FANUC Robot R-2000*i*C

MECHANICAL UNIT
OPERATOR'S MANUAL

B-83644EN/03

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

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

SAFETY PRECAUTIONS

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

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

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

1 DEFINITION OF USER

The personnel can be classified as follows.

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

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

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

- Operator is not allowed to work in the safety fence.
- 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.

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

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

2 DEFINITION OF SAFETY NOTATIONS

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

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

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

3 SAFETY OF THE USER

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

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

FANUC provides various training courses. Contact our sales office for details.

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

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

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

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

(9) When adjusting each peripheral equipment independently, be sure to turn off the power of the robot.
(10) Operators should be ungloved while manipulating the operator panel or teach pendant. Operation with gloved fingers could cause an operation error.
(11) Programs, system variables, and other information can be saved on memory card or USB memories. Be sure to save the data periodically in case the data is lost in an accident. (refer to Controller OPERATOR'S MANUAL.)
(12) The robot should be transported and installed by accurately following the procedures recommended by FANUC. Wrong transportation or installation may cause the robot to fall, resulting in severe injury to workers.
(13) In the first operation of the robot after installation, the operation should be restricted to low speeds. Then, the speed should be gradually increased to check the operation of the robot.
(14) Before the robot is started, it should be checked that no one is inside the safety fence. At the same time, a check must be made to ensure that there is no risk of hazardous situations. If detected, such a situation should be eliminated before the operation.
(15) When the robot is used, the following precautions should be taken. Otherwise, the robot and peripheral equipment can be adversely affected, or workers can be severely injured.
- Avoid using the robot in a flammable environment.
- Avoid using the robot in an explosive environment.
- Avoid using the robot in an environment full of radiation.
- Avoid using the robot under water or at high humidity.
- Avoid using the robot to carry a person or animal.
- Avoid using the robot as a stepladder. (Never climb up on or hang from the robot.)
- Outdoor

(16) When connecting the peripheral equipment related to stop (safety fence etc.) and each signal (external emergency, fence etc.) of robot, be sure to confirm the stop movement and do not take the wrong connection.
(17) When preparing footstep, please consider security for installation and maintenance work in high place according to Fig. 3 (c). Please consider footstep and safety belt mounting position.

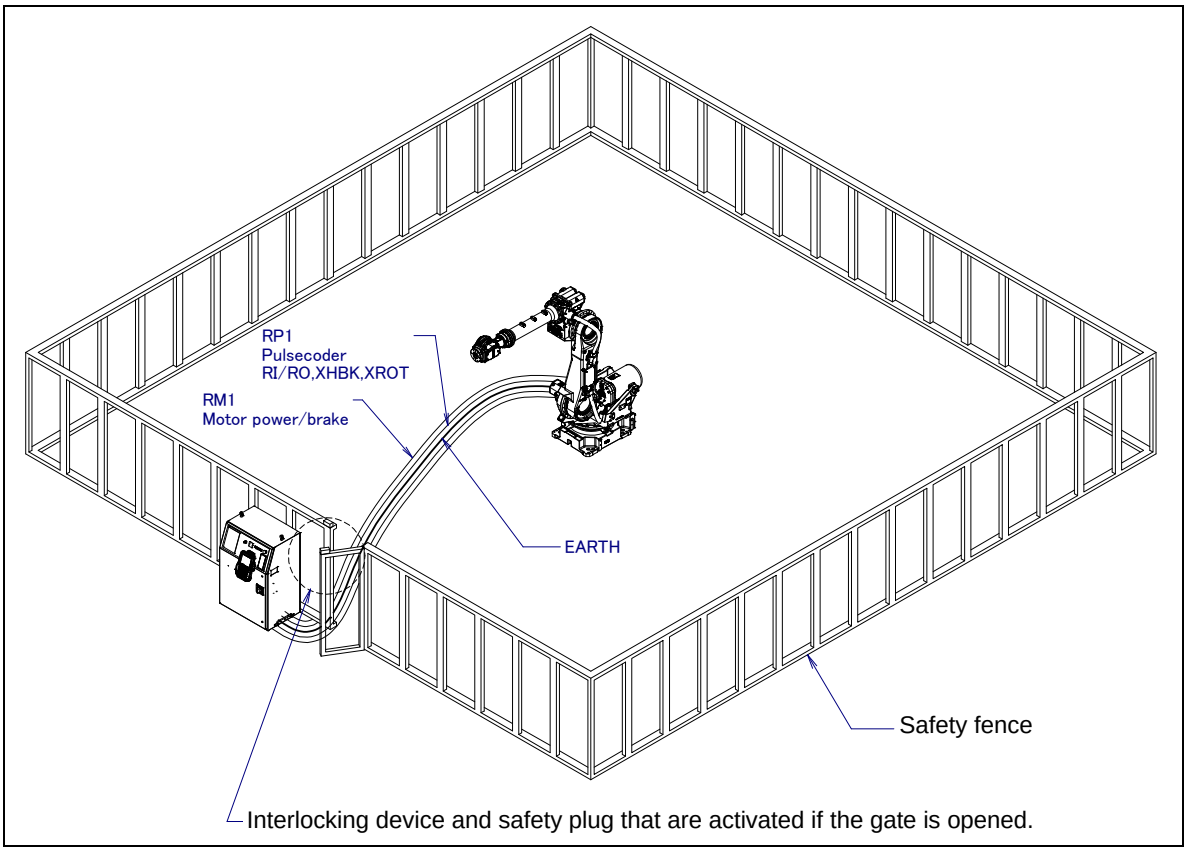


Fig. 3 (a) Safety fence and safety gate

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

> ⚠ **WARNING**
> After the door interlock switch is actuated , robot slows down and stops within 2 seconds , and then servo power is cut off. Before cutting off the servo power, never enter the safeguarded area (inside of safety fence, etc.).

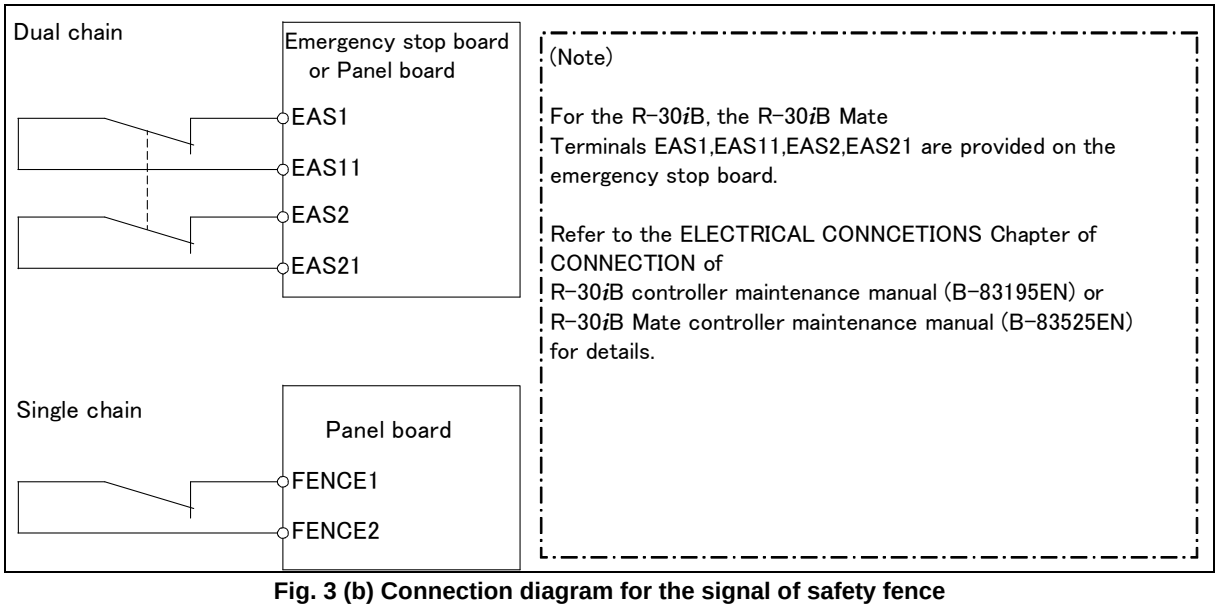


Fig. 3 (b) Connection diagram for the signal of safety fence

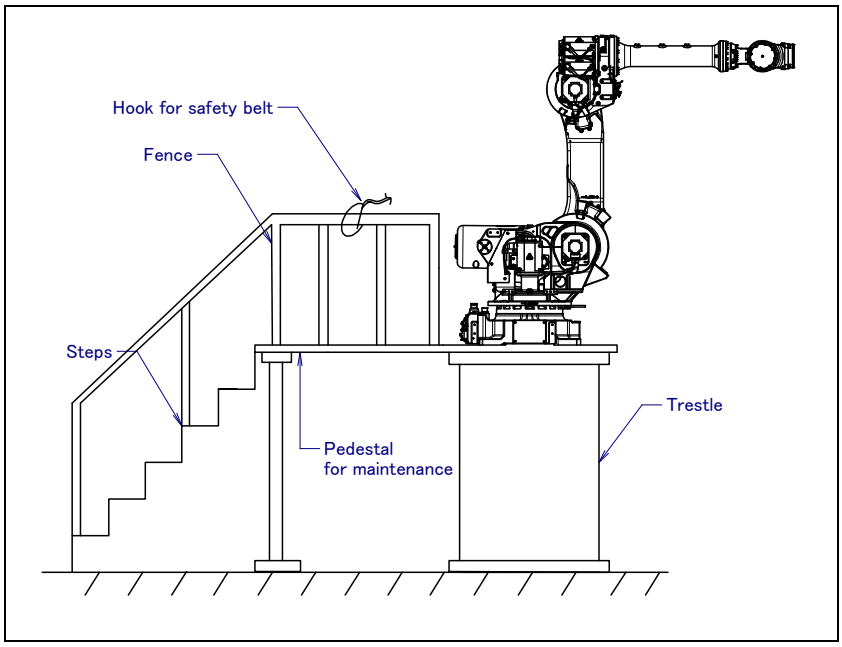


Fig. 3 (c) Pedestal for maintenance

3.1 SAFETY OF THE OPERATOR

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

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

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

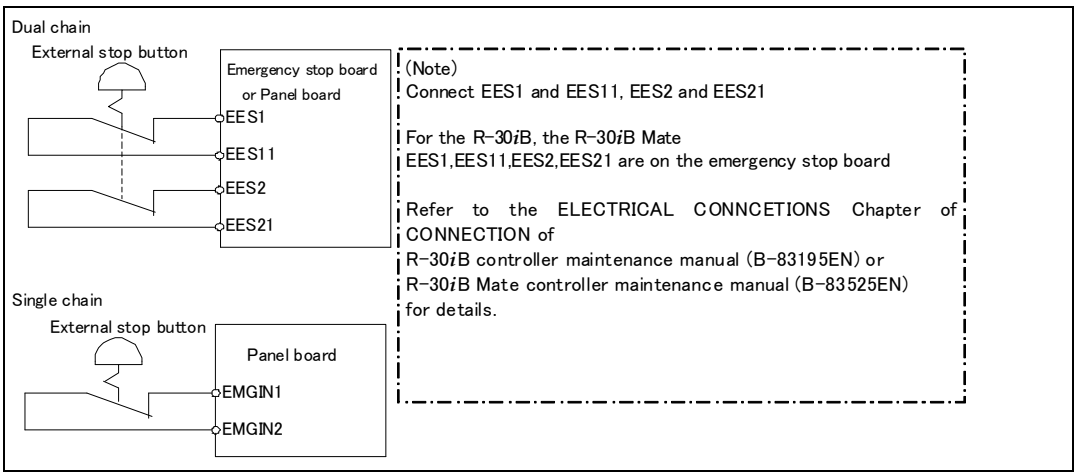


Fig. 3.1 Connection diagram for external emergency stop button

3.2 SAFETY OF THE PROGRAMMER

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

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

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

Our teach pendant is provided with a DEADMAN switch as well as an emergency stop button. These button and switch function as follows:
(1) Emergency stop button: Causes the stop of the robot (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type) when pressed.
(2) DEADMAN switch: Functions differently depending on the teach pendant enable/disable switch setting status.
   (a) Enable: Servo power is turned off when the operator releases the DEADMAN switch or when the operator presses the switch strongly.
   (b) Disable: The DEADMAN switch is disabled.
   (Note) The DEADMAN switch is provided to stop the robot when the operator releases the teach pendant or presses the pendant strongly in case of emergency. The R-30*i*B/R-30*i*B Mate employs a 3-position DEADMAN switch, which allows the robot to operate when the 3-position DEADMAN switch is pressed to its intermediate point. When the operator releases the DEADMAN switch or presses the switch strongly, the robot stops immediately.

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

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

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

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

T1, T2 mode: DEADMAN switch is effective.

(1) To start the system using the operator box or operator panel, make certain that nobody is the robot operating space area and that there are no abnormalities in the robot operating space.
(2) When a program is completed, be sure to carry out a test operation according to the following procedure.
  (a) Run the program for at least one operation cycle in the single step mode at low speed.
  (b) Run the program for at least one operation cycle in continuous operation at low speed.
  (c) Run the program for one operation cycle in continuous operation at the intermediate speed and check that no abnormalities occur due to a delay in timing.
  (d) Run the program for one operation cycle in continuous operation at the normal operating speed and check that the system operates automatically without trouble.
  (e) After checking the completeness of the program through the test operation above, execute it in the automatic operation.
(3) While operating the system in the automatic operation, the programmer should leave the safety fence.

3.3 SAFETY OF THE MAINTENANCE ENGINEER

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

(1) During operation, never enter the robot operating space.
(2) A hazardous situation may arise when the robot or the system, are kept with their power-on during maintenance operations. Therefore, for any maintenance operation, the robot and the system should be put into the power-off state. If necessary, a lock should be in place in order to prevent any other person from turning on the robot and/or the system. In case maintenance needs to be executed in the power-on state, the emergency stop button must be pressed.
(3) If it becomes necessary to enter the robot operating space while the power is on, press the emergency stop button on the operator box or operator panel, or the teach pendant before entering the range. The maintenance worker must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.
(4) When entering the area enclosed by the safety fence, the worker must check the whole robot system in order to make sure no dangerous situations exist. In case the worker needs to enter the safety area whilst a dangerous situation exists, extreme care must be taken, and whole robot system status must be carefully monitored.
(5) Before the maintenance of the pneumatic system is started, the supply pressure should be shut off and the pressure in the piping should be reduced to zero.
(6) Before the start of maintenance work, check that the robot and its peripheral equipment are all in the normal operating condition.
(7) Do not operate the robot in the automatic operation while anybody is in the robot operating space.

(8) When you maintain the robot alongside a wall or instrument, or when multiple users are working nearby, make certain that their escape path is not obstructed.
(9) When a tool is mounted on the robot, or when any movable device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.
(10) If necessary, have a user who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the user should be ready to press the EMERGENCY STOP button at any time.
(11) When replacing a part, please contact your local FANUC representative. If a wrong procedure is followed, an accident may occur, causing damage to the robot and injury to the user.
(12) When replacing or reinstalling components, take care to prevent foreign material from entering the system.
(13) When handling each unit or printed circuit board in the controller during inspection, turn off the circuit breaker to protect against electric shock.
If there are two cabinets, turn off the both circuit breaker.
(14) A part should be replaced with a part recommended by FANUC. If other parts are used, malfunction or damage would occur. Especially, a fuse that is not recommended by FANUC should not be used. Such a fuse may cause a fire.
(15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the operating space and that the robot and the peripheral equipment are not abnormal.
(16) When a motor or brake is removed, the robot arm should be supported with a crane or other equipment beforehand so that the arm would not fall during the removal.
(17) Whenever grease is spilled on the floor, it should be removed as quickly as possible to prevent dangerous falls.
(18) The following parts are heated. If a maintenance user needs to touch such a part in the heated state, the user should wear heat-resistant gloves or use other protective tools.
- Servo motor
- Inside the controller
- Reducer
- Gearbox
- Wrist unit

(19) Maintenance should be done under suitable light. Care must be taken that the light would not cause any danger.
(20) When a motor, reducer, or other heavy load is handled, a crane or other equipmenthould be used to protect maintenance workers from excessive load. Otherwise, the maintenance workers would be severely injured.
(21) The robot should not be stepped on or climbed up during maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.
(22) When performing maintenance work in high place, secure a footstep and wear safety belt.
(23) After the maintenance is completed, spilled oil or water and metal chips should be removed from the floor around the robot and within the safety fence.
(24) When a part is replaced, all bolts and other related components should put back into their original places. A careful check must be given to ensure that no components are missing or left not mounted.
(25) In case robot motion is required during maintenance, the following precautions should be taken :
- Foresee an escape route. And during the maintenance motion itself, monitor continuously the whole robot system so that your escape route will not become blocked by the robot, or by peripheral equipment.
- Always pay attention to potentially dangerous situations, and be prepared to press the emergency stop button whenever necessary.

(26) The robot should be periodically inspected. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can adversely affect the performance or service life of the robot and may cause an accident
(27) After a part is replaced, a test execution should be given for the robot according to a predetermined method. (See TESTING section of “Controller operator’s manual”.) During the test execution, the maintenance worker should work outside the safety fence.

4 SAFETY OF THE TOOLS AND PERIPHERAL EQUIPMENT

4.1 PRECAUTIONS IN PROGRAMMING

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

4.2 PRECAUTIONS FOR MECHANISM

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

(5) The frequent power-off stop for the robot during operation causes the trouble of the robot. Please avoid the system construction that power-off stop would be operated routinely. (Refer to bad case example.) Please perform power-off stop after reducing the speed of the robot and stopping it by hold stop or cycle stop when it is not urgent. (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type.)
(Bad case example)
- Whenever poor product is generated, a line stops by emergency stop and power-off of the robot is incurred.
- When alteration is necessary, safety switch is operated by opening safety fence and power-off stop is incurred for the robot during operation.
- An operator pushes the emergency stop button frequently, and a line stops.
- An area sensor or a mat switch connected to safety signal operates routinely and power-off stop is incurred for the robot.
- Power-off stop is regularly incurred due to an inappropriate setting for Dual Check Safety (DCS).

(6) Power-off stop of Robot is executed when collision detection alarm (SRVO-050) etc. occurs. Please try to avoid unnecessary power-off stops. It may cause the trouble of the robot, too. So remove the causes of the alarm.

5 SAFETY OF THE ROBOT MECHANICAL UNIT

5.1 PRECAUTIONS IN OPERATION

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

5.2 PRECAUTIONS IN PROGRAMMING

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

5.3 PRECAUTIONS FOR MECHANISMS

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

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

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

Name	Specification	
Brake release unit	A05B-2450-J350	(Input Voltage AC100-115V single-phase)
	A05B-2450-J351	(Input Voltage AC200-240V single-phase)
Robot connection cable	A05B-2450-J360 (5 m)	
	A05B-2450-J361 (10m)	
Power cable	A05B-2525-J010 (5 m)	(AC100-115V Power plug) (*)
	A05B-2525-J011 (10m)	(AC100-115V Power plug) (*)
	A05B-2450-J364 (5 m)	(AC100-115V or AC200-240V No power plug)
	A05B-2450-J365 (10m)	(AC100-115V or AC200-240V No power plug)

(*) These do not support CE marking.

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

⚠ CAUTION

Robot systems installed without adequate number of brake release units or similar means are not in compliance with EN ISO 10218-1 and the Machinery Directive and therefore cannot bear the CE marking.

⚠ WARNING

Robot arm would fall down by releasing its brake because of gravity. Especially because spring balancer is used for J2-axis, it is hard to predict J2-arm movement by the condition of Robot posture and end effecter. Therefore it is strongly recommended to take adequate measures such as hanging Robot arm by a crane before releasing a brake.

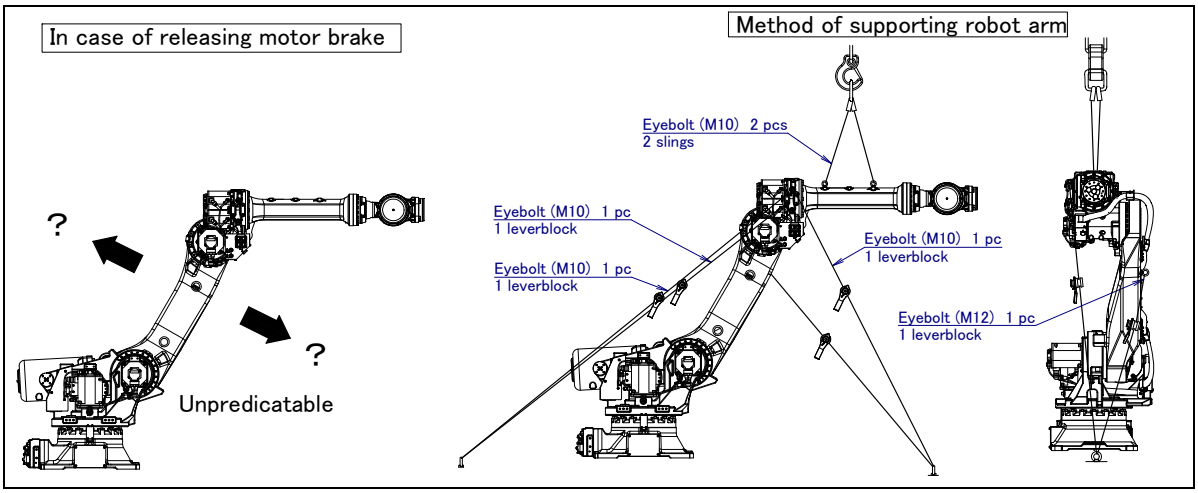


Fig. 5.4 (a) Arm operation by the release of J2-axis motor brake and measures

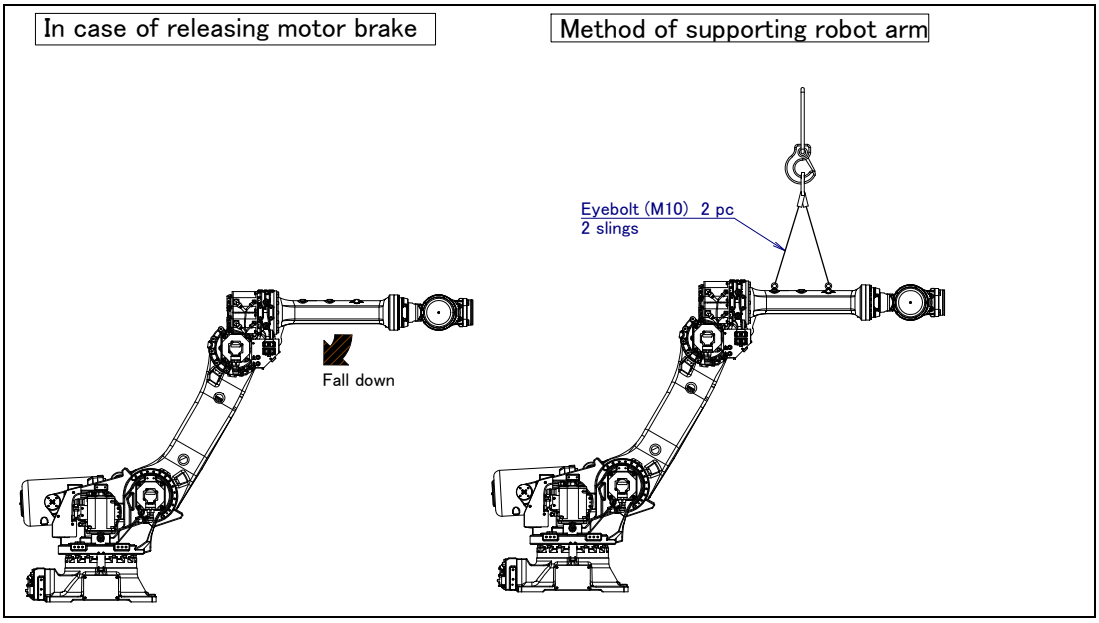


Fig. 5.4 (b) Arm operation by the release of J3-axis motor brake and measures

6 SAFETY OF THE END EFFECTOR

6.1 PRECAUTIONS IN PROGRAMMING

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

7 STOP TYPE OF ROBOT

The following three robot stop types exist:

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

Servo power is turned off and the robot stops immediately. Servo power is turned off when the robot is moving, and the path of the deceleration is uncontrolled.
The following processing is performed at Power-Off stop.
- An alarm is generated and servo power is turned off.
- The robot operation is stopped immediately. Execution of the program is paused.

Frequent Power-Off stop of the robot during operation can cause failures of the robot.
Avoid system designs that require routine or frequent Power-Off stop conditions.

Controlled stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.
The following processing is performed at Controlled stop.
- The alarm "SRVO-199 Controlled stop" occurs along with a decelerated stop. Execution of the program is paused.
- An alarm is generated and servo power is turned off.

Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.
The following processing is performed at Hold.
- The robot operation is decelerated until it stops. Execution of the program is paused.

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

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

There are the following 3 Stop patterns.

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

P-Stop: Power-Off stop
C-Stop: Controlled stop
-: Disable

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

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

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

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

"Controlled stop by E-Stop" option

When "Controlled stop by E-Stop" (A05B-2600-J570) option is specified, the stop type of the following alarms becomes
Controlled stop but only in AUTO mode. In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

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

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

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

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

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

8 WARNING & CAUTION LABEL

(1) Greasing and degreasing label

Fig. 8 (a) Greasing and degreasing label

Description

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

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

> ⚠ **CAUTION**
> See Chapter 7 ″CHECKS AND MAINTENANCE″ for explanations about specified grease, the grease amount, and the locations of grease and degrease outlets for individual models.

(2) Disassembly prohibitive label

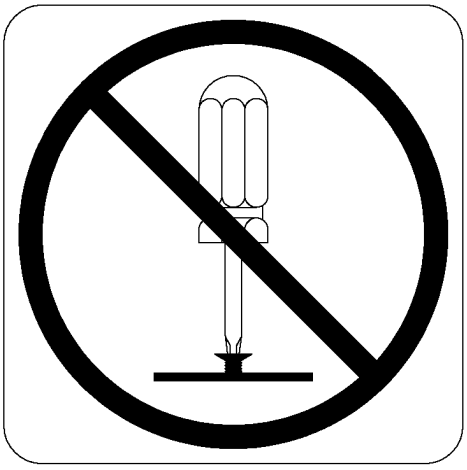


Fig. 8 (b) Disassembly prohibitive label

Description

Do not disassemble the balancer unit because it contains a spring, which may cause serious danger (for the R-2000*i*C, a disassembly prohibitive label is affixed only to the balancer).

(3) Step-on prohibitive label

Fig. 8 (c) Step-on prohibitive label

Description

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

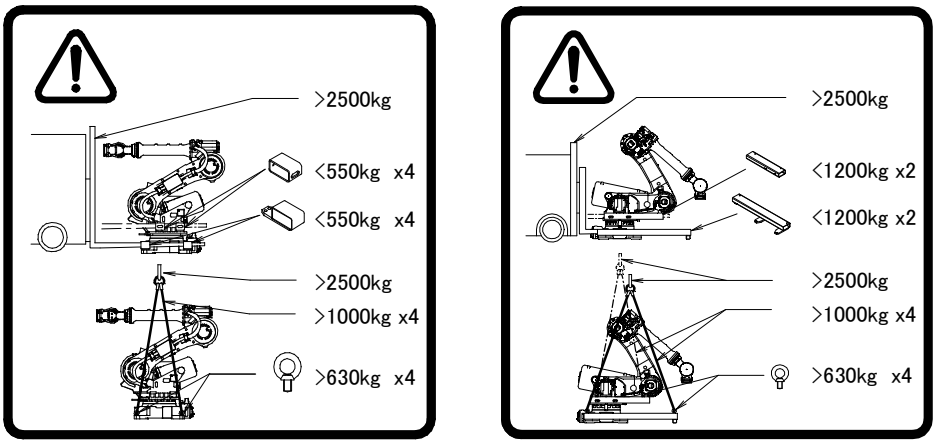
(4) High-temperature warning label

Fig. 8 (d) High-temperature warning label

Description

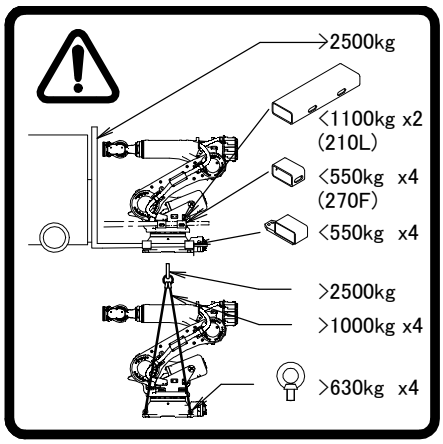
Be cautious about a section where this label is affixed, as the section generates heat. If you have to inevitably touch such a section when it is hot, use a protective provision such as heat-resistant gloves.

(5) Transportation label



R-2000*i*C/165F/210F/125L **R-2000*i*C/165R/210R**

Fig. 8 (e) Transportation label



R-2000*i*C/270F/210L

Fig. 8 (f) Transportation label

Description

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

1) Using a forklift

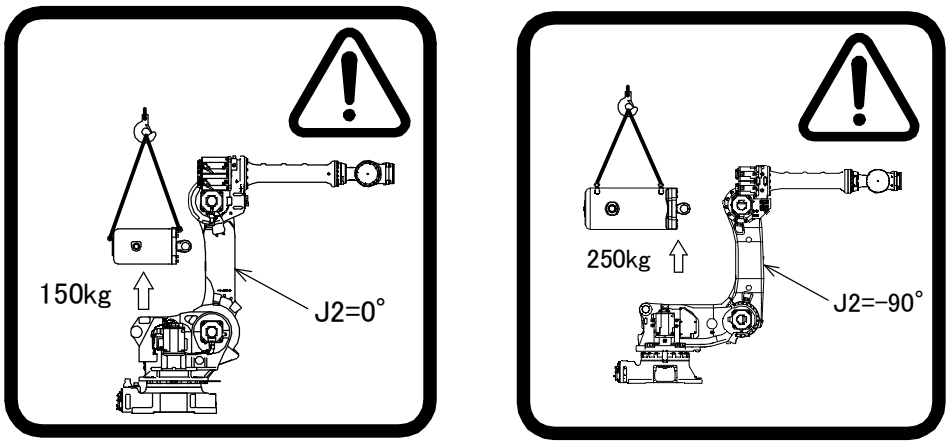
- Use a forklift having a load capacity of 2500 kg or greater.
- In case of R-2000*i*C/165F/210F/125L/270F, keep the total weight of the robot to be transported to within 2200 kg, because the load capacity of the forklift bracket (option) is 5390 N (550 kgf).
- In case of R-2000*i*C/165R/210R, keep the total weight of the robot to be transported to within 2400 kg, because the load capacity of the forklift bracket (option) is 11760 N (1200 kgf).
- In case of R-2000*i*C/210L, keep the total weight of the robot to be transported to within 2200 kg, because the load capacity of the forklift bracket (option) is 10780 N (1100 kgf).

2) Using a crane

- Use a crane with a load capacity of 2500 kg or greater.
- Use four slings each with each load capacity of 9800 N (1000 kgf) or greater.
- Use at least four eyebolts with each load capacity of 6174 N (630 kgf) or greater.

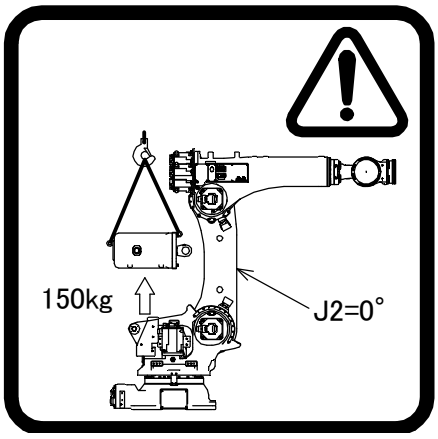
> ⚠ **CAUTION**
> Transportation labels are model-specific. Before transporting the robot, see the transportation label affixed to the J2 arm side.
> See Subsection 1.1 TRANSPORTATION for explanations about the posture a specific model should take when it is transported.

(6) Balancer replacement label



R-2000*i*C/165F/210F/125L **R-2000*i*C/165R/210R**

Fig. 8 (g) Balancer replacement label



R-2000*i*C/270F/210L

Fig. 8 (h) Balancer replacement label

Description

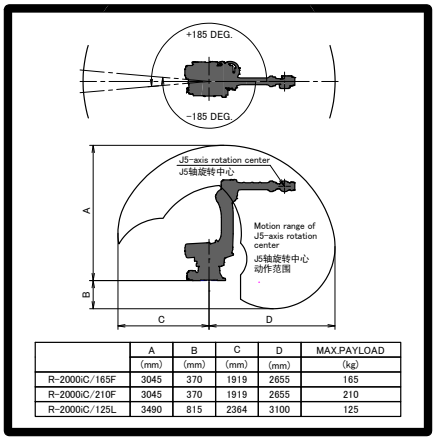
When replacing the balancer, observe the instructions indicated on this label.
The above balancer replacement label indicates the following:

- While replacing the balancer for R-2000*i*C/165F/210F/125L/270F/210L keep the J2-axis at 0°.
- While replacing the balancer for R-2000*i*C/165R/210R keep the J2-axis at -90°.
- The mass of the balancer for R-2000*i*C/165F/210F/125L/270F/210L is 150 kg.
- The mass of the balancer for R-2000*i*C/165R/210R is 250 kg.

> ⚠ **CAUTION**
> For information about balancer replacement, contact your local FANUC representatives.

(7) Operating space and payload capacity label

In the case of CE specification, the following label is added:



	A (mm)	B (mm)	C (mm)	D (mm)	MAX.PAYLOAD (kg)
R-2000iC/165F	3045	370	1919	2655	165
R-2000iC/210F	3045	370	1919	2655	210
R-2000iC/125L	3490	815	2364	3100	125

Fig. 8 (i) Operating space and payload label (Example of R-2000*i*C/165F/210F/125L)

(8) Transportation prohibitive label

Fig. 8 (j) Transportation prohibitive label (for eyebolt option)

Description

Do not pull eyebolts sideways when transporting the robot.

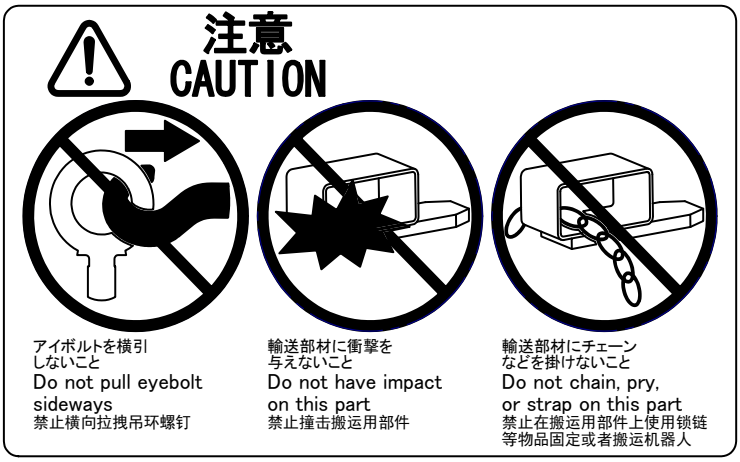


Fig. 8 (k) Transportation prohibitive label
(Example of transport equipment option)

Description

Keep the following in mind when transporting the robot.

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

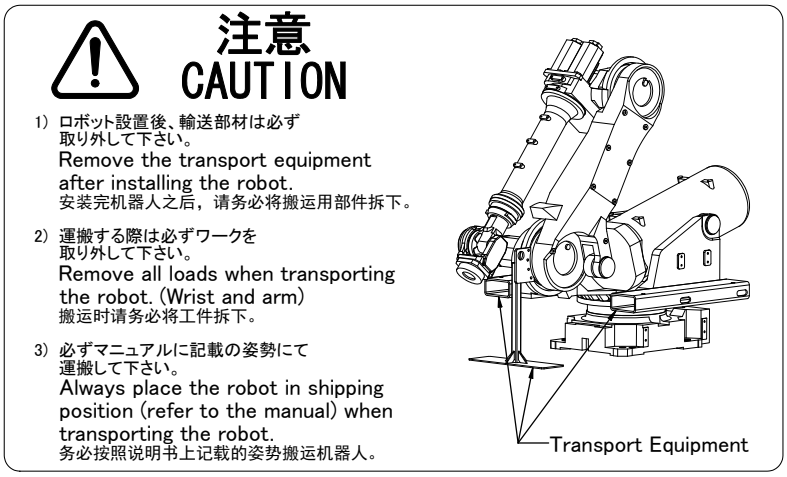


Fig. 8 (l) Transportation prohibitive label
(for transport equipment option of R-2000*i*C/165R/210R J2 base type)

Description

1) Remove the transport equipment after installing the robot.
2) Remove all loads when transporting the robot. (Wrist and arm)
3) Always place the robot in shipping position (refer to the manual) when transporting the robot.

(9) Mastering caution label

Fig. 8 (m) Mastering caution label

Description

Keep the following in mind when performing the mastering. The motion limits are temporarily invalid during mastering. Cables may be damaged if the J1-axis exceeds +/-185^{O}.

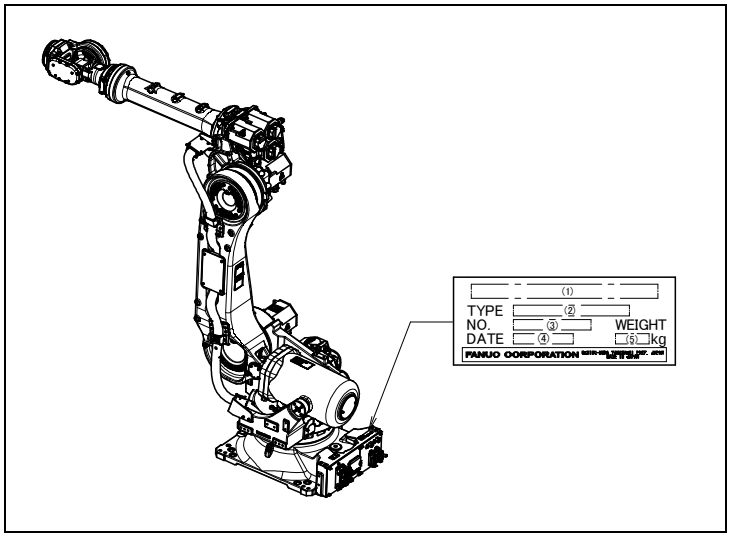
160203

PREFACE

This manual explains about the operation procedures for the following robot mechanical units:

Model name	Mechanical unit specification No.	Max. payload
FANUC Robot R-2000*i*C/165F	A05B-1333-B201	165kg
FANUC Robot R-2000*i*C/210F	A05B-1333-B205	210kg
FANUC Robot R-2000*i*C/125L	A05B-1333-B261	125kg
FANUC Robot R-2000*i*C/165R	A05B-1334-B201	165kg
FANUC Robot R-2000*i*C/210R	A05B-1334-B205	210kg
FANUC Robot R-2000*i*C/270F	A05B-1337-B201	270kg
FANUC Robot R-2000*i*C/210L	A05B-1337-B261	210kg

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



Position of label indicating mechanical unit specification number

TABLE 1

	(1)	(2)	(3)	(4)	(5)
CONTENTS	**MODEL NAME**	**TYPE**	**No.**	**DATE**	**WEIGHT kg (Without controller)**
LETTERS	FANUC Robot R-2000*i*C/165F	A05B-1333-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	1090
	FANUC Robot R-2000*i*C/210F	A05B-1333-B205			1090
	FANUC Robot R-2000*i*C/125L	A05B-1333-B261			1115
	FANUC Robot R-2000*i*C/165R	A05B-1334-B201			1370
	FANUC Robot R-2000*i*C/210R	A05B-1334-B205			1370
	FANUC Robot R-2000*i*C/270F	A05B-1337-B201			1320
	FANUC Robot R-2000*i*C/210L	A05B-1337-B261			1350

RELATED MANUALS

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

SAFETY HANDBOOK B-80687EN All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook		Intended readers : Operator, System designer Topics : Safety items for robot system design, Operation, Maintenance
R-30*i*B, R-30*i*B Mate controller	OPERATOR'S MANUAL (Basic Operation) **B-83284EN** OPERATOR'S MANUAL (Alarm Code List) **B-83284EN-1** Optional Function OPERATOR'S MANUAL **B-83284EN-2** Spot Welding Function OPERATOR'S MANUAL **B-83284EN-4** Dispense Function OPERATOR'S MANUAL **B-83284EN-5** Servo Gun Function OPERATOR'S MANUAL **B-83264EN**	Intended readers : Operator, Programmer, Maintenance engineer, System designer Topics : Robot functions, Operations, Programming, Start-up, Interfaces, Alarms Use : Robot operation, Teaching, System design
	MAINTENANCE MANUAL **R-30*i*B : B-83195EN** **R-30*i*B Mate : B-83525EN**	Intended readers : Maintenance 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

TABLE OF CONTENTS

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

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

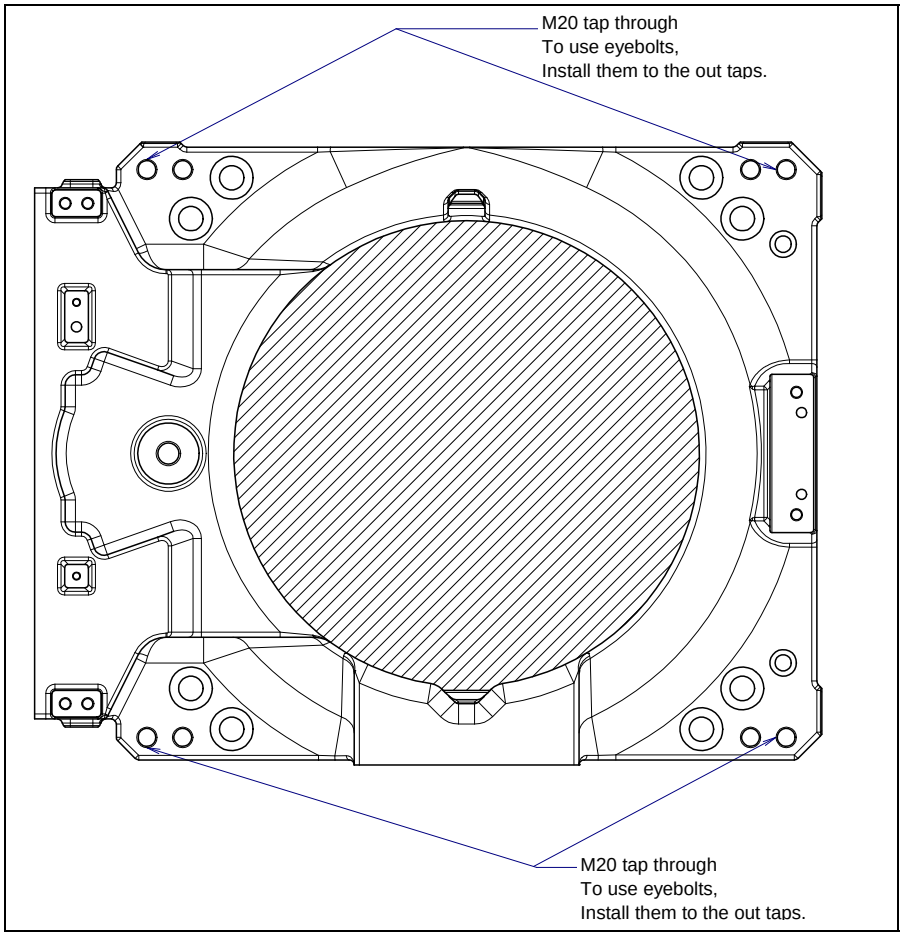


Fig. 1.1 (a) Position of the eyebolts and transportation equipment

(1) Transportation using a crane (Fig. 1.1 (b) to (e))
Fasten the M20 eyebolts at the four points and lift the robot by the four slings.

⚠ CAUTION
When lifting the robot, be careful not to damage motors, connectors, or cables of the robot by slings.

(2) Transportation using a forklift (Fig. 1.1 (f) to (k))
The robot is transported with the specific transport equipment attached.
There are two types of transport equipment: one to be attached to the J1 base and the other to the J2 base. Transport equipment are prepared as an option.

⚠ WARNING
When hoisting or lowering the robot with a crane or forklift, move it slowly with great care. When placing the robot on the floor, exercise care to prevent the installation surface of the robot from striking the floor strongly.

⚠ WARNING
Detach the end effectors and the floor plate before transporting the robot. If the robot need to be transported with the floor plate or end effectors attached, take the following precautions:
- The entire position of center of gravity is changed by installing the end effector and the floor plate. Please note the balance enough.
- The end effector swings by the vibration when transported, and there is a possibility that an excessive load acts on the robot. Secure the end effector firmly according to Subsection 1.1.1.
- When you lift robot with the floor plate installed, please lift up not the robot but the floor plate.

⚠ WARNING
Use the forklift transport equipment only to transport the robot with a forklift. Do not use the forklift transport equipment to secure the robot.
Before moving the robot by using transport equipment, check the bolts on the transport equipment and tighten any loose bolts if any.
When J1/J2-axis motor covers (option) are installed, be sure to remove them before transporting robot with a crane.

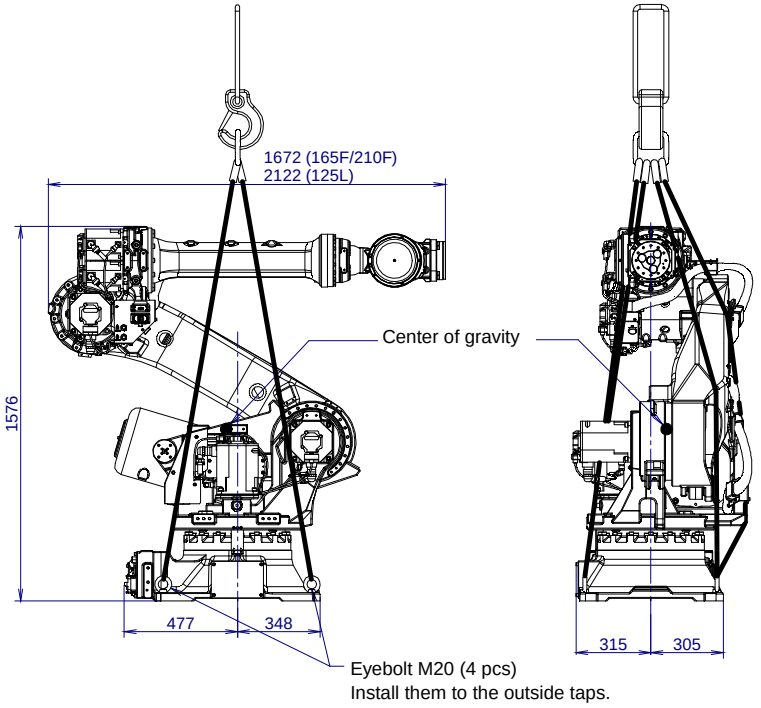
NOTE
1 If the transport equipment of the J2 base type for the R-2000*i*C/165R/210R are used with a crane or forklift to hoist or lower the robot in the state where the robot is tilted, all load may be imposed on the strut bar used to protect against falling, thus deforming the strut bar. When you operate a crane or fork lift, please confirm whether the robot is the horizontal enough.
2 Please be sure to remove the strut bar after fixing the robot J1 base with bolts.

Note)
1 Machine mass
R-2000*i*C/165F/210F : 1090 kg
R-2000*i*C/125L : 1115 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs
Crane
Capacity min.: 2.5 ton

Sling
Capacity min. : 1.0 ton/sling

Robot posture on transportation

J1	0º or ±180º
J2	-60º
J3	0º
J4	0º
J5	0º
J6	0º



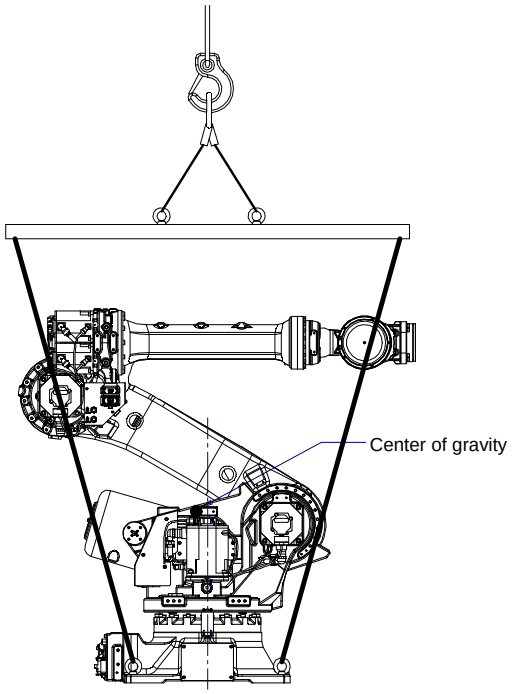


Fig. 1.1 (b) Transportation using a crane (R-2000*i*C/165F/210F/125L)

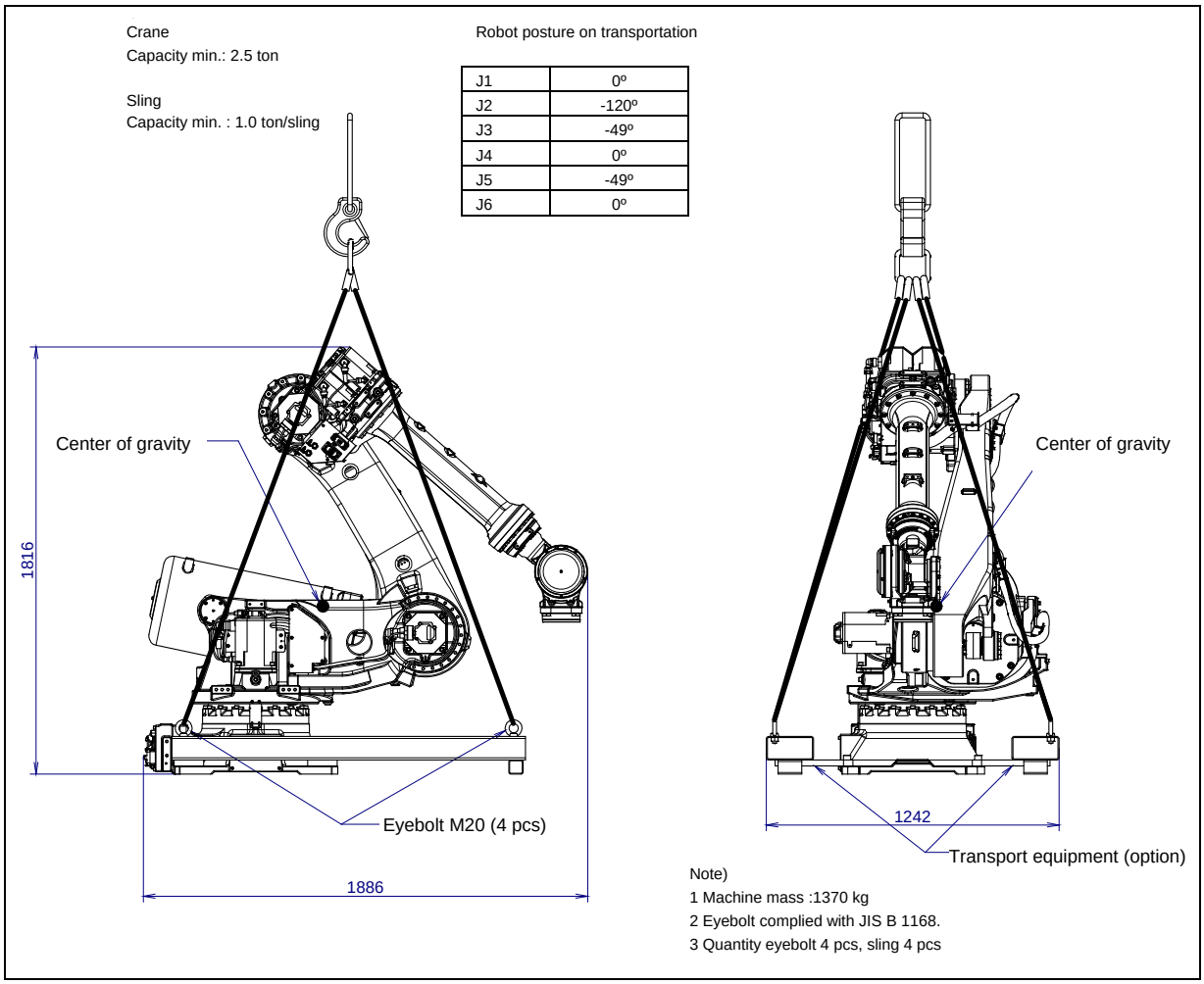


Fig. 1.1 (c) Transportation using a crane (R-2000*i*C/165R/210R J1 base type)

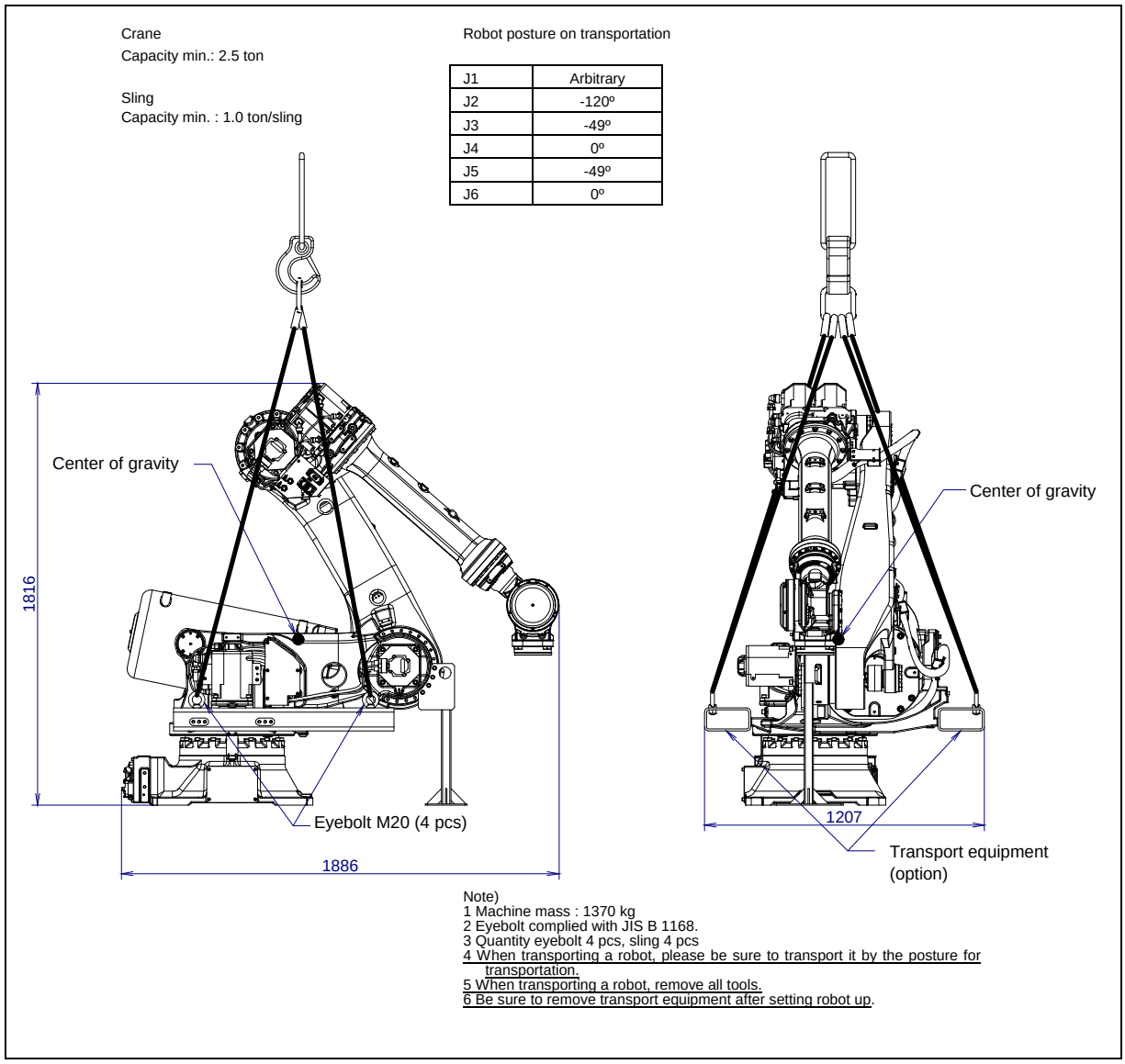


Fig. 1.1 (d) Transportation using a crane (R-2000*i*C/165R/210R J2 base type)

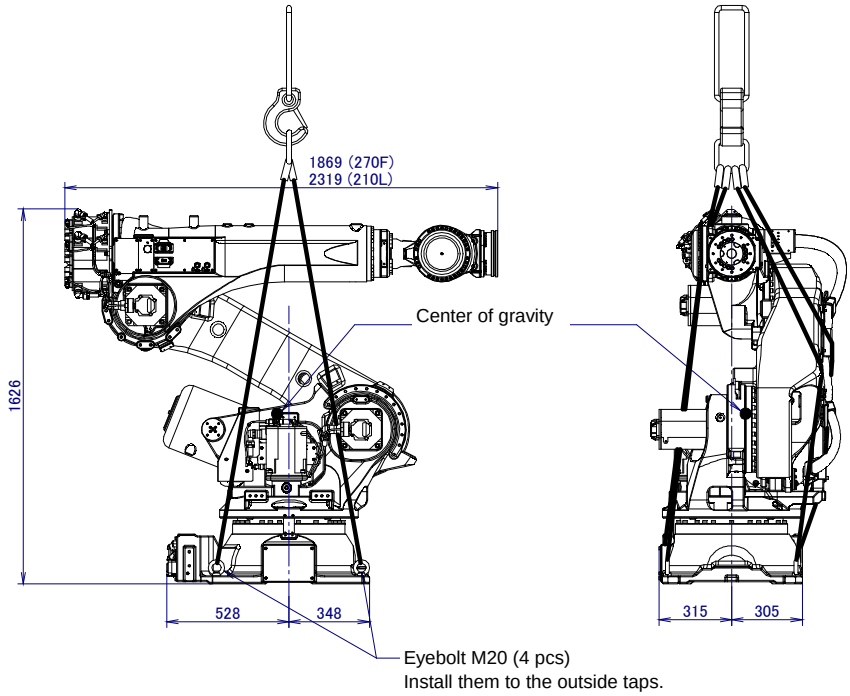
Crane
Capacity min.: 2.5 ton

Sling
Capacity min. : 1.0 ton/sling

Note)
1 Machine mass
R-2000*i*C/270F : 1320 kg
R-2000*i*C/210L : 1350 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs

Robot posture on transportation

J1	0º or ±180º
J2	-60º
J3	0º
J4	0º
J5	0º
J6	0º



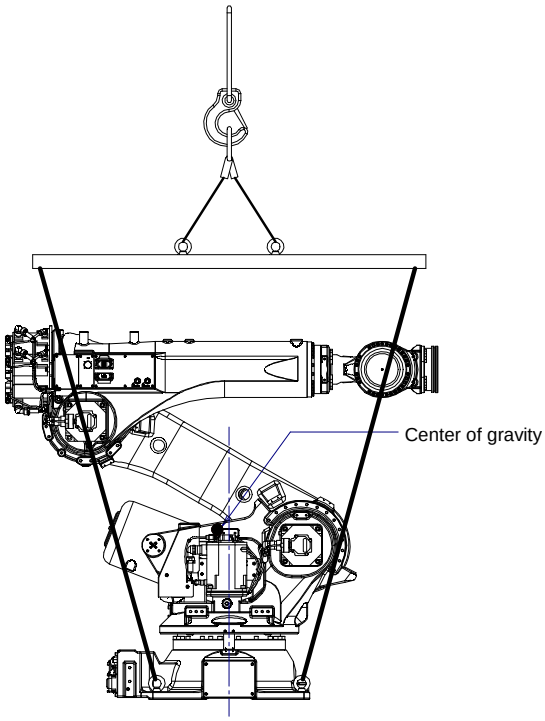


Fig. 1.1 (e) Transportation using a crane (R-2000*i*C/270F/210L)

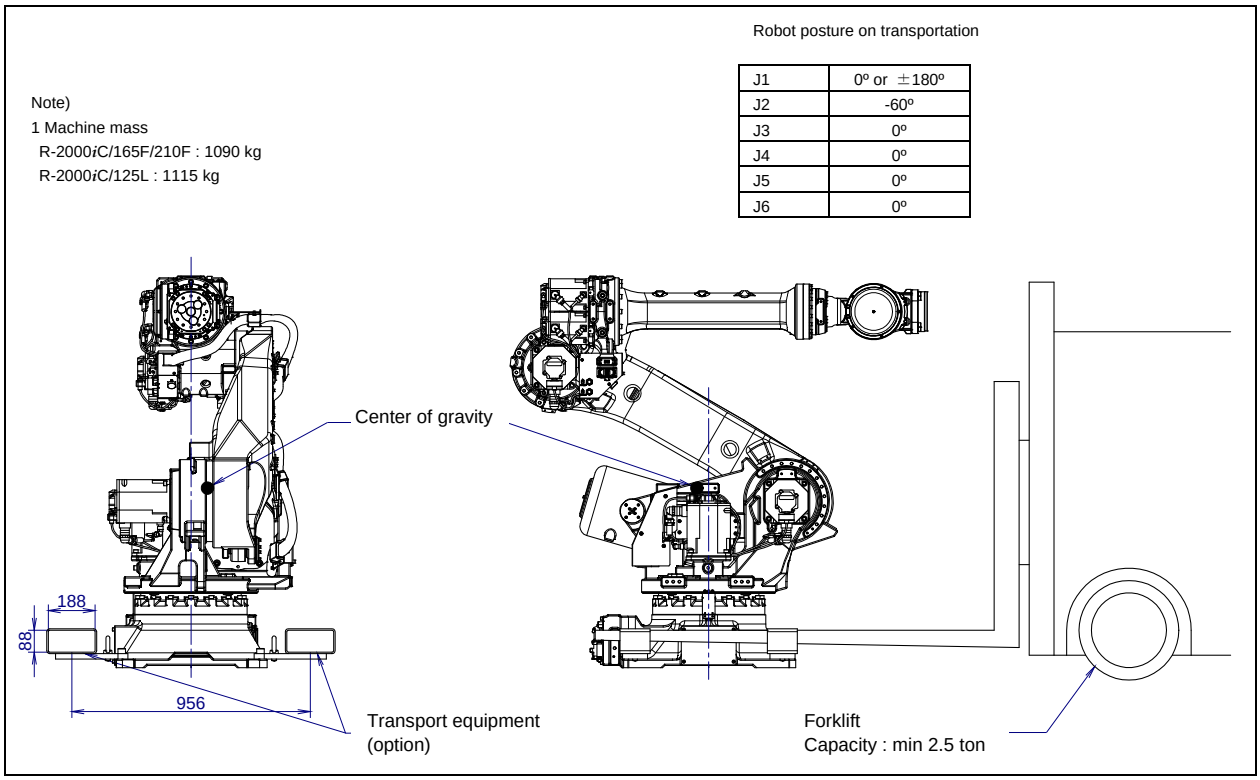


Fig. 1.1 (f) Transportation using a forklift (R-2000*i*C/165F/210F/125L J1 base type)

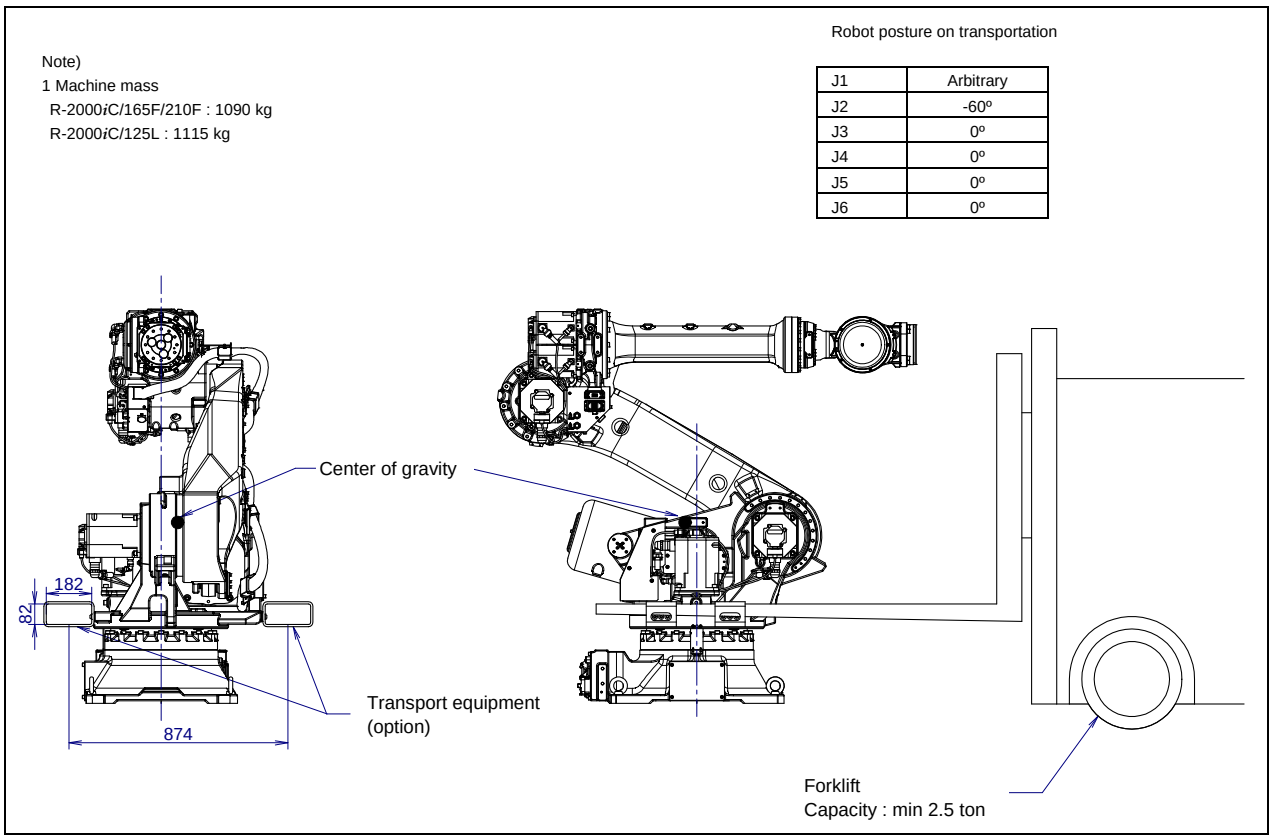


Fig. 1.1 (g) Transportation using a forklift (R-2000*i*C/165F/210F/125L J2 base type)

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

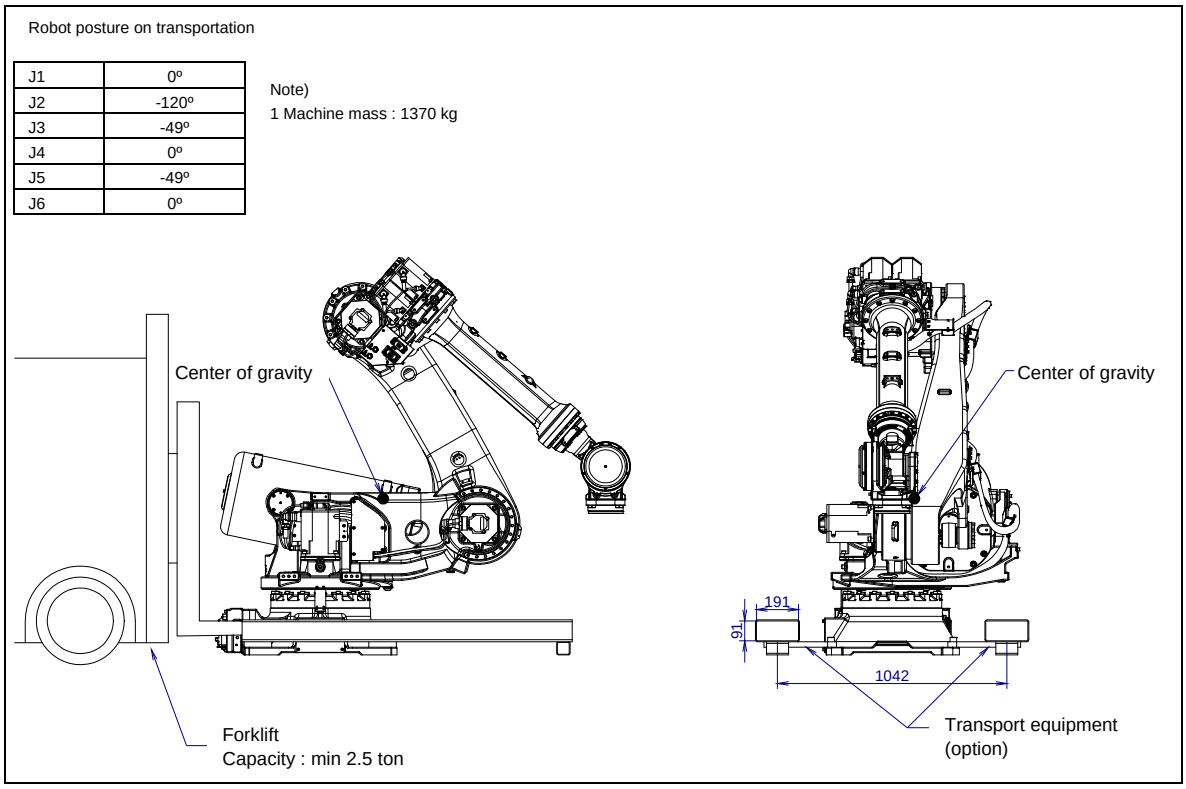


Fig. 1.1 (h) Transportation using a forklift (R-2000*i*C/165R/210R J1 base type)

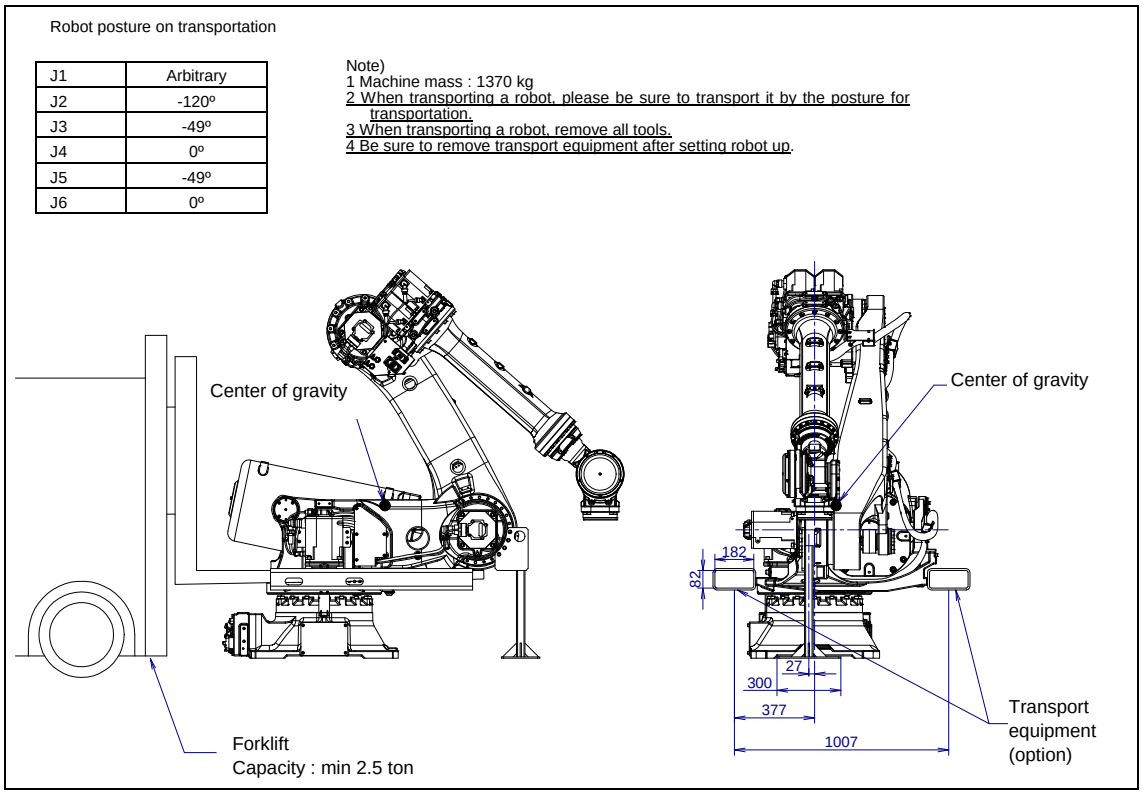


Fig. 1.1 (i) Transportation using a forklift (R-2000*i*C/165R/210R J2 base type)

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

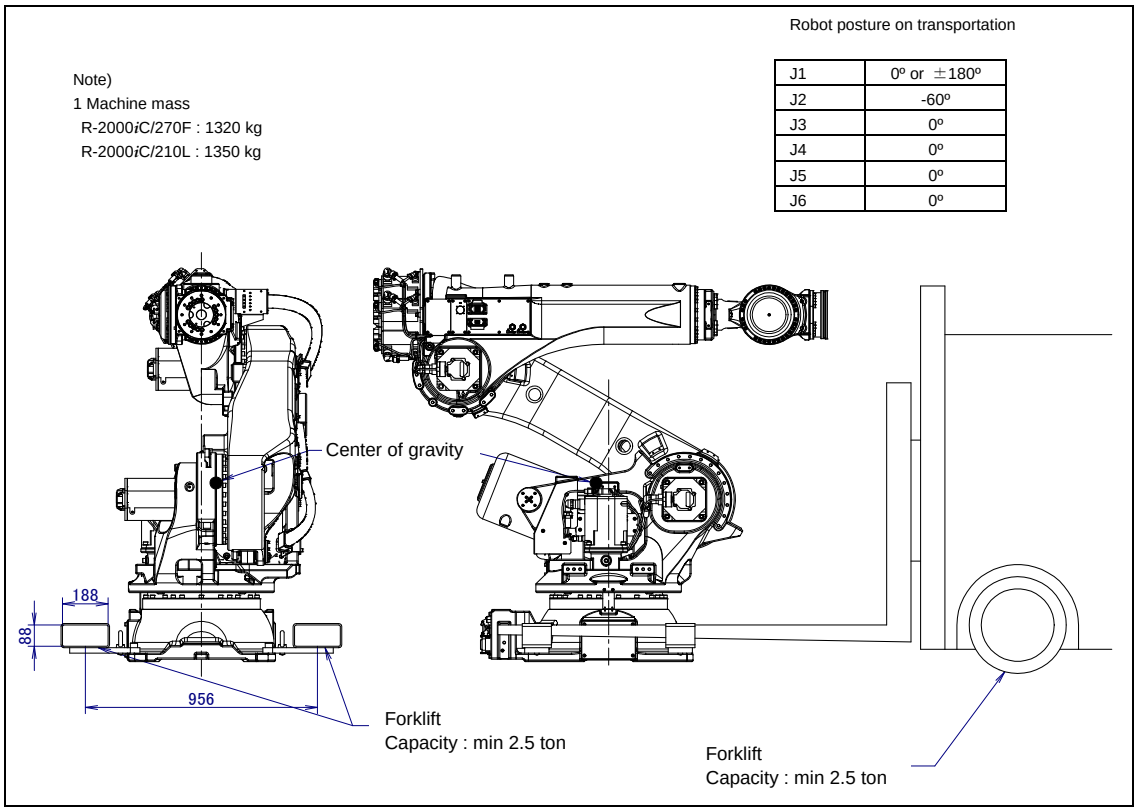


Fig. 1.1 (j) Transportation using a forklift (R-2000*i*C/270F/210L J1 base type)

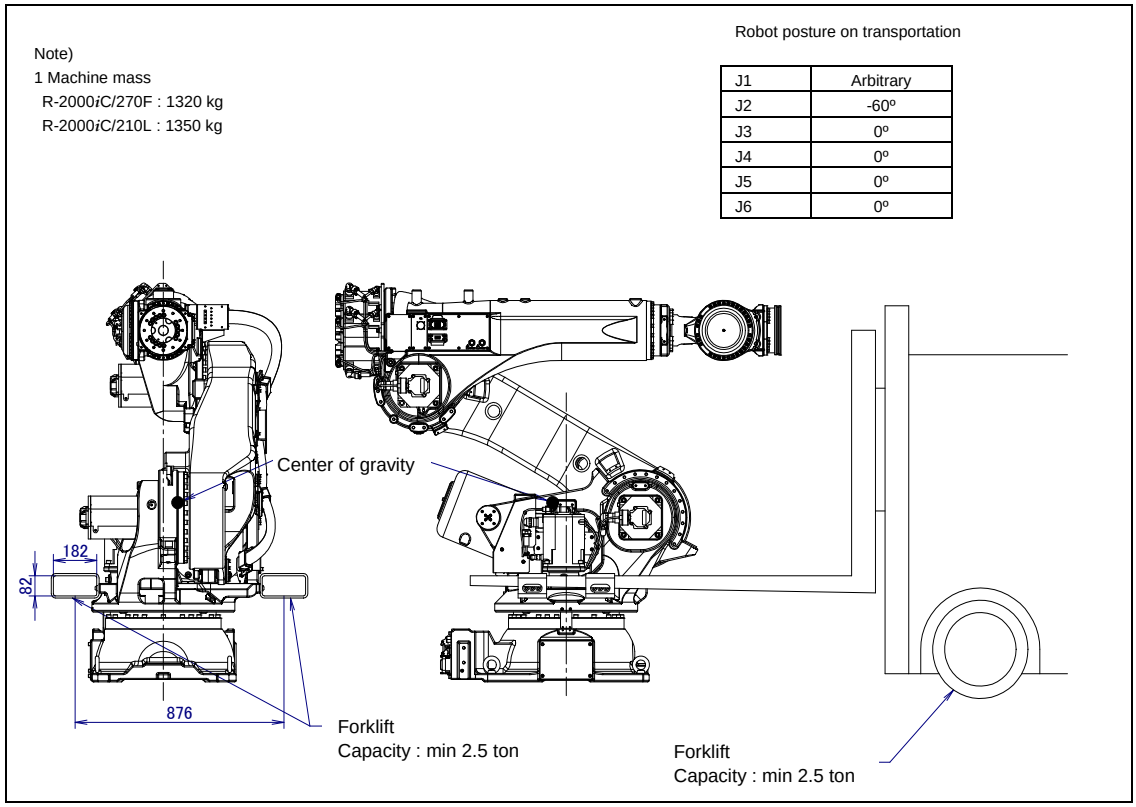


Fig. 1.1 (k) Transportation using a forklift (R-2000*i*C/270F/210L J2 base type)

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

1.1.1 Transportation with an End Effector Attached

When transporting a robot with an end effector such as a welding gun or hand attached, secure the arm with wood. If the arm is not secured, the end effector may oscillate for a cause such as vibration during transportation, as a result, a large impact load, imposes on the reducer of the robot, cause premature failure of the reducer.

