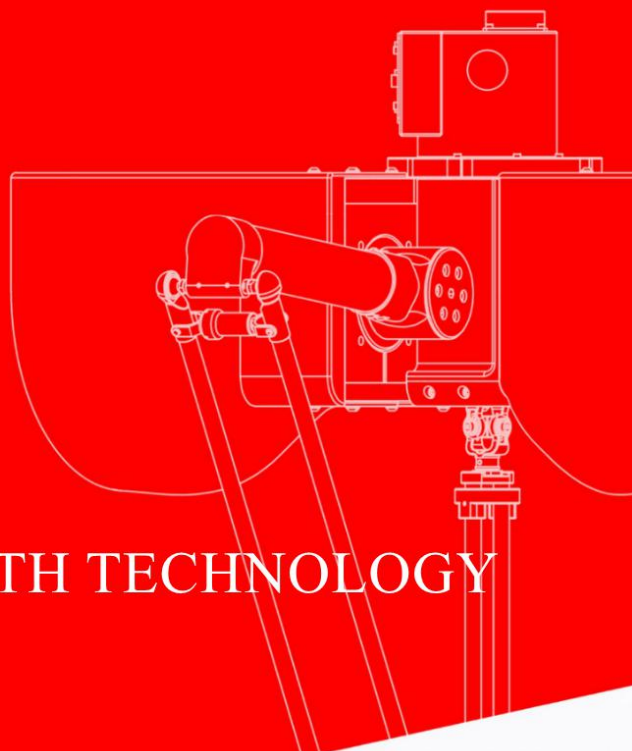


atomrobot®  
阿童木机器人



FREE HANDS WITH TECHNOLOGY



# Maintenance Manual

**产品** 维护保养手册(D3)

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Dec.2021 Versioin 4.0



CHENXING (TIANJIN) AUTOMATION EQUIPMENT CO., LTD.

# Foreword

Thank you for purchasing our company's robot products. This manual specifies the requirements for proper use of the robot. Please read the contents of this manual carefully before using the robot.

## Overview

This manual describes in detail the daily maintenance of Atomrobot and the handling of common abnormal situations, so that users can better maintain the Atomrobot.



## Applicable targets

Suitable for: assembly engineer, commissioning engineer, maintenance engineer

## The icon means

The ICONS in this document will clearly indicate all hazards, warnings, cautions, and reminders that may occur when performing the work described in this manual; Pay attention to the following slogans when they appear in the document.

The following table describes the icon that appear in this manual.

Icon	Description
Danger	Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.
Warning	Indicates a potentially hazardous situation which, if not avoided, could result in personal injury or robot damage.
Attention	Indicates an unexpected situation that, if not avoided, could result in robot damage, performance degradation, or data loss.
Introduction	Represents the presentation of key information.

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#### Legal Disclaimer

Companies and individuals using Atomrobot should read up on local and national standards and laws, and install appropriate safety facilities to protect robot users. The user should be familiar with the instructions of the robot system. However, Even if the operator follows all the safety information in the manual, Chenxing company cannot guarantee that the operator will not be harmed.

Please be careful when maintaining the robot. Users should maintain the robot under safe environmental conditions. Chenxing Automation has no obligation and responsibility for incidental or corresponding losses caused by the robot. Chenxing Automation shall not be liable for any direct, indirect, special or incidental losses caused by the wrong use of the product.

Dec. 2020

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## Chapter 1 Security Maintenance

The industrial robot of our company conforms to the current technical level and the current safety technical regulations. Improper use may result in personal injury, damage to robot systems and other equipment.

The company's regulations only allow the use of industrial robots in a technically sound state and with safety awareness. Chenxing Automation Equipment Co., Ltd. will not be responsible for any loss caused by users' illegal use. To ensure the service life of the robot, the robot should be maintained regularly according to this manual.

### 1.1 Related Personnel

Readers of this manual and manufacturers of robots using this model, including the installation, debugging, maintenance of the robot personnel. Any personnel who install, debug, use and repair the robot must be trained by the company and read this manual carefully before carrying out activities related to the robot.

Users should meet the following conditions:

- Training in industrial robotics is required.
- Knowledge and experience in the field, familiar with the standards prescribed by the robot, able to make correct judgments about the job to be performed, and able to identify potential hazards.

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**Warning** Only professionals are allowed to work on the electrical and mechanical devices of the robot to avoid injury to the operator.

---

### 1.2 Safety zone

During the use of robots, safety areas should be marked and attention should be paid to avoid accidents caused by neglecting safety areas.

- Working area

The working area is determined by the trajectory of the robot, and the safety of the working area is ensured by the protection device.

- Protection area

The protected area must be larger than the working area, and protective devices

should be placed in the protected area for warning, and pay attention to the use of safety. Common isolation protection devices are: guardrail; Common warning protective devices are: warning signs and slogans.

- Dangerous zone

The dangerous area includes any position that the robot body and the robot arm can stay in the movement track, which can be protected by isolated protective devices to avoid loss of personnel or property.

When the robot stops running, the robot arm stops in the danger zone.

### 1.3 E-Stop

When the robot is abnormal, it is necessary to press the emergency stop device to ensure personnel safety and avoid damage to the robot and personnel.

The emergency stop device of the industrial robot should be set in a convenient position. This device must be pressed in case of danger or emergency. What happens when the device is pressed:

An emergency stop means that all power connected to the robot is disconnected, but the power to the brake on the servo motor is not disconnected. You must release the emergency stop button and restart the robot so that the robot can operate again.

Emergency stops for robotic systems need to be distinguished:

1. An uncontrolled emergency stop that stops the robot by cutting power to all servo motors.
2. A controlled emergency stop, which stops the robot by giving instructions to the servo motor so that the robot can complete the path, and when the path is complete, the servo motor stops power supply.

There are several emergency stop buttons in the robot system to stop the robot in an emergency. There is a red button on the indicator and the electric control cabinet. Of course, users can also set the emergency stop button according to their needs.



**Danger**

To avoid causing danger, the emergency stop circuit of the robot should include relevant supporting equipment, such as tools or other devices at the end of the robot arm.

## 1.4 Safety signs

Do not change or remove the nameplates, instructions, signs and marks related to the robot or equipment.

Signs on the robot include:

- The power nameplate
- Safety Signs
- Cable marker

## 1.5 General safety measures

Any working robot is a potentially deadly machine. When operating, the robot may have unpredictable movements, all of which are powerful enough to cause serious injury to people within its working range or damage to equipment.

How to avoid it: Test the reliability of all safety measures (locks) before preparing the robot for work.

Safety measures include: safety door, lock, safety indicator light.

Measures to avoid: Before starting the robot, ensure that there are no other miscellaneous people within the working range of the robot.

### 1.5.1 Change the operation

- Changes to the robot must be made to check whether it meets the necessary safety requirements and to test the safety performance of all safety features.
  - The changed program should be tested at startup with reduced system speed, and then gradually increased speed.

### 1.5.2 Failure occurrence

- Turn off the robot's control system to prevent unauthorized and accidental restarts.
  - Place a visible sign at the site of the fault to indicate the fault.
  - Record faults.



- Troubleshoot and perform functional checks.

### 1.5.3 Put into operation and put back into operation

An inspection must be carried out before equipment and devices are put into operation for the first time to ensure that the equipment and devices are complete and functional, can operate safely and can identify faults.

The following items need to be checked before being put into operation for the first time or again:

- All protective devices are properly installed and functional.
- Check whether electrical cables are connected properly. If compressed air is used, check whether the corresponding gas pipes are connected properly.
- Show whether the working area of the robot is reasonable and exclude other objects in the working area.

### 1.5.4 Stop running

Note when the robot stops running:

- Reduce the speed of the robot and stop the servo operation of the robot when it can be stopped
- Recover materials related to the device to ensure that the device can be safely restarted

Set up protection device, show the current state of equipment, prevent others from misoperation and cause accidents.

