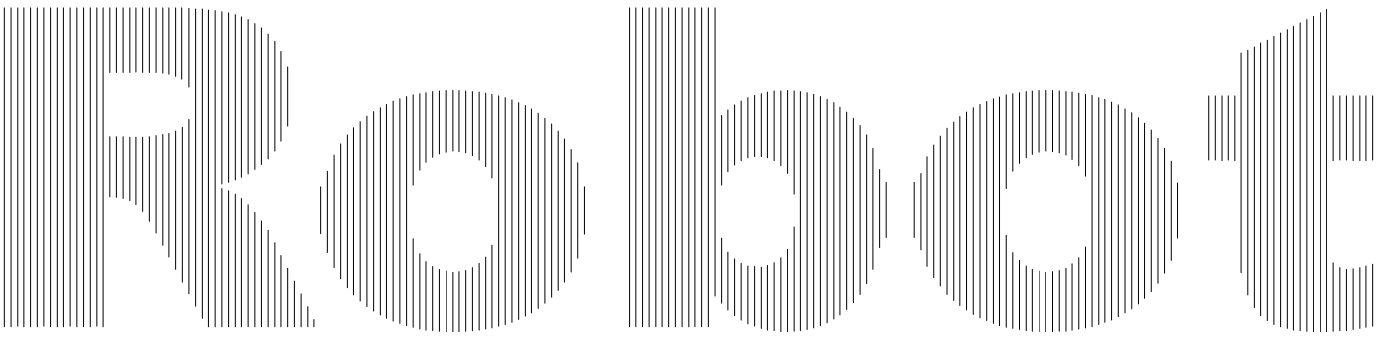
Simple and friendly

Kawasaki

Kawasaki Robot
KG264

Installation and Connection Manual



Kawasaki Heavy Industries, Ltd.

90202-1114DEA

PREFACE

This manual describes the installation and connection of Kawasaki Painting Robot KG264.

Read and understand the contents of this manual and the safety manuals thoroughly, and strictly observe all safety rules before proceeding with any operation.

This manual describes only the installation and connection of KG264 robot arm. For installation and connection of the controller and cables, see the separate manual “Installation and Connection Manual” for the controller for explosion-proof robot.

Kawasaki will not take any responsibility for any accidents and/or damages caused by operations that are based on only a limited reading of this manual.

This manual supports the following robot models.

KG264

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.

Copyright © 2009 Kawasaki Heavy Industries Ltd . All rights reserved.

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 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.**
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 the safety manual, all pertinent laws, regulations and related materials as well as all the safety explanations described in each chapter, and prepare safety measures suitable for actual work.**

CONTENTS

1.0 SAFETY

This chapter only describes safety precautions during installation and connection of the robot arm. For all other safety matters, refer to the “Safety Manual”, a separate-volume.

1.1 PRECAUTIONS DURING TRANSPORTATION AND STORAGE

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

⚠ WARNING

1. **When transporting a robot arm with a crane or a forklift, never support the robot arm manually.**
2. **During transportation, never climb on the robot arm or stay out from under the lifted robot arm.**

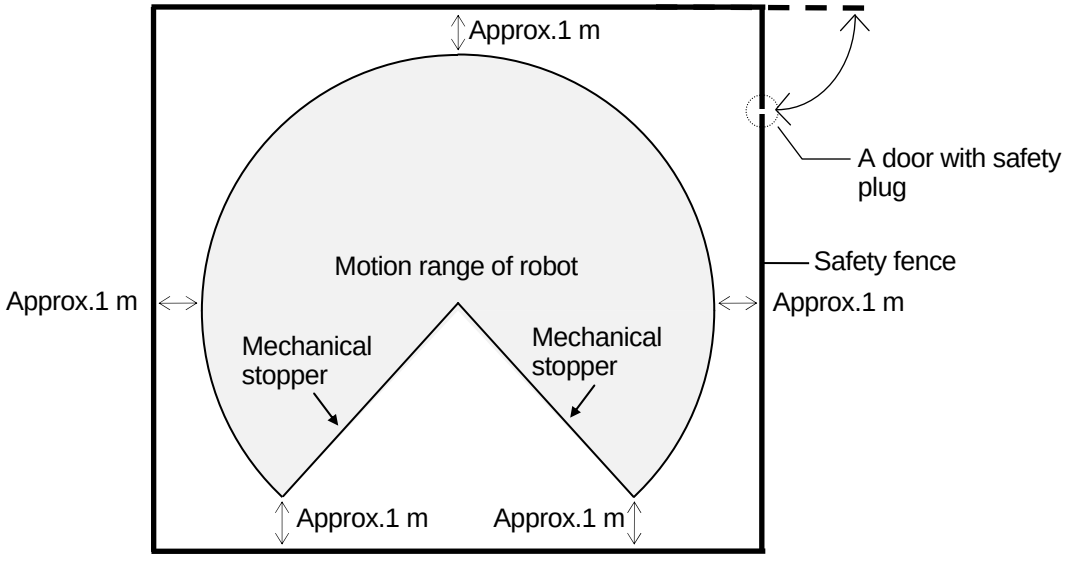
⚠ CAUTION

1. **Since the robot arm is composed of precision parts, be careful not to apply excessive shocks or vibrations during transportation.**
2. **To carry out smooth and safe installation, remove all obstacles before installing a robot arm. Clear a passage to the transportation of the robot using a crane or forklift.**
3. **When transporting or storing a robot arm,**
   - **(1) keep the ambient temperature within the range of minus 10 - 60°C**
   - **(2) keep the relative humidity within the range of 35 - 85% RH (Non condensing)**
   - **(3) keep free from excessively large shock and vibration.**

1.2 INSTALLATION ENVIRONMENTS OF ROBOT ARM

Install the robot arm in a site that satisfies all the following environmental conditions:

1. When installing on the floor, secure the levelness within ± 5 °.
2. Ensure the floor or stand provides sufficient rigidity.
3. Secure flatness so excessive force is not applied on the base unit. (If flatness cannot be achieved, insert liners and adjust flatness within 0.3 mm of the surface.)
4. Ambient temperature during operation should be within 0 °C - 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. Relative humidity should be 35 % - 85 % RH; without condensation.
6. Secure an area with very little exposure to dust, smoke, oil and water.
7. Secure an area not affected by excessively large vibrations.
8. Secure an area with minimal electrical noise.
9. Secure a place that is spacious enough for motion range of robot.
   (1) Set up a safety fence around the robot providing adequate space for the robot's maximum motion range and without causing any interference to the tools on the robot arm.
   (2) Provide an entrance door with a safety plug for the safety fence.
   (3) Follow national local standards regarding safety fence construction/function.
   (e.g. EN953, EN294, EN811, EN1088, ISO13852, ISO13854, ISO/NP14120)



[NOTE]

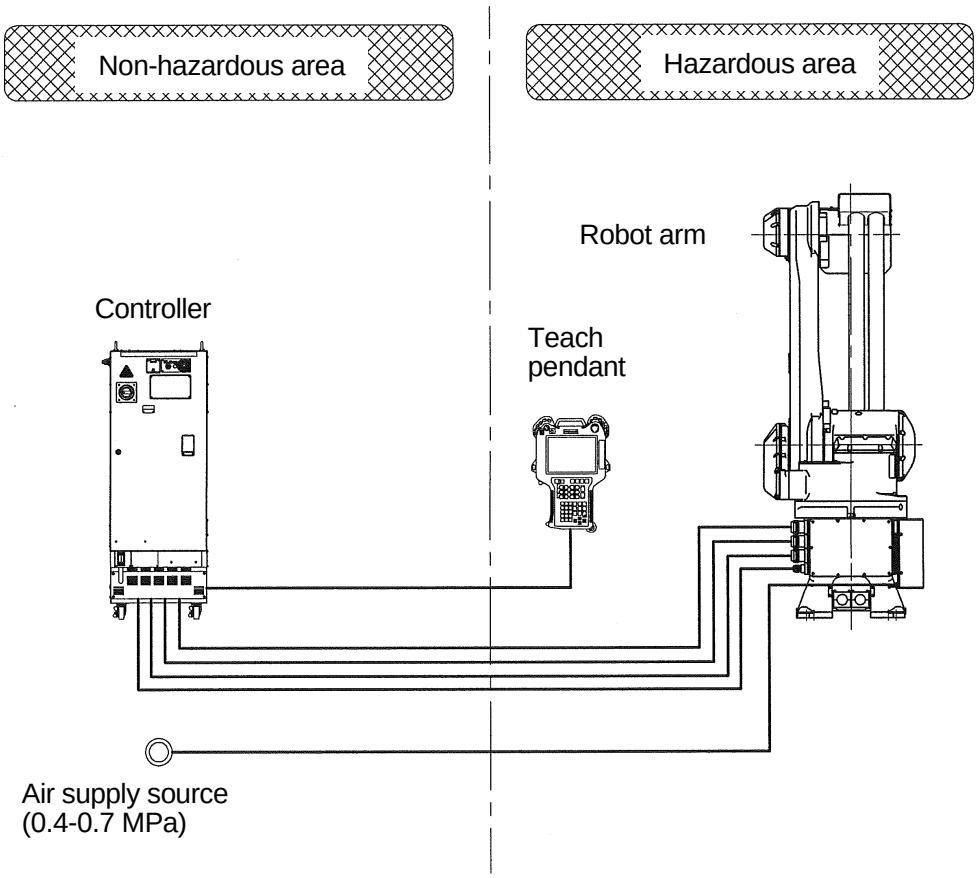
Protect sealed joints, etc. on the robot arm axes with vinyl sheets, etc. to prevent paint mist/foreign materials from entering.

