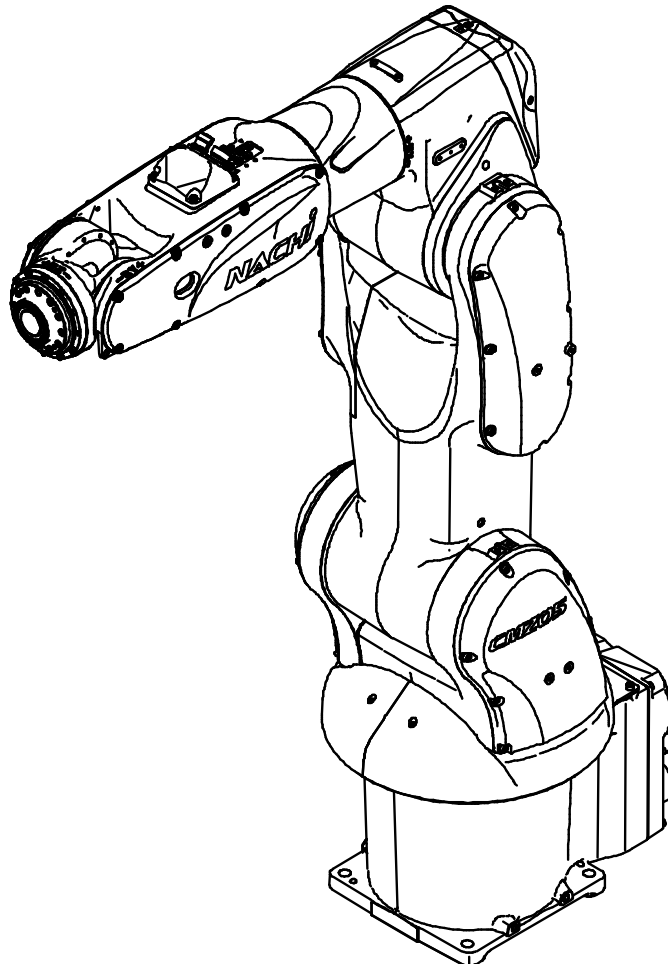


NACHI

Standard specifications
CMZ05-01 [CFDs-0000C]

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 industries utilizing welding and the material handling techniques.

"CMZ05-01" is a small robot that can be used for collaborative operation (*) and non-collaborative operation depending on the customer's specifications. Intrinsically safe design is adapted to reduce the risk of being caught by the cover for the J1 axis stopper section and the J3 axis offset structure. And in collaborative operation, the torque detection system equipped on the robot detects robot collision and pinching, and the robot stops or evacuates. Also, a minimum gap of 25 mm or more can be secured by properly designing of the tool shape.

Model CMZ05-01 and CFDs-0000C controller dedicated for this model have obtained third-party certification for the following safety standards.

- ISO10218-1 (Safety requirements for industrial robots)
- ISO13849-1 (safety-related parts of control systems)
- ISO/TS15066 (safety requirements for collaborative robots)

By adopting the hollow wrist tip structure common to the MZ-F series, the wiring from the robot body to the various tools has been simplified, greatly reducing the burden of installation by the customer. This document is the specifications of the robot body. As for the controller, refer to the separate Standard Specifications CFDs Controller (SCFEN-022).

(*) Collaborative operation

This is a condition of which the "collision detection function" that detects external force and stops the robot using the robot's built-in sensor is working and the various robot operation status monitoring by the robot monitoring unit (RMU50-11) in the controller is working.

Although this function allows humans and robots to be placed in the same space, it does not guarantee safety.

When using this robot system, conduct a risk assessment according to the system to be built, identify the parts of the human body where contact or pinching may occur, and be sure to measure the force at the time of collision and the force at the time of pinching according to the part, and confirm that the risk has been reduced.

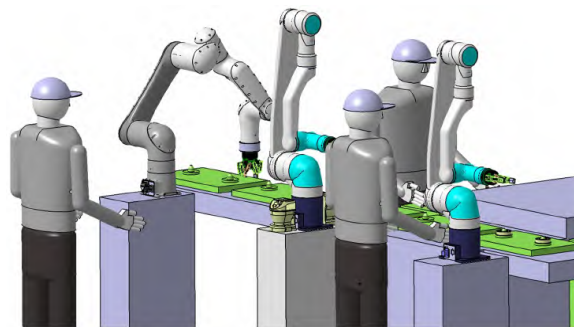


Image of collaborative operation
(Robot in this figure is different from this model)

Also please confirm following matters.

- During non-collaborative operation, the collision detecting function to stop robot does not work. When a safety signal is not input, robot is operated in collaborative operation. For non-collaborative operation, safety signals must be separately input to the controller.
- The collision detection function does not work during manual operation in teach mode. It works during check operation. The collision detection function can be enabled or disabled in teach mode only.
- There are gaps near the joints of the robot where fingers and other objects can enter. Never put your hand in the robot while it is in operation, even in collaborative operation. Do not insert your hand into the robot while it is in operation or work while placing your hand on the robot.
- Tools and workpieces to be mounted on the robot should not be sharp, hot, extremely cold, or noisy. We do not guarantee the safety of the tools and workpieces mounted on the robot.
- When using the robot in an application where external force is applied to the robot, prior consideration and verification of the usage conditions are required. Please be sure to set the tool constants correctly or use the dedicated function, as the collision detection function may detect a false collision. (e.g., nut runner, pressing, etc.)
- Tool constants should be set correctly. If the set value differs from the actual load, the collision detection function may miss-detect.

Due to its specifications and technical limitations, this robot has the following residual risks.

- Body parts with a thickness of 25 mm or more are at risk of being caught.
- The collision detection function is activated by the force externally applied to the joints of the robot, but the detection sensitivity near the center of rotation of the joints is sluggish, and collisions may not be detected or the force may not meet the ISO/TS15066 requirements.
- The collision detection function is adjusted to work in such a way that the force specified in ISO/TS15066 is satisfied, but it may not be satisfied depending on the operating conditions (speed, installed load, etc.). After building the system, be sure to measure the force at the time of collision, and review the operating conditions (lower load, lower speed, etc.) as necessary.

2. Robot type details

CMZ05-01-***

Connecting specification

Mark	Specification	Remarks
0	Rear connection	Rear connection of robot~controller cable

Installation specification

Mark	Specification	Remarks
0	Standard	Inclined installation ±30deg at maximum

Application specification (Indispensable option)

Mark	Specification	SOL valve	Signal	LAN	Remarks
0	Standard (I/O20 wires +LAN8 wires x1 line)	3 valves *1	20 wires	8 wires, 1 line	
E	I/O20 wires only	3 valves *1	20 wires	—	
V	I/O12 wires +LAN8 wires x2 lines	3 valves *1	12 wires	8 wires, 2 lines	

Arm specification

Mark	Specification	Remarks
None	Standard arm	6 axes, Maximum reach 927mm ²

*1: Only three solenoid valves. Also, there is no specification without a solenoid valve. Type SYJ3220-5GR-M3 (SMC), 2-position double solenoid, coil rated voltage DC24V, power consumption 0.35w, with surge voltage protection circuit (non-polar type), non-lock push manual operation, no piping subplate, no bracket

*2: Arm length is only one type.




CAUTION

Installation at an angle of 30 degrees or more is not allowed. Install at an angle of less than 30 degrees. If robot is to be installed on the inclined or inverted surface, measure the installation angle and register the angle correctly in the menu below even if the angle is less than 30 degrees.

Failure to do so may result in improper motor torque control, which may lead to premature damage to the robot. In addition, the collision detection function may not operate properly and may cause hypersensitivity reactions.

< Constant Settings > [12 Format and Default Settings] – [5 Installation Angle]

 For details, refer to CFDs Controller Instruction Manual "Setup", "3.2 Configuration", "Setting the Installation Angle".

For various electricity-related options and the robot controller "CFDs Controller," the following specifications and instruction manuals are also available.

