

NACHI

Standard specifications

SC400L-04/05-FD11
SC500-04/05-FD11

1st edition

NACHI-FUJIKOSHI CORP.

1306, SSCEN-053-001, 001

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1. Outline

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

SC500 (pay load : 500kg) and SC400L (pay load : 400kg) is the robot, which is optimal for application of material handling of the big and heavy load weight.

< Characteristic >

1. It is possible to apply to car body and heavy load weight, which is not possible to apply formerly.
2. It is possible to apply to big work by wide operation range. Maximum reach of SC500 is 2703 mm and SC400L is 3623 mm.
3. It is possible to apply to every material handling application by big wrist torque "1960 N·m"

2. Basic specifications

Item		Specifications			
Robot model		SC400L-04	SC400L-05 *1	SC500-04	SC500-05 *1
Construction		Articulated			
Number of axis		6			
Drive system		AC servo motor			
Max. working envelope	Axis 1	±2.62 rad (±150°)			
	Axis 2	+1.83 to -0.44 rad (+105 to -25°)		+1.31 to -0.96 rad (+75 to -55°)	
	Axis 3	+2.09 to -0.44 rad (+120 to -25°)		+0.52 to -2.18 rad (+30 to -125°)	
	Axis 4	±5.24 rad (±300°)			
	Axis 5	±2.09 rad (±120°)			
	Axis 6	±6.28 rad (±360°)			
Max. speed	Axis 1	1.40 rad/s (80°/s)			
	Axis 2	1.40 rad/s (80°/s)			
	Axis 3	1.40 rad/s (80°/s)			
	Axis 4	1.57 rad/s (90°/s)			
	Axis 5	1.57 rad/s (90°/s)			
	Axis 6	2.53 rad/s (145°/s)			
Max. pay load	Wrist	400 kg		500 kg	
	Forearm	10 kg *2 *3		30 kg *2 *3	
	Upper of Axis 3	30 kg *2 *3		30 kg *2 *3	
Allowable static load torque	Axis 4	1960 N·m			
	Axis 5	1960 N·m			
	Axis 6	980 N·m			
Allowable moment of inertia *4	Axis 4	200 kg·m ²			
	Axis 5	200 kg·m ²			
	Axis 6	147 kg·m ²			
Position repeatability *5		±0.5 mm			
Installation		Shelf mounting		Floor mounting	
Ambient conditions		Temperature: 0 to 45 °C *6 Humidity: 20 to 85%RH (No dew condensation allowed) Vibration to the installation face: Not more than 0.5G (4.9 m/s ²)			
Robot mass		3,800 kg		3,000 kg	

1[rad] = 180/π[°], 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 this specification might change without a previous notice for the improvement.
- Explosion-proof is not available.

*1: Only application wiring differs between SC400L-04 and SC400L-05, also between SC500-04 and SC500-05.

*2: Select either Forearm or Upper of axis 3 about the pay load on arm.

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

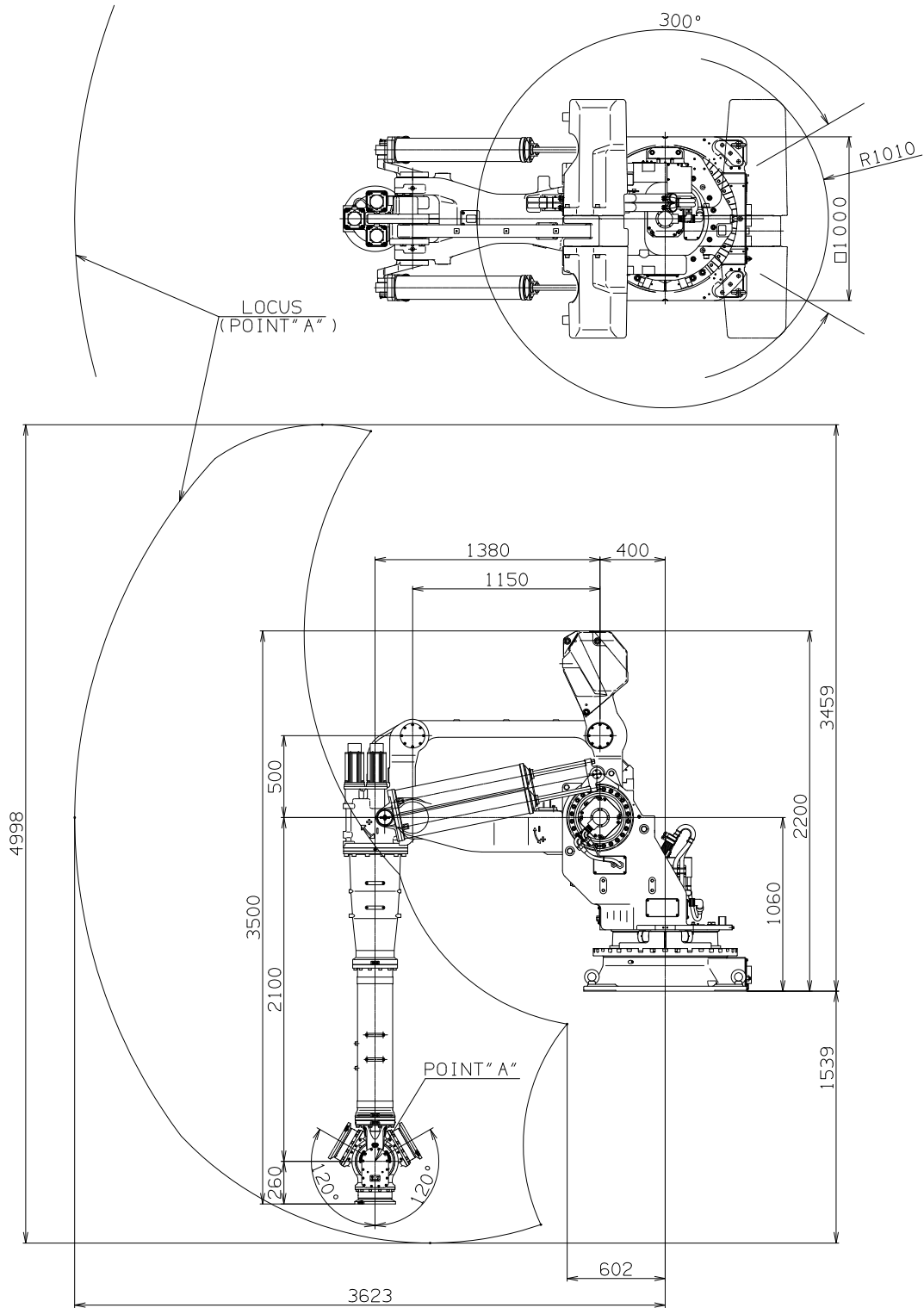
*4: The Allowable moment of inertia of a wrist changes with load conditions of a wrist.

*5: This value conforms to "JIS B 8432".

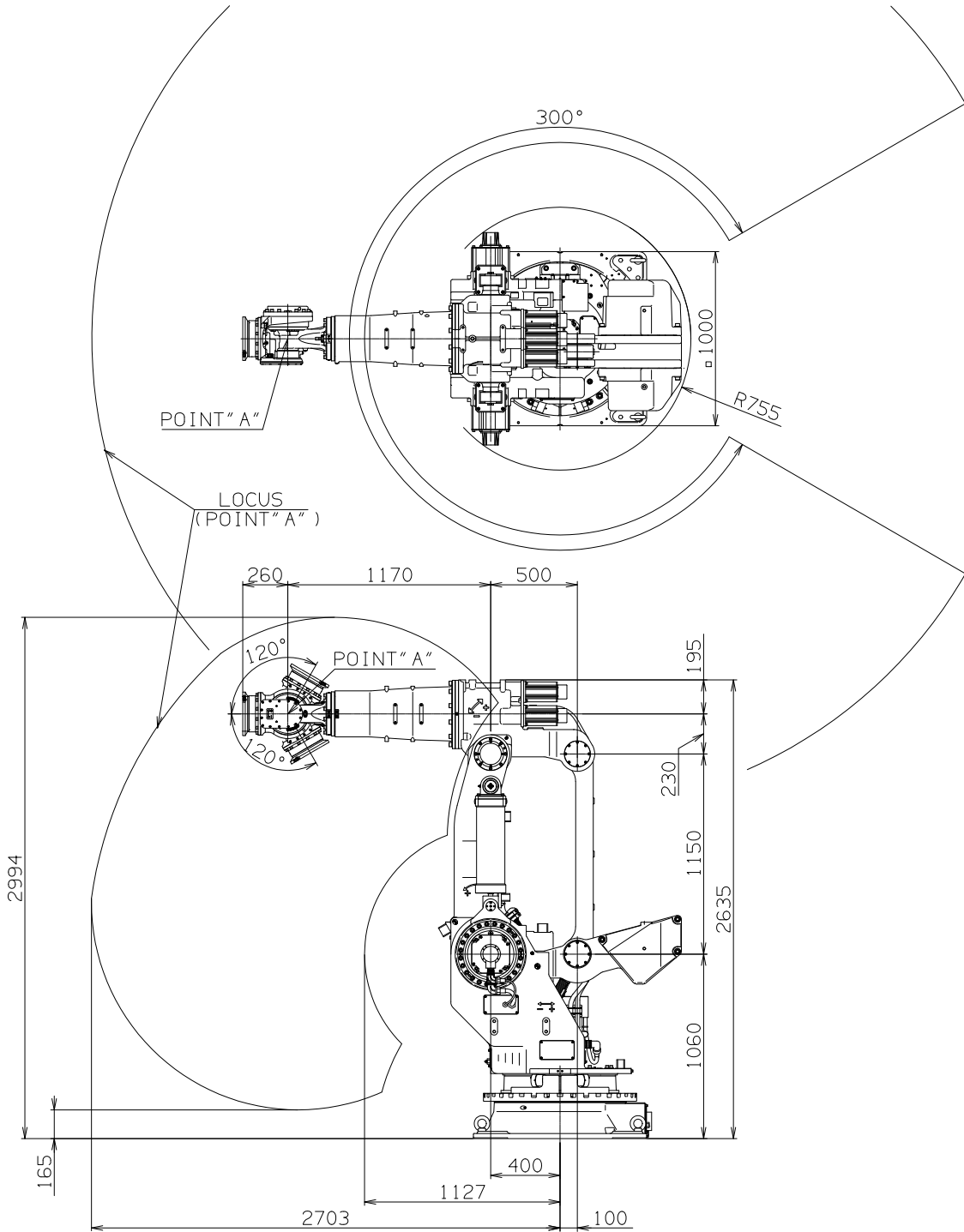
*6: Permitted height is not higher than 1,000m above sea level. If used in higher place, permitted temperature is affected by height.

