.1 (a) Specifications (1/2)**

| Item | | Specification | | |
|---|---|---|---|---|
| Model | | LR Mate 200*i* C<br>LR Mate 200*i* C/5C<br>LR Mate 200*i* C/5WP<br>ARC Mate 50*i* C | LR Mate 200*i* C/5H | LR Mate 200*i* C/5L<br>LR Mate 200*i* C/5LC<br>ARC Mate 50*i* C/5L |
| Type | | Articulated Type | | |
| Controlled axis | | 6-axes(J1,J2,J3,J4,J5,J6) | 5-axes(J1,J2,J3,J4,J5) | 6-axes(J1,J2,J3,J4,J5,J6) |
| Reach | | 704mm | | 892mm6-axes(J1,J2,J3,J4,J5,J6) |
| Installation (NOTE 1) | | Floor, Upside-down, (Angle mount) | | |
| Motion range (Max. speed) (NOTE 2) | J1-axis | 340°/360° (option) (350°/sec)<br>5.93rad/6.28rad(option) (6.11rad/sec) | | 340°/360° (option) (270°/sec)<br>5.93rad/6.28rad(option) (4.71rad/sec) |
| | J2-axis | 200° (350°/sec)<br>3.49rad (6.11rad/sec) | | 230° (270°/sec)<br>4.01rad (4.71rad/sec) |
| | J3-axis | 388° (400°/sec)<br>6.77rad (6.98rad/sec) | | 373° (270°/sec)<br>6.51rad (4.71rad/sec) |
| | J4-axis | 380° (450°/sec)<br>6.63rad (7.85rad/sec) | 240° (450°/sec)<br>4.19rad (7.85rad/sec) | 380° (450°/sec)<br>6.63rad (7.85rad/sec) |
| | J5-axis | 240° (450°/sec)<br>4.19rad (7.85rad/sec) | 720° (720°/sec)<br>12.57rad (12.57rad/sec) | 240° (450°/sec)<br>4.19rad (7.85rad/sec) |
| | J6-axis | 720° (720°/sec)<br>12.57rad (12.57rad/sec) | | 720° (720°/sec)<br>12.57rad (12.57rad/sec) |
| Max. load capacity (NOTE 3) | Wrist | Max.5 kg | | |
| Allowable load moment at wrist | J4-axis | 11.9Nm | | |
| | J5-axis | 11.9Nm | 6.7Nm | 11.9Nm |
| | J6-axis | 6.7Nm | | 6.7Nm |
| Allowable load inertia at wrist | J4-axis | 0.3 kg·m$^2$ | | |
| | J5-axis | 0.3 kg·m$^2$ | 0.1 kg·m$^2$ | 0.3 kg·m$^2$ |
| | J6-axis | 0.1 kg·m$^2$ | | 0.1 kg·m$^2$ |
| Installation environment (NOTE 4) (NOTE 5) (NOTE 6) | | Ambient temperature: 0 - 45°C<br>Ambient humidity: Normally 75%RH or less. No dew, nor frost allowed.<br>Short time (within one month) Max 95%RH<br>Height: Up to 1,000 meters above the sea level required,<br>no particular provision for attitude.<br>Vibration: 0.5G or less<br>Free of corrosive gases (Note 7) | | |
| Acoustic noise level | | Less than 70dB<br>NOTE) This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.<br>- Maximum load and speed<br>- Operating mode is AUTO | | |
| Drive method | | Electric servo drive by AC servo motor | | |
| Repeatability | | ±0.02mm | | ±0.03mm |
| Dust.proof and drip.proof mechanism（NOTE 8） | | Conform to IP67(When severe dust/liquid protection specification or 5WPis selected.) | | |
| Weight of machine unit (NOTE 9) | | 27kg | 26 kg | 29kg |

NOTE 1) Under the installation condition within ( ), the J1 and J2 axis motion range will be limited. See Section 3.7.

NOTE 2) It does not arrive at each axial maximum speed at the short movement distance.

NOTE 3) The all up weight including the equipment and connection cables and its swing must not exceed this value when you install the equipment. See section 3.6.

NOTE 4) LR Mate 200*i*C/5C,5LC has clean class 100 and clean class 10-2 kind.

NOTE 5) Don't use the LR Mate 200*i*C/5C,5LC clean class 10 in splash, mist ,dust and corrosive environment. Vacuum 180Nl/min of the air from the suction port.

NOTE 6) In case that the mechanical unit is no severe dust/liquid protection specification or the controller is open air type, they should be installed in the environment of "Pollusion degree 2" regulated in IEC 60664-1 (JIS C 0664). "Pollution degree 2" means cleanly environment like an office.

NOTE 7) 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.
NOTE 8 ) The liquid that is the deterioration of the seal material such as Organic solvent, acid, alkali, chlorine system, and gasoline system cutting liquid cannot be use.(See Section 3.2.)
NOTE 9) It doesn't contain the mass of the control part.

**Table 3.1 (b) Specifications (2/2)**

| Item | | Specification | |
|---|---|---|---|
| Model | | LR Mate 200*i* C/5H<br>High speed wrist | LR Mate 200*i* C/5F |
| Type | | Articulated Type | |
| Controlled axis | | 5-axes(J1,J2,J3,J4,J5) | |
| Reach | | 704mm | 711mm |
| Installation (NOTE 1) | | Floor, Upside-down, (Angle mount) | |
| Motion range (Max. speed) (NOTE 2) | J1-axis | 340°/360°(option) (350°/sec)<br>5.93rad/6.28rad(option) (6.11rad/sec) | |
| | J2-axis | 200° (350°/sec)<br>3.49rad (6.11rad/sec) | |
| | J3-axis | 388° (400°/sec)<br>6.77rad (6.98rad/sec) | |
| | J4-axis | 240° (450°/sec)<br>4.19rad (7.85rad/sec) | |
| | J5-axis | 720° (1200°/sec)<br>12.57rad (20.94rad/sec) | |
| Max. load capacity (NOTE 3) | Wrist | Max. 5 kg | |
| Allowable load moment at wrist | J4-axis | 11.9Nm | |
| | J5-axis | 4.0Nm | |
| Allowable load inertia at wrist | J4-axis | 0.3 kg·m$^2$ | |
| | J5-axis | 0.036 kg·m$^2$ | |
| Installation environment (NOTE 4) (NOTE 5) (NOTE 6) | | Ambient temperature: 0 - 45°C<br>Ambient humidity: Normally 75%RH or less. No dew, nor frost allowed.<br>Short time (within one month) Max 95%RH<br>Height: Up to 1,000 meters above the sea level required,<br>no particular provision for attitude.<br>Vibration: 0.5G or less<br>Free of corrosive gases (Note 7) | |
| Acoustic noise level | | Less than 70dB<br>NOTE) This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.<br>- Maximum load and speed<br>- Operating mode is AUTO | |
| Drive method | | Electric servo drive by AC servo motor | |
| Repeatability | | ±0.02mm | |
| Dust.proof and drip.proof mechanism（NOTE 8） | | Conform to IP67(When severe dust/liquid protection specification or 5Fis selected.) | |
| Weight of machine unit (NOTE 9) | | 26kg | |

# 3.2 NOTE WHEN SEVERE DUST/LIQUID SPECIFICATION IS SELECTED

## 3.2.1 Cautions in Selecting the Severe Dust/Liquid Protection Specification, 5WP or 5F

1 The liquids below cannot be applied because they may causedeterioration or corrosion of the rubber parts (such as packings, oil seals, and O-rings) used in the robot.
   (a) Organic solvent
   (b) Chlorine- or gasoline-based cutting fluid
   (c) Amine-based cleaning fluid
   (d) Liquid or solution that includes a corrosive such as an acid or alkali or causes rust
   (e) Some other liquid or solution to which nitrile rubber (NBR) does not have resistance
2 When the robot is used in an environment where a liquid such as water is dashed over the robot, great attention should be given to drainage under the J1 base. A failure may be caused if the J1 base is kept immersed inwater due to poor drainage.
3 Please exchange it absolutely for the new article when you remove the gasket or packings by the component replacement and the check.
4 Don't use unconfirmed liquid.

## 3.2.2 Cautions in Selecting the 5WP

1 The 5WP specifies cleaning liquids usable with the robot.
(Always keep all the liquids at or below 60°C.)

| Liquid model name | Manufacturer name | Permissible concentration |
|---|---|---|
| CleanMate MS-1 | TOHO Chemical Industry Co., LTD. | 5.0%<br>Diluted to 20 parts of water |
| Toyosol ST-91P | Toyoda Chemical Industry Co., Ltd. | 2.0%<br>Diluted to 50 parts of water. |
| Toyosol SE-78P | Toyoda Chemical Industry Co., Ltd. | 5.0%<br>Diluted to 20 parts of water. |
| TOYOKNOCK RE-777P | Toyoda Chemical Industry Co., Ltd. | 3.0%<br>Diluted to 33 parts of water. |
| Detergent 2200 | NEOS COMPANY LIMITED | 1.5%<br>Diluted to 67 parts of water. |
| MP-70 | Henkel Japan | 3.0%<br>Diluted to 33 parts of water. |
| Pakuna FD-800 | YUKEN Industry CO., LTD. | 5.0%<br>Diluted to 20 parts of water. |
| Yushiro cleaner W51H | YUSHIRO CHEMICAL INDUSTRY CO., LTD. | 3.3%<br>Diluted to 30 parts of water. |
| Yushiro cleaner W80 | YUSHIRO CHEMICAL INDUSTRY CO., LTD. | 3.3%<br>Diluted to 30 parts of water. |

2 Note that applying a cleaning liquid not included in the specification or one beyond its permissible concentration or temperature even if it is included in the specification to the robot may results in serious damage to the robot.
3 The cables connecting the robot, controller, and external battery are not resistant to any cleaning liquid.So, install them in such a way that no cleaning liquid will be splashed to the cables.

4 Be sure to perform air purge by regulated pressure.(See Section 5.2.) Please do the air purge whenever the robot is stopping or the power supply is cut. The air purge stop causes the flood and the be dewy in the mechanism.
Don't apply factory air without any filter.

### 3.2.3 Cautions in Selecting the 5C or 5LC (clean class 100)

1 As for the clean specification, only the robot mechanical unit satisfies clean class 100 (0.5 μm). Note that none of the controller, the cables between the controller and robot, and teach pendant does not meet the clean specification.
2 When using liquids in cleaning, see 1 and 4 in Subsection 3.2.1.
3 If packings are dismounted during parts replacement or inspection, replace them with new ones.

### 3.2.4 Cautions in Selecting the 5C or 5LC (clean class 10)

1 As for the clean specification, only the robot mechanical unit satisfies clean class 100 (0.5 μm). Note that none of the controller, the cables between the controller and robot, and teach pendant does not meet the clean specification.
2 When using liquids in cleaning, see 1 and 4 in Subsection 3.2.1.
3 If packings are dismounted during parts replacement or inspection, replace them with new ones.
4 Don't use the robot in splash, mist ,dust and corrosive environment
5 Vacuum 180Nl/min of the air from the suction port. (See Section 5.1)

## 3.3 MECHANICAL UNIT OPERATION AREA AND INTERFERENCE AREA

Fig. 3.3 (a) to (c) show the robot interference area. When installing peripheral devices, be careful to clear away any objects that are the robot and the robot's motion path in normal operation.

> ⚠ **NOTE**
> Fig. 3.3 (a) and Fig. 3.3 (b) are examples of LR Mate 200*i*C and ARC Mate 50*i*C, please read J5-axis as J4-axis throughout these figures in case of LR Mate 200*i*C/5H.

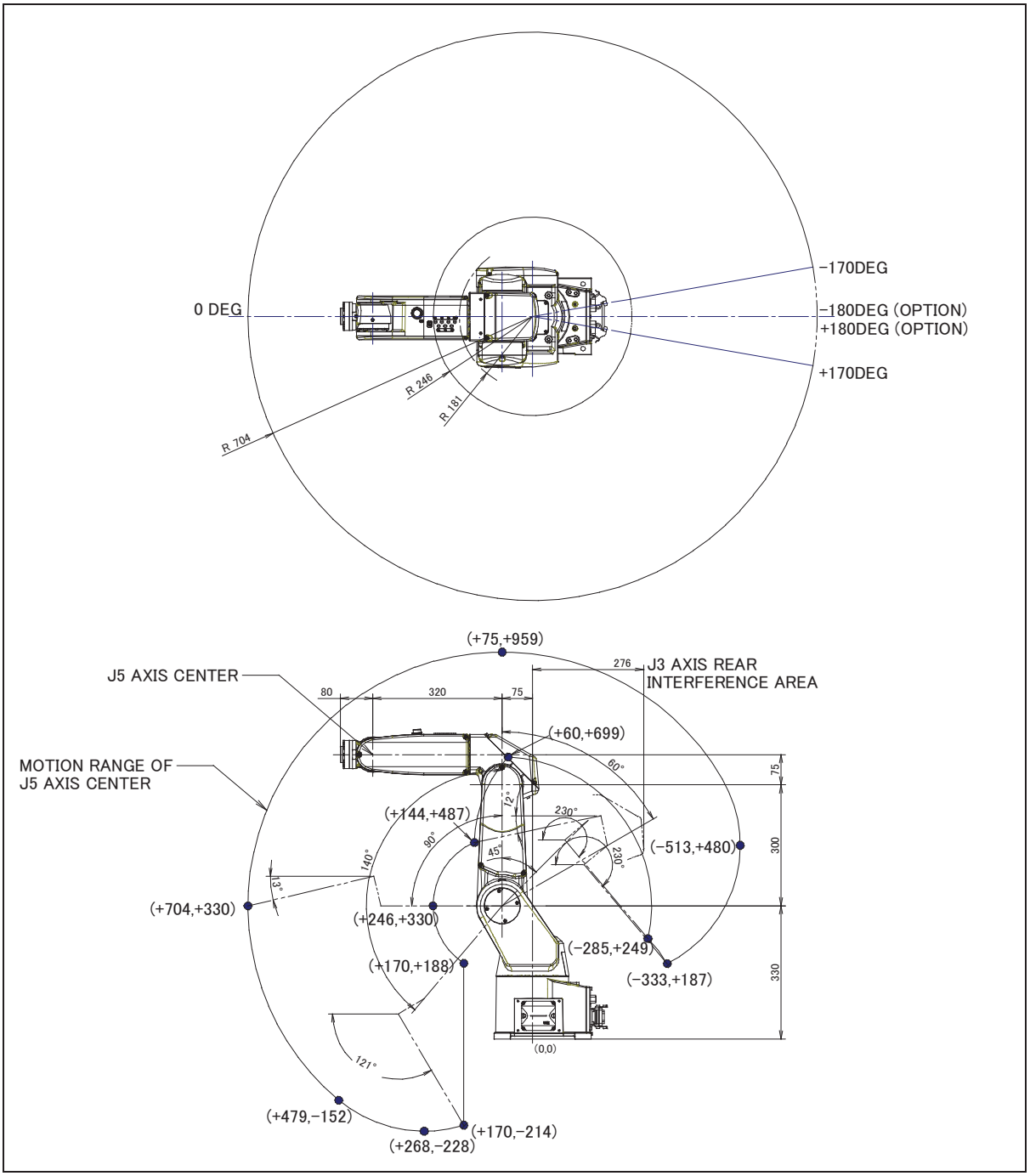



**Fig. 3.3 (a) Interference area(LR Mate 200*i*C,LR Mate 200*i*C/5C,5WP,5H, ARC Mate 50*i*C)**

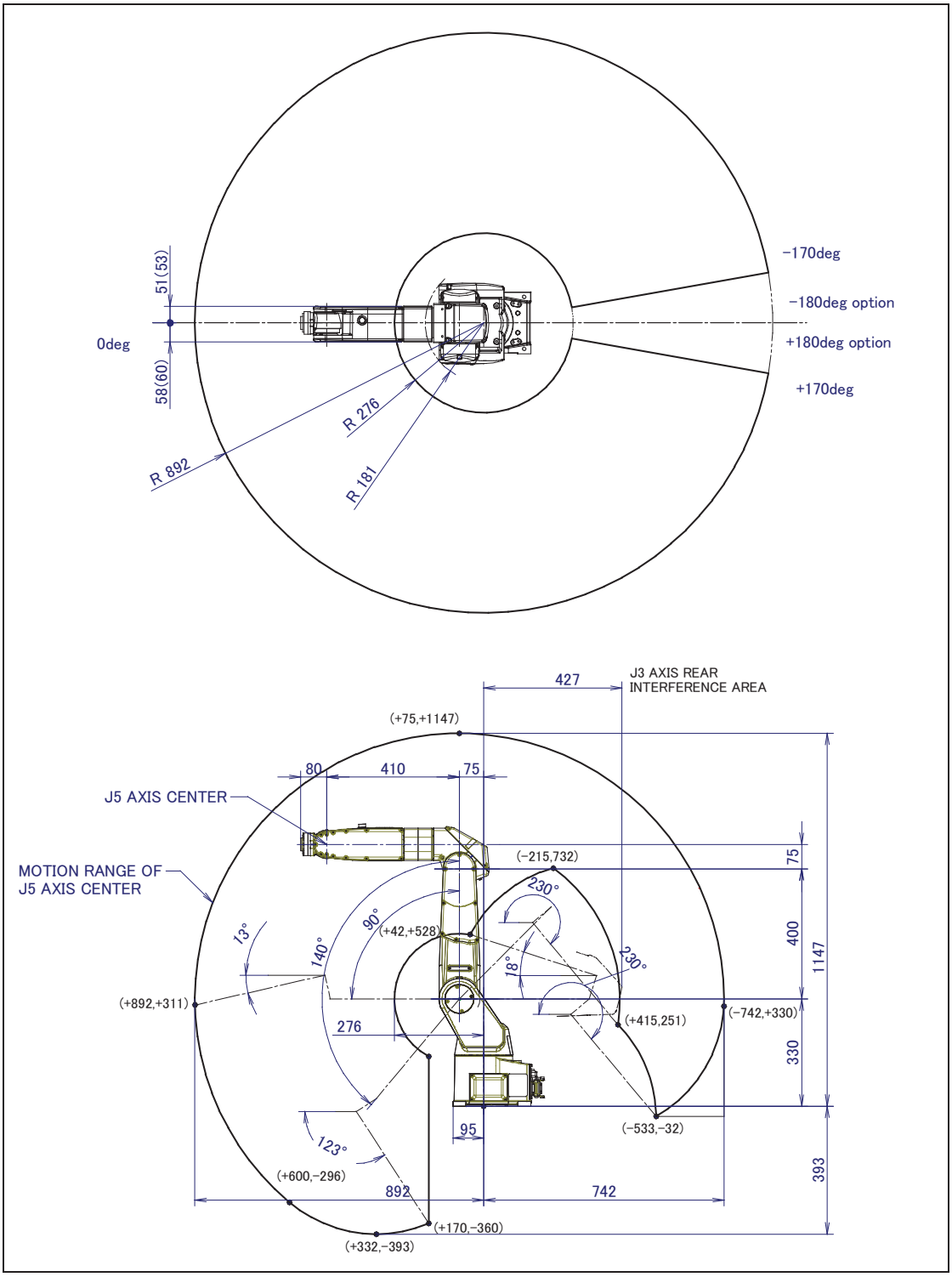



**Fig. 3.3 (b) Interference area(LR Mate 200*i*C/5L,5LC ARC Mate 50*i*C/5L)**

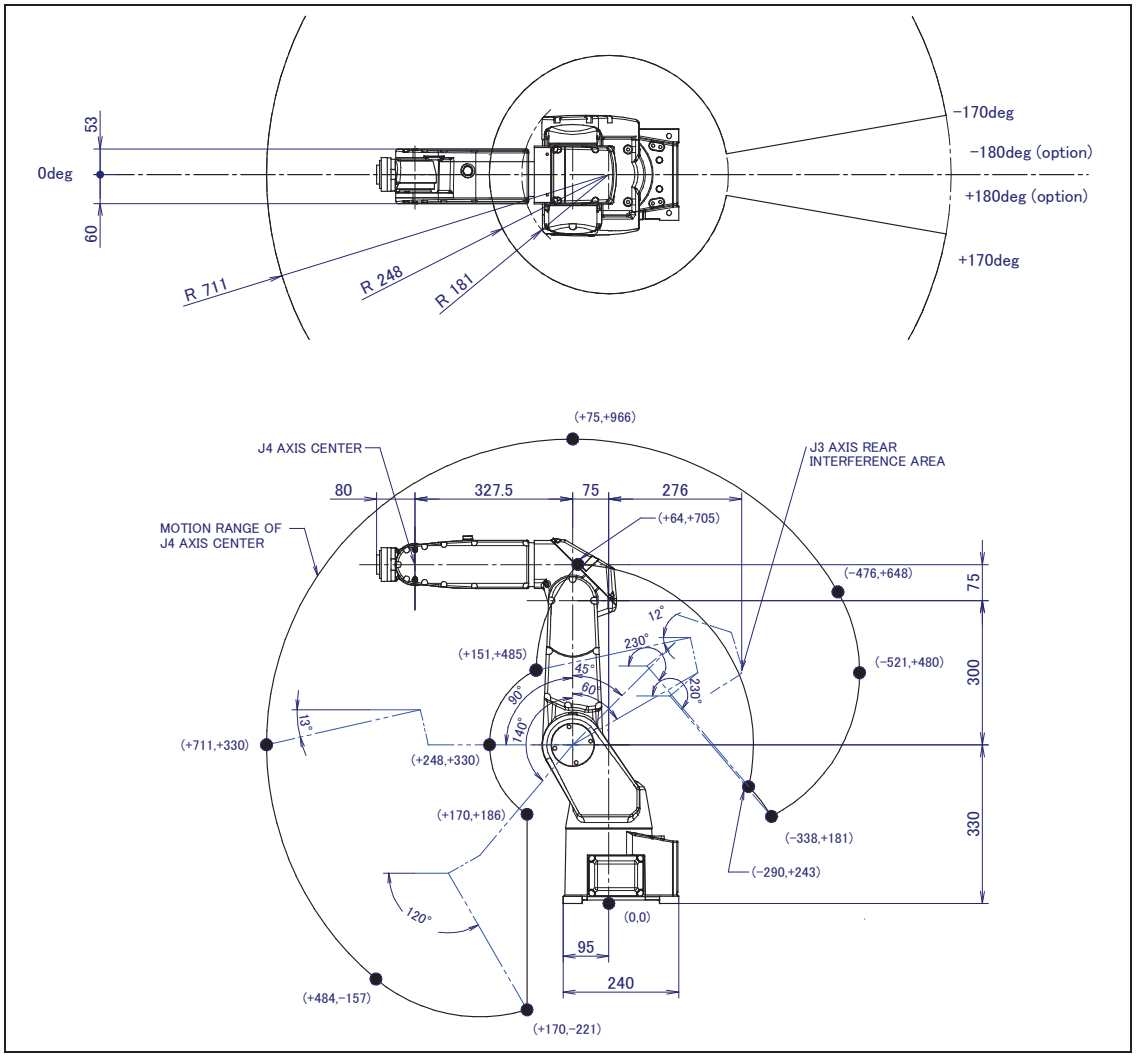



**Fig. 3.3 (c) Interference area(LR Mate 200*i*C/5F)**

# 3.4 ZERO POINT POSITION AND MOTION LIMIT

Zero point and software motion limit are provided for each controlled axis. The robot cannot exceed the software motion limit unless there is a failure of the system causing loss of zero point position or there is a system error.

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.
In addition, the motion range limit by a mechanical stopper is also prepared to improve safety.

Fig.3.4 (a) shows position of mechanical stopper. Don't reconstruct the mechanical stopper. There is a possibility that the robot doesn't stop normally.

