FANUC Robot R-2000*i*C

MECHANICAL UNIT

OPERATOR'S MANUAL

Thank you very much for purchasing FANUC Robot.

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

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

1 PERSONNEL

Personnel can be classified as follows.

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

Programmer or Teaching operator:
- Operates the robot
- Teaches the robot inside the safeguarded space

Maintenance technician:
- Operates the robot
- Teaches the robot inside the safeguarded space
- Performs maintenance (repair, adjustment, replacement)

- The operator is not allowed to work in the safeguarded space.
- The programmer or teaching operator and maintenance technician are allowed to work in the safeguarded space. Work carried out in the safeguarded space include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safeguarded space, the person must be trained on proper robot operation.

Table 1 (a) lists the work outside the safeguarded space. In this table, the symbol "O" means the work allowed to be carried out by the specified personnel.

Table 1 (a) List of work outside the Safeguarded Space

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

During robot operation, programming and maintenance, the operator, programmer, teaching operator and maintenance technician take care of their safety using at least the following safety protectors:

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

2 DEFINITION OF SAFETY NOTATIONS

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

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

3 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 (5m) A05B-2450-J361(10m)
Power cable	A05B-2525-J010 (5m) (AC100-115V Power plug) (*) A05B-2525-J011(10m) (AC100-115V Power plug) (*) A05B-2450-J364 (5m) (AC100-115V or AC200-240V No power plug) A05B-2450-J365(10m) (AC100-115V or AC200-240V No power plug)

(*) Not supporting CE Marking.

(2) Prepare and store adequate numbers of brake release units which are ready and readily accessible for robot system before installation.

(3) Regarding how to use brake release unit, please refer to "**Robot controller maintenance manual**".

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

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

Fig. 3 (a) Releasing J2-axis motor brake and measures (except R-2000*i*C/220U/190U)

Fig. 3 (b) Releasing J3-axis motor brake and measures
(except R-2000iC/220U/190U)

Fig. 3 (c) Releasing J2-axis motor brake and measures
(R-2000iC/220U/190S upside-down mounting)

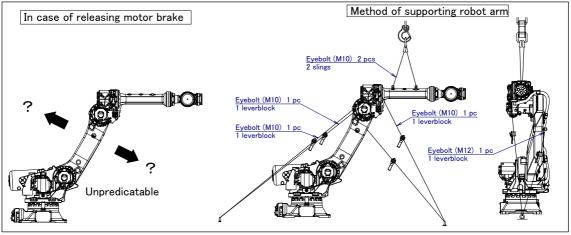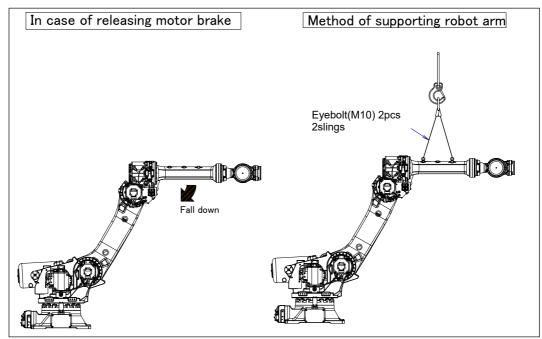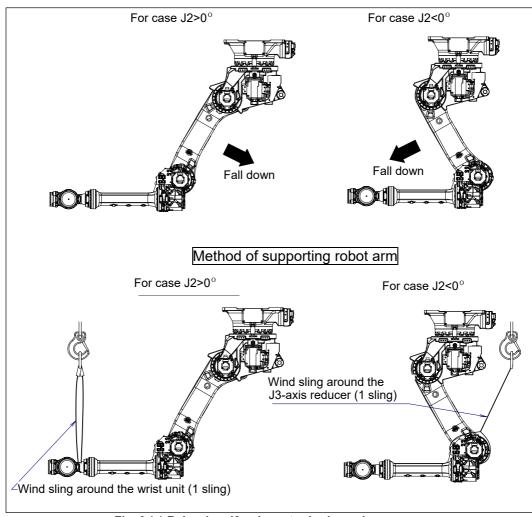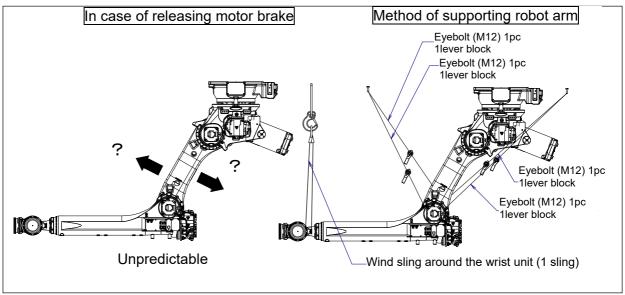**Fig. 3 (d) Releasing J2-axis motor brake and measures**
(R-2000*i*C/190U)
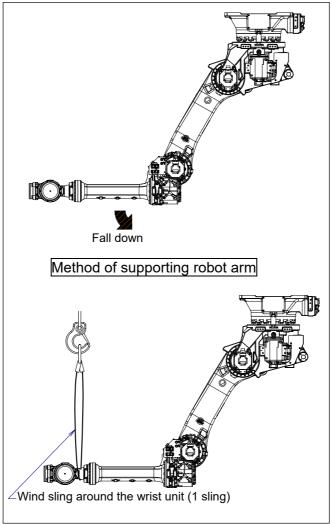
Fig. 3 (e) Releasing J3-axis motor brake and measures
(R-2000*i*C/220U/190S upside-down mounting/190U)

4   WARNING & CAUTION LABEL

(1)   Greasing and degreasing label

Fig. 4 (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. 4 (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. 4 (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
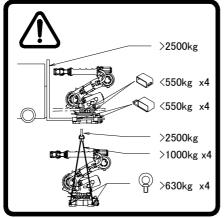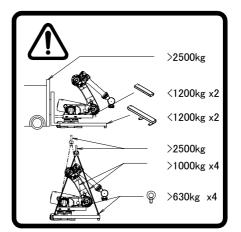
Fig. 4 (d) High-temperature warning label

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
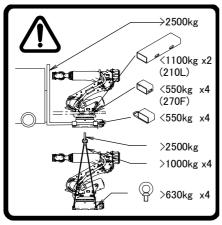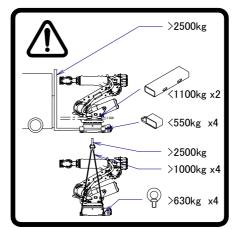
R-2000*i*C/165F/210F/240F/125L/220U   **R-2000*i*C/165R/210R/100P/100PH**
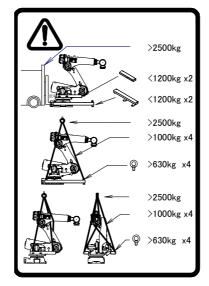
Fig. 4 (e) Transportation label

R-2000*i*C/270F/190S/210L   **R-2000*i*C/190U**

R-2000*i*C/270R

Fig. 4 (f) Transportation label

Description

When transporting the robot, observe the instructions indicated on this label. The above label indicates the following:

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/240F/220U/125L/270F/190S, 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/100P/100PH/270R, 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/190U, 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 1000 kg or greater.
- In case of using eyebolts, use four eyebolts with each allowable load of 6174 N (630 kgf) or greater.
- In case of R-2000*i*C/165F/210F/240F/220U/125L/270F/190S/210L/190U, 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/100P/100PH/270R, 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).
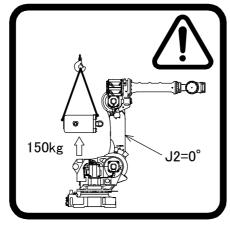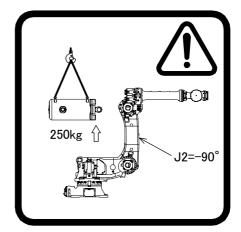
⚠ **CAUTION**

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.

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(6)   Balancer replacement label
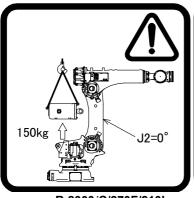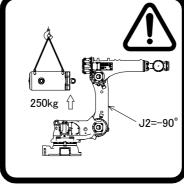
R-2000*i*C/165F/210F/240F/125L   **R-2000*i*C/165R/210R/100P/100PH**

Fig. 4 (g) Balancer replacement label

R-2000*i*C/270F/210L   **R-2000*i*C/270R**   **R-2000*i*C/190U**

Fig. 4 (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/240F/125L/270F/210L keep the J2-axis at 0°.
- While replacing the balancer for R-2000*i*C/165R/210R/100P/100PH/270R keep the J2-axis at -90°.
- While replacing the balancer for R-2000*i*C/190U follow the steps designated by FANUC.
- The mass of the balancer for R-2000*i*C/165F/210F/240F/125L/270F/210L is 150 kg.
- The mass of the balancer for R-2000*i*C/165R/210R/100P/100PH/270R is 250 kg.
- The mass of the balancer for R-2000*i*C/190U is 200 kg.

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

(7) Reach and payload capacity label

When CE specification is specified, the following label is added:

	MAX.PAYLOAD (kg)	REACH (mm)
R-2000iC/165F	165	2655
R-2000iC/210F	210	2655
R-2000iC/240F	240	2655
R-2000iC/125L	125	3100
R-2000iC/220U	220	2518
R-2000iC/165R	165	3095
R-2000iC/210R	210	3095
R-2000iC/100P	100	3540
R-2000iC/100PH	100	3540
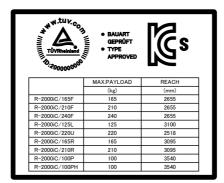
Fig. 4 (i) Reach and payload label (Example of R-2000iC/165F/210F/240F/125L/220U/165R/210R/100P/100PH)

(8) Danger label

When CE specification is specified, the following label is added:
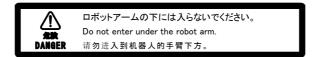
Fig. 4 (j) Danger label

(9) Transportation caution label

Fig. 4 (k) Transportation prohibitive label (for eyebolt option)

Description

Do not pull eyebolts sideways when transporting the robot.

Fig. 4 (l) Transportation prohibitive label
(Example of transport equipment option)

Fig. 4 (m) 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) Do not pull hanging hole of this part sideways.
3) Prevent the forks of the forklift from having impact on a transport equipment.
4) Do not thread a chain or the like through a transport equipment.
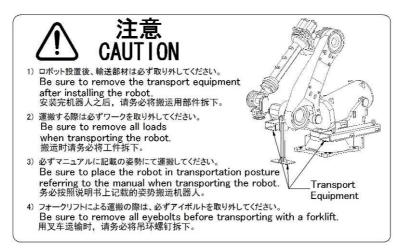
Fig. 4 (n) Transportation caution label
(For transport equipment option of R-2000*i*C/165R/210R/100P/100PH/270R J2 base type)

Description

1) Be sure to remove the transport equipment after installing the robot.
2) Be sure to remove all loads when transporting the robot.
3) Be sure to place the robot in transportation posture referring to the manual when transporting the robot.
4) Be sure to remove all eyebolts before transporting with a forklift.

(10) Transportation caution label (For transport equipment option of R-2000*i*C/165R/210R/100P/100PH/270R J1 base type)

Fig. 4 (o) Transportation caution label
(For transport equipment option of R-2000*i*C/165R/210R/100P/100PH/270R J1 base type)

Description

Remove all eyebolts before transporting with a forklift.

(11)   Mastering caution label

Fig. 4 (p) 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°.

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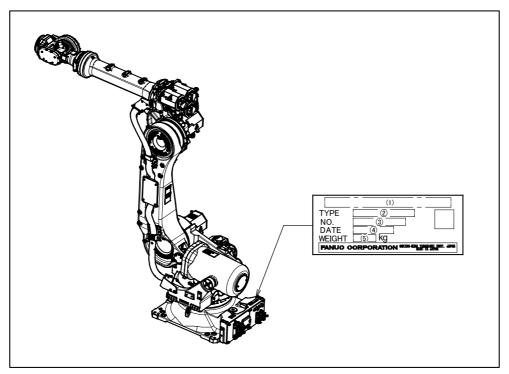
This manual explains about the operation procedures for the following robot mechanical units:

Model name Note 1)	Mechanical unit specification No.	Max. payload
FANUC Robot R-2000iC/165F	A05B-1333-B201	165kg
FANUC Robot R-2000iC/210F	A05B-1333-B205	210kg
FANUC Robot R-2000iC/240F	A05B-1333-B215	240kg
FANUC Robot R-2000iC/125L	A05B-1333-B261	125kg
FANUC Robot R-2000iC/220U	A05B-1333-B295	220kg
FANUC Robot R-2000iC/165R	A05B-1334-B201	165kg
FANUC Robot R-2000iC/210R	A05B-1334-B205	210kg
FANUC Robot R-2000iC/100P	A05B-1334-B231	100kg
FANUC Robot R-2000iC/100PH	A05B-1334-B232	100kg
FANUC Robot R-2000iC/270F	A05B-1337-B201	270kg / 300kg Note 2)
FANUC Robot R-2000iC/270R	A05B-1337-B221	270kg
FANUC Robot R-2000iC/190S	A05B-1337-B241	190kg
FANUC Robot R-2000iC/210L	A05B-1337-B261	210kg
FANUC Robot R-2000iC/190U	A05B-1337-B295	190kg

Note 1) Please refer to the "FANUC Robot R-2000iC/210WE MECHANICAL UNIT OPERATOR'S MANUAL (B-84014EN)" for the FANUC Robot R-2000iC/210WE.

Note 2) When 300kg option is specified.

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

Position of label indicating mechanical unit specification number

TABLE 1

CONTENTS	(1) MODEL NAME	(2) TYPE	(3) No.	(4) DATE	(5) WEIGHT kg (Without controller)
LETTERS	FANUC Robot R-2000iC/165F	A05B-1333-B201	SERIAL NO. IS PRINTED	PRODUCTION YEAR AND MONTH ARE PRINTED	1090
	FANUC Robot R-2000iC/210F	A05B-1333-B205			1090
	FANUC Robot R-2000iC/240F	A05B-1333-B215			1090
	FANUC Robot R-2000iC/125L	A05B-1333-B261			1115
	FANUC Robot R-2000iC/220U	A05B-1333-B295			1020
	FANUC Robot R-2000iC/165R	A05B-1334-B201			1370
	FANUC Robot R-2000iC/210R	A05B-1334-B205			1370
	FANUC Robot R-2000iC/100P	A05B-1334-B231			1470
	FANUC Robot R-2000iC/100PH	A05B-1334-B232			1495
	FANUC Robot R-2000iC/270F	A05B-1337-B201			1320
	FANUC Robot R-2000iC/270R	A05B-1337-B221			1590
	FANUC Robot R-2000iC/190S	A05B-1337-B241			1120
	FANUC Robot R-2000iC/210L	A05B-1337-B261			1350
	FANUC Robot R-2000iC/190U	A05B-1337-B295			1400

RELATED MANUALS

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

SAFETY HANDBOOK B-80687EN
All persons who use the FANUC Robot and system designer must read and understand thoroughly this handbook
		Intended readers :
		  Operator, System designer
		Topics :
		  Safety items for robot system design, Operation, Maintenance

R-30iB,
R-30iB Mate,
R-30iB Plus,
R-30iB Mate Plus 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 technician, System designer
		Topics :
		  Robot functions, Operations, Programming, Start-up, Interfaces, Alarms
		Use :
		  Robot operation, Teaching, System design

	MAINTENANCE MANUAL
	R-30iB, R-30iB Plus :
	  B-83195EN
	R-30iB Mate, R-30iB Mate Plus :
	  B-83525EN
		Intended readers :
		  Maintenance technician, 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. Before 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 designed points.
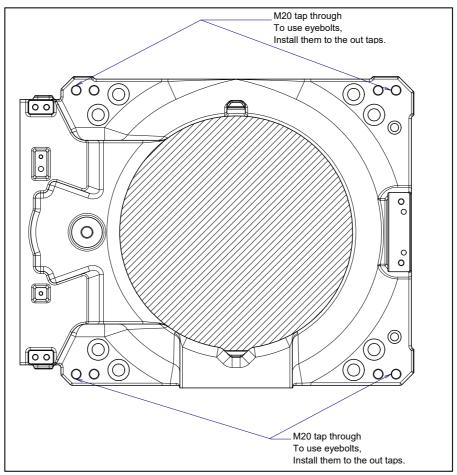
Fig. 1.1 (a) Position of the eyebolts and transportation equipment

(1) Transportation using a crane (Fig. 1.1 (b) to (k))
    Fasten M20 eyebolts or the transport equipment and eyebolts or the transport equipment at the four points and lift the robot by the four slings. (Some transport equipment does not need eyebolts.)

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⚠ CAUTION
    When lifting the robot, be careful not to damage motors, connectors, or cables of
    the robot by slings.
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(2) Transportation using a forklift (Fig. 1.1 (l) to (u))
    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**
1   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.
2   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.
3   Use the forklift transport equipment only to transport the robot with a forklift. Do not use the forklift transport equipment to secure the robot.
4   Before moving the robot by using transport equipment, check the bolts on the transport equipment and tighten any loose bolts if any.
5   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/100P/100PH/270R 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/240F : 1090 kg
  R-2000*i*C/125L :   1115 kg
  R-2000*i*C/220U :   1020 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs

  Crane
  Load capacity. : 2.5 ton or more

  Sling
  Load capacity. : 1.0 ton/sling or more

  Eyebolt
  Allowable load. : 630kgf/each or more

Robot posture on transportation

J1	0º or ±180º
J2	-60º (165F/210F/240F/125L) -62º (220U)
J3	0º
J4	0º
J5	0º
J6	0º

1672 (165F/210F/240F/220U)
2122 (125L)

1576 (165F/210F/240F/125L)
1543 (220U)

Center of gravity

477   348

Eyebolt (M20)
JB-BEY-20 (4 pcs)
Install them to the outside taps

315   305

Center of gravity

Fig. 1.1 (b) Transportation using a crane (R-2000*i*C/165F/210F/240F/125L/220U)

Note)
1 Machine mass
   R-2000*i*C/165F/210F/240F : 1090 kg
   R-2000*i*C/125L :   1115 kg
   R-2000*i*C/220U :   1020 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs
   Crane
   Load capacity. : 2.5 ton or more

   Sling
   Load capacity. : 1.0 ton/sling or more

   Eyebolt
   Allowable load. : 630kgf/each or more

Robot posture on transportation

J1	0° or ±180°
J2	-60° (165F/210F/240F/125L) -62° (220U)
J3	0°
J4	0°
J5	0°
J6	0°

1672 (165F/210F/240F/220U)
2122 (125L)

1576 (165F/210F/240F/125L)
1543 (220U)

Center of gravity

Eyebolt (M20)
JB-BEY-20

Until Sep.,2018

From Oct., 2018

477

355.5 (Until Sep.,2018)
348 (From Oct., 2018)

578 (Until Sep.,2018)
579 (From Oct., 2018)

578 (Until Sep.,2018)
579 (From Oct., 2018)

Center of gravity

Fig. 1.1 (c) Transportation using a crane
(R-2000*i*C/165F/210F/240F/125L/220U when using the transport equipment)

Crane
Load capacity. : 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Eyebolt
Allowable load. : 630kgf/each or more

Robot posture on transportation

J1	0º
J2	-120º
J3	41º
J4	0º
J5	-41º
J6	0º

Center of gravity
(165R/210R)

Center of gravity
(100P/100PH)

1816 (165R/210R)
1831 (100P/100PH)

Center of gravity
(165R/210R)

Center of gravity
(100P/100PH)

Eyebolt (M20)
JB-BEY-20 (4 pcs)

1886 (165R/210R)
2135 (100P/100PH)

1242

Transport equipment (option)

Note)
1 Machine mass
  R-2000iC/165R/210R : 1370 kg
  R-2000iC/100P :   1470 kg
  R-2000iC/100PH :   1495 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs

Fig. 1.1 (d) Transportation using a crane (R-2000iC/165R/210R/100P/100PH J1 base type)

Crane
Load capacity. : 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Eyebolt
Allowable load. : 630kgf/each or more

Robot posture on transportation

J1	0º
J2	-120º
J3	85º
J4	0º
J5	-85º
J6	0º

Note)
1 Machine mass 1590 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs

Center of gravity

1973

Center of gravity

Eyebolt (M20)
JB-BEY-20 (4 pcs)

2128

1242

Transport equipment (option)

Fig. 1.1 (e) Transportation using a crane (R-2000iC/270R J1 base type)

Crane
Load capacity.: 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Eyebolt
Allowable load. : 630kgf/each or more

Robot posture on transportation

J1	Arbitrary
J2	-120º
J3	41º
J4	0º
J5	–41º
J6	0º

Note)
1 Machine mass
  R-2000iC/165R/210R : 1370 kg
  R-2000iC/100P :   1470 kg
  R-2000iC/100PH :   1495 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs
4 When transporting a robot, please be sure to transport it by the posture for transportation.
5 When transporting a robot, remove all tools.
6 Be sure to remove transport equipment after setting robot up.
7 Detach the fan cable connector of J2 axis before transporting R-2000iC/100PH with a crane.

Center of gravity (165R/210R)
Center of gravity (100P/100PH)

1816 (165R/210R)
1831 (100P/100PH)

Center of gravity (165R/210R)
Center of gravity (100P/100PH)

Fan cable connector
VIEW A Note 7

Eyebolt (M20)
JB-BEY-20 (4 pcs)

1886 (165R/210R)
2135 (100P/100PH)

1207 (165R/210R)
1238 (100P/100PH)
Transport equipment (option)

Fig. 1.1 (f) Transportation using a crane (R-2000iC/165R/210R/100P/100PH J2 base type)

Crane
Load capacity. : 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Eyebolt
Allowable load. : 630kgf/each or more

Robot posture on transportation

J1	Arbitrary
J2	-120º
J3	85º
J4	0º
J5	-85º
J6	0º

Note)
1 Machine mass 1590 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs
4 When transporting a robot, please be sure to transport it by the posture for transportation.
5 When transporting a robot, remove all tools.
6 Be sure to remove transport equipment after setting robot up

Center of gravity

1961

Center of gravity

Eyebolt (M20)
JB-BEY-20 (4 pcs)

2128

1207

Transport equipment (option)

Fig. 1.1 (g) Transportation using a crane (R-2000iC/270R J2 base type)

Crane
Load capacity.: 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Eyebolt
Allowable load. : 630kgf/each or more

Note）
1 Machine mass
   R-2000*i*C/270F : 1320 kg
   R-2000*i*C/210L : 1350 kg
   R-2000*i*C/190U : 1400 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

1868（270F)
2318 (210L/190U)

1626

528   348

315   305

Center of gravity

Eyebolt (M20)
JB-BEY-20 (4 pcs)
Install them to the outside taps

Center of gravity

Fig. 1.1 (h) Transportation using a crane (R-2000*i*C/270F/210L/190U)

Crane
Load capacity.: 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Eyebolt
Allowable load. : 630kgf/each or more

Robot posture on transportation

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

Note)
1 Machine mass
    R-2000iC/270F : 1320 kg
    R-2000iC/210L : 1350 kg
    R-2000iC/190U : 1400 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs

1868 (270F)
2319 (210L/190U)

1626

Center of gravity

528

355.5 (Until Sep.,2018)
348 (From Oct., 2018)

578 (Until Sep.,2018)
579 (From Oct., 2018)

Eyebolt (M20)
JB-BEY-20

Until Sep.,2018

From Oct., 2018

578 (Until Sep.,2018)
579 (From Oct., 2018)

Center of gravity

Fig. 1.1 (i) Transportation using a crane (R-2000iC/270F/210L/190U when using the transport equipment)

Crane
Load capacity.: 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Eyebolt
Allowable load. : 630kgf/each or more

Note)
1 Machine mass
   R-2000*i*C/190S : 1120 kg
2 Eyebolt complied with JIS B 1168.
3 Quantity eyebolt 4 pcs, sling 4 pcs

Robot posture on transportation

J1	0° or ±180°
J2	-77°
J3	0°
J4	90°
J5	Arbitrary
J6	Arbitrary

1489

1268

Center of gravity

528   348

315   305

Eyebolt (M20)
JB-BEY-20 (4 pcs)
Install them to the outside taps

Center of gravity

Fig. 1.1 (j) Transportation using a crane (R-2000*i*C/190S)

Crane
Load capacity.: 2.5 ton or more

Sling
Load capacity. : 1.0 ton/sling or more

Note)
1 Machine mass
  R-2000*i*C/190S : 1120 kg

Robot posture on transportation

J1	0º or ±180º
J2	-77º
J3	0º
J4	90º
J5	Arbitrary
J6	Arbitrary

Fig. 1.1 (k) Transportation using a crane (R-2000*i*C/190S when using the transport equipment)

Robot posture on transportation

J1	0º or ±180º
J2	-60º (165F/210F/240F/125L) -62º (220U)
J3	0º
J4	0º
J5	0º
J6	0º

Note)
1 Machine mass
 R-2000*i*C/165F/210F/240F : 1090 kg
 R-2000*i*C/125L :   1115 kg
 R-2000*i*C/220U :   1020 kg

Center of gravity

Until Sep.,2018

From Oct., 2018

188

88

956 (Until Sep.,2018)
952 (From Oct., 2018)

Transport equipment
(option)

Forklift
Load capacity 2.5 ton or more

Fig. 1.1 (l) Transportation using a forklift (R-2000*i*C/165F/210F/240F/125L/220U J1 base type)

Robot posture on transportation

J1	Arbitrary
J2	-60º (165F/210F/240F/125L) -62º (220U)
J3	0º
J4	0º
J5	0º
J6	0º

Note)
1 Machine mass
 R-2000*i*C/165F/210F/240F : 1090 kg
 R-2000*i*C/125L : 1115 kg
 R-2000*i*C/220U : 1020 kg

Center of gravity

182

82

874

Transport equipment
(option)

Forklift
Load capacity 2.5 ton or more

Fig. 1.1 (m) Transportation using a forklift (R-2000*i*C/165F/210F/240F/125L/220U J2 base type)

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

Robot posture on transportation

J1	0º or ±180º
J2	-120º
J3	41º
J4	0º
J5	--41º
J6	0º

Note)
1 Machine mass
  R-2000*i*C/165R/210R : 1370 kg
  R-2000*i*C/100P :   1470 kg
  R-2000*i*C/100PH :   1495 kg
2 When transporting a robot, remove all eyebolts attached to the transport equipment.

Center of gravity (165R/210R)
Center of gravity (100P/100PH)

Forklift
Load capacity 2.5 ton or more

Center of gravity (165R/210R)
Center of gravity (100P/100PH)

191
91
1042

Transport equipment (option)

Fig. 1.1 (n) Transportation using a forklift (R-2000*i*C/165R/210R/100P/100PH J1 base type)

Robot posture on transportation

J1	Arbitrary
J2	-120º
J3	41º
J4	0º
J5	--41º
J6	0º

Note)
1 Machine mass
  R-2000*i*C/165R/210R : 1370 kg
  R-2000*i*C/100P :   1470 kg
  R-2000*i*C/100PH :   1495 kg
2 When transporting a robot, please be sure to transport it by the posture for transportation.
3 When transporting a robot, remove all tools.
4 When transporting a robot, remove all eyebolts attached to the transport equipment.
5 Be sure to remove transport equipment after setting robot up.

Center of gravity (165R/210R)
Center of gravity (100P/100PH)

Forklift
Load capacity 2.5 ton or more

Center of gravity (165R/210R)
Center of gravity (100P/100PH)

182
82
27
300
377 (165R/210R)
408 (100P/100PH)
1007 (165R/210R)
1038 (100P/100PH)

Transport equipment (option)

Fig. 1.1 (o) Transportation using a forklift (R-2000*i*C/165R/210R/100P/100PH J2 base type)

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

Note)
1 Machine mass
 R-2000*i*C/270F : 1320 kg
 R-2000*i*C/210L : 1350 kg
 R-2000*i*C/190U : 1400 kg

Robot posture on transportation

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

Center of gravity

188

88

Until Sep.,2018

From Oct., 2018

Transport equipment
(option)

956 (Until Sep.,2018)
952 (From Oct., 2018)

Forklift
Load capacity 2.5 ton or more

Fig. 1.1 (p) Transportation using a forklift (R-2000*i*C/270F/210L/190U J1 base type)

Note)
1 Machine mass
 R-2000*i*C/270F : 1320 kg
 R-2000*i*C/210L : 1350 kg
 R-2000*i*C/190U : 1400 kg

Robot posture on transportation

J1	Arbitrary
J2	-60º
J3	0º
J4	0º
J5	0º
J6	0º

Center of gravity

182

82

876

Transport
equipment
(option)

Forklift
Load capacity 2.5 ton or more

Fig. 1.1 (q) Transportation using a forklift (R-2000*i*C/270F/210L/190U J2 base type)

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

Robot posture on transportation

J1	0º
J2	-120º
J3	85º
J4	0º
J5	-85º
J6	0º

Note)
1 Machine mass 1590 kg
2 When transporting a robot, remove all eyebolts attached to
  the transport equipment.

Center of gravity

Center of gravity

191
91
1042

Forklift
Load capacity 2.5 ton or more

Transport
Equipment (option)

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

Robot posture on transportation

J1	Arbitrary
J2	-120º
J3	85º
J4	0º
J5	-85º
J6	0º

Note)
1 Machine mass 1590 kg
2 When transporting a robot, please be sure to transport it by the
  posture for transportation.
3 When transporting a robot, remove all tools.
4 When transporting a robot, remove all eyebolts attached to the
  transport equipment.
5 Be sure to remove transport equipment after setting robot up.

Center of gravity

Center of gravity

182
82
27
300
377
1007

Forklift
Load capacity 2.5 ton or more

Transport
Equipment
(option)

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

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

Note)
1 Machine mass
  R-2000*i*C/190S 1120 kg

Robot posture on transportation

J1	0º or ±180º
J2	-77º
J3	0º
J4	90º
J5	Arbitrary
J6	Arbitrary

Center of gravity

188

88

952

Transport equipment (option)

Forklift
Capacity : min 2.5 ton

Fig. 1.1 (t) Transportation using a forklift (R-2000*i*C/190S J1 base type)

Note)
1 Machine mass
  R-2000*i*C/190S 1120 kg

Robot posture on transportation

J1	Arbitrary
J2	-77º
J3	0º
J4	90º
J5	Arbitrary
J6	Arbitrary

Center of gravity

182

82

826

Transport equipment (option)

Forklift
Capacity : min 2.5 ton
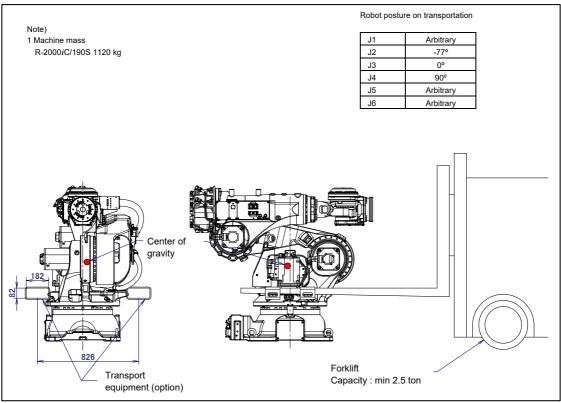
Fig. 1.1 (u) Transportation using a forklift (R-2000*i*C/190S J2 base type)

⚠ **CAUTION**
  Be careful not to strike the transport equipment 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.
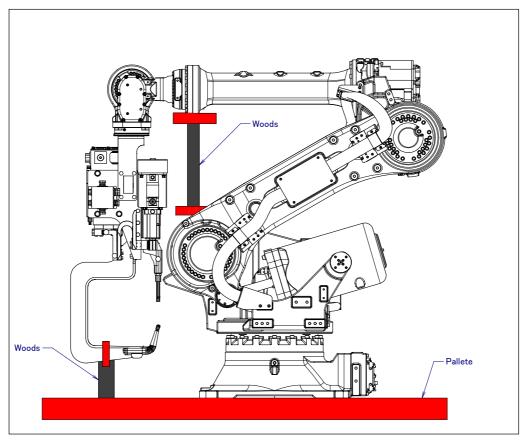

Fig. 1.1.1 (a) Example of securing the arm during transportation when an end effector is attached

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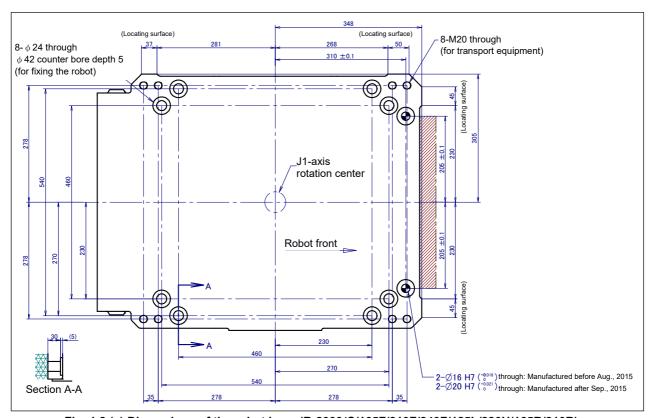> For the R-2000*i*C/165R/210R, the mastering fixture is placed below the J1 base installation surface.

Fig. 1.2 (a) Dimensions of the robot base (R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)

NOTE
For the R-2000*i*C/100P/100PH/270R, the mastering fixture is placed below the J1 base installation surface.
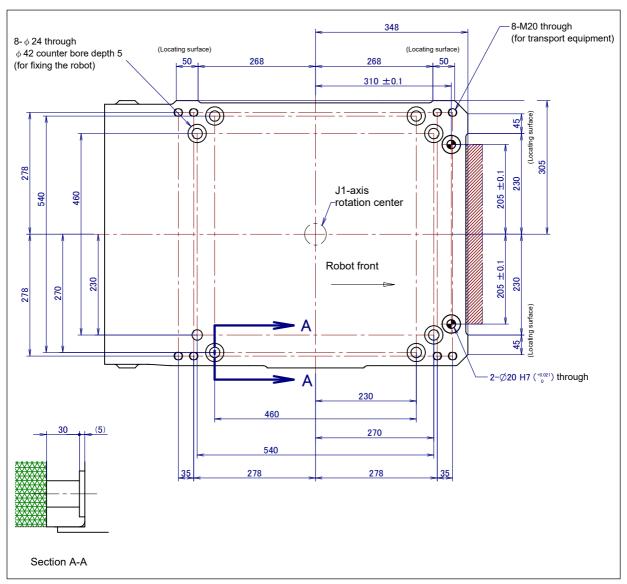
Fig. 1.2 (b) Dimensions of the robot base (R-2000*i*C/100P/100PH/270F/190S/270R/210L/190U)

1.2.1   Actual Installation Example

The following show three actual examples of the robot installation. Select a method according to the customer's installation environment, and install the robot.

- Installation example 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 x 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 example 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 $\phi20$ 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 example 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-2000iC/165R/210R/100P/100PH/270R, the mastering fixture is placed below the J1 base installation surface.

The following parts are required to install the robot.
(◯ : Parts needs to be prepared.)

Required parts	Remarks	Example I	Example II	Example III
Robot mounting bolts	M20 x 65 (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	$\phi20$ 3 pcs		◯	

NOTE
- 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.
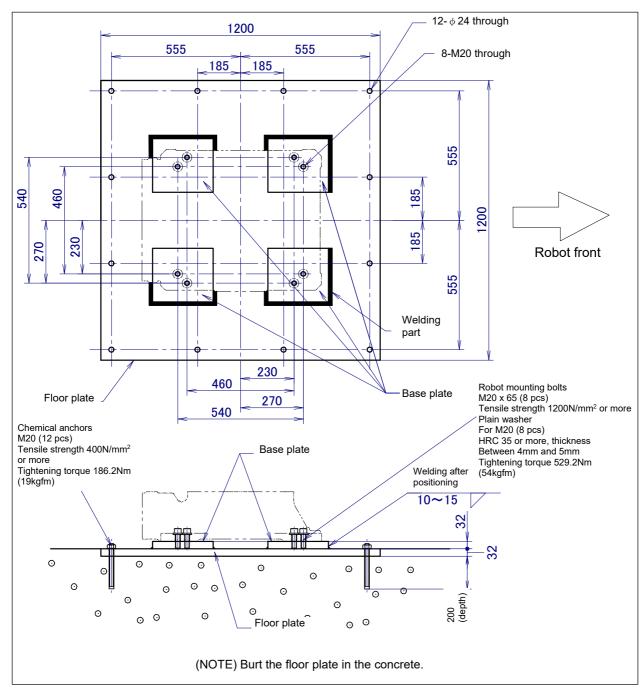

Fig. 1.2.1 (a) Actual installation example I (R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)
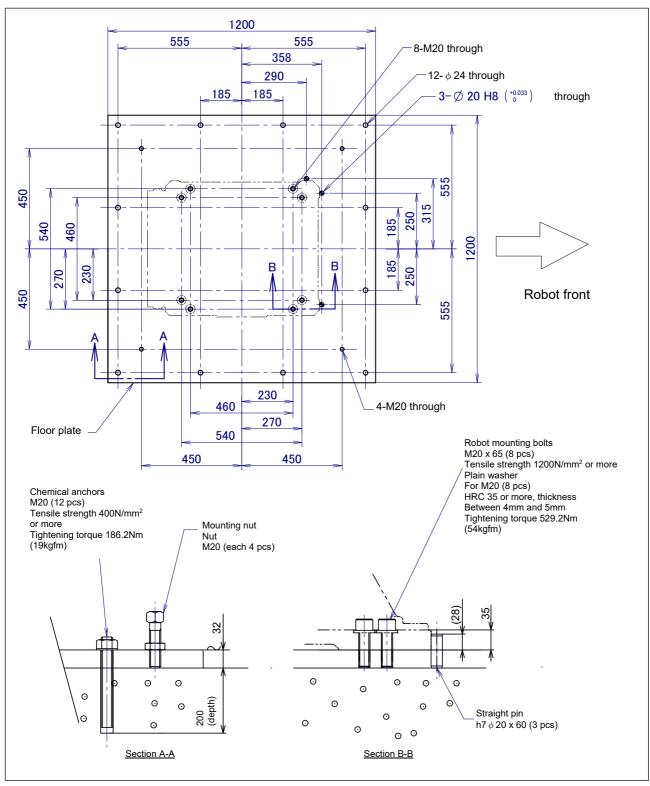
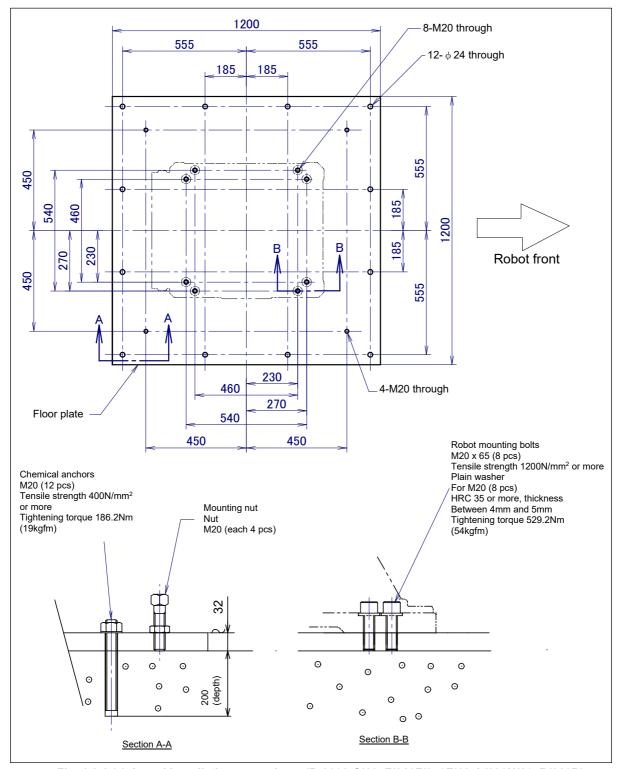**Fig. 1.2.1 (b) Actual installation example II (R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)**

Fig. 1.2.1 (c) Actual installation example III (R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)
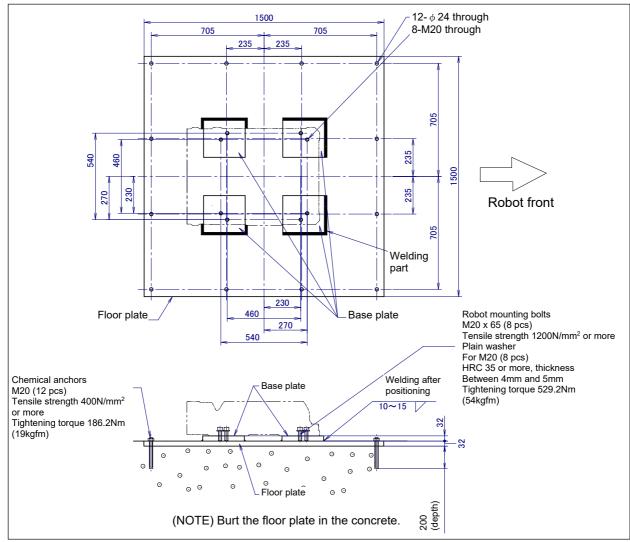
Fig. 1.2.1 (d) Actual installation example I (R-2000*i*C/100P/100PH/270F/270R/190S/210L/190U)
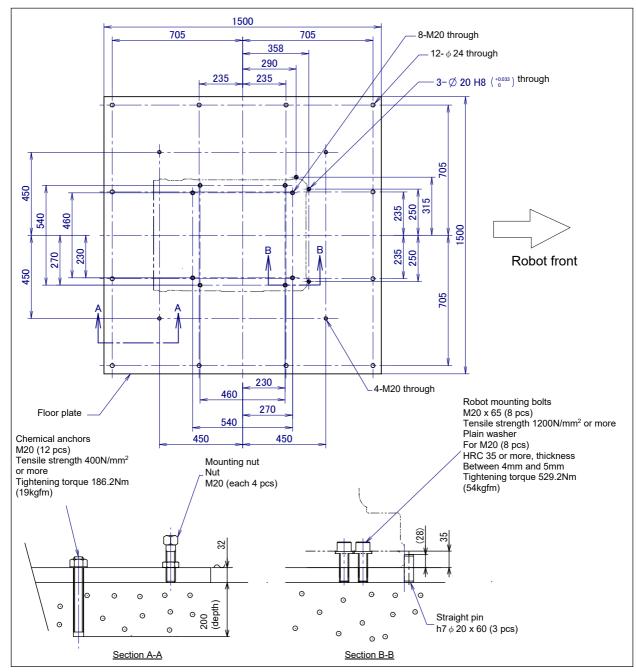
Fig. 1.2.1 (e) Actual installation example II (R-2000*i*C/100P/100PH/270F/270R/190S/210L/190U)
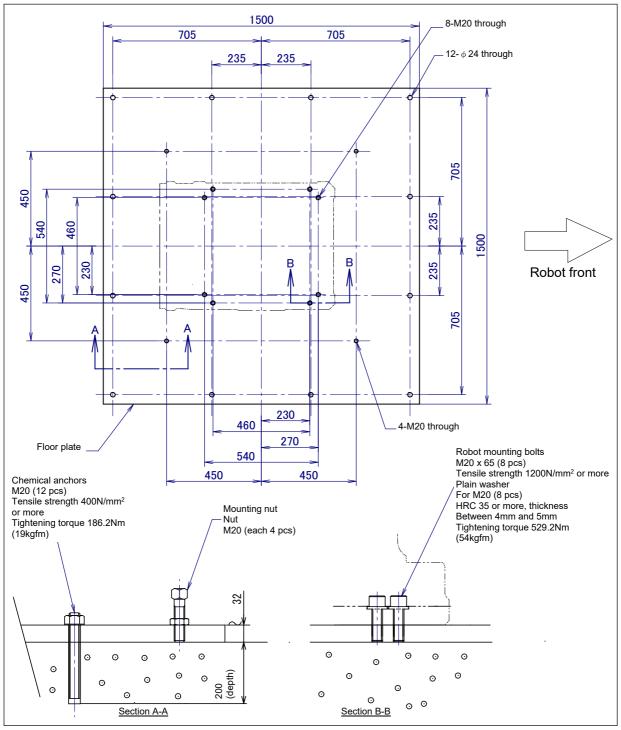
Fig. 1.2.1 (f) Actual installation example III (R-2000*i*C/100P/100PH/270F/270R/190S/210L/190U)

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) to (d) indicate the stopping distance and time of the J1 to J3 axis until the robot stopping by Power-Off stop, by Smooth stop or by Controlled stop after input of the stop signal. Refer to the data when considering the strength of the installation face.

