
User Manual

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PREFACE

Before using the robot, be sure to read the STEP robot user manual carefully and operate the robot based on your understanding of the contents.

Key points

This user manual systematically explains the installation, use, function parameter setting, and maintenance of the SA6/1440H robot. This manual can be used as a reference for system integrators to design user workstation systems using our company's SA6/1440H robot and can also be used as a reference for system installation, debugging, and maintenance.

To ensure the correct installation and use of the SA6/1440H robot, please read this instruction manual carefully before use.

Target audience

- System Integrator
- On-site technical support staff
- Equipment maintenance personnel
- After-sales service staff

Contents

The contents of this manual may be supplemented and modified. Please pay attention to our company's website and update the manual regularly.

Our company's official website: www.stepelectric.com.

Main Features

- a) Small size;
- b) Large working space;
- c) Lightweight;
- d) Fast operation speed;
- e) High repeatability and positioning accuracy;
- f) Strong welding stability.

Safety marking

This instruction manual contains relevant precautions to ensure the personal safety of the operator and prevent damage to the robot system, and is described as "Danger", "Caution", and "Important" according to their importance in safety. Before operating the robot, the user must be familiar with these markings and strictly abide by them.

Improper use may cause dangerous situations that may result in personal injury or death.

Improper use may cause danger and may result in minor or serious personal injury and equipment damage.

The parts that users need to comply with and pay special attention to.

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Version Revision Notes

Version Number	describe	time	Revised by
V1.0	Added	2024.04.30	LY
V2.0	Optimize the entire file	2024/06/01	LY
V3.0	Detailed dimensions of the base and drive housing	2024/10/31	LY
V3.1	Increase the permitted altitude, etc.	2024/11/14	LY
V4.0	Optimize lifting method	2025.03.14	LY
V4.1	Overall optimization (Chinese characters on the picture are replaced by letters)	2025.04.02	LY

Chapter 1 Instructions for Use

1.1 Scope of application

It is mainly used in arc welding, handling, stacking, packaging, assembly, grinding and polishing, etc., which completely or partially replace manual work.

1.2 Security Overview



- ◎ Electrical or mechanical debugging and maintenance of industrial robots are only allowed to be performed by professional personnel, and all personnel working on the robots must receive training on the use of the robots.
- ◎ Incorrect installation (e.g. overloading) or mechanical damage (e.g. brake failure) can cause the robot or external axes to sink. If work is to be done on a switched-off robot system, the robot and external axes must first be moved to a state where they cannot move on their own, whether under load or without load. If this is not possible, the robot and external axes must be secured accordingly.
- ◎ During maintenance, especially after replacing the motor, driver, or battery, the robot must be reset to zero before it can automatically run the program, otherwise accidents may occur.



- ◎ Please pay attention to the axis of rotation of the robot body. Keep a distance from the axis to prevent hair or clothing from being entangled. Also, be careful of any dangers that may be caused by rotating tools or other devices installed on the robot or in the cell.
- ◎ Do not, under any circumstances, stand underneath any axis of the robot!
- ◎ Electrical or mechanical debugging and maintenance of industrial robots are only allowed to be performed by professional personnel, and all personnel working on the robot must read and understand the instructions for the robot system safety content.
- ◎ If you are disassembling the control system immediately after it stops running due to power failure, you must wear protective gloves to avoid burns caused by excessive temperature on the radiator surface or motor.
- ◎ When replacing the battery, be careful to avoid short circuiting the positive and negative poles of the battery.



- ◎ Maintenance and servicing must be performed in accordance with the operating instructions, and relevant instructions must be read carefully before operation. This process is generally performed by professionals.
- ◎ The emergency stop button is a safety device used in emergency situations. It is strictly prohibited to use it frequently and without purpose, which will affect the service life of robot-related components (motor brake, etc.). In particular, it is prohibited to arbitrarily and repeatedly turn off the emergency stop button during high-speed operation of the robot.
- ◎ During maintenance, the access switch may be temporarily short-circuited, but it is strictly forbidden to work on live parts of the control system at this time to avoid accidents.

1.3 Unpacking and Inspection



- ◎ Visually inspect the robot to ensure that it is not damaged. Do not install a damaged robot or one that is missing parts, otherwise there is a risk of major accidents and personal injury.
- ◎ Before moving the robot, please check the stability of the robot to avoid the danger of tilting.
- ◎ Cable packaging is susceptible to mechanical damage. Cable packaging must be handled with care, especially connectors, to avoid damaging the cable packaging.
Otherwise the robot cannot operate normally.

When unpacking, please carefully check whether there is any damage during transportation; whether the model and specifications on the nameplate of the machine are consistent with the order requirements. If you find that the model does not match or components are missing, please contact the manufacturer or supplier as soon as possible.

Unpacking list:

1. Robot body;
2. Control cabinet;
3. Teaching pendant;
4. Interdisk line;
5. USB flash drive.

1.4 Usage Environment



- ◎ When the robot works in an abnormal environment, it may cause equipment damage.

The robot's working environment is 0°C ~45°C and without direct sunlight.

