

FANUC Robot **LR Mate 200iD** **FANUC** Robot **ARC Mate 50iD**

MECHANICAL UNIT **OPERATOR'S MANUAL**

MAROT200D01121E REV. F

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FANUC 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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Patents

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

FANUC America Corporation 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**

Thank you very much for purchasing FANUC Robot.

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

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

Safety

FANUC America Corporation 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 America Corporation 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 America Corporation 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 America Corporation therefore, recommends that all personnel who intend to operate, program, repair, or otherwise use the robotics system be trained in an approved FANUC America Corporation 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 Safe

The safety of people is always of primary importance in any situation. When applying safety measures to your robotic system, consider the following:

- 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 America Corporation 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 America Corporation 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.

 **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 DCS (Dual Check Safety), 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. DCS (Dual Check Safety), 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.

SAFETY PRECAUTIONS

This chapter must be read before using the robot.

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

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

For safe use of FANUC robots, you must read and follow the instructions in “FANUC Robot SAFETY HANDBOOK (B-80687EN)”.

1 DEFINITION OF USER

The personnel can be classified as follows.

Operator:

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

Programmer or Teaching operator.

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

Maintenance engineer:

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

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

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

Table 1 List of work outside the fence

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

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

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

2 DEFINITION OF SAFETY NOTATIONS

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

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

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

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

Please drop the power supply of the robot control system at once when the worker is placed by the robot by any chance or it is confined, push the robot arm directly, change posture, and liberate the worker.

4 WARNING & CAUTION LABEL

(1) Transportation label

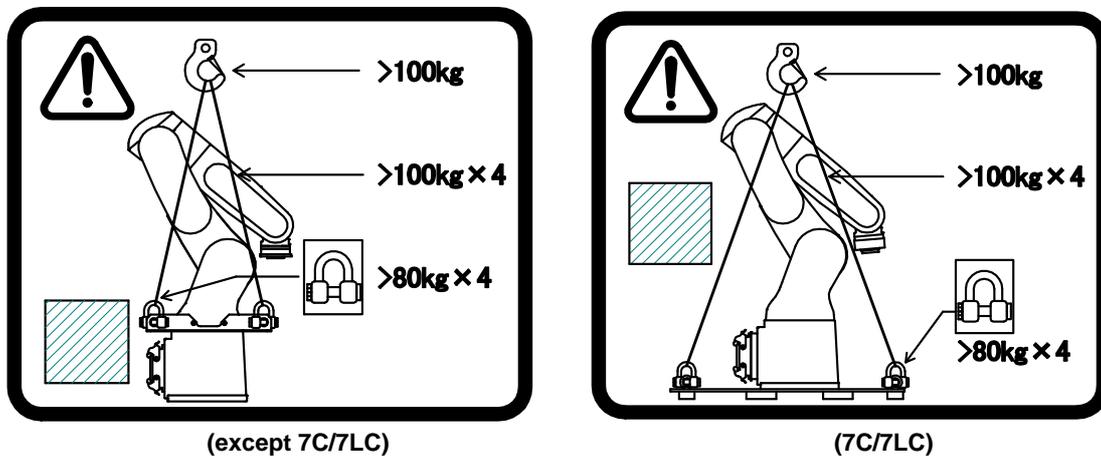


Fig. 4 (a) Transportation label

Description

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

- 1) Use a crane having a load capacity of 100 kg or greater.
- 2) Use at least four slings each having a load capacity of 100 kg or greater.
- 3) Use at least four shackles and eyebolts each having an allowable load of 784 N (80 kgf) or greater.

(2) Greasing label
 (if greasing kit A05B-1142-K021, A05B-1142-K023 is specified)



Fig. 4 (b) Greasing label

Description

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

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

(3) Operation space and payload label

The following label is added if the CE specification is requested.

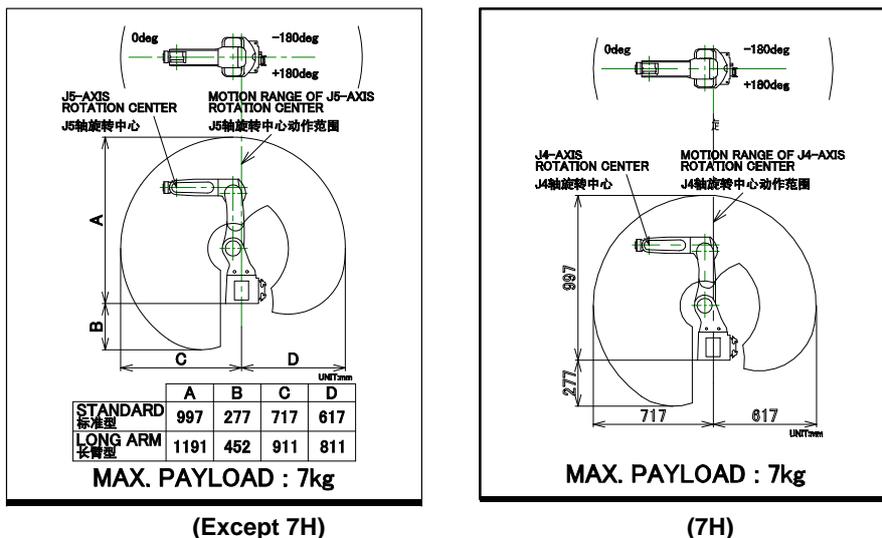


Fig. 4 (c) Operation space and payload label

PREFACE

This manual explains maintenance procedures for the following mechanical units:

Model name	Mechanical unit specification No.	Maximum load	Remarks
FANUC Robot LR Mate 200iD	A05B-1142-B201	7kg	
FANUC Robot LR Mate 200iD/7H	A05B-1142-B211		5-axes type
FANUC Robot LR Mate 200iD/7C	A05B-1142-B221		Clean type
FANUC Robot LR Mate 200iD/7WP	A05B-1142-B231		For washing
FANUC Robot ARC Mate 50iD	A05B-1142-B251		
FANUC Robot LR Mate 200iD/7L	A05B-1142-B301		Long arm type
FANUC Robot LR Mate 200iD/7LC	A05B-1142-B321		Long arm, clean type
FANUC Robot ARC Mate 50iD/7L	A05B-1142-B351		Long arm type

NOTE

The following abbreviations are used herein.

STANDARD : LR Mate 200iD, ARC Mate 50iD

7H : LR Mate 200iD/7H

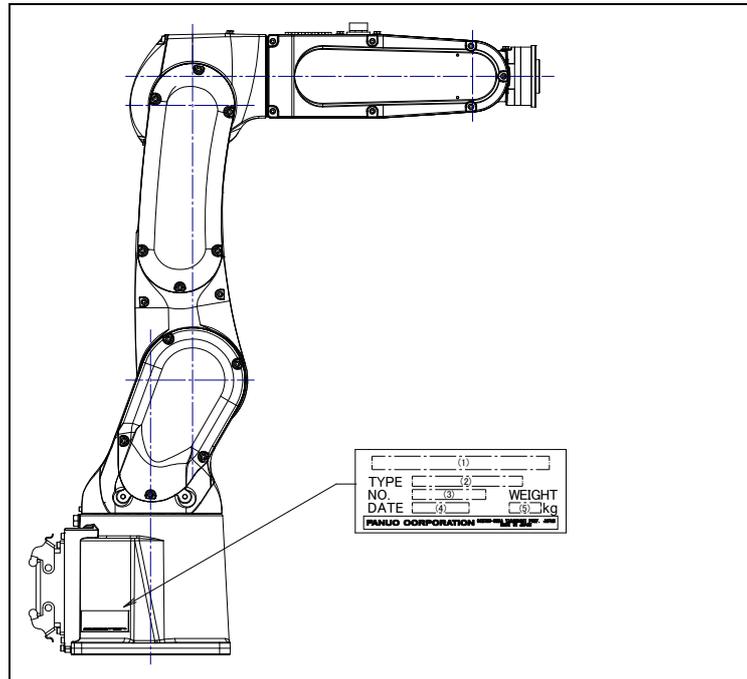
7C : LR Mate 200iD/7C

7WP : LR Mate 200iD/7WP

7L : LR Mate 200iD/7L, ARC Mate 50iD/7L

7LC : LR Mate 200iD/7LC

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



Position of label indicating mechanical unit specification number

TABLE 1)

	(1)	(2)	(3)	(4)	(5)
CONTENTS	Model name	TYPE	No.	DATE	WEIGHT kg (Without controller)
LETTERS	FANUC Robot LR Mate 200iD	A05B-1142-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	25
	FANUC Robot LR Mate 200iD/7H	A05B-1142-B211			24
	FANUC Robot LR Mate 200iD/7C	A05B-1142-B221			25
	FANUC Robot LR Mate 200iD/7WP	A05B-1142-B231			25
	FANUC Robot ARC Mate 50iD	A05B-1142-B251			25
	FANUC Robot LR Mate 200iD/7L	A05B-1142-B301			27
	FANUC Robot LR Mate 200iD/7LC	A05B-1142-B321			27
	FANUC Robot ARC Mate 50iD/7L	A05B-1142-B351			27

RELATED MANUALS

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

SAFETY HANDBOOK B-80687EN All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers : Operator, system designer Topics : Safety items for robot system design, operation, maintenance
R-30iB Mate R-30iB Mate Plus controller	OPERATOR'S MANUAL Basic Operation B-83284EN Alarm Code List B-83284EN-1 Optional Function B-83284EN-2	Intended readers : Operator, programmer, maintenance engineer, system designer Topics : Robot functions, operations, programming, setup, interfaces, alarms Use : Robot operation, teaching, system design
	MAINTENANCE MANUAL Standard : B-83525EN Open Air : B-83555EN	Intended readers : Maintenance engineer, system designer Topics : Installation, start-up, connection, maintenance Use : Installation, start-up, connection, maintenance

This manual uses following terms.

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

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1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

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



WARNING

- 1 The robot becomes unstable when it is transported with the end effector applied to wrist. Please be sure to remove the end effector when the robot is transported.
- 2 Before moving the robot with a crane, check and tighten any loose bolts on the transport equipment on the robot.
- 3 Do not pull eyebolts sideways.

Transportation using a crane (Fig. 1.1 (a) to (f))

Fasten the transport equipment to the robot base and lift the robot with the four slings.



CAUTION

Note that slings with insufficient length may break the J2 base or J2 arm cover.

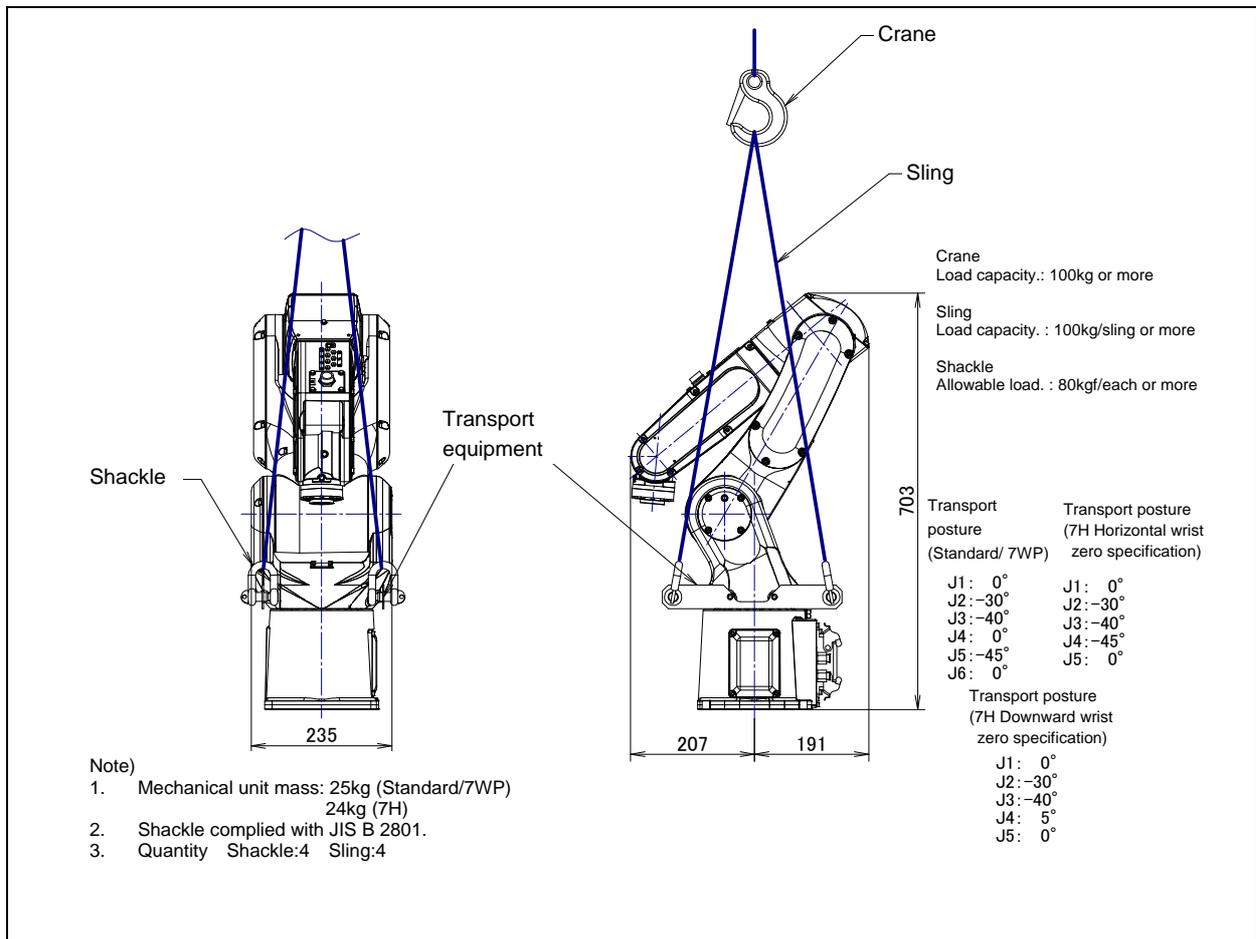
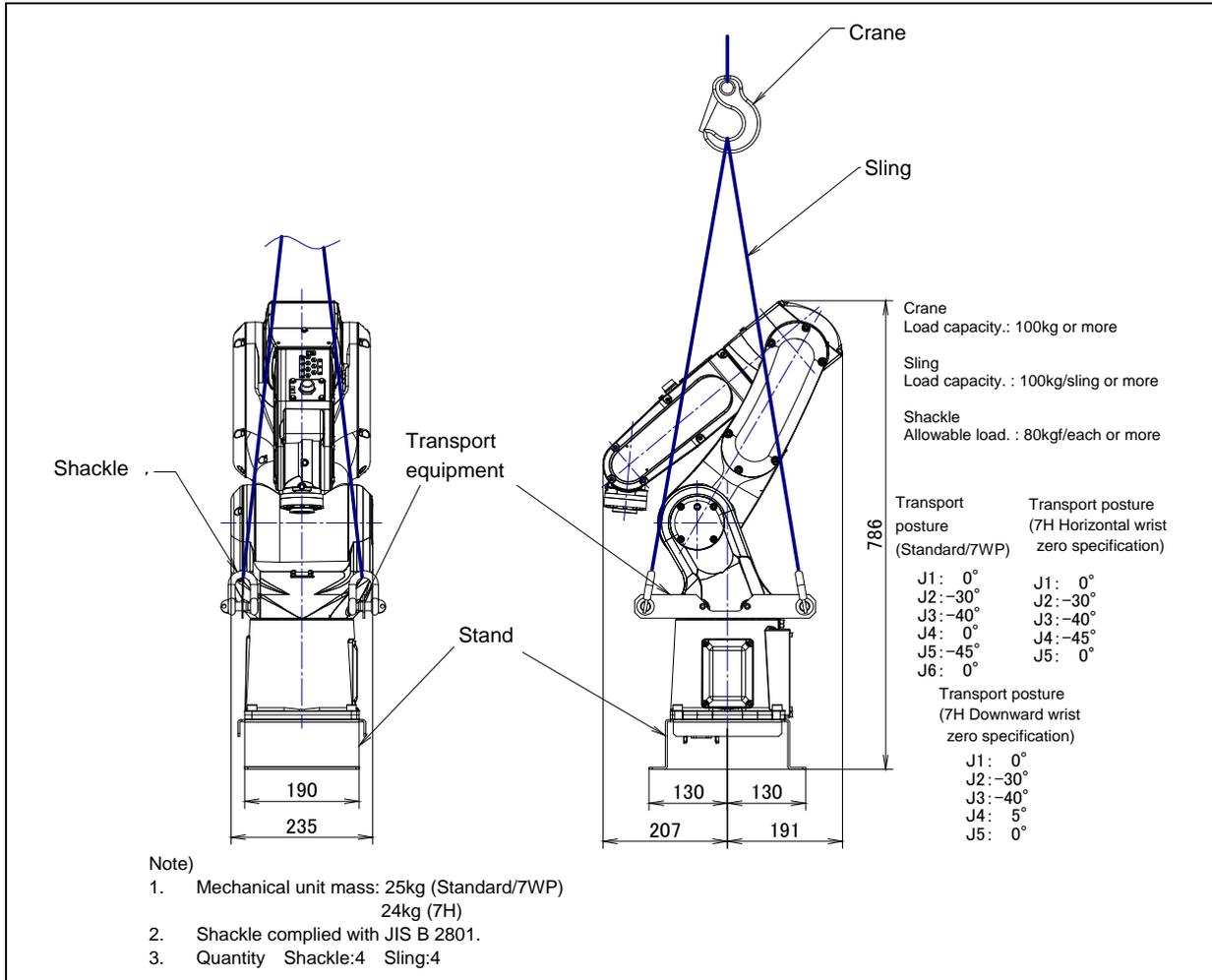


Fig. 1.1 (a) Transportation using a crane (back side connector plate)
(Standard/7H/7WP)



**Fig. 1.1 (b) Transportation using a crane (bottom connector plate)
(Standard/7H/7WP)**

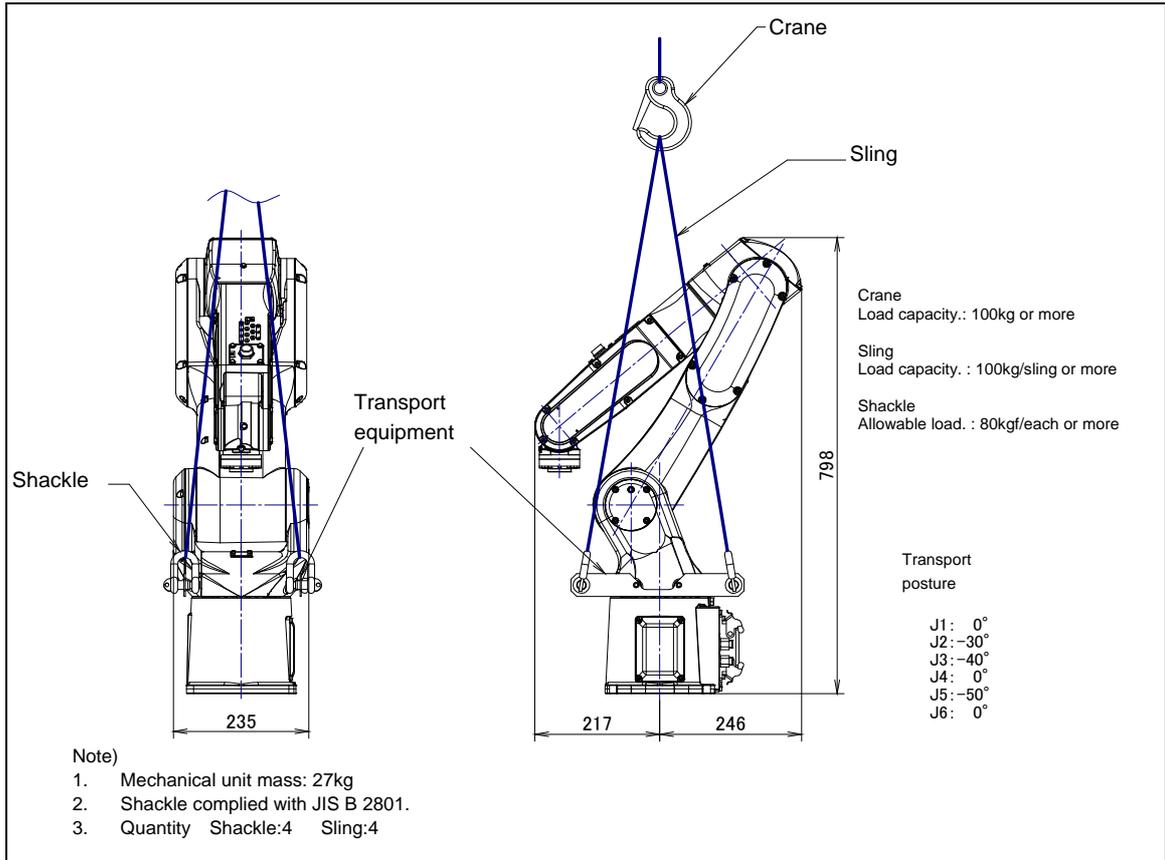


Fig. 1.1 (c) Transportation using a crane (back side connector plate) (7L)

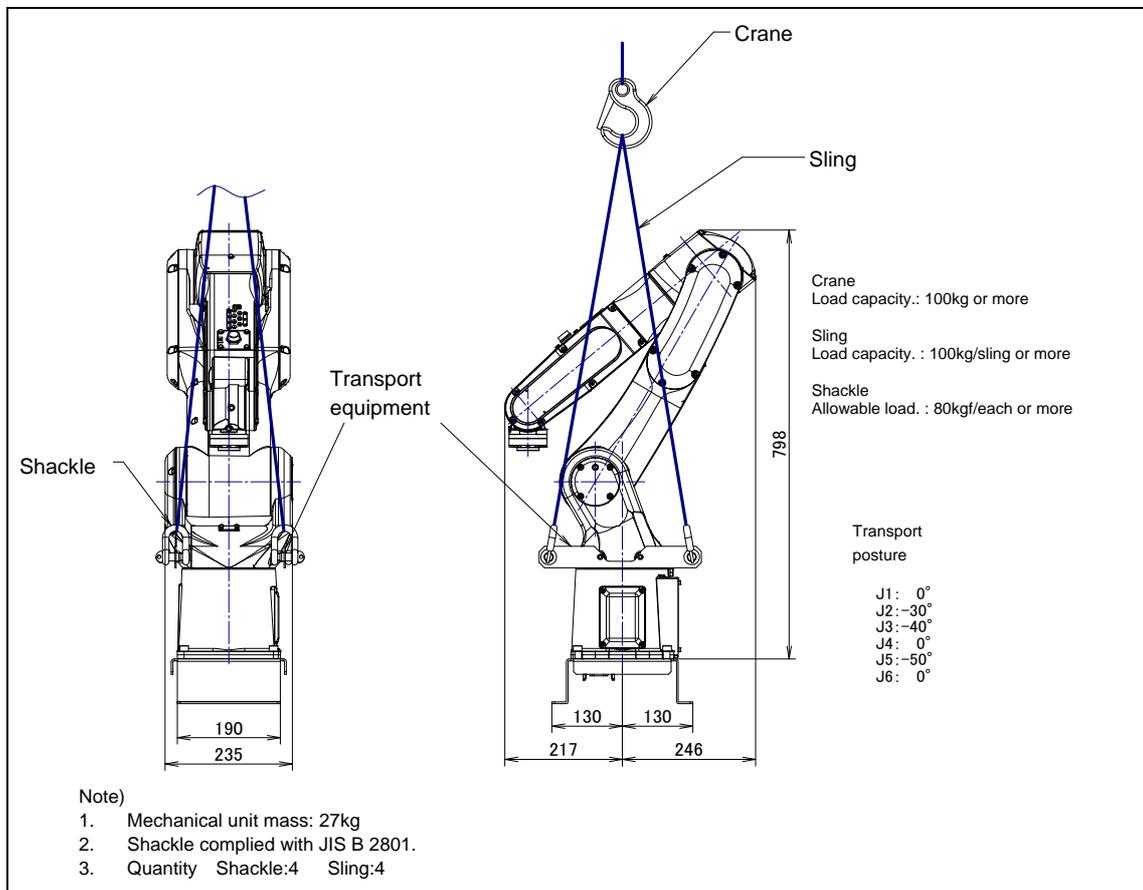


Fig. 1.1 (d) Transportation using a crane (bottom connector plate) (7L)

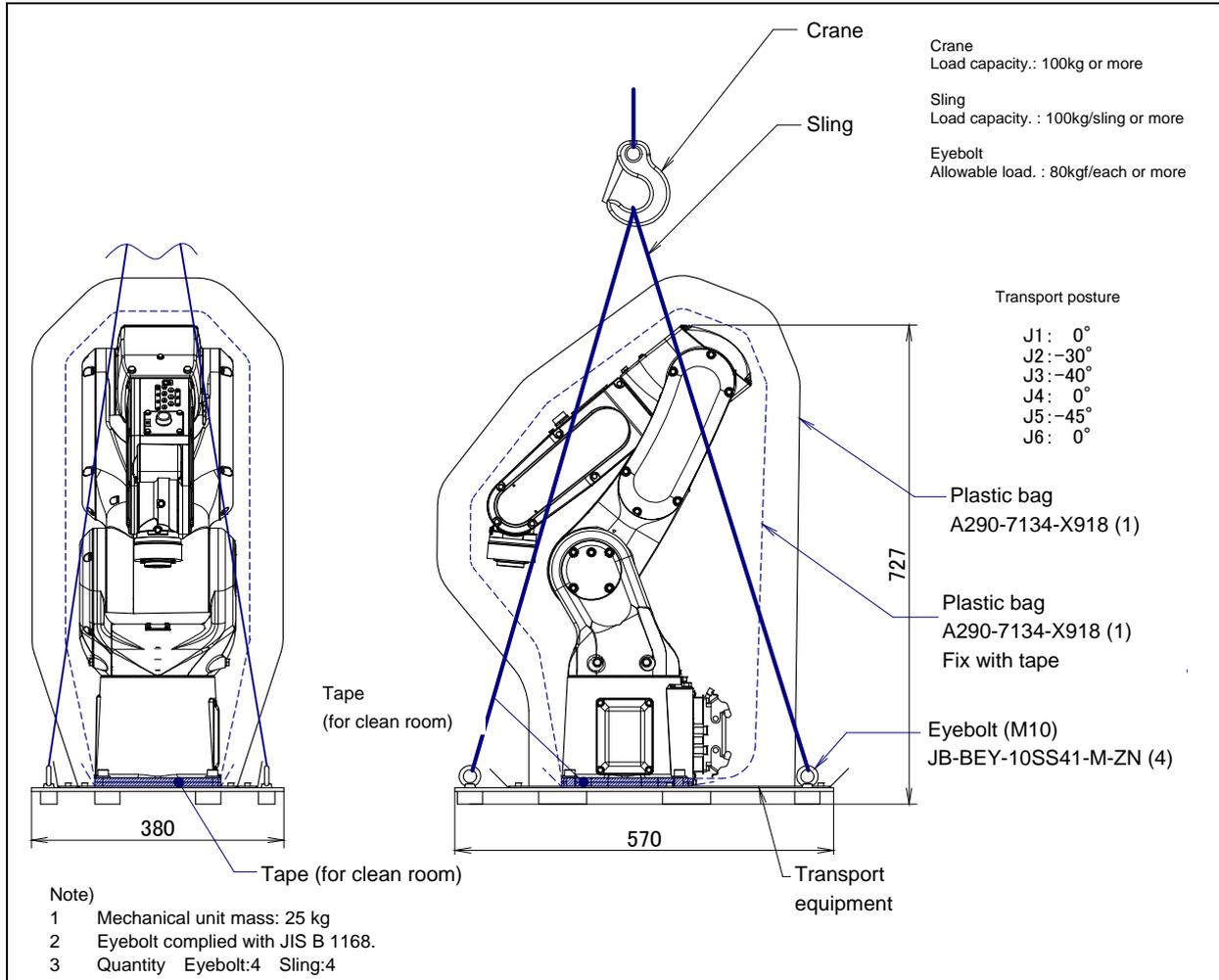


Fig. 1.1 (e) Transportation using a crane (7C)

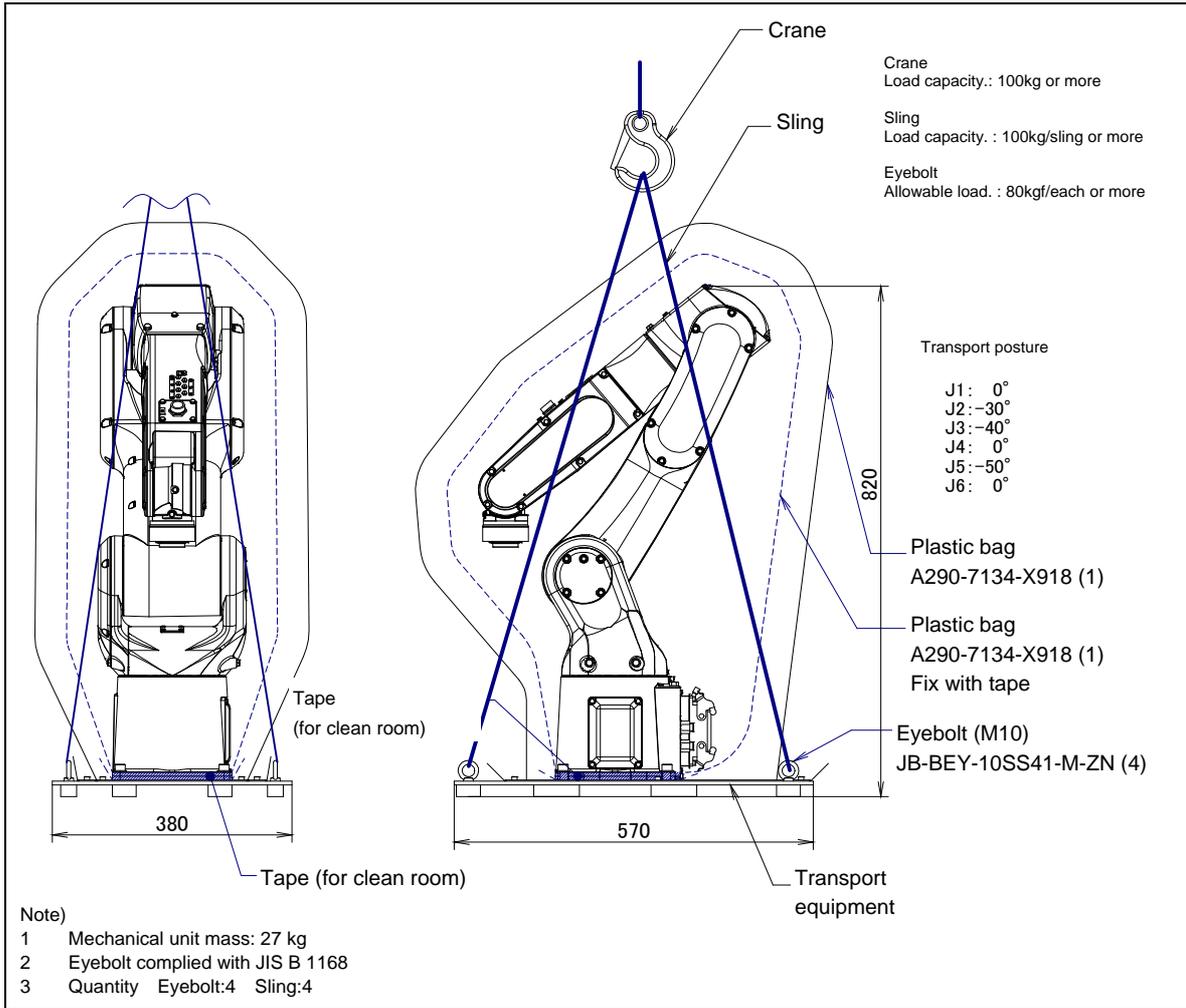


Fig. 1.1 (f) Transportation using a crane (7LC)

NOTE

About the LR Mate 200iD/7C/7LC

- 1 Before shipment of the LR Mate 200iD/7C/7LC, it is cleaned in a clean room, covered with an antistatic sheet, then packed as shown in Fig. 1.1 (e),(f).
- 2 The transport plate can be used as a roll-over prevention plate in a clean room. If the plate is cleaned before being carried in a clean room, it can be carried in the room together with the robot.
- 3 The antistatic sheet can be removed in a clean room.
- 4 When installing the robot, use the eyebolts to lift it as shown Fig. 1.1 (e), (f).
- 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.

