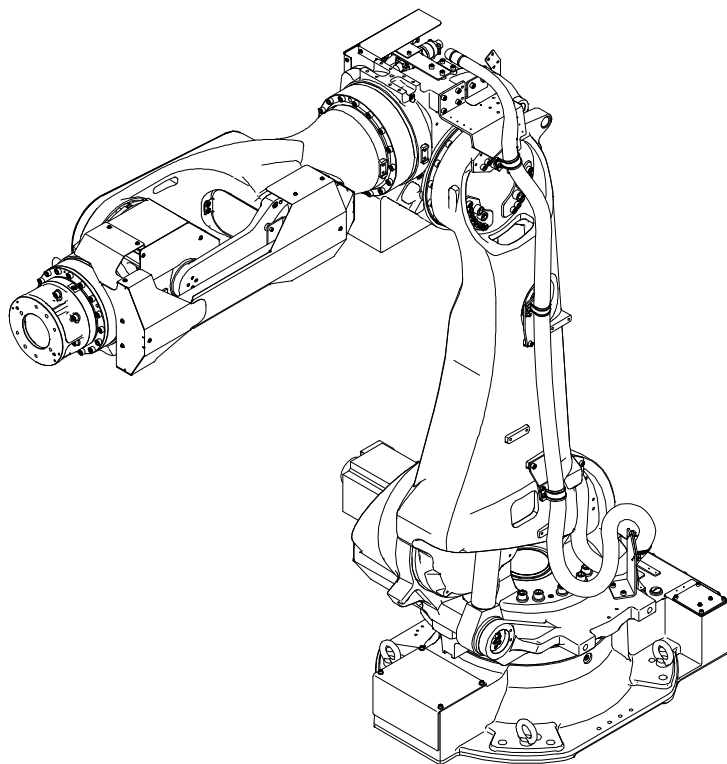


NACHI

Standard specifications

SRA220H-01-FD11
SRA220HV-01-FD11

7th edition



NACHI-FUJIKOSHI CORP.

1707, SSRAEN-064-007,001

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1. Outline

NACHI ROBOT “SRA220H” is optimal robot for spot welding, material handling and other applications, and provides dramatically improved productivity by its overwhelming speed and compact body.

Floor mount and inverted mount type is prepared.

Standard type

Installation	Max. payload 220 kg
Floor mount	SRA220H-01
Inverted mount	SRA220HV-01

■ More flexible installation

- By hollow forearm and wrist, cables to end effector such as spot welding gun and or so are installed inside arm. So it is possible to install robot in narrow space where used to be difficult to install it.

■ Improved reliability

- Reliability of cable is improved because cable behavior is stable and damage by welding spatter and damage by interference with peripheral equipment can be avoided.

■ Shortage of start up time

- Considering cable interference is unnecessary. Start up time for robot simulation and for actual robot check after installation is shorter than existing model.

2. Basic specifications

Item		Specifications	
Robot model		SRA220H-01	SRA220HV-01
Construction		Articulated	
Number of axis		6	
Drive system		AC servo motor	
Max. working envelope	Axis 1	$\pm 3.14 \text{ rad} (\pm 180^\circ)$	$\pm 2.88 \text{ rad} (\pm 165^\circ)$
	Axis 2	$-1.40 \sim +1.05 \text{ rad} (-80 \sim +60^\circ)$	
	Axis 3	$-2.69 \sim +2.62 \text{ rad} (-154 \sim +150^\circ)$	
	Axis 4	$\pm 3.66 \text{ rad} (\pm 210^\circ)$	
	Axis 5	$\pm 2.27 \text{ rad} (\pm 130^\circ)$	
	Axis 6	$\pm 3.66 \text{ rad} (\pm 210^\circ)$	
Max. speed	Axis 1	2.01 rad/s (115°/s)	
	Axis 2	1.83 rad/s (105°/s)	
	Axis 3	1.97 rad/s (113°/s)	
	Axis 4	2.27 rad/s (130°/s)	
	Axis 5	2.27 rad/s (130°/s)	
	Axis 6	3.58 rad/s (205°/s)	
Max. pay load	Wrist	220 kg	
	Forearm *1	20kg (45kg at maximum)	
Allowable static load torque	Axis 4	1,337 N·m	
	Axis 5	1,337 N·m	
	Axis 6	720 N·m	
Allowable moment of inertia *2	Axis 4	141.1 kg·m ²	
	Axis 5	141.1 kg·m ²	
	Axis 6	79.0 kg·m ²	
Position repeatability *3		$\pm 0.15 \text{ mm}$	
Installation		Floor mount	Inverted mount
Ambient conditions		Temperature: 0 to 45 °C *4 Humidity: 20 to 85%RH (No dew condensation allowed) Vibration to the installation face: Not more than 0.5G (4.9 m/s ²)	
Dust-proof / Drip-proof performance		Wrist & Body ; IP54 equivalent	
Noise *5		79.6 dB	
Robot mass		1,100 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.

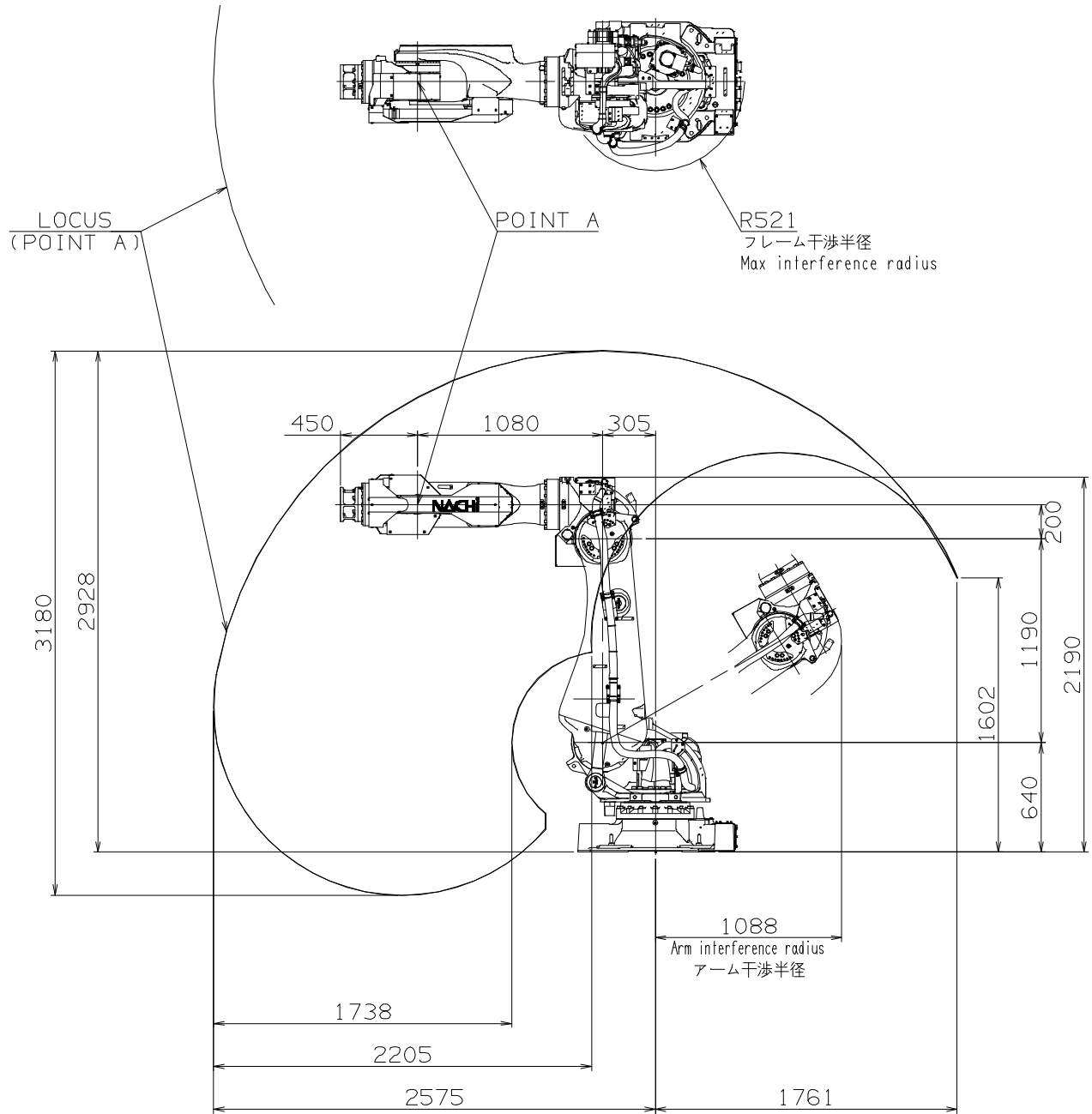
*3: This value conforms to "JIS B 8432".