1.3 CAUTIONARY INSTRUCTIONS FOR EXPLOSION-PROOF

KG264 is an explosion-proof specified robot protected by pressurized and intrinsically safe structures. Strictly observe the following instructions for safe operation.

⚠ DANGER

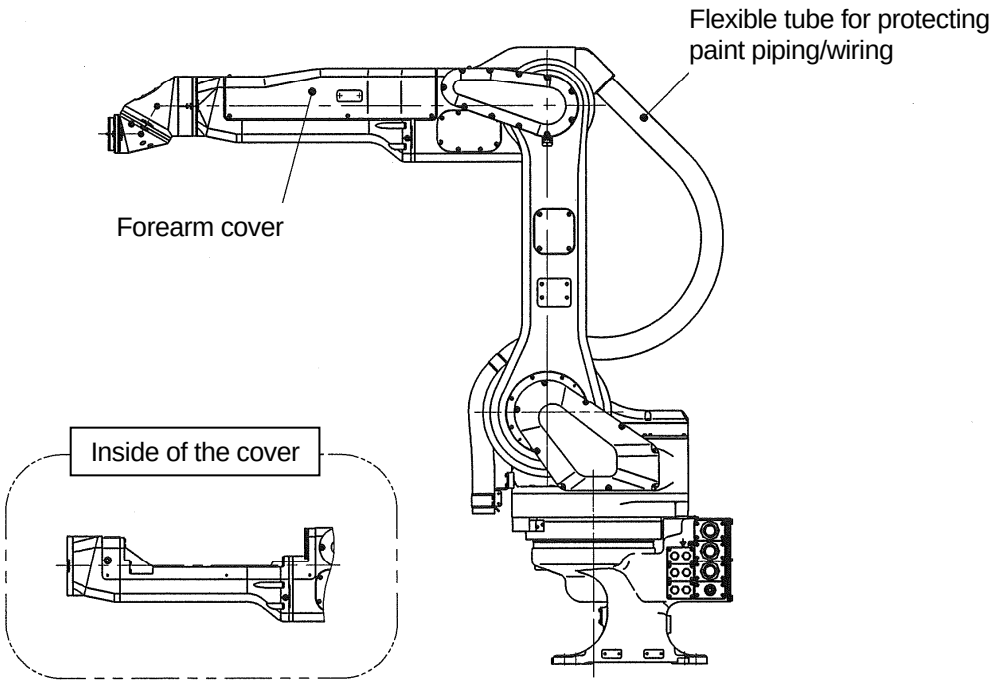
1. **This painting robot has pressurized enclosures for explosion-proof specifications. Before loosening the bolts from any pressurized enclosure, always follow instructions from the person in charge.**
   - **(1) Do not loosen tightening bolts of pressurized enclosures without instructions from the person in charge.**
   - **(2) Do not open the cover of a pressurized enclosure while electricity is supplied to robot.**
2. **Install controller in a non-hazardous area where there is no possibility of explosion. Before accessing the robot for maintenance, inspection, or for making adjustments to robot and painting system, always turn OFF controller power switch and external power switch, close the air supply valve and confirm there is no residual pressure in any air supply lines.**



The forearm cover for KG264 robot is made of FRP resin, and the flexible tube for protecting paint piping/wiring is made of polyamide resin. For safety, pay attention to the followings when working in a hazardous area where there is possibility of explosion.

⚠ WARNING

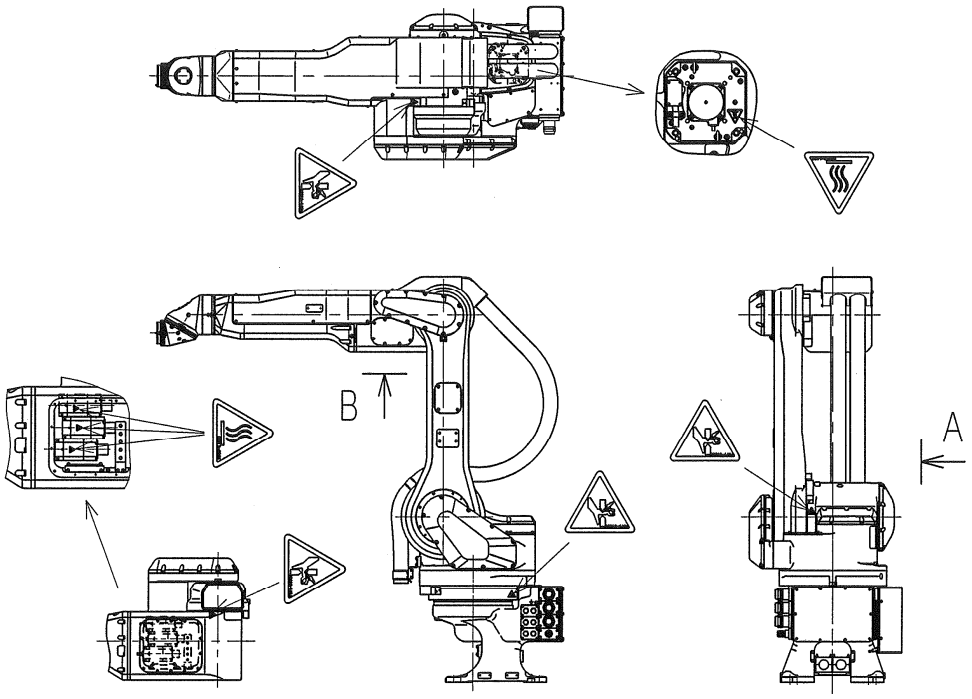
1. **If static electricity is charged in resin part, it may spark and cause ignition. Conduct working after discharging static electricity using neutralizing apparatus, etc.**
2. **During maintenance/inspection, use only anti-static tools to prevent electrification of robot parts.**



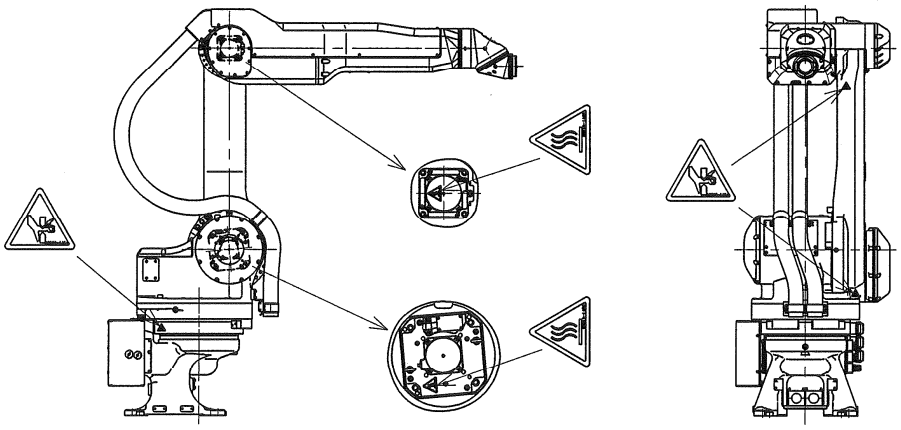
1.4 WARNING LABEL

WARNING

During operations, pay attention to the warning labels on the robot exterior as shown in the figures below.