CFDs Controller Standard Specifications, (SCFEN-022)

CFDs Controller Instruction Manual "Controller Maintenance", (CFDs-EN-301)

CFDs Controller Instruction Manual "Option", (CFDs-EN-182)

3. Basic specifications

3.1 Robot specification

Item		Specifications	
Robot type		CMZ05-01	
Structure		Articulated	
Degree of Freedom		6	
Drive system		AC servo	
Maximum motion range	Axis 1	± 2.97 rad ($\pm 170^\circ$)	
	Axis 2	When shipped	$-2.00 \sim 0.69$ rad ($-115 \sim +40^\circ$)
		Maximum ^{*1}	$-2.36 \sim 1.40$ rad ($-135 \sim +80^\circ$)
	Axis 3	$-2.48 \sim 2.69$ rad ($-142 \sim +154^\circ$)	
	Axis 4	± 3.32 rad ($\pm 190^\circ$)	
	Axis 5	When shipped	± 1.57 rad ($\pm 90^\circ$)
		Maximum ^{*1}	± 2.09 rad ($\pm 120^\circ$)
Axis 6	± 6.28 rad ($\pm 360^\circ$)		
Maximum Velocity ^{*2}	Axis 1	4.71 rad/s (270 °/s)	
	Axis 2	4.28 rad/s (245 °/s)	
	Axis 3	5.42 rad/s (310 °/s)	
	Axis 4	9.60 rad/s (550 °/s)	
	Axis 5	9.60 rad/s (550 °/s)	
	Axis 6	16.58 rad/s (950 °/s)	
Tool tip speed	Non-collaborative	2500 mm/s	
	Collaborative	1000 mm/s ^{*3}	
Maximum payload	Wrist	5 kg	
Maximum static load torque	Axis 4	16.9 N·m	
	Axis 5	16.9 N·m	
	Axis 6	9.4 N·m	
Maximum moment of inertia ^{*4}	Axis 4	0.49 kg·m ²	
	Axis 5	0.49 kg·m ²	
	Axis 6	0.15 kg·m ²	
Position repeatability ^{*5}		± 0.020 mm	
Maximum Reach		927 mm	
Air piping		$\phi 6 \times 2$ (3 solenoid valves installed as standard) Available pressure range: 0.1~0.5Mpa	
Application signal line		20 wires or 12 wires (Depends on option selection)	
LAN		None, 8 wires 1 line or 8 wires 2 lines (Depends on option selection)	
Mounting Condition ^{*6}		Floor / Inverted	
Ambient conditions		Temperature: 0 to 40 °C ^{*7} Humidity: 20 to 85 %RH (No dew, nor frost allowed) Vibration to the installation face: Not more than 0.5G (4.9 m/s ²) ^{*8}	
Protection class ^{*9}		IP67 equivalent (dust-proof and moisture-resistant)	
Clean class		ISO CLASS5 equivalent ^{*10}	
Noise level ^{*11}		75 dB	
Robot weight		53 kg	

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

- Axis 1 - Axis 6 are displayed as J1-J6 each on the controller screen.

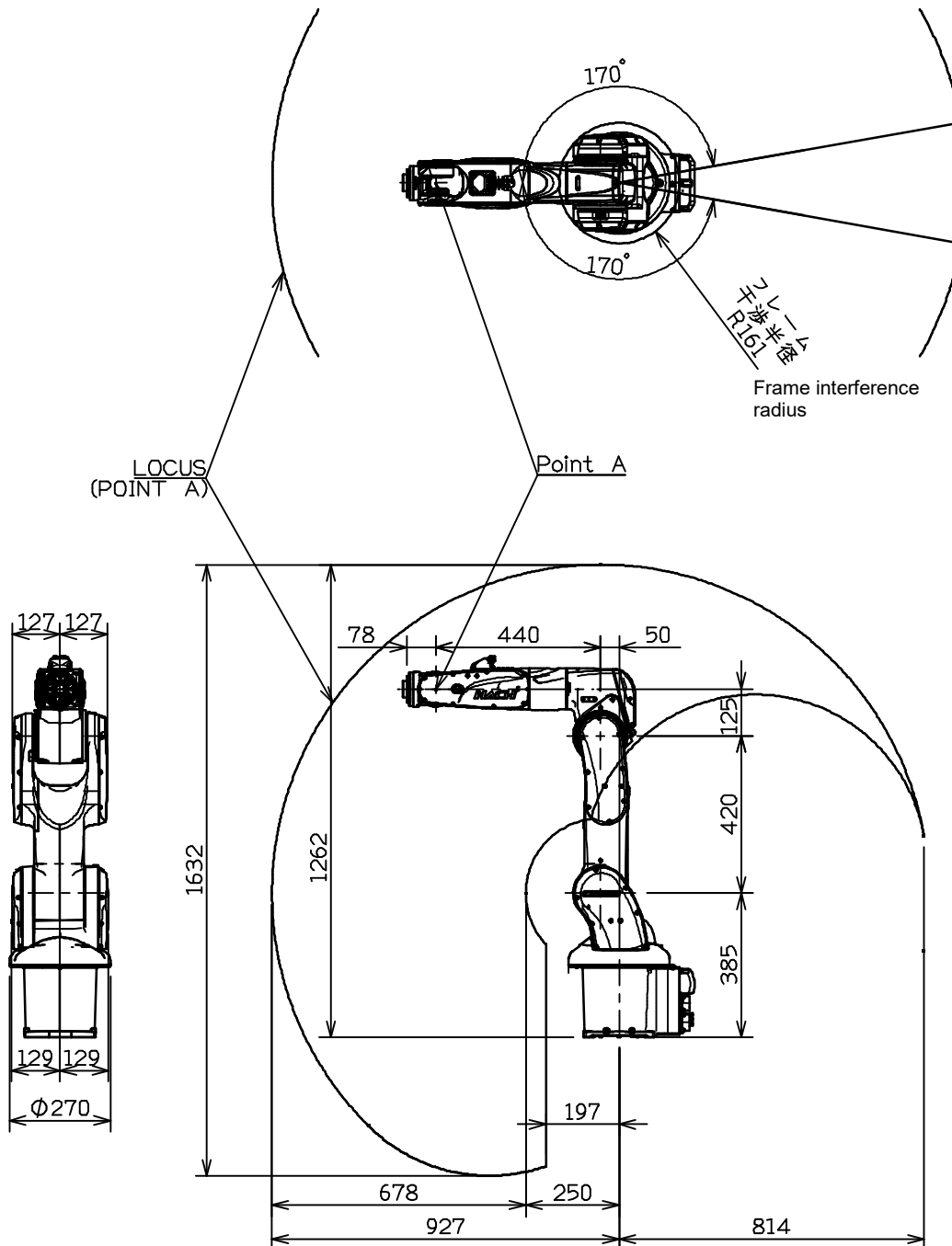
- Specifications are subject to change without prior notice for technical changes.

- Explosion-proof version is not available.

- *1: When the J2 and J5 axes are operated to their maximum motion range, there is a risk that human finger may be pinched even without a tool or workpiece. To eliminate this risk, the motion range is limited by the robot monitoring unit (RMU50-11, conforming to ISO13849-1) at the time of shipment. The motion range can be changed only when a risk assessment based on the actual operating environment confirms that the risk has been reduced. Depending on the shape of the mounted tool or workpiece, there is a possibility that human finger may be pinched even if the motion range is limited.
- *2: The maximum speed in the table is the maximum and varies depending on the work program and wrist load conditions. This specification shows the maximum value for each item in normal playback mode.
- *3: A risk assessment in accordance with the basic safety standard ISO12100 must be performed to determine the operating speed according to the area of impact.
- *4: Note that the allowable wrist moment of inertia varies with wrist load conditions.
- *5: Conforms to JIS B 8432.
- *6: Cannot be installed at an angle of more than 30 degrees. Install at an angle of less than 30 degrees.
- *7: Using at 1000m or lower sea level. Ambient temperature has limitations when allowable altitude is exceeded.
- *8: When the robot is used in collaborative operation, vibration of the floor or gripper may cause the robot to stop. The source of vibration must be eliminated when the robot is used.
- *9: Liquid such as organic compound, acidity, alkalinity, chlorine or gasoline cutting fluid which deteriorates the seal material are not available to use.
- *10: Based on internal assessment in accordance with ISO14644-1. To ensure cleanliness, install the robot in a clean room with downflow. The robot is not packed in a dustproof package, so dust removal and wiping and cleaning of the robot are required when bringing it into the clean room.
- *11: Robot noise is A-weighted equivalent sound level measured under "JIS Z 8737-1" (ISO 11201) with maximum payload and maximum velocity.

