

NACHI

Standard specifications

**MR20-02-AX20/FD11
MR20L-01-AX20/FD11**

11th edition

NACHI-FUJIKOSHI CORP.

1309, SMREN-014-011,001



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1. Outline

NACHI ROBOT has used mechatronic techniques, cultivated throughout the last few decades, to supply robots suited for industries utilizing welding, spray painting and the material handling techniques.

The MR robot is a robot of seven axis, high speed and high rigid structure, which is optimal for handling, and other applications.

Arm type Load	Standard arm 20 kg (Max.30Kg)	Long arm 20 kg
weight Installation		
Floor mount	MR20-02	MR20L-01
Ceiling mount		

■ Characteristic

1. Because axis 7 is added between axis 2 and axis 3, the degree of freedom increased and more flexible motion became possible. It is possible to choose several different postures of the robot for the same tool position and orientation. Because of this, a motion in which the robot avoids the interference against the peripheral devices in the work space also becomes possible.
2. This robot is designed so that the size of the motion range is similar to that of one worker. Therefore, it becomes possible to make a compact robot cell. And, this robot is also suitable for a loading application for randomly workpieces.
3. The wide motion range and the 7-axes structure lighten the limitation of the actual motion range due to the wrist posture. And examining applicability becomes easier than before.
4. An installation in a narrow work space is possible because the application signal wires and the tubes are embedded inside the arm.
5. The enhanced torque of the wrist axes make it possible to use a large workpice and a hand that has a center of gravity whose position is far from the wrist center. This fact enhances the applicability of this robot.
6. The motion range suitable for the weight of the workpieces or tools can be selected. Because of this, it becomes possible to use a heavier workpiece, double hand, etc.

2. Basic specifications

Item		Specifications	
Robot model		MR20-02	MR20L-01
Construction		Articulated	
Number of axis		7	
Drive system		AC servo motor	
Max. working envelope	Axis 1	± 3.14 rad	
	Axis 2	+ 0.96~ - 2.09 rad	
	Axis 3	+ 2.35 ~ - 2.89 rad	
	Axis 4	± 3.14 rad	
	Axis 5	± 2.35 rad	±2.42 rad
	Axis 6	± 6.28 rad	
	Axis 7	± 3.14 rad	
Max. speed	Axis 1	2.96 rad / s	
	Axis 2	2.96 rad / s	
	Axis 3	2.96 rad / s	
	Axis 4	4.36 rad / s	6.28 rad/s
	Axis 5	4.36 rad / s	6.28 rad/s
	Axis 6	5.23 rad / s	10.5 rad/s
	Axis 7	2.96 rad / s	
Max. pay load ^{*1}		20 kg (Max. 30 kg)	20 kg
Allowable static load torque	Axis 4	80.8 N·m	49 N·m
	Axis 5	80.8 N·m	49 N·m
	Axis 6	44.1 N·m	23.5 N·m
Allowable moment of inertia ^{*2}	Axis 4	6.0 kg·m ²	1.6 kg·m ²
	Axis 5	6.0 kg·m ²	1.6 kg·m ²
	Axis 6	2.3 kg·m ²	0.8 kg·m ²
Position repeatability ^{*3}		± 0.06 mm	
Maximum air pressure		Not more than 0.49 MPa (5.0 kgf / cm ²)	
Installation		Floor mounting or ceiling mounting type	
Ambient conditions		Temperature: 0 to 45 °C ^{*4} Humidity: 20 to 85%RH (No dew condensation allowed) Vibration to the installation face: Not more than 0.5G (4.9 m/s ²)	
Dust-proof / Drip-proof performance ^{*5}		Equivalent to IP65 (dust and drain proof-type)	
Robot mass		230 kg	

1 [rad] = 180 / π [°], 1 [N·m] = 1 / 9.8 [kgf·m]

- On controller display, axis 1 to 7 is displayed J1 to J7 for each.

- The specification and externals described in this specification might change without a previous notice for the improvement.

^{*1}: The operating range is limited depending on the wrist load mass. ^{*2}: Note that the allowable moment of inertia of wrist varies with the wrist load conditions. ^{*3}: This value conforms to "JIS B 8432". ^{*4}: Permitted height is not higher than 1,000m above sea level. If used in higher place, permitted temperature is affected by height. ^{*5}: The liquid which degrades the seal components such as organic solvent and cutting fluid containing acid, alkali, chlorine, or gasoline, cannot be used.

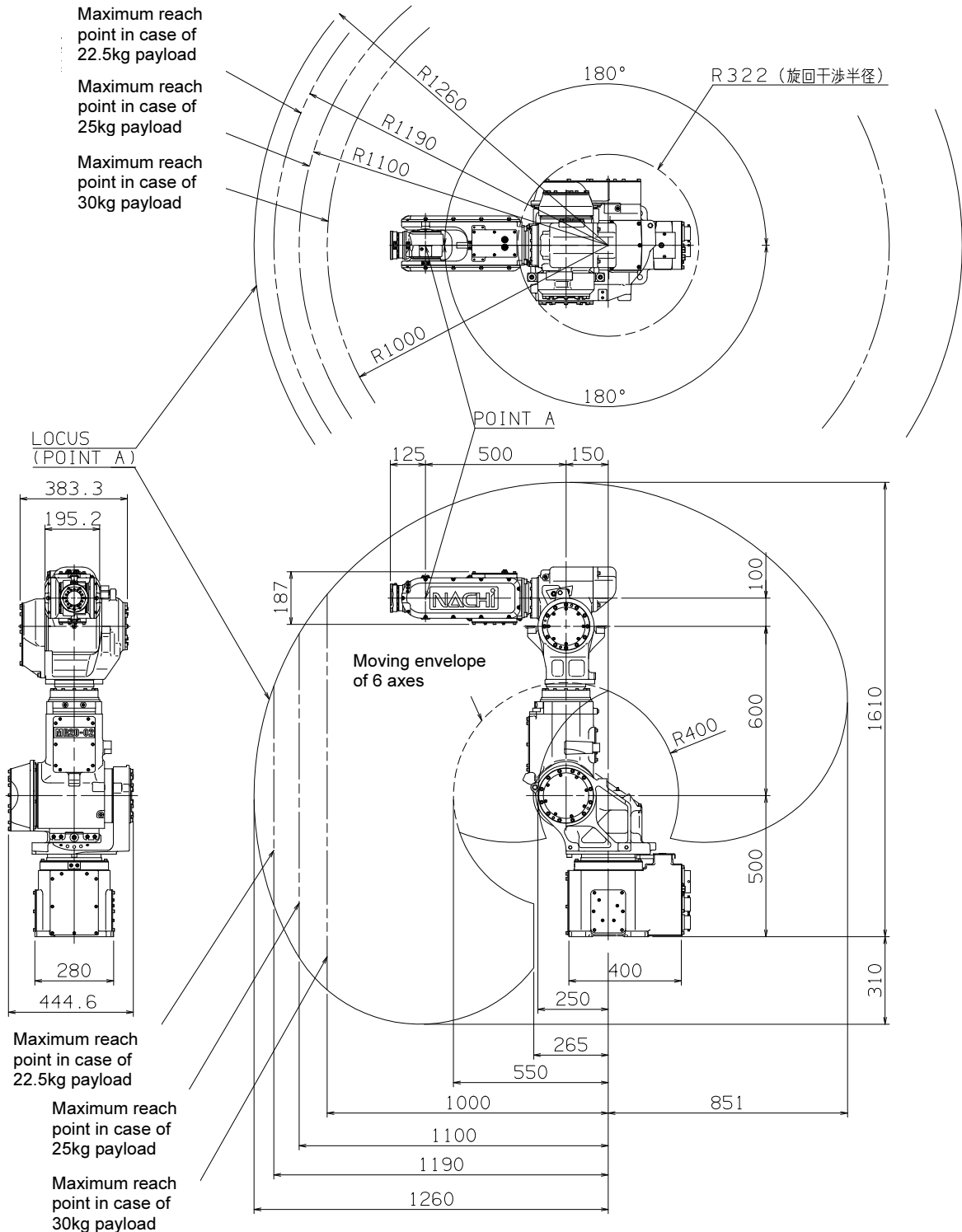
3. Robot dimensions and working envelope

