

**NACHI**

Standard specifications

**MR35/50-01-AX20/FD11**

10th edition



**NACHI-FUJIKOSHI CORP.**

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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, spray painting and the material handling techniques.

"MR series" is a robot for handling that flexible operation becomes possible by seven-axis structure. "MR35-01" is the basic model, and 2 types of robots are featured in the "MR series".

Load weight	35 kg	50 kg
Installation	MR35-01	MR50-01
Floor mount Inverted mount (option) Wall mount (option) Tilted mount (option)		

In case of wall mount and tilted mount, working envelope of axis 1 is limited. Consult with each NACHI-FUJIKOSHI office for detail.

### ■ 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. 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.
3. The application that can be applied has extended, because the environmental resistance became IP67.
4. It became easy to add the cables and the hoses for the application by installing "S-Trac" and "A-Trac".

## 2. Basic specifications

Item		Specifications	
Robot model		MR35-01	MR50-01
Construction		Articulated	
Number of axis		7	
Drive system		AC servo motor	
Max. working envelope	Axis 1	±2.88 rad (±165 °)	
	Axis 2	+0.96 ~ -2.09 rad (+55 ~ -120 °)	
	Axis 3	+2.44 ~ -2.55 rad (+140 ~ -146 °)	
	Axis 4	±6.28 rad (±360 °)	
	Axis 5	±2.18 rad (±125 °)	
	Axis 6	±7.84 rad (±450 °)	
	Axis 7	±3.32 rad (±190 °)	
Max. speed	Axis 1	3.14 rad/s (180 °/s)	3.05 rad/s (175 °/s)
	Axis 2	3.05 rad/s (175 °/s)	2.44 rad/s (140 °/s)
	Axis 3	3.14 rad/s (180 °/s)	2.88 rad/s (165 °/s)
	Axis 4	5.32 rad/s (305 °/s)	4.45 rad/s (255 °/s)
	Axis 5	5.32 rad/s (305 °/s)	4.45 rad/s (255 °/s)
	Axis 6	7.33 rad/s (420 °/s)	6.46 rad/s (370 °/s)
	Axis 7	2.27 rad/s (130 °/s)	2.27 rad/s (130 °/s)
Max. pay load	Wrist	35 kg	50 kg
	Forearm	15 kg	
Allowable static load torque	Axis 5	160 N·m	210 N·m
	Axis 6	160 N·m	210 N·m
	Axis 7	90 N·m	130 N·m
Allowable moment of inertia *1	Axis 5	16 kg·m <sup>2</sup>	30 kg·m <sup>2</sup>
	Axis 6	16 kg·m <sup>2</sup>	30 kg·m <sup>2</sup>
	Axis 7	5 kg·m <sup>2</sup>	12 kg·m <sup>2</sup>
Position repeatability *2		±0.07 mm	
Maximum air pressure		0.49 MPa (5.0 kgf/cm <sup>2</sup> ) or less	
Installation *3		Floor mount	
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 <sup>2</sup> )	
Dust-proof / Drip-proof performance *5	Body	Equivalent to IP67	
	Wrist	Equivalent to IP67	
Robot mass		745 kg	

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

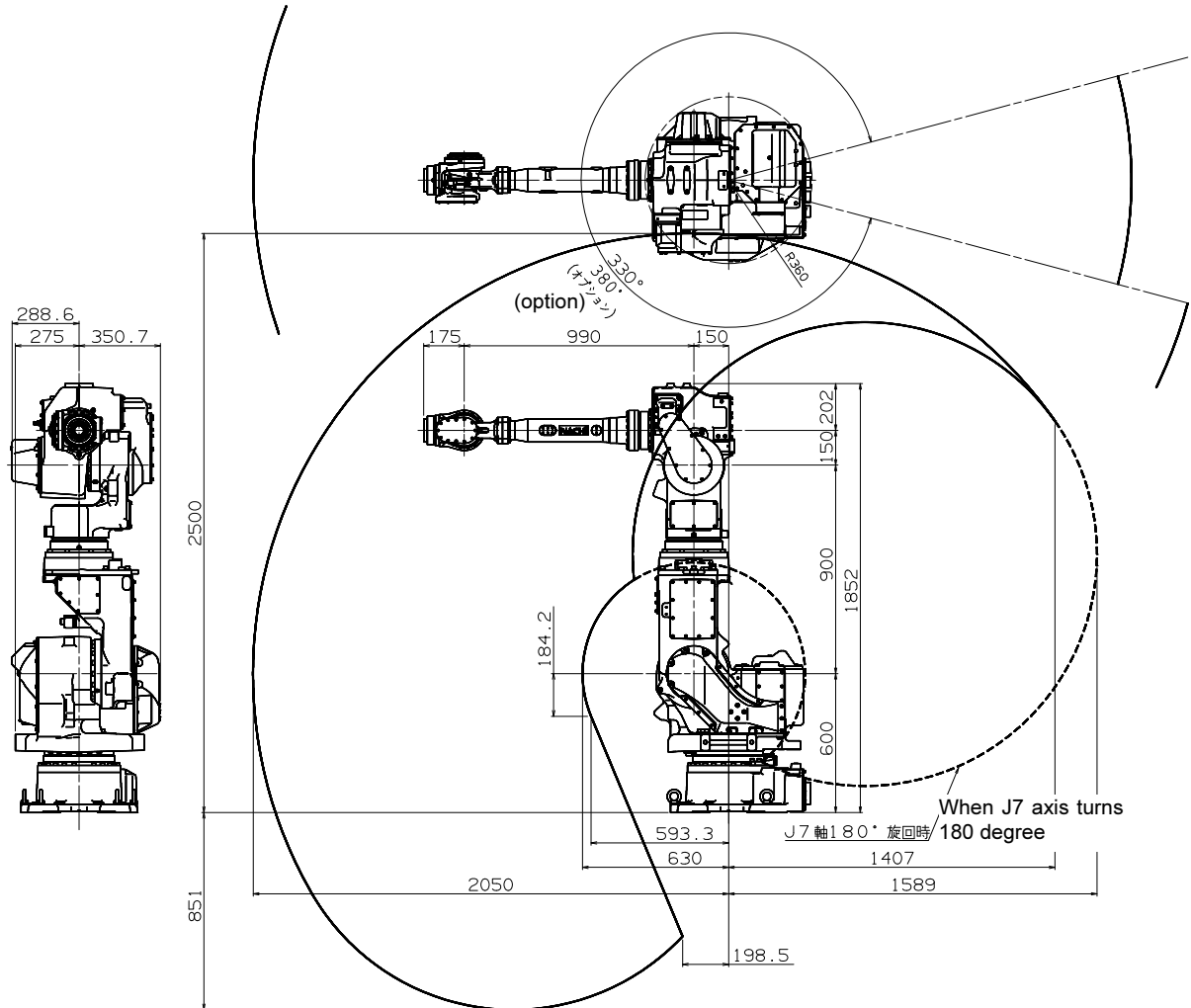
- On controller display, axis 1 to 7 is displayed J1 to J7 for each.