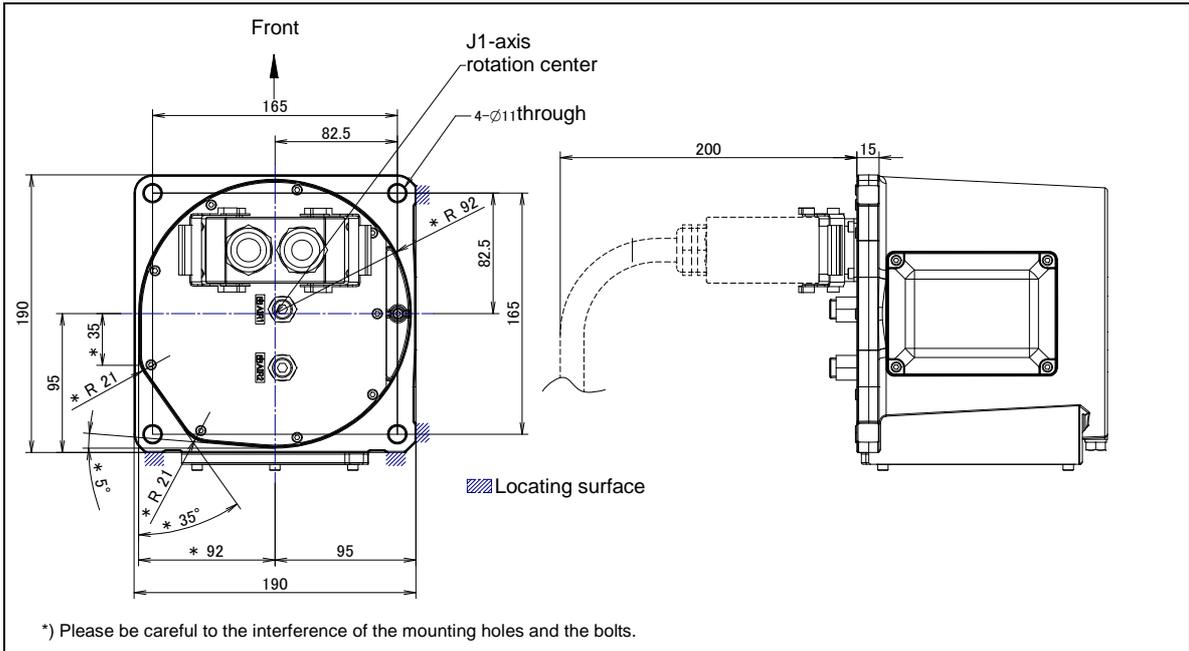


Fig. 1.2 (b) Dimensions of the robot base (bottom connector plate)

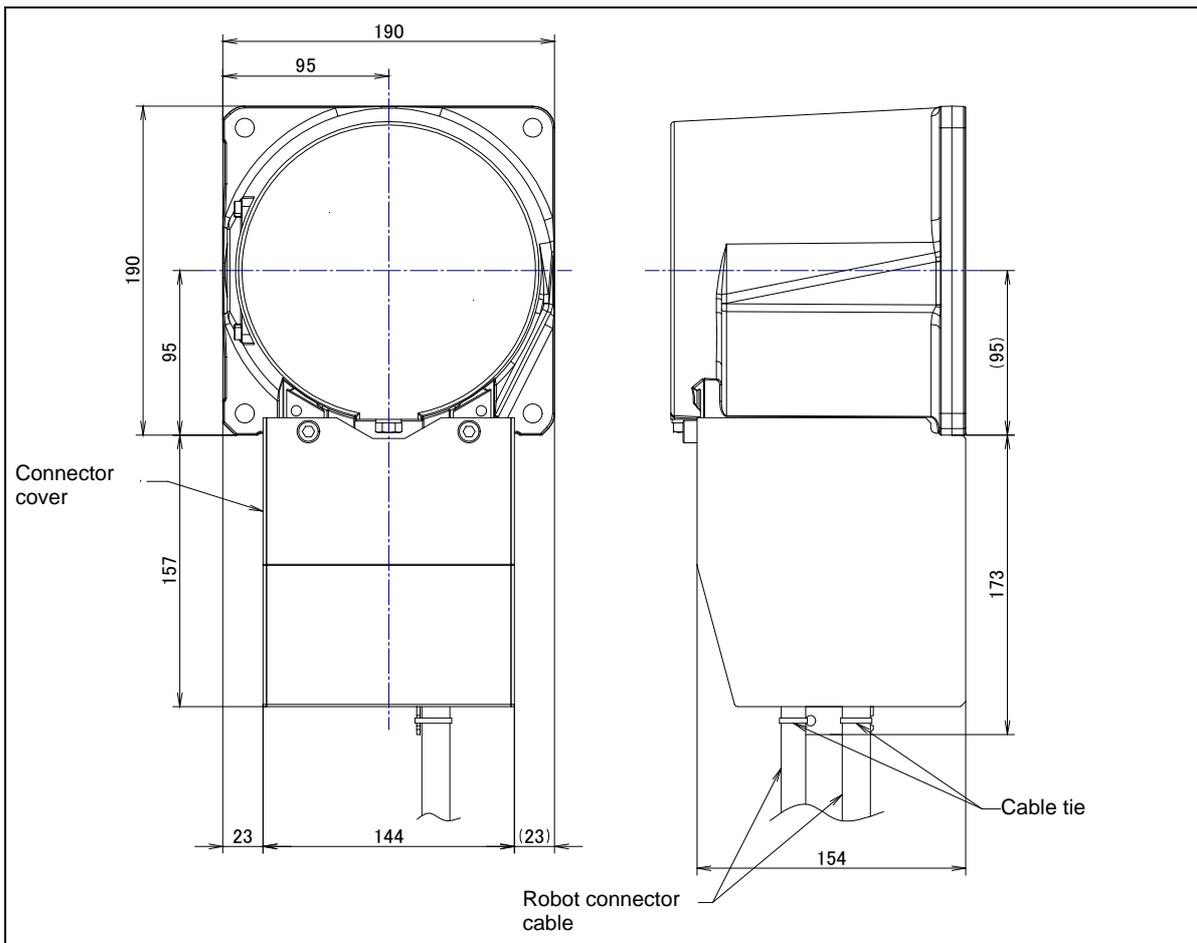


Fig. 1.2 (c) Dimensions of the connector cover for IP69K option (back side connector plate)

NOTE

Bottom connector plate does not have the connector cover.

Fig. 1.2 (d), Table 1.2 (a) to Table 1.2 (d) indicate the force and moment applied to the base plate at the time of Power-Off stop of the robot and indicate the stopping distance and time of the J1 through J3 axes until the robot stopping by Power-Off stop or by Controlled stop after input of the stop signal. Refer to the data when considering the strength of the installation face.

Table 1.2 (a) Force and moment that acts on J1 base (Standard/7H/7WP/7C)

	Vertical moment Mv(Nm)	Force in Vertical direction Fv(N)	Horizontal moment Mh(Nm)	Force in Horizontal direction Fh(N)
During stillness	115.5	313.6	0	0
During acceleration or deceleration	605.2	595.2	289.1	860.3
During Power-Off stop	768.3	1054.6	402.2	1100.1

Table 1.2 (b) Force and moment that acts on J1 base (7L/7LC)

	Vertical moment Mv(Nm)	Force in Vertical direction Fv(N)	Horizontal moment Mh(Nm)	Force in Horizontal direction Fh(N)
During stillness	147.3	333.2	0	0
During acceleration or deceleration	439.8	602.1	336.3	784.8
During Power-Off stop	1657.2	1612.7	1285.6	1656.8

Table 1.2 (c) Stopping time and distance until the robot stopping by Power-Off stop after input of stop signal

		J1	J2	J3
Standard/7WP/7C	Stopping time [ms]	348	284	332
	Stopping angle [deg] (rad)	82.1 (1.43)	43.0 (0.75)	63.7 (1.11)
7H	Stopping time [ms]	372	300	398
	Stopping angle [deg] (rad)	77.2 (1.35)	45.9 (0.80)	65.3 (1.14)
7L/7LC	Stopping time [ms]	372	364	324
	Stopping angle [deg] (rad)	69.0 (1.20)	57.3 (1.00)	54.4 (0.95)

* Max payload and max speed

Table 1.2 (d) Stopping time and distance until the robot stopping by Controlled stop after input of stop signal

		J1	J2	J3
Standard/7WP/7C	Stopping time [ms]	516	516	540
	Stopping angle [deg] (rad)	128.4 (2.24)	92.0 (1.61)	122.7 (2.14)
7H	Stopping time [ms]	516	508	524
	Stopping angle [deg] (rad)	129.0 (2.25)	92.6 (1.62)	124.1 (2.16)
7L/7LC	Stopping time [ms]	524	508	540
	Stopping angle [deg] (rad)	106.9 (1.86)	79.6 (1.39)	117.9 (2.06)

* Max payload and max speed

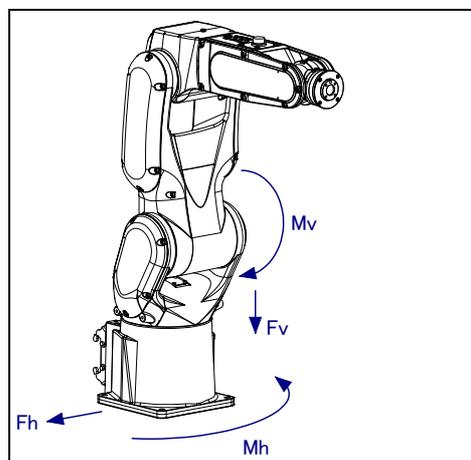


Fig. 1.2 (d) Force and moment that acts on J1 base

1.2.1 Angle of Mounting Surface Setting

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

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

```

ROBOT MAINTENANCE          CTRL START MANU
-----
Setup Robot System Variables

Group  Robot Library/Option Ext Axes
1      LR Mate 200iD          0

[TYPE]ORD NO      AUTO      MANUAL
  
```

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

```

*****Group 1 Initialization*****
*****LR Mate 200iD*****

--- MOUNT ANGLE SETTING ---

  0 [deg] : floor mount type
  90 [deg] : wall mount type
 180 [deg] : upside-down mount type

Set mount_angle (0-180[deg])->
Default value = 0
  
```

- 6 Input the mount angle referring to Fig. 1.2.1. 7H Downward wrist zero specification is restricted to floor mount and upside-down mount.

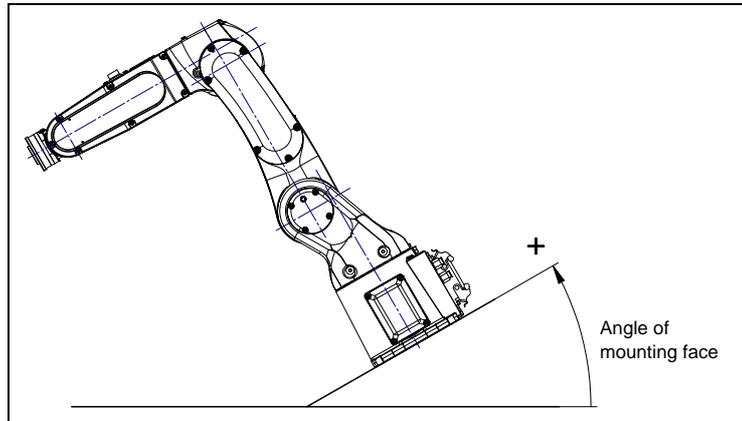
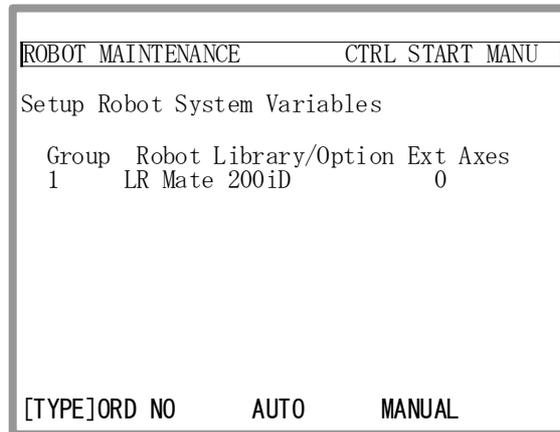


Fig. 1.2.1 Robot mounting angle

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



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

1.3 MAINTENANCE AREA

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

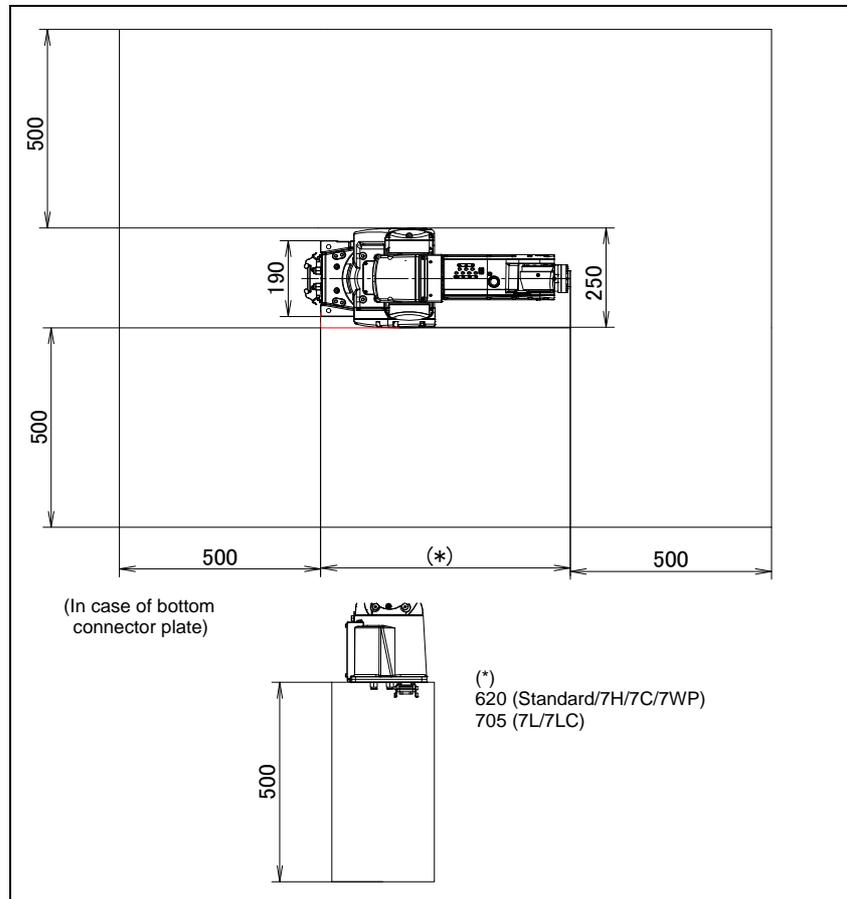


Fig. 1.3 Maintenance area

1.4 INSTALLATION CONDITIONS

Refer to the caution below concerning installation conditions.

Refer to also to the specifications found in Section 3.1 and Section 3.2.

⚠ CAUTION

- 1 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.
- 2 Damage of coating of robot connection cable and external battery cable can causes water intrusion. Take care when installing the cable and exchange it if it is damaged.

2 CONNECTION WITH THE CONTROLLER

2.1 CONNECTION WITH THE CONTROLLER

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

⚠ WARNING

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

⚠ CAUTION

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

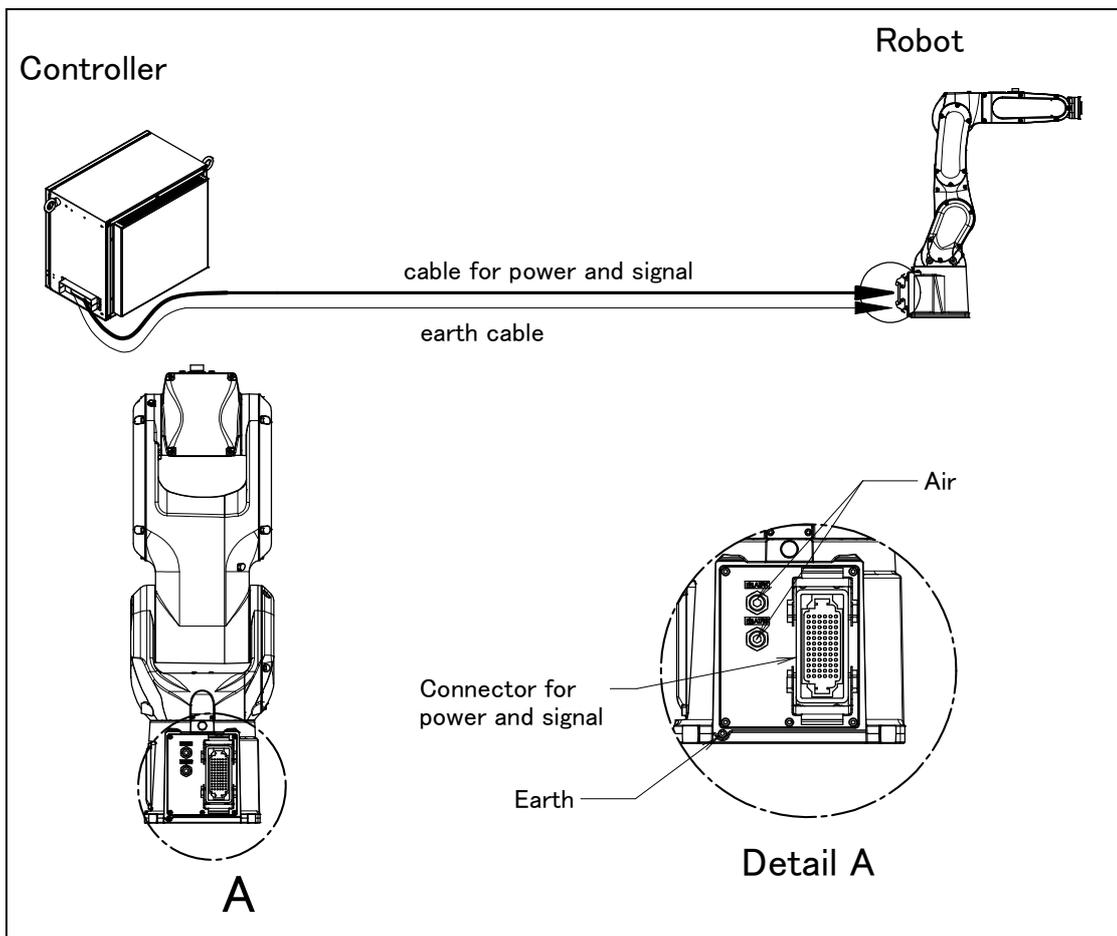


Fig. 2.1 (a) Cable connection (back side connector plate)

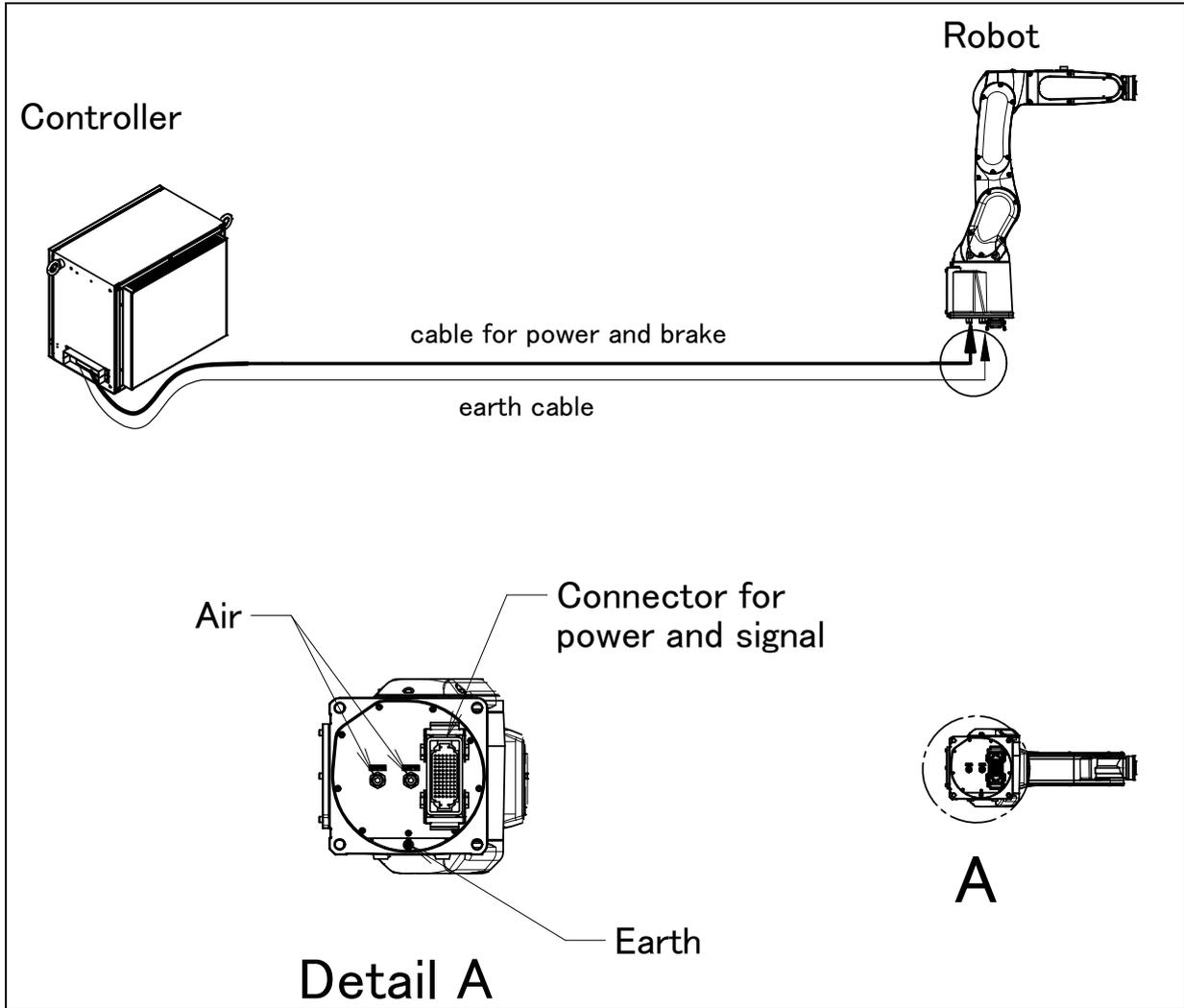


Fig. 2.1 (b) Cable connection (bottom connector plate)

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

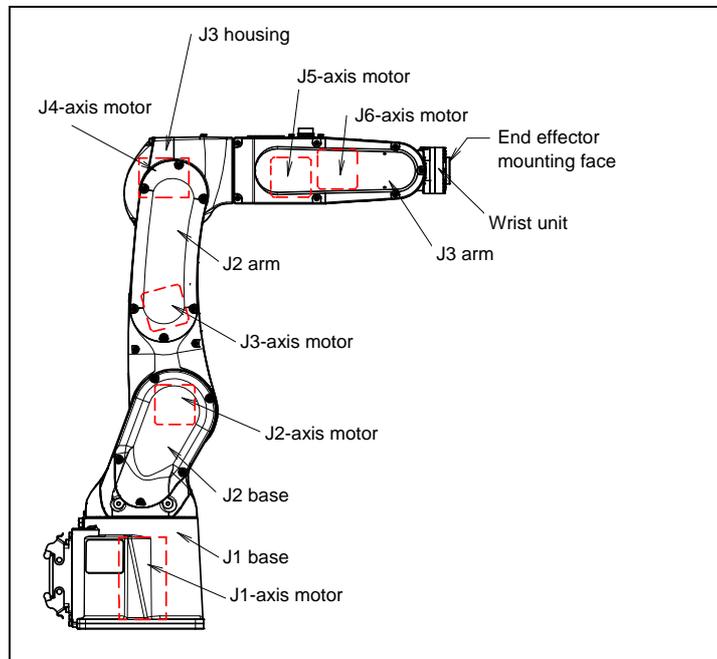


Fig. 3.1 (a) Mechanical unit configuration (Except 7H)

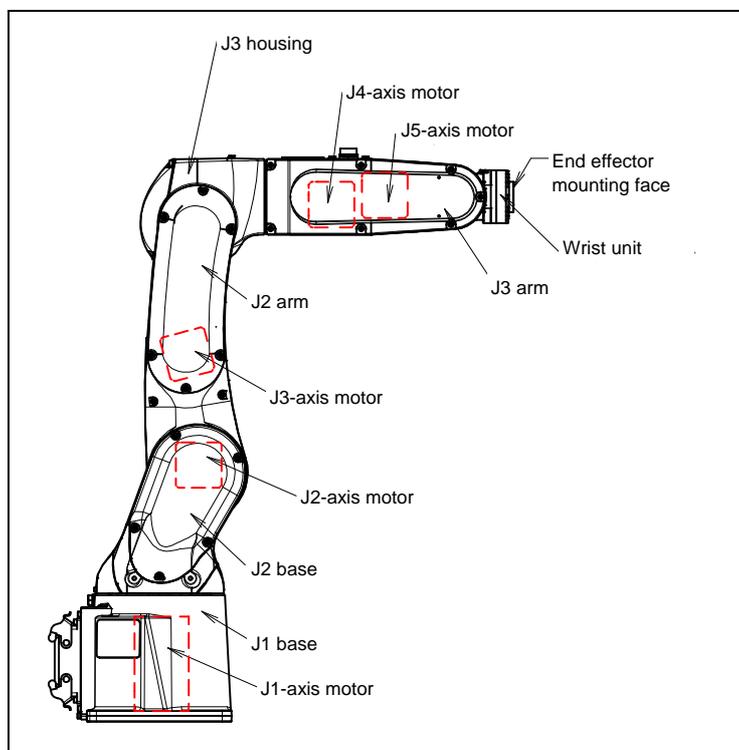


Fig. 3.1 (b) Mechanical unit configuration (7H)

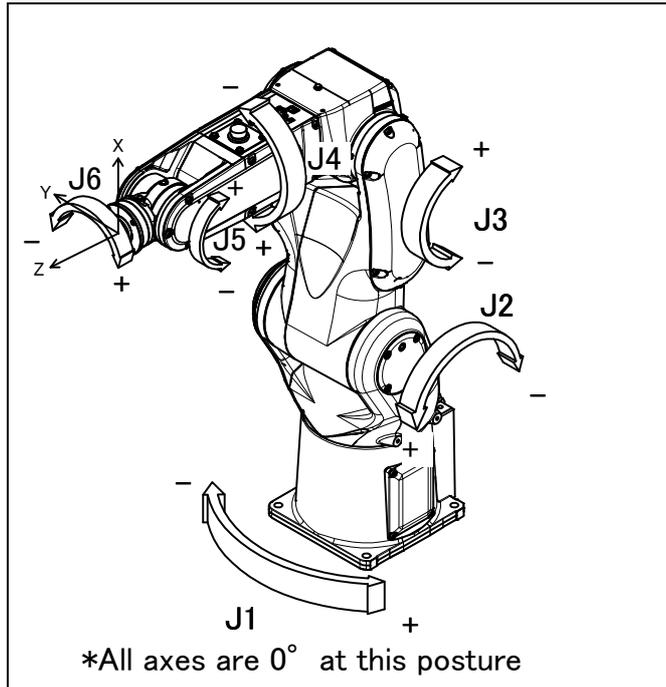


Fig. 3.1 (c) Each axis coordinates and mechanical interface coordinates (Except 7H)

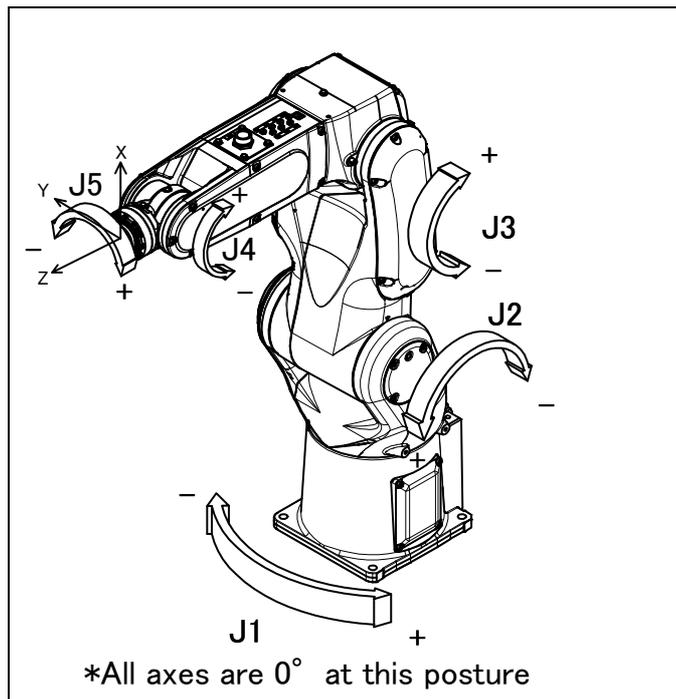


Fig. 3.1 (d) Each axis coordinates and mechanical interface coordinates (7H Horizontal wrist zero specification)

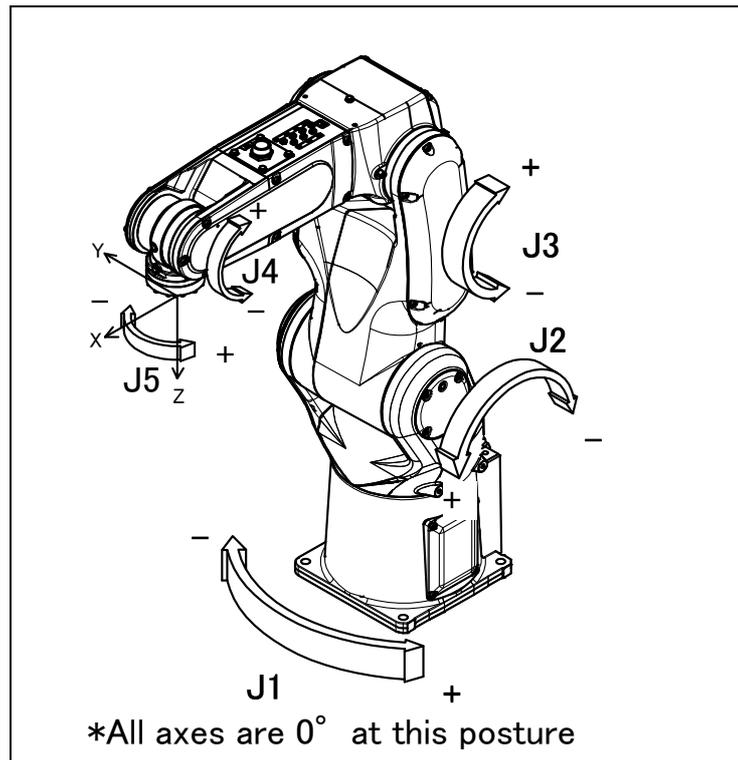


Fig. 3.1 (e) Each axis coordinates and mechanical interface coordinates
(7H Downward wrist zero specification)

NOTE

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

Table 3.1 Specifications

Item		Specifications		
Model	LR Mate 200iD ARC Mate 50iD LR Mate 200iD/7C LR Mate 200iD/7WP	LR Mate 200iD/7H		LR Mate 200iD/7L ARC Mate 50iD/7L LR Mate 200iD/7LC
Type	Articulated Type			
Controlled axis	6-axis(J1, J2, J3, J4, J5, J6)		5-axis(J1, J2, J3, J4, J5)	6-axis(J1, J2, J3, J4, J5, J6)
Reach	717mm		911mm	
Installation (NOTE 1)	Floor, Upside-down (Angle mount)			
Motion range (Max. speed) (NOTE 2)	J1-axis	340°/360°(option) (450°/s) 5.93rad/6.28rad(option) (7.85rad/s)		340°/360°(option) (370°/s) 5.93rad/6.28rad(option) (6.45rad/s)
	J2-axis	245° (380°/s) 4.28rad (6.63rad/s)		245° (310°/s) 4.28rad (5.41rad/s)
	J3-axis	420° (520°/s) 7.33rad (9.08rad/s)		430° (410°/s) 7.50rad (7.15rad/s)
	J4-axis	380° (550°/s) 6.63rad (9.60rad/s)	250° (545°/s) 4.36rad (9.51rad/s)	380° (550°/s) 6.63rad (9.60rad/s)
	J5-axis	250° (545°/s) 4.36rad (9.51rad/s)	720° (1500°/s) 12.57rad (26.18rad/s)	250° (545°/s) 4.36rad (9.51rad/s)
	J6-axis	720° (1000°/s) 12.57rad (17.45rad/s)		720° (1000°/s) 12.57rad (17.45rad/s)
Max. load capacity (NOTE 3)	Wrist	7 kg		
Allowable load moment at wrist	J4-axis	16.6Nm	16.6Nm	16.6Nm
	J5-axis	16.6Nm	4.0Nm 5.5Nm (NOTE 4)	16.6Nm
	J6-axis	9.4Nm		9.4Nm
Allowable load inertia at wrist	J4-axis	0.47kg·m ²	0.47 kg·m ²	0.47kg·m ²
	J5-axis	0.47kg·m ²	0.046 kg·m ² 0.15 kg·m ² (NOTE 4)	0.47kg·m ²
	J6-axis	0.15kg·m ²		0.15kg·m ²
Drive method	Electric servo drive by AC servo motor			
Repeatability (NOTE 5)	±0.01mm			
Mass (NOTE 6)	25kg	24kg	27kg	
Dust proof and drip proof mechanism (NOTE 7)	Conform to IP67 (Option :IP69K) (Except 7C/7LC) Conform to IP67 , Class 10 (ISO class 4) (Option :IP69K) (7C/7LC) *7LC does not support IP69K option			
Acoustic noise level	64.7dB (Note 8)			
Installation environment	Ambient temperature: 0 - 45°C (NOTE 9) Ambient humidity: Normally 75%RH or less. No dew, nor frost allowed. Short time (within one month) Max 95%RH Height: Up to 1000 meters above the sea level required, no particular provision for posture. Vibration acceleration : 4.9m/s ² (0.5G) or less Free of corrosive gases (NOTE 10)			

NOTE 1) Under the installation condition within (), the J1 and J2 axis motion range will be limited. See Section 3.6. 7H Downward wrist zero specification is restricted to floor mount and upside-down mount.