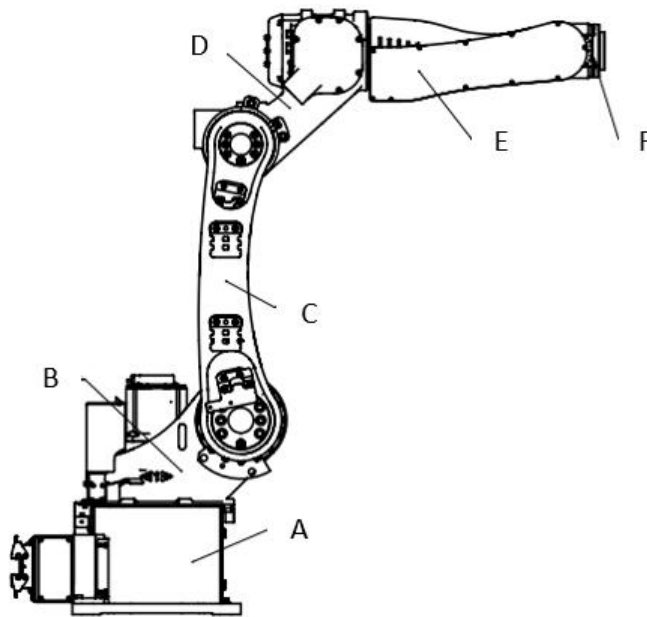
The robot can be used normally in an environment of 10°C~45°C; in an environment of 0°C~10°C, the robot needs to be preheated (run at a low speed for more than 5 minutes) before it can be used normally. It is not recommended to use the robot in an environment below 0°C and above 45°C; otherwise, the equipment may be damaged.

Chapter 2 Technical Parameters

2.1 Robot body structure diagram

The SA6/1440H robot is compact, small and light. It is a dedicated arc welding robot that can achieve stable welding, obtain highly accurate welding paths, shorten welding cycles, and extend the life of pipes and cables. At the same time, the SA6/1440H robot can flexibly perform welding operations in a small space, and the installation method can be selected as ground installation, hanging installation, and inverted installation.

The SA6/1440H wrist has a rated load of 6kg and a maximum working radius of 1475mm. It has the characteristics of small size, light weight, fast running speed, high repeatability, and strong welding stability. The robot body is shown in Figure 2.1.



A	Base
B	Rotating seat
C	Upper arm
D	Forearm drive box
E	forearm
F	wrist

Figure 2.1 SA6/1440H robot body structure

2.2 Robot mechanical parameters

The mechanical parameters of the SA6/1440H robot are shown in Table 2-1.

Table 2-1 Mechanical parameters of SA6/1440H robot

model	SA6/1440H
Degrees of Freedom	6
Maximum load weight (wrist joint)	6kg
Maximum working radius	1475mm
Weight	165kg
Installation	Bottom, wall mount, inverted

Drive mode	AC drive
Repeat positioning accuracy	±0.05mm
noise	<80dB(A)
Operating temperature	0°C ~45°C
Transport and storage temperature	-25°C ~55°C
humidity	≤75%RH (95%RH in short term) without condensation
Allowed altitude	Below 1000 meters (please consult us if it exceeds)
vibration	≤4.9m/s ²
IP protection level of the robot	IP54
IO	16DI/16DO
trachea	1-Φ6, 1-Φ8

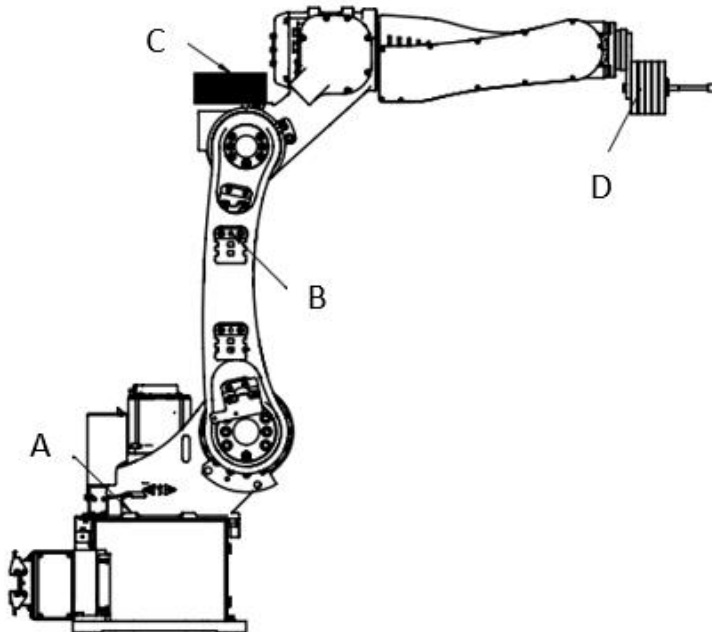
2.3 Robot load parameters

The load parameters of SA6/1440H robot are shown in Table 2-2.

Table 2-2 SA6/1440H robot load parameters

Robot Model	Wrist joint load (kg)	Drive housing load (kg)	Boom load (kg)	Rotating seat load (kg)
SA6/1440H	6	10	10	20

The load position of the SA6/1440H robot is shown in Figure 2.2.



A	Rotating seat load
B	Boom load
C	Drive housing load
D	Wrist load

Figure 2.2 SA6/1440H robot load position diagram

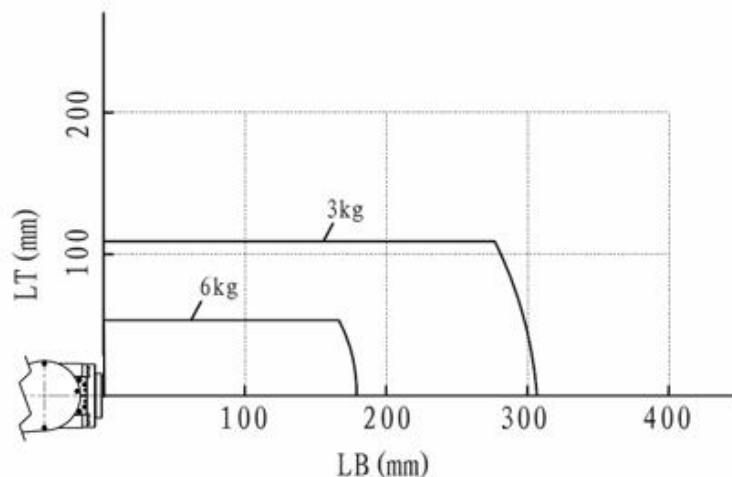


Figure 2.3 SA6/1440H robot load curve

2.4 Robot motion parameters

The joint motion parameters of the SA6/1440H robot (wrist load 6kg) are shown in Table 2-3.