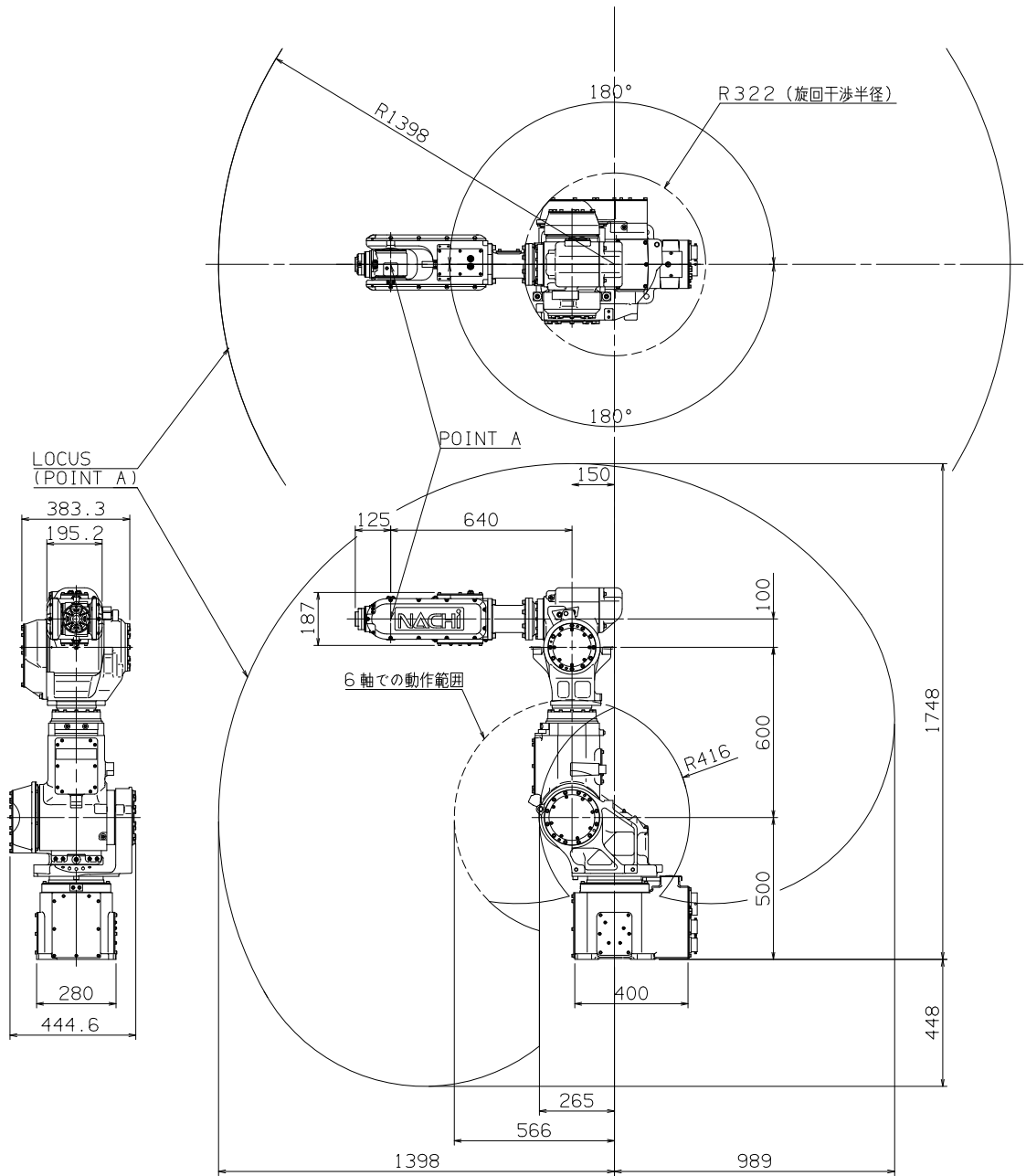
MR20-02

Maximum reach point in case of 22.5kg payload

Maximum reach point in case of 25kg payload


Maximum reach point in case of 30kg payload



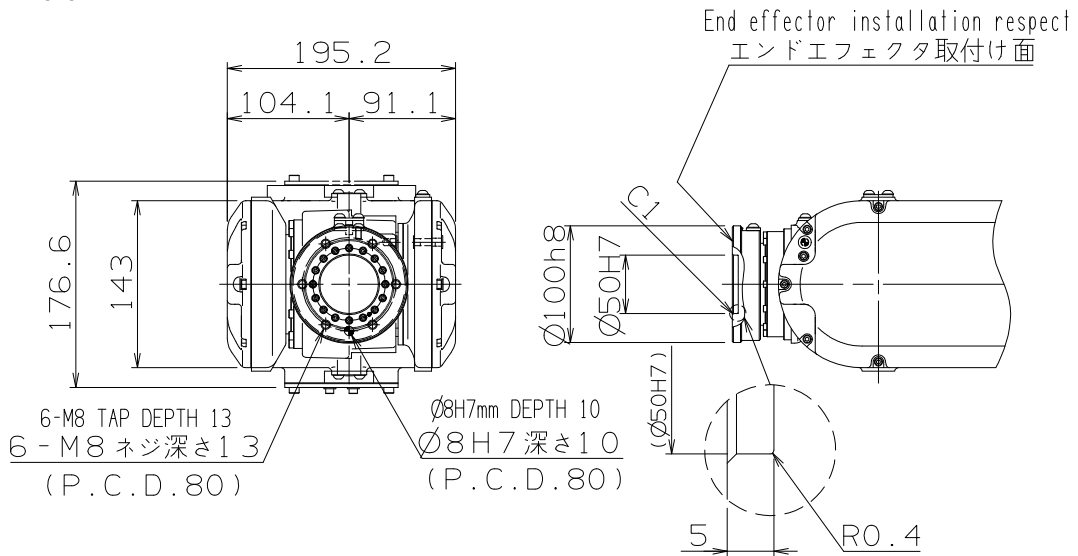


4. Detail of tool mounting plate

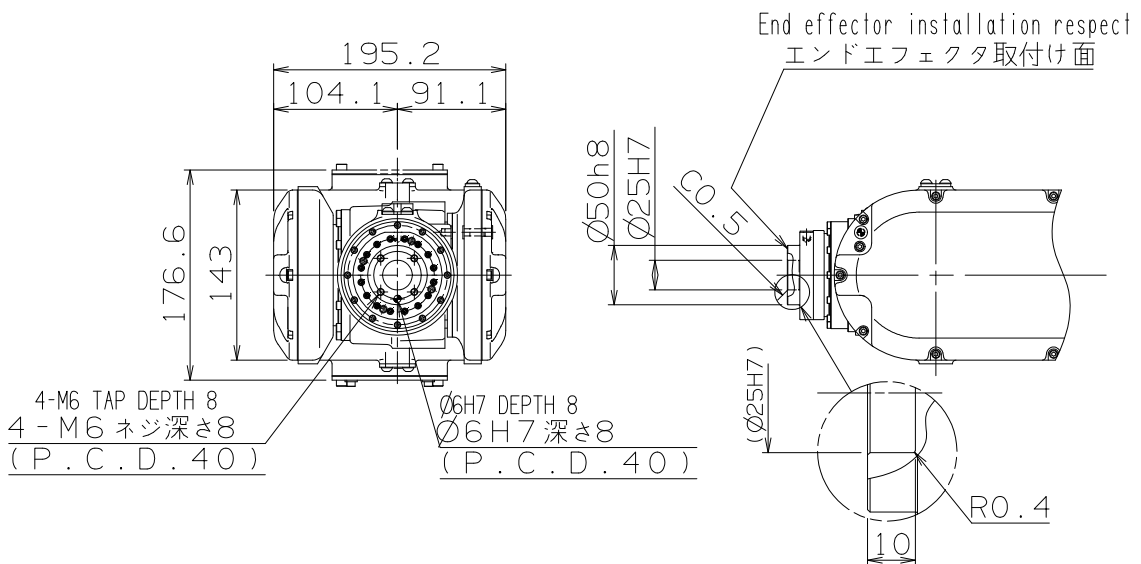
Please use installation P.C.D. of following figure, when tightening the end effector installation bolt.

 CAUTION	Don't screw in installation bolts over thread tap depth. Installation bolts over thread tap depth may damage the wrist.
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MR20-02



MR20L-01




5. Installation Procedure

The installation location and the installation procedure of the robot are critical factors to maintain robot functions. The ambient conditions of installation location not only have influence on the life of mechanical sections of the robot, but also get involved in safety issues. Consequently, strictly observe the environmental conditions shown below. Furthermore, utmost care should be exerted for the installation procedure and the foundation for the robot in order to maintain the robot performance. Strictly observe the installation procedure for the robot provided below.

Installation

To install the robot, give it first priority to thoroughly consider safety of workers and take safety measures. The following describes precautions for this purpose.

Safety measures against entry in the robot operating area

 WARNING	<p>While the robot is in operation, workers are in danger of coming in contact with the robot. To avoid that, install a Safety fence so as to keep the worker away from the robot. Not doing so will cause the workers or other persons to accidentally enter the operating area, thus resulting in accidents.</p>
