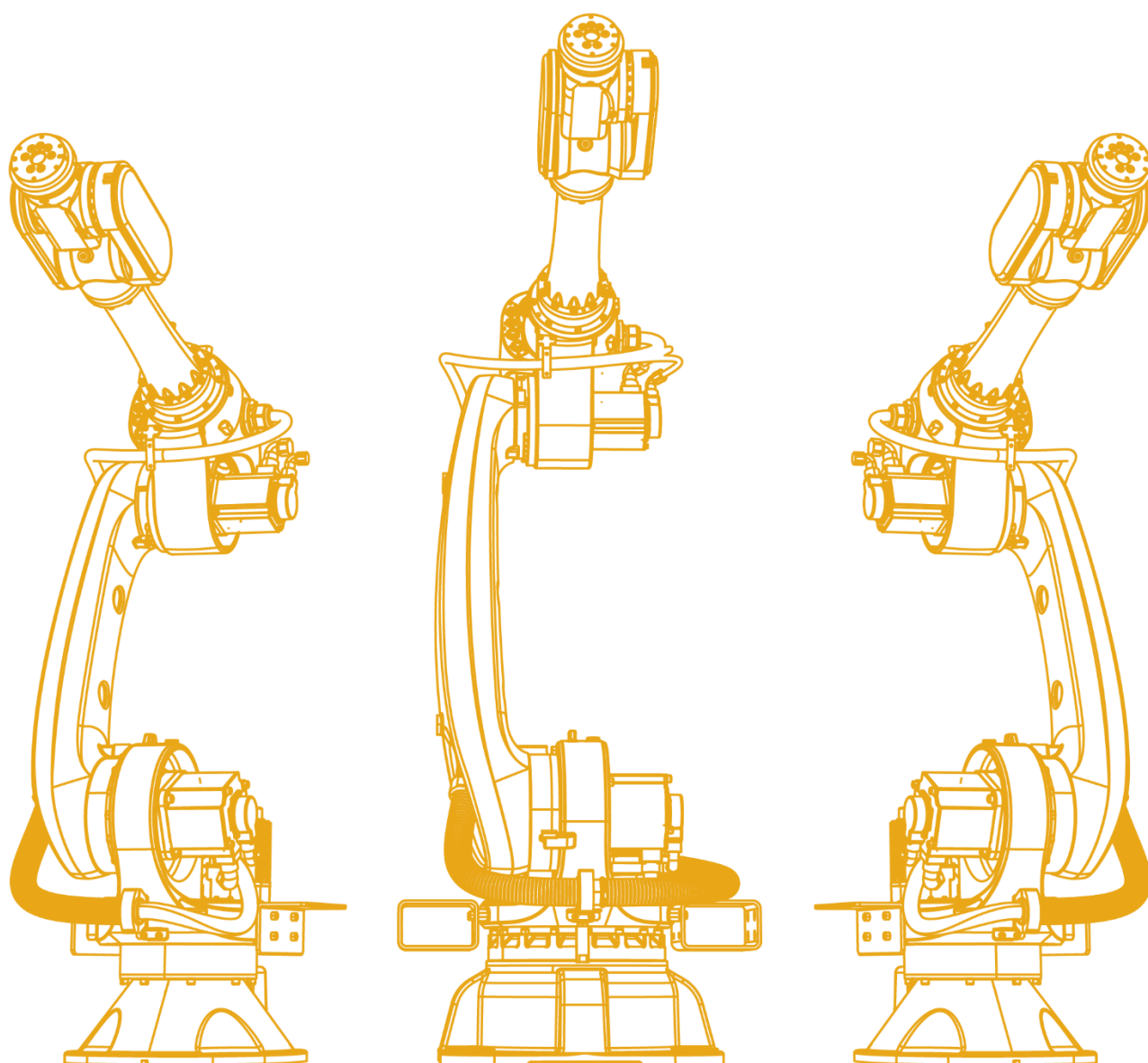


# Medium Load Operation Manual

**AIR20-3100/AIR35-2700**  
**AIR50-2260/AIR50-2700**  
**AIR80-2260/AIR80-2560**

**V1.0.0**





# Foreword

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## About this manual

This manual is for technicians to install and use the medium load industrial robot quickly, correctly, and safely, to be familiar with the relevant precautions, and to perform regular routine maintenance work on the manipulator.

## Prerequisites

Before operating the robot, be sure to read the relevant safety instructions and operation instructions of the product carefully. Users must understand the safety knowledge and basic operation knowledge before using the robot.

Please read the following documents when necessary:

- "ARC5-280 Control Cabinet Manual"
- "AIR-TP teach pendant operation manual"
- "ARL Programming Manual"
- "AIR Series Industrial Robot System Fault and Handling Manual"

## Target groups

- Operators
- Product technicians
- Technical service personnel
- Robot teachers

## Scope of application





This manual is applicable to the following robot models:

Model name	Portable weight
AIR20-3100	20kg
AIR35-2700	35kg
AIR50-2260/AIR50-2700	50kg
AIR80-2260/AIR80-2560	80kg

## Meaning of common signs

The signs and their meanings in this manual are detailed in Table 1.

Table 1 Signs used in this manual

Sign	Meaning
 Danger	Failure to follow the instructions may result in an accident causing the severe or fatal injury or the great losses of property.
 Warning	Failure to follow the instructions may result in an accident causing the severe or fatal injury or the great losses of property.
 Caution	Prompt for the environmental conditions and important things or shortcuts you shall pay attention to
 Prompt	Prompt for additional literature and instructions for additional information or more detailed operating instructions

#### Manual description

The contents of this manual are subject to supplementation and modification. Please visit "Download Center" on the website regularly to obtain the latest version of this manual in a timely manner.

Website URL: <http://robot.peitian.com/>

#### Revision history

The revision history contains the instructions for each document update. The latest version of the document contains updates to all previous versions of the document.

Table 2 Signs used in this manual

Version	Publication date	Modification description
V1.0.0	2024.11.30	1st official release

#### Manual Number and Version

The manual-related information is shown in Table 3.

Table 3 Document-related information

Document name	Medium Load Operation Manual
Document number	UM-P05310000179-001
Document version	V1.0.0

#### Declaration of applicable with product standards

The requirements for industrial robot system design are detailed in Table 4.

Table 4 Declaration of applicable safety standards

Standard	Description	Version
2006/42/EC	Machinery directive: Machinery directive 2006/42/EC (new version) issued by European Parliament and Council on May 17, 2006 to modify 95/16/EC	2006
2014/30/EU	Electromagnetic compatibility directive: 2014/30/EU directive issued by European Parliament and Council on February 26, 2014 to balance the electromagnetic compatibility regulations of member states	2014
2014/68/EU	Pressure facility directive: Electromagnetic compatibility directive: 2014/68/EU directive issued by European Parliament and Council on May 15, 2014 to balance the pressure facility regulations of member states (It is only suitable for the robot with hydraulic balance weight)	2014
ISO 13850	Safety of machinery: Emergency stop function - Principles for design	2015
ISO 13849-1	Safety of machinery: Safety-related parts of control systems - Part 1: General principles for design	2015
ISO 12100	Safety of machinery: General principles for design - Risk assessment and risk reduction	2010
ISO 10218-1	Robots and robotic devices - Safety requirements for industrial robots: Part 1: Robots (Prompt: Information is consistent with ANSI/RIAR.15.06-2012, Part 1)	2011
61000-6-2	Electromagnetic compatibility (EMC): Part 6-2: Generic standards - Immunity for industrial environments	2005
61000-6-4 + A1	Electromagnetic compatibility (EMC): Part 6-4: Generic standards - Emission standard for industrial environments	2011
60204-1 + A1	Safety of machinery: Electrical equipment of machines - Part 1: General requirements	2009
IEC 60529	IP rating provided by enclosures (IP Code):	2001

Standard	Description	Version
	This standard applies to the IP rating for the electrical equipment with enclosures and the rated voltage exceeding 72.5kv.	

## General safety description

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Thank you for purchasing our manipulator. This description is required for the safe use of the manipulator. before using the operator, please read the manual carefully and use the manipulator correctly on the premise of understanding it.

For the detailed functions of the manipulator, please fully understand its specifications through the relevant instructions.

### Safety considerations

In general, the manipulator cannot be operated by a single operation, and only install the end effector, and the frame functions as the peripheral equipment and the system to perform the operation.

When considering its security, the manipulator should not be considered independently, but should be considered in the system environment.

When using the manipulator, be sure to take corresponding measures to the safety fence.

#### WARNING, CAUTION AND PROMPTS.

This specification includes matters needing attention to ensure the personal safety of operators and prevent damage to operators. According to their safety importance, they are described as "warning" and "caution" in this paper, and the supplementary instructions are described as "prompts".

Before using the operator, the user must read these "warnings ", "cautions" and "prompts ".



In the case of an incorrect operation, it is possible to cause death or serious injury to the operator or other operator.




If the operation is wrong, it may cause the manipulator or other manipulator to slightly injure or damage the equipment.


### General considerations





- When connecting or disconnecting related peripheral devices (such as safety fences, etc.) and various signals of the manipulator, be sure to confirm that the manipulator is in a stopped state to avoid incorrect connections.
- Do not use the operator in the situation shown below. Otherwise, it will not only have a negative impact on operators and peripherals, but also cause casualties.

	<ul style="list-style-type: none"> <li>● Used in flammable environments.</li> <li>● Used in explosive environments.</li> <li>● Used in environments where there is a lot of radiation.</li> <li>● Used in water or in high humidity environments.</li> <li>● Used for the purpose of transporting people or animals.</li> <li>● Use as a foot (e.g., on or depending on the operator)</li> <li>■ Operators who use the operator should wear the safety appliances shown below before carrying out their work. <ul style="list-style-type: none"> <li>● Work clothes suitable for the job content</li> <li>● Safety shoes</li> <li>● Safety helmet</li> </ul> </li> </ul>
 Prompt	Personnel who carry out programming and maintenance operations must receive appropriate training through the relevant training of the company.


#### Considerations during installation

 Warning	<ul style="list-style-type: none"> <li>■ When handling and installing the machines, they must be carried out correctly according to the method shown in our manual. If the operation is carried out in the wrong way, it is possible that the operator will be killed or injured due to the overturning of the operator.</li> <li>■ When using the operator for the first time after installation, be sure to do so at a low speed, and then gradually accelerate the speed and confirm that there are any anomalies.</li> </ul>
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#### Matters needing attention in operation

 Warning	<ul style="list-style-type: none"> <li>■ When using the operator, be sure to make sure there are no personnel in the safety fence before carrying out the operation. At the same time, check to see if there is a potential danger, and when it is confirmed that there is a potential danger, be sure to eliminate the danger before carrying out the operation.</li> <li>■ When using the instruction device, because there may be errors in the operation of wearing gloves, it is important to take off the gloves before carrying out the work.</li> </ul>
 Prompt	Information such as programs and system variables can be stored in storage media such as memory cards. In order to prevent data loss caused by unexpected accidents, it is recommended that users back up data regularly.


#### Considerations in programming

 Warning	When programming, try to do it outside the safety fence, the following matters shall be taken into account when the safety fence needs to be carried out as a last resort:
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	<ul style="list-style-type: none"> <li>■ Check the safety fence carefully and make sure it is not dangerous before entering the fence.</li> <li>■ The emergency stop button can be pressed at any time.</li> <li>■ The manipulator shall be operated at low speed</li> <li>■ The operation should be carried out after confirming the state of the whole system, so as to avoid the operator falling into a dangerous situation due to the remote-control instructions or actions for the peripheral equipment.</li> </ul>
 Caution	<p>After the program is finished, it is important to perform the test operation in accordance with the specified procedure. At this time, the operator must operate outside the safety fence.</p>
 Prompt	<p>For operators who are programmed, it is important to receive appropriate training through the company.</p>

Attention should be paid to maintenance work

 Warning	<ul style="list-style-type: none"> <li>■ When switching on the power supply, part of the maintenance operation is in danger of electric shock, as far as possible, the maintenance operation should be carried out in the state of power off; professional maintenance personnel should be designated according to the need to carry out maintenance operation; other personnel should be avoided to turn on the power supply when maintaining the operation; even if the power supply must be turned on before the operation can be carried out, the emergency stop button should be pressed and then the operation should be carried out.</li> <li>■ Please consult our company when you need to replace the parts.</li> <li>■ The replacement of parts by the client may result in unexpected accidents, which may cause the operator to be damaged and the operator is injured.</li> <li>■ When entering the security fence, check the whole system carefully and make sure it is not dangerous. If there is a dangerous situation and have to enter the fence, you must grasp the state of the system and be very careful.</li> <li>■ If you need to replace the parts, be sure to use our specified parts. If you use a part other than the specified part, it may cause damage to the operator.</li> <li>■ When removing the motor and brake, the crane hoisting and other measures should be taken to remove the motor and brake, so as to avoid the falling of the manipulator arm.</li> <li>■ When carrying out maintenance operations, when it is necessary to move the operator as a last resort, the following matters should be taken into account:             <ul style="list-style-type: none"> <li>● It is important to ensure that the escape channel is smooth and that the operation should be carried out again under the operation of the whole system in order to avoid blockage of the retreat by the operator and peripherals.</li> </ul> </li> </ul>
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- Always pay attention to the danger around you and be prepared so that you can press the emergency stop button at any time when you need it.
- The auxiliary equipment such as the crane shall be used when the moving motor and the speed reducer and the like have certain weight parts, so as to avoid the excessive work load for the operators. At the same time, it is necessary to avoid the wrong operation, otherwise, the operation and death of the operation may be caused.
- Be careful not to fall because of the lubricating oil that falls on the ground, wipe the lubricating oil that falls on the ground as soon as possible, and eliminate the possible danger.
- Do not place any part of the body on any part of the manipulator during the operation, and it is prohibited to climb on the manipulator, so as to avoid unnecessary personal injury or adverse effect on the manipulator.
- The following parts will be hot and need attention. When you have to touch the equipment when you have to touch it in the event of heat, you should prepare protective appliances such as heat-resistant gloves:
  - Servo motor
  - Reducer
  - Adjacent to motor / reducer
  - Inside the control cabinet
- The parts (such as screws, etc.) removed during the replacement of the parts should be correctly loaded back to their original parts, and if the parts are found to be insufficient or surplus, they should be reconfirmed and installed correctly.
- During the maintenance of the pneumatic system and hydraulic system, it is important to release the internal pressure to zero and operate again.
- After replacing the parts, be sure to carry on the test operation according to the prescribed method. At this point, the operator must operate outside the safety fence.
- After the maintenance operation, the grease, debris and water sprinkled on the ground around the operator and inside the safety fence should be thoroughly cleaned.
- When replacing parts, dust and other foreign bodies should be prevented from entering the manipulator.
- Operators who carry out maintenance and repair operations must receive the training of the company and pass the relevant assessment.
- When carrying out maintenance operations, appropriate lighting appliances should be equipped, but care should be taken not to make the lighting appliances a source of new danger.
- Be sure to refer to this specification for regular maintenance, if not regular maintenance, will affect the service life of the operator, and may lead to accidents.

## Safety protection measures before use

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Before operating the manipulator and peripheral equipment and the manipulator system composed of them, the safety precautions of the operators and the system must be fully studied.

Figure 1 is a diagram of the safe work of industrial robots.

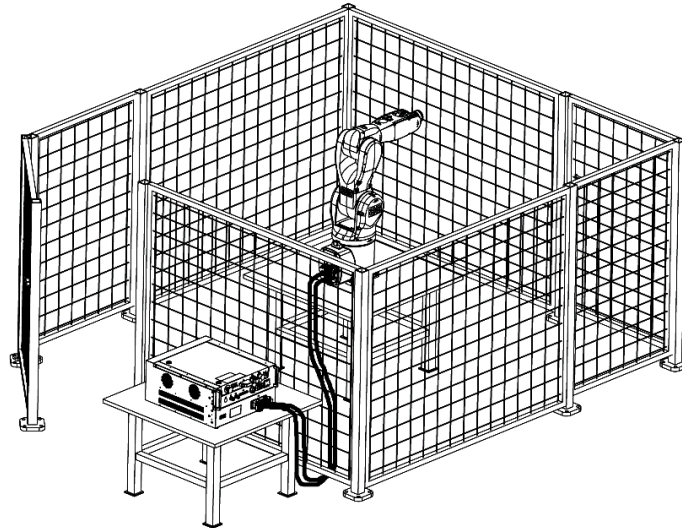


Figure 1 Diagram of safe work of industrial robots

### Definition of operating personnel

Manipulator operation personnel consist of operator, teacher and maintenance engineer who shall satisfy the following conditions:

#### Operator

- Switch on/off the power supply of manipulator.
- Start the manipulator program via the operating panel.
- have no right to operate within the safety barrier

#### Teacher

- Execute the functions of operator.
- Perform the manipulator teaching, etc. outside the safety barrier.

#### Maintenance Engineer

- Execute the functions of teacher.
- Perform the maintenance (repair, adjustment, replacement, etc.) of manipulator.

### Safety of operation personnel

Operator, teacher and maintenance engineer shall carefully perform the operation, programming and maintenance of manipulator, and shall at least wear the following items:

- Work clothes suitable for task
- Safety shoe
- Helmet

When the auto system is used, be sure to protect the operation personnel. The measures shall be taken to prevent the operation personnel from entering the range of manipulator.

The general precautions are listed below. Please take the appropriate measures to ensure the safety of operation personnel:

- The operation personnel running the manipulator system shall receive the training from the company and pass the relevant assessment.
- While the equipment is running, even if the manipulator seems to have stopped, the manipulator is possibly waiting for the start signal and is about to act. The manipulator shall be regarded as operating at this state. To ensure the safety of operation personnel, it is necessary to confirm that the manipulator is in the operating state via the audible and visual alarms such as the warning lamp
- Be sure to set the safety barrier and safety door around the system so that the operation personnel cannot enter the safety barrier without opening the safety door. The interlock switch, safety pin, etc. shall be set on the safety door so that when the operator opens the safety door, the manipulator will stop.
- Peripheral equipment shall be electrically grounded.
- The peripheral equipment shall be set outside the range of manipulator if possible.
- The range of manipulator shall be clearly marked with the lines on the floor to make the operator understand the range of manipulator including the mechanical arm and other tools.
- A proximity switch or photoelectric switch shall be installed on the floor so that when the operation personnel are about to enter the range of manipulator, the audible and visual alarms such as the buzzer are issued to stop the manipulator, thereby ensuring the safety of operation personnel.
- A lock shall be set to make sure that the manipulator power cannot be turned on except by the operation personnel responsible for the operation.
- Always disconnect the manipulator power when performing the individual commissioning of peripheral equipment.

#### Safety of operators

Operators are not authorized to perform jobs within the safety barrier:

- Disconnect the power supply of manipulator control cabinet or press the emergency stop button when the manipulator is not operated.
- Operate the manipulator system outside the safety barrier.

- The guard fence and safety door shall be provided to prevent the unrelated personnel from entering the range of manipulator or to prevent operators from entering a hazardous location.
- Emergency stop button shall be set within the reach of operators.



Prompt

Manipulator controller is designed to be connected to an external emergency stop button. With this connection, the manipulator will stop when the external emergency stop button is pressed.

### Safety of teachers

In some cases, it is necessary to enter the scope of operation of the manipulator when carrying out the operation of the manipulator, especially at this time, the safety should be paid attention to:

- If you do not need to enter the operation maneuvering range, be sure to operate outside the operating maneuvering range.
- Before proceeding with the teaching, verify that the manipulator or peripheral equipment is in a safe state.
- If it is inevitable to enter the range of manipulator to conduct the teaching, first confirm the positions and states of safety devices (such as the emergency stop button, emergency automatic stop switching of teach pendant, etc.).
- Teachers shall pay special attention to make other people away from the range of manipulator
- Before starting the manipulator, first confirm that there is no people and no abnormality in the range of manipulator.
- After the teaching is over, be sure to perform the test run following the steps below:
  - step1. At low speed, execute at least one cycle intermittently to confirm no abnormality.
  - step2. At low speed, execute at least one cycle continuously to confirm no abnormality
  - step3. At intermediate speed, execute at least one cycle continuously to confirm no abnormality
  - step4. At operating speed, execute at least one cycle continuously to confirm no abnormality
  - step5. Execute the program in automatic operation mode.
- The teacher must evacuate outside the safety fence when the operator operates automatically.

### Safety of repair engineer

To ensure the safety of repair engineer, full attention shall be paid to the following items:

- Never enter the range of manipulator while the manipulator is running.

- Perform the repair operation while the controller is powered off if possible. Main circuit breaker shall be locked to prevent other personnel from turning on the power.
- If it is inevitable to enter the range of manipulator when it is powered on, you shall first press the emergency stop button of control cabinet or teach pendant. In addition, the operators shall hang the "Repairing" sign to remind other people not to operate the manipulator.
- Before performing a repair, verify that the manipulator or peripheral equipment is in a safe status.
- Do not perform the automatic operation when there is someone in the range of manipulator.
- When working near the walls and appliances, or when several operators are close to each other, be careful not to block the escape routes of other operators.
- When the manipulator is equipped with a tool, and there are movable devices such as conveyor belts in addition to the manipulator, pay attention to the operation of these devices.
- A person who is familiar with the manipulator system and is able to detect the danger shall be assigned next to the operating panel and operating box so that he can press the emergency stop button at any time.
- When replacing or reassembling the parts, be sure to prevent the foreign matters from sticking or entering.
- In case of the repair inside the controller, If the unit, printed circuit board, etc. may be contacted, be sure to disconnect the power supply of main circuit breaker of controller to prevent electric shock.
- Be sure to replace with the parts designated by us.
- When the manipulator system is restarted after the repair operation, it shall be confirmed in advance that there are no people in the range of manipulator, and the manipulator and peripheral equipment are in a normal status.

#### Safety of peripheral equipment

##### Precautions in terms of procedures:

- The detection devices such as the limit switch shall be used to detect the dangerous status, and the manipulator shall be stopped as needed according to the signals of detection device.
- In case of abnormalities of other manipulators or peripheral equipment, the measures shall be taken, such as stopping the manipulator, even if there is no abnormality in the manipulator.
- For the system of which the manipulator is operating synchronously with the peripheral equipment, special care shall be taken to avoid the interference with each other.

- The manipulator may be interlocked with peripheral equipment and the manipulator may be stopped if required so as to control the status of all devices in the system from the manipulator.

#### Mechanical precautions:

- Manipulator system shall be kept clean and the use environments shall be free of grease, water, dust, etc.
- Do not use the cutting fluids and cleaning agents of unknown nature.
- Limit switches and mechanical brakes shall be used to limit the operation of manipulator to avoid the collisions between the manipulator and peripheral equipment.
- User cables and hoses shall not be added to the manipulator.
- When installing the cable outside the manipulator, do not interfere with the movement of machine.
- For the models of which the cable is exposed, do not conduct the modification that will interfere with the exposed part of cable.
- When installing the external device on the manipulator, be sure not to interfere with other parts of manipulator.
- For the manipulator in action, the frequent power-off operation via the emergency stop button may lead to the fault of manipulator.

#### Mechanical safety of manipulator

##### Precautions for operation:

When the manipulator is operated in slow feed mode, the operators shall be highly vigilant regardless of the circumstances and quickly respond to various problems.

##### Precautions in terms of procedures:

If the ranges of multiple manipulators overlap, care shall be taken to avoid the interference between manipulators.

Be sure to specify an operation origin for the manipulator program and create a program that starts and ends at the origin, so that it is clear from the outside whether the manipulator operation has ended.

##### Mechanism precautions:

The working environments of manipulator shall be kept clean and free of grease, water, dust, etc.

#### Safety of end effector

When controlling various types of transmissions (pneumatic, hydraulic, and electrical), after issuing the control command, be sure to fully consider the time difference from the issuance to the actual action and conduct the control with certain room of extension and retraction.

A detection unit shall be set on the end effector to monitor the status of end effector and control the action of manipulator.



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# 1 Overview and basic composition of the medium load manipulator

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## 1.1 Overview of industrial robot

Industrial robot consists of the following parts is as shown in Figure 1-1:

- Manipulator
- Control cabinet
- Teach pendant
- Connecting cable [power supply], etc.

Figure 1-1 is an example of the composition of the industrial robot system.

1. Manipulator
2. Control cabinet
3. Teach pendant
4. Connecting (power supply) cable

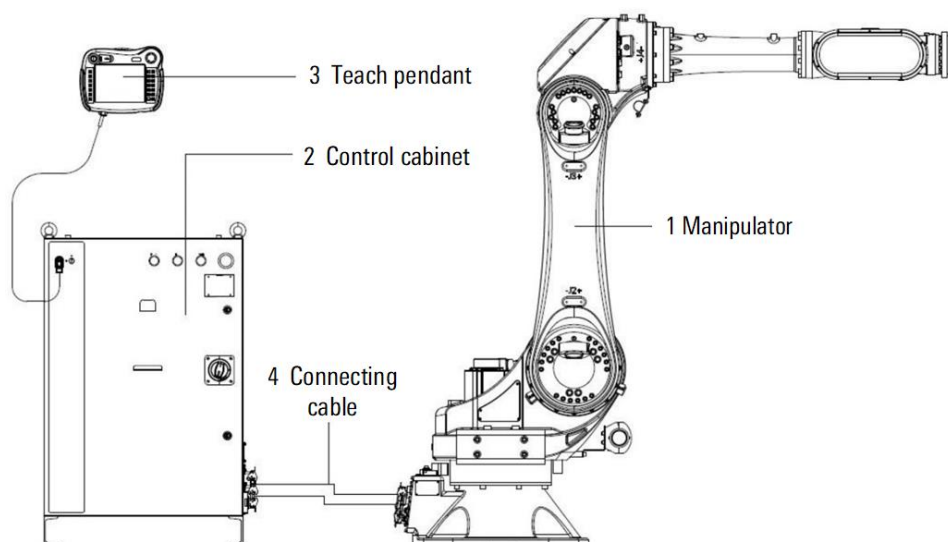


Figure 1-1 Medium-load robot system configuration

## 1.2 Basic composition

Manipulator refers to the mechanism of robot system to grab or move the objects (tools or workpieces), also known as the robot body. This manipulator is the 6-DOF tandem industrial robot that consists of three swing axes and three rotating axes.

The medium load manipulators and the names of its various parts are as shown in Figure 1-2~Figure 1-6.

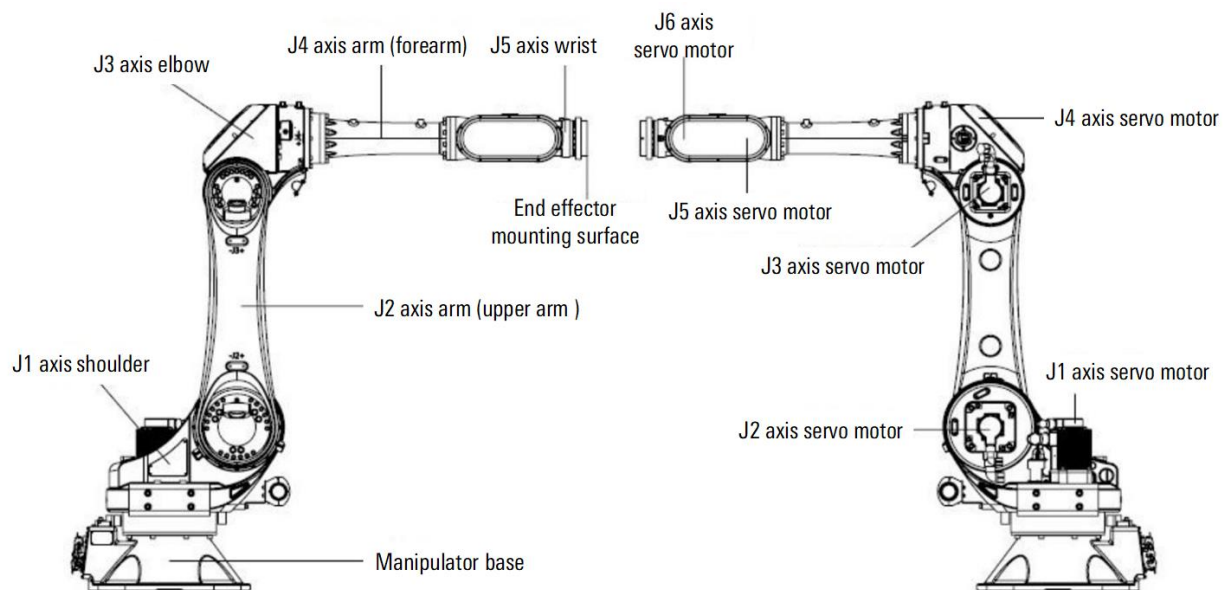


Figure 1-2 AIR50-2260/AIR80-2260 robot manipulator and its parts

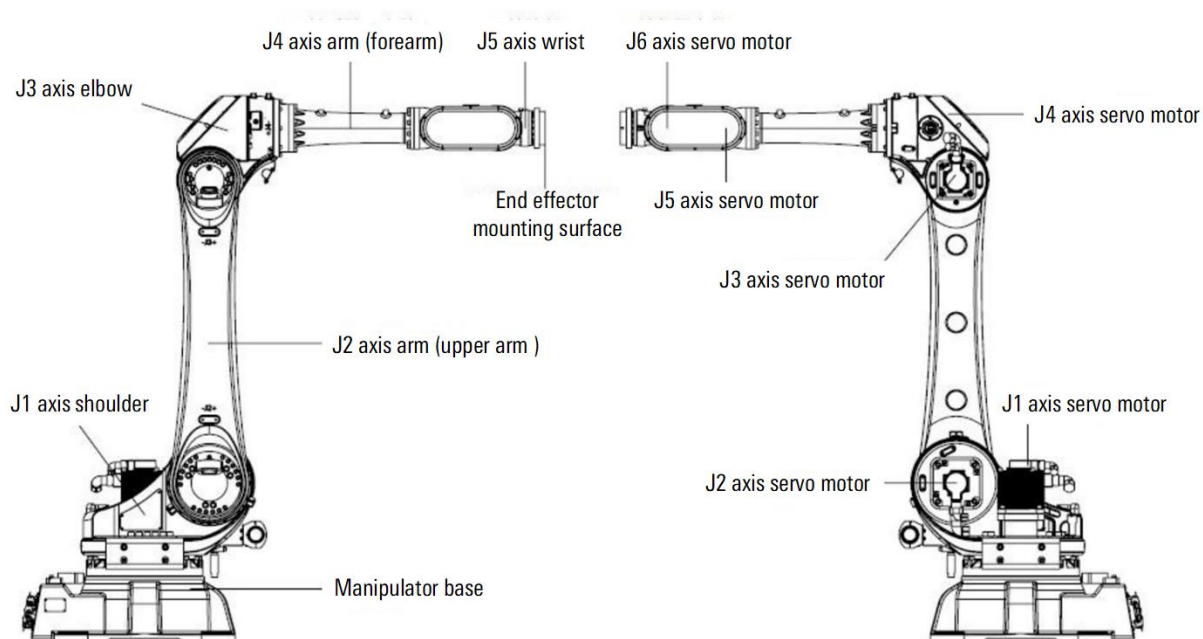


Figure 1-3 AIR80-2560 robot manipulator and its parts

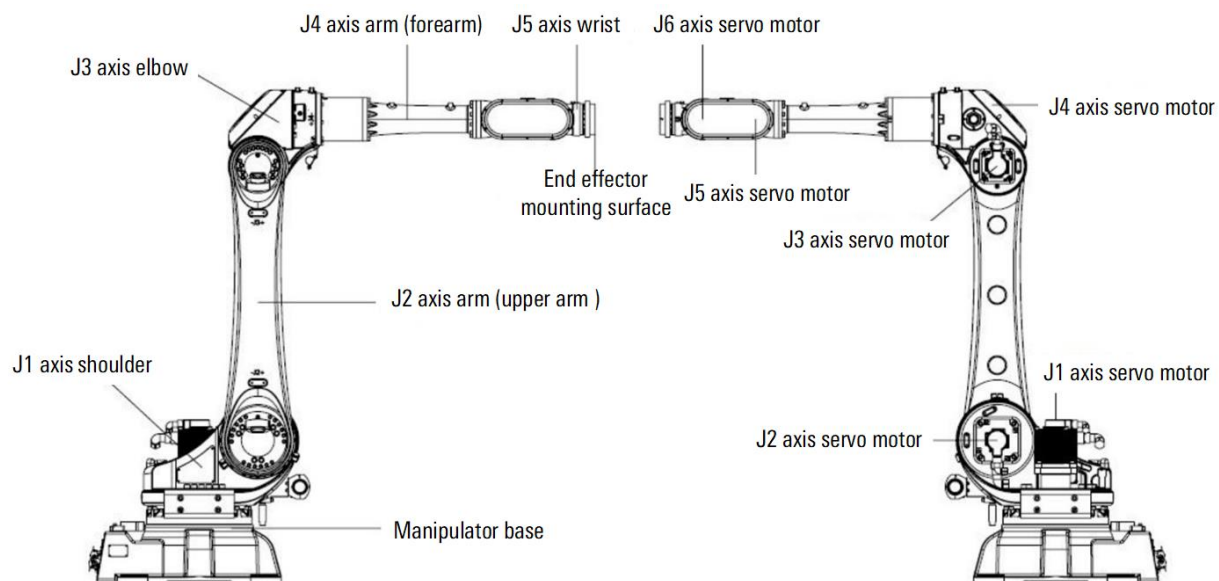


Figure 1-4 AIR50-2700 robot manipulator and its parts

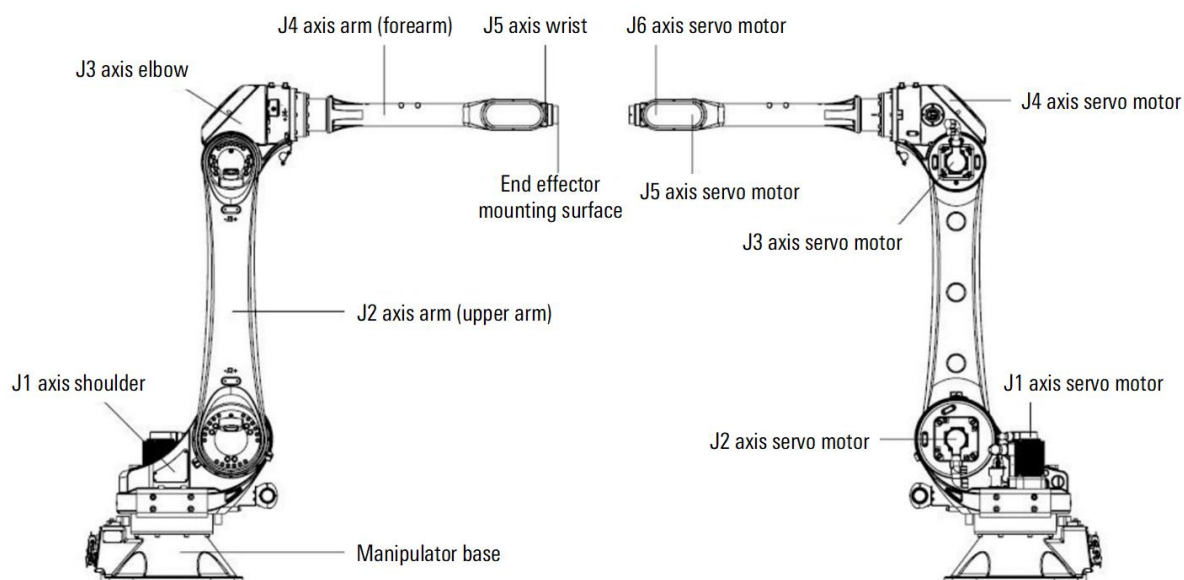


Figure 1-5 AIR35-2700 robot manipulator and its parts

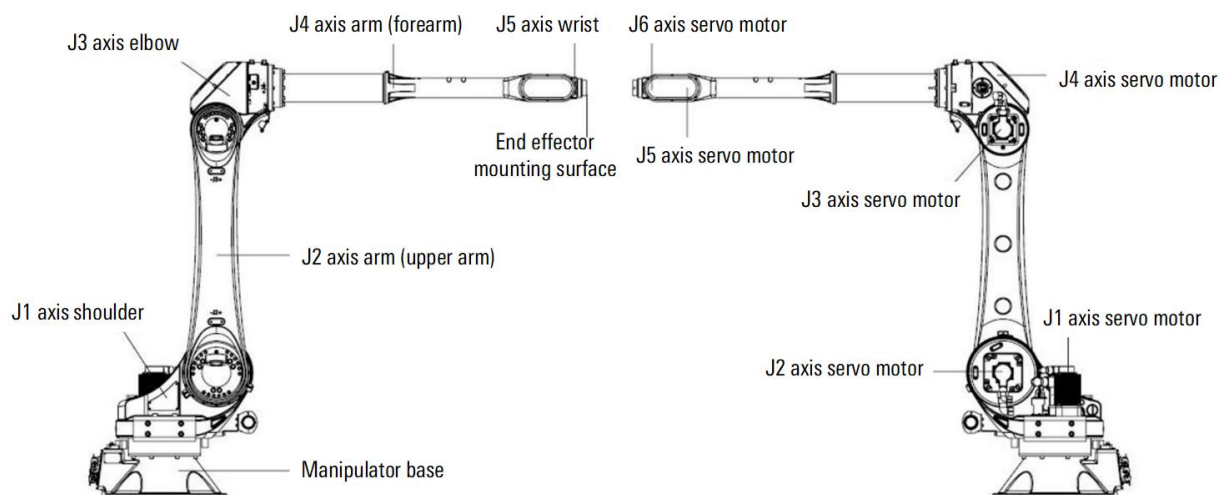


Figure 1-6 AIR20-3100 robot manipulator and its parts

## 1.3 Basic specifications

The basic specifications of medium load robot manipulator are as shown in Table 1-1 and Table 1-2:

