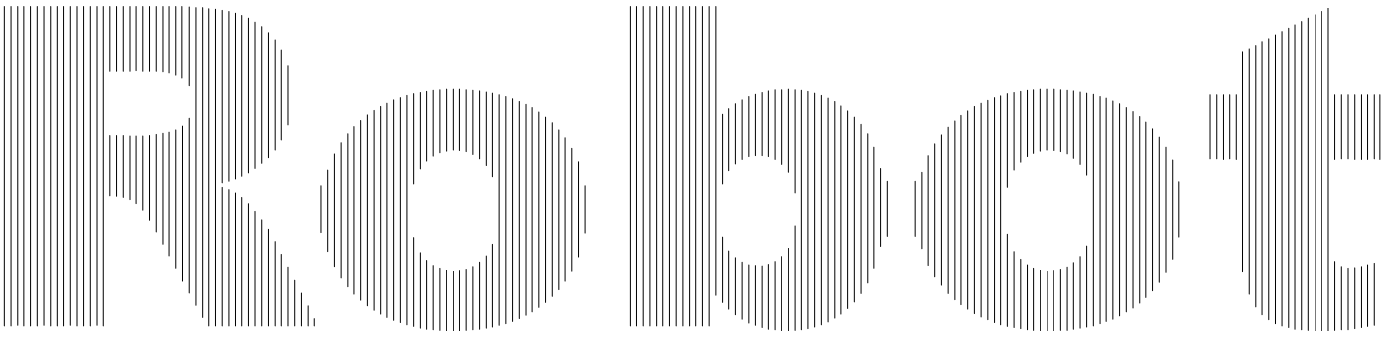
Simple and friendly

Kawasaki

Kawasaki Robot

Instruction Manual

(Original instructions)



Kawasaki Heavy Industries, Ltd.

90201-1163DEB

PREFACE

This manual summarizes the necessary instructions for Kawasaki Robot from its introduction to the maintenance procedures.

This manual applies to the following robot arm and controller models.

Robot arm: Y, R, Z, M series
Controller: E40, E42, E43, E44, E70, E71 (European Specification)

For specifications of robot arms not shown in this manual, see the specification sheets, delivered separately.

1. This manual does not constitute a guarantee of the systems in which the robot is utilized. Accordingly, Kawasaki is not responsible for any accidents, damage, and/or problems relating to industrial property rights as a result of using the system.
2. It is recommended that all personnel assigned for activation of operation, teaching, maintenance or inspection of the robot attend the necessary education/training course(s) prepared by Kawasaki, before assuming their responsibilities.
3. Kawasaki reserves the right to change, revise, or update this manual without prior notice.
4. This manual may not, in whole or in part, be reprinted or copied without the prior written consent of Kawasaki.
5. Store this manual with care and keep it available for use at any time. If the robot is reinstalled or moved to a different side or sold off to a different use, attach this manual to the robot without fail. In the event the manual is lost or damaged severely, contact Kawasaki.

SYMBOLS

The items that require special attention in this manual are designated with the following symbols.

Ensure proper and safe operation of the robot and prevent physical injury or property damage by complying with the safety matters given in the boxes with these symbols.

⚠ DANGER

Failure to comply with indicated matters can result in imminent injury or death.

⚠ WARNING

Failure to comply with indicated matters may possibly lead to injury or death.

⚠ CAUTION

Failure to comply with indicated matters may lead to physical injury and/or mechanical damage.

[NOTE]

Denotes precautions regarding robot specification, handling, teaching, operation and maintenance.

⚠ WARNING

1. **The accuracy and effectiveness of the diagrams, procedures, and explanations given in this manual cannot be confirmed with absolute certainty. Should any unexplained problems arise, please contact the nearest Kawasaki office or distributor in your country.**
2. **In order to perform every work in safety, read and fully understand this manual, all pertinent laws, regulations and related materials as well as all the safety explanations described in each chapter, and prepare safety measures and procedures suitable for actual work.**

CONTENTS

1.0 KAWASAKI ROBOT

Kawasaki Robot is an industrial robot, used for variant applications according to the user's needs.

An industrial robot is officially defined by ISO as an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes. Typical applications of industrial robot includes welding, painting, assembly, pick and place, packaging, palletizing, product inspection, sealing, cutting, and so on.

Please do not use industrial robot by the following purposes:
Nuclear power
Munitions
Medical treatment
Nursing, etc.

1.1 NOMENCLATURE

Kawasaki robots are named according to the arm part characteristics (1 through 4) and the controller type (5) as shown in the chart below.

1	2	3	4	5
YF	003	N	D	E40
RS	005	L	F	E71
RS	020	N	F	E40
ZX	165	U	G	E42
ZD	130	S	D	E43
MX	500	N	F	E44
MD	500	N	E	E44
1	2	3	4	5

1. Robot type
   The first two letters show the robot type. Following robot types are used with E4x and E7x controllers:
   YF: picker
   RS: small sized floor mounted robot
   RA: small sized robot for arc welding
   RD: small sized robot for palletizing

ZX: medium sized floor mounted robot
ZT: medium sized shelf mounted robot
ZB: medium sized robot with short arm
ZH: medium sized robot with compact arm
ZD: medium sized robot for palletizing
MT: large sized shelf mounted robot
MX: large sized floor mounted robot
MD: large sized robot for palletizing

2. Payload (kg)

3. Variation

4. Number of axes
   The number of axes the robot has is represented by alphabet. Ex. D=4, E=5, F=6, and so on.

5. Controller model

1.2 DECLARATION

DECLARATION OF INCORPORATION OF PARTLY COMPLETED MACHINERY

Manufacturer : KAWASAKI HEAVY INDUSTRIES, LTD.
Robot Division
Address : 1-1, Kawasaki-cho, Akashi, 673-8666, Japan

Herewith declares that

Product Name	Industrial robot
Function	Handle the materials or the tools
Make :	KAWASAKI ROBOT
Robot Type :	FS006NFD40
Serial number(s) :	0123
WO or PO	81L5567

is intended to be incorporated into machinery or to be assembled with other machinery to constitute machinery covered by

Machinery Directive 2006/42/EC
Low Voltage Directive 2006/95/EC
EMC Directive 2004/108/EC

and that

the following standards have been applied ;

EN ISO 10218-1: 2008	Robot for industrial environments - Safety requirements - Part 1: Robot
EN ISO 13849-1: 2008	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN 60204-1: 2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-4: 2007	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-6-2: 2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

and that

the following essential health and safety requirements have been applied and fulfilled,and the relevant technical documentation is compiled in accordance with Annex Ⅶ,part B of Directive 2006/42/EC;

・1.1.2; 1.1.3; 1.1.5; 1.1.6; 1.2; 1.3.1; 1.3.2; 1.3.4; 1.3.6; 1.5.1; 1.5.2; 1.5.4-1.5.6; 1.5.8-1.5.10; 1.6.3; 1.6.4; 1.7

and that

the relevant information will be transmitted by the electronic method in response to a reasoned request by the national authorities;

and furthermore declares that

it is not allowed to put the machinery into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of Directive 2006/42/EC and with national implementing legislation, i,e. as a whole, including the machinery referred to in this declaration.

Authorized representative and Person authorized to compile the Technical documentation in Europe:

KAWASAKI ROBOTICS GMBH
Sperberweg 29, 41468 Neuss, Germany
Masanori Iwase
President

Place and Date : Neuss, 26-May-09
signature:

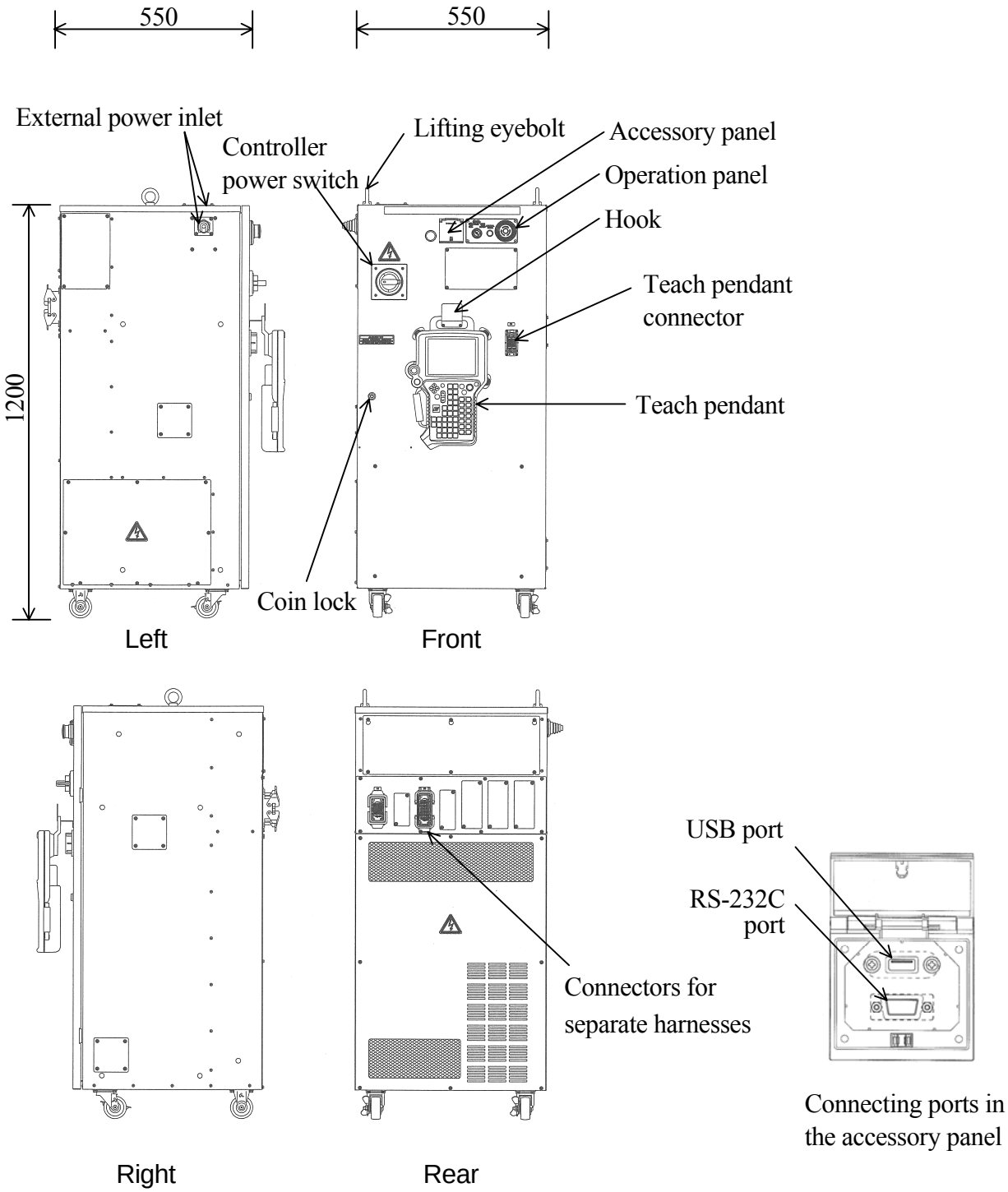
2.0 ROBOT SPECIFICATION

The European spec. robot arm and controller complies with the following standards.

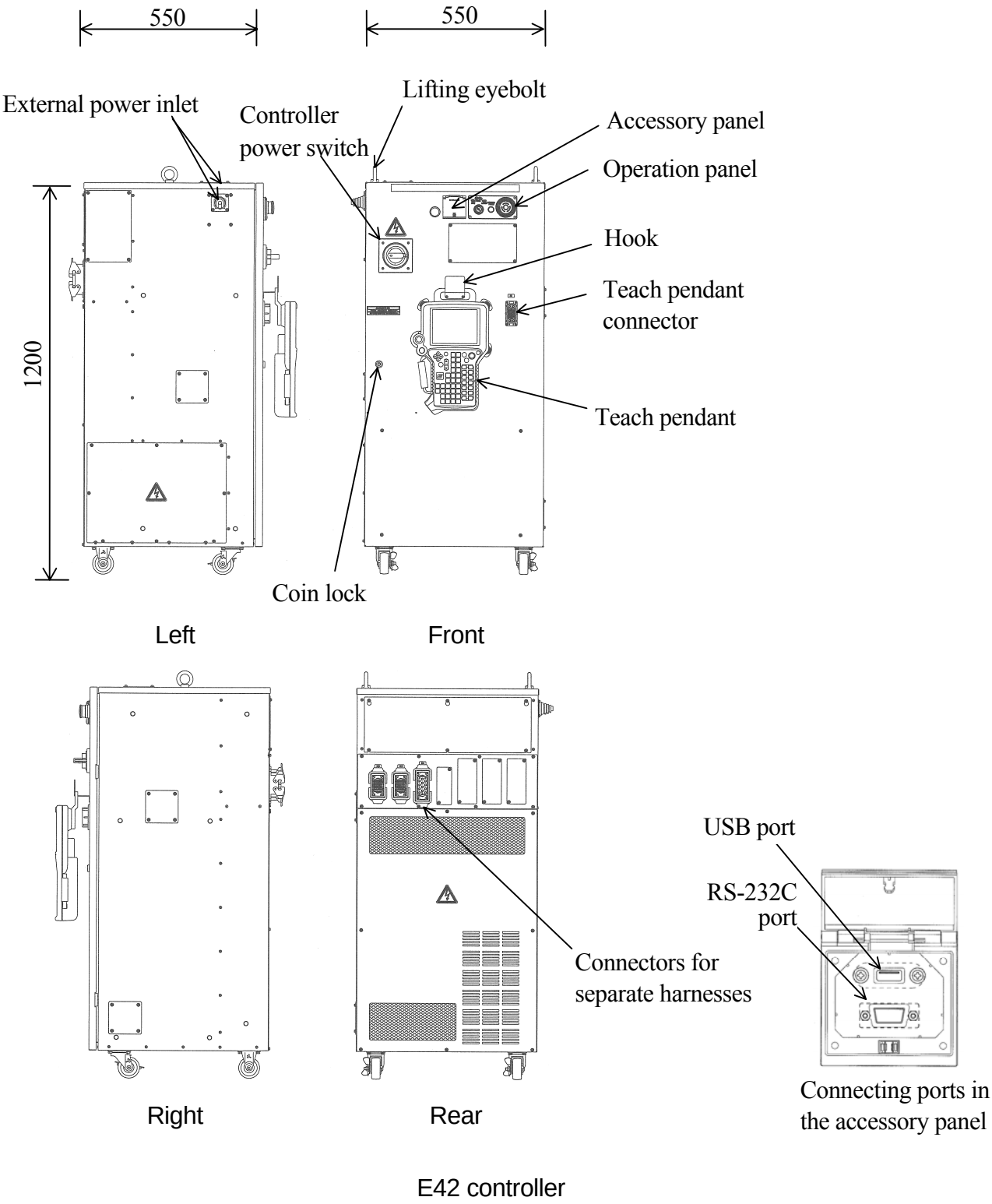
EN ISO 10218-1:2006	Robots for industrial environments - Safety requirements - Part 1: Robot
EN 954-1: 1997	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
EN ISO 13849-1:2008	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
EN 60204-1:2006	Electrical equipment of industrial machines General requirements
EN 61000-6-4:2007	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

2.1 CONTROLLER APPEARANCE AND SPECIFICATION

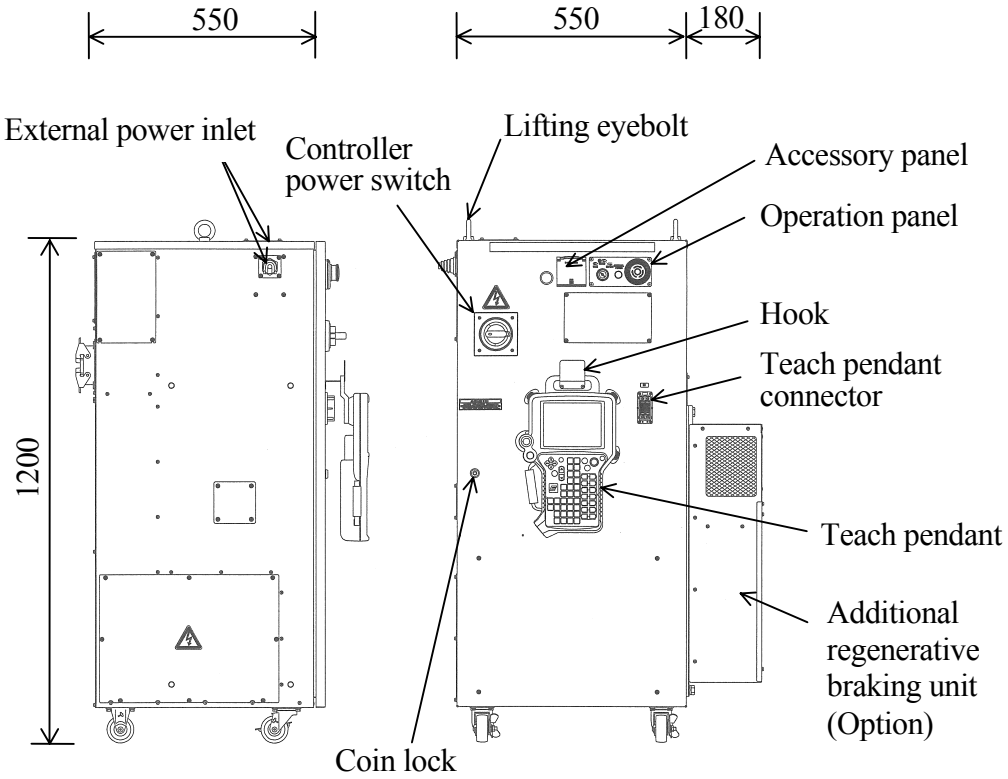
2.1.1 APPEARANCE OF E SERIES CONTROLLERS

