ESTUN
ROBOTICS

OPERATION INSTRUCTIONS

ESTUN ER20-MI series Robot

Robot instruction manual

ALL MADE BY ESTUN

ESTUN AUTOMATION

ESTUN ER20-MI series robot

ROBOT INSTRUCTION MANUAL

M-0504EN-02

Thank you for using ESTUN robots

Before using the robot, be sure to read the SAFETY PRECAUTION and understand the content.

ESTUN endeavor to improve the products. All specifications and designs are subject to change without notice.

ln this manual, all statements, information and recommendations has been treated with care, but we are not able to guarantee total conformity. ESTUN assumes no responsibility for any direct or indirect losses arising from use of this manual.

Users must take full responsibility for any product they apply, and must use this manual and product with care.

The interpretation of all contents of this manual belongs to Nanjing ESTUN Robotics Engineering Co., Ltd.

Service Line: 400-025-3336
ADD: NO. 1888, Ji Yin Avenue, Jiang Ning Area, Nanjing, China Post Code: 211102
TEL: 025-85097068
WEB: www.estun.com
E-mail: robot@estun.com

SAFETY

This chapter describes the precautions which must be followed to ensure the safe use of the robot. Before using the robot, be sure to read and understand this chapter thoroughly.

ESTUN robots must be transported, mounted and operated in accordance with the applicable national laws, regulations and standards. Appropriate safeguards must be correctly situated to protect the users. Before using (mounting, operating, maintaining, repairing) the robot, be sure to read and understand this manual and its relevant manuals. Be sure to have familiarization with the knowledge of robot system and the safety precaution. Even if all instructions are followed, this is not a guarantee that the robot will not cause personal injuries or material damage.

DEFINITION OF USER

The personal can be classified as follows

- Operator
  Turns the robot controller power on/off.
  Starts the robot program from operator panel.
- Programmer
  Operates the robot.
  Teaches the robot inside the safety zone.
- Maintenance engineer
  Operates the robot.
  Teaches the robot inside the safety zone.
  Maintenance (repair, adjustment, replacement)

Operator is not allowed to work in the safety zone.

Programmers and maintenance engineers can work in the safe area.

During the operation, programming, and maintenance of the robot system, the programmer, operator and maintenance engineer should take additional care of their safety by wearing the following safety items.

- Adequate clothes for operation
- Safety shoes
- A helmet

SPECIAL TRAINING

Tasks in the safety zone including transportation, teaching, calibrating, repairing, etc.

Have the operator attending the training courses before using the robot system.

For more information on training, please consult Nanjing ESTUN Robotics Engineering Co., Ltd.

SAFETY NOTATIONS

If the contents of the following symbols appear in this manual, the user must read them carefully and strictly abide by them.

Symbol	Definitions
DANGER	**Danger notation** Death or serious injury will be expected to occur if the user fails to comply with the instructions that follow this sign
CAUTION	**Caution notation** Equipment damage or personal injury will be expected to occur if the user fails to comply with the approved procedure.
INFO	**Information** A supplementary explanation help users operating the robot more efficiently.

SAFETY OF THE USER

(1) The robot should be transported and installed by accurately following the procedures recommended by ESTUN. Wrong transportation or installation may cause the robot to fall, resulting in severe injury or damage.

(2) Draw an outline on the floor, clearly indicating the range of safety zone before install the robot. If necessary, install a safety fence or warning board to ensure the safety operation of the robot and keep unauthorized person outside the safety zone.

(3) Never hang any items above the robot. Failure to observe this caution may result in injury or equipment damage.

(4) Never lean on the controllers, and avoid inadvertently pushing buttons. Failure to observe this caution may result in injury or damage by unexpected movement of the manipulator.

(5) Take precaution for falling parts when disassemble the robot.

(6) When adjusting each peripheral equipment independently, be sure to turn off the power of the robot.

(7) The peripheral equipment must be grounded.

(8) In the first operation of the robot after installation, the operation should be restricted to low speed. Then, the speed should be gradually increased to check the operation of the robot.

(9) Operators should be ungloved while manipulating the operator panel or teach pendant. Operation with gloved fingers could cause an operation error.

(10) Programs, system variables, and other information can be saved on memory card or USB memories. Be sure to save the data periodically in case the data is lost in an accident.

(11) Never forcibly move the robot axes. Failure to observe this caution may result in injury or equipment damage.

(12) Take precaution when wiring and piping between the controller, the robot and the peripheral equipment. Run the piping, wiring, or cables through a pit or use a protective cover, so that they are not stepped on by personnel or run over by forklift.

(13) Any robot in working condition may cause severe personnel injury or equipment damage due to unexpected moving. Test must be performed on each safety measure (safe door, brake, safe indicators, etc.). Before turn on the system, make sure that no one is in the working space.

(14) Never set motion range or load condition that exceeds the range indicated in specification table. Incorrect setting may result in personnel injury and equipment damage.

(15) Observe the following precautions when performing teaching operations within the working space of the robot:

- Do not enable the system unless the mode is switched to manual, and make sure that all auto-control is cut off.

- Speed must be limited under 250mm/s at manual mode. Only authorized person with fully understand of the risks can adjust the robot to rated speed manually.
- Be careful about rotating joints to prevent hair and clothes involved. Take precautions of injury or damage caused by the manipulator or other auxiliary devices.
- Check the motor brake to avoid personnel injuries caused by unexpected situation.
- Always have an escape plan in mind in case the robot comes towards you unexpectedly.
- Ensure that there is a place to retreat to in case of emergency

DANGER	**Never stand beneath the manipulator in case that the robot moves unexpectedly or the system be turned on inadvertently.**

CAUTION	**Make sure that a CO2 fire extinguisher is always available in case of fire.**

SAFETY OF THE OPERATOR:

(1) Before operating the robot, press the EMERGENCY STOP on the front door of the electric cabinet and the upper right of the teaching pendant to check whether the indicator light of “SERVO ON” is off and confirm that power supply is turned off.

(2) Never allow unauthorized personnel to touch the controller during operation. Failure to observe this precaution may result in unexpected movement of the robot, severe injuries and material damage.

(3) When attaching a equipment to the robot, be sure to turn off the power of the controller and the peripheral equipment, and display a warning sign. Turning the power on during equipment installation may cause electric shock or injury due to unexpected movement of the robot.

(4) Emergency stop

Emergency stop is an external button of the controller that can stop all the robot operation.

When emergency button is pressed, the power of the robot (except the power of the servo) is cut off. The system will not run unless the pressed emergency button being released and the system being turned on

	**There may be several emergency stop buttons in a robot system to stop the robot in case of emergencies. The red button, as shown in the left figure, shall be mounted on the teach pendant and the controller. Certainly, the emergency buttons can be mounted by your requirement.** **Emergency stop button shall be located on the place where is easy to reach, so that the buttons can be pressed down immediately in case of emergencies.**

DANGER	**Operators must take precautions to avoid high voltage from cables of servo motors, grippers and other devices.**

CAUTION	**Emergency button is used in case of emergency only. It cannot be used to stop the manipulator for normal operation.**

SAFETY OF THE PROGRAMMER:

While teaching the robot, the programmer must enter the robot operation area. The programmer must ensure the safety especially.

CAUTION	**Turn on or off the system by press or release Mot button on the teach pendant.**

To use the teach pendant safely, the following precautions should be taken:

- Be sure that the enable switch is effective at any time.
- Enable switch must be turned off when pausing, programming or testing the system.
- Teach pendant must be taken with the programmer when performing teaching jobs in the work space, to avoid inadvertent operation by unauthorized person.
- Teach pendant must not be left within the work space of the robot, as injury or damage can occur if the robot comes in contact with the teach pendant.

SAFETY OF THE MAINTENANCE:

(1) Pay attention to the parts that are prone to heat in the robot

Some parts of the robot are heated when the robot is operating, especially the servo motor and reducer. If a maintenance user needs to touch such a part in the heated state, the user should wear heat-resistant gloves or use other protective tools

CAUTION	**Try to feel the temperature of heated parts before touching them, to avoid burn injuries. After turning off the power supply, wait until the heated parts cool down before performing any maintenance**

(2) Safety Precautions for Disassembling Parts

Open the cover or shell only after interior parts such as gears are not moving any more. Never open the cover or shell when the gear or bearing is moving. Use auxiliary device to keep interior part to its position.

Observe the following precaution when performing the first test after installation, inspection or maintenance:

a) Clear tools to proper locations outside of the working space of the robot.
b) Make sure that all precaution measures are available.
c) Make sure that there is no one in the working space of the robot.
d) Pay special attention to working condition of the maintenance parts when performing test.

Never use the manipulator as a ladder when performing maintenance. Never climb on the robot to avoid falling.

(3) Safety Precautions Regarding Pneumatics/Hydraulics

There may be air/liquid residue in the system when the air pump or hydraulic pump is turned off. Before checking the pneumatic or hydraulic parts, release remaining pressure from the system to avoid personnel injury or equipment damage.

CAUTION	**Install a safety valve in case of accident.**

(4) Although the power supply needs to be turned on for fault diagnosis, be sure to turn off the power supply and disconnect other power connections when servicing the robot.

(5) Brake detection

Brake may be wearing in daily operation. So brake inspection should be performed by the following procedure:

a) Move each joint to the position where the joint bears maximum load.

b) Turn off the robot. The brake works.
c) Mark each joint.
d) Check if the joint moves over a period of time.

(6) Safety precautions when adding lubricating oil

Personnel injury or equipment damage may occur during greasing. Observe the following precautions before greasing.

- Take additional care of safety by wearing safety items (such as gloves) to avoid injury from heated oil or reducer.
- Open the oil chamber with special caution and keep away from the opening. Oil may spray due to oil pressure.
- Feed the oil according to required quantity and never fill up the oil chamber. Check the oil indicator when finished.
- Never mix different types of oil into one reducer. Clean remained oil thoroughly before changing another type.
- Oil draining must be performed thoroughly. Check the oil indicator when finished.

INFO	**Operate the robot for a short period of time before oil draining to heat the oil.**

SAFETY OF THE TOOLS AND PERIPHERAL

Peripheral device may still be running even after the system has been turned off. Personnel injury may occur due to damaged power lines.

ROBOT SAFETY

For abnormal or emergency situations, e.g. persons trapped in or pinched by the robot, the robot axes should be moved. (Contact ESTUN for more details about dismantling).

Small robotic arms can be removed manually, but larger robots require a crane or other small equipment. Before releasing the joint brake, the mechanical arm must be fixed first to ensure that the mechanical arm will not cause secondary injury to the trapped person under the action of gravity.

STOP TYPE OF ROBOT

The following three robot stop types exist:

Power-off stop

Servo power is turned off and the robots stops immediately. Servo power is turned off when the robot is moving, the path of the deceleration in uncontrolled.

The following processing is performed at Power-off stop:

- An alarm is generated and servo power is turned off immediately
- Pause the running program

Frequent Power-off stop of the robot during operation can cause failures of the robot. System configurations in which a power outage stops under normal circumstances should be avoided.

Alarm stop

This is a robot stop method that decelerates the movement of the robot to a stop with a control command after the robot system issues an alarm (except for a power failure alarm).

By controlling the stop, the following processing is performed:

- An alarm (not include power-off alarm) is generated due to overload, system faulty, etc.
- The servo system issues a “control stop” command, decelerates to stop the robot, and suspends the execution of the program.
- Disconnect the servo power.

Hold

The robot is decelerated until it stops, and servo power remains on.

The following processing is performed at Hold:

- Decelerates the motion of the robot to a stop, and suspends the execution of the program.

Warning and caution labels

(1) Electric shock warning sign

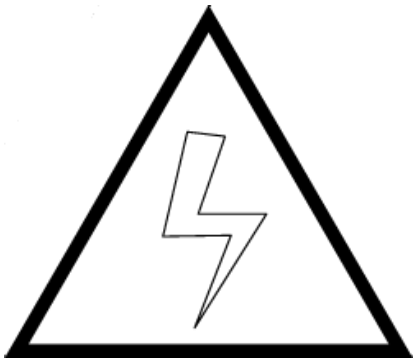


Fig 0.1 Electric Shock Warning

This label indicates hazardous voltage or electric shock.

(2) High-temperature Warning

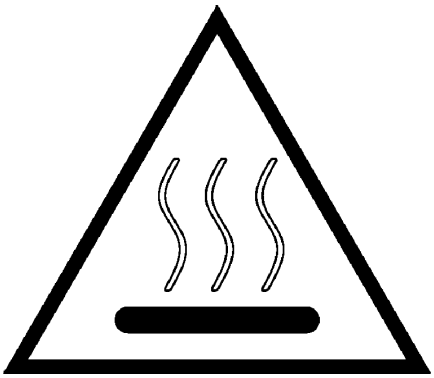


Fig 0.2 High-temperature Warning

The area where this label is attached will heat up, so be careful. Wear heat-resistant gloves and other protective equipment when you must touch the device in a hot state.

(3) No Step-on Warning

Fig 0.3 No Step-on Warning

Do not put your feet on the robot or climb on it. Stepping on it will cause adverse effects on the equipment and may also cause injury to the operator.

(4) Personal injury warning

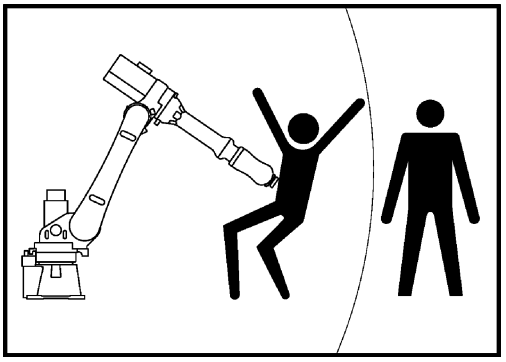


Fig 0.4 Personal injury warning sign

There is a risk of being injured by the robot when working within the robot's motion range.

(5) Disassembly is prohibited

Fig 0.5 Disassembly is prohibited

The parts with this mark are not allowed to be disassembled by the user. Disassembly should be carried out by professionals using professional tools.

(6) Transport Position Label

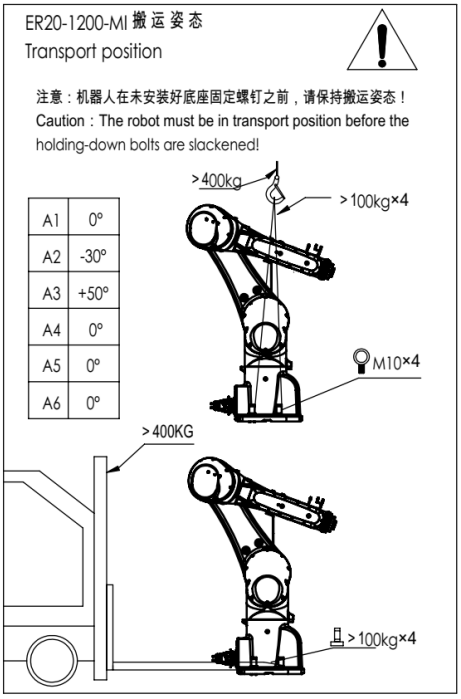


Fig 0.6 Transport Label（ER20-1200-MI）

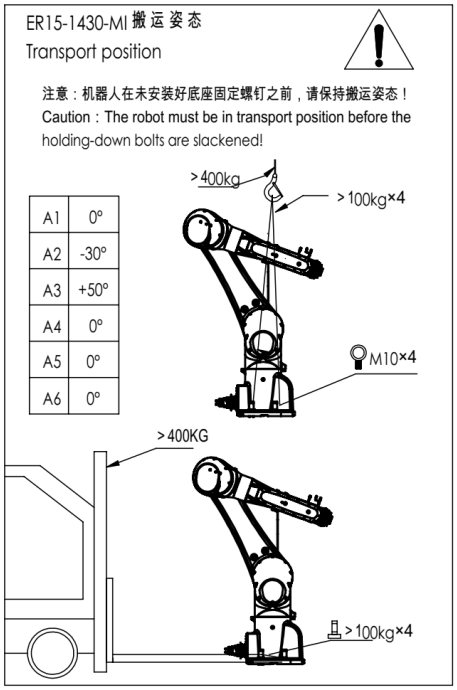


Fig 0.7 Transport Label（ER15-1430-MI）

PREFACE

This manual describes the following manipulators:

Name	Load Capacity
ER20-1200-MI	20kg
ER15-1430-MI	15kg

Related manuals

ESTUN Robot ER20-MI Series User Manual
ESTUN Robot C2E Control Cabinet Operation Instructions
ESTUN RCS2 System User Manual

CONTENTS

1 TRANSPORTATION AND INSTALLATION

1.1 TRANSPORTATION

DANGER	**When handling the robot, ensure that the robot is safe and reliable, otherwise it will cause damage to the robot or personal injury.**

Turn each axis to transportation gesture before move the robot and be sure to keep the gesture during transportation until it be properly installed and mounted. Transportation gesture of each axis is shown below. Refer below perform the transportation properly, or it may result in personnel injury or equipment damage.

