

**Kawasaki Robot
MS Series**

**Installation and
Connection Manual**

Robot

Kawasaki Heavy Industries, Ltd.

PREFACE

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

Read and understand the contents of this and safety manuals 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 following manual for installation and connection of controller.

“Installation and Connection Manual” for controller.

This manual is applicable to the following robot arms.

MS005N


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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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SAFETY

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. Should any unexplained questions or problems arise, 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 the 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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1.0 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.



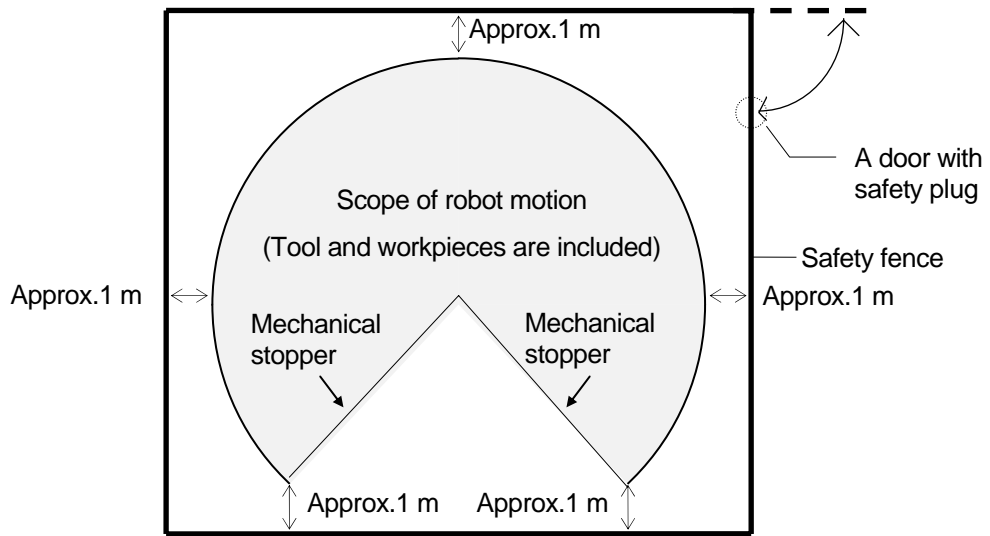
CAUTION

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 using a crane or forklift.
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 – 85 % RH without dew condensation,
 - (3) Keep free from excessively strong shock and vibration.

1.2 INSTALLING ENVIRONMENT OF ROBOT ARM

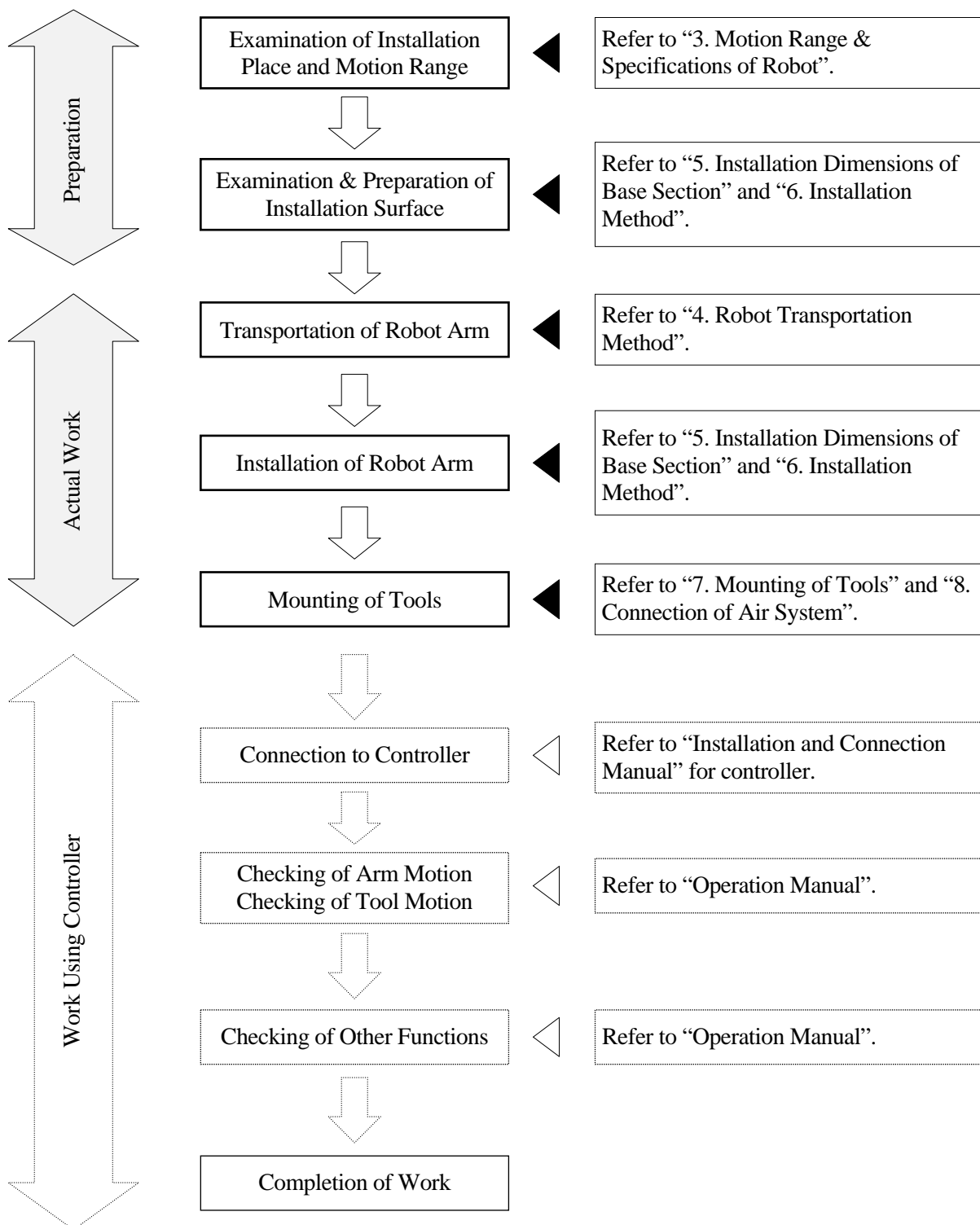
The robot arm must be installed in a place that satisfies all the following environmental conditions:

