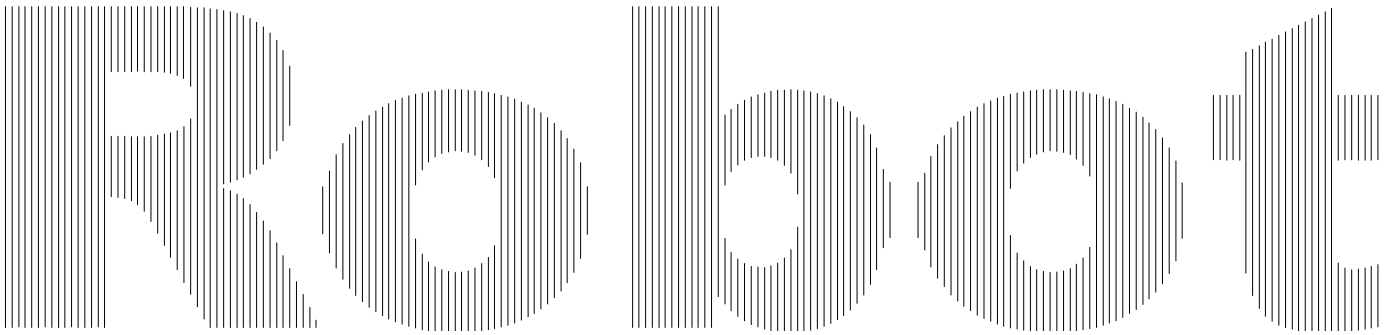
Simple and friendly

Kawasaki

Kawasaki Robot
CP Series

Installation and Connection Manual



Kawasaki Heavy Industries, Ltd.

90202-1141DED

Preface

This manual describes installation and connection procedures for Kawasaki Robot CP Series.

Read and understand the contents of this and “Safety Manual” thoroughly and strictly observe all rules for safety before proceeding with any operation. Kawasaki cannot take any responsibility for any accidents and/or damages caused by operations that are based on only the limited part of this manual.

This manual describes only the installation and connection of the robot arm. Please refer to the following manual for installation and connection of Controller.

“Installation and Connection Manual” for controller

This manual is applicable to the following robot arms.

CP180L: Standard spec. (180 kg load) to High speed spec. (130 kg load)
CP300L: Standard spec. (300 kg load) to High speed spec. (250 kg load)
CP500L
CP700L

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, damages, 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 site or sold off to a different user, 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 damages 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 detail explanations given in this manual cannot be confirmed with absolute certainty. Accordingly, it is necessary to give one's fullest attention when using this manual to perform any work. Should any unexplained questions or problems arise, please contact Kawasaki.**
2. **Safety related contents described in this manual apply to each individual work and not to all robot work. In order to perform every work in safety, read and fully understand "Safety Manual", all pertinent laws, regulations and related materials as well as all the safety explanation described in each chapter, and prepare safety measures suitable for actual work.**

Table of Contents

1 Precautions

1.1 Precautions during Transportation, Installation and Storage

When transporting the Kawasaki Robot to its installation site, strictly observe the following cautions.

⚠ WARNING

1. **When the robot arm is to be transported by using a crane or forklift, never support the robot arm manually.**
2. **During transportation, never climb on the robot arm or stay under the hoisted robot arm.**
3. **Prior to installation, turn OFF the controller power switch and the external power switch for shutting down 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 when someone accidentally turns ON the power.**
4. **Prior to moving robot, ensure safety by first confirming no abnormality is observed in 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 due to careless approach to robot and peripheral equipment. After setting robot to the specified pose, turn OFF the controller power and the external power switch again as mentioned above. Display signs indicating clearly "Installation and connection in progress", and lockout/tagout the external power switch before starting installation and connection.**

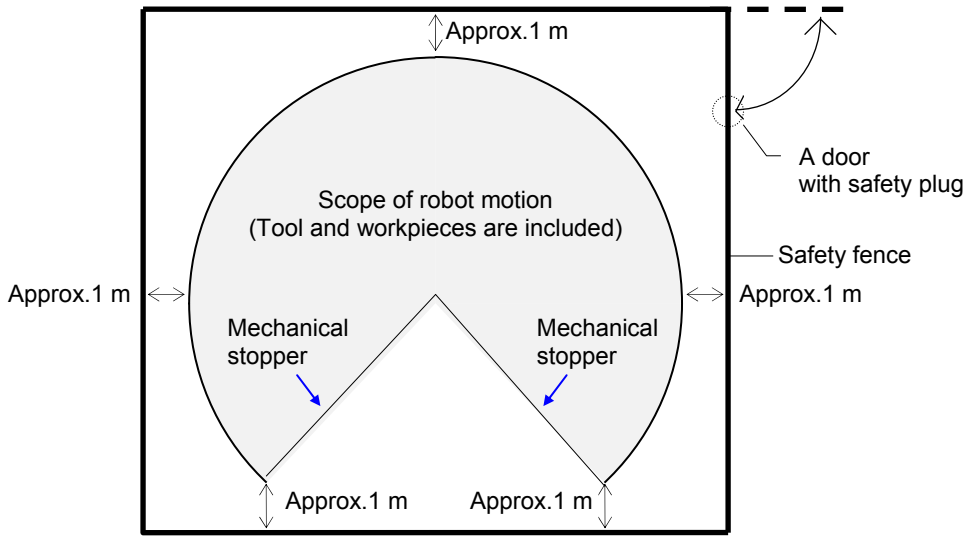
⚠ CAUTION

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 a passage to the installation area for transportation of the robot arm.**
3. **During transportation and storage,**
   (1) Keep the ambient temperature within the range of minus 10 to 60°C,
   (2) Keep the relative humidity within the range of 35 to 85% RH without dew condensation,
   (3) Keep free from excessively strong vibration.

1.2 Installing Environment of Robot Arm

The robot arm must be installed in a place that satisfies all the following environmental conditions:

1. When robot is installed on the floor, the levelness must be within ±5°.
2. Be sure that the installation floor/pedestal has sufficient rigidity.
3. Secure a flatness to prevent undue force applied to the installation section. (If sufficient flatness is unobtainable, insert liners and adjust the flatness.)
4. Keep the ambient temperature during operation within the range of 0 to 45°C. (Deviation or overload error may occur due to high viscosity of grease/oil when starting operation at low temperatures. In this case, move the 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 robot installing place should be free from dust, dirt, oil, smoke, water, and other foreign matters.
7. The robot installing place should be free from flammable or corrosive liquid or gas.
8. The robot installing place should be free from excessively strong vibration. (0.5 G or less)
9. The robot installing place should be free from electric noise interference.
10. The robot installing place should be sufficiently larger than the motion range of robot arm.
    (1) Install safety fence so the maximum movement of fully equipped robot arm (with tools and workpieces) does not cause interference.
    (2) Minimize the number of entrance gates (only one is best) and equip the entrance gate with a safety plug.
    (3) Observe the requirements of ISO 10218, etc. established in each region for details of the safety fence.

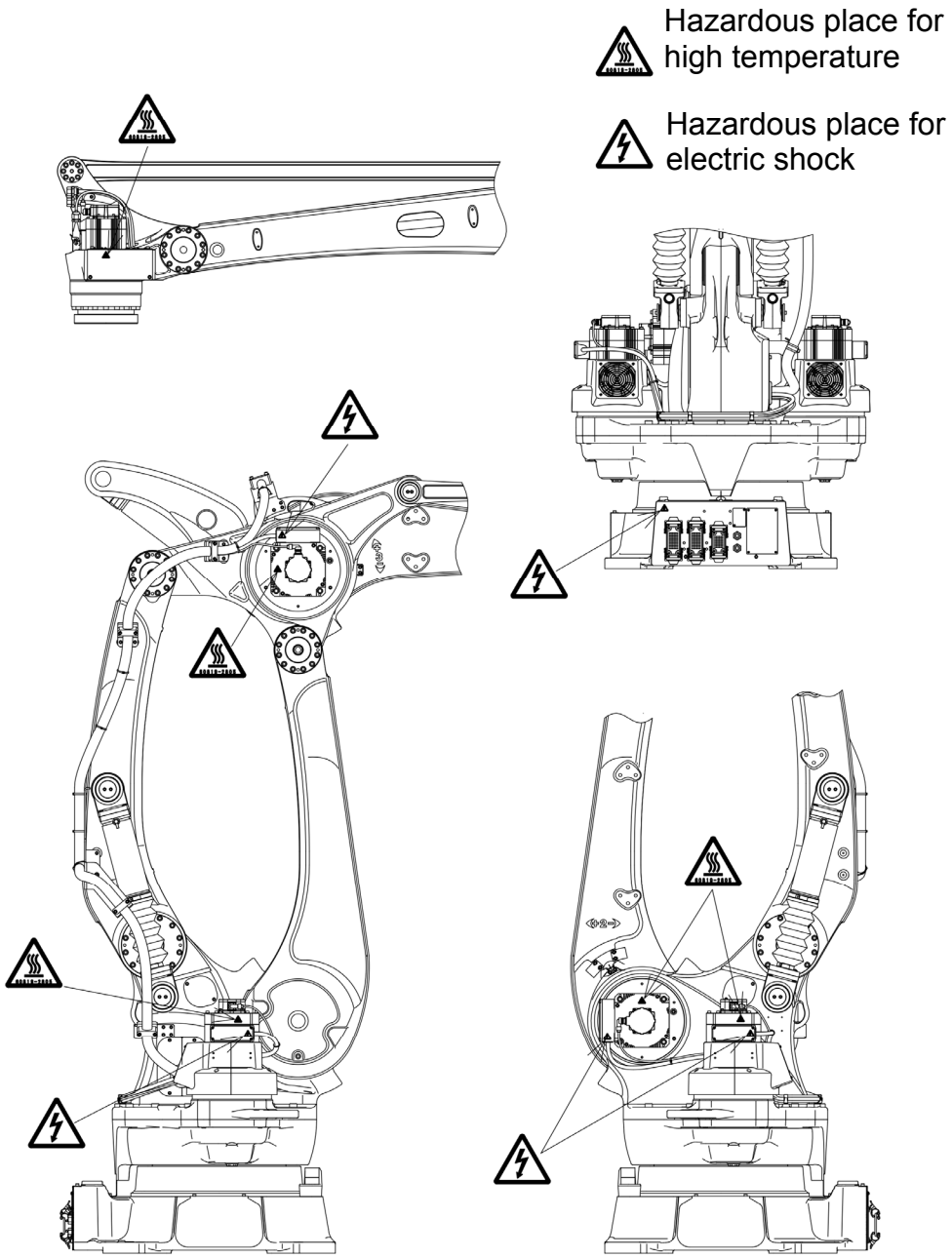


1.3 Residual Risks during Work

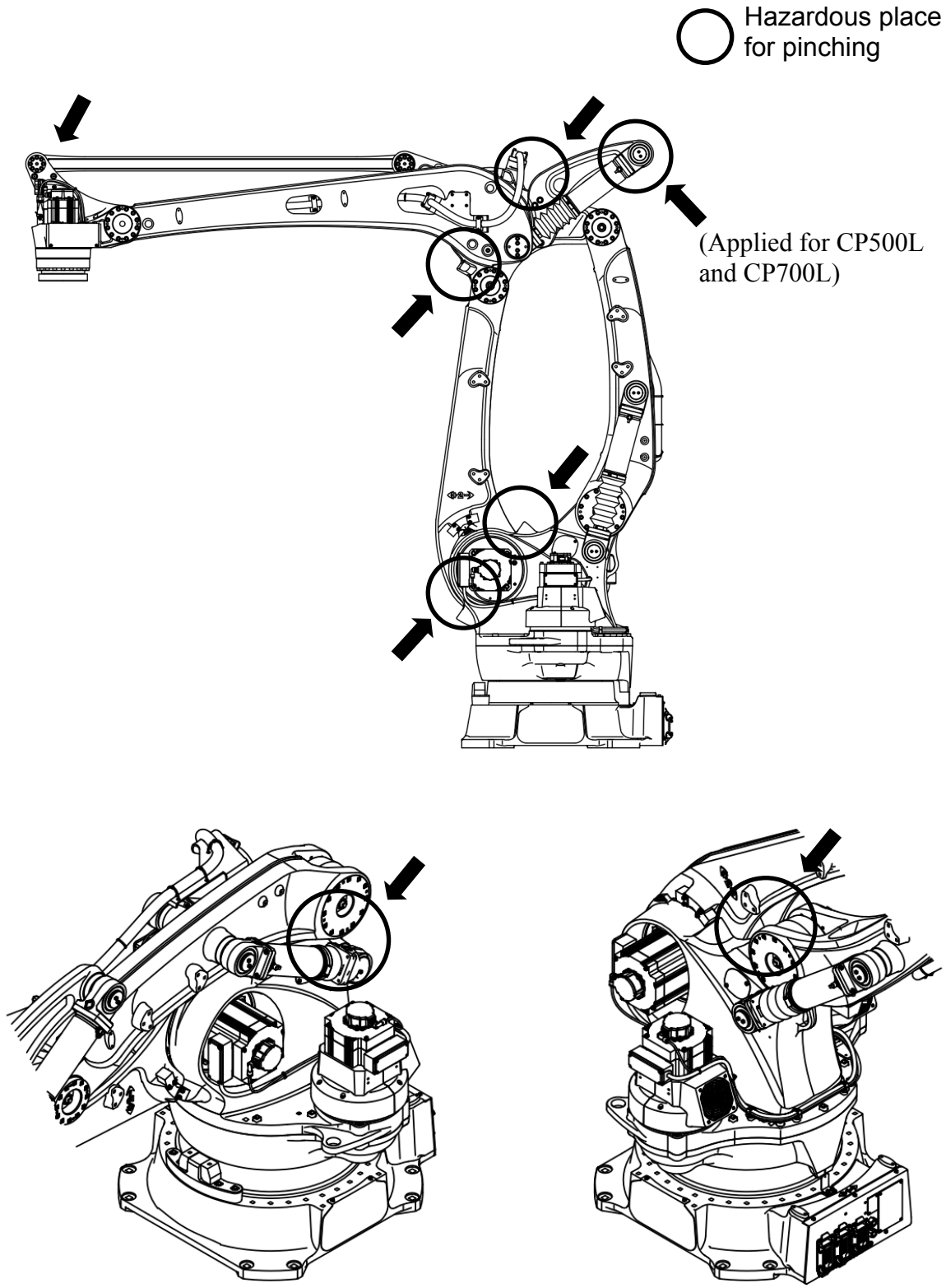
WARNING

Pay attention to the hazardous places listed in the drawings below.

