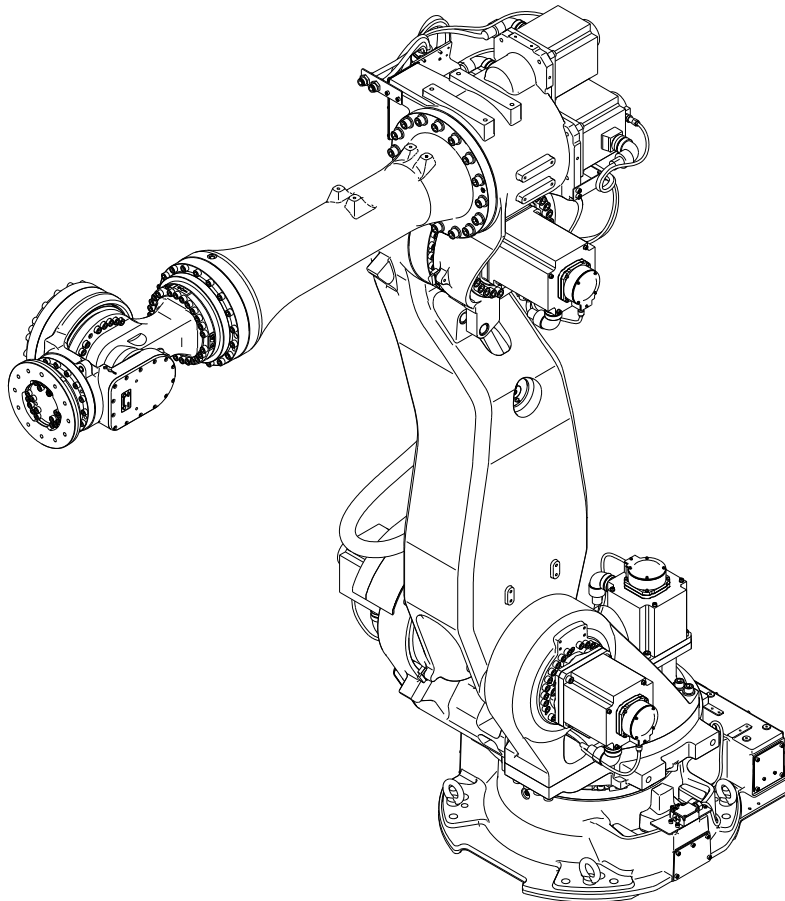


NACHI

Standard specifications

MC280L-05, -06 [TFD11]

1st edition



NACHI-FUJIKOSHI CORP.

1801, SMCEN-108-001,001

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1. Outline

“NACHI ROBOT” has used mechatronic techniques, cultivated throughout the last few decades, to supply robots suited for multi-purpose industries utilizing welding and the material handling techniques.

“MC280L” is a robot of simple highly rigid structure which is optimal for spot welding and material handling applications.

Installation	Max. payload 280kg
Floor mount	MC280L-05 MC280L-06

■ Characteristics

1. Due to high wrist torque and high moment of inertia, this robot is suitable for handling of heavy payload.
2. Wide motion range makes easier applicability than before.
3. By installing the balance unit inside arm, swivel base becomes slim and interference radius gets substantially shorter than before.
4. Due to making higher maximum speed, cycle time is shortened. Also it is possible to get faster air-cut motion that is changing wrist attitude widely.
5. This robot features the largest wrist bend angle in its class due to the slim compact wrist. The reduction of restriction due to wrist operation opens the robot to more diverse applications.
6. The required installation area has been reduced by routing water, air and cables through the swivel base for material handling application.

2. Basic specifications

Item	Specifications	
Robot model	MC280L-05, -06	
Construction	Articulated	
Number of axis	6	
Drive system	AC servo motor	
Max. working envelope	Axis 1	± 3.14 rad ($\pm 180^\circ$)
	Axis 2	$+1.75 \sim -0.70$ rad ($+100 \sim -40^\circ$)
	Axis 3	$-2.57 \sim +2.27$ rad ($-147 \sim +130^\circ$)
	Axis 4	± 6.28 rad ($\pm 360^\circ$)
	Axis 5	± 2.18 rad ($\pm 125^\circ$)
	Axis 6	± 6.28 rad ($\pm 360^\circ$)
Max. speed	Axis 1	1.83 rad/s ($105^\circ/s$)
	Axis 2	1.83 rad/s ($105^\circ/s$)
	Axis 3	1.66 rad/s ($95^\circ/s$)
	Axis 4	2.09 rad/s ($120^\circ/s$)
	Axis 5	2.09 rad/s ($120^\circ/s$)
	Axis 6	3.49 rad/s ($200^\circ/s$)
Max. pay load	Wrist	280 kg
	Forearm *1	25 kg at maximum
Allowable static load torque	Axis 4	1921 N·m
	Axis 5	1921 N·m
	Axis 6	988 N·m
Allowable moment of inertia *2	Axis 4	400 kg·m ²
	Axis 5	400 kg·m ²
	Axis 6	250 kg·m ²
Position repeatability *3	± 0.2 mm	
Installation	Floor mounting	
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)	
Robot mass	1660 kg	

1[rad] = $180/\pi$ [°], 1[N·m] = 1/9.8[kgf·m]

- On controller display, axis 1 to 6 is displayed as JT1 to JT6 for each.

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

- Explosion-proof is not available.

- Concerning the -05 type and the -06 type, only the internal application cable specification is different. (-05 : "DeviceNet", -06 : "Ethernet")

*1: This value changes by placement and load conditions of a wrist.