NOTE

Table 1.2.1 (b) to (d) are measured reference value complied with ISO10218-1. Values differs depending on each robot individual difference, payload and the program. So confirm the real value by measurement. Values in Table 1.2.1 (b) is affected by the robot operating status and number of times of the Servo-Off stop. Periodically measure the real values and confirm those.

Table 1.2.1 (a) Force and moment during Power-Off stop

| Model	Vertical moment M_V [kNm(kgfm)]	Force in vertical direction F_V [kN(kgf)]	Horizontal moment M_H [kNm(kgfm)]	Force in horizontal direction F_H [kN(kgf)]
R-2000iC/165F	63.70 (6500)	37.24 (3800)	24.50 (2500)	28.42 (2900)
R-2000iC/210F	73.50 (7500)	41.16 (4200)	25.48 (2600)	29.40 (3000)
R-2000iC/240F	75.46 (7700)	41.16 (4200)	25.48 (2600)	30.38 (3100)
R-2000iC/125L	62.72 (6400)	35.28 (3600)	24.50 (2500)	26.46 (2700)
R-2000iC/220U	62.72 (6400)	32.34 (3300)	24.50 (2500)	26.46 (2700)
R-2000iC/165R	75.46 (7700)	39.20 (4000)	25.48 (2600)	28.42 (2900)
R-2000iC/210R	84.28 (8600)	41.16 (4200)	25.48 (2600)	28.42 (2900)
R-2000iC/100P	77.42 (7900)	38.22 (3900)	25.48 (2600)	26.46 (2700)
R-2000iC/100PH	78.40 (8000)	39.20 (4000)	25.48 (2600)	27.44 (2800)
R-2000iC/270F	90.16 (9200)	47.04 (4800)	27.44 (2800)	33.32 (3400)
R-2000iC/270F 300kg option	90.16 (9200)	47.04 (4800)	27.44 (2800)	34.30 (3500)
R-2000iC/270R	100.94 (10300)	48.02 (4900)	26.46 (2700)	33.32 (3400)
R-2000iC/190S	65.66 (6700)	43.12 (4400)	23.52 (2400)	32.34 (3300)
R-2000iC/210L	91.14 (9300)	44.10 (4500)	27.44 (2800)	30.38 (3100)
R-2000iC/190U	86.24 (8800)	38.22 (3900)	27.44 (2800)	28.42 (2900)
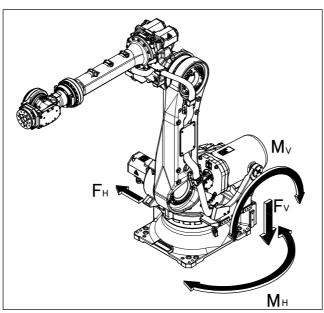
Fig. 1.2.1 (g) Force and moment during Power-Off stop

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-2000iC/165F	Stopping time [ms]	458	291	228
	Stopping distance [deg] (rad)	31.1 (0.54)	16.3 (0.28)	10.9 (0.19)
R-2000iC/210F	Stopping time [ms]	515	419	204
	Stopping distance [deg] (rad)	29.2 (0.51)	18.8 (0.33)	11.0 (0.19)
R-2000iC/240F	Stopping time [ms]	620	416	336
	Stopping distance [deg] (rad)	38.2 (0.67)	17.8 (0.31)	17.8 (0.31)
R-2000iC/125L	Stopping time [ms]	472	371	272
	Stopping distance [deg] (rad)	30.9 (0.54)	18.3 (0.32)	14.2 (0.25)
R-2000iC/220U	Stopping time [ms]	472	325	193
	Stopping distance [deg] (rad)	24.3 (0.42)	12.8 (0.22)	9.8 (0.17)
R-2000iC/165R	Stopping time [ms]	484	384	189
	Stopping distance [deg] (rad)	27.8 (0.49)	18.6 (0.32)	10.8 (0.19)
R-2000iC/210R	Stopping time [ms]	609	405	215
	Stopping distance [deg] (rad)	30.0 (0.52)	16.5 (0.29)	10.5 (0.18)
R-2000iC/100P	Stopping time [ms]	571	417	305
	Stopping distance [deg] (rad)	32.5 (0.57)	18.6 (0.32)	15.4 (0.27)
R-2000iC/100PH	Stopping time [ms]	640	432	320
	Stopping distance [deg] (rad)	33.2 (0.58)	18.0 (0.31)	14.2 (0.25)
R-2000iC/270F	Stopping time [ms]	503	359	192
	Stopping distance [deg] (rad)	24.7 (0.43)	14.1 (0.25)	7.8 (0.14)
R-2000iC/270F 300kg option	Stopping time [ms]	520	416	272
	Stopping distance [deg] (rad)	23.9 (0.42)	17.0 (0.30)	9.6 (0.17)
R-2000iC/270R	Stopping time [ms]	769	385	265
	Stopping distance [deg] (rad)	36.2(0.63)	16.4 (0.29)	8.4 (0.15)
R-2000iC/190S	Stopping time [ms]	324	228	228
	Stopping distance [deg] (rad)	15.5 (0.27)	10.2 (0.18)	17.2 (0.30)
R-2000iC/210L	Stopping time [ms]	522	440	249
	Stopping distance [deg] (rad)	26.9 (0.47)	17.9 (0.31)	9.3 (0.16)
R-2000iC/190U	Stopping time [ms]	554	419	256
	Stopping distance [deg] (rad)	27.5 (0.48)	18.0 (0.31)	10.5 (0.18)

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

Model		J1-axis	J2-axis	J3-axis
R-2000iC/165F	Stopping time [ms]	874	1020	910
	Stopping distance [deg] (rad)	53.5 (0.93)	41.4 (0.72)	51.4 (0.90)
R-2000iC/210F	Stopping time [ms]	1014	1210	1082
	Stopping distance [deg] (rad)	55.3 (0.97)	45.3 (0.79)	48.3 (0.84)
R-2000iC/240F	Stopping time [ms]	1032	1076	924
	Stopping distance [deg] (rad)	55.6 (0.97)	42.6 (0.74)	41.7 (0.73)
R-2000iC/125L	Stopping time [ms]	856	996	910
	Stopping distance [deg] (rad)	48.1 (0.84)	39.9 (0.70)	46.0 (0.80)
R-2000iC/220U	Stopping time [ms]	978	928	1034
	Stopping distance [deg] (rad)	57.7 (1.01)	36.2 (0.63)	46.0 (0.80)
R-2000iC/165R	Stopping time [ms]	1074	1118	969
	Stopping distance [deg] (rad)	59.9 (1.05)	46.1 (0.80)	53.3 (0.93)
R-2000iC/210R	Stopping time [ms]	1134	1146	866
	Stopping distance [deg] (rad)	57.1 (1.00)	41.2 (0.72)	35.5 (0.62)
R-2000iC/100P	Stopping time [ms]	896	1005	999
	Stopping distance [deg] (rad)	50.1 (0.87)	36.9 (0.64)	45.7 (0.80)
R-2000iC/100PH	Stopping time [ms]	928	792	1008
	Stopping distance [deg] (rad)	50.4 (0.88)	37.1 (0.65)	46.1 (0.80)
R-2000iC/270F	Stopping time [ms]	752	854	444
	Stopping distance [deg] (rad)	38.7 (0.68)	33.3 (0.58)	18.7 (0.33)
R-2000iC/270F 300kg option	Stopping time [ms]	820	830	590
	Stopping distance [deg] (rad)	38.3 (0.67)	34.0 (0.59)	23.2 (0.40)

Model		J1-axis	J2-axis	J3-axis
R-2000*i*C/270R	Stopping time [ms]	1005	821	433
	Stopping distance [deg] (rad)	51.5 (0.90)	30.3 (0.53)	17.7 (0.31)
R-2000*i*C/190S	Stopping time [ms]	725	730	470
	Stopping distance [deg] (rad)	37.0 (0.65)	29.7 (0.52)	29.9 (0.52)
R-2000*i*C/210L	Stopping time [ms]	818	928	698
	Stopping distance [deg] (rad)	42.5 (0.74)	36.1 (0.63)	30.4 (0.53)
R-2000*i*C/190U	Stopping time [ms]	930	940	668
	Stopping distance [deg] (rad)	45.0 (0.79)	37.1 (0.65)	28.2 (0.49)

Table 1.2.1 (d) 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	1024	1038
	Stopping distance [deg] (rad)	65.2 (1.14)	53.9 (0.94)	61.8 (1.08)
R-2000*i*C/210F	Stopping time [ms]	1022	1388	1192
	Stopping distance [deg] (rad)	66.8 (1.17)	57.7 (1.01)	60.8 (1.06)
R-2000*i*C/240F	Stopping time [ms]	1232	1400	1400
	Stopping distance [deg] (rad)	67.3 (1.17)	56.5 (0.99)	66.0 (1.15)
R-2000*i*C/125L	Stopping time [ms]	1180	1364	1372
	Stopping distance [deg] (rad)	77.7 (1.36)	61.9 (1.08)	75.1 (1.31)
R-2000*i*C/220U	Stopping time [ms]	1074	1020	1094
	Stopping distance [deg] (rad)	63.6 (1.11)	41.4 (0.72)	56.0 (0.98)
R-2000*i*C/165R	Stopping time [ms]	1178	1400	1245
	Stopping distance [deg] (rad)	68.2 (1.19)	63.0 (1.10)	75.5 (1.32)
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/100P	Stopping time [ms]	1124	1202	1216
	Stopping distance [deg] (rad)	64.3 (1.12)	50.3 (0.88)	61.4 (1.07)
R-2000*i*C/100PH	Stopping time [ms]	1176	1048	1224
	Stopping distance [deg] (rad)	64.4 (1.12)	48.4 (0.84)	61.1 (1.07)
R-2000*i*C/270F	Stopping time [ms]	1060	1092	1020
	Stopping distance [deg] (rad)	57.8 (1.01)	48.0 (0.84)	45.9 (0.80)
R-2000*i*C/270F 300kg option	Stopping time [ms]	1090	1140	1070
	Stopping distance [deg] (rad)	55.1 (0.96)	48.4 (0.84)	47.2 (0.82)
R-2000*i*C/270R	Stopping time [ms]	1153	1253	1165
	Stopping distance [deg] (rad)	57.4 (1.00)	49.3 (0.86)	49.9 (0.87)
R-2000*i*C/210L	Stopping time [ms]	1075	1050	955
	Stopping distance [deg] (rad)	55.7 (0.97)	45.0 (0.79)	43.7 (0.76)
R-2000*i*C/190U	Stopping time [ms]	1012	1040	988
	Stopping distance [deg] (rad)	52.9 (0.92)	43.7 (0.76)	42.8 (0.75)

1.3   MAINTENANCE AREA

Fig. 1.3 (a) to (d) 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 mastering information.

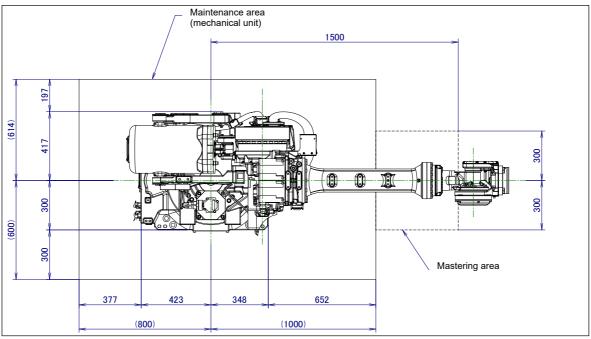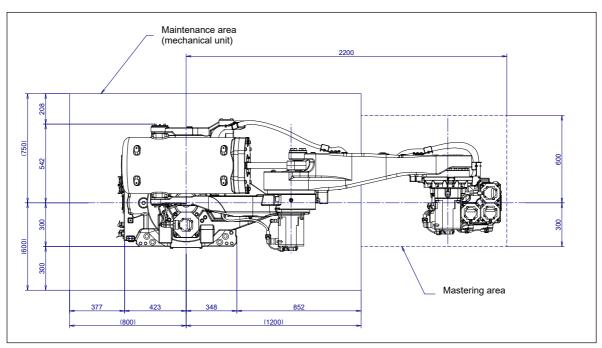**Fig. 1.3 (a) Maintenance area (R-2000*i*C/165F/210F/240F/125L/220U)**

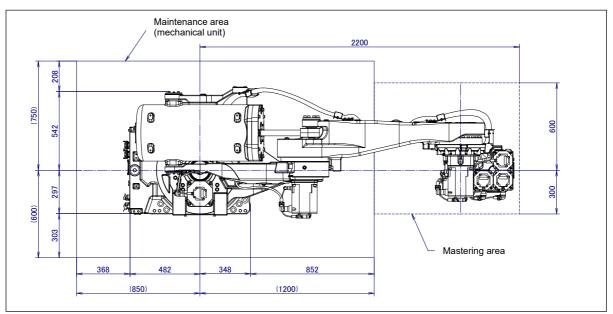**Fig. 1.3 (b) Maintenance area (R-2000*i*C/165R/210R)**

Fig. 1.3 (c) Maintenance area (R-2000*i*C/100P/100PH/270R)
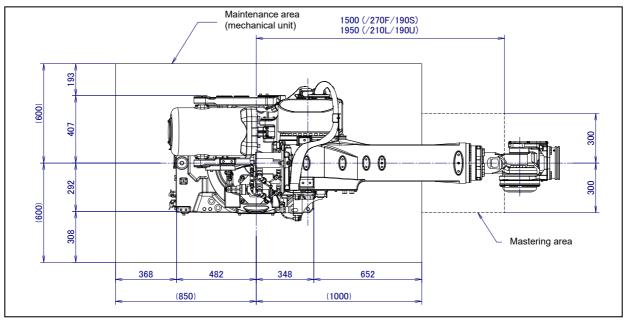

Fig. 1.3 (d) Maintenance area (R-2000*i*C/270F/190S/210L/190U)

1.4   INSTALLATION CONDITIONS

Refer to the caution below concerning installation conditions. Refer to also to the specifications found in Section 3.1.

⚠ **CAUTION**

1 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.

2 Damage to the cable jacket can cause water intrusion. Take care not to damage the cable jacket when installing the robot. Replace the cable if it is damaged.

3 Liqud intrusion into the balancer inside might cause corrosion of the spring. Be careful to prevent liquid splashing to the balancer.

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

⚠ **WARNING**

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

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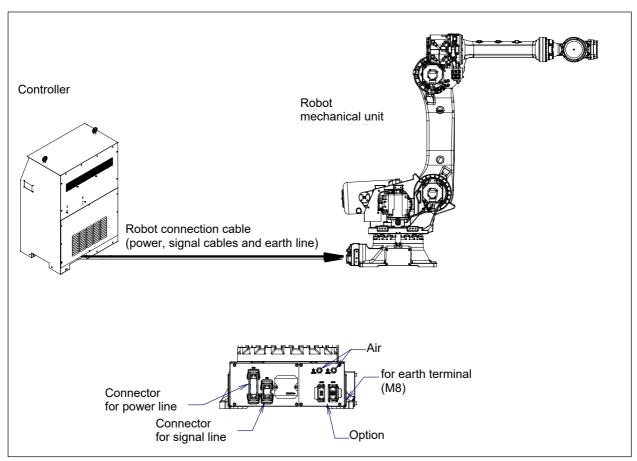
Fig. 2 (a) Cable connection

3 BASIC SPECIFICATIONS

3.1 ROBOT CONFIGURATION
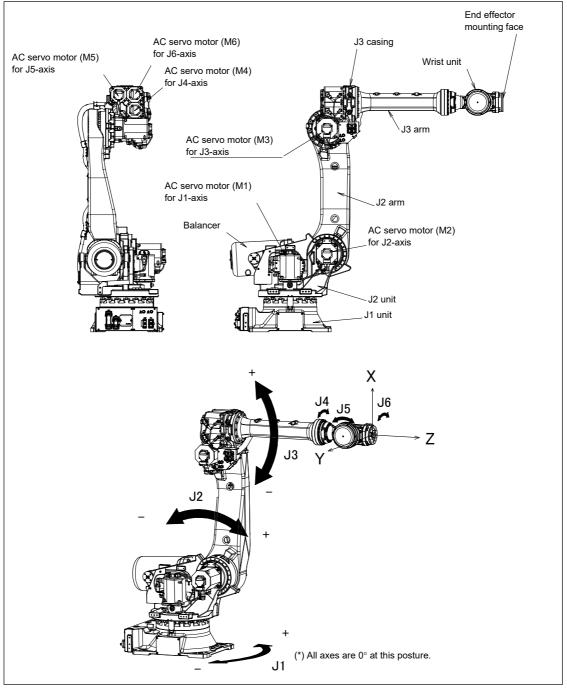
Fig. 3.1 (a) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates (R-2000*i*C/165F/210F/240F/125L/220U)

> **NOTE**
> 1 There is no balancer for R-2000*i*C/220U.
> 2 The end effector mounting face center is 0, 0, 0 of the mechanical interface coordinates.

**Fig. 3.1 (b) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates
(R-2000*i*C/165R/210R/100P/100PH)**

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

**Fig. 3.1 (c) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates
(R-2000*i*C/270F/190S/210L/190U)**

NOTE
1   There is no balancer for R-2000*i*C/190S.
2   The end effector mounting face center is 0, 0, 0 of the mechanical interface
    coordinates.
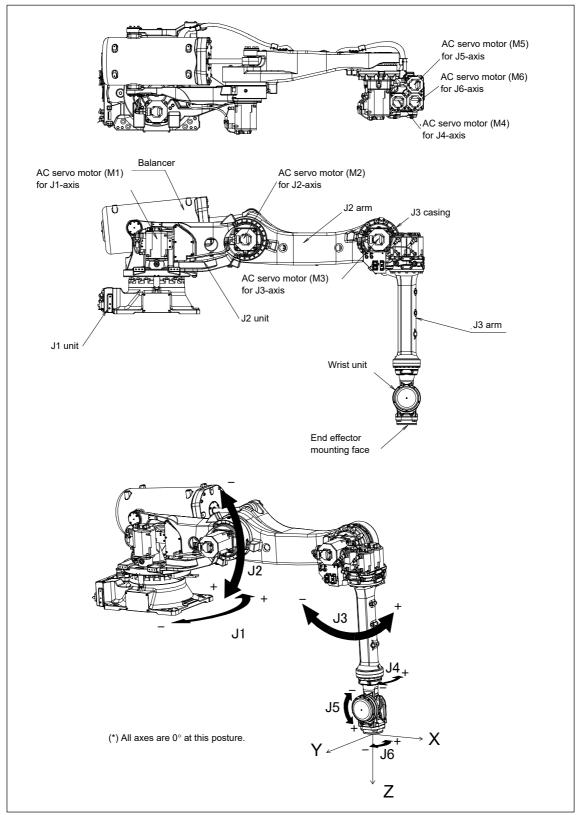
Fig. 3.1 (d) Mechanical unit configuration, each axis coordinates, and mechanical interface coordinates (R-2000*i*C/270R)

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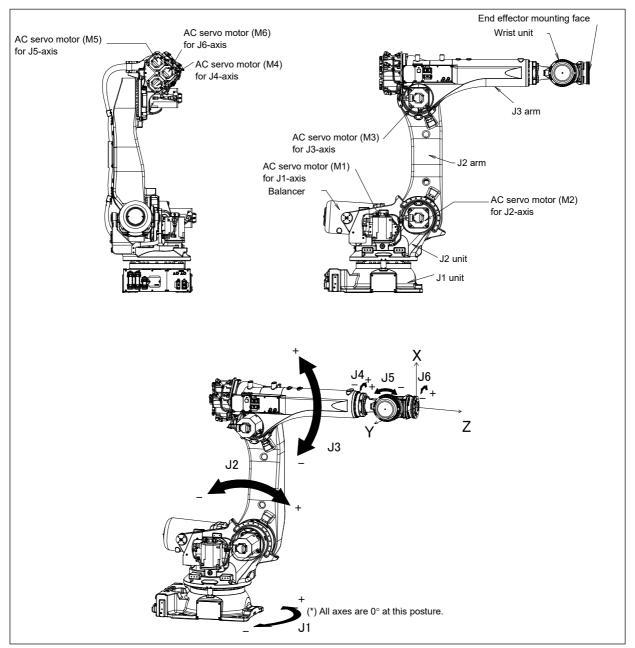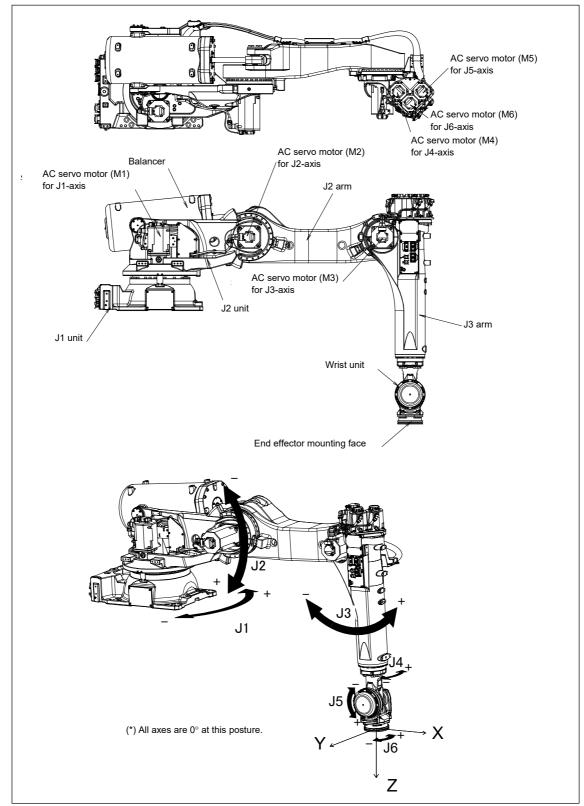The end effector mounting face center is 0, 0, 0 of the mechanical interface coordinates.

Specifications Note 1) (1/5)

Model			R-2000*i*C/165F	R-2000*i*C/210F	R-2000*i*C/240F
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)	-132° (-2.30rad)
	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 2)	J1-axis		130°/s (2.27rad/s)	120°/s (2.09rad/s)	115°/s (2.01rad/s)
	J2-axis		115°/s (2.01rad/s)	105°/s (1.83rad/s)	90°/s (1.57rad/s)
	J3-axis		125°/s (2.18rad/s)	110°/s (1.92rad/s)	105°/s (1.83rad/s)
	J4-axis		180°/s (3.14rad/s)	140°/s (2.44rad/s)	130°/s (2.27rad/s)
	J5-axis		180°/s (3.14rad/s)	140°/s (2.44rad/s)	130°/s (2.27rad/s)
	J6-axis		260°/s (4.54rad/s)	220°/s (3.84rad/s)	210°/s (3.67rad/s)
Max. payload	At wrist		165kg	210kg	240kg
	On J3 arm		25kg (A) / (A)+(B)≦50kg	25kg (A) / (A)+(B)≦50kg	25kg (A) / (A)+(B)≦50kg
	On J3 casing		50kg (B)	50kg (B)	50kg (B)
	On J2 base		550kg	550kg	550kg
Allowable load moment at wrist	J4-axis		940N·m (96kgf·m)	1360N·m (139kgf·m)	1400N·m (143kgf·m)
	J5-axis		940N·m (96kgf·m)	1360N·m (139kgf·m)	1400N·m (143kgf·m)
	J6-axis		490N·m (50kgf·m)	735N·m (75kgf·m)	800N·m (82kgf·m)
Allowable load inertia at wrist	J4-axis		Note 3) 89kg·m^2 (908kgf·cm·s^2) / Note 3) 120kg·m^2 (1225kgf·cm·s^2)	Note 3) 147kg·m^2 (1500kgf·cm·s^2) / Note 3) 225.4kg·m^2 (2300kgf·cm·s^2)	250kg·m^2 (2551kgf·cm·s^2)
	J5-axis		Note 3) 89kg·m^2 (908kgf·cm·s^2) / Note 3) 120kg·m^2 (1225kgf·cm·s^2)	Note 3) 147kg·m^2 (1500kgf·cm·s^2) / Note 3) 225.4kg·m^2 (2300kgf·cm·s^2)	250kg·m^2 (2551kgf·cm·s^2)
	J6-axis		Note 3) 46kg·m^2 (469kgf·cm·s^2) / Note 3) 100kg·m^2 (1020kgf·cm·s^2)	Note 3) 82kg·m^2 (837kgf·cm·s^2) / Note 3) 196kg·m^2 (2000kgf·cm·s^2)	200kg·m^2 (2041kgf·cm·s^2)
Drive method			Electric servo drive by AC servo motor		
Repeatability Note 4)			±0.05mm		
Mass			1090kg	1090kg	1090kg
Acoustic noise level			70.5dB Note 5)		
Installation environment			Ambient temperature: 0 to 45°C Note 6) Ambient humidity: Normally 75%RH or less. (No condensation allowed.) Short time (within one month) Max 95%RH (No condensation allowed.) Permitted altitude: Up to 1000 m above sea level. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases Note 7) Note 8)		

Note 1)   Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat. Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.

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

Note 3)   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 4)   Compliant with ISO9283.

Note 5)   This value is the 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 6)   When the robot is used in a low temperature environment that is near to 0ºC, or the robot is not operated for a long time in an environment that is less than 0ºC, for example during a holiday or overnight, viscous resistance of the drive train may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing a warm up operation for several minutes.

Note 7)   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, water, water vapor, cutting oil, cleaning fluid splash and or other foreign materials.

Note 8)   Liquid intrusion into the balancer inside might cause corrosion of the spring. Be careful to prevent liquid splashing to the balancer.

Specifications Note 1) (2/5)

Model			R-2000*i*C/125L	R-2000*i*C/220U	R-2000*i*C/165R
Type				Articulated Type	
Controlled axis				6 axes (J1,J2,J3,J4,J5,J6)	
Installation			Floor mount	Upside-down	Rack 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)	80°　(1.40rad)
		Lower limit	-60°　(-1.05rad)	-60°　(-1.05rad)	-120°　(-2.09rad)
	J3-axis	Upper limit	180°　(3.14rad)	180°　(3.14rad)	270°　(4.71rad)
		Lower limit	-121°　(-2.11rad	-132°　(-2.30rad)	-105°　(-1.83rad)
	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 2)	J1-axis		130°/s (2.27rad/s)	120°/s (2.09rad/s)	115°/s (2.01rad/s)
	J2-axis		115°/s (2.01rad/s)	85°/s (1.48rad/s)	110°/s (1.92rad/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		125kg	220kg	165kg
	On J3 arm		25kg (A)	25kg (A)	25kg (A)
	On J3 casing		40kg (B)　(A)+(B)≦40kg	30kg (B)　6/5*(A)+(B)≦30kg	50kg (B)　(A)+(B)≦50kg
	On J2 base		550kg	-	550kg
Allowable load moment at wrist	J4-axis		710N·m　(72kgf·m)	1360N·m　(139kgf·m)	940N·m　(96kgf·m)
	J5-axis		710N·m　(72kgf·m)	1360N·m　(139kgf·m)	940N·m　(96kgf·m)
	J6-axis		355N·m　(36kgf·m)	735N·m　(75kgf·m)	490N·m　(50kgf·m)
Allowable load inertia at wrist	J4-axis		72kg·m^2 (735kgf·cm·s^2)	147kg·m^2 (1500kgf·cm·s^2)	89kg·m^2 (908kgf·cm·s^2)
	J5-axis		72kg·m^2 (735kgf·cm·s^2)	147kg·m^2 (1500kgf·cm·s^2)	89kg·m^2 (908kgf·cm·s^2)
	J6-axis		40kg·m^2 (408kgf·cm·s^2)	82kg·m^2 (837kgf·cm·s^2)	46kg·m^2 (469kgf·cm·s^2)
Drive method				Electric servo drive by AC servo motor	
Repeatability Note 3)				±0.05mm	
Mass			1115kg	1020kg	1370kg
Acoustic noise level				70.5dB Note 4)	
Installation environment			Ambient temperature:　　0 to 45°C　Note 5) Ambient humidity:　　Normally 75%RH or less. (No condensation allowed.) 　　Short time (within one month) Max 95%RH 　　(No condensation allowed.) Permitted altitude:　　Up to 1000 m above sea level. Vibration acceleration :　　4.9m/s^2　(0.5G) or less Free of corrosive gases　Note 6) Note 7)		

Note 1) Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat.
　　　　Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.

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

Note 3) Compliant with ISO9283.

Note 4) This value is the 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 5) When the robot is used in a low temperature environment that is near to 0ºC, or the robot is not operated for a long time in an environment that is less than 0ºC, for example during a holiday or overnight, viscous resistance of the drive train may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing a warm up operation for several minutes.

Note 6) 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, water, water vapor, cutting oil, cleaning fluid splash and or other contaminations.

Note 7) Liquid intrusion into the balancer inside might cause corrosion of the spring. Be careful to prevent liquid splashing to the balancer.

Specifications Note 1) (3/5)

Model			R-2000iC/210R	R-2000iC/100P/100PH	R-2000iC/270F
Type			Articulated Type		
Controlled axis			6 axes(J1,J2,J3,J4,J5,J6)		
Installation			Rack mount		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	80° (1.40rad)	80° (1.40rad)	76° (1.33rad)
		Lower limit	-120° (-2.09rad)	-120° (-2.09rad)	-60° (-1.05rad)
	J3-axis	Upper limit	270° (4.71rad)	270° (4.71rad)	180° (3.14rad)
		Lower limit	-105° (-1.83rad)	-105° (-1.83rad)	-132° (-2.30rad)
	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 2)	J1-axis		105°/s (1.83rad/s)	120°/s (2.09rad/s)	105°/s (1.83rad/s) 100°/s (1.75rad/s) Note 8)
	J2-axis		100°/s (1.75rad/s)	100°/s (1.75rad/s)	90°/s (1.57rad/s)
	J3-axis		110°/s (1.92rad/s)	115°/s (2.01rad/s)	85°/s (1.48rad/s)
	J4-axis		140°/s (2.44rad/s)	140°/s (2.44rad/s)	120°/s (2.09rad/s)
	J5-axis		140°/s (2.44rad/s)	140°/s (2.44rad/s)	120°/s (2.09rad/s)
	J6-axis		220°/s (3.84rad/s)	210°/s (3.66rad/s)	200°/s (3.49rad/s) 190°/s (3.32rad/s) Note 8)
Max. payload	At wrist		210kg	100kg	270kg / 300kg Note 8)
	On J3 arm		30kg (A) 4/3*(A)+(B)≦	25kg (A) 2*(A)+(B)≦50kg	40kg (A) 5/4*(A)+(B)≦50kg
	On J3 casing		40kg (B) 40kg	50kg (B)	50kg (B)
	On J2 base		550kg	550kg	550kg
Allowable load moment at wrist	J4-axis		1360N·m (139kgf·m)	1000N·m (102kgf·m)	1730N·m (177kgf·m) 1755N·m (179kgf·m) Note 8)
	J5-axis		1360N·m (139kgf·m)	1000N·m (102kgf·m)	1730N·m (177kgf·m) 1755N·m (179kgf·m) Note 8)
	J6-axis		735N·m (75kgf·m)	706N·m (72kgf·m)	900N·m (92kgf·m) 1000N·m (102kgf·m) Note 8)
Allowable load inertia at wrist	J4-axis		147kg·m^2 (1500kgf·cm·s^2)	227kg·m^2 (2316kgf·cm·s^2)	320kg·m^2 (3265kgf·cm·s^2)
	J5-axis		147kg·m^2 (1500kgf·cm·s^2)	227kg·m^2 (2316kgf·cm·s^2)	320kg·m^2 (3265kgf·cm·s^2)
	J6-axis		82kg·m^2 (837kgf·cm·s^2)	196kg·m^2 (2000kgf·cm·s^2)	230kg·m^2 (2347kgf·cm·s^2)
Drive method			Electric servo drive by AC servo motor		
Repeatability Note 3)			±0.05mm		
Mass			1370kg	1470 kg (100P) / 1495 kg (100PH)	1320kg
Acoustic noise level			70.5dB Note 4)	73.7dB Note 4)	70.5dB Note 4)
Installation environment			Ambient temperature: 0 to 45°C Note 5) Ambient humidity: Normally 75%RH or less. (No condensation allowed.) Short time (within one month) Max 95%RH (No condensation allowed.) Permitted altitude: Up to 1000 m above sea level. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases Note 6) Note 7)		

Note 1) Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat.
　　　　Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.

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

Note 3) Compliant with ISO9283.

Note 4) This value is the 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 5) When the robot is used in a low temperature environment that is near to 0ºC, or the robot is not operated for a long time in an environment
　　　　that is less than 0ºC, for example during a holiday or overnight, viscous resistance of the drive train may cause occurrence　of collision
　　　　detect alarm (SRVO –050) etc. In this case, we recommend performing a warm up operation for several minutes.

Note 6) 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, water, water vapor, cutting oil, cleaning fluid splash and or other contaminations.

Note 7) Liquid intrusion into the balancer inside might cause corrosion of the spring. Be careful to prevent liquid splashing to the balancer.

Note 8) When 300kg option is specified at R-2000iC/270F.

Specifications Note 1) (4/5)

Model			R-2000iC/270R	R-2000iC/190S	R-2000iC/210L
Type				Articulated Type	
Controlled axis				6 axes(J1,J2,J3,J4,J5,J6)	
Installation			Rack mount	Floor mount, Upside-down	Floor mount
Motion range	J1-axis	Upper limit	185° (3.23rad)	185° (3.23rad) 165° (2.88rad) Note 2)	185° (3.23rad)
		Lower limit	-185°(-3.23rad)	-185° (-3.23rad) -165° (-2.88rad) Note 2)	-185° (-3.23rad)
	J2-axis	Upper limit	80°(1.40rad)	130° (2.27rad)	76° (1.33rad)
		Lower limit	-120°(-2.09rad)	-80° (-1.40rad)	-60° (-1.05rad)
	J3-axis	Upper limit	270° (4.71rad)	180° (3.14rad)	180° (3.14rad)
		Lower limit	-105°(-1.83rad)	-160° (-2.79rad)	-121° (-2.11rad)
	J4-axis	Upper limit	360°(6.28rad)	360° (6.28rad) 153° (2.67rad) Note 2)	360° (6.28rad)
		Lower limit	-360°(-6.28rad)	-360° (-6.28rad) -153° (-2.67rad) Note2)	-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 3)	J1-axis		105°/s (1.83rad/s)	105°/s (1.83rad/s)	105°/s (1.83rad/s)
	J2-axis		85°/s (1.48rad/s)	90°/s (1.57rad/s)	85°/s (1.48rad/s)
	J3-axis		85°/s (1.48rad/s)	145°/s (2.53rad/s)	85°/s (1.48rad/s)
	J4-axis		120°/s (2.09rad/s)	120°/s (2.09rad/s)	120°/s (2.09rad/s)
	J5-axis		120°/s (2.09rad/s)	120°/s (2.09rad/s)	120°/s (2.09rad/s)
	J6-axis		200°/s (3.49rad/s)	200°/s (3.49rad/s)	200°/s (3.49rad/s)
Max. payload Note 4)	At wrist		270kg	190kg	210kg
	On J3 arm		30kg (A) 4/3*(A)+(B)≦40kg	40kg (A) 5/4*(A)+(B)≦50kg	20kg (A) 5/2*(A)+ (B) ≦
	On J3 casing		40kg (B)	50kg (B)	50kg (B) 50 kg
	On J2 base		550kg	550kg	550kg
Allowable load moment at wrist	J4-axis		1730N·m (177kgf·m)	1200N·m (122kgf·m)	1700N·m (173kgf·m)
	J5-axis		1730N·m (177kgf·m)	1200N·m (122kgf·m)	1700N·m (173kgf·m)
	J6-axis		900N·m (92kgf·m)	630N·m (64kgf·m)	900N·m (92kgf·m)
Allowable load inertia at wrist	J4-axis		320kg·m² (3265kgf·cm·s²)	200kg·m² (2041kgf·cm·s²)	320kg·m² (3265kgf·cm·s²)
	J5-axis		320kg·m² (3265kgf·cm·s²)	200kg·m² (2041kgf·cm·s²)	320kg·m² (3265kgf·cm·s²)
	J6-axis		230kg·m² (2347kgf·cm·s²)	180kg·m² (1837kgf·cm·s²)	230kg·m² (2347kgf·cm·s²)
Drive method				Electric servo drive by AC servo motor	
Repeatability Note 5)			±0.05mm	±0.03mm	±0.05mm
Mass			1590 kg	1120 kg / 1135kg Note 2)	1350 kg
Acoustic noise level				70.5dB Note 6)	

Installation environment			Ambient temperature: 0 to 45°C Note 7)
			Ambient humidity: Normally 75%RH or less. (No condensation allowed.)
			                                 Short time (within one month) Max 95%RH
			                                 (No condensation allowed.)
			Permitted altitude: Up to 1000 m above sea level.
			Vibration acceleration : 4.9m/s² (0.5G) or less
			Free of corrosive gases Note 8) Note 9)		

Note 1) Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat. Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.
Note 2) When accuracy and stiffness enhancement option is specified
Note 3) During short distance motions, the axis speed may not reach the maximum value stated.
Note 4) Load at fore J3 arm is unavailable when accuracy and stiffness enhancement option is specified.
Note 5) Compliant with ISO9283.
Note 6) This value is the 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 7) When the robot is used in a low temperature environment that is near to 0°C, or the robot is not operated for a long time in an environment that is less than 0°C, for example during a holiday or overnight, viscous resistance of the drive train may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing a warm up operation for several minutes.
Note 8) 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, water, water vapor, cutting oil, cleaning fluid splash and or other contaminations.
Note 9) Liquid intrusion into the balancer inside might cause corrosion of the spring. Be careful to prevent liquid splashing to the balancer.