NOTE 2) During short distance motions, the axis speed may not reach the maximum value stated.

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. Section 3.5.

NOTE 4) This value is for high inertia mode. Please refer to Section 4.4 about change method.

NOTE 5) Compliant with ISO 9283.

NOTE 6) It doesn't contain the mass of the control part.

NOTE 7) The liquid that is the deterioration of the seal material such as Organic solvent, acid, alkali and chlorine system, cutting liquid cannot be use. (See Subsection 3.1.1.)

NOTE 8) This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.

- Maximum load and speed
- Operating mode is AUTO

NOTE 9) When robot is used in low temperature environment that is near to 0°C, or robot is not operated for a long time in the environment that is less than 0°C in a holiday or the night, because viscous resistance of the drive train is so big that may cause occurrence of collision detect alarm (SRVO -050) etc. In this case, we recommend performing the warm up operation for several minutes.

NOTE 10) 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.

3.1.1 Note of Severe Dust /Liquid Specification

- 1 The liquids below cannot be applied because they may cause deterioration or corrosion of the rubber parts (such as gaskets, oil seals, and O-rings) used in the robot.
 - (a) Organic solvent
 - (b) Chlorine-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 in water due to poor drainage.
- 3 Gaskets can be reused.
- 4 Don't use unconfirmed liquid.

3.1.2 Cautions in Selecting the 7WP

The 7WP specifies cleaning fluids usable with the robot. (Always keep all the liquids at or below 60°C.)

Liquid model name	Manufacturer name	Permissible concentration	Reference pH
Lub clean 54	TOHO Chemical Industry Co., LTD.	5% Diluted to 20 parts of water	10.4
Sun cleaner G-2000B	SUGIMURA Chemical Industry Co., LTD.	3% Diluted to 50 parts of water	10.0
Sun cleaner G-2100S	SUGIMURA Chemical Industry Co., LTD.	5% Diluted to 20 parts of water	10.0
Sun cleaner G-2300F	SUGIMURA Chemical Industry Co., LTD.	3% Diluted to 33 parts of water	10.0
Toyosol SE-78P	Toyoda Chemical Industry Co., Ltd.	5% Diluted to 20 parts of water	10.5
Toyosol SE-91P	Toyoda Chemical Industry Co., Ltd.	2% Diluted to 50 parts of water	10.3
Toyoknock R747P	Toyoda Chemical Industry Co., Ltd.	3% Diluted to 33 parts of water	10.3
Toyoknock RE-777P	Toyoda Chemical Industry Co., Ltd.	3% Diluted to 33 parts of water	9.5
Detergent 2000	NEOS Co., LTD.	5% Diluted to 20 parts of water	11.0
Packna FD-800	YUKEN Industry CO., LTD.	5% Diluted to 20 parts of water	9.0
Packna FD-85	YUKEN Industry CO., LTD.	3% Diluted to 33 parts of water	11.0
Yushiro cleaner PCW553	YUSHIRO CHEMICAL INDUSTRY CO., LTD.	5% Diluted to 20 parts of water	9.8
Yushiro cleaner W80	YUSHIRO CHEMICAL INDUSTRY CO., LTD.	3.3% Diluted to 30 parts of water	9.0
Quakerclean 624CP	Quaker Chemical Corporation	3% Diluted to 30 parts of water	9.7

Please don't use the cleaning fluid under the condition over the allowable concentration or temperature.

Using cleaning fluid other than those above

When using some other cleaning fluid, please choose it carefully in accordance with the following description.

Choosing cleaning fluid

Please confirm that pH of the cleaning fluid is 8.5 to 11.0. LR Mate 200iD/7WP has a good resistance against alkali but not acid or neutral.

Confirmation test by using a dipping test kit (A05B-1142-K024)

FANUC provides the dipping test kit (A05B-1142-K024) to confirm the usability of the cleaning fluid.

Test condition is as follows:

Concentration : 1.3 times of the concentration that you plant to use.

Temperature : Test at 5 degrees Celsius higher than specified temperature.

Period : 14 days

If the following situation happens with the test pieces, the liquid doesn't suit for use. (*1)

Causing precipitate : It may indicate that the test piece dissolves.

Causing corrosion on the metal parts

Changes (swelling, etc.) on the rubber parts

(*1) LR Mate 200iD/7WP doesn't have painting. Please use only the test pieces without painting.

Management of cleaning fluid

Insufficient management of cleaning fluid causes bad effects such as corrosion on the robot. Please manage it carefully in accordance with the following description.

Management of pH

Please monitor pH by using pH test paper, etc., and keep pH in 8.5 to 11.0.

PH decrease causes deterioration of cleaning fluid, and it makes the robot parts corroded.

Cleaning filtration of cleaning fluid

- Removing foreign materials

Removing chips and foreign materials with a high efficiency filter, etc. The more chloride ions from diluted solution accumulate, the more cleaning fluid becomes harmful to the robot. In cases that the chloride ions may enter from tap water, please take measures such as installation of some removing filter.

- Removing oil from other processes

FANUC recommends installing oil skimmer or oil removal equipment. Other simple ways are as below.

- Absorbing floating ingredients of the oil with non-woven fabric, etc.
- Scooping floating ingredients of the oil by a dedicated container (please use a dedicated one to prevent other contaminations).

Other verification items**Appearance**

Please check the followings of cleaning fluid on a daily basis and find the abnormality beforehand.

Cleanliness / Discoloration / Occurrence of film and sludge

Bad smell

Bad smell occurs when microorganisms are bred. Please check the smell of cleaning fluid on a daily basis.

Examples of typical bad smell are as follows.

Rotten egg smell / Acidulous smell / Moldy smell / Other putrid smell

Concentration

Cleaning fluid is perishable when concentration is decreased, and the robot is also damaged when cleaning fluid is too much concentrated. Keep the appropriate concentration in reference to the manual of cleaning fluid.

Refilling of diluted solution

Cleaning fluid is likely to be reduced by splashing or evaporation and carried out with workpieces and chips. Please refill diluted solution regularly. Refilling before holidays will help to prevent decay of cleaning fluid and maintain pH and antirust effect.

FANUC recommends making a check-sheet of the above items and recording a management history.

OTHER CAUTIONS

- 1 The cables connecting the robot, controller, and external battery are not resistant to any cleaning fluid. So, install them in such a way that no cleaning fluid will be splashed to the cables.
- 2 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.

3.1.3 Cautions for 7C/7LC

- 1 As for the clean specification, only the robot mechanical unit satisfies clean class 10. Note that none of the controller, the cables between the controller and robot, and teach pendant does not meet the clean specification.
- 2 When using liquids in cleaning, see 1 and 4 in Subsection 3.1.1.
- 3 If gaskets are dismantled during parts replacement or inspection, replace them with new ones.

3.1.4 IP69K (option)

Definition of IP69K is below.

Robot are sprayed at high pressure via a flat jet nozzle from at angles of 0°, 30°, 60°, 90°.

- each for at least 30 seconds.

The nozzle is held 100 to 150mm from the robot

- at a water pressure of 80-100 bars and a temperature of 80°C

- the quantity of water is 14-16 L/minute

After testing, water must not be present inside the robot.

3.2 MECHANICAL UNIT OPERATION AREA AND INTERFERENCE AREA

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

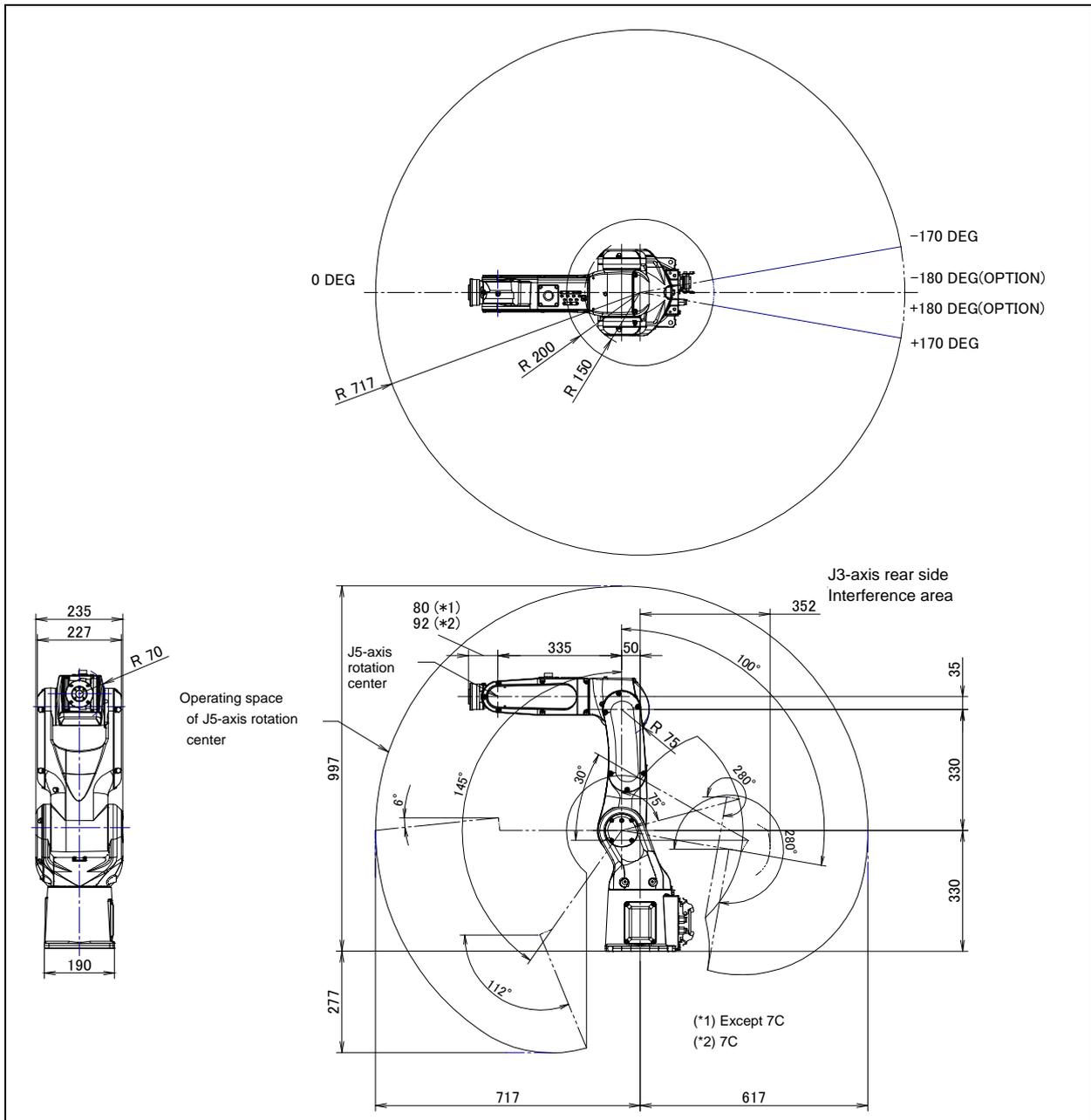


Fig. 3.2 (a) Operating space (Standard/7H/7C/7WP)

NOTE

Fig. 3.2 (a) is an example of Standard, please read J5-axis as J4-axis throughout these figures in case of 7H.

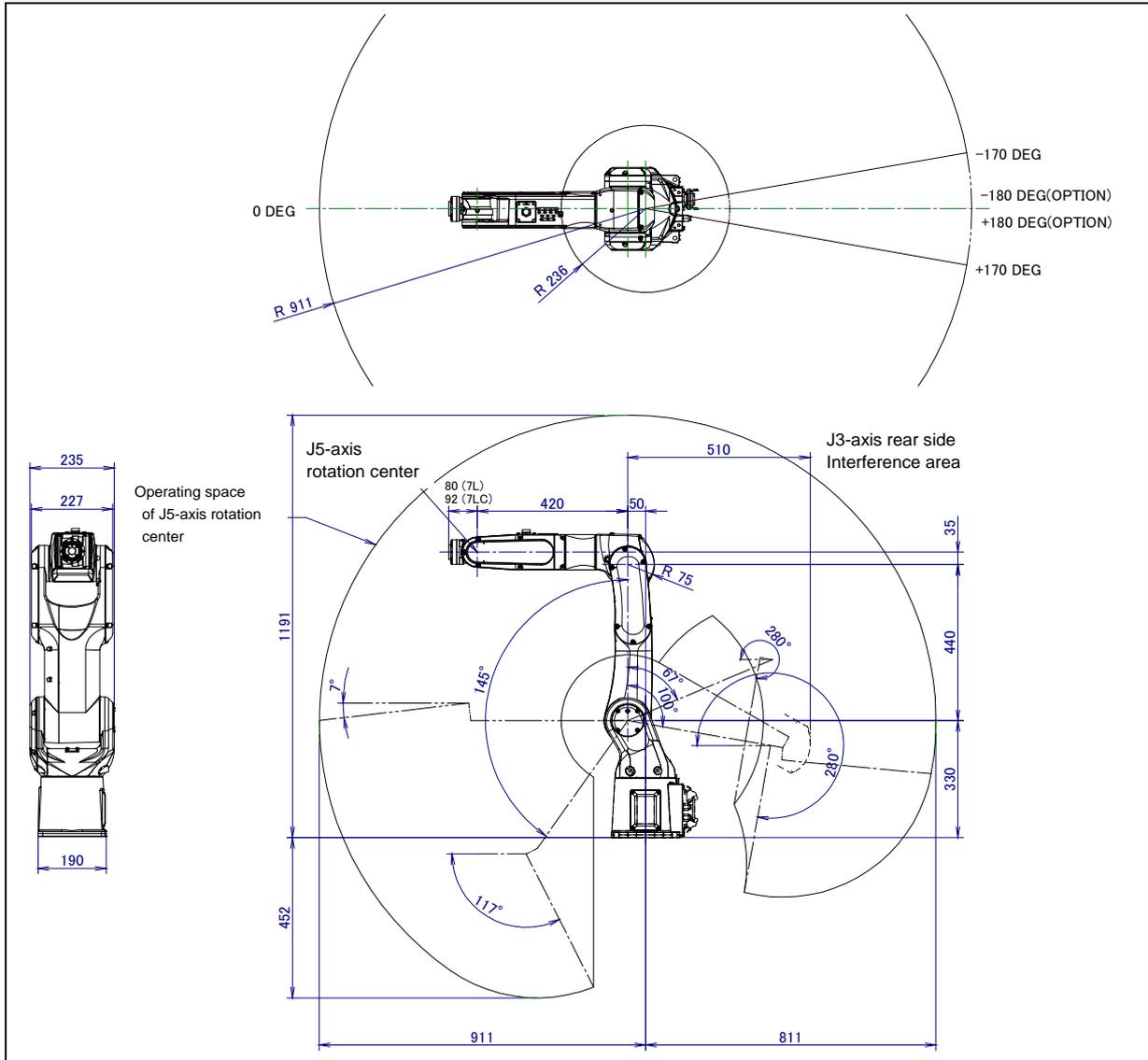


Fig. 3.2 (b) Operating space (7L/7LC)

3.3 ZERO POINT POSITION AND MOTION LIMIT

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

Fig. 3.3 (a) shows the position of the mechanical stopper. Don't reconstruct the mechanical stopper. If you do, there is a possibility that the robot will not stop normally.

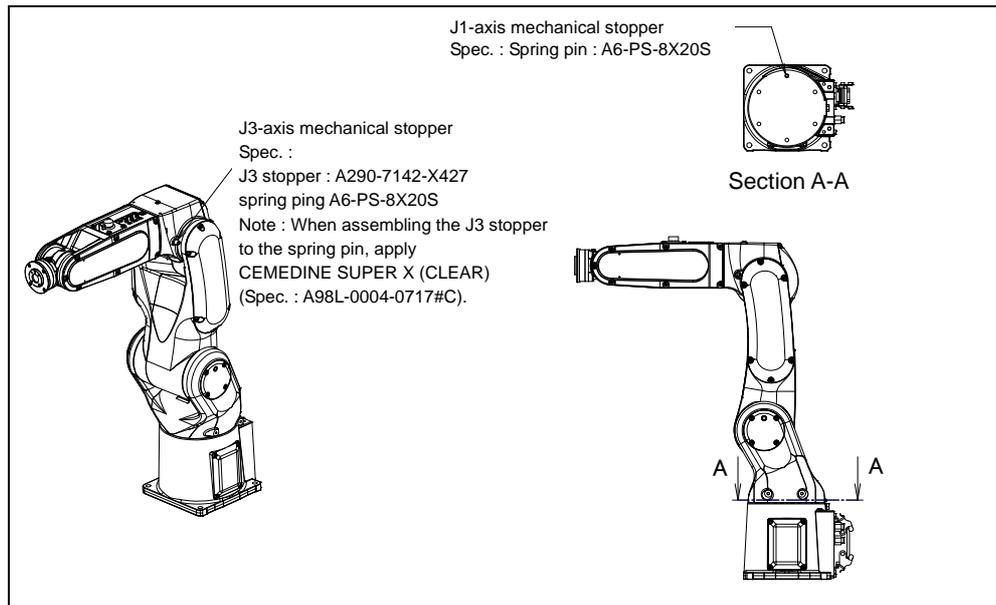


Fig. 3.3 (a) Position of mechanical stopper

Fig.3.3 (b) to (j) 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 the J1, J3-axis, when the robot comes in contact with the mechanical stopper, it may deform. When the mechanical stopper is deformed, replacement is needed. See Fig.3.3 (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".

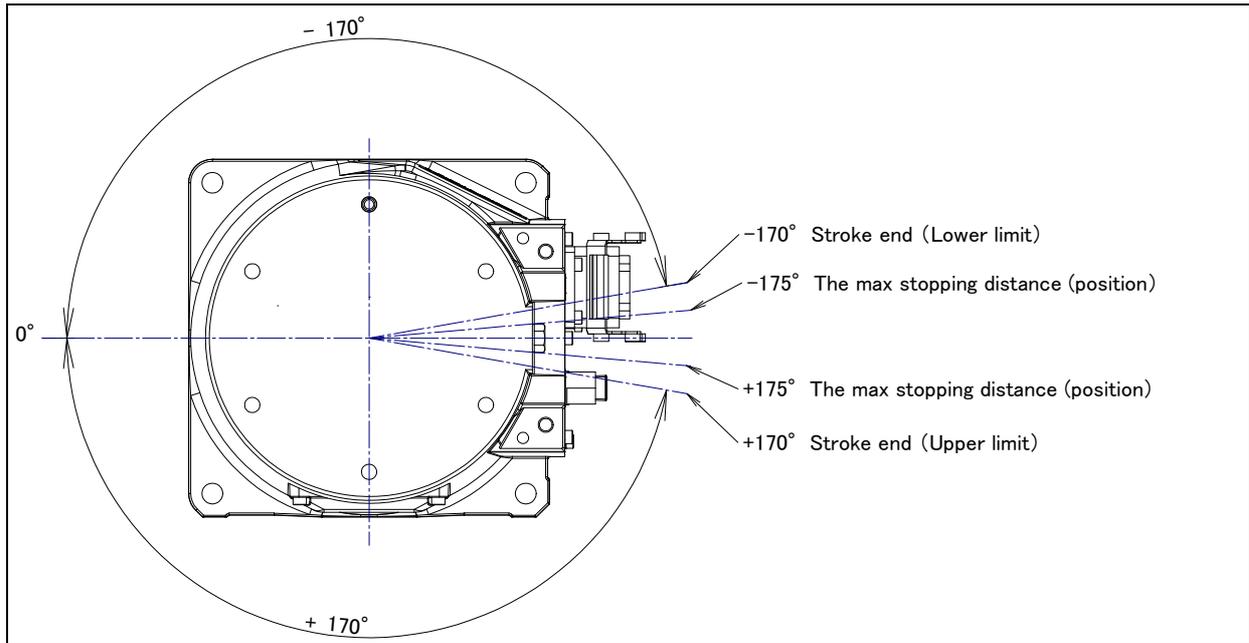


Fig. 3.3 (b) J1-axis motion limit (J1-axis 340°turn specification)

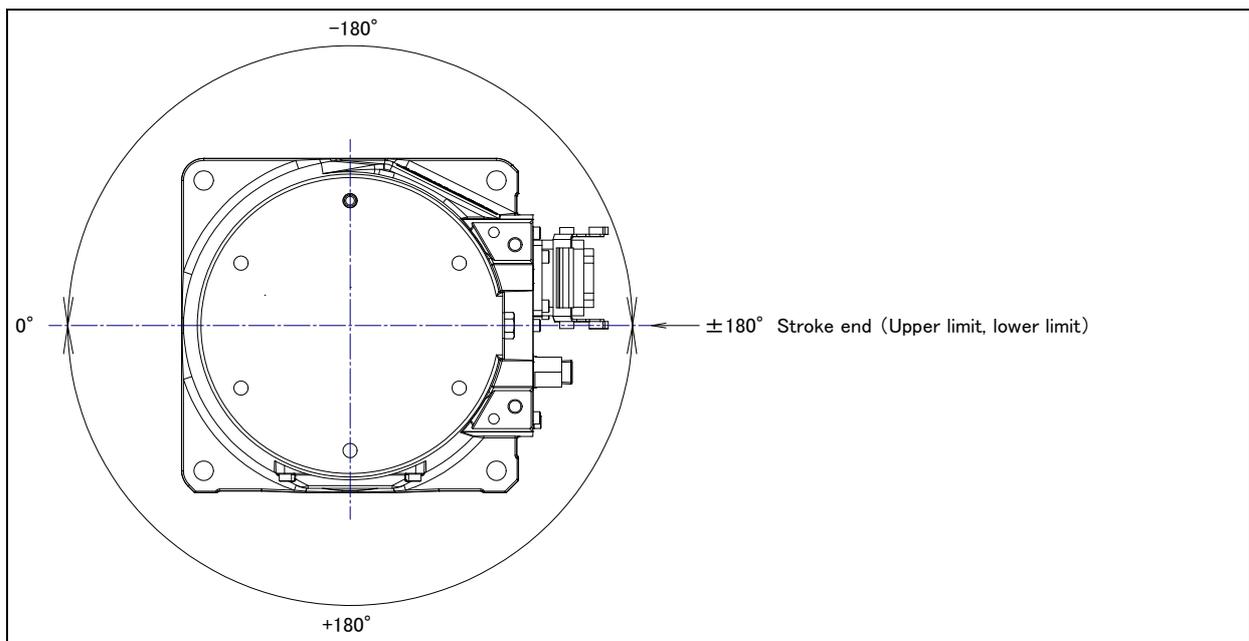


Fig. 3.3 (c) J1-axis motion limit (J1-axis 360°turn specification)

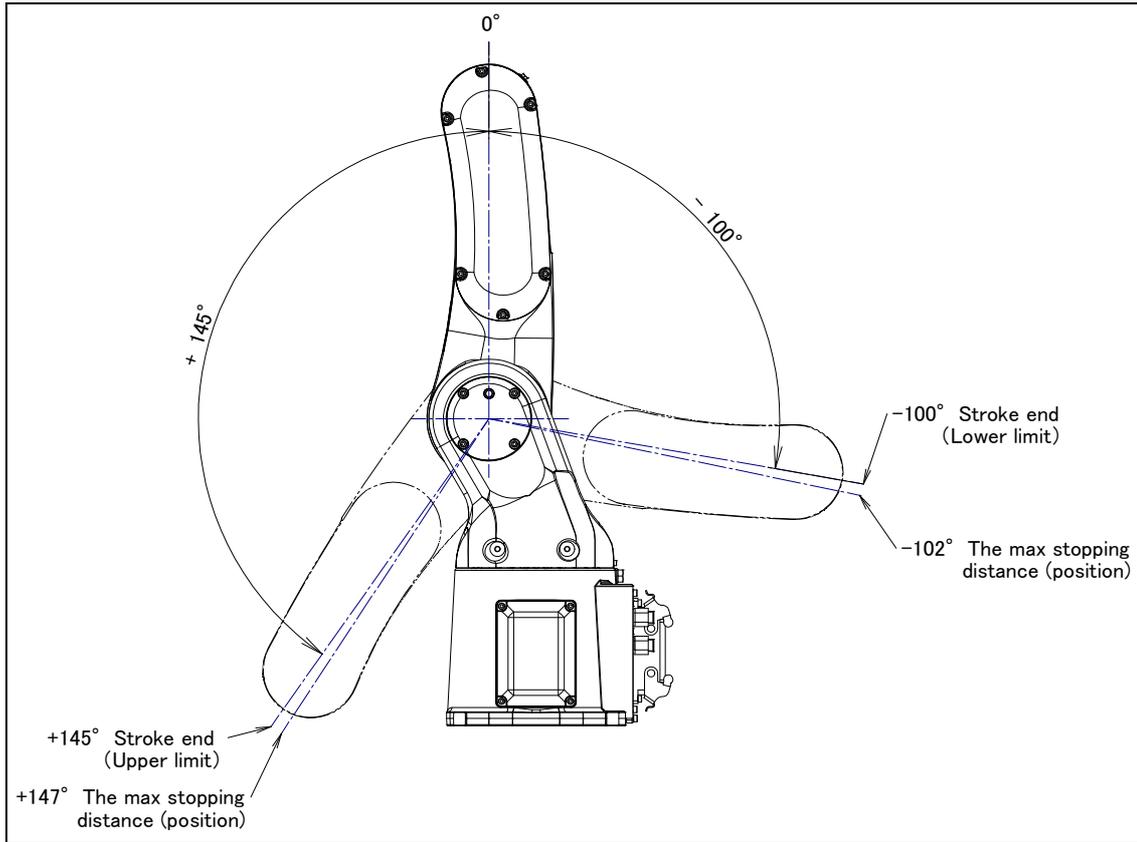


Fig. 3.3 (d) J2-axis motion limit

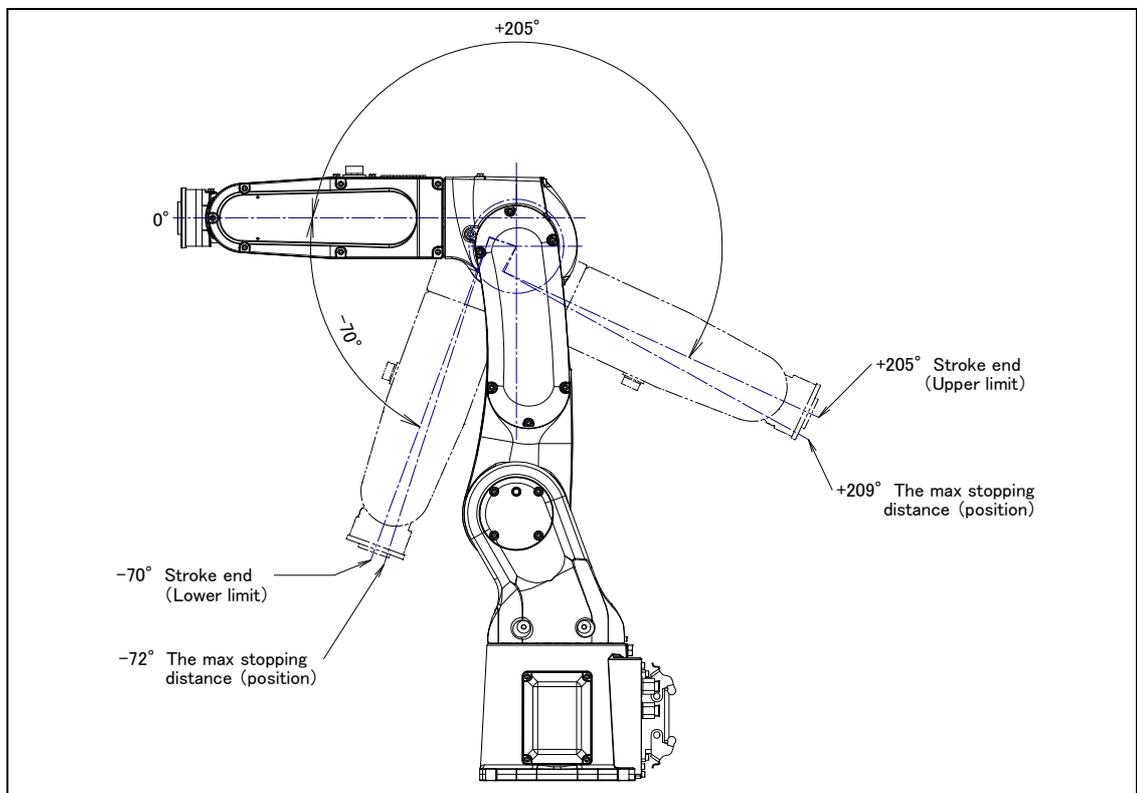


Fig.3.3 (e) J3-axis motion limit
(Standard/7H/7C/7WP)