## Chapter 2 Robot key structure and disassembly instructions

### 2.1 Mechanism components

As shown in Figure 2-1, D3P-1100-P0 is taken as an example. D3 series includes base, moveable platform(End-effector mount), servo arm, driven arm and pivot axis.



Figure 2-1 (D3P-1100-P0 Mechanism components)

#### 2.1.1 Base

The main body of the base is made of high hardness aluminum alloy, and the installation sequence is divided into the upper, middle and lower parts of the base from top to bottom. The shell is made of non-metallic materials, and the servo motor and gearbox are installed inside. The servo arm is installed on the output end face of the gearbox, and the top is connected with the mounting flange of the frame by bolts.

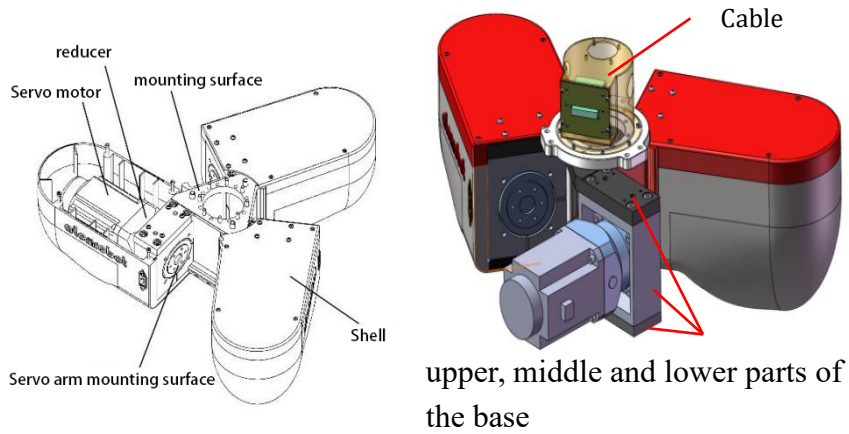


Figure 2-2 (D3P-1100-P0 base)

Base disassembly is shown in the left figure, and the general disassembly sequence is: servo arm—Motor cover—Servomotor—Gearbox. It is necessary to explain that the servo arm bolts of each model are divided into Fixing bolts and positioning pins, the positioning pin must be installed in the corresponding hole to play the positioning role, otherwise, there will be inaccurate positioning of the servo arm, or even pin fracture. The positioning pin position of the model D3P-1100-P0 is shown in figure 2-4.

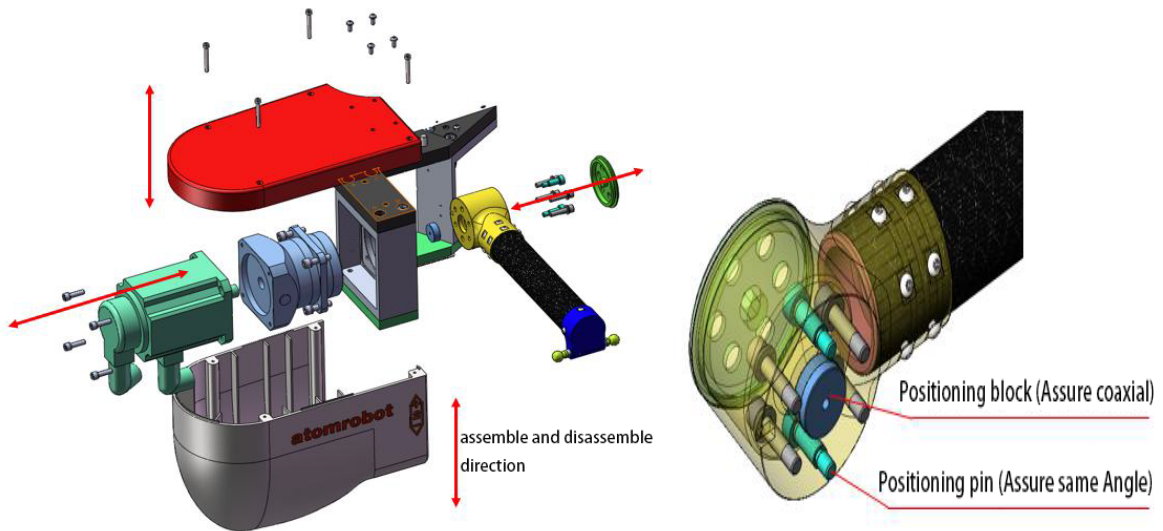


Figure 2-3 Schematic diagram of base disassembly Figure 2-4 (Servo arm bolt position)

### 2.1.2 Servo arm

The servo arm joint is made of high strength aluminum alloy , and the carbon fiber tube through a special process, ball joint and driven arm ball bowl, the end terminal joint is connected with the servo arm gearbox by bolt and positioning pin.

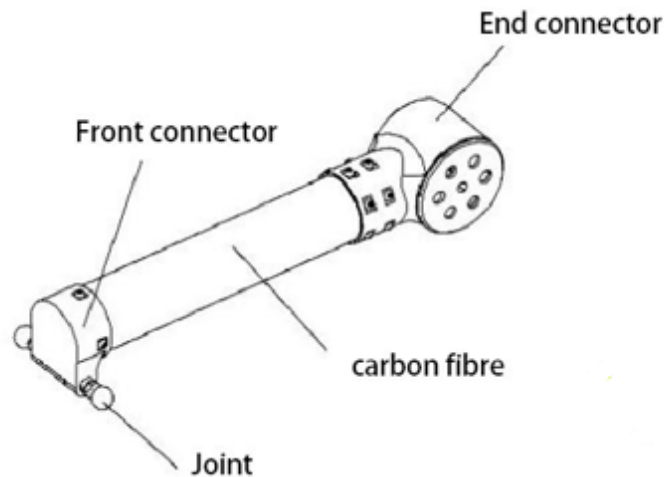


Figure 2-5 D3P-1100-P0 servo arm

### 2.1.3 Driven arm

The driven arm joint is made of high strength aluminum alloy , and the carbon fiber tube through a special process. At the same time, the hinge pin passes through the hollow pin and an oil-free bushing is installed at both ends to fix the limiter; The driven arm tightens the ball joint through the spring in the limiter and closely matches the corresponding position of the servo arm.

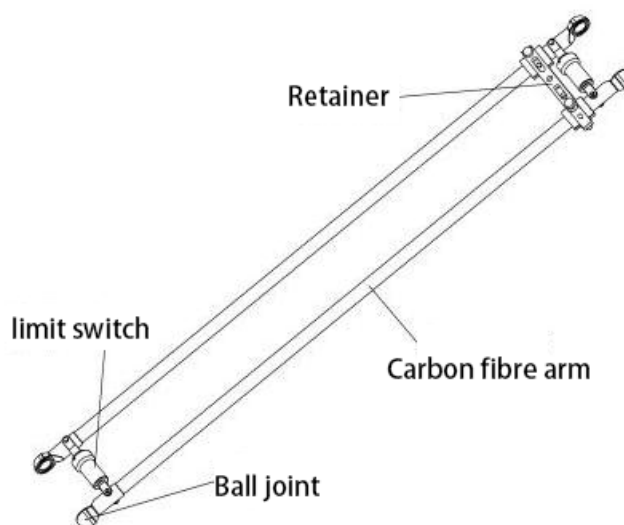


Figure 2-6 D3P-1100-P0 Driven arm

#### 2.1.4 Pivot axis

The pivot axis is used to transfer the rotation of the top central motor to increase the rotational freedom of the end effector. The output shaft of the gearbox on the central shaft is connected with the upper rotating shaft through a coupling, and the end is connected with the universal joint. The middle slide rod is a sliding pair formed by linear bearing and aluminum rod. The mounting seat of aluminum rod is divided into fixed parts and sliding parts according to the state in the process of movement. The wear-resistant linear bearing made of IGUS material is installed in the middle of the sliding part and the aluminum rod with hard oxidation treatment on the surface is oil-free friction.

