

**Kawasaki Robot
CP110L**

**Installation and
Connection Manual**

Robot

Kawasaki Heavy Industries, Ltd.

Preface

This manual describes installation and connection procedures for Kawasaki Robot CP110L.

Read and understand the contents of this and “Safety Manual” thoroughly and strictly observe all rules for safety before proceeding with any operation. This manual describes only the installation and connection of the arm section. For information regarding the controller section, refer to the controller's "Installation and Connection Manual."

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 is applicable to the following robot —


CP110L

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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.
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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.**

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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 lock out/tag out 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 lock out/tag out the external power switch before starting installation and connection.



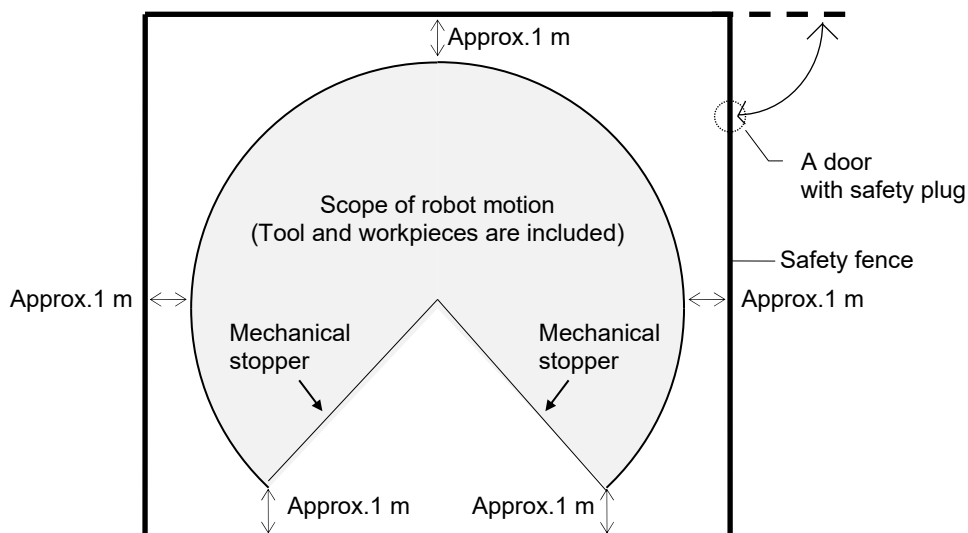
CAUTION

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:

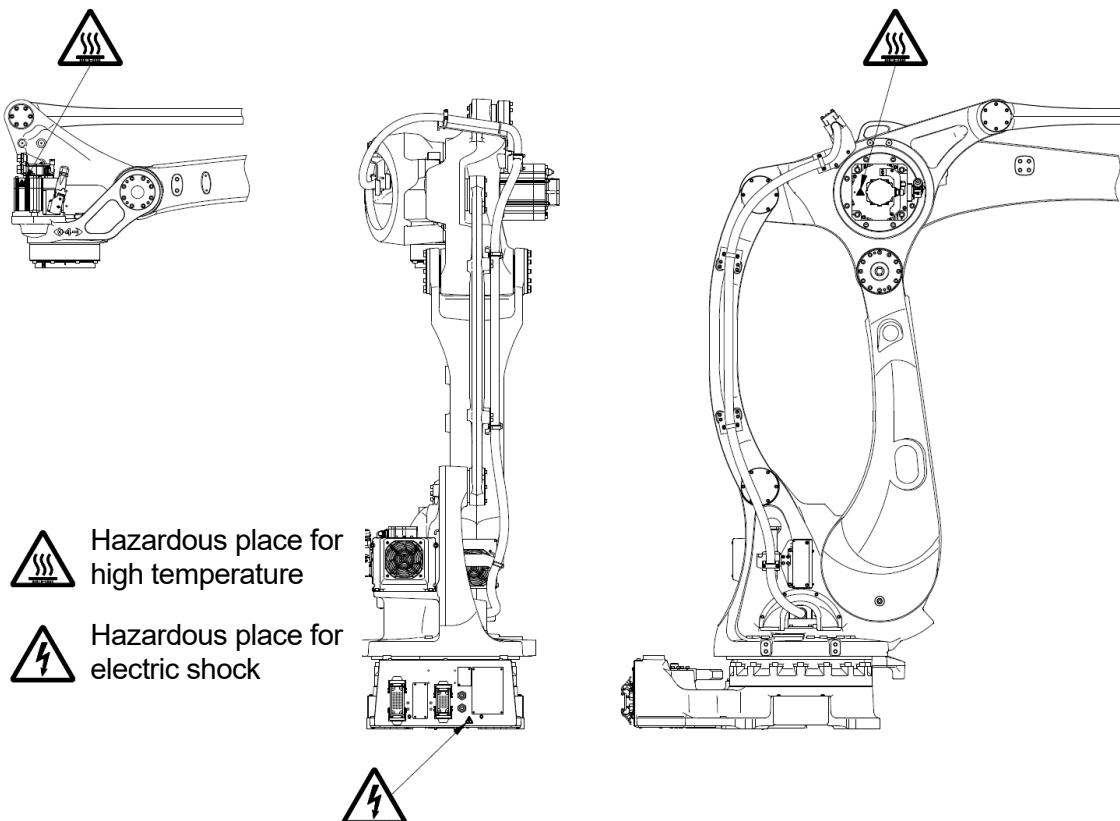
1. When robot is installed on the floor, the levelness must be within $\pm 5^\circ$.
2. Be sure that the installation floor/pedestal has sufficient rigidity.
3. Secure a flatness to prevent undue force applied to the installation section. (If sufficient flatness is unobtainable, insert liners and adjust 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

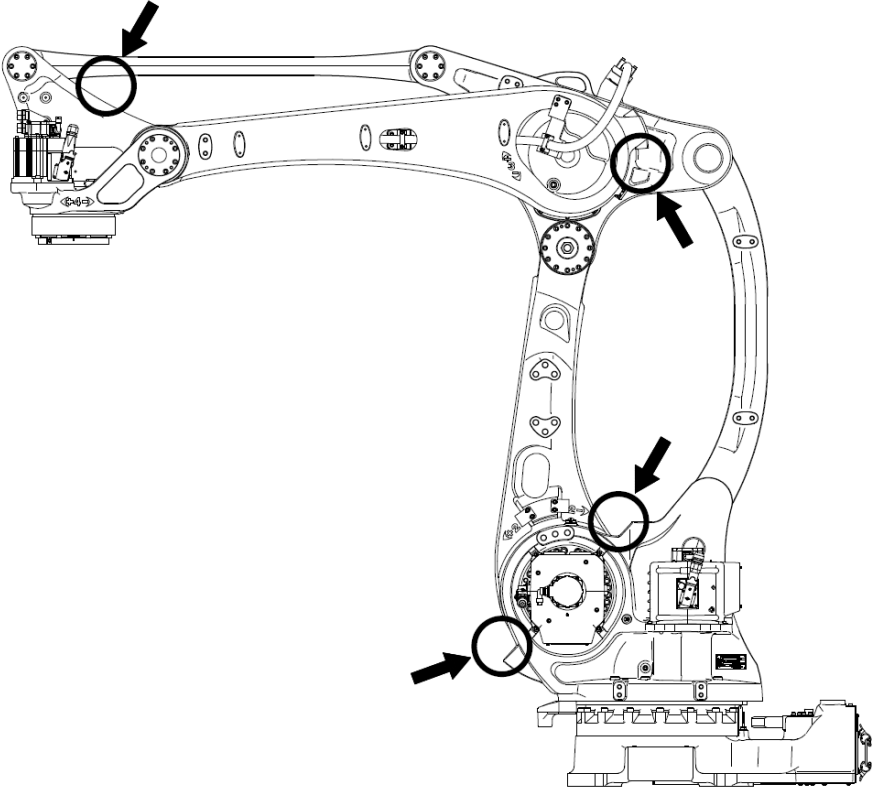
! WARNING
Pay attention to the hazardous places listed in the drawings below.