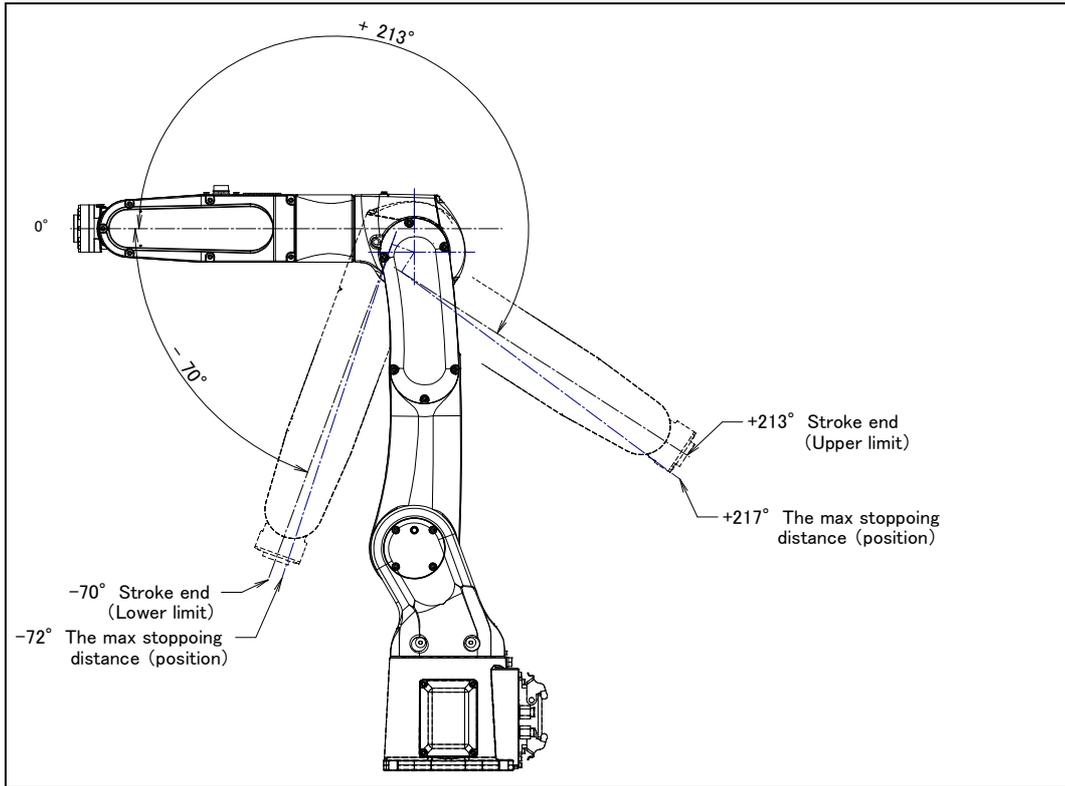


Fig. 3.3 (f) J3-axis motion limit (7L/7LC)

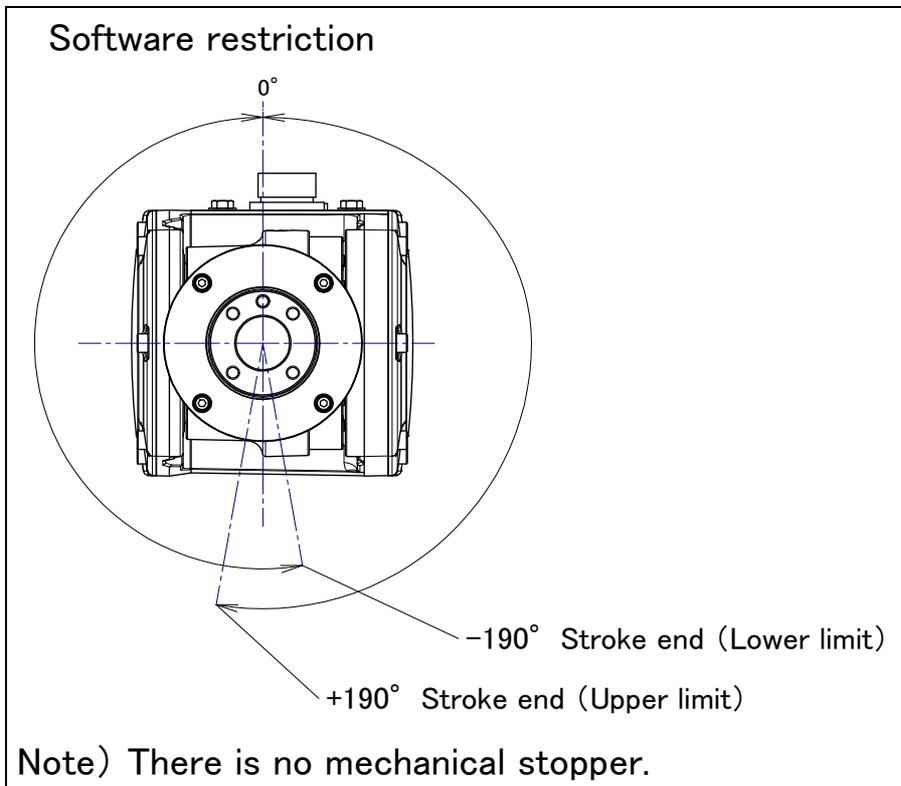
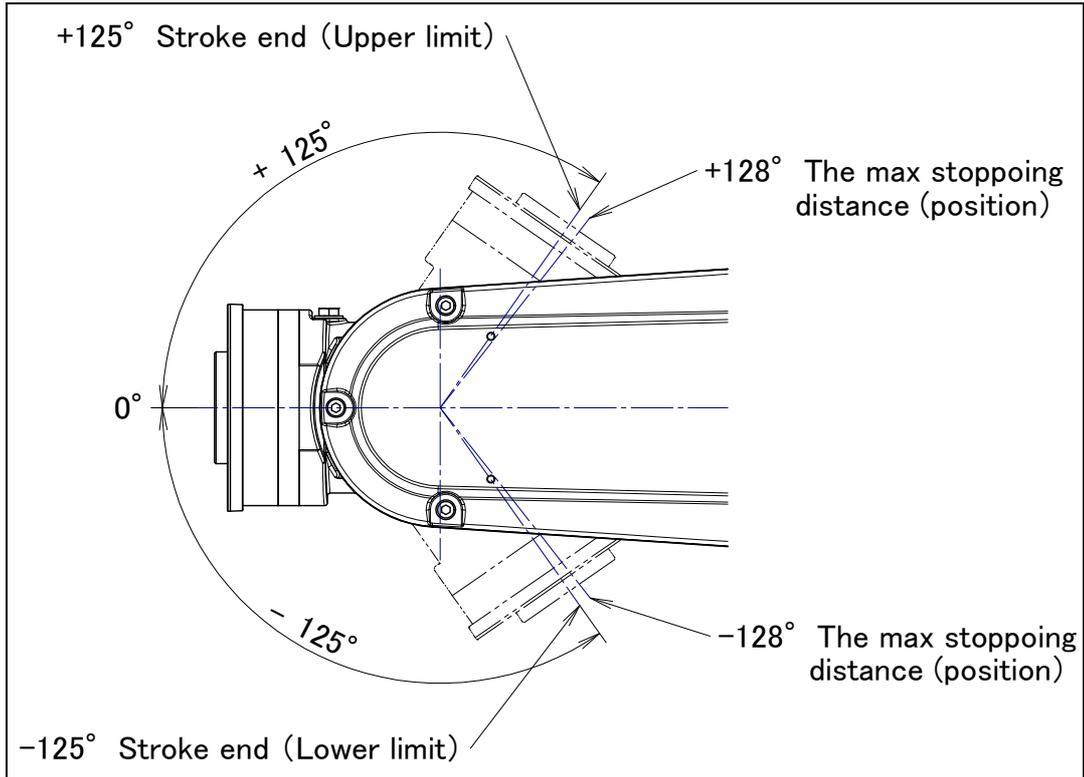


Fig. 3.3 (g) J4-axis motion limit (Except 7H)



**Fig. 3.3 (h) J5-axis motion limit (Except 7H)
J4-axis motion limit (7H Horizontal wrist zero specification)**

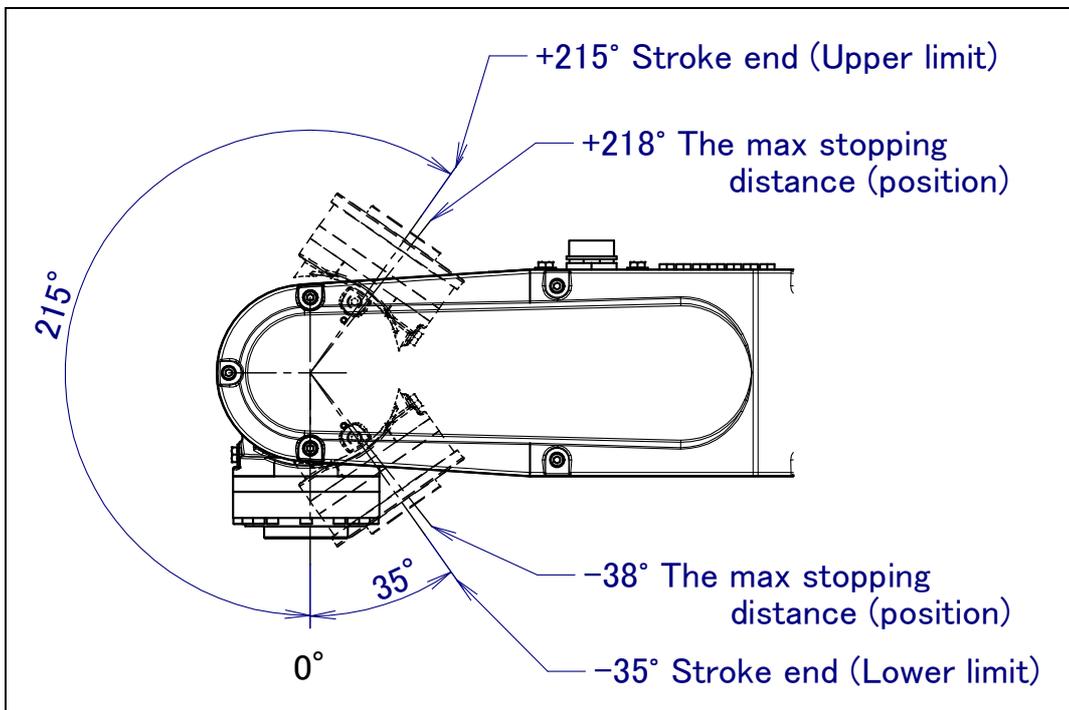
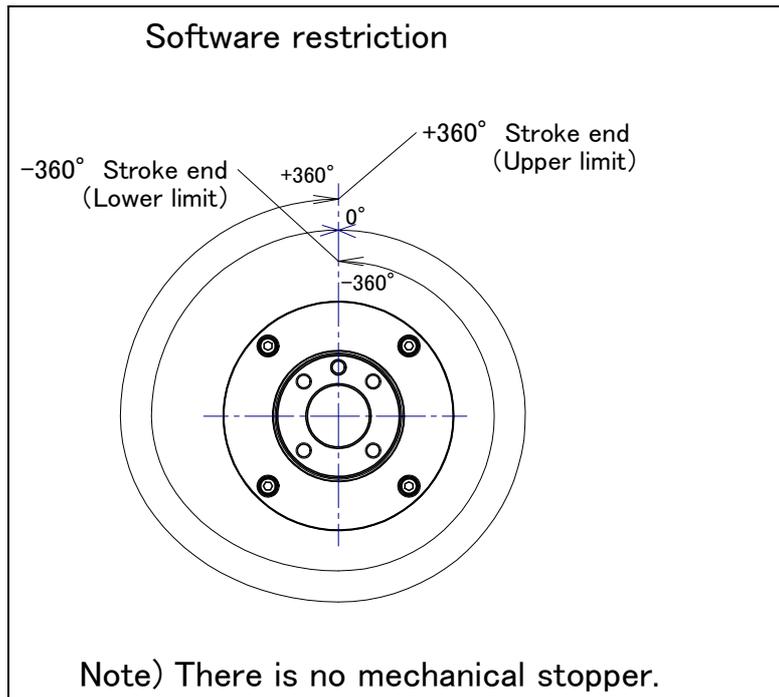


Fig. 3.3 (i) J4-axis motion limit (7H Downward wrist zero specification)



**Fig. 3.3 (j) J6-axis motion limit (Except 7H)
J5-axis motion limit (7H)**

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (a) to (d) are 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 the mounting of an end effector.

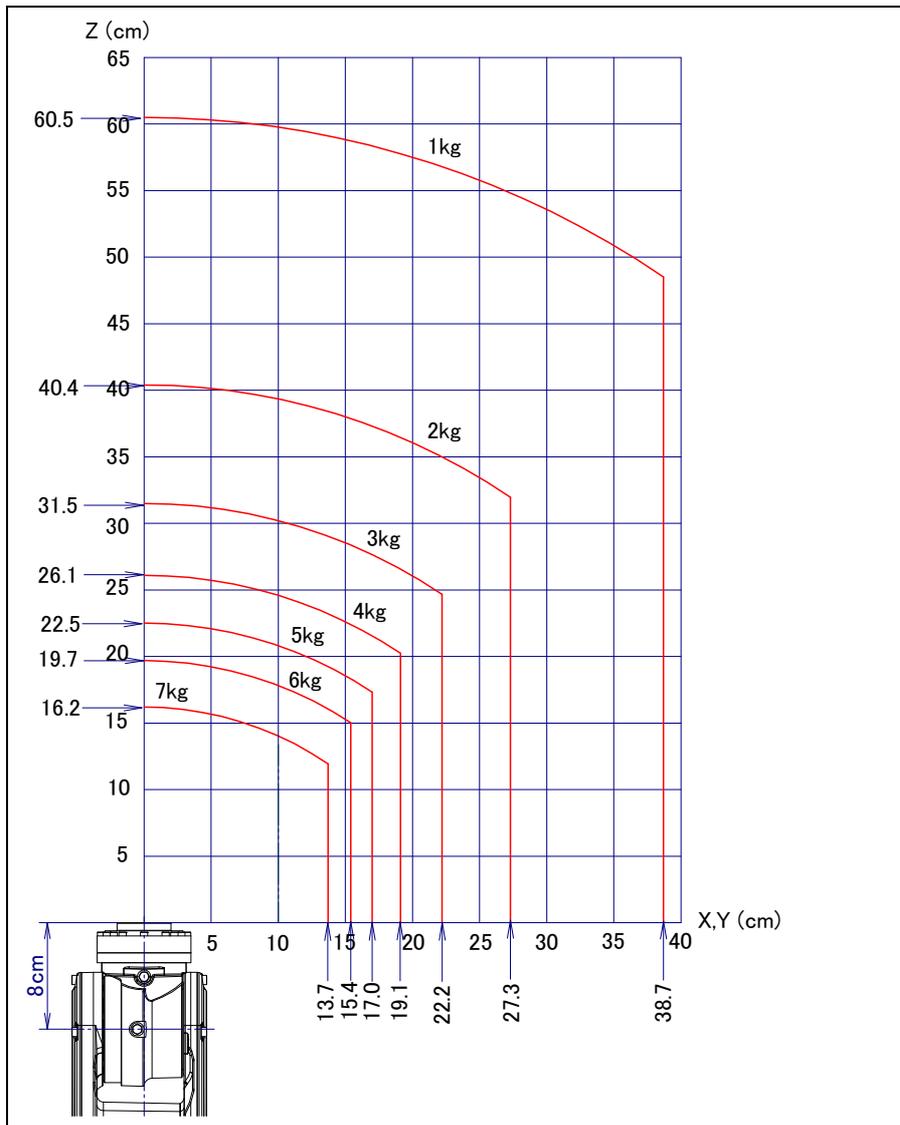


Fig. 3.4 (a) Wrist load diagram (Standard/7L/7WP)

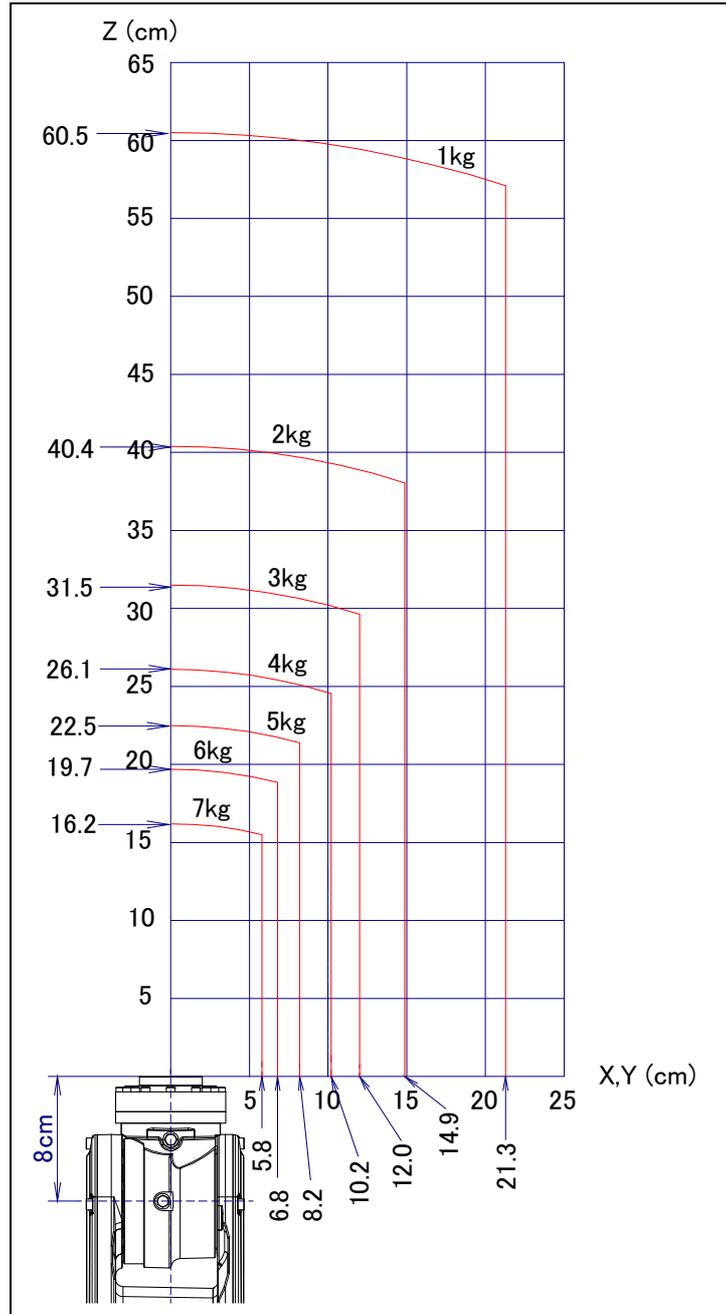


Fig. 3.4 (b) Wrist load diagram (7H standard mode)

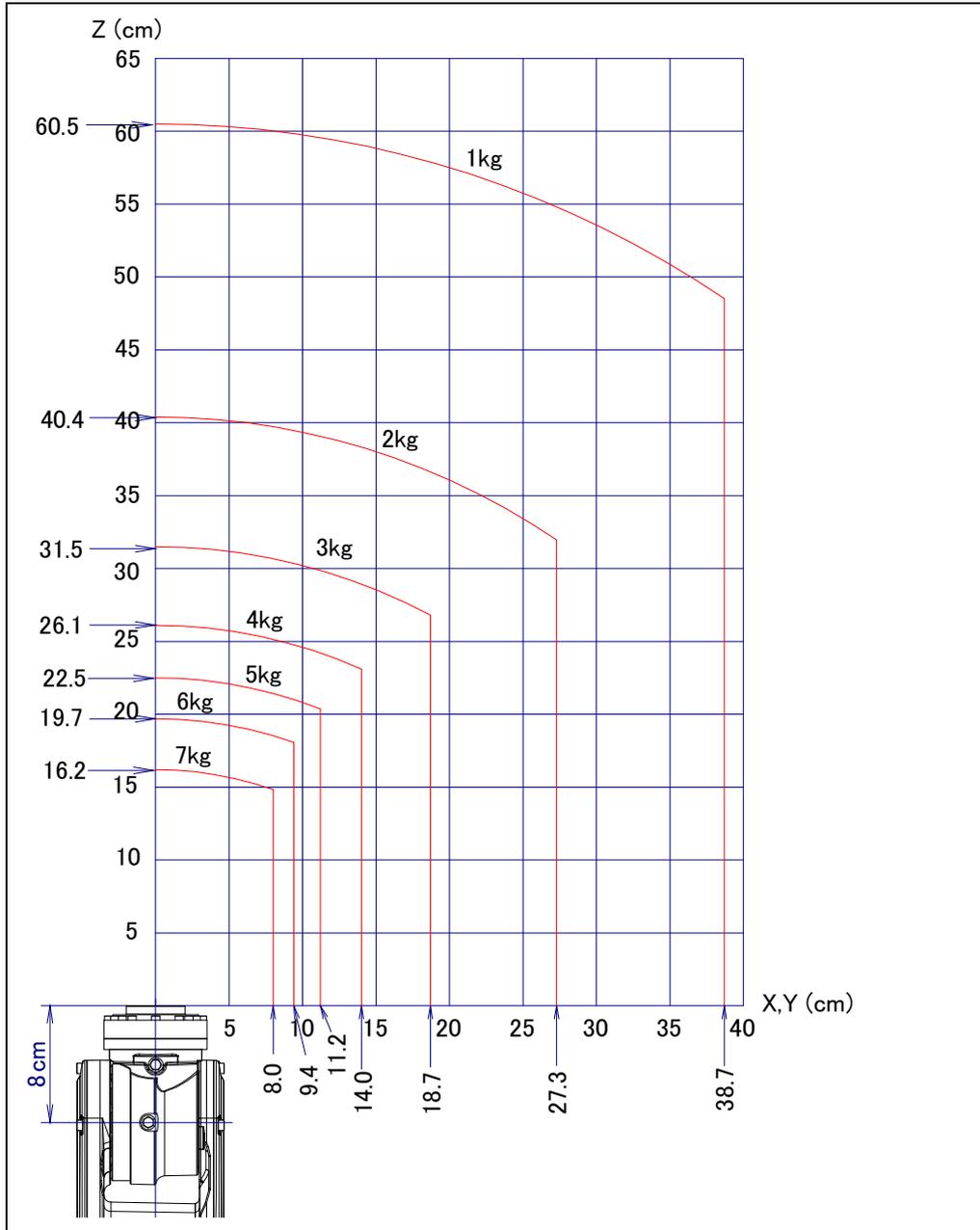


Fig. 3.4 (c) Wrist load diagram (7H High inertia mode)

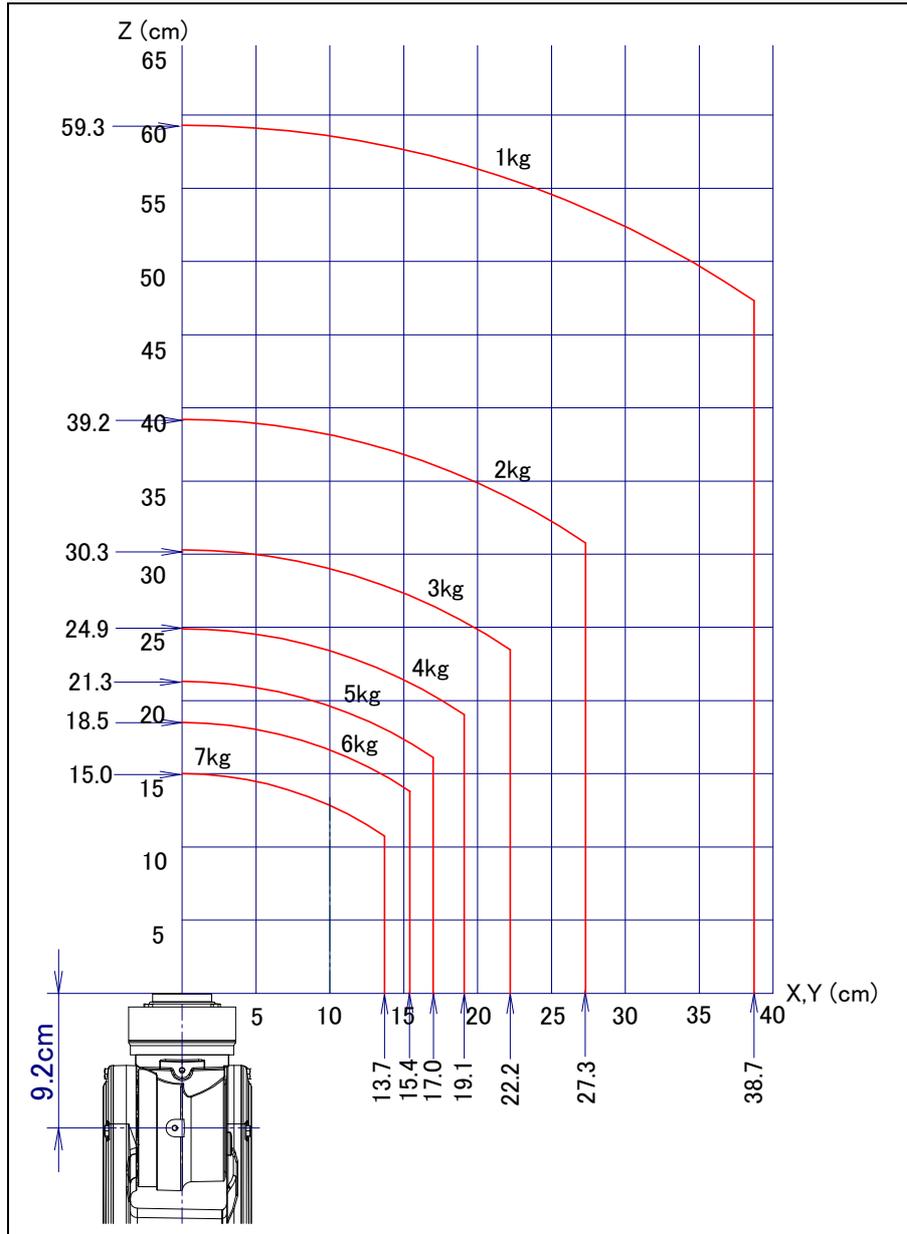


Fig. 3.4 (d) Wrist load diagram (7C/7LC)

3.5 LOAD CONDITION ON EQUIPMENT MOUNTING FACE

The equipment can be installed as shown in Fig. 3.5. When the equipment is installed, the total mass of the installed equipment, hand and work must not exceed 7kg. Please refer to Chapter 4 for the size on the equipment installation side.

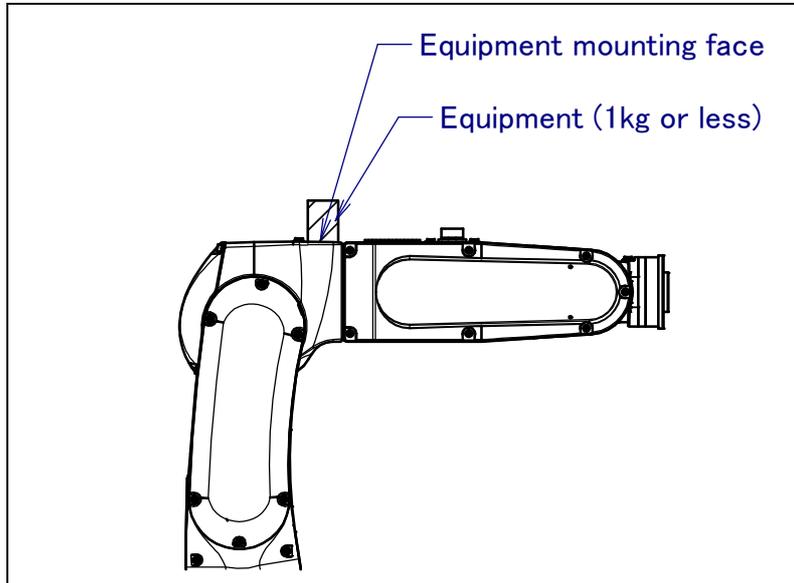


Fig. 3.5 Load condition of equipment mounting face

3.6 OPERATING AREA FOR INCLINATION INSTALLATION

If applied load on the robot exceeds 5kg, 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 3.6 (a) and (b). If payload is less than 5kg, there is no restriction of the operating space. 7H Downward wrist zero specification is restricted to floor mount and upside-down mount.

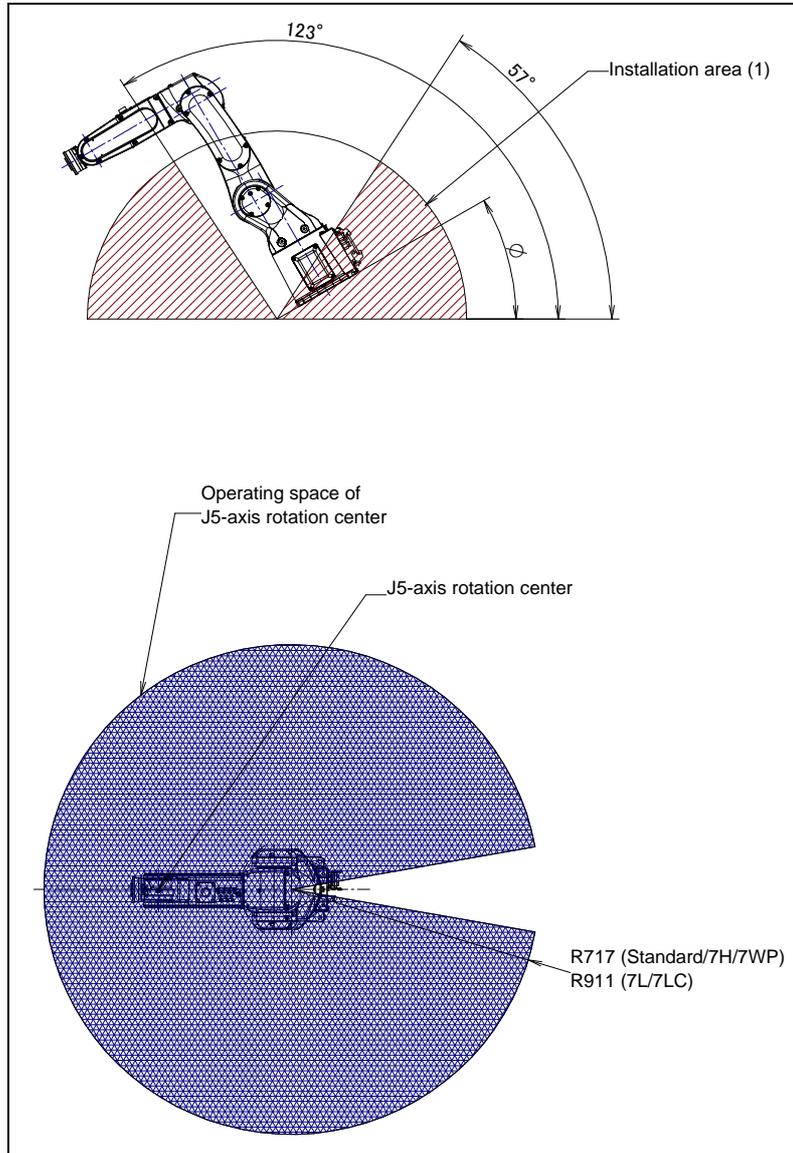


Fig. 3.6 (a) Installation area (1) Operation area
 $(0^\circ \leq \phi \leq 57^\circ, 123^\circ \leq \phi \leq 180^\circ)$

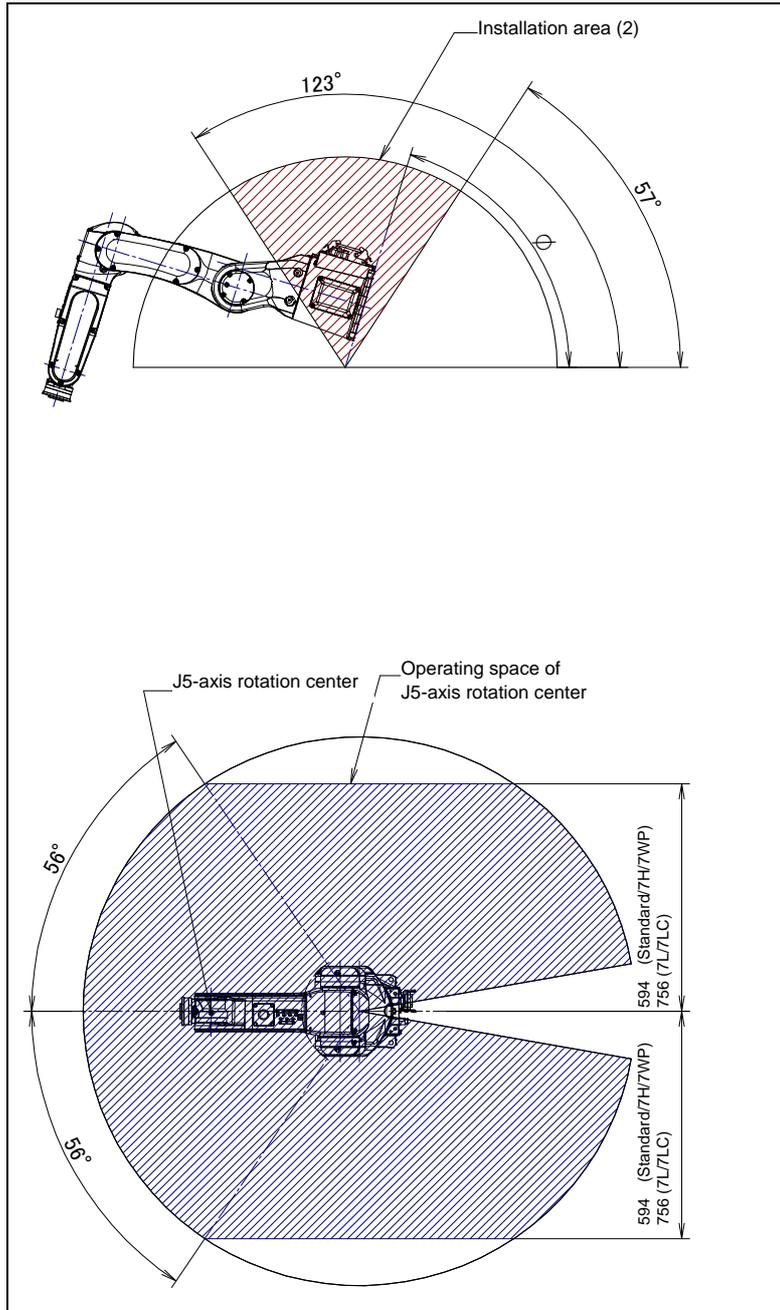


Fig. 3.6 (b) Installation area (2) Operation area
(57° < ϕ < 123°)

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 is 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 attaching the end effector referring to Appendix B for the tightening torque.

