Peitian Robot

AIR165-2750A | Robot Manipulator Manual

A solution provider for intelligent

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AIR165-2750A Robot Manipulator Manual

version V1.1.2

Sign

Before using an industrial robot, be sure to read the manual carefully and use it correctly while understanding its content.

Nothing in this manual shall be reproduced or transmitted in any way.
All parameters and design may be changed at any time without notice.
There may be no liability for any errors that may occur in this manual.

We try to describe as many cases as possible in this manual. However, for various reasons that do not have to be done and are not possible, we have not described it for a variety of reasons.
Therefore, for those situations that are not described in the manual, the "impossible" can be regarded as the case.

The products described in this specification are subject to the limitations of "the Foreign Trade Law of the People's Republic of China".
The export of the product from China to other countries must be subject to the export license of the Chinese Government.
In addition, when the product is re-exported to other countries, the Government's permission to re-export the product should be obtained.
To export or re-export such products, please contact us

The Identity Used in This Article

The marks and their meanings are shown in Table 1.

Table 1 Common identifiers in this article

Sign	Name	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

General Safety Description

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

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

Safety considerations

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

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

When using the operating machine, it is important 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 ".

Warning

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

Caution

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

Prompt

- The State party points out a supplementary note other than warning and attention.

General considerations

Warning

- When connecting or disconnecting relevant peripheral equipment(such as safety fence, etc.)and various signals of the operator, make sure that the operator is in the stop state to avoid wrong connection.

Warning

- 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.
  - Used in flammable environments.
  - Used in explosive environments.
  - Used in environments where there is a lot of radiation.
  - Used in water or in high humidity environments.
  - Used for the purpose of transporting people or animals.
  - Use as a foot (e.g., on or depending on the operator).

Warning

- Operators who use the operator should wear the safety appliances shown below before carrying out their work.

  1. Work clothes suiTable for homework content
  2. Safety shoes
  3. Safety helmet

Prompt

Personnel who carry out programming and maintenance operations must receive appropriate training through the relevant training of the company.

Considerations during installation

Warning

- 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.

Warning

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.

Matters needing attention in operation

Warning

- 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.

Warning

- 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.

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 the safety fence is to be programmed, as much as possible 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:

  1. Check the safety fence carefully and make sure it is not dangerous before entering the fence.
  2. The emergency stop button can be pressed at any time.
  3. The operating machine shall be operated at low speed
  4. 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.

Caution

- 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.

Prompt

For operators who are programmed, it is important to receive appropriate training through the company.

Attention should be paid to maintenance work.

Warning

- 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.

Warning

- Please consult our company when you need to replace the parts.
- 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.

Warning

- 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.

Warning

- 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.

Warning

- 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.

Warning

- 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:

  1. 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.
  2. 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.

Warning

- 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.

Warning

- 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.

Warning

- 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 operating machine, so as to avoid unnecessary personal injury or adverse effect on the operating machine.

Warning

- 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:

  1. Servo motor
  2. reducer
  3. Adjacent to motor / reducer
  4. Inside the control cabinet

Warning

- 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.

Warning

- During the maintenance of the pneumatic system and hydraulic system, it is important to release the internal pressure to zero and operate again.

Warning

- 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.

Warning

- 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.

Warning

- When replacing parts, dust and other foreign bodies should be prevented from entering the manipulator.

Warning

- Operators who carry out maintenance and repair operations must receive the training of the company and pass the relevant assessment.

Warning

- 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.

Warning

- 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

Before running the manipulator and peripheral equipment and the whole system, be sure to fully study the safety protection measures of operator and system. Safe operation of industrial robot is as shown in Figure 1.

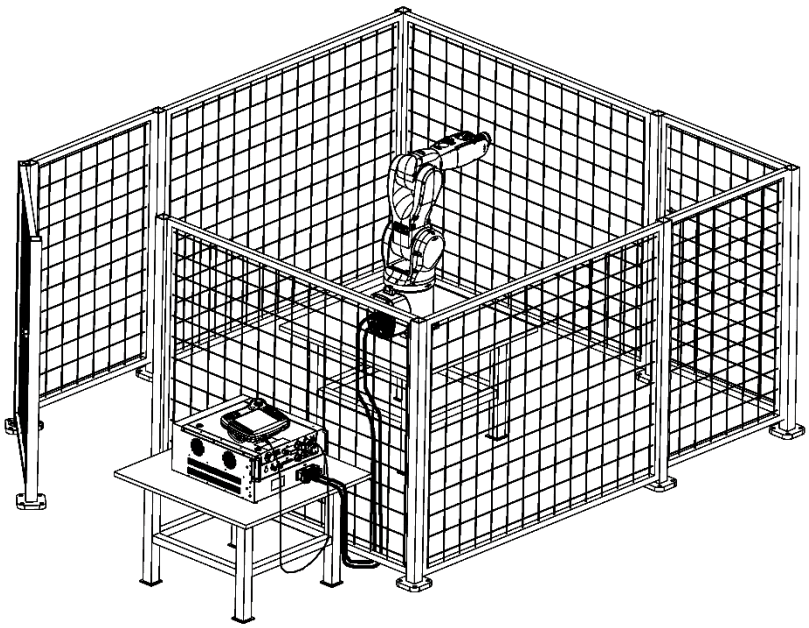


Figure1-1 The Figure of safe operation of industrial robot Schematic Diagram of Safety Operation of Industrial Robot

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.

Service

- 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 if possible 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 operator when carrying out the operation of the operator, 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 switch 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:
  1. At low speed, execute at least one cycle intermittently to confirm no abnormality.
  2. At low speed, execute at least one cycle continuously to confirm no abnormality
  3. At intermediate speed, execute at least one cycle continuously to confirm no abnormality
  4. At operating speed, execute at least one cycle continuously to confirm no abnormality
  5. 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 if necessary 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 is 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.

Sign of Manipulator

Nameplate

Fig. 2 Nameplate of the Manipulator

The nameplate of the manipulator is shown in Figure 2, which is generally located at the base of the manipulator. It indicates the model, version number, weight, serial number, production date and other information of the manipulator.

No Approaching

Fig. 3 Sign of No Approaching

The sign of no approaching is shown in Figure 3. If it’ s been seen, please keep away from the working area of the manipulator, otherwise the operation of which may cause accidents.

No Treading

Fig. 4 Sign of No Treading

The Sign of no treading is shown in Figure 4, which reminds the operators not to tread the manipulator casually, otherwise it will bring adverse effects to the manipulator, and may cause injury due to stepping on the air.

Sign of High Temperature

Fig. 5 Sign of High Temperature

The place with sign of high temperature (as shown in Figure 5) can generate heat heavily, where you should pay attention and avoid being scalded. If you have to touch the equipment when it’ s hot, please use heat-resistant gloves or other protective devices.

Motion Direction of Each Joint

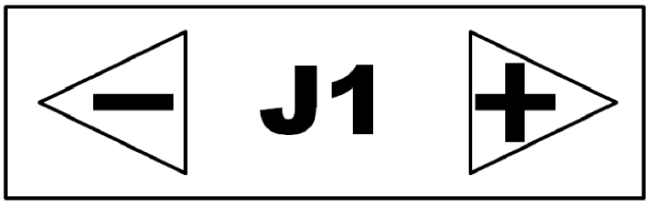


Fig. 6 Motion Direction of Each Joint of the Manipulator

The motion direction of each joint of the manipulator is shown in Figure 6. There are positive and negative sign of direction marked on the connecting parts of rotation or swing from joint J1 to J6 of the manipulator. In Figure 6, the "J1" indicates the joint J1, and the sign "+" and "-" respectively indicates the positive and negative direction of rotation. Other joints are represented by corresponding numbers.

Contents

1 AIR165-2750A Product Overview

1.1 Product Purpose and Content

The product is written so that the technician can install and use the operator quickly, correctly and safely, be familiar with the relevant precautions and do regular maintenance work on the operator.

1.2 Product Version, Release Number (Software) or File Version

The relevant information of the product is shown in Table 1-1.

Table 1-1 Product Related Information

Product name	Product num	Product version
AIR165-2750A robot manipulator Manual	UM-P05310000014-001	V1.1.2

1.3 Product Use Objects

- Operator
- Teacher
- Service

1.4 Relevant Documentation Information

The contents of this article may involve the following documents, please refer to them as necessary:

- *AIR-TP teaching apparatus operator Manual*
- *ARL programming manual*
- *AIR series industrial robot system failure and handling manual*
- *AIR series industrial robot system packing list*

1.5 Declaration of Compliance with Product Standards

The requirements for industrial robot system design are detailed in Table 1-2。

Table 1-2 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

Standard	Description	Version
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): This standard applies to the IP rating for the electrical equipment with enclosures and the rated voltage exceeding 72.5kv.	2001

2 AIR165-2750A Robot Overview and Basic Composition

2.1 Overview of Industrial Robot

Industrial robot consists of the following parts:

- Manipulator
- Control cabinet
- Teach pendant
- Connecting (power supply) cable, etc.

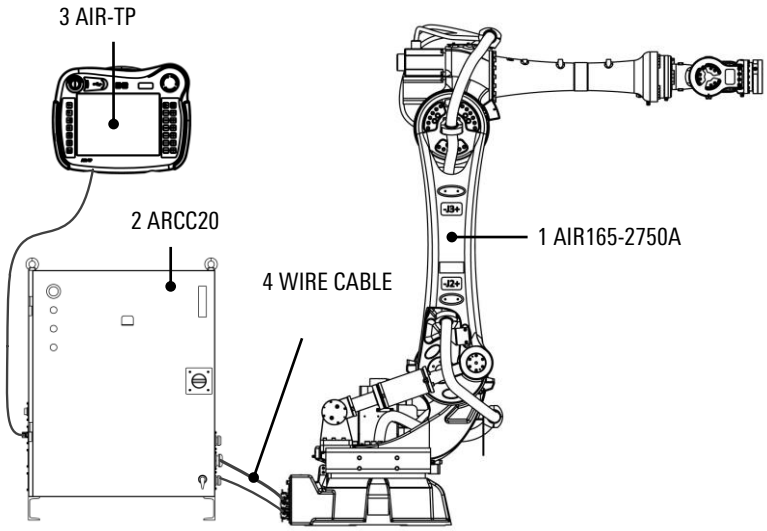


Figure 2-1 Composition of Robot System

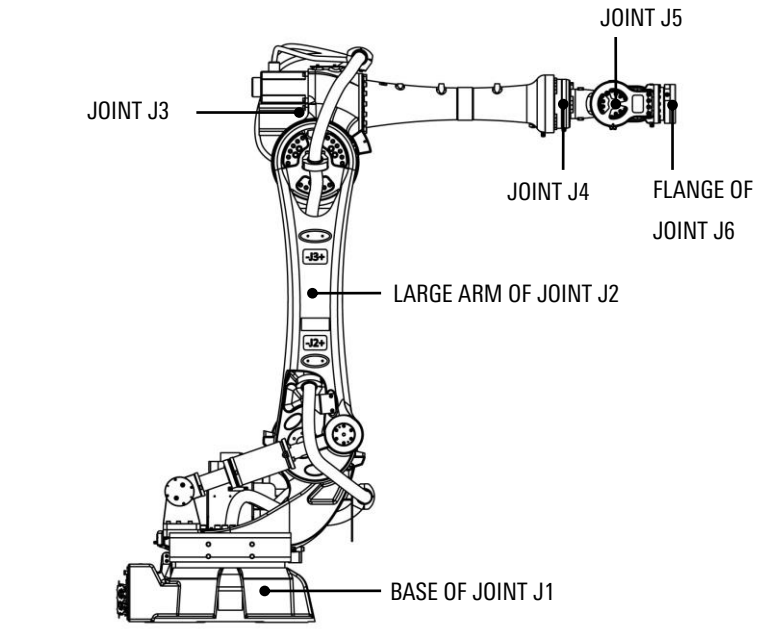
Figure 2-1 shows an example of industrial robot system in which:

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

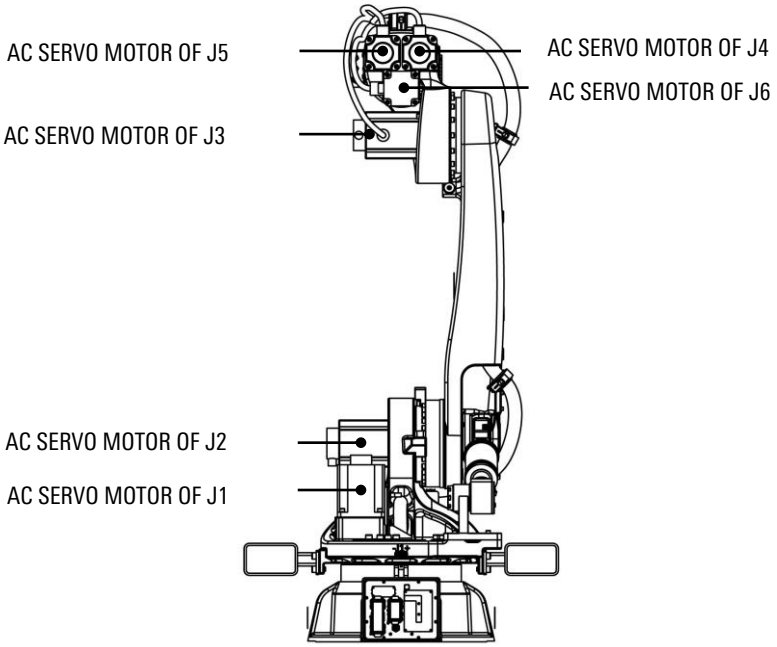
2.2 Basic Structure

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.

AIR165-2750A robot manipulator and the names of its various parts are as shown in Figure 2-2.



(a)



(b)

Figure 2-2 AIR165-2750A Robot Body and Its Various Parts

2.3 Basic Specifications

The basic specifications of AIR165-2750A robot manipulator are as shown in Table 2-1.

Table 2-1 Basic Specifications of AIR165-2750A

		AIR165-2750A
Coordinate form		6-DOF articulated robot
Number of control axes		6 axes (J1, J2, J3, J4, J5 and J6)
Mounting mode		Ground mounting
Range (upper limit/ lower limit)	J1	-170°~170°
	J2	-60°~85°
	J3	-120°~155°
	J4	-360°~360°
	J5	-125°~125°
	J6	-360~360
Max speed	J1	125°/s
	J2	113°/s
	J3	125°/s
	J4	180°/s
	J5	175°/s
	J6	280°/s
Transport capacity	Wrist	165kg
	Elbow	100kg
Drive mode		Electrical servo drive with AC servo motor
Repeated positioning accuracy		±0.1mm
Robot weight		1200kg
Noise		75dB
IP rating		IP54
Mounting conditions		Ambient temperature :0~45°C Humidity: not more than 95% at constant temperature without condensation Allowable altitude: not more than 1,000m above sea level No corrosive, flammable or explosive gases

2.4 Environmental Requirements for Operation

Temperature

The range of ambient temperature for AIR165-2750A manipulator is as shown in Table 2-2：

Table 2-2 Temperature Limits

Requirement	Value (°C)
Min. temperature	0
Max. temperature	45

Humidity

The humidity in the installation environment of manipulator shall not be more than 95% as specified in "IEC 60721-3-3-2002 Classification of environmental conditions".

Altitude

The altitude of normal operation environment for manipulator shall not exceed 1,000 m, and the manipulator shall be derated from 1,000 m to 4,000m

Resistance to vibration

Robot manipulator shall be used in an environment where there is no vibration. The limit frequency of ambient vibration is 22 Hz and the amplitude shall not exceed 0.15 mm.

Special environment requirements

Do not operate this manipulator in the flammable, explosive and corrosive environments.