Hazardous places for high temperature and electric shock



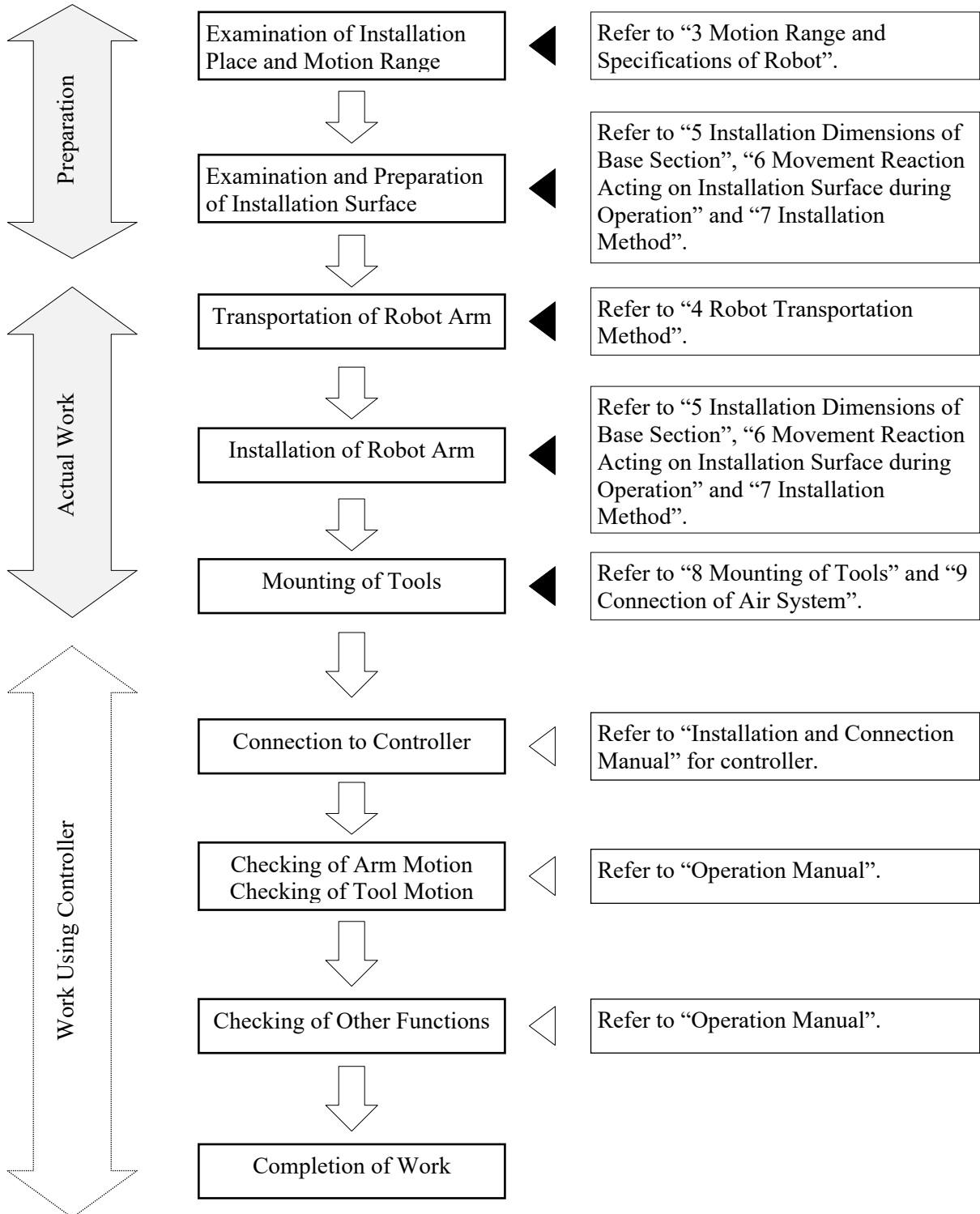
Hazardous places for pinching

○ Hazardous place for pinching



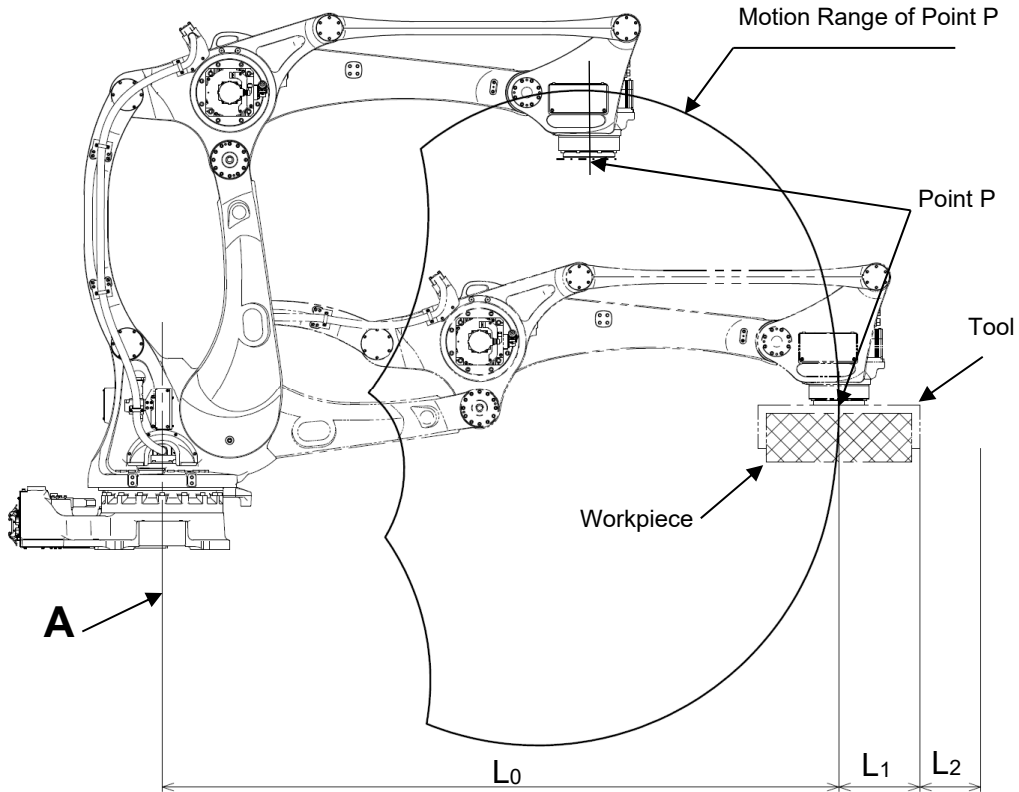
2 Work Flow at Arm Installation and Connection

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

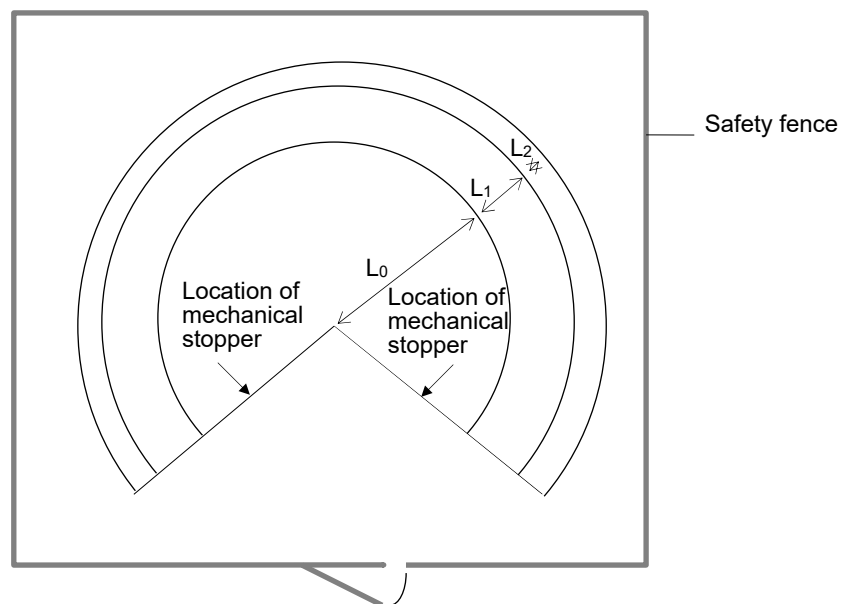


3 Motion Range and Specifications of Robot

3.1 Determination of Safety Fence Installation Location

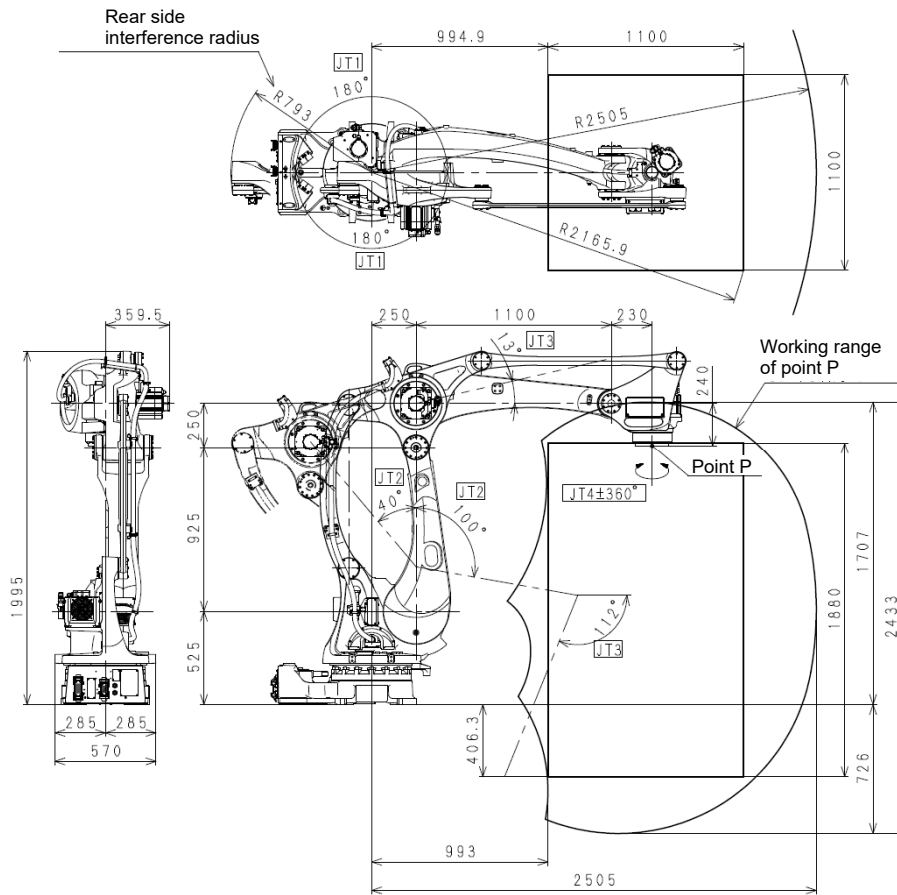


The motion range of the robot is represented by the maximum area that can be covered by point P in the figure above. Therefore, as shown in the figure below, install the safety fence outside circle whose radius is $L_0+L_1+L_2$. Where; L_0 is the length from the center line of arm (point A shown above) 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

CP110L



Type		Vertical Articulated Robot	
Degree of Freedom		4	
Motion Range		JT1	±180°
		JT2	+100° to -40°
		JT3	+13° to -112°
		JT4	±360°
Maximum Speed*2		JT1	145°/s
		JT2	140°/s
		JT3	170°/s
		JT4	420°/s
Wrist Load Capacity	Torque	JT4	-
	Moment of Inertia	JT4	70 kg·m ²
Max. Payload		-	110 kg
Repeatability		±0.05 mm	
Mass		820 kg	
Acoustic Noise		71 dB (A)*1	