⚠ CAUTION

- 1 Notice the tooling coupling depth to wrist flange should be shorter than the flange coupling length.
- 2 Don't use a pin without tap for removal at wrist flange.

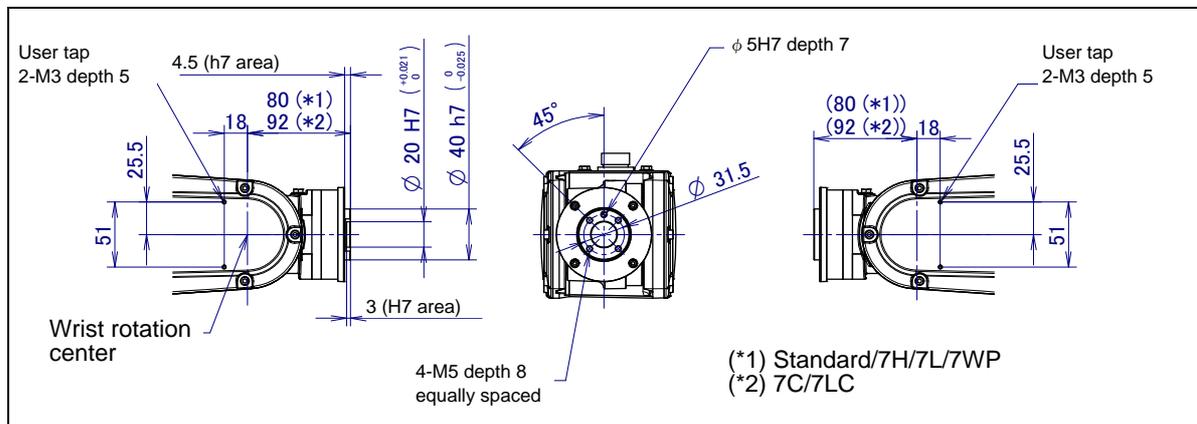


Fig. 4.1 Surface for installing the end effector

NOTE: Figure is example with J6-axis reducer bolt cover (A05B-1142-J001)
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

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

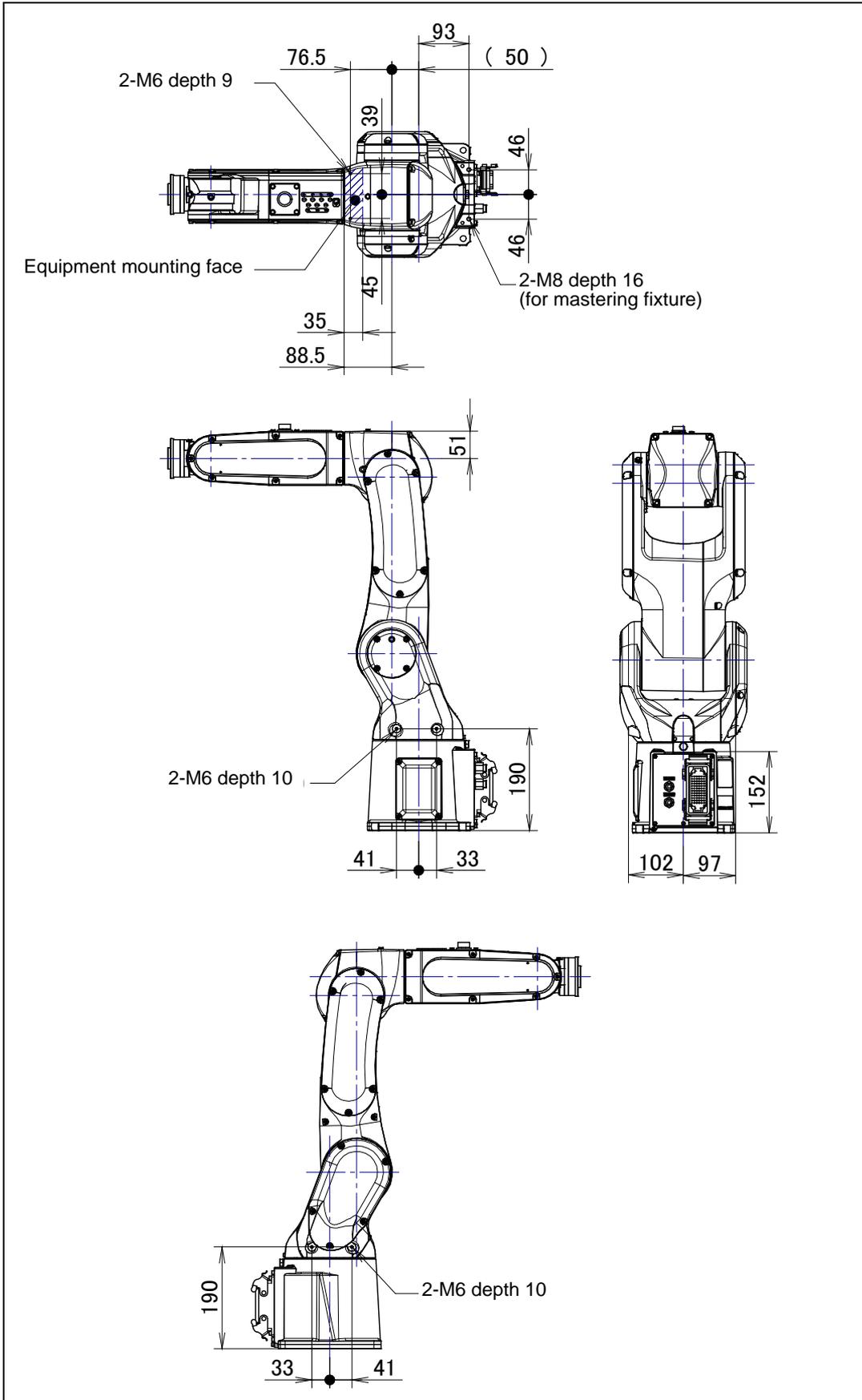


Fig. 4.2 Equipment mounting faces

4.3 LOAD SETTING

CAUTION

- 1 Set the load condition parameter before the robot runs. Do not operate the robot when its payload is exceeded. Don't exceed the allowable payload including connection cables and its swing. Operation in with the robot over payload may result in troubles such as reducer life reduction.
- 2 When performing load estimation after parts replacement
If wrist axes (J5/J6-axis) motors or reducers are replaced, estimation accuracy may go down. Perform the calibration for load estimation before performing load estimation. Refer to Chapter 9 "LOAD ESTIMATION" in Optional Function OPERATOR'S MANUAL (B-83284EN-2).

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

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

MOTION PERFORMANCE		JOINT 10%	
Group1			
No.	PAYLOAD[kg]	Comment	
1	7.00	[]
2	0.00	[]
3	0.00	[]
4	0.00	[]
5	0.00	[]
6	0.00	[]
7	0.00	[]
8	0.00	[]
9	0.00	[]
10	0.00	[]
Active PAYLOAD number =0			
[TYPE] GROUP DETAIL ARMLoad SETIND >			

- 5 Ten different pieces of payload information can be set using condition 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 10%	
Group 1			
1	Schedule No[1]:[Comment]
2	PAYLOAD	[kg]	7.00
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	[kgfcm ²]	138.974
7	PAYLOAD INERTIA Y	[kgfcm ²]	169.538
8	PAYLOAD INERTIA Z	[kgfcm ²]	102.039
[TYPE] GROUP NUMBER DEFAULT HELP			

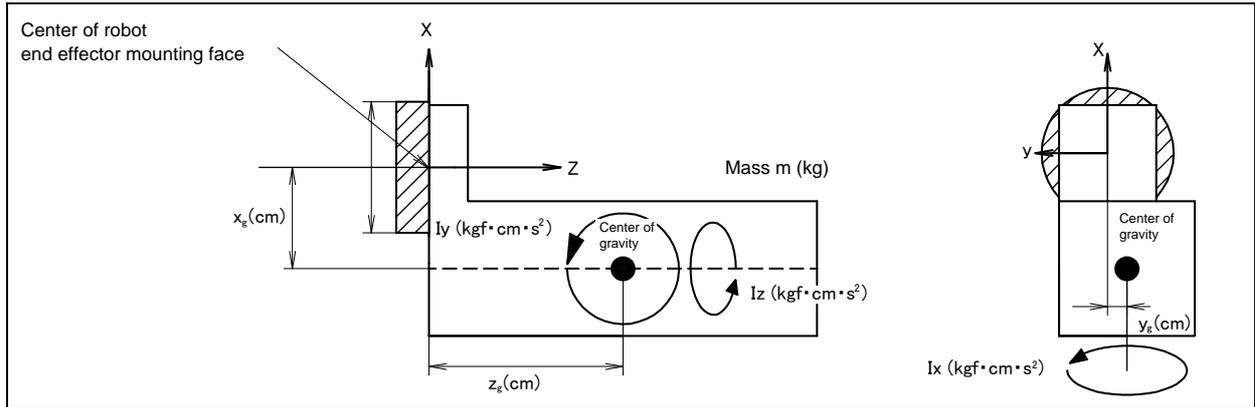


Fig. 4.3 Standard tool coordinate

- 6 Set the payload, gravity center position, and inertia around the gravity center on the MOTION PAYLOAD SET screen. The X, Y, and Z directions displayed on this screen correspond to the respective standard tool coordinates (with no tool coordinate system set up). When values are entered, the following message appears: “Path and Cycletime will change. Set it?” Respond to the message with F4 ([YES]) or F5 ([NO]).
- 7 Pressing F3 ([NUMBER]) will bring you to the MOTION PAYLOAD SET screen for another condition number. For a multigroup system, clicking F2 ([GROUP]) will bring you to the MOTION PAYLOAD SET screen for another group.
- 8 Press the [PREV] key to return to the MOTION PERFORMANCE screen. Click F5 ([SETIND]), and enter the desired payload setting condition number.
- 9 On the list screen, pressing F4 ARMLOAD brings you to the device-setting screen.

MOTION ARMLOAD SET		JOINT	100%
Group 1			
1	ARM LOAD AXIS #1 [kg]		0.00
2	ARM LOAD AXIS #3 [kg]		1.00
[TYPE]	GROUP	DEFAULT	HELP

- 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.

4.4 HIGH INERTIA MODE (OPTION) (LR Mate 200iD/7H)

High Inertia Option

Two servo motion parameters are prepared depending on the magnitude of load inertia. The best addition and subtraction velocity operation can be achieved by setting the parameter matched to the load inertia mode. The parameter is changed by the following methods.

- 1 Turn on the controller with [PREV] key and the [NEXT] key pressed.
Then select “3. Controlled start”.
- 2 Press the [MENU] key and select “9. MAINTENANCE”.
- 3 You will see a screen similar to the following.
Press arrow (↑, ↓) keys and move the cursor to “LR Mate 200iD/7H”. Then press F4, MANUAL.

ROBOT MAINTENANCE			1/10
Setup Robot System Variables			
Group	Robot Library/Option	Ext Axes	
1	LR Mate 200iD/7H	0	

- 4 Set “Standard Inertia Mode” or “High Inertia Mode” on the INERTIA MODE SETTING screen.

***** Group 1 Initialization *****	
----- INERTIA MODE SETTING -----	
1. Standard Inertia Mode	
2. High Inertia Mode	
Select Inertia Mode (1 or 2)->	

- 5 Press the [FCTN] key and select “1. START (COLD)”.

Robot is set in standard inertia mode when robot is shipped.

5 PIPING AND WIRING TO THE END EFFECTOR

⚠ WARNING

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

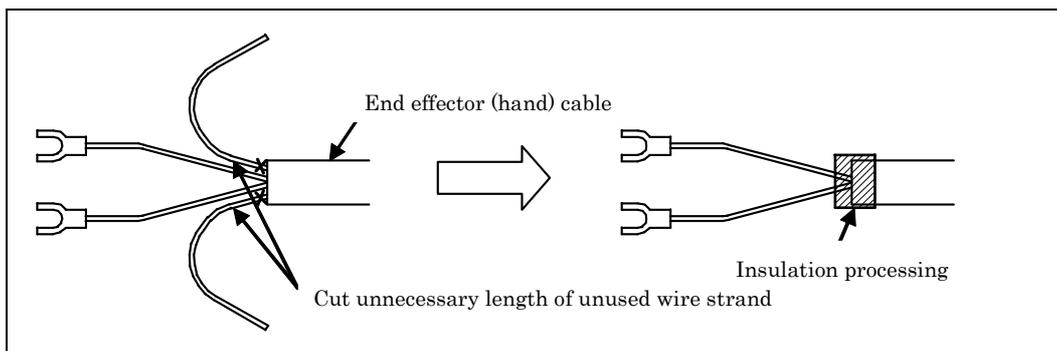


Fig. 5 Treatment method of end effector (hand) cable

5.1 AIR SUPPLY (OPTION)

Air supply holes (Rc1/4) exists on the J1-axis connector panel for end effector as shown in Fig.5.1 (c) and (d). Optional solenoid valves can be mounted as shown in Tables 5.1 (a). Plugs are inserted in all the ports used for supplying air before the robot is shipped. To use the air circuit, you must remove the plugs and connect couplings to the ports.

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

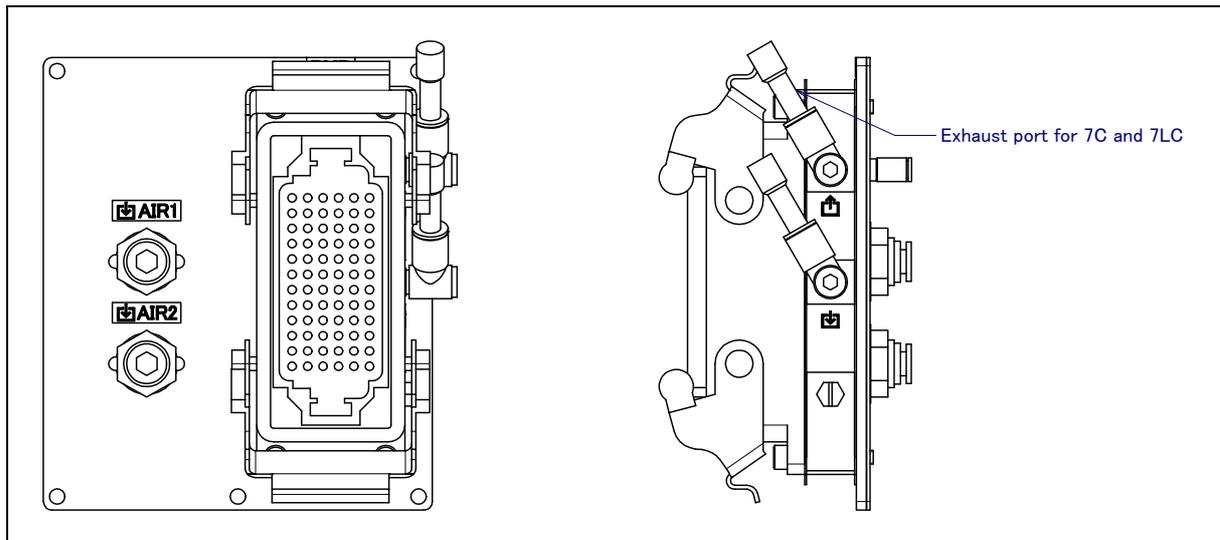
Table 5.1 (a) Optional solenoid valves

Option spec.	Model	Description	Solenoid (Manifold) spec.	Remarks	RO
A05B-1142-H091#B	Standard/ 7H/7C	Path 2 air piping, RO connector output (without solenoid valve)	—	—	—
A05B-1142-H092#B	Standard/ 7H/7WP	Double solenoids x 1	A97L-0218-0130#D1 (manufactured by SMC)	2 position x 1	RO1 to 2
A05B-1142-H093#B	Standard/ 7H/7WP	Double solenoids x 2	A97L-0218-0130#D2 (manufactured by SMC)	2 position x 2	RO1 to 4
A05B-1142-H094#B	Standard/ 7H/7WP	Double solenoids x 3	A97L-0218-0130#D3 (manufactured by SMC)	2 position x 3	RO1 to 6
A05B-1142-H095#B	Standard/ 7H/7WP	Double solenoids x 3	A97L-0218-0130#D3B (SMC 製)	3 position (closed center) x 3	RO1 to 6
A05B-1142-H096#B	Standard/ 7H/7WP/ 7LC	Double solenoids x 3	A97L-0218-0130#D3R (SMC 製)	3 position (exhaust center) x 3	RO1 to 6
A05B-1142-H097#B	Standard/ 7H/7C /7WP/7LC	Without air piping, RO connector output (without solenoid valve) for IP69K	—	—	—
A05B-1142-H099#B	Standard/ 7H	Path 1 air piping, RO connector output (without solenoid valve)	—	—	—
A05B-1142-H091#L	7L/7LC	Path 2 air piping, RO connector output (without solenoid valve)	—	—	—
A05B-1142-H095#L	7L/7LC	Double solenoids x 3	A97L-0218-0130#D3B (manufactured by SMC)	3 position (closed center) x 3	RO1 to 6
A05B-1142-H096#L	7L/7LC	Double solenoids x 3	A97L-0218-0130#D3R (manufactured by SMC)	2 position (exhaust center) x 3	RO1 to 6
A05B-1142-H090#L	7L/7LC	pressure center x 1 Double solenoids x 2	A97L-0218-0130#D3R (manufactured by SMC)	3 position x2 3 position (pressure center) x 1	RO1 to 6
A05B-1142-H092#L	7L	Double solenoids x 1	A97L-0218-0130#D1 (manufactured by SMC)	2 position x 1	RO1 to 6
A05B-1142-H093#L	7L	Double solenoids x 2	A97L-0218-0130#D2 (manufactured by SMC)	2 position x 2	RO1 to 6
A05B-1142-H094#L	7L	Double solenoids x 3	A97L-0218-0130#D3 (manufactured by SMC)	2 position x 3	RO1 to 6
A05B-1142-H092#CB	7C	Double solenoids x 1	A97L-0218-0130#D1 (manufactured by SMC)	2 position x 1	RO1 to 2
A05B-1142-H093#CB	7C	Double solenoids x 2	A97L-0218-0130#D2 (manufactured by SMC)	2 position x 2	RO1 to 4
A05B-1142-H094#CB	7C	Double solenoids x 3	A97L-0218-0130#D3 (manufactured by SMC)	2 position x 3	RO1 to 6
A05B-1142-H095#CB	7C	Double solenoids x 3	A97L-0218-0130#D3B (manufactured by SMC)	3 position (closed center) x 3	RO1 to 6
A05B-1142-H096#CB	7C	Double solenoids x 3	A97L-0218-0130#D3R (manufactured by SMC)	3 position (exhaust center) x 3	RO1 to 6
A05B-1142-H092#CL	7LC	Double solenoids x 1	A97L-0218-0130#D1 (manufactured by SMC)	2 position x 1	RO1 to 6
A05B-1142-H093#CL	7LC	Double solenoids x 2	A97L-0218-0130#D2 (manufactured by SMC)	2 position x 2	RO1 to 6
A05B-1142-H094#CL	7LC	Double solenoids x 3	A97L-0218-0130#D3 (manufactured by SMC)	2 position x 3	RO1 to 6
A05B-1142-H095#CL	7LC	Double solenoids x 3	A97L-0218-0130#D3B (manufactured by SMC)	3 position (closed center) x 3	RO1 to 6
A05B-1142-H096#CL	7LC	Double solenoids x 3	A97L-0218-0130#D3R (manufactured by SMC)	3 position (exhaust center) x 3	RO1 to 6

Available section area of the solenoid valve : 1.98mm² (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 $5\mu\text{m}$ 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 For 7C/7LC, remove the exhaust port plug before using it. (Fig.5.1 (a)) Air of the built-in solenoid valve exhaust port is exhausted from here. So connect the piping and exhaust it to outer of the clean room.

**Fig. 5.1 (a) Exhaust port plug for 7C and 7LC**

5. PIPING AND WIRING TO THE END EFFECTOR

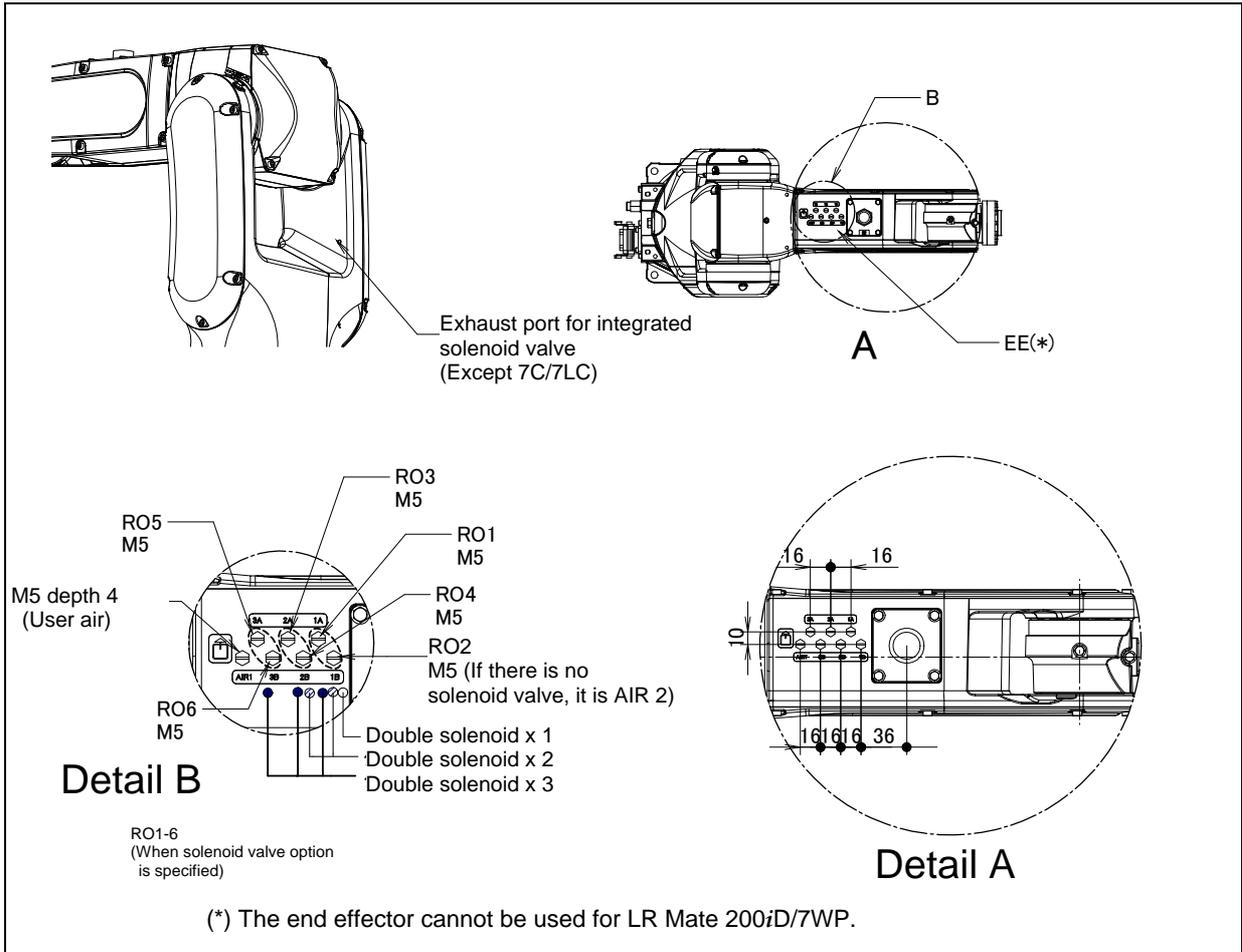


Fig. 5.1 (b) Air supply (J2 arm, J3 arm side)

5. PIPING AND WIRING TO THE END EFFECTOR

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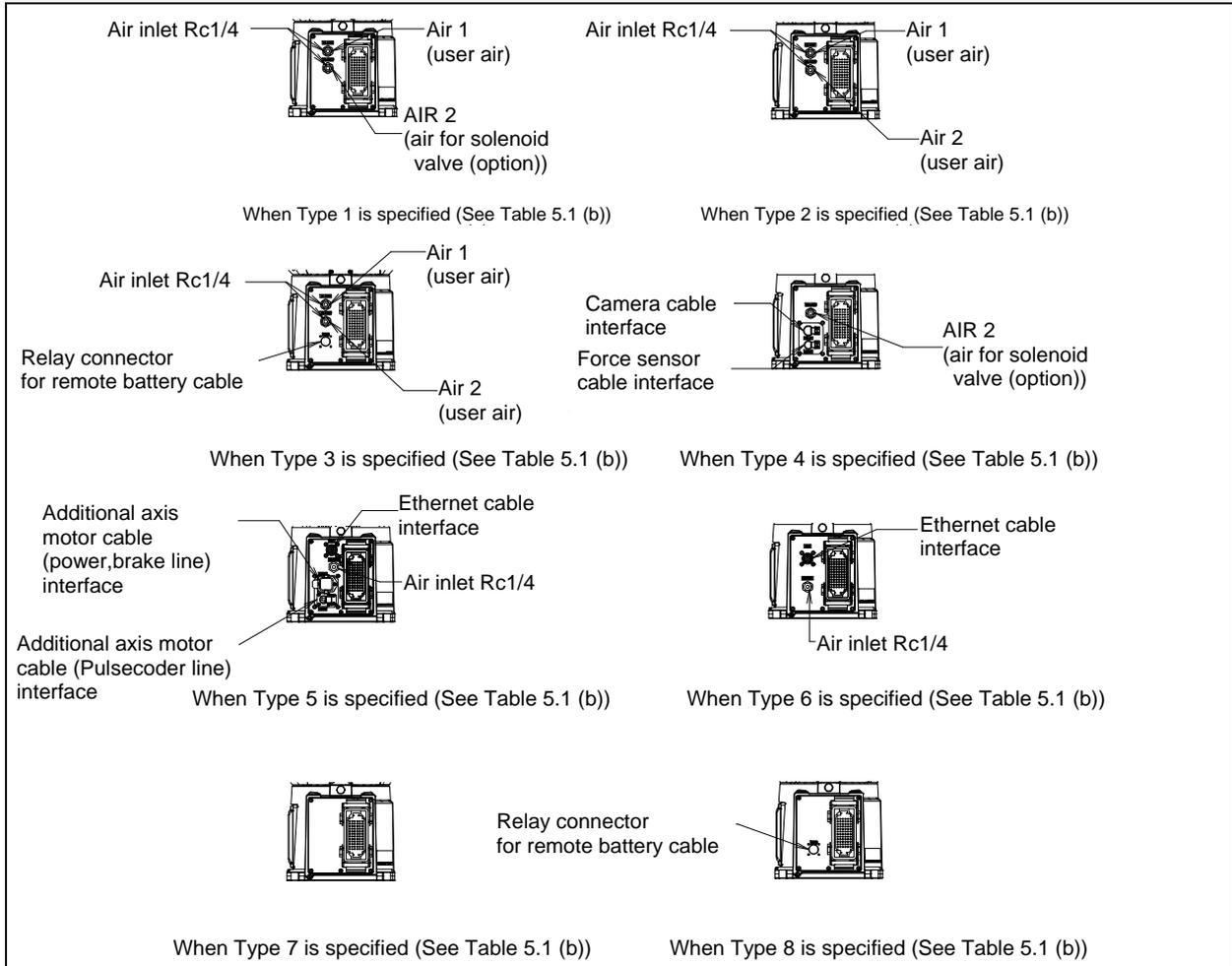


Fig. 5.1 (c) Air supply (back side connector panel)

Table 5.1 (b) Correspondence table for mechanical unit cable

Type	Spec. of mechanical unit cable
Type 1	A05B-1142-H301, H501, H502, H701#STB, H701#STL, H706#STB, H714#STB, H721#CB, H726#CB
Type 2	A05B-1142-H302, H702#STB, H702#STL, H707#STB, H722#CB
Type 3	A05B-1142-H306, H307, H341, H706#STB, H707#STB, H726#CB, H741#WPB
Type 4	A05B-1142-H303, H323, H703#STB, H723#CB
Type 5	A05B-1142-H304, H704#STB
Type 6	A05B-1142-H305, H313, H705#STB, H713#STB, H725#CB, H733#CB
Type 7	A05B-1142-H311, H331, H711#STB, H731#CB
Type 8	A05B-1142-H312, H332, H342, H712#STB, H732#CB, H742#WPB

5. PIPING AND WIRING TO THE END EFFECTOR

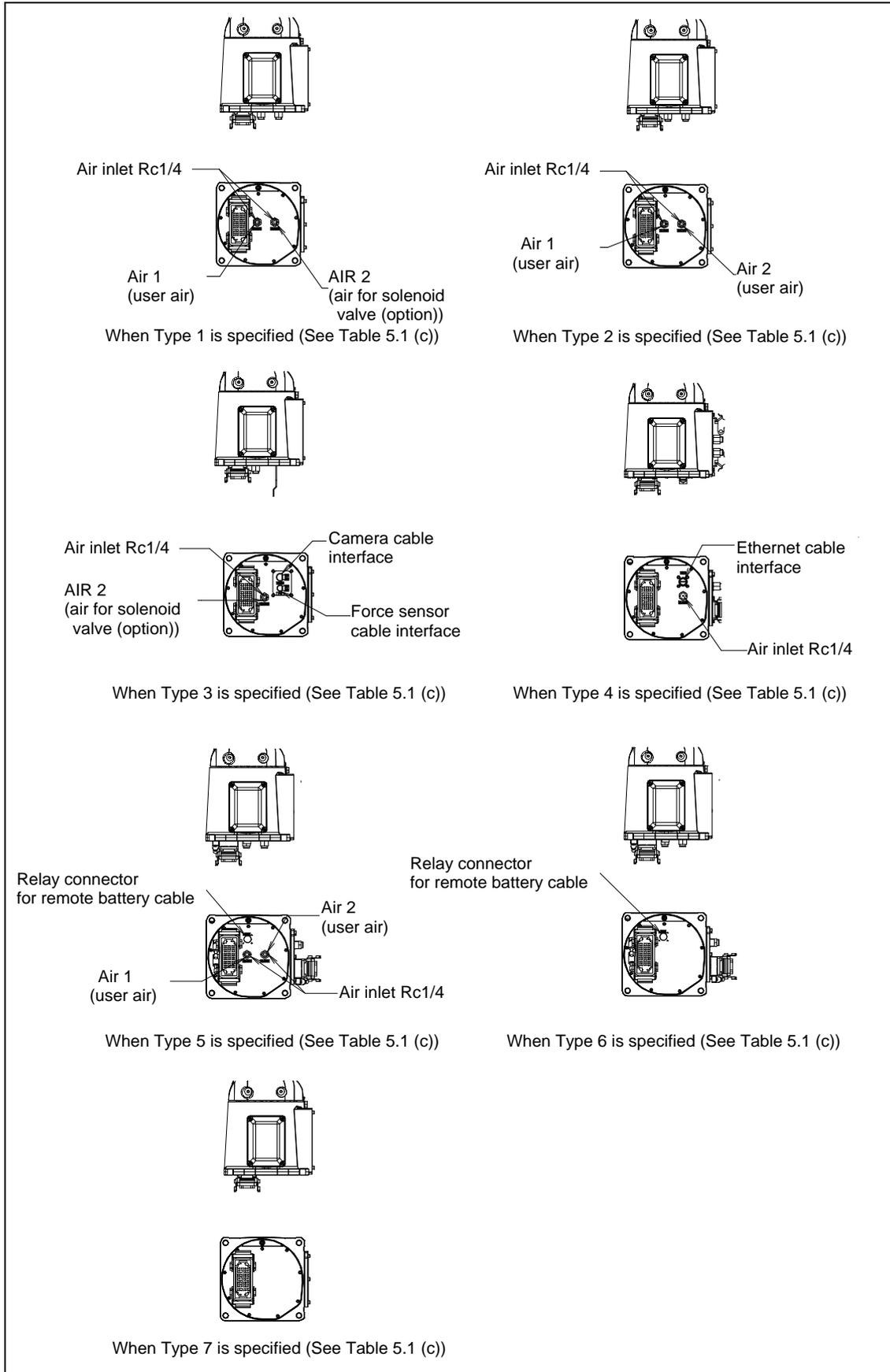


Fig. 5.1 (d) Air supply (bottom side connector panel)

Table 5.1 (c) Correspondence table for mechanical unit cable

Type	Spec. of mechanical unit cable
Type 1	A05B-1142-H351, H352, H551, H556, H751#STB, H751#STL, H752#STB, H756#STB
Type 2	A05B-1142-H552, H752#STB, H752#STL, H757#STB
Type 3	A05B-1142-H553, H753#STB, H753#STL
Type 4	A05B-1142-H355, H363, H755#STB, H755#STL, H763#STB, H763#STL
Type 5	A05B-1142-H356, H357, H556, H557, H756#STB, H756#STL, H757#STB, H757#STL, H791#WPB
Type 6	A05B-1142-H362, H562, H762#STB, H762#STL, H782#CB
Type 7	A05B-1142-H331, H361, H731#CL, H761#STB, H781#CB

Air pressure	Supply air pressure	0.49 to 0.69MPa(5 to 7kgf/cm ²), Setting: 0.49MPa(5kgf/cm ²)
	Amount of consumption	Maximum instantaneous amount 120Nl/min (0.12Nm ³ /min)

* The air should be dry. Do not use oiled compressed air.