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

\*1: This value changes by placement and load conditions of a wrist. \*2: This value conforms to "JIS B 8432" standard. \*3: Ceiling mount, wall mount and angle mount are the options. \*4: Permitted height is not higher than 1,000m above sea level. If used in higher place, permitted temperature is affected by height. \*5: Liquid such as organic compound, acidity, alkalinity, chlorine or gasoline cutting fluid which deteriorates the seal material are not available to use.

## 3. Robot dimensions and working envelope


【MR35-01】【MR50-01】



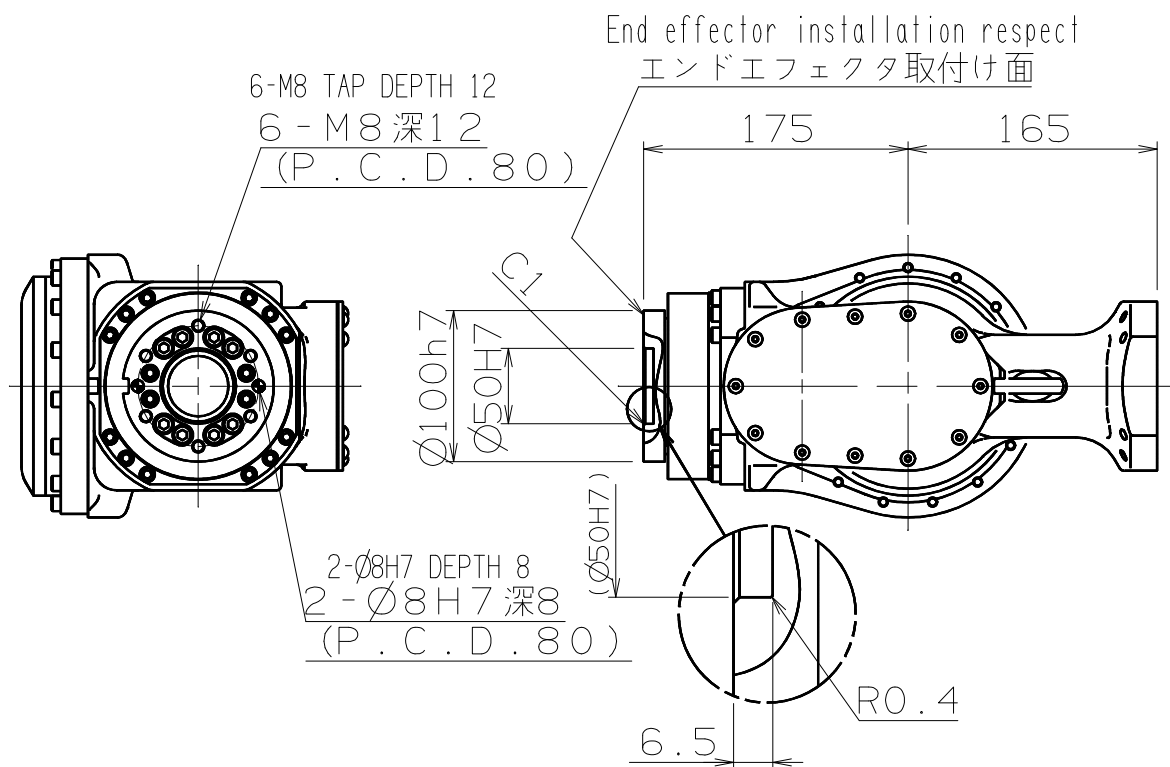
## 4. Details of load mounting face

### ■ Wrist

For the end effector fixing bolts, use the mounting P.C.D. shown below.

