



# OPERATION INSTRUCTIONS

## **ESTUN** Palletizing Series Robot Body Operation Instructions

**ALL  
MADE  
BY ESTUN**

**ESTUN**  
AUTOMATION

# **ESTUN Palletizing Series**

## **Robot Body Operation Instructions**

**M-0301EN-08**

## **Thank you for using ESTUN robot products.**

Before using a robot, please be sure to carefully read the safety instructions and understand the contents. The company is committed to continuously improving product quality. Specifications and information related to products in this manual are subject to change without prior notice. All statements, information and recommendations provided in this manual have been carefully processed, but they are not guaranteed to be totally correct. We shall not be liable for any direct or indirect losses caused by the use of this manual. Users shall take full responsibility for application of any product and shall use this manual and products with caution. All contents of this manual shall be interpreted by ESTUN Robotics Co., Ltd.

**No part of this manual may be reproduced in any form.  
ESTUN Robotics. All Rights Reserved Copyright.**

**Service Line: 400-025-3336**

ADD: NO.1888, Jiyin Avenue, Jiangning Development Zone, Nanjing

Post Code: 211102

TEL: +86-025-58328532

WEB: [www.estun-robotics.com](http://www.estun-robotics.com)

E-mail: [export@estun.com](mailto:export@estun.com)



# SAFETY

This chapter describes what is required for the safe use of robots. Before using a robot, please be sure to carefully read and understand the contents of this chapter.

Companies and individuals using ESTUN robots should be familiar with local and national standards and laws, and install appropriate safety facilities to protect users. Before use (installation, operation, maintenance and overhaul) of the robot, please be sure to carefully read and fully understand the Manual and other attached materials, and use it after understanding all equipment details, safety information and precautions. However, even if the user closely follows all the safety information given in the manual, ESTUN cannot guarantee that the user would be free from any injury.

## DEFINITION OF USER

---

A user is defined as follows:

- Operator  
Turns the robot power ON/OFF.  
Starts the robot program from the panel.
- Programmer  
Operates the robot.  
Teaches the robot inside the safety area.
- Maintenance engineer
- Maintenance engineer  
Operates the robot.  
Teaches the robot inside the safety area.  
Maintenance (repair, adjustment, replacement).

Operator must not work in the safety area.

Programmer and maintenance engineer can work in the safety area.

During operation, programming, and maintenance of the robot, the operator, programmer, and maintenance engineer should take precautions to ensure the safety by wearing the following safety items.

- Clothes for operation
- Safety shoes
- A helmet

## SPECIAL TRAINING

---

Tasks in the safety area including transportation, setting, teaching, adjustment, maintenance, etc.

Training course must be performed before operating the robot.

For more information about training course, contact ESTUN.

## DEFINITION OF SAFETY NOTATIONS

---

Precautions and information are defined as follows.





| Symbol                                                                                              | Definitions                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br><b>WARNING</b> | <b>Danger notation</b><br>Death or serious injury will be expected to occur if the user fails to follow the approved procedure.                                   |
| <br><b>CAUTION</b> | <b>Caution notation</b><br>Minor or moderate injury of the user or equipment damage will be expected to occur if the user fails to follow the approved procedure. |
| <br><b>IN FO</b>   | <b>Information</b><br>A supplementary explanation help users operating the robot more efficiently.                                                                |

## SAFETY OF THE USER

- (1) The robot should be transported and installed as procedures recommended by ESTUN. Wrong procedures may cause severe injuries or damage due to the robot fall.
- (2) Draw an area clearly indicates the safety area. Install a fence or hang a warning board to ensure the safety operation of the robot, and keep unauthorized personnel outside the safety area.
- (3) Never hang any tools above the robot. Falling of these tools may cause damage to equipment.
- (4) Never lean on the cabinet. Never touch any buttons without permission. Unexpected movement of the robot may cause personnel injuries and equipment damage.
- (5) Take precautions for falling parts to avoid injuries when disassemble the robot.
- (6) Turn off the power when adjusting peripheral equipment.
- (7) Peripheral equipment must be grounded.
- (8) The robot should be operated in a low speed in the first operation. The speed should be added gradually to check if there is any abnormal situation.
- (9) Do not wear gloves when using the teach pendant. Operate with gloves may cause an operation error.
- (10) Programs, system variables, and other information can be saved on the memory card or USB memories. Be sure to save the data periodically in case that the data is lost.
- (11) Never forcibly move any axis of the robot. Move the axes forcibly may cause injuries or damage.
- (12) Take precautions when wiring and piping between the robot, the cabinet, and peripheral equipment. Put the pipes, wires or cables through a pit or covered with a protective lid, to avoid stepped by personnel or run over by a forklift.
- (13) Unexpected movement may occur on any operating robot, which will cause severe injuries or damages in the working area. Test (safe door, brake, safe indicators, etc.) must be performed on each safety measures before using the robot. Before turn on the system, make sure that no one is in the working space.
- (14) Never set motion range or load condition exceeds the rated range. Incorrect setting may cause personnel injury and equipment damage.
- (15) Observe the following precautions when teaching inside 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.



**Never stand beneath the robot in case of unexpected movement or the system be turned on inadvertently.**



**Make sure there is a CO<sub>2</sub> fire extinguisher at hand.**

## SAFETY OF OPERATORS

- (1) Before operating the robot, check that the SERVO ON indicator goes out when the EMERGENCY STOP button on the right of the front door of the controller and the pendant are pressed. And confirm that the power is turned off.
- (2) Never allow unauthorized personnel to touch the controller during operation. This may result in unexpected movement of the robot, severe injuries and material damage.
- (3) When attaching tools 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 is an external button of the controller that can stop 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 are 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, can be mounted on the teach pendant and the controller. Certainly, the emergency buttons can be mounted by special requirement.**

**Emergency stop button should be mounted where is easy to reach, so that the buttons can be pressed down immediately in case of emergencies.**



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



**Emergency button is used in case of emergency only. Do not use it to stop the robot for normal operation.**

## SAFETY OF PROGRAMMERS

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





**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.
- Turn off the enable switch when pausing, programming or testing the system.
- Teach pendant must be taken with the programmer when teaching 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 MAINTENANCE ENGINEERS

### (1) Heated parts

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



**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) Disassembly 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 manipulator to avoid falling down.

### (3) Pneumatic / hydraulic pressure

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.



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

(4) Although the power supply need to be turned on during fault diagnosis, it must be turned off when perform maintenance.

### (5) Brake inspection

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) Greasing

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 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 the oil chamber thoroughly before changing oil type.
- Oil draining must be performed thoroughly. Check the oil indicator when finished.

IN FO

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

## SAFETY OF THE TOOLS AND PERIPHERAL EQUIPMENT

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

## SAFETY OF THE ROBOT MECHANICAL UNIT

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 arms can be moved by hand. Lager arms should be moved by crane or other handling equipment.

Fasten the robot firmly before releasing the brake to avoid secondary injury caused by falling arms.

## STOP TYPE OF ROBOT

There are three types of robot stop.

### 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 is uncontrolled.

The following processing is performed at Power-off stop:

- An alarm is generated and servo power is turned off immediately.
- Execution of the program is paused.

Frequent Power-off stop of the robot during operation can cause failures of the robot. Avoid system designs that require routine or frequent Power-off stop conditions.







## Alarm stop

The robot system sends alarm (not include power-off alarm), and the robot is decelerated until it stops by control instructions.

The following processing is performed at Alarm stop:

- An alarm (not include power-off alarm) is generated due to overload, system faulty, etc.
- Control instruction is send from servo system. The robot operation is decelerated until it stops. Execution of the program is paused.
- Servo power is off.

## Hold

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

The following processing is performed at Hold:

- The robot operation is decelerated until it stops. Execution of the program is paused.

## LABELS

---

### (1) Electric Shock Warning

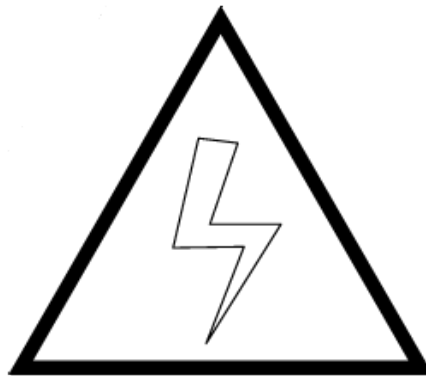


Fig 0.1 Electric Shock Warning

This label indicates hazardous voltage or electric shock.

### (2) High-temperature Warning

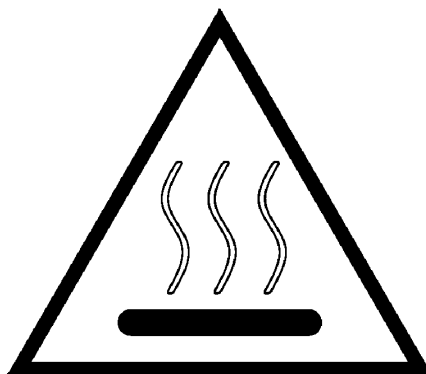


Fig 0.2 High-temperature Warning

Be cautious about a section where this label is affixed, as the section generates heat. If you have to





inevitably touch such a section when it is hot, use a protection provision such as heat-resistant gloves.

### (3) No Step-on Warning



Fig 0.3 Step-on prohibitive Warning

Never step on or climb the robot or controller as it may adversely affect the robot or controller and may get hurt if you lose your footing as well.

### (4) Personal Injury Warning

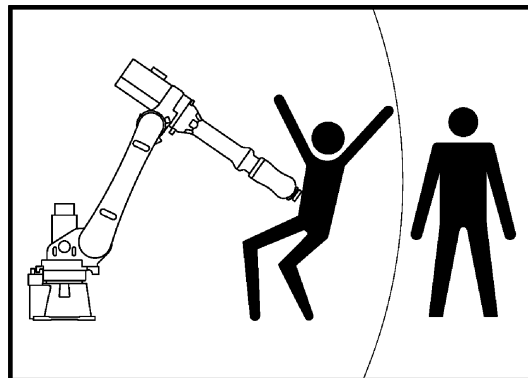


Fig 0.4 Personal Injury Warning

Never enter the operation area while the Manipulator is moving. This is extremely hazardous and may result in serious safety problems.

### (5) No Disassembly Warning

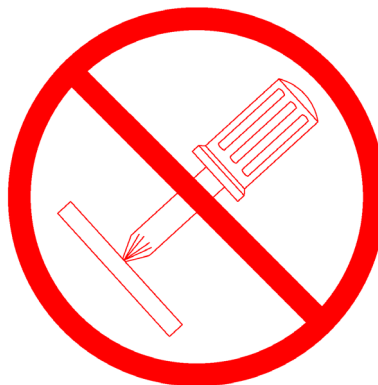


Fig 0.5 No Disassembly Warning

Never perform disassembly arbitrarily where the warning is affixed. Contact ESTUN for disassembly.



## (6) Energy Storage Warning

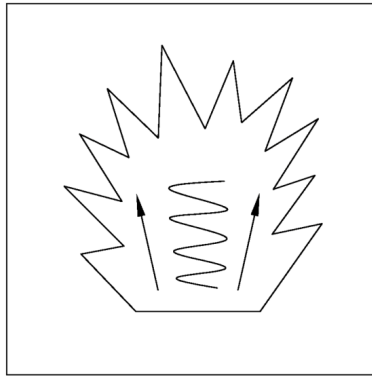
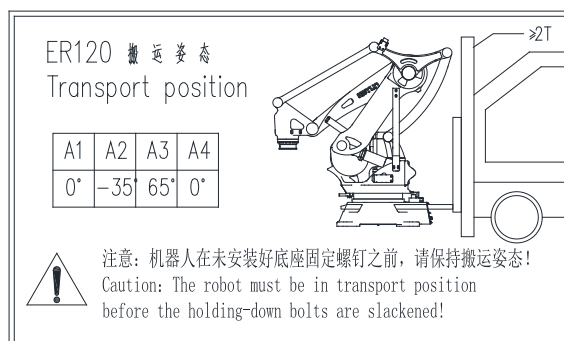
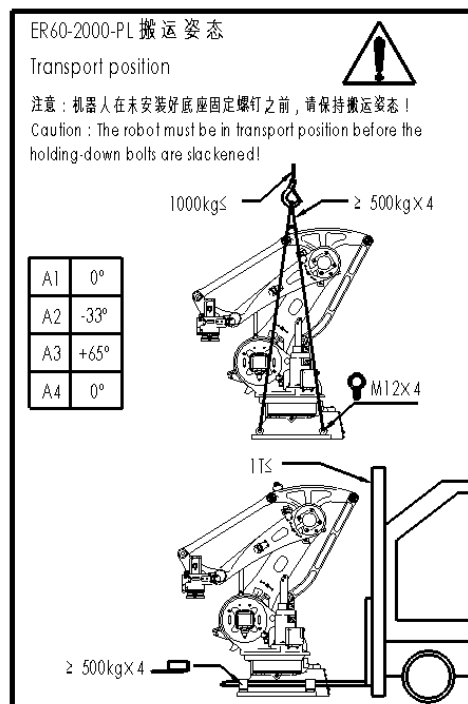
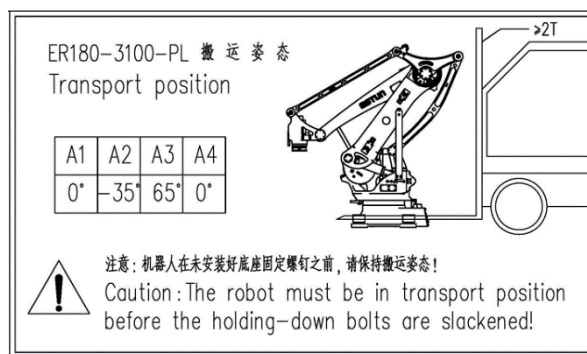


Fig 0.6 Energy Storage Warning

The balance cylinder is equipped with springs, high-pressure gas or high-pressure liquid. Never disassemble the balance cylinder without permission.