The moveable platform of D3, D2 series is made of high hardness aluminum alloy, joint is made of stainless steel material. Different models of moving platform have different structures. The upper part of D3P moveable platform is connected with the pivot axis, D3W has no pivot axis, servo motor and gearbox are installed on moveable platform for D3PM series. At present, the company's existing moveable platform with rotation is divided into two categories: 1. Keyless bushing; 2. Cross roller classes. Keyless bushing movable platform end-effector and intermediate rotating shaft are connected by keyless bushing. The rotating shaft at the end of the cross roller movable platform is supported by a single cross roller bearing, which is smaller in volume and weight. Universal joint is connected the head of rotating shaft

of the moveable platform. Because the product is still in the update iteration, the specific style is subject to the actual installation.

The connecting surface of the end of arm and the EOATs is provided with an installation hole and a positioning hole. As shown in figure 2-15,  $\phi 10H7dp5$  is the central positioning hole, and M4dp5 is the mounting hole. The company's existing models can be divided into a variety of moveable platforms with different connection sizes according to the load, space and fixed mode of the motor, for the detailed size of the connection part, please refer to the atomrobot selection manual.

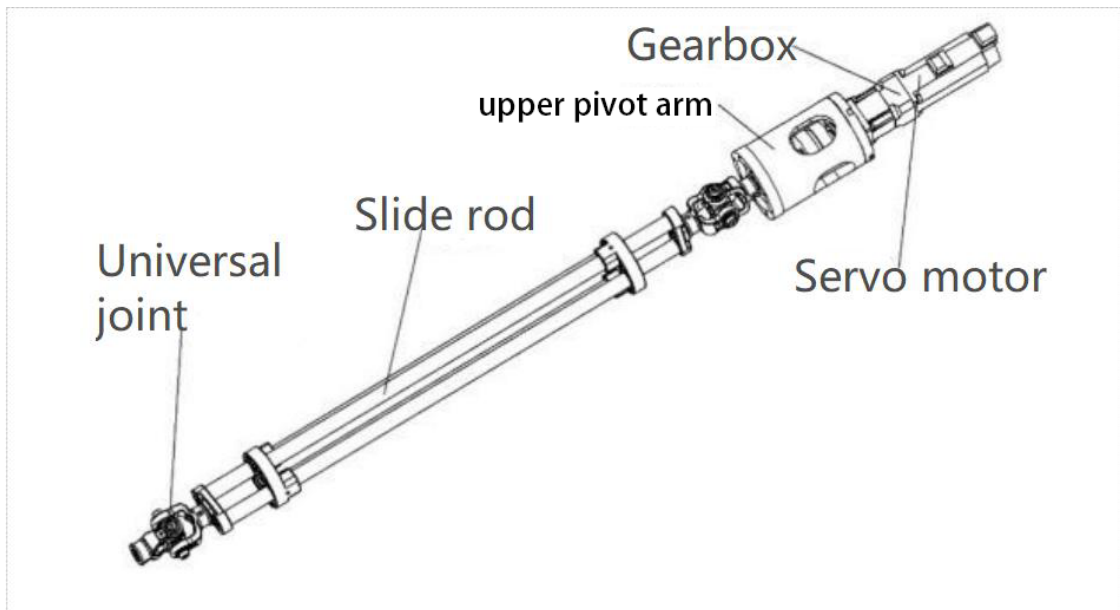


Figure 2-7 D3P-1100-P0 pivot axis

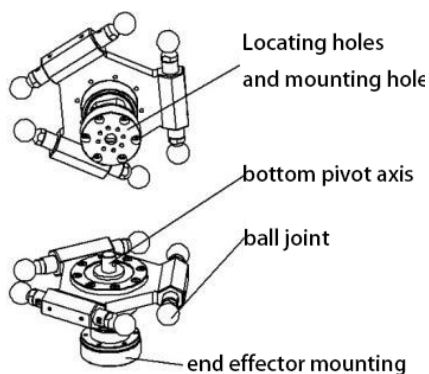


Figure 2-8 Keyless shaft bushing moveable platform

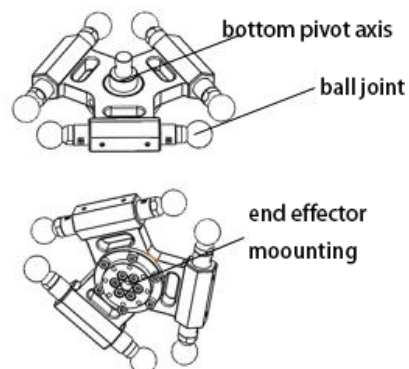


Figure 2-9 Cross roller moveable platform

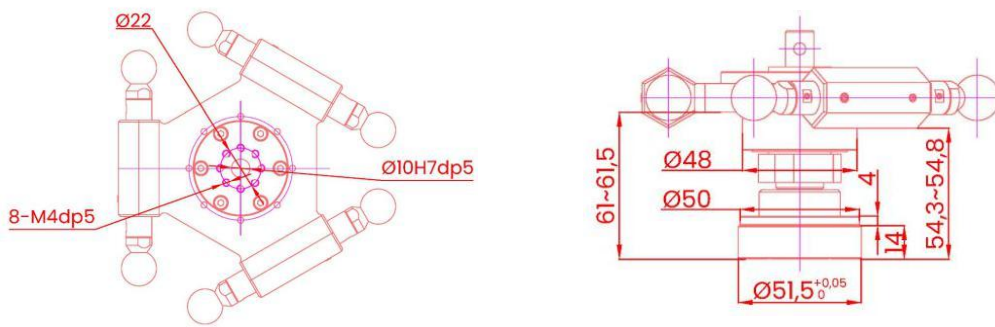


Figure 2-9 Moveable platform dimensions

## 2.2 Description of mechanism dimensions and working space

In our "Product Selection manual", each model has a separate overall size, figure 2-11 shows the dimensions of D3P-1100-P0.

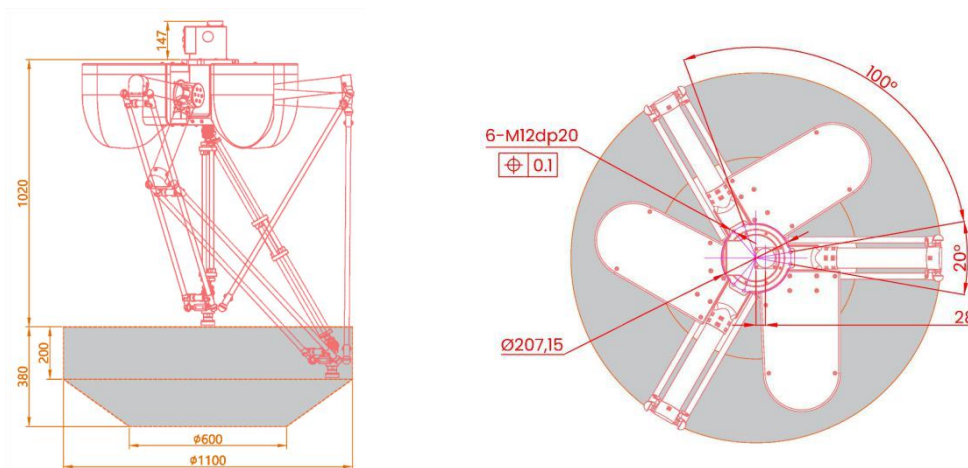


Figure 2-11 D3P-1100-P0 Dimensions of mechanism and workspace

In the figure, 1020mm is the distance from the top mounting surface of the robot to the upper surface of the workspace, and the lower gray mounting space is the theoretical area that can be reached by the center point of the lower surface of the existing end of arm. In practice, the upper cylinder area should be preferred, and the limit position close to the theoretical boundary should be avoided as far as possible.

It should be noted that when the end-effector is installed, the workspace position should be moved down synchronously according to the descending distance of the end-plane.