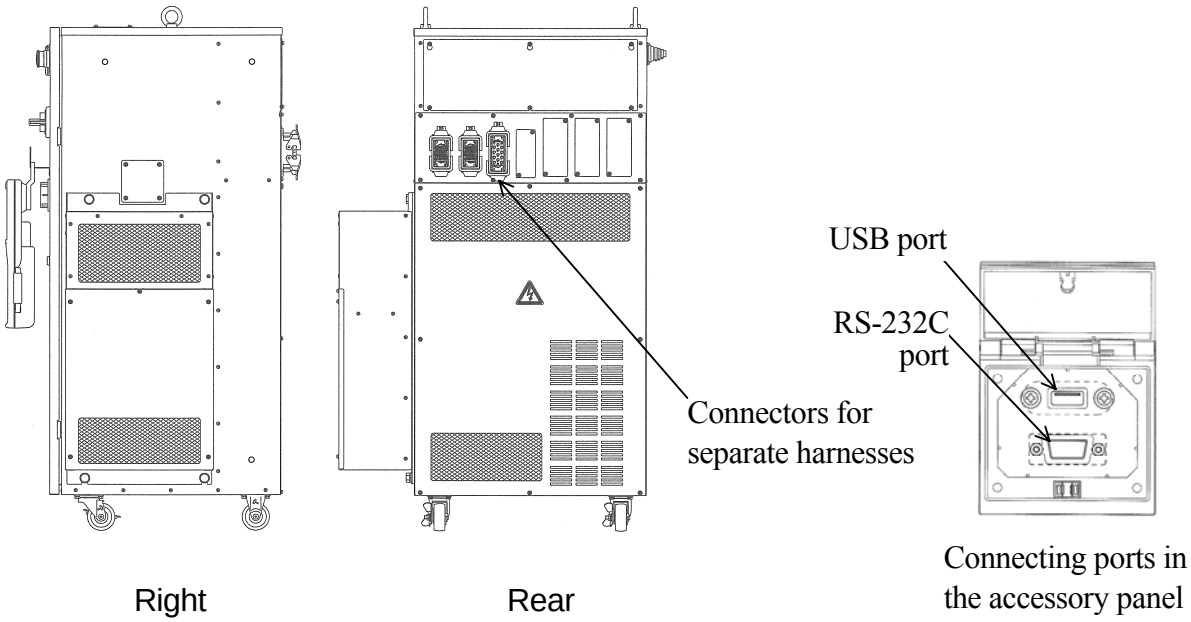


E40 controller

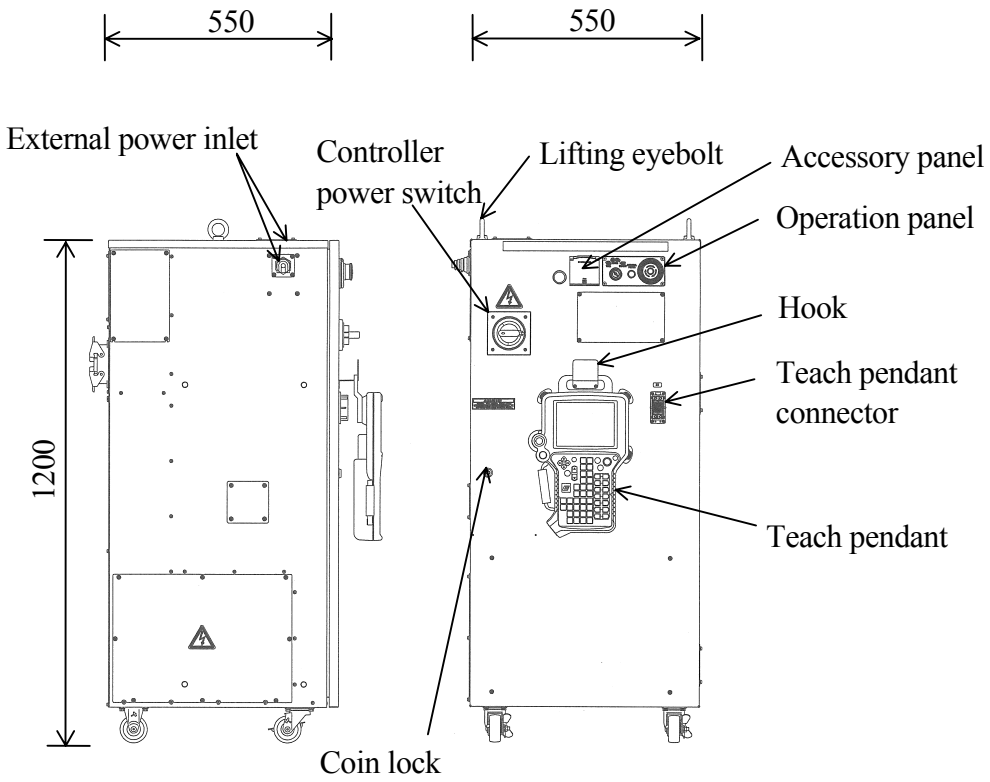


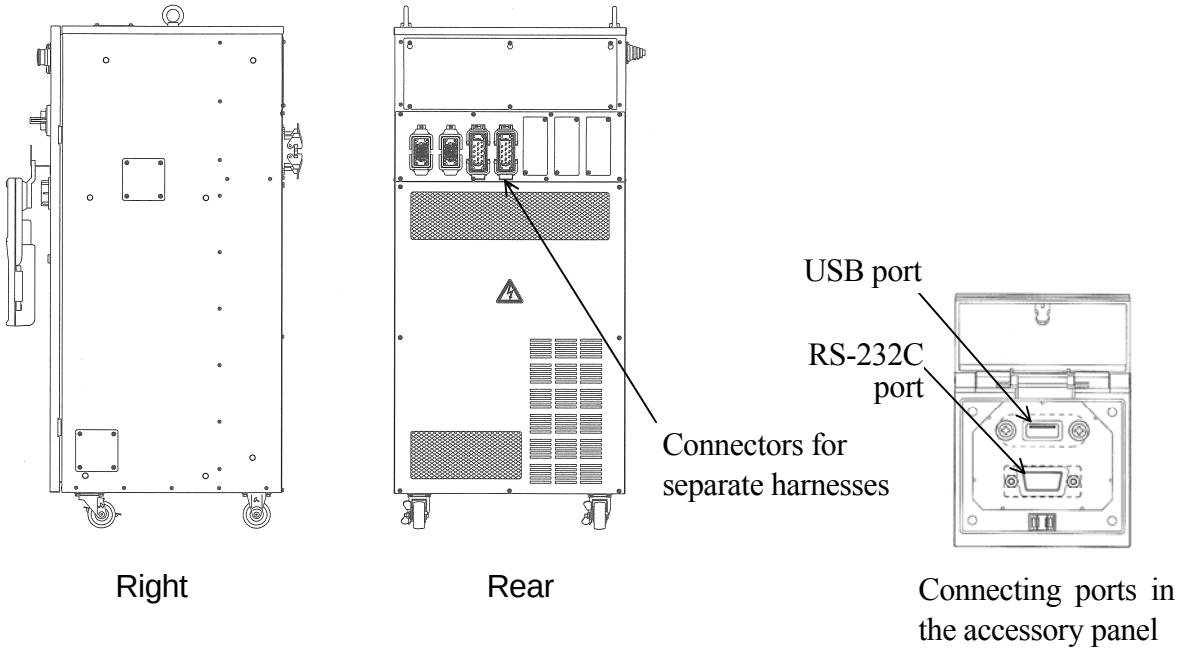
E42 controller



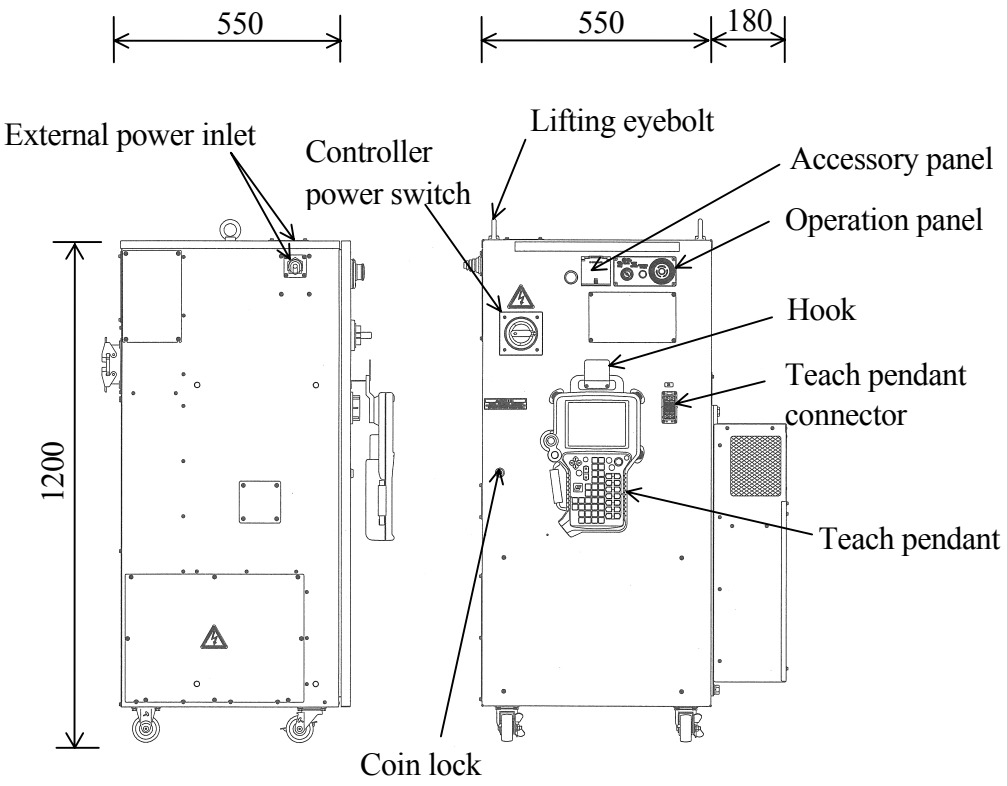


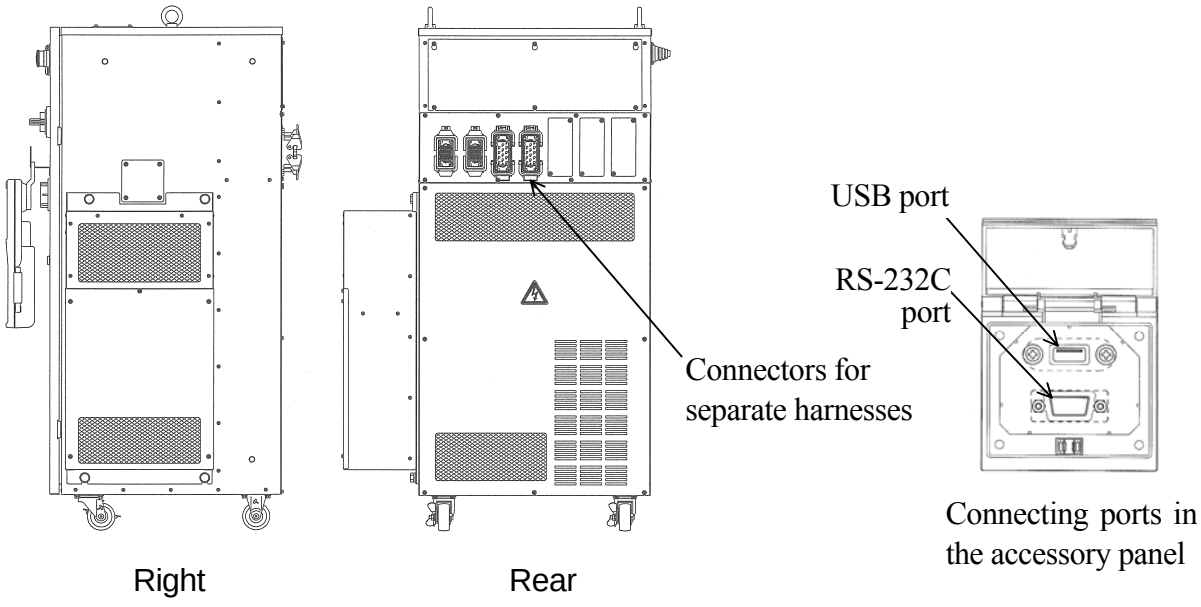
E43 controller



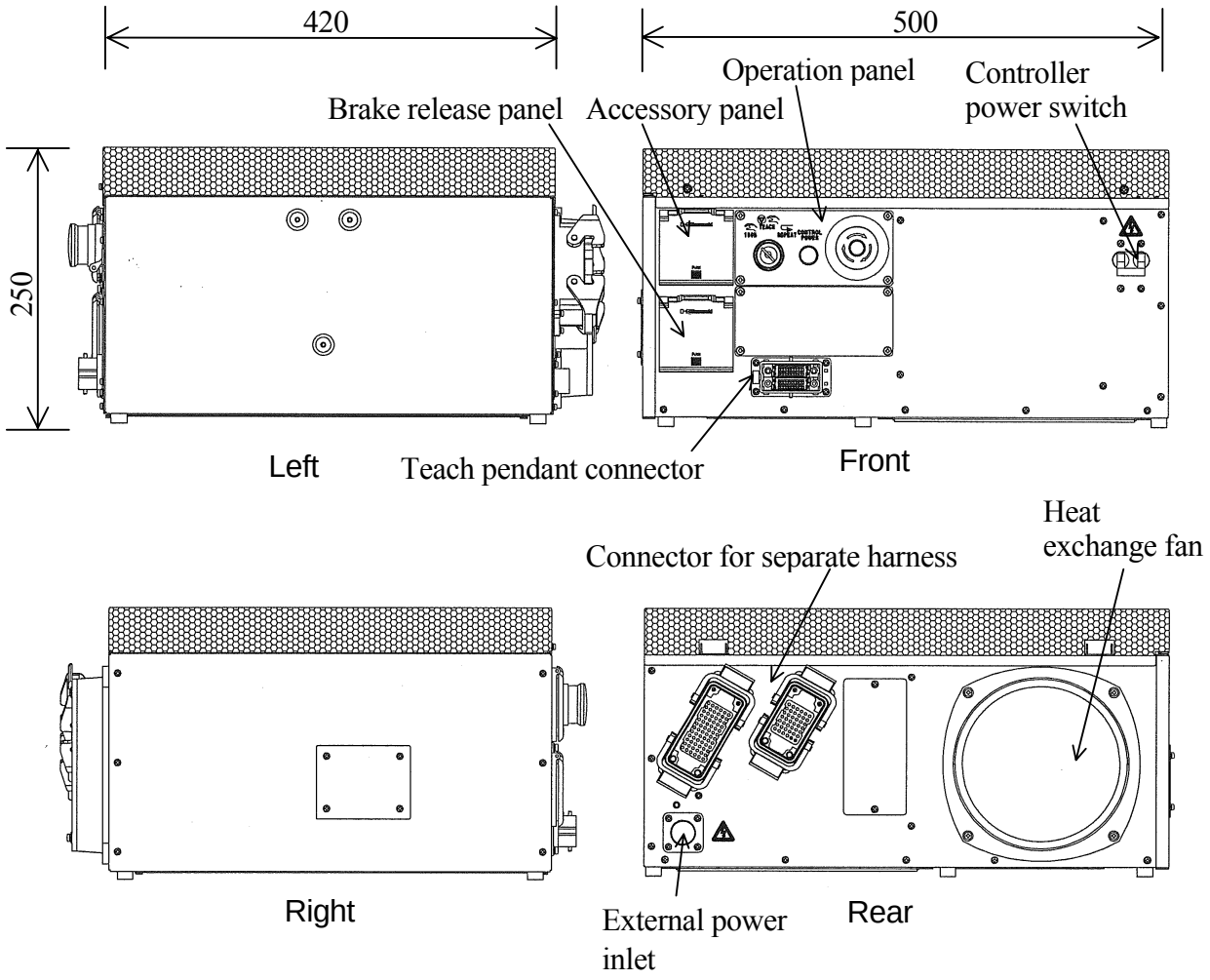


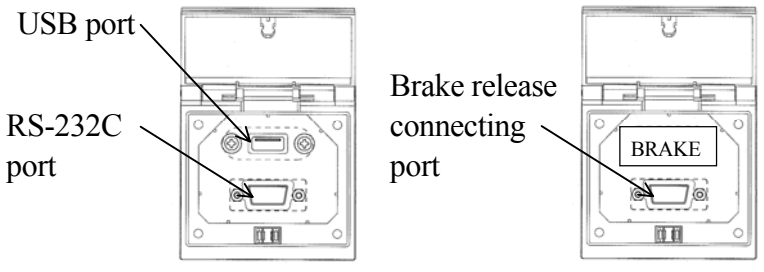
E44 controller (MX)





E44 controller (MD)





E70/E71 controllers

2.1.2 CONTROLLER SPECIFICATIONS

Model		E4x	E7x
Construction		Self-sustaining fully closed, indirect cooling system	Horizontal enclosed structure, indirect cooling system
Mass		E40: 145 kg E42, E44 (MX): 180 kg E43, E44 (MD): 195 kg	30 kg
Ambient environment	Temperature	0 - 45 °C	0 - 45 °C (0 - 40 °C in vertical placing)
	Humidity	35 - 85 %RH (Non condensing)	
	Altitude	Up to 1000 meters above mean sea level	
Power source		AC 380-415 V±10 %, 50/ 60 Hz, 3 Phase	AC 200-240 V±10 %, 50/ 60 Hz, Single phase
Power capacity		Refer to the table below.	
Earthing		Dedicated earthing (100 Ω or less)	
Length of Teach pendant cable		5 m/10 m/15 m (5 m, 15 m are options.)	
Length of separate harnesses*		5 m/10 m/15 m (5 m, 15 m are options.)	

NOTE* Harness length between robot arm and controller.

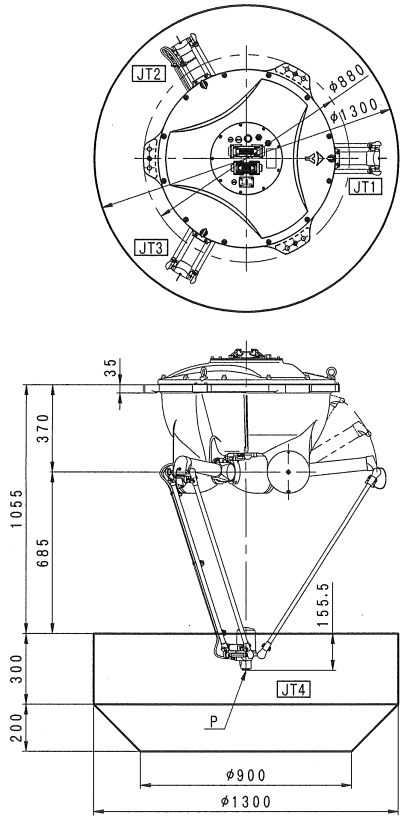
Power capacity

Controller model	Arm model	Power capacity	Recommended power cable size (Including earth wire)	Length requirement
E40	RS10 series RS20 series	4.9 KVA max.	3.5 mm^2 or more (AWG #12 or more)	Less than 200 m
E42/E43	RS50 series Z series MT series	9.9 KVA max.	8.0 mm^2 or more (AWG #8 or more)	
E44	MX/MD series			
E70	RS03 series	1.5 KVA max.	2-2.5 mm^2 or more (AWG #14)	
E71	RS05 series RS10 series	3.0 KVA max.		

2.2 ARM SPECIFICATIONS

The motion ranges shown in the figures below are based on point P. For specifications of robot arms not shown in this manual, see the specification sheets, delivered separately.

YF003



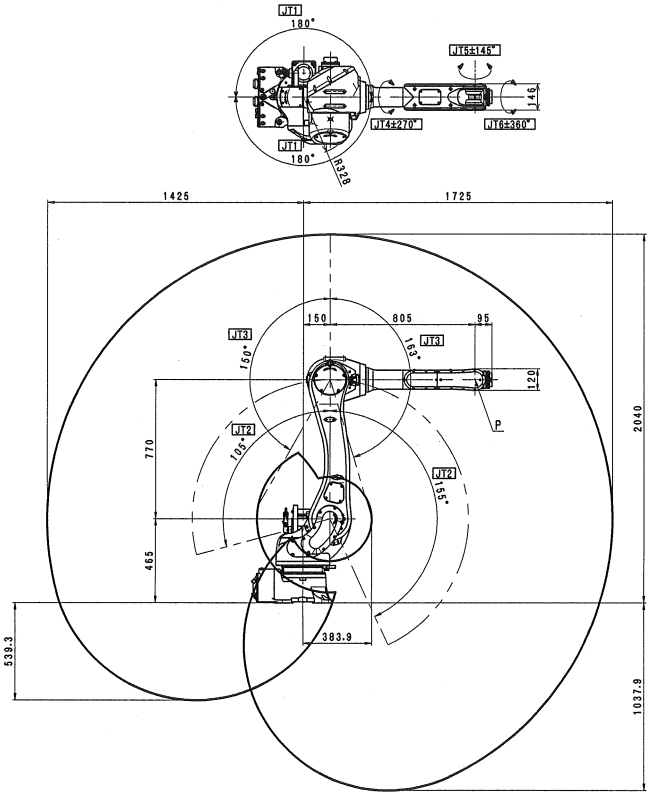
Type	Delta-type parallel link		
Degree of Freedom	4		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	+95° to -54°	1090.9 °/s
	2	+95° to -54°	1090.9 °/s
	3	+95° to -54°	1090.9 °/s
	4	±360°	1714.3 °/s
Max. Payload	3 kg		
Wrist Load Capacity	Differs according to the payload.		
Repeatability	±0.10 mm		
Mass	145 kg		
Acoustic noise	<70 db (A) *		

***measured condition**

- installed on a plate with height of 2150 mm above the floor
- 1650 mm away from A axis

(Noise level depends on the conditions)

RS20N



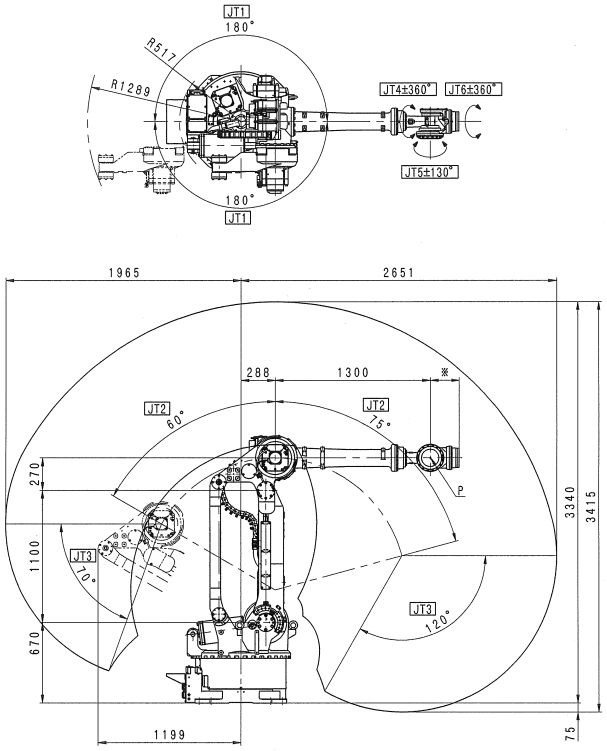
Type	Articulated Robot		
Degree of Freedom	6		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	±180°	190 °/s
	2	+155° to -105°	205 °/s
	3	+150° to -163°	210 °/s
	4	±270°	400 °/s
	5	±145°	360 °/s
	6	±360°	645 °/s
Max. Payload	20 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	45 N-m	0.9 kg-m^2
	5	45 N-m	0.9 kg-m^2
	6	29 N-m	0.3 kg-m^2
Repeatability	±0.05 mm		
Acoustic noise	<70 db (A) ※		

*****measured condition

- installed on the plate rigidly fixed on the floor
- 3000 mm away from JT1 center

(Noise level depends on the conditions)

ZX165U

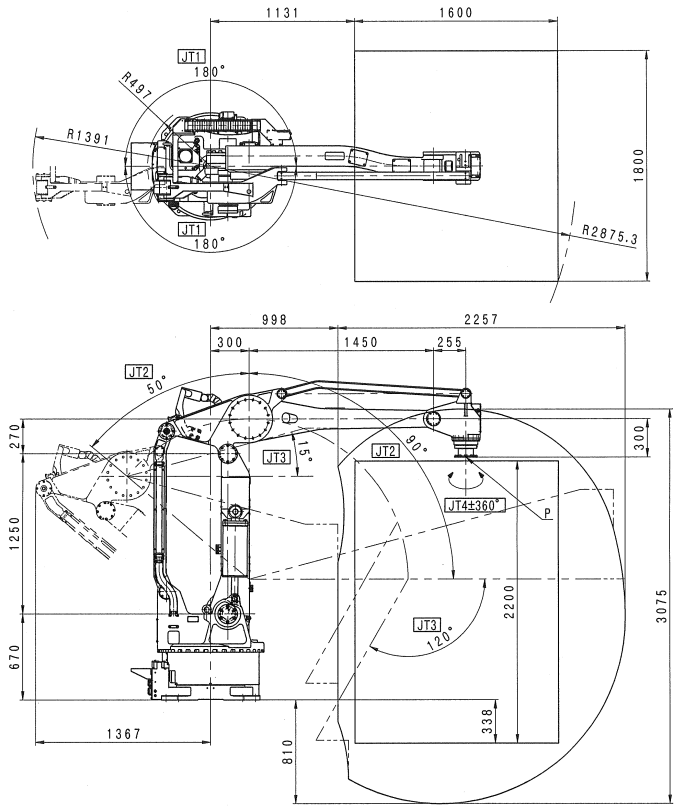


Type	Articulated Robot		
Degree of Freedom	6		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	±180°	110°/s
	2	+75° to -60°	110°/s
	3	+250° to -120°	115°/s
	4	±360°	140°/s
	5	±130°	155°/s
	6	±360°	260°/s
Max. Payload	165 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	911.4 N-m	78.4 kg-m^2
	5	911.4 N-m	78.4 kg-m^2
	6	450.8 N-m	40.2 kg-m^2
Repeatability	±0.3 mm		
Mass	Approx. 1350 kg		
Acoustic noise	<70 db (A) *		

*****measured condition
- installed on the plate rigidly fixed on the floor
- 4650 mm away from JT1 center

(Noise level depends on the conditions)

ZD130S



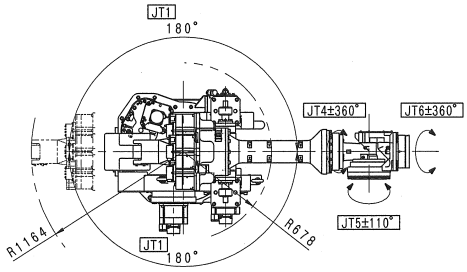
Type	Articulated Robot		
Degree of Freedom	4		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	±180°	135°/s
	2	+90° to -50°	110°/s
	3	+15° to -120°	130°/s
	4	±360°	300°/s
Max. Payload	130 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	-	50 kg-m^2
Repeatability	±0.5 mm		
Mass	Approx. 1350 kg		
Acoustic noise	<70 db (A) *		

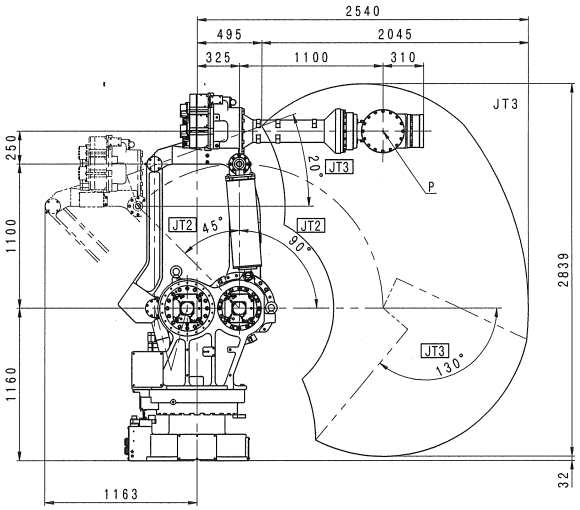
*****measured condition

- installed on the plate rigidly fixed on the floor
- 5260 mm away from JT1 center

(Noise level depends on the conditions)

MX500N





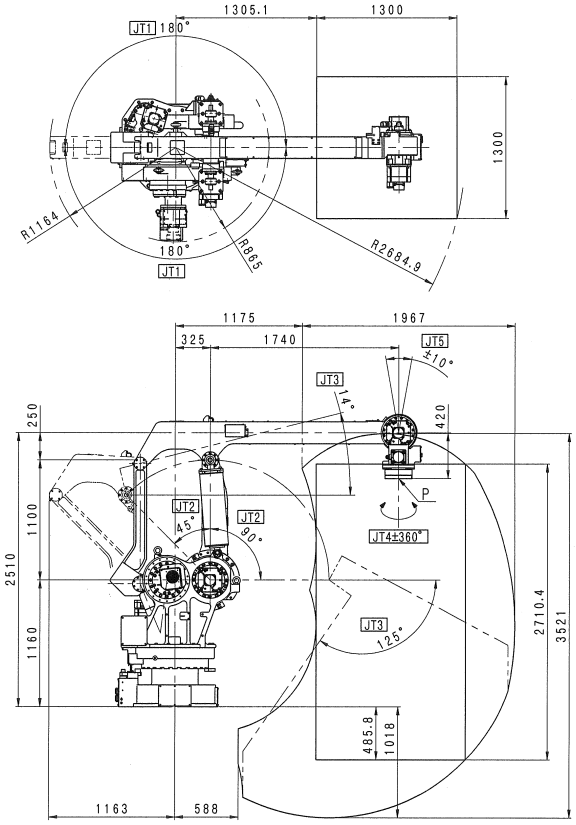
Type	Articulated Robot		
Degree of Freedom	6		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	+180 ° to -180 °	80 °/s
	2	+90 ° to -45 °	70 °/s
	3	+20 ° to -130 °	70 °/s
	4	+360 ° to -360 °	80 °/s
	5	+110 ° to -110 °	80 °/s
	6	+360 ° to -360 °	120 °/s
Max. Payload	500 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	3920 N-m	400 kg-m^2
	5	3920 N-m	400 kg-m^2
	6	1960 N-m	259 kg-m^2
Repeatability	±0.5 mm		
Max. Payload	Approx. 2750 kg		
Acoustic noise	< 70 db (A)*****		

*****measured condition

- installed on the plate rigidly fixed on the floor
- 4540 mm away from JT1 center

(Noise level depends on the conditions)

MD500N



Type	Articulated Robot		
Degree of Freedom	5		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	+180 ° to -180 °	70 °/s
	2	+90 ° to -45 °	65 °/s
	3	+14 ° to -125 °	45 °/s
	4	+360 ° to -360 °	160 °/s
	5	+10 ° to -10 °*	—
	* ±10 ° in vertical direction.		
Max. Payload	500 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	—	250 kg-m^2
Repeatability	±0.5 mm		
Max. Payload	Approx. 2680 kg		
Acoustic noise	< 70 db (A)*		

***measured condition**

- installed on the plate rigidly fixed on the floor
- 5142 mm away from JT1 center

(Noise level depends on the conditions)

3.0 RISK ASSESSMENT

For each procedure of system setting, installation, teaching, operation, maintenance, disposal, etc., always make sure the instructions and specifications match the requirements of the purpose of robot use. Also, perform the adequate risk assessment without fail to reduce any avoidable risk.