*1 Measured condition

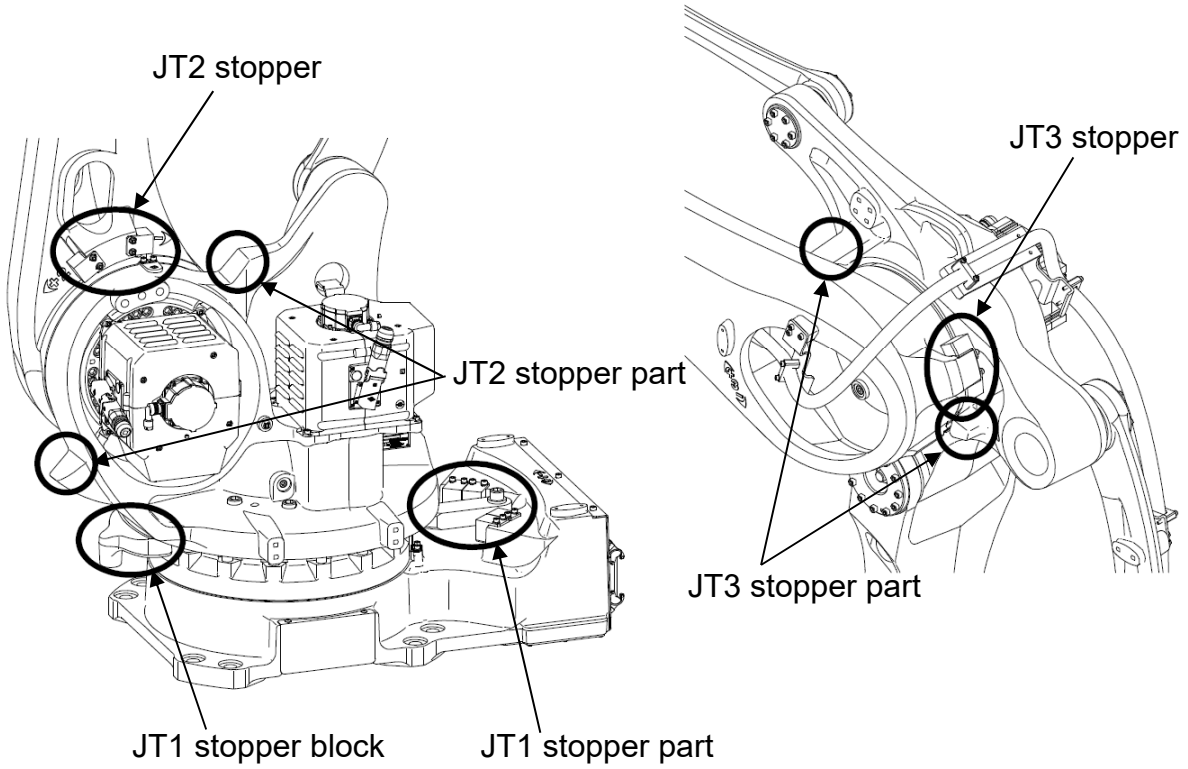
- ISO 11201 equivalent
 - Kawasaki standard operation
- Acoustic noise varies depending on the individual unit. It also varies depending on the load and operating conditions. Depending on the applicable operation, such as moving a single axis at maximum speed, noise may exceed 80 dB. Provide noise protection for personnel as necessary.

*2 The values in the table are maximum values and may vary depending on conditions such as load and operating range. For details, please contact Kawasaki.

3.3 Mechanical Stopper

Mechanical stoppers are installed at the points shown in the figure below at JT1, JT2, and JT3 of the base axes.

CP110L



4 Robot Transportation Method

4.1 Using Wire Sling

Attach fork pockets to the arm as shown in the figure below, attach wires to four locations, and hoist up the robot.

⚠ 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. Remove the fork pockets attached to the arm once the transportation of the robot is complete.

Model		CP110L
Hoisted up posture		
Hoisted up posture	JT1	0°
	JT2	-40°
	JT3	-37°
	JT4	0°
	JT5	0°
	JT6	0°

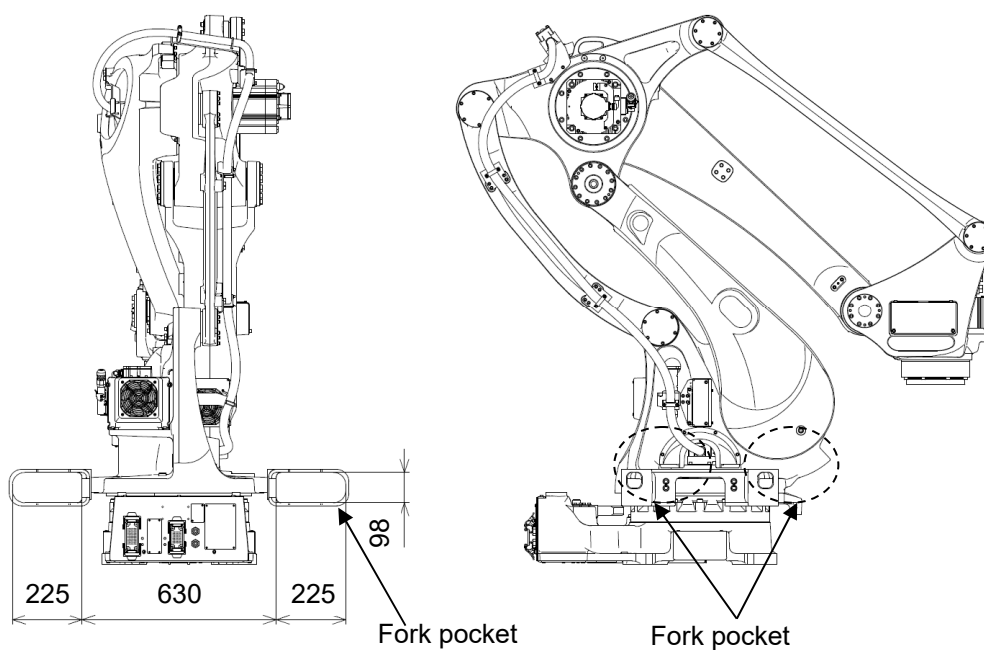
4.2 Forklift

A 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

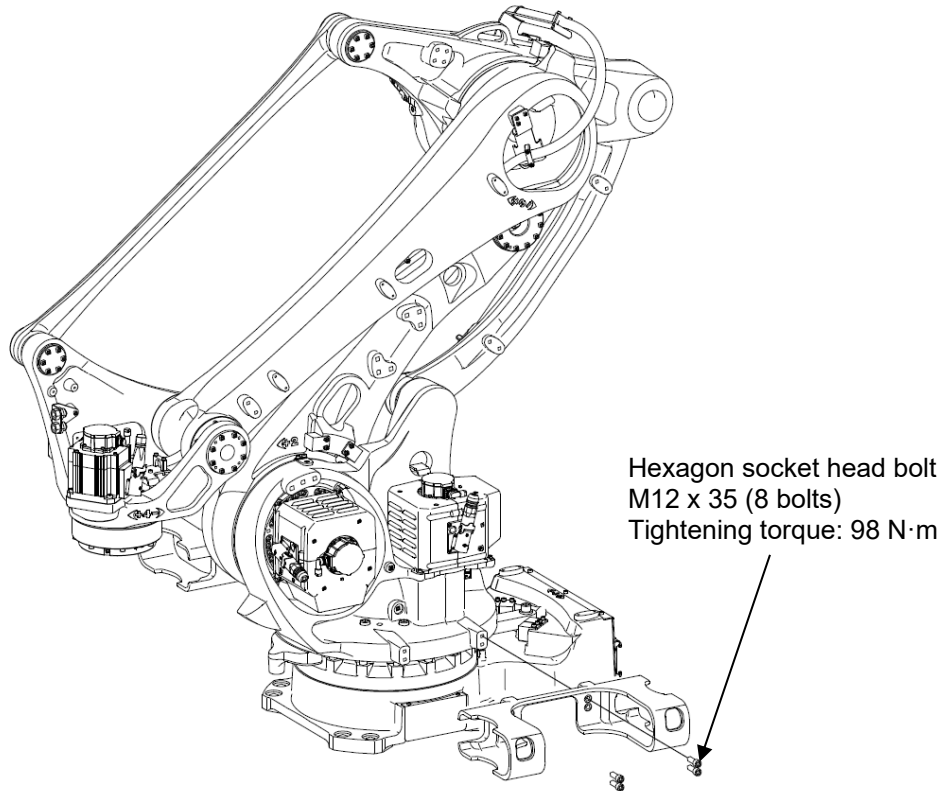
1. Check if a fork of the forklift penetrates the transportation jig sufficiently without fail.
2. When transporting robot on an inclined or rough surface, be careful to maintain balance to prevent forklift/robot from falling.
3. Remove the transportation jig attached to the arm once the installation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

  60819-5496	WARNING REMOVE THIS JIG AFTER INSTALLING ROBOT.	ATENCION RETIRE LA HERRAMIENTA DESPUES DE INSTALAR ROBOT.
	警告 この治具は、ロボット据付け後取り外すこと。	WAARSCHUWING VERWIJDER DE MAL NA HET INSTALLEREN VAN ROBOT.
	警告 此夹具，在机器人安装完成之后必需取下。	WARNUNG ENTFERNEN SIE DIE SPANNVORRICHTUNG NACH DER INSTALLATION DES ROBOTERS.
	경고 이 치구는, 로봇 설치후 떼십시오.	ATTENTION RETIRER LE DISPOSITIF APRES L'INSTALLATION DU ROBOT.
	ATTENZIONE RIMUOVA L'UTENSILE DOPO L'INSTALLAZIONE DI ROBOT.	



5 Installation Dimensions of Base Section

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

Model	CP110L
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	Robot motion	M (Inversion Moment)	T (Rotating Torque)
CP110L	When normal operation	21,700 N·m	13,800 N·m
	At emergency stop ^{*1}	29,000 N·m	18,400 N·m

*1 Stopping category: 0

See the next chapter for M and T.