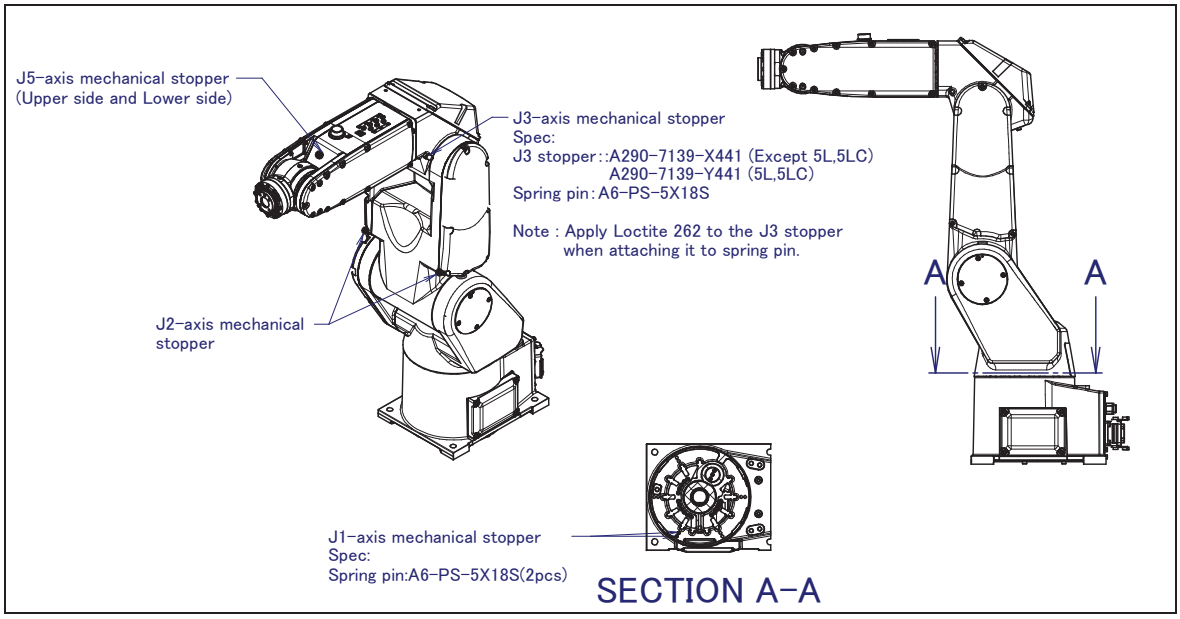



**Fig. 3.4 (a) Position of mechanical stopper**

Fig.3.4 (b) - (i) show the zero point , motion limit and maximum stopping distance (stopping distance in condition of max.speed and max.load) of each axis.
Only in case of J1-axis and J3-axis ,robot stops by transforming mechanical stopper. When the mechanical stopper is transformed, the exchange is needed. See Fig.3.4 (a) about replacing J3-axis mechanical stopper. Contact FANUC about replacing J1-axis mechanical stopper.

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

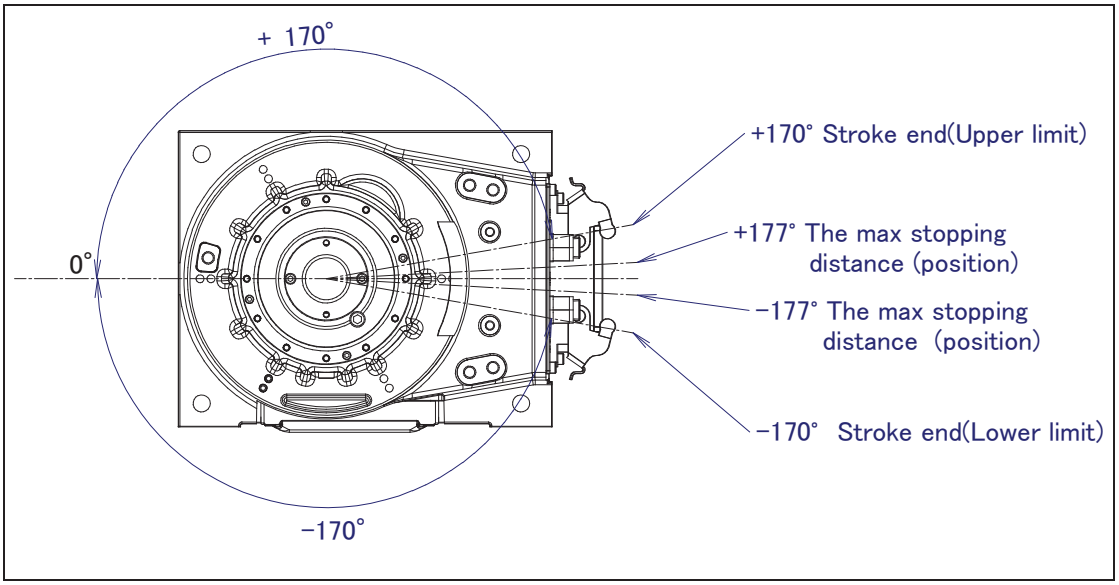



**Fig. 3.4 (b) J1-axis motion limit (J1-axis 340°turn specification)**

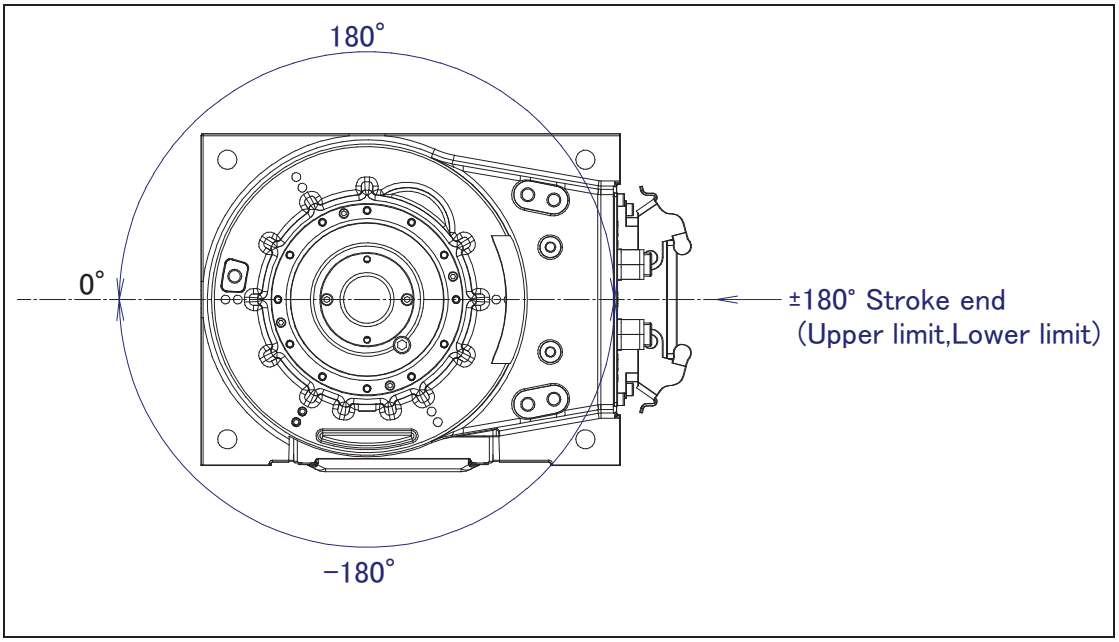



**Fig. 3.4 (c) J1-axis motion limit (J1-axis 360°turn specification)**

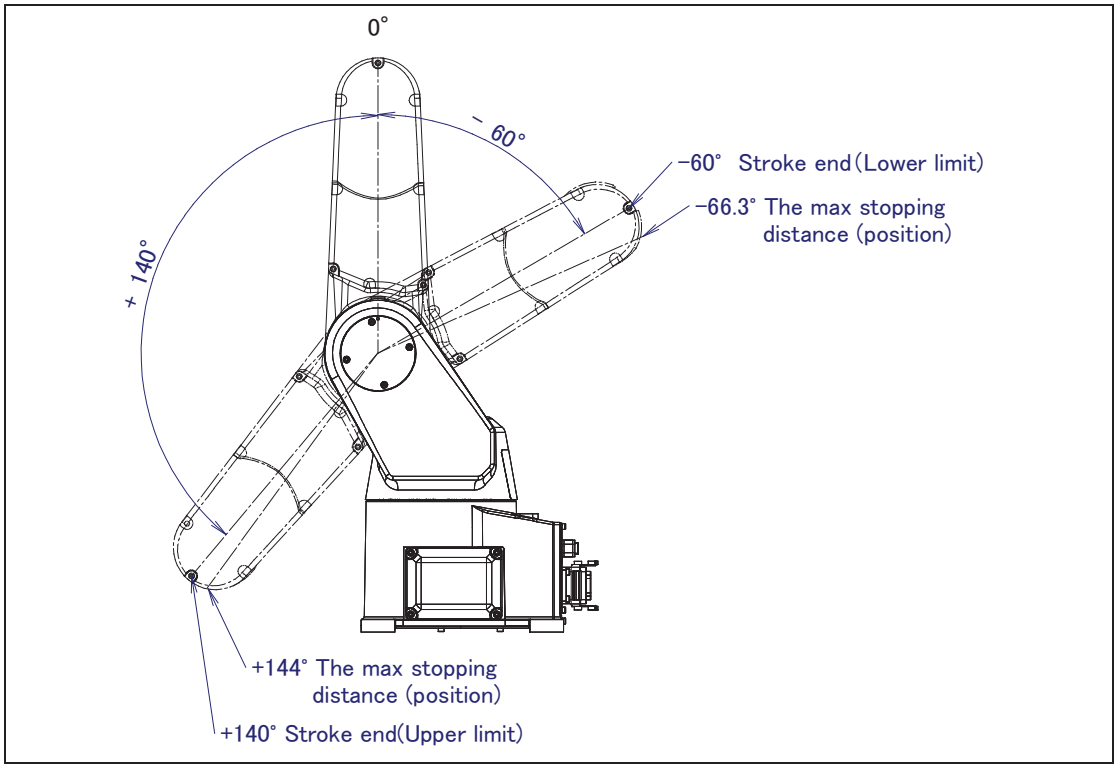



**Fig. 3.4 (d) J2-axis motion limit(LR Mate 200*i*C,LR Mate 200*i*C/5C,5WP,5H,ARC Mate 50*i*C)**

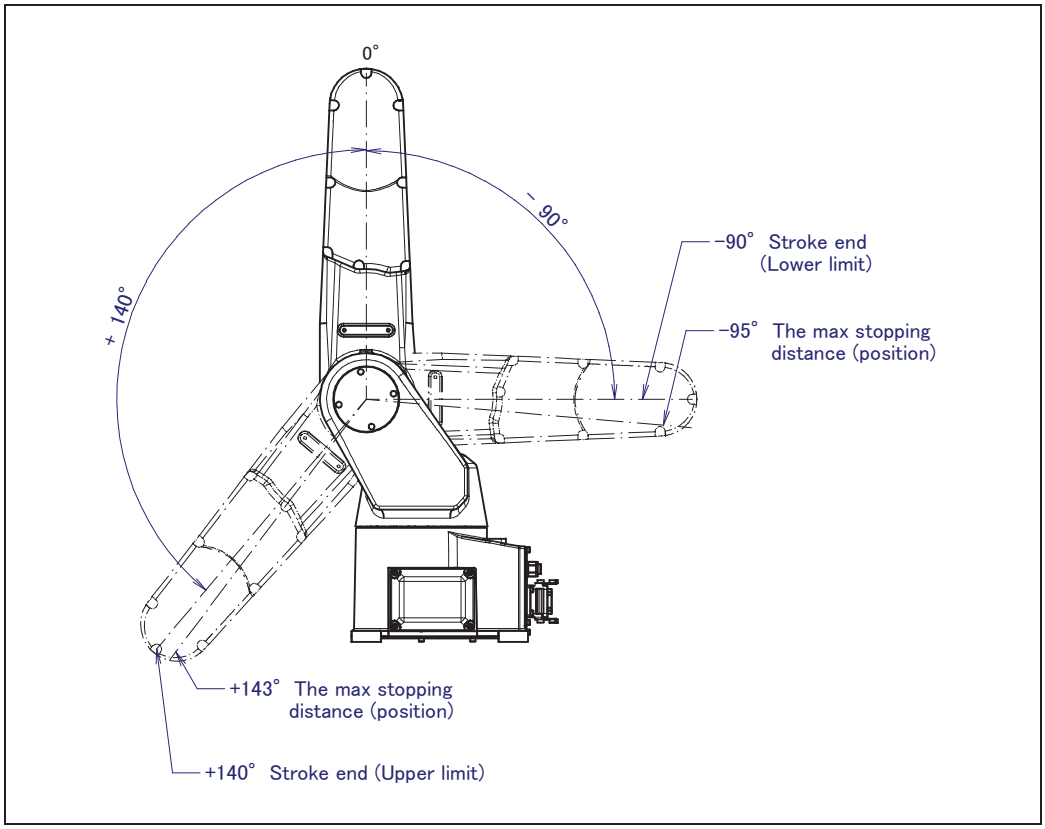



**Fig. 3.4 (e) J2-axis motion limit (LR Mate 200*i*C/5L,5LC,ARC Mate 50*i*C/5L)**

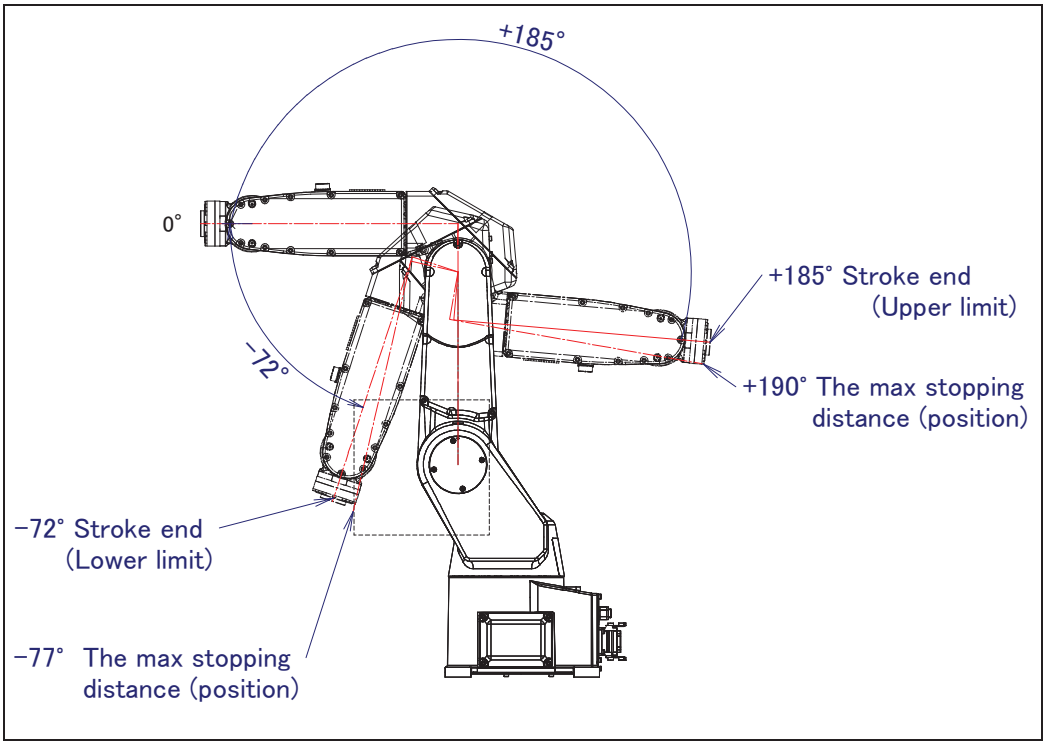



**Fig. 3.4 (f) J3-axis motion limit**

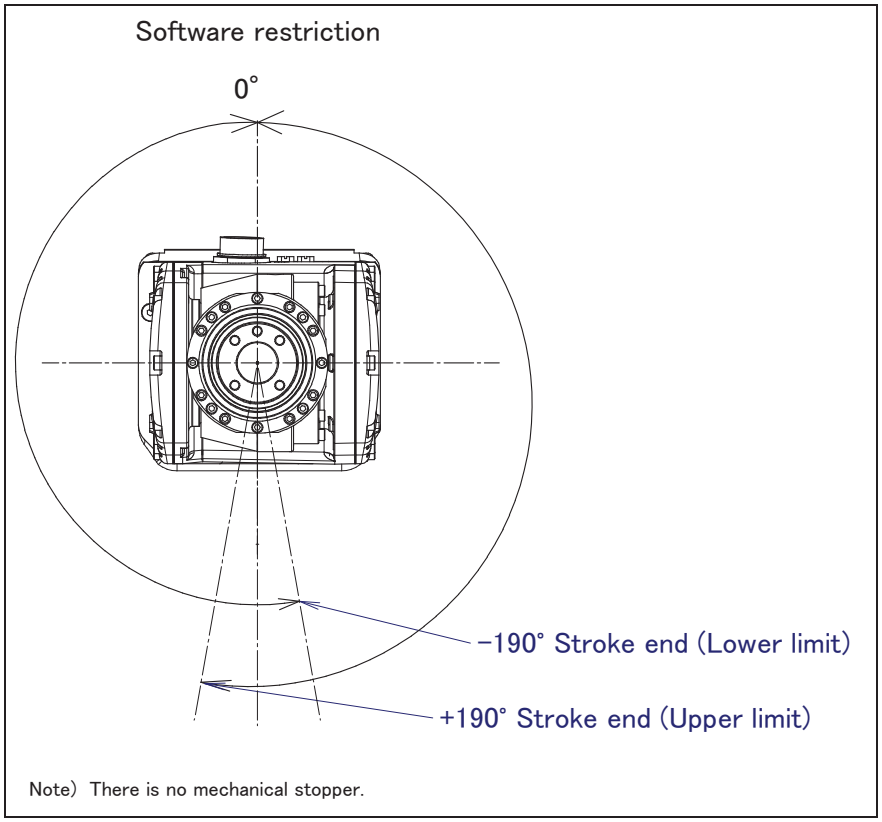



**Fig. 3.4 (g) J4-axis motion limit**
**(LR Mate 200*i*C, LR Mate 200*i*C/5L,5LC,5C,5WP, ARC Mate 50*i*C,ARC Mate 50*i*C/5L)**

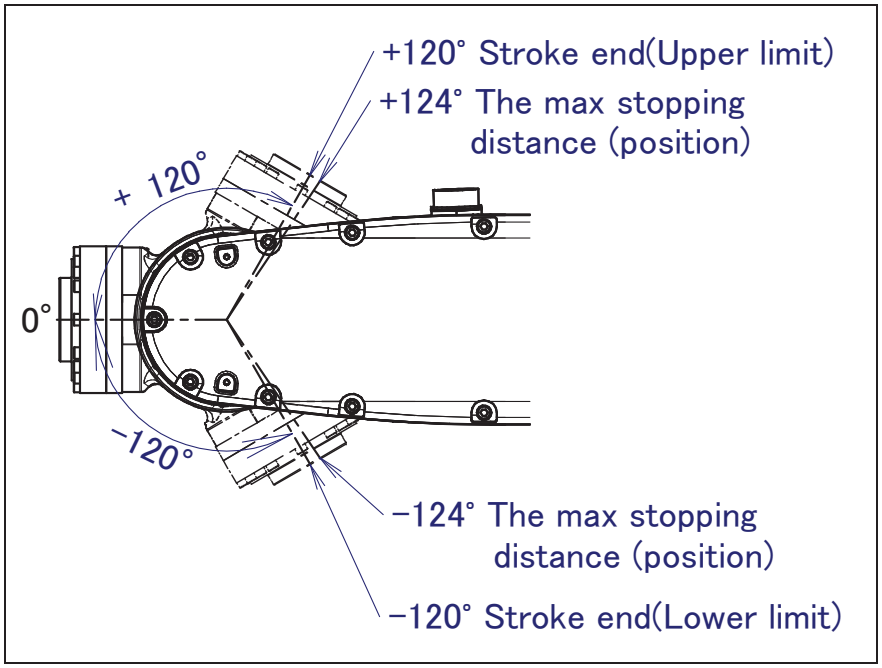



**Fig. 3.4 (h) J5-axis motion limit**
**(LR Mate 200*i*C,LR Mate 200*i*C/5L,5LC,5C,5WP, ARC Mate 50*i*C,ARC Mate 50*i*C/5L)**
**J4-axis motion limit (LR Mate 200*i*C/5H,5F)**

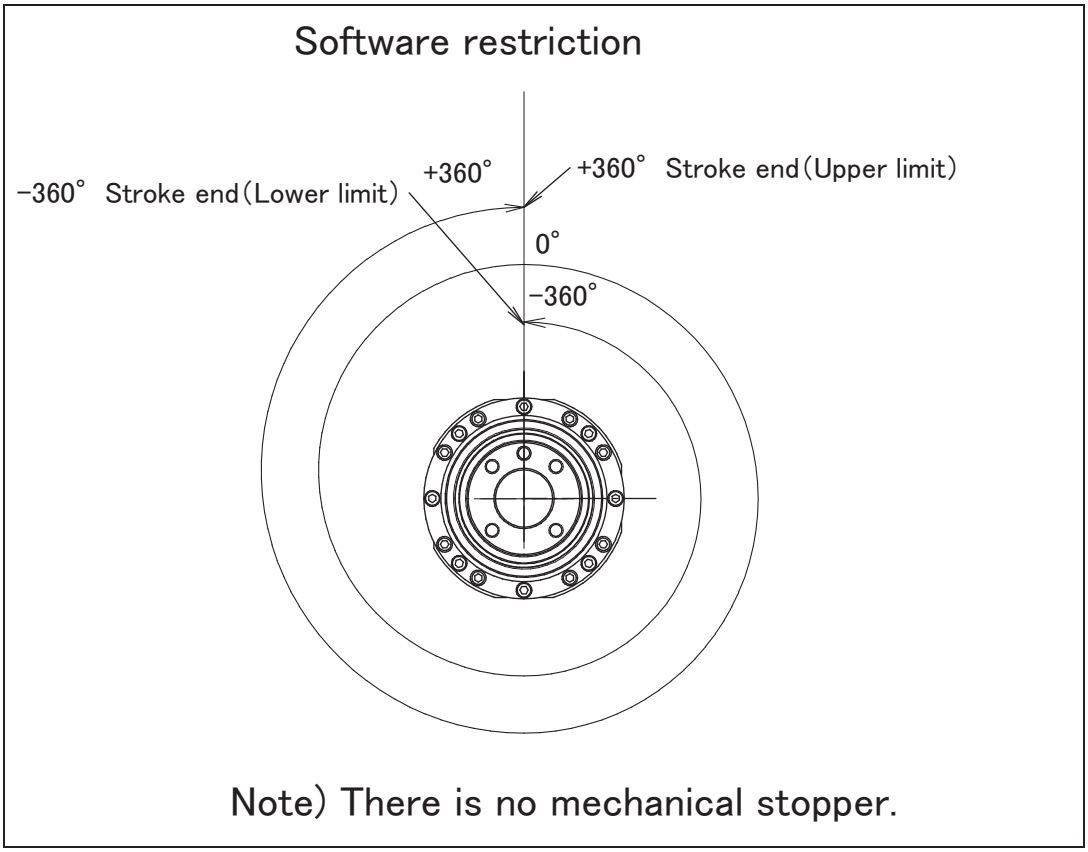



**Fig. 3.4 (i) J6-axis motion limit(LR Mate 200*i*C,LR Mate 200*i*C/5L,5LC,5C,5WP, ARC Mate 50*i*C,ARC Mate 50*i*C/5L)**
**J5-axis motion limit(LR Mate 200*i*C/5H,5F )**

## 3.5 WRIST LOAD CONDITIONS

Fig. 3.5 is diagram to limit loads applied to the wrist.

- Apply a load within the region indicated in the graph.
- Apply the conditions of the allowable load moment and the allowable load inertia. See Section 3.1 about the allowable load moment and the allowable load inertia.
- See Section 4.1 about mounting of end effector.