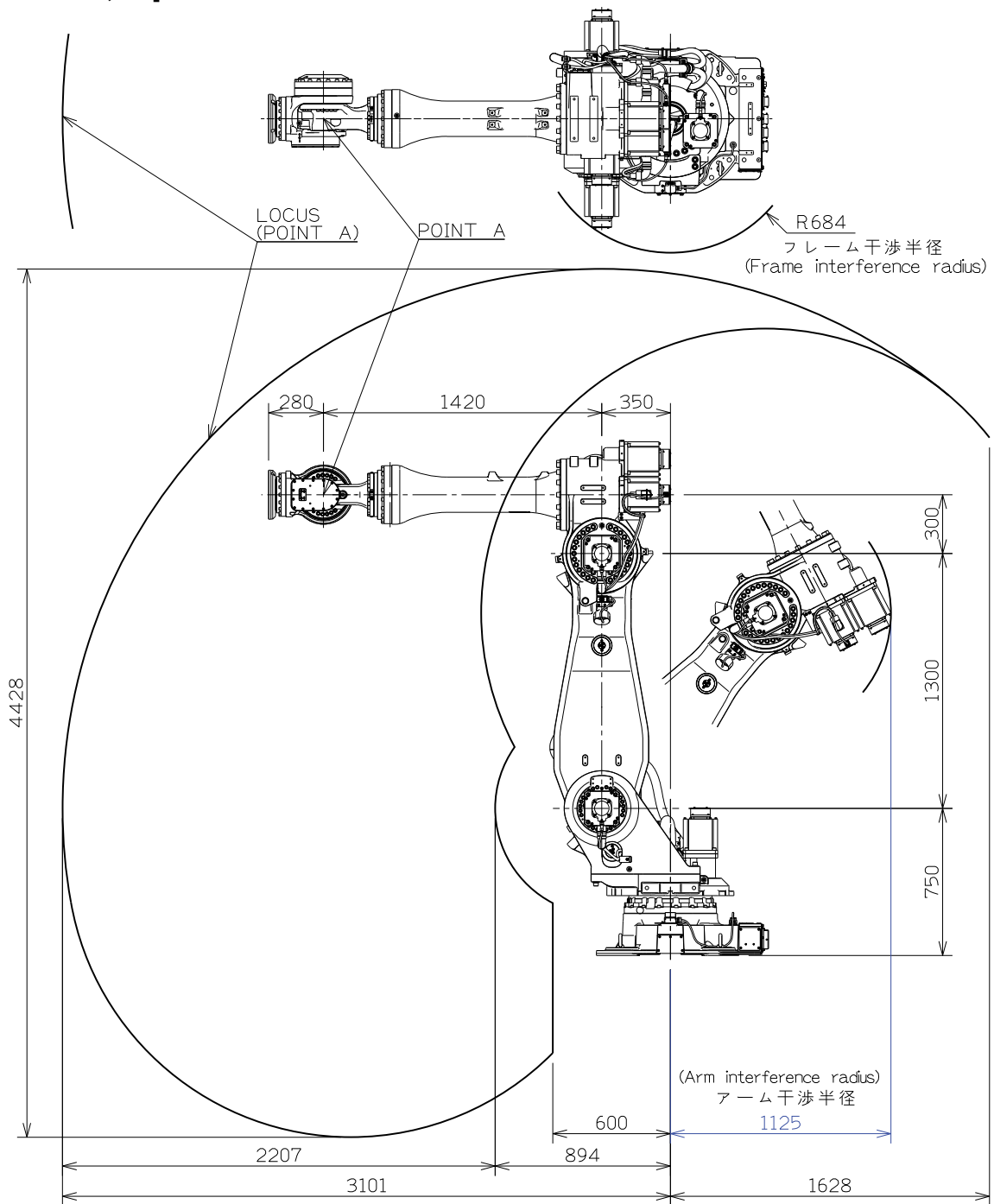
*2: The Allowable moment of inertia of a wrist changes with load conditions of a wrist.

*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.

3. Robot dimensions and working envelope


[MC280L-05, -06]



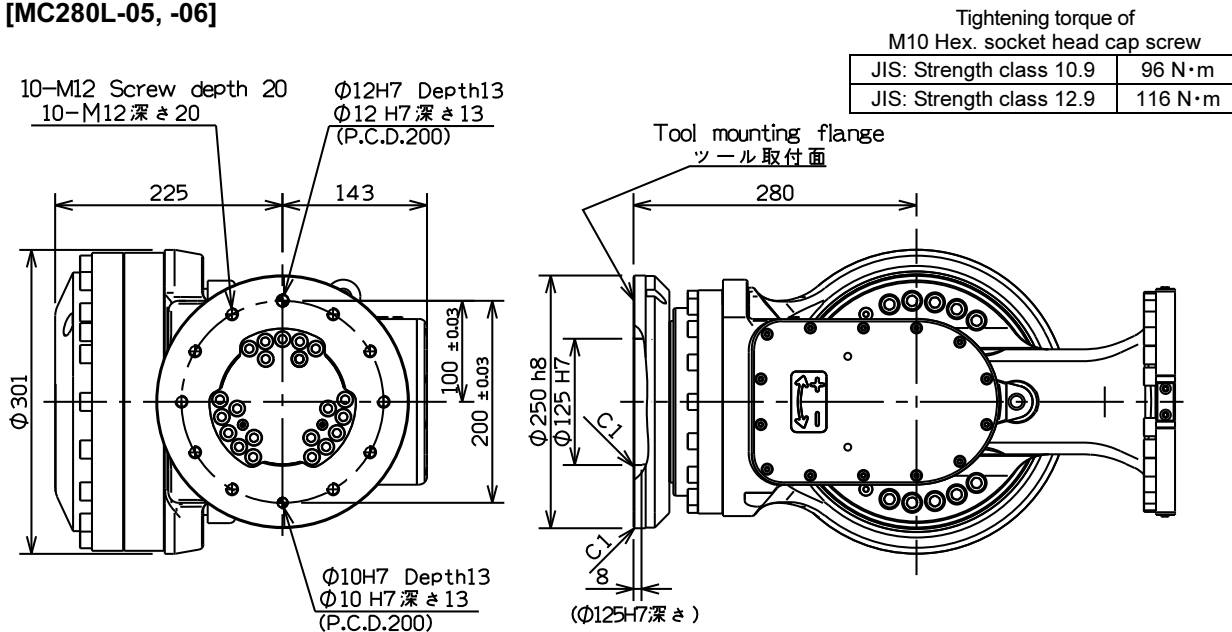
4. Detail of load mounting plate

■ Wrist

For the end effector fixing bolts, use the mounting P.C.D. shown in the following figures.
Besides the mounting P.C.D., different P.C.D. (option) is available. For details, contact our service division.