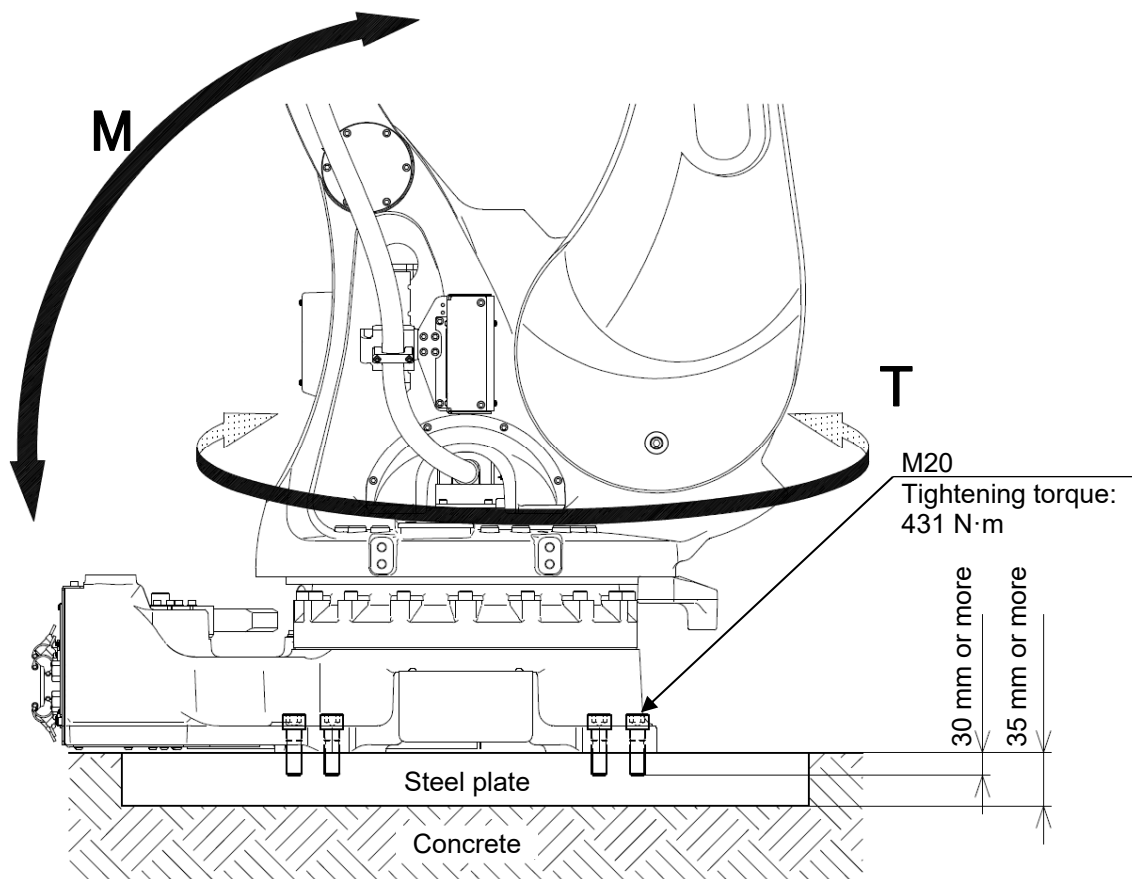
7 Installation Method

! **CAUTION**

The protection rating is ensured by covering the opening on the bottom of the robot base with the installation surface.
When creating an opening in the installation surface, conduct a risk assessment.

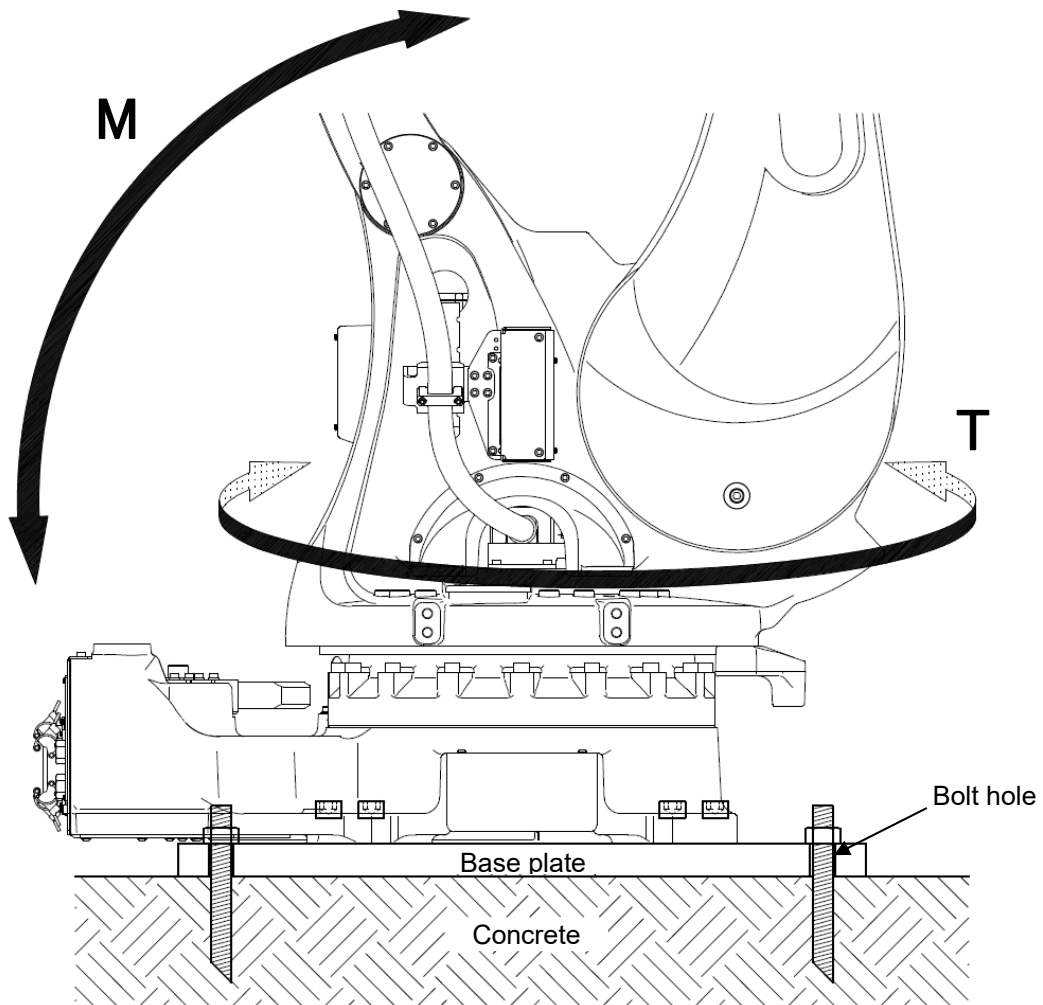
7.1 When Installing the Base Directly on the Floor

In this case, bury steel plate (Thickness: 35 mm or more) 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.

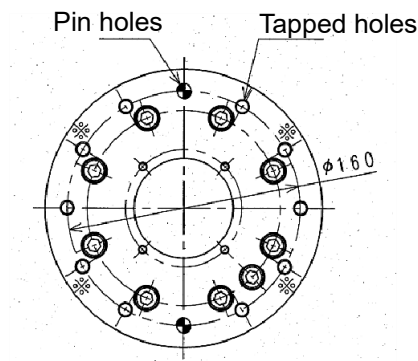


8 Mounting of Tools

⚠ WARNING

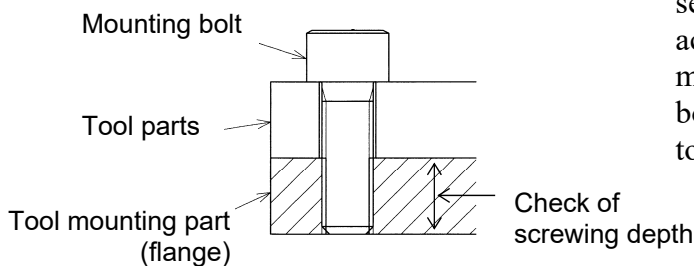
Prior to mounting tools on the robot, turn OFF the controller power switch and the external power switch. Display signs indicating clearly “Installation and connection in progress”, and lock out/tag out the external power switch to prevent personnel from accidentally turning ON the power.

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 $\phi 160$ 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	6-M10
ϕD	$\phi 160$
Screw depth	19 mm
Screwing depth	13 to 14 mm
High tension bolt	SCM435, 10.9 min
Tightening torque	56.84 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 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.

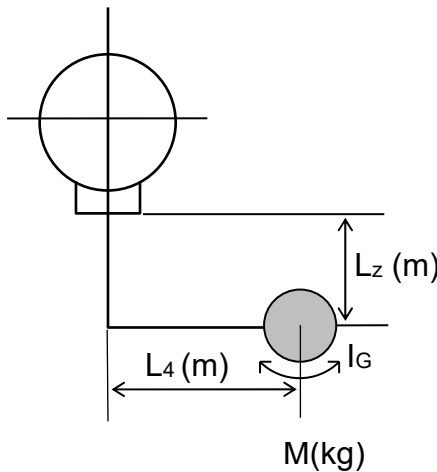


CAUTION

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): $M \leq M_{max}.$ (kg)
- Load torque: not specified
- Load moment of inertia: $I = M \cdot L^2 + I_G$ (kg·m²) $\leq I_{max}.$ (kg·m²)
- Center position of load mass (L_4, L_z): See diagrams below.
- $M_{max}.$: Rated load mass
 - CP110L : 110 (kg)
- $I_{max}.$: Rated load moment of inertia
 - CP110L : 70 (kg·m²)
- I_G : Moment of inertia around center of gravity (kg·m²)
- 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.