Angle	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
ER20-1200-MI	0°	-30°	+50°	0°	0°	0°
ER15-1430-MI	0°	-30°	+50°	0°	0°	0°

When installing, disassembling and transporting the robot, the weight of the robot is an important parameter. The following table lists the theoretical weight of the main parts of the robot.

Part name	Weight (kg)	
	ER20-1200-MI	ER15-1430-MI
Robot	148	155
Big arm assembly	13.6	17.4
Base assembly (Including rotation base)	83.4	83.4
Motor base assembly (Including J4-axis motor)	26.6	28.9
Forearm assembly (Including wrist and J5&J6-axis motors)	17.2	17.2

INFO	**Some parts with less weight are not listed. Contact ESTUN if you need the details.**

When the robot is transported, it is necessary to install the fixing bracket and the protective pad. Before installing the robot, remove the fixing bracket and protective pad. The following chart lists the screw hole size of the fixing bracket and the position of the protective pad, which is convenient for users to disassemble.

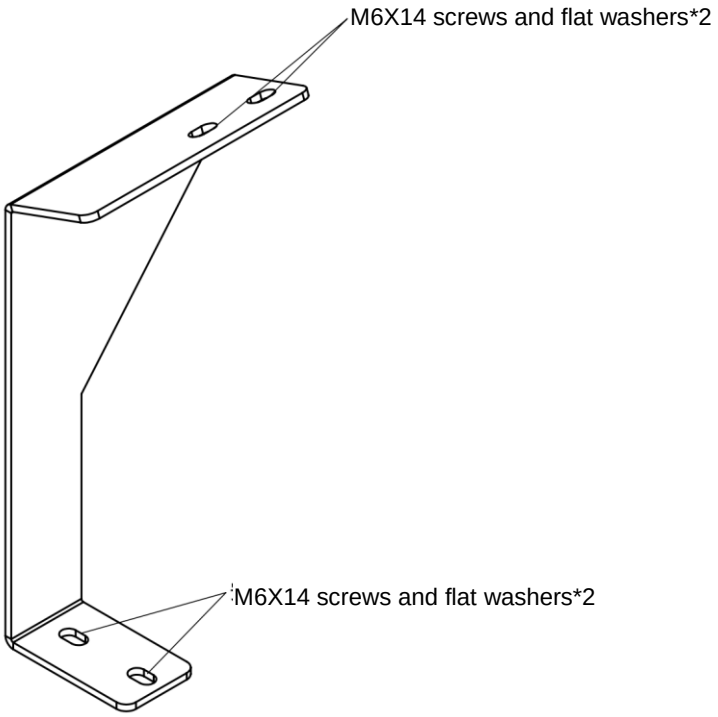


Fig 1.1 Robot fixing bracket (ER-1200-MI)

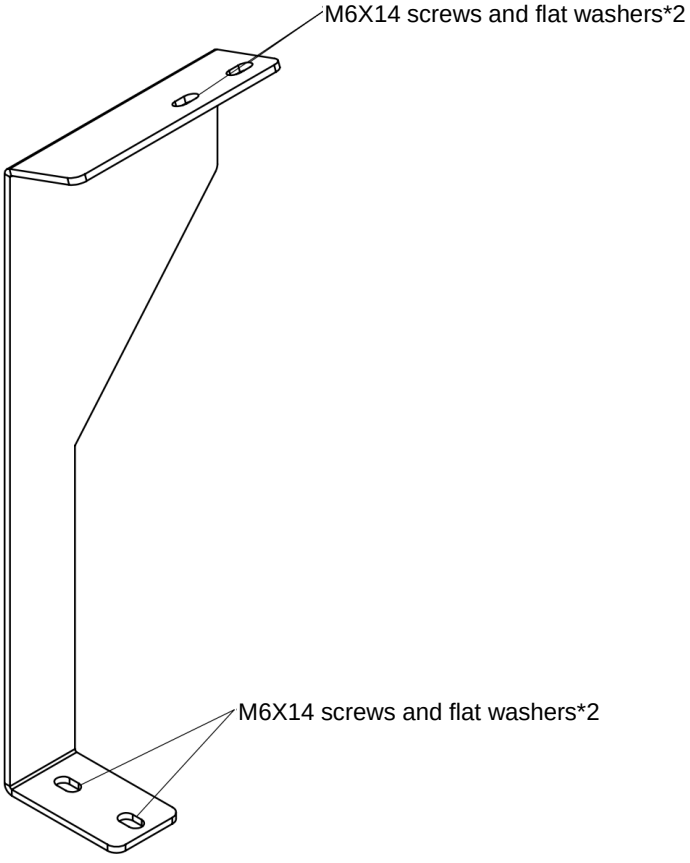
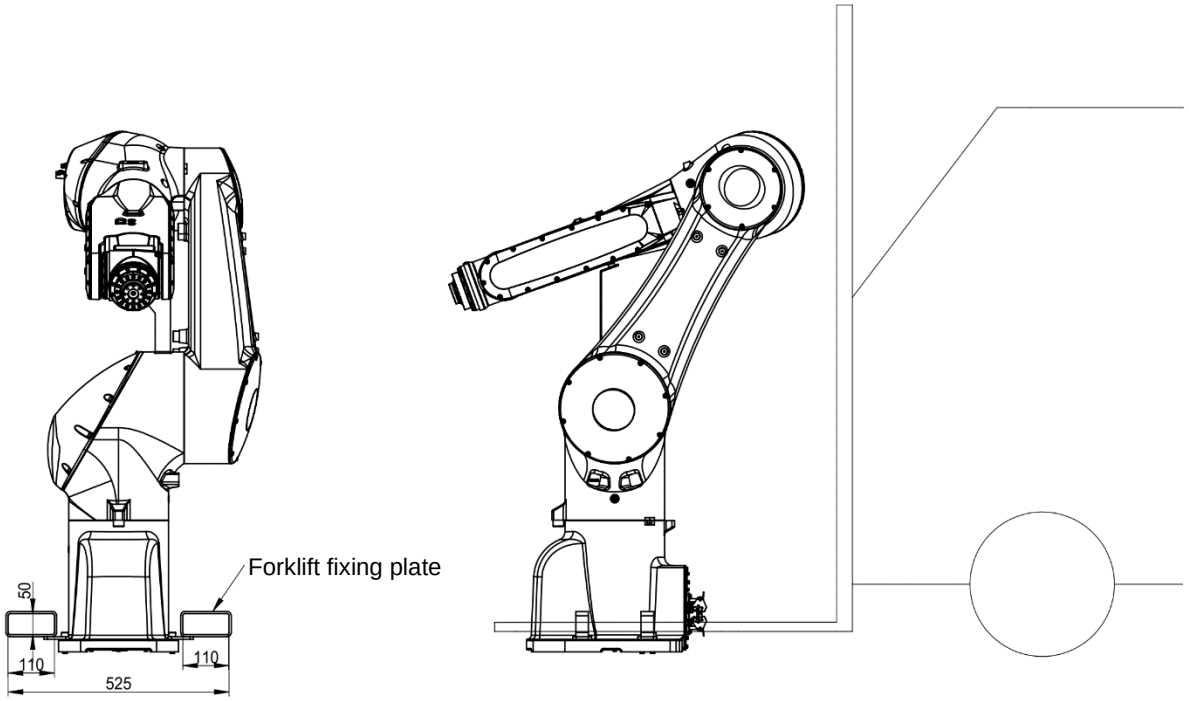


Fig 1.2 Robot fixing bracket (ER15-1430-MI)

1.1.1 Transport by a forklift

This series of robots can be handled by forklift. As shown in the figure, the forklift fixing plate is mounted on the robot base with screws respectively before handling, and the forklift is forked into the fixing plate for handling; it is necessary to make sure that the fixing bolts of the robot are all removed before handling the robot.



CAUTION

Forklift fixing plate and screws are optional by the customer.

Handling conditions: Forklift can handle weight 400kg, 4 pieces of forklift fixing plate, hexagonal screws in accordance with GB/T70.1-2000 standard.

Fig 1.3Robotic forklift handling diagram

1.1.2 Transport by a crane

This series of robots can also be handled by crane. Attach the eyebolt to the robot base and lift it up with a sling. In this case, please make the slings crosswise as shown in the drawing, and protect the contact part of the slings with the robot body accordingly to prevent the paint from being scratched.

> CAUTION
>
> **The eyebolts are standard, and the slings are provided by the customer.**
>
> **Handling conditions: the crane can handle weight of 400kg, the sling can handle weight of 400kg, the sling ring conforms to ISO 3266:1984 standard.**

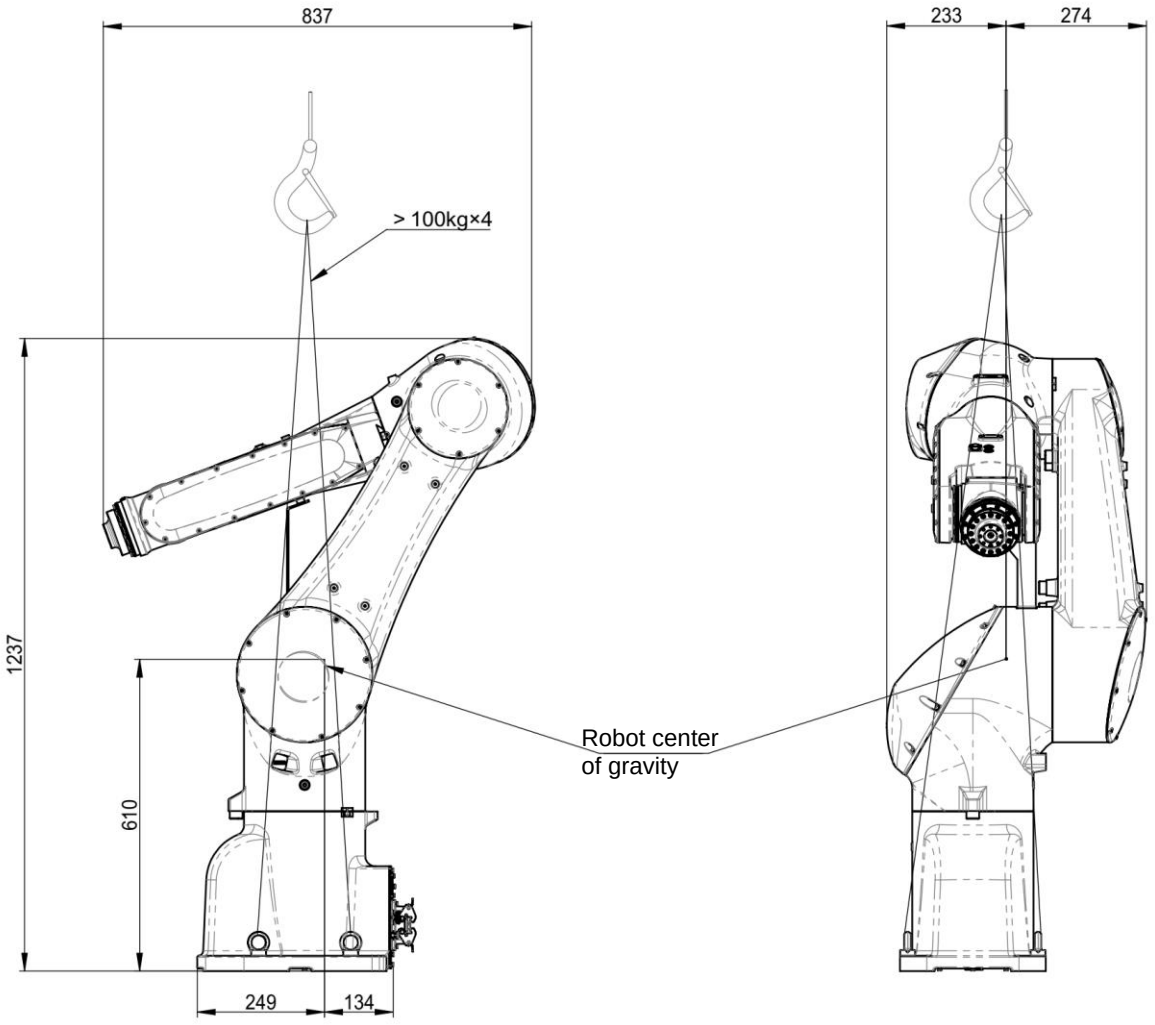


Fig 1.4 Robotic crane handling diagram (ER20-1200-MI)

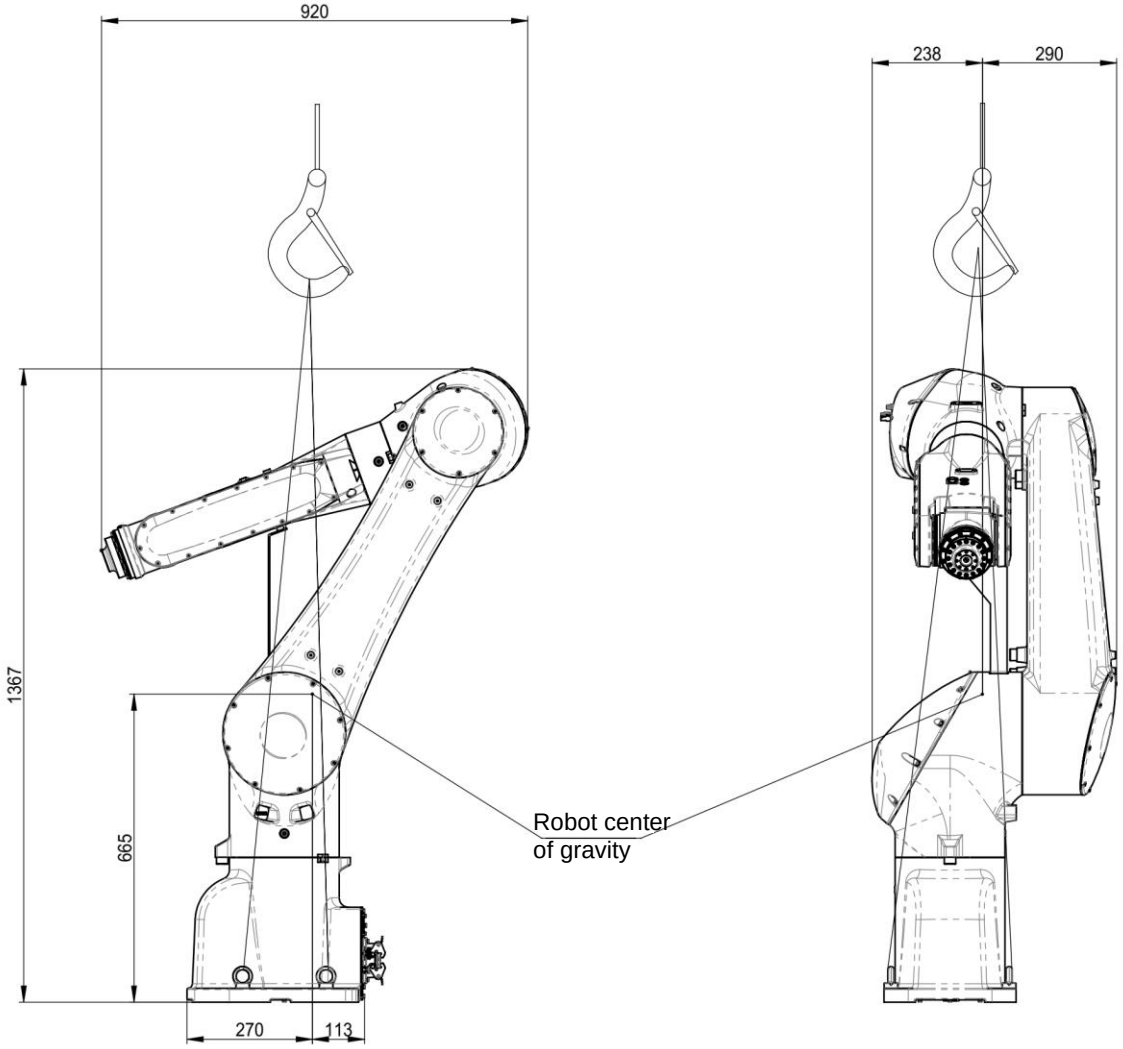


Fig 1.5 Robotic crane handling diagram (ER15-1430-MI)