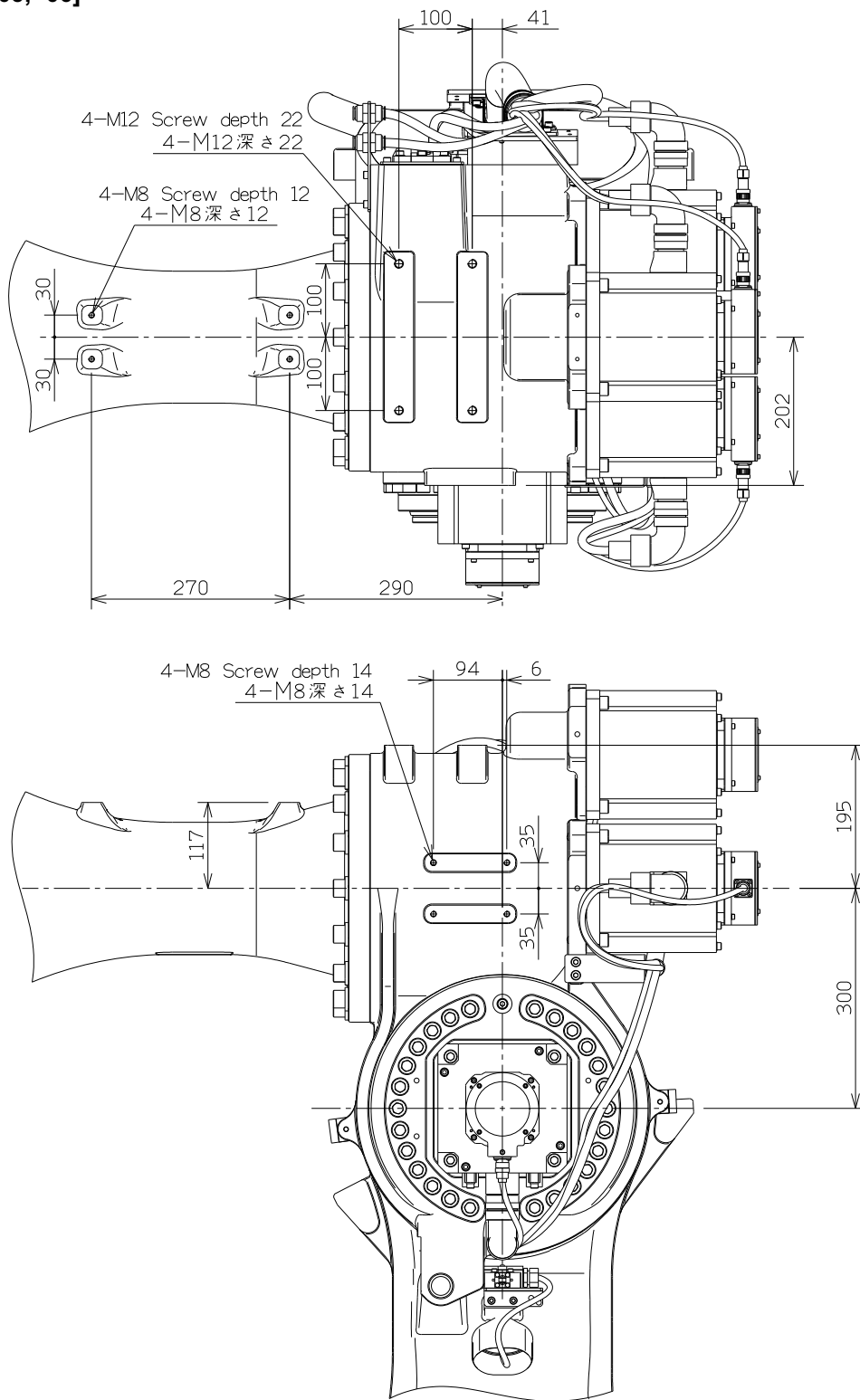
 CAUTION	Be sure to screw the M12 tool fixing bolts in the wrist not deeper than the screw depth in the mounting face. Screwing the bolts deeper than the screw depth may damage the wrist.
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[MC280L-05, -06]



■ Upper part of forearm

[MC280L-05, -06]




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

 <p>WARNING</p>	<p>While the robot is in operation, workers are in danger of coming in contact with the robot. To avoid that, install a guard 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 not only the static loads but also the reaction force caused by robot movement.

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	All
Thickness of floor concrete	Not less than 160 mm
Installation parts *1	8 bolts of M20 (JIS: Strength class 12.9) not less than 65mm 8 plain washers of not less than 4.5 mm in thickness and HRC35 in hardness
Tightening torque *2	560 ± 30 N·m
Allowable repeated tensile *3	Approximately 47,000 N




*1 : Installation parts are not accessory of robot.

*2 : Apply a coating of lubricating oil to the threaded parts of bolts, and then tighten bolts by using torque wrench to the specified tightening torque.

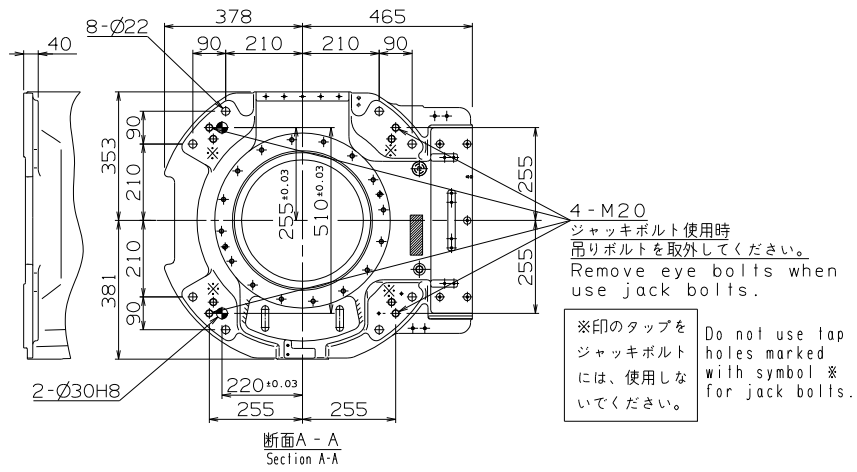
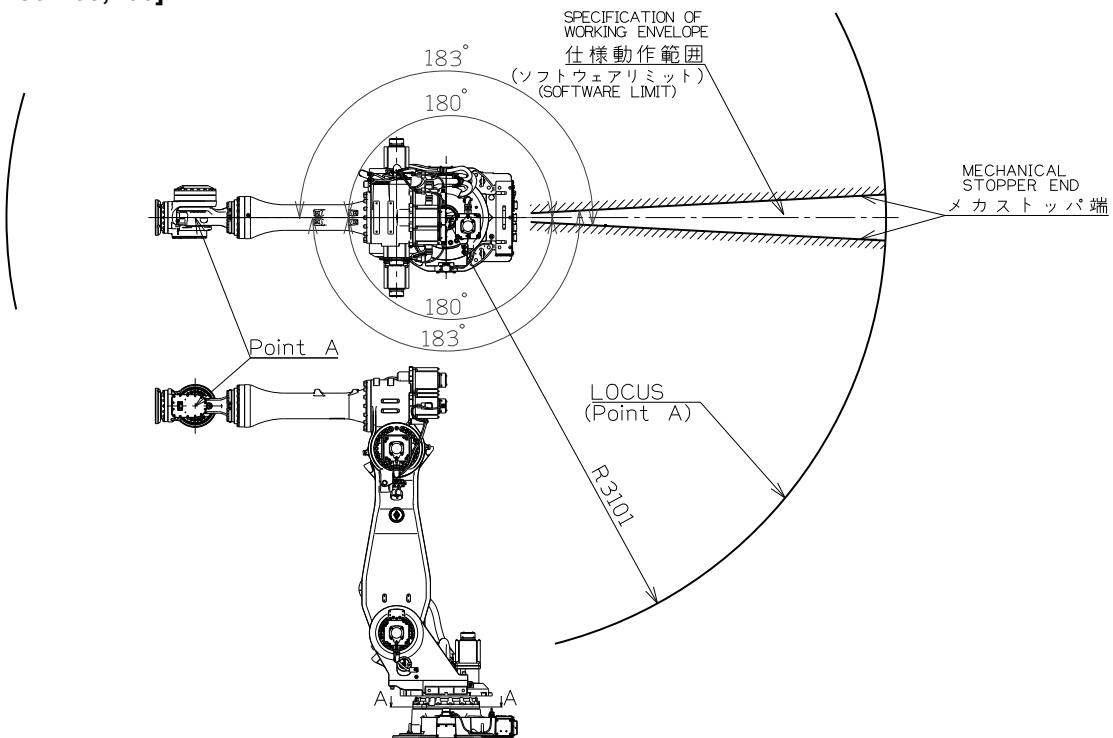
*3 : This tensile is per installation bolt when robot is installed with all bolts written in table above.