View B



View A

Warning label for pinching

Warning label for high temperature

2.0 MOTION RANGE AND SPECIFICATIONS

Determine safety fence dimensions and location based on motion range of the robot.

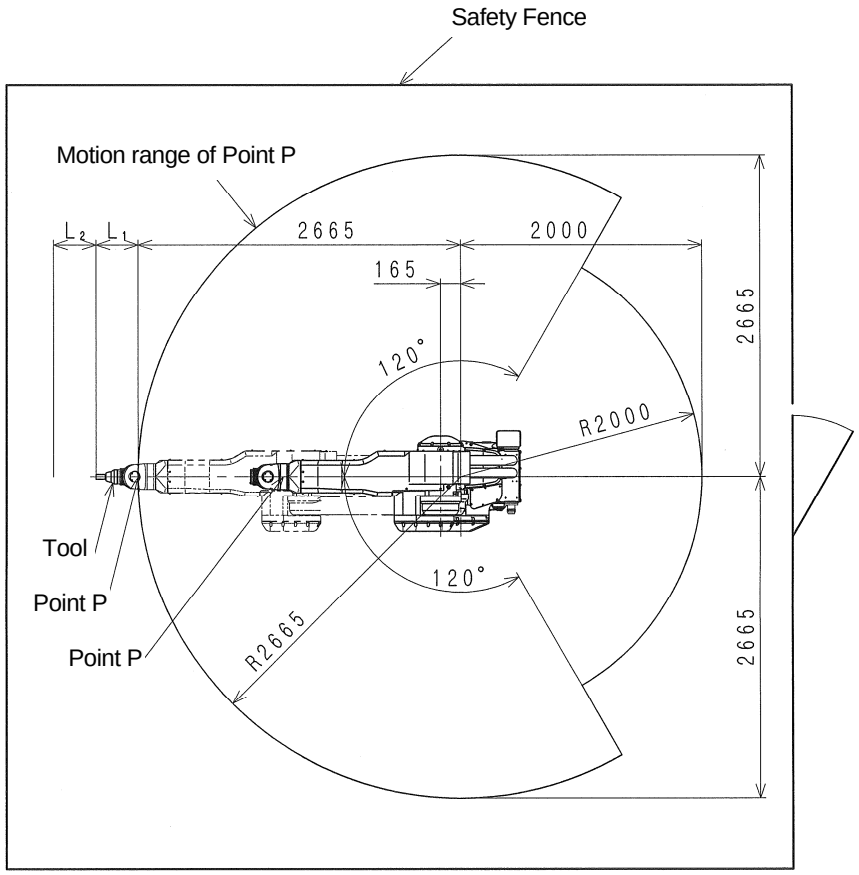
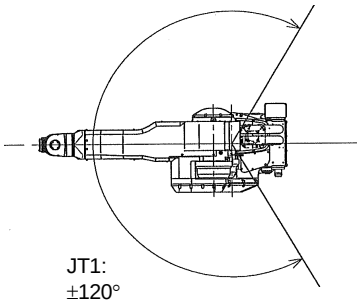
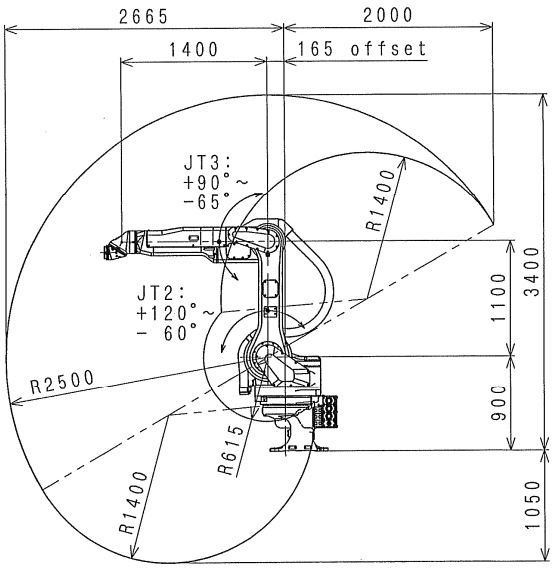


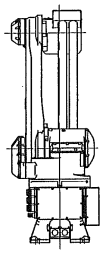
Figure above shows top view of robot, with robot mounted on shelf and facing sideways. The maximum motion range of the robot is based on point P. Safety fence dimensions must exceed the sum distance calculated as: maximum motion range of robot + L_1+L_2, where L_1 is max. distance from B to tool tip, and L_2 is distance for safety allowance

KG264

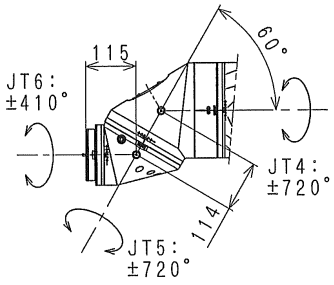
Floor mounted







Type	Articulated robot		
Degree of freedom	6		
Motion range	JT	Motion range	
	1	±120°	
	2	+120° - -60°	
	3	+90° - -65°	
	4	±720°	
	5	±720°	
	6	±410°	
Load capacity	Wrist section: 20 kg Forearm section: 30 kg		
Wrist load capacity	JT	Torque	Moment of inertia
	4	79.9 N·m	3.33 kg·m^2
	5	61.3 N·m	1.95 kg·m^2
	6	15.6 N·m	0.12 kg·m^2
Repeatability	±0.5 mm (Face of wrist flange)		
Mass	Approx. 795 kg		
Acoustic noise	79 dB (A)*		



Wrist part

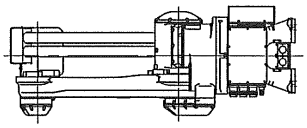
NOTE* Conditions at measurement:

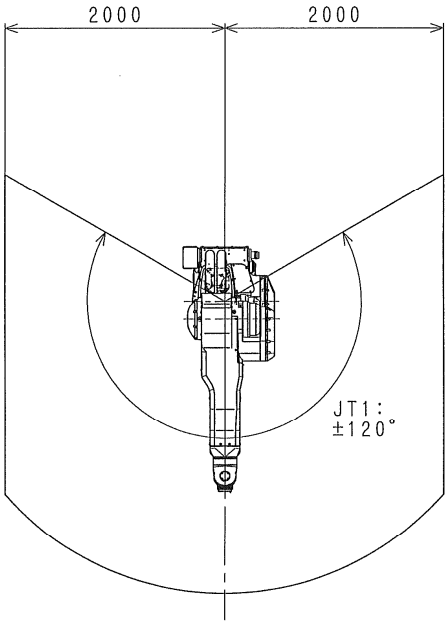
- Robot installed on the plate rigidly fixed on the floor.
- Measured at point 4000 mm from the center of base installation surface

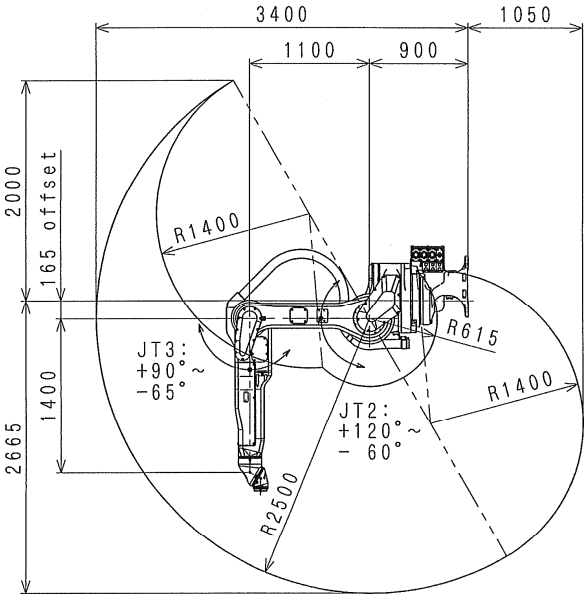
(The noise level depends on the conditions.)