**CAUTION**

The user air and the solenoid valve is not available when the IP69K option is specified

5.2 INSTALLING THE AIR PURGE KIT

Air purge kit, air purge kit with a monitor port are preparatory as the option, and use it, please. Use the prepared air purge kit. In case of LR Mate 200iD/7WP, be sure to perform air purge.

- Air purge kit (A05B-1142-J061, J064)

Set the air purge pressure to 10 kPa (0.01 MPa, 0.1 kgf/cm²) or less. Air purge regulator kit (A05B-1138-J062) is appropriate for controlling the purge pressure.

- Air purge kit with a monitor port (A05B-1142-J062, J063, J065)

This is air purge with purge monitor port. By adding a pressure sensor etc. to the port, the robot inside pressure can be monitored. If the monitor port is not utilized, be sure to close the port by a plug. Air purge regulator kit (A05B-1138-J062) is appropriate for controlling the purge pressure. Combination with mechanical unit cables and solenoid valves has some restrictions. Set the air purge pressure to 10 kPa (0.01 MPa, 0.1 kgf/cm²) or less.

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 an 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. Intermittent purge sometimes causes liquid entrance or internal dew.
- 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.
- 4 Air purge kit cannot be used when using 7C/7LC in the clean room. It causes particle generation. Except for clean room, such as food environment is acceptable.

5. PIPING AND WIRING TO THE END EFFECTOR

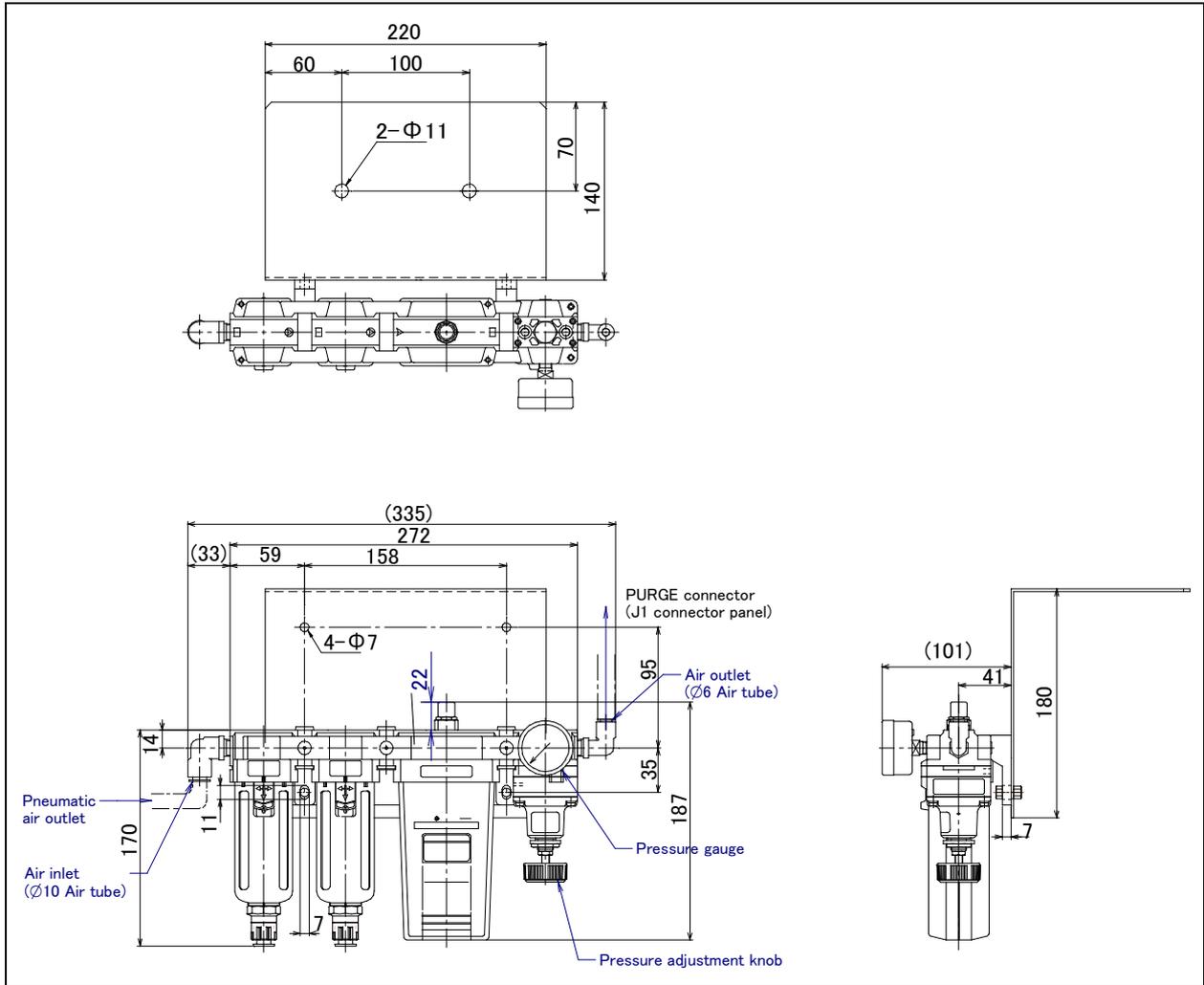


Fig. 5.2 (a) Regulator kit for air purge external dimensions

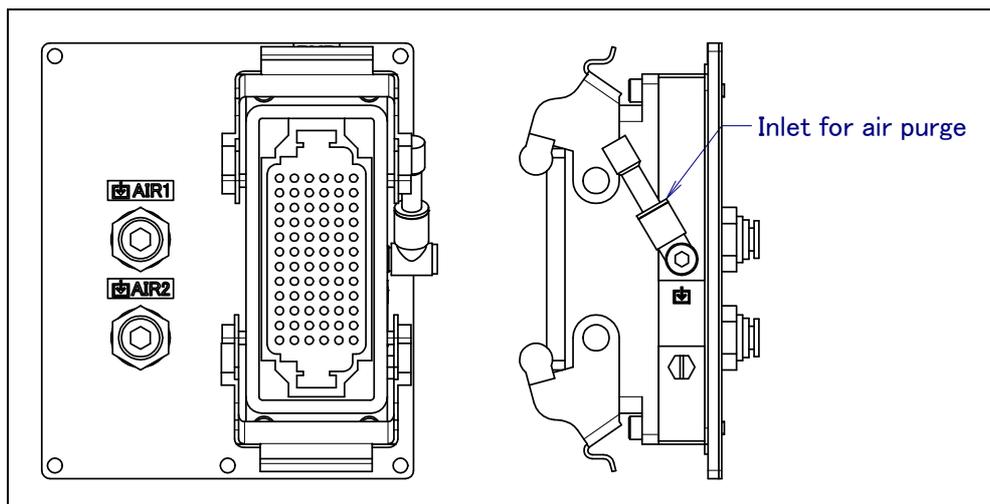


Fig. 5.2 (b) Inlet for air purge (A05B-1142-J061, J064 for backside connector plate)

5. PIPING AND WIRING TO THE END EFFECTOR

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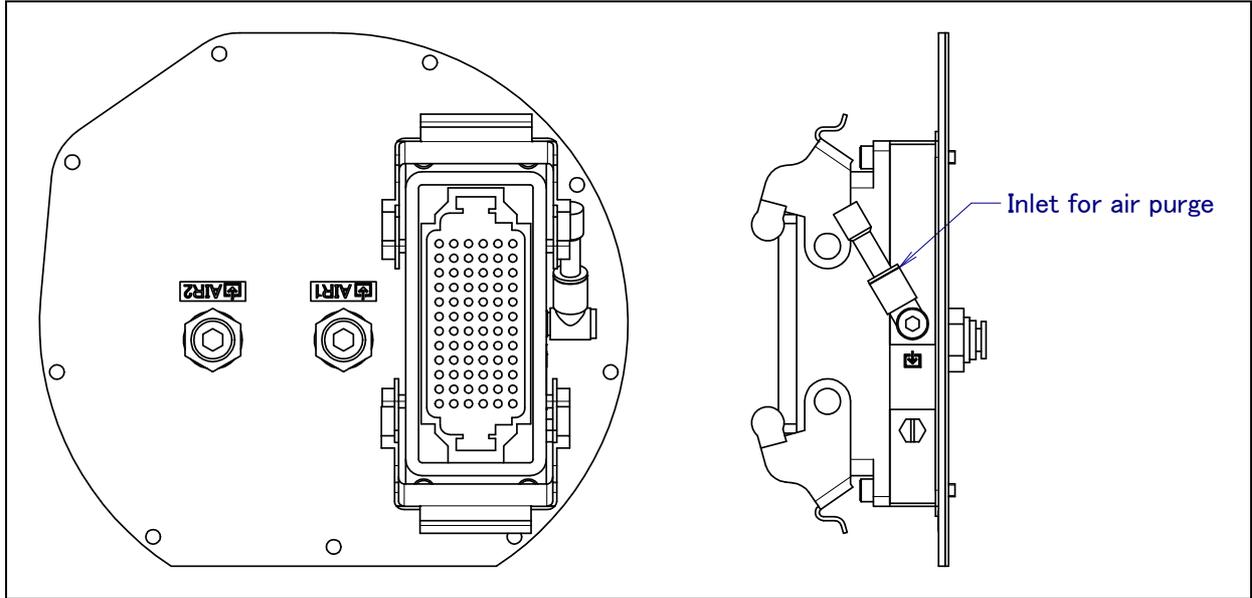


Fig. 5.2 (c) Inlet for air purge (A05B-1142-J061, J064 for bottom connector plate)

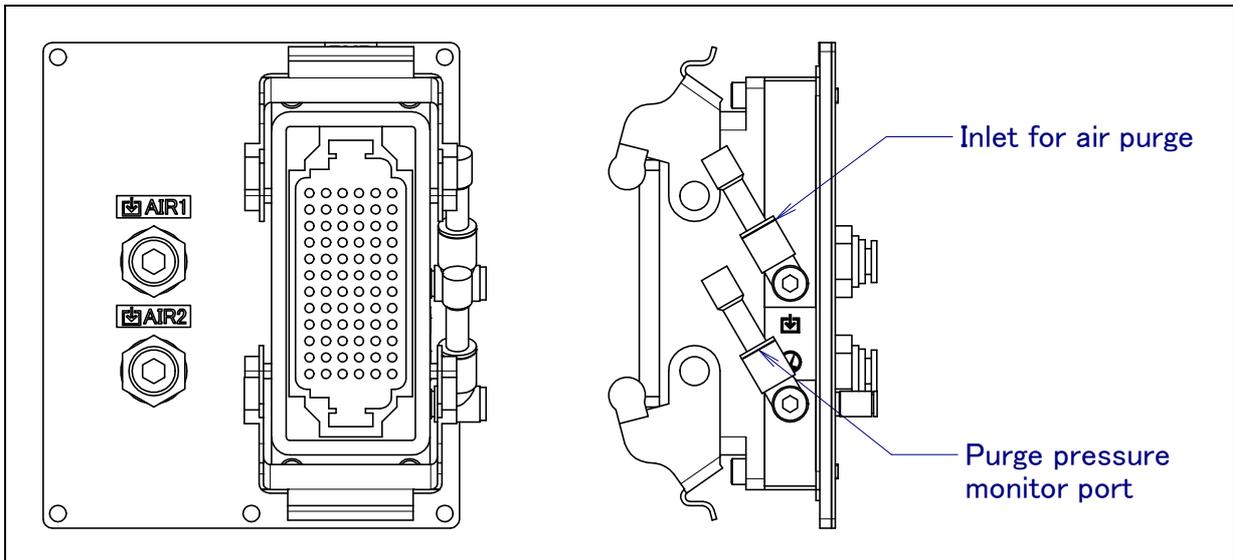


Fig. 5.2 (d) Inlet for air purge (A05B-1142-J062, J63, J065 for backside connector plate)

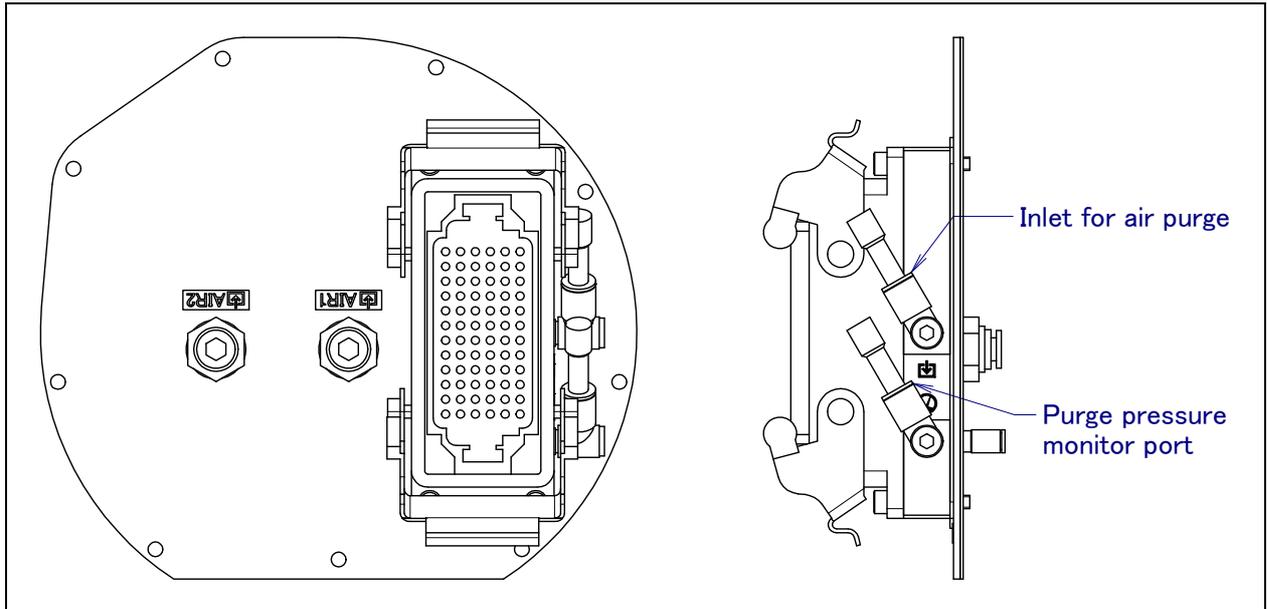


Fig. 5.2 (e) Inlet for air purge (A05B-1142-J062, J63, J065 for bottom connector plate)

5.3 INTERFACE FOR OPTION CABLE

⚠ CAUTION

- 1 The connector to be plugged into the interface and the cable attached to that connector should be prepared by the customer.
- 2 Please cover the unused connector and air port reliably by a metal cap (option) and a plug. If the covering is loose, unexpected substances will enter into the robot and cause any troubles. At ex-factory, the interfaces are covered by easy caps in order to avoid dust during transportation. Please keep in mind that the cap doesn't work enough as a protect means in factory environment.
- 3 Please do the waterproof processing of the hand cable surely to prevent the flood in the mechanism.
Moreover, the damage of the cover of the cable causes the flood so exchange it, please when it is damaged.

(1) EE interface (RI/RO signal)

Fig. 5.3 (a) shows the pin layout for the EE interface (RI/RO signal).

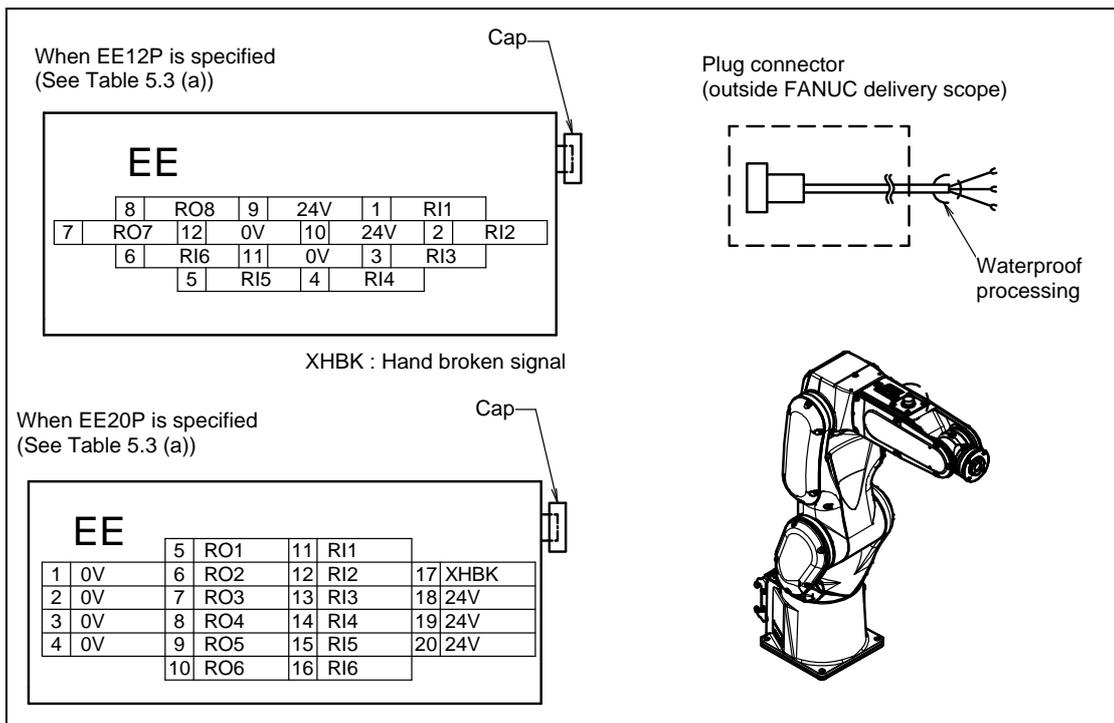


Fig. 5.3 (a) EE interface pin layout (RI/RO signal)

Table 5.3 (a) Correspondence table for mechanical unit cable

EE Type	Spec. of mechanical unit cable
EE12P	A05B-1142-H301, H303, H306, H313, H321, H323, H333, H351, H353, H356, H363, H501, H503, H551, H701#STB, H701#STL, H703#STB, H703#STL, H706#STB, H706#STL, H713#STB, H713#STL, H721#CB, H723#CB, H726#CB, H733#CB, H751#STB, H751#STL, H753#STB, H753#STL, H756#STB, H763#STB, H763#STL
EE20P	A05B-1142-H302, H305, H307, H322, H325, H352, H355, H357, H502, H702#STB, H702#STL, H705#STB, H707#STB, H707#STL, H721#CL, H722#CB, H723#CL, H725#CB, H726#CL, H733#CL, H752#STB, H752#STL, H755#STB, H757#STB, H757#STL, H763#STB

5. PIPING AND WIRING TO THE END EFFECTOR

(2) J3 arm interface

Fig. 5.3 (b) shows the J3 arm interface.

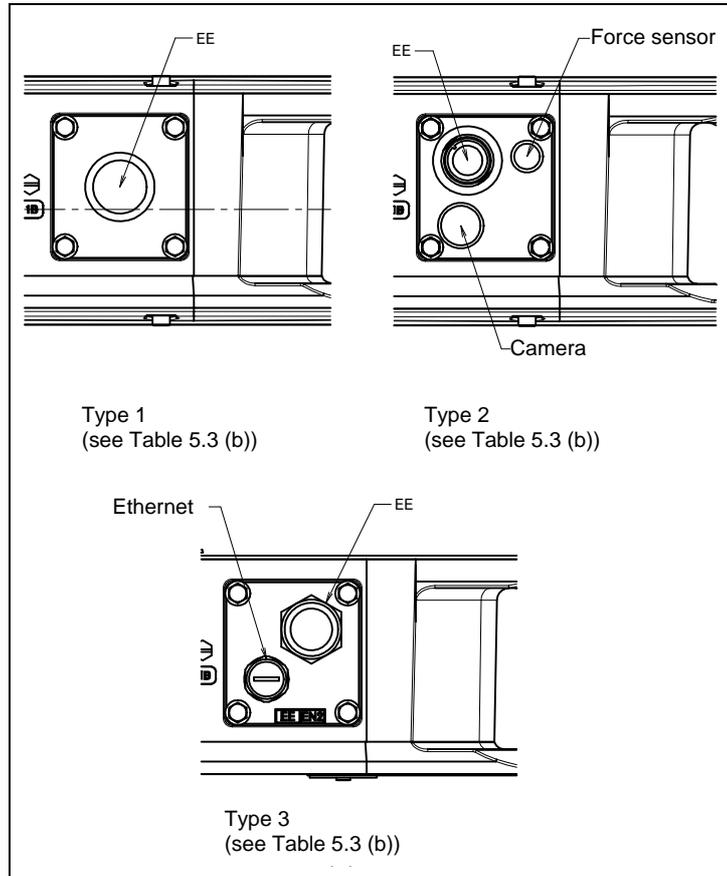


Fig. 5.3 (b) J3 arm interface

Table 5.3 (b) Correspondence table for mechanical unit cable

Type	Spec. of mechanical unit cable
Type 1	A05B-1142-H301, H302, H306, H307, H313, H701#STB, H702#STB, H706#STB, H707#STB, H713#STB
Type 2	A05B-1142-H303, H323, H503, H523, H703#STB, H703#STL, H723#CB, H723#CL
Type 3	A05B-1142-H305, H313, H325, H333, H505, H513, H525, H705#STB, H705#STL, H713#STB, H713#STL, H725#CB, H733#CB, H733#CL

CAUTION

- For wiring of the peripheral device to the EE interface, refer to -Chapter 4 "ELECTROCAL CONNECTIONS" of manuals below, too.
R-30iB Mate/R-30iB Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
R-30iB Mate Controller Open Air MAINTENANCE MANUAL (B-83555EN)
- This interface is not available when the IP69K option is specified.

Connector specifications

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

Table 5.3 (c) Supported connector (user side)

Maker	Manufacturer specification	Remarks
Hirose Electric Co. Ltd.	Plug: RM15WTPZ-12P(71) Clamp: JR13WCC-*(72)	Straight type connector (12 pins) * indicates an applicable cable diameter selected from the following: * : ϕ 5, 6, 7, 8, 9, 10mm (For EE12P See Table 5.3 (a))
	Plug: RM15WTLP-12P(71) Clamp: JR13WCC-*(72)	Elbow type connector (12 pins) * indicates an applicable cable diameter selected from the following: * : ϕ 5, 6, 7, 8, 9, 10mm (For EE12P See Table 5.3 (a))
	Plug: RM15WTLP-20P Clamp: JR13WCC-*(72)	Elbow type connector * indicates an applicable cable diameter selected from the following: * : ϕ 5, 6, 7, 8, 9, 10mm (For EE20P See Table 5.3 (a))

NOTE

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

Table 5.3 (d) Supported option

Option specification	Remarks
A05B-1137-J057	Straight type connector (12-pins) Applicable cable diameter: 8mm
A05B-1137-J058	Elbow type connector (12-pins) Applicable cable diameter: 9mm
A05B-1139-J059	Elbow type connector (20-pins) Applicable cable diameter: 9mm
A05B-1142-K052	Cable with elbow type connector (12-pins) Length: 300mm
A05B-1142-K053	Cable with elbow type connector (20-pins) Length: 300mm

Table 5.3 (e) shows the connector parts supported by the Ethernet cable (ES) interface.

Table 5.3 (e) Connector specifications (user side)

Cable name	Input side (J1 base)	Maker/ dealer	Output side (J3 arm)	Maker/ dealer
ES	2103 881 1405 2103 881 1415 2103 281 1405 2103 282 1405 Many other types are available.	HARTING K.K	←The same	HARTING K.K

NOTE

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

6

AXIS LIMIT SETUP

When axis limits are defined, the motion range of the robot can be changed from the standard value. The motion range of the robot axes can be restricted because of:

- Used motion range of the robot is limited.
- Tools and peripheral equipment interfere each other in some areas.
- Length of the cable or hose attached to the application is limited.
- The following method used to prevent the robot from going beyond the necessary motion range.
- Axis limit by DCS (All axes (option))

WARNING

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

6.1 SOFTWARE SETTING CHANGE AXIS LIMIT BY DCS (OPTION)

The robot motion can be restricted with DCS (Dual check safety) function by using the following software. For J2/J3-axis, the same effect as an adjustable mechanical stopper can be obtained.

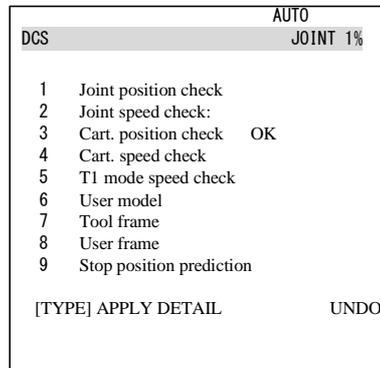
The robot motion can be restricted at any angle and position if it is in robot motion area. DCS functions are certified to meet the requirements of International Standard ISO13849-1 and IEC61508 approved by certificate authority. If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot's momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the workspace. To stop the robot within the robot workspace, use the DCS Stop Position Prediction function. The stop position prediction is disabled by default.

- DCS position/speed check function (J567)

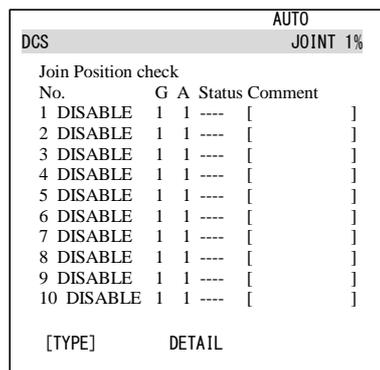
As an example, we shows the procedure to set $\pm 90^\circ$ for J2-axis in here. Refer to R-30iB/R-30iB Mate /R-30iB Plus Controller Dual check safety function Operator's Manual (B-83184EN) for details of other setting, function and DCS stop position prediction.

Setting procedure

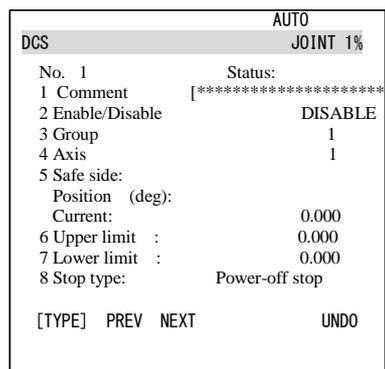
- 1 Press the [MENU] key to display the screen menu.
- 2 Press [0 NEXT] and press [6 SYSTEM].
- 3 Press the F1 ([TYPE]).
- 4 Select [DCS]. The following screen will be displayed.



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

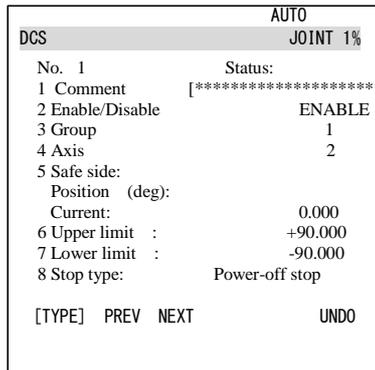


- 6 Move the cursor to [1], then press the [DETAIL].

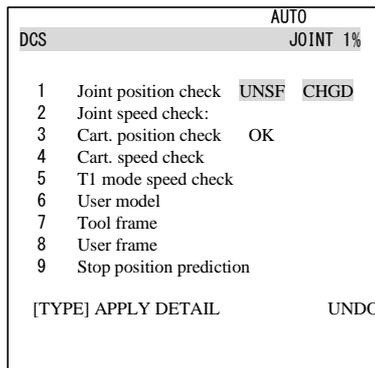


- 7 Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
- 8 Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
- 9 Move the cursor to [Axis], then input "2", then press the [ENTER] key.
- 10 Move the cursor to [Upper limit] right side, then input "90", then press the [ENTER] key.
- 11 Move the cursor to [Lower limit] right side, then input "-90", then press the [ENTER] key.