3.2 Robot dimension and motion range


【CMZ05-01】
(Floor installation)



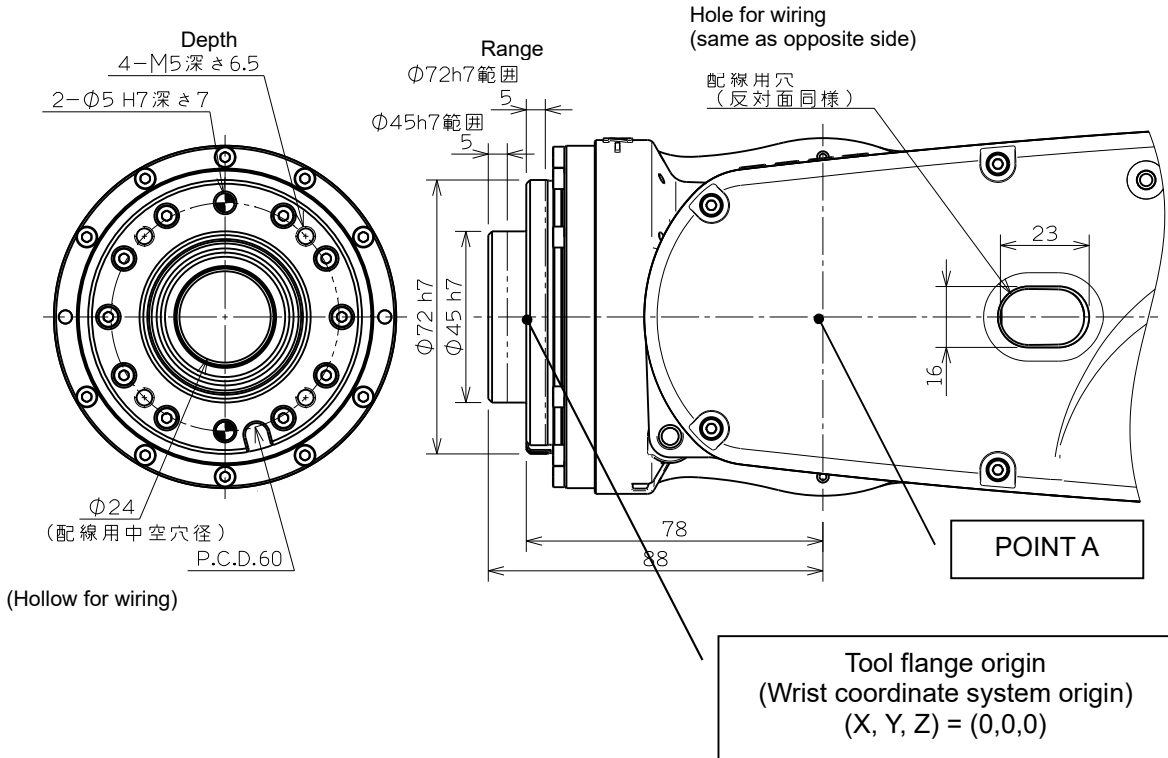
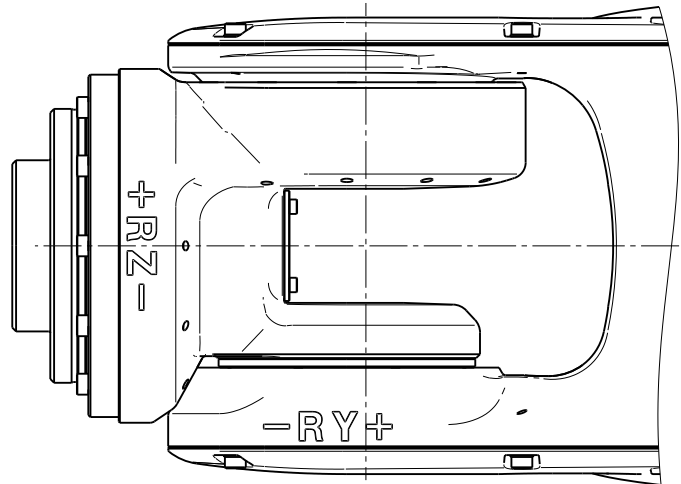
*When the robot is used in collaborative operation, the rigidity and fixation of the trestle must be strong.
The CMZ05-01's collision detection function may malfunction if the trestle or equipment vibrates due to the movement of the robot or the surrounding conditions.

4. Details of load mounting face

For the tool fixing bolts, use the mounting P.C.D. shown in the figure below. (common with MZ07F)

 CAUTION	Be sure to screw the depth of the M5 tool installation bolts less than the screw depth of the installation face. Screwing the bolts deeper than the screw depth may damage the wrist.
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【CMZ05-01】







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.






■ Safety measures against entry in the robot operating area





 WARNING	<p>Basically, there is a risk of worker collision with the robot during robot operation. Ensure worker safety by conducting risk assessment according to the system and taking appropriate countermeasures. The operating conditions for collaborative and non-collaborative operation of this model are as follows.</p> <ul style="list-style-type: none"> ·When there is no safety input signal, this robot operates in collaborative operation. Measure the force at the time of collision at the part where collision may occur, and confirm that the force is less than or equal to the permissible level. ·The system operates in non-collaborative operation only when it is determined that no one is present by a safety signal input from a safety laser scanner, safety door, safety mat (safety certification is recommended), etc.
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■ Safety measures for the robot and peripheral equipment locations

 WARNING	<p>Do not install the operation and the adjustment part within the robot operating area. Install the robot control panel, interlock panel, and all the other operation panels where it's safe, so that they can be operated outside of the guard fence. In case those operation panels are installed near the robot, workers can get caught in the robot, when the robot operation fails.</p>
 WARNING	<p>Perform compensation for the collision detection sensor every month. Otherwise, the collision detection function may detect incorrectly. From this background, install the robot in a place where the correction operation can be performed. For details on the zero point correction procedure, refer to the instruction manual "Manipulator" (MCMZEN-381).</p>
 WARNING	<p>After installing the robot, be sure to connect the ground of the robot body. See "7. Application wiring and piping diagram" for connection points and recommended parts.</p>
 WARNING	<p>When mounting the robot on a mobile cart or AGV, be sure to ground the robot as described in the previous section. Be sure to ground the robot from the mobile cart or AGV (e.g., use a ground belt). (Use a ground belt, etc.).</p>

■ Safety measures for installation work



 WARNING	<p>To install the robot, it is important to position the robot so that no workers will get pinched by the robot. Robot installing position needs to be determined by considering the motion range of robot with tool mounted. If necessary, provide a margin outside the motion range to ensure safety.</p>
 WARNING	<p>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.</p>
 WARNING	<p>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.</p>
 WARNING	<p>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.</p>
 WARNING	<p>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.</p>

 IMPORTANT	<p>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.</p>
 IMPORTANT	<p>If robot has operated in poor conditions for a long time or has been left as it was, please carry out the inspection by referring to the instruction manual "Manipulator" (MCMZEN-381), "Chapter 3 Maintenance 3.1 Inspection items and periods".</p>
 CAUTION	<p>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%.</p>
 CAUTION	<p>Installation structures (robot raiser, etc.) may cause problems such as vibration and servo tracking error. If such problem occurs, please promptly improve the installation structure. If installation structures are kept using as they are, reliability and lifetime of not only the robot but also the installation structures may be damaged, due to the vibration and sudden braking of robot.</p>

■ **Installation location and ambient conditions**

Conditions (temperature, humidity, height and vibration) are written in “Chapter 3 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.
- (4) Check the grounding conditions so that the potential difference between the grounding of controller and the grounding of robot is small.

 IMPORTANT	<p>Special environment such as X-ray environment</p> <p>Our company's robot, controller and related option equipment are designed for general industrial use. Unless otherwise specified in the specifications or manuals, operations in special conditions and environments such as outdoor, X-ray environment, radiation environment, nuclear power control, aerospace equipment, public transportation, medical equipment, etc. are not assumed. Our company and its subsidiaries are not liable for any accidents, failures, etc., that may occur if the robot is used in such an environment without asking our company to do so.</p>
 IMPORTANT	<p>Using mounting condition that does not comply with specifications may cause the robot system to malfunction or fail prematurely. In that case, robot will be out of warranty. Please understand it in advance.</p>

■ **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, needless 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.

	CMZ05-01 Standard installation
Thickness of floor concrete	Not less than 150 mm
Installation parts *1	4 bolts of M10×30 (JIS: Strength class 12.9) 4 plain washers of not less than 3.2 mm in thickness, and HRC35 in hardness
Tightening torque *2	67 N·m
Allowable repeated tensile *3	Approximately 700 N



*1; Installation parts are not accessory of robot.