■ Installation space

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

 WARNING	<p>The mechanical stopper end is located in a position exceeding the specified working envelope (software limit) of axis 1 by 3°. To install the safety fence, with consideration given to the wrist configuration and the shape of end effector.</p>
 WARNING	<p>On axes 1, 2 and 3, the robot working envelope can be regulated for safety (optional function). Since optional parts should be installed to enable this function, do not independently move the standard parts (e.g. mechanical stopper).</p>
 WARNING	<p>If mechanical stopper collides and robot stops, it's possible that some parts are already damaged, for example, mechanical stopper is transformed or fixing bolts are broken. In this case, sufficient intensity and function can not be kept. Mechanical stopper and reduction gear of collided joint are needed to be replaced to the new one.</p>

[MC280L-05, -06]



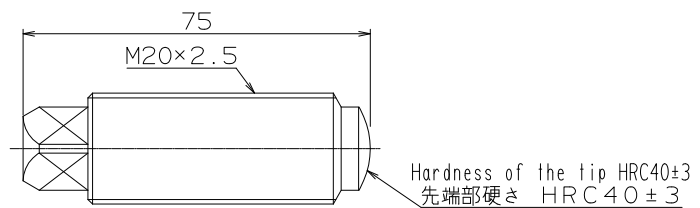
■ Accuracy of installation surface

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 1.0 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 1.0 mm (± 0.5 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.

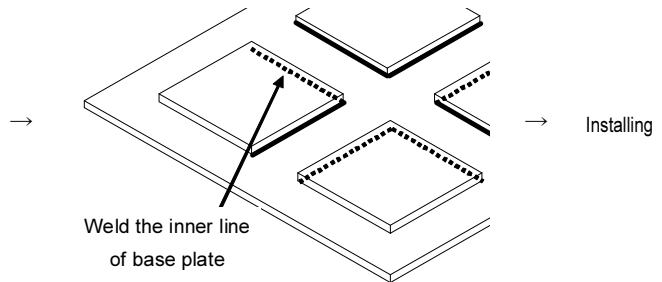
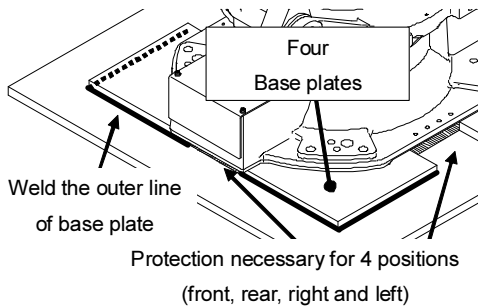


■ Welding of base plate

Protect the space (4 places of the front, back, left and right) on robot bottom and installed side by the cover etc. as follows when you weld with the base plate installed in the robot body by the welding spatter and the spark, etc. so that wiring in the robot should not receive damage. After welding the outer line, once remove the robot and weld the inner line.

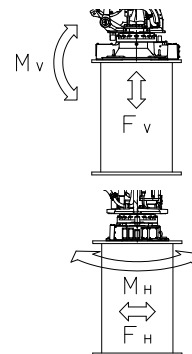
Temporary install the robot, and weld the outer line of base plate.

Once remove the robot and weld the inner line.



■ Maximum robot generative force

Robot model	Max. vertical generative force F_V	Max. horizontal generative force F_H	Max. vertical generative moment M_V	Max. horizontal generative moment M_H
All	64,900 N	47,300 N	147,700 N·m	122,200 N·m



6. Allowable wrist load



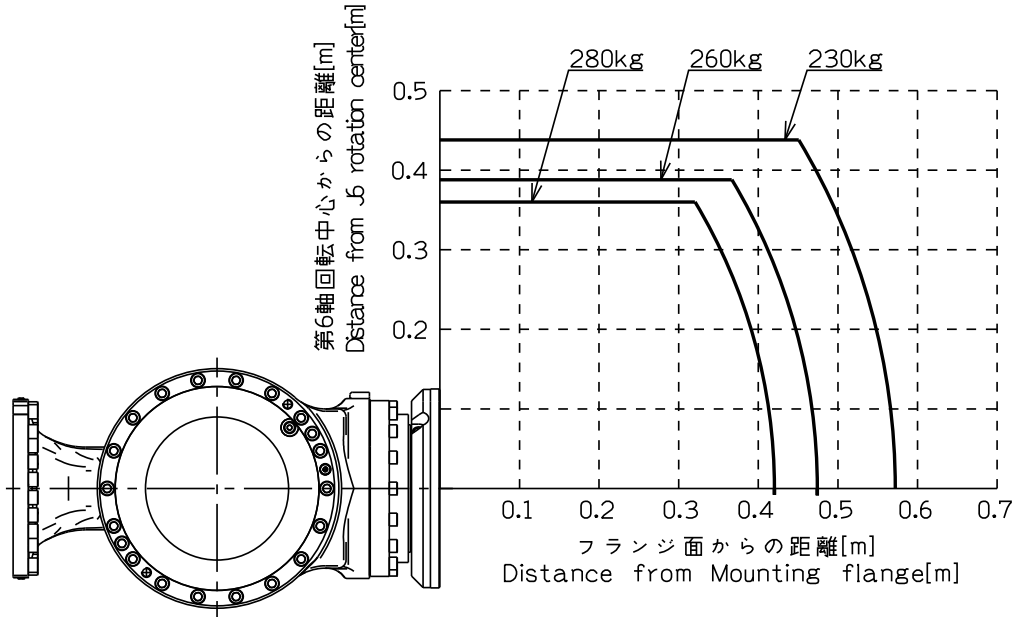
CAUTION

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.

