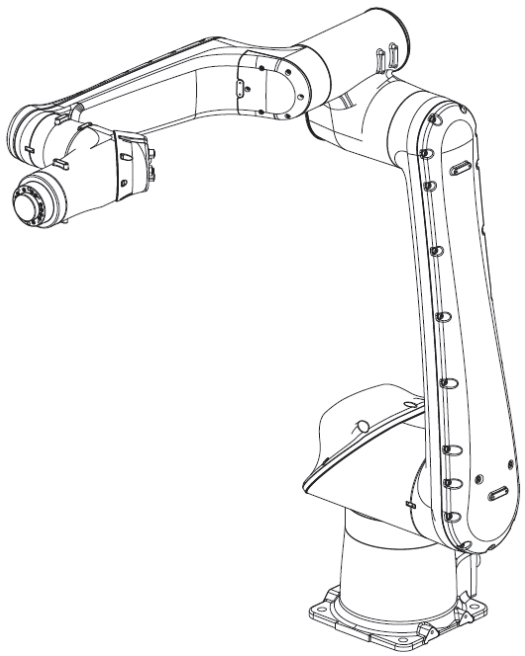
NACHI

Standard specifications

CZ10-01 [CCZ]

5th edition



NACHI-FUJIKOSHI CORP.

1808, SCZEN-113-005, 001

NACHI

Table of Contents

1. Outline

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

Features of the "CZ10-01".

(Safety functions)
- It can secure the minimum space of 25mm or more to prevent pinching as inherent safety.
- Detect the contact between the worker and robot by the torque sensing system that is equipped at each axis, and stops for safety.
- ISO10218-1 and ISO/TS15066 certified by third party.
  (One requirement for the collaborative work (*) ; people and the robot work in the same space.)

(Operability)
- Teaching work can be performed easily by customers since it has the direct teaching function.
- Intuitive teaching is enabled since the inline wrist structure is adopted.
- Digital I/O connector for application and the built-in air piping are applied at the wrist part, so it can reduce the construction burden of the customers.

Also, this manual is for the robot's specification, so for please refer to the "Standard specification CCZ controller" (SCCZEN-016) of the separated manual regarding the controller.

(*) Collaborative work

Robot is operated with sharing the same space with workers.
Nachi supplies the robot CZ10-01 to be used for collaborative work, but Nachi never guarantee the safety of system itself.
Risk assessment base on ISO10218-2 (Robots and robotic devices -- Safety requirements for industrial robots) is required for customer when collaborative robot is used.

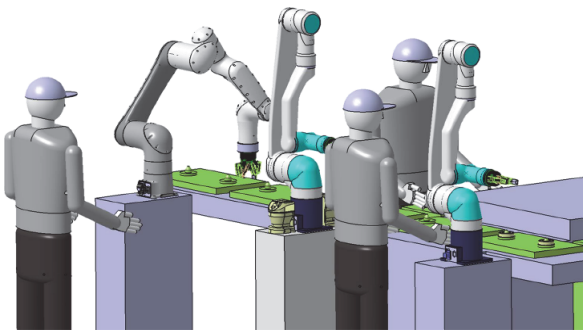


Image of collaborative work

Please confirm the followings.
- Workers are not pinched by the obstacles (work-piece tray, equipment and or so) in moving envelope, and the obstacles never occupy the evacuation way.
- Risk must be reduced, which exists in environment that end effecter mounted on robot is sharp, is high temperature, is dangerous moving, and or so.
- Robot speed is considered to be slow down in order to avoid the injury of workers.
- In non-collaborative mode, do not forget that robot never stop automatically when contacting workers.

Also due to the limit of technological reason, remaining risks listed below exist in this robot. Before using this robot these remaining risks need to be reduced by risk assessment.
- Human body part thicker than 25mm may be pinched by robot.
- Human body which is highly possible to contact with robot, such as head, face, eyes and or so, need to be protected using protector.
- Robot joint will stop when detecting unexpected torque, however, closing position from joint may not stop because detecting sensitivity is low.

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE

No. Z1 18 06 63642 017

Holder of Certificate: **NACHI-FUJIKOSHI CORP.**
1-1-1 Fujikoshi-Honmachi
Toyama
Toyama
930-8511 JAPAN

Production Facility(ies): 63714

Certification Mark:

Product: **Robot system**

Model(s): **CZ10-01-CCZ-0000**

Parameters:

Rated voltage:	AC 200-220 V +10% / -10%
Rated frequency:	50 Hz / 60 Hz
Rated input current:	1 KVA
Protection class:	I

Tested according to:
EN ISO 10218:2011
EN ISO 12100:2010
EN 60204-1:2006/AC:2010

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

Test report no.: 73568054-00

Valid until: 2023-06-10

Date, 2018-06-12 (Shigehisa Ishikawa)