3 AIR165-2750A Preparation before Installation

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 *Chapter 2.4*.
- 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 M24 screws with appropriate length and strength grade 12.9 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 Φ24 or other specifications.
- Several round pins (Φ 20 mm). Please see *Chapter 4.2* in this manual for details。

4 Installation of AIR165-2750A Manipulator

4.1 Technical Specifications

It should 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.

Dimensions of AIR165-2750A manipulator base are as shown in Figure 4-1:

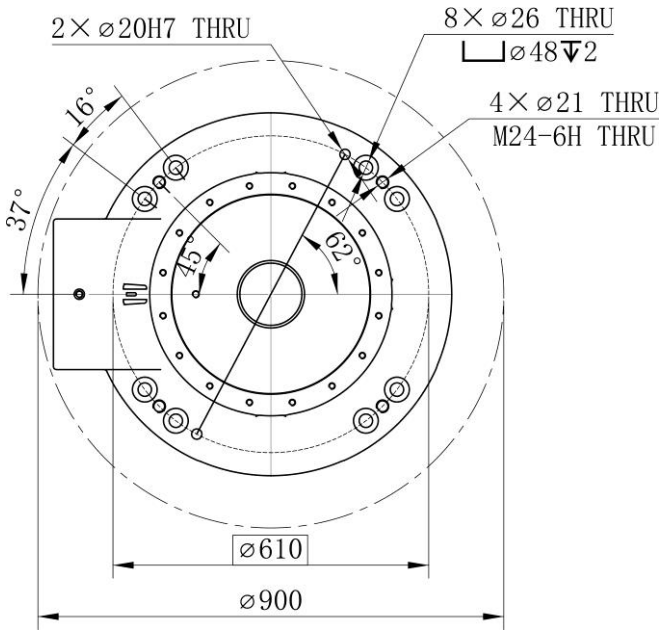


Figure 4-1 Dimensions of AIR165-2750A Manipulator Base Interface

4.2 Fixed Mode

Two ways of fixing are suiTable for AIR165-2750A manipulator:

- Ground fixing (mode 1).
- Bracket fixing (mode 2).

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 4-1:

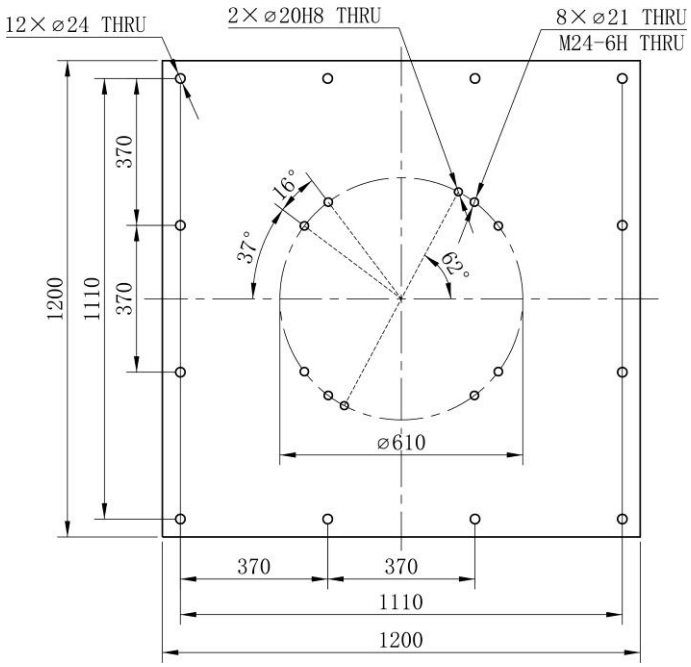
Table 4-1 Parts for Fixing AIR165-2750A Manipulator

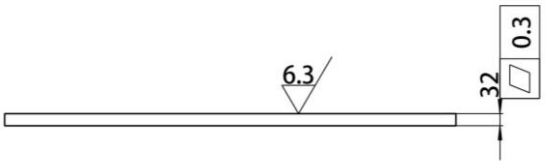
Part Name	Remarks	Ground fixing	Bracket fixing
Fixing screw	Eight M24x50 (Grade 12.9)	○	○
Chemical bolt	Twelve M20 (not less than Grade 4.8)	○	○
Fixing plate of robot	32 mm, 1 piece	○	
Mounting bracket	32mm， 4 piece		○

Prompt

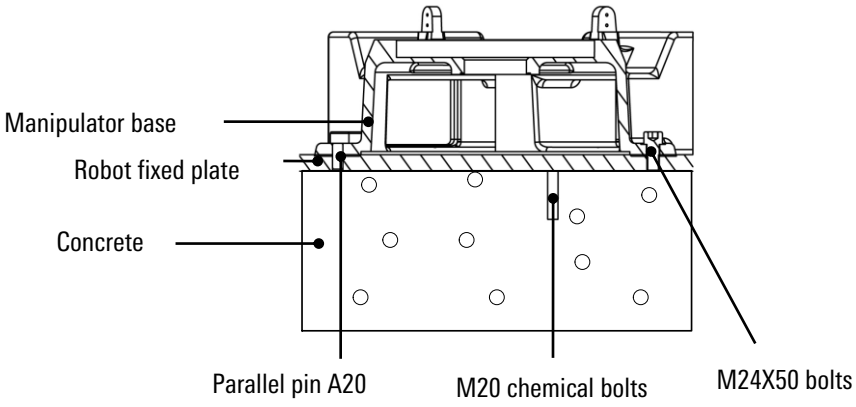
- Mark "○" means that the part is in need.
- There shall be no insulating materials between the fixing plate and mounting bracket of robot and the manipulator and concrete.
- Bracket shall be firmly installed on the ground with the strength not less than the fixing strength between the fixing plate of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

Ground fixing





(a)



(b)

Figure 4-2 Fixed mode 1 of Fixing for Manipulator

- Ground fixing process (mode 1) is as follows:

1. Hold the fixing plate of robot close to the mounting surface and secure it with twelve M20 chemical bolts (strength not less than Grade 4.8).
2. Install the manipulator base on the fixing plate with eight M24x50 bolts (Grade 12.9).

Prompt

- Fixing plate surface shall meet certain roughness and flatness requirements as detailed in Figure 4-2.

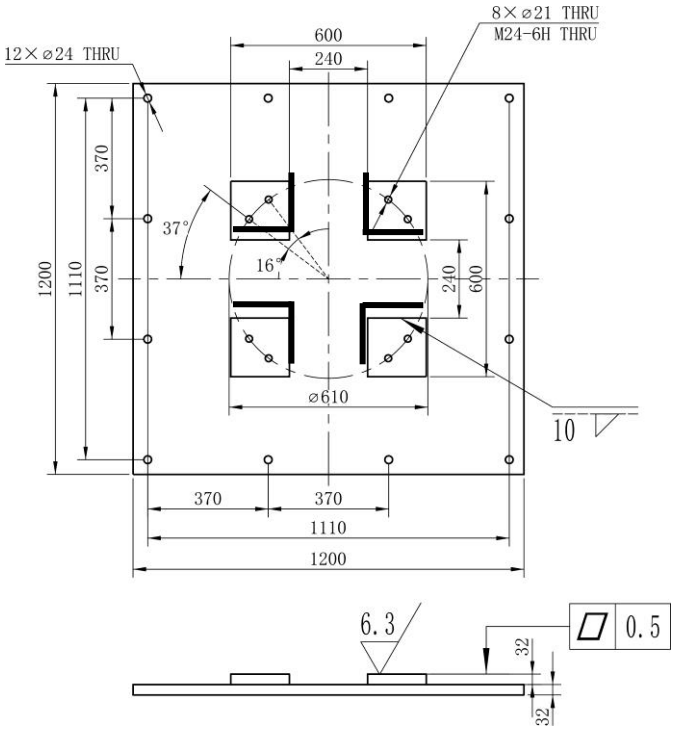
Bracket fixing

- Bracket fixing process (mode 2) is as follows:

1. Four mounting brackets inside shall be welded on the fixed plate of robot base which is embedded in concrete.
2. Install the manipulator base on the bracket with eight M24x50 bolts (Grade 12.9).

Prompt

Mounting surface of bracket shall meet certain flatness requirements as shown in Figure 4-3.



(a)

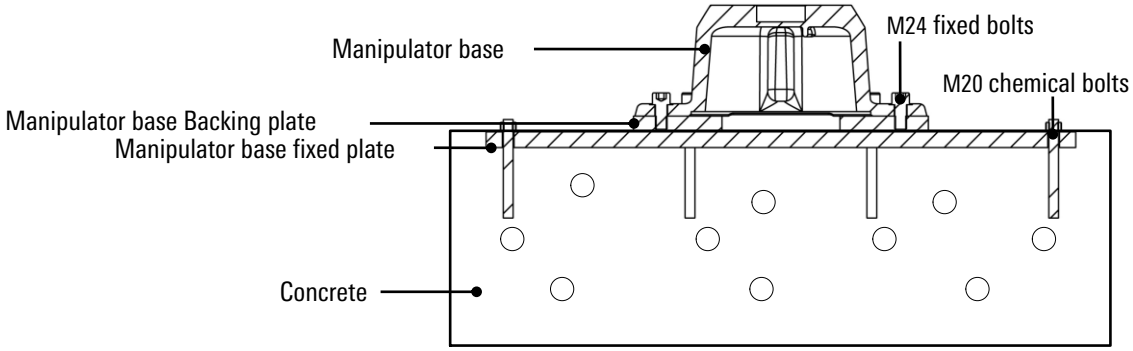


Figure 4-3 Fixed mode 2 of Fixing for Manipulator

Caution

Manipulator base fixed plate shall be embedded in concrete.

Warning

- Fixing screw M24 of manipulator shall not be shorter than 40 mm, and the insufficient length will cause the poor fixing and other accidents.
- When installing the manipulator ceiling, the length of fixing screws for manipulator shall be increased to 60 mm and the thickness of mounting plate shall be not less than 40 mm.

5 Electrical Connection of AIR165-2750A Manipulator

5.1 Electrical Interface Type of Manipulator

There are gas pipeline interface and heavy-duty connector on manipulator base of AIR165-2750A, as shown in Figure 5-1.

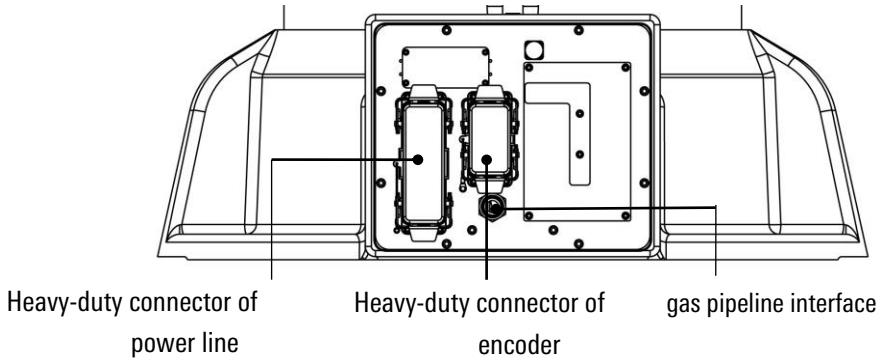


Figure 5-1 Heavy-duty connector of AIR165-2750A manipulator

There is gas pipeline interface on joint J3 of AIR165-2750A, as shown in Figure 5-2.

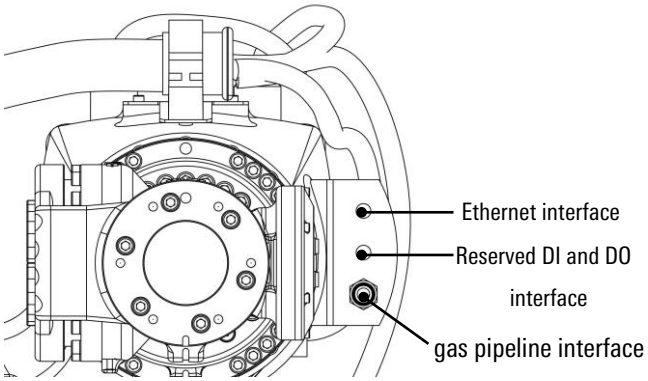


Figure 5-2 AIR165-2750A manipulator

5.2 Definitions of Heavy-duty Interfaces of Manipulator

Heavy-duty interfaces of AIR165-2750A manipulator is defined as shown in Figure 5-3.

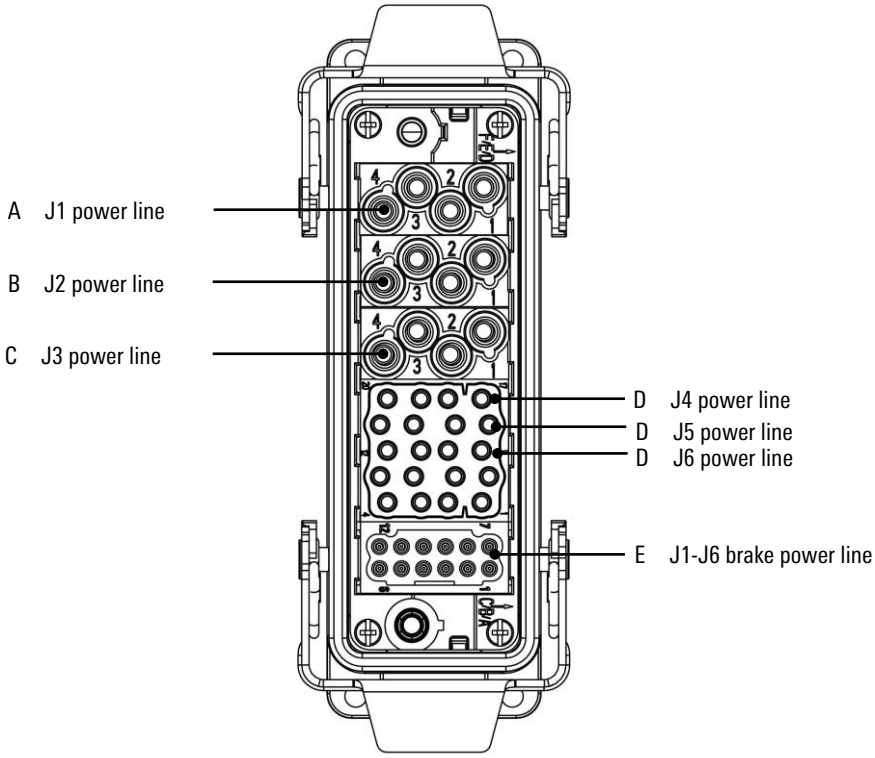


Figure 5-3 Heavy-duty connector of AIR165-2750A manipulator

Definitions of power lines of AIR165-2750A manipulator’ s heavy-duty interfaces, as shown in Table 5-1.

Table 5-1 Definitions of power lines of AIR165-2750A manipulator’ s heavy-duty interfaces

Signal name	Joint number	Pin number	Signal name	Joint number	Pin number
U1	J1	A1	U4	J4	D17
V1	J1	A2	V4	J4	D18
W1	J1	A3	W4	J4	D19
PE	J1	A4	PE	J4	D20
U2	J2	B1	U5	J5	D13
V2	J2	B2	V5	J5	D14
W2	J2	B3	W5	J5	D15
PE	J2	B4	PE	J5	D16
U3	J3	C1	U6	J6	D9
V3	J3	C2	V6	J6	D10
W3	J3	C3	W6	J6	D11

Signal name	Joint number	Pin number	Signal name	Joint number	Pin number
PE	J3	C4	PE	J6	D12
BK1+	J1	1	BK4+	J4	7
BK1-	J1	2	BK4-	J4	8
BK2+	J2	3	BK5+	J5	9
BK2-	J2	4	BK5-	J5	10
BK3+	J3	5	BK6+	J6	11
BK3-	J3	6	BK6-	J6	12

IO interfaces of encoder on AIR165-2750A manipulator, as shown in Figure 5-4.