Table 1-1 Basic specifications of medium load robot

Parameter		Explanation
Coordinate form		6-DOF articulated robot
Number of control axes		6 axes (J1,J2,J3,J4,J5,J6)
Mounting mode		Ground installation, hoisting installation and wall installation
Range (Upper limit/ lower limit)	J1*	-170° ~170°
	J2	-100° ~100°
	J3	-110° ~165°
	J4	-350° ~350°
	J5	-125° ~125°
	J6	-360° ~360°
Transport capacity	Wrist	<ul style="list-style-type: none"> <li>■ 20kg (AIR20-3100)</li> <li>■ 35kg (AIR35-2700)</li> <li>■ 50kg (AIR50-2260/AIR50-2700)</li> <li>■ 80kg (AIR80-2260/AIR80-2560)</li> </ul>
	Elbow	20kg
Drive mode		Electrical servo drive with AC servo motor
Repeated positioning accuracy		<ul style="list-style-type: none"> <li>■ ± 0.03mm (AIR20-3100/AIR35-2700)</li> <li>■ ± 0.06mm (AIR50/2260/AIR50-2700/AIR80-2260/AIR80-2560)</li> </ul>
Noise		70dB
IP rating		IP54 (Wrist IP67)
Mounting conditions		<ul style="list-style-type: none"> <li>■ Ambient temperature : 5°C ~45°C</li> <li>■ Humidity: not more than 95% at constant temperature without condensation</li> <li>■ Allowable altitude: not more than 1,000m above sea level</li> <li>■ No corrosive, flammable or explosive gases</li> </ul>

Table 1-2 Robot's maximum speed and quality

Parameters		AIR20-3100	AIR35-2700	AIR50-2260	AIR50-2700	AIR80-2260	AIR80-2560
Maximum speed	J1	185° /s	185° /s	185° /s	155° /s	185° /s	155° /s
	J2	180° /s	180° /s	175° /s	145° /s	145° /s	145° /s
	J3	180° /s	180° /s	180° /s	180° /s	180° /s	185° /s
	J4	310° /s	310° /s	310° /s	310° /s	310° /s	310° /s
	J5	375° /s	375° /s	395° /s	395° /s	270° /s	270° /s

Parameters		AIR20-3100	AIR35-2700	AIR50-2260	AIR50-2700	AIR80-2260	AIR80-2560
	J6	470° /s	470° /s	465° /s	465° /s	465° /s	465° /s
Robot quality		550kg	545kg	570kg	745kg	570kg	730kg



" \* " If the mechanical limit of J1 axle is removed, the range may reach -185° to 185°.

## 1.4 Product naming rules

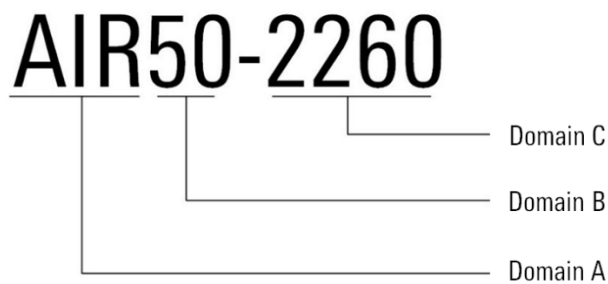


Figure 1-7 Diagram of product naming rules


Table 1-3 Description of product naming rules

Domain	Meaning	Domain value	Explain
Domain A	Product range	AIR	It means that this product belongs to the product series of Peitian AIR
Domain B	Wrist load	50	Indicates that the wrist load of the robot does not exceed 50kg
Domain C	Arm extension	2260	Indicates the arm extension of the robot is 2260mm

## 1.5 Environmental requirements for operation

See Table 1-4 for the operating environment requirements of medium load manipulator.

Table 1-4 Operating environment requirements for medium load manipulator

Parameter	Explanation	
Temperature	Minimum temperature	5℃
	Maximum temperature	45℃
	 When the ambient temperature is lower than 10℃, it is recommended to heat up the engine for a few minutes before use to avoid robot alarm or performance degradation caused by the change of grease viscosity	
Humidity	The installation environment of the operator shall not exceed the humidity level not higher than 95% specified in the document "IEC 60721-3-3-2002 classification of environmental conditions"	

Parameter	Explanation
Altitude	The altitude of the normal working environment of the operator shall not exceed 1000m. Within the altitude range of 1000m-4000m, the manipulator shall be derated for use
Vibration strength	The manipulator shall be used in an environment without vibration as far as possible. The limit frequency of environmental vibration is 22Hz and the amplitude shall not exceed 0.15mm
Special environmental requirements	It is forbidden to use this machine in flammable, explosive and corrosive environment



## 2 Medium load manipulator identification definition and meaning

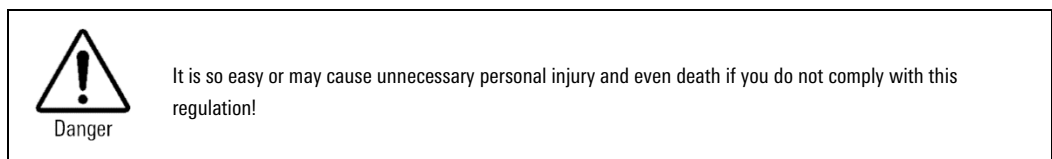
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### 2.1 Safety sign of manipulator

A manipulator safety label shall be pasted on the back of the upper arm of the manipulator. As shown in Figure 2-1.



Figure 2-1 Safety signs on the manipulator



### 2.2 Manipulator nameplate

The nameplate of the manipulator can be seen on the base of the manipulator. The nameplate contains the corresponding model, version number, weight, serial number, production date and other information. As shown in Figure 2-2.

 <b>配天机器人技术有限公司</b> Peitian Robotics Technology Co., Ltd.	
型号	Type
产品号	Product No.
序列号	Serial No.
生产日期	Date
重量	Weight
负载	Load
运动半径	Range

Figure 2-2 Robot nameplate

## 2.3 Direction sign of each axis

"+" or "-" sign is provided at the rotating or swinging joints of axes 1~6 of manipulator as shown in Figure 2-3~Figure 2-7 to indicate the moving direction of each Joint. "J1" in sign represents the axis 1 (other axes are represented by the corresponding numbers), "+" indicates the positive direction, and "-" indicates the negative direction.

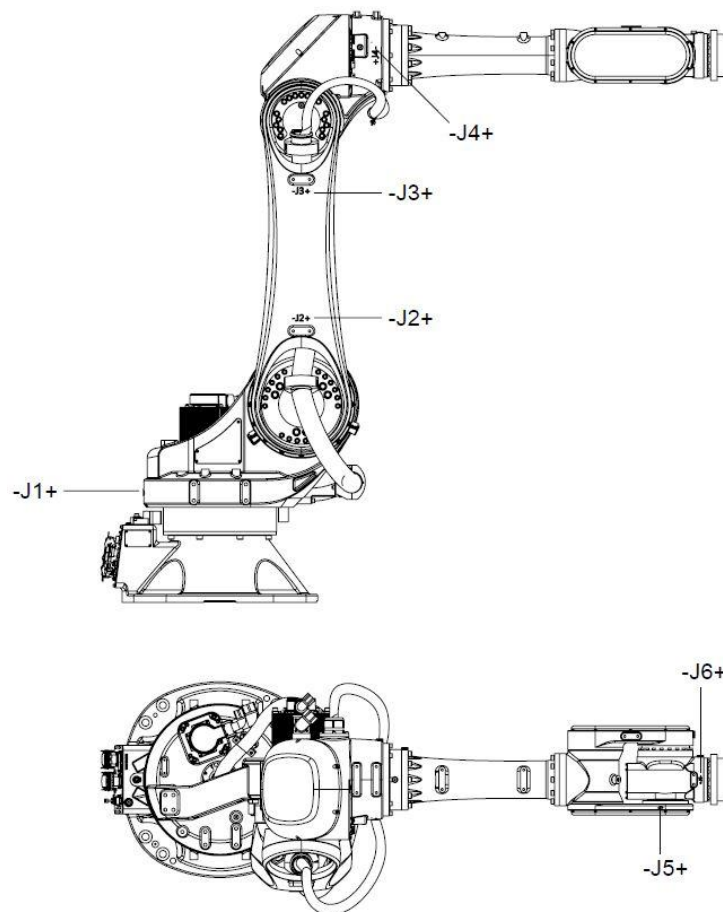


Figure 2-3 Axis direction signs on AIR50-2260/AIR80-2260 manipulator

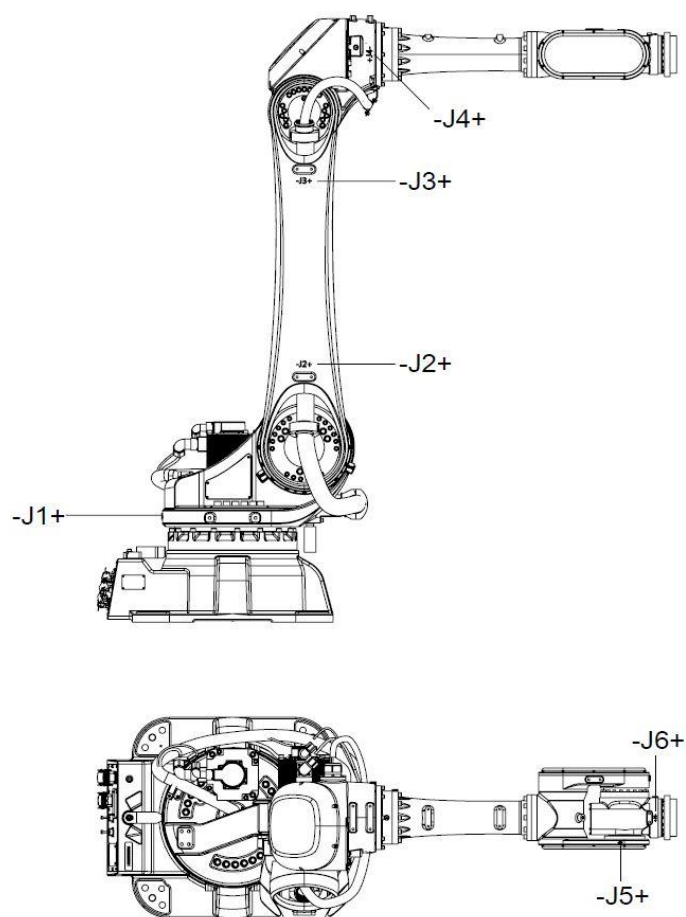


Figure 2-4 Axis direction signs on AIR80-2560 manipulator

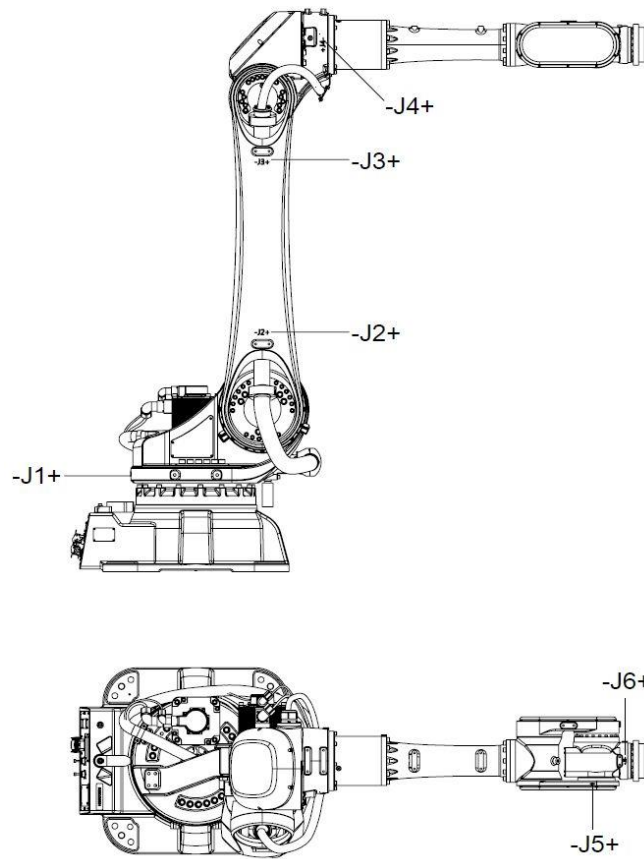


Figure 2-5 Axis direction signs on AIR50-2700 manipulator

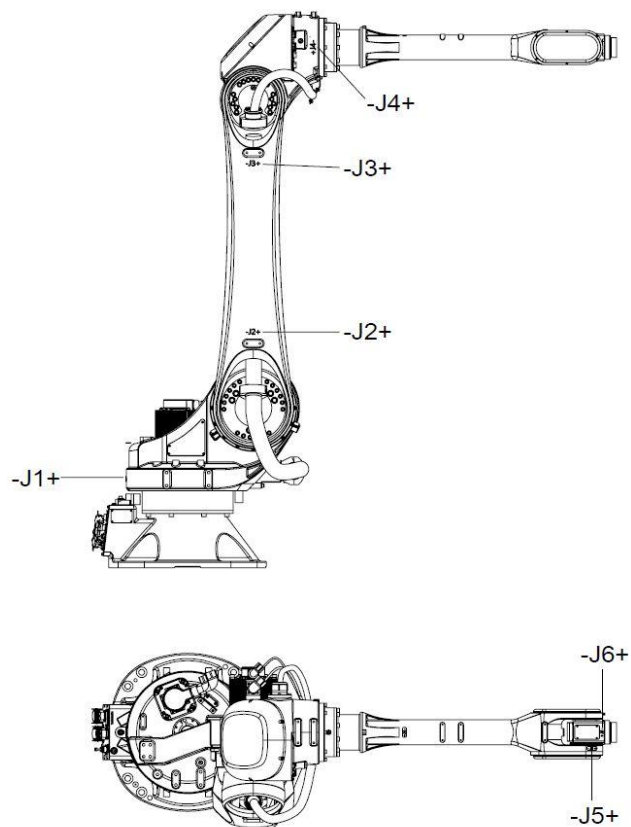


Figure 2-6 Axis direction signs on AIR35-2700 manipulator

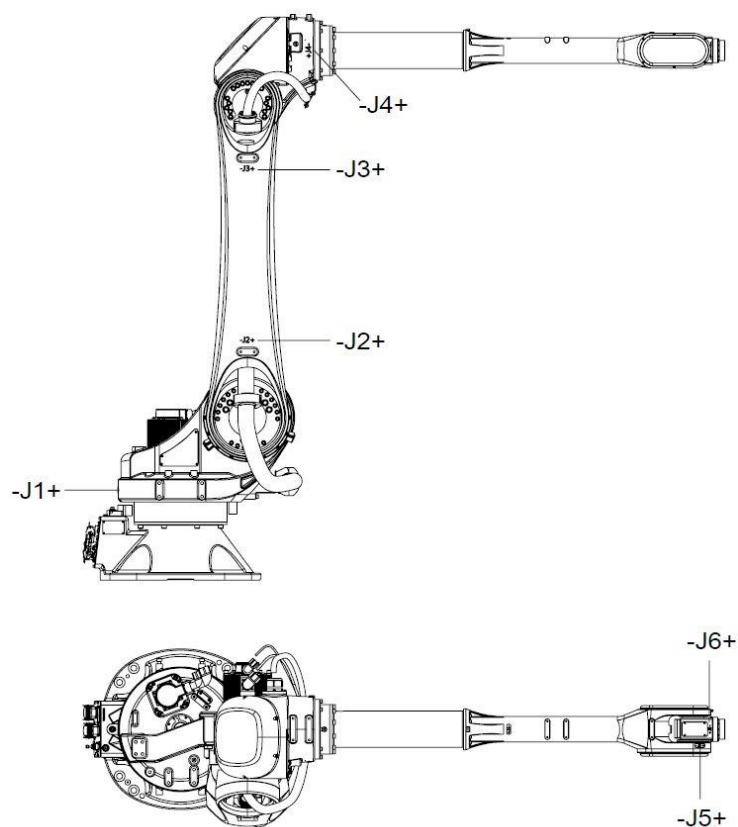


Figure 2-7 Axis direction signs on AIR20-3100 manipulator



## 3 Preparation for installation of medium load manipulator

---

### 3.1 Check item

Following requirements shall be strictly adhered to before installation:

- Ensure that the installers pass the relevant training of company and perform the installation according to the international and local laws and regulations.
- After the unpacking, make sure that the product is not bumped or damaged
- Make sure that the carrier bracket, swinging ring screws, etc. are installed to the manipulator as required.
- Make sure the installation environments are as required by Chapter1.4.
- Make sure that the installation site can withstand the pressure or pull from the manipulator and its load.

### 3.2 Installation tool and required connectors

The following tools may be required to install the manipulator (more tools may be required, depending on the installation method).

- A set of Internal hexagonal wrench;
- Adjustable wrench;
- Torque wrenches of different specifications, etc.

The following connectors may be required to install the manipulator (more connectors may be required, depending on the installation method).

- Several M20 screws with appropriate length and strength grade12.9 or other hexagonal head cap screws;
- A number of chemical bolts of appropriate length and strength grade not less than 4.8;
- Several spring pads of  $\Phi 20$  or other specifications;
- Several round pins ( $\Phi 10$  mm). Please see Chapter4.2 in this manual for details.





## 4 Medium load manipulator installation

### 4.1 Technical specifications

The forces and torques applied to the foundation during the movement are shown in Table 4-1, Enough thought shall be given to the strength of foundation installation surface for the installation of manipulator. The installation ground inclination shall be less than 5° for manipulator.

Table 4-1 The maximum force applied to foundation by medium load manipulator

Load type	Force/torque/mass
Vertical force Fz	<ul style="list-style-type: none"> <li>■ 18.1kN (Working)</li> <li>■ 22.8kN (Emergency stop)</li> </ul>
Horizontal force Fxy	<ul style="list-style-type: none"> <li>■ 15kN (Working)</li> <li>■ 20kN (Emergency stop)</li> </ul>
Overturning torque Mxy	<ul style="list-style-type: none"> <li>■ 20.9kNm (Working)</li> <li>■ 38.8kNm (Emergency stop)</li> </ul>
Rotary torque Mz	<ul style="list-style-type: none"> <li>■ 9.3kNm (Working)</li> <li>■ 15.7kNm (Emergency stop)</li> </ul>
Manipulator quality	<ul style="list-style-type: none"> <li>■ 20kg (AIR20-3100)</li> <li>■ 35kg (AIR35-2700)</li> <li>■ 50kg (AIR50-2260/AIR50-2700)</li> <li>■ 80kg (AIR80-2260/AIR80-2560)</li> </ul>

Dimensions of the medium load manipulator base are as shown in Figure 4-1 and Figure 4-2.

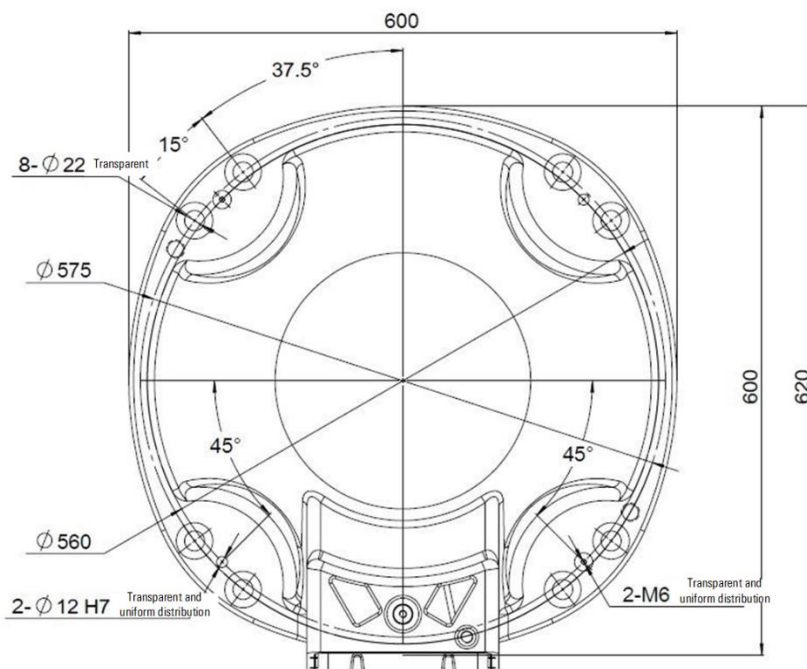


Figure 4-1 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 base entrance size

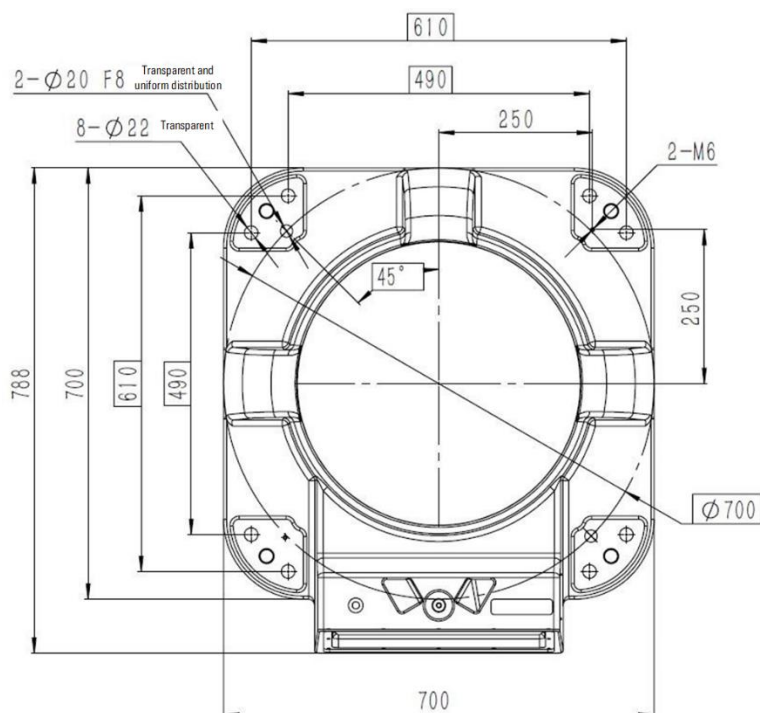


Figure 4-2 AIR50-2700/AIR80-2560 base entrance size

## 4.2 Fixed mode

#### 4.2.1 AIR50-2260, AIR80-2260, AIR35-2700 and AIR20-3100 fixed method

AIR50-2260, AIR80-2260, AIR35-2700 and AIR20-3100 provide two fixing methods:

- Ground fixation
- Bracket fixation



Prompt

- Specific fixing mode depends on the usage environments.
- Strength of chemical bolt is subject to the strength of concrete. Therefore, the safety shall be fully considered according to the design guidelines of manufacturer before the construction.

The names and specifications of parts required to fix the manipulator are as shown in Table 4-2.

#### Table 4-2 Parts for fixing the manipulator

Part Name	Remarks	Ground fixation	Bracket fixation
Fixing screw	4-M20x40 (12.9 level, with 8 fixed brackets)	○	○
Chemical bolt	8-M20 (not lower than 4.8)	○	○
Fixing plate of robot	25mm thick, 1 piece	○	
Adapter plate	25mm thick, 4 pieces		○



Prompt

- There shall be no insulating materials between the fixing plate and mounting bracket of robot and the manipulator and concrete.
- Mark "○" means that the part is in need.
- Bracket shall be firmly installed on the ground with the strength not less than the fixing strength between the fixing plate of robot and the ground for the ground fixing (mode 1).

## Ground fixation

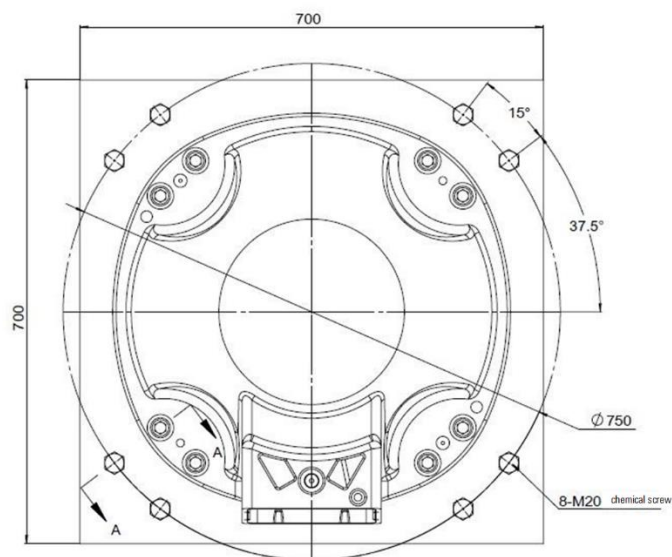
Fixing steps:

- Step1. Arrange M20 chemical bolts (with a strength grade of not less than 4.8) on the concrete foundation according to the recommended dimensions shown in Figure 4-3. Please strictly follow the instructions for installing the selected chemical bolts.
- Step2. Attach the robot fixing plate tightly to the installation plane and fix it with 8 M20 chemical bolts (strength grade not lower than 4.8) and M20 flat washers.
- Step3. In the handling posture (refer to Chapter 9), transfer the manipulator to above the robot fixed plate, adjust the direction of the manipulator, and align the base's  $\phi 22$  through-hole with the robot fixed plate's M20 threaded hole
- Step4. Check if the base is tightly attached to the fixed plate without shaking. Use 8 M20x40 bolts (strength grade 12.9) to fix and install the manipulator base onto the fixed plate.

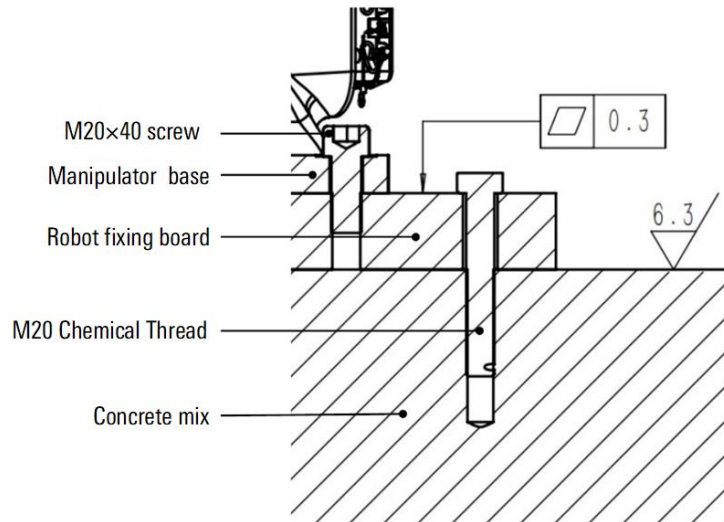


Prompt

The surface of the fixing plate should meet certain flatness requirements, and the flatness of the mounting surface should be within 0.3.



(a)



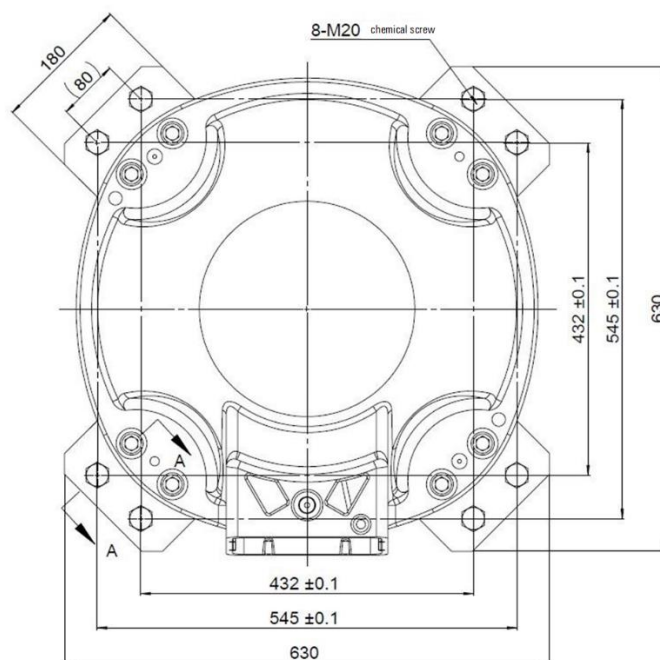
(b)

Figure 4-3 Diagram of ground fixing of manipulator

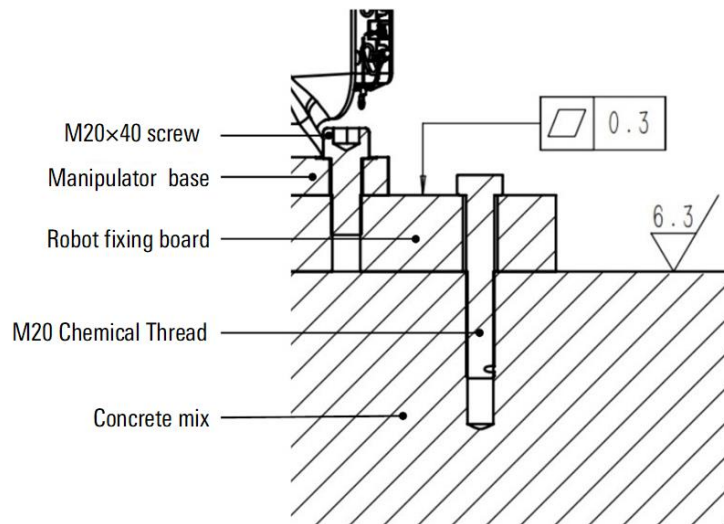
### Bracket fixation

Fixing steps:

- Step1. Use 8 M20 chemical bolts (with a strength grade of not less than 4.8) to fix the 4 installation brackets, refer to Figure 4-4.
- Step2. In the transport position, transfer the manipulator to above the installation bracket, adjust the direction of the manipulator, and align the base's  $\phi 22$  through-hole with the M20 threaded hole of the installation bracket.
- Step3. Check whether the base is tightly attached to the surface of the installation bracket without shaking. Use 8 M20x40 bolts (strength grade 12.9) to fix the manipulator base on the bracket. The installation surface of the bracket should meet certain flatness requirements.