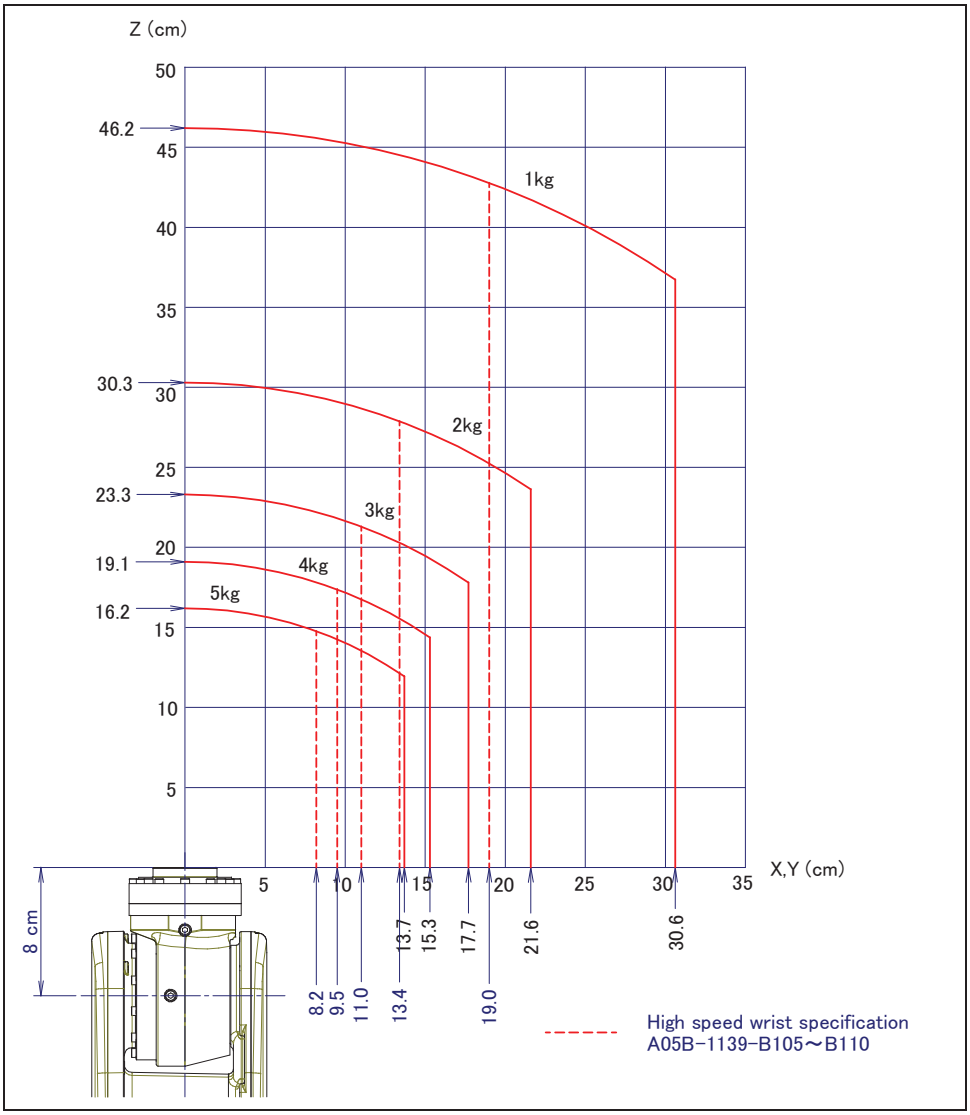



**Fig. 3.4 Wrist load diagram**

# 3.6 LOAD CONDITION ON EQUIPMENT MOUNTING FACE

The equipment can be installed as shown in Fig.3.6.When equipment is installed, total weight of installed equipment, hand and work must not exceed 5kg. Please refer to Chapter 4 for the size on the equipment installation side.

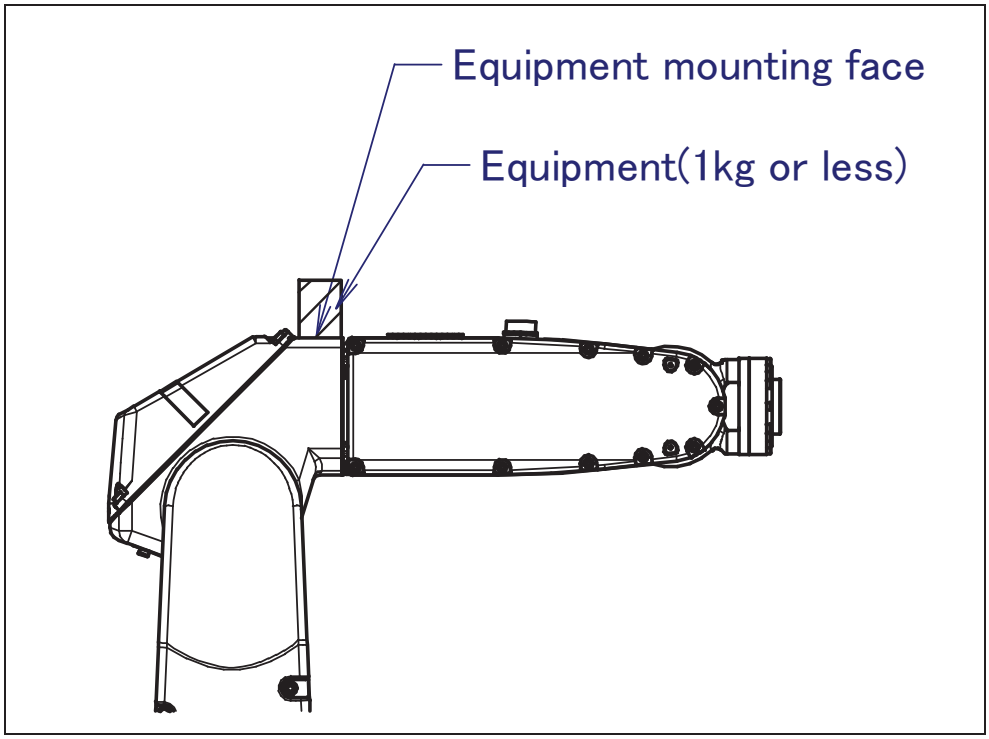



**Fig. 3.6 Load condition of equipment mounting face**

## 3.7 OPERATING AREA FOR INCLINATION INSTALLATION

When the robot is installed on an angle, the operating area is limited as the angle. The robot can't stop except for the ranges that are shown in the figure 3.7 (a) to (f).

**NOTE**
Please read J5-axis as J4-axis throughout these figures in case of 5H or 5F

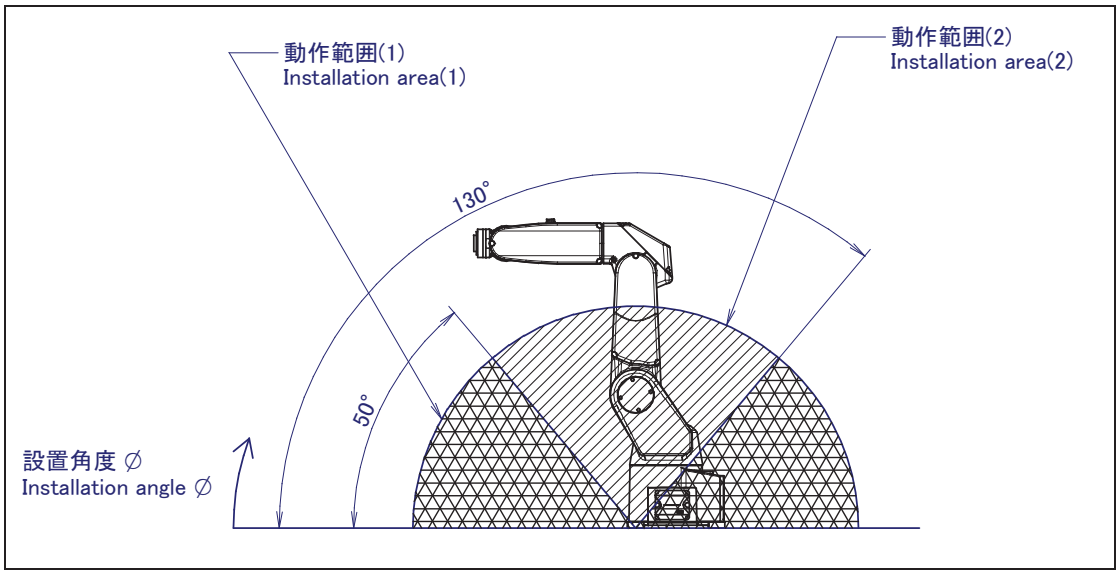



**Fig. 3.7 (a) Installation angle area (LR Mate 200*i*C,LR Mate 200*i*C/5C,5WP,5H,5F,ARC Mate 50*i*C)**

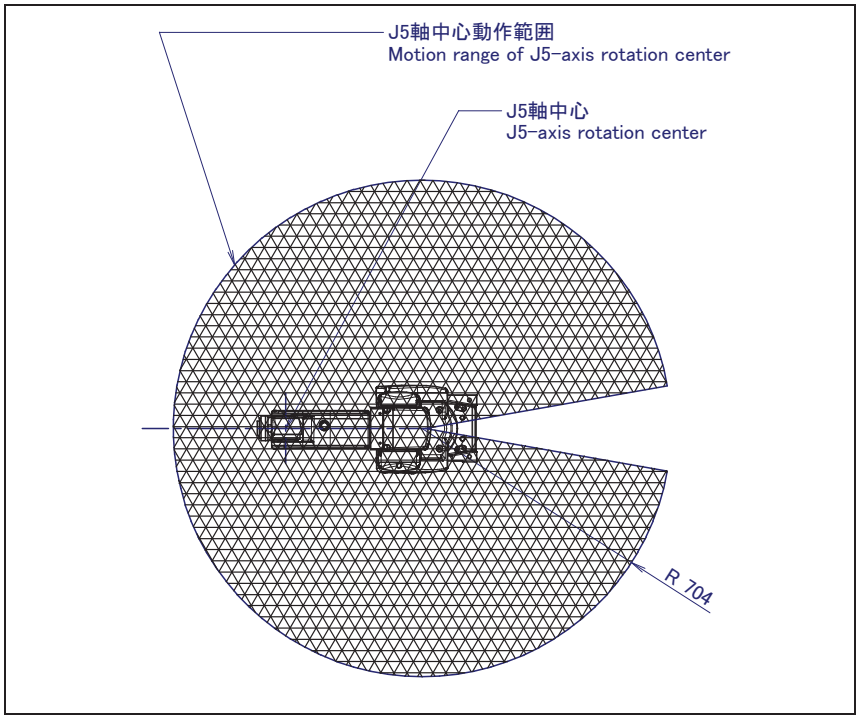



**Fig. 3.7 (b) Installation area (1) Operation area (LR Mate 200*i*C,LR Mate 200*i*C/5C,5WP,5H,5F,ARC Mate 50*i*C)**

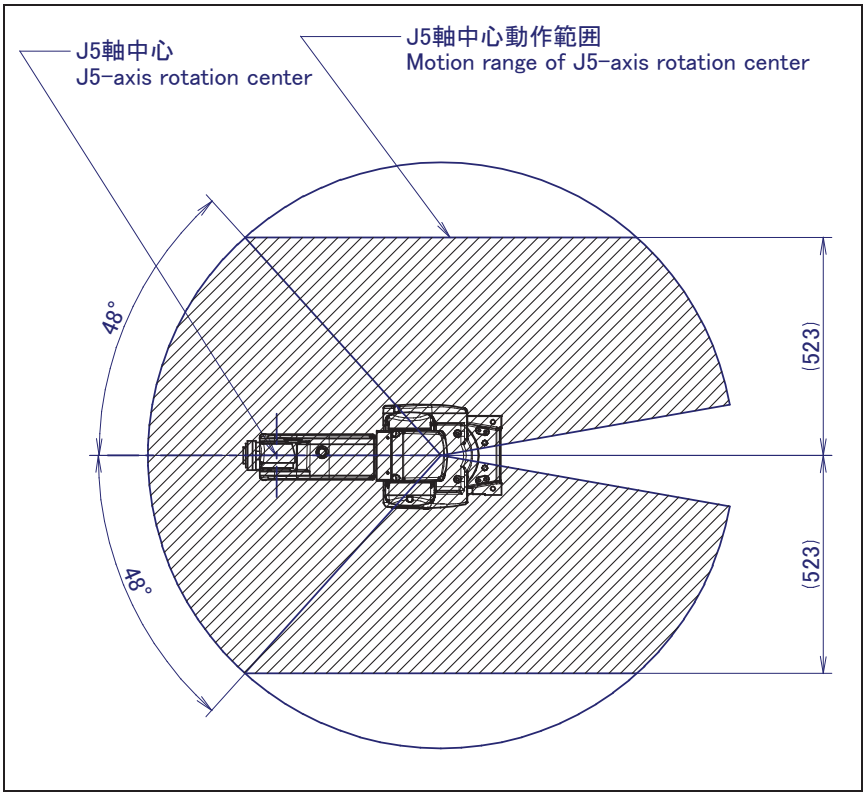



**Fig. 3.7 (c) Installation area (2) Operation area (LR Mate 200*i*C,LR Mate 200*i*C/5C,5WP,5H,5F,ARC Mate 50*i*C)**

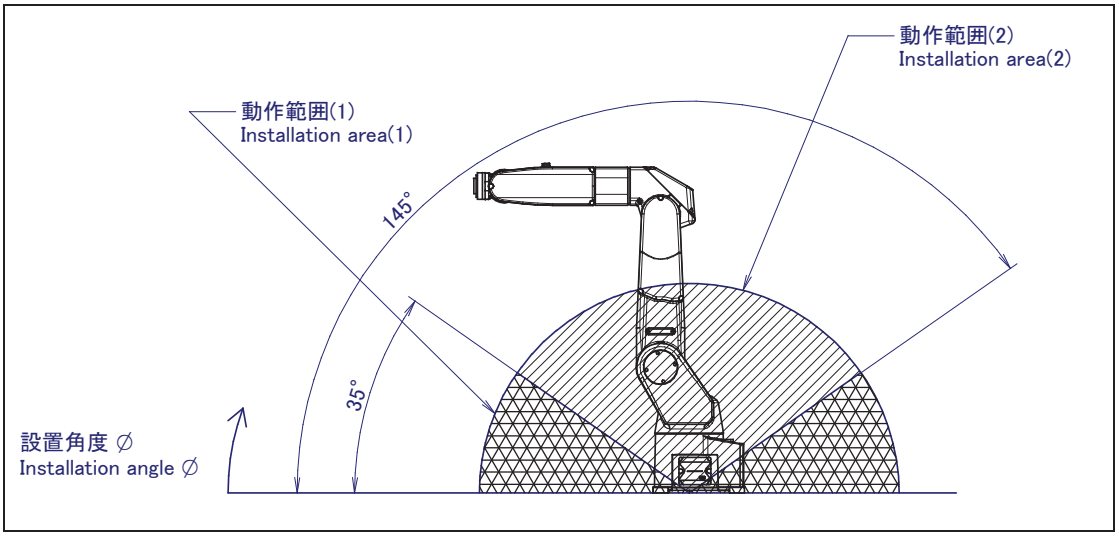



**Fig.3.7 (d) Installation angle area (LR Mate 200*i*C/5L,5LC,ARC Mate 50*i*C/5L)**

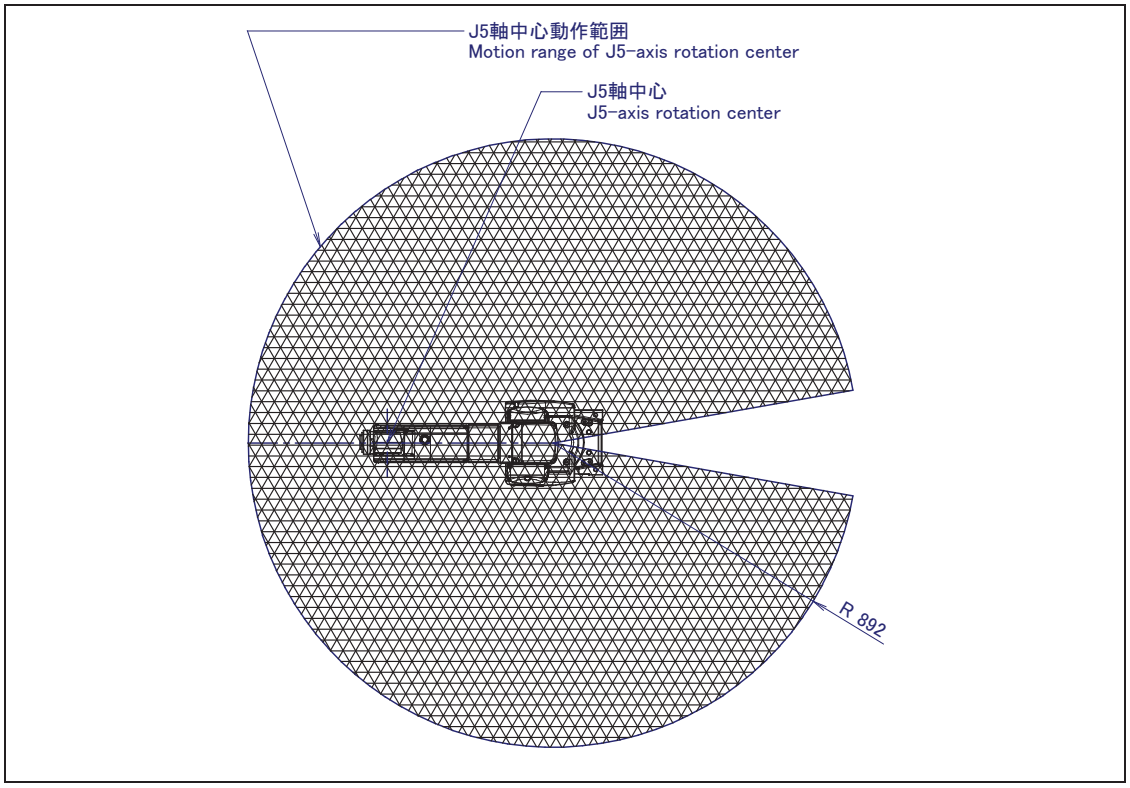



**Fig. 3.7 (e) Installation area (1) Operation area (LR Mate 200*i*C/5L,5LC,ARC Mate 50*i*C/5L)**

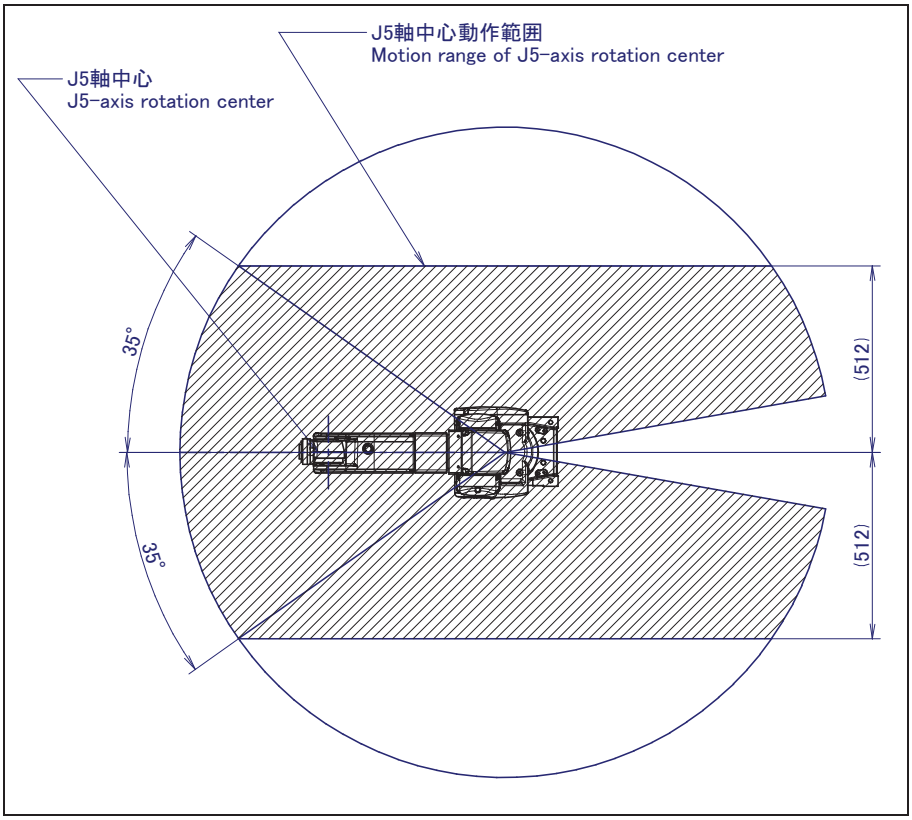



**Fig. 3.7 (f) Installation area (2) Operation area (LR Mate 200*i*C/5L,5LC,ARC Mate 50*i*C/5L)**

# 4 MECHANICAL COUPLING TO THE ROBOT

## 4.1 MECHANICAL COUPLING OF END EFFECTOR TO WRIST

Fig. 4.1 (a) and (b) are the diagrams for installing end effectors on the wrist. Select screws and positioning pins of a length that matches the depth of the tapped and pin holes. Fasten the bolt for fixing the end effector with following torque.

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

**NOTE**
Fig. 4.1 (a) and Fig. 4.1 (b) are examples of LR Mate 200*i*C and ARC Mate 50*i*C, please read J5-axis as J4-axis throughout these figures in case of 5H or 5F.

**NOTE**
Don't use a pin without tap for removal at wrist flange.

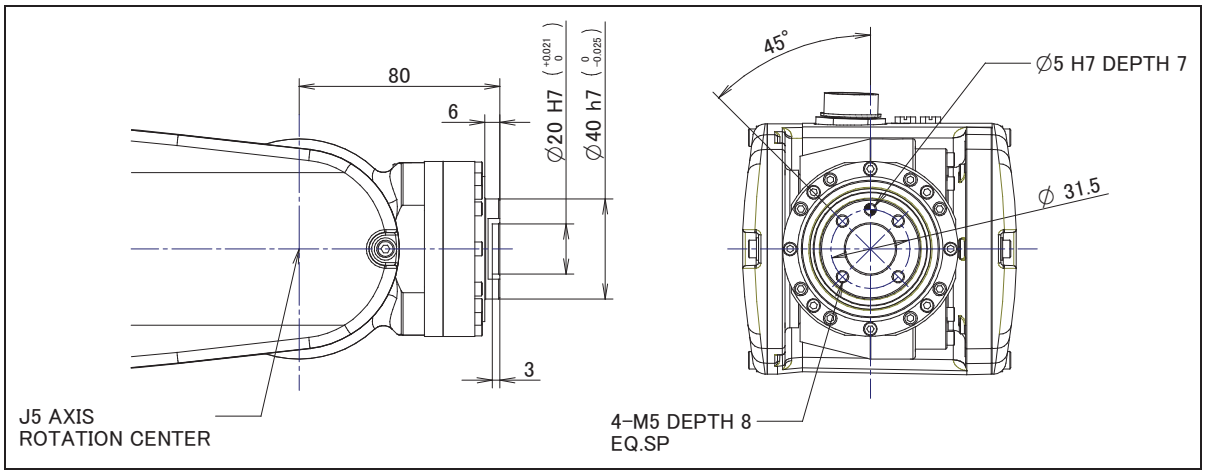



**Fig. 4.1 (a) Surface for installing the end effector**
**(Non-severe dust/liquid protection specification of LR Mate 200*i*C, LR Mate 200*i*C/5L,5H)**

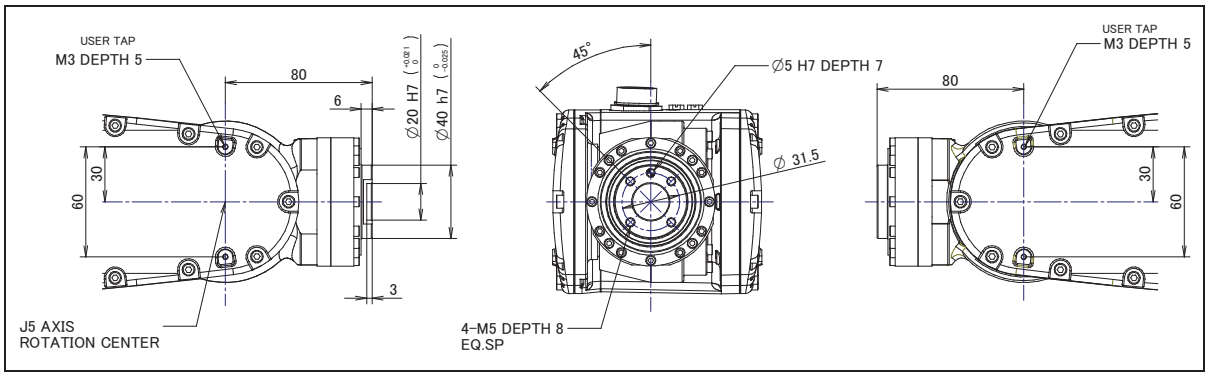



**Fig. 4.1 (b) Surface for installing the end effector(Severe dust/liquid protection specification of LR Mate 200*i*C, LR Mate 200*i*C/5L,5Hor LR Mate 200*i*C/5C, 5LC, 5WP, 5F)**

**NOTE : User tap(2-M3) is for piping and wiring to the end effector**

# 4.2 EQUIPMENT MOUNTING FACE

As shown in Fig. 4.2 tapped holes are provided to install equipment to the robot.