Hazardous places for high temperature and electric shock

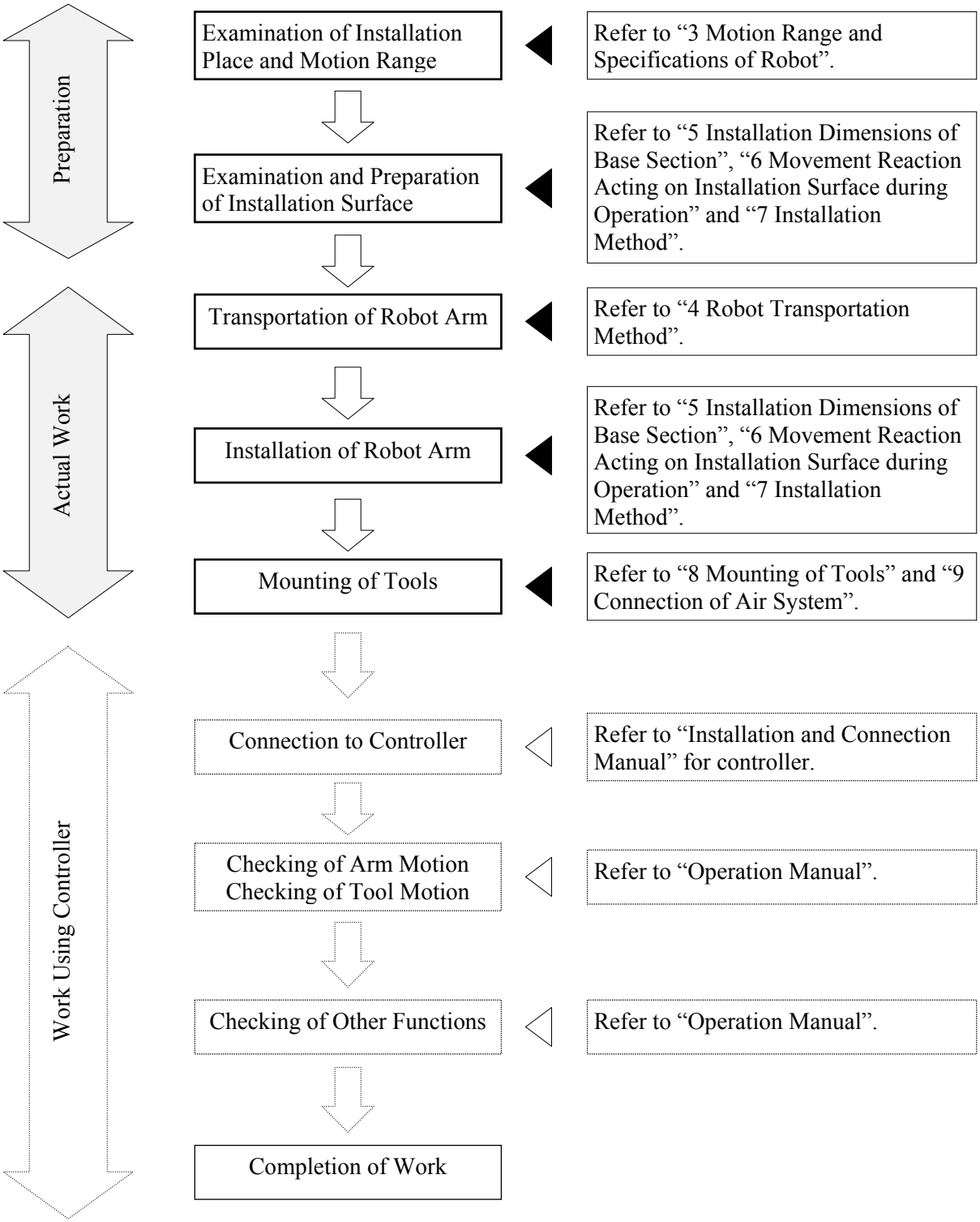


Hazardous places for pinching



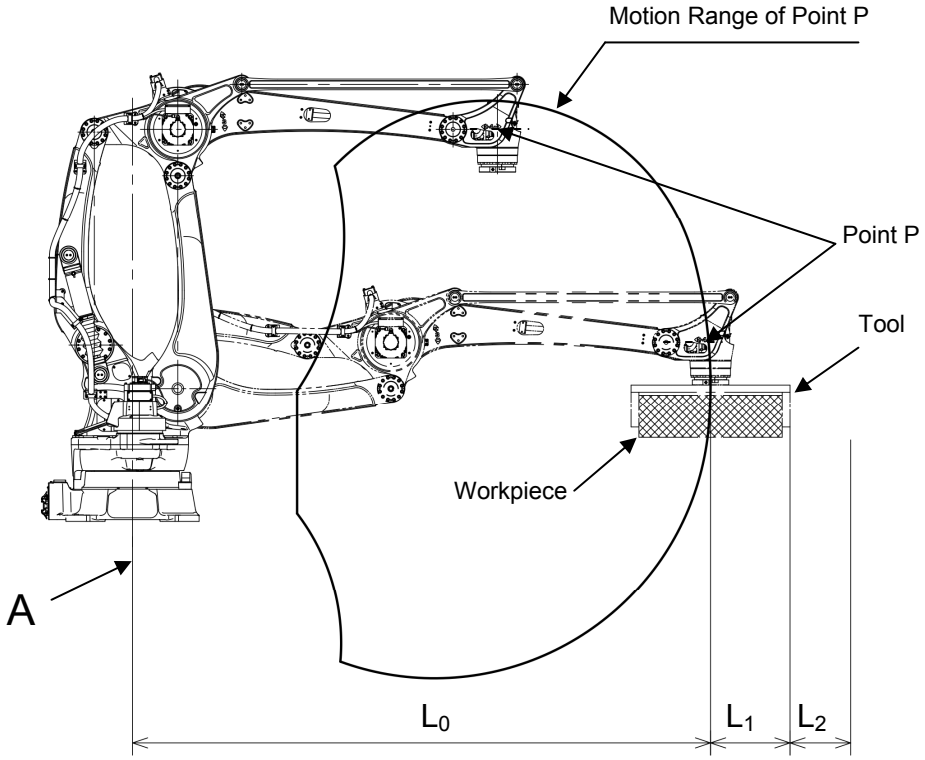
2 Work Flow at Arm Installation and Connection

This workflow describes only the robot arm section. For the controller, refer to “Installation and Connection Manual” for controller.

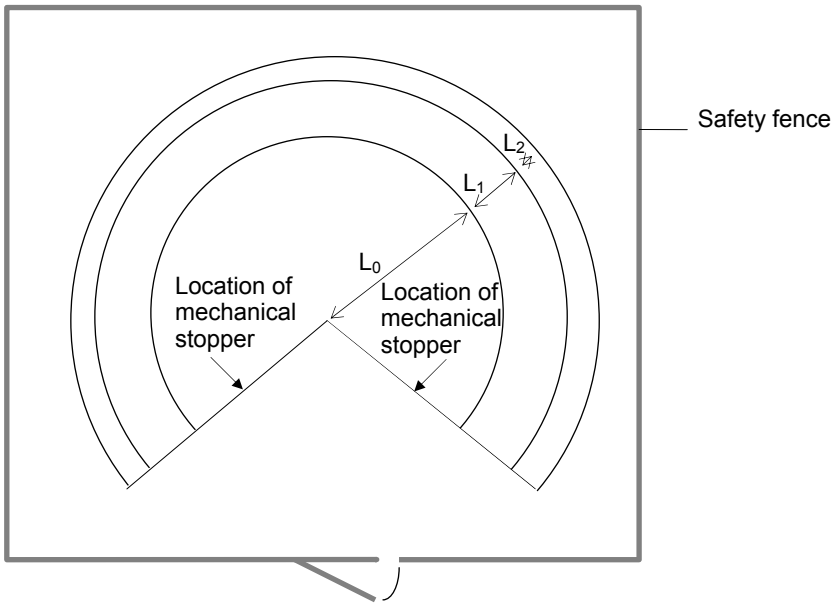


3 Motion Range and Specifications of Robot

3.1 Determination of Safety Fence Installation Location

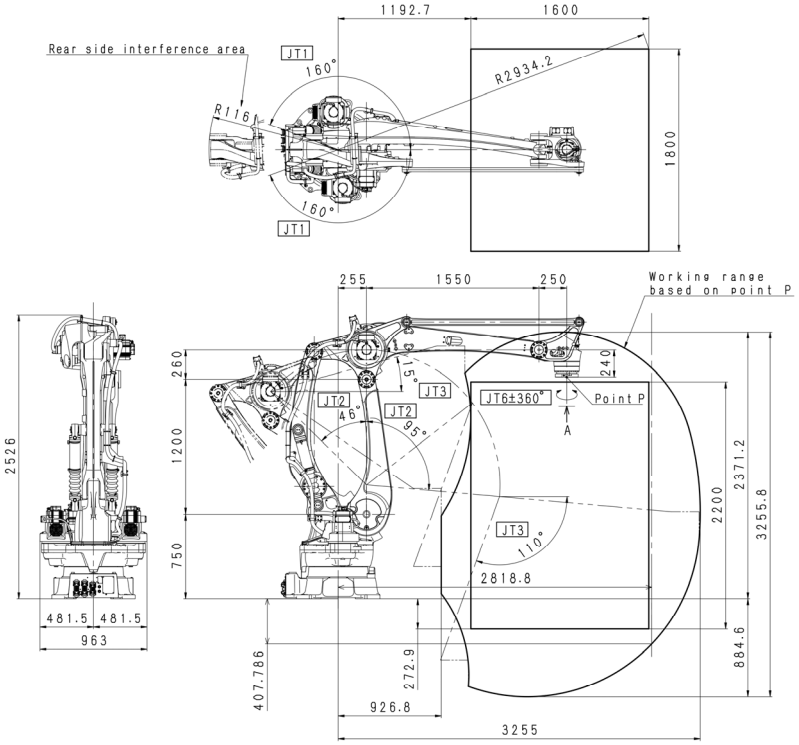


The motion range of the robot is represented by the maximum area that can be covered by point P in the figure above. Therefore, as shown in the figure below, install the safety fence outside circle whose radius is $L_0+L_1+L_2$. Where; L_0 is the length from the center line of arm (point A shown above) to the farthest point of P, L_1 is the length from point P to the farthest point of wrist flange, tool and workpiece, and L_2 is safety margin. For the length of L_0, refer to the drawings in the section 3.2.



3.2 Motion Range and Specifications of Robot

CP180L: Standard spec. (180 kg load) to High speed spec. (130 kg load)



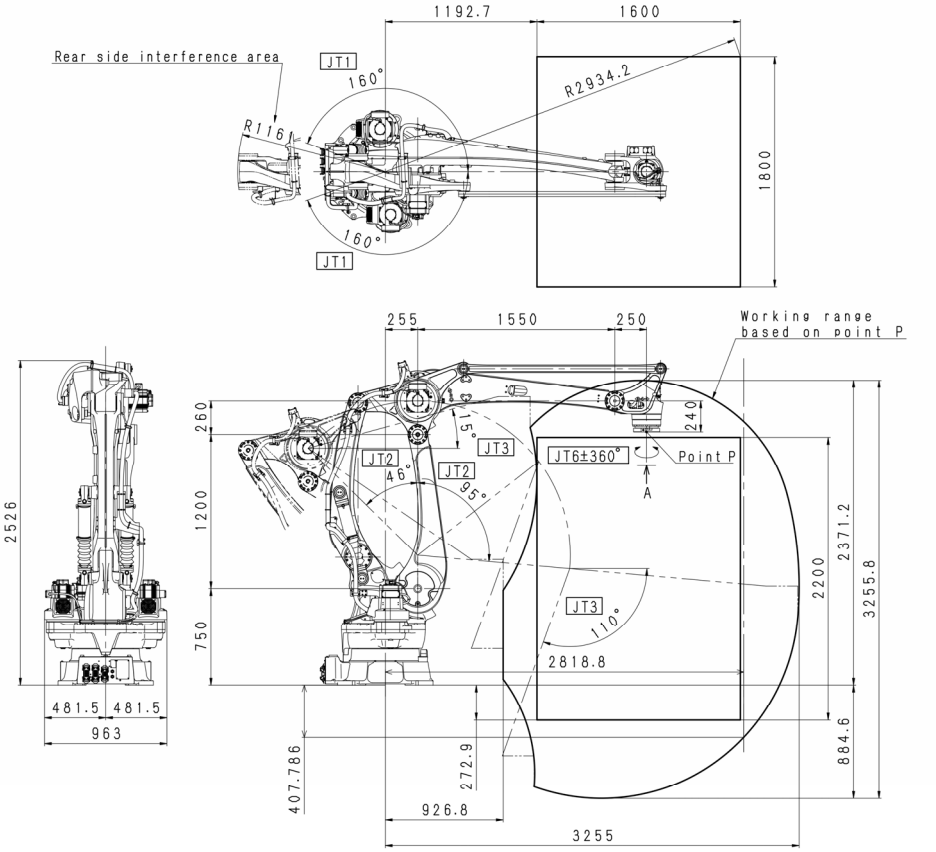
Type		Vertical Articulated Robot		
Degree of Freedom		4		
Motion Range		JT1	±160°(320°): When installing mechanical stopper ±180°(360°): When not installing mechanical stopper	
		JT2	+95° to -46°	
		JT3	+15° to -110°	
		JT4	±360°	
Maximum Speed		-	High speed spec.*	Standard spec.*
		JT1	140°/s	130°/s
		JT2	125°/s	120°/s
		JT3	130°/s	125°/s
		JT4	400°/s	330°/s
Wrist Load Capacity	Torque	JT4	-	-
	Moment of Inertia	JT4	50 kg·m^2	85 kg·m^2
Max. Payload		-	130 kg	180 kg
Repeatability		±0.5 mm		
Mass		1600 kg		
Acoustic Noise		<80 dB (A)**		

*Maximum speed and moment of inertia change depending on max. payload (130 to 180 kg).

**Measured condition
- installed on the plate rigidly fixed on the floor
- 5255 mm away from JT1 center

The noise level depends on the conditions.