## (7) Transportation Label





Transport position and precautions are described.



# PREFACE

This manual describes the following manipulators.

| Robot type    | Load capacity |
|---------------|---------------|
| ER60-2000-PL  | 60kg          |
| ER120-2400-PL | 120kg         |
| ER180-3100-PL | 180kg         |

Related manuals

|                                                            |
|------------------------------------------------------------|
| ESTUN Palletizing Series Robot Body Operation Instructions |
| ESTUN Robot ER Series Cabinet Operator's Manual            |
| ER Series Industrial Robot Operation Manual RSC2           |





# CONTENTS

|                                                                                |    |
|--------------------------------------------------------------------------------|----|
| SAFETY .....                                                                   | 1  |
| PREFACE .....                                                                  | 1  |
| CONTENTS .....                                                                 | 1  |
| 1. TRANSPORTATION AND INSTALLATION .....                                       | 1  |
| 1.1 TRANSPORTATION .....                                                       | 1  |
| 1.1.1. Transport by a forklift .....                                           | 1  |
| 1.1.2. Transport by a crane .....                                              | 5  |
| INSTALLATION .....                                                             | 8  |
| 1.1.3. INSTALLATION CONDITIONS .....                                           | 14 |
| 2. CONNECTION WITH THE CONTROLLER .....                                        | 15 |
| 3. SPECIFICATIONS .....                                                        | 16 |
| 3.1. ROBOT CONFIGURATION .....                                                 | 16 |
| 3.2. EXTERNAL DIMENSIONS AND OPERATING SPACE .....                             | 18 |
| 3.3. ZERO POINT POSITION AND MOTION LIMIT .....                                | 21 |
| 3.4. WRIST LOAD CONDITION .....                                                | 25 |
| 4. EQUIPMENT INSTALLATION TO THE ROBOT .....                                   | 27 |
| 4.1. FLANGE DIMENSION .....                                                    | 27 |
| 4.2. TUBES AND PIPES .....                                                     | 29 |
| 5. CHECK AND MAINTENANCE .....                                                 | 30 |
| 5.1. DAILY CHECKS .....                                                        | 30 |
| 5.2. PERIODIC CHECKS AND MAINTENANCE .....                                     | 30 |
| 5.2.1. Inspection of gas spring .....                                          | 33 |
| 5.3. REPLACING THE BATTERY .....                                               | 34 |
| 5.4. GREASING .....                                                            | 35 |
| 5.4.1. Position of oil inlet/outlet on each axis .....                         | 36 |
| 5.4.2. Procedures of greasing .....                                            | 42 |
| 5.4.3. Procedure for releasing remaining pressure within the grease bath ..... | 43 |
| 6. CALIBRATING .....                                                           | 47 |
| 6.1. INTRODUCTION .....                                                        | 47 |
| 6.2. QUICK ZERO POSITION CALIBRATION .....                                     | 47 |
| 6.3. MECHANICAL ZERO POSITION CALIBRATION .....                                | 48 |
| 6.3.1. J1-axis calibration .....                                               | 48 |
| 6.3.2. J2-axis calibration .....                                               | 50 |
| 6.3.3. J3-axis calibration .....                                               | 51 |
| 6.3.4. J4-axis calibration .....                                               | 52 |
| 7. TROUBLESHOOTING .....                                                       | 53 |
| 7.1. TOOLS .....                                                               | 53 |
| 7.2. TROUBLESHOOTING .....                                                     | 53 |
| 7.3. REPLACING THE SERVO MOTOR .....                                           | 54 |





|                                              |    |
|----------------------------------------------|----|
| APPENDIX.....                                | 55 |
| APPENDIX A BOTL TORQE LIST.....              | 55 |
| APPENDIX B SPECIFICATION OF BOLT .....       | 55 |
| APPENDIX C Part list for ER60-2000-PL .....  | 56 |
| APPENDIX D Part list for ER120-2400-PL ..... | 56 |
| APPENDIX E Part list for ER180-3100-PL ..... | 56 |
| REVISION RECORD .....                        | 57 |





# 1. TRANSPORTATION AND INSTALLATION

## 1.1 TRANSPORTATION



**When transport the robot, be sure the robot is in safe condition, or it may result in serious personnel injury and/or equipment damage.**

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. Perform the transportation properly, or it may result in personnel injury or equipment damage.

| Position             | J1 axis | J2 axis | J3 axis | J4 axis |
|----------------------|---------|---------|---------|---------|
| <b>ER60-2000-PL</b>  | 0°      | -33°    | +65°    | 0°      |
| <b>ER120-2400-PL</b> | 0°      | -35°    | +65°    | 0°      |
| <b>ER180-3100-PL</b> | 0°      | -35°    | +65°    | 0°      |

Refer to theoretical weight of main parts shown below to install, disassemble and transport the robot.

| Parts                                   | Weight (kg)  |               |               |
|-----------------------------------------|--------------|---------------|---------------|
|                                         | ER60-2000-PL | ER120-2400-PL | ER180-3100-PL |
| Robot                                   | 500          | 1050          | 1120          |
| Big arm casting                         | 62           | 118           | 168           |
| Base assembly (Including rotation base) | 317          | 465           | 460           |
| Small arm assembly                      | 16           | 62            | 83            |
| Wrist                                   | 15           | 43            | 43            |
| Balance cylinder                        | 0            | 25            | 25            |
| Auxiliary parts                         | 31           | 61            | 77            |



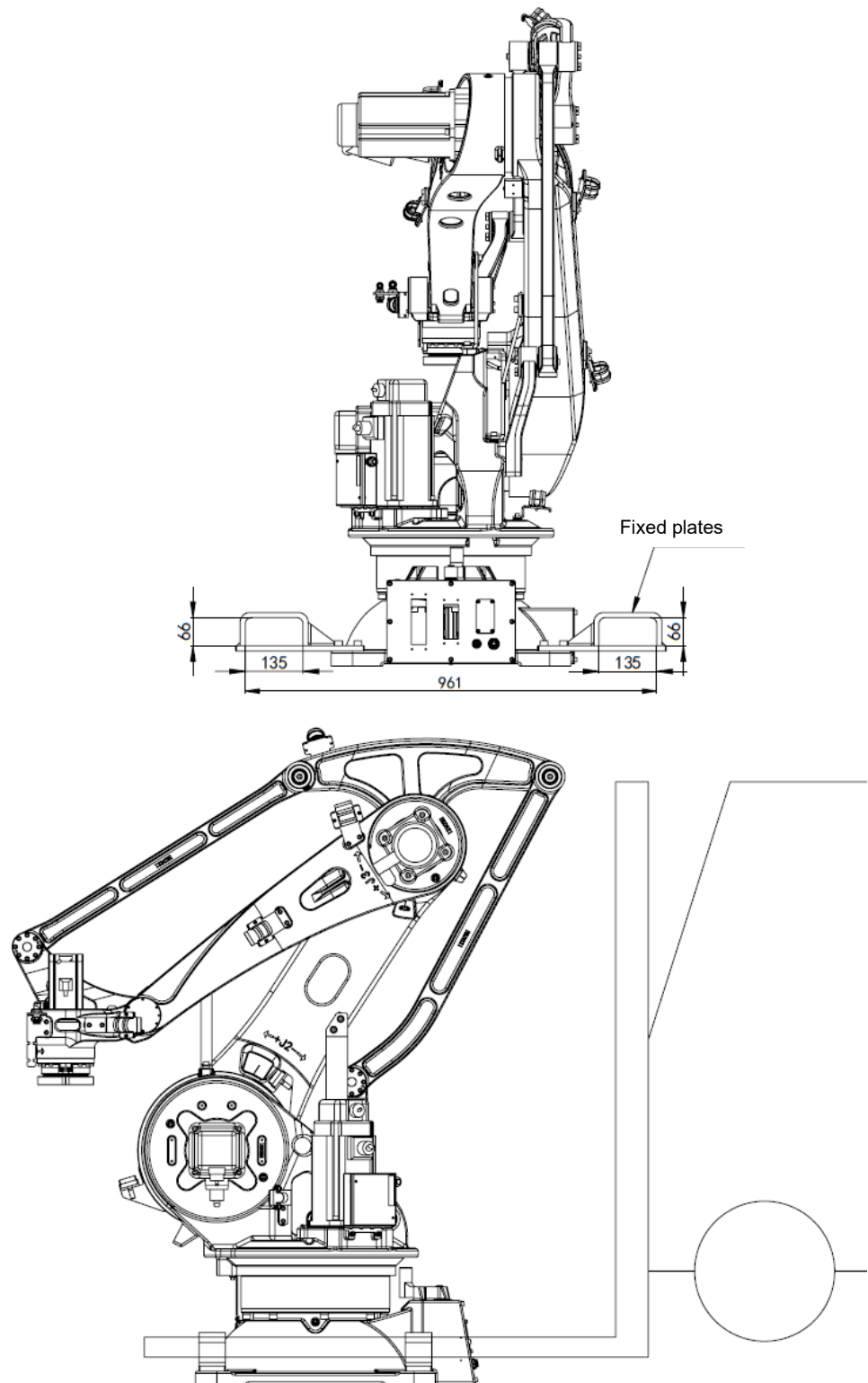
**Some parts with less weight are not listed. Contact ESTUN if you need the details.**

### 1.1.1. Transport by a forklift

The ER60-2000-PL robot can be handled by forklift. As shown in the figure, the 4 forklift fixed plates are installed on the robot base with 8 M12X35 screws before handling, and the forklift forklifts into the fixed plate for handling; Before handling the robot, it must be confirmed that all the fixing bolts of the robot have been removed.







Notes:

- ① Forklift load capacity above 1 tons. ② Four fixed plates ③Hedonal screw M12X35 with specifications conforming GB/T70.1-2000.

Fig 1.1 Use a forklift to transport the robot (ER60-2000-PL)

The ER120-2400-PL and ER180-3100-PL robots use forklift handling mode. As shown in the figure, the 4 forklift fixed plates are installed on the robot base with 12 M16X50 screws before handling, and the forklift forklifts into the fixed plate for handling; Before handling the robot, it must be confirmed that all the fixing





bolts of the robot have been removed.