Specifications Note 1) (5/5)

Model			R-2000*i*C/190U	
Type			Articulated Type	
Controlled axis			6 axes(J1,J2,J3,J4,J5,J6)	
Installation			Upside-down	
Motion range	J1-axis	Upper limit	185°(3.23rad)	
		Lower limit	-185°(-3.23rad)	
	J2-axis	Upper limit	76°(1.33rad)	
		Lower limit	-60°(-1.05rad)	
	J3-axis	Upper limit	180°(3.14rad)	
		Lower limit	-121°(-2.11rad)	
	J4-axis	Upper limit	360°(6.28rad)	
		Lower limit	-360°(-6.28rad)	
	J5-axis	Upper limit	125°(2.18rad)	
		Lower limit	-125°(-2.18rad)	
	J6-axis	Upper limit	360°(6.28rad)	
		Lower limit	-360°(-6.28rad)	
Max. speed Note 2)	J1-axis		105°/s (1.83rad/s)	
	J2-axis		85°/s (1.48rad/s)	
	J3-axis		85°/s (1.48rad/s)	
	J4-axis		120°/s (2.09rad/s)	
	J5-axis		120°/s (2.09rad/s)	
	J6-axis		200°/s (3.49rad/s)	
Max. payload	At wrist		190kg	
	On J3 arm	20kg (A)	5/2*(A)+ (B) $\leqq$ 50 kg	
	On J3 casing	50kg (B)		
	On J2 base		550kg	
Allowable load moment at wrist	J4-axis		1700N·m (173kgf·m)	
	J5-axis		1700N·m (173kgf·m)	
	J6-axis		900N·m (92kgf·m)	
Allowable load inertia at wrist	J4-axis		320kg·m^2 (3265kgf·cm·s^2)	
	J5-axis		320kg·m^2 (3265kgf·cm·s^2)	
	J6-axis		230kg·m^2 (2347kgf·cm·s^2)	
Drive method			Electric servo drive by AC servo motor	
Repeatability Note 3)			±0.05mm	
Mass			1400 kg	
Acoustic noise level			70.5dB Note 4)	
Installation environment			Ambient temperature: 0 to 45°C Note 5) Ambient humidity: Normally 75%RH or less. (No condensation allowed.) Short time (within one month) Max 95%RH (No condensation allowed.) Permitted altitude: Up to 1000 m above sea level. Vibration acceleration : 4.9m/s^2 (0.5G) or less Free of corrosive gases Note 6) Note 7)	

Note 1) Even if the robot is used according to the defined specifications, motion programs might shorten reducer life or cause the robot to overheat. Use ROBOGUIDE (system design support tool by FANUC) for further evaluation before running production.

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

Note 3) Compliant with ISO9283.

Note 4) This value is the 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 5) When the robot is used in a low temperature environment that is near to 0ºC, or the robot is not operated for a long time in an environment that is less than 0ºC, for example during a holiday or overnight, viscous resistance of the drive train may cause occurrence of collision detect alarm (SRVO –050) etc. In this case, we recommend performing a warm up operation for several minutes.

Note 6) 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, water, water vapor, cutting oil, cleaning fluid splash and or other contaminations.

Note 7) Liquid intrusion into the balancer inside might cause corrosion of the spring. Be careful to prevent liquid splashing to the balancer.

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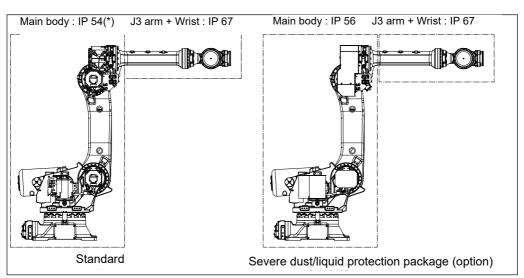
Fig. 3.1 (e) Severe dust/liquid protection characteristics of R-2000*i*C

NOTE
Definition of IP code
Definition of IP 67
6= Dust-tight: Complete protection against contact
7= Protection from water immersion: Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time.
Definition of IP 66
6= Dust-tight: Complete protection against contact
6= Protection from powerful water jets: Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.
Definition of IP 54
5= Dust-tight: Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory of the equipment.
4= Protection from water immersion: Water splashing against the enclosure from any direction shall have no harmful effect.
Definition of IP 56
5= Dust-tight: Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory of the equipment.
6= Protection from powerful water jets: Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.

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.) and deterioration or corrosion of the balancer spring. (As exception to this only liquids tested and approved by FANUC can be used with the robot.)

(a) Organic solvents
(b) Cutting fluid or detergent including chlorine / gasoline
(c) Amine type cutting fluid or 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.

* In case of liquid splashing to the balancer, it might cause corrosion and deterioration of the spring and failures.

3.2   MECHANICAL UNIT EXTERNAL DIMENSIONS AND OPERATING SPACE

Fig. 3.2 (a) to (j) show the robot operating space. When installing peripheral devices, be careful not to interfere with the robot and its operating space.
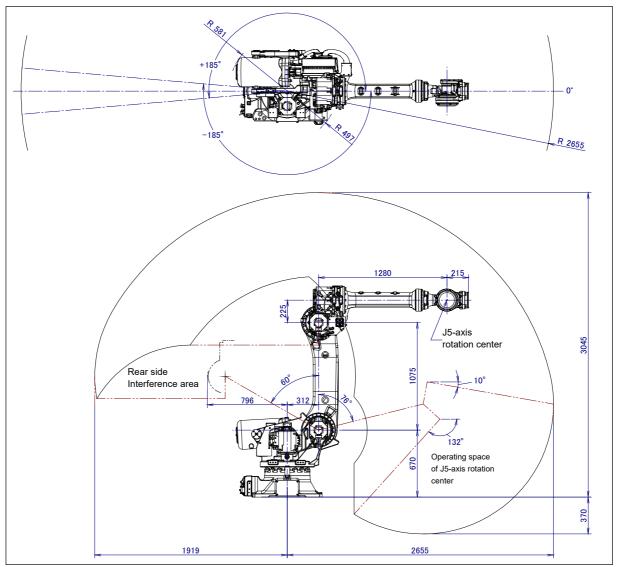
Fig. 3.2 (a) Operating space (R-2000*i*C/165F/210F/240F)
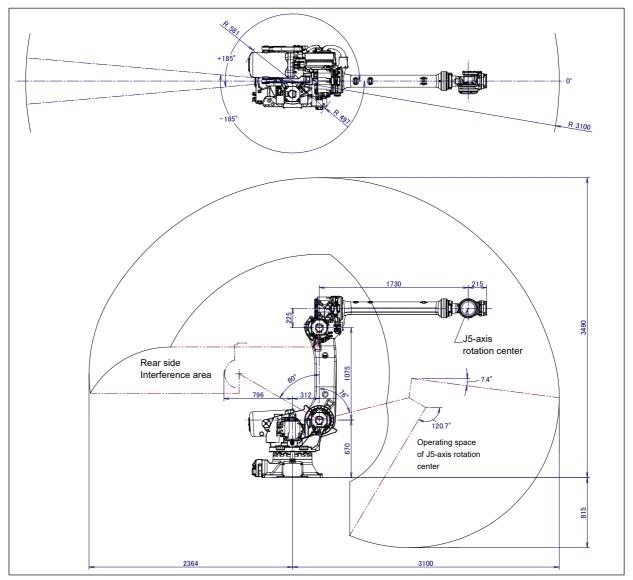
Fig. 3.2 (b) Operating space (R-2000*i*C/125L)
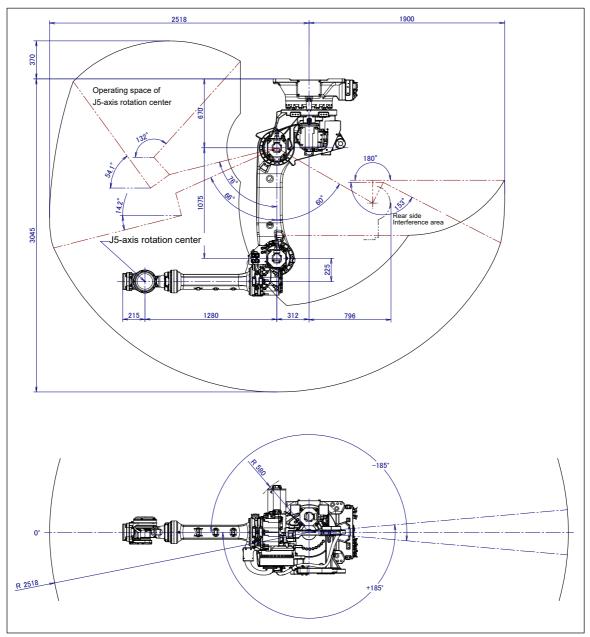
Fig. 3.2 (c) Operating space (R-2000*i*C/220U)
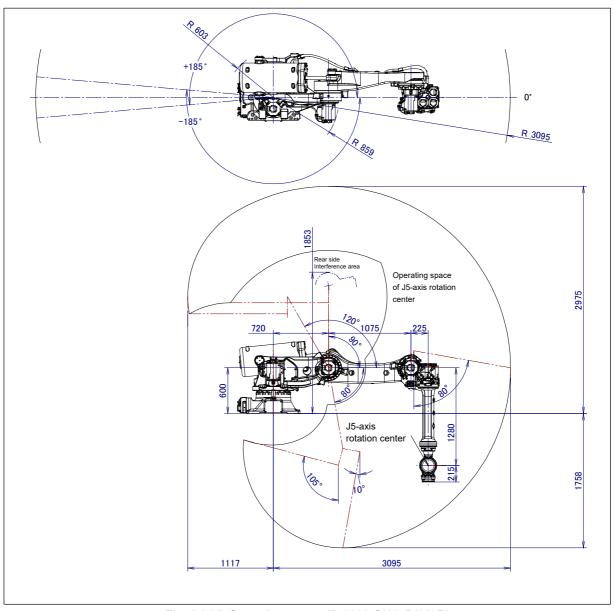
Fig. 3.2 (d) Operating space (R-2000*i*C/165R/210R)
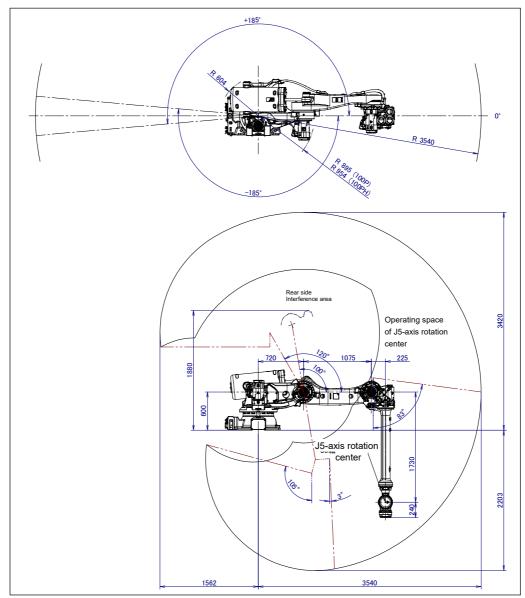
Fig. 3.2 (e) Operating space (R-2000*i*C/100P/100PH)
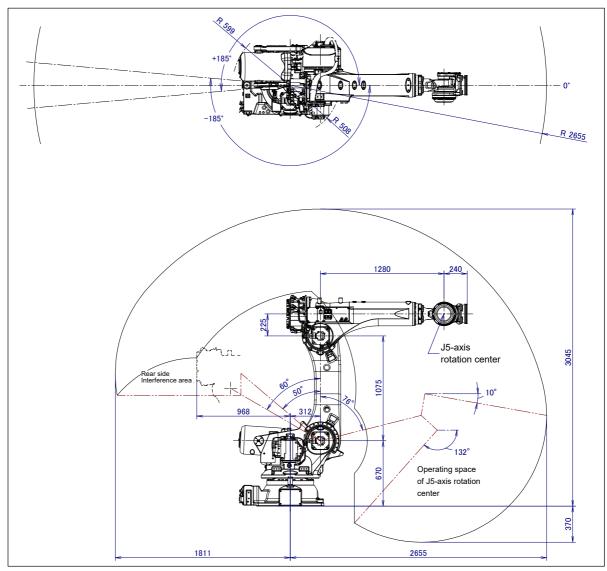
Fig. 3.2 (f) Operating space (R-2000*i*C/270F)
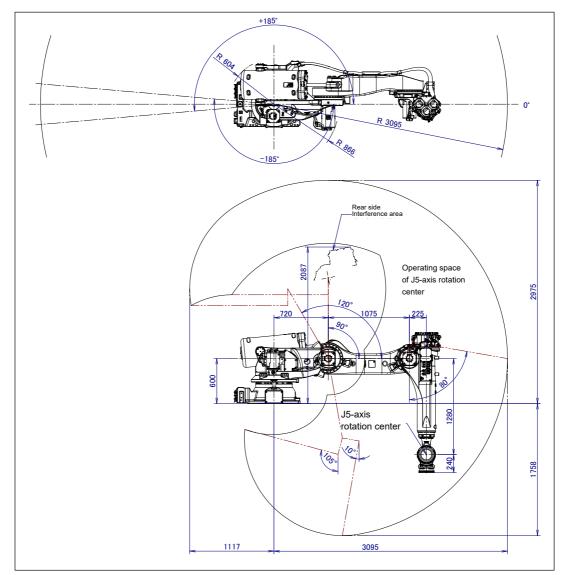
Fig. 3.2 (g) Operating space (R-2000*i*C/270R)
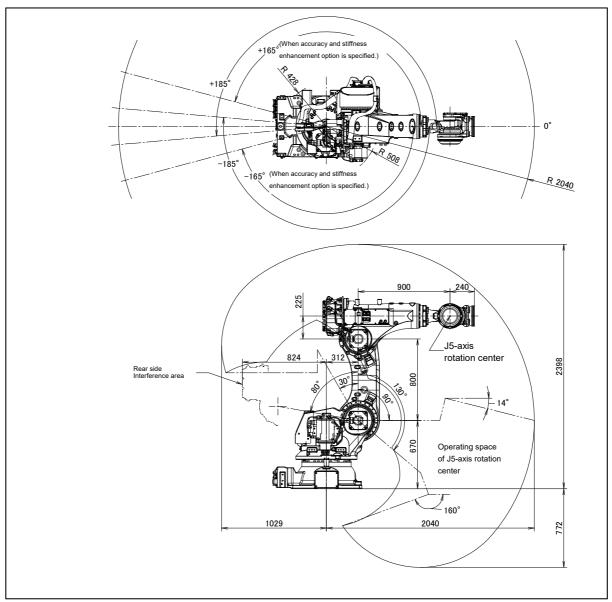
Fig. 3.2 (h) Operating space (R-2000*i*C/190S)
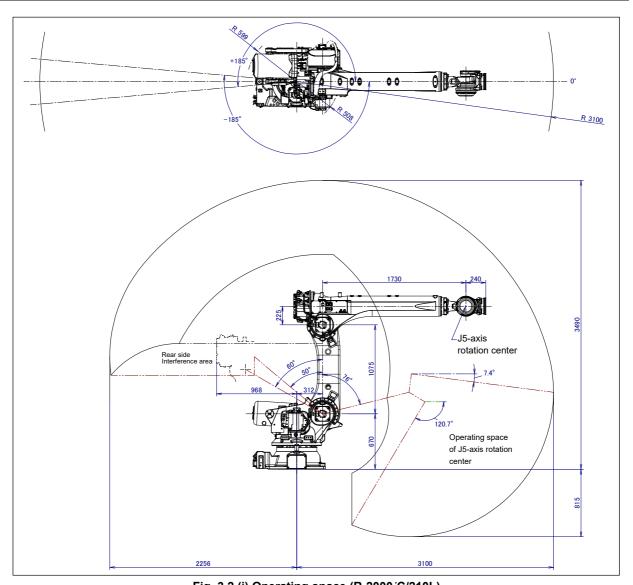
Fig. 3.2 (i) Operating space (R-2000*i*C/210L)
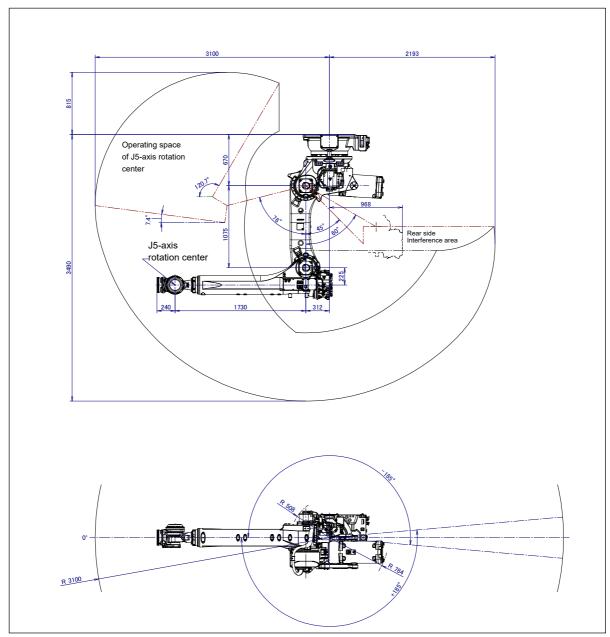
Fig. 3.2 (j) Operating space (R-2000*i*C/190U)

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.
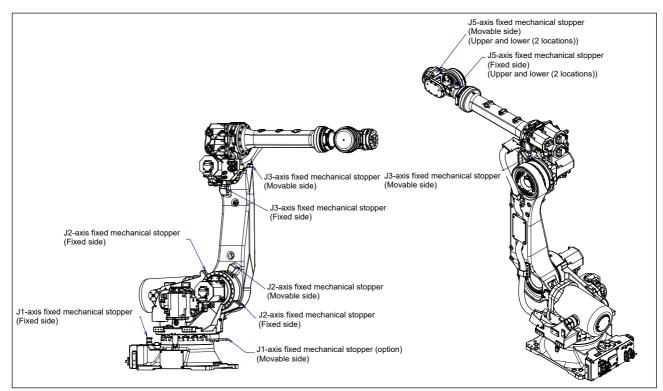
Fig. 3.3 (a) Position of fixed mechanical stopper

Fig. 3.3 (b) to (l) 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 LIMITS SETUP".
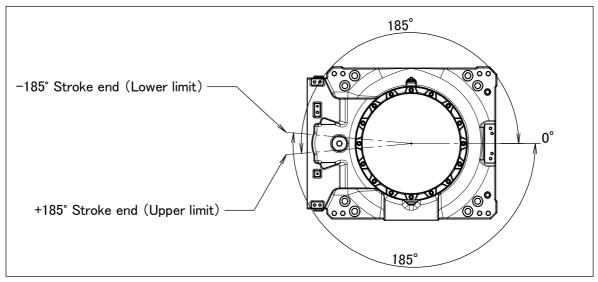
Fig. 3.3 (b) J1-axis motion limit (When fixed mechanical stopper is not specified)
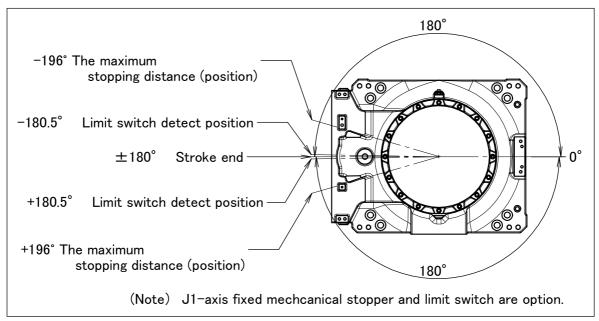
Fig. 3.3 (c) J1-axis motion limit (When fixed mechanical stopper is specified)
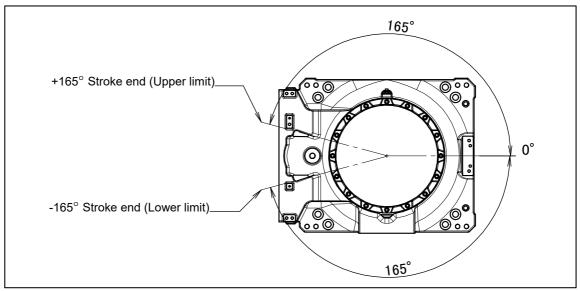
Fig. 3.3 (d) J1-axis motion limit (When accuracy and stiffness enhancement option is specified)

(Note) Motion limit is restricted by the position of the J3-axis.
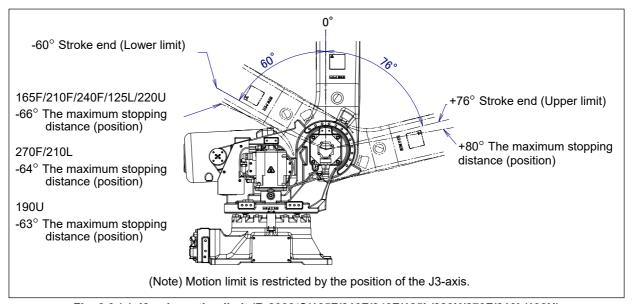
Fig. 3.3 (e) J2-axis motion limit (R-2000*i*C/165F/210F/240F/125L/220U/270F/210L/190U)

(Note) Motion limit is restricted by the position of the J3-axis.
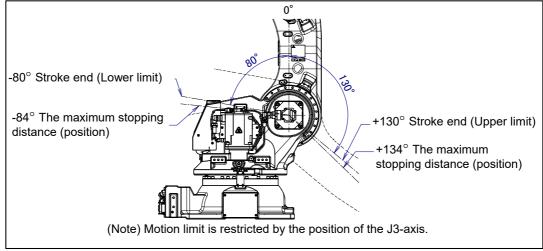
Fig. 3.3 (f) J2-axis motion limit (R-2000*i*C/190S)
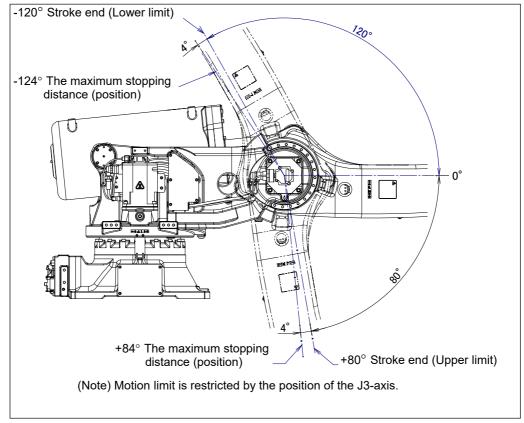
Fig. 3.3 (g) J2-axis motion limit (R-2000*i***C/165R/210R/100P/100PH/270R)**
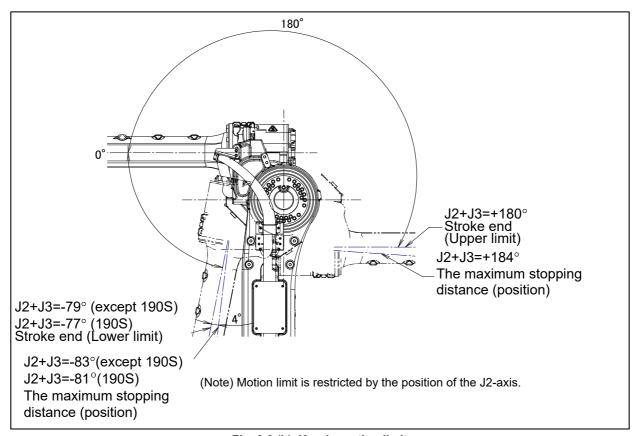
Fig. 3.3 (h) J3-axis motion limit
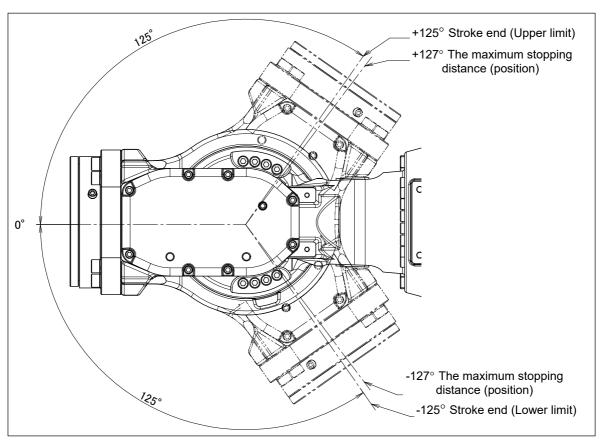
Fig. 3.3 (i) J5-axis motion limit

(Note) J4−axis does not have the limit switch and the mechanical stopper.

(Note) J6−axis does not have the limit switch and the mechanical stopper.
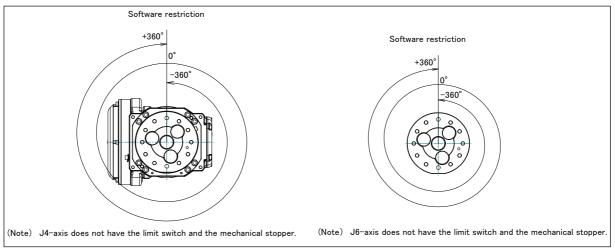
Fig. 3.3 (j) J4-axis motion limit   **Fig. 3.3 (k) J6-axis motion limit**
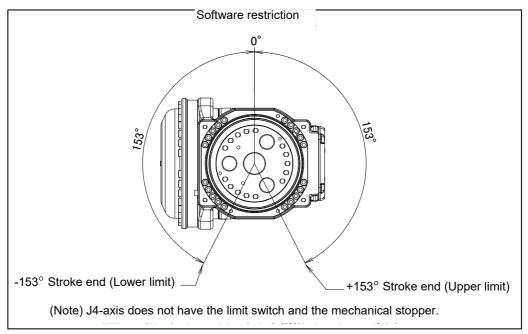
Fig. 3.3 (l) J4-axis motion limit (When accuracy and stiffness enhancement option is specified)

3.4 WRIST LOAD CONDITIONS

Fig. 3.4 (a) to (t) 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 the mounting of the end effector.
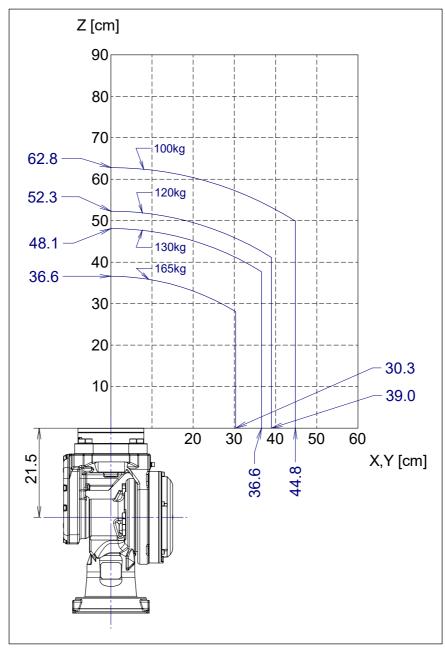
Fig. 3.4 (a) Wrist load diagram (ISO flange)
(R-2000iC/165F/165R)
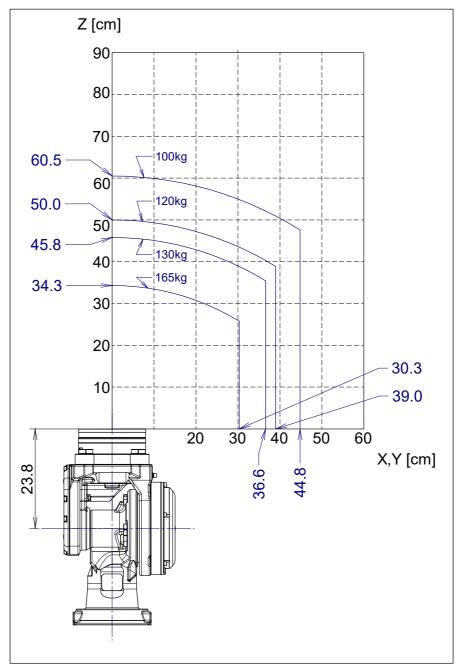
Fig. 3.4 (b) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/165F/165R)
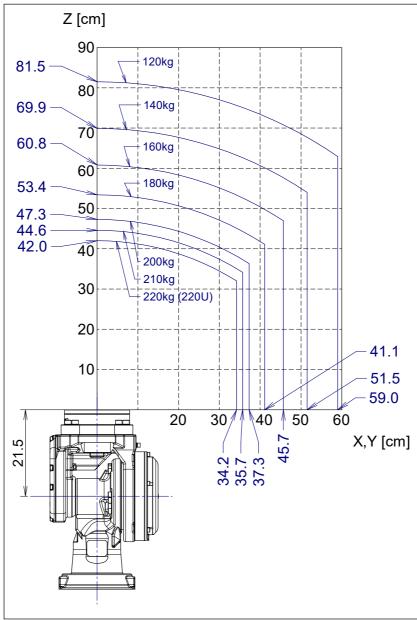
Fig. 3.4 (c) Wrist load diagram (ISO flange)
(R-2000*i*C/210F/220U/210R)
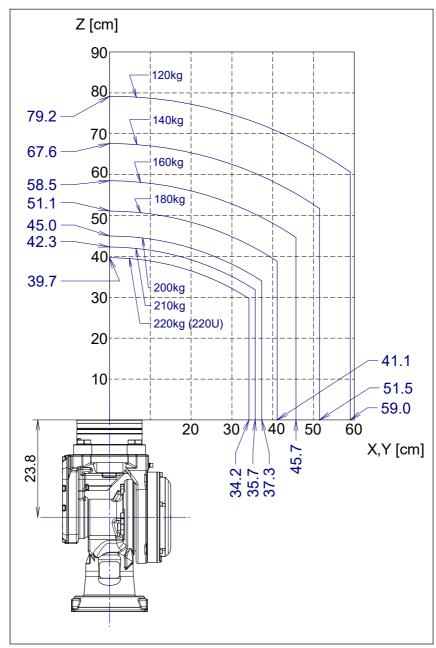
Fig. 3.4 (d) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/210F/220U/210R)
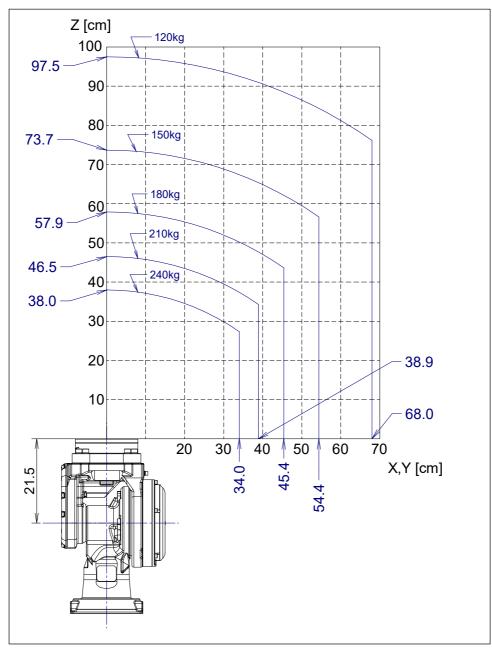
Fig. 3.4 (e) Wrist load diagram (ISO flange)
(R-2000*i*C/240F)
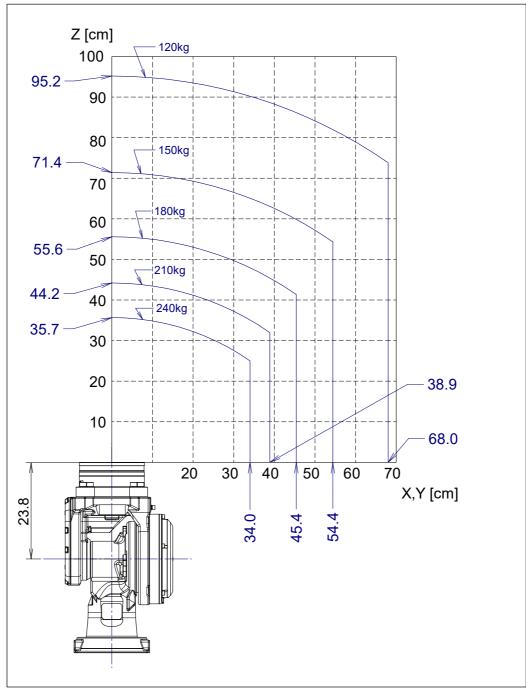
Fig. 3.4 (f) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/240F)
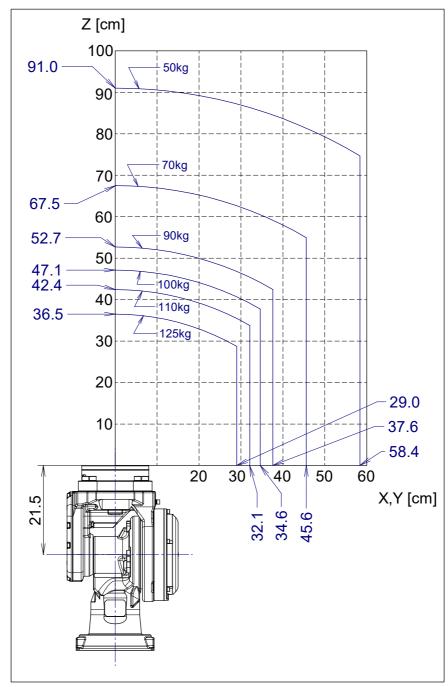
Fig. 3.4 (g) Wrist load diagram (ISO flange)
(R-2000*i*C/125L)
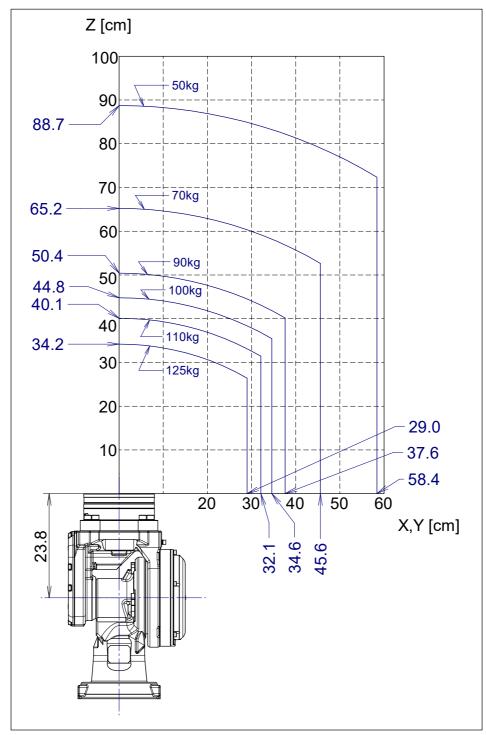
Fig. 3.4 (h) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/125L)
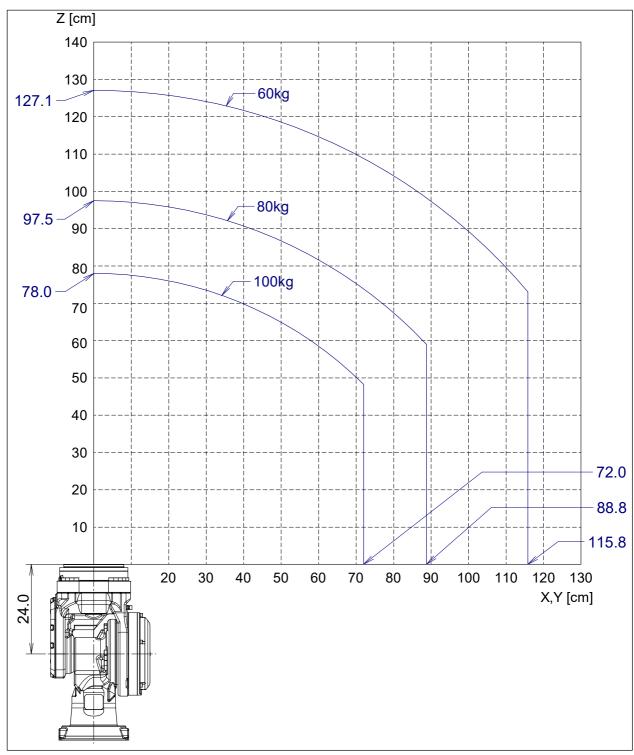
Fig. 3.4 (i) Wrist load diagram (Insulated ISO flange)
(R-2000iC/100P/100PH)
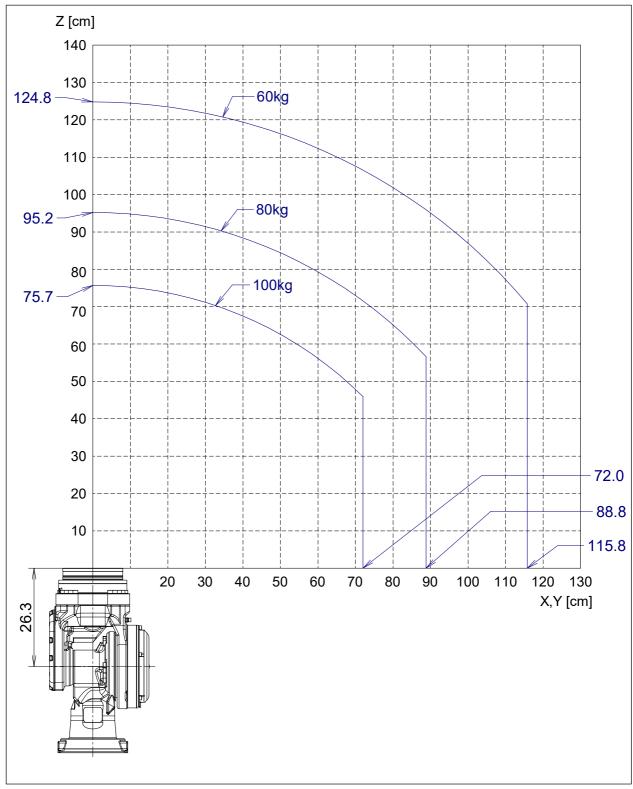
Fig. 3.4 (j) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/100P/100PH)
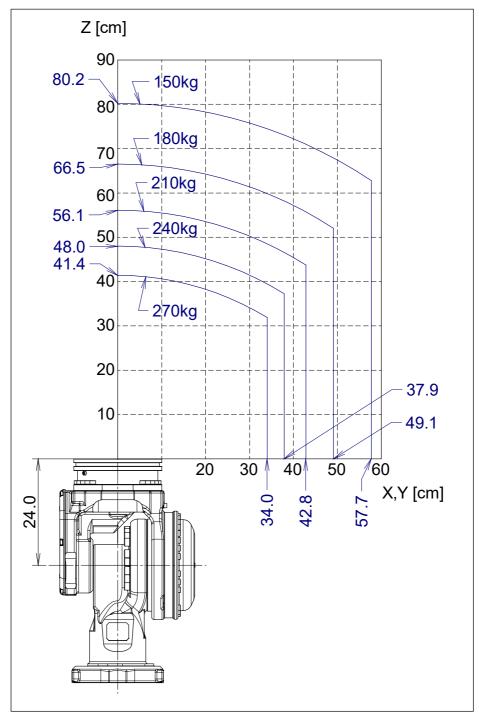
Fig. 3.4 (k) Wrist load diagram (ISO flange)
(R-2000*i*C/270F/270R)
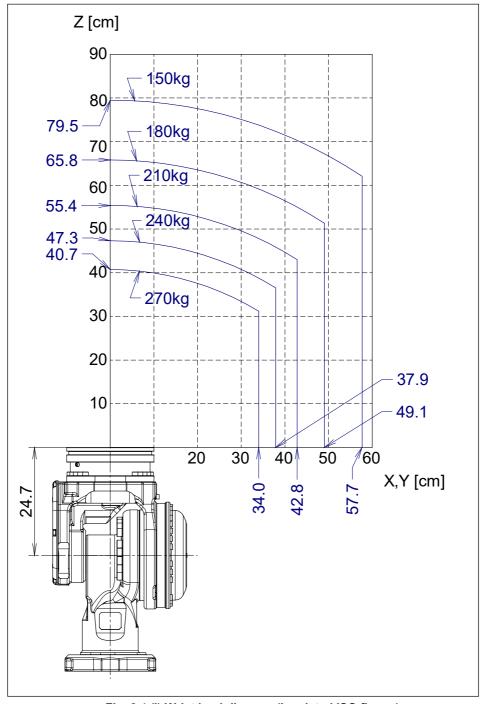
Fig. 3.4 (I) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/270F/270R)
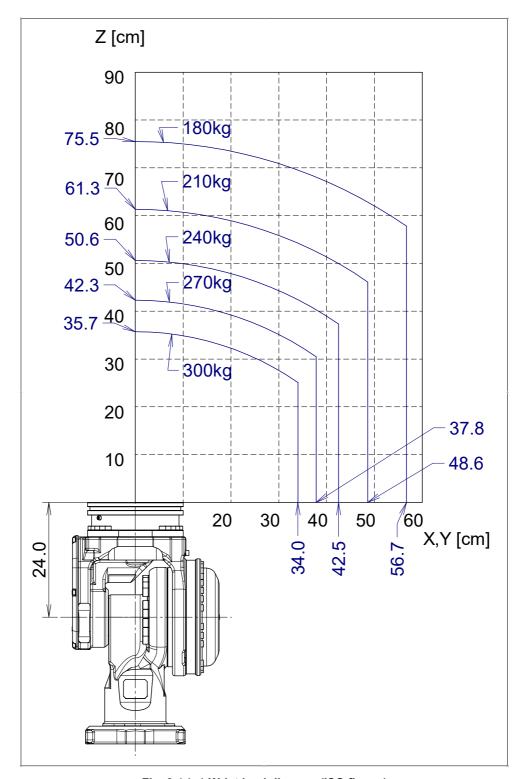
Fig. 3.4 (m) Wrist load diagram (ISO flange)
(R-2000*i*C/270F 300kg option)
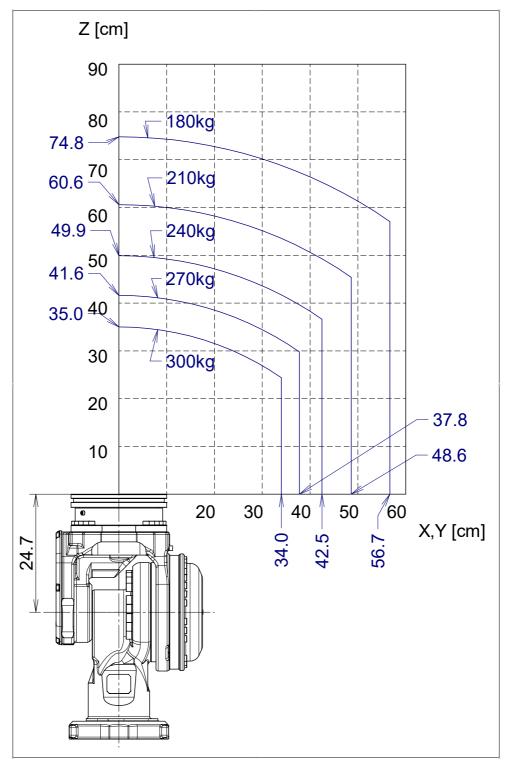
Fig. 3.4 (n) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/270F 300kg option)
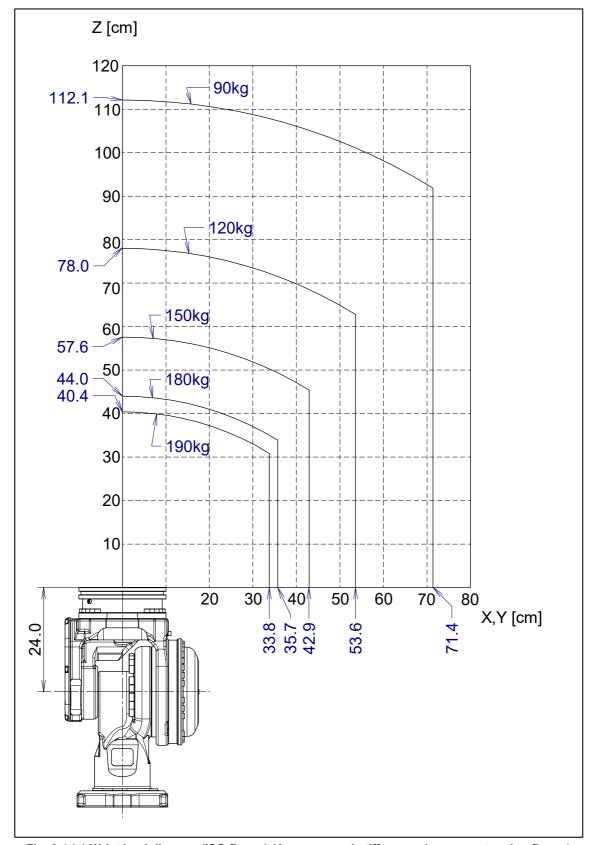
Fig. 3.4 (o) Wrist load diagram (ISO flange) (Accuracy and stiffness enhancement option flange)
(R-2000*i*C/190S)
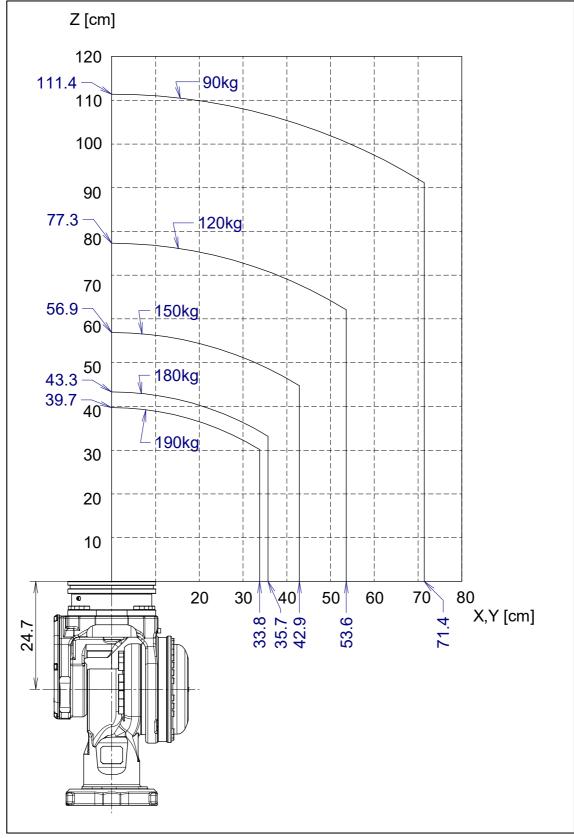
Fig. 3.4 (p) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/190S)
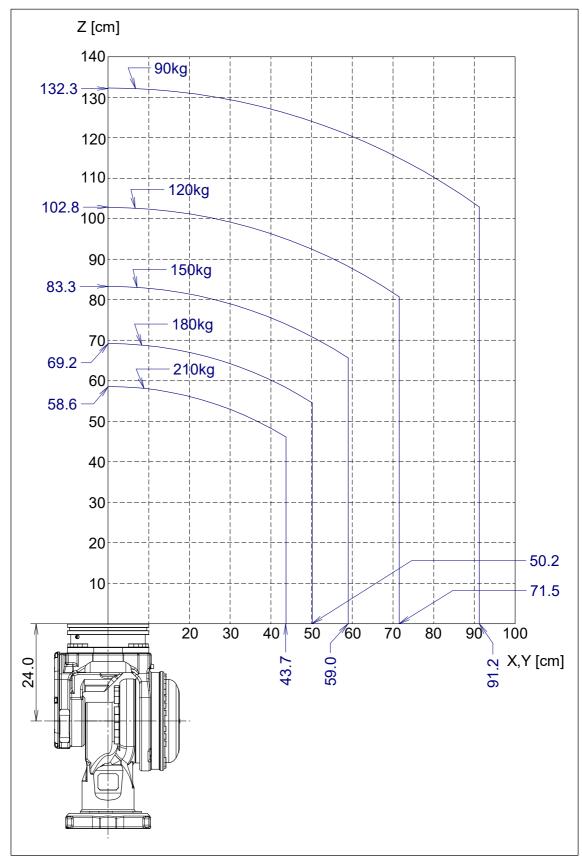
Fig. 3.4 (q) Wrist load diagram (ISO flange)
(R-2000*i*C/210L)
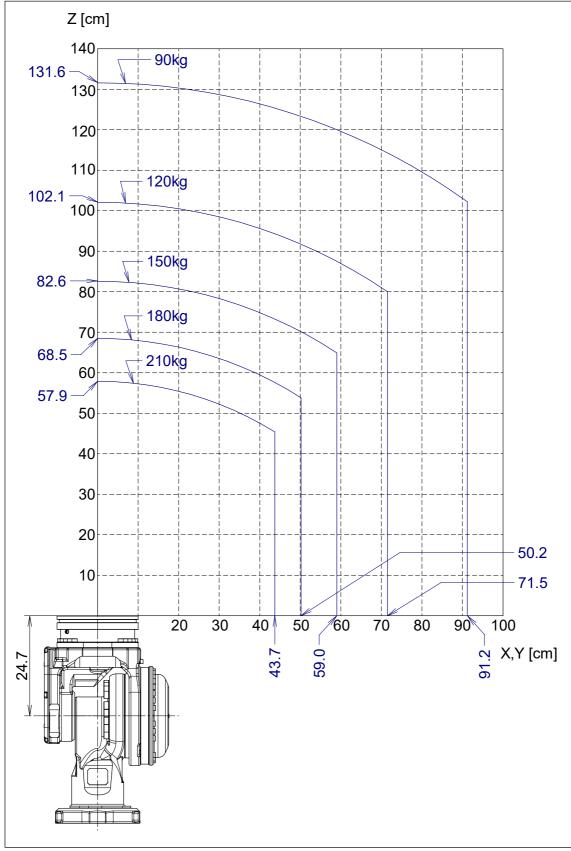
Fig. 3.4 (r) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/210L)
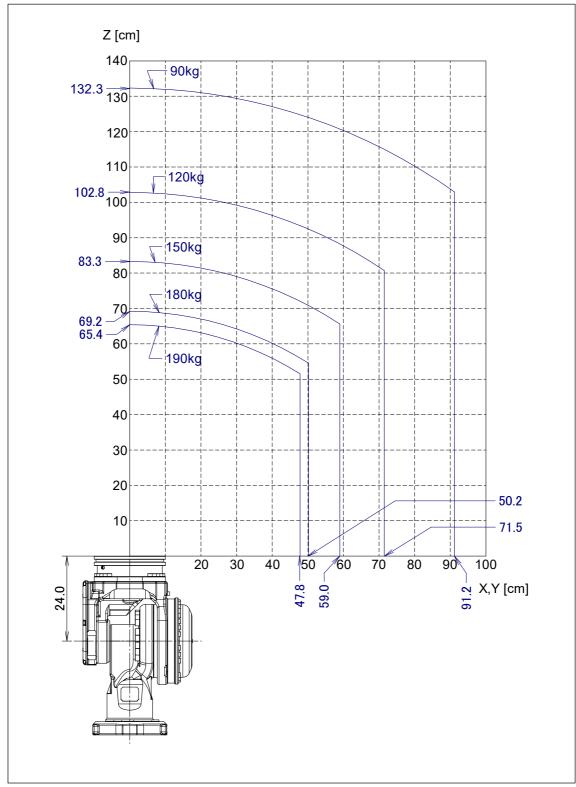
Fig. 3.4 (s) Wrist load diagram (ISO flange)
(R-2000*i*C/190U)
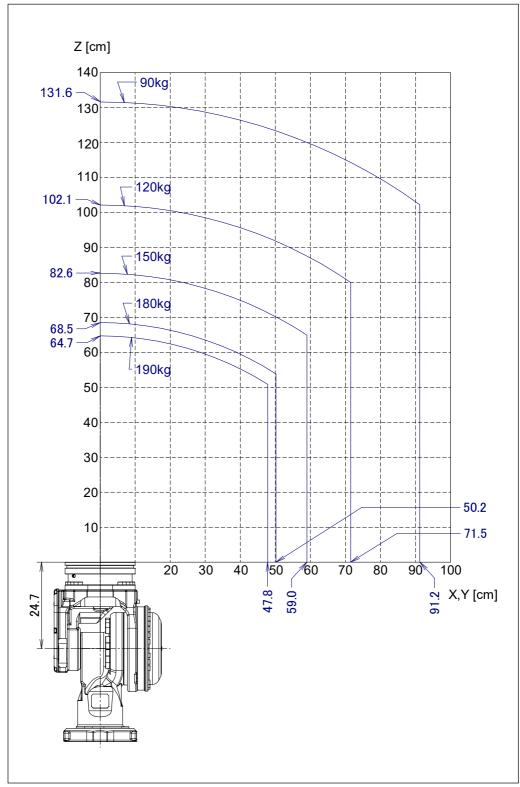
Fig. 3.4 (t) Wrist load diagram (Insulated ISO flange)
(R-2000*i*C/190U)

