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Intelligent Manufacturing Expert

ER20-1700

Mechanical Operation and Maintenance Manual for Industrial Robot

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Statement

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EFORT is not responsible for the losses, injuries and any legal liabilities caused by the direct or indirect use of this product. Users should follow but not limited to the safety guidelines mentioned in this manual.

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Chapter One Safety

1.1 Instructions for Safe Use of Robots

Before performing installation, operation, maintenance, and overhaul operations, please be sure to read this manual and other attached documents thoroughly and use this product correctly. Please fully grasp the equipment knowledge, safety information and all precautions before using this product. This manual uses the following symbols to indicate their importance.

	**It means that if the handling is wrong, it will cause the user's death or serious injury, and the situation is very dangerous.**
	**It indicates a situation that will cause death or serious injury to the user if the handling is incorrect.**
	**It indicates a situation that will cause minor injuries or property damage to the user if the handling is incorrect.**

1.1.1 Safety Precautions during Adjustment, Operation, Maintenance, etc.

1） Operators must wear work clothes, safety helmets, safety shoes, etc.

2） When turning on the power, make sure that there are no workers within the robot's operating range.

3） The power must be cut off before entering the robot's range of motion for work.

4） When overhaul, maintenance and other operations must be carried out under the power-on state, two persons should work in a team at this time. One person maintains a posture that can immediately press the emergency stop button, while the other person is within the robot's range of motion, staying vigilant and working quickly. In addition, you should confirm the retreat path before proceeding.

5） The load on the wrist and the robot arm must be controlled within the allowable carrying weight and torque. If the allowable carrying weight and torque regulations are not observed, it will lead to abnormal action or premature damage of mechanical components.

6） It is forbidden to disassemble and work on parts not covered in the maintenance manual.
The robot is equipped with various self-diagnostic functions and abnormality detection functions, so that it can stop safely even if an abnormality occurs. Even so, accidents caused by robots still occur from time to time.

	**Danger! Most robot accidents are as follows:** **1、The automatic operation was performed without confirming whether there is anyone in the robot's motion range.** **2、It enters the robot's motion range in the automatic operation state, and the robot starts suddenly during the operation.** **3、You just notice the robot in front of you, ignoring the others.**

The above-mentioned accidents were all caused by the same reasons as "ignorance of safety operation procedures" and "no idea that the robot would move suddenly". In other words, they are all accidents caused by man-made unsafe behaviors such as "temporary negligence" and "failure to follow the prescribed steps."

"Emergency situations" make it too late for operators to implement "emergency stop", "flee" and other behaviors to avoid the accident, which may lead to major accidents. "Emergency situations" generally have the following types.

1） Low-speed action suddenly becomes high-speed action.

2） Other operators performed the operation.

3） A different program was started due to an abnormality or program error in the peripheral equipment.

4） Abnormal operation due to noise, malfunction, defect, etc.

5） Misoperation.

6） Originally planned to regenerate at low speed to perform the action, but it performed the high-speed action.

7） The work pieces transported by the robot fall and scatter.

8） When the work piece is in the stopped state of clamping and interlocking standby, it suddenly loses control.

9） The next or behind robot performed the action.

Stop time and stop distance refer to appendix.The above are only some examples, and there are many forms of "emergency situations". In most cases, it is impossible to "stop" or "escape" a robot that moves suddenly, so the following best countermeasures should be implemented to avoid such accidents.

	**Be careful and approach the robot cautiously.**
	**When the robot is not in use, measures such as "press the emergency stop button" and "cut off the power" should be taken to prevent the robot from moving.**
	**During the operation of the robot, please conFiga monitor (the third party) who can immediately press the emergency stop button to monitor the safety status.**
	**During the operation of the robot, the operation should be carried out in a state where the emergency stop button can be pressed immediately.**

In order to comply with these principles, it is necessary to fully understand the following precautions and follow them.

1.1.2 Safety Countermeasures of Robot Body

 Attention	**The design of the robot should remove unnecessary protrusions or sharp parts, use materials that adapt to the working environment, and adopt a fail-safe protection structure that is not prone to damage or accidents during operation. In addition, it should be equipped with misoperation detection stop function and emergency stop function when the robot is in use, as well as interlocking function to prevent the danger of the robot when the peripheral equipment is abnormal, so as to ensure safe operation.**
 Warning	**The main body of the robot is a multi-joint manipulator structure, and the angle of each joint in the movement is constantly changing.** **When you must approach the robot for teaching and other tasks, be careful not to get caught by the joints. Each joint action end is equipped with a mechanical stop, which has a high risk of being clamped, so special attention should be paid to it.** **In addition, if the servo motor is removed or the brake is released, the robot arm may fall due to its own weight or move in an uncertain direction. Therefore, measures to prevent falling must be implemented, and the surrounding safety conditions must be confirmed before operation.**
 Attention	**When installing the attached machine on the end effector and the mechanical arm, the size and quantity of screws specified in this book should be strictly observed, and the torque wrench should be used to tighten according to the specified torque.** **In addition, do not use rusty or dirty screws.** **Unspecified tightening and imperfect methods will loosen the screws and cause major accidents.**
 Attention	**When designing and manufacturing the end effector, it is controlled within the allowable load range of the robot wrist.**
 Attention	**The fail-safe protection structure should be adopted, even if the power supply or compressed air supply of the end effector is cut off, the installation object will not be released or fly out, and the corner or protruding part should be treated to prevent damage to people and objects.**
 Attention	**It is strictly forbidden to supply power, compressed air, and welding cooling water outside the specifications, which will affect the performance of the robot and cause abnormal operations, malfunctions, damage and other dangerous situations.**

	**Although electromagnetic interference is related to its type or intensity, there is no perfect countermeasure with current technology.** **When the robot is in operation or when the power is on, the operation precautions and regulations should be followed. Due to electromagnetic waves, other noises, and substrate defects, the recorded data will be lost.** **Therefore, please back up programs or frequently used data to an external storage medium such as a Compact flash card.**
	**In a large-scale system, multiple operators are involved in the work. When it is necessary to talk at a distance, the intention should be correctly conveyed by means of gestures, etc.** **Factors such as noise in the environment can make it impossible to convey the meaning correctly and cause accidents.**

Industrial robot gesture method (example)

1. Connect  Do the work related to the connection.	2. No way! Disconnect  Raise your right hand and wave vigorously left and right.
3. Is that OK? (to confirm)  Raise your right hand up high forward.	4. OK  Raise your right hand up high forward. Use your thumb and index finger to form a circle.
5. Wait a moment  The right hand is facing the opponent. Straight up arms.	6. Leave  Stretch your right arm horizontally and weave to the

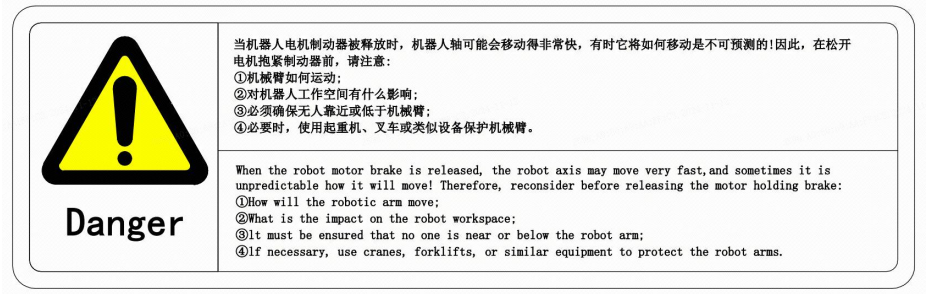
	**Operators should also maintain awareness of escape at all times during operations. It must be ensured that in an emergency, you can escape immediately.**
	**Always pay attention to the actions of the robot, and do not work with your back to the robot. Slow response to robot movements can also lead to accidents.**
	**When an abnormality is found, the emergency stop button should be pressed immediately. This requirement must be thoroughly implemented.**
	**According to the setting place and operating content, the relevant operation regulations and checklists such as starting method, operation method, solution in case of abnormality, etc. of the robot should be compiled. And carry out the operation according to the operating regulations. Operation only based on the memory and knowledge of the operator can cause accidents due to forgetting and mistakes.**
	**For the completed program, use the storage protection function to prevent accidental editing.**
	**When teaching, confirm the program number or step number before proceeding. Editing procedures and steps incorrectly can cause accidents.**
	**When it is not necessary to make the robot move and operate, please turn off the power before performing the work.**
	**After the teaching operation is completed, the robot movement should be manually checked at a low speed. If you run at 100% speed in automatic mode immediately, accidents will occur due to program errors and other factors.**

Attention	**After the teaching work is over, clean up and check if you have forgotten to take the tool. The work area is contaminated by oil, and tools are forgotten, etc., which can cause accidents such as falls.** **Ensuring safety starts with tidying up.**

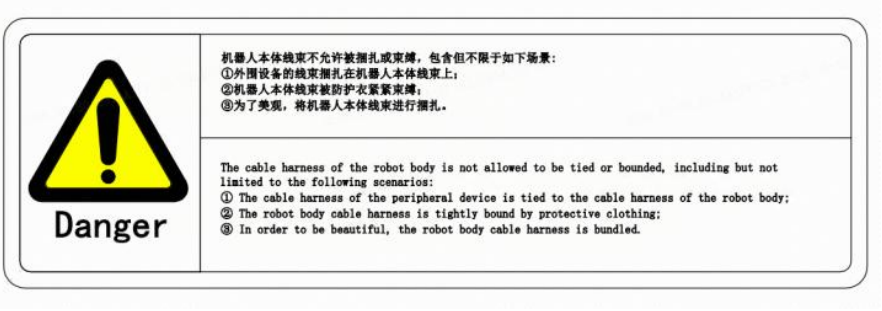
1.2 Robot Body Label Description

Safety warning labels will be pasted on the robot body. These labels are pasted on specific parts of the robot body to remind users of safety matters that need to be paid attention to when operating and maintaining the robot.

Icon	Name	Description	Pasting Parts
	**Be careful with your hands**	**The moving parts of the robot may pinch your hands**	**It is generally pasted on the rotating joint of the power arm and the connecting rod.**
	**Beware of hot hands**	**After the robot is running, there are high-temperature heating parts**	**It is usually pasted on the motor to warn that the motor is hot and it is forbidden to touch it with bare hands.**
	**Be careful of electric shock**	**There is a risk of electric shock at the electrical connection of the robot**	**It is generally pasted on the motor and the circular connector panel of the base, prompting the user to pay attention to safety when connecting and removing the cable connector.**
	**No step, fragile**	**During the maintenance work, it is forbidden to step on the robot, so as to avoid the injury of people when they step on the air. At the same time, it is also to avoid damaging the parts and affecting the performance of the robot**	**It is generally pasted on the motor.**



Anti-drop damage, attached to the upper arm.



The peripheral pipeline is not allowed to bundle other cable labels, and is generally attached to the arm.

1.3 Shift, Transfer, and Sale of Robots and the environmental control requirements

Attention	**When the robot is transferred, transferred and sold, it must be ensured that the robot auxiliary documents such as the mechanical operation and maintenance manual, the electrical maintenance manual, and the robot programming manual are handed over to the new user.** **When the robot is transferred, transferred or sold abroad, the customer must be responsible for preparing the mechanical maintenance manual, electrical maintenance manual, robot programming manual, etc. in the appropriate language, modifying the display language, and ensuring compliance with local laws and regulations.** **Accidents can occur when new users perform incorrect or unsafe operations without reading the manual.**
Attention	**When the robot is transferred, transferred, and sold abroad, the contract terms at the time of the initial sale shall not be inherited by the new inheritor unless otherwise specified, including safety-related provisions.** **A new contract must be signed between the original client and the new client.**
	The main hazardous solid waste generated during robot field service includes the following types and disposal options: **Waste industrial batteries, waste circuit boards: brought back by our field service personnel or kept by customers as an exchange when purchasing new parts.**

	**Waste grease, waste oil drums, sticky oil rags: to the units with special hazardous waste qualifications for collection, transportation and treatment.** **Damaged parts: repaired by our field service personnel or suppliers can continue to use in use, can not be repaired for scrap.** **Packaging materials: The company's field service personnel recommend customers to the recycling company for recycling.**

1.4 Abandonment of Robots and the environmental control requirements

	**Do not decompose, heat or incinerate the batteries used for the control device and robot body. Otherwise, fire, rupture and burning accidents will occur.**
	**Do not disassemble the board and components of the control device before discarding it.** **Sharp parts such as cracks or cuts, wires, etc. may cause injury.**
	**After the cables and external wiring are removed from the connector and junction box, do not disassemble them further and then discard them. Otherwise, it may cause injury to hands or eyes due to conductors, etc.**
	**When carrying out abandoned work, please pay full attention not to be pinched or injured.**
	**Waste products should be discarded in a safe state.**
	**The waste grease and oil-involved rags that appear in the robot maintenance process need to be transferred to the special disposal device for polluting flammable and dangerous goods, and handed over to the unit with the special hazardous waste qualification for collection, transportation, treatment and disposal.**
	**In the process of robot maintenance, the parts that need to be scrapped within the warranty need to be sent back to the company, and the company will centrally scrap them in accordance with the relevant laws and regulations.**

 Attention	**In the process of robot maintenance, equipment operators and maintenance personnel must strictly follow the relevant documents of the environmental management system for standardized operation and regular inspection and maintenance to prevent the environmental impact caused by equipment movement, loosening, inadequate maintenance and other reasons.** **Control the environment when the device is abnormal. When the device is abnormal, such as turning on and off the device, periodically checking and maintaining the device, the operation and maintenance personnel must strictly control the environment.** **During regular inspection and maintenance of equipment, maintenance personnel should take effective measures to prevent grease, fuel or other oil droplets from polluting the ground.** **The used oilcloth and oil-absorbing sponges shall not be discarded or incinerated, and must be placed in the hazardous solid waste collection tank.** **When excessive noise may occur in maintenance activities, it is necessary to take sound insulation measures and wear personal anti-noise earplugs to prevent excessive emissions and personnel safety.**

Chapter Two Basic Description

2.1 Robot system composition

- ✓ The inRobot body
- ✓ Control cabinet
- ✓ Teach pendant
- ✓ Connection (power supply) cables, etc.