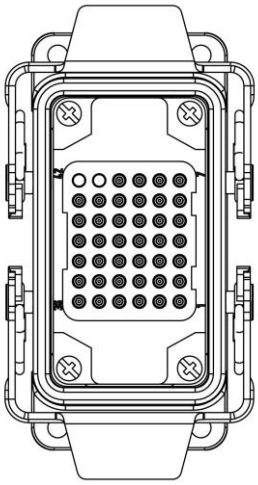


Figure 5-4 IO interfaces of encoder on AIR165-2750A manipulator

Definitions of power lines of AIR165-2750A manipulator’ s encoder interfaces, as shown in Table 5-2.

Table 5-2 Definitions of power lines of AIR165-2750A manipulator’ s encoder interfaces

Signal name	Joint number	Pin number	Signal name	Joint number	Pin number
1-PS-	J1	1	4-PS-	J4	22
1-PS+	J1	2	4-PS+	J4	23
1-E0V	J1	3	4-E0V	J4	24
1-E5V	J1	4	4-E5V	J4	25
2-PS-	J2	8	5-PS-	J5	29
2-PS+	J2	9	5-PS+	J5	30
2-E0V	J2	10	5-E0V	J5	31
2-E5V	J2	11	5-E5V	J5	32
3-PS-	J3	15	6-PS-	J6	36
3-PS+	J3	16	6-PS+	J6	37
3-E0V	J3	17	6-E0V	J6	38
3-E5V	J3	18	6-E5V	J6	39

6 AIR165-2750A Transport and Handing

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 Chapter 6.1 of this manual Precautions for manipulator during handing as shown in Figure 6-1.

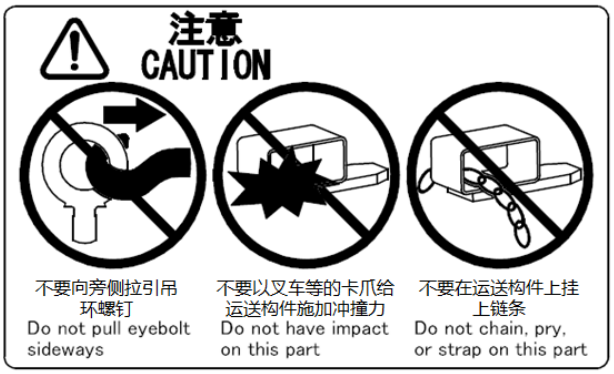


Figure 6-1Precautions for manipulator during handing

During handing, the following points should be noted:

- Do not pull eyebolt sideways.
- Do not use forklift and other grippers to apply impact force to the delivery support.
- Do not put chains on delivery support.

6.1 Handing Posture

Angle values of axes for AIR165-2750A manipulator during handling are as shown in Table 6-1.

Table 6-1 Angle Values of Axes for Robot during Handling

A1	A2	A3	A4	A5	A6
0	-55°	155°	0	80°	0

AIR165-2750A manipulator during handling shall be posed as shown in Figure 6-2.

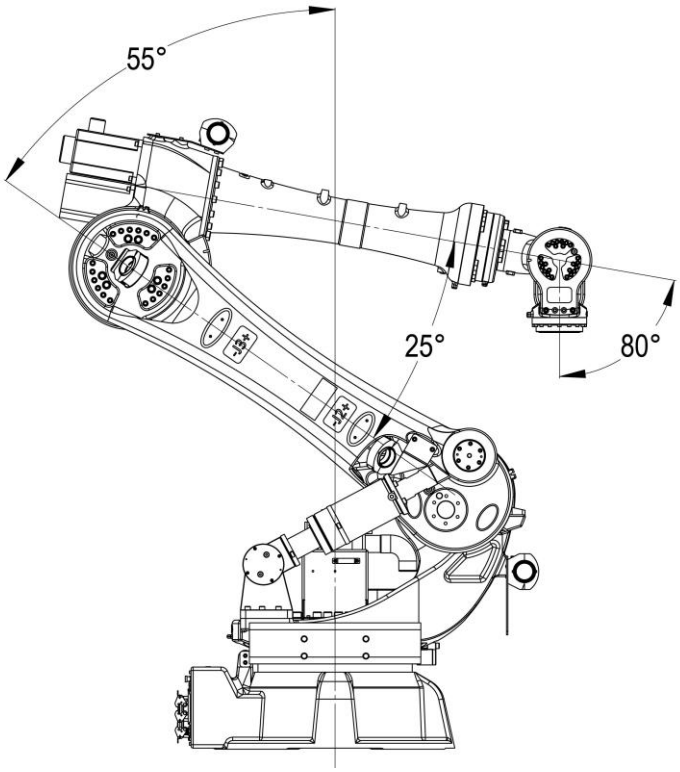


Figure 6-2 Handling Posture of AIR165-2750A Manipulator

Warning

- Manipulator shall be handled in strict accordance with the posture in the Table, otherwise it may fall due to unstable center of gravity.
- During the long distance transportation, the operator shall add wood support between the forearm and the casting of J2 to reduce the impact load during the transportation. A soft cushion should be used between the wood and the support point to prevent the wood from scratching the surface of the machine.

6.2 Handing Dimensions

Three views of manipulator during the handling process are as shown in Figure 6-3(it shall be noted that the actual dimensions may be slightly larger than those in the Figure):

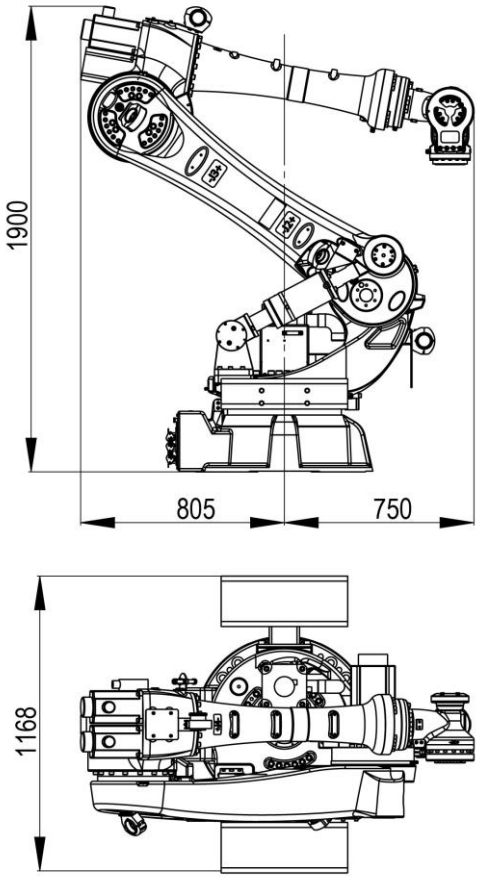


Figure 6-3 Dimensions of AIR165-2750A Manipulator during the Handling Process

6.3 Handing with Forklift

Handling with forklift is as shown in Figure 6-4. Forklift shall meet the requirement for the weight of manipulator. The total weight of manipulator and handling device is about 1200kg.

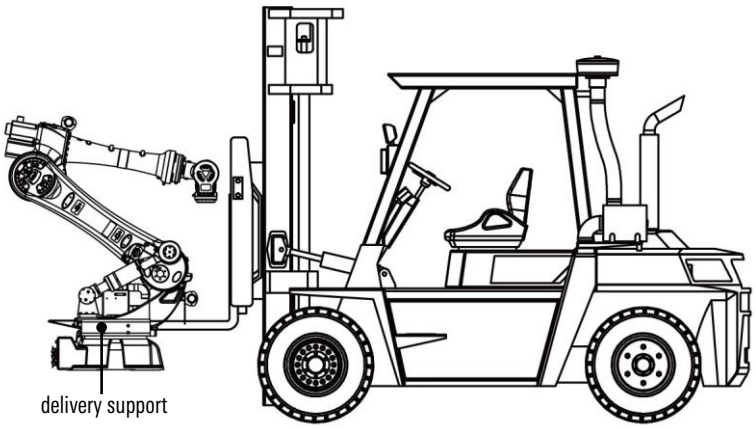


Figure 6-4 AIR165-2750A Handling with Forklift

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 Chapter 6.1 of this manual.

6.4 Handing with Swinging Ring

Handling with swinging ring is as shown in Figure 6-6, lifting device shall meet the requirement for the weight of manipulator. The total weight of manipulator and handling device is about 1200kg.

A single sling can carry more than 1t, and a crane can carry more than 2.5t.

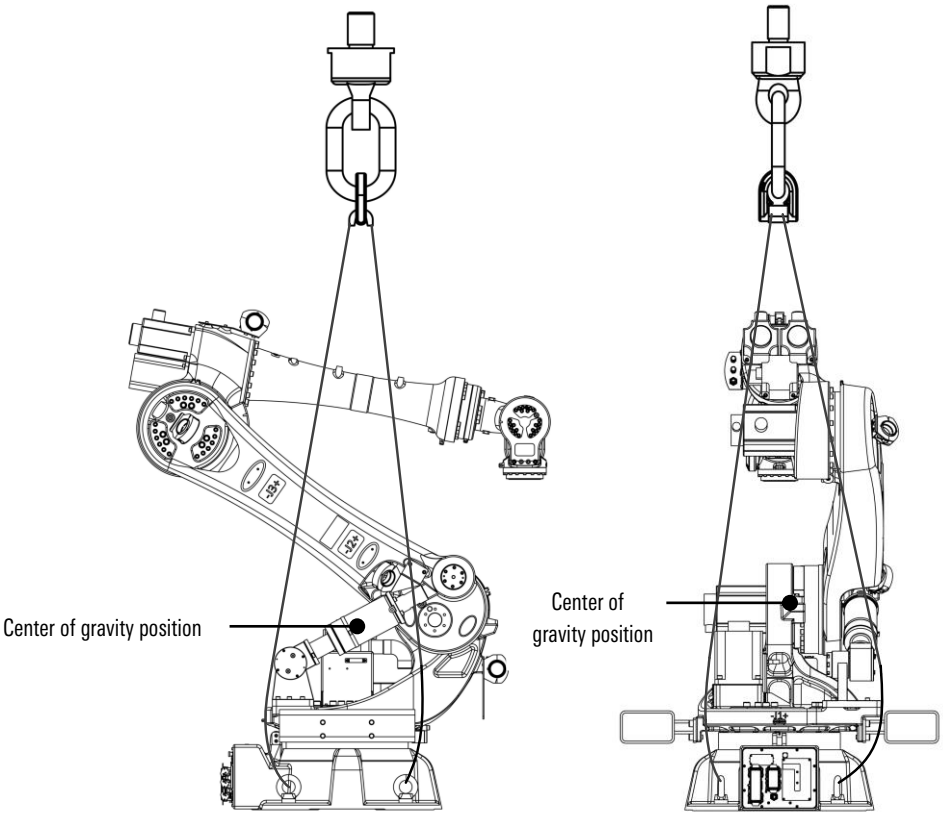


Figure 6-5 Diagram 1 of AIR165-2750A Manipulator Handling with Swinging Ring

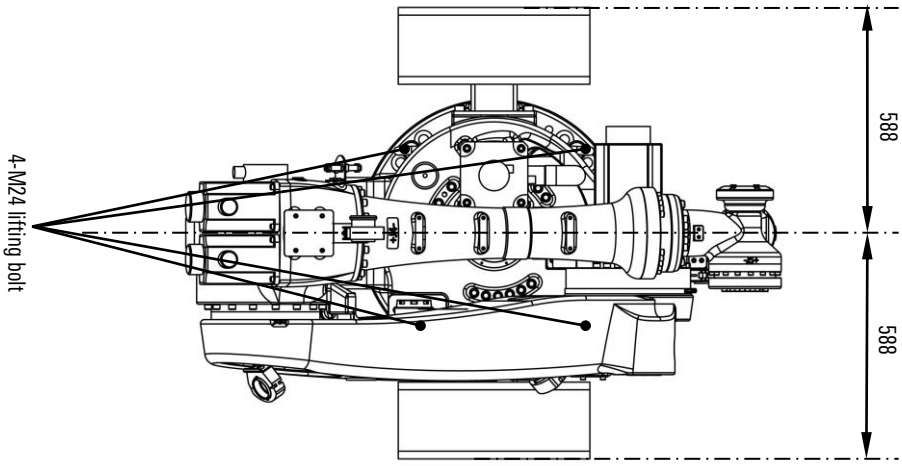


Figure 6-6 Diagram 2 of AIR165-2750A Manipulator Handling with Swinging Ring

Caution

When manipulator is handled with swinging ring, insert a soft object between the sling and manipulator to avoid the scratching on the manipulator body by sling.

Caution

Manipulator may turn over when transported with swinging ring. During the handling, please take special care to keep the manipulator steady.

Caution

Do not pull the swinging ring to the side to avoid the damage to the manipulator and the unpredicTable failure.

7 Adaptation and Connection of AIR165-2750A Manipulator and Accessories

7.1 Examples of Accessory Types

The accessory equipment of the manipulator mainly includes mechanical grab (Figure 7-1), hydraulic pressure sucker (Figure 7-2), welding gun welder (Figure 7-3), infrared identification equipment, visual identification equipment, cutting machine and other special equipment, etc.

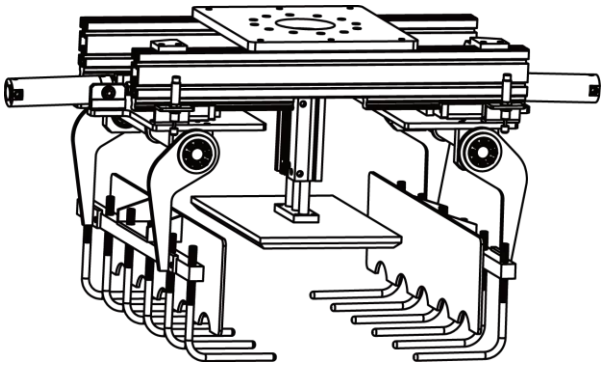


Figure 7-1 Industrial robot grab

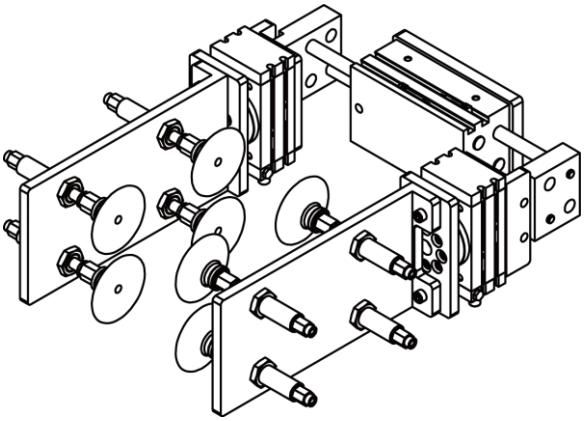


Figure 7-2 Suction cups for industrial robots

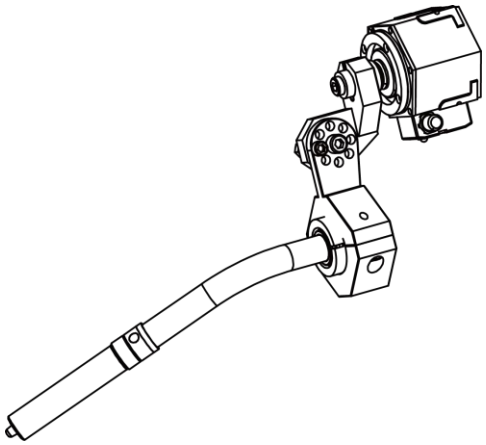


Figure 7-3 Arc welding gun for industrial robot

7.2 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 operator through the flange, which is detailed in *Chapter 9.6* of this manual.