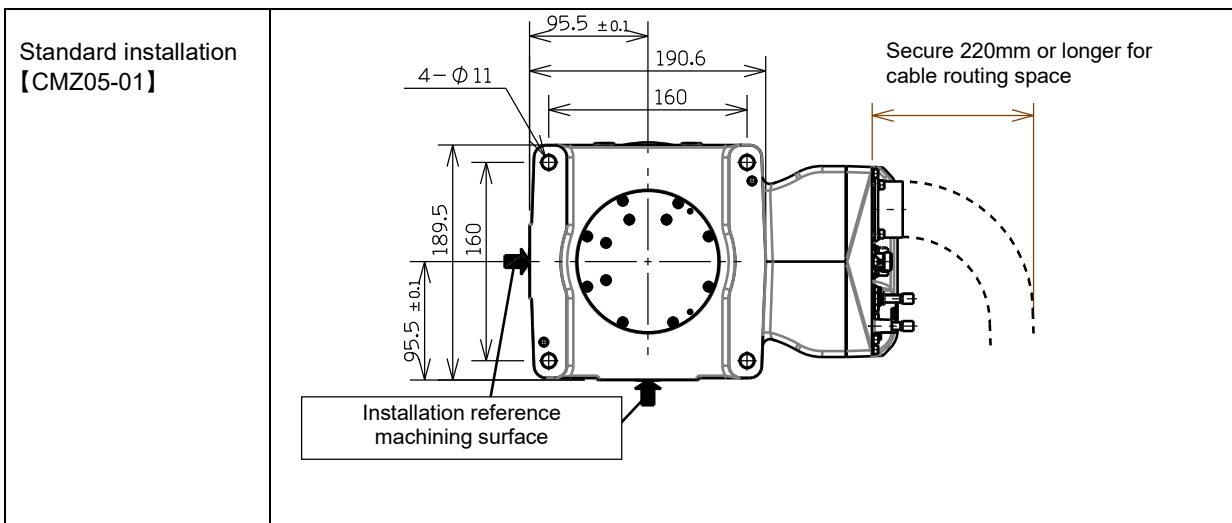
*2; Apply a coating of lubricating oil to the threaded parts of bolts, and then tighten bolts by using torque wrench to the specified tightening torque.

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

■ Installing dimension

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

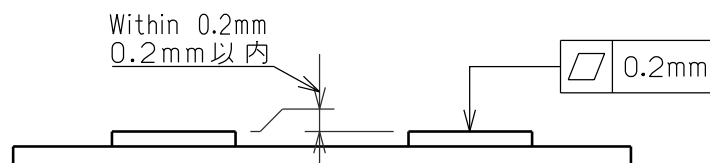
 WARNING	<p>The mechanical stopper end is located in a position exceeding the specified working envelope (software limit) of axis 1. To install the safety fence, with consideration given to the motion range in use and the wrist configuration and the shape of tool.</p>
 WARNING	<p>Installation work should 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, robot may fall down. Especially when dismounting installation parts from robot body, robot falls down immediately.</p>



■ Accuracy of installation surface

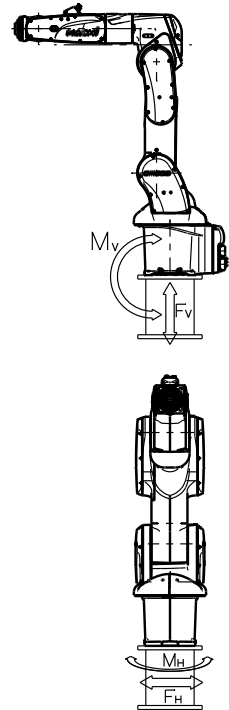
When installing robot, strictly observe precautions listed below to cause no deformation in the base.

- (1) Keep the flatness of the 4 plates on the robot installation surface within 0.2 mm.
- (2) 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
CMZ05-01	2000N	1500N	1250Nm	1130Nm



■ Safety measures for entering in the robot motion range during 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 is an 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, switch the robot to the collaborative operation or stop the robot automatically.
 WARNING	<p>It takes time for the robot to decelerate after the input from a sensor conforming to the functional safety standard changes from High to Low. Install sensors with considering to the transition time (deceleration time).</p> For details, see CFDs controller instruction manual, "10.3 Collaborative Mode Display".
 WARNING	<p>Please make sure that the robot operation range must be easy to distinguish the risk range by coloring the floor.</p> 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 7. Application wiring and piping diagram) will turn on green in 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.
 WARNING	Make sure that there are no obstacles (devices) in the operating area of the robot, including tools, that could block the escape route of the operator. There is a possibility that the worker may be caught between the obstacle and the robot.
 WARNING	Consider installing a safety fence after conducting a thorough risk assessment.
 WARNING	Do not switch to the non-collaborative mode when a worker is within the operating range of the robot. Provide a display or lock to prevent other workers from accidentally switching the mode.
 WARNING	During operation, work in a position where the robot is within the field of view. Otherwise, there is a risk of collision.
 WARNING	<p>In the factory default setting, the collision detection function in teach mode is set to "only during check operation" to prevent miss-detection.</p> For details on how to change the setting, see CFDs/CFDq Controller Instruction Manual BASIC OPERATIONS, (CFDs-EN-002), "Section 10.4 Disabling Collision Detection during Teaching".

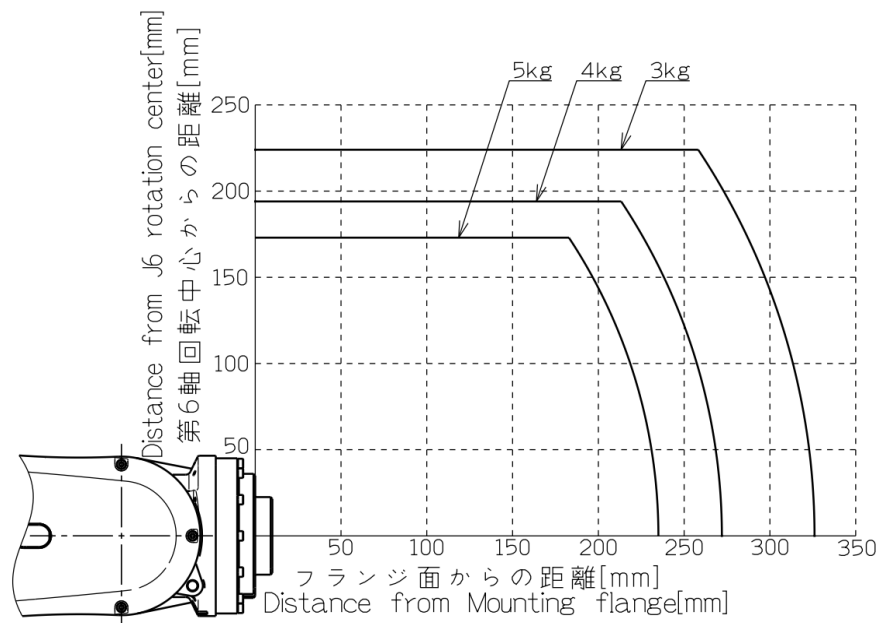
6. Allowable wrist load

 CAUTION	<p>Make sure that the load fixed on the tip of the wrist stays in the allowable range of “Maximum payload”, “Maximum static load torque” and “Maximum moment of inertia”. If wrist load exceeds the allowable value, this is out of guarantee.</p> <p>Please refer to “2. Basic specifications” and following figures for the numeric value of the each condition.</p>						
 CAUTION	<p>Before using the robot, please register the "weight", "COG (center of gravity) position" and "inertia Moment" of wrist payload as the load condition. Robot is controlled to minimize the operating time according to the registered value.</p> <p>Therefore, even if the load condition was within the specifications, if that is incorrect, excessive acceleration will be generated, and reliability and life may be damaged.</p> <p>Even if the correct value is registered, vibration or servo tracking error may occur due to the insufficient rigidity of the payload. If such problem occurs, please adjust the “speed”, “acceleration” and “smoothness”. Those factors can be adjusted in every step. See the instruction manual for details.</p> <table border="1" data-bbox="359 808 1018 902"> <thead> <tr> <th>Speed</th> <th>Acceleration(D)</th> <th>Smoothness(S)</th> </tr> </thead> <tbody> <tr> <td>10.0 mm/s</td> <td>LIN A1 T1</td> <td>D3S3</td> </tr> </tbody> </table> <p> CFDs/CFDq controller instruction manual BASIC OPERATIONS (CFDs-EN-002) 4.3 Teaching</p>	Speed	Acceleration(D)	Smoothness(S)	10.0 mm/s	LIN A1 T1	D3S3
Speed	Acceleration(D)	Smoothness(S)					
10.0 mm/s	LIN A1 T1	D3S3					

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.

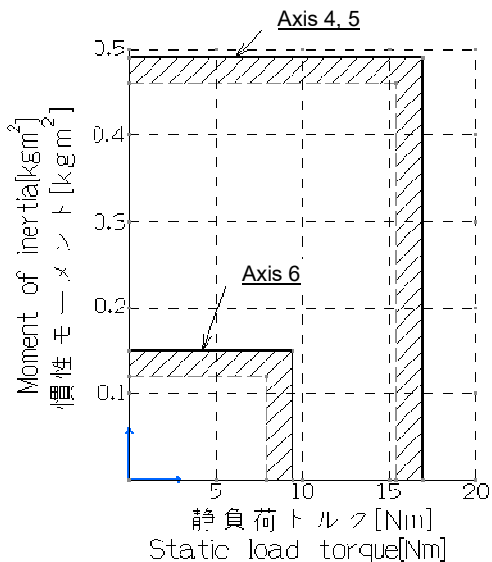
[CMZ05-01]





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.