1.2 INSTALLATION

> CAUTION
>
> **When performing installation with the system power on, make sure the earth wire is properly connected.**

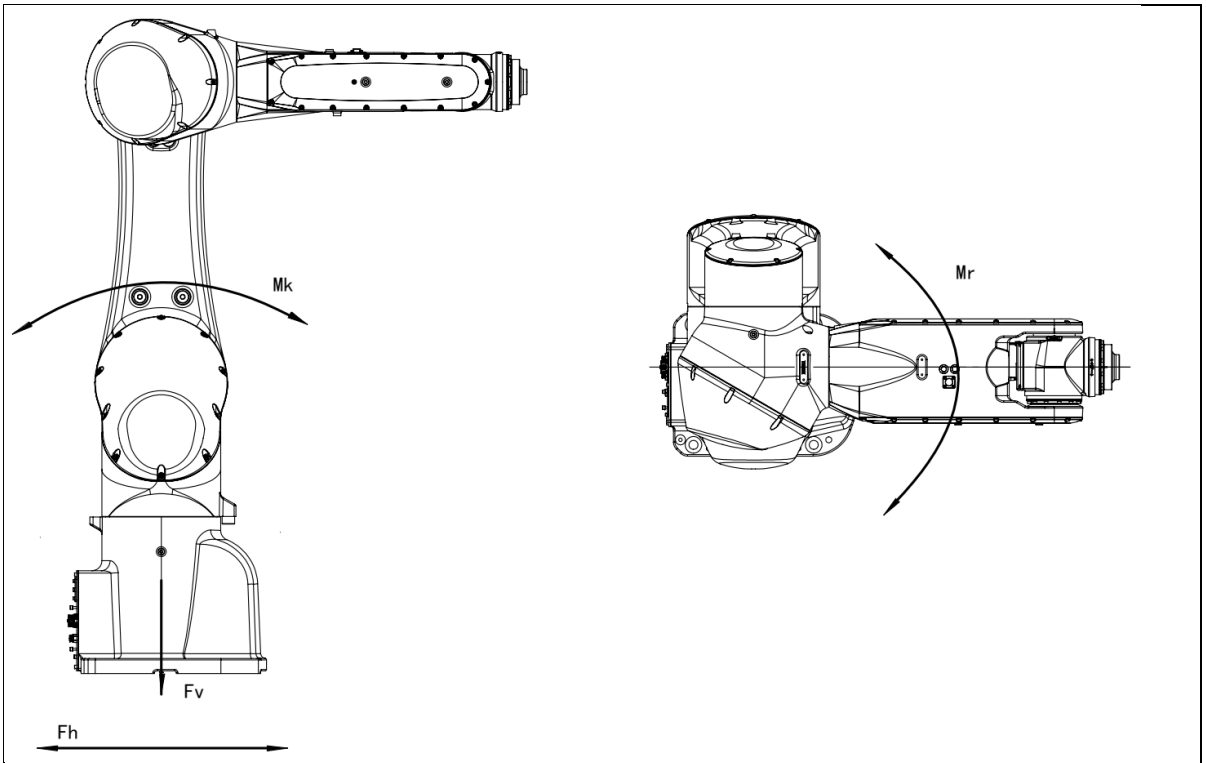
The following precautions must be fully understood and observed before installing the robot:

- Be sure to read and understand INSTRUCTIONS FOR SAFE USE chapter thoroughly.;
- Ensure that the robot is installed by a qualified installer, and the installation procedures must comply with local legal regulations;
- Check the external damage of the robot package. Open the package and check the external damage of the robot;
- Make sure that the lifting equipment can bear the weight of the lifting robot parts when installing the robot. Details see Section *1.1 TRANSPORTATION.*
- Storage and mounting condition should be complied with Section *1.3 INSTALLATION CONDITION.*

CAUTION

When mounting the robot base, consider its structure and the force upon it. Concrete on the base may not have any crack and conform to the specified codes. The bearing capacity and compaction of the concrete foundation shouldbe in accordance with the design guideline. Concrete strength level C20/C25 should be in accordance with the following codes:

- **GB50010-2010 *Code for design of concrete structures***
- **ISO 1920:2007 *Standard for test method of mechanical properties on ordinary concrete***



Item	Definition	Maximum value	
		ER20-1200-MI	ER15-1430-MI
Mk	Maximum overturning force	9800（N·m）	9800（N·m）
Mr	Maximum torsional force	3675（N·m）	3675（N·m）
Fv	Maximum vertical force	8000（N）	8250（N）
Fh	Maximum horizontal force	5100（N）	4500（N）

Fig 1.6 Force data of robot base

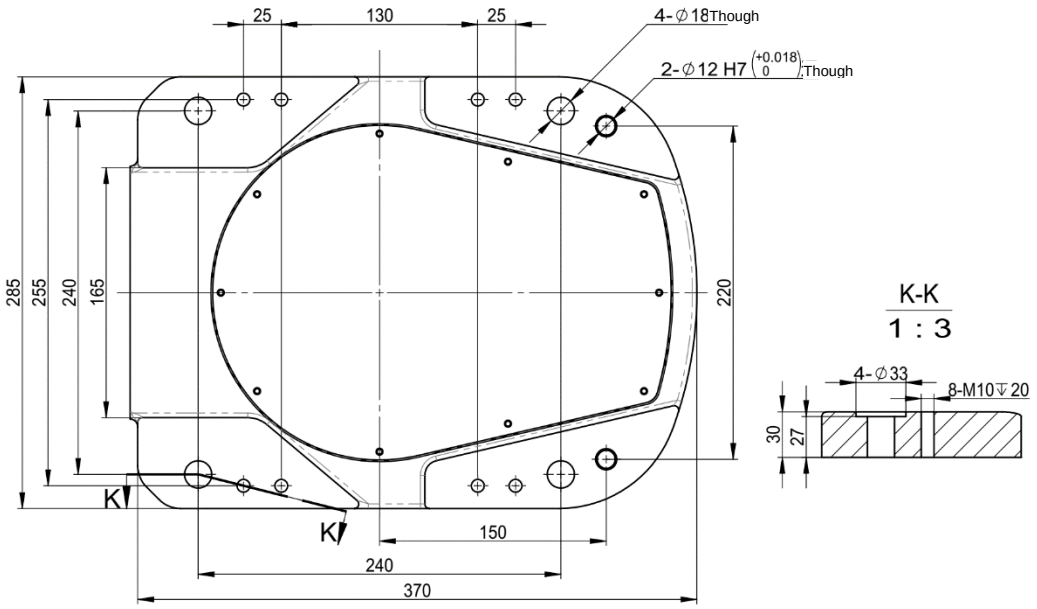


Fig 1.7 Robot base installation dimensions

CAUTION

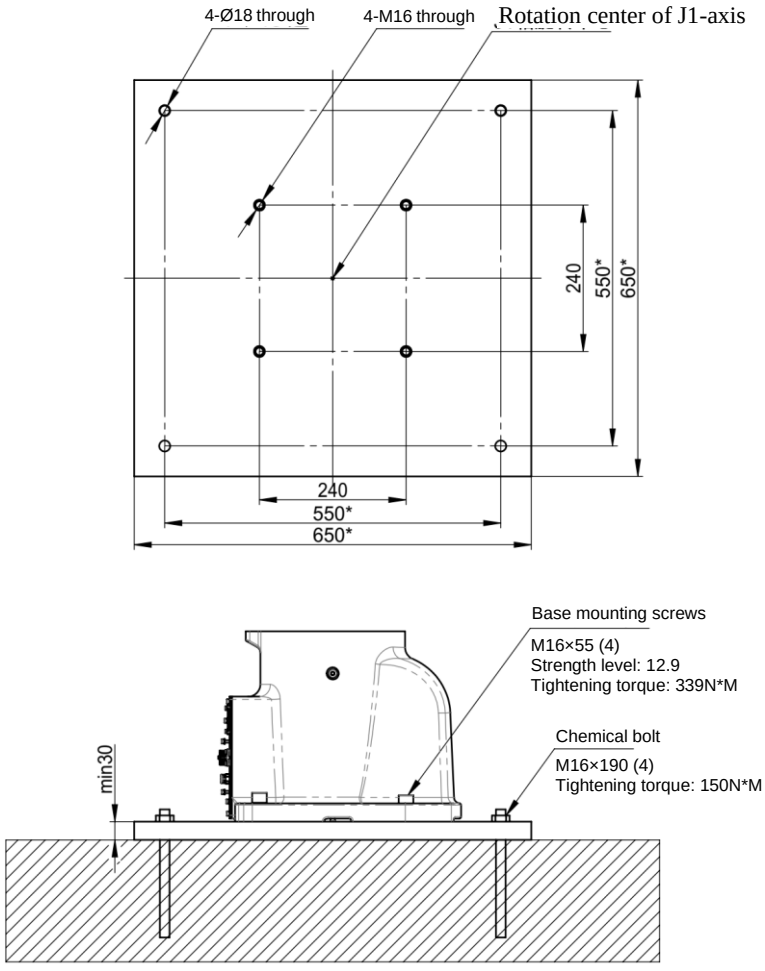
If necessary, it can also be fixed using the 8-M12 threaded holes in the base.

Tab 1.1 Required parts for fixing

Item and model	Amount
Fixed screw: M16X55 (ISO4762 level 12.9)	4
Spring washer: Spring washer 16 (DIN 7880-1987)	4
Positioning pin:Cylindrical pin 12X45 (ISO 8735)	2

INFO

Positioning pin can reduce the influence on current program caused by reinstallation or replacement of the robot. If the recovery of programmed path is needed, perform a fine adjustment. If not, the mounting of positioning pin can be eliminated



Note: use four M16x190 chemical bolts to fix the mounting plate on the concrete floor. The thickness of the concrete should be no less than 160mm, effective area no less than 1000mmx1000mm. Fix the robot base with parts shown in the table above. The dimension with a * is recommended. A strict calculation based on the force upon the base and the structure of the base must be performed before any change of these dimensions.

Fig 1.8 Robot installation iron plate size

1.3 INSTALL CONDITIONS

> CAUTION **Damage of the cable jacket can cause water intrusion. Take care when installingthe cable and exchange if it is damaged.**

Foundation	
Maximum surface unevenness	0.5mm
Maximum inclination angle	5°
Storage condition	
Minimum ambient temperature	-25℃
Maximum ambient temperature	+55℃
Maximum humidity	95%RH
Protection level	
ER20-1200-MI	IP67
ER15-1430-MI	

Performance of resistant chemicals and resistant solvents are as follows:

(1) The following liquids may cause deterioration or corrosion of the rubber parts (seals, oil seals, O-rings, etc.) on the robot, so please do not use them. (Except for products approved by our company)
   (a) Organic solvent
   (b) Chlorine-based and gasoline-based cutting fluids
   (c) Amine-based cleaning agent
   (d) Acid, alkali and liquid causing rust
   (e) Other liquids or solutions, that will harm NBR or CR rubber

(2) When using the robot in an environment where liquid such as water splashes on the robot, pay sufficient attention to the drainage of the base. If the drainage is insufficient and the base is frequently flooded with water, it will cause the robot to malfunction.

(3) Do not use cutting fluid or cleaning fluid with unknown properties.

(4) The robot cannot be immersed in water for a long time, or used in an environment that is easily wet. For example, in the case of an exposed motor, if the motor shows that it has been wet for a long time, the liquid can penetrate into the motor and cause a failure.

2 CONNECTION WITH THE CONTROLLER

Connection cable between robot and control unit. Connect each cable to the connector on the back of the chassis.

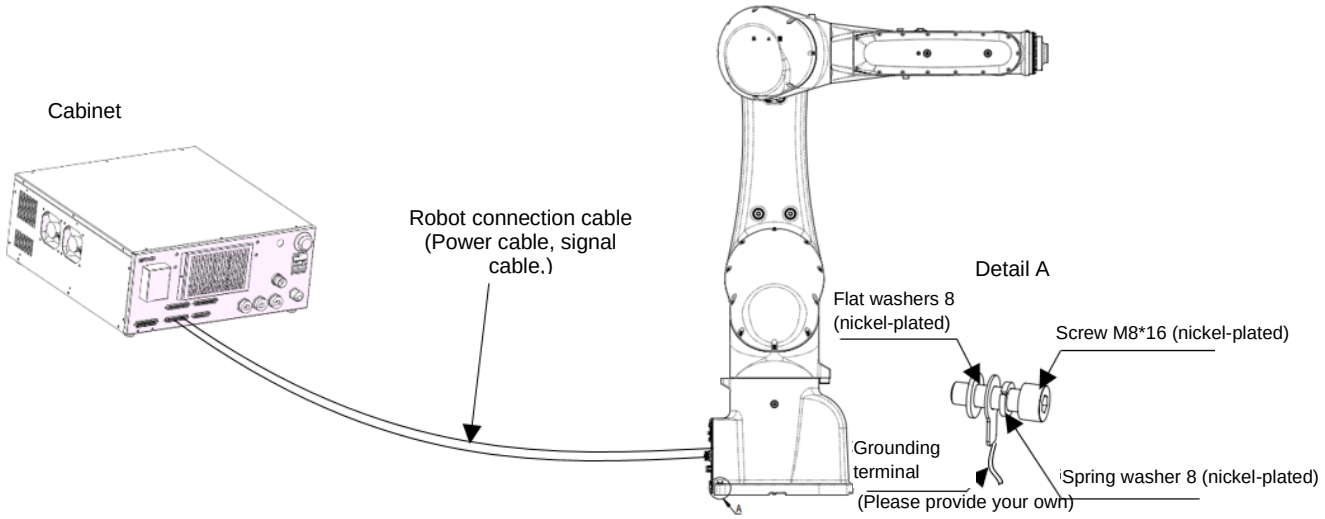


Fig 2.1 Cable connection diagram

CAUTION

- **The robot body serial number must match the control cabinet serial number. Incorrect serial number matching will result in robot accuracy deviations.**
- **The robot body needs to be grounded by the user, and the user should use a grounding wire to ground the robot body well. There is a risk of electric shock if the earth wire is not connected.**
- **The earth wire should be installed between the flat washer and the elastic washer. There is a small amount of antirust oil in the robot's grounding position, so please clean it well before grounding. It is recommended that the core diameter of the grounding wire be 5.5mm² or more, and that the size of the grounding wire terminal be noted (inner diameter greater than 8mm, outer diameter less than 18mm).**