Connection between operator and control cabinet

As described in *Chapter 5.1* of this manual, the heavy-duty connector on the operator body is connected to the control cabinet through three cables. The definition of heavy-duty connector on the control cabinet of AIR165-2750A operator is shown in Figure 7-4 below. For more details, please refer to the corresponding manual of the electrical part.

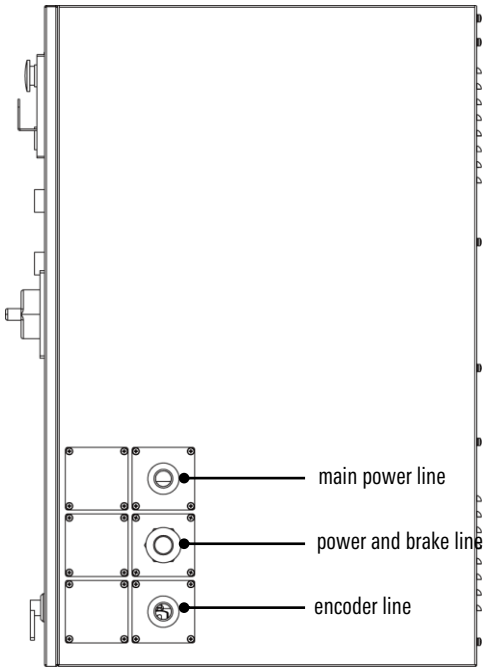


Figure 7-4 The definition of AIR165-2750A cabinet cable connector

8 The Label Name and Meaning of AIR165-2750A

8.1 Safety Sign of Manipulator

An operator safety label shall be pasted on the back of the upper arm of the operator, as shown in Figure 8-1.

Figure 8-1 Safety sign of manipulator

Danger

It is so easy or may cause unnecessary personal injury and even death if you do not comply with this regulation!

8.2 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 8-2.

Figure 8-2 Manipulator nameplate

8.3 Direction Sign of Each Joint

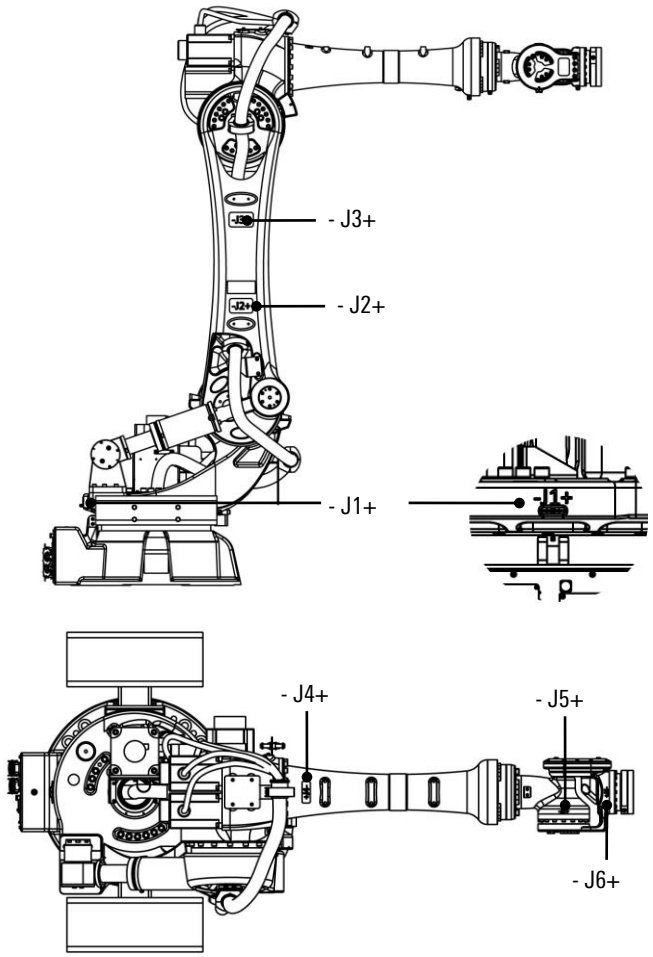


Figure 8-3 Direction sign of each axle on manipulator

“+” or “-” sign is provided at the rotating or swinging joints of axes 1~6 of manipulator as shown in Figure 8-3 to indicate the moving direction of each axle. "J1" in sign represents the axle 1 (other axes are represented by the corresponding numbers), "+" indicates the positive direction, and "-" indicates the negative direction.

9 Performance Parameters of AIR165-2750A Manipulator

9.1 Basic Specification

See *Chapter 2.3* of this manual for the basic specifications of AIR165-2750A manipulator.

9.2 Dimension and Working Range of Each Joint

See Figure 9-1 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.

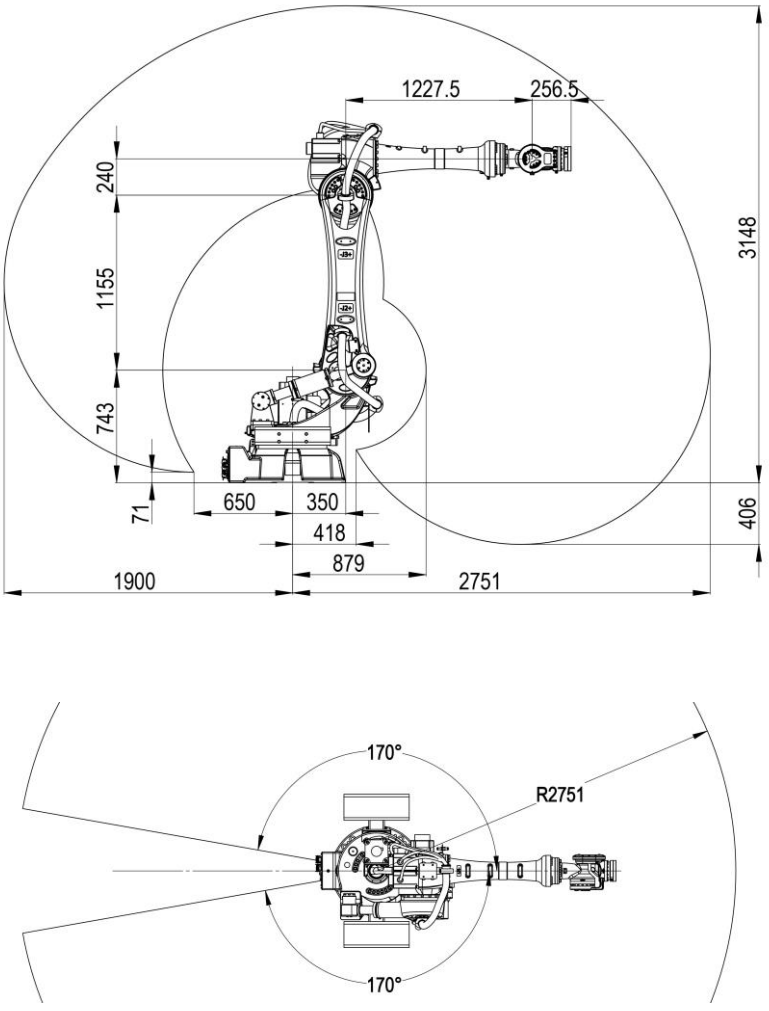


Figure 9-1 Working range of AIR165-2750A manipulator

The motion range of each axis of AIR165-2750A manipulator is shown in Table 9-1.

Table 9-1 Motion range of each axis of AIR165-2750A manipulator

Axis number	Motion range
J1	-170°~170°
J2	-60°~85°
J3	-120°~155°
J4	-360°~360°
J5	-125°~125°
J6	-360°~360°

9.3 Mechanical Limit

Zero point and movable range are respectively set on each axle. Robot is limited to the movable range except that the origin position is lost due to the servo system abnormality and system error. In addition, an optional mechanical brake is also available on some axle to limit the movable range in order to further ensure the safety.

Figure 9-2 shows the position of mechanical brake.

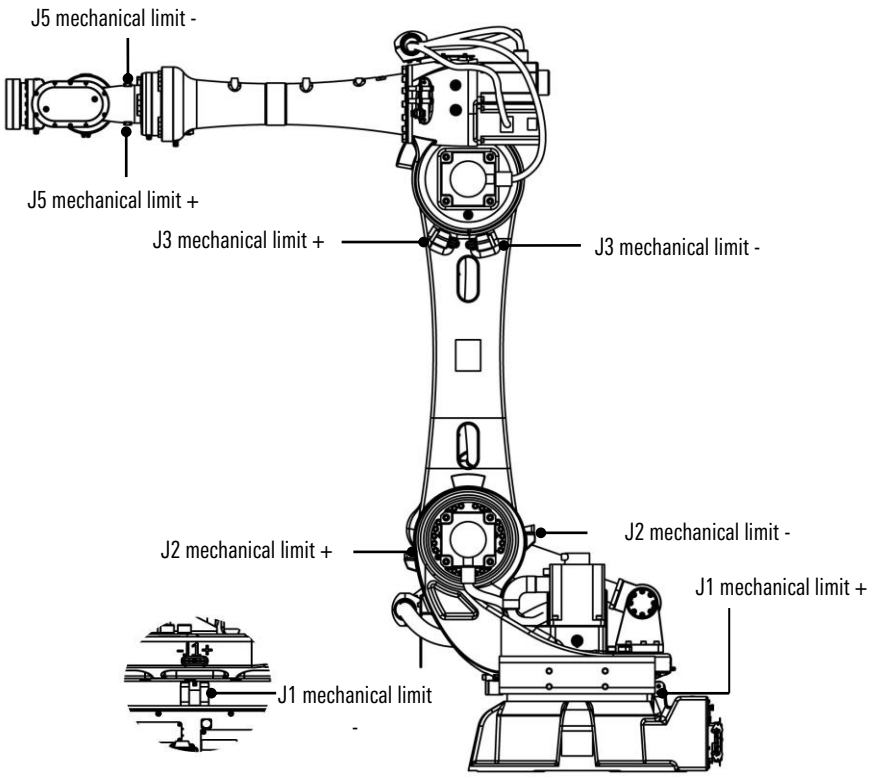


Figure 9-2 Mechanical brake on AIR165-2750A manipulator

Caution

Do not modify the mechanical brake. Otherwise the robot may not stop properly.

9.4 Speed of Each Joint

The maximum angular speed of each axis of the manipulator is shown in Table 9-2.

Table 9-2 Maximum angular speed of each axis of the manipulator

Axis number	Maximum angular velocity（°/s）
J1	125
J2	113
J3	125
J4	180
J5	175
J6	280

9.5 Output Flange Size

Figure 9-3 show output flange connection size of AIR165-2750A.

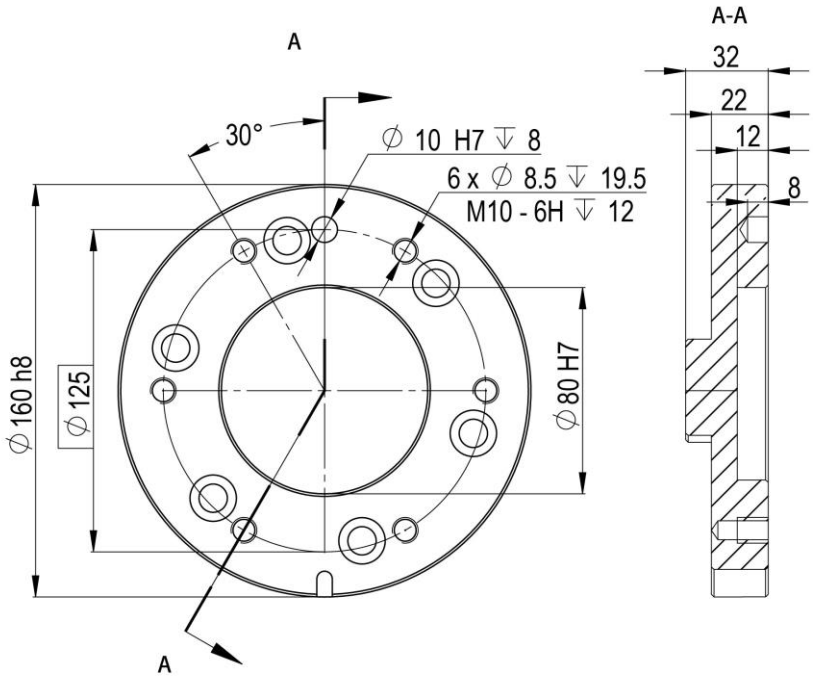


Figure 9-3 The flange dimension diagram of wrist of AIR165-2750A manipulator

Table 9-3 The output mechanical interface specifications of AIR165-2750A

Locating circle diameter	160mm
Diameter of graduation circle of threaded hole	125mm
Screw grade	12.9 grade
Screw diameter	M10
Screw quantity	6
Locating pin	10mm
Screw standard	GB/T 70.1-2000

The Table 9-3 show output flange specification of AIR165-2750A. Tightening torque of screws is shown in *Appendix B(Nm)*.

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 (12mm) and the depth of the pin hole (8mm), otherwise the wrist of the operator will be damaged.

9.6 Load and Installation Method

Wrist load installation of manipulator

During the installation of the wrist load of AIR165-2750A manipulator, that shall be paid attention to:

- The load conditions shall be within the limits shown in the Figure 9-4 and Table 9-4.
- The allowable wrist torque of axis 4 is less than 802.8Nm, that of axis 5 is less than 802.8Nm, and that of axis 6 is less than 436.6Nm.
- The allowable load moment of inertia of 4-axis is less than 40.7kgm², that of 5-axis is less than 40.7kgm², and that of 6-axis is less than 12kgm².

The wrist load line diagram of AIR165-2750A manipulator is shown in Figure 9-4.

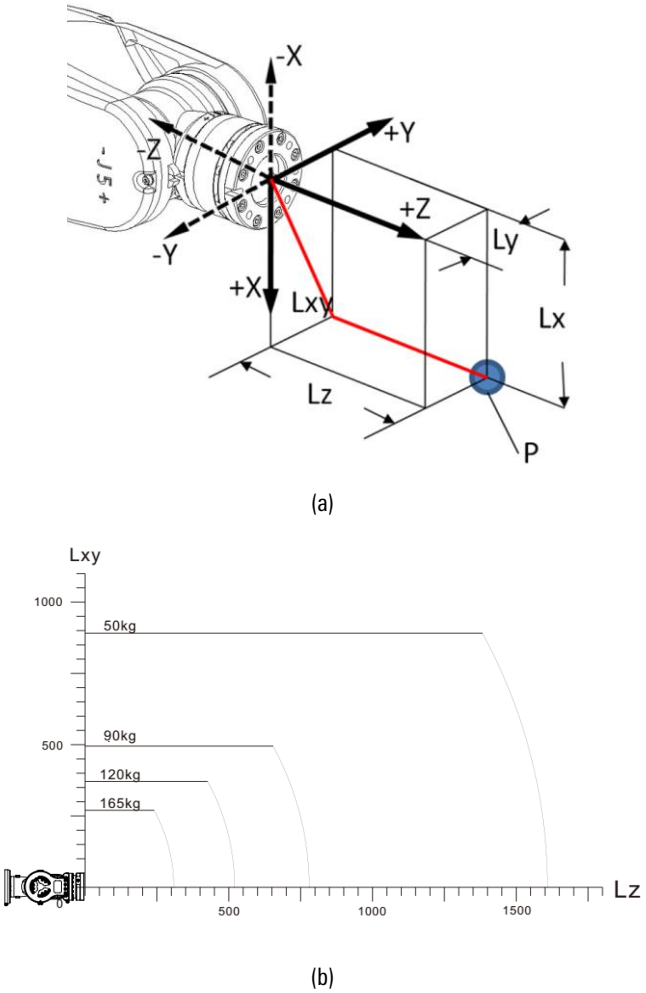


Figure 9-4 Location of wrist load center of AIR165-2750A manipulator

See Table 9-4 for data of load torque and load rotational inertia of AIR165-2750A manipulator.