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

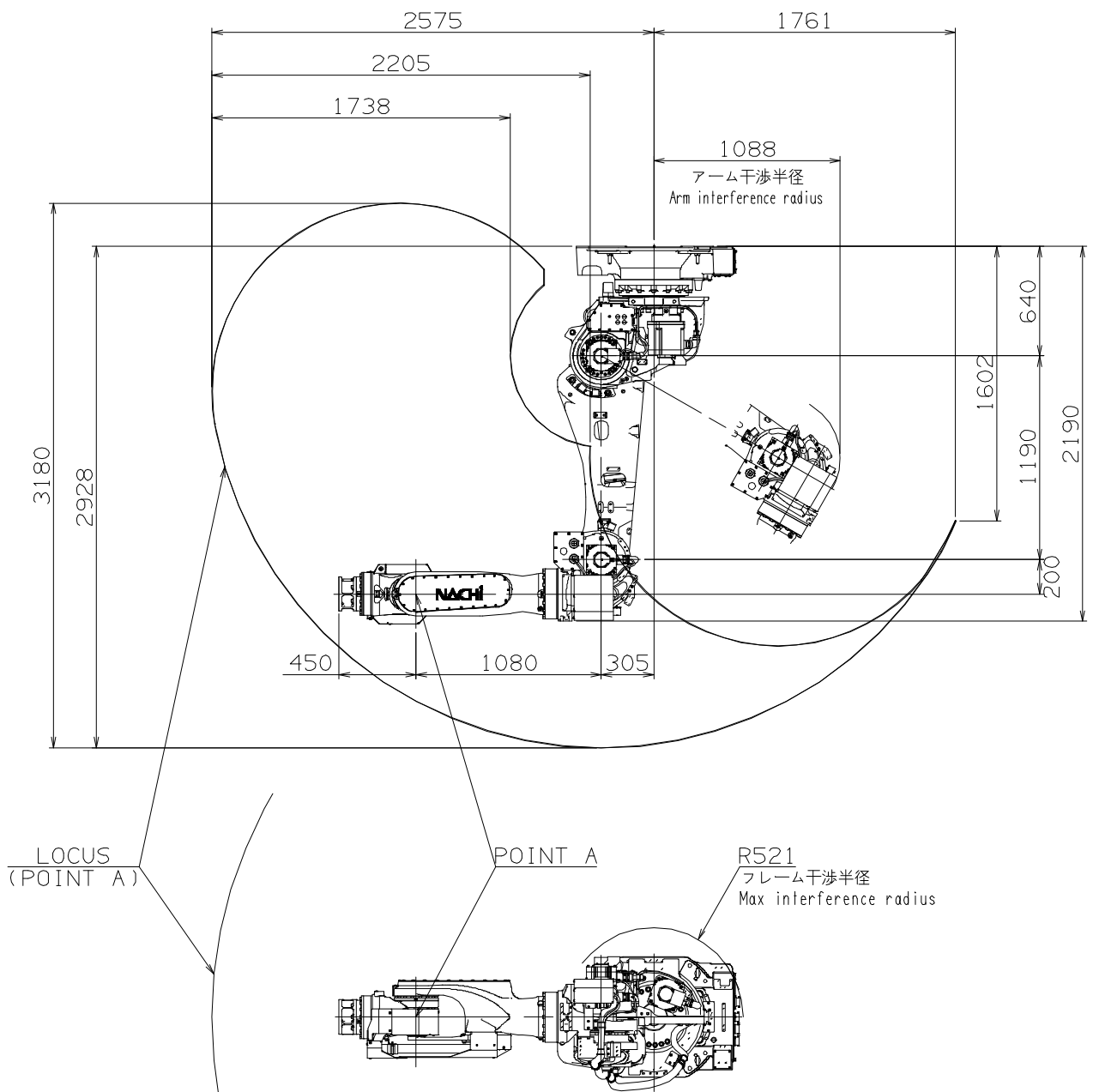
*5: Robot noise is A-weighted equivalent sound level measured under "JIS Z 8737-1" (ISO 11201) with max. payload and max. speed.

3. Robot dimensions and working envelope

【SRA220H-01】



【SRA220HV-01】



4. Detail of load mounting plate

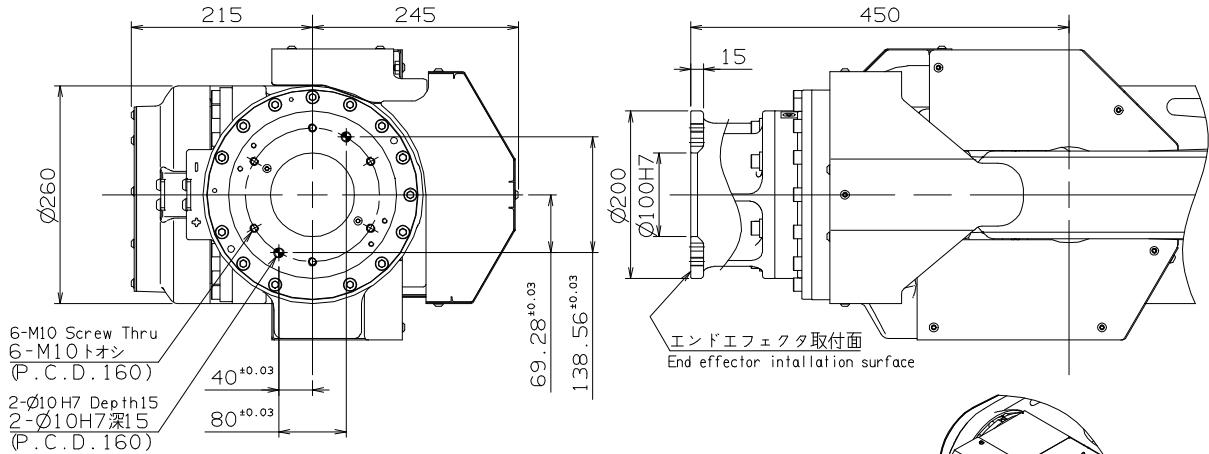
■ Wrist

For the end effector 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.