3 PRODUCT SPECIFICATIONS

3.1 ROBOT STRUCTURE

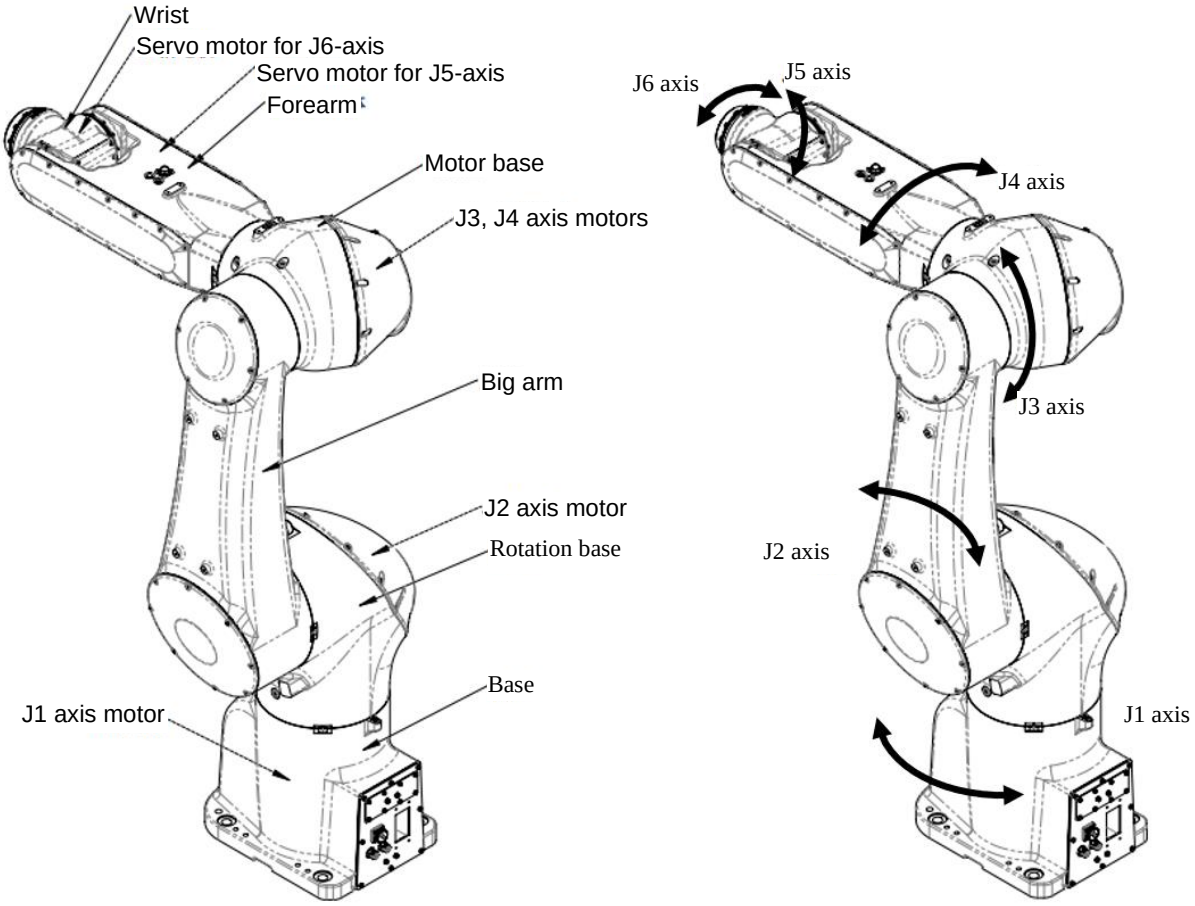


Fig 3.1 Robot structure

Tab 3.1 Robot specification table

Model		ER20-1200-MI	ER15-1430-MI
Type		Articulated robot	
Number of control axes		6 axes (J1, J2, J3, J4, J5, J6)	
Installation		Floor/Ceiling	
Range of motion	J1 axis	±170°	±170°
	J2 axis	±140°	±140°
	J3 axis	-250°~ +70°	-250°~ +70°
	J4 axis	±210°	±210°
	J5 axis	±130°	±130°
	J6 axis	±360°	±360°
Maximum action speed	J1 axis	270°/s	270°/s
	J2 axis	250°/s	250°/s
	J3 axis	380°/s	380°/s
	J4 axis	520°/s	520°/s

(Note 1)	J5 axis	450°/s	450°/s
	J6 axis	700°/s	700°/s
Max. payload	Wrist	20kg	15kg

Allowable load inertia at wrist	J4 axis	2.05 kg·m²	1.45 kg·m²
	J5 axis	2.05 kg·m²	1.45 kg·m²
	J6 axis	1.33 kg·m²	0.94 kg·m²
Allowable load torque at wrist	J4 axis	47.9 N·m	34.2 N·m
	J5 axis	47.9 N·m	34.2 N·m
	J6 axis	20.5 N·m	14.5 N·m
Drive mode		Electrical servo drive with AC servo motor	
Pipe		2φ8mm pneumatic tubes：0.59Mpa(6kgf/cm2:86psi)	
Repeatability		±0.03mm	±0.03mm
Reach		1200mm	1430mm
Installed wire		12-pole snap-in connectors WY20J12TU	
Weight		148kg	155kg
Input power		Single phase AC3800V±10%50Hz	
Digital IO		small arm: 12 pole; base plate: 12 pole	
Cables		5m	
Installation conditions		Ambient temperature: 0～45℃ (Note 2） Ambient humidity: 20~80%RH Height: Below 1000m above sea level Vibration acceleration:4.9m/s² (0.5G) or less There should be no corrosive gas (Note 3)	

(Note 1) The maximum speed of each axis may not be reached during short-distance movement. The maximum motion range of each axis is measured when the robot is in the zero position, and the actual motion may be limited by the positions of other axes.

(Note 2) When the robot is used in a low temperature environment close to 0°C, or when the robot is stopped for a long time in an environment below 0°C on holidays or at night, immediately after the start of operation, the moving parts The resistance is great, and a collision detection alarm may occur. In this case, a few minutes of warm-up operation is recommended.

(Note 3) Please consult our company when using in environments with high temperature and low temperature, vibration, dust, cutting oil, etc. with high concentration.

Tab 3.2 Power Source Consumption Table

Robot status	**ER20-1200-MI**	**ER15-1430-MI**
Disable on zero position	0.20KW	0.22KW
Enable on zero state	0.41KW	0.42KW
Full load and full speed operation	1.43KW	1.23KW

Note: The moving trajectory space is 400×800×400mm, as shown in Fig 3.2:

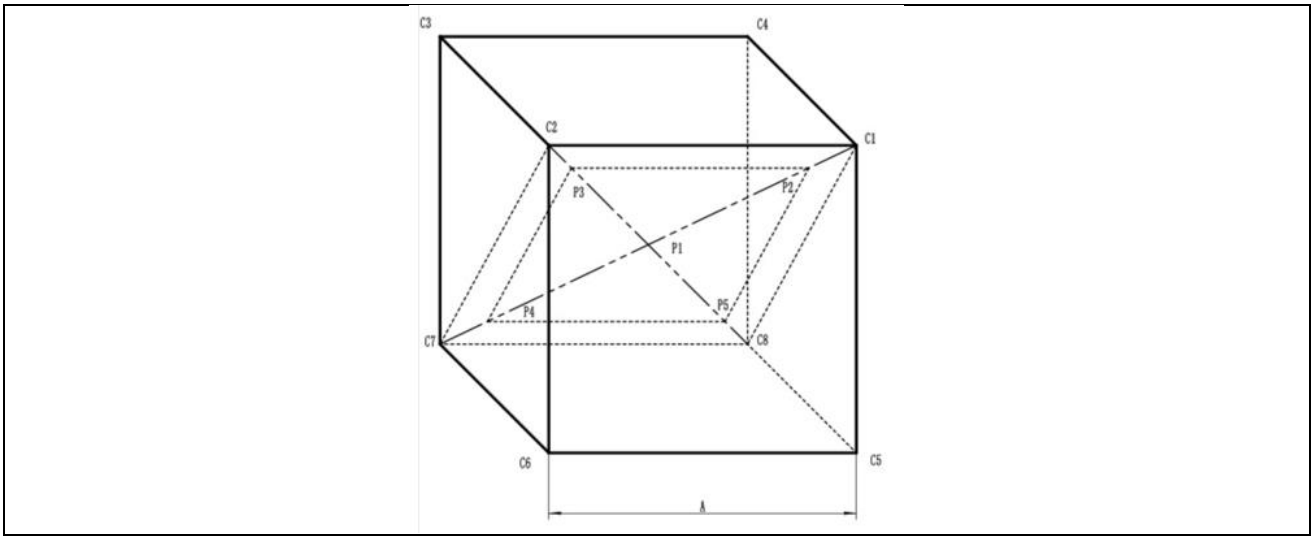


Fig 3.2 Movement trajectory space map

3.2 DIMENSIONS AND MOTION RANGE

The following figure describes the motion range of the robot, which is used as a reference when selecting a robot and setting the installation position of the robot. When installing peripheral equipment, care should be taken to avoid interference with the main body and motion range of the robot.

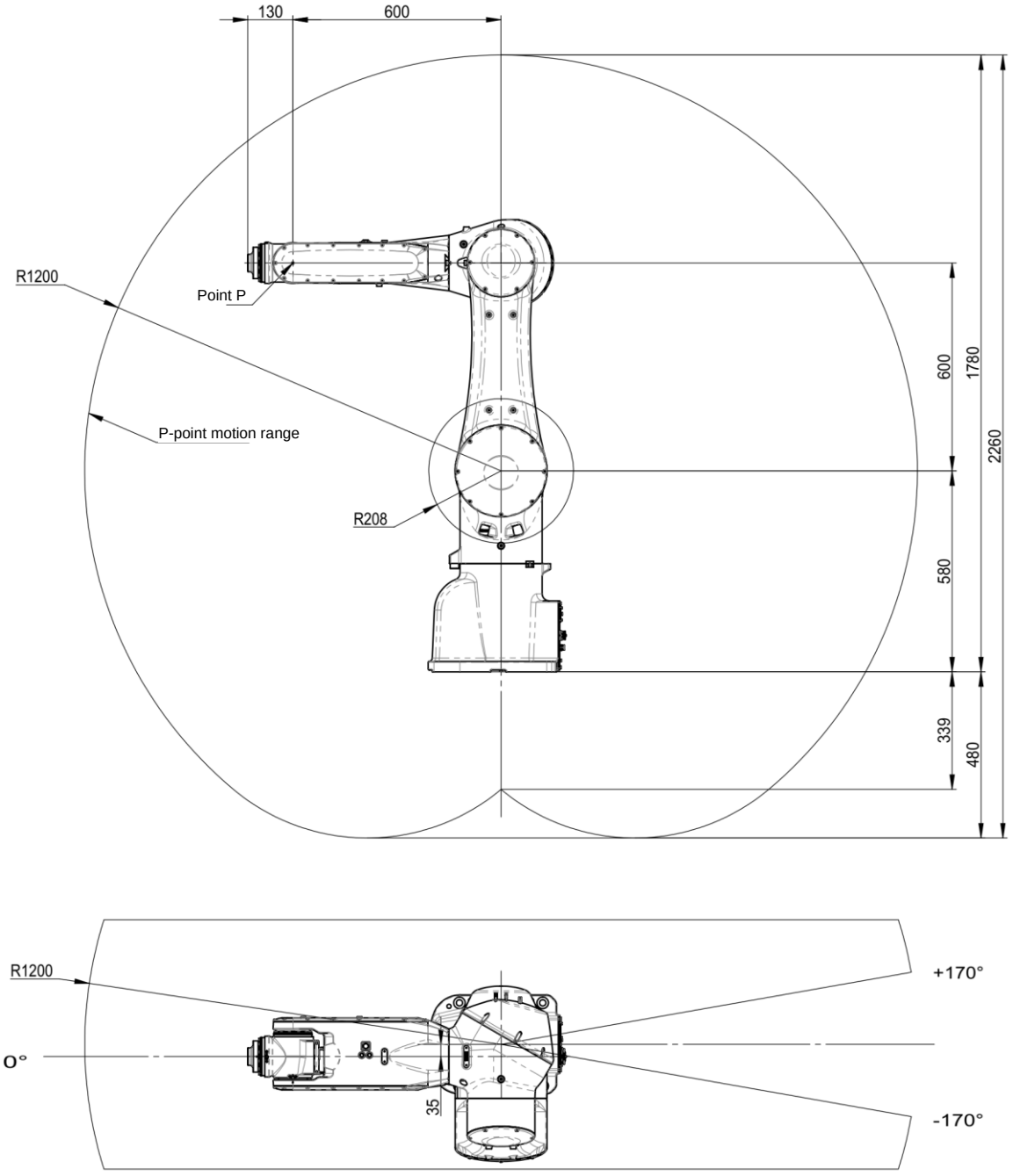


Fig 3.3 Motion range (ER20-1200-MI)

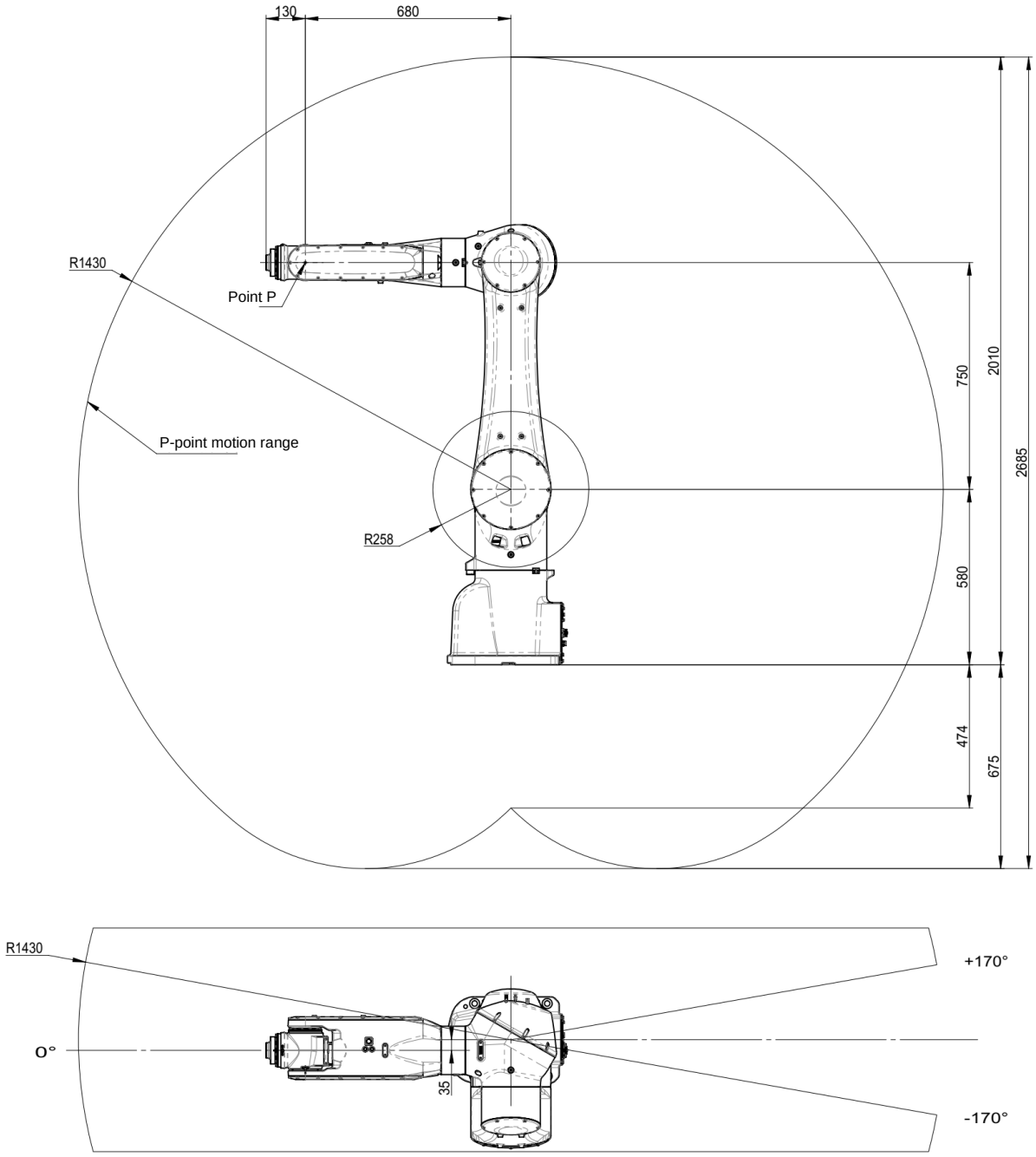


Fig 3.4 Motion range (ER15-1430-MI)

3.3 ORIGIN POSITION AND MOVABLE RANGE

Zero point and motion range are provided for each controlled axis. Exceeding the software motion limit of a controlled axis is called overtravel (OT). Overtravel is detected at both ends of the motion limit for each axis. The robot cannot exceed the motion range unless there is a loss of zero point position due to abnormalities in servo system or system error.