3. Robot dimensions and working envelope

[SC400L-04] [SC400L-05]




[SC500-04] [SC500-05]

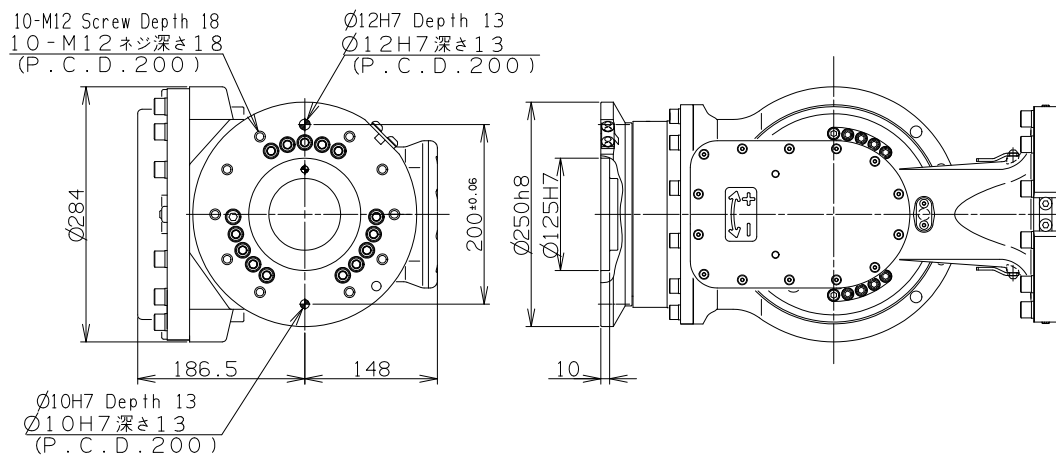


4. Detail of load mounting face

■ Wrist

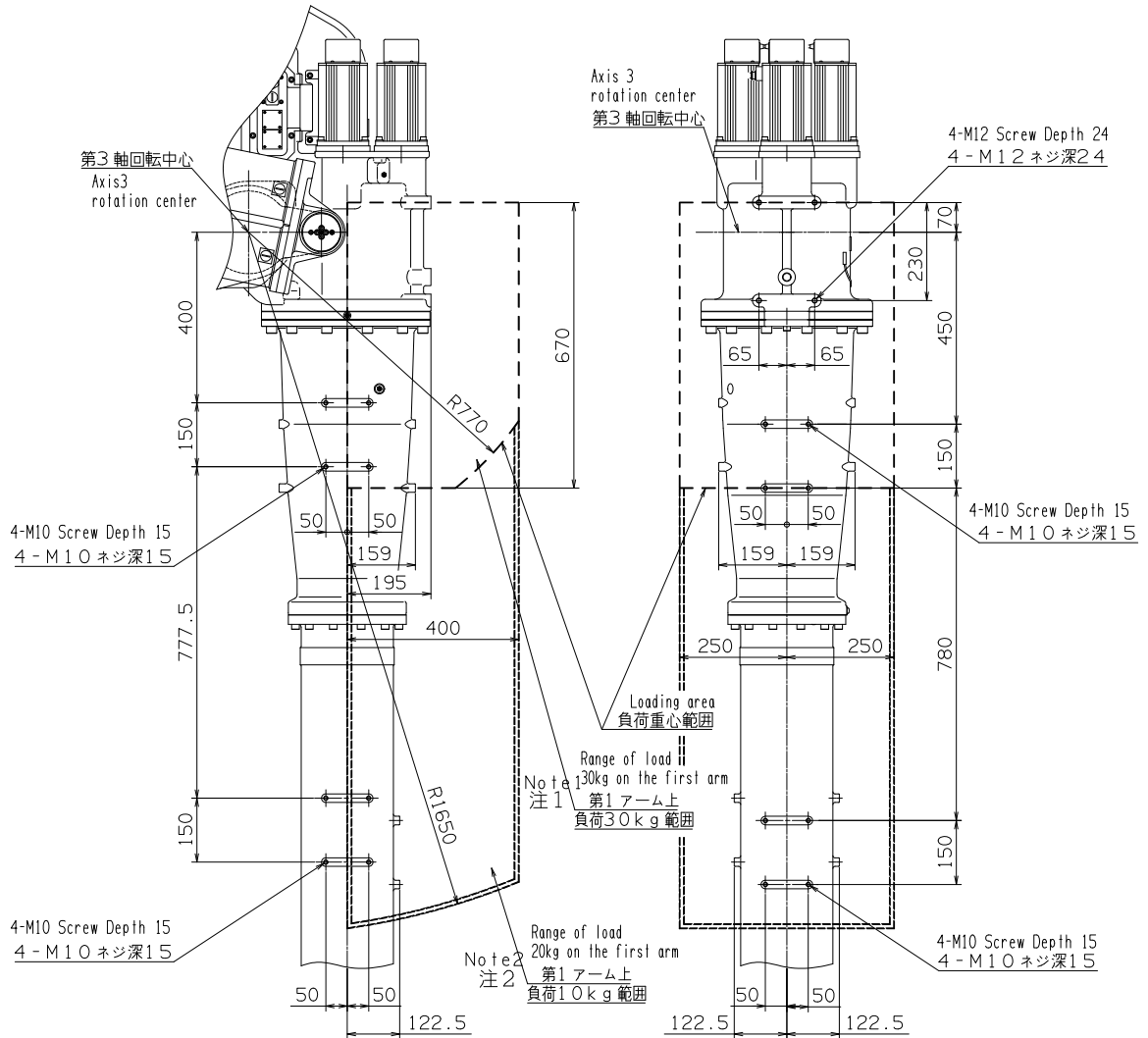
 CAUTION	Don't screw in attachment bolts over thread tap depth. Attachment bolts over thread tap depth may damage the wrist.
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[SC400L-04] [SC400L-05] [SC500-04] [SC500-05]