■ Torque map

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

MC280L-05
MC280L-06



■ Wrist load conditions

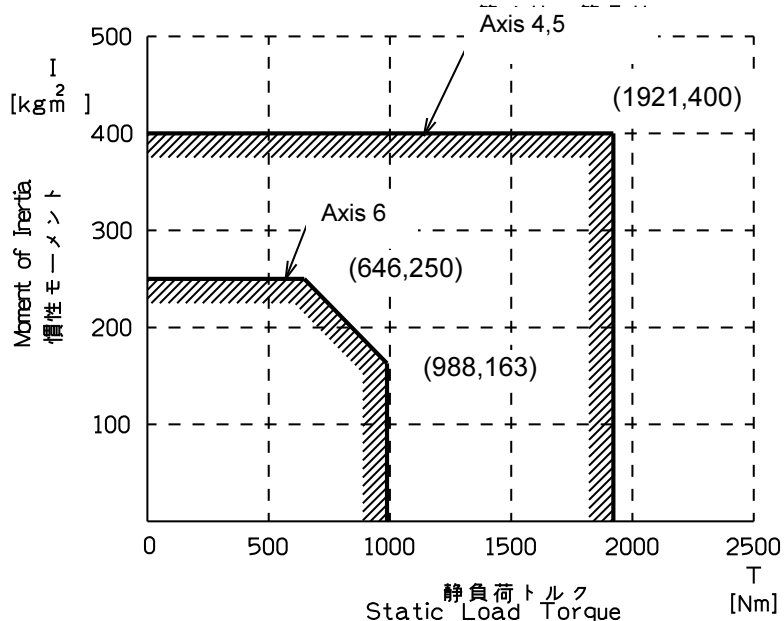
Static load torque and moment of inertia of wrist load should exist inside the range shown below.



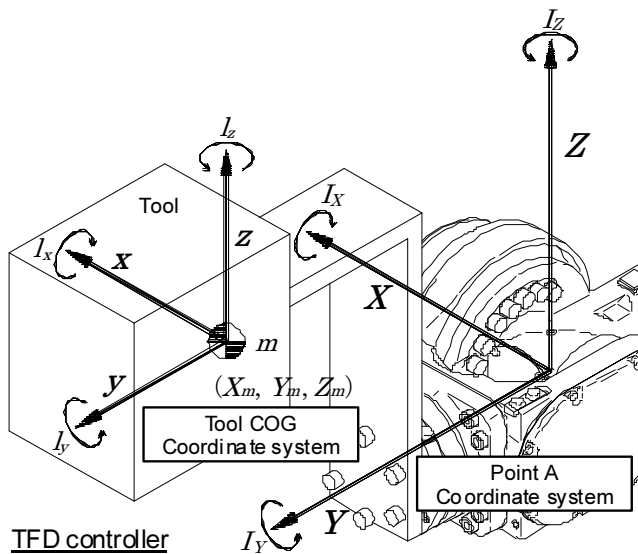
IMPORTANT

If the real inertia is over the limit, maximum speed will be restrained by software to protect the robot.

MC280L-05
MC280L-06



How to find the inertia moment of each axis



Point A coordinate system

Origin is Point A (intersection point of axis 6, 4 rotation center and axis 5 rotation center) and its X, Y and Z direction are defined as
 X: Axis 5 rotation center when wrist is in reference position
 Y: Axis 6 and 4 rotation center when wrist is in reference position
 Z: Perpendicular coordinate with Y, Z

Tool COG coordinate system

Origin is COG of tool, and parallel to point A coordinate system
 x: Parallel to X
 y: Parallel to Y
 z: Parallel to Z

Inertia moment

I_x: Around X on point A coordinate system
 I_y: Around Y on point A coordinate system
 I_z: Around Z on point A coordinate system
 I_x: Around x on tool COG coordinate system
 I_y: Around y on tool COG coordinate system
 I_z: Around z on tool COG coordinate system

m: Tool mass

(X_m, Y_m, Z_m): COG of tool on point A coordinate system

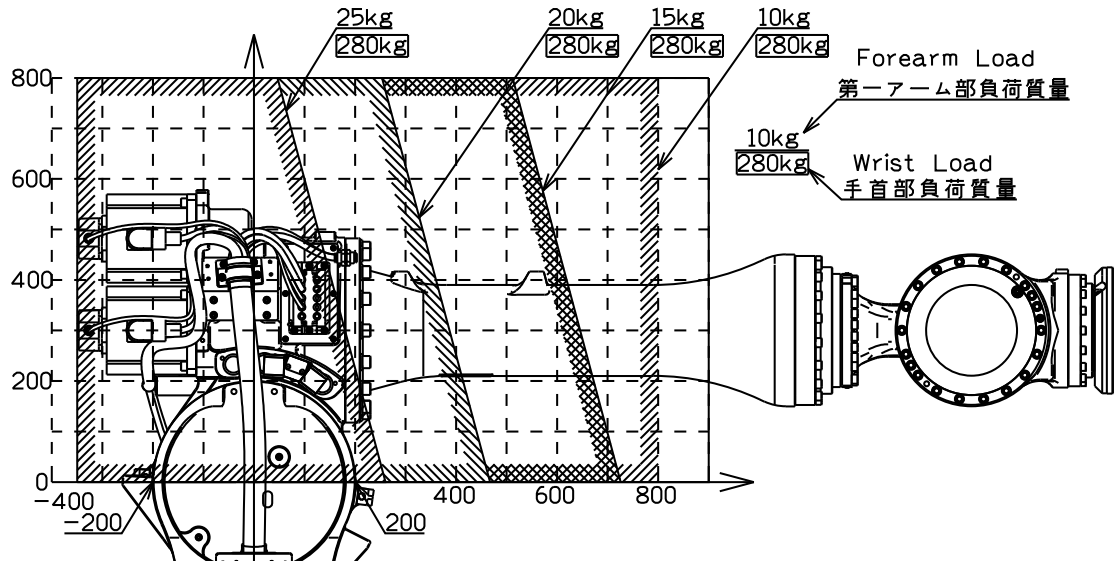
TFD controller

<p>1 Calculate inertia moment defined on tool COG coordinate system (xyz). If tool is regarded as prism, it is calculated as right formula.</p>	<p>Inertia moment example on tool COG coordinate system</p> <p>If tool is regarded as prism</p> $I_x = \frac{1}{12} m \cdot (A^2 + C^2)$ $I_y = \frac{1}{12} m \cdot (B^2 + C^2)$ $I_z = \frac{1}{12} m \cdot (A^2 + B^2)$ <p>These values (I_x, I_y, I_z) are registered to controller.</p> <p>Inertia moment on tool COG coordinate system</p> <p>This is different from "allowable moment of inertia" written in robot specification sheet.</p>
<p>2 Calculate inertia moment defined on point A coordinate system (XYZ), then calculate inertia moment around robot wrist joint (axis 4, 5 and 6). This result must not be larger than "Allowable moment of inertia" written in robot specification sheet.</p>	<p>Inertia moment on point A coordinate system (XYZ) is</p> $I_X = m \cdot (Y_m^2 + Z_m^2) + I_x$ $I_Y = m \cdot (X_m^2 + Z_m^2) + I_y$ $I_Z = m \cdot (X_m^2 + Y_m^2) + I_z$ <p>Axis 4 and 5 inertia moment is larger value of I_x and I_y, because this depends on axis 6 position. Axis 6 inertia moment is I_y itself.</p> $I_{JT4} = I_{JT5} = \max(I_X, I_Z)$ $I_{JT6} = I_Y$

■ Allowable forearm load

Use the robot under condition that COG of the ancillary equipment on the forearm falls in the range shown below.