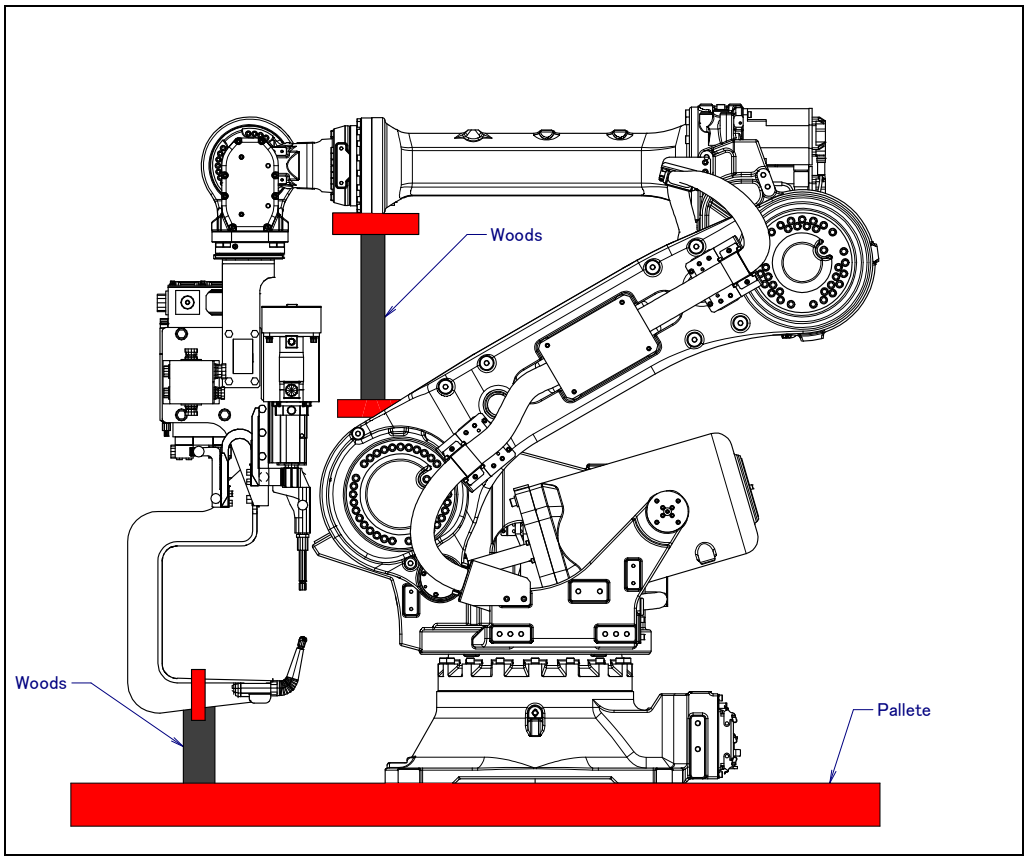


Fig. 1.1.1 Example of securing the arm during transportation when an end effector is attached

1.2 INSTALLATION

Fig. 1.2 (a) and (b) show the robot base dimensions. Avoid placing any object in front of the robot on the locating surface to facilitate the installation of the mastering fixture. (Shaded portion)

NOTE
For the R-2000*i*C/165R and 210R, the mastering fixture is placed below the J1 base installation surface.

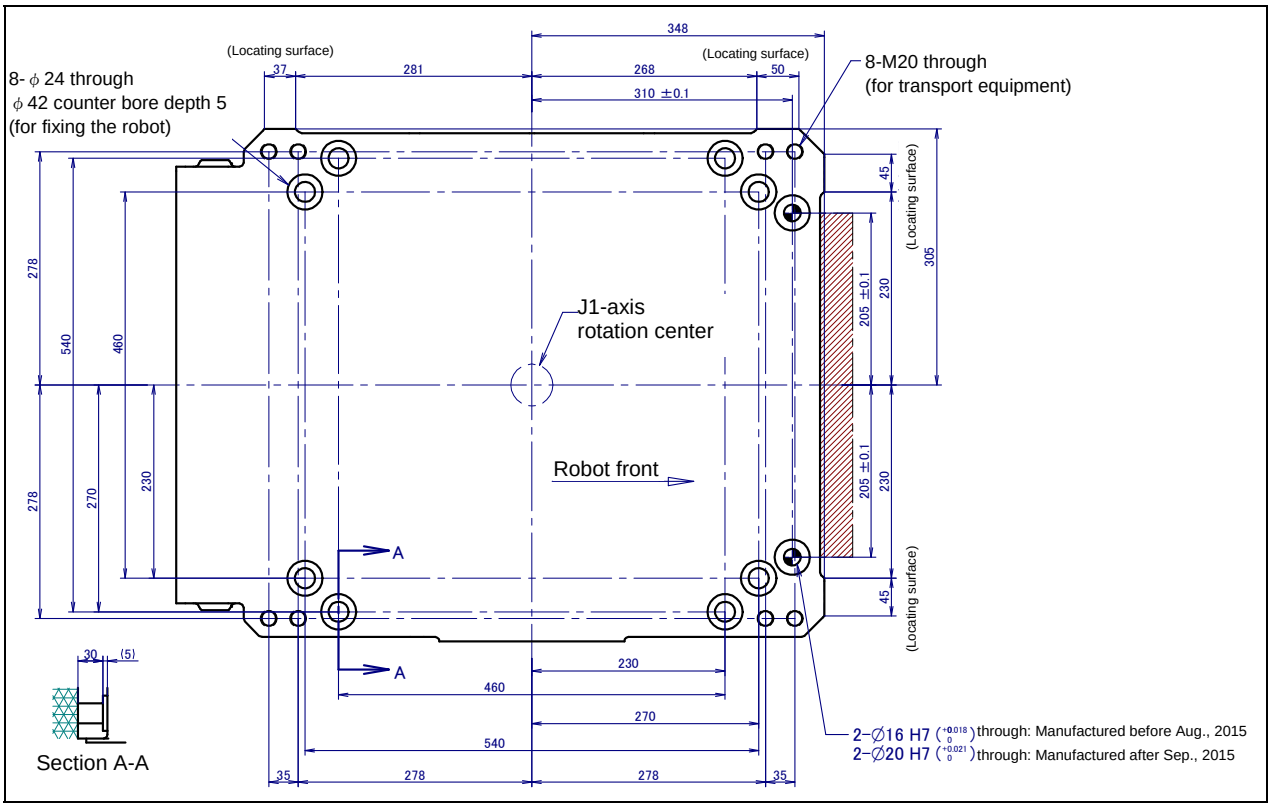


Fig. 1.2 (a) Dimensions of the robot base (R-2000*i*C/165F/210F/125L/165R/210R)

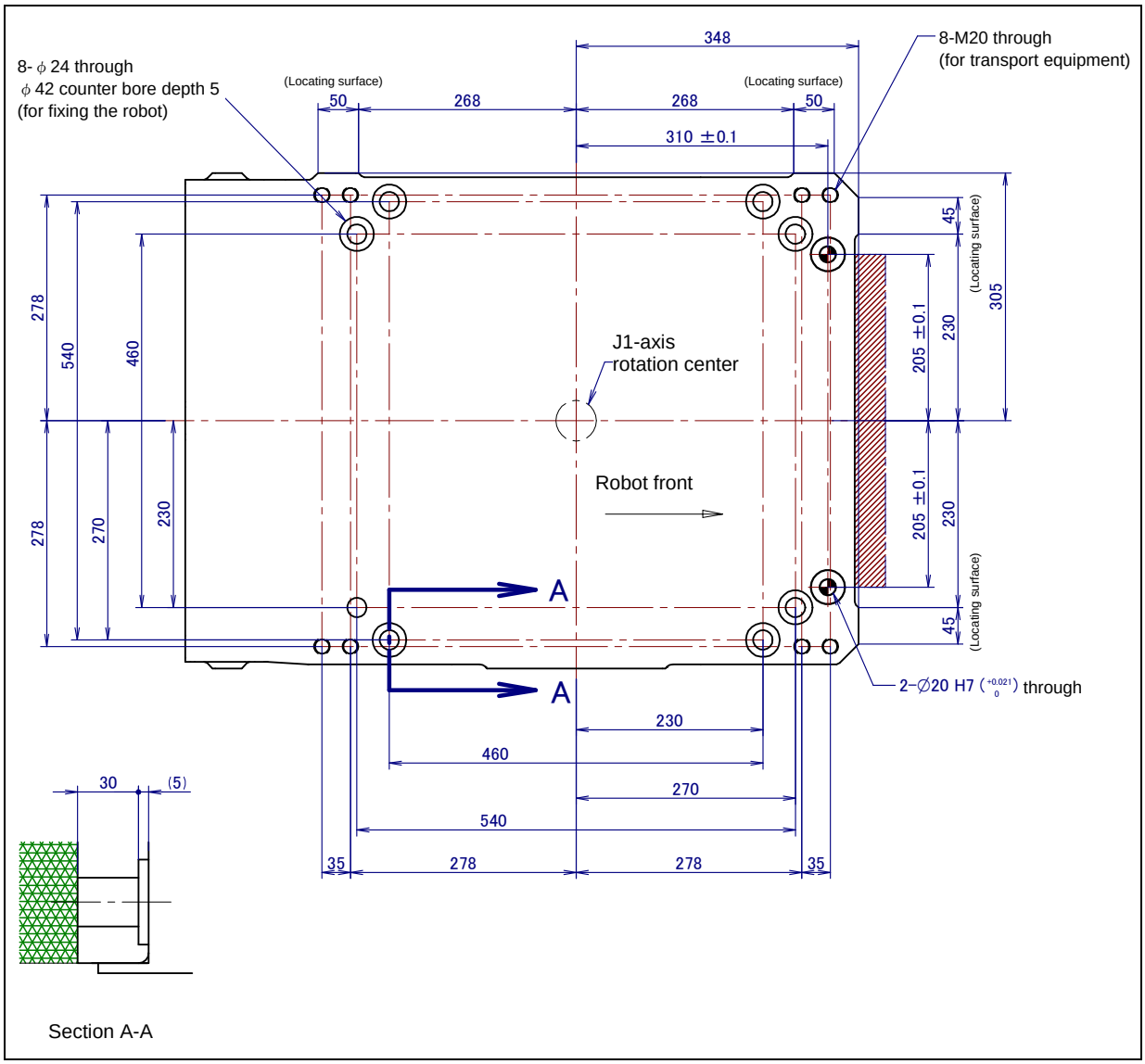


Fig. 1.2 (b) Dimensions of the robot base (R-2000*i*C/270F/210L)

1.2.1 Installation Method

There are three methods for installation of the robot as given below. Select a method according to the customer's installation environment, and install the robot.

- Installation method I Fig. 1.2.1 (a), (d)
  The floor plate is imbedded in concrete and fastened with twelve M20 (Tensile strength 400N/mm^2 or more) chemical anchors. Also fasten the base plate to the robot base using eight M20×65 bolts (Tensile strength 1200N/mm^2 or more). Next, position the robot, and weld the base plate to the floor plate. (Floor length is 10 to 15mm.) (The base plate is prepared as the option.)

- Installation method II Fig. 1.2.1 (b), (e)
  The floor plate is not imbedded in concrete. The floor plate is fastened at the twelve points with M20 chemical anchors (Tensile strength 400N/mm^2 or more) and the inclination of the floor plate is adjusted with the four fixing screws. The robot is positioned with the robot base pushed against the three ϕ20 parallel pins inserted into the floor plate and the robot base is fastened on the floor plate with eight M20 x 65 bolts (Tensile strength 1200N/mm^2 or more).

- Installation method III Fig. 1.2.1 (c), (f)
  The installation method is generally the same as described above except that the parallel pins for pushing the robot base are not used.

The strength of the chemical anchor depends on the concrete strength. See the design guideline of the manufacturer for the execution of the chemical anchor and consider the safety ratio sufficiently before use.

NOTE
For the R-2000*i*C/165R and 210R, the mastering fixture is placed below the J1 base installation surface.

The following parts are required to install the robot.

Required parts	Remarks	Methods I	Methods II	Methods III
Robot mounting bolts	M20X65 (Tensile strength 1200N/mm^2 or more) 8 pcs	○	○	○
Plain washers	For M20 (HRC 35 or more, thickness between 4 and 5 mm) 8 pcs	○	○	○
Chemical anchors	M20 (Tensile strength 400N/mm^2 or more) 12 pcs	○	○	○
Floor plate	Thickness 32t 1 pc	○	○	○
Base plates	Thickness 32t 4 pcs	○		
Fixing screws	M20 4 pcs		○	○
Nuts	M20 4 pcs		○	○
Parallel pins	ϕ20 3 pcs		○	

NOTE
- Damage to robot will occur in case the mechanical unit is installed by a method other than one of those 3 methods validated by FANUC.
- Customer must provide all necessary arrangements for the actual installation work (such as welding and anchoring).
- Flatness of robot installation surface must be less than or equal to 0.5mm. Inclination of robot installation surface must be less than or equal to 0.5º. If robot base is placed on uneven ground, it may result in the base breakage or low performance of the robot.

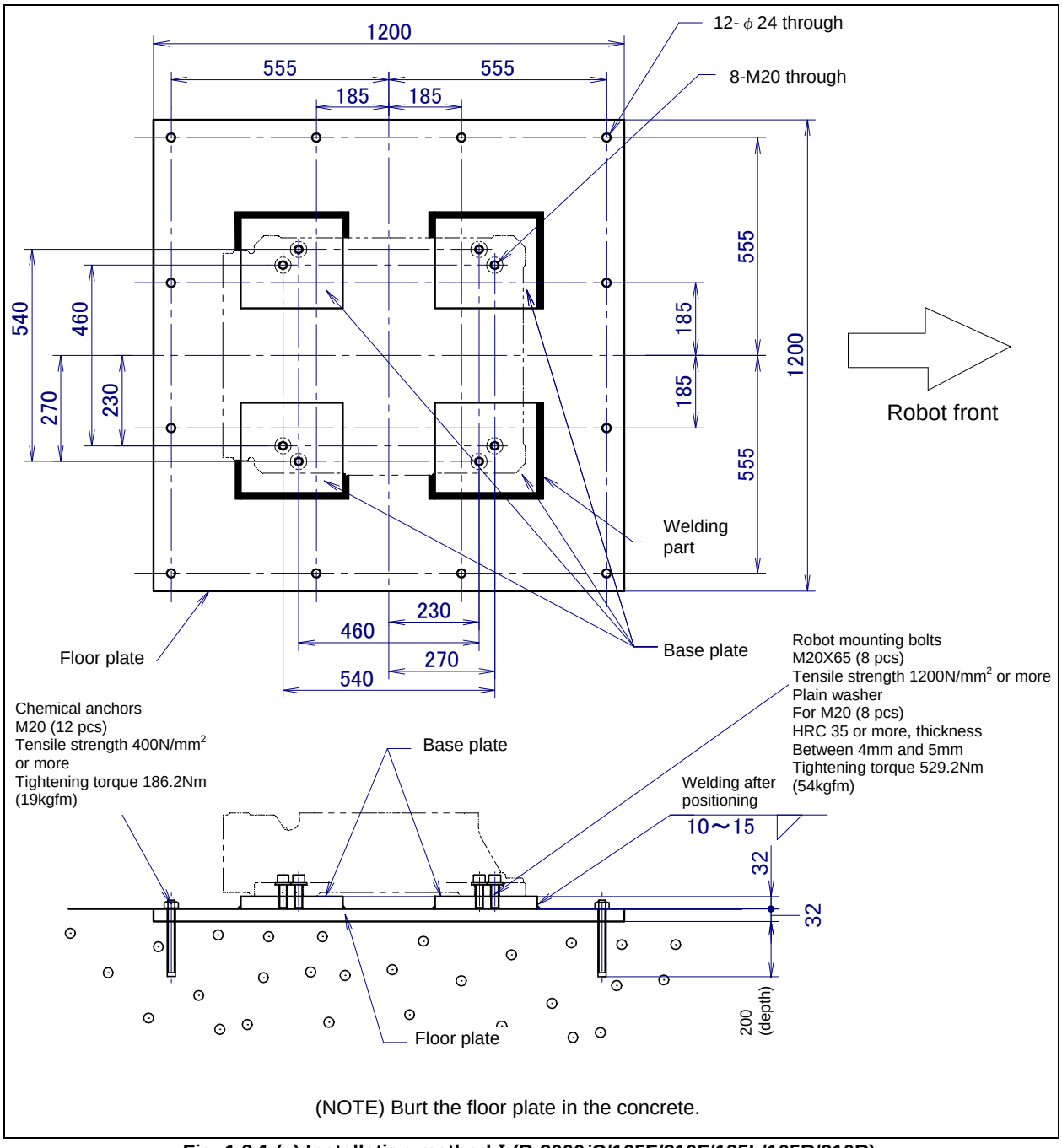


Fig. 1.2.1 (a) Installation method Ⅰ (R-2000*i*C/165F/210F/125L/165R/210R)

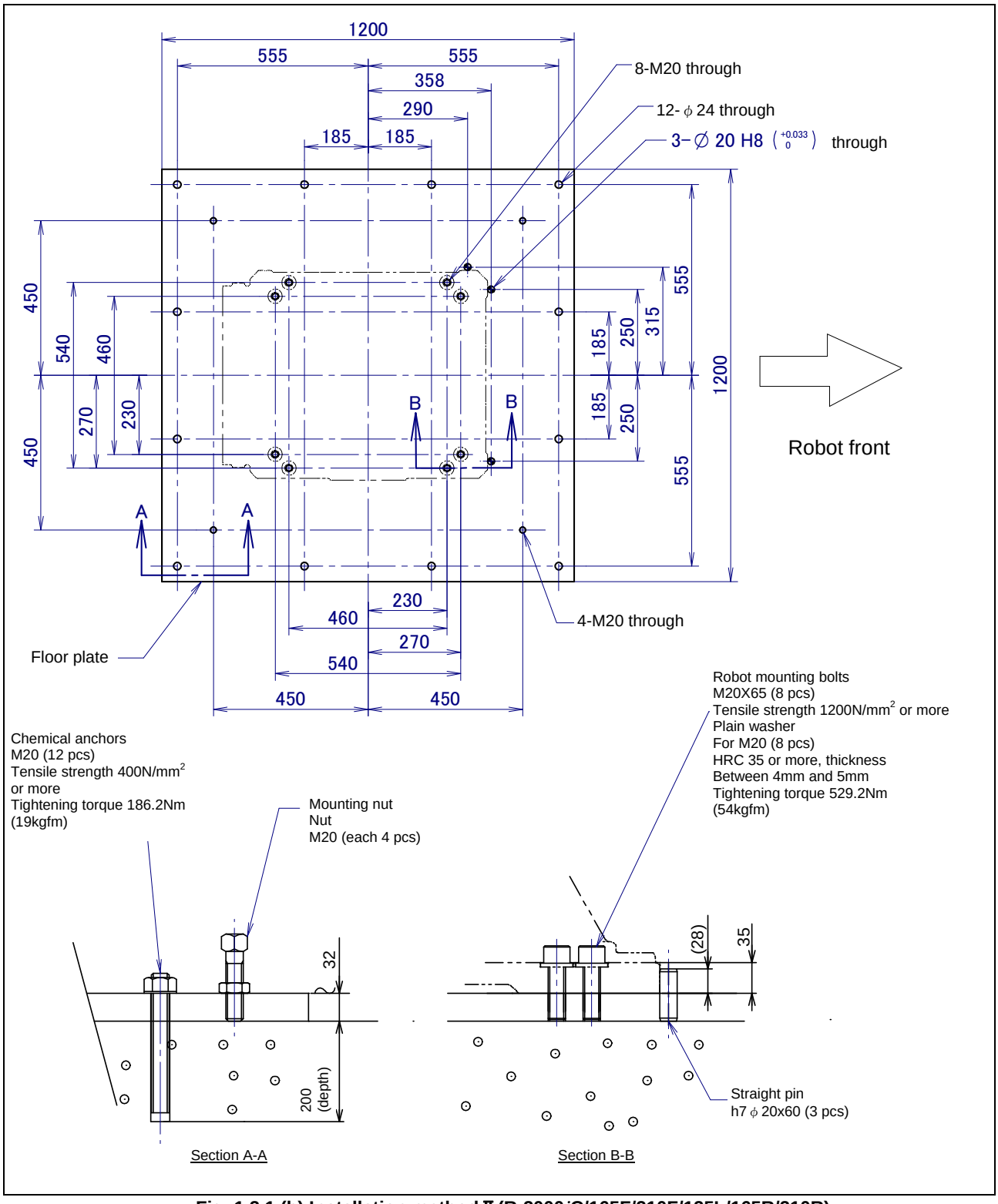


Fig. 1.2.1 (b) Installation method Ⅱ (R-2000*i*C/165F/210F/125L/165R/210R)

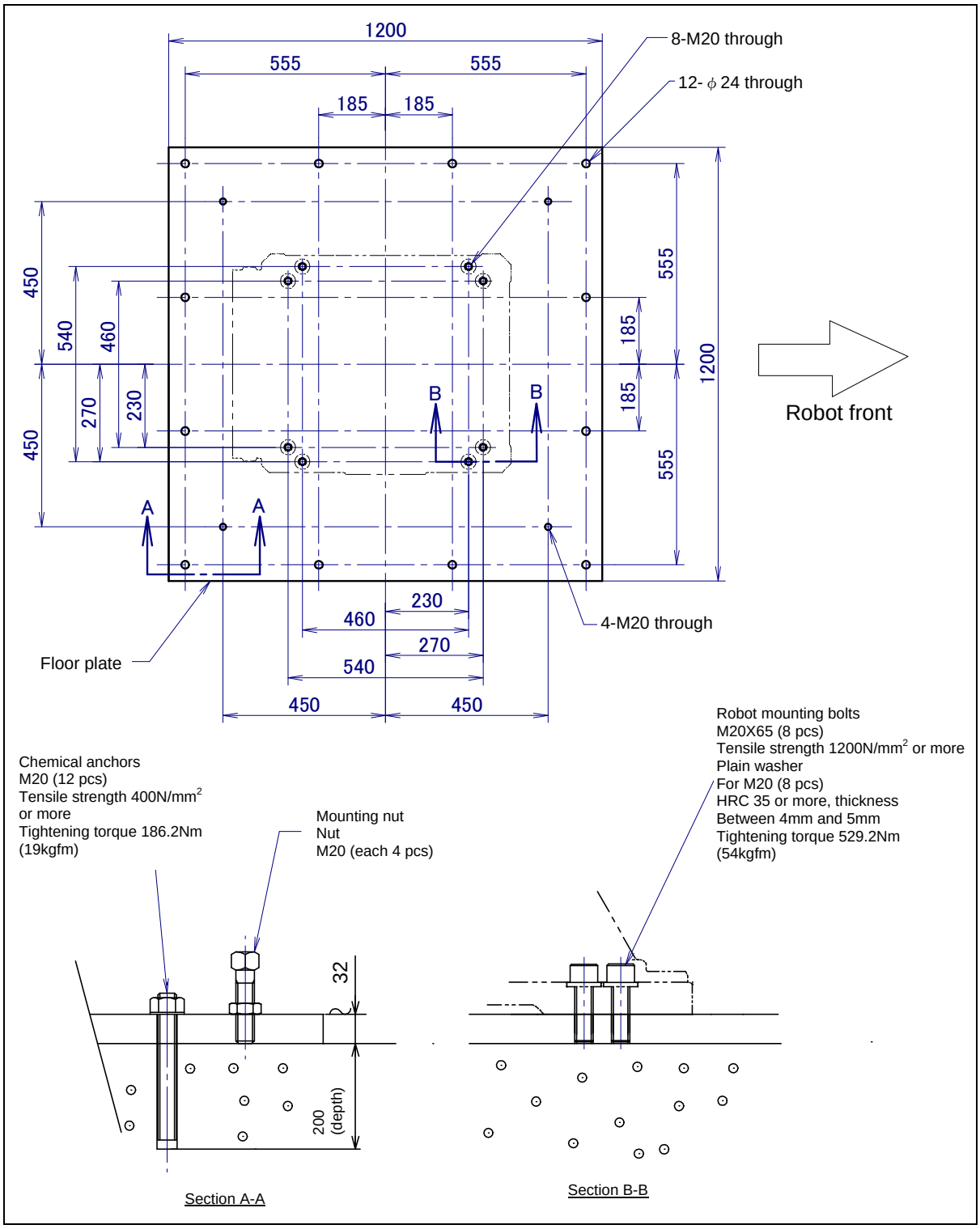


Fig. 1.2.1 (c) Installation method Ⅲ(R-2000*i*C/165F/210F/125L/165R/210R)

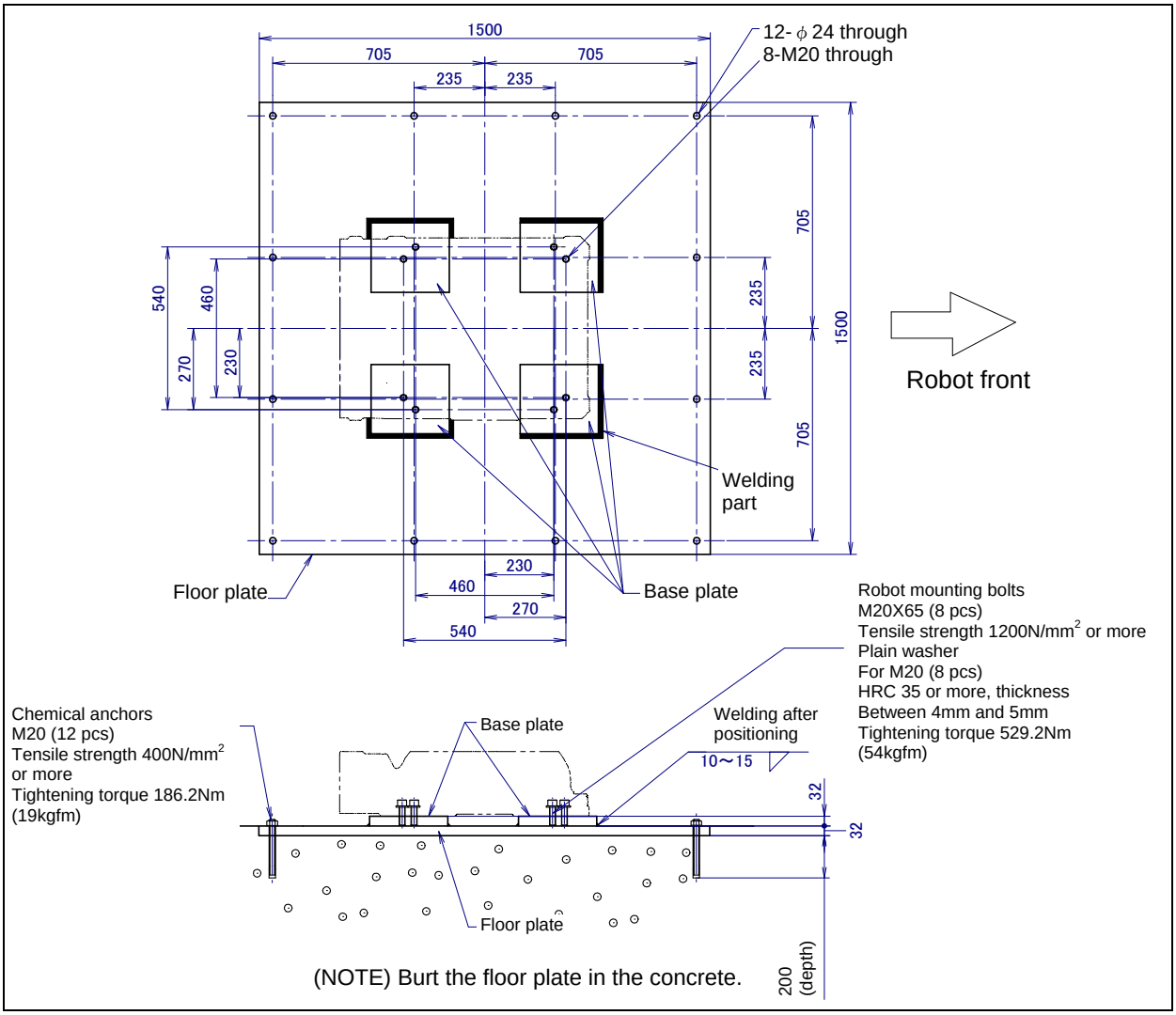


Fig. 1.2.1 (d) Installation method Ⅰ (R-2000*i*C/270F/210L)

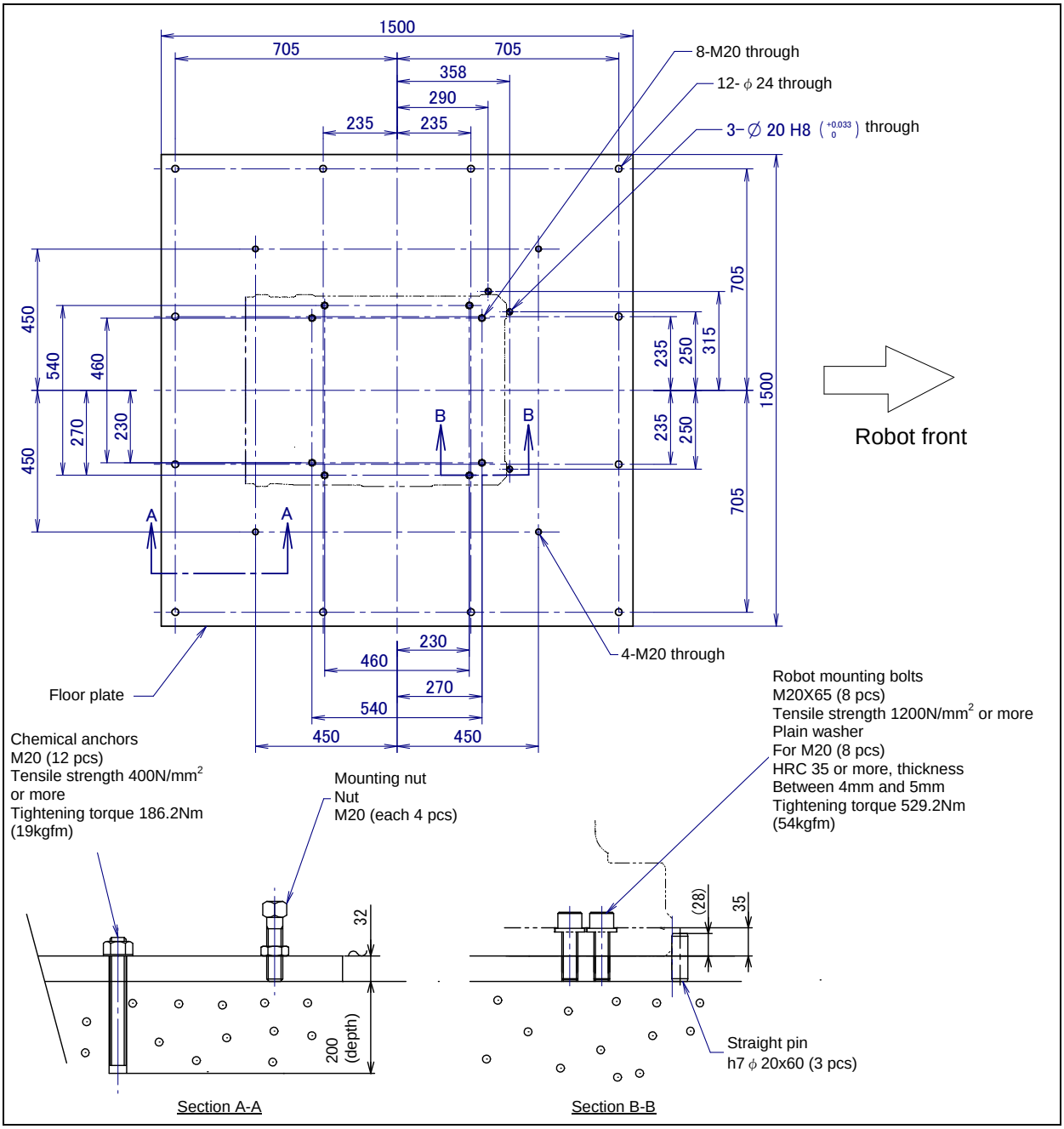


Fig. 1.2.1 (e) Installation method Ⅱ (R-2000*i*C/270F/210L)

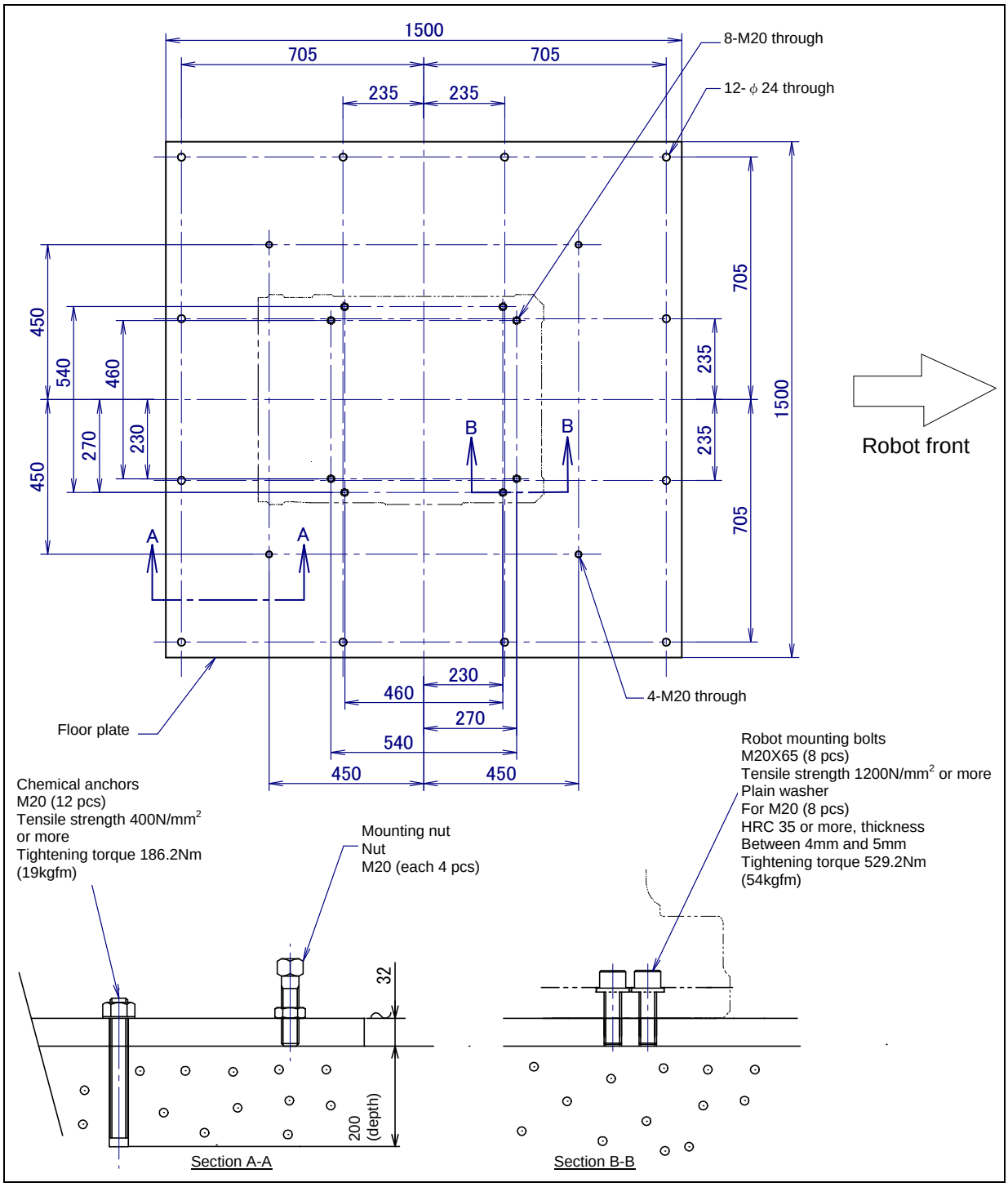


Fig. 1.2.1 (f) Installation method Ⅲ (R-2000*i*C/270F/210L)

Fig. 1.2.1 (g) and Table 1.2.1 (a) indicate the force and moment applied to the base plate at the time of Power-off stop of the robot. Table 1.2.1 (b),(c) indicate the stopping distance and time of the J1 to J3 axis 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 1.2.1 (a) Force and moment during Power-Off stop

Model	Vertical moment MV [kNm(kgfm)]	Force in vertical direction FV [kN(kgf)]	Horizontal moment MH [kNm(kgfm)]	Force in horizontal direction FH [kN(kgf)]
R-2000*i*C/165F	63.70 (6500)	37.24 (3800)	24.50 (2500)	28.42 (2900)
R-2000*i*C/210F	73.50 (7500)	41.16 (4200)	25.48 (2600)	29.40 (3000)
R-2000*i*C/125L	62.72 (6400)	35.28 (3600)	24.50 (2500)	26.46 (2700)
R-2000*i*C/165R	75.46 (7700)	39.20 (4000)	25.48 (2600)	28.42 (2900)
R-2000*i*C/210R	84.28 (8600)	41.16 (4200)	25.48 (2600)	28.42 (2900)
R-2000*i*C/270F	90.16 (9200)	47.04 (4800)	27.44 (2800)	33.32 (3400)
R-2000*i*C/210L	91.14 (9300)	44.10 (4500)	27.44 (2800)	30.38 (3100)

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

Model		J1-axis	J2-axis	J3-axis
R-2000*i*C/165F	Stopping time [ms]	458	291	228
	Stopping distance [deg] (rad)	31.1 (0.54)	16.3 (0.28)	10.9 (0.19)
R-2000*i*C/210F	Stopping time [ms]	515	419	204
	Stopping distance [deg] (rad)	29.2 (0.51)	18.8 (0.33)	11.0 (0.19)
R-2000*i*C/125L	Stopping time [ms]	472	371	272
	Stopping distance [deg] (rad)	30.9 (0.54)	18.3 (0.32)	14.2 (0.25)
R-2000*i*C/165R	Stopping time [ms]	484	384	189
	Stopping distance [deg] (rad)	27.8 (0.49)	18.6 (0.32)	10.8 (0.19)
R-2000*i*C/210R	Stopping time [ms]	609	405	215
	Stopping distance [deg] (rad)	30.0 (0.52)	16.5 (0.29)	10.5 (0.18)
R-2000*i*C/270F	Stopping time [ms]	503	359	192
	Stopping distance [deg] (rad)	24.7 (0.43)	14.1 (0.25)	7.8 (0.14)
R-2000*i*C/210L	Stopping time [ms]	522	440	249
	Stopping distance [deg] (rad)	26.9 (0.47)	17.9 (0.31)	9.3 (0.16)

*Max payload and max speed

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

Model		J1-axis	J2-axis	J3-axis
R-2000*i*C/165F	Stopping time [ms]	966	1020	1038
	Stopping distance [deg] (rad)	64.5 (1.13)	50.1 (0.87)	61.6 (1.07)
R-2000*i*C/210F	Stopping time [ms]	1022	1388	1192
	Stopping distance [deg] (rad)	66.8 (1.17)	51.5 (0.90)	59.5 (1.04)
R-2000*i*C/125L	Stopping time [ms]	1180	1364	1372
	Stopping distance [deg] (rad)	73.7 (1.29)	58.6 (1.02)	72.7 (1.27)
R-2000*i*C/165R	Stopping time [ms]	1172	1400	1245
	Stopping distance [deg] (rad)	66.3 (1.16)	56.1 (0.98)	75.1 (1.31)
R-2000*i*C/210R	Stopping time [ms]	1210	1380	1365
	Stopping distance [deg] (rad)	66.6 (1.16)	61.8 (1.08)	70.0 (1.22)
R-2000*i*C/270F	Stopping time [ms]	1060	1092	1020
	Stopping distance [deg] (rad)	57.8 (1.01)	47.7 (0.83)	45.7 (0.80)
R-2000*i*C/210L	Stopping time [ms]	1075	1050	955
	Stopping distance [deg] (rad)	55.7 (0.97)	42.9 (0.75)	43.7 (0.76)

*Max payload and max speed

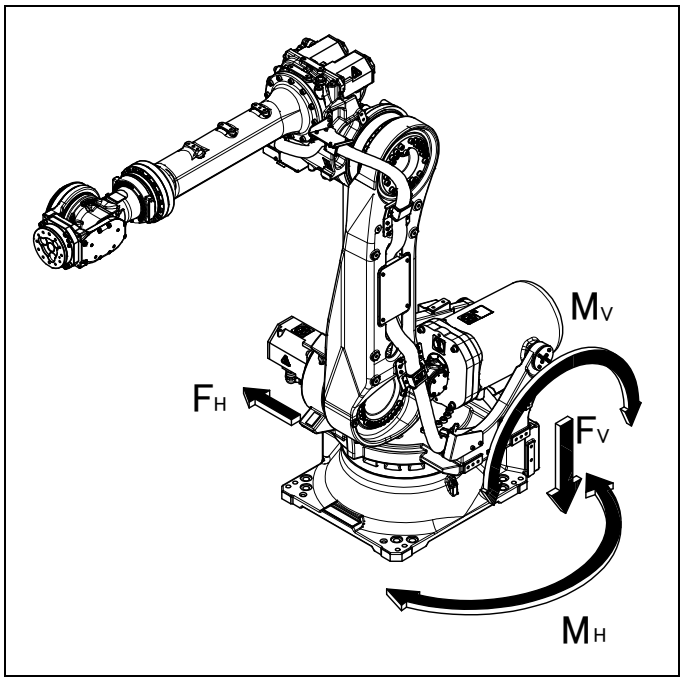


Fig. 1.2.1 (g) Force and moment during Power-Off stop

1.3 MAINTENANCE AREA

Fig. 1.3 (a) to (c) show the maintenance area of the mechanical unit. Dotted line area is necessary for mastering .Be sure to leave enough room for the robot to be mastered. See Chapter 8 for the mastering.

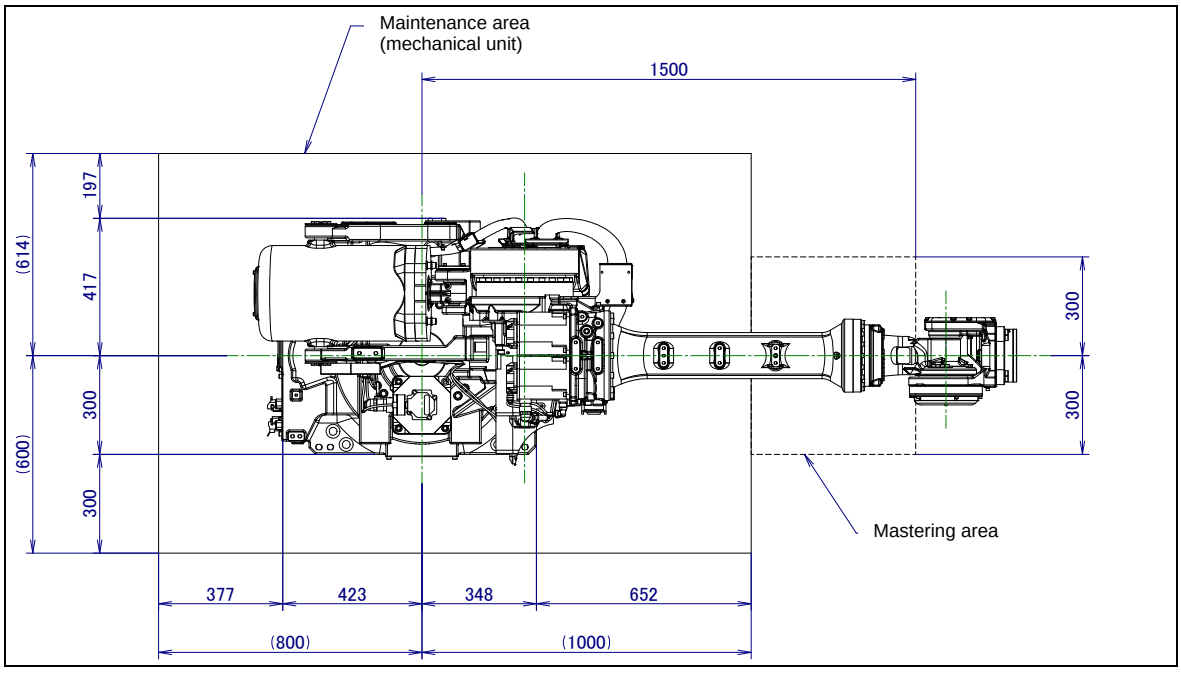


Fig. 1.3 (a) Maintenance area (R-2000*i*C/165F/210F/125L)

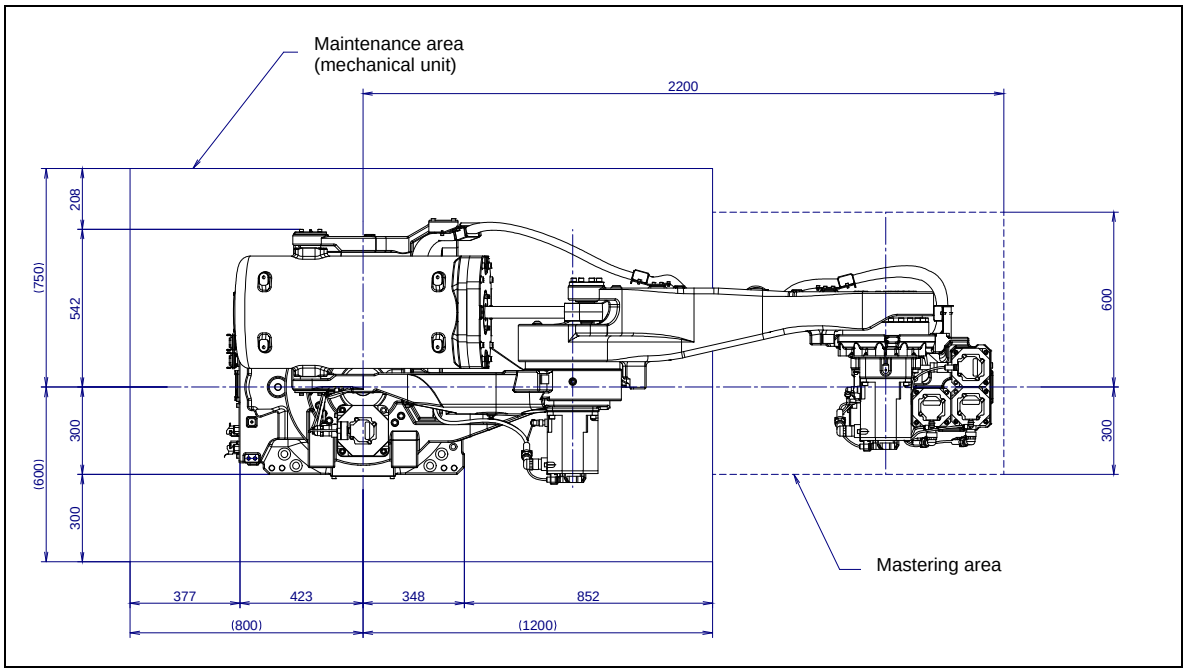


Fig. 1.3 (b) Maintenance area (R-2000*i*C/165R/210R)

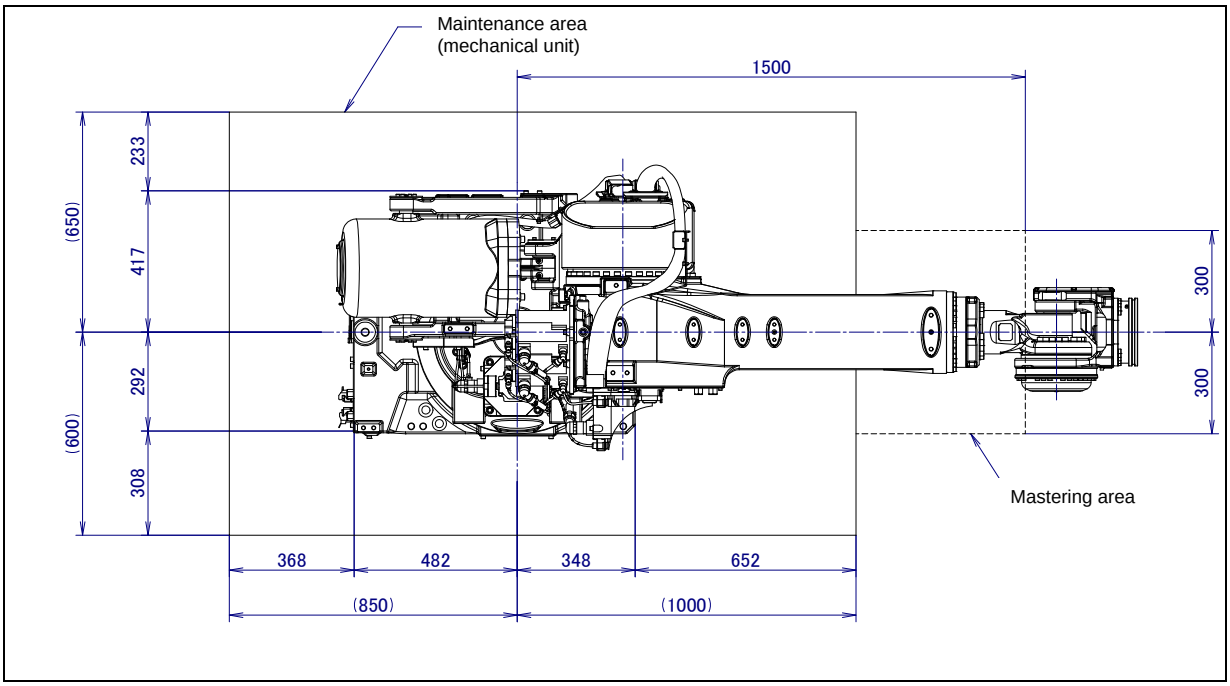


Fig. 1.3 (c) Maintenance area (R-2000*i*C/270F/210L)

1.4 INSTALLATION CONDITIONS

See Section 3.1 and caution below about robot installation conditions.

⚠ CAUTION

If the robot is used especially in an adverse environment stated below, grease the balancer as required.

- Dusty environment; for example, an application in which the robot is used to handle tiles or bricks.
- Environment full of spatters developed in spot welding; for example, an application in which welding spatters deposit and accumulate on and around the balancer

  In addition, if the robot is used in a special environment stated below, use a robot jacket or some other means to protect the balancer support part (which joins with the J2 arm and J2 base) and rod sliding part.
- Environment where glass abrasive powders and others are used; for example, and application in which the robot or balancer is subjected to splashes of powders in handling and other operations during glass abrasion.
- Environment where metal powders are used; for example, an application in which the robot or balancer is subjected to splashes of powders in handling and other operations during metal working.

⚠ CAUTION

Damage of the cable jacket can cause 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, the signal cable and the earth cable. Connect these cables to the connectors on the back of the base. For details on air and option cables, see Chapter 5.

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

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

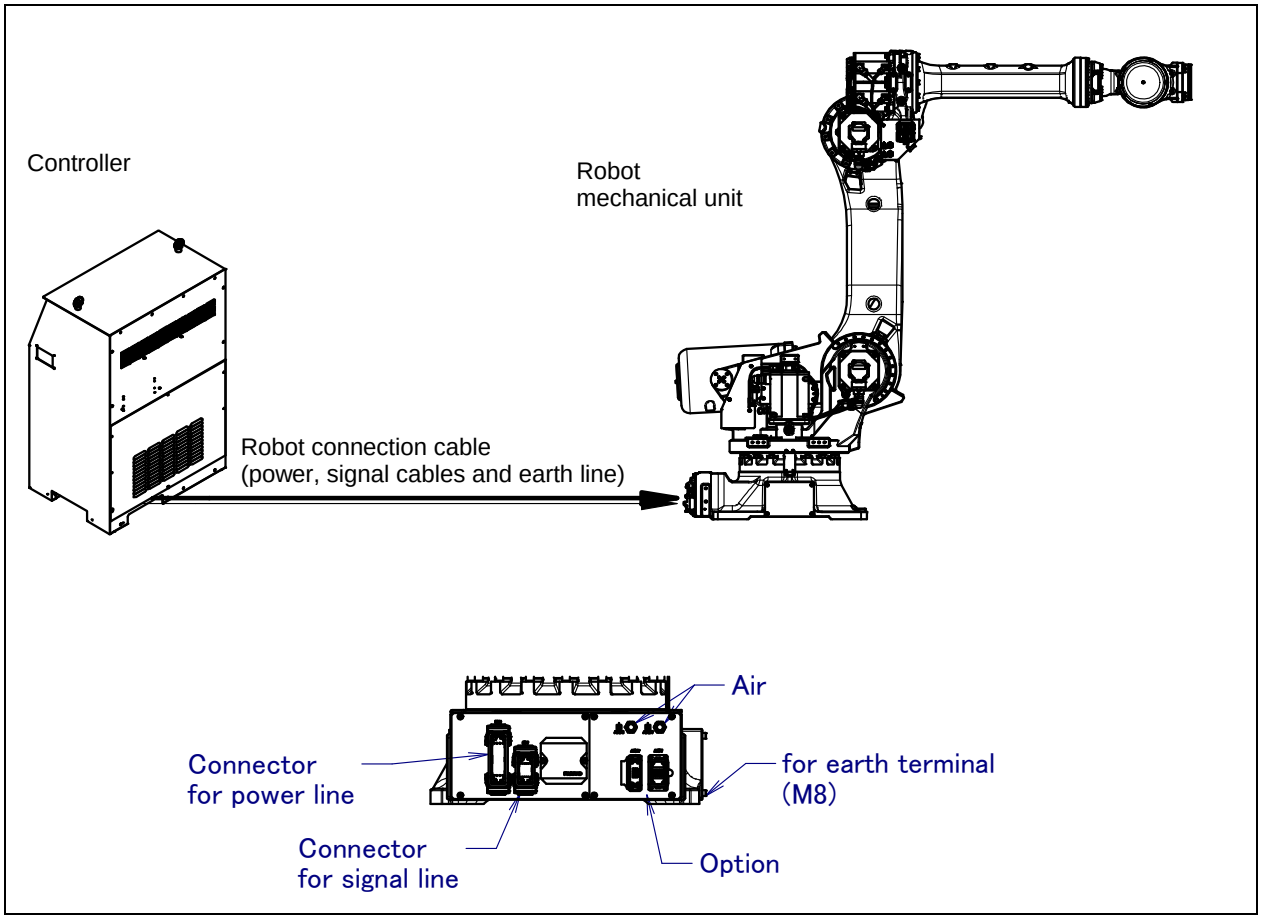


Fig. 2.1 Cable connection

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION

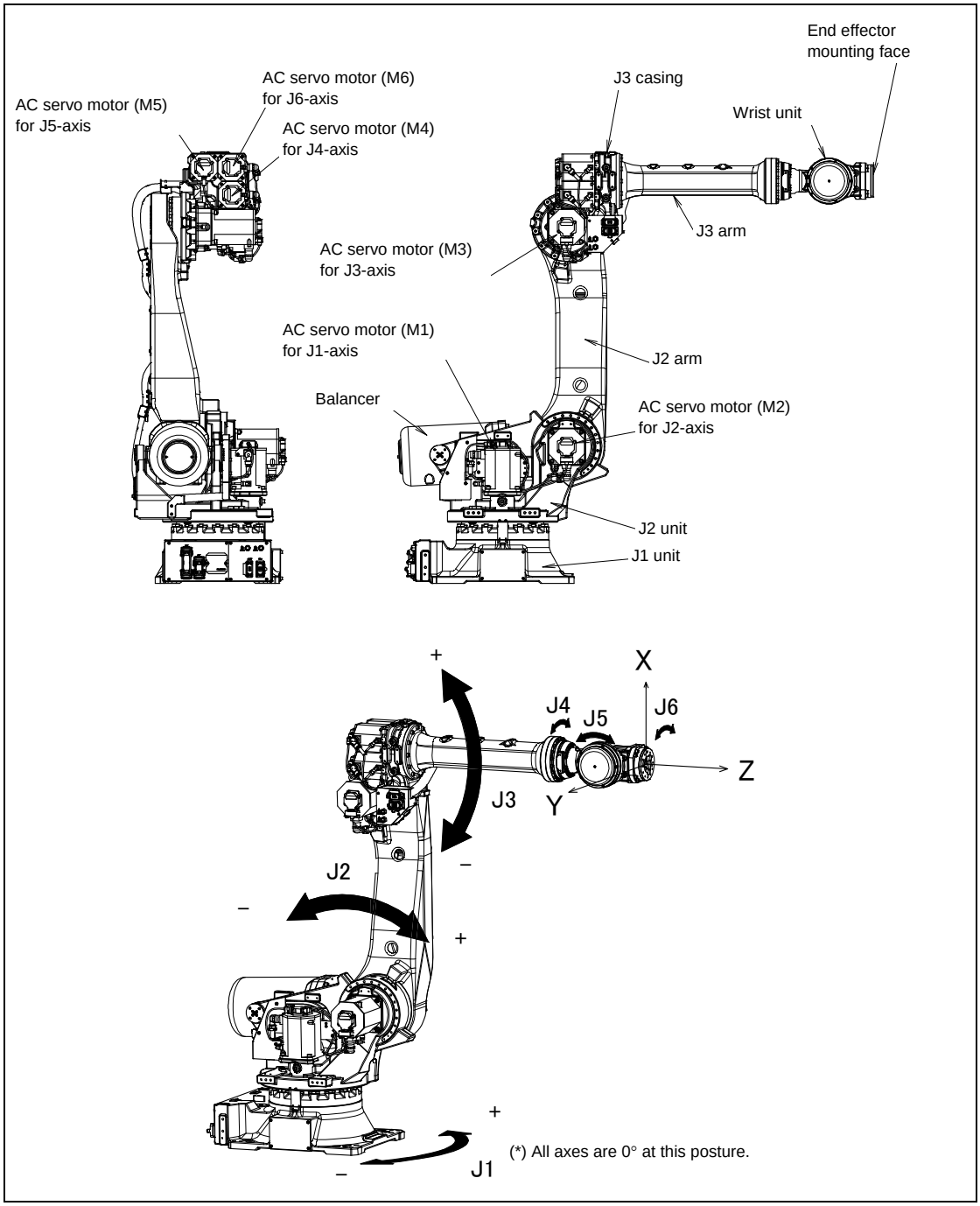


Fig. 3.1 (a) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates (R-2000*i*C/165F/210F/125L)

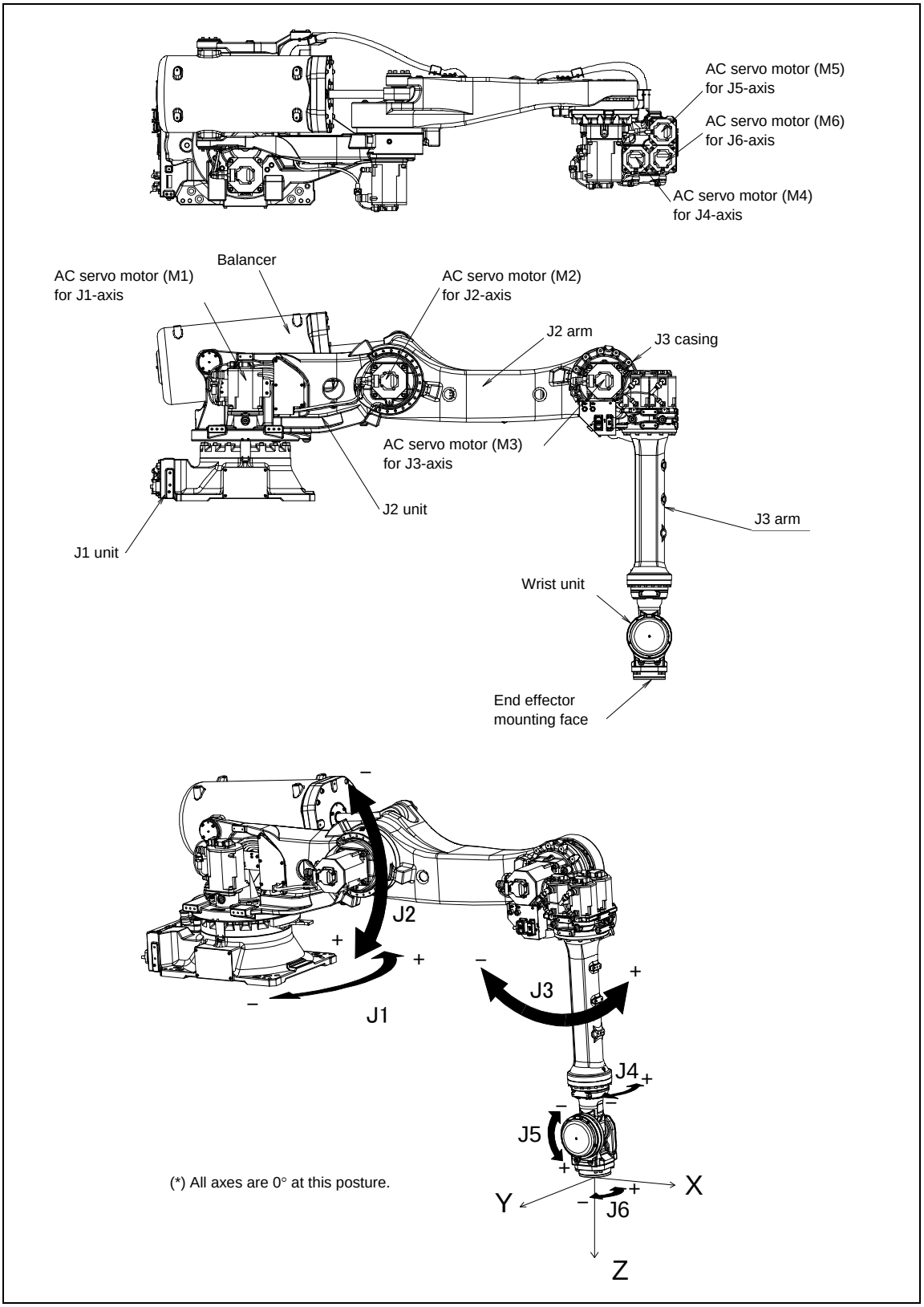


Fig. 3.1 (b) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates (R-2000*i*C/165R/210R)

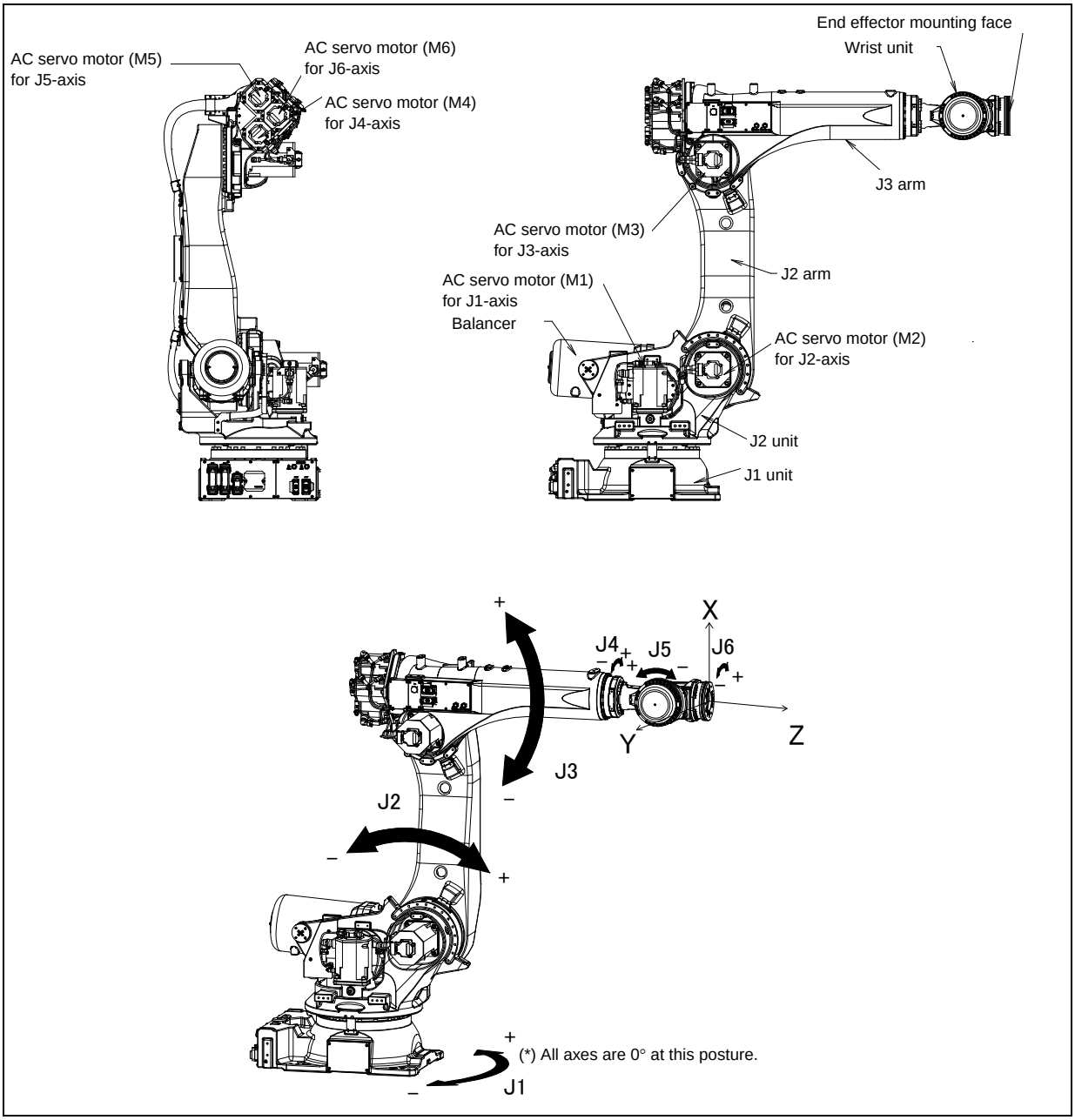


Fig. 3.1 (c) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates (R-2000*i*C/270F/210L)

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

Specifications (1/3)

Model			R-2000*i*C/165F	R-2000*i*C/210F	R-2000*i*C/125L
Type			Articulated Type		
Controlled axis			6 axes(J1,J2,J3,J4,J5,J6)		
Installation			Floor mount		
Motion range	J1-axis	Upper limit	185° (3.23rad)	185° (3.23rad)	185° (3.23rad)
		Lower limit	-185° (-3.23rad)	-185° (-3.23rad)	-185° (-3.23rad)
	J2-axis	Upper limit	76° (1.33rad)	76° (1.33rad)	76° (1.33rad)
		Lower limit	-60° (-1.05rad)	-60° (-1.05rad)	-60° (-1.05rad)
	J3-axis	Upper limit	180° (3.14rad)	180° (3.14rad)	180° (3.14rad)
		Lower limit	-132° (-2.30rad)	-132° (-2.30rad)	-121° (-2.11rad)
	J4-axis	Upper limit	360° (6.28rad)	360° (6.28rad)	360° (6.28rad)
		Lower limit	-360° (-6.28rad)	-360° (-6.28rad)	-360° (-6.28rad)
	J5-axis	Upper limit	125° (2.18rad)	125° (2.18rad)	125° (2.18rad)
		Lower limit	-125° (-2.18rad)	-125° (-2.18rad)	-125° (-2.18rad)
	J6-axis	Upper limit	360° (6.28rad)	360° (6.28rad)	360° (6.28rad)
		Lower limit	-360° (-6.28rad)	-360° (-6.28rad)	-360° (-6.28rad)
Max. speed Note 1)	J1-axis		130°/s (2.27rad/s)	120°/s (2.09rad/s)	130°/s (2.27rad/s)
	J2-axis		115°/s (2.01rad/s)	105°/s (1.83rad/s)	115°/s (2.01rad/s)
	J3-axis		125°/s (2.18rad/s)	110°/s (1.92rad/s)	125°/s (2.18rad/s)
	J4-axis		180°/s (3.14rad/s)	140°/s (2.44rad/s)	180°/s (3.14rad/s)
	J5-axis		180°/s (3.14rad/s)	140°/s (2.44rad/s)	180°/s (3.14rad/s)
	J6-axis		260°/s (4.54rad/s)	220°/s (3.84rad/s)	260°/s (4.54rad/s)
Max. payload	At wrist		165kg	210kg	125kg
	On J3 arm		25kg (A) (A)+(B)≦50kg	25kg (A) (A)+(B)≦50kg	25kg (A) (A)+(B)≦40kg
	On J3 casing		50kg (B)	50kg (B)	40kg (B)
	On J2 base		550kg	550kg	550kg
Allowable load moment at wrist	J4-axis		940N·m (96kgf·m)	1360N·m (139kgf·m)	710N·m (72kgf·m)
	J5-axis		940N·m (96kgf·m)	1360N·m (139kgf·m)	710N·m (72kgf·m)
	J6-axis		490N·m (50kgf·m)	735N·m (75kgf·m)	355N·m (36kgf·m)
Allowable load inertia at wrist	J4-axis		Note 2) 89kg·m^2 (908kgf·cm·s^2)	Note 2) 147kg·m^2 (1500kgf·cm·s^2)	72kg·m^2 (735kgf·cm·s^2)
			Note 2) 120kg·m^2 (1225kgf·cm·s^2)	Note 2) 225.4kg·m^2 (2300kgf·cm·s^2)	
	J5-axis		Note 2) 89kg·m^2 (908kgf·cm·s^2)	Note 2) 147kg·m^2 (1500kgf·cm·s^2)	72kg·m^2 (735kgf·cm·s^2)
			Note 2) 120kg·m^2 (1225kgf·cm·s^2)	Note 2) 225.4kg·m^2 (2300kgf·cm·s^2)	
	J6-axis		Note 2) 46kg·m^2 (469kgf·cm·s^2)	Note 2) 82kg·m^2 (837kgf·cm·s^2)	40kg·m^2 (408kgf·cm·s^2)
			Note 2) 100kg·m^2 (1020kgf·cm·s^2)	Note 2) 196kg·m^2 (2000kgf·cm·s^2)	
Drive method			Electric servo drive by AC servo motor		
Repeatability			±0.2mm		
Mass			1090kg	1090kg	1115kg
Acoustic noise level			70.5dB Note 3)		
Installation environment			Ambient temperature: 0 to 45°C Note 4) 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 attitude. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases Note 5)		

Note 1) During short distance motions, the axis speed may not reach the maximum value stated.