■ Upper part of forearm

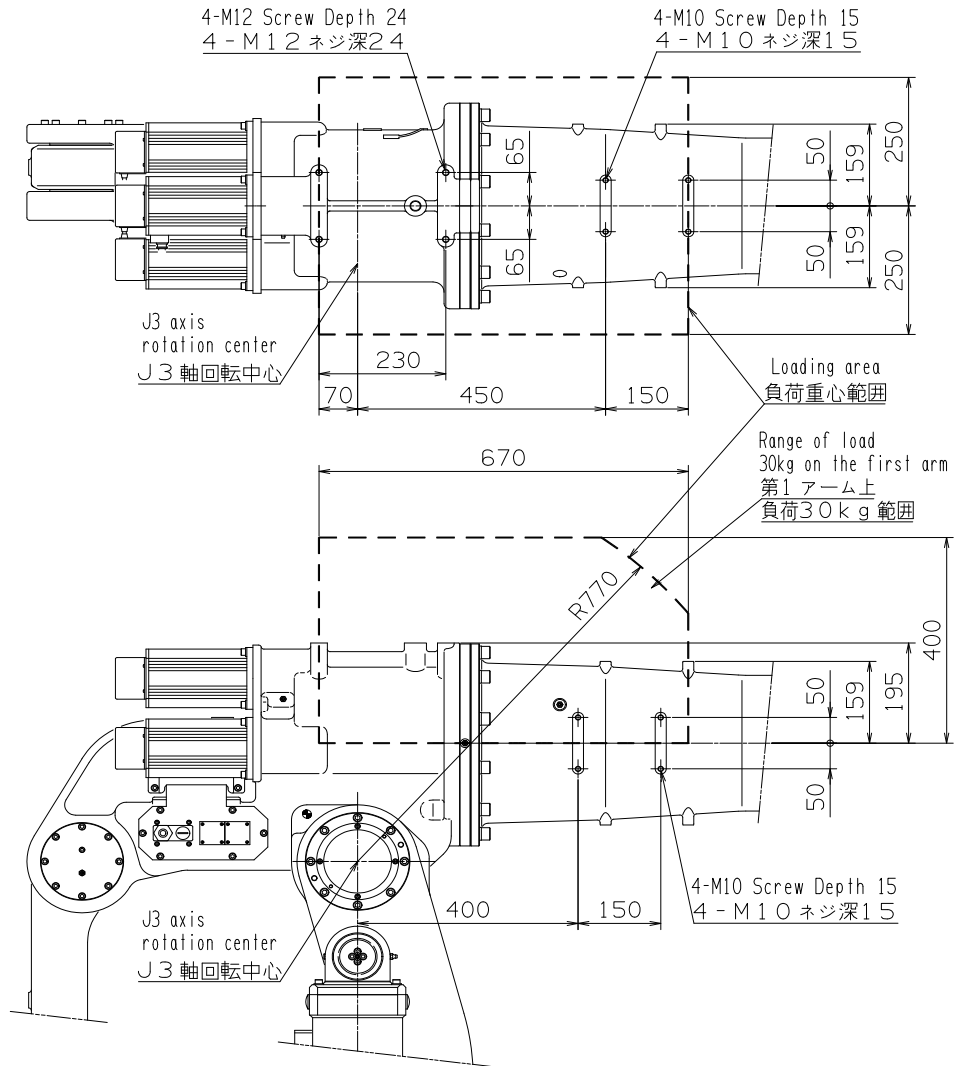
[SC400L-04] [SC400L-05]



Note1: Area marked " [dashed box] " is shown range which is possible to mount pay load below 60 kg on the arm, on the condition that total pay load of wrist and arm is limited to below 430 kg.

Note2: Area marked " [dotted box] " is shown range which is possible to mount pay load below 20 kg on the arm, on the condition that total pay load of wrist and arm is limited to below 410 kg.

[SC500-04] [SC500-05]




5. Installation

The installation location and the installation procedure of the robot are critical factors to maintain robot functions. The ambient conditions of installation location not only have influence on the life of mechanical sections of the robot, but also get involved in safety issues. Consequently, strictly observe the environmental conditions shown below. Furthermore, utmost care should be exerted for the installation procedure and the foundation for the robot in order to maintain the robot performance. Strictly observe the installation procedure for the robot provided below.

Installation

To install the robot, give it first priority to thoroughly consider safety of workers and take safety measures. The following section describes precautions for this purpose.

Safety measures against entry in the robot operating area

 WARNING	<p>While the robot is in operation, workers are in danger of coming in contact with the robot. To avoid that, install a guard fence so as to keep the worker away from the robot. Not doing so will cause the workers or other persons to accidentally enter the operating area, thus resulting in accidents.</p>
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■ Installation location and ambient conditions

Conditions (temperature, humidity, height and vibration) are written in “2 Basic Specifications”. Further ambient conditions listed below must be observed.

- (1) Location with the drainage structure so that swivel base is not flooded, when the liquid such as water or cutting fluid is splashed on the robot body
- (2) Location with no flammable or corrosive fluid or gas.
- (3) Type D grounding (the grounding resistance is 100Ω or less) is necessary.

■ Installation procedure

While robot moves, large reaction force is applied to the swiveling base from all directions. Consequently, the robot should be installed in such a manner that the foundation endures reaction force caused by accelerating or decelerating the speed to lock the robot, not to mention that it endures static loads.




To install the robot on the floor, if the floor concrete is not less than 150 mm in thickness, repair uneven spots, cracks, and others on the floor, and then install the robot with the use of 12 bolts (option) of M24 (JIS: Strength class 12.9) not less than 75mm and plain washers (option) of not less than 4.5 mm in thickness and HRC35 in hardness. At this time, apply a coating of lubricating oil to the threaded parts of the bolts, and then torque the bolts to 560 ± 30 N·m. Furthermore, to install the robot in an exact position, use location pins (option). If the floor concrete is not more than 150 mm in thickness, an independent foundation should be constructed. Inspect the foundation prior to the robot installation, and then construct the foundation, if necessary.

Allowable load of foundation bolt

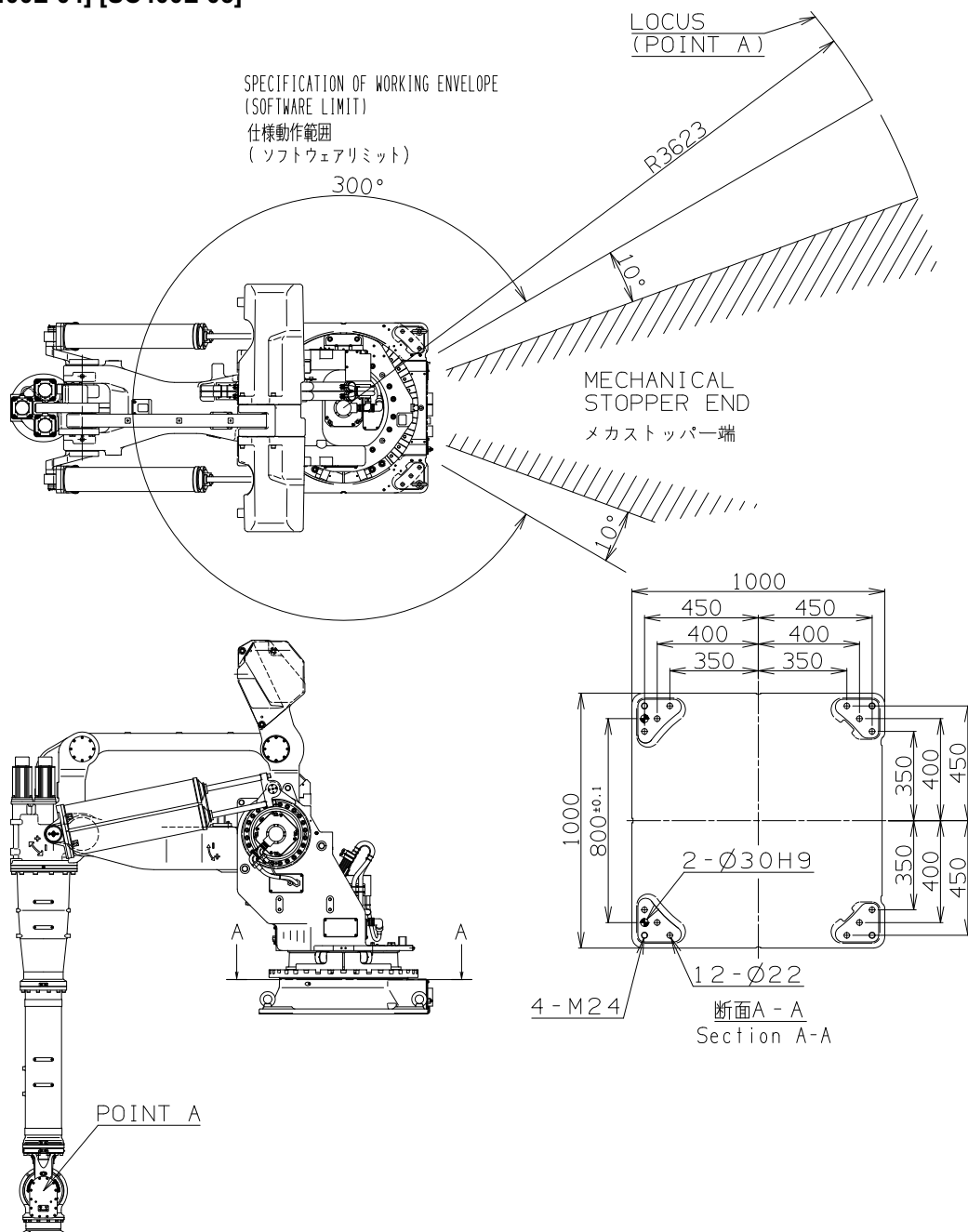
Robot Model	Allowable repeated tensile load per bolt when the robot is installed with 12 bolts
SC400L-04 SC400L-05 SC500-04 SC500-05	Approximately 12,000N

■ Installation dimension

Fix the robot swivel base for the robot installation.