**⚠CAUTION**
Never perform additional machining operations such as drilling or tapping on the robot body. This can seriously affect the safety and function of the robot.

**NOTE**
Note that the use of a tapped hole not shown in the following figure is not assured. Please do not tighten both with the conclusion bolt in the mechanism.

**NOTE**
Please do not interfere with the mechanical unit cable when equipment is installed in the robot.
There is a possibility that the mechanical unit cable is disconnected and the trouble not anticipated occurs.

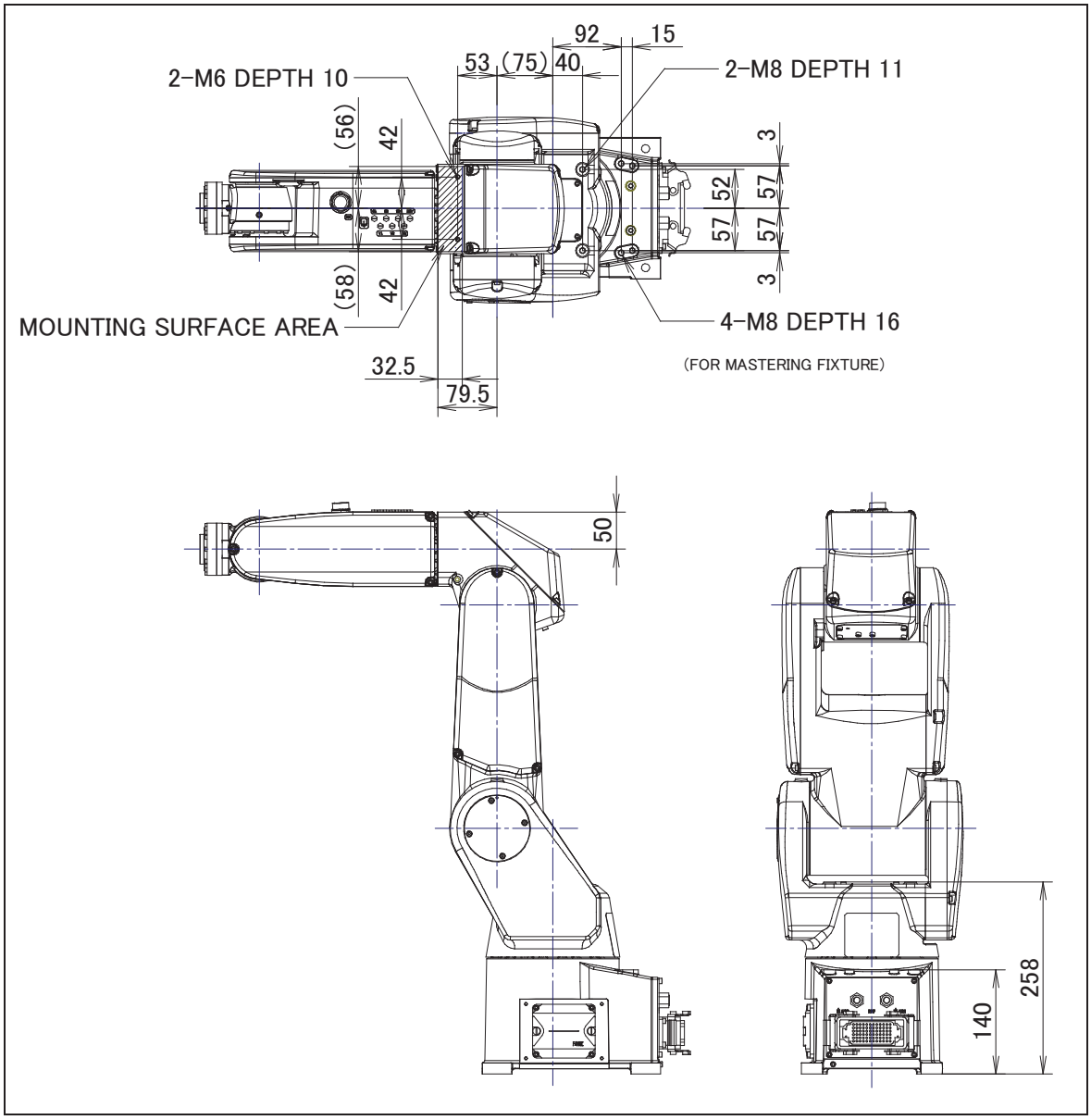



**Fig. 4.2 Equipment mounting faces**

# 4.3 LOAD SETTING

**NOTE**

Set load condition parameter before robot runs. Do not operate the robot in over payload. Operation in over payload may occur troubles such as reducer life reduction. Don't exceed allowable payload including connection cables and its swing.

### Motion performance screens

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

1 Click the [MENUS] key to display the screen menu.
2 Select "6 SYSTEM" from the next page,

3 Click F1 ([TYPE]).
4 Select “MOTION.” The MOTION PERFORMANCE screen appears.

```
MOTION PERFORMANCE                    JOINT 10%
    Group1
 No.   PAYLOAD[kg]          Comment
  1              5.00  [                    ]
  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  SETING >
         IDENT                          >
```

5 Ten different pieces of payload information can be set using condition Nos. 1 to 10 on this screen. Place the cursor on one of the numbers, and click F3 (DETAIL). The MOTION PAYLOAD SET screen appears.

```
MOTION PAYLOAD SET      JOINT        100 %

     Group1
 1   Schedule No [     1]:    [ Comment          ]
 2   PAYLOAD                  [ kg ]          4.97
 3   PAYLOAD  CENTER  X       [ cm ]        -13.72
 4   PAYLOAD  CENTER  Y       [ cm ]          0.00
 5   PAYLOAD  CENTER  Z       [ cm ]         11.954
 6   PAYLOAD  INERTIA X       [kgfcms^2]    138.974
 7   PAYLOAD  INERTIA Y       [kgfcms^2]    169.538
 8   PAYLOAD  INERTIA Z       [kgfcms^2]    102.039

 [ TYPE ]  GROUP  NUMBER  DEFAULT  HELP
```

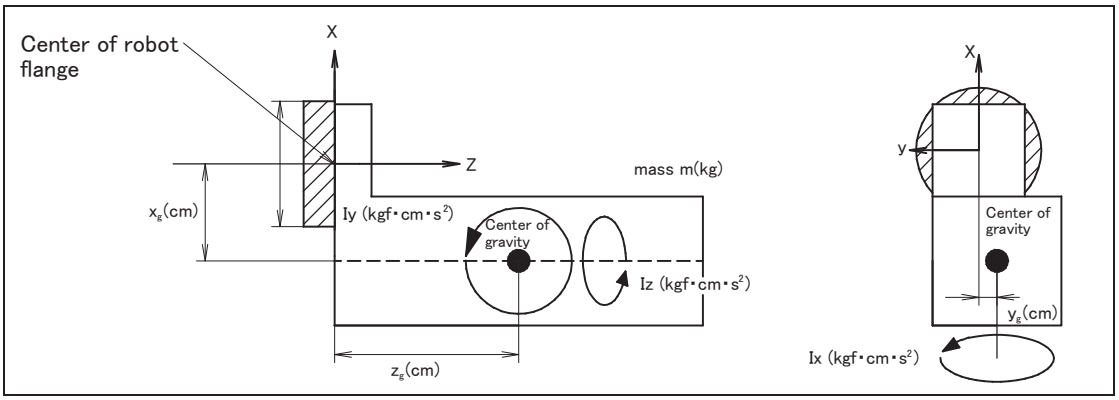


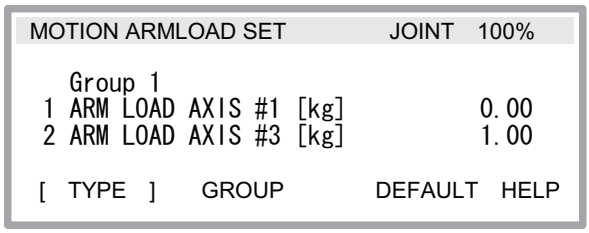

**Fig. 4.3 Standard tool coordinate**

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

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

8 Click the previous page 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.




10 Specify the mass of the loads on the J2 base and J3 arm. When you enter ARMLOAD AXIS #1[kg]: Mass of the load on the J2 base and 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.

# 5 PIPING AND WIRING TO THE END EFFECTOR

## 5.1 AIR SUPPLY (OPTION)

Air supply holes (Rc1/4) are prepared on the J1–axis connector panel for endeffector as shown in Fig.5.1. Optional solenoid valves can be mounted as shown in Tables 5.1. Plugs are inserted in all the ports used for supplying air before the robot is shipped. To use the air circuit, you must remove the plugs and connect the couplings with the ports.
When the solenoid valve is to be replaced, the entire manifold should be replaced.

**Table 5.1 Optional solenoid valves**

| Option spec. | Model | Description | Solenoid (Manifold) spec | Remarks | RO |
|---|---|---|---|---|---|
| A05B-1139-H001 | Standard,5H | Path 2 air piping, RO connector output (with no solenoid valve) | — | — | — |
| A05B-1139-H002 | Standard,5H | Double solenoids X1 | A97L-0218-0113#D1 (manufactured by SMC) | 2 positionX1 | RO1 to 2 |
| A05B-1139-H003 | Standard,5H | Double solenoids X2 | A97L-0218-0113#D2 (manufactured by SMC) | 2 positionX2 | RO1 to 4 |
| A05B-1139-H004 | Standard,5H | Double solenoids X3 | A97L-0218-0113#D3 (manufactured by SMC) | 2 positionX3 | RO1 to 6 |
| A05B-1139-H005 | Standard,5H | Double solenoids X3 | A97L-0218-0113#D3R (manufactured by SMC) | 2 positionX2 | RO1 to 4 |
| | | | | 3 positionX1 | RO5 to 6 |
| A05B-1139-H006 | Standard,5H | Path 2 air piping, RO connector output (with no solenoid valve) | — | — | — |
| A05B-1139-H007 | 5F | Double solenoids X1 | A97L-0218-0113#D1 (manufactured by SMC) | 2 positionX1 | RO1 to 2 |
| A05B-1139-H008 | 5F | Double solenoids X2 | A97L-0218-0113#D2 (manufactured by SMC) | 2 positionX2 | RO1 to 4 |
| A05B-1139-H011 | 5L | Path 2 air piping, RO connector output (with no solenoid valve) | — | — | — |
| A05B-1139-H012 | 5L | Double solenoids X1 | A97L-0218-0113#D1 (manufactured by SMC) | 2 position X 1 | RO1 to 2 |
| A05B-1139-H013 | 5L | Double solenoids X2 | A97L-0218-0113#D2 (manufactured by SMC) | 2 position X 2 | RO1 to 4 |
| A05B-1139-H014 | 5L | Double solenoids X3 | A97L-0218-0113#D3 (manufactured by SMC) | 2 position X 3 | RO1 to 6 |
| A05B-1139-H015 | 5L | Double solenoids X3 | A97L-0218-0113#D3R (manufactured by SMC) | 2 position X 2 | RO1 to 4 |
| | | | | 3 position X 1 | RO5 to 6 |
| A05B-1139-H016 | 5L | Path 2 air piping, RO connector output (with no solenoid valve) | — | — | — |
| A05B-1139-H017 | 5LC | Double solenoids X1 | A97L-0218-0113#D1 (manufactured by SMC) | 2 position X 1 | RO1 to 2 |
| A05B-1139-H018 | 5LC | Double solenoids X2 | A97L-0218-0113#D2 (manufactured by SMC) | 2 position X 2 | RO1 to 4 |
| A05B-1139-H022 | 5C | Double solenoids X1 | A97L-0218-0113#D1 (manufactured by SMC) | 2 position X 1 | RO1 to 2 |
| A05B-1139-H023 | 5C | Double solenoids X2 | A97L-0218-0113#D2 (manufactured by SMC) | 2 position X 2 | RO1 to 4 |
| A05B-1139-H024 | 5C | Double solenoids X3 | A97L-0218-0113#D3 (manufactured by SMC) | 2 position X 3 | RO1 to 6 |
| A05B-1139-H026 | 5C | Path 2 air piping, RO connector output (with no solenoid valve) | — | — | — |
| A05B-1139-H032 | 5WP | Double solenoids X1 | A97L-0218-0113#D1 (manufactured by SMC) | 2 position X 1 | RO1 to 2 |
| A05B-1139-H033 | 5WP | Double solenoids X2 | A97L-0218-0113#D2 (manufactured by SMC) | 2 position X 2 | RO1 to 4 |

| Option spec. | Model | Description | Solenoid (Manifold) spec | Remarks | RO |
|---|---|---|---|---|---|
| A05B-1139-H034 | 5WP | Double solenoids X3 | A97L-0218-0113#D3 (manufactured by SMC) | 2 positionX3 | RO1 to 6 |
| A05B-1139-H035 | 5WP | Double solenoids X3 | A97L-0218-0113#D3R (manufactured by SMC) | 2 positionX2 | RO1 to 4 |
| | | | | 3 positionX1 | RO5 to 6 |

Available section area of the solenoid valve : 1.98mm$^2$ (CV value : 0.11)

**NOTE**
1 When the air circuit is not used, reinstall the plugs as originally installed for the purpose of dust and water protection.
2 Attach an air filter with a mesh size of 5$\mu$m or better on the upstream side near the robot. Compressed air including much drainage causes valve malfunctions. Take action to prevent the entry of drainage, and also drain the air filter periodically.
3 Vacuum 180Nl/min of the air from the suction port for LR Mate 200*i*C/5C,5LC clean class 10.

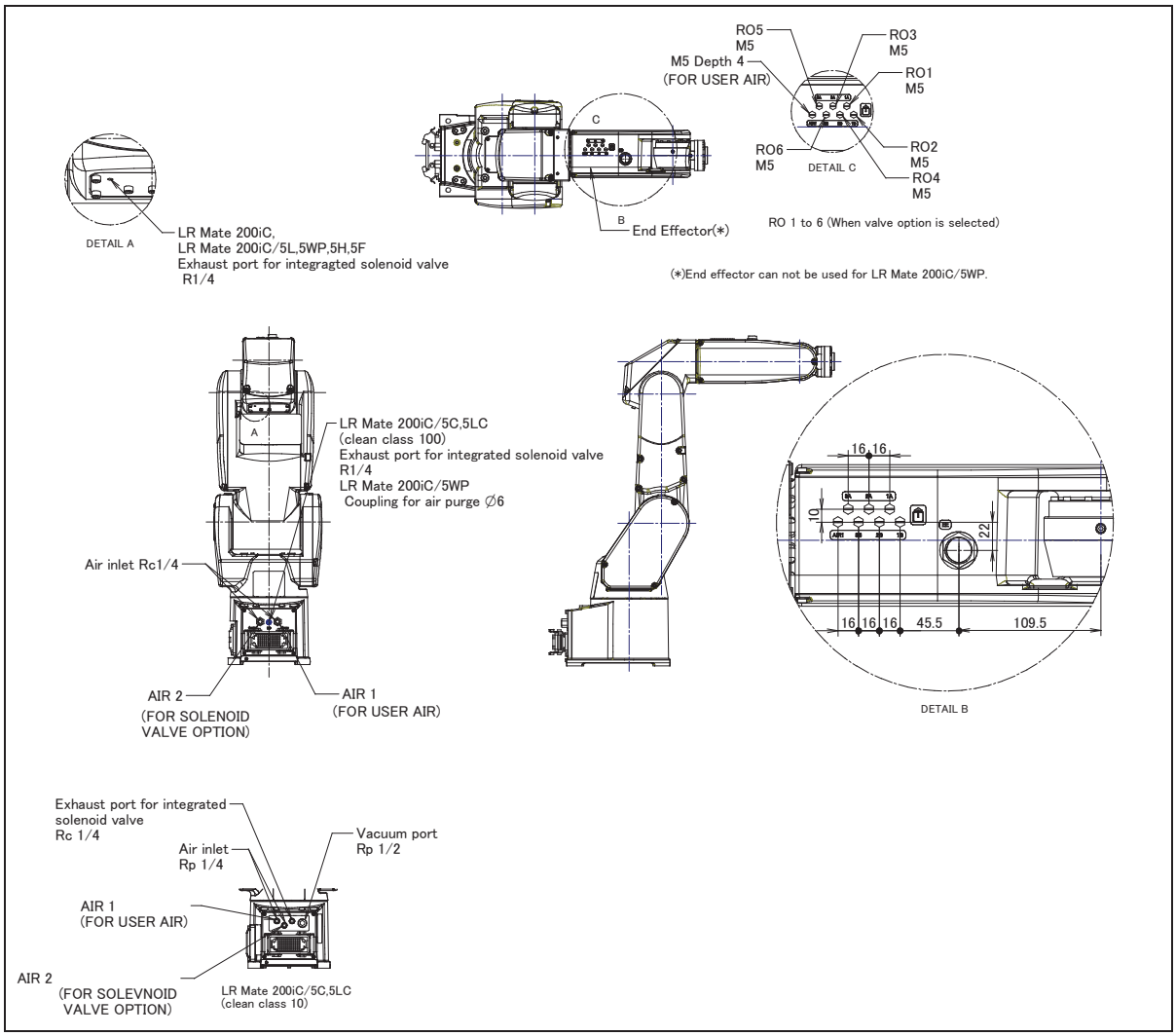



**Fig. 5.1 (a) Air supply (option) (except A05B-1139-H001,H006,H011,H016,H026)**

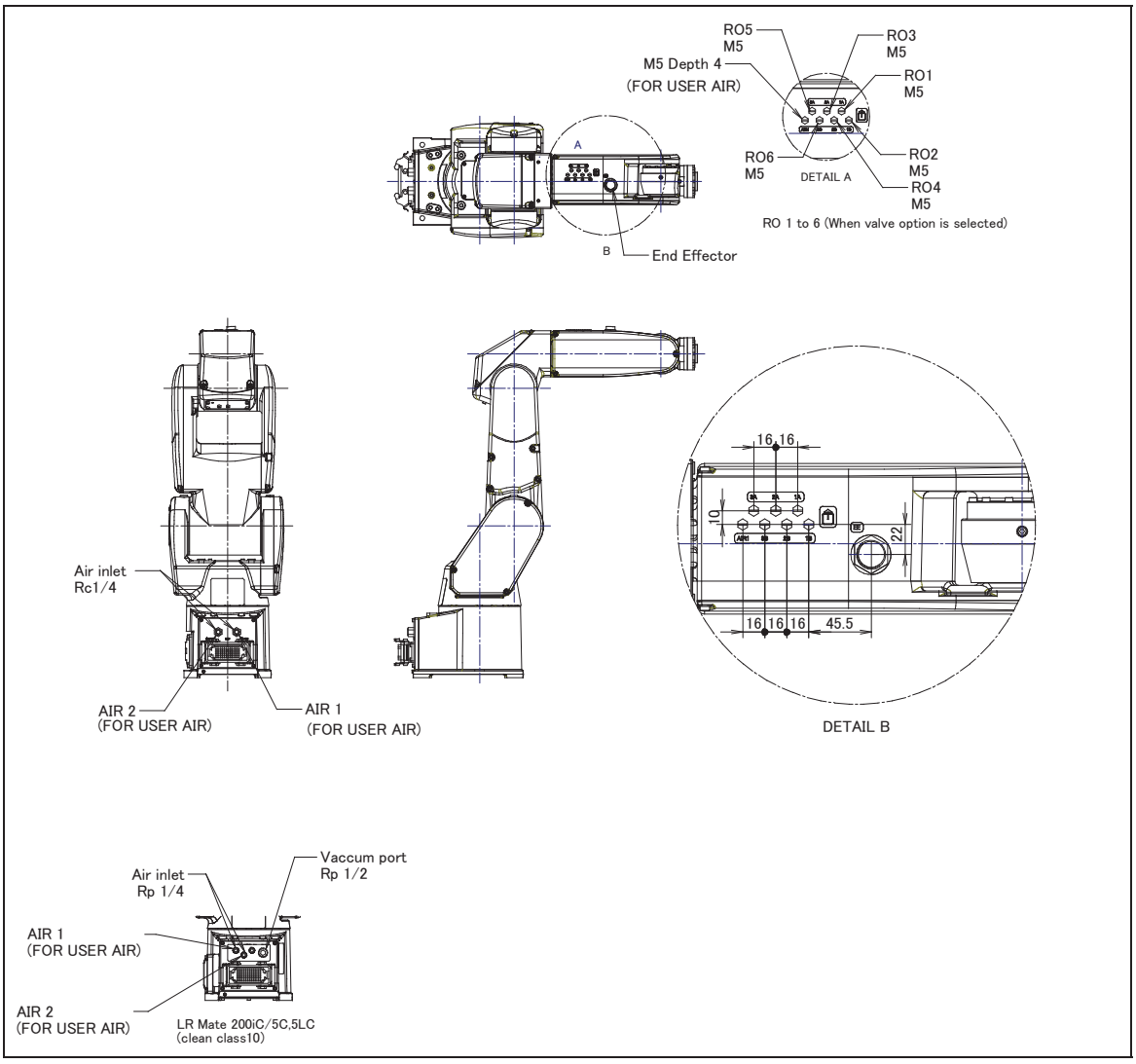



**Fig. 5.1 (b) Air supply (option) (A05B-1139-H001,H006,H011,H016,H026)**

# 5.2 INSTALLING THE AIR PURGE KIT

Air parge kit is preparatory as the option, and use it, please. Use the prepared air purge kit.
Set the air purge pressure to 10 kPa (0.1 kgf/cm$^2$).
In case of 5WP,be sure to use air purge kit.

**NOTE**

1 It is recommended that a dedicated air pressure source be used for an air purge. Do not use the same air pressure source for both the air purge kit and others. Otherwise, the dryer capacity is exceeded and water or oil remains in air, causing serious damage to the robot.
2 After installing the robot, perform a air purge at all times.
Even when the robot is not operating, an air purge is required if it is placed in a bad condition.
3 When removing the air tube from the air inlet of the J1 connector panel, replace the joint together. Be careful to prevent cleaning fluids from entering into the joint. Otherwise, rubbers in the joint are degraded and the robot may be damaged.