Table 2-3 Joint motion parameters of SA6/1440H robot

		Specification
	J1	260°/s
	J2	240°/s
	J3	260°/s
	J4	470°/s
	J5	396°/s
	J6	720°/s
	J1	±165°
	J2	+155°~-90°
	J3	Handling conditions: +78°~-165° Welding conditions: +78°~-90°
	J4	±190°
	J5	±130°
	J6	Handling conditions: ±360° Welding conditions: ±220°
	J4	11.8 N·m
	J5	9.8 N·m
	J6	4.2 N·m
	J4	0.6 kg·m ²
	J5	0.25 kg·m ²
	J6	0.06 kg·m ²

The schematic diagram of the joint movements of the SA6/1440H robot is shown in Figure 2.4.

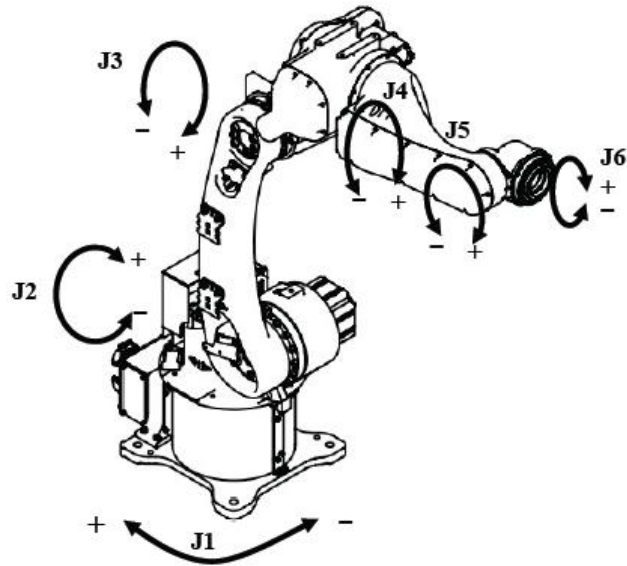
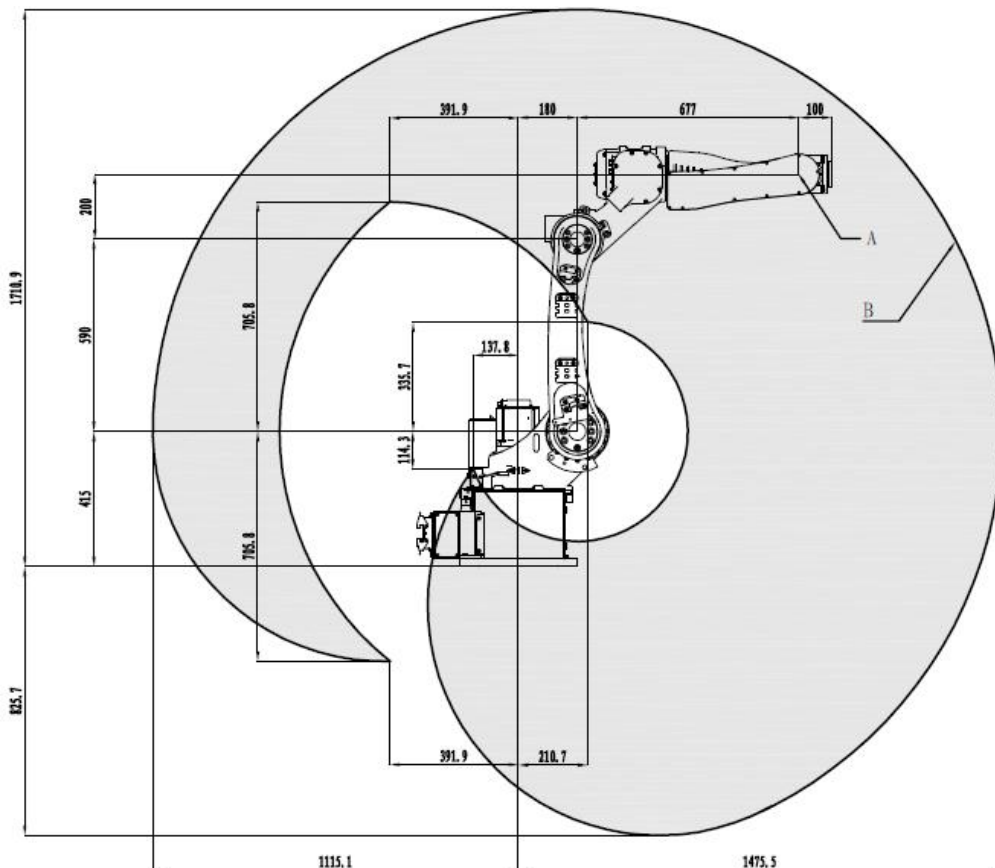


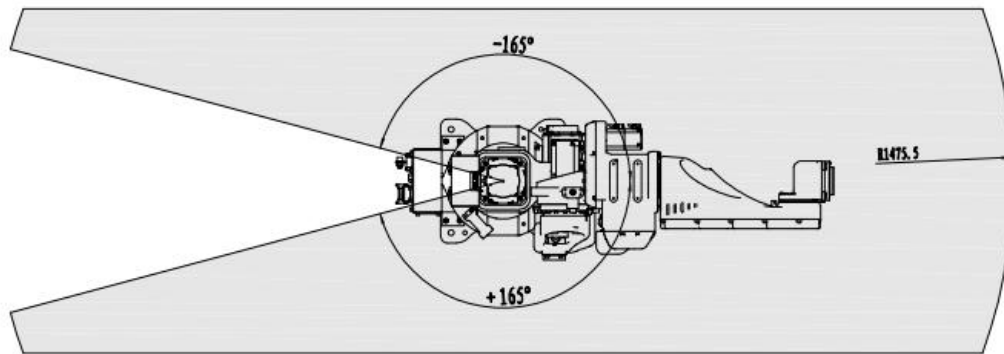
Figure 2.4 Schematic diagram of the joint movements of the SA6/1440H robot

2.5 Robot workspace

This workspace reflects the zero point and operating range of the mechanical system, which is slightly different from the definition in the control system manual. When the user operates the robot, it must be based on the definition in the control system manual, otherwise the system will report an error.