 <b>CAUTION</b>	Be sure to screw the M8 end effector 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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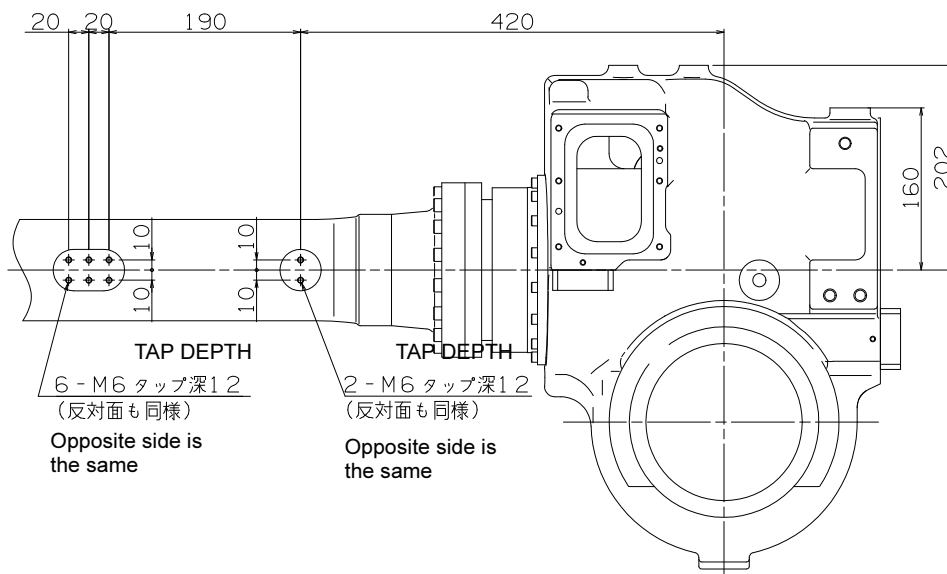
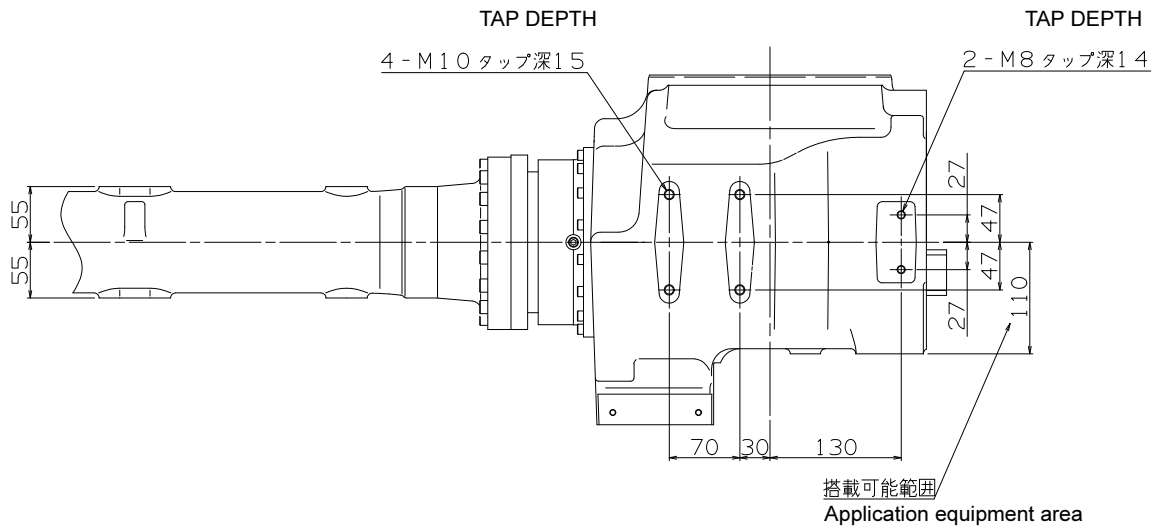
【MR35-01】【MR50-01】



## ■ Upper part of forearm

Ancillary equipment can be mounted to the upper part of robot forearm.

【MR35-01】【MR50-01】




## 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

	<p>While the robot is in operation, workers are in danger of coming in contact with the robot. To avoid that, install a <b>guard fence</b> 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	MR35-01, MR50-01
Thickness of floor concrete	Not less than 150 mm
Installation parts *1	4 bolts of M20X65 (JIS: Strength class 12.9) 4 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 36,154 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.

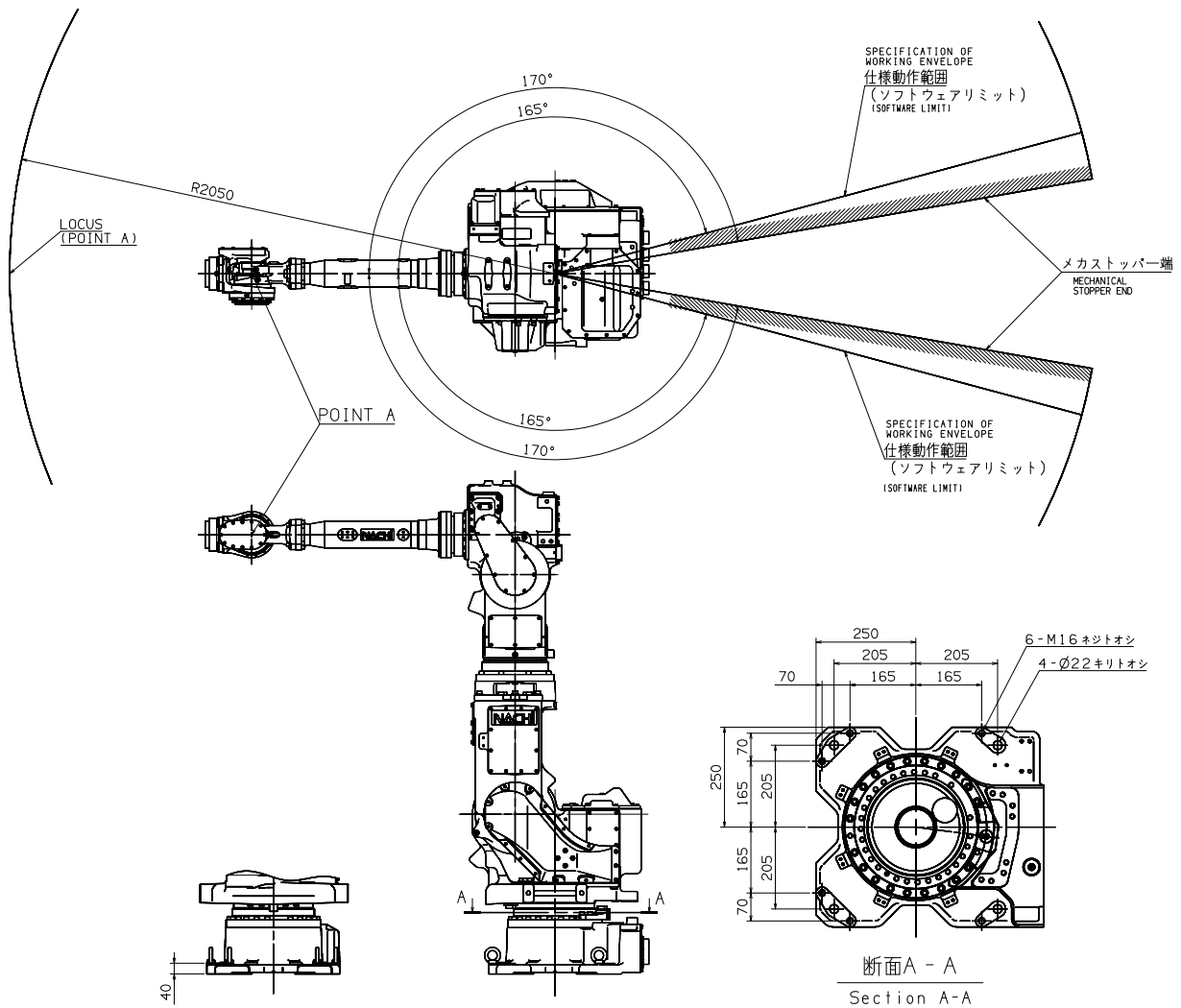


### ■ Installation space

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

 <b>WARNING</b>	<p>The mechanical stopper end is located in a position exceeding the specified working envelope (software limit) of axis 1 by 4°. To install the safety fence, with consideration given to the wrist configuration and the shape of end effector.</p>
 <b>WARNING</b>	<p>On axis 1, axis 2 and axis 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>