 WARNING	The mechanical stopper end is located in a position exceeding the specified operating range (software limit) of axis 1 by 10°. To install the guard fence, refer to the figures in this section with consideration given to the wrist configuration and the shape of end effector.
 WARNING	On axis 1, 2 and 3, the robot operating range can be regulated for safety (optional function). Since optional parts (e.g. limit switches or additional stopper blocks) should be installed to enable this function, do not independently move the standard parts (e.g. stopper block).
 WARNING	If mechanical stopper collides and robot stops, it's possible that some parts are already damaged, for example, mechanical stopper is transformed or fixing bolts are broken. In this case, sufficient intensity and function can not be kept. Mechanical stopper and reduction gear of collided joint are needed to be replaced to the new one.

[SC400L-04] [SC400L-05]

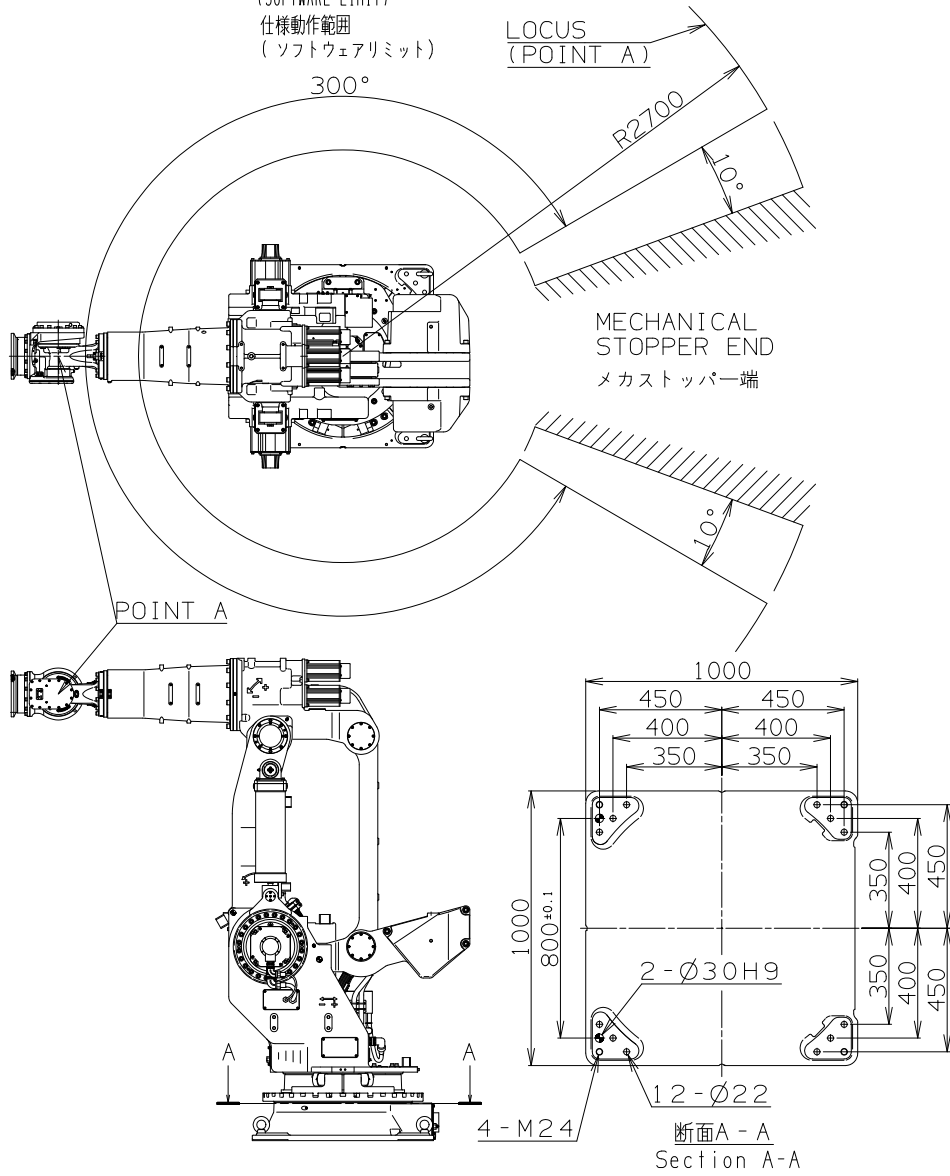


[SC500-04] [SC500-05]


SPECIFICATION OF WORKING ENVELOPE
(SOFTWARE LIMIT)

仕様動作範囲
(ソフトウェアリミット)

LOCUS
(POINT A)



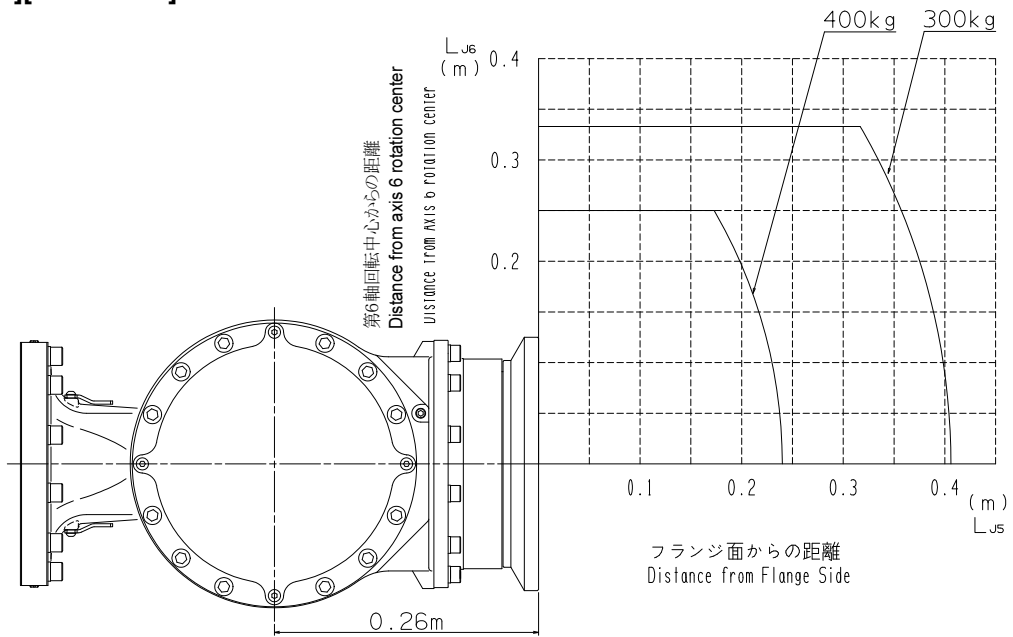
8. Allowable load

 CAUTION	<p>The wrist load is regulated by the allowable pay load mass, allowable static load torque, and allowable moment of inertia. If wrist load exceeds these allowable values, this robot is out of guarantee.</p> <p>Please refer to "2 List of basic specifications" and following figures for detail.</p>
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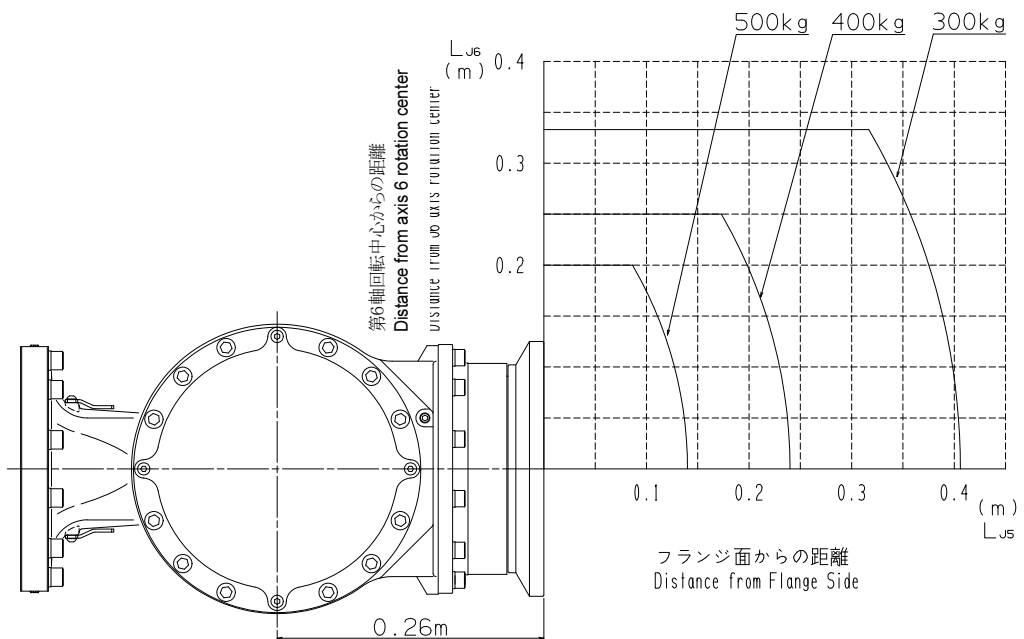
■ Torque map for the wrist load