(a)



(b)

Figure 4-4 Diagram of fixing the manipulator bracket



The mounting surface of the bracket should meet certain flatness requirements, and the flatness of the mounting surface should be within 0.5.



- The length of the M20 screw for fixing the manipulator shall not be shorter than 40mm. Too short a length may cause accidents such as poor fixing.
- When installing the manipulator on the ceiling, it is necessary to increase the length of the manipulator fixing screws to 45mm, and ensure that the thickness of the installation plate is not less than 30mm.

#### 4.2.2 AIR50-2700 and AIR80-2560 fixed method

AIR50-2700 and AIR80-2560 manipulator provide two fixing methods:

- Ground fixation
- Bracket fixation



- The specific fixing method should be selected appropriately according to the environment in which the user is using it.
- The strength of chemical bolts is affected by the strength of concrete. When constructing chemical bolts, refer to the design guidelines of each manufacturer and use them after giving full consideration to safety.

The parts and specifications required for fixing the manipulator are shown in Table 4-3.

Table 4-3 Parts required for manipulator fixing

Part name	Remark	Ground fixed	Bracket fixation
Fixing screw	8-M20x65 (12.9 grade)	○	○
Chemical Screws	12-M20 (not less than 4.8 level)	○	○
Robot fixing board	Thickness 30mm, 1 piece	○	

Part name	Remark	Ground fixed	Bracket fixation
Adapter plate	Thickness 30mm, 4 pieces		○



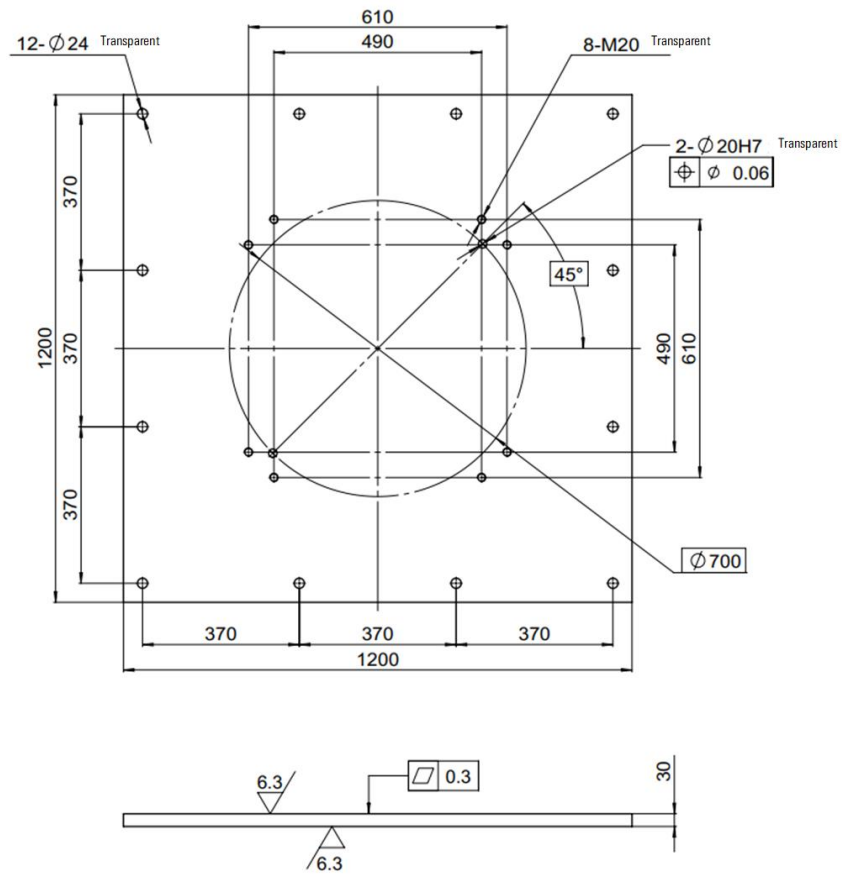
Prompt

- There must be no insulating material between the robot fixing plate and mounting bracket and the manipulator and concrete.
- The parts with "○" mark are required.
- The bracket must be firmly installed on the ground, and its strength should be no less than the fixing strength between the robot fixing plate and the ground in fixing method 1.

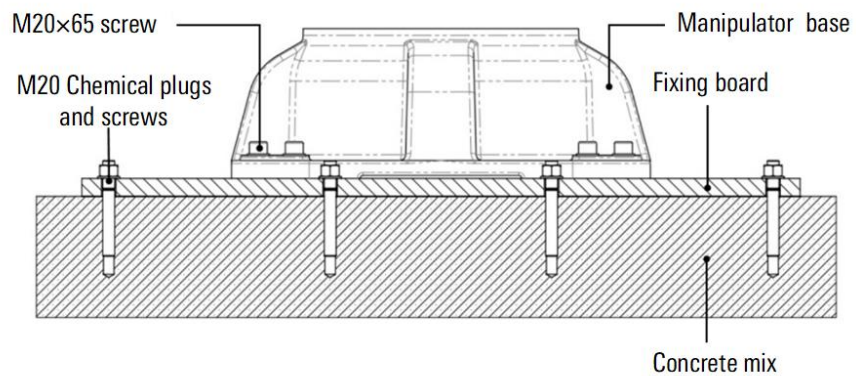
## Ground fixation

Fixing steps:

- Step1. According to the recommended dimensions shown in Figure 4-5, M20 chemical bolts (strength grade not less than 4.8) are arranged on the concrete foundation. The concrete thickness is required to be not less than 190mm. Please strictly follow the instructions for the selected chemical bolts for installation.
- Step2. Place the robot fixing plate close to the installation plane and fix it with 8 M20 chemical bolts (strength grade not less than 4.8) and M20 flat washers.
- Step3. In the transport posture (refer to Chapter 9), move the manipulator to the top of the robot fixing plate, and adjust the direction of the manipulator so that the  $\phi 22$  through hole position of the base is aligned with the M20 threaded hole position of the robot fixing plate.
- Step4. Check whether the base fits tightly against the fixing plate without any shaking. Use 8 M20x65 bolts (strength grade 12.9) to fix the base of the manipulator to the fixing plate.



(a) Fixing plate dimensions



(b) Ground fixed section

Figure 4-5 Diagram of ground fixing of manipulator

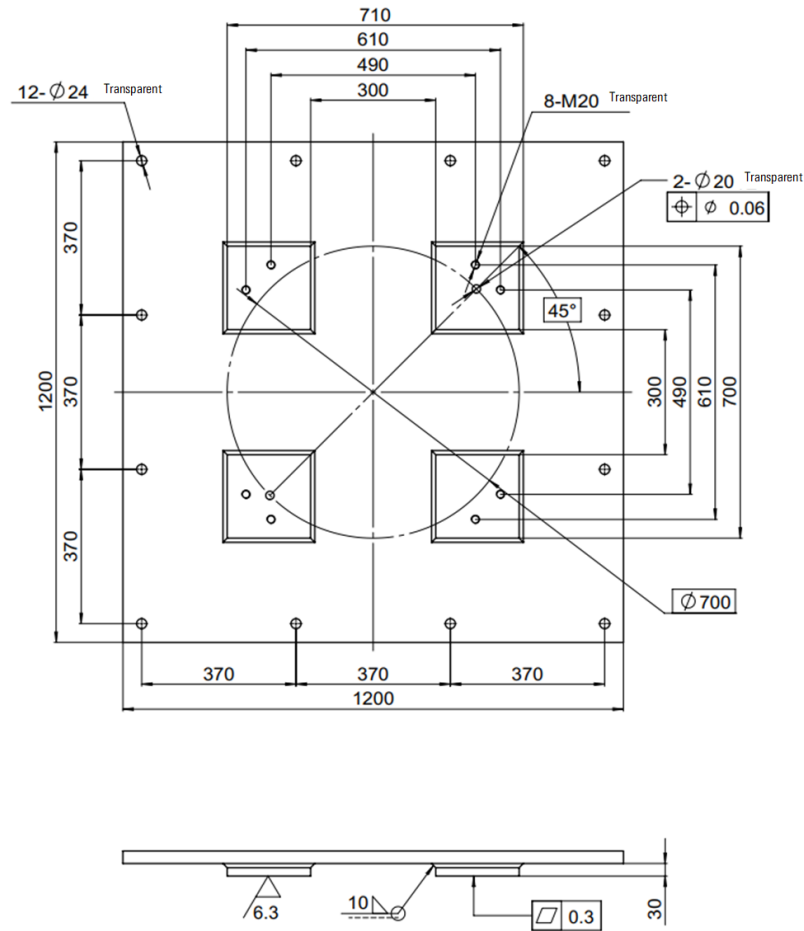


The surface of the fixing plate should meet certain roughness and flatness requirements. The flatness of the mounting surface should be within 0.3, see Figure 4-5 for details.

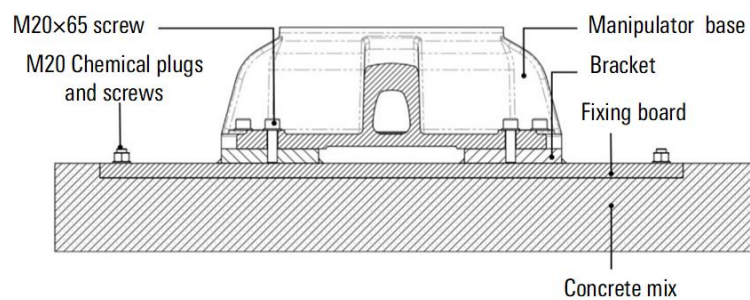
## Bracket fixation

Fixing steps:

- Step1. Use welding to weld the four mounting brackets (inside) to the robot base fixing plate (the robot base fixing plate should be buried in the concrete), refer to Figure 4-6.
- Step2. In the transport posture, move the manipulator to the top of the mounting bracket, and adjust the direction of the manipulator so that the  $\phi 22$  through hole position of the base is aligned with the M20 threaded hole position of the mounting bracket.
- Step3. Check whether the base fits tightly against the surface of the mounting bracket without shaking. Use 8 M20x65 bolts (strength grade 12.9) to fix the base of the manipulator on the bracket.



(a) Bracket fixed plane layout dimensions



(b) Bracket fixing section

Figure 4-6 Diagram of fixing the manipulator bracket





Prompt

The mounting surface of the bracket should meet certain flatness requirements, and the flatness of the mounting surface should be within 0.3, see Figure 4-6 for details.



Warning

- The length of the M20 screw for fixing the manipulator shall not be shorter than 60mm. Too short a length may cause accidents such as poor fixing.
- When installing the manipulator on the ceiling, it is necessary to increase the length of the manipulator fixing screws to 70mm and ensure that the thickness of the mounting plate is not less than 40mm.



## 5 Electrical connection of the medium load manipulator

### 5.1 Manipulator electrical interface type

The base of the manipulator has an aviation plug, a heavy-duty connector, an IO interface and an air pipe connector (for connecting a  $\phi 10$  air pipe). The components are shown in Figure 5-1 and Figure 5-2.

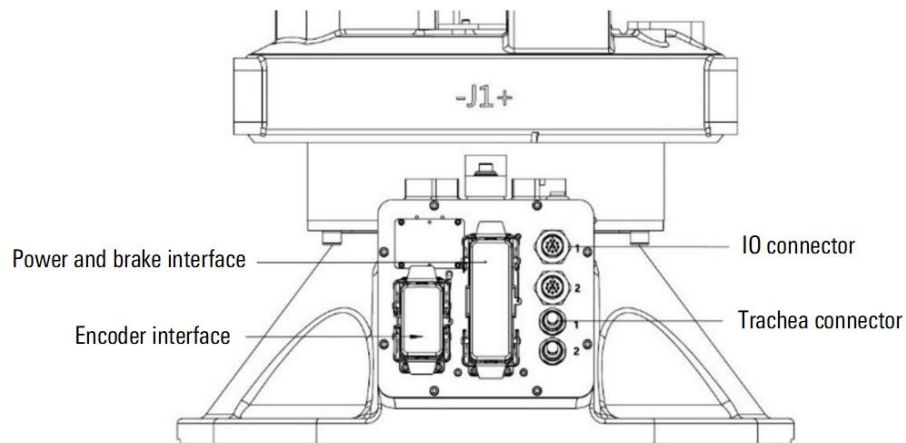


Figure 5-1 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 base electrical interface

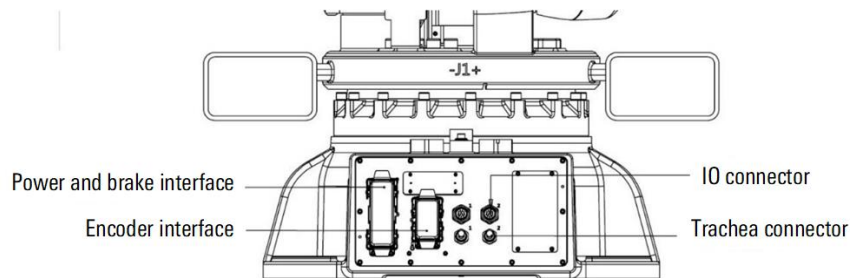


Figure 5-2 AIR50-2700/AIR80-2560 base electrical interface

There are IO interface and air pipe interface (connecting  $\phi 10$  air pipe) at the forearm of the manipulator, the specific locations are shown in Figure 5-3.

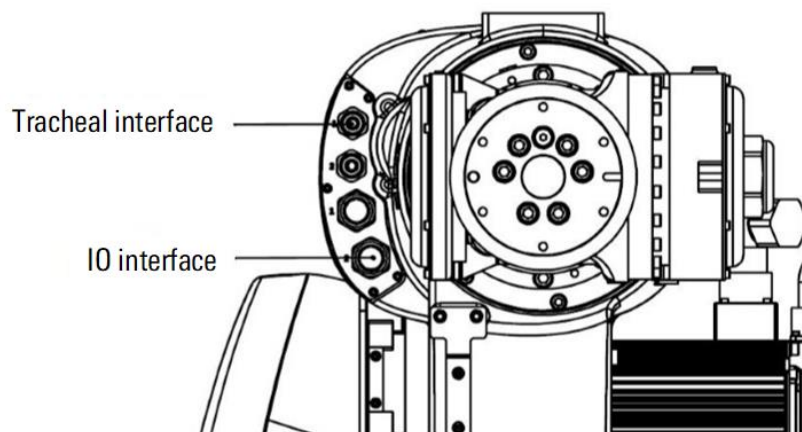


Figure 5-3 Electrical interface of medium load manipulator arm

## 5.2 Definition of the manipulator heavy duty interface

### Power line heavy duty interface definition

The diagram of the heavy-duty interface of the medium load manipulator power line is shown in Figure 5-4, and the definitions are as shown in Table 5-1.

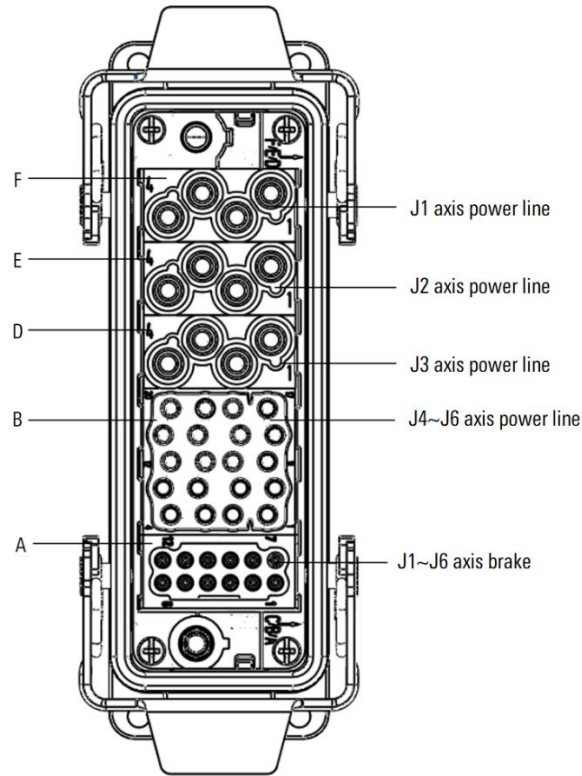


Figure 5-4 Medium load manipulator power heavy-duty connector

Table 5-1 Power and brake interface pin definition table

Signal name	Axis number	Pin number	Signal name	Axis number	Pin number	Signal name	Axis number	Pin number
U1	1 axis	F1	U4	4 axis	B17	BK1+	1 axis	A1
V1	1 axis	F2	V4	4 axis	B18	BK1-	1 axis	A2
W1	1 axis	F3	W4	4 axis	B19	BK2+	2 axis	A3
PE1	1 axis	F4	PE4	4 axis	B20	BK2-	2 axis	A4
U2	2 axis	E1	U5	5 axis	B13	BK3+	3 axis	A5
V2	2 axis	E2	V5	5 axis	B14	BK3-	3 axis	A6
W2	2 axis	E3	W5	5 axis	B15	BK4+	4 axis	A7
PE2	2 axis	E4	PE5	5 axis	B16	BK4-	4 axis	A8
U3	3 axis	D1	U6	6 axis	B9	BK5+	5 axis	A9
V3	3 axis	D2	V6	6 axis	B10	BK5-	5 axis	A10

Signal name	Axis number	Pin number	Signal name	Axis number	Pin number	Signal name	Axis number	Pin number
W3	3 axis	D3	W6	6 axis	B11	BK6+	6 axis	A11
PE3	3 axis	D4	PE6	6 axis	B12	BK6-	6 axis	A12

### Definition of encoder line heavy duty interface

The diagram of the heavy-duty interface of the medium load manipulator encoder is shown in Figure 5-5 and the definition is shown in Table 5-2.

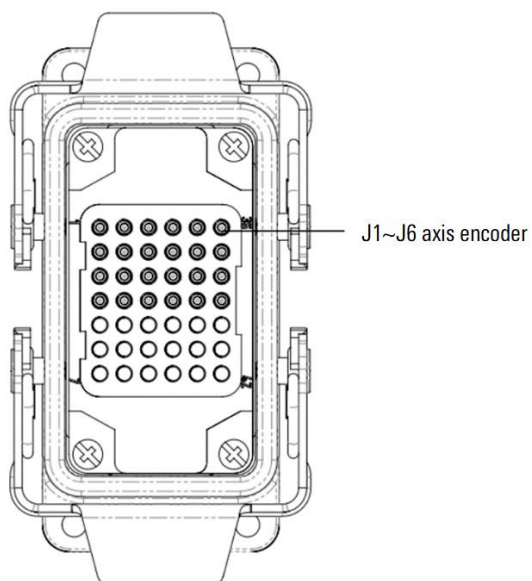


Figure 5-5 Heavy-duty connector for encoder cable of medium load manipulator

Table 5-2 Encoder heavy duty interface definition table

Signal name	Axis number	Pin number	Signal name	Axis number	Pin number
J1_PS-	1 axis	1	J4_PS-	4 axis	22
J1_PS+	1 axis	2	J4_PS+	4 axis	23
J1_0V	1 axis	3	J4_0V	4 axis	24
J1_5V	1 axis	4	J4_5V	4 axis	25
J2_PS-	2 axis	8	J5_PS-	5 axis	29
J2_PS+	2 axis	9	J5_PS+	5 axis	30
J2_0V	2 axis	10	J5_0V	5 axis	31
J2_5V	2 axis	11	J5_5V	5 axis	32
J3_PS-	3 axis	15	J6_PS-	6 axis	36
J3_PS+	3 axis	16	J6_PS+	6 axis	37
J3_0V	3 axis	17	J6_0V	6 axis	38
J3_5V	3 axis	18	J6_5V	6 axis	39

User IO interface definition

The base IO and the forearm IO of the medium-load manipulator are connected and can be used as needed. The interfaces of the base and the forearm IO are shown in Figure 5-5, and the corresponding relationships are shown in Table 5-3. The IO aviation plug model on the base is Weipu SA2015-P12B, and the IO aviation plug model on the forearm is Weipu SA2015-S12B. Please refer to the relevant manual to select the corresponding aviation plug model.

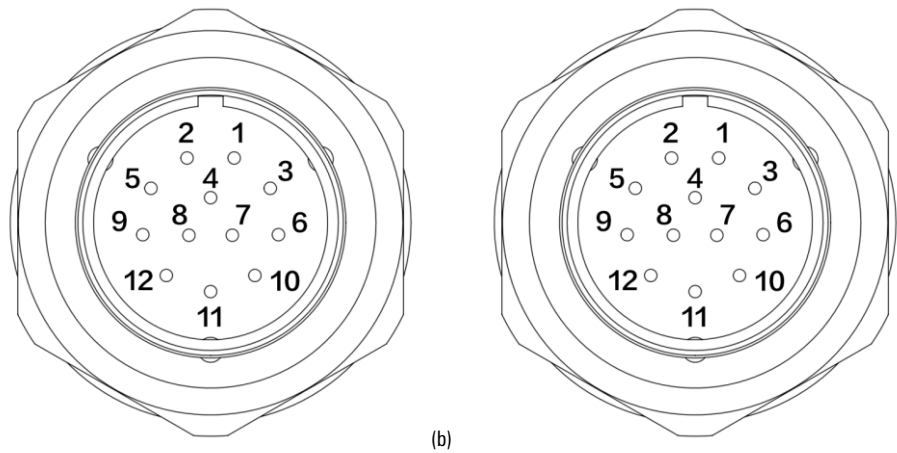


Figure 5-6 Medium-load manipulator base IO flight plug interface (left) and forearm IO flight plug interface (right)

Table 5-3 User IO aviation plug interface definition table

1-way IO		2-way IO	
Pin number (base)	Pin number (forearm)	Pin number (base)	Pin number (forearm)
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12

## 6 Adaptation and connection of the medium load manipulator and accessories

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### 6.1 Examples of accessory types

The accessory equipment of the manipulator mainly includes mechanical grab (Figure 6-1), hydraulic pressure sucker (Figure 6-2), welding gun welder (Figure 6-3), infrared identification equipment, visual identification equipment, cutting machine, other special equipment, etc.

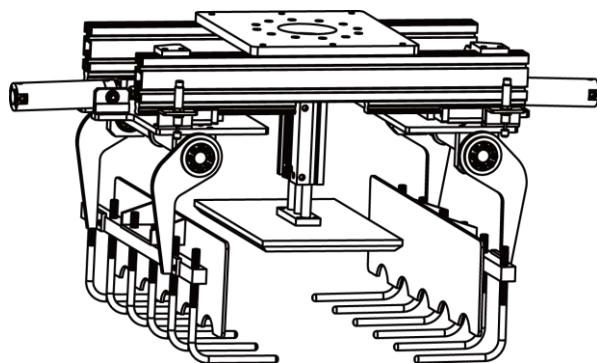


Figure 6-1 Industrial robot grab

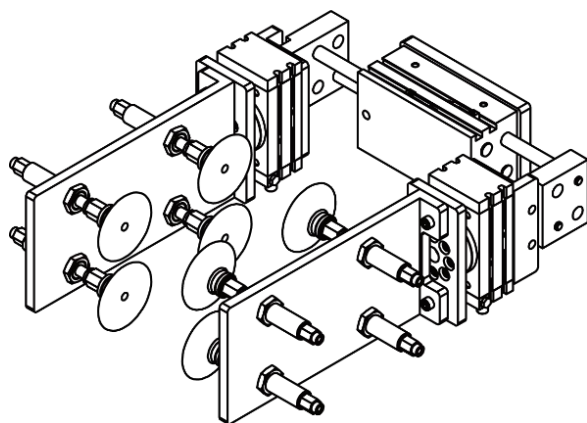


Figure 6-2 Suction cups for industrial robots

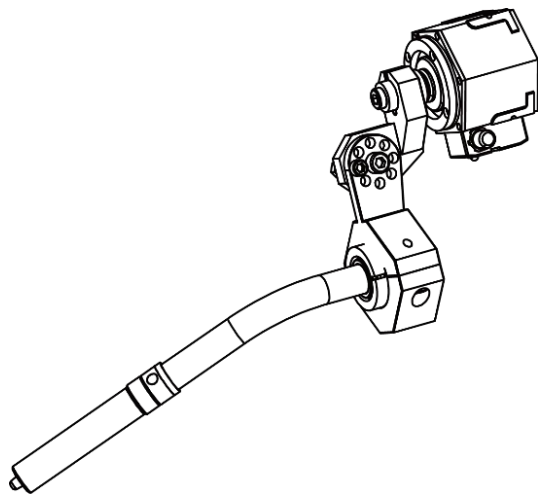


Figure 6-3 Arc welding gun for industrial robot

## 6.2 Connection mode

### Connection between operator and accessories

The connection and load between the external auxiliary equipment and the manipulator are similar to those of the manipulator, and can be directly or indirectly connected to the manipulator through the flange. See Chapter 7.7 of this manual for details.

### Connection between manipulator and control cabinet

As described in Chapter 5.2 definitions of heavy-duty interfaces of manipulator of this manual, the heavy-duty connector on the manipulator is connected to the control cabinet through a cable. Both ends of the Heavy-duty line are used to connect the manipulator and the control cabinet respectively (see Figure 6-4)).

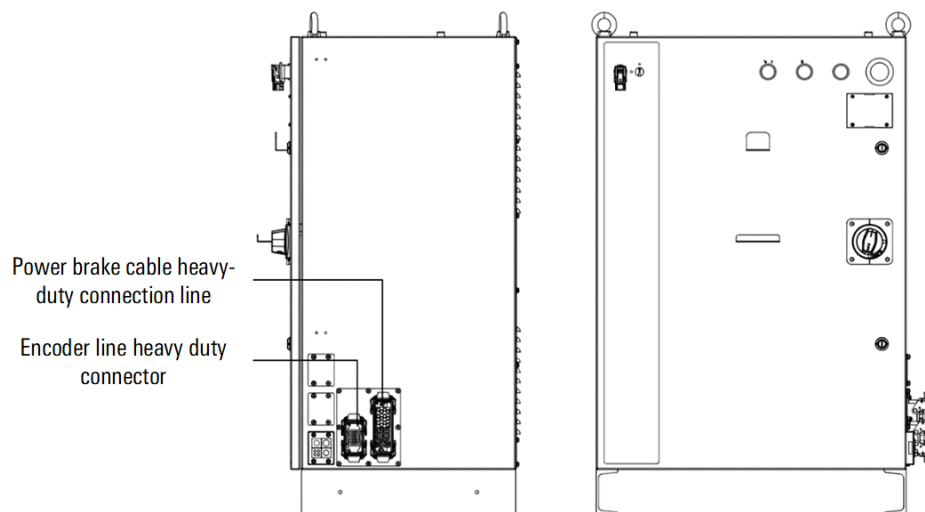


Figure 6-4 Control cabinet cable connector definition



## 7 Performance parameters of the medium load manipulator

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### 7.1 Basic specification

See Chapter 1.3 basic specifications of this manual for the basic specifications of medium load manipulator.

### 7.2 Movement direction of each axis

For the 6-DOF industrial robot manipulator, the movement direction is defined as shown in Figure 7-1 to Figure 7-3.

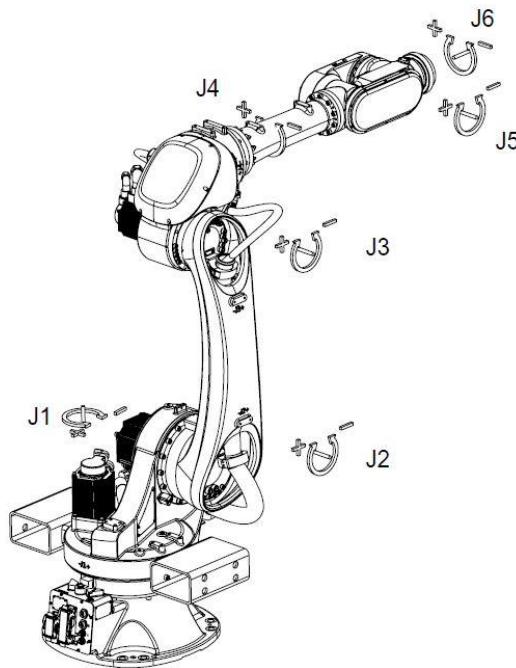


Figure 7-1 AIR50-2260/AIR80-2260 each axis movement direction

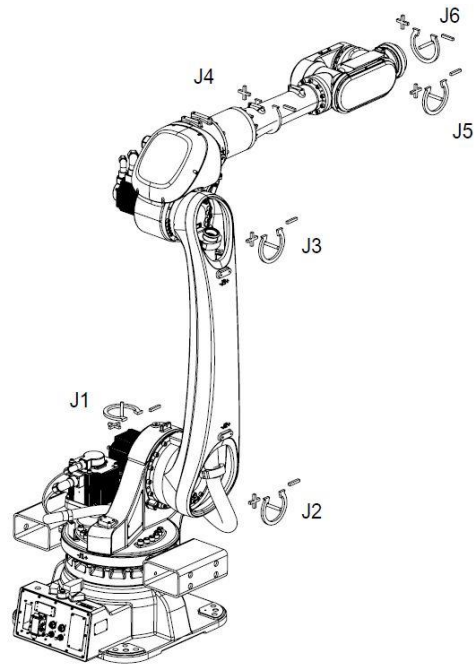


Figure 7-2 AIR50-2700/AIR80-2560 each axis movement direction

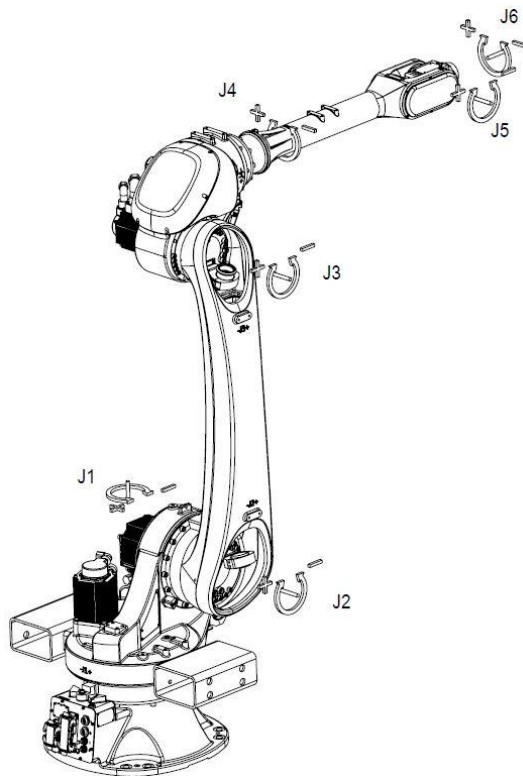


Figure 7-3 AIR35-2700/AIR20-3100 each axis movement direction

### 7.3 Dimension and working range of each axis

The motion range of each axis of the medium load manipulator is shown in Table 7-1 as follows.

Table 7-1 Motion range of each axis of medium load manipulator

Axis number	Motion range (°)
J1*	-170 ~ +170
J2	-100 ~ +100
J3	-110 ~ +165
J4	-350 ~ +350
J5	-125 ~ +125
J6	-360 ~ +360

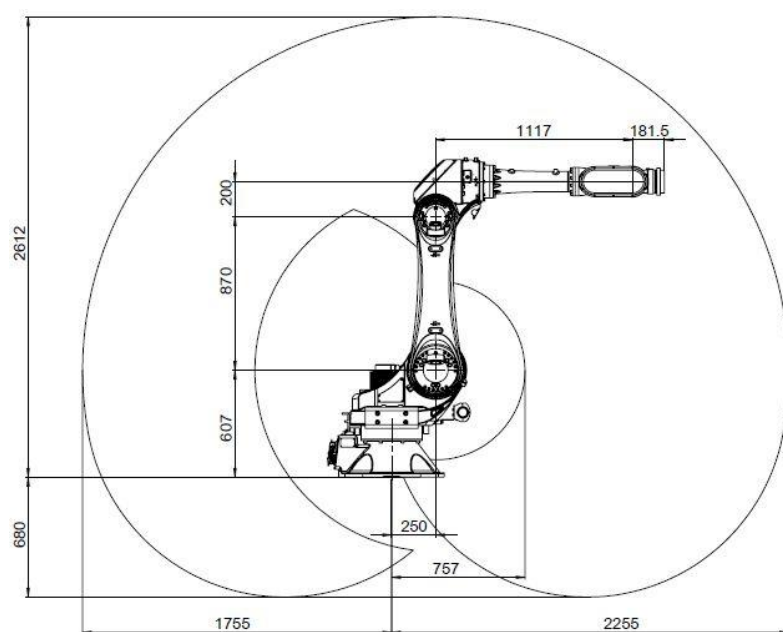


Prompt

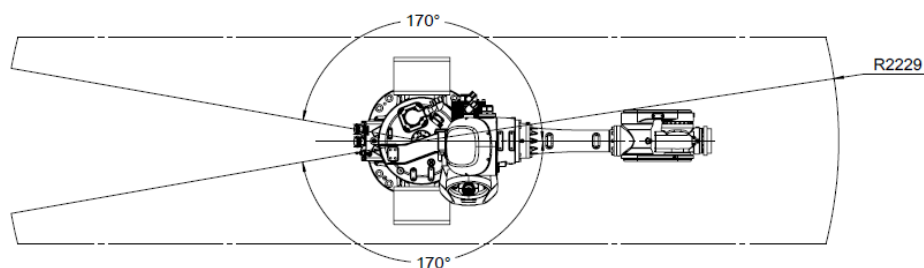
\*\*\*: If the mechanical limit of J1 axis is removed, the range of motion can reach  $-185^{\circ} \sim 185^{\circ}$

See Figure 7-4~Figure 7-8 for the motion range of the manipulator.