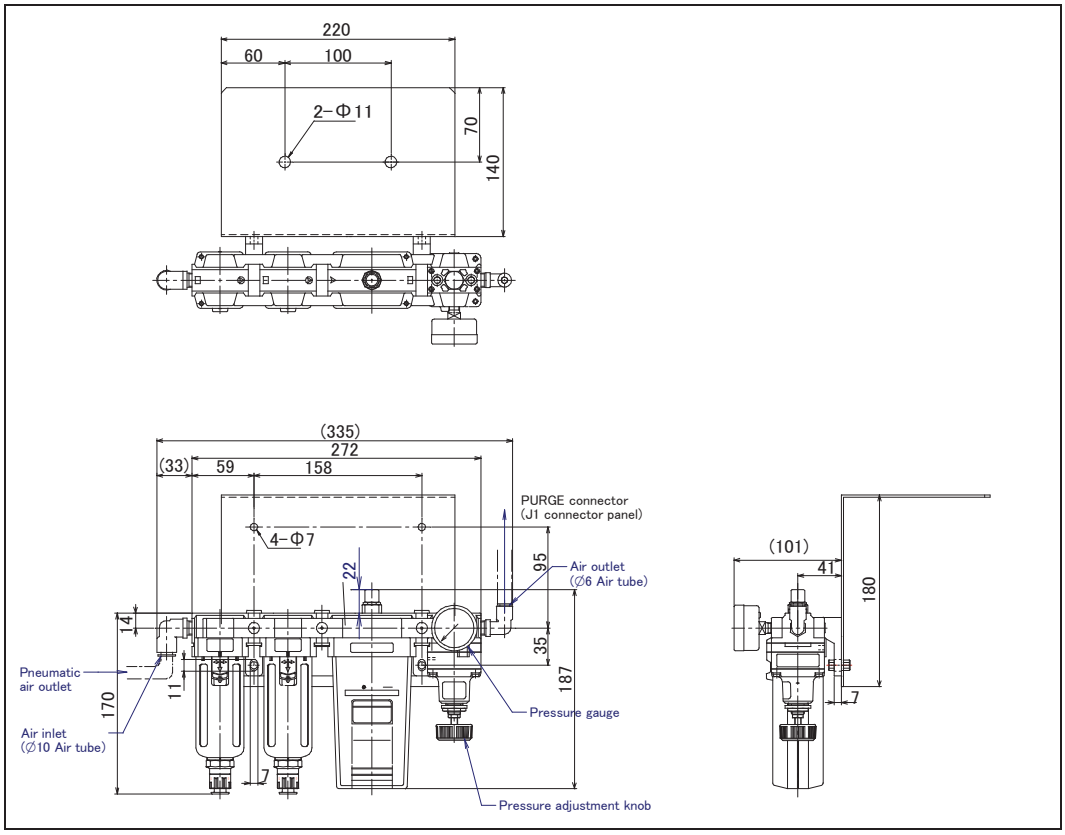



**Fig 5.2 Air purge kit outside dimensions**

# 5.3 INTERFACE FOR OPTION CABLE (OPTION)

Fig. 5.3 shows the position of the end effector interface.
End effector interface (RI signal) is prepared .

**NOTE**
1 The connector to be plugged into the interface and the cable attached to that connector should be prepared by the customer.
2 When the robot is shipped, a cap is mounted on the end effector interface. When the interface is not used, mount the cap on the interface to ensure that the interface is sealed up.
3 Please do the waterproof processing of the hand cable surely to prevent the flood in the mechanism.
Moreover, the wound of the cover of the cable causes the flood and exchange it, please when damaging.

(1) End effector interface(RI signal)
Fig. 5.2 show the pin layout for the end effector interface (RI signal).

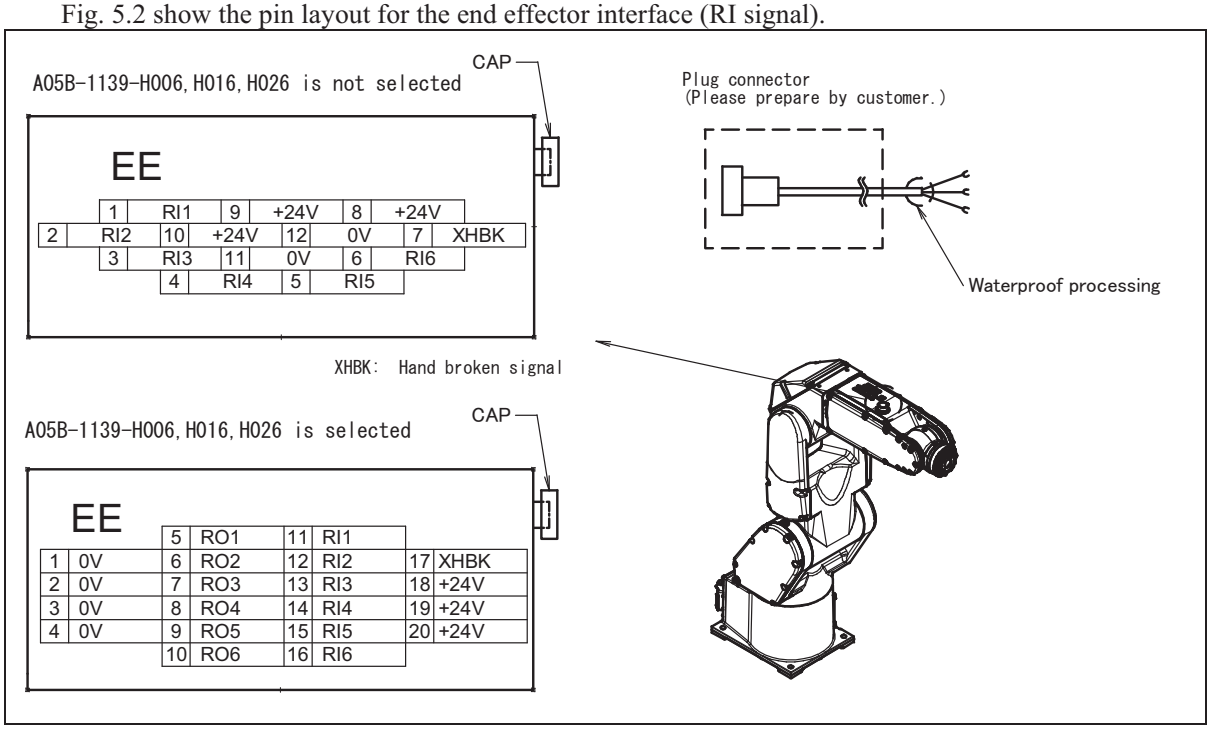



**Fig. 5.3 End effector interface (RI signal)**

**⚠CAUTION**
This end effector interface is not available for LR Mate 200*i*C/5WP. For wiring of the peripheral device to the end effector interface, refer to the CONTROLLER MAINTENANCE MANUAL or contact FANUC.

## Connector specifications

Table 5.3 (a), (b)show the connector parts supported by the end effector interface. Some of these parts are available as an option from FANUC. (Table 5.3 (a), (b))

**Table 5.3 (a) Supported connector (user side)**

| Maker | Manufacturer specification | Remarks |
|---|---|---|
| Hirose Electric Co. Ltd. | Plug : RM15WTPZ-12P(71)<br>Clamp : JR13WCC-*(72) | Straight type<br>∗indicates an applicable cable diameter selected from the following:<br>∗ : ϕ5, 6, 7, 8, 9, 10mm<br>Unusable for "A05B-1139-H006, H016 or H026". |
| | Plug : RM15WTLP-12P(71)<br>Clamp : JR13WCC-*(72) | Elbow type<br>∗indicates an applicable cable diameter selected from the following:<br>∗ : ϕ5, 6, 7, 8, 9, 10mm<br>Unusable for "A05B-1139-H006 or H016 or H026". |
| | Plug : RM15WTLP-20P<br>Clamp : JR13WCC-*(72)<br>(exclusive use for [A05B-1139-H006, H016 or H026]) | Usable only for "A05B-1139-H006 or H016".<br>Elbow type<br>*indicates an applicable cable diameter selected from the following:<br>* : ϕ5, 6, 7, 8, 9, 10mm |

**Table 5.3 (b) Supported option**

| Option specification | Remarks |
|---|---|
| A05B-1137-J057 | Straight type (12-pins)<br>Applicable cable diameter : 8mm<br>Unusable for "A05B-1139-H006,H016 or H026". |
| A05B-1137-J058 | Elbow type (12-pins)<br>Applicable cable diameter : 9mm<br>Unusable for "A05B-1139-H006, H016 or H026". |
| A05B-1139-J059<br>(exclusive use for [A05B-1139-H006. H016 or H026]) | Elbow type (20-pins)<br>Applicable cable diameter : 9mm<br>Usable only for "A05B-1139-H006, H016 or H026". |

**NOTE**
For details, such as the dimensions, refer to the related catalogs offered by the respective manufacturers, or contact FANUC.

**NOTE**
See Appendix C, "OPTIONAL CONNECTOR WIRING PROCEDURE," for explanations about how to wire optional connectors.

# 6 AXIS LIMIT SETUP

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

- Work area limitations
- Tooling and fixture interference points
- Cable and hose lengths

The software method used to prevent the robot from going beyond the necessary motion range.

- Axis limit software settings (All axes)

**⚠CAUTION**
Changing the motion range of any axis affects the operation range of the robot. To avoid trouble, carefully consider a possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition occurs; for example, an alarm may occur in a previous taught position.

## 6.1 SOFTWARE SETTING

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

### Procedure

### Setting Up Axis Limits

1 Press MENUS.
2 Select SYSTEM.
3 Press F1, [TYPE].
4 Select Axis Limits. You will see a screen similar to the following.

System Axis Limits JOINT 100%
Group1 1/16

| AXIS | GROUP | LOWER | UPPER | |
|---|---|---|---|---|
| 1 | 1 | -150.00 | 150.00 | deg |
| 2 | 1 | -60.00 | 75.00 | deg |
| 3 | 1 | -70.00 | 50.00 | deg |
| 4 | 1 | -170.00 | 170.00 | deg |
| 5 | 1 | -110.00 | 110.00 | deg |
| 6 | 1 | -360.00 | 360.00 | deg |
| 7 | 1 | 0.00 | 0.00 | mm |
| 8 | 1 | 0.00 | 0.00 | mm |
| 9 | 1 | 0.00 | 0.00 | mm |

[ TYPE]

**NOTE**
0 indicates the robot does not have these axes.

5 Move the cursor to the axis limit you want to set.
6 Type the new value using the numeric keys on the teach pendant.
7 Repeat Steps 5 through 6 until you are finished setting the axis limits.

**⚠WARNING**
You must turn off the controller and then turn it back on to use the new information; otherwise injury to personnel or damage to equipment could occur.

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

# 7 CHECKS AND MAINTENANCE

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

**NOTE**
The periodic maintenance procedures described in this chapter assume that the FANUC robot is used for up to 3,840 hours a year. When using the robot beyond this total operating time, correct the maintenance frequencies shown in this chapter by calculation in proportion to the difference between the actual operating time and 3,840 hours/year.

## 7.1 PERIODIC MAINTENANCE

### 7.1.1 DAILY CHECKS

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

(1) Before turning on power

| Item | Check items | | Check points |
|---|---|---|---|
| 1 | When air control set is provided. | Air pressure | Check air pressure using the pressure gauge on the air regulator as shown in Fig.1.1.If it does not meet the specified pressure of 0.49MPa (5 kg/cm2), adjust it using the regulator pressure setting handle. |
| 2 | | Leakage from hose | Check the joints, tubes, etc. for leaks. Repair leaks, or replace parts, as required. |
| 3 | | Drain | Check drain and release it. When quantity of the drain is remarkable, examine the setting of the air dryer to the air supply side. |
| 4 | When air purge kit is provided. | Supply pressure | Check the supply pressure using the air purge kit shown in Fig.7.1.1 (b). If it does not meet the specified pressure of 10 KPa (0.1 kgf/cm2), adjust it using the regulator pressure setting handle. |
| 5 | | Dryer | Check whether the color of the dew point checker is blue. When it is not blue, identify the cause and replace the dryer. Maintenance for air purge kit, refer to the operator's manual attached kit. |
| 6 | | Drain | Check drain. When quantity of the drain is remarkable, examine the setting of the air dryer to the air supply side. |
| 7 | Cleaning and checking each part | | Clean each part (remove chips, etc.) and check component parts for cracks and flaws. |

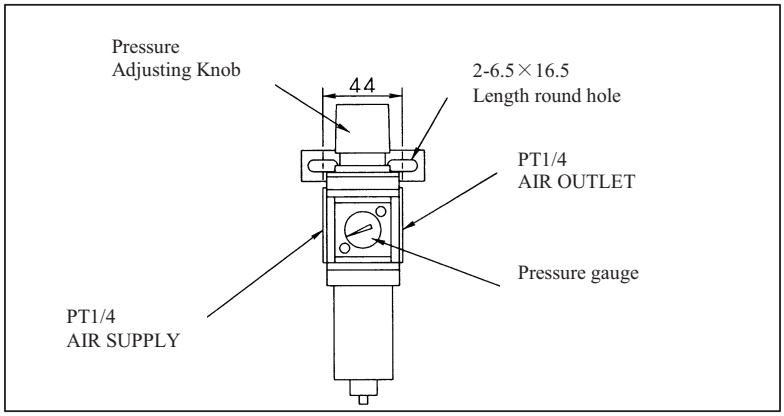



**Fig. 7.1.1 (a) Air control set**

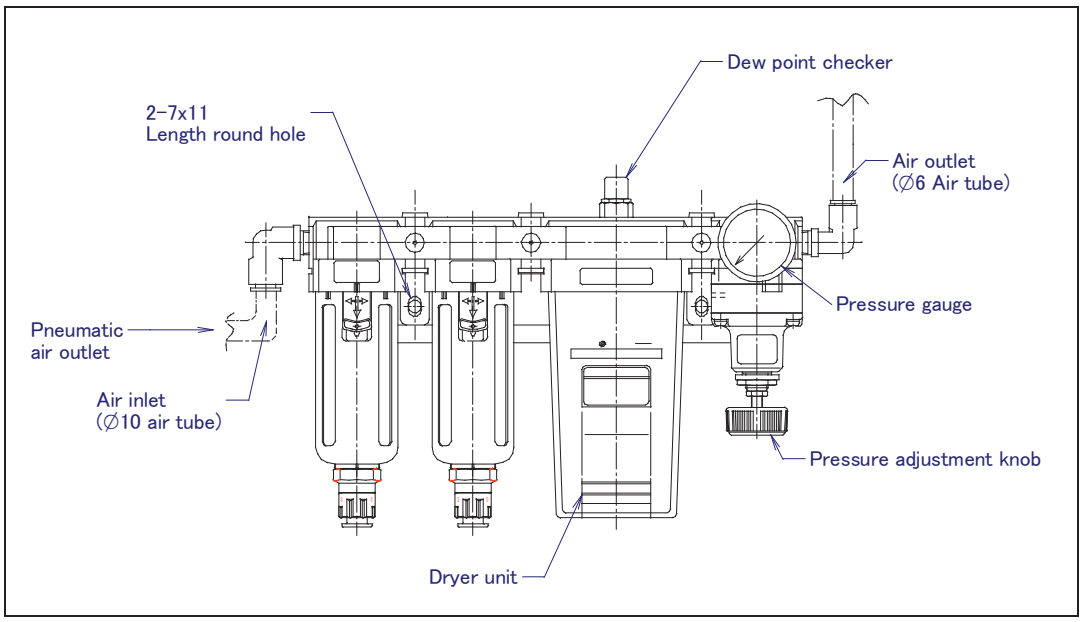



**Fig. 7.1.1 (b) Air purge kit (option)**

(2) After automatic operation

| Item | Check items | Check points |
|---|---|---|
| 1 | Vibration, abnormal noises, and motor heating | Check whether the robot moves along and about the axes smoothly without unusual vibration or sounds. Also check whether the temperature of the motors are excessively high. |
| 2 | Changing repeatability | Check to see that the stop positions of the robot have not deviated from the previous stop positions. |
| 3 | Peripheral devices for proper operation | Check whether the peripheral devices operate properly according to commands from the robot. |
| 4 | Brakes for each axis | Check that the end effector drops within 2 mm when the power is cut. |

## 7.1.2 First 1-Month (320 hours) check

Check the following items at the first month(320 hours ) inspection, then every 3 months (960 hours) thereafter. (See Subsection 7.1.4.)

**First 1-month check**

| Item | Check items | Check points |
|---|---|---|
| 1 | Ventilation portion of controller | If the ventilation portion of the controller is dusty, turn off power and clean the unit. |

## 7.1.3 First 3-month (960 hours) checks

Check the following items at the first quarterly inspection, then every year thereafter. (See Subsection 7.1.5.)

| Item | Check items | Check points |
|---|---|---|
| 1 | Connector used in mechanical unit | Check the looseness of connector of connector panel. (NOTE 1) |
| 2 | Retightening external main bolts | Retighten the end-effecter mounting bolts and external main bolts.(NOTE 2) |
| 3 | Check the mechanical stopper | Check the spring ping of J1-axis mechanical stopper is not transformed, if it is transformed, replace it to new one.<br>Check the looseness of J3-axis stopper mounting bolts. If they are loosen, they are needed to be retightened. (NOTE 3) |
| 4 | Cleaning and checking each part | Clean each part (remove chips, etc.) and check component parts for cracks and flaws. (NOTE 4) |
| 5 | Application cable and external battery cable (option) | Confirm whether there is wound in the cable |
| 6 | Check the robot cable, teach pendant cable and robot connecting cable | Check whether the cable connected to the teach pendant and robot is unevenly twisted. |

### (NOTE 1) Inspection points of the connectors

- Robot connection cables, earth terminal and user cables

### Check items

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

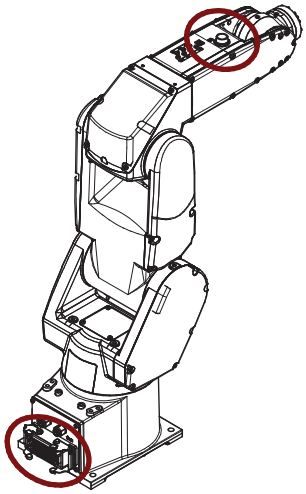


**Fig. 7.1.3 (a) Check items of connector**

## (NOTE 2) Points to be retightened

- The end effecter mounting bolts, robot installation bolts, and bolts to be removed for inspection need to be retightened.
- The bolts exposed to the outside of the robot need to be retightened.
  For the tightening torque, see the recommended bolt tightening torque shown in the Appendix.
  A loose prevention agent (adhesive) is applied to some bolts. If the bolts are tightened with greater than the recommended torque, the loose prevention agent may be removed. So, follow the recommended tightening torque when retightening them.

## (NOTE 3) Check of mechanical stopper and adjustable mechanical stopper.

- Check the spring ping of J1-axis mechanical stopper is not transformed, if it is transformed, replace it to new one.
  Check the looseness of J3-axis stopper mounting bolts. If they are loose, they are needed to be retightened.

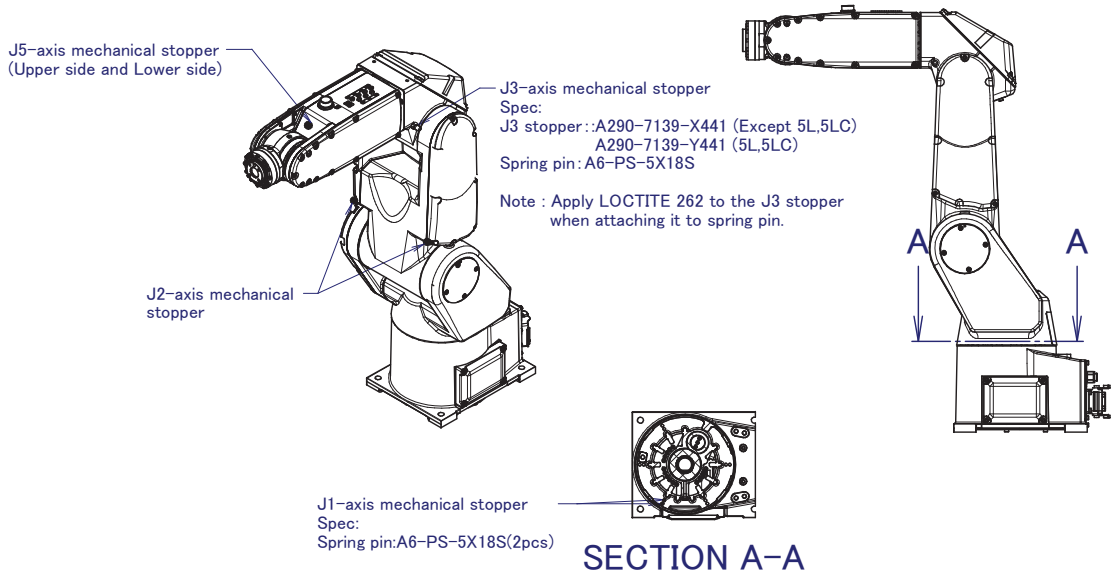



**Fig. 7.1.3 (b) Check of mechanical stopper.**

## (Note 4) Cleaning

- Necessary cleaning points, dust on the flat part, sedimentation of spatters
  Clean sediments periodically.
  In particular, clean the following points carefully.

  Vicinity of the wrist axis and oil seal
  →If chippings or spatters are attached to the oil seal, an oil leak may be caused.
- Check if the vicinity of the necessary inspection points, wrist part, and J3 arm significantly wears due to rubbing against the welding cable or hand cable.
- Check if there is a trace of a collision around the hand.
- Check the reducer or grease bath for an oil leak.

  → If oil can be found a day after wiping oil, an oil leak may be caused.

  Vicinity of the welding torch and wrist flange (When ARC welding application is specified.)

→ The insulation failure occurs when the spatter has collected around the wrist flange or welding, and there is a possibility of damaging the robot mechanism by the welding current. (See Appendix D)

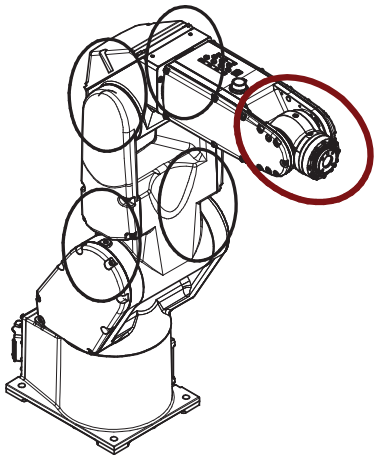


**Fig. 7.1.3 (c) Cleaning part**

## 7.1.4 3-month (960 hours) checks

Check the following items in the cycle that is shorter between every three months and 960 hours of operating. Additional inspection areas and times should be added to the table according to the robot's working conditions, environment, etc.

| Item | Check items | Check points |
|---|---|---|
| 1 | Ventilation portion of controller | If the ventilation portion of the controller is dusty, tum off power and clean the unit. |

## 7.1.5 1-year (3,840 hours) checks

Check the following items in the cycle that is shorter between every year and 3,840 hours of operating.

| Item | Check itmes | Check points |
|---|---|---|
| 1 | Connector used in mechanical unit | (See Subsection 7.1.3) |
| 2 | Retightening external main bolts | (See Subsection 7.1.3) |
| 3 | Check the mechanical stopper | (See Subsection 7.1.3) |
| 4 | Cleaning and checking each part | (See Subsection 7.1.3) |
| 5 | Application cable and external battery cable (option) | (See Subsection 7.1.3) |
| 6 | Replacing battery | Replace battery in the mechanical unit. (See Section 7.2) |
| 7 | Check the robot cable, teach pendant cable and robot connecting cable | (See Subsection 7.1.3) |

## 7.1.6 1.5-year(5,760 hours) checks

Check the following items in the cycle that is shorter between every 1,5 years and 5,760 hours of operating.

| Item | Check items | Check points |
|---|---|---|
| 1 | Replacing battery<br>(if external batteries are specified) | Replace the batteries in the mechanical unit.<br>(See Section 7.2.) |

## 7.1.7 2-year (7,680 hours) checks (LR Mate 200*i*C /5WP,5F) 4-year (15,360 hours) checks (LR Mate 200*i*C, LR Mate 200*i*C/5L , /5C, /5LC, /5H,ARC Mate 50*i*C, ARC Mate 50*i*C/5L)

Check the following items about once in the cycle that is shorter between every two years and 7,680 hours for LR Mate 200*i*C/5WP,5F. Check the following items about once in the cycle that is shorter between every four years an 15,360 hours for LR Mate 200*i*C ,LR Mate 200*i*C/5L , /5C, /5LC, /5H ,ARC Mate 50*i*C, ARC Mate 50*i*C/5L

| Item | Check itmes | Check points |
|---|---|---|
| 1 | Greasing of reducers of each-axis<br>(Except LR Mate 200*i*C /5F) | Specified grease<br>Harmonic grease 4BNo.2<br>Spec:A98L-0040-0230<br><br>Greasing kit (tube of grease plus injector)<br>Spec:A05B-1139-K021<br><br>Tube of grease (80 g)<br>Spec:A05B-1139-K022<br><br>Do not use Harmonic grease SK-3 or unspecified grease.<br>Please contact FANUC about the method of greasing. |
| | Greasing of reducers of each-axis<br>(LR Mate 200*i*C /5F) | Specified grease<br>NOK<br>Klubersynth UH1 14-1600<br>Spec:A98L-0040-0218<br><br>Greasing kit (tube of grease plus injector)<br>Spec:A05B-1139-K023<br><br>Tube of grease (80 g)<br>Spec:A05B-1139-K024<br><br>Do not use unspecified grease.<br>Please contact FANUC about the method of greasing. |

# 7.2 MAINTENANCE

## 7.2.1 Replacing the Batteries (1-Year Periodic Inspection If Built-in Batteries Are Specified) (1.5-Year Periodic Inspection If External Batteries Are Specified)

The position data of each axis is preserved by the backup batteries. If built-in batteries are in use, replace them every year. If external batteries are in use, replace them every year and a half. Also use the following procedure to replace when the backup battery voltage drop alarm occurs.