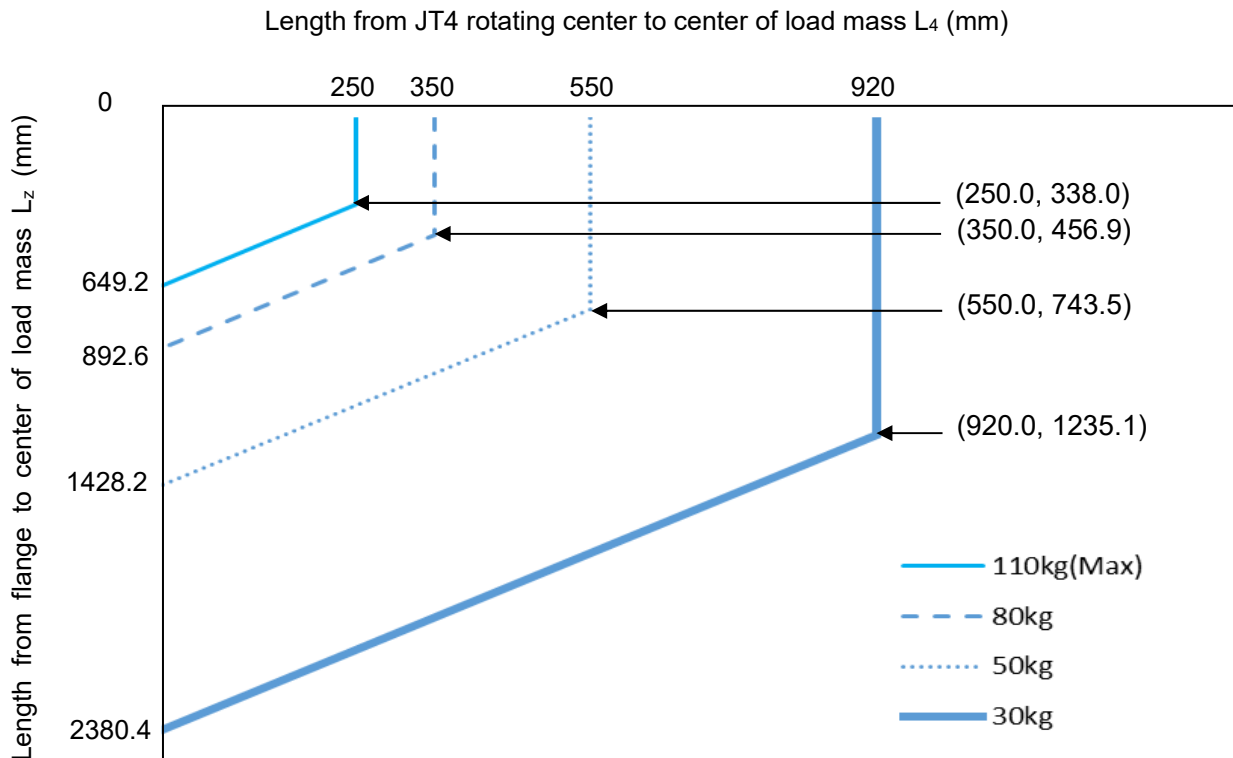
Strictly observe the following restrictions applied to wrist sections.

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 I_{max}. 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 CP110L

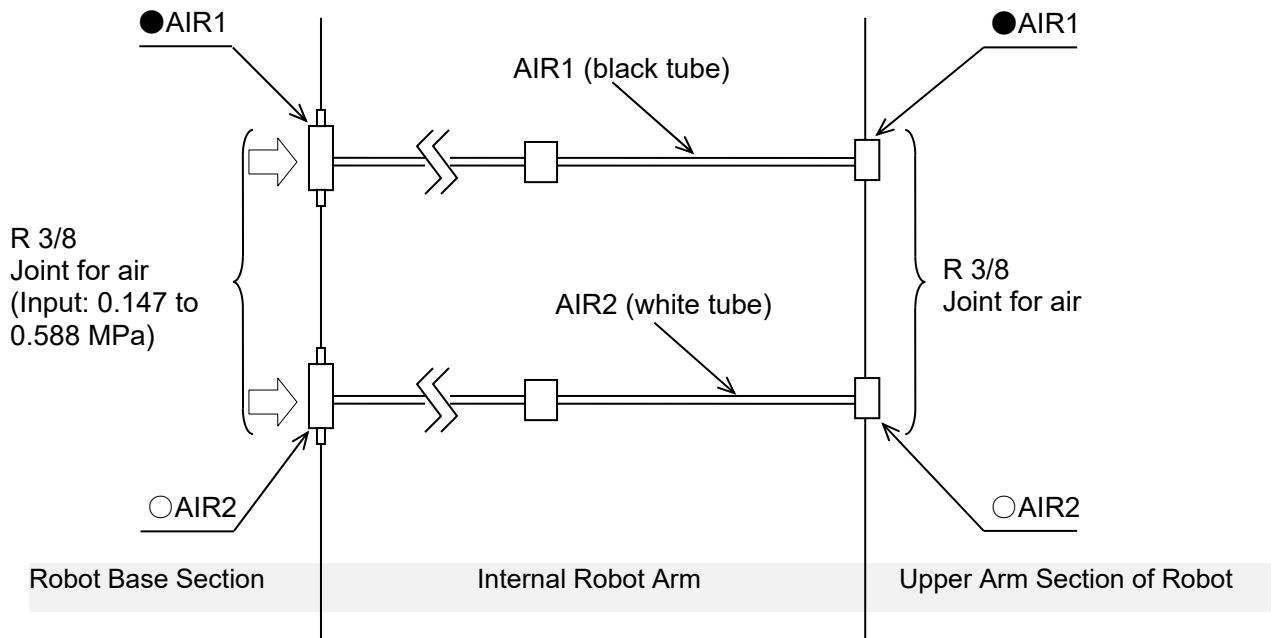


Even if the load is less than 30 kg, the center of mass should be positioned within the load diagram of 30 kg.

9 Connection of Air System

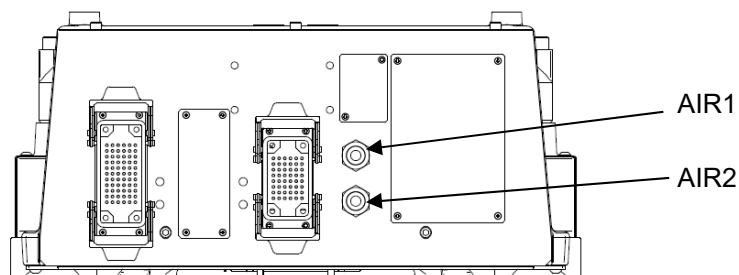
CP110L includes air piping for driving tool in the robot arm.

9.1 Air Piping Diagram



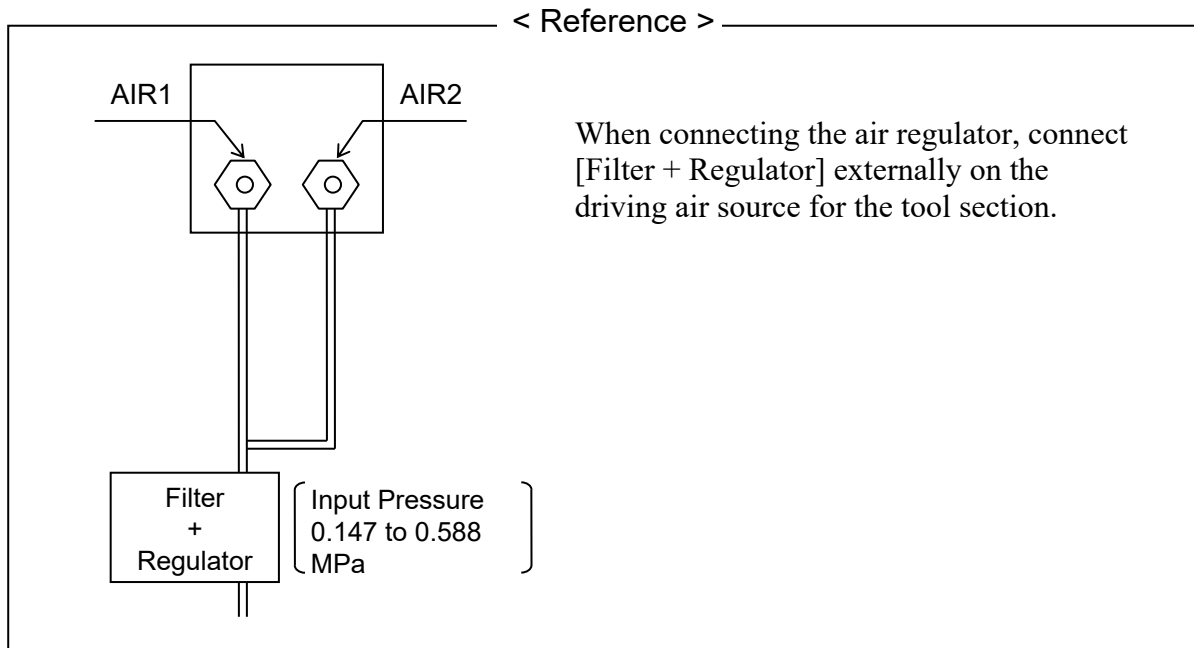
9.2 Air Supply to the Robot Arm

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



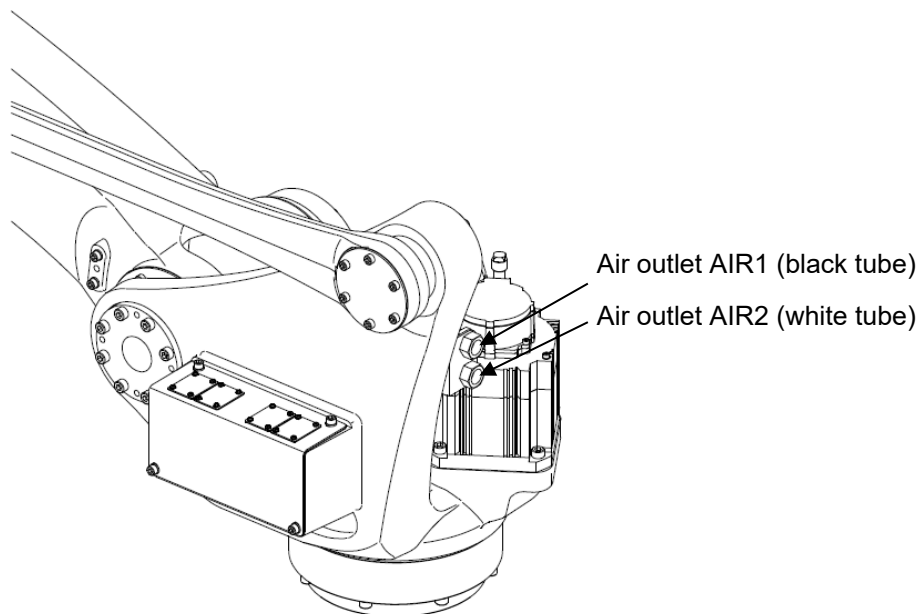
CAUTION

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



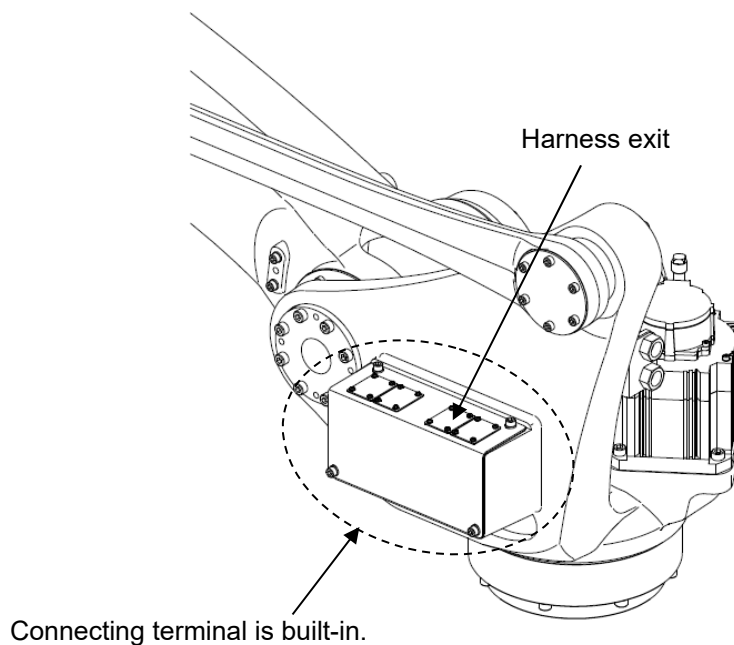
9.3 Connection to the Tool from the Air Outlet Ports

Air outlet ports are provided on CP110L robot as shown in the figure below. For CP110L, the outlet ports are R 3/8 joint ports on the wrist section.