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■ Installation location and ambient conditions

Conditions (temperature, humidity, height and vibration) are written in “2. Basic Specifications”. Further ambient conditions listed below must be observed.

- (1) Location with the drainage structure so that swivel base is not flooded, when the liquid such as water or cutting fluid is splashed on the robot body
- (2) Location with no flammable or corrosive fluid or gas.
- (3) Type D grounding (the grounding resistance is 100Ω or less) is necessary.

■ Installation procedure

While robot moves, large reaction force is applied to the swiveling base from all directions. Consequently, the robot should be installed in such a manner that the foundation endures reaction force caused by accelerating or decelerating the speed to lock the robot, not to mention that it endures static loads.

Repair uneven spots, cracks, and others on the floor, and then install the robot by following to the table below. If thickness of floor concrete is less than needed level, an independent foundation should be constructed. Inspect the foundation prior to the robot installation, and then construct the foundation, if necessary.



Robot Model	MR20-02, MR20L-01
Thickness of floor concrete	Not less than 150 mm
Installation parts *1	4 bolts of M16 X 45 (JIS: Strength class 12.9) 4 plain washers of not less than 4.5 mm in thickness and HRC35 in hardness
Tightening torque	287 ± 30 N·m
Allowable repeated tensile *2	Approximately 7,940N

*1 : Installation parts are not accessory of robot.

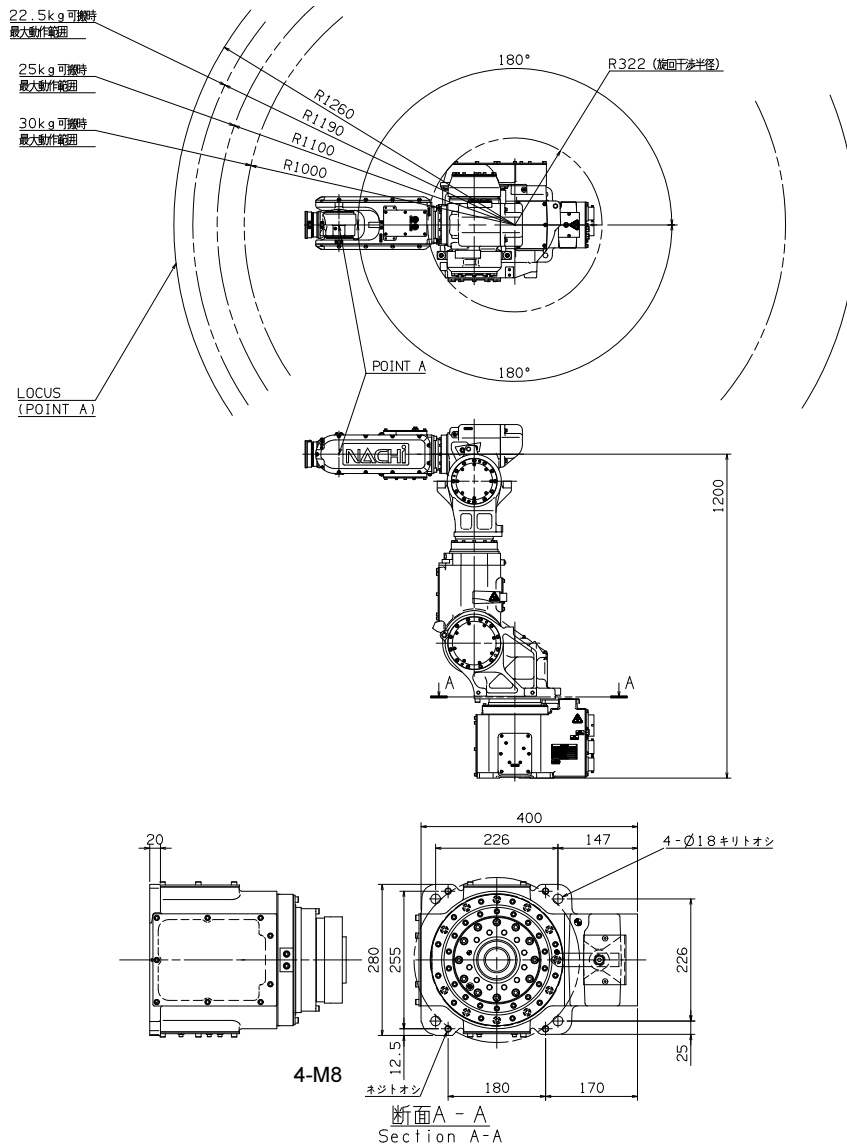
*2 : This tensile is per installation bolt when robot is installed with all bolts written in table above.