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.

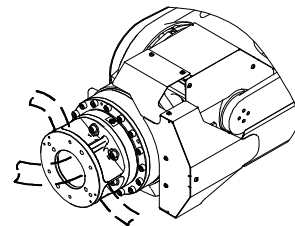
【SRA220H-01】【SRA220HV-01】



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

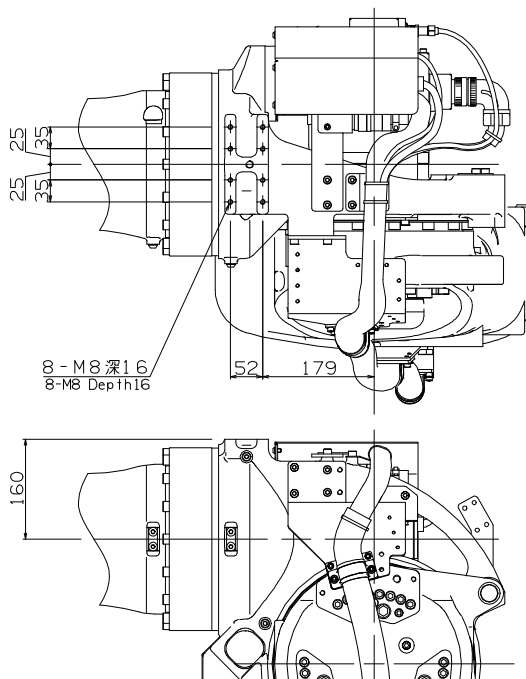
※ Cable inside arm can be accessed from 3 directions those are front and both side of end effector.



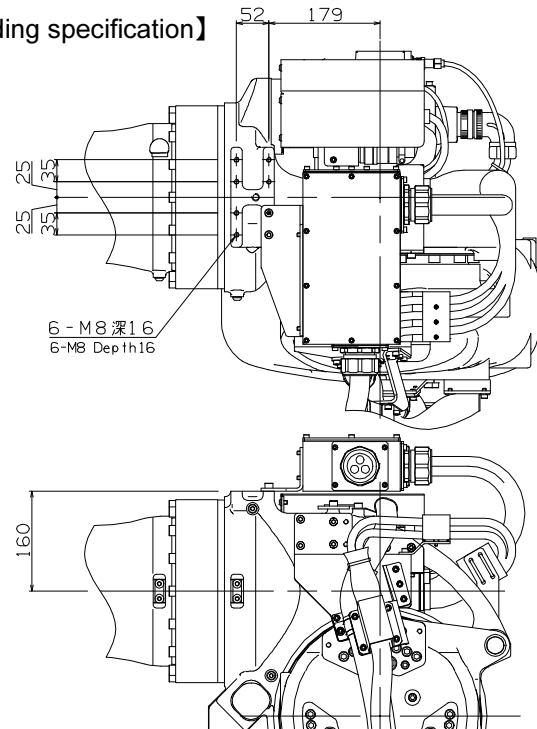
■ Upper part of forearm

Ancillary equipment can be mounted to the upper part of robot forearm.
(In case of spot welding specification, mounting tap is restricted because joint box is mounted.)

【Standard specification】



【Spot welding specification】




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

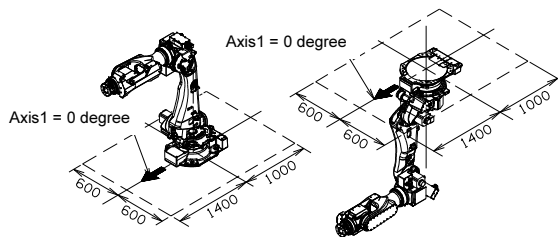
To install the robot, give it first priority to thoroughly consider safety of workers and take safety measures. The following describes precautions for this purpose.

Safety measures against entry in the robot operating area

 <p>WARNING</p>	<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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■ Space surrounding robot

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



■ 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.

【SRA220H-01】

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.

【SRA220HV-01】

Repair uneven spots, cracks, and others on the floor, and then install the robot under hanger. If hanger can not endure the generated force and floor concrete is not enough to endure the hanger, an independent foundation should be constructed. Inspect the foundation prior to the robot installation.

When installing this robot, please utilize “turning over fixture” option.

Robot Model	SRA220H-01	SRA220HV-01
Thickness of floor concrete	Not less than 160 mm	--- *4
Installation parts *1	8 bolts of M20 (JIS: Strength class 12.9) not less than 65mm 8 plain washers of not less than 4.5 mm in thickness and HRC35 in hardness	
Tightening torque *2	560 ± 30 N·m	
Allowable repeated tensile *3	Approximately 30,000 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.

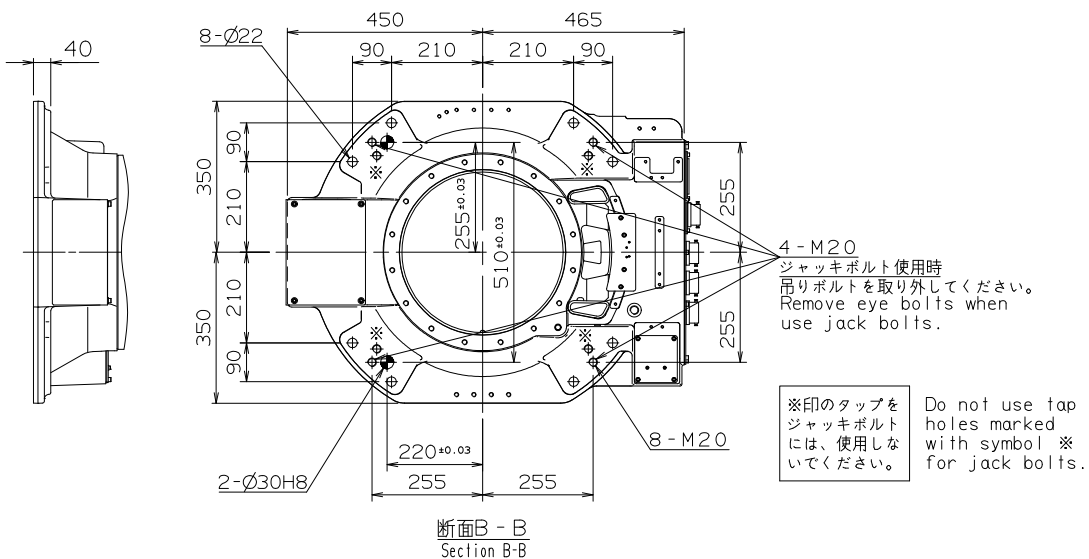
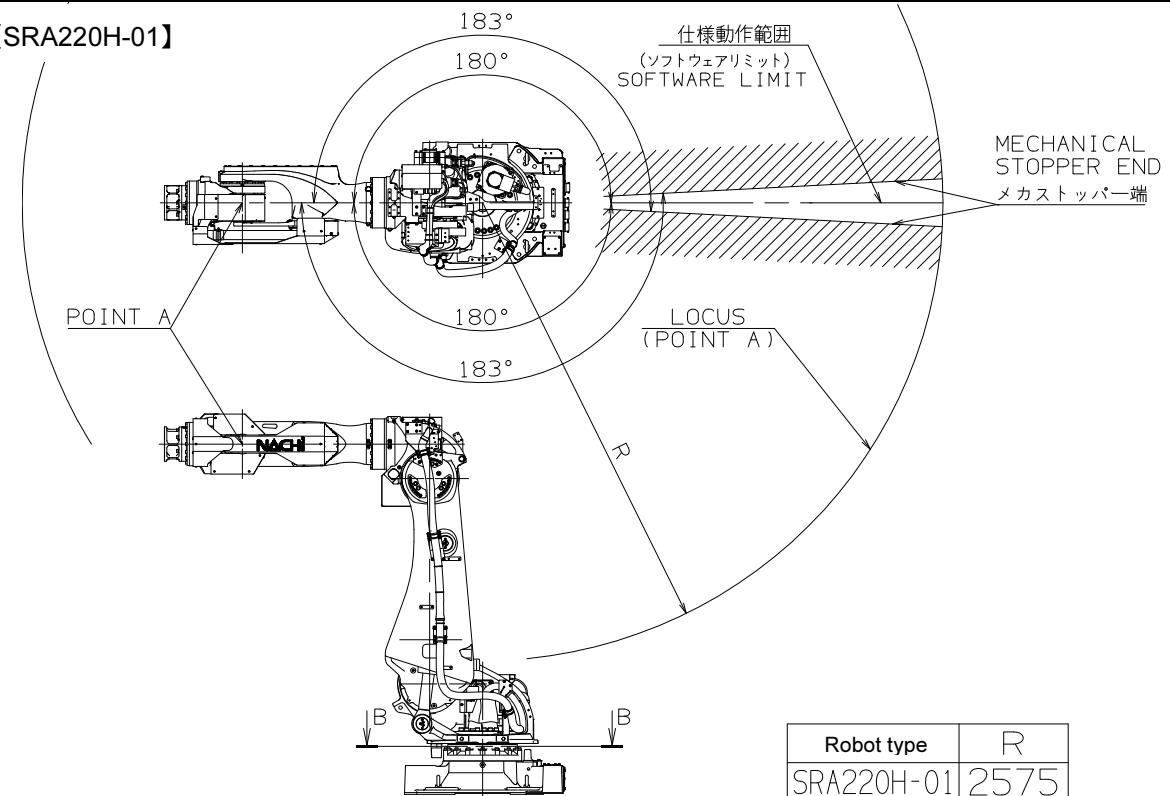
*4 : Inverted type robot can not be installed on floor.