During the installation of peripheral equipment, attention shall be paid to avoid interference with the main part and motion range of the robot. Unit: mm.

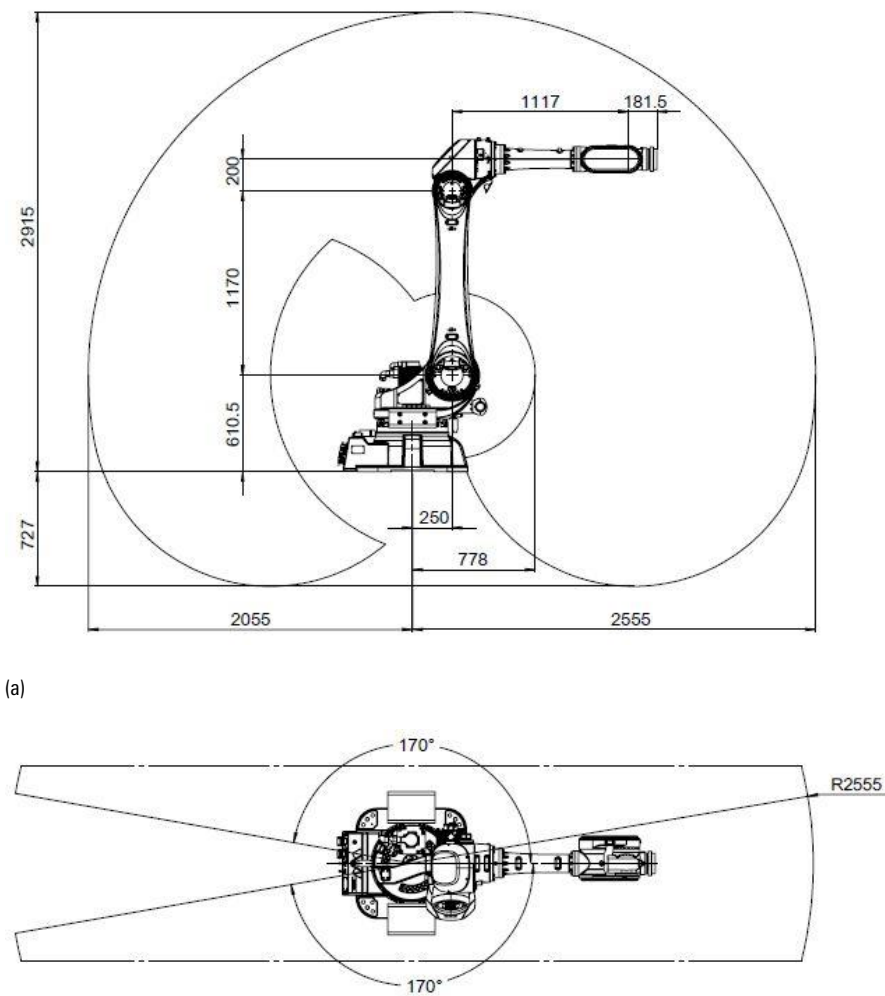


(a)

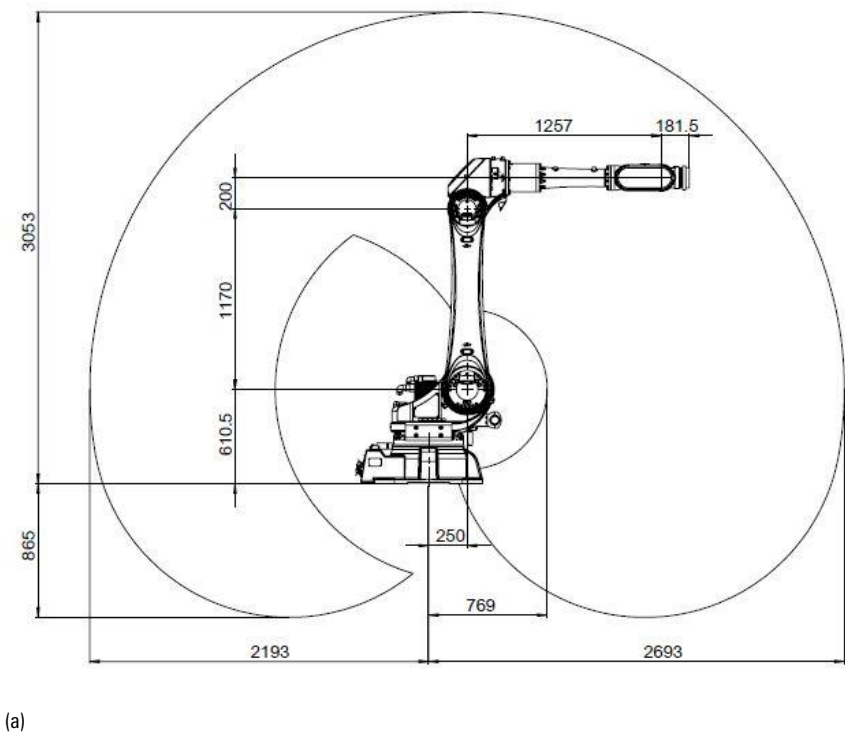


(b)

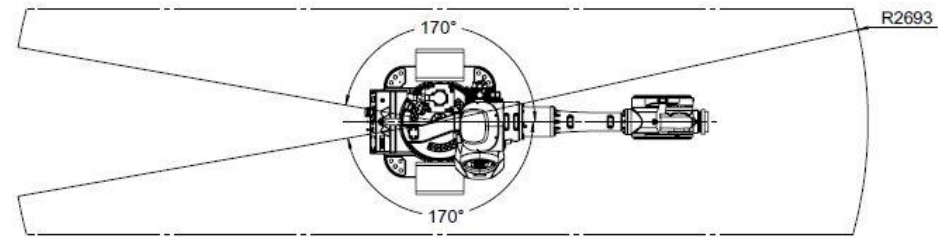
Figure 7-4 AIR50-2260/AIR80-2260 working range



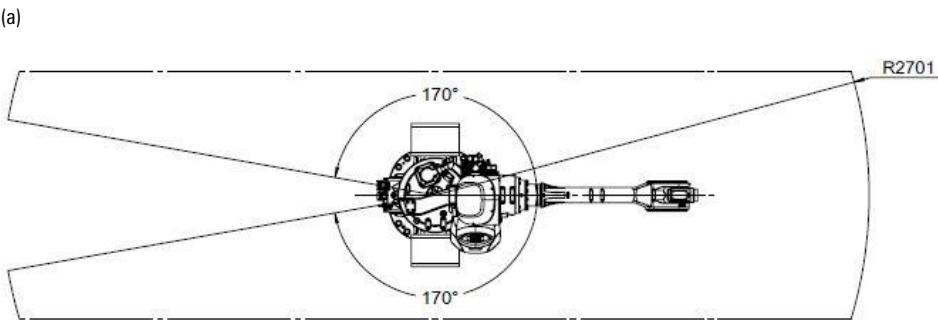
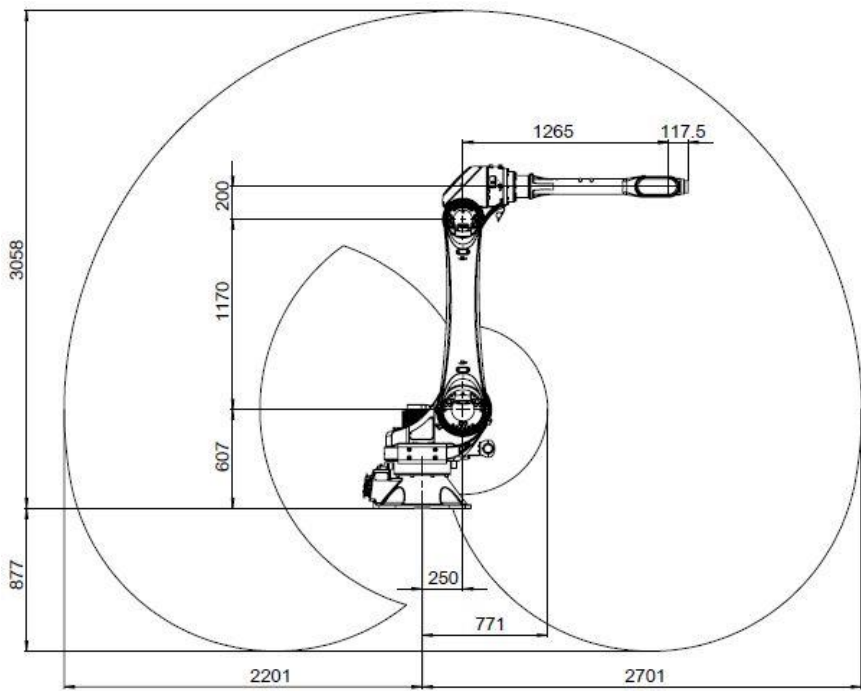
(a)  
Figure 7-5 AIR80-2560 working range



(a)



(b)  
Figure 7-6 AIR50-2700 working range



(b)  
Figure 7-7 AIR35-2700 working range

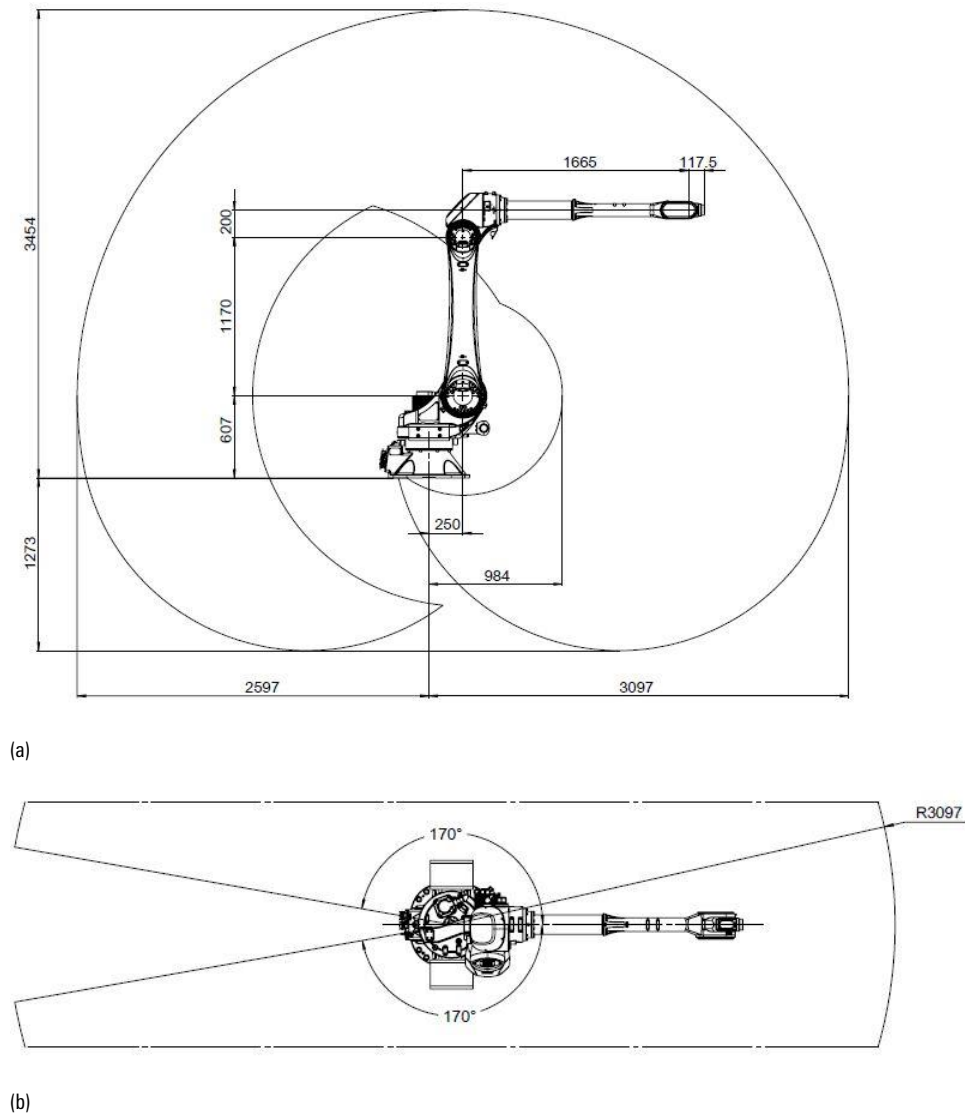


Figure 7-8 AIR20-3100 working range

## 7.4 Mechanical limit

Zero point and movable range are respectively set on each axis. As long as the origin position is not lost due to servo system abnormality and system error, the robot is controlled to move within the movable range. In addition, in order to further ensure safety, mechanical brakes are provided on some axes to limit the movable range.

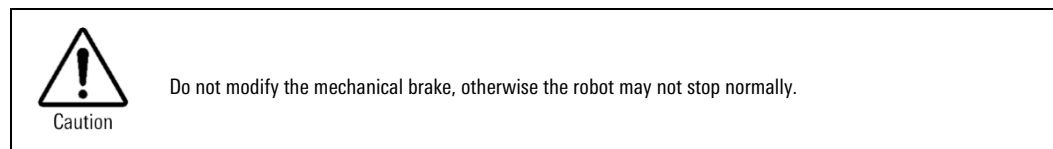


Figure 7-9~Figure 7-10 show the position of mechanical brake.

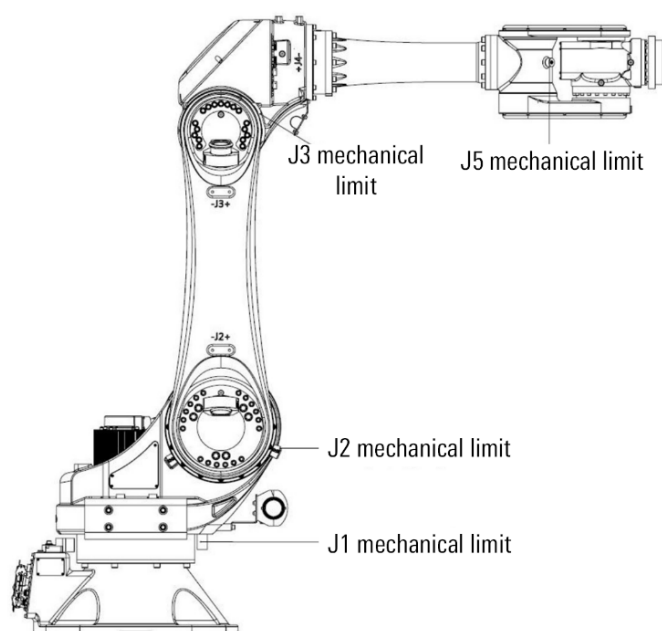


Figure 7-9 AIR50-2260/AIR80-2260 mechanical brake

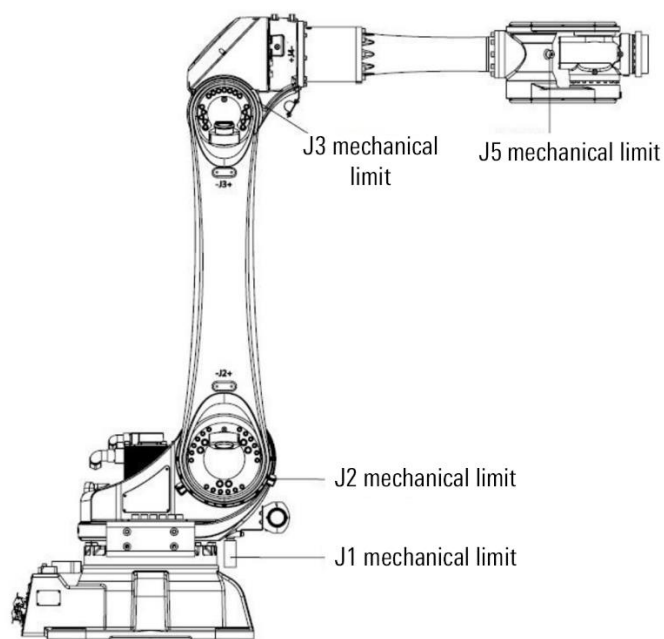


Figure 7-10 AIR50-2700/AIR80-2560 mechanical brake

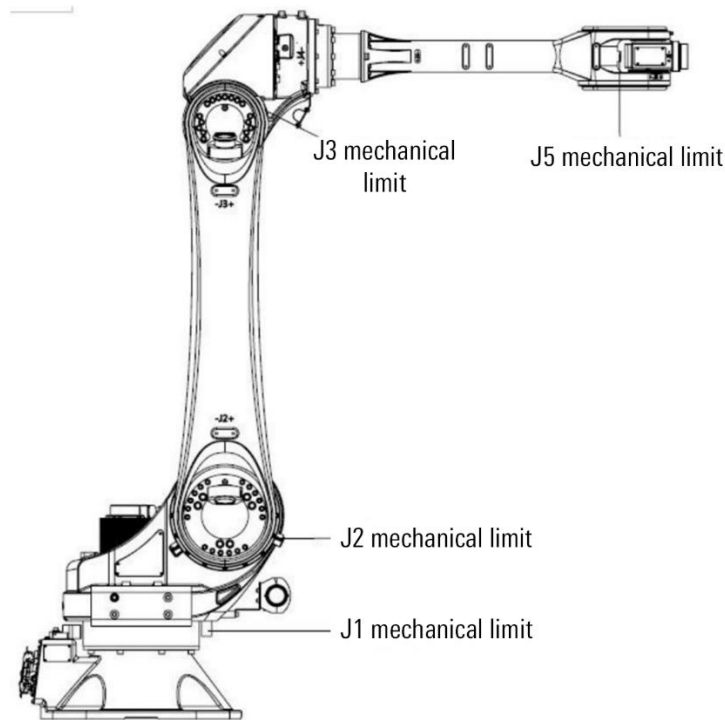


Figure 7-11 AIR35-2700/AIR20-3100 mechanical brake

## 7.5 Speed of each axis

The maximum angular speed of each axis of the manipulator is shown in Table 7-2.

Table 7-2 Maximum angular speed of each axis of the manipulator

Parameters		AIR20-3100	AIR35-2700	AIR50-2260	AIR50-2700	AIR80-2260	AIR80-2560
Maximum speed	J1	185° /s	185° /s	185° /s	155° /s	185° /s	155° /s
	J2	180° /s	180° /s	175° /s	145° /s	145° /s	145° /s
	J3	180° /s	180° /s	180° /s	180° /s	180° /s	185° /s
	J4	310° /s	310° /s	310° /s	310° /s	310° /s	310° /s
	J5	375° /s	375° /s	395° /s	395° /s	270° /s	270° /s
	J6	470° /s	470° /s	465° /s	465° /s	465° /s	465° /s

## 7.6 Output flange size

The Table 7-3, Figure 7-12, Table 7-4 and Figure 7-12 show output flange specification and connection size. Tightening torque of screws is shown in Appendix B.

Table 7-3 AIR50-2260/AIR80-2260/AIR50-2700/AIR80-2560 output mechanical interface specifications

Parameter	Value
Locating circle diameter	35mm or 130mm
Diameter of graduation circle of threaded hole	115mm



Parameter	Value
Screw grade	12.9 grade
Screw diameter	M8
Screw quantity	6
Locating pin	8mm
Screw standard	GB/T 70.1-2000

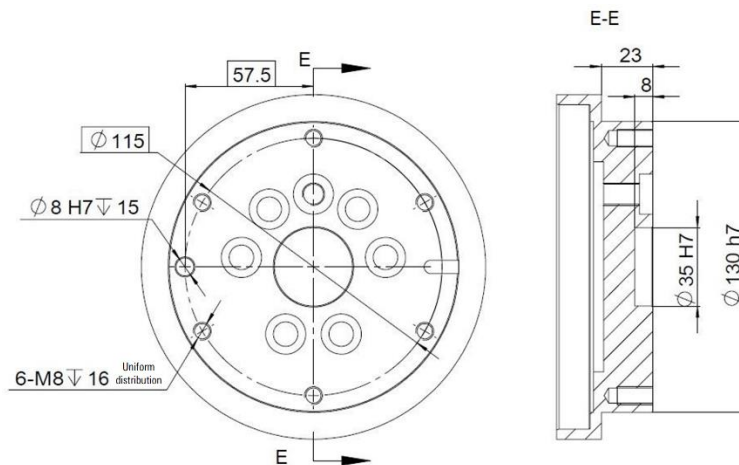


Figure 7-12 AIR50-2260/AIR80-2260/AIR50-2700/AIR80-2560 wrist flange dimensions



Warning

When installing the fixture, the depth of the threaded hole and pin hole shall be fully considered for the screws and locating pins used. It is forbidden to install the length beyond the depth of the threaded hole (16mm) and the depth of the pin hole (15mm), otherwise the wrist of the manipulator will be damaged.

Table 7-4 AIR35-2700/AIR20-3100 output mechanical interface specifications

Parameter	Value
Locating circle diameter	18mm or 75mm
Diameter of graduation circle of threaded hole	45mm
Screw grade	12.9 grade
Screw diameter	M6
Screw quantity	6
Locating pin	4mm
Screw standard	GB/T 70.1-2000

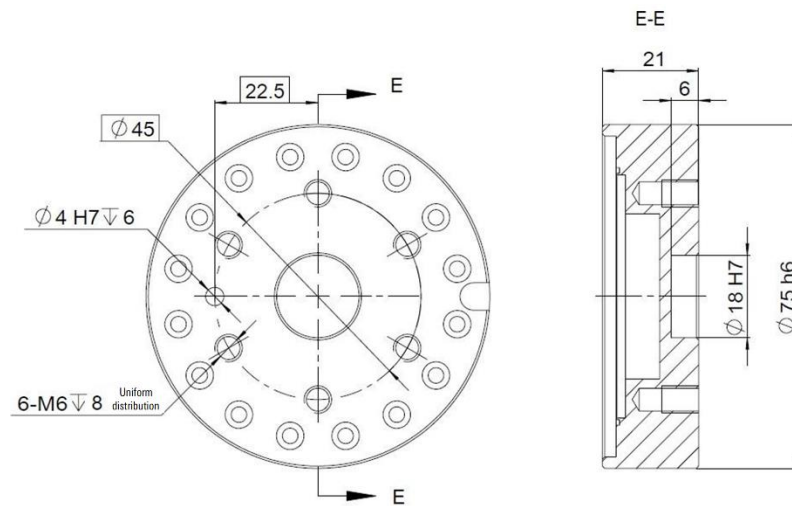


Figure 7-13 AIR35-2700/AIR20-3100 wrist flange dimensions



Warning

When installing the fixture, the depth of the threaded hole and pin hole shall be fully considered for the screws and locating pins used. It is forbidden to install the length beyond the depth of the threaded hole (8mm) and the depth of the pin hole (6mm), otherwise the wrist of the manipulator will be damaged.

## 7.7 Load and installation method

### Calculation method of inertia moment

Inertia moment refers to the difficulty of rotation of the load (clamp end + workpiece) when the robot joint starts to rotate (inertia). The moment of inertia increases with the weight of the load and eccentricity. Since this will also increase the load on the joints, please ensure that the inertia moment is within the allowable range.

The moment  $M$  ( $N \cdot m$ ) and inertia moment  $I$  ( $kgm^2$ ) can be obtained when the load (clamp end + workpiece) volume is small by the following formula.

$$M(N \cdot m) = m(kg) \times L(m) \times g(m/s^2)$$

$$I(kgm^2) = m(kg) \times L^2(m)$$

Where,  $M$  is the load weight (kg),  $L$  is the load eccentricity (m), and  $g$  is the gravitational acceleration ( $m/s^2$ ).

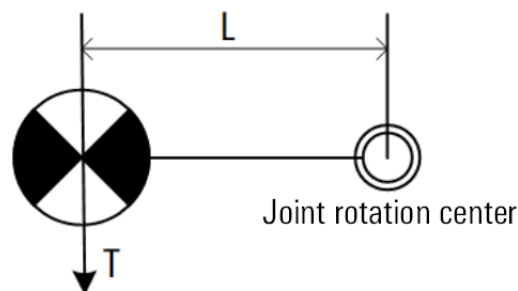
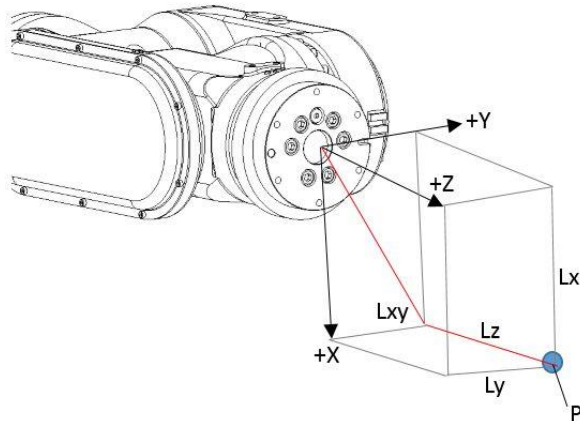


Figure 7-14 Diagram of load eccentricity

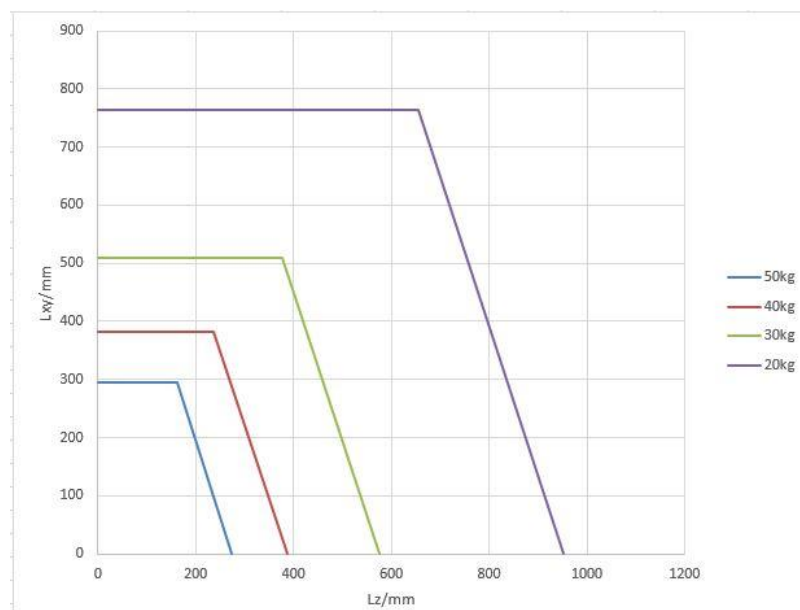
### AIR50-2260/AIR50-2700 wrist load installation

When installing the AIR50-2260/AIR50-2700 wrist load, please note:

- For loads with a mass not exceeding 50 kg, the center of mass positions  $L_{xy}$  and  $L_z$  should be within the range of the corresponding wireframes shown in Figure 7-15 (b); Figure 7-15 (a) defines the meanings of  $L_{xy}$  and  $L_z$ , where  $L_{xy}$  represents the distance between the center of mass of the load projected on the flange plane and the origin, and  $L_z$  represents the distance between the center of mass of the load projected on the flange axis and the origin.
- The 4-axis allows wrist torque is less than 222Nm, the 5-axis allows wrist torque is less than 222Nm, and the 6-axis allows wrist torque is less than 145Nm.
- The allowable load moment of inertia of 4-axis is less than 28kgm<sup>2</sup>, the allowable load moment of inertia of 5-axis is less than 28kgm<sup>2</sup>, and the allowable load moment of inertia of 6-axis is less than 22kgm<sup>2</sup>.



(a)



(b)

Figure 7-15 AIR50-2260/AIR50-2700 wrist load center of mass position diagram

The manipulator load torque and load rotation inertia data are shown in Table 7-5.

Table 7-5 Manipulator load torque and load moment of inertia data

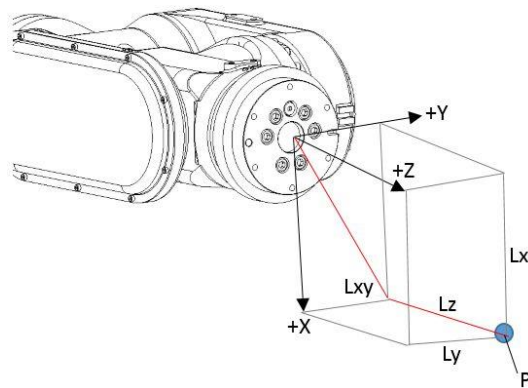
Manipulator model	Axis	Load torque	Load moment of inertia
Wrist load 50kg		Nm	Kgm <sup>2</sup>
AIR50-2260	J4	222	28

Manipulator model	Axis	Load torque	Load moment of inertia
AIR50-2700	J5	222	28
	J6	145	22

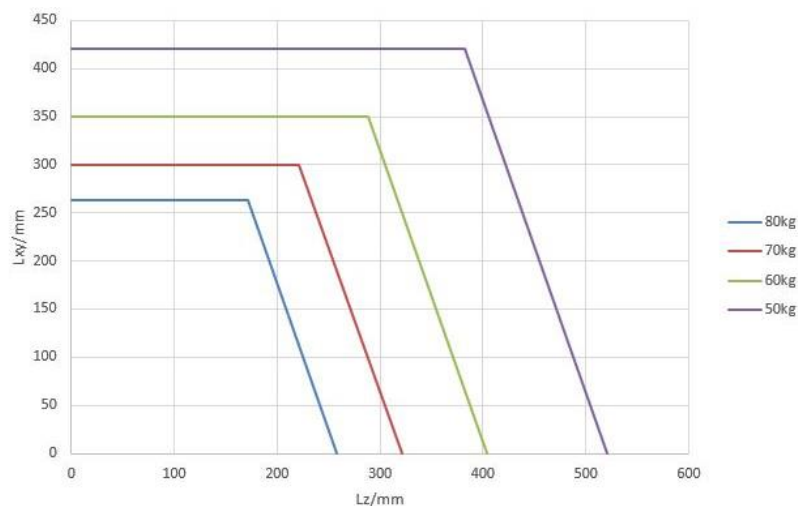
### AIR80-2260/AIR80-2560 wrist load installation

When installing the AIR80-2260/AIR80-2560 wrist load, please note:

- For loads with a mass not exceeding 80kg, the center of mass positions  $L_{xy}$  and  $L_z$  should be within the range of the corresponding wireframes shown in Figure 7-16(b); Figure 7-16 (a) defines the meanings of  $L_{xy}$  and  $L_z$ , where  $L_{xy}$  represents the distance between the center of mass of the load projected on the flange plane and the origin, and  $L_z$  represents the distance between the center of mass of the load projected on the flange axis and the origin.
- The allowable wrist torque of 4-axis is less than 344Nm, the allowable wrist torque of 5-axis is less than 344Nm, and the allowable wrist torque of 6-axis is less than 206Nm.
- The allowable load moment of inertia of 4-axis is less than 30kgm<sup>2</sup>, the allowable load moment of inertia of 4-axis is less than 30kgm<sup>2</sup>, and the allowable load moment of inertia of 6-axis is less than 20kgm<sup>2</sup>.



(a)



(b)

Figure 7-16 AIR80-2260/AIR80-2560 wrist load center of mass position diagram

The manipulator load torque and load rotation inertia data are shown in Table 7-6.