【MR35-01】【MR50-01】



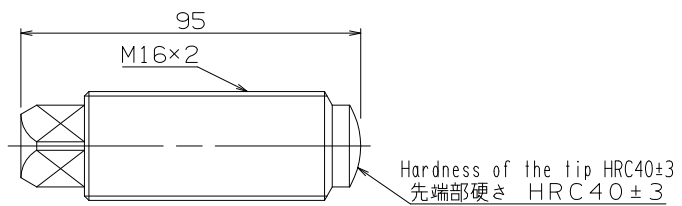
### ■ Accuracy of installation surface

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 ( $\pm 0.25$  mm).

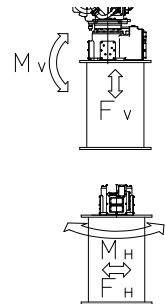


- (3) If the two precautions above cannot be observed, use jack bolts to bring the four places into even contact with the installation surface.




### ■ 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
MR35-01 MR50-01	23,700 N	16,700 N	32,900 N·m	28,300 N·m



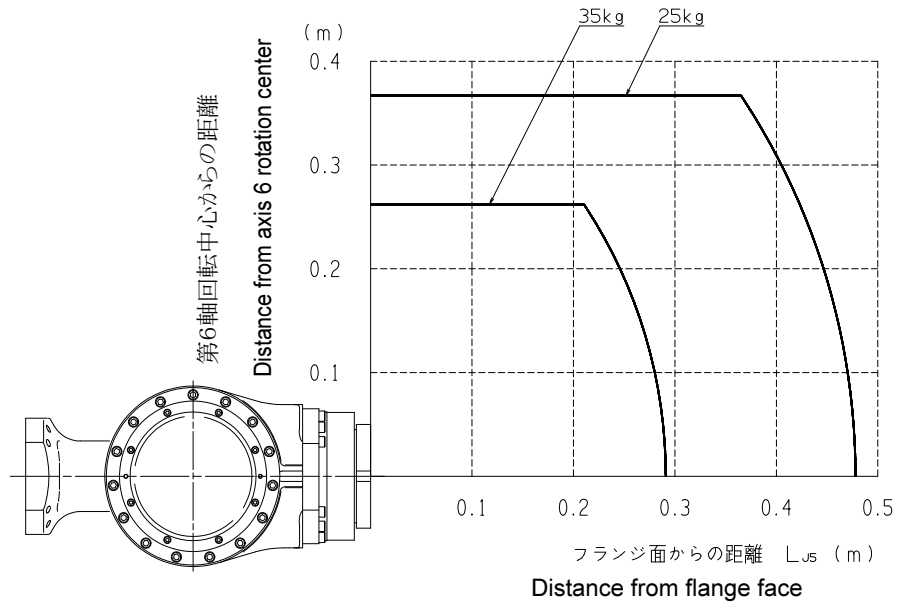
## 6. Allowable wrist load

 <b>CAUTION</b>	<p>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.</p>
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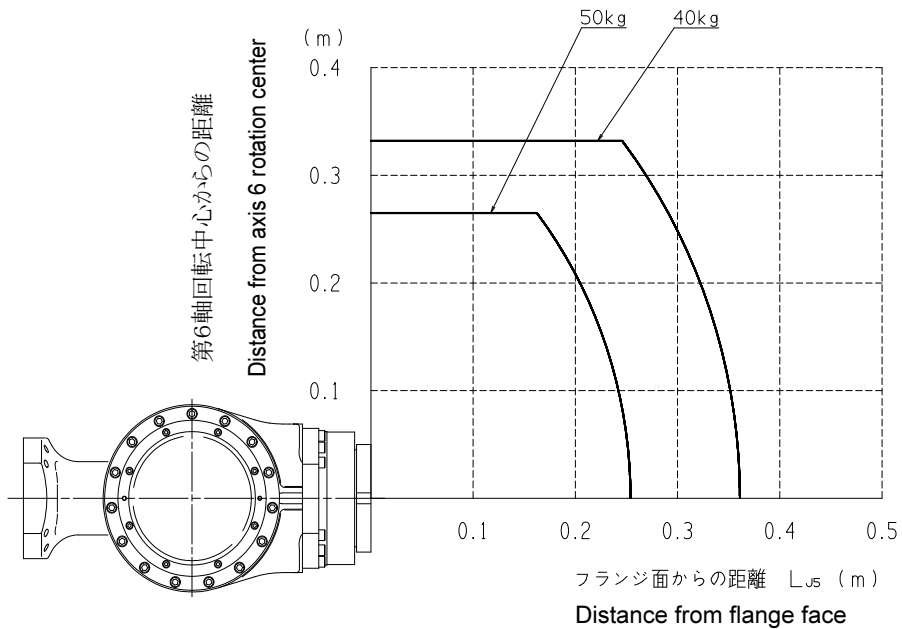
### ■ Torque map

