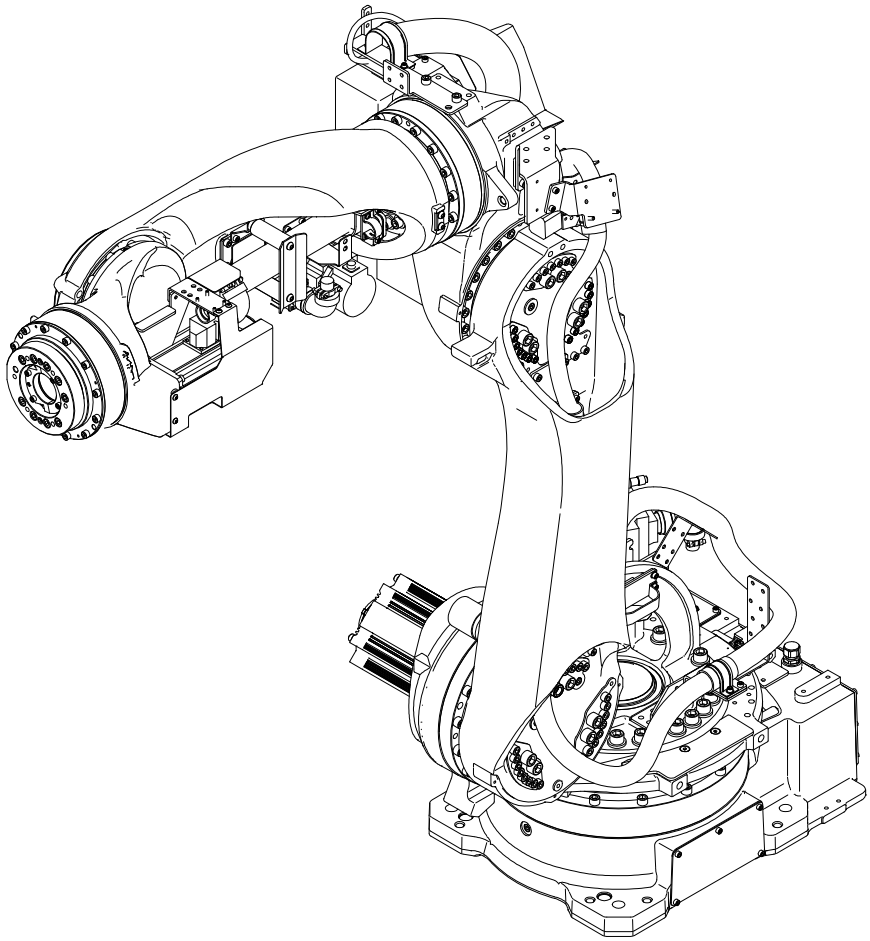
NACHI

# Standard specifications

# SRA100HB-01-FD11

1st edition



NACHI-FUJIKOSHI CORP.

1405, SSRAEN-072-001,001

NACHI

# Table of contents

# 1. Outline

NACHI ROBOT “SRA100HB” is optimal robot for spot welding, material handling and other applications, and provides dramatically improved productivity by its overwhelming speed and compact body.

Standard type

| Installation | Max. payload 100 kg |
|---|---|
| Floor mount | SRA100HB-01 |

1. Due to the compact body, high- density installation is possible.
2. Because the height of the robot is small, a multi-layer installation with other robots is possible.
3. This robot features a powerful wrist that can support a large tool.
4. Due to a wide operation area, it is possible to use for various production process.
5. By attaching importance to higher acceleration performance, powerful arm enables quick short pitch movement.
6. This robot features the largest wrist bend angle in its class due to the slim compact wrist. The reduction of restriction due to wrist operation opens the robot to more diverse applications.
7. The required installation area has been reduced by routing water, air and cables through the swivel base for spot application.