Note 2) The allowable load in standard inertia mode is shown in upper half and the allowable load in high inertia mode in lower half. For details, see Section 4.4.

Note 3) 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 4) When robot is used in low temperature environment that is near to 0ºC, or not operated for a long time in the environment that is less than 0ºC in a holiday or the night, collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation.
In this case, we recommend performing the warm up operation for several minutes.

Note 5) Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

Specifications (2/3)

Model			R-2000*i*C/165R	R-2000*i*C/210R
Type			Articulated Type	
Controlled axis			6 axes (J1,J2,J3,J4,J5,J6)	
Installation			Rack mount	
Motion range	J1-axis	Upper limit	185° (3.23rad)	185° (3.23rad)
		Lower limit	-185° (-3.23rad)	-185° (-3.23rad)
	J2-axis	Upper limit	80° (1.40rad)	80° (1.40rad)
		Lower limit	-120° (-2.09rad)	-120° (-2.09rad)
	J3-axis	Upper limit	270° (4.71rad)	270° (4.71rad)
		Lower limit	-105° (-1.83rad)	-105° (-1.83rad)
	J4-axis	Upper limit	360° (6.28rad)	360° (6.28rad)
		Lower limit	-360° (-6.28rad)	-360° (-6.28rad)
	J5-axis	Upper limit	125° (2.18rad)	125° (2.18rad)
		Lower limit	-125° (-2.18rad)	-125° (-2.18rad)
	J6-axis	Upper limit	360° (6.28rad)	360° (6.28rad)
		Lower limit	-360° (-6.28rad)	-360° (-6.28rad)
Max. speed Note 1)	J1-axis		115°/s (2.01rad/s)	105°/s (1.83rad/s)
	J2-axis		110°/s (1.92rad/s)	100°/s (1.75rad/s)
	J3-axis		125°/s (2.18rad/s)	110°/s (1.92rad/s)
	J4-axis		180°/s (3.14rad/s)	140°/s (2.44rad/s)
	J5-axis		180°/s (3.14rad/s)	140°/s (2.44rad/s)
	J6-axis		260°/s (4.54rad/s)	220°/s (3.84rad/s)
Max. payload	At wrist		165kg	210kg
	On J3 arm		25kg (A) (A)+(B)≦50kg	30kg (A) 4/3*(A)+(B)≦40kg
	On J3 casing		50kg (B)	40kg (B)
	On J2 base		550kg	550kg
Allowable load moment at wrist	J4-axis		940N·m (96kgf·m)	1360N·m (139kgf·m)
	J5-axis		940N·m (96kgf·m)	1360N·m (139kgf·m)
	J6-axis		490N·m (50kgf·m)	735N·m (75kgf·m)
Allowable load inertia at wrist	J4-axis		89kg·m^2 (908kgf·cm·s^2)	147kg·m^2 (1500kgf·cm·s^2)
	J5-axis		89kg·m^2 (908kgf·cm·s^2)	147kg·m^2 (1500kgf·cm·s^2)
	J6-axis		46kg·m^2 (469kgf·cm·s^2)	82kg·m^2 (837kgf·cm·s^2)
Drive method			Electric servo drive by AC servo motor	
Repeatability			±0.2mm	
Mass			1370kg	1370kg
Acoustic noise level			70.5dB Note 2)	
Installation environment			Ambient temperature: 0 to 45°C Note 3) 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 attitude. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases Note 4)	

Note 1) During short distance motions, the axis speed may not reach the maximum value stated.

Note 2) This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.
- Maximum load and speed
- Operating mode is AUTO

Note 3) When robot is used in low temperature environment that is near to 0ºC, or not operated for a long time in the environment that is less than 0ºC in a holiday or the night, collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.

Note 4) Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

Specifications (3/3)

Model			R-2000*i*C/270F	R-2000*i*C/210L
Type			Articulated Type	
Controlled axis			6 axes(J1,J2,J3,J4,J5,J6)	
Installation			Floor mount	
Motion range	J1-axis	Upper limit	185° (3.23rad)	185° (3.23rad)
		Lower limit	-185° (-3.23rad)	-185° (-3.23rad)
	J2-axis	Upper limit	76° (1.33rad)	76° (1.33rad)
		Lower limit	-60° (-1.05rad)	-60° (-1.05rad)
	J3-axis	Upper limit	180° (3.14rad)	180° (3.14rad)
		Lower limit	-132° (-2.30rad)	-121° (-2.11rad)
	J4-axis	Upper limit	360° (6.28rad)	360° (6.28rad)
		Lower limit	-360° (-6.28rad)	-360° (-6.28rad)
	J5-axis	Upper limit	125° (2.18rad)	125° (2.18rad)
		Lower limit	-125° (-2.18rad)	-125° (-2.18rad)
	J6-axis	Upper limit	360° (6.28rad)	360° (6.28rad)
		Lower limit	-360° (-6.28rad)	-360° (-6.28rad)
Max. speed Note 1)	J1-axis		105°/s (1.83rad/s)	105°/s (1.83rad/s)
	J2-axis		90°/s (1.57rad/s)	90°/s (1.57rad/s)
	J3-axis		85°/s (1.48rad/s)	85°/s (1.48rad/s)
	J4-axis		120°/s (2.09rad/s)	120°/s (2.09rad/s)
	J5-axis		120°/s (2.09rad/s)	120°/s (2.09rad/s)
	J6-axis		200°/s (3.49rad/s)	200°/s (3.49rad/s)
Max. payload	At wrist		270kg	210kg
	On J3 arm		40kg (A) 50kg (B) 5/4*(A)+(B)≦50kg	20kg (A) 50kg (B) 5/2*(A)+(B)≦50kg
	On J2 base		550kg	550kg
Allowable load moment at wrist	J4-axis		1730N·m (177kgf·m)	1700N·m (173kgf·m)
	J5-axis		1730N·m (177kgf·m)	1700N·m (173kgf·m)
	J6-axis		900N·m (92kgf·m)	900N·m (92kgf·m)
Allowable load inertia at wrist	J4-axis		320kg·m^2 (3265kgf·cm·s^2)	320kg·m^2 (3265kgf·cm·s^2)
	J5-axis		320kg·m^2 (3265kgf·cm·s^2)	320kg·m^2 (3265kgf·cm·s^2)
	J6-axis		230kg·m^2 (2347kgf·cm·s^2)	230kg·m^2 (2347kgf·cm·s^2)
Drive method			Electric servo drive by AC servo motor	
Repeatability			±0.2mm	
Mass			1320kg	1350kg
Acoustic noise level			70.5 dB Note 2)	
Installation environment			Ambient temperature: 0 to 45°C Note 3) 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 attitude. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases Note 4)	

Note 1) During short distance motions, the axis speed may not reach the maximum value stated.

Note 2) This value is equivalent continuous A-weighted sound pressure level that applied with ISO11201 (EN31201). This value is measured with the following conditions.
- Maximum load and speed
- Operating mode is AUTO

Note 3) When robot is used in low temperature environment that is near to 0ºC, or not operated for a long time in the environment that is less than 0ºC in a holiday or the night, collision detection alarm (SRVO-050) etc. may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.

Note 4) Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

The following table lists the IEC60529-based Severe dust/liquid protection characteristics of the R-2000*i*C. Refer to Chapter 10 about severe dust/liquid protection package (option).

	Standard	Severe dust/liquid protection package (option)
J3 arm and wrist section	IP67	IP67
Drive unit of the main body	IP66	IP66
Main body	IP54 (*)	IP56

(*) Except some connectors

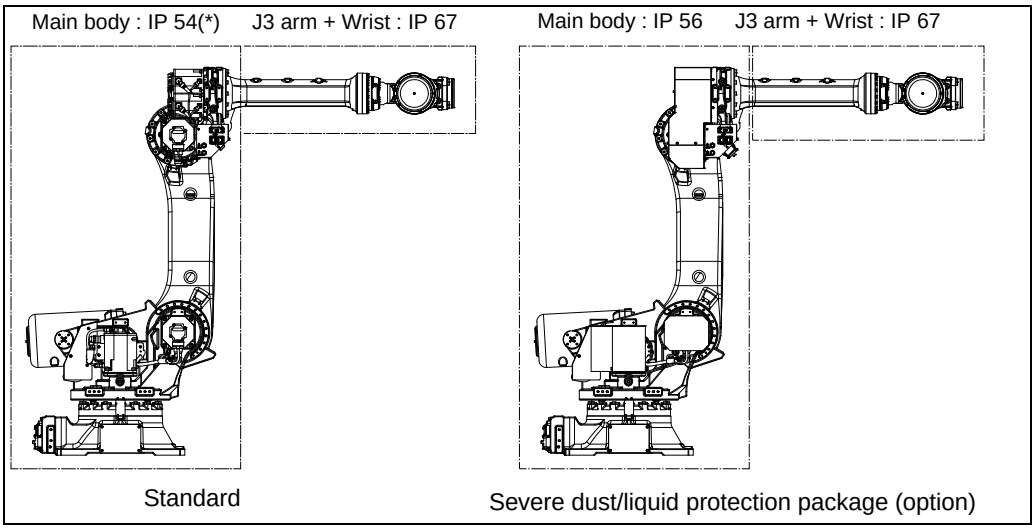


Fig. 3.1 (d) Severe dust/liquid protection characteristics of R-2000*i*C

NOTE

Definition of IP code
Definition of IP 67
- 6=Dust-tight
- 7=Protection from water immersion

Definition of IP 66
- 6=Dust-tight
- 6=Protection from powerful water jets

Definition of IP 54
- 5=Dust-protected
- 4=Protection from splashing water

Definition of IP 56
- 5=Dust-protected
- 6=Protection from powerful water jets

Performance of resistant chemicals and resistant solvents

(1) The robot (including severe dust/liquid protection model) cannot be used with the following liquids. Potentially these liquids will cause irreversible damage to the rubber parts (such as: gaskets, oil seals, O-rings etc.). (As exception to this only liquids tested and approved by FANUC can be used with the robot.)
   (a) Organic solvents
   (b) Cutting fluid including chlorine / gasoline
   (c) Amine type detergent
   (d) Acid, alkali and liquid causing rust
   (e) Other liquids or solutions, that will harm NBR or CR rubber

(2) When the robots work in the environment, using water or liquid, complete draining of J1 base must be done. Incomplete draining of J1 base will make the robot break down.

(3) Don not use unconfirmed liquid.

(4) Do not use the robot immersed in water, neither temporary nor permanent. Robot must not be wet permanently. *Example : in case motor surface is exposed to water for a long time, liquid may invade inside the motor and cause failure.

3.2 MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE

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

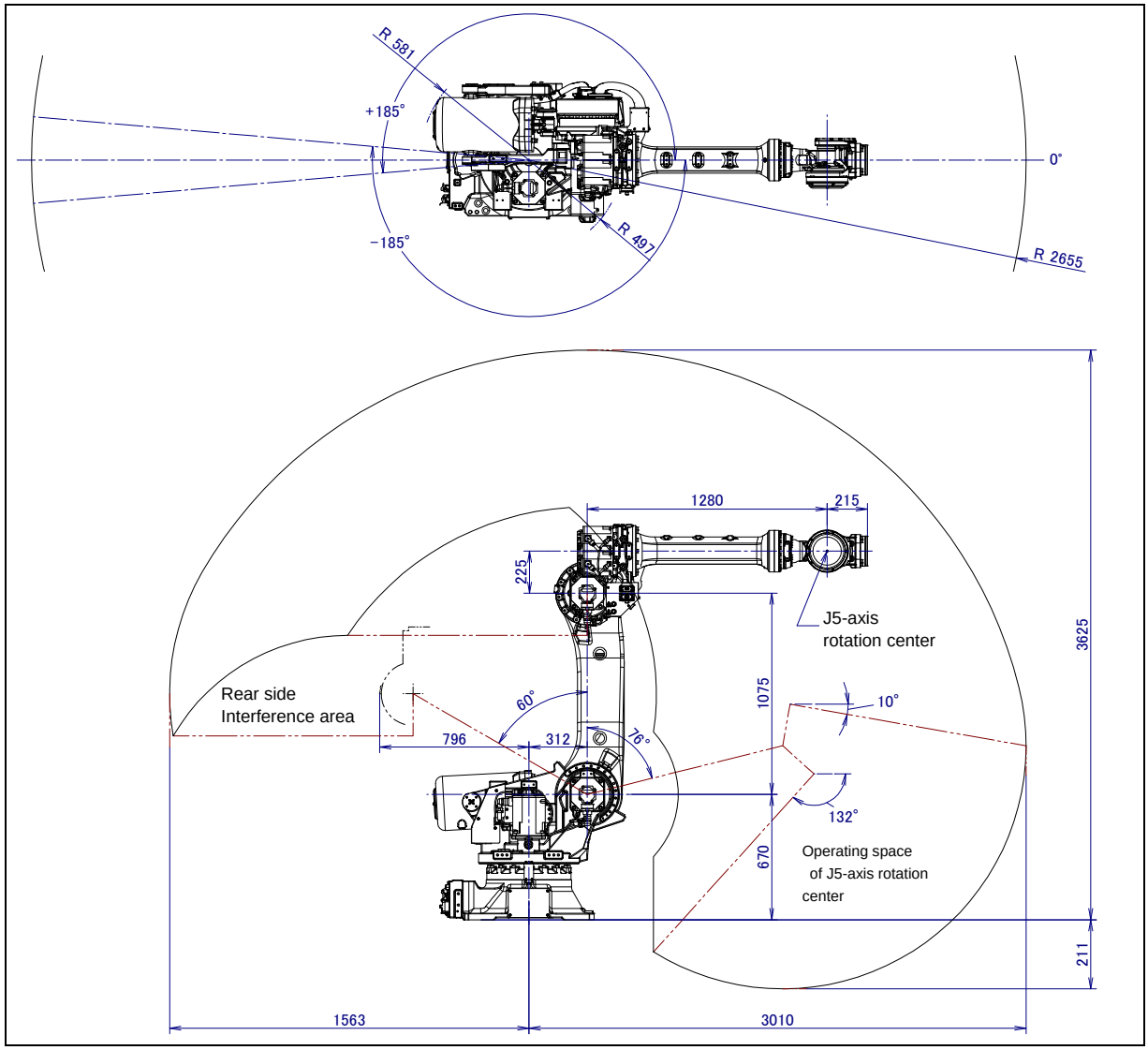


Fig. 3.2 (a) Operating space (R-2000*i*C/165F/210F)

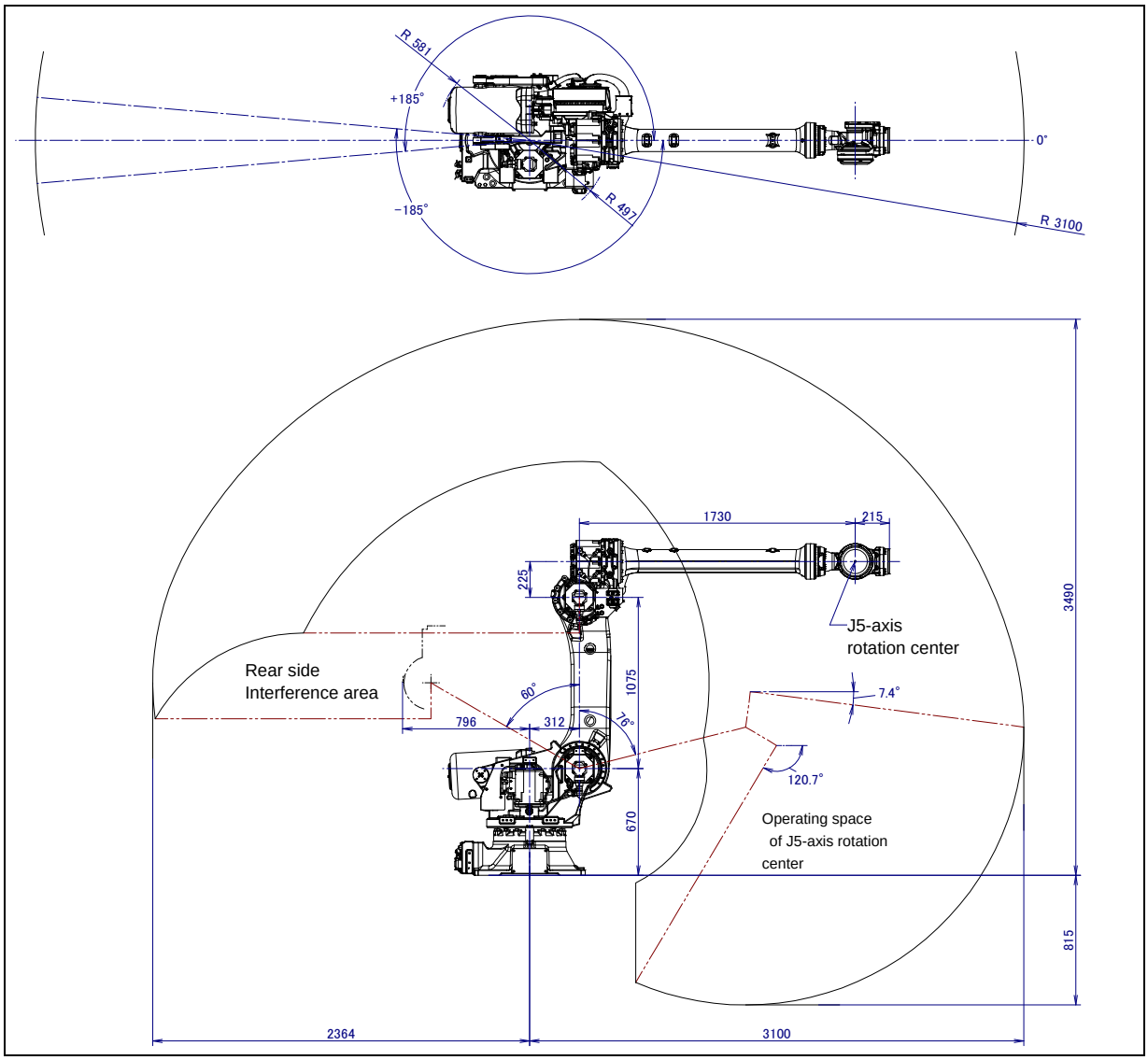


Fig. 3.2 (b) Operating space (R-2000*i*C/125L)

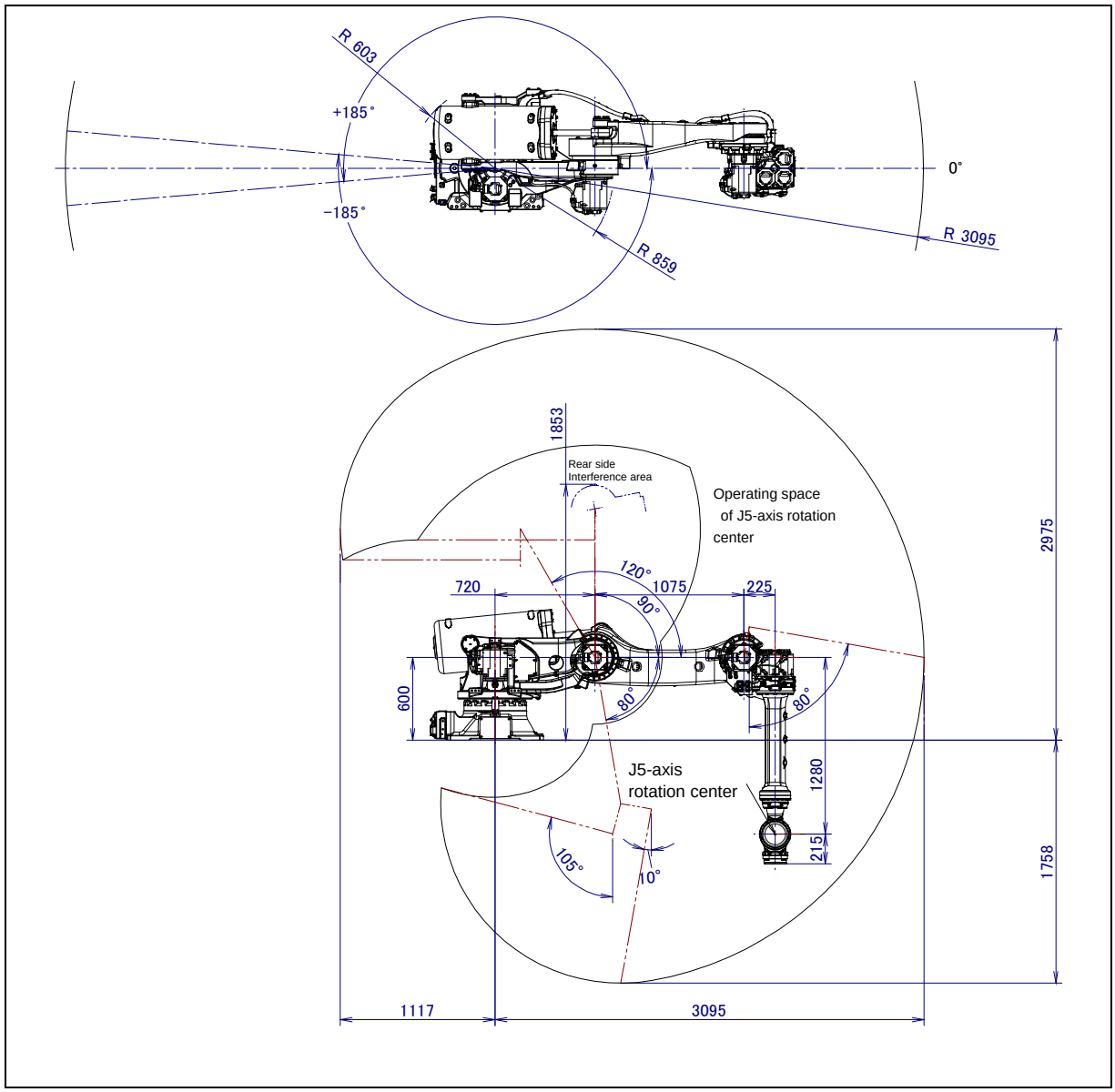


Fig. 3.2 (c) Operating space (R-2000*i*C/165R/210R)

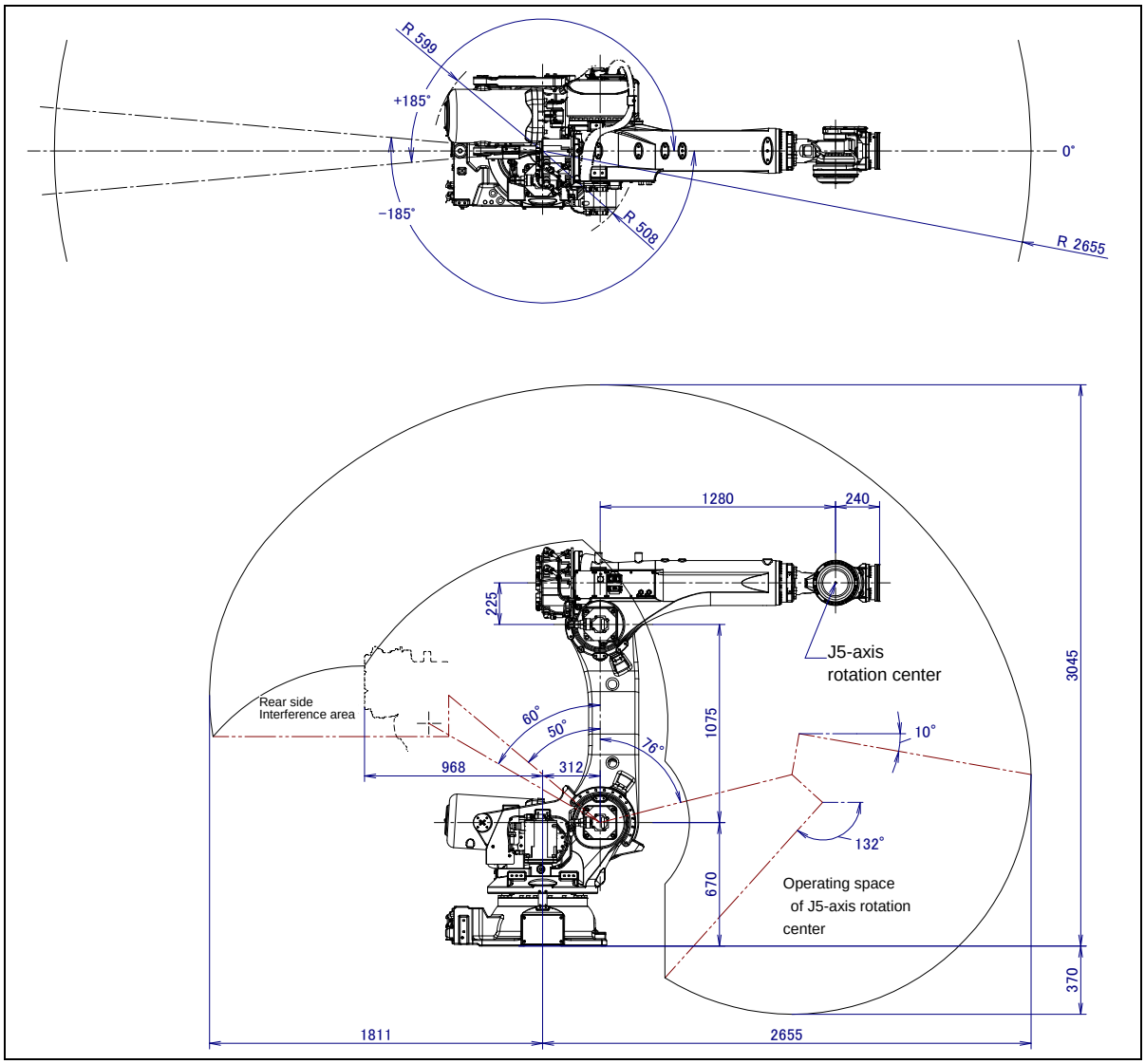


Fig. 3.2 (d) Operating space (R-2000*i*C/270F)

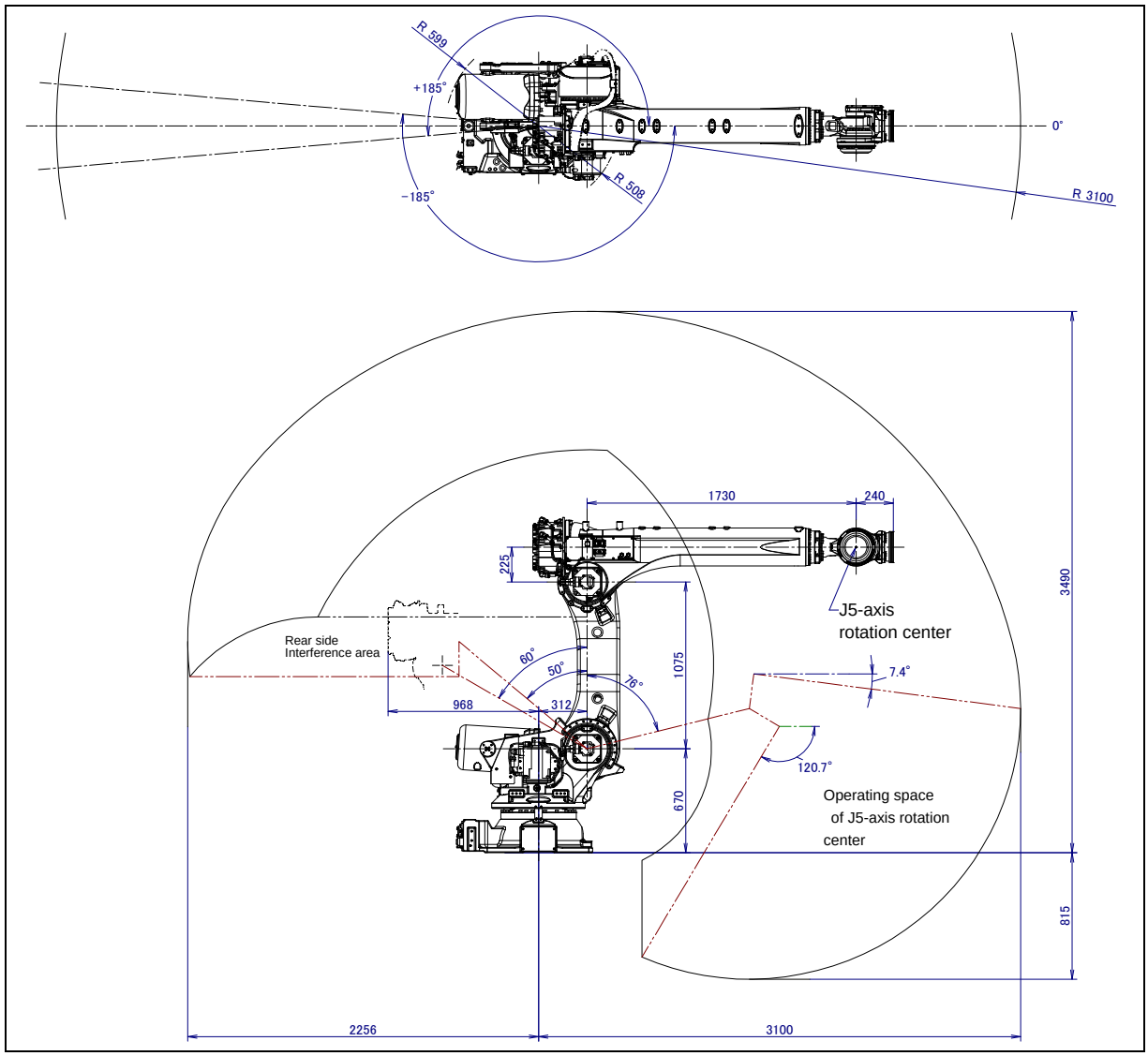


Fig. 3.2 (e) Operating space (R-2000*i*C/210L)

3.3 ZERO POINT POSITION AND MOTION LIMIT

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 zero point position due to abnormalities in servo system or system error. In addition, the motion range limit by a fixed mechanical stopper or limit switch is also prepared to improve safety.

Fig. 3.3 (a) shows the position of fixed mechanical stopper.
Only in case of J1, robot stops by transforming fixed mechanical stopper (option).
Be sure to replace transformed stopper to new one. Tighten bolts with regulated torque referring to Appendix B [MOUNTING BOLT TORQUE LIST].
Replace mechanical stopper of J1-axis referring to Section 6.2.

> ⚠ **WARNING**
> Do not reconstruct the fixed mechanical stopper. There is a possibility that the robot doesn't stop normally.

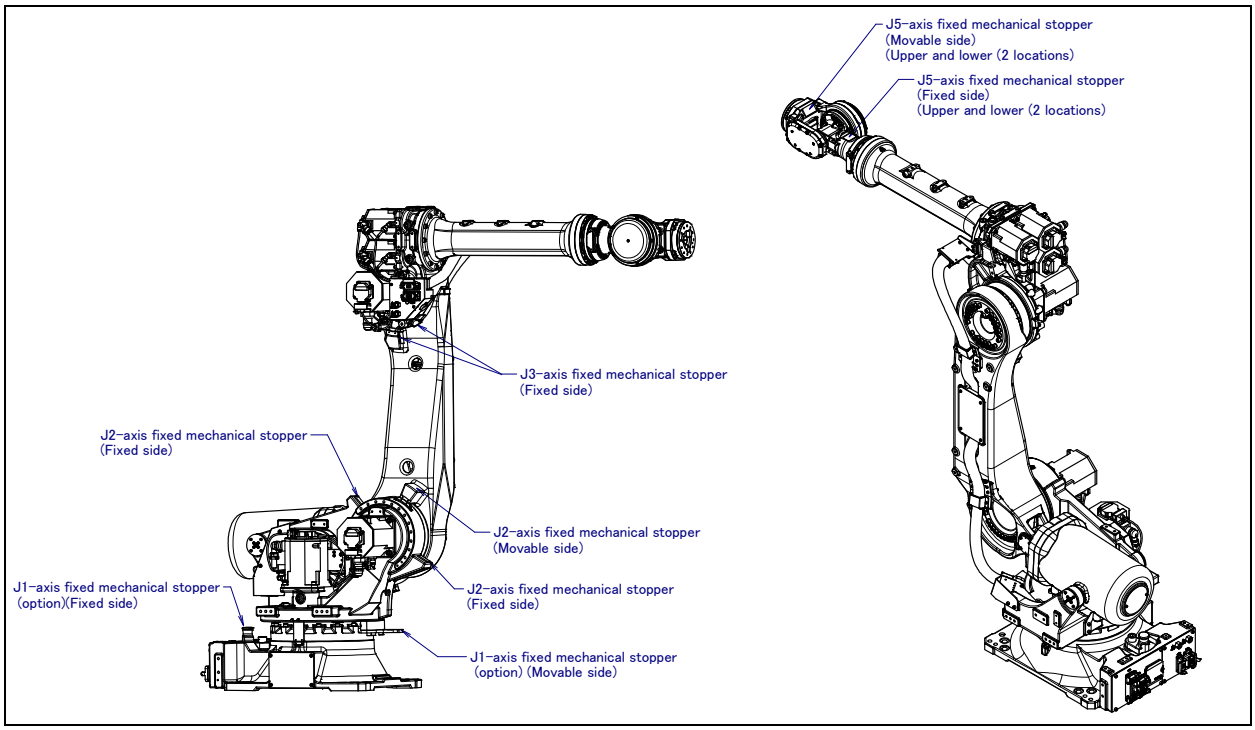


Fig. 3.3 (a) Position of fixed mechanical stopper

Fig. 3.3 (b) to (i) show the zero point and motion limit, limit switch detection position, and maximum stopping distance (stopping distance in condition of maximum speed and maximum load) of each axis.

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

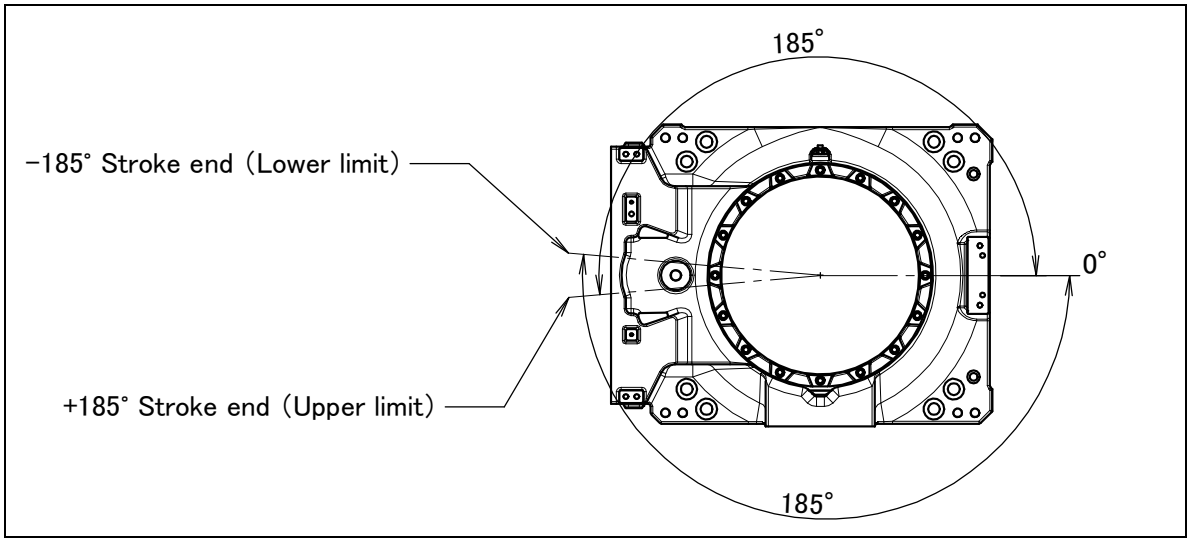


Fig. 3.3 (b) J1-axis motion limit (When fixed mechanical stopper is not specified)

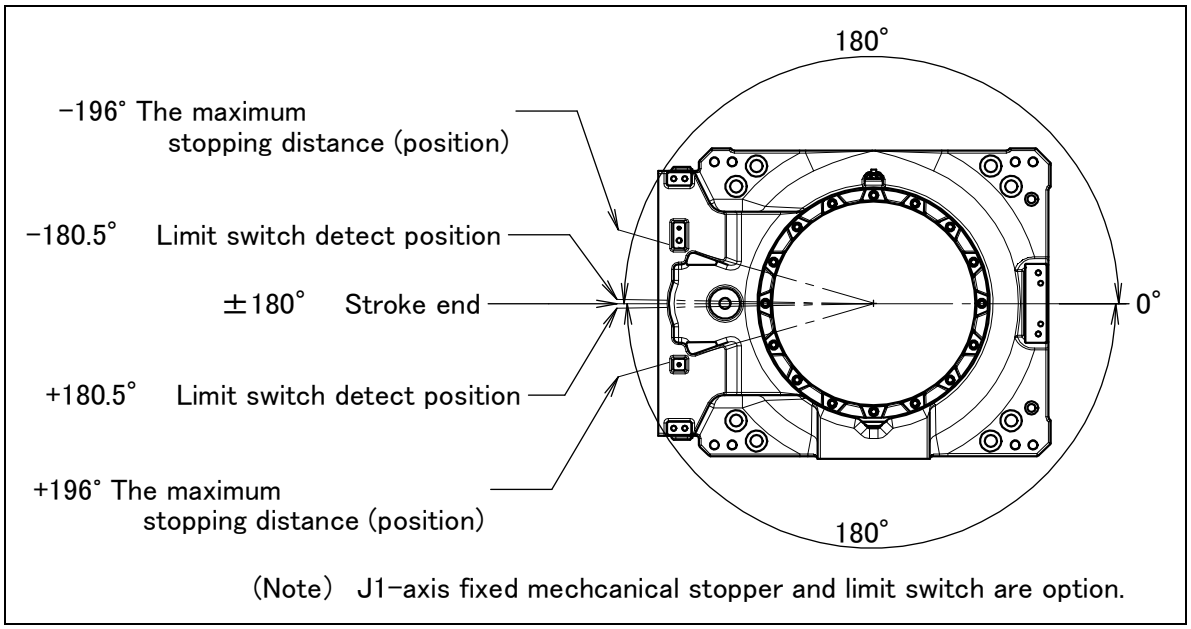
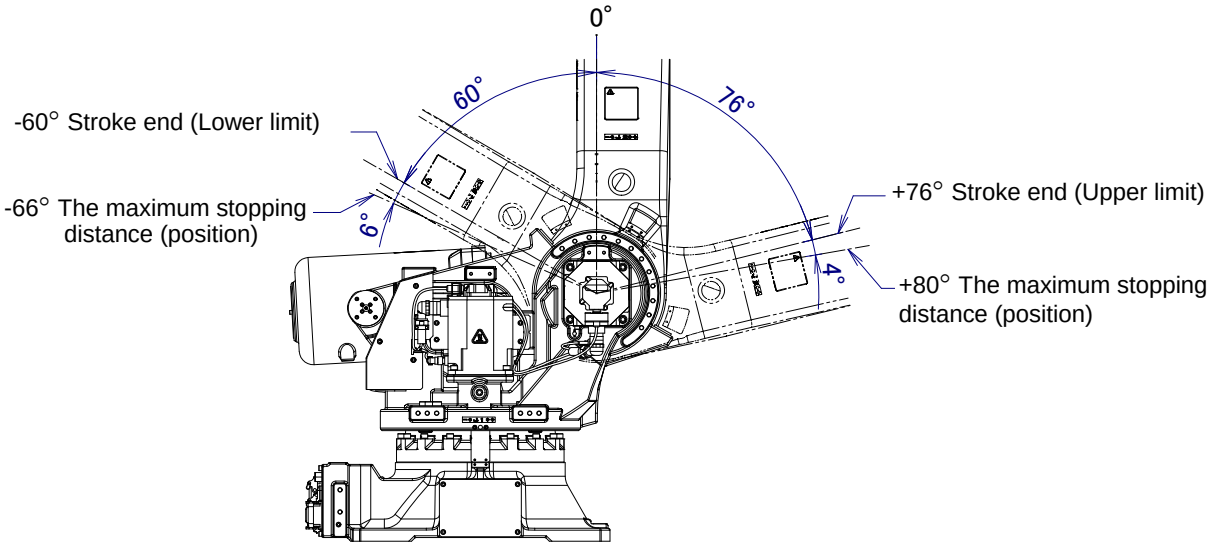
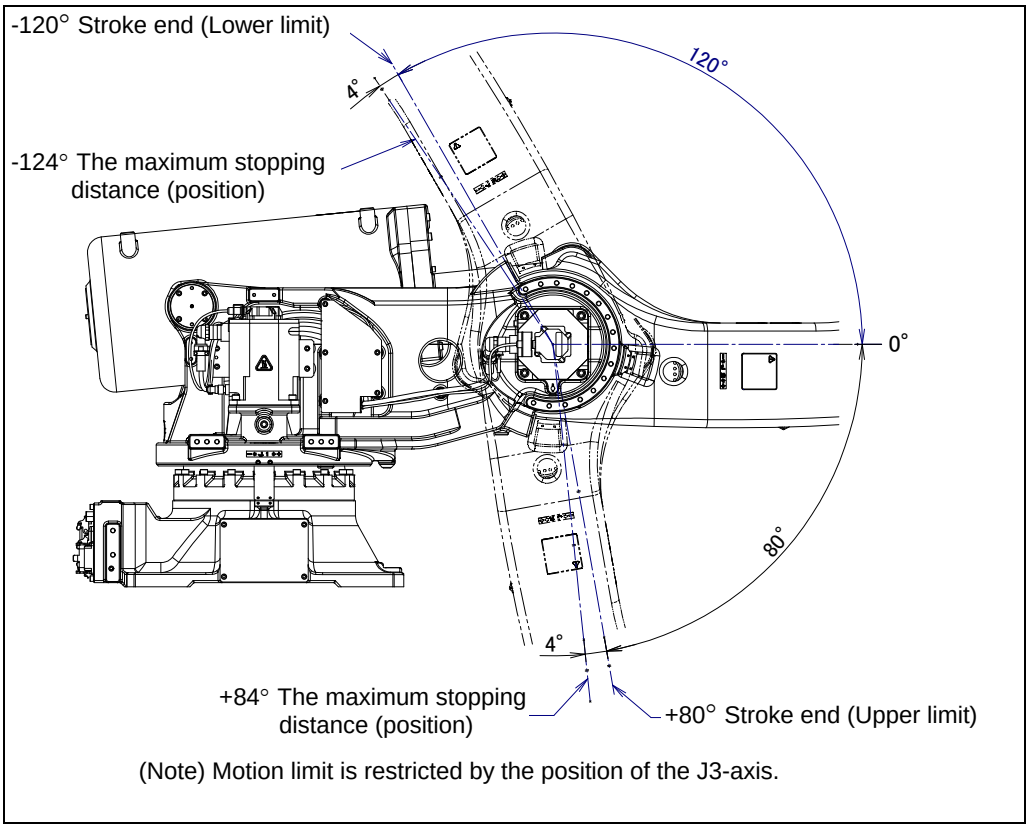


Fig. 3.3 (c) J1-axis motion limit (When fixed mechanical stopper is specified)



(Note) Motion limit is restricted by the position of the J3-axis.

Fig. 3.3 (d) J2-axis motion limit (R-2000*i*C/165F/210F/125L/270F/210L)



(Note) Motion limit is restricted by the position of the J3-axis.

Fig. 3.3 (e) J2-axis motion limit (R-2000*i*C/165R/210R)

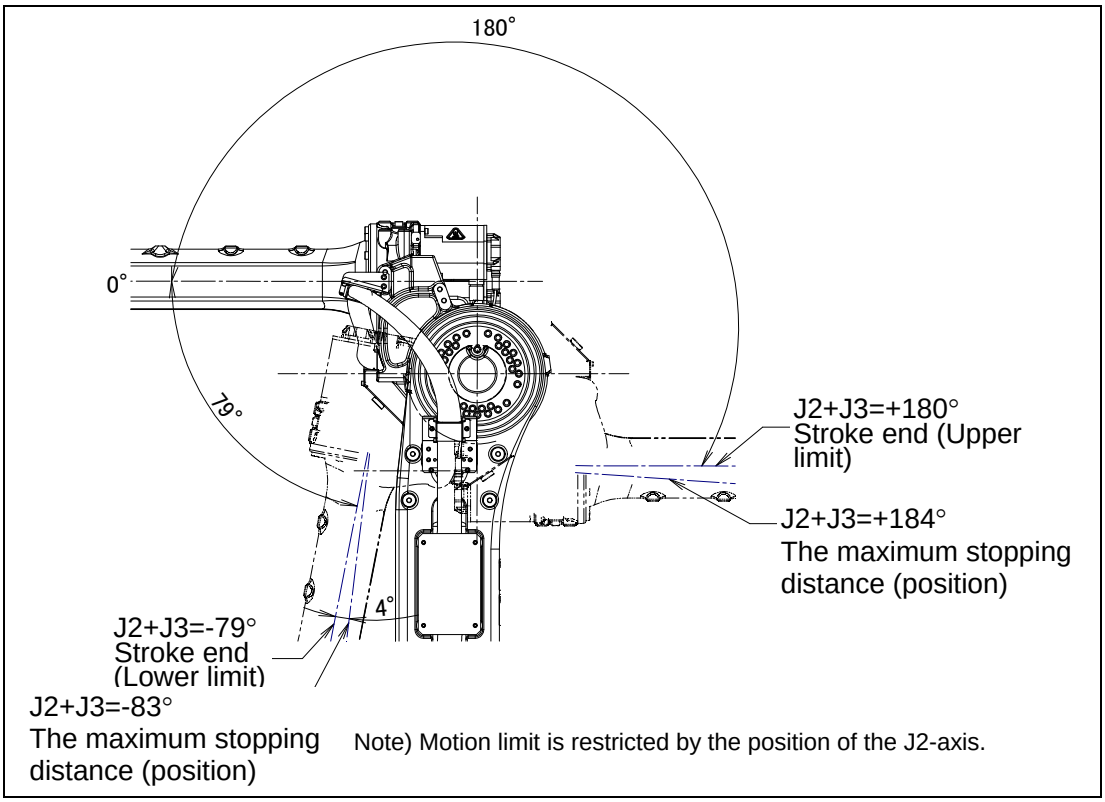


Fig. 3.3 (f) J3-axis motion limit

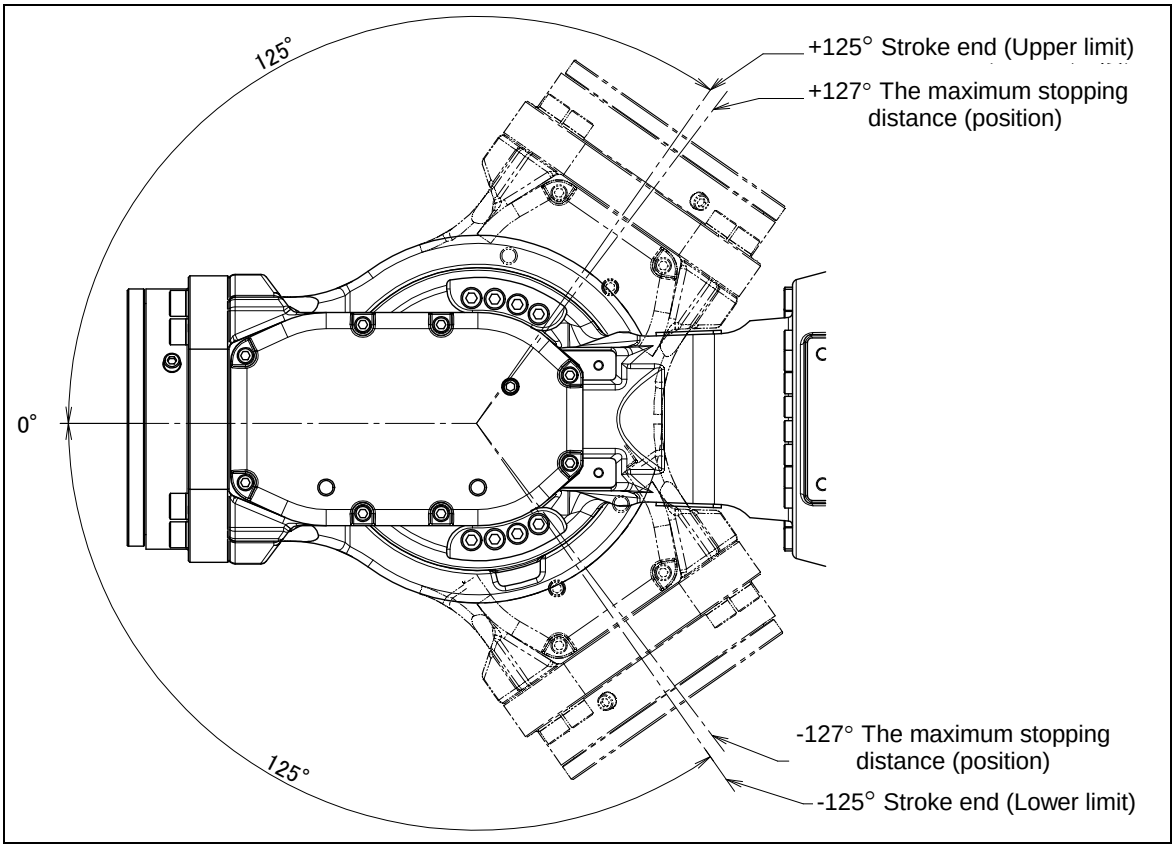


Fig. 3.3 (g) J5-axis motion limit

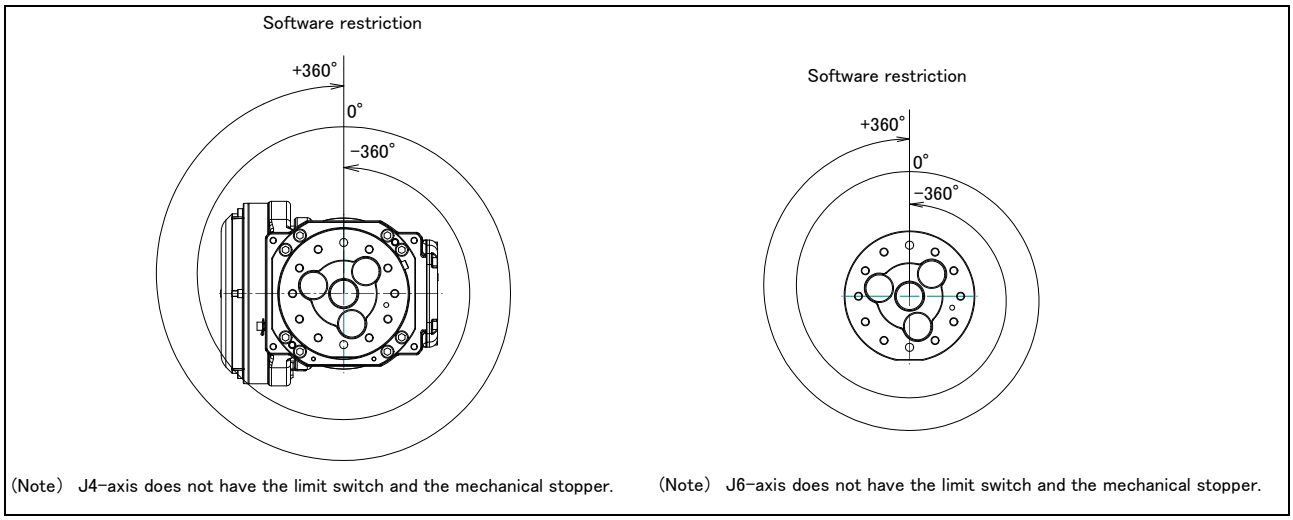


Fig. 3.3 (h) J4-axis motion limit **Fig. 3.3 (i) J6-axis motion limit**

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (a) to (j) are diagrams to limit loads applied to the wrist.

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

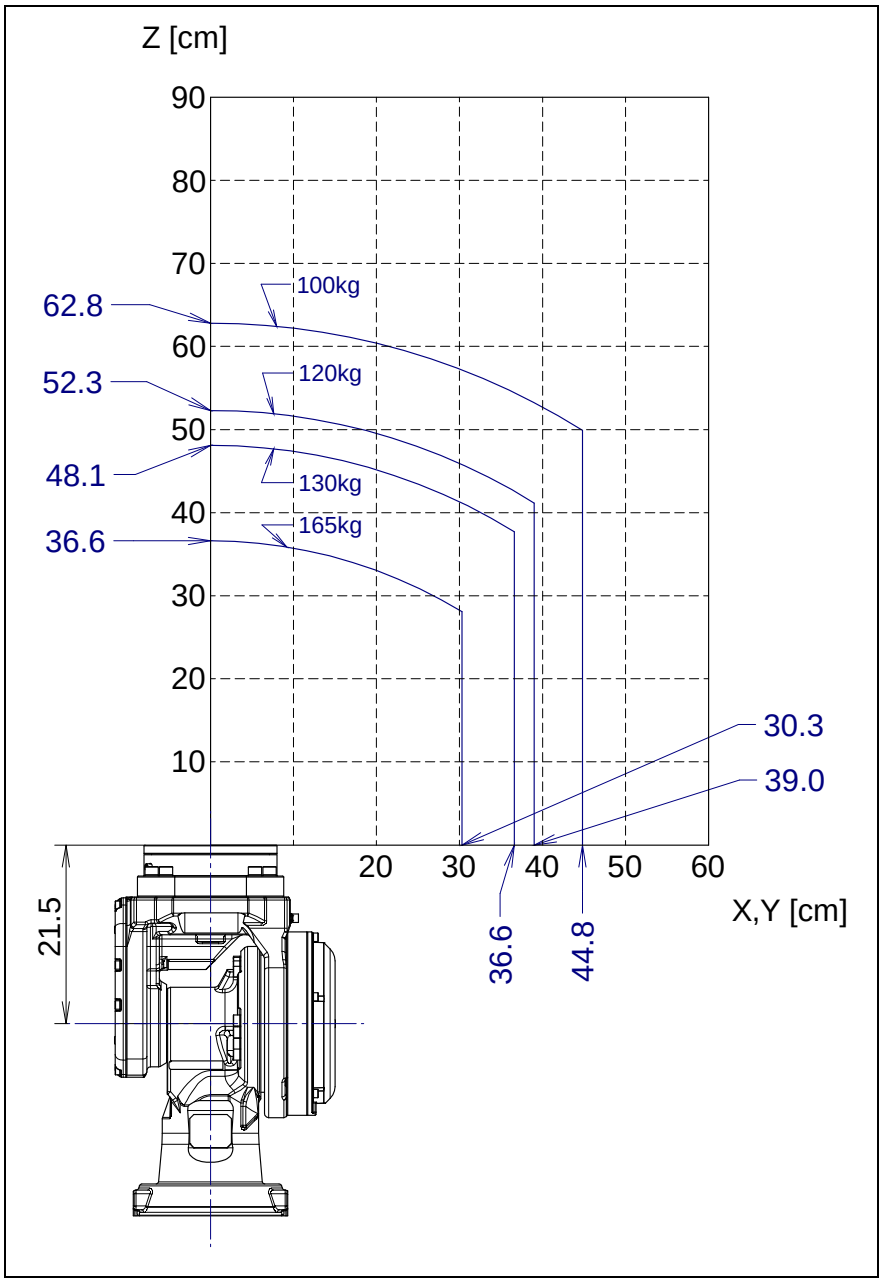


Fig. 3.4 (a) Wrist load diagram (ISO flange) (R-2000*i*C/165F/165R)

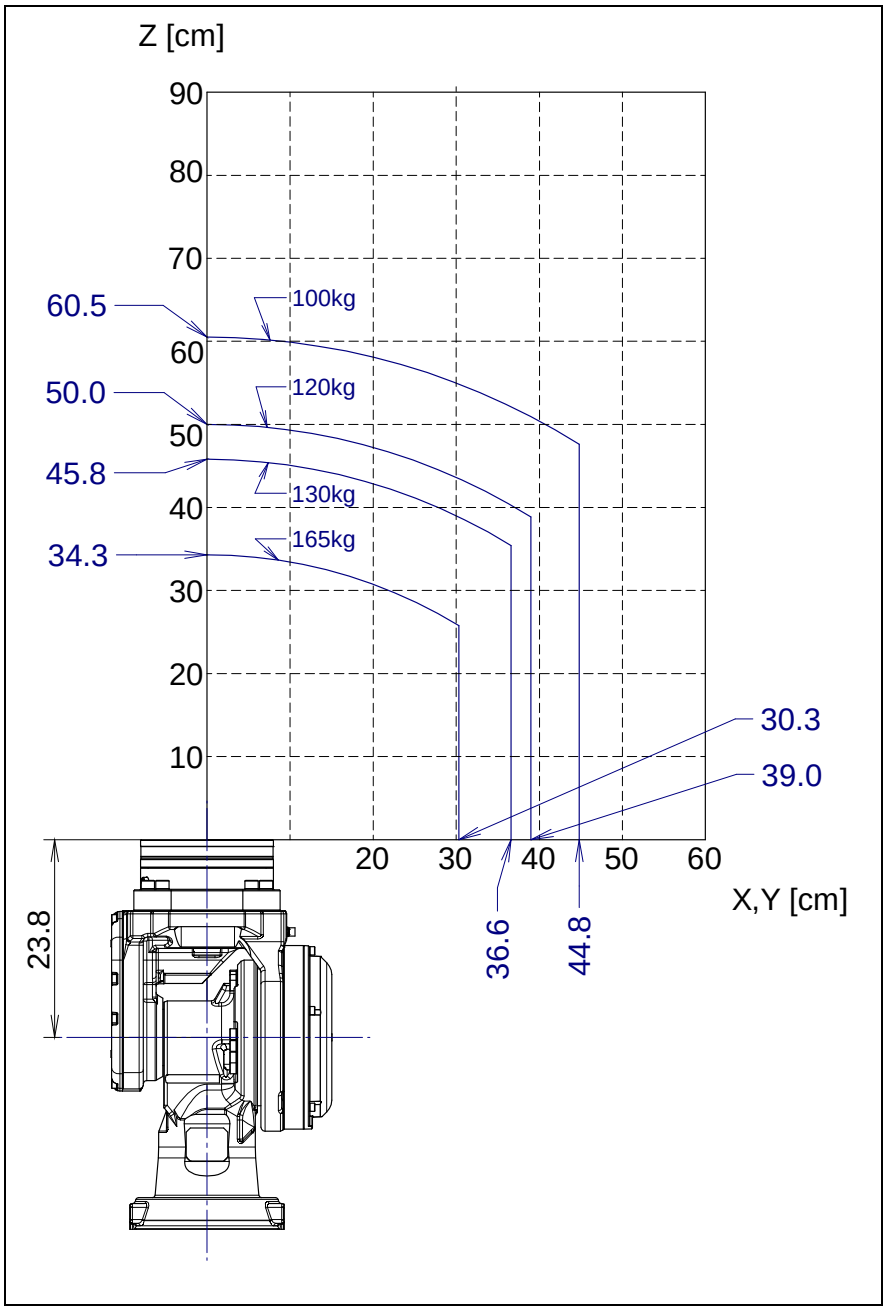


Fig. 3.4 (b) Wrist load diagram (Insulated ISO flange) (R-2000*i*C/165F/165R)

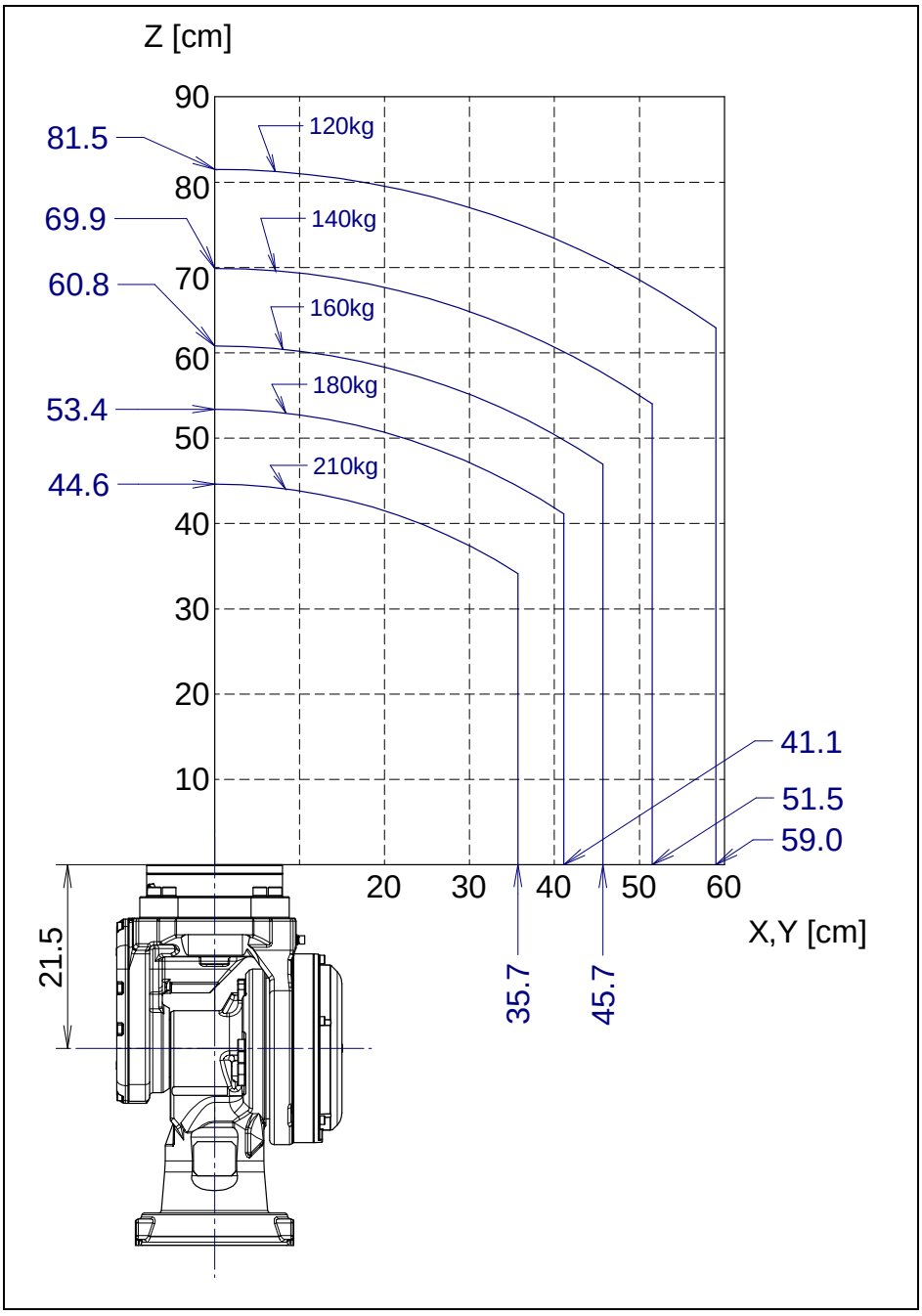


Fig. 3.4 (c) Wrist load diagram (ISO flange) (R-2000*i*C/210F/210R)

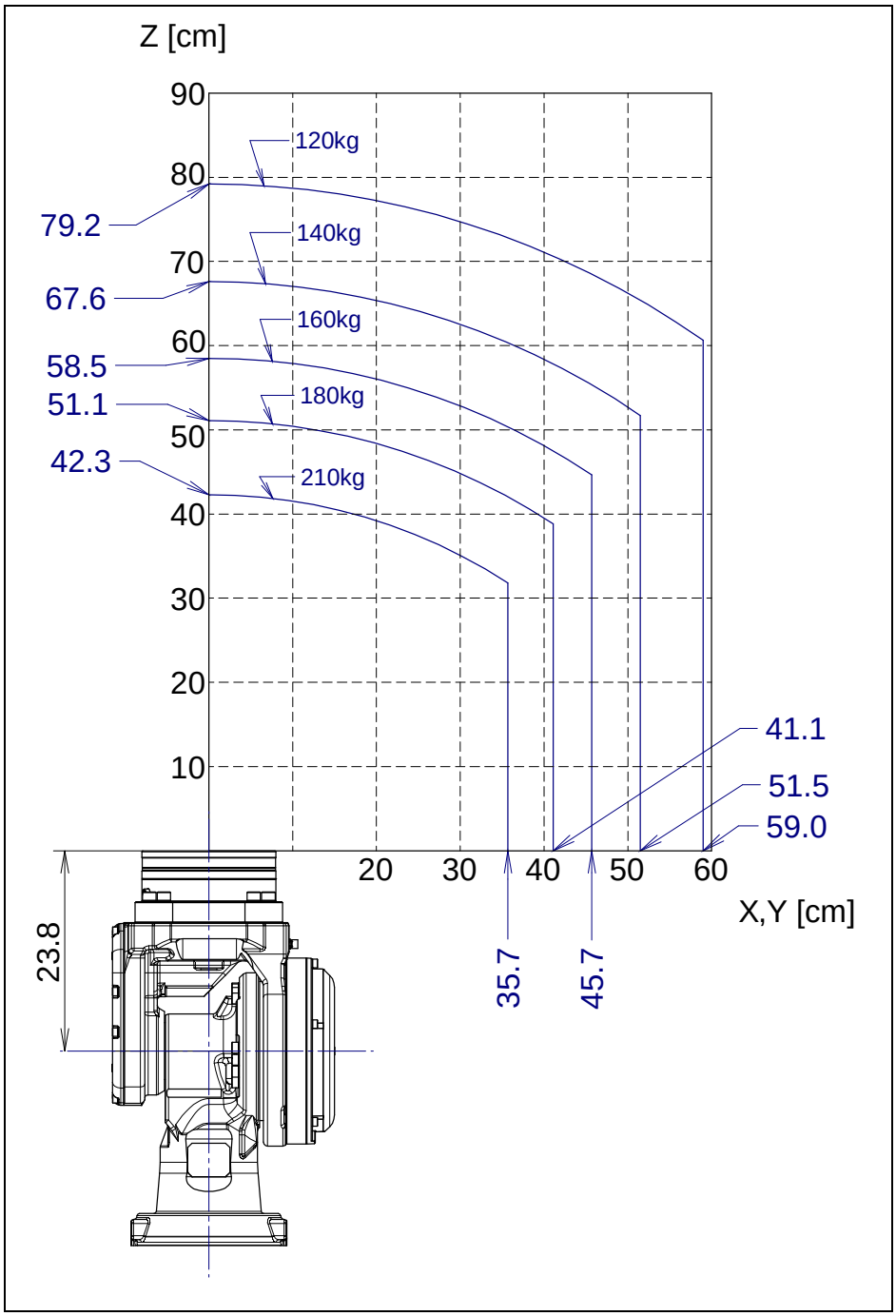


Fig. 3.4 (d) Wrist load diagram (Insulated ISO flange) (R-2000*i*C/210F/210R)