CP300L: Standard spec. (300 kg load) to High speed spec. (250 kg load)



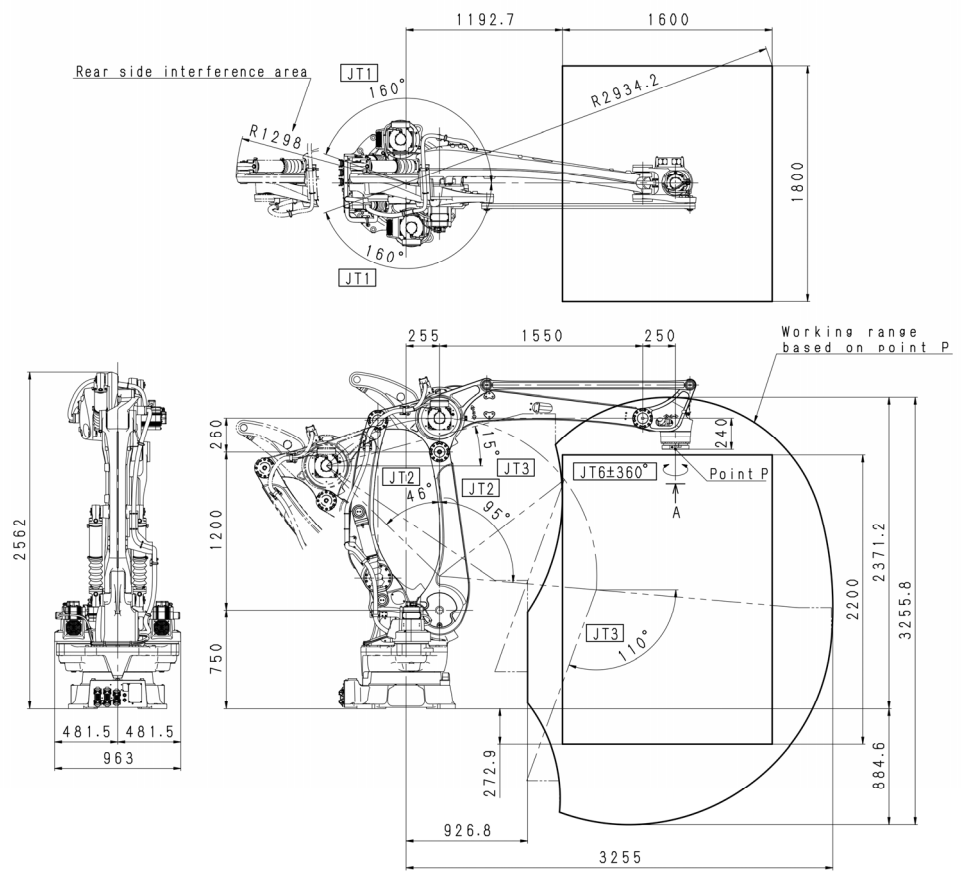
Type		Vertical Articulated Robot		
Degree of Freedom		4		
Motion Range		JT1	±160°(320°): When installing mechanical stopper ±180°(360°): When not installing mechanical stopper	
		JT2	+95° to -46°	
		JT3	+15° to -110°	
		JT4	±360°	
Maximum Speed		-	High speed spec.*	Standard spec.*
		JT1	115°/s	100°/s
		JT2	100°/s	90°/s
		JT3	100°/s	90°/s
		JT4	250°/s	220°/s
Wrist Load Capacity	Torque	JT4	-	-
	Moment of Inertia	JT4	100 kg·m^2	140 kg·m^2
Max. Payload		-	250 kg	300 kg
Repeatability		±0.5 mm		
Mass		1600 kg		
Acoustic Noise		<80 dB (A)**		

*Maximum speed and moment of inertia change depending on max. payload (250 to 300 kg).

**Measured condition
- installed on the plate rigidly fixed on the floor
- 5255 mm away from JT1 center

The noise level depends on the conditions.

CP500L

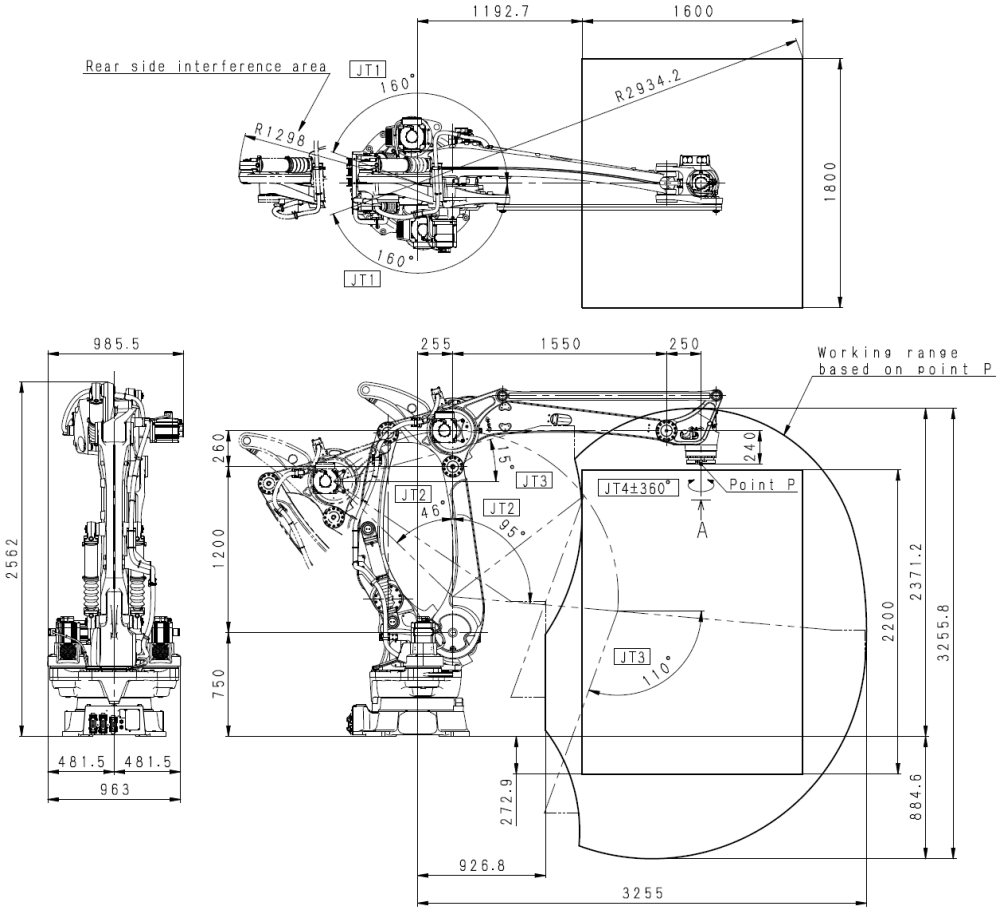


Type	Vertical Articulated Robot		
Degree of Freedom	4		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	±160°(320°): When installing mechanical stopper ±180°(360°): When not installing mechanical stopper	85°/s
	2	+95° to -46°	80°/s
	3	+15° to -110°	80°/s
	4	±360°	180°/s
Max. Payload	500 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	-	250 kg·m^2
Repeatability	±0.5 mm		
Mass	1650 kg		
Acoustic Noise	<80 dB (A)*		

*Measured condition
- installed on the plate rigidly fixed on the floor
- 5255 mm away from JT1 center

(The noise level depends on the conditions.)

CP700L



Type	Vertical Articulated Robot		
Degree of Freedom	4		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	±160°(320°): When installing mechanical stopper ±180°(360°): When not installing mechanical stopper	75°/s
	2	+95° to -46°	65°/s
	3	+15° to -110°	65°/s
	4	±360°	170°/s
Max. Payload	700 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	-	500 kg·m^2
Repeatability	±0.5 mm		
Mass	1650 kg		
Acoustic Noise	<80 dB (A)*		

*Measured condition
- installed on the plate rigidly fixed on the floor
- 5255 mm away from JT1 center

The noise level depends on the conditions.

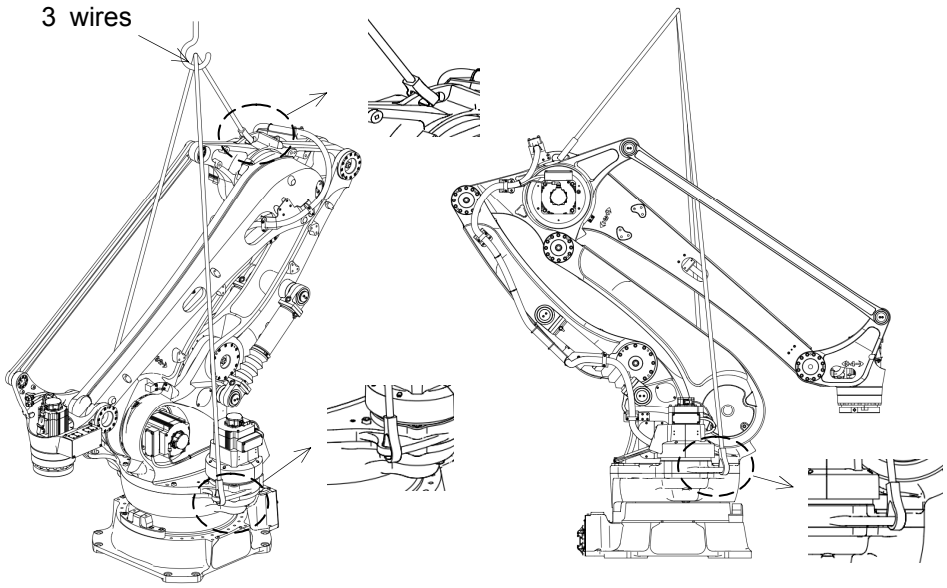
4 Robot Transportation Method

4.1 Using Wire Sling

Hoist up the robot arm by fastening wire slings directly to the three hook points of the arm shown in the figure below.

⚠ CAUTION

When hoisting up the robot, be careful as robot may lean forward/backward depending on robot posture and installation condition of the options. If the robot is hoisted up in an inclined posture, it may swing, damage or the wire may interfere with the harness, piping etc., or it may damage due to interfering with surrounding objects.

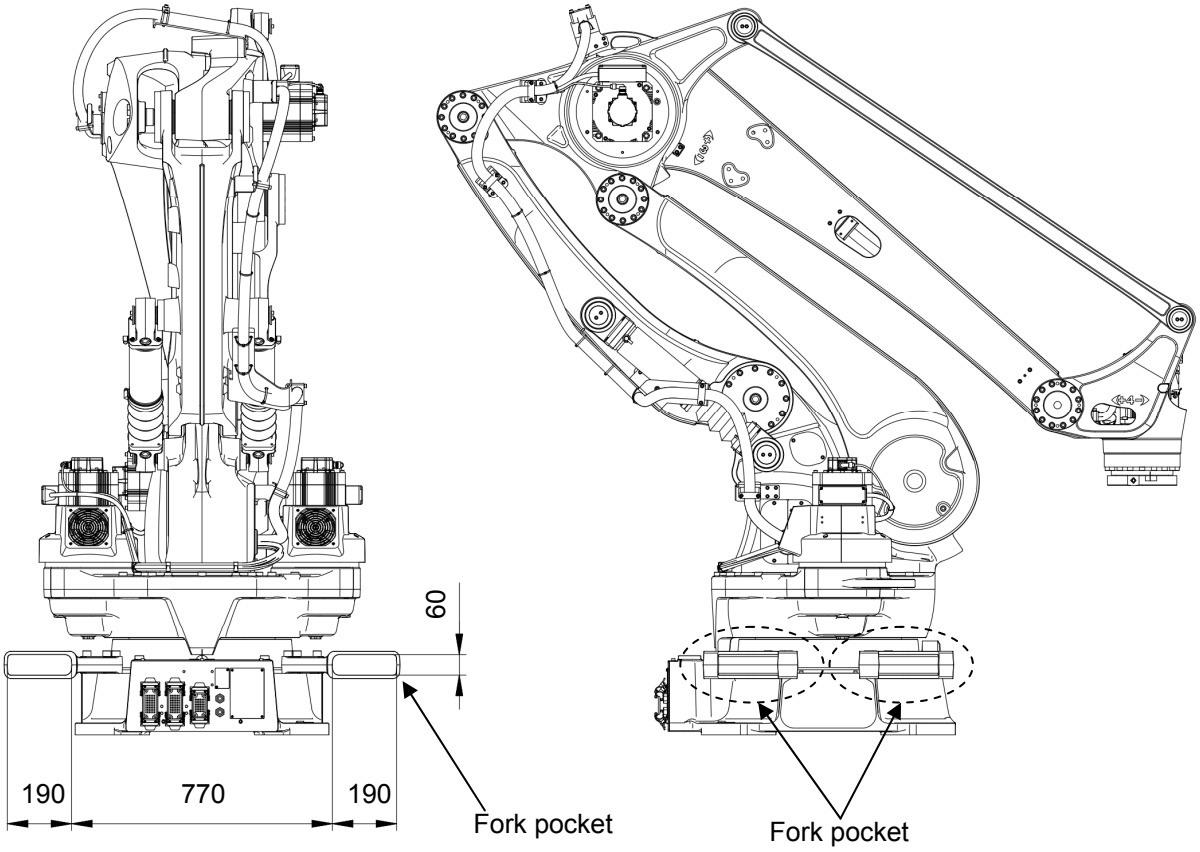
Model		CP series
Hoisted up posture		
Hoisted up posture	JT1	0°
	JT2	-46°
	JT3	-34°
	JT4	0°
	JT5	0°
	JT6	0°

4.2 Forklift

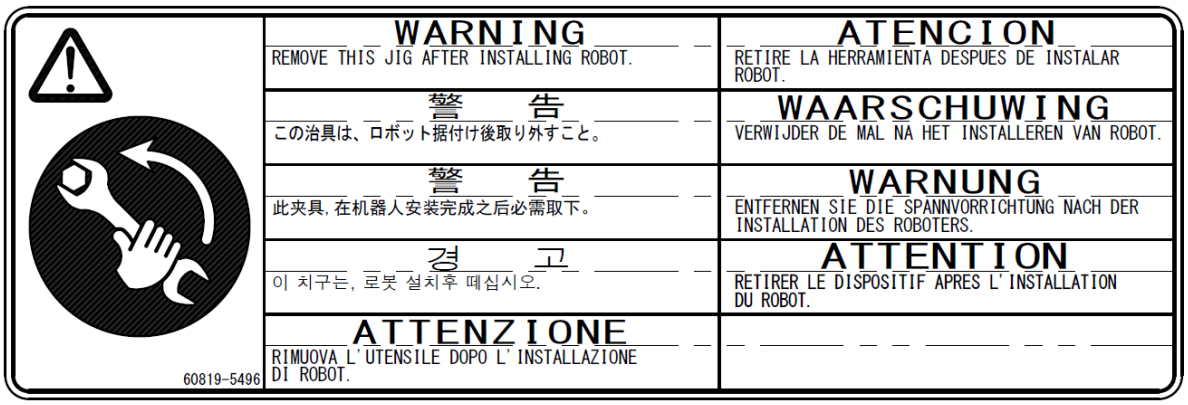
An optional fork pocket is provided as a forklift jig. The fork pocket can be mounted in the arm base section and can be used when using a forklift.