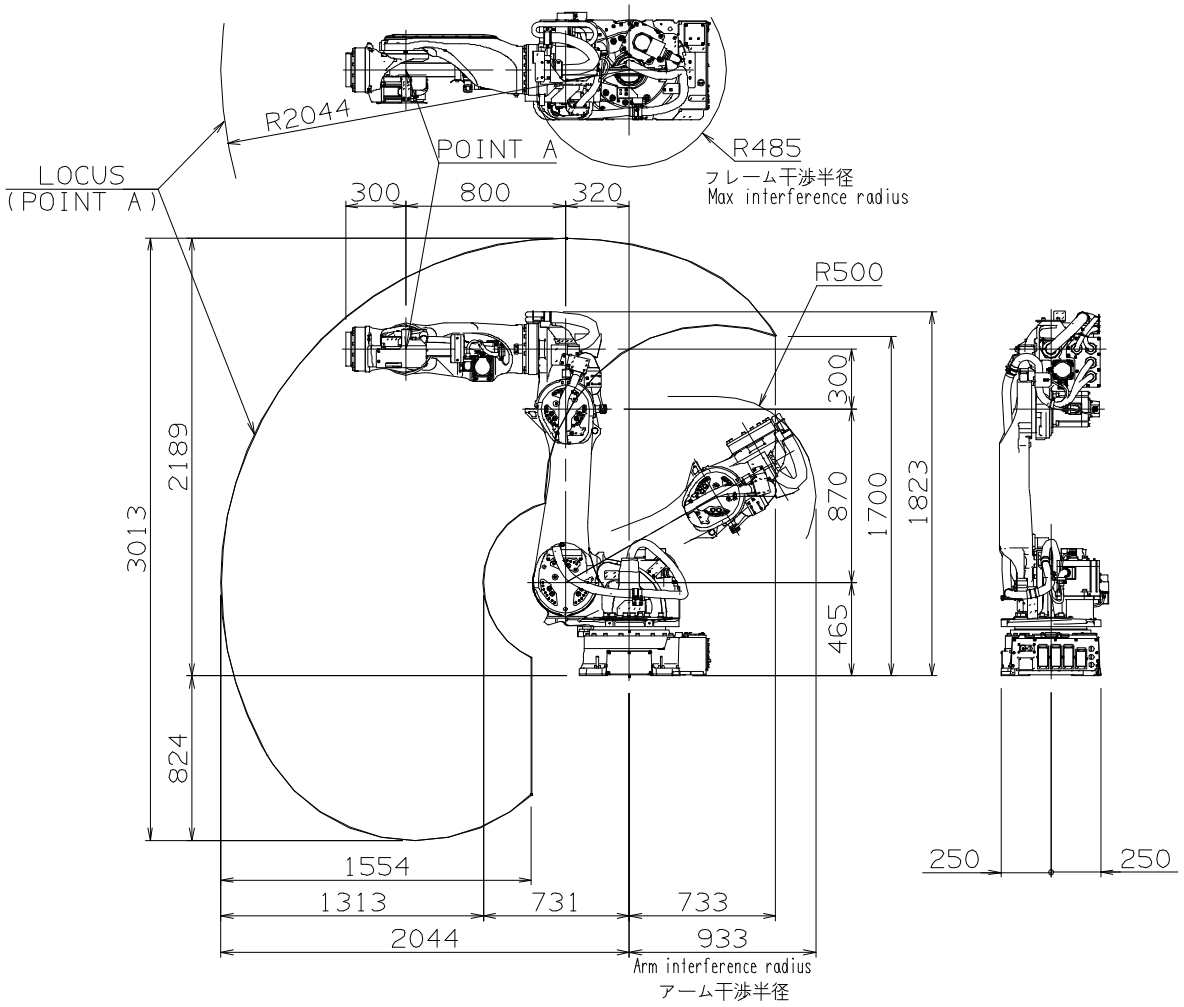
## 2. Basic specifications

| Item | | Specifications |
|---|---|---|
| Robot model | | SRA100HB-01 |
| Construction | | Articulated |
| Number of axis | | 6 |
| Drive system | | AC servo motor |
| Max. working envelope | Axis 1 | ±3.14 rad (±180°) |
| | Axis 2 | -2.09 ～ +1.05 rad (-120 ～ +60°) |
| | Axis 3 | +1.57 ～ -2.64 rad ( +90 ～ -151°) |
| | Axis 4 | ±3.66 rad (±210°) |
| | Axis 5 | ±2.18 rad (±125°) |
| | Axis 6 | ±3.66 rad (±210°) |
| Max. speed | Axis 1 | 2.37 rad/s (136°/s) |
| | Axis 2 | 2.00 rad/s (115°/s) |
| | Axis 3 | 2.79 rad/s (160°/s) |
| | Axis 4 | 3.93 rad/s (225°/s) |
| | Axis 5 | 3.05 rad/s (175°/s) |
| | Axis 6 | 5.50 rad/s (315°/s) |
| Max. pay load | Wrist | 100 kg |
| | Forearm *1 | 20 kg |
| Allowable static load torque | Axis 4 | 650 N·m |
| | Axis 5 | 650 N·m |
| | Axis 6 | 315 N·m |
| Allowable moment of inertia *2 | Axis 4 | 85 kg·m$^2$ |
| | Axis 5 | 85 kg·m$^2$ |
| | Axis 6 | 45 kg·m$^2$ |
| Position repeatability *3 | | ±0.1 mm |
| Installation | | Floor mount |
| Ambient conditions | | Temperature: 0 to 45 ºC *4<br>Humidity: 20 to 85%RH (No dew condensation allowed)<br>Vibration to the installation face: Not more than 0.5G (4.9 m/s$^2$) |
| Noise *5 | | 79.6 dB |
| Robot mass | | 750 kg |

1[rad] = 180/π[°], 1[N·m] = 1/9.8[kgf·m]
- On controller display, axis 1 to 6 is displayed J1 to J6 for each.
- The specification and externals described in this specifications might change without a previous notice for the improvement.
- Explosion-proof is not available.

*1: This value changes by placement and load conditions of a wrist.
*2: The Allowable moment of inertia of a wrist changes with load conditions of a wrist.
*3: This value conforms to "JIS B 8432".
*4: Permitted height is not higher than 1,000m above sea level. If used in higher place, permitted temperature is affected by height.
*5: Robot noise is A-weighted equivalent sound level measured under “JIS Z 8737-1” (ISO 11201) with max. payload and max. speed.

# 3. Robot dimensions and working envelope

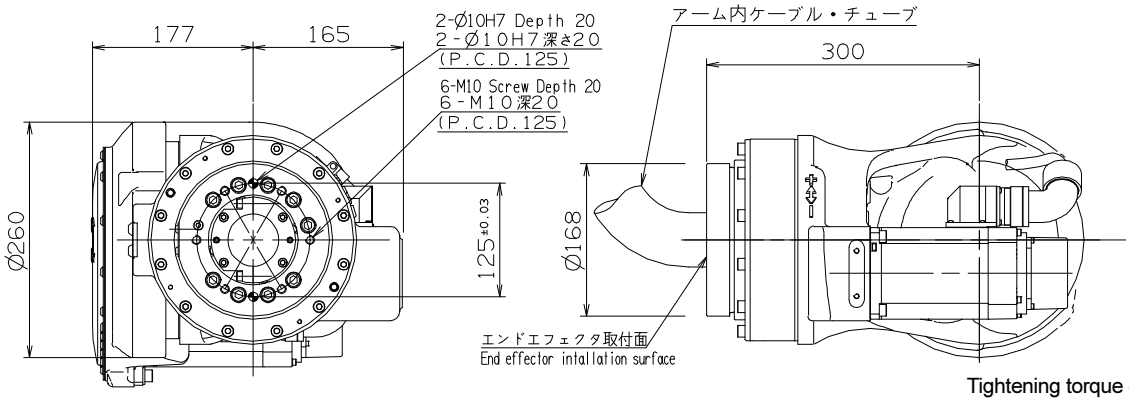


# 4. Detail of load mounting plate

**■ Wrist**

For the end effecter fixing bolts, use the mounting P.C.D. shown in the following figures.
Another P.C.D. is prepared as option. Consult with each NACHI-FUJIKOSHI office for the details.

| | |
|---|---|
| CAUTION | Be sure to screw the M10 tool fixing bolts in the wrist not deeper than the screw depth in the mounting face. Screwing the bolts deeper than the screw depth may damage the wrist. |
| IMPORTANT | Cables and tubes are pulled out from the center portion of end effecter. So please make a hole of φ100 on end effecter for easier maintenance without dismounting it.<br>If making hole on end effecter is impossible, extension flange (option) is prepared in order to pull out cables from the side. |

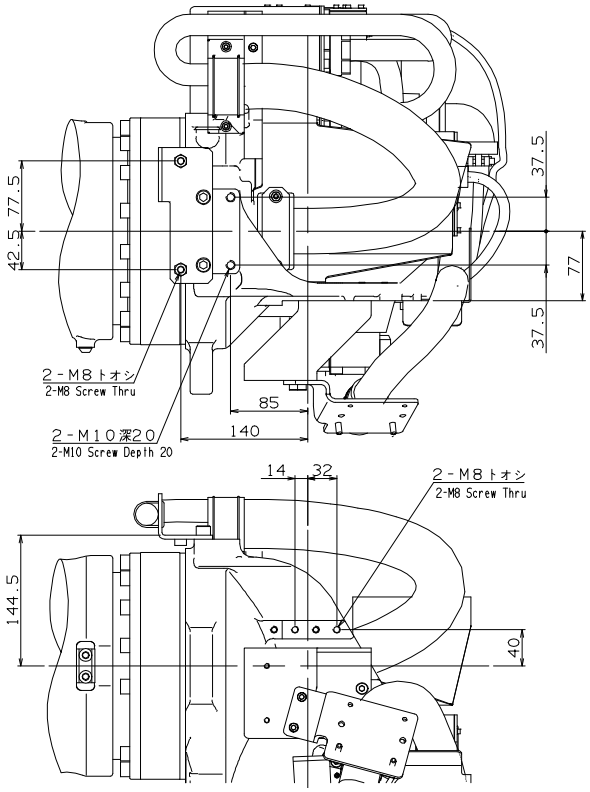



Tightening torque of
M10 Hex. socket head cap screw

| | |
|---|---|
| JIS: Strength class 10.9 | 55 N·m |
| JIS: Strength class 12.9 | 67 N·m |

**■ Upper part of forearm**

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



# 5. Installation procedure

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

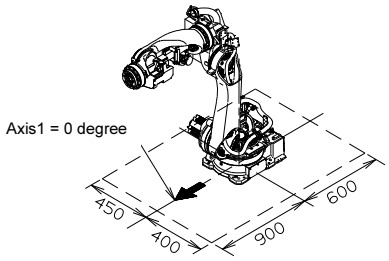
## Installation

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

## Safety measures against entry in the robot operating area

| | |
|---|---|
| WARNING | 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. |

### ■ Space surrounding robot

| | | |
|---|---|---|
| IMPORTANT | When installing this robot, open space written in figure is necessary for maintenance work such as motor replacement, balancer replacement and other work. |  |

### ■ 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 not only the static loads but also the reaction force caused by robot movement.
Repair uneven spots, cracks, and others on the floor, and then install the robot by following to the table below. If thickness of floor concrete is less than needed level, an independent foundation should be constructed. Inspect the foundation prior to the robot installation.