### Procedure of replacing the battery (if built-in batteries are specified)

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

**⚠CAUTION**
The LR Mate 200*i*C/5WP supports no built-in battery. Be sure to keep the power supply turned on. Replacing the batteries with the power supply turned off causes all current position data to be lost. Therefore, mastering will be required again.

2 When severe dust/liquid protection or 5LC,5C,5WP,5F is selected, remove the battery case cap.( Fig.7.2.1)
3 Loosen the plate screw and take out the lid of the battery box and replace battery. Battery can be taken out by pulling the stick which is center of the battery box.
4 Assemble them by the opposite procedure. Pay attention to the direction of batteries.
It is necessary to exchange packing when severe dust/liquid protection specification or 5LC,5C,5WP,5F is selected.

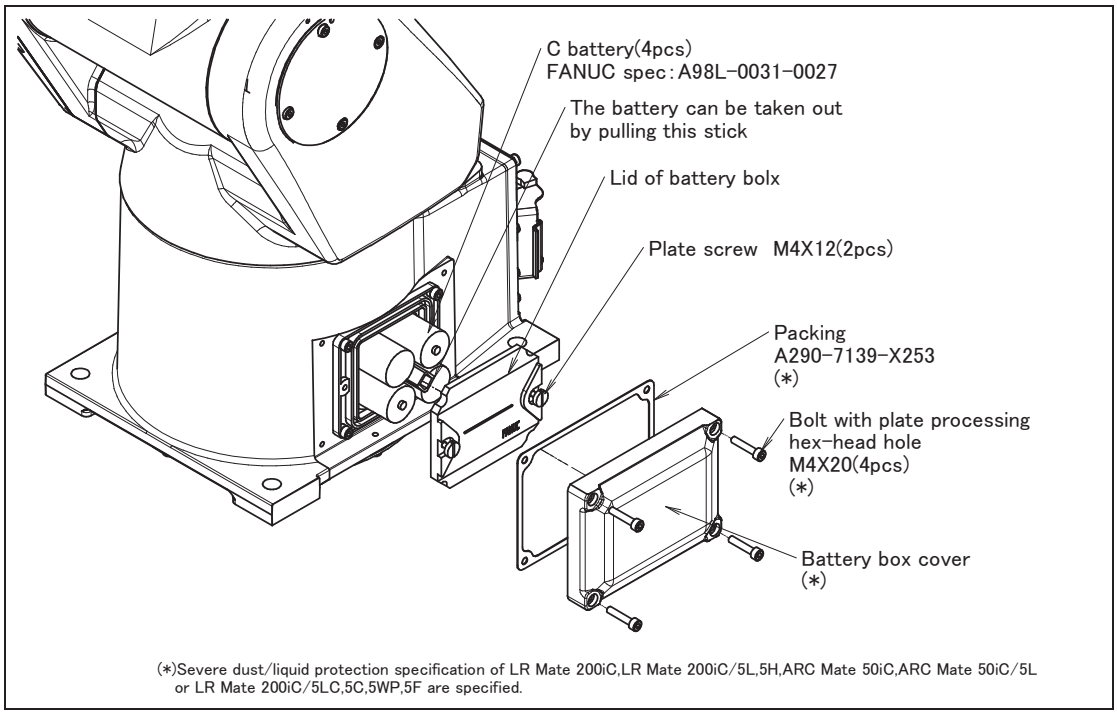



**Fig. 7.2.1 (a) Replacing the battery (if built-in batteries are specified)**

## Procedure of replacing the battery (if external batteries are specified)

1 During battery replacement, hold down the emergency stop button for the sake of safety.

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

2 Uncap the battery case (Fig. 7.2.1 (b)).
3 Take out the old batteries from the battery case.
4 Insert new batteries into the battery case while observing their correct orientation.
5 Cap the battery case.

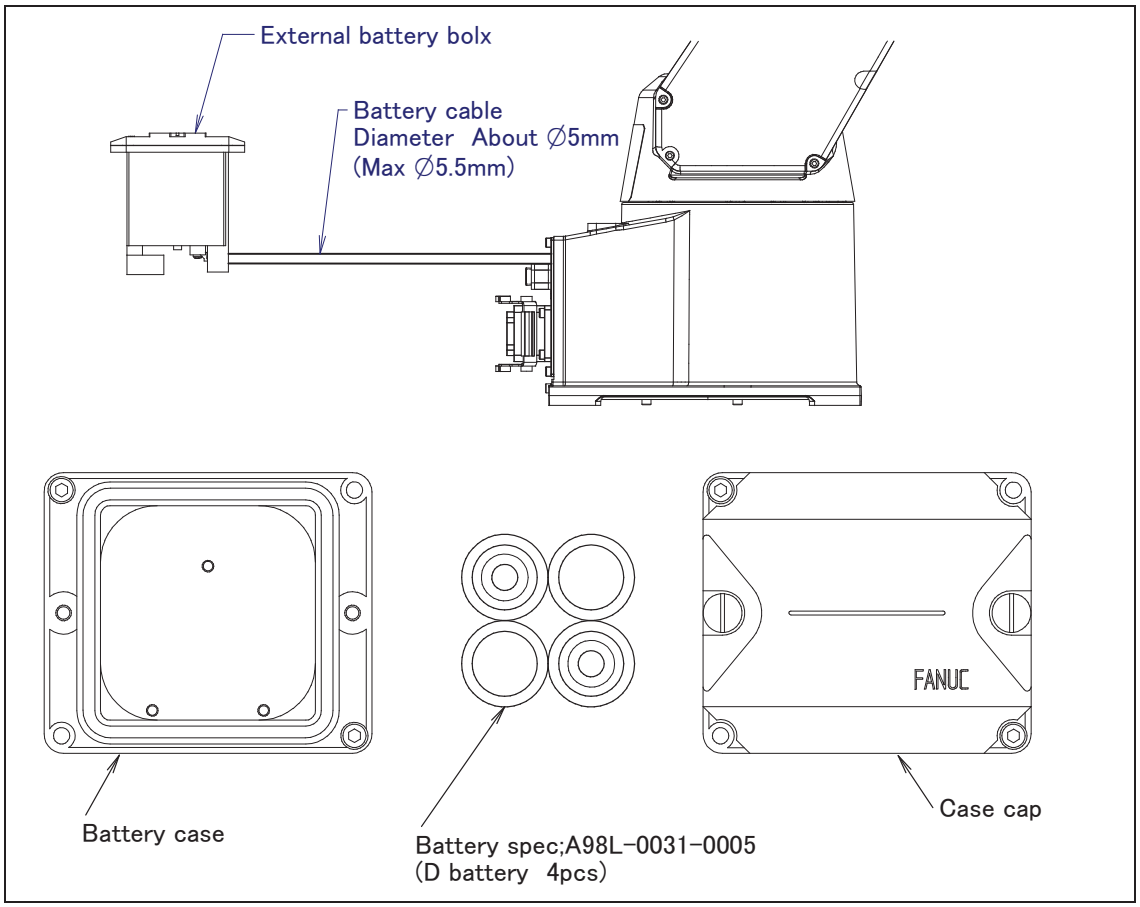



**Fig. 7.2.1 (b) Replacing the battery (if external batteries are specified)**

Fig 7.2.1 (c) shows the external size of external battery box.
When the battery box needs to be built into the controller or other internal units, refer to the outer dimensions shown in Fig.7.2.1 (c)
The battery box can be fixed by using M4 flat–head screws. (The bolts do not come with the system.)
A maximum of six terminals can be attached to the backplane of the battery box.

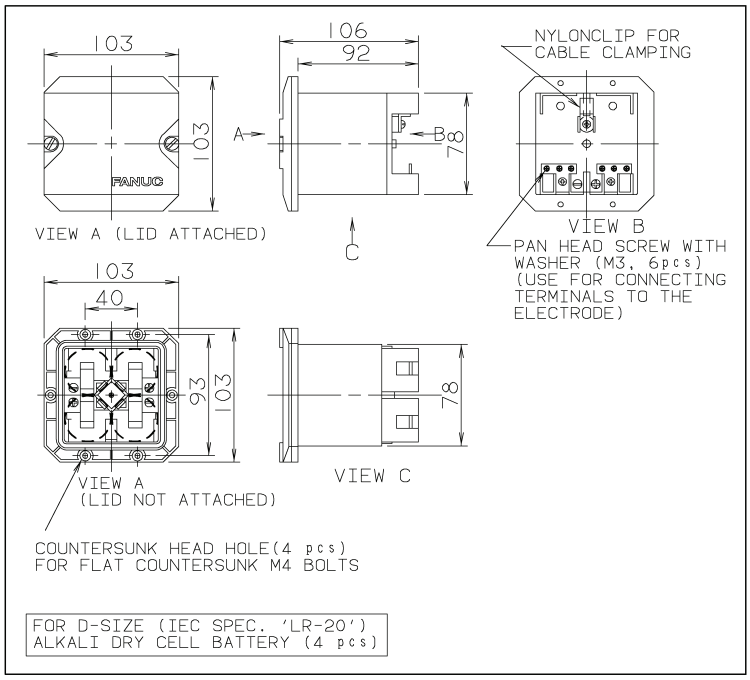



**Fig. 7.2.1 (c) Outer dimensions of the battery box**

# 7.3 CLEANING (LR Mate 200*i*C/5F)

## 7.3.1 CLEANING THE ROBOT

LR Mate 200*i*C/5F can be cleaned with sprinkling water or cleaner diluted properly.

If strong jet strike robot, it is probable that the jet causes excessive water pressure and destroy waterproof of robot arm. The water or cleaner should be sprinkled from the shower nozzle.

Stains stuck on the robot surface should be wiped with a cloth. Do not brush robot surface hard, because brushing has possibility to affect the coating on robot surface and sealing on the robot joints.

Do not sprinkle water or cleaner on the controller.

> ⚠ **CAUTION**
> Please make the cleaning frequency once a week or less.

## 7.3.2 CLEANER

The appropriate treatment and material is adopted for robot LR Mate 200*i*C/5F, which the treatment and material have enough chemical resistance. It is possible to spray cleaners directly on the robot surface, and the robot can be kept in sanitary condition by daily cleaning.

The cleaners written in the Table 7.3.2 is confirmed that they are not affect the robot surface. Other cleaner has to be checked the impact to robot surface, please contact FANUC for them.

Use cleaner whose dilution rate is correct. If dilution rate is not correct, it may cause bad influence to the robot surface. Use the water and cleaner equal to or less than 50 degrees.

Alcohol and organic solvent may cause bad infulence robot surface. Do not use them to cleaning robot.

**Table 7.3.2 Cleaners whose harmlessness for the robot surface is confirmed**

| NAME | MAKER | TYPE | MAIN INGREDIENT | DILUTION RATE (NOTE 1) |
|---|---|---|---|---|
| Geron Ⅳ | ANDERSON | Sanitizer | Quaternary ammonium chloride | 0.2% |
| Reg13 | ANDERSON | Sanitizer | Sodium hypochloride | 0.15% |
| FOMENT | ANDERSON | Alkali cleaner | Potassium hydroxide<br>Sodium hypochlorite | 1.5% |
| SUPERLOX X-40 | ANDERSON | Acid cleaner | Phosphoric acid | 1.5% |
| SAN-TEC 5 | ANDERSON | Acid cleaner | Hydrogen peroxide<br>Acetic acid<br>Peroxyacetic acid | 0.2% |
| P3-topax 99 | ECOLAB | Sanitizer | N-3(-Aminopropyl)-N-Dodecylpropan -1,3-diamin | 2% |
| P3-topax 91 | ECOLAB | Sanitizer | Benzalkonium chloride | 0.5% |
| P3-topax 66 | ECOLAB | Sanitizer | Sodium hydroxide<br>Sodium hypochlorite<br>Alkylamine oxide | 5% |
| P3-topactive DES | ECOLAB | Acid cleaner | Hydrogen peroxide<br>Acetic acid<br>Alkylamine oxide<br>Peroxyacetic acid | 3% |
| P3-topactive 200 | ECOLAB | Alkali cleaner | Ethanol<br>Potassium hydroxide<br>Sodium hydroxide | 4% |
| ACIFOAM VF10 | JohsonDiversey | Acid cleaner | Phosphoric acid<br>Alkylbenzenesulfonic acid | 10% |
| DIVOSAN ACTIV VT5 | JohsonDiversey | Acid cleaner | Hydrogen peroxide<br>Acetic acid<br>Peroxyacetic acid | 4% |
| Hypofoam VF6 | JohsonDiversey | Sanitizer | Sodium hydroxide<br>Sodium hypochlorite<br>Amine | 10% |
| DIVOSAN EXTRA VT55 | JohsonDiversey | Sanitizer | Quaternary ammonium chloride | 1% |

**NOTE 1**
DILUTION RATE = STOCK SOLUTION / (STOCK SOLUTION+WATER)

**NOTE**
Acid cleaner have to be rinsed diligently and it should never remain on the robot surface. Robot surface cannot contact with acid cleaner continuously for over 15 minute.

**NOTE**
The use of cleaner in Table 7.3.2 might be restricted by the law of the country or the region, and obtaining is difficult.

## 7.4 STORAGE

To store the robot, set it to the same posture as that used for trasportation. (See Section 1.1.)

# 8 MASTERING

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

## 8.1 GENERAL

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

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

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

### Types of Mastering

There are five methods of the following mastering.

**Table 8.1 Type of mastering**

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

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

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

**⚠CAUTION**
If mastering is performed incorrectly, the robot may behave unexpectedly. This is very dangerous. So, the positioning screen is designed to appear only when the $MASTER_ENB system variable is 1 or 2. After performing positioning, press F5 [DONE] on the positioning screen. The $MASTER_ENB system variable is reset to 0 automatically, thus hiding the positioning screen.

**⚠CAUTION**
It is recommended that the current mastering data be backed up before mastering is performed.

**⚠CAUTION**
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 in the correct mastering position, the cables in the mechanical unit are 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. 6.1 (a) and 6.1 (b).

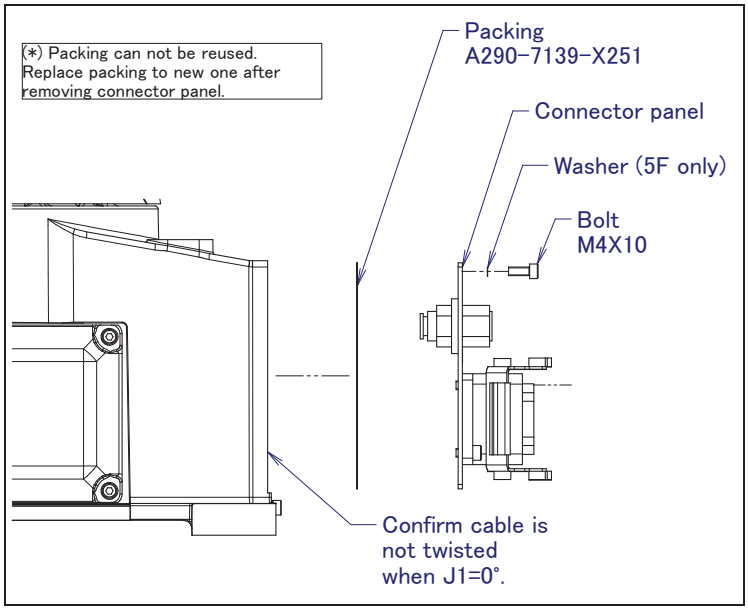



**Fig. 8.1 (a) Confirming the state of cable (J1-axis)**

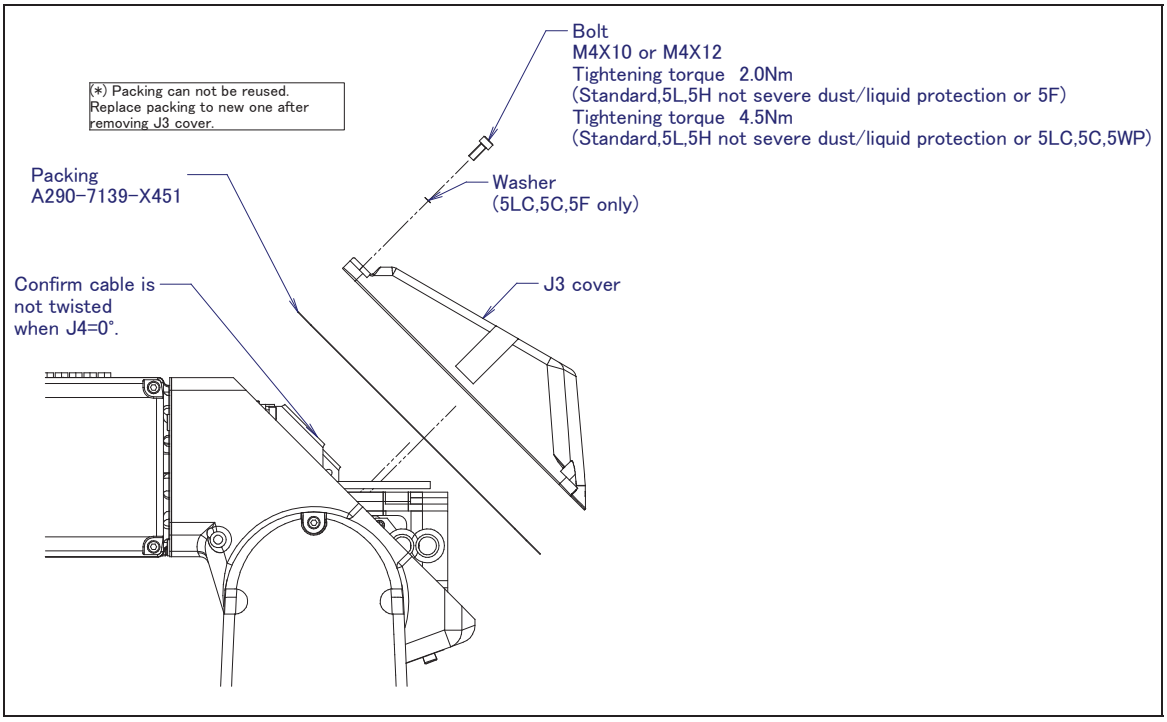



**Fig. 8.1 (b) Confirming the state of cable (J4-axis)**

# 8.2 RESETTING ALARMS AND PREPARING FOR MASTERING

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

## Alarm displayed

"Servo 062 BZAL" or "Servo 075 Pulse mismatch"

## Procedure

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

2 To reset the "Servo 062 BZAL" alarm, follow steps 1 to 5.
- (1) Press the screen slelection key.
- (2) Press [0 NEXT] and select [6 SYSTEM].
- (3) Press F1 [TYPE], and select [Master/Cal] from the menu.
- (4) Press the F3 RES_PCA, then press F4 [TRUE].
- (5) Turn off the controller power and on again.

3 To reset the "Servo 075 Pulse not established" alarm, follow steps 1 to 3.
- (1) When the controller power is switched on again, the message "Servo 075 Pulse mismatch" appears again.
- (2) Rotate the axis for which the message mentioned above has appeared through 10 degrees in either direction.

(3) Press [FAULT RESET]. The alarm is reset.

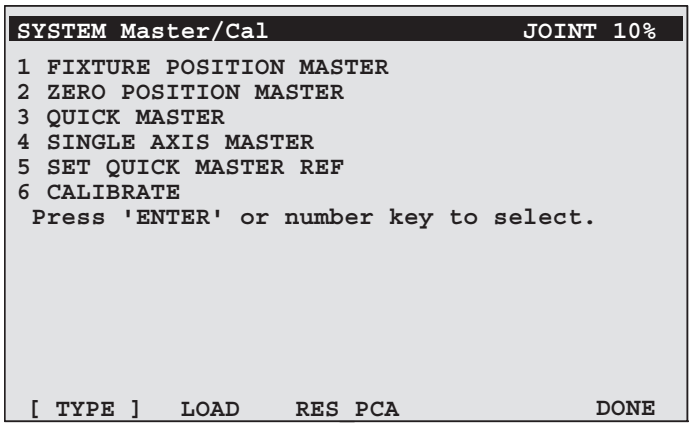
# 8.3 ZERO POSITION MASTERING

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

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

## Procedure of Zero-position Mastering

1 Press MENUS.
2 Select NEXT and press SYSTEM.
3 Press F1, [TYPE].
4 Select Master/Cal.




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, switch the controller power off and on again.

6 Select Zero Position Master.
7 Press F4, YES. Mastering will be performed automatically. Alternatively, switch the power off and on again. Switching the power on always causes positioning to be performed.
8 Return brake control to original setting, and turn off the controller power and on again.

**Table 8.3 Posture with position marks 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 |

> ⚠ **NOTE**
> There is no J6-axis for LR Mate 200*i*C/5H,5F.