■ Installation space

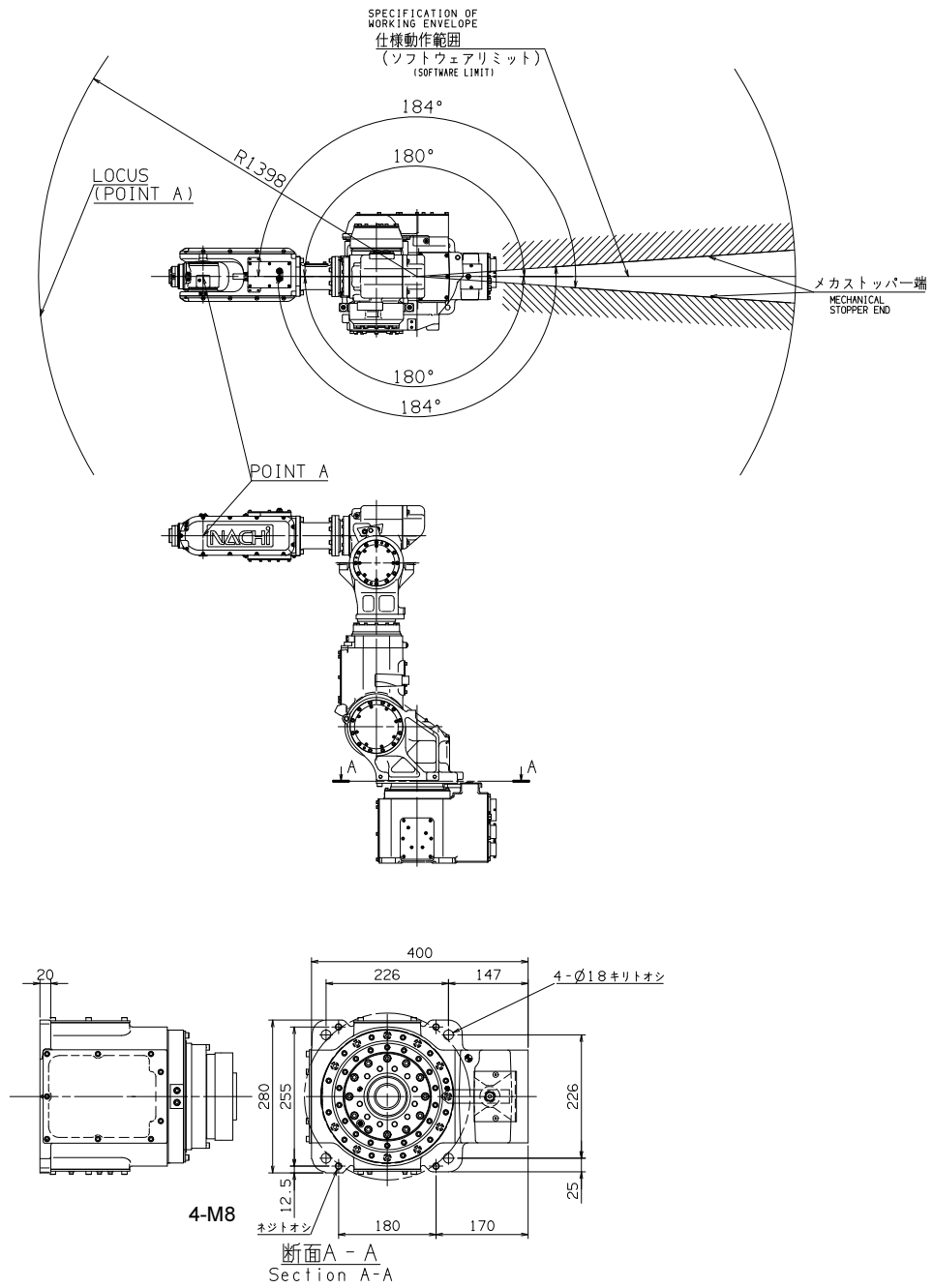
To install the robot, fix the swiveling base of the robot.

 WARNING	A mechanical stopper is mounted 1 degree over axis 1 working envelope (software limit). When installing a guard fence (safety fence), please make sure to consider the motion range, wrist posture, and the shape of the end effector.
 WARNING	To operate safely, range of the motion can be restricted in axis 1, axis 2, axis 3 and axis 7 (Option). Because the option parts are always necessary to restrict the motion range, do not move the standard parts (mechanical stopper block etc.) alone.

MR20-02



MR20L-01



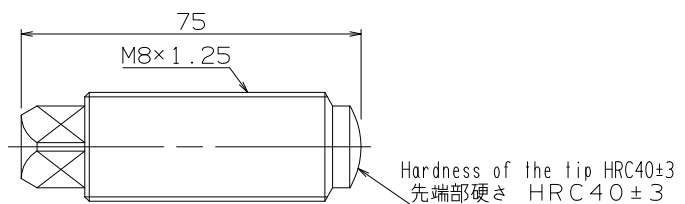
■ Accuracy of installation surface

When installing robot, strictly observe precautions listed below to cause no deformation in the swivel base.

- (1) Make the deviation from the flatness of the 4 plates on the robot installation surface fall within 0.5 mm.
- (2) Make the deviation in height between the 4 places of each base plate installation surface and the robot installation surface fall in the range of 0.5 mm (± 0.25 mm).

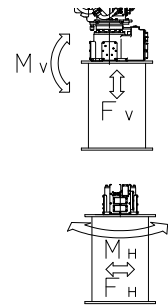


- (3) If the two precautions above cannot be observed, use jack bolts to bring the four places into even contact with the installation surface.





■ Maximum Robot Generative Force

Robot model	Maximum Vertical generative force FV	Maximum horizontal generative force FH	Maximum Vertical generative moment MV	Maximum horizontal generative moment MH
MR20-02 MR20L-01	8,200 N	5,800 N	7,100 N·m	6,100 N·m

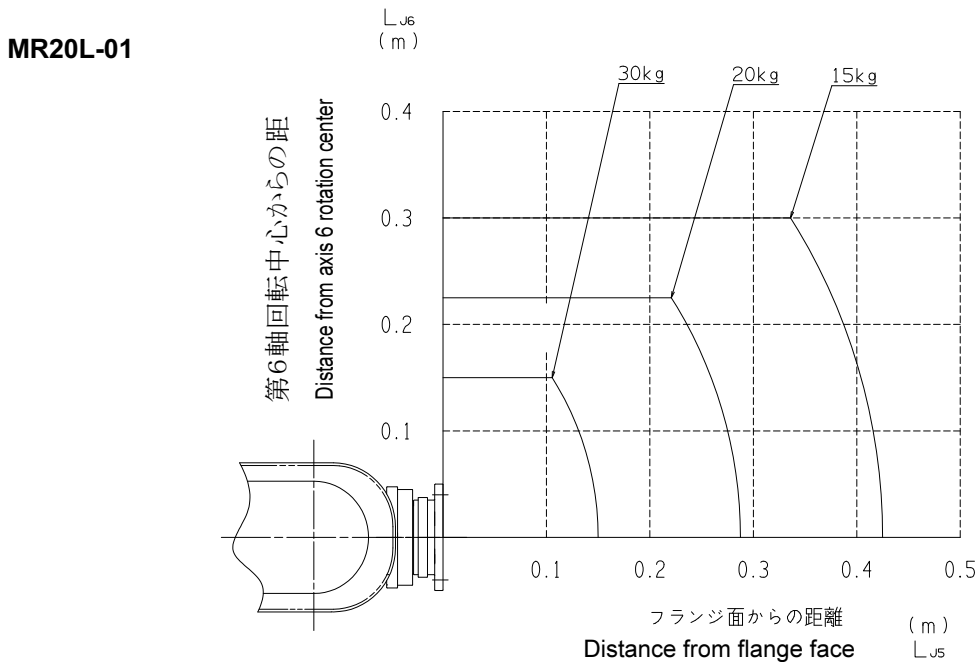
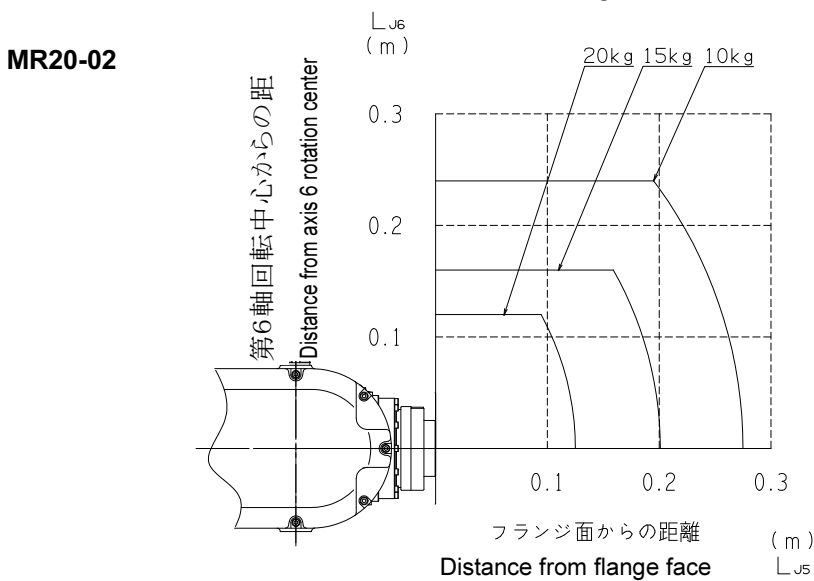