In addition, the motion range limit by a fixed mechanical stopper or limit switch is also prepared to improve safety

CAUTION

Do not modify the mechanical brake, etc. Otherwise, the robot may not stop normally

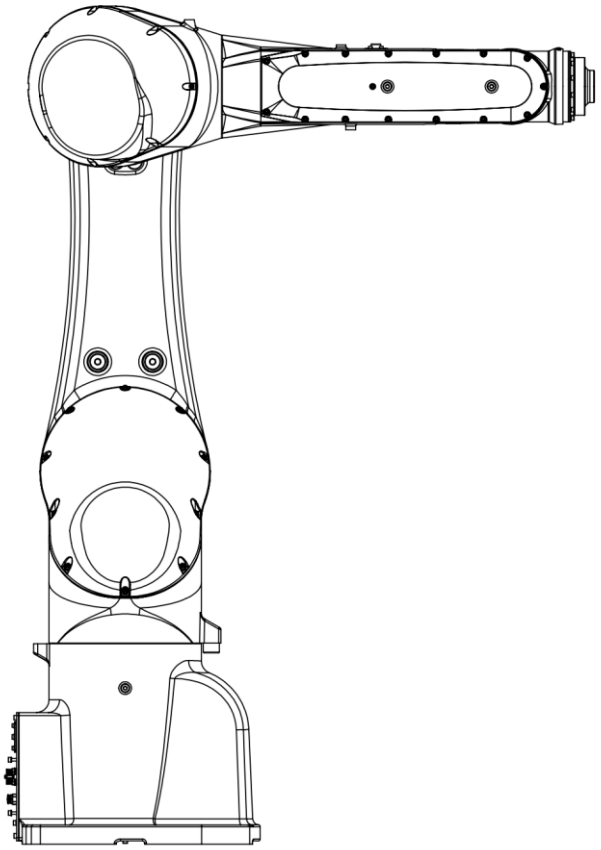


Fig 3.5 Home position

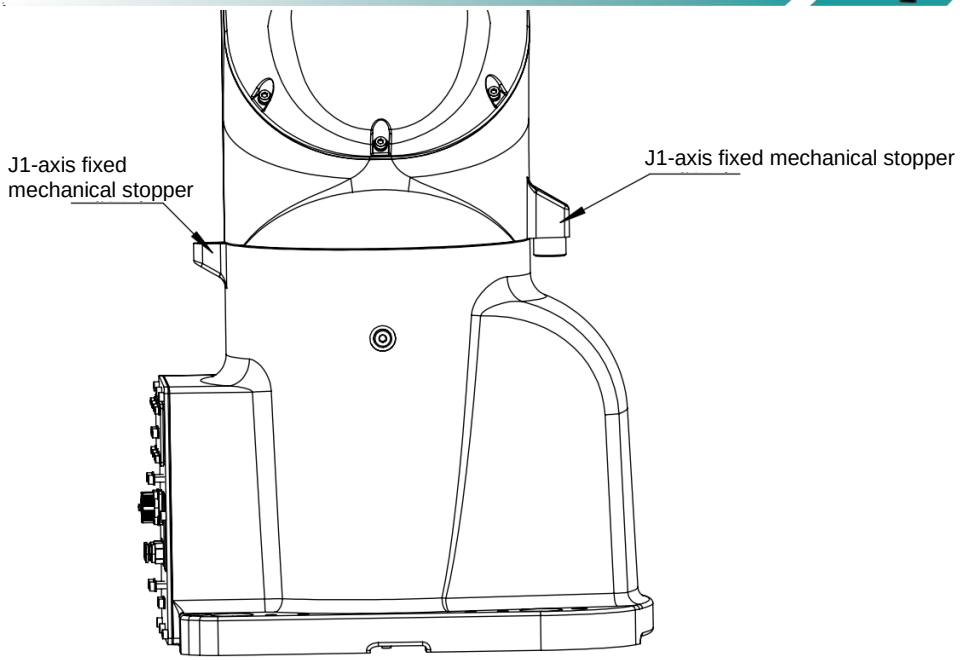


Fig 3.6 J1 axis brake position

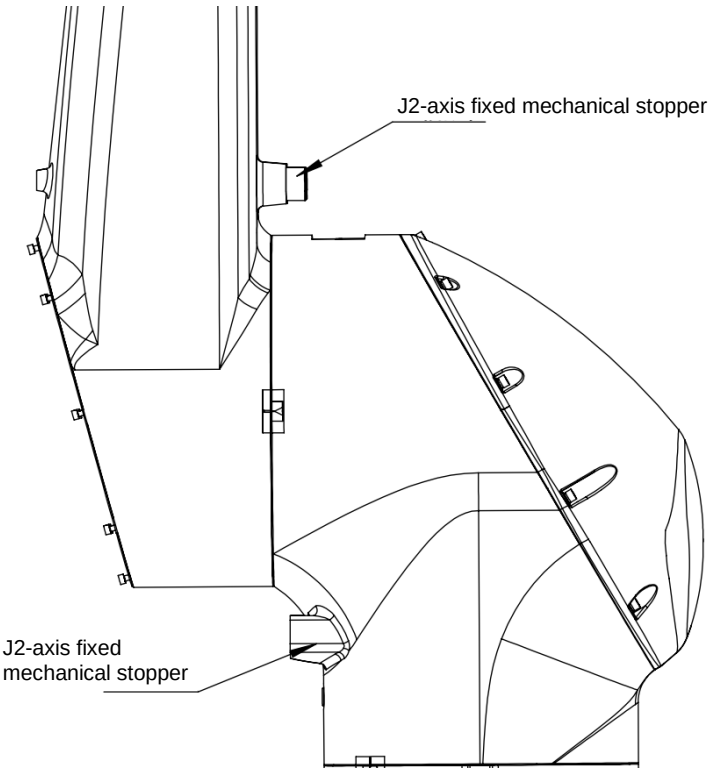


Fig 3.7 J2 axis brake position

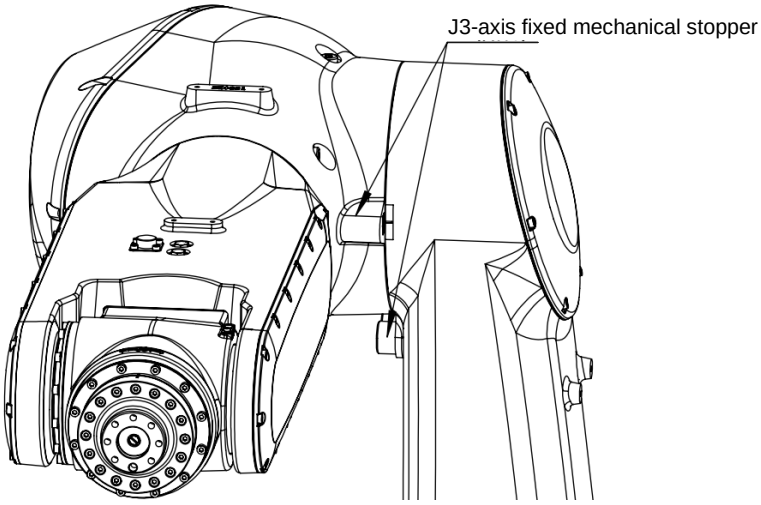


Fig 3.8 J3 axis brake position

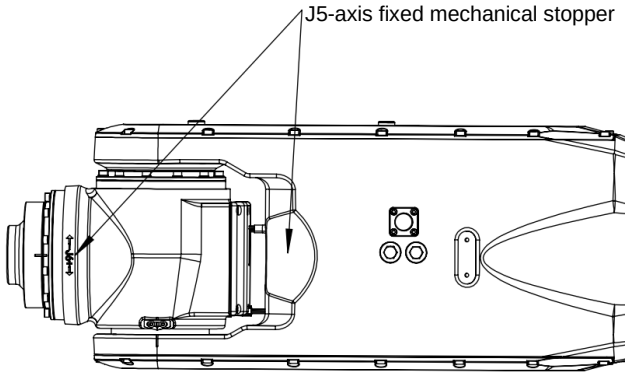


Fig 3.9 J5 axis brake position

Please refer to the operation manual for the setting operation of the movable range.

3.4 WRIST LOAD CONDITION

Robot load capacity (including weight of gripper or welding gun) coincides with robot model. Observe restrict of load torque and load inertia strictly. Refer to ESTUN robot bearing capacity calculation table when calculate load torque and load inertia. Contact ESTUN sales representatives for more detail.

CAUTION

Overload may result in a worse movement performance or a reduction of servicetime on the reducer.

Load capacity includes: total mass of all tools such as grippers, tool changers, shock absorbers, etc. Once the total mass exceeds the maximum load capacity,be sure to consult ESTUN representatives.

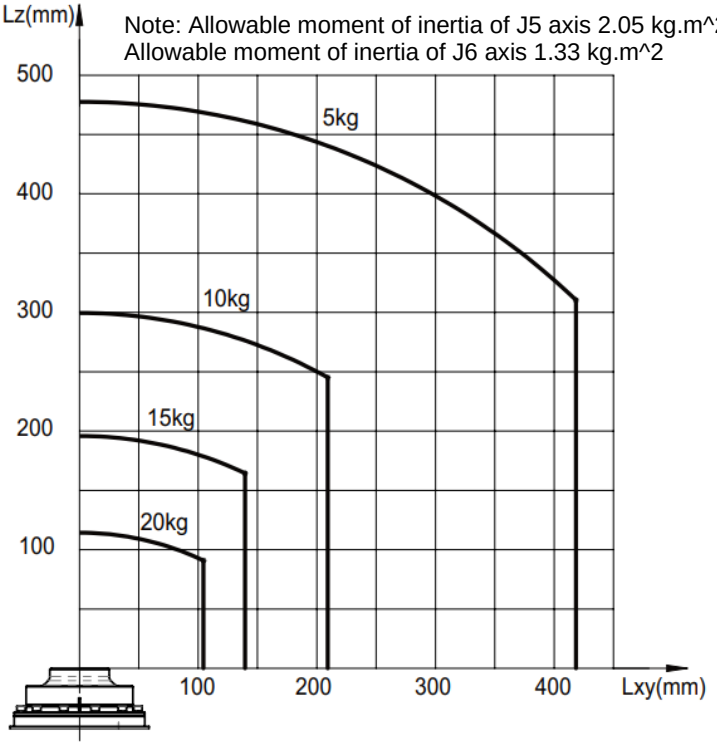


Fig3.10 Load capacity at wrist (ER20-1200-MI)

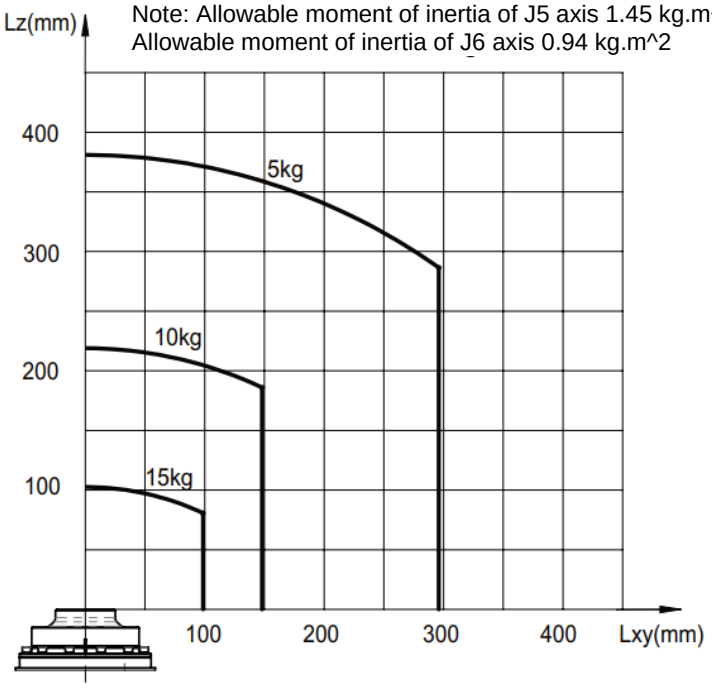


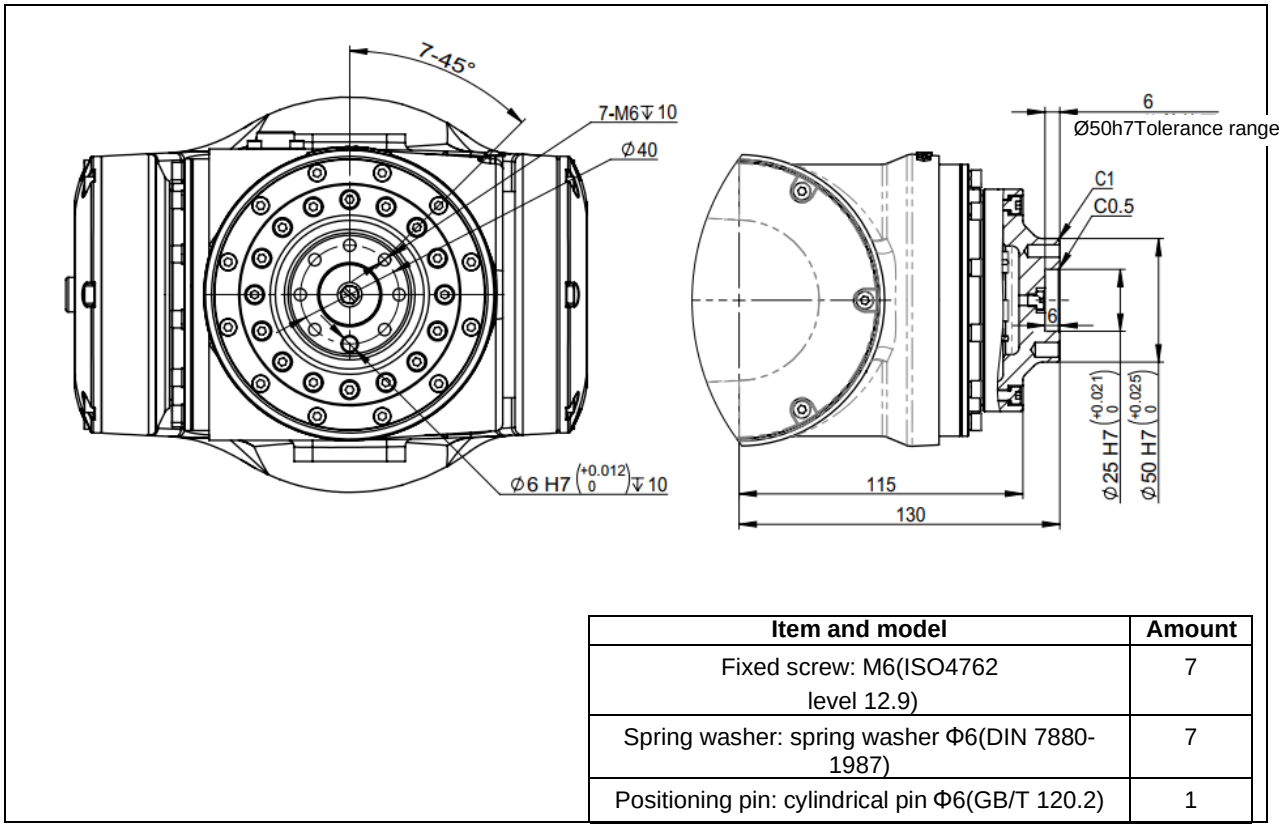
Fig3.11 Load capacity at wrist (ER15-1430-MI)

4 INSTALL EQUIPMENT

4.1 END FLANGE MOUNTING INTERFACE

This section describes the mounting face dimension of the end effector. Consider the depth of the screw holes and pin holes sufficiently before choose the length of the bolts and pins. Antirust measures of screws, grippers, etc., should be considered as well.

> **CAUTION**
>
> **When this series of robots is used in the die-casting industry, it is necessary to install a heat insulating plate between the end flange (or reducer) and the end-effector to avoid damage to the reducer at the wrist or a serious reduction in the life of the reducer.**



Item and model	Amount
Fixed screw: M6(ISO4762 level 12.9)	7
Spring washer: spring washer Φ6(DIN 7880-1987)	7
Positioning pin: cylindrical pin Φ6(GB/T 120.2)	1

Fig 4.1 End flange mounting interface

4.2 EQUIPMENT MOUNTING SURFACE

The figure shows the positions of the screw holes for device installation. The robot reserves threaded holes for external device installation on the top of the forearm part.