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. (Natural frequency: 30 Hz or more)
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 10 to 35 °C. (Deviation or overload error may occur due to high viscosity of grease/oil when starting operation at low temperatures. When this occurs, perform break-in operation at low speed (approx. half speed of regular operation) for 5 to 10 minutes before regular operation.)
5. Keep the relative humidity during operation within the range of 35-85 %RH without dew condensation.
6. The robot installing place should be free from dust, dirt, oil, smoke, water, and other foreign matters. (Arm satisfies the requirements for IP67, dust and water protection grating.)
7. The robot installing place should be free from flammable or corrosive liquid or gas. (Liquids and gases specific to sterilization washing are acceptable. For conditions of acceptable liquids and gases, contact Kawasaki.)
8. The robot installing place should be free from excessively strong vibration. (0.5G 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 JIS B8433, etc. established in each region for details of the safety fence.



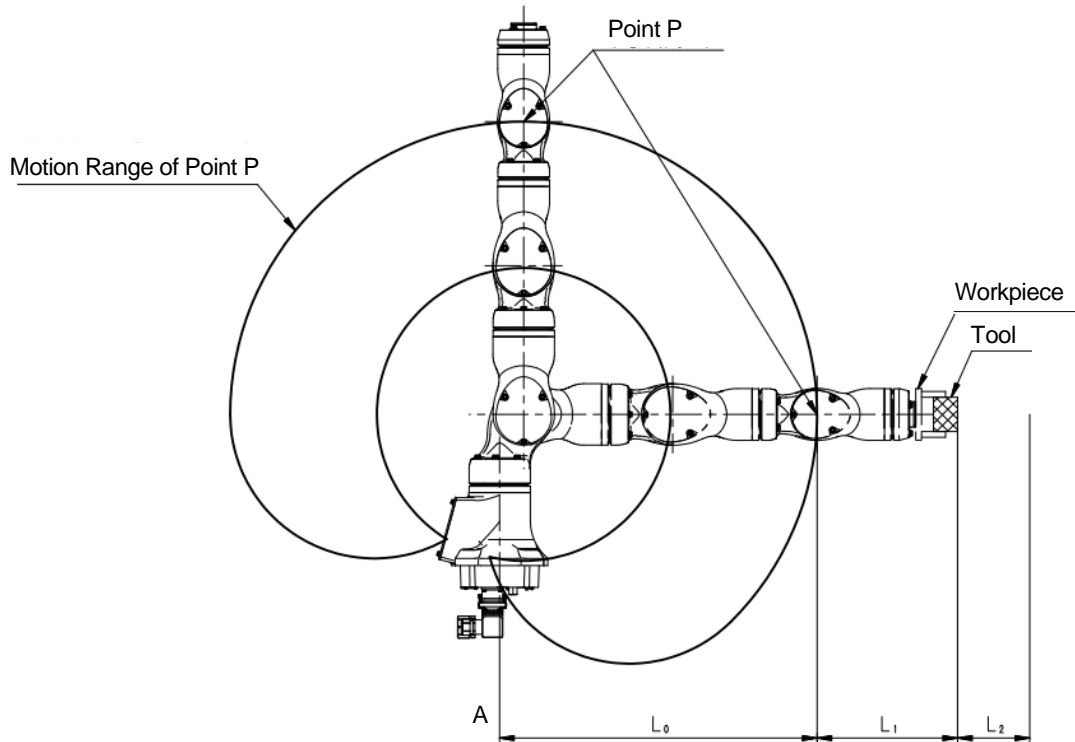
2.0 WORK FLOW AT ARM INSTALLATION AND CONNECTION

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

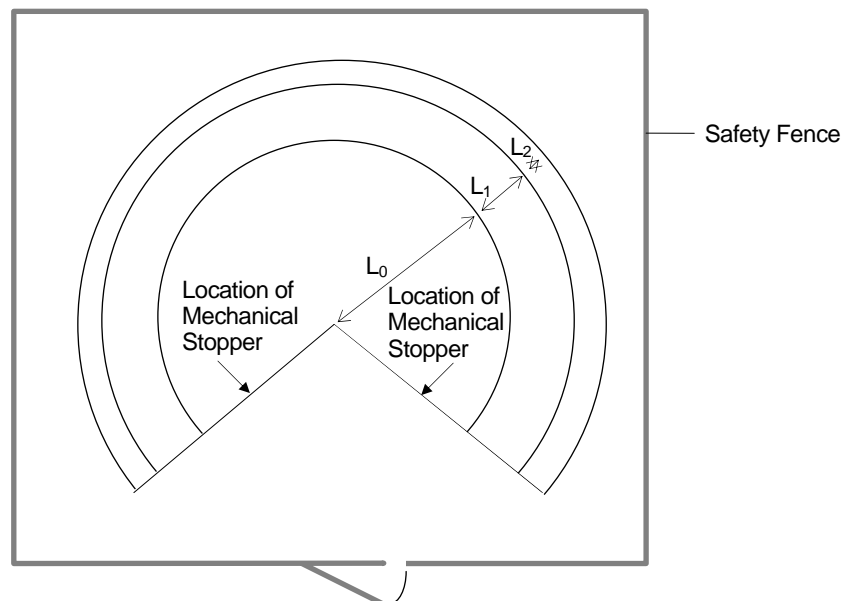


3.0 MOTION RANGE & SPECIFICATIONS OF ROBOT

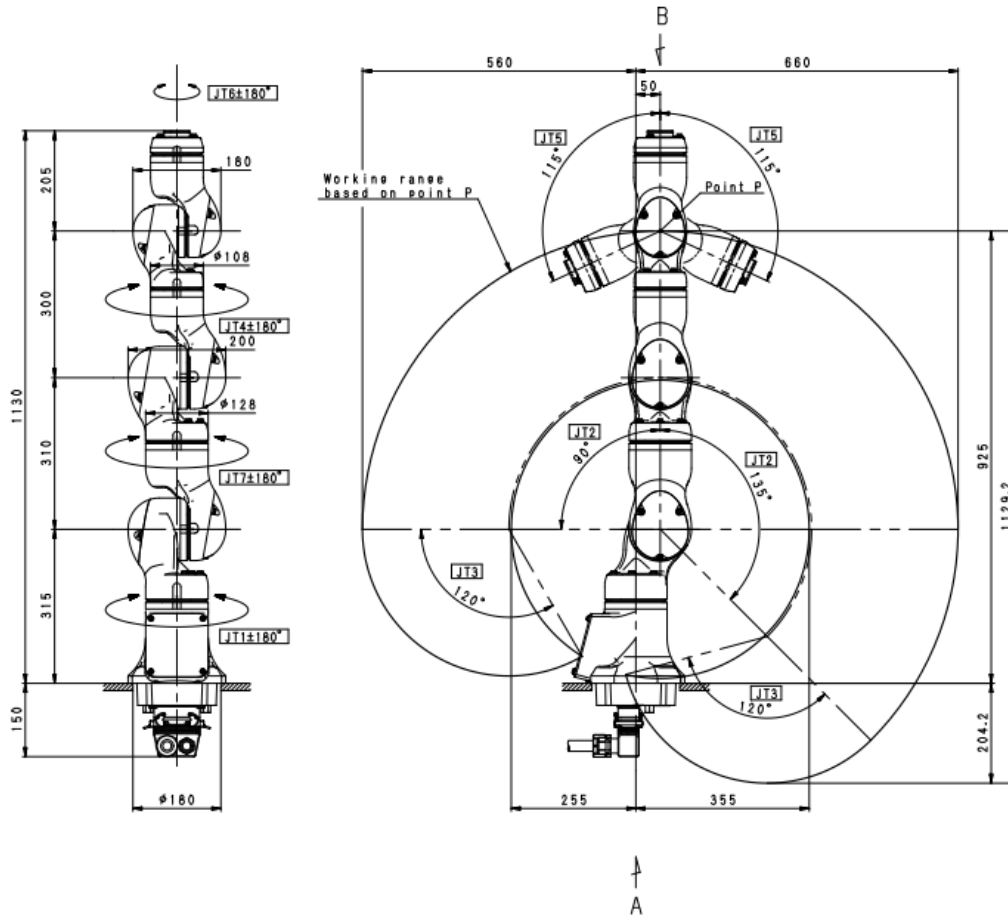
3.1 DETERMINATION OF SAFETY FENCE INSTALLATION LOCATION



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 in the figure) 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 & SPECIFICATIONS OF ROBOT



Type	Articulated Robot		
Degree of Freedom	7		
Motion Range and Maximum Speed	JT	Motion Range	Max. Speed
	1	±180°	130 °/s
	2	+135° - -90°	130 °/s
	3	±120°	215 °/s
	4	±180°	300 °/s
	5	±115°	300 °/s
	6	±180°	480 °/s
7	±180°	215 °/s	
Max. Payload	5 kg		
Wrist Load Capacity	JT	Torque	Moment of Inertia
	4	17 N·m	0.9 kg·m ²
	5	17 N·m	0.9 kg·m ²
6	7 N·m	0.4 kg·m ²	
Repeatability	±0.1 mm		
Mass	50 kg		
Max. Payload	<70 dB (A)*		

*measured condition
 • fixed on the flat floor rigidly
 • 1700 mm away from JT1 center

The noise level depends on the conditions.