6. Maximum wrist load

 CAUTION	Load fixed on the tip of wrist is regulated by “allowable payload mass”, “allowable static load torque”, and “allowable moment of inertia”. Strictly keep the wrist load within each allowable value. If wrist load exceeds the allowable value, this robot is out of guarantee. Refer to the table of “2 Basic specifications” and following figures for the detail of each specification.
 CAUTION	In case of MR20-02, if the mass of the wrist load exceeds 20 kg, please use the robot in a condition in which the most far reached point in the work program is inside the rated range by referring “3 Robot dimensions and working envelope”.

■ Torque map

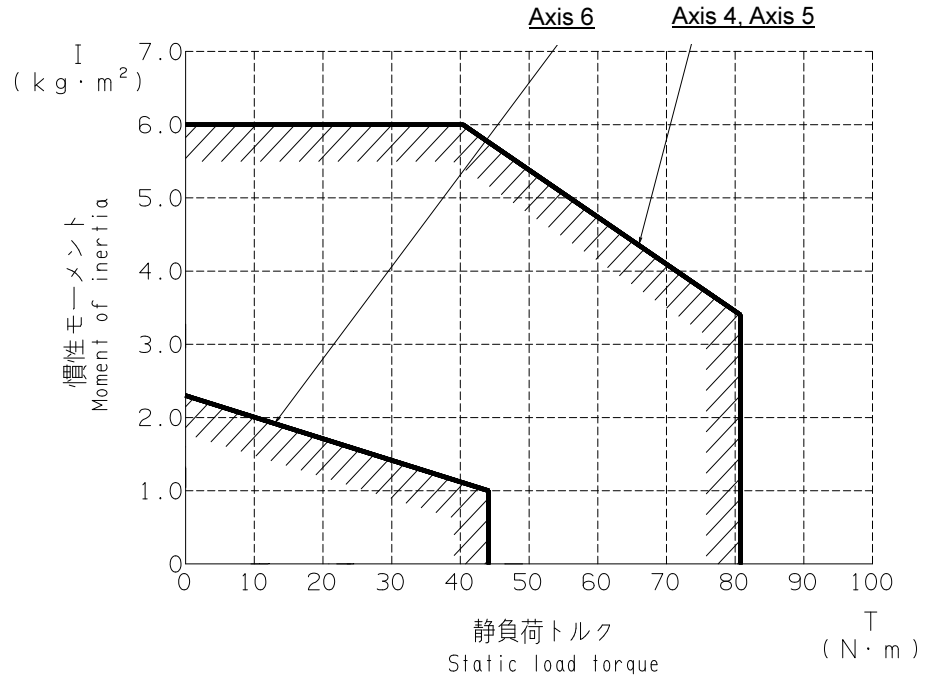
C.O.G. of wrist load should exist inside the range shown below.



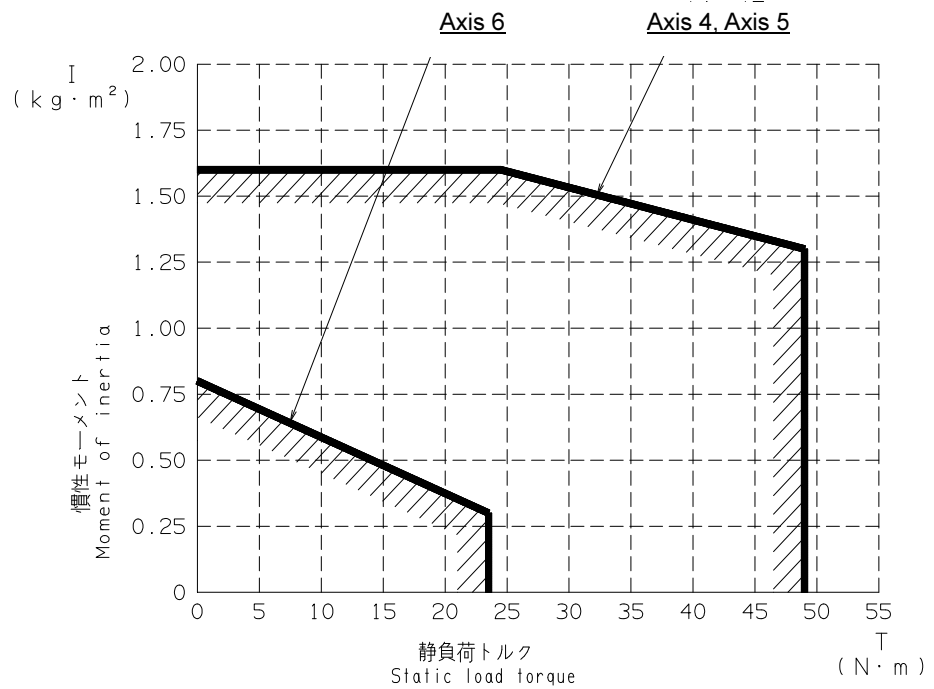
■ Moment of inertia map

Static load torque and moment of inertia of wrist load should exist inside the range shown below.