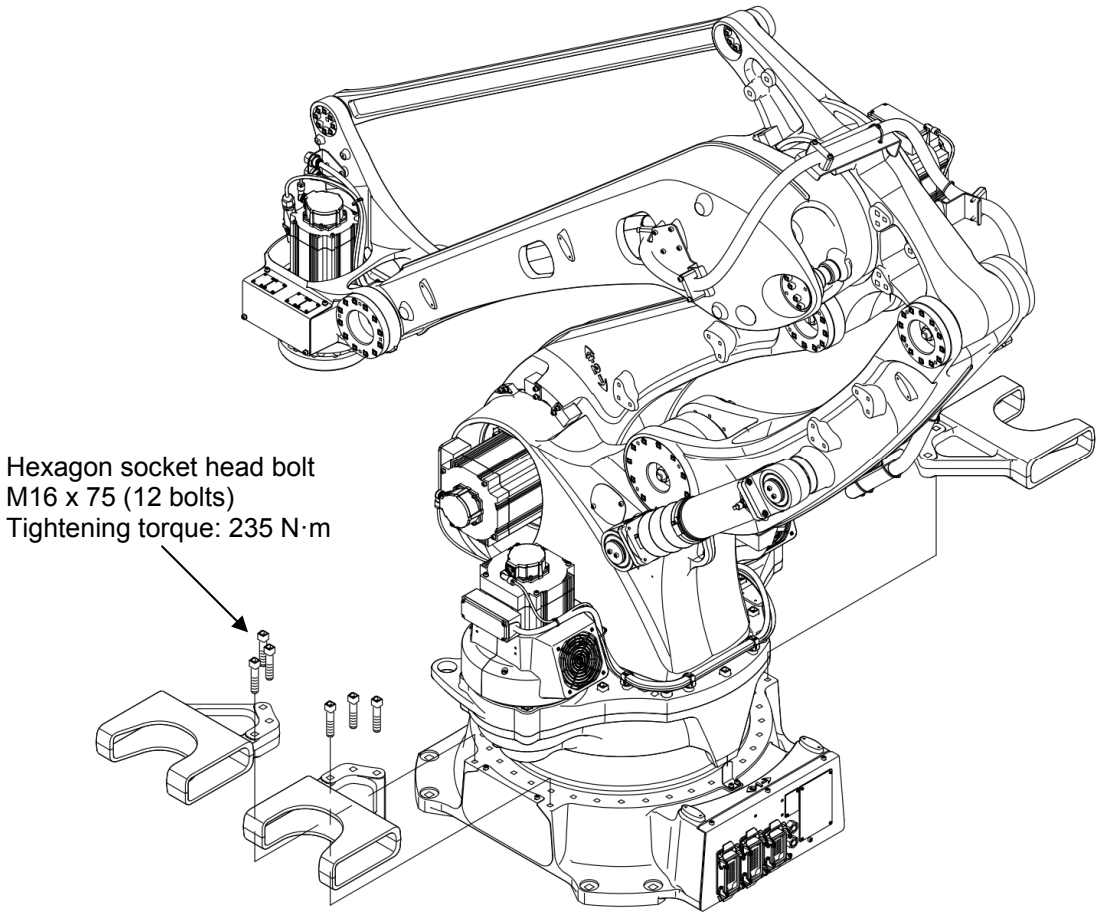
⚠ CAUTION

1. **Check if a fork of the forklift penetrates the transportation jig sufficiently without fail.**
2. **When transporting robot on an inclined or rough surface, be careful to maintain balance to prevent forklift/robot from falling.**
3. **Remove the transportation jig attached to the arm once the installation of robot is complete.**



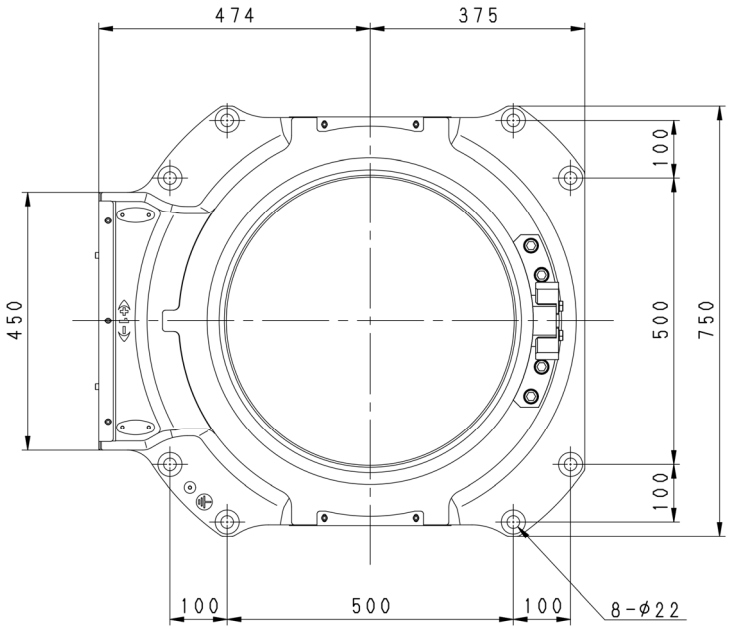
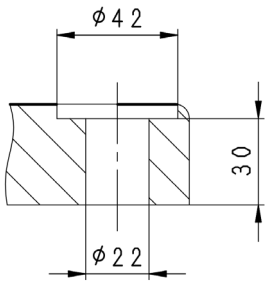
Attach the transportation jig as shown in the figure below.
Remove the transportation jig attached to the arm once the transportation of the robot is complete.





5 Installation Dimensions of Base Section

When installing a robot, fix the base section with high tension bolts through the bolt holes.

Model	CP series
Dimensions for installation	
Cross-section of installation section	
Bolt hole	8-ϕ22
High tension bolt	8-M20 Material: SCM435 Strength class: 10.9 min.
Tightening torque	431 N·m
Levelness	Within ±5°

6 Movement Reaction Acting on Installation Surface during Operation

Refer to the list below for the movement reaction that acts on the installation surface during operation. Consider these values at installation.

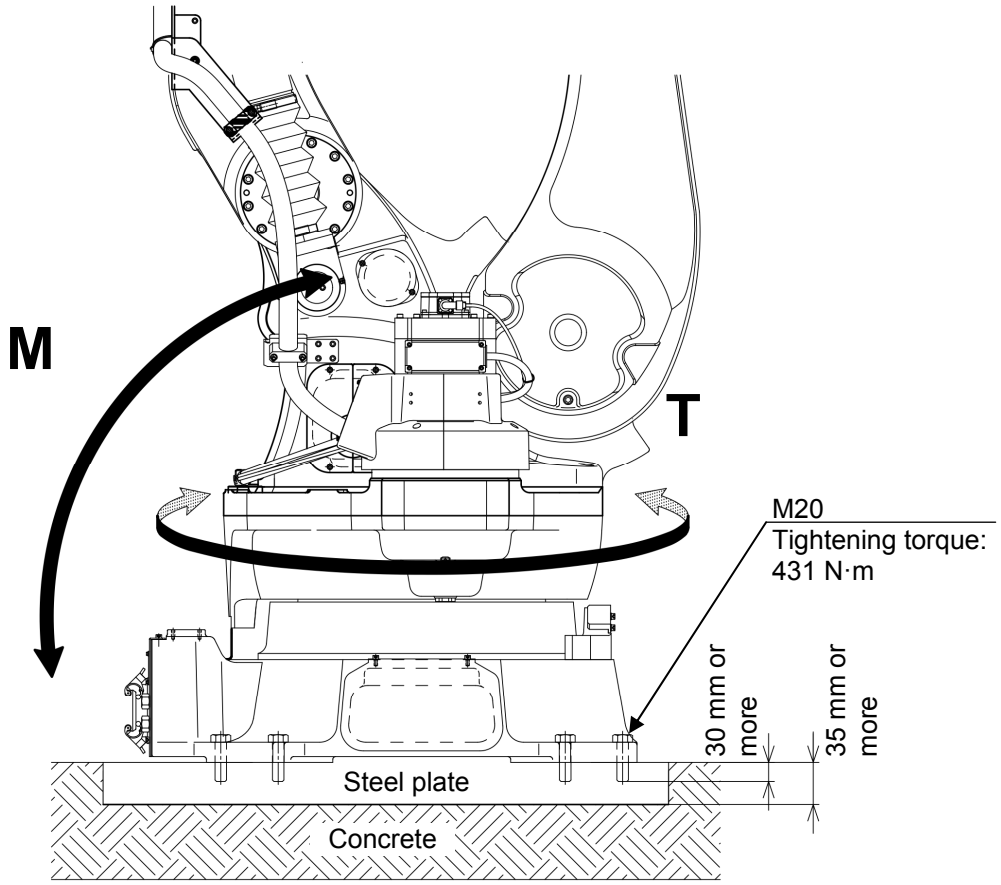
Model	CP180L (Standard spec. to High speed spec.)	CP300L (Standard spec. to High speed spec.)	CP500L	CP700L
M (Inversion Moment N·m)	40000	50000	60000	83000
T (Rotating Torque N·m)	28000	28000	28000	28000

See the next chapter for M and T.

7 Installation Method

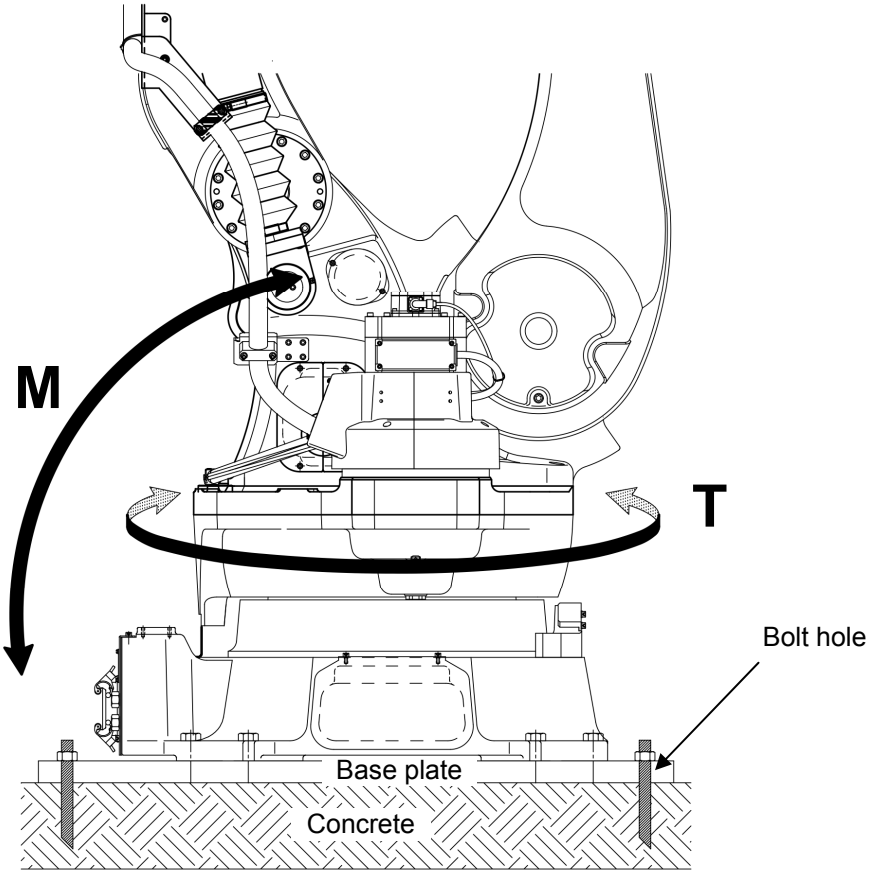
7.1 When Installing the Base Directly on the Floor

In this case, bury steel plate (35 mm Min. thickness) 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.



7.2 When Installing the Robot Base Plate on the Floor

In this case, install the base plate on concrete floor or steel plate using bolt holes on the base plate. Reaction forces received from robot are the same as when installing the base directly on the floor.

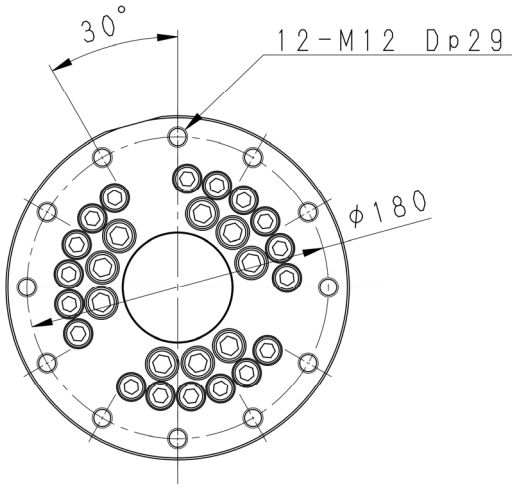


8 Mounting of Tools

WARNING

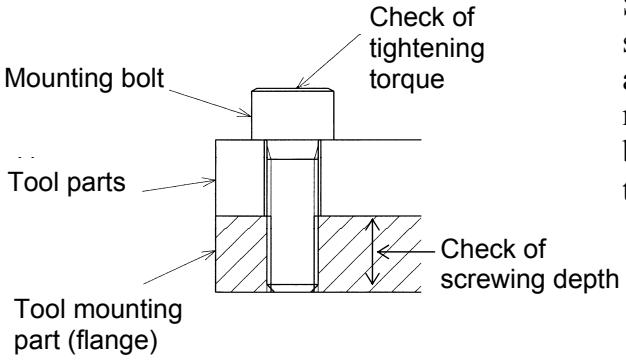
Prior to mounting tools on the robot, turn OFF the controller power switch and the external power switch. Display signs indicating clearly "Installation and connection in progress", and lockout/tagout the external power switch to prevent personnel from accidentally turning ON the power.