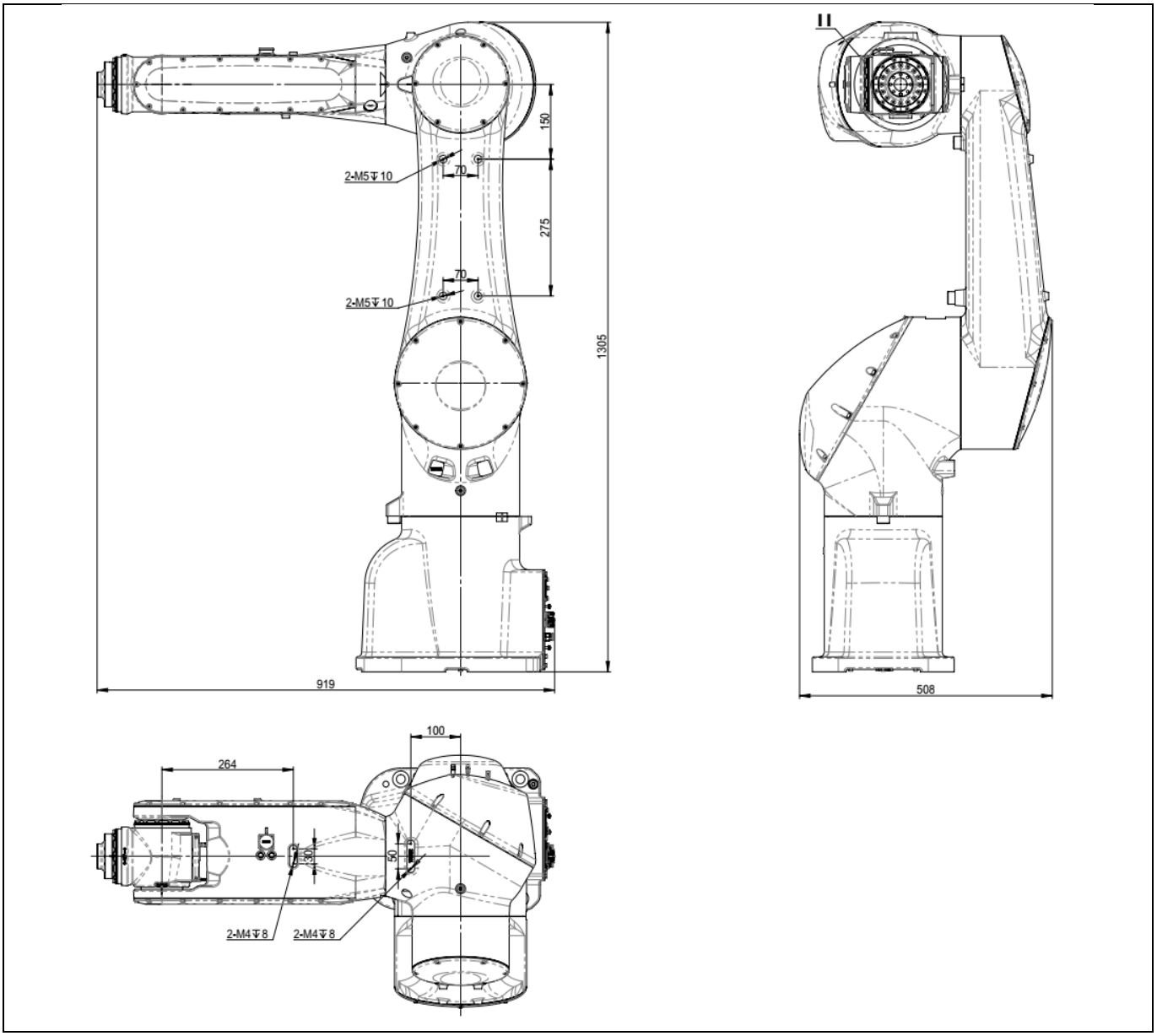


Fig 4.2 Equipment mounting face (ER20-1200-MI)

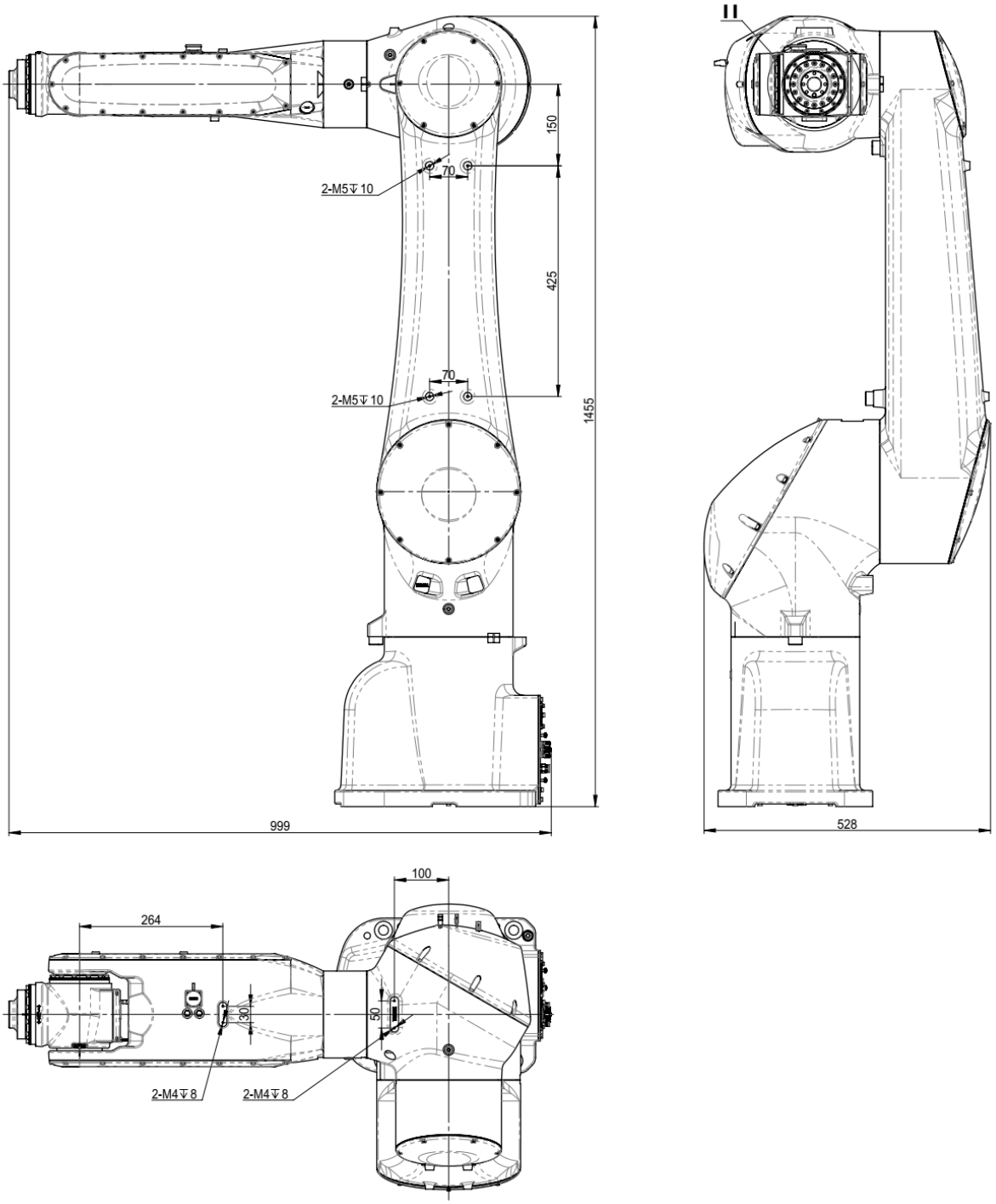


Fig 4.3 Equipment mounting face (ER15-1430-MI)

CAUTION	**When installing external equipment, be careful not to interfere with the robot body to avoid accidents.** **The load on the external interface of the J3 axis shall not exceed 2kg (the sum of the load on the wrist and the load on the wrist shall not exceed the total load).**

4.3 EXTERNAL PIPELINE

The mini-series robots provide access to the end effector for supply of air or hydraulic pressure.

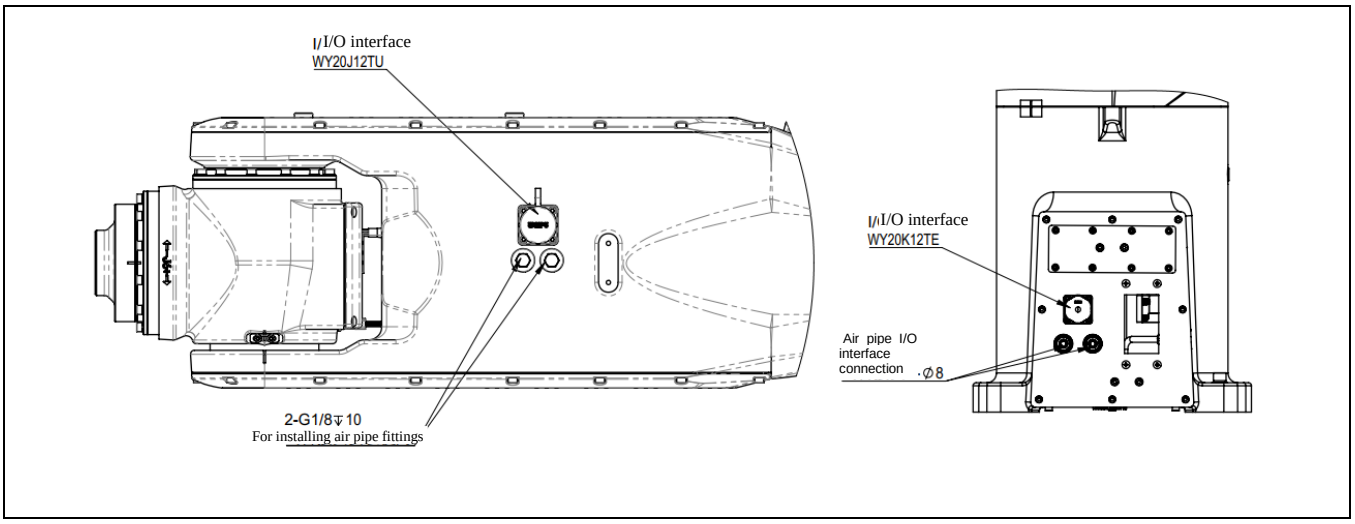


Figure 4.4 Schematic diagram of external pipeline

5 CHECK AND MAINTENANCE

Before performing all maintenance activities, carefully read the first chapter on safety precautions.

> **CAUTION** **Never implement any maintenance unless the power of the robot is cut off.**

5.1 DAILY MAINTENANCE

When operating the system every day, the following items should be checked at any time

Item	Check items	Check points
1	Oil seepage.	Check if there is oil on the sealed part. If there is an oil seepage, clean it.
2	Vibration, abnormal noises	Check whether vibration or abnormal noises occur in each transmission mechanism. If there is vibration or abnormal noises, perform measures referring to section7.2.
3	Positioning accuracy	Check whether the taught positions of the robot have not deviated from the previous taught positions. Check whether the stop position have not deviated from the previous stop positions.
4	Cooling fan in the cabinet	Check whether poor ventilation or abnormal noise occur in the cooling fan on the backside.
5	Peripheral cable set part	Check if there is missing parts, fray or rust.
6	Peripheral electrical equipment	Check whether the connection of peripheral electrical equipment or the button is normal. Check if there is any fray on the surface.
7	Warnings	Check whether a warning appears on the teach pendant warning screen. If so, please refer to the alarm code list for processing.

5.2 REGULAR INSPCTION AND MAINTENANCE

Inspection and maintenance are carried out at approximately predetermined intervals of operation cycle or accumulated operation time. Perform regular maintenance steps to keep your robot performing at its best. Regular inspection and maintenance can be operated by users according to the following table, or contact our professional staff to provide services.

Check and maintenance intervals (Operating time, Accumulated operating time)						Check and maintenance item	Check points, management and maintenance method
1 month 320h	3months 960h	1year 3840 h	1.5years 5760h	3years 11520 h	4years 15360 h		
Only 1st check						Cleaning the controller ventilation system	If a large amount of dust adheres to the air vents of the controlunit, it should be removed.
						Check the external damage or peeling pain	Check whether the robot has external damage or peeling paint due to the interference with the peripheral equipment. If an interference occurs, eliminate the cause. Also, if the external

							damage is serious, and causes a problem in which the robot will

							not operate, replace the damaged parts.
						Check damages of the cable protection sheaths	Check whether the cable protection sheaths of the mechanical unit cable have holes or tears. If damage is found, replace the cable protection sheath. If the cable protection sheath is damaged due to the interference with peripheral equipment, eliminate the cause
						Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.
	Only 1st check					Check for damages to the teach pendant, the control cabinet connection cable, and the robot connection cable.	Check whether the cable connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.
	Only 1st check					Check for damage to the mechanical unit cable (movable part)	Please observe the movable part of the robot cable, and check whether the coating of the cable is damaged, and whether there is local bending or twisting.
	Only 1st check					Check for damage to the end effector (manipulator) cable	Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.
	Only 1st check					Check the connection of each axis motor and other exposed connectors	Check the connectors of each axis motor and other exposed connectors for looseness
	Only 1st check					Check whether the end effector mounting bolts are tight	Retightening the end effector mounting bolts
	Only 1st check					Check whether the external main bolts are fastened	Tighten the robot mounting bolts, loose bolts for inspection, etc., and bolts exposed to the outside of the robot. For bolt tightening torque, please refer to Appendix A Screw tightening torque table. Some bolts are coated with anti-loosening joint compound. Tightening with a torque higher than the recommended tightening torque may cause the anti-loosening adhesive to peel off, so be sure to tighten with the recommended tightening torque.
	Only 1st check					Check the mechanical stopper	Check whether the mechanical brake has any signs of impact such as trauma, deformation, etc., and whether the brake fixing bolts are loose.
	Only 1st check					Clean splashes, chips, dust, etc.	Check that spatters, sawdust, or dust does not exist on the robot main body. If dust has accumulated, remove it. Especially, clean the robot movable parts well (each joint, balance cylinder rod, balance cylinder front/rear support

							parts, and cable protection cover).
	Only 1st check					Check the operation of the cooling fan	(When cooling fans are installed on the each axis motor) Check whether the cooling fans are operating correctly. If the cooling fans do not operate, replace them.
						Replacing the battery of the robot body	Please replace the battery of the robot body.
						Lubricating oil replacement for each shaft reducer	Please replace the lubricating oil of each axis reducer.
						Replacing the cables inside the robot	Please replace the cable inside the robot. For the replacement method, please consult our company.

5.3 REPLACING THE BATTERIES

The position data of each axis is preserved by the backup batteries. The batteries need to be replaced every 1 year. Also use the following procedure to replace when the backup battery voltage drop alarm occurs.

Procedure of replacing the battery:

1. Press the emergency stop button to stop the robot motion.
2. Remove the plug cover on the robot base.
3. Take out the old batteries from the battery case fixed on the base.
4. Insert new batteries into the battery case while observing the correct direction.
5. Re-mount the plug cover after replacing the battery.

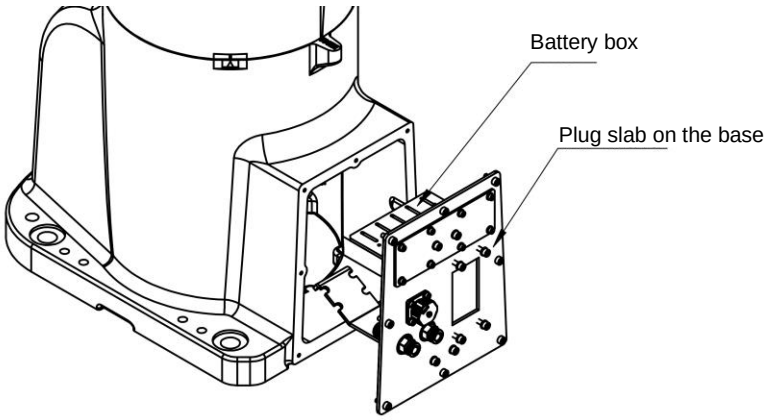


Fig 5.1 Schematic diagram of battery location

CAUTION	**During the battery replacement process, the control cabinet should be kept uninterrupted. If the control cabinet is powered off, the robot position information will be lost, and zero calibration is required after battery replacement.**

5.4 OIL LEAKAGE INSPECTION

Maintenance Area:

Insert a cloth or similar material into the gaps of each joint to check for any oil leakage from the oil seals.