3.1 SAFETY FEATURES

To safeguard the user, Kawasaki robot systems are equipped with many safety features, including the following:

1. All E-stops are hard-wired.
2. All robot controllers are equipped with a redundant dual channel safety circuit. Both channels of the safety circuit must be closed to allow for robot operation in the teach and automatic playback modes.
3. Safety circuits of E4x/E70/E71 controller satisfy requirements of PLd in category 3 defined by ISO 13849-1:2006. Category and Performance level (PL) are determined by the whole system and conditions. The safety circuit of this controller is available in the system of category: up to 3, PL: up to d.
4. The teach pendant and operation panel are equipped with red mushroom-type E-stop switches. All robot controllers have external E-stop inputs.
5. The teach pendant is equipped with two, three-position, enabling devices. One of the two enabling devices must be pressed to enable motor power in the teach and check modes.
6. Teach and check mode velocities are limited to a maximum of 250 mm/s (10.0 in/s).
7. E4x/E70/E71 controller is equipped with Fast Check mode that satisfies the requirements of ISO 10218-1:2006. Teach and check mode velocities are not limited to 250 mm/s (10.0 in/s) in the Fast Check mode.
8. JT1 is equipped with overtravel limit switches. Optional overtravel limit switches are available on JT2 and JT3 for Z series and M series robots.
9. All R-series, M-series, and Z-series arms have overtravel hardstops on JT1, JT2 and JT3 (optional for JT2 and JT3) axes. Mechanical hardstops are capable of stopping the robot moving at full speed and with maximum payload.
10. All robot axes are equipped with electromechanical brakes that engage when power is removed. If the robot loses power unexpectedly, the arm is held in position by the brakes.

3.2 SAFETY CIRCUIT OFF

The following 3 types of input signals are available for externally shutting down the robot motor power for safety purposes.

1. External emergency stop (Valid in teach and automatic playback mode.)
2. Safety fence input (Valid only in automatic playback mode.)
3. External trigger input (Valid only in teach mode.)

⚠ WARNING

Safety circuit OFF function and operation must be designed based on IEC60204-1, ISO10218 and ISO13849-1, because it is very important for human safety. Safety circuit of E4X/E70/E71 controller satisfy requirements of PLd in category 3 defined by ISO 13849-1:2006. When constructing the comprehensive safety system including robot, conduct risk assessments and make sure that safety circuit of the controller satisfies performance requirements.

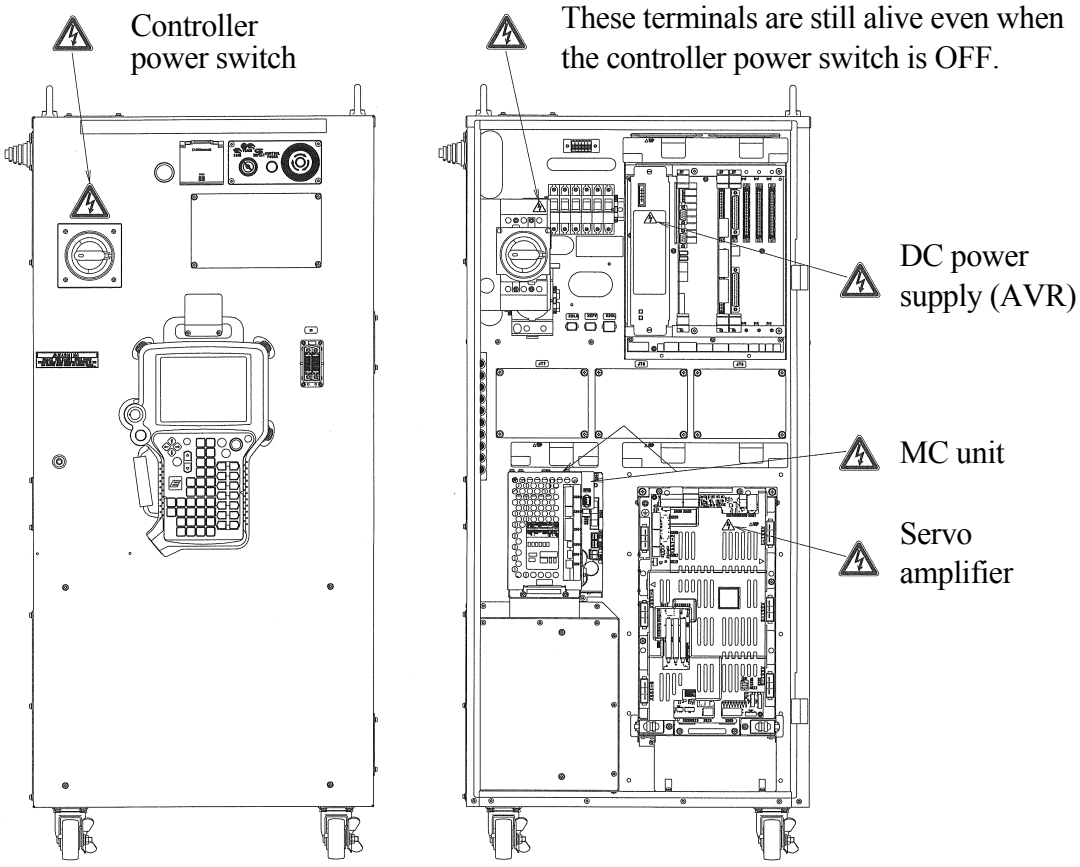
For details on safety circuit connection, consult a personnel who has completed the required special education and training courses.

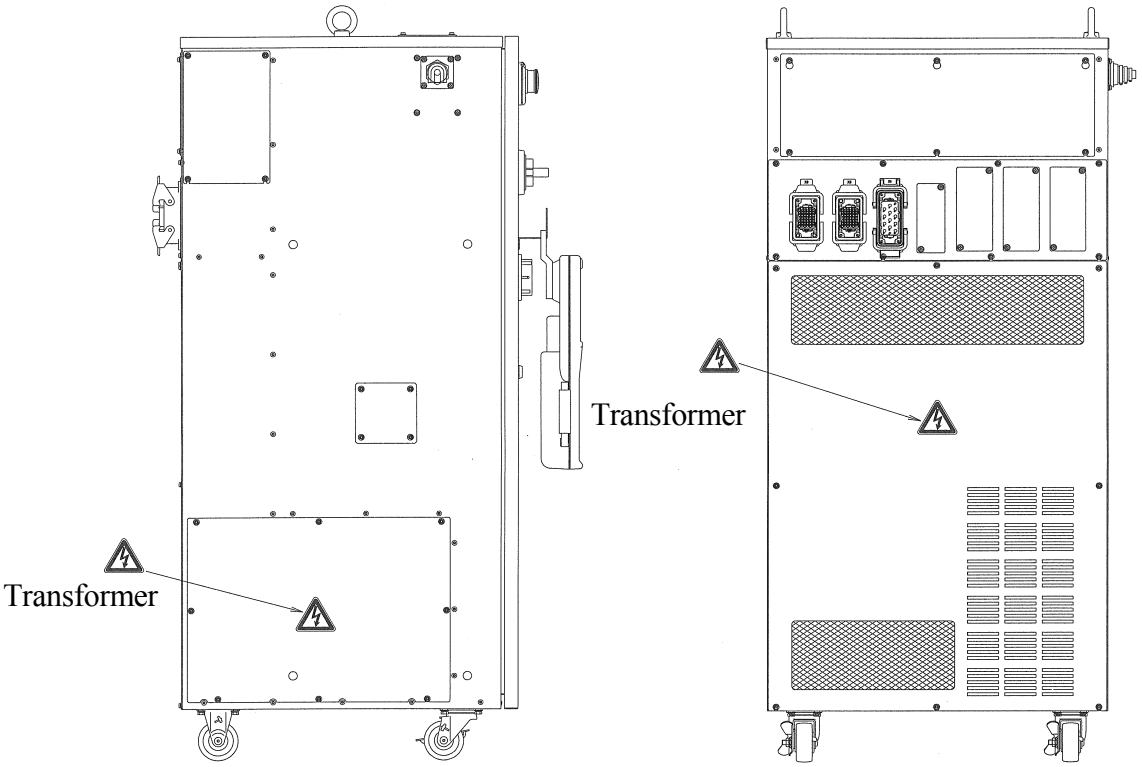
3.3 RESIDUAL RISKS

Warning labels for residual risks are on locations indicated in the figures below.

3.3.1 CONTROLLER ELECTRIFICATION RISK

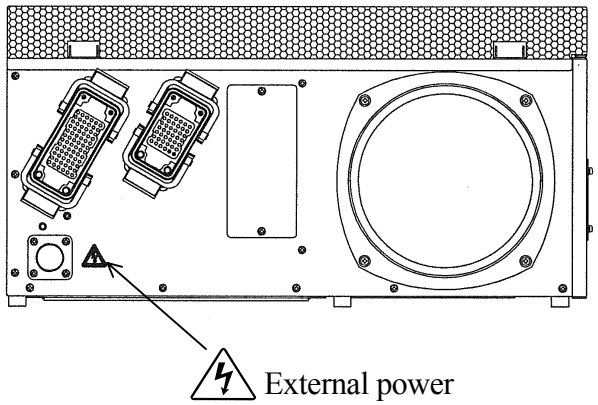
E4x controller



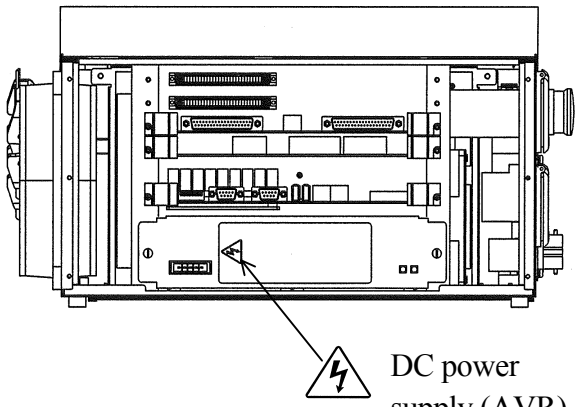


Left Rear

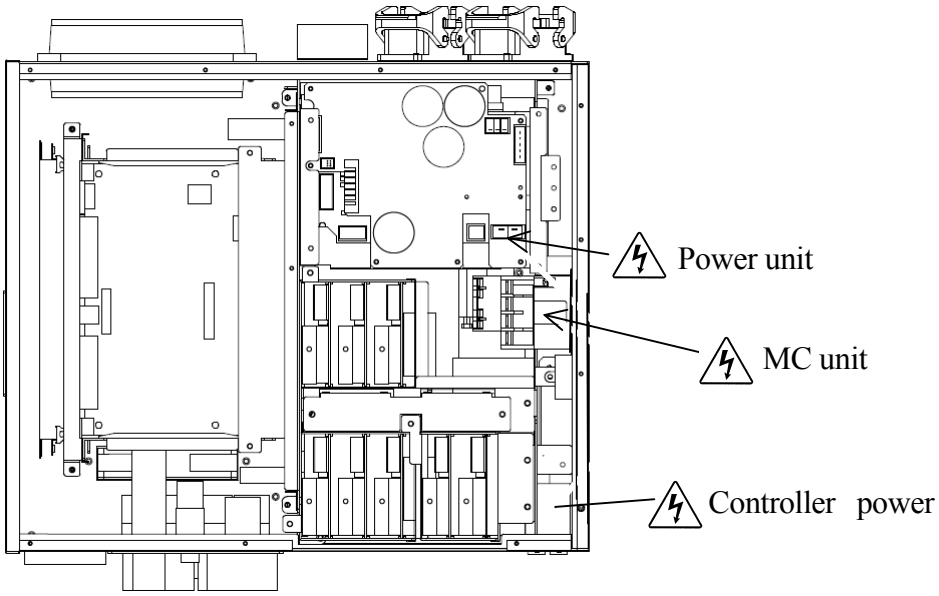
E7x controller



Left



Rear

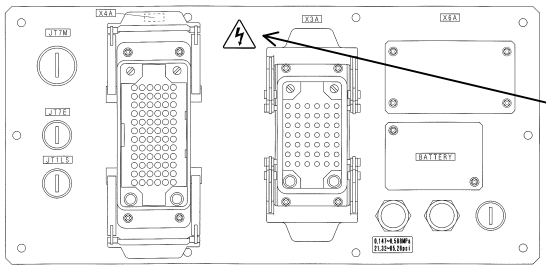


Above

3.3.2 ARM ELECTRIFICATION, HIGH TEMPERATURE AND PINCHING RISKS

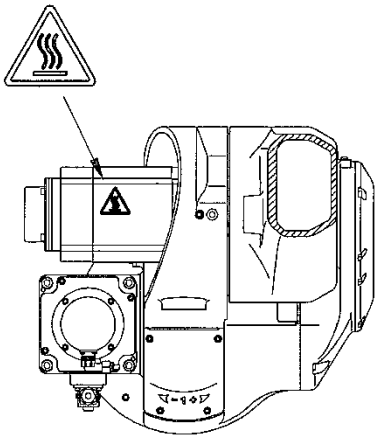
The figures below show the residual risk warning labels on RS20 arm as an example. Residual risk warning signs are located on similar places on all arm series.

RS20



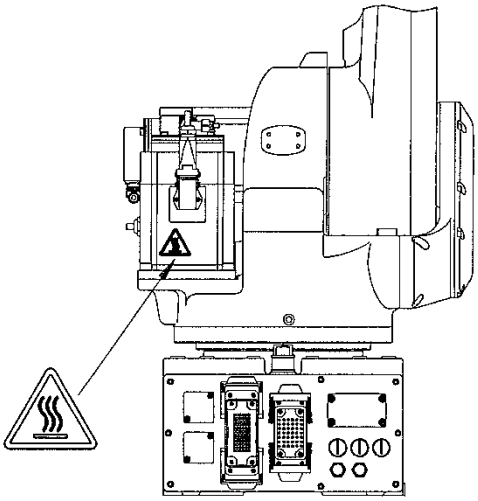
Warning label for electrification

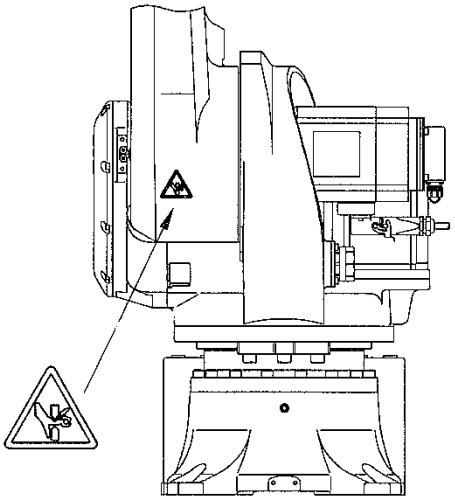
Base plate



Warning label for high temperature

Warning label for pinching





4.0 TRANSPORTATION

4.1 SAFETY PRECAUTIONS DURING TRANSPORTATION, INSTALLATION AND STORAGE

To transport the Kawasaki Robot to its installation place, strictly observe the following cautions while carrying out the transportation and installation work.

[**NOTE**]

The installation shall be made by qualified installation personnel and should conform to all national and local codes.

⚠ WARNING

1. **When transporting a controller or a robot arm with a crane or a forklift, never support the controller manually.**
2. **During the transportation, stay out from under the lifted controller or robot arm.**
3. **Prior to installation, turn OFF the controller power switch and the external power switch to shut down the power supply to the controller. Display signs indicating clearly "Installation and connection in progress", and lockout/tagout the external power switch to prevent accidents of electric shock etc. caused by someone accidentally turning ON the power.**
4. **When moving the robot, ensure safety by first confirming no abnormality is observed in the installing condition, etc., and then turn ON motor power to set robot to the desired pose. Be careful not to be caught by/between any moving parts by carelessly approaching the robot and peripheral equipment. After setting the robot to the specified pose, turn OFF the controller and external power switch again. Display signs indicating clearly "Installation and connection in progress", and lockout/tagout the external power switch before starting installation and connection.**

⚠ CAUTION

1. **Since the robot arm is composed of precision parts, be careful not to apply excessive shocks or vibrations during transportation.**
2. **Prior to installation, remove all obstacles so the installation is carried out smoothly and safely. Clear the passage to the installation area for transportation of the robot arm using a crane or forklift.**
3. **During transportation and storage,**
   - **(1) keep the ambient temperature within the following range:**
     0 - 45 °C for Y, R series arm,
     -10°C to 60 °C for Z, M series arm and controller,
   - **(2) keep the relative humidity within the range of 35 - 85 % RH without dew condensation,**
   - **(3) keep free from excessively strong vibration.**

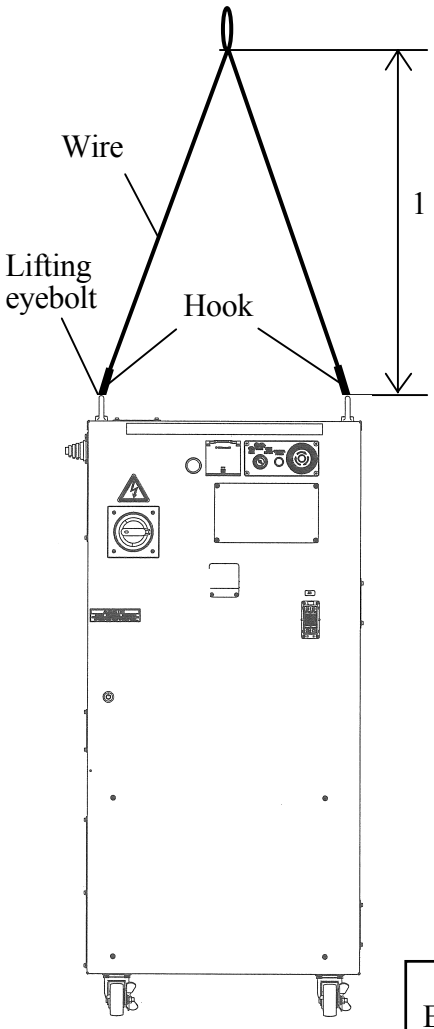
4.2 TRANSPORTATION OF CONTROLLER

When transporting the controller, strictly observe the precautions given in the sections below for whichever transport method is chosen.

4.2.1 BY CRANE LIFTING (E4X)

⚠ WARNING

1. **Never support the controller manually when it is lifted up. And, never go under or stay too close to the controller during transport.**
2. **Hook the wire at the lifting eyebolts as shown below.**
3. **Ensure that the lifting eyebolts are not loose. Check each one and retighten if loose. Otherwise, the controller may fall and suffer damage.**



E4x controller

⚠ CAUTION

1. **Prepare wire and crane capable of hoisting 300 kg or more, sufficient for a controller loaded with full options.**
2. **Remove the teach pendant and teach pendant holder (if equipped) before lifting with the wire sling.**
3. **Wire length: 1 m or more as shown in the figure on the left.**
4. **Be careful as the controller may tilt when lifted up.**
5. **Be careful not to let the wire to get caught on other equipments.**

[NOTE]

E7x controller must not be transported by crane lifting.

4.2.2 BY CASTER (E4X)

⚠ WARNING

1. **The controller can be moved on its casters only when the entire transport path is level enough. Otherwise, moving the controller on an inclined or an uneven surface will cause it to topple, resulting in a serious damage.**
2. **E4x controller falls over if it is tilted as follows.**
   Back or forth: Approx. 15° or more
   Right or left: Approx. 15° or more

⚠ CAUTION

1. **Release the stoppers on the two front casters of the controller when moving the controller. (Push the "OFF" side pedal.)**
2. **Relock the casters after the transport is complete.**
   (Push the "ON" side pedal for locking.)

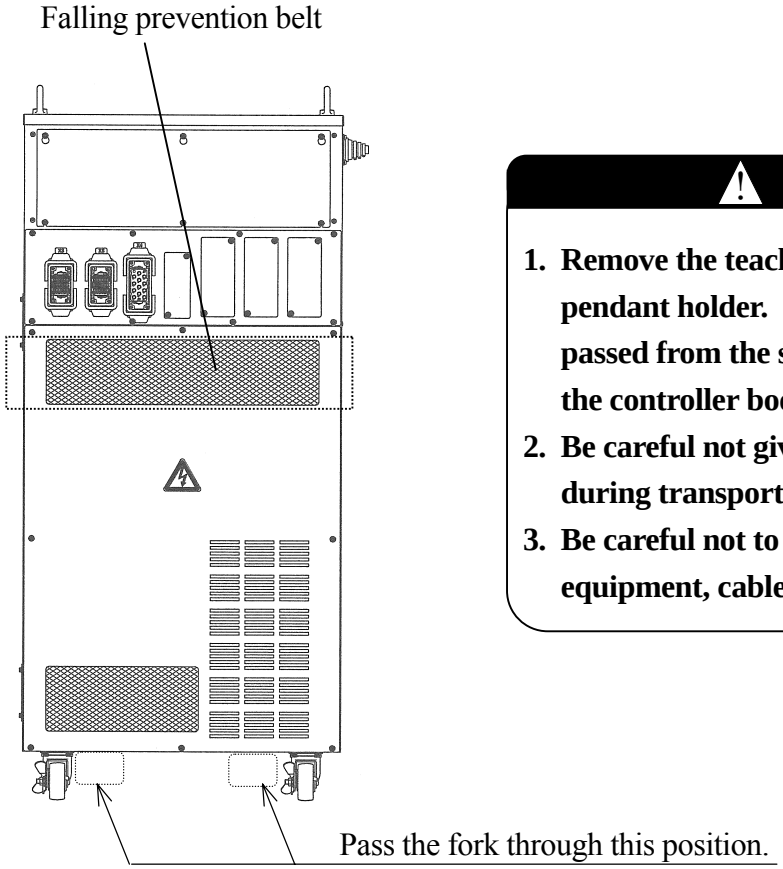
[**NOTE**]

E7x controller must not be transported by caster.

4.2.3 BY FORKLIFT TRUCK (E4X)

⚠ WARNING

To avoid the controller from toppling over, fasten it to the forklift with a belt as shown below.



⚠ CAUTION

1. **Remove the teach pendant and teach pendant holder. The fork cannot be passed from the side. Pass the fork under the controller body as shown on the left.**
2. **Be careful not give shock to the controller during transport.**
3. **Be careful not to get caught on other equipment, cables, etc.**

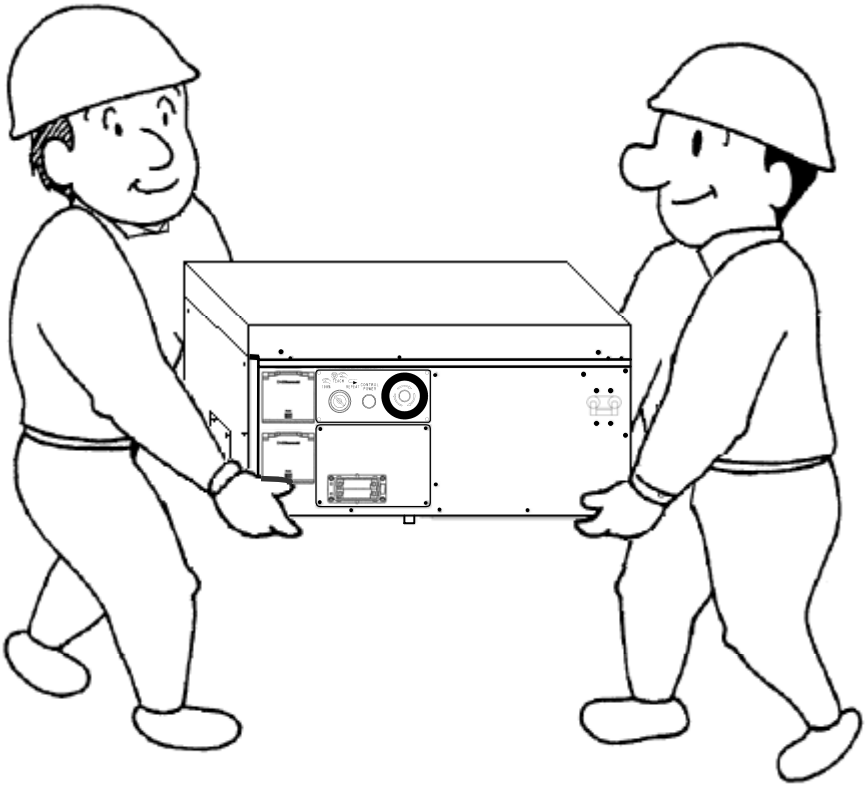
[NOTE]

E7x controller must not be transported by forklift.

4.2.4 BY TWO PERSONS (E7X)

CAUTION

1. **Disconnect the Teach Pendant.**
2. **Be careful not give shock on the controller during transportation.**



[NOTE]

E4x controllers must not be carried manually.