■ 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 effector.
 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 be kept. Mechanical stopper and reduction gear of collided joint are needed to be replaced to the new one.

【SRA220H-01】



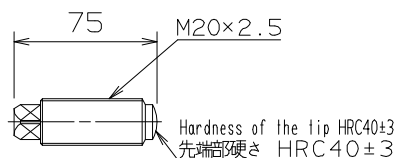
■ Accuracy of installation surface

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.

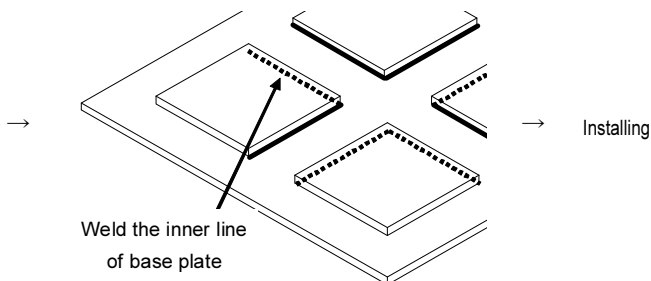
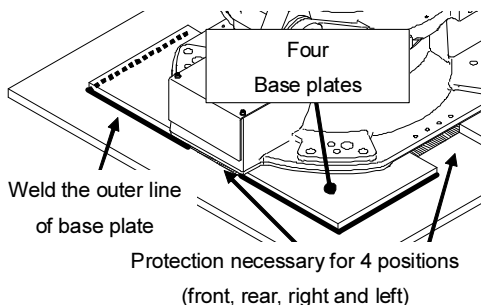


■ Welding of base plate

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.

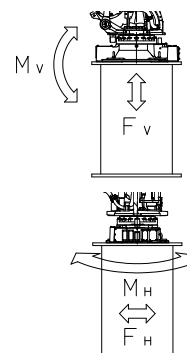
Temporary install the robot, and weld the outer line of base plate.

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
SRA220H-01 SRA220HV-01	56,300 N	43,700 N	122,000 N·m	106,300 N·m



6. Allowable wrist load

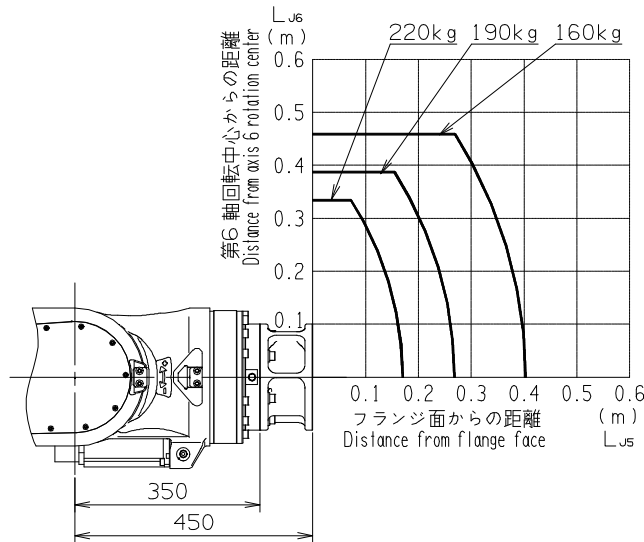


Load fixed on the tip of wrist is regulated by “allowable payload mass”, “allowable static load torque”, and “allowable moment of inertia”. Strictly keep the wrist load within each allowable value. If wrist load exceeds the allowable value, this robot is out of guarantee. Refer to the table of “2. Basic 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.