The workspace of the SA6/1440H robot is shown in Figure 2.5. Mechanical CAD format drawings can be downloaded from the official website of STEP: www.stepelectric.com.





A	Point P
B	P point motion range

Figure 2.5 SA6/1440H robot workspace

Chapter 3 Transportation and Installation

3.1 Transportation

The robot needs to be transported by a forklift. When transported by a forklift, two fork slots need to be installed on the robot base. The fork slots are accessories of the robot equipment. During each transportation, please ensure that the fork slots are securely installed and the robot must be adjusted to the transport posture.

The transfer posture of the SA6/1440H robot is shown in Figure 3.1.

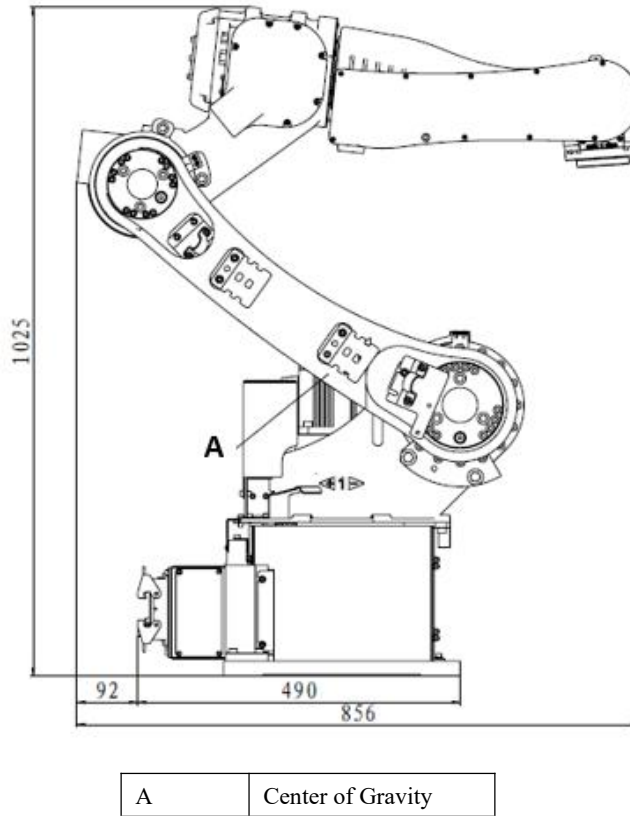


Figure 3.1 SA6/1440H robot transfer posture diagram

When the SA6/1440H robot is in the transport posture, the angles of each joint are shown in Table 3-1.

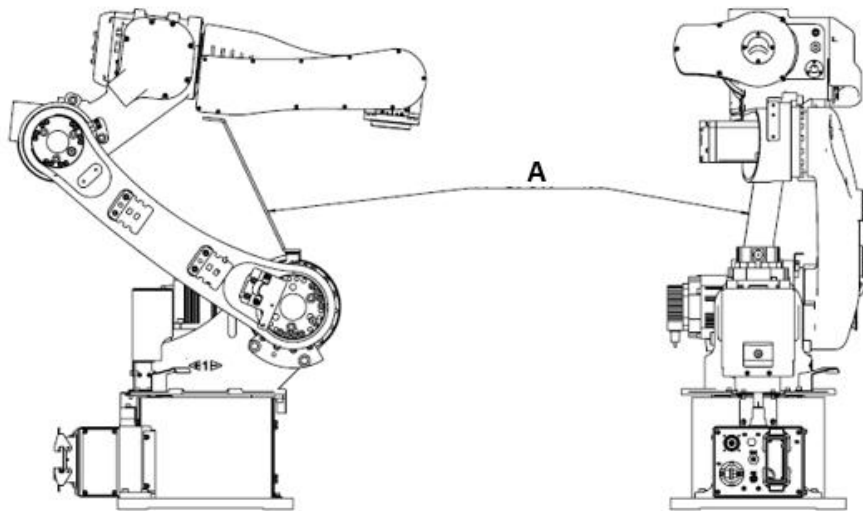
Table 3-1 Joint angles of SA6/1440H robot

joint	Angle (°)
J1	0
J2	-55
J3	+61
J4	0
J5	+80
J6	0

The instructions for use of the SA6/1440H transfer support tooling are shown in Figure 3.2.

The SA6/1440H lifting schematic diagram is shown in Figure 3.3.

Figure 3.2 SA6/1440H robot forklift handling diagram



A	Transfer support tooling
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Figure 3.2 Schematic diagram of