### 2.3 Robot coordinate system

The world coordinate system of D3 series robot is shown in Figure 2-12, where axis X of the robot is parallel to axis 1. The 1th axis position will be marked on the motor cover. The zero position of the mechanism, strictly speaking, is the position of the long right angle edge of each servo arm is perpendicular to the Z axis after the base is horizontal.

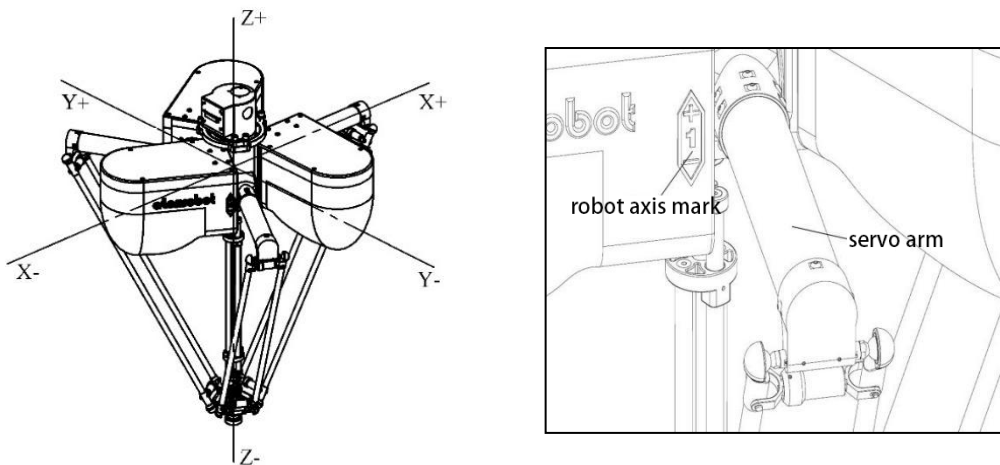


Figure 2-12 D3P-1100-P0 World coordinate definition

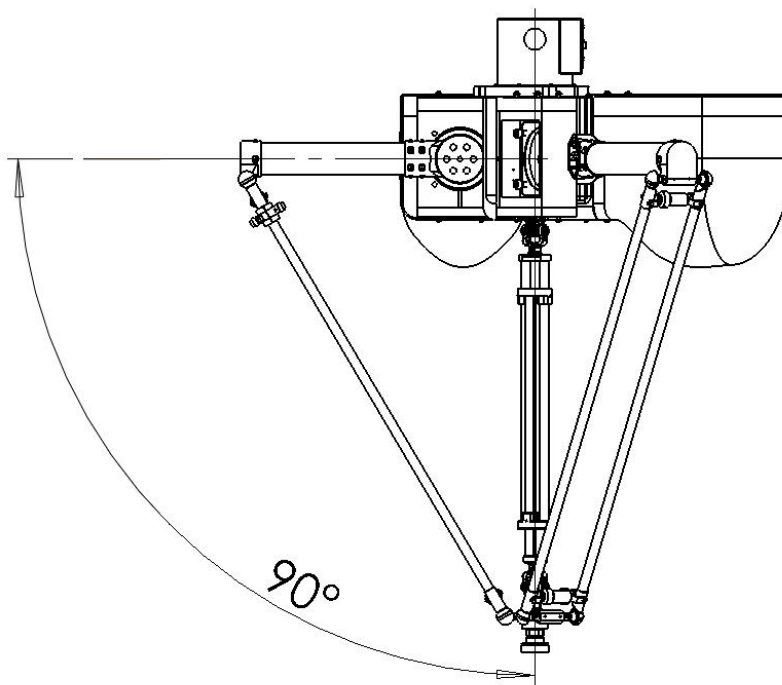


Figure 2-13 D3P-1100-P0 mechanical zero point attitude



## 2.4 Installation of mechanism and frame

After unpacking, the mechanism and frame should be installed in accordance with the following process. This is mentioned in detail in the Mechanism Quick Installation Instructions delivered along with the goods. It should be noted that: after the mechanism is installed, the direction of axis 1 is perpendicular to the beam in most cases.

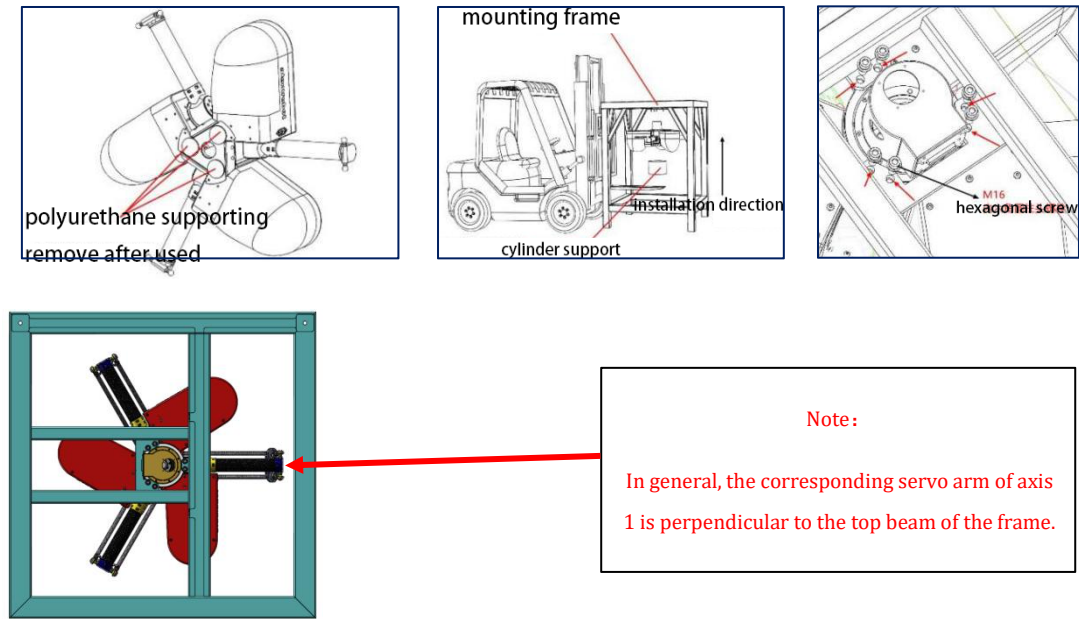


Figure 2-14 Installation of mechanism and frame

Then install the pivot axis components. Under normal circumstances, the upper power part of the pivot axis has been installed with the base when it is delivered. Only the sliding rod and the moveable platform need to be connected on site. The sliding rod and the upper and lower universal joint are connected by four M4\*12 bolts.

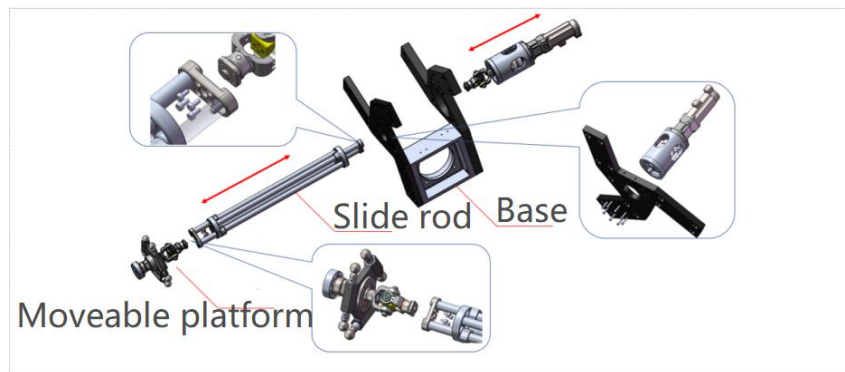


Figure 2-15 Schematic disassembly and assembly of pivot axis

It should be noted that the orientation of the upper and lower universal joint should be the same during installation, as shown in the following figure. Otherwise, irregular rotation of the terminal pivot axis will occur in the process of translation when the motor of the pivot axis does not rotate.