【SRA220H-01】
【SRA220HV-01】



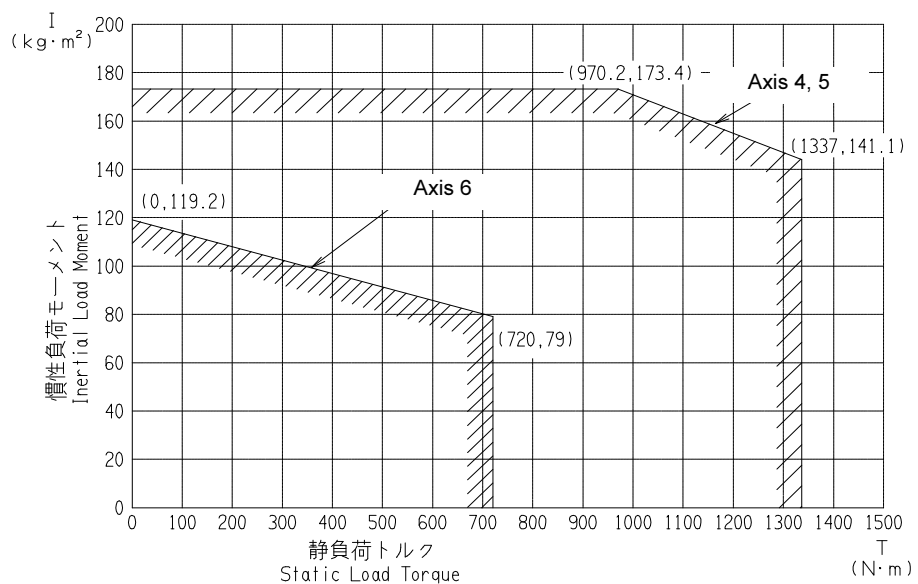
■ Wrist load conditions

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

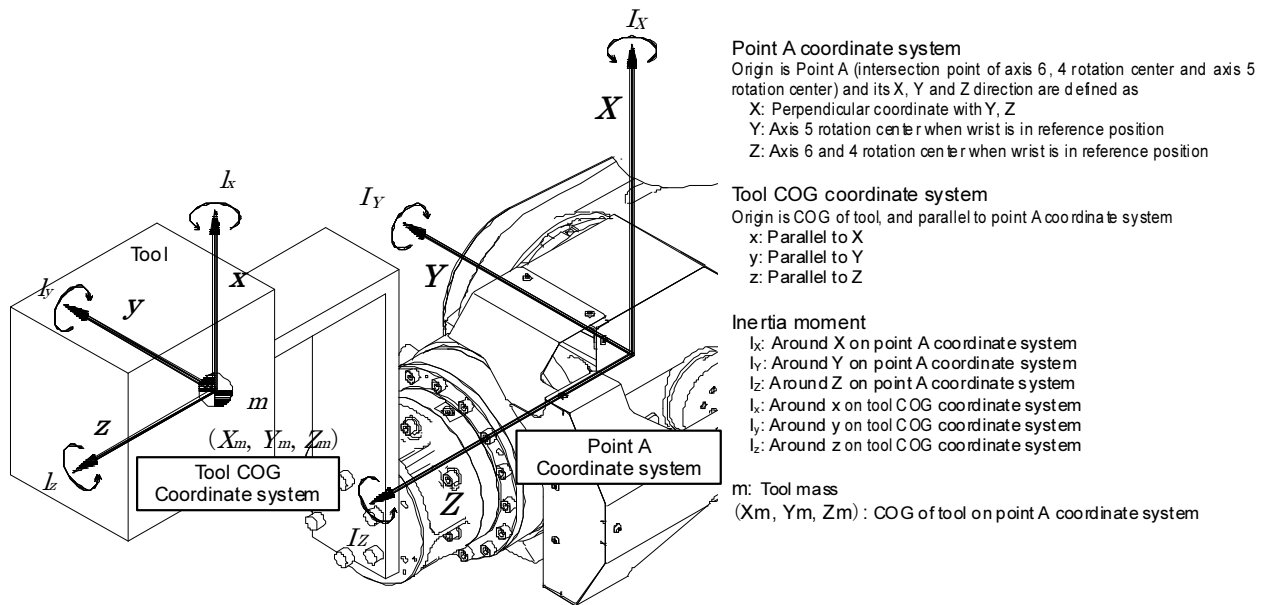


If the real inertia is over the limit written in “2. Basic specifications”, maximum speed will be restrained by software.

【SRA220H-01】
【SRA220HV-01】

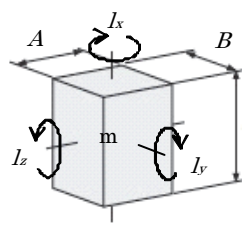


■ How to find the inertia moment of each axis



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

Inertia moment example on tool COG coordinate system



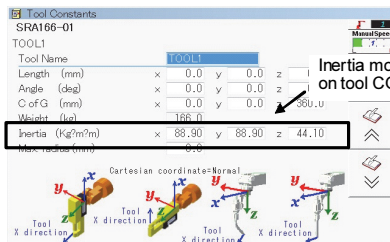
If tool is regarded as prism

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

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

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

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



Inertia moment on tool COG coordinate system
 This is different from "allowable moment of inertia" written in robot specification sheet.

2 Calculate inertia moment defined on point A coordinate system (XYZ), then calculate inertia moment around robot wrist joint (axis 4, 5 and 6).
 This result must not be larger than "Allowable moment of inertia" written in robot specification sheet.