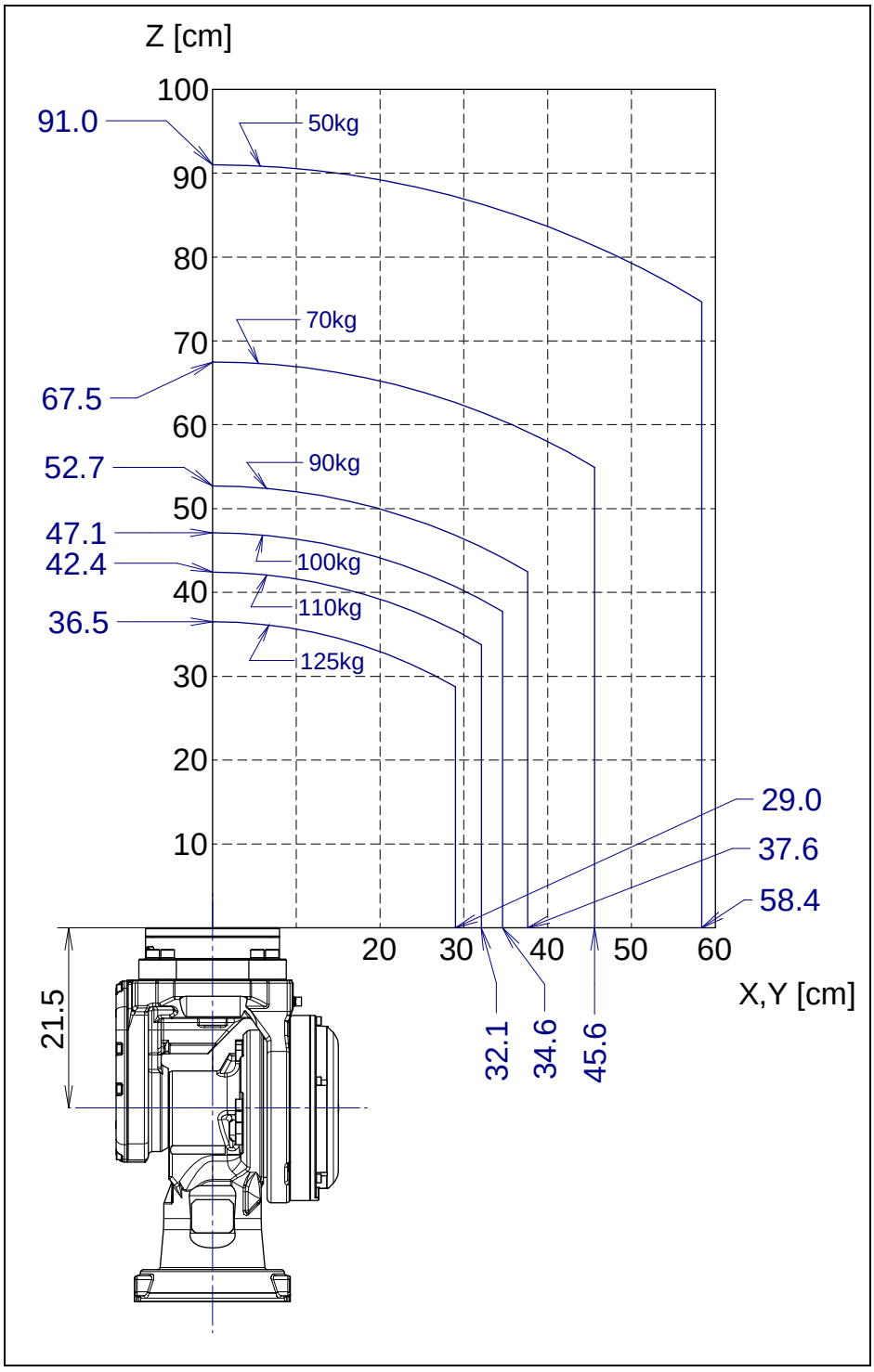


Fig. 3.4 (e) Wrist load diagram (ISO flange) (R-2000*i*C/125L)

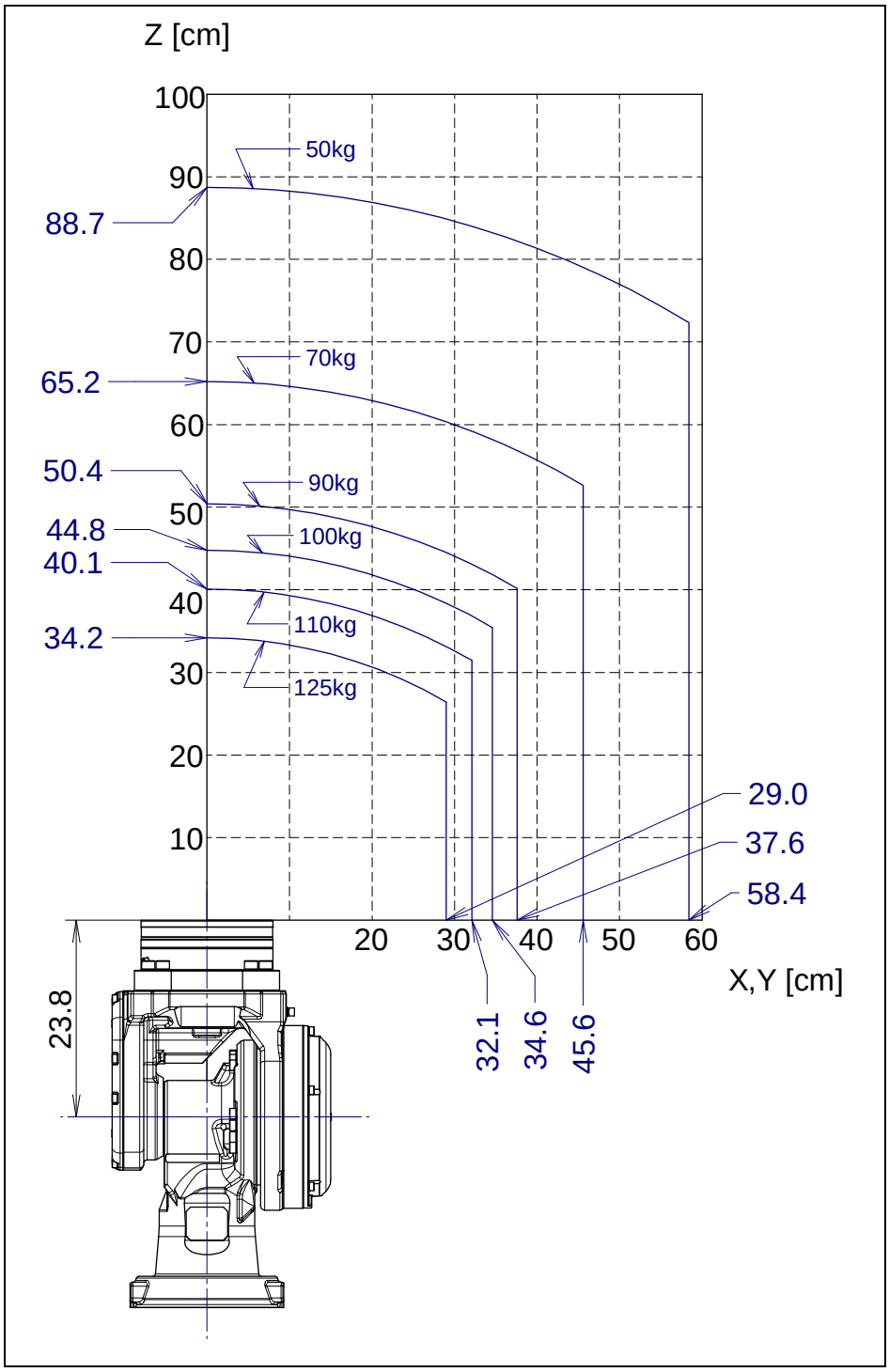


Fig. 3.4 (f) Wrist load diagram (Insulated ISO flange) (R-2000*i*C/125L)

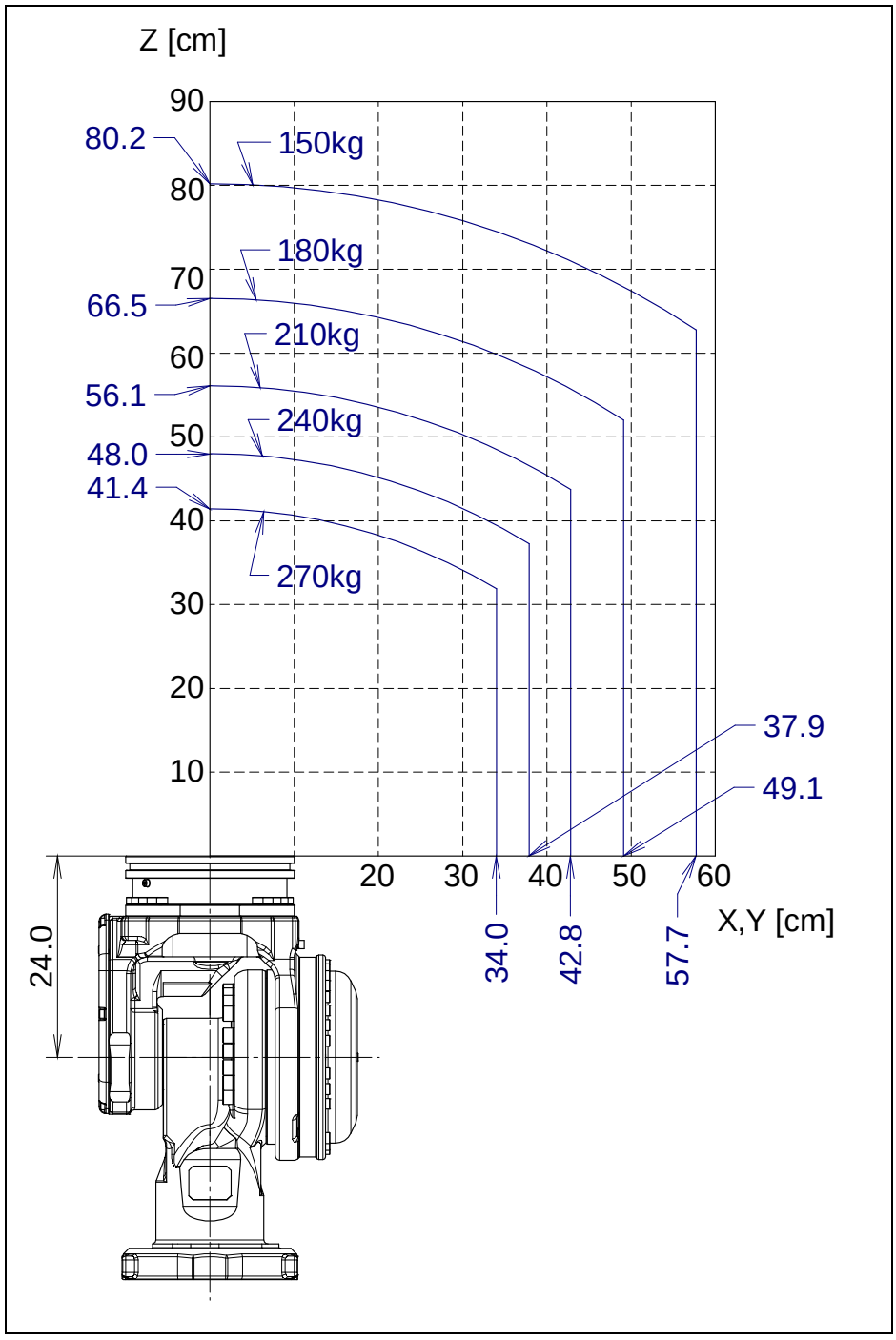


Fig. 3.4 (g) Wrist load diagram (ISO flange) (R-2000*i*C/270F)

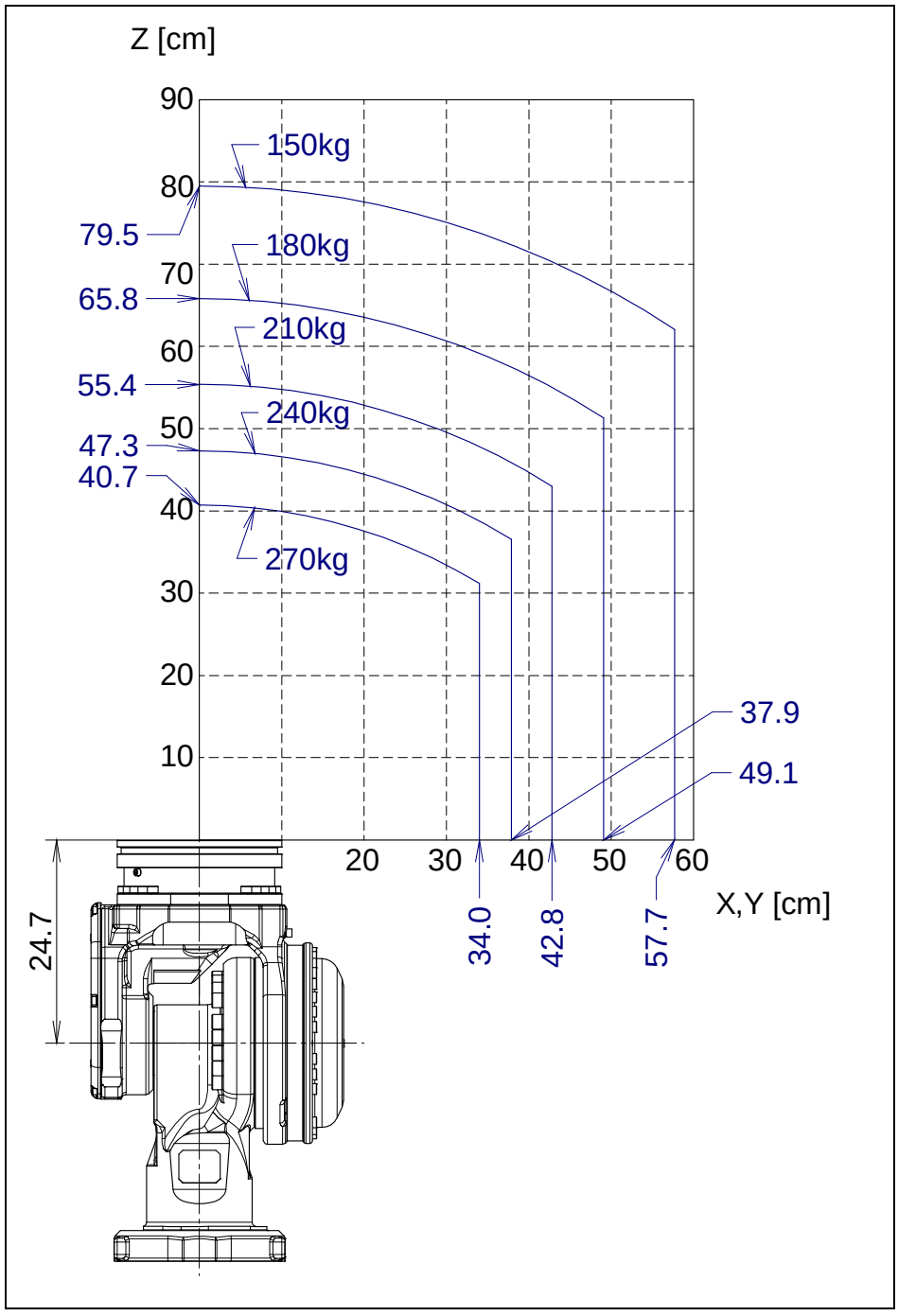


Fig. 3.4 (h) Wrist load diagram (Insulated ISO flange) (R-2000*i*C/270F)

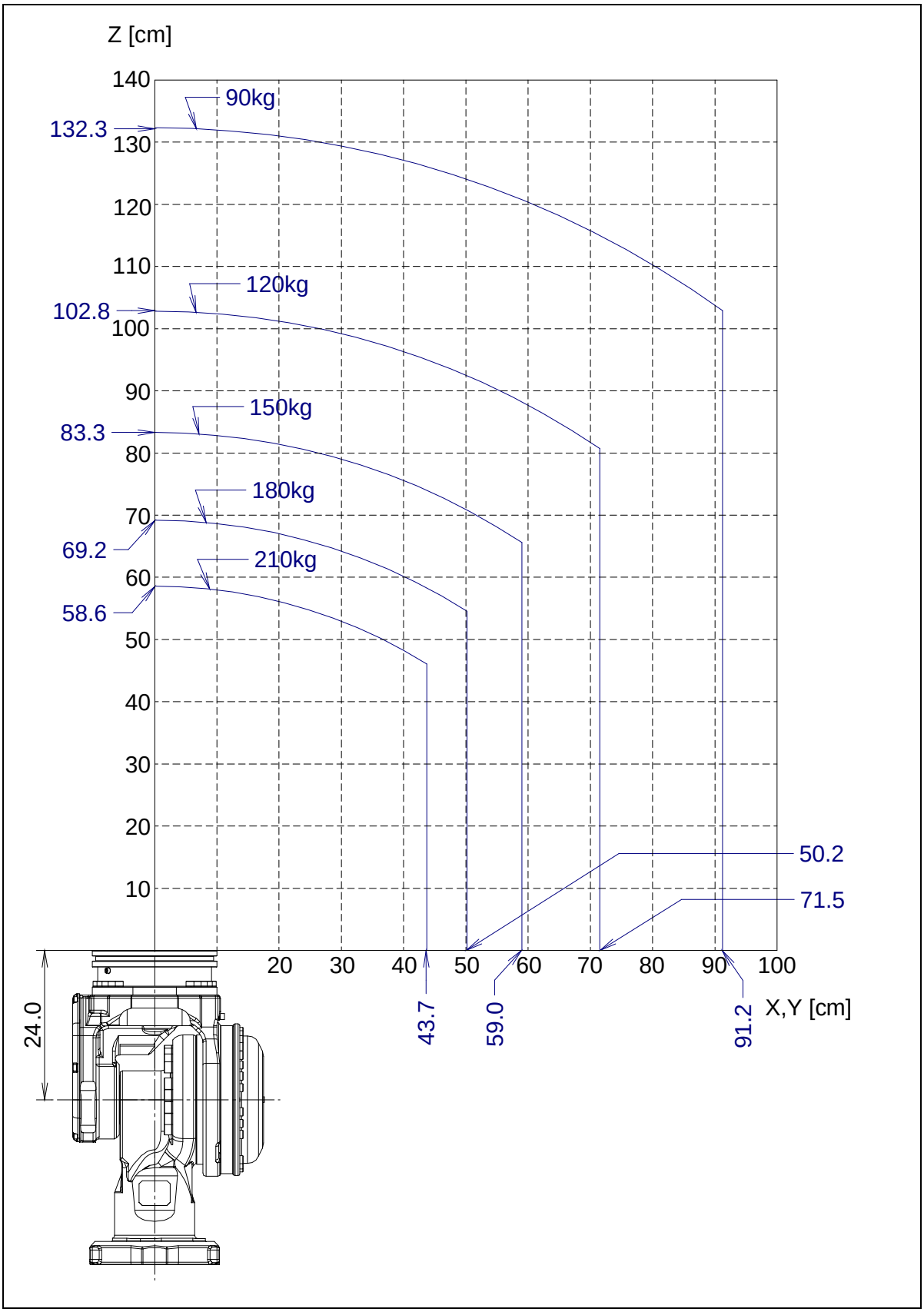


Fig. 3.4 (i) Wrist load diagram (ISO flange) (R-2000*i*C/210L)

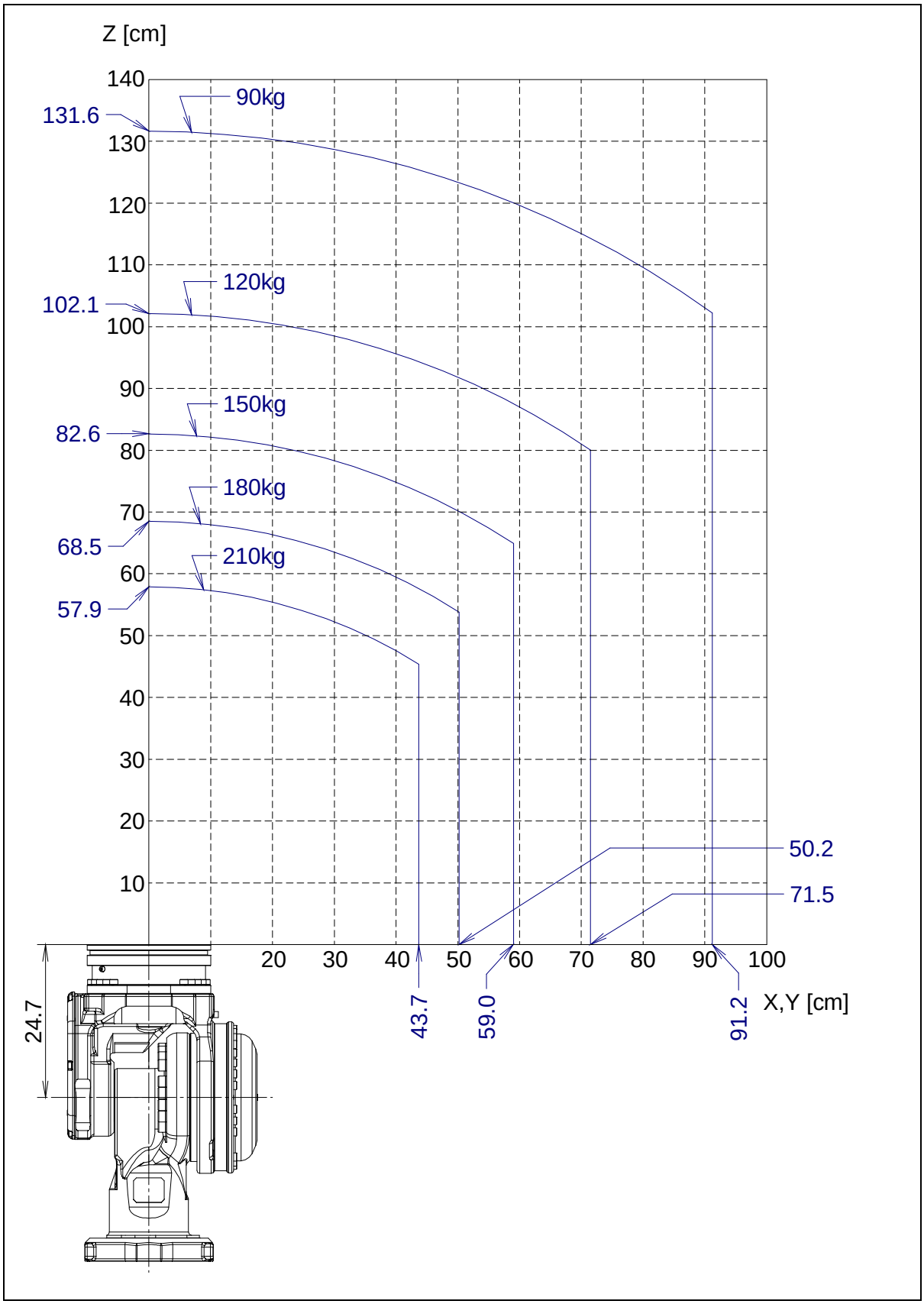


Fig. 3.4 (j) Wrist load diagram (Insulated ISO flange) (R-2000*i*C/210L)

3.5 LOAD CONDITIONS ON J2 BASE, J3 ARM AND J3 CASING

Table 3.5 (a) to (f) and Fig. 3.5 (b) to (d) show J2 base, J3 arm and J3 casing load condition.

> ⚠ **CAUTION**
> Take great care to avoid the load on the J3 arm from interfering with the J2 balancer during backflip operation of the J3-axis.

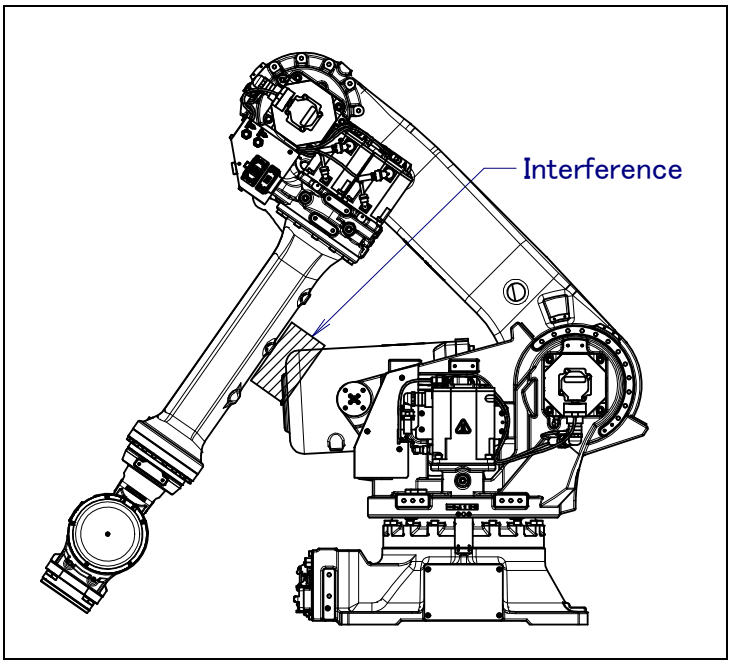


Fig. 3.5 (a) Interference of the J3 arm and the balancer

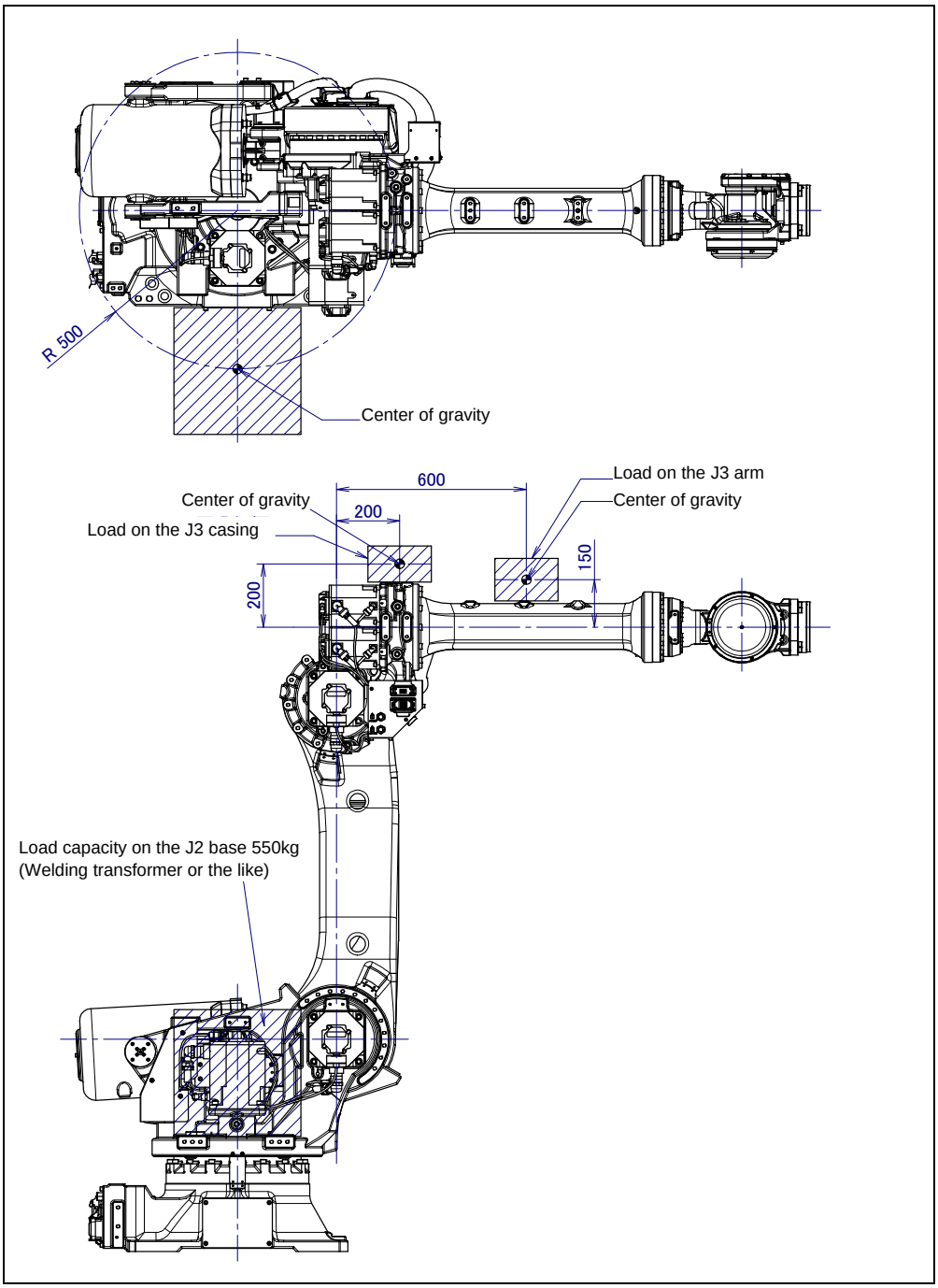


Fig. 3.5 (b) J2 base/J3 arm/J3 casing load condition (R-2000*i*C/165F/210F/125L)

Table 3.5 (a) J3 arm/J3 casing load condition (R-2000*i*C/165F/210F)

J3 arm load weight (A)	J3 casing load weight (B)
25kg or less	50kg or less
(A)+(B)≦50kg	

Table 3.5 (b) J3 arm/J3 casing load condition (R-2000*i*C/125L)

J3 arm load weight (A)	J3 casing load weight (B)
25kg or less	40kg or less
(A)+(B)≦40kg	

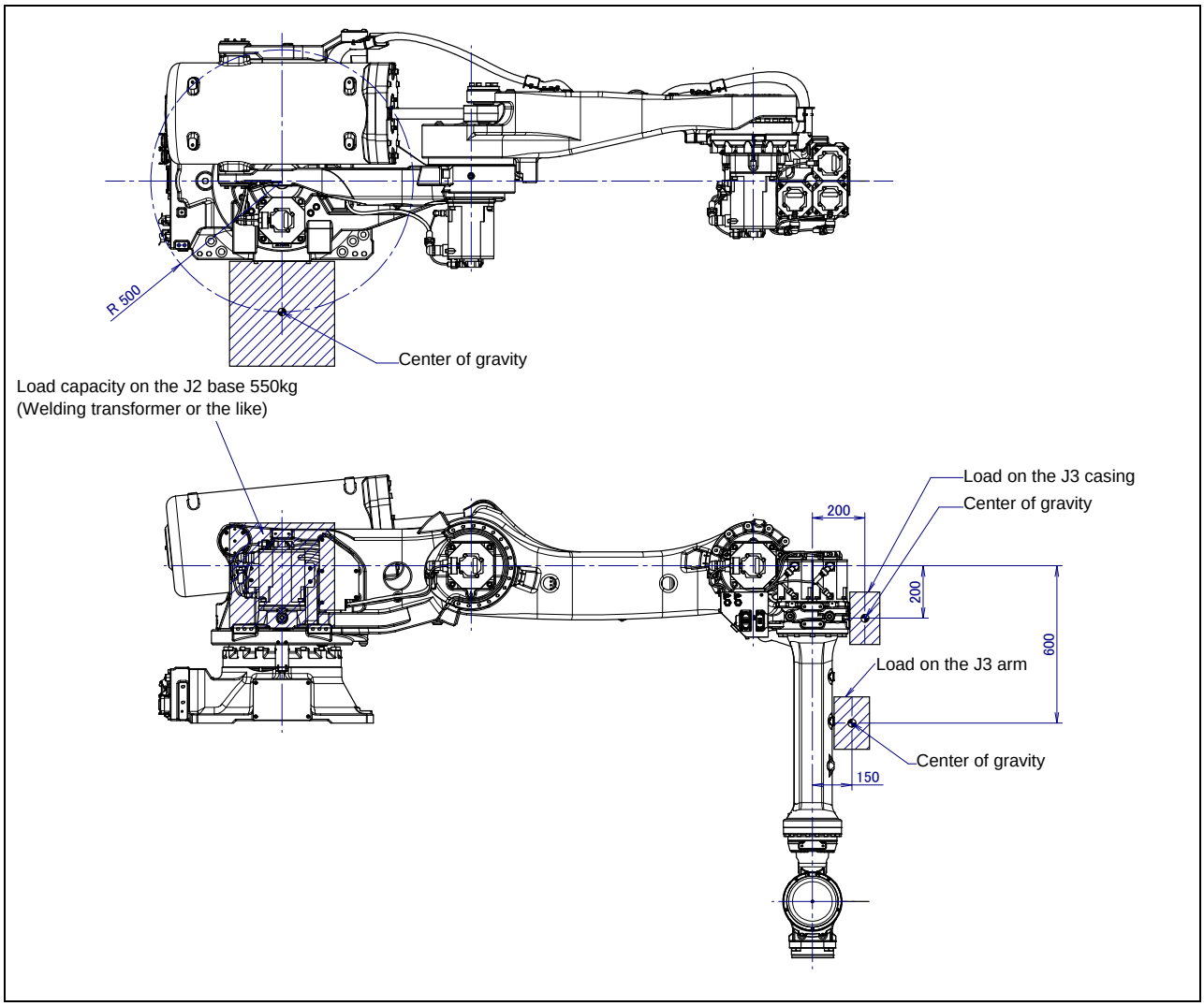


Fig. 3.5 (c) J2 base /J3 arm/J3 casing load condition (R-2000*i*C/165R/210R)

Table 3.5 (c) J3 arm/J3 casing load condition (R-2000*i*C/165R)

J3 arm load weight (A)	J3 casing load weight (B)
25kg or less	50kg or less
(A)+(B)≦50kg	

Table 3.5 (d) J3 arm/J3 casing load condition (R-2000*i*C/210R)

J3 arm load weight (A)	J3 casing load weight (B)
30kg or less	40kg or less
4/3*(A)+(B)≦40kg	

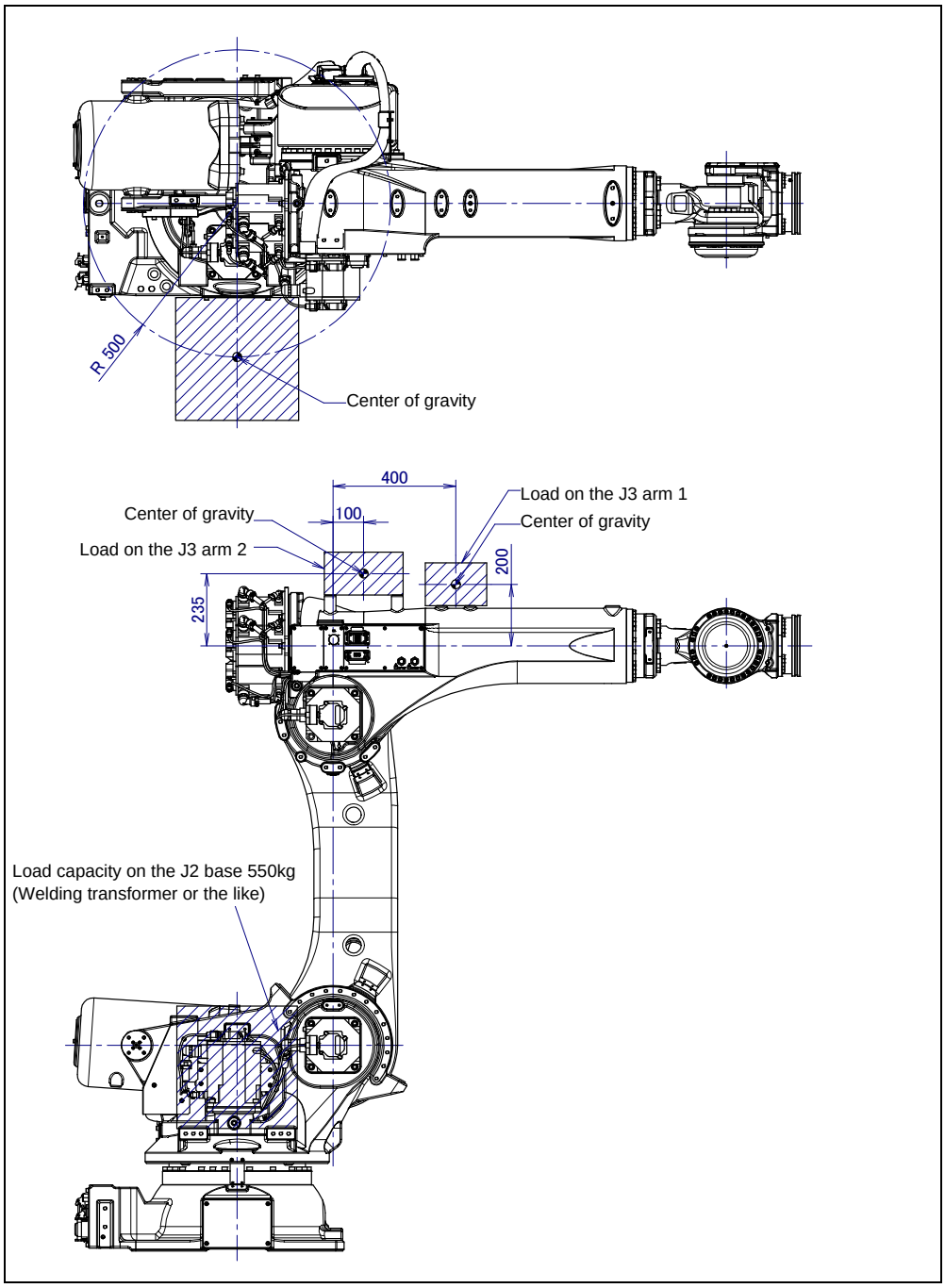


Fig. 3.5 (d) J2 base/J3 arm load condition (R-2000*i*C/270F/210L)

Table 3.5 (e) J3 arm load condition (R-2000*i*C/270F)

J3 arm load weight 1 (A)	J3 arm load weight 2 (B)
40kg or less	50kg or less
5/4*(A)+(B)≦50kg	

Table 3.5 (f) J3 arm load condition (R-2000*i*C/210L)

J3 arm load weight 1 (A)	J3 arm load weight 2 (B)
20kg or less	50kg or less
5/2*(A)+(B)≦50kg	

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) to (d) are the diagrams for installing end effectors on the wrist. To fasten the end effector, first position it by using fitting [A] or [B], two pin holes at [C], then lock it using screws at [D]. Select screws and positioning pins of a length that matches the depth of the tapped and pin holes. Fasten the bolt for fixing the end effector with following torque.

73.5±3.4Nm (750±35kgfcm)

Generally, the ISO flange is specified as the end effecter mounting face. When using the insulated ISO flange, however, the corresponding adaptor needs to be attached.

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

> ⚠ **CAUTION**
> For the high inertia mode, it is desirable to attach the end effector with 10 bolts.

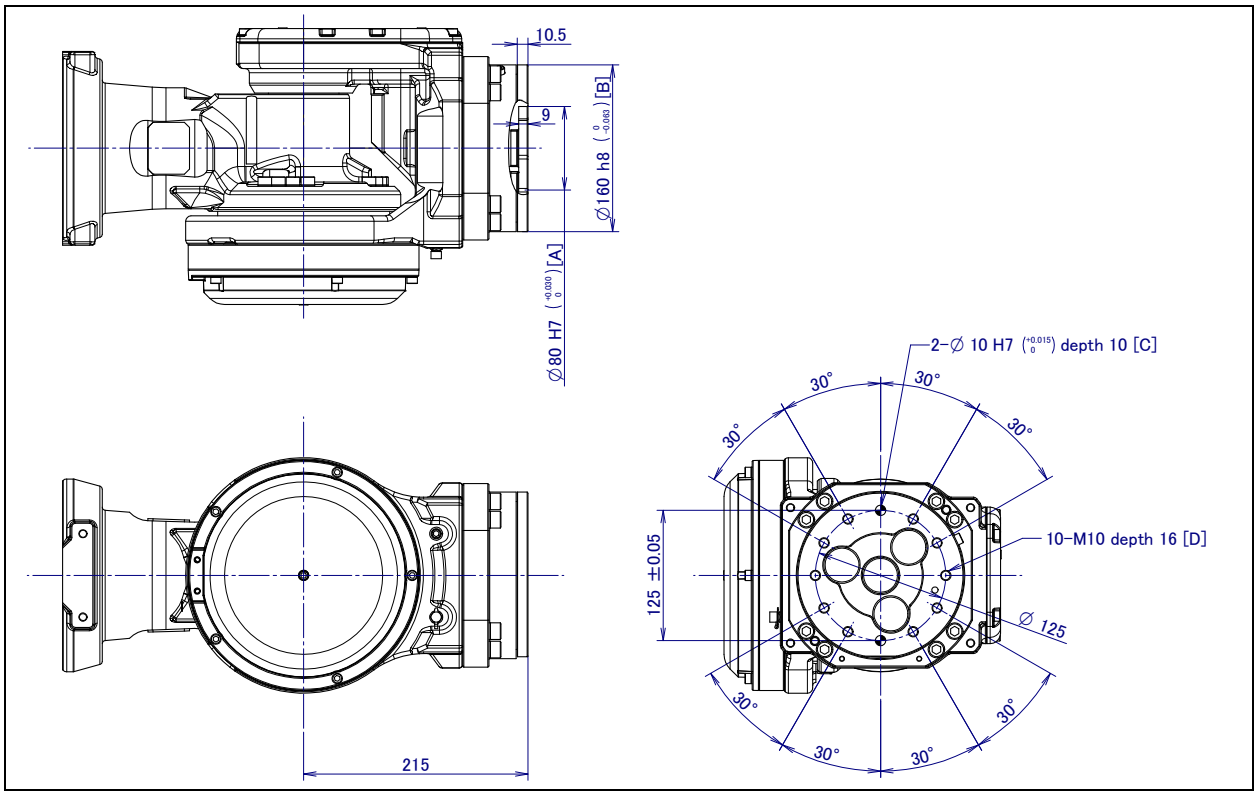


Fig. 4.1 (a) ISO flange (R-2000*i*C/165F/210F/125L/165R/210R)

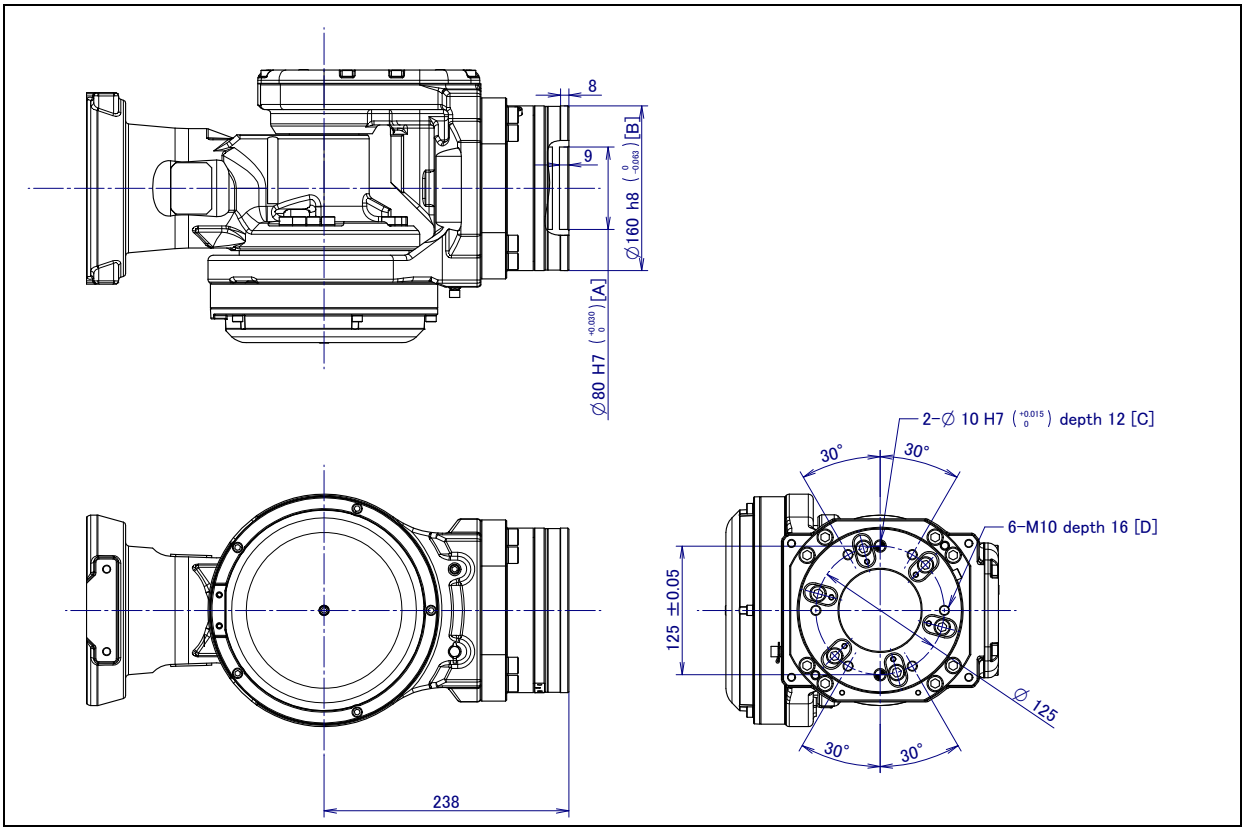


Fig. 4.1 (b) Insulated ISO flange (R-2000*i*C/165F/210F/125L/165R/210R)

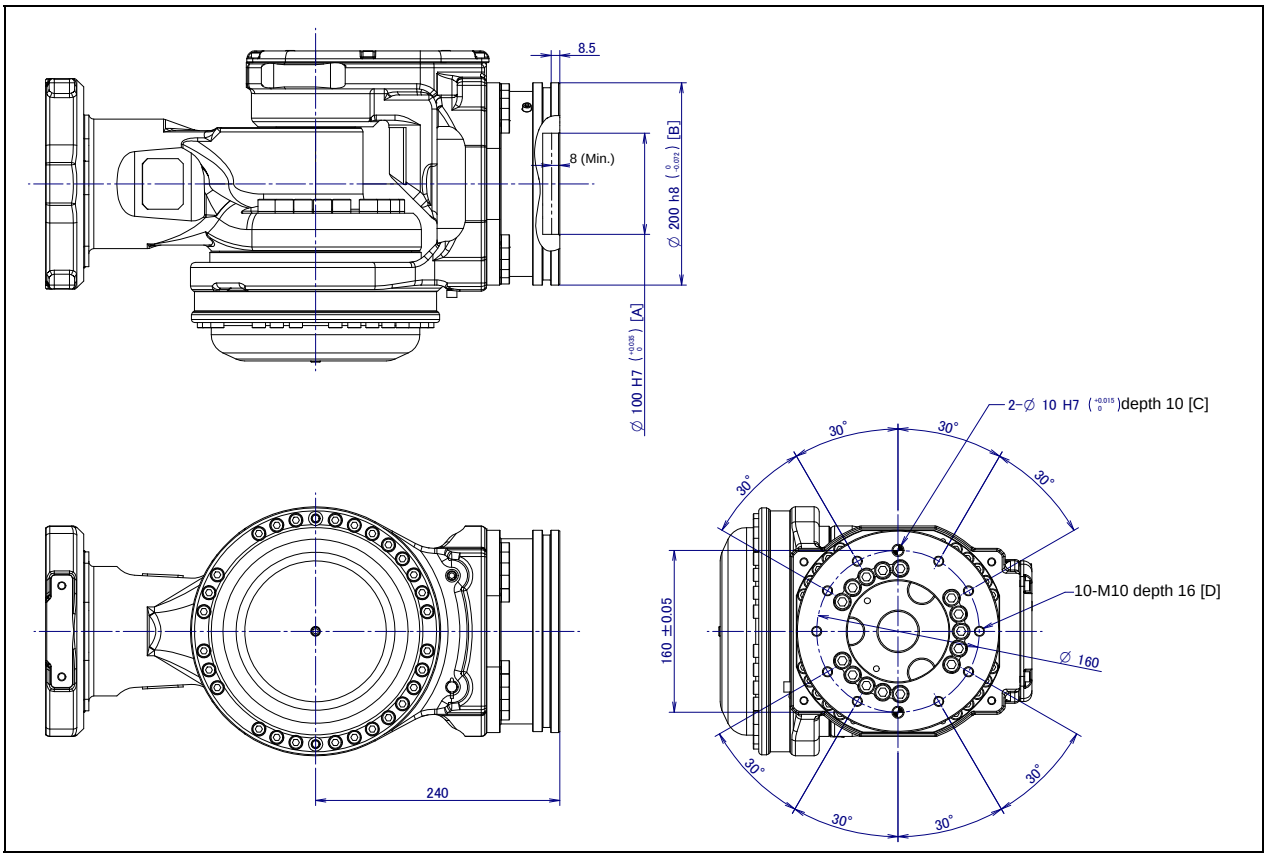


Fig. 4.1 (c) ISO flange (R-2000*i*C/270F/210L)

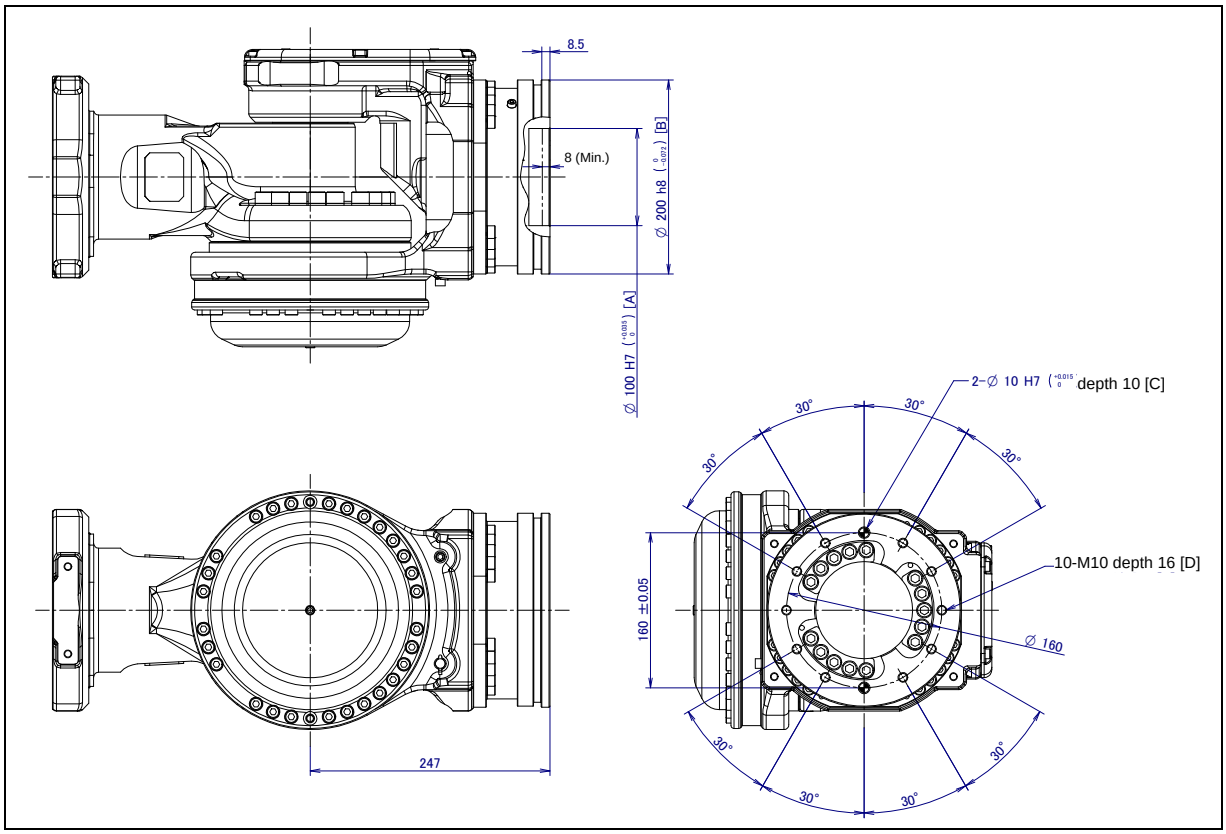


Fig. 4.1 (d) Insulated ISO flange (R-2000*i*C/270F/210L)

4.2 EQUIPMENT MOUNTING FACE

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

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

> ⚠ **CAUTION**
> When using a user tap shown in Fig. 4.2 (a) to (d), keep the center of gravity position of the equipment according to Section 3.5.

> ⚠ **CAUTION**
> Equipment should be installed so that mechanical unit cable does not interfere. If equipment interfere, the mechanical unit cable might be disconnected, and unexpected troubles might occur.

> ⚠ **CAUTION**
> 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.

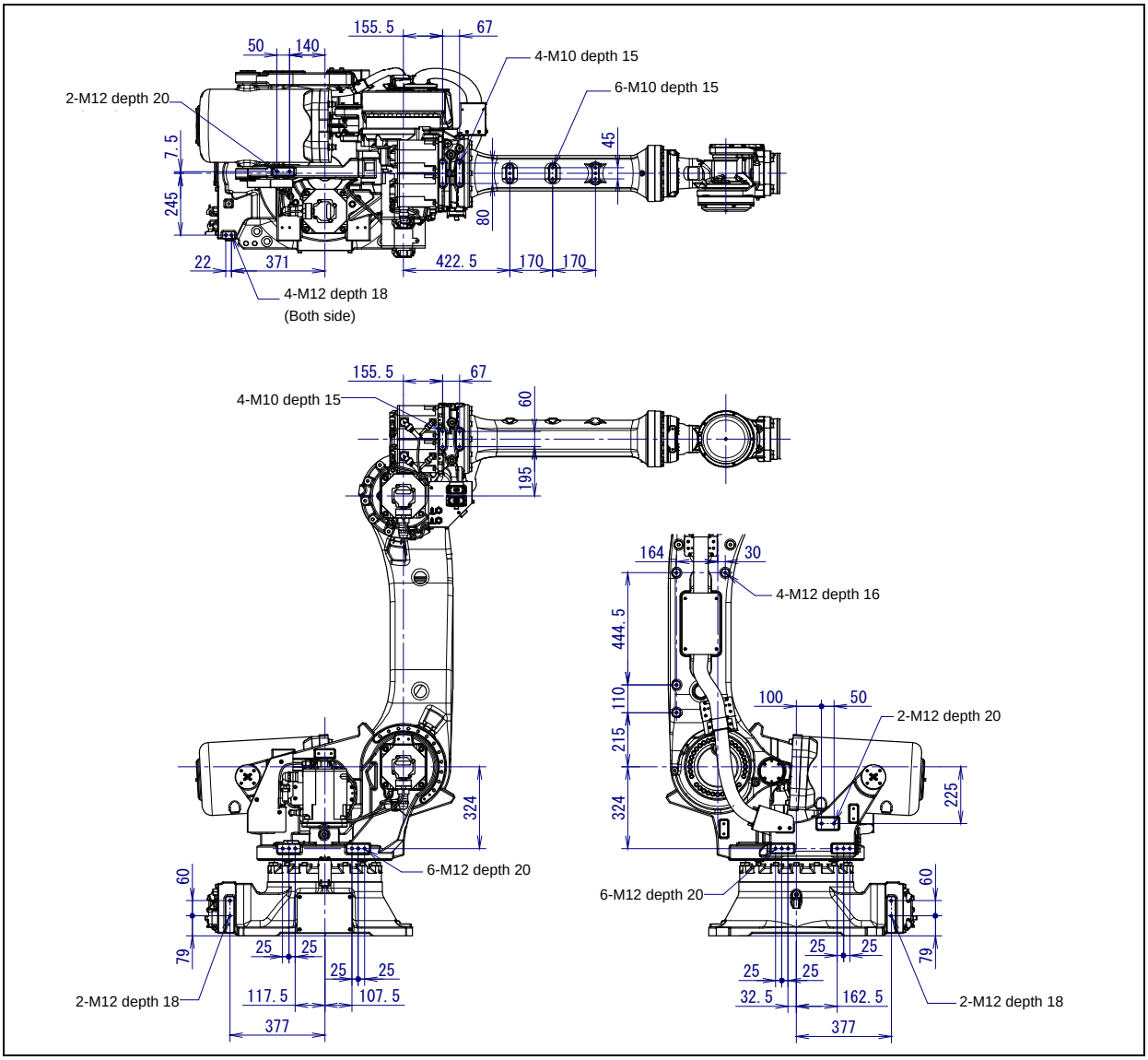


Fig. 4.2 (a) Equipment mounting faces (R-2000*i*C/165F/210F)

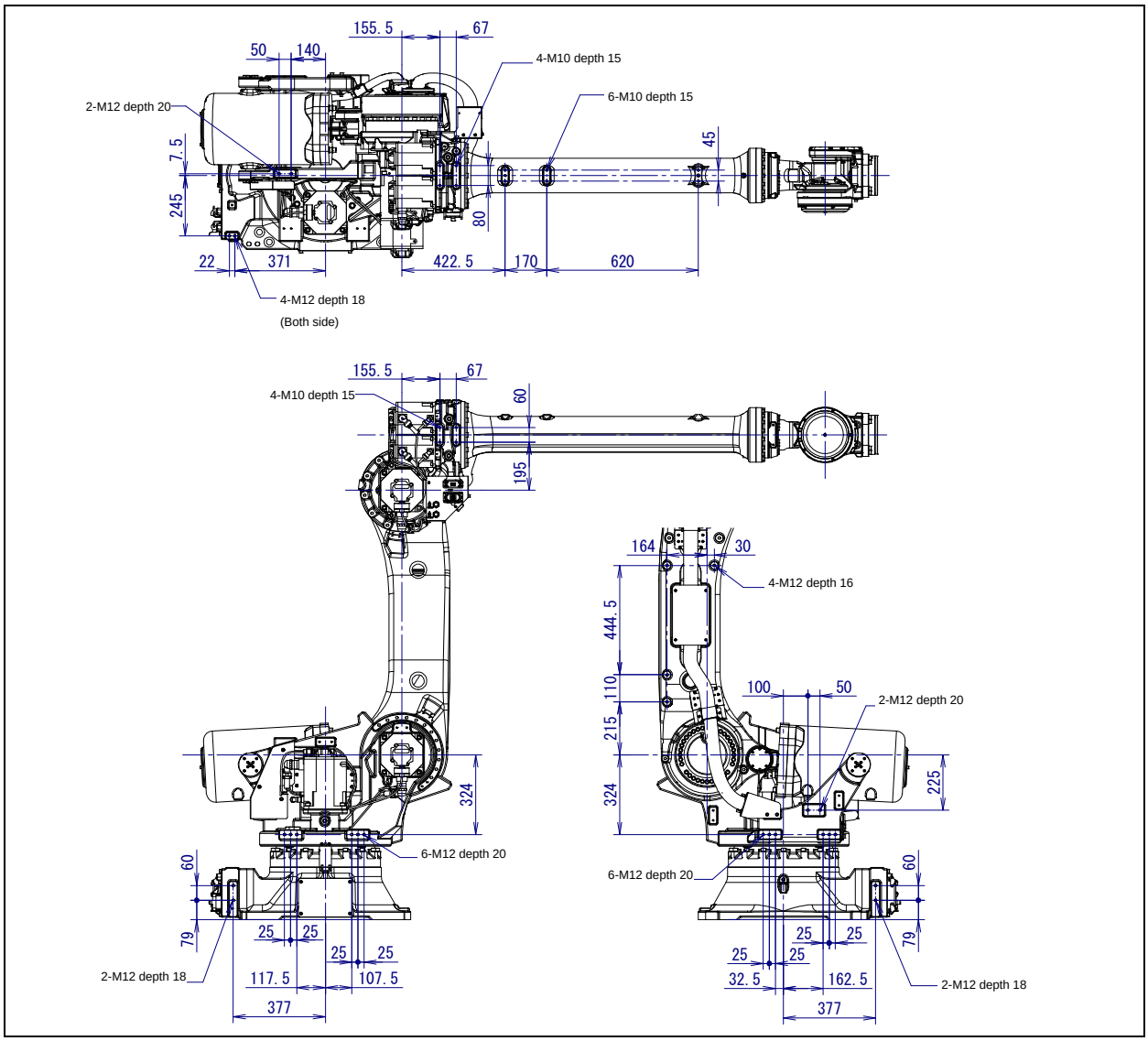


Fig. 4.2 (b) Equipment mounting faces (R-2000*i*C/125L)

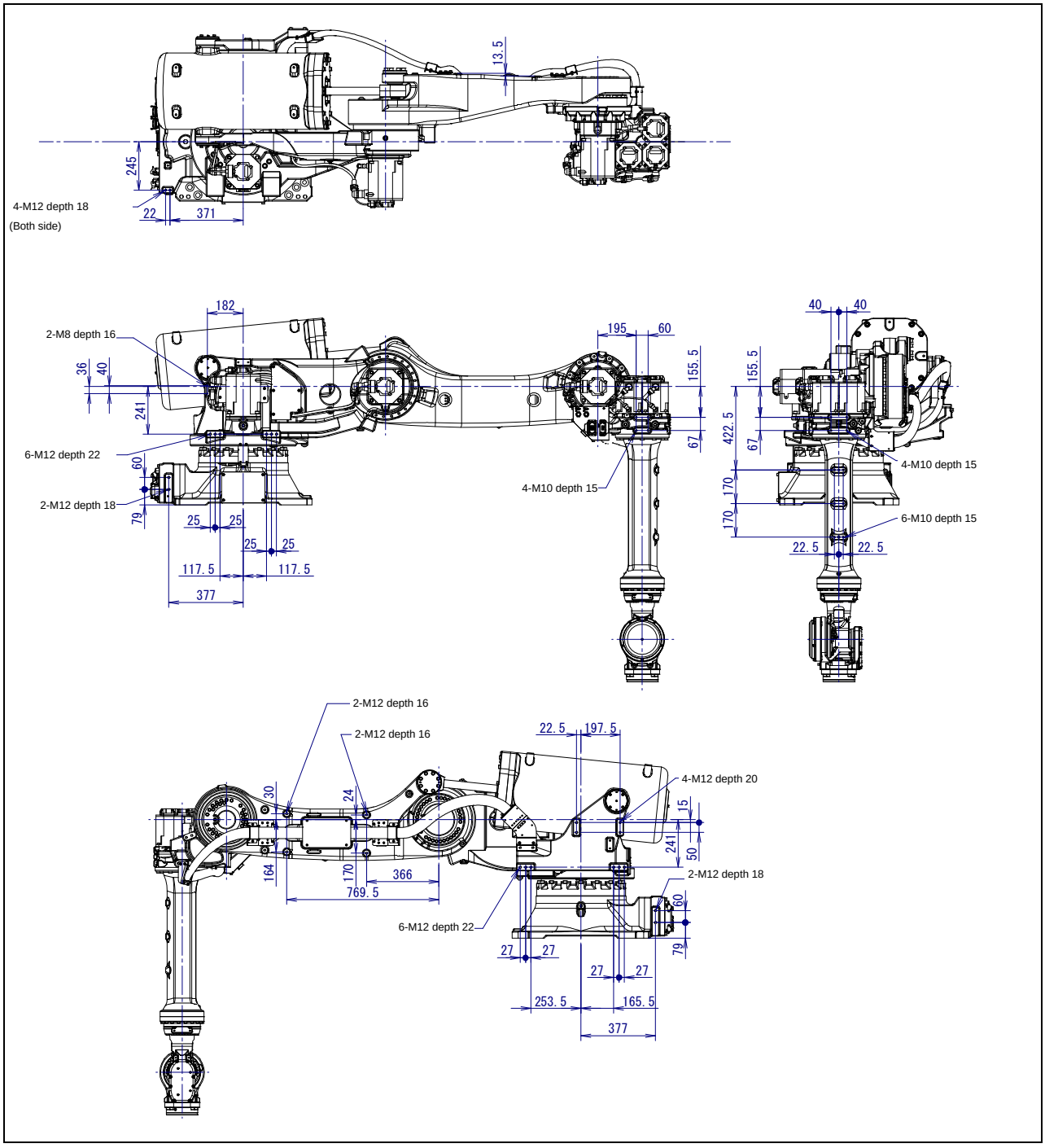


Fig. 4.2 (c) Equipment mounting faces (R-2000*i*C/165R/210R)

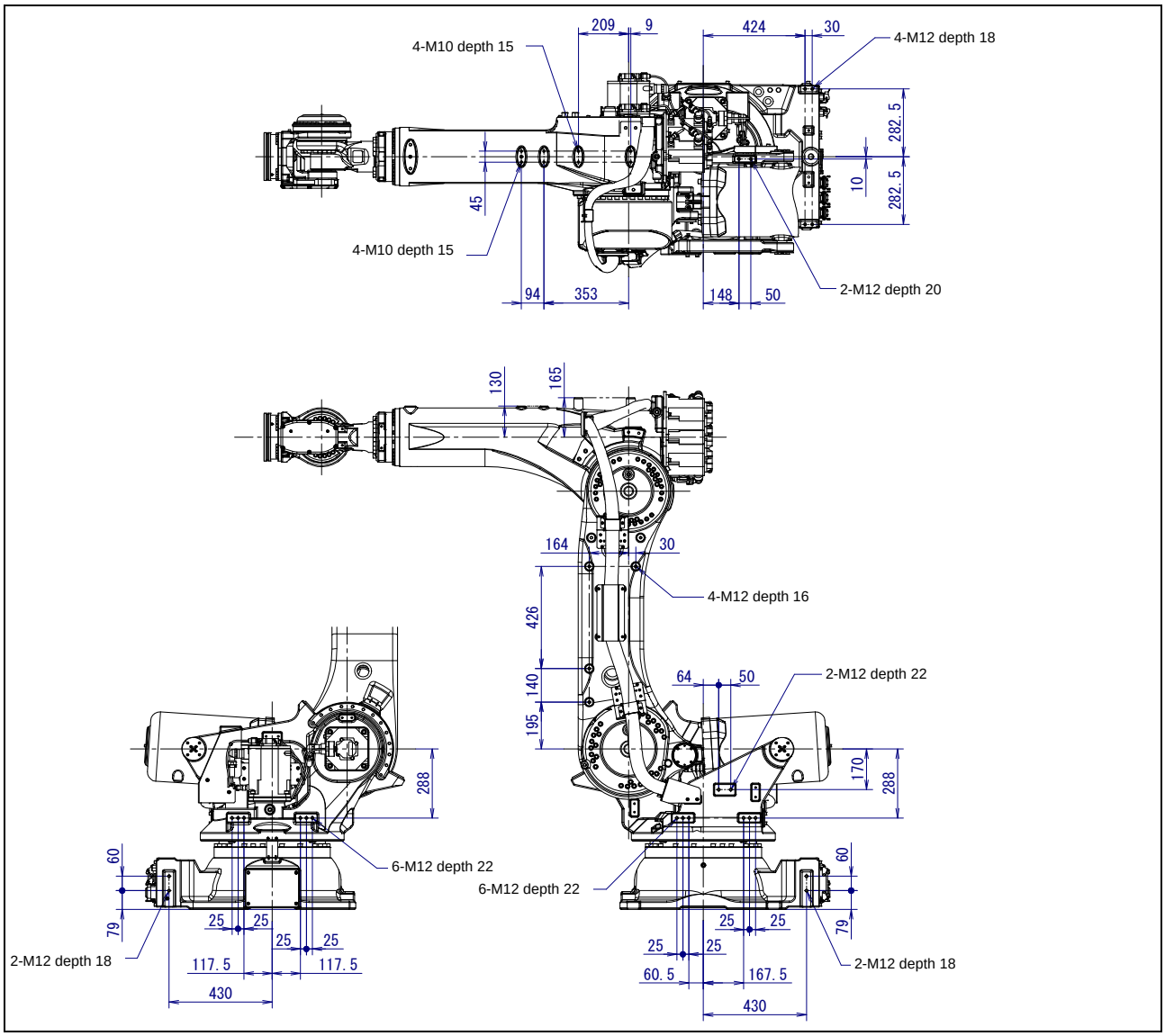


Fig. 4.2 (d) Equipment mounting faces (R-2000*i*C/270F/210L)

4.3 LOAD SETTING

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

> ⚠ **CAUTION**
> WHEN PERFORMING LOAD ESTIMATION AFTER PARTS REPLACEMENT
> If wrist axis motors (J5/J6-axis) or reducers are replaced, payload estimation accuracy may decrease. Perform calibration of load estimation without the load such as hand before performing load estimation.
> Refer to Chapter 9 “LOAD ESTIMATION” in the R-30*i*B/R-30*i*B Mate Controller Optional Function OPERATOR’S MANUAL

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          165.00      [                ]
 2            0.00      [                ]
 3            0.00      [                ]
 4            0.00      [                ]
 5            0.00      [                ]
 6            0.00      [                ]
 7            0.00      [                ]
 8            0.00      [                ]
 9            0.00      [                ]
10            0.00      [                ]

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

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

```
MOTION PAYLOAD SET              JOINT   100%

    Group 1
    Schedule No[    1]: [Comment          ]
 1  PAYLOAD                [kg]        165.00
 2  PAYLOAD CENTER   X     [cm]        -28.33
 3  PAYLOAD CENTER   Y     [cm]          0.00
 4  PAYLOAD CENTER   Z     [cm]         27.78
 5  PAYLOAD INERTIA X      [kgfcms^2]   56.84
 6  PAYLOAD INERTIA Y      [kgfcms^2]   59.39
 7  PAYLOAD INERTIA Z      [kgfcms^2]   15.10

 [TYPE]  GROUP  NUMBER  DEFAULT  HELP
```

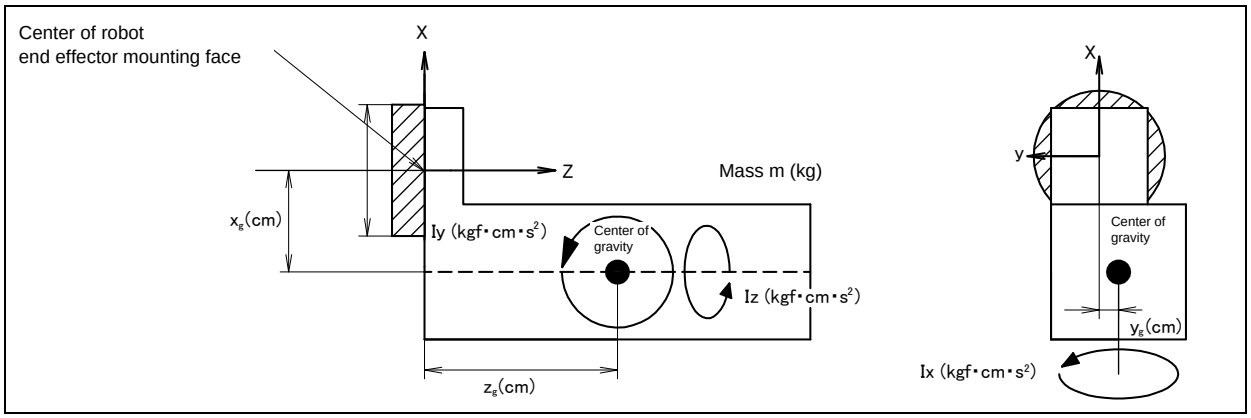


Fig. 4.3 Standard tool coordinate

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, pressing F2 [GROUP] will bring you to the MOTION PAYLOAD SET screen for another group

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

9 On the MOTION PERFORMANCE screen, press F4 [ARMLOAD] to display the MOTION ARMLOAD SET screen.
(* This screen differs depending on the robot model.)

```
MOTION ARMLOAD SET                JOINT   100%

      Group 1
 1    J2 BASE LOAD [kg]          550.00
 2    J3 ARM  LOAD [kg]           25.00
 3    J3 CASING LOAD [kg]         10.00

[ TYPE ]     GROUP          DEFAULT   HELP
```

10 Specify the weight of the load on the J2 base and J3 arm as follows:
J2 BASE LOAD[kg]: Weight of the load on the J2 base
J3 ARM LOAD[kg]: Weight of the load on the J3 arm
J3 CASING LOAD[kg]: Weight of the load on the J3 casing

(*) Load mounting face differs depending on the robot model. Refer to “3.5 LOAD CONDITIONS ON J2 BASE, J3 ARM AND J3 CASING”.

The following message appears: “Path and Cycletime will change. Set it?” Select F4 [YES] or F5 [NO]. Once the loads are set up, the settings are completed by switching the power off and on again.