SA6/1440H robot transfer tooling

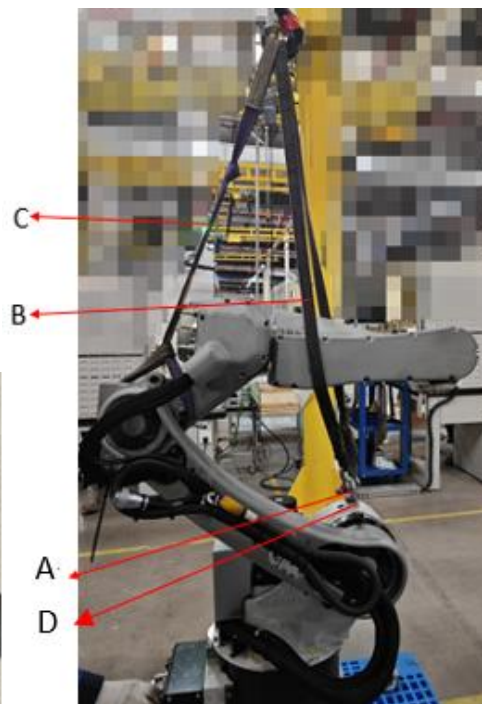
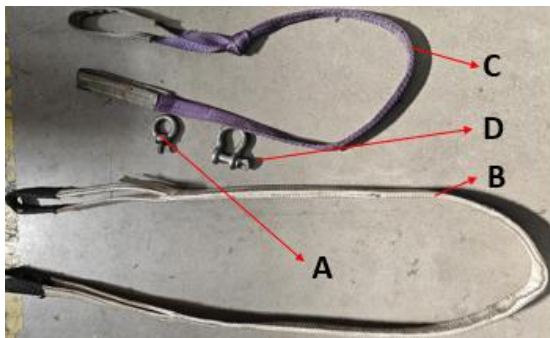




Figure 3.3 Schematic diagram of SA6/1440H robot lifting tools and lifting methods

Lifting tools:

1. Two lifting straps B (2M long) and C (1.5M long)
2. A: M12 lifting eye screw
3. D: Bow lifting shackle

Hoisting steps and precautions:

1. Install (A) M12 eyebolts;
2. Pass the lifting strap (B) through the eye screw using the bow lifting shackle (D) (note that the lifting strap needs to be distributed on both sides of the forearm assembly to maintain balance);
3. Pass the sling (C) around the three-axis drive housing to provide auxiliary support. Note that the position is as shown in Figure 3.3;

Note: Before lifting, add soft pads to the contact position between the forearm and the drive housing and the sling to prevent scratches on the robot surface during lifting;

3.2 Installation

3.2.1 Base load

There are three ways to install the robot: ground installation, inverted installation, and wall installation. If you need inverted installation or wall installation, please contact STEP technicians.

Figure 3.4 shows the directions of stresses in the robot, which are valid for all ground-mounted and suspended robots.

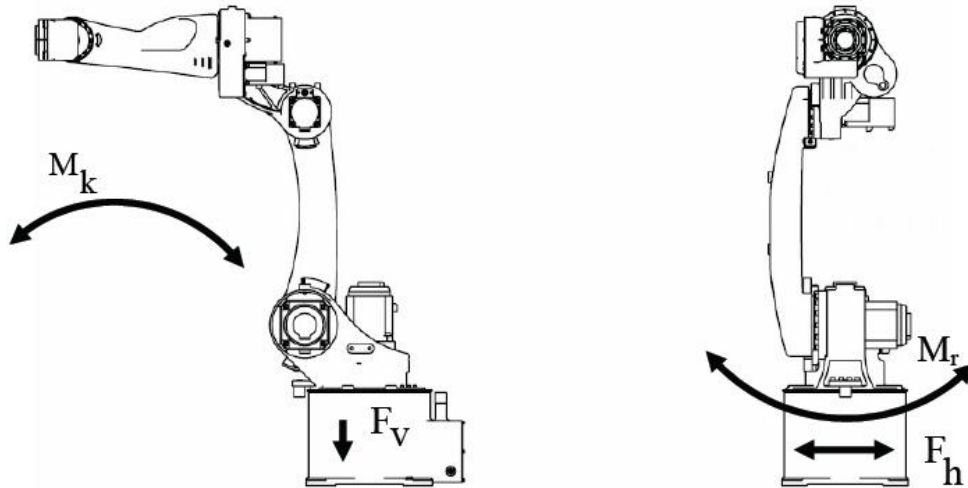


Figure 3.4 Stress direction of the robot

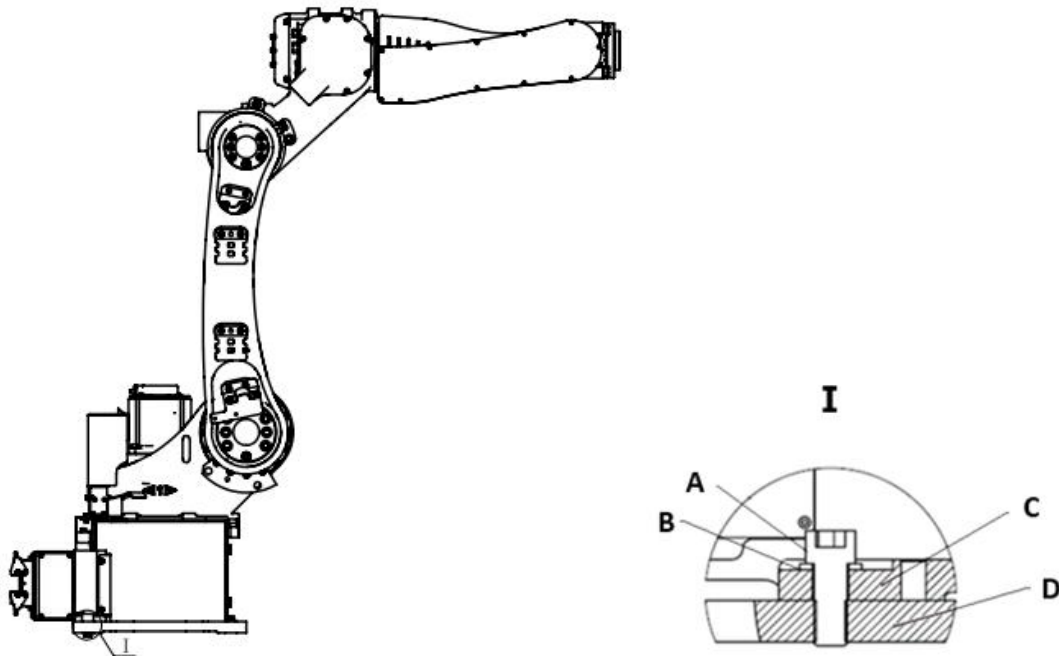
Among them: F_v --force in the direction vertical to the base; F_h --force in the horizontal direction; M_k --tilt bending moment; M_r --torque around the A1 axis.