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

【MR35-01】



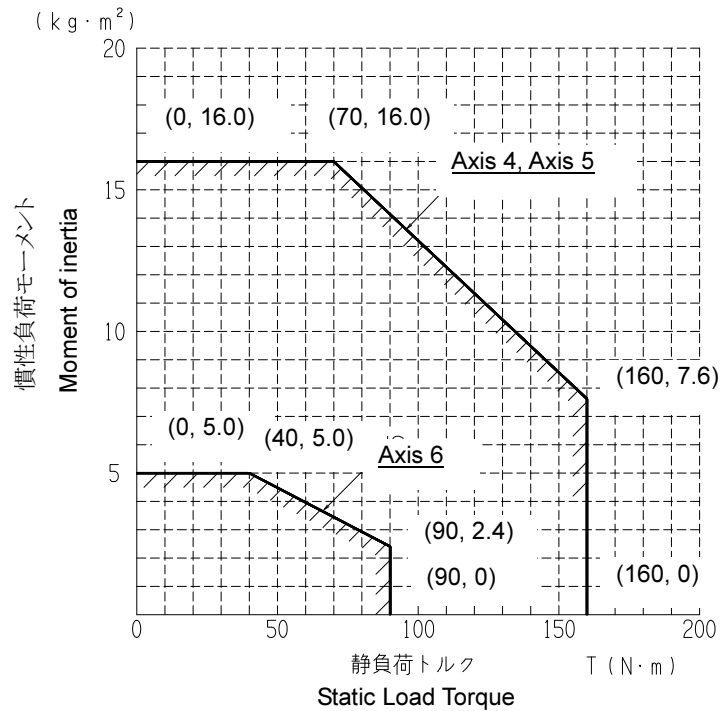
【MR50-01】



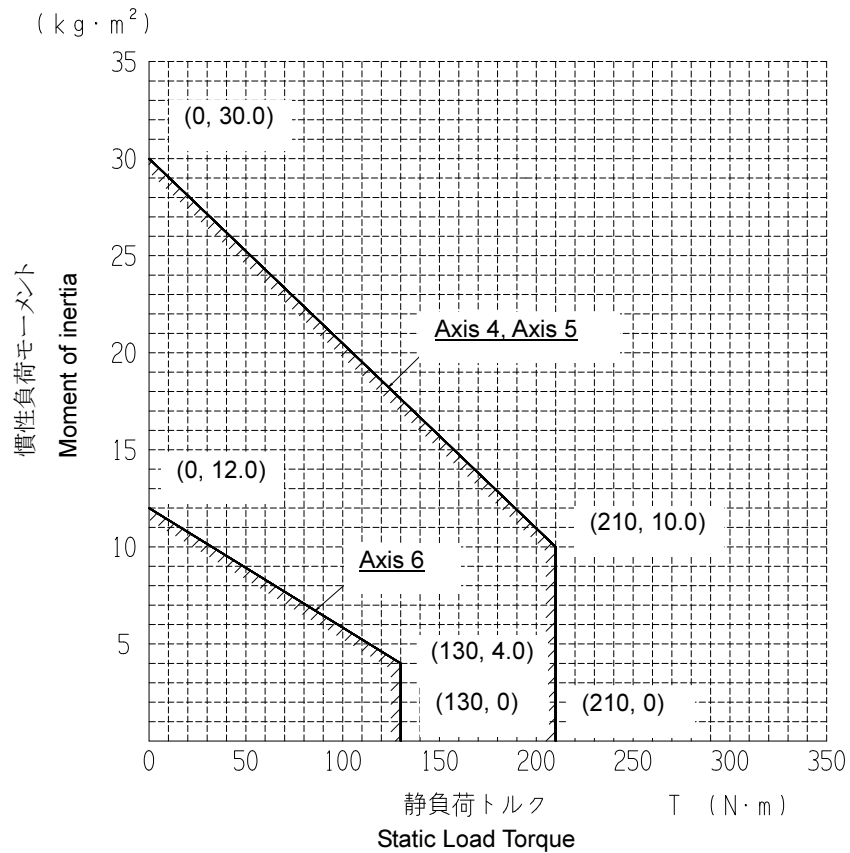
## ■ Moment of inertia map

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

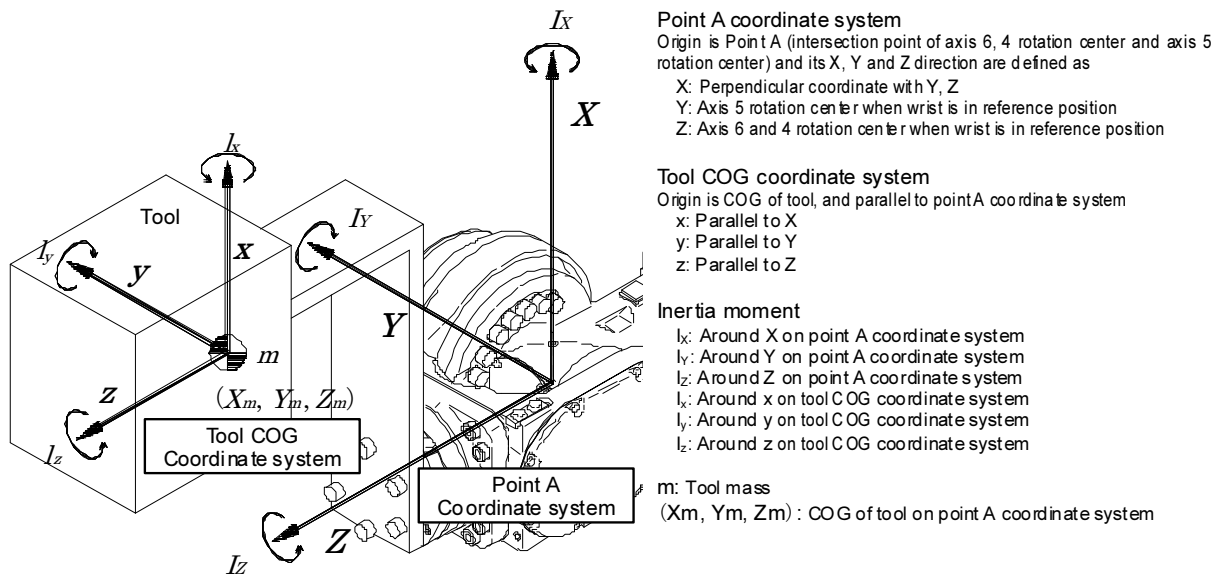
【MR35-01】



【MR50-01】



## How to find the inertia moment



<p><b>1</b> 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> $I_x = \frac{1}{12} m \cdot (A^2 + B^2)$ $I_y = \frac{1}{12} m \cdot (A^2 + C^2)$ $I_z = \frac{1}{12} m \cdot (B^2 + C^2)$ <p>These values (I<sub>x</sub>, I<sub>y</sub>, I<sub>z</sub>) 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><b>2</b> 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<sub>X</sub> and I<sub>Y</sub>, because this depends on axis 6 position.          Axis 6 inertia moment is I<sub>Z</sub> itself.</p> $I_{J4} = I_{J5} = \max(I_X, I_Y)$ $I_{J6} = I_Z$