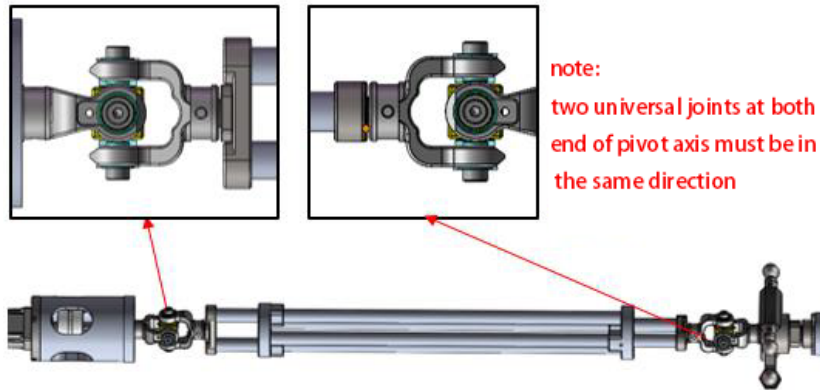


Figure 2-16 universal joint status

The driven arm depends on the tension spring, and can be held near the ball handle to pull the driven arm to increase its distance, and then set on the ball joint. After the installation of the three sets of driven arms, it is necessary to check whether the ball bowl and ball joint are tightened.

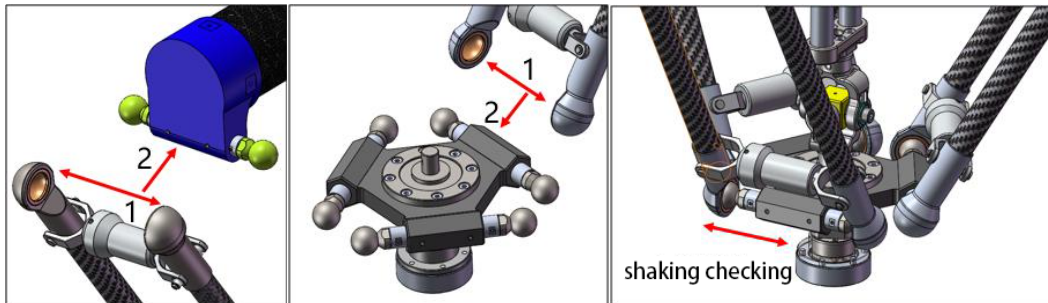


Figure 2-17 Driven arm installation

Figure 2-18 Shake to check

Table 2-1 List of tools and accessories

Item	Name of tools and accessories	QTY	Remark
1	Internal hexagonal wrench	1 set	
2	Non-woven or dust-free paper	Several	Wipe the surface of the opened components
3	Paperboard	Several	Place the opened parts

## Chapter 3 Routine maintenance

### 3.1 Routine cleaning and environmental requirements

Routine maintenance is preventive maintenance. During the normal running of the device, maintenance personnel periodically check and maintain the device to discover and eliminate potential faults in a timely manner.

The maintenance personnel must determine the maintenance period based on the local conditions and perform routine check and maintenance on the device. If a fault occurs, handle it in a timely manner.

Dust or dirt may appear on the surface of the robot after it has been working for a long time. Therefore, the robot needs to be cleaned and maintained regularly. Table 3-1 shows the maintenance period in general working conditions.

Table 3-1 Routine cleaning and maintenance schedule

Maintain Items	Maintenance period	Recommended Maintenance Methods
Mechanism	2 weeks	Wipe the surface dust with a clean cloth
Ball joint	2 weeks	Use air gun or clean cloth to remove impurities in bushing and surface of ball head
Moveable platform	2 weeks	Wipe the surface dust with a clean cloth
Cables	2 weeks	Wipe the surface dust with a clean cloth
Pivot axis	2 weeks	Wash or wipe the surface with a clean cloth, remember to wipe the surface water layer clean, add lubricating oil or grease

Atomrobot can be cleaned with universal neutral cleaning agent for food machinery at room temperature. Prolonged and frequent corrosive cleaning or exposure to the sun may cause discoloration of the robot's materials, but there is no significant loss of material to worry about.

The mechanism and most parts are made of aluminum alloy, which can effectively withstand the load brought by high pressure washing. Similarly, high quality aluminum makes the robot somewhat resistant to cleaning agents. The robot's smooth surface helps with cleaning agents and fluids. The main materials of the robot's servo arm and driven arm are carbon fiber and aluminum alloy, which are

suitable for caustic soda cleaning agent and flushing cleaning. After cleaning, the surface cleaner can be used. Ball joint design can be fully suitable for caustic soda cleaning agent and flushing cleaning, clean water on the top of the robot, ball joint, moving platform may have a small amount of water, you can use a clean cloth to wipe off excess water or natural air drying or blow drying can be used, without adding lubricant.

The protection level of atomrobot is IP55, which can be sprayed locally, but please pay attention to avoid water entering the motor connection when spraying water.

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**Attention** Anodized parts are not suitable for immersion cleaning, and highly corrosive cleaning is not suitable Robot cleaning.

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### 3.2 Safety system inspection

Make daily or monthly inspection table according to the user's on-site situation, to ensure that the robot and its external equipment will be tested within the specified time.

Safety system test cycle: generally six months.

To ensure the safety and reliability of the robot. Please make sure that the robot is in low power condition, test any of the following switches and buttons. If any of the tests fail, the robot must be restored to a working state before it can continue.

#### Content inspection

- Emergency stop.
- Automatic and manual switch located on the teach pendant.
- PWR.

### 3.3 Common exception handling

Please refer to Table 3-3 for handling and maintenance if abnormal status occurs during robot maintenance.

Table 3-3 Common exception handling table

Common exception	Possible cause	Handling method
The monitor power light is not on.	The power cord is not plugged in properly	Check whether the power cable is properly inserted; Check whether the power supply is connected
Press the "brake button" and the brake does not open	The servo motor is power on	Servo motor power off
The communication function of RS-232 and RS-485 is invalid.	The plug is not properly inserted. The parameters are incorrectly configured	Check the plug, and use bolts to lock; Reconfigure parameters
Communication network port failure	The plug is loose or damaged	Unplug and reinsert, or replace a network cable.
The I/O communication port is invalid	The I/O cable plug is damaged	Check whether the PLUG of the I/O cable is correctly connected
The ball bowl worn	Beyond the specified service life	Confirm normal use time and replace wearing parts on time

Please contact atomrobot customer service when the following abnormal conditions occur.

- 1, Zero point lost and needs to be retrieved by calibration operation.
- 2, The robot encoder battery is loose or the encoder battery is low.
- 3, Parts are defective or missing.
- 4, Abnormal sound appears during robot operation.

### 3.4 Inspection and maintenance of robot parts

Due to mechanical wear, vibration, use environment (acid, alkali, dust, high temperature, high humidity) and other factors during the operation of the robot, operation failure or component damage will occur after a period of time. Therefore, in order to ensure the stability and safety of the product, regular inspection and maintenance of each part is very important.

The following describes the fault diagnosis, maintenance methods, and periodic maintenance of the existing common mechanism (D3P-1100-P0).

## 3.4.1 Servo arm

Check item:

- 1, Whether there is impact or wear damage, whether there is serious deformation;
- 2, If the brake is not loosened, push the servo arm according to the figure whether there is more than  $5^\circ$  clearance;
- 3, Whether there is abnormal sound in the process of rotation.