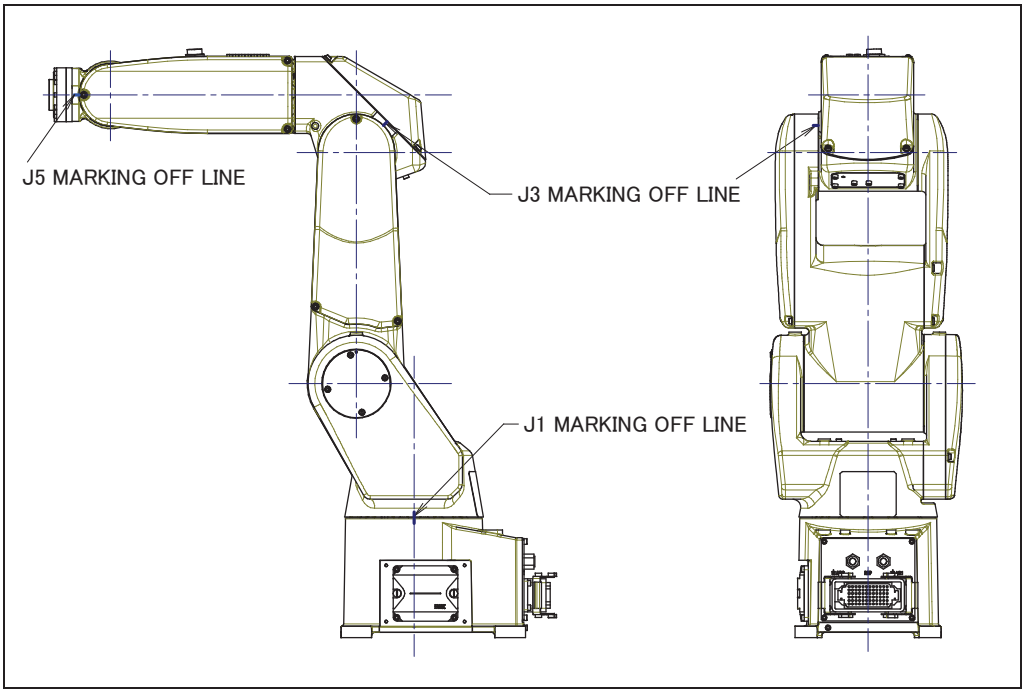



**Fig. 8.3 (a) Marking position 1**
**(LR Mate 200*i*C,LR Mate 200*i*C/5L,5C,5LC,5WP, ARC Mate 50*i*C,ARC Mate 50*i*C/5L)**

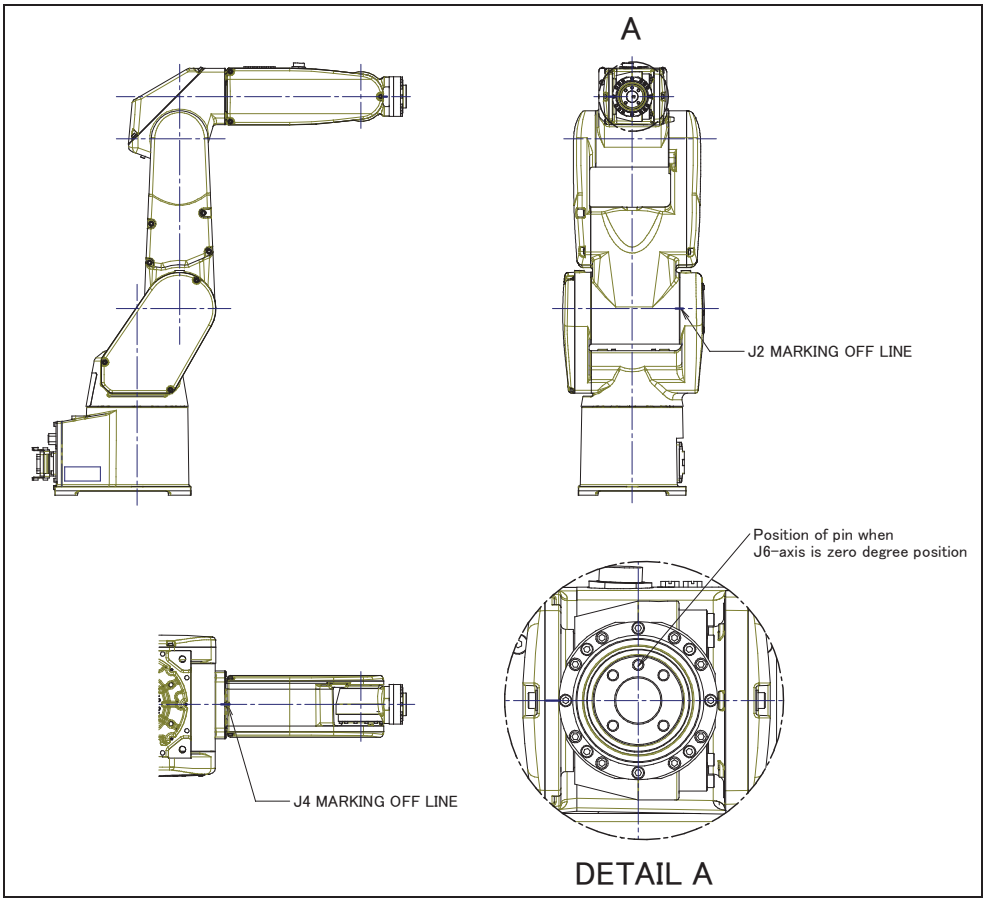



**Fig. 8.3 (b) Marking position 2**
**(LR Mate 200*i*C,LR Mate 200*i*C/5L,5C,5LC,5WP, ARC Mate 50*i*C,ARC Mate 50*i*C/5L)**

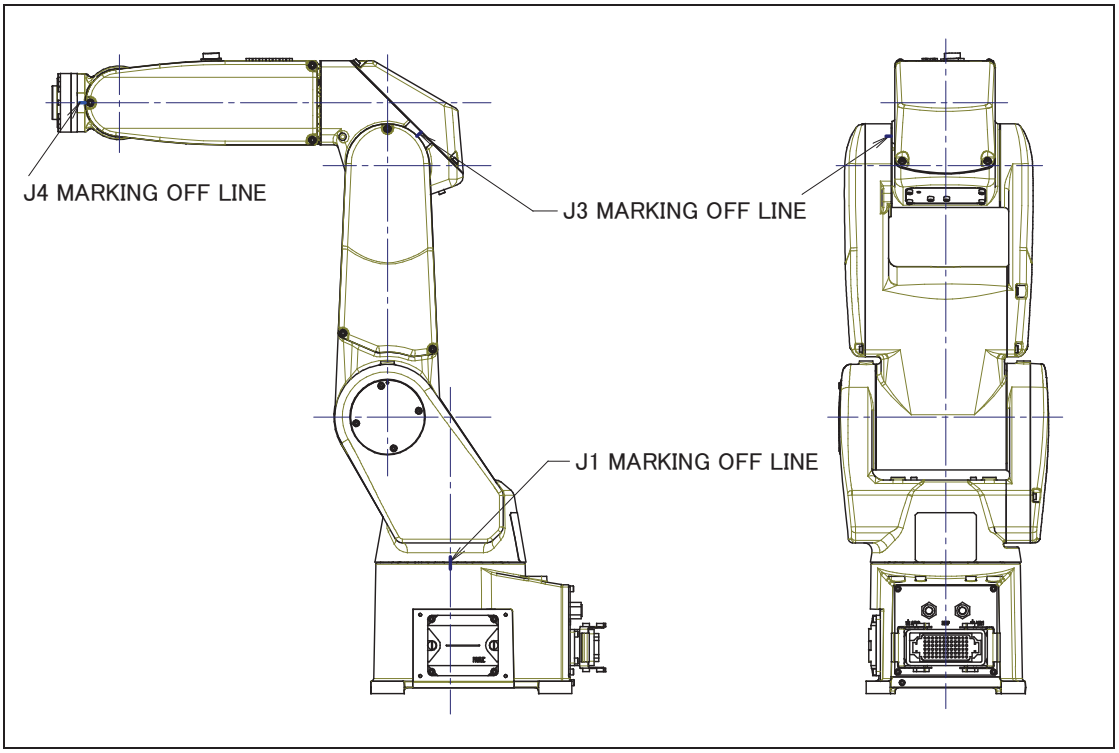



**Fig. 8.3 (c) Marking position1 (LR Mate 200*i*C/5H,5F)**

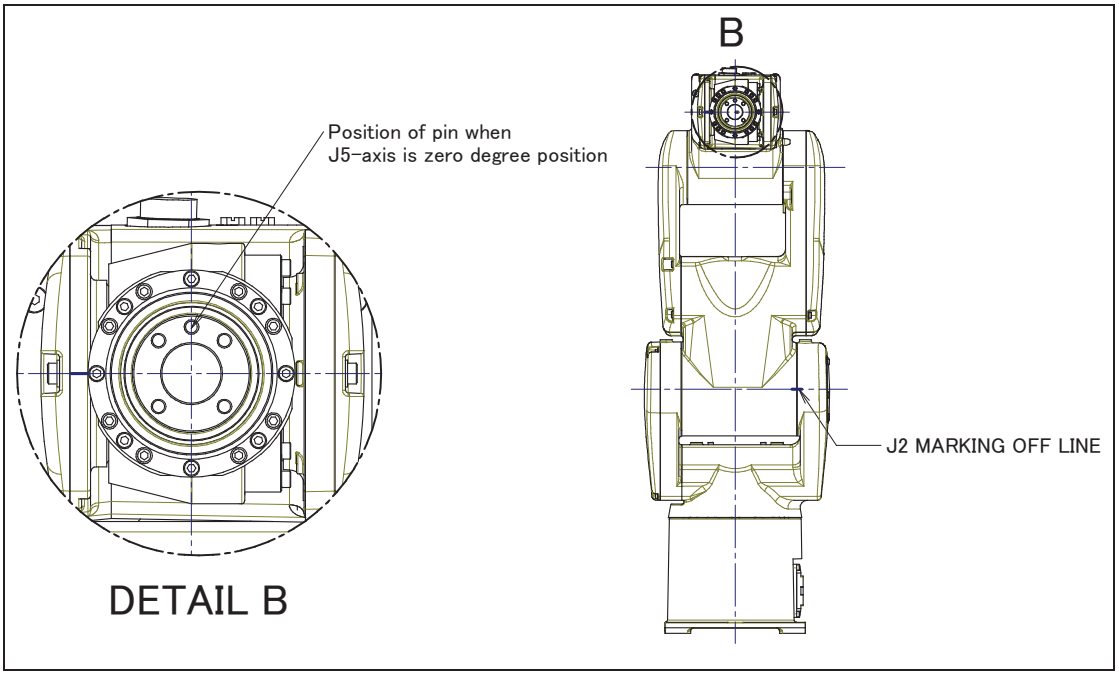



**Fig. 8.3 (d) Marking position 2 (LR Mate 200*i*C/5H,5F)**

# 8.4 QUICK MASTERING

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

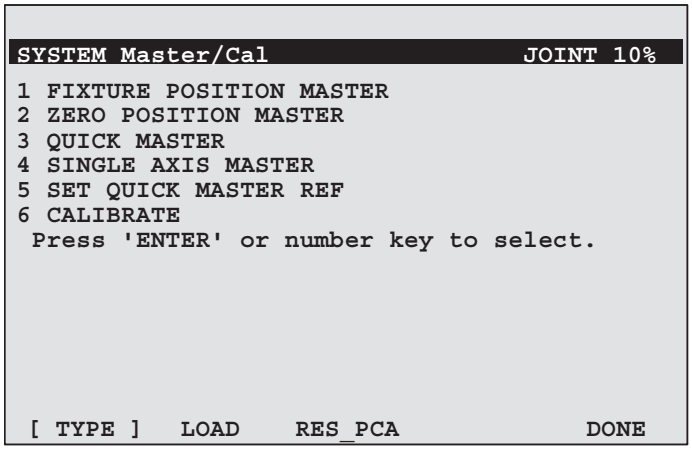
Quick mastering is factory-performed at the position indicated in Table 8.3. Do not change the setting unless there is any problem.

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

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

## Procedure Recording the Quick Mastering Reference Position

1 Select SYSTEM.
2 Select Master/Cal.

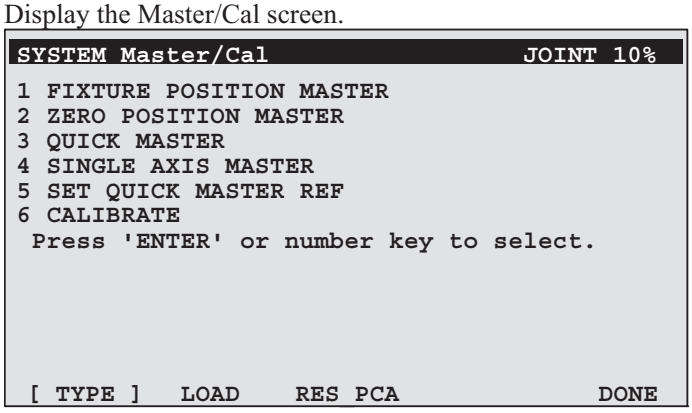



3 Release brake control, and jog the robot to the quick mastering reference position.
4 Set quick master ref? [NO] Move the cursor to SET QUICK MASTER REF and press ENTER. Press F4, YES.

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

### Procedure Quick Mastering

1 Display the Master/Cal screen.




2 Release brake control,and jog the robot to the quick mastering reference position.
3 Quick master? [NO] Move the cursor to QUICK MASTER and press ENTER. Press F4, YES. Quick mastering data is memorized.

```
Quick master? [NO]
```

4 Move the cursor to CALIBRATE and press ENTER. Calibration is executed.Calibration is executed by power on again.
5 After completing the calibration, press F5 Done.
6 Return brake control to original setting, and turn off the controller power and on again.

## 8.5 SINGLE AXIS MASTERING

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

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

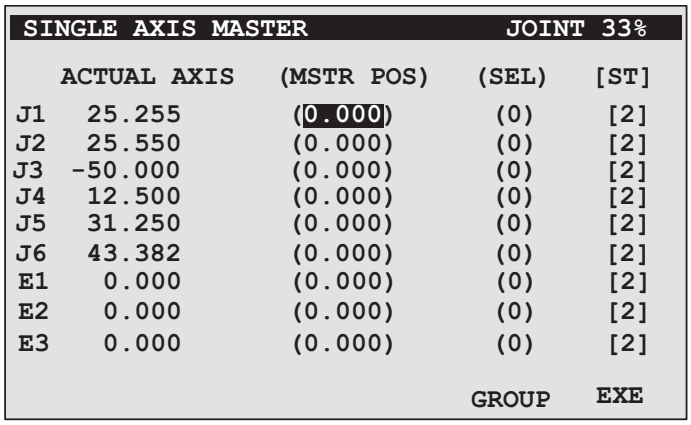
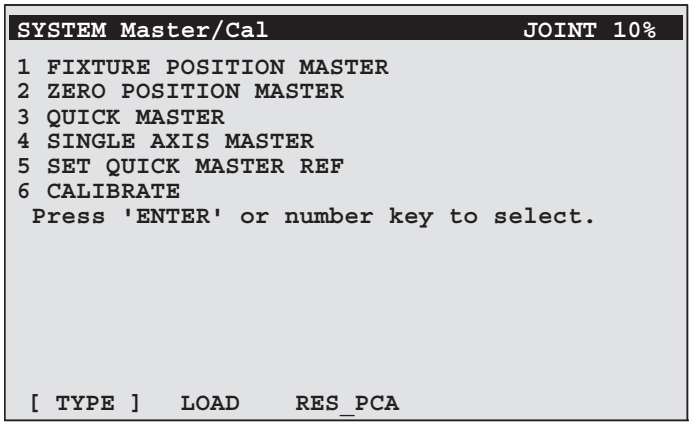



**Table 8.5 Items set in single axis mastering**

| 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 to set to it to the 0_ 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.<br>The value of the item is reflected in $EACHMST_DON<br>(1 to 9).<br>0 :Mastering data has been lost. Single axis mastering is necessary.<br>1 :Mastering data has been lost. (Mastering has been performed only for the other interactive axes.) Single axis mastering is necessary.<br>2 :Mastering has been completed. |

## Procedure of Single axis mastering

1 Select SYSTEM.
2 Select Master/Cal.




3 Select 4, Single Axis Master. You will see a screen similar to the following.

```
   SINGLE AXIS MASTER                JOINT 10%
                                          1/9
   ACTUAL POS      (MSTR POS)   (SEL)   [ST]
J1   25.255         (   0.000)   (0)     [2]
J2   25.550         (   0.000)   (0)     [2]
J3  -50.000         (   0.000)   (0)     [2]
J4   12.500         (   0.000)   (0)     [2]
J5   31.250         (   0.000)   (0)     [0]
J6   43.382         (   0.000)   (0)     [0]
E1    0.000         (   0.000)   (0)     [2]
E2    0.000         (   0.000)   (0)     [2]
E3    0.000         (   0.000)   (0)     [2]

  [ TYPE ]                       GROUP   EXE
```

4 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.

5 Turn off brake control as required, then jog the robot to the mastering position

6 Enter axis data for the mastering position.

```
                          JOINT 30%
                                5/9
(0.000)    (0)    [2]
(0.000)    (0)    [2]
```

```
SINGLE AXIS MASTER                JOINT 30%
                                        5/9
J5   31.250    (0.000)    (0)    [2]
J6   43.382    (90.000)   (0)    [2]
                                GROUP   EXEC
```

7 Press F5 [EXEC]. Mastering is performed. So, SEL is reset to 0, and ST is re-set to 2 or 1.

```
                    GROUP   EXEC
```

F5

```
SINGLE AXIS MASTER                JOINT 30%
                                          1/9
   ACTUAL AXIS     (MSTR POS)   (SEL)   [ST]
J1   25.255         (0.000)      (0)     [2]
J2   25.550         (0.000)      (0)     [2]
J3  -50.000         (0.000)      (0)     [2]
J4   12.500         (0.000)      (0)     [2]
J5    0.000         (0.000)      (0)     [2]
J6   90.000         (90.000)     (0)     [2]
E1    0.000         (0.000)      (0)     [2]
E2    0.000         (0.000)      (0)     [2]
E3    0.000         (0.000)      (0)     [2]
                                GROUP   EXEC
```

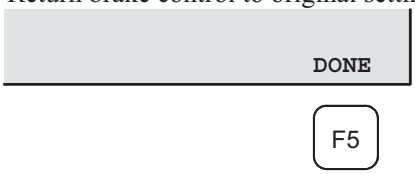
8 When single axis mastering is completed, press the previous page key to resume the previous screen.

```
SYSTEM Master/Cal                 JOINT 30%
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
 Press 'ENTER' or number key to select.




 [ TYPE ]                          DONE
```

9 Select [6 CALIBRATE], then press F4 [YES]. Positioning is performed. Alternatively, switch the power off and on again. Positioning is performed.
10 After positioning is completed, press F5 [DONE].
11 Return brake control to original setting, and turn off the controller power and on again.

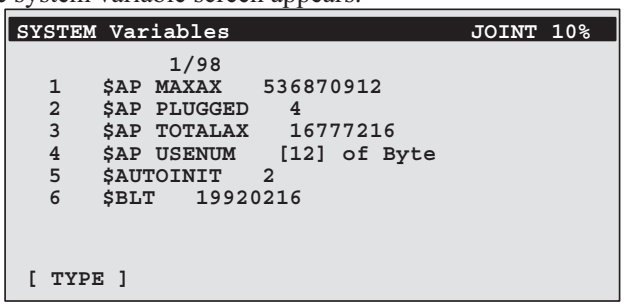



# 8.6 MASTERING DATA ENTRY

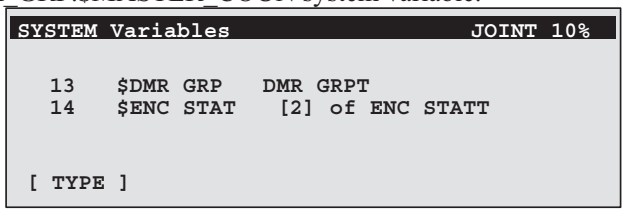
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

## Mastering data entry method

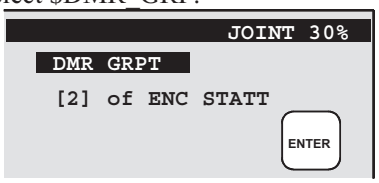
1 Press MENUS, then press NEXT and select SYSTEM.
2 Press F1, [TYPE]. Select [Variables]. The system variable screen appears.



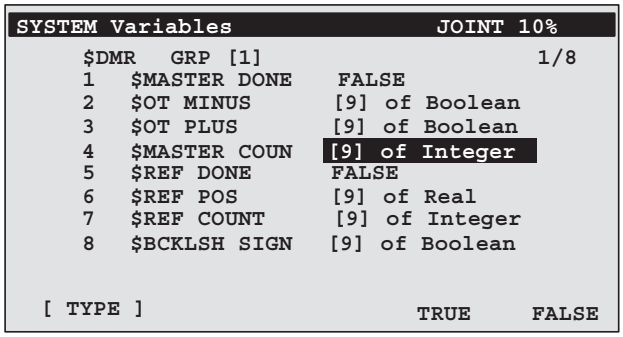

3 Change the mastering data.
The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.



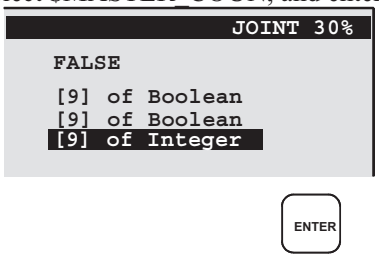
4 Select $DMR_GRP.

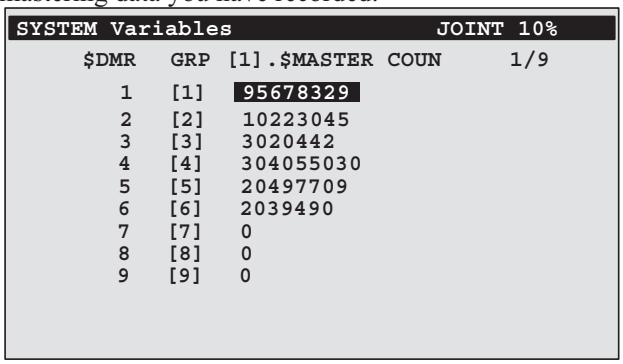






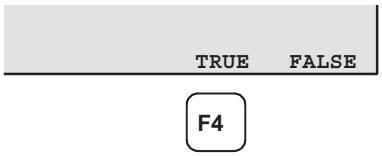

5 Select $MASTER_COUN, and enter the mastering data you have recorded.

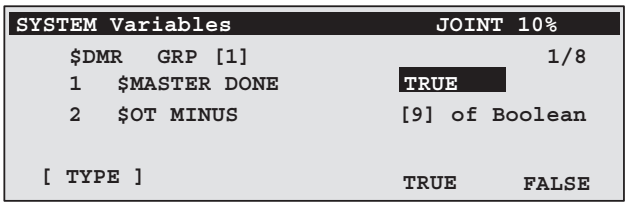



6 Press the PREV key.

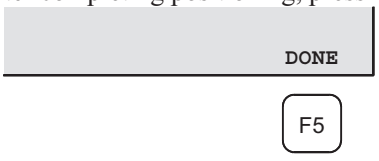
7 Set $MASTER_DONE to TRUE.




8 Display the positioning screen, and select [6 CALIBRATE], then press F4 [YES].

9 After completing positioning, press F5 [DONE].




# 8.7 CHECKING THE MASTERING

1 Checking whether mastering has been made correctly

Usually, positioning is performed automatically at power-on. To check whether mastering has been made correctly, note whether the displayed current position agrees with the actual robot position. Use the procedure described below:

(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0rad) positions. Check that the zero-degree position marks indicated in Section 8.3 are aligned. There is no need to use any visual aid.
(3) Using fixtures, set the robot to the mastering position in the same way as when performing mastering. Check that the displayed current position agrees with the actual mastering position.

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

2 Alarms that may be output during mastering and remedy for it

(1) BZAL alarm
This alarm is output if the voltage of the pulsecoder's backup battery falls to 0 V while the power to the controller is disconnected. Also, if pulsecoder connector is removed for replacing cables etc. this alarm is output because voltage becomes to 0. To clear the alarm, fit a new battery, execute the pulse reset (See section 8.2.), then turn the power off then on again and confirm alarm is not output.
Battery might be weak if you can’t reset alarm, then replace battery to new one , perform pulse reset , turn off and on the controller power.Note that, if this alarm occurs, all data originally held by the pulsecoder will have been lost. Mastering must be performed again.
(2) BLAL alarm
This alarm is output if the voltage of the pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is output, fit a new battery immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
(3) CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL, alarms
Contact the FANUC because the pulsecoder may be defective.

# 9 TROUBLESHOOTING

## 9.1 OVERVIEW

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

## 9.2 FAILURES, CAUSES AND MEASURES

Table 9.2 lists the major failures, causes and measures that may occur in the mechanical unit and their probable causes. If you cannot pinpoint a failure cause or which measures to apply, contact FANUC.