KG264

Wall mounted

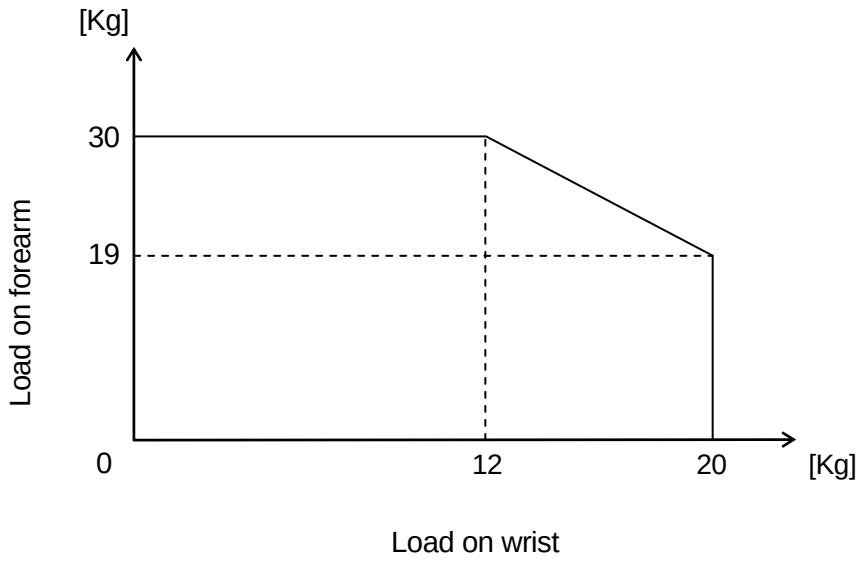






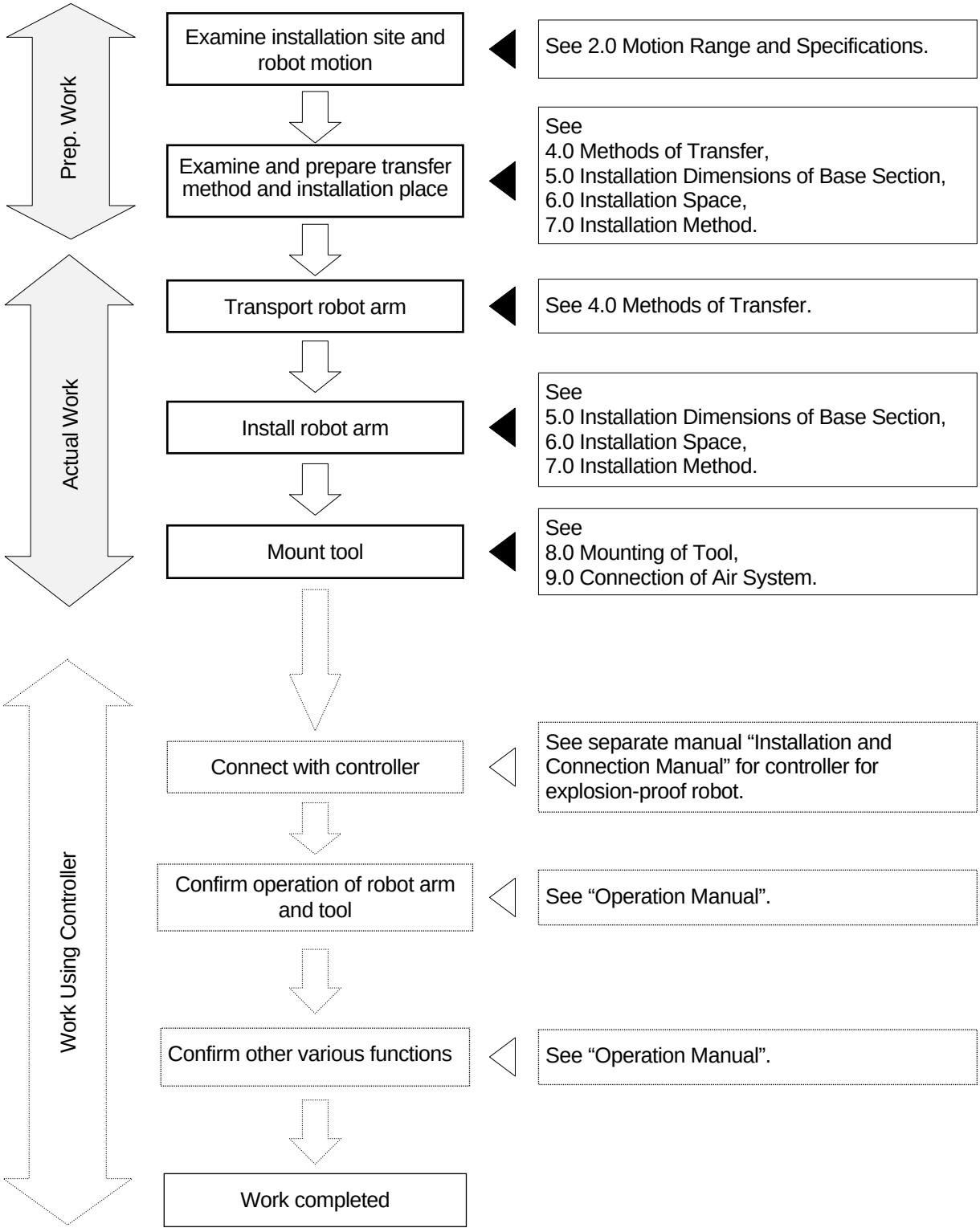
Motion limit in horizontal direction

Motion limit in horizontal direction can be extended from 2 meters to 2.2 meters if both the load on wrist axis and that on forearm are within the acceptable range shown below.



3.0 WORKFLOW FOR ARM INSTALLATION & CONNECTION

This flowchart covers only installation of robot arm. For details on installation and connection of controller, see the separate manual for controller.



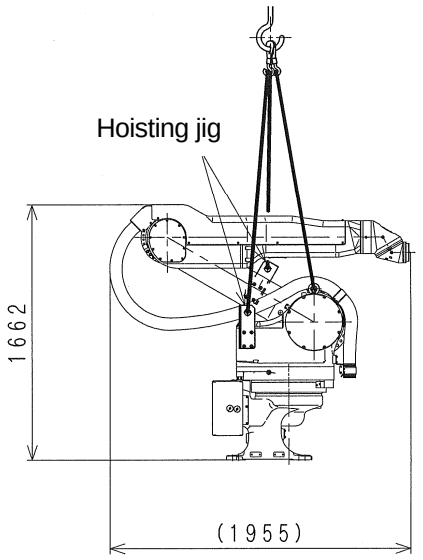
4.0 METHODS OF TRANSFER

4.1 WIRE SLING

Lift the robot by fastening the wires between the M20 eyebolts on the robot arm and the hoisting jig as shown in the figure below. Remove the hoisting jig after working.

⚠ WARNING

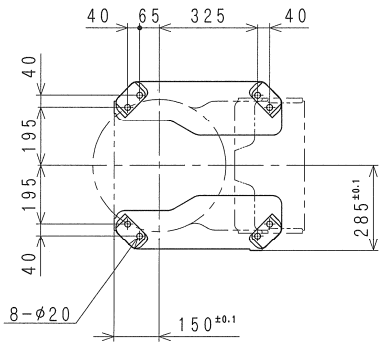
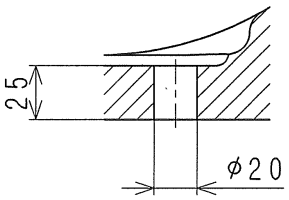
1. **Adjust the length of wire using chain block, etc. because the height of hoisting jig differs from that of eyebolt. Do not lift the robot using only one hoisting jig.**
2. **When lifting up robot, be careful as robot may lean forward/backward/ left/right depending on the robot posture. Be sure to hoist the robot in the specified hoisting posture on the following pages, otherwise it may swing excessively or the sling may interfere with other objects, resulting in damage. In places where sling touches the arm, protect arm with board, cloth, etc.**

Model		KG264
Hoisted posture*		
Hoisting posture	JT1	0 °
	JT2	-60 °
	JT3	-60 °
	JT4	0 °
	JT5	0 °
	JT6	0 °

NOTE* Consult Kawasaki for the hoisted posture when installing a robot on wall.

5.0 INSTALLATION DIMENSIONS OF BASE SECTION

When installing the robot arm, fix it by using high-tension bolts and flat washers in the bolt holes on the base section.

Model	KG264
Dimensions of base installation section	
Cross-section of installation bolt hole	
Bolt holes	8- ϕ 20
High tension bolts	8-M16 Material: SCM435 Strength level:10.9 or more
Tightening torque	235 N·m
Inclination	Within ±5 °
Plain washer	Material: S45CⒽ Hardness: HRC38-45 Thickness: 4.5 mm Part No: RHTWM1645

⚠ CAUTION

Be sure to install the arm on a surface with flatness of 0.3 mm or less, otherwise robot arm may suffer damage.