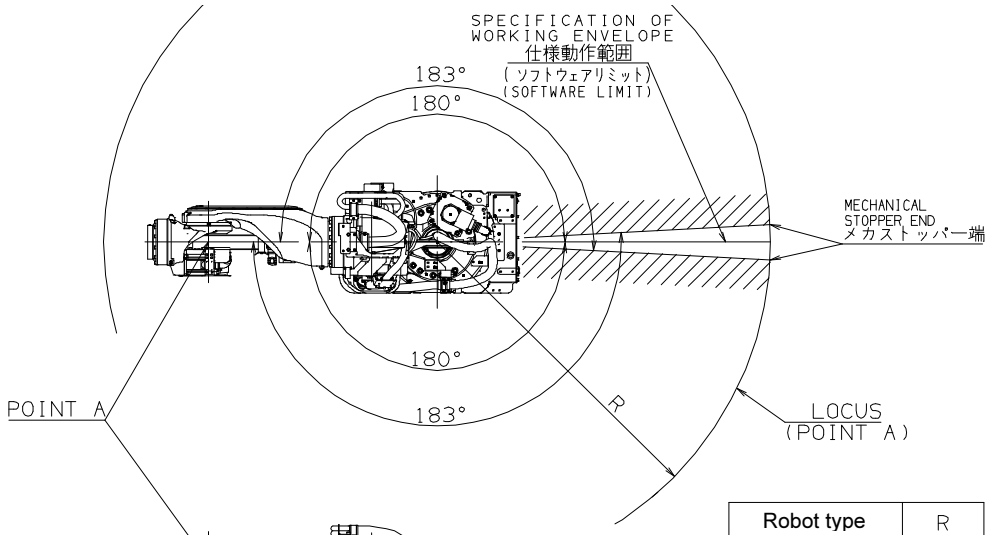
| Robot Model | SRA100HB-01 |
|---|---|
| Thickness of floor concrete | Not less than 150 mm |
| Installation parts *1 | 4 bolts of M20 (JIS: Strength class 12.9) not less than 70mm<br>4 plain washers of not less than 4.5 mm in thickness and HRC35 in hardness |
| Tightening torque | 560 ± 30 N·m |
| Allowable repeated tensile *2 | Approximately 36,000 N |

*1 : Installation parts are not accessory of robot.
*2 : This tensile is per installation bolt when robot is installed with all bolts written in table above.

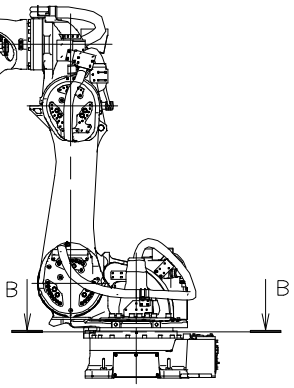
## ■ Installation space

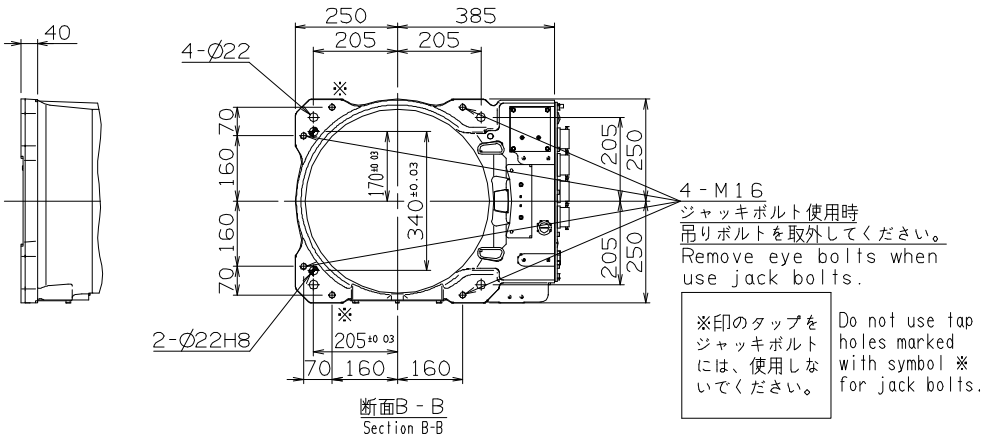
To install the robot, lock the swiveling base of the robot.

| | |
|---|---|
| WARNING | The mechanical stopper end is located in a position exceeding the specified working envelope (software limit) of axis 1 by 3°. To install the safety fence, with consideration given to the wrist configuration and the shape of end effecter. |
| WARNING | On axes 1, 2 and 3, the robot working envelope can be regulated for safety (optional function). Since optional parts should be installed to enable this function, do not independently move the standard parts (e.g. mechanical stopper). |
| 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 been kept. Mechanical stopper and reduction gear of collided joint are needed to be replaced to the new one. |




| Robot type | R |
|---|---|
| SRA100HB-01 | 2044 |



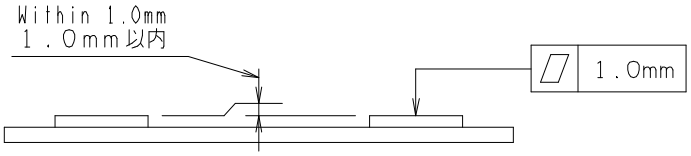



## ■ Accuracy of installation surface

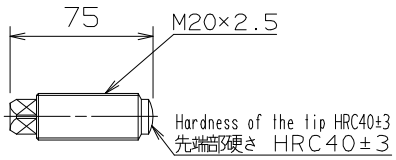
When installing robot, strictly observe precautions listed below to cause no deformation in the swivel base.

(1) Make the deviation from the flatness of the 4 plates on the robot installation surface fall within 1.0 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 1.0 mm (±0.5 mm).