Note: The following extreme values rarely occur during robot operation, and these values cannot reach the maximum value at the same time:

$$F_v=4500N; F_h=4800N; M_k=5200Nm; M_r=4200Nm$$

3.2.2 Base requirements

The requirements of the SA6/1440H robot for the base are shown in Figure 3.5. Use M16 screws to connect the robot base and the base. The thickness of the base plate must be no less than 20mm.



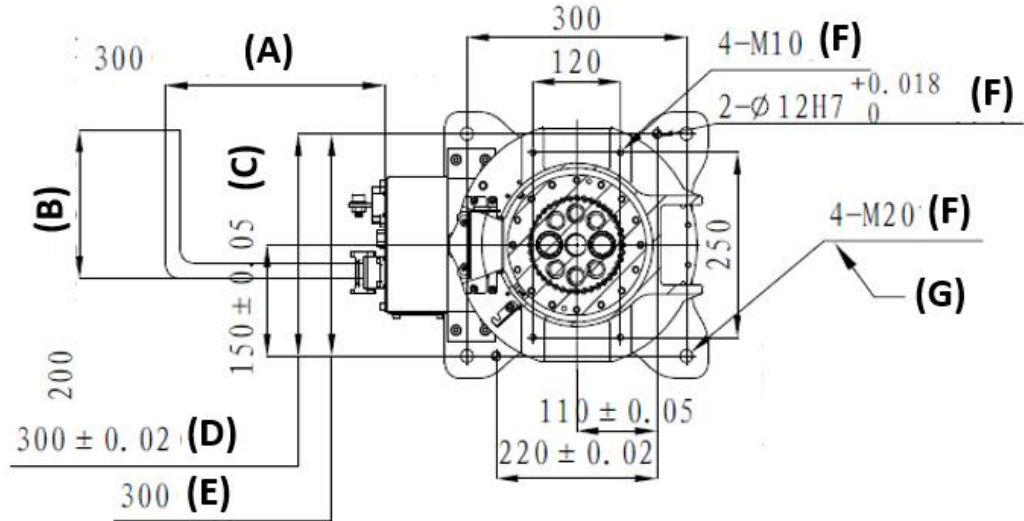
A	Hexagon socket head screw M16
B	Gasket
C	Robot base
D	The thickness of the bottom plate is not less than



Figure 3.5 SA6/1440H robot base requirements

3.2.3 Interface size

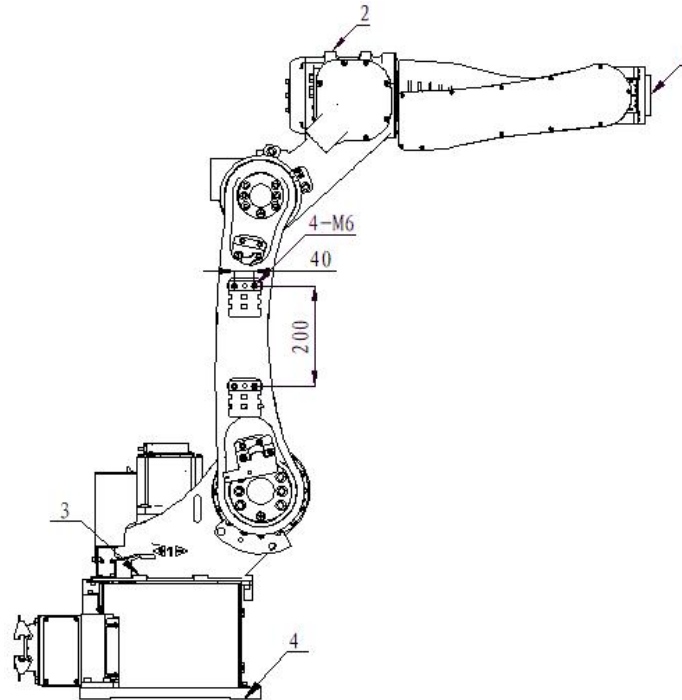
1、 The mounting hole dimensions of the SA6/1440H robot base are shown in Figure 3.6.



A	Cable avoidance safety distance
B	Cable avoidance safety distance
C	Pin hole
D	Pin hole
E	Threaded Hole
F	Run through
G	Note: The customer base uses M16 threaded holes, which are used with M16 full-thread screws. The body end threaded holes are M20 (minor diameter φ17.5mm)

Figure 3.6 SA6/1440H robot base mounting hole dimensions

2. The dimensions of the auxiliary mounting holes of the SA6/1440H boom are shown in Figure 3.7;



1 Tool flange interface; 2 Forearm drive box interface; 3 Rotating seat interface; 4 Base interface

Figure 3.7 SA6/1440H arm auxiliary mounting hole dimensions

3. The dimensions of the auxiliary mounting holes of the SA6/1440H forearm drive box and swivel seat are shown in Figure 3.8.