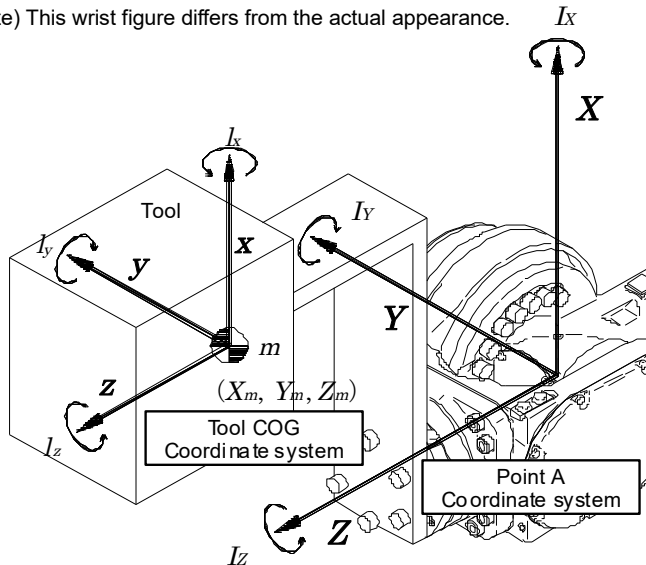
【CMZ05-01】



 IMPORTANT	<p>By setting the tool weight and COG (utilizing "Automatic COG setting") and setting the tool's moment of inertia correctly in advance, robot speed is automatically limited when the generated moment of inertia is going to be over the permitted level in high speed. Especially in case that tool's moment of inertia was high and that proper setting was not completed, robot lifetime may be shorter. It is strongly recommended to set the correct tool's moment of inertia.</p> <p>Please refer to the following instruction manual for detail.</p> <p> CFDs controller instruction manual "SETUP", (CFDs-EN-001) "Chapter 3 Setup", "3.5.5 Tool's moment of inertia"</p>
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6.3 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

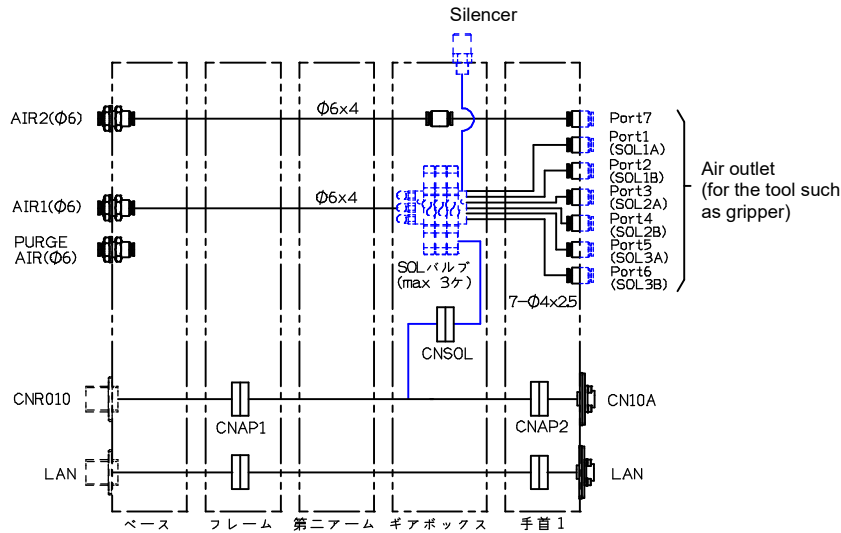
m: Tool mass

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

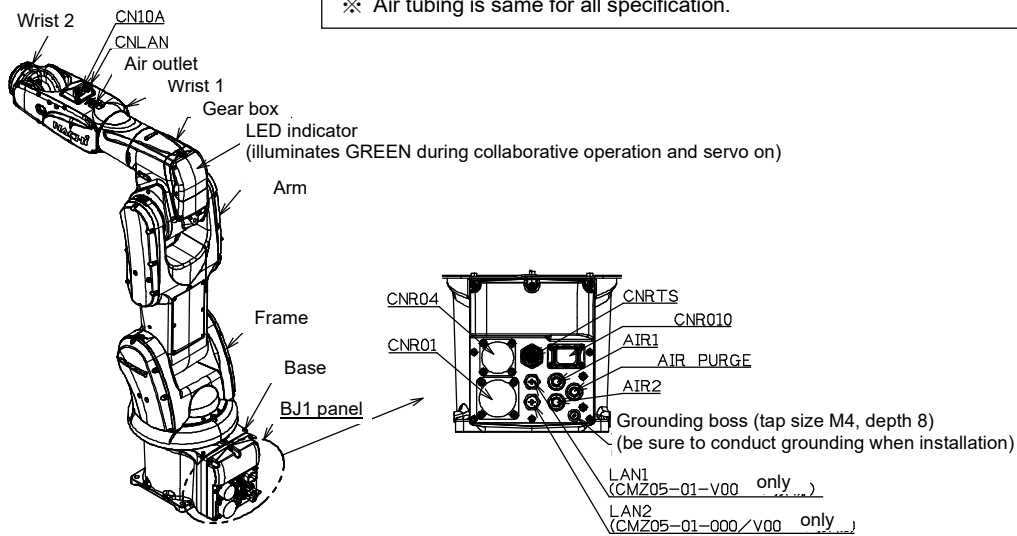
<p>1 Calculate the inertia moment around the tool COG coordinate system (xyz axis). If the tool is regarded as prism, it is calculated as the formula on the right side.</p>	<p>Inertia moment example on tool COG coordinate system</p> <p>If tool is regarded as prism</p> $I_x = \frac{1}{12} m \cdot (A^2 + B^2)$ $I_y = \frac{1}{12} m \cdot (A^2 + C^2)$ $I_z = \frac{1}{12} m \cdot (B^2 + C^2)$ <p>These values (I_x, I_y, I_z) are registered to the controller.</p> <p>Inertia moment on tool COG coordinate system</p> <p>This is different from "allowable moment of inertia" written in the robot specification.</p>
<p>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.</p>	<p>Inertia moment on point A coordinate system (XYZ axis) is as below.</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 its value changes depend on axis 6 position. Axis 6 inertia moment is I_z itself.</p> $I_{J4} = I_{J5} = \max(I_X, I_Y)$ $I_{J6} = I_Z$

7. Application wiring and tube diagram

7.1 Solenoid valve (3 valves as standard) tube



Specification of on arm connection and BJ1 connection differs due to the robot type. This figure shows the standards specification (CMZ05-01-000, application 20 wires + LAN 8 wires 1 line).
 ※ Air tubing is same for all specification.



IMPORTANT

Be sure to connect ground using the grounding boss (M4, depth 8) provided on the BJ1 panel. The following parts must be used strictly when making the ground connection.

- Use round terminals (standard-compliant). Do not use Y terminals, etc., because of the risk of disconnection.
- The size of the ground wire should be AWG10 (5.5 sq) or larger (be sure to secure 5 sq or larger).

7.2 Suction air inside the arm

It is possible to suck air inside robot arm (include inside the arm cover) from the PURGE AIR port (φ6) on the base. Vacuum unit is customer preparation. Vacuum air needs to be adjusted by vacuum regulator, etc. so that its flow rate is 15~20 L/min.


Our company Verified Equipment

Vacuum generator	KOGANEI MEDT14
Vacuum regulator	PISCO RVV6

7.3 Supply Pressure of Air tubing and Supply Air temperature

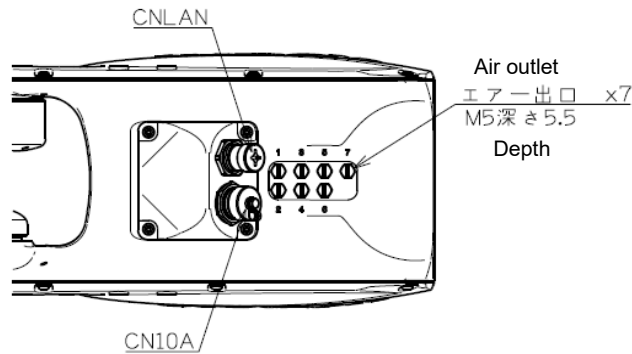
Supply air pressure and temperature should be within the following range.

Pressure range	Temperature	Remarks
0.1MPa~0.5MPa	-5°C~50°C	Use air that has passed through a filter and is normal.