Table 9-4 Data of load torque and load rotational inertia of AIR165-2750A manipulator

Model of manipulator	Axis	Load torque	Load rotational inertia
Wrist load 165kg		Nm	kgm²
AIR165-2750A	J4	802.8	40.7
	J5	802.8	40.7
	J6	436.6	12

Prompt

The data in Table 9-4 shows the maximum load torque and rotational inertia of joint J4, J5 and J6 under rated working condition during installing 165kg load for wrist (LZ = 240mm, Lxy = 270mm).

Installation of elbow equipment of J3 of manipulator

The elbow and wrist of AIR165-2750A manipulator can be equipped with external equipment with a weight of no more than 100kg, as shown like A and B in Figure 9-5. The conditions to be met are:

- The weight of A shall be not more than 50kg.
- The weight of B shall be not more than 100kg.
- The sum of weight of A and B shall be not more than 100kg.

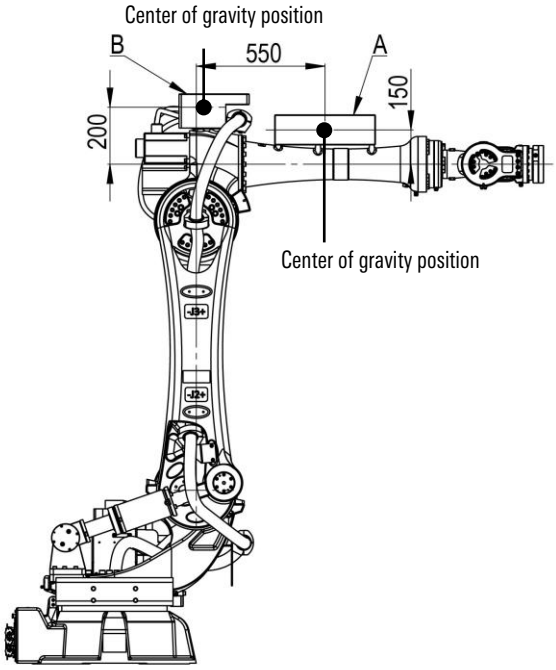


Figure 9-5 Installation dimension of elbow equipment of AIR165-2750A manipulator

See Figure 9-6 for the specification and size of the installation hole of the manipulator jib.

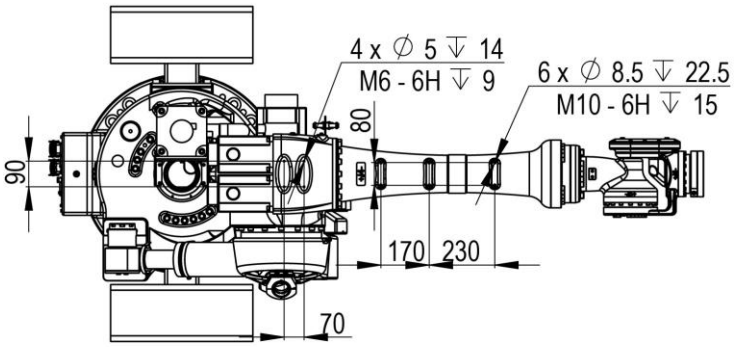


Figure 9-6 interface dimension drawing of AIR165-2750A manipulator jib

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.

Warning

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 body.

Warning

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 (10mm), otherwise the elbow of the manipulator will be damaged.

Warning

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.

Warning

When installing the equipment at the elbow of the manipulator, pay attention to avoid the interference with the operator body and the cable, otherwise the

main body cable is broken, resulting in unexpected serious faults and consequences.

Installation of shoulder equipment of J1 of manipulator

The shoulder of AIR165-2750A manipulator can be equipped with external equipment with a weight of no more than 500kg, as shown in Figure 9-7. The mass center of the load shall not be more than 0.5m away from the rotation center of J1.

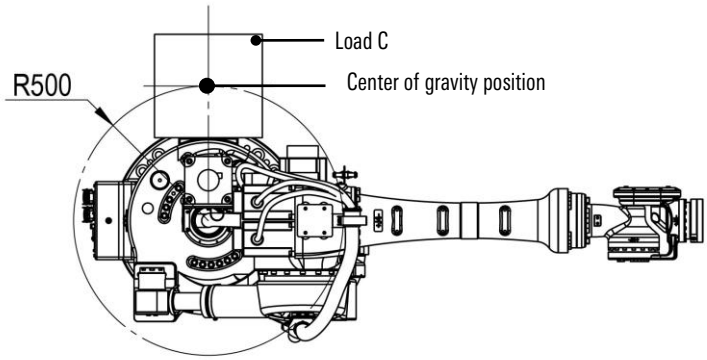


Figure 9-7 Installation dimension of shoulder equipment of AIR165-2750A manipulator

See Figure 9-8 for the specification and size of the installation hole of the manipulator jib, handling bracket is used to locate the position of the hole.

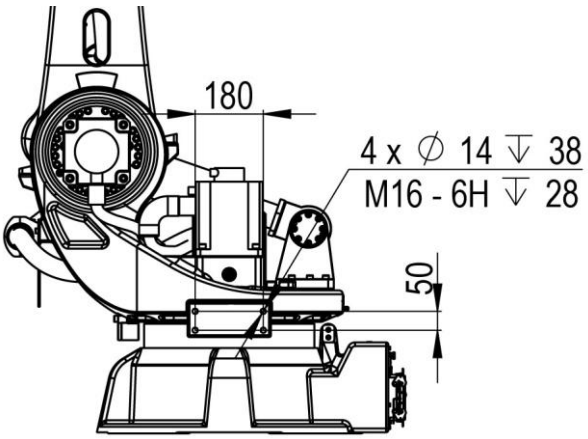


Figure 9-8 Specification and size of the installation hole of shoulder equipment of AIR165-2750A manipulator

Installation position of external cable of manipulator

In order to fix external equipment cable of manipulator, hole location of cable installation are reserved for AIR165-2750A manipulator, as shown in Figure 9-9.

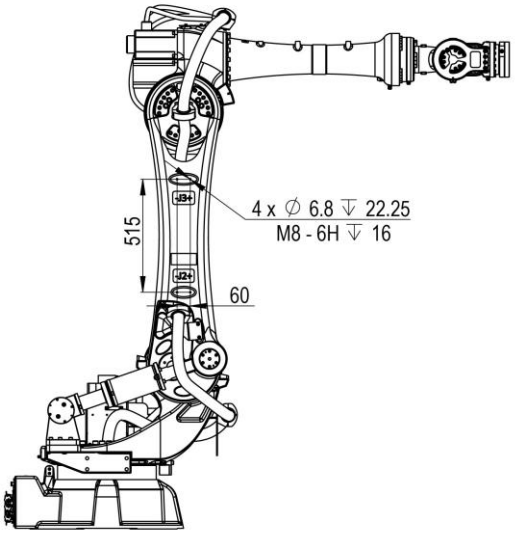


Figure 9-9 Cable fixed position of jib of AIR165-2750A manipulator

Cable shall be fixed on the small jib of AIR165-2750A manipulator, or load can be installed on it without cable. When fixing the cable on the jib, dimension of the mounting hole size is shown in Figure 9-6.

Warning

- When installing the equipment, the screw used shall take full account of the depth of the threaded hole, and the installation length shall not exceed the depth of the threaded hole, otherwise the internal components or cables of the operator will be damaged.
- 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.

10 Calibration of the Axes of AIR165-2750A Manipulator

10.1 General

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

10.2 When Calibration is Required

The operator 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).

10.3 Calibration Position of Each Joint

The position of each axis of the manipulator is shown in Figure 10-1 below, in which, except for the J3 axis, it is 90 °, and the other axes are 0 °.

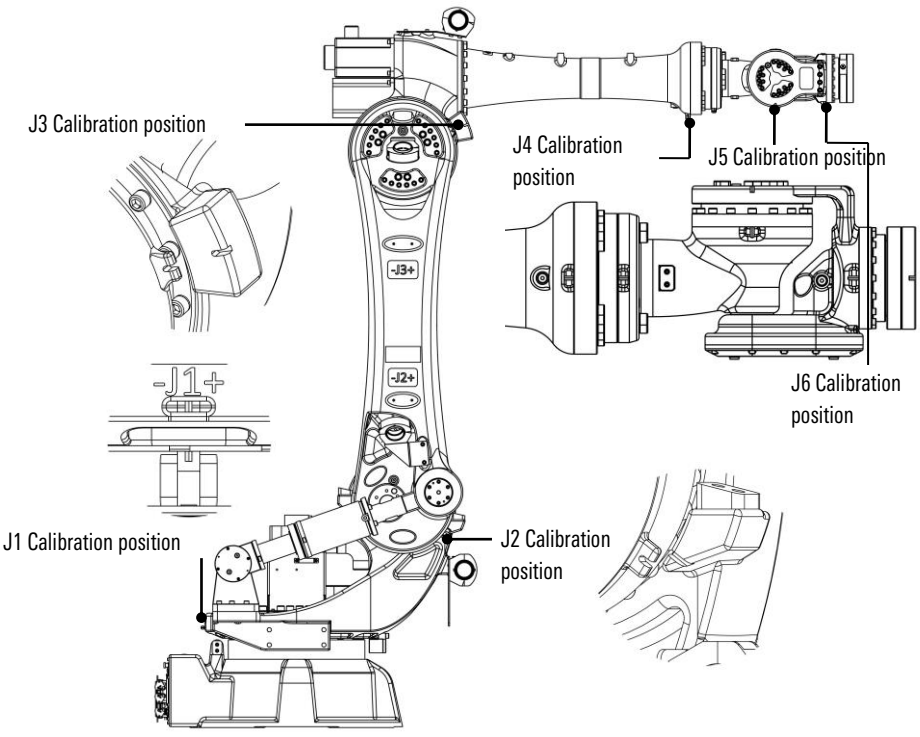


Figure 10-1 zero point diagram of each axis of AIR165-2750A manipulotor

Caution

The robot calibration must always be performed at the same temperature conditions to avoid errors due to thermal expansion and contraction.

Caution

The AIR165-2750A industrial robot calibration must be calibrated in sequence from the joint J1 to J6.

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 10-1, the naked eye shall be used to make the zero point position of each shaft to be aligned, as shown in Figure 10-2.

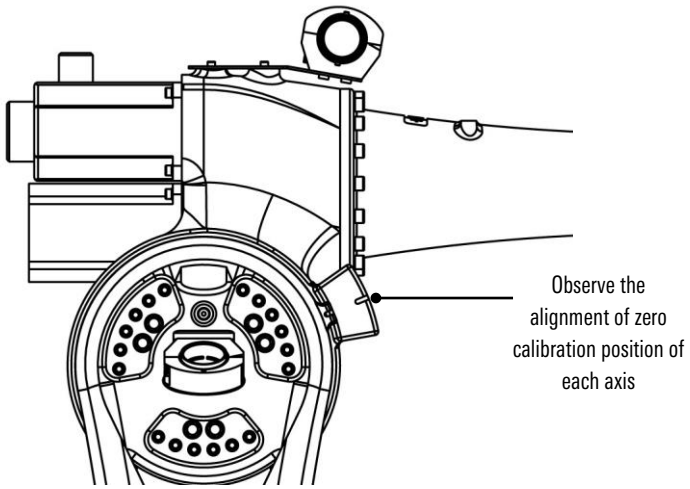


Figure 10-2 Calibration method of naked eye observation zero

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 10-3.

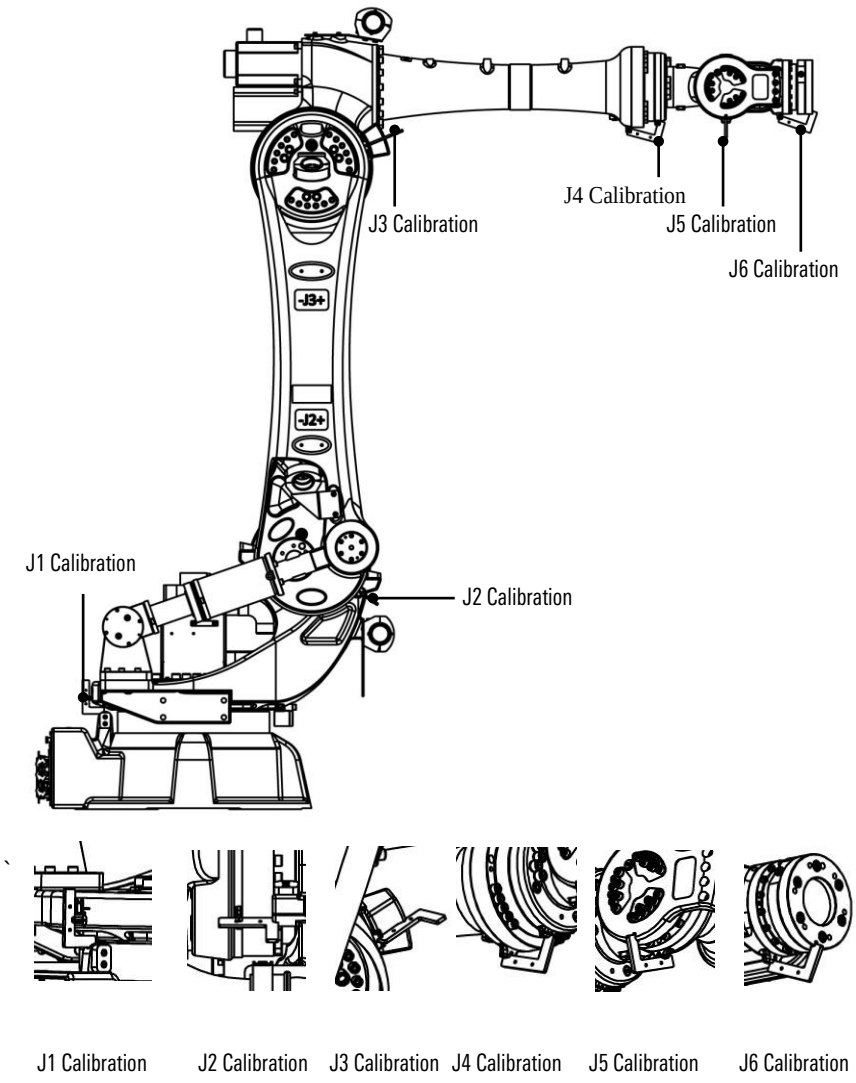


Figure 10-3 Calibration method of zero calibration block

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 10-3.

Calibration under the requirement of High path Positioning accuracy

When the operator 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.

10.4 Calibrate the Direction of Motion of Each Joint

For a 6-degree-of-freedom industrial robot manipulator, its movement direction is defined as shown in Figure 10-4. The axis 2, axis 3, axis 5 clockwise movement is positive, counter-clockwise is negative. Observe from top to bottom, the axis 1 ,axis 4,axis 6 counter-clockwise movement is positive, clockwise is negative.