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

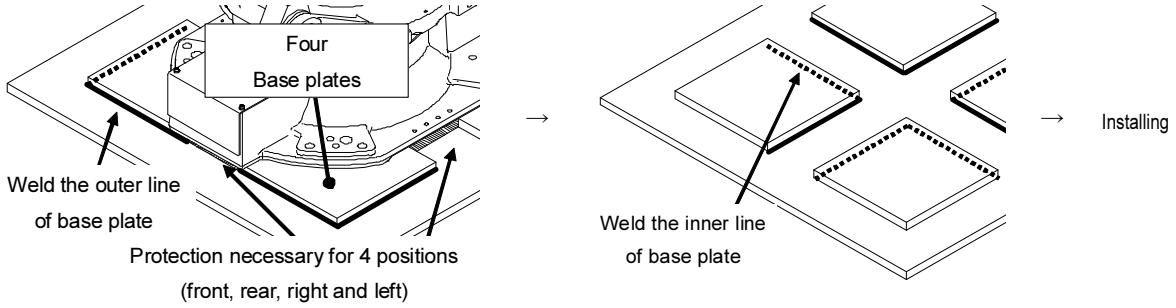



## ■ Welding of base plate

Protect the space (4 places of the front, back, left and right) on robot bottom and installed side by the cover etc. as follows when you weld with the base plate installed in the robot body by the welding spatter and the spark, etc. so that wiring in the robot should not receive damage. After welding the outer line, once remove the robot and weld the inner line.

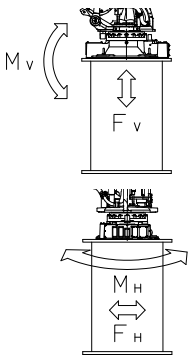
Temporary install the robot, and weld the outer line of base plate.

Once remove the robot and weld the inner line.




## ■ Maximum robot generative force

| Robot model | Max. vertical generative force $F_V$ | Max. horizontal generative force $F_H$ | Max. vertical generative moment $M_V$ | Max. horizontal generative moment $M_H$ |
|---|---|---|---|---|
| SRA100HB-01 | 34,200 N | 26,000 N | 56,300 N·m | 48,500 N·m |



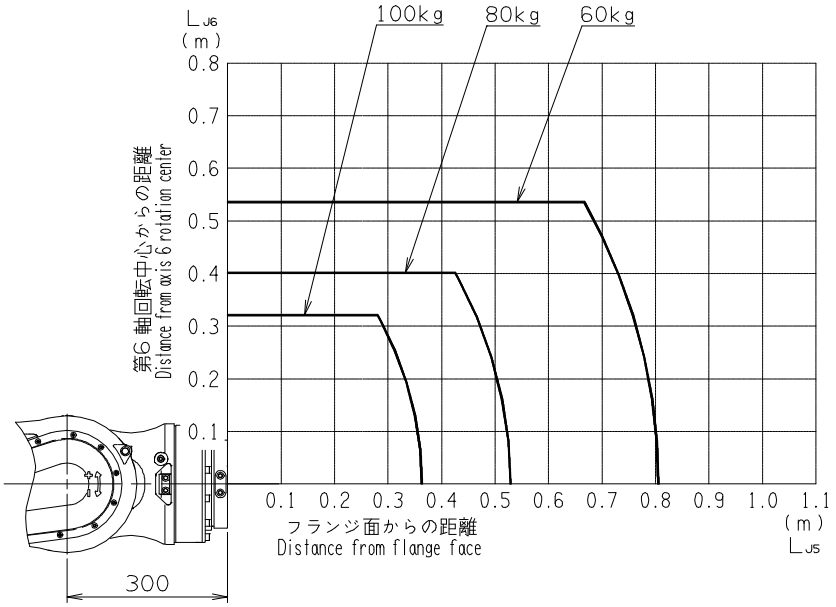
# 6. Allowable wrist load

| | |
|---|---|
| CAUTION | 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. |

## ■ Torque map

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

【SRA100HB-01】

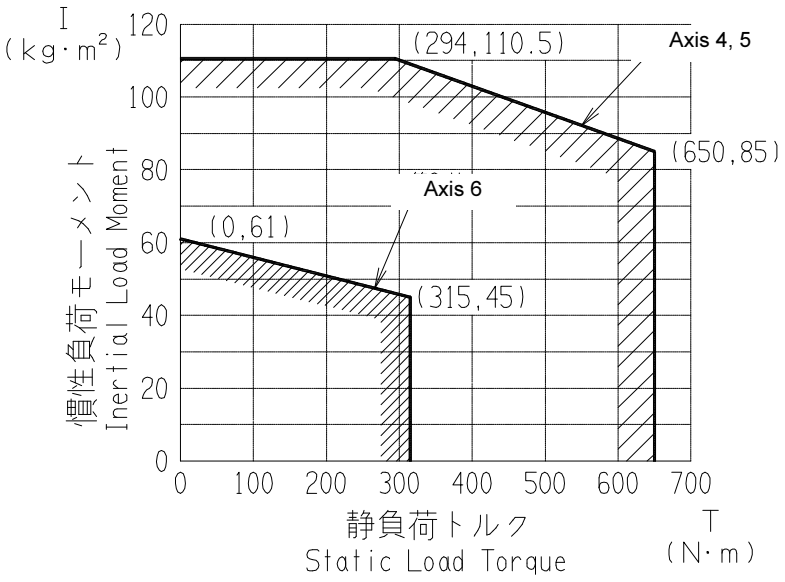



## ■ Wrist load conditions

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

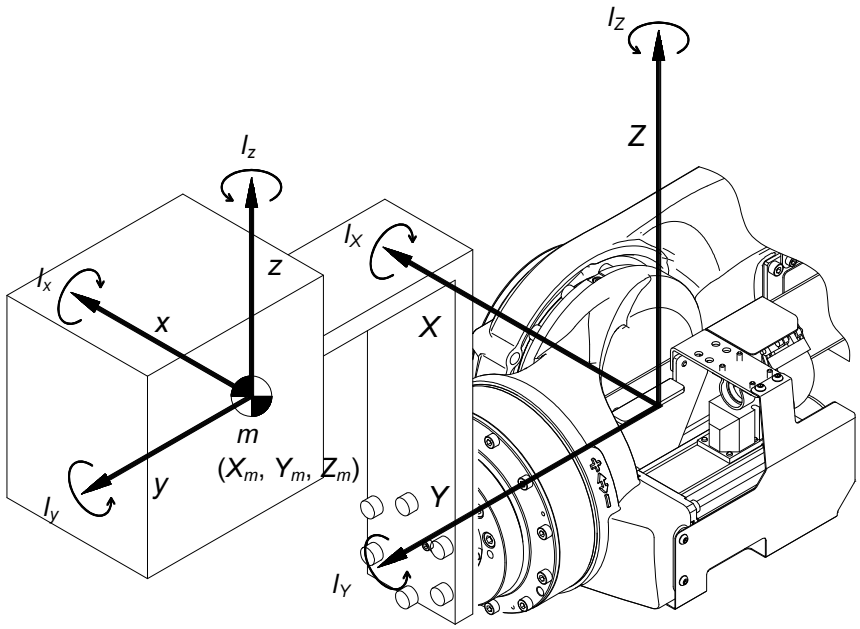
| | |
|---|---|
| IMPORTANT | If the real inertia is over the limit written in “2. Basic specifications”, maximum speed will be restrained by software. |

【SRA100HB-01】



## ■ How to find the inertia moment of each axis

The following section shows general methods of calculating the inertia moment around each axis.