4.3 TRANSPORTATION METHOD OF ROBOT ARM

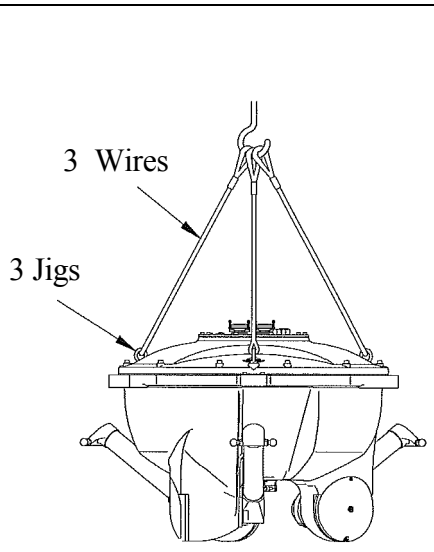
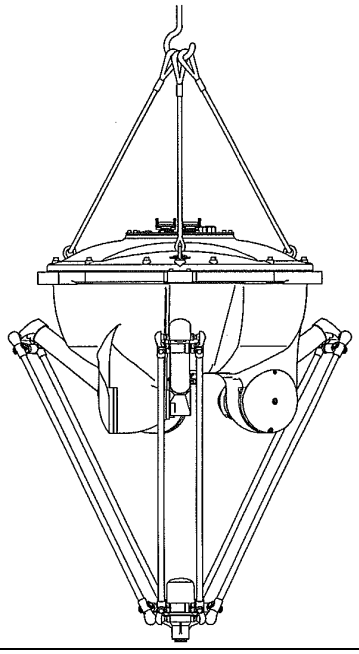
⚠ CAUTION

1. **When lifting up the robot, be careful as robot may tilt forward/backward depending on robot posture and installation condition of the options. If the robot is lifted up in an inclined posture, it may swing or damage. Also, the wire may interfere with the harness, piping etc., or it may damage due to interfering with surrounding objects.**
2. **Remove the eyebolt attached to the arm once the transportation of robot is complete.**

4.3.1 YF SERIES

Wire sling

Attach three hoisting jig on the arm as shown in the figure below. Fasten the wire through the hoisting jigs to lift the robot arm.

<table>
<tr><td>Model</td><td colspan="2">YF003N</td></tr>
<tr><td rowspan="2"></td><td>At time of shipment</td><td>After assembly of lower arm</td></tr>
<tr><td> 
</td><td>  </td></tr>
<tr><td rowspan="4">Hoisting posture</td><td>JT1</td><td>-28°</td></tr>
<tr><td>JT2</td><td>-28°</td></tr>
<tr><td>JT3</td><td>-28°</td></tr>
<tr><td>JT4</td><td>0°</td></tr>
<tr><td>Jigs for hoisting</td><td colspan="2">60154-1879 (Jig, eyebolt)×3</td></tr>
</table>

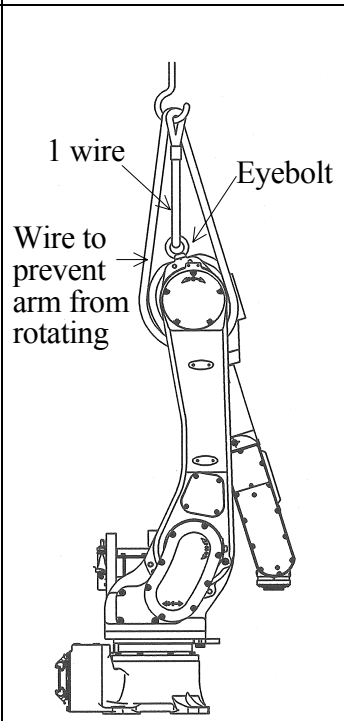
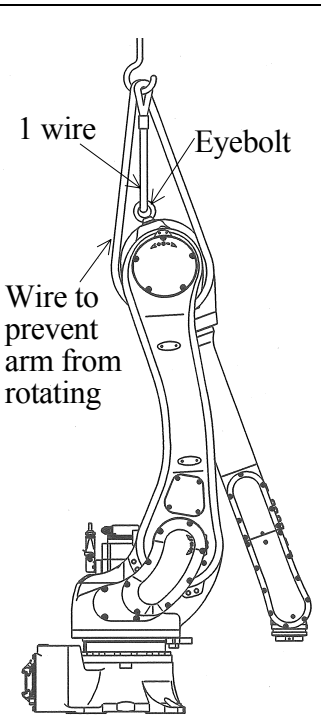
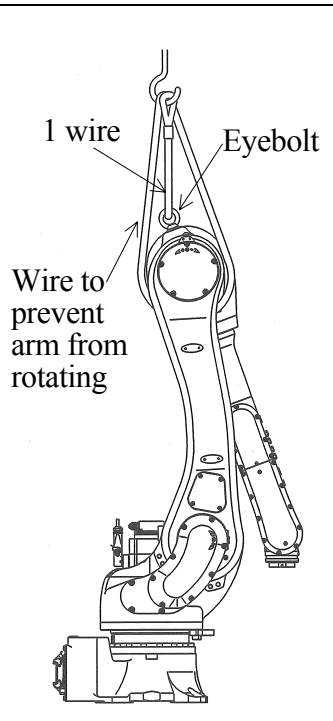
4.3.2 RS SERIES

⚠ WARNING

When lifting up the RS series arm with a wire sling, support the arm with an additional wire to avoid the arm from rotating. The eyebolt may loosen and cause the robot to fall if the arm rotates when lifted.

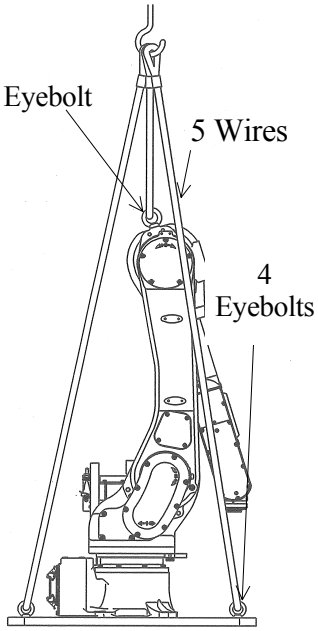
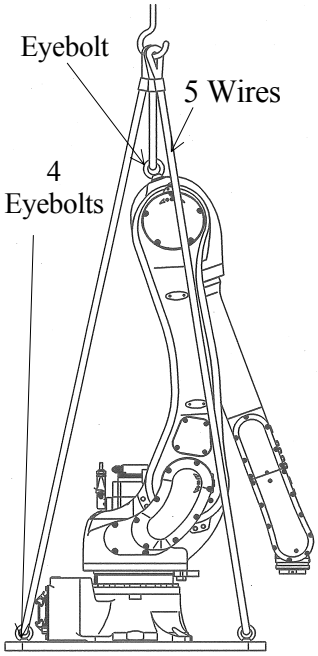
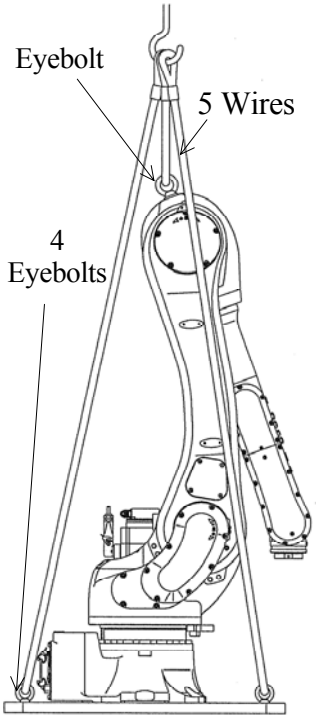
Using Wire Sling (Without base plate)

As shown in the figure below, hoist up the robot by fastening a wire sling to the eyebolt attached to robot arm. (Use the same method for hoisting up the robot with pedestal.)

Model		RS10N	RS10L	RS20N
Posture				
Hoisting posture	JT1	0°	0°	0°
	JT2	0°	-3°	-3°
	JT3	-163°	-163°	-163°
	JT4	0°	0°	0°
	JT5	-17°	-20°	-20°
	JT6	0°	0°	0°
Eyebolt for arm		M16×1	M16×1	M16×1

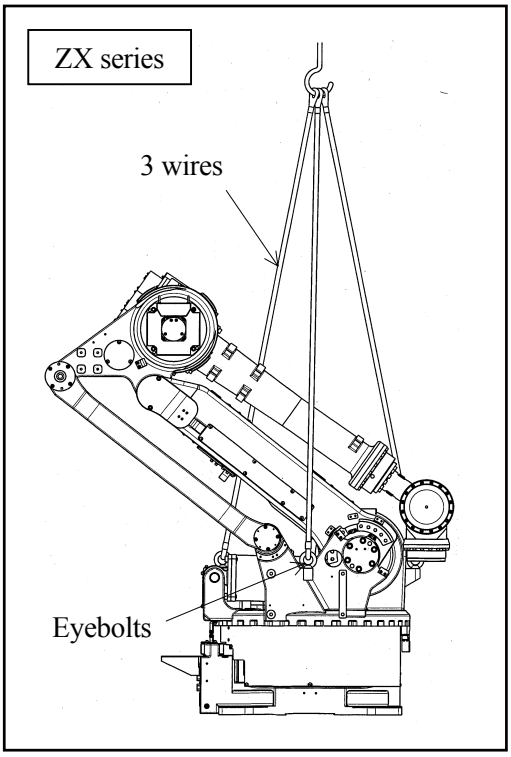
Using Wire Sling (With base plate)

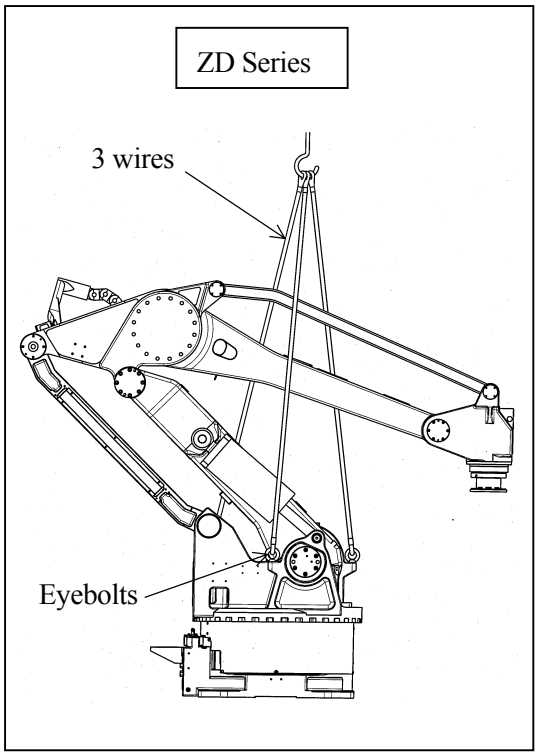
According to the figure below, hoist up the robot by fastening four wire slings to four eyebolts on the base plate. In addition, fasten a wire sling to the eyebolt on the arm to prevent the robot from accidentally falling. (Use the same method for hoisting up the robot with pedestal.)

Model		RS10N	RS10L	RS20N
Posture				
Hoisted up posture	JT1	0°	0°	0°
	JT2	0°	-3°	-3°
	JT3	-163°	-163°	-163°
	JT4	0°	0°	0°
	JT5	-17°	-20°	-20°
	JT6	0°	0°	0°
Eyebolts for arm		M16×1	M16×1	M16×1

4.3.3 ZX/ZD SERIES

Using Wire Slings
According to the figure, hoist up the robot by three wires through three eyebolts.



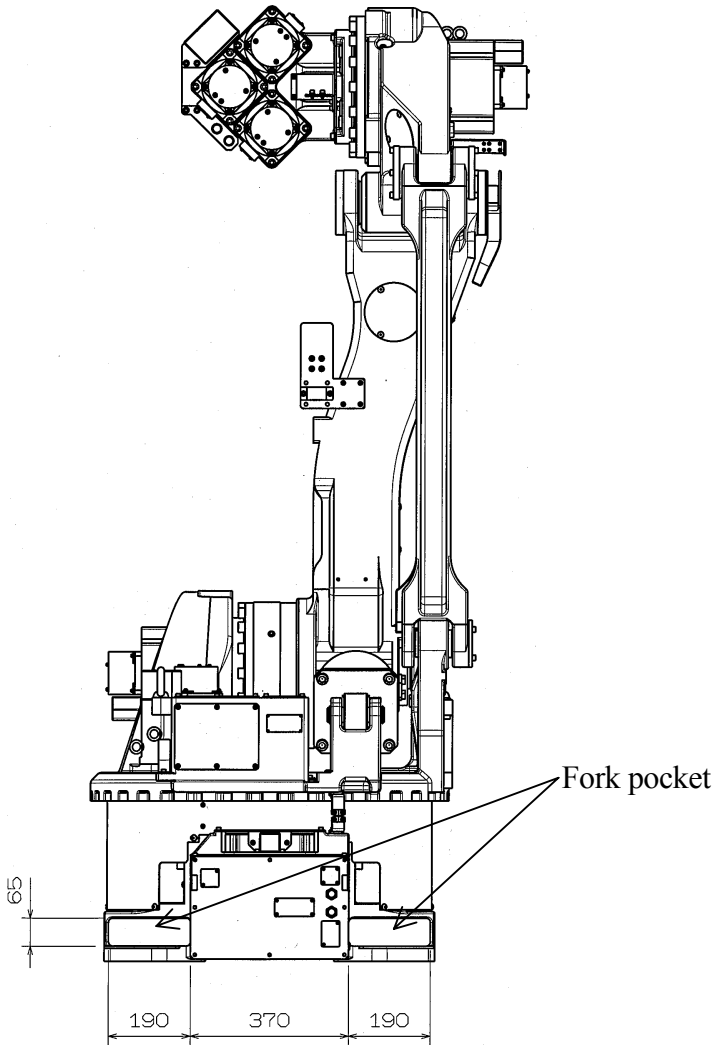


Model		ZX
Hoisting posture	JT1	0°
	JT2	-52°
	JT3	-35°
	JT4	0°
	JT5	-55°
	JT6	0°

Model		ZD
Shipment posture	JT1	0°
	JT2	-45°
	JT3	-20°
	JT4	0°

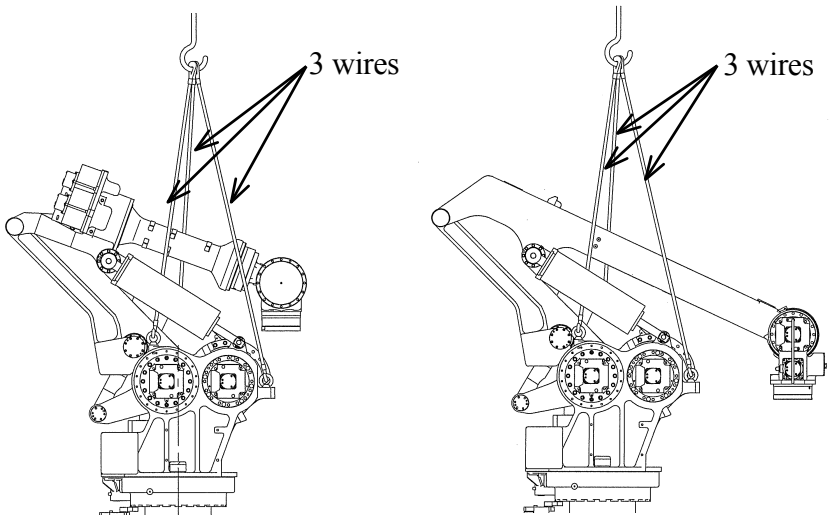
Using Forklift

1. When carrying by forklift, use the pocket for the forklift located at the robot base.
2. Confirm that the forks of forklift penetrate sufficiently without fail.
3. When transporting robot on an inclined or rough surface, be careful to maintain balance to prevent forklift/robot from falling.
4. When the retract stopper and retract pin (Option) are mounted, set the forks of forklift to a height of 54 mm or less.



4.3.4 MX/MD SERIES

Wire sling
Attach three eye bolts on the arm as shown in the figure below. Fasten the wires through the eyebolts to lift the robot arm.



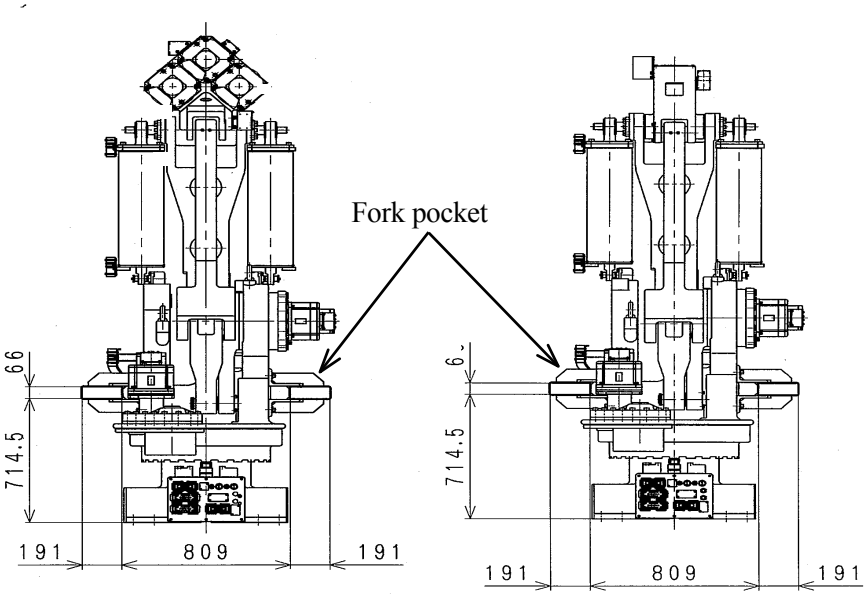
MX Series MD Series

Model		MX	MD
Hoisting posture	JT1	0 °	0 °
	JT2	-45 °	-45 °
	JT3	-23 °	-20 °
	JT4	0 °	0 °
	JT5	0 °	0 °
	JT6	—	0 °

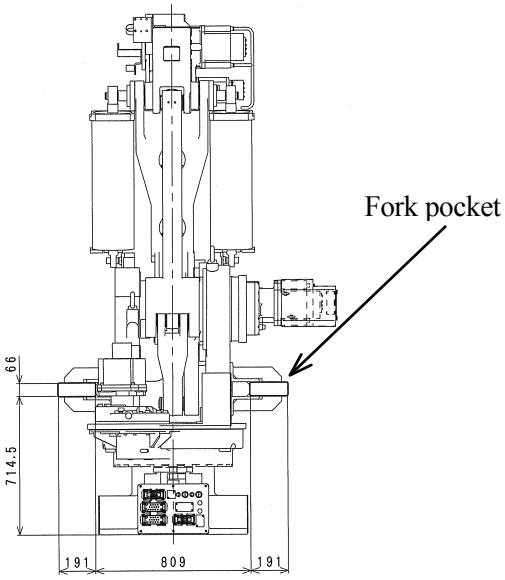
Using Forklift

Fork pocket comes as an optional jig to use when lifting the robot with a forklift.

1. When carrying MX or MD series robot by forklift, JT 2 should be at the angle of 0° to - 45°.
2. When carrying MT400N by forklift, JT 2 should be at the angle of -135°.
3. Confirm that the forks of forklift penetrate sufficiently without fail.
4. When transporting robot on an inclined or rough surface, be careful to maintain balance to prevent forklift/robot from falling.



MX Series MD Series



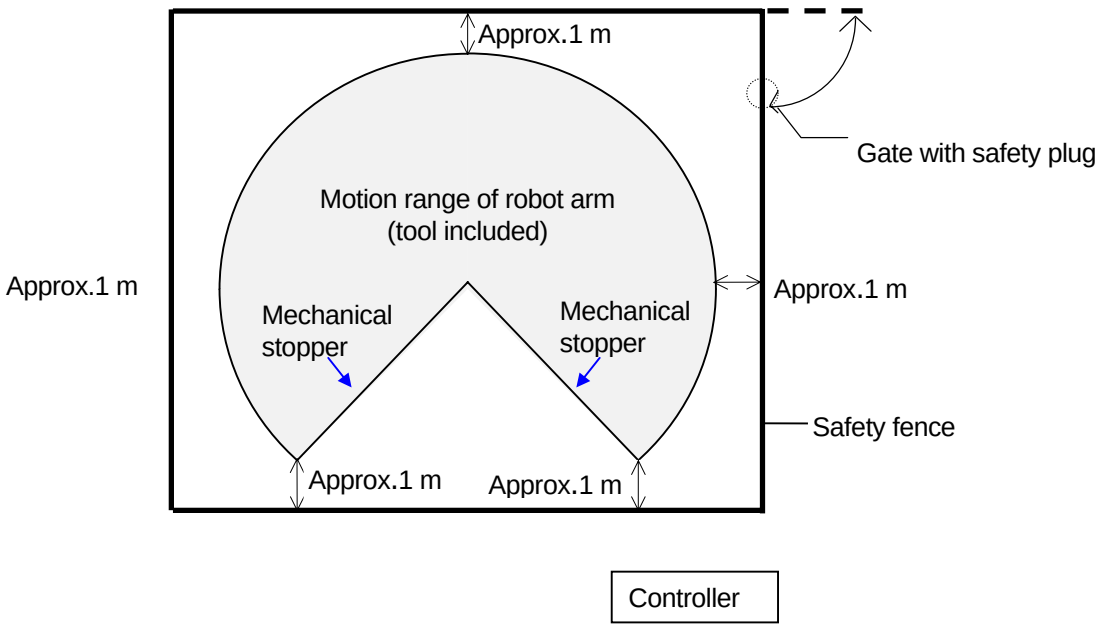
MT Series

5.0 INSTALLATION

5.1 INSTALLATION ENVIRONMENT

The installation site of the robot must fulfill all the following environmental conditions:

1. When robot arm is installed on the floor, the levelness must be within ±5°.
2. Be sure that the floor/stand has sufficient rigidity.
3. Secure a flat place to prevent the base section from receiving undue force.
   (If an accurate flatness is unobtainable, insert liners and adjust the flatness).
4. Keep the ambient temperature during operation within the range of 0°C to 45°C (with the exception of E7x controller installed on the side: 0°C to 40°C). Deviation or overload error may occur due to high viscosity of grease/oil when starting operation at low temperatures. In this case, warm-up robot at low speed before regular operation.
5. Keep the relative humidity during operation within the range of 35% to 85%RH without dew condensation.
6. The altitude of the installation place should be within the range of 0 m to 1000 m above mean sea level.
7. The robot installing place should be free from dust, dirt, smoke, water, and other foreign matters. (In dusty or moist condition, use a robot arm with dust-proof or waterproof spec.)
8. The robot installing place should be free from flammable or corrosive liquid or gas. (Use an explosion-proof arm in a flammable environment.)
9. The robot installing place should be free from excessively strong vibration. (0.5 G or less)
10. The robot installing place should be free from electric noise interference.
11. Place where power satisfying the specification is supplied.
12. Place where dedicated earthing is provided. (100 Ω or less)
13. The robot installing place should be sufficiently larger than the motion range of robot arm. Safety fence must enclose area larger than the maximum motion range of fully equipped robot arm (with tools) so it does not interfere with the surrounding objects.
    (1) Enough space for easy access to the controller during maintenance.
    (2) An entrance gate with a safety plug should be provided to the safety fence.
    (3) About details of the safety fence, observe the requirements which are established in each region. (e.g. EN953, EN294, EN811, EN1088, ISO13852, ISO13854, and ISO/NP 14120)



5.2 SAFETY MEASURES CONCERNING ROBOT INSTALLATION

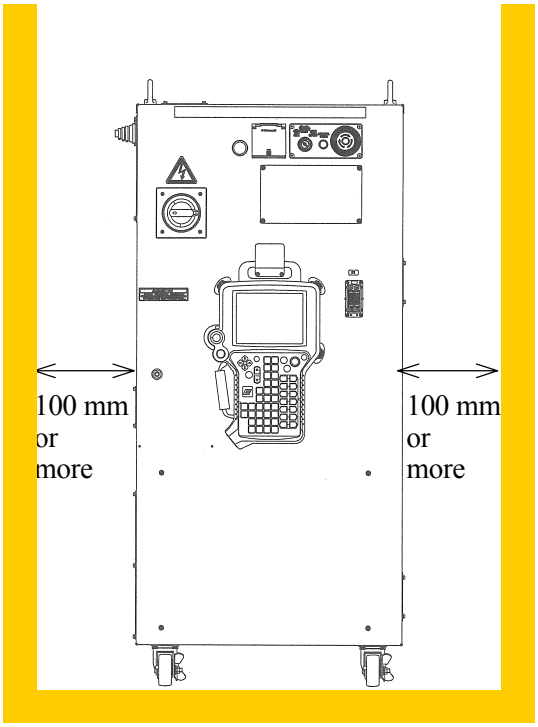
(1) Always place the robot arm within the safeguarding devices (guard, fence, equipment, etc. provided for preventing hazards) so that the robot arm is put off limits. Also, install an emergency stop device in an easily accessible area within reach of the operator.
(2) Safety guarding zone (area surrounded by the safety fence) should be built so as to prevent the robot arm from jumping over or extending beyond the fence in the event of breakdown and/or error.
(3) Minimize the number of doors on the safeguarding devices (preferably only one). The door should be equipped with a safety plug which must be removed manually in order to open/close the door. Then, set motor power to be turned OFF if plug is removed during automatic operation. Confirm that safety devices such as EMERGENCY STOP switch and safety plug function normally before entering the safeguarding devices. Then, the operator must set TEACH LOCK switch on the teach pendant to ON to prevent personnel from accidentally switching to automatic mode. Also, the operator must keep the plug on him/herself.
(4) Display the robot state clearly, such as: automatic mode, teaching, and emergency stop, etc. on the safeguarding devices so the current condition of the robot can be seen by everybody.
(5) Limit the robot operating personnel to only those who have taken and completed the training course(s) authorized by Kawasaki.