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

Table 3.5 (a) to (i) and Fig. 3.5 (b) to (e) 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.
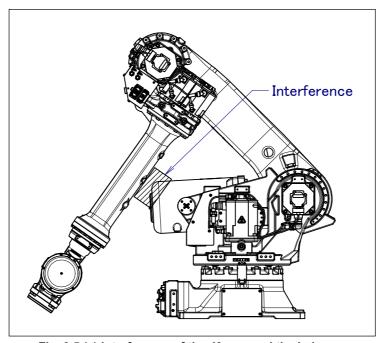
Fig. 3.5 (a) Interference of the J3 arm and the balancer
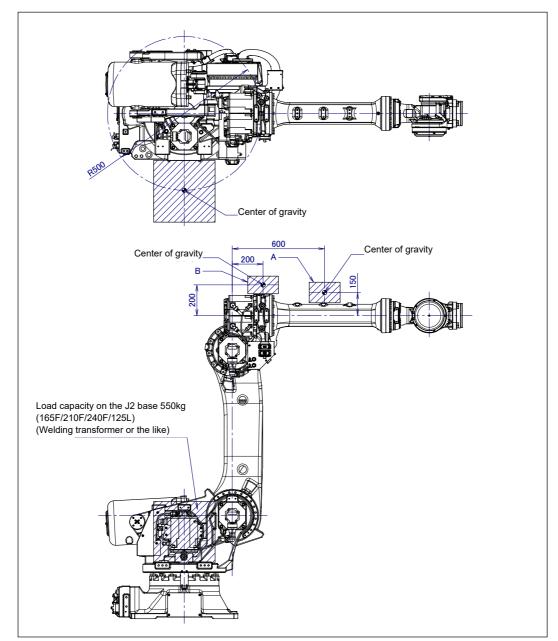
Fig. 3.5 (b) J2 base/J3 arm/J3 casing load condition (R-2000*i*C/165F/210F/240F/125L/220U)

Table 3.5 (a) J3 arm/J3 casing load condition (R-2000*i*C/165F/210F/240F)

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	

Table 3.5 (c) J3 arm/J3 casing load condition (R-2000*i*C/220U)

J3 arm load weight (A)	J3 casing load weight (B)
25kg or less	30kg or less
6/5*(A)+(B)≦30kg	
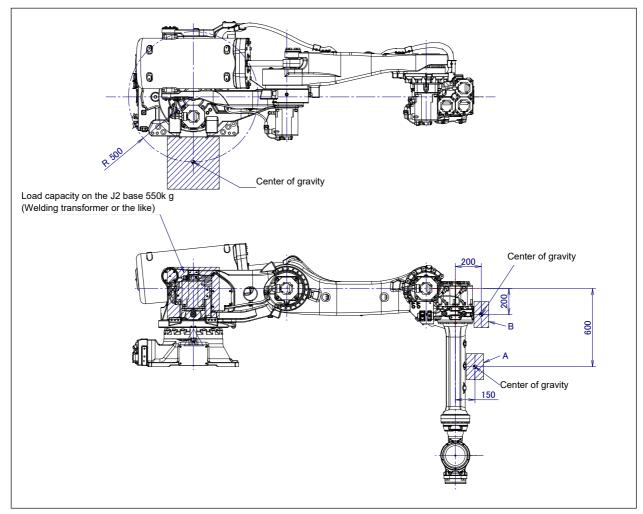
Fig. 3.5 (c) J2 base /J3 arm/J3 casing load condition (R-2000*i*C/165R/210R/100P/100PH)

Table 3.5 (d) 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 (e) 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	

Table 3.5 (f) J3 arm/J3 casing load condition (R-2000*i*C/100P/100PH)

J3 arm load weight (A)	J3 casing load weight (B)
25kg or less	50kg or less
2*(A)+(B)≦50kg	
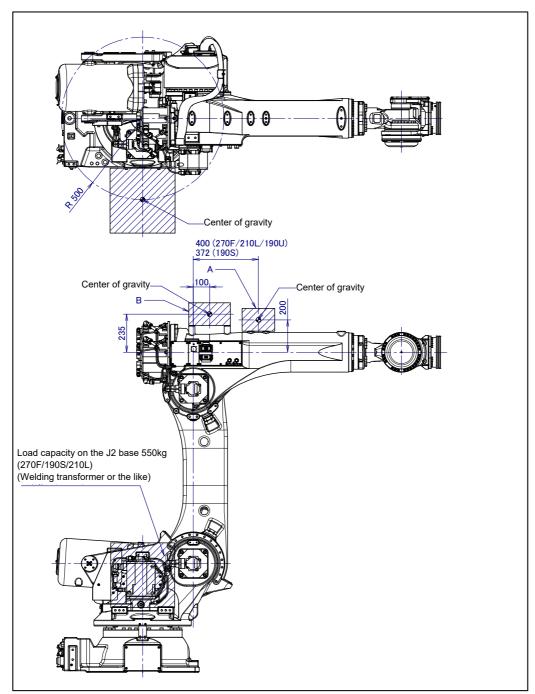
Fig. 3.5 (d) J2 base/J3 arm load condition (R-2000*i*C/270F/190S/210L/190U)

Table 3.5 (g) J3 arm load condition (R-2000*i*C/270F/190S)

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

(Note 1) When accuracy and stiffness enhancement option is specified, the load cannot be installed on here.

Table 3.5 (h) J3 arm load condition (R-2000*i*C/210L/190U)

J3 arm load weight 1 (A)	J3 arm load weight 2 (B)
20kg or less	50kg or less
5/2*(A)+(B)≦50kg	
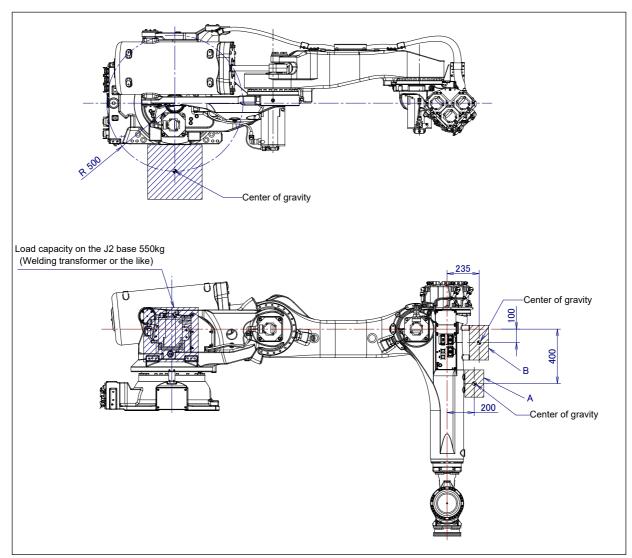
Fig. 3.5 (e) J2 base/J3 arm load condition (R-2000*i*C/270R)

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

J3 arm load weight 1 (A)	J3 arm load weight 2 (B)
30kg or less	40kg or less
4/3*(A)+(B)≦40kg	

- 84 -

4 EQUIPMENT INSTALLATION TO THE ROBOT

4.1 END EFFECTOR INSTALLATION TO WRIST

Fig. 4.1 (a) to (h) 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)

> ⚠ **CAUTION**
> 1 Notice the tooling coupling depth to wrist flange should be shorter than the flange coupling length.
> 2 For the high inertia mode, it is desirable to attach the end effector with 10 bolts.
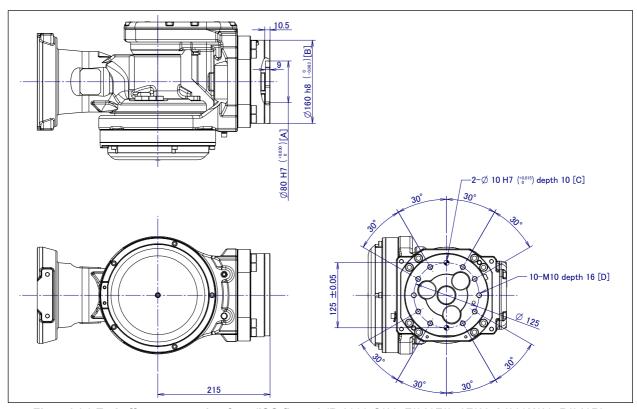
Fig. 4.1 (a) End effector mounting face (ISO flange) (R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)
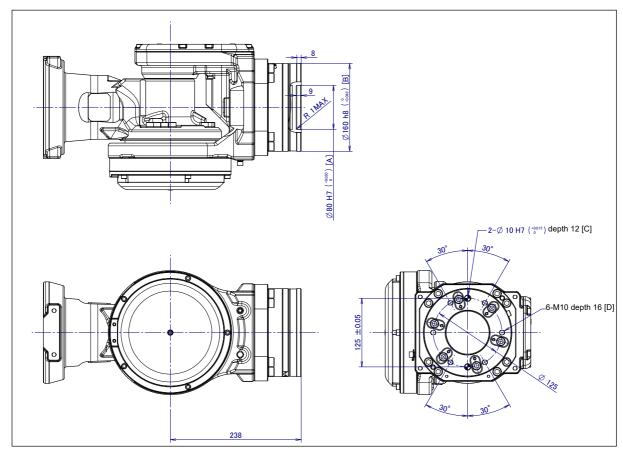
Fig. 4.1 (b) End effector mounting face (Insulated ISO flange A05B-1329-H151)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)
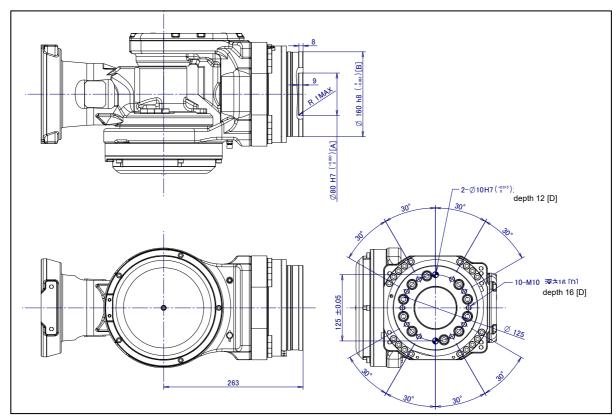
Fig. 4.1 (c) End effector mounting face (Insulated ISO flange A05B-1333-H153)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)
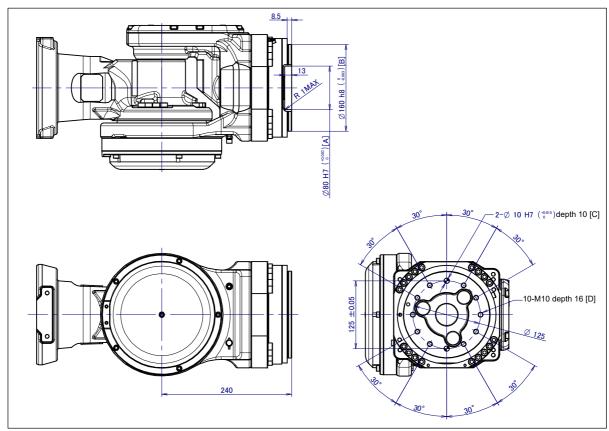
Fig. 4.1 (d) End effector mounting face (ISO flange) (R-2000*i*C/100P/100PH)
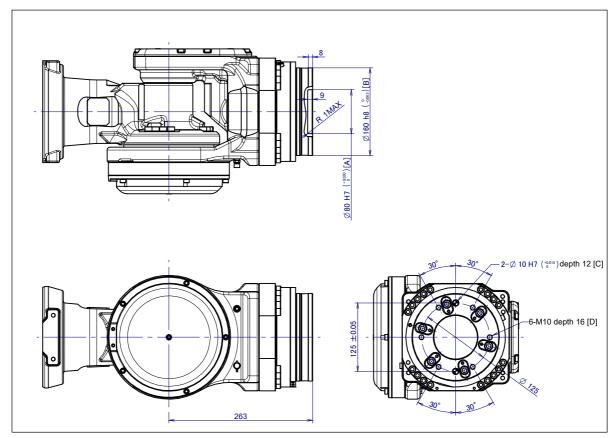
**Fig. 4.1 (e) End effector mounting face (Insulated ISO flange A05B-1329-H151)
(R-2000*i*C/100P/100PH)**
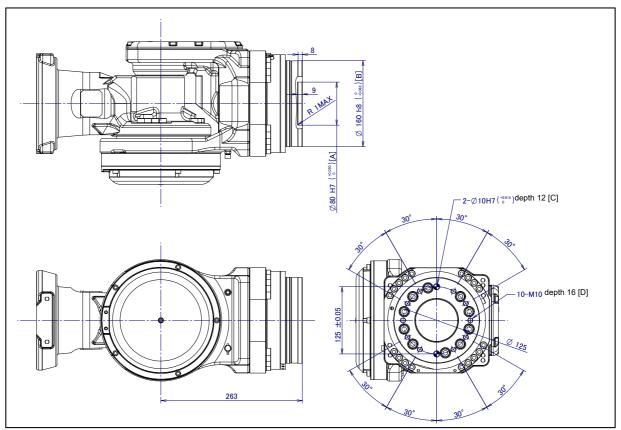
Fig. 4.1 (f) End effector mounting face (Insulated ISO flange A05B-1333-H153)
(R-2000*i*C/100P/100PH)
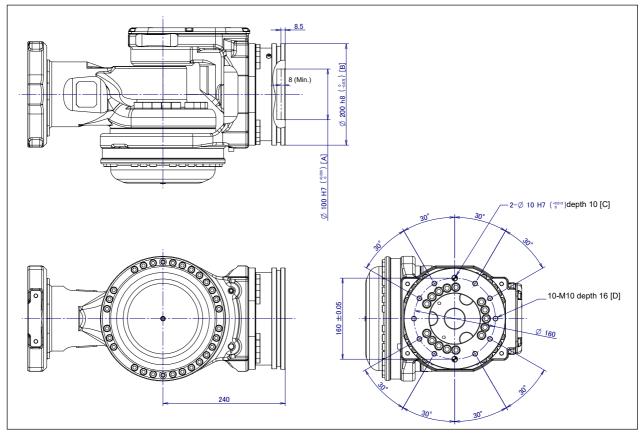
Fig. 4.1 (g) End effector mounting face (ISO flange) (R-2000*i*C/270F/270R/190S/210L/190U)
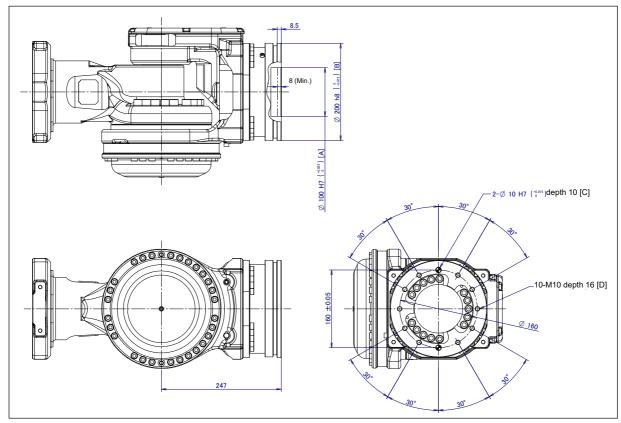
Fig. 4.1 (h) End effector mounting face (Insulated ISO flange) (R-2000*i*C/270F/270R/190S/210L/190U)
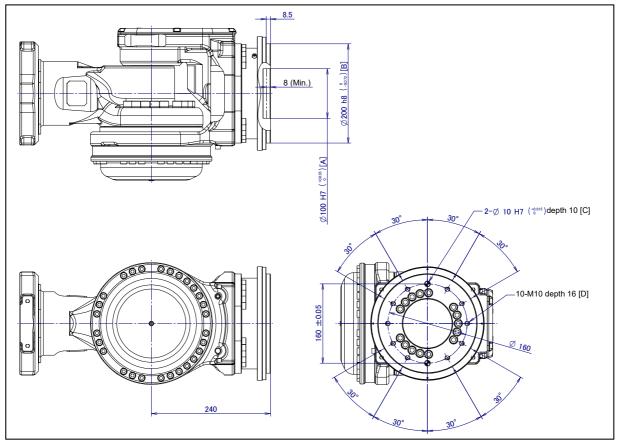
Fig. 4.1 (i) End effector mounting face (Accuracy and stiffness enhancement option flange) (R-2000*i*C/190S)

4.2 EQUIPMENT MOUNTING FACE

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

> ⚠ **CAUTION**
> 1 Never perform additional machining operation such as drilling or tapping on the robot body. This will seriously affect the safety and function of the robot.
> 2 When using a user tap shown in Fig. 4.2 (a) to (h), keep the center of gravity position of the equipment according to Section 3.5.
> 3 Equipment should be installed so that mechanical unit cable does not interfere. If equipment interferes, the mechanical unit cable might be disconnected, and unexpected troubles might occur.
> 4 Note that the use of a tapped hole not shown in the following figure is not assured. Please do not use existing bolts that fasten the mechanical units to install equipment to the robot.
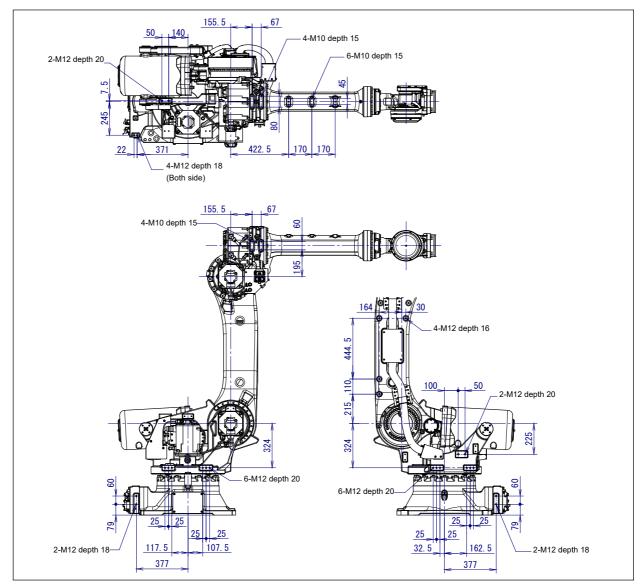
Fig. 4.2 (a) Equipment mounting faces (R-2000*i*C/165F/210F/240F/220U)

- 90 -
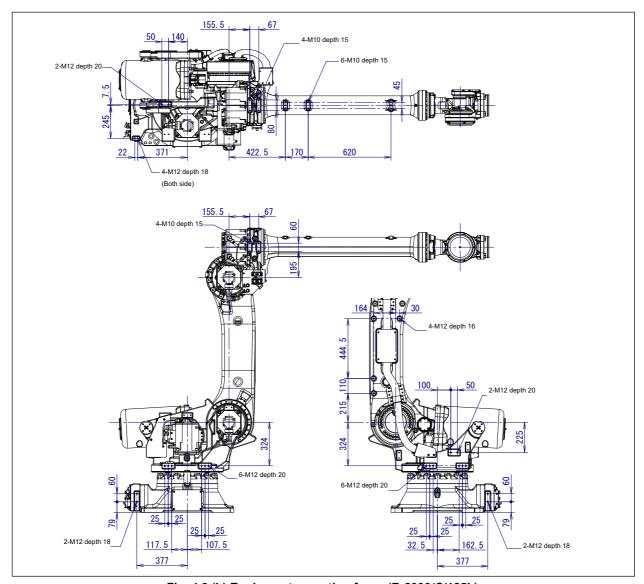
Fig. 4.2 (b) Equipment mounting faces (R-2000*i*C/125L)
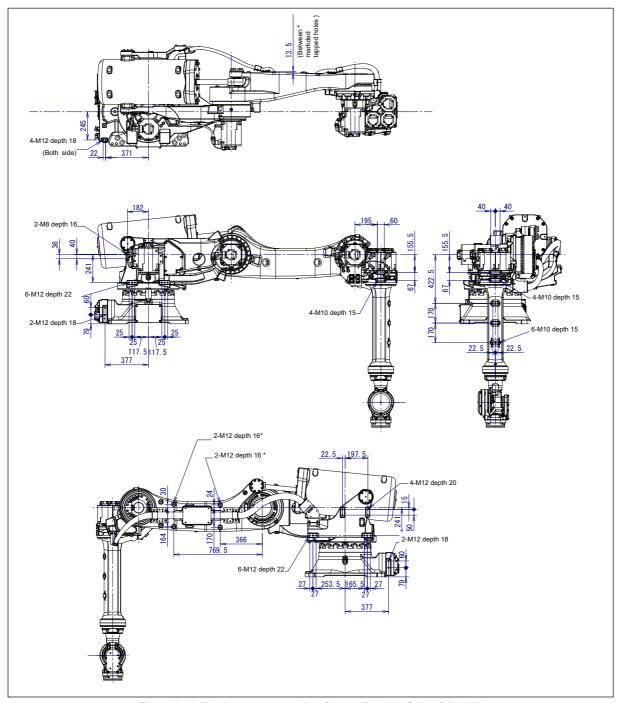
Fig. 4.2 (c) Equipment mounting faces (R-2000iC/165R/210R)
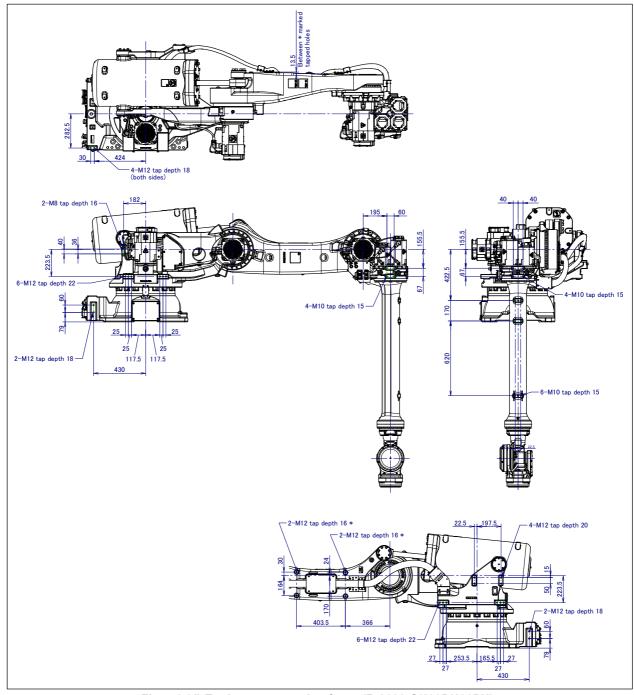
Fig. 4.2 (d) Equipment mounting faces (R-2000*i*C/100P/100PH)
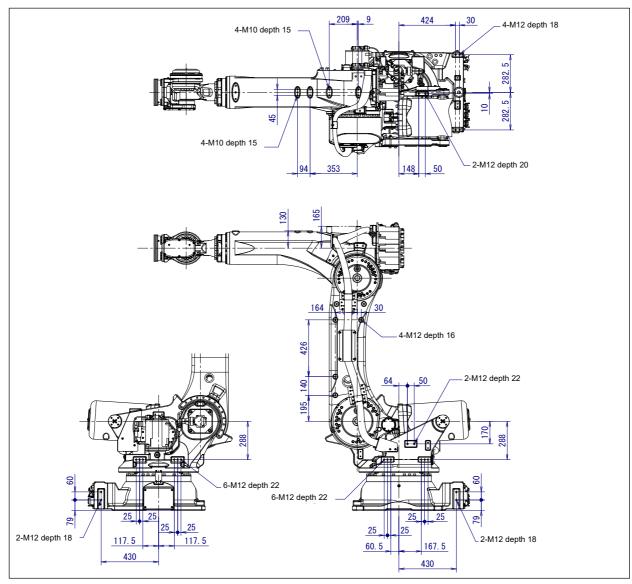
Fig. 4.2 (e) Equipment mounting faces (R-2000*i*C/270F/210L/190U)
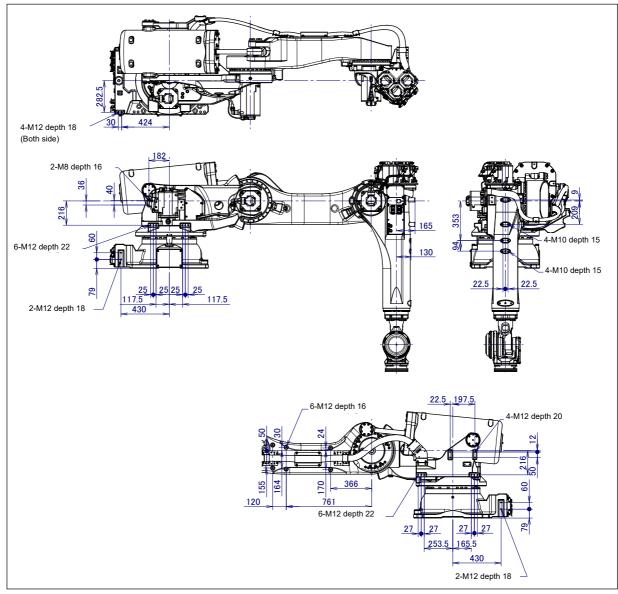
Fig. 4.2 (f) Equipment mounting faces (R-2000*i*C/270R)
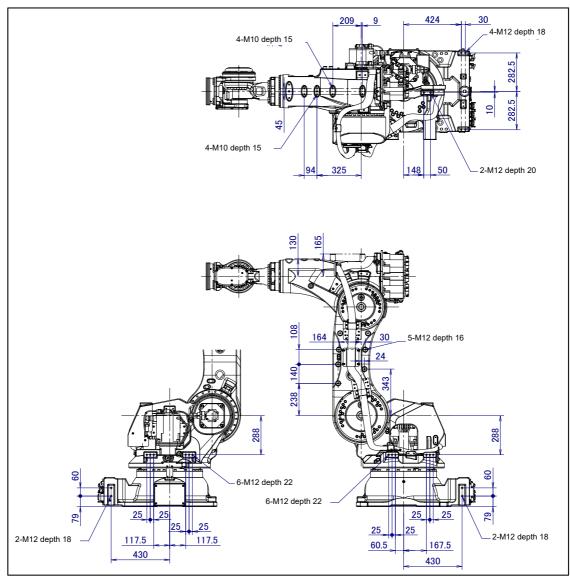
Fig. 4.2 (g) Equipment mounting faces (R-2000*i*C/190S)
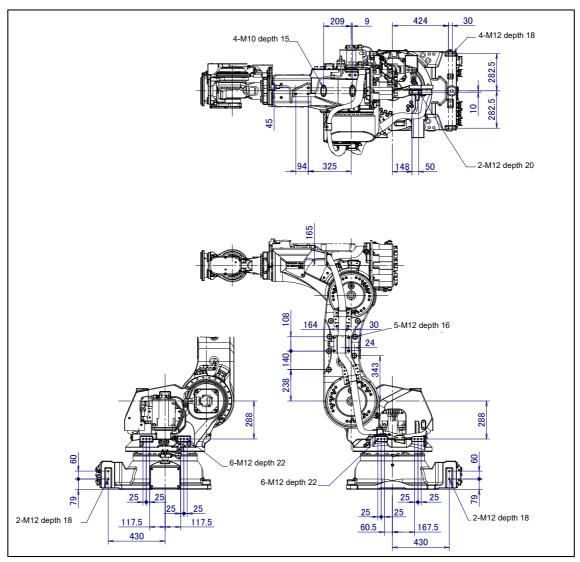
Fig. 4.2 (h) Equipment mounting faces
(R-2000*i*C/190S When accuracy and stiffness enhancement option is specified.)

4.3 LOAD SETTING

> **⚠ CAUTION**
> 1 Set the correct load condition parameter before the robot runs. Do not operate the robot in over when its payload is exceeded or incorrect. Do not exceed the allowable payload including connection cables. Operation with the robot over payload may result in troubles such as reducer life reduction.
> 2 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 CONTROLLER Optional Function OPERATOR'S MANUAL (B-83284EN-2).

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

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

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

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

```
 MOTION PAYLOAD SET                JOINT 10%

    Group 1
  1 Schedule No[        1]:[Comment          ]
  2 PAYLOAD            [kg]          165.00
  3 PAYLOAD CENTER  X [cm]          -28.53
  4 PAYLOAD CENTER  Y [cm]            0.00
  5 PAYLOAD CENTER  Z [cm]           27.78
  6 PAYLOAD INERTIA X [kgfcms^2]     56.84
  7 PAYLOAD INERTIA Y [kgfcms^2]     59.39
  8 PAYLOAD INERTIA Z [kgfcms^2]     15.10

    [TYPE] GROUP NUMBER   DEFAULT   HELP
```
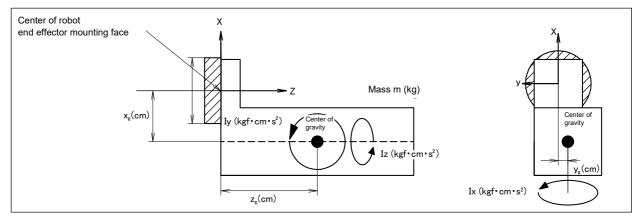
Fig. 4.3 (a) Standard tool coordinate

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 will be displayed: "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 the [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, J3 arm and J3 casing as follows:
(*)   Load mounting face differs depending on the robot model. Refer to "3.5 LOAD CONDITIONS ON J2 BASE, J3 ARM AND J3 CASING".
      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
    The following message will be displayed: "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 (a) shows allowable load moment at wrist of standard inertia mode and high inertia mode.

Table 4.4 (a) 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	$89kg \cdot m^2$ ($908kgf \cdot cm \cdot s^2$)	$120kg \cdot m^2$ ($1225kgf \cdot cm \cdot s^2$)
		210F	$147kg \cdot m^2$ ($1500kgf \cdot cm \cdot s^2$)	$225.4kg \cdot m^2$ ($2300kgf \cdot cm \cdot s^2$)
	J5-axis	165F	$89kg \cdot m^2$ ($908kgf \cdot cm \cdot s^2$)	$120kg \cdot m^2$ ($1225kgf \cdot cm \cdot s^2$)
		210F	$147kg \cdot m^2$ ($1500kgf \cdot cm \cdot s^2$)	$225.4kg \cdot m^2$ ($2300kgf \cdot cm \cdot s^2$)
	J6-axis	165F	$46kg \cdot m^2$ ($469kgf \cdot cm \cdot s^2$)	$100kg \cdot m^2$ ($1020kgf \cdot cm \cdot s^2$)
		210F	$82kg \cdot m^2$ ($837kgf \cdot cm \cdot s^2$)	$196kg \cdot m^2$ ($2000kgf \cdot cm \cdot s^2$)

4.5 SWITCHING METHOD OF MAX PAYLOAD SPECIFICATION

About switching max payload specification

At R-2000*i*C/270F, payload 270kg setting and payload 300kg setting are prepared. By ordering R-2000*i*C/270F 300kg option (A05B-2600-S535), 300kg payload specification will be set when it is shipped by our factory.