*X*: Axis 5 rotation in the basic wrist configuration
*Y*: Axis 6 and axis 4 rotation in the basic wrist configuration
*Z*: Axis at right angles to the X and Y axes in the basic wrist configuration
*x*: Axis parallel to the X axis in the load gravity center
*y*: Axis parallel to the Y axis in the load gravity center
*z*: Axis parallel to the Z axis in the load gravity center
$I_x$: Inertia moment around the X axis passing through the load gravity center
$I_y$: Inertia moment around the Y axis passing through the load gravity center
$I_z$: Inertia moment around the Z axis passing through the load gravity center
*m*: Load mass
$(X_m, Y_m, Z_m)$: Gravity center coordinates of load

1. Inertia moment around axis 6

The inertia moment of around axis 6 is found by the expression shown below.

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

2. Inertia moment around axis 4 and axis 5

The inertia moment around axis 4 and axis 5 varies with axis 6 configuration. Consequently, in order to simplify the calculation, take a maximum value around the X and Z axes in above figure, as the inertia moment.

$$I_{J4J5} = \max ( I_X , I_Z )$$

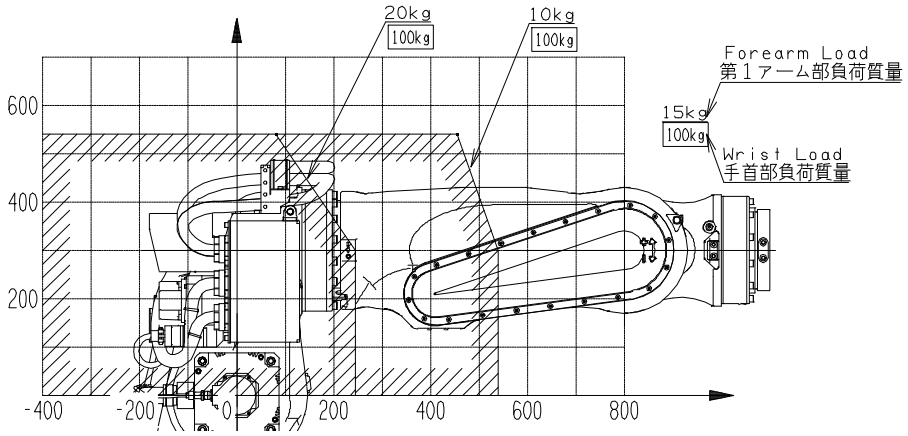
$$\because I_X = m \cdot (Y_m{}^2 + Z_m{}^2) + I_x$$

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

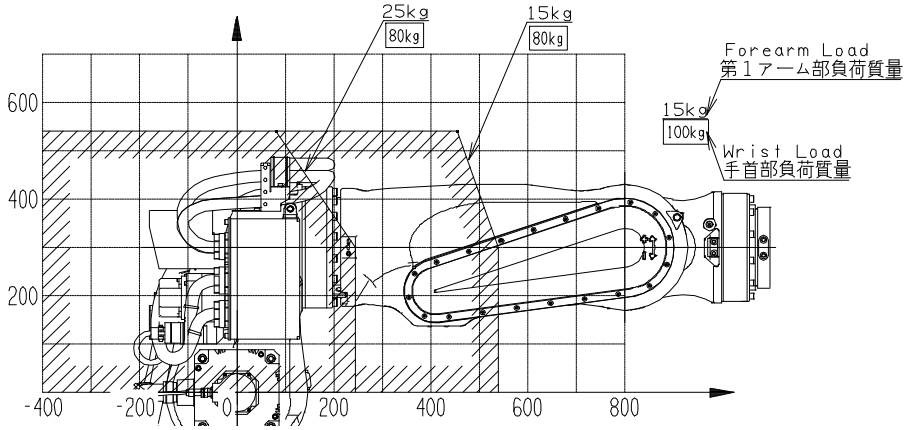
## ■ Allowable forearm load

Use the robot under condition that COG of the ancillary equipment on the forearm falls in the range shown below.

【SRA100HB-01】
When wrist
load is 100kg




【SRA100HB-01】
When wrist
load is 00kg



# 7. Option specifications

○: Possible to correspond／－: Impossible to correspond

| No. | Item | Specifications | | Parts No. |
|---|---|---|---|---|
| 1 | Installation parts *1 | Chemical anchor specification Base plate welded (anchors not included) | with pin hole | OP-F1-029 |
| | | | without pin hole | OP-F1-033 |
| | | Ore anchor specification Base plate welded (anchors not included) | with pin hole | OP-F2-020 |
| | | | without pin hole | OP-F2-021 |
| | | Pins set (Installation pins & polyethylene plug) | | OP-F1-030 |
| | | Leveling plate (□180mm×t=32mm, 4 plates) | | OP-F1-031 |
| | | Installation bolts & washers | | OP-F1-032 |
| 2 | Axis 1 adjustable stopper *1, *2, *3 | Restriction of axis 1 operation edge (±3.14 rad to ±0, every 0.017 rad) | | OP-S5-023 |
| 3 | Axis 2 adjustable stopper *1, *3 | Restriction of axis 2 operation edge (-0.26 and -0.52 rad from the operation edge) | | OP-A5-029 |
| 4 | Dual circuit limit switch | For axes 1, 2 and 3 (3pcs. of dual circuit LS) | | OP-D7-015 |
| 5 | Transfer jig | Fork bracket for floor mounting type | | OP-S2-031 |
| 6 | Zeroing pin & Zeroing block *1 | | | OP-T2-082 |
| 7 | Extension flange | Flange to pull out cable from side (P.C.D.92／P.C.D125) | | OP-W3-013 |
| 8 | Scale seal | For wrist three axes | | OP-N2-020 |
| 9 | Water proof coolant Paint | | | OP-N5-043 |
| 10 | Encoder connector Protector | For axis 3 | | OP-P6-005 |
| 11 | Bypass cable *1 | | | BCUNIT20-20 |

*1 : These parts are packed separately from the robot. (Not attached on the robot)
*2 : A dog part for adjustable LS is included. If motion limit LS is not used, this dog is also not used.
*3 : Concerning the motion range limit options, please refer to the table in the next page.

■Motion range limit option table (Please select the option part number to order referring to the following table.)