4.4 INERTIA LOAD SETTING

High inertia mode is provided for R-2000*i*C/165F/210F. The inertia mode is automatically set according to the load value set in Section 4.3. Table 4.4 shows allowable load moment at wrist of standard inertia mode and high inertia mode.

Table 4.4 Wrist unit allowable load inertia of standard inertia mode and high inertia mode

			Standard inertia mode	High inertia mode
Wrist unit allowable load inertia	J4-axis	165F	89kg·m^2 (908kgf·cm·s^2)	120kg·m^2 (1225kgf·cm·s^2)
		210F	147kg·m^2 (1500kgf·cm·s^2)	225.4kg·m^2 (2300kgf·cm·s^2)
	J5-axis	165F	89kg·m^2 (908kgf·cm·s^2)	120kg·m^2 (1225kgf·cm·s^2)
		210F	147kg·m^2 (1500kgf·cm·s^2)	225.4kg·m^2 (2300kgf·cm·s^2)
	J6-axis	165F	46kg·m^2 (469kgf·cm·s^2)	100kg·m^2 (1020kgf·cm·s^2)
		210F	82kg·m^2 (837kgf·cm·s^2)	196kg·m^2 (2000kgf·cm·s^2)

5 PIPING AND WIRING TO THE END EFFECTOR

⚠ WARNING

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

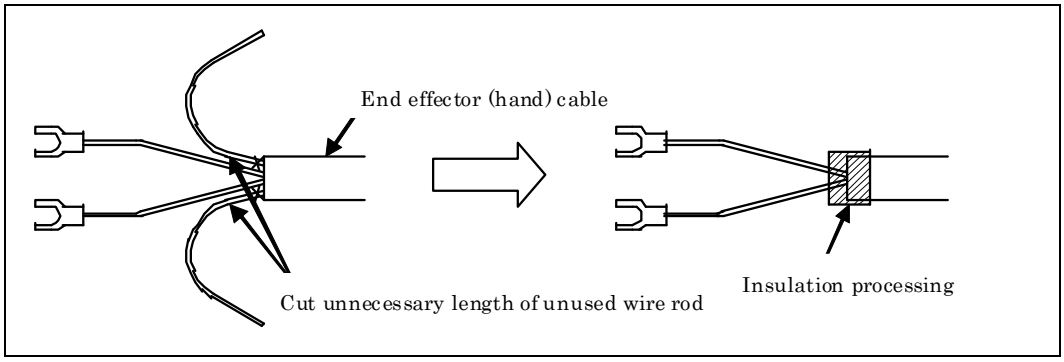


Fig.5 Treatment method of end effector (hand) cable

5.1 AIR SUPPLY (OPTION)

Robot has air inlets and air outlets openings on the back of the J1 base and the side of the J3 casing or the J3 arm used to supply air pressure to the end effector. The connector is a Rc1/2 female (ISO).
As coupling are not supplied, it will be necessary to prepare couplings which suit to the hose size.

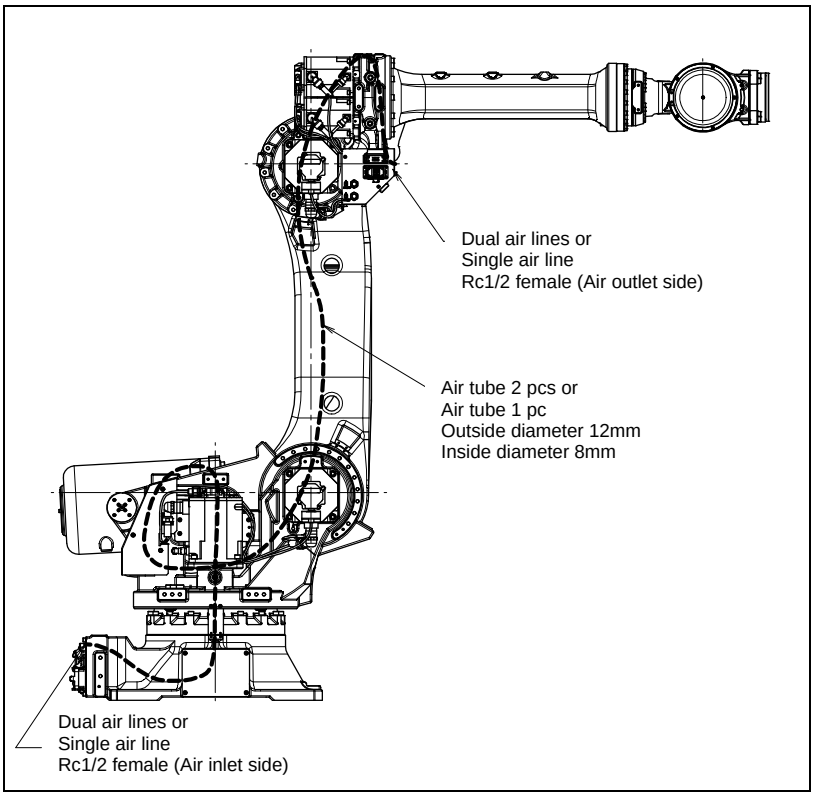


Fig. 5.1 (a) Air supply (option) (R-2000*i*C/165F/210F/125L)

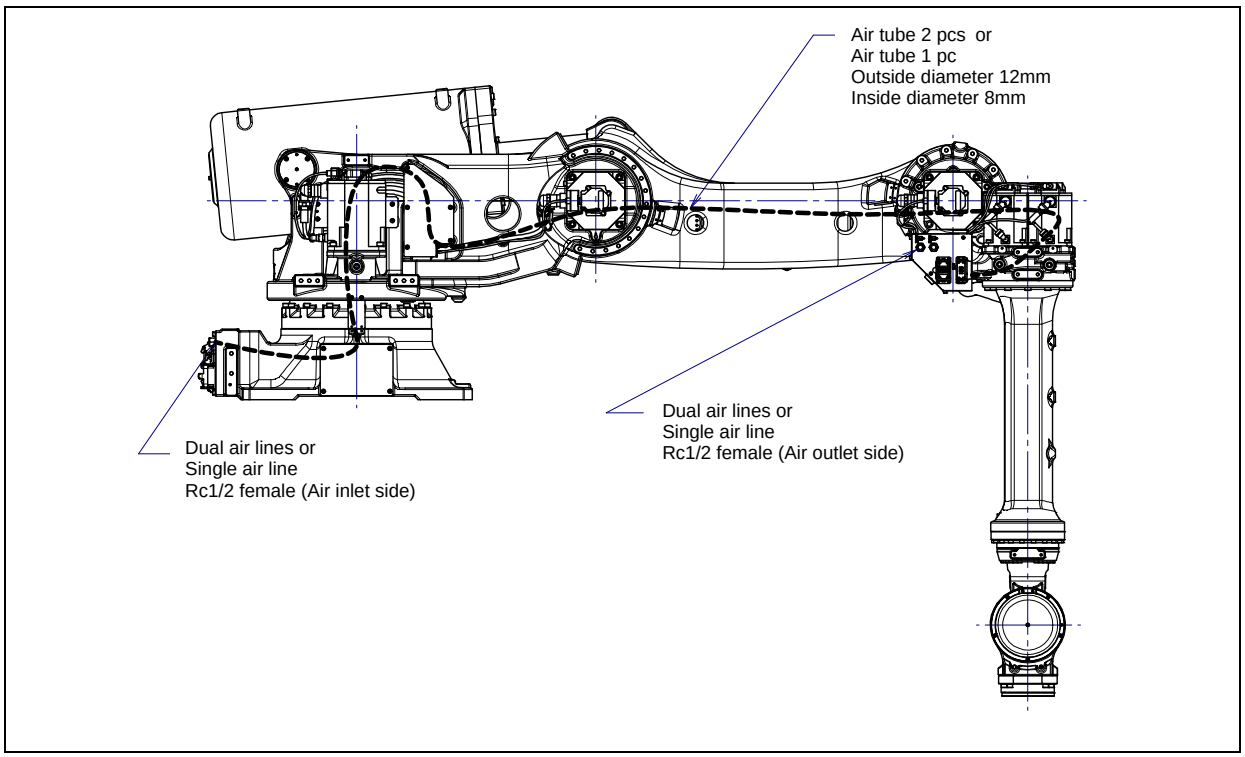


Fig. 5.1 (b) Air supply (option) (R-2000*i*C/165R/210R)

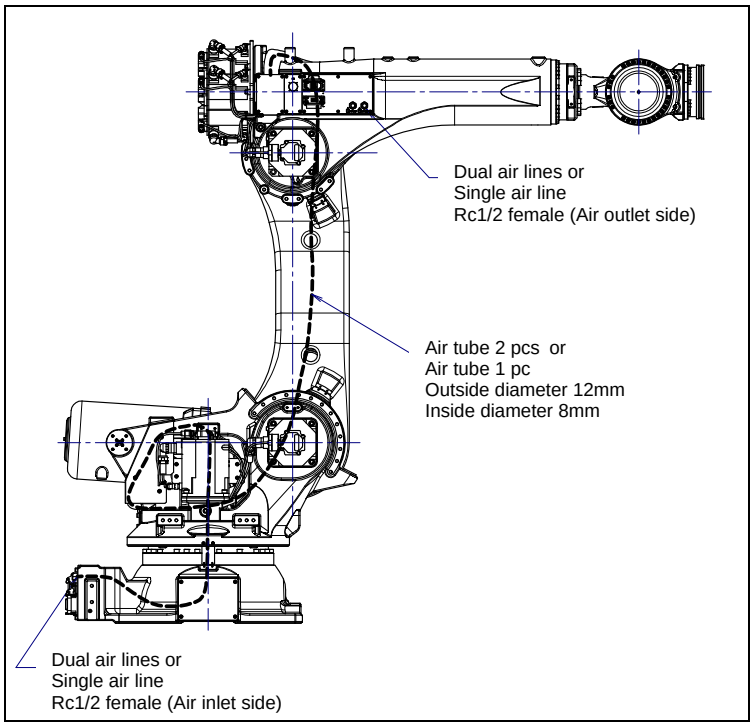


Fig. 5.1 (c) Air supply (option) (R-2000*i*C/270F/210L)

5.2 AIR PIPING (OPTION)

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

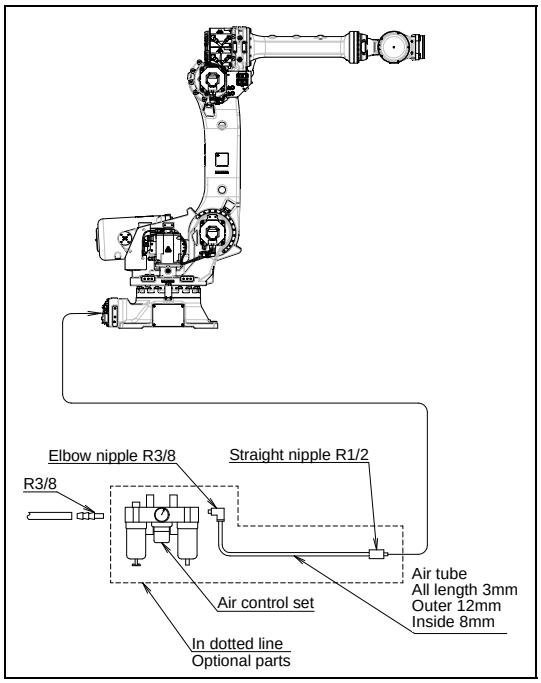


Fig. 5.2 (a) Air piping (option)

Air control set

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

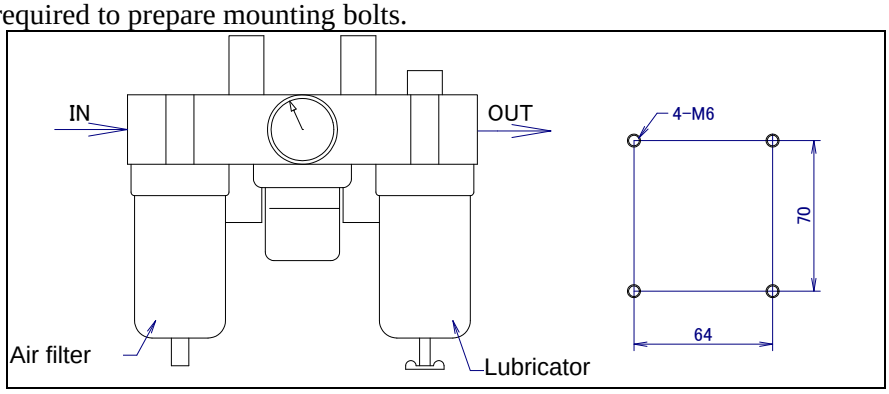


Fig. 5.2 (b) Air control set option (option)

NOTE
The capacity values of the three air components are determined as follows. These values must not be exceeded.

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

5.3 INTERFACE FOR OPTION CABLE (OPTION)

Fig. 5.3 (a), (b), (i) show the position of the option cable interface. Fig. 5.3 (c) to (h), (j), (k) show the option cable interface. EE interface (RI/RO), user cable (signal line, signal line usable to the force sensors and 3D Laser Vision sensor, signal line usable to the force sensor, power lines), DeviceNet cable (signal line), DeviceNet cable (power line), additional axis motor cable (Pulsecoder line), additional axis motor cable (power, brake line) ,camera cable, sensor cable, Ethernet cable (signal line/power line) and PROFINET cable (signal line/power line) are prepared as options.

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

EE interface (RI/RO) :	EE
User cable (signal) :	AS
User cable (signal usable to force sensor and 3D Laser Vision sensor) :	ASi
User cable (signal usable to force sensor) :	ASH
User cable (power) :	AP
DeviceNet cable (signal) :	DS
DeviceNet cable (power) :	DP
Additional axis motor cable (Pulsecoder) :	ARP
Additional axis motor cable (power, brake) :	ARM
Camera cable :	CAM
Sensor cable :	SEN
Ethernet cable (signal) :	ES
Ethernet cable (power) :	EP
PROFINET cable (signal) :	PNS
PROFINET cable (power) :	PNP

NOTE
There is no option cable and an air piping for mechanical unit cable A05B-1333-H557, A05B-1334-H554, A05B-1337-H557.

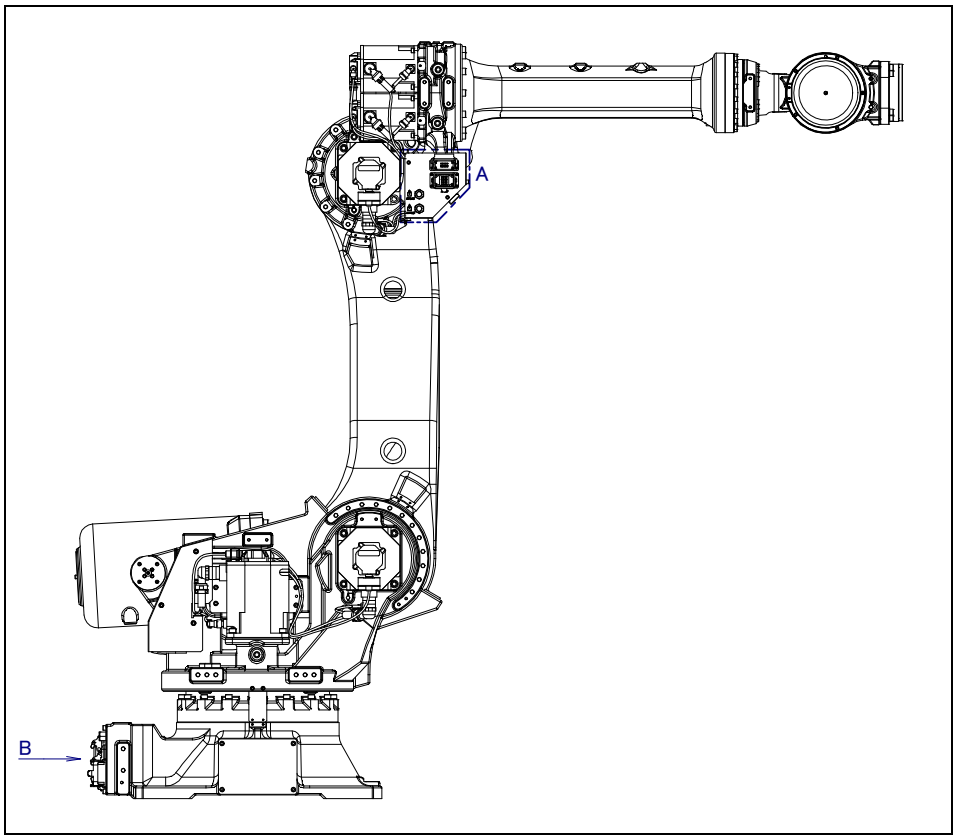


Fig. 5.3 (a) Interface for option cable (OPTION)
(R-2000*i*C/165F/210F/125L)

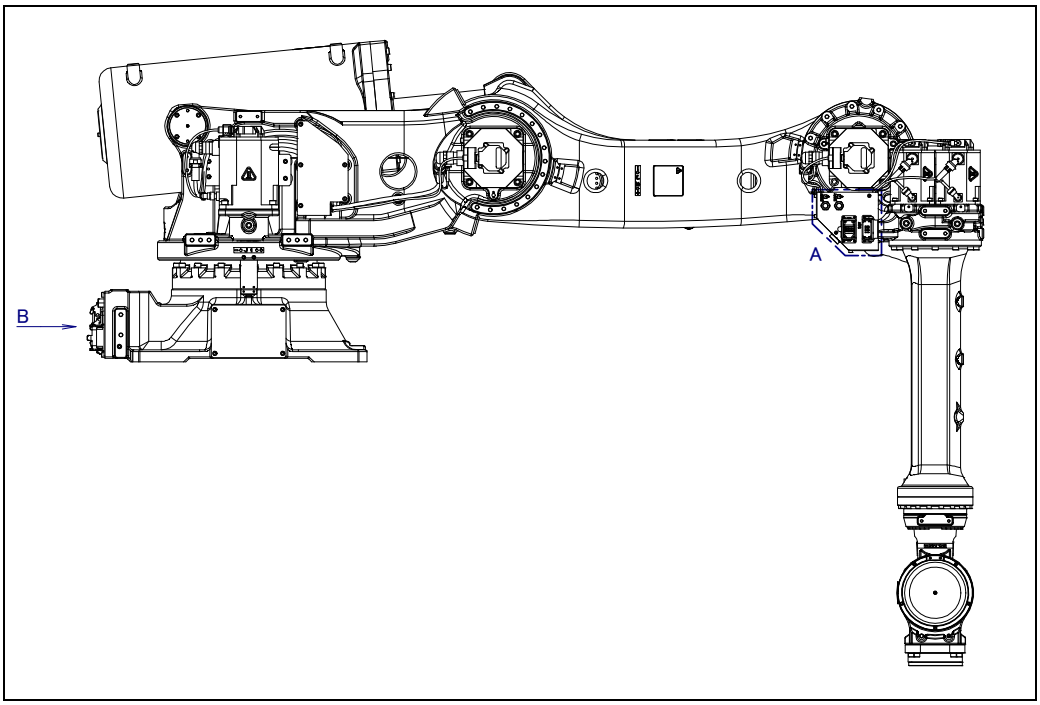
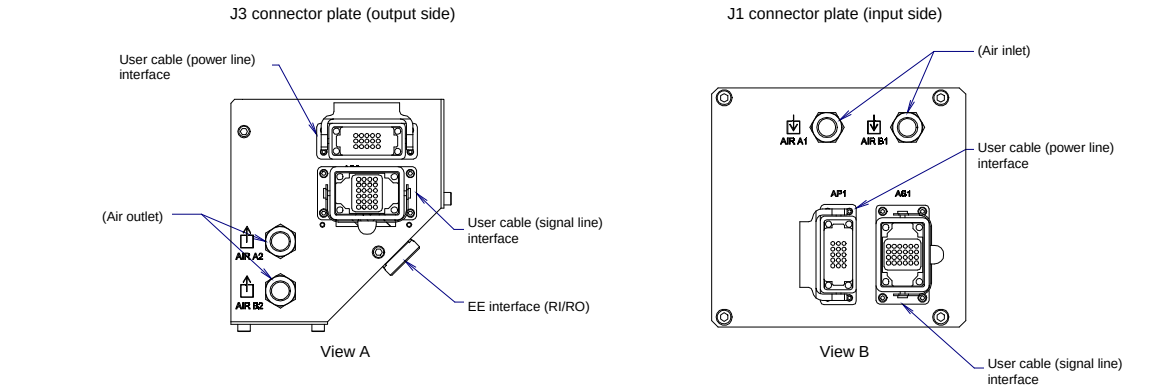
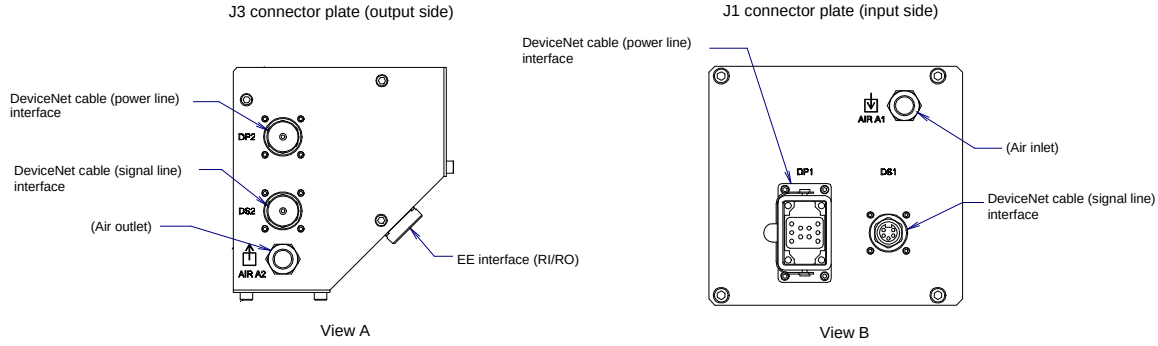


Fig. 5.3 (b) Interface for optional cable (OPTION)
(R-2000*i*C/165R/210R)



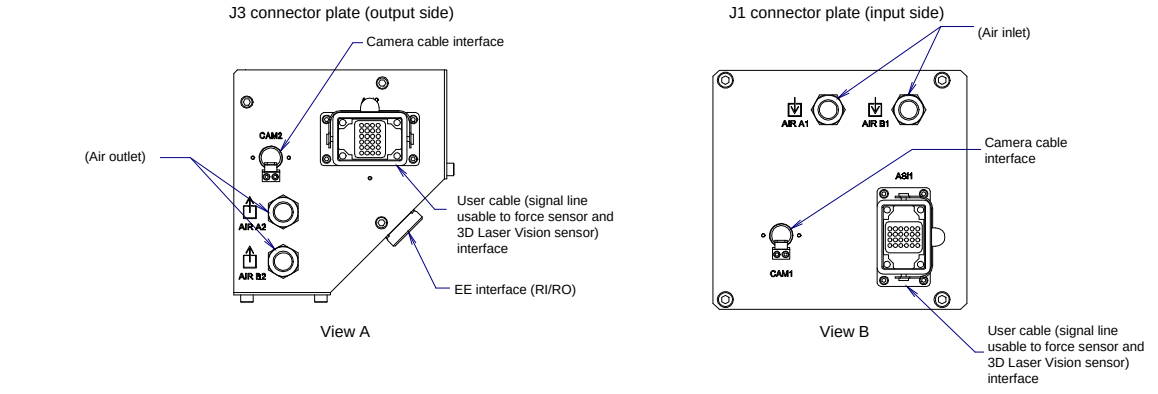
With user cable (signal line/power line)

Cable spec.
165F/210F/125L : Standard: A05B-1333-H201/CE: A05B-1333-H501
165R/210R : Standard: A05B-1334-H201/CE: A05B-1334-H501



With DeviceNet cable (signal line/power line)

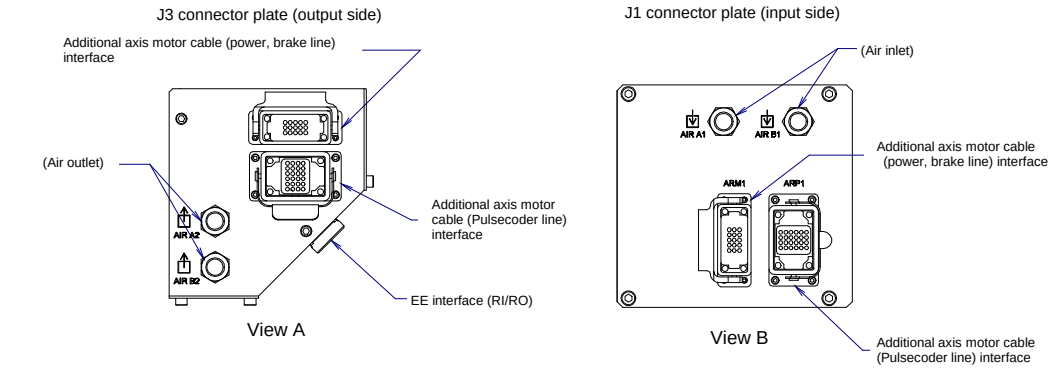
Cable spec.
165F/210F/125L : Standard: A05B-1333-H202/CE: A05B-1333-H502
165R/210R : Standard: A05B-1334-H202/CE: A05B-1334-H502



With user cable (signal line usable to force sensor and 3D Laser Vision sensor) and camera cable

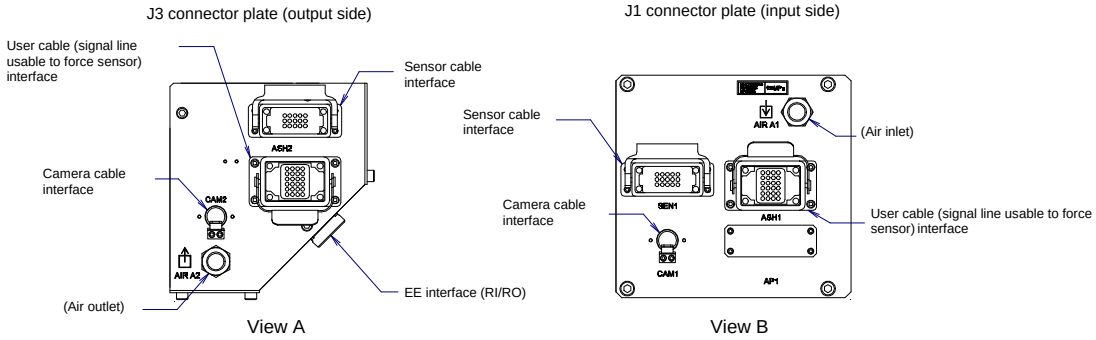
Cable spec.
165F/210F/125L : Standard: A05B-1333-H203/CE: A05B-1333-H503
165R/210R : Standard: A05B-1334-H203/CE: A05B-1334-H503

Fig. 5.3 (c) Interface for option cable (1/8)



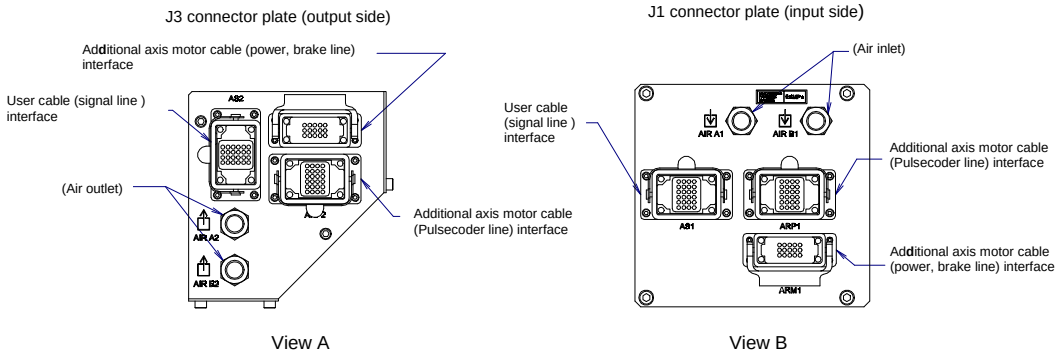
With additional axis motor cable (Pulsecoder line, power, brake line)

Cable spec.
165F/210F/125L : Standard: A05B-1333-H204/CE: A05B-1333-H504
165R/210R : Standard: A05B-1334-H204/CE: A05B-1334-H504



With user cable (signal line usable to force sensor) , camera cable and sensor cable

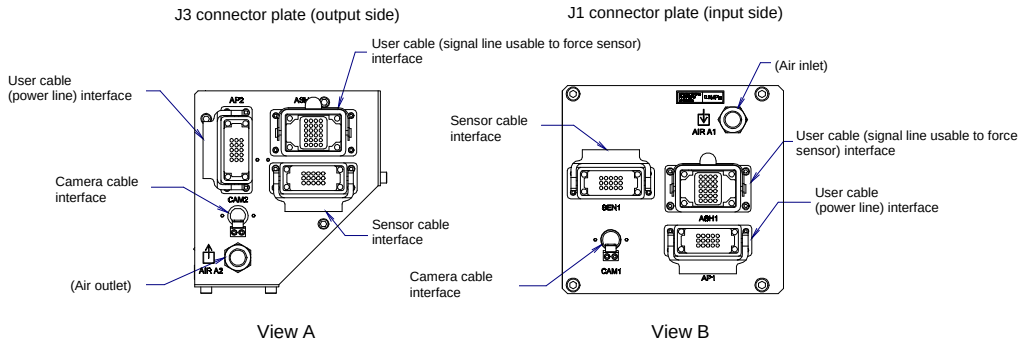
Cable spec.
165R/210R : CE: A05B-1334-H505



With additional axis motor cable (Pulsecoder line, power, brake line) and user cable (signal line)

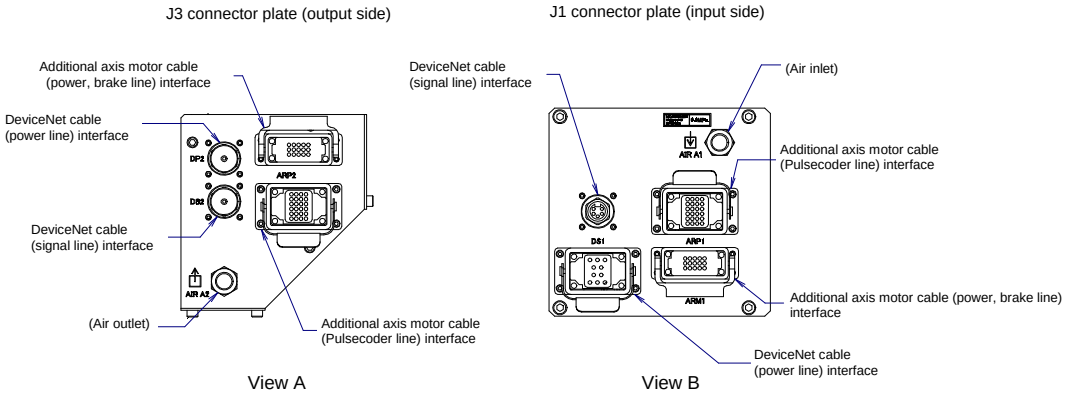
Cable spec.
165F/210F/125L : CE: A05B-1333-H553
165R/210R : CE: A05B-1334-H553

Fig. 5.3 (d) Interface for option cable (2/8)



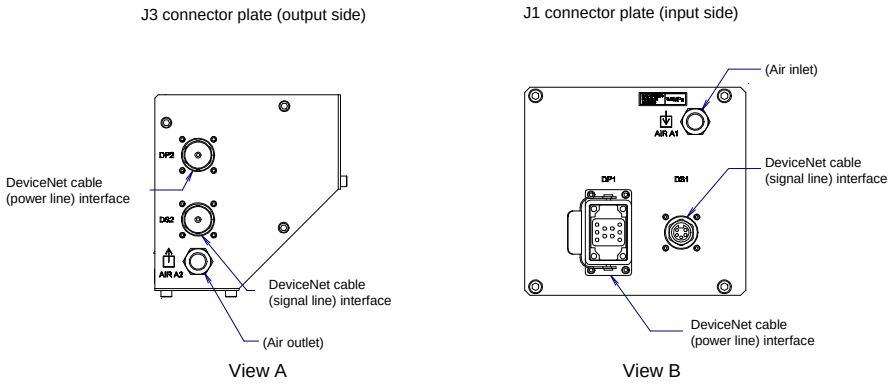
With user cable (signal line usable to force sensor), camera cable and sensor cable

Cable spec.
165F/210F/125L : CE : A05B-1333-H556



With DeviceNet cable (signal line/power line) and additional axis motor cable (Pulsecoder line, power, brake line)

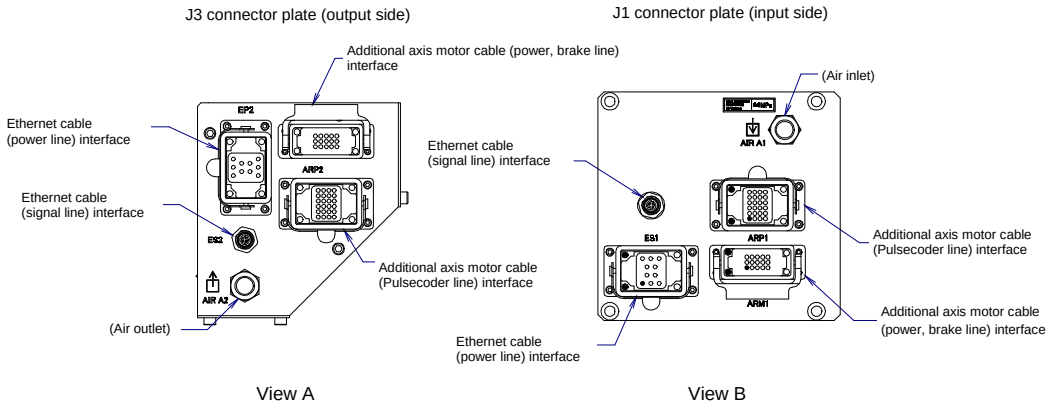
Cable spec.
165F/210F/125L : CE : A05B-1333-H563



With DeviceNet cable (signal line/power line)

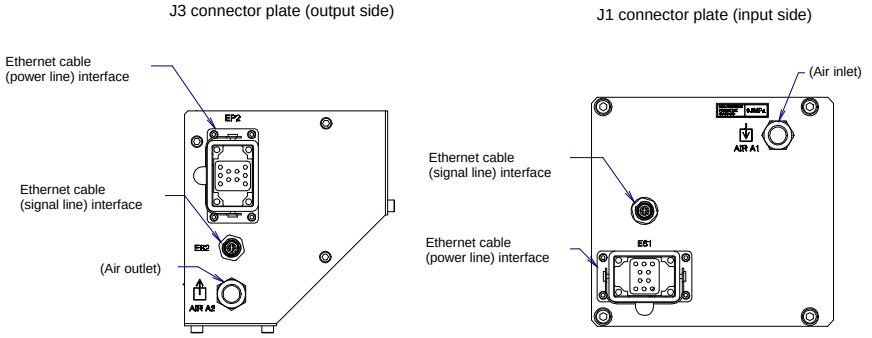
Cable spec.
165F/210F/125L : CE : A05B-1333-H564

Fig. 5.3 (e) Interface for option cable (3/8)



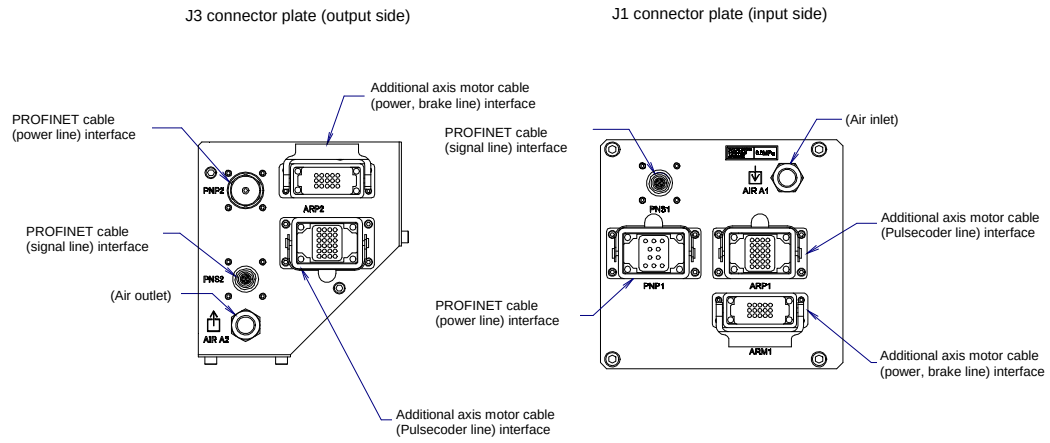
With Ethernet cable (signal line/power line) and additional axis motor cable (Pulsecoder line, power, brake line)

Cable spec.
165F/210F/125L : CE : A05B-1333-H565



With Ethernet cable (signal line/power line)

Cable spec.
165F/210F/125L : CE : A05B-1333-H566



With additional axis motor cable (Pulsecoder line, power, brake line) and PROFINET cable (signal line/power line)

Cable spec.
165F/210F/125L : CE : A05B-1333-H567

Fig. 5.3 (f) Interface for option cable (4/8)

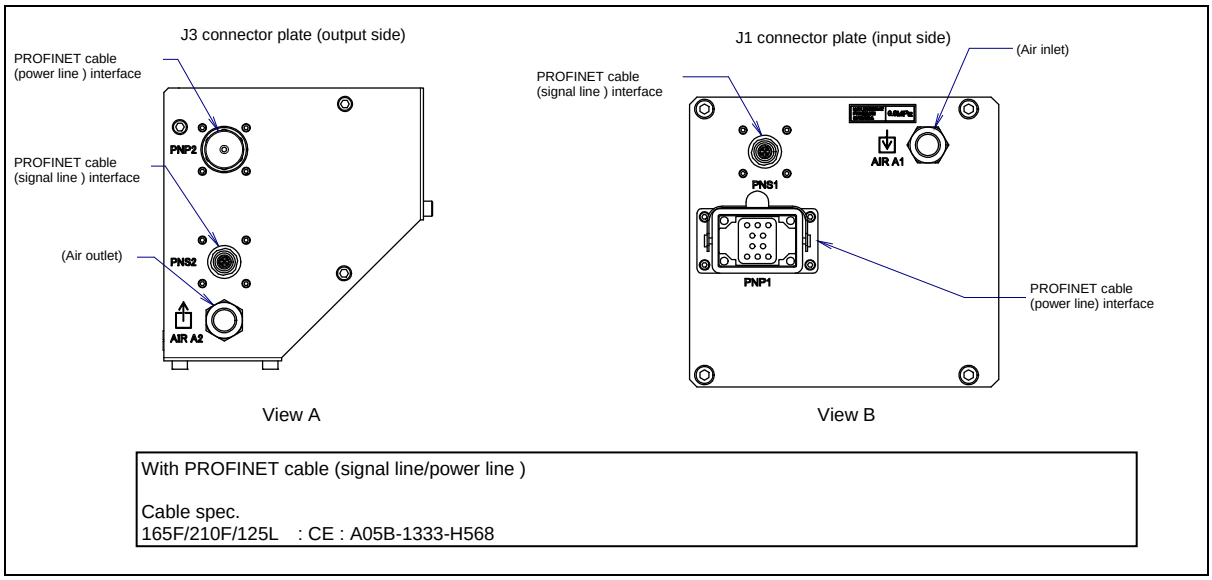
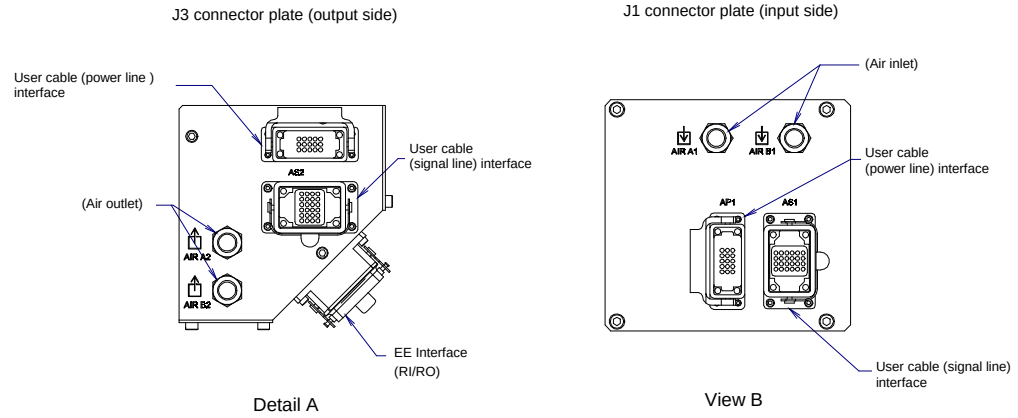
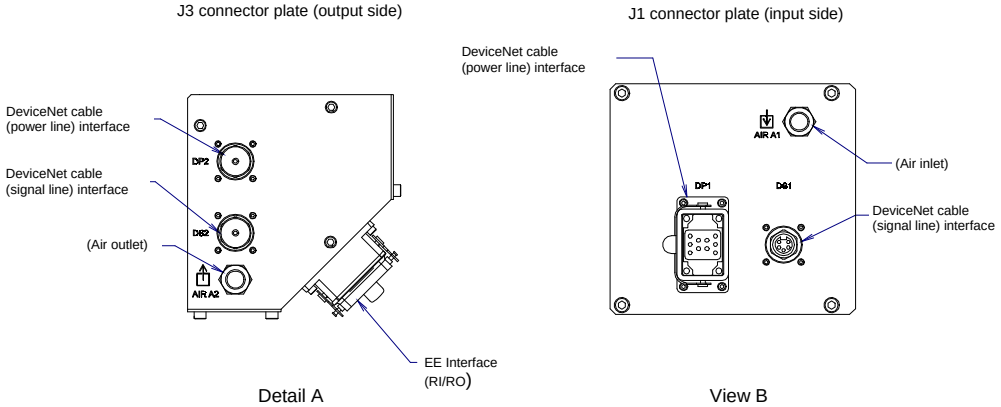


Fig. 5.3 (g) Interface for option cable (5/8)



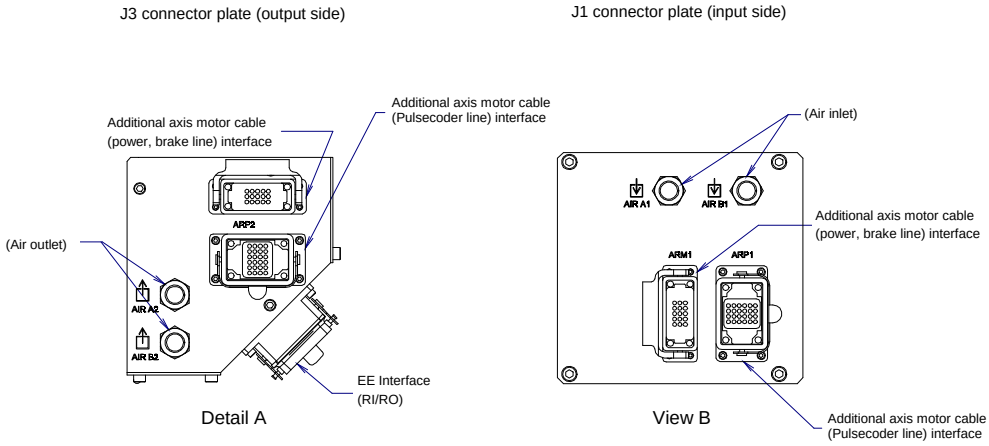
With user cable (signal line/power line)

Cable spec.
165F/210F/125L : A05B-1333-H801
165R/210R : A05B-1334-H801



With DeviceNet cable (signal line/power line)

Cable spec.
165F/210F/125L : A05B-1333-H802
165R/210R : A05B-1334-H802



With additional axis motor cable (Pulsecoder line/power, brake line)

Cable spec.
165F/210F/125L : A05B-1333-H803
165R/210R : A05B-1334-H803

Fig. 5.3 (h) Interface for option cable
(When severe dust/liquid protection package is specified) (6/8)

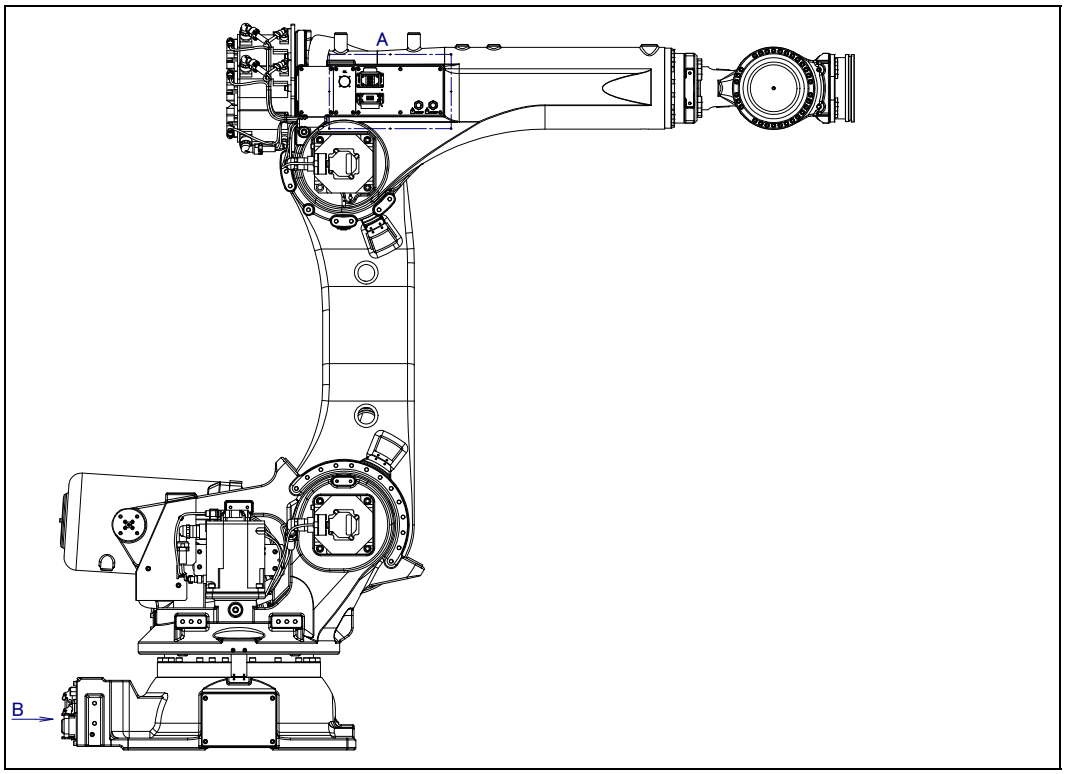


Fig. 5.3 (i) Interface for optional cable (option)
(R-2000*i*C/270F/210L)

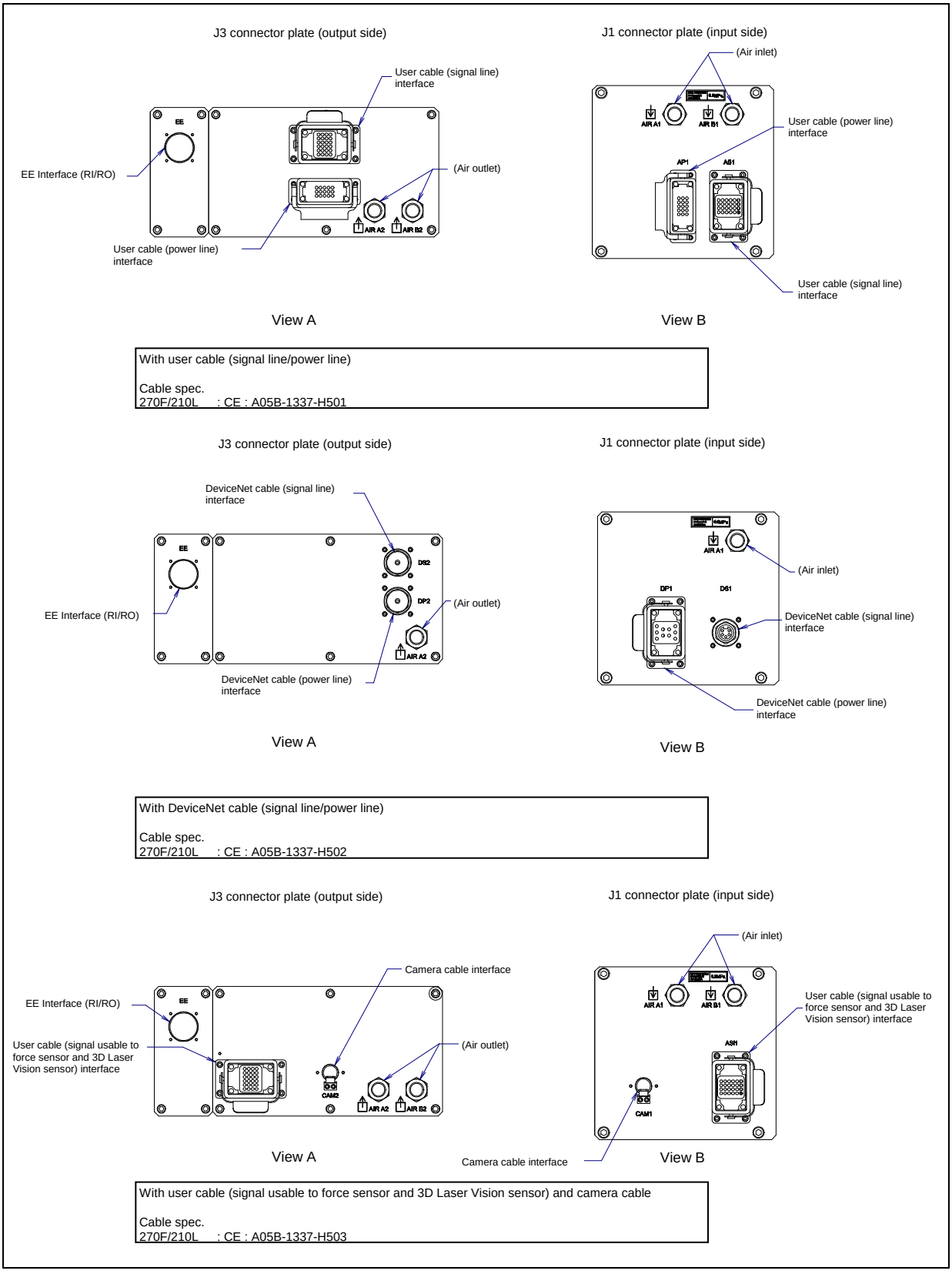


Fig. 5.3 (j) Interface for option cable (7/8)

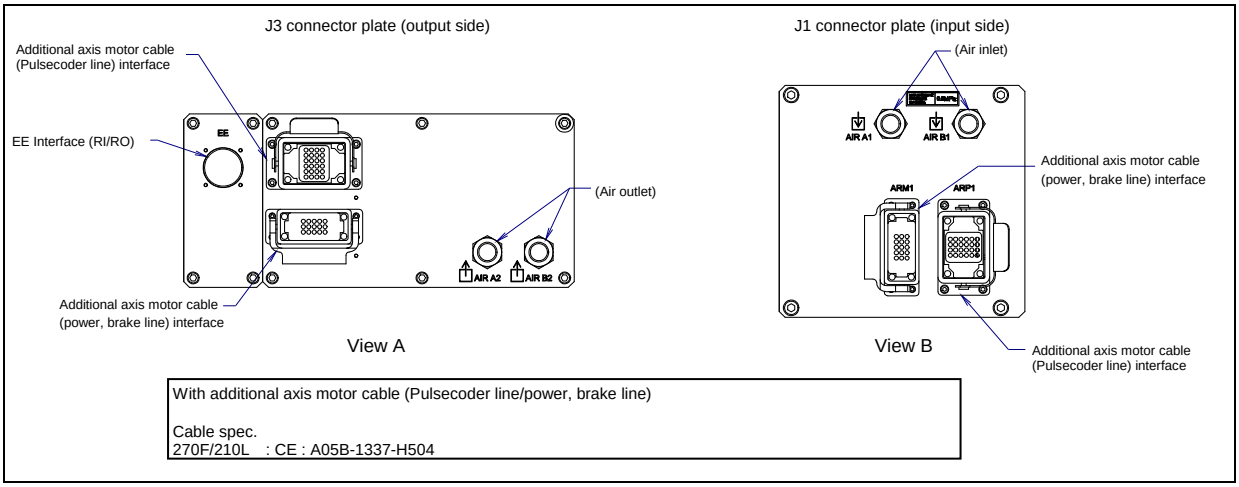


Fig. 5.3 (k) Interface for option cable (8/8)

1 EE interface (RI/RO) (option)

Fig. 5.3 (l) and (m) show pin layout for EE interface (RI/RO). When severe dust/liquid protection package is specified, the connector has guide pins and bushes for preventing improper insertion. For cables prepared by the user, use these guide pins and bushes.

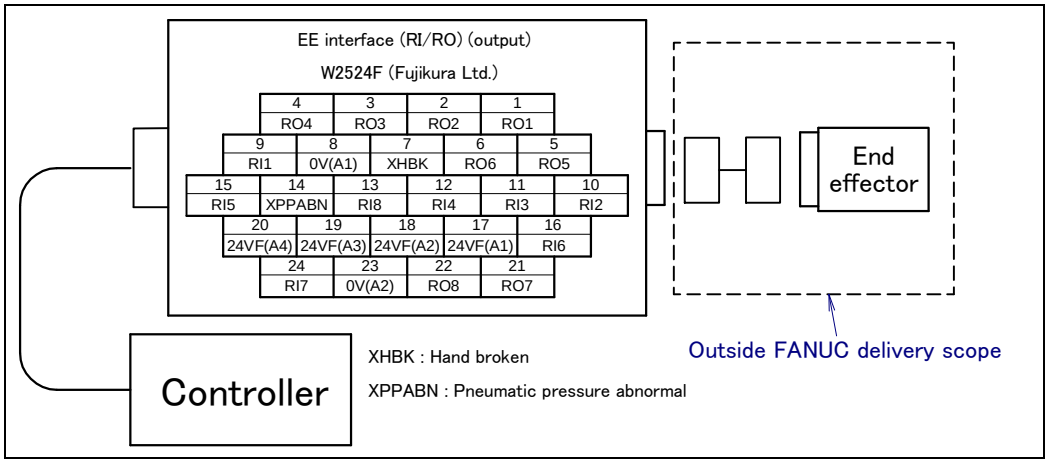


Fig. 5.3 (l) Pin layout for EE interface(RI/RO) (option)

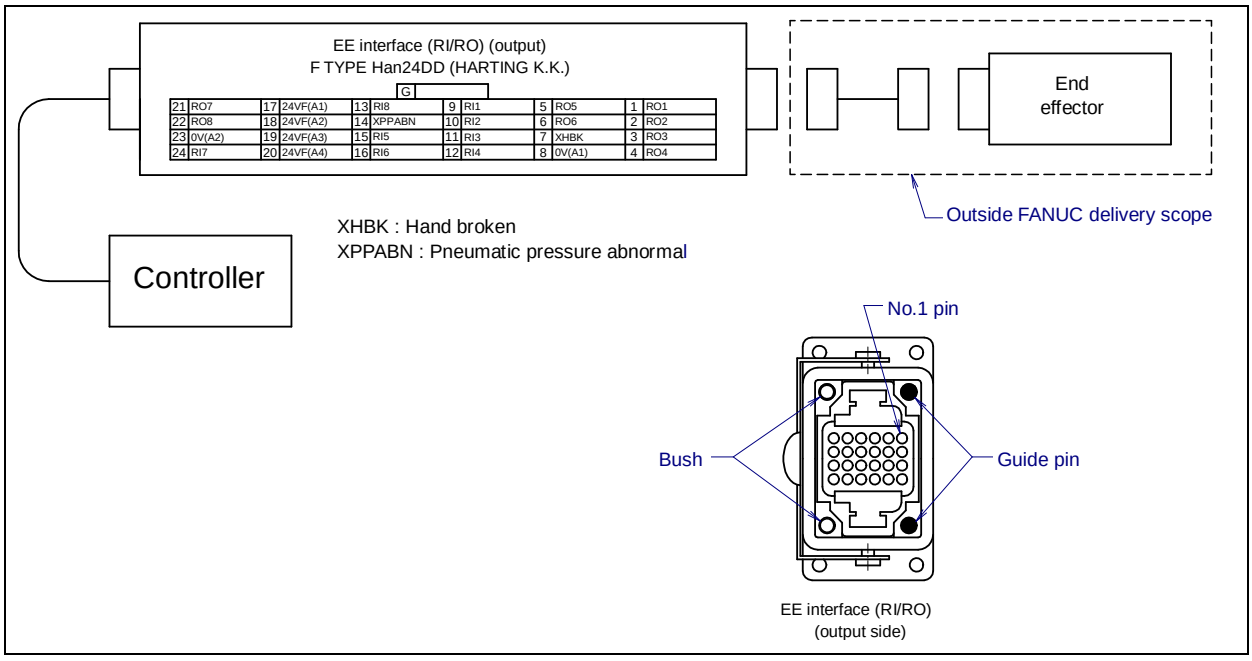


Fig. 5.3 (m) Pin layout for EE interface(RI/RO)
(When severe dust/liquid protection package is specified) (option)

NOTE

For wiring of the peripheral device to the EE interface, refer to the “ELECTRICAL CONNECTIONS Chapter of CONTROLLER MAINTENANCE MANUAL”, too.

2 User cable (signal line) (AS) Interface (option)
Fig. 5.3 (n) shows pin layout for user cable (signal line) interface.
The connector has a code pin for preventing improper insertion. For cables prepared by the user, use this code pin.

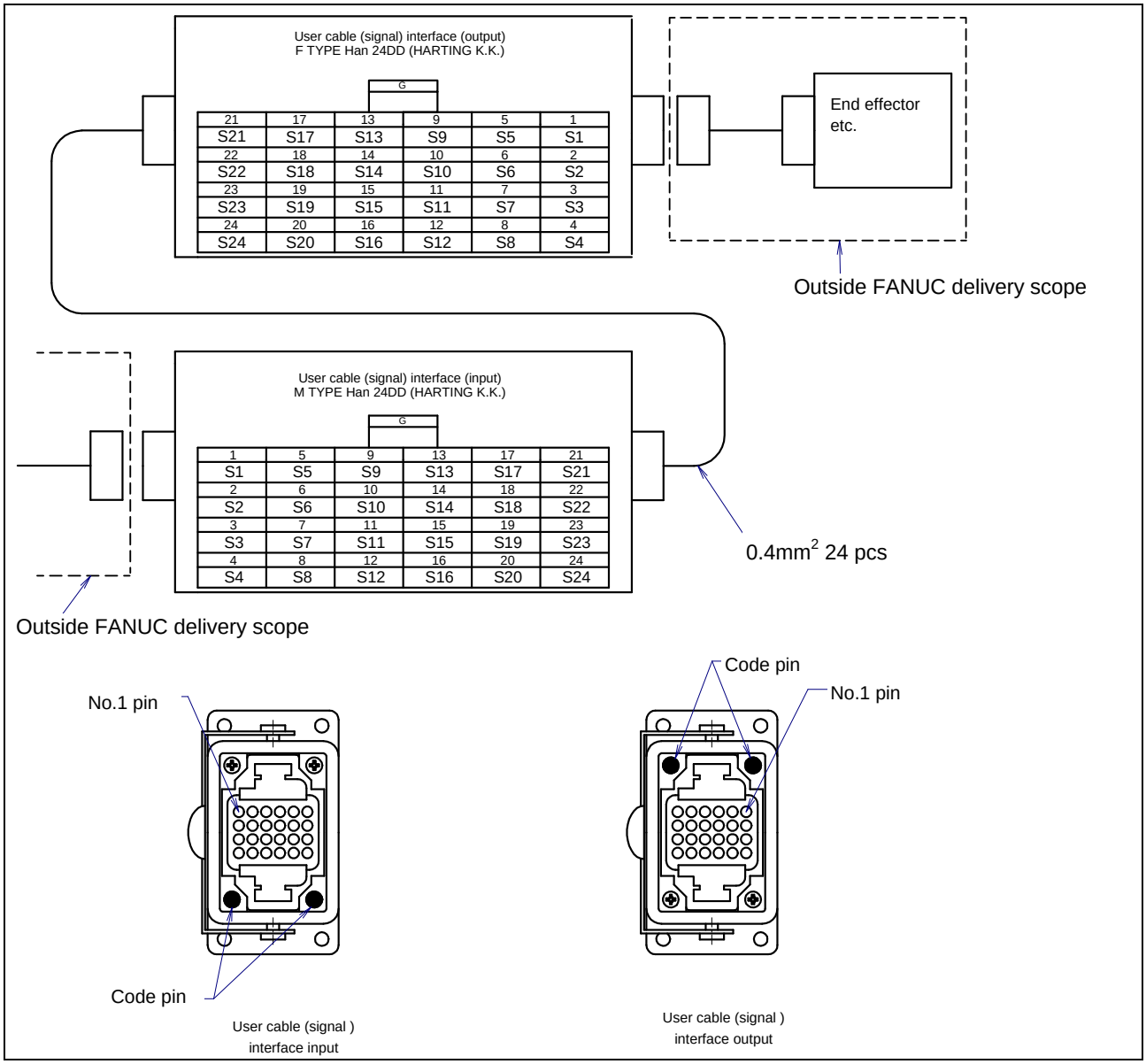


Fig. 5.3 (n) Pin layout for user cable (signal line) (AS) interface and code pin layout (option)

3 User cable (signal line usable to force sensor and 3D Laser Vision sensor) (ASi) (signal line usable to force sensor Vision sensor) (ASH)Interface (option)
Fig. 5.3 (o) shows the pin layout for the user cable (signal line usable to force sensor and 3D Laser Vision sensor)/(signal line usable to force sensor Vision sensor) (ASH) interface.
The connector has a code pin for preventing improper insertion. The code pin is required for the cable which is prepared by the user.

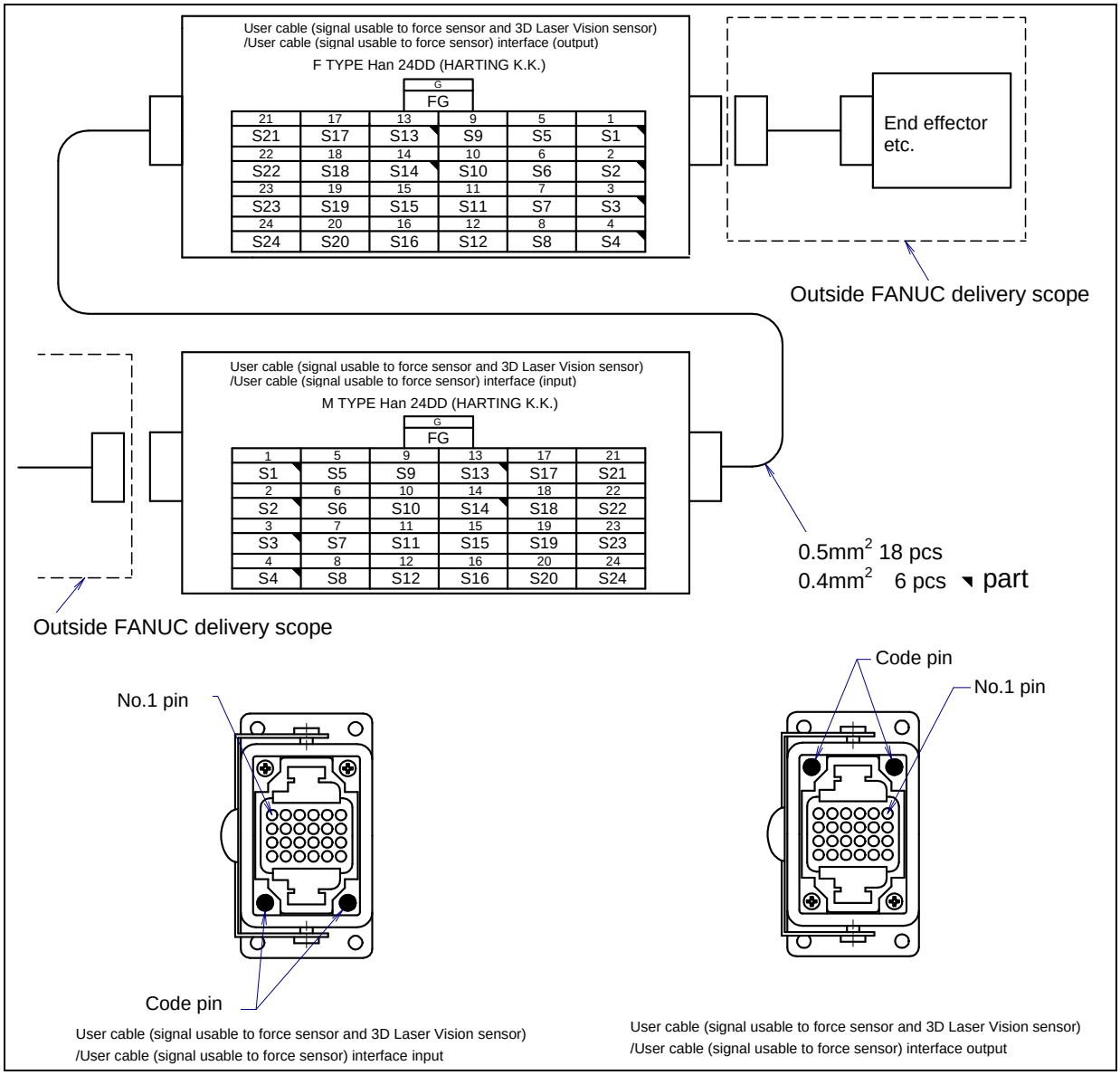


Fig. 5.3 (o) Pin layout for user cable (signal line usable to force sensor and 3D Laser Vision sensor) (ASi) (signal line usable to force sensor) (ASH)/interface and code pin layout (option)

4 User cable (power line) (AP) Interface (option)
Fig. 5.3 (p) shows the pin layout for the user cable (power line) interface.
The connector has a code pin for preventing improper insertion. The code pin is required for the cable which is prepared by the user.

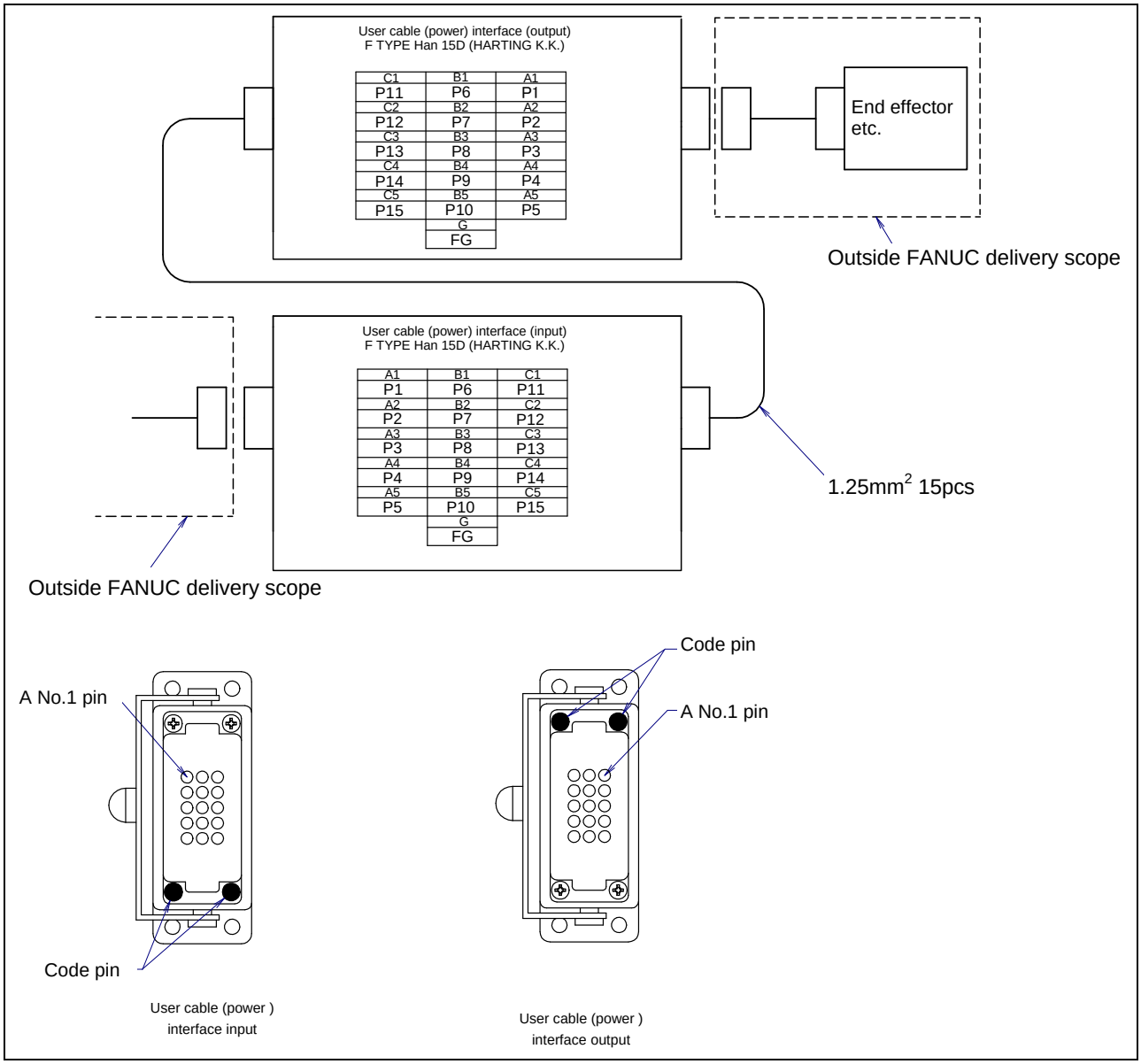


Fig. 5.3 (p) Pin layout for user cable (power line) (AP) interface and code pin layout (option)

5 DeviceNet cable (signal line) (DS) Interface (option)
Fig. 5.3 (q) shows the pin layout for the DeviceNet cable (signal line) interface.

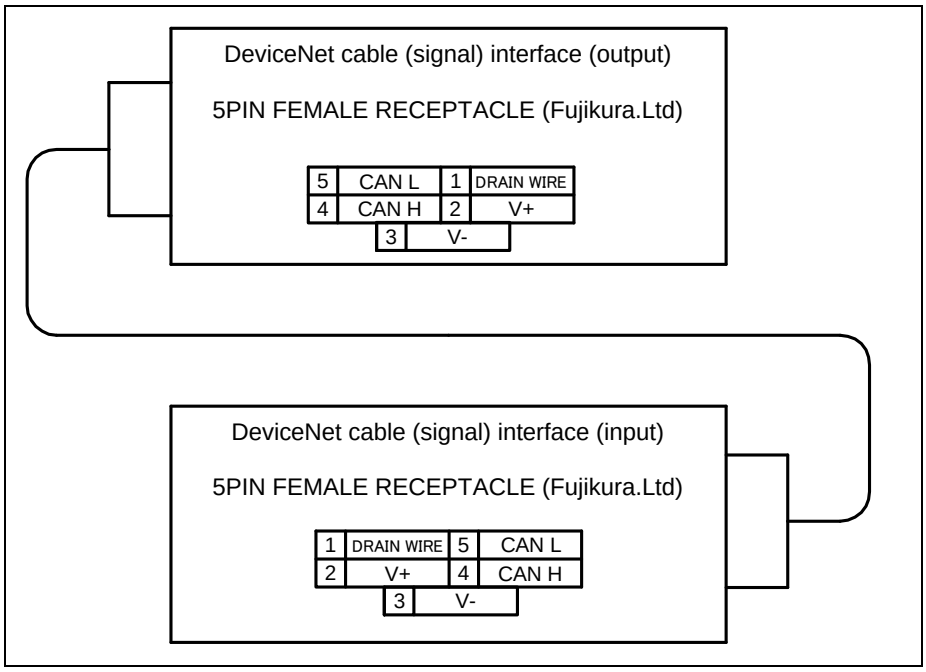


Fig. 5.3 (q) Pin layout for DeviceNet cable (signal line) (DS) interface (option)

6 DeviceNet cable (power line) (DP) Interface (option)
Fig. 5.3 (r) shows the pin layout for the DeviceNet cable (power line) interface.