8.1 Dimensions of Wrist End (Flange Surface)



In the robot arm end section, a flange is provided on which tools are mounted. Screw the mounting bolts into the tapped holes on the circumference of ϕ180 on the flange, referring to the figure on the left.

8.2 Specification of Mounting Bolt



Select mounting bolts with proper length to secure the specified screwing depth according to the screw depth of tool mounting flange. Use high tension mounting bolts and tighten them to the specified torque.

	Standard flange
Tapped holes	12-M12
ϕD	ϕ180
Screw depth	29 mm
Screwing depth	18 to 28 mm
High tension bolt	SCM435, 10.9 min
Tightening torque	98.07 N·m

CAUTION

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

8.3 Adapter Plates (Options)

In addition to the standard adapter plate (180 mm dia.), the following two types of conversion adapter plates are available.

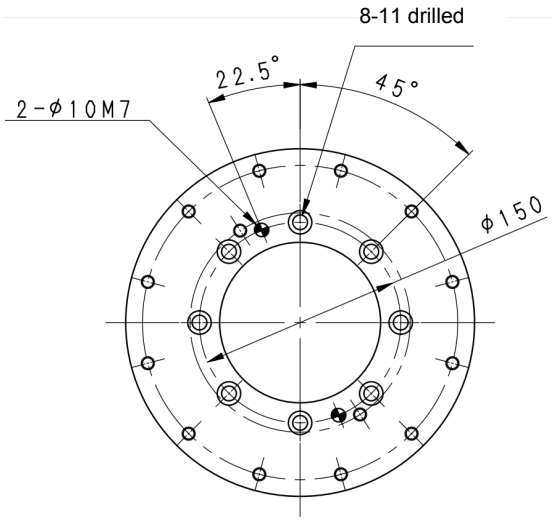
- ϕ150 conversion adapter plate
- ϕ200 conversion adapter plate

When using a ϕ150 conversion adapter plate, screw the mounting bolts into the through-holes on the circumference of diameter 150 mm on the flange. When using a ϕ200 conversion adapter plate, screw the mounting bolts into the tapped holes on the circumference of diameter 200 mm on the flange. Refer to "8.4 Conversion Adapter Plate Mounting Procedure" for how to mount the adapter plate.

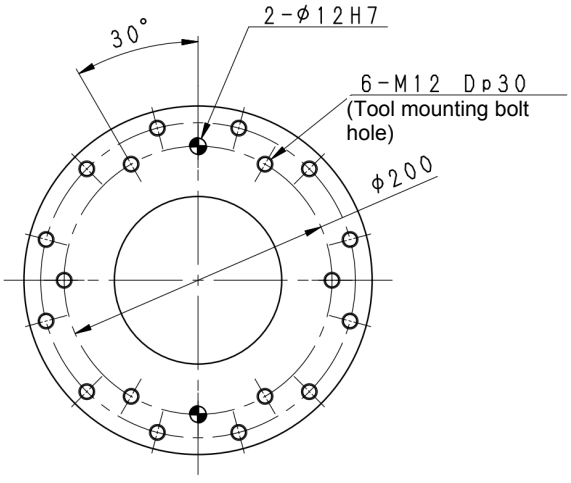
■ Optional adapter plate parts

ϕ150 conversion adapter plate		ϕ200 conversion adapter plate	
1	ϕ150 conversion adapter plate A	1	ϕ200 conversion adapter plate A
2	ϕ150 conversion adapter plate B	2	ϕ200 conversion adapter plate B
3	Bolt A (M12, L30, Strength class 10.9 x 12 pcs)	3	Bolt A (M12, L30, Strength class 10.9 x 12 pcs)
4	Bolt B (M10, L25, Strength class 10.9 x 12 pcs)	4	Bolt B (M12, L30, Strength class 10.9 x 12 pcs)
5	Bolt C (M10, L25, Strength class 12.9 x 8 pcs)		
6	Pin (ϕ10, L30 x 2 pcs)		

ϕ150 conversion adapter plate



ϕ200 conversion adapter plate



■ Specification of tool mounting bolts

	ϕ150 conversion adapter plate	ϕ200 conversion adapter plate
Mounting bolt holes	8-11 drilled	6-M12
ϕD	ϕ150	ϕ200
Pin holes	2-ϕ10M7 depth 20	2-ϕ12H7 depth 12
Screw depth	-	30 mm
Screwing depth	-	18 to 29 mm
High tension bolt	SCM435, 12.9 min.	SCM435, 10.9 min
Tightening torque	73.53 N·m	98.07 N·m

⚠ WARNING

Operate the robot at below 80 percent of the monitoring speed if no pin is used to tighten the tool on a ϕ150 conversion adapter plate.

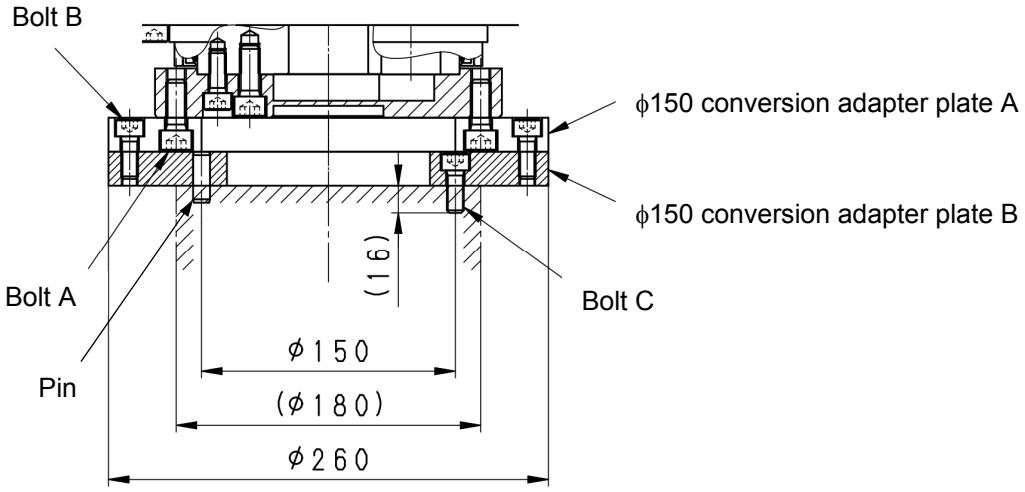
⚠ CAUTION

Use tool mounting bolts specified in "8.2 Specification of Mounting Bolt". (Note that ϕ150 conversion adapter plates come with bolts. Contact Kawasaki if the bolts are missing.)

8.4 Conversion Adapter Plate Mounting Procedure

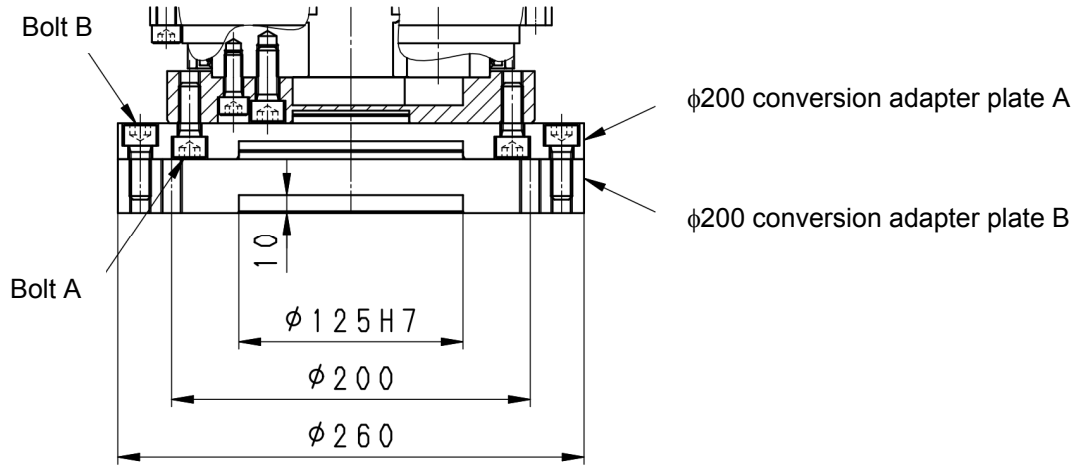
■ ϕ150 Conversion Adapter Plate

1. Secure the ϕ150 conversion adapter plate A on the flange with 12 bolts A. Use a tightening torque of 98 N·m.
2. Tap the two pins in the ϕ150 conversion adapter plate B.
   (Operate the robot at below 80 percent of the monitoring speed if no pin is used.)
3. Secure the tool and the ϕ150 conversion adapter plate B with eight bolts C. Use a tightening torque of 73.5 N·m.
4. Secure the ϕ150 conversion adapter plates A and B with 12 bolts B. Use a tightening torque of 57 N·m.



■ ϕ200 conversion adapter plate

1. Secure the ϕ200 conversion adapter plate A on the flange with 12 bolts A. Use a tightening torque of 98 N·m.
2. Secure the ϕ200 conversion adapter plate B on the adapter plate A with 12 bolts B. Use a tightening torque of 98 N·m.



8.5 Load Capacity

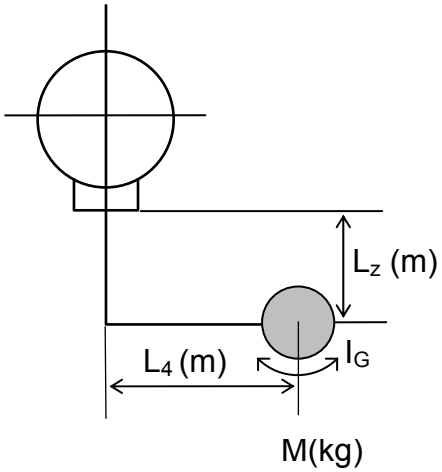
Load mass applicable to robot is specified for each model and includes the mass of tool, etc. Applicable load moment of inertia around wrist axes (JT4) is also specified. Strictly observe the following restrictions on them.

⚠ CAUTION

Using the robot beyond its specified load may result in degradation of movement performance and shortening of machine service life. The load mass includes the tool mass. If using the robot in excess of its load capacity, first contact Kawasaki without fail.

The load torque and the moment of inertia in wrist section should be calculated by expressions below.

Calculation Expression



Load mass (including tool): $M \leq Mmax.(kg)$
Load torque: not specified
Load moment of inertia: $I=M \cdot L^2+I_G\ (kg \cdot m^2) \leq Imax\ (kg \cdot m^2)$
Center position of load mass (L_4, L_z): See diagrams below.
Mmax.: Rated load mass

CP180L (High speed spec.)	: 130 (kg)
CP180L (Standard spec.)	: 180 (kg)
CP300L (High speed spec.)	: 250 (kg)
CP300L (Standard spec.)	: 300 (kg)
CP500L	: 500 (kg)
CP700L	: 700 (kg)

Imax.: Rated load moment of inertia

CP180L (High speed spec.)	: 50 ($kg \cdot m^2$)
CP180L (Standard spec.)	: 85 ($kg \cdot m^2$)
CP300L (High speed spec.)	: 100 ($kg \cdot m^2$)
CP300L (Standard spec.)	: 140 ($kg \cdot m^2$)
CP500L	: 250 ($kg \cdot m^2$)
CP700L	: 500 ($kg \cdot m^2$)

I_G: Moment of inertia around center of gravity ($kg \cdot m^2$)
L_z: Length from flange to center of load mass (m)
L_4: Length from JT4 rotating center to center of load mass (m)

When calculating the load by dividing it into sections (for example, tool section, workpiece section, etc.), evaluate the inertia moment from the sum of all the sections.

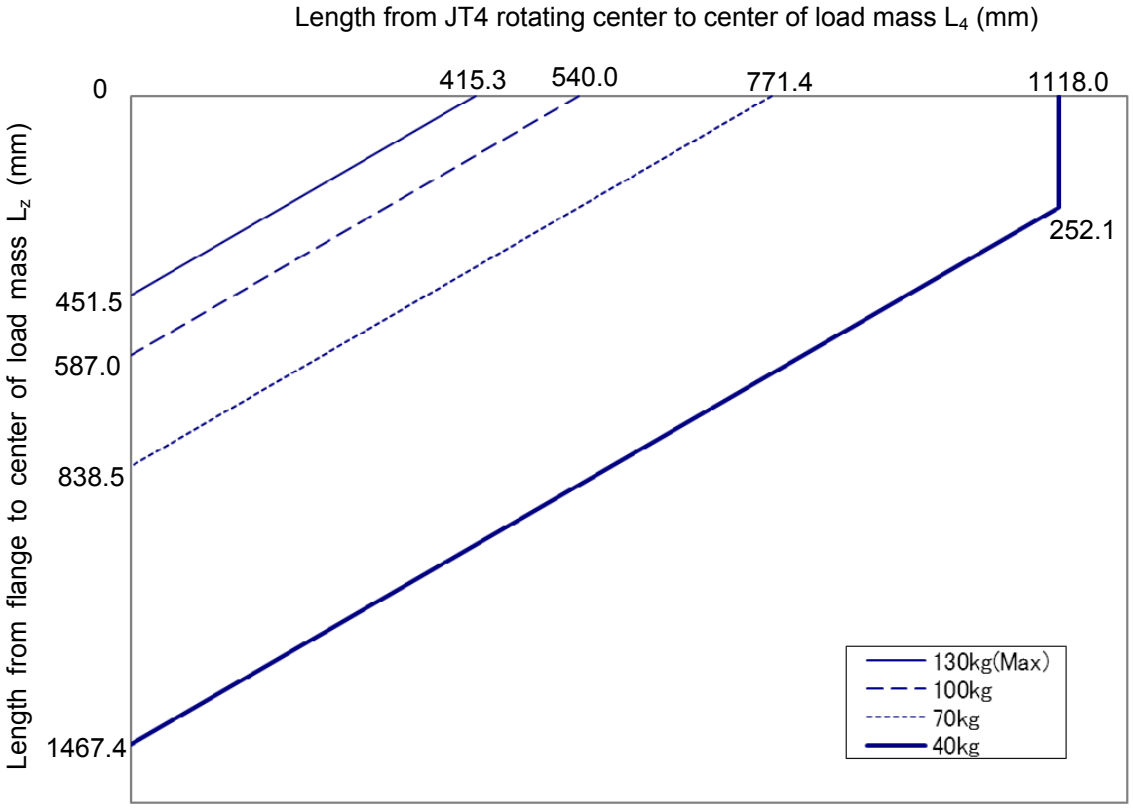
Strictly observe the following restrictions applied to wrist sections.