MR20-02

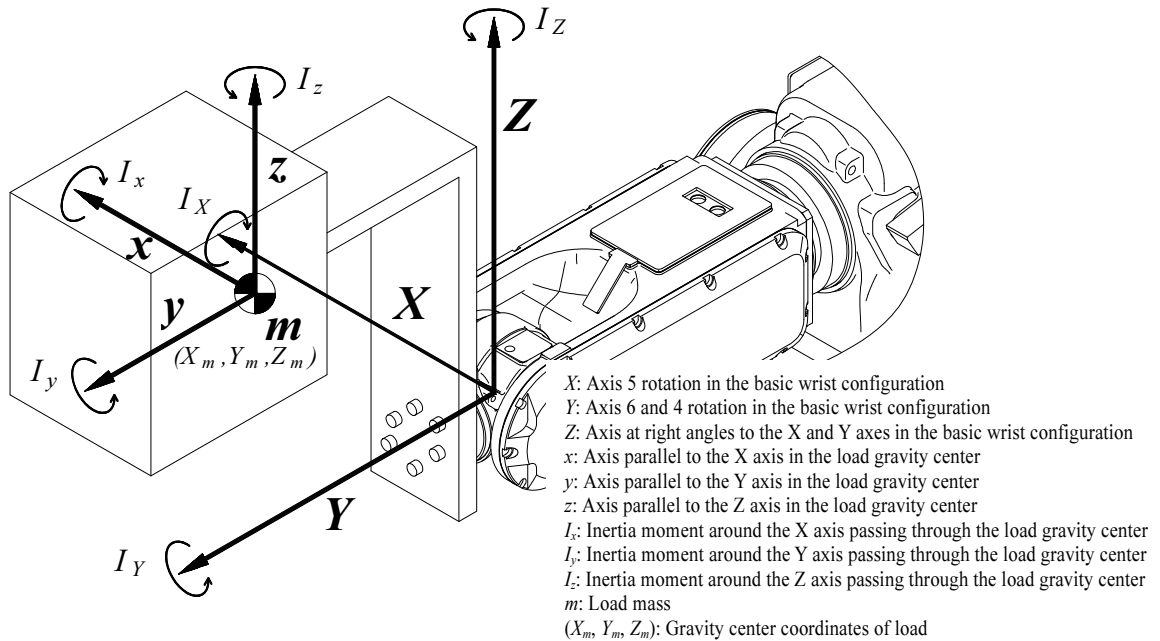


MR20L-01



■ How to calculate inertia moment of wrist axes

The method of calculating the inertia moment around a general each axis is shown below.



1. Inertia moment around axis 6

The inertia moment around axis 6 becomes the following expressions.

$$I_{J6} = I_Y = m \cdot (X_m^2 + Z_m^2) + I_y$$

2. Inertia moment around axis 4 and axis 5

The value changes into the inertia moment around axis 4 and axis 5 depending on the posture of axis 6. The maximum value around X axis and Z axis in above figure is assumed to be an inertia moment.

$$I_{J4J5} = \max (I_X , I_Z)$$

$$\because I_X = m \cdot (Y_m^2 + Z_m^2) + I_x$$

$$\because I_Z = m \cdot (X_m^2 + Y_m^2) + I_x$$

7. Option specifications

No.	Item	Specifications	Parts No.
1	Parts for installation	Chemical anchor specification (Base plate + chemical anchor bolts)	OP-F1-019
		Ore anchor specification (Base plate + ore anchor bolts)	OP-F2-015
		Installation bolts	OPJ-F1-0051
2	Axis 1 adjustable stopper	Restriction of Axis 1 operation edge (± 3.14 rad from ± 0.52 rad, every 0.17 rad)	OP-S5-013
3	Axis 2 adjustable limit switch	Axis 2 adjustable limit switch	OP-S8-004
4	Axis 3 adjustable limit switch	Axis 3 adjustable limit switch	OP-S4-002
5	Axis 7 adjustable stopper	Restriction of Axis 7 operation edge (± 1.57 rad from ± 0.00 rad, every 0.51 rad)	OP-S10-001
6	Solenoid valve plate ^{*1}	For storage in wrist of solenoid valve	OP-H1-018
7	Solenoid valve inside arm ^{*2}		(table below)
8	Additional tools	Zeroing pin & Zeroing block	For MR20-02 OP-T2-049
			For MR20L-01 OP-T2-060
9	Hanging jig	Jig for installation of ceiling mount robot	OP-S7-006
10	Assembly jig	Jig for assembling option parts	OP-TY-004
11	Name seal for ceiling mount	Name seal for MR20-02 ceiling mount	OP-N2-018
		Name seal for MR20L-01 ceiling mount	OP-N2-023
12	Water proof coolant paint	Double liquid type urethane resin paint	OP-N5-017

*1: When solenoid valve is installed inside, exhaust air must be exhausted to the outside of the robot (not inside).

*2: Detail of "Solenoid valve inside arm"

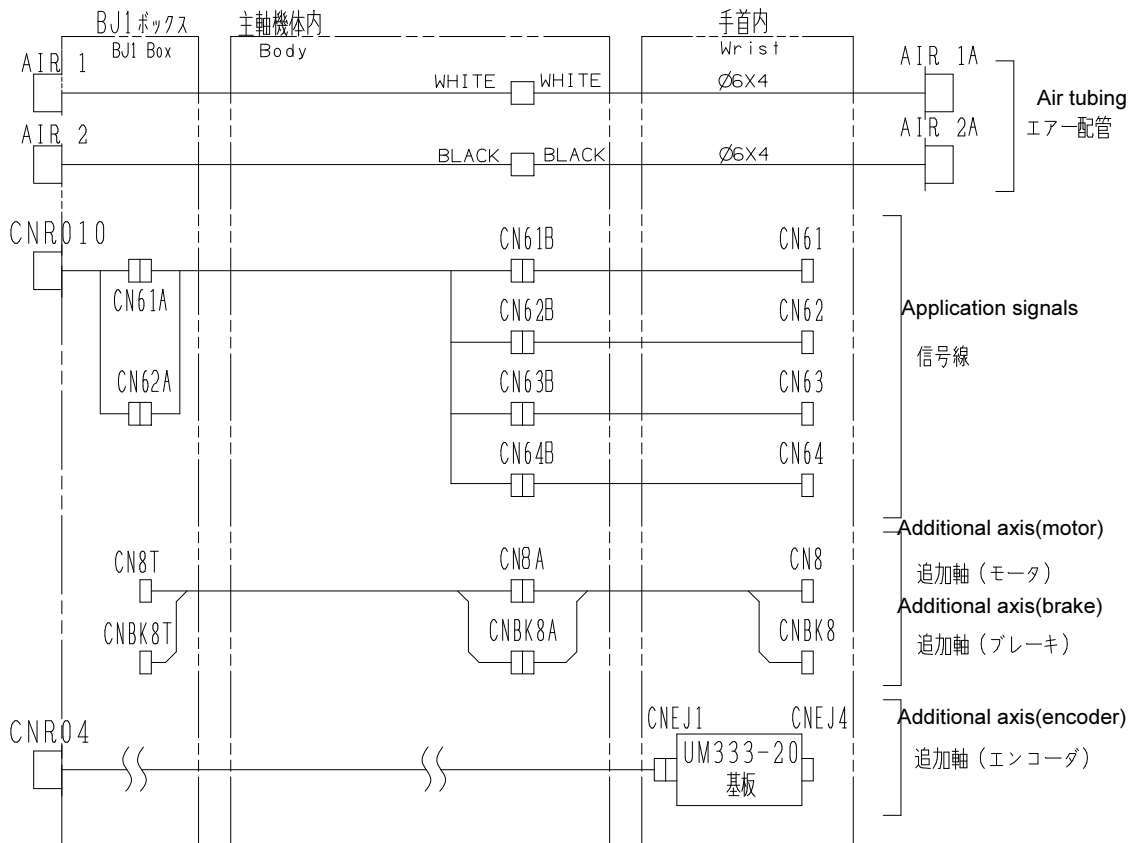
	Specifications	Parts No.
1	2 Double solenoids + Application cable	CABLEMR-DD-A + OPJ-H1-0008
2	2 Double solenoids	CABLEMR-DD + OPJ-H1-0008
3	1 Double solenoid + Application cable	CABLEMR-D-A + OPJ-H1-0010
4	1 Double solenoid	CABLEMR-D + OPJ-H1-0010
5	2 Single solenoids + Application cable	CABLEMR-SS-A + OPJ-H1-0009
6	2 Single solenoids	CABLEMR-SS + OPJ-H1-0009
7	1 Single solenoid + Application cable	CABLEMR-S-A + OPJ-H1-0011
8	1 Single solenoid	CABLEMR-S + OPJ-H1-0011
9	1 Double solenoid + 1 Single solenoid + Application cable	CABLEMR-DS-A + OPJ-H1-0012
10	1 Double solenoid + 1 Single solenoid	CABLEMR-DS + OPJ-H1-0012