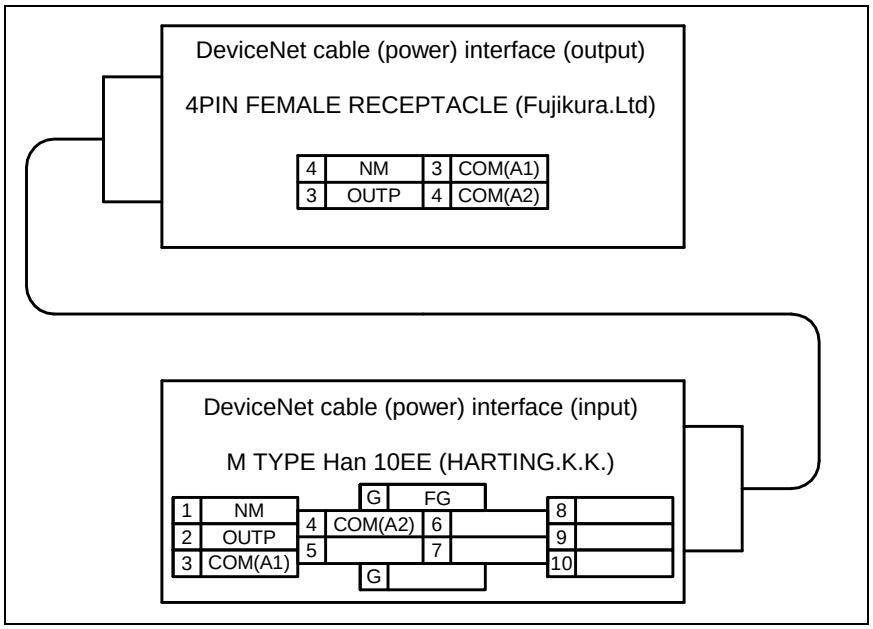


Fig. 5.3 (r) Pin layout for DeviceNet cable (power line) (DP) interface (option)

7 Additional axis motor cable (Pulsecoder cable) (ARP) interface (option)
Fig. 5.3 (s) shows the pin layout of the additional axis motor cable (Pulsecoder cable) interface.
The connector has a code pin for preventing improper insertion.

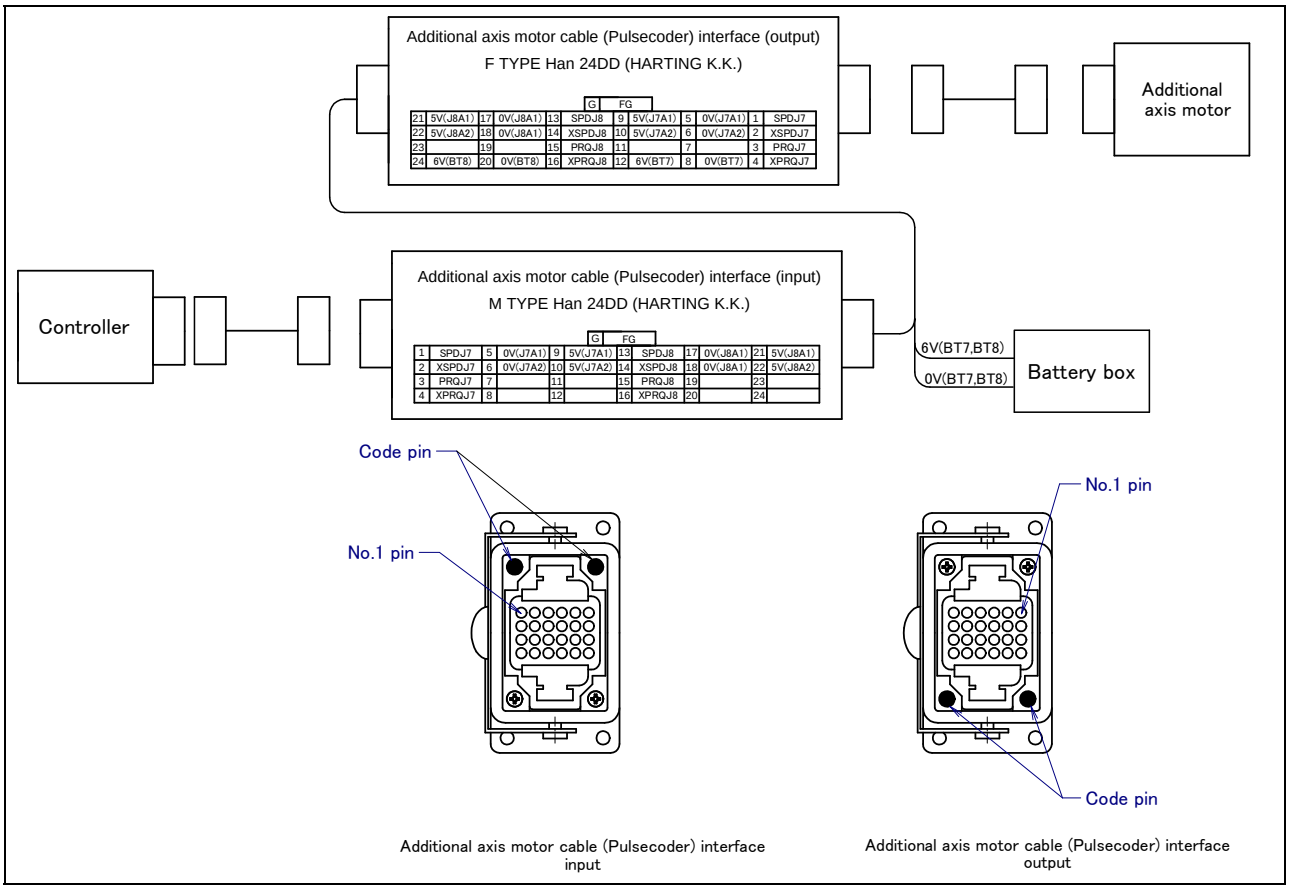


Fig. 5.3 (s) Pin layout of the additional axis motor cable (Pulsecoder cable) (ARP) interface and layout position of the code pin (option)

Table 5.3 (a) Comparative table of signal name according to the motor

ARP	α motor, β motor	αi, αi –B motor, βi, βi-B motor
SPD	SD	-
XSPD	*SD	-
PRQ	REQ	RD
XPRQ	*REQ	*RD

8 Additional axis motor cable (power and brake cables) (ARM) interface (option)
Fig. 5.3 (t) shows the pin layout of the additional axis motor cable (power and brake cables) interface. The connector has a code pin for preventing improper insertion.

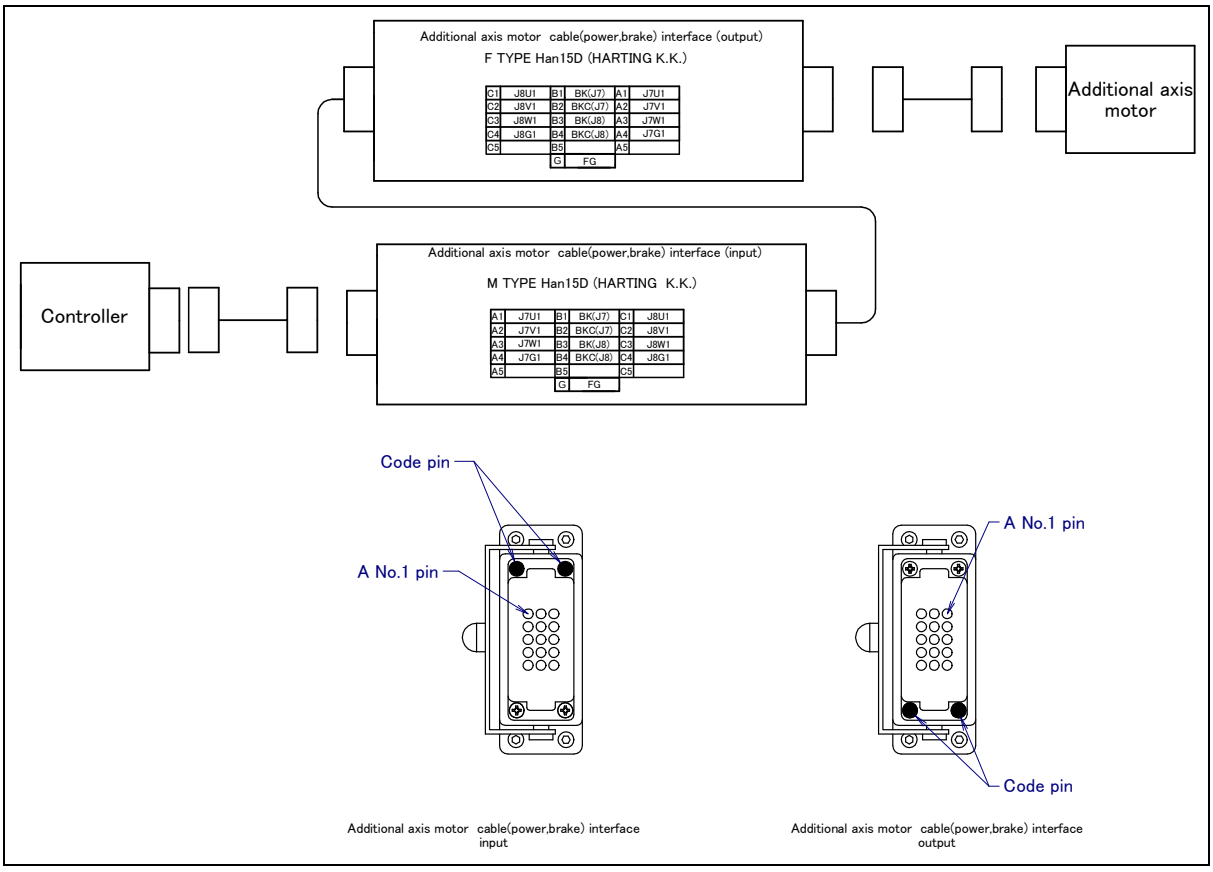


Fig. 5.3 (t) Pin layout of the additional axis motor cable (power and brake cables) (ARM) interface and layout position of the code pin (option)

9 Ethernet cable (signal line) (ES) interface (option)
Fig. 5.3 (u) shows the pin layout of the Ethernet cable (signal line) (ES) interface.

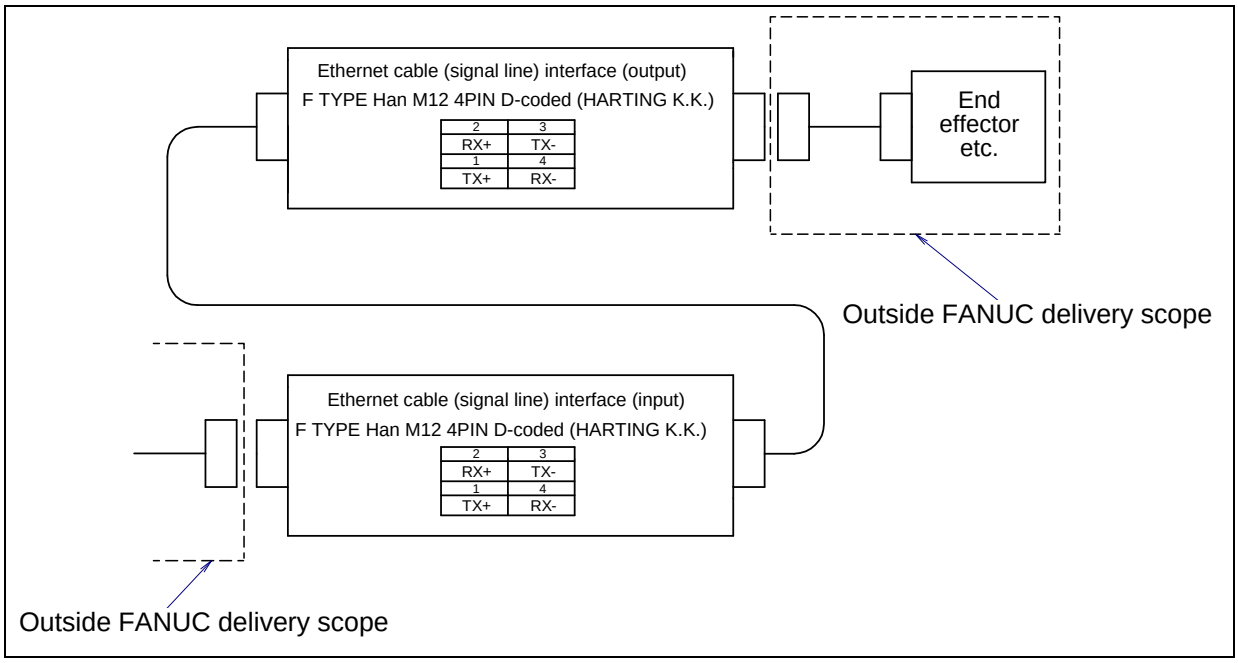


Fig. 5.3 (u) Pin layout for Ethernet cable (signal line) (ES) interface (option)

10 Ethernet cable (power line) (EP) interface (option)
Fig. 5.3 (v) shows the pin layout of the Ethernet cable (power line) (EP) interface. The connector has a code pin for preventing improper insertion.

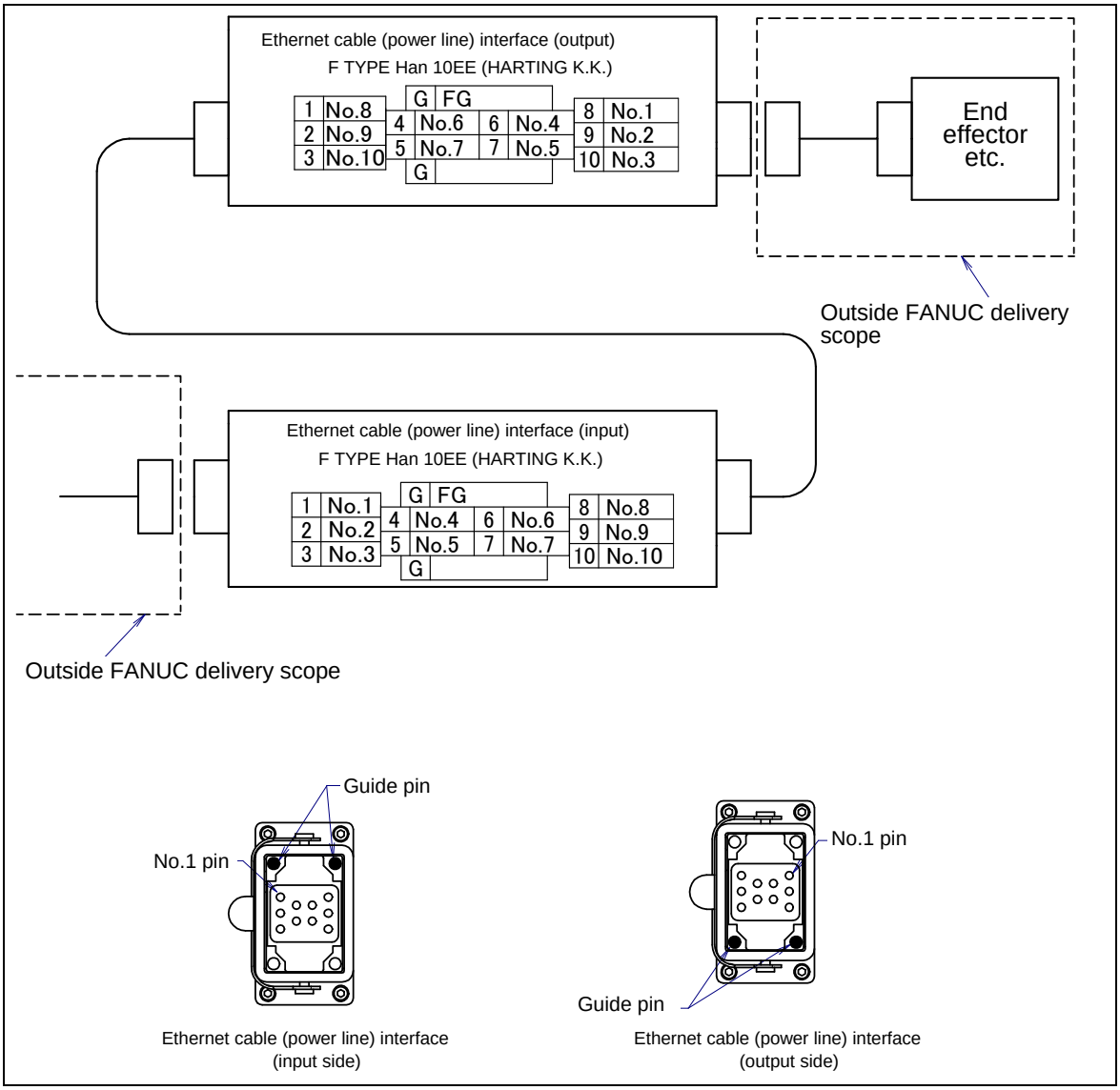


Fig. 5.3 (v) Pin layout for Ethernet cable (power line) (EP) interface (option)

11 PROFINET cable (signal line) (PNS) interface (option)
Fig. 5.3 (w) shows the pin layout of the PROFINET cable (signal line) (PNS) interface.

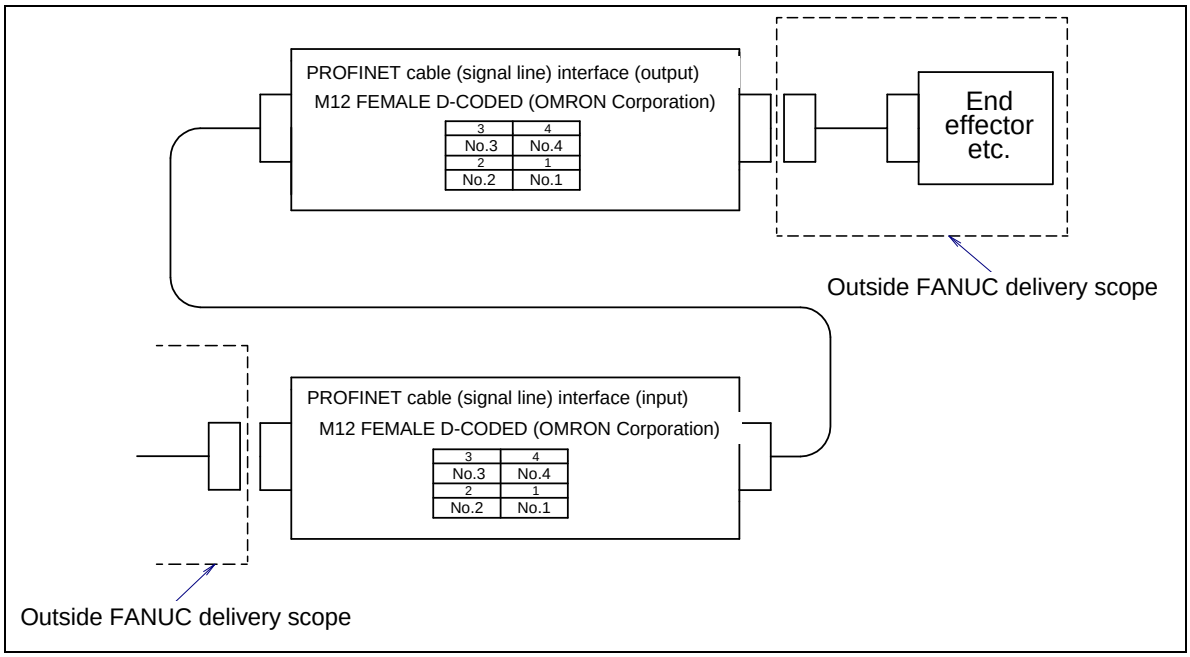


Fig. 5.3 (w) Pin layout for PROFINET cable (signal line) (PNS) interface (option)

12 PROFINET cable (power line) (PNP) interface (option)
Fig. 5.3 (x) shows the pin layout of the PROFINET cable (power line) (PNP) interface.

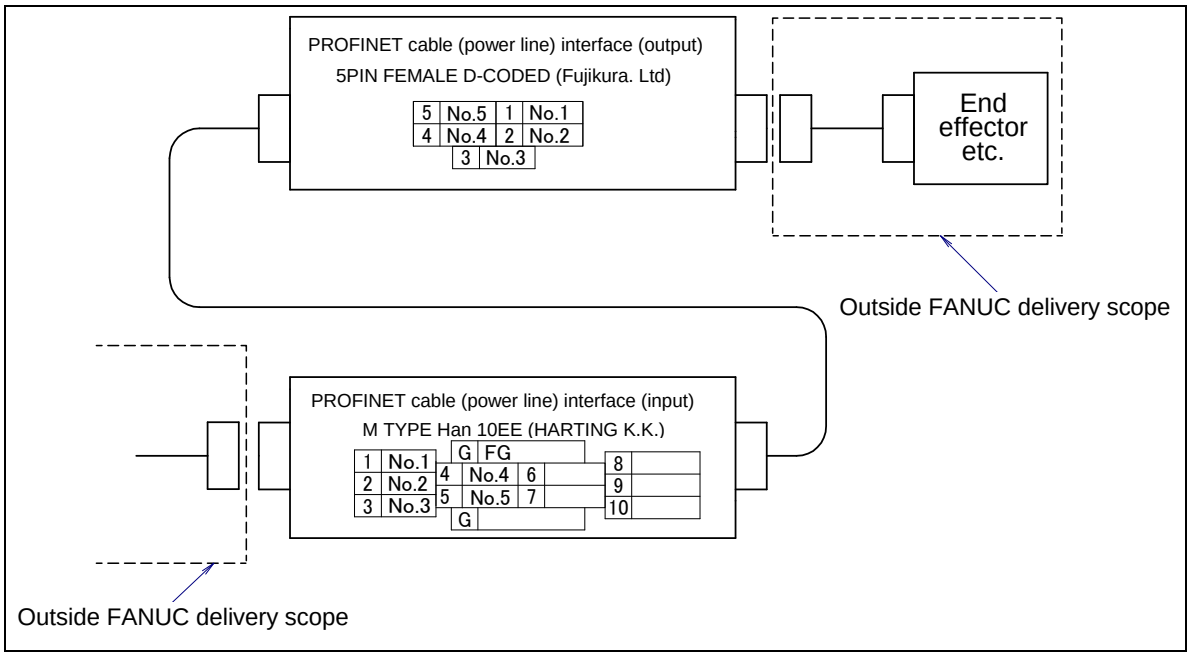


Fig. 5.3 (x) Pin layout for PROFINET cable (power line) (PNP) interface (option)

Connector specifications

Table 5.3 (b) Connector specifications (Mechanical unit side) (1/2)

Cable	Input side (J1 connector panel)		Output side (J3 connector panel)		Maker /dealer
EE (RI/RO)	———		JMWR2524F		Fujikura Ltd.
EE (RI/RO) (When severe dust/liquid protection package is specified)	———		Housing Insert Contact Guide pin Bush	09 30 006 0301 09 16 024 3101 09 15 000 6204 09 33 000 9908 09 33 000 9909	HARTING K.K.
AS ASi ASH	Housing Insert Contact Code pin	09 30 006 0301 09 16 024 3001 09 15 000 6103 09 30 000 9901	Housing Insert Contact Code pin	09 30 006 0301 09 16 024 3101 09 15 000 6203 09 30 000 9901	
AP	Housing Insert Contact Code pin	09 20 010 0301 09 21 015 3001 09 15 000 6101 09 30 000 9901	Housing Insert Contact Code pin	09 20 010 0301 09 21 015 3101 09 15 000 6201 09 30 000 9901	
ARP	Housing Insert Contact Contact Code pin	09 30 006 0301 09 16 024 3001 09 15 000 6103 09 15 000 6104 09 30 000 9901	Housing Insert Contact Contact Code pin	09 30 006 0301 09 16 024 3101 09 15 000 6203 09 15 000 6204 09 30 000 9901	
ARM	Housing Insert Contact Contact Code pin	09 20 010 0301 09 21 015 3001 09 15 000 6101 09 15 000 6106 09 30 000 9901	Housing Insert Contact Contact Code pin	09 20 010 0301 09 21 015 3101 09 15 000 6201 09 15 000 6206 09 30 000 9901	
ES	Connector Contact	21 03 882 2425 09 67 000 7476	Connector Contact	21 03 882 2425 09 67 000 7476	
EP	Housing Insert Contact Contact Guide pin Bush	09 30 006 0301 09 32 010 3001 09 33 000 6105 09 33 000 6121 09 30 000 9908 09 30 000 9909	Housing Insert Contact Contact Guide pin Bush	09 30 006 0301 09 32 010 3101 09 33 000 6205 09 33 000 6220 09 30 000 9908 09 30 000 9909	
PNS	XS5P-T426-5		XS5P-T426-5		OMRON Corporation

Table 5.3 (c) Connector specifications (Mechanical unit side) (2/2)

Cable	Input side (J1 connector panel)		Maker /dealer	Output side (J3 connector panel)	Maker /dealer
DS	CM03A-R5P-S-2		Fujikura Ltd.	CM03A-PR5S-S-2	Fujikura Ltd.
DP	Housing Insert Contact	09 30 006 0301 09 32 010 3001 09 33 000 6104	HARTING K.K.	CM03A-PR4S-S-2	Fujikura Ltd.
PNP	Housing Insert Contact Guide pin Bush	09 30 006 0301 09 32 010 3001 09 33 000 6105 09 30 000 9908 09 30 000 9909		CM03A-PR5S-S-2	

Table 5.3 (d) Connector specifications (User side) (1/3)

Cable	Input side (J1 connector panel)	Output side (J3 connector panel)		Maker /dealer
EE (RI/RO)	———	JMSP2524M (*1) Straight JMLP2524M Angle		Fujikura Ltd.
EE (RI/RO) (When severe dust/liquid protection package is specified)	———	Hood (Note 2)	09 30 006 1540 Side entry 1541 ↓ 0542 0543 1440(*2) Top entry 1440 ↓ 1441 0442 0443	HARTING K.K.
		Insert	09 16 024 3001 (*3)	
		Contact (24 pcs)	09 15 000 6104 (*4) AWG 26-22 6103 AWG 20 6105 AWG 18 6102 AWG 18 6101 AWG 16 6106 AWG 14	
		Clamp (Note 2)	09 00 000 5085 (*5) 5086 5090 5094 Many other types are available	
		Guide pin (2 pcs)	09 33 000 9908 (*6)	
		Bush (2 pcs)	09 33 000 9909 (*7)	

NOTE 1

Underlined parts are attached. Below shows spec. to order in our company.

(*1) A63L-0001-0234#S2524M
(*2) A63L-0001-0453#06B1440
(*3) A63L-0001-0453#24DDM
(*4) A63L-0001-0453#CA6104
(*5) A63L-0001-0453#A-152D
(*6) A63L-0001-0453#A-9908
(*7) A63L-0001-0453#A-9909

Table 5.3 (e) Connector specifications (User side) (2/3)

Cable	Input side (J1 connector panel)		Output side (J3 connector panel)		Maker /dealer
AS ASi ASH	Hood (Note 2)	09 30 006 1540 Side entry 1541 ↓ 0542 0543 1440 Top entry 1441 ↓ 0442 0443	Hood (Note 2)	←The same	HARTING K.K.
	Insert	09 16 024 3101	Insert	09 16 024 3001	
	Contact (Note 2)	09 15 000 6204 AWG 26-22 6203 AWG 20 6205 AWG 18 6202 AWG 18 6201 AWG 16 6206 AWG 14	Contact (Note 2)	09 15 000 6104 AWG 26-22 6103 AWG 20 6105 AWG 18 6102 AWG 18 6101 AWG 16 6106 AWG 14	
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094 etc. Many other types are available	Clamp (Note 2)	←The same	
	Code pin	09 30 000 9901	Code pin	09 30 000 9901	
AP	Hood (Note 2)	09 20 010 1541 Side entry 0540 ↓ 0541 1440 Top entry 0440 ↓ 0441	Hood (Note 2)	←The same	
	Insert	09 21 015 3101	Insert	09 21 015 3001	
	Contact (Note 2)	09 15 000 6204 AWG 26-22 6203 AWG 20 6205 AWG 18 6202 AWG 18 6201 AWG 16 6206 AWG 14	Contact (Note 2)	09 15 000 6104 AWG 26-22 6103 AWG 20 6105 AWG 18 6102 AWG 18 6101 AWG 16 6106 AWG 14	
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094 etc. Many other types are available	Clamp (Note 2)	←The same	
	Code pin	09 30 000 9901	Code pin	09 30 000 9901	
PNS	XS5H-T421-☐M0-K XS5W-T421-☐M2-K XS5W-T421-☐M2-KR XS5W-T421-☐MC-K XS5W-T421-☐MC-KR Many other types are available		←The same		OMRON Corporation
ES	Connector	21 03 882 1415	Connector	←The same	HARTING K.K.
	Contact (Note 2)	09 67 000 7576 AWG 28-24 5576 AWG 26-22 8576 AWG 24-20 3576 AWG 22-18	Contact (Note 2)	←The same	

Cable	Input side (J1 connector panel)		Output side (J3 connector panel)		Maker /dealer
EP	Hood (Note 2)	09 20 010 1541 Side entry 0540 ↓ 0541 1440 Top entry 0440 ↓ 0441	Hood (Note 2)	←The same	HARTING K.K.
	Insert	09 21 015 3101	Insert	09 21 015 3001	
	Contact (Note 2)	09 15 000 6204 AWG 26-22 6203 AWG 20 6205 AWG 18 6202 AWG 18 6201 AWG 16 6206 AWG 14	Contact (Note 2)	09 15 000 6104 AWG 26-22 6103 AWG 20 6105 AWG 18 6102 AWG 18 6101 AWG 16 6106 AWG 14	
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094 Many other types are available.	Clamp (Note 2)	←The same	
	Code pin	09 30 000 9901	Code pin	09 30 000 9901	

Table 5.3 (f) Connector specifications (User side) (3/3)

Cable	Input side (J1 connector panel)		Maker /dealer	Output side (J3 connector panel)	Maker /dealer
DS	MINI connector for use on the device net 5-pin, FEMALE CM03-P5S		Fujikura Ltd.	MINI connector for use on the device net 5-pin, MALE CM03-J5P	Fujikura Ltd.
DP	Hood (Note 2)	09 30 006 1540 Side entry 1541 0542 0543 1440 Top entry 1441 0442 0443	HARTING K.K.	MINI connector for use on the device net 4-pin, MALE CM03-J4P	Fujikura Ltd.
	Insert	09 32 010 3101			
	Contact (Note 2)	09 33 000 6220 AWG20 6214 AWG18 6205 AWG18 6204 AWG16 6202 AWG14 6207 AWG12			
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094 Many other types are available.			
PNP	Hood (Note 2)	09 15 000 1541 Side entry 0540 0541 1440 Top entry 0440 0441		MINI connector for use on the device net 5-pin, MALE CM03-J5P	
	Insert	09 21 015 3101			
	Contact (Note 2)	09 15 000 6204 AWG 26-22 09 15 000 6203 AWG 20 09 15 000 6205 AWG 18 09 15 000 6202 AWG 185 6201 AWG 16 6206 AWG 14			
	Clamp (Note 2)	09 00 000 5083 5086 5090 5094 Many other types are available.			
	Code pin	09 30 000 9901			

NOTE 2
For details, such as the dimensions, of the parts listed above, refer to the related catalogs offered by the respective manufactures, or contact your local FANUC representative.

6 AXIS LIMITS SETUP

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

- Used motion range limitations
- Tooling and fixture interference points
- Cable and hose lengths

There are three methods used to prevent the robot from going beyond the necessary motion range. These are

- Axis limit software settings (All axes)
- Axis limit adjustable mechanical stopper (J1/J2/J3-axes (option))
- Axis limit switches (J1-axis (option))

⚠ WARNING

1 Changing the motion range of any axis affects the operation range of the robot. To avoid trouble, carefully consider a possible effect of the change to the movable range of each axis in advance. Otherwise, it is likely that an unexpected condition occurs; for example, an alarm may occur in a previous taught position.
2 For the J1, J2, and J3-axes, do not count merely on software-based limits to the movable range when changing the movable range of the robot. When changing the movable range, use fixed mechanical stoppers together so that damage to peripheral equipment and injuries to human bodies can be avoided. In this case, make the software-specified limits match the limits based on the mechanical stoppers.
3 Mechanical stoppers are physical obstacles. For J1 to J3-axis, it is possible to re-position the adjustable mechanical stoppers. But the robot cannot move beyond them. For J5-axis, the mechanical stoppers are fixed. For the J4 and J6-axes, only software-specified limits are available.
4 For changing J2 andJ3-axes interference angles, only adjustable mechanical stoppers are available; a software-specified movable range cannot be changed.
5 Adjustable mechanical stoppers (J1, J2, and J3-axes) are deformed in a collision to stop the robot. Once a stopper is subject to a collision, it can no longer assure its original strength and, therefore, may not stop the robot. When this happens, replace it with a new one.

6.1 SETTING MOTION LIMITATION BY SOFTWARE

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

Setting procedure

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

System Axis Limits JOINT 100%
Group1 1/16

AXIS	GROUP	LOWER	UPPER	
1	1	-185.00	185.00	deg
2	1	-76.00	60.00	deg
3	1	-132.00	180.00	deg
4	1	-360.00	360.00	deg
5	1	-125.00	125.00	deg
6	1	-360.00	360.00	deg
7	1	0.00	0.00	mm
8	1	0.00	0.00	mm
9	1	0.00	0.00	mm

[TYPE]

⚠ WARNING
1 0.00 indicates the robot does not have these axes.
2 Do not depend on J1, J2, and J3-axes limit software settings to control the motion range of your robot. Use the axis limit switches or adjustable mechanical stopper also; otherwise injury to personnel or damage to equipment could occur.

5 Move the cursor to the axis limit to be set. Type the new value using the numeric keys on the teach pendant.

System Axis Limits 2/16

AXIS	GROUP	LOWER	UPPER	
2	1	-76.00	60.00	deg

[TYPE]

6 Perform the setting for all axes.
7 Turn off the controller and then turn it back on again in the cold start mode so the new information can be used.

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

6.2 ADJUSTABLE MECHANICAL STOPPER AND LIMIT SWITCH SETTING (OPTION)

For the J1, J2, and J3-axes, adjustable mechanical stopper (option) can be installed. It is possible to re-position adjustable mechanical stoppers. Change the position of the adjustable mechanical stoppers according to the desired movable range. For the J1-axis, the limit switch-based movable range can also be changed. Refer to Section 6.2 and 6.3 for details.

Table 6.2 (a) motion range that can be set by the adjustable mechanical stopper and space between the upper and lower limits

Item		R-2000*i*C/165F/210F/125L
J1-axis adjustable mechanical stopper, limit switch	Upper limit	Settable in steps of 7.5° in the range of -120° to +180°
	Lower limit	Settable in steps of 7.5° in the range of -180° to +120°
	Space between the upper and lower limits	A space of 60° or more is required.
J2-axis adjustable mechanical stopper	Upper limit	Settable in steps of 15° in the range of -60° to +60°. A fixed mechanical stopper is also provided at the upper limit +76° of the standard movable range.
	Lower limit	Settable in steps of 15° in the range of -30° to +75°. A fixed mechanical stopper is also provided at the lower limit -60° of the standard movable range.
	Space between the upper and lower limits	A space of 30° or more is required.
J3-axis (J2+J3) adjustable mechanical stopper	Upper limit	Settable in steps of 15° in the range of -30° to +105°. A fixed mechanical stopper is also provided at the upper limit +180° of the standard movable range.
	Lower limit	Settable in steps of 15° in the range of 0° to +135°. A fixed mechanical stopper is also provided at the lower limit -79° of the standard movable range.
	Space between the upper and lower limits	A space of 15° or more is required.

Table 6.2 (b) motion range that can be set by the adjustable mechanical stopper and space between the upper and lower limits

Item		R-2000*i*C/165R/210R
J1-axis adjustable mechanical stopper, limit switch	Upper limit	Settable in steps of 7.5° in a range of -120° to +180°
	Lower limit	Settable in steps of 7.5° in the range of -180° to +120°
	Space between the upper and lower limits	A space of 60° or more is required.
J2-axis adjustable mechanical stopper	Upper limit	Settable in steps of 15° in the range of -120° to +60°. A fixed mechanical stopper is also provided at the upper limit +80° of the standard movable range.
	Lower limit	Settable in steps of 15° in the range of -90° to +75°. A fixed mechanical stopper is also provided at the lower limit -120° of the standard movable range.
	Space between the upper and lower limits	A space of 30° or more is required.
J3-axis (J2+J3) adjustable mechanical stopper	Upper limit	Settable in steps of 15° in the range of -30° to +105°. A fixed mechanical stopper is also provided at the upper limit +180° of the standard movable range.
	Lower limit	Settable in steps of 0° in the range of 0° to +135°. A fixed mechanical stopper is also provided at the lower limit -79° of the standard movable range.
	Space between the upper and lower limits	A space of 15° or more is required.

Table 6.2 (c) motion range that can be set by the adjustable mechanical stopper and space between the upper and lower limits

Item		R-2000*i*C/270F/210L
J1-axis adjustable mechanical stopper, limit switch	Upper limit	Settable in steps of 5° in the range of -110° to +180°
	Lower limit	Settable in steps of 5° in the range of -180° to +110°
	Space between the upper and lower limits	A space of 70° or more is required.
J2-axis adjustable mechanical stopper	Upper limit	Settable in steps of 15° in the range of -60° to +60°. A fixed mechanical stopper is also provided at the upper limit +76° of the standard movable range.
	Lower limit	Settable in steps of 15° in the range of -45° to +90°. A fixed mechanical stopper is also provided at the lower limit -60° of the standard movable range.
	Space between the upper and lower limits	A space of 30° or more is required.
J3-axis (J2+J3) adjustable mechanical stopper	Upper limit	Settable in steps of 15° in the range of -30° to +90°. A fixed mechanical stopper is also provided at the upper limit +180° of the standard movable range.
	Lower limit	Settable in steps of 15° in the range of 0° to +120°. A fixed mechanical stopper is also provided at the lower limit -79° of the standard movable range.
	Space between the upper and lower limits	A space of 15° or more is required.

⚠ CAUTION
If the newly set operation range does not include 0°, you must change it by zero degree mastering so that 0° is included.

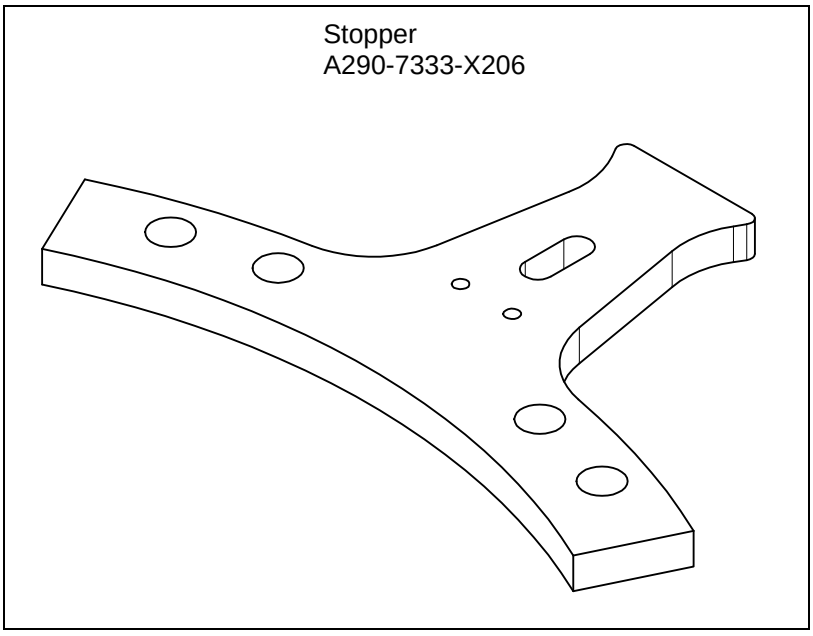


Fig. 6.2 (a) J1-axis adjustable mechanical stopper (option)
(R-2000*i*C/165F/210F/125L/165R/210R)

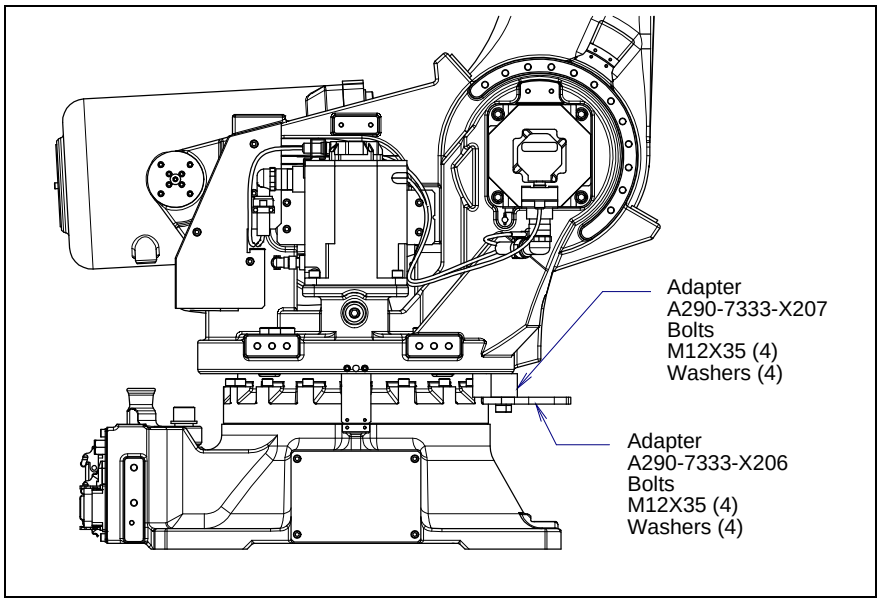


Fig. 6.2 (b) Mounting the J1-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/165F/210F/125L/165R/210R)

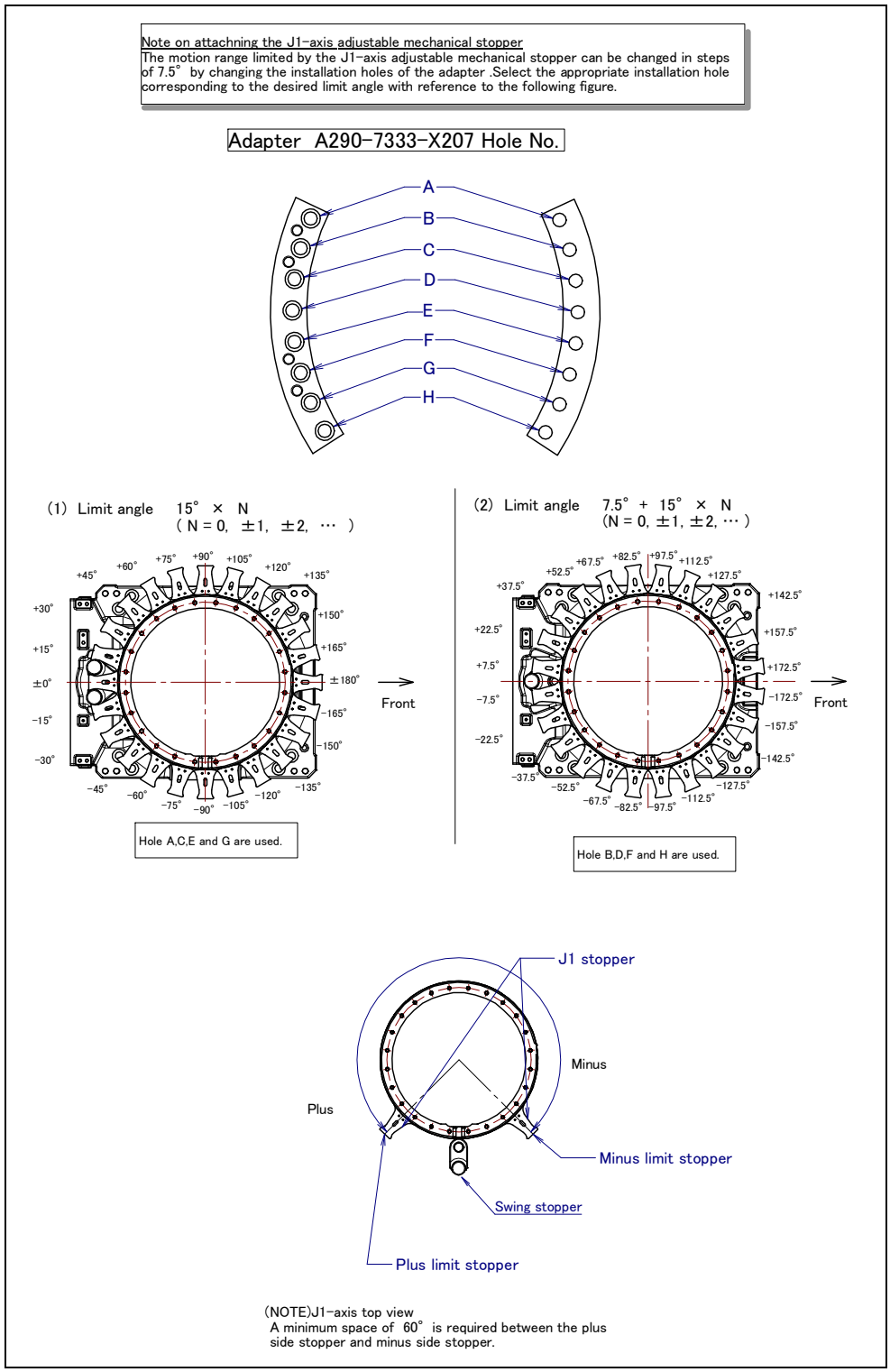


Fig. 6.2 (c) Mounting the J1-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/165F/210F/125L/165R/210R)

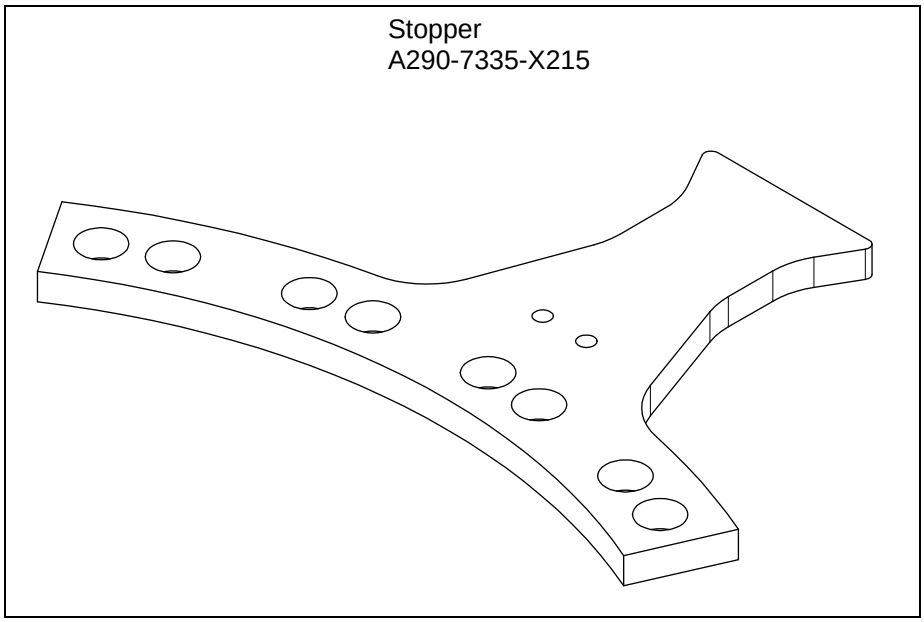


Fig. 6.2 (d) J1-axis adjustable mechanical stopper (option)
(R-2000*i*C/270F/210L)

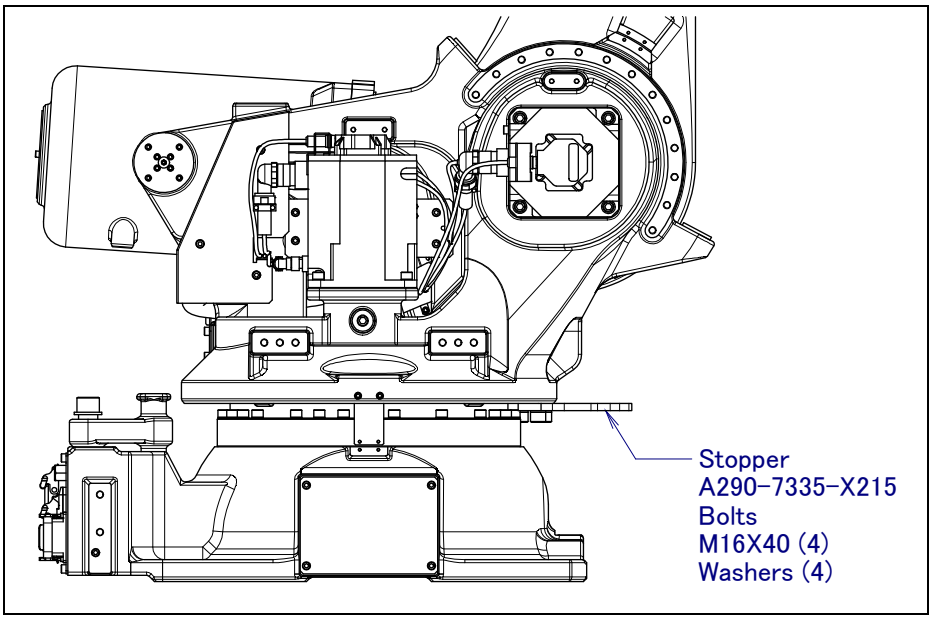
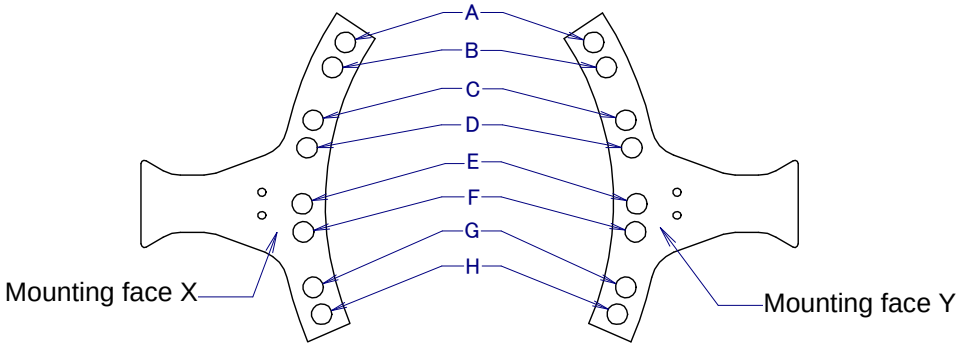
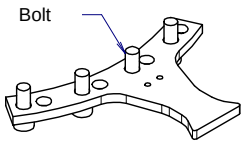
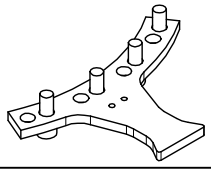
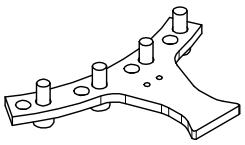
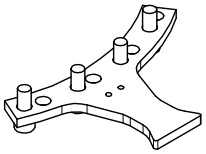


Fig. 6.2 (e) Mounting the J1-axis adjustable mechanical stopper (1/3)
(R-2000*i*C/270F/210L)

Note on attaching the J1-axis adjustable mechanical stopper
The motion range limited by the J1-axis adjustable mechanical stopper can be changed in steps of 7.5°by changing the installation holes of the adapter .Select the appropriate installation hole corresponding to the desired limit angle with reference to the following figure.

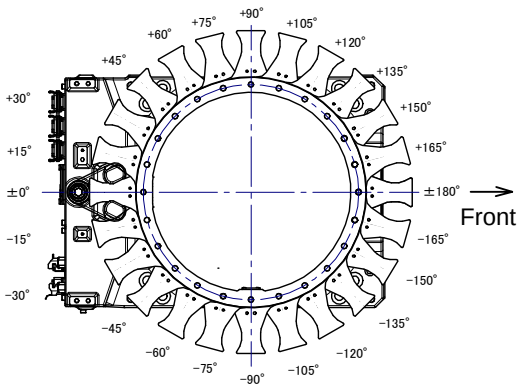
Adapter A290-7335-X215 hole number



	Mounting face X	Mounting face Y
For holes A,C,E and G	Mounting pattern A 	Mounting pattern B 
For holes B,D,F and H	Mounting pattern C 	Mounting pattern D 

(1) Limit angle 15° × N
（N = 0, ±1, ±2, ⋯ ）

Mounting pattern A or B



(2) Limit angle 5° + 15° × N
（N = 0, ±1, ±2, ⋯）

Mounting pattern C

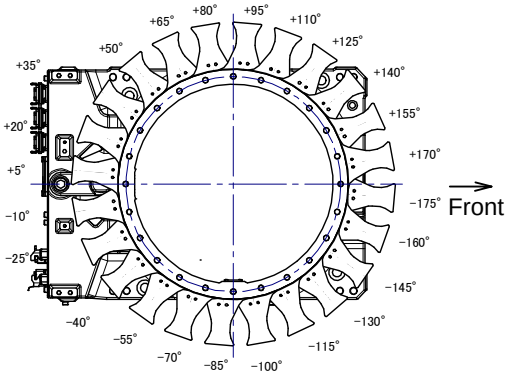
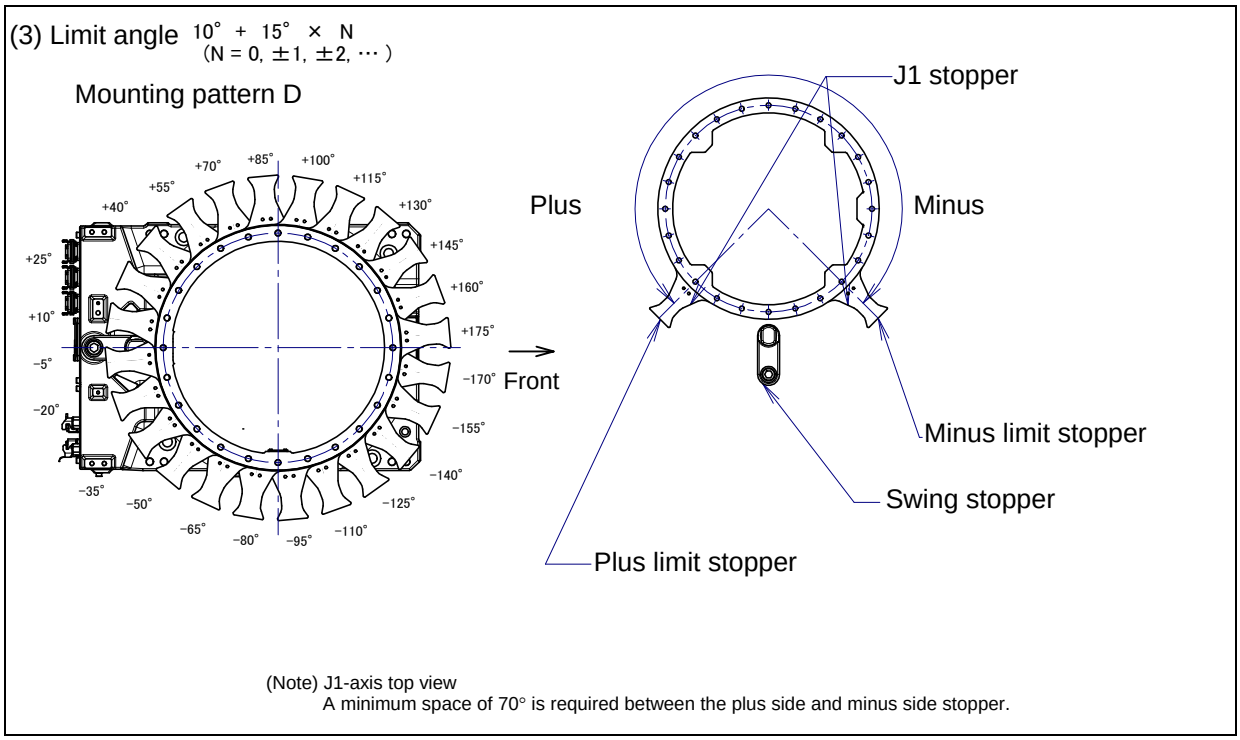


Fig. 6.2 (f) Mounting the J1-axis adjustable mechanical stopper (2/3)
(R-2000*i*C/270F/210L)



(Note) J1-axis top view
A minimum space of 70° is required between the plus side and minus side stopper.

Fig. 6.2 (g) Mounting the J1-axis adjustable mechanical stopper (3/3)
(R-2000*i*C/270F/210L)

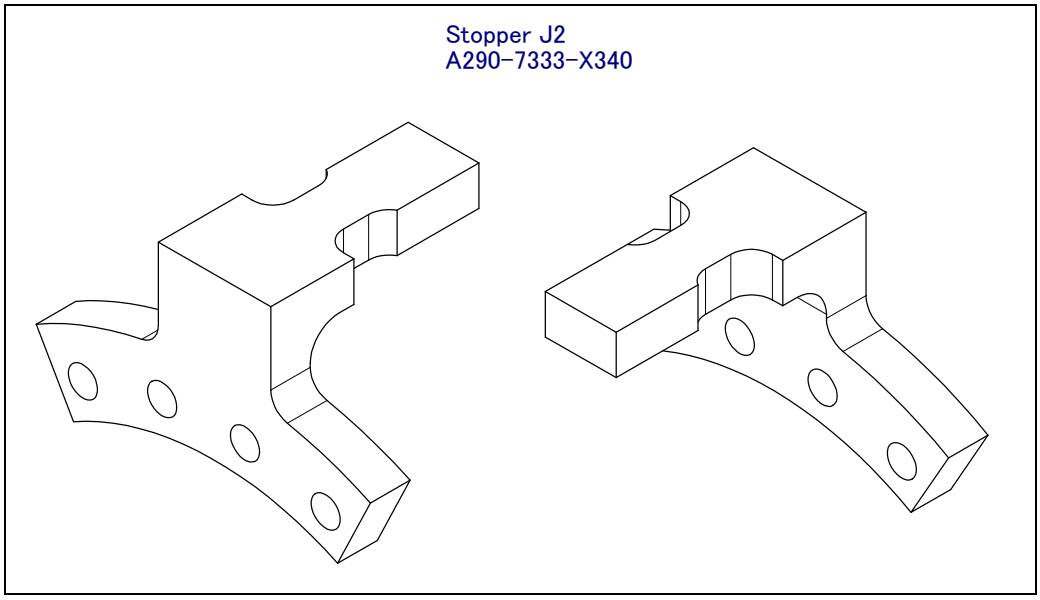


Fig. 6.2 (h) J2-axis adjustable mechanical stopper (option)
(R-2000*i*C/165F/210F/125L/165R/210R)

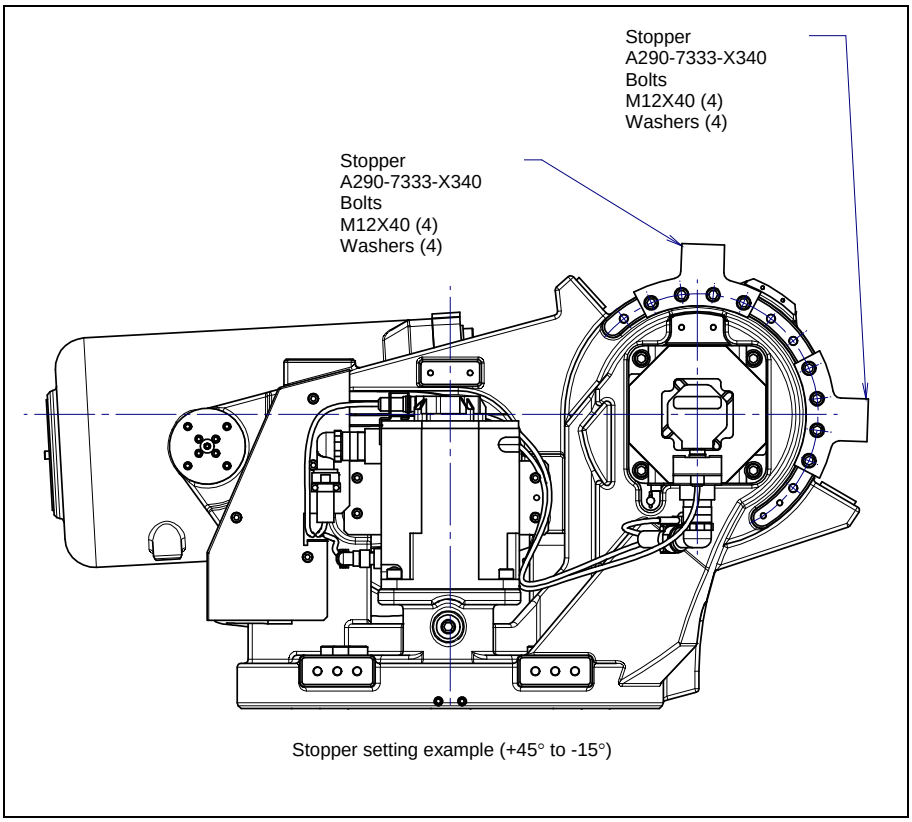


Fig. 6.2 (i) Mounting the J2-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/165F/210F/125L)

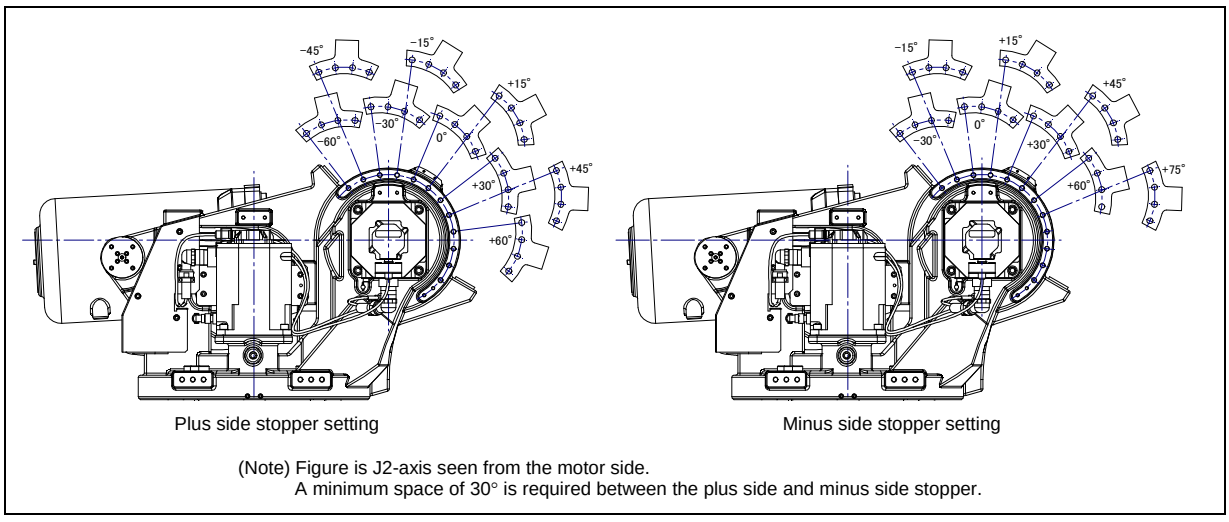


Fig. 6.2 (j) Mounting the J2-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/165F/210F/125L)

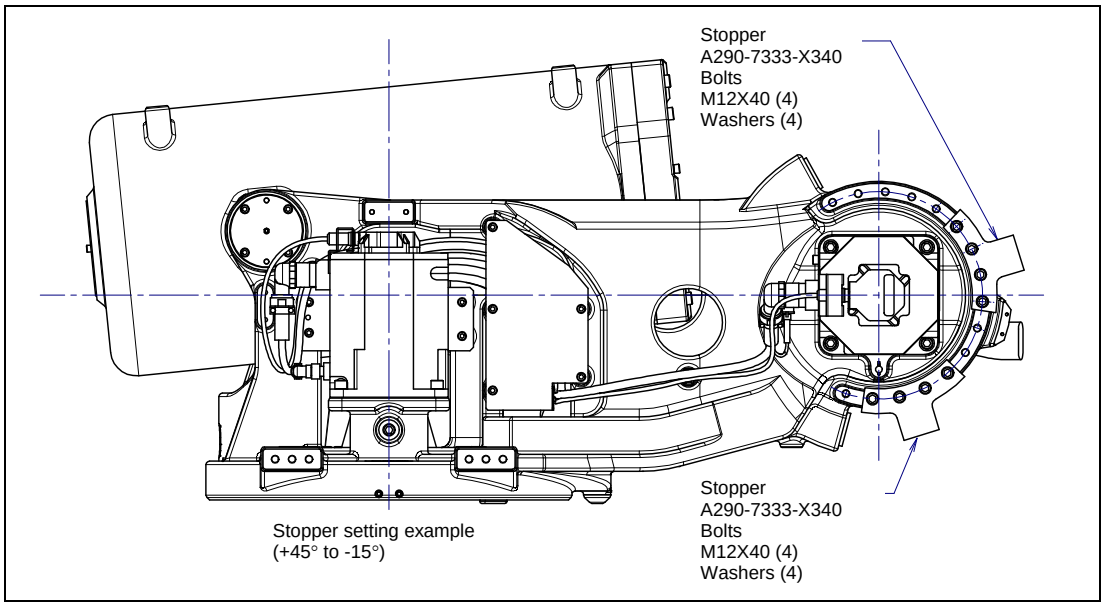


Fig. 6.2 (k) Mounting the J2-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/165R/210R)

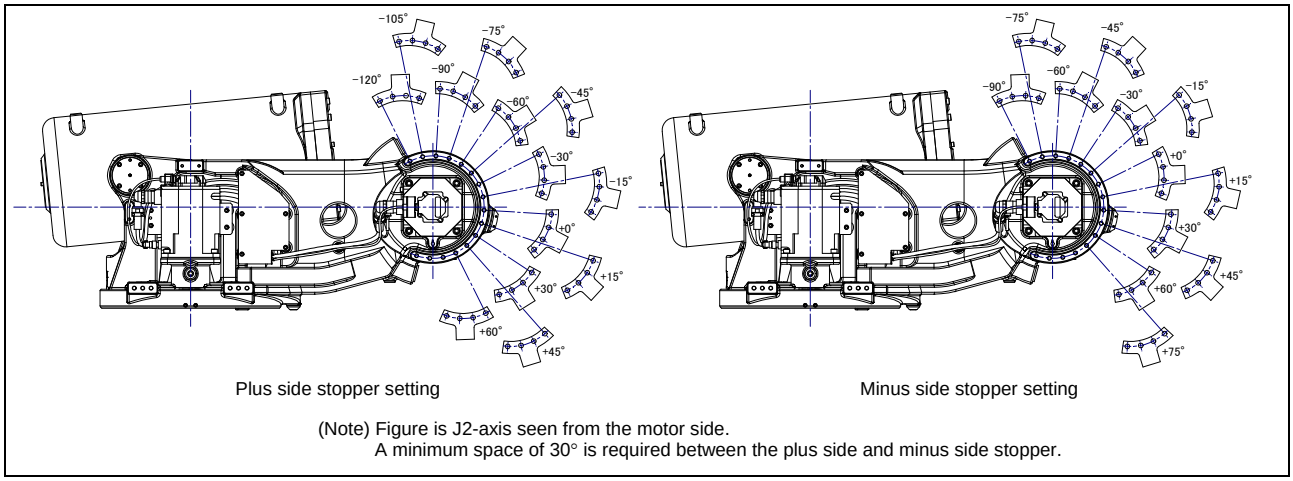


Fig. 6.2 (l) Mounting the J2-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/165R/210R)

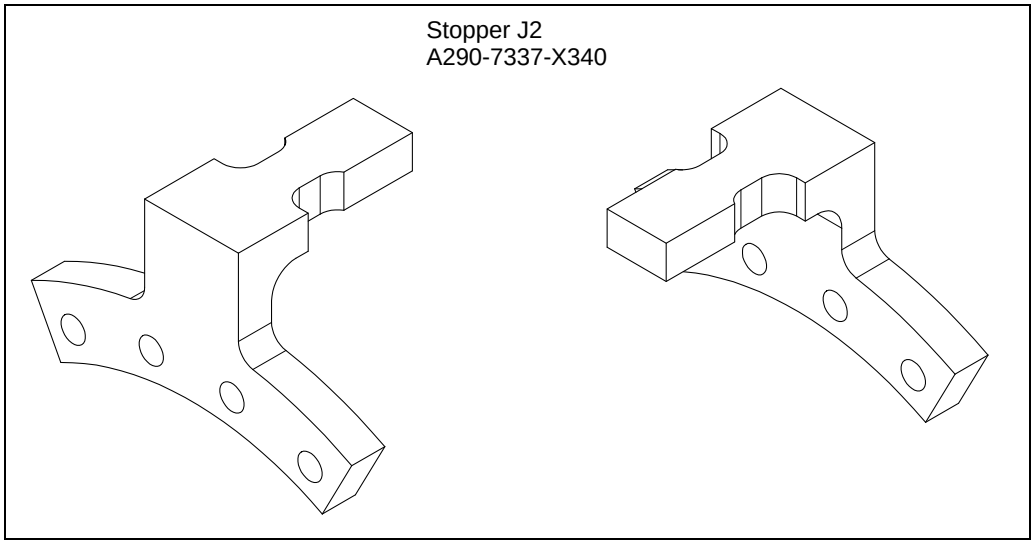


Fig. 6.2 (m) J2-axis adjustable mechanical stopper (option)
(R-2000*i*C/270F/210L)

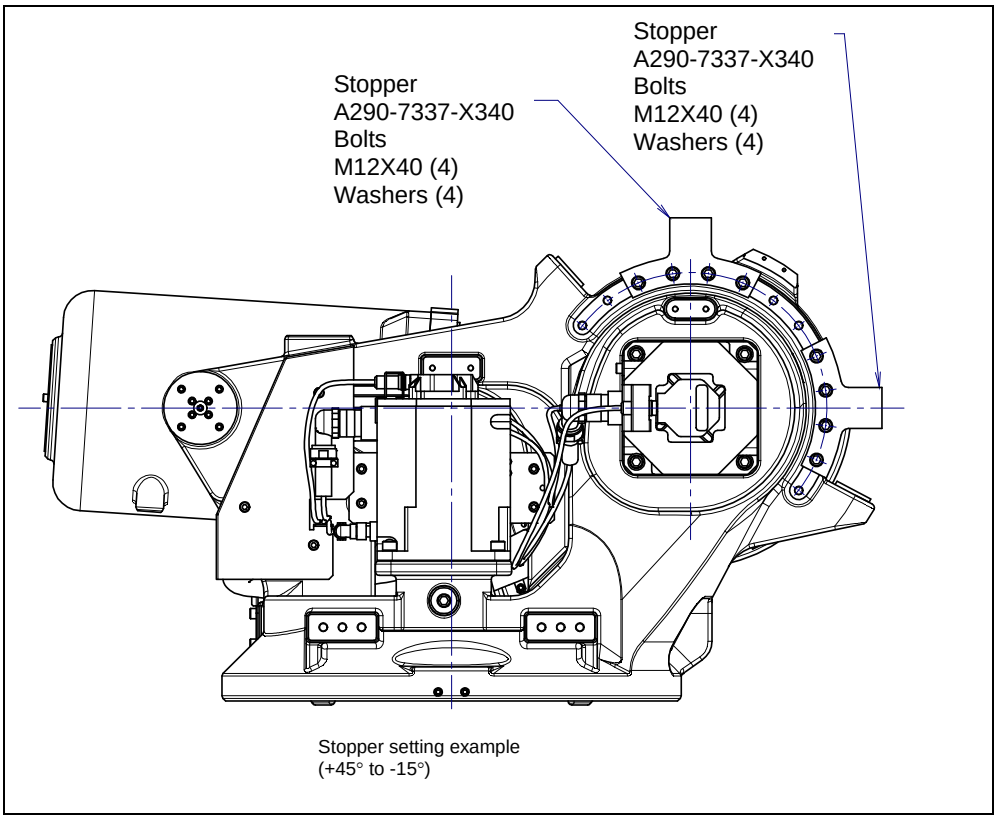


Fig. 6.2 (n) Mounting the J2-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/270F/210L)

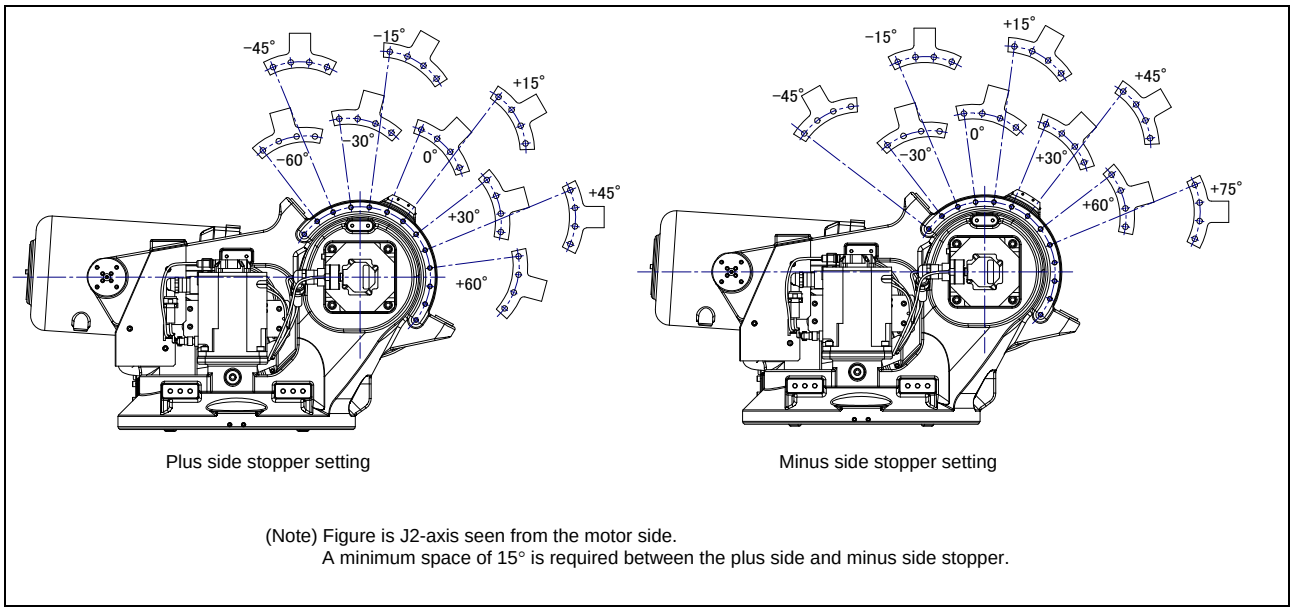


Fig. 6.2 (o) Mounting the J2-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/270F/210L)

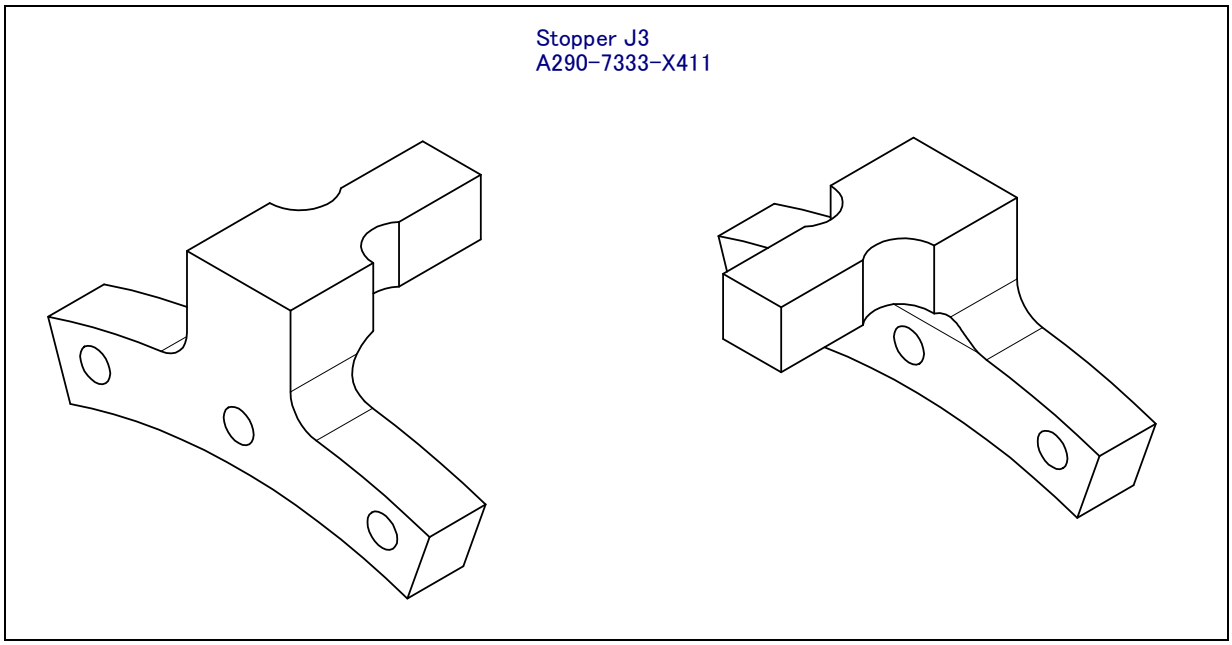


Fig. 6.2 (p) J3-axis adjustable mechanical stopper (option)
(R-2000*i*C/165F/210F/125L/165R/210R)

When the J3/J4/J5/J6-axis motor full cover option (A05B-1333-J044) is specified, remove the lower side cover B, then install the J3-axis adjustable mechanical stopper. After installation, install the cover B.