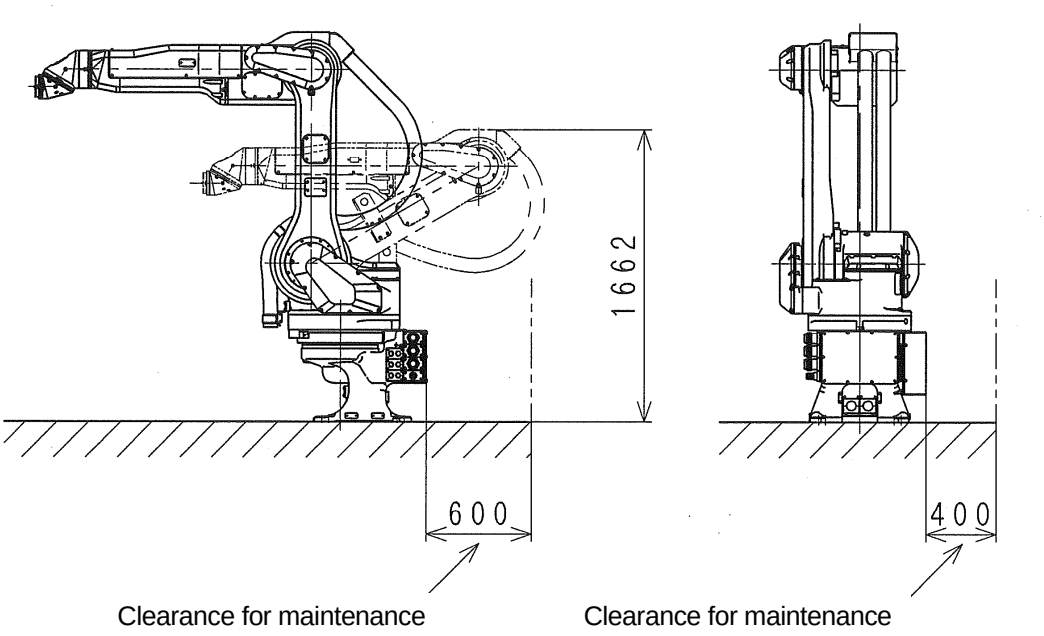
6.0 INSTALLATION SPACE

Secure the installation space for robot arm as below.

For maintenance purposes, leave at least 600 mm clearance behind the robot arm and at least 400 mm on sides of the base.

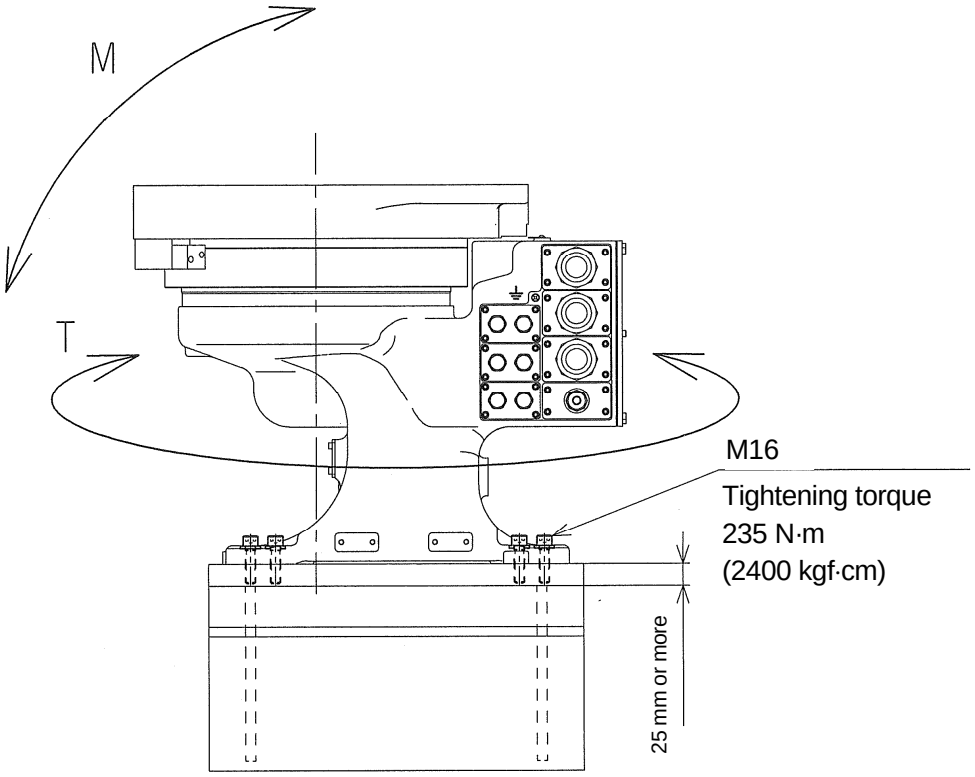
⚠ CAUTION

Consider the maintenance space shown in the figure below in robot arm installation. For installation space of safety fence, refer to Motion Range and Specifications.



7.0 INSTALLATION METHOD

When the robot base is installed on the steel mount, the thickness of the steel plate must be 25 mm or more. The steel mount must be fixed on the floor as firmly as possible to withstand the reaction forces (M, T) from the robot arm.



Model	KG264
M (Inversion moment)	27000 N·m
T (Rotating torque)	23000 N·m

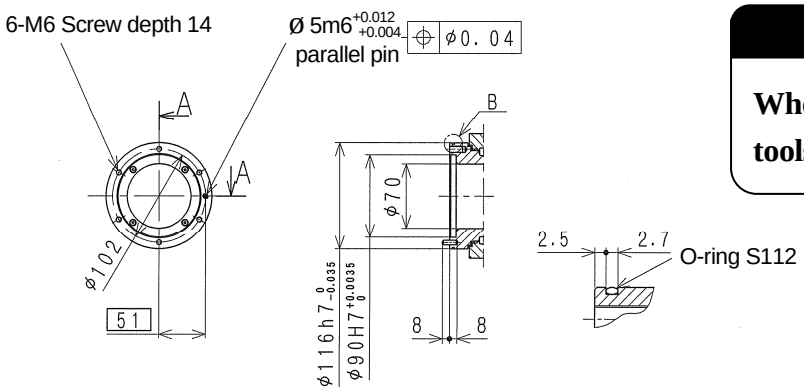
8.0 MOUNTING OF TOOLS

WARNING

When mounting tools on the robot, always turn OFF controller power switch and external power switch. Display signs indicating clearly "Inspection and Maintenance in progress". Lockout/tagout the external power switch to prevent personnel from accidentally turning on the power.

1. Dimensions of wrist end (flange face)

A flange is provided for mounting of tools at the end of robot arm. Tighten mounting bolts using the tapped holes on pitch circle diameter ϕ 102 shown below. Also, use the pin and spigot hole for positioning tools.



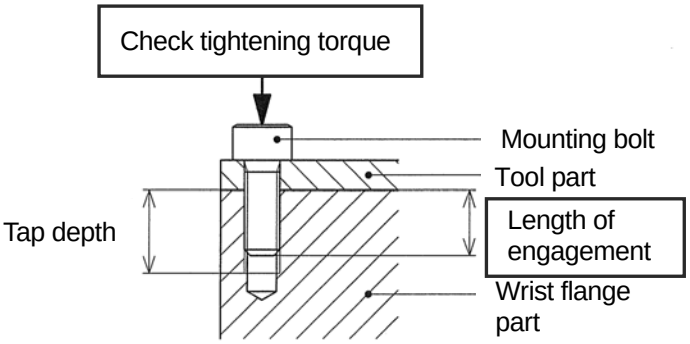
Cross-section A-A Details of B

CAUTION

When detaching or replacing the tools, also replace the O-ring.

2. Specification of mounting bolts

Select the length of mounting bolt according to the tap depth in wrist flange so that the specified screwing engagement can be attained. Also screw high tension mounting bolts into the tapped holes and tighten via specified torque shown below.



Model	KG264
Tap holes	6-M6
P.C.D. of tap holes	ϕ 102
Pin	ϕ 5m6 Length 8
Spigot shaft	ϕ 116h7
Tap depth	14 mm
Length of engagement	9-12 mm
High tension bolts	SCM435, 10.9 or more
Tightening torque	12.0 N·m

CAUTION

If tightening depth exceeds the tap depth, mounting bolt reaches the bottom and tool cannot be fixed safely to flange.