 CAUTION	Install a lockout on the pneumatic source to prevent unintended pressure changes. Erroneous settings may cause damage to the robot or bodily injury.
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7.4 Detailed diagram of the application connectors

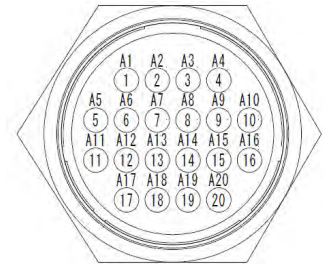
■ Application connector 20 wires + LAN 8 wires 1 line (Robot type: CMZ05-01-000)



CNR010

	1	2	3	4	5	6	7	8
D	A16	A17	A18	A19	A20	A24		
C	A11	A12	A13	A14	A15	A23	A27	
B	A06	A07	A08	A09	A10	A22	A26	
A	A01	A02	A03	A04	A05	A21	A25	

CN10A



※A21~A27 are used for solenoid valve. Not assigned for others.

Connector CNR010 at base
 Tyco AMP 1981914-1, 1981913-1, 1903112-2
 Partner connector type
 Tyco AMP 1981919-1, 1981921-1, 1827570-2

Connector CN10A at wrist 1
 Hirose HR22-12WTRA-20SC(73)
 Partner connector type
 Hirose HR22-12WTLP-20PC

※The pin layout is a view of the connector on the robot body side from the mating surface.

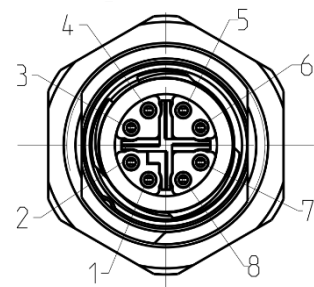
 CAUTION	The maximum load current at the output terminal should be as follows per pin. A1~A12 : 1A or lower A13~A20 : 0.75A or lower
 CAUTION	When connecting air tubes, it is recommended to use elbow type joints. The application connector may interfere with the air piping or straight joints on the arm. (This is because the application connector is installed at an angle to prevent a large load from being placed on it when it makes contact.)

CNLAN2

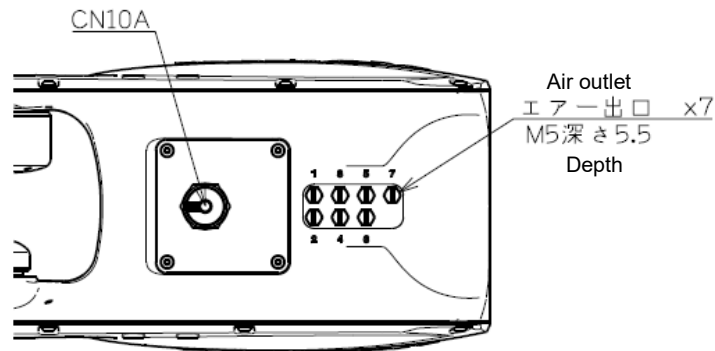
1	2	3	4	5	6	7	8
A+	A-	B+	B-	C+	C-	D+	D-

IEC61076-2-109 CAT6 Ethernet compatible 8-pole X-Coding connector
 (Both BJ1 side and wrist side)

CNLAN2



■ Application connector 20 wires only (Robot type: CMZ05-01-E00)



CNR010

	1	2	3	4	5	6	7	8
D	A16	A17	A18	A19	A20	A24		
C	A11	A12	A13	A14	A15	A23	A27	
B	A06	A07	A08	A09	A10	A22	A26	
A	A01	A02	A03	A04	A05	A21	A25	

CN10A



※A21~A27 are used for solenoid valve. Not assigned for others.

Connector CNR010 at base
 Tyco AMP 1981914-1, 1981913-1, 1903112-2
 Partner connector type
 Tyco AMP 1981919-1, 1981921-1, 1827570-2

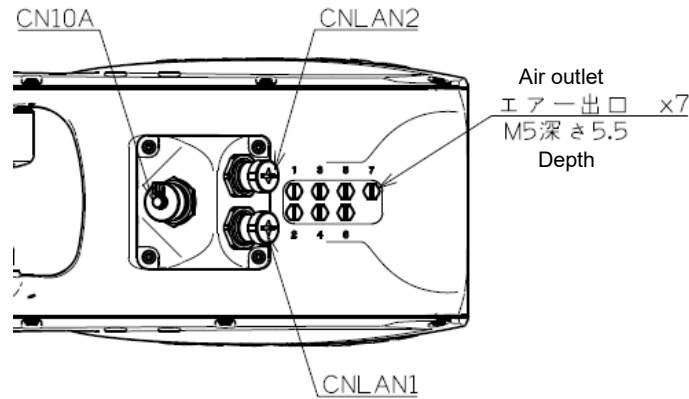
Connector CN10A at wrist 1
 Hirose HR22-12WTRA-20SC(73)
 Partner connector type
 Hirose HR22-12WTLP-20PC

※The pin layout is a view of the connector on the robot body side from the mating surface.



The maximum load current at the output terminal should be as follows per pin.
 A1~A12 : 1A or lower
 A13~A20 : 0.75A or lower

■ Application connector 12 wires + LAN 8 wires 2 lines (Robot type: CMZ05-01-V00)



CNR010

	1	2	3	4	5	6	7	8
D	A16	A17	A18	A19	A20	A24		
C	A11	A12	A13	A14	A15	A23	A27	
B	A06	A07	A08	A09	A10	A22	A26	
A	A01	A02	A03	A04	A05	A21	A25	

CN10A



※A13~A20 are not available.

※A21~A27 are used for solenoid valve. Not assigned for others.

Connector CNR010 at base
 Tyco AMP 1981914-1, 1981913-1, 1903112-2
 Partner connector type
 Tyco AMP 1981919-1, 1981921-1, 1827570-2

Connector CN10A at wrist 1
 Hirose HR22-12WTRA-20SC(73)
 Partner connector type
 Hirose HR22-12WTLP-20PC

※The pin layout is a view of the connector on the robot body side from the mating surface.

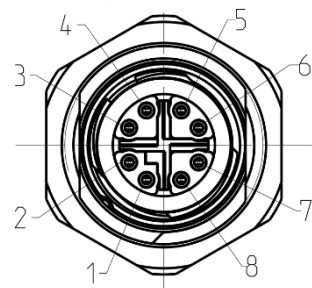
<p>CAUTION</p>	The maximum load current at the output terminal should be as follows per pin. A1~A12 : 1A or lower
<p>CAUTION</p>	When connecting air tubes, it is recommended to use elbow type joints. The application connector may interfere with the air piping or straight joints on the arm. (This is because the application connector is installed at an angle to prevent a large load from being placed on it when it makes contact.)

CNLAN1/2

1	2	3	4	5	6	7	8
A+	A-	B+	B-	C+	C-	D+	D-

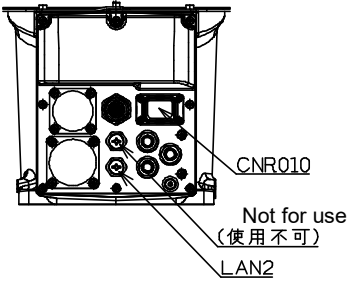
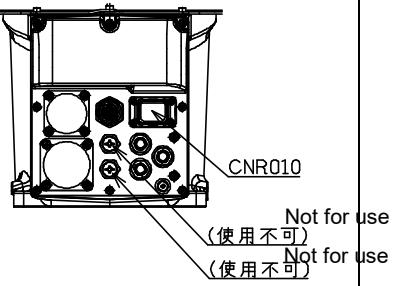
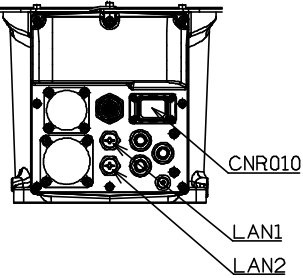
IEC61076-2-109 CAT6 Ethernet compatible 8-pole X-Coding connector
 (Both BJ1 side and wrist side)

CNLAN1/2



7.5 Detailed diagram of the application connectors (BJ1 panel)

Note that the connection points of the BJ1 section and the number of available wires differ depending on the application specifications.