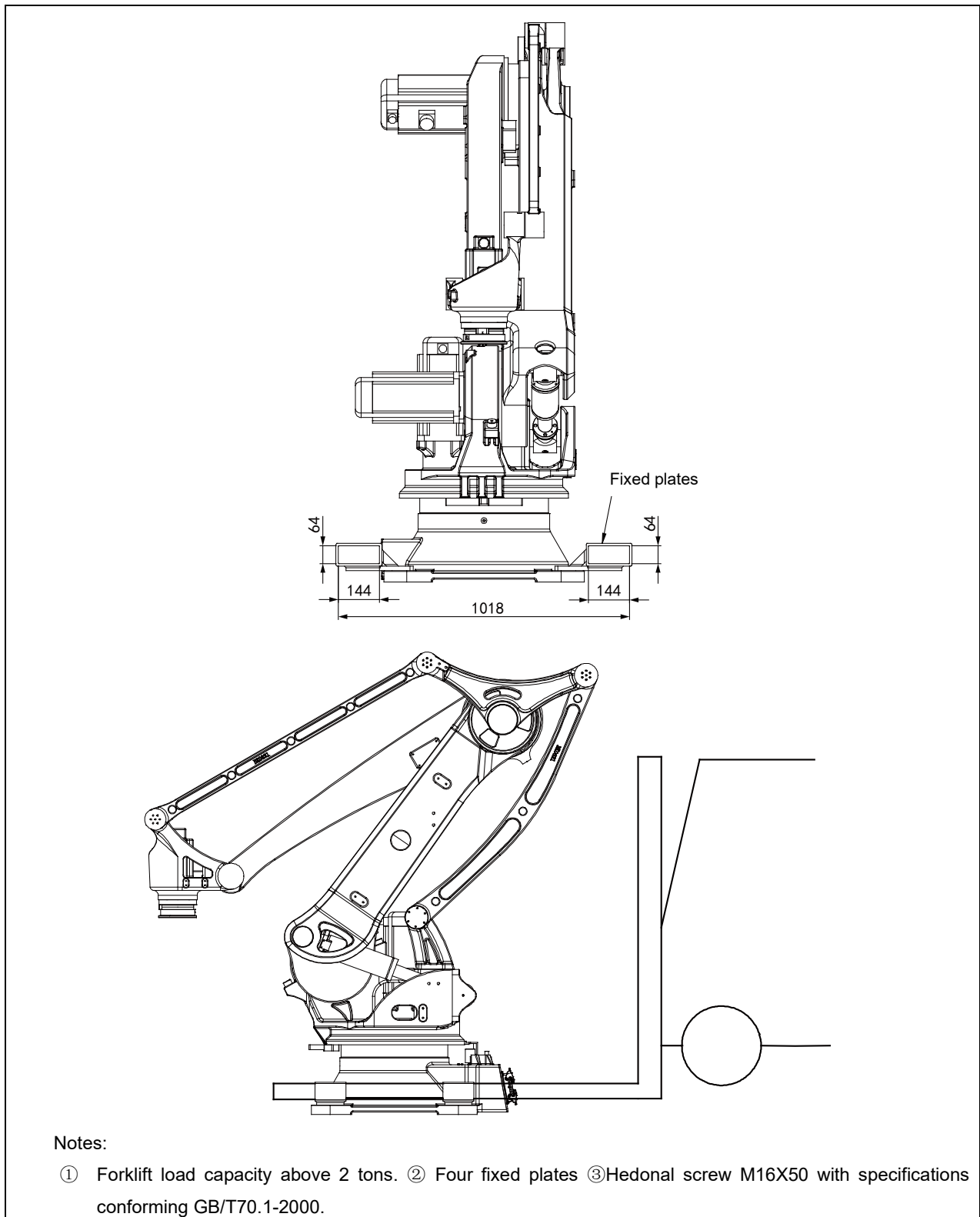


Fig 1.2 Use a forklift to transport the robot (ER120-2400-PL, ER180-3100-PL)

When transporting the robot, a fixed bracket needs to be installed. The fixing bracket needs to be removed before installation. The following table lists the mounting position of the fixing bracket and the size of the screw hole for easy user removal.





Tab 1.1 Installation position of fixed plates and supports

|               | Between big arm and rotation base | Between big arm and rotation base(or small arm) |
|---------------|-----------------------------------|-------------------------------------------------|
| ER60-2000-PL  | ER60-2000-PL fixed support        | ER60-2000-PL fixed support                      |
| ER120-2400-PL | ER120-2400-PL fixed support       | ER120-2400-PL fixed plate                       |
| ER180-3100-PL | ER180-3100-PL fixed plate         | ER180-3100-PL fixed support                     |