5.3 METHODS OF INSTALLATION

5.3.1 INSTALLING ROBOT CONTROLLER

In order for the controller to maintain the proper internal temperature, the installation site must confirm to the four points below.

5.3.1.1 INSTALLING E4X CONTROLLERS



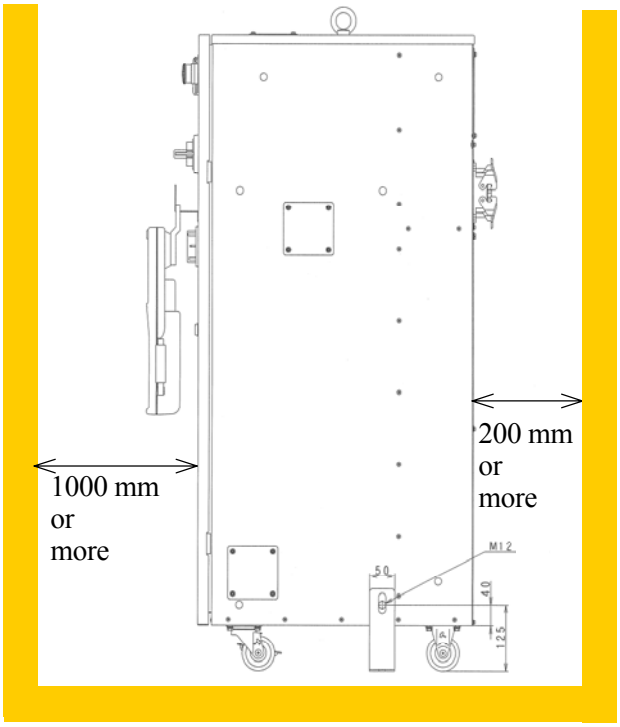
1. Place the controller on a horizontal floor.

2. Separate the controller right/left side from the wall by 100 mm or more.

3. The inlet port for air-cooling is on the rear upside of the controller, and the air exhaust port is on the rear downside.

⚠ CAUTION

Do not block the air inlet and exhaust ports when installing the controller. Separate the controller backside from the wall by 200 mm or more.



4. Make fixing bracket(s), and fix the controller with M12 bolts.

⚠ CAUTION

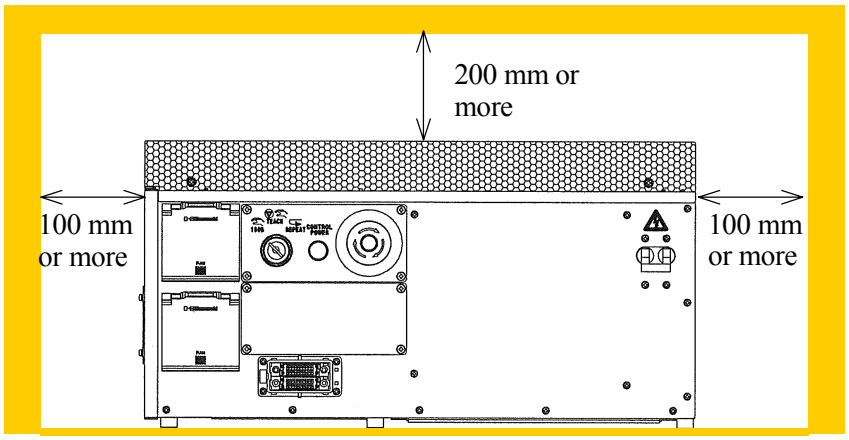
1. **Release the stoppers on the two front casters of the controller when moving the controller. (Push the "OFF" side pedal.)**
2. **Relock the casters after the transport is complete. (Push the "ON" side pedal for locking.)**

5.3.1.2 INSTALLING E7X CONTROLLERS

1. Place the controller on a horizontal floor.

2. Separate the controller right/left side from the wall by 100 mm or more.

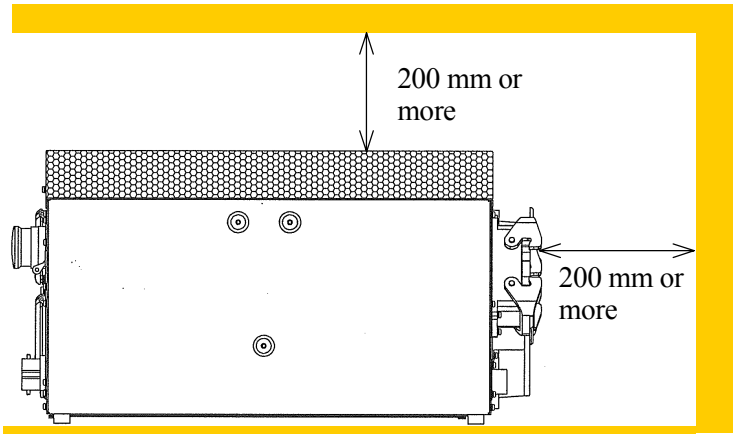
3. Separate the controller top surface from the wall by 200 mm or more.



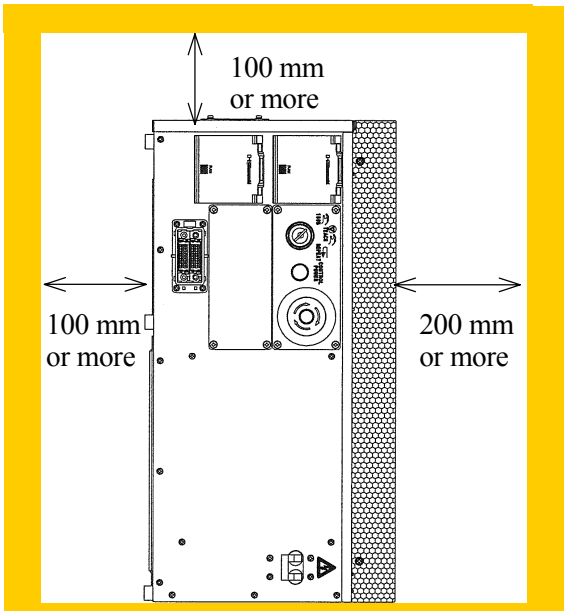
4. Heat exchange fan is provided on the rear of the controller.

⚠ CAUTION

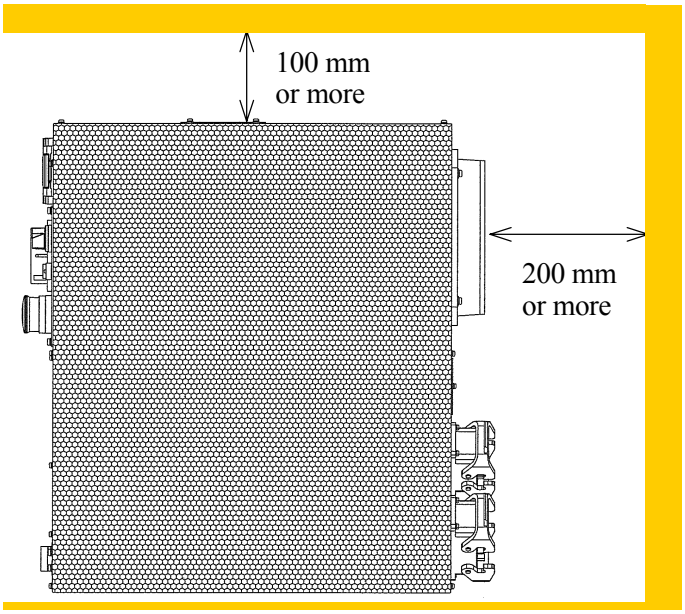
Do not block the air inlet and exhaust ports when installing the controller. Separate the controller backside from the wall by 200 mm or more.



Follow the procedure below when arranging E7x controller vertically. The ambient temperature should be within 0-40 C°.



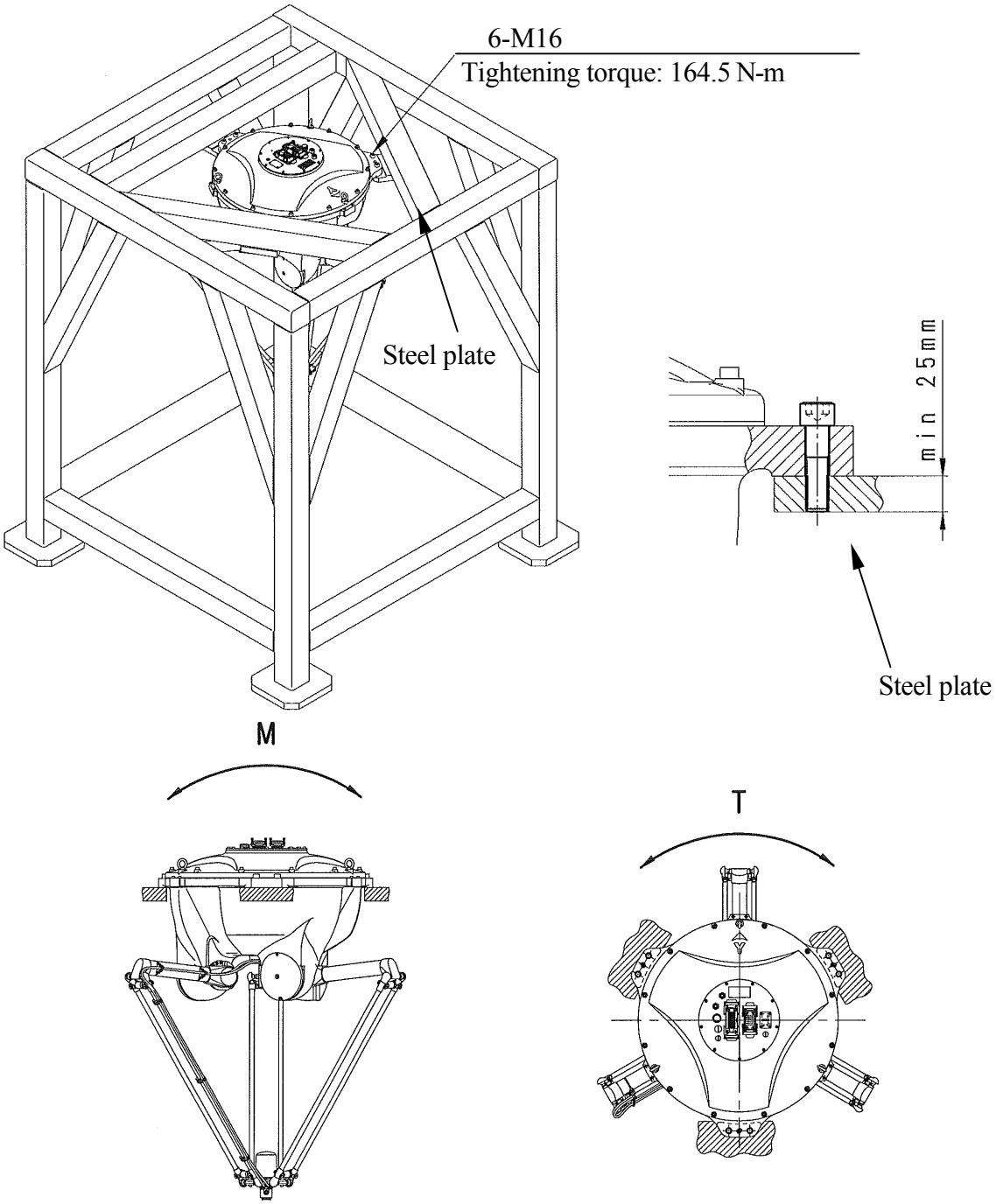
1. Place the controller on a horizontal floor with its controller power switch facing downward.
2. Separate the controller right side (or ceiling surface when arranging the controller vertically) from the wall by 200 mm or more.
3. Separate the controller top/left side from the wall by 100 mm or more.
4. Separate the controller rear side from the wall by 200 mm or more.



5.3.2 INSTALLING ROBOT ARM

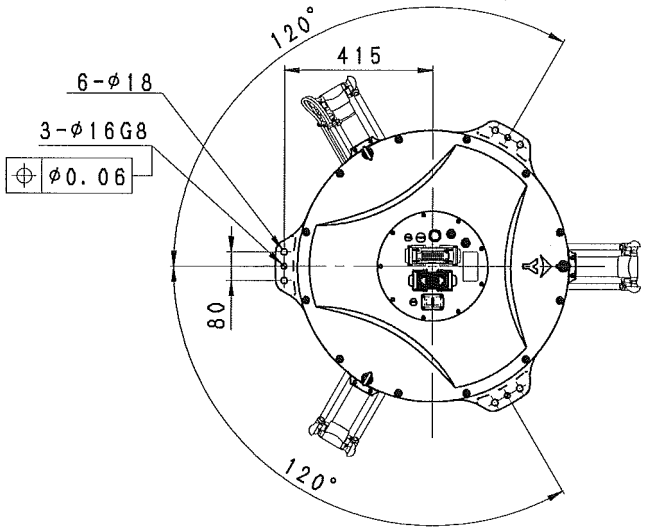
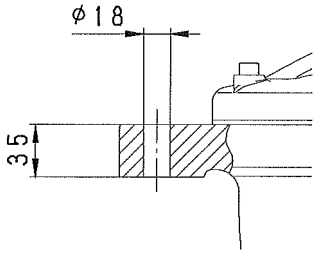
5.3.2.1 INSTALLING Y SERIES ARMS

Fix the robot arm to a pedestal as shown in the figure below. The arm should be fixed on to steel plate (25 mm min. thickness) and the pedestal should be rigid with natural frequency of 30 Hz or more. Secure the pedestal strongly enough to endure the reaction forces produced by the robot arm.



Installation Dimensions of Base Section

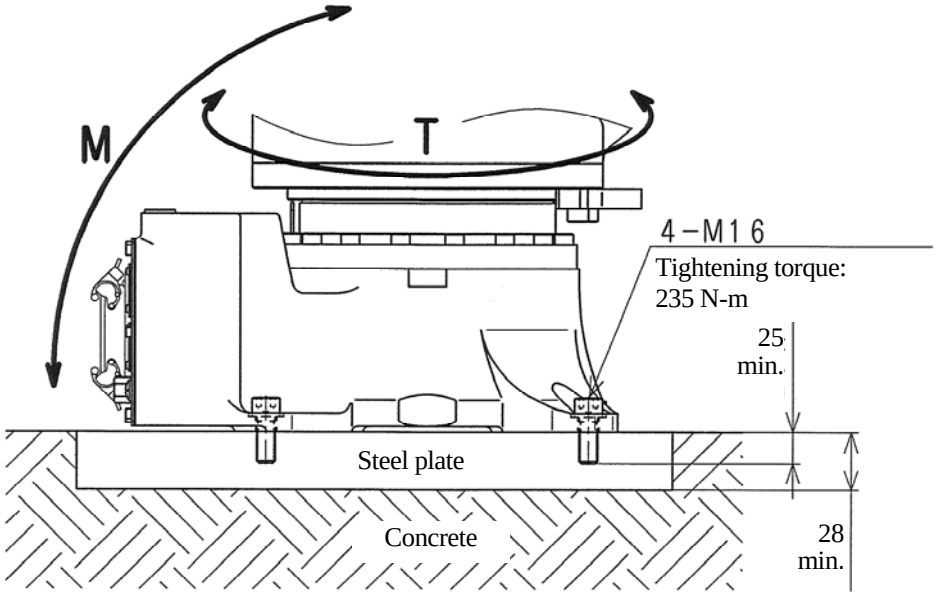
Fix the base section with high tension bolts through the bolt holes.

Model	YF003N
Dimensions for installation	
Cross-section of installation section	
Bolt hole	6- 18 dia.
Bolt	6-M16 Material: SUS304
Tightening torque	164.5 N-m
Inclination of inst. plane	Within ±5°

5.3.2.2 INSTALLING R SERIES ARMS

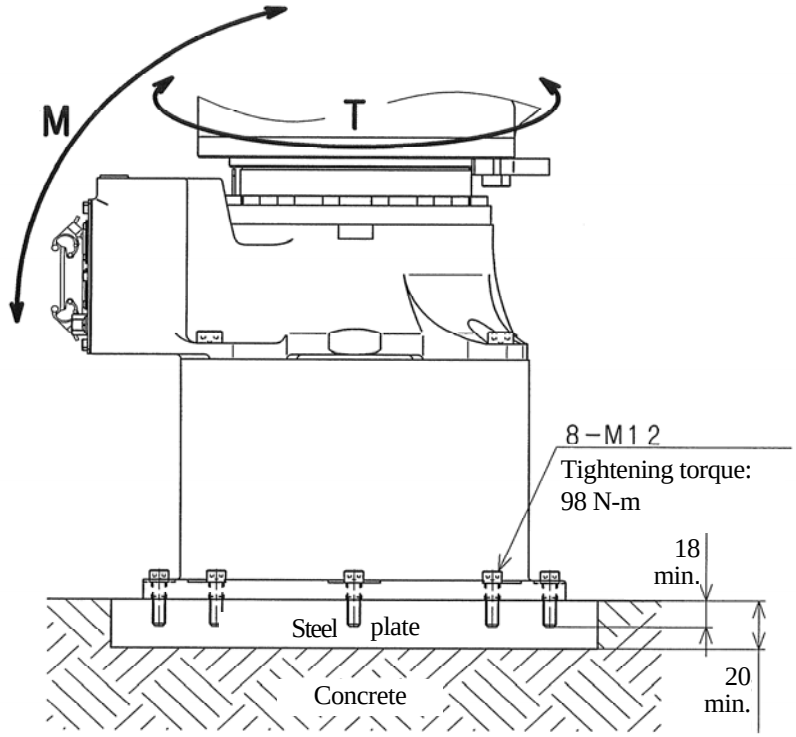
When Installing the Robot Directly to the Floor

Bury a steel plate (28 mm Min. thick) in the concrete floor as shown in the figure below or fix it with anchors. Fix the steel plate firmly enough to endure the reaction forces produced by the robot arm.



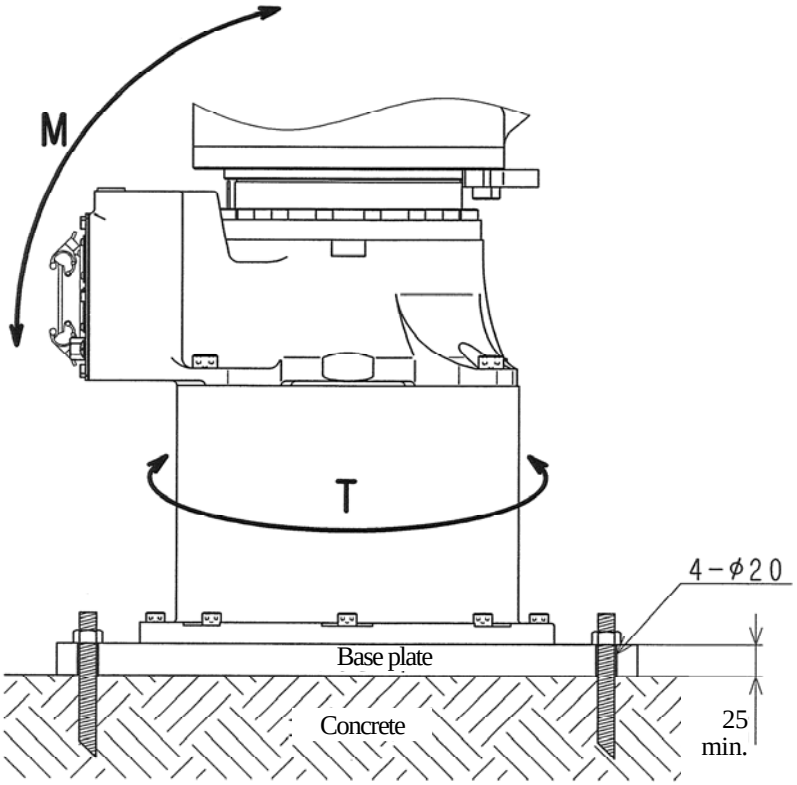
When Installing the Robot Pedestal on the Floor

In this case, the installation procedures are practically the same as the procedure shown in the prior section.



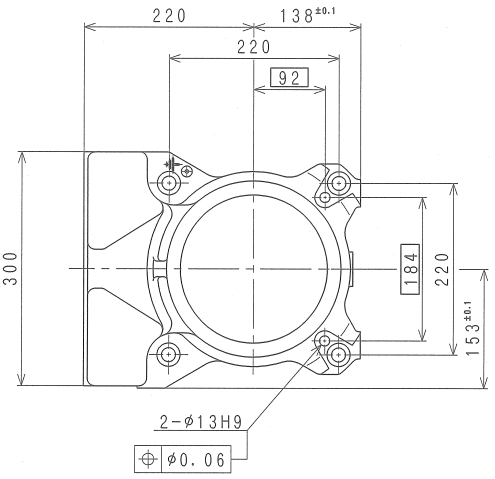
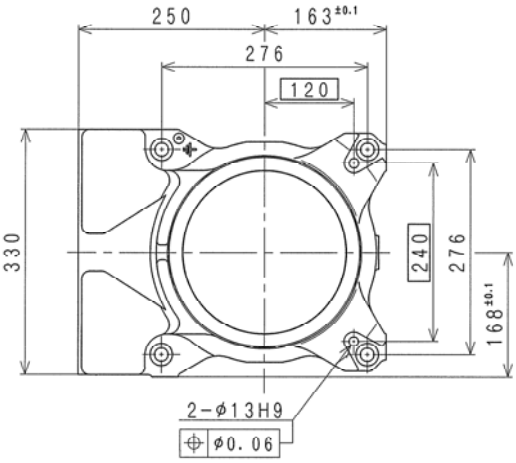
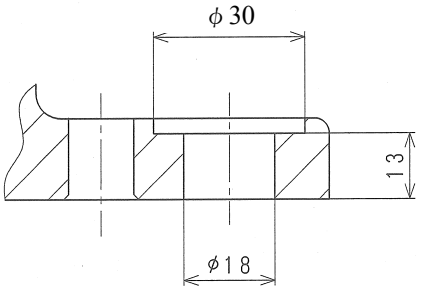
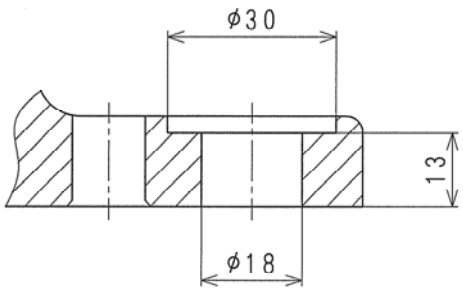
When Installing the Robot Base Plate on the Floor

In this case, install the base plate on concrete floor or steel plate using 4 of 20 - or 22 - diameter bolt holes (PCD800).



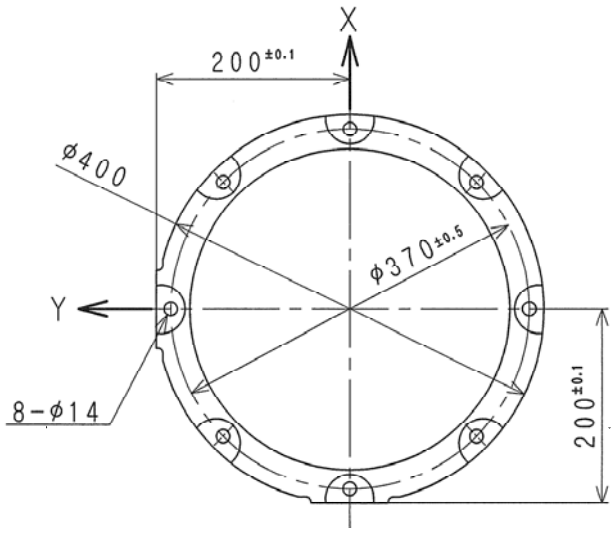
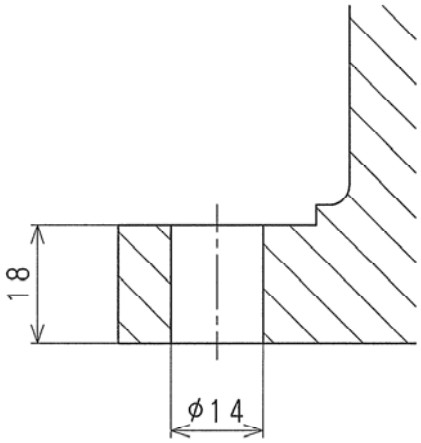
Installation Dimensions of Base Section

Fix the base section with high tension bolts through the bolt holes.