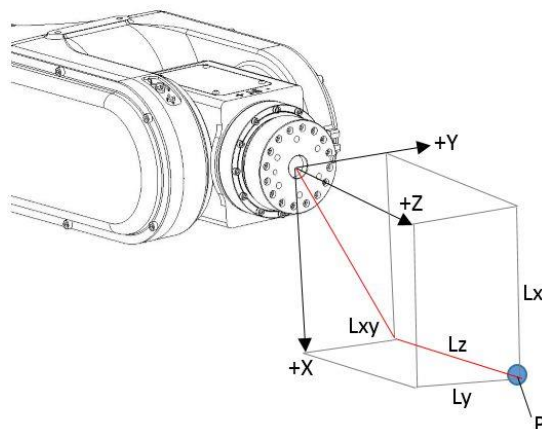
Table 7-6 Manipulator load torque and load moment of inertia data

Manipulator model	Axis	Load torque	Load moment of inertia
Wrist load 80kg		Nm	Kgm2
AIR80-2260 AIR80-2560	J4	344	30
	J5	344	30
	J6	206	20

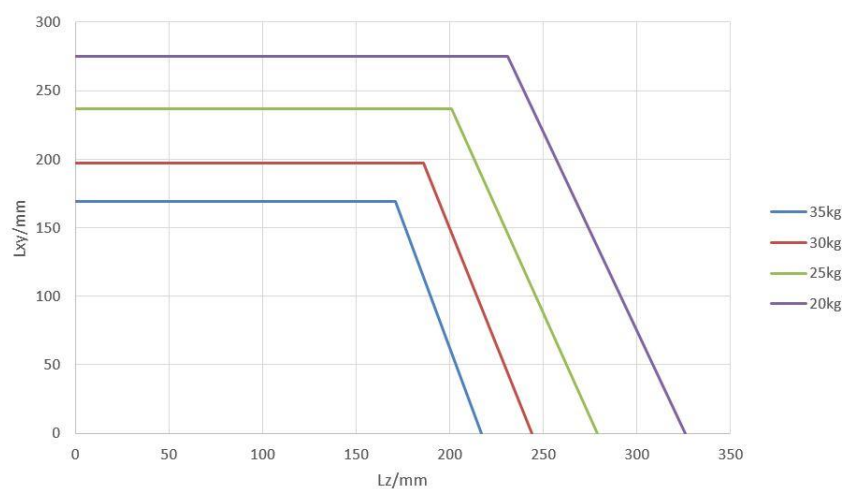
### AIR35-2700 wrist load installation

When installing the wrist load of the AIR35-2700 manipulator, please note:

- For loads with a mass not exceeding 35kg, the center of mass positions  $L_{xy}$  and  $L_z$  should be within the range of the corresponding wireframes shown in Figure 7-17(b); Figure 7-17(a) defines the meanings of  $L_{xy}$  and  $L_z$ , where  $L_{xy}$  represents the distance between the center of mass of the load projected on the flange plane and the origin, and  $L_z$  represents the distance between the center of mass of the load projected on the flange axis and the origin.
- The allowable wrist torque of the 4-axis is less than 131Nm, the allowable wrist torque of the 5-axis is less than 131Nm, and the allowable wrist torque of the 6-axis is less than 58Nm.
- The allowable load moment of inertia of the 4-axis is less than 4kgm<sup>2</sup>, the allowable load moment of inertia of the 5-axis is less than 4kgm<sup>2</sup>, and the allowable load moment of inertia of the 6-axis is less than 1.5kgm<sup>2</sup>.



(a)



(b)

Figure 7-17 AIR35-2700 wrist load center of mass position diagram

The manipulator load torque and load rotation inertia data are shown in Table 7-7.

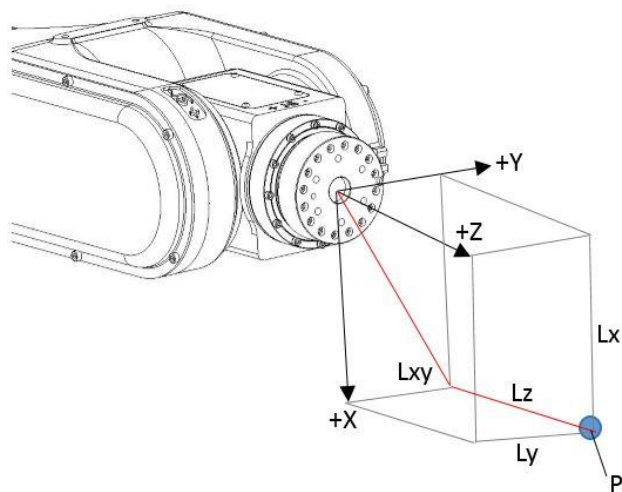
Table 7-7 Manipulator load torque and load moment of inertia data

Manipulator model	Axis	Load torque	Load moment of inertia
Wrist load 35kg		Nm	Kgm <sup>2</sup>
AIR35-2700	J4	131	4
	J5	131	4
	J6	58	1.5

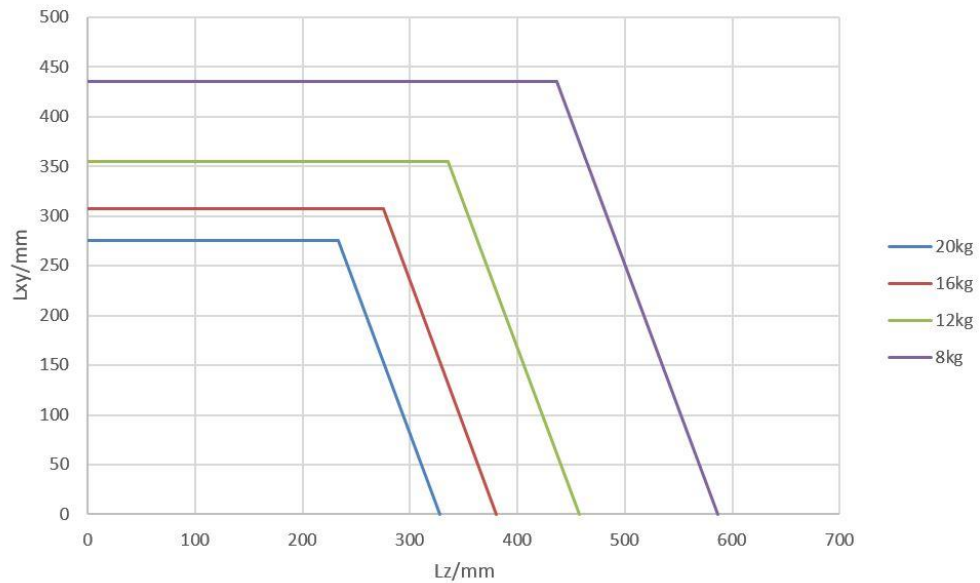
### AIR20-3100 wrist load installation

When installing the wrist load of the AIR20-3100 manipulator, please note:

- For loads with a mass not exceeding 20kg, the center of mass positions  $L_{xy}$  and  $L_z$  should be within the range of the corresponding wireframes shown in Figure 7-18(b); Figure 7-18(a) defines the meanings of  $L_{xy}$  and  $L_z$ , where  $L_{xy}$  represents the distance between the load center of mass projected on the flange plane and the origin, and  $L_z$  represents the distance between the load center of mass projected on the flange axis and the origin.
- The allowable wrist torque of the 4-axis is less than 131Nm, the allowable wrist torque of the 5-axis is less than 131Nm, and the allowable wrist torque of the 6-axis is less than 58Nm.
- The allowable load moment of inertia of the 4-axis is less than 4kgm<sup>2</sup>, the allowable load moment of inertia of the 5-axis is less than 4kgm<sup>2</sup>, and the allowable load moment of inertia of the 6-axis is less than 1.5kgm<sup>2</sup>.



(a)



(b)

Figure 7-18 AIR20-3100 wrist load center of mass position diagram

The manipulator load torque and load rotation inertia data are shown in Table 7-8.

Table 7-8 Manipulator load torque and load moment of inertia data

Manipulator model	Axis	Load torque	Load moment of inertia
Wrist load 20kg		Nm	Kgm <sup>2</sup>
AIR20-3100	J4	131	4
	J5	131	4
	J6	58	1.5

### Installation of elbow equipment of axis 3 of manipulator

When installing the elbow load of the manipulator, please note:

- The elbow and wrist of the medium load manipulator can be equipped with external equipment with a weight of no more than 20kg.
- The position of center of mass of elbow load shall be located in the area of 80mm × 60mm as shown in Figure 7-19.
- The height of the center of mass from the installation surface shall not exceed 60mm.

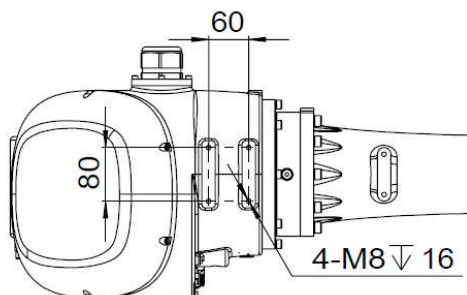



Figure 7-19 Medium load elbow load interface dimension diagram



- When installing the equipment, the reliability of installation shall be fully considered. It is recommended to use 12.9 grade screws to install according to the specified torque, and apply thread glue on the thread, otherwise the long-term operation may lead to looseness or even fracture, resulting in accidents.
- Since it may cause adverse effects on the safety and function of the manipulator, it is absolutely not allowed to add machining holes and screw holes to the Manipulator.
- When installing the equipment, the screw used shall fully consider the depth of the threaded hole, and the installation length shall not exceed the depth of the threaded hole (16mm), otherwise the elbow of the manipulator will be damaged.
- The mass center of elbow load shall not exceed the above value, otherwise the manipulator may give an alarm, fail to work normally, or reduce the working life.
- When installing the equipment at the elbow of the manipulator, pay attention to avoid the interference with the manipulator and the cable, otherwise the main body cable is broken, resulting in unexpected serious faults and consequences.

### Installation position of other parts of the manipulator

In order to facilitate cable fixation on the manipulator, other parts are reserved for the medium load manipulator as follows:

#### Fixed position of manipulator forearm

See Figure 7-20 and Figure 7-21 for the specification and size of the installation hole of the manipulator forearm.

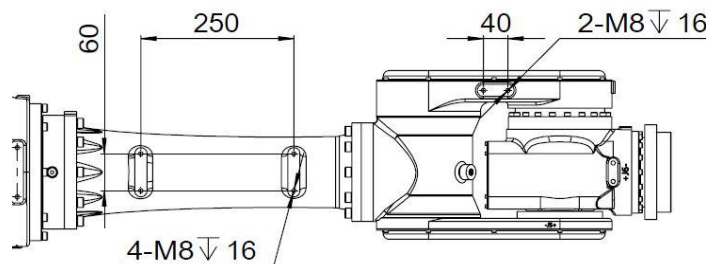


Figure 7-20 AIR50-2260/AIR80-2260/AIR50-2700/AIR80-2560 forearm interface dimensions

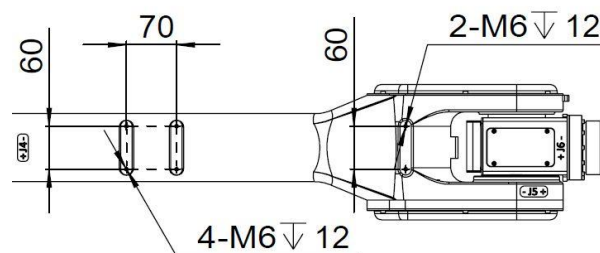


Figure 7-21 AIR35-2700/AIR20-3100 forearm interface dimensions

#### Fixed position of manipulator upper arm

The specifications and dimensions of the mounting hole of the manipulator upper arm are shown in Figure 7-22 and Figure 7-23.



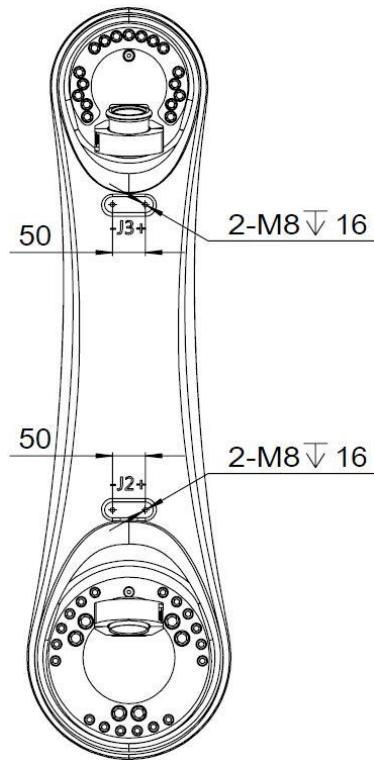


Figure 7-22 AIR50-2260/AIR80-2260 upper arm interface dimensions

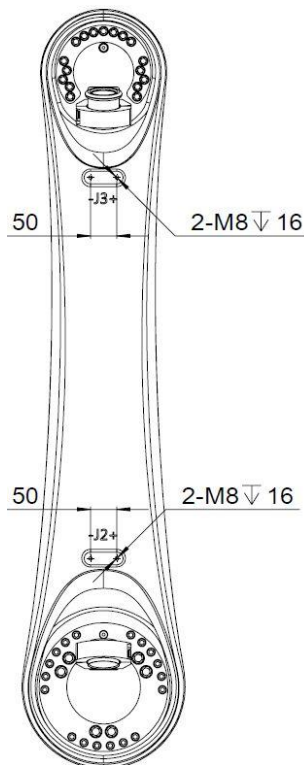


Figure 7-23 AIR80-2560/AIR50-2700/AIR35-2700/AIR20-3100 upper arm interface dimensions

#### Fixed position of manipulator shoulder

The specifications and dimensions of the mounting hole on the shoulder of the manipulator are shown in Figure 7-24 and Figure 7-25.

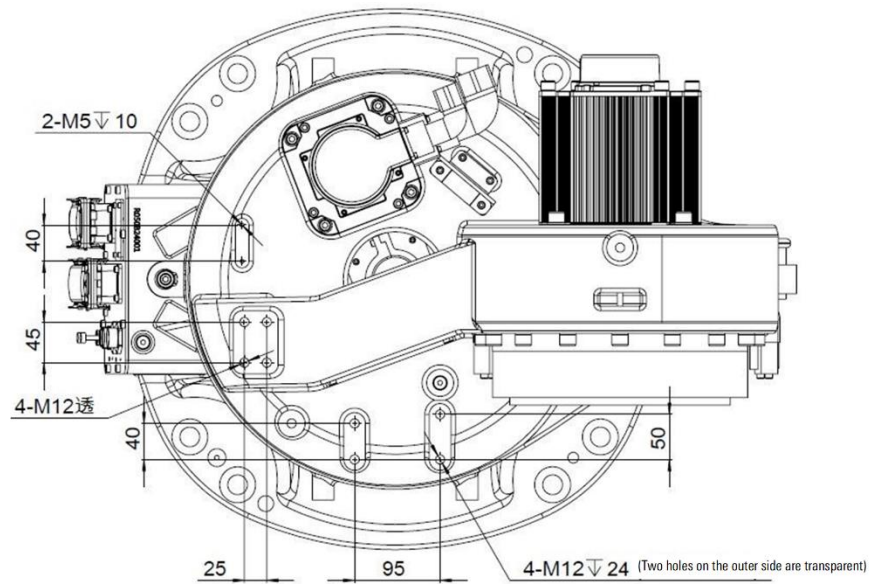


Figure 7-24 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 shoulder interface dimensions

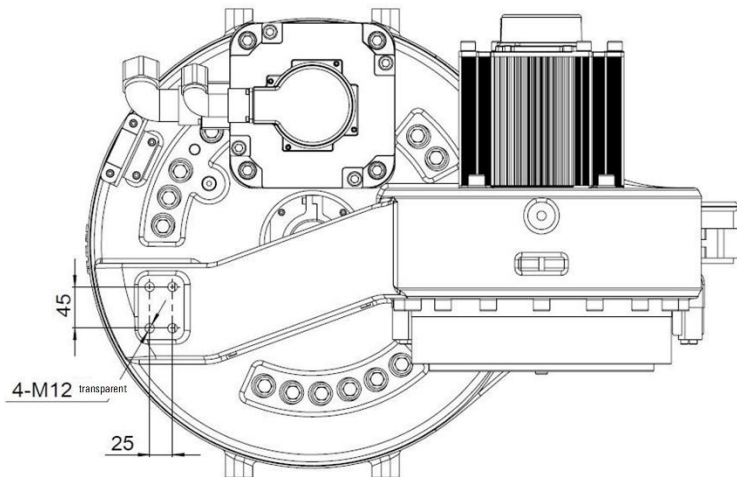


Figure 7-25 AIR50-2700/AIR80-2560 shoulder interface dimensions



Warning

When installing the equipment, the screws used should fully consider the depth of the threaded holes. The installation length is prohibited from exceeding the depth of the threaded holes, otherwise the internal components or cables of the manipulator may be damaged.

The above parts are designed for cable fixing. If you need to install equipment, you must ensure that:

- Forearm load + wrist load <80kg (AIR80-2260/AIR80-2560)
- Forearm load + wrist load <50kg (AIR50-2260/AIR50-2700)
- Forearm load + wrist load <35kg (AIR35-2700)
- Forearm load + wrist load <20kg (AIR20-3100)
- Shoulder load + upper arm load + elbow load <20kg

When installing the equipment, full consideration must be given to the reliability of the installation. It is recommended to use 12.9-grade screws to install it according to the specified torque, and apply thread glue to the threads. Otherwise, it may become loose or even break during long-term operation, causing accidents.

## 8 Calibration of the axes of the medium load manipulator

### 8.1 General

This section describes the case where the manipulator needs to be calibrated and the zero-point calibration method under different requirements.

### 8.2 When calibration is required

The manipulator needs to be recalibrated when the following situations occur:

- Repair such as motor replacement or belt pulley removal.
- Replace the encoder battery.
- The encoder wire of the motor is loose or reinstalled.
- The manipulator has a strong collision.
- Replace the control cabinet or control system (e.g., industrial personal computer).

### 8.3 Calibration position of each joint

The position of each axis of the manipulator is shown in Figure 8-1 and Figure 8-5 below, in which, except for the J3 axis, it is 90°, and the other axes are 0°.

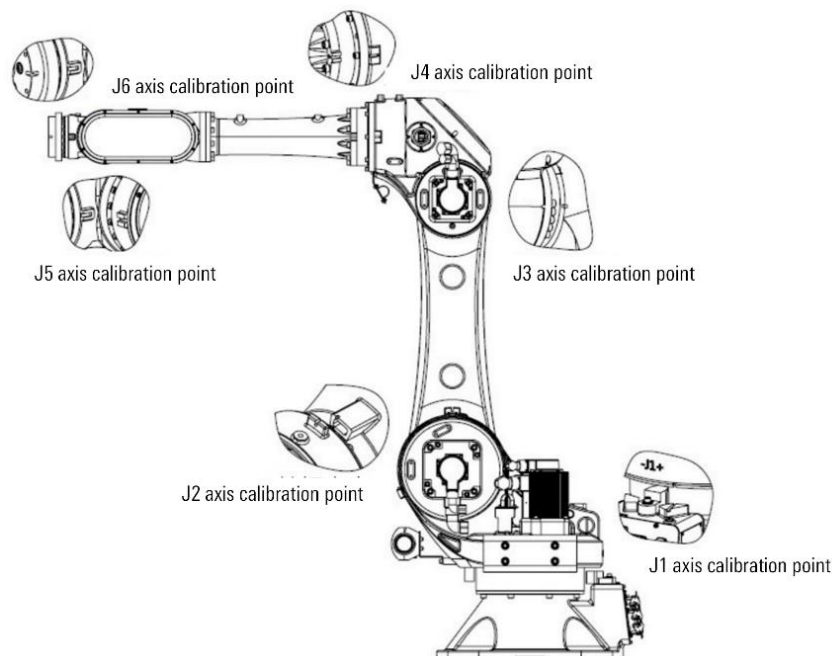


Figure 8-1 AIR50-2260/AIR80-2260 zero point diagram of each axis

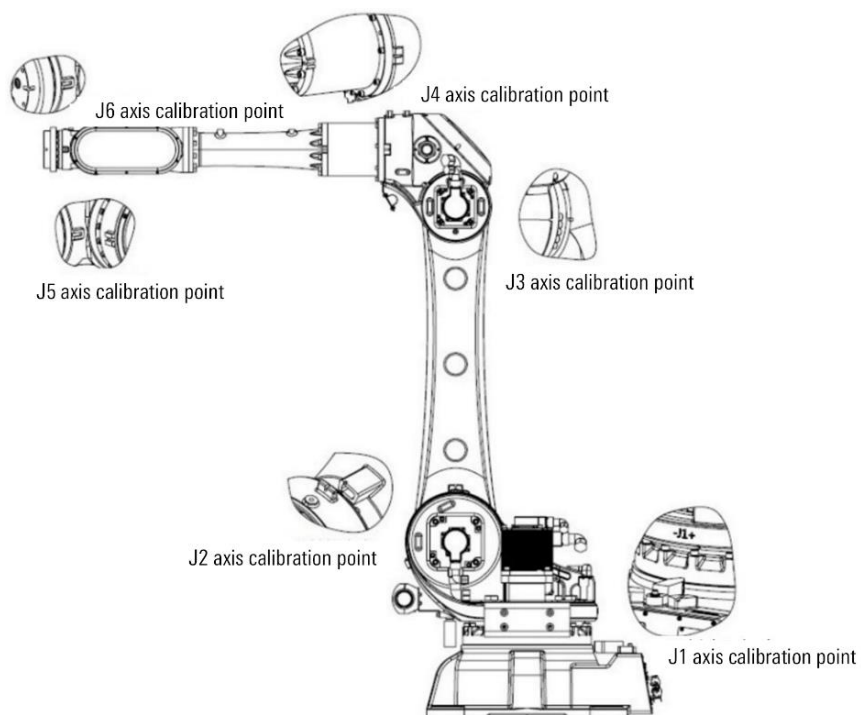


Figure 8-2 AIR50-2700 zero point diagram of each axis

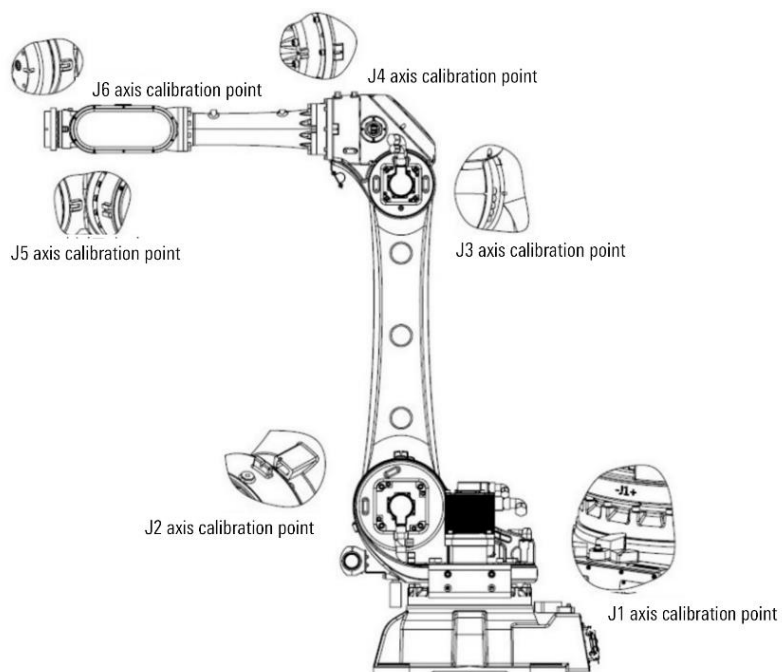


Figure 8-3 AIR80-2560 zero point diagram of each axis

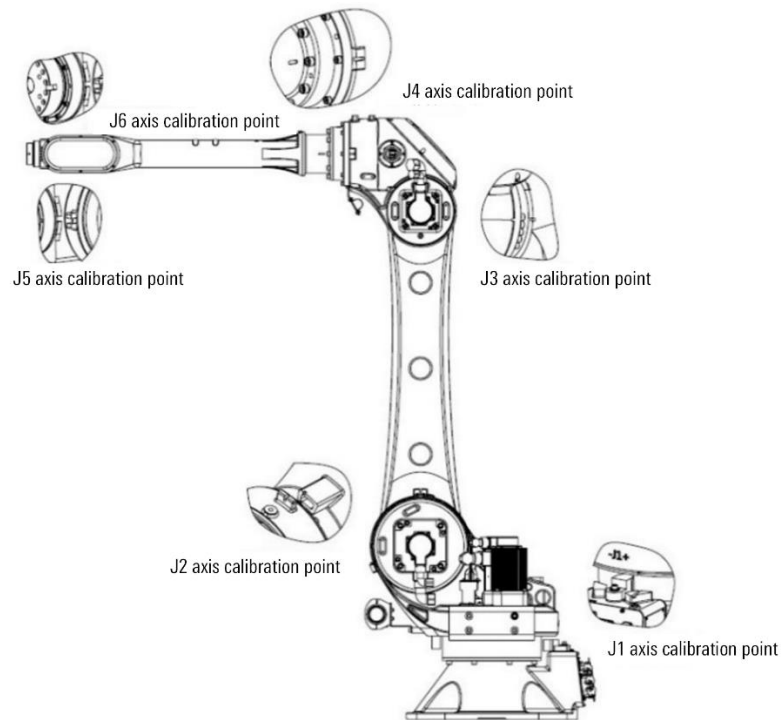


Figure 8-4 AIR35-2700 zero point diagram of each axis

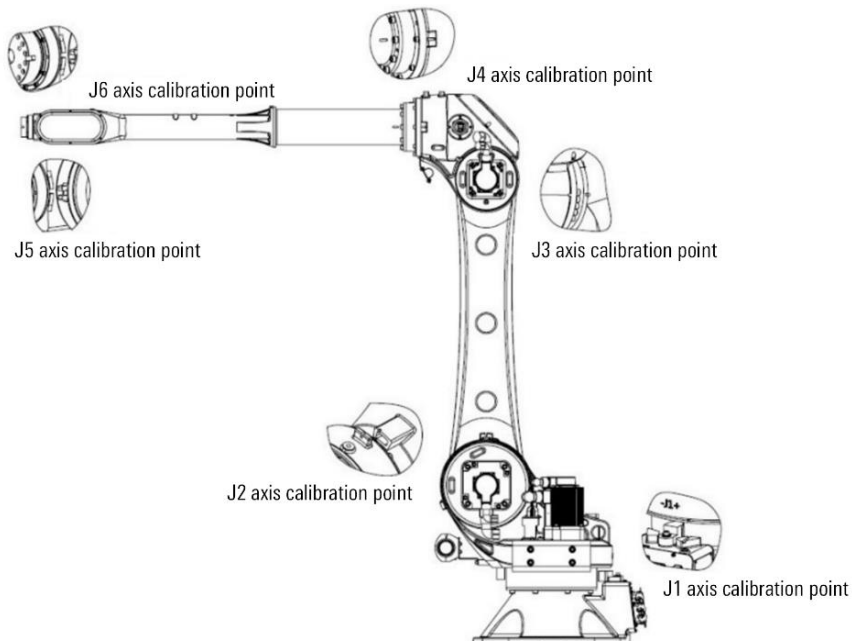


Figure 8-5 AIR20-3100 zero point diagram of each axis



Caution

- The robot calibration must always be performed at the same temperature conditions to avoid errors due to thermal expansion and contraction.
- The medium load robot calibration must be calibrated in sequence from the J1 axis to the J6 axis.

### Calibration required for high repetitive positioning accuracy

During the operation of the manipulator, only when it is required to have higher repeat positioning accuracy, the positioning accuracy of the path shall not be required. According to the zero point calibration position shown in Figure

8-1~Figure 8-5, the naked eye shall be used to make the zero point position of each axis to be aligned, as shown in Figure 8-6.

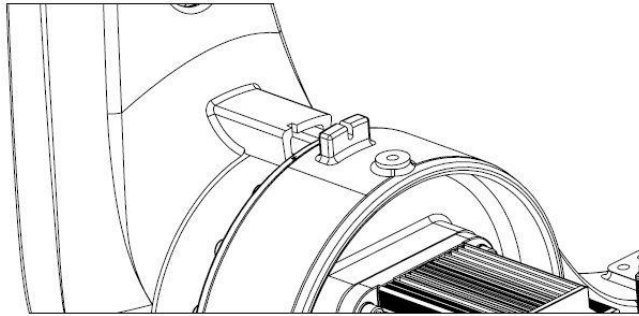


Figure 8-6 Calibration method of naked eye observation zero



Warning

In the calibration process of the manipulator, the speed should be reduced as much as possible, and the operator should not enter the working range of the robot. After each time the robot stops moving, the alignment of the zero scale on the axis position should be observed.

### Calibration for rough requirements for path positioning accuracy

When the path positioning accuracy is roughly required, the calibration block is used, as shown in Figure 8-7.

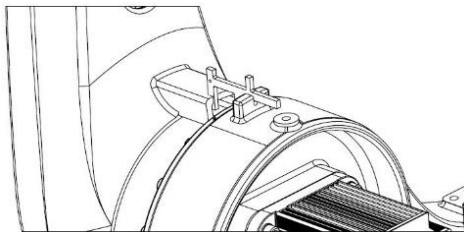


Figure 8-7 Calibration method of zero calibration block



Warning

In the calibration process of the manipulator, the speed should be reduced as much as possible, and the operator should not enter the working range of the robot. After each time the robot stops moving, the alignment of the zero scale on the axis position should be observed.



Caution

When the calibration block is used for calibration of the manipulator, the basic alignment of the calibration slot shall be observed with the naked eye, the operating speed of the manipulator is reduced to the manual lowest gear, and after the position of the fine adjustment shaft, the calibration block is used for calibration, and the calibration block can be inserted into the two calibration grooves at the same time after multiple fine adjustment, as shown in Figure 8-7.

### Calibration under the requirement of high path positioning accuracy

When the manipulator is required to have high path positioning accuracy, it is necessary to calibrate and compensate the angle and length of each axis accurately, and to contact the company to use special equipment for calibration.

## 9 Medium load manipulator transportation and handling



Figure 9-1 Precautions for manipulator during handling

When handling the robot, pay attention to the following matters:

- Do not pull the eyebolt sideways.
- Do not use the claws of forklifts, cranes, etc. to exert impact force on the transport components.
- Do not hang chains, etc. on transport components.

### 9.1 Handling posture

The postures of the first to sixth axes during the medium-load manipulator transportation are shown in Figure 9-2 to Figure 9-6 and Table 9-1 to Table 9-5.