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



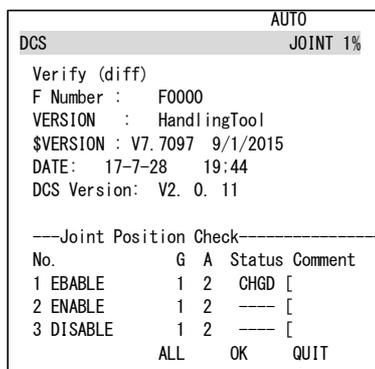
12 Press the [PREV] key two times, back to the first screen.



13 Press the [APPLY].

14 Input 4-digit password, then press the [ENTER] key. (Password default setting is "1111".)

15 The following screen will be displayed, then press the [OK].



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

DCS		AUTO	JOINT 1%
1	Joint position check	UNSF	PEND
2	Joint speed check:		
3	Cart. position check	OK	
4	Cart. speed check		
5	T1 mode speed check		
6	User model		
7	Tool frame		
8	User frame		
9	Stop position prediction		
[TYPE] APPLY DETAIL			UNDO

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



WARNING

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

7 CHECKS AND MAINTENANCE

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

NOTE

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

7.1 CHECKS AND MAINTENANCE

7.1.1 Daily Checks

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

Check items	Check points and management
Oil seepage	Check to see if there is oil on the sealed part of each joint. If there is an oil seepage, clean it. ⇒"7.2.1 Confirmation of Oil Seepage"
Air control set Air purge kit	(When air control set or air purge kit is used) ⇒"7.2.2 Confirmation of the Air Control Set and Air Purge kit"
Vibration, abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: ⇒"9.1 TROUBLESHOOTING"(symptom : Vibration, Noise)
Positioning accuracy	Check that the taught positions of the robot have not deviated from the previously taught positions. If displacement occurs, perform the measures as described in the following section: ⇒"9.1 TROUBLESHOOTING" (Symptom : Displacement)
Peripheral equipment for proper operation	Check whether the peripheral equipment operates properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the end effector drops 2 mm or less when servo power is turned off. If the end effector (hand) drops, perform the measures as described in the following section: ⇒"9.1 TROUBLESHOOTING" (symptom : Dropping axis)
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: ⇒"OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)"

7.1.2 Periodic Check and Maintenance

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

Check and maintenance intervals (Period, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	2 years 7680h	4 years 15360h			
○ Only 1st check	○					Cleaning the controller ventilation system	Confirm that the controller ventilation system is not dusty. If dust has accumulated, remove it.	13
	○					Check for external damage or peeling paint	Check whether the robot has external damage or peeling paint due to contact with the peripheral devices. If unintended contact has occurred, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check for water (except 7WP)	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.	2
	○ Only 1st check	○				Check for damages to the teach pendant cable, the operation box connection cable or the robot connection cable	Check whether the cable connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.	12
	○ Only 1st Check	○				Check for damage to the end effector (hand) cable and external batteries cable	Check whether the end effector cables and external batteries cable are unevenly twisted or damaged. If damage is found, replace the damaged cables.	8
	○ Only 1st check	○				Check the exposed connectors	Check the exposed connectors. ⇒"7.2.3 Check the Connectors"	3
	○ Only 1st check	○				Retightening the end effector mounting bolts	Retighten the end effector mounting bolts. Refer to the following section for tightening torque information: ⇒"4.1 END EFFECTOR INSTALLATION TO WRIST"	4
	○ Only 1st check	○				Retightening the external main bolts	Retighten the robot installation bolts, bolts that have been removed for inspection, and bolts exposed to the outside. Refer to the recommended bolt tightening torque guidelines at the end of the manual. An adhesive to prevent bolts from loosening is applied to some bolts. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	5

7. CHECKS AND MAINTENANCE

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Check and maintenance intervals (Period, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	2 years 7680h	4 years 15360h			
	○ Only 1st check	○				Check the mechanical stopper	Check that the spring pin of J1/J3-axis mechanical stopper is not deformed, if it is deformed, replace it with a new one. ⇒”7.2.4 Check of Mechanical Stopper ”	6
	○ Only 1st check	○				Clean spatters, sawdust and dust	Check that spatters, sawdust, or dust does not exist on the robot main body. If dust has accumulated, remove it. Especially, clean the robot movable parts well (each joint). For 7WP <ul style="list-style-type: none"> - Remove sludge and foreign materials in the cleaner. - Replace the cleaner periodically. - Wash the strainer, and replace it periodically. - Clean the joints of mechanical unit and clean the foreign materials. For an arc welding robot Insulation failure might occur when spatter has collected around the wrist flange or welding torch, and there is a possibility of damaging the robot mechanism by the welding current. (See Appendix D)	7
		○ (*)	○ (*)			Replacing the mechanical unit batteries	Replace the mechanical unit batteries (*) Periodic interval differs according to the batteries. built-in batteries : 1 years (3840 hours) external batteries: 1.5 years (5760 hours) ⇒”7.3.1 Replacing the batteries”	9
				○ (*)	○ (*)	Replenish grease to each axis reducer	Grease each axis reducer (*) Periodic interval differs according to the model. 7C/7LC : 2 years (7680 hours) Except 7C/7LC : 4 years (15360 hours) ⇒”7.3.2 Replenish the Grease of the Reducer”	10
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	11
					○	Replacing the controller batteries	Replace the controller batteries ⇒Chapter 7 Replacing batteries of R-30iB Mate/R-30iB Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN) R-30iB Mate CONTROLLER Open Air MAINTENANCE MANUAL (B-83555EN)”	14

7.2 CHECK POINTS

7.2.1 Confirmation of Oil Seepage

Check items

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

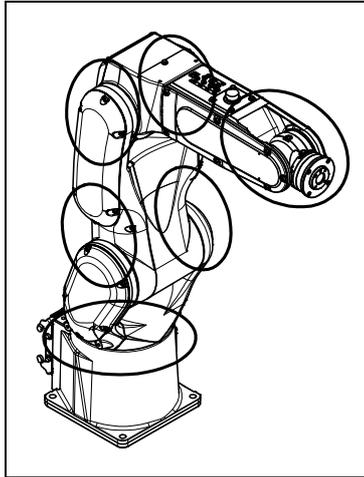


Fig. 7.2.1 Check points of oil seepage

Management

- Oil might accumulate on the outside of the seal lip depending on the movement condition or environment of the axis. If the oil changes to a state of liquid, the oil might fall depending on the axis movement. To prevent oil spots, be sure to wipe away any accumulated oil under the axis components before you operate the robot.
- Also, motors might become hot and the internal pressure of the grease bath might rise by frequent repetitive movement and use in high temperature environments. In these cases, normal internal can be restored by venting the grease inlet. (When opening the grease inlet, refer to Subsection .7.3.2 and ensure that grease is not expelled onto the machine or tooling.)
- If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.
 - ⇒"9.1 TROUBLESHOOTING" (symptom : Grease leakage)

7.2.2 Confirmation of the Air Control Set and Air Purge kit (option)

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

Item	Check items	Check points
1	When air control set is provided.	Air pressure
2		Leakage from hose
3		Drain
4	When air purge kit is provided.	Supply pressure
5		Dryer
6		Drain

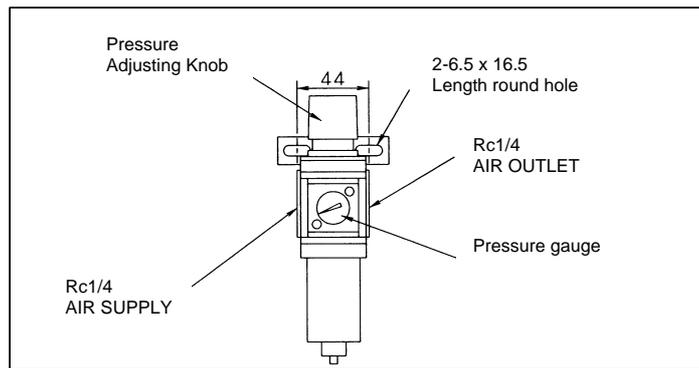


Fig. 7.2.2 (a) Air control set (option)

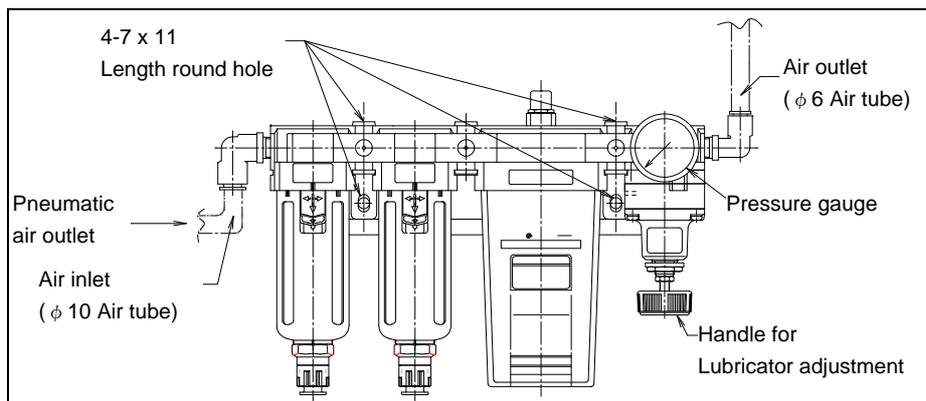


Fig. 7.2.2 (b) Air purge kit (option)

7.2.3 Check the Connectors

Inspection points of the connectors

- Robot connection cables, earth terminal and user cables

Check items

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

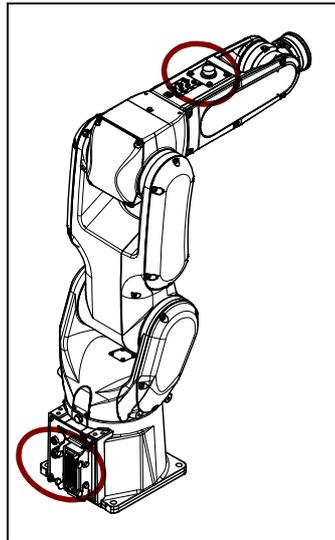


Fig. 7.2.3 Connector Inspection points

7.2.4 Check of Mechanical Stopper

- Check the spring pin of J1/J3-axis mechanical stopper is not deformed, if it is deformed, replace it with a new one.

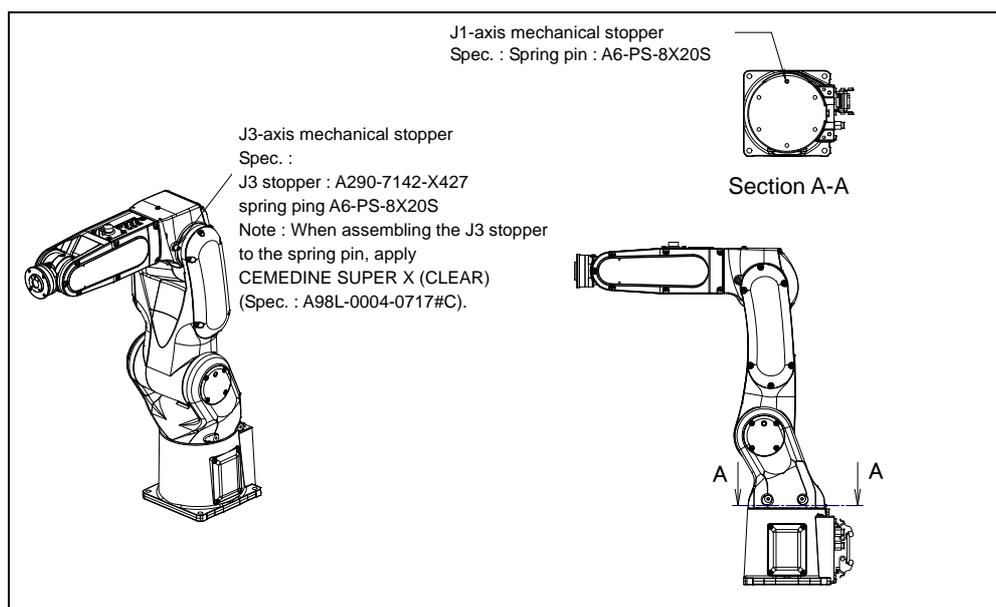


Fig. 7.2.4 Check of mechanical stopper

7.3 MAINTENANCE

7.3.1 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 them when the backup battery voltage drop alarm occurs.

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

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



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. If this occurs, mastering will be required again.

- 2 Remove the battery case cap. (Fig. 7.3.1 (a)) If it cannot be removed, tap it on the side with a plastic hammer.
- 3 Loosen the plate screw and take off the lid of the battery box and replace the battery. The battery can be taken out by pulling the stick which is in the center of the battery box.
- 4 Assemble them by reversing the sequence. Pay attention to the direction of batteries. It is necessary to replace the gasket.

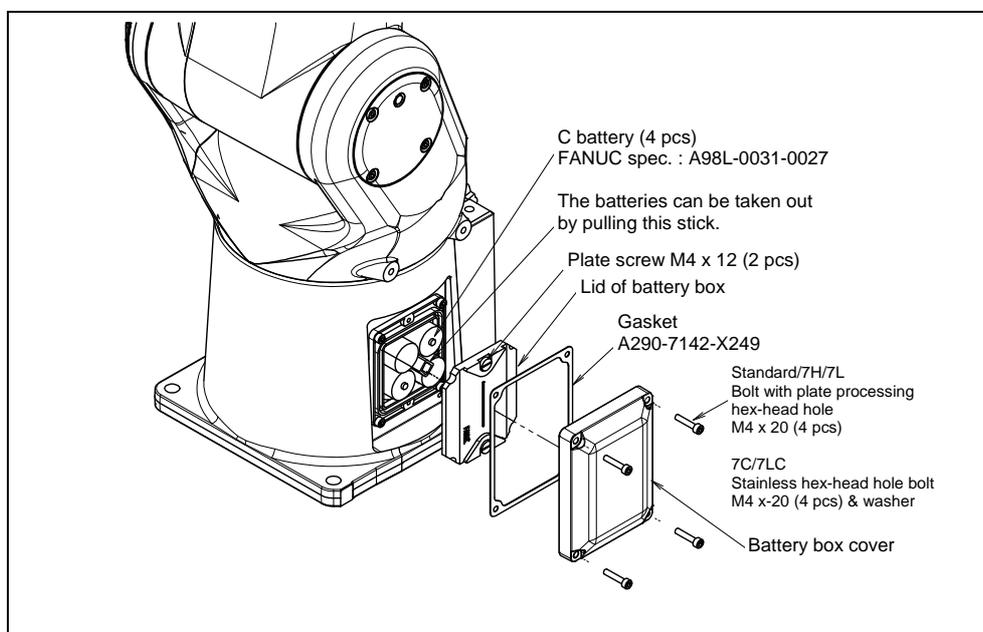


Fig. 7.3.1 (a) Replacing the battery (if built-in batteries are specified)

Procedure for replacing the battery (if external batteries are specified)

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



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. If this occurs, mastering will be required again.

- 2 Uncap the battery case (Fig. 7.3.1 (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.

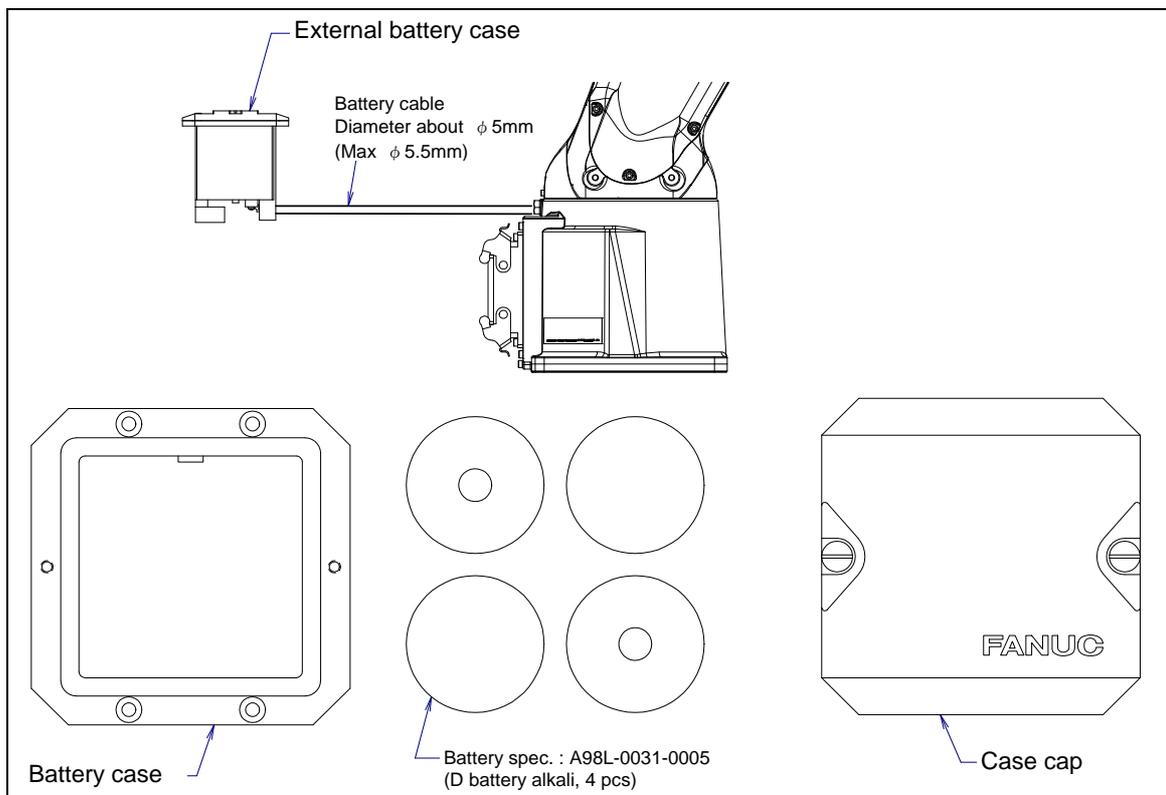


Fig. 7.3.1 (b) Replacing the battery (if external batteries are specified)

Fig. 7.3.1 (c) shows the external size of external battery box.

When the battery box needs to be built into the controller or other internal units, refer to the external dimensions shown in Fig. 7.3.1 (c)

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

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

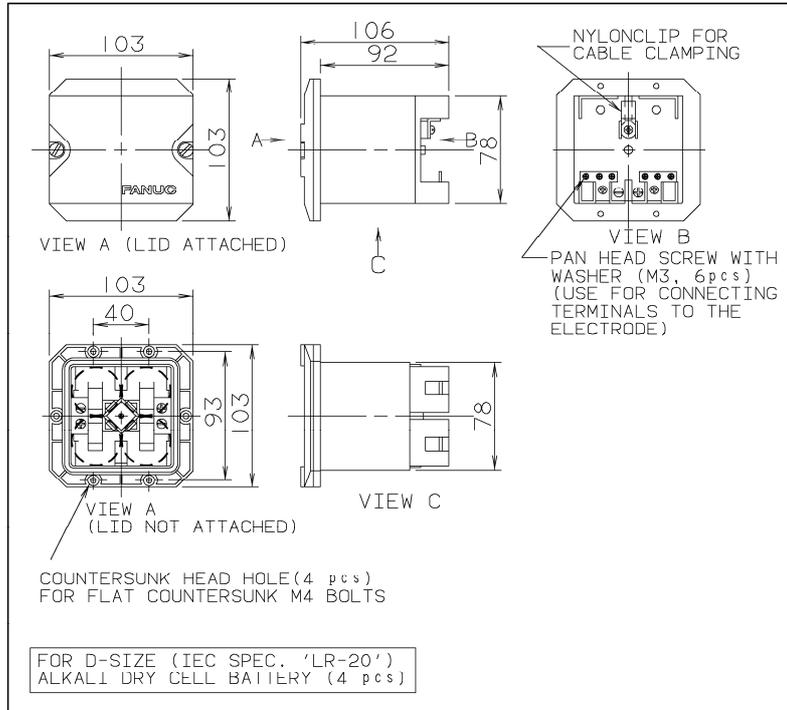


Fig. 7.3.1 (c) External dimensions of the battery box

7.3.2 Replenish the Grease of the Reducer (4 years (15360 hours) or 2 years (7680 hours) checks)

For Standard/7H/7L/7WP, supply reducer grease every four years or 15360 hours by using the following procedures.

For 7C/7LC supply reducer grease every two years or 7680 hours by using the following procedures.

For the grease name and quantity, see the Table 7.3.2 (a).

Table 7.3.2 (a) Grease for 4-year (15360 hours) or 2-year (7680 hours) periodical greasing

Greasing points	Greasing amount	Models	Specified grease
J1-axis reducer	2.7g (3ml)	Except 7C/7LC	Harmonic grease 4BNo.2 Spec: A98L-0040-0230
J2-axis reducer	2.7g (3ml)		
J3-axis reducer	1.8g (2ml)		
J4-axis reducer	1.8g (2ml)		
J5-axis reducer	1.8g (2ml)		
J6-axis reducer	1.8g (2ml)		
J1-axis reducer	0.9g (1ml)	7C/7LC	MOBIL, SHC POLYREX 005 Spec: A98L-0040-0259
J2-axis reducer	0.9g (1ml)		
J3-axis reducer	0.9g (1ml)		
J4-axis reducer	0.9g (1ml)		
J5-axis reducer	0.9g (1ml)		
J6-axis reducer	0.9g (1ml)		

For grease replacement, use the arbitrary postures.

CAUTION

The following maintenance kits are prepared for the greasing.

- Greasing kit: (for Standard/7H/7WP) A05B-1142-K021
(This a set of greasing syringe and grease in tube. (80g))
- Greasing kit (for 7C/7LC) : A05B-1142-K023
(This a set of greasing syringe and grease in tube. (80g))
- Grease in tube: A05B-1139-K022
(for Standard/7H/7WP) (grease in tube. (80g))
- Grease in tube: A05B-1139-K024
(for 7C/7LC) (grease in tube. (80g))

LR Mate 200iD/7H does not have J6-axis.

CAUTION

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

- 1 Use specified grease. Use of non-approved grease may damage the reducer or lead to other problems. Do no use Harmonic grease SK-3.
- 2 To prevent slipping accidents and catching fire, completely remove any excess grease from the floor or robot.
- 3 Please fill a necessary amount to the injection syringe after softening grease in the tube massaging it by the hand when you use the grease greasing kit. Please install the nozzle in the point of the injection syringe. Please remove the nozzle and do the cap when you do not use the injection syringe.

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

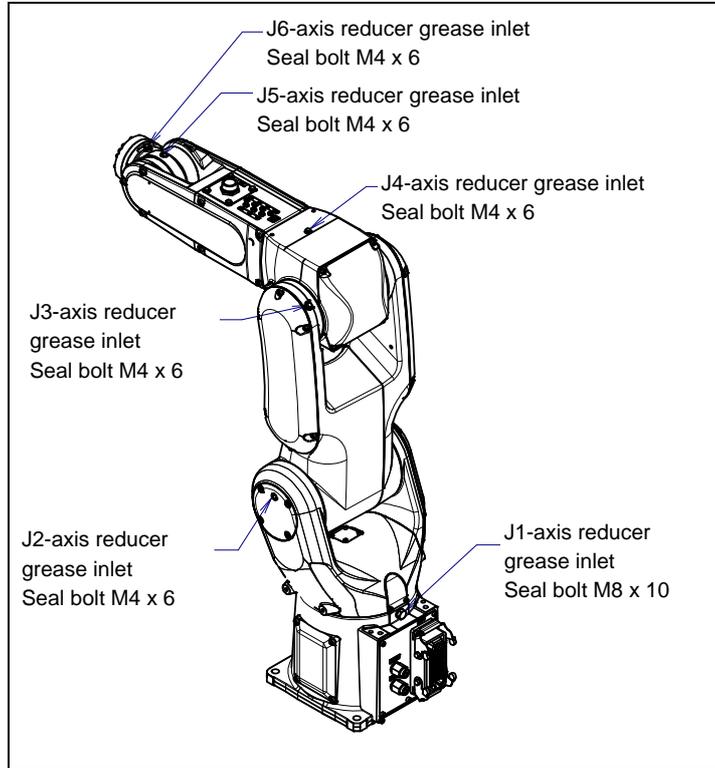


Fig. 7.3.2 Applying grease of the reducer

Table 7.3.2 (b) Spec. of seal bolts

Parts name	Specifications	Remarks
Seal bolt	A97L-0318-0410#040606EN	J2 to J6-axis grease inlet 5 pcs/1 robot
Seal bolt	A97L-0318-0410#081010S	J1-axis grease inlet

7.4 CLEANING THE ROBOT (7C/7LC)

The LR Mate 200iD/7C/7LC robot has been specially treated and materials have been used which are resistant to Alkaline cleaning solution and disinfectant solution. It is, therefore, possible to spray some cleaners directly on the robot surface so that the robot can be kept in sanitary condition by daily cleaning.

The cleaners in Table 7.4 have been proven to have no harmful effects on the robot LR Mate 200iD/7C/7LC surface. Other cleaners have to be checked in order to know the impact to the robot surface. Please contact your local FANUC representative if other cleaners are to be used.

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

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

Table 7.4 Cleaners whose harmlessness for the robot surface is confirmed

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

NOTE

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

7.5 STORAGE

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

8 MASTERING

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



CAUTION

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

8.1 OVERVIEW

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

Mastering is factory-performed. It is unnecessary to perform mastering in daily operations. However, mastering 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 die. Replace the batteries in the controller and mechanical units periodically. An alarm will alert you when battery voltage is low.

Types of Mastering

Table 8.1 describes the following mastering methods. Note that "Quick Mastering for Single Axis" is not supported in software version 7DC2 (V8.20P) or earlier.

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 count of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the fact that the absolute value of a rotation angle within one rotation will not be lost. (All axes at the same time)
Quick mastering for single axis	This is performed at a user-specified position for one axis. The corresponding count value is obtained from the rotation count of the Pulsecoder connected to the relevant motor and the rotation angle within one rotation. Quick mastering uses the fact that the absolute value of a rotation angle within one rotation will not be lost.
Single-axis mastering	This is performed for one axis at a time. The mastering position for each axis can be specified by the user. This is useful in performing mastering on a specific axis.
Mastering data entry	Mastering data is entered directly.

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

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

⚠ CAUTION

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

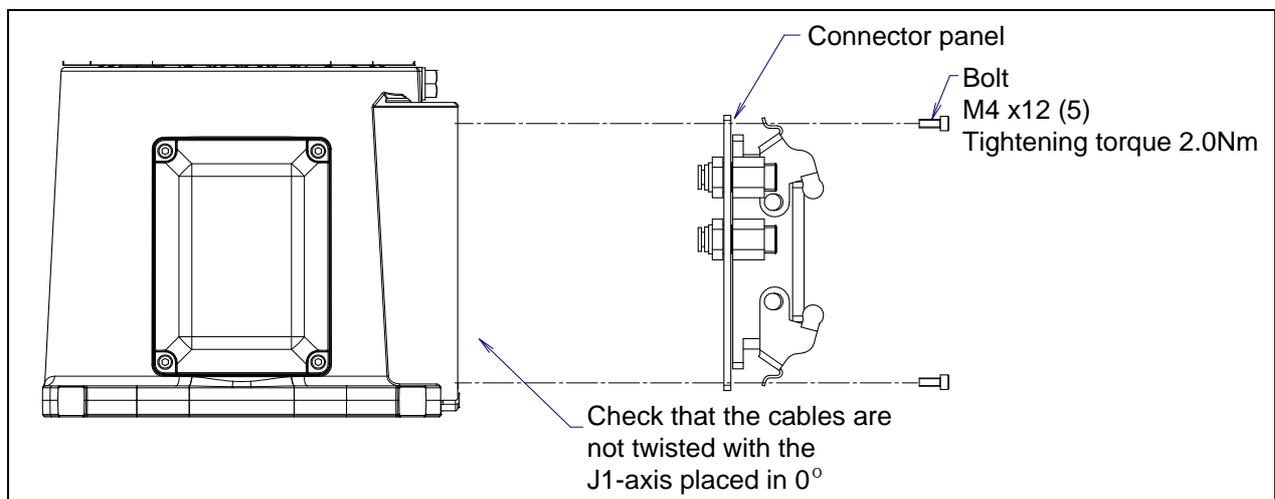


Fig. 8.1 (a) Confirming the state of cable (J1-axis)

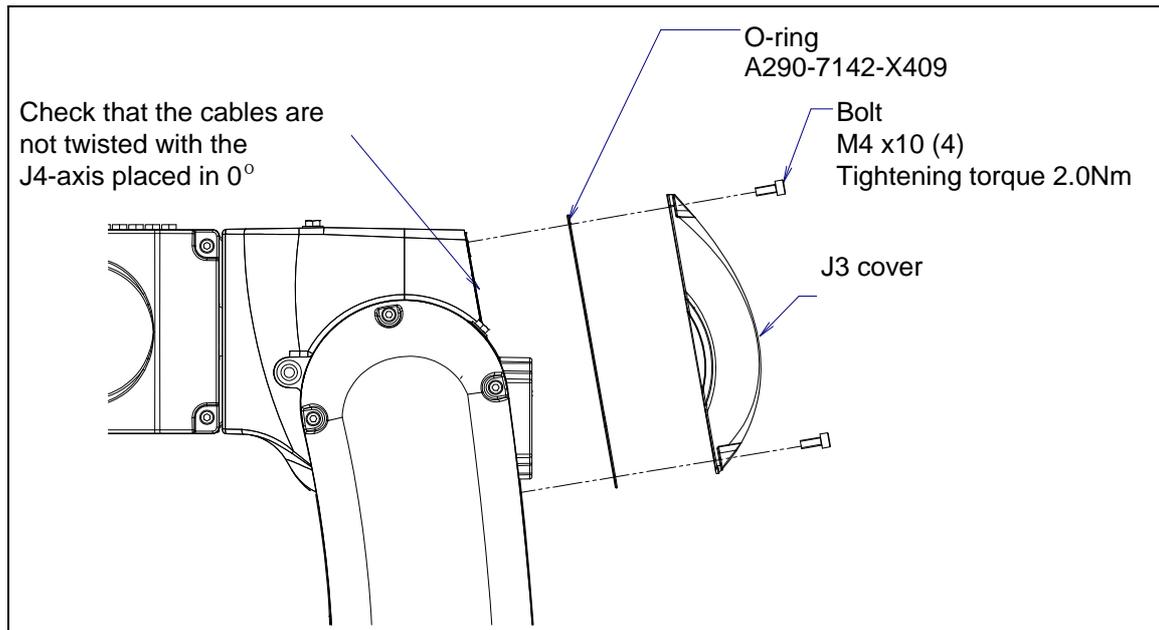


Fig. 8.1 (b) Confirming the state of cable (J4-axis)

8.2 RESETTING ALARMS AND PREPARING FOR MASTERING

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

Alarm displayed

“SRVO-062 BZAL” or “SRVO-075 Pulse not established”

Procedure

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

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

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

8.3 ZERO POSITION MASTERING

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

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

Zero-position Mastering Procedure

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE or TRUE

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

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

After changing the system variables, cycle power of the controller.