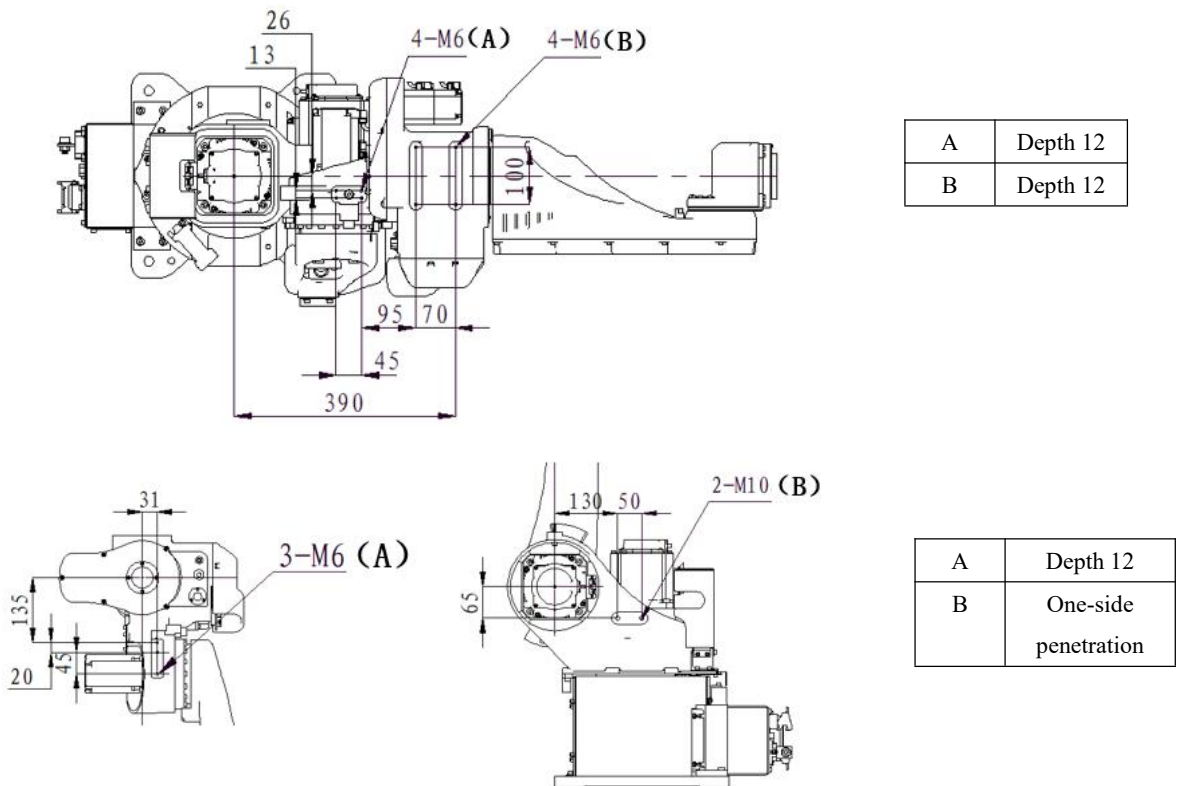


Figure 3.8 SA6/1440H forearm drive box and swivel seat auxiliary installation hole dimensions

4. The installation dimensions of the SA6/1440H tool flange are shown in Figure 3.9.

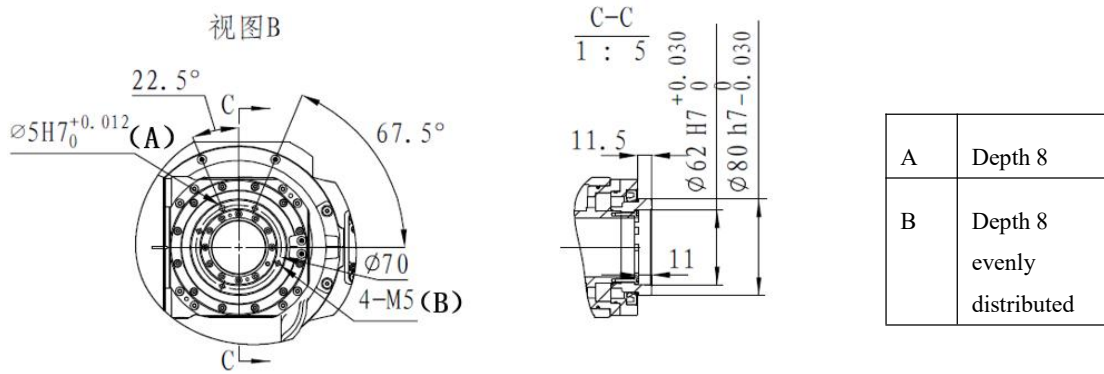


Figure 3.9 SA6/1440H tool flange installation dimensions

5. Hollow diameter dimensions of SA6/1440H four-axis and six-axis, as shown in Figure 3.10

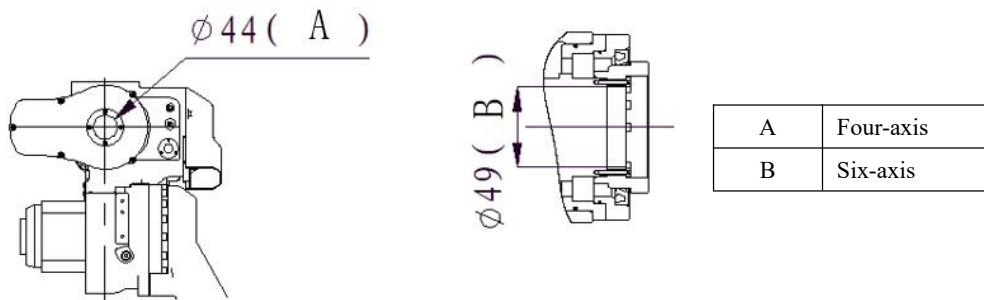


Figure 3.10 SA6/1440H four-axis and six-axis hollow diameter dimensions

6. SA6/1440H air pipe and IO interface are shown in Figure 3.11. Note: GAS is phi 8 air pipe, AIR is phi 6 air pipe, maximum air pressure is 0.8Mpa, R3 represents IO connector,

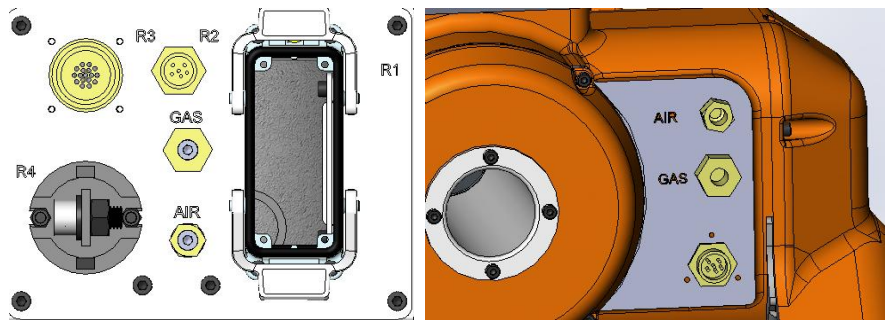


Figure 3.11 SA6/1440H air pipe and IO interface diagram

The schematic diagram of the IO connector is shown in Figure 3.12: The corresponding relationship of the IO connections is shown in the figure on the right.