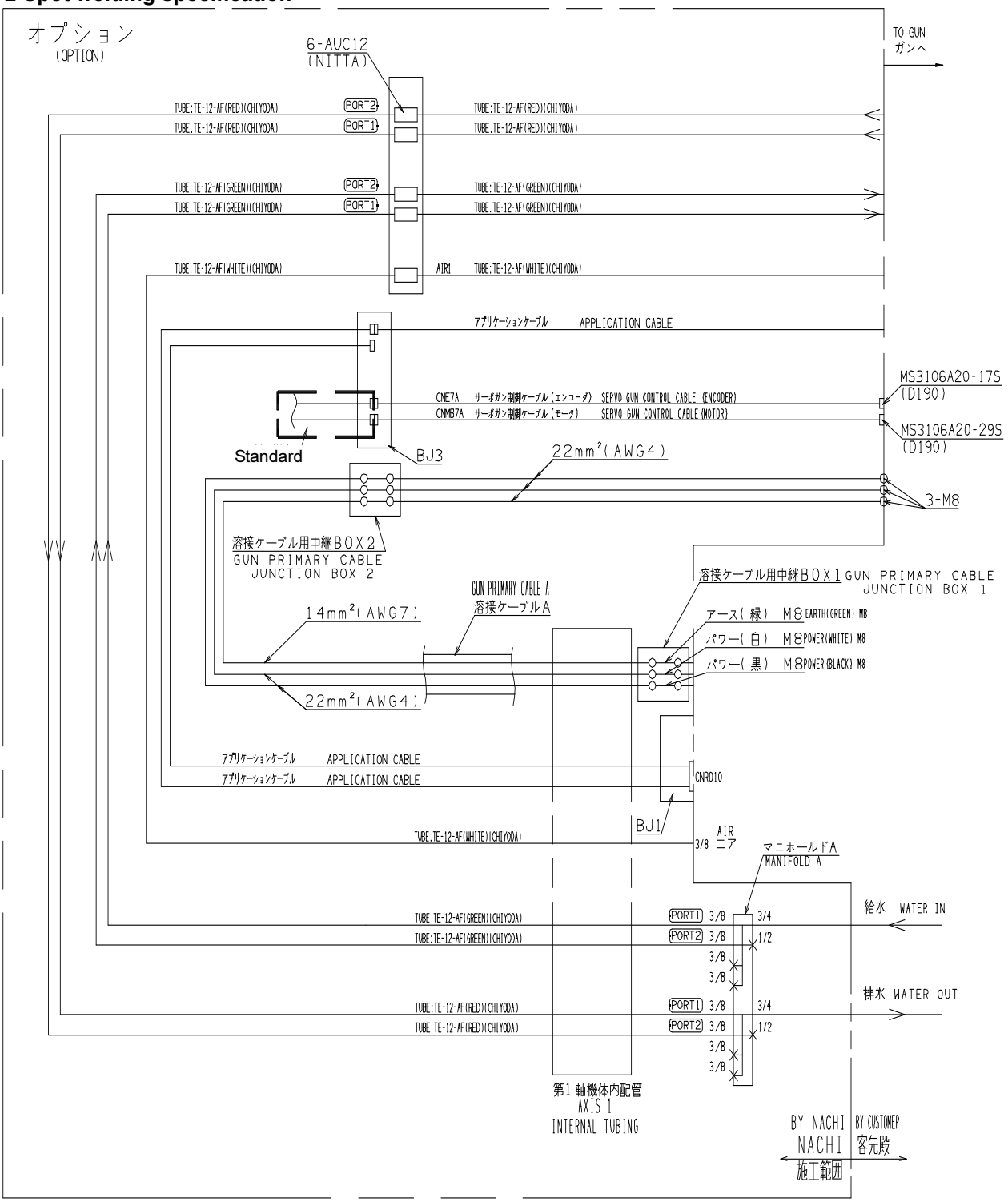
| Function | | Axis | Part No. |
|---|---|---|---|
| Without Limit Switch | Only adjustable stopper | Axis 1 | OP-S5-023 |
| | | Axis 2 | OP-A5-029 |
| | | Axis 3 | - |
| Dual circuit Limit Switch | Limit Switch | Axis 1･2･3 (3 pcs.set) | OP-D7-015*3 |
| | Adjustable LS | Axis 2 | OP-D7-015＆OP-S5-023 |
| | | Axis 3 | OP-D7-015＆OP-A5-029 |
| | Adjustable stopper and Adjustable LS | Axis 1 | - |
| | | Axis 2 | OP-S5-023 |
| | | Axis 3 | OP-A5-029 |

*1: OP-S5-023 and OP-A5-029 are packed separately from the robot. (Not attached on the robot)
*2: Both axis 1 adjustable stopper and axis 1 adjustable LS dog part are supplied in 1 package.
(Please be sure that even if only the stopper part is used and no LS is used, the dog part is also included in this package)
*3: Adjustable LS dog for axis 2 and 3 is included in OP-D7-015.
*4: Adjustable stopper can not been mounted on axis 3 by its constructive reason. Select limit switch to limit working envelope.

# 8. Application wiring and piping diagram

Application wiring and piping written here is the best designed specification for spot welding usage.
No free space is remained in hollow space.
If another specification is required, please contact to NACHI-FUJIKOSHI office.

## ■ Spot welding specification

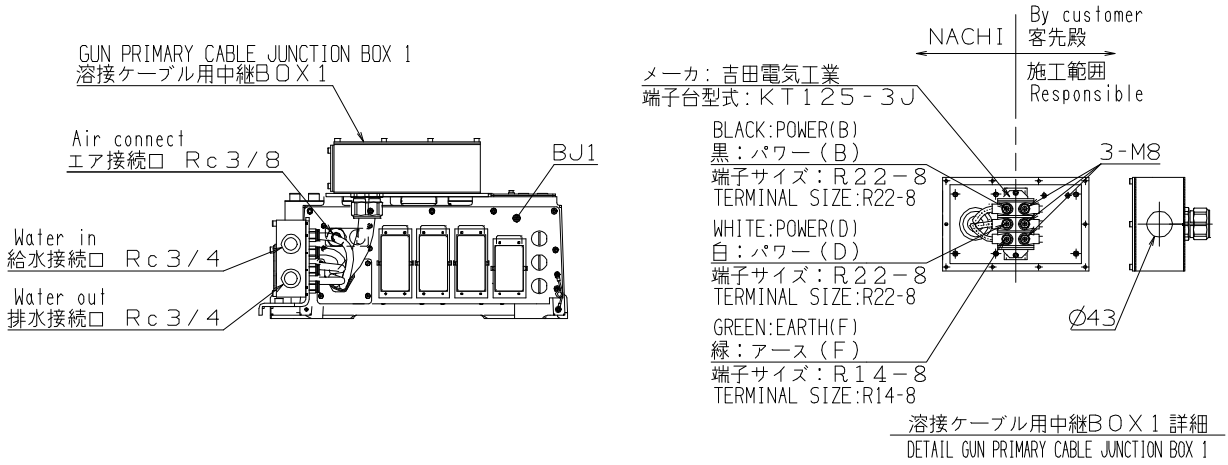



Connecting diagram

## Tool side wiring specification

| No. | Name | Item | Specification | Cable diameter (mm) | Edge manufacturing (length: 1.5m from end effecter attachment face) |
|---|---|---|---|---|---|
| 1 | Spot welding specification | Cable | ・Welding cable 22 $mm^2$ (single wire) x3 (Piping of axis 1 ; 22 $mm^2$ ×2 14 $mm^2$ ×1 (complex cable) ) | 12.9~13.5 | 3-M8 terminal (R-228S) Without seal connector |
| | | | ・Signal cable 0.2$mm^2$ x20 wires | 11.5 | Cut, with seal connector (AYS12-14) Hole diameter 21mm |
| | | | ・Servo gun cable (power) x1 | | Connector type: MS3106A20-17S(190) |
| | | | ・Servo gun cable (signal) x1 | | Connector type:MS3106A20-29S(190) |
| | | Utility | ・Water inlet tube:Green(*1,*2) φ12×φ8 - 2<br>・Water outlet tube:Red(*1,*2) φ12×φ8 - 2<br>・Air tube:White(*1,*3) φ12×φ8 - 1 | | Manufacturer : Chiyoda engineering Cut, (tube type: TE-12-AF) Recommended joint: one touch joint for φ12) (*1) |