**Table 9.2 Failures, causes and measures**

| Symptom | Description | Cause | Measure |
|---|---|---|---|
| Vibration Noise | -The J1 base lifts off the floor plate as the robot operates.<br>-There is a gap bfetween the J1 base and floor plate.<br>-A J1 base retaining bolt is loose. | [J1 base fastening]<br>-It is likely that the robot J1 base is not securely fastened to the floor plate.<br>-Probable causes are a loose bolt, an insuffcient degree of surface flatness, or foreign material caught between the floor plate and floor plate.<br>-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 wihich, in turn, leads to vibration. | -If a bolt is loose, apply LOCTITE and tighten it to the appropriate torque.<br>-Adjust the floor plate surface flatness to within the specified tolenrance.<br>-If there is any foreign matter between the J1 base and floor plate, remove it. |
| | -Apply epoxy to the floor surface and re-install the plate. | [Rack or floor]<br>-It is likely that the rack or floor is not suffciently rigid.<br>-If the rack or floor is not sufficiently rigid, reaction from the robot deforms the rack or floor, leading to vibration. | -Reinforce the rack or floor to make it more rigid.<br>-If it is impossible to reinforce the rack or floor, modify the robot control program; doing so might reduce the amount of vibration. |
| | -Vibration becomes more serious when the robot adopts a specific posture.<br>-If the operating speed of the robot is reduced, vibration stops.<br>-Vibration is most noticeable when the robot is accelerating.<br>-Vibration occurs when two or more axes operate at the same time. | [Overload]<br>-It is likely that the load on the robot is greater than the maximum rating.<br>-It is likely that the robot control program is too demanding for the robot hardware.<br>-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.<br>-Vibration in a specific portion can be reduced by modifying the robot control program while slowig the robot and reducing its acceleration (to minimize the influenece on the entire cycle time). |

| Symptom | Description | Cause | Measure |
|---|---|---|---|
| Vibration<br>Noise<br>(Continued) | -Vibration was first noticed after the robot collided with an object or the robot was overloaded for a long period.<br>-The grease of the vibrating axis has not been exchanged for a long period. | [Broken gear, bearing, or reducer]<br>- It is likely that collision or overload applied an excessive force on the drive mechanism, thus damaging the geartooth surface or rolling surface of a bearing, or reducer.<br>- It is likely that prolonged use of the robot while overloaded caused fretting of the gear tooth surface or rolling surface of a bearing, or reducer due to resulting metal fatigue.<br>- It is likely that foreign matter caught in a gear, bearing, or within a reducer caused damage on the gear tooth surface or rolling surface of the bearing, or reducer.<br>- It is likely that, because the grease has not been changed for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue.<br><br>These factors all generate cyclic vibration and noise. | -Operate one axis at a time to determine which axis is vibrating.<br>-Remove the motor, and replace the gear , the bearing, and the reducer. For the spec. of parts and the method of replacement, contact FANUC.<br>-Using the robot within its maximum rating prevents problems with the drive mechanism.<br>-Regularly changing the grease with a specified type can help prevent problems. |

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

| Symptom | Description | Cause | Measure |
|---|---|---|---|
| Vibration Noise (Continued) | -There is some relationship between the vibration of the robot and the operation of a machine near the robot. | [Noise from a nearby machine]<br>-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.<br>-If the robot is grounded at an unsuitable point, its grounding potential becomes unstable, and noise is likely to be induced on the grounding line, thus leading to vibration. | -Connect the grounding wire firmly to ensure a reliable ground potential and prevent extraneous electrical noise. |
| Rattling | -While the robot is not supplied with power, pushing it with the hand causes part of the mechanical unit to wobble.<br>-There is a gap on the mounting face of the mechanical unit. | [Mechanical section coupling bolt]<br>-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.<br>-Motor retaining bolt<br>-Reducer retaining bolt<br>-Base retaining bolt<br>-Arm retaining bolt<br>-Casting retaining bolt<br>-End effecter retaining bolt |

| Symptom | Description | Cause | Measure |
|---|---|---|---|
| Motor overheating | -The ambient temperature of the installation location increases, causing the motor to overheat.<br>-After the robot control program or the load was changed, the motor overheated. | [Ambient temperature]<br>-It is likely that a rise in the ambient temperature prevented the motor from releasing heat efficiently, thus leading to overheating.<br>[Operating condition]<br>-It is likely that the robot was operated with the maximum average current exceeded. | -The teach pendant can be used to monitor the average current. Check the average current when the robot control program is running. The allowable average current is specified for the robot according to its ambient temperature. Contact FANUC for further information.<br>-Relaxing the robot control program and conditions can reduce the average current, thus preventing overheating.<br>-Reducing the ambient temperature is the most effective means of preventing overheating.<br>-Having the surroundings of the robot well ventilated enables the robot to release heat efficiently, thus preventing overheating. Using a fan to direct air at the motor is also effective.<br>-If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. |
| | -After a control parameter was changed, the motor overheated. | [Parameter]<br>-If data input for a workpiece is invalid, the robot cannot be accelerated or decelerated normally, so the average current increases, leading to overheating. | -Input an appropriate parameter as described in CONTROLLER OPERATOR'S MANUAL. |
| | -Symptom other than stated above | [Mechanical section problems]<br>-It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor.<br>[Motor problems]<br>-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.<br>-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.<br>-Check that, when the servo system is energized, the brake is released.<br>If the brake remains applied to the motor all the time, replace the motor.<br>-If the average current falls after the motor is replaced, it indicates that the first motor was faulty. |

| Symptom | Description | Cause | Measure |
|---|---|---|---|
| Grease leakage | -Grease is leaking from the mechanical unit. | [Poor sealing]<br>-Probable causes are a crack in the casting, a broken O-ring, a damaged oil seal, or a loose seal bolt.<br>-A crack in a casting can occur due to excessive force that might be caused in collision.<br>-An O-ring can be damaged if it is trapped or cut during disassembling or re-assembling.<br>-An oil seal might be damaged if extraneous dust scratches the lip of the oil seal.<br>-A loose seal bolt might allow grease to leak along the threads. | -If a crack develops in the casting, sealant can be used as a quick-fix to prevent further grease leakage. However, the component should be replaced as soon as possible, because the crack might extend.<br>-O-rings are used in the locations listed below.<br>-Motor coupling section<br>-Reducer coupling section<br>-Wrist coupling section<br>-J3 arm coupling section<br>-Inside the wrist<br>-Oil seals are used in the locations stated below.<br>-Inside the reducer<br>-Inside the wrist<br>-Seal bolts are used in the locations stated below.<br>-Grease drain inlet and outlet |
| Dropping axis | -An axis drops because the brake does not function.<br>-An axis drops gradually when it should be at rest. | [Brake drive relay and motor]<br>-It is likely that brake drive relay contacts are stuck to each other to keep the brake current flowing, thus preventing the brake from operating when the motor is deenergized.<br>-It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently.<br>-It is likely that oil or grease has entered the motor, causing the brake to slip. | -Check whether the brake drive relay contacts are stuck to each other. If they are found to be stuck, replace the relay.<br>-If the brake shoe is worn out, if the brake main body is damaged, or if oil or grease has entered the motor, replace the motor. |
| Displacement | -The robot operates at a point other than the taught position.<br>-The repeatability is not within the tolerance. | [Mechanical section problems]<br>-If the repeatability is unstable, probable causes are a failure in the drive mechanism or a loose bolt.<br>-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.<br>-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.<br>-If the repeatability is stable, correct the taught program. Variation will not occur unless another collision occurs.<br>-If the pulsecoder is abnormal, replace the motor or the pulsecoder. |
| | -Displacement occurs only in a specific peripheral unit. | [Peripheral unit displacement]<br>-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.<br>-Correct the taught program. |

| Symptom | Description | Cause | Measure |
|---|---|---|---|
| Displacement (Continued) | -Displacement occurred after a parameter was changed. | [Parameter]<br>-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.<br>-If correct mastering data is unavailable, perform mastering again. |
| BZAL alarm occured | -BZAL is displayed on the controller screen | - It is likely that the voltage of the memory backup battery is low.<br>- It is likely that the pulsecoder cable is defected. | -Replace the battery.<br>-Replace the cable. |

# APPENDIX

# A PERIODIC MAINTENANCE TABLE

FANUC Robot LR Mate 200*i*C, LR Mate 200*i*C/5C, /5L, /5LC
ARC Mate 50*i*C,ARC Mate 50*i*C/5L Periodic Maintenance Table

| Items | | | Check time | Grease amount | First check 320 | 3 months 960 | 6 months 1920 | 9 months 2880 | 1 years 3840 | 4800 | 5760 | 6720 | 2 years 7680 | 8640 | 9600 | 10560 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechanical unit | 1 | Check the exposed connector.(loosening) | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 2 | Tighten the end effector bolt. | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 3 | Tighten the cover and main bolt. | 2.0H | — | | ○ | | | ○ | | | | ○ | | | |
| | 4 | Check the mechanical stopper. | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 5 | Remove spatter and dust etc. | 1.0H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 6 | Check hand cable and external battery cable (option) | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 7 | Replacing battery. (if built-in batteries are specified) | 0.1H | — | | | | | ● | | | | ● | | | |
| | | Replacing battery. (if external batteries are specified) | 0.1H | — | | | | | | | ● | | | | | |
| | 8 | Greasing the reducers. | 0.5H | 14ml | | | | | | | | | | | | |
| | 9 | Replacing cable of mechanical unit *1 | 4.0H | — | | | | | | | | | | | | |
| Controller | 10 | Check the robot cable, teach pendant cable and robot connecting cable | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 11 | Cleaning the ventilator | 0.2H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 12 | Replacing battery *1 | 0.1H | — | | | | | | | | | | | | |

*1 Refer to manual of controller.
*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | Overhaul | 1 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 2 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 3 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 4 |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | 5 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 6 |
| ● | | | | ● | | | | ● | | | | ● | | | | ● | | | | | 7 |
| ● | | | | | | ● | | | | | | ● | | | | | | ● | | | |
| | | | | ● | | | | | | | | | | | | | | | | | 8 |
| | | | | ● | | | | | | | | | | | | | | | | | 9 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 10 |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | 11 |
| | | | | ● | | | | | | | | | | | | | | | | | 12 |

FANUC Robot LR Mate 200*i*C/5WP Periodic Maintenance Table

| | | Items \ Working time (H) | Check time | Grease amount | First check 320 | 3 months 960 | 6 months 1920 | 9 months 2880 | 1 years 3840 | 4800 | 5760 | 6720 | 2 years 7680 | 8640 | 9600 | 10560 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechanical unit | 1 | Check the exposed connector.(loosening) | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 2 | Tighten the end effector bolt. | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 3 | Tighten the cover and main bolt. | 2.0H | — | | ○ | | | ○ | | | | ○ | | | |
| | 4 | Check the mechanical stopper. | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 5 | Remove spatter and dust etc. | 1.0H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 6 | Check hand cable and external battery cable (option) | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 7 | Replacing battery.(external battery) | 0.1H | — | | | | | | | ● | | | | | |
| | 8 | Greasing the reducers. | 0.5H | 14ml | | | | | | | | | ● | | | |
| | 9 | Replacing cable of mechanical unit * | 4.0H | — | | | | | | | | | | | | |
| Controller | 10 | Check the robot cable, teach pendant cable and robot connecting cable | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 11 | Cleaning the ventilator | 0.2H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 12 | Replacing battery *1 | 0.1H | — | | | | | | | | | | | | |

*1 Refer to manual of controller.

*2 ●: requires order of parts

○: does not require order of parts

| 3 years 11520 | 12480 | 13440 | 14400 | 4 years 15360 | Item |
|---|---|---|---|---|---|
| ○ | | | | Overhaul | 1 |
| ○ | | | | | 2 |
| ○ | | | | | 3 |
| ○ | | | | | 4 |
| ○ | ○ | ○ | ○ | | 5 |
| ○ | | | | | 6 |
| ● | | | | | 7 |
| | | | | | 8 |
| | | | | | 9 |
| ○ | | | | | 10 |
| ○ | ○ | ○ | ○ | | 11 |
| | | | | | 12 |

FANUC Robot LR Mate 200*i*C/5H Periodic Maintenance Table

| | | Items \ Working time (H) | Check time | Grease amount | First check 320 | 3 months 960 | 6 months 1920 | 9 months 2880 | 1 years 3840 | 4800 | 5760 | 6720 | 2 years 7680 | 8640 | 9600 | 10560 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechanical unit | 1 | Check the exposed connector.(loosening) | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 2 | Tighten the end effector bolt. | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 3 | Tighten the cover and main bolt. | 2.0H | — | | ○ | | | ○ | | | | ○ | | | |
| | 4 | Check the mechanical stopper. | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 5 | Remove spatter and dust etc. | 1.0H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 6 | Check hand cable and external battery cable (option) | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 7 | Replacing battery. (if built-in batteries are specified) | 0.1H | — | | | | | ● | | | | ● | | | |
| | | Replacing battery. (if external batteries are specified) | 0.1H | — | | | | | | | ● | | | | | |
| | 8 | Greasing the reducers. | 0.5H | 12ml | | | | | | | | | | | | |
| | 9 | Replacing cable of mechanical unit * | 4.0H | — | | | | | | | | | | | | |
| Controller | 10 | Check the robot cable, teach pendant cable and robot connecting cable | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 11 | Cleaning the ventilator | 0.2H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 12 | Replacing battery *1 | 0.1H | — | | | | | | | | | | | | |

*1 Refer to manual of controller.

*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | Overhaul | 1 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 2 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 3 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 4 |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | 5 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 6 |
| ● | | | | ● | | | | ● | | | | ● | | | | ● | | | | | 7 |
| ● | | | | | | ● | | | | | | ● | | | | | | ● | | | |
| | | | | ● | | | | | | | | | | | | | | | | | 8 |
| | | | | ● | | | | | | | | | | | | | | | | | 9 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 10 |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | 11 |
| | | | | ● | | | | | | | | | | | | | | | | | 12 |

FANUC Robot LR Mate 200*i*C/5F Periodic Maintenance Table

| | | Items \ Working time (H) | Check time | Grease amount | First check 320 | 3 months 960 | 6 months 1920 | 9 months 2880 | 1 years 3840 | 4800 | 5760 | 6720 | 2 years 7680 | 8640 | 9600 | 10560 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechanical unit | 1 | Check the exposed connector.(loosening) | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 2 | Tighten the end effector bolt. | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 3 | Tighten the cover and main bolt. | 2.0H | — | | ○ | | | ○ | | | | ○ | | | |
| | 4 | Check the mechanical stopper. | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 5 | Remove spatter and dust etc. | 1.0H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 6 | Check hand cable and external battery cable (option) | 0.1H | — | | ○ | | | ○ | | | | ○ | | | |
| | 7 | Replacing battery. | 0.1H | — | | | | | ● | | | | ● | | | |
| | 8 | Greasing the reducers. | 0.5H | 12ml | | | | | | | | | ● | | | |
| | 9 | Replacing cable of mechanical unit * | 4.0H | — | | | | | | | | | | | | |
| Controller | 10 | Check the robot cable, teach pendant cable and robot connecting cable | 0.2H | — | | ○ | | | ○ | | | | ○ | | | |
| | 11 | Cleaning the ventilator | 0.2H | — | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | 12 | Replacing battery *1 | 0.1H | — | | | | | | | | | | | | |

*1 Refer to manual of controller.

*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | Overhaul | 1 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 2 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 3 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 4 |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | 5 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 6 |
| ● | | | | ● | | | | ● | | | | ● | | | | ● | | | | | 7 |
| | | | | ● | | | | | | | | ● | | | | | | | | | 8 |
| | | | | ● | | | | | | | | | | | | | | | | | 9 |
| ○ | | | | ○ | | | | ○ | | | | ○ | | | | ○ | | | | | 10 |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | 11 |
| | | | | ● | | | | | | | | | | | | | | | | | 12 |

# B MOUNTING BOLT TORQUE LIST

**NOTE**

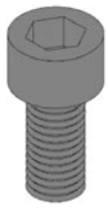
When applying LOCTITE to the important bolt tightening points, make sure that it is applied to the entire longitudinal portion in the engaging section of the female threads. If it is applied to the male threads, the bolts may be loosened because sufficient adhesion cannot be obtained. Remove the dust within the bolts and taps and wipe oil off the engaging section. Make sure that there is no solvent in the taps.

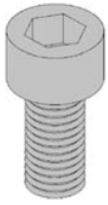
Be sure to wipe the excess LOCTITE after tightening screw.

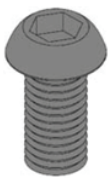
If no tightening torque is specified for a bolt, tighten it according to this table.

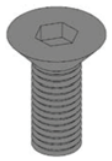
**Recommended bolt tightening torques** **Unit: Nm (kgf-cm)**

| Nominal diameter | Hexagon socket head bolt (Steel in strength category 12.9) | | Hexagon socket head bolt (stainless) | | Hexagon socket head boss bolt Hexagon socket head flush bolt (steel in strength category 12.9) | |
|---|---|---|---|---|---|---|
| | Tightening torque | | Tightening torque | | Tightening torque | |
| | Upper limit | Lower limit | Upper limit | Lower limit | Upper limit | Lower limit |
| M3 | 1.8(18) | 1.3(13) | 0.76(7.7) | 0.53(5.4) | - | - |
| M4 | 4.0(41) | 2.8(29) | 1.8(18) | 1.3(13) | 1.8(18) | 1.3(13) |
| M5 | 7.9(81) | 5.6(57) | 3.4(35) | 2.5(25) | 4.0(41) | 2.8(29) |
| M6 | 14(140) | 9.6(98) | 5.8(60) | 4.1(42) | 7.9(81) | 5.6(57) |
| M8 | 32(330) | 23(230) | 14(145) | 9.8(100) | 14(140) | 9.6(98) |
| M10 | 66(670) | 46(470) | 27(280) | 19(195) | 32(330) | 23(230) |
| M12 | 110(1150) | 78(800) | 48(490) | 33(340) | - | - |
| (M14) | 180(1850) | 130(1300) | 76(780) | 53(545) | - | - |
| M16 | 270(2800) | 190(1900) | 120 (1200) | 82(840) | - | - |
| (M18) | 380(3900) | 260(2700) | 160(1650) | 110(1150) | - | - |
| M20 | 530(5400) | 370(3800) | 230(2300) | 160(1600) | - | - |
| (M22) | 730(7450) | 510(5200) | - | - | - | - |
| M24 | 930(9500) | 650(6600) | - | - | - | - |
| (M27) | 1400(14000) | 960(9800) | - | - | - | - |
| M30 | 1800(18500) | 1300(13000) | - | - | - | - |
| M36 | 3200(33000) | 2300(23000) | - | - | - | - |









# C OPTIONAL CONNECTOR WIRING PROCEDURE

Source of information: Hirose Electric Co., Ltd.

## Plug – Disassembly / Assembly

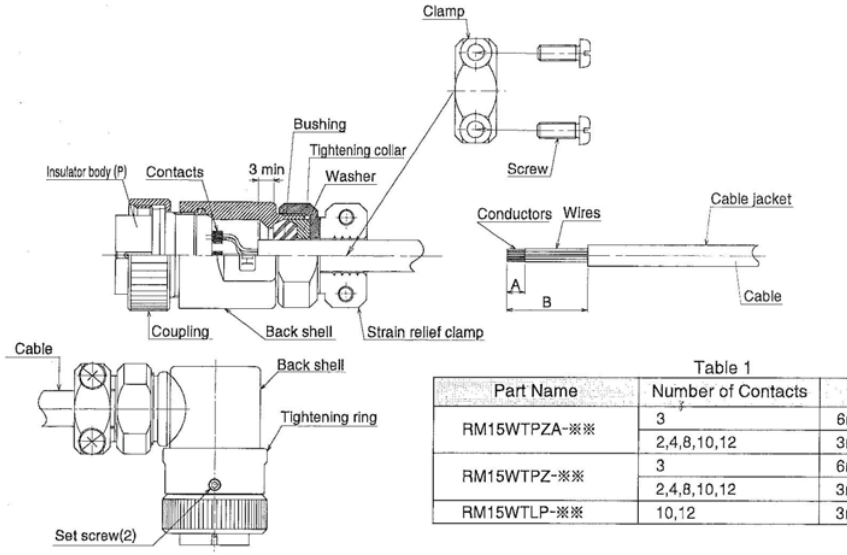



Table 1

| Part Name | Number of Contacts | A | B | |
|---|---|---|---|---|
| RM15WTPZA-※※ | 3 | 6mm | 21mm | |
| | 2,4,8,10,12 | 3mm | 21mm | |
| RM15WTPZ-※※ | 3 | 6mm | 12mm | |
| | 2,4,8,10,12 | 3mm | 12mm | NOTE1 |
| RM15WTLP-※※ | 10,12 | 3mm | 25mm | NOTE2 |

| | |
|---|---|
| 1. | **Disassembly**<br>① Fix the plug in the assembly fixture (RM15TP-T01 (CL150-0098-0)), then remove the insulator body (P) and the back shell. Right-angle plugs have set screws in the tightening ring at 2 locations. Loosen the set screws before removing the back shell.<br>② Remove the 2 screws of the strain relief clamp, and then remove the clamp from the tightening collar. |
| 2. | **Wiring**<br>① Assure that the cable outer diameter will fit the strain relief clamp, and is prepared as recommended in Table 1. It is recommended that the exposed conductors be pre-soldered, to assure easier insertion in the soldering cup.<br>② Pass the parts over the cable in the order of: tightening collar, washer, bushing, back shell, and coupling. Refer to the drawings (above) for assembly orientation of all components.<br>③ Solder the wires to the contacts of the insulator body (P).<br>Use of heat-shrink tubing or another insulating media between the soldered contacts is suggested. |
| 3. | **Connector Assembly**<br>Straight Plugs<br>① Place the completely wired insulator body (P) in the assembly fixture secured in a vise. Insert in the coupling, then back shell. The back shell should be tightened to a torque of 3 N·m.<br>Right-angle Plugs<br>① Place the completely wired insulator body (P) in an assembly fixture secured by a vise. Insert in the coupling, then back shell (with tightening ring). When attaching the back shell, orient the cable in the desired direction and fasten the tightening ring to the insulator body (P) with a torque of 3 N·m. After this, tighten and fix the 2 sets crews with a torque of 0.2 to 0.3 N·m.<br>Additional assembly recommendations:<br>In applications where continuous extremely high vibrations may be encountered it is recommended that a thread locking compound be applied to male threads prior to assembly (Loctite 271 , manufactured by Henkel Japan K.K. or equivalent) |
| 4. | **Waterproof verification - plug assembly**<br>Apply air pressure of 17.6 kPa for 30 seconds from the mating side of the plug assembly. There shall not be any air leakage from inside the connector when submerged in the water tank. |
| 5. | **Precautions**<br>① Follow the correct assembly sequence, cable preparation and tightening torques.<br>② Assure that the applicable cable outer surfaces are free of scratches, oil, grease or any other contamination.<br>③ Do not use excessive forces or improper tools when assembling or mounting the connectors. |

NOTE1) Corresponds to A05B-1137-J057.
NOTE2) Corresponds to A05B-1137-J058 and A05B-1139-J059.

# D INSULATION ABOUT ARC WELDING ROBOT

## D.1 ABSTRACT

The arc welding robot performs welding, using a welding torch attached to its end effector via a bracket. Because a high welding current flows through the welding torch, the insulation between the end effector and torch is dualized.
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 sections, possibly resulting in the motor being damaged or the sheaths of cables in the mechanical sections melting.

## D.2 INSULATION AT THE WRIST

- Design the insulation between the end effector and welding torch so that no current will leak from the end effector. Concretely, when fastening the insulating material inserted between the end effector and torch bracket, use different bolts on the insulation material and torch bracket.
- Insert the insulating material between the torch and torch bracket so that the insulation is dualized. 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.
- Insert the insulating material between the torch and torch bracket so that the insulation is dualized. 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.
- Even after the insulation is reinforced, it is likely that, if a pileup of spatter grows excessively, current may leak. Periodically remove spatter when the robot is in service.

# INDEX

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## Revision Record

FANUC Robot LR Mate 200*i*C,ARC Mate 50*i*C MECHANICAL UNIT OPERATOR'S MANUAL (B-82584EN)

| | | | | | |
|---|---|---|---|---|---|
| 05 | Jun. ,2008 | - Addition of LR Mate 200*i*C/5H High speed wrist and 5F<br>- Addition of notes | | | |
| 04 | Mar. ,2008 | - Change of motion range for inclined surface mounted robots<br>- Addition note about cable<br>- Addition note about non severe dust/liquid protection specification<br>- Correction of errors | | | |
| 03 | Nov. ,2007 | - Addition of the LR Mate 200*i*C/5L, 5C, 5LC, 5WP<br>- Addition of descriptions of connector wiring procedure<br>- Correction of errors | | | |
| 02 | Aug.,2007 | - Addition of the LR Mate 200*i*C/5H<br>- Addition of motion range for inclined surface mounted robots<br>- Correction of errors | 07 | Mar. ,2010 | - Addition cleaning method of LR Mate 200iC/5F<br>- Addition about insulation of ARC robot<br>- Correction of errors |
| 01 | May.,2007 | ——— | 06 | Oct. ,2008 | - Addition of LR Mate 200*i*C/5C, 5LC clean class 10<br>- Addition of ARC Mate 50*i*C, ARC Mate 50*i*C/5L |
| **Edition** | **Date** | **Contents** | **Edition** | **Date** | **Contents** |

B-82584EN/07