Measure:

- Depending on the operating conditions and surrounding environment, oil may leak from the outer lip of the oil seals. When accumulated oil forms droplets, it may drip during certain movements. Prior to operating the robot, please wipe off any oil accumulation on the underside of the oil seals.
- Additionally, if the temperature during operation is excessively high, the internal pressure in the joint chambers may increase. In such cases, after the operation, please open the oil filling port once to restore the internal pressure. (When opening the oil filling port, please refer to 5.5 and be careful to avoid splashing of grease.)

CAUTION	**When opening the oil filling port, there is a possibility of high-temperature grease spraying out. Please prepare a plastic bag or similar item in advance to catch the grease.**

- If oil leakage persists even after frequent wiping, please refer to 7.2 Troubleshooting.

5.5 ROBOTIC GREASING

The oil chamber of the J1~J4 axis of this series of robots must be replaced with grease and oil in accordance with the following procedure every 1 year, or the shorter of 5000 hours of accumulated operating time. See the following table for the grade and quantity of grease supplied to each joint.

CAUTION	**When the operating environment of the robot is harsh, or when small angles are frequently used, or when it runs continuously at high frequencies for extended periods, the lubricating grease replacement cycle for the corresponding joints should be shortened to 3000 hours.**

Tab 5.1 Replacement grease intervals

Model	Position	Quantity
ER20-1200-MI ER15-1430-MI	J1 shaft reducer	745g
	J2 shaft reducer	1050g
	J3 shaft reducer	405g

	J4 shaft reducer	250g
	J5 shaft reducer	150ml

The following table lists the grease replacement or replenishment operations and the recommended azimuths. Please note that users are not allowed to change the grease at the wrist of the ER20 robot by themselves.

Tab 5.2 Robot Lubrication Joint Angles

<table>
<tr><td rowspan="2">Supply position</td><td colspan="4">Azimuth</td></tr>
<tr><td>J1</td><td>J2</td><td>J3</td><td>J4</td></tr>
<tr><td>J1 shaft reducer</td><td rowspan="5">Arbitrary</td><td rowspan="5">0°</td><td>Arbitrary</td><td rowspan="3">Arbitrary</td></tr>
<tr><td>J2 shaft reducer</td><td rowspan="3">0°</td></tr>
<tr><td>J3 shaft reducer</td></tr>
<tr><td>J4 shaft reducer</td><td>+90°</td></tr>
<tr><td>J5 shaft reducer</td><td>+90°</td></tr>
</table>

5.5.1Oil inlet/outlet on each axis

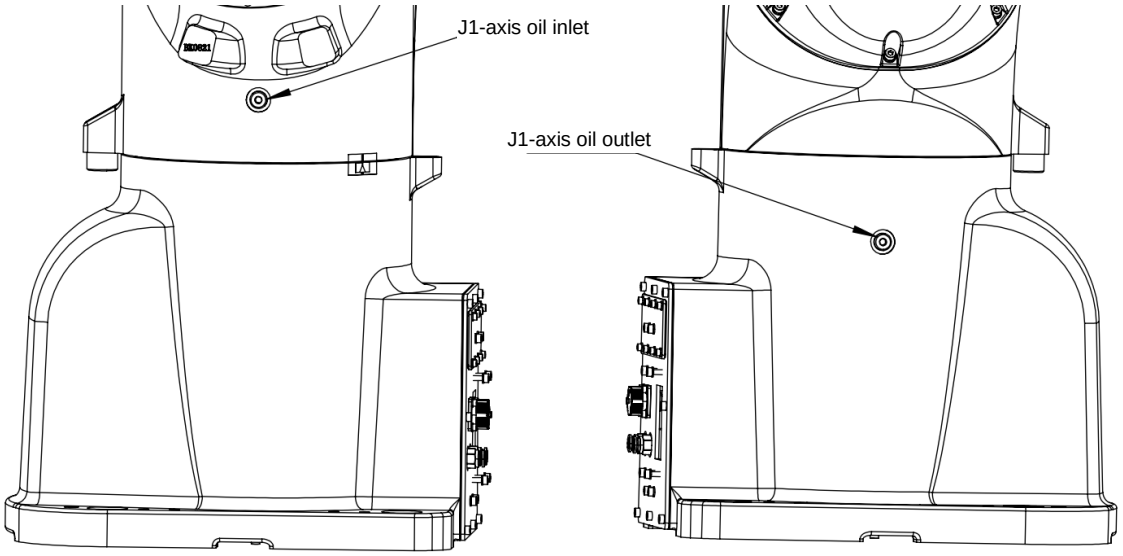


Fig 5.2 J1 axis oil inlet and outlet

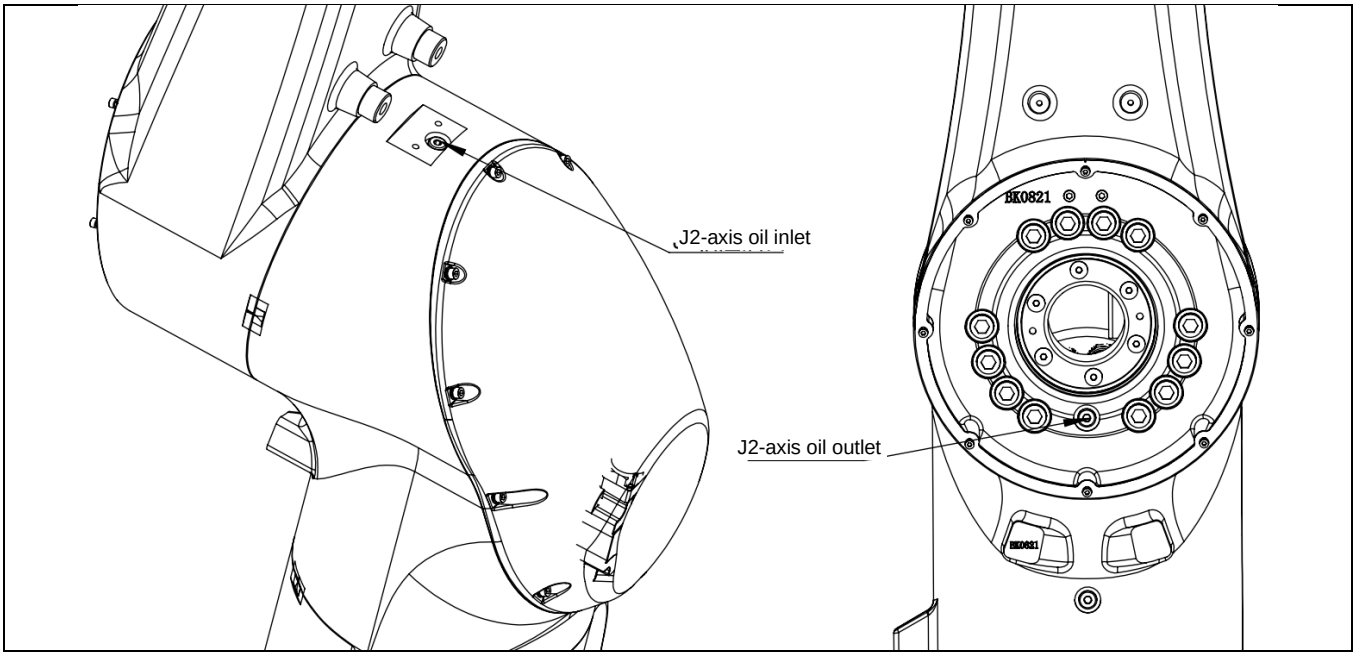


Fig 5.1 J2 axis oil inlet and outlet

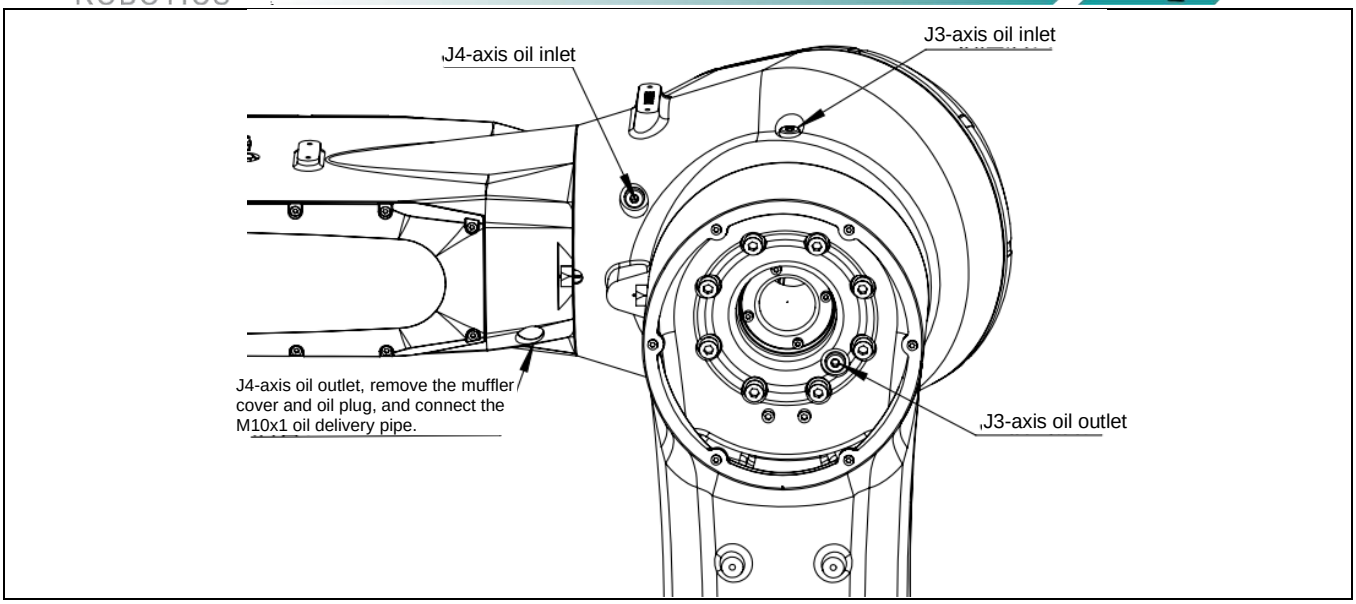


Fig 5.2 J3, J4 axis oil inlet and outlet (ER20-1200-MI)

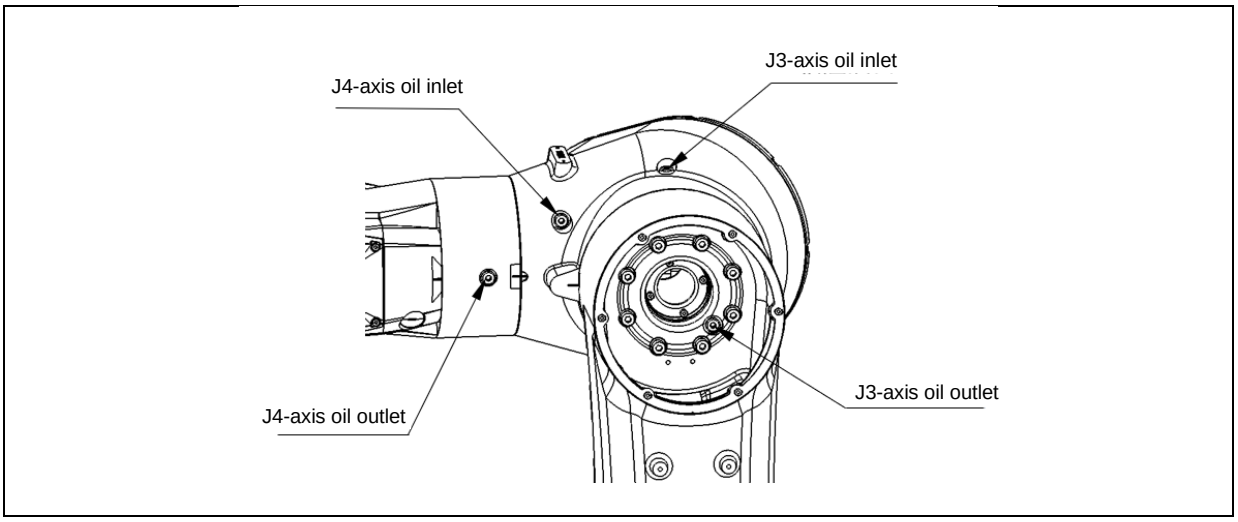


Fig 5.5 J3, J4 axis oil inlet and outlet (ER15-1430-MI)

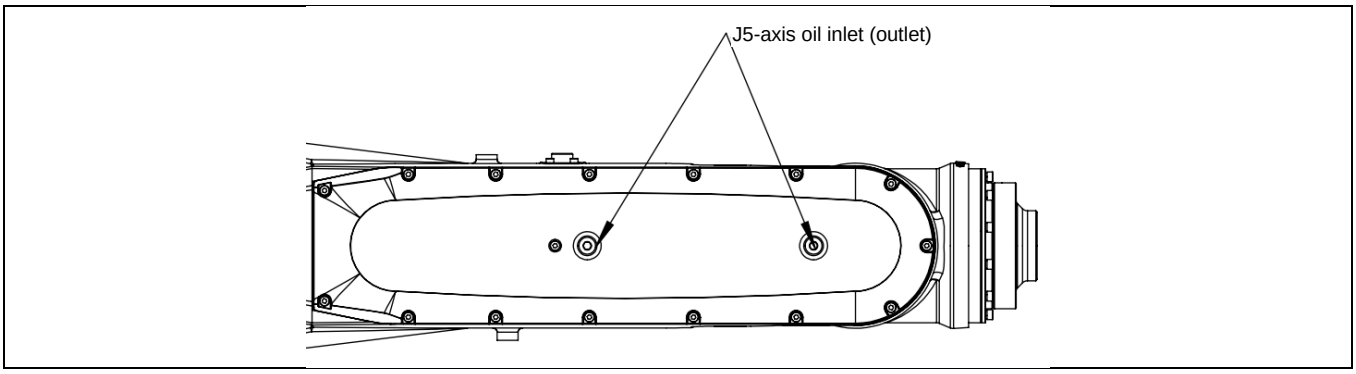


Fig 5.6 J5 axis oil inlet and outlet

The J5 and J6 axis gearboxes of this series of robots do not need to be greased under normal operating conditions (except when replacing the gearbox). However, under severe conditions (high duty cycle, high speed, heavy loads, etc.), grease filling is required at regular intervals. Please contact us for grease filling.

6. ZERO CALIBRATION

6.1. OVERVIEW

Zero calibration refers to the operation of correlating the angle of each robot joint with the pulse count value. The purpose of the calibration is to obtain the pulse count value corresponding to the zero position.

"Zero Calibration" is done before leaving the factory. It is not necessary to calibrate in daily operation. However, a calibration operation is required in the following cases.

- Motor replacement
- Pulse coder replacement
- Reducer replacement
- Cable replacement
- The battery used for pulse count backup in the machine body is exhausted

⚠ **CAUTION**	**Data including calibration data and pulse encoder data are stored by their respective backup batteries. Data loss will result when the battery runs out. The batteries of the controls and robot should be replaced regularly. When the battery voltage drops, the system will issue an alarm to notify the user.**

6.2. DEDICATED INSTRUMENT CALIBRATION

The factory setting requires removing all loads and completed with a dedicated instrument. This calibration method is based on the parameters of the whole robot, using professional instruments and software, and the zero point is the most accurate.

If the zero position data is lost due to electrical or software problems, the saved zero position data is restored as a quick teaching and debugging reference. This method cannot be used if the robot zero point data is lost due to mechanical disassembly or repair.