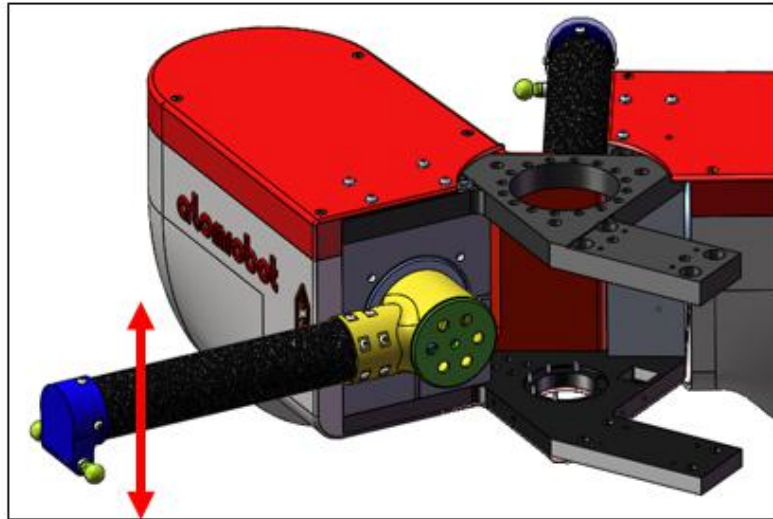


Figure 3-1 Check servo arm

Repair method:

- 1, If the first case exists, a new servo arm should be replaced.
- 2, If there is a second case, first open the end cover of the back joint of the servo arm and check whether the fixing bolt is loose. Secondly, remove the motor cover and lock the gearbox and servo motor through the wrench hole of the reducer as shown in the figure.

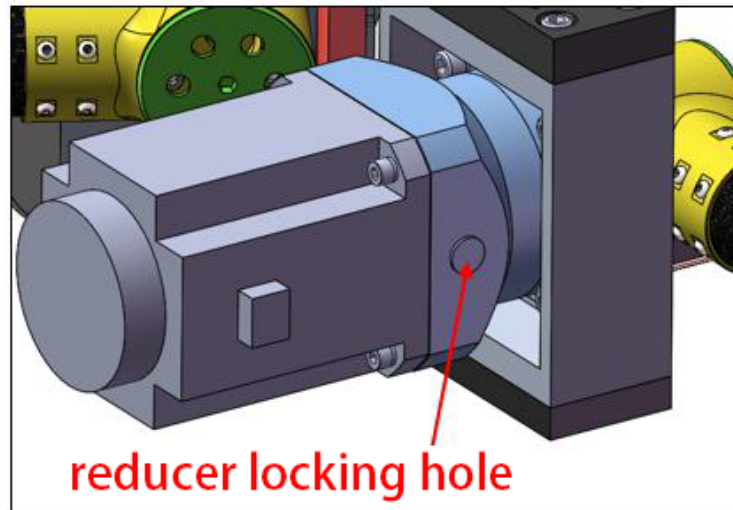


Figure 3-2 Lock servo motor and gearbox

3, If the third condition exists, first remove the servo arm for single-axis operation to identify the source of abnormal sound. If there is abnormal sound at the motor or gearbox part, it should be replaced accordingly. If abnormal sound occurs for the servo arm and its following parts, the vulnerable parts should be replaced or adjusted according to the source.

#### 3.4.2 Driven arm

Check item:

- 1, Whether there is a gap between the ball bowl and ball joint.
- 2, Where the ball bowl without wear.
- 3, The tension spring is normal rebound tension.
- 4, Whether the carbon fiber rod has impact or wear damage.
- 5, Whether the tension spring hinge pin oil-free bushing is seriously worn.

Repair method:

- 1, If the fourth case occurs, a new driven arm should be replaced directly.
- 2, When the ball bowl and ball joint there are gap, there are generally two reasons: 1, The ball bowl wear is serious, the tension spring has reached the minimum distance is still unable to tighten. 2, Tension spring failure, unable to spring back to the initial position or insufficient resilience.

For the wear of the ball bowl, it can be directly replaced with a new ball bowl. The method is shown below:



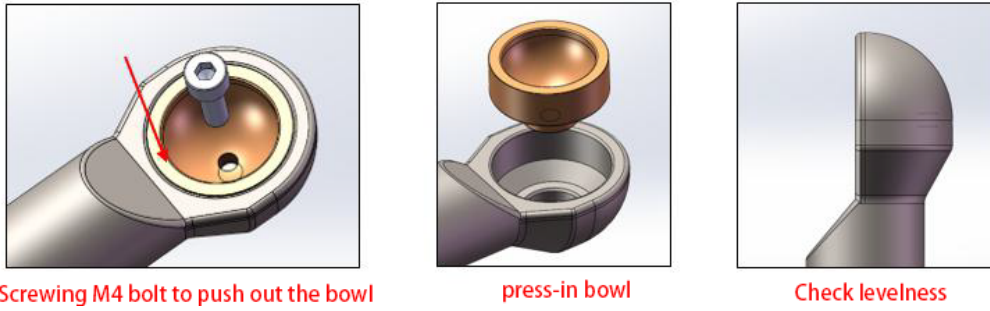


Figure 3-3 Replace the ball bowl

In view of the tension spring problem, we can first try to further tighten the tension spring. The method is shown below:

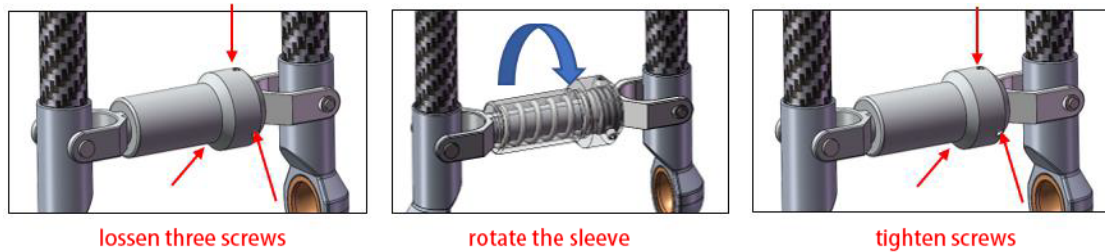


Figure 3-4 Tighten the tension spring

3, If it is still invalid after tightening, it is necessary to replace the tension spring assembly. At the same time for the fifth case, the replacement of oil-free bushing can also be completed when the tension spring assembly is replaced. The method is shown as Figure 3-5.

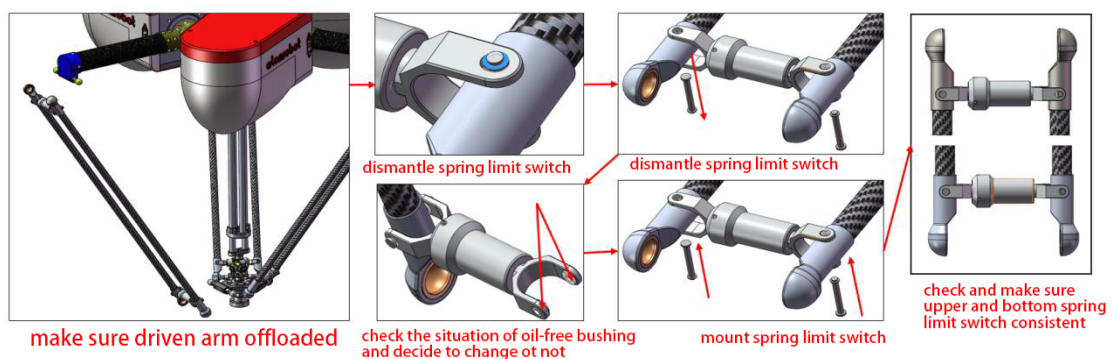


Figure 3-5 Replace tension spring and oil-free bushing

### 3.4.3 Pivot axis and universal joint

Check item:



- 1, Whether the bearing and bolt are intact and loose.
- 2, Whether the slide is smooth.
- 3, Whether terminal rotation occurs during translation.
- 4, Whether the rotation is precise, whether there is abnormal sound in the process.