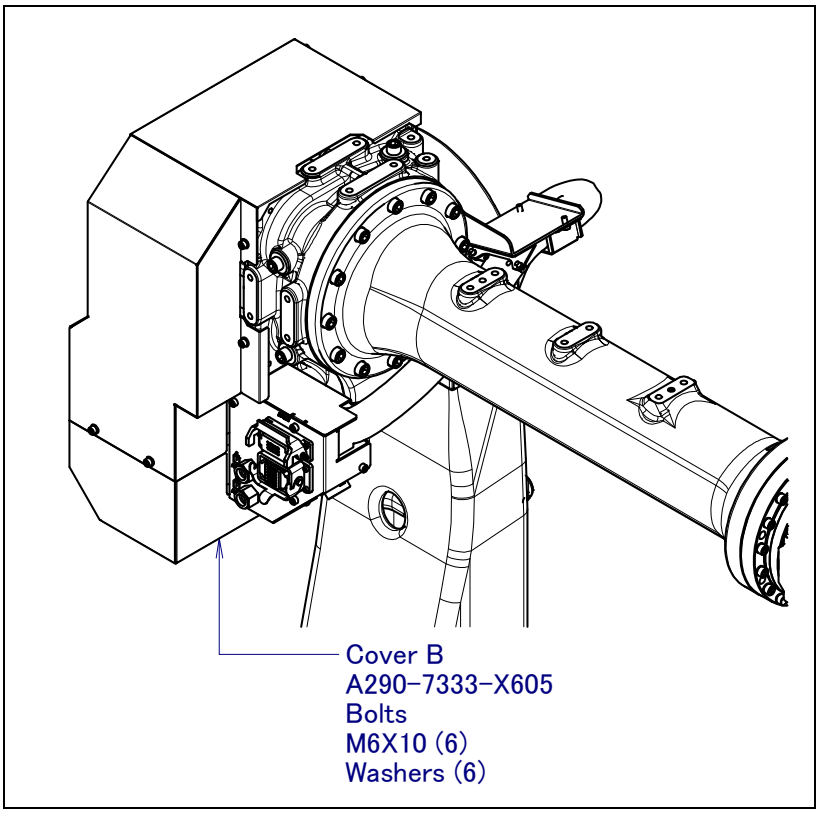


Fig. 6.2 (q) Mounting the J3-axis adjustable mechanical stopper (1/3)
(R-2000*i*C/165F/210F/125L/165R/210R)

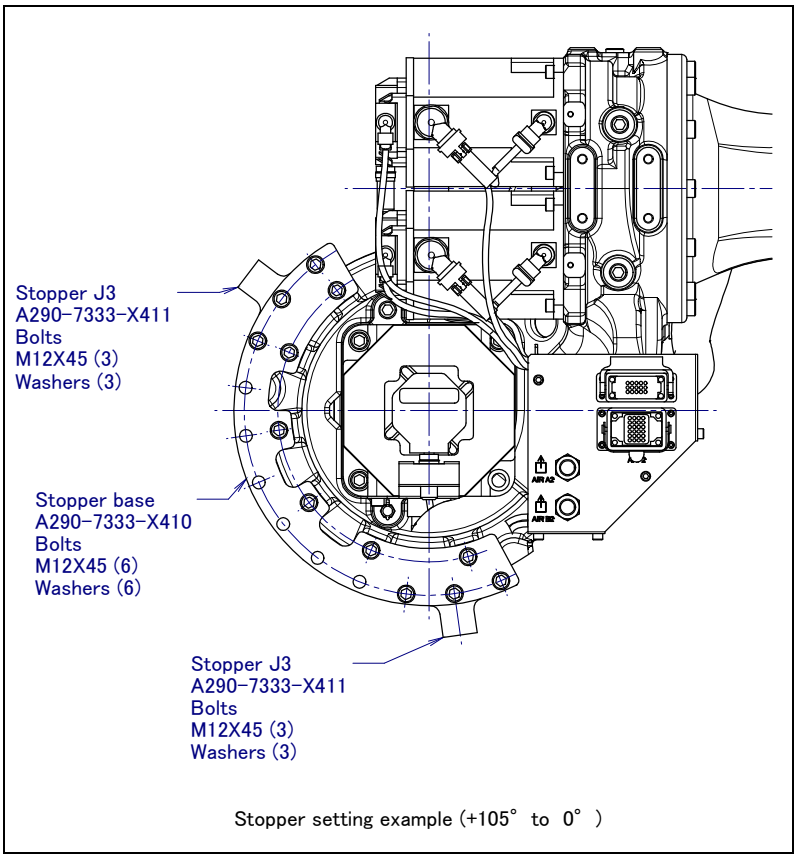


Fig. 6.2 (r) Mounting the J3-axis adjustable mechanical stopper (2/3)
(R-2000*i*C/165F/210F/125L/165R/210R)

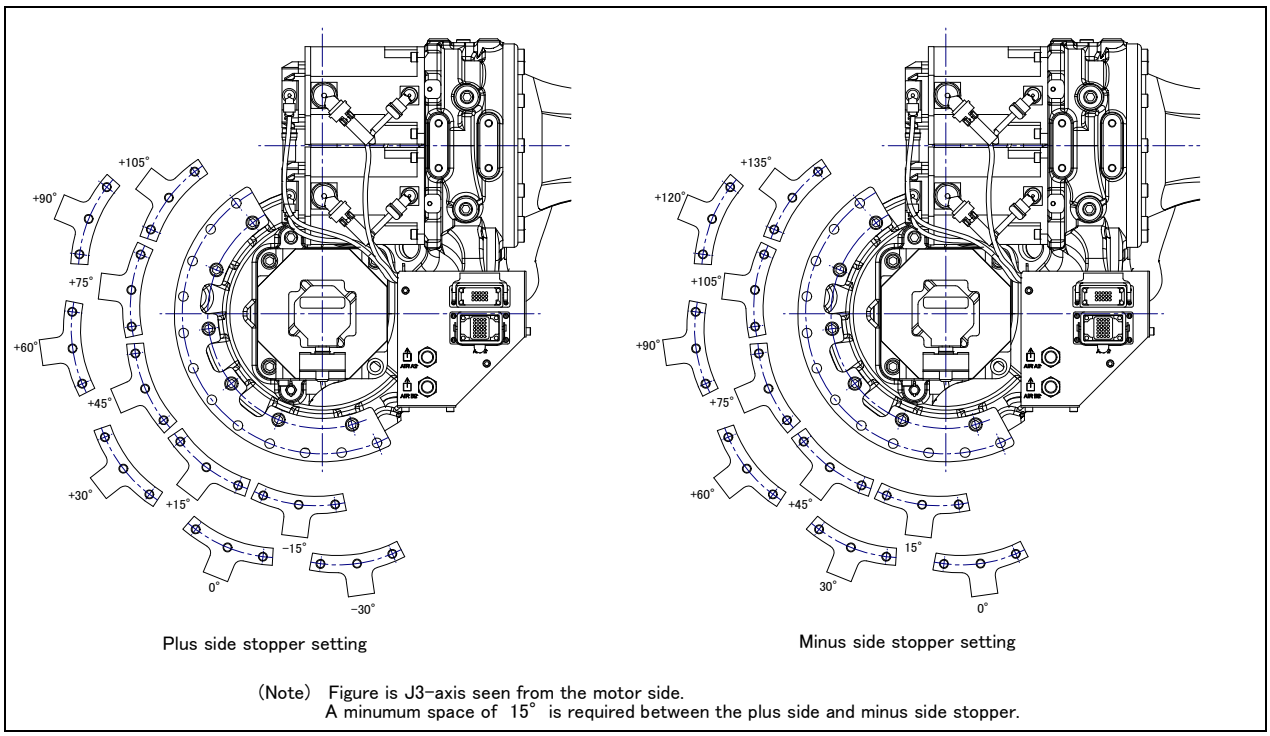


Fig. 6.2 (s) Mounting the J3-axis adjustable mechanical stopper (3/3)
(R-2000*i*C/165F/210F/125L/165R/210R)

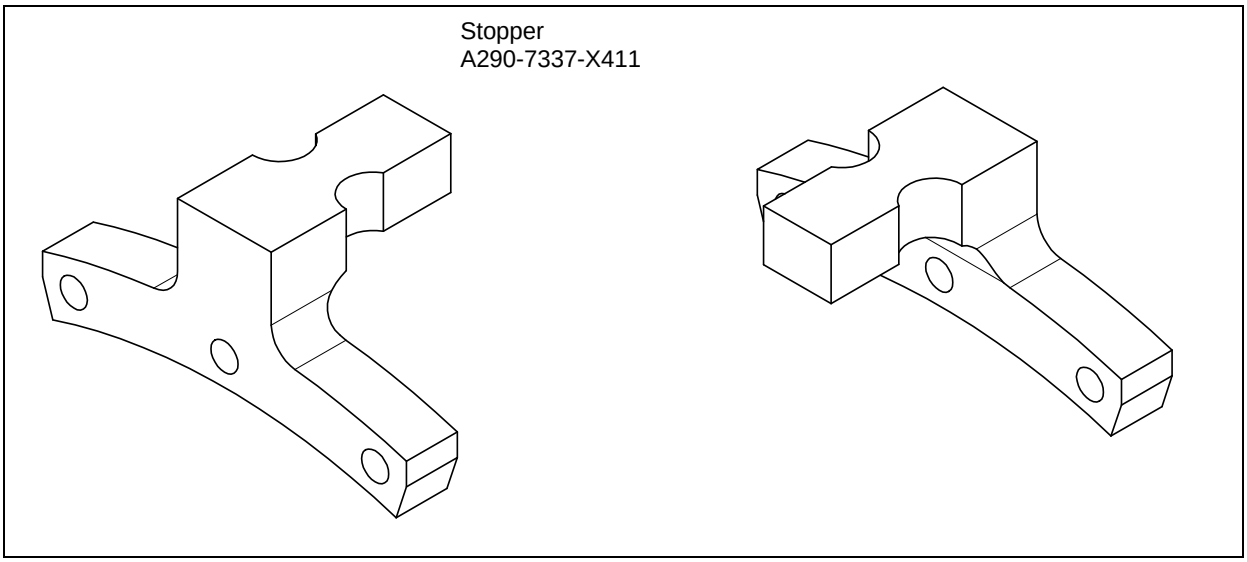


Fig. 6.2 (t) J3-axis adjustable mechanical stopper (option)
(R-2000*i*C/270F/210L)

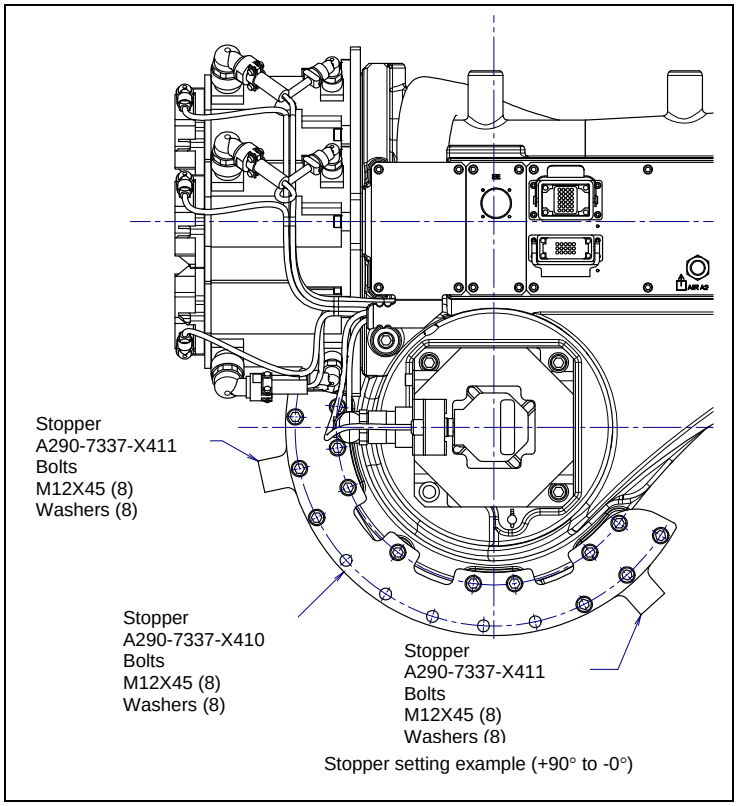
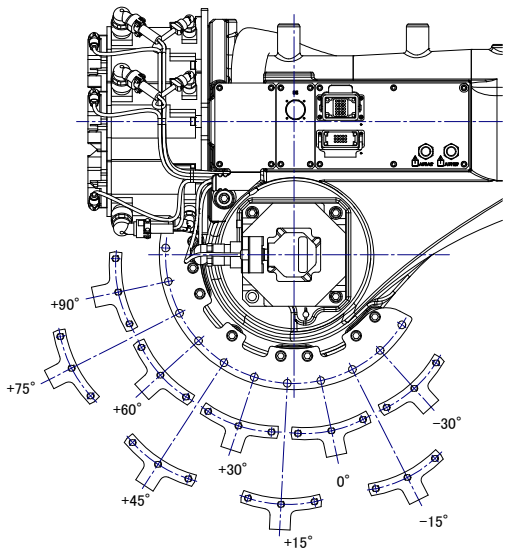
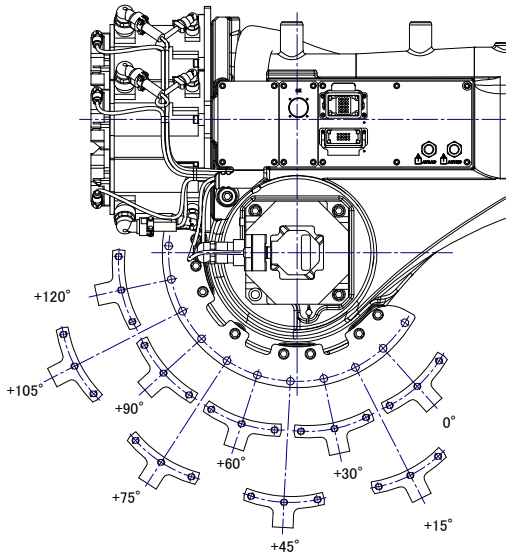


Fig. 6.2 (u) Mounting the J3-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/270F/210L)



Plus side stopper setting



Minus side stopper setting

(Note) Figure is J3-axis seen from the motor side.
A minimum space of 15° is required between the plus side and minus side stopper.

Fig. 6.2 (v) Mounting the J3-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/270F/210L)

The adjustable mechanical stopper is a mechanism that can be adjusted in its position. The robot can work safely inside the adjusted motion range, up to the maximum range as shown in Table 6.2 (d) to (f) and Fig. 6.2 (w) to (ab). A robot attempting to travel beyond this set range of motion, will be stopped by these stoppers, by collision; and therefore the robot will remain contained within the setup range .
Stopping the robot will cause the mechanical stopper to be “transformed” (means : permanently damaged). Be sure to replace the deformed stopper before using the robot again.

Table 6.2 (d) The maximum stopping distance (position) of adjustable mechanical stopper
(R-2000*i*C/165F/210F/125L)

	Plus side	Minus side
J1-axis	+16°	-16°
J2-axis	+18°	-17°
J3-axis	+11°	-13°

Table 6.2 (e) The maximum stopping distance (position) of adjustable mechanical stopper
(R-2000*i*C/165R/210R)

	Plus side	Minus side
J1-axis	+21°	-21°
J2-axis	+22°	-16°
J3-axis	+11°	-13°

Table 6.2 (f) The maximum stopping distance (position) of adjustable mechanical stopper
(R-2000*i*C/270F/210L)

	Plus side	Minus side
J1-axis	+18°	-18°
J2-axis	+17°	-13°
J3-axis	+15°	-14°

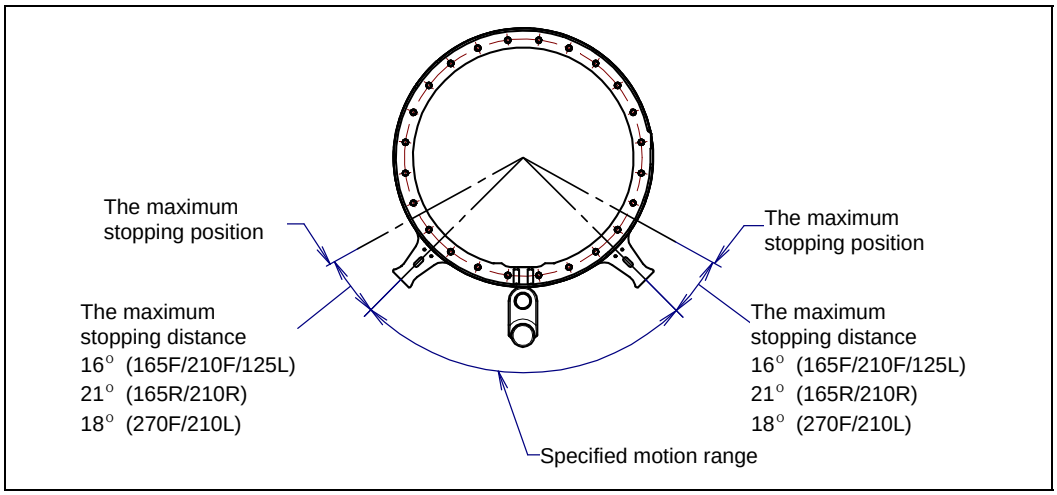


Fig. 6.2 (w) The maximum stopping distance of adjustable mechanical stopper of J1-axis (R-2000*i*C/165F/210F/125L/165R/210R/270F/210L)

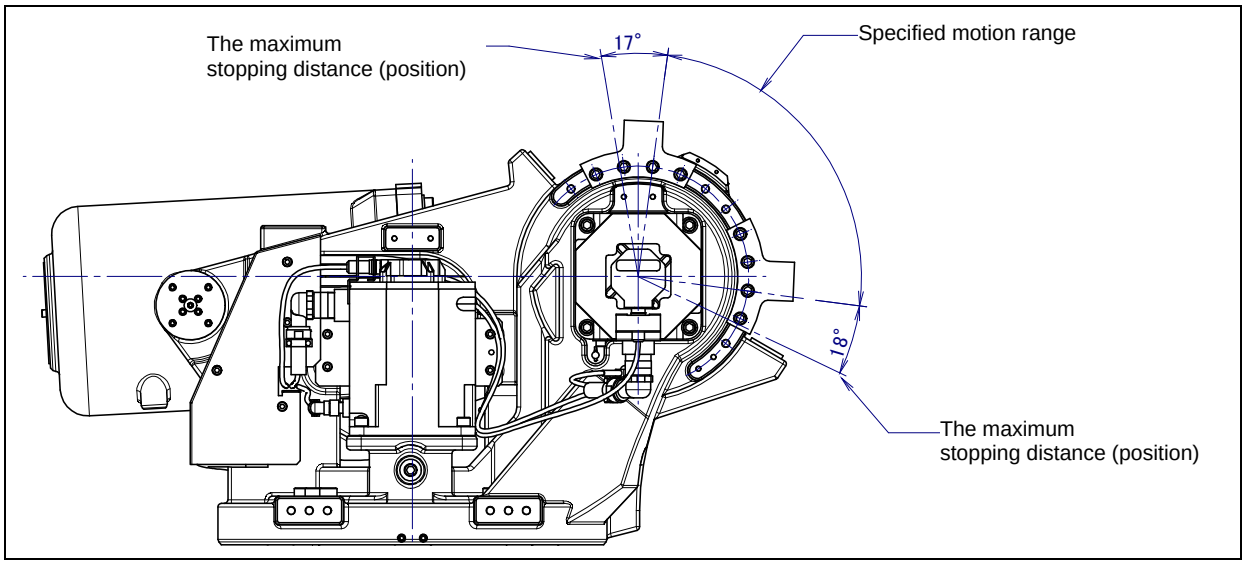


Fig. 6.2 (x) The maximum stopping distance of adjustable mechanical stopper of J2-axis (R-2000*i*C/165F/210F/125L)

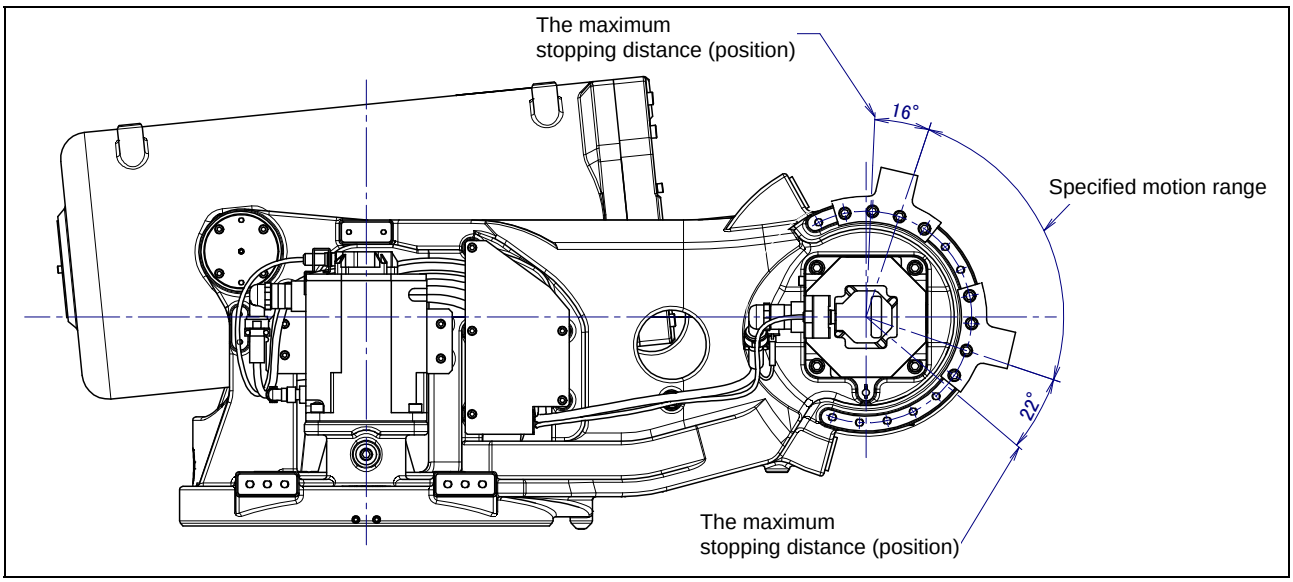


Fig. 6.2 (y) The maximum stopping distance of adjustable mechanical stopper of J2-axis (R-2000*i*C/165R/210R)

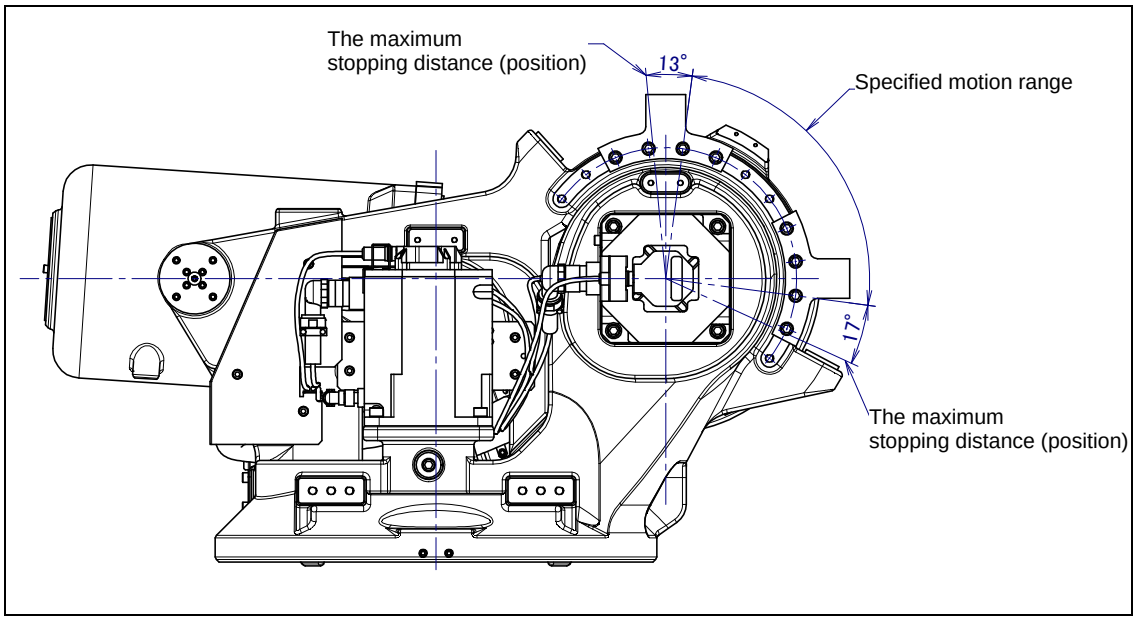


Fig. 6.2 (z) The maximum stopping distance of adjustable mechanical stopper of J2-axis (R-2000*i*C/270F/210L)

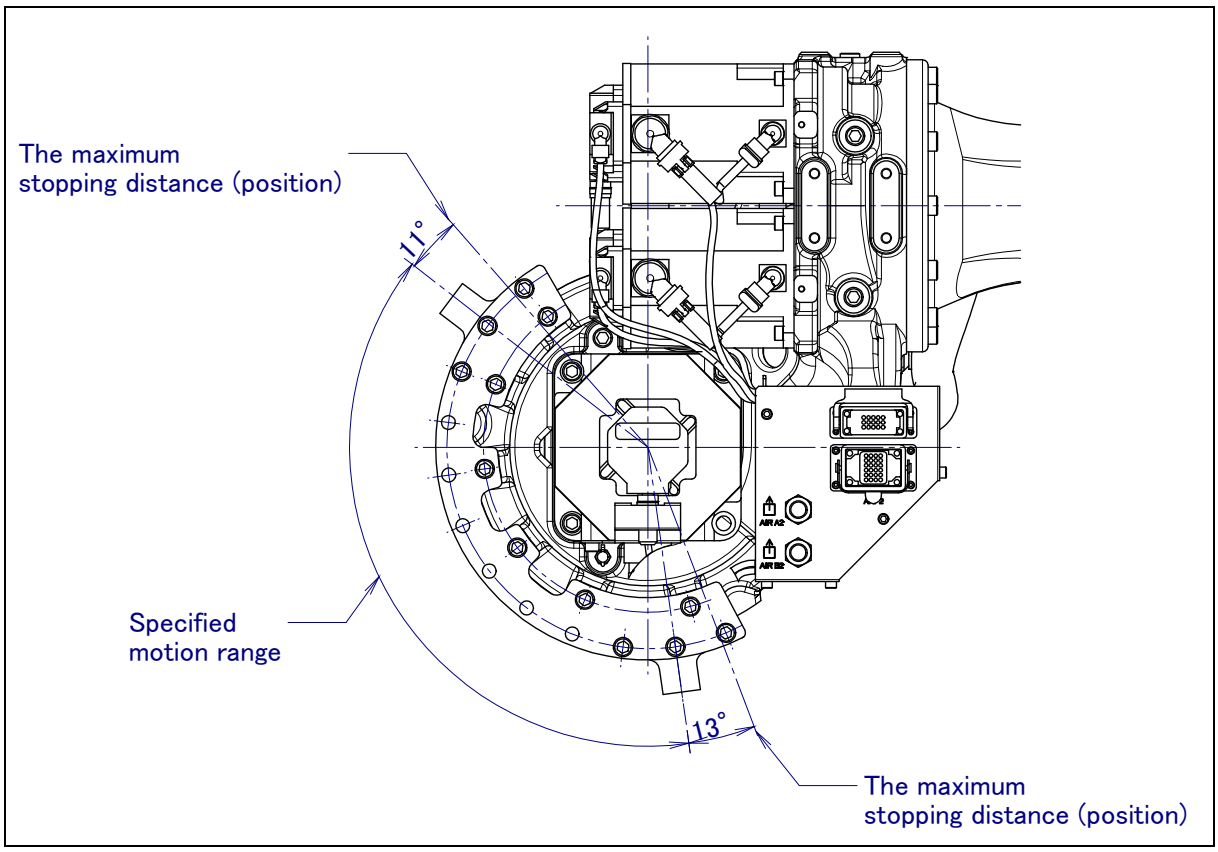


Fig. 6.2 (aa) The maximum stopping distance of adjustable mechanical stopper of J3-axis (R-2000*i*C/165F/210F/125L/165R/210R)

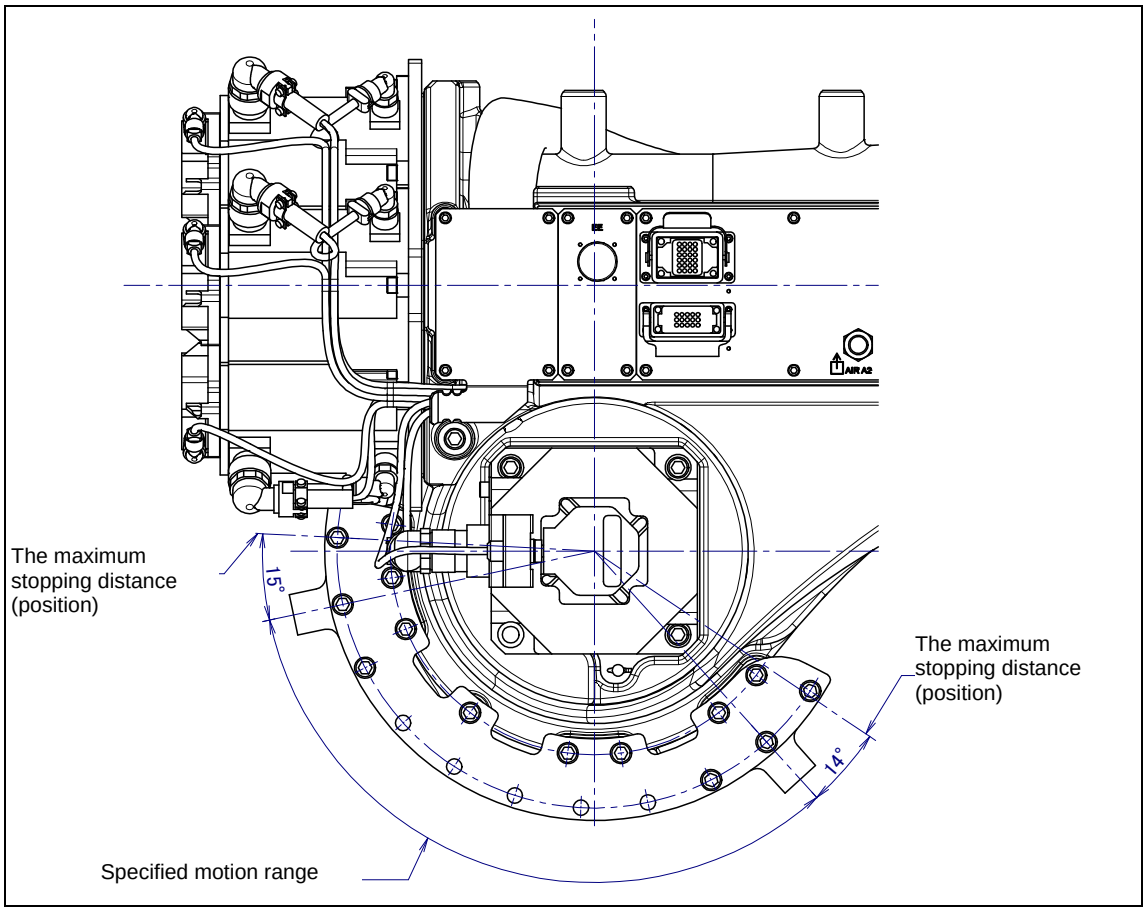


Fig. 6.2 (ab) The maximum stopping distance of adjustable mechanical stopper of J3-axis (R-2000*i*C/270F/210L)

6.3 CHANGING THE MOTION RANGE BY THE LIMIT SWITCH (OPTION)

The limit switch is an over travel switch, which interrupts power to the servo motor and stops the robot when turned on. The limit switch is optionally provided for the J1-axis.
To change the motion range by the limit switch, move the dog. The following figure shows the relationship between the dog position and the motion range.
The dog of the J1-axis is placed in the same position as with the adjustable mechanical stopper.

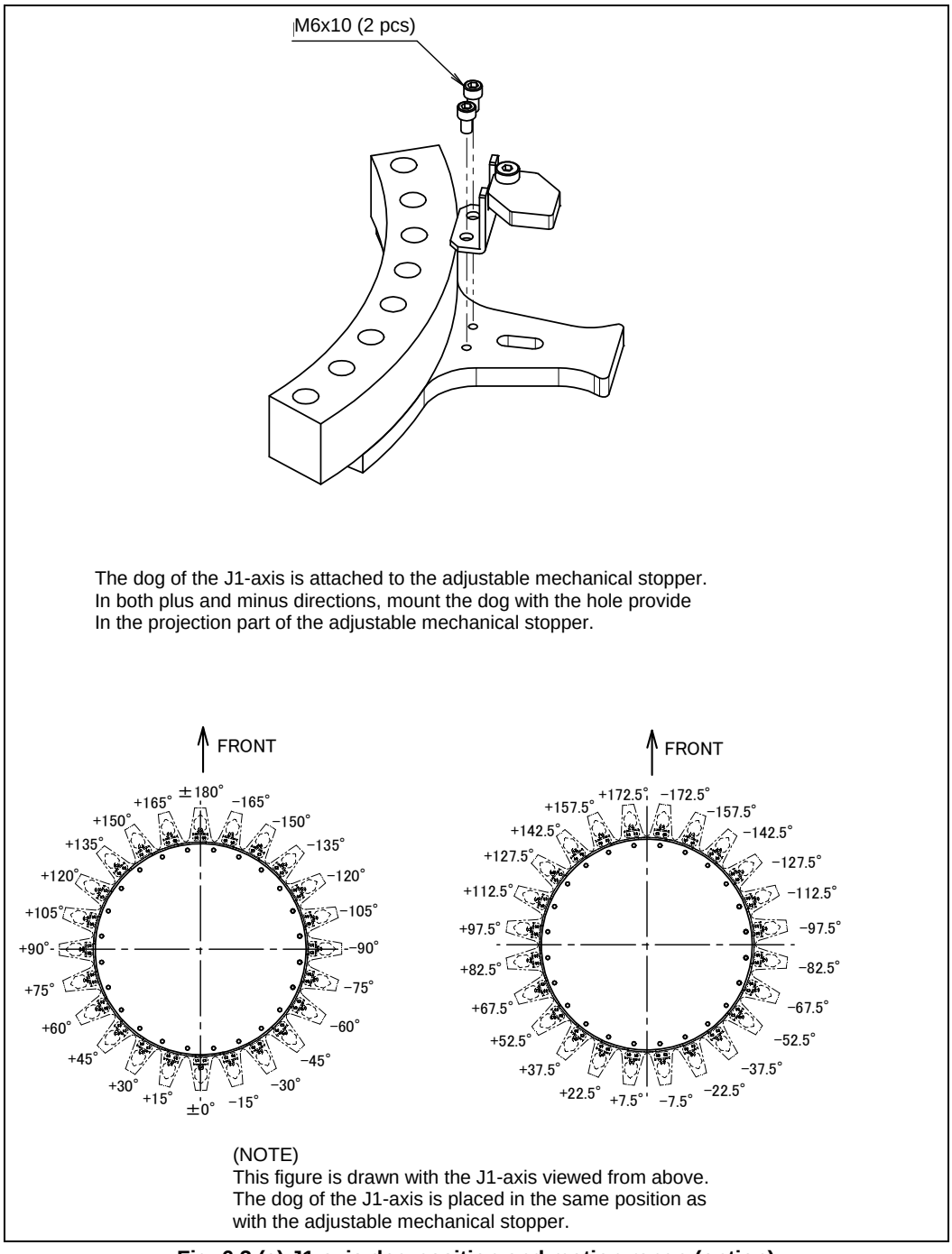
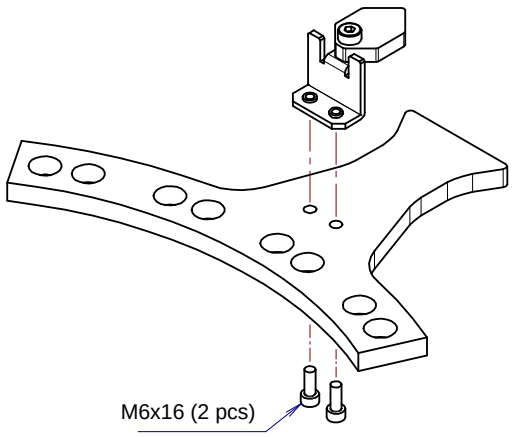
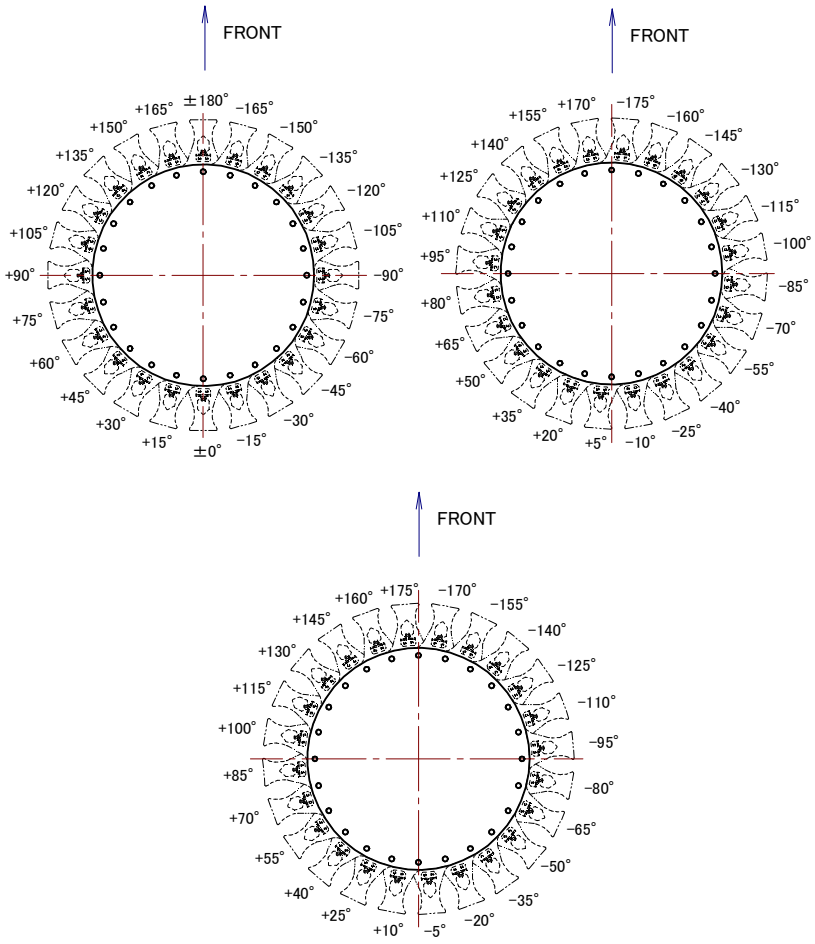


Fig. 6.3 (a) J1-axis dog position and motion range (option)
(R-2000*i*C/165F/210F/125L/165R/210R)



The dog of the J1-axis is attached to the adjustable mechanical stopper.
In both plus and minus directions, mount the dog with the hole provide
In the projection part of the adjustable mechanical stopper.



(NOTE)
This figure is drawn with the J1-axis viewed from above.
The dog of the J1-axis is placed in the same position as
with the adjustable mechanical stopper.

Fig. 6.3 (b) J1-axis dog position and motion range (option)
(R-2000*i*C/270F/210L)

6.4 ADJUSTING LIMIT SWITCH (OPTION)

After the motion range is changed by the limit switch, be sure to make adjustment.

ADJUSTING PROCEDURE

1 Set the $MOR_GRP.$CAL_DONE system parameter to FALSE. This disables the motion limit specified by the software. As a result, the operator can rotate the robot by a jog feed which goes beyond the motion limit.
2 Loosen the following bolts that hold the limit switch.
J1-axis : M8x12 2 pcs M4x25 2 pcs
3 Move the limit switch so that the robot activates it at about 0.5° before the stroke end. Step on the dog, and position the limit switch in such a place that only one of the step-on allowance indication lines at the tip of the switch is hidden.
4 When the limit switch operates and detects overtravel (OT), the robot stops, and an error message, "OVERTRAVEL", is displayed. To restart the robot, hold on the SHIFT key and press the [RESET] key. Then, while holding on the [SHIFT] key, move the adjusting axis off the OT limit switch by jogging in joint mode.
5 Check that the robot also activates the limit switch when the robot is approx. 0.5° from the opposite stroke end in the same way as above. If the limit switch does not operate at the position, adjust the position of the switch again.
6 Set the $MOR_GRP.$CAL_DONE system parameter to TRUE.
7 Turn off the controller power, then turn it on again to restart the controller.

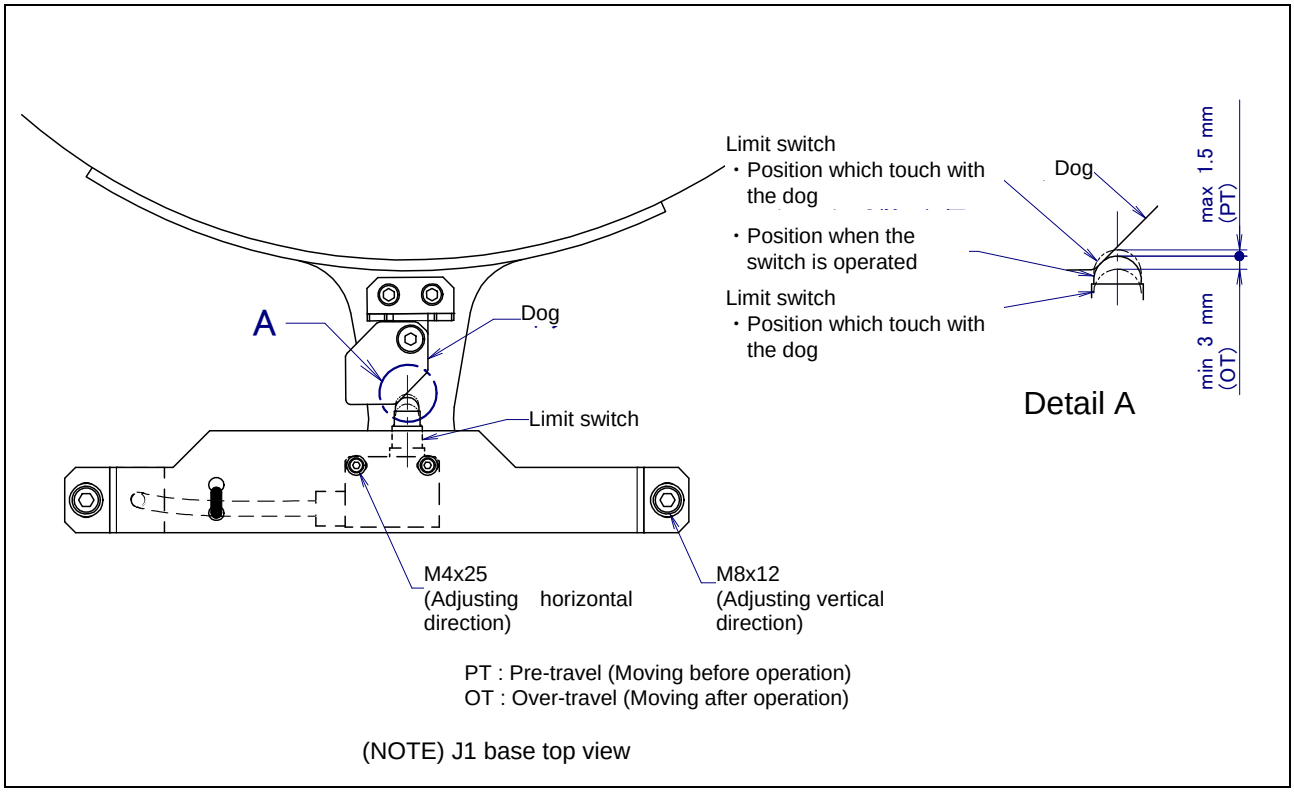


Fig. 6.4 (a) Adjusting J1-axis limit switch (option)
(R-2000*i*C/165F/210F/125L/165R/210R)

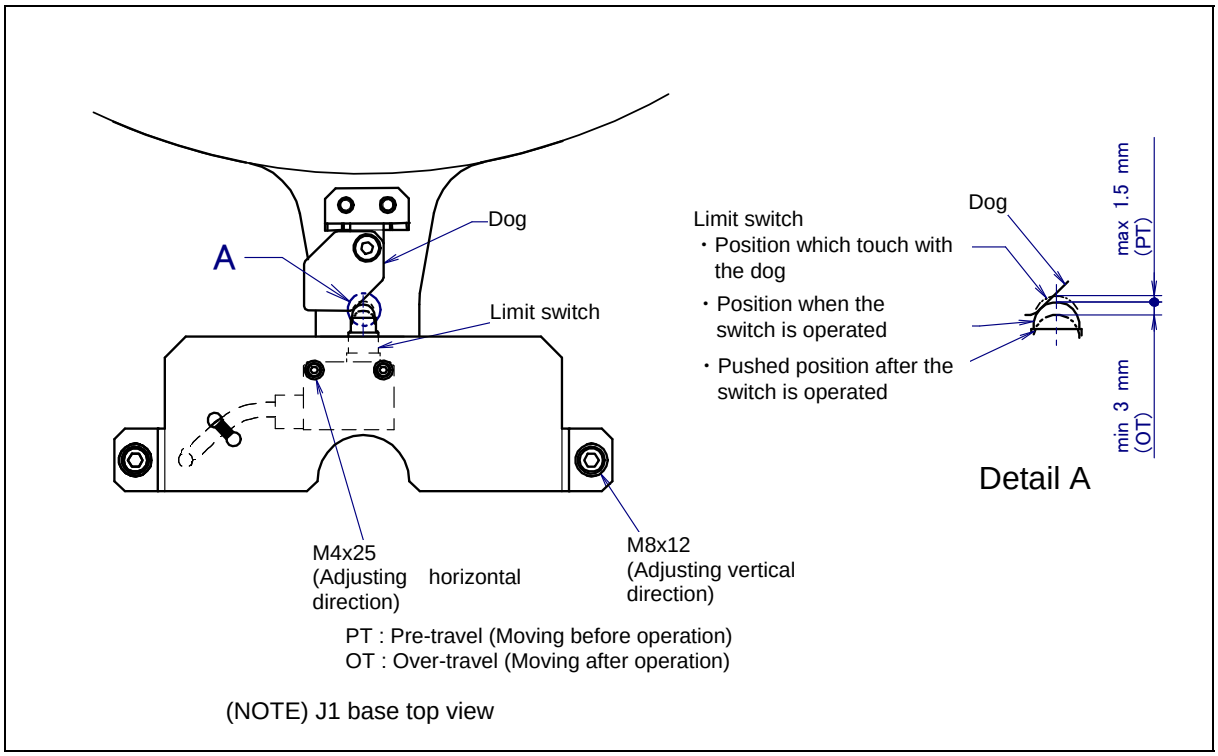


Fig. 6.4 (b) Adjusting J1-axis limit switch (option)
(R-2000*i*C/270F/210L)

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 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	(When air control set is used) **⇒"7.2.2 Confirmation of the Air Control Set"**
Vibration, abnormal noises	Check whether vibration or abnormal noises occur. When vibration or abnormal noises occur, perform measures referring to the following section: **⇒"9.1 TROUBLESHOOTING"(symptom：Vibration, Noise)**
Positioning accuracy	Check whether the taught positions of the robot have not deviated from the previous taught positions. When the 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 operate properly according to commands from the robot and the peripheral equipment.
Brakes for each axis	Check that the end effector drops within 0.2 mm when servo power is turned off. If the end effector (hand) drops, perform the measures as described in the following section: **⇒"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: **⇒"R-30*i*B/R-30*i*B Mate CONTROLLER OPERATOR'S MANUAL (Alarm Code List)(B-83284EN-1)"**

7.1.2 Periodic Checks and Maintenance

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

Check and maintenance intervals (Operating time, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	3 years 11520h	4 years 15360h			
○ Only 1st check	○					Cleaning the controller ventilation system	Confirm the controller ventilation system is not dusty. If dust has accumulated, remove it.	21
	○					Check the external damage or peeling paint	Check whether the robot has external damage or peeling paint due to the interference with the peripheral equipment. If an interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.	1
	○					Check damages of the cable protection sheaths	Check whether the cable protection sheaths of the mechanical unit cable have holes or tears. If damage is found, replace the cable protection sheath. If the cable protection sheath is damaged due to the interference with peripheral equipment, eliminate the cause. **⇒"7.2.3 Check the Mechanical Unit Cables and Connectors"**	2
	○					Check wear debris of the balancer and J1-axis swing stopper	Check whether wear debris is generated on the following parts. ・Balancer rod, support part of in front and behind of the balancer ・J1-axis swing stopper rotation part If serious wear occurs on the part that generated the wear debris, replace the part.	3
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.	4
	○ 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.	22
	○ Only 1st check	○				Check for damage to the mechanical unit cable (movable part)	Observe the movable part of the mechanical unit cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted. **⇒"7.2.3 Check the Mechanical Unit Cables and Connectors"**	5
	○ Only 1st Check	○				Check for damage to the end effector (hand) connection cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.	6

Check and maintenance intervals (Operating time, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	3 years 11520h	4 years 15360h			
	○ Only 1st check	○				Check the connection of each axis motor and other exposed connectors	Check the connection of each axis motor and other exposed connectors. **⇒"7.2.3 Check the Mechanical Unit Cables and Connectors"**	7
	○ 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"**	8
	○ Only 1st check	○				Retightening the external main bolts	Retighten the robot installation bolts, bolts to be removed for inspection, and bolts exposed to the outside. Refer to the recommended bolt tightening torque guidelines at the end of the manual. An adhesive to prevent bolts from loosening is applied to some bolts. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	9
	○ Only 1st check	○				Check the mechanical stopper and the adjustable mechanical stopper	Check that there is no evidence of a collision on the mechanical stopper, the adjustable mechanical stopper, and check the looseness of the stopper mounting bolts. Check that the J1-axis swing stopper rotates smoothly. **⇒"7.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper"**	10
	○ 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, the balancer rod. the support part of in front and behind of the balancer, and the cable protection sheaths).	11
	○ Only 1st check	○				Check the operation of the cooling fan	(When cooling fans are installed on the each axis motor) Check whether the cooling fans are operating correctly. If the cooling fans do not operate, replace them.	12
		○				Greasing to the balancer bush	Supply grease to the balancer bush. **⇒"7.3.1 Greasing the Balancer Bush"**	13
			○			Replacing the mechanical unit batteries	Replace the mechanical unit batteries **⇒"7.3.2 Replacing the Batteries"**	14
				○		Replacing the grease of each axis reducer	Replace the grease of each axis reducer **⇒"7.3.3 Replacing the Grease of the Drive Mechanism"**	15 to 19
					○	Replacing the mechanical unit cable	Replace the mechanical unit cable Contact your local FANUC representative for information regarding replacing the cable.	20
					○	Replacing the controller batteries	Replace the controller batteries **⇒Chapter 7 Replacing batteries of R-30*i*B CONTROLLER MAINTENANCE MANUAL (B-83195EN)"**	23

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.

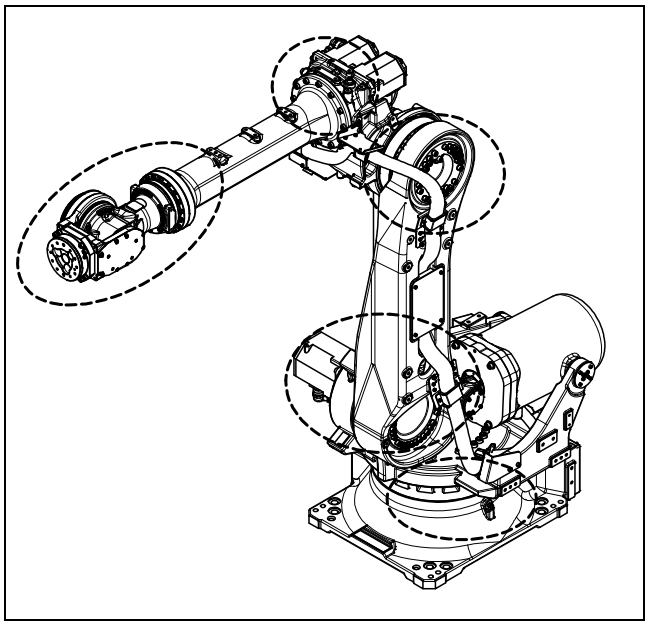


Fig.7.2.1 Check points of oil seepage

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, drive mechanisms 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 pressure can be achieved by venting the grease outlet. (When opening the grease outlet, refer to Subsection 7.3.3 and ensure that grease is not expelled onto the machine or tooling.)

> ⚠ **WARNING**
> Grease may come out suddenly when opening the grease outlet. Attach bags for collecting grease.

- 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

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

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

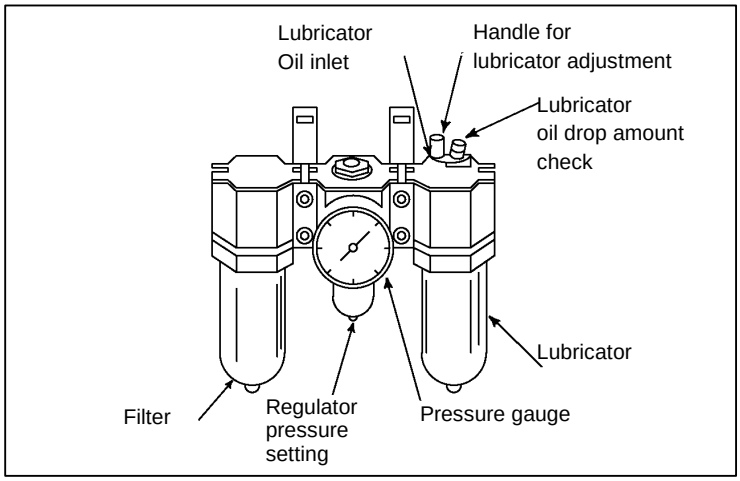


Fig. 7.2.2 Air control set (option)

7.2.3 Check the Mechanical Unit Cables and Connectors

Check points of the mechanical unit cables

Fixed part cables can interfere with the J1, J2, and J3 movable parts and peripheral equipment

* For the J1-axis, inspect the cables from above the J2 base and from the side by removing the metal plate on the side of the J1 base.

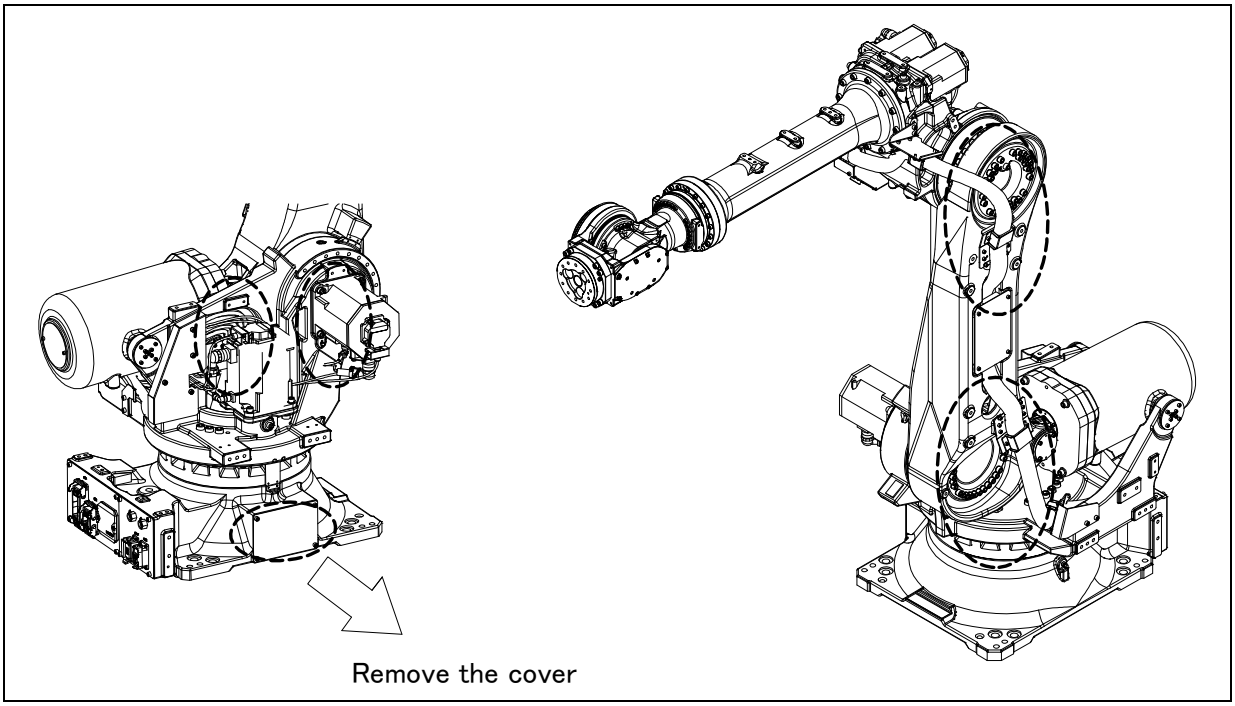


Fig. 7.2.3 (a) Check points of the mechanical unit cables

Check items

＜Cable protection sheath＞

- Check that no holes or tears exist on the cable protection sheaths.
- If there is damage as shown in Fig.7.2.3 (b), replace the cable protection sheaths.

Fig. 7.2.3 (b) Damages on the cable protection sheath

＜Cables＞

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

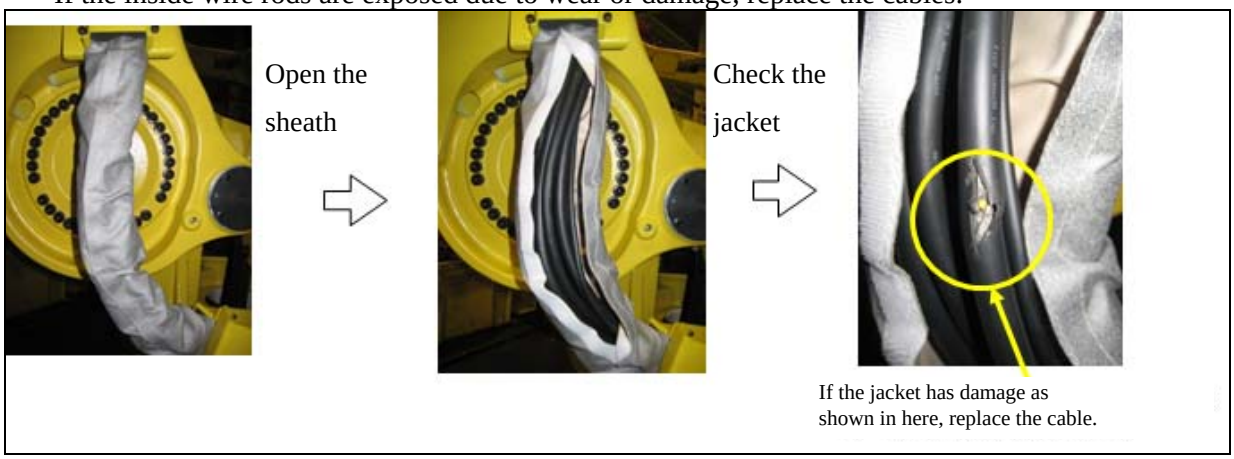


Fig. 7.2.3 (c) Cable check method

Inspection points of the connectors

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

Check items

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

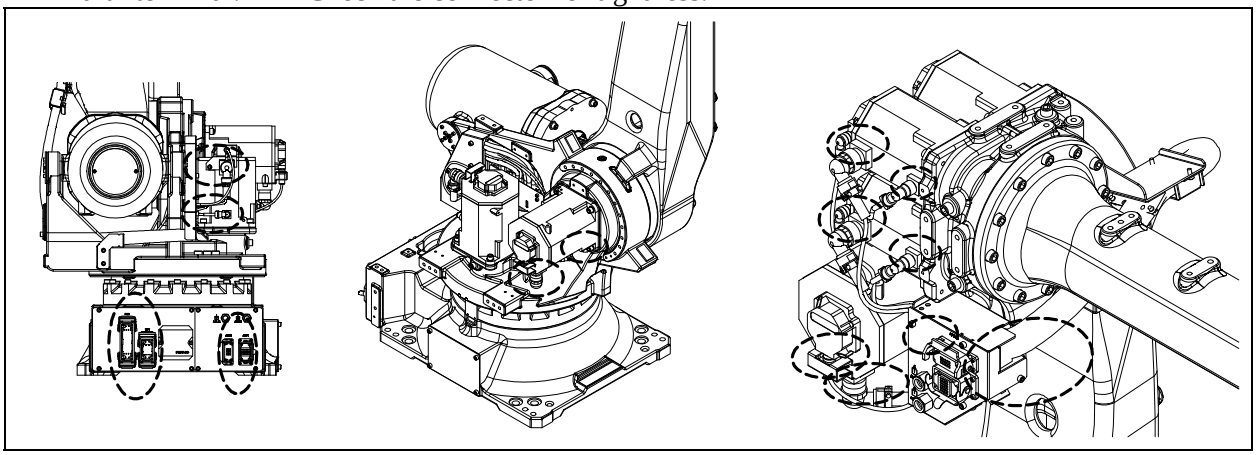


Fig. 7.2.3 (d) Connector Inspection points (R-2000*i*C/165F/210F/125L/165R/210R)

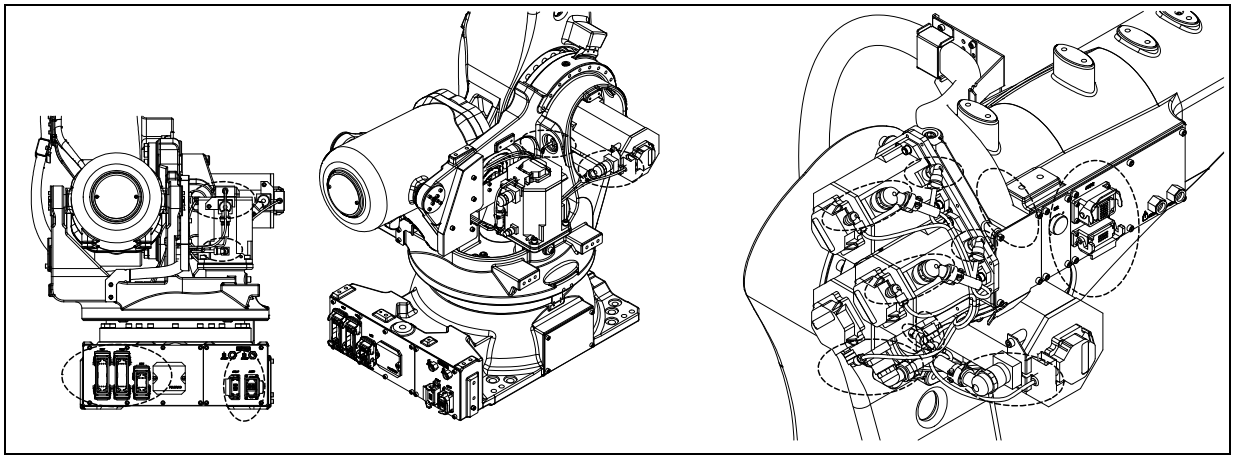


Fig. 7.2.3 (e) Connector Inspection points (R-2000*i*C/270F/210L)

7.2.4 Check of Fixed Mechanical Stopper and Adjustable Mechanical Stopper

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

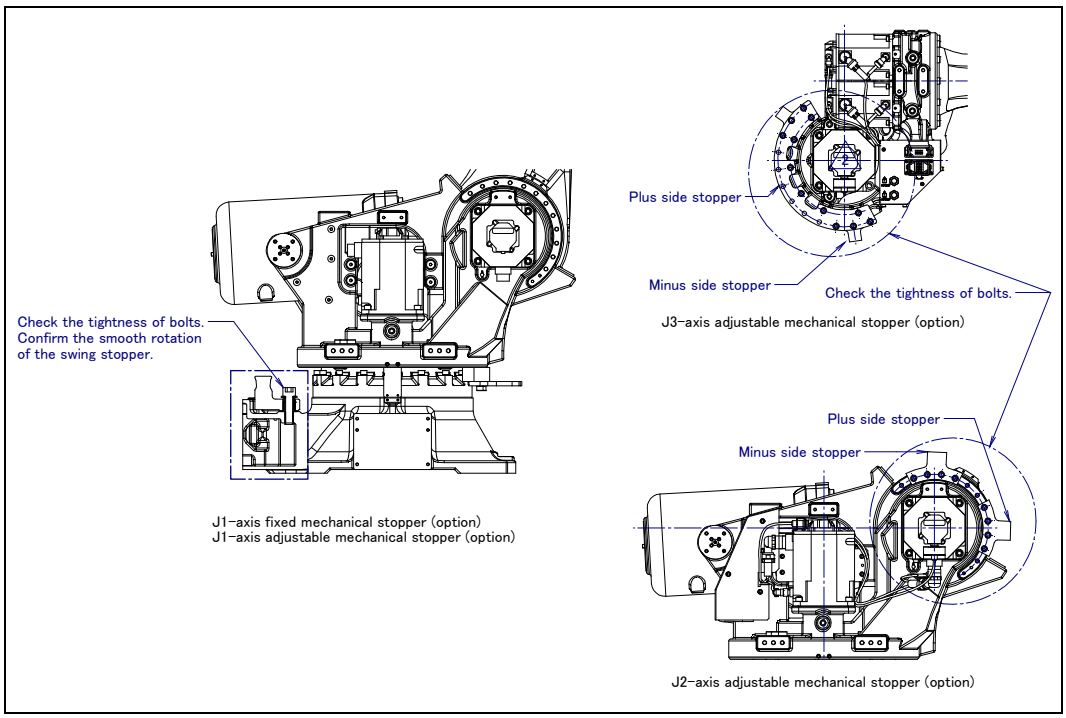


Fig. 7.2.4 Check of fixed mechanical stopper and adjustable mechanical stopper

7.3 MAINTENANCE

7.3.1 Greasing the Balancer Bush (1 year (3840 hours) Periodic Maintenance)

Be sure to grease the balancer bush at specified intervals as shown in Tables 7.3.1 (a) to (b). When the installation environment of the robot is bad, however, greasing needs to be made as appropriate. If water splashes on the robot, supply grease immediately. Fig. 7.3.1 shows the greasing points of the balancer bush.