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

[SC400L-04][SC400L-05]




[SC500-04][SC500-05]

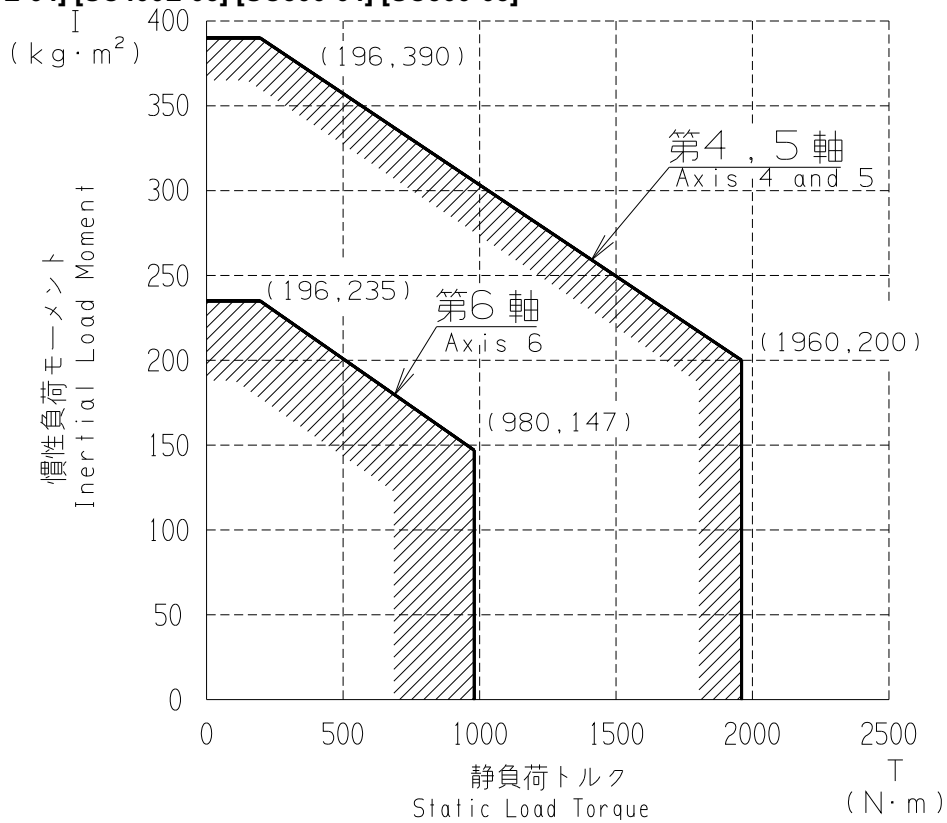


■ **Moment of inertia map for the wrist load**

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

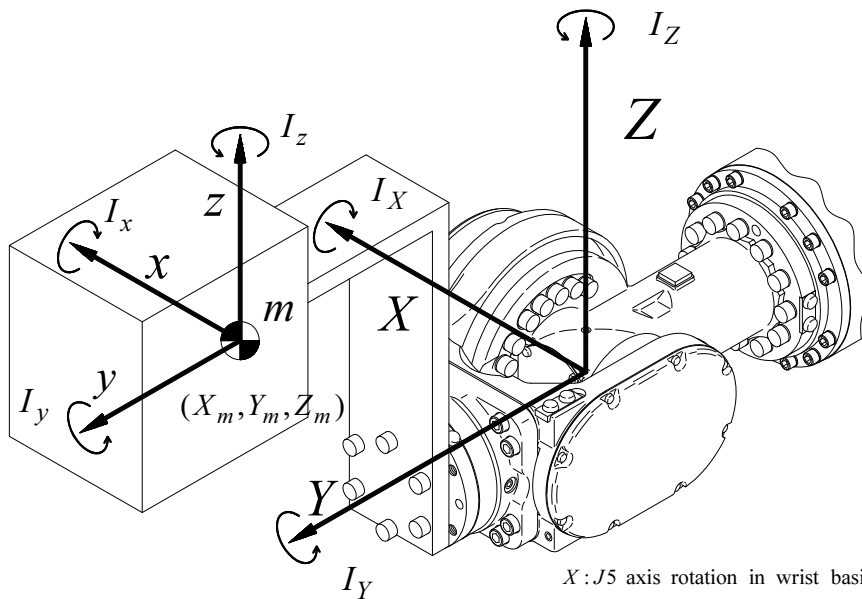
	<p>If the moment of inertia exceeds the specification, maximum speed is automatically limited by the software to protect the robot.</p>
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[SC400L-04] [SC400L-05] [SC500-04] [SC500-05]



■ How to calculate inertia moment of wrist axes

The method of calculating the inertia moment around a general each axis is shown below.



- X : J5 axis rotation in wrist basic posture
- Y : J4 and J6 axis rotation in wrist basic posture
- Z : It is a right - angled axis in X and Y axis in wrist basic posture
- x : Parallel axis to X axis in load center of gravity point
- y : Parallel axis to Y axis in load center of gravity point
- z : Parallel axis to Z axis in load center of gravity point
- I_x : Inertia moment around x axis in load center of gravity
- I_y : Inertia moment around y axis in load center of gravity
- I_z : Inertia moment around z axis in load center of gravity
- m : Mass of load
- (X_m, Y_m, Z_m) : Center of gravity coordinates of load

(1) Inertia moment around axis 6

The inertia moment around axis 6 becomes the following expressions.

$$I_{J6} = I_Y = m \cdot (X_m^2 + Z_m^2) + I_y$$

(2) Inertia moment around axis 4 and 5

The value changes into the inertia moment around axis 4 and 5 depending on the posture of axis 6. The maximum value around X axis and Z axis in above figure is assumed to be an inertia moment.

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

Select either large value.

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

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

7. Option specifications

[SC400L-04][SC400L-05]



No.	Item	Specifications	Parts no.
1	Water supply parts	1 system (1/2-inch considerably). To inside axis 1.	OP-H1-013
2	Additional air tubing	Added 1 system of air hoses (Inside diameter 8mm). To the forearm from axis 1.	OP-H5-006
3	Cable support of axis 1	1 piece for the weld power supply cable. Inside axis 1.	OP-K1-008
		2 pieces for the weld power supply cable. Inside axis 1.	OP-K2-007
4	Transfer jig	Fork bracket (for both domestic and abroad)	OP-S2-021
5	Accessory	Positioning pin & block	OP-T2-022
6	Axis 2 adjustable stopper	Restriction of axis 2 operation edge (-0.17rad, -0.34rad, -0.52rad from backward edge) (-0.17rad, -0.34rad, -0.44rad from front edge)	OP-A5-016
7	Axis 3 adjustable stopper	Restriction of axis 3 operation edge (-0.17rad, -0.34rad, -0.52rad from both edge)	OP-A6-012
8	Axis 2 arm clear LS *1)	Axis 2 home position, shelter position confirmation	OP-D3-0011 OPJ-EH-0029
9	Installed parts	Chemical anchor specification (Base plate welded)	OPJ-F1-0036
		Ore anchor specification (Base plate welded)	OPJ-F2-0013
10	Wrist positioning mark	Paint mark on wrist	OP-N3-004

*1) When ordering "axis 2 arm clear LS", both option "OP-D3-0011" and "OPJ-EH-0029" are necessary.