Repair method:

1, When the second situation occurs, the general priority is to check whether the linear bearing at the slide rod is seriously worn, whether the slide rod is parallel, and whether there is distortion. If the above situation exists, the linear bearing or slide rod can be replaced according to the following figure:

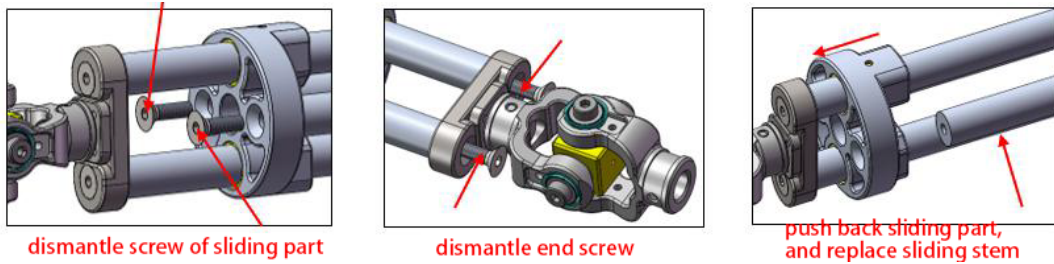


Figure 3-6 Replace slide rod

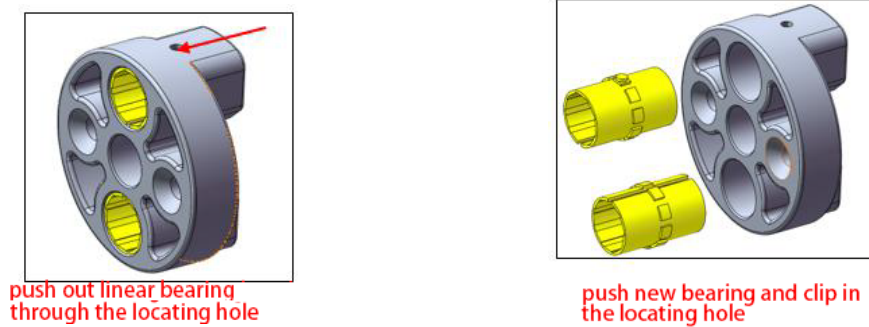


Figure3-7 Replace linear bearing

2, When the third case occurs, priority should be given to whether the upper and lower hook hinges are in the same position (explained in Chapter 2). If there is any inconsistency, adjust one of the hook hinges to make it correct as shown below:

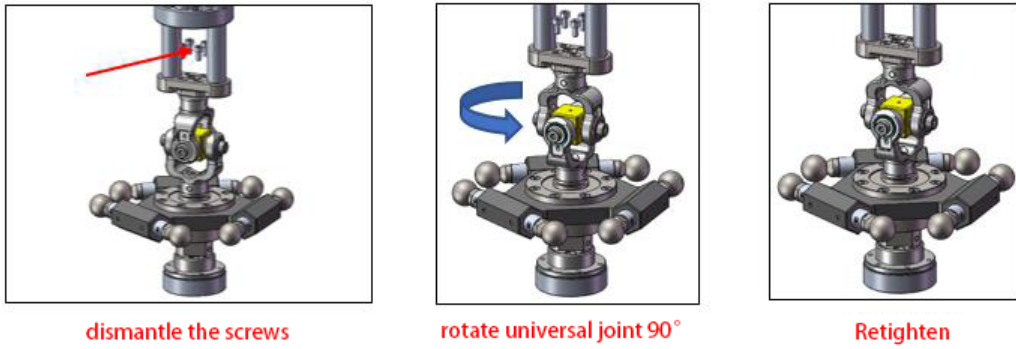


Figure 3-8 Adjust the direction of the universal joint

3, When abnormal sound or control rotation angle is inconsistent with the actual, in the case of eliminating the above problems and ensuring that the gearbox and motor parameters are correctly configured, priority should be given to whether the motor and gearbox mounted on the pivot axis are in normal state. If necessary, the coupling can be locked in the following way to ensure that there is no slip during output. Or remove the motor and gearbox assembly to replace according to the situation.

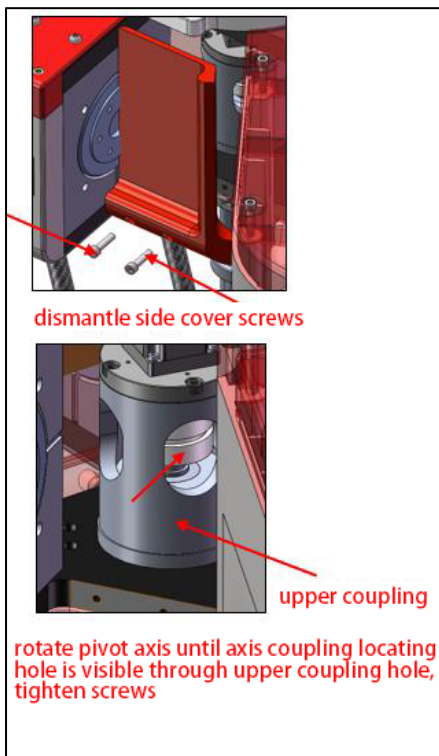


Figure 3-9 Lock pivot axis coupling

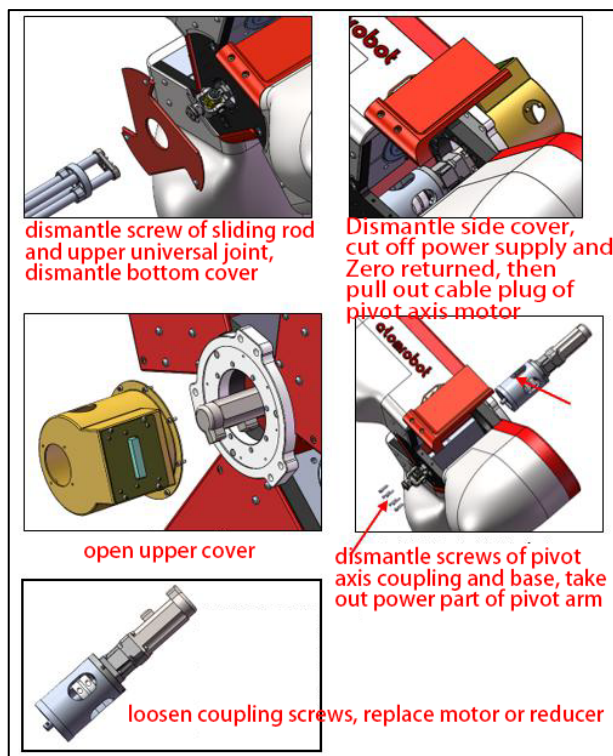


Figure 3-10 Remove pivot axis motor and gearbox

### 3.4.4 Moveable platform

Check item:

- 1, Whether serious deformation occurs.
- 2, Whether the rotation of the pivot axis is smooth, whether the axis line of the pivot axis is vertical, whether the free key bushing is loose and whether the shaft shoulder is attached well.
- 3, Whether there is swing clearance at the end of arm.

Repair method

- 1, In the first case, a new moveable platform should be replaced directly.
- 2, When the second case occurs, the position of the end of arm keyless bushing should be adjusted as shown below, or the tension should be adjusted.

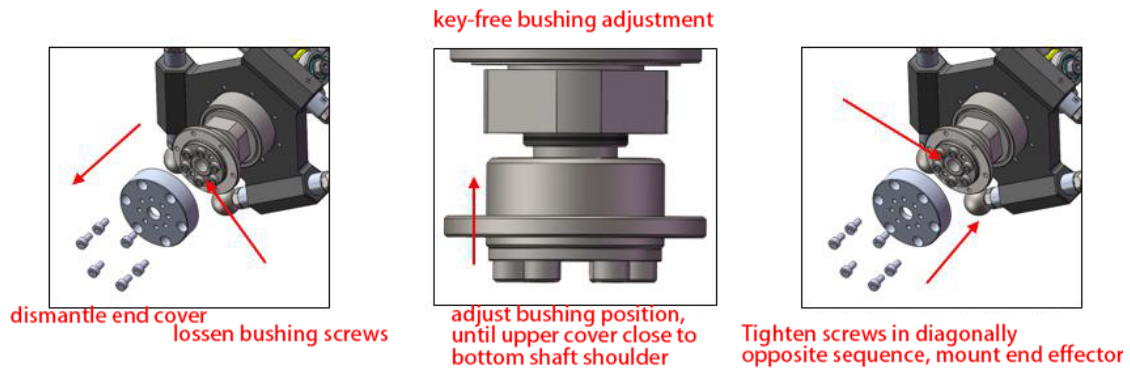


Figure 3-11 Adjust keyless bushing

- 3, When the third case occurs, it should be checked whether the end of the diagonal contact bearing pretightening bolt is loose. And install the following diagram for re-pretightening.