10 Connection of Optional Harness for External Axis

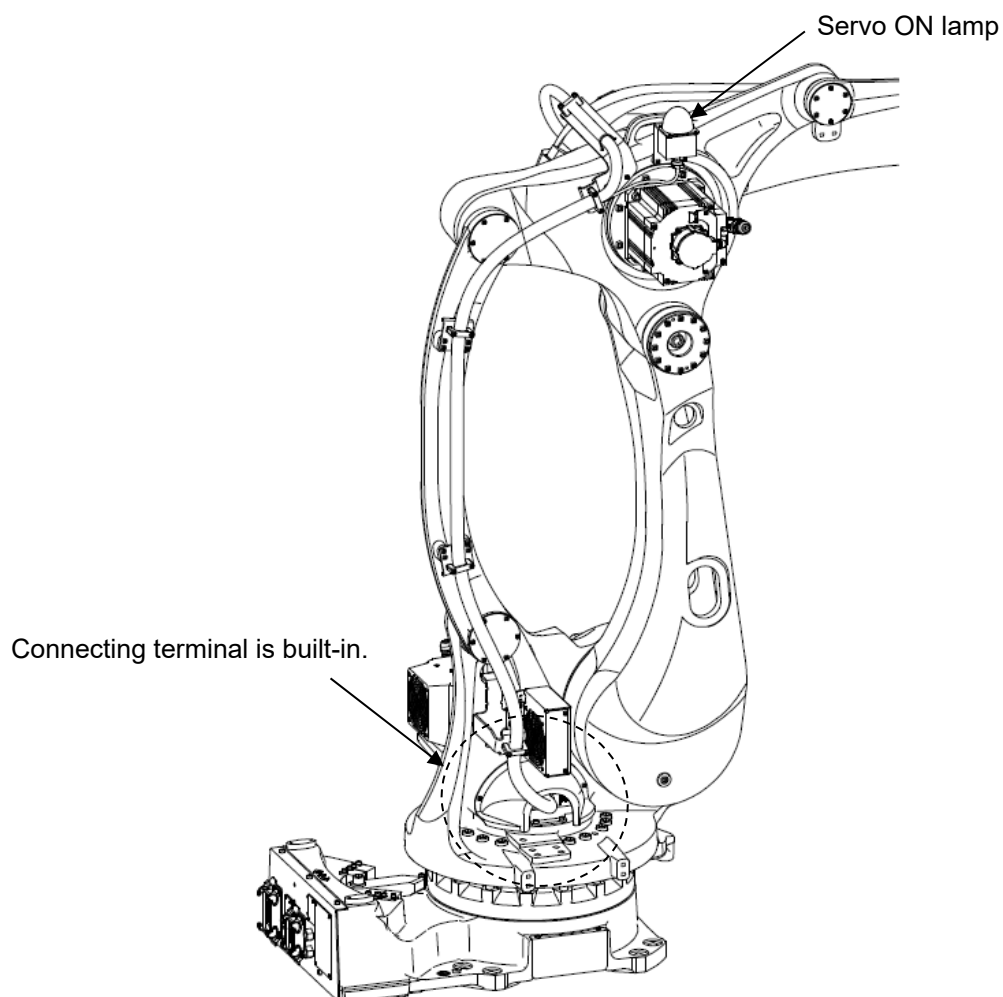
Optional motor/sensor harness/valve harness for external axis are available for CP110L, and these connecting terminals are built-in in the wrist section.



Contact Kawasaki when requesting harness connection.

11 Mounting Servo ON Lamp

Optional Servo ON lamp is available for CP110L, and this connecting terminal is built inside the base cover.



Contact Kawasaki when requesting Servo ON lamp mounting.

12 Mounting External Equipment

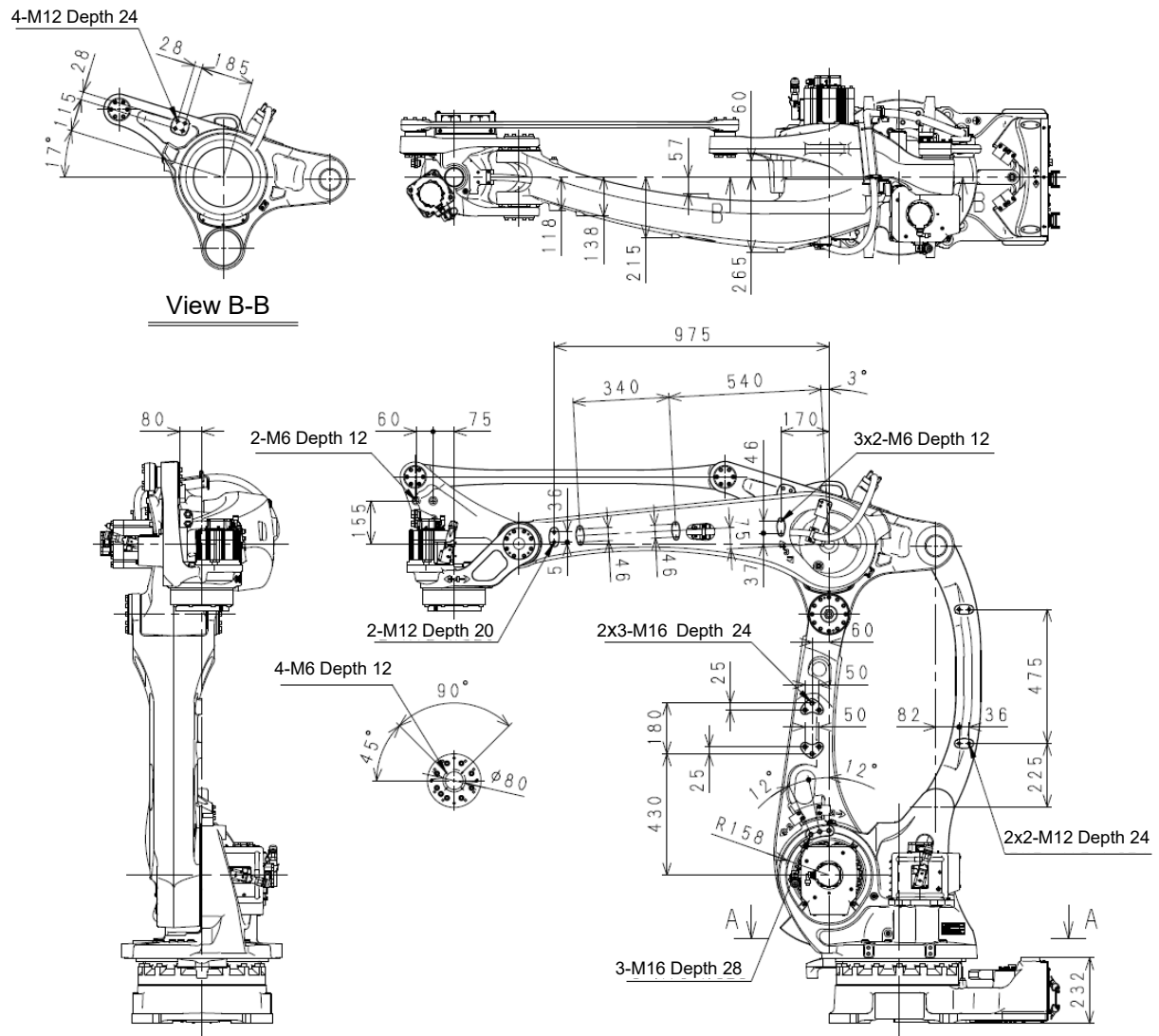
12.1 Service Tapped Hole Positions

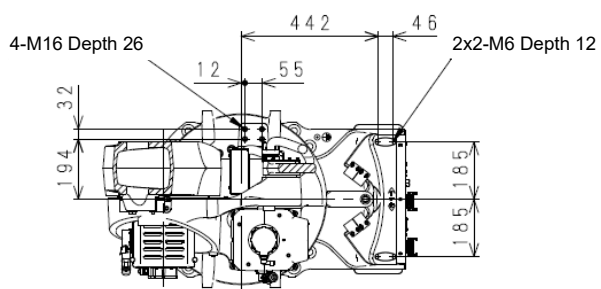
Service tapped holes shown in the figure below are available to mount wiring brackets and external equipment on each part of robot arm.