## 7. Option specifications

○: Possible to correspond / —: Impossible to correspond

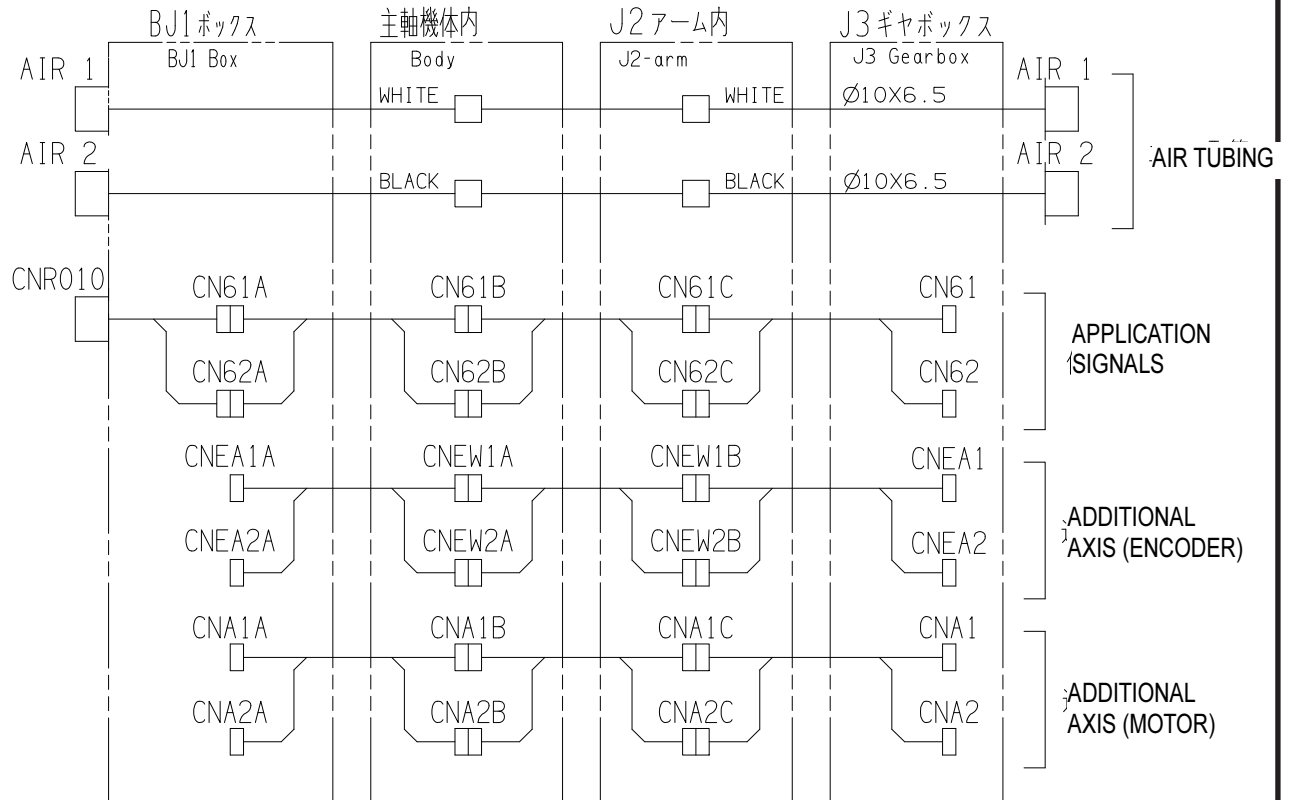
No.	Item	Specifications	Parts No.	Robot model: MR35/50-01
1	Installation parts	Chemical anchor specification (Installation plate with welded base plate + chemical anchor bolts)	OP-F1-020	○
		Hammer drive anchor specification (Installation plate with welded base plate + ore anchor bolts)	OP-F2-016	○
		Leveling plate (□180mm × t=25mm 4 plates)	OPJ-F1-0055	○
		Installation bolts ; washers (Robot installation bolts and washers)	OPJ-F1-0047	○
2	Axis 1 380° stopper	Axis 1 ±190° operation	OP-S3-011	○
3	Axis 1 adjustable stopper	Restriction of axis 1 operation edge (-2.88~+2.88 rad, every 0.26 rad)	OP-S3-016	○
4	Axis 2 adjustable stopper	Restriction of axis 2 operation edge (From the advancement edge and the retreat edge to 0.52rad, every 0.26 rad)	OP-A5-023	○
5	Axis 3 working envelope restriction stopper	Restriction of axis 3 operation edge		—
6	Adjustable limit switch	Axis 2, axis 3 adjustable limit switch		—
7	Axis 1 base LS	For axis 1 zone detection	With LS, 1 base	—
			No LS, 1 base	—
			With LS, 3 base	—
			No LS, 3 base	—
8	Axis 2 arm clear LS	For axis 2 zeroing point and shelter point confirmation	The dog installation plate attachment	—
			No dog installation plate	—
9	Axis 3 motor guard	Protection of encoder and connectors of axis 3 motor		Unnecessary
10	Wrist axis motor guard	Protection of encoder and connectors of wrist axis motor		
11	Air tubing	2 systems (inside diameter φ6.5X2), from swivel base to axis 3 gear box		Standard
12	Application signal line	20 wires (0.2 mm <sup>2</sup> ), from swivel axis to axis 3 gear box		Standard
13	Solenoid valve	Built-in type		—
14	Transfer jig	Fork bracket	OP-S2-037	○
15	Transfer fixed jig	Arm fixing jig (for axis 2)		Unnecessary
16	Zeroing pin & Zeroing block	Axis 1~axis 4, axis 7: Pin hole Axis 5, axis 6 axis: Block	OP-T2-055	○
17	Flange adaptor	ISO Flange		Standard
18	Bypass cable		BCUNIT20-50	○
19	Wrist positioning mark	Stickers for the wrist axes reference position adjustment	OP-N2-021	○
20	Cable	ID registration cable	MR20-OP03-A	○
21	Axis 1 bearing installation jig	for axis 1 motor shaft portion	KP-ZJ-007	○
22	Bearing installation jigs for wrist axes	for axis 4 – axis 6 motor shaft portions	KP-ZJ-008	○
23	Name plate for ceiling mount	Name plates to install the ceiling mount robot	OP-N3-015	○
24	Water proof coolant paint	Double liquid type urethane resin paint	OP-N5-019	○