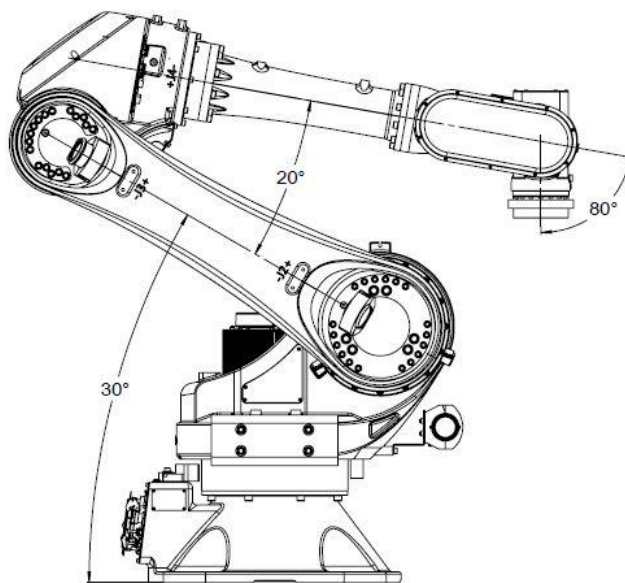


Figure 9-2 AIR50-2260/AIR80-2260 transport posture diagram



Table 9-1 AIR50-2260/AIR80-2260 angle values of each axis during transportation

A1	A2	A3	A4	A5	A6
0	-60°	160°	0	80°	0

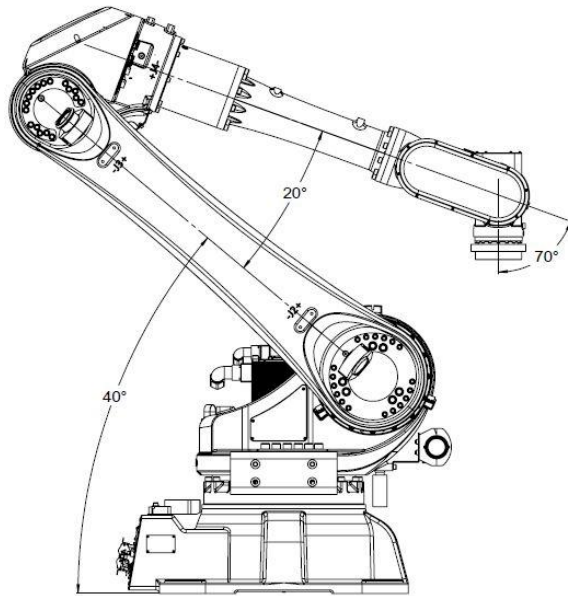


Figure 9-3 AIR50-2700 transport posture diagram

Table 9-2 AIR50-2700 angle values of each axis during transportation

A1	A2	A3	A4	A5	A6
0	-50°	160°	0	70°	0

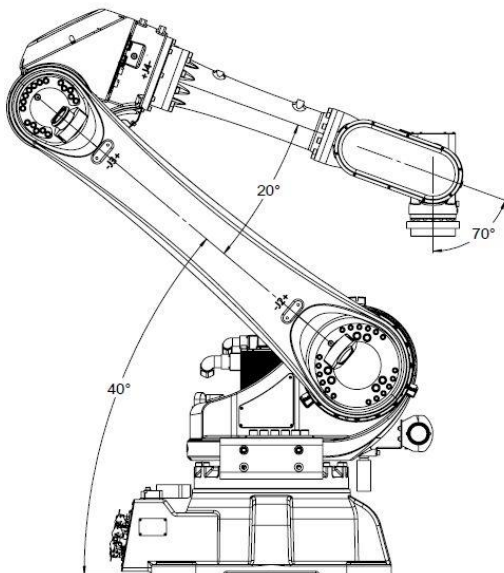


Figure 9-4 AIR80-2560 transport posture diagram

Table 9-3 AIR80-2560 angle values of each axis during transportation

A1	A2	A3	A4	A5	A6
0	-50°	160°	0	70°	0



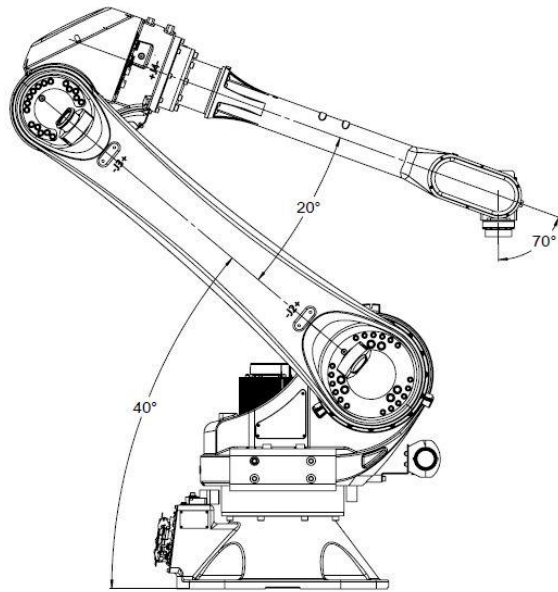


Figure 9-5 AIR35-2700 transport posture diagram

Table 9-4 AIR35-2700 angle values of each axis during transportation

A1	A2	A3	A4	A5	A6
0	-50°	160°	0	70°	0

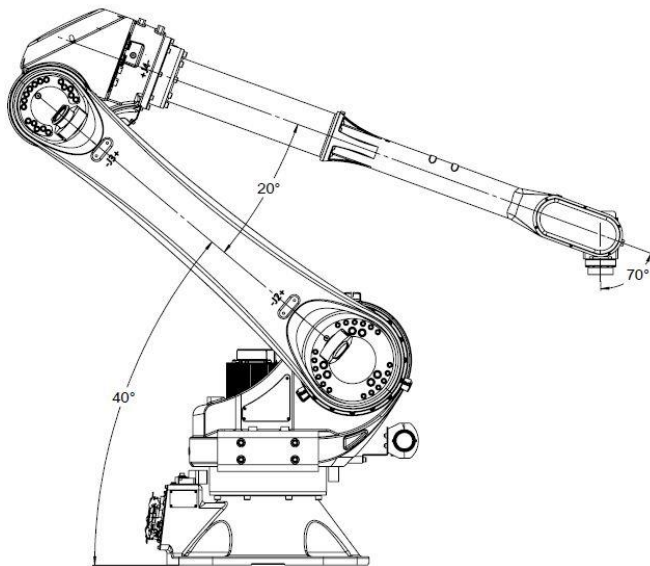


Figure 9-6 AIR20-3100 transport posture diagram

Table 9-5 AIR20-3100 angle values of each axis during transportation

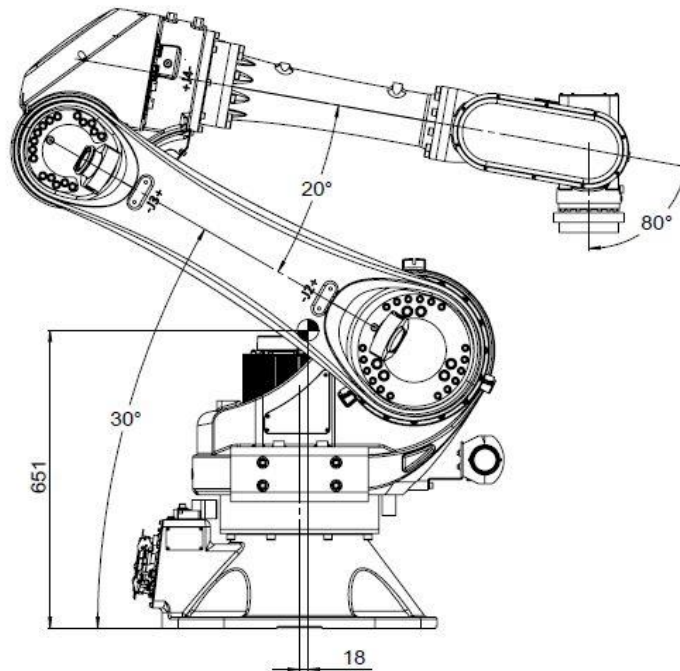
A1	A2	A3	A4	A5	A6
0	-50°	160°	0	70°	0



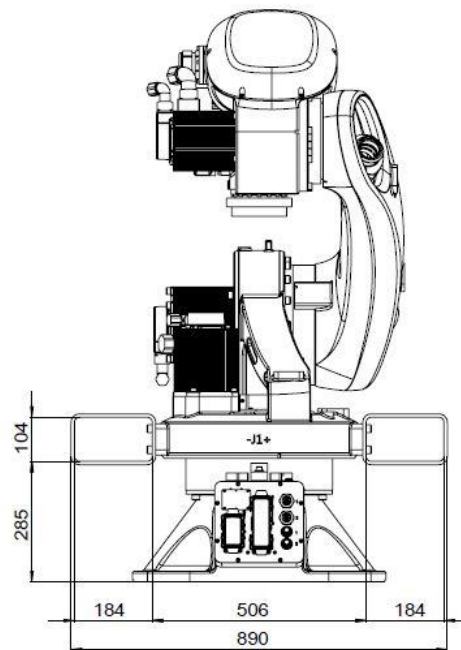
The operating machine must be moved in strict accordance with the posture shown in the table, otherwise it may topple over.

## 9.2 Handling dimensions

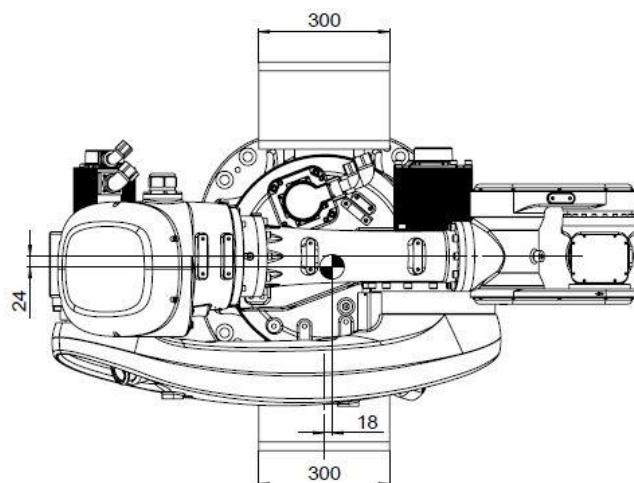
The dimensions of the three views of the manipulator during transportation are shown in Figure 9-7 to Figure 9-11 respectively (please note that the actual dimensions may be slightly larger than the dimensions in the figure).



(a)

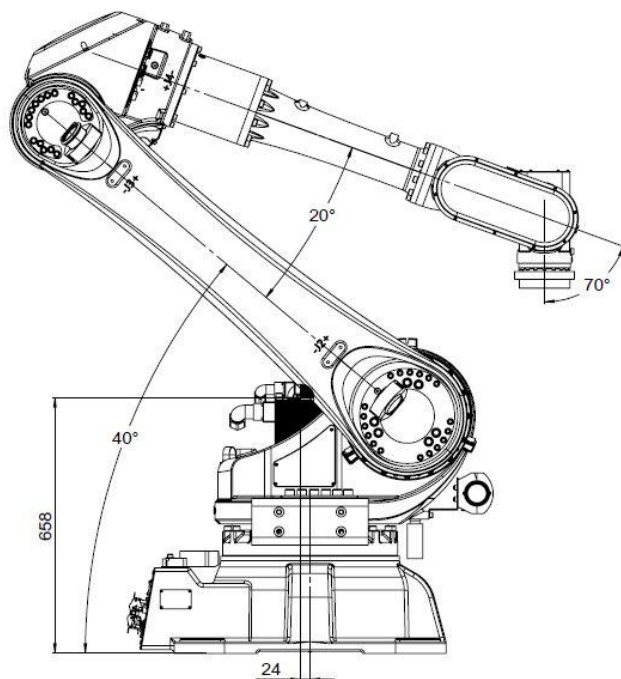


(b)

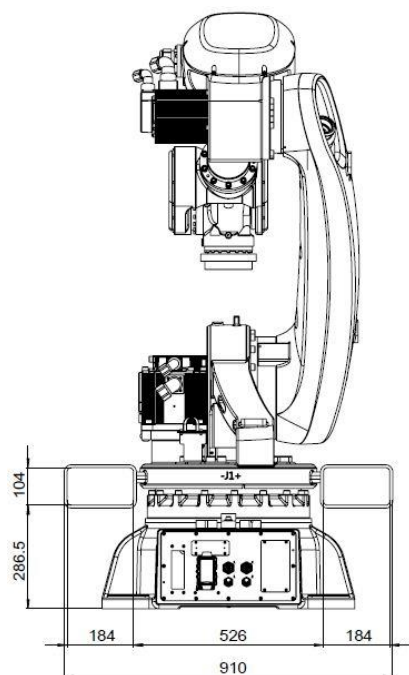


(c)

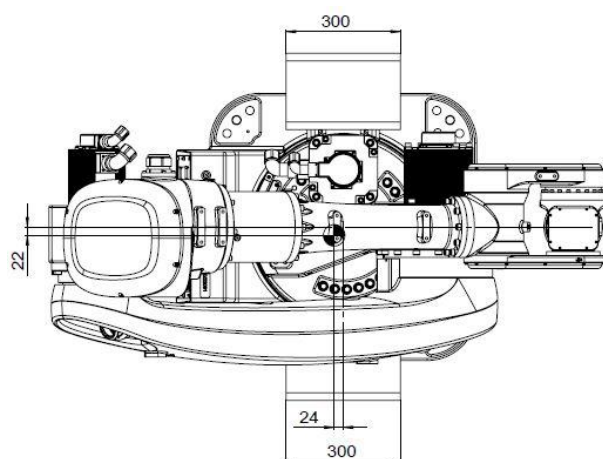
Figure 9-7 AIR50-2260/AIR80-2260 dimensions for transport



(a)

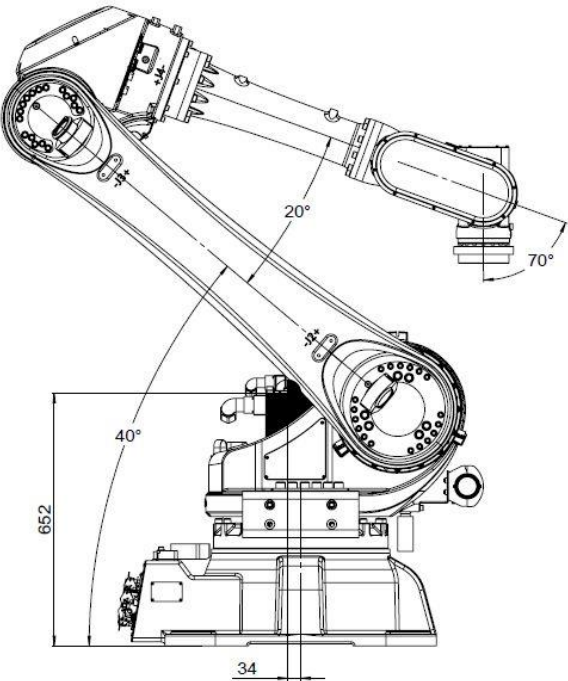


(b)

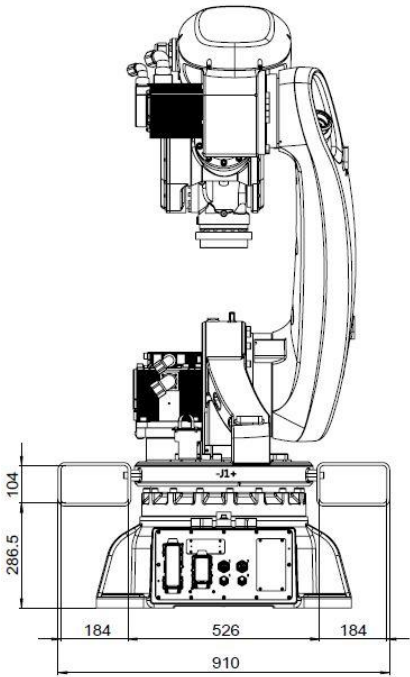


(c)

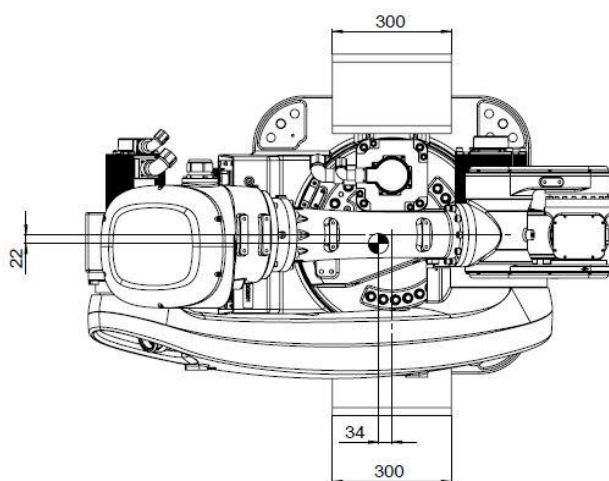
Figure 9-8 AIR50-2700 dimensions for transport



(a)

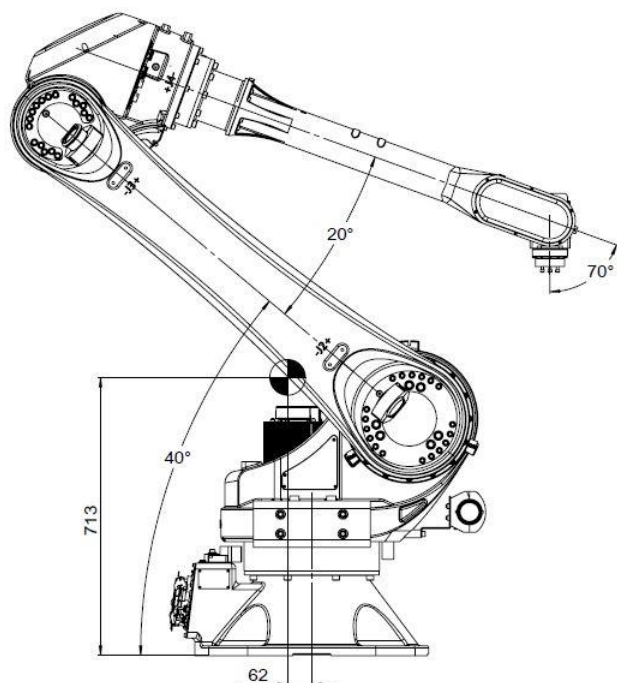


(b)

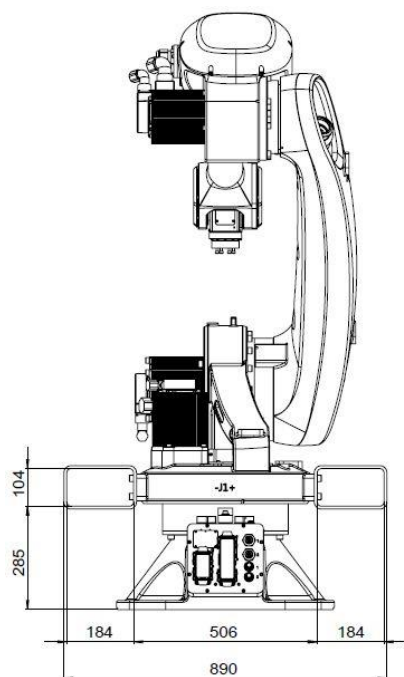


(c)

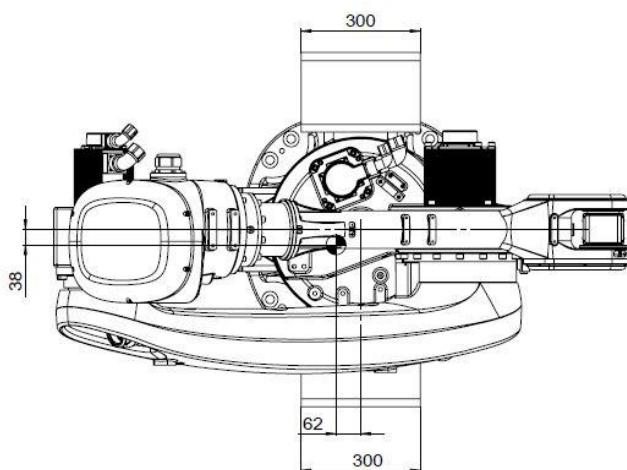
Figure 9-9 AIR80-2560 dimensions for transport



(a)

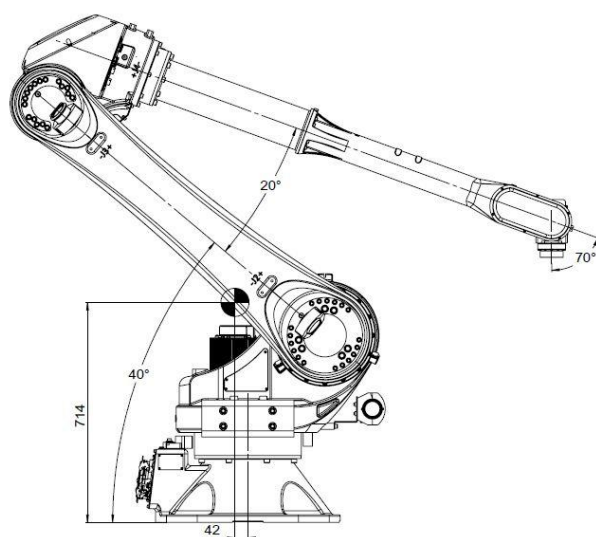


(b)

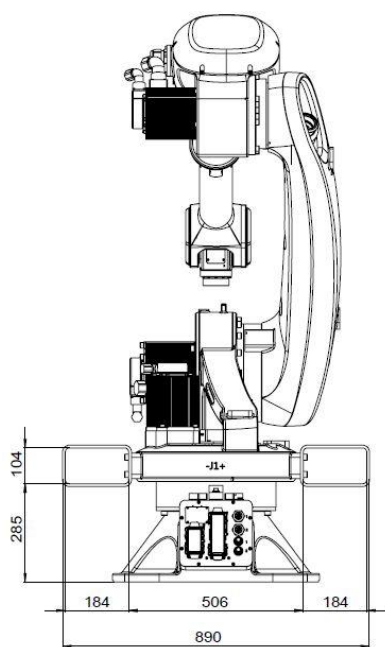


(c)

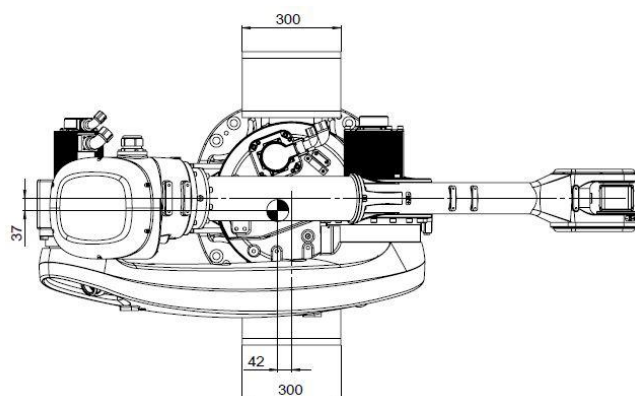
Figure 9-10 AIR35-2700 dimensions for transport



(a)



(b)



(c)

Figure 9-11 AIR20-3100 dimensions for transport



### 9.3 Handling with forklift

The diagram of using a forklift for transportation is shown in Figure 9-12 and Figure 9-13. The forklift should be able to meet the weight requirements of the manipulator:

- The total weight of the AIR50-2260 manipulator and handling device is about 595kg
- The total weight of the AIR80-2260 manipulator and handling device is about 600kg
- The total weight of the AIR80-2560 manipulator and handling device is about 755kg
- The total weight of the AIR50-2700 manipulator and handling device is about 770kg
- The total weight of the AIR35-2700 manipulator and handling device is about 570kg
- The total weight of the AIR20-3100 manipulator and handling device is about 575kg

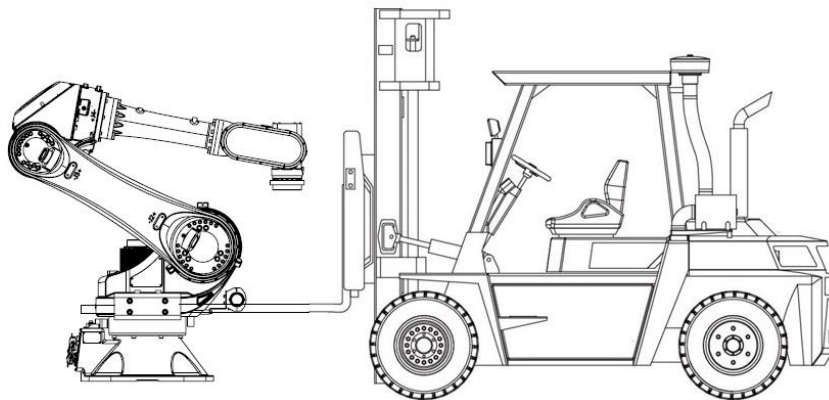


Figure 9-12 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 forklift handling diagram

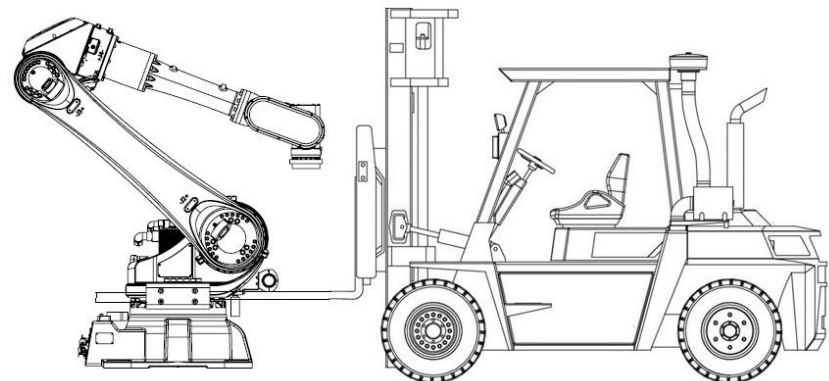


Figure 9-13 AIR50-2700/AIR80-2560 forklift handling diagram



Caution

Manipulator shall be equipped with the matching handling bracket. The incorrect handling method may cause the damage to manipulator. Manipulator posture during handling is subject to the description in Chapter0 Handling Posture of this manual.

### 9.4 Handling with swinging ring

The diagram of the manipulator being transported by a lifting ring is shown in Figure 9-14 and Figure 9-15 below. The lifting device should be able to meet the weight requirements of the manipulator:

- The total weight of the AIR50-2260 manipulator and handling device is about 595kg
- The total weight of the AIR80-2260 manipulator and handling device is about 600kg

- The total weight of the AIR80-2560 manipulator and handling device is about 755kg
- The total weight of the AIR50-2700 manipulator and handling device is about 770kg
- The total weight of the AIR35-2700 manipulator and handling device is about 570kg
- The total weight of the AIR20-3100 manipulator and handling device is about 575kg

The lifting ring is made of 20 or 25 steel. The lifting ring specification of AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 manipulators is M12. The lifting ring specification of AIR50-2700/AIR80-2560 manipulators is M24.

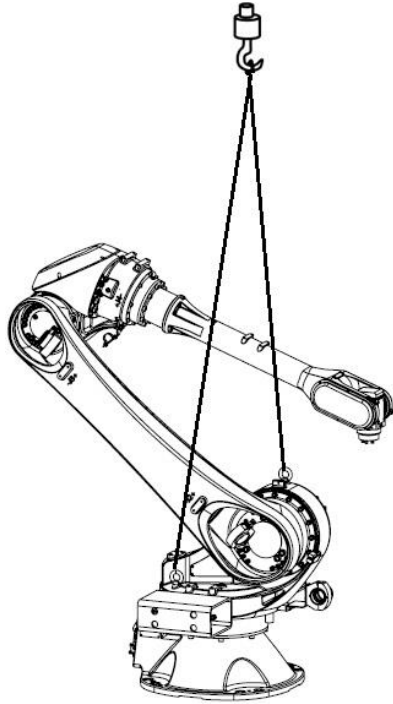


Figure 9-14 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 lifting ring handling diagram

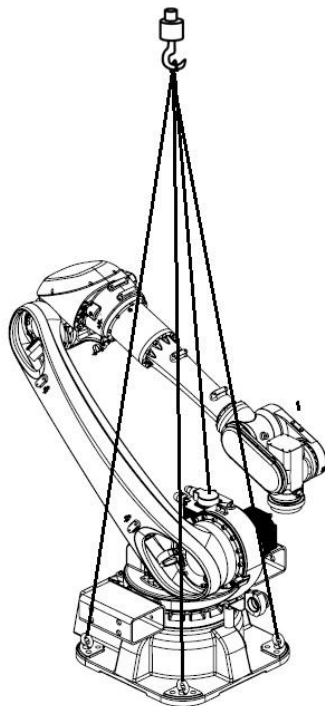


Figure 9-15 AIR50-2700/AIR80-2560 lifting ring handling diagram



- When manipulator is handled with swinging ring, insert a soft object between the sling and manipulator to avoid the scratching on the manipulator by sling.
- Manipulator may turn over when transported with swinging ring. During the handling, please take special care to keep the manipulator steady.
- Do not pull the swinging ring to the side to avoid the damage to the manipulator and the unpredictable failure.



## 10 General principles of maintenance

---

This manual is a description of preventive maintenance of the medium load manipulator. For the maintenance of a complete set of industrial robot systems, it should also include:

- Control cabinet maintenance-see "Control cabinet maintenance manual".
- End-effector maintenance-see related manual.



- No maintenance can be performed until the Safety guidelines and safety precautions are read, and maintenance can only be done by properly trained technicians.
- The primary objective of preventive maintenance is to ensure the maximum use of the operating system. Every plan, and well-implemented periodic maintenance, should help to achieve this goal. If regular maintenance cannot achieve the goal of shortening the downtime of the device, it is unnecessary to maintain and cause waste.
- Robot systems are designed to work under rather demanding conditions and require minimal maintenance. Nevertheless, daily inspection and regular maintenance must be carried out according to a given interval cycle.
- The time interval in the maintenance table is the recommended value, and the time interval actually required by the maintenance operator can be changed due to the actual working environment of the manipulator.
- When carrying out daily maintenance or maintenance, many precautions must be kept in mind so as not to introduce additional errors or dangers into the system.
- For well-functioning equipment, do not carry out more maintenance than required on a regular basis.
- All surfaces should be wiped clean before starting the maintenance process.
- In order to avoid unnecessary pollution caused by the impurities such as dust, the outside shall be cleaned before opening the control cabinet door and the outer cover of the manipulator.



## 11 Maintenance items

### 11.1 Daily maintenance

When running the manipulator every day, the following items should be checked. As shown in Table 11-1.

Table 11-1 Daily Maintenance of operation machine

Ordinal	Inspection item	Main points of inspection
1	Vibration, sound, motor heating	Check if there is abnormal vibration, abnormal noise and abnormally high temperature of each axis
2	presence or absence of positioning accuracy change	Check if there is a deviation from the last start up position and if there is a deviation from the stop position
3	Action confirmation of peripherals	Confirm that the operation of the operator and the peripherals are consistent with the instructions

### 11.2 First maintenance

The manipulator shall run for the first time 320 hours or 1 month (whichever is shorter), and the following items shall be inspected and maintained. As shown in Table 11-2.

Table 11-2 Manipulator first maintenance project

Ordinal	Inspection item	Main points of inspection
1	Whether the cable and cable sheath of the operator are damaged differently and whether the motor connector is loose	Observe the cable activity part of the manipulator, check whether the cable is damaged, whether the cable is bent or distorted locally, check whether the cable sheath is damaged or not, and check whether the motor connector is loose (Note 1)
2	Fasten external main bolts	Torque wrench to tighten the end-effector mounting bolts and the external main bolts (Note 2)
3	All parts of the cleaning manipulator	Clean and maintain the parts of the manipulator, and check whether the parts are damaged (Note 3).
4	Whether the terminal actuator cable is damaged or not	Inspect the cable for damage, and the cable sheath is damaged
5	Whether the synchronous belt is worn or not	Check if the synchronous belt is worn, elongated, and broken (note 4)
6	Check if that the stop rubber block at the J1 J2, J3, J5 shaft is damaged	Check whether the limit rubber block is loose, collision damage, aging and so on.

Note 1:

Maintenance site

- Internal cable and cable sheath inside the manipulator base (with the electrical mounting plate removed).
- Big arm of manipulator and internal cable and cable sheath of J1 axle body.
- Connecting cable of manipulator, grounding terminal, user cable joint

## Confirmation

- Check the cable sheath for crack and wear, and if so, replace it.
- Check if the lubricating grease on the surface of internal cable of J1 axle body and the internal cable of big arm is disappeared, and if the lubricating grease is about to disappear, add it properly.
- Check the line for wear and replace it if it is exposed.
- Round connector: Turn it manually to see if it is loose.
- Square heavy load: Check if the control lever is off.
- Grounding terminal: Check if it is loose.

Note 2:

## Tightening Part

- Tighten the mounting bolts of end effector and fixing bolts of manipulator, etc.
- The external connecting screws of manipulator, especially the connecting screws of shaft and the reducer or gearbox.
- For the tightening torque, please refer to the values suggested in the appendix of this manual.

Note 3:

## About Cleaning

- The parts that need to be cleaned, the dust on the plane, and the accumulation of splashes shall be cleaned regularly.
- Special care shall be taken to clean the place between the rotating parts of wrist J5 axle to remove debris in time.
- Check if oil is leaking from the reducer or gearbox.
- If the oil is still seen one day after the oil is wiped off, the oil leakage is possible.

Note 4:

## About the Maintenance of Synchronous Belt

- After disassembling the manipulator cover plate, check whether the synchronous belt is worn or damaged. For the details, see Chapter12.5 in this manual.
- Check the inside of synchronous belt teeth for white hair, the belt side for wear, belt teeth for crush, the belt body for breakage and elongation (pre-tightening force is decreasing), etc.

## 11.3 Regular maintenance

### 960 hours (3 months) regular maintenance

For every 960 hours or 3 months of operation of the manipulator (whichever is the shorter time), the following items need to be inspected and repaired. As shown in Table 11-3.

Table 11-3 Manipulator 960 hours (3 months) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Control cabinet vent cleaning	If there is a lot of dust stuck to the vent of the control cabinet, please remove it
2	Cleaning of operators	Wipe away dirt, remove accumulated spatter, dust, dust, chips, etc.



## 1920 hours (6 months) regular maintenance

The manipulator shall run for 1920 hours or 6 months (whichever is shorter), and the following items shall be inspected and repaired. As shown in Table 11-4.

Table 11-4 Manipulator 1920 hours (6 months) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Whether the cable and cable sheath of the manipulator are damaged	See Chapter 11.2
2	Whether the synchronous belt is worn or not	Check the synchronous belt for wear, elongation and fracture

## 3840 hours (1 year) regular maintenance

For every 3840 hours or 1 year (whichever is the shorter time), the operator needs to carry out the inspection and maintenance of the following items. As shown in Table 11-5.

Table 11-5 Manipulator 3840 hours (1 year) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Whether the cable and cable sheath of the manipulator are damaged	See Chapter 11.2
2	Fasten external main bolts	See Chapter 11.2
3	All parts of the cleaning manipulator	See Chapter 11.2
4	Whether the terminal actuator cable is damaged or not	See Chapter 11.2
5	Replacement of synchronous tape	See Chapter 11.2
6	Whether the J1 shaft limit rubber block is damaged or not	See Chapter 11.2

## 7860 hours (2 years) regular maintenance

The manipulator shall be operated for 2 years or 7860 hours (whichever is short), and the following items shall be inspected and repaired. As shown in Table 11-6.

Table 11-6 Manipulator 7860 hours (2 years) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Replacement of battery	See Chapter 12.3

## 11520 hours (3 years) regular maintenance

The manipulator shall be operated for 3 years or 11520 hours (whichever is less), and the following items shall be inspected and repaired. As shown in Table 11-7.

Table 11-7 Manipulator 11520 hours (3 years) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Replacement of synchronous tape	See Chapter 11.2

**15360 hours (4 years) periodic maintenance**

The manipulator shall be operated for 4 years or 15360 hours (whichever is short), and the following items shall be inspected and repaired. As shown in Table 11-8.

Table 11-8 Manipulator 15360-hour (4-year) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Replacement of internal cable of manipulator	To replace the manipulator cable, please consult with us

**19200 hours (5 years) regular maintenance**

For every 5 years or 19200 hours (whichever is the shorter time), the manipulator needs to be overhauled and many parts need to be replaced. Please contact us. As shown in Table 11-9.

Table 11-9 Manipulator 19200 hours (5 years) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Overhaul of manipulator	Please consult our company

## 12 Project maintenance process

### 12.1 Cleaning of manipulator

To ensure the long-term operation of robot, the manipulator shall be cleaned every 960 h or 3 months (whichever comes first) according to the following process:

Step1. Adjust the robot to the calibration state.

Step2. To prevent the hazards, turn off the power, hydraulic, and pneumatic sources connected to the robot.

Step3. Clean the manipulator with the vacuum cleaner or wipe it with a cloth.

Step4. After all safety conditions are met, conduct the follow-up work of manipulator.



- Do not apply the water jet on the manipulator, especially the joints and seals.
- Do not clean the manipulator with compressed air.
- Do not remove any protector of manipulator.
- Do not clean the manipulator with solvent.