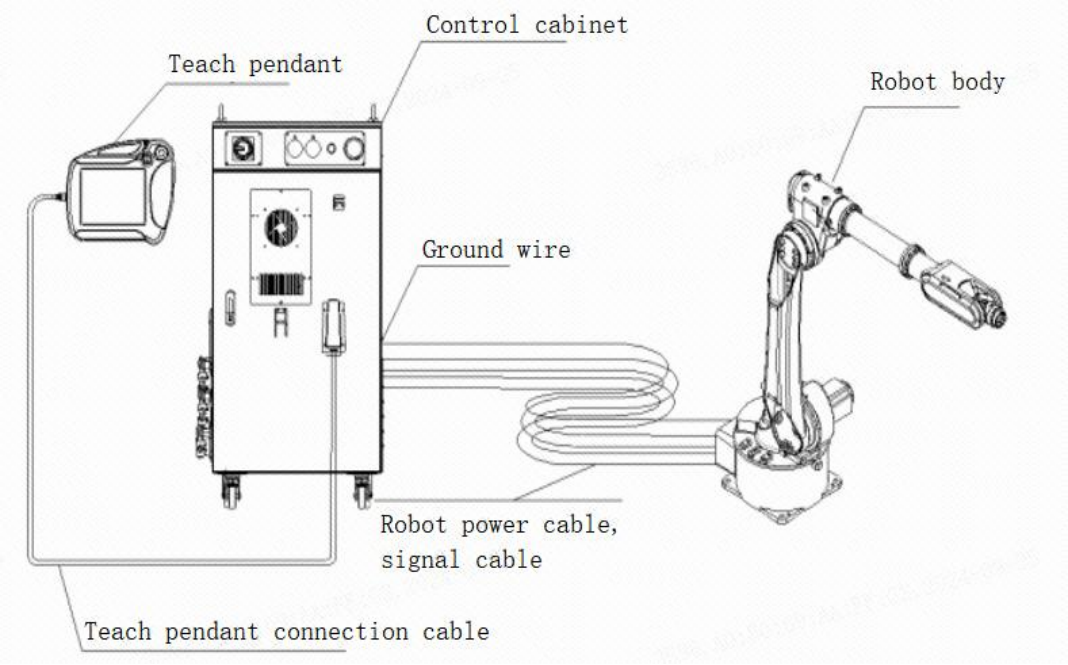


Fig.2-1 Industrial Robot System Composition

2.2 Unpacking Check

Attention	**1、Before unpacking, please confirm whether the outer packaging of the product is intact;** **2、After unpacking, please confirm whether all parts of the robot are complete and whether the model is consistent with the order.** **If you find missing or wrong parts, please contact the supplier in time.**

Table 2-1 List of Parts and Accessories

Name	Model	Number	Unit	Remarks
robot body	ER20-1700	one	PC	
control cabinet	EC-M6	one	PC	
teach pendant + teach pendant wire	standard configuration	one	PC	
body-control cabinet connection wire	power wire	one	PC	The standard length is 8m, and it supports conventional customization

				of 12m、16m and 20m
	encoder wire	one	PC	The standard length is 8m, and it supports conventional customization of 12m、16m and 20m
ground wire	standard configuration	one	PC	The cable is equipped with 8.5m as standard.
control cabinet power supply circular connector	standard configuration	one	PC	Installed on the control cabinet
	standard configuration	one	PC	
	standard configuration	one	PC	
circular connector shield	standard configuration	two	PC	Installed on the control cabinet and body
	standard configuration	two	PC	
instruction manual	Mechanical Operation and Maintenance Manual for Industrial Robot	one	PC	QR code
	Electrical Operation and Maintenance Manual for Industrial Robot	one	PC	
	ER Series Robot Operation Manual	one	PC	
product certification	enterprise standard	one	PC	/

Note：The details have been subject to actual conditions.

2.3 Machine Body Nameplate

The name plate of the operator can be seen on the robot body, which contains the corresponding model type, weight, voltage, production number,manufacturing date and other information. As shown in Fig2-2 below.



Fig 2-2 Robot Body Nameplate

2.4 Body Part Composition and Direction Identification of Each Axis

The robot mechanical body is mainly composed of the base part, the rotating part, the big arm part, the small arm part, and the wrist part. The joints of the machine body are driven by servo motors, and the joints cooperate with each other to realize the adjustment of the position and posture of the robot end in space.

The names of the various components of the machine body and the identification of each axis direction are shown in Fig2-3:

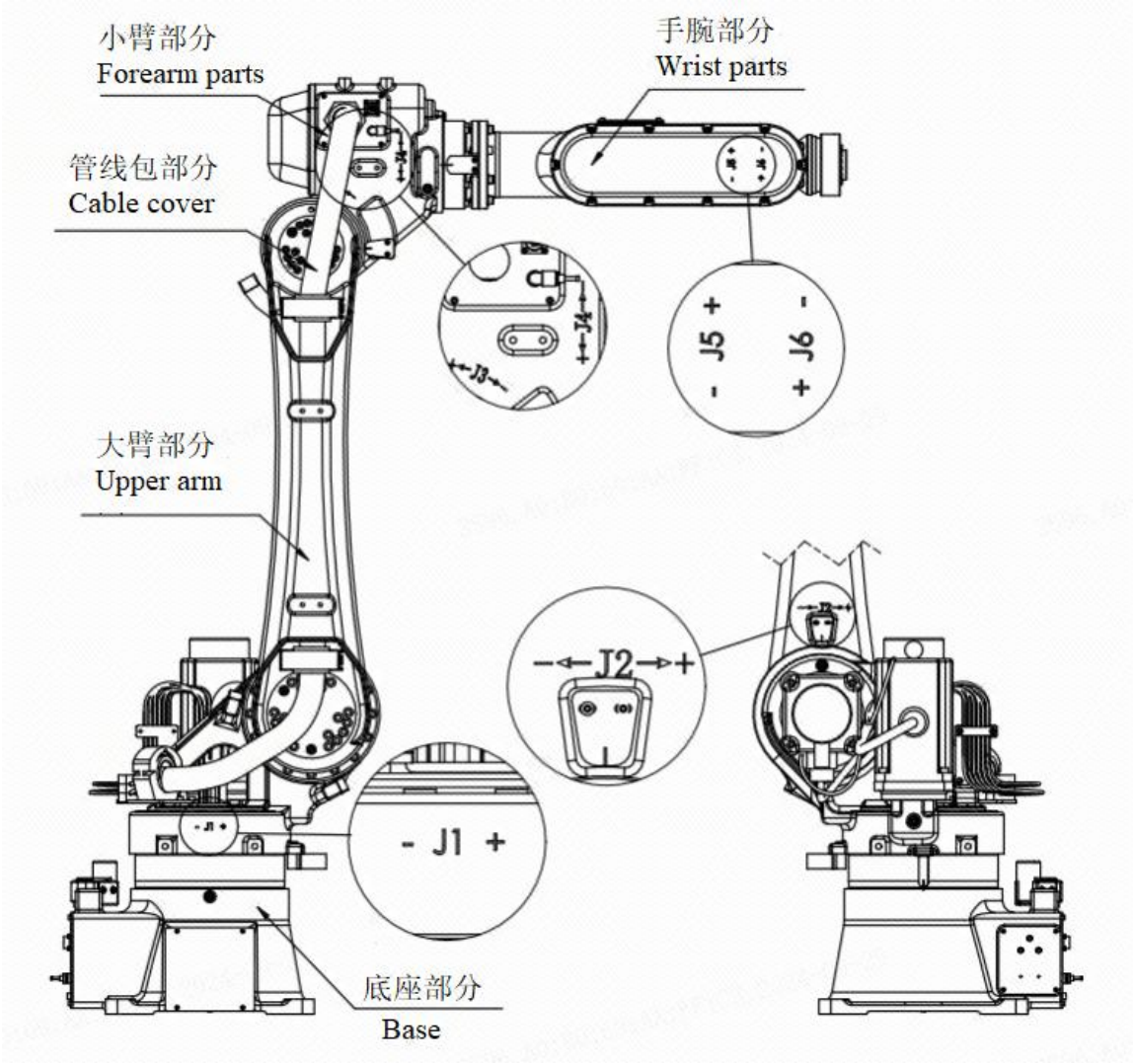


Fig.2-3 Components of the Machine Body

2.5 Robot Axis Range Limit and Home Position

Each axis of the robot body has a home position and range limit.When the robot system is running normally, each axis of the robot is controlled to move within the allowable range. In addition, in order to ensure further safety, mechanical end stops are provided on some axes to prevent the robot from operating beyond the allowable range when the robot (control) system is abnormal.

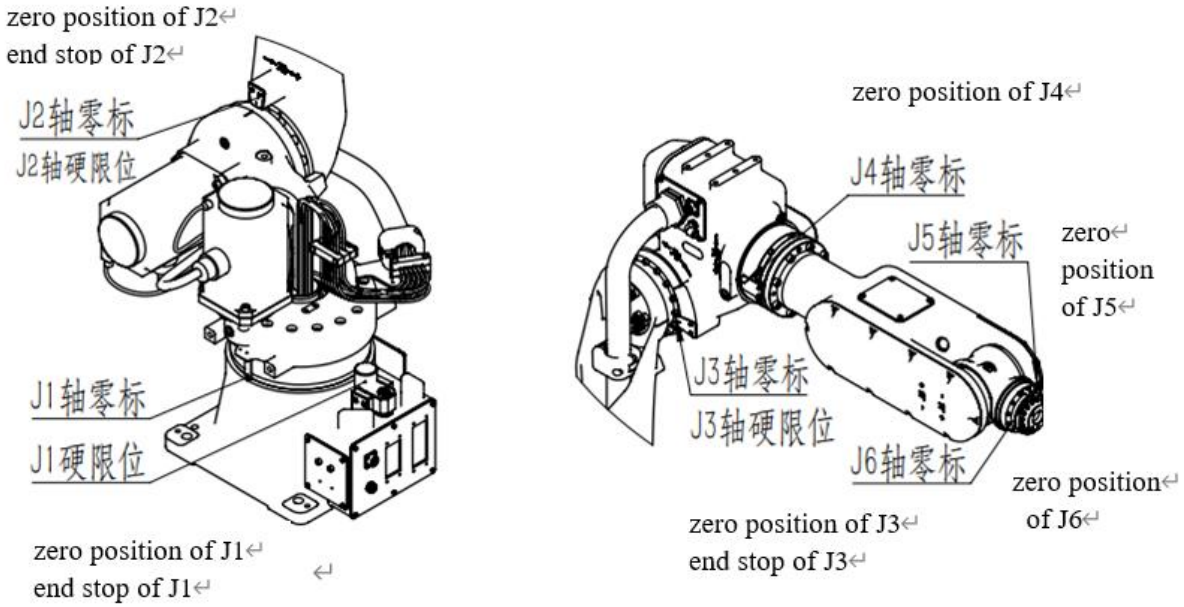


Fig 2-4 Mechanical End Stop Position and Home Position

2.6 Robot Performance Parameters

Table 2-2 Performance Parameter Table

Model		ER20-1700
Movement Type		multi joint
Control axis		six axes
Maximum speed	Axis J1	170° /s
	Axis J2	150° /s
	Axis J3	146° /s
	Axis J4	360° /s
	Axis J5	360° /s
	Axis J6	550° /s
Maximum Motion Range	Axis J1	±175°
	Axis J2	+64° /-142°
	Axis J3	+165° /-73°
	Axis J4	±178°
	Axis J5	±128°
	Axis J6	±720°
Arm span		1722mm
Maximum writ payload		20kg
Installation conditions		ground, support, upside down
Protection class		IP65(wrist)/ IP54(other parts)
repeatability		±0.06mm
Body weight		220kg

The above repeated positioning accuracy test was carried out in the robot heat engine state at room temperature, under the maximum load, maximum offset value and 1.6 m/s speed on the inclined ISO test surface, with all 6 axes in action