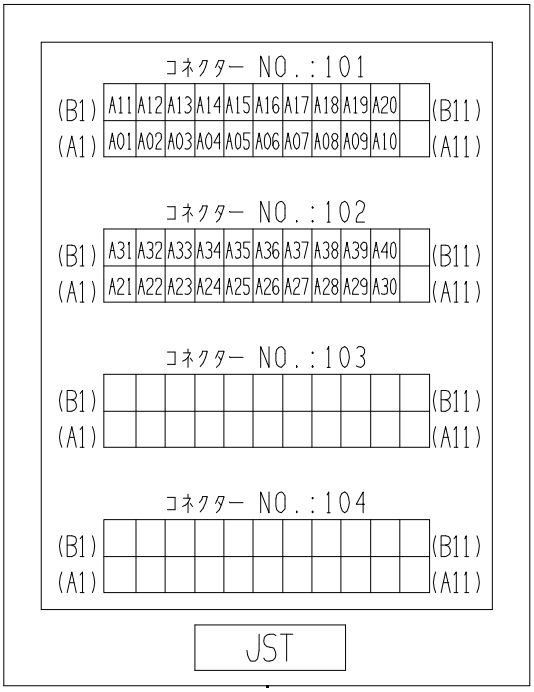
*1) Joint is not included.
*2) Water pressure is 0.3MPa or lower.
*3) Air pressure is 0.8MPa or lower.




Application wires and tubes at base frame

## ■ Detailed diagram of the application connectors

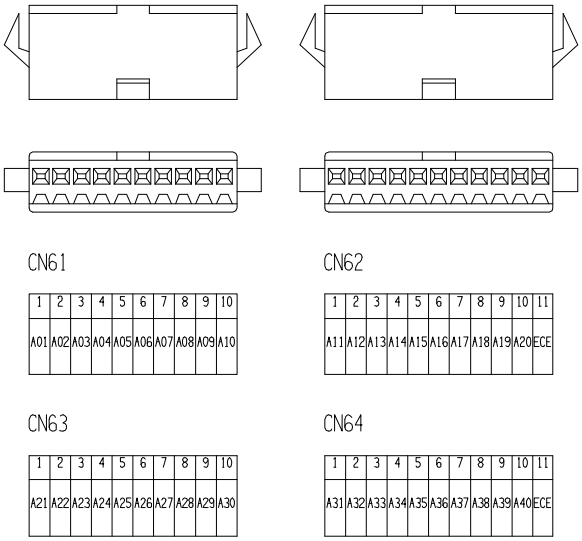
BJ1 side (connector) (option)




User-side Connectors
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 ~ 0.50sq)
b: SJ2F-21GF-P1.0 (JST) (0.30 ~ 0.75sq)
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
(Pin location shows the connector mounted on robot body and is the view from connecting side.)

Application wiring specification
Rated voltage Max. AC/DC 115 V
Rated current rating Max. 1 A

BJ3 side (connector) (option)




Connector form (CN61, CN63)
Housing SMP-10V-BC (JST)
User-side Connectors
Housing SMR-10V-B (JST)
Contact SYM-001T-P0.6 (Wire of Application : AWG#22~28)
Pressure tool YRS-121

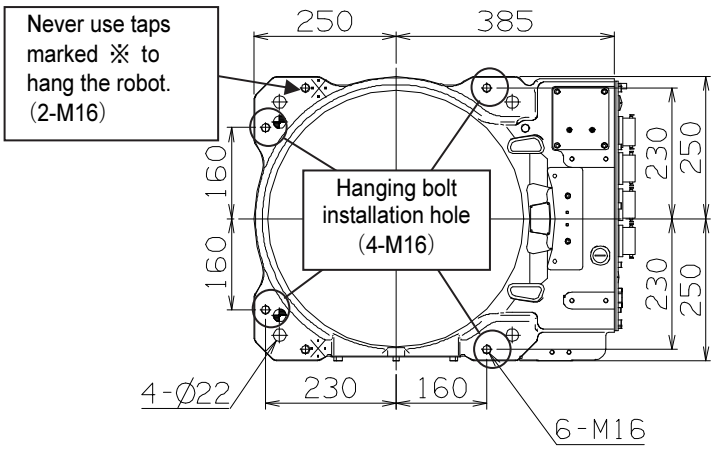
Connector form (CN62, CN64)
Housing SMP-11V-BC (JST)
User-side Connectors
Housing SMR-11V-B (JST)
Contact SYM-001T-P0.6 (Wire of Application : AWG#22~28)
Pressure tool YRS-121

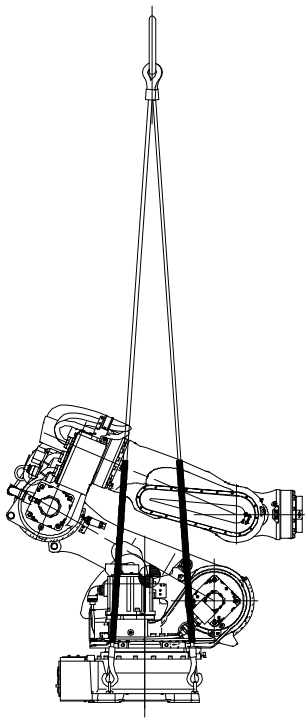
In case of spot welding specification, CN61 and CN62 are already connected as application cable to the tool side. So these connectors are not prepared inside BJ3 box.

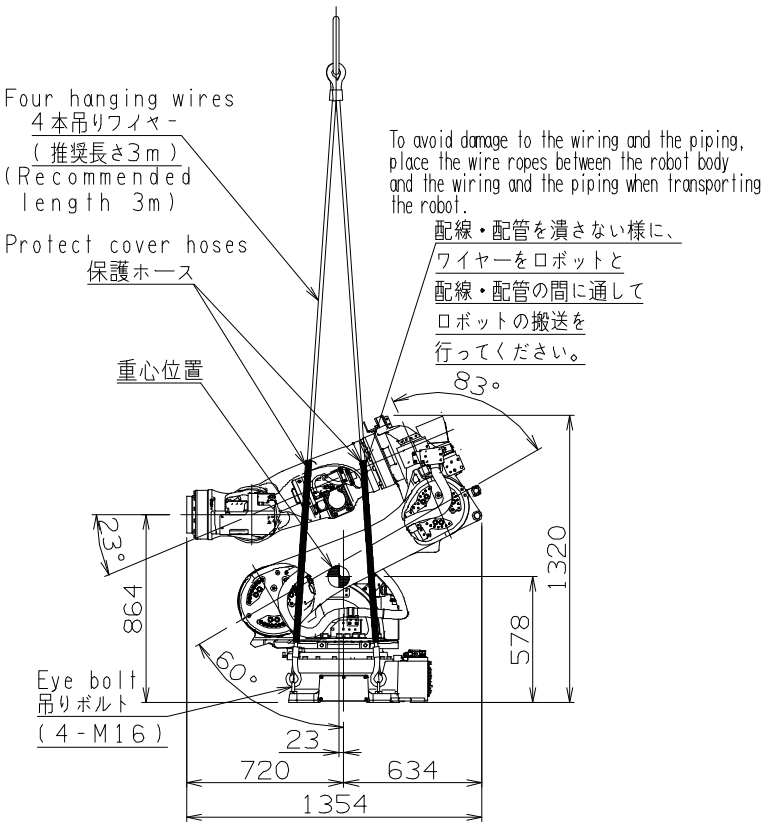
# 9. Safety measures against transport

| | |
|---|---|
| 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. |
| WARNING | During transport or installation work of the robot, pay utmost care not to cause damage to wirings. Furthermore, after installing the robot, take protective measures such as using protective guards so that the wirings will not be damaged by workers or other persons, or forklift trucks or else. |