Model	RS10N	RS10L, RS20N
Dimensions for installation		
Cross-section of installation section		
Bolt hole	4- 18 in dia.	4- 18 in dia.
High tension bolt	4-M16 Material: SCM435 Strength class: 10.9 min.	4-M16 Material: SCM435 Strength class: 10.9 min.
Tightening torque	235 N-m	235 N-m
Inclination of inst. plane	Within ±5°	Within ±5°

Installation Dimensions of Robot Pedestal

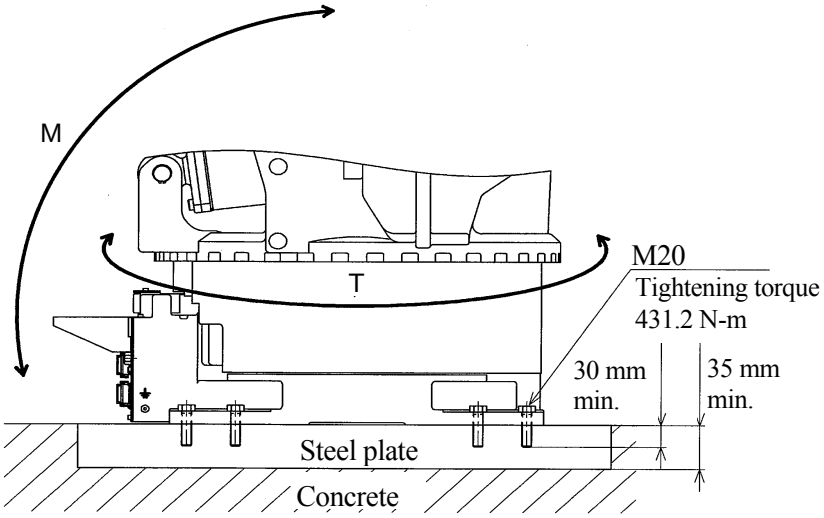
When installing a robot on the pedestal, fix the pedestal with high tension bolts through the bolt holes.

Model	RS10N, RS10L, RS20N
Dimensions for installation	
Cross-section of installation section	
Bolt hole	8- 14 in dia.
High tension bolt	8-M12 Material: SCM435 Strength class: 10.9 min
Tightening torque	98 N-m
Inclination of inst. plane	Within ±5°

5.3.2.3 INSTALLING Z SERIES ARMS

When installing the base directly on the floor:

As shown in the figure below, embed steel plate (35 mm Min. thick) in the concrete floor or fix with anchor bolts. The steel plate must be fixed firmly so as to sustain reaction forces from the robot.



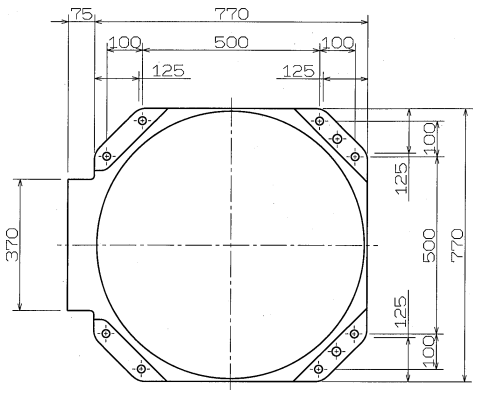
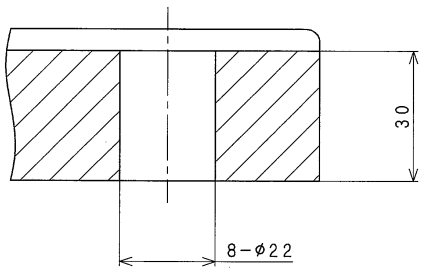
When installing the base plate with positioning holes on the floor:

Install the base plate utilizing 8 holes of 22 in diameter. Install the base plate on the concrete floor or the steel plate floor. Reaction forces received from robot are the same as when installing the base directly on the floor.

There are two pin holes on the base plate for positioning, which enable the base plate to join with the base precisely. Thus, replacement of a broken robot can be done quickly and easily. (Beware that usually JT1 is not precision zeroed. This function is only provided as Option.)

Installing Dimensions of Base Section

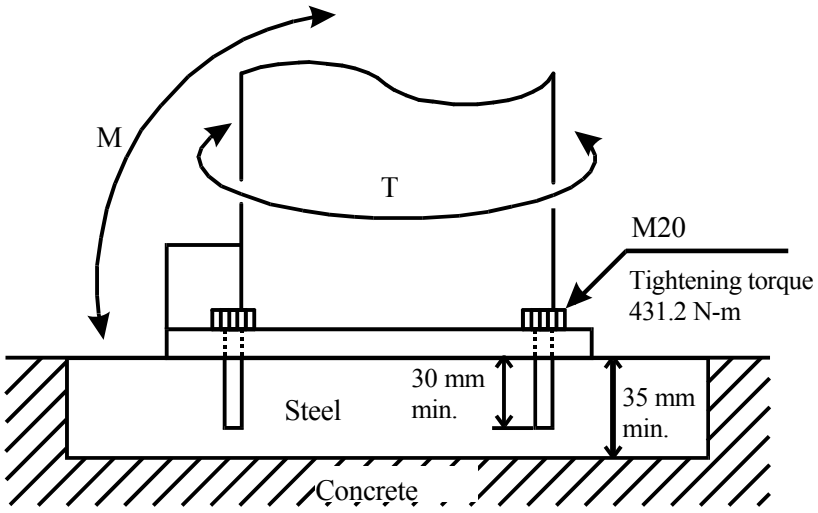
Fix the base section with high tension bolts through the bolt holes.

Installing Dimensions of Base Section	
Cross-section of Base installation hole	
Bolt Hole	8- 22 dia.
High Tension Bolt	8-M20 Material: SCM435 Strength class: 10.9 min.
Tightening Torque	431.2 N-m
Levelness	Within ±5°

5.3.2.4 INSTALLING M SERIES ARMS

When installing the base directly on the floor:

As shown in the figure below, embed steel plate (35 mm Min. thick) in the concrete floor or fix with anchor bolts. The steel plate must be fixed firmly so as to sustain reaction forces from the robot.



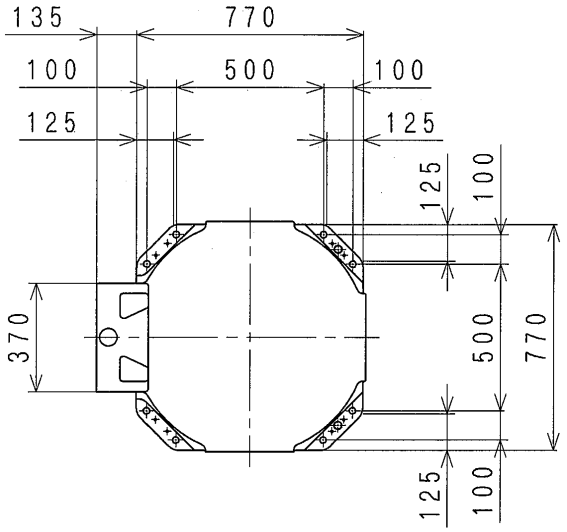
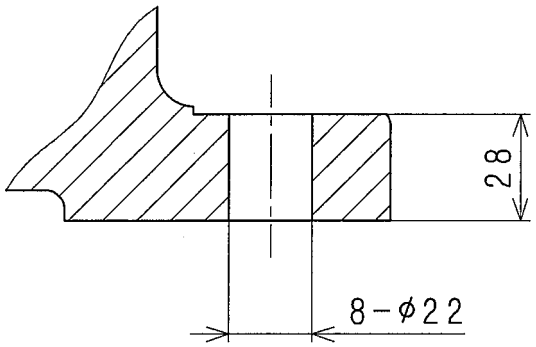
When installing the base plate on the floor:

Install the base plate utilizing 8 holes of 22 diameter. Install the base plate on the concrete floor or the steel plate floor. Reaction forces received from robot are the same as when installing the base directly on the floor.

There are two pin holes on the base plate for positioning, which enable the base plate to join with the base precisely. Thus, replacement of a broken robot can be done quickly and easily. (Beware that usually JT1 is not precision zeroed. This function is only provided as Option.)

Installing Dimensions of Base Section

Fix the base section with high tension bolts through the bolt holes.

Installing Dimensions of Base Section	
Cross-section of Base installation hole	
Bolt Hole	8- 22 dia.
High Tension Bolt	8-M20 Material: SCM435 Strength class: 10.9 min.
Tightening Torque	431.2 N-m
Levelness	Within ±5°

5.3.3 MOVEMENT REACTION ACTING ON INSTALLATION SURFACE DURING OPERATION

Refer to the list below for the movement reaction that acts on the installation surface during normal operation. Consider these values at when installing robot arms as shown in the previous pages.

Model	T (Rotating Torque)	M (Inversion Moment)
YF003N	500 N-m	700 N-m
RS10N	2168 N-m	3223 N-m
RS10L RS20N	5614 N-m	6300 N-m
ZX Series (Excluding ZX300S)	12000 N-m	34000 N-m
ZX 300S	12000 N-m	41000 N-m
ZT Series	12000 N-m	35000 N-m
ZD Series	10000 N-m	26000 N-m
MX500N	15500 N-m	48000 N-m
MX420L	14500 N-m	43500 N-m
MX350L	13500 N-m	40000 N-m
MD500N	14000 N-m	37000 N-m
MD400N	11500 N-m	44500 N-m
MT400N	18500 N-m	46500 N-m

5.4 MOUNTING OF TOOL

At the end of the robot arm, a flange is provided for mounting a tool. To mount a tool, tighten the mounting bolts into the tap holes machined on circumference of the flange surface. Position the tool utilizing the pin holes and positioning hole or boss. Select the length of mounting bolts according to the depth of tap in arm side and thickness of tool parts so that the specified screwing engagement can be attained. Use high tension mounting bolts and tighten them to the specified torque. Refer to the following sections for specifications of the flange, mounting bolts, etc. for each robot arm.

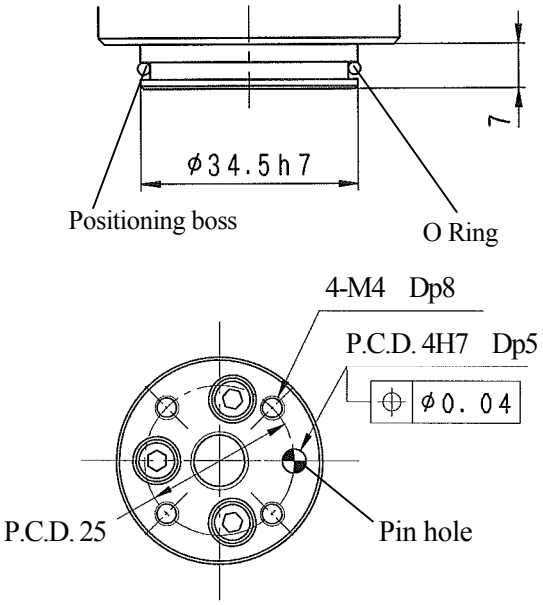
⚠ WARNING

Prior to mounting tools on the robot arm, turn OFF the controller power switch and the external power switch. Display signs indicating clearly "Installation and connection in progress", and lockout/ tagout the external power switch to prevent personnel from accidentally turning ON the power.

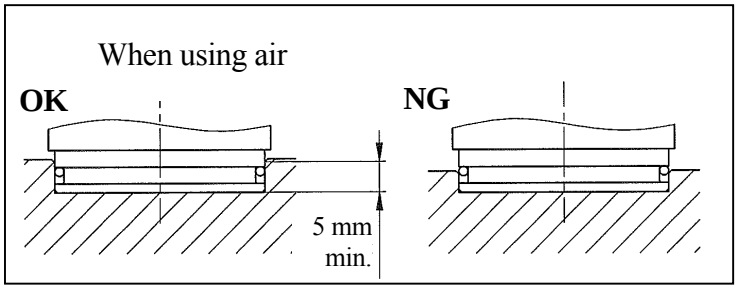
⚠ CAUTION

If the engagement length has exceeded the specified value, the mounting bolt might bottom out, and the tool will not be fixed securely.

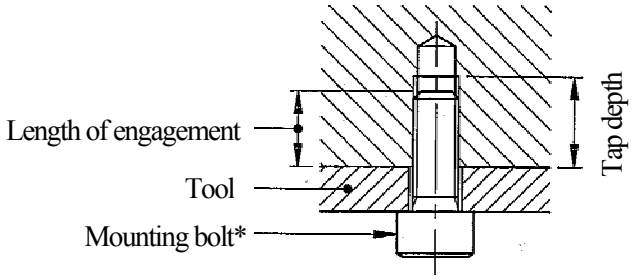
5.4.1 MOUNTING TOOL TO YF SERIES ARM



When using air, the positioning hole depth should be 5 mm or deeper.



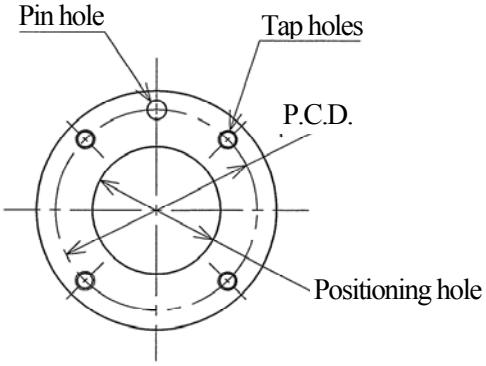
Specification of Mounting Bolts



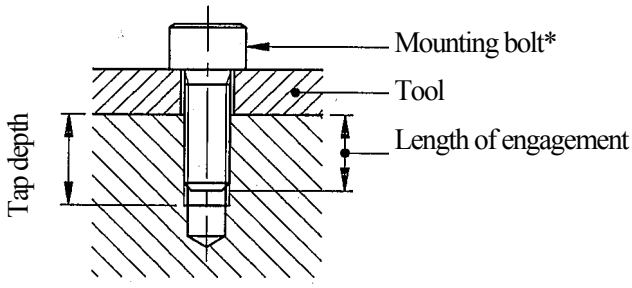
Tap depth	8 mm
Length of engagement	6 to 7 mm
Bolt	SUS304
Tightening torque	2.4 N-m

5.4.2 MOUNTING TOOL TO R SERIES ARM

Dimensions of Wrist End



Specification of Mounting Bolts



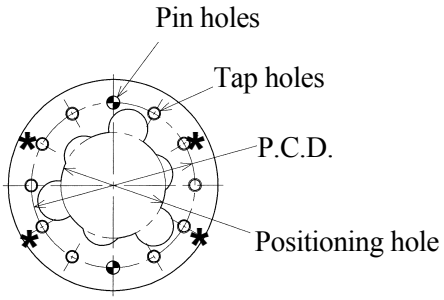
Note*: Tighten the mounting bolt to the tightening torque specified below.

Model	RS10N	RS10L , RS20N
Tap holes	4-M6	4-M6
P.C.D.	40	63
Pin hole	6H7 in dia., Depth 6	6H7 in dia., Depth 6
Positioning hole	17H7 in dia., Depth 6	40H7 in dia., Depth 6
Tap depth	8 mm	9 mm
Length of engagement	6 - 7 mm	7 - 8 mm
High tension bolt	SCM435, 10.9 min	SCM435, 10.9 min
Tightening torque	11.76 N-m	11.76 N-m

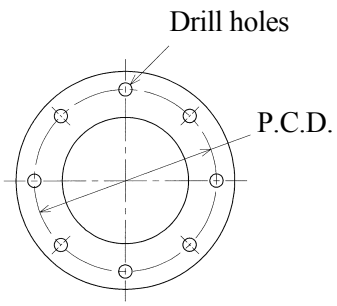
5.4.3 MOUNTING TOOL TO Z SERIES ARM

Dimensions of Wrist End (Flange)

ZX Series/ZT Series



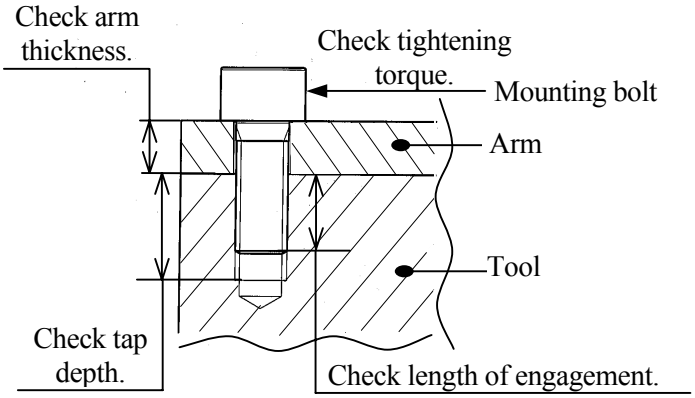
ZD Series



NOTE: 4 tap holes marked ***** require no tightening.

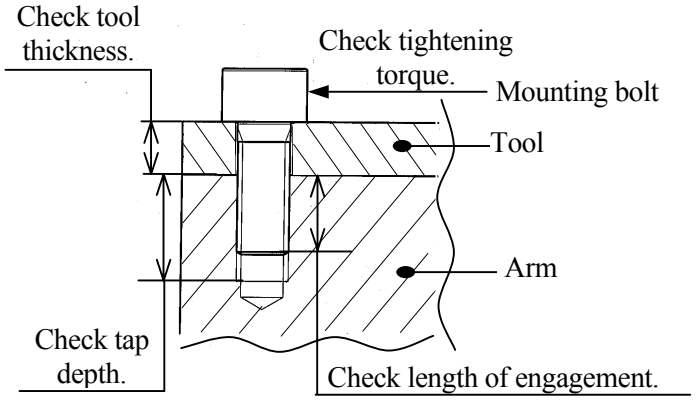
Specification of Mounting Bolts

ZD Series



Model	ZD130S, ZD250S
Drill holes	8-11 dia.
P.C.D.	150
Pin holes	-
Positioning hole	-
Arm flange thickness	15 mm
High tension bolt	SCM435, 10.9 Min

ZX Series/ZT Series

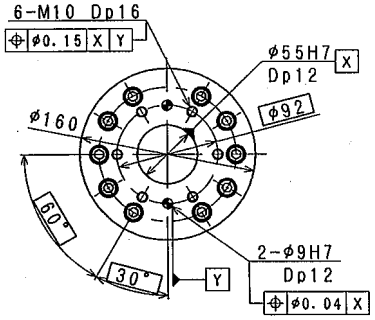


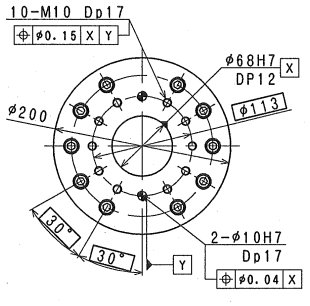
Model	ZX130S, ZX130U, ZX130L, ZX165U, ZX165L, ZX200S, ZT130S, ZT130U, ZT130L, ZT165U, ZT200U	ZX200S, ZX300S, ZT200S
Tap holes	6-M10	6-M10
P.C.D	125	160
Pin holes	2-10H7 in dia., Depth 12	2-10H7 in dia., Depth 12
Positioning hole	80H7 in dia., Depth 8	100H7 in dia., Depth 8
Tap depth	12 mm	12 mm
Length of engagement	10 to 11 mm	10 to 11 mm
High tension bolt	SCM435, 10.9 Min	SCM435, 10.9 Min
Tightening torque	56.84 N-m	56.84 N-m

[NOTE]

The above mounting sizes for ZX, ZT series are based on ISO. For the dimension below, insert the adapter plate (option) prior to mounting tools.

Model	ZX130S, ZX130U, ZX130L, ZX165U, ZX165L, ZX200S, ZT130S, ZT130U, ZT130L, ZT165U, ZT200U	ZX200S, ZX300S, ZT200S
Tap holes	6-M10	10-M10
P.C.D	92 in dia.	113 in dia.
Pin holes	2-9H7 in dia., Depth 12	2-10H7 in dia., Depth 17
Positioning hole	55H7 in dia., Depth 12	68H7 in dia., Depth 12
Tap depth	16 mm	17 mm
Length of engagement	14 to 15 mm	15 to 16 mm
High tension bolt	SCM435, 10.9 Min	SCM435, 10.9 Min
Tightening torque	56.84 N-m	56.84 N-m

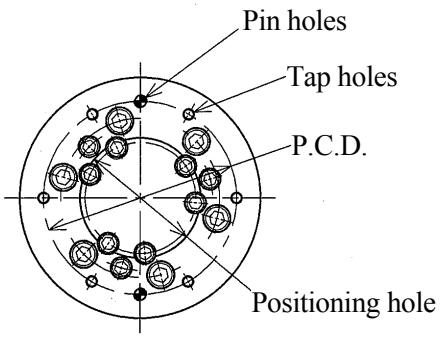




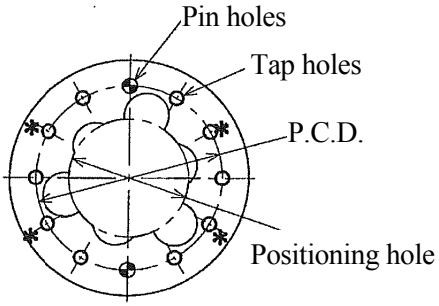
5.4.4 MOUNTING TOOL TO M SERIES ARM

Dimensions of Wrist End (Flange)

MX/MD Series



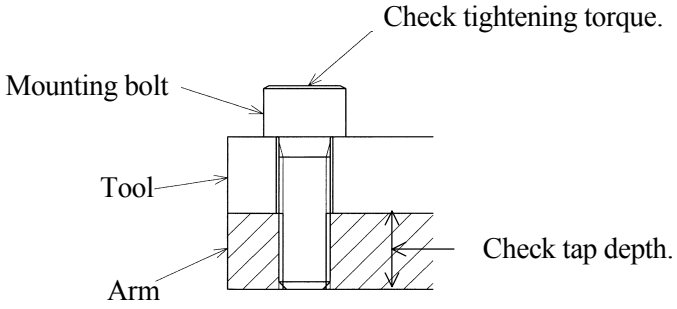
MT400N Series



⚠ CAUTION

Always secure the pin so the tool mounted on the flange does not loosen.

Specification of Mounting Bolts



Model	MX500N, MX420L MX350L, MD500N MD400N	MT400N
Tap holes	6-M12	6-M10
P.C.D	200	160
Pin holes	2-12H7 in dia., Depth 12	2-10H7 in dia., Depth 12
Positioning hole	125H7 in dia., Depth 8.5	100H7 in dia., Depth 8.5
Tap depth	29 mm	12 mm
Length of engagement	18 - 28 mm	10-11 mm
High tension bolt	SCM435, 10.9 Min	SCM435, 10.9 Min
Tightening torque	98.07 N-m	56.84 N-m
Pin Material	S45C H*	S45C H*

NOTE* Quenched-tempered S45C, or material with equal or more hardness.

6.0 CONNECTION

6.1 PRECAUTIONS FOR ROBOT CONNECTION

⚠ WARNING

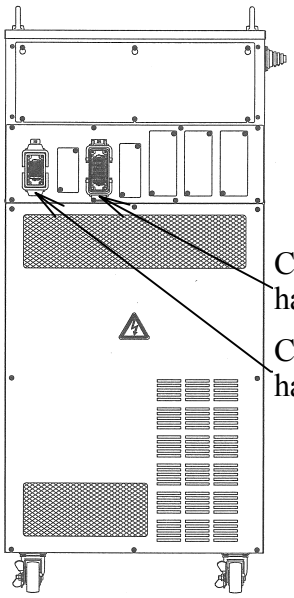
Do not connect the external power until connections between controller and robot are complete. Accidents, such as electric shock may occur.