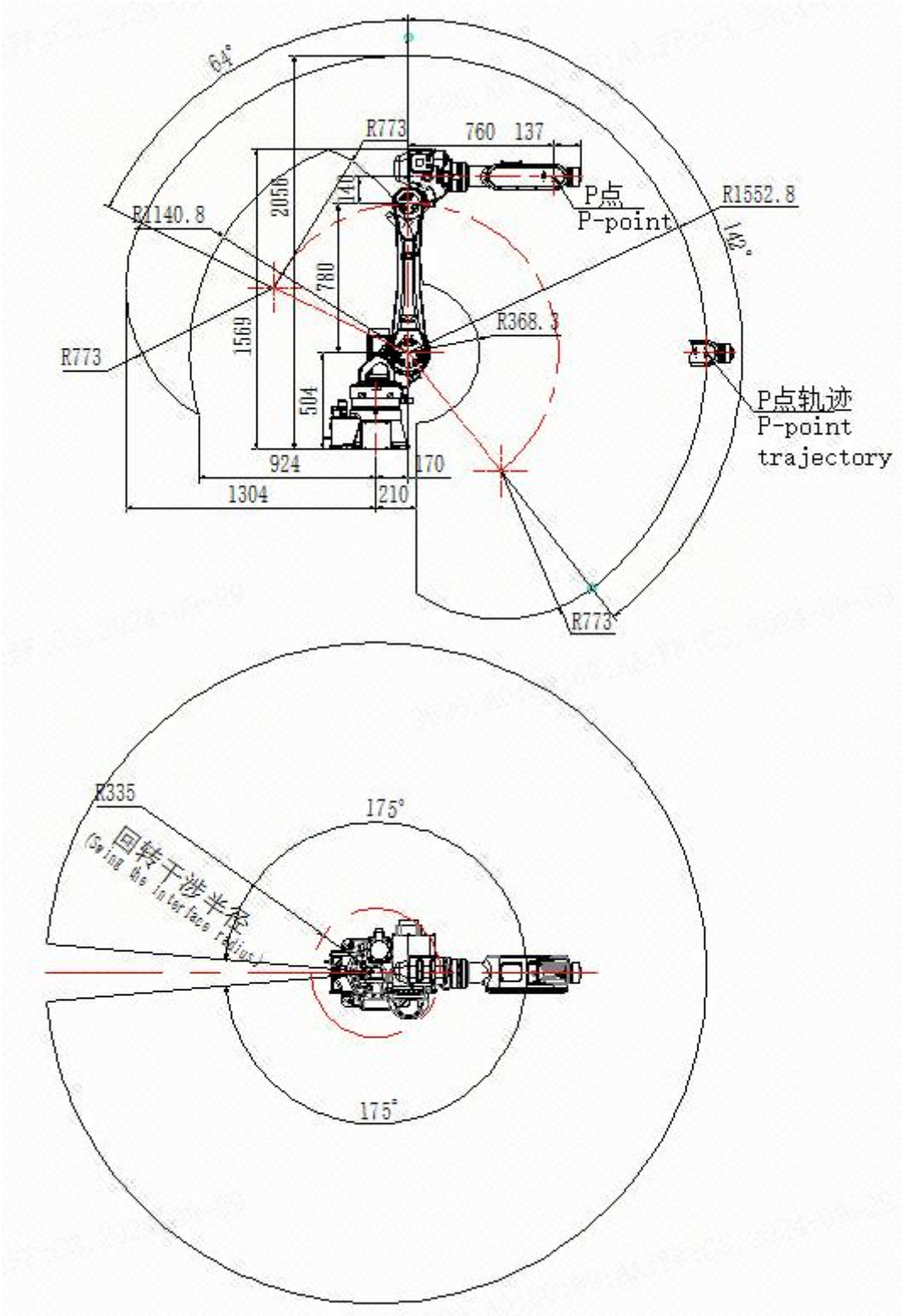


Fig.2-5 Robot Workspace Diagram

Note: The working space shown in this Figis the theoretical maximum reachable range of point p. It will change due to the influence of the installation method in actual operation. In actual use, please consider the influence of the installation method on the working space.

2.7 Allowable Value of Wrist Payload

Attention	**The installation load at the end of the wrist of the robot is affected by the allowable weight of the wrist, the allowable load torque value and the allowable moment of inertia value, and the allowable load torque value changes according to the actual load moment of inertia. Wrist load should be strictly controlled within each allowable value. When the robot is installed with a wrist load other than the allowable value, normal action cannot be guaranteed.**

2.7.1 Allowable Weight

Table 2-3 Allowed weights at the wrist end of the robot.

Robot model	Allowable weight
ER20-1700	20 kg

2.7.2 Allowable Maximum of Static Payload Torque

Table 2-4 Allowable load torque at the end of the robot wrist

Robot model	Allowable static payload torque		
	J4 axis rotation	J5 axis rotation	J6 axis rotation
ER20-1700	42 Nm	42 Nm	26Nm

2.7.3 Allowable Maximum of Moment of Inertia

Table 2-5 Allowable load moment of inertia at the end of the robot wrist

Robot model	Allowable moment of inertia		
	J4 axis rotation	J5 axis rotation	J6 axis rotation
ER20-1700	1.18kgm2	1.18 kgm2	0.8 kgm2

2.7.4 Allowable Payload Curve Diagram

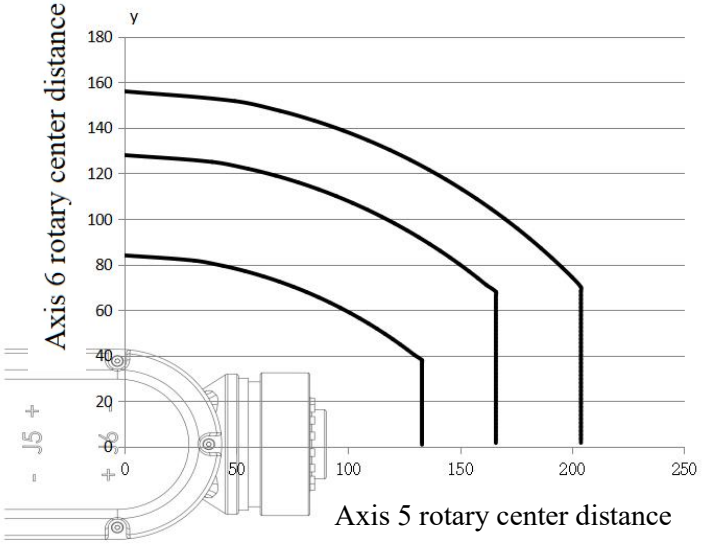


Fig.2-6 Wrist Axis Torque Diagram of ER20-1700

Chapter Three Handling and Installation

3.1 Robot Handling

3..1.1 Handling Precautions

The following are precautions for robot handling operations. Please work safely after fully understanding the following:

	**The handling of robots and control devices must be carried out by qualified personnel for hook, lifting operation, forklift, etc. Carrying operations by operators who do not have the correct skills may cause accidents such as tipping and falling.**
	**When transporting the robot and control device, please follow the method described in the manual and confirm the weight and steps before proceeding.** **If the operation cannot be performed in accordance with the specified method, the robot and the control device may tip over or fall during the handling process, resulting in accidents.**
	**When carrying out transportation and installation operations, care should be taken to avoid damaging the wiring. In addition, after the device is assembled, protective measures such as covering the protective cover should be taken to avoid damage to the wiring by operators and forklifts.**

3.1.2 Auxiliary Handling Tooling

The wrist part should be fastened before transportation to prevent damage from shaking and collision. It is usually done by connecting the wrist and swivel part using a packing fixing bracket.

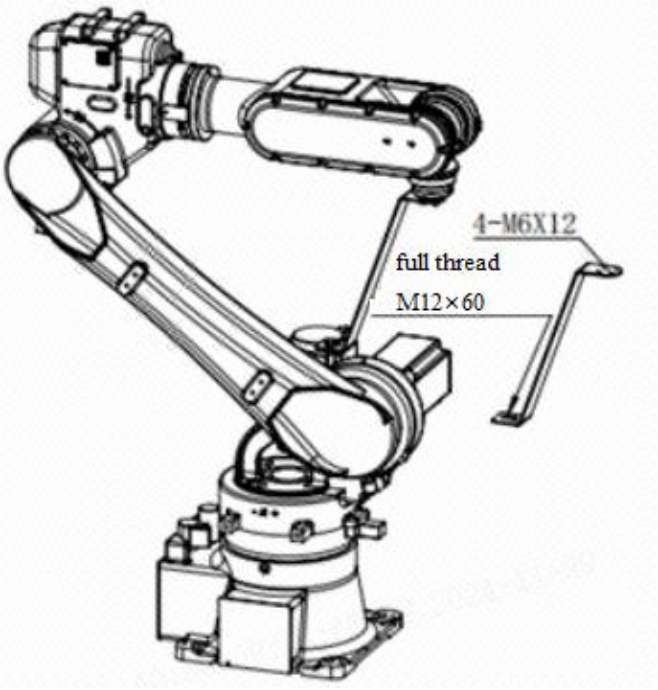


Fig.3-1 Packing and Fixing Bracket Installation Diagram

If you choose a forklift to carry the robot, you need to observe whether there are fork foot position near the base of the robot.The base of the ER20-1700 robot has no fork feet, and external fork feet need to be installed to assist forklift handling. After handling, remove the fork foot in time to avoid interference with the movement of the robot

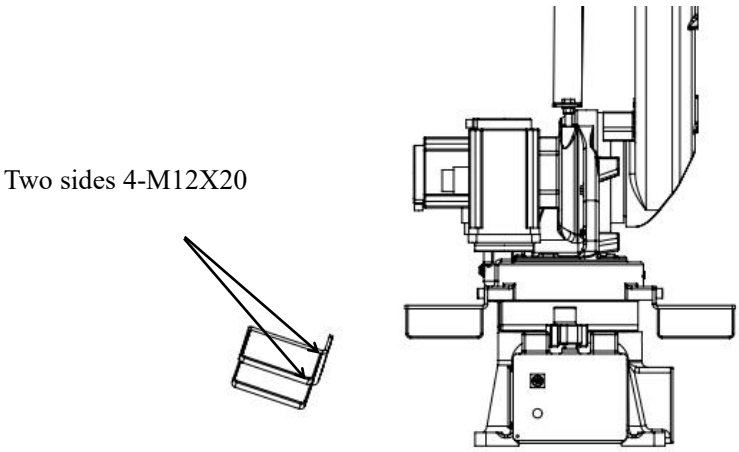


Fig.3-2 Fork Foot Installation Diagram

3.1.3 Handling Method

1） Handling method one

When transporting the robot, first set up the robot according to the posture shown in Fig3-3, and then install four M10 eyebolts on the main frame, and use 4 steel cables for lifting. It is suggested that the length of the steel cable should not be less than 3m, and rubber hose should be put on the contact part between the steel cable and the main body of the robot for protection.

 Attention	**In Fig3-3, no other devices are installed on the end effector and robotic arm, so please pay more attention once you install other devices.**

2） Handling method two

Set the robot to the posture shown in Fig3-4 and use a forklift to carry it.

The angles of each axis of the handling posture are set as follows:

position	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
Articular angle/°	0	+54	-54	0	-90	0

 Attention	**（1）When lifting and transporting, the customer shall prepare the eye bolts and slings by themselves. The eyebolt shall meet the requirements of GB / T 825-1988. The sling shall be able to bear the weight of the robot. It is recommended that a single sling should bear more than 500kg** **（2）Forklift and hoisting lifting equipment shall be able to handle more than 1000kg**
 Attention	**When transporting, be sure to install the fixing jig for transport!** **When using other transportation methods without using cranes and forklifts, please note that the robot arm and motor cannot be subjected to external forces!** **After unpacking and installing, be sure to remove the transport fixture and rubber pad!** **Fixing fixtures will be needed for robot handling in the future, so please keep them properly!**