Robot type	Connecting portion of BJ1 panel	Application signal (CNR10)	CNLAN1	CNLAN2
CMZ05-01-000		20 wires	Not for use	8 wires
CMZ05-01-E00		20 wires	Not for use	Not for use
CMZ05-01-V00		12 wires	8 wires	8 wires

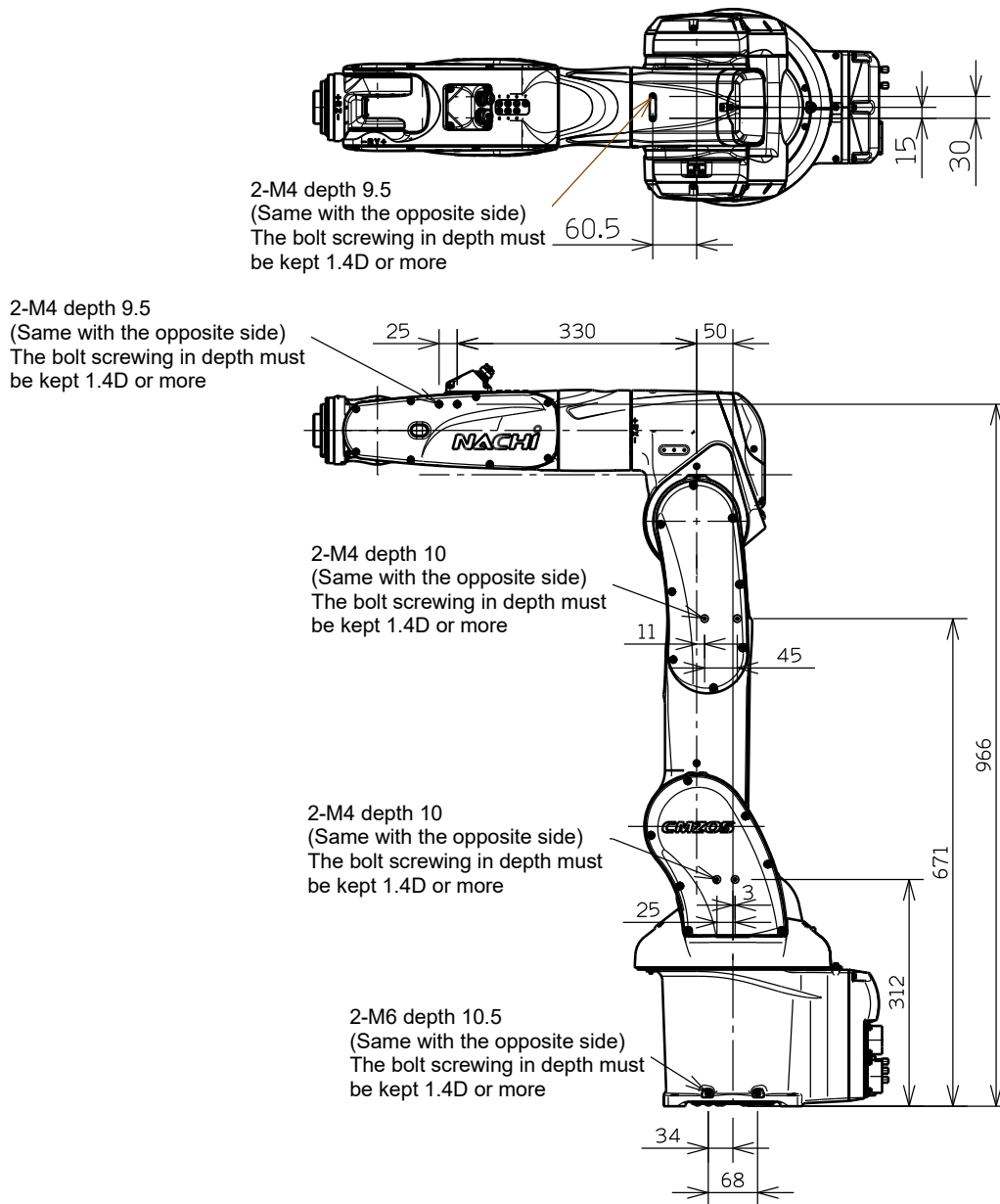
(Supplement)


Cables connected to CNR010 (on BJ1 panel) and CN10A (on arm) are prepared as option.

Also refer to the following documents.

- “Standard specifications CFDs controller” (SCFEN-022)
- “Instruction manual CFDs controller OPTION” (CFDs-EN-184)
- “Instruction manual OPTION (MZ07F-01 series)” (MMZEN-371OP)

7.6 Locations of service taps for application wiring/tubing

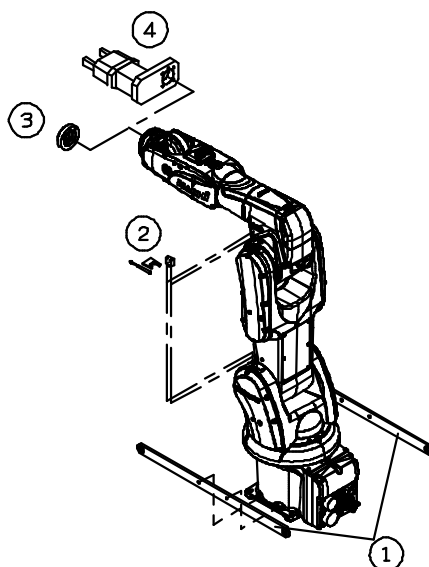


 CAUTION	<p>Only the lightest possible object such as hoses and wiring should be fixed to the service tap. When installing objects weighing more than 1 kg, the collision detection function may miss-detect depending on the robot movement.</p>
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8. Options

8.1 Mechanical options

【CMZ05-01】



No.	Item	Specification	Parts No.	Remarks
1	Transportation jig	Commonly used for crane transporting and inverted transporting	OP-S2-042	Common with MZ07F/MZ07LF
2	Inverted installation jig	Jig for inverted installation (Robot reversal jig)	OP-S7-017	
3	Accessory tool	Zeroing pin and block ^{*1}	OP-T2-117	
4	ISO flange	P.C.D.31.5 ^{*2}	OP-W2-012	Common with MZ07F/MZ07LF
5	Standard gripper	Parallel gripper Single S ^{*3}	OP-F10-002	Gripping force 320N (Supply pressure 0.5MPa) Operating stroke 24mm
		Parallel gripper Double S ^{*3}	OP-F10-003	Gripping force 600N (Supply pressure 0.5MPa) Operating stroke 30mm
		Parallel gripper Single M ^{*3}	OP-F10-004	Gripping force 300N (Supply pressure 0.5MPa) Operating stroke 8mm
		3 claw chuck Single S ^{*3}	OP-F10-005	Gripping force 410N (Supply pressure 0.5MPa) Operating stroke 10mm
		3 claw chuck Double S ^{*3}	OP-F10-006	
		3 claw chuck Single M ^{*3}	OP-F10-007	
		3 claw chuck Double M ^{*3}	OP-F10-008	

1: Includes zeroing pin, block and assembly bolts M4x25 (2 pcs).

2: Includes ISO flange and assembly bolts M5x15 (4 pcs).

For details, refer to Instruction Manual "Options (MZ07F-01 Series)", (MMZEN-370OP).

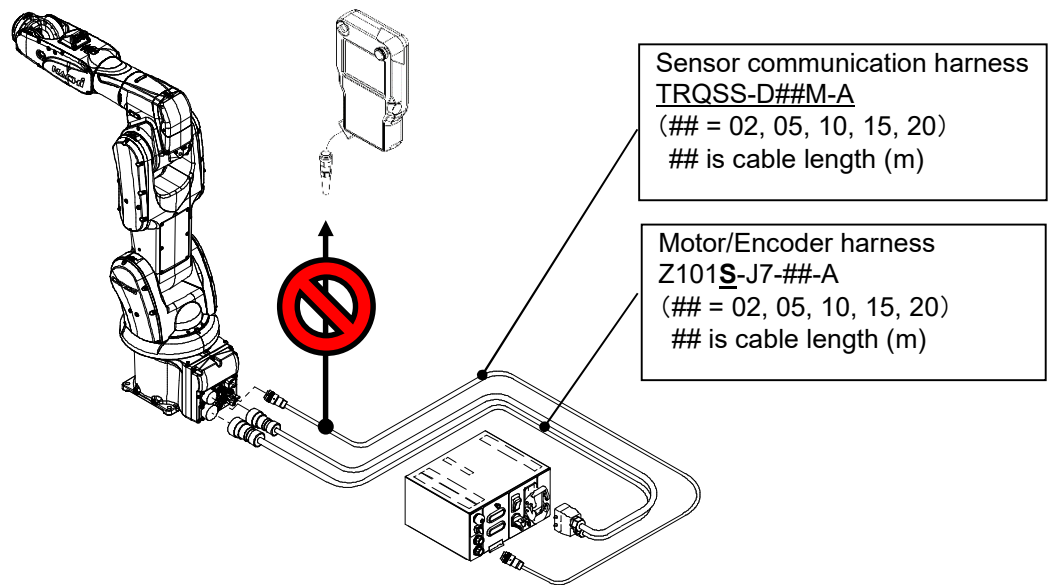
3: Standard gripper; The gripping force varies depending on the air pressure supplied (0.3~0.5MPa) and the length of the mounting claw. Please use this option after thorough risk assessment. We cannot follow up on the full responsibility related to this gripper. The same applies to grippers other than our option.