The company uses the robot encoder information to assist the zero position calibration. The steps are as follows:

a) Manually operate the robot to adjust the axis to the alignment of the zero mark and tick marks.

b) Open the encoder information display interface, compare the deviation between the current actual single-turn data and the last calibration given single-turn data, and adjust the axis at a lower speed so that the current single-turn data is basically equal to the given single-turn data.

c) Calibrate the axis zero point. Create a new program in the teach pendant, create a new command "RefRobotAxis", select the axis number to be calibrated, and execute the command.

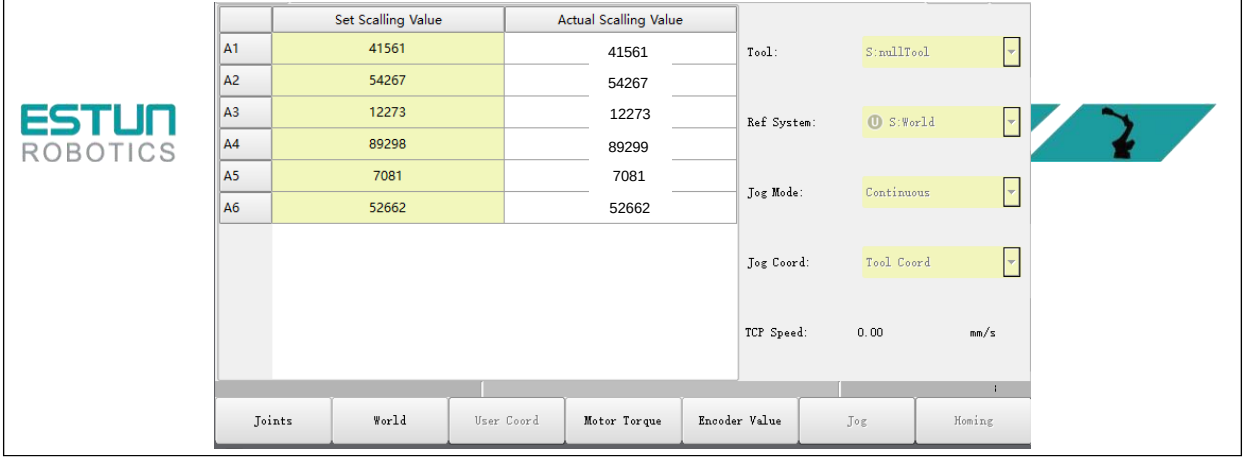


Fig 6.1 Quick zero calibration single turn value information

6.3. MECHANICAL ZERO CALIBRATION

Mechanical disassembly or maintenance may cause zero position data lost. Mechanical zero position calibration is performed with all axes jogged to zero-position using their respective witness marks.

6.3.1. Zero calibration for J1-axis

The zero calibration of the equipment is mainly to calibrate the joint score line and the middle score line of the zero mark patch by visual inspection. Now take J1 axis as an example to calibrate the zero point of this joint: adjust the robot to align the scale line indicated in the figure.

As shown in the figure, there is a mark on the base and the swivel. Please comply with the following steps to calibrate.

a) Use the teaching box to rotate the J1 axis so that the middle scale lines of the two scale plates are aligned.

b) Set this position as the zero point position of J1 axis through the teaching box.

At this point, the calibration of J1 axis has been completed. The user can refer to the above steps to complete the calibration of other axes, or after finding the zero point positions of all joints, set the zero point positions of all joints at once through the teaching box. The other schematics in this section will help the user with the calibration operation.

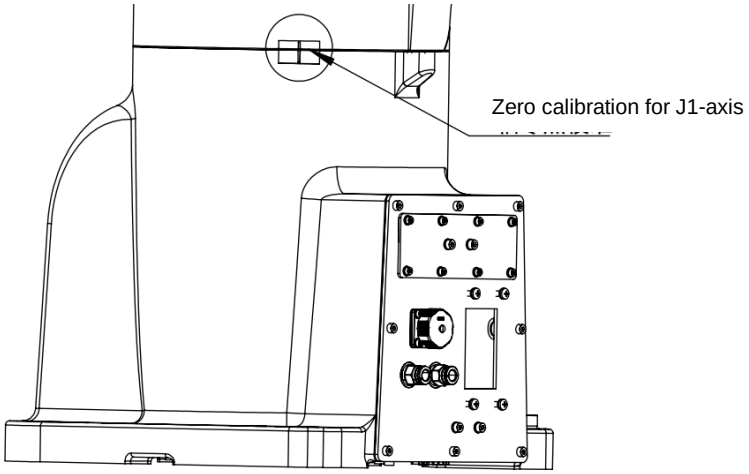


Fig 6.2 Schematic diagram of J1 axis calibration

6.3.2. Zero calibration for J2-axis

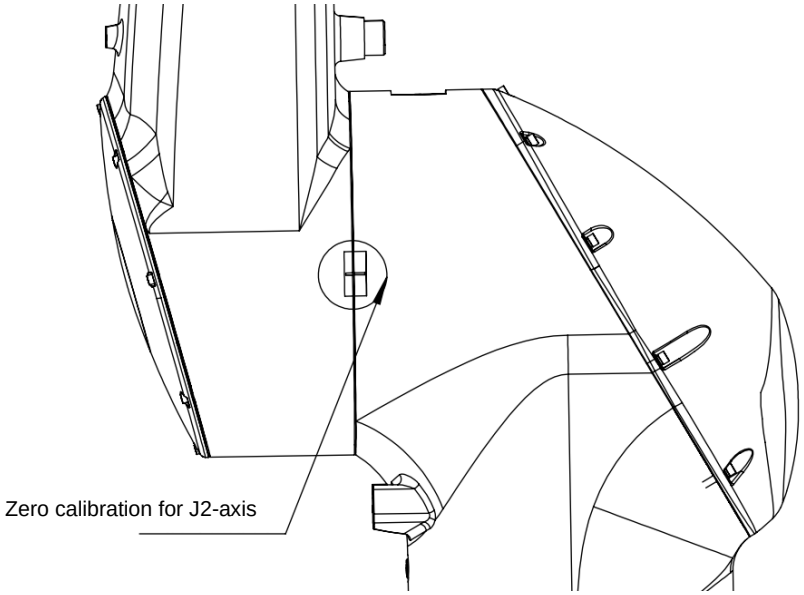


Fig 6.3 Schematic diagram of J2 axis calibration

6.3.3. Zero calibration for J3, J4-axis

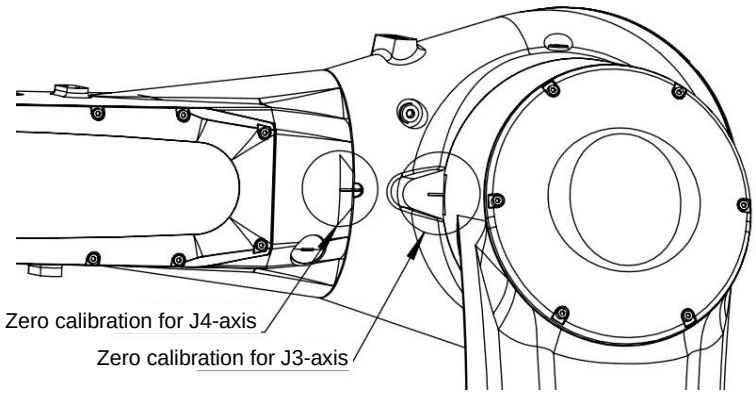


Fig 6.4 Schematic diagram of J3, J4 axis calibration (ER20-1200-MI)

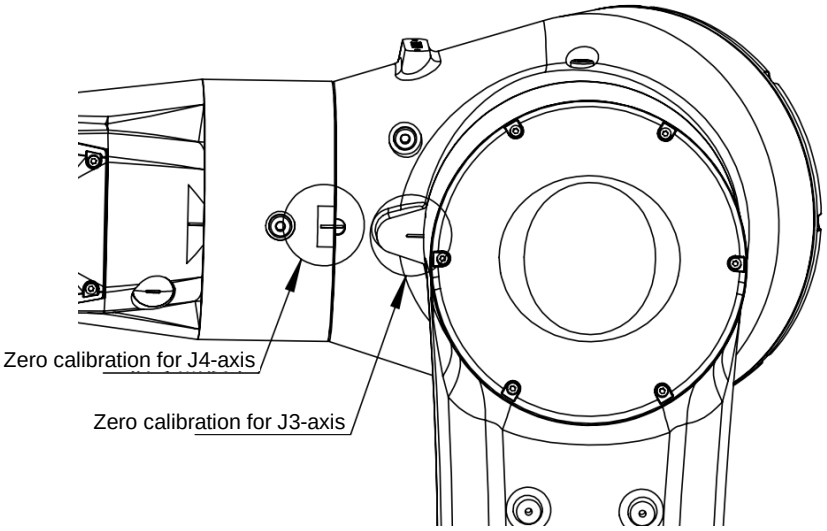


Fig 6.5 Schematic diagram of J3, J4 axis calibration (ER15-1430-MI)

6.3.4. Zero calibration for J5, J6-axis

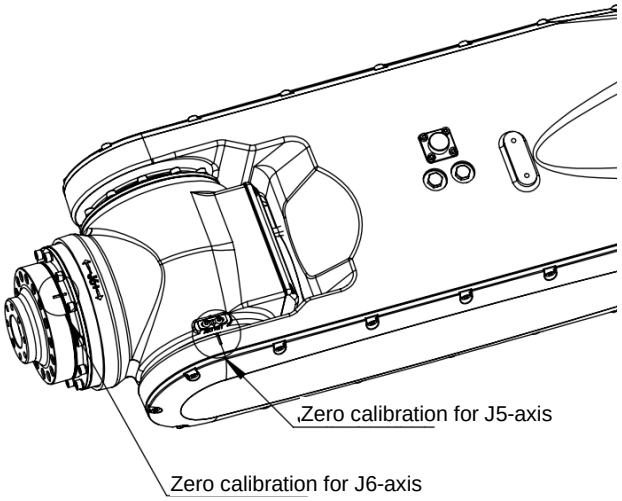


Fig 6.6 Schematic diagram of J5, J6 axis calibration

7. FAQ

Before performing all maintenance activities, read the safety precautions in Chapter 1 carefully.

> **CAUTION** **Never perform any maintenance unless the power of the robot system is turned off.**

7.1. NECESSARY TOOLS

Crane, forklift, Allen wrench, adjustable wrench and special tools for disassembling and assembling bearings, etc.

7.2. COMMON PROBLEMS AND SOLUTIONS

Symptom	Description	Cause	Measure
Vibration Noise	Unfirm connection between base and floor.	The connection between the base and the ground is loose due to the frequent vibration of the robot.	Reinforce the connection between robot base and floor.
	Joint connection is loose	It is likely caused by a loose bolt, or lack of bolt fastening measures (such as screw fastening agent, spring washer) on the joint.	Re-mount and re-fasten the bolts.
	Vibration becomes serious when the robot exceeds a specific posture.	The program the robot walks is laborious for the robot hardware.	Adjust the bot route.
	Vibration becomes serious when the robot adopts a specific posture.	It is likely the robot is overloaded.	Reduce the robot load.
	Damaged reducer.	Prolonged usage of the reducer.	Replace the reducer.
	Vibration after a collision or the robot was overloaded for a long period.	It is likely that collision or overload damaged the joint structure or reducer.	Replace the reducer or structure at where the vibration occurs.
	There is some relationship between the vibration of the robot and the operation of a machine near the robot.	The robot resonates with the machine near it.	Change the distance between the robot and other machines.
Rattling	When the robot is turned off, the robot is moved by hand, causing the robot to shake.	Loosening of bolts on robot joints due to overload and impact.	Check whether the joint bolts are loose, including motor bolts, reducer bolts, and connecting bolts. If they are loose, tighten them.

Symptom	Description	Cause	Measure
Motor overheated	The temperature of the robot's working environment rises or the servo motor is covered byobjects	The ambient temperature rises or the motor heat cannot be dissipated, causing the temperatureto rise	Reducing the ambient temperature, make ventilation well to enable the motor to release heat efficiently, and remove the cover on the motor.
	Changing the robot control program or the load.	The program or load exceeds the robot's range.	Modify the program and reduce the load.
	Parameters imported into the controller changed causing the motor to overheat.	Parameters imported are not correct with the robot.	Import correct parameters.
Gear case grease leakage	Oil leaks in joints.	Prolonged usage of the robot leads to a damage of the oil seal.	Replace the oil seal and O-ring.
		Damage to seals due to inadvertent disassembly and reassembly.	Replace the oil seal and O-ring.
		Damage to the oil seal may be caused by scratches on the lip of the oil seal due to the intrusion of dust and other foreign objects.	According to the location of oil leakage, the oil seal at the reducer position needs to be replaced; the oil seal at the motor end needs to be replaced with a new one.
		There is a gap on the surface of the seal.	Re-mount and tighten the oil seal.
		Motor or reducer mounting surface sealant failure.	Reapply sealant.
		There is a problem with the oil inlet or the bolt.	Re-mount and tighten the oil seal.
		Cracked castings, broken oil cavities due to collision, etc.	Replacement of new parts.
Joint does not lock	The robot cannot stop at a certain position accurately, or the joints rotate under the action of gravity after a period of time after stopping.	The servo motor brake went out.	Replace the servo motor.

7.3. REPLACING SERVO MOTOR PARTS

Contact ESTUN representative if servo motor replacement is needed

⚠ **GANGER**	**When removing some parts of the robot, other parts may lose support, thus leads to unexpected movement, and cause personnel injury and equipment damage. Disassembling of the robot must been performed by authorized person.**

CAUTION **When replacing servo motors, the disassembled parts should be kept properly and cleaned thoroughly before remounting. Replace it when damage occurs.**

APPENDIX

APPENDIX A SCREW TIGHTENING TORQUE TABLE

Bolt Models (ISO4762)	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18
Tightening Torque /N·m (level12.9)	2	4	9.01 ±0.49	15.6 ±0.78	37.2 ±1.86	73.5 ±3.43	129 ±6.37	205 ±10.2	319 ±15.9	441 ±22

APPENDIX B SPECIFICATION OF BELT

Nominal diameter	Screw Specifications	Drill diameter	Anchor depth (mm)	Max. anchor thickness (mm)	Designed pulling force (KN)	Designed shearing force (KN)	Anti-pull force (KN)
M8	Φ8×110	Φ10	80	13	10.3	12.3	⩾20KN
M10	Φ10×130	Φ12	90	20	12.3	14.2	⩾30KN
M12	Φ12×160	Φ14	110	25	16.8	17.5	⩾40KN
M16	Φ16×190	Φ18	125	35	28.9	35	⩾60KN
M20	Φ20×260	Φ25	170	65	50.1	51.5	⩾90KN
M24	Φ24×300	Φ28	210	65	75.5	80	⩾140KN
M30	Φ30×380	Φ35	280	70	121.3	163.7	⩾200KN
M33	Φ33×420	Φ38	300	90	135	182	⩾260KN

APPENDIX C PARTS LIST OF ER20-1200-MI (ONE SET REQUIRED)

No.	Material code	Name	Amount	Note
1	12700000685	Servo motor for (J1-axis)	1	
2	12700000326	Servo motor for (J2-axis)	1	
3	12700000062	Servo motor for (J3-axis)	1	
4	12J00000072	Servo motor for (J4-axis, J5-axis)	2	
5	12J00000149	Servo motor for （J6-axis）	1	
6	51200000154	EVE_3.6V/AA/ER14505_ EVE Energy Co., Ltd (Witch plastic case)	6	

APPENDIX D PARTS LIST OF ER15-1430-MI (ONE SET REQUIRED)

No.	Material code	Name	Amount	Note
1	12700000685	Servo motor for (J1-axis)	1	
2	12700000326	Servo motor for (J2-axis)	1	
3	12700000062	Servo motor for (J3-axis)	1	
4	12J00000072	Servo motor for (J4-axis, J5-axis)	2	
5	12J00000149	Servo motor for （J6-axis）	1	
6	51200000154	EVE_3.6V/AA/ER14505_ EVE Energy Co., Ltd (Witch plastic case)	6	

REVISION HISTORY

Revision	Date	Contents
01	2023.02	New edition
02	2023.09	Update Robot specification table

www.estun.com

WeChat

Home

ADD：No. 1888, Jiyin Avenue, Jiangning Development Zone, Nanjing
Tel.：025-85097068
Post Code：211102
Electronic mail：robot@estun.com