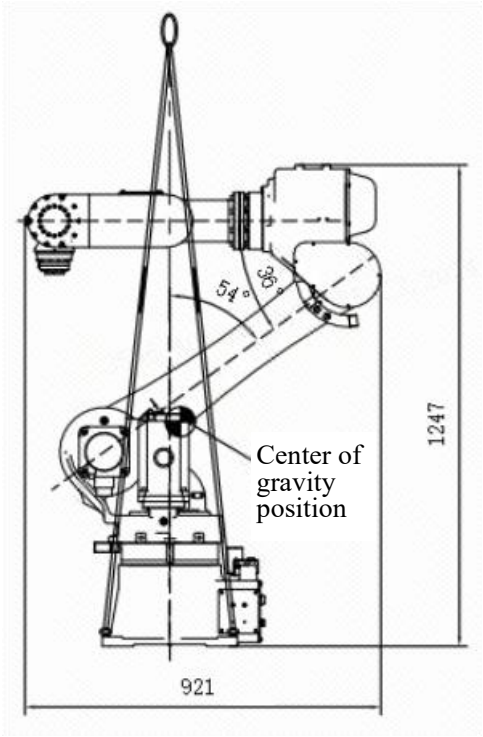


Fig.3-3 Schematic Diagram of Lifting and Handling

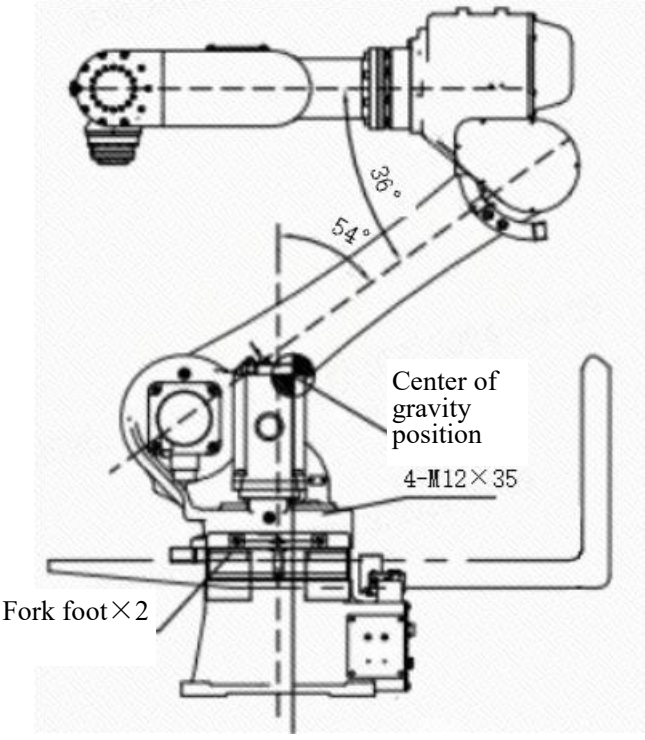


Fig.3-4 Schematic Diagram of Forklift Handling

3.2 Robot Installation

	**（1）Set up safety fence** **Otherwise, accidents such as personal injury and equipment damage may occur. The robot should be placed in a position where the tool and the tip of work piece of the robot arm will not touch the safety fence even if the robot arm reaches the longest.** **（2）If the robot is not fixed, it cannot be electrified and operated.** **Otherwise, accidents such as toppling, personal injury, and equipment damage may occur.** **（3）When choosing the suspended or wall-mounted installation method, it should be fixed on the ceiling and wall with sufficient strength, and the treatment plan to prevent falling should also be considered.** **Otherwise, accidents such as personal injury and equipment damage may occur.**
	**This is a Partly Completed Machine to be integrated with suitable safety devices according to the measures defined in the final risk assessment (e.g. fences)**

3.2.1 Setting of Safety Fence

It is necessary to comply with the national standard of the People's Republic of China GB11291.2-2013-that is" Safety Requirements for Robots and Robot Equipment; Industrial Robots, Part 2: Robot System and Integration" , and see more in 5.4 Robot Movement Restrictions: "The design and integration of robotic equipment should reduce the potential exposure of personnel to danger". In 5.4.2, the establishment of safety protection space and limited space stipulates that "safe protection space shall be established through peripheral protection. The establishment of safety protection space shall fully consider the location and layout of the machine and the hazards in the safety protection space". Safety protection in 5.10 regulates: "when the design cannot remove the danger or can not reduce the risk sufficiently, then the safety protection shall be applied. Access to hazardous areas shall be protected by safety guards such as guards and protection devices. "

In order to avoid equipment damage and personal injury to the operator and surrounding personnel during the operation of the robot, please be sure to set up a safety fence (and with safety settings such as interlocking doors)!

Note: GB 11291.2-2013 is equivalent to ISO 10218-2:2011;

Also Please refer to the standard EN ISO 13857-2019 for the design of the safety fence

3.2.2 Robot Installation Method

The installation of the robot, especially the fixing of the base and the foundation, can withstand the dynamic load of the robot during acceleration and deceleration and the static weight of the robot and fixtures. In addition, if the installation surface of the robot is not flat, the robot may deform and its performance may be affected.

Please ensure that the flatness of the robot installation is less than 0.5mm.

The dimensions of the base installation interface are shown in Fig3-5 as follows:

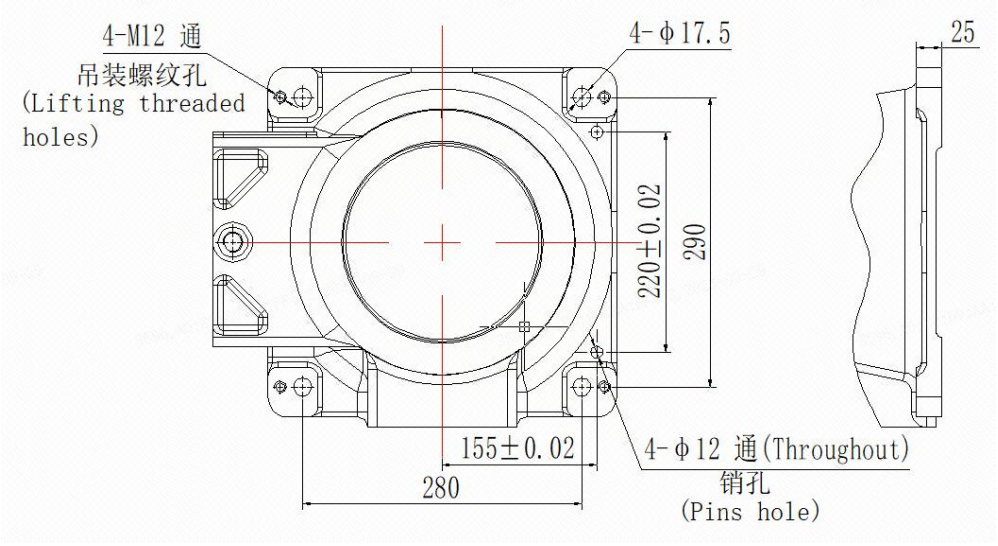


Fig.3-5 Robot Base Size

Considering that the robot may be installed against the wall, the minimum bending size of the rear cover plate of the base and the cable is shown in the Figbelow:

Among them,

the diameter of the power line is φ26mm,

the diameter of the encoder wire is φ12mm, and others can be increased if any

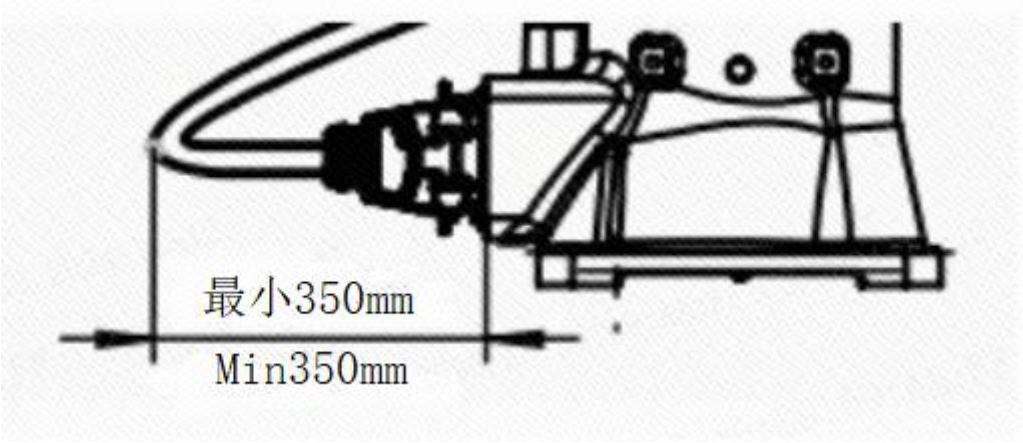


Fig3-6 The minimum bend size of the cable at the back of the base

3.2.3 Ground Mounting

Ground mounting requires the concrete foundation to be firm, the strength level and load-bearing capacity should meet the relevant quality specifications, the thickness of the concrete should not be less than the filling depth of the chemical bolts, and the effective range should completely cover the fixed bottom plate to ensure the safety and reliability of the bottom plate installation. The concrete specification refers to GB50010-2010 "Concrete Structure Design Code" (2015 version) and GB/T50081-2002 "Standard for Mechanical Properties Test Methods of Ordinary Concrete", and the strength grade refers to C20/C25.

Table 3-1 Parts List Required for Robot Fixation

Name	Specifications	Quantity
bottom plate	thickness≥30mm	one
	reference area（600mm×600mm）	
chemical bolt group	M16 above，strength level≥4.8	eight
fixing screws	M16×55，strength level 12.9	four
bottom plate	M12x45	two

When installing on the ground, first fix the bottom plate on the ground. We recommend that the thickness of the bottom plate should be more than 30mm. Use 8 chemical bolts of M16 or more to fix the bottom plate on the ground. The base of the robot is firmly fixed on the bottom plate with M16 hexagon socket screws of strength grade 12.9 through the four mounting holes (the length of the screw must ensure that the screw thread length reaches 1.5 times the nominal diameter of the thread). If there is no loosening during operation, please fully fix and prevent loosening as shown in Fig3-7 "Robot Installation Example".

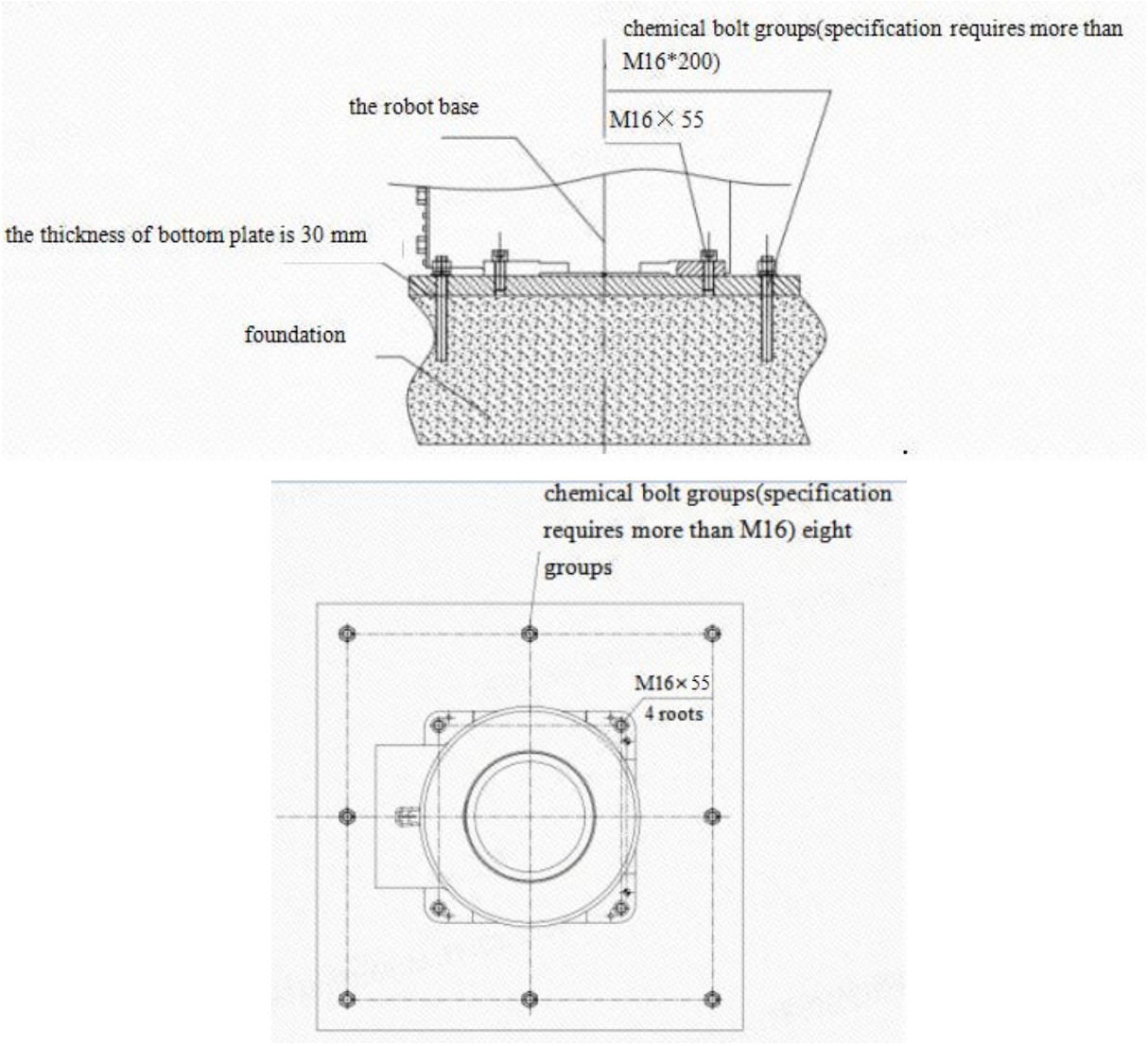


Fig.3-7 Robot Installation Example

Attention	**Too long or too short screws for fixing the base of the robot will cause bad fixing accidents!** **The connection strength of chemical bolts depends on the strength of concrete. When the strength of concrete is insufficient, it can be strengthened by the following methods:** **Increase the number of chemical bolt groups;** **Increase the embedded depth of chemical bolts;**