MC280L-05
MC280L-06



7. Option specifications

○: Possible to correspond / —: Impossible to correspond

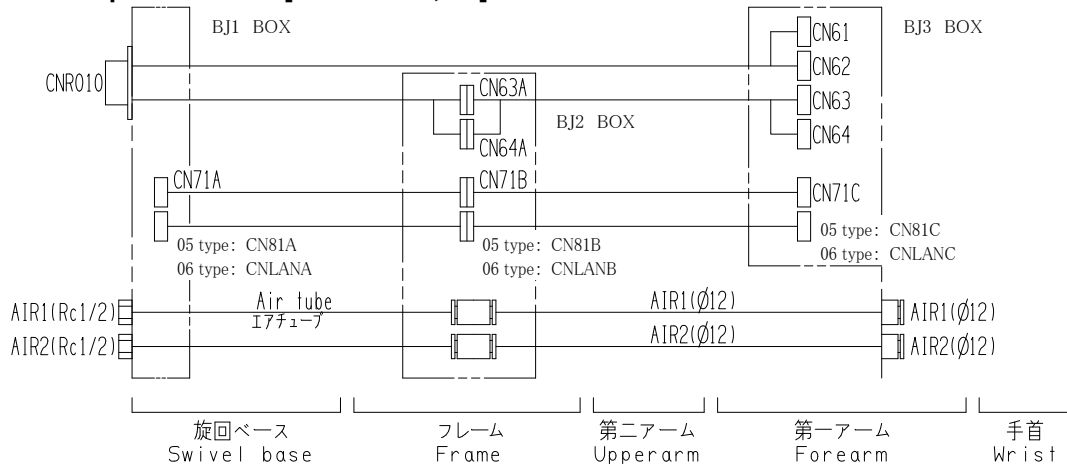
No.	Item	Specifications		Parts No.	Robot model
					MC280L-05,06
1	Installation parts *1	Chemical anchor specification	with pin hole	OP-F1-024	○
		Base plate welded	without pin hole	OP-F1-028	○
		Hammer drive anchor specification	with pin hole	OP-F2-018	○
		Base plate welded	without pin hole	OP-F2-019	○
		Pins set (Installation pins & polyethylene plug)		OP-F1-025	○
		Leveling plate (□200mm×t=32mm, 4 plates)		OP-F1-026	○
		Installation bolts & washers		OP-F1-027	○
		Chemical anchor		OP-F1-038	○
Hammer drive anchor		OP-F2-023	○		
2	Axis 1 adjustable stopper *1	Restriction of axis 1 operation edge Including adjustable limit switch dog (±2.61 rad every 0.17 rad)		OP-S5-012	○
3	Axis 2 adjustable stopper *1	Restriction of axis 2 operation edge (-0.26 and -0.52 rad from the operation edge)		OP-A5-027	○
4	Axis 3 adjustable stopper *1	Restriction of axis 3 upside operation edge (-1.05 rad·-1.31 rad from upper end, -1.31 rad from lower end)		OP-A5-027	○
5	Axis 2 adjustable LS dog	Axis 2 axis adjustable limit switch dog set		OP-S8-008	○
6	Axis 3 adjustable LS dog	Axis 3 axis adjustable limit switch dog set		OP-S4-012	○
7	Axis 1 base LS	To detect Axis 1 zone	No LS (dog only) 1 base	—	—
			No LS (dog only) 3 bases		
8	Axis 2 arm clear LS	To detect axis 2 home position and back position	With dog attaching plate	—	—
			Without dog attaching plate		
9	Transfer jig	Fork bracket for floor mounting type		OP-S2-041	○
10	Zeroing pin & block *1			OP-T2-073	○
11	ISO Flange adapter	Converts to the tool installation size of ISO		OP-W2-010	○
12	Flange adapter *2	Converts to the tool installation size of P.C.D.113		OP-W2-011	○
13	Dual circuit limit switch	For axis 1, 2 and 3 (3pcs. of dual circuit LS)		standard	○
14	Encoder connector Protector	For axis 1, 2 and 3		OP-P6-008	○
15	Bypass cable *1			BCUNIT20-100	○
16	Scale seal	For wrist three axes		standard	○

*1 : These parts are packed separately from the robot. (Not attached on the robot)

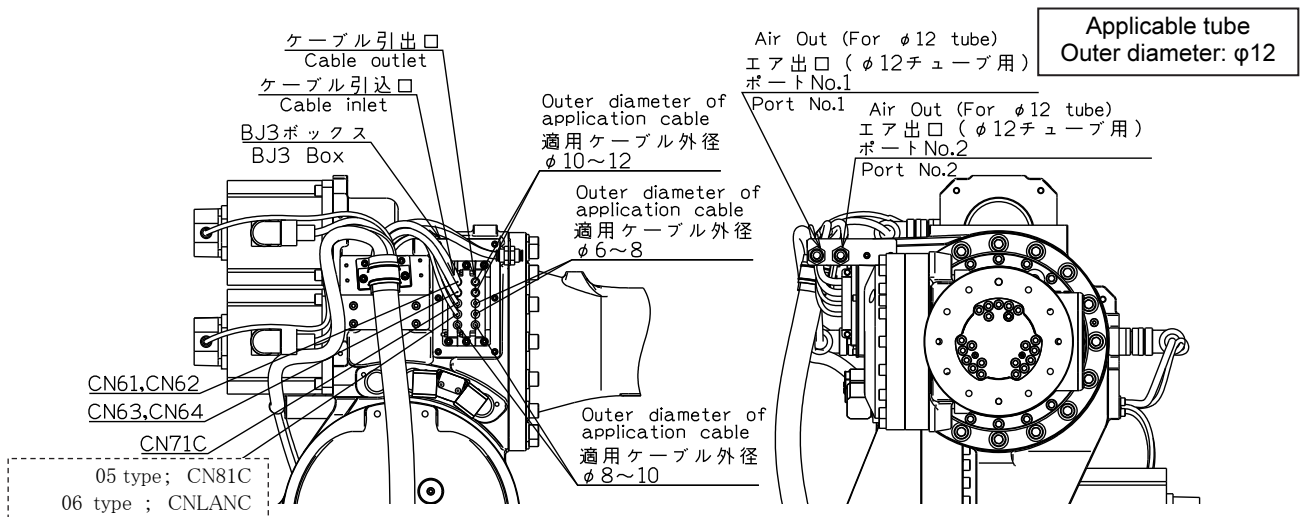
*2 : Flange adapter can't be installed alone. Purchase it together with OP-W2-010 and attach it.