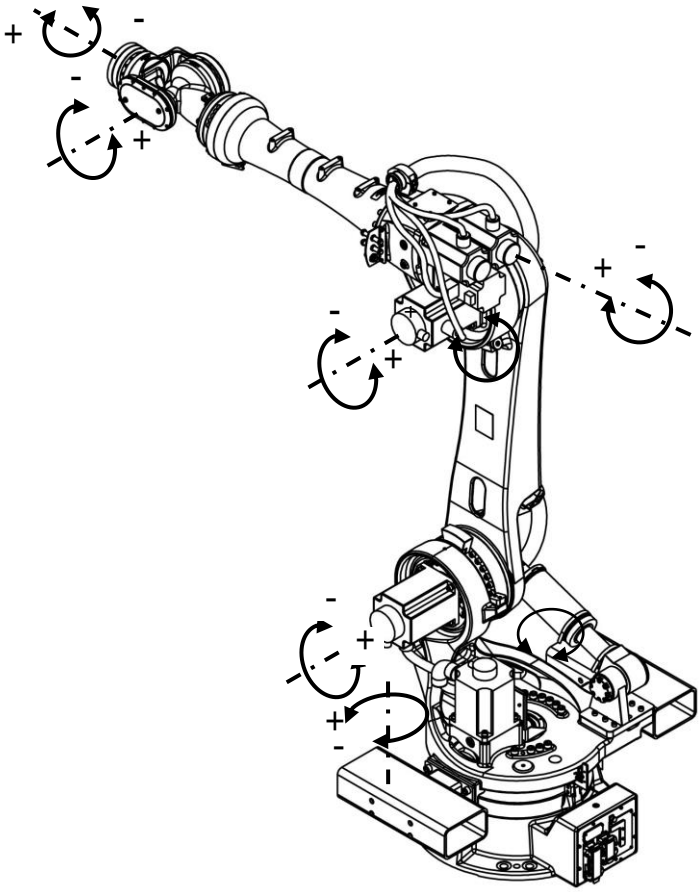


Figure 10-4 Direction of motion of each joint of the manipulator

11 General principles of maintenance

This manual is a description of preventive maintenance of AIR165-2750A operators. 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.

Warning

- 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 operating machine.

12 Maintenance Items

12.1 Daily Maintenance

When running the operator every day, the following items should be checked. As shown in Table 12-1:

Table 12-1 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 shaft
2	presence or absence of positioning accuracy change	Check if there is a deviation from the last startup 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

12.2 First Maintenance

The operation machine 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 12-2:

Table 12-2 Operating Machine 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	Clean all parts of the	Clean and maintain the parts of the manipulator, and check whether the parts are damaged (Note

Ordinal	Inspection item	Main points of inspection
	manipulator	3).
4	Whether the terminal actuator cable is damaged or not	Inspect the cable for damage, and the cable sheath is damaged
5	Check if the stop rubber block at the J1 shaft is damaged	Check whether the limit rubber block is loose, collision damage, aging and so on.

Note 1:

Maintenance site

- The internal cable and cable sheath of the base of the operator (the electrical installation board needs to be removed).
- Big arm of manipulator and internal cable and cable sheath of J1 axle body.
- Operator connection cable, grounding terminal, user cable connector.

Confirmation of matters

- Check whether the wire sheath of the circuit is cracked or worn. If the sheath is damaged, replace it.
- Check the internal cable of J1 axis body, whether the grease on the surface of the inner cable of the big arm disappears, if the grease is about to disappear, it will be replenished.
- Check whether the wiring is worn or not. If the internal wire can be visible, replace it.
- Circular connector: turn by hand to see if it is loose.
- Square heavy load: confirm whether the control rod falls off.
- Grounding terminal: make sure it is loose.

Note 2:

Fastening part

- Fasten the end actuator installation bolt, operator fixed bolt, etc.
- The external connecting screws of the manipulator, especially the connecting screws of each shaft to the reducer or gearbox.
- For the tightening torque, refer to the values recommended in the appendix to this specification.

Note 3:

Related cleaning

- Clean the parts to be cleaned, the dust on the plane, the accumulation of the splash, and shall be cleaned on a regular basis.
- Special attention should be paid to cleaning and timely removal of sundries between the rotating parts of the J5 axis of the wrist.
- Confirm that there is oil leaking from the reducer or gearbox.
- When the oil is wiped off, the oil can also be seen after 1 day, and there may be oil leakage.

12.3 Regular Maintenance

960 hours (3 months) regular maintenance

For every 960 hours or 3 months of operation of the operator (whichever is the shorter time), the following items need to be inspected and repaired. As shown in Table 12-3:

Table 12-3 Operator 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 operation machine shall run for 1920 hours or 6 months (whichever is shorter), and the following items shall be inspected and repaired. As shown in Table 12-4:

Table 12-4 Operation machine 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 *12.2 First Maintenance*
2	Nitrogen spring pressure detection	See *13.5 Check and Repair of Nitrogen Spring*

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 12-5:

Table 12-5 Operation machine 3840 hours (1 year) 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	See *12.2 First Maintenance*
2	Fasten external main bolts	See *12.2 First Maintenance*
3	Clean all parts of the manipulator	See *12.2 First Maintenance*
4	Whether the terminal actuator cable is damaged or not	See *12.2 First Maintenance*
5	Check if the stop rubber block at the J1 shaft is damaged	See *12.2 First Maintenance*

7860 hours (2 years) regular maintenance

The operation machine 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 12-6:

Table 12-6 Operator 7860 hours (2 years) maintenance project

Ordinal	Inspection item	Main points of inspection
1	Replacement of battery	See *13.3 replacement of batteries*

15360 hours(4 years)periodic maintenance

The operation machine 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 12-7:

Table 12-7 Operation machine 15360-hour (4-year) maintenance project

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

19200 hours (5 years) regular maintenance

For every 5 years or 19200 hours (whichever is the shorter time), the operator needs to be overhauled and many parts need to be replaced. Please contact us. As shown in Table 12-8:

Table 12-8 Operator 19200 hours (5 years) maintenance project

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

13 Project Maintenance Process

13.1 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:

- Adjust the robot to the calibration state.
- To prevent the hazards, turn off the power, hydraulic, and pneumatic sources connected to the robot.
- Clean the manipulator with the vacuum cleaner or wipe it with a cloth.
- After all safety conditions are met, conduct the follow-up work of manipulator.

Warning

- 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.

13.2 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), as shown in Figure 13-1.

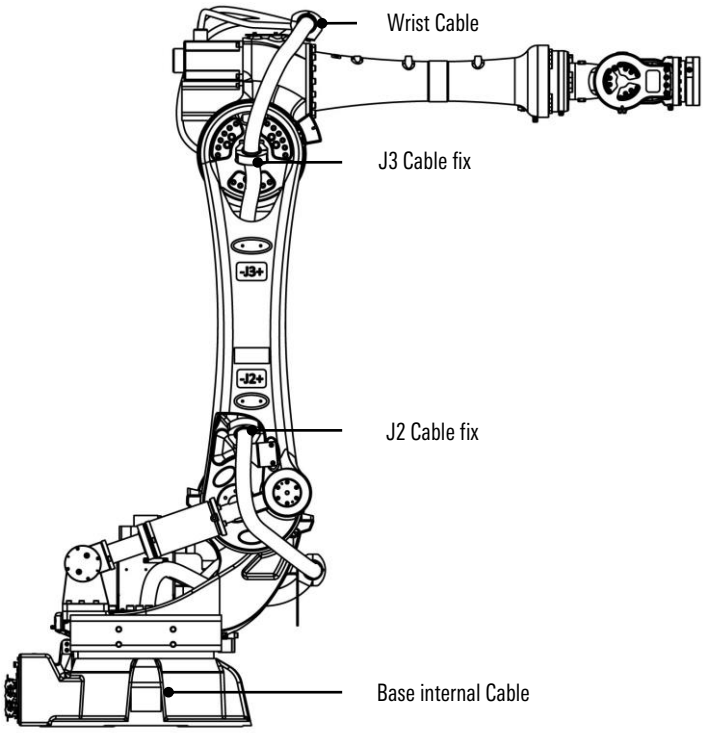


Figure 13-1 Layout for cables of manipulator

Check and overhaul process for external cables

Check and repair process as follows:

- Adjust the manipulator from J1 to J6's angle is 0°,0°,90°,-180°,0°,0°.
- To prevent the damage, please shutdown the electric power and hydraulic power and pneumatic power of the manipulator.
- Check all the external cables for wear or damage.
- Check all the cables connector for wear or damage.
- Check all the bracket and Tie-down straps are fixed on the operation
- Check the fixation between the cable and bracket for wear or damage.
- In case of crack, wear or damage, please contact us for replacement timely

Check and repair process for internal cables of base

Check and repair process as follows:

- Remove the electrical mounting plate as shown in Figure 13-2, and pull out the internal cables of base.
- Check if the fixing plate secures the cables on the mounting plate.

- Check the fixation between the cables and fixing plate for wear or damage.
- Check the internal cables for wear or damage.
- In case of crack, wear or damage, please contact us for replacement timely.
- Check if the lubricating grease on the internal cable surface has disappeared.
- If the grease on the cable surface disappears, it shall be replenished timely.
- The cable shall be installed into the base.
- When installing the cover plate, coat the joint surface between the cover plate and base with sealant.

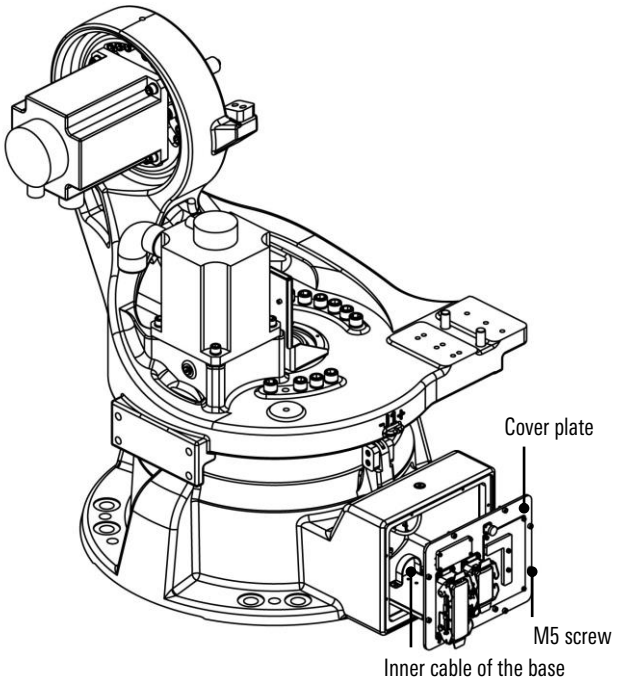


Figure 13-2 Inner cable of the base

13.3 Battery Replacement

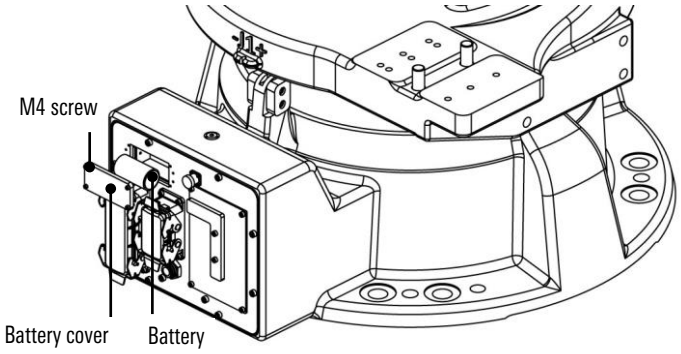


Figure 13-3 Schematic Diagram of Battery Replacement

he data on the positions of manipulator axes is saved with the encoder battery. The battery shall be replaced according to the following process every 7,860 h or 2 years (whichever comes first).

Replacement as follows:

- Adjust the robot to the calibration state.
- To prevent the hazards, turn off the power, hydraulic, and pneumatic sources connected to the robot.
- Remove the battery cover on the electrical mounting plate of manipulator, as shown in Figure 13-3.
- 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.
- When installing the battery cover, coat the joint surface between the electrical mounting plate and battery cover with the sealant.
- Make sure that all safety conditions are met, and then perform the calibration and testing of manipulator.

13.4 Grease replacement

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 13-1:

Table 13-1 Type and quantity of operator grease

Operator model	Replace the grease part	Amount of grease	Grease type
AIR165-2750A	J1 axis reducer	4522g	VIGOGREASE RE0

Operator model	Replace the grease part	Amount of grease	Grease type
	J2 axis reducer	2328g	
	J3 axis reducer	1474g	
	J4 axis gear case	2980g	
	J4 axis reducer	962.7g	
	J5 axis reducer	686g	
	J6 axis gear case	282g	
	J6 axis reducer	344g	

When replacing the grease, please refer to Table 13-2 for the attitude of the manipulotor:

Table 13-2 Grease changing attitude of operator

Replace the grease part	J1	J2	J3	J4	J5	J6
J1 axis reducer	0°	Arbitrarily	Arbitrarily	Arbitrarily	Arbitrarily	Arbitrarily
J2 axis reducer	Arbitrarily	0°	Arbitrarily	Arbitrarily	Arbitrarily	Arbitrarily
J3 axis reducer	Arbitrarily	0°	90°	Arbitrarily	Arbitrarily	Arbitrarily
Elbow gear case	Arbitrarily	0°	90°	Arbitrarily	Arbitrarily	Arbitrarily
J4 axis reducer	Arbitrarily	0°	90°	87.93°	Arbitrarily	Arbitrarily
J5 axis reducer	Arbitrarily	0°	90°	0°	60°	Arbitrarily
Wrist gear case	Arbitrarily	0°	90°	0°	0°	Arbitrarily
J6 axis reducer	Arbitrarily	0°	90°	0°	0°	4.95°

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

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the waste oil collector near the grease outlet.
- Remove the grease outlet M10x1 plug, as shown in Figure 13-4.
- Install grease drain tubing to ensure waste oil flows into the sump tank.
- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3.
- 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; From the fat injection port injection lack of quantity can be.
- Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.

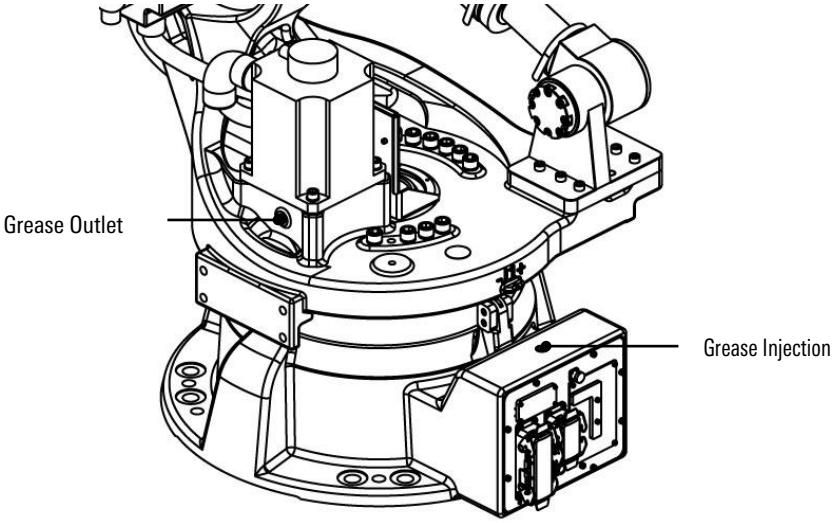


Figure 13-4 Replace the lubricating grease of J1 axis reducer13

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 0.3 Mpa.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

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the sump tank for collecting waste oil near the grease outlet.
- Remove the grease outlet M10x1 plug, as shown in Figure 13-5.
- Install grease drain tubing to ensure waste oil flows into the sump tank.
- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3.

- 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; From the fat outlet injection lack of quantity can be.
- Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.