3.2.4 Support Installation

When the height of the bracket is less than 600mm, its fixing mode is similar to the ground mounting mode, which is divided into two parts: robot base installation, bracket and ground mounting;

When the height of the bracket is above 600mm, the connection strength between the bracket and the ground shall be strictly checked to ensure the safety and reliability of the connection between the bracket and the ground;

Attention	**Measures such as the specification, quantity, and embedded depth of the chemical bolt group can be appropriately increased;** **Improve the strength of the concrete foundation, the strength of concrete foundation is higher than that of chemical bolt components;**

3.2.5 Suspended Installation

Attention	**In order to ensure safety, the following precautions should be taken when implementing upside down and wall mounted installations;** **1. Install the anti-fall safety device, as shown in Fig3-7;** **2. The connecting screws need to use 12.9-strength screws, and the screw tightening torque needs to meet the pre-tightening force requirements of the screws of this specification!**

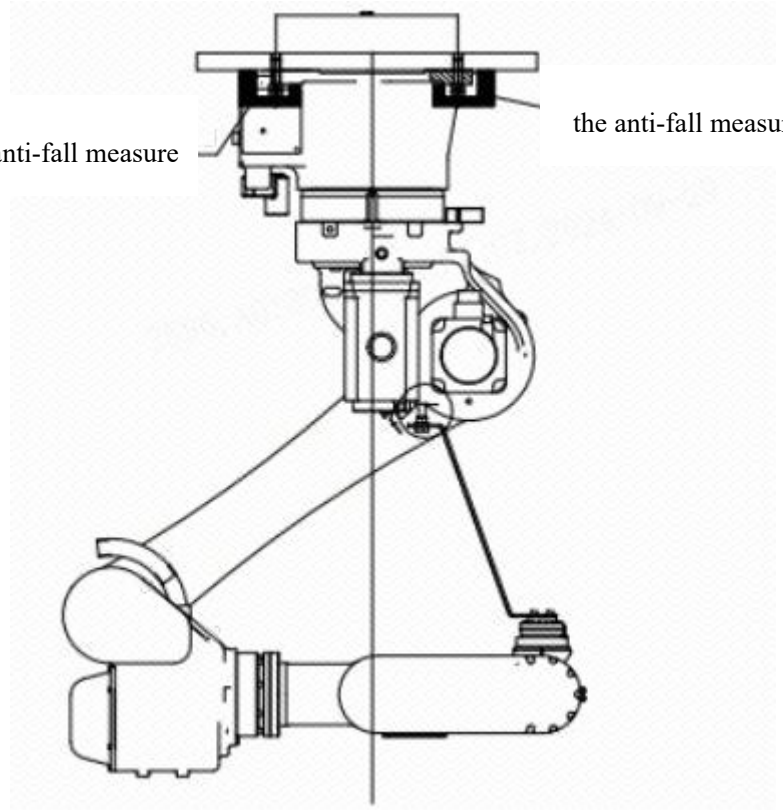


Fig.3-8 Suspended Installation

3.3 Installation Site and Environment

The robot should be able to keep normal when used, transported and stored under the specified environmental conditions, and its performance should meet the requirements.

Robot Environmental Conditions		
environmental conditions	working conditions	storage and transportation conditions
ambient temperature	0-45℃	-25~55 ℃
relative humidity	≤80%（40℃）	≤93%（40℃）
atmospheric pressure（altitude）	86~91.3 kPa (Under 1000m)	
vibration	less than 0.5G，4.9m/s^2	
others	no corrosive gas (Note)	

Note: For the robot to be used, if there is strong vibration in the use environment, a lot of dust, cutting oil splash, or other objects, or other environment use, please contact the company's after-sales service department, the use of robot protective covers or other ways to protect the robot parts. For the use of robots at higher altitudes, exhaust treatment should be performed on each joint before use.At lower ambient temperatures (below 10 ° C), it is recommended to have a preheating stage,otherwise the robot may be hard to start or reduced performance. The viscosity of lubricating grease is affected by temperature. Lubricating grease with high viscosity at low temperatures may have high friction resistance during startup.

3.4 Integrated Application Installation Interface

Table 3-2 Size of External Interfaces

Size of external interfaces	as shown in the Fig	Remarks
end load installation flange size	Fig.3-9	end load installation size
dimensions of the external component installed on the boom	Fig.3-10	external component installation size
dimensions of the external component installed on the motor base	Fig.3-11	external component installation size
locations of gas and signal cable interfaces	Fig.3-12	trachea and signal line location
specifications of external air pipes and signal cables	Fig.3-13	tubing and signal line specification definition

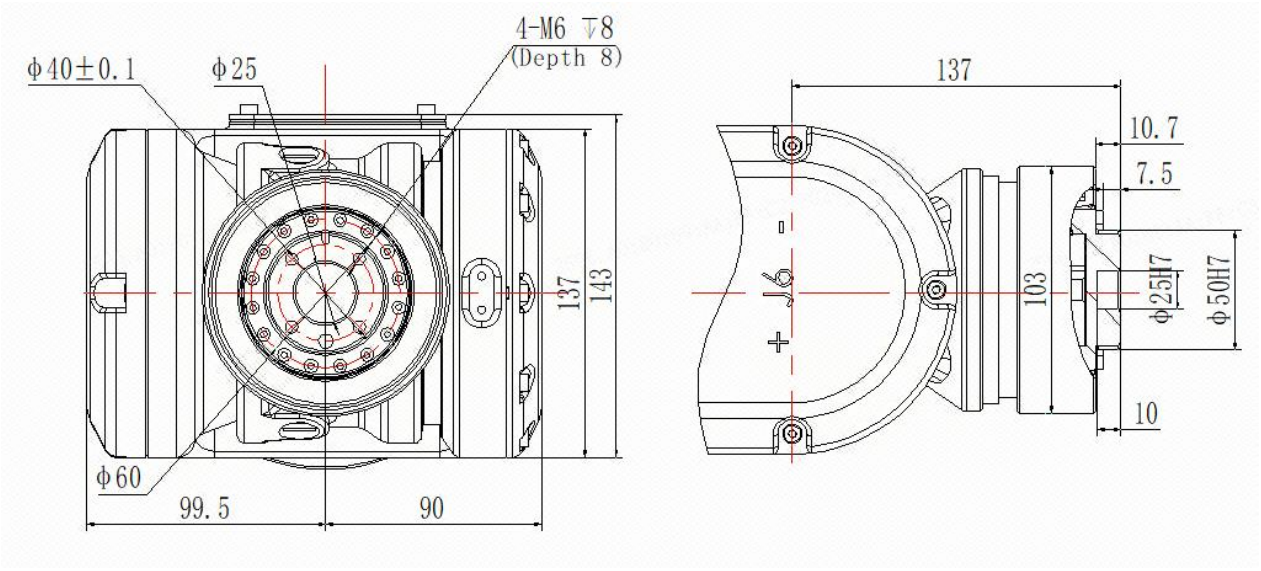


Fig.3-9 End Load Installation Flange Size

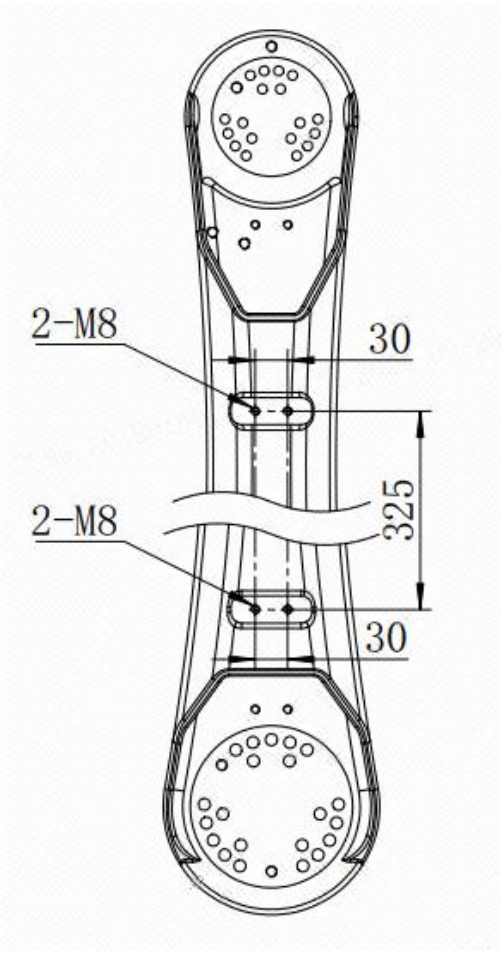


Fig 3-10 Dimensions of the External Component Installed on the Boom

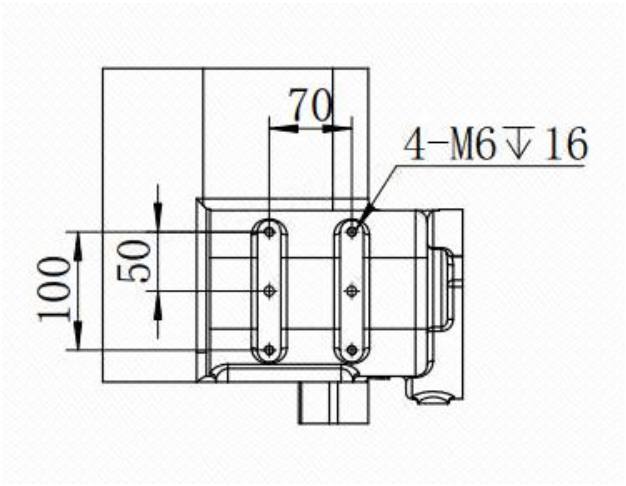


Fig 3-11 Dimensions of the External Component Installed on the Motor Base

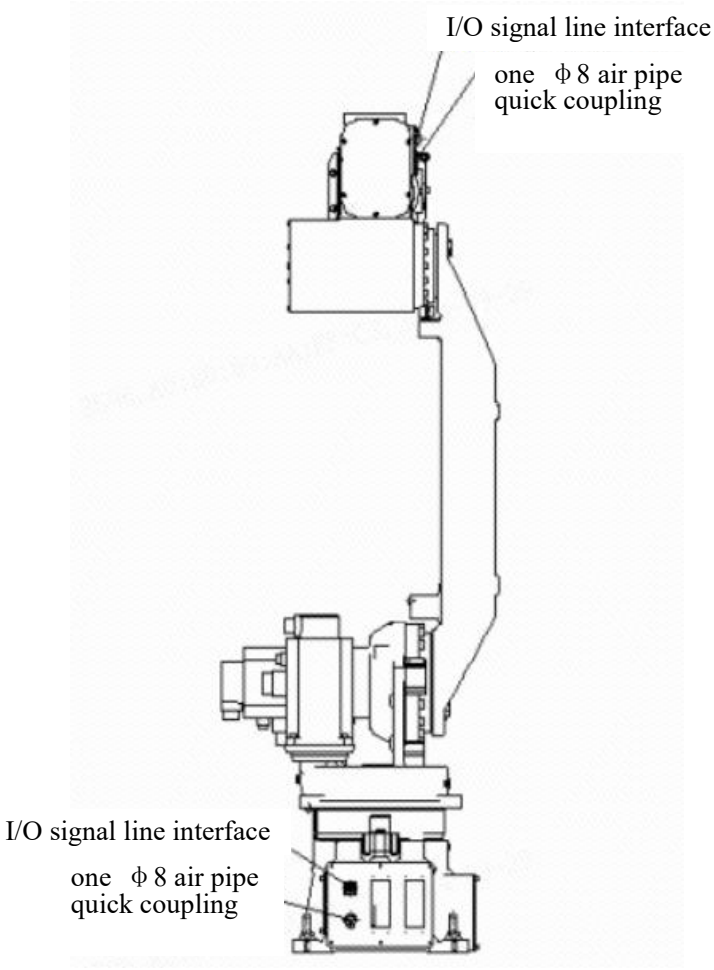
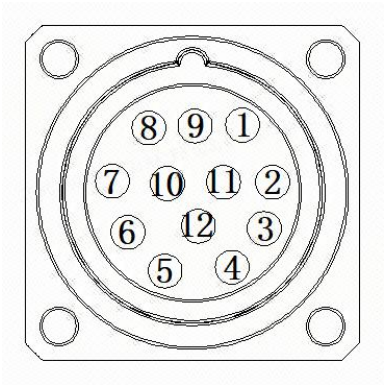


Fig 3.12 Locations of gas and signal cable interfaces

ER20-1700 Robot Base and Arm IO Signal Connector Definition		
Number	Guide wire marking	Remark diagram
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	
11	11	
12	12	

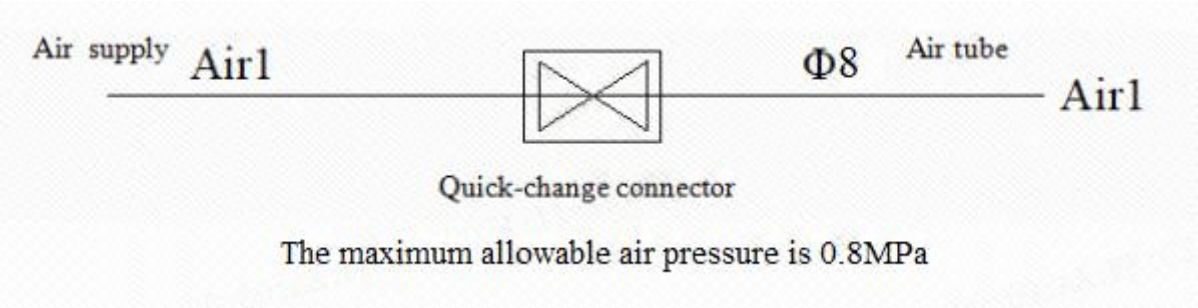


Fig3-13 Specifications of external air pipes and signal cables

Chapter Four Overhaul and Maintenance

Overhaul is divided into daily overhaul and regular overhaul. Inspectors must prepare overhaul plans and carry out overhaul. Please refer to the table below for overhaul items and overhaul periods.