The best addition and subtraction velocity operation can be achieved by the setting matched to the max payload specification. The setting is changed by executing the following KAREL.

- R27SET27.PC：max payload 270kg specification
- R27SET30.PC：max payload 300kg specification

However these KAREL programs cannot be used with the wrist axis solution arm.
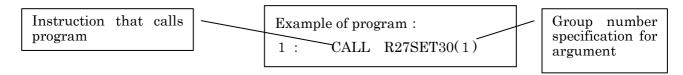
⚠ **CAUTION**
1 Refer to "Specification table" in Section 3.1 and "Wrist load diagram" in Section 3.4, and set max payload specification so that the payload does not exceed it. When the robot is moved with the wrong max payload specification, the robot functions and life might be affected significantly.
2 Be careful that the tracks and the cycle time of an existing instruction program change if setting change is executed.

Method of switching

There are the following two in the method of executing KAREL for switching method of max payload specification. Please use them properly according to the purpose.

1   Method of executing KAREL program by using "Call program" →Subsection 4.5.1
    The KAREL program is set in the program call instruction of the TP program and the setting is changed by specifying with the argument that shows the group number, and executing it. The setting of a specific group R-2000*i*C/270F can be switched in this method.

Instruction that calls program	Example of program : 1 : CALL R27SET30(1)	Group number specification for argument

2   Method of executing KAREL program directly → Subsection 4.5.2
    Select and execute the KAREL program in program select screen. If two or more R-2000*i*C/270F exist in the multi group system, it is possible to change the setting of two or more R-2000*i*C/270F together by this method.

It depends as follows, and it explains the methods of executing KAREL for switching methods of max payload specification.

4.5.1   Method of Executing KAREL Program by Using "Call program"

The following procedures assume that R-2000*i*C/270F of the first group is switched to the max payload 300kg setting.
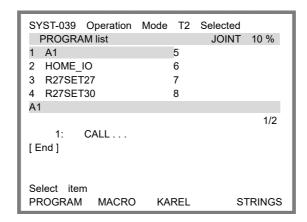
Execution procedure
1   Call the system variable screen.

MENU key   →   Select "System" and press F1 key(screen)   →   Select "System variables"
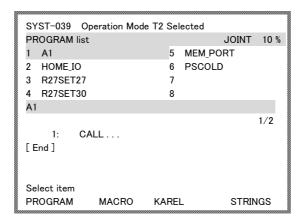
2   Set system variables $KAREL_ENB to 1.
3   Open TP program edit screen.
4   Select "call program" from among the program instruction.

F1 key   (INST) →Select "CALL"   →Select "CALL program"

Then, the following screen will be displayed.

```
SYST-039  Operation  Mode  T2  Selected
   PROGRAM list                  JOINT  10 %
1  A1                    5
2  HOME_IO               6
3  R27SET27              7
4  R27SET30              8
A1
                                      1/2
     1:     CALL . . .
[ End ]


Select  item
PROGRAM   MACRO    KAREL       STRINGS
```
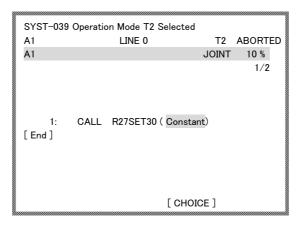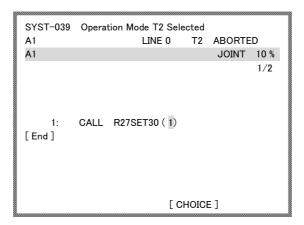
5   Press the F3 key (KAREL). The following screen will be displayed. Then select KAREL R27SET30 (for 300kg payload specification).

```
SYST-039   Operation Mode T2 Selected
PROGRAM list                              JOINT   10 %
1   A1                        5   MEM_PORT
2   HOME_IO                   6   PSCOLD
3   R27SET27                  7
4   R27SET30                  8
A1
                                              1/2
        1:      CALL . . .
[ End ]



Select item
PROGRAM      MACRO      KAREL         STRINGS
```

6   Press F4 key (CHOICE). Choose "Constant" from there. Then, the following screen will be displayed.

```
SYST-039  Operation Mode T2 Selected
A1                    LINE 0        T2   ABORTED
A1                                  JOINT   10 %
                                              1/2




        1:      CALL   R27SET30 ( Constant)
[ End ]




                              [ CHOICE ]
```
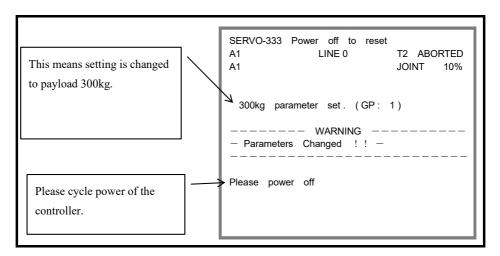
7   The group number (It is 1 here) is put with the cursor in "Constant".

```
SYST-039   Operation Mode T2 Selected
A1                    LINE 0    T2   ABORTED
A1                                  JOINT   10 %
                                              1/2




        1:      CALL   R27SET30 ( 1)
[ End ]




                              [ CHOICE ]
```

8   Execute this program.

    Push the [FWD] key while pushing the [SHIFT] key

Then, the following screen will be displayed. This shows that KAREL R27SET30.PC of max payload 300kg specification is executed.

```
┌──────────────────────────────────────────────────────────┐
│  ┌────────────────────────┐   SERVO-333  Power  off  to  reset │
│  │ This means setting is changed │  A1              LINE 0      T2  ABORTED │
│  │ to payload 300kg.      │      A1                        JOINT   10% │
│  └────────────────────────┘                                 │
│                            ↗   300kg  parameter  set . ( GP : 1 ) │
│                                                             │
│                                ─ ─ ─ ─ ─ ─ ─  WARNING  ─ ─ ─ ─ ─ ─ ─ ─ │
│                                ─ Parameters  Changed  ! !  ─ │
│                                ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ │
│  ┌────────────────────────┐                                 │
│  │ Please cycle power of the │ →  Please  power  off       │
│  │ controller.            │                                 │
│  └────────────────────────┘                                 │
└──────────────────────────────────────────────────────────┘
```

9   Turn on the controller power again.

The change of the setting ends above.

4.5.2   Method of Executing KAREL Program Directly

Use scene

For instance, it is assumed that the following multi group system exists.
1st group: R-2000*i*C/270F (except wrist axis solution arm)
2nd group: R-2000*i*C/270F (except wrist axis solution arm)
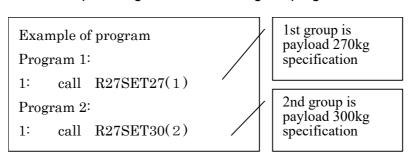
It is possible to set R-2000*i*C/270F of the 1st group and 2nd to the max payload 300kg at the same time by the method explained in this Subsection.

┌──┐
│ **NOTE** │
│   To set R-2000*i*C/270F of 1st group to max payload 300kg specification and R-2000*i*C/270F of 2nd group to max payload 270kg specification, method of this subsection cannot be used. In that case, please make two programs as follows, and change the setting by the method of Subsection 4.5.1. │
│   1 Turn on the controller power again after executing the program 1. │
│   2 Turn on the controller power again after executing the program 2. │
│ │
│   ┌─────────────────────────┐   ┌───────────────────┐ │
│   │ Example of program   │   │ 1st group is   │ │
│   │   │   ╱   │ payload 270kg   │ │
│   │ Program 1:   │   │ specification   │ │
│   │   │   └───────────────────┘ │
│   │ 1:   call   R27SET27(1) │   │
│   │   │   ┌───────────────────┐ │
│   │ Program 2:   │   ╱   │ 2nd group is   │ │
│   │   │   │ payload 300kg   │ │
│   │ 1:   call   R27SET30(2) │   │ specification   │ │
│   └─────────────────────────┘   └───────────────────┘ │
└──┘

Execution procedure
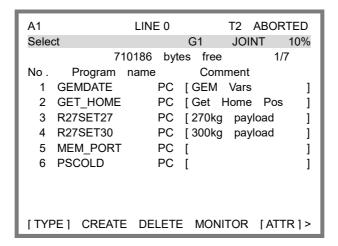
1   Call the system variable screen.

MENU key → Press F1 key (screen) after selecting "system"→ Select system variables
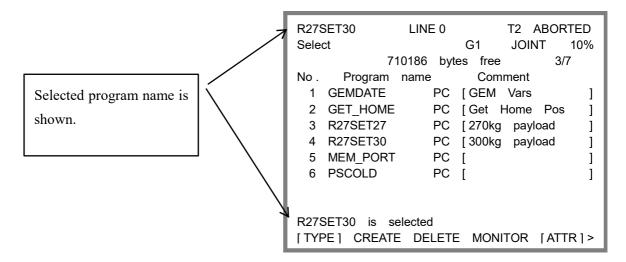
2   Set system variables $KAREL_ENB to 1.
3   Call program select screen and select "KAREL".

program select key→ select KAREL by F1 key（type）

Then, two KAREL programs are displayed as follows.

```
A1                   LINE 0          T2   ABORTED
Select                      G1     JOINT    10%
                710186  bytes  free          1/7
No .    Program  name         Comment
  1  GEMDATE         PC  [ GEM  Vars         ]
  2  GET_HOME        PC  [ Get  Home  Pos    ]
  3  R27SET27        PC  [ 270kg   payload   ]
  4  R27SET30        PC  [ 300kg   payload   ]
  5  MEM_PORT        PC  [                   ]
  6  PSCOLD          PC  [                   ]


[ TYPE ]  CREATE  DELETE  MONITOR  [ ATTR ] >
```
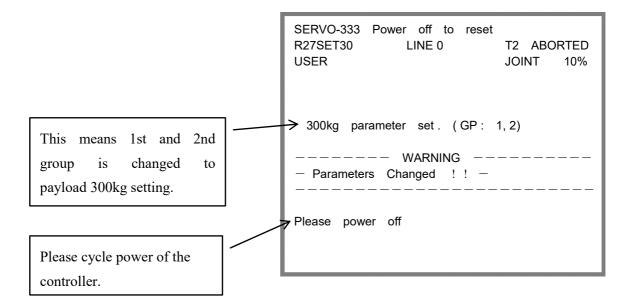
4   Match the cursor to the KAREL program of the load that wants to be set, and press the [ENTER] key.
     It is time when it selected R27SET30.PC that is KAREL of max payload 300kg specification as
     follows. The selected program name is displayed to two places as follows.

Selected program name is
shown.

```
R27SET30            LINE 0          T2   ABORTED
Select                      G1     JOINT    10%
                710186  bytes  free          3/7
No .    Program  name         Comment
  1  GEMDATE         PC  [ GEM  Vars         ]
  2  GET_HOME        PC  [ Get  Home  Pos    ]
  3  R27SET27        PC  [ 270kg   payload   ]
  4  R27SET30        PC  [ 300kg   payload   ]
  5  MEM_PORT        PC  [                   ]
  6  PSCOLD          PC  [                   ]


R27SET30  is  selected
[ TYPE ]  CREATE  DELETE  MONITOR  [ ATTR ] >
```

5   Execute the program.

Press the [FWD] key while pushing the [SHIFT] key

Then, the following screen will be displayed. This is case of executing KAREL R27SET30.PC of max payload 300kg specification.

```
SERVO-333  Power  off  to  reset
R27SET30            LINE 0            T2   ABORTED
USER                                  JOINT    10%



 300kg   parameter   set .   ( GP :   1, 2)

 — — — — — — — —  WARNING   — — — — — — — — —
 —  Parameters   Changed   ! !  —
 — — — — — — — — — — — — — — — — — — — — — — —

Please   power   off


```

This means 1st and 2nd group is changed to payload 300kg setting.

Please cycle power of the controller.

6   Turn on the controller power again.

The change of the setting ends above.

5 PIPING AND WIRING TO THE END EFFECTOR

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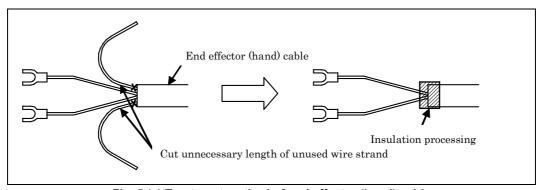
Fig. 5 (a) Treatment method of end effector (hand) cable

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.

Dual air lines or
Single air line
Rc1/2 female (Air outlet side)

Air tube 2 pcs or
Air tube 1 pc
Outside diameter 12mm
Inside diameter 8mm

Dual air lines or
Single air line
Rc1/2 female (Air inlet side)
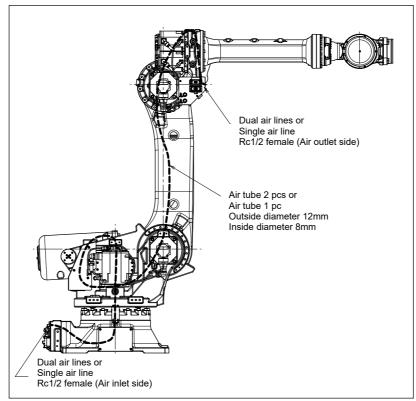
Fig. 5.1 (a) Air supply (option) (R-2000*i*C/165F/210F/240F/125L/220U)

Air tube 2 pcs or
Air tube 1 pc
Outside diameter 12mm
Inside diameter 8mm

Dual air lines or
Single air line
Rc1/2 female (Air outlet side)

Dual air lines or
Single air line
Rc1/2 female (Air inlet side)
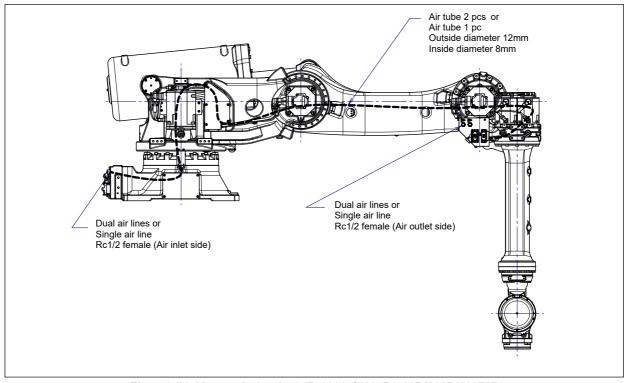
Fig. 5.1 (b) Air supply (option) (R-2000*i*C/165R/210R/100P/100PH)
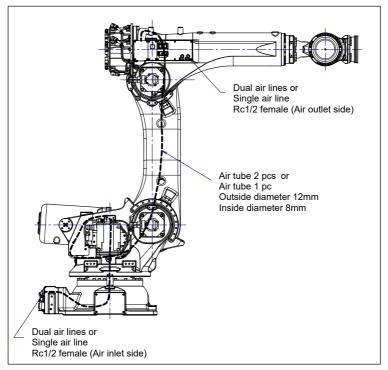
Fig. 5.1 (c) Air supply (option) (R-2000*i*C/270F/270R/190S/210L/190U)

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.
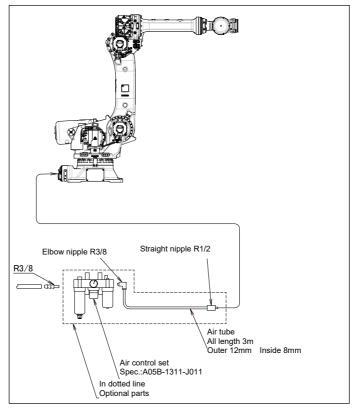
Fig. 5.2 (a) Air piping (option)

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. This is outside FANUC delivery scope.
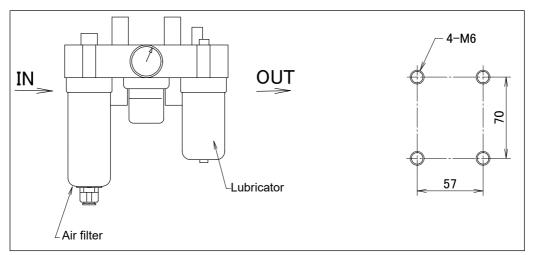
Fig. 5.2 (b) Air control set option (option)

> **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), (j), (k) show the position of the option cable interface. Fig. 5.3 (c) to (i) and (l) to (o) 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), PROFINET cable (signal line/power line), accuracy and stiffness enhancement option cable are prepared as options.

NOTE

1 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
Accuracy and stiffness enhancement option cable (only for R-2000iC/190S)	: ARE

2 There is no option cable and an air piping for mechanical unit cable A05B-1333-H557, A05B-1334-H554, A05B-1337-H252, A05B-1337-H557.

3 Specifications of camera cable for R-30iB/R-30iB Mate and R-30iB Plus/ R-30iB Mate Plus are different.
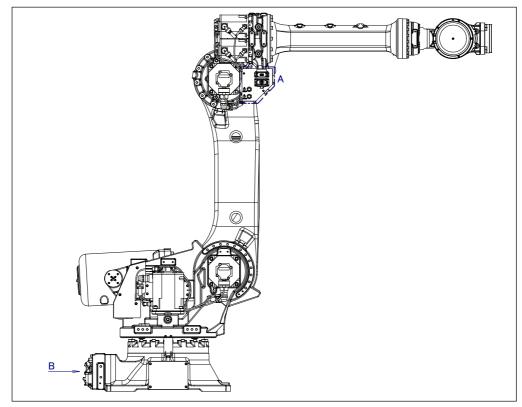
Fig. 5.3 (a) Position of interface for option cable (OPTION)
(R-2000*i*C/165F/210F/240F/125L/220U)

Fig. 5.3 (b) Position of interface for optional cable (OPTION)
(R-2000*i*C/165R/210R/100P/100PH)

J3 connector plate (output side)

J1 connector plate (input side)

User cable (power line)
interface

(Air inlet)

(Air outlet)

AIR A2

AIR B2

AIR A1

AIR B1

AP1

AS1

User cable (power line)
interface

User cable (signal line)
interface

EE interface (RI/RO)

Detail A

View B

User cable (signal line)
interface

With user cable (signal line/power line)

Cable spec.
165F/210F/240F/125L : Standard: A05B-1333-H201 / CE: A05B-1333-H501
220U   CE: A05B-1333-H701
165R/210R   : Standard: A05B-1334-H201 / CE: A05B-1334-H501
100P   CE: A05B-1334-H701
100PH   CE: A05B-1334-H751

J3 connector plate (output side)

J1 connector plate (input side)

DeviceNet cable (power line)
interface

DeviceNet cable (power line)
interface

DeviceNet cable (signal line)
interface

(Air outlet)

DP2

DS2

AIR A2

AIR A1

DP1

DS1

(Air inlet)

DeviceNet cable (signal line)
interface

EE interface (RI/RO)

Detail A

View B

With DeviceNet cable (signal line/power line)

Cable spec.
165F/210F/240F/125L : Standard: A05B-1333-H202 / CE: A05B-1333-H502
220U   CE: A05B-1333-H702
165R/210R   : Standard: A05B-1334-H202 / CE: A05B-1334-H502
100P   CE: A05B-1334-H702
100PH   CE: A05B-1334-H752

J3 connector plate (output side)

J1 connector plate (input side)

Camera cable interface

(Air inlet)

(Air outlet)

CAM2

AIR A2

AIR B2

AIR A1

AIR B1

AS1

CAM1

Camera cable
interface

User cable (signal line
usable to force sensor and
3D Laser Vision sensor)
interface

EE interface (RI/RO)

Detail A

View B

User cable (signal line
usable to force sensor and
3D Laser Vision sensor)
interface

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

Cable spec. (for the R-30*i*B/R-30*i*B Mate)
165F/210F/240F/125L : Standard: A05B-1333-H203 / CE: A05B-1333-H503
220U   CE: A05B-1333-H703
165R/210R   : Standard: A05B-1334-H203 / CE: A05B-1334-H503

Fig. 5.3 (c) Interface for option cable (1/11)

J3 connector plate (output side)

Additional axis motor cable (power, brake line) interface

(Air outlet)

AIR A2

AIR B2

Detail A

Additional axis motor cable (Pulsecoder line) interface

EE interface (RI/RO)

J1 connector plate (input side)

(Air inlet)

AIR A1   AIR B1

ARM1   ARP1

Additional axis motor cable (power, brake line) interface

View B

Additional axis motor cable (Pulsecoder line) interface

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

Cable spec.
165F/210F/240F/125L : Standard: A05B-1333-H204 / CE: A05B-1333-H504
220U   CE: A05B-1333-H704
165R/210R   : Standard: A05B-1334-H204 / CE: A05B-1334-H504

J3 connector plate (output side)

User cable (signal line usable to force sensor) interface

Camera cable interface

CAM2

AIR A2

(Air outlet)

Detail A

A2H2

Sensor cable interface

EE interface (RI/RO)

J1 connector plate (input side)

AIR A1

Sensor cable interface

Camera cable interface

SEN1

CAM1

A2H1

AP1

(Air inlet)

User cable (signal line usable to force sensor) interface

View B

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

Cable spec. (for the R-30*i*B/R-30*i*B Mate)
165R/210R   : CE: A05B-1334-H505

J3 connector plate (output side)

Camera cable interface

CAM2

EE2

AIR A2

(Air outlet)

Detail A

User cable (signal line usable to force sensor and 3D Laser Vision sensor) interface

EE interface (RI/RO)

Ethernet cable interface

J1 connector plate (input side)

(Air inlet)

AIR A1

EE1   CAM1

A2H1

Camera cable interface

User cable (signal line usable to force sensor and 3D Laser Vision sensor) interface

Ethernet cable interface

View B

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

Cable spec. (for the R-30*i*B Plus/R-30*i*B Mate Plus)
165F/210F/240F/125L : CE: A05B-1333-H506
220U   : CE: A05B-1333-H706
165R/210R   : CE: A05B-1334-H506

Fig. 5.3 (d) Interface for option cable (2/11)

J3 connector plate (output side)

J1 connector plate (input side)

Additional axis motor cable (power, brake line) interface

User cable (signal line) interface

(Air outlet)

(Air inlet)

User cable (signal line) interface

Additional axis motor cable (Pulsecoder line) interface

Additional axis motor cable (Pulsecoder line) interface

Additional axis motor cable (power, brake line) interface

Detail A

View B

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

Cable spec.
165F/210F/240F/125L : CE: A05B-1333-H553
220U   : CE: A05B-1333-H753
165R/210R   : CE: A05B-1334-H553

J3 connector plate (output side)

J1 connector plate (input side)

User cable (signal line usable to force sensor) interface

(Air inlet)

User cable (power line) interface

Sensor cable interface

User cable (signal line usable to force sensor) interface

Camera cable interface

User cable (power line) interface

(Air outlet)

Sensor cable interface

Camera cable interface

Detail A

View B

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

Cable spec. (for the R-30iB/R-30iB Mate)
165F/210F/240F/125L : CE : A05B-1333-H556

J3 connector plate (output side)

J1 connector plate (input side)

Additional axis motor cable (power, brake line) interface

DeviceNet cable (signal line) interface

(Air inlet)

DeviceNet cable (power line) interface

Additional axis motor cable (Pulsecoder line) interface

DeviceNet cable (signal line) interface

Additional axis motor cable (power, brake line) interface

(Air outlet)

Additional axis motor cable (Pulsecoder line) interface

DeviceNet cable (power line) interface

Detail A

View B

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

Cable spec.
165F/210F/240F/125L   : CE : A05B-1333-H563

Fig. 5.3 (e) Interface for option cable (3/11)

J3 connector plate (output side)

J1 connector plate (input side)

(Air inlet)

AIR A1

DeviceNet cable
(power line) interface

DeviceNet cable
(signal line) interface

DeviceNet cable
(signal line) interface

(Air outlet)

Detail A

DeviceNet cable
(power line) interface

View B

With DeviceNet cable (signal line/power line)

Cable spec.
165F/210F/240F/125L   : CE : A05B-1333-H564

J3 connector plate (output side)

J1 connector plate (input side)

Additional axis motor cable (power, brake line)
interface

(Air inlet)

AIR A1

Ethernet cable
(power line) interface

Ethernet cable
(signal line) interface

Ethernet cable
(signal line) interface

Additional axis motor cable
(Pulsecoder line) interface

Additional axis motor cable
(Pulsecoder line) interface

Ethernet cable
(power line) interface

Additional axis motor cable
(power, brake line) interface

(Air outlet)

Detail A

Ethernet cable
(power line) interface

View B

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

Cable spec.
165F/210F/240F/125L   : CE : A05B-1333-H565

J3 connector plate (output side)

J1 connector plate (input side)

(Air inlet)

AIR A1

Ethernet cable
(power line) interface

Ethernet cable
(signal line) interface

Ethernet cable
(signal line) interface

Ethernet cable
(power line) interface

(Air outlet)

Detail A

View B

With Ethernet cable (signal line/power line)

Cable spec.
165F/210F/240F/125L   : CE : A05B-1333-H566
165R/210R   : CE : A05B-1334-H567
100P   : CE : A05B-1334-H705

Fig. 5.3 (f) Interface for option cable (4/11)

J3 connector plate (output side)

J1 connector plate (input side)

PROFINET cable
(power line) interface

Additional axis motor cable
(power, brake line) interface

PROFINET cable
(signal line) interface

(Air inlet)

PROFINET cable
(signal line) interface

PNP2

ARP2

PNS1

AIR A1

PNS2

Additional axis motor cable
(Pulsecoder line) interface

ARP1

PROFINET cable
(power line) interface

PNP1

(Air outlet)

AIR A2

Additional axis motor cable
(power, brake line) interface

ARM1

Additional axis motor cable
(Pulsecoder line) interface

Detail A

View B

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

Cable spec.
165F/210F/240F/125L   : CE : A05B-1333-H567

J3 connector plate (output side)

J1 connector plate (input side)

PROFINET cable
(power line) interface

PROFINET cable
(signal line) interface

(Air inlet)

PROFINET cable
(signal line) interface

PNP2

PNS1

AIR A1

(Air outlet)

PNS2

PNP1

PROFINET cable
(power line) interface

AIR A2

Detail A

View B

With PROFINET cable (signal line/power line)

Cable spec.
165F/210F/240F/125L   : CE : A05B-1333-H568

Fig. 5.3 (g) Interface for option cable (5/11)

J3 connector plate (output side)

User cable (power line)
interface

(Air outlet)

AIR A2

AIR B2

User cable
(signal line) interface

AB2

EE Interface
(RI/RO)

Detail A

J1 connector plate (input side)

(Air inlet)

AIR A1   AIR B1

AP1   AB1

User cable
(power line) interface

User cable (signal line)
interface

View B

With user cable (signal line/power line) and waterproof/CE (for severe dust/liquid protection)

Cable spec.
165F/210F/240F/125L   : A05B-1333-H801
165R/210R   : A05B-1334-H801

J3 connector plate (output side)

DeviceNet cable
(power line) interface

DeviceNet cable
(signal line) interface

(Air outlet)

DP2

DB2

AIR A2

EE Interface
(RI/RO)

Detail A

J1 connector plate (input side)

DeviceNet cable
(power line) interface

AIR A1

DP1   DB1

(Air inlet)

DeviceNet cable
(signal line) interface

View B

With DeviceNet cable (signal line/power line) and waterproof/CE (for severe dust/liquid protection)

Cable spec.
165F/210F/240F/125L   : A05B-1333-H802
165R/210R   : A05B-1334-H802

J3 connector plate (output side)

Additional axis motor cable
(power, brake line) interface

Additional axis motor cable
(Pulsecoder line) interface

(Air outlet)

ARP2

AIR A2

AIR B2

EE Interface
(RI/RO)

Detail A

J1 connector plate (input side)

(Air inlet)

AIR A1   AIR B1

ARM1   ARP1

Additional axis motor cable
(power, brake line) interface

Additional axis motor cable
(Pulsecoder line) interface

View B

With additional axis motor cable (Pulsecoder line/power, brake line) and waterproof/CE (for severe dust/liquid protection)

Cable spec.
165F/210F/240F/125L   : A05B-1333-H803
165R/210R   : A05B-1334-H803

Fig. 5.3 (h) Interface for option cable (6/11)
(When severe dust/liquid protection package is specified)

J3 connector plate (output side)

J1 connector plate (input side)

Camera cable interface

(Air inlet)

AIR A1

CAM2

E82

Camera cable interface

User cable (signal line usable to force sensor and 3D Laser Vision sensor) interface

(Air outlet)

AIR A2

E81

CAM1

A81

User cable (signal line usable to force sensor and 3D Laser Vision sensor) interface

EE Interface (RI/RO)

Ethernet cable interface

Ethernet cable interface

Detail A

View B

With Ethernet cable (signal line) , user cable (signal line usable to force sensor) , camera cable and waterproof/CE (for severe dust/liquid protection)

Cable spec. (for the R-30*i*B Plus/R-30*i*B Mate Plus)
165F/210F/240F/125L   : A05B-1333-H805
165R/210R   : A05B-1334-H805

Fig. 5.3 (i) Interface for option cable (7/11)
(When severe dust/liquid protection package is specified)

A

B

Fig. 5.3 (j) Position of interface for optional cable (option)
(R-2000*i*C/270F/190S/210L/190U)

Fig. 5.3 (k) Position of interface for optional cable (OPTION)
(R-2000*i*C/270R)

J3 connector plate (output side)

EE Interface (RI/RO)

User cable (signal line) interface

(Air outlet)

User cable (power line) interface

Detail A

J1 connector plate (input side)

(Air inlet)

User cable (power line) interface

User cable (signal line) interface

View B

With user cable (signal line/power line)

Cable spec.
270F/210L/190U : CE : A05B-1337-H501
270R   : CE : A05B-1337-H201
190S   : CE : A05B-1337-H701

J1 connector plate (input side)

J3 connector plate (output side)

DeviceNet cable (signal line) interface

EE Interface (RI/RO)

(Air outlet)

DeviceNet cable (power line) interface

Detail A

(Air inlet)

DeviceNet cable (signal line) interface

DeviceNet cable (power line) interface

View B

With DeviceNet cable (signal line/power line)

Cable spec.
270F/210L/190U   : CE : A05B-1337-H502

J1 connector plate (input side)

(Air inlet)

J3 connector plate (output side)

Camera cable interface

EE Interface (RI/RO)

User cable (signal usable to force sensor and 3D Laser Vision sensor) interface

(Air outlet)

Detail A

Camera cable interface

User cable (signal usable to force sensor and 3D Laser Vision sensor) interface

Camera cable interface

View B

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

Cable spec. (for the R-30*i*B)
270F/210L/190U   : CE : A05B-1337-H503

J1 connector plate (input side)

(Air inlet)

Additional axis motor cable (Pulsecoder line) interface

J3 connector plate (output side)

EE Interface (RI/RO)

(Air outlet)

Additional axis motor cable (power, brake line) interface

Detail A

Additional axis motor cable (power, brake line) interface

Additional axis motor cable (Pulsecoder line) interface

View B

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

Cable spec.
270F/210L/190U   : CE : A05B-1337-H504
270R   : CE : A05B-1337-H204
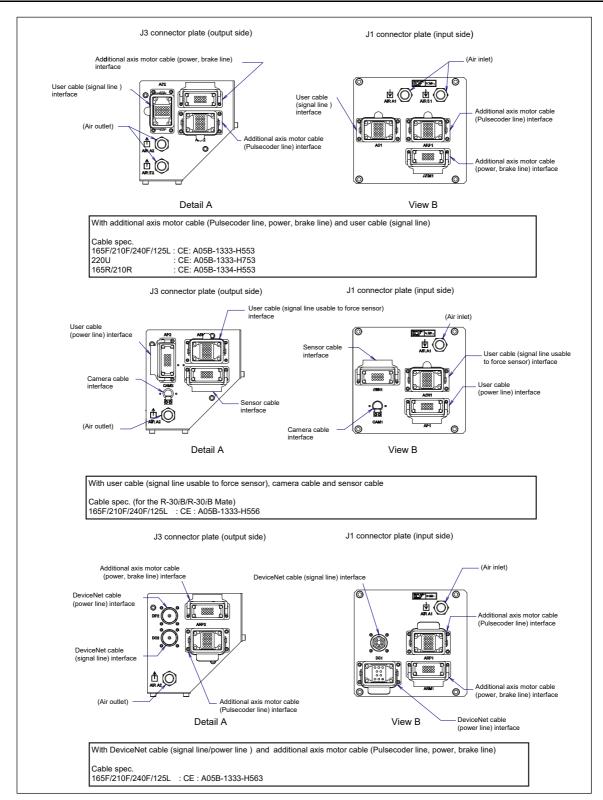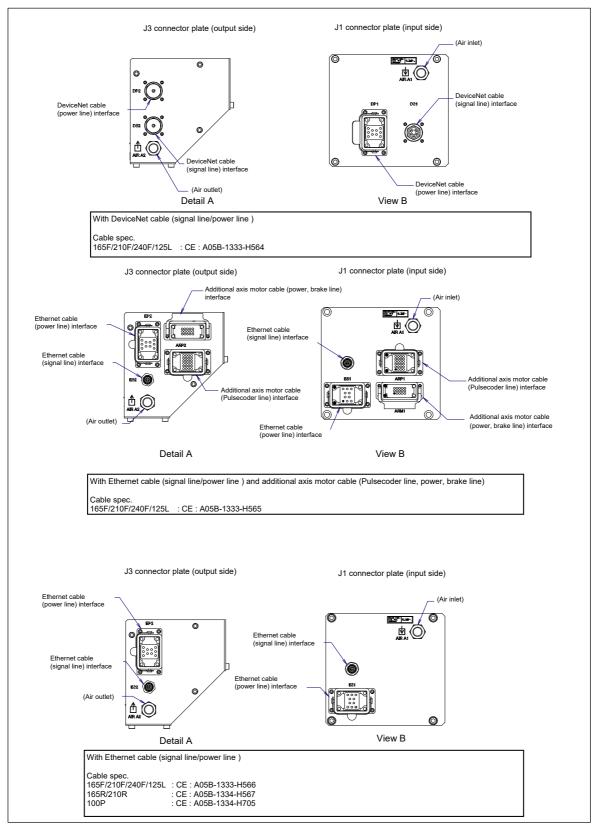190S   : CE : A05B-1337-H704

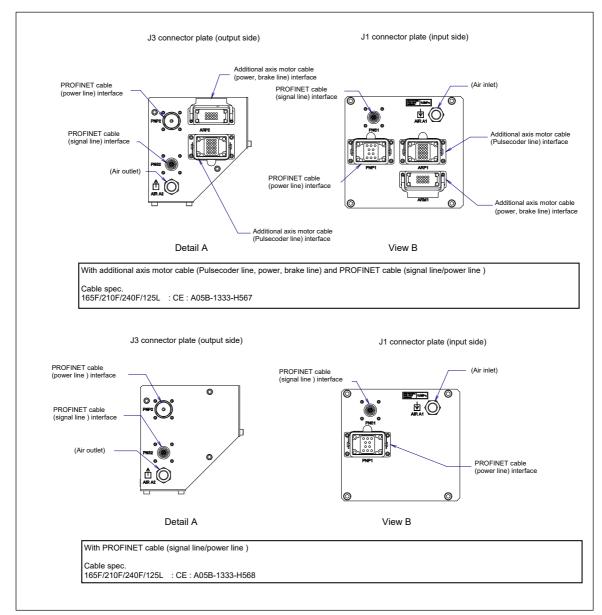**Fig. 5.3 (I) Interface for option cable (8/11)**

Fig. 5.3 (m) Interface for option cable (9/11)
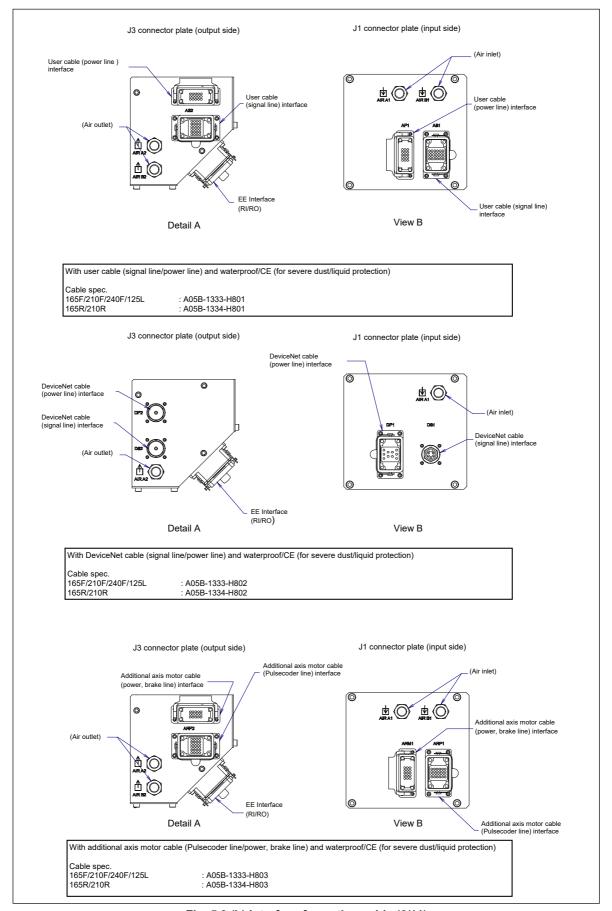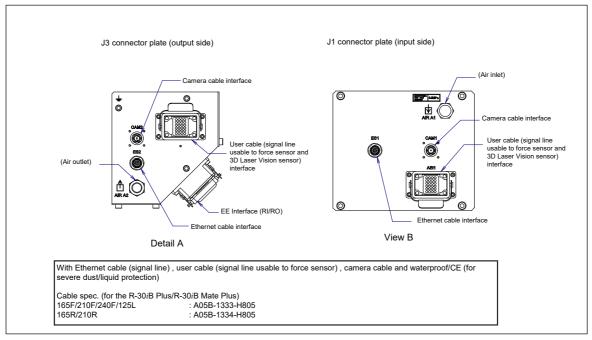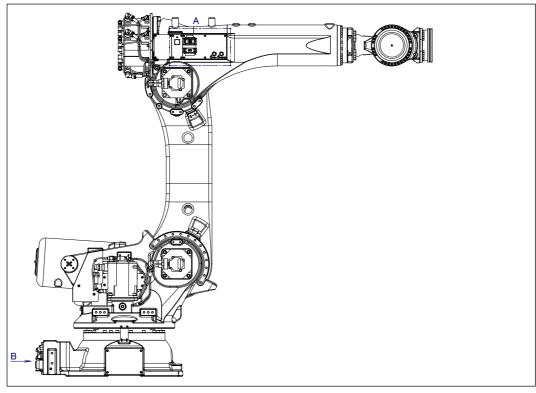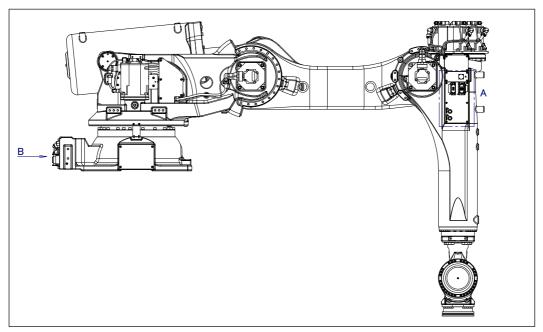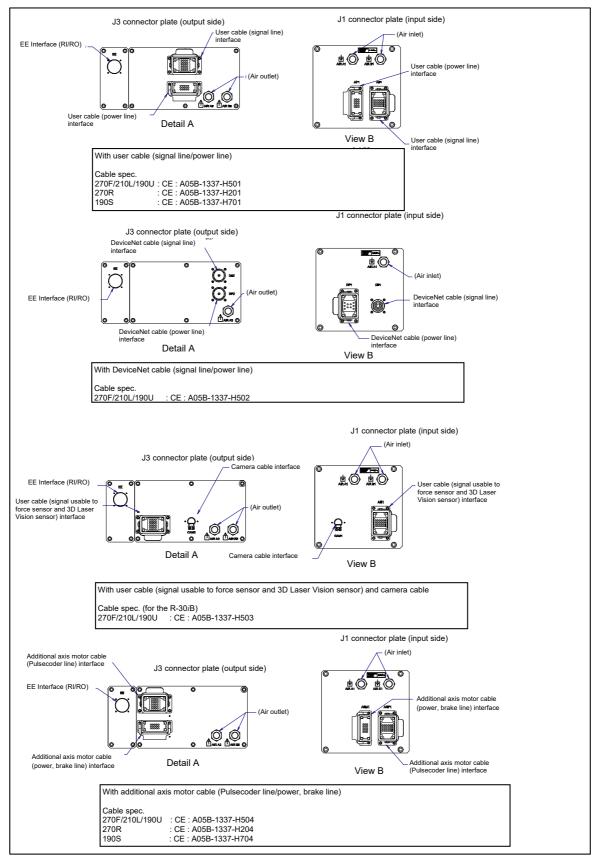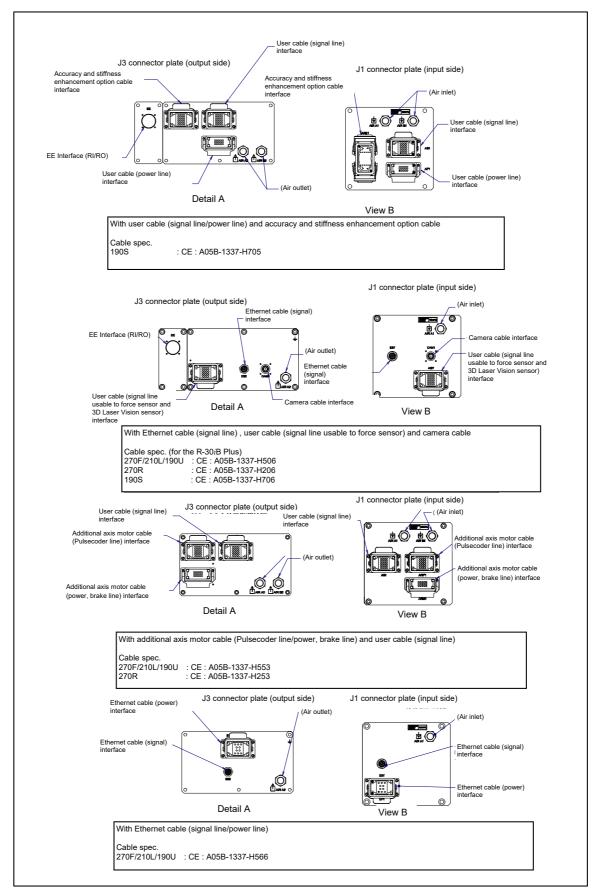
Fig. 5.3 (n) Interface for option cable (10/11)
(When severe dust/liquid protection package is specified)

With Ethernet cable (signal line) , user cable (signal line usable to force sensor) , camera cable and waterproof/CE (for severe dust/liquid protection)

Cable spec. (for the R-30*i*B Plus)
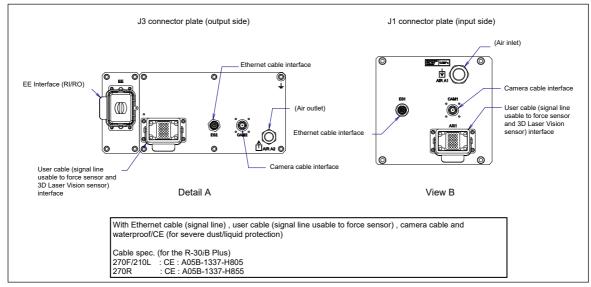270F/210L　: CE : A05B-1337-H805
270R　　　: CE : A05B-1337-H855

Fig. 5.3 (o) Interface for option cable (11/11)
(When severe dust/liquid protection package is specified)

1　EE interface (RI/RO) (option)

Fig. 5.3 (p) and (q) 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.
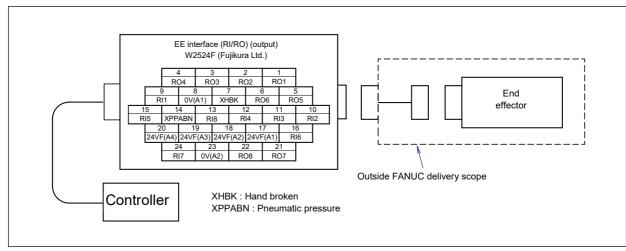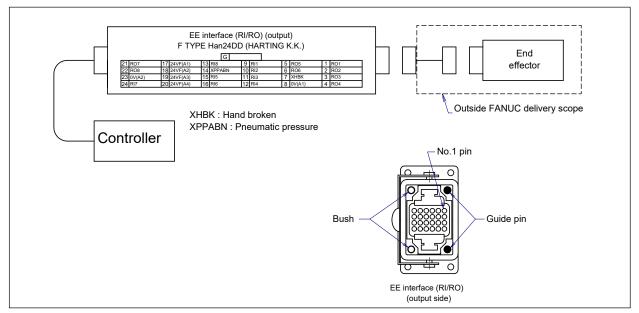

Fig. 5.3 (p) Pin layout for EE interface(RI/RO) (option)

Fig. 5.3 (q) 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 (r) 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
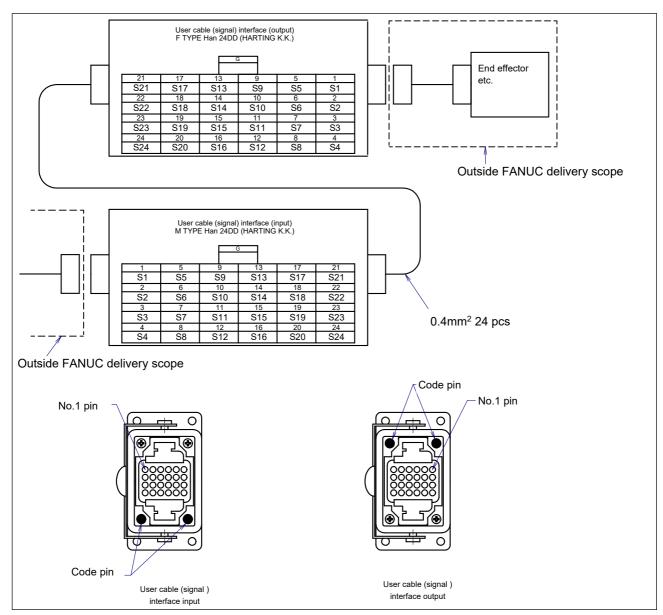this code pin.