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A1 / 07.17

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

Certification of TUV SUD

2. Basic specifications

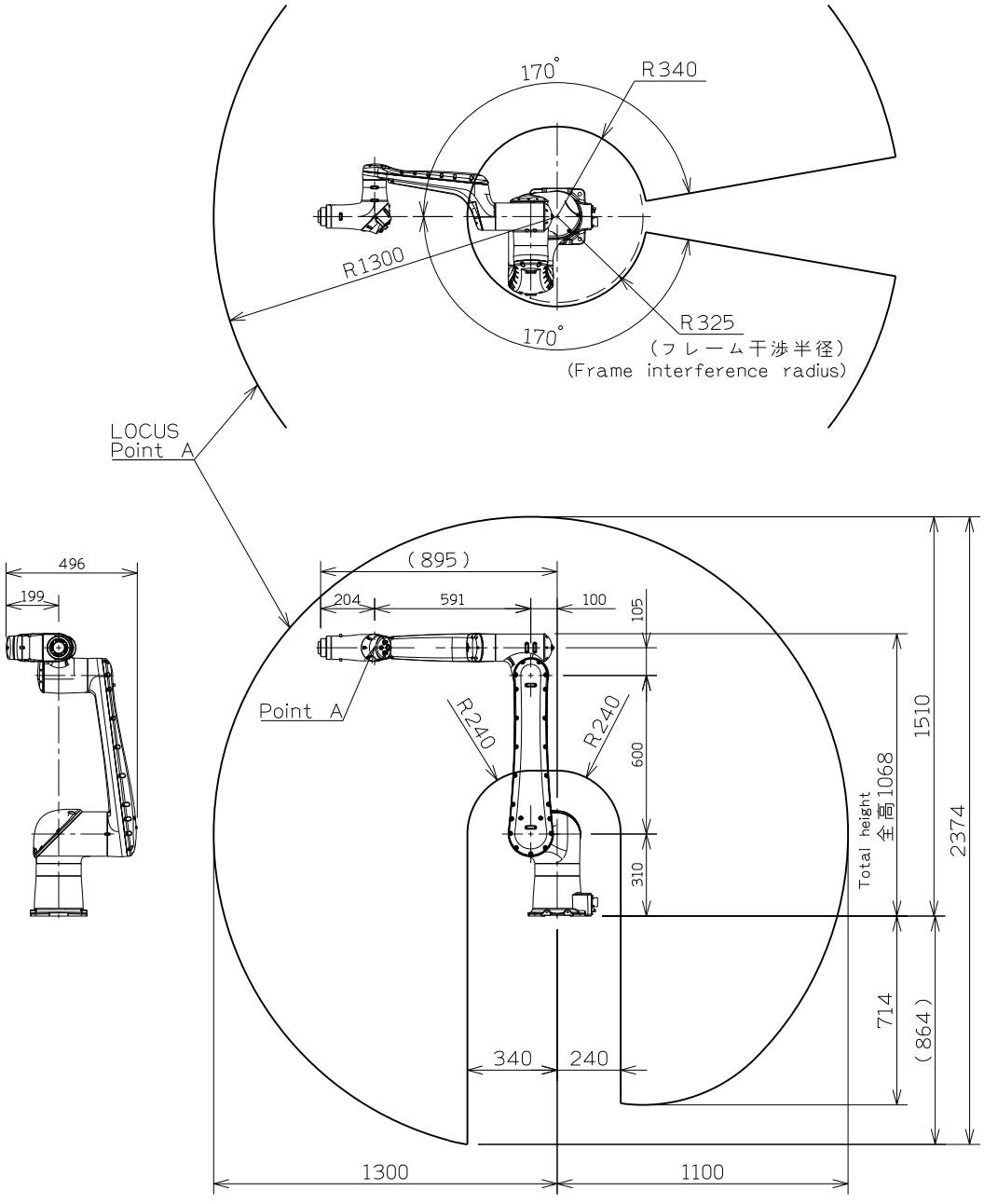
Item		Specifications
Robot model		CZ10－01
Construction		Articulated
Number of axis		6
Drive system		AC servo motor
Max. working envelope *1	Axis 1	±2.96rad （±170 °）
	Axis 2	-1.30～+3.92rad （-75～+225 ° ）
	Axis 3	-1.34～3.96rad （-77～+227 ° ）
	Axis 4	±3.14rad （±180 ° ）
	Axis 5	±2.96rad （±170 ° ）
	Axis 6	±6.28rad （±360 ° ）
Max. speed Speed *2	Axis 1	2.09rad/s （120 ° /s）
	Axis 2	2.09rad/s （120 ° /s）
	Axis 3	3.14rad/s （180 ° /s）
	Axis 4	3.14rad/s （180 ° /s）
	Axis 5	3.14rad/s （180 ° /s）
	Axis 6	3.14rad/s （180 ° /s）
Max. payload	Wrist	10kg
Allowable static load torque	Axis 4	25.9 N・m
	Axis 5	25.9 N・m
	Axis 6	5.9 N・m
Allowable moment of inertia *3	Axis 4	0.75 kg・m^2
	Axis 5	0.75 kg・m^2
	Axis 6	0.08 kg・m^2
Position repeatability *4		±0.1mm
Max. reach		1300mm
Air piping		ϕ4×1
Application signal line		(Digital Input)×4, (Digital Output)×3
Installation		Floor / Inverted
Ambient conditions		Temperature: 0 to 45 ºC *5 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 *6		IP54 equivalent (dust and drain proof-type)
Noise level *7		70 dB
Robot mass		61 kg

1[rad] = 180/π[°], 1[N･m] = 1/9.8[kgf･m]
- On controller display each axis (1-6) is displayed as J1-J6.
- This specification is subject to change due to improvements of the products without notification.
- Explosion-proof is not available.

*1: Maximum operation angle of the each axis. *2: Above specifications show maximum score of each item, and maximum 250mm/s when in the collaborative operation. *3: The allowable moment of inertia of a wrist changes with load conditions of wrist. *4: This value conforms to "JIS B 8432". *5: Permitted height is not higher than 1,000m above sea level. If used in higher place, permitted temperature is affected by height. *6: Liquid such as organic compound, acidity, alkalinity, chlorine or gasoline cutting fluid which deteriorates the seal material are not available to use. Wire harness part is equivalent of IP54, and the controller is equivalent of IP20. *7: Robot noise is A-weighted equivalent sound level measured under “JIS Z 8737-1” (ISO 11201) with maximum payload and maximum speed.