1. The allowable load including tool should be less than the Mmax. above.
2. Restrictions are applied to the load moment of inertia in wrist section (JT4). The load moment of inertia should be less than the Imax. above.
3. Restrictions are applied to the center of load mass. The center should be positioned within the allowable range shown below.

CAUTION

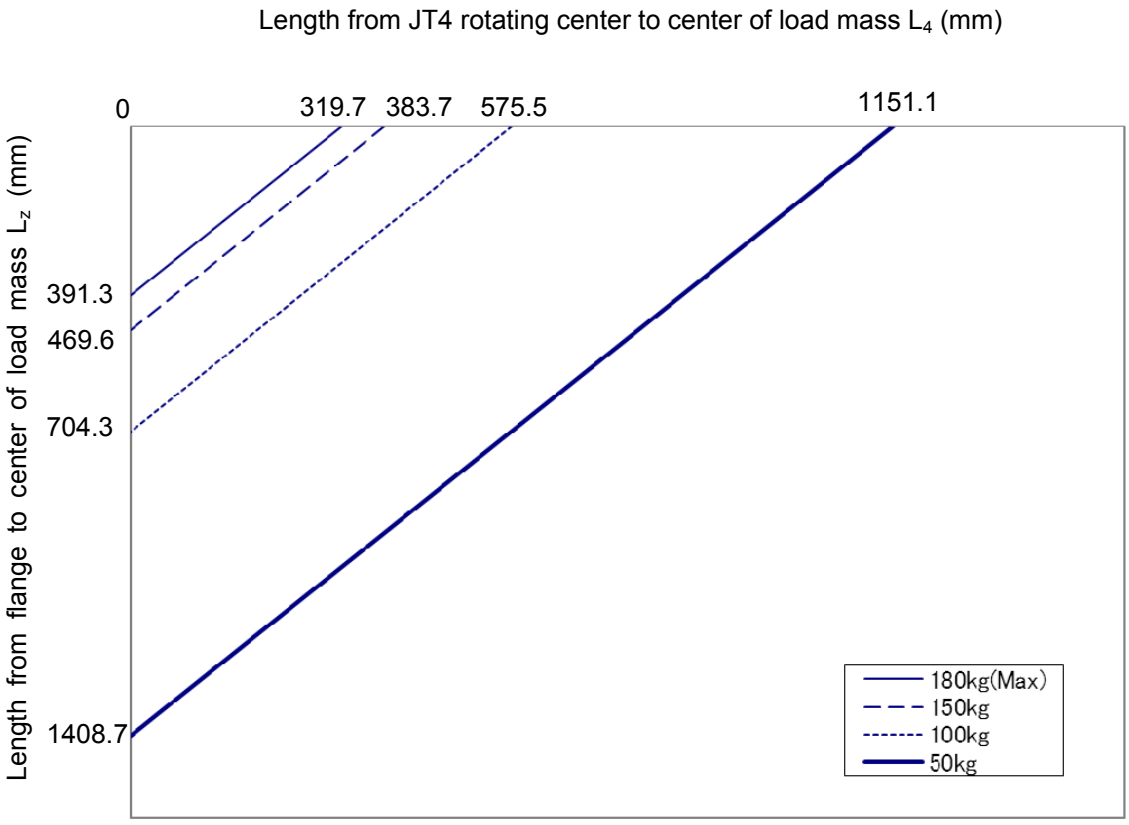
Set the load data via Auxiliary function 0304 after mounting of tools without fail. Operating robot with wrong settings may cause vibrations in motion, degradation of movement performance and shortening of machine service life.

Diagram of load on wrist section for CP180L (High speed spec.)



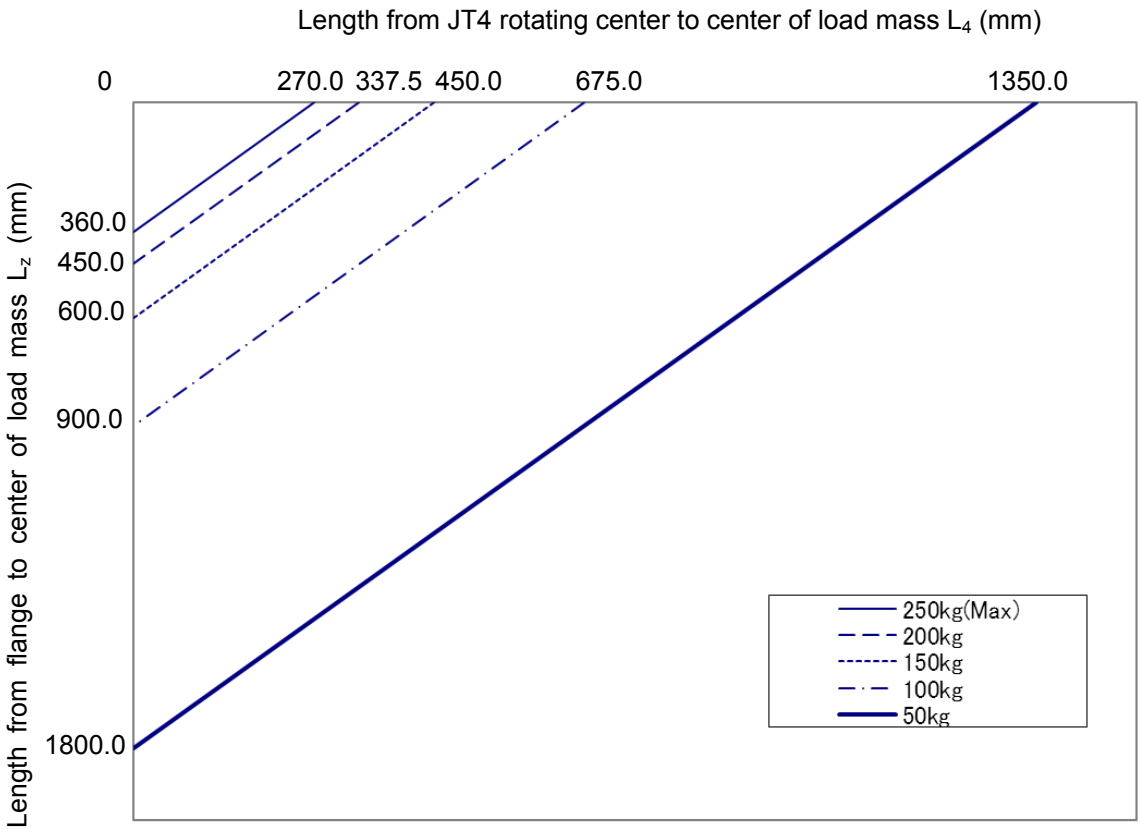
Even if the load is less than 40 kg, the center of mass should be positioned within the load diagram of 40 kg.

Diagram of load on wrist section for CP180L (Standard spec.)



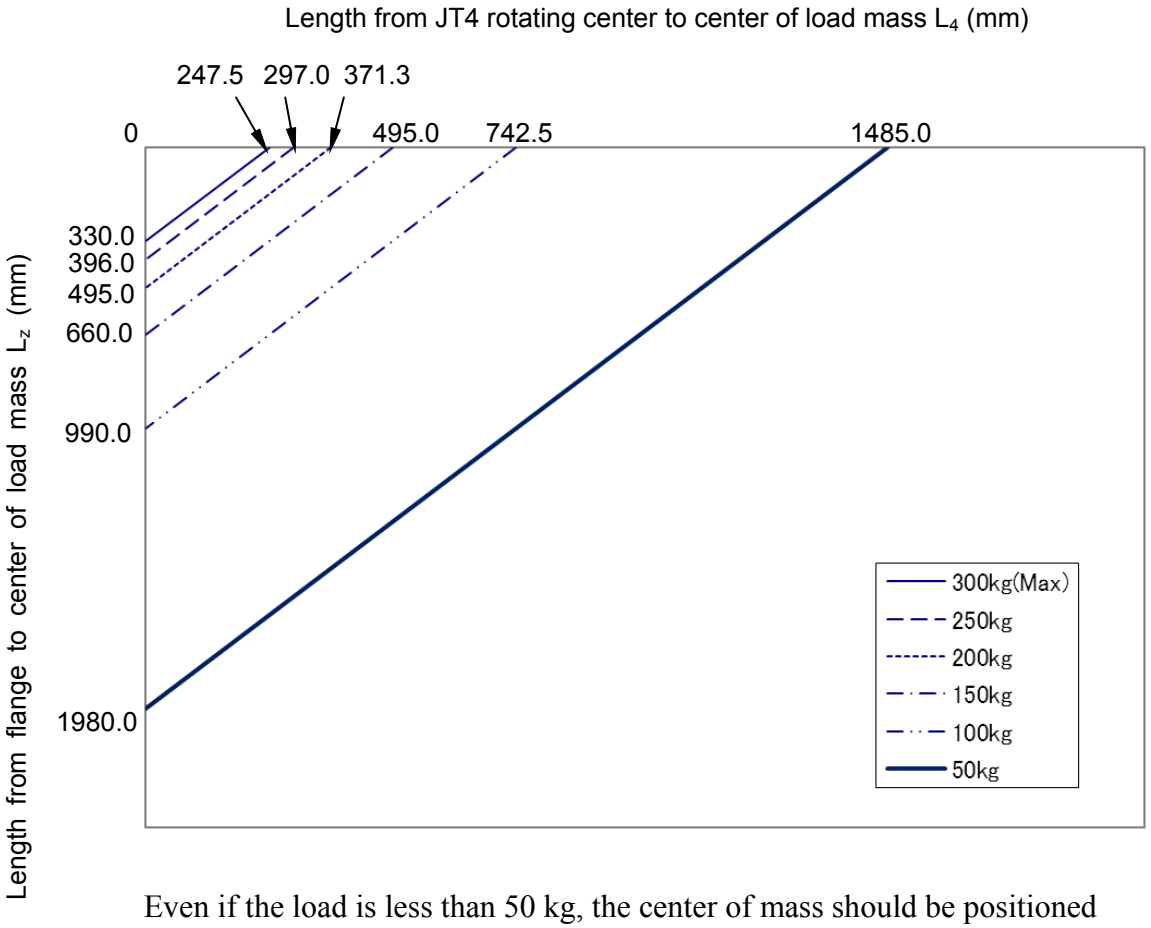
Even if the load is less than 50 kg, the center of mass should be positioned within the load diagram of 50 kg.

Diagram of load on wrist section for CP300L (High speed spec.)



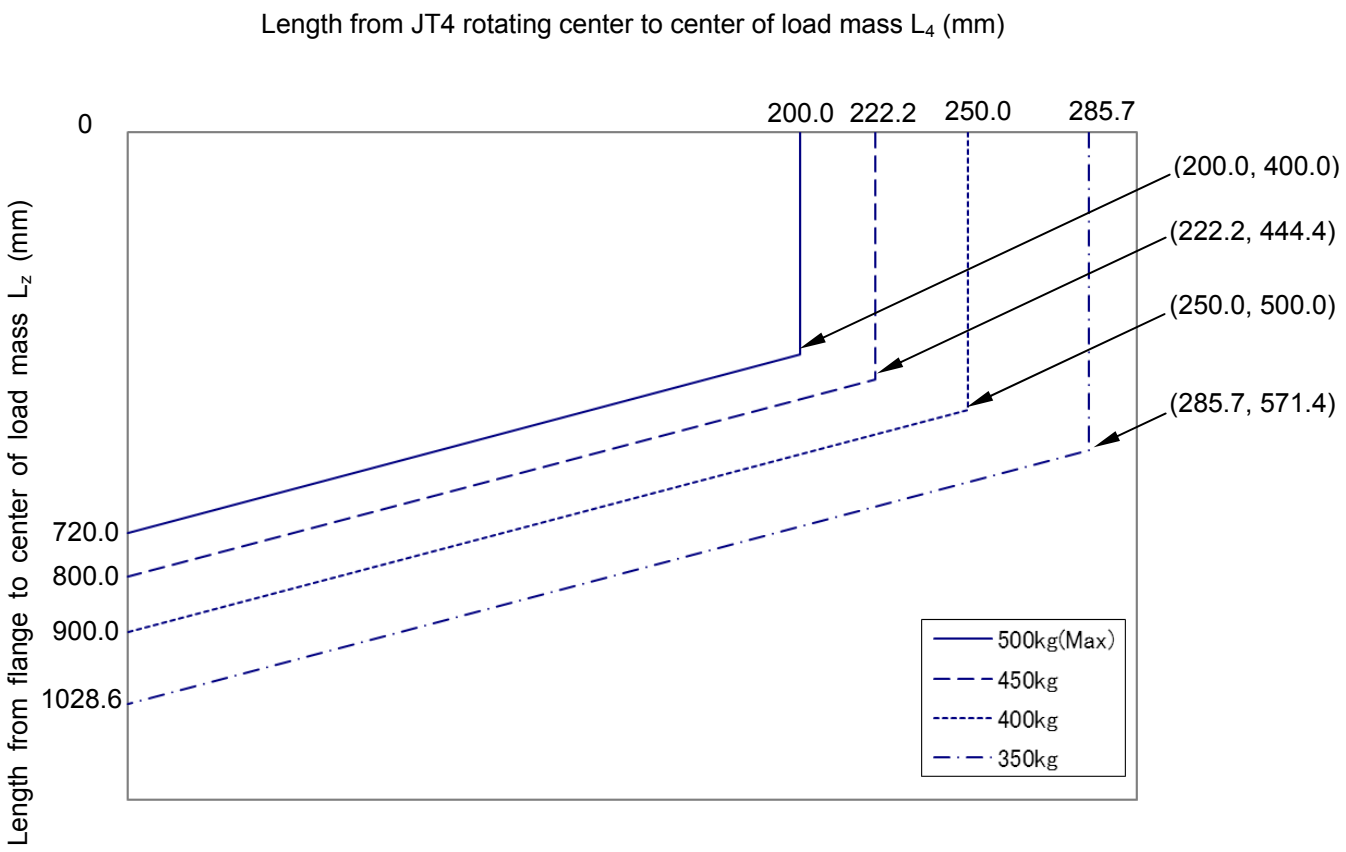
Even if the load is less than 50 kg, the center of mass should be positioned within the load diagram of 50 kg.