User cable (signal) interface (output)
F TYPE Han 24DD (HARTING K.K.)

G

21	17	13	9	5	1
S21	S17	S13	S9	S5	S1
22	18	14	10	6	2
S22	S18	S14	S10	S6	S2
23	19	15	11	7	3
S23	S19	S15	S11	S7	S3
24	20	16	12	8	4
S24	S20	S16	S12	S8	S4

End effector
etc.

Outside FANUC delivery scope

User cable (signal) interface (input)
M TYPE Han 24DD (HARTING K.K.)

G

1	5	9	13	17	21
S1	S5	S9	S13	S17	S21
2	6	10	14	18	22
S2	S6	S10	S14	S18	S22
3	7	11	15	19	23
S3	S7	S11	S15	S19	S23
4	8	12	16	20	24
S4	S8	S12	S16	S20	S24

0.4mm^2 24 pcs

Outside FANUC delivery scope

No.1 pin

Code pin

Code pin

No.1 pin

User cable (signal)
interface input

User cable (signal)
interface output

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

- 125 -

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 (s) 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.
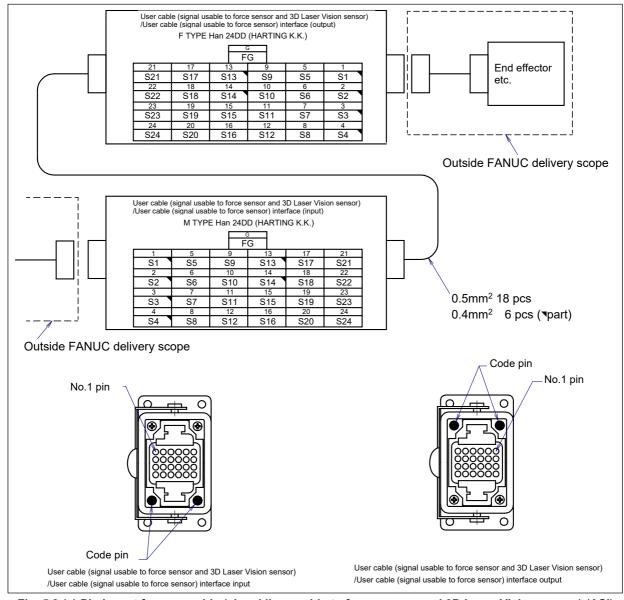

Fig. 5.3 (s) Pin layout for user cable (signal line usable to force sensor and 3D Laser Vision sensor) (ASi) (signal line usable to force sensor) (ASH)/interface and code pin layout (option)

4   User cable (power line) (AP) Interface (option)
     Fig. 5.3 (t) 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
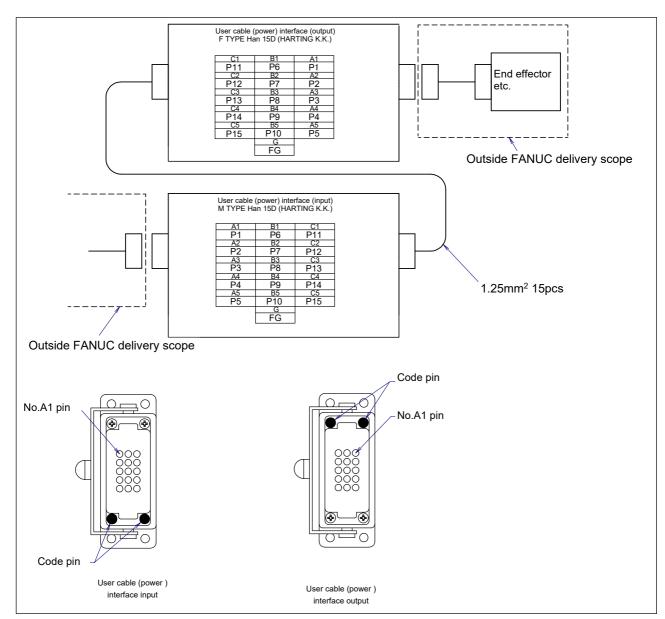   which is prepared by the user.

User cable (power) interface (output)
F TYPE Han 15D (HARTING K.K.)

C1	B1	A1
P11	P6	P1
C2	B2	A2
P12	P7	P2
C3	B3	A3
P13	P8	P3
C4	B4	A4
P14	P9	P4
C5	B5	A5
P15	P10	P5
	G	
	FG	

End effector etc.

Outside FANUC delivery scope

User cable (power) interface (input)
M TYPE Han 15D (HARTING K.K.)

A1	B1	C1
P1	P6	P11
A2	B2	C2
P2	P7	P12
A3	B3	C3
P3	P8	P13
A4	B4	C4
P4	P9	P14
A5	B5	C5
P5	P10	P15
	G	
	FG	

1.25mm^2 15pcs

Outside FANUC delivery scope

Code pin

No.A1 pin

No.A1 pin

Code pin

User cable (power)
interface input

User cable (power)
interface output

Fig. 5.3 (t) 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 (u) shows the pin layout for the DeviceNet cable (signal line) interface.
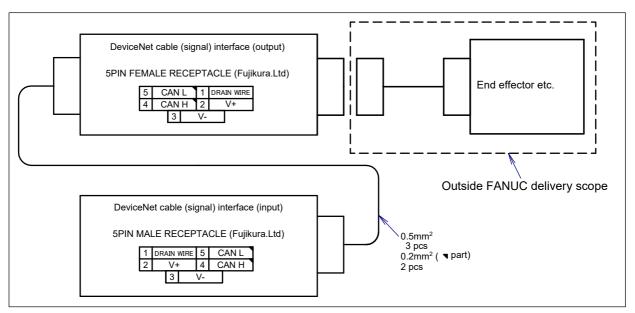

Fig. 5.3 (u) Pin layout for DeviceNet cable (signal line) (DS) interface (option)

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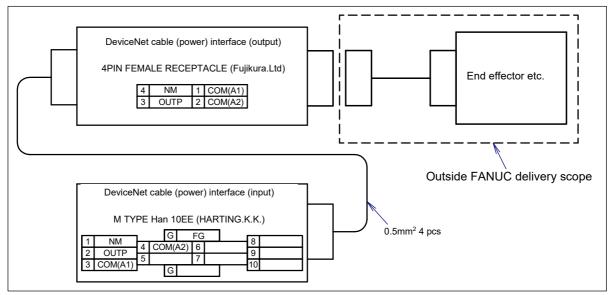   Fig. 5.3 (v) shows the pin layout for the DeviceNet cable (power line) interface.

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

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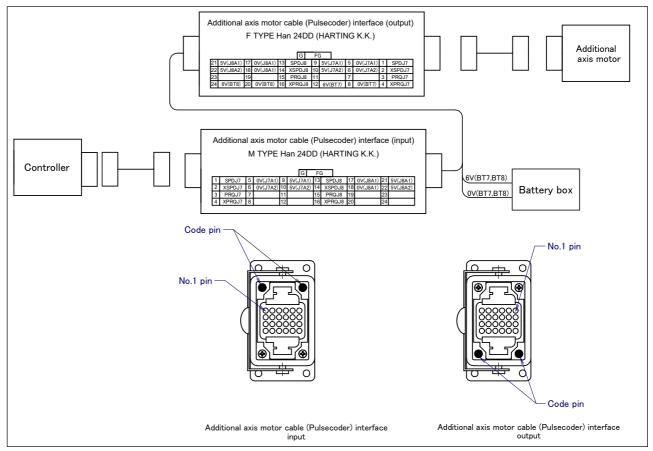The connector has a code pin for preventing improper insertion.

**Fig. 5.3 (w) 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 (x) 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.
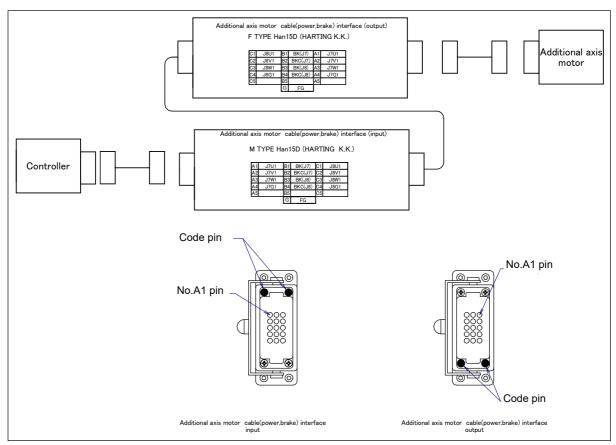
Additional axis motor cable(power,brake) interface (output)
F TYPE Han15D (HARTING K.K.)

C1	J8U1	B1	BK(J7)	A1	J7U1
C2	J8V1	B2	BKC(J7)	A2	J7V1
C3	J8W1	B3	BK(J8)	A3	J7W1
C4	J8G1	B4	BKC(J8)	A4	J7G1
C5		B5		A5	
		G	FG		

Additional axis motor cable(power,brake) interface (input)
M TYPE Han15D (HARTING K.K.)

A1	J7U1	B1	BK(J7)	C1	J8U1
A2	J7V1	B2	BKC(J7)	C2	J8V1
A3	J7W1	B3	BK(J8)	C3	J8W1
A4	J7G1	B4	BKC(J8)	C4	J8G1
A5		B5		C5	
		G	FG		

Additional axis motor cable(power,brake) interface
input

Additional axis motor cable(power,brake) interface
output

**Fig. 5.3 (x) 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 (y) shows the pin layout of the Ethernet cable (signal line) (ES) interface.

Ethernet cable (signal line) interface (output)
F TYPE Han M12 4PIN D-coded (HARTING K.K.)

2	3
RX+	TX-
1	4
TX+	RX-

Ethernet cable (signal line) interface (input)
F TYPE Han M12 4PIN D-coded (HARTING K.K.)

2	3
RX+	TX-
1	4
TX+	RX-

End effector etc.

Outside FANUC delivery scope

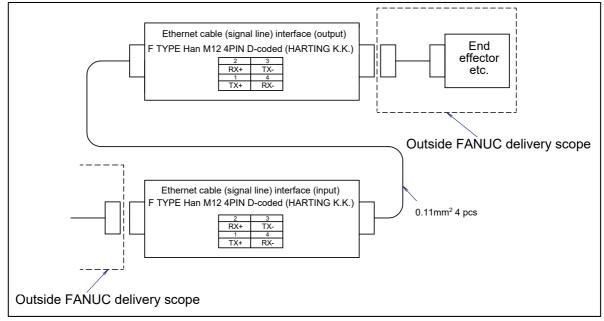0.11mm^2 4 pcs

Outside FANUC delivery scope

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

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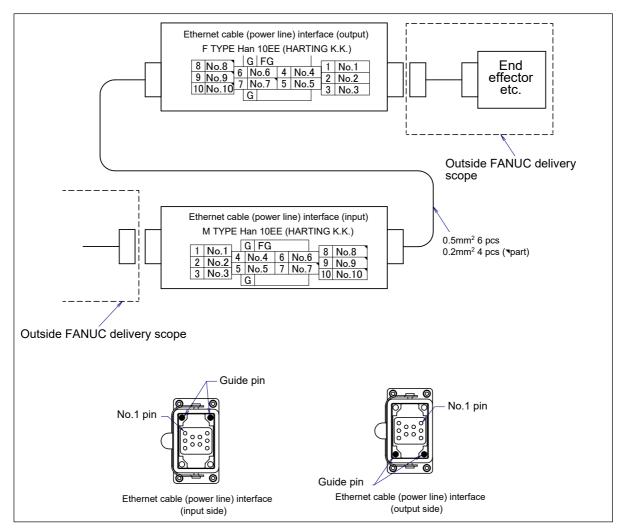

Fig. 5.3 (z) Pin layout for Ethernet cable (power line) (EP) interface (option)

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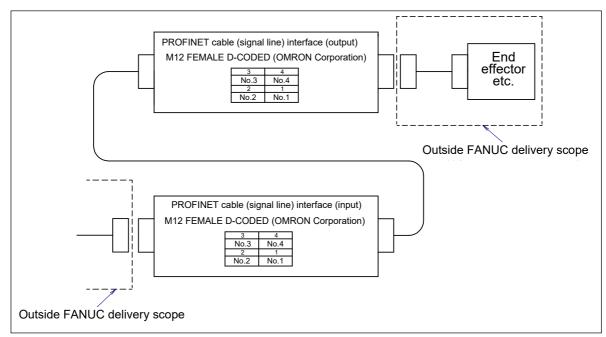   Fig. 5.3 (aa) shows the pin layout of the PROFINET cable (signal line) (PNS) interface.

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

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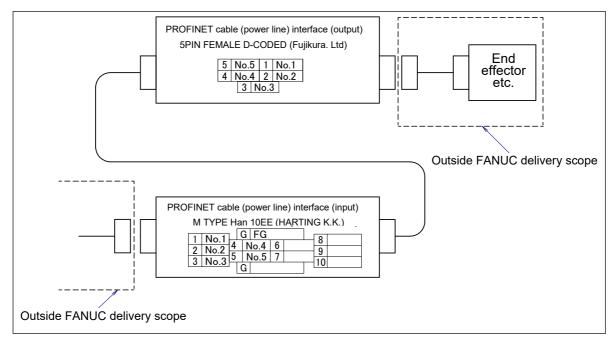

Fig. 5.3 (ab) Pin layout for PROFINET cable (power line) (PNP) interface (option)

Connector specifications

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

Cable	Input side (J1 connector panel)		Maker /dealer	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	HARTING K.K.	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	HARTING K.K.
ES	Connector Contact	21 03 881 2425 09 67 000 7476		Connector Contact	21 03 881 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 33 000 9908 09 33 000 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 33 000 9908 09 33 000 9909	
PNS	XS5P-T426-5		OMRON Corporation	XS5P-T426-5		OMRON Corporation
DS	CM03A-R5P-S-2		Fujikura Ltd.	CM03A-PR5S-S-2		
DP	Housing Insert Contact	09 30 006 0301 09 32 010 3001 09 33 000 6105	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 33 000 9908 09 33 000 9909		CM03A-PR5S-S-2		

Table 5.3 (c) Connector specifications (User side) (1/4)

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 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 (d) Connector specifications (User side) (2/4)

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	←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	←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	←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	←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 03 881 1405	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	←The same	

Table 5.3 (e) Connector specifications (User side) (3/4)

Cable	Input side (J1 connector panel)			Maker /dealer	Output side (J3 connector panel)			Maker /dealer
EP	Hood (NOTE 2)	09 20 010 1540 1541 0542 0543 1440 1441 0442 0443	Side entry ↓ Top entry ↓	HARTING K.K.	Hood	←The same		HARTING K.K.
	Insert	09 32 010 3101			Insert	09 32 010 3001		
	Contact (NOTE 2)	09 33 000 6220 6214 6205 6204 6202 6207	AWG 20 AWG 18 AWG 18 AWG 16 AWG 14 AWG 12		Contact (NOTE 2)	09 33 000 6121 6114 6105 6104 6102 6107	AWG 20 AWG 18 AWG 18 AWG 16 AWG 14 AWG 12	
	Clamp (NOTE 2)	09 00 000 5083 5086 5090 5094 Many other types are available.			Clamp	←The same		
	Guide pin	09 33 000 9908			Guide pin	←The same		
	Bush	09 33 000 9909			Bush	←The same		
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 1541 0542 0543 1440 1441 0442 0443	Side entry ↓ Top entry ↓	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 6214 6205 6204 6202 6207	AWG20 AWG18 AWG18 AWG16 AWG14 AWG12					
	Clamp (NOTE 2)	09 00 000 5083 5086 5090 5094 Many other types are available.						

Table 5.3 (f) Connector specifications (User side) (4/4)

Cable	Input side (J1 connector panel)			Maker /dealer	Output side (J3 connector panel)	Maker /dealer
PNP	Hood (NOTE 2)	09 15 000 1541 0540 0541 1440 0440 0441	Side entry ↓ Top entry ↓	HARTING K.K.	MINI connector for use on the device net 5-pin, MALE CM03-J5P	Fujikura Ltd.
	Insert	09 32 010 3101				
	Contact (NOTE 2)	09 15 000 6204 09 15 000 6203 09 15 000 6205 09 15 000 6202 6201 6206	AWG 26-22 AWG 20 AWG 18 AWG 18 AWG 16 AWG 14			
	Clamp (NOTE 2)	09 00 000 5083 5086 5090 5094 Many other types are available.				
	Guide pin	09 33 000 9908				
	Bush	09 33 000 9909				

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

By setting the motion range of each axis, you can change the robot's motion range from the standard values.
Changing the motion range of the robot is effective under the following circumstances:
· Used motion range of the robot is limited.
· There is an area where tool and peripheral devices interfere with the robot.
· The length of cables and hoses attached for application is limited.
There are three methods used to prevent the robot from going beyond the necessary motion range.
- Limit axis motion range by DCS (All axes (option))
- Limit axis motion range adjustable mechanical stopper (J1/J2/J3-axes (option))
- Limit axis motion range by adjustable mechanical stopper and switches (J1-axis (option))

⚠ **WARNING**

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

2 For J1-axis, use adjustable mechanical stoppers, for J2/J3-axis, use the adjustable mechanical stoppers or DCS function so that damage to peripheral equipment and injuries to human bodies can be avoided.

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 DCS-specified limits are available.

4 For changing J2 andJ3-axes interference angles, only adjustable mechanical stoppers are available; DCS 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.
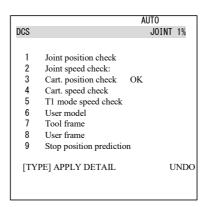

6.1   CHANGE AXIS LIMIT BY DCS (OPTION)

The robot motion can be restricted with DCS (Dual check safety) function by using the following software. For J2/J3-axis, the same effect as adjustable mechanical stopper described in Section 6.2 can be obtained. The robot motion can be restricted at any angle and position if it is in robot motion area. DCS functions are certified to meet the requirements of International Standard ISO13849-1 and IEC61508 approved by notified body. If only the operating space is set using Joint Position Check, the robot stops after it goes beyond the workspace. When the motor power is shut down, the robot's momentum causes it to move some distance before it completely stops. The actual "Robot Stop Position" will be beyond the workspace. To stop the robot within the robot workspace, use the DCS Stop Position Prediction function. The stop position prediction is disabled by default.

·   DCS position/speed check function (J567)
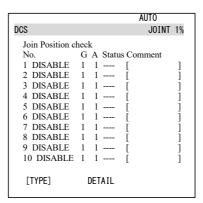
As an example, we shows the procedure to set $\pm 30^{\circ}$ for J2-axis in here. Refer to Dual check safety function Operator's Manual (B-83184EN) for details of other setting, function and DCS stop position prediction.
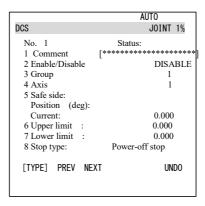
Setting procedure
1   Press the [MENU] key to display the screen menu.
2   Press [0 NEXT] and press [6 SYSTEM].
3   Press the F1 ([TYPE]).
4   Select [DCS].   The following screen will be displayed.

```
                                    AUTO
DCS                              JOINT 1%


        1     Joint position check
        2     Joint speed check:
        3     Cart. position check      OK
        4     Cart. speed check
        5     T1 mode speed check
        6     User model
        7     Tool frame
        8     User frame
        9     Stop position prediction

     [TYPE] APPLY DETAIL                  UNDO

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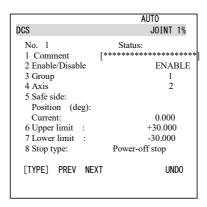
5   Move the cursor to [1 Joint position check], then press the [DETAIL].

```
                                    AUTO
DCS                              JOINT 1%

  Join Position check
  No.          G A Status Comment
  1  DISABLE   1  1 ----  [            ]
  2  DISABLE   1  1 ----  [            ]
  3  DISABLE   1  1 ----  [            ]
  4  DISABLE   1  1 ----  [            ]
  5  DISABLE   1  1 ----  [            ]
  6  DISABLE   1  1 ----  [            ]
  7  DISABLE   1  1 ----  [            ]
  8  DISABLE   1  1 ----  [            ]
  9  DISABLE   1  1 ----  [            ]
  10 DISABLE   1  1 ----  [            ]

     [TYPE]        DETAIL

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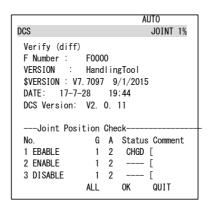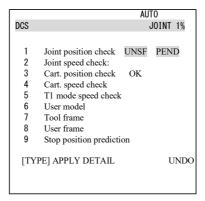
6   Move the cursor to [1], then press the [DETAIL].

```
                                  AUTO
DCS                          JOINT 1%

  No.  1                 Status:
  1 Comment        [********************]
  2 Enable/Disable              DISABLE
  3 Group                             1
  4 Axis                              1
  5 Safe side:
   Position  (deg):
   Current:                      0.000
  6 Upper limit  :               0.000
  7 Lower limit  :               0.000
  8 Stop type:         Power-off stop

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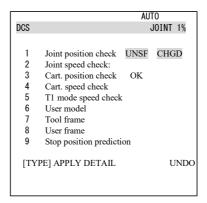
7   Move the cursor to [DISABLE], then press [CHOICE], set the status to [ENABLE].
8   Move the cursor to [Group], then input the robot group number, then press the [ENTER] key.
9   Move the cursor to [Axis], then input "2", then press the [ENTER] key.
10   Move the cursor to [Upper limit] right side,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

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

```
                                  AUTO
DCS                          JOINT 1%

  No.  1                 Status:
  1 Comment        [********************]
  2 Enable/Disable              ENABLE
  3 Group                             1
  4 Axis                              2
  5 Safe side:
   Position  (deg):
   Current:                      0.000
  6 Upper limit  :             +30.000
  7 Lower limit  :             -30.000
  8 Stop type:         Power-off stop

  [TYPE]  PREV  NEXT                UNDO
```

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

```
                                  AUTO
DCS                          JOINT 1%

  1    Joint position check   UNSF  CHGD
  2    Joint speed check:
  3    Cart. position check    OK
  4    Cart. speed check
  5    T1 mode speed check
  6    User model
  7    Tool frame
  8    User frame
  9    Stop position prediction

  [TYPE] APPLY DETAIL               UNDO
```

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

```
                              AUTO
DCS                       JOINT 1%

 Verify (diff)
 F Number :    F0000
 VERSION   :   HandlingTool
 $VERSION : V7.7097  9/1/2015
 DATE:   17-7-28    19;44
 DCS Version: V2.0.11


 ---Joint Position Check----------------
 No.           G  A  Status Comment
 1 EBABLE      1  2   CHGD [
 2 ENABLE      1  2   ---- [
 3 DISABLE     1  2   ---- [
                   ALL     OK     QUIT
```

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

```
                              AUTO
DCS                       JOINT 1%

 1      Joint position check   UNSF   PEND
 2      Joint speed check:
 3      Cart. position check     OK
 4      Cart. speed check
 5      T1 mode speed check
 6      User model
 7      Tool frame
 8      User frame
 9      Stop position prediction

 [TYPE] APPLY DETAIL                UNDO
```

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

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

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 be used together. Refer to Section 6.3 and 6.4 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 (R-2000iC/165F/210F/240F/125L/220U)

Item		Settable motion range
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 +76°. (+76° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of -30° to +75°. A fixed mechanical stopper is also provided at the -60°. (-60° is lower limit of the standard motion 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 +180°. (+180° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of 0° to +135°. A fixed mechanical stopper is also provided at -79°. (-79° is lower limit of the standard motion 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 (R-2000iC/165R/210R)

Item		Settable motion range
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 +80°. (+80° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of -90° to +75°. A fixed mechanical stopper is also provided at -120°.(-120° is lower limit of the standard motion 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 +180°.(+180° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 0° in the range of 0° to +135°. A fixed mechanical stopper is also provided at -79°. (-79° is lower limit of the standard motion 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 (R-2000*i*C/100P/100PH)

Item		Settable motion range
J1-axis adjustable mechanical stopper	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 -120° to +60°. A fixed mechanical stopper is also provided at +80°. (+80° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of -90° to +75°. A fixed mechanical stopper is also provided at -120°. (-120° is lower limit of the standard motion 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 +180°. (+180° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of 0° to +135°. A fixed mechanical stopper is also provided at -79°. (-79° is lower limit of the standard motion range.)
	Space between the upper and lower limits	A space of 15° or more is required.

Table 6.2 (d) Motion range that can be set by the adjustable mechanical stopper and space between the upper and lower limits (R-2000*i*C/270F/210L/190U)

Item		Settable motion range
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	In case of 270F/210L, settable in steps of 15° in the range of -60° to +60°. In case of 190U, settable in steps of 15° in the range of -45° to +60°. A fixed mechanical stopper is also provided at +76°.(+76° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of -45° to +75°. A fixed mechanical stopper is also provided at -60°.(-60° is lower limit of the standard motion 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 +180°.(+180° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of 0° to +120°. A fixed mechanical stopper is also provided at -79°. (-79° is lower limit of the standard motion range.)
	Space between the upper and lower limits	A space of 15° or more is required.

Table 6.2 (e) Motion range that can be set by the adjustable mechanical stopper and space between the upper and lower limits (R-2000*i*C/270R)

Item		Settable motion range
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 -120° to +60°. A fixed mechanical stopper is also provided at +80°.(+80° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of -90° to +75°. A fixed mechanical stopper is also provided at -120°.(-120° is lower limit of the standard motion 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 +180°.(+180° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of 0° to +120°. A fixed mechanical stopper is also provided at -79°. (-79° is lower limit of the standard motion range.)
	Space between the upper and lower limits	A space of 15° or more is required.

Table 6.2 (f) Motion range that can be set by the adjustable mechanical stopper and space between the upper and lower limits (R-2000*i*C/190S)

Item		Settable motion range
J1-axis adjustable mechanical stopper, limit switch	Upper limit	Settable in steps of 5° in the range of -110° to +180° When accuracy and stiffness enhancement option is specified, set to -110° to -60°, -50° is impossible.
	Lower limit	Settable in steps of 5° in the range of -180° to +110° When accuracy and stiffness enhancement option is specified, set to -145°, -135° to -60°, -50° is impossible.
	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 +130°.(+130° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of -45° to +90°. A fixed mechanical stopper is also provided at -80°.(-80° is lower limit of the standard motion 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 +180°.(+180° is upper limit of the standard motion range.)
	Lower limit	Settable in steps of 15° in the range of 0° to +120°. A fixed mechanical stopper is also provided at -79°. (-79° is lower limit of the standard motion range.)
	Space between the upper and lower limits	A space of 15° or more is required.

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

6.2.1   Installing adjustable mechanical stopper option

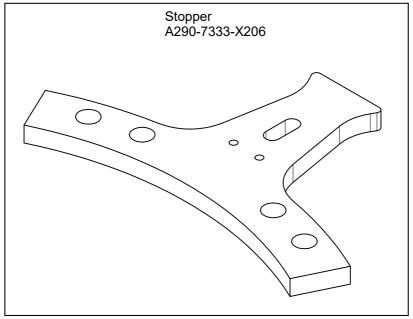Attach adjustable mechanical stoppers referring to Fig. 6.2.1 (a) to (w).

Fig. 6.2.1 (a) J1-axis adjustable mechanical stopper (option)
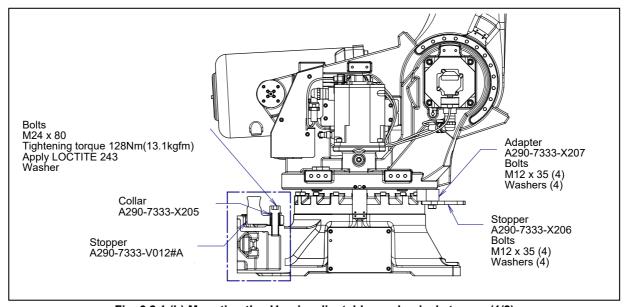**(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)**

Fig. 6.2.1 (b) Mounting the J1-axis adjustable mechanical stopper (1/2)
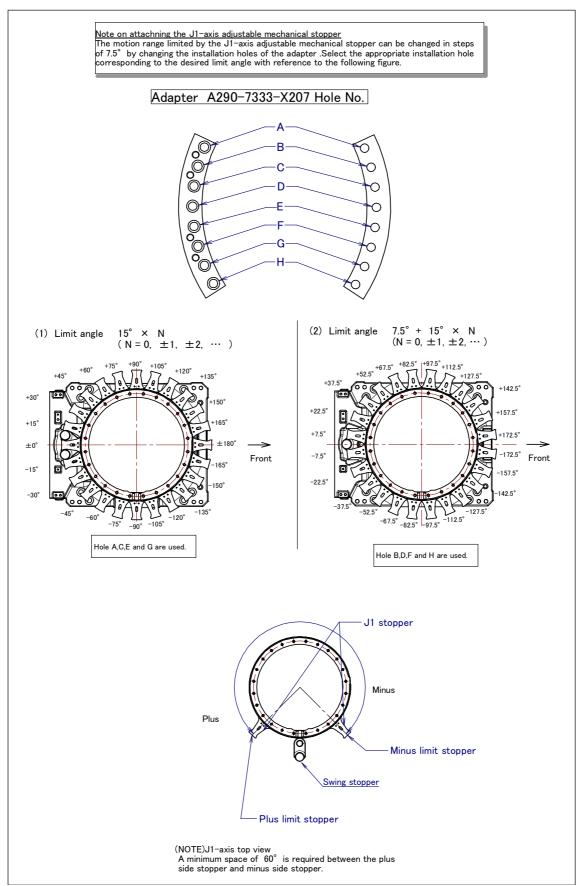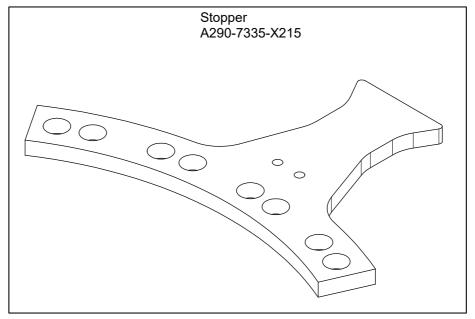**(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)**

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 A290-7333-X207 Hole No.

A
B
C
D
E
F
G
H

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

Front

Hole A,C,E and G are used.

(2) Limit angle   7.5° + 15° × N
     (N = 0, ±1, ±2, ⋯)

Front

Hole B,D,F and H are used.

J1 stopper

Minus

Plus

Minus limit stopper

Swing stopper

Plus limit stopper

(NOTE)J1-axis top view
 A minimum space of 60° is required between the plus
 side stopper and minus side stopper.

Fig. 6.2.1 (c) Mounting the J1-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)

Stopper
A290-7335-X215

Fig. 6.2.1 (d) J1-axis adjustable mechanical stopper (option)
(R-2000*i*C/100P/100PH/270F/270R/190S/210L/190U)

Stopper unit
A290-7335-V012#X213

Collar
A290-7324-X214

Stopper
A290-7333-X215
Bolts
M16 x 40 (4)
Washers (4)

Bolts
M24 x 80
Tightening torque 128Nm(13.1kgfm)
Apply LOCTITE 243
Washers
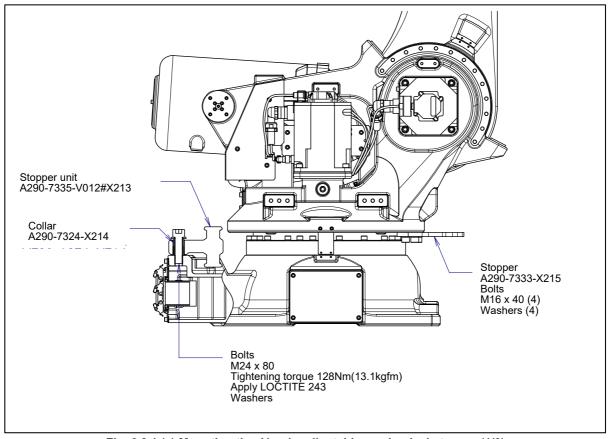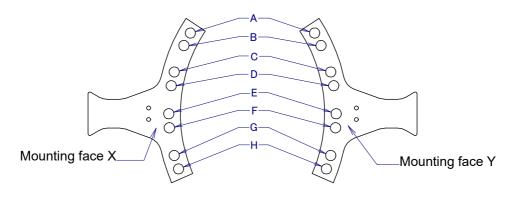
Fig. 6.2.1 (e) Mounting the J1-axis adjustable mechanical stopper (1/3)
(R-2000*i*C/100P/100PH/270F/270R/190S/210L/190U)

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 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
	Mounting pattern A	Mounting pattern B
For holes A,C,E and G	Bolt	
	Mounting pattern C	Mounting pattern D
For holes B,D,F and H		

(1) Limit angle $15° \times N$
(N = 0, ±1, ±2, ⋯)

Mounting pattern A or B

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

Mounting pattern C
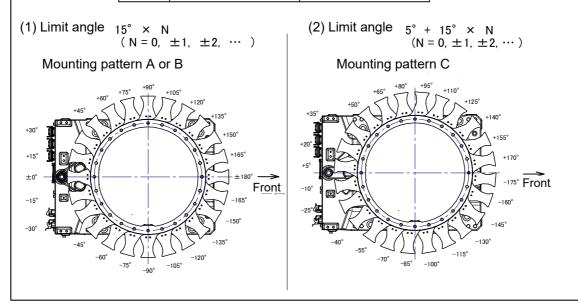
Fig. 6.2.1 (f) Mounting the J1-axis adjustable mechanical stopper (2/3)
(R-2000iC/100P/100PH/270F/270R/190S/210L/190U)

(3) Limit angle $10° + 15° × N$
                  $(N = 0, ±1, ±2, \cdots)$

Mounting pattern D

(Note) J1-axis top view
A minimum space of 70° is required between the plus side and minus side stopper.
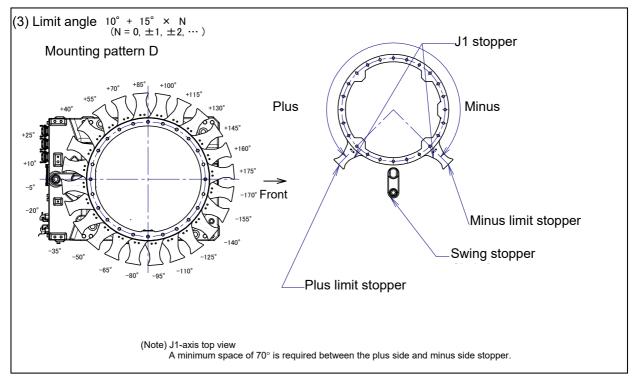
Fig. 6.2.1 (g) Mounting the J1-axis adjustable mechanical stopper (3/3)
(R-2000*i*C/100P/100PH/270F/270R/190S/210L/190U)

Stopper J2
A290−7333−X340
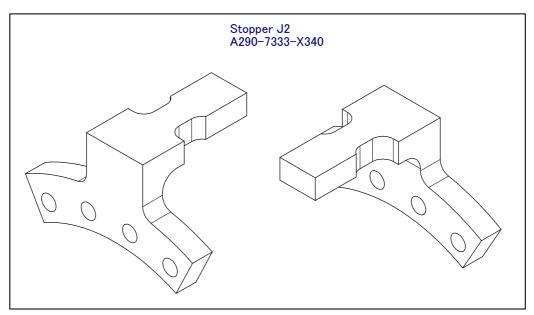
Fig. 6.2.1 (h) J2-axis adjustable mechanical stopper (option)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH)
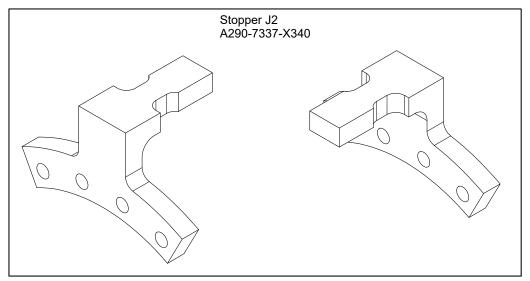
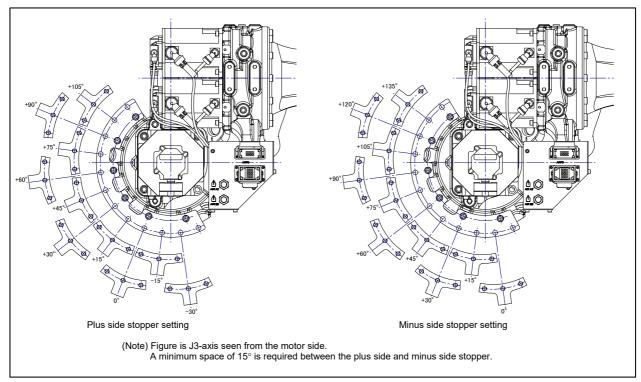**Fig. 6.2.1 (i) J2-axis adjustable mechanical stopper (option)**
(R-2000*i*C/270F/270R/190S/210L/190U)
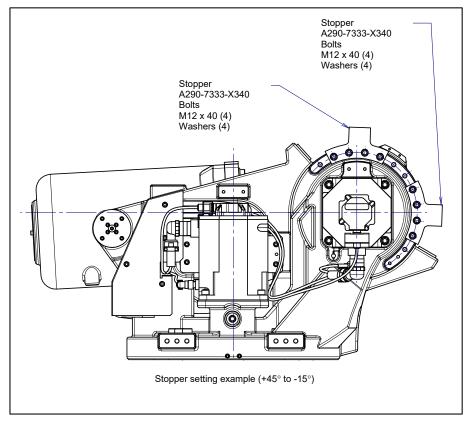
Fig. 6.2.1 (j) Mounting the J2-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/165F/210F/240F/125L/220U)

Plus side stopper setting   Minus side stopper setting

(Note) Figure is J2-axis seen from the motor side.
A minimum space of 30° is required between the plus side and minus side stopper.
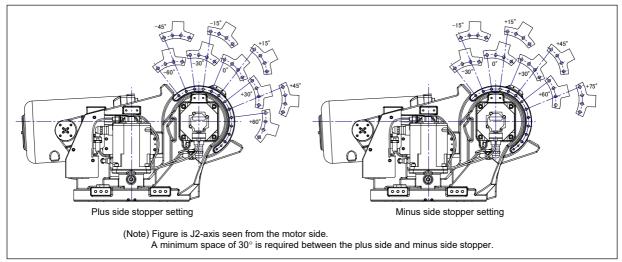
Fig. 6.2.1 (k) Mounting the J2-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/165F/210F/240F/125L/220U)
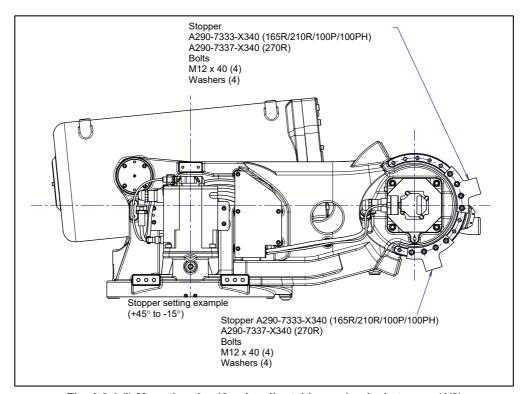
Stopper
A290-7333-X340 (165R/210R/100P/100PH)
A290-7337-X340 (270R)
Bolts
M12 x 40 (4)
Washers (4)

Stopper setting example
(+45° to -15°)

Stopper A290-7333-X340 (165R/210R/100P/100PH)
A290-7337-X340 (270R)
Bolts
M12 x 40 (4)
Washers (4)

Fig. 6.2.1 (l) Mounting the J2-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/165R/210R/100P/100PH/270R)

- 151 -

Plus side stopper setting   Minus side stopper setting

(Note) Figure is J2-axis seen from the motor side.
A minimum space of 30° is required between the plus side and minus side stopper.
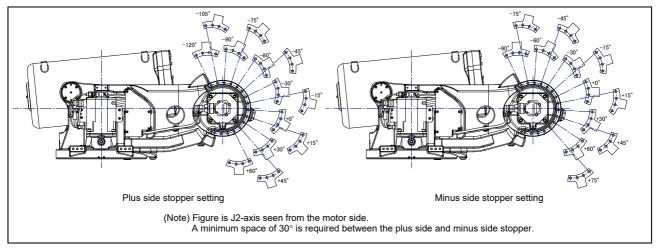
Fig. 6.2.1 (m) Mounting the J2-axis adjustable mechanical stopper (2/2)
(R-2000iC/165R/210R/100P/100PH/270R)

Stopper
A290-7337-X340
Bolts
M12 x 40 (4)
Washers (4)

Stopper
A290-7337-X340
Bolts
M12 x 40 (4)
Washers (4)

Stopper setting example
(+45° to -15°)
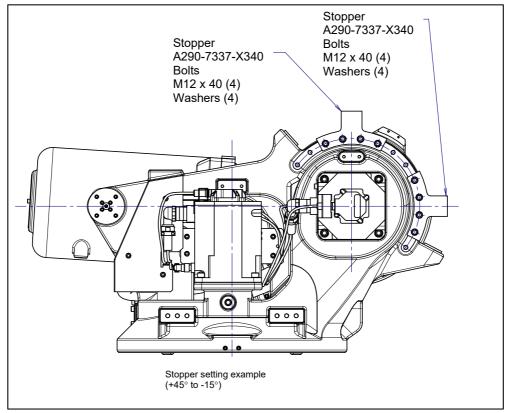
Fig. 6.2.1 (n) Mounting the J2-axis adjustable mechanical stopper (1/3)
(R-2000iC/270F/190S/210L/190U)

Plus side stopper setting   Minus side stopper setting

(Note) Figure is J2-axis seen from the motor side.
       A minimum space of 30° is required between the plus side and minus side stopper.
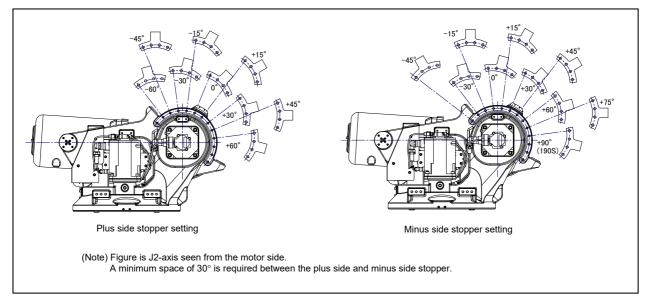
**Fig. 6.2.1 (o) Mounting the J2-axis adjustable mechanical stopper (2/3)
(R-2000iC/270F/190S/210L)**

Detach this stopper when the mechanical
stopper is installed to -45° or -30°
position. Be sure to reinstall this stopper
when the adjustable stopper is detached.
Stopper
A290-7337-X351
Bolts
M12x20 (2)
Washers (2)

Plus side stopper setting   Minus side stopper setting

(Note) Figure is J2-axis seen from the motor side.
       A minimum space of 30° is required between the plus side and minus side stopper.

**Fig. 6.2.1 (p) Mounting the J2-axis adjustable mechanical stopper (3/3)
(R-2000iC/190U)**

Stopper J3
A290-7333-X411
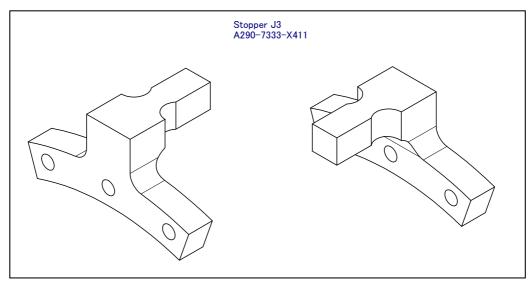
**Fig. 6.2.1 (q) J3-axis adjustable mechanical stopper (option)
(R-2000iC/165F/210F/240F/125L/220U/165R/210R/100P/100PH)**

- 153 -

For R-2000*i*C/165F/210F/240F/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.

Cover B
A290−7333−X605
Bolts
M6X10（6）
Washers（6）
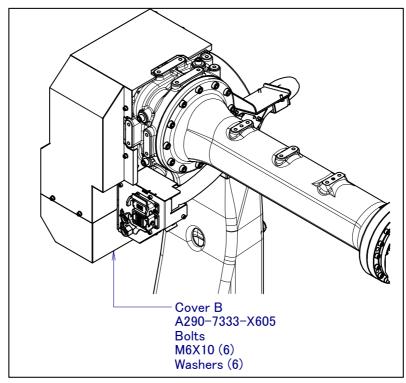
Fig. 6.2.1 (r) Mounting the J3-axis adjustable mechanical stopper (1/3)
(R-2000*i*C/165F/210F/240F/125L/165R/210R)

Stopper J3
A290−7333−X411
Bolts
M12X45（3）
Washers（3）

Stopper base
A290−7333−X410
Bolts
M12X45（6）
Washers（6）

Stopper J3
A290−7333−X411
Bolts
M12X45（3）
Washers（3）

Stopper setting example（+105°　to　0°）
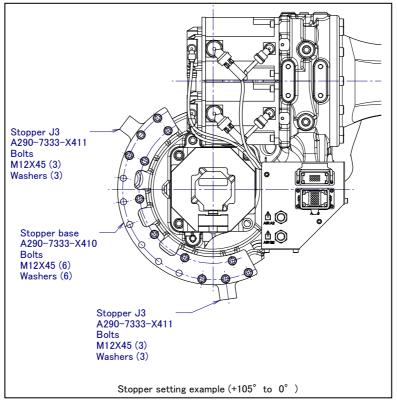
Fig. 6.2.1 (s) Mounting the J3-axis adjustable mechanical stopper (2/3)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH)

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. 6.2.1 (t) Mounting the J3-axis adjustable mechanical stopper (3/3)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH)

Stopper
A290-7337-X411
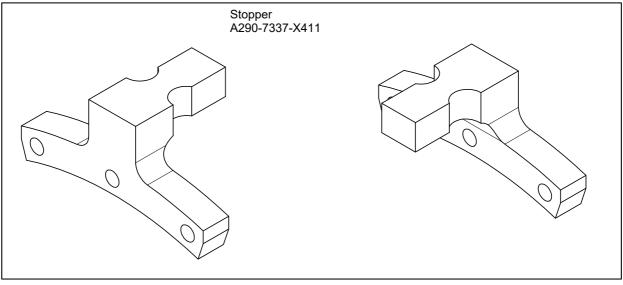
Fig. 6.2.1 (u) J3-axis adjustable mechanical stopper (option)
(R-2000*i*C/270F/270R/190S/210L/190U)

- 155 -

Stopper
A290-7337-X411
Bolts
M12 x 45 (3)
Washers (3)

Stopper
A290-7337-X410
Bolts
M12 x 45 (8)
Washers (8)

Stopper
A290-7337-X411
Bolts
M12 x 45 (3)
Washers (3)

Stopper setting example (+90° to -0°)
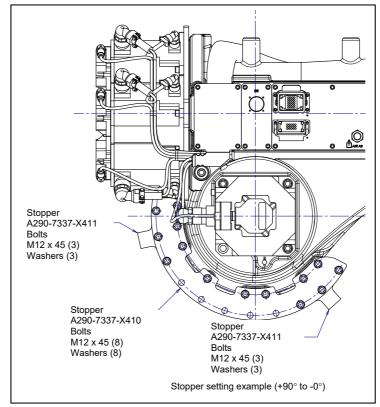
Fig. 6.2.1 (v) Mounting the J3-axis adjustable mechanical stopper (1/2)
(R-2000*i*C/270F/270R/190S/210L/190U)

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.
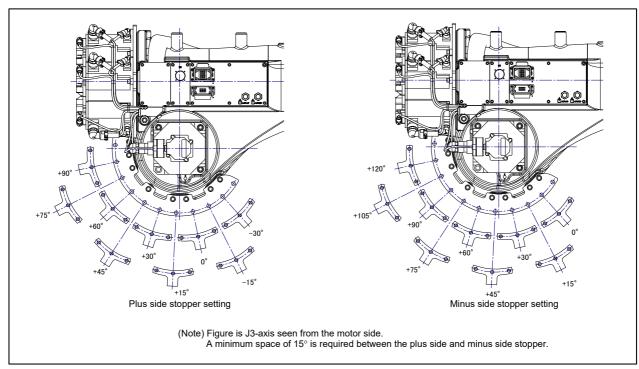
Fig. 6.2.1 (w) Mounting the J3-axis adjustable mechanical stopper (2/2)
(R-2000*i*C/270F/270R/190S/210L/190U)

6.2.2 Changing the parameter setting

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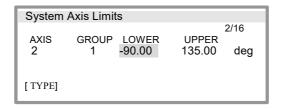
1   Press the [MENU] key to display the screen menu.
2   Select [0 NEXT] and press [6 SYSTEM].
3   Press F1 [TYPE].
4   Select [Axis Limits]. The following screen will be displayed.