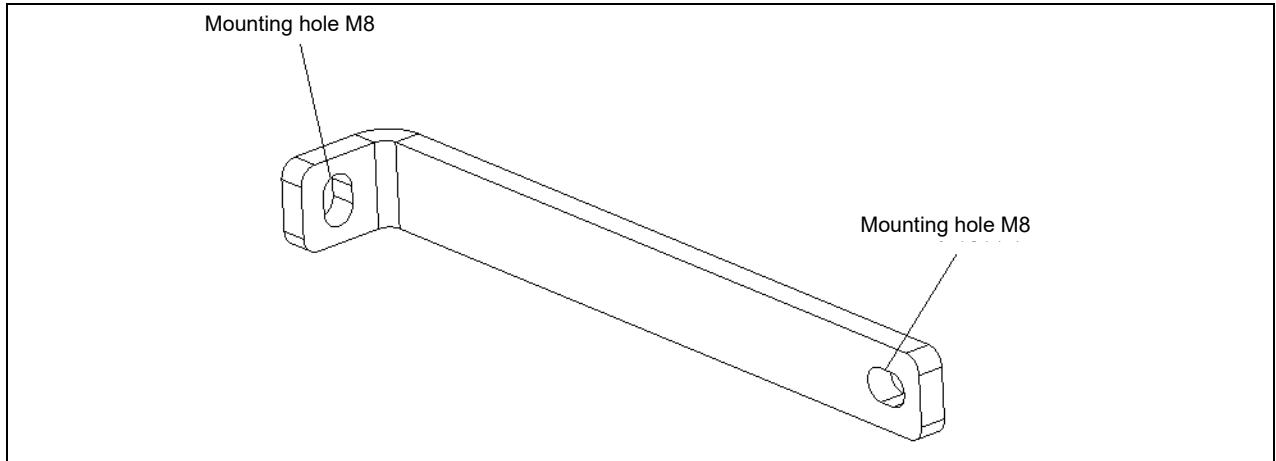


Fig 1.3 ER60-2000-PLfixed plate

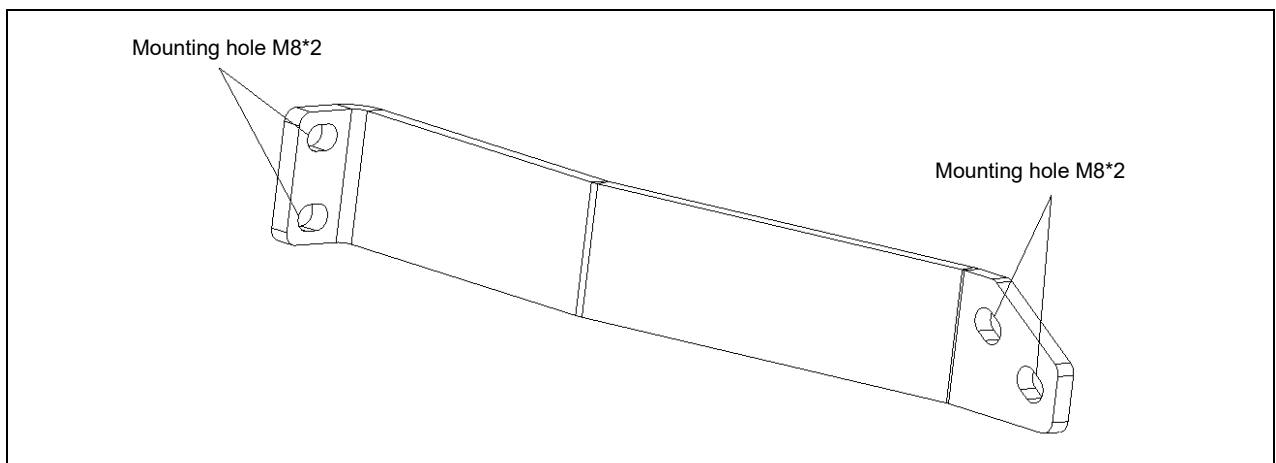


Fig 1.4 ER60-2000-PLfixed plate

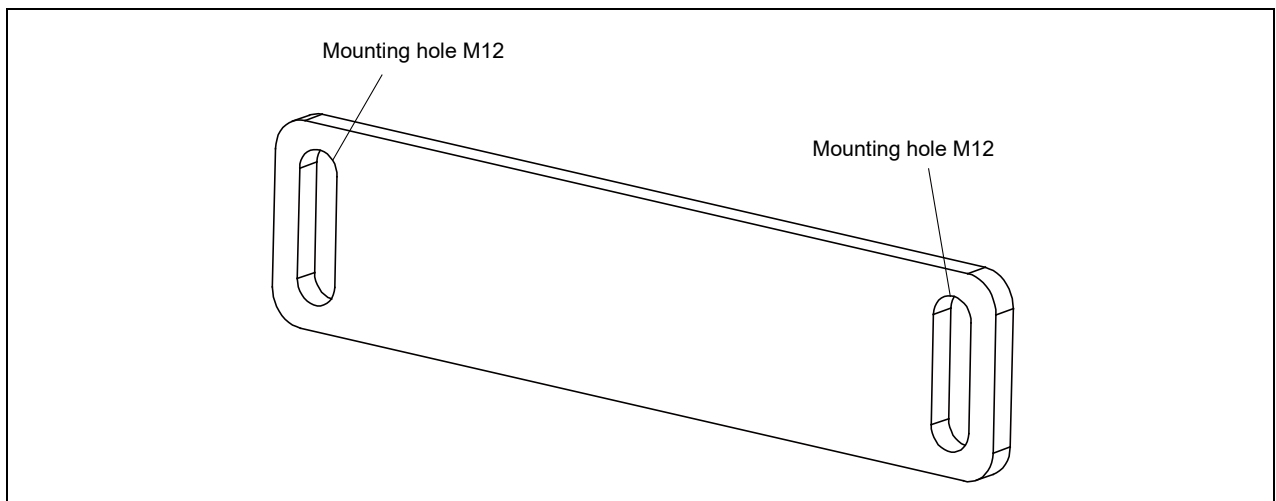


Fig 1.5 ER120-2400-PL fixed plate



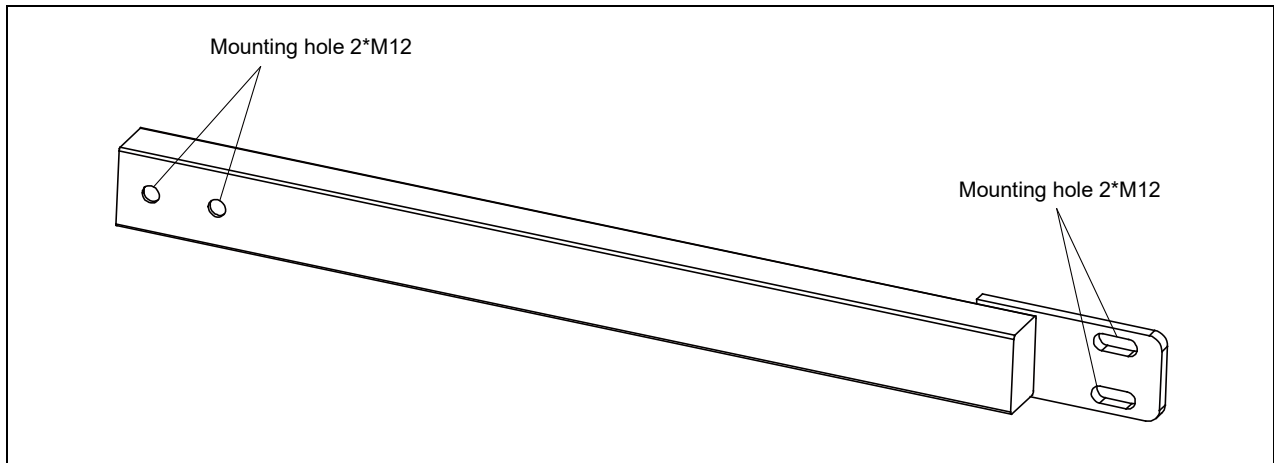


Fig 1.6 ER120-2400-PL fixed support

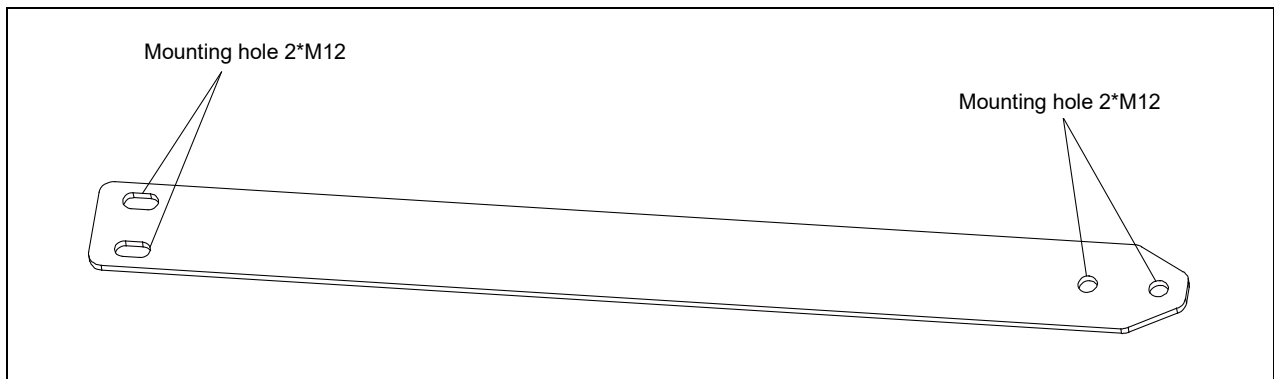


Fig 1.7 ER180-3100-PL fixed plate

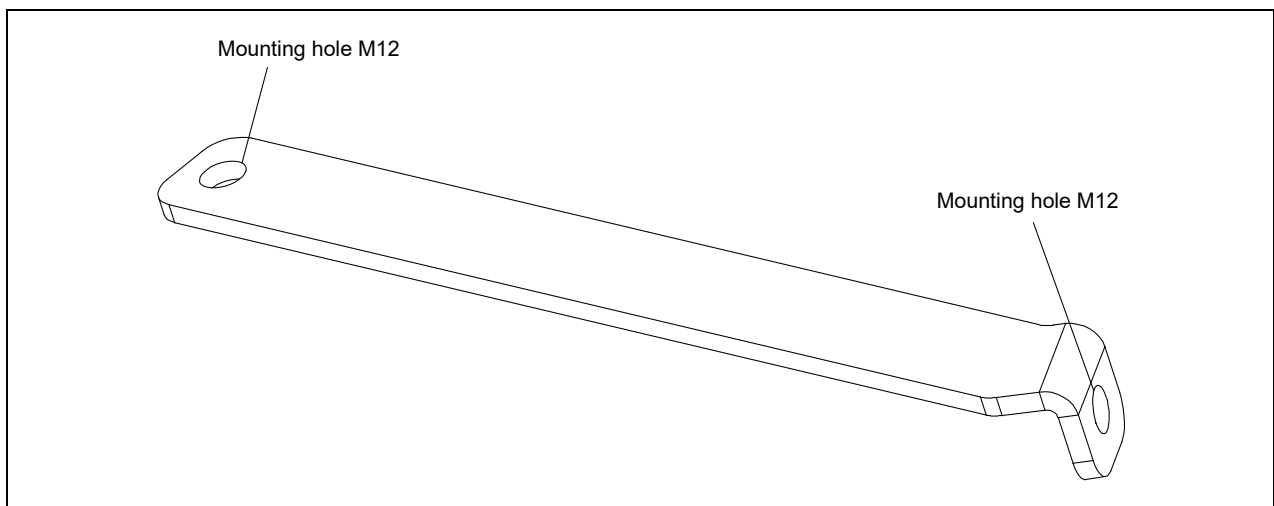


Fig 1.8 ER180-3100-PL fixed support

### 1.1.2.Transport by a crane

This series of robots can also be transported using a crane. Install lifting eye bolts on the robot's base and use slings to lift it. Please refer to the provided diagram to ensure that the slings are crossed during lifting. Take necessary precautions to protect the robot's surface where the slings come in contact to prevent any paint damage.





**Eyebolt and sling should be prepared by customers.**

**Transportation conditions: Crane load capacity above 1000kg. String load capacity above 500kg. Rings with specifications conforming GB/T 825-1988.**

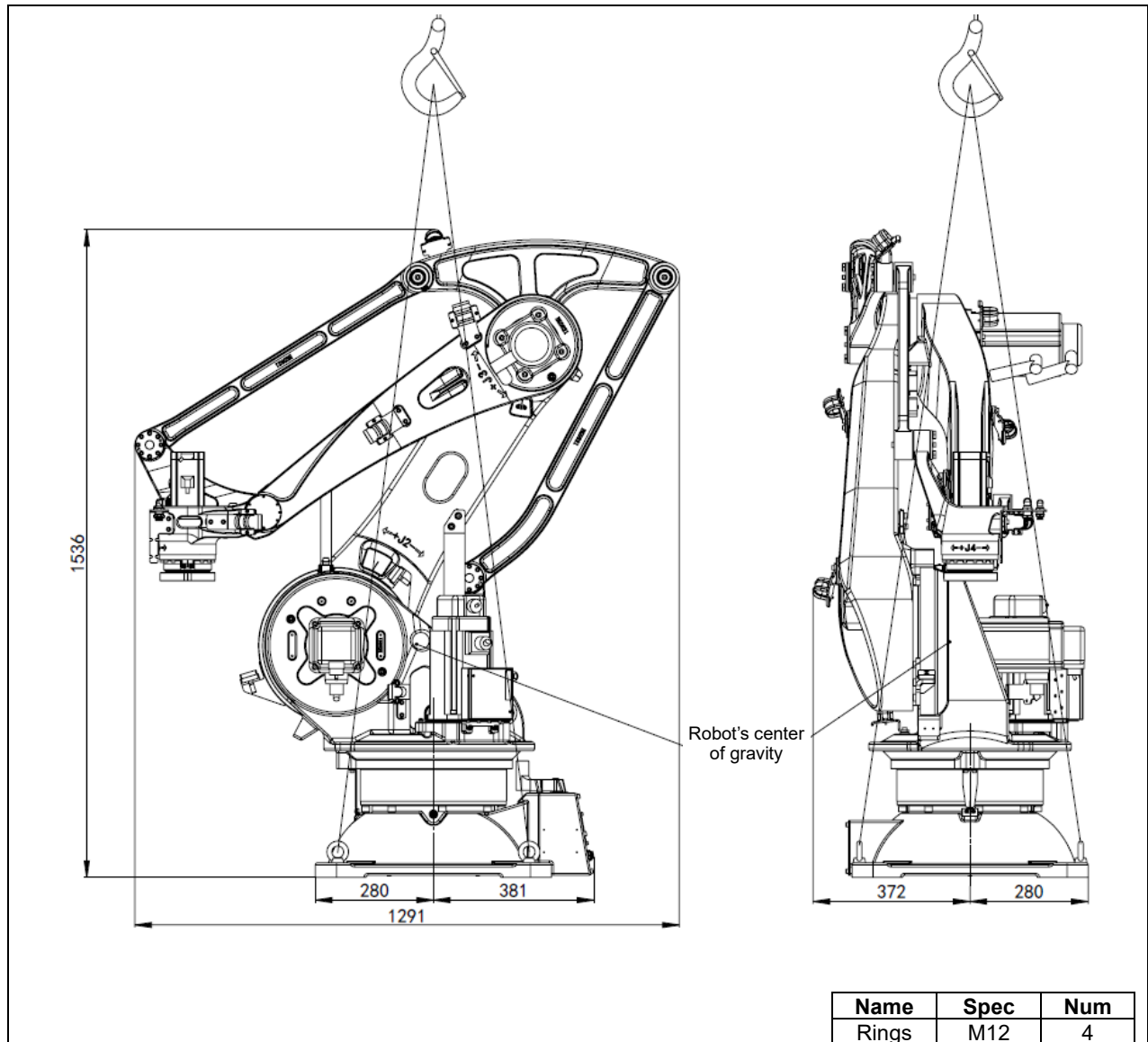


Fig 1.9 Use a crane to transport the robot (ER60-2000-PL)



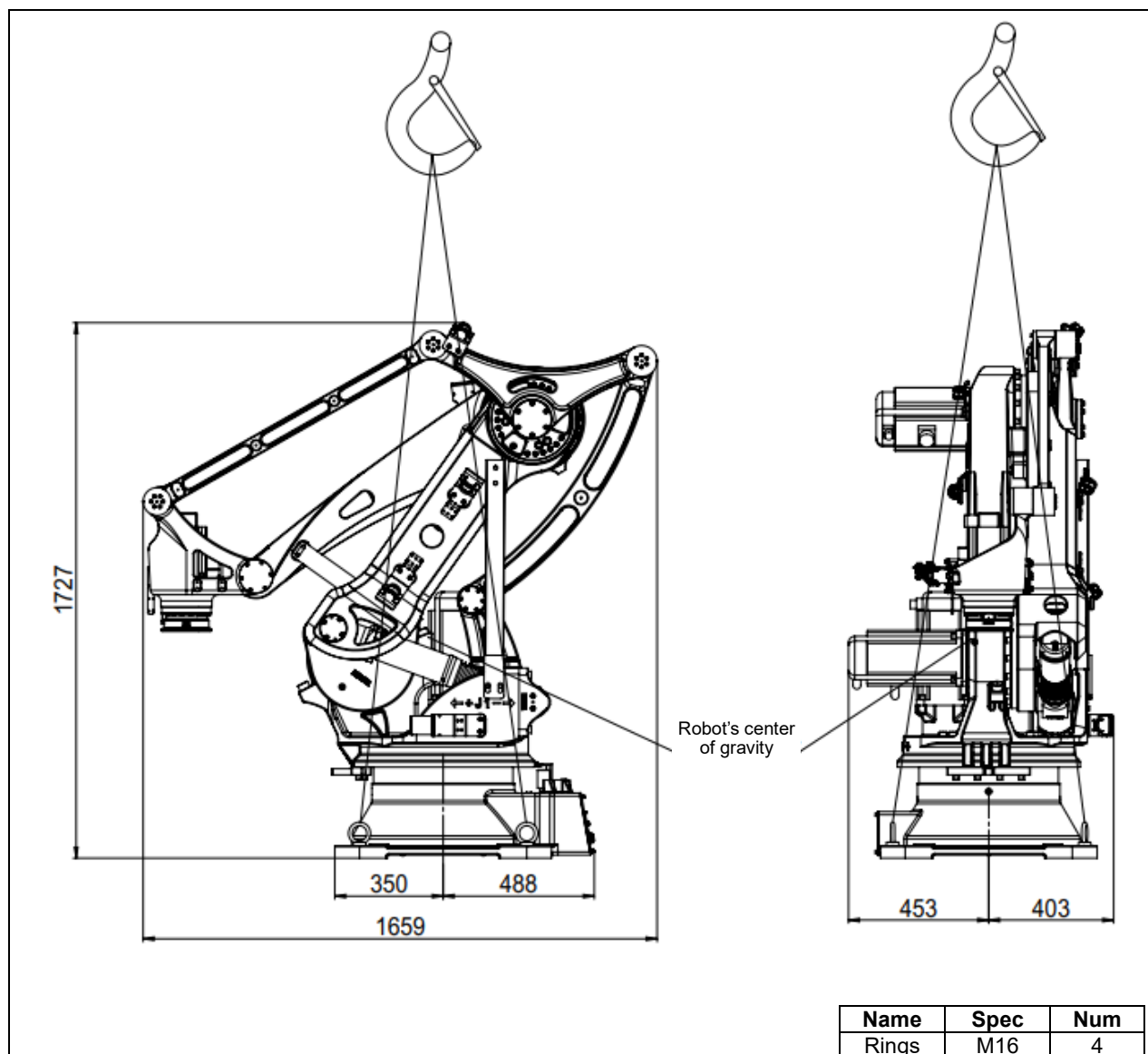


Fig 1.10 Use a crane to transport the robot (ER120-2400-PL)



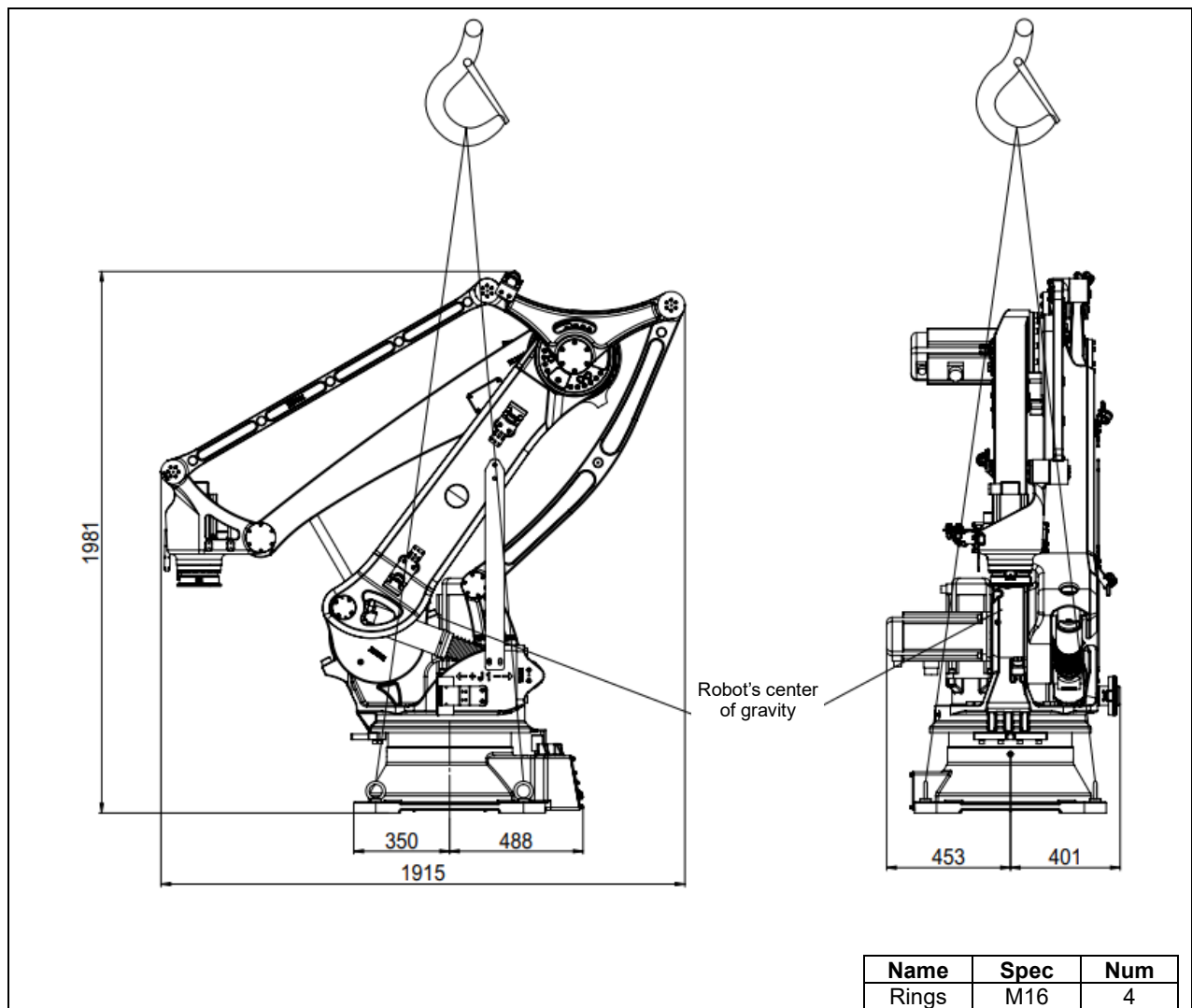


Fig 1.11 Use a crane to transport the robot (ER180-3100-PL)