Inertia moment on point A coordinate system (XYZ) is

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

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

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

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

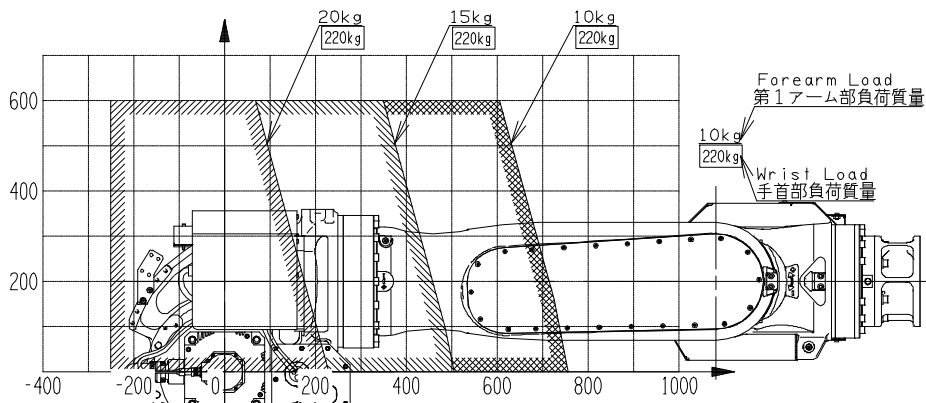
$$I_{J4} = I_{J5} = \max(I_X, I_Y)$$

$$I_{J6} = I_Z$$

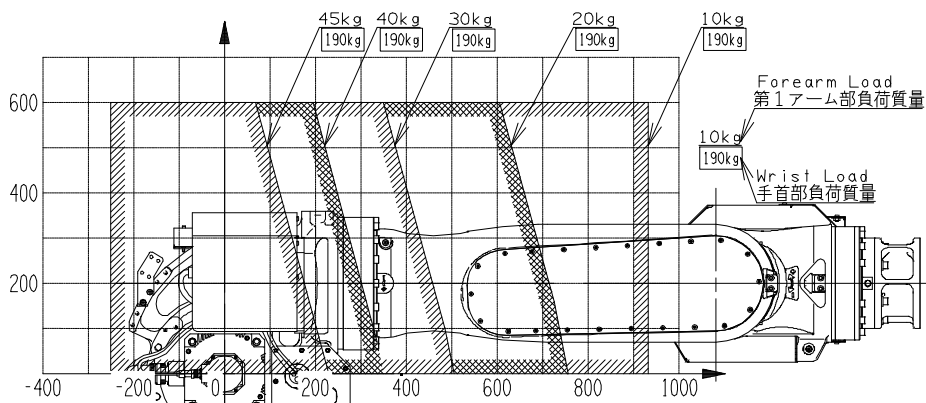
■ Allowable forearm load

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

【SRA220H-01】
【SRA220HV-01】
When wrist load is 220kg



【SRA220H-01】
【SRA220HV-01】
When wrist load is 190kg



7. Option specifications

○: Possible to correspond / -: Impossible to correspond

No.	Item	Specifications	Parts No.	Robot model	
				SRA220H-01	SRA220HV-01
1	Installation parts *1	Chemical anchor specification with pin hole	OP-F1-024	○	-
		Base plate welded (anchors not included) without pin hole	OP-F1-028	○	-
		Hammer drive anchor specification with pin hole	OP-F2-018	○	-
		Base plate welded (anchors not included) without pin hole	OP-F2-019	○	-
		Pins set (Installation pins & polyethylene plug)	OP-F1-025	○	-
		Leveling plate (□200mm×t=32mm, 4 plates)	OP-F1-026	○	-
		Installation bolts & washers	OP-F1-027	○	○
		Inverted mount Pins set (Installation pins)	OP-F5-003	-	○
		Inverted mount Leveling plate (□250mm×t=32mm, 4 plates)	OP-F5-002	-	○
		Inverted mount Protection block from falling down *5	OP-F5-004	-	○
		Chemical anchor	OP-F1-038	○	-
Hammer drive anchor	OP-F2-023	○	-		
2	Axis 1 adjustable stopper *1, *2, *3	Restriction of axis 1 operation edge (±2.61rad~±0 rad every 0.017 rad)	OP-S5-019	○	-
		Restriction of axis 1 operation edge (±2.35rad~±0 rad every 0.017 rad)	OP-S5-020	-	○
3	Axis 2 adjustable stopper *1, *3	Restriction of axis 2 operation edge (-0.26 and -0.52 rad from the operation edge)	OP-A5-027	○	○
4	Axis 2 adjustable stopper *1, *3	Restriction of axis 3 operation edge upper limit (-0.52rad, -0.79rad, -1.05rad, -1.31rad, -1.57rad from the operation edge)	OP-A6-027	○	○
5	Axis 2 adjustable LS *1, *3	Dog set for axis 2 adjustable LS	OP-S8-007	○	○
6	Axis 3 adjustable LS *1, *3	Dog set for axis 3 adjustable LS	OP-S4-013	○	○
7	Dual circuit limit switch	For axes 1, 2 and 3 (3pcs. of dual circuit LS)	OP-D7-013	○	-
			OP-D7-016	-	○
8	Transfer jig	Folk bracket	OP-S2-033	○	○
		Inverted mount Turning over fixture	OP-S7-009	-	○
		Inverted mount Axis 2 fixing jig *6	OP-S9-008	-	○
9	Zeroing pin & Zeroing block *1		OP-T2-077	○	○
10	Encoder connector Protector	For axis 3	OP-P6-005	○	○
11	Connector protection cover	Cable connection at BJ1 box and BJ3 box	OP-E7-007	○	○
12	Bypass cable *1		BCUNIT20-30	○	○
13	Arm fixed jig *1	For axis 2	KP-ZD-005	○	○
		For axis 3	KP-ZJ-088	○	○
14	Gas balancer unit Pressure gauge *1	Analog pressure gauge	KP-ZJ-013	○	○
		Digital pressure gauge	KP-ZJ-014	○	○
15	Gas balancer unit Charging equipment *1 *4	Charging unit (W22, pitch14, Female)	KP-ZJ-015	○	○
		Charging unit (W23, pitch14, Male)	KP-ZJ-016	○	○
		Joint of Female->Male (W22)	KP-ZJ-019	○	○
		Analog pressure gauge	KP-ZJ-015	○	○

*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.

*4: If diameter of charging equipment is "W22, pitch14, Female, Right screw, Metal contacts", please prepare the charging equipment "KP-ZJ-015" and the joint "KP-ZJ-019".

*5: Inverted mount protection block must be ordered with leveling plate OP-F5-002 together.

*6: This is used to fix axis 2 in order to transfer robot safely.

If there is height limit in customer's plant, this jig can make robot posture lower by changing axis 2 angle not to +134°.

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

Function		Axis name	Motion range Limit Switch (dual circuit) 3pcs. set	Axis 1 adjustable stopper (including dog part for adjustable LS)	Axis 2 Adjustable LS dog part set	Axis 3 Adjustable LS dog part set	Axis 2 Adjustable stopper	Axis 3 Adjustable stopper
			OP-D7-013 ----- OP-D7-016	OP-S5-019*1 ----- OP-S5-020*1	OP-S8-007*1	OP-S4-013*1	OP-A5-027*1	OP-A6-027*1
Without LS	Only adjustable stopper	Axis 1	—	● *2				
		Axis 2	—			●		
		Axis 3	—					●
Dual circuit Limit Switch	Motion range Limit Switch	Axis 1·2·3 (3 pcs.set)	●					
	Adjustable LS	Axis 2	●		●			
		Axis 3	●			●		
	Adjustable stopper and Adjustable LS	Axis 1	●	●				
		Axis 2	●		●		●	
		Axis 3	●			●		●

*1 : These parts are packed separately from the robot. (Not attached on the robot)

*2 : In this option, 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)

(Example 1) To add only an adjustable stopper for axis 2, please order;
OP-A5-027.

(Example 2) To add dual circuit adjustable limit switch for axis 2 and 3, please order the following options.
OP-D7-013、OP-S8-007、OP-S4-013

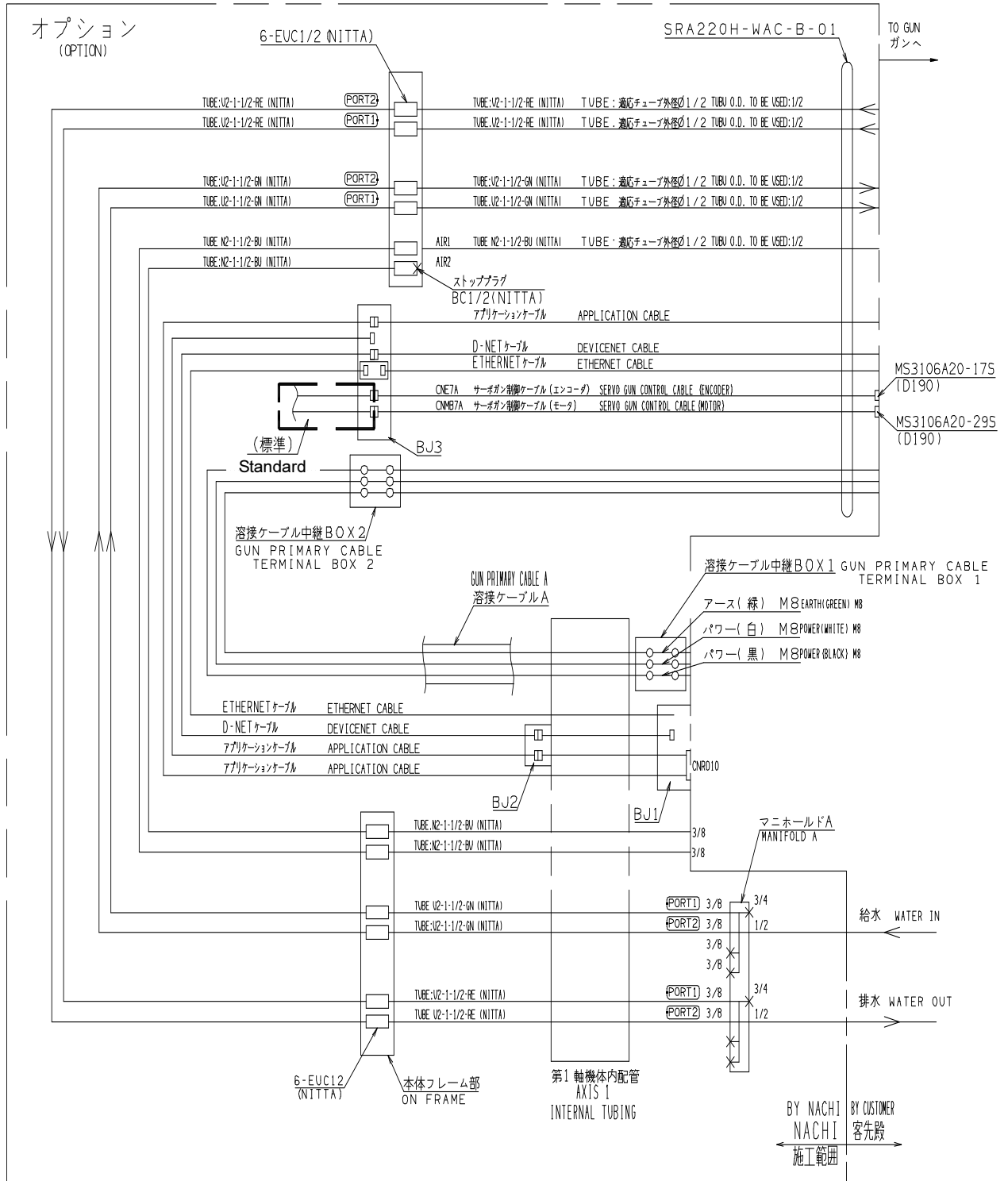
(NOTE) To use the limit switch for axis 1 as an adjustable limit switch, OP-S5-019 is also necessary.