3. Calculating the load on wrist axis

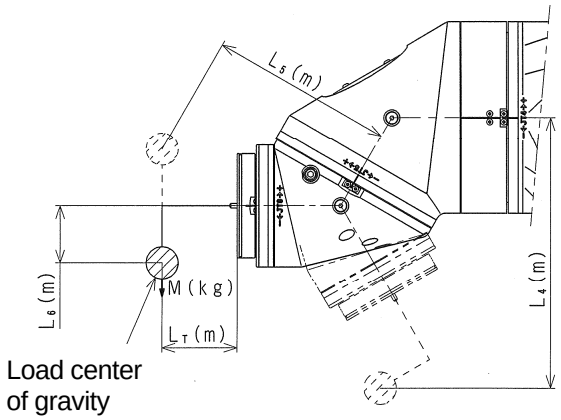
(1) The maximum load capacity of the robot is specified per robot model.
(2) Strictly observe the limiting conditions for load torque and load moment of inertia around each wrist axis (JT4, JT5, JT6) as shown below.

WARNING

Exceeding the specified load capacity may cause deterioration in motion performance and shorten the life of robot. The specified load capacity includes the mass of all attachments such as spray gun, gun bracket, piping/wiring, etc. If total mass exceeds the capacity specification, consult Kawasaki before starting operations.

The load torque and load moment of inertia are evaluated by the following formulae.

Formulae



Load mass: $M \leqq Mmax.(kg)$

Load torque: $T=9.8 \cdot M \cdot L(N \cdot m)$

Load moment of inertia: $I=M \cdot L^2+I_G(kg \cdot m^2)$

M: Load capacity

Mmax.: 20 kg

I_G: Load moment of inertia around center of gravity

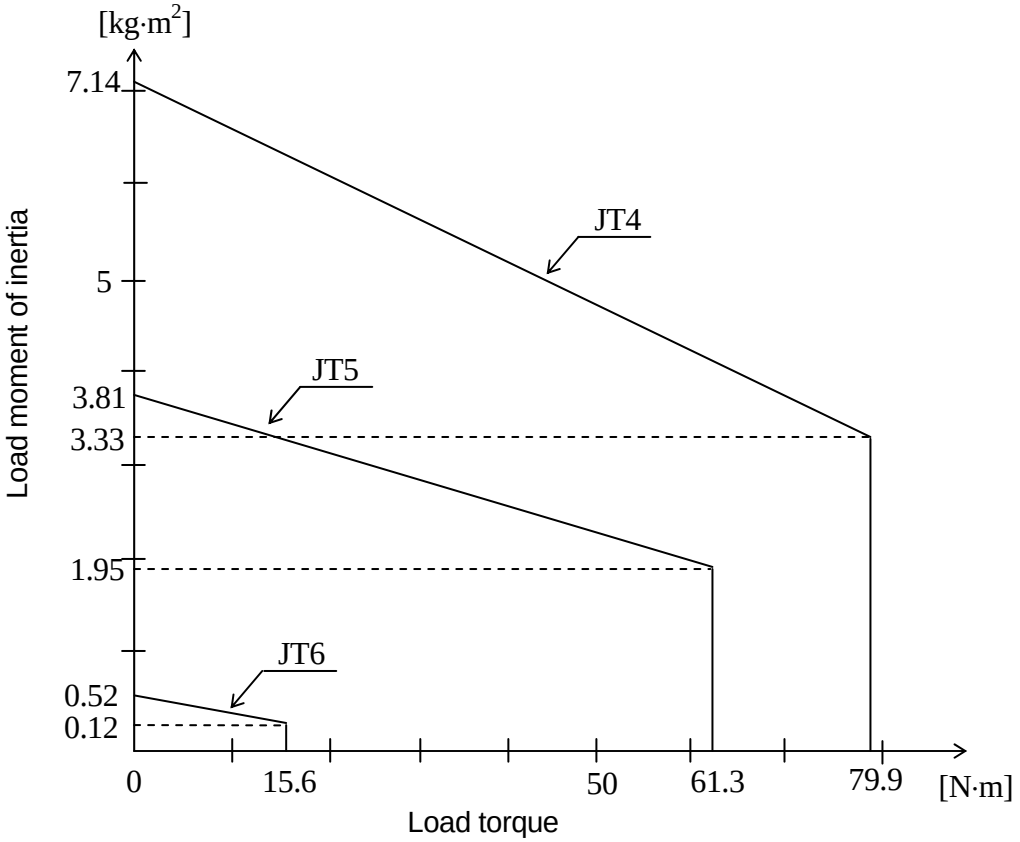
$L_{(4\text{-}6)}$: Length from center of rotation axis to load center of gravity (Unit: m) (See figure left)

$L_4= L_T \cdot \sin 60° + L_6 \cdot \cos 60° + 0.195$ (m)

$L_5= L_T \cdot \sin 60° + L_6 \cdot \cos 60° + 0.100$ (m)

Adhere to the following limiting conditions for the load torque and the load moment of inertia around each wrist axis.

KG264



4. Load capacity of the forearm

For load on forearm, obey below conditions. Load mass of parts mounted inside forearm is included in spec.

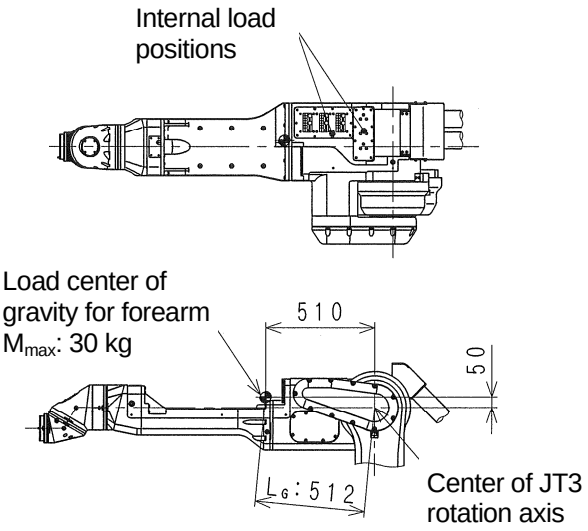
Load conditions of the forearm

- Load mass:M≦Mmax (kg)
- Load position: M・L≦Mmax・L_G

L: Length from center of JT3 rotation axis (mm)

Mmax: 30 kg

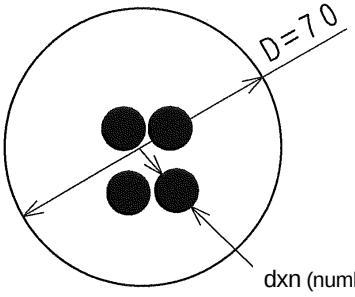
L_G: 512 mm



5. Paint wiring/piping

5.1 Hose(s) housed in the wrist

(1) Inside diameter of hollow wrist is ϕ 70.
The recommended volume ratio of the housed hose(s) is less than 25 %.*



$$\text{volume ratio} = \underbrace{\frac{d^2}{4}\pi n}_{\text{Area of hose(s)}} \div \underbrace{\frac{D^2}{4}}_{\text{Area of wrist hollow}} \pi \times 100[\%]$$

CAUTION

As calculated above, if sum cross-sectional area of the hose(s) exceeds the 25 % of cross-sectional area of the wrist hollow, hose lifetime will shorten. Also, even if sum volume ratio is less than 25 %, hose lifetime may become short depending on posture/angle of the wrist. Therefore, fully examine and test the hose(s) and their arrangement in wrist before starting operations.

NOTE* Consult Kawasaki before starting operations if volume ratio exceeds 25 % or when using a hose with ϕ 12 or greater diameter.

(2) Nylon is the recommended material for the enclosed hose.