## INSTALLATION



**Make sure the system is properly grounded before installation.**

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

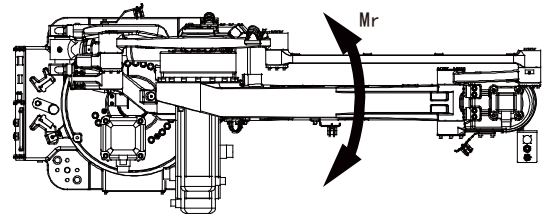
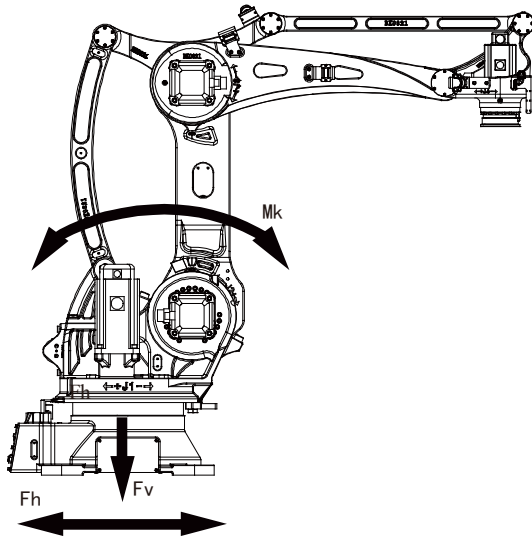
- Be sure to read and understand SAFETY chapter thoroughly.
- ESTUN robots must be transported, mounted and operated by authorized person, and in accordance with the applicable national laws, regulations and standards.
- Check the external damage of the robot package. Open the package and check the external damage of the robot.
- Make sure the weight of the robot is within the forklift or crane load capacity. Details see Section 1.1 TRANSPORTATION.
- Storage and mounting condition should be complied with Section 1.3 INSTALLATION CONDITION.





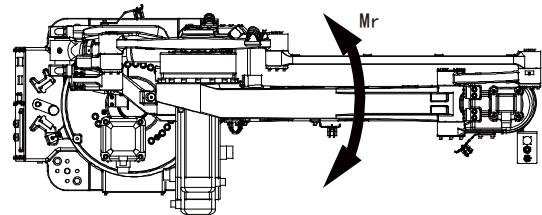
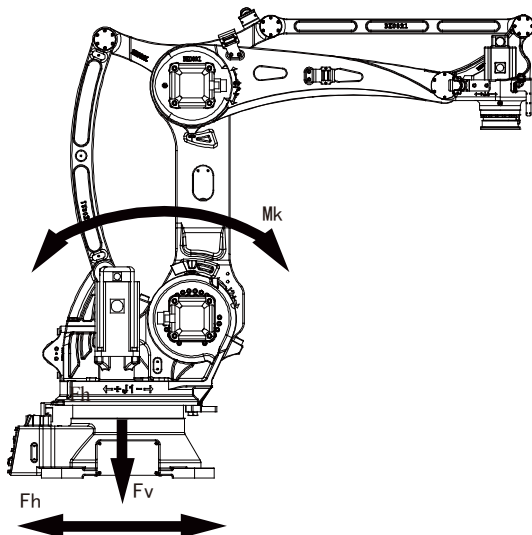
When mounting the robot base, consider its structure and the force upon it. Concrete on the base may not have any crack and conform to the specified codes. The bearing capacity and compaction of the concrete foundation should be in accordance with the design guideline. Concrete strength level C20/C25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

- GB50010-2010 *Code for design of concrete structures*
- GB/T50081-2002 *Standard for test method of mechanical properties on ordinary concrete*



| Item | Definition              | Max value   |
|------|-------------------------|-------------|
| Mk   | Max. overturning torque | 19600 (N·m) |
| Mr   | Max. torsional torque   | 14700 (N·m) |
| Fv   | Max. vertical force     | 23250 (N)   |
| Fh   | Max. horizontal force   | 12900 (N)   |

Fig 1.12 Robot base force (ER60)



| Item | Definition              | Max value   |
|------|-------------------------|-------------|
| Mk   | Max. overturning torque | 15721 (N·m) |
| Mr   | Max. torsional torque   | 15680 (N·m) |
| Fv   | Max. vertical force     | 25480 (N)   |
| Fh   | Max. horizontal force   | 2946 (N)    |

Fig 1.13 Robot base force (ER120-2400-PL)





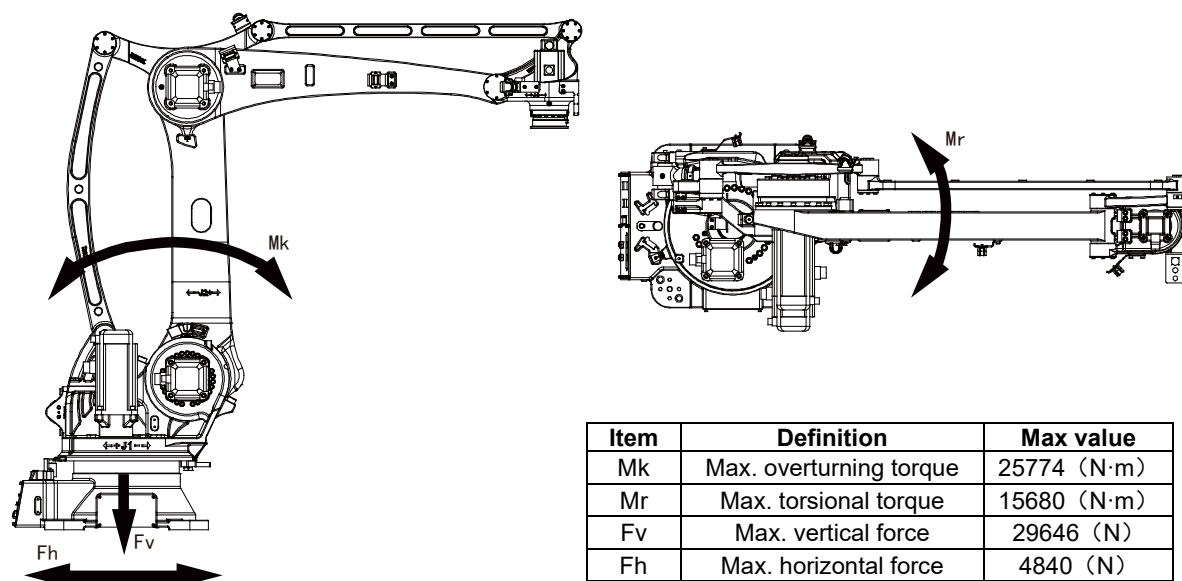


Fig 1.14 Robot base force (ER180-3100-PL)

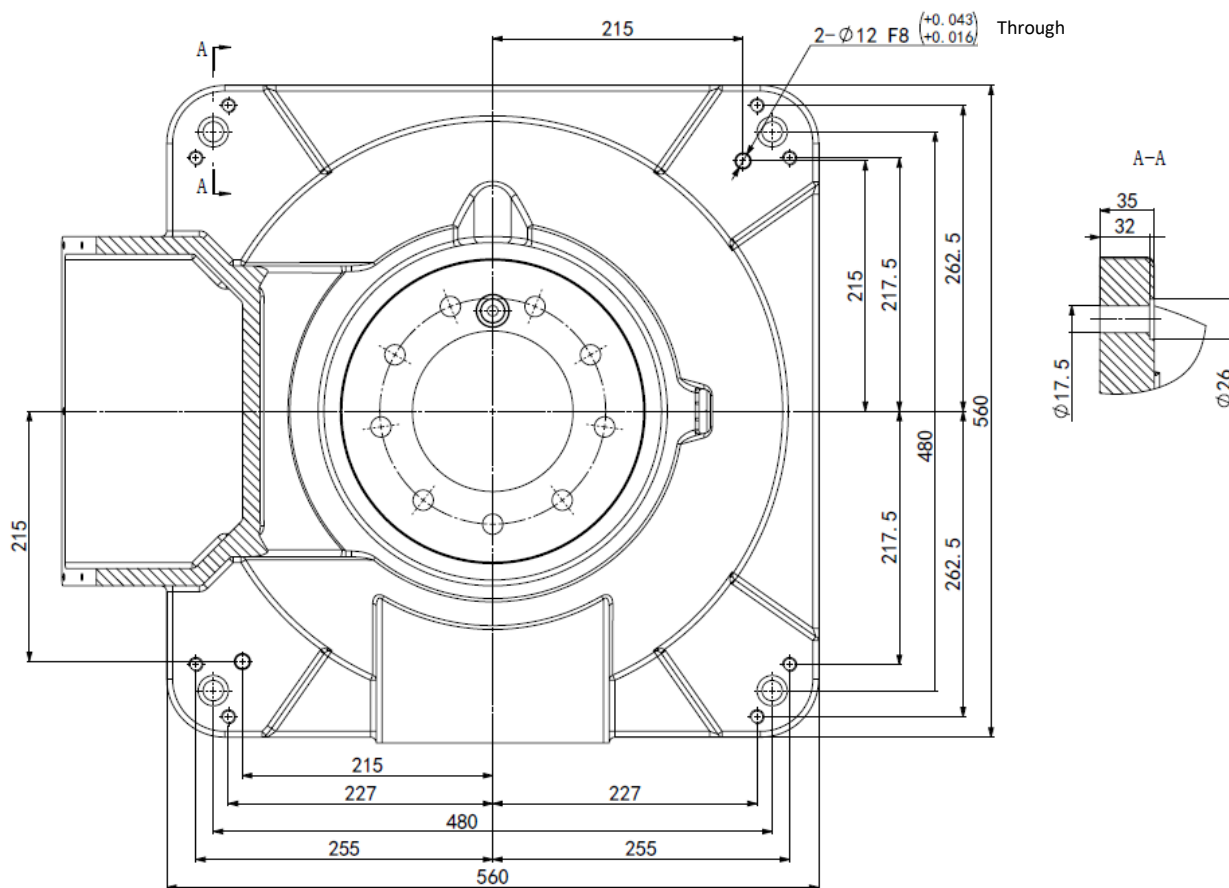


Fig 1.15 Robot base mounting dimension (ER60-2000-PL)