Diagram of load on wrist section for CP300L (Standard spec.)



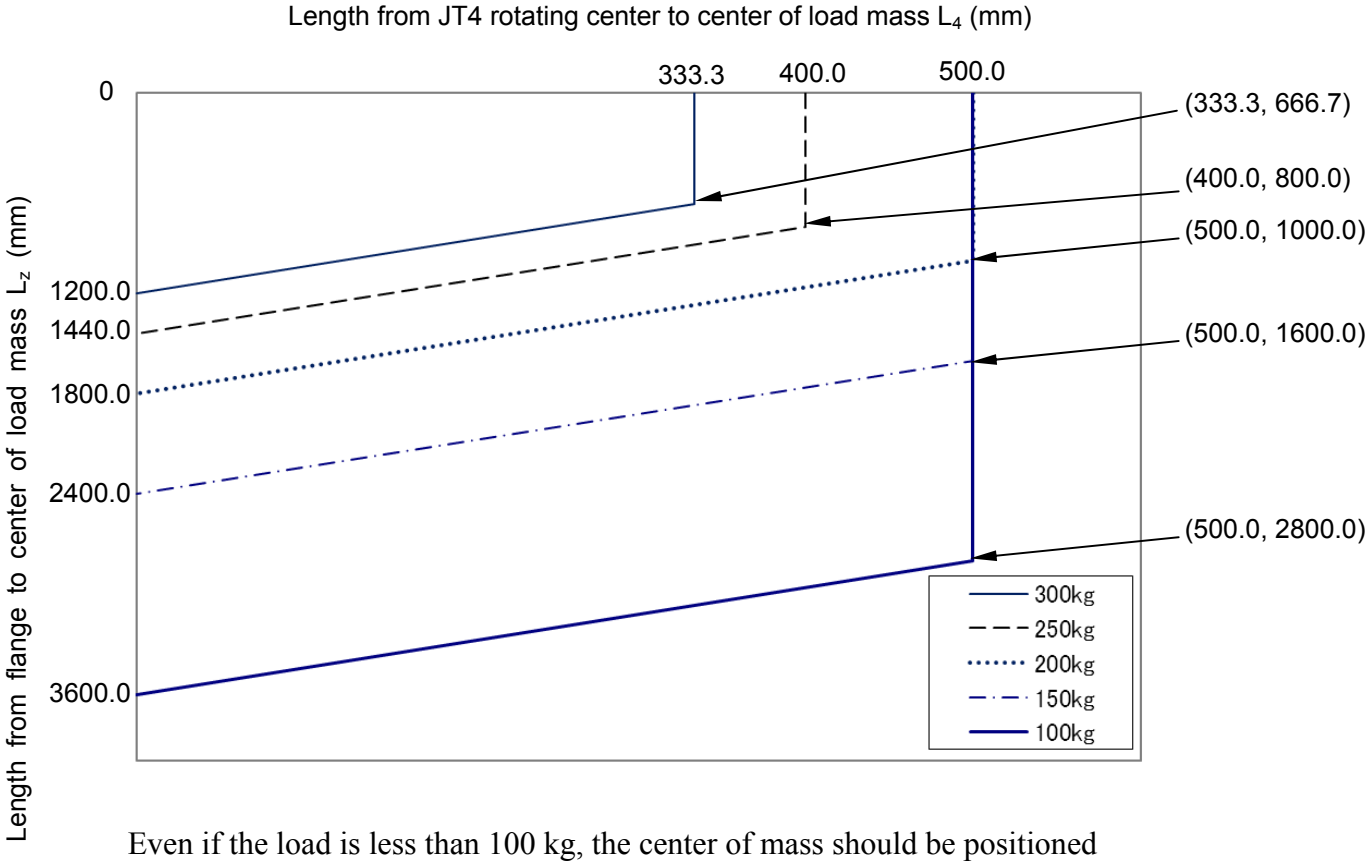
Even if the load is less than 50 kg, the center of mass should be positioned within the load diagram of 50 kg.

Diagram of load on wrist section for CP500L
Case 1: Load 500 to 350 (kg)



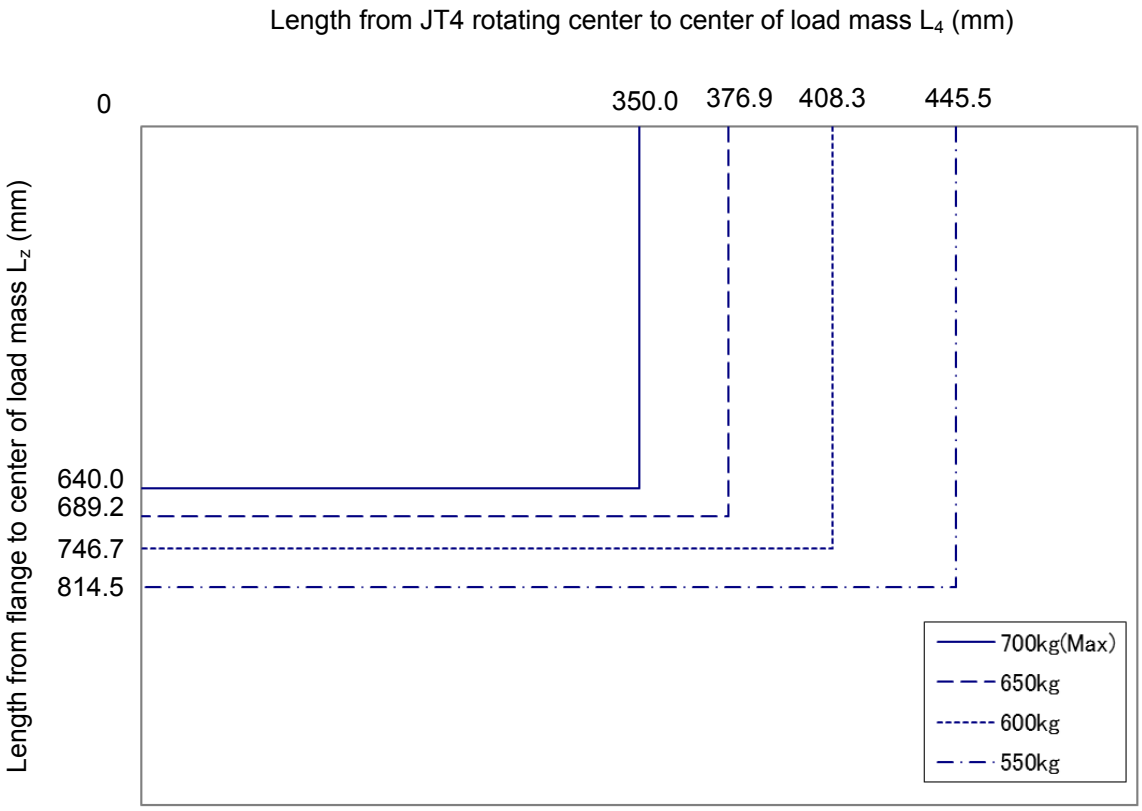
See the next page when the load is less than 350 kg.

Diagram of load on wrist section for CP500L
Case 2: Load 300 to 100 (kg)



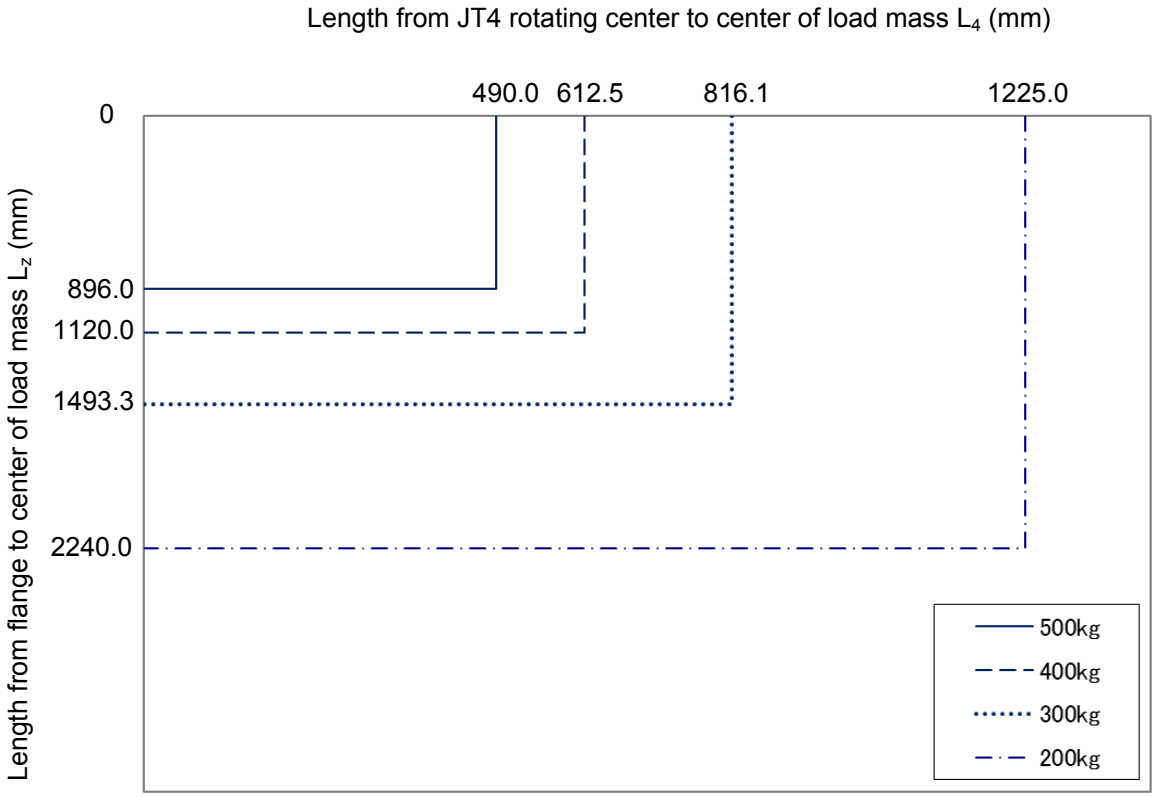
Even if the load is less than 100 kg, the center of mass should be positioned within the load diagram of 100 kg.

Diagram of load on wrist section for CP700L
Case 1: Load 700 to 550 (kg)



See the next page when the load is less than 500 kg.

Diagram of load on wrist section for CP700L
Case 2: Load 500 to 200 (kg)

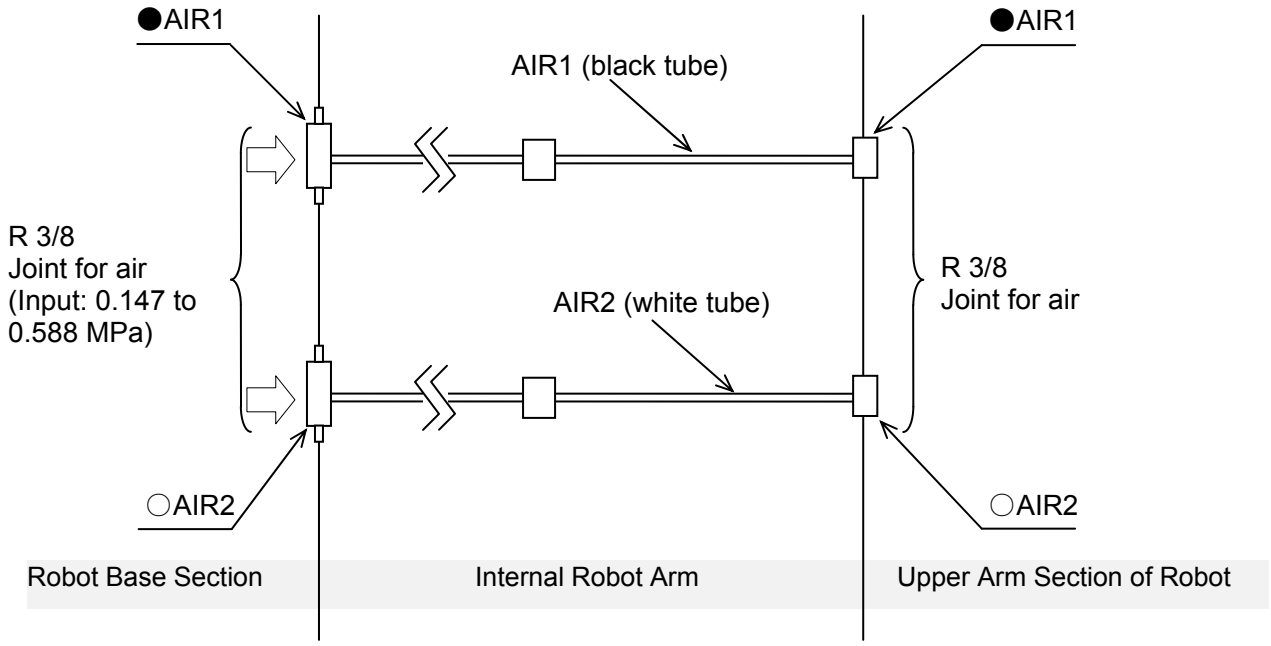


Even if the load is less than 200 kg, the center of mass should be positioned within the load diagram of 200 kg.

9 Connection of Air System

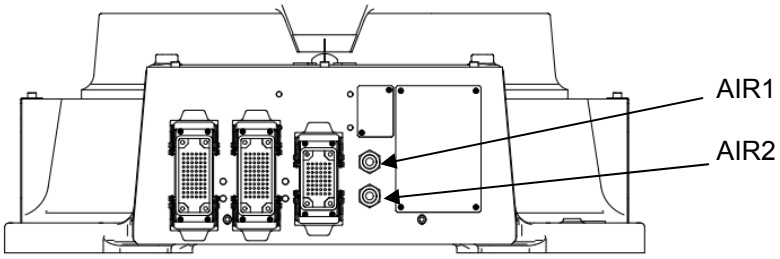
CP series includes air piping for driving tool in the robot arm.