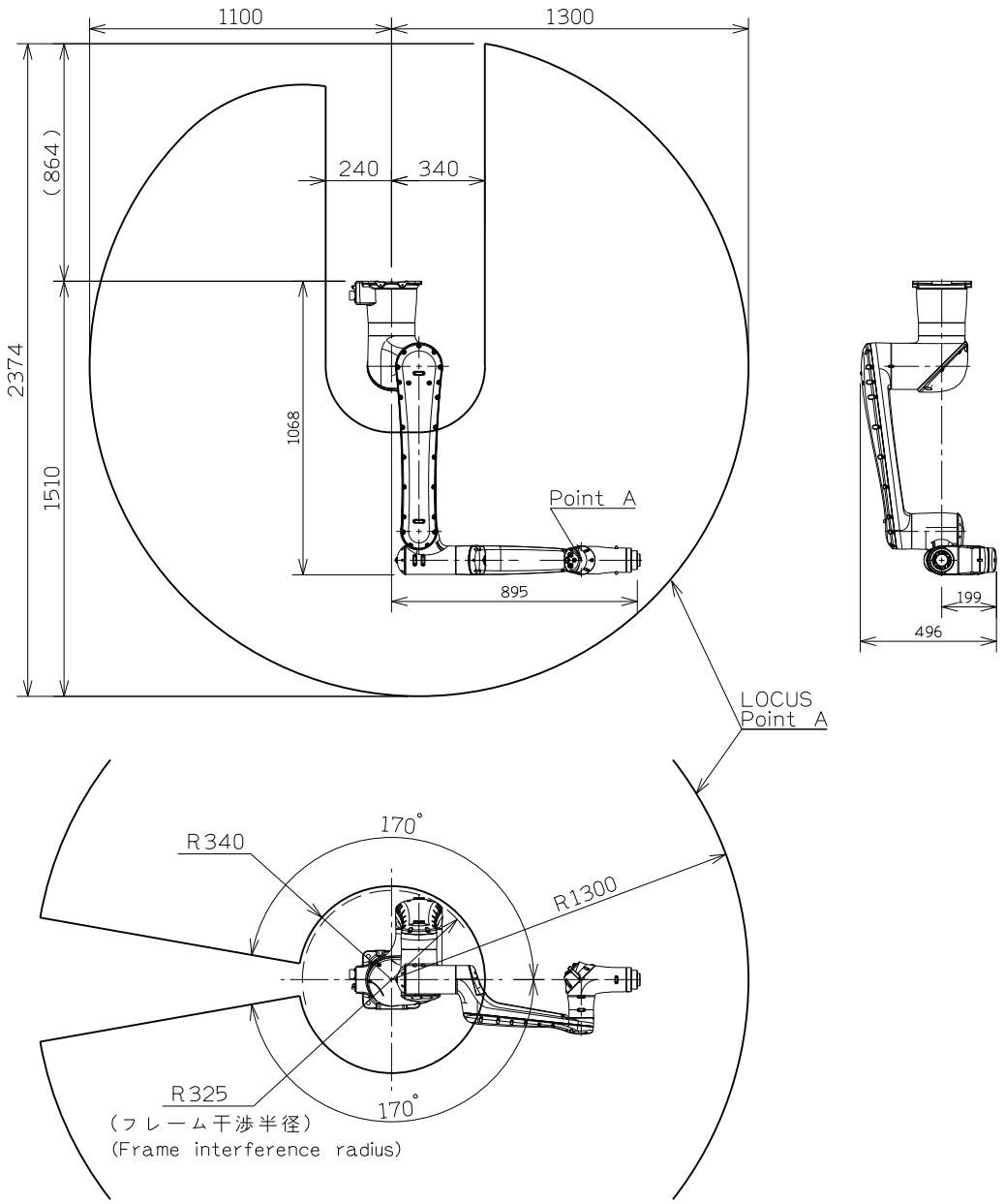
3. Dimensions

【CZ10-01】
(Setting method: Floor)



*The above operation range diagram is the operation range diagram of POINT A when 1st, 2nd and 3rd axis are operated. When the 4th and 5th axis are operated, the operation range may become smaller than the above.
*POINT A is the rotation center of the axis 5, and there is 204mm to the tool flange origin. (Refer to the 4.Details of load mounting face.)

(Installation method: Inverted) Operation range is same as floor setting.

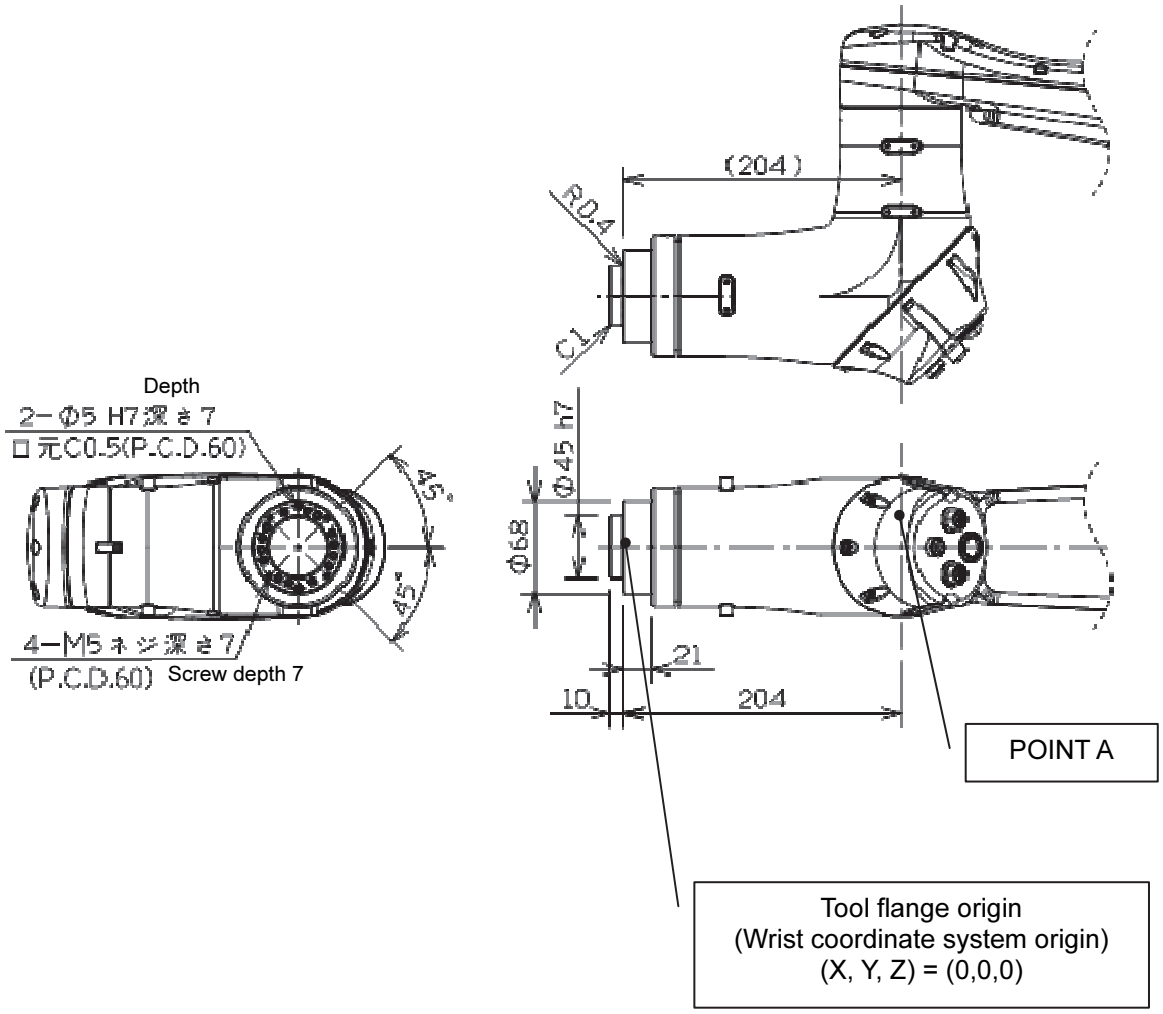


4. Details of load mounting face

For the tool fixing bolts, use the mounting P.C.D. shown in the following figures.

CAUTION	Be sure to screw the depth of the M5 tool installation bolts 5mm or more of bolt diameter and less than the screw depth of the installation face. Screwing the bolts deeper than the screw depth may damage the wrist.