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

## 8. Application wiring and tubing diagram

### ■ Wiring and tubing diagram

【MR35-01】【MR50-01】



## ■ Details of base and flame

【MR35-01】【MR50-01】

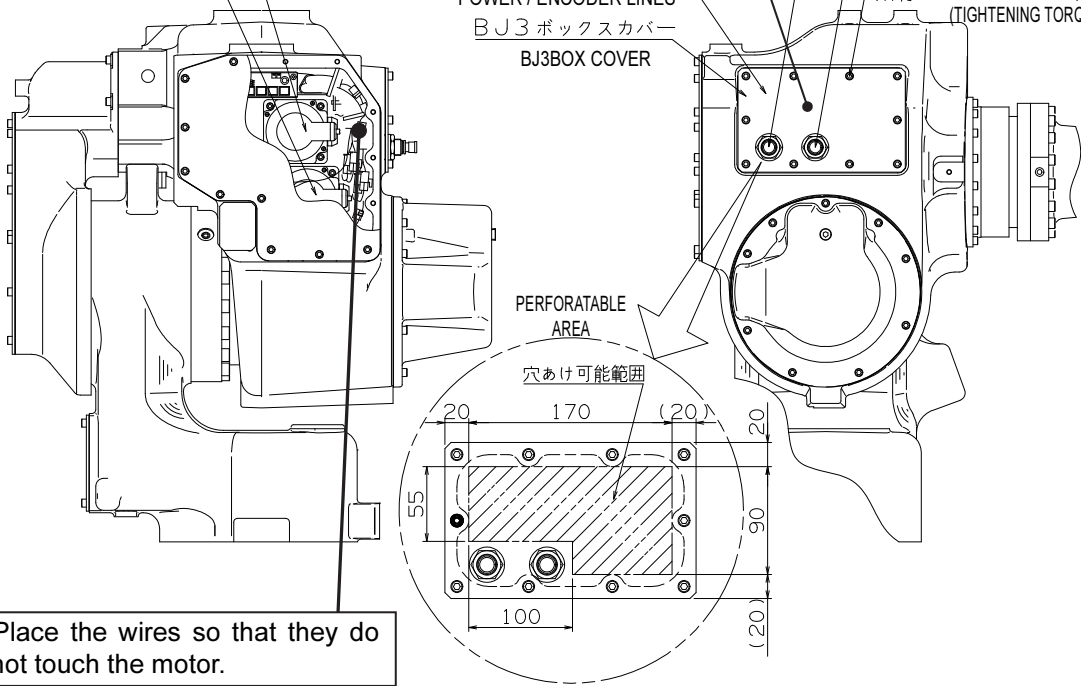
Application cables are inside the box.  
When pulling them out from the box to use,  
drill the cover and install a cable clamp.  
The cable clamp must be water-proof type.

J5 MOTOR J5 モータ  
J6 MOTOR J6 モータ

APPLICATION SIGNALS  
アプリケーション線  
動力線、エンコーダ線  
POWER / ENCODER LINES  
BJ3 ボックスカバー  
BJ3BOX COVER

AIR 2 OUT TUBE  
エア-2出口 (φ10チューブ用)  
AIR 1 OUT TUBE  
エア-1出口 (φ10チューブ用)

10-M6x10  
(締付トルク: 8.8Nm)  
(TIGHTENING TORQUE: 8.8 Nm)



Place the wires so that they do not touch the motor.

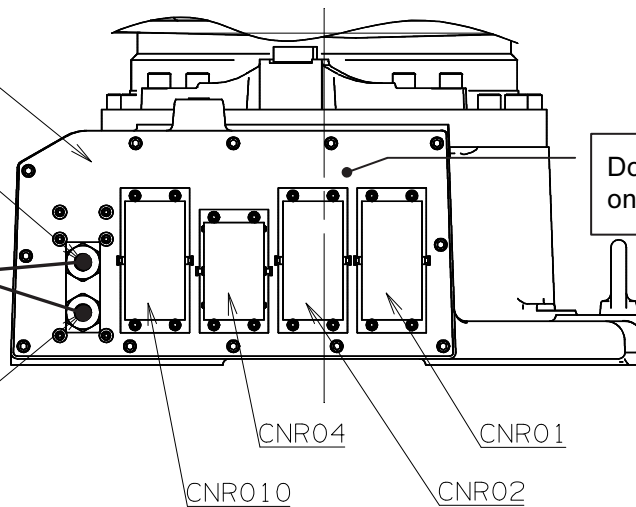
BJ1 パネル  
BJ1 Panel  
AIR 1 IN  
エア-1入口  
(Rc 1/4 タップ)

Use air pressure not more than 0.49MPa.

AIR 2 IN  
エア-2入口  
(Rc 1/4 タップ)

CNR04  
CNR01  
CNR010  
CNR02

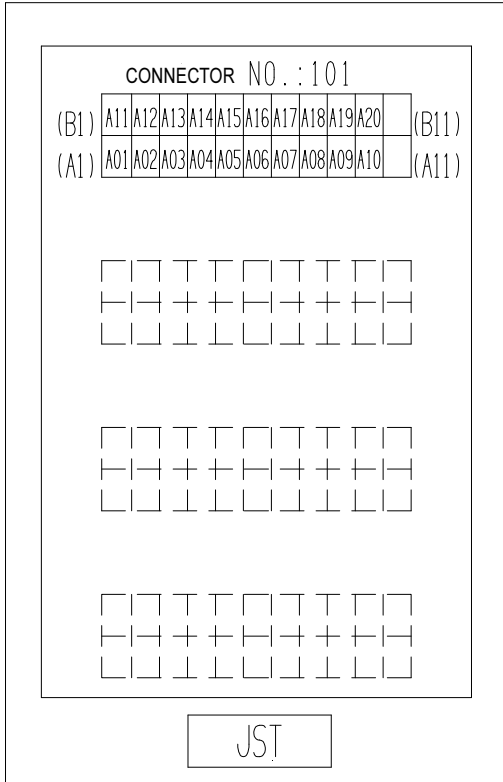
Do not install anything on the BJ1 panel.