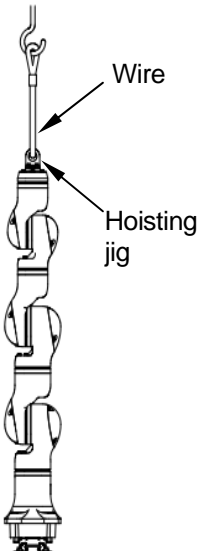
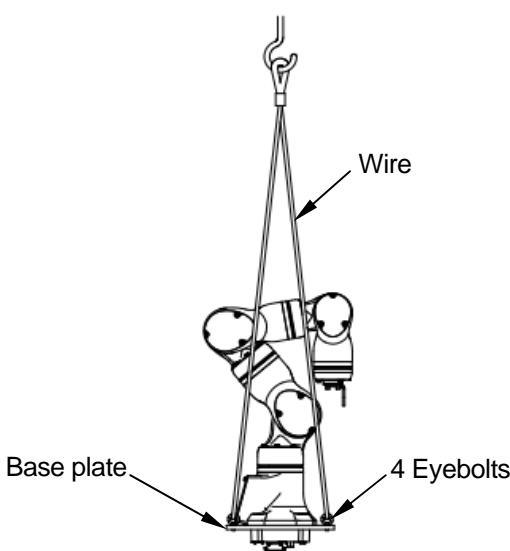
4.0 ROBOT TRANSPORTATION METHOD

4.1 USING WIRE SLING

Attach a hoisting jig or eyebolts on arm or base plate as shown in the figure, and hoist up the robot with wires.

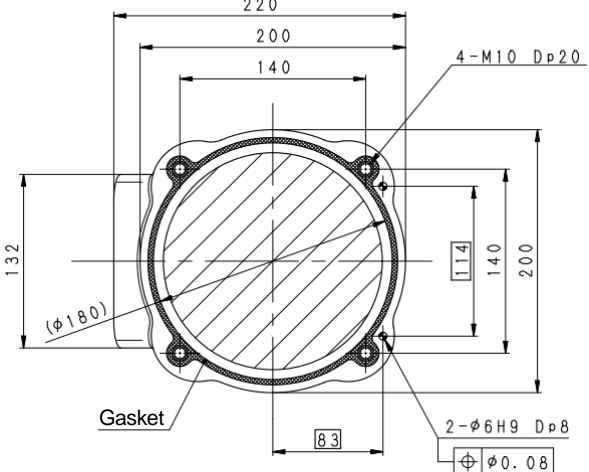
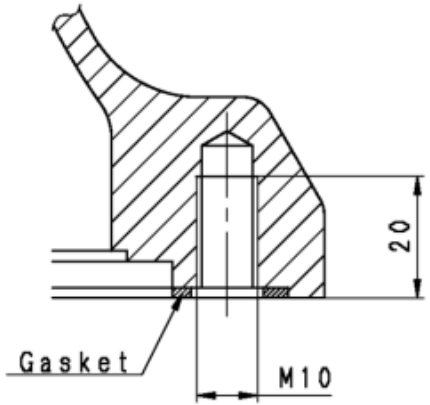
⚠ CAUTION

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 eyebolt attached to the arm once the transportation of robot is complete.

Model		MS005N	MS005N (with base plate)
Hoisted up posture			
Hoisted up posture	JT1	0°	0°
	JT2	0°	-40°
	JT3	0°	-120°
	JT4	0°	0°
	JT5	0°	-100°
	JT6	0°	0°
	JT7	0°	0°
Hoisting jig		60154-3715 (jig, lifting) RSBM616Z×4	60333-7009 (plate, base) 0EBM8Z (eyebolt)×4

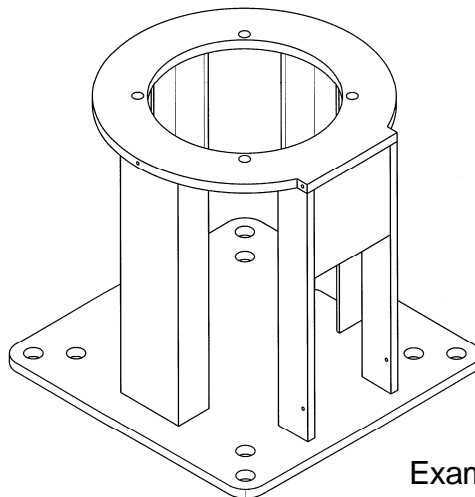
5.0 INSTALLATION DIMENSIONS OF BASE SECTION