【CZ10-01】



5. Installation procedure

5.1 Installation of Robot body

WARNING	To install the robot, it is important to position the robot so that no workers will get pinched by the robot inside or around a device to use the robot. If necessary, keep some space outside the operating range in order to secure safety.
WARNING	Be sure to install the robot according to the specified procedure. Otherwise it will cause the robot to move or topple over while in operation, thus inducing an imminent hazardous situation.
WARNING	To make wire connections between the robot and the controller or the peripheral equipment, fully understand the connection procedure for proper wire connections. Making wire connections according to improper procedure will cause the robot to malfunction.
WARNING	Be sure to establish a proper ground for the robot. If equipment such as a welder that causes substantial noises is needed to use, establish the specified ground for the equipment.
WARNING	During transport or installation 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 ambient temperature is low, vibration, overload error and tracking error may occur at the beginning of starting robot (due to the condition of movement and payload). In such case, please start robot under 30% to 50% velocity override in approximately 5 minutes as test running, and gradually raise the speed up to 100%.

■ Installation location and ambient conditions

Conditions (temperature, humidity, height and vibration) are written in “Chapter 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, needles to say that it endures static loads. Repair uneven spots, cracks, and others on the floor, and then install the robot by following 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.

Female screw is necessary to the installation face. If this screw (M12) is made on the obstacles other than the foundation, we recommend the installation plate. Installation plate needs steel thicker than 25mm. If aluminum plate is used, heri-sert processing is necessary. Installation plate must be fixed to the foundation by anchor bolts.

	Standard mount
Thickness of floor concrete	Not less than 150 mm
Installation parts *1	4 bolts of M12×35 (JIS: Strength class 12.9) 4 plain washers of not less than 3.2 mm in thickness, Outer diameter φ26, and HRC35 in hardness
Tightening torque *2	104 N·m
Allowable repeated tensile *3	Approximately 1900 N

*1; Installation parts are not accessory of robot. NACHI prepares installation parts as option (OP-F1-050).

*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.

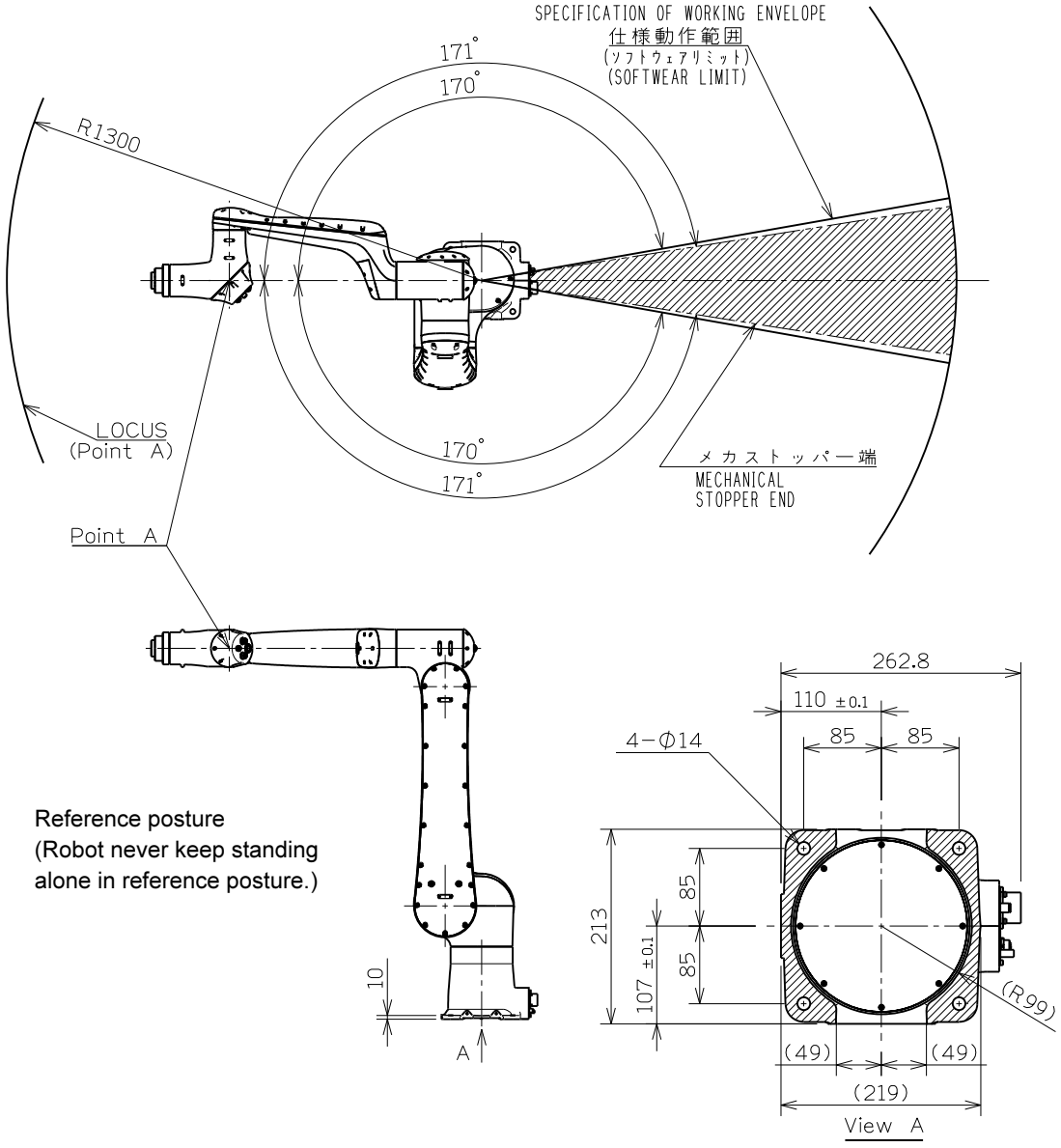
*3; This tensile is per installation bolt when robot is installed with all bolts written in table above.

■ Installing dimension

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

WARNING	The mechanical stopper end is located in a position exceeding the specified working envelope (software limit) of axis 1. To install the safety fence, with consideration given to the wrist configuration and the shape of tool.
WARNING	Installation work should be done in transportation posture (refer to 9. Transport procedure), because robot COG is near the center of axis 1. If robot COG is not near the center of axis 1, such as reference posture written below, robot may fall down. Especially when dismounting installation parts from robot body, robot falls down immediately.