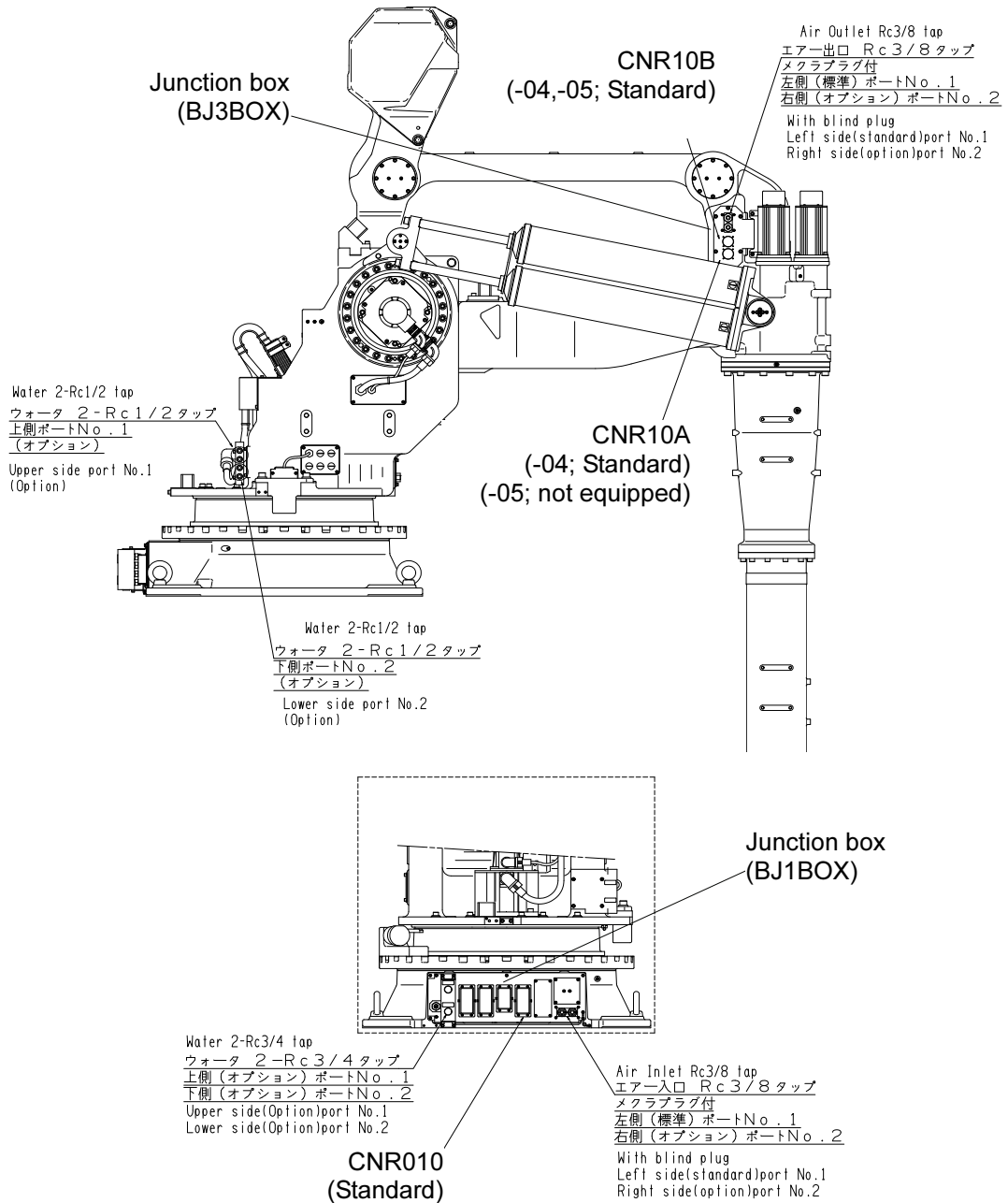
[SC500-04][SC500-05]

No.	Item	Specifications	Parts no.
1	Water supply parts	1 system (1-inch considerably) To Inside axis 1.	OP-H1-013
2	Additional air tubing	added 1 system of air hoses (Inside diameter 8mm). To the forearm from J1 axis.	OP-H5-006
3	Cable support of axis 1	1 piece for the weld power supply cable. Inside axis 1.	OP-K1-008
		2 pieces for the weld power supply cable. Inside axis 1.	OP-K2-007
4	Transfer jig	Fork bracket	OP-S2-018
5	Accessory	Positioning pin & block	OP-T2-022
6	Axis 2 adjustable stopper	Restriction of axis 2 operation edge (-0.17rad, -0.34rad, -0.52rad from both edge)	OP-A5-014
7	Axis 3 adjustable stopper	Restriction of axis 3 operation edge (-0.17rad, -0.34rad, -0.52rad from both edge)	OP-A6-012
8	Axis 2 arm clear LS	Axis 2 home position, shelter position confirmation	OP-D3-007
9	Installed parts	Chemical anchor specification (Base plate welded)	OPJ-F1-0036
		Ore anchor specification (Base plate welded)	OPJ-F2-0013

8. Application wiring and piping

 IMPORTANT	Use air pressure not more than 0.49MPa.
 CAUTION	Do not apply external force to the robot control connectors / cables. Do not clamp other cables / pipes to the robot control connectors / cables.

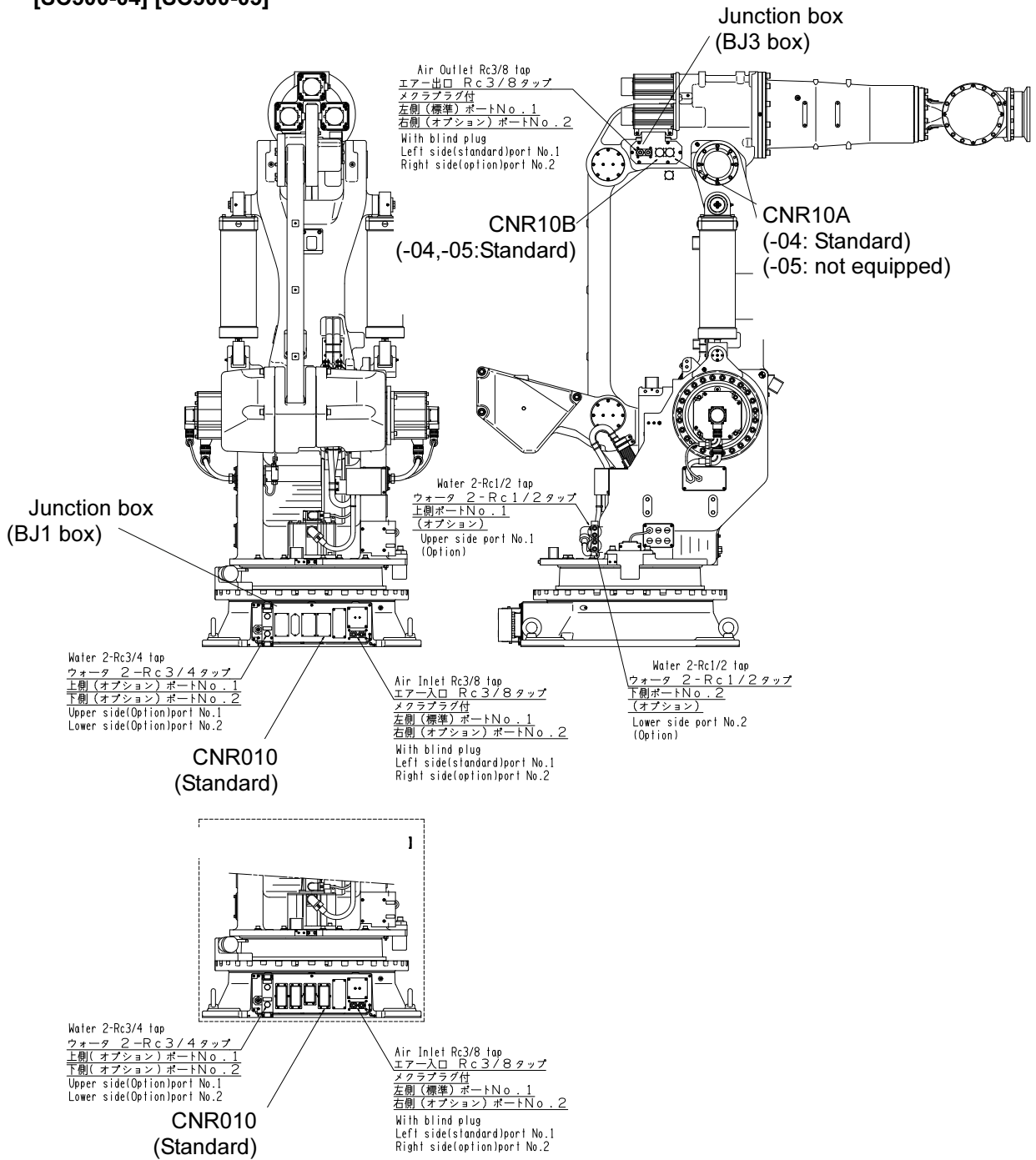
[SC400L-04] [SC400L-05]



Supplement for SC400L-05

Cable connector CN71A and CN81A for customer is inside the BJ1BOX.
 Cable connector CN71C and CN81C for customer is inside the BJ3BOX.
 And, connector CNR01B is installed on the BJ3 panel.
 (CNR10A does not exist on the BJ3 panel)

[SC500-04] [SC500-05]



Supplement for SC500-05

Cable connector CN71A and CN81A for customer is inside the BJ1BOX.
 Cable connector CN71C and CN81C for customer is inside the BJ3BOX.
 And, connector CNR01B is installed on the BJ3 panel.
 (CNR10A does not exist on the BJ3 panel)

■ Details of application connectors

[SC400L-04] [SC500-04]

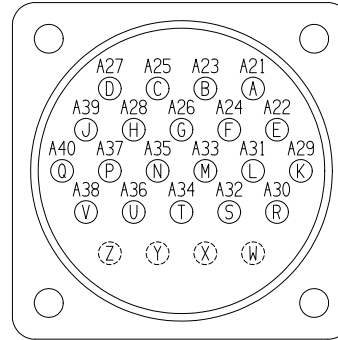
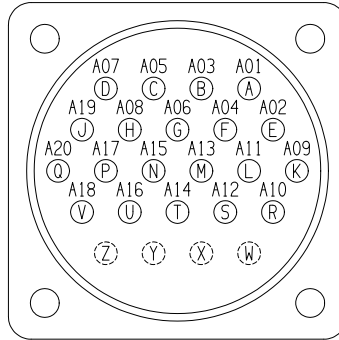
CNR10A, CNR10B on the BJ3BOX