⚠ CAUTION

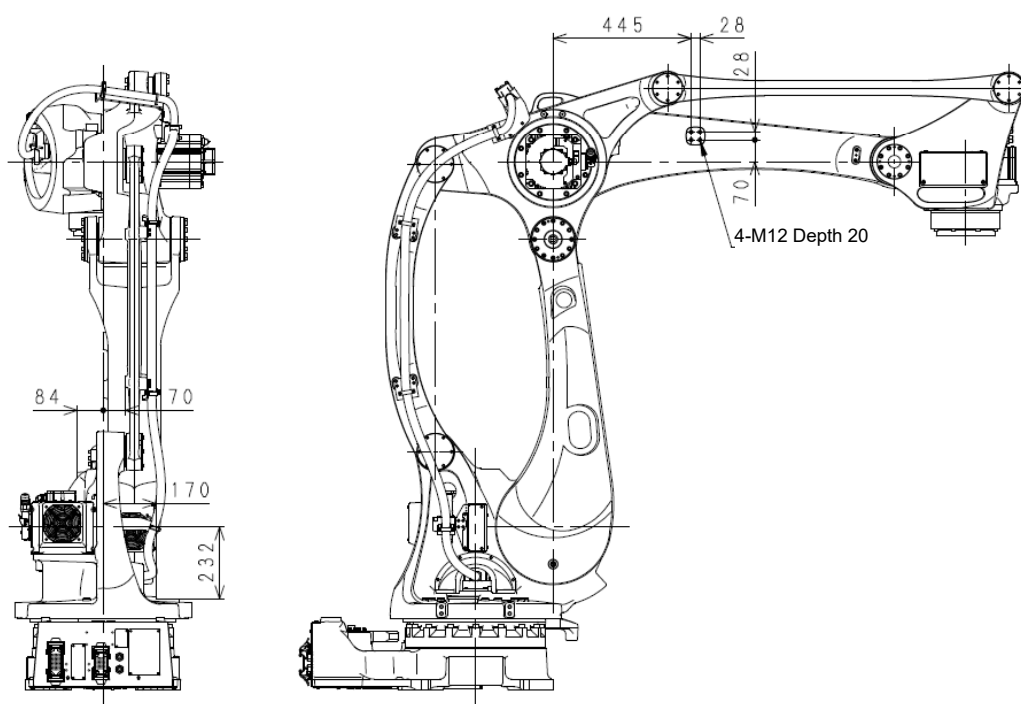
Check the robot movement very carefully and confirm that mounted brackets and external equipment do not interfere with peripheral equipment and robot arm itself.

CP110L





View A-A



12.2 Calculation of Load Caused by External Equipment

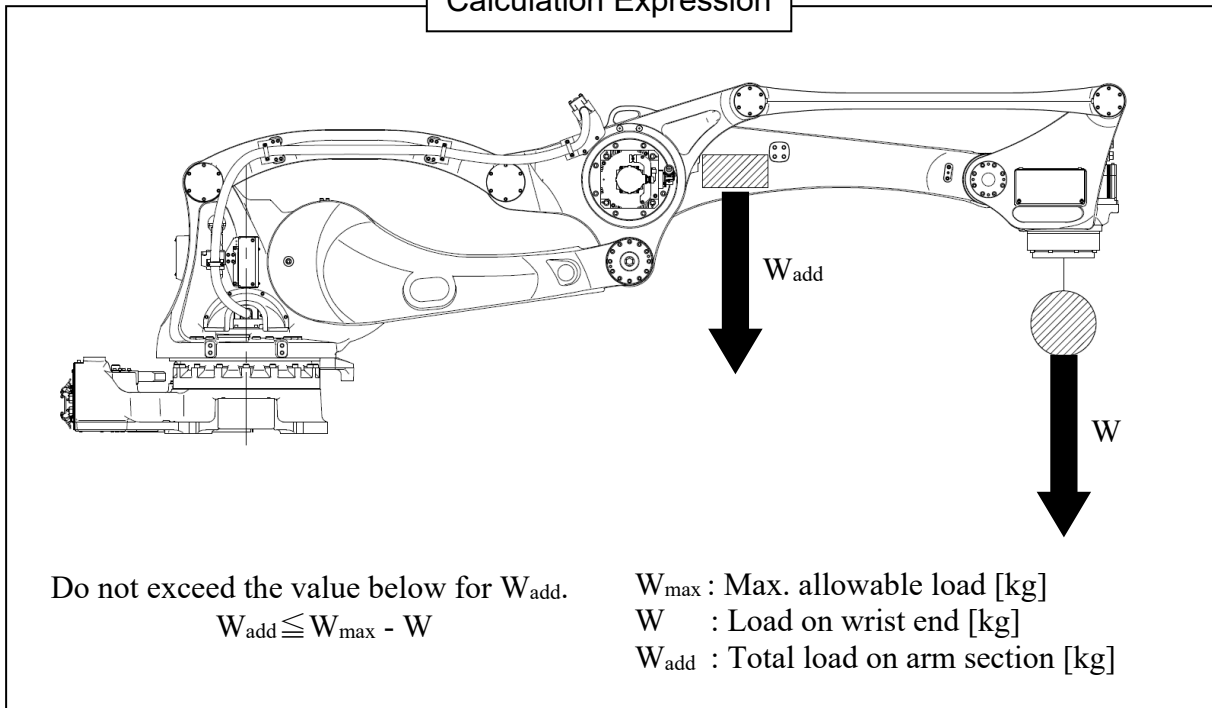
The load capacity is set for each arm model. Strictly observe the following restrictions of the load torque and load moment of inertia on arm.



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



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.

Appendix 1 Stopping Performance of Robot

This robot is controlled by the stopping method prescribed in the standard IEC60204-1. In this section, the stopping distance or angle and the stopping time by categories are shown. The stopping distance or angle and the stopping time are based on Annex B of ISO 10218-1 standard.

Stopping distance (angle): The distance or angle until the robot comes to a complete stop after the stop command is given

Stopping time: The time until the robot comes to a complete stop after the stop command is given

Calculate the stopping distance from the stopping angle of each axis considering stopping category, load, speed, extension and workpiece size shown in this section, and perform appropriate risk assessments. The values shown in this section may be different from the actual stopping distance or angle and the stopping time depending on the influence inside and outside the robot and the motion and posture at stop, so check the values before use. Avoid operation that requires frequent emergency stop by category 0. Doing so may cause the robot malfunction.

1. Definition of terms

Load: Loading mass on flange section

Speed: Speed of robot

Extension: Distance from JT1 center of rotation to TCP (tool center point)

2. JT1/JT2/JT3 stopping angle and stopping time in category 0

[Measurement conditions]

Load: Maximum load

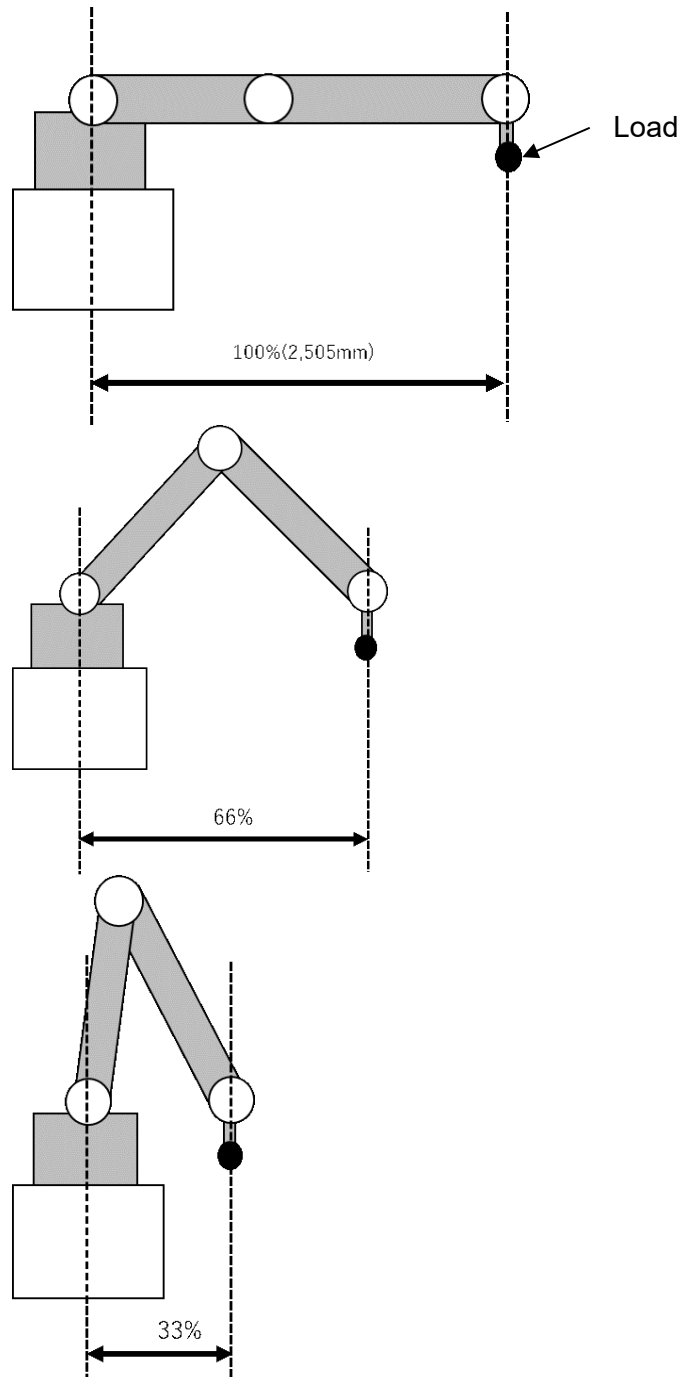
Speed: Maximum speed

Extension: Maximum extension

Axis	Stopping angle [deg]	Stopping time [sec]
JT1	26.7	0.7
JT2	19.5	0.5
JT3	17.1	0.4