8. Application wiring and piping diagram

■ Standard specification [MC280L-05,-06]

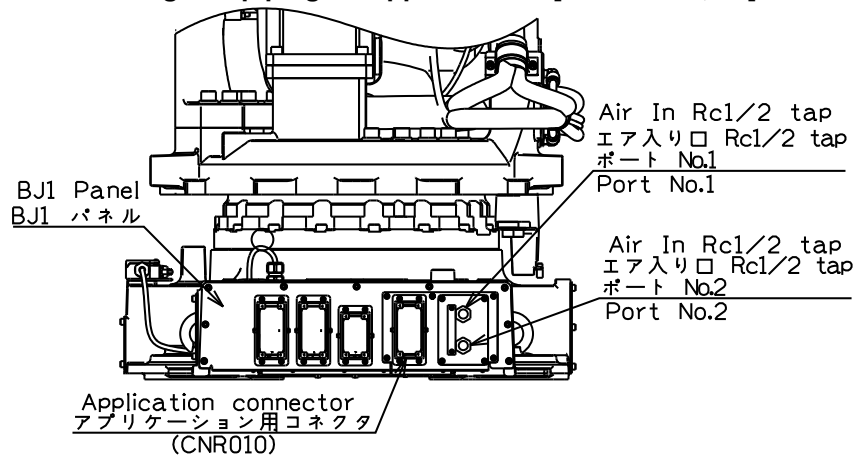


■ Upper part of forearm - Wiring and piping for application [MC280L-05,-06]



(NOTE) In wiring box BJ3, there are application connectors shown in the next page
When connecting cables inside BJ3, select the adequate hole that corresponds to the cable size.

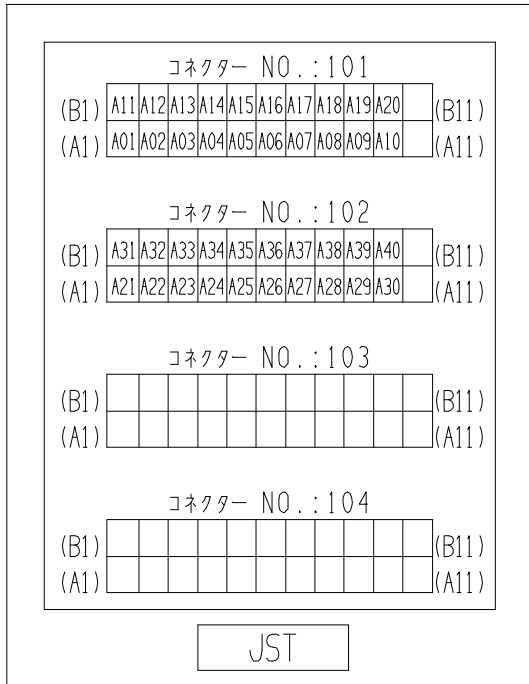
■ Base frame block - Wiring and piping for application [MC280L-05,-06]



(NOTE) In wiring box BJ1, there are application connectors shown in next page. In order to connect application wires (05 type; Devicenet, 06 type; Ethernet), BJ1 panel needs to be processed by customer.

■ Details of application connectors (standard) [MC280L-05, -06]

BJ1 side (connector)



User-side Connectors

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

or JFM-WSA-4-C (JST)

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

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

Receptacle contact:

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

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

Manual crimp tool:

a: YRS-8861

b: YRF-1120

Cable diameter suitable for wire-side shell:

JFM-WSA-4-A $\phi 26.2 \sim \phi 28.0$

JFM-WSA-4-C $\phi 15.5 \sim \phi 16.5$

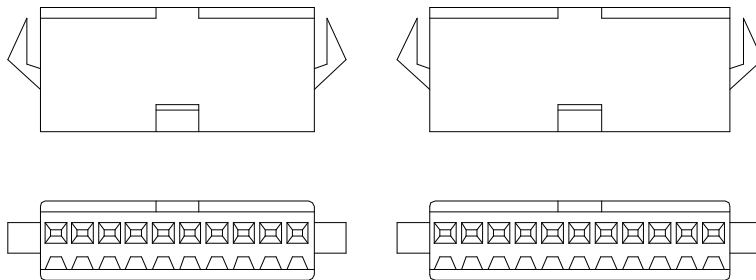
(Pin location shows the connector mounted on robot body and is the view from connecting side.)

Application wiring specification

Rated voltage Max. AC/DC 115 V

Rated current rating Max. 1 A

BJ3 side (connector)



CN61

1	2	3	4	5	6	7	8	9	10
A01	A02	A03	A04	A05	A06	A07	A08	A09	A10

CN62

1	2	3	4	5	6	7	8	9	10	11
A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	ECE

CN63

1	2	3	4	5	6	7	8	9	10
A21	A22	A23	A24	A25	A26	A27	A28	A29	A30

CN64

1	2	3	4	5	6	7	8	9	10	11
A31	A32	A33	A34	A35	A36	A37	A38	A39	A40	ECE

Connector models (CN61,CN63)

Housing SMP-10V-BC (JST)

User-side connectors

Housing SMR-10V-B (JST)

Contact SYM-001T-P0.6

(Suitable cable: AWG#22~28)

Manual crimp tool: YRS-121

Connector models (CN62,CN64)

Housing SMP-11V-BC (JST)

User-side connectors

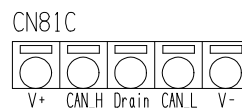
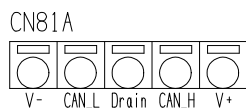
Housing SMR-11V-B (JST)

Contact SYM-001T-P0.6

(Suitable cable: AWG#22~28)

Manual crimp tool: YRS-121

■ Details of DeviceNet connectors (standard) [MC280L-05]

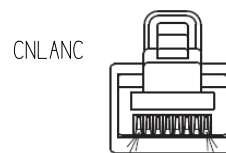
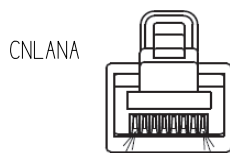