In addition, the overhaul must be carried out every 40,000 hours of work or every 8 years (the principle of choosing which way to reach the deadline first). The overhaul period is based on the handling operation. It is recommended to implement maintenance and overhaul in a period of about 1/2 for high frequency operations such as glaze spraying operations.

In addition, if the inspection and adjustment method is unclear, please contact the company service department.

4.1 Preventive Maintenance

Follow the method introduced in this chapter and perform regular maintenance steps to maintain the best performance of the robot.

4.1.1 Daily Inspection

Table 4-1 Daily Inspection Table

Number	Inspection items	Inspection positions
1	abnormal noise inspection	check whether the transmission mechanism has abnormal noise
2	interference inspection	check whether the transmission mechanism is running smoothly and whether there is abnormal vibration
3	air cooling inspection	check whether the fan behind the control cabinet is well ventilated
4	pipeline accessories inspection	check whether it is complete, whether it is worn or not, whether there is rust
5	peripheral electrical accessories inspection	check the external wiring of the robot and whether the buttons are normal
6	leak inspection	check whether there is lubricating oil leakage on the body

4.1.2 Quarterly Inspection

Table 4-2 Quarterly Inspection Table

Number	Inspection items	Inspection positions
1	control unit cable	check whether the teach pendant cable is improperly twisted
2	ventilation unit of control unit	If the ventilation unit is dirty, cut off the power supply and clean the ventilation unit
3	cables in the mechanical unit	check whether the socket of the mechanical unit is damaged, whether it is bent abnormally, and whether the servo motor connector and the circular connector are connected reliably

4	cleaning and overhaul of various components	check whether there is a problem with the component and deal with it
5	tightening of external main screws	tighten the end effector screws and external main screws

4.1.3 Annual Inspection

Table 4-3 Annual Inspection Table

Number	Inspection items	Inspection position
1	cleaning and overhaul of various components	check whether there is a problem with the component and deal with it
2	tightening of external main screws	tighten the end effector screws and external main screws

4.1.4 Check Every Two Years

Table 4-4 Table of Inspect Every Two Years

Number	Inspection items	Inspection position
1	replace the Grease of the reducer and gear box	replace according to lubrication requirements
2	replace the Grease of the wrist parts	replace according to lubrication requirements

 Attention	**Note:** **1）Regarding cleaning parts, mainly at the oil seal of the mechanical wrist, cleaning chips and splashes.** **2）Regarding the fastening parts, tighten the installing screws of end effector , installing screws of robot body, and screws that have been removed for overhaul. All screws exposed to the outside of the robot should be tightened. For installation torque, refer to the screw tightening torque table in the appendix. And paint the corresponding fastening glue or sealant.**

4.2 Overhaul of Main Bolts

Table 4-5 Main Screw Inspection Position

Number	Inspection position	Number	Inspection position
1	For robot installation	6	For installation of J5 axis servo motor
2	For installation of J1 axis servo motor	7	For installation of J6 axis servo motor
3	For installation of J2 axis servo motor	8	For wrist parts installation
4	For installation of J3 axis servo motor	9	For end load installation
5	For installation of J4 axis servo motor		

 Attention	**To tighten and replace the screws, you must use a torque wrench to tighten with the correct torque, and then paint to fix it. In addition, it should be noted that bolts that are not loose should not be tightened with a torque higher than the required torque.**

4.3 Checking the Grease

1. Each axis of the robot has been injected with grease when leaving the factory, and the grease is filled with an oil injection gun when it is replaced;

2. According to the date of 2 years or cumulative operation time of 4083 hours from the date of leaving the robot, the grease is replaced for the first time in a shorter cycle;

3. The interval between subsequent grease replacement is 11520 hours every 2 years or each cumulative operating time, and the grease is replaced in a shorter cycle;

4. When measuring the concentration of grease iron powder of the reducer exceeds the standard value (0.1% Wt), it is necessary to replace the grease or reducer, please contact the company's after-sales service department.

 Attention	**When the robot operating environment is harsh, when the surface temperature of the reducer reaches more than 40°C, please confirm the aging and contamination of the grease and appropriately shorten the period of replacing the grease.**
 Attention	**During maintenance, if more than the necessary amount of grease (about 1/3 of the specified value) flows out of the body, please use the grease gun to supplement the outflow part. At this time, the nozzle diameter of the grease gun used should be less than φ17mm. The amount of added grease is more than the outflow, which may lead to grease leakage or poor trajectory of robot action, and should be paid attention to.**

	**After maintenance or refueling is complete, wrap sealing tapes on grease pipe joints and holes to prevent oil leakage before installing grease pipes.** **It is recommended to use a grease gun that can specify the amount of fuel. When an oil gun can not be prepared to specify the amount of fuel, the amount of fuel in the grease is confirmed by measuring the change in the weight of the grease before and after refueling.**
	**In the short time when the robot has just stopped, when the pressure inside the reducer chamber rises, the grease may spray out at the moment when the access port plug is removed, and the internal pressure of the reducer should be slowly released before refueling.**
	**The maintenance of the robot shall be regularly lubricated and overhauled in accordance with the following provisions to ensure the normal use of the robot.**

4.4 Change the Grease

4.4.1 The Oil Supply Quantity of Grease

Table 4-6 Oil Supply Table of Changing the Grease

Position	Amount	Lubricant Name	Remarks
J1 axis reducer	1310cc	MOLYWHITERE No.00	Rapid oiling will cause the pressure in the oil tank to rise, the crack of sealing ring, and the leakage of lubricating oil. The oil supply speed should be controlled below 40cc/s.Grease pump pressure control below 0.3MPa
J2 axis reducer	1000cc		
J3 axis reducer	320cc		
J4 axis reducer	125cc		
wrist parts	140cc	LD super No.096	Grease the reducer when installing it

4.4.2 Space Orientation of Lubrication

For lubricating oil replacement or replenishment operations, it is recommended to use the orientation given below.

Table 4-7 The Orientation of Each Axis When Filling Grease

Provide location	Orientation					
	J1	J2	J3	J4	J5	J6
J1 axis reducer	Any	Any	Any	Any	Any	Any
J2 axis reducer		0°				
J3 axis reducer		0°	0°			
J4 axis reducer		Any	0°			
wrist parts			0°	0°	0°	0°

4.4.3 Grease Replacement Steps for J1~J4 Axis Reducer and Wrist Parts

1） Move the robot to the lubrication position described in Table 4-7
2） Cut off the power.
3） Remove the M10*1 hexagon socket screw plugs of the Grease filling and drain ports, see Fig4-1.
4） Provide the new Grease until the new one flows out of the oil drain port.
5） Install the hexagon socket screw plug on the Grease filling and drain port.
6） After the oil is supplied, follow the steps in item 4.4.4 to release the residual pressure in the Grease chamber.

If the lubrication operation is not performed correctly, the internal pressure of the lubrication cavity may suddenly increase, which may damage the sealing part, resulting in Grease leakage and abnormal operation. Therefore, when performing lubrication operations, please observe the following:

1） Before performing the lubrication operation, open the oil drain port (remove the oil drain plug or screw plug).
2） Slowly provide Grease, the oil supply speed should be controlled below 40cc/s, do not use too much force, you must use a lubricating gun that can clearly determine oil quantity.If the oil pump is used for oil supply, the oil pump pressure is controlled below 0.3MPa. If there is no oil gun that can clarify the amount of lubrication, the amount of Grease should be confirmed by measuring the change in the weight of the Grease before and after refueling.
3） The hose on the oil filling side is first filled with grease, and be careful not to contain air in the grease.
4） If the oil supply does not reach the required amount, you can use a precision regulator for air supply to squeeze out the gas in the cavity and then supply the oil. When using the regulator, the air pressure should be controlled below the maximum 0.025MPa.
5） Use only specified types of Greases. If you use other Grease other than the specified type, it may damage the reducer or cause other problems.
6） When installing the hexagon socket screw plug after the oil is supplied, pay attention to winding the sealing tape to avoid oil leakage at the oil inlet and outlet.
7） In order to avoid accidents caused by slips and falls, the excess Grease on the ground and the robot should be completely removed.
8） After the oil is supplied, follow the steps in item 4.4.4 to release the residual pressure in the lubricating oil tank and install the hexagon socket screw plug. Pay attention to winding the sealing tape to avoid grease leakage of the supply and drain oil ports.

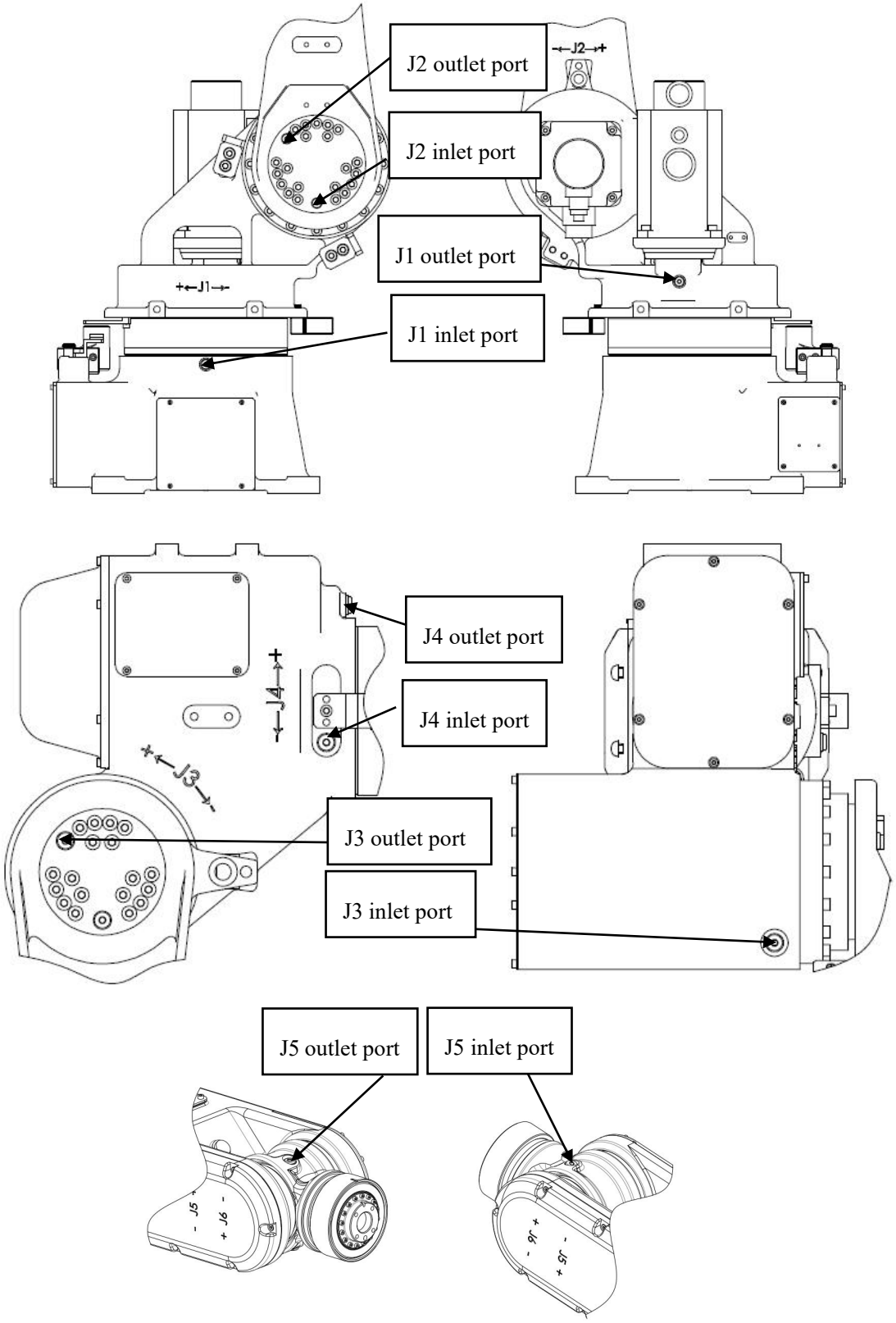


Fig.4-1 Inlet Port and Outlet Port Distribution

Table 4-8 Tools Required for Changing Grease

Number	Specification	Remarks
1	Grease gun	with the function of checking and counting oil
2	[M10x1]oil supply joint	one piece
3	[φ8x1m]oil supply hose	one strip
4	weight meter	Measure the weight of Grease
5	sealing tape	/
6	gas source	/

4.4.4 Release the Residual Pressure in the Lubricating Oil Cavity

After the oil is supplied, in order to release the residual pressure in the lubrication tank, the robot should be properly operated. At this time, install a recovery bag under the Grease inlet and outlet to avoid the spilled lubricating oil from scattering.