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

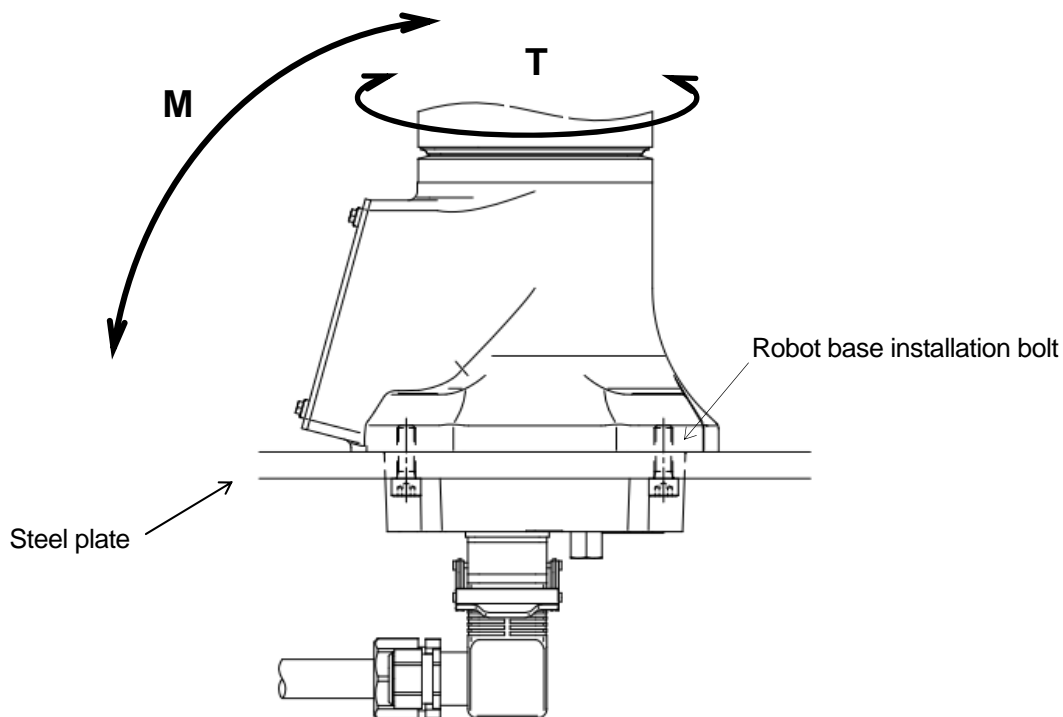
Model	MS005N
Dimensions for installation	 <p>The diagram shows a top view of the base section with the following dimensions and specifications:</p> <ul style="list-style-type: none"> Overall width: 220 Inner width: 200 Inner diameter: $\phi 180$ Distance between bolt centers (horizontal): 140 Distance between bolt centers (vertical): 140 Distance from center to bolt center (horizontal): 70 Distance from center to bolt center (vertical): 70 Distance from center to mounting edge (horizontal): 114 Distance from center to mounting edge (vertical): 114 Overall height: 200 Mounting edge thickness: 8.3 Bolt specifications: 4-M10 Dp20 Mounting holes: 2-$\phi 6$H9 Dp8 Mounting hole tolerance: $\phi 0.08$ Component: Gasket
Cross-section of installation section	 <p>The diagram shows a cross-section of the installation section with the following details:</p> <ul style="list-style-type: none"> Mounting edge thickness: 20 Bolt specification: M10 Component: Gasket
Tightening bolt	4-M10 Material: SUS304
Tightening torque	39 N·m
Levelness	Within $\pm 5^\circ$

6.0 INSTALLATION METHOD

Fix the robot on the pedestal through hole ($\phi 180$) in steel plate of thickness of 17 mm as shown in the figure below. Fix the pedestal firmly enough to endure the reaction forces produced by the robot.



Example of pedestal



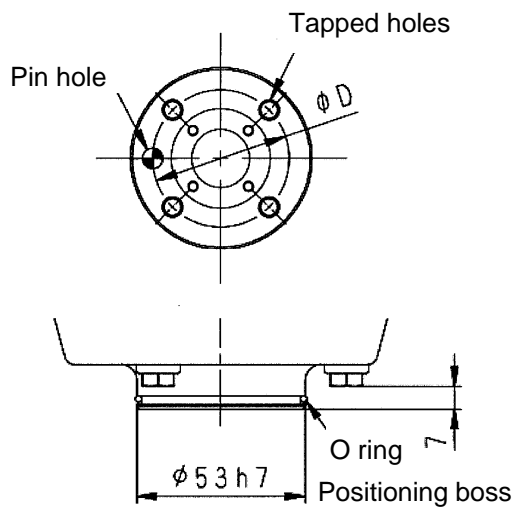
Model	MS005N
M (Inversion moment)	810 N·m
T (Rotating torque)	430 N·m
Robot base installation bolt	4-M10
Tightening torque	39 N·m
Thickness of steel plate	17 mm or more

7.0 MOUNTING OF TOOLS

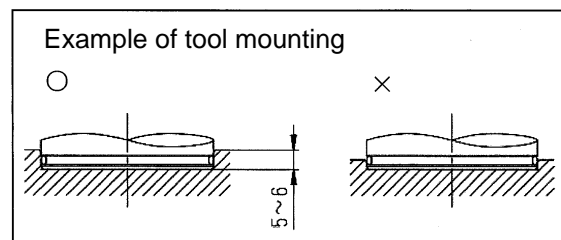
⚠ WARNING

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 accidents of electric shock etc. caused when someone accidentally turns ON the power.