Single solenoid valve type SYJ3130-5GS [SMC]

Double solenoid valve type SYJ3230-5GS [SMC]

8. Application wiring and tubing diagram (standard)

■ Wiring and tubing system diagram



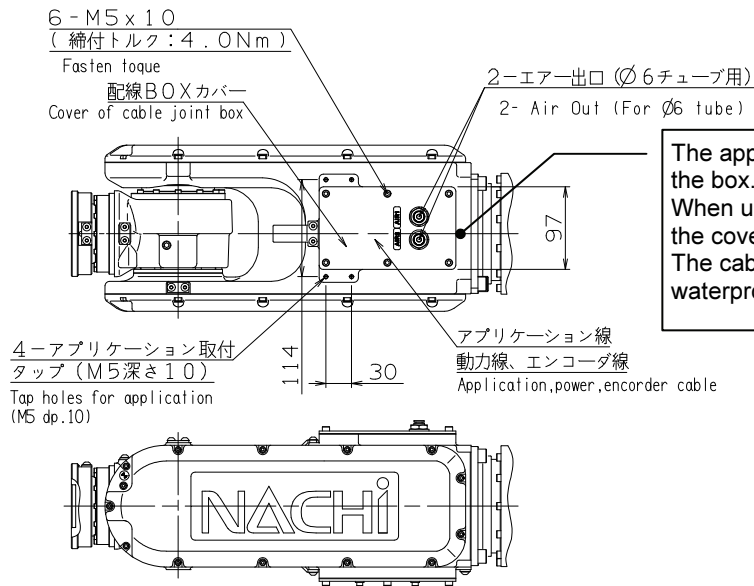
For additional axis encoder, it is necessary to use a bus-connection type encoder that is designated by NACHI. For more details, please contact our technical department.

■ Detailed diagram of the base frame

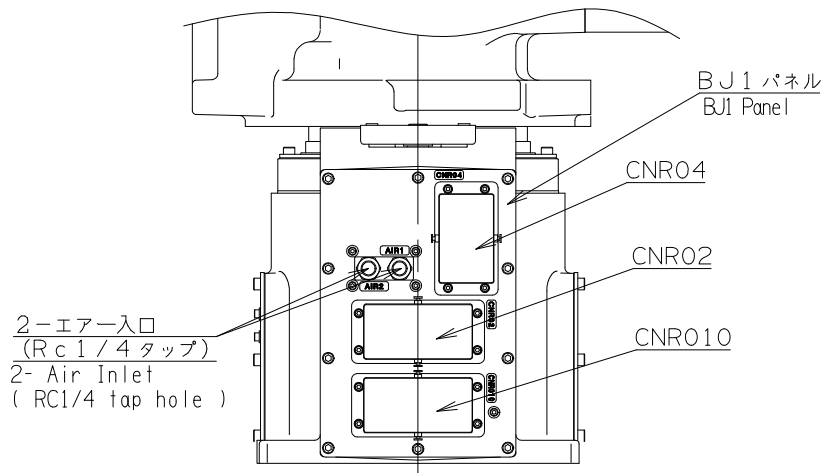


CAUTION

- When not using air, attach plugs to the air in/out holes so that water or oil can not get into the robot arm. (The plugs are attached when the robot is shipped)
- When attaching air valves or cable brackets etc., please use "Tap holes for application (4-M5)" shown in the figure. Tightening those things with the cover fixing bolts or making holes on the box cover itself may cause water leakage or oil leakage into the arm and the parts of the robot may be damaged.

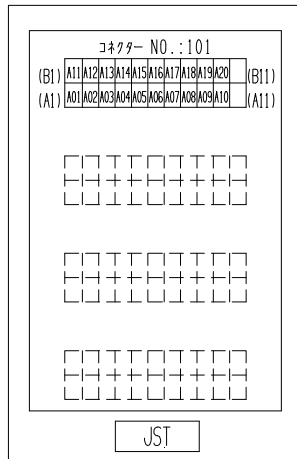


The application signal lines are in the box.
When using those, make a hole on the cover and attach a cable clamp.
The cable clamp must be waterproof type.



■ Detailed diagram of the connectors

1. BJ1 side (connector)



Connector for application cable

Wire-side shell: JFM-WSA-4-A (JST)

Guide plate A kit: FM-GPAK-4 (JST)

Receptacle housing: JFM2FDN-22V-K (JST)

Receptacle contact: SJ2F-01GF-P1.0 (JST) 0.20 ~ 0.50sq

Manual crimp tool: YRS-8861

Receptacle contact: SJ2F-21GF-P1.0 (JST) 0.30 ~ 0.75sq

Manual crimp tool: YRF-1120

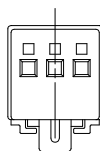
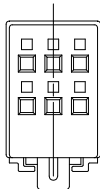
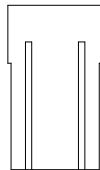
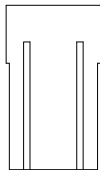
Cable diameter suitable for wire-side shell: $\phi 26.2 \sim \phi 28.0$

(This figure is drawn seeing from the backside of the robot.)

2. BJ3 side (junction connector)

CN61, CN62, CN63

CN64



Connector form (CN61, CN62 and CN63)

Housing: J21DF-06V-KX (JST)

Partner connector

Housing: J21DPM-06-KX (JST)

Contact: SJ2M-01GF-M1.0N (applicable wire: 0.20~0.50 mm²)

Manual crimp tool: YRS-8861

Contact: SJ2M-21GF-M1.0N (applicable wire: 0.30~0.75 mm²)

Manual crimp tool: YRF-1120

Contact: SJ2M-01GF-M1.0S (applicable wire: 0.20~0.50 mm²)

Manual crimp tool: YRS-8861

Connector form (CN64)

Housing: J21SF-03V-KX (JST)

Partner connector

Housing: J21SPM-03V-KX (JST)

Contact: SJ2M-01GF-M1.0N (applicable wire: 0.20~0.50 mm²)

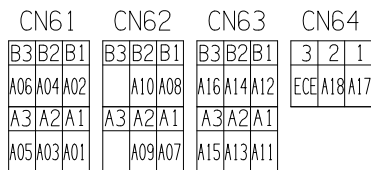
Manual crimp tool: YRS-8861

Contact: SJ2M-21GF-M1.0N (applicable wire: 0.30~0.75 mm²)

Manual crimp tool: YRF-1120

Contact: SJ2M-01GF-M1.0S (applicable wire: 0.20~0.50 mm²)

Manual crimp tool: YRS-8861






(This figure is drawn seeing from the backside of the robot.)

9. Transport procedure

Safety measures against transport

The following describes precautions for transporting the robot. Fully understand the precautions for safe transport work.