```
System Axis Limits                    JOINT 100%
   Group1                                  1/16
   AXIS     GROUP     LOWER     UPPER
   1          1       -185.00    185.00    deg
   2          1        -90.00    135.00    deg
   3          1       -160.00    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]
```

> **NOTE**
>   0.00 indicates the robot does not have these axes.

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

```
System Axis Limits
                                          2/16
   AXIS      GROUP   LOWER        UPPER
   2           1     -90.00       135.00     deg


[ TYPE]
```

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

> ⚠ **WARNING**
> 1   You must cycle power of the controller to use the new information; otherwise, the old settings remain valid and could cause personnel injury or equipment damage.
> 2   After changing system variables, be sure to run the robot at a low speed and make sure that the robot stops at the ends of the stroke.
> 3   If a collision should occur, the adjustable mechanical stopper becomes deformed to absorb energy, so that the robot can stop safely. If the stopper is deformed by mistake, replace it.
> 4   Do not depend on parameter settings to control the motion range of your robot.

6.2.3   The maximum stopping distance (position) of adjustable mechanical stopper

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 6.2.3 (a) to (d) and Fig. 6.2.3 (a) to (f). 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 6.2.3 (a) The maximum stopping distance (position) of adjustable mechanical stopper
(R-2000*i*C/165F/210F/240F/125L/220U)

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

Table 6.2.3 (b) The maximum stopping distance (position) of adjustable mechanical stopper
(R-2000*i*C/165R/210R/100P/100PH)

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

Table 6.2.3 (c) The maximum stopping distance (position) of adjustable mechanical stopper
(R-2000*i*C/270F/190S/210L/190U)

	Plus side	Minus side
J1-axis	+18°	-18°
J2-axis	+17°	-13° (270F/210L) -17° (190S/190U)
J3-axis	+15°	-14° (270F/210L) -15° (190S/190U)

Table 6.2.3 (d) The maximum stopping distance (position) of adjustable mechanical stopper
(R-2000*i*C/270R)

	Plus side	Minus side
J1-axis	+21°	-21°
J2-axis	+17°	-13°
J3-axis	+15°	-14°
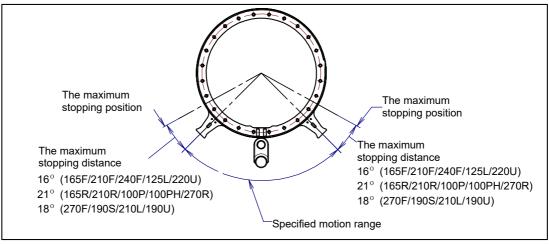
Fig. 6.2.3 (a) The maximum stopping distance of adjustable mechanical stopper of J1-axis
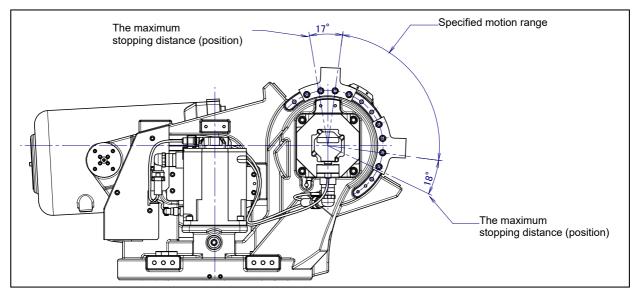
Fig. 6.2.3 (b) The maximum stopping distance of adjustable mechanical stopper of J2-axis
(R-2000*i*C/165F/210F/240F/125L/220U)
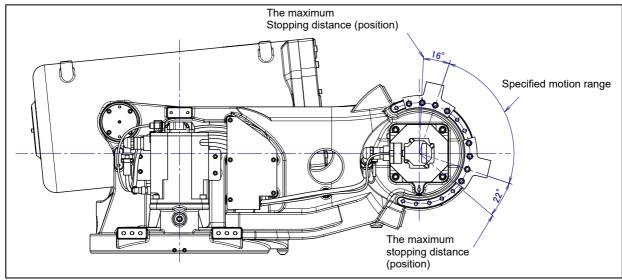
Fig. 6.2.3 (c) The maximum stopping distance of adjustable mechanical stopper of J2-axis
(R-2000*i*C/165R/210R/100P/100PH)
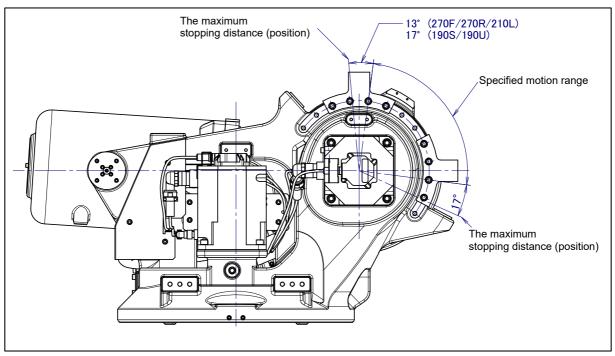
Fig. 6.2.3 (d) The maximum stopping distance of adjustable mechanical stopper of J2-axis
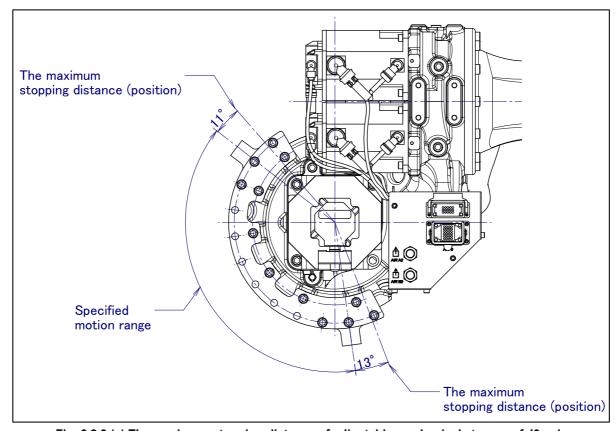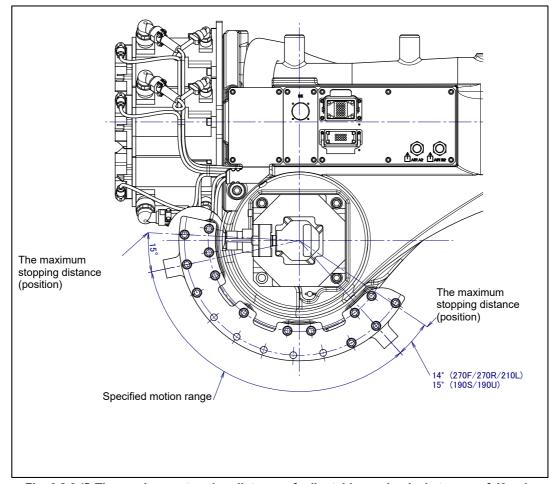**(R-2000*i*C/270F/270R/190S/210L/190U)**

Fig. 6.2.3 (e) The maximum stopping distance of adjustable mechanical stopper of J3-axis
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH)

Fig. 6.2.3 (f) The maximum stopping distance of adjustable mechanical stopper of J3-axis
(R-2000*i*C/270F/270R/190S/210L/190U)

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.
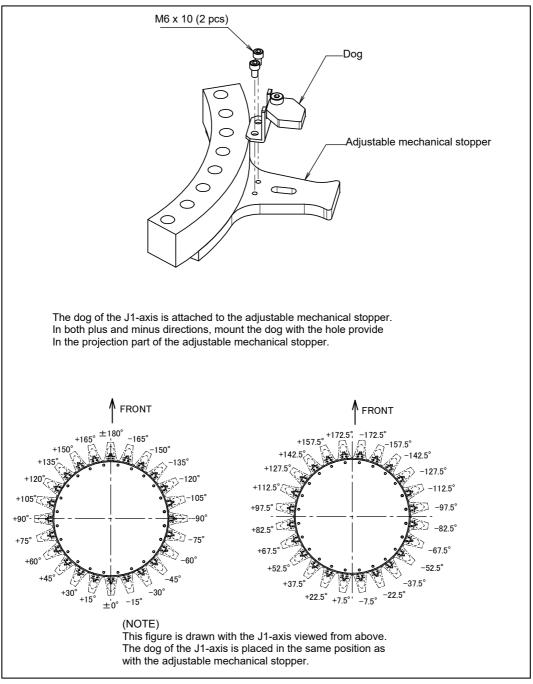
Fig. 6.3 (a) J1-axis dog position and motion range (option)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)

M6 x 16 (2 pcs)

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.
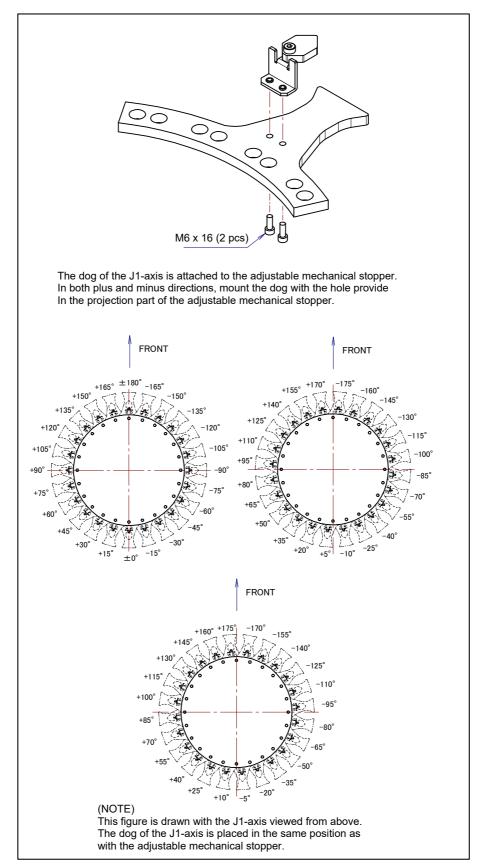
Fig. 6.3 (b) J1-axis dog position and motion range (option)
(R-2000*i*C/270F/210L/190U)

- 163 -

6.4   ADJUSTING LIMIT SWITCH (OPTION)

After the motion range is changed by the adjustable mechanical stopper and 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 : M8 x 12   2 pcs   M4 x 25   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.
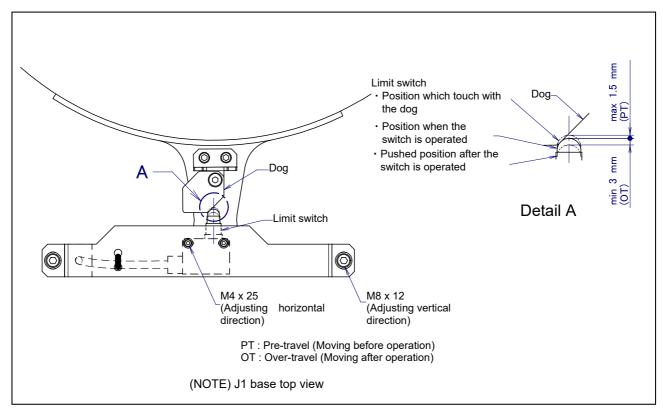
Fig. 6.4 (a) Adjusting J1-axis limit switch (option)
(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R)
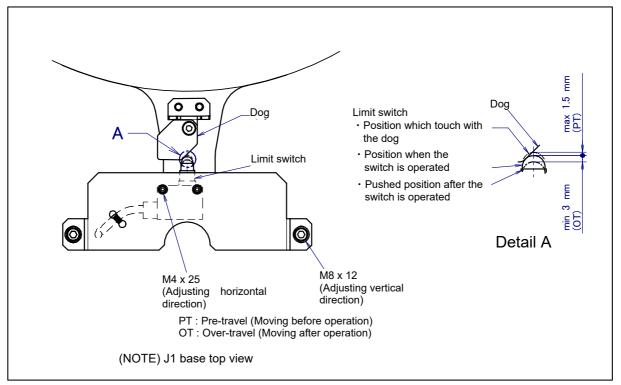
Fig. 6.4 (b) Adjusting J1-axis limit switch (option)
(R-2000*i*C/270F/210L/190U)

7   CHECKS AND MAINTENANCE

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

> **NOTE**
> The periodic maintenance procedures described in this chapter assume that the FANUC robot is used for up to 3840 hours a year. In cases where robot use exceeds 3840 hours/year, adjust the given maintenance frequencies accordingly. The ratio of actual operation 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 with a recommended maintenance interval of 3 years or 11520 hours, use the following calculation to determine the maintenance frequency: 3 years / 2 = perform maintenance every 1.5 years.

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 that the taught positions of the robot have not deviated from the previously taught positions. When the displacement occurs, perform the measures as described in the following section: ⇒"**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 0.2 mm or less when servo power is turned off. If the end effector (hand) drops, perform the measures as described in the following section: ⇒"**9.1 TROUBLESHOOTING**" (Symptom : Dropping axis)
Warnings	Check whether unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform the measures as described in the following manual: ⇒" **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 period or the accumulated operating time, whichever comes first. (○ : Item needs to be performed.)

Check and maintenance intervals (Period, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	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 protective sleeves	Check whether the cable protective sleeves of the mechanical unit cable have holes or tears. If damage is found, replace the cable protective sleeve. If the cable protective sleeve is damaged due to the interference with peripheral 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 fluid. 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 (Period, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method	Periodic maintenance table No.
1 month 320h	3 months 960h	1 year 3840h	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 bolts which were installed, removed, or exposed during inspection. Refer to the recommended bolt tightening torque guidelines at the end of the manual. Some bolts are attached with adhesive. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts.	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 protective sleeves).	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. Regardless of operating time, replace batteries at 1.5 years. ⇒"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. Regardless of operating time, replace batteries at 4 years. ⇒"Chapter 7 Replacing batteries of R-30iB/R-30iB Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN) or R-30iB Mate/R-30iB Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)"	23

7.2 CHECK POINTS

7.2.1 Confirmation of Oil Seepage

Check items

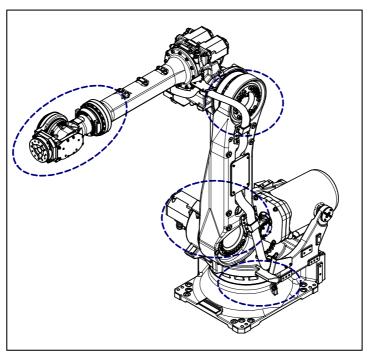Check to see whether there is an oil seepage on the rotating parts of each joint axis.

Fig.7.2.1 (a) 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 restored 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**

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

・ If you must wipe oil frequently, and opening the grease outlet does not stop the seepage, perform the measures below.
　⇒"9.1 TROUBLESHOOTING"(symptom：Grease leakage)

7.2.2 Confirmation of the Air Control Set (option)

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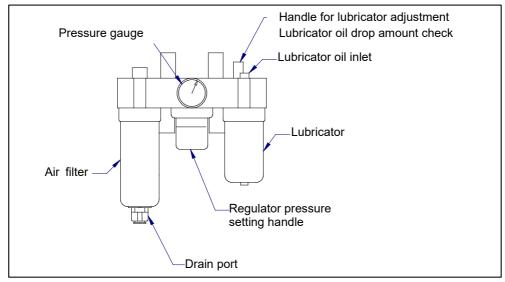
Fig. 7.2.2 (a) Air control set (option)

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.
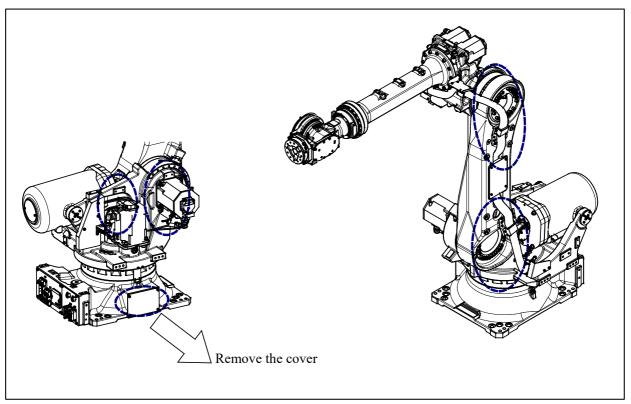

Remove the cover

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

Check items

＜Cable protective sleeve＞

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

Fig. 7.2.3 (b) Damage on the cable protective sleeve

＜Cables＞
・   Check that there is no wear or damage on the cable jacket.
・   If the inside wire strands are exposed due to wear or damage, replace the cables.

Open the
sleeve

Check the
jacket

If the jacket has damage as
shown here, replace the cable.
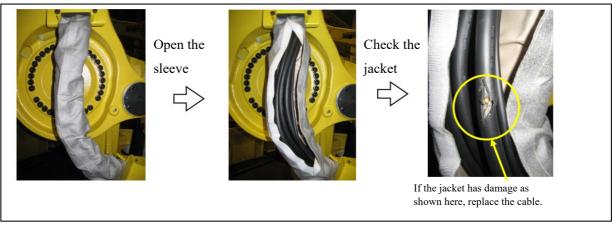
Fig. 7.2.3 (c) Cable check method

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 terminal for tightness.
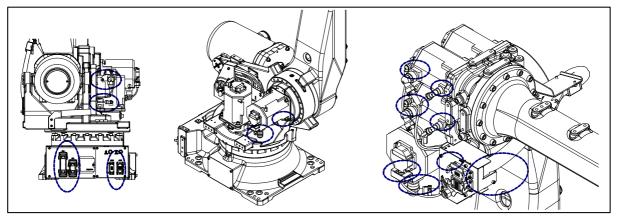
Fig. 7.2.3 (d) Connector Inspection points (R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH)
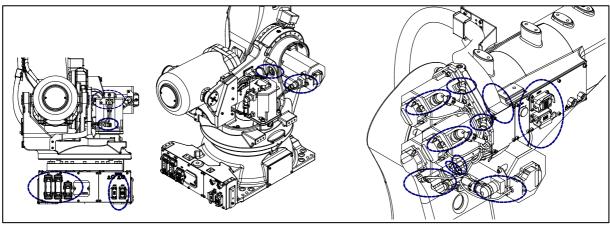
Fig. 7.2.3 (e) Connector Inspection points (R-2000*i*C/270F/270R/190S/210L/190U)

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 the J1-axis swing stopper rotates smoothly.
・   Refer to Section 6.2 of the operator's manual for details regarding the adjustable mechanical stopper.
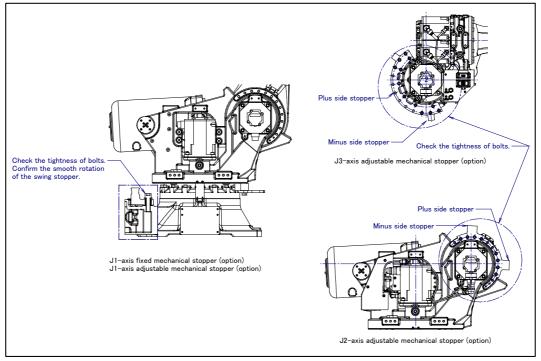
Fig. 7.2.4 (a) Check of fixed mechanical stopper and adjustable mechanical stopper

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 (a) shows the greasing points of the balancer bush.

Table 7.3.1 (a) Greasing the balancer bush

Recommended grease	Amount of grease	Greasing interval
Shell Lubricants Shell Alvania grease S2 Specification: A98L-0004-0602#CTG	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

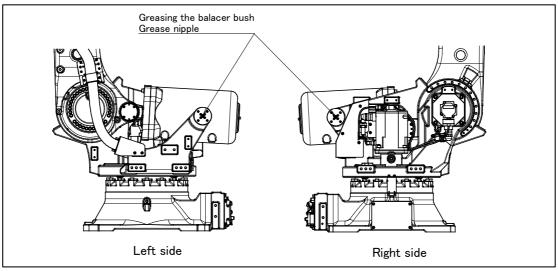| Maker	Grease name
Exxon Mobile	Mobilux EP2
ENEOS	Multinoc 2
ENEOS	Epinoc grease AP(N)2
Idemitsu Kosan Co., Ltd.	Eponex grease No. 2
Cosmo Oil Co., Ltd.	Dynamax No. 2
Shell Lubricant	Shell Gadus S2 V100 2

Fig. 7.3.1 (a) Balancer bush greasing points

7.3.2   Replacing the Batteries (1.5 year 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 plate from the battery case as shown in Fig. 7.3.2 (b) to replace the battery. After replacing the battery, reinstall the plate. At this time, please be sure to replace gasket with new one for severe dust/liquid protection.
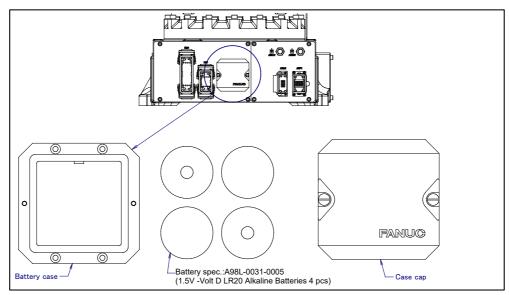

Battery case
Battery spec.:A98L-0031-0005
(1.5V -Volt D LR20 Alkaline Batteries 4 pcs)
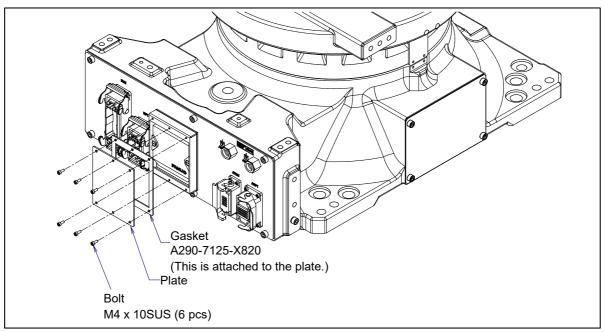Case cap

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-2000iC/165F R-2000iC/210F R-2000iC/240F R-2000iC/125L R-2000iC/220U R-2000iC/165R R-2000iC/210R	J1-axis reducer	4250g (4730ml)		
	J2-axis reducer	2250g (2500ml)		
	J3-axis reducer	1950g (2170ml)		
	wrist 1 (J4/J5-axis reducer)	2300g (2560ml)		
	wrist 2 (J6-axis reducer)	400g (440ml)		
R-2000iC/100P R-2000iC/100PH	J1-axis reducer	6200g (6900ml)		
	J2-axis reducer	2250g (2500ml)		
	J3-axis reducer	1950g (2170ml)		
	wrist 1 (J4/J5-axis reducer)	2300g (2560ml)	0.15MPa or less (NOTE)	Spec : A98L-0040-0174
	wrist 2 (J6-axis reducer)	620g (690ml)		
R-2000iC/270F R-2000iC/270R R-2000iC/210L R-2000iC/190U	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)	560g (630ml)		
R-2000iC/190S	J1-axis reducer	5150g (5720ml)		
	J2-axis reducer	3120g (3470ml)		
	J3-axis reducer	2370g (2640ml)		
	wrist 1 (J4/J5-axis reducer)	4980g (5540ml)		
	wrist 2 (J6-axis reducer)	560g (630ml)		

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

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

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

Table 7.3.3 (b) Postures for greasing (R-2000iC/165F/210F/240F/125L/220U/270F/190S/210L/190U)

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-2000iC/165R/210R/100P/100PH/270R)

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 (g)).
4 Supply new grease through the grease inlet until new grease is output from grease outlet.
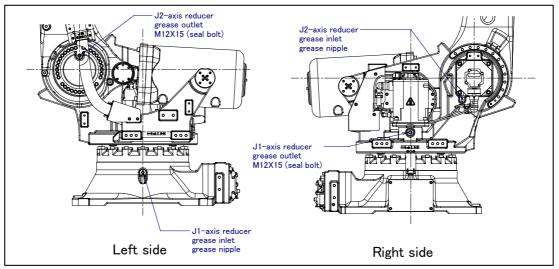5 Release remaining pressure using the procedure given in Subsection 7.3.4.

Fig. 7.3.3 (a) Replacing grease of the J1/J2-axis reducer (R-2000iC/165F/210F/240F/125L/220U)
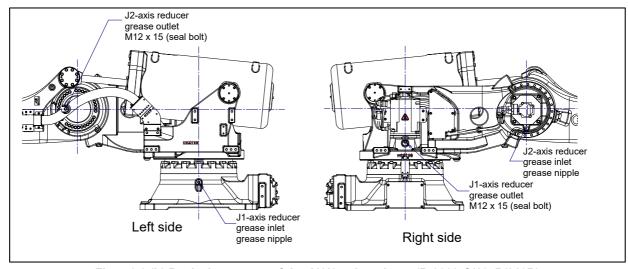
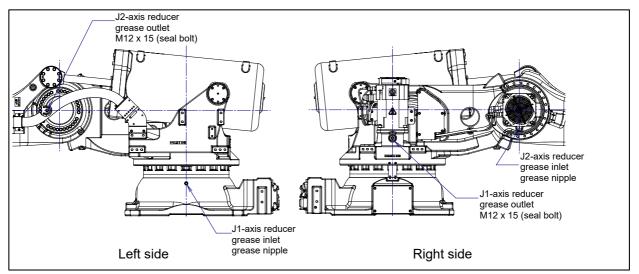**Fig. 7.3.3 (b) Replacing grease of the J1/J2-axis reducer (R-2000*i*C/165R/210R)**

Fig. 7.3.3 (c) Replacing grease of the J1/J2-axis reducer (R-2000*i*C/100P/100PH)

- 178 -

J2-axis reducer grease outlet
M12 x 15 (seal bolt)

J1-axis reducer
grease outlet
M12 x 15 (seal bolt)

J1-axis reducer grease inlet
grease nipple

Left side

Right side

A

J2-axis reducer grease inlet
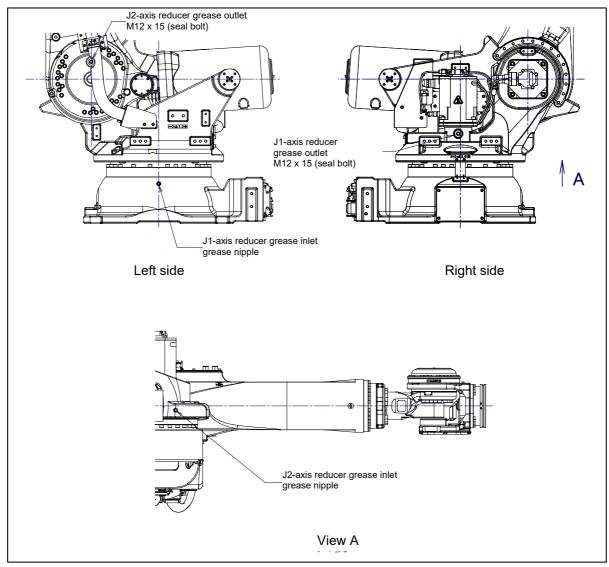grease nipple

View A

Fig. 7.3.3 (d) Replacing grease of the J1/J2-axis reducer (R-2000*i*C/270F/270R/210L/190U)
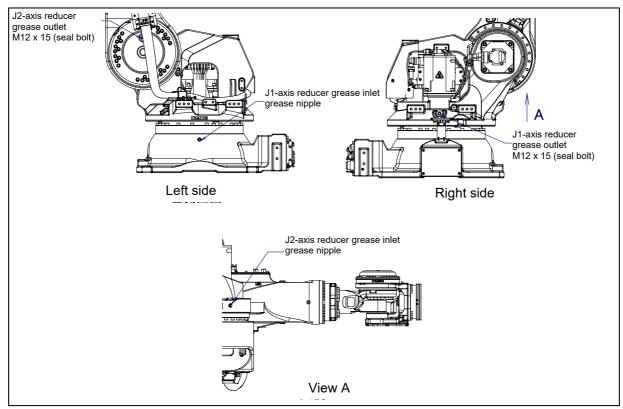
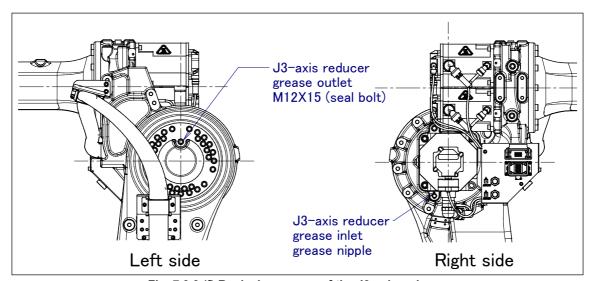**Fig. 7.3.3 (e) Replacing grease of the J1/J2-axis reducer (R-2000*i*C/190S)**

Fig. 7.3.3 (f) Replacing grease of the J3-axis reducer
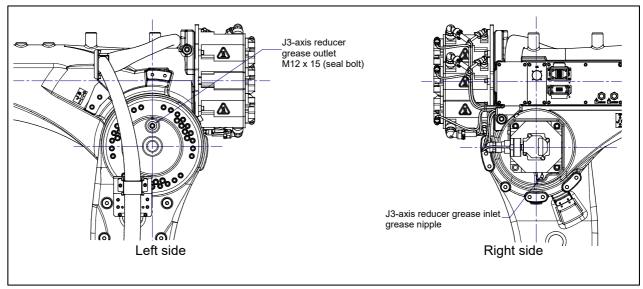**(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH)**

Fig. 7.3.3 (g) Replacing grease of the J3-axis reducer (R-2000*i*C/270F/270R/190S/210L/190U)

Grease Replacement Procedure for the Wrist

> ⚠ **CAUTION**
> Grease replacing methods differ from R-2000*i*B, R-2000*i*A, please be careful.

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 (h), (i)).
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.
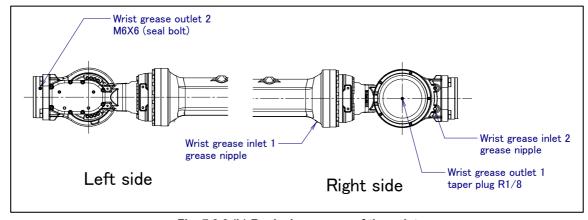7   Release remaining pressure using the procedure given in Subsection 7.3.4.

Fig. 7.3.3 (h) Replacing grease of the wrist
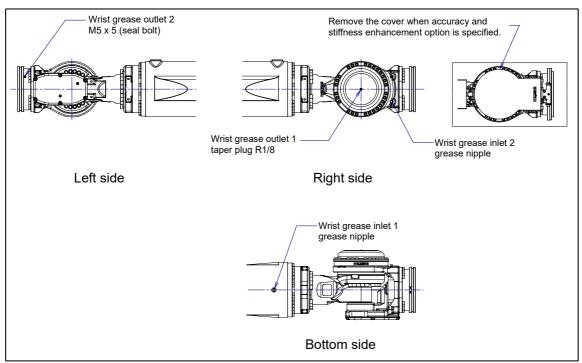**(R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH)**

Fig. 7.3.3 (i) Replacing grease of the wrist
(R-2000*i*C/270F/270R/190S/210L/190U)

Table 7.3.3 (d) Spec. of the seal bolts, taper plugs and the grease nipple

Parts name	Specifications
Seal bolt (M5)	A97L-0218-0417#050505
Seal bolt (M6)	A97L-0218-0417#060606
Seal bolt (M12)	A97L-0218-0417#121515
Taper plug (R1/8)	A97L-0001-0436#1-1D
Grease nipple (J1 to J3-axis)	A97L-0218-0013#A610
Grease nipple (Wrist)	A97L-0218-0013#A110

> ⚠ **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, remove the seal bolts or the taper plugs of the
>   grease outlet to allow the grease to come out.
> 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 accidents and catching fire, completely 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	Procedure
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, adjust the operating time according to the operating angle. (If only half of the predetermined motion angle can be set, perform an operation for a time twice as long as the specified time.) If you grease multiple axes, you can exercise 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 that was used for transportation. (See Section 1.1.)

8   MASTERING

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

> ⚠ **CAUTION**
> 1   The motion limits are temporarily invalid during mastering. Cables may be damaged if the J1-axis exceeds +/-185º.
> 2   In case of performing mastering with gravity compensation (option) is enabled, if load setting (See Section 4.3) is not correct, it will influence the precision of the mastering.

8.1   OVERVIEW

The current position of the robot is determined according to the pulse count value supplied from the Pulsecoder on each axis.
Mastering is factory-performed. It is unnecessary to perform mastering in daily operations. However, mastering becomes necessary after:
- Motor replacement.
- Pulsecoder replacement
- Reducer replacement
- Cable replacement
- Batteries for pulse count backup in the mechanical unit have gone dead

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

Types of Mastering

Table 8.1 (a) 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 (a) Type of mastering

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

Once mastering is performed, you must carry out positioning, 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 accurate mastering (fixture position mastering), contact your local FANUC representative.

⚠ **CAUTION**
1   If mastering is performed incorrectly, the positioner may behave unexpectedly. This is very dangerous. Therefore, the positioning screen is designed to appear only when the $MASTER_ENB system variable is 1 or 2. After performing positioning, press F5 [DONE] on the positioning screen. The $MASTER_ENB system variable is reset to 0 automatically, thus hiding the positioning screen.
2   It is recommended that you back up the current mastering data before performing mastering.

8.2   RESETTING ALARMS AND PREPARING FOR MASTERING

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

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

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

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

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

If "SRVO-062 BZAL" alarm or "SRVO-068 DTERR" alarm occurred, and you cannot release the alarm, Please check there is no faulty wiring or disconnected part.

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]. Then select [Variables] from the menu.
4 If $DMR_GRP [group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
$PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)
Brake control can be released by setting the system variables as follows:
$PARAM_GROUP.SV_OFF_ALL   : FALSE
$PARAM_GROUP.SV_OFF_ENB[*]   : FALSE (for all axes)
After changing the system variables, cycle power of the controller.

---

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

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


[ TYPE ]   LOAD   RES_PCA           DONE
```
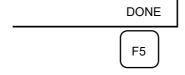
9   Jog the robot into a posture for mastering.
10   Select [2 ZERO POSITION MASTER]. Press F4 [YES].