In order to release the residual pressure, when the oil drain port is opened, the J1 axis is in the range of ± 30 °, the J2 / J3 axis is in the range of ± 5 °, the J4 axis and J6 axis are in the range of 30 ° for more than 20 minutes, and the speed is controlled in the low-speed movement state.

When the above actions cannot be performed due to the surrounding conditions, the robot should be operated for the same number of times (if the axis angle can only be half, the robot should be operated for twice the original time). After the above actions are completed, install the sealing screw plug on the oil drain port (use a combination pad or wrap a sealing tape).

4.5 Timing Belt Maintenance

The J5 and J6 axes of the robot are driven by timing belt, which may become loose after running for a period of time, resulting in the decline of the accuracy of the robot. At the same time, after a long time of operation, the timing belt may be worn, cracked, etc. If it is not replaced and maintained, it may cause transmission failure and even economic loss.Therefore, it is necessary to check the running status of the timing belt regularly (recommended every six months). If it is loose, it should be tensioned in time. If it is damaged, it should be replaced in time to ensure the transmission accuracy and stability of the timing belt.

4.5.1 Timing Belt Tension

A tension gauge is required for timing belt tensioning. Customers can operate it by themselves or contact our company's after-sales service personnel.

The standard range of the tension force of the J5 axis timing belt of the ER20-1700 robot is 88±5HZ, and the standard range of the tension force of the J6 axis timing belt is 110±5HZ. Refer to the standard for testing and adjustment.The specific operation procedures are as follows:

（1）Remove the cover plate of the robot wrist part, and use the timing belt tension gauge to detect the tension of the J5 and J6 axis timing belts. If the tension is within the standard range, there is no need to tension and the maintenance ends. If the tension deviates from the standard range, proceed as follows.

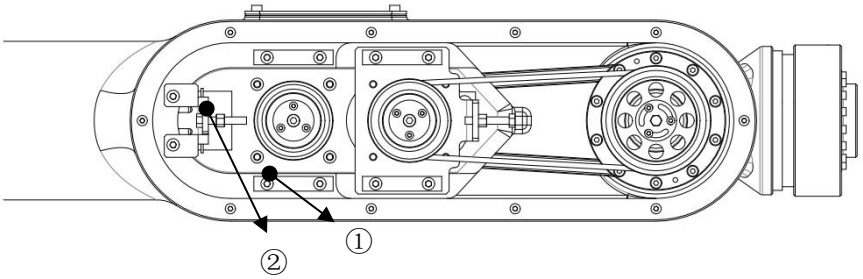
（2）Loosen the fixing screw of the motor mounting plate until the position can be adjusted left and right.

（3）Adjust the tension of the timing belt through the adjusting screw of the motor mounting plate, and use a tension gauge to detect the tension until it meets the standard range.

（4）Tighten the fixing screws of the motor mounting plate, and refer to the appendix standard for torque specifications.

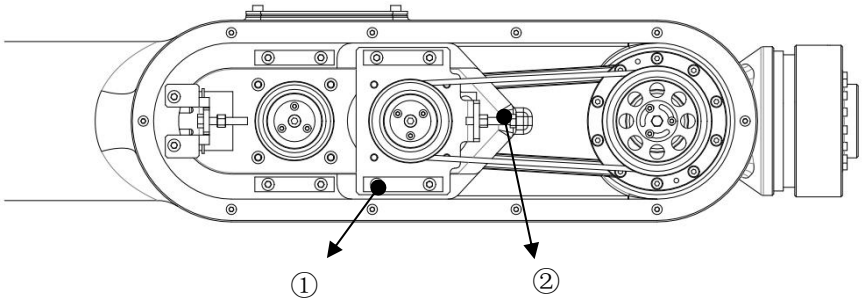
（5）Properly loosen the adjusting screw, and then tighten the lock nut on the adjusting screw to prevent the screw from loosening.

（6）Install the cover of the wrist body part, and the maintenance is over.



Note：①fixing screw，four M5×16；②adjusting screw，one M5×35

Fig.4-2 J5 Axis Timing Belt Structure of ER20-1700 Robot



Note：①fixing screw，four M5×16；②adjusting screw，one M5×35

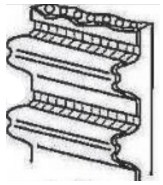
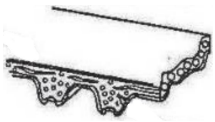
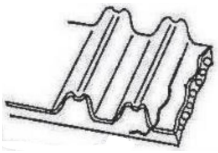
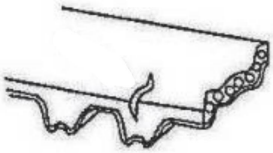
Fig.4-3 J6 Axis Timing Belt Structure of ER20-1700 Robot

4.5.2 Timing Belt Replacementt

The timing belt needs to be replaced every 3 years or every 11520 hours of operation of the robot.

At the same time, customers should pay attention to the appearance of the timing belt every time they perform maintenance on the timing belt. If the following damage occurs, please replace the timing belt in time.

Table 4-9 Timing Belt Damage Statistics Table

Excessive wear		Cracks appear	
The teeth form are worn and the rubber is exposed	The corners are worn and the core wire is dropped	tooth root crack	side crack
			

Attention	**The replacement of the timing belt involves the disassembly posture of the robot, the selection of the timing belt and the zero calibration after replacement, and special tools are needed in the process of disassembly and assembly. There are potential safety hazards in the disassembly and assembly of the customer. If you need to replace it, please contact the after-sales service department of our company.**

4.6 Robot Maintenance and Use Area

The maintenance area and use area of the mechanical unit are shown in Fig4-4. The use area of the robot can be adjusted according to the user's working environment.

4.6.1 The use area must have the following safety conditions

1） A safety fence and safety gate must be installed around the robot. If the safety gate is not opened, the operator cannot enter the safety fence. An interlock switch, safety latch, etc. are set on the safety gate. The robot will stop after opening the safety gate;

2） A safety carpet or photoelectric switch should be installed on the floor so that when the operator enters the robot's range of motion, an alarm will be issued through the buzzer and photoelectric switch to stop the robot from moving to ensure the safety of the operator;

3） The height of the safety fence is not less than 2 meters;

4.6.2 Qualification requirements and precautions for maintenance personnel

1） To enter the safety fence, you must go through professional training;

2） When entering the robot's working area, it must be powered off and locked；

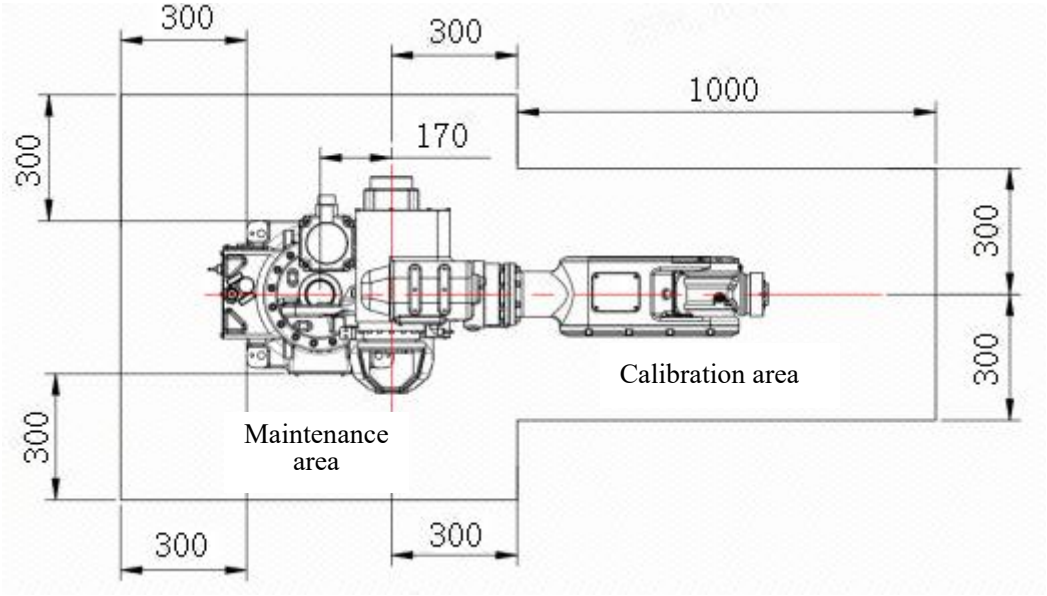


Fig.4-4 Maintenance and Operation Area

4.7 Home Position Calibration

Home position calibration refers to an operation performed to associate the angle of each robot axis with the encoder count value. The purpose of the home position calibration operation is to obtain the encoder count value corresponding to the home position.

"Home position calibration" is done before leaving the factory. In daily operations, there is generally no need to perform home position calibration operations. However, in the following cases, it is necessary to perform the home position calibration operation.

1） If the servo motor is replaced.

2） If the encoder is replaced.

3） If the reducer is replaced.

4） If the cable is replaced.

4.7.1 Home Position Calibration Method

Home position calibration is a relatively complicated process. According to the current actual situation and objective conditions, the following describes the tools and methods of home calibration, as well as some common problems and methods to solve these problems.

1)Software Home Position Calibration

The laser tracker needs to be used to establish the coordinate system of each joint of the robot, and the system encoder's reading is set to zero. The software calibration is more complicated and needs to be operated by professionals of our company.

2) Mechanical Home Position Calibration (Line Calibration)

Rotate the marking line of the home block to the fully aligned state, that is, the home position.

4.7.2 Mechanical Home Position Calibration of Each Axis

When re-calibrating the mechanical home position of each axis of the robot, operate the robot in the jog mode to make each axis of the robot run to the home position alignment mark of each axis, and then enter the home position information interface of the robot teaching box to record the coordinates of each axis. For the specific home position calibration method, please refer to the "ER Series Robot Operation Manual" provided by our company.

The mechanical home position distribution of each axis is as follows:

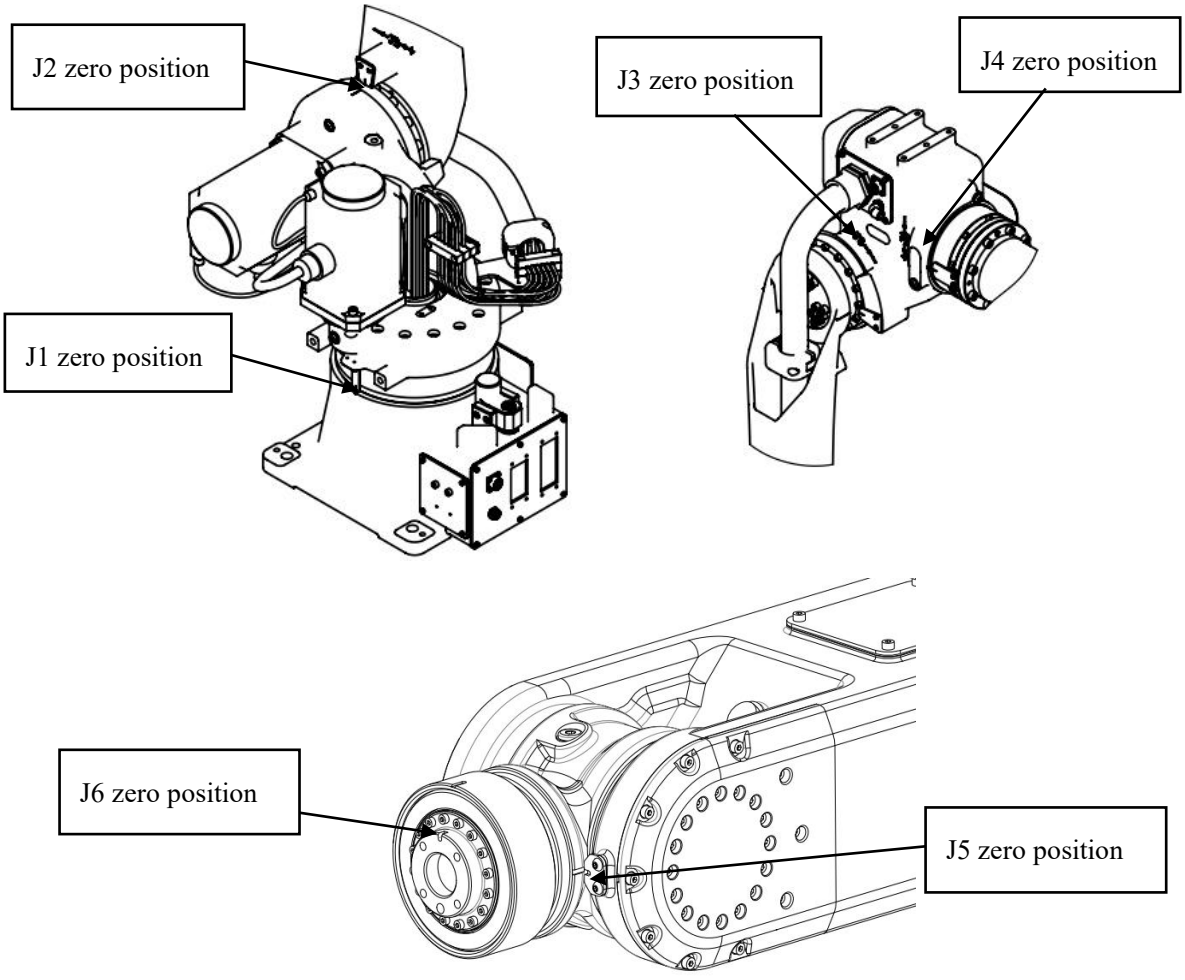


Fig.4-5 Robot Home Position Map

4.8 Battery Replacement

The home position data of each axis of the robot is saved by the encoder battery. Every 7860 hours or 2 years of operation (whichever is shorter), the battery should be replaced in time. The process is as follows:

Adjust the robot to the state of calibration (home position of each axis). To prevent danger, turn off the power supply, hydraulic pressure source and air pressure source connected to the robot.