⚠ CAUTION

1. **When connecting the harnesses, be sure to use the correct harnesses. Using an incorrect harness, or misconnecting the harness may damage connectors or cause a break in the electrical system.**
2. **Use conduits, ducts, etc. to prevent people or equipment (forklift etc.) from stepping on or riding over the signal and motor harness lines. Otherwise, an unprotected harness may become damaged causing breaks in the electrical system.**
3. **Separate the harnesses from any nearby high voltage lines (min. 1 m apart). Do not bundle or run the harnesses in parallel with other power lines. Otherwise, the noise generated from power lines will cause malfunctions.**
4. **Separate the motor harness from the communication and sensor cables, and distribute the lines so they are neither bundled nor running in parallel. Moreover, connect the communication and sensor cables using shield mesh wire that includes twisted pair lines and connect the mesh wire to an adequate FG terminal. Otherwise, PWM noise radiated from the robot's motor drive lines may penetrate into various cables, such as communication cable and cause communication errors.**
5. **Separate the welder secondary cable from the robot's signal harness. Do not wire them in the same duct.**
6. **The motor harness (power line) between the robot and controller will generate PWM noise due to the PWM control driving the motors. This noise may cause interference with signal lines. Prevent interference using these countermeasures:**
   - **(1) Separate the power and signal lines as much as possible.**
   - **(2) Use the shortest possible length for the power line.**
   - **(3) Avoid bundling, wiring in parallel the power and signal lines as much as possible.**
   - **(4) Do not wire the power and signal line within the same duct/conduit.**
   - **(5) Set and secure a firm earth line connection for the controller.**

6.2 CONNECTING BETWEEN CONTROLLER AND ROBOT

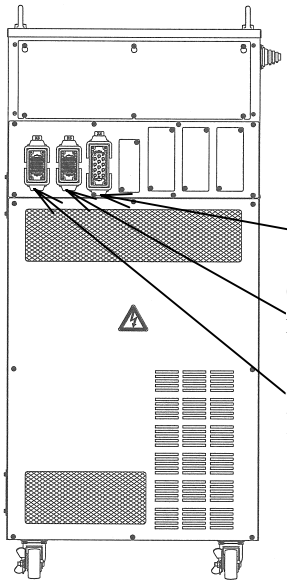
6.2.1 CONTROLLER SIDE



Connector for motor harness (X4)

Connector for signal harness (X3)

E40

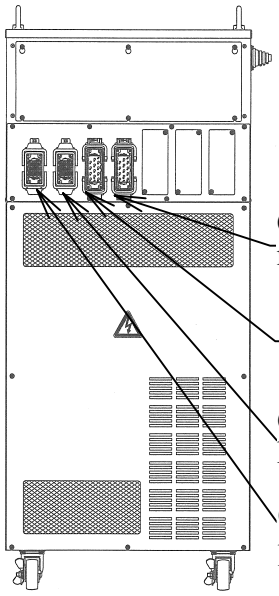


Connector for major axis motor harness (X4)

Connector for wrist axis motor harness (X5)

Connector for signal harness (X3)

E42/E43



Connector for wrist axis motor harness (X5)

Connector for major axis motor harness (X4)

Connector for brake and JT7 motor harness (X5)

Connector for signal harness (X3)

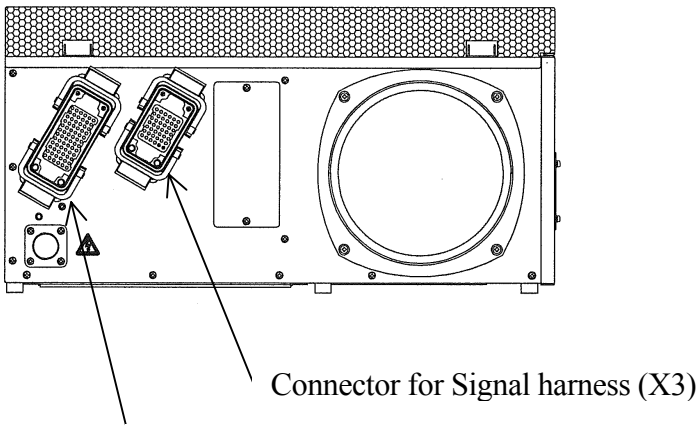
E44 controller

⚠ CAUTION

1. Fix each connector securely. The robot may malfunction if connectors loosen or detach.

2. Because connectors are located at the upper part of controller, if the connected harnesses are pulled to the controller side or rear direction, the controller might be toppled.

E7x Controller



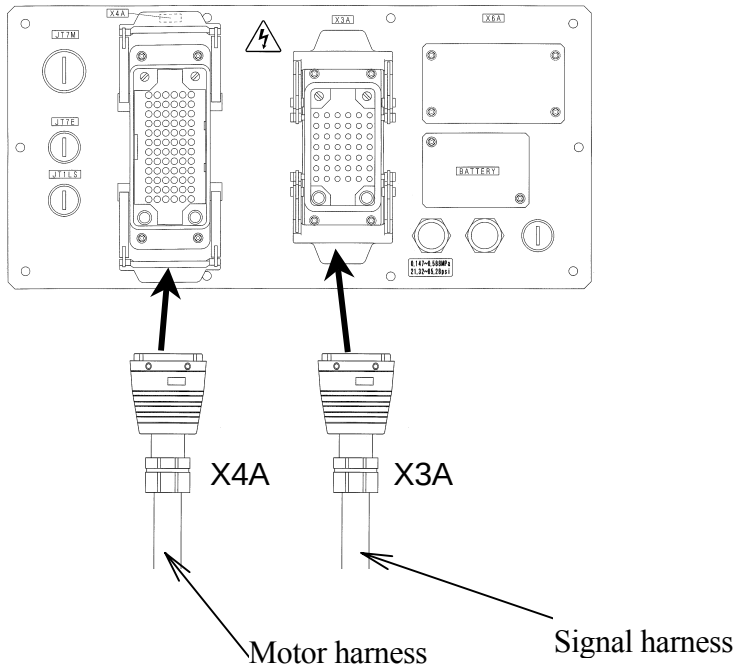
CAUTION

Fix each connector securely. The robot may malfunction if connectors loosen or detach.

6.2.2 ARM SIDE

Match the name of the connector on the controller side and arm side to connect the harnesses correctly. The controller side and arm side connectors are distinguished by an "A" placed at the end of the name of the arm connector. The connectors on the controller side are named without the "A". Below figure shows RS20 as an example.

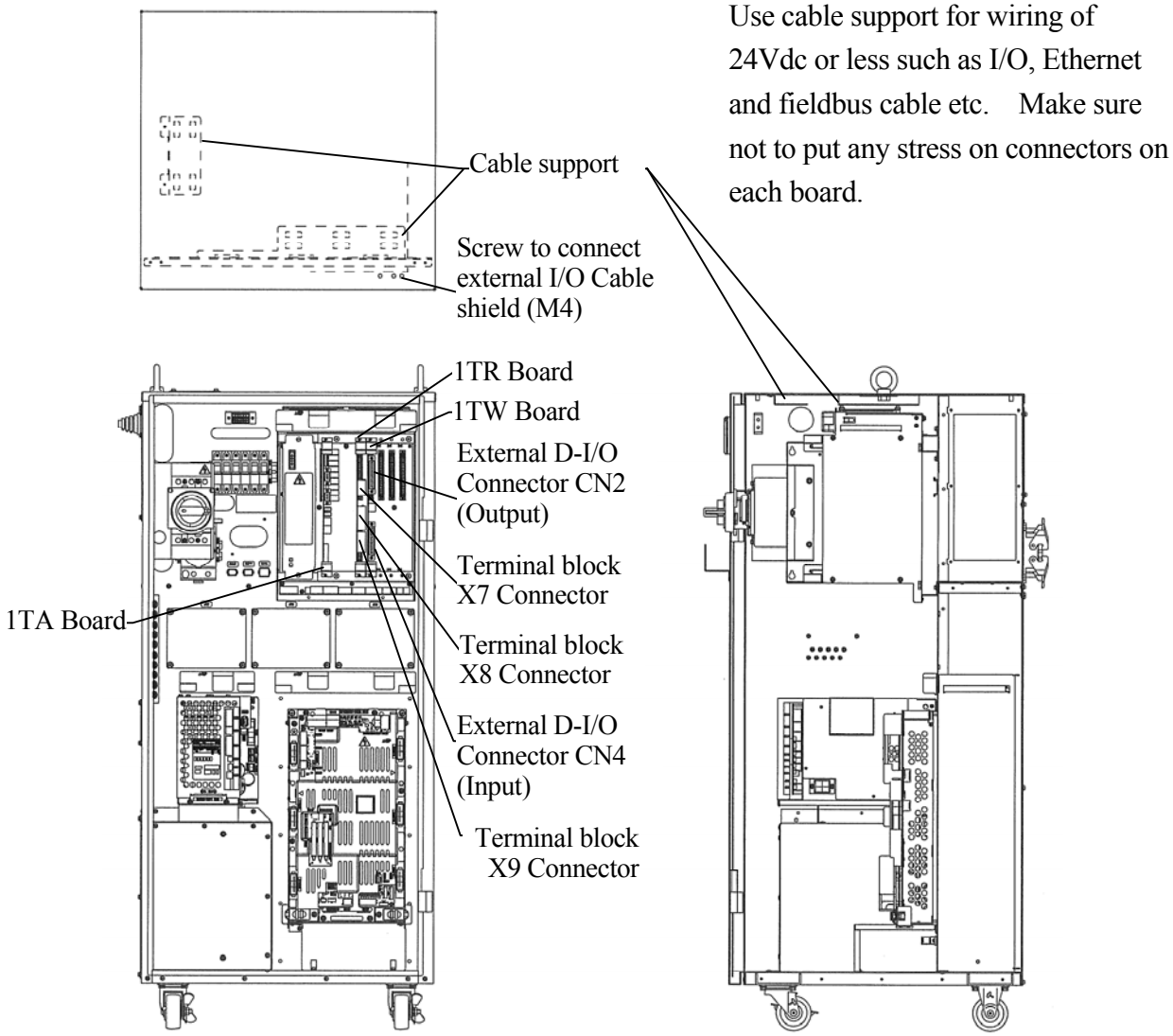
RS20



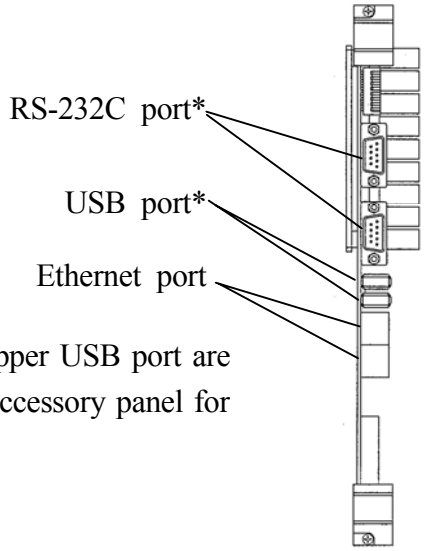
6.3 CONNECTING PERIPHERAL CONTROL EQUIPMENT

According to application specifications, connect respective connectors in the controller shown below with the peripheral controller or devices.

E4x controller

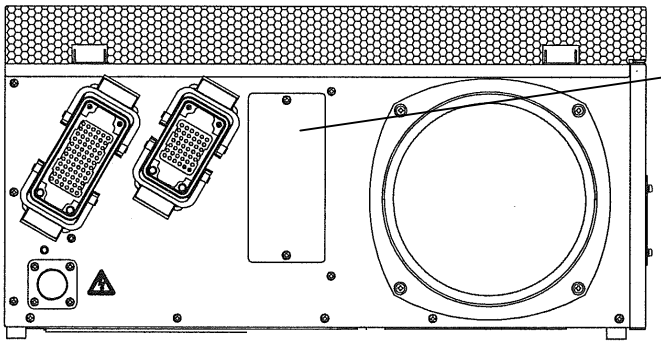


See the figure on the right for details on connecting ports of 1TA board.



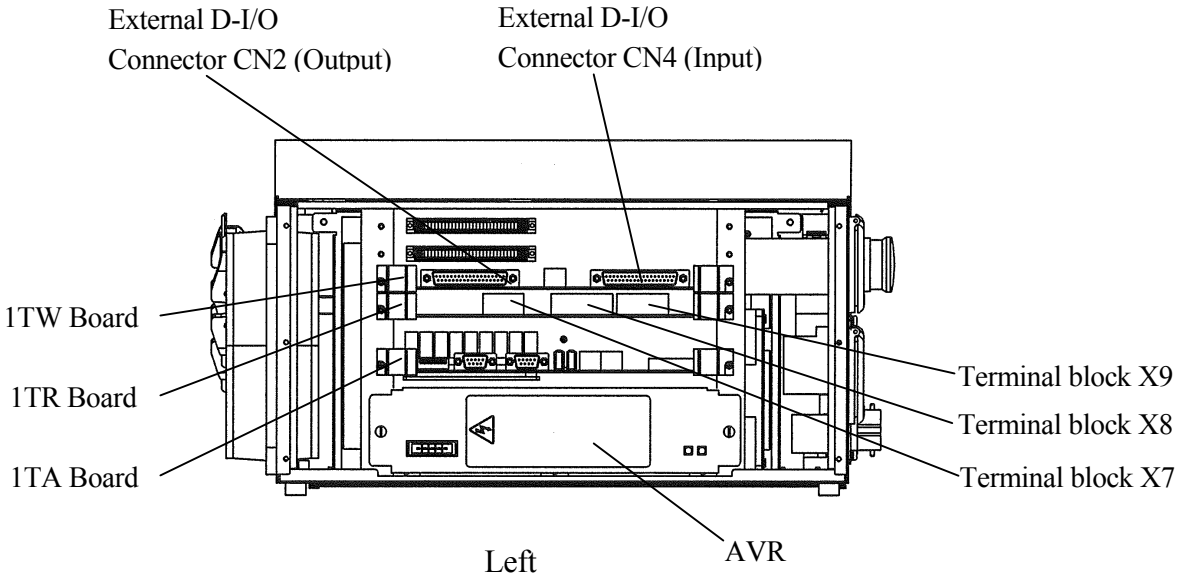
NOTE*: The upper RS-232C port and the upper USB port are connected to the each port in the accessory panel for standard specification.

E7x controller



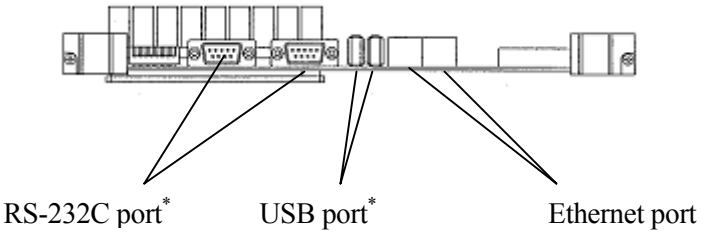
Rear

Connect each connecting port with peripheral equipment and devices, using the I/O signal inlet on the rear of the controller.



Left

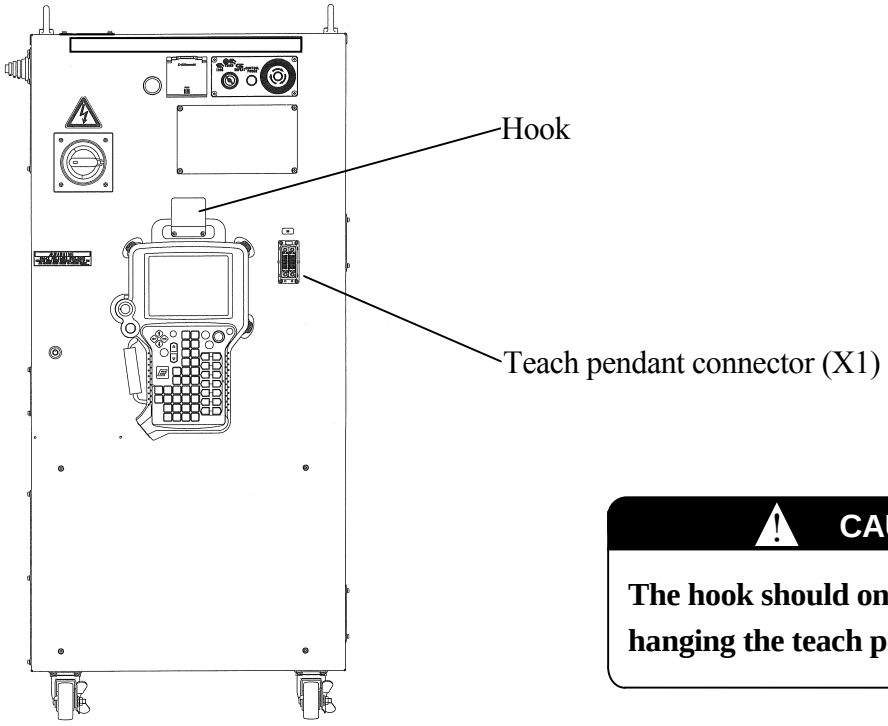
See the figure on the right for details on connecting ports of 1TA board.



6.4 CONNECTING BETWEEN CONTROLLER AND TEACH PENDANT

1. Connect the teach pendant cable with the connector located below the operation panel. Pull up the lever and insert the cable side connector, and then pull down the lever to lock the connectors.

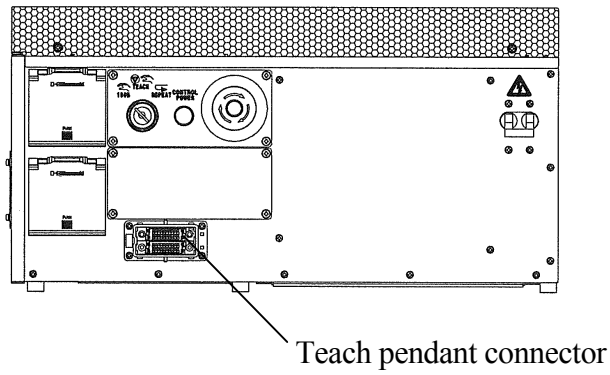
2. Hang the teach pendant and the teach pendant cable on the hook. (No hook is provided for E7x controller.)



E4x controller.

⚠ CAUTION

The hook should only be used for hanging the teach pendant or cable.



E7x controller

6.5 CONNECTING THE EXTERNAL POWER

Strictly observe the following precautions when connecting the external power.

⚠ DANGER

Before beginning the connection work, confirm that the external power supply for the controller is cut off at the source. To prevent external power from being turned ON accidentally, tag the breaker and indicate clearly that work is in progress. Or, assign a supervisor in front of the breaker until all the connections are complete. Connecting components while power is supplied is extremely dangerous and may cause electric shock.

⚠ WARNING

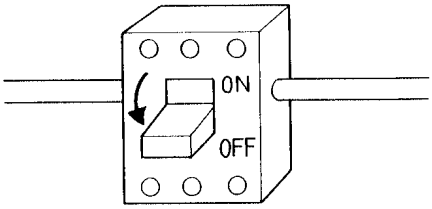
1. **Make sure the power supply meets the specifications listed on the name plate. Connecting to a power source outside specifications may damage internal components.**
2. **Earth the controller to prevent against electrical noise and shock.**
3. **Use dedicated earth wire (100 Ω or less), which is equal to or larger than the recommended power cable size (3.5 - 8.0 mm^2).**
4. **Do not use a common earth wire for the controller and the other devices. Also do not connect earth wires of several controllers to one earth port.**
5. **Never share an earth line with workpiece to be welded or another machine (weld machine, etc.).**
6. **In arc welding applications, connect the negative pole of the weld power supply to a jig or directly to workpiece to be welded. Insulate the robot body and controller so that they do not share a common earth line.**
7. **Before turning ON the external power to controller, make sure the power supply wiring is complete and all the covers are reattached properly. Failure to do so may cause electric shock.**
8. **Orange electric cables in the controller are possibly alive even when external power supply is turned OFF. Therefore, please pay attention carefully.**

⚠ CAUTION

1. **Prepare external power that meets the specifications of the controller in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the controller's specified range (above/below ratings), then the power monitoring circuit activates cutting off the power, and an error is returned.**
2. **If the external power emits excessive electrical noise (Noise level: 1 kv/1 μs or more), set up a noise filter to reduce the interference.**
3. **Install a separate external power switch (breaker) for the robot, independent and unconnected to the weld machine.**
4. **To prevent shorting or accidental leakage on the external power switch, install an earth leakage breaker. (Use a time delay type with sensitivity of 100 mA or more.)**
5. **Check for fluctuations in the power supply before making any power connections to the robot. Ensure a stable power supply, fluctuations of +/-10 % or more will degrade the robot's efficiency.**
6. **Likewise, PWM noise coming through the power line from the robot motors may also affect machines with low noise tolerance, resulting in malfunction. Plan and arrange the system so that all the peripheral equipment* can withstand the PWM noise.**
7. **If there is a possibility that surge voltage such as lightning surge might be applied from external power line, decrease the surge voltage level by mounting a surge absorber.**

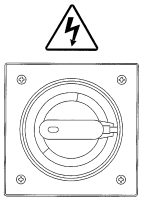
NOTE* Beware that some devices are easily exposed to PWM noise, e.g.: proximity switch coupled directly to power supply, etc.

E4x controllers



Connect with the external power circuit breaker at the installation site.

CONTROLLER POWER Switch



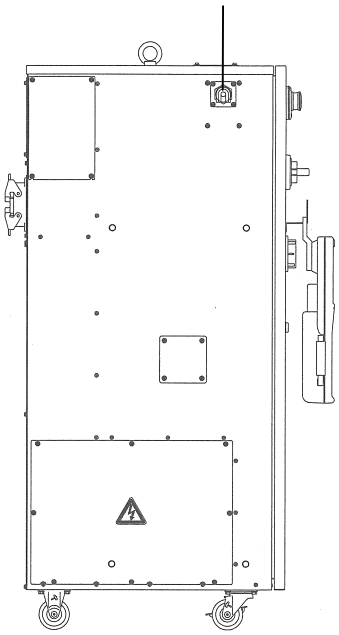
Connect the external power according to the following procedure.

1. Turn OFF the external power for the controller.

2. Set CONTROLLER POWER switch on the controller door to the OFF side.

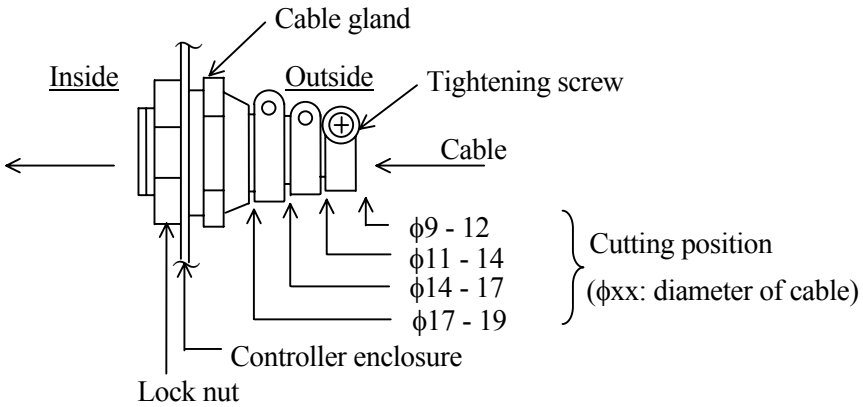
3. Feed the external power cable into the inlet on the left side of controller.

External power inlet



Detailed procedure of fixing a cable is shown below.

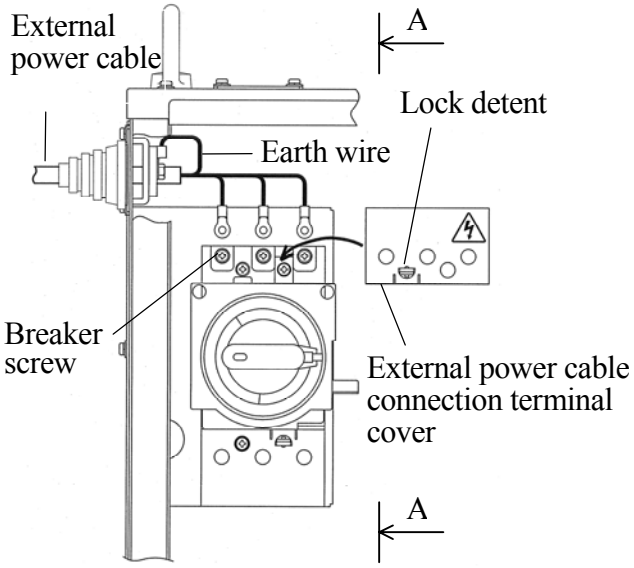
- Cut a cable gland (supplied with the controller) in accordance with the diameter of the cable.
- Pass the cable through the cable gland.
- Tighten the screw after adjusting length of the cable.
- Pass the cable through the inlet and tighten the lock nut.