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.

8.1 Spot welding specification 1



Connecting diagram

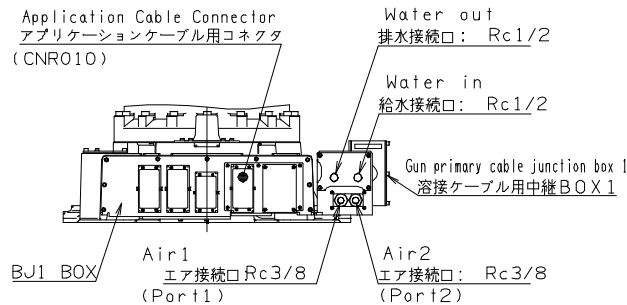
Tool side wiring specification

No.	Name	Item	Specification	Edge manufacturing
1	Spot welding specification	Cable	•Welding cable 38mm ² (single wire) x3	No manufacturing
			•Signal cable 0.2mm ² x20 wires	No manufacturing
			•D-ET cable	No manufacturing
			•ETHERNET cable	No manufacturing
			•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) φ 12.7 x φ 9.56 - 2 •Water outlet tube: Red(*1,*2) φ 12.7 x φ 9.56 - 2 •Air tube: White(*1,*3) φ 12.7 x φ 9.56 - 1	Tube type: For water U2-1-1/2 For air N2-1-1/2 Recommended joint : 1/2 inch One touch joint (*1)

*1) Joint is not included.

*2) Water pressure is 0.2MPa or lower.

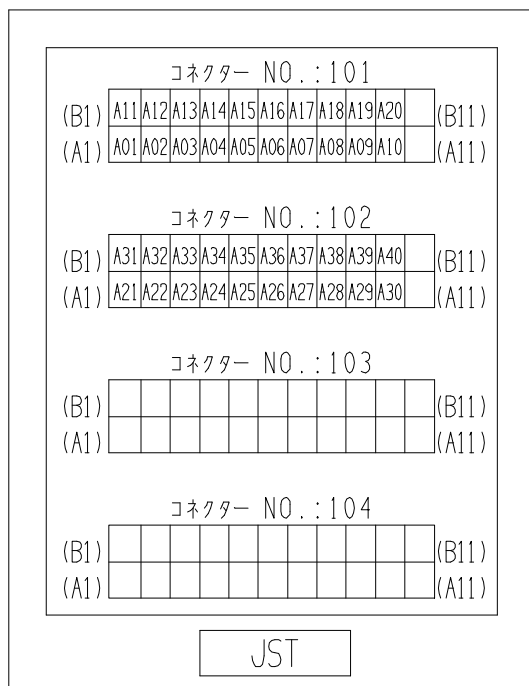
*3) Air pressure is 0.49MPa or lower.



Application wires and tubes at base frame

■ Detailed diagram of the application connectors

BJ1 side (connector)



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

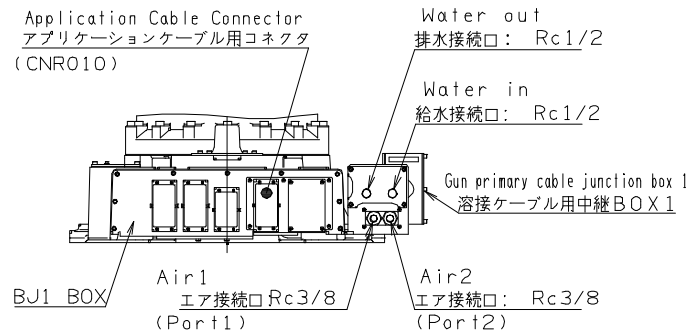
Tool side wiring specification

No.	Name	Item	Specification	Edge manufacturing
1	Spot welding specification	Cable	•Welding cable 22mm ² (single wire) x3	3-M8 terminal
			•Signal cable 0.2mm ² x20 wires	No manufacturing
			•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) φ 12 x φ 8 - 2 •Water outlet tube: Red(*1,*2) φ 12 x φ 8 - 2 •Air tube: White(*1,*3) φ 12 x φ 8 - 1	Tube type: TE-12-AF Recommended joint : One touch joint forφ12 (*1)

*1) Joint is not included.

*2) Water pressure is 0.2MPa or lower.

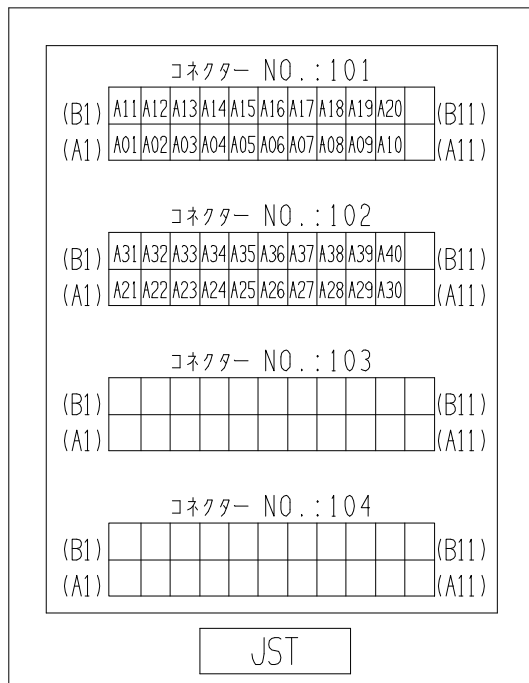
*3) Air pressure is 0.49MPa or lower.