### 12.2 Check and repair of cable

To ensure the long-term operation of robot, the manipulator cable shall be checked every 1,920 h or 6 months (whichever comes first). Layout for Cables of manipulator as shown in Figure 12-1~Figure 12-3.

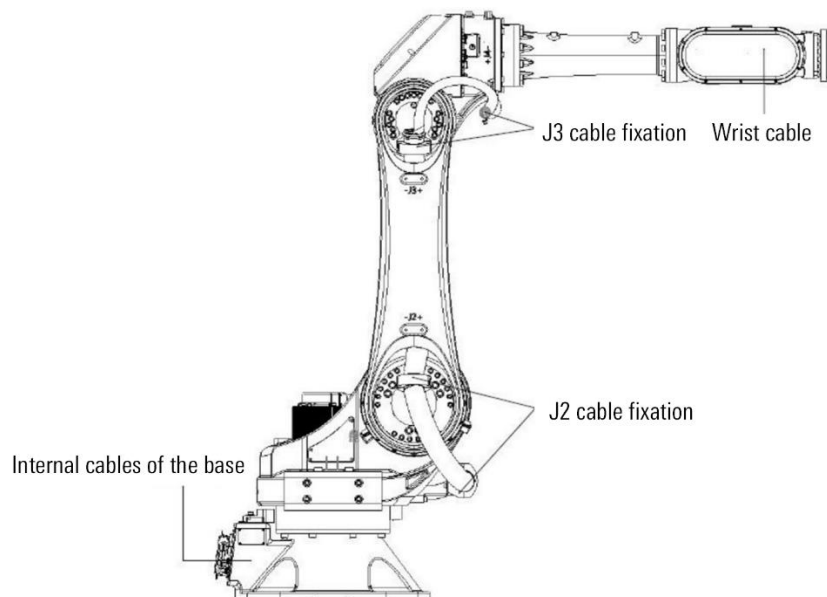


Figure 12-1 AIR50-2260/AIR80-2260 manipulator cable layout diagram

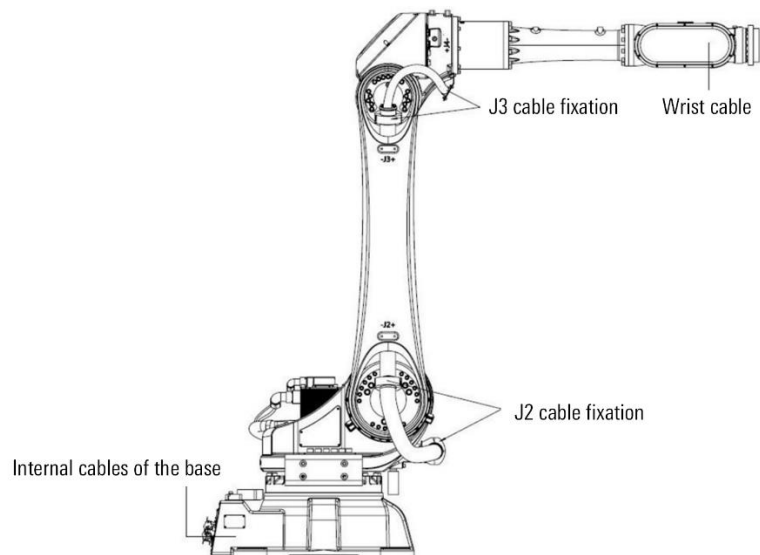


Figure 12-2 AIR50-2700/AIR80-2560 manipulator cable layout diagram

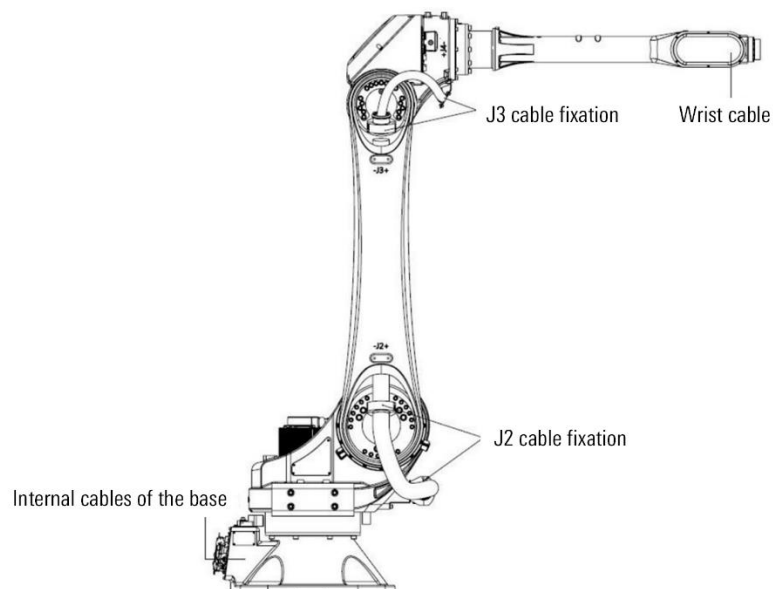


Figure 12-3 AIR35-2700/AIR20-3100 manipulator cable layout diagram

## Check and repair external cables

Maintenance steps:

- Step1. Adjust the manipulator from J1 to J6's angle is  $0^{\circ}, 0^{\circ}, 90^{\circ}, 0^{\circ}, 0^{\circ}, 0^{\circ}$ .
- Step2. To prevent the damage, please shutdown the electric power and hydraulic power and pneumatic power of the manipulator.
- Step3. Check all the external cables for wear or damage.
- Step4. Check all the cables connector for wear or damage.
- Step5. Check all the bracket and Tie-down straps are fixed on the operation
- Step6. Check the fixation between the cable and bracket for wear or damage.

Step7. In case of crack, wear or damage, please contact us for replacement timely

## Check and repair the internal cables of the base

Maintenance steps:

Step1. Remove the electrical mounting plate as shown in Figure 12-4 or Figure 12-5, and pull out the internal cables of base.

Step2. Check if the fixing plate secures the cables on the mounting plate.

Step3. Check the fixation between the cables and fixing plate for wear or damage.

Step4. Check the internal cables for wear or damage.

Step5. In case of crack, wear or damage, please contact us for replacement timely.

Step6. Check if the lubricating grease on the internal cable surface has disappeared.

Step7. If so, it shall be replenished timely.

Step8. The cable in the base to keep the shape "U" type like the Figure 12-4 and Figure 12-5.

Step9. Install the cover plate, and coat the joint surface between the cover plate and base with sealant

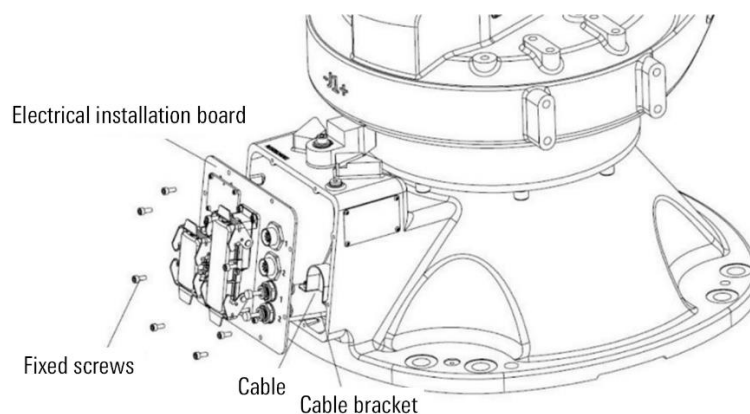


Figure 12-4 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 base internal cable

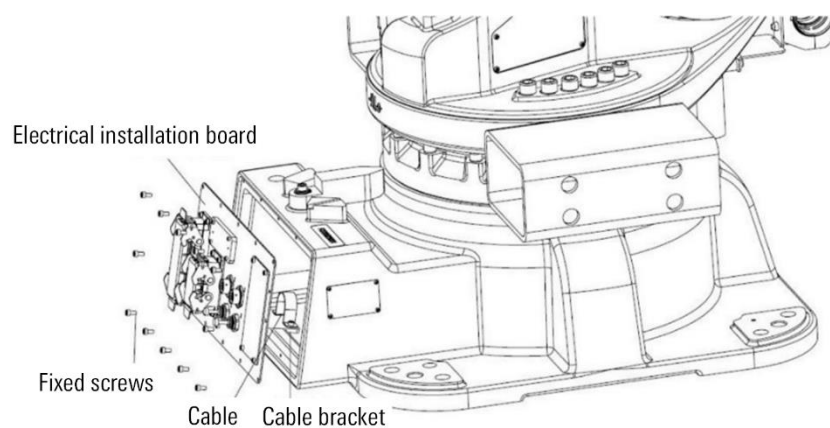
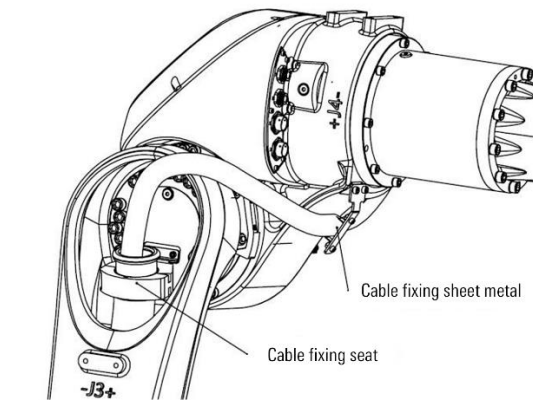


Figure 12-5 AIR50-2700/AIR80-2560 base internal cable

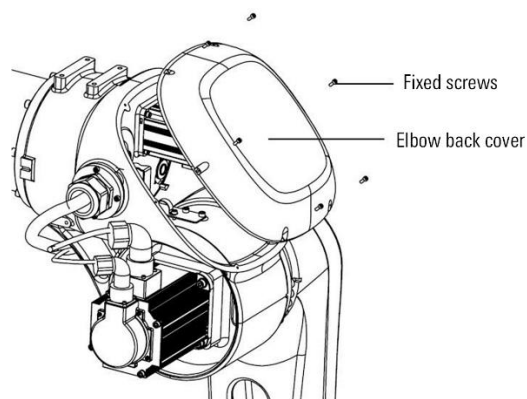
## Check and repair the elbow internal cable

Maintenance steps:

- Step1. Remove elbow cable retaining plate as shown in Figure 12-6.
- Step2. Pull out the cable and check whether the cable is reliably connected to the fixed plate.
- Step3. Check whether the cable and the bracket are fixed for wear or damage.
- Step4. Inspect internal cables for wear and tear.
- Step5. In case of cracks, wear or damage, please contact us for replacement.
- Step6. Check internal cable surface grease for disappearance.
- Step7. If the grease on the cable surface disappears, it should be replaced in time.
- Step8. Put the cable inside the elbow.
- Step9. Install the cable fixing seat, cable fixing sheet metal, and elbow rear cover.



(a)



(b)

Figure 12-6 Internal cable at elbow

## Check and repair process for internal cables of the wrist

Maintenance steps:

- Step1. Remove the cover plate as shown in Figure 12-7 or Figure 12-8.

- Step2. Check the fixation between the cable and bracket for wear or damage.
- Step3. Check the internal cables for wear or damage.
- Step4. In case of crack, wear or damage, please contact us for replacement timely.
- Step5. Check if the lubricating grease on the internal cable surface has disappeared.
- Step6. If so, it shall be replenished timely.
- Step7. Install the cover plate, and coat the joint surface between the cover plate and forearm with sealant.

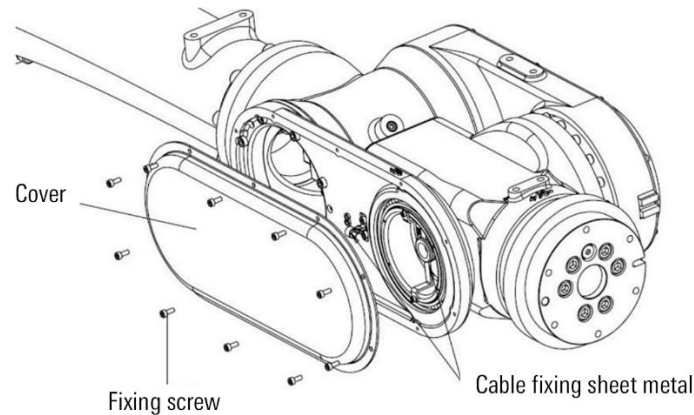


Figure 12-7 AIR50-2260/AIR80-2260/AIR50-2700/AIR80-2560 wrist internal cable

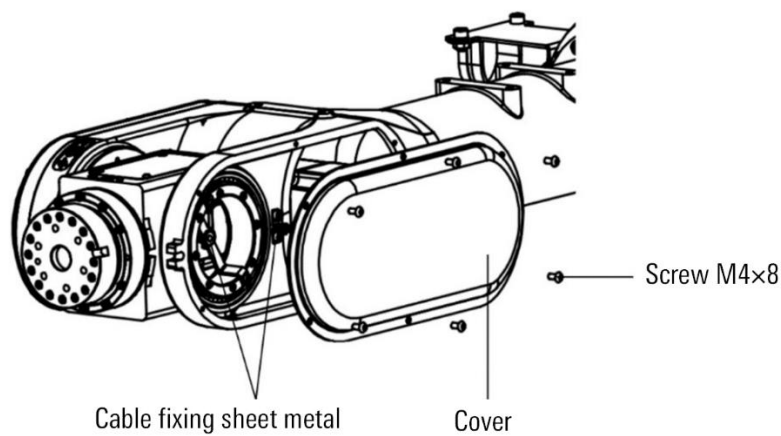


Figure 12-8 AIR35-2700/AIR20-3100 wrist internal cable



Please entrust the service department of the company to replace the internal cables of the operator. The use of substandard cables may result in the robot not working properly.

## 12.3 Battery replacement

The position data of each axis of the manipulator shall be stored by the encoder battery. The battery shall be replaced in time every 7860 hours or 2 years (whichever is shorter).

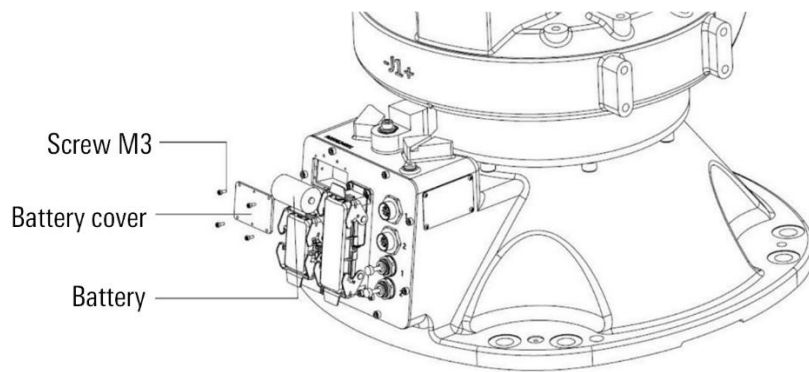


Figure 12-9 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 battery replacement

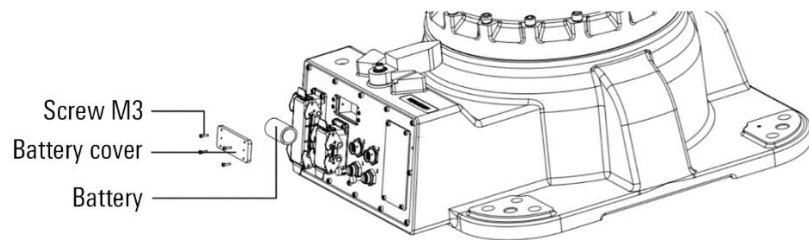


Figure 12-10 AIR50-2700/AIR80-2560 battery replacement

Maintenance steps:

- Step1. Adjust the robot to the calibration state.
- Step2. To prevent the hazards, turn off the power, hydraulic, and pneumatic sources connected to the robot.
- Step3. Remove the battery cover on the electrical mounting plate of manipulator as shown in Figure 12-9 or Figure 12-10.
- Step4. Remove the old battery from the box and put the new battery into the box. Be sure to keep the positive and negative polarities of battery same as the old one.
- Step5. Make sure that all safety conditions are met, and then perform the calibration and testing of manipulator.

## 12.4 Replace grease

Operation machine J1 axis to J6 axis reducer, every 11520 hours or 3 years (whichever is shorter), need to replace the internal grease.

Grease type and grease quantity, please refer to Table 12-1~Table 12-3.

Table 12-1 AIR50-2260/AIR80-2260 grease model and grease quantity

Manipulator model	Replace the grease part	Amount of grease	Grease type
AIR50-2260 AIR80-2260	J1 axis reducer	2800g	VIGOGREASE RE0
	J2 axis reducer	1585g	
	J3 axis reducer	1200g	
	J4 axis reducer	700g	



Manipulator model	Replace the grease part	Amount of grease	Grease type
	J5 axis reducer	210g	
	J6 axis reducer	225g	

Table 12-2 AIR50-2700/AIR80-2560 grease model and grease quantity

Manipulator model	Replace the grease part	Amount of grease	Grease type
AIR50-2700 AIR80-2560	J1 axis reducer	4300g	VIGOGREASE REO
	J2 axis reducer	1585g	
	J3 axis reducer	1200g	
	J4 axis reducer	700g	
	J5 axis reducer	210g	
	J6 axis reducer	225g	

Table 12-3 AIR35-2700/AIR20-3100 grease model and grease quantity

Manipulator model	Replace the grease part	Amount of grease	Grease type
AIR35-2700 AIR20-3100	J1 axis reducer	2800g	VIGOGREASE REO
	J2 axis reducer	1585g	
	J3 axis reducer	1200g	
	J4 axis reducer	700g	

When replacing grease, see Table 12-4 for manipulator attitude:

Table 12-4 Grease changing attitude of manipulator

Replace the grease part	J1	J2	J3	J4	J5	J6
J1 axis reducer	0°	0°	90°	Any	Any	Any
J2 axis reducer	0°	0°	90°	Any	Any	Any
J3 axis reducer	0°	0°	-90°	Any	Any	Any
J4 axis reducer	0°	0°	-90°	0°	Any	Any
J5 axis reducer	0°	0°	-90°	0°	0°	Any
J6 axis reducer	0°	0°	-90°	0°	0°	0°



Warning

- Reducer oil temperature may be higher than 90°, to be replaced after cooling.
- Wear gloves to prevent allergic reactions.
- Open the drain carefully and slowly to prevent oil spatter.

## J1 axis reducer replacement grease process

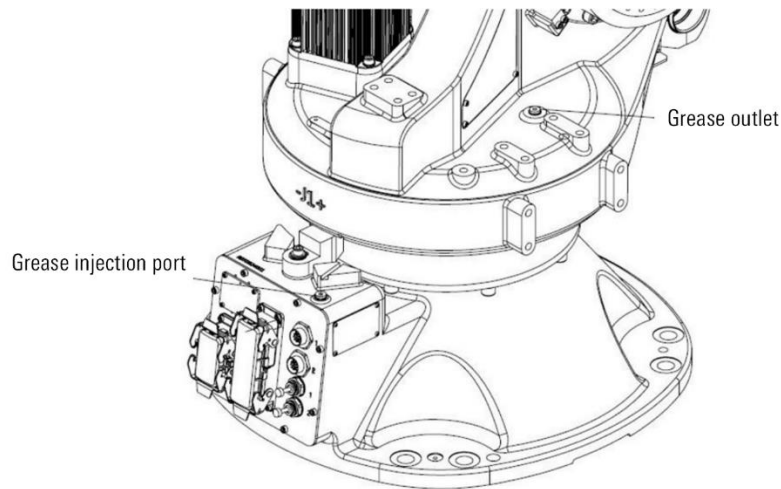


Figure 12-11 AIR50-2260/AIR80-2260/AIR35-2700/AIR20-3100 replacement of J1 axis reducer grease

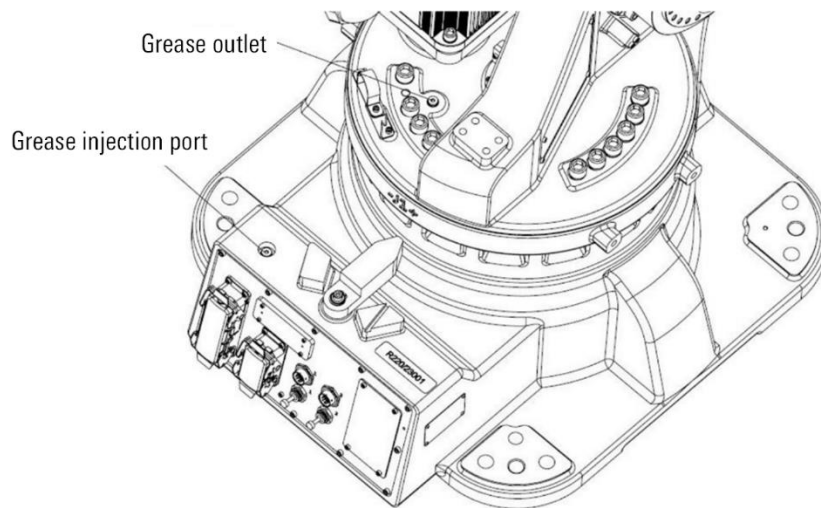


Figure 12-12 AIR50-2700/AIR80-2560 replacement of J1 axis reducer grease

The replacement process is as follows:

- Step1. Run the manipulator as shown in Table 12-4.
- Step2. To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Step3. Place the waste oil collector near the grease outlet.
- Step4. Remove the grease outlet M10x1 plug, as shown in Figure 12-11 or Figure 12-12.
- Step5. Install grease drain tubing to ensure waste oil flows into the sump tank.
- Step6. Remove the grease injection port M10x1 plug, install the grease injection nozzle, and use manual grease injection gun to inject grease until the new grease is discharged from the outlet.
- Step7. Release the grease pressure inside the reducer as shown in Table 12-5.
- Step8. The amount of oil discharged by weighing shall be equal to the amount of oil injected. If the discharge amount is less than the injection amount, the excess amount is discharged by gas at the fat injection port. If the

discharge volume is greater than the injection volume, inject the missing amount from the grease injection port.

Step9. Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.



Caution

When injecting fat from the fat injection port into the inner part of the operation machine, the fat injection speed by hand pump is less than 8g/s and the fat injection pressure is less than 0.3mpa. In order to ensure the smooth elimination of the old oil inside the reducer, after a period of oil injection, take a rest for a while, such as the oil outlet no old oil discharge to continue the oil injection. When the oil filling speed is too fast, the instantaneous pressure inside the reducer becomes higher, and the grease may cause damage to the motor oil seal and the grease enters the motor.

### J2 axis reducer replacement grease process

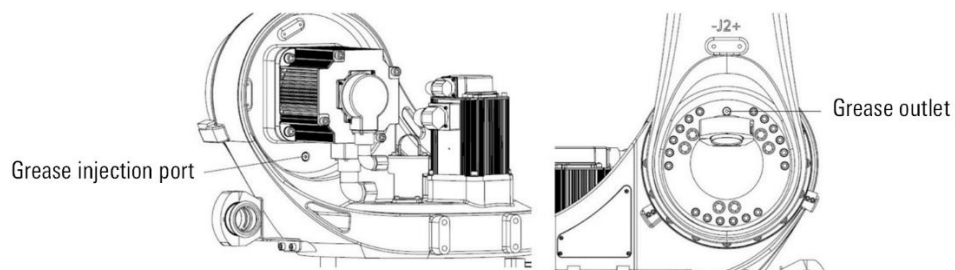


Figure 12-13 Replace the grease of J2 axis reducer

The replacement process is as follows:

- Step1. Run the manipulator as shown in Table 12-4.
- Step2. To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Step3. Place the sump tank for collecting waste oil near the grease outlet.
- Step4. Remove the grease outlet M10x1 plug, as shown in Figure 12-13.
- Step5. Install grease drain tubing to ensure waste oil flows into the sump tank.
- Step6. Remove the grease injection port M10x1 plug, install the grease injection nozzle, and use manual grease injection gun to inject grease until the new grease is discharged from the outlet.
- Step7. Release the grease pressure inside the reducer as shown in Table 12-5.
- Step8. The amount of oil discharged by weighing shall be equal to the amount of oil injected. If the discharge amount is less than the injection amount, the excess amount is discharged by gas at the fat injection port. If the discharge volume is greater than the injection volume, inject the missing amount from the grease injection port.
- Step9. Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.



Caution

When injecting fat from the fat injection port into the inner part of the manipulator, the fat injection speed by hand pump is less than 8g/s and the fat injection pressure is less than 0.3mpa. In order to ensure the smooth elimination of the old oil inside the reducer, after a period of oil injection, take a rest for a while, such as the oil outlet no old oil discharge to continue the oil injection. When the oil filling speed is too fast, the instantaneous

pressure inside the reducer becomes higher, and the grease may cause damage to the motor oil seal and the grease enters the motor.

### J3 axis reducer replacement grease process

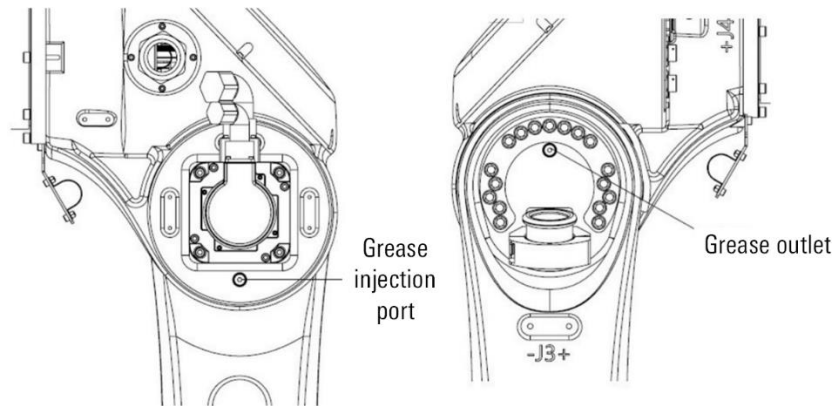


Figure 12-14 Replace the lubricating grease of J3 axis reducer

The replacement process is as follows:

- Step1. Run the manipulator as shown in Table 12-4.
- Step2. To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Step3. Place the sump tank for collecting waste oil near the grease outlet.
- Step4. Remove the grease outlet M10x1 plug, as shown in Figure 12-14.
- Step5. Install grease drain tubing to ensure waste oil flows into the sump tank.
- Step6. Remove the grease injection port M10x1 plug, install the grease injection nozzle, and use manual grease injection gun to inject grease until the new grease is discharged from the outlet.
- Step7. Release the grease pressure inside the reducer as shown in Table 12-5.
- Step8. The amount of oil discharged by weighing shall be equal to the amount of oil injected. If the discharge amount is less than the injection amount, the excess amount is discharged by gas at the fat injection port. If the discharge volume is greater than the injection volume, inject the missing amount from the grease injection port.
- Step9. Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.



When injecting fat from the fat injection port into the inner part of the operation machine, the fat injection speed by hand pump is less than 8g/s and the fat injection pressure is less than 0.3mpa. In order to ensure the smooth elimination of the old oil inside the reducer, after a period of oil injection, take a rest for a while, such as the oil outlet no old oil discharge to continue the oil injection. When the oil filling speed is too fast, the instantaneous pressure inside the reducer becomes higher, and the grease may cause damage to the motor oil seal and the grease enters the motor.

## J4 axis reducer replacement grease process

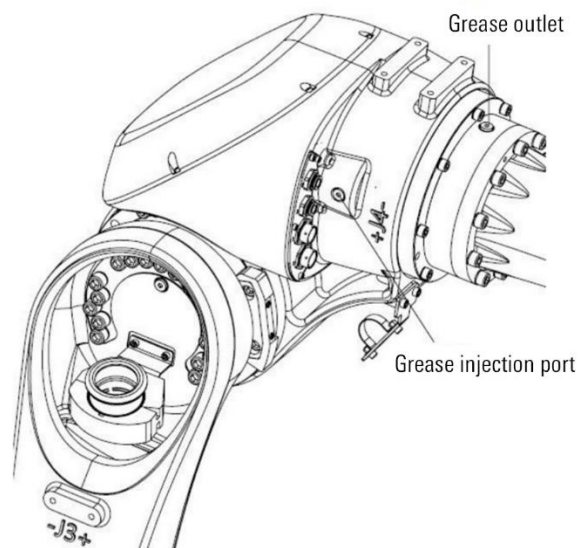


Figure 12-15 Replace the J4 axis reducer grease

The replacement process is as follows:

- Step1. Operate the manipulator to the posture shown in Table 12-4.
- Step2. To prevent any danger, turn off the power, hydraulic and air pressure sources connected to the robot.
- Step3. Place an oil collection tank for collecting waste oil near the grease drain port.
- Step4. Remove the M10x1 plug from the grease outlet, as shown in Figure 12-15
- Step5. Install the grease discharge oil pipe to ensure that the waste oil flows into the oil collection tank.
- Step6. Release the lubricating grease pressure inside the reducer as shown in Table 12-5.
- Step7. The amount of oil discharged by weighing shall be equal to the amount of oil injected. If the discharge amount is less than the injection amount, the excess amount is discharged by gas at the fat injection port. If the discharge volume is greater than the injection volume, inject the missing amount from the grease injection port.
- Step8. Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.



When injecting fat from the fat injection port into the inner part of the operation machine, the fat injection speed by hand pump is less than 8g/s and the fat injection pressure is less than 0.3mpa. In order to ensure the smooth elimination of the old oil inside the reducer, after a period of oil injection, take a rest for a while, such as the oil outlet no old oil discharge to continue the oil injection. When the oil filling speed is too fast, the instantaneous pressure inside the reducer becomes higher, and the grease may cause damage to the motor oil seal and the grease enters the motor.

## J5 axis reducer replacement grease process

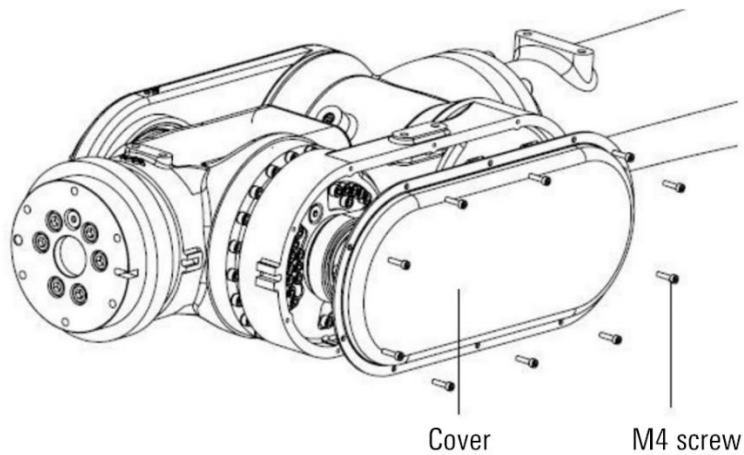


Figure 12-16 Remove the J5 axis cover plate

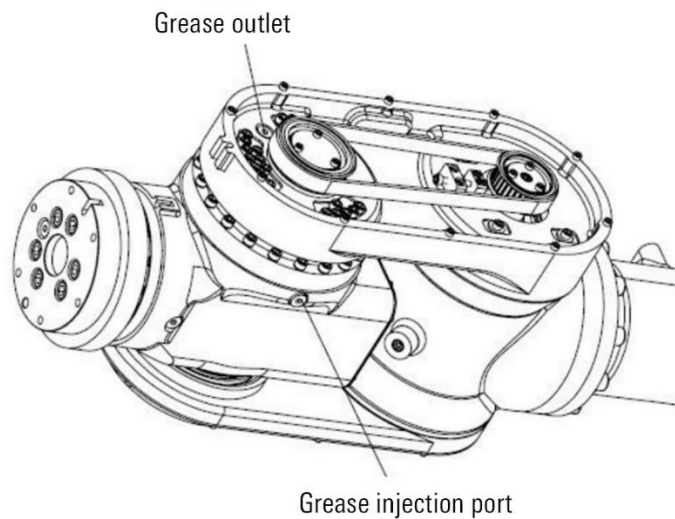


Figure 12-17 Replace the lubricating grease of J5 axis reducer

The replacement process is as follows:

- Step1. Run the manipulator to assume the posture shown in Table 12-4.
- Step2. To prevent danger, turn off the power, hydraulic, and pneumatic sources connected to the robot.
- Step3. Remove the M4 screws from the J5 axis cover plate, as shown in Figure 12-16.
- Step4. Place the waste oil collection tank near the grease outlet.
- Step5. Remove the plug of the M10x1 grease outlet, as shown in Figure 12-17.
- Step6. Install the grease discharge oil pipe to ensure that the waste oil flows into the oil collection tank.
- Step7. Remove the M10x1 plug from the grease injection port, install the grease nozzle, and use a manual grease gun to inject grease until new lubricating grease is discharged from the grease discharge port.
- Step8. Release the lubricating grease pressure inside the reducer as shown in Table 12-5.

Step9. The amount of oil discharged by weighing shall be equal to the amount of oil injected. If the discharge amount is less than the injection amount, the excess amount is discharged by gas at the fat injection port. If the discharge volume is greater than the injection volume, inject the missing amount from the grease injection port.

Step10. Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.



Caution

When injecting fat from the fat injection port into the inner part of the operation machine, the fat injection speed by hand pump is less than 8g/s and the fat injection pressure is less than 0.3mpa. In order to ensure the smooth elimination of the old oil inside the reducer, after a period of oil injection, take a rest for a while, such as the oil outlet no old oil discharge to continue the oil injection. When the oil filling speed is too fast, the instantaneous pressure inside the reducer becomes higher, and the grease may cause damage to the motor oil seal and the grease enters the motor.