Remove the rear cover of the robot base and remove the battery pack, as shown in Fig4-6.

Remove the old battery from the battery box and put the new battery into the battery box, paying attention to the positive and negative polarity of the battery. Reconnect the battery cable and fix the battery pack.

After installation, follow the steps to fix the rear cover of the base.

After ensuring that all safety conditions are met, perform the home position re-recording of the robot and the verification test of the related home position accuracy. For detailed steps, see the home calibration chapter in the "EFORT Industrial Robot Operation Manual".

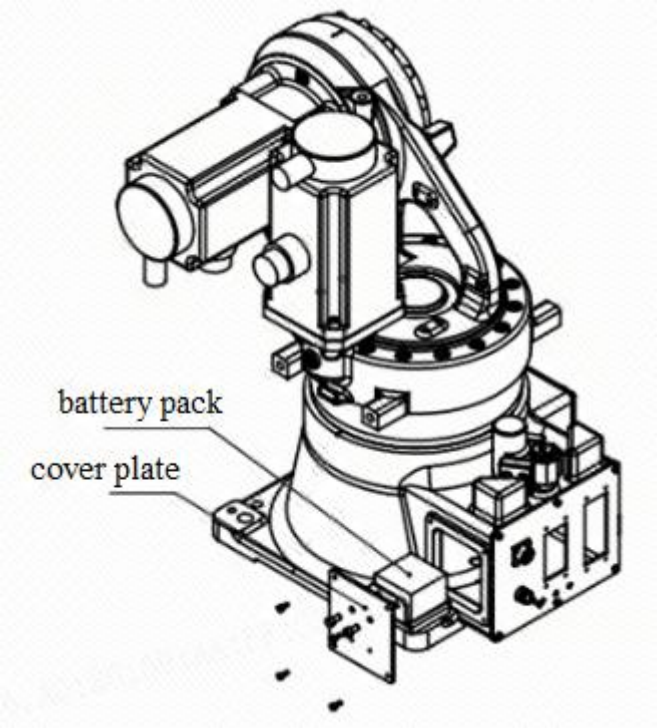


Fig.4-6 Robot Battery Pack Location Map

Chapter Five Common Faults and Treatment Measures

When the robot body fails, please refer to this chapter for initial fault diagnosis. The conditions listed below cover the common faults that may occur on the robot body, the analysis of the fault causes, and the corresponding handling measures, which can help users to troubleshoot common faults.

Fault	Fault classification	Possible cause of fault	Treatment measures
Vibration and abnormal noise	The base and the mounting base are not firmly fixed	（1）The flatness of the base and the installation base is not enough, or foreign matter is included, which makes it unable to fit tightly during installation; （2）When connecting the base and the installation base, the screws are not tightened, or the screws are loose after long-term operation.	（1）Check and trim the flatness of the base and the installation base to make the tolerance meet the installation requirements; （2）If there is a foreign object between the base and the installation base, please clean it and reinstall it firmly; （3）When tightening the screws, use a torque wrench to tighten with the required torque.
	The mounting base and the foundation are not firmly fixed	（1）The ground installation conditions do not meet the requirements, resulting in insufficient foundation rigidity; （2）The specifications and strength of chemical bolts do not meet the requirements.	Refer to the "3.2.3 Ground Installation" section of this manual to make the concrete foundation and chemical bolt set meet the installation requirements.
	The robot vibrates obviously in a certain posture or state	（1）The load exceeds the allowable value, resulting in insufficient stiffness in a specific posture, resulting in vibration; （2）Improper operating procedures and parameter settings can cause vibration.	（1）Reduce the load and ensure it is within the allowable range; （2）Modify the program and adjust the parameters, step by step from low speed to high speed, until the robot's action status returns to normal.
	The vibration and abnormal noise of the robot in the following three situations: （1）After the	These three conditions will cause damage to internal components (gears, bearings, reducers, etc.), resulting in vibration and abnormal noise.	（1）Check each axis of the single-action robot, and consult the after-sales service department of our company for replacement after confirming the damaged joint; （2）In the later operation process, try

	collision; （2）Long-term overload operation; （3）Long-term operation in the absence of maintenance.		to avoid collision and long-term overload operation, and regularly replace the Grease according to the maintenance requirements of this manual.
	The robot vibrates due to the influence of other equipment around the working environment	（1）Resonance occurs when the robot and peripheral equipment are running at the same time; (2) Electromagnetic interference to the robot when peripheral equipment is running.	(1) Try to adjust the distance between the robot and peripheral equipment; （2）Check the ground connection of the robot to ensure that the ground is effective.
	The abnormal noise of the robot in the following two situations: （1）When restarting after a long-term shutdown; （2）When starting operation after replacing the grease.	In these two cases, the robot will have running -in phase in the early stage of its operation.	（1）Run at low speed first, and gradually return to normal speed according to the improvement of noise; （2）If the noise situation does not improve after running at low speed for 1-2 days, the internal parts may be damaged. Please consult our after-sales service department for replacement.
	Other faults that may cause vibration and abnormal noise	（1）The connection cable between the robot body and the control cabinet is abnormal, resulting in unsmooth signal interaction and vibration; （2）Abnormal external voltage or electromagnetic environment interferes with the normal operation of the control cabinet, causing the robot to vibrate.	（1）Check whether the cable is damaged and make sure that the connector is in good contact; （2）Improve the external voltage or electromagnetic environment to ensure that the control cabinet can operate normally.
The robot body vibrates	When the power is turned off, some parts of the robot body can be shaken	The robot's long-term operation and possible abnormal operation conditions cause the	（1）Check whether the screw connections of the following connection parts are loose, including the reducer, motor connection screws,

	by hand	following conditions to cause shaking: （1）Loose screws at key connection parts; （2）Damage to internal parts of the robot, such as worn or damaged gears and bearings, resulting in a large backlash.	base and joint fixing screws, end flange connection screws, etc., use a torque wrench to tighten with the required torque; （2）If it can be determined that the parts are damaged, please consult our after-sales service department for replacement.
Motor overheated	The motor is overheated by the environment: （1）The temperature of the robot operating environment is high; (2) Motor is covered	Too high ambient temperature and covering the motor will affect the heat dissipation of the motor and cause overheating.	（1）Reduce the ambient temperature, if there is a heat source in the operating environment of the robot, increase the thermal insulation of protective clothing; (2) Improve the ventilation conditions around the motor.
	The motor is overheated due to improper operating conditions: （1）The parameters do not match; （2）Inappropriate program instructions; (3) The load exceeds the allowable value.	These three conditions will cause the motor to work in an abnormal state, the average current value increases, and overheating occurs.	Please set the parameters and program instructions reasonably according to the operation manual, and the load should be controlled within the allowable range.
	Other faults that may cause the motor to overheat	（1）The joints of the robot are abnormal, causing the motor to be overloaded and overheating; （2）Motor failure	（1）Check the state of the robot joints corresponding to the heating motors, including external interference and damage to internal parts. If there is any abnormality, contact the company's after-sales service department for repair and replacement; （2）Replace the motor. If the overheating is eliminated, the original motor has faults.
Joints cannot be locked	The robot’s joints fail to lock and cannot stay at the specified position, and will fall back under the	（1）Due to its own wear or circuit failure, the motor brake fails （2）Due to the failure of the seal, the lubricating oil	（1）If only the motor fails, replace the motor; （2）If it is observed that lubricating oil enters the motor and causes the brake to fail, it is necessary to find the cause of

	influence of gravity.	enters the motor brake, causing the brake to fail.	the seal failure, and then replace the motor after solving the seal problem.
Oil spill	Oil leakage of robot joints	(1)The joint parts are abnormal due to impact or long-term overload, including casting damage, O-ring wear, oil seal damage, etc.; (2) If the robot has undergone disassembly and reassembly, it is possible that the O-ring assembly is abnormal; (3) If the operating environment is bad, the joints of the robot lack protection, and the entry of dust particles will damage the oil seal; （4）Loose oil port plugs can also cause oil leakage.	（1）Check whether the relevant parts are normal, and replace them in time if they are abnormal; （2）Check and ensure that the O-ring is properly assembled; （3）If the working environment is bad, it is recommended to take necessary protective measures for the robot body; （4）Check the oil port plug to make sure it is tightened.
Shift command position	The robot repeat positioning accuracy is greater than the allowable value	（1）The position accuracy cannot be guaranteed due to loose screws and abnormal connection of the main body structure; （2）Due to impact or long-term overload, the joint position is shifted, and even parts are damaged.	（1）Tighten the screws and check the joint connection; （2）Adjust and restore the shifted joint position. If any parts are damaged, replace them in time.
	Position shift occurs when connecting peripheral devices	（1）The connection of the peripheral equipment is unstable, prone to position shift; （2）Peripheral equipment is subjected to environmental interference during operation, resulting in positional deviation.	Check the working environment and connection of the peripheral equipment to ensure that the connection is firm and there is no interference in the movement process.
	Position shift occurs after parameter modification	Modifying the parameters causes the robot zero point to be lost	Restore the previous parameters, or re-calibrate the zero point.

Shift command position	The robot repeat positioning accuracy is greater than the allowable value	（1）The position accuracy cannot be guaranteed due to loose screws and abnormal connection of the main body structure; （2）Due to impact or long-term overload, the joint position is shifted, and even parts are damaged.	（1）Tighten the screws and check the joint connection; （2）Adjust and restore the shifted joint position. If any parts are damaged, replace them in time.

	**After some parts of the robot body are removed, other parts may lose support, resulting in unpredictable movements and causing damage to personnel and equipment. Therefore, the replacement and maintenance of parts requires professionals to use professional tools to operate. If necessary, please contact our company's after-sales service department.**

Appendix

A Screw Tightening Torque Table

Screw 12.9 grade	Tightening torque (cast iron)	Tightening torque (cast aluminum)
M3	2±0.18	2±0.18
M4	4.5±0.33	4±0.33
M5	9.01±0.49	7.35±0.49
M6	15.6±0.78	12.4±0.78
M8	37.2±1.86	30.4±1.86
M10	73.5±3.43	59.8±3.43
M12	128.4±6.37	104±6.37
M14	204.8±10.2	180±10.2
M16	318.5±15.9	259±15.9

Note: Due to the special material of the motor flange, the tightening torque cannot be too large, please refer to the note in the table to add.

B Backup List

Table1 Servo Motor and Gear Whee

Name	Material code	Unit per robot	Remarks
servo motor	/	1	J1
servo motor	/	1	J2
J1 input gear	/	1	J1
J2 input gear	/	1	J2

Table2 Sealing Ring and Screw Plug, etc.

Name	Material code	Unit per robot	Application area
O-ring rubber seal	103*3.55	1	J1 axis servo motor，3 axis connection part
O-ring rubber seal	107.7*1.78	1	J2 axis servo motor
O-ring rubber seal	AS568-263	1	1、2 axis connection part
hexagon socket screw plug	M10x1	10	whole
combined sealing washer	10	10	whole

Table3 Sealant and others

Name	Model specification	Unit per robot	Application area
grease	MOLYWHITE RENO.00	According to refueling volume	
flat sealant	THREEBOND 1110F	1	
screw tightening agent	THREEBOND 1374	1	
detergent	THREEBOND 6602T	2	
thread sealant	LOCTITE577	1	

Revision History

Version	Date of Revision	Details of Revision	Reviser No.
V1.5.3	2024.11.29	1. Add Fig3-6 to mark the diameter of flexible cables such as power lines and encoder lines. 2. Add Fig3-13 Schematic diagram of IO interface and air path. 3. Modify the installation environment air pressure modification in Chapter 3.3; 4. Modify the description in Section 2.7. 5. Modification of document fonts, picture fonts and formats.	3596

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