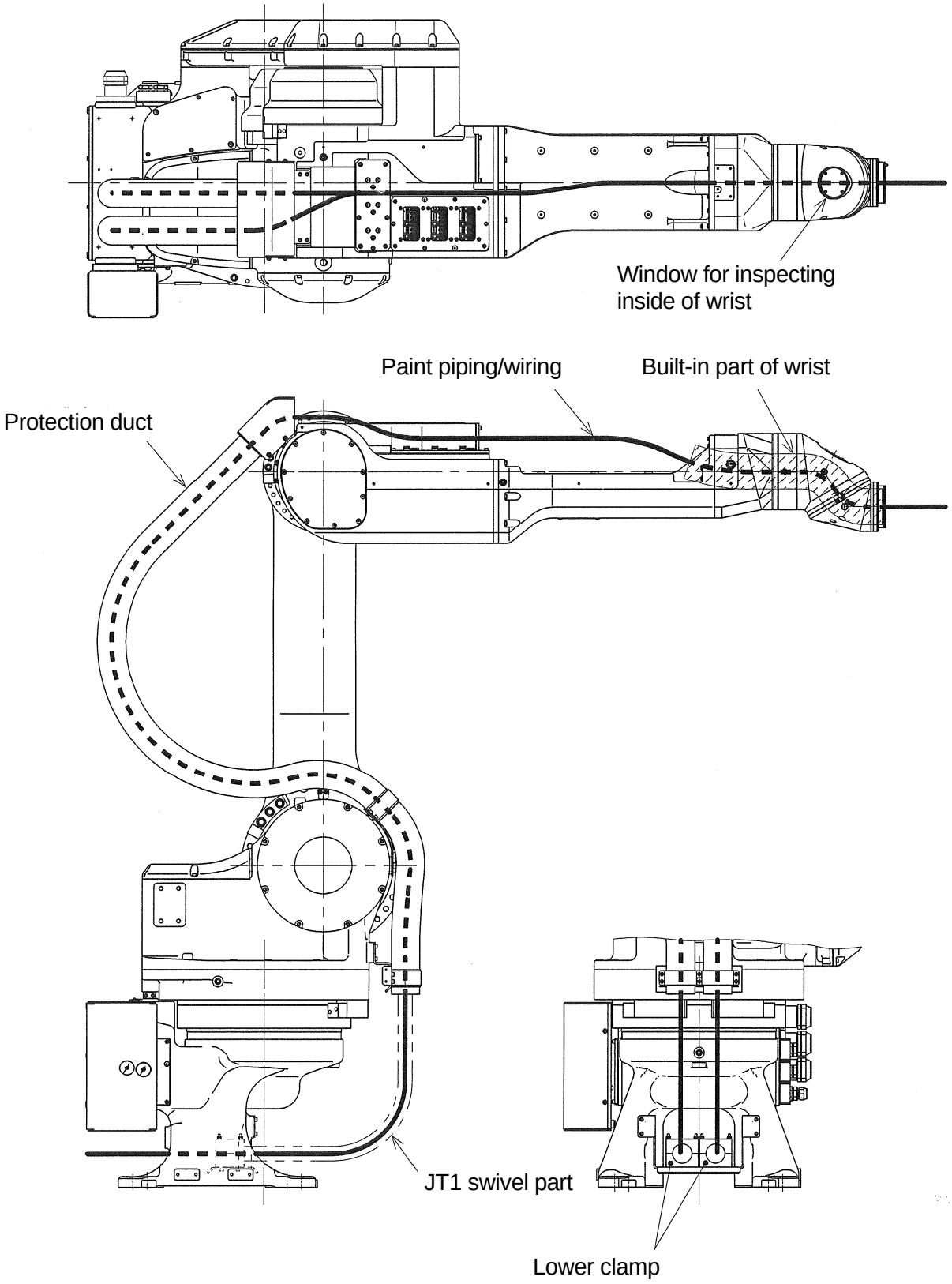
CAUTION

Using a non-nylon hose may significantly reduce hose lifetime.

(3) When installing the hose in the wrist, always apply lubricants, such as vaseline etc., to the entire hose. Inspect the housed hoses regularly** and replace them when any indication of failure or damage is found.
Recommended inspection period: every 500 hours
Replacement period of hoses (estimated): every 10000 hours
NOTE** Also, whenever hoses are inspected, apply lubricants to the housed hoses.

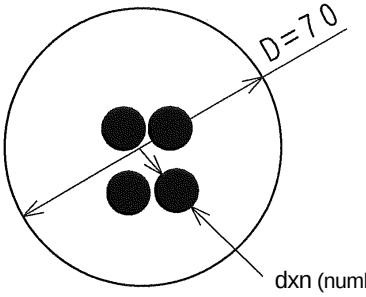
[NOTE]

The above replacement period is a recommended standard and is not meant as a period guaranteeing the life of the hoses.


Window for inspecting
inside of wrist
Paint piping/wiring
Built-in part of wrist
Protection duct
JT1 swivel part
Lower clamp

5.2 Hose(s) housed in the protection duct

(1) Inside diameter of protection duct is ϕ 70.
The recommended volume ratio of the housed hose(s) is less than 40 %.*



$$\text{volume ratio} = \underbrace{\frac{d^2}{4}\pi n}_{\text{Area of hose(s)}} \div \underbrace{\frac{D^2}{4}\pi}_{\text{Area of wrist hollow}} \times 100[\%]$$

⚠ CAUTION

As calculated above, if sum cross-sectional area of the hose(s) exceeds the 40 % of cross-sectional area of the wrist hollow, hose lifetime will shorten. Also, even if sum volume ratio is less than 40 %, hose lifetime may become short depending on posture/angle of the wrist. Therefore, fully examine and test the hose(s) and their arrangement in wrist before starting operations.

NOTE* Consult Kawasaki before starting operations if volume ratio exceeds 40 % or when using a hose with ϕ 12 or greater diameter.

(2) Adjust hose length of JT1 swivel part and apply lubricant by the following procedure when mounting/replacing the hose built in the protection duct.
1) Put hoses through the protection duct and connect the paint equipment on the forearm. Apply lubricant, such as vaseline etc., to the hoses inside the protection duct without fail. Do not apply the lubricant around the clamp at this time.
2) Wrap hose protection rubber sheets (Width: 50 mm, Thickness: 1 mm) around the hoses at upper clamp mounting position* until they become thicker than the clamp inner diameter of ϕ60.
3) Tighten clamp over the hoses wrapped by rubber sheets and fix the hoses. After fixing them, make sure that the hoses and the rubber sheets do not move.
4) Move the robot until it takes the home posture (0°,0°,0°).
5) Fix the hose adjusting jig (50154-0001 “Jig assy, KG264 hose”) to the mounting stand of lower bracket of protection duct, and adjust the hose length along the guide of the jig. At this time, be careful not to twist the hoses and bundle them.

6) Wrap hose protection rubber sheets (Width: 100 mm, Thickness: 1 mm) around the hoses at lower clamp position* until it becomes thicker than the clamp inner diameter of ϕ54.
7) Fix the hoses by tightening the lower clamp. (Tightening torque 25 kgf·cm) After fixing, make sure that the hoses and the rubber sheets do not move.
8) Remove the hose adjusting jig.
9) Apply lubricant, such as vaseline etc., to the enter hose of JT1 swivel part without fail. Do not apply the lubricant to the lower clamp part at this time.
10) Move JT1,2,3 within their motion range in teach mode and check if the hose touches the robot, the hose moves from the clamp position and any hose is pulled. If any abnormality is found, make the adjustment again.

⚠ CAUTION

Improper hose length and fixing may result in a shortened service life for hoses due to damage of the hoses because they touches robot or setting surface or are pulled excessively. Accordingly, check the motion without fail after mounting/replacing hoses.

NOTE* Wipe away lubricant with a rag, etc. which is soaked with cleaning liquid before wrapping the rubber sheet around the hoses if the lubricant is attached on the clamp mounting position.

(3) Nylon is the recommended material for hoses housed in the protection duct.