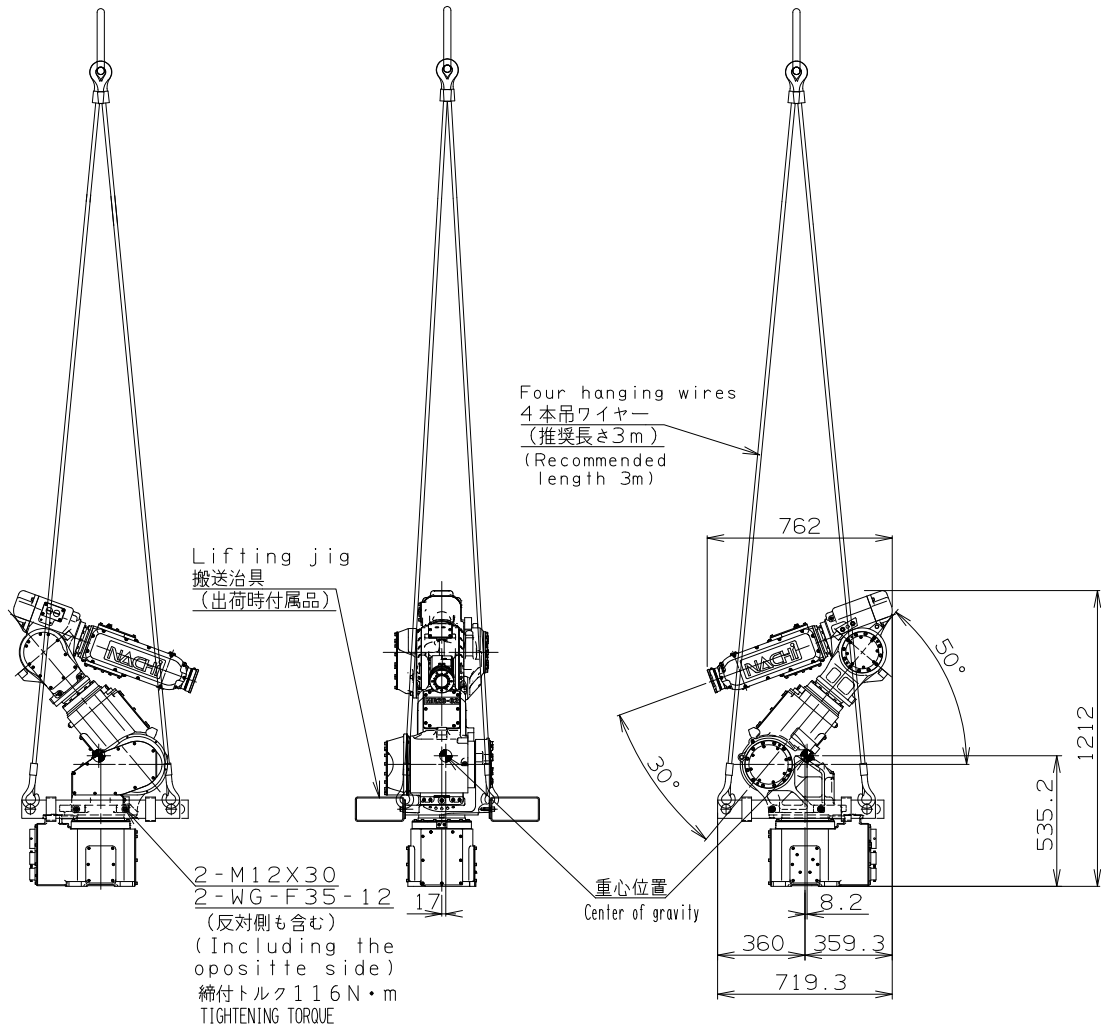
 WARNING	The robot must be transported by personnel who have licenses required for slinging work, crane operation, forklift truck operation, and others.
 WARNING	To lift the robot or the controller, follow the procedures specified in the Maintenance Manual. Following any procedures other than those specified will cause the robot to topple over or drop during transport, thus resulting in accidents.
 CAUTION	During transport or installation work of the robot, pay utmost care not to cause damage to wirings. Furthermore, after installing the robot, take protective measures such as using protective guards so that the wirings will not be damaged by workers or other persons, or forklift trucks or else.

To transport the robot, make it a rule to use a crane.

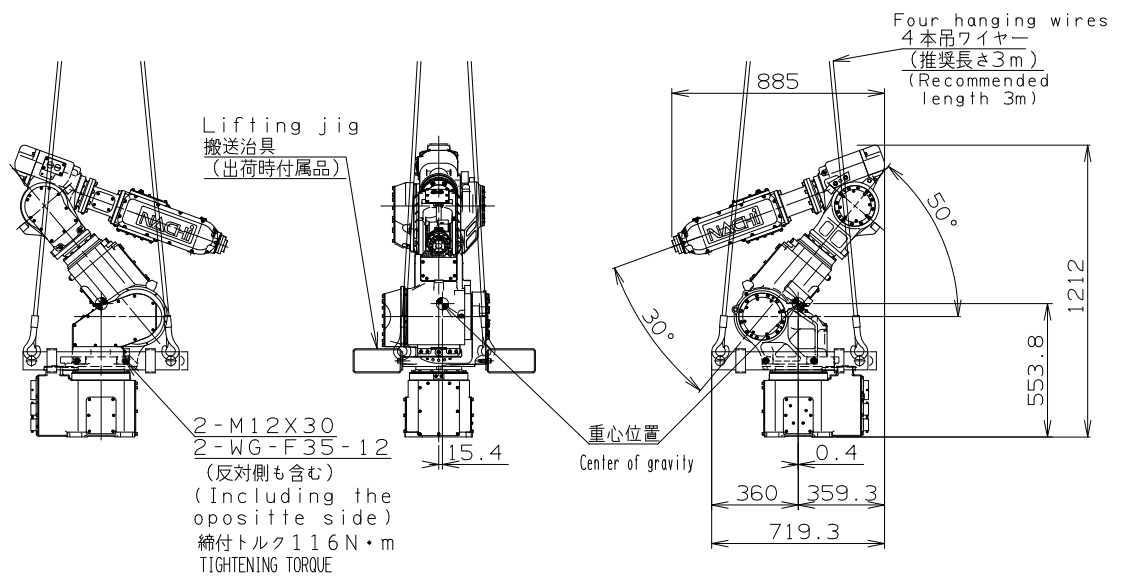
First, put the robot into the configuration shown in figure and mount the two carrier brackets dedicated to the transport of the robot to both sides of the robot frame. Then, lift the robot using four hanging wires. Fix these dedicated brackets with the two M12 X 30 bolts. The tightening torque is 116 N·m. Recommended length of the hanging wires is 3 m.

NACHI

MR20-02



MR20L-01



10. Installation (specification which contains a robot)

1. Delivery condition

Because the expense is different, which form to choose be sufficiently examined.

Style	Condition	Details
1	Delivery on the truck	Robot is delivered on the truck near the entrance of customer's plant.
2	Delivery after installation and test-run	Robot is installed and test-run done.
3	Delivery after installation and test-run with work piece	After style 2, teaching with work piece is done.

2. Operation and maintenance education

The special spot operation guide and the special spot preservation guide are the outside of the estimation. Also, there is schooling system in the Toyama factory, too.

Consult with each NACHI-FUJIKOSHI office for the details.

3. The earth wire construction of controller is class D earthing things above mentioned are necessary.

11. Consuming power (Robot + Controller)

1.0kVA (peak)

12. Paint color

Standard color	Controller cabinet	Munsell 10GY9/1
	Robot body	Munsell 10GY9/1

Water proof coolant paint option is useful for the circumstance such as that coolant splashes on robot body. Please refer to "8 Option specifications" for the type of this option.

13. Warranty

Elapse of 1 year after delivery.

The specifications and appearances in this document might change without a previous notice for the improvement.

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