Connector
in wiring box BJ1

Connector
in wiring box BJ3

		CN81A	CN81C
Connector		231-635/010-DM	231-305/037/010-DM
User-side connector	Connector	231-305/037/010-DM	231-635/010-DM
	Crimp tool	231-131	
	Contact	CAN_L, CAN_H : 216-301 V-, V+ : 216-201 Drain : 216-201 Crimp tool : 206-204	

■ Details of Ethernet connectors (standard) [MC280L-06]

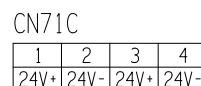
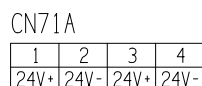


Connector
in wiring box BJ1

Connector
in wiring box BJ3

		CNLANA	CNLANC
Connector	RJ45 plug connector	6-569550-2	6-569550-2
User-side connector	Hood	RJ45 type connector	RJ45 type connector

■ Details of 24V power connectors (standard) [MC280L-05,-06]







Connector
in wiring box BJ1

Connector
in wiring box BJ3

		CN71A	CN71C
Connector	Housing	VLR-04V	VLP-04V
User-side connector	Housing	VLP-04V	VLR-04V
	Contact	SVF-61T-P2.0 (0.5~2.0 mm ²) SVF-42T-P2.0 (0.3~1.25 mm ²)	SVM-61T-P2.0 (0.5~2.0 mm ²) SVM-42T-P2.0 (0.3~1.25 mm ²)
	Retainer	VLS-02V	
	Crimp tool	YC-590 (SV*-61T-P2.0) YC-592 (SV*-42T-P2.0)	

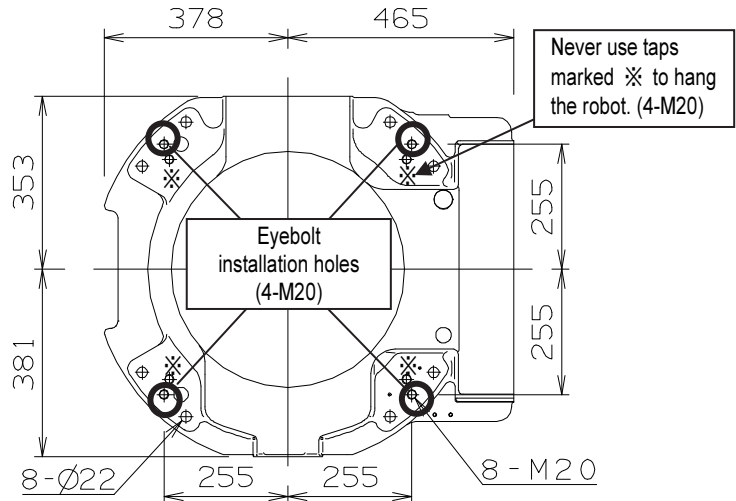
(NOTE) (Pin location shows the connector mounted on robot body and is the view from connecting side.)
Adequate contact and manual crimp tool should be used for each cable.
User-side connectors need to be prepared by customer.

9. Transport procedure

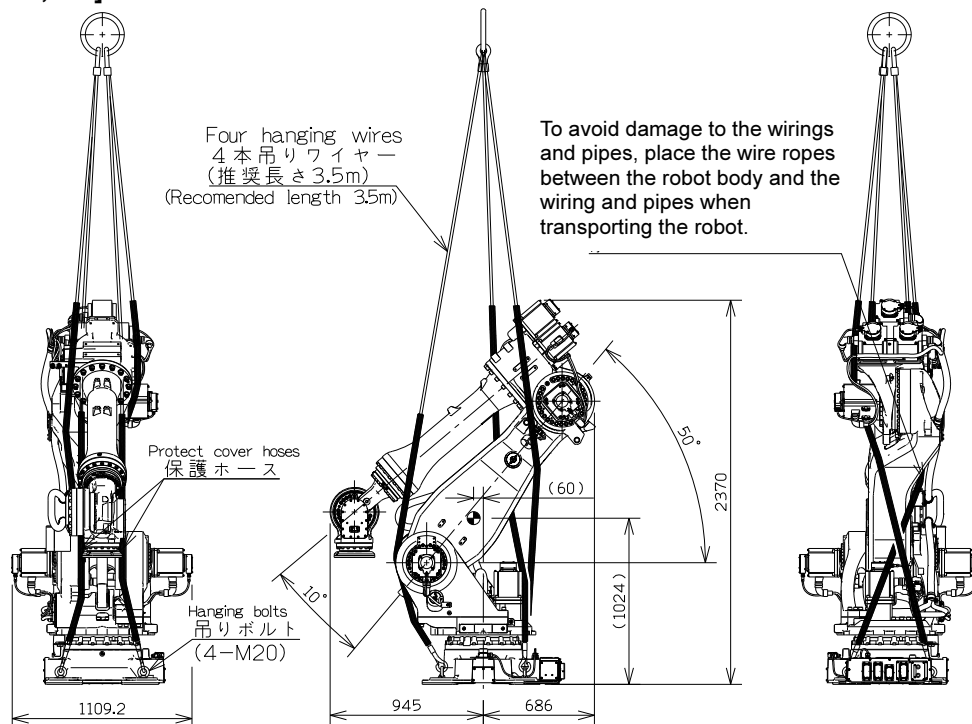
 WARNING	The robot must be transported by personnel who have licenses required for slinging work, crane operation, forklift truck operation, and others. The weight of the robot and controller is listed in the Operating Manual and the Maintenance Manual. Check for the weight, and then handle them according to procedures suitable for the weight.
 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.
 WARNING	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.
 CAUTION	If hanging wires push the encoder connectors or wiring/piping, they may be broken when hanging the robot. When hanging the robot, please pay attention not to make the wires touch the encoder connectors and wiring/piping.

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

At first, move the robot to the configuration shown in figure and mount four M20 hanger bolts to the robot frame. Then, be sure to lift the robot using four hanging wires (recommended length is 3.5m). Protect areas that contact the robot by rubber hoses to cover the wire ropes. For the areas to be covered, please refer to figure.



[MC280L-05, -06]



10. Delivery style (specification which contains a robot)

1. There are three styles as shown below.

	Style	Details
1	Delivery on the truck	Robot is delivered on the truck near the entrance of customer's plant. (Installation and test-run is not included)
2	Delivery after installation and test-run	Robot is installed and test-run is done. (Teaching with work piece is not included.)
3	Delivery after installation and teaching with work piece	After style 2, teaching with work piece is done.

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

2. Operation and maintenance education

The special spot operation guide and the special spot preservation guide are the outside of the estimation. Consult with each NACHI-FUJIKOSHI office for the details as for the schooling system.

11. Consuming power (Robot + Controller)

9.0 kVA at maximum (may vary according to the application and motion pattern.)

12. Paint color

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

13. Warranty

Elapse of 1 year after delivery. (8 hours/day running)

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

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