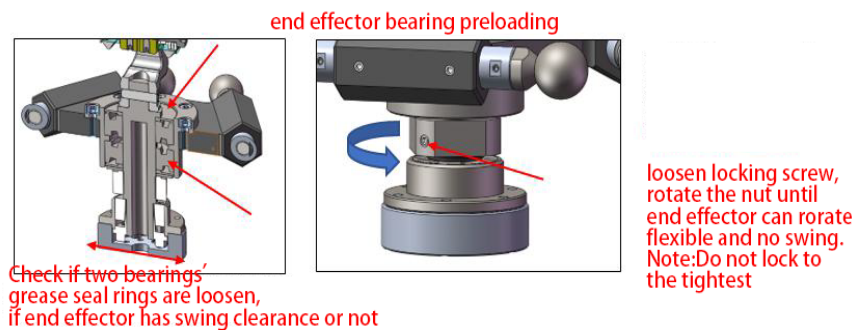


Figure 3-12 Bearing preload

## 3.4.5 List of periodic checks and maintenance

The following table summarizes the above problems and solutions.

In normal use, check the components periodically according to the following table to discover problems and perform maintenance in time to ensure the stable running of the device. The above steps are accompanied by a specially recorded instructional video, if necessary, please contact our company.

Inspection item	Examination period	Examination content	Maintenance method
Servo arm	6 months	1, Whether there is impact or wear damage 2, Whether there is gap to the pitching of the servo arm or not 3, There is abnormal sound in the process of movement or not	1, If there is serious damage, the servo arm needs to be replaced 2, If there is a gap, try locking the servo arm, try locking the gearbox 3, Replace reducer or motor
Driven arm	3 months	1, Whether the bowl and handle are open 2, Whether the ball bowl is worn 3, Whether the spring bounces back and tightens normally 4, Whether carbon fiber rod has impact or wear damage 5, Whether the tension spring hinge pin oil-free bushing is seriously worn	1, Replace the ball bowl if it is seriously worn 2, Try tightening the tension spring 3, Replace the tension spring components 4, If the driven arm is damaged, replace it 5, If the shaft bushing is worn seriously, replace it
pivot axis and universal joint	3 months	1, Whether the bearings and bolts are intact and loose 2, Whether the end effector rotates during translation 2, Whether the slide and rotation is smooth 3, Whether the rotation is precise, is there noise in the process	1, Tighten the universal joint bolts and correct the universal joint attitude 2, Try adjusting the slider or replacing the slider 3, Replace the linear bearing 4, Try to lock the pivot axis coupling 5, Replace reducer or motor
Movable platform	3 months	1, Whether severe deformation occurs 2, Whether the middle axis rotates smoothly 3, Whether the center line of pivot axis is perpendicular 4, Whether the keyless bushing is loose and whether the shaft shoulder is properly attached 5, Whether there is gap at the end effector.	1, Replace moveable platform 2, Try to preload the bearing 3, Readjust keyless bushing

Figure 3-13 Maintenance details of each part

Item	inspection cycle	inspection content	maintenance methods	replacement cycle
Servo arm	6month	1.Collision or abrasion 2.clearance fit 3.abnormal sound	1.replace arm if serious damaged 2.try tighten servo arm or reducer 3.replace reducer or motor	60month
driven arm	3month	1.clearance fit between ball and bowl 2.spring performance 3.carbon fibre arm damage 4.bushing abrasion	1.Change bowl if serious abrasion 2.tighten spring 3.replace spring parts 4.change arm if damaged 5.change bushing if damaged	driven arm:40month limit switch:30month ball bowl:12month
Pivot axis universal joint	3month	1.bearing or screw loosen 2.end effector rotate in translational motion 3.sliding or rotate smoothly 4.rotation precision, abnormal sound	1.tighten universal joint screw, correct attitude 2.adjust or replace sliding rod 3.replace linear bearing 4.try tighten pivot axis coupling 5.replace motor or reducer	pivot axis:24month sliding bearing: 24month universale joint: 24month
dynamic platform	3month	1.out of shape 2.pivot axis rotate smoothly 3.pivot axis still vertical 4.bushing loosen or close to shaft shoulder 5.clearance fit for end effector swing	1.replace dynamic platform 2.try bearing preloading 3.re-adjusting bushing	40month

Figure 3-14 List of maintenance details of each part (mechanics)

Items checking	inspection cycle	content checking	Maintenance method	replacement cycle
transfer switch	1 month	1. Is the function normal? 2. Is the switch state transition smooth?	Replace the transfer switch	Replace if damaged
Self-locking power button	1 month	1. Is the function normal? 2.Whether the indicator light is normally on in the self-locking state	Replace the Self-locking power button	Replace if damaged
emergency button	1 month	1.Whether there is an emergency stop signal when pressed 2.Whether the body stops running when pressed	Replace the emergency button	40 months
breaker	1 month	1. Is the function normal? 2. Whether the circuit breaker is stuck from closing to opening	Replace the breaker	Replace if damaged
contactor	1 month	1. Is the function normal?	Replace the contactor	24months
relay	1 month	1. Is the function indicator light normally on? 2. Whether the relay function meets the requirements	Replace the relay	24months
fan	1 month	1.Is the function normal? 2.Is the installation direction correct?	Replace the fan or adjust the installation direction	Replace if damaged
switching power supply	1 month	1.Whether the indicator light is normal when working 2.Is the voltage across the output terminal V+V- normal?	Replace the switching power supply	30 months
end cable	3 months	1.Whether the outer surface is damaged? 2.Whether the joints are loose and the solder joints fall off	Replace the end cable	Replace if damaged
battery	6 months	1.Are the terminals loose? 2.Check if the voltage is normal	Attempt to repair the power terminals or replace the battery	18 months
Trunk cable	3 months	1.Whether the outer surface is damaged? 2.Whether the joint and cold pressing needle are loose	Replace the Trunk cable	Replace if damaged
teach pendant	1 month	1. Is the function normal? 2.Whether the connection with the control cabinet connector is tight	Attempt to repair the teach pendant or replace it	24months

Figure 3-15 List of maintenance details of each part (control cabinet)

## Chapter 4 Environment

The external environment will affect the operating performance of the robot in the environment and the impact of the robot on the environmental cleaning.

- The Atomrobot is designed for the following conditions:
  - 1, The ambient temperature must be between  $-10^{\circ}\text{C}$  and  $50^{\circ}\text{C}$ .
  - 2, The relative humidity must be between 20% and 80%RH. (No condensation)
  - 3, Altitude: 0m to 3000m
  - 4, Environmental conditions of dust, oil, smoke, water, etc. : Pollution should be below level 3 or IP53/54(no dust that disables the controller enters the controller, and there is protection against water droplets.)
  - 5, No electrical interference. (Electrical noise of external power supply of controller: less than 1kV/1s)
- The environmental protection of atomrobot is as follows:
  - 1, High level of surface coating and surface treatment technology, so that the robot in the cleaning process will not affect the environment.
  - 2, Lubricants can be used under multiple sealing conditions without leakage.
  - 3, Self-lubricating performance of ball joint without lubricant.
  - 4, Even tiny robot parts are tightly connected enough not to pollute the environment.