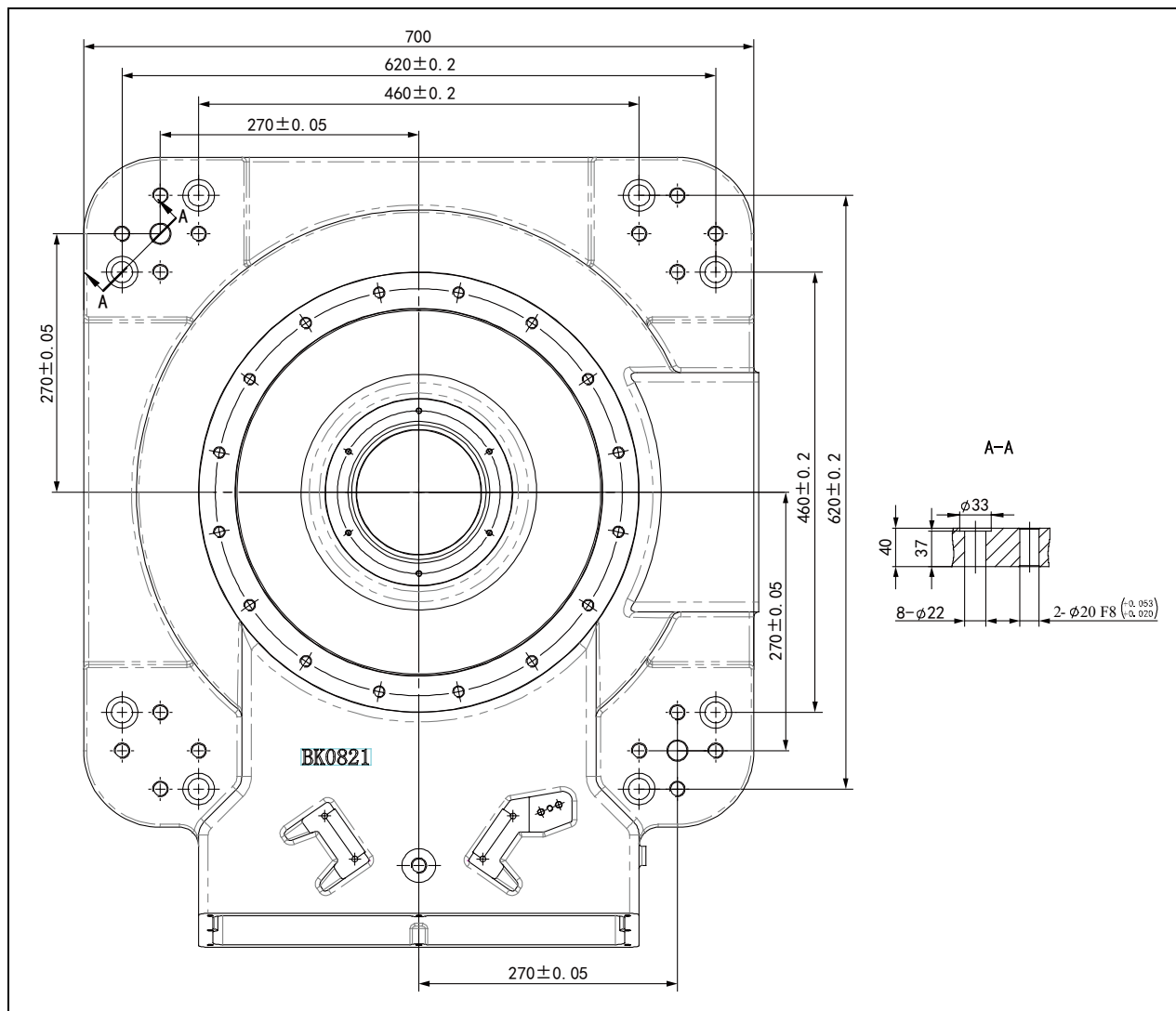


Fig 1.16 Robot base mounting dimension (ER120-2400-PL, ER180-3100-PL)



**ER120-2400-PL and ER180-3100-PL robots can also be fixed using 16-M16 threaded holes on the base if necessary; The ER60-2000-PL robot can also be fixed with 8-M12 threaded holes on the base if necessary.**

Tab 1.2 Robot fixing components (ER60-2000-PL)

| Item and model                                     | Amount |
|----------------------------------------------------|--------|
| Fixed screw: M16X55 (GB/T 70.1 grade 12.9)         | 4      |
| Spring washer: Spring washer 16 (GB/T 93)          | 4      |
| Positioning pin: Cylindrical pin 20X80 (GB/T120.2) | 2      |

Tab 1.3 Robot fixing components (ER120-2400-PL、ER180-3100-PL)

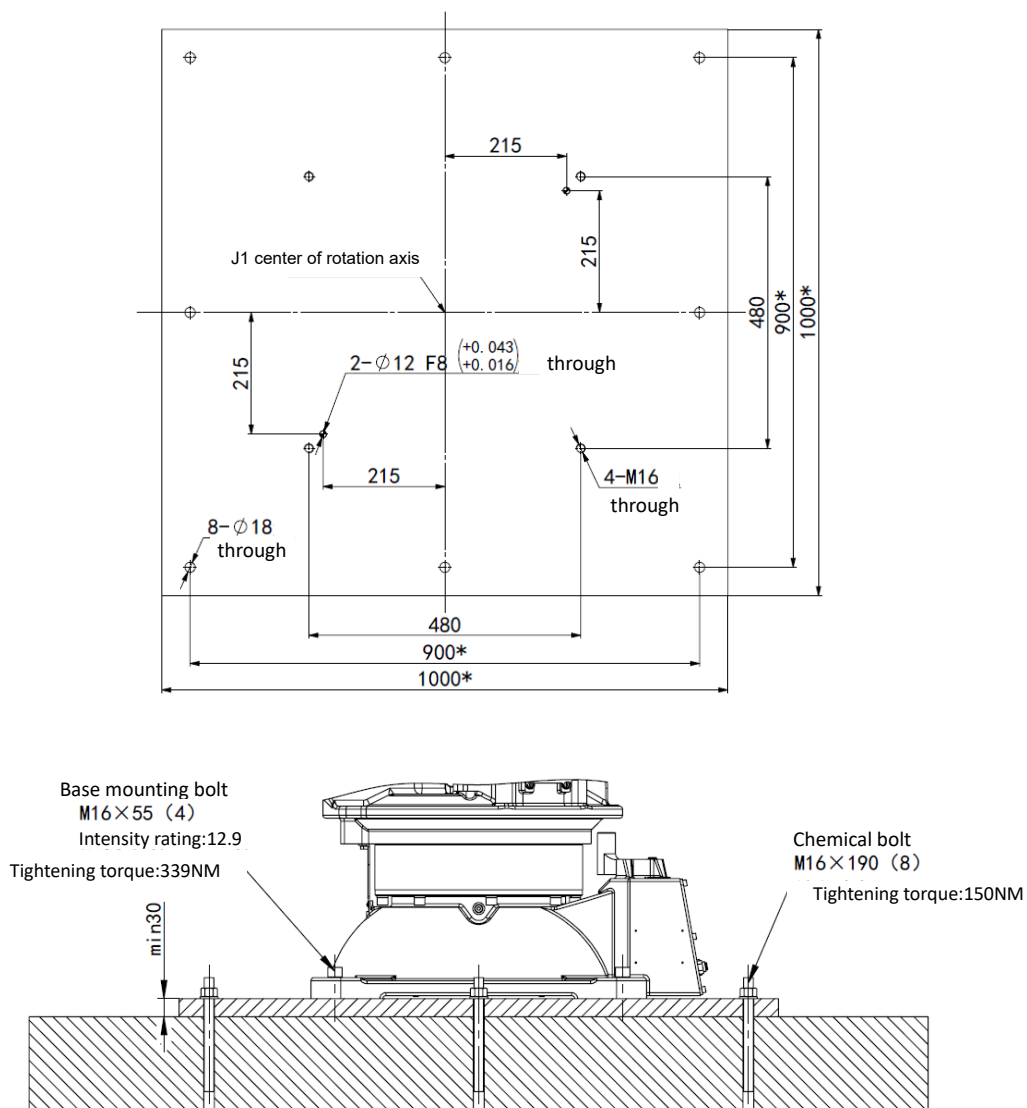
| Item and model                                     | Amount |
|----------------------------------------------------|--------|
| Fixed screw: M20X80 (GB/T 70.1 grade 12.9)         | 8      |
| Spring washer: Spring washer 20 (GB/T 93)          | 8      |
| Positioning pin: Cylindrical pin 20X80 (GB/T120.2) | 2      |





IN FO

Positioning pin can minimize the influence on current program caused by re-installation or replacement of the robot. If the recovery of programmed path is needed, perform adjustment. If not, positioning pin can be eliminated.

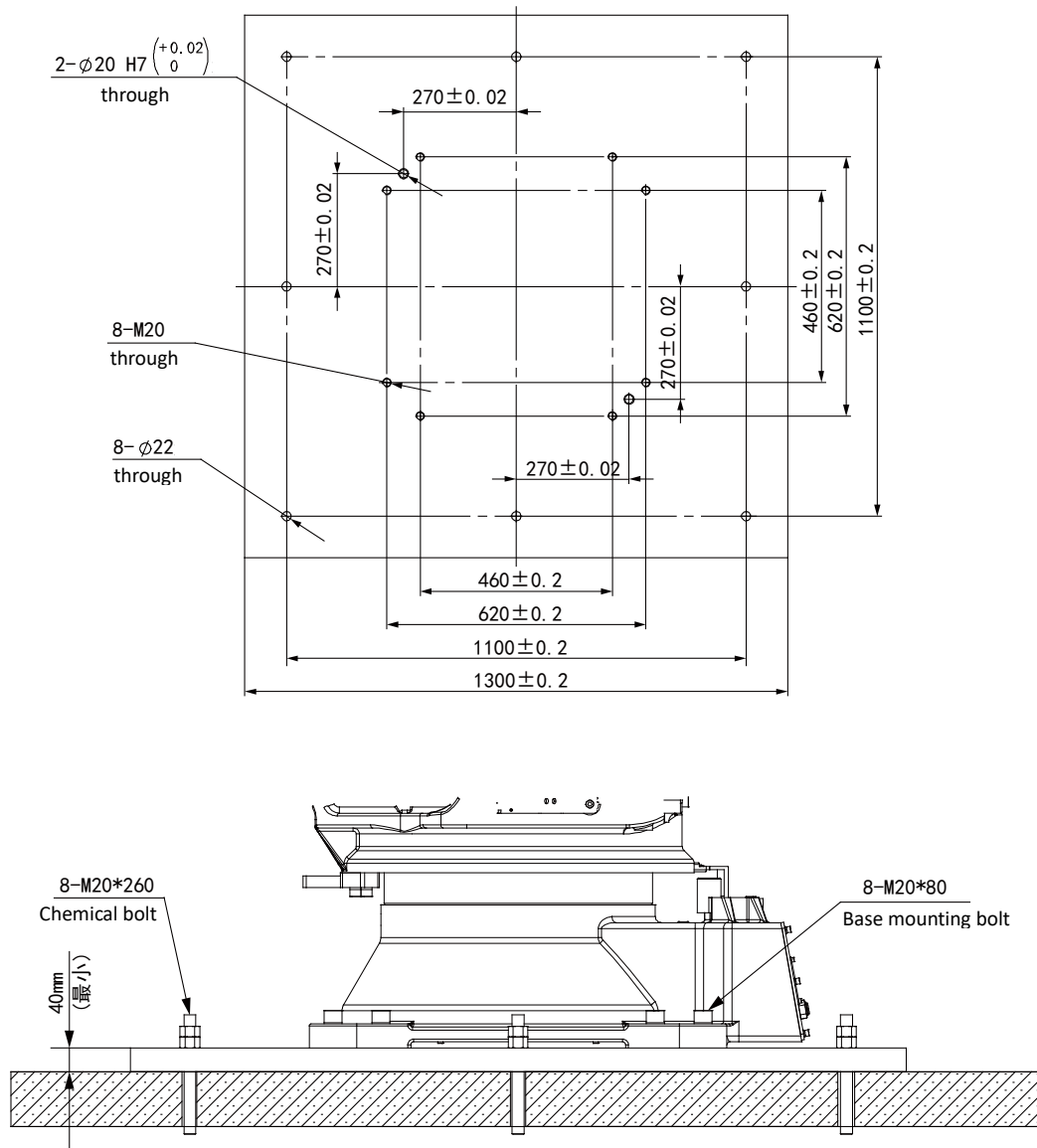


#### Notes:

Note: When installing iron plate on the ground, fix the robot installation plate to the concrete ground with eight  $M16 \times 190$  chemical bolts. The concrete thickness should be at least 190mm and the effective area 1300mm x 1300mm. The base is fixed to the iron plate with the parts listed above. The sizes marked with an asterisk (\*) are recommended. If the user requires alteration, he should consider the force of the robot exerted on the base and the structure of the base. All changes must be made after exact calculation.

Fig 1.17 Robot mounting plate dimension(ER60-2000-PL)





## Notes:

Note: When installing iron plate on the ground, fix the robot installation plate to the concrete ground with eight M20\*260 chemical bolts. The concrete thickness should be at least 190mm and the effective area 1300mm x 1300mm. The base is fixed to the iron plate with the parts listed above. The sizes marked with an asterisk (\*) are recommended. If the user requires alteration, he should consider the force of the robot exerted on the base and the structure of the base. All changes must be made after exact calculation.

Fig 1.18 Robot mounting plate dimension (ER120-2400-PL、ER180-3100-PL)





### 1.1.3.INSTALLATION CONDITIONS



**Damage of the cable jacket may cause water intrusion. Take care when installing the cable and exchange it if it is damaged.**

See the table below about installation conditions. Robot storage conditions are also listed in case that the robot needs to be stored for a period of time.

| Foundation               |       |
|--------------------------|-------|
| Max. surface roughness   | 0.5mm |
| Max. inclination angle   | 5°    |
| Storage condition        |       |
| Min. ambient temperature | -25℃  |
| Max. ambient temperature | +55℃  |
| Min. humidity            | 95%RH |
| Protection level         |       |
| ER60-2000-PL             | IP54  |
| ER180-3100-PL            |       |
| ER120-2400-PL            |       |

Performance of resistant chemicals and resistant solvents is listed below.