Table 3-2 IO connection correspondence

At the base (R3)	Wrist	Remark
1	1	Customizable
2	2	Customizable
3	3	Customizable
4	4	Customizable
5	6	Customizable
6	6	Customizable
7	7	Customizable
8	8	Customizable
9	9	Customizable
10	10	Customizable
11	11	Customizable
12	12	Customizable
13	13	Customizable
14	14	Customizable
15	15	Customizable
16	16	Customizable

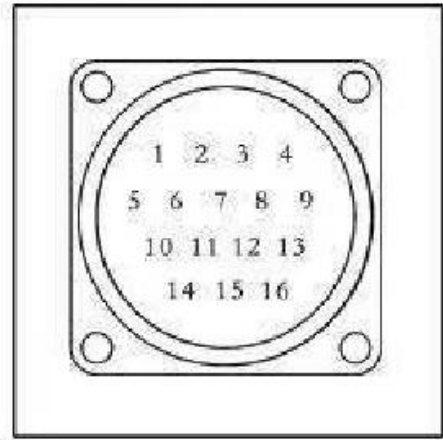


Figure 3.12 Schematic diagram of the IO connector of SA6/1440H

3.3 Safe use of robots

3.3.1 Methods for rescuing trapped persons - use of manual brake plate

1. Safety precautions:

When the robot has an abnormality (such as a workpiece stuck) and needs to release the motor brake manually, you can use the manual brake plate to achieve this. The robot's brake should be released manually when powered. Before releasing the brake, be sure to confirm the following safety matters:

- 1) How will the robot axes move after the brake is released?
- 2) Whether the robot's movement will pose a possible risk of injury to the operator.
- 3) What effects will the possible movements of the robot have on the stuck tool.
- 4) Whether the surrounding environment is safe and the operating range is sufficient.

Manually releasing the brake may cause personal injury or property damage. Perform this operation only when necessary and pay special attention to the above safety precautions. If necessary, use auxiliary devices such as lifting equipment and forklifts to protect the robot arm and prevent possible unexpected movement.

2. Manual brake release method

- 1) Find the location of the manual brake plate, which is usually on the right side of the upper surface of the control cabinet, as shown in Figure 3.13. First remove the outer cover

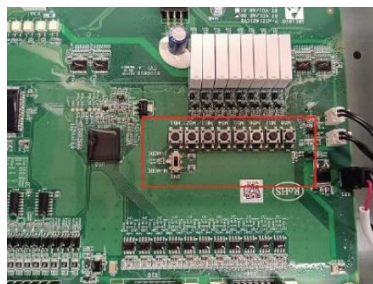


Figure 3.13 Manual brake plate

- 1) —X5 terminal 2—Each axis brake release button 3—X1 terminal
- 2) Set the SM1 switch mode to M-MODE. (The factory default is I-MODE).
- 3) According to the current state of the robot, click the brake release button of each axis (MB1~MB8 corresponds to J1~J8), observe the movement of the robot, and be ready to release the button at any time.
- 4) After the robot reaches the appropriate position, release the brake release button and take out the stuck workpiece if any.
- 5) Set the SM1 switch mode to I-MODE and cover the manual brake plate cover to prevent misoperation.
- 6) Manually reset the safety circuit on the teach pendant to restore the robot status.

When manually releasing the brake, please use inching operation. Do not hold it down for a long time to avoid the robot falling too much and causing unnecessary risks.

3.3.2 Safety warning for gun collision during use

During the use of the robot, a gun collision accident may occur due to misoperation or improper placement of tooling, as shown in Figure 3.14. This may cause damage to the five-axis reducer and affect the use of the entire machine.

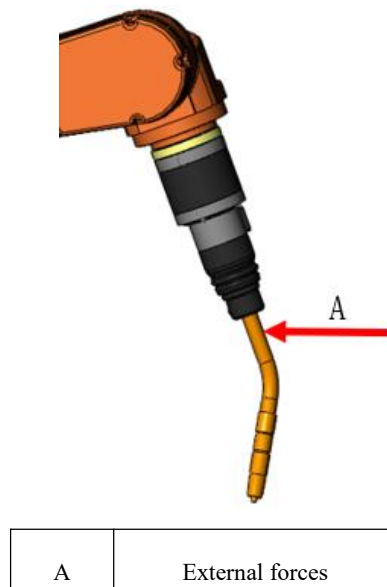


Figure 3.14 The welding gun is hit by external force

During use, when the welding gun is hit by external force, the five-axis reducer may be damaged. Before operation, you should fully learn the robot operation and ensure that the tooling and other related facilities are placed in the correct position.

Technical Support

◆ Technical Services

Shanghai STEP Robotics Co., Ltd. is happy to provide information about the operation and operation of the machine, and can help you troubleshoot and provide detailed consultation. If your robot fails during production, please contact our service organization immediately and provide the following information as much as possible:

- ✧ Robot model and serial number
- ✧ Control system model and serial number
- ✧ Control system system version number
- ✧ Additional software packages (optional)
- ✧ Existing applications
- ✧ Other additional devices (positioner, guide rail, etc., optional)
- ✧ Description of the problem, duration and frequency of the fault, etc.

◆ Contact Details

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