8.2 Wire harness

This cable connects the controller to the robot.





Please be sure to purchase wire harness. Purchase one that is compatible with the type of controller.

TRQSS-D##M-A in following figure is a communication harness between sensors in the robot and the controller, but this harness can be miss-connected to teach pendant as their connector shape is same. Be very careful with your connection by referring to the name seal on sensor communication harness.



Refer to CFDs controller Standard Specifications (SCFEN-022)

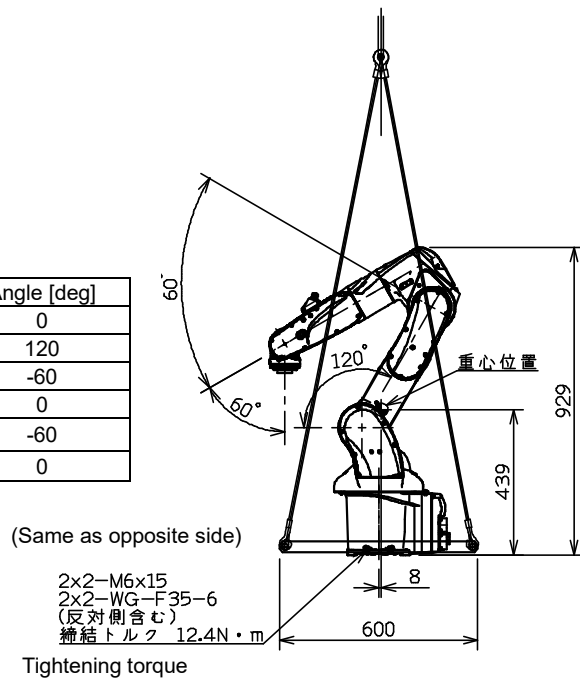
9. Transport procedure




 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	When lifting the robot or controller, use the method specified in the maintenance manual. If work is performed using an unspecified method, the robot or controller may fall or topple over during transport, resulting in an accident.
 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.

■ Utilizing transporting bracket

As a general rule, use a crane to transport the robot body.
 To transport the robot, first operate the robot in the transport posture shown in figure, attach a special transport jig (OP-S2-042) to the robot, and lift it with four wires.

Axis	Angle [deg]
J1	0
J2	120
J3	-60
J4	0
J5	-60
J6	0

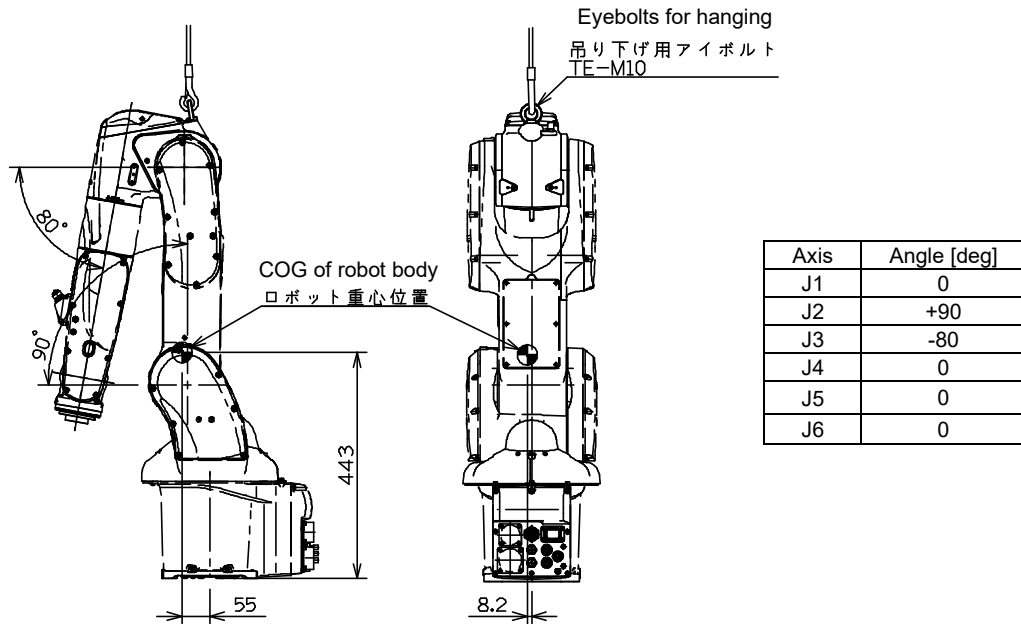


 WARNING	Place the robot on the horizontal position. Robot can stand by alone with its transportation posture. But if robot is placed on the inclined position, robot may fall down and resulting in serious injury.
 WARNING	After the robot installation, make sure to remove the transporting-jig. Without removing the transporting jig, the transporting-jig and the robot may interfere when the robot operates.
 WARNING	Please do not shock when transporting the robot. Internal sensors may be damaged.

■ Use of eyebolts for hanging

Transport using eyebolts for hanging is also possible. Since eyebolts for hanging are not available as an option, customers are requested to prepare them themselves. As a rule, use a crane to transport the robot.

Set the robot in the posture shown in the figure, attach the eyebolt (1) to the gearbox, and lift it up with the wire (1). The posture shown in the figure is without the tool attached. The weight and center of gravity of the tool may change the center of gravity of the entire robot, so please be very careful when lifting the robot.



 WARNING	Place the robot on a surface that is not inclined. Although the robot is self-supporting in the transport position, it may tip over if it is tilted, which is very dangerous.
 WARNING	After installing the robot, be sure to remove the eyebolts. The eyebolts are projecting parts and may cause injury in the event of a collision.
 WARNING	When installing the robot, be sure to avoid impact. The internal sensors may be damaged.
 WARNING	When using the robot in a clean room, select and use eye bolts that are compatible with cleanliness.

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)

0.8 kVA

This is the average value when the rated load is installed and robot is operated in our standard pattern. May vary according to the application and operation pattern.

12. Paint color (Robot + Controller)







Standard color

Robot cover, fore arm	Munsell 6.5PB9/1
Robot upper arm	Munsell N5.5
Robot installation base, swing base	Munsell N2.5

13. Warranty






Elapse of 1 year after delivery

14. Precautions for handling

 CAUTION	<p>Although tool setting was correctly done, sometimes arm vibration may occur at the beginning of starting robot according to the robot movement or shape of tool. Reason is that arm driving vibration frequency and arm natural vibration frequency is very closed.</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 pose
 CAUTION	<p>If ambient temperature is low, vibration, overload error and tracking error may occur at the beginning of starting 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> <p>(Reference) Following function allows to change the velocity override during playback of program. If necessary please utilize them.</p> <p>FN317 SETOVR Set the velocity override FN318 GETOVR Get the velocity override</p>
 CAUTION	<p>When transporting robot without fixing, robot may be damaged due to the vibration or crush during transportation.</p> <p>When transporting robot, certainly fix arms with the bracket which is used when shipped.</p>
 CAUTION	<p>Position repeatability is defined in accordance with JIS B 8432 (ISO9283) (Pose repeatability). Repeatability under the following conditions is not guaranteed.</p> <ul style="list-style-type: none"> • During repeated operation, the case in which approaching movement involves different directions and different orientations toward the measuring point. • During repeated operation, the case in which payload condition changes. (For example, existence and no-existence of workpiece) • During repeated operation, the case in which environment temperature changes. (Robot arm or belt stretch may cause the position repeatability to deteriorate.) • The case in which position repeatability before and after warm-up is required. • The case in which position repeatability of numeric position written in robot coordinate system and position in real space is required. (this is "Absolute position accuracy") • The case in which position repeatability of position generated by shift command or palletize command and position in real space is required.
 CAUTION	<p>Make sure that the ambient temperature in the robot installation environment does not change significantly. (Approximate ambient temperature fluctuation 10°C or less)</p> <p>When used in an environment with large temperature fluctuations (10°C or higher), it is necessary to frequently correct the sensor to point 0.</p>
 CAUTION	<p>When building a system using this robot, refer to ISO10218-2, etc., and carry out the sufficient risk assessment.</p> <p>Please measure the force generated in the event of a collision after the final operation and system environment, and confirm whether the risk is reduced before starting use.</p>

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

NOTE

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NACHI ROBOTIC SYSTEMS, INC. (NRS)	www.nachirobotics.com	
NACHI EUROPE GmbH	www.nachi.de	
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