【CZ10-01】

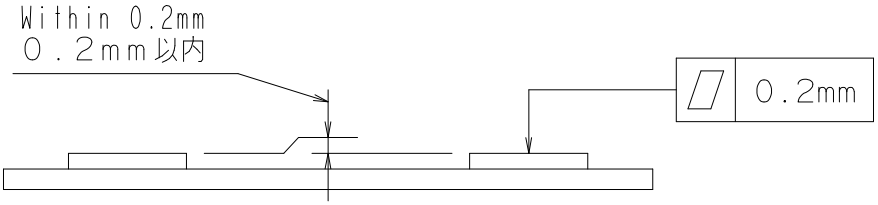


■ Accuracy of installation surface

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

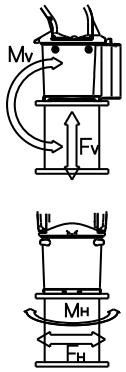
(1) Keep the flatness of the 4 plates on the robot installation surface within 0.2 mm

(2) Please keep the mutual error of the height of the plate (4 sheets) on the robot installation surface within 0.2 mm (± 0.1 mm) relative to the installation surface.



■ Maximum robot generative force

Robot model	Maximum Vertical generative force F_V	Maximum horizontal generative force F_H	Maximum Vertical generative moment M_V	Maximum horizontal generative moment M_H
CZ10-01	1,900N	1,200N	1,900Nm	1,400Nm



■ Safety measures for entering in the operation range of the robot when collaborative operation

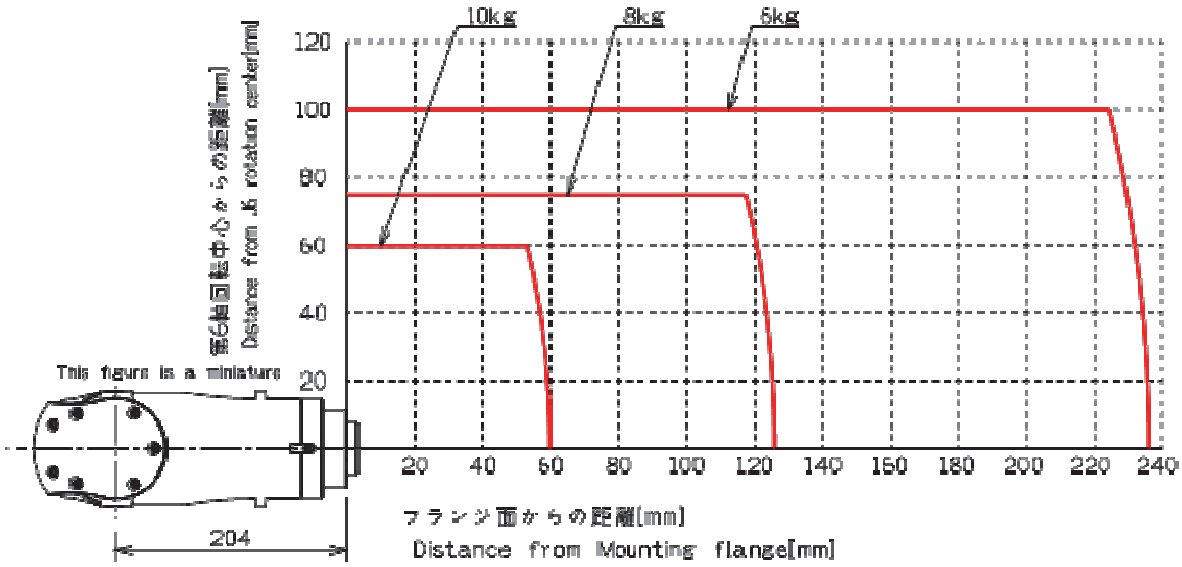
WARNING	Please install the emergency stop button of the robot to the place where the worker can press immediately. If the emergency stop button is at the unreachable place then, the accidents may occur since the robot cannot be stopped. (There are external emergency stop input signal in the controller.)
WARNING	Please install the sensor (Photoelectric switch/Mat switch etc.) that can detect the person entered in the robot operation range. If the person entered in, please switch to the collaborative operation automatically or stop the robot.
WARNING	Please make sure that the robot operation range must be easy to distinguish the risk range by coloring the floor. If necessary, keep some space outside the operating range and paint the floor with different color in order to secure safety.
WARNING	LED light (refer to 8. Application wiring and piping diagram) will turn on green when collaborative operation. If the LED light will not turn on then, please leave from the operation range of the robot immediately. And install the sign board in order that other person can understand the situation of robot.

6. Allowable wrist load

CAUTION	Make sure that the load fixed on the tip of the wrist stays in the allowable range of “Allowable payload mass”, “Allowable static load torque” and “Allowable moment of inertia”. If wrist load exceeds the allowable value, this is out of guarantee. Please refer to “2. Basic specifications” and following figures for the numeric value of the each condition.

■ **Torque map for wrist load**

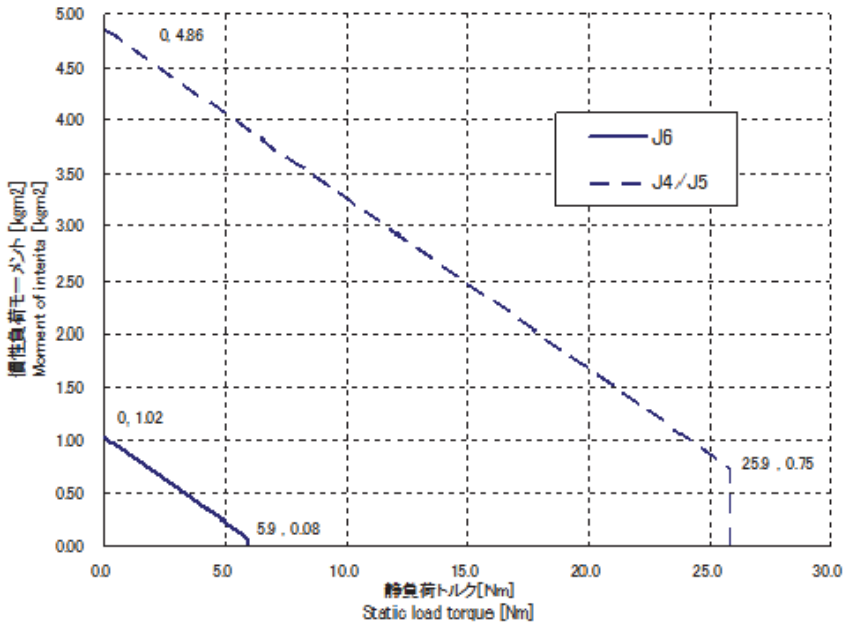
Use the robot under condition that COG of wrist load falls in the range shown in the torque map.