Application wires and tubes at base frame

■ Detailed diagram of the application connectors

BJ1 side (connector)



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 φ 26.2~φ 28.0

JFM-WSA-4-C φ 15.5~φ 16.5

(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

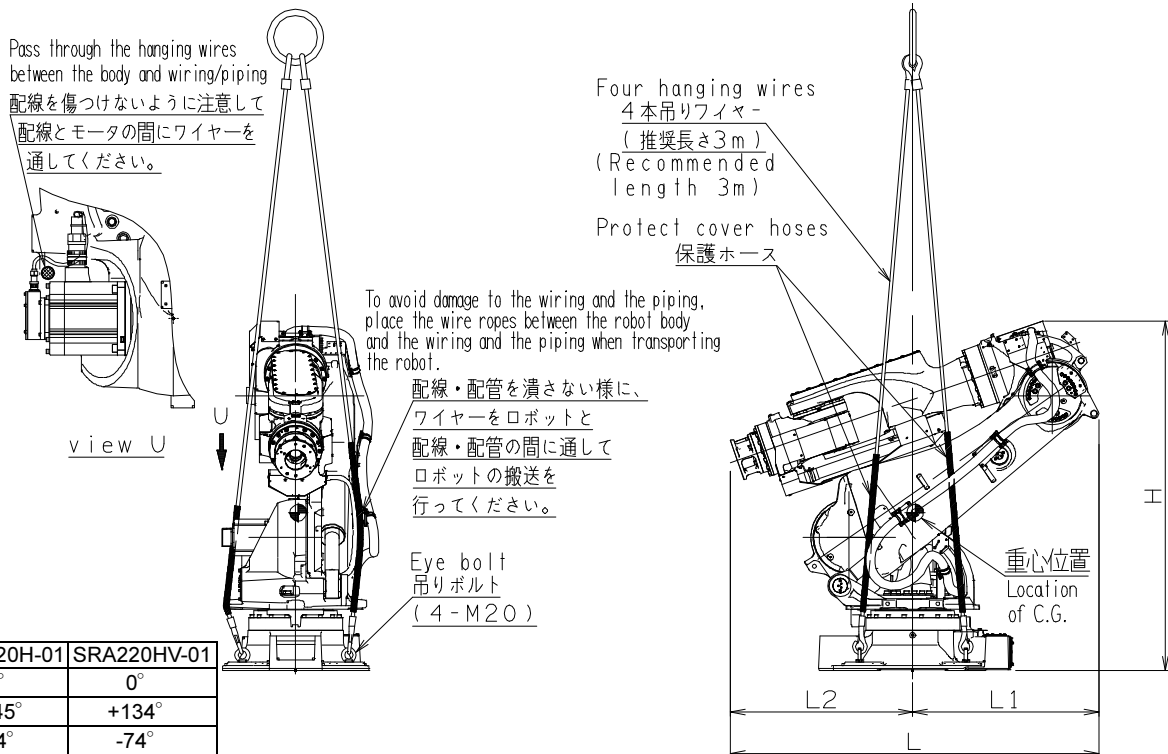
9. Safety measures against transport

The following describes precautions for transporting the robot. Fully understand the precautions for safe transport work.

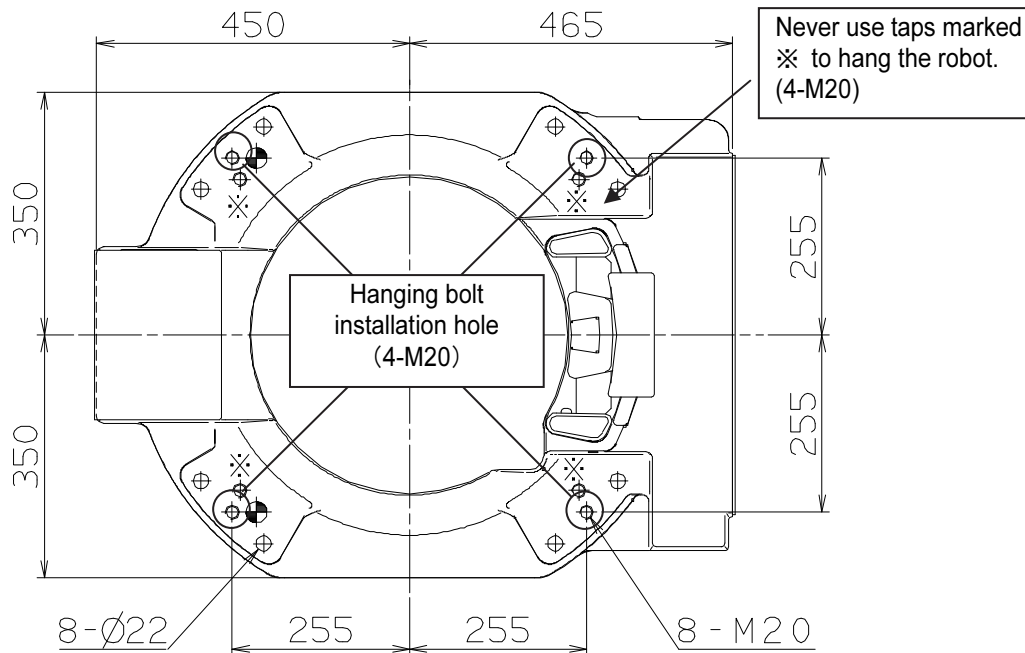
 WARNING	The robot must be transported by personnel who have licenses required for slinging work, crane operation, forklift truck operation, and others. The weight of the robot and controller is listed in the Operating Manual and the Maintenance Manual. Check for the weight, and then handle them according 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.
 WARNING	Gas in balancer must be released 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.

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

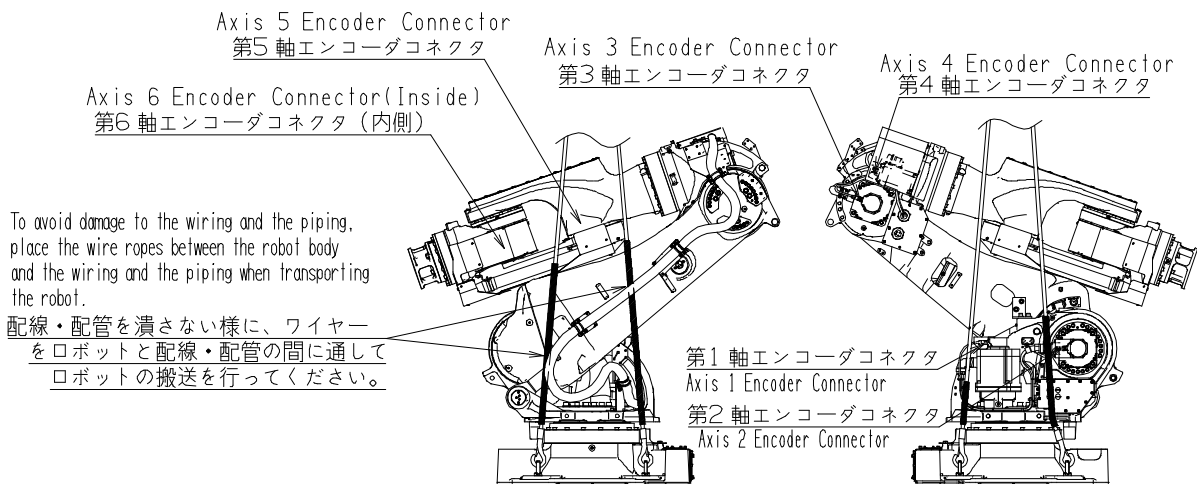
At first, put the robot into the configuration shown in figure below and mount the four M20 hanger bolts to the swivel base. Then, be sure to lift the robot using four hanging wires. For this purpose, it is recommended to use hanging wires of 3 m in length and protect areas that contact the robot, using rubber hoses to cover the wire ropes. For the areas to be covered with the rubber hoses refer to figure below.



	SRA220H-01	SRA220HV-01
Axis 1	0°	0°
Axis 2	+145°	+134°
Axis 3	-74°	-74°
Axis 4	-90°	-90°
Axis 5	0°	0°
Axis 6	+90°	+90°
L	1766mm	1709mm
L1	892mm	756mm
L2	874mm	953mm
H	1681mm	1839mm



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.



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