### J6 axis reducer replacement grease process

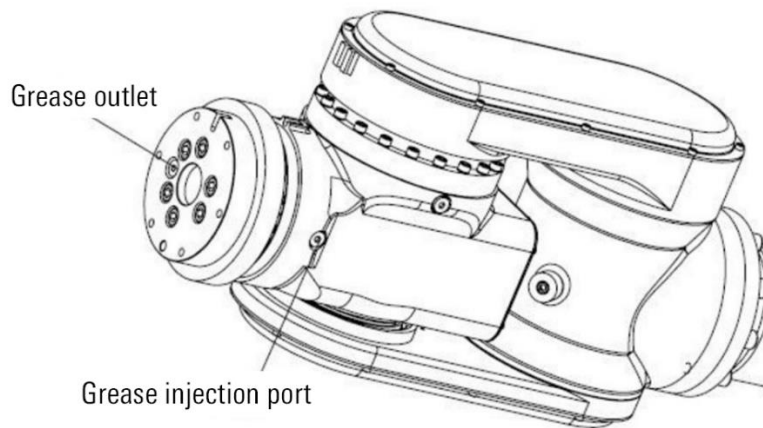


Figure 12-18 Replace the lubricating grease of the J6 axis reducer

The replacement process is as follows:

- Step1. Run the manipulator to assume the posture shown in Table 12-4.
- Step2. To prevent any danger, turn off the power, hydraulic and air pressure sources connected to the robot.
- Step3. Place an oil collection tank for collecting waste oil near the grease drain port.
- Step4. Remove the M10x1 plug from the grease outlet, as shown in Figure 12-18.
- Step5. Install the grease discharge oil pipe to ensure that the waste oil flows into the oil collection tank.
- Step6. Remove the M10x1 plug from the grease injection port, install the grease nozzle, and use a manual grease gun to inject grease until new lubricating grease is discharged from the grease discharge port.
- Step7. Release the lubricating grease pressure inside the reducer as shown in Table 12-5.
- Step8. The amount of oil discharged by weighing shall be equal to the amount of oil injected. If the discharge amount is less than the injection amount, the excess amount is discharged by gas at the fat injection port. If the

discharge volume is greater than the injection volume, inject the missing amount from the grease injection port.

Step9. Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.



Caution

When injecting fat from the fat injection port into the inner part of the operation machine, the fat injection speed by hand pump is less than 8g/s and the fat injection pressure is less than 0.3mpa. In order to ensure the smooth elimination of the old oil inside the reducer, after a period of oil injection, take a rest for a while, such as the oil outlet no old oil discharge to continue the oil injection. When the oil filling speed is too fast, the instantaneous pressure inside the reducer becomes higher, and the grease may cause damage to the motor oil seal and the grease enters the motor.

### Release grease pressure inside reducer

When releasing the inner grease pressure of the reducer, please install the recovery device at the outlet of the exhaust grease to avoid the splash of the grease and the pollution of the environment.

Table 12-5 Release internal pressure of reducer and gearbox

Replace the grease part	Action point	The action time	The premise
J1 axis reducer	>90°	Ten minutes	Sealing head or oil nozzle shall be installed at the grease injection port, and sealing screws shall not be installed at the grease injection port
J2 axis reducer	>90°	Ten minutes	
J3 axis reducer	>90°	Ten minutes	
J4 axis reducer	>90°	Ten minutes	
J5 axis reducer	>90°	Ten minutes	
J6 axis reducer	>90°	Ten minutes	



Caution

Improper fat-feeding operations may cause a sharp increase in the pressure in the reducer or gearbox, damaging internal parts such as the sealing ring, resulting in oil leakage or poor operation.

The following precautions must be observed:

- Be sure to remove the sealing screw on the grease outlet before fatting.
- Use a hand pump to slowly feed the fat.
- Be sure to use the specified grease.
- After the grease supply, install the sealing screw after releasing the internal pressure as shown in Table 12-5.
- Thoroughly remove grease from floor and manipulator to avoid slipping.

## 12.5 Replacement of synchronous belt

Synchronous belt of J5 axis shall be replaced every 11520h or 13year (whichever comes first)

For the model of synchronous belt, please see Table 12-6.



Table 12-6 Synchronous belt model for manipulator

Manipulator model	Timing belt position	Synchronous belt model
AIR50-2260 AIR50-2700	J5 axis inside the forearm	GT3, 625-5GT-15
AIR80-2260 AIR80-2560	J5 axis inside the forearm	GT3, 655-5GT-15
AIR35-2700 AIR20-3100	J5 axis inside the forearm	GT3, 475-5MGT-9

At the replacement of synchronous belt, the manipulator shall be posed as shown in Table 12-7.

Table 12-7 Posture of manipulator at the replacement of synchronous belt

J1	J2	J3	J4	J5	J6
Any	0°	90°	0°	0°	Any

### Replacement process for synchronous belt of J5 axis

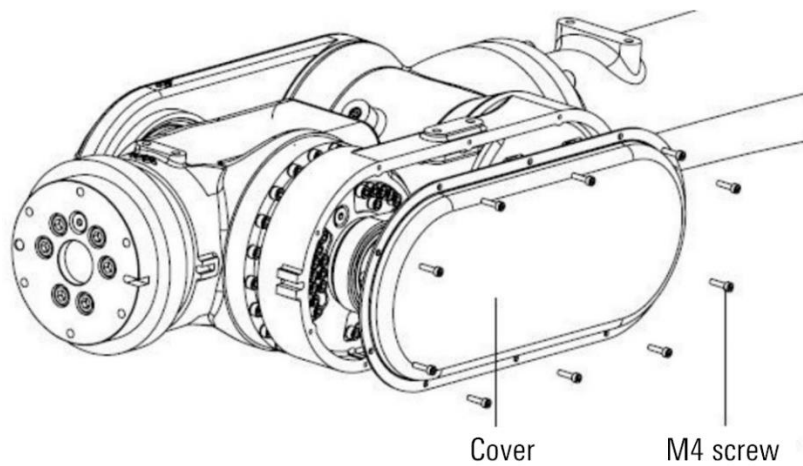


Figure 12-19 AIR50-2260/AIR50-2700 removal cover

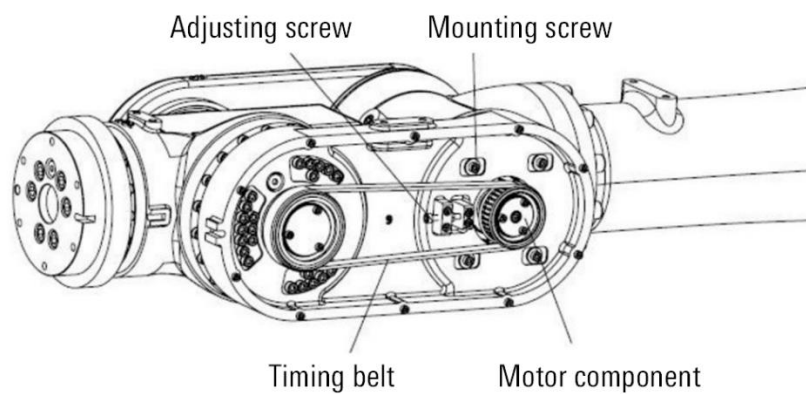


Figure 12-20 AIR50-2260/AIR50-2700 removing synchronous belt

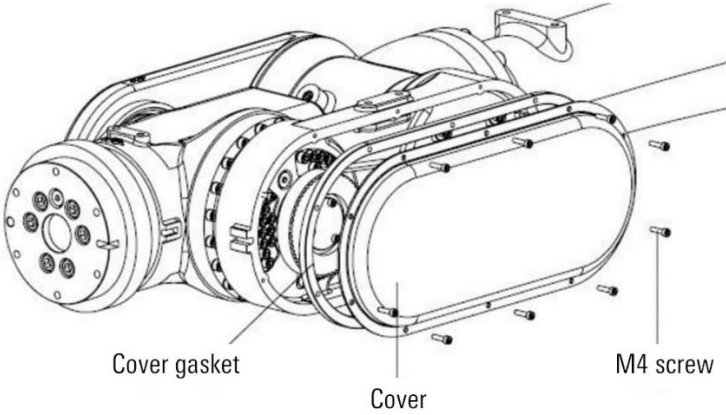


Figure 12-21 AIR80-2260/AIR80-2560 removal cover

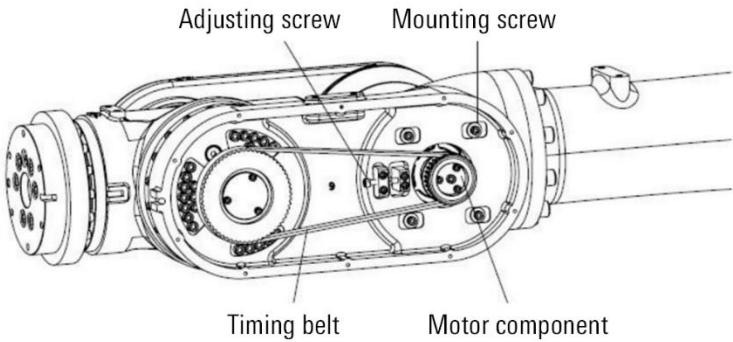


Figure 12-22 AIR80-2260/AIR80-2560 removing synchronous belt

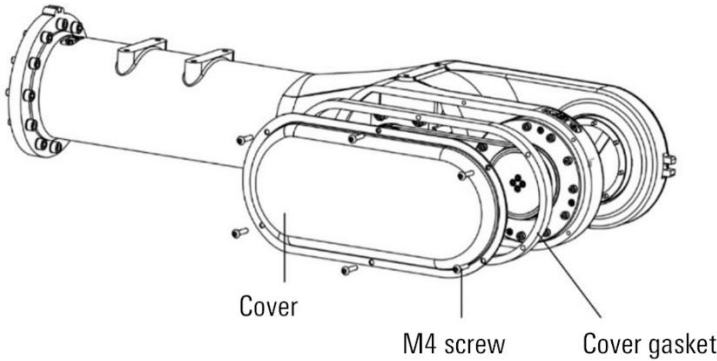


Figure 12-23 AIR35-2700/AIR20-3100 removal cover

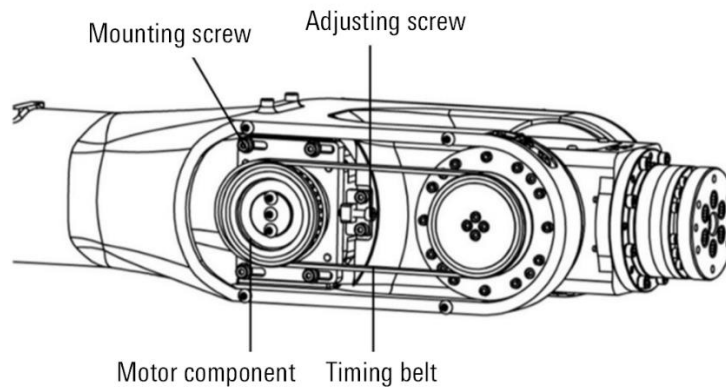


Figure 12-24 AIR35-2700/AIR20-3100 removing synchronous belt

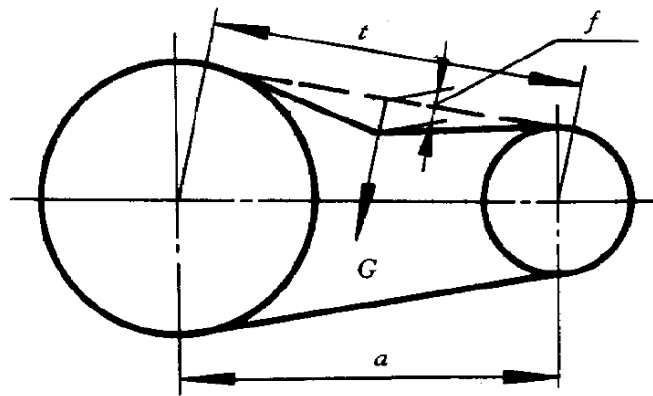


Figure 12-25 Installation deflection of synchronous belt

Replacement as follows:

- Step1. Operate the manipulator to the attitude shown in Table 12-7.
- Step2. Cut off the power supply of the control device.
- Step3. Remove the manipulator cover and M4 fixing screws, as shown in Figure 12-19 (or Figure 12-21, or Figure 12-23).
- Step4. Loosen the synchronous belt adjusting screw.
- Step5. Remove four M4 screws from the motor base (AIR35-2700/AIR20-3100 has four M4 screws), as shown in Figure 12-20 (or Figure 12-22, or Figure 12-24).
- Step6. Move the motor pulley assembly, remove the old synchronous belt and install the new synchronous belt.
- Step7. Preliminarily install the motor base screw M5. (AIR35-2700/AIR20-3100 uses M4 screws)
- Step8. Use the hexagon wrench to install the adjusting screw and adjust the timing belt to the appropriate tension; AIR50-2260/AIR50-2700 J5-axis timing belt frequency is 101Hz~105Hz; AIR80-2260/AIR80-2560 J5-axis timing belt frequency is 104Hz~109Hz; AIR35-2700/AIR20-3100 J5-axis timing belt frequency is 116Hz~122Hz.
- Step9. Install the motor base screw M5 with the specified torque. (AIR35-2700/AIR20-3100 uses M4 screws)
- Step10. Install the manipulator cover plate and apply sealant at the joint.

Step11. Calibrate the J5 axis of the manipulator.



Warning

After the replacement of synchronous belt, the J5 axis of manipulator shall be calibrated. For details, see Chapter 8.

## 13 Common faults and treatment

The fault of manipulator may be caused by a number of different reasons. It is often difficult to thoroughly find out the cause. If the wrong handling method is used, the fault may be further deteriorated. Therefore, it is very important to analyze the fault situation and find out the real cause.

### Vibration or abnormal noise

The possible fault and causes of manipulator are as shown in Table 13-1. If you are unsure of the cause or do not know how to proceed, please contact us.

Table 13-1 Possible faults and causes of manipulator

Fault	Classification	Possible Causes	Treatment
Vibration Abnormal noise	<ul style="list-style-type: none"> <li>When the manipulator operates, its base floats from the workshop pedestal</li> <li>There is a gap between the base and workshop pedestal</li> <li>The screws connecting the base and workshop pedestal are loose</li> </ul>	Fixation of Base: <ul style="list-style-type: none"> <li>The manipulator base is not firmly fixed on the workshop pedestal</li> <li>The base floats from the workshop pedestal and generates the vibration when the manipulator acts due to the screw looseness, insufficient flatness of base and the foreign objects.</li> </ul>	<ul style="list-style-type: none"> <li>When the screw is loose, tighten it with the torque wrench according to the proper torque</li> <li>Trim the base flatness in accordance with the tolerance</li> <li>Check if the foreign matters are trapped, and if so, remove them</li> <li>Please consult with us</li> </ul>
	Workshop pedestal vibrates when the manipulator acts	Workshop Pedestal: <ul style="list-style-type: none"> <li>Pedestal is not completely fixed on the foundation. Therefore, the workshop pedestal vibrates when the manipulator acts.</li> <li>The insufficient rigidity of workshop pedestal, and the reaction force and torque generated by the manipulator cause the deformation and vibration.</li> </ul>	<ul style="list-style-type: none"> <li>Completely fix the workshop pedestal according to the corresponding method</li> <li>Workshop pedestal shall be processed to improve its rigidity</li> <li>For the workshop pedestal with machining difficulty, the vibration may be mitigated through the modification of moving program</li> <li>Please consult with us</li> </ul>
Vibration Abnormal noise	<ul style="list-style-type: none"> <li>Vibration at a specific posture during the action</li> <li>No vibration at the slow action</li> <li>Obvious vibration during acceleration and deceleration</li> <li>Simultaneous vibration of multiple axes</li> </ul>	<ul style="list-style-type: none"> <li>Load of manipulator exceeds the allowable value</li> <li>Action procedures are too strict on the manipulator</li> <li>Improper acceleration</li> </ul>	<ul style="list-style-type: none"> <li>Confirm whether the manipulator load exceeds the allowable value, and reduce the load or change the action procedures</li> <li>Mitigate the specific vibrations by reducing speed, reducing acceleration and changing the action procedures</li> </ul>

Fault	Classification	Possible Causes	Treatment
	<ul style="list-style-type: none"> <li>■ Collision or long-term overload operation of manipulator</li> <li>■ No replacement of lubricating grease for a long time</li> </ul>	<ul style="list-style-type: none"> <li>■ Mechanical transmission system is subjected to excessive external force due to collision or overload, causing the damage to the gear surface or rolling surface of the gear, bearing, reducer or the peeling due to fatigue</li> <li>■ The gear surfaces or rolling surfaces of gear, bearing and reducer are damaged due to the foreign matters trapped in the gear, bearing or reducer.</li> <li>■ The gear surfaces or rolling surfaces of gear, bearing and reducer peel off due to fatigue because of no replacement of lubricating grease for long term</li> <li>■ The above reasons may cause the periodic vibration or abnormal noise</li> </ul>	<ul style="list-style-type: none"> <li>■ Make the manipulator operate uniaxially to confirm the Joint that produces the vibration and noise</li> <li>■ If you need to replace the gear, bearing and reducer, please contact us.</li> <li>■ Do not use the manipulator at overloaded status</li> <li>■ If you need to replace the lubricating grease, please contact us.</li> <li>■ Please consult with us</li> </ul>
Vibration Abnormal noise	Causes may not be determined mechanically	<ul style="list-style-type: none"> <li>■ Fault of the circuit inside the controller, failure of command to transmit to the motor, or the motor information not correctly transmitted to the controller</li> <li>■ Fault of pulse encoder and the position of motor not correctly transmitted to the controller</li> <li>■ Failure of motor body to perform its original functions</li> <li>■ Breakage of internal motor cable of manipulator causes the command not to be correctly transmitted to the motor and control system</li> <li>■ Voltage reduction and no guarantee for the specified voltage</li> <li>■ Incorrect control parameters are input</li> </ul>	<ul style="list-style-type: none"> <li>■ For the fault of controller, see the controller manual</li> <li>■ Replace the motor of vibrating Joint to confirm whether it vibrates</li> <li>■ Check the cables of the manipulator body, between the manipulator body and control cabinet, and inside the controller for damage, and if so, replace the cable.</li> <li>■ Check whether the cable joint is in good contact. In case of the poor contact or looseness, re-tighten or take appropriate measures to ensure the good contact.</li> <li>■ Check whether the action control parameters are correct, and if not, re-enter the correct parameters.</li> <li>■ Please consult with us</li> </ul>

Fault	Classification	Possible Causes	Treatment
	The mechanical action near the manipulator is closely related to the vibration of robot.	<ul style="list-style-type: none"> <li>■ Mechanical electrical noise from the manipulator</li> <li>■ If the grounding wire is not connected properly, the electrical noise will mix into the grounding wire, causing the vibration of manipulator due to the interference with command</li> <li>■ Poor connection of grounding wire will lead to the unstable grounding, causing the vibration of manipulator due to electrical noise interference.</li> </ul>	<ul style="list-style-type: none"> <li>■ Connect the grounding wire properly to avoid the electrical noise mixed into the manipulator</li> <li>■ Please consult with us</li> </ul>
Vibration Abnormal noise	<ul style="list-style-type: none"> <li>■ Abnormal noise after the replacement of lubricating grease</li> <li>■ Abnormal noise occurs during the operation of robot after a long-term shutdown</li> <li>■ Abnormal noise at low speed</li> </ul>	Abnormal noise from the manipulator at low speed immediately after the replacement or at the restart after the long-term shutdown.	Observe the operation of manipulator for 1-2 days. Usually, the abnormal noise will disappear.

### Shake of manipulator

shows the causes and treatment measures of the shaking of the manipulator. If you cannot determine the cause or how to deal with it, please contact our company.

Table 13-2 Causes and treatment measures of manipulator shaking

Fault	Classification	Possible Causes	Treatment
Shake of manipulator	<ul style="list-style-type: none"> <li>■ After power-off, some parts of manipulator may be shaken manually.</li> <li>■ There is a gap between the connecting surfaces of manipulator</li> </ul>	<ul style="list-style-type: none"> <li>■ Manipulator bolts are loose</li> <li>■ Connecting bolts on the manipulator are loose due to the overload, collision, etc., thus resulting in the shake</li> </ul>	<p>For each Joint, check if the bolts at the following parts are loose. If so, tighten it with a torque wrench according to a suitable torque.</p> <ul style="list-style-type: none"> <li>■ Fixing bolts of motor</li> <li>■ Fixing bolts of reducer shell</li> <li>■ Fixing bolts of output shaft of reducer</li> <li>■ Fixing bolts of pedestal</li> <li>■ Fixing bolts between arms</li> <li>■ Fixing bolts of shell</li> <li>■ Fixing bolts of end effector</li> </ul>

Fault	Classification	Possible Causes	Treatment
	Turn off the power of manipulator, and confirm that the screws are tightened, and shake the entire head of manipulator manually	Large backlash is resulted from the wear or damage of internal gears of manipulator due to the overload, collision, etc.	If you need to replace the internal gear, please consult with us

## Motor overheating

The causes and treatment measures of motor overheating are shown in Table 13-3. If you cannot determine the cause or how to deal with it, please contact our company.

Table 13-3 Causes and treatment measures of motor overheating

Fault	Classification	Possible Causes	Treatment
Motor overheating	<ul style="list-style-type: none"> <li>Ambient temperature rises for installation of manipulator, and the overheating of motor</li> <li>Motor overheats after the cover plate is mounted on the motor</li> <li>Motor overheats after the action procedures of manipulator and load conditions are changed</li> </ul>	<p>Ambient temperature:</p> <ul style="list-style-type: none"> <li>Ambient temperature rises or the deterioration of heat dissipation of motor after the cover plate is installed</li> </ul> <p>Load Action:</p> <ul style="list-style-type: none"> <li>Current value of motor exceeds its rated value due to the load and operating procedures</li> </ul>	<ul style="list-style-type: none"> <li>Decrease of ambient temperature may prevent the motor from overheating</li> <li>Improvement of ventilation conditions around the motor, i.e., the heat dissipation of motor, may effectively prevent the motor from overheating.</li> <li>A radiation shielding plate if there is a heat source around the motor may prevent the motor from overheating.</li> <li>Slowing down the action procedures and reducing the load may decrease the average current value of motor, thus preventing the motor from overheating.</li> <li>Please consult with us</li> </ul>
	Motor overheats after the action control parameters of manipulator are changed	<p>Control Parameter:</p> <ul style="list-style-type: none"> <li>Improper input parameters will cause the incorrect acceleration and deceleration of robot, so that the average current value of increases.</li> </ul>	<ul style="list-style-type: none"> <li>Enter the appropriate parameters according to the relevant instructions.</li> <li>Please consult with us</li> </ul>
	Motor overheats due to the causes other than above ones	<p>Mechanical Fault of Manipulator:</p> <ul style="list-style-type: none"> <li>Mechanical system fault of manipulator causes the overload of motor</li> <li>Motor fault:</li> <li>Brake fault causes the motor to always operate when the brake is</li> </ul>	<ul style="list-style-type: none"> <li>Please rectify the mechanical fault by reference to the instructions of vibration, abnormal noise and looseness.</li> <li>Please confirm whether the brake is released when the motor is powered on.</li> </ul>



Fault	Classification	Possible Causes	Treatment
		<p>applied, which causes the motor to withstand excessive load</p> <ul style="list-style-type: none"> <li>■ Failure of motor body to perform its functions causes the excessive current to flow through the motor</li> </ul>	<ul style="list-style-type: none"> <li>■ After the motor is replaced, the overheating of motor disappears. It is confirmed that the condition is abnormal.</li> <li>■ Please consult with us</li> </ul>

### Leakage of lubricating grease

The causes and treatment measures of grease leakage are shown in Table 13-4. If you cannot determine the cause or how to deal with it, please contact our company.

Table 13-4 Causes of grease leakage and treatment measures

Fault	Classification	Possible Causes	Treatment
Leakage of lubricating grease	Lubricating grease leaks out from the mechanical part	<p>Poor Sealing:</p> <ul style="list-style-type: none"> <li>■ Crack of casting due to the excessive external force caused by the collision</li> <li>■ Damage of O-ring during the disassembly and reassembly</li> <li>■ Scratch of oil seal due to the dust intrusion</li> <li>■ Poor sealing between the cover plate and casting</li> </ul>	<ul style="list-style-type: none"> <li>■ In case of casting crack, etc., the sealant may be used to block the lubricating grease as an emergency measure, but in view of the further extension of crack, the part shall be replaced as soon as possible.</li> <li>■ Please consult with us</li> </ul>

### Falling of manipulator

Table 13-5 shows the reasons and treatment measures for the falling of the manipulator axis. If you cannot determine the cause or how to deal with it, please contact our company.

Table 13-5 Causes and treatment measures of manipulator axis falling

Fault	Classification	Possible Causes	Treatment
Falling of manipulator axis	<ul style="list-style-type: none"> <li>■ The brake is completely ineffective and the Joint falls quickly</li> <li>■ After the brake is contracted, the shaft falls slowly</li> </ul>	<ul style="list-style-type: none"> <li>■ The damage of brake drive relay causes the brake to always be powered on and not to work.</li> <li>■ Wear and damage of brake body affect the braking effect.</li> <li>■ The lubricating oil and grease inside the motor cause the brake to slip.</li> </ul>	<ul style="list-style-type: none"> <li>■ Check if the brake drive relay is damaged, and if so, replace the relay</li> <li>■ In case of the wear of brake, the damage of brake body and the lubricating grease inside the motor, replace the motor.</li> <li>■ Please consult with us</li> </ul>

## Position offset

The causes and treatment measures of position deviation are shown in Table 13-6. If you cannot determine the cause or how to deal with it, please contact our company.

Table 13-6 Causes of position deviation and treatment measures

Fault	Classification	Possible Causes	Treatment
Position offset	<ul style="list-style-type: none"> <li>■ Manipulator deviates from the teaching position</li> <li>■ The repeated positioning accuracy of manipulator is greater than the allowed value</li> </ul>	<p>Mechanical Fault:</p> <ul style="list-style-type: none"> <li>■ The unstable repeated positioning accuracy may be caused by the mechanical system abnormality, screw looseness, etc.</li> <li>■ The repeated positioning accuracy keeps stable after the deviation; the joint surface of pedestal surface, Joint casting and reducer may slide due to the excessive load such as the collision.</li> <li>■ Abnormality of motor encoder</li> </ul>	<ul style="list-style-type: none"> <li>■ In case of the unstable repeated positioning accuracy, please rectify the mechanical fault by reference to the instructions for the vibration, abnormal noise and shaking.</li> <li>■ If the repeated positioning accuracy keeps stable, please modify the teaching program. If the collision does not occur again, the deviation may be avoided.</li> <li>■ In case of the abnormality of motor encoder, replace the motor or encoder.</li> <li>■ Please consult with us</li> </ul>
	Position only deviates from the specific peripheral equipment	<p>Deviation of Peripheral Equipment</p> <ul style="list-style-type: none"> <li>■ The external equipment under the external force leads to the deviation relative to the manipulator</li> </ul>	<ul style="list-style-type: none"> <li>■ Please relocate the peripheral equipment</li> <li>■ Please modify the teaching program</li> <li>■ Please consult with us</li> </ul>

Fault	Classification	Possible Causes	Treatment
	Deviation occurs after the modification of parameters	<p>Parameters:</p> <ul style="list-style-type: none"><li>■ The modification of calibration data causes the loss of manipulator origin</li></ul>	<ul style="list-style-type: none"><li>■ Re-enter the previous correct calibration data</li><li>■ In case of uncertain calibration data, please recalibrate the manipulator</li><li>■ Please consult with us</li></ul>



## 14 Conditions of storage

### 14.1 Environmental conditions for long-term storage of manipulator

Table 14-1 Environmental conditions for long-term storage of manipulator

Parameter	Value
Min. ambient temperature	-25℃
Max. ambient temperature	55℃
Max. ambient temperature (storage time less than 24 h)	70℃
Max. ambient humidity	Less than 95% at constant temperature, no condensation
Max. vibration condition	Frequency: 22Hz, amplitude: 0.15mm

### 14.2 Precautions for storage of manipulator

In addition to Chapter 1.5 Environmental Requirements for Operation of this manual, the following shall be paid with attention for the long-term storage of manipulator:

- Before the long-term storage of manipulator, it shall be posed for handling and placed on the horizontal surface. For details, see Chapter9 Transport and Handling of this manual
- When the manipulator is not in use for a long time, cut off all powers, unplug the heavy-duty connector on the body, and cover the heavy-duty connector.
- The exterior protection such as the paper or wooden packing box shall be provided to protect the manipulator body from the long-term exposure of sunlight, water, oil, corrosive liquids, etc.
- The manipulator surface shall be cleaned regularly for dust and pollutant with the specific cleaning cycle depending on the storage environment of manipulator.
- When the storage period is over and the manipulator is put into the operation again, the manipulator shall be checked in accordance with Chapter 3.1 Check item of this manual

## Appendix A Periodic maintenance schedule of medium load manipulator

Note: ○ indicates that maintenance is required.

Schedule A Periodic maintenance schedule of the manipulator

Item	Maintenance cycle	First Maintenance 320h	3 months 960h	6 months 1,920 h	9 months 2,880 h	1 year 3,840 h	15 months 4,800 h	18 months 5,760 h	21 months 6,720 h	2 years 7,680 h	27 months 8,640 h	30 months 9,600 h	33 months 10,560 h	3 years 11,520 h	39 months 12,480 h	42 months 13,440 h	45 months 14,400 h	4 years 15,360h	51 months 16,320 h	54 months 17,280 h	57 months 18,240 h	5 years 19,200 h
Cleaning of manipulator	0.5h	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cleaning of control cabinet vent	0.1h	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Check the timing belt for wear	0.5h	○		○	○	○		○		○		○		○		○		○		○		○
Check the manipulator cable for damage	3h	○		○	○	○		○		○		○		○		○		○		○		○
Check the manipulator cable sheath for damage	2h	○		○	○	○		○		○		○		○		○		○		○		○
Check the connecting cable of teach	0.2h	○			○	○				○				○				○				○

Item	Maintenance cycle	First Maintenance 320h	3 months 960h	6 months 1,920 h	9 months 2,880 h	1 year 3,840 h	15 months 4,800 h	18 months 5,760 h	21 months 6,720 h	2 years 7,680 h	27 months 8,640 h	30 months 9,600 h	33 months 10,560 h	3 years 11,520 h	39 months 12,480 h	42 months 13,440 h	45 months 14,400 h	4 years 15,360h	51 months 16,320 h	54 months 17,280 h	57 months 18,240 h	5 years 19,200 h
pendant, control cabinet and manipulator for damage																						
Check the connectors of motor, etc. for looseness	0.2h	○			○	○				○				○				○				○
Tighten the end effector screws	0.2h	○			○	○				○				○				○				○
Tighten the external main screws	1h	○			○	○				○				○				○				○
Check the end effector cable for damage	0.2h	○			○	○				○				○				○				○
Check the limit rubber block for damage	0.1h	○			○	○				○				○				○				○
Replacement of Synchronous	1h					○				○				○				○				○

Item	Maintenance cycle	First Maintenance 320h	3 months 960h	6 months 1,920h	9 months 2,880h	1 year 3,840h	15 months 4,800h	18 months 5,760h	21 months 6,720h	2 years 7,680h	27 months 8,640h	30 months 9,600h	33 months 10,560h	3 years 11,520h	39 months 12,480h	42 months 13,440h	45 months 14,400h	4 years 15,360h	51 months 16,320h	54 months 17,280h	57 months 18,240h	5 years 19,200h
Belt																						
Battery Replacement	0.5h									○								○				
Replace the internal cables of manipulator	8h																	○				
Manipulator overhaul																						○



## Appendix B Table of screw strength and tightening torque (Nm)

Appendix B Table of screw strength and tightening torque (Nm)

Performance level Thread specification	8.8 level	10.9 level	12.9 level
M3	1.2	1.6	2.0
M4	2.8	3.7	4.4
M5	5.6	7.5	9
M6	9.5	12.5	15
M8	23	31	36
M10	45	60	70
M12	78	104	125
M14	113	165	195
M16	195	250	305
M20	370	500	600

Appendix B2 Stainless steel screw strength and screw tightening torque table (Nm)

Thread specification	Stainless steel A4-80	Stainless steel A2-70 and A4-70	Stainless steel A2-50
M3	1.0	0.8	0.4
M4	2.4	1.9	0.9
M5	4.8	3.8	1.9
M6	8.0	6.4	3.1
M8	19.5	15.5	7.5
M10	38.5	30.5	15.0
M12	66.0	52.0	25.5
M14	106.0	84.0	41.0
M16	165.0	130.0	64.0
M20	320.0	253.0	125.0
M24	557.0	441.0	217.0
M30	1107.0	876.0	-



Prompt

- All screws must be tightened with proper torque.
- Except for the torque specified in the text, the corresponding tightening torque shall be selected according to the screw performance level.
- Remove foreign matters in screws and threaded holes.

- Torque for lightly lubricated screws.
- Screws shall be tightened evenly and symmetrically.
- According to the installation requirements of the reducer and other moving parts, apply thread adhesive to the engagement part of some screws.



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