Standard keyseat

Keyseat X

CNR10A

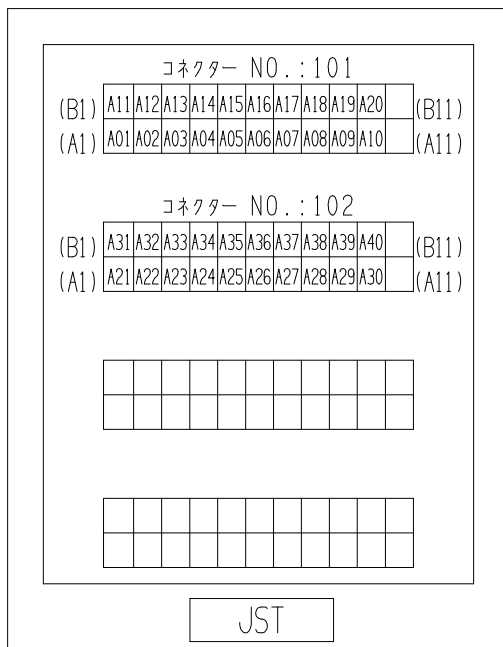
CNR10B



		CNR10A	CNR10B
Recommended cable		0.3 mm ² x20p	0.3 mm ² x20p
connector	Receptacle	JL02-2A-24-B28SC-F0 (JAE)	JL02-2A-24-B28SCX-F0 (JAE)
Matching connector type	Plug	MS3106B24-28P (JAE)	MS3106B24-28PX (JAE)
	cable clamp	MS3057-16A (JAE) Max. permissible cable diameter φ23.8	MS3057-16A (JAE) Max. permissible cable diameter φ23.8

(This pin layout diagram is drawn seeing the robot side connector from the contact side)

CNR010 on the BJ1BOX



Connectors for application cables

- Wire-side shell : JFM-WSA-4-A (JST) or JFM-WSA-4-C (JST)
- Guide plate A kit : JFM-GPAK-4 (JST)
- Receptacle housing : JFM2FDN-22V-K (JST)
- Receptacle contact
 - a: SJ2F-01GF-P1.0 (JST) 0.20~0.50 mm²
 - b: SJ2F-01GF-P1.0 (JST) 0.30~0.75 mm²
- Manual crimp tool
 - a: YRS-8861
 - b: YRF-1120
- Cable diameter suitable for wire-side shell
 - JFM-WSA-4-A : φ26.2~φ28.0
 - JFM-WSA-4-C : φ15.5~φ16.5

(This pin layout diagram is drawn seeing the robot side connector from the contact side)

Specification of Application wires
 Rated voltage maximum AC/DC 115 V
 Rated ampere maximum 1 A

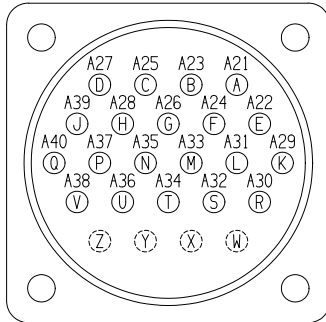
(Notes) Terminals suitable for recommended cable and manual solder less terminal tool should be used. Matching connector should be prepared by customer.

[SC400L-05] [SC500-05]

CNR10B on the BJ3BOX

Keyseat X

CNR10B



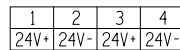
		CNR10B
Recommended cable		0.3 mm ² x 20p
connector	Receptacle	JL02-2A-24-B28SCX-F0 (JAE)
Matching connector type	Plug	MS3106B24-28PX (JAE)
	cable clamp	MS3057-16A (JAE) Max. permissible cable diameter: φ23.8

(This pin layout diagram is drawn seeing the robot side connector from the contact side)

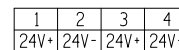
* In case of SC400L-05 and SC500-05, CNR10A does not exist.

CN71A,71C,81A,81C connectors inside the BJ1BOX and BJ3BOX

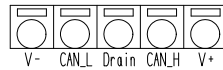
CN71A



CN71C



CN81A



CN81C



Above connectors are
Inside of BJ1 box

Above connectors are
Inside of BJ3box

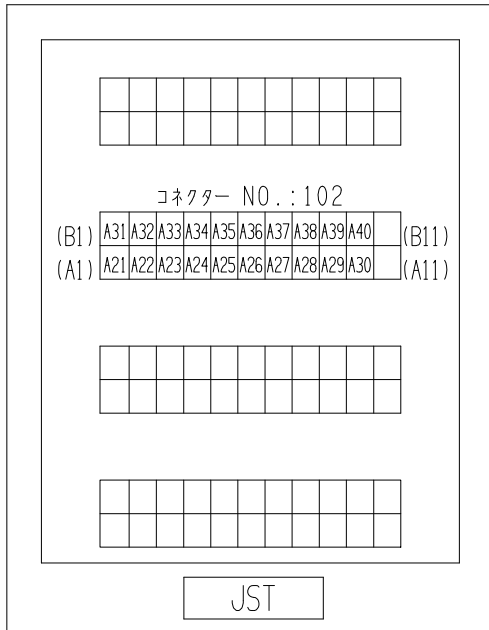
		CN71A	CN71C
connector	housing	VLR-04V	VLP-04V
Matching connector type	housing	VLP-04V	VLR-04V
	Contact	SVF-61T-P2.0 (0.5~2.0 mm ²) SVF-42T-P2.0 (0.3~1.25 mm ²)	SVM-61T-P2.0 (0.5~2.0 mm ²) SVM-42T-P2.0 (0.3~1.25 mm ²)
	Retainer	VLS-02V	
	Crimp tool	YC-590 (SV*-61T-P2.0) YC-592 (SV*-42T-P2.0)	

		CN81A	CN81C
Connector		231-635/010-DM	231-305/037/010-DM
Matching connector type	Connector	231-305/037/010-DM	231-635/010-DM
	Tool	231-131	
	Terminal	CAN_L, CAN_H : 216-301 V-, V+ : 216-201 Drain : 216-201 Crimping tool : 206-204	

(This pin layout diagram is drawn seeing the robot side connector from the contact side)

(Notes) Terminals suitable for recommended cable and manual solder less terminal tool should be used. Matching connector should be prepared by customer.

CNR010 on the BJ1BOX



Connectors for application cables

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

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

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

Receptacle contact

a: SJ2F-01GF-P1.0 (JST) 0.20~0.50 mm²

b: SJ2F-01GF-P1.0 (JST) 0.30~0.75 mm²

Manual crimp tool

a: YRS-8861

b: YRF-1120

Cable diameter suitable for wire-side shell

JFM-WSA-4-A : φ26.2~φ28.0

JFM-WSA-4-C : φ15.5~φ16.5

(This pin layout diagram is drawn seeing the robot side connector from the contact side)





Specification of Application wires

Rated voltage maximum AC/DC 115 V

Rated ampere maximum 1 A

(Notes) Terminals suitable for recommended cable and manual solder less terminal tool should be used. Matching connector should be prepared by customer.