■ **Moment of inertia map for wrist load**

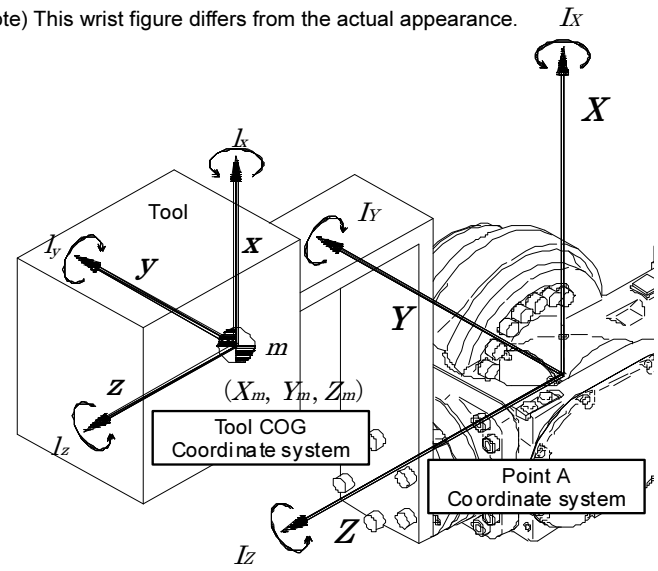
Use the robot under condition that static load torque and moment of inertia fall in the range shown in the figures below.

IMPORTANT	If the moment of inertia exceeds the specification, maximum speed is automatically limited by the software to protect the robot.



■ How to find the inertia moment of each axis

Note) This wrist figure differs from the actual appearance.



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: Perpendicular coordinate with Y, Z
- Y: Axis 5 rotation center when wrist is in reference position
- Z: Axis 6 and 4 rotation center when wrist is in reference position

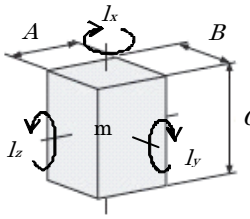
Tool COG coordinate system
Origin is COG of tool, and parallel to point A coordinate system
- x: Parallel to X
- y: Parallel to Y
- z: Parallel to Z

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
(Xm, Ym, Zm) : COG of tool on point A coordinate system

1 Calculate the inertia moment around the tool COG coordinate system (*xyz* axis).
If the tool is regarded as prism, it is calculated as the formula on the right side.

Inertia moment example on tool COG coordinate system



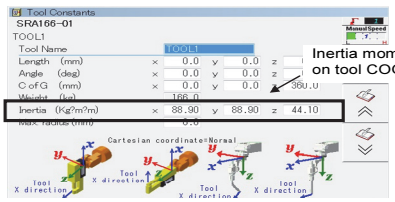
If tool is regarded as prism

$$I_x = \frac{1}{12} m \cdot (A^2 + B^2)$$

$$I_y = \frac{1}{12} m \cdot (A^2 + C^2)$$

$$I_z = \frac{1}{12} m \cdot (B^2 + C^2)$$

These values (I_x, I_y, I_z) are registered to the controller.



2 After converting the inertia moment around point A coordinate system (*XYZ* axis), then calculate the inertia moment around robot wrist joint (axis 4, 5 and 6).
Please make sure that this value does not go over the "Allowable moment of inertia" that indicates the robot specification.

Inertia moment on point A coordinate system (*XYZ* axis) is as below.

$$I_X = m \cdot (Y_m^{\,2} + Z_m^{\,2}) + I_x$$

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

$$I_Z = m \cdot (X_m^{\,2} + Y_m^{\,2}) + I_z$$

Axis 4 and 5 inertia moment is larger value of I_X and I_Y, because its value changes depend on axis 6 position.
Axis 6 inertia moment is I_Z itself.

$$I_{J4} = I_{J5} = \max (I_X , I_Y)$$

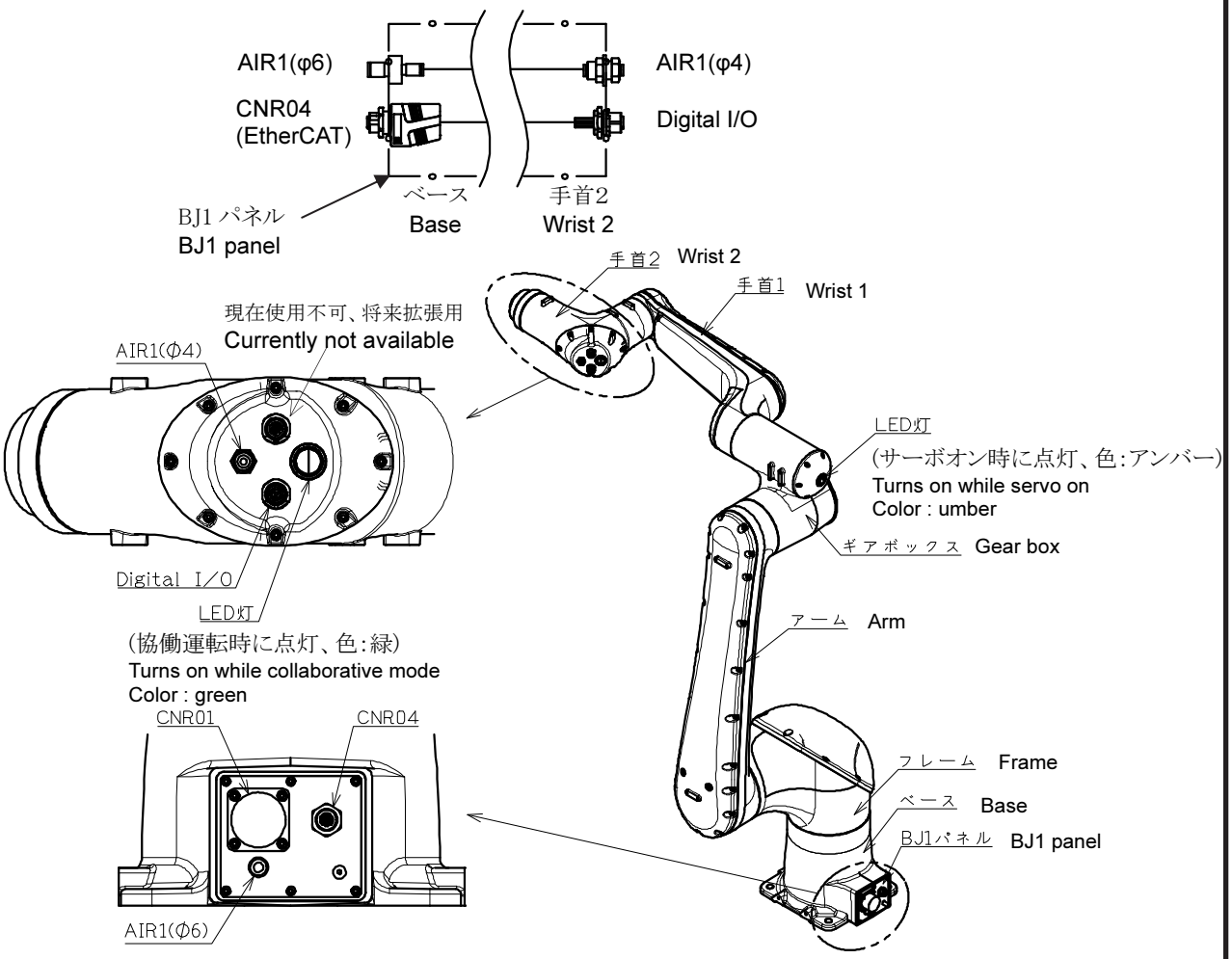
$$I_{J6} = I_Z$$

7. Options

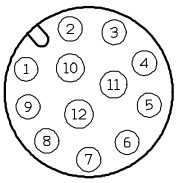
No.	Item	Specification	Parts No.
1	Variable stopper *1	For axis 1（Operation range: ±140°）	OP-S5-040
2	Transportation jig *2	Crane transport jig (Forklift transport is not possible.)	OP-S2-053
3	Inverted installation jig	Jig for inverted installation (Robot reversal jig)	OP-S7-013
4	Accessory tool	Zero point positioning block	OP-T2-104
5	ISO Flange *3	P.C.D.31.5	OP-W2-012
6	Brake release switch *4	Manual brake release option (L:05,10,15,20m)	CCZ-OP90-A-L
7	Parts for installation	Robot installation bolts and washers	OP-F1-050
8	Robot connection cable set *5	Cable length: 5m	CZ101Z-J1-05-A
		Cable length: 10m	CZ101Z-J1-10-A
		Cable length: 15m	CZ101Z-J1-15-A
		Cable length: 20m	CZ101Z-J1-20-A
9	Cables on arm for CZ *6	Connector: L type, Cable length 1.5m	CZ10-OP02L-1P5M
		Connector: L type, Cable length 3.0m	CZ10-OP02L-3P0M
		Connector: L type, Cable length 5.0m	CZ10-OP02L-5P0M
		Connector: L type, Cable length 10m	CZ10-OP02L-10PM
		Connector: straight type, Cable length 1.5m	CZ10-OP02S-1P5M
		Connector: straight type, Cable length 3.0m	CZ10-OP02S-3P0M
		Connector: straight type, Cable length 5.0m	CZ10-OP02S-5P0M
		Connector: straight type, Cable length 10m	CZ10-OP02S-10PM

* 1: Since this product is shipped installed inside the robot body, please specify when ordering the robot.
* 2: This product is included as standard with this robot. When the extra transporting jig is necessary for transport, please make an order by the parts No. above.
* 3: Include this product on the tool side and consider "6. Allowable wrist load".
* 4: When releasing the brake, the arm may fall due to the gravity, so make sure to perform with the release axis supported by the crane or etc. This product is shipped together with the robot. (It's not attached on the robot.)
EN ISO10218-1 requires that adequate quantity of brake release switch, as robot system, must be prepared.
* 5: This is the cable to connect between the robot and the controller. This option must be selected. Please select one of them.
* 6: This is the cable with connector of robot side.

8. Application wiring and piping diagram



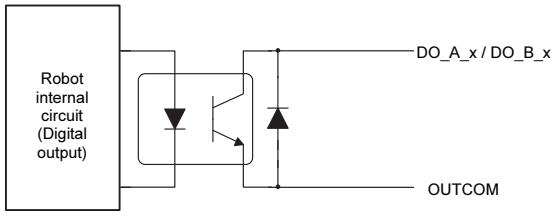
Digital I/O



①	②	③	④	⑤	⑥
FG	DI_A_5	DI_B_5	DI_A_6	DI_B_6	24V
⑦	⑧	⑨	⑩	⑪	⑫
OUTCOM	DO_A_5	DO_B_5	DO_B_6	INCOM	GND

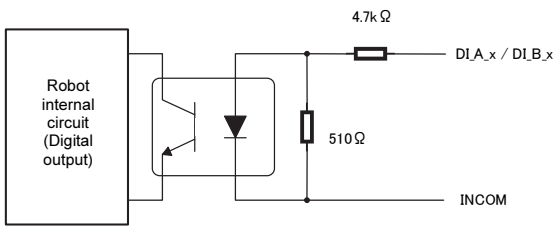
M12 connector on the wrist: Digital I/O model
SACC-E-FS-12CON-M16/0.5 SCO
Partner connector: SACC-M12MR-12SOL-PG9-M SH
(Phoenix contact)
Applicable cable: AWG 28～24 (soldering)
Reference:
・NACHI prepares cable with connector as option. (refer to 7. Options)
・Digital I/O is connected directly to the controller via internal communication, can be operated with TP.

NPN open collector output circuit



Output: DC24V (NPN max voltage DC30V
Current 300mA/1 wire, total current 800mA)

Photo coupler insulation input circuit



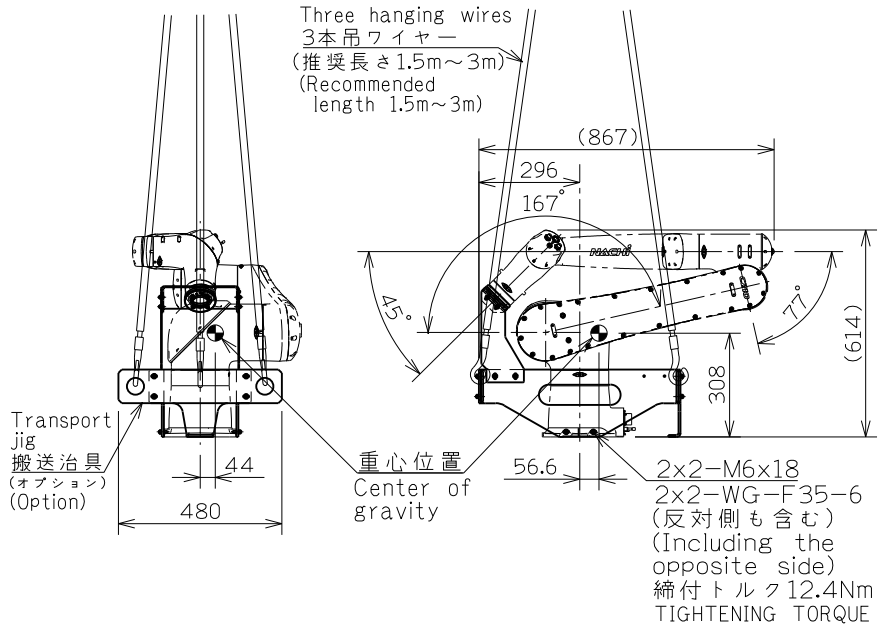
Input: DC24V (input resistance 4.7kΩ)

9. Transport procedure

WARNING	The robot and controller must be transported by personnel who have licenses required for slinging work, crane operation, forklift truck operation, and others. If the transportation works are not performed by the qualified person, accidents may occur. (E.g. turnover, fall and etc.)
WARNING	Before transporting the robot and the controller, be sure to check the weight and the transportation procedures which are described in the Maintenance Service Manual of the robot. If the transportation works are performed by the unspecified procedures, accidents may occur. (E.g. turnover, fall, etc.)
WARNING	During transport of the robot and controller, pay utmost care not to cause damage to wirings. Furthermore, after installing the robot, take protective measures such as using protective covers so that the wirings will not be damaged by workers or other persons, or forklift trucks or else.

As a general rule, please use a crane to transport the robot body. As for the transporting method, first set the robot to the posture shown in the figure, attach a specialized transport jig (OP S2-053) to the robot and lift it with three wires. Recommended wire length is 1.5m to 3m. If wire is too long, wire may interfere with robot body. In this case robot body needs to be protected.

【CZ10-01】



軸 Axis	角度 Angle
1	0°
2	167°
3	-77°
4	0°
5	-45°
6	0°

WARNING	Place the robot on the horizontal position. Robot can stand by alone with its transportation posture. But if robot is placed on the position where inclines 8 degrees or more, robot may fall down and resulting in serious injury.
WARNING	After the robot installation, make sure to remove the transporting-jig. Without removing the transporting jig, there is a possibility that the transporting-jig and the robot may interfere when the robot operates.

10. Delivery /Service (Specification including a robot)

1. There are three services available as shown below.

	Services	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 provided. (Teaching with work piece is not included.)
3	Delivery after installation and teaching with work piece	Besides no.2, teaching with work piece is provided.

The costs differ depending on the service, so please consider enough before making a decision.

2. Operation and maintenance education

The special operation/ maintenance guide are not included in the estimates. Consult with each NACHI-FUJIKOSHI office for the details of the training.

11. Consuming power (Robot + Controller)

1.0 kVA at maximum (may vary according to the application and operation pattern.)

12. Paint color

Standard color	Robot base	Munsell N2.5
	Inner part of arm	Munsell N5.5
	Others	Munsell 6.5PB9/1

13. Warranty

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

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

NACHI NACHI-FUJIKOSHI CORP.			*http://www.nachi-fujikoshi.co.jp/*
Japan Main Office	Phone: +81-3-5568-5245	Fax: +81-3-5568-5236	Shiodome Sumitomo Bldg. 17F, 1-9-2 Higashi-Shinbashi Minato-ku, TOKYO, 105-0021 JAPAN
Nachi Robotic Systems Inc. (NRS)			*http://www.nachirobotics.com/*
North America Headquarters	Phone: 248-305-6545	Fax: 248-305-6542	42775 W. 9 Mile Rd. Novi, Michigan 48375, U.S.A
Indiana Service Center	Phone: 248-305-6545	Fax: 248-305-6542	Greenwood, Indiana
Ohio Service Center	Phone: 248-305-6545	Fax: 248-305-6542	Cincinnati, Ohio
South Carolina Service Center	Phone: 248-305-6545	Fax: 248-305-6542	Greenville, South Carolina
Canada Branch Office	Phone: 905-760-9542	Fax: 905-760-9477	89 Courtland Ave., Unit No.2, Concord, Ontario, L4K 3T4, CANADA
Mexico Branch Office	Phone :+52-555312-6556	Fax:+52-55-5312-7248	Urbina No.54, Parque Industrial Naucalpan, Naucalpan de Juarez, Estado de Mexico C.P. 53489, MEXICO
NACHI EUROPE GmbH			*http://www.nachi.de/*
Central Office Germany	Phone: +49-2151-65046-0	Fax: +49-2151-65046-90	Bischofstrasse 99, 47809, Krefeld, GERMANY
U.K. branch	Phone: +44-0121-423-5000	Fax: +44-0121-421-7520	Unit 3, 92, Kettles Wood Drive, Woodgate Business Park, Birmingham B32 3DB, U.K.
Czech branch	Phone: + 420-255-734-000	Fax: +420-255-734-001	Obchodni 132, 251 01 Cestlice, PRAGUE-EAST CZECH REPUBLIC
Turkey branch	Phone: + 90-(0)216-688-4457	Fax: +90-(0)216-688-4458	Ataturk Mah. Mustafa Kemal Cad. No:10/1A 34758 Atasehir / Istanbul - TURKEY
NACHI AUSTRALIA PTY. LTD.			*http://www.nachi.com.au/*
Robotic Division & Victoria office	Phone: +61-(0)3-9796-4144	Fax: +61-(0)3-9796-3899	38, Melverton Drive, Hallam, Victoria 3803, , AUSTRALIA
Sydney office	Phone: +61-(0)2-9898-1511	Fax: +61-(0)2-9898-1678	Unit 1, 23-29 South Street, Rydalmere, N.S.W, 2116, AUSTRALIA
Brisbane office	Phone: +61-(0)7-3272-4714	Fax: +61-(0)7-3272-5324	7/96 Gardens Dr,Willawong,QLD 4110, , AUSTRALIA
NACHI SHANGHAI CO., LTD.			*http://www.nachi.com.cn/*
Shanghai office	Phone: +86-(0)21-6915-2200	Fax: +86-(0)21-6915-2200	11F Royal Wealth Centre, No.7 Lane 98 Danba Road Putuo District, Shanghai 200062, China
NACHI KOREA			*http://www.nachi-korea.co.kr/*
Seoul office	Phone: +82-(0)2-469-2254	Fax: +82-(0)2-469-2264	2F Dongsan Bldg. 276-4, Sungsu 2GA-3DONG, Sungdong-ku, Seoul 133-123, KOREA

Robot Division
1-1-1, FUJIKOSHIHONMACHI, TOYAMA CITY, JAPAN 930-8511
Phone +81-76-423-5137
Fax +81-76-493-5252

Original manual is written in Japanese.