(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

- 5 Press the [MENU] key to display the screen menu.
- 6 Select [0 NEXT] and press [6 SYSTEM].
- 7 Press F1 [TYPE], display the screen change menu.
- 8 Select [Master/Cal]. The positioning screen will be displayed.

```

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

[ TYPE ]  LOAD  RES_PCA          DONE

```

- 9 Jog the robot into a posture for mastering.
- 10 Select [2 ZERO POSITION MASTER]. Press F4 [YES].

```

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

```

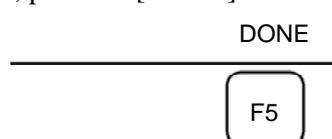
- 11 Select [7 CALIBRATE] and press F4 [YES]. Mastering will be performed automatically. Alternatively, turn off the controller power and on again. Turning on the power always causes positioning to be performed.

```

SYSTEM Master/Cal  AUTO  JOINT 10 %
                    TORQUE = [ON ]
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 QUICK MASTER FOR SINGLE AXIS
5 SINGLE AXIS MASTER
6 SET QUICK MASTER REF
7 CALIBRATE
Robot Calibrated! Cur Jnt Ang(deg):
  < 0.0000> < 0.0000> < 0.0000>
  < 0.0000> < 0.0000> < 0.0000>

```

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



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

Table 8.3 Posture with position marks aligned

Axis	Position
J1-axis	0 deg
J2-axis	0 deg
J3-axis	0 deg (When J2-axis is 0 deg.)
J4-axis	0 deg (NOTE 1) 90 deg (When J3-axis is 0 deg.) (NOTE 2)
J5-axis	0 deg
J6-axis	0 deg

(NOTE 1) Except 7H Downward wrist zero specification

(NOTE 2) 7H Downward wrist zero specification

NOTE

There is no J6-axis for LR Mate 200iD/7H.

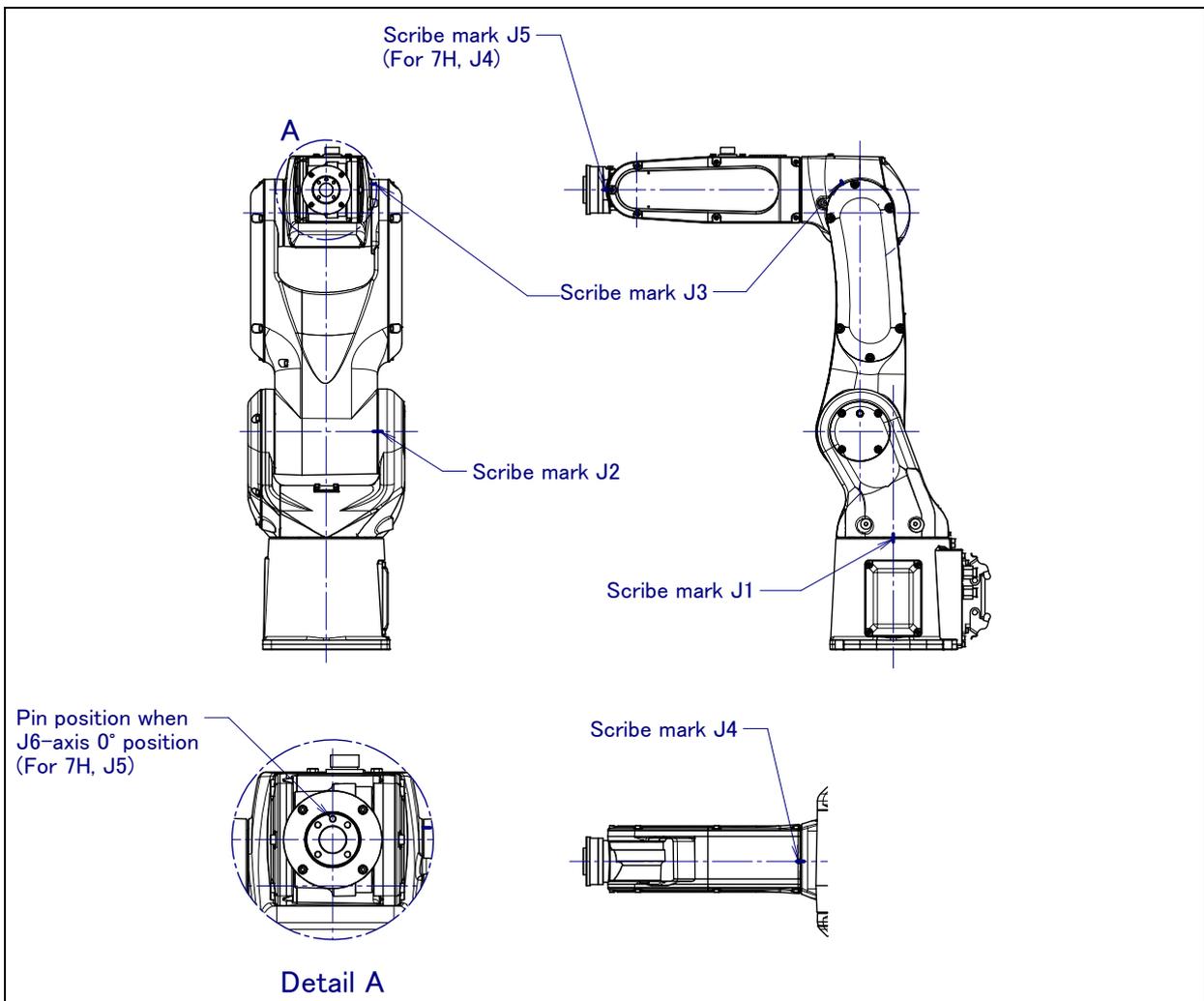


Fig. 8.3 Marking position

8.4 QUICK MASTERING

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

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

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 for Recording the Quick Mastering Reference Position

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE or TRUE

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

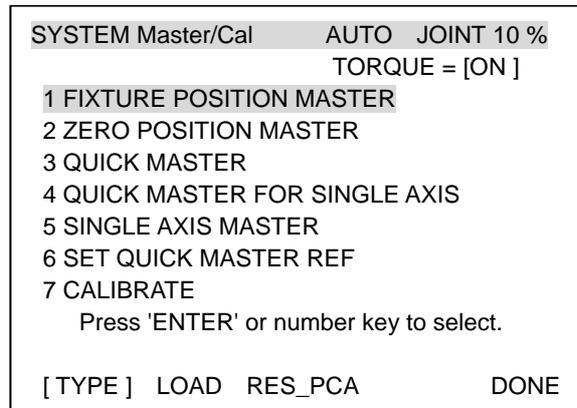
\$PARAM_GROUP.SV_OFF_ALL : FALSE

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

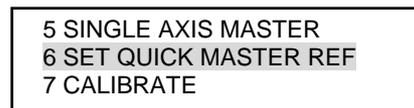
After changing the system variables, cycle power of the controller.

(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

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



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



F4

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



CAUTION

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

Procedure of Quick Mastering

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE or TRUE

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

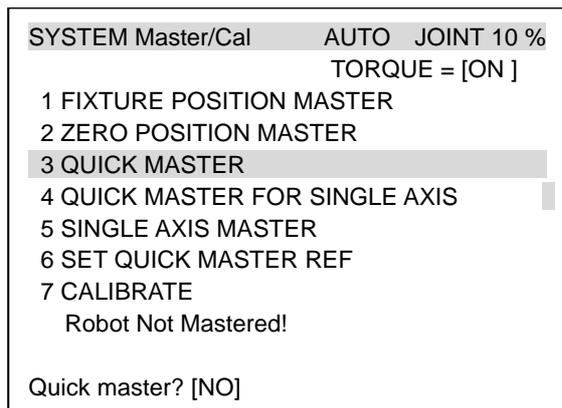
\$PARAM_GROUP.SV_OFF_ALL : FALSE

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

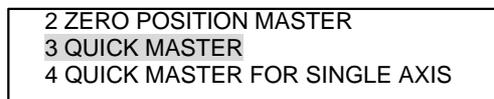
After changing the system variables, cycle power of the controller.

(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

- 5 Display the Master/Cal screen.



- 6 Jog the robot to the quick mastering reference position.
- 7 Move the cursor to [3 QUICK MASTER] and press [ENTER]. Press F4 [YES]. Quick mastering data is memorized.



F4

- 8 Move the cursor to [7 CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration can also be executed by cycling power.
- 9 After completing the calibration, press F5 Done.

DONE

F5

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

8.5 QUICK MASTERING FOR SINGLE AXIS

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

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

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

CAUTION

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

Procedure for Recording the Quick Mastering Reference Position

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE or TRUE

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

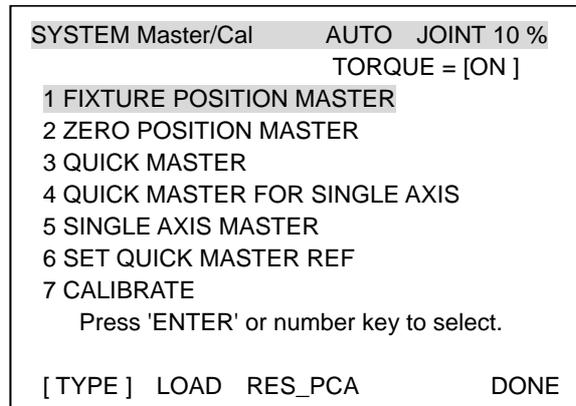
\$PARAM_GROUP.SV_OFF_ALL : FALSE

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

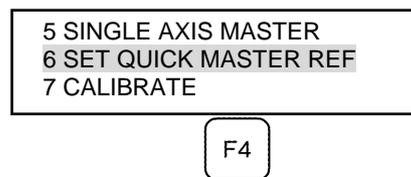
After changing the system variables, cycle power of the controller.

(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

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



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



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

**CAUTION**

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

Procedure of Quick Mastering for single axis

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE or TRUE

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

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

After changing the system variables, cycle power of the controller.

(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

- 5 Display the Master/Cal screen.

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

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

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

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

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

- 8 Jog the robot to the quick mastering reference position.
- 9 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2.
- 10 Move the cursor to [7 CALIBRATE] and press the [ENTER] key. Calibration is executed. Calibration can also be executed by cycling power.
- 11 After completing the calibration, press F5 Done.



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

8.6 SINGLE AXIS MASTERING

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

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

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

Table 8.6 Items set in single axis mastering

Item	Description
Current position (ACTUAL AXIS)	The current position of the robot is displayed for each axis in degree units.
Mastering position (MSTR POS)	A mastering position is specified for an axis to be subjected to single axis mastering. It would be convenient 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. The value of the item is reflected in \$EACHMST_DON (1 to 9). 0 :Mastering data has been lost. Single axis mastering is necessary. 1 :Mastering data has been lost. (Mastering has been performed only for the other interactive axes.) Single axis mastering is necessary. 2 :Mastering has been completed.

Procedure of Single axis mastering

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

NOTE

Gravity compensation can be set to enabled/disabled by setting the system variables as follows:

\$PARAM_GROUP[group].\$SV_DMY_LNK[8] : FALSE or TRUE

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

\$PARAM_GROUP.SV_OFF_ALL : FALSE

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

After changing the system variables, cycle power of the controller.

(Mastering can be performed without setting of gravity compensation. However, it will affect precision.)

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

```

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

[ TYPE ]  LOAD  RES_PCA          DONE

```

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

```

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

```

- 8 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.
- 9 Turn off brake control, then jog the robot to the mastering position.
- 10 Enter axis data for the mastering position.
- 11 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2 or 1.

EXEC

F5

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

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

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

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

DONE

F5

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

8.7 MASTERING DATA ENTRY

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

Mastering data entry method

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

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

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

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

- 4 Select \$DMR_GRP.

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

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

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

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

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

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

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



8.8 VERIFYING MASTERING

- 1 How to verify that the robot is mastered properly:

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

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

If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described in 2. Alternatively, the mastering data in system variable \$DMR_GRP.\$MASTER_COUN may have been overwritten as a result of an operation error or some other reason.

Compare the data with the values indicated on the supplied data sheet. This system variable is overwritten whenever mastering is performed. Whenever mastering is performed, record the value of the system variable on the data sheet.
- 2 Alarm types displayed during mastering and their solution method:
 - (1) BZAL alarm

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

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

This alarm is displayed if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is displayed, replace the battery with a new one immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
 - (3) Alarm notification like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may have trouble with Pulsecoder, contact your local FANUC representative.

9 TROUBLESHOOTING

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

9.1 TROUBLESHOOTING

Table 9.1 shows the problems that may occur in the mechanical unit and their probable causes. If you cannot pinpoint the cause of a failure or which measures to take, contact your local FANUC representative.

Table 9.1 Troubleshooting

Symptom	Description	Cause	Measure
Vibration Noise	<ul style="list-style-type: none"> - The J1 base lifts off the floor plate as the robot operates. - There is a gap between the J1 base and floor plate. - A J1 base retaining bolt is loose. 	[J1 base fastening] <ul style="list-style-type: none"> - It is likely that the robot J1 base is not securely fastened to the floor plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or foreign material caught between the robot and floor plate. - If the robot is not securely fastened to the floor plate, the J1 base lifts the floor plate as the robot operates, allowing the base and floor plates to strike each other. That, in turn, leads to vibration. 	<ul style="list-style-type: none"> - If a bolt is loose, apply LOCTITE and tighten it to the appropriate torque. - Adjust the floor plate surface flatness to within the specified tolerance. - If there is any foreign material between the J1 base and floor plate, remove it.
	<ul style="list-style-type: none"> - The rack or floor plate vibrates during operation of the robot. 	[Rack or floor] <ul style="list-style-type: none"> - It is likely that the rack or floor is not rigid enough. - If they are not rigid enough, counterforce deforms the rack or floor, and is responsible for the vibration. 	<ul style="list-style-type: none"> - Reinforce the rack or floor to make it more rigid. - If reinforcing the rack or floor is impossible, modify the robot control program; doing so might reduce the vibration.
	<ul style="list-style-type: none"> - Vibration becomes more serious when the robot adopts a specific posture. - If the operating speed of the robot is reduced, vibration stops. - Vibration is most noticeable when the robot is accelerating. - Vibration occurs when two or more axes operate at the same time. 	[Overload] <ul style="list-style-type: none"> - It is likely that the load on the robot is greater than the maximum rating. - It is likely that the robot control program is too demanding for the robot hardware. - It is likely that the ACCELERATION value is excessive. 	<ul style="list-style-type: none"> - Check the maximum load that the robot can handle once more. If the robot is found to be overloaded, reduce the load, or modify the robot control program. - Vibration in a specific portion can be reduced by modifying the robot control program while slowing the robot and reducing its acceleration (to minimize the influence on the entire cycle time).

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	<ul style="list-style-type: none"> - Vibration was first noticed after the robot collided with an object or the robot was overloaded for a long period. - The grease of the vibrating axis has not been replenished for a long period. - Cyclical vibration and noise occur. 	<p>[Gear, bearing, or reducer]</p> <ul style="list-style-type: none"> - It is likely that the collision or overload applied an excessive force to the drive mechanism, thus damaging the geartooth surface or rolling surface of a bearing, or reducer. - Prolonged overloaded use may cause fretting fatigue on the gear tooth surface or the rolling surface of bearing and reducer. - It is likely that foreign material which was caught in a gear, bearing, or within a reducer caused damage on the gear tooth surface or rolling surface of the bearing, or reducer. - It is likely that foreign material which was caught in a gear, bearing, or within a reducer cause vibration. - It is likely that, because the grease has not been supplied for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue. 	<ul style="list-style-type: none"> - Operate one axis at a time to determine which axis is vibrating. - Remove the motor, and replace the gear , the bearing, and the reducer. For the spec. of parts and the method of replacement, contact FANUC. - Using the robot within its maximum rating prevents problems with the drive mechanism. - Using the specified grease at the recommended interval will prevent problems.

Symptom	Description	Cause	Measure
Vibration Noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical unit.	<p>[Controller, cable, and motor]</p> <ul style="list-style-type: none"> - 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. - Pulse coder defect may be the cause of the vibration as the motor cannot propagate the accurate position. - If the motor becomes defective, vibration might occur because the motor cannot deliver its rated performance. - If a power line in a movable cable of the mechanical unit has an intermittent break, vibration might occur because the motor cannot accurately respond to commands. - If a Pulsecoder wire in a movable part of the mechanical unit has an intermittent break, vibration might occur because commands cannot be sent to the motor accurately. - If a robot connection cable has an intermittent break, vibration might occur. - If the power cable between them has an intermittent break, vibration might occur. - If the power source voltage drops below the rating, vibration might occur. - The robot may vibrate when the invalid value parameter was set. - If the noise occurs on a belt driving axis, damage of the bel may cause the noise. 	<ul style="list-style-type: none"> - Refer to the Controller Maintenance Manual for troubleshooting related to the controller and amplifier. - Replace the motor of the axis that is vibrating, and check whether vibration still occurs. For the method of replacement, contact your local FANUC representative. - If vibration occurs only when the robot assumes a specific posture, it is likely that there is a mechanical problem. - Check whether the cable jacket of the robot connection cable is damaged. If so, replace the connection cable, and check whether vibration still occurs. - Check whether the power cable jacket is damaged. If so, replace the power cable, and check whether vibration still occurs. - Check that the robot is supplied with the rated voltage. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct them. Contact your local FANUC representative for further information if necessary. - Contact your local FANUC representative if performing the belt check.
	- There is some relationship between the vibration of the robot and the operation of a machine near the robot.	<p>[Noise from a nearby machine]</p> <ul style="list-style-type: none"> - If the robot is not grounded properly, electrical noise may be induced on the grounding wire, preventing commands from being transferred accurately, thus leading to vibration. - If the 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. 	<ul style="list-style-type: none"> - Connect the grounding wire firmly to ensure a reliable ground potential and prevent extraneous electrical noise.

Symptom	Description	Cause	Measure
Rattling	<ul style="list-style-type: none"> - While the robot is not supplied with power, pushing it with the hand causes part of the mechanical unit to wobble. - There is a gap on the mounting face of the mechanical unit. 	<p>[Mechanical unit coupling bolt]</p> <ul style="list-style-type: none"> - It is likely that overloading or a collision has loosened a mounting bolt in the robot mechanical unit. 	<ul style="list-style-type: none"> - 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. <ul style="list-style-type: none"> - Motor retaining bolt - Reducer retaining bolt - Base retaining bolt - Arm retaining bolt - Casting retaining bolt - End effector retaining bolt
Motor overheating	<ul style="list-style-type: none"> - The motor overheated due to a rise in temperature in the installation area. - After changing the Robot control program or the load, the motor overheated. 	<p>[Ambient temperature]</p> <ul style="list-style-type: none"> - It is likely that the motor overheated when the ambient temperature rose, and could not dissipate the heat. <p>[Operating condition]</p> <ul style="list-style-type: none"> - It is likely that the overcurrent is above the specified permissive average current. 	<ul style="list-style-type: none"> - Reducing the ambient temperature is the most effective means of preventing overheating. - If there is a source of heat near the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is an effective way to reduce the average current. Thus, prevent overheating. - The teach pendant can be used to monitor the average current. Check the average current when the robot control program is running.
	<ul style="list-style-type: none"> - After a control parameter (load setting etc.) was changed, the motor overheated. 	<p>[Parameter]</p> <ul style="list-style-type: none"> - If data input for a workpiece is invalid, the robot cannot be accelerate or decelerate normally, so the average current increases, leading to the motor overheating. 	<ul style="list-style-type: none"> - As for load setting, Input an appropriate parameter referring to Section 4.3.
	<ul style="list-style-type: none"> - Symptom other than stated above 	<p>[Mechanical unit problems]</p> <ul style="list-style-type: none"> - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. <p>[Motor problems]</p> <ul style="list-style-type: none"> - It is likely that a failure of the motor brake resulted in the motor running with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor. 	<ul style="list-style-type: none"> - Repair the mechanical unit while referring to the above descriptions of vibration, noise, and rattling. - Check that, when the servo system is energized, the brake is released. If the brake remains applied to the motor all the time, replace the motor. - If the average current falls after the motor is replaced, it indicates that the first motor was faulty.

Symptom	Description	Cause	Measure
Grease leakage	<ul style="list-style-type: none"> - Grease is leaking from the mechanical unit. 	<p>[Poor sealing]</p> <ul style="list-style-type: none"> - Probable causes are a crack in the casting, a broken O-ring, a damaged oil seal, or a loose seal bolt. - A crack in a casting can occur due to excessive force that might be caused in a collision. - An O-ring can be damaged if it is pinched or cut during disassembling or re-assembling. - An oil seal might be damaged if extraneous dust scratches the lip of the oil seal. - A loose seal bolt might allow grease to leak along the threads. 	<ul style="list-style-type: none"> - If a crack develops in the casting, sealant can be used as a quick-fix to prevent further grease leakage. However, the component should be replaced as soon as possible, because the crack might extend. - O-rings are used in the locations listed below. <ul style="list-style-type: none"> - Motor coupling section - Reducer coupling section - Wrist coupling section - J3 arm coupling section - Inside the wrist - Oil seals are used in the locations stated below. <ul style="list-style-type: none"> - Inside the reducer - Inside the wrist - Seal bolts are used in the locations stated below. <ul style="list-style-type: none"> - Grease inlet and outlet
Dropping axis	<ul style="list-style-type: none"> - An axis drops because the brake does not function. - An axis drops gradually when it should be at rest. 	<p>[Brake drive relay and motor]</p> <ul style="list-style-type: none"> - It is likely that brake drive relay contacts are stuck to each other to keep the brake current flowing, thus preventing the brake from operating when the motor is deenergized. - It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently. - It is likely that oil or grease has entered the motor, causing the brake to slip. 	<ul style="list-style-type: none"> - Check whether the brake drive relays contacts are stuck to each other or not. If they are found to be stuck, replace the relays. - Replace the motor after confirming whether the following symptoms have occurred. <ul style="list-style-type: none"> - Brake shoe is worn out - Brake main body is damaged - Oil soaked through the motor

Symptom	Description	Cause	Measure
Displacement	<ul style="list-style-type: none"> - The robot moves to a point other than the taught position. - The repeatability is not within the tolerance. 	[Mechanical unit problems] <ul style="list-style-type: none"> - If the repeatability is unstable, probable causes are a failure in the drive mechanism or a loose bolt. - If the repeatability becomes stable it is likely that a collision imposed an excessive load, leading to slipping on the base surface or the mating surface of an arm or reducer. - It is likely that the Pulsecoder is faulty. 	<ul style="list-style-type: none"> - If the repeatability is unstable, repair the mechanical unit by referring to the above descriptions of vibration, noise, and rattling. - If the repeatability is stable, correct the taught program. The problem will not reoccur unless another collision occurs. - If the Pulsecoder is faulty, replace the motor.
	<ul style="list-style-type: none"> - Displacement occurs only in specific peripheral unit. 	[Peripheral unit displacement] <ul style="list-style-type: none"> - It is likely that an external force was applied to the peripheral unit, thus shifting its position relative to the robot. 	<ul style="list-style-type: none"> - Correct the setting of the peripheral unit position. - Correct the taught program.
	<ul style="list-style-type: none"> - Displacement occurred after a parameter was changed. 	[Parameter] <ul style="list-style-type: none"> - It is likely that the mastering data was rewritten in such a way that the robot origin was shifted. 	<ul style="list-style-type: none"> - Re-enter the previous mastering data, which is known to be correct. - If correct mastering data is unavailable, perform mastering again.
BZAL alarm occurred	<ul style="list-style-type: none"> - BZAL is displayed on the controller screen 	<ul style="list-style-type: none"> - It is likely that the voltage of the memory backup battery is low. - It is likely that the Pulsecoder cable is defective. 	<ul style="list-style-type: none"> - Replace the battery. - Replace the cable.

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot LR Mate 200iD, ARC Mate 50iD, LR Mate 200iD/7H/7L, ARC Mate 50iD/7L
Periodic Maintenance Table

Items		Accumulated operating time (H)	Check time	Grease amount	First check	3 months	6 months	9 months	1 year			2 years			
					320	960	1920	2880	3840	4800	5760	6720	7680	8640	9600
Mechanical unit	1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○
	2	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○
	3	Check the exposed connector.(loosening)	0.2H	—		○			○			○			
	4	Tighten the end effector bolt.	0.2H	—		○			○			○			
	5	Tighten the cover and main bolt.	2.0H	—		○			○			○			
	6	Check the mechanical stopper.	0.1H	—		○			○			○			
	7	Clean spatters, sawdust and dust	1.0H	—		○	○	○	○	○	○	○	○	○	○
	8	Check hand cable and external battery cable (option)	0.1H	—		○			○			○			
	9	Replacing battery. (if built-in batteries are specified)	0.1H	—					●			●			
		Replacing battery. (if external batteries are specified)	0.1H	—							●				
	10	Greasing the reducers.	0.5H	14ml (*1) 12ml (*2)											
11	Replacing cable of mechanical unit	4.0H	—												
Controller	12	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○			○			
	13	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	
	14	Replacing battery *3	0.1H	—											

*1 Except 7H

*2 7H

*3 Refer to the “REPLACING UNITS Chapter of “MAINTENANCE” in the following manuals.
R-30iB Mate/R-30iB Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
R-30iB Mate CONTROLLER Open Air MAINTENANCE MANUAL (B-83555EN)

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

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

FANUC Robot LR Mate 200iD/7C/7LC **Periodic Maintenance Table**

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

*1 Refer to “REPLACING UNITS Chapter of MAINTENANCE” of the following manuals.
 R-30iB Mate/R-30iB Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
 R-30iB Mate CONTROLLER Open Air MAINTENANCE MANUAL (B-83555EN)

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

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

FANUC Robot LR Mate 200iD/7WP **Periodic Maintenance Table**

Items		Accumulated operating time (H)	Check time	Grease amount	First check	3 months	6 months	9 months	1 year	4800	5760	6720	2 years	7680	8640	9600	10560	
																		320
Mechanical unit	1	Check for external damage	0.1H	—		○	○	○	○	○	○	○	○	○	○	○	○	
	3	Check the exposed connector.(loosening)	0.2H	—		○			○				○					
	4	Tighten the end effector bolt.	0.2H	—		○			○				○					
	5	Tighten the cover and main bolt.	2.0H	—		○			○				○					
	6	Check the mechanical stopper.	0.1H	—		○			○				○					
	7	Clean spatters, sawdust and dust	1.0H	—		○	○	○	○	○	○	○	○	○	○	○	○	○
	8	Check hand cable and external battery cable (option)	0.1H	—		○			○				○					
	9	Replacing battery. (if external batteries are specified)	0.1H	—								●						
	10	Greasing the reducers.	0.5H	14ml														
	11	Replacing cable of mechanical unit	4.0H	—														
	Controller	12	Check the robot cable, teach pendant cable and robot connecting cable	0.2H	—		○			○				○				
13		Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○	○	
14		Replacing battery *1	0.1H	—														

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

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

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

B STRENGTH OF BOLT AND BOLT TORQUE LIST

NOTE

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

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

Hexagon socket head bolt made of steel:

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

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

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

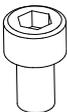
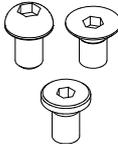
Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)

Tensile strength 400N/mm² or more

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

Recommended bolt tightening torques

Unit: Nm

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

C OPTIONAL CONNECTOR WIRING PROCEDURE

Source of information: Hirose Electric Co., Ltd.

◆ Plug – Disassembly / Assembly

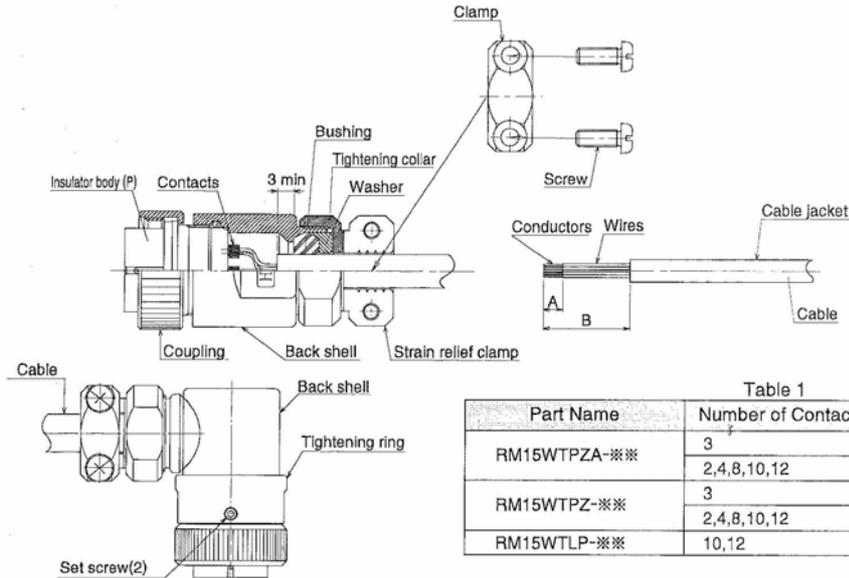


Table 1

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
RM15WTLP-※※	10,12	3mm	25mm

NOTE1
NOTE2

1.	Disassembly
	<p>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.</p> <p>② Remove the 2 screws of the strain relief clamp, and then remove the clamp from the tightening collar.</p>
2.	Wiring
	<p>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.</p>
	<p>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.</p> <p>③ Solder the wires to the contacts of the insulator body (P). Use of heat-shrink tubing or another insulating media between the soldered contacts is suggested.</p>
3.	Connector Assembly
	<p>Straight Plugs</p> <p>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.</p> <p>Right-angle Plugs</p> <p>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.</p> <p>Additional assembly recommendations: 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)</p>
4.	Waterproof verification - plug assembly
5.	Waterproof verification - plug assembly
	Precautions
	<p>① Follow the correct assembly sequence, cable preparation and tightening torques.</p> <p>② Assure that the applicable cable outer surfaces are free of scratches, oil, grease or any other contamination.</p> <p>③ Do not use excessive forces or improper tools when assembling or mounting the connectors.</p>

NOTE1) Corresponds to A05B-1137-J057.

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

D INSULATION ABOUT ARC WELDING ROBOT

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

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

D.1 INSULATION AT THE WRIST

Please be careful to the following contents.

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

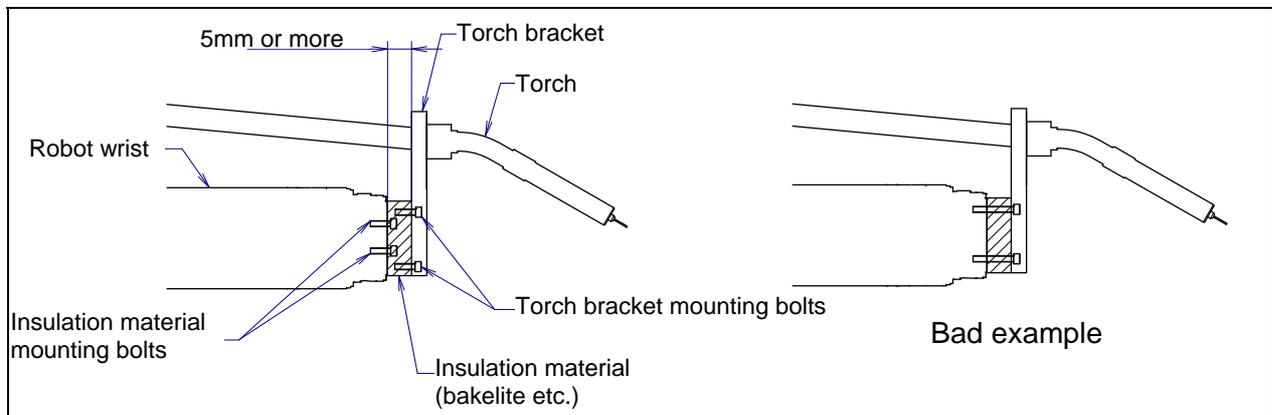


Fig. D.1 Insulation at the wrist

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

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REVISION RECORD

Edition	Date	Contents
06	Apr., 2018	<ul style="list-style-type: none"> • Correction of errors
05	Jul., 2017	<ul style="list-style-type: none"> • Addition of R-30iB Mate Plus controller • Addition of cleaning method of 7C/7LC • Correction of errors
04	Jan., 2015	<ul style="list-style-type: none"> • Addition of quick master for single axis • Correction of errors
03	Dec., 2013	<ul style="list-style-type: none"> • Addition of LR Mate 200iD/7H/7C/7WP/7LC • Addition of air purge kit • Correction of errors
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01	Dec., 2012	

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