- (1) The robot (including severe dust/liquid protection model) cannot be used with the following liquids. Potentially these liquids will cause irreversible damage to the rubber parts (such as gaskets, oil seals, O-rings etc.). (As exception to this only liquids tested and approved by ESTUN can be used with the robot).
  - (a)Organic solvents
  - (b)Cutting fluid including chlorine/gasoline
  - (c)Amine type detergent
  - (d)Acid, alkali and liquid causing rust
  - (e)Other liquids or solutions that will harm NBR or CR rubber
- (2) When the robots work in the environment, using water or liquid, complete draining of J1 base must be done. Incomplete draining of J1base will make the robot break down.
- (3) Do not use unconfirmed liquid.
- (4) Do not use the robot immersed in water, neither temporary nor permanent. Robot must not be wet permanently. Example: in case motor surface is exposed to water for a long time, liquid may invade inside the motor and cause failure.





## 2. CONNECTION WITH THE CONTROLLER

The figure below shows the cables connect the robot with the controller. Connect these cables on the back of the base.

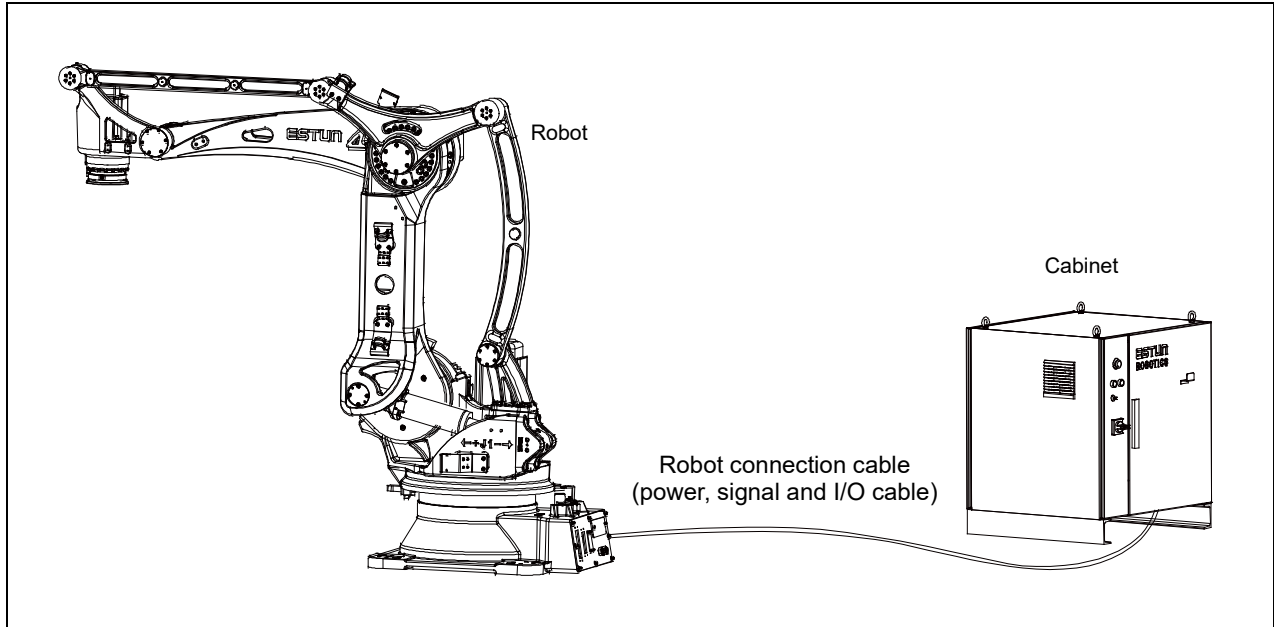


Fig 2.1 Cable connection



**The serial number of the robot should be accordance with that of the cabinet.  
Precision deviation may occur due to unmatched serial numbers.**





## 3. SPECIFICATIONS

### 3.1. ROBOT CONFIGURATION

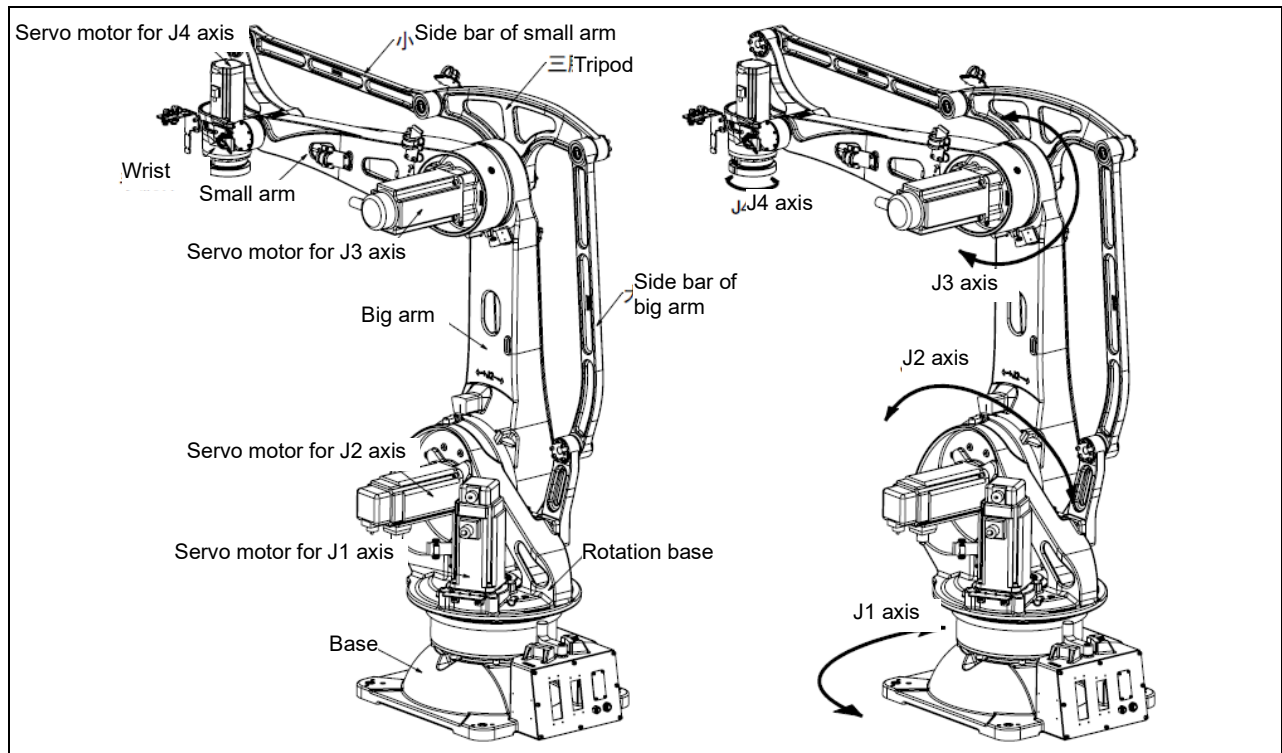


Fig 3.1 Robot Configuration (ER60-2000-PL)



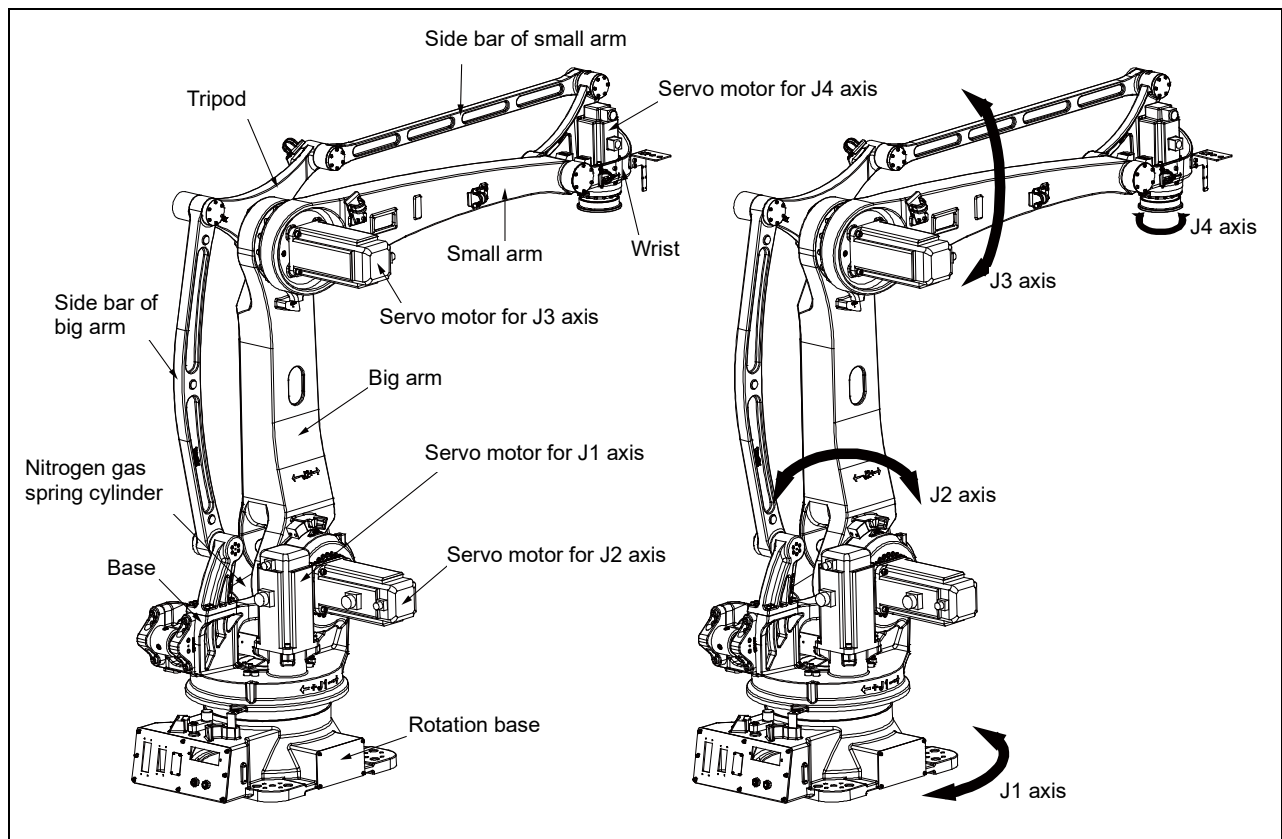


Fig 3.2 Robot Configuration (ER120-2400-PL, ER180-3100-PL)





Tab 3.1 Specifications

| Model                           |          | ER60-2000-PL                                                                                                                                                                                                                  | ER120-2400-PL               | ER180-3100-PL               |
|---------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------|
| Type                            |          | Articulated robot                                                                                                                                                                                                             |                             |                             |
| Controlled axis                 |          | FOUR axes                                                                                                                                                                                                                     |                             |                             |
| Installation                    |          | Floor                                                                                                                                                                                                                         |                             |                             |
| Motion range                    | J1-axis  | $\pm 180^\circ$                                                                                                                                                                                                               | $\pm 180^\circ$             | $\pm 180^\circ$             |
|                                 | J2-axis  | $-35^\circ \sim +90^\circ$                                                                                                                                                                                                    | $-40^\circ \sim +85^\circ$  | $-40^\circ \sim +90^\circ$  |
|                                 | J3-axis  | $-10^\circ \sim +110^\circ$                                                                                                                                                                                                   | $-20^\circ \sim +110^\circ$ | $-17^\circ \sim +110^\circ$ |
|                                 | J4-axis  | $\pm 360^\circ$                                                                                                                                                                                                               | $\pm 360^\circ$             | $\pm 360^\circ$             |
| Max. speed<br>(Note 1)          | J1-axis  | 170°/s                                                                                                                                                                                                                        | 114°/s                      | 114°/s                      |
|                                 | J2-axis  | 148°/s                                                                                                                                                                                                                        | 120°/s                      | 108°/s                      |
|                                 | J3-axis  | 185°/s                                                                                                                                                                                                                        | 149°/s                      | 118°/s                      |
|                                 | J4-axis  | 285°/s                                                                                                                                                                                                                        | 295°/s                      | 295°/s                      |
| Max. payload                    | At wrist | 60kg                                                                                                                                                                                                                          | 120kg                       | 180kg                       |
| Allowable load inertia at wrist | J4-axis  | 6.5 kg·m <sup>2</sup>                                                                                                                                                                                                         | 53 kg·m <sup>2</sup>        | 87kg·m <sup>2</sup>         |
| Drive method                    |          | Electric servo drive by AC servo motor                                                                                                                                                                                        |                             |                             |
| Repeatability                   |          | $\pm 0.03\text{mm}$                                                                                                                                                                                                           | $\pm 0.2\text{mm}$          | $\pm 0.2\text{mm}$          |
| Reach                           |          | 2000mm                                                                                                                                                                                                                        | 2400mm                      | 3060mm                      |
| Weight                          |          | 500kg                                                                                                                                                                                                                         | 1050kg                      | 1120kg                      |
| Installation environment        |          | Ambient temperature: 0~40℃ (Note 2)<br>Ambient humidity: 20~80%RH<br>Height: Up to 1000 meters above the sea level required<br>Vibration acceleration: 4.9m/s <sup>2</sup> (0.5G) or less<br>Free of corrosive gases (Note 3) |                             |                             |

**(Note 1)** During short distance motions, the axis speed may not reach the maximum value stated. The maximum speed is measured at zero position of the robot, and will be limited by the position of other axes.