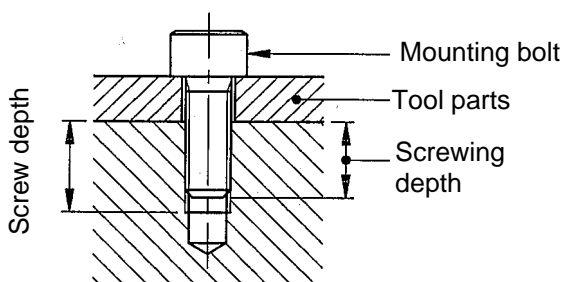
7.1 DIMENSIONS OF WRIST END (FLANGE FACE)



In the robot arm end section, a flange is provided on which hand, gun, or other tools are mounted. Screw the mounting bolts into the tapped holes on the circumference of ϕD on the flange, referring to the figure on the left. Moreover, position the tool by utilizing the pin hole and the positioning boss.



7.2 SPECIFICATION OF MOUNTING BOLT



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

⚠ CAUTION

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

Model	MS005N
Tapped holes	4-M6
ϕD	$\phi 40$
Pin hole	$\phi 6H7$ Depth 12
Positioning boss	$\phi 53h7$
Screw depth	12 mm
Screwing depth	7-9 mm
Tightening bolt	SUS304
Tightening torque	8.3 N·m

7.3 LOAD CAPACITY

Load mass applicable to robot is specified for each model and includes the mass of tool, etc. Applicable load torque and moment of inertia around wrist axes (JT4, JT5, JT6) are 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 such as hand, tool changer, shock absorber, etc. If using the robot in excess of its load capacity, first contact Kawasaki without fail.

The load torque and the moment of inertia can be calculated by the expression below:

Calculation Expression

The diagram illustrates a load mass M (kg) represented by a grey circle. A vertical double-headed arrow indicates the distance L_6 (m) from the JT6 axis to the center of gravity of the load. A diagonal double-headed arrow indicates the distance $L_{4,5}$ (m) from the JT4(5) axis to the center of gravity. A curved arrow around the load center represents the moment of inertia I_G .

Load mass : $M \leq M_{max}$. (kg)
(including tool)

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

Load moment of inertia : $I = M \cdot L^2 + I_G$ (kg·m²)

M_{max} : Maximum load mass: See 3.2.

L : Length from axis rotation center to load center of gravity. (Unit: m)

L_6 : Length from JT6 axis rotation center to load center of gravity.

$L_{4,5}$: Length from JT4(5) axis rotation center to load center of gravity.

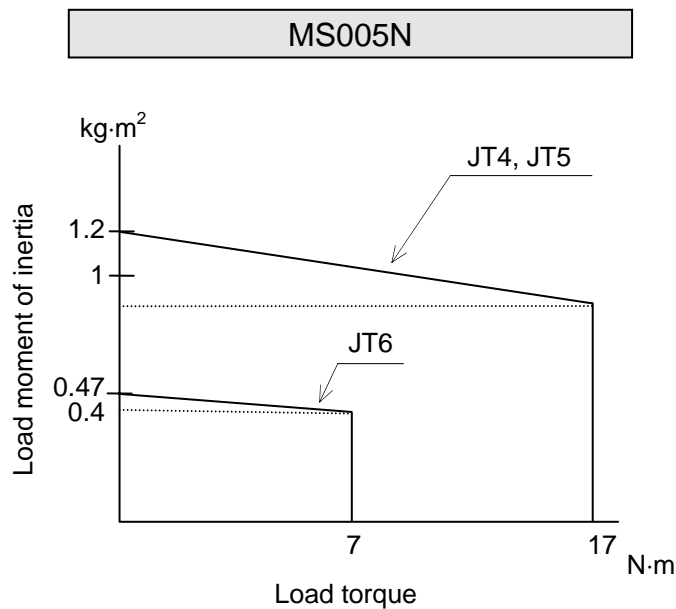
I_G : Moment of inertia around center of gravity. (Unit: kg·m²)

If calculation of load is made by dividing the load into construction parts, such as tools and workpieces, use the total calculation values of each part as load torque and moment of inertia.