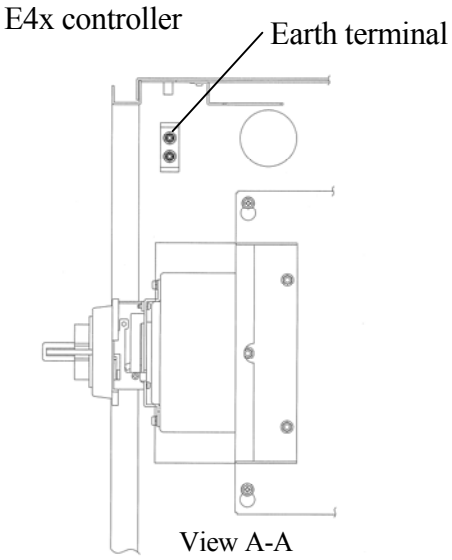
CAUTION

1. Confirm current requirements and select a power cable with adequate capacity.

2. Do not install wire that is too small in diameter, the voltage may drop or the cable may overheat.



Connect the earth wire to the earth terminal as shown below.



4. Attach round, crimp-type terminals on the ends of the individual wires of the power cable. Use round insulators on each of these wires to prevent contact between the crimped part and metal. (See left figure.)

5. Connect the external power cable to the breaker terminal (3 screws), and the dedicated earth terminal.

⚠ WARNING

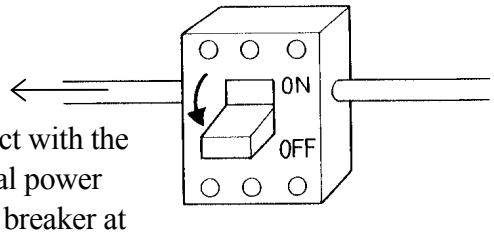
Tighten the terminal screws securely. Operating the robot with loose terminals is very dangerous and may lead to electric shock, robot malfunction, or breakdown of the electrical system.

6. Mount the external power cable connection terminal cover.

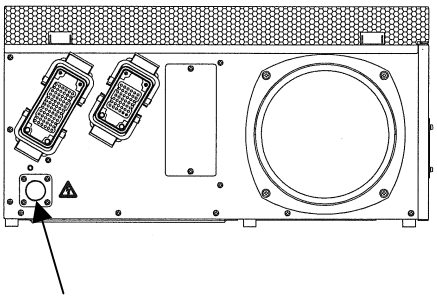
⚠ DANGER

Mount the external power cable connection terminal cover when the wiring is complete. Failing to mount the cover may lead to electric shock due to accidental contact with power line.

E7x controller



Connect with the external power circuit breaker at the installation site.



External power connector

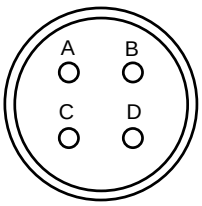
Connect the external power according to the following procedure.

1. Turn OFF the external power for the controller.

2. Set CONTROLLER POWER switch on the front of the controller to the OFF position without fail.

3. Feed the external power cable* into the inlet on the rear of the controller.

Note* Mount the attached connector on the external power cable. The figure below shows pin configuration of connector.



Wiring diagram of attached connector

A	AC(L)
B	(N.C.)
C	AC(N)
D	FG

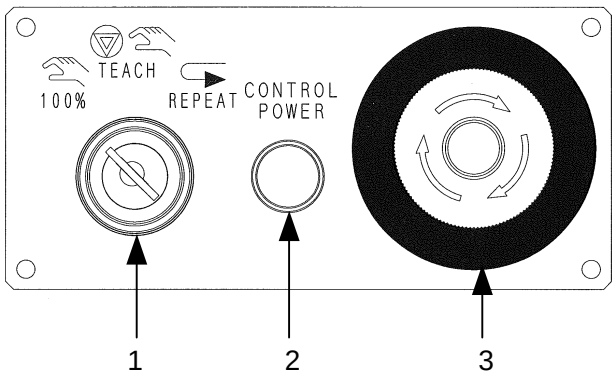
7.0 SWITCHES ON THE ROBOT CONTROLLER

7.1 OPERATION PANEL

Following switches and lamps are equipped on the operation panel of the controller. Some model may be equipped with optional operation panel.

Operation panel

Europe spec. (Standard)



	No.	Switch and Lamp	Function
	1	100%/TEACH/REPEAT (100%/Teach/Repeat switch)	Switches the mode to Fast check, Teach* or Repeat**.
	2	CONTROL POWER (Controller power lamp)	Lights when the controller power is ON.
	3	Emergency stop button	Intercepts motor power and stops the robot when this button is pressed in an emergency. At the same time, the <MOTOR> lamp and <CYCLE> lamp on teach pendant are turned OFF. However, the controller power is not cut OFF.

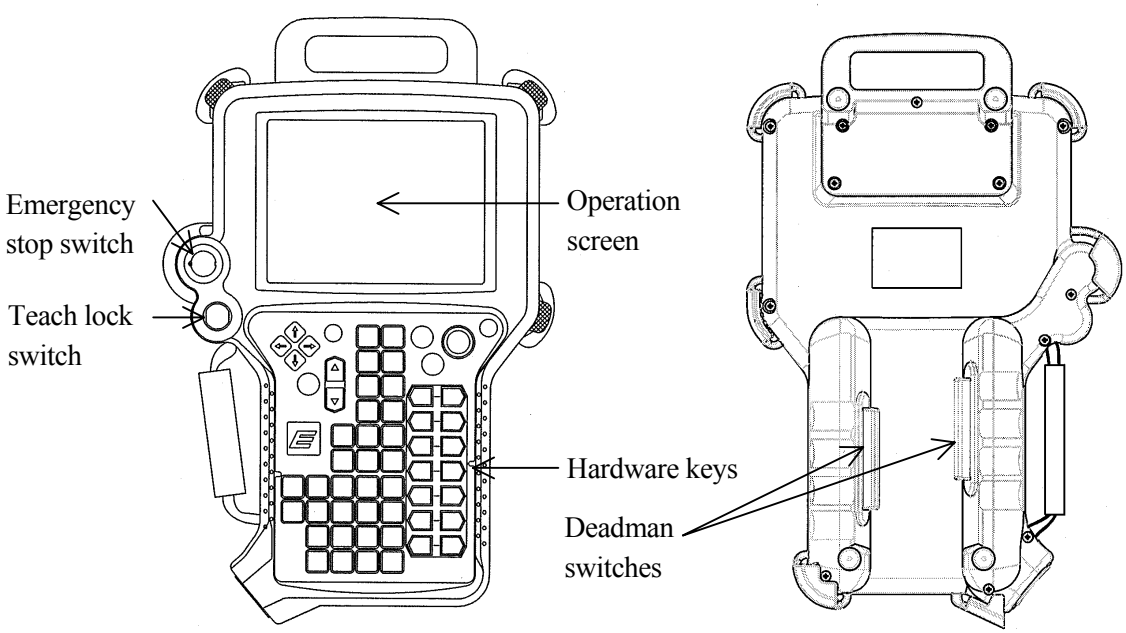
NOTE* Selected when teaching an instruction or its parameter to a robot or when operating a robot manually using the operation console called TP. Repeat operation is not possible while in teach mode though check operation is possible.

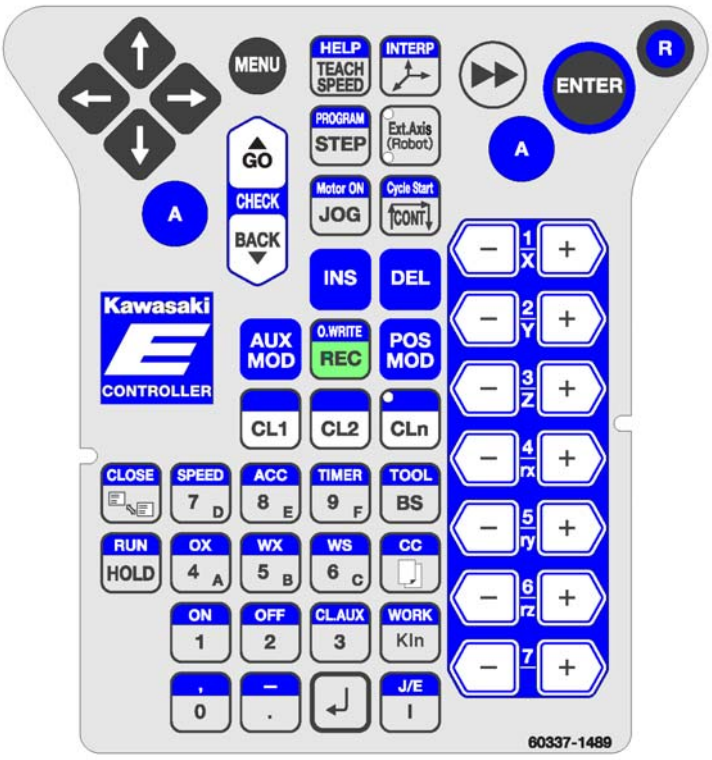
NOTE** The mode for automatic playback operation

NOTE*** Condition in which the robot automatically works and executes a memorized program continuously.

7.2 OVERVIEW OF TEACH PENDANT

Figures below (top) show the overview of the teach pendant (hereinafter referred to as TP). TP provides hardware keys and switches which are necessary for manual operation of robot and data editing, and a screen for editing/displaying various kinds of data. Figure (bottom) shows the arrangement of the hardware keys.





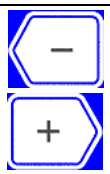
Following keys are the keys that are used the most on the teach pendant. Some of the keys other than shown below may differ according to the option setting.

Switches

Switches	Function
 Emergency stop	Cuts OFF the motor power and stops the robot. To release emergency stop, turn this button to the right until the button returns to its original position.
 Teach lock	Turning ON this switch (in teach mode) enables manual and check motions. Turning OFF this switch (in automatic playback mode) enables repeat operations. **Note:** Make sure this switch is turned ON before starting teaching operation to prevent robot from being operated in automatic playback mode erroneously.
 Deadman	This is the enable switch. Robot axes cannot operate manually without pressing this switch. Motor power cuts OFF and robot stops if switch is fully depressed to its third deadman position, or if it is released completely.

Hardware keys

Keys	Function	Functions when pressing A key
	Used with other key. The function on the upper part of the key is enabled when it is pressed with this A key.	
	Increases robot motion speed in teach or check mode. **Note:** Effective only while being pressed.	Turns ON the motor power when the motor power is OFF. Conversely, turns OFF the motor power when the motor power is ON. **Note:** Motor power cannot be turned OFF during robot motion.

Keys	Function	Functions when pressing A key
	Sets how program is repeated in check mode. Toggles between Once and Continuous. **Note:** Turning controller power switches to Check Once mode.	Starts cycle operation in automatic playback mode.
	Moves each axis from JT1 to JT7. Called AXIS keys hereinafter.	
	Puts the robot into hold (stop) state.	Puts the robot into run (active) state.

8.0 PROCEDURES FOR POWER ON/OFF AND STOPPING THE ROBOT

This chapter describes the power ON/OFF procedures for the robot controller and methods for stopping the robot.

[NOTE]

This manual explains operation procedures assuming that the optional operation panel is not used. When using the optional operation panel, both switches on the TP and the optional operation panel can be used for turning ON/OFF motor power and cycle operation start. However, for the robot activation (RUN), robot will not activate unless both settings of the TP and optional operation panel are RUN. That is, if the setting of the optional operation panel is HOLD, robot cannot be activated even if A+RUN on the TP is pressed.

8.1 POWER ON PROCEDURE

Ensure that all personnel are clear of the work cell, and that all safety devices are in place and operational. Follow the steps below to turn ON the controller power first, and then the motor power.

⚠ WARNING

When turning ON the controller power and motor power of the robot controller, thorough attention should be taken to prevent personnel from entering the motion range of the robot and the peripheral equipment controlled by the robot controller. The robot may move or operate accidentally when turning ON the motor power, if the robot servo system is damaged.

8.1.1 CONTROLLER POWER ON PROCEDURE

1. Confirm that the external power is supplied to the controller.

2. Turn ON the CONTROLLER POWER on the controller front.

8.1.2 MOTOR POWER ON PROCEDURE

1. Ensure that all personal are clear of the work cell, and that all safety devices are in place and operational. (e.g.: door on safety fence is closed and safety plug is inserted, etc.)

2. Press A + MOTOR ON on the TP to turn ON. The motor power turns ON and the <MOTOR> lamp on the top right of the TP screen illuminates at this time.*

NOTE* If motor power does not turn ON, read the contents displayed in the error screen and system message area and restore the system accordingly, and then press A + MOTOR ON again.

⚠ DANGER

Before turning ON the controller power and the motor power, ensure that all personnel are clear of the work cell and that no interfering objects are around the robot(s).

8.2 POWER OFF PROCEDURE

Stop the robot and shut down the controller in the reverse order in which it was turned ON. However, in the case of emergency, press the EMERGENCY STOP immediately to cut OFF the motor power.

1. Confirm the robot has completely stopped.

2. Press HOLD or A+<RUN> on the TP.

3. Press the EMERGENCY STOP on the controller or the TP to cut OFF the motor power.*

NOTE* In automatic playback mode, turning the TEACH/REPEAT on the controller to TEACH also cuts OFF the motor power.

4. After the <MOTOR> lamp on the TP screen turns OFF, shut OFF the power by turning OFF the CONTROLLER POWER on the controller front.

⚠ WARNING

When shutting down the controller power, press the EMERGENCY STOP to cut OFF the motor power first, and then turn OFF the CONTROLLER POWER.

8.3 METHOD FOR STOPPING THE ROBOT

The methods for stopping the robot are different in teach mode and automatic playback mode.

1. In teach mode,

   (1) Release the DEADMAN on the TP.

   (2) Confirm that the robot has come to a complete stop, and press HOLD or A+<RUN> on the TP.

2. In automatic playback mode,

   (1) Confirm that the robot has come to a complete stop, and press HOLD or A+<RUN> on the TP.

⚠ CAUTION

1. **After robot has stopped, cut OFF power to the motors to disable any further motion by pressing EMERGENCY STOP.**
2. **Once motor power has been cut OFF, take measures to prevent personnel from accidentally turning ON the power supply (tag and lock out power switches, etc.).**

3. In emergency stop,

When the robot works abnormally and there is a possibility of danger such as injury, press immediately any EMERGENCY STOP wherever they are located, on the controller front, TP, safety fence etc. to cut off the motor power.

Applying emergency stop may cause the error screen to pop up. To restart the robot from this condition, reset errors before turning ON the motor power.

⚠ DANGER

Before moving the robot, ensure that all EMERGENCY STOP on the TP, controller and external emergency stop switches, etc. are working correctly.

9.0 TEACHING/ AUTOMATIC PLAYBACK

9.1 TEACHING

Teaching is defined as creating a robot motion program by moving the robot manually using the teach pendant. A program makes the robot work in accordance with other robots or peripheral equipments to perform the required task.

9.2 AUTOMATIC PLAYBACK

In automatic playback, a taught program is played back automatically and the robot moves in accordance with other robots and peripheral equipments to perform the required operation.

⚠ WARNING

For all teaching and automatic playback operations, risk assessment must be performed for the whole robot system used in the operation. Take safety measures and plan the operation procedures complying with international, national, and local laws and standards. In addition to this, teaching and automatic playback must only be done by certified personnel(s) who has attended the Kawasaki prepared education/training course(s) pertinent to the operation concerned.

9.3 EMERGENCY PROCEDURES

In case of emergency, any personnel available should be able to stop the robot by pressing the EMERGENCY STOP button on the operation panel or the teach pendant.

Turn back ON the motor power to move the robot manually to an adequate position to restart operation.

When the motor power does not turn back ON, a certified personnel who has completed the special education and training course should perform the brake release procedure. Before performing the brake release procedure, make sure that no parts fall off due to its own weight, and if there is any axis or part that may fall, perform the necessary countermeasures as described in the following section.

10.0 BRAKE RELEASE PROCEDURES FOR EMERGENCY CASES

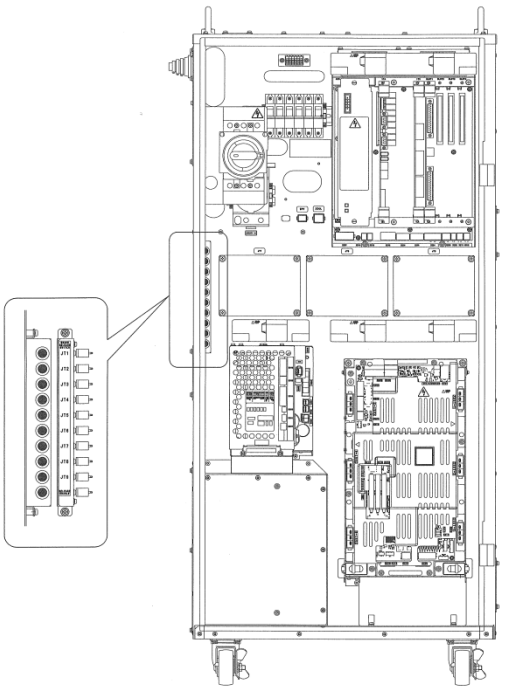
The manual brake release switches allow the operator to move individual arm axes without using motor power for maintenance and emergency situations. (E7x controllers: Option, E4x controllers: Standard)

10.1 LOCATION OF BRAKE RELEASE SWITCH

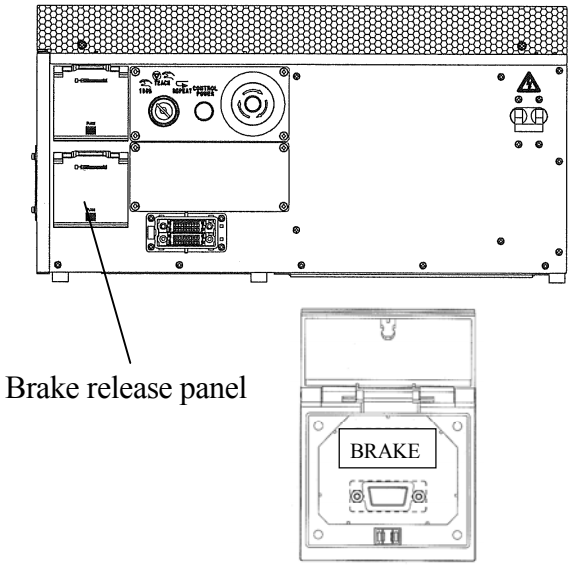
The manual brake release switches are located:
E4x controller: Inside the door on the controller (E4x controller, figure below left)
E7x controller: Front of the controller (E7x controller, figure below right)

⚠ WARNING

When no servo power is applied, electromagnetic brakes lock to maintain the robot arm posture. Unsupported axes may fall when the brake release switch is pressed. Axes which are overhung, particularly JT2 and JT3, will fall the fastest, depending on robot position, weight of the tool, and wrist axis position. Position yourself to observe the entire robot arm and keep your eyes on the arm when operating this switch.

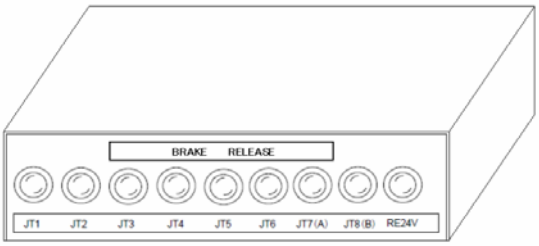


Manual brake release switches
E4x controller



Manual brake release switches
E7x controller

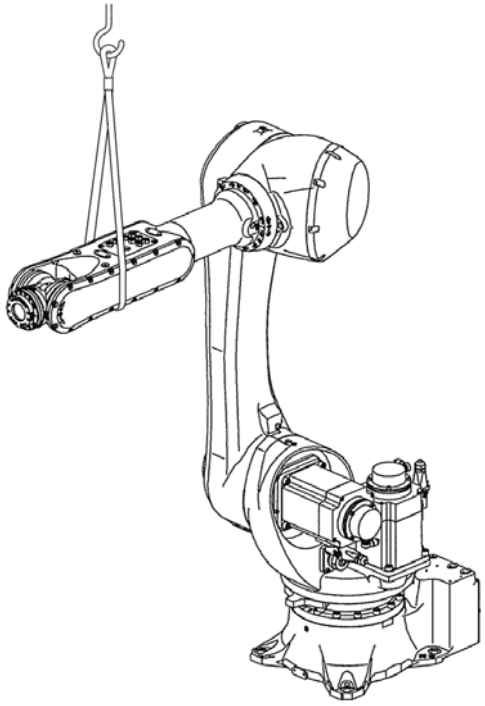
Connecting port of brake release switch is provided at the position shown in the figure.
・Brake release box is the option.



Brake release box

⚠ WARNING

To prevent injury to persons or damage to robotic equipment; provide suitable support for the robot arm, tool and load, before using a brake release switch. The robot arm can be supported from overhead using a sling and overhead crane (Figure below).



Robot arm support

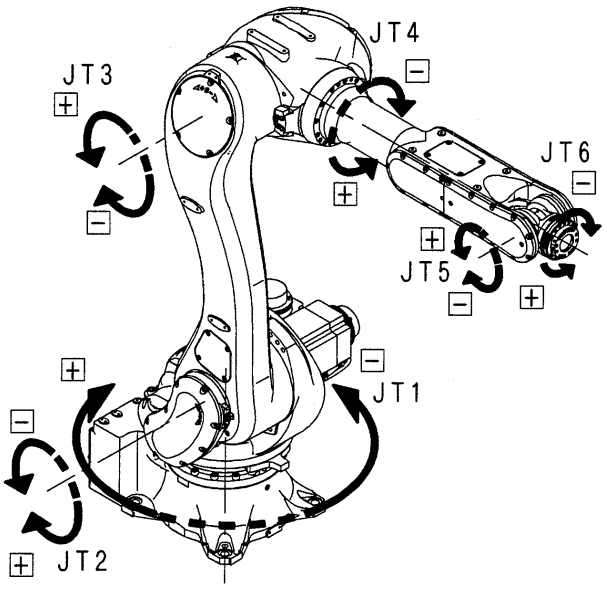
10.2 BRAKE RELEASE PROCEDURES

To manually release axes brakes use the following procedure.

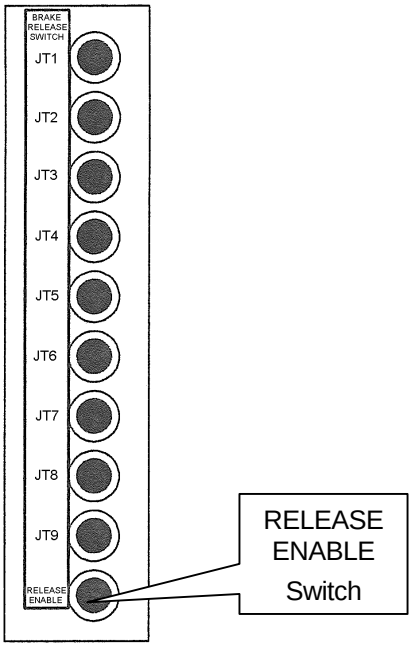
1. Set motor power OFF.
2. Ensure all personnel are clear and all safety precautions are followed.
3. Provide suitable support of the robot arm, tool, and load if there is a risk of personal injury (see above figure).
4. Open the access door to the manual brake release switches.
5. Ensure the switches are in the OFF position and in operating condition.
6. Press the brake release switch of the axis to release for a moment, and confirm that the brake will not be released.
7. Press and hold the "RELEASE ENABLE" switch (see lower right figure). If the brake is released at this time, do not use the switch (see CAUTION).
8. Press the manual brake release switch for the axis to release the brake (see lower right figure).
9. The brake remains released until the brake release switch is released.
10. After using the brake release switches, close the access door.

⚠ CAUTION

Stop using the manual brake release switch immediately if the electromagnetic brake is released by pressing only one switch. The switch may be defective.



Robot brake release axes



Manual brake release SW

11.0 MAINTENANCE

⚠ WARNING

For all maintenance operations, risk assessment must be performed for the whole robot system used in the operation. Take safety measures and plan the operation procedures complying with international, national, and local laws and standards. In addition to this, maintenance operation must only be done by certified personnel(s) who has attended the Kawasaki prepared education/training course(s) pertinent to the operation concerned.

11.1 PRECAUTIONS FOR MOTOR REPLACEMENT PROCEDURES

⚠ WARNING

1. **Prior to starting motor replacement, turn OFF control power up to the main power source. Display signs indicating clearly "Inspection and Maintenance in progress", and lockout/ tagout the main power switch to prevent personnel from accidentally turning ON the power.**
2. **When replacing a motor, support the arm safely using a crane/forklift truck or place the arm on a support so as to prevent the arm from falling/rotating accidentally by its own weight.**
3. **Servo motors are heavy, so be careful when handling it.**

12.0 CONTACT US

If you have any questions or problems, please contact us at the following:

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http://www.kawasakirobot.de/

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