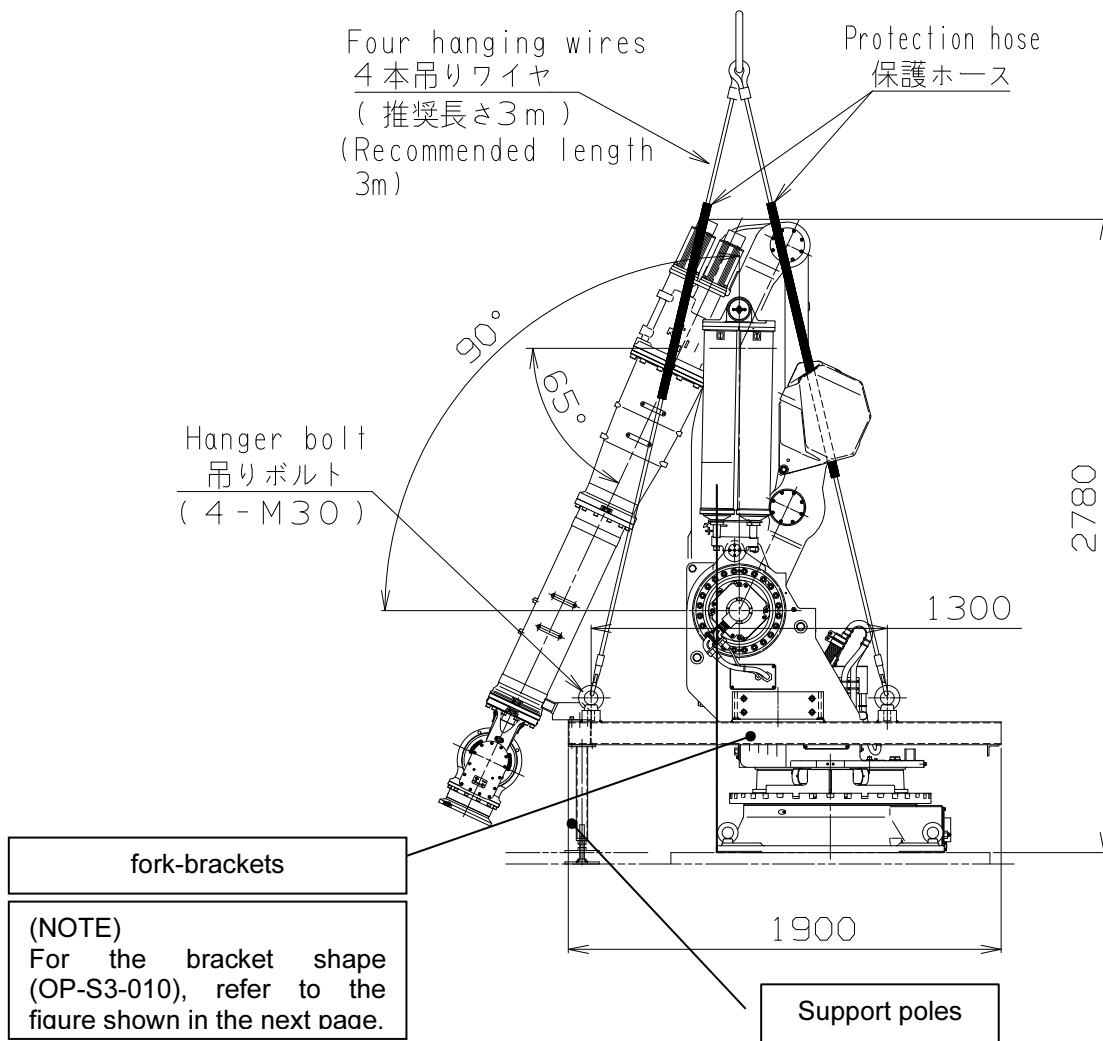
9. Transporting

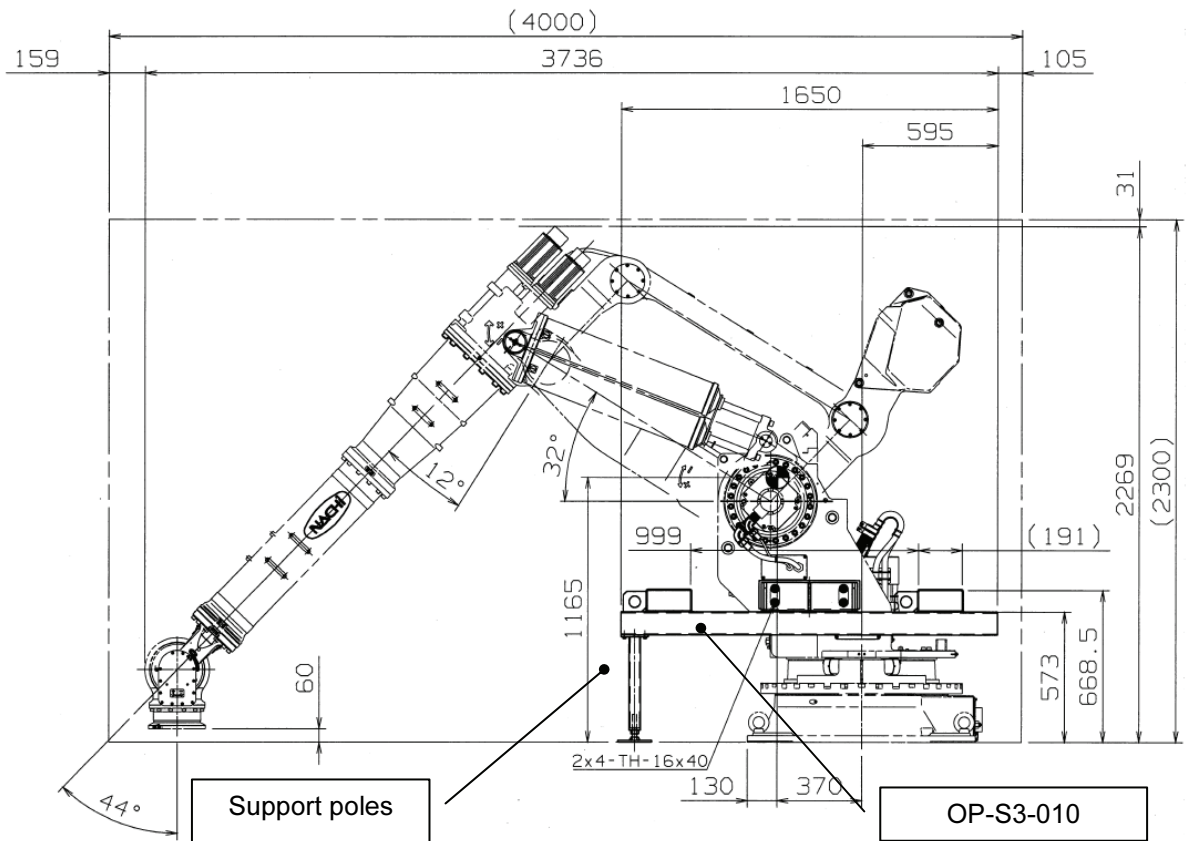
 WARNING	The robot must be transported by personnel who have licenses required for slinging work, crane operation, forklift truck operation, and others. The weight of the robot and controller is listed in the Operating Manual and the Maintenance Manual. Check for the weight, and then handle them according to procedures suitable for the weight.
 WARNING	To lift the robot or the controller, follow the procedures specified in the Maintenance Manual. Following any procedures other than those specified will cause the robot to topple over or drop during transport, thus resulting in accidents.
 CAUTION	During transport or installation work of the robot, pay utmost care not to cause damage to wirings. Furthermore, after installing the robot, take protective measures such as using protective guards so that the wirings will not be damaged by workers or other persons, or forklift trucks or else.
 CAUTION	Please pay utmost care not to hurt the motor and encoder cables by hanging wires.

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

At first, move the robot to the configuration shown in figure and mount fork-brackets to the robot frame and mount four M30 hanger bolts to them. Then, be sure to lift the robot using four hanging wires (recommended length is 3m). Protect areas that contact the robot by rubber hoses to cover the wire ropes. For the areas to be covered, please refer to figure.

[SC400L-04] [SC400L-05]

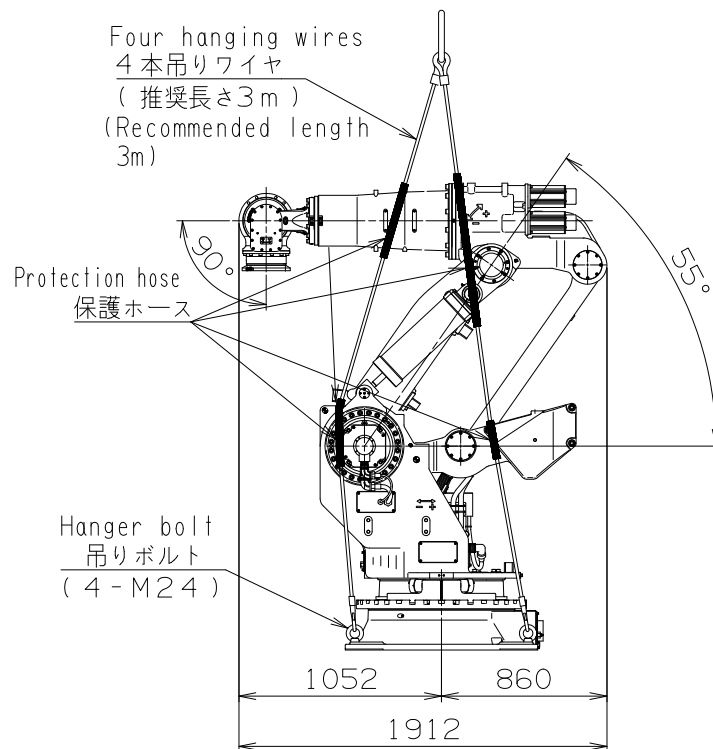




(CAUTION)

In case of SC400L, if there is a limitation of the height for the transportation posture, please use the posture shown above. But, **do not forget to attach the support poles shown in the figure (Both of the left side and the right side).**

[SC500-04] [SC500-05]



10. Delivery style (specification which contains a robot)

1. There are three styles as shown below

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

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

2. Operation and maintenance education

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

11. Consuming power (Robot + Controller)

6.7 kVA (may vary according to the application and motion pattern.)

12. Paint color

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

13. Warranty

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

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

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