Regarding the load on the robot wrist section, meet the following restriction conditions:

1. The load mass including tool mass should be 5 kg or less.
2. The load torque and the moment of inertia around each wrist axis (JT4, JT5, JT6) should be within the following restriction*:

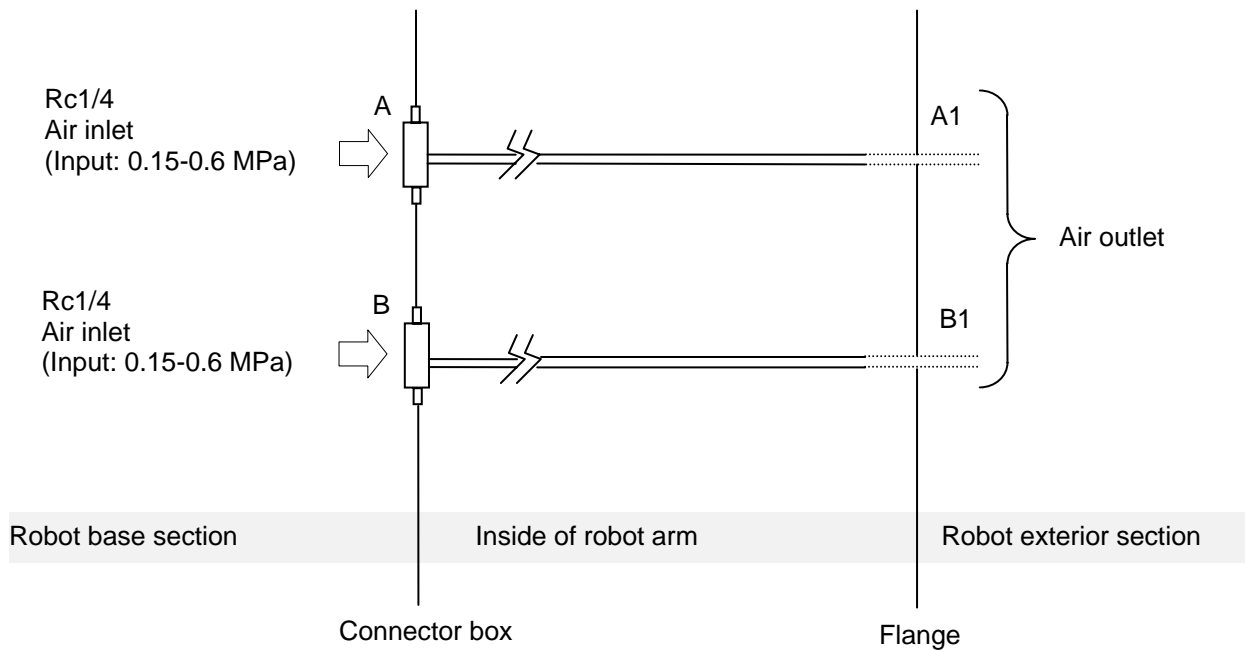
NOTE* Load moment of inertia exceeding the restriction may be acceptable. In this case, ensure to specify the load. (However, the robot movement may become slow because of optimizing acceleration and deceleration.) See AS Language Reference Manual for setting the load. Operating the robot with wrong settings may result in degradation of movement performance and shortening of machine service life.



8.0 CONNECTION OF AIR SYSTEM

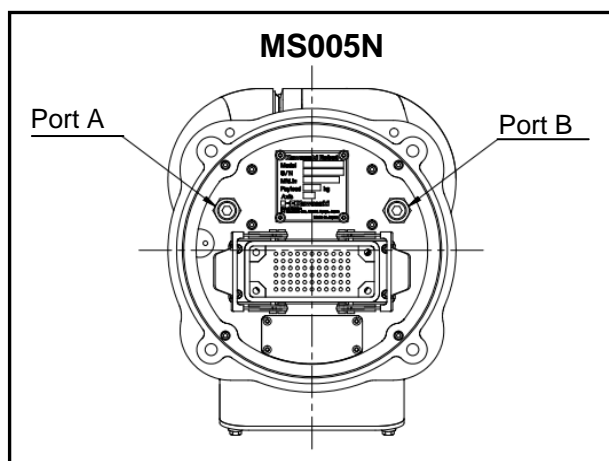
8.1 AIR PIPING ARRANGEMENT

MS series robot houses air piping and valves for driving the tool on the robot arm. For the air specifications, connect supply air to ports A and B in the base section. Normally, there is piping up to the lower of wrist flange and air outlet is available outside the flange. (Option)



NOTE: Air piping can be extended outside the robot as shown with (dashed line) (option).

8.2 AIR SUPPLY TO THE ROBOT ARM




As shown on above, the air connection port is provided in the base section of robot arm.

⚠ CAUTION
Supply input pressure; 0.15 - 0.6 MPa to the Ports A and B (Rc1/4).