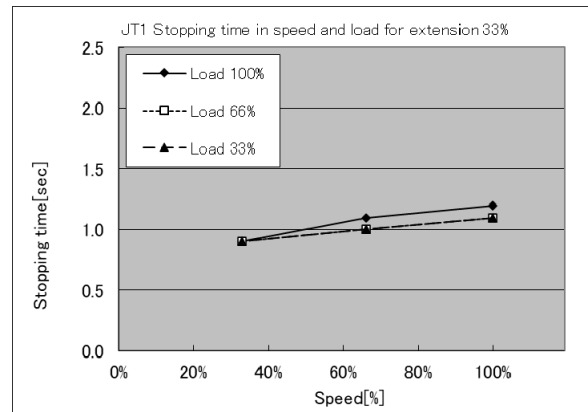
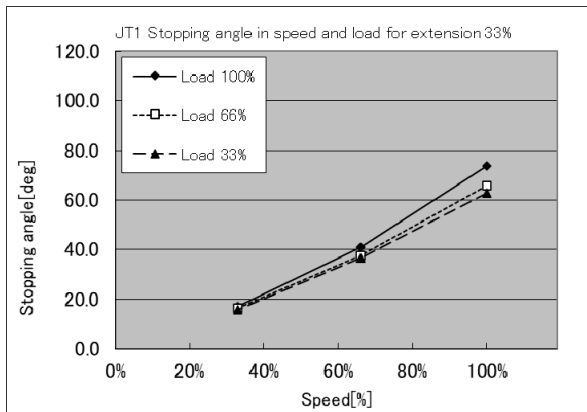
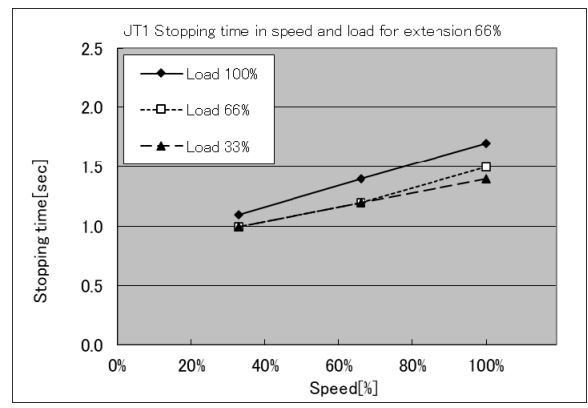
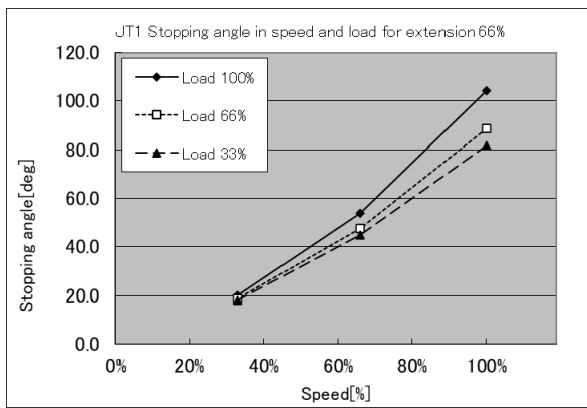
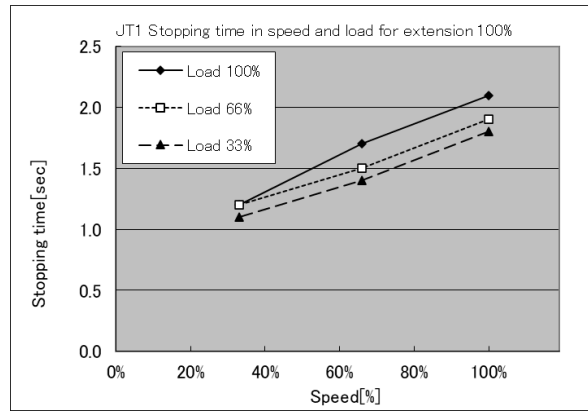
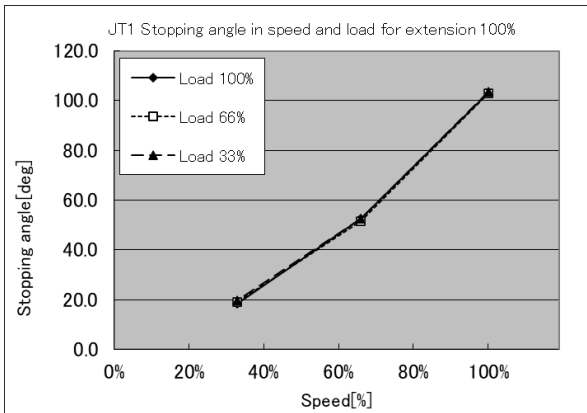
3. JT1/JT2/JT3 stopping angle and stopping time in category 1
The stopping angle and the stopping time are values for each combination when load, speed, and extension are at 33%, 66%, and 100%, respectively.

- CP110L extension diagram

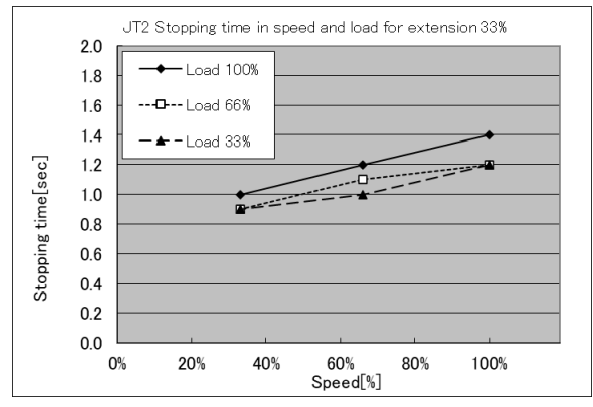
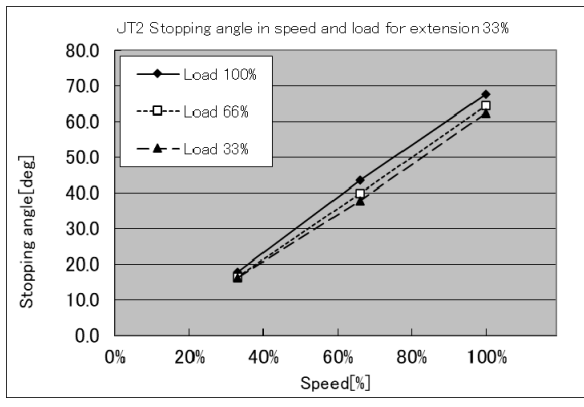
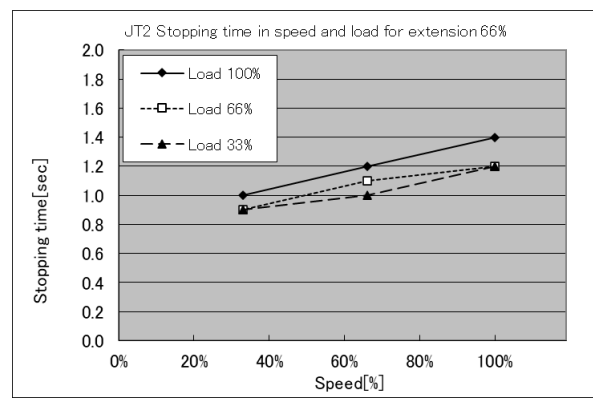
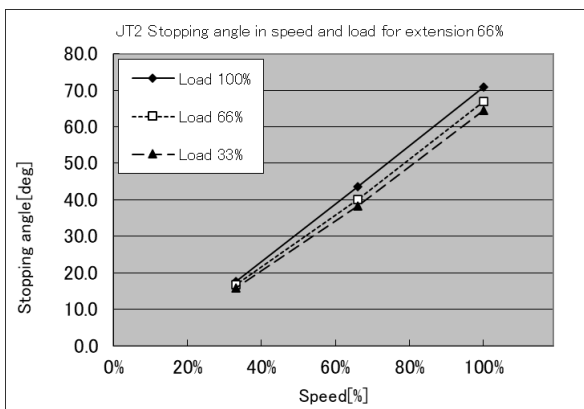
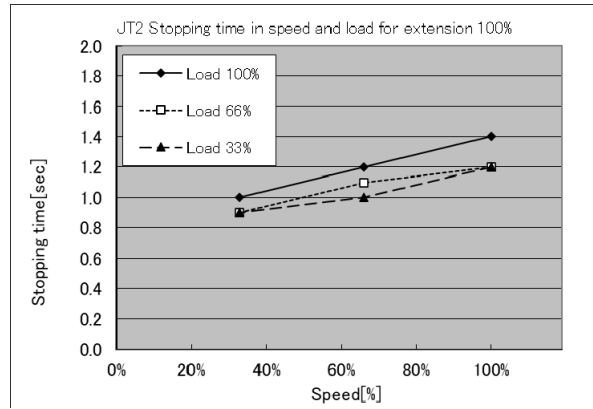
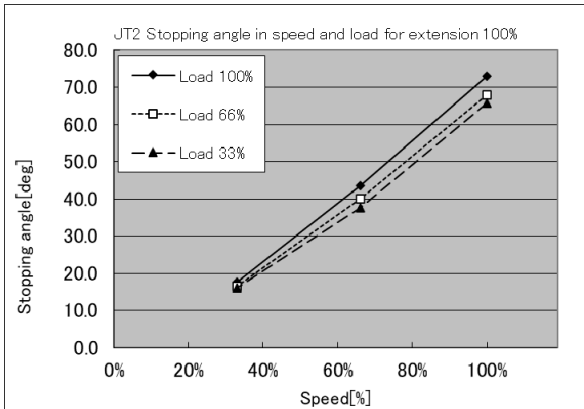


■ Stopping angle and stopping time

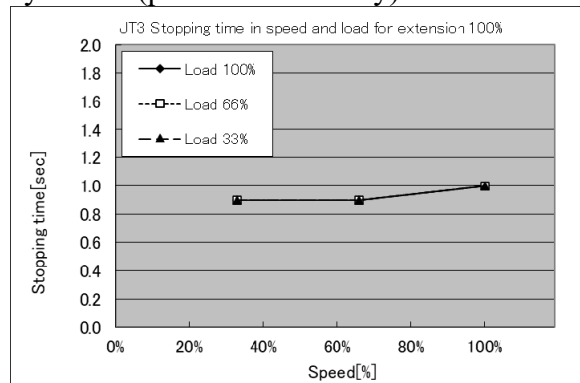
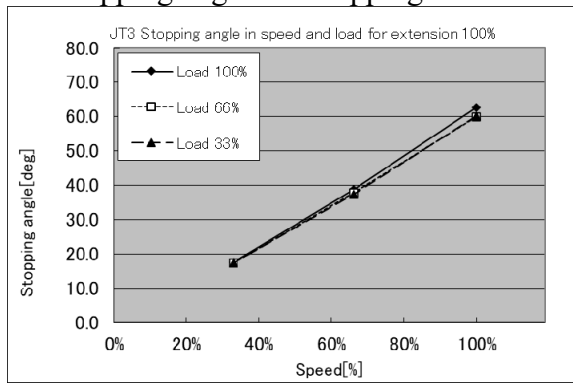
- Stopping angle and stopping time in category 1: JT1



• Stopping angle and stopping time in category 1: JT2



- Stopping angle and stopping time in category 1: JT3 (posture 100% only)





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