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

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

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

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

```
                          DONE
          _____|
                     |
                   ___|___
                  |  F5   |
                  |_____|
```

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

Table 8.3 (a) 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

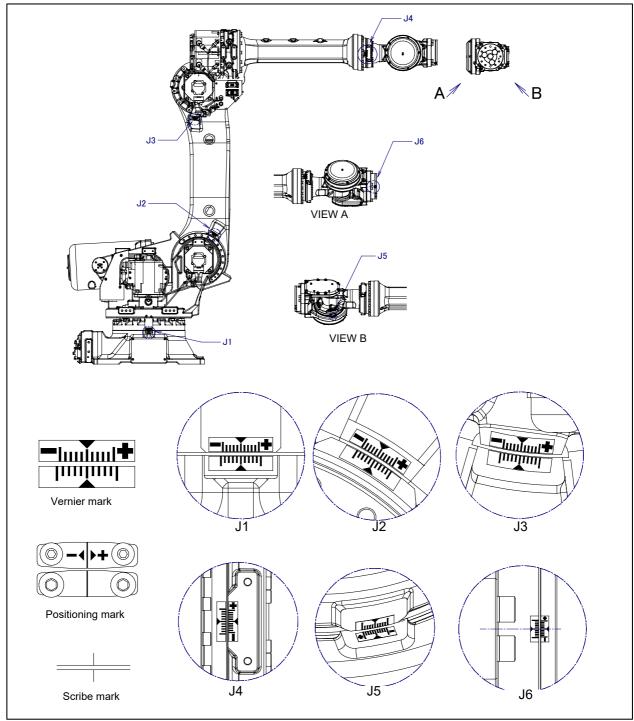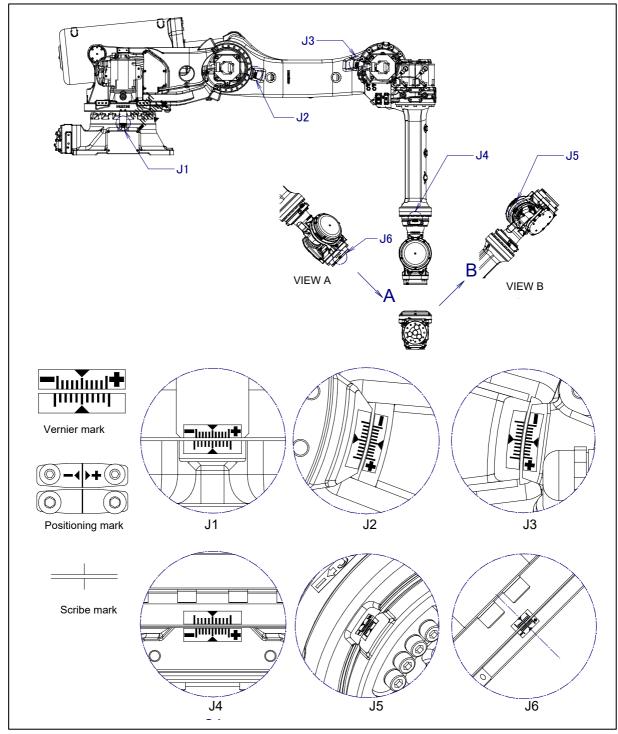**Fig. 8.3 (a) Zero-position mark (witness mark) for each axis (R-2000*i*C/165F/210F/240F/125L/220U)**

Fig. 8.3 (b) Zero-position mark (witness mark) for each axis (R-2000*i*C/165R/210R/100P/100PH)

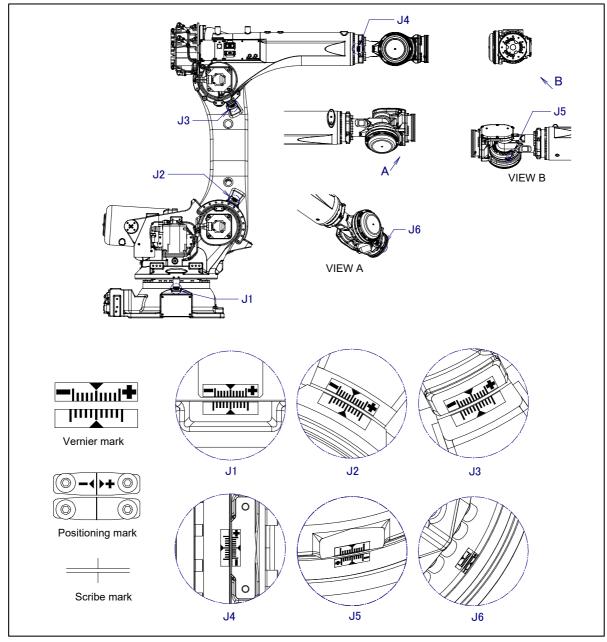**Fig. 8.3 (c) Zero-position mark (witness mark) for each axis (R-2000*i*C/270F/270R/190S/210L/190U)**

8.4 QUICK MASTERING

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

Quick mastering is factory-performed at the position indicated in Table 8.3 (a). 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   Press the [MENU] key to display the screen menu.
2   Select [0 NEXT] and press [6 SYSTEM].
3   Press F1 [TYPE]. Then select [Variables] from the menu.
4   If $DMR_GRP [group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

NOTE
   Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
      $PARAM_GROUP[group].$SV_DMY_LNK[8]   : FALSE (disabled) or TRUE (enabled)
   Brake control can be released by setting the system variables as follows:
      $PARAM_GROUP.SV_OFF_ALL   : FALSE
      $PARAM_GROUP.SV_OFF_ENB[*]   : FALSE (for all axes)
   After changing the system variables, cycle power of the controller.

---

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

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


[ TYPE ]   LOAD   RES_PCA              DONE
```

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

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

```
 [ TYPE ]                   YES    NO
```

```
F4
```

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

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

Procedure of Quick Mastering

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

```
NOTE
    Gravity compensation can be set to enabled/disabled by setting the system
    variables as follows:
    $PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE (disabled) or TRUE
    (enabled)
    Brake control can be released by setting the system variables as follows:
    $PARAM_GROUP.SV_OFF_ALL          : FALSE
    $PARAM_GROUP.SV_OFF_ENB[*]        : FALSE (for all axes)
    After changing the system variables, cycle power of the controller.
```
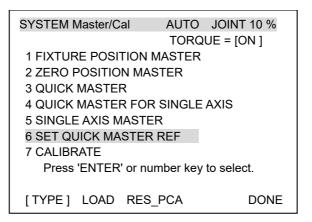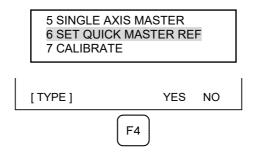
5   Display the Master/Cal screen.

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

Quick master? [NO]
```

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

```
 2 ZERO POSITION MASTER
 3 QUICK MASTER
 4 QUICK MASTER FOR SINGLE AXIS
```

```
F4
```

8   Select [7 CALIBRATE] and press the [ENTER] key.   Calibration is executed.   Calibration is executed by cycling power.
9   After completing the calibration, press F5 [DONE].

```
DONE
```

```
F5
```

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

8.5   QUICK MASTERING FOR SINGLE AXIS

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

Quick mastering is factory-performed at the position indicated in Table 8.3 (a). 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   Press the [MENU] key to display the screen menu.
2   Select [0 NEXT] and press [6 SYSTEM].
3   Press F1 [TYPE]. Then select [Variables] from the menu.
4   If $DMR_GRP [group].$GRAV_MAST=1, set the gravity compensation to enabled, if it is 0, set the gravity compensation to disabled. In addition release the brake control.

> **NOTE**
>   Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
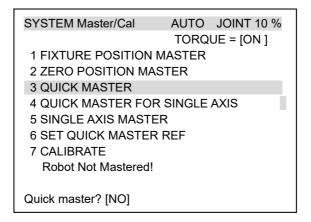> $PARAM_GROUP[group].$SV_DMY_LNK[8]   : FALSE (disabled) or TRUE (enabled)
>   Brake control can be released by setting the system variables as follows:
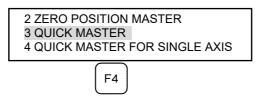> $PARAM_GROUP.SV_OFF_ALL   : FALSE
> $PARAM_GROUP.SV_OFF_ENB[*]   : FALSE (for all axes)
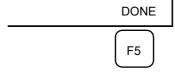>   After changing the system variables, cycle power of the controller.

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

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


[ TYPE ]  LOAD   RES_PCA           DONE
```

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

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

```
[ TYPE ]                    YES    NO
```

```
F4
```

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

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

Procedure of Quick Mastering for single axis

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

> **NOTE**
> Gravity compensation can be set to enabled/disabled by setting the system
> variables as follows:
> $PARAM_GROUP[group].$SV_DMY_LNK[8]   : FALSE (disabled) or TRUE
> (enabled)
> Brake control can be released by setting the system variables as follows:
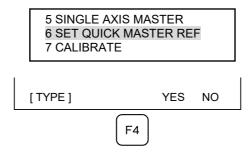> $PARAM_GROUP.SV_OFF_ALL   : FALSE
> $PARAM_GROUP.SV_OFF_ENB[*]   : FALSE (for all axes)
> After changing the system variables, cycle power of the controller.

5   Display the Master/Cal screen.

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


[ TYPE ]   LOAD   RES_PCA          DONE
```

6   Select [4 QUICK MASTER FOR SINGLE AXIS]. You will see the quick master for single axis screen.
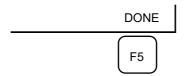
```
                              AUTO JOINT 1%

QUICK MASTER FOR SINGLE AXIS
                                                    1/9
        ACTUAL  POS   (MSTR POS)   (SEL)   [ST]
   J1      0.000    (     0.000)    (0)     [2]
   J2      0.000    (     0.000)    (0)     [2]
   J3      0.000    (     0.000)    (0)     [2]
   J4      0.000    (     0.000)    (0)     [2]
   J5      0.000    (     0.000)    (0)     [2]
   J6      0.000    (     0.000)    (0)     [0]
   E1      0.000    (     0.000)    (0)     [0]
   E2      0.000    (     0.000)    (0)     [0]
   E3      0.000    (     0.000)    (0)     [0]

                                                    EXEC
```

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

```
                              AUTO JOIN 1%

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

                                                    EXEC
```

8   Jog the robot to the quick mastering reference position.
9   Press F5 [EXEC]. Mastering is performed. So, (SEL) is reset to 0, and [ST] is re-set to 2.
10   Select [7 CALIBRATE] and press F4 [YES]. Calibration is executed.   Calibration is executed by cycling power.
11   After completing the calibration, press F5 [DONE].

```
                          DONE  |
              _____  |
                          ____
                         | F5 |
                          ____
```

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

8.6   SINGLE AXIS MASTERING

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

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

```
SINGLE AXIS MASTER          AUTO    JOINT 10%
                                         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
```

Table 8.6 (a) 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.

Single axis mastering for interaction axis

When single axis mastering is done in interaction axis, the axis of the interaction pair is also influenced. Therefore, mastering of these interaction axes must be done at the same time. Interaction axis depends on the robot model. Following table shows the relation between robot model and interaction axis. For example, when robot model is R-2000*i*B/165F and J4 motor is changed, mastering of J5 and J6 should be done at the same time with J4. (Provided that if 7DC2(V8.20P)/14 or later software version is installed, axis numbers which should be selected to do single axis mastering at the same time are displayed if these are not selected. In this case, it is unnecessary to refer to a following table.)

Table 8.6 (b)   Relation between robot model and interaction axis

Robot model		Interaction axis
R-2000*i*C	/165F/210F	· J2/J3 · J4/J5/J6

Procedure of Single axis mastering

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

NOTE
    Gravity compensation can be set to enabled/disabled by setting the system variables as follows:
    $PARAM_GROUP[group].$SV_DMY_LNK[8] : FALSE (disabled) or TRUE (enabled)
    Brake control can be released by setting the system variables as follows:
    $PARAM_GROUP.SV_OFF_ALL   : FALSE
    $PARAM_GROUP.SV_OFF_ENB[*]   : FALSE (for all axes)
    After changing the system variables, cycle power of the controller.

---

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

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


[ TYPE ]   LOAD   RES_PCA            DONE
```

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

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

                                        EXEC
```
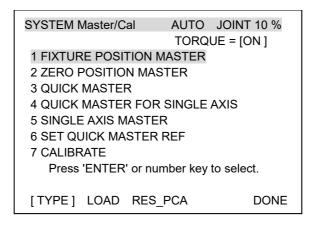
8   Move the cursor to the [SEL] column for the unmastered axis and press the numeric key [1].   Setting of [SEL] is available for one or more axes.
9   Turn off brake control, then jog the robot to the mastering position.
10   Enter axis data for the mastering position.

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

```
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
```

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

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


 [ TYPE ]   LOAD   RES_PCA            DONE
```

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

```
                    DONE
    _____
                  |  F5  |
```

15   Return the setting of the gravity compensation.
16   Return brake control to the 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.

```
                              AUTO
SYSTEM Variables                     JOINT 1%

                            TORQUE = [ON]
    1 $AO_MAXAX            536870912
    2 $AP_PLUGGED          4
    3 $AP_TOTALAX          1677216
    4 $AP_USENUM           [12] of Byte
    5 $AUTOINIT            2
    6 $BLT                 19920216

       [ TYPE ]
```

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

```
                              AUTO
SYSTEM Variables                     JOINT 1%

                            TORQUE = [ON]
   135   $DMR_GRP          DMR_GRP_T
   136   $ENC_STAT         [2] of ENC STATT

       [ TYPE ]
```

4　Select $DMR_GRP.

```
                              AUTO
SYSTEM Variables                     JOINT 1%
  $DMR_GRP                           1/1

     1      [1]           DMR_GRP_T
```

```
                              AUTO
SYSTEM Variables                     JOINT 1%

  $DMR_GRP                           1/29

     1    $MASTER_DONE     FALSE
     2    $OT_MINUS        [9] of BOOLEAN
     3    $OT_PLUS         [9] of BOOLEAN
     4    $MASTER_COUNT    [9] of INTEGER
     5    $REF_DONE        FALSE
     6    $REF_POS         [9] of REAL
     7    $REF_COUNT       [9] of INTEGER
     8    $BCKLSH SIGN     [9] of BOOLEAN


       [ TYPE ]             TRUE      FALSE
```

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

```
                              AUTO
SYSTEM Variables            JOINT 1%

$DMR GRP                       1/1
   1  [1]         95678329
   2  [2]         10223045
   3  [3]         3020442
   4  [4]         304055030
   5  [5]         20497709
   6  [6]         2039490
   7  [7]         0
   8  [8]         0
   9  [9]         0
```

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

```
                              AUTO
SYSTEM Variables            JOINT 1%

$DMR GRP                       1/1
   1  $MASTER_DONE    TRUE
   2  $OT MINUS       [9] of BOOLEAN
[TYPE]                  TRUE   FALSE
```

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

```
                  DONE

                  F5
```

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 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 (a) shows the major troubleshooting symptoms that may occur in the mechanical unit and their probable causes. If you cannot pinpoint the cause of a failure or which measures to take, contact your local FANUC representative. For the troubleshooting except the mechanical unit, refer to "CONTROLLER MAINTENANCE MANUAL (B-83195EN etc.)" and Alarm Code List (B-83284EN-1).

Table 9.1 (a) TROUBLESHOOTING

Symptoms	Descriptions	Causes	Measures
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 floor plate, the J1 base lifts the floor plate as the robot operates, allowing the base and floor plates to strike each other. That, in turn, leads to vibration.	- If a bolt is loose, apply LOCTITE and tighten it with 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 can deform the rack or floor, and causes 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 will reduce the vibration.

Symptoms	Descriptions	Causes	Measures
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 overloaded, reduce the load, or modify the robot control program. - Vibration can be reduced by re-modifying the robot control program; reducing speed or acceleration with minimizing 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. - Periodic vibration and noise occur.	[Gear, bearing, or reducer] - It is likely that the collision or overload applied an excessive force to the drive system, thus damaged the geartooth surface or rolling surface of a bearing, or reducer. - It is likely that prolonged use of the robot while overloaded caused fretting of the gear tooth surface or rolling surface of a bearing, or reducer due to resulting metal fatigue. - It is likely that foreign 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 caused vibration. - It is likely that, because the grease has not been replaced for a long period, fretting occurred on the gear tooth surface or rolling surface of a bearing, or reducer due to metal fatigue.	- 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. - Supplying the specified grease at the recommended interval will prevent problems.

Symptoms	Descriptions	Causes	Measures
Vibration Noise (Continued)	- The cause of problem cannot be identified from examination of the floor, rack, or mechanical unit.	[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 robot connection cable 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 an 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 there is a mechanical problem. - Shake the movable part cable while the robot is at rest, and check whether an alarm occurs. If an alarm or any other abnormality occurs, replace the mechanical unit cable. - Check whether the cable jacket of the robot connection cable is damaged. If so, replace the connection cable, and check whether vibration still occurs. - Check whether the power cable jacket is damaged. If so, replace the power cable, and check whether vibration still occurs. - Check that the robot is supplied with the rated voltage. - Check that the robot control parameter is set to a valid value. If it is set to an invalid value, correct it. Contact your local FANUC representative for further information if necessary.

Symptoms	Descriptions	Causes	Measures
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 can be induced on the grounding wire, preventing commands from being transferred accurately, thus leading to vibration. - If the robot is grounded at an unsuitable point, its grounding potential becomes unstable, and noise is likely to be induced on the grounding line, thus will lead to vibrate.	- Connect the grounding wire firmly to ensure a reliable ground potential thereby preventing extraneous electrical noise.
	- There is an unusual sound after replacing grease. - There is an unusual sound after a long time. - There is an unusual sound during operation at low speed.	- There may be an unusual sound when using other than the specified grease. - Even for the specified grease, there may be an unusual sound during operation at low speed immediately after replacement or after a long period of time.	- Use the specified grease. - When there is an abnormal noise even when using the specified grease, operate for one or two days as an experiment. Generally, any abnormal noise will disappear.
	- Unusual noise occurred at the balancer inside.	- Liquid might intruded into the balancer, and it caused corrosion of the spring and breakage.	- Prevent liquid splashing to the balancer.

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 effector retaining bolt

Symptoms	Descriptions	Causes	Measures
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 is 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 the motor, it is advisable to install shielding to protect the motor from heat radiation. - Relaxing the robot control program and load condition is an effective way to reduce the average current. Thus, prevent 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 accelerate or decelerate normally, so the average current increases, leading to the motor overheating.	- 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 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. - Judgment is possible if the average current decreased after replacing the motor, the former motor had been defected. - If the cooling fan is broken, replace it with a new one.

Symptoms	Descriptions	Causes	Measures

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 outlet
			- Replace the grease nipple.

Dropping axis	- An axis falls because the brake went out.
	- An axis falls while standing still.
		[Brake drive relay and motor]
		- It is likely that brake drive relay contacts 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 are stuck to each other or not. If they are found to be stuck, replace the relays.
			- Replace the motor after confirming whether the following symptoms have occurred.
			  - Brake shoe is worn out
			  - Brake main body is damaged
			  - Oil soaked through the motor

Symptoms	Descriptions	Causes	Measures
Displace ment	- The robot moves to 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 fasting surface of each axis arm, and reducer. - It is likely that the Pulsecoder is faulty.	- If the repeatability is unstable, repair the mechanical unit by referring to the above descriptions of vibration, noise, and rattling. - If the repeatability is stable, correct the taught program. The problem will not reoccur unless another collision occurs. - If the Pulsecoder is faulty, replace the motor.
	- Displacement occurs only in 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 overwritten, and the origin had misaligned.	- Re-enter the previous optimal mastering data. - If correct mastering data is unavailable, perform mastering again.

Symptoms	Descriptions	Causes	Measures
CLALM alarm occurred. Move error excess alarm occurred.	- Ambient temperature of the robot installation location is low, CLALM alarm is displayed on the teach pendant screen. - Ambient temperature of the robot installation position is low, "Move error excess" alarm is displayed on the teach pendant screen.	[Peripheral temperature] - When the robot is used in a low temperature environment that is near to 0ºC, or the robot is not operated for a long time in an environment that is less than 0ºC, there will be a large viscous resistance of the drive train immediately after starting which will cause the alarm.	- Perform a warm up operation or a low speed operation for several minutes.
	- After changing the motion program or the load condition, the CLALM alarm is displayed. - After changing the motion program or the load condition, the "Move error excess" alarm is displayed.	- It is likely that a robot collision occurred.	- If a robot collision has occurred, press the [RESET] key while pressing the [SHIFT] key. Then, jog the robot in the opposite direction while pressing the [SHIFT] key. - Check the motion program.

		[Overload]
		 - It is likely that load exceeded the permissible value.
		 - It is likely that the motion program is too severe for the robot.
		   · Excessive motion due to a large "ACC (value)".
		   · Tight motion such as reverse motion using "CNT".
		   · Linear motion occurs near singularity point where axes revolve in high speed.
			- Check the permissible value of the robot payload. If the load exceeds the permissible value, reduce the load or change the motion program.
			 - Consider minimizing the influence on cycle time by reducing the speed or acceleration, and changing the motion program.
			 - Check that the load setting is performed correctly.

	- None of the symptoms stated above are the problem.	- It is likely the vibration occurred.	- Refer to the Symptoms: Vibration, Noise section of this troubleshooting for more information.
		- It is likely that rated voltage is not supplied due to the voltage drop.	- Check that the robot is supplied with the proper rated voltage.
CLALM alarm occurred. Move error excess alarm occurred.	- CLALM alarm is displayed on the teach pendant screen, because ambient temperature of the robot installation location is low, - "Move error excess" alarm is displayed on the teach pendant screen, because ambient temperature of the robot installation position is low	[Peripheral temperature] - When the robot is used in a low temperature environment that is near to 0ºC, or the robot is not operated for a long time in an environment that is less than 0ºC, there will be a large viscous resistance of the drive train immediately after starting which will cause the alarm.	- Perform a warm up operation or a low speed operation for several minutes.

Symptoms	Descriptions	Causes	Measures
CLALM alarm occurred. Move error excess alarm occurred.	- After changing the motion program or the load condition, the CLALM alarm is displayed. - After changing the motion program or the load condition, the "Move error excess" alarm is displayed.	- It is likely that a robot collision occurred.	- If a robot collision has occurred, press the [RESET] key while pressing the [SHIFT] key. Then, jog the robot in the opposite direction while pressing the [SHIFT] key. - Check the motion program.
		[Overload] - It is likely that load exceeded the permissible value. - It is likely that the motion program is too severe for the robot. 　· Excessive motion due to a large "ACC (value)". 　· Tight motion such as reverse motion using "CNT". 　· Linear motion occurs near singularity point where axes revolve in high speed.	- Check the permissible value of the robot payload. If the load exceeds the permissible value, reduce the load or change the motion program. - Consider minimizing the cycle time by reducing the speed or acceleration, and changing the motion program. - Check that the load setting is performed correctly.
	- None of the symptoms stated above are the problem.	- It is likely the vibration occurred.	- Refer to the Symptoms: Vibration, Noise section of this troubleshooting for more information.
		- If the power source voltage drops below the rating, a vibration might occur.	- Check that the robot is supplied with the proper rated voltage.
BZAL alarm displayed.	- BZAL is displayed on the teach pendant screen.	- It is likely that the voltage of the memory backup battery is low. - It is likely that the Pulsecoder cable is defective.	- Replace the battery. - Replace the cable.
Encoder alarm displayed	- Primary encoder alarm is displayed on the teach pendant screen.	- The cause of the alarms occurring at the same time is Pulsecoder.	- Check the Pulsecoder.
	- Secondary encoder alarm is displayed on the teach pendant screen.	- The cause of the alarms occurring at the same time is secondary encoder.	- Contact your local FANUC representative.

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.

> **NOTE**
> Contact your FANUC representative for confirmation that the Severe Dust/liquid protection package is suitable for your environment.

Model	Severe dust/liquid protection package specification
R-2000*i*C/165F/210F/240F/125L	A05B-1333-J801
R-2000*i*C/165R/210R	A05B-1334-J801
R-2000*i*C/270F/210L	A05B-1337-J801
R-2000*i*C/270R	A05B-1337-J802

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 steel bolt Black oxide finish steel bolt	FR coating bolt Stainless steel 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	

J3/J4/J5/J6-axis
motor cover
(upper side)

J3/J4/J5/J6-axis
motor cover
(lower side)

J1-axis motor cover

Waterproof type
EE connector

J2-axis motor cover

Cable protective sleeve
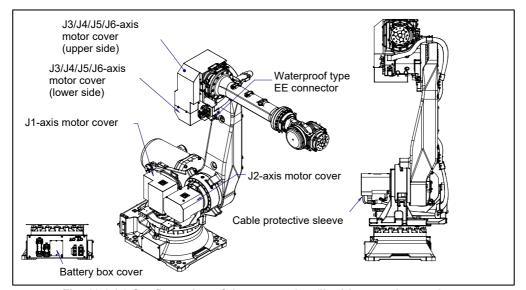
Battery box cover

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

11 PRESS HANDLING PACKAGE (OPTION)

The press handling package improves heat radiation performance by installing cooling fans to the J1/J2 -axis motors or J1/J2/J3-axis motors to prevent motor overheat under high temperature environment.

NOTE
1 Contact your FANUC representative for confirmation that the press handling package is suitable for your environment.
2 When overheat occurs, see troubleshooting chapter and consider countermeasures.

Model	Axis	Press handling package spec.
R-2000*i*C/165F/210F/240F/125L	For J1/J2	A05B-1333-J821
	For J1/J2/J3	A05B-1333-J822
R-2000*i*C/165R/210R	For J1/J2	A05B-1334-J821
	For J1/J2/J3	A05B-1334-J822
R-2000*i*C/270F/210L/190U	For J1/J2	A05B-1337-J821
	For J1/J2/J3	A05B-1337-J822
R-2000*i*C/100P	For J1/J2	A05B-1334-H181
	For J1/J2/J3	A05B-1334-H182
R-2000*i*C/100PH	For J1/J2	A05B-1334-H185
	For J1/J2/J3	A05B-1334-H184
R-2000*i*C/270R	For J1/J2	A05B-1337-J871
	For J1/J2/J3	A05B-1337-J872

NOTE
In addition, the fan connection cable which length is same as the robot connection cable is required.
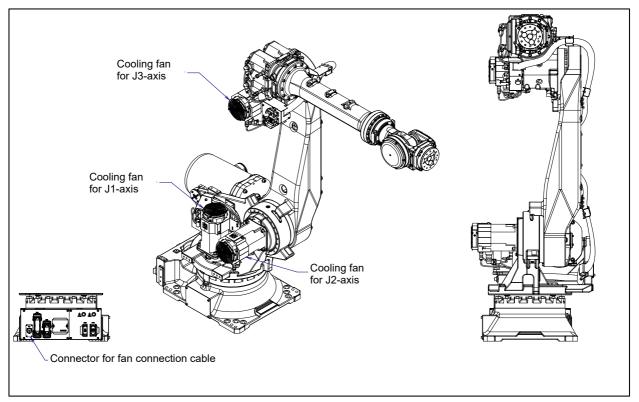

Fig. 11 (a) Configuration of the press handling package

12 ACCURACY AND STIFFNESS ENHANCEMENT OPTION

The accuracy and stiffness enhancement option eliminates the effects of the backlash and distortion of mechanical unit by additional encoders, and maintains high accuracy even if the robot receives external force such as milling.

> **NOTE**
> Contact your FANUC representative for confirmation that the accuracy and stiffness enhancement option is suitable for your environment and use.

Model	Accuracy and stiffness enhancement option spec.
R-2000*i*C/190S	A05B-1337-J841

> **NOTE**
> 1 Exclusive mechanical unit cable is required.
> 2 In addition, the accuracy and stiffness enhancement option connection cable which length is same as the robot connection cable is required.
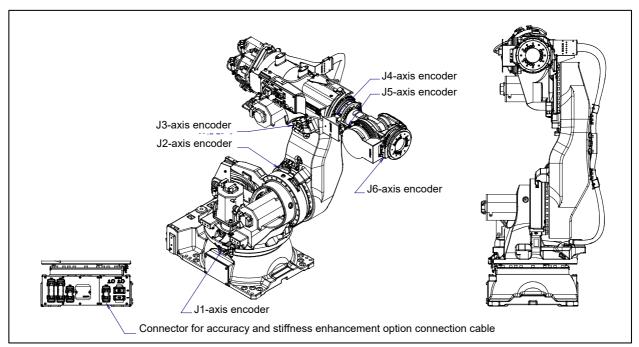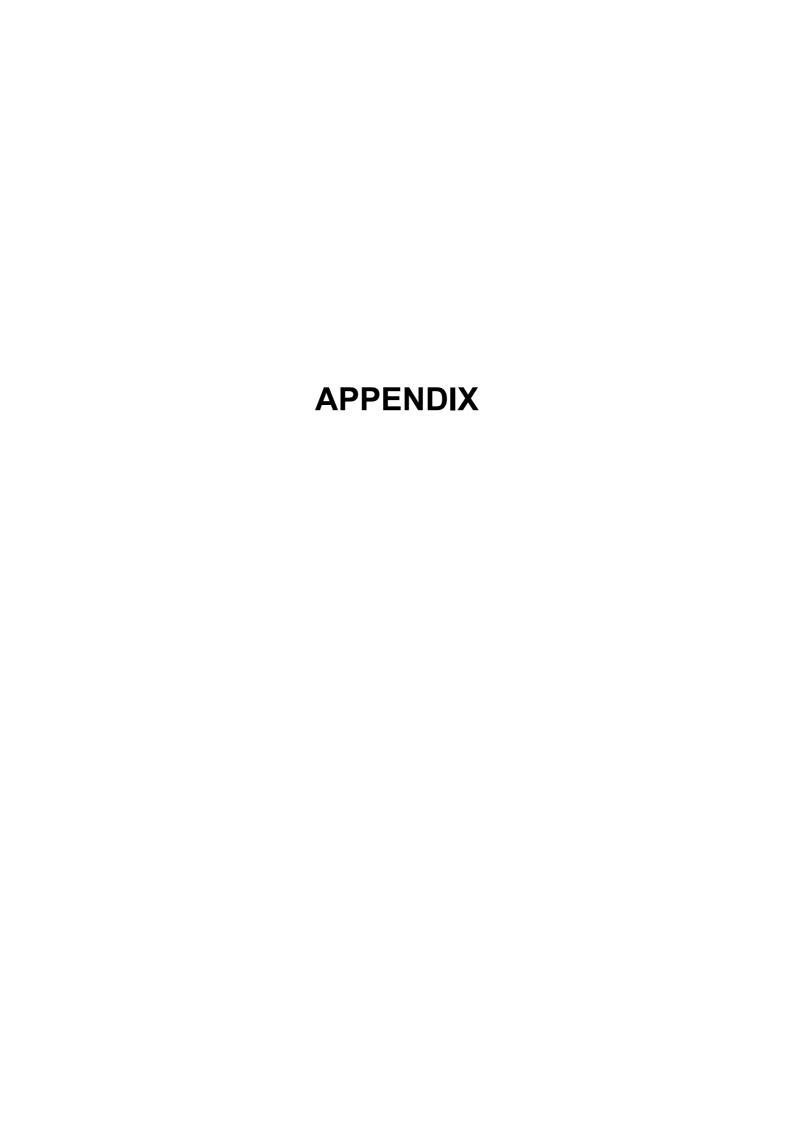

Fig. 12 (a) Configuration of the accuracy and stiffness enhancement option

APPENDIX

A PERIODIC MAINTENANCE TABLE

FANUC Robot R-2000*i*C/165F/210F/240F/125L/220U/165R/210R/100P/100PH   Periodic Maintenance Table

	Accumulated operating time (H) / Items	Check time	Grease amount	First check 320	3 months 960	6 months 1920	9 months 2880	1 year 3840	4800	5760	6720	2 years 7680	8640	9600	10560
1	Check for external damage or peeling paint	0.1H	—		○	○	○	○	○	○	○	○	○	○	○
2	Check damages of the cable protective sleeves	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 tightness 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 *1	0.1H	Each 10ml					●				●			
14	Replacing the mechanical unit batteries*1 *3	0.1H	—							●					
15	Replacing the grease of J1-axis reducer*1	1.0H	4730ml 6900ml (100P /100PH)												
16	Replacing grease of J2-axis reducer*1	0.5H	2500ml												
17	Replacing grease of J3-axis reducer*1	0.5H	2170ml												
18	Replacing grease of wrist axis 1 (J4, J5-axis)*1	0.5H	2560ml												
19	Replacing grease of wrist axis 2 (J6-axis)*1	0.2H	440ml 690ml (100P/ 100PH)												
20	Replacing the mechanical unit cable*1	4.0H	—												
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 *1 *3	0.1H	—												

Position of grease nipple

*1   For descriptions about the items marked with an asterisk (*), refer to "REPLACING UNITS Chapter" of this manual or the following manuals.
R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),
R-30*i*B Mate/R-30*i*B Mate Plus CONTROLLER MAINTENANCE MANUAL (B-83525EN)
*2   ●: Requires order of parts   ○: Does not require order of parts
*3   Regardless of the operating time, replace the mechanical unit batteries at 1.5 year, replace controller batteries at 4 years.
*4   R-2000*i*C/220U has no balancer.

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
○				○				○				○				○					5
○				○				○				○				○					6
○				○				○				○				○					7
○				○				○				○				○					8
○				○				○				○				○					9
○				○				○				○				○					10
○				○				○				○				○					11
○				○				○				○				○				Overhaul	12
●				●				●				●				●					13
●						●						●						●			14
●												●									15
●												●									16
●												●									17
●												●									18
●												●									19
				●																	20
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		21
○				○				○				○				○					22
				●																	23

FANUC Robot R-2000*i*C/270F/270R/190S/210L/190U   **Periodic Maintenance Table**

		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 protective sleeves	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*1	0.1H	Each 10ml					●				●			
	14	Replacing the mechanical unit Batteries*1 *3	0.1H	—							●					
	15	Replacing the grease of J1-axis reducer*1	1.0H	6250ml (except 190S) 5720ml (190S)												
	16	Replacing grease of J2-axis reducer*1	0.5H	3470ml												
	17	Replacing grease of J3-axis reducer*1	0.5H	2640ml												
	18	Replacing grease of wrist axis 1 (J4, J5-axis)*1	0.5H	5540ml												
	19	Replacing grease of wrist axis 2 (J6-axis)*1	0.2H	630ml												
	20	Replacing the mechanical unit cable*1	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 *1 *3	0.1H	—												

Position of grease nipple

*1 For descriptions about the items marked with an asterisk (*), refer to "REPLACING UNITS Chapter" of this manual or the following manuals.
   R-30*i*B/R-30*i*B Plus CONTROLLER MAINTENANCE MANUAL (B-83195EN),
*2 ●: Requires order of parts   ○: Does not require order of parts
*3 Regardless of the operating time, replace the mechanical unit batteries at 1.5 year, replace controller batteries at 4 years.
*4 R-2000*i*C/190S has no balancer.

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
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		1
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		2
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		3
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		4
O				O				O				O				O					5
O				O				O				O				O					6
O				O				O				O				O					7
O				O				O				O				O					8
O				O				O				O				O					9
O				O				O				O				O					10
O				O				O				O				O					11
O				O				O				O				O				Overhaul	12
●				●				●				●				●					13
●						●						●						●			14
●												●									15
●												●									16
●												●									17
●												●									18
●												●									19
				●																	20
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		21
O				O				O				O				O					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 any oil on the engaging section. Make sure that there is no solvent left in the threaded holes. When finished, remove all the excess LOCTITE when you are finished screwing the bolts into the threaded holes.

Use the following strength bolts. Comply with any bolt specification instructions.
Hexagon socket head bolt made of steel:
   Size M22 or less: Tensile strength 1200N/mm^2 or more
   Size M24 or more: Tensile strength 1000N/mm^2 or more
   All size plating bolt: Tensile strength 1000N/mm^2 or more
Hexagon bolt, stainless bolt, special shape bolt (button bolt, low-head bolt, flush bolt .etc.)
                              Tensile strength 400N/mm^2 or more
Refer to the following tables if the bolts tightening torque is not specified.

Recommended bolt tightening torques   **Unit: Nm**

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

INDEX

REVISION RECORD

Edition	Date	Contents
09	Apr., 2022	・Addition of R-2000*i*C/190S ・Addition of R-2000*i*C/270F 300kg option ・Correction of errors
08	Sep., 2021	・Addition of R-2000*i*C/100PH ・Correction of errors
07	Aug., 2020	・Addition of R-2000*i*C/240F ・Correction of errors
06	Jan., 2020	・Addition of R-2000*i*C/270R ・Correction of errors
05	Aug., 2018	・Addition of R-2000*i*C/190U ・Correction of errors
04	Sep., 2017	・Addition of R-2000*i*C/100P/220U ・Addition of R-30*i*B Plus/R-30*i*B Mate Plus Controller ・Correction of errors
03	Apr., 2016	・Addition of R-2000*i*C/270F/210L ・Correction of errors
02	Dec., 2014	・Addition of R-2000*i*C/165R/210R ・Addition of quick master for single axis ・Correction of errors
01	Apr., 2014	

B-83644EN/09