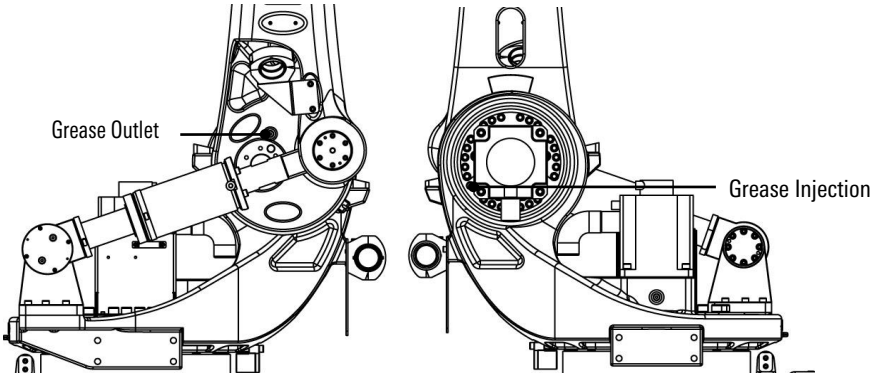


Figure 13-5 Replace the grease of J2 axis reducer13

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 0.3 Mpa.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

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the sump tank for collecting waste oil near the grease outlet.
- Remove the grease outlet M10x1 plug, as shown in Figure 13-6.
- Install grease drain tubing to ensure waste oil flows into the sump tank.
- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3. 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; From the fat outlet injection lack of quantity can be.
- Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.

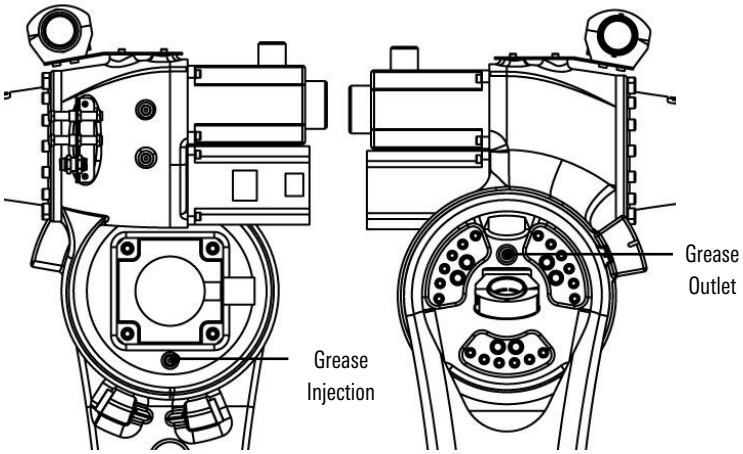


Figure 13-6 Replace the lubricating grease of J3 axis reducer13

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 0.3 Mpa.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.

Elbow gear case replacement grease process

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the sump tank for collecting waste oil near the grease outlet.
- Remove the grease outlet M10x1 plug, as shown in Figure 13-7.
- Install grease drain tubing to ensure waste oil flows into the sump tank.
- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3.
- 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; From the fat outlet injection lack of quantity can be.

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

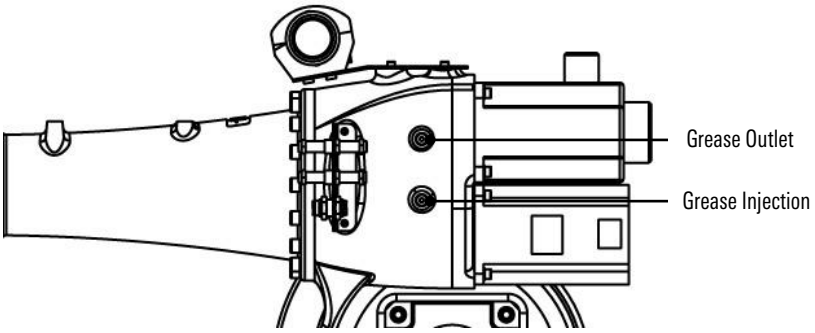


Figure 13-7 Replace the lubricating grease of elbow gear case

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 0.3 Mpa.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

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the sump tank for collecting waste oil near the grease outlet.
- Remove the grease outlet M10x1 plug, as shown in Figure 13-8.
- Install grease drain tubing to ensure waste oil flows into the sump tank.
- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3.
- 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; From the fat outlet injection lack of quantity can be.
- Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.

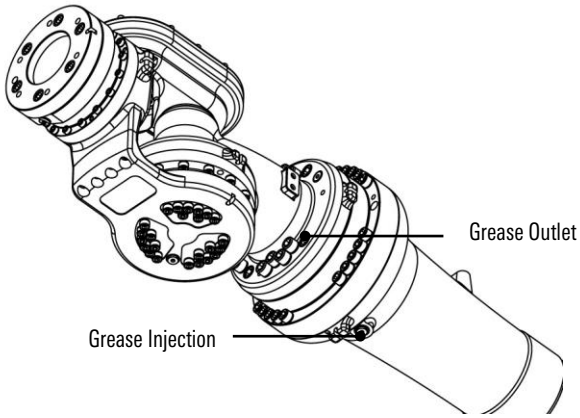


Figure 13-8 Replace the lubricating grease of J4 axis reducer

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 0.3 Mpa. 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 and gear case replacement grease process

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the sump tank for collecting waste oil near the grease outlet.
- Remove the grease outlet M10x1 plug, as shown in Figure 13-9.
- Install grease drain tubing to ensure waste oil flows into the sump tank.
- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3.
- 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; From the fat outlet injection lack of quantity can be.

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

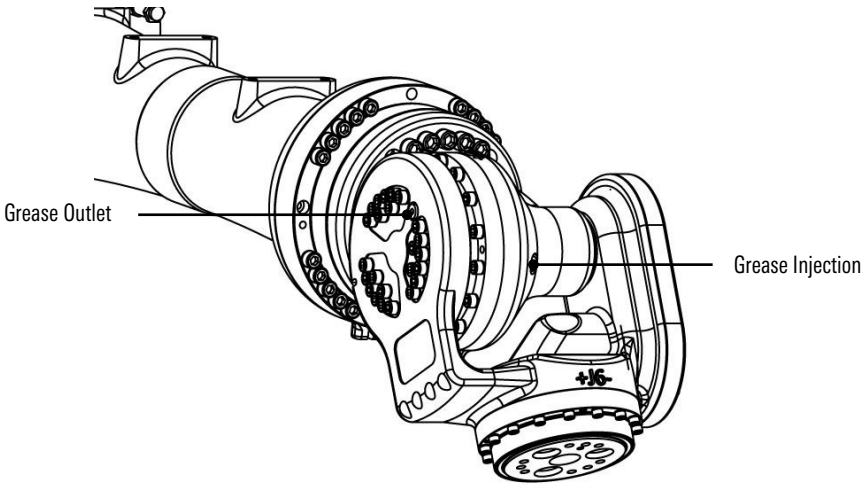


Figure 13-9 Replace the lubricating grease of J5 axis reducer and gear case

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 0.3 Mpa. 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.

Wrist gear case replacement grease process

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the sump tank for collecting waste oil near the grease outlet.
- Remove the grease outlet M10x1 plug, as shown in Figure 13-10.
- Install grease drain tubing to ensure waste oil flows into the sump tank.

- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3.
- 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; From the fat outlet injection lack of quantity can be.
- Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.

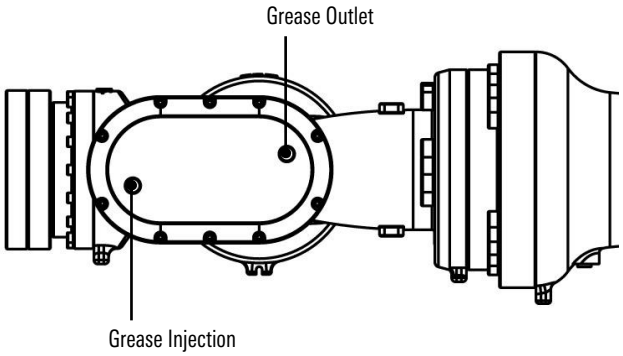


Figure 13-10 Replace the lubricating grease of wrist gear case

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 0.3 Mpa.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 and gear case replacement grease process

- Run the manipulator as shown in Table 13-2.
- To prevent danger, turn off the power, hydraulic and pneumatic sources connected to the robot.
- Place the sump tank for collecting waste oil near the grease outlet.

- Remove the grease outlet M10x1 plug, as shown in Figure 13-11.
- Install grease drain tubing to ensure waste oil flows into the sump tank.
- 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.
- Release the grease pressure inside the reducer as shown in Table 13-3.
- 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; From the fat outlet injection lack of quantity can be.
- Remove the grease injector, install the M10x1 plug on the grease outlet and grease injector, and apply the sealing tape/sealant.

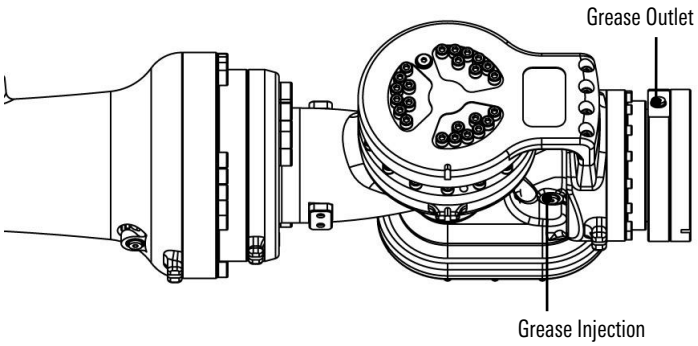


Figure 13-11 Replace the lubricating grease of J6 axis reducer and gear case

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 0.3 Mpa.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.

When the grease of multiple shafts is replaced at the same time, the pressure of them can be released.

Table 13-3 Release internal pressure of reducer and gear case

Replace the grease part	Action point	The action time	The premise
J1 axis reducer	> 90°	20minutes	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	> 60°	20minutes	
J3 axis reducer	> 90°	20minutes	
Elbow gear case	J4 > 60° J5 > 120° J6 > 60°	20minutes	
J4 axis reducer	> 90°	20minutes	
J5 axis reducer	J5 > 120° J6 > 60°	20minutes	
Wrist gear case	J6 > 60°	10minutes	
J6 axis reducer	> 180°	10minutes	

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 Table14-2.
- Thoroughly remove grease from floor and operating machine to avoid slipping.

13.5 Check and Repair of Nitrogen Spring

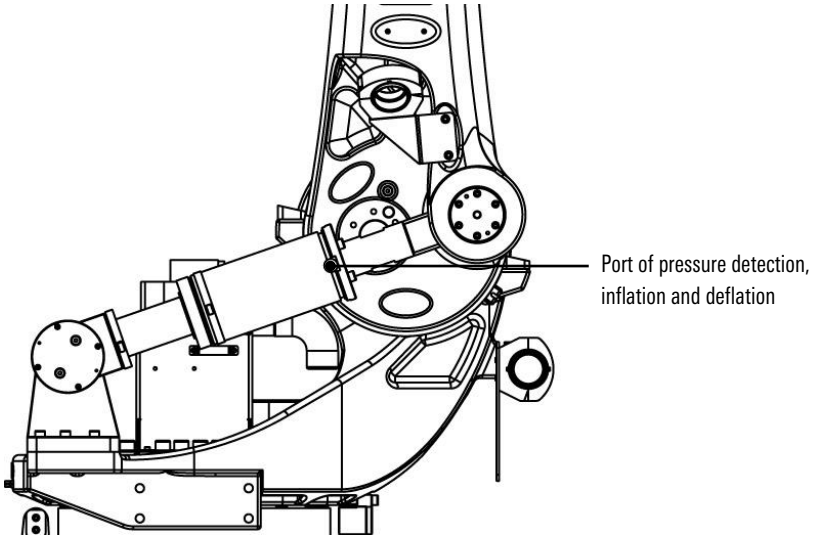


Figure 13-12 Nitrogen spring interface of pressure detection, inflation and deflation

Caution

In order to ensure the normal operation of the nitrogen spring and avoid accidents caused by the insufficient pressure, the pressure of the nitrogen spring shall be tested every 3000h (or 6 months, whichever is shorter). When the pressure is insufficient or too large, gas filling and deflation operation shall be carried out in time. The pressure detection, inflation and deflation of the nitrogen spring are shown in Figure 13-12.

Nitrogen spring pressure detection process

- Prepare a set of tools for nitrogen spring pressure detection: surface thermometer, pressure detection tool and torque wrench.
- Move the manipulator to the calibration position where J2 is on 0°, and turn off the power supply of the robot.
- Unscrew the nitrogen spring inflation plug (including the check valve, without air leakage), and screw in the nitrogen spring pressure gauge then tighten it.
- Measure the surface temperature of the nitrogen spring.
- Refer to Table 13-4, and check the pressure of nitrogen spring according to the surface temperature value. When the pressure is higher than 1MPa of the list data, deflate refering to the nitrogen spring deflation process. When the pressure is lower than 1MPa of the list data, inflate refering to the nitrogen spring inflation process and observe again after 24 hours.

When the test data is within ± 1MPa of the list data, continue the following operations.

- Quickly screw out the nitrogen spring pressure detection tool, and screw in the nitrogen spring plug with tightening torque of 5Nm.

Table 13-4 Surface temperature and internal pressure of nitrogen spring

Surface temperature (℃)	Pressure (Mpa)	Surface temperature (℃)	Pressure (Mpa)
0	11.1	30	12.7
5	11.4	35	13
10	11.6	40	13.2
15	11.9	45	13.5
20	12.2	50	13.8
25	12.4		

Caution

When detecting the pressure of nitrogen spring for a single time, the pressure in the cylinder will drop by 0.05Mpa. While 6 times of detection being reached, the nitrogen spring shall be inflated.

Nitrogen spring inflation process

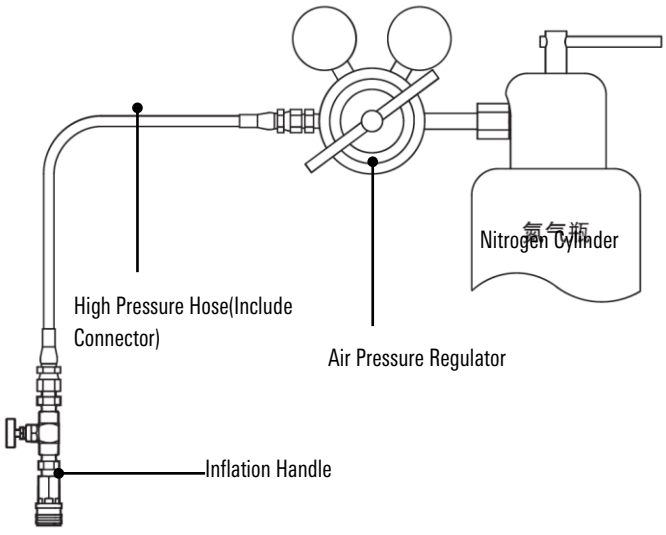


Figure 13-13 Inflation tool of the nitrogen spring

- Prepare the inflation tool of the nitrogen spring: nitrogen cylinder (pressure is more 15MPa), nitrogen filling tool, charging valve, air pressure regulator, high pressure pipe, referring to Figure 13-13.

- Connect the nitrogen charging device with the nitrogen cylinder, and make sure no leakage.
- Check the valve of the pressure regulator if it’ s closed, then slowly open the valve of the gas cylinder. At this time, the inlet pressure of regulator will slowly rise, while the outlet pressure will be zero. The valve of gas cylinder will be completely opened, and then check the pressure of gas cylinder which must be greater than the inflation pressure.
- Take out the nitrogen spring plug, and screw the nitrogen filling tool into the inflation port, then tighten and fix it, And then install the quick connector, with which connect the inflation handle and make it in the inflation state.
- Slowly open the outlet valve of the pressure regulator, and observe the pressure gauge at the outlet, then slowly pressurize in 0.1MPa until reaching the required pressure, and stay for one minute.
- Close the valve of gas cylinder, and pay attention to the residual pressure in the hose at this time, and then make the inflation handle in the deflated state to eliminate the residual pressure in the pipe.
- Pull out the quick connector from the filling tool, then screw out the filling tool and screw in the nitrogen spring plug.