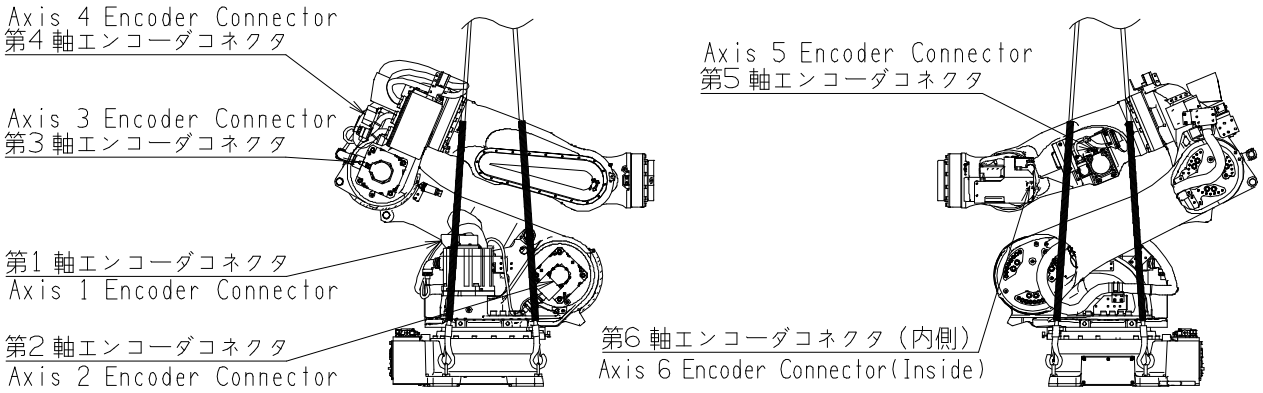
To transport the robot, make it a rule to use a crane.
At first, move the robot to the configuration shown in figure and mount four M16 hanger bolts to the robot frame. Then, be sure to lift the robot using four hanging wires (recommended length is 3m). Protect areas that contact the robot by rubber hoses to cover the wire ropes. For the areas to be covered, please refer to figure.





| | |
|---|---|
| CAUTION | If hanging wires push the encoder connectors or wiring/piping, they may be broken when hanging the robot. When hanging the robot, please pay attention not to make the wires touch the encoder connectors and wiring/piping. |



# 10. Delivery style (specification which contains a robot)

1. There are three styles as shown below.

| | Style | 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.

Gas in balancer is not filled when robot is transported by air. Gas in balancer must be charged before using robot, so customer needs to prepare the nitrogen gas and charging unit. Please contact to NACHI-FUJIKOSHI office to order the charging unit. Charging procedure is written in manipulator maintenance manual.

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)

7.0 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.

| NACHI NACHI-FUJIKOSHI CORP. | | | *http://www.nachi-fujikoshi.co.jp/* |
|---|---|---|---|
| **Japan Main Office** | Phone:<br>+81-3-5568-5245 | Fax:<br>+81-3-5568-5236 | Shiodome Sumitomo Bldg. 17F,<br>1-9-2 Higashi-Shinbashi<br>Minato-ku, TOKYO, 105-0021 JAPAN |
| **Nachi Robotic Systems Inc. (NRS)** | | | *http://www.nachirobotics.com/* |
| **North America Headquarters** | Phone: 248-305-6545 | Fax: 248-305-6542 | 22285 Roethel Drive, Novi, Michigan 48375-4700 U.S.A. |
| **Training Office** | Phone: 248-334-8250 | Fax: 248-334-8270 | 22213 Roethel Drive, Novi, Michigan 48375 U.S.A. |
| **Greenville Service Office** | Use 248-305-6545 | Use 248-305-6542 | South Carolina, U.S.A. |
| **San Antonio Service Office** | Use 248-305-6545 | Use 248-305-6542 | Texas, U.S.A. |
| **Kentucky Branch Office** | Phone: 502-695-4816 | Fax: 502-695-4818 | 116 Collision Center Drive, Suite A, Frankfort, KY 40601 U.S.A |
| **Toronto Branch Office** | Phone: 905-760-9542 | Fax: 905-760-9477 | 89 Courtland Avenue, Unit 2, Vaughan,<br>Ontario L4K3T4 CANADA |
| **Mexico Branch Office** | Phone :+52-555312-6556 | Fax:+52-55-5312-7248 | Urbina # 54, Parque Industrial Naucalpan,<br>Naucalpan de Juarez, 53370, Estado de México, MEXICO |
| **Saltillo Service Office** | Phone :+52-844416-8053 | Fax: +52-844416-8053 | Canada 544 Privada Luxemburgo<br>C. P. 25230, Saltillo, Coahuila, MEXICO |
| **NACHI EUROPE GmbH** | | | |
| **Central Office Germany** | Phone:<br>+49-2151-65046-0 | Fax:<br>+49-2151-65046-90 | Bischofstrasse 99, 47809, Krefeld, GERMANY<br>***http://www.nachirobotics.eu/*** |
| **U.K. branch** | Phone:<br>+44-0121-423-5000 | Fax:<br>+44-0121-421-7520 | Unit 3, 92, Kettles Wood Drive, Woodgate Business Park,<br>Birmingham B32 3DB, U.K. |
| **Czech branch** | Phone:<br>+ 420-255-734-000 | Fax:<br>+420-255-734-001 | Obchodni 132, 251 01 Cestlice, PRAGUE-EAST<br>CZECH REPUBLIC |
| **NACHI AUSTRALIA PTY. LTD.** | | | *http://www.nachi.com.au/* |
| **Robotic Division &<br>Victoria office** | Phone:<br>+61-(0)3-9796-4144 | Fax:<br>+61-(0)3-9796-3899 | 38, Melverton Drive, Hallam, Victoria 3803, , AUSTRALIA |
| **Sydney office** | Phone:<br>+61-(0)2-9898-1511 | Fax:<br>+61-(0)2-9898-1678 | Unit 1, 23-29 South Street, Rydalmere, N.S.W, 2116, AUSTRALIA |
| **Brisbane office** | Phone:<br>+61-(0)7-3272-4714 | Fax:<br>+61-(0)7-3272-5324 | 7/96 Gardens Dr,Willawong,QLD 4110, , AUSTRALIA |
| **NACHI SHANGHAI CO., LTD.** | | | |
| **Shanghai office** | Phone:<br>+86-(0)21-6915-2200 | Fax:<br>+86-(0)21-6915-2200 | 11F Royal Wealth Centre, No.7<br>Lane 98 Danba Road Putuo District, Shanghai 200062, China |
| **NACHI KOREA** | | | *http://www.nachi-korea.co.kr/* |
| **Seoul office** | Phone:<br>+82-(0)2-469-2254 | Fax:<br>+82-(0)2-469-2264 | 2F Dongsan Bldg.<br>276-4, Sungsu 2GA-3DONG, Sungdong-ku,<br>Seoul 133-123, KOREA |



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



Original manual is written in Japanese.