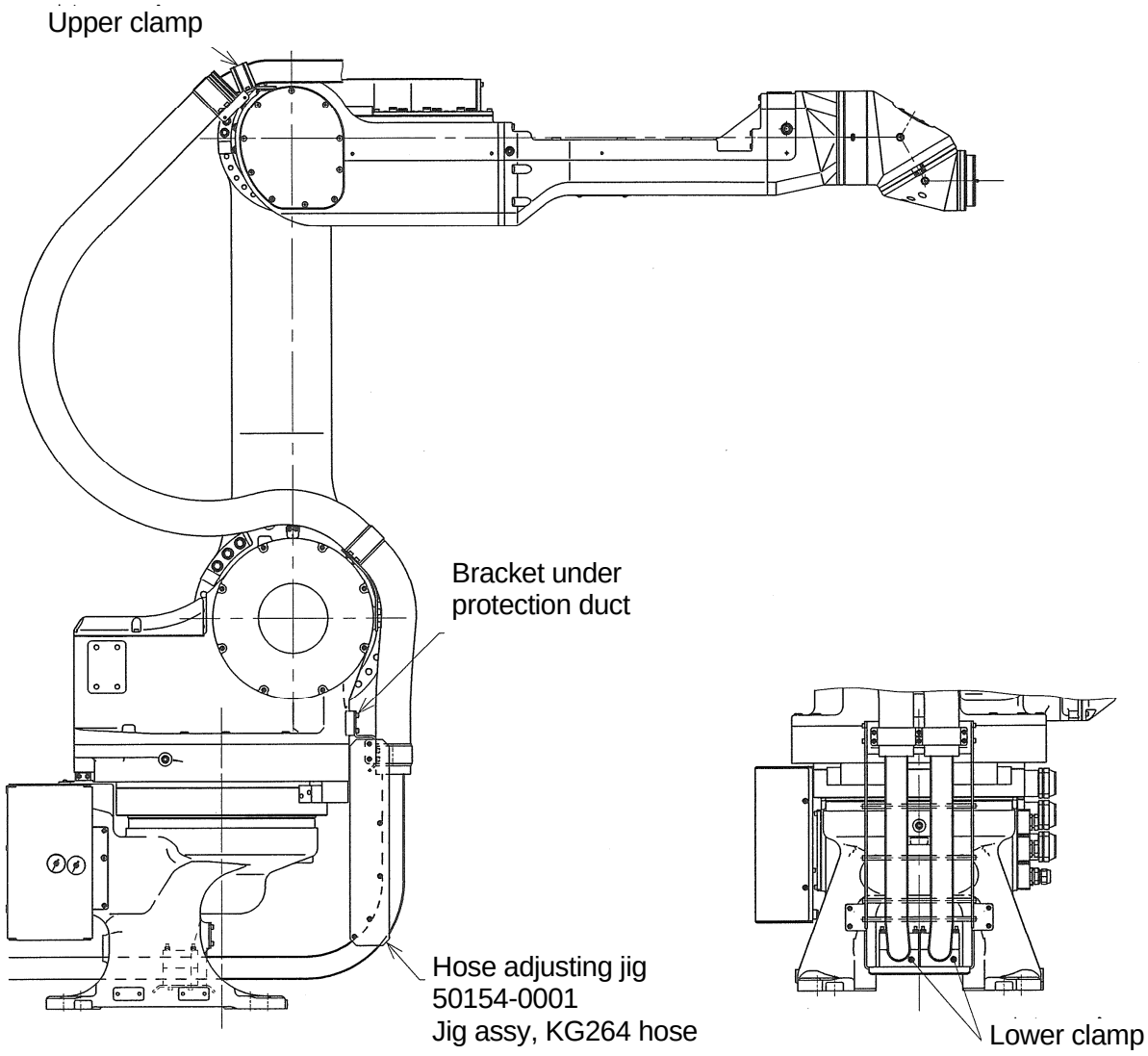
⚠ CAUTION

Using a non-nylon hose may significantly reduce hose lifetime.

(4) When housing hoses in the protection duct, always apply lubricants, such as vaseline etc., to the protection duct and JT1 swivel part. However, do not apply the lubricant around the clamp. Inspect the hoses housed in the protection duct and lower clamp regularly** and replace them when any indication of failure or damage is found.
Recommended inspection period: every 500 hours
Replacement period of hoses (estimated): every 10000 hours
NOTE** Also, whenever hoses are inspected, apply lubricants to the protection duct and JT1 swivel part.

[NOTE]

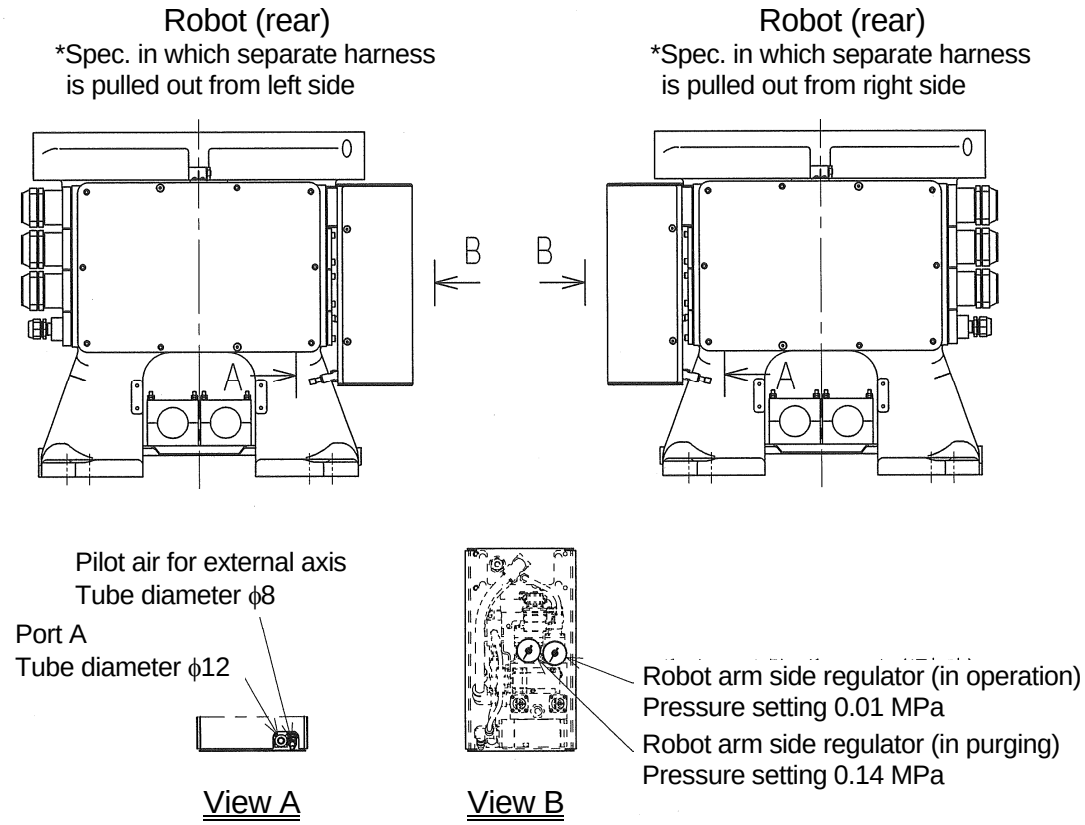
The above replacement period is a recommended standard and is not meant as a period guaranteeing the life of the hoses.


Upper clamp
Bracket under
protection duct
Hose adjusting jig
50154-0001
Jig assy, KG264 hose
Lower clamp

9.0 CONNECTION OF AIR SYSTEM

KG264 is a explosion-proof specified robot protected by pressurized and intrinsically safe structures that comply with national laws and safety standards. The following explains the air supply to robot arm.

Air connecting port is provided in base section of robot arm. Supply air from the air inlet of port A (tube diameter: ϕ12) on the rear of robot arm as shown in the figure below.



⚠ CAUTION

Do not change regulator setting on side of robot arm because it is adjusted at factory shipment. Pilot air for external axis is connected to the pilot air inlet of external axis when an external axis is connected to the robot and is blocked when no external axis is used. Therefore, do not remove tube and plug.

⚠ CAUTION

Use clean air that meets specifications below.

1. **Solid material.....0.01 μm or less**
2. **Oil content.....Mist separation: 99.9999 % or more**
3. **Humidity.....Dew point: -17 °C or less at atmospheric pressure**
4. **Input pressure.....0.4-0.7 MPa (4.1-7.1 kgf/cm^2)**
5. **Input quantity.....350 L/min. (nor) (Only at purging)**

[**NOTE**]

When purging completes, the air operated valve set on exhaust port closes. After that, air consumption is minimized to only a little air leakage from various sealed sections.

⚠ CAUTION

When trying to operate the robot with insufficient air pressure (e.g. immediately after a compressor which supplies air is activated), an error occurs due to insufficient inner pressure and robot cannot be operated. Accordingly, operate the robot after sufficient air pressure is obtained.

MEMO

Kawasaki Robot KG264
Installation and Connection Manual

November 2009 : 1st Edition

Published by KAWASAKI HEAVY INDUSTRIES, LTD.

90202-1114DEA

Copyright © 2009 KAWASAKI HEAVY INDUSTRIES, LTD. All rights reserved.