■ Detailed diagram of the connectors

【MR35-01】【MR50-01】



Partner connector

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

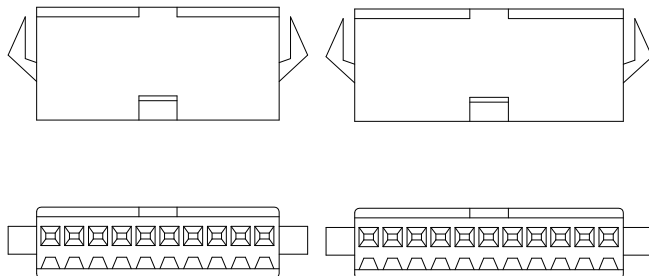
Manual crimp tool:

for a: YRS-8861

for b: 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.)



Connector form (CN61)

Housing: SMP-10V-BC (JST)

Partner connector

Housing: SMR-10V-B (JST)

Contact: SYM-001T-P0.6

(Wire of Application: AWG#22~28)

Pressure tool: YRS-121

Connector form (CN62)

Housing: SMP-11V-BC (JST)

Partner connector

Housing: SMR-11V-B (JST)

Contact: SYM-001T-P0.6

(Wire of Application: AWG#22~28)

Manual crimp tool: YRS-121

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

CN61

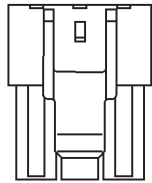
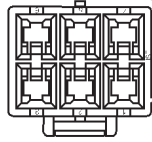
1	2	3	4	5	6	7	8	9	10
A01	A02	A03	A04	A05	A06	A07	A08	A09	A10

CN62

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

■ Details diagram of the connectors for additional axis

(1) BJ3 side (intermediate connector)



CNA1

3	WA1	2	VA1	1	UA1
6	BAA1	5	PBA1	4	G

CNA2

3	WA2	2	VA2	1	UA2
6	BAA2	5	PBA1	4	G

Connector form (CNA1,CNA2)

Housing  
VLP-06V (JST)

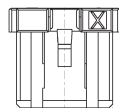
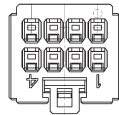
Partner connector

Housing  
VLR-06V (JST)  
Retainer  
VLS-03V (JST)  
Contact  
SVM-42T-P2.0  
(Wire of Application : AWG#22 - 16)

Contact  
SVM-61T-P2.0  
(Wire of Application : AWG#20~14)

Manual crimp tool: : YC-592:(AWG#22 - 16)  
YC-590:(AWG#20 - 14)

(This pin layout is drawn seeing from the connection side of the robot side connector.)



CNEA1

B4	M3E	B3	ECE	B2	SA1-	B1	M5E
A4	P3E	A3		A2	SA1+	A1	P5E

CNEA2

B4	M3E	B3	ECE	B2	SA2-	B1	M5E
A4	P3E	A3		A2	SA2+	A1	P5E

Connector form (CNEA1,CNEA2)

Housing  
1-1827864-4 (AMP)

Partner connector

Housing  
1-1903130-4 (AMP)  
Contact  
1903116-2  
(Wire of Application : AWG#28 - 22)




Manual crimp tool : 1762846-1

(This pin layout is drawn seeing from the connection side of the robot side connector.)

## 9. Transport procedure

### Safety measures against transport

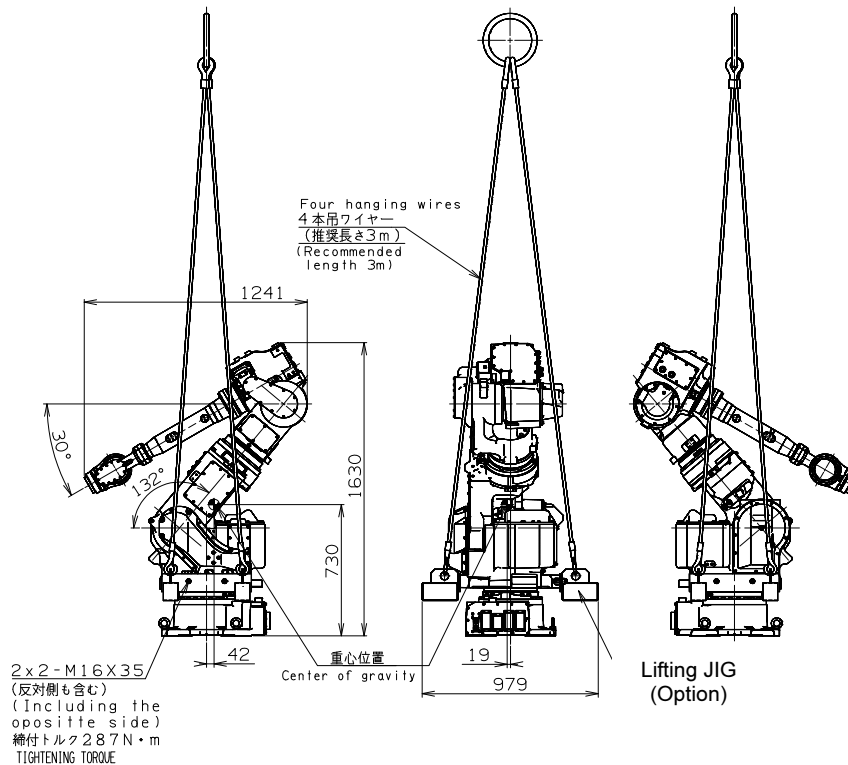
The following describes precautions for transporting the robot. Fully understand the precautions for safe transport work.

 <b>WARNING</b>	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.
 <b>WARNING</b>	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.
 <b>WARNING</b>	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 below 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 M16 X 35 bolts. The tightening torque is 287 N·m. Recommended length of the hanging wires is 3 m. Protect the part where the robot contacts the wire by inserting the wire through a protect cover hose such as a rubber hose.

【MR35-01】【MR50-01】



## **10. Installation (specification which contains a robot)**

### 1. Delivery condition

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

	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 type D grounding (the grounding resistance is 100Ω or less) is necessary.

## **11. Consuming power (Robot + Controller)**

4.1kVA (Peak power)

## **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 "7 Option specifications" for the type of this option.

## **13. Warranty**

Elapse of 1 year after delivery.

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



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