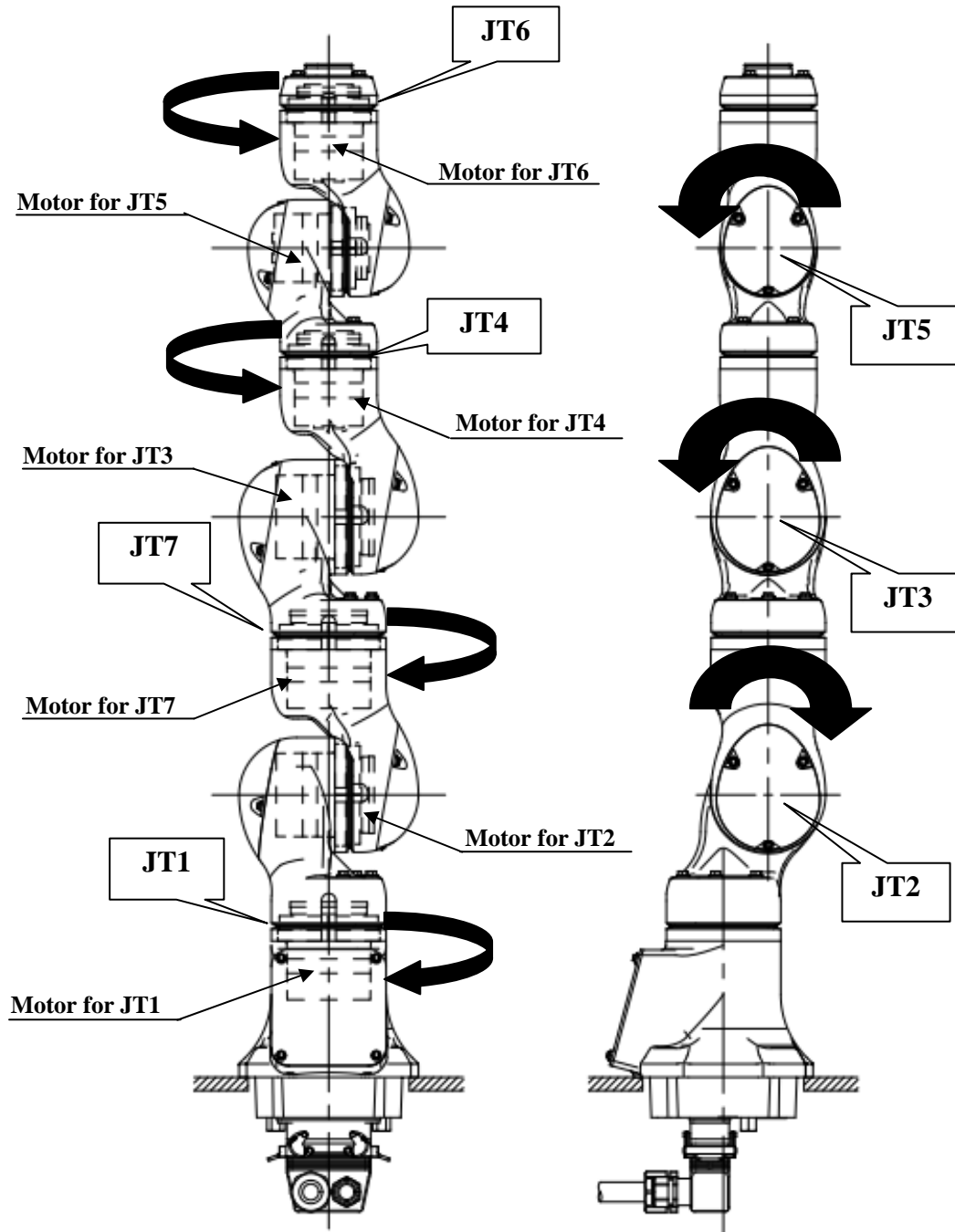
APPENDIX 1 TIGHTENING TORQUES OF BOLTS, ETC.

Tightening torques of bolts, etc. are shown below. However, if tightening torque is specified in the manual, tighten the bolts with the specified torque.

Type	Hexagon socket head bolt Hexagon head bolt		Hexagon socket head button cap bolt Hexagon socket head flush bolt
	SUS304 Stainless Strength class: A2-70	SCM435 Steel Strength class: min. 10.9	SCM435 Steel Strength class: min. 10.9
Nominal diameter [mm]	Tightening torque [N·m]	Tightening torque [N·m]	Tightening torque [N·m]
M2	0.3	0.4	-
M2.5	0.6	0.8	0.4
M3	1.1	1.5	0.8
M4	2.4	3.4	1.5
M5	4.9	6.9	3.4
M6	8.3	12.0	6.9
M8	20.0	29.0	12.0
M10	39.0	57.0	29.0
M12	69.0	98.0	57.0
M14	-	155.0	98.0
M16	165.0	235.0	155.0
M18	-	333.0	235.0
M20	-	431.0	333.0
M24	-	785.0	431.0

Type		Hexagon socket head taper screw plug
		
Nominal diameter [mm]	Width across flat [mm]	Tightening torque [N·m]
R1/8	5	5.9
R1/4	6	6.9
R3/8	8	11.8
R1/2	10	29.4
R3/4	14	29.4

APPENDIX 2 MOTOR ARRANGEMENT AND MOVING DIRECTIONS



The above figures show the motor arrangement and moving direction with the postures of JT1-JT7 being 0 degrees. For rotation, the direction of arrow indicates plus direction.



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