Table 7.3.1 (a) Greasing the balancer bush

Recommended grease	Amount of grease	Greasing interval
Showa Shell Sekiyu K. K. Shell Alvania grease S2 Specification: A97L-0001-0179#2	10 ml for each (two points)	1 year or every 3840 hours of accumulated operation time

Table 7.3.1 (b) Grease alternative to Alvania GREASE S2

Mobile	Mobilux EP2
JX Nippon Oil & Energy Corporation	Multinoc 2
JX Nippon Oil & Energy Corporation	Epinoc AP-2
Idemitsu Kosan Co., Ltd.	Eponex grease No. 2
Cosmo Oil Co., Ltd.	Dynamax No. 2
Showa Shell Sekiyu K.K.	Shell Gadus S2 V100 2

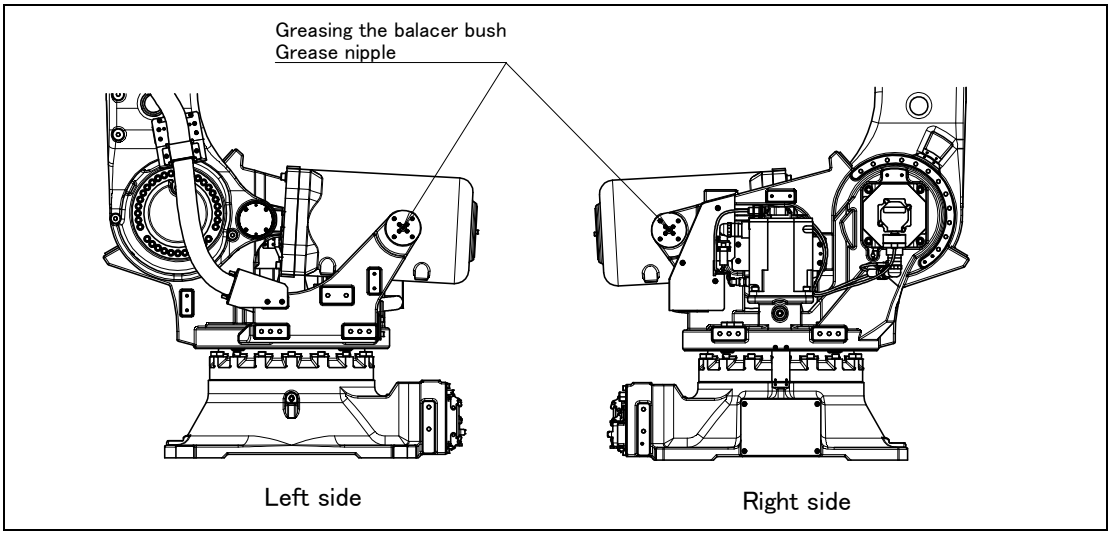


Fig. 7.3.1 Balancer bush greasing points

7.3.2 Replacing the Batteries (1.5 year (5760 hours) Periodic Maintenance)

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1.5 year. Also use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery

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

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

2 Remove the battery case cap.(Fig. 7.3.2 (a))
3 Take out the old batteries from the battery case.
4 Insert new batteries into the battery case while observing their correct direction.
5 Close the battery case cap.

> ⚠ **CAUTION**
> When using a robot with the severe dust/liquid protection option, remove the cover from the battery case as shown in Fig. 7.3.2 (b) to replace the battery. After replacing the battery, reinstall the cover. At this time, please be sure to replace gasket with new one for severe dust/liquid protection.

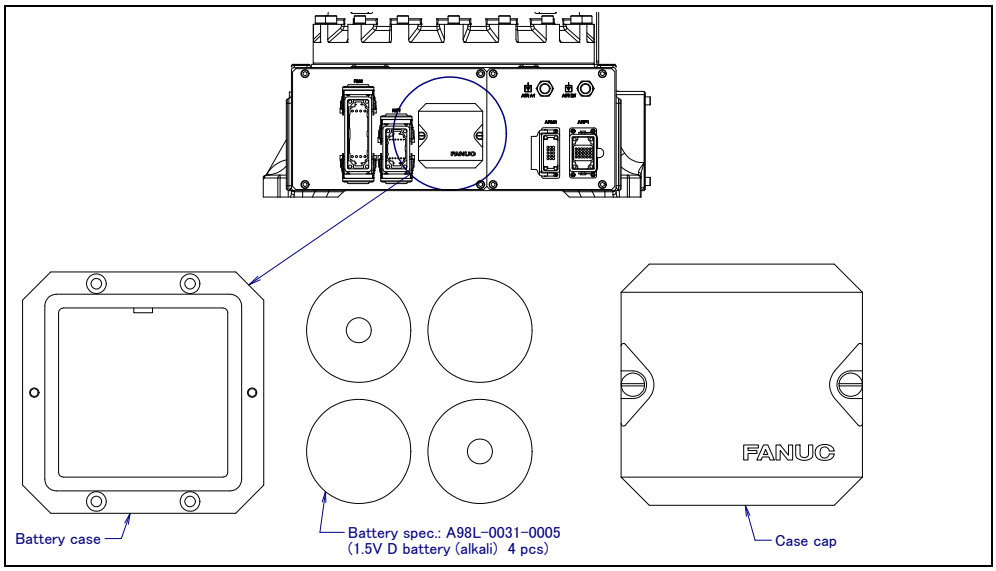


Fig. 7.3.2 (a) Replacing the battery

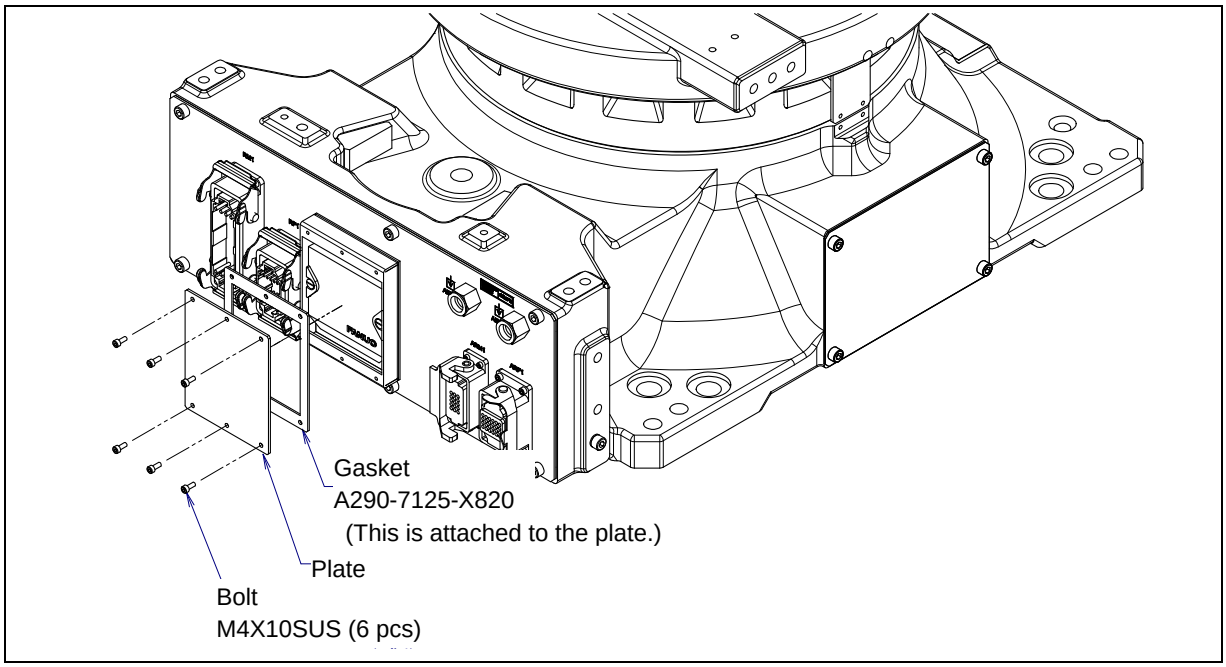


Fig.7.3.2 (b) Removing the battery cover plate (When severe dust/liquid protection is specified)

7.3.3 Replacing the Grease of the Drive Mechanism (3 years (11520 hours) Periodic Maintenance)

According to below, replace the grease of the reducers of J1, J2, and J3 axes, and the wrist at the intervals based on every 3 years or 11520 hours, whichever comes first. See Table 7.3.3 (a) for the grease name and the quantity.

Table 7.3.3 (a) Grease for 3-years (11520 hours) periodical replacement

Models	Greasing point	Quantity	Gun tip pressure	Specified grease
R-2000*i*C/165F R-2000*i*C/210F R-2000*i*C/125L R-2000*i*C/165R R-2000*i*C/210R	J1-axis reducer	4250g (4730ml)	0.15MPa or less (NOTE)	Kyodo yushi VIGOGREASE RE0 Spec : A98L-0040-0174
	J2-axis reducer	2250g (2500ml)		
	J3-axis reducer	1950g (2170ml)		
	wrist 1 (J4/J5-axis reducer)	2300g (2560ml)		
	wrist 2 (J6-axis reducer)	450g (500ml)		
R-2000*i*C/270F R-2000*i*C/210L	J1-axis reducer	5620g (6250ml)		
	J2-axis reducer	3120g (3470ml)		
	J3-axis reducer	2370g (2640ml)		
	wrist 1 (J4/J5-axis reducer)	4980g (5540ml)		
	wrist 2 (J6-axis reducer)	620g (690ml)		

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

For grease replacement or replenishment, use the posture indicated below.

Table 7.3.3 (b) Postures for greasing (R-2000*i*C/165F/210F/125L/270F/210L)

Supply position	Posture					
	J1	J2	J3	J4	J5	J6
J1-axis reducer	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
J2-axis reducer		0°				
J3-axis reducer		0°	0°			
Wrist		Arbitrary	0°	0°	0°	0°

Table 7.3.3 (c) Postures for greasing (R-2000*i*C/165R/210R)

Supply position	Posture					
	J1	J2	J3	J4	J5	J6
J1-axis reducer	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
J2-axis reducer		-90°				
J3-axis reducer		-90°	90°			
Wrist		Arbitrary	90°	0°	0°	0°

Grease replacement procedure of the J1/J2/J3-axis reducer

1 Move the robot to the greasing posture described in Table 7.3.3 (b) and (c).
2 Turn off the controller power.
3 Remove the seal bolt from grease outlet (Fig.7.3.3 (a) to (e)).
4 Supply new grease through the grease inlet until new grease is output from grease outlet.
5 Release remaining pressure using the procedure given in Subsection 7.3.4.

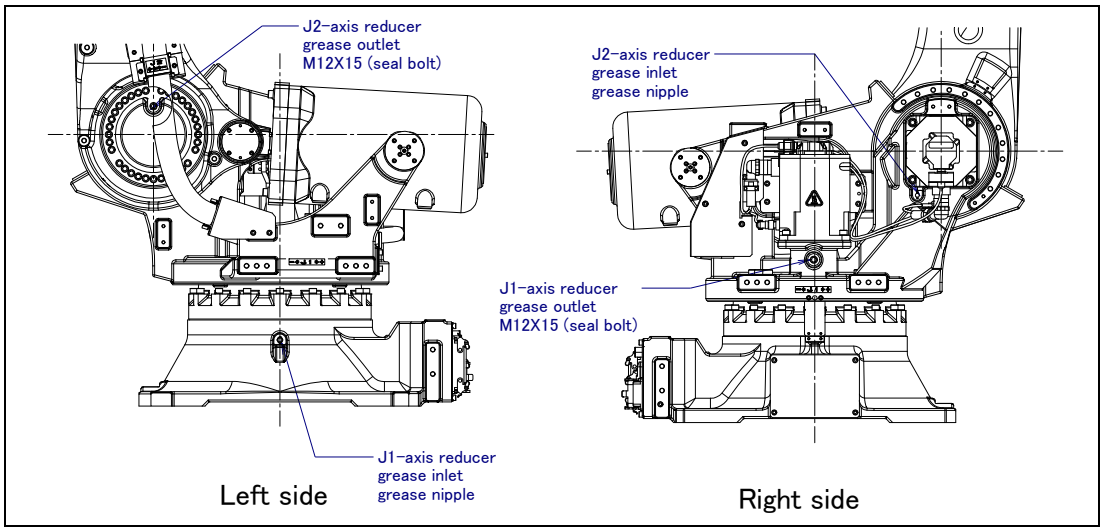


Fig. 7.3.3 (a) Replacing grease of the J1/J2-axis reducer (R-2000*i*C/165F/210F/125L)

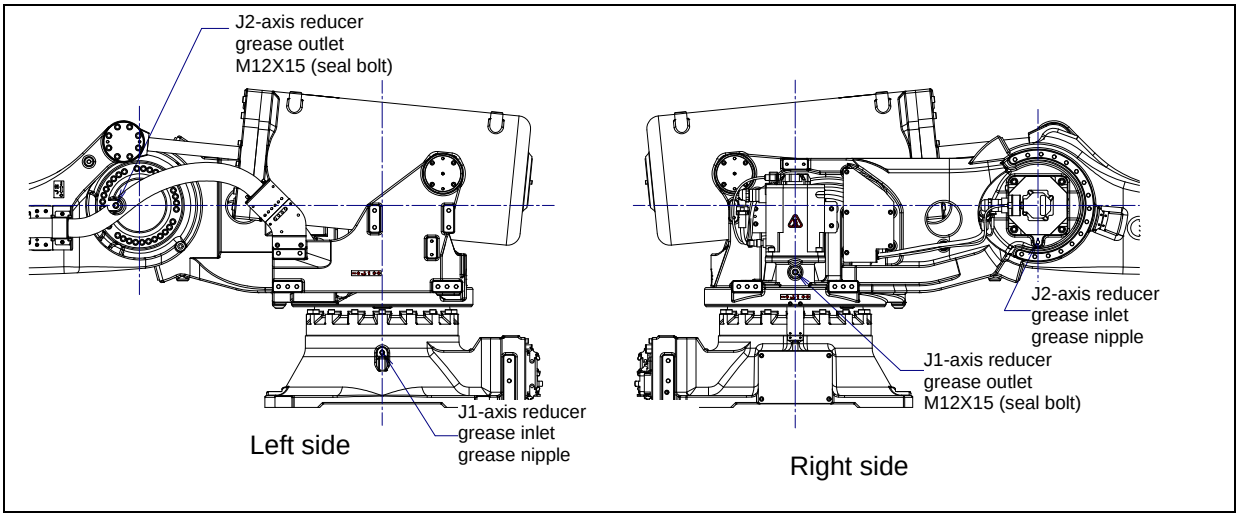


Fig. 7.3.3 (b) Replacing grease of the J1/J2-axis reducer (R-2000*i*C/165R/210R)

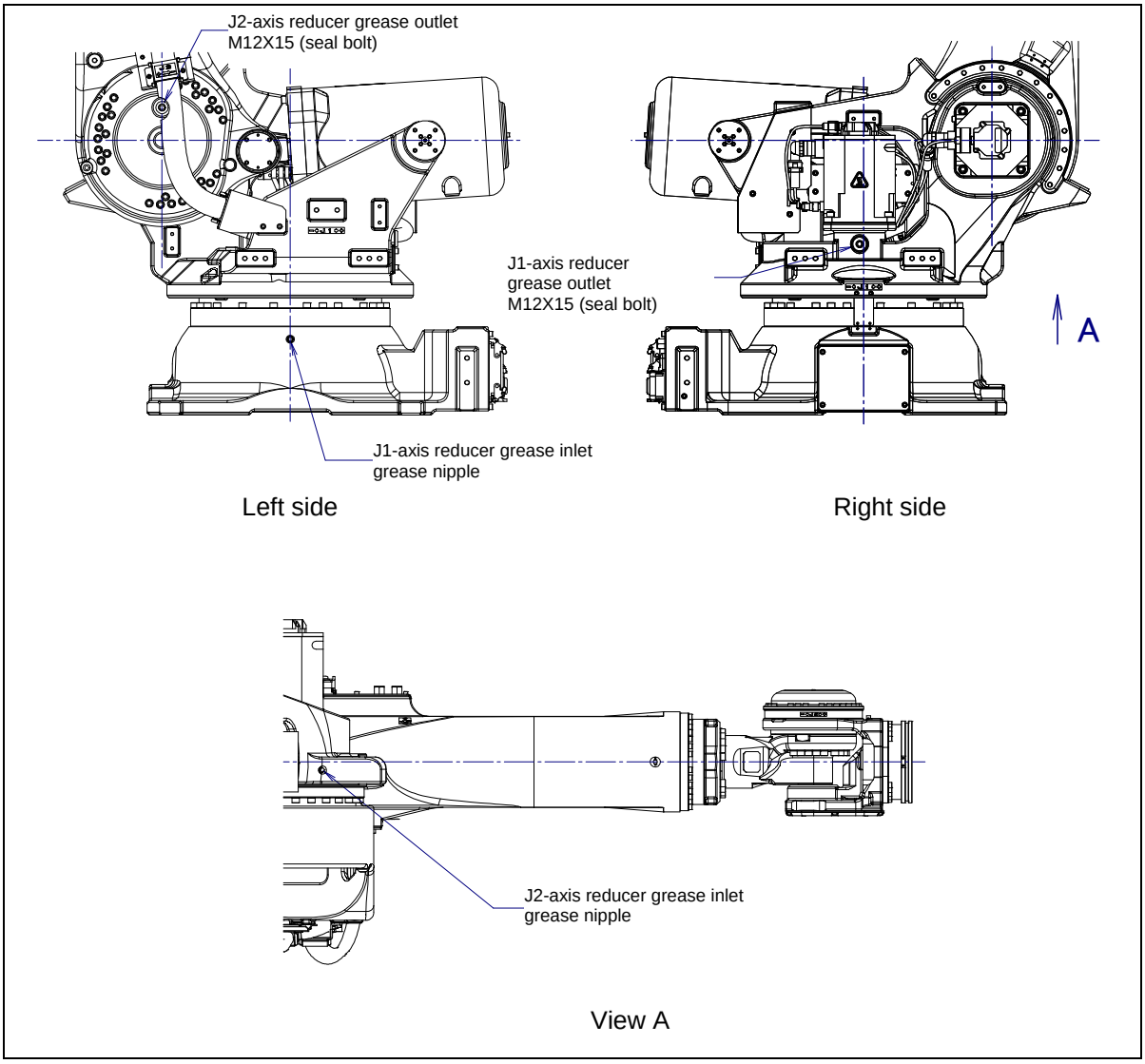


Fig. 7.3.3 (c) Replacing grease of the J1/J2-axis reducer (R-2000*i*C/270F/210L)

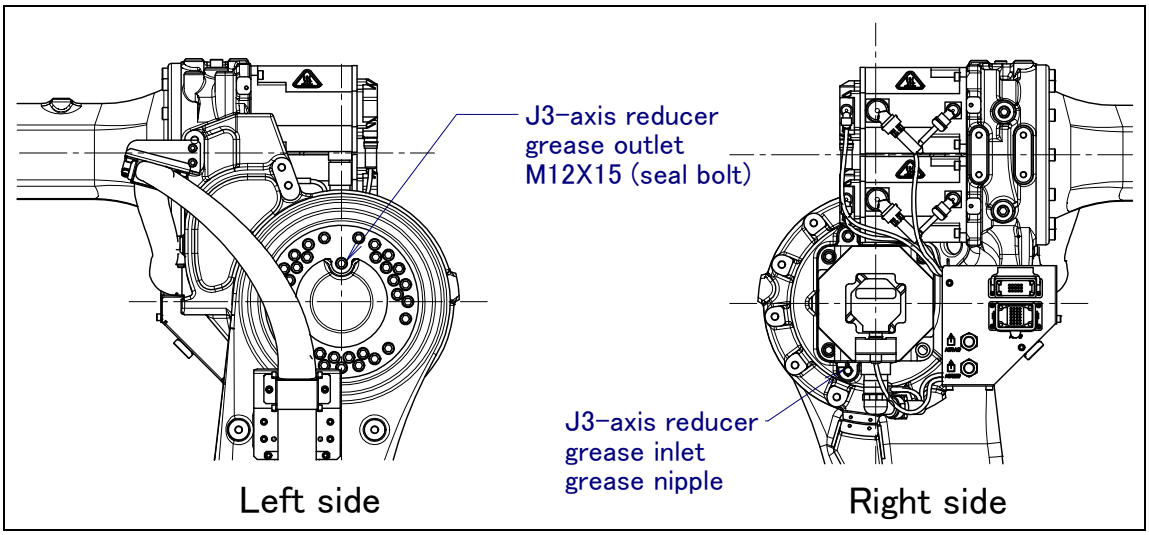


Fig. 7.3.3 (d) Replacing grease of the J3-axis reducer (R-2000*i*C/165F/210F/125L/165R/210R)

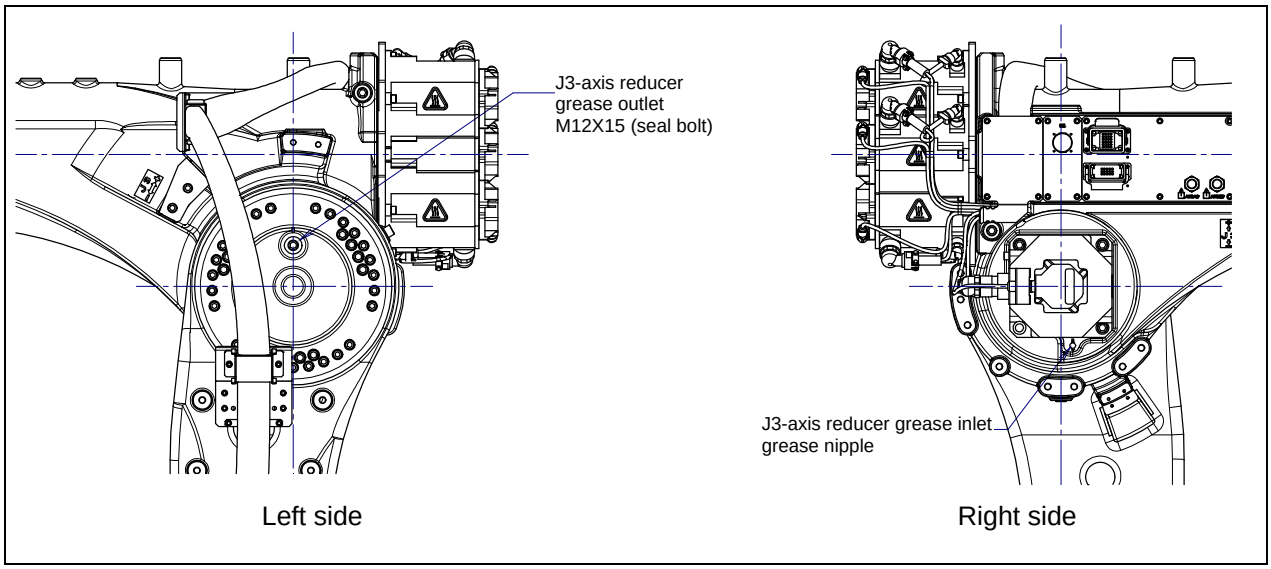


Fig. 7.3.3 (e) Replacing grease of the J3-axis reducer (R-2000*i*C/270F/210L)

Grease Replacement Procedure for the Wrist

1 Move the robot to the greasing posture described in Table 7.3.3 (b) and (c).
2 Turn off the controller power.
3 Remove the taper plug of wrist grease outlet 1 (Fig. 7.3.3 (f), (g)).
4 Supply grease to the wrist grease inlet 1 until new grease outputs from wrist grease outlet 1.
5 Next, remove the seal bolt of wrist grease outlet 2.
6 Supply new grease through the wrist grease inlet 2 until new grease is output from wrist grease outlet 2.
7 Release remaining pressure using the procedure given in Subsection 7.3.4.

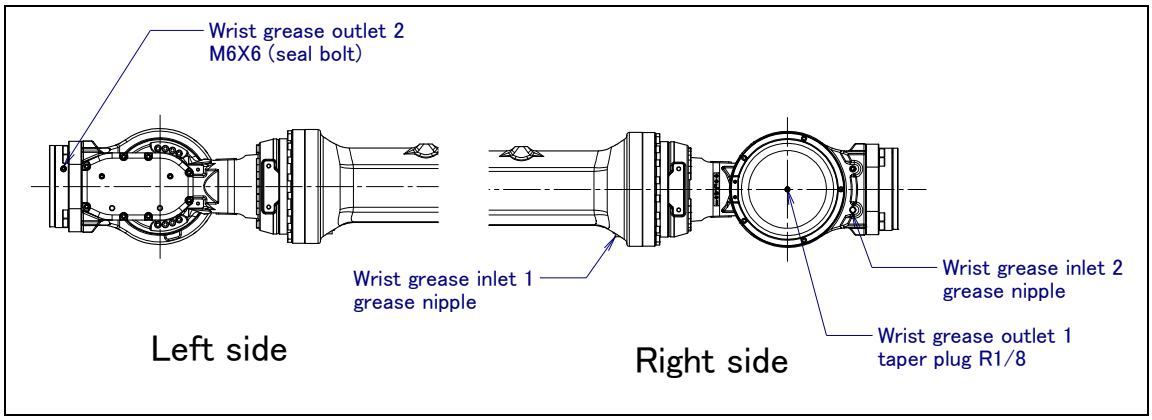


Fig. 7.3.3 (f) Replacing grease of the wrist (R-2000*i*C/165F/210F/125L/165R/210R)

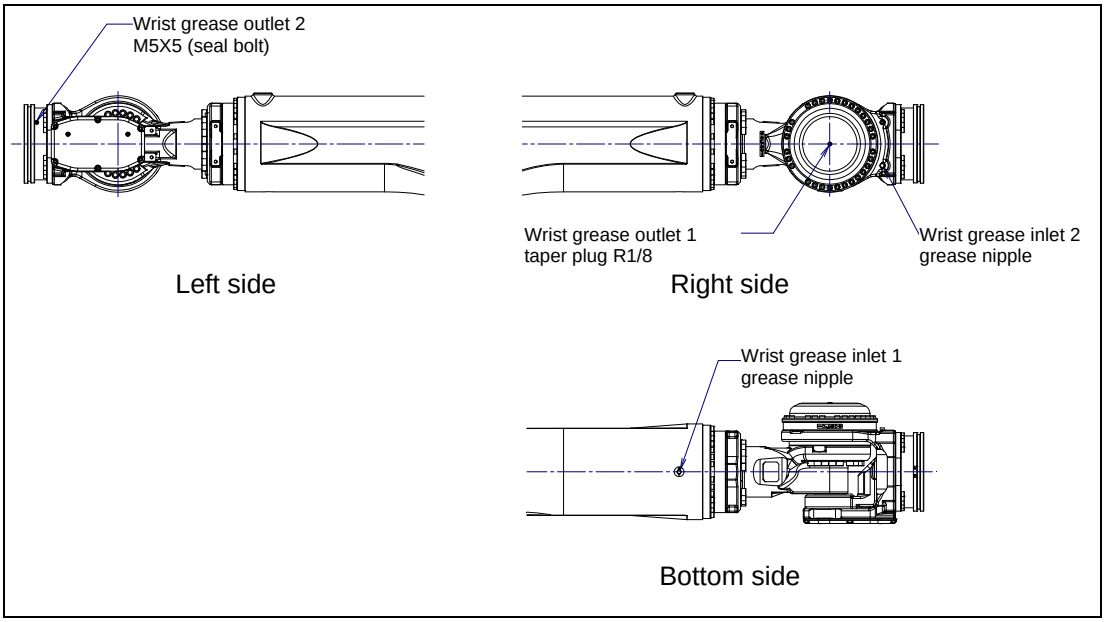


Fig. 7.3.3 (g) Replacing grease of the wrist (R-2000*i*C/270F/210L)

⚠ CAUTION

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

1 Before starting to grease, open the grease outlet (remove the plug or bolt from the grease outlet).
2 Supply grease slowly, using a manual pump.
3 Whenever possible, avoid using an air pump, which is powered by the factory air supply.
  If the use of an air pump is unavoidable, supply grease with the pump at a pressure lower than or equal to the gun tip pressure (see Table 7.3.3 (a)).
4 Use specified grease. Use of non-approved grease may damage the reducer or lead to other problems.
5 After greasing, release remaining pressure from the grease bath using the procedure given in Subsection 7.3.4, and then close the grease outlet.
6 To prevent slipping accident like fall, fire, remove all any excess grease from the floor or robot.

7.3.4 Procedure for Releasing Remaining Pressure from the Grease Bath

Release remaining pressure as described below.
Under the grease inlets and outlets, attach bags for collecting grease so that grease does not spatter when it comes out of the inlets or outlets.

Grease replacement position	Motion angle	OVR	Operating time	Open point
J1-axis reducer	80° or more	50%	20 minutes	Open the grease inlets and outlets and perform continuous operation.
J2-axis reducer	90° or more	50%	20 minutes	
J3-axis reducer	70° or more	50%	20 minutes	
Wrist	J4 : 60° or more J5 : 120° or more J6 : 60° or more	100%	10 minutes	

If the above operation cannot be performed due to the environment, prolong the operating time so that an equivalent operation can be performed. (If only half of the predetermined motion angle can be set, perform an operation for a time twice as long as the specified time.) When you supply grease to multiple axes, you can run the multiple axes at the same time. After completion of the operation, attach the seal bolts, taper plugs and grease nipples to the grease inlets and outlets. When reusing the seal bolts, taper plugs and grease nipples, be sure to seal them with seal tape.

7.4 STORAGE

When storing the robot, place it on a level surface with the same posture 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**
> The motion limits are temporarily invalid during mastering. Cables may be damaged if the J1-axis exceeds +/-185º.

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

Table 8.1 Type of mastering

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

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

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

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

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

8.2 RESETTING ALARMS AND PREPARING FOR MASTERING

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

Alarm displayed

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

Procedure

Step

1 Display the positioning menu by following steps 1 to 6.
   1 Press the [MENU] key to display the screen menu.
   2 Press [0 NEXT] and select [6 SYSTEM].
   3 Press F1 [TYPE], and select [SYSTEM Variable] from the menu.
   4 Place the cursor on $MASTER_ENB, then key in [1] and press [ENTER] key.
   5 Press F1 [TYPE], and select[Master/Cal] from the menu. 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 to display the screen menu.
   2 Press [0 NEXT] and select [6 SYSTEM].
   3 Press F1 [TYPE], and select [Master/Cal] from the menu.
   4 Press the F3 [RES_PCA], then press F4 [YES].
   5 Turn off the controller power and on again.

3 To reset the "SRVO-075 Pulse not established " alarm, follow steps 1 to 2.
   1 When the controller power is turned on again, 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 [FAULT RESET].

8.3 ZERO POSITION MASTERING

Zero-position mastering (witness mark mastering) is performed with all axes set at the 0-degree position. A zero-position mark (witness mark) is attached to each robot axis. (Fig. 8.3 (a) to (c)) This mastering is performed with all axes set at the 0-degree position using their respective witness marks.
Zero-position mastering involves a visual check, 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], display the screen change menu.
4 Select [Master/Cal]. The positioning screen appears.

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

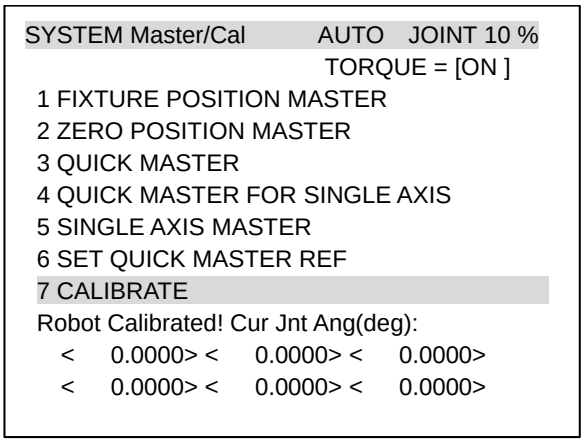
5 Release brake control, and jog the robot into a posture for mastering.

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

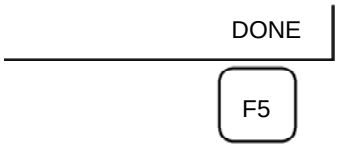
6 Select [Zero Position Master]. Press F4 [YES].

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

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



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



9 Return brake control to the original setting, and turn off the controller power and on again.

Table 8.3 Posture with position marks (witness mark) aligned

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

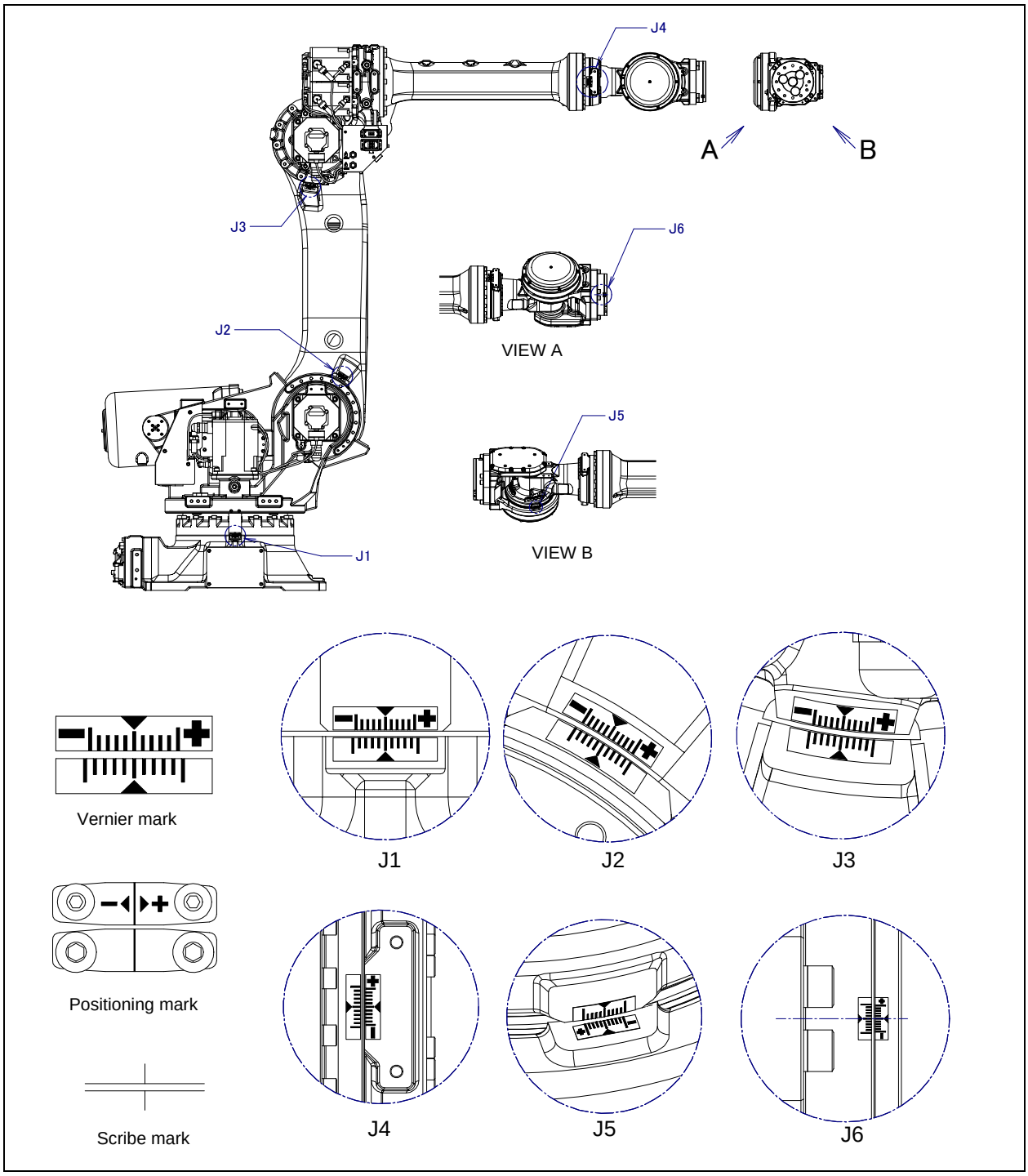


Fig. 8.3 (a) Zero-position mark (witness mark) for each axis (R-2000*i*C/165F/210F/125L)

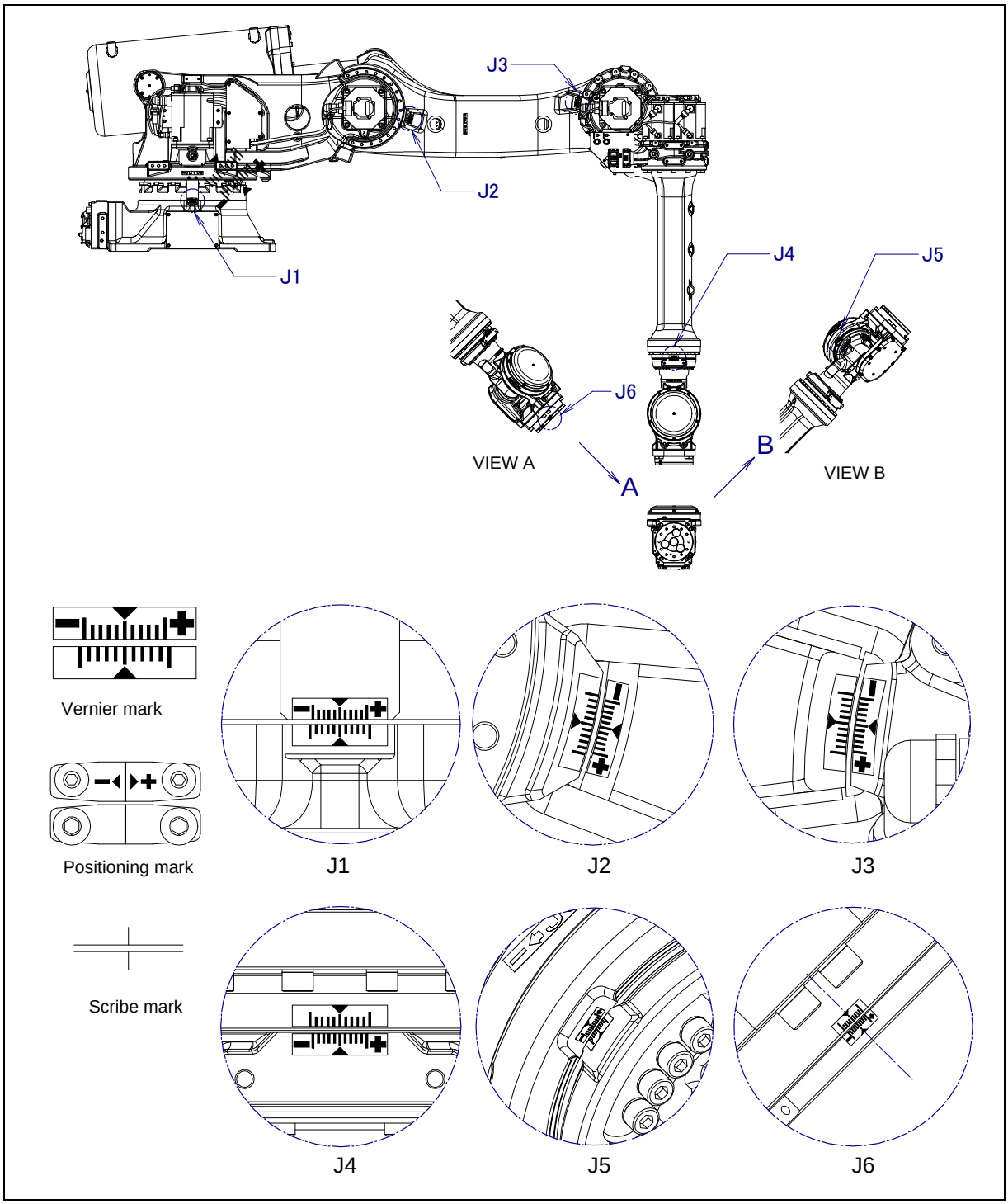


Fig. 8.3 (b) Zero-position mark (witness mark) for each axis (R-2000*i*C/165R/210R)

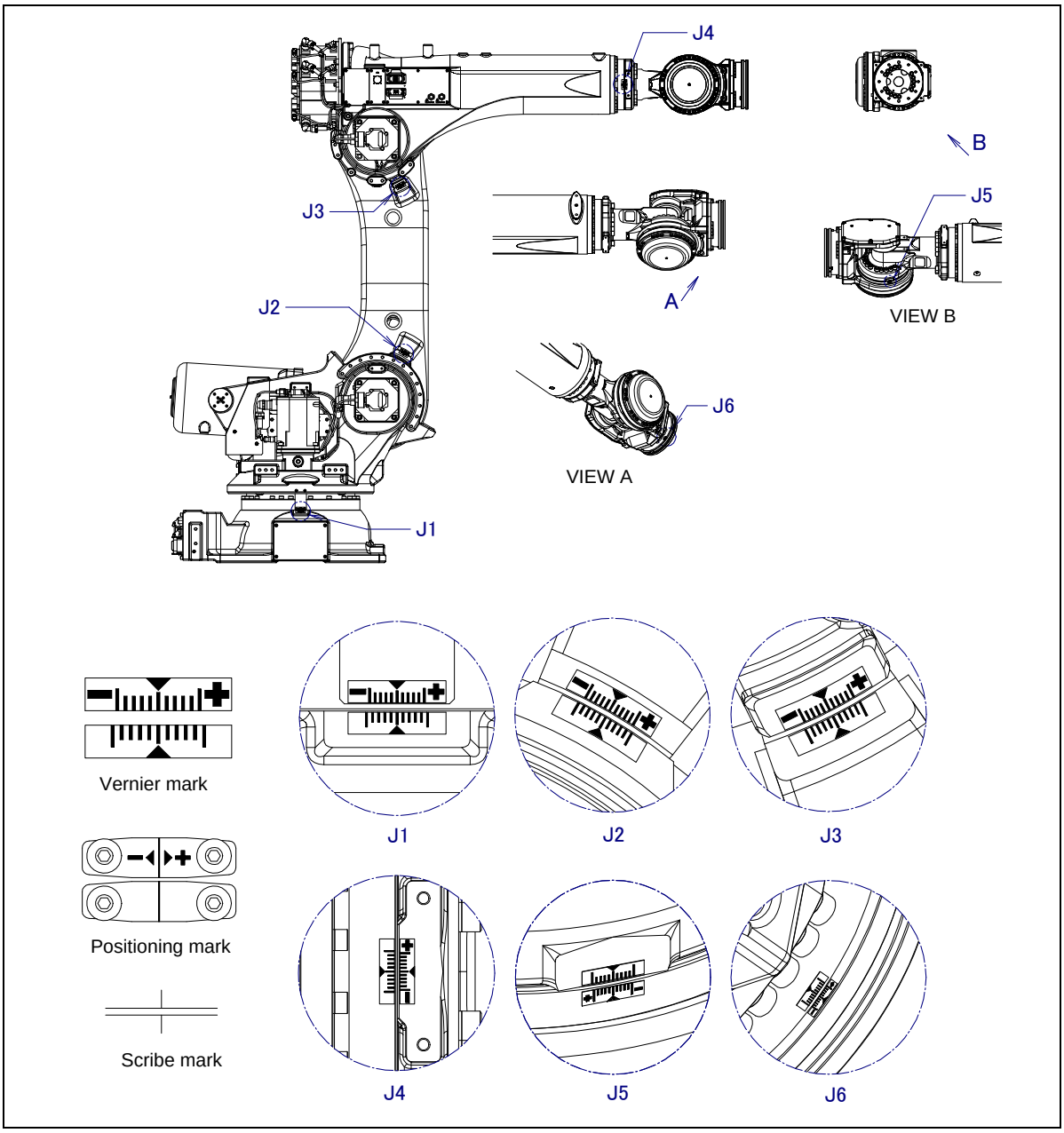


Fig. 8.3 (c) Zero-position mark (witness mark) for each axis (R-2000*i*C/270F/210L)

8.4 QUICK MASTERING

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

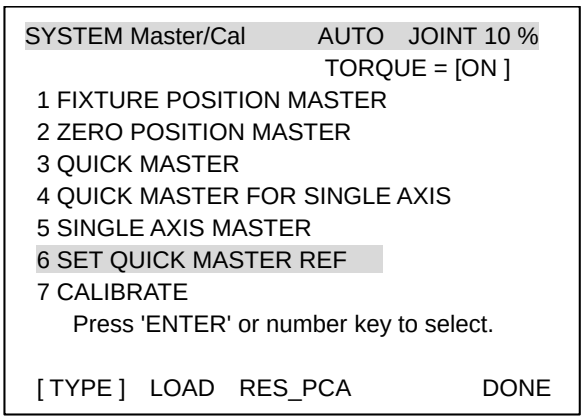
Quick mastering is factory-performed at the position indicated in Table 8.3. If possible, do not change the setting.

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.)

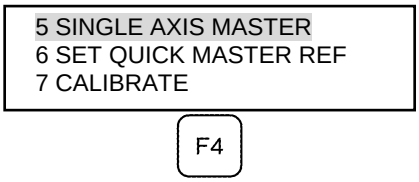
⚠ CAUTION
1 Quick mastering can be used, if the pulse count value is lost, for example, because a low voltage has been detected on the backup battery for the pulse counter.
2 Quick mastering cannot be used, after the Pulsecoder is replaced or after the mastering data is lost from the robot controller.

Procedure Recording the Quick Mastering Reference Position

1 Select [6 SYSTEM].
2 Select [Master/Cal]. The positioning screen appears.



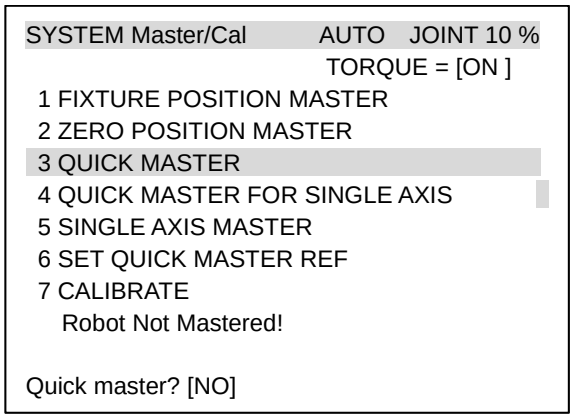
3 Release brake control, and jog the robot to the quick mastering reference position.
4 Select [6 SET QUICK MASTER REF] and press F4 [YES]. Quick mastering reference position is saved.



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

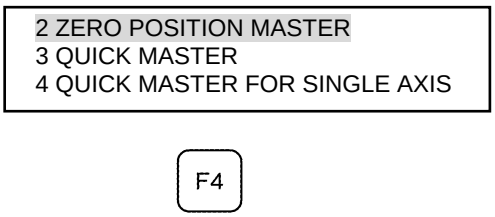
Procedure of Quick Mastering

1 Display the Master/Cal screen.



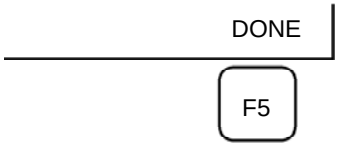
2 Release brake control, and jog the robot to the quick mastering reference position.

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



4 Select [7 CALIBRATE] and press [ENTER] key. Calibration is executed. Calibration is executed by cycling power.

5 After completing the calibration, press F5 Done.



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

8.5 QUICK MASTERING FOR SINGLE AXIS

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

Quick mastering is factory-performed at the position indicated in Table 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 Recording the Quick Mastering Reference Position

1 Select [6 SYSTEM].
2 Select [Master/Cal]. The positioning screen appears.

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

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

```
 5 SINGLE AXIS MASTER
 6 SET QUICK MASTER REF
 7 CALIBRATE
```

F4

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

Procedure of Quick Mastering for single axis

1 Display the Master/Cal screen.

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

Quick master? [NO]
```

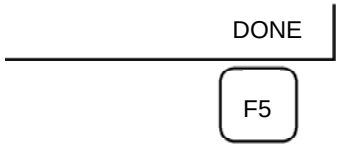
2 Select [4 QUICK MASTER FOR SINGLE AXIS]. You will see the quick master for single axis screen.

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

                                             EXEC
```

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

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

                                             EXEC
```

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



8 Return brake control to original setting, and turn off the controller power and on again.

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.

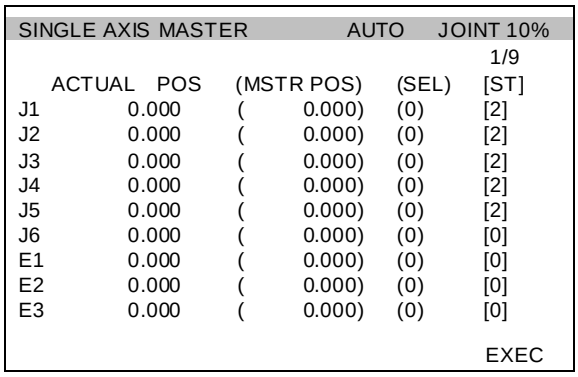


Table 8.6 Items set in single axis mastering

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 Select [6 SYSTEM].
2 Select [Master/Cal]. The positioning screen appears.

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

 [ TYPE ]   LOAD   RES_PCA                DONE
```

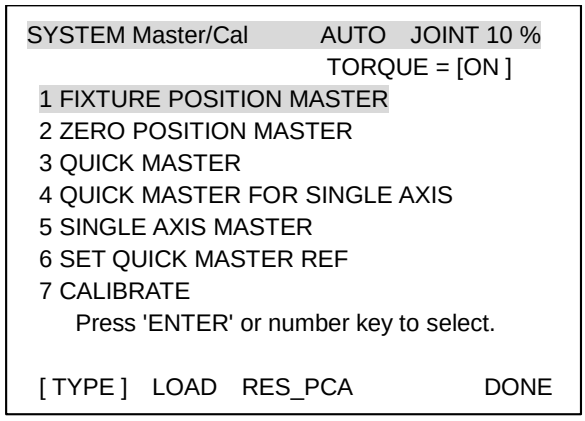
3 Select [5 Single Axis Master]. You will see a screen similar to the following.

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

                                            EXEC
```

4 Move the cursor to the [SEL] column for the unmastered axis and press the numeric key [1]. Setting of [SEL] is available for one or more axes.
5 Turn off brake control, then jog the robot to the mastering position.
6 Enter axis data for the mastering position.
7 Press F5 [EXEC]. Mastering is performed. So, [SEL] is reset to 0, and [ST] is re-set to 2 or 1.

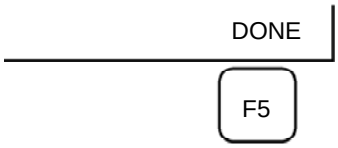
```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                            6/9
    ACTUAL   POS    (MSTR POS)    (SEL)   [ST]
J1          0.000   (     0.000)  (0)     [2]
J2          0.000   (     0.000)  (0)     [2]
J3          0.000   (     0.000)  (0)     [2]
J4          0.000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

                                            EXEC
```

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



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

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



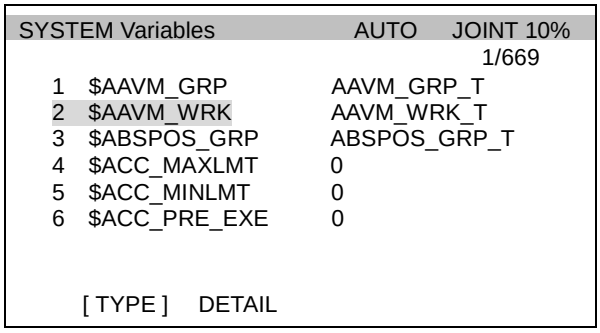
11 Return brake control to original setting, and cycle power of the controller .

8.7 MASTERING DATA ENTRY

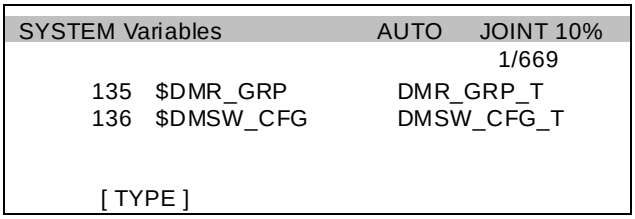
This function enables mastering data values to be assigned directly to a system variable. It can be used if mastering data has been lost but the pulse count is preserved.

Mastering data entry method

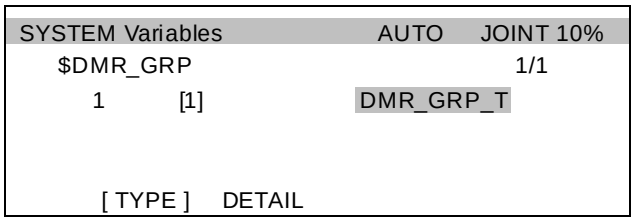
1 Press the [MENU] key, then press [0 NEXT] and select [6 SYSTEM].
2 Press F1 [TYPE]. Select [Variables]. The system variable screen appears.

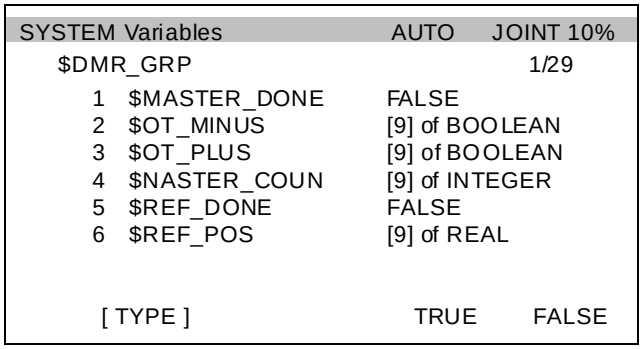


3 Change the mastering data.
The mastering data is saved to the $DMR_GRP.$MASTER_COUN system variable.

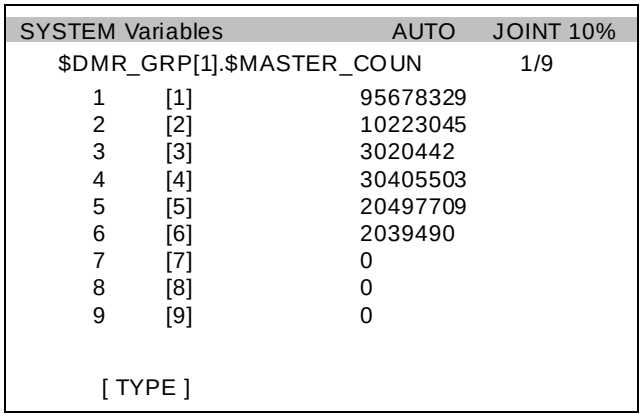


4 Select $DMR_GRP.

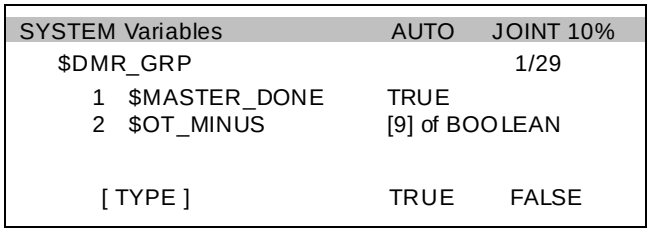




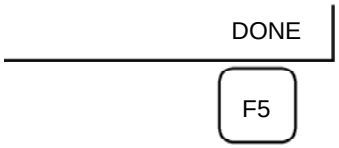
5 Select $MASTER_COUN, and enter the mastering data you have recorded.



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



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



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 meets the actual robot position by using the procedure described below:
(1) Reproduce a particular point in a program. Check whether the point agrees with the specified position.
(2) Set all axes of the robot to their 0-degree (0 rad) positions. Check that the zero-degree position marks indicated in Section 8.3 of OPERATOR'S MANUAL are aligned. There is no need to use a visual aid.
If the displayed and actual positions do not match, the counter value for a Pulsecoder may have been invalidated as a result of an alarm described in 8.2. Alternatively, the mastering data in system variable $DMR_GRP.$MASTER_COUN may have been overwritten as a result of an operation error or some other reason.
Compare the data with the values indicated on the supplied data sheet. This system variable is overwritten whenever mastering is performed. Whenever mastering is performed, record the value of the system variable on the data sheet.

2 Alarm type displayed during mastering and their solution method:
(1) BZAL alarm
This alarm is displayed if the Pulsecoder's backup battery voltage decreases to 0 V while the power to the controller is disconnected. Furthermore, if the Pulsecoder connector is removed for cable replacement, etc. this alarm is displayed as the voltage decreases to 0. Confirm if the alarm will disappear by performing a pulse reset (See Section 8.2.). Then, cycle power of the controller to check if the alarm disappears or not.
The battery may be drained if the alarm is still displayed. Perform a pulse reset, and turn off and on the controller power after replacing the battery. Note that, if this alarm is displayed, all the original data held by the Pulsecoder will be lost. Mastering is required.
(2) BLAL alarm
This alarm is displayed if the voltage of the Pulsecoder's backup battery has fallen to a level where backup is no longer possible. If this alarm is displayed, replace the battery with a new one immediately while keeping the power turned on. Check whether the current position data is valid, using the procedure described in 1.
(3) Alarm notification like CKAL, RCAL, PHAL, CSAL, DTERR, CRCERR, STBERR, and SPHAL may have trouble with Pulsecoder, contact your local FANUC representative.

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

Table 9.1 TROUBLESHOOTING

Symptom	Description	Cause	Measure
Vibration Noise	- As the robot operates, its base plate lifts off the floor plate. - There is a gap between the base plate and the floor plate. - There is a crack in the weld that fastens the base plate to the floor plate.	[Base plate and floor plate fastening] - It is likely that the base plate is not securely fastened to the floor plate because of poor welding. - If the base plate is not securely fastened to the floor plate, it lifts as the robot operates, allowing the base and floor plates to strike each other which, in turn, leads to vibration.	- Re-weld the base plate to the floor plate. - If the weld is not strong enough, increase its width and length.
	- The J1 base lifts off the base plate as the robot operates. - There is a gap between the J1 base and base plate. - A J1 base retaining bolt is loose.	[J1 base fastening] - It is likely that the robot J1 base is not securely fastened to the base plate. - Probable causes are a loose bolt, an insufficient degree of surface flatness, or foreign material caught between the base plate and floor plate. - If the robot is not securely fastened to the base plate, the J1 base lifts the base plate as the robot operates, allowing the base and floor plates to strike each other which, in turn, leads to vibration.	- If a bolt is loose, apply LOCTITE and tighten it to the appropriate torque. - Adjust the base plate surface flatness to within the specified tolerance. - If there is any foreign material between the J1 base and base plate, remove it. - Apply adhesive between the J1 base and base plate.
	- The rack or floor plate vibrates during operation of the robot.	[Rack or floor] - It is likely that the rack or floor is not rigid enough. - If they are not rigid enough, counterforce deforms the rack or floor, and responsible for the vibration.	- Reinforce the rack or floor to make it more rigid. - If reinforcing the rack or floor is impossible, modify the robot control program; doing so might reduce the vibration.

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

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

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

Symptom	Description	Cause	Measure
Motor overheat	- The motor overheated due to the temperature in the installation area rose. - After a cover was attached to the motor, the motor overheated. - After changing the Robot control program or the load, the motor overheat.	[Ambient temperature] - It is likely that the motor overheated along with the ambient temperature rose, and could not release heat. [Operating condition] - It is likely that the overcurrent above the specified permissive average current.	- Reducing the ambient temperature is the most effective means of preventing overheat. - Having the surroundings of the motor well ventilated enables the motor to release heat efficiently, thus preventing overheat. - If there is a source of heat near, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is effective to reduce the average current. Thus, prevent overheat. - The teach pendant can monitor the average current. Check the average current when the robot control program launched.
	- After a robot control parameter (load setting etc.) was changed, the motor overheated.	[Parameter] - If data input for a workpiece is invalid, the robot cannot be accelerated or decelerated normally, so the average current increases, leading to overheat.	- As for load setting, Input an appropriate parameter referring to Section 4.3 of the operator's manual.
	- Symptom other than stated above	[Mechanical section problems] - It is likely that problems occurred in the mechanical unit drive mechanism, thus placing an excessive load on the motor. [Motor problems] - It is likely that a failure of the motor brake resulted in the motor running with the brake applied, thus placing an excessive load on the motor. - It is likely that a failure of the motor prevented it from delivering its rated performance, thus causing an excessive current to flow through the motor. - It is likely that cooling fan is broken.	- 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. - If the cooling fan is broken, replace it by new one.

Symptom	Description	Cause	Measure
Grease leakage	- Grease leaks from the mechanical unit.	[Poor sealing] - Probable causes are a crack in the casting, a damaged O-ring, a damaged oil seal, or a loose seal bolt. - The casting may crack with excessive force caused in collision. - An O-ring can be damaged if it is trapped or cut during disassembling or re-assembling. - An oil seal may be damaged if dust scratches the lip. - A loose seal bolt may allow grease to leak along the threads. - Problems with the grease nipple.	- If the casting cracks, sealant can be used as a quick-fix to prevent further grease leakage. However, the component must be replaced as soon as possible, as the crack will widen. - O-rings are used in the locations listed below. -Motor coupling section -Reducer (case and shaft) coupling section -Wrist coupling section -J3 arm coupling section -Inside the wrist - Oil seals are used in the locations stated below. -Inside the reducer -Inside the wrist - Seal bolts are used in the locations stated below. -Grease drain outlet - Replace the grease nipple.
Dropping axis	- An axis falls because the brake went out. - An axis falls in standstill.	[Brake drive relay and motor] - It is likely that brake drive relays are stuck to each other and keep the brake current flowing, thus preventing the brake from operating when the motor is reenergized. - It is likely that the brake shoe has worn out or the brake main body is damaged, preventing the brake from operating efficiently. - It is likely that oil or grease soak through the motor, causing the brake to slip.	- Check whether the brake drive relays stuck each other or not. If they are found to be stuck, replace the relay. - Replace the motor confirmed following symptoms. -Brake shoe is worn out -Brake main body is damaged -Oil soak through the motor

Symptom	Description	Cause	Measure
Displacement	- The robot operates at a point other than the taught position. - The repeatability is not within the tolerance.	[Mechanical unit problems] - If the repeatability is unstable, probable causes are a failure in the drive mechanism or a loose bolt, and so on. - If the repeatability is stable, it is likely that collision by an excessive load caused slip on the mounting face of each axis arm, and reducer. - It is likely that the Pulsecoder is abnormal.	- 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. Variation will not occur unless another collision occurs. - If the Pulsecoder is abnormal, replace the motor.
	- Displacement occurs only in a specific peripheral equipment.	[Peripheral equipment displacement] - It is likely that an external force was applied to the peripheral equipment, thus shifting its position relative to the robot.	- Correct the setting of the peripheral equipment position. - Correct the taught program.
	- Displacement occurred after a parameter was changed.	[Parameter] - It is likely that the mastering data was rewritten in such a way that the robot origin was shifted.	- Re-enter the previous mastering data, which is known to be correct. - If correct mastering data is unavailable, perform mastering again.
BZAL alarm occurred	- BZAL is displayed on the teach pendant screen	- The voltage of the memory backup battery may be low. - The Pulsecoder cable may be broken.	- Replace the battery. - Replace the cable.

10 SEVERE DUST/LIQUID PROTECTION PACKAGE

10.1 SEVERE DUST/LIQUID PROTECTION PACKAGE(OPTION)

The package is intended to improve the severe dust/liquid protection characteristics of the robot so that it can be used in a severe environment.
Refer to Section 3.1 about dustproof and waterproof characteristics of the R-2000*i*C.

Model	Severe dust/liquid protection package specification
R-2000*i*C/165F/210F/125L	A05B-1333-J801
R-2000*i*C/165R/210R	A05B-1334-J801

10.2 CONFIGURATION OF THE SEVERE DUST/LIQUID PROTECTION PACKAGE

The following table lists the major differences between the R-2000*i*C standard specification and severe dust/liquid protection package.

	Standard specifications	Severe dust/liquid protection option	
	Entire mechanical unit	Main unit	J3 arm and wrist
Bolts	Black oxide finish steel bolt Black oxide finish washer	FR coating bolt Black chromate washer Stainless bolt Black oxide finish steel bolt	FR coating bolt Stainless bolt Black chromate washer
Covers		J1-axis motor cover J2-axis motor cover J3/J4/J5/J6-axis motor cover Battery box cover Cable cover in mechanical unit (for all exposed cables)	
J3 connector panel EE(RI/RO) connector	Non-waterproof connector	Waterproof connector	

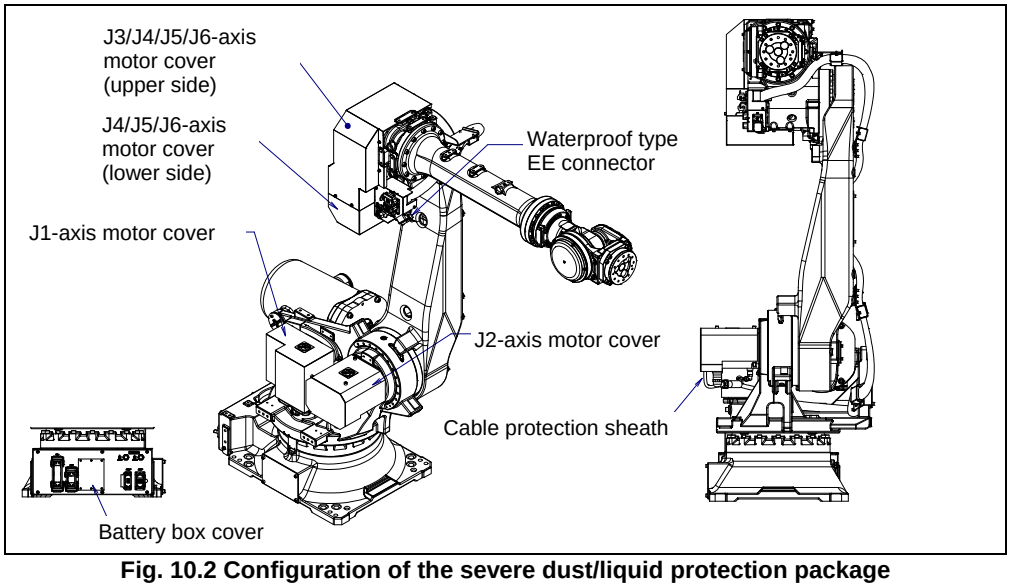


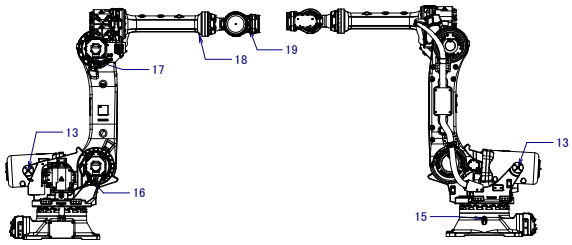
Fig. 10.2 Configuration of the severe dust/liquid protection package

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot R-2000*i*C/165F/210F/125L/165R/210R Periodic Maintenance Table

		Items \ Accumulated operation time (H)	Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protection sheaths	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check wear debris of the balancer and the J1-axis swing stopper	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	4	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	5	Check damages of the mechanical unit cable (movable part)	0.2H	—		○			○				○			
	6	Check damage of the end effector (hand) cable	0.1H	—		○			○				○			
	7	Check looseness of each axis motor and other exposed connector	0.2H	—		○			○				○			
	8	Retightening the end effector mounting bolts	0.2H	—		○			○				○			
	9	Retightening the external main bolts	2.0H	—		○			○				○			
	10	Check the fixed mechanical stopper and the adjustable mechanical stopper	0.1H	—		○			○				○			
	11	Clean spatters, sawdust and dust	1.0H	—		○			○				○			
	12	Check the operation of the cooling fan	0.1H	—		○			○				○			
	13	Greasing to the balancer bush	0.1H	Each 10ml					●				●			
	14	Replacing the mechanical unit Batteries*	0.1H	—							●					
	15	Replacing the grease of J1-axis reducer*	1.0H	4730ml												
	16	Replacing grease of J2-axis reducer*	0.5H	2500ml												
	17	Replacing grease of J3-axis reducer*	0.5H	2170ml												
	18	Replacing grease of wrist axis 1 (J4, J5-axis)*	0.5H	2560ml												
	19	Replacing grease of wrist axis 2 (J6-axis)*	0.2H	500ml												
	20	Replacing the mechanical unit cable*	4.0H	—												
Controller	21	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	22	Check damages of the teach pendant cable, the operation box connection cable and the robot connection cable	0.2H	—		○			○				○			
	23	Replacing battery *	0.1H	—												



Position of grease nipple

For descriptions about the items marked with an asterisk (*), refer to this manual or “REPLACING UNITS Chapter of MAINTENANCE of Control Maintenance Manual”.

●: 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	Items
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		3
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		4
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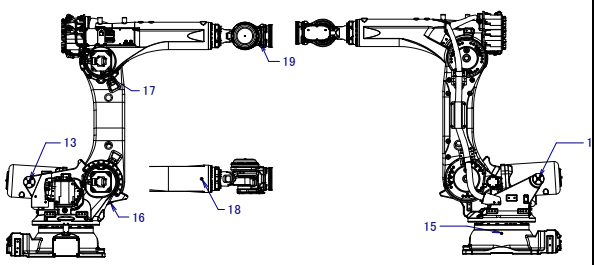
○				○				○				○				○					22
				●																	23

Overhaul

FANUC Robot R-2000*i*C/270F/210L Periodic Maintenance Table

Items		Accumulated operation time (H)	Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
Mechanical unit	1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	2	Check damages of the cable protection sheaths	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	3	Check wear debris of the balancer and the J1-axis swing stopper	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	4	Check for water	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
	5	Check damages of the mechanical unit cable (movable part)	0.2H	—		○			○				○			
	6	Check damage of the end effector (hand) cable	0.1H	—		○			○				○			
	7	Check looseness of each axis motor and other exposed connector	0.2H	—		○			○				○			
	8	Retightening the end effector mounting bolts	0.2H	—		○			○				○			
	9	Retightening the external main bolts	2.0H	—		○			○				○			
	10	Check the fixed mechanical stopper and the adjustable mechanical stopper	0.1H	—		○			○				○			
	11	Clean spatters, sawdust and dust	1.0H	—		○			○				○			
	12	Check the operation of the cooling fan	0.1H	—		○			○				○			
	13	Greasing to the balancer bush	0.1H	Each 10ml					●				●			
	14	Replacing the mechanical unit Batteries*	0.1H	—							●					
	15	Replacing the grease of J1-axis reducer*	1.0H	6250ml												
	16	Replacing grease of J2-axis reducer*	0.5H	3470ml												
	17	Replacing grease of J3-axis reducer*	0.5H	2640ml												
	18	Replacing grease of wrist axis 1 (J4, J5-axis)*	0.5H	5540ml												
	19	Replacing grease of wrist axis 2 (J6-axis)*	0.2H	690ml												
	20	Replacing the mechanical unit cable*	4.0H	—												
Controller	21	Cleaning the controller ventilation system	0.2H	—	○	○	○	○	○	○	○	○	○	○	○	○
	22	Check damages of the teach pendant cable, the operation box connection cable and the robot connection cable	0.2H	—		○			○				○			
	23	Replacing battery *	0.1H	—												



Position of grease nipple

For descriptions about the items marked with an asterisk (*), refer to this manual or “REPLACING UNITS Chapter of MAINTENANCE of Control Maintenance Manual”.

●: 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	Items
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		2
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		3
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		4
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○				○				○				○				○					22
				●																	23

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 the oil on the engaging section. Make sure that there is no solvent left in the threaded holes. In this case, remove all the excess LOCTITE when you are finished screwing the bolts into the threaded holes.

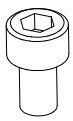
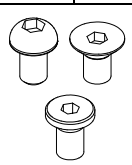
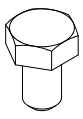
Adopt following strength bolts. Comply with any bolt specification instructions as specified.

Hexagon socket head bolt made by steel:
Size M22 or less: Tensile strength 1200N/mm^2 or more
Size M24 or more: Tensile strength 1000N/mm^2 or more
All size plating bolt: Tensile strength 1000N/mm^2 or more

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

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

Recommended bolt tightening torques **Unit: Nm**

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

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REVISION RECORD

Edition	Date	Contents
03	Apr., 2016	・Addition of R-2000iC/270F/210L ・Correction of errors
02	Dec., 2014	・Addition of R-2000iC/165R/210R ・Addition of quick master for single axis ・Correction of errors
01	Apr., 2014	

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