**(Note 2)** When the robot is used in low temperature environment that is near 0℃ or not operated for a long time in the environment that is less than 0℃ in a holiday or the night, collision detection alarm may occur since the resistance of the drive mechanism could be high immediately after starting the operation. In this case, we recommend performing the warm up operation for several minutes.

**(Note 3)** Contact the service representative, if the robot is to be used in an environment or a place subjected to hot/cold temperatures, severe vibrations, heavy dust, cutting oil splash and or other foreign substances.

## 3.2. EXTERNAL DIMENSIONS AND OPERATING SPACE

The following figures show the robot operating space, for the reference of robot installation. When install peripheral devices, be careful not to interfere with the robot and its motion range.



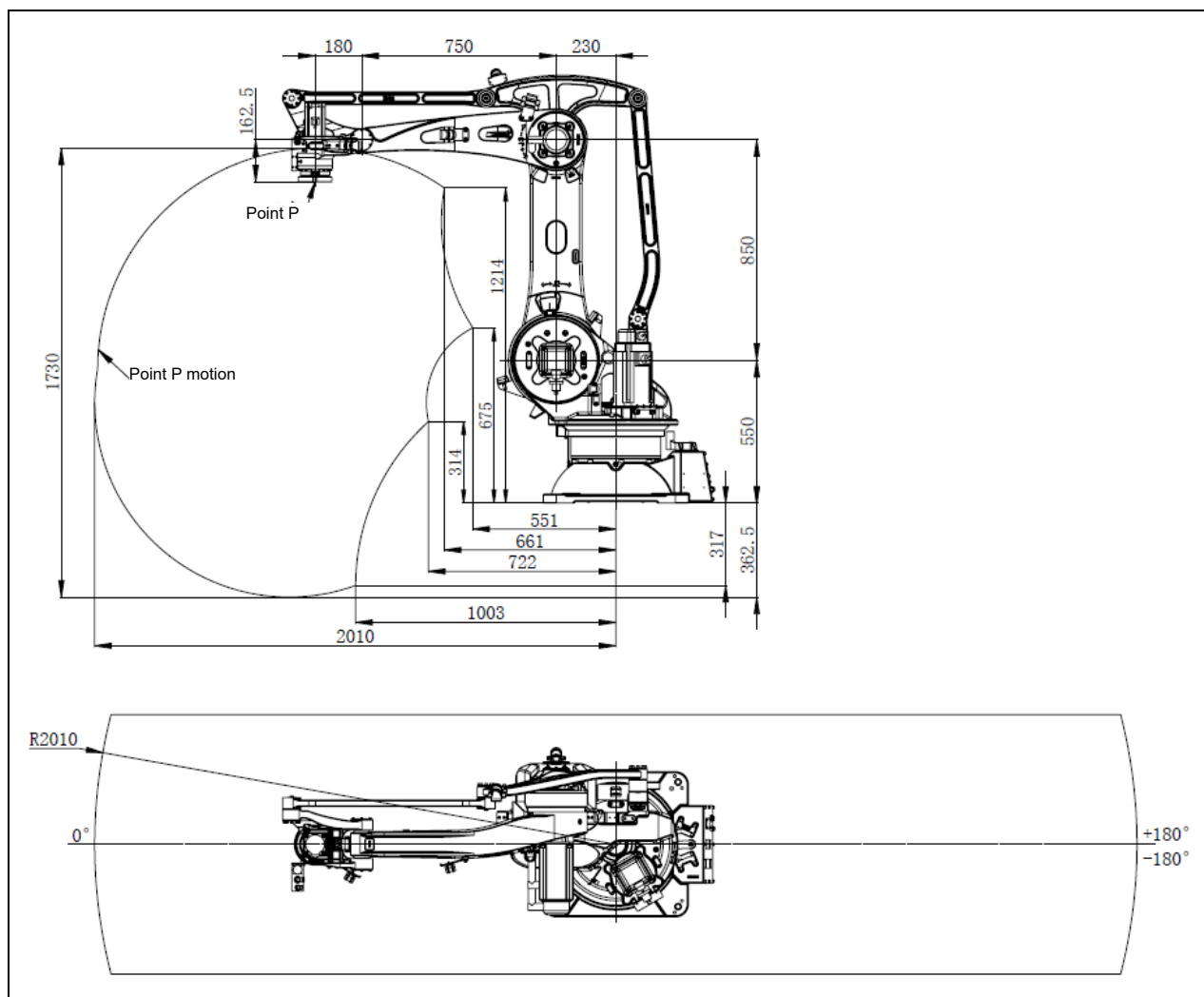


Fig 3.3 Motion range (ER60-2000-PL)

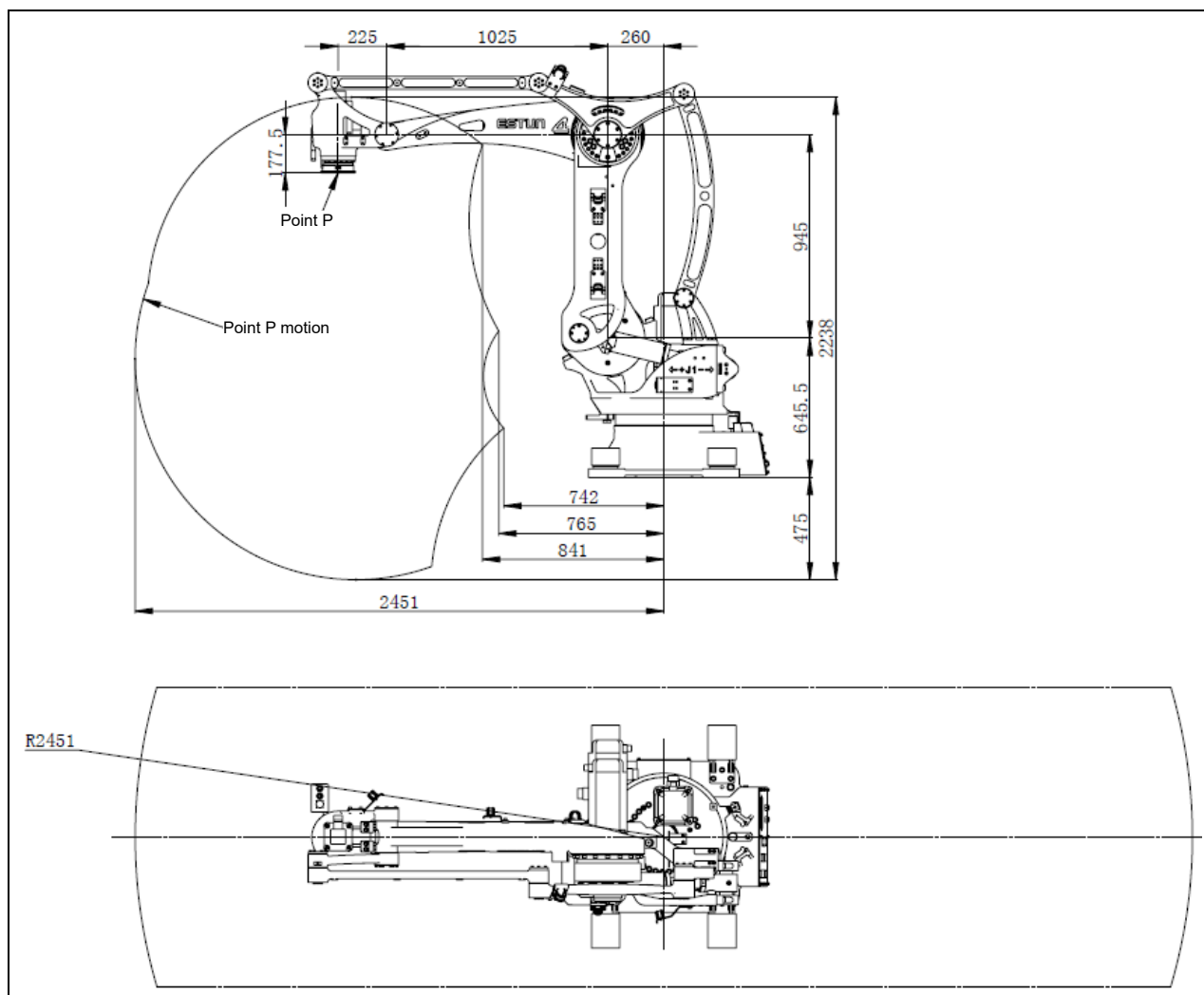


Fig 3.4 Motion range (ER120-2400-PL)

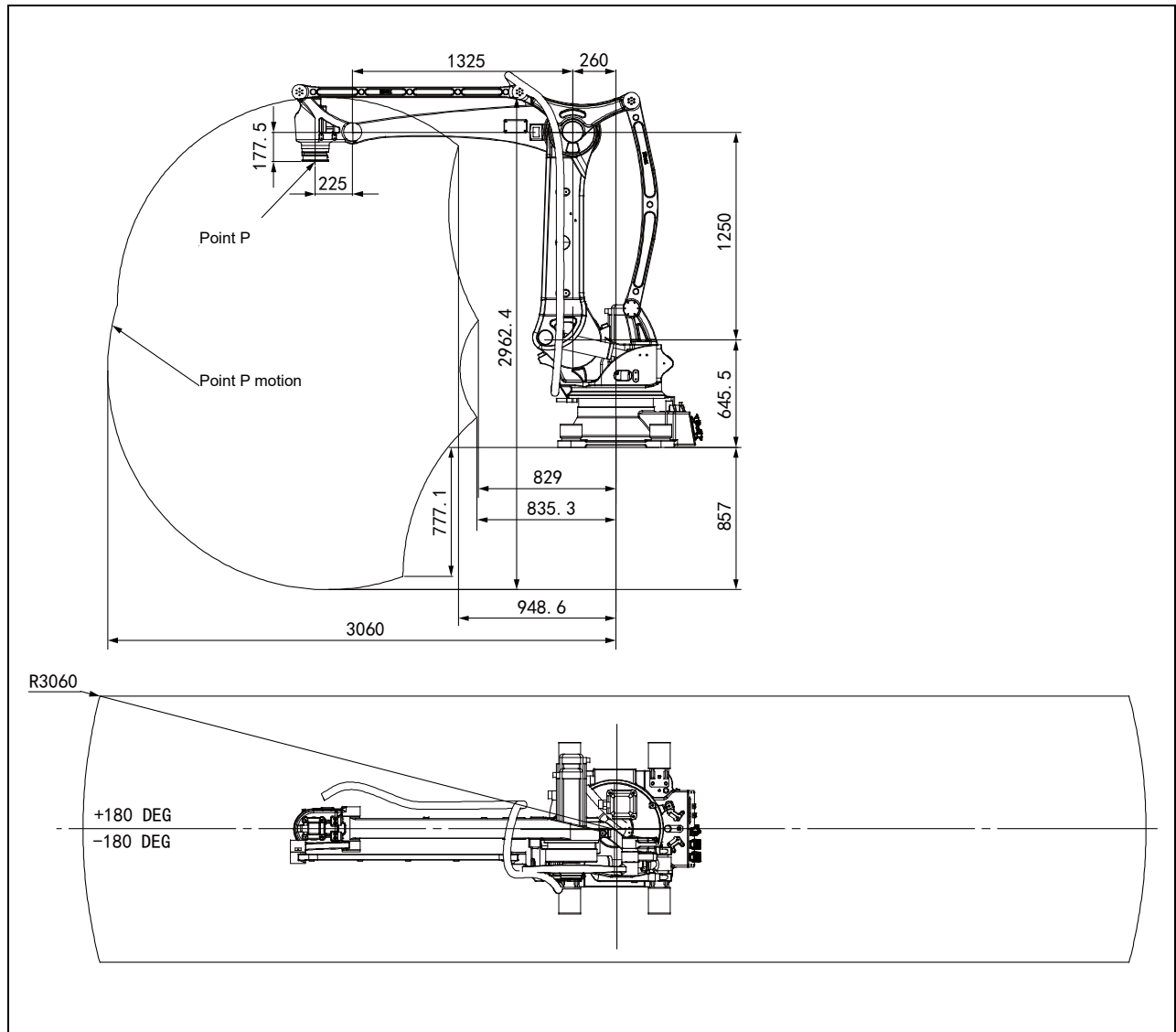


Fig 3.5 Motion range (ER180-3100-PL)

### 3.3. ZERO POINT POSITION AND MOTION LIMIT

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 is also prepared to improve safety.



CAUTION

**Do not reconstruct the fixed mechanical stopper. There is a possibility that the robot doesn't stop normally.**