Nitrogen spring pressure adjustment process

- Prepare the pressure adjusting tool of nitrogen spring: drain tool (or M5x20 hexagon socket head cap screw) and torque wrench.
- Screw out the nitrogen spring plug, then screw the drain tool into the inflation port, at this time the nitrogen spring starts to deflate, and when the drain tool is screwed out, deflation stops.
- Check the pressure value of nitrogen spring referring to pressure detector and thermometer of the connector, and repeat work above until the pressure is within the range of the list above.
- Tighten the nitrogen spring plug for charging and discharging.
-  Caution

Under the situation of frequent expansion and use of the axis J2, please contact the after-sales service personnel to replace the nitrogen spring when axis J2 of robot moves in circles more than 1 million times.

In the process of inflation, deflation and pressure adjustment, the robot must be in the state of power off or motor locked, otherwise the robot arm will fall.

Maintenance process of bearing in balancing device

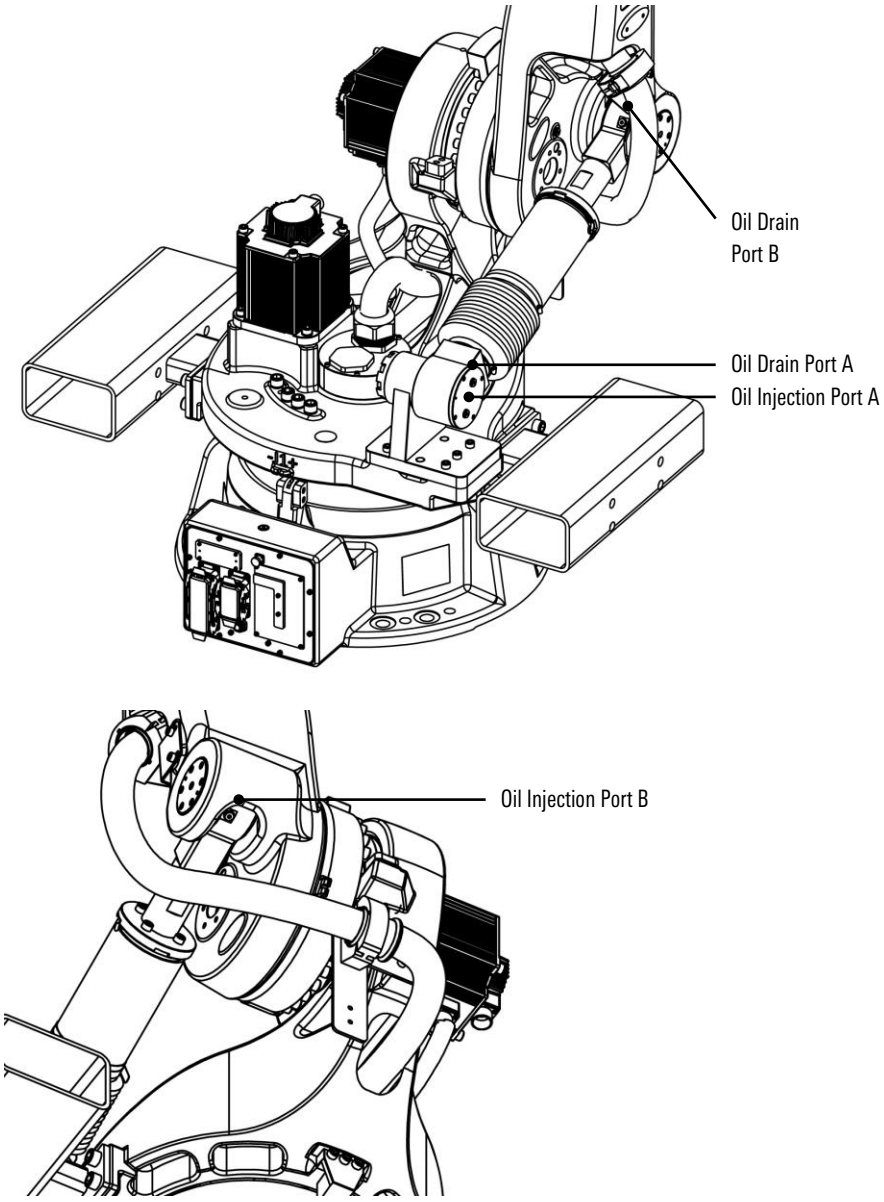


Figure 13-14 Bearing in balancing device

- Screw out the hexagon socket plug of the injection and the drain port, put the oil pipe into the drain port to receive the overflow grease.
- Screw the oil nozzle for injection port, and inject 10g of grease into the injection port A and 6g into the injection port B, with the grease type of VIGOGREASE RE0.
- Screw out the oil nozzle of injection port and screw in hexagon socket plug for the injection port and the drain port.
- Clean the grease around the injection and drain port with rags.

Caution

The bearing in balancing device of nitrogen spring shall be supplemented with lubricating grease for every 6000h (or 12 months, whichever is shorter).

14 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. The possible fault and causes of manipulator are as shown in Table 14-1 Possible Faults and Causes of Manipulator. If you are unsure of the cause or do not know how to proceed, please contact us.

Table 14-1 Possible Faults and Causes of Manipulator

Fault	Classification	Possible Causes	Treatment
Vibration Abnormal noise	■ When the manipulator operates, its base floats from the workshop pedestal ■ There is a gap between the base and workshop pedestal ■ The screws connecting the base and workshop pedestal are loose	Fixation of Base: 1. The manipulator base is not firmly fixed on the workshop pedestal 2. 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.	1. When the screw is loose, tighten it with the torque wrench according to the proper torque 2. Trim the base flatness in accordance with the tolerance 3. Check if the foreign matters are trapped, and if so, remove them 4. Please consult with us
	■ Workshop pedestal vibrates when the manipulator acts	Workshop Pedestal: 1. Pedestal is not completely fixed on the foundation. Therefore, the workshop pedestal vibrates when the manipulator acts. 2. The insufficient rigidity of workshop pedestal, and the reaction force and torque generated by the manipulator cause the deformation and vibration.	1. Completely fix the workshop pedestal according to the corresponding method 2. Workshop pedestal shall be processed to improve its rigidity 3. For the workshop pedestal with machining difficulty, the vibration may be mitigated through the modification of moving program 4. Please consult with us

Table14-2 Possible Faults and Causes of Manipulator

Fault	Classification	Possible Causes	Treatment
Vibration Abnormal noise	■ Vibration at a specific posture during the action ■ No vibration at the slow action ■ Obvious vibration during acceleration and deceleration ■ Simultaneous vibration of multiple axes	1. Load of manipulator exceeds the allowable value 2. Action procedures are too strict on the manipulator 3. Improper acceleration	1. Confirm whether the manipulator load exceeds the allowable value, and reduce the load or change the action procedures 2. Mitigate the specific vibrations by reducing speed, reducing acceleration and changing the action procedures
	■ Collision or long-term overload operation of manipulator No replacement of lubricating grease for a long time	1. 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 2. 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. 3. 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 4. The above reasons may cause the periodic vibration or abnormal noise	1. Make the manipulator operate uniaxially to confirm the Joint that produces the vibration and noise 2. If you need to replace the gear, bearing and reducer, please contact us. 3. Do not use the manipulator at overloaded status 4. If you need to replace the lubricating grease, please contact us. 5. Please consult with us

Table14-3 Possible Faults and Causes of Manipulator

Fault	Classification	Possible Causes	Treatment
Vibration Abnormal noise	■ Causes may not be determined mechanically	1. 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 2. Fault of pulse encoder and the position of motor not correctly transmitted to the controller 3. Failure of motor body to perform its original functions 4. Breakage of internal motor cable of manipulator causes the command not to be correctly transmitted to the motor and control system 5. Voltage drop and no guarantee for the specified voltage 6. Incorrect control parameters are input	1. For the fault of controller, see the controller manual 2. Replace the motor of vibrating Joint to confirm whether it vibrates 3. 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. 4. 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. 5. Check whether the action control parameters are correct, and if not, re-enter the correct parameters. 6. Please consult with us
	The mechanical action near the manipulator is closely related to the vibration of robot.	1. Mechanical electrical noise from the manipulator 2. 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 3. Poor connection of grounding wire will lead to the unstable grounding, causing the vibration of manipulator due to electrical noise interference.	1. Connect the grounding wire properly to avoid the electrical noise mixed into the manipulator 2. Please consult with us

Table14-4 Possible Faults and Causes of Manipulator

Fault	Classification	Possible Causes	Treatment
Vibration Abnormal noise	■ Abnormal noise after the replacement of lubricating grease ■ Abnormal noise occurs during the operation of robot after a long-term shutdown ■ Abnormal noise at low speed	1. Abnormal noise from the manipulator at low speed immediately after the replacement or at the restart after the long-term shutdown.	1.Observe the operation of manipulator for 1-2 days. Usually the abnormal noise will disappear.
Shake of manipulator	■ After power-off, some parts of manipulator may be shaken manually. ■ There is a gap between the connecting surfaces of manipulator	1. Manipulator bolts are loose 2. Connecting bolts on the manipulator are loose due to the overload, collision, etc., thus resulting in the shake	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. 1. Fixing bolts of motor 2. Fixing bolts of reducer shell 3. Fixing bolts of output shaft of reducer 4. Fixing bolts of pedestal 5. Fixing bolts between arms 6. Fixing bolts of shell 7. Fixing bolts of end effector
	Turn off the power of manipulator, and confirm that the screws are tightened, and shake the entire head of manipulator manually	1. Large backlash is resulted from the wear or damage of internal gears of manipulator due to the overload, collision, etc.	1. If you need to replace the internal gear, please consult with us

Table14-5 Possible Faults and Causes of Manipulator

Fault	Classification	Possible Causes	Treatment
Motor overheating	■ Ambient temperature rise for installation of manipulator, and the overheating of motor ■ Motor overheats after the cover plate is mounted on the motor ■ Motor overheats after the action procedures of manipulator and load conditions are changed	Ambient Temperature : 1. Ambient temperature rise or the deterioration of heat dissipation of motor after the cover plate is installed Load Action: 1. Current value of motor exceeds its rated value due to the load and operating procedures	1. Decrease of ambient temperature may prevent the motor from overheating 2. Improvement of ventilation conditions around the motor, i.e. the heat dissipation of motor, may effectively prevent the motor from overheating. 3. A radiation shielding plate if there is a heat source around the motor may prevent the motor from overheating. 4. Slowing down the action procedures and reducing the load may decrease the average current value of motor, thus preventing the motor from overheating. 5. Please consult with us
	Motor overheats after the action control parameters of manipulator are changed	Control Parameter: 1. Improper input parameters will cause the incorrect acceleration and deceleration of robot, so that the average current value of increases.	1. Enter the appropriate parameters according to the relevant instructions. 2. Please consult with us
	Motor overheats due to the causes other than above ones	Mechanical Fault of Manipulator: 1. Mechanical system fault of manipulator causes the overload of motor Motor fault: 1. Brake fault causes the motor to always operate when the brake is applied, which causes the motor to withstand excessive load 2. Failure of motor body to perform its functions causes the excessive current to flow through the motor	1. Please rectify the mechanical fault by reference to the instructions of vibration, abnormal noise and looseness. 2. Please confirm whether the brake is released when the motor is powered on. 3. After the motor is replaced, the overheating of motor disappears. It is confirmed that the this condition is abnormal. 4. Please consult with us

Table14-6 Possible Faults and Causes of Manipulator

Fault	Classification	Possible Causes	Treatment
Leakage of lubricating grease	■ Lubricating grease leaks out from the mechanical part	Poor Sealing: 1. Crack of casting due to the excessive external force caused by the collision 2. Damage of O-ring during the disassembly and reassembly 3. Scratch of oil seal due to the dust intrusion 4. Poor sealing between the cover plate and casting	1. 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. 2. Please consult with us
Falling of manipulator Joint	■ The brake is completely ineffective and the Joint falls quickly ■ After the brake is contracted, the shaft falls slowly	1. The damage of brake drive relay causes the brake to always be powered on and not to work. 2. Wear and damage of brake body affect the braking effect. 3. The lubricating oil and grease inside the motor cause the brake to slip.	1. Check if the brake drive relay is damaged, and if so, replace the relay 2. In case of the wear of brake, the damage of brake body and the lubricating grease inside the motor, replace the motor. 3. Please consult with us

Table14-7 Possible Faults and Causes of Manipulator

Fault	Classification	Possible Causes	Treatment
Position offset	■ Manipulator deviates from the teaching position ■ The repeated positioning accuracy of manipulator is greater than the allowed value	Mechanical Fault: 1. The unstable repeated positioning accuracy may be caused by the mechanical system abnormality, screw looseness, etc. 2. 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. 3. Abnormality of motor encoder	1. 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. 2. If the repeated positioning accuracy keeps stable, please modify the teaching program. If the collision does not occur again, the deviation may be avoided. 3. In case of the abnormality of motor encoder, replace the motor or encoder. 4. Please consult with us
	Position only deviates from the specific peripheral equipment	Deviation of Peripheral Equipment 1. The external equipment under the external force leads to the deviation relative to the manipulator	1. Please relocate the peripheral equipment 2. Please modify the teaching program 3. Please consult with us
	Deviation occurs after the modification of parameters	Parameters: 1. The modification of calibration data causes the loss of manipulator origin	1. Re-enter the previous correct calibration data 2. In case of uncertain calibration data, please recalibrate the manipulator 3. Please consult with us

15 Conditions of Storage

15.1 Environmental Conditions for Long-term Storage of Manipulator

For the purpose of long-term storage of AIR165-2750A manipulator, the specific environmental requirements are as shown in Table 15-1.

Table 15-1 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 without condensation
Max. vibration condition	Frequency 22 Hz, amplitude 0.15 mm

15.2 Precautions for Storage of Manipulator

In addition to *Chapter 2.4* 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 *Chapter 4* 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* of this manual.

Appendix A Periodic Maintenance Schedule of AIR165-2750A Manipulator

Appendix A Periodic Maintenance Schedule of AIR165-2750A 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 year 7,680 h	27 months 8,640 h	30 months 9,600 h	33 months 10,560 h	3 year 11,520 h	39 months 12,480 h	42 months 13,440 h	45 months 14,400 h	4 year 15,360 h	51 months 16,320 h	54 months 17,280 h	57 months 18,240 h	5 year 19,200 h
1	Cleaning of manipulator	0.5h	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
2	Cleaning of control cabinet vent	0.1h	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
3	Wether the synchronous belt worn	0.5h	○		○		○		○		○		○		○		○		○		○		○
4	Check the manipulator cable for damage	3h	○		○		○		○		○		○		○		○		○		○		○
5	Check the manipulator cable sheath for damage	2h	○		○		○		○		○		○		○		○		○		○		○
6	Check the connecting cable of teach pendant, control cabinet and manipulator for damage	0.2h	○				○				○				○				○				○
7	Check the	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 year 7,680 h	27 months 8,640 h	30 months 9,600 h	33 months 10,560 h	3 year 11,520 h	39 months 12,480 h	42 months 13,440 h	45 months 14,400 h	4 year 15,360 h	51 months 16,320 h	54 months 17,280 h	57 months 18,240 h	5 year 19,200 h
	connectors of motor, etc. for looseness																						
8	Tighten the end effector screws	0.2h	○				○				○				○				○				○
9	Tighten the external main screws	1h	○				○				○				○				○				○
10	Check the end effector cable for damage	0.2h	○				○				○				○				○				○
11	Check the limit rubber block for damage	0.1h	○				○				○				○				○				○
12	Replacement of Synchronous Belt	1h					○				○				○				○				○
13	Battery Replacement	0.5h									○								○				
14	Replace the internal cables of manipulator	8h																	○				
15	Manipulator overhaul																						○
Note: ○ indicates that maintenance is required																							

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
M24	651	940	1098
M20	370	500	600

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.

PEITIAN ROBOTICS

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