9.1 Air Piping Diagram



9.2 Air Supply to the Robot Arm

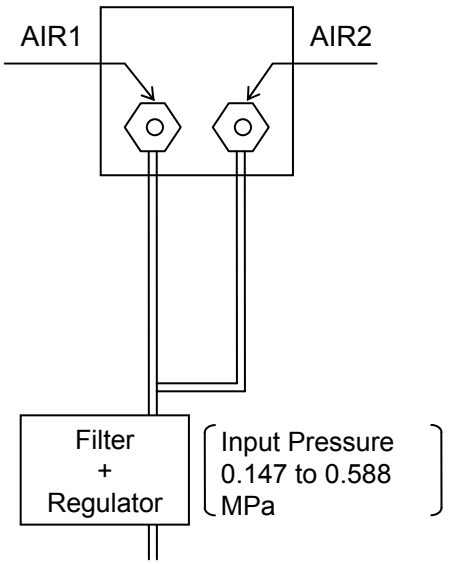
As shown in the figure below, air connection ports are provided on the base section of robot arm.



⚠ CAUTION

Supply air to the air inlet ports (R 3/8 joint for air, 2 places).
Air pressure; 0.147 to 0.588 MPa

< Reference >

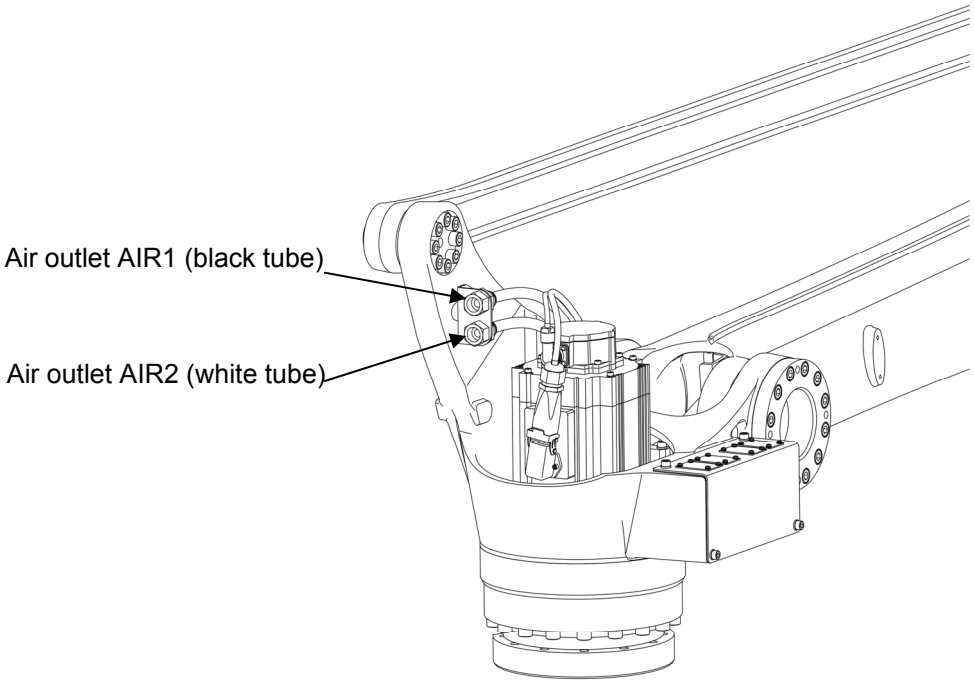


When connecting the air regulator, connect [Filter + Regulator] externally on the driving air source for the tool section.

Since the built-in valve on the upper arm is unlubricated type, do not use any lubricator (oiler).

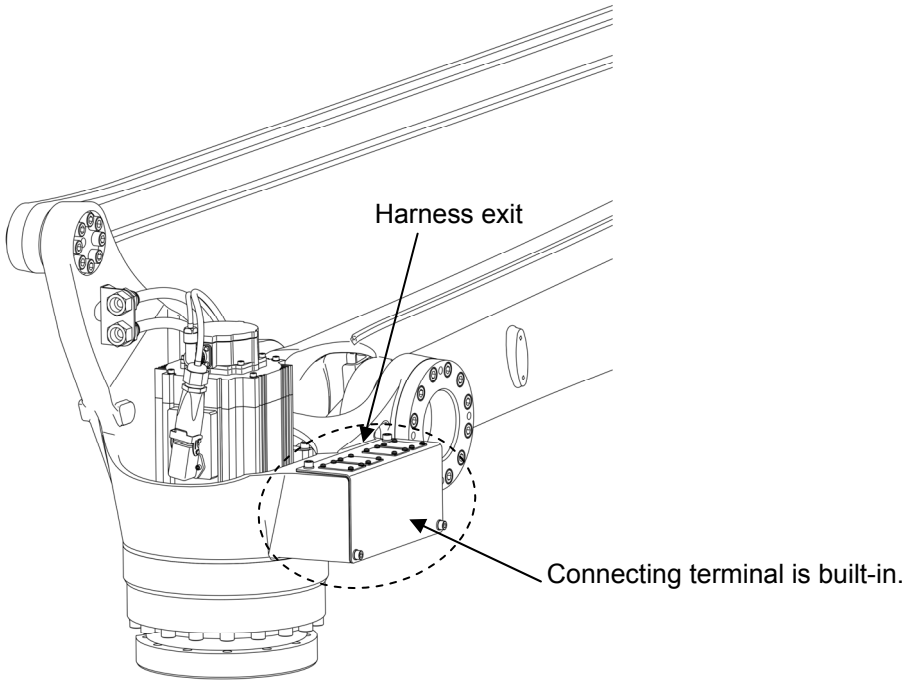
9.3 Connection to the Tool from the Air Outlet Ports

Air outlet ports are provided on CP series robot as shown in the figure below. For CP series, the outlet ports are R 3/8 joint ports on the wrist section.



10 Connection of Optional Harness for External Axis

Optional motor/sensor harness/valve harness for external axis are available for CP series, and these connecting terminals are built-in in the wrist section.



Contact Kawasaki when requesting harness connection.

11 Mounting External Equipment

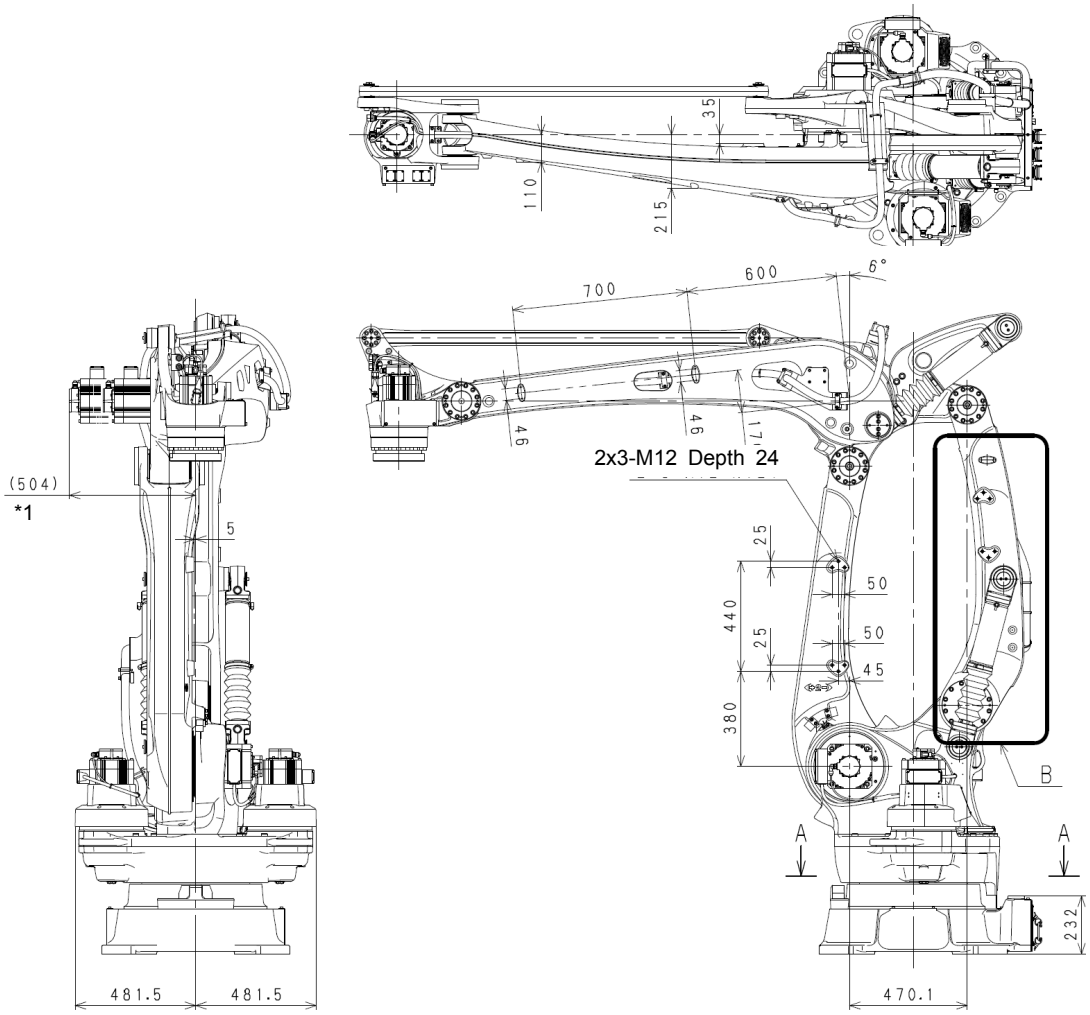
11.1 Service Tapped Hole Positions

Service tapped holes shown in the figure below are available to mount wiring brackets and external equipment on each part of robot arm.

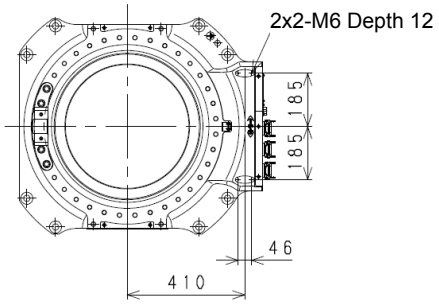
⚠ CAUTION

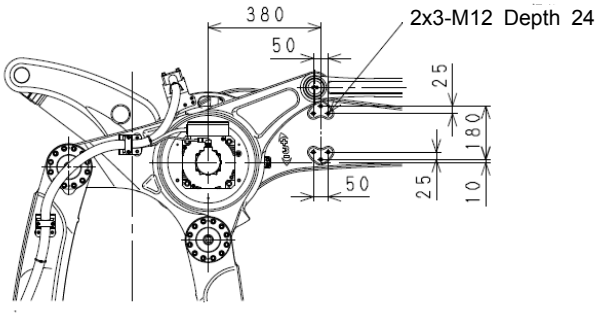
Check the robot movement very carefully and confirm that mounted brackets and external equipment do not interfere with peripheral equipment and robot arm itself.

CP Series

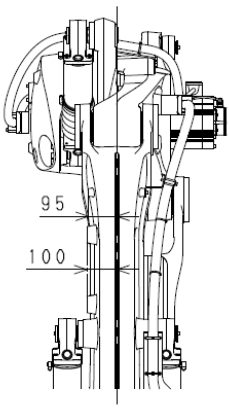


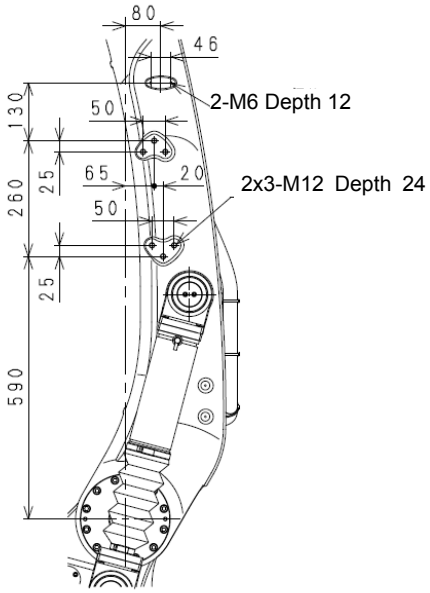
*1 Consider the dimension in ( ) for CP700L only.





View A-A





Details of section B

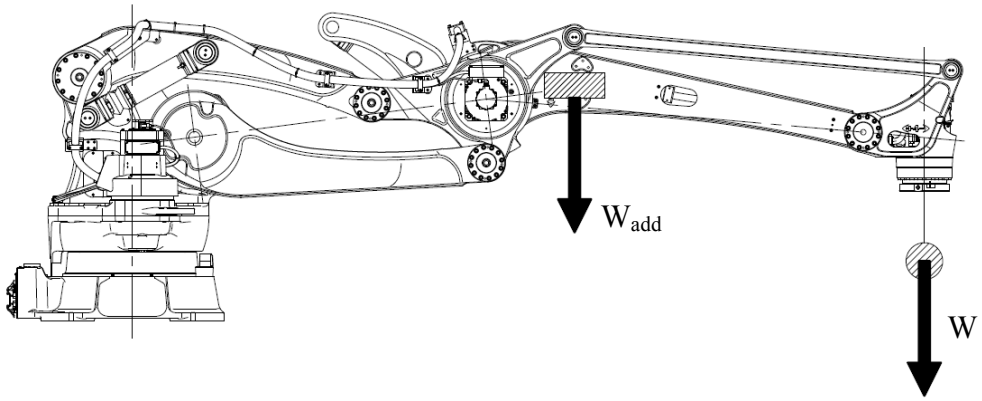
11.2 Calculation of Load Caused by External Equipment

The load capacity is set for each arm model. Strictly observe the following restrictions of the load torque and load moment of inertia on arm.

⚠ CAUTION

Using the robot beyond its specified load capacity may result in degradation of movement performance and shortening of machine service life. If the load exceeds load capacity, first contact Kawasaki without fail.

Calculation Expression



Do not exceed the value below for W_{add}.

$W_{add} \leqq W_{max} - W$

W_{max} : Max. allowable load [kg]
W : Load on wrist end [kg]
W_{add} : Total load on arm section [kg]

⚠ CAUTION

W is set as default in shipment. When using a robot for the first time or when changing the load mass or the position of the gravity center of the load, set the W via Auxiliary 0304. When setting W_{add}, add the mass of W_{add} to the load mass of W. Operating robot with wrong settings may cause vibrations in motion, degradation of movement performance and shortening of machine service life.

Kawasaki Robot CP Series

Installation and Connection Manual

2014-09 : 1st Edition

2017-10 : 2nd Edition

Publication : Kawasaki Heavy Industries, Ltd.

90202-1141DED