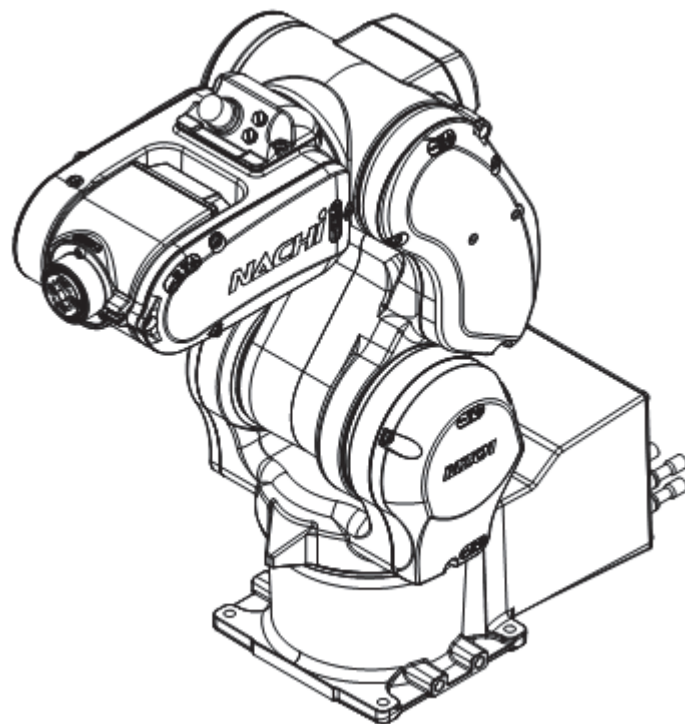


NACHI

Standard specifications

MZ01-01-CFD-0050

3rd 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.

“MZ01” is a 6 axes, simple structure, high speed and high accuracy robot which are optimal for material handling and other application.

	Load weight	1.0kg
Installation		MZ01-01

■Characteristic

1. By realizing the weight saving and high rigidity of the robot body, high-speed and high precision operation at the top level becomes possible.
2. We realized down-sizing arm that can locate 2 robot arms to the work area of one worker.
3. We have secured cleanliness (equivalent to ISO class 5) so that it can be applied to clean environments.
4. Provide variety of built-in wirings and pipings to support the various applications. (Signal wire 12 wires, Air2 system.)

Please refer to the specification below for various electrical related options and the robot controller “CFD controller”.

“Standard specification CFD controller” (SCFEN-010)

2. Basic specifications

2.1 Basic specifications of the robot

Item		Specifications
Robot model		MZ01-01
Construction		Articulated
Number of axis		6
Drive system		AC servo motor
Max. working envelope	Axis 1	± 2.97 rad ($\pm 170^\circ$)
	Axis 2	$-1.57 \sim 1.48$ rad ($-90 \sim 85^\circ$)
	Axis 3	$-0.87 \sim 1.57$ rad ($-50 \sim 90^\circ$)
	Axis 4	± 2.53 rad ($\pm 145^\circ$)
	Axis 5	± 2.18 rad ($\pm 125^\circ$)
	Axis 6	± 6.28 rad ($\pm 360^\circ$)
Max. speed *1	Axis 1	5.59 rad/s (320 °/s)
	Axis 2	5.59 rad/s (320 °/s)
	Axis 3	6.54 rad/s (375 °/s)
	Axis 4	10.47 rad/s (600 °/s)
	Axis 5	10.47 rad/s (600 °/s)
	Axis 6	10.47 rad/s (600 °/s)
Max. pay load *2	Wrist	Rated 1.0 kg
	Forearm	Maximum 0.25 kg
Allowable static load torque	Axis 4	0.9 N·m
	Axis 5	0.9 N·m
	Axis 6	0.78 N·m
Allowable moment of inertia *3	Axis 4	0.008 kg·m ²
	Axis 5	0.008 kg·m ²
	Axis 6	0.006 kg·m ²
Position repeatability *4		± 0.02 mm
Max. reach		350mm
Air tubes		IN : $\phi 6 \times 2$, inside : $\phi 4 \times 2$, OUT : M5
Application signal wires		12 wires
Installation		Floor / Inverted installation
Ambient conditions		Temperature: 0 to 40 °C *5 Temperature: 20 to 85%RH (No dew condensation allowed) Vibration to the installation face: Not more than 0.5G (4.9 m/s ²)
Environment performance *6		Robot body IP40 equivalent
Cleanliness *7		ISO 14644-1 CLASS 5 equivalent
Noise *8		70 dB
Robot mass		10kg

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

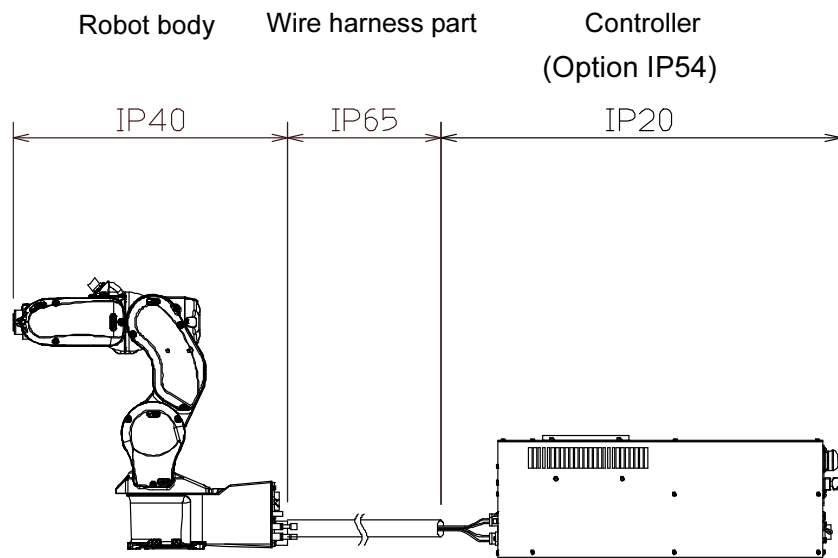
- On controller display, axis 1 to 6 is displayed as J1 to J6 for each.

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

- Explosion-proof is not supported.

*1: The "Max. speed" in this table is the available maximum value and will change depending on the work-program and the wrist load condition. *2: If in case of not installing the load on the forearm (Arm of the axis 3), maximum wrist load will be 1.0kg, however if loading on the forearm 0.25kg then, the wrist load will be up to 0.75kg. *3: The Allowable moment of inertia of a wrist changes with load conditions of a 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 is not available to use. Wire harness part is equivalent to IP65, and the controller is equivalent to IP20. Please refer to P.3 Supplement: Environment performance. *7: Liquid such as organic compound, acidity, alkalinity, chlorine or gasoline cutting fluid which deteriorates the seal material is not available to use. *8: Robot noise is A-weighted equivalent sound level measured under "JIS Z 8737-1" (ISO 11201) with max. payload and max. speed.

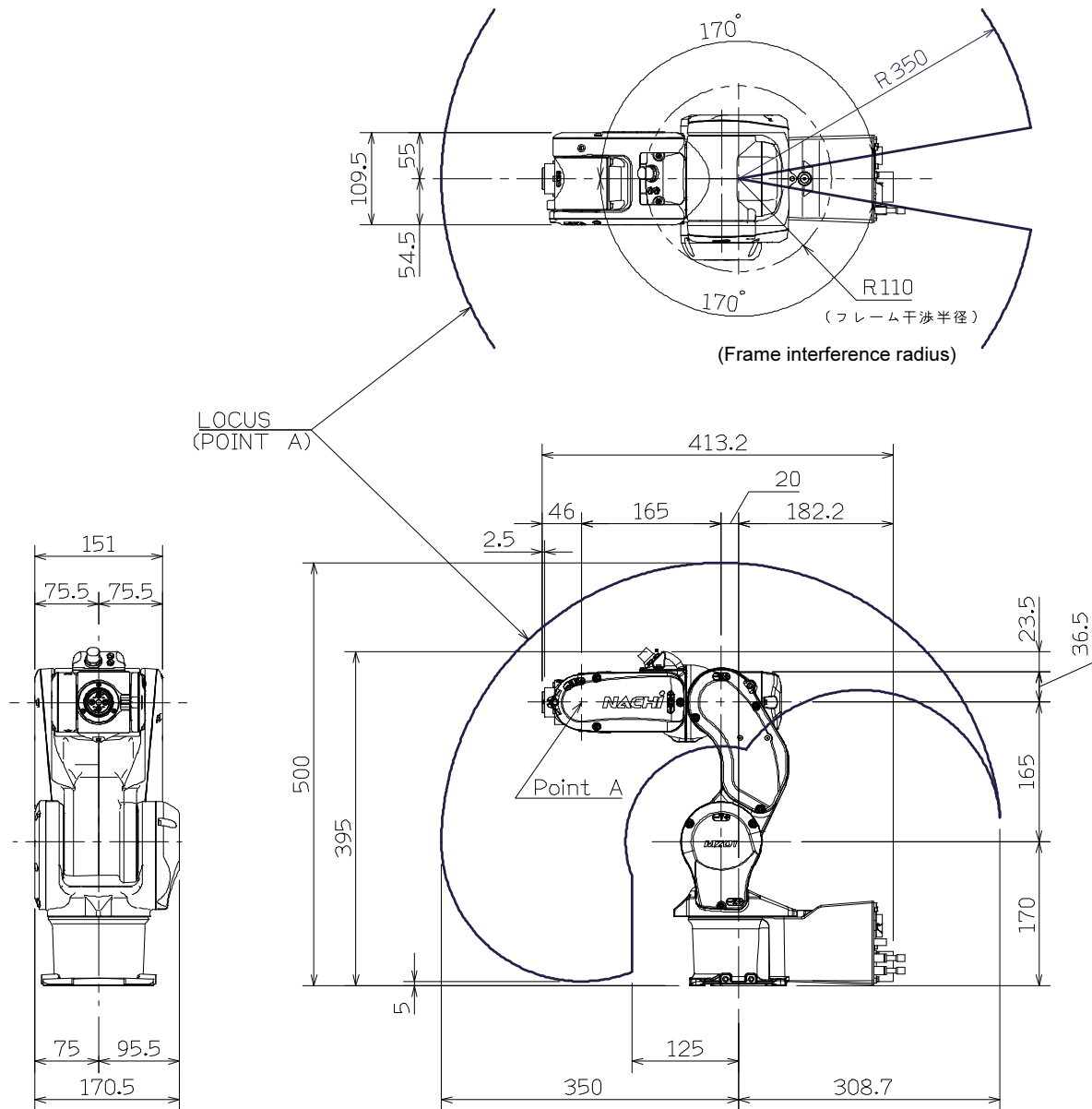
【Supplement: Environment performance】



3. Dimensions


3.1 Robot body dimensions and its working envelope

【MZ01-01】

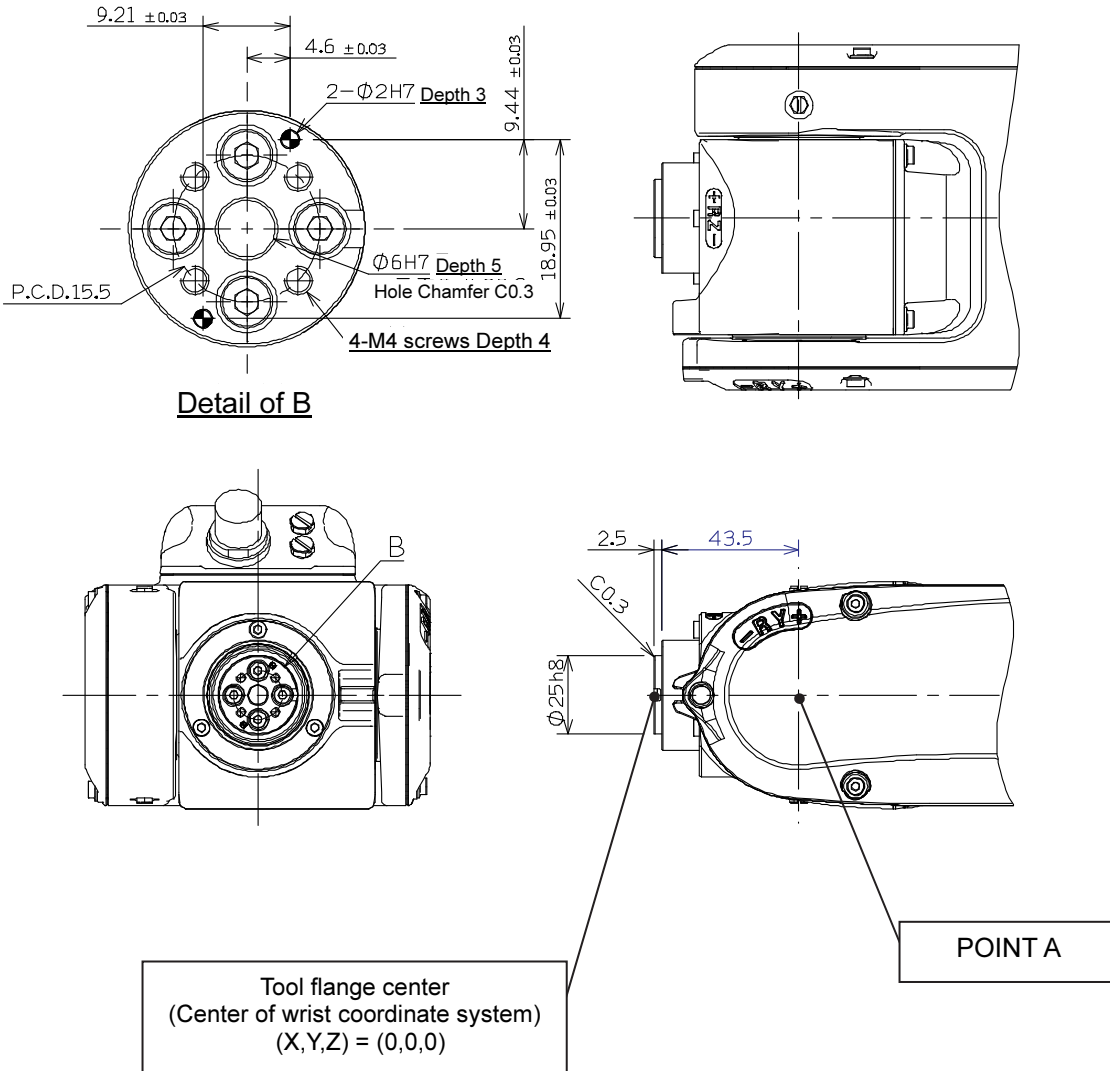


4. Details of load mounting face

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









 CAUTION	Be sure to screw the M3 tool fixing bolts in the wrist not deeper than the screw depth in the mounting face. (Bolt dia. 3mm or more.) Screwing the bolts deeper than the screw depth may damage the wrist.
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【MZ01-01】



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. The robot must not come into contact with any peripheral equipment when operating in the maximum operating range with a tool mounted on it.
 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.
 IMPORTANT	Robot is not dust-tight packaged. If robot is used in clean room, abrasive or fine particles shall be removed before carrying it in clean room. It is recommended that robot should be cleaned by swabbing with isopropyl alcohol (IPA). Use of other solvents or pure water could contribute rust or peel of coating materials.
 IMPORTANT	It is to be noted that cleanliness of robot is worse if it has operated in poor conditions for a long time or if it has been left as it was.
 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 in order 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.

Robot model	MZ01-01
Installation parts *1	4 bolts of M5×20 (JIS: Strength class 12.9) Plain washers; HRC35 in hardness, Diameter φ10 or more, thickness 1.6mm or thicker, 4pcs
Tightening torque *2	8.1N·m
Allowable repeated tensile *3	Approximately 1000 N

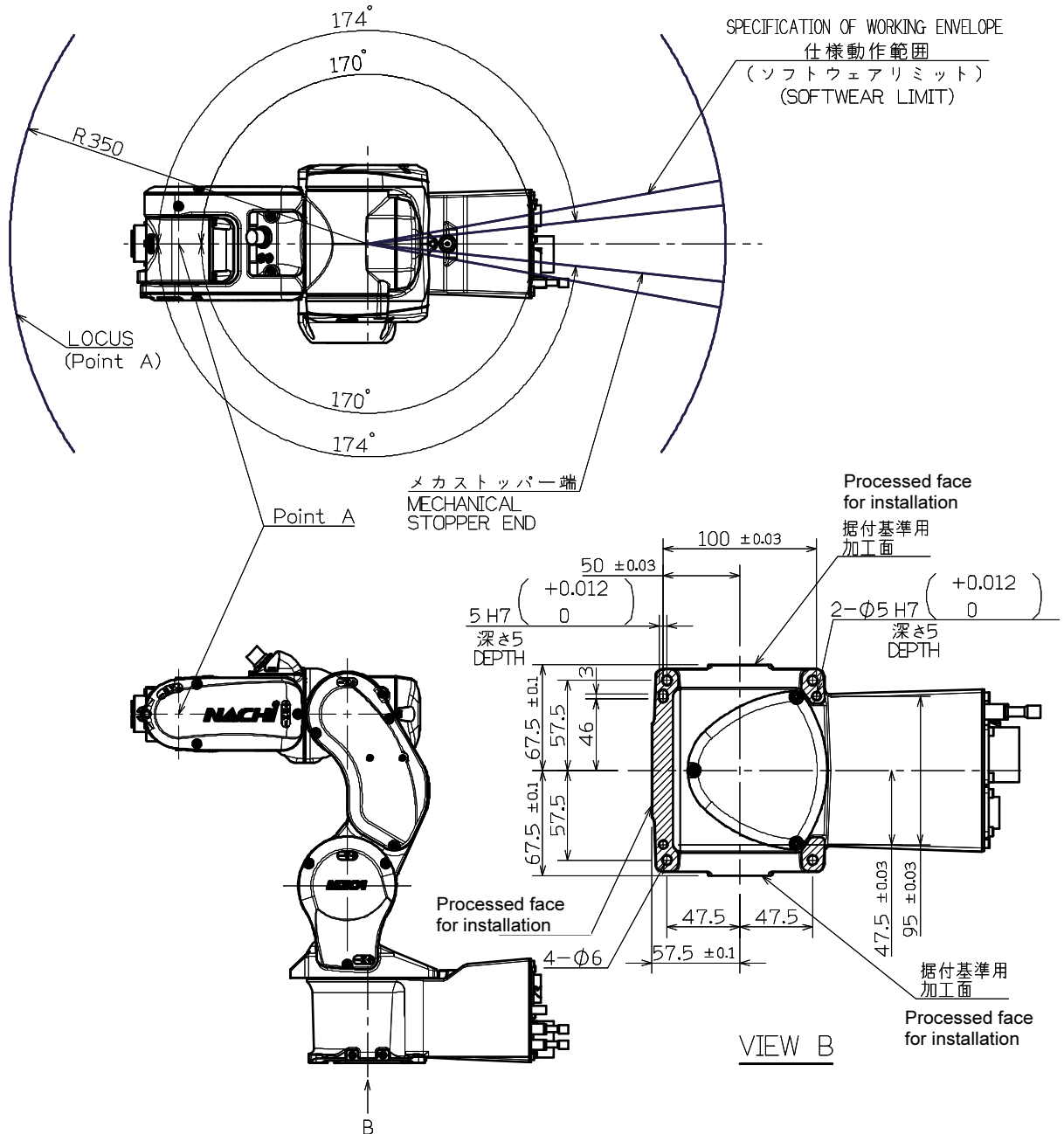
*1 : Installation parts are not accessory of robot. *2 : Apply a coating of lubricating oil to the threaded parts of bolts, and then tighten bolts by using torque wrench to the specified tightening torque. *3 : This tensile is per installation bolt when robot is installed with all bolts written in table above.

■ Installation dimension

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

	<p>The mechanical stopper end is located in a position beyond the specified working envelope (software limit) of axis 1. Please consider well over the specification working envelope, wrist configuration, tool shape and etc. when installing the safety fence.</p>
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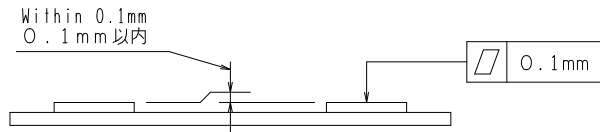
【MZ01-01】



■ Accuracy of installation surface

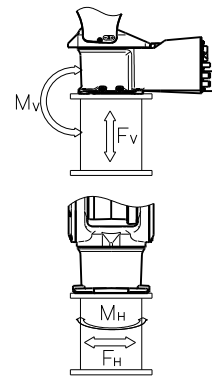
When installing robot, strictly observe precautions listed below to cause no deformation in the base.

- (1) Make the deviation from the flatness of the 4 plates on the robot installation surface keeps within 0.1 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 0.1 mm (± 0.05 mm).




■ 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
MZ01-01	500N	400N	100Nm	100Nm

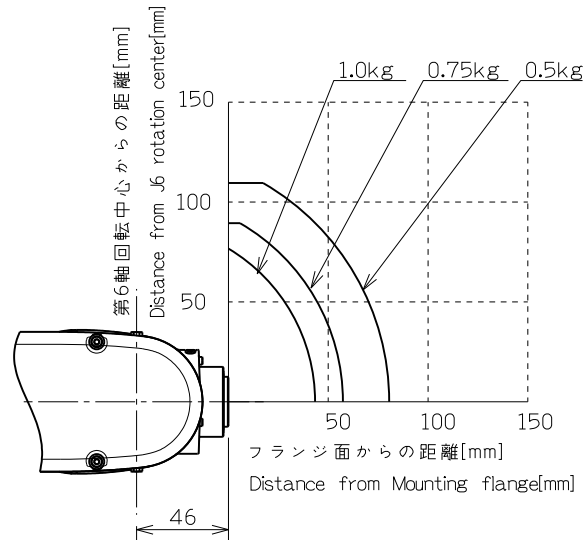


6. Allowable wrist load

 CAUTION	<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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6.1 Torque map for wrist load

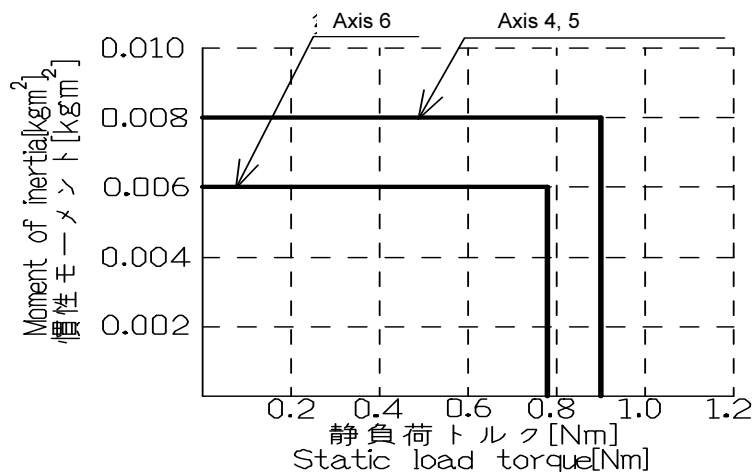
Use the robot under condition that COG of wrist load falls in the range shown in the torque map. 【MZ01-01】




6.2 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.

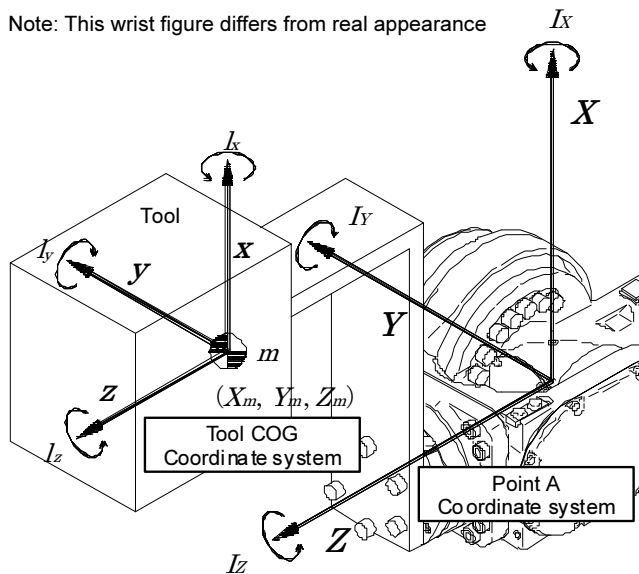
【MZ01-01】



 IMPORTANT	<p>If the moment of inertia exceeds the specification, maximum speed is automatically limited by the software to protect the robot.</p>
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6.3 How to find the inertia moment of each axis

Note: This wrist figure differs from real 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
 (X_m, Y_m, Z_m): COG of tool on point A coordinate system

1 Calculate inertia moment defined on tool COG coordinate system (xyz).
 If tool is regarded as prism, it is calculated as right formula.

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 controller.

Tool Constants						
SRA166-01						
TOOL1						
Tool Name	TOOL1					
Length (mm)	x	0.0	y	0.0	z	1
Angle (deg)	x	0.0	y	0.0	z	1
C of G (mm)	x	0.0	y	0.0	z	1
Weight (kg)	166.0					
Inertia (kg?m ²)	x	88.90	y	88.90	z	44.10
Max. radius (mm)	0.6					

Inertia moment on tool COG coordinate system

This is different from "allowable moment of inertia" written in robot specification sheet.

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.

Inertia moment on point A coordinate system (XYZ) is

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

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

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

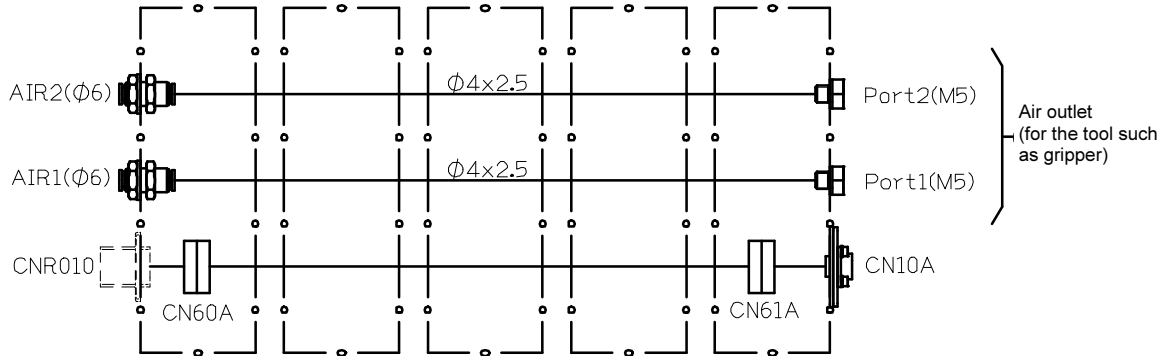
Axis 4 and 5 inertia moment is larger value of I_X and I_Y, because this depends on axis 6 position.
 Axis 6 inertia moment is I_Z itself.

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

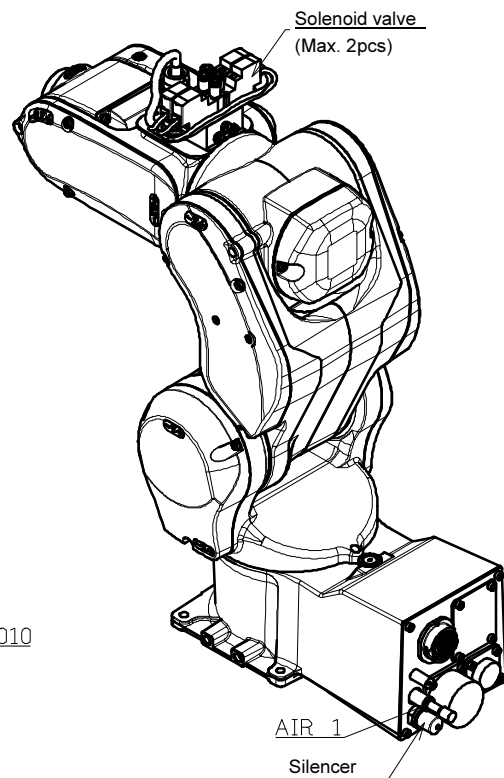
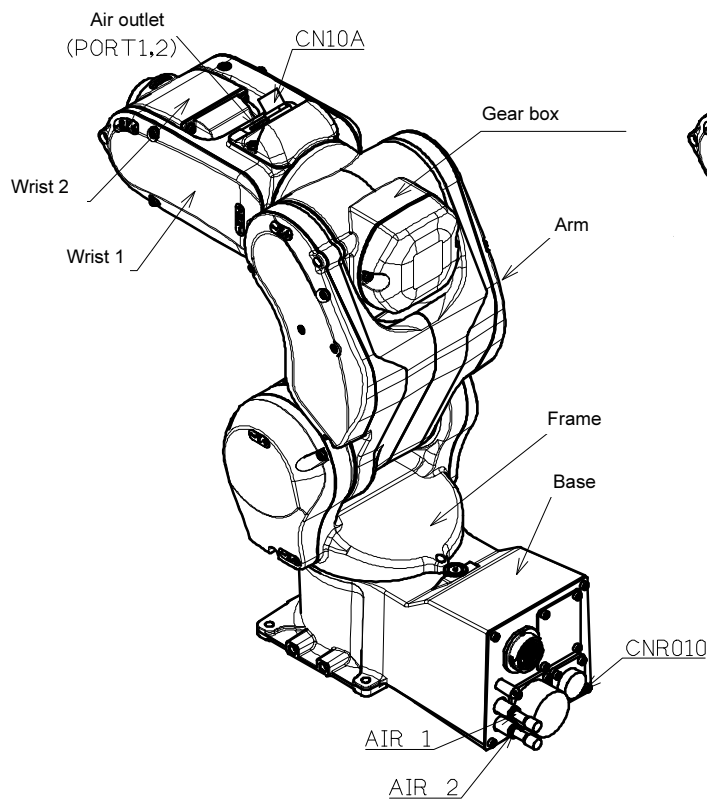
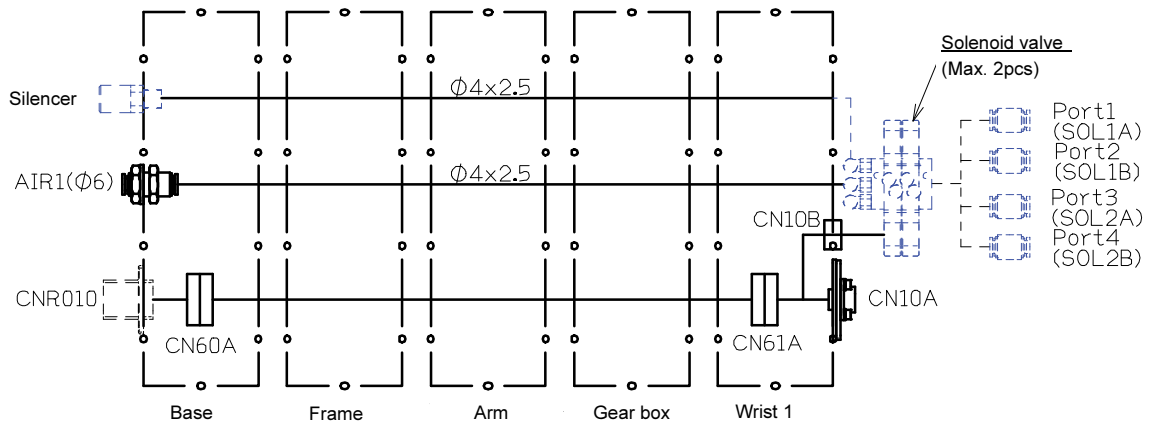
$$I_{J6} = I_Z$$

7. Application wiring and tube diagram

■ Standard specification

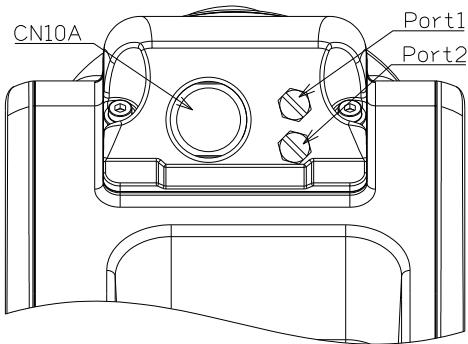


■ When installing solenoid valve (Option)

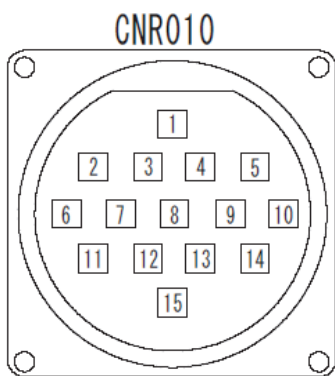
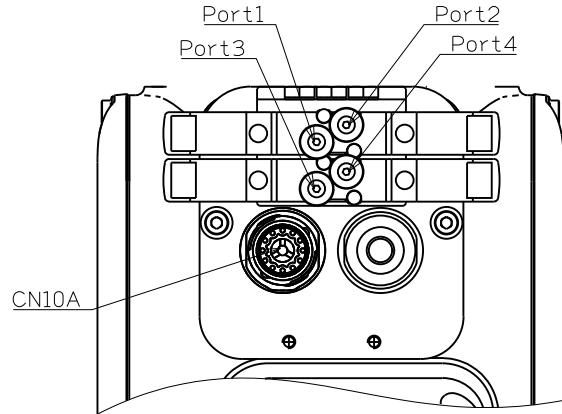


Detailed diagram of the application connectors (standard)

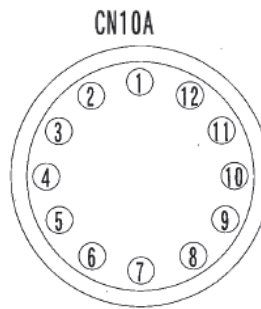
■ Standard specification



■ When installing solenoid valve (Option)



1	A01
2	A02
3	A03
4	A04
5	A05
6	A06
7	A07
8	A08
9	A09
10	A10
11	A11
12	A12
13	
14	
15	ECE



Standard specification

1	A01
2	A02
3	A03
4	A04
5	A05
6	A06
7	A07
8	A08
9	A09
10	A10
11	A11
12	A12

When installing solenoid valve

1	A01
2	A02
3	A03
4	A04
5	A05
6	A06
7	A07
8	-
9	A09 ※
10	A10 ※
11	-
12	-

※ Only when one valve is installed

On base	On wrist 1 (standard)	On wrist 1 (installing solenoid valve Option)
CNR010 connector type JAE JN2AW15PL1 Partner connector type JAE JN22DW15SL1	CN10A connector type Tyco EEGA002NN00000008000 Partner connector type Tyco ESTB001NN0033000N000	CN10A connector type Tyco EEA002N00000012000 Partner connector type ←

(Supplement)

Specification of application cable inside robot body;
Maximum current: 2.0A/1 pole, rated voltage: 63V, Endurance voltage 500V

For details, see the following document.

“Standard specifications CFD controller”

(SCFEN-010)

“CFD CONTROLLER INSTRUCTION MANUAL OPTION (I/O CONNECTION)”

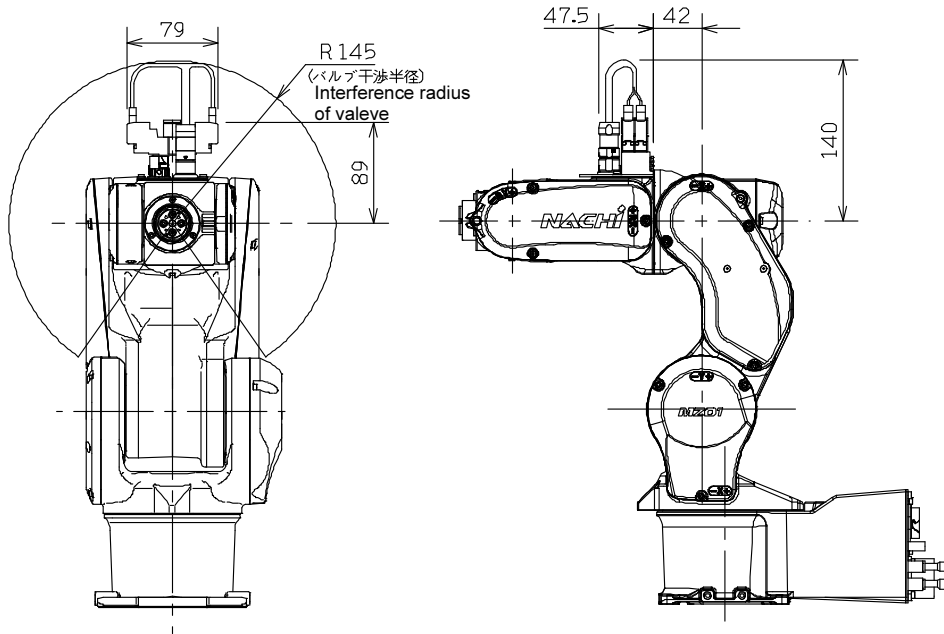
(TCFEN-183)

“INSTRUCTION MANUAL OPTION (MZ series)”

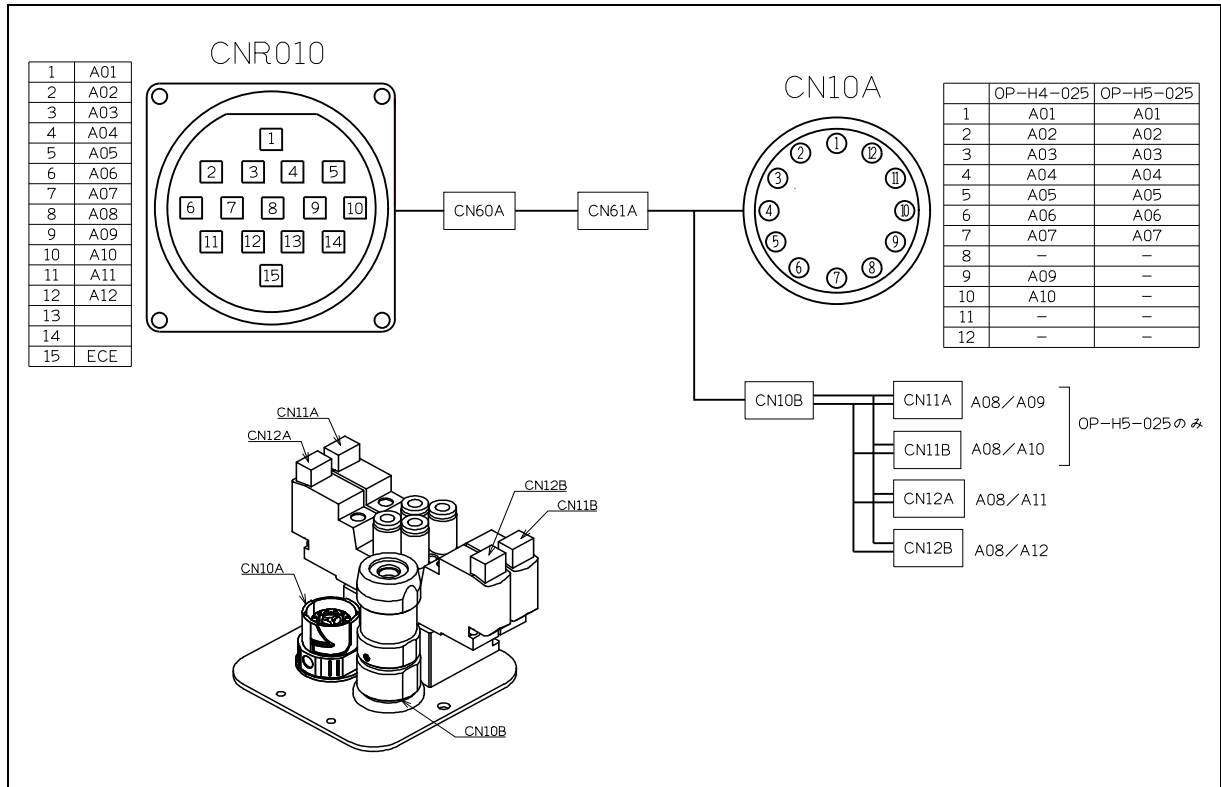
(TCFEN-184)

■ Detail of solenoid valve (option)

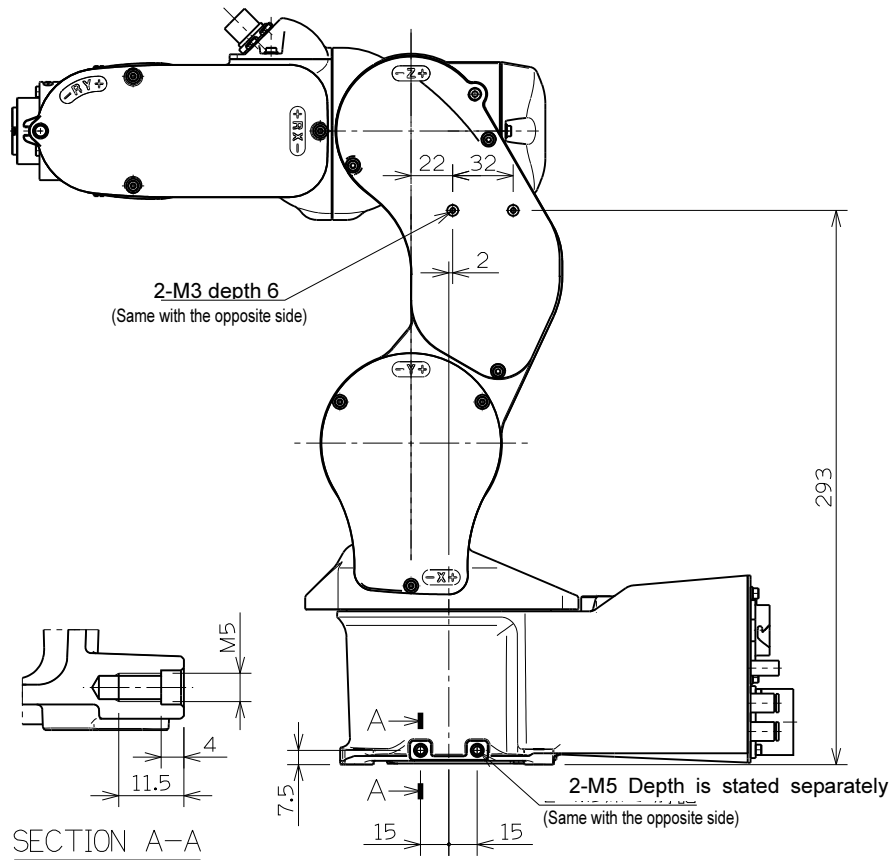
External dimension



Wiring conection



■ Service tap locations
【MZ01-01】



8. Option specification

8.1 MZ01 series mechanical option

No.	Item	Specification	Parts No.	Remarks
1	Tools	Zeroing pin & Zeroing block	OP-T2-105	Shipped with the robot
2	Solenoid valve	1 valve	OP-H4-025	Pressure range : 0.1 to 0.5MPa
		2 valves	OP-H5-025	Coil voltage : DC24V Pre-installed when shipping
3	Variable stopper	axis 1	OP-S5-043	Shipped with the robot
4	ISO Flange	Compatible with P.C.D 25	OP-W2-017	Shipped with the robot

8.2 MZ01 series Wire-harness

The “wire-harness” is a cable to connect the robot controller and the robot.
This option must be selected when purchasing the robot.

No.	Name	Product number	Remarks
1	Wire-harness	ZA101C-J1-##-A (## is the cable length:02,035,05,10,15,20[m])	035:3.5m

(NOTE)

- This part includes 2 cables. (Motor power + Encoder)
- Motor / encoder harness (fixed)
 - Motor cable diameter ϕ 16.6mm, minimum bending radius (inside): 100mm
 - Encoder cable diameter ϕ 13.2mm, minimum bending radius (inside): 80mm
 - Total length after the extension is 20m at maximum

For details, refer to the following specification.

“Standard specifications: CFD controller” (SCFEN-010)

9. Terms of delivery and Installation (Specification that includes a robot)

1. There are 3 terms available.

	Terms	Details
1	Only delivery	Robot is delivered at the front entrance of the designated building. Unloading and installation work must be performed by customer.
2	Delivery and installation with test-run	Robot is installed and test-run is performed by Nachi. (This does not include Teaching work.)
3	Delivery, installation with test-run and Teaching	Perform teaching with work piece including the Term 2.

Costs differ significantly according to which term you select, so please discuss well and make a decision according to your company needs.

2. Education of operation and maintenance

The special operation and maintenance guidance are not included. Consult with each NACHI-FUJIKOSHI office for the training and etc.

10. Consuming power (Robot + Controller)

0.4 kVA (peak) This value varies according to the moving pattern.

11. Robot body paint color (Robot + Controller)

Standard color Robot cover and upper arm Munsell 6.5PB9/1
 Lower arm part Munsell N5.5
 Base part Munsell N2.5





Controller Munsell N1.5

12. Warranty

1 year after delivery.

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

13. Precautions for handling

 CAUTION	<p>Although tool setting was correctly done, sometimes arm vibration may occur at slow speed according to the robot movement or shape of tool. This is because of the arm driving vibration frequency and arm natural vibration frequency comes closer.</p> <p>In such case, following countermeasures can reduce vibration by making the resonance point different.</p> <ul style="list-style-type: none"> • Change the step speed of robot program. • Change the tool weight or moment of inertia. • Change the robot posture.
 CAUTION	<p>If ambient temperature is low, vibration, overload error and tracking error may occur on the startup of the robot.</p> <p>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%.</p>
 CAUTION	<p>When transporting the robot without fixing, robot may be damaged due to the vibration or crush during transportation.</p> <p>Therefore when transporting the robot, certainly fix arms with the bracket which is used when shipped.</p>
 CAUTION	<p>This robot has no mechanical brake in axis 1, 4, 5 and 6. When motor power is off, wrist posture may gratefully change and tool may interfere with the robot body or the peripheral equipment, due to the tool condition.</p> <p>So following attention is necessary.</p> <ul style="list-style-type: none"> • If motor power needs to be turned off at stand-by position, its robot posture must be that no torque is necessary for wrist axes (axis 4, 5 and 6). • When checking movement in teach mode, place the robot to the posture that no torque is necessary for wrist axes (axis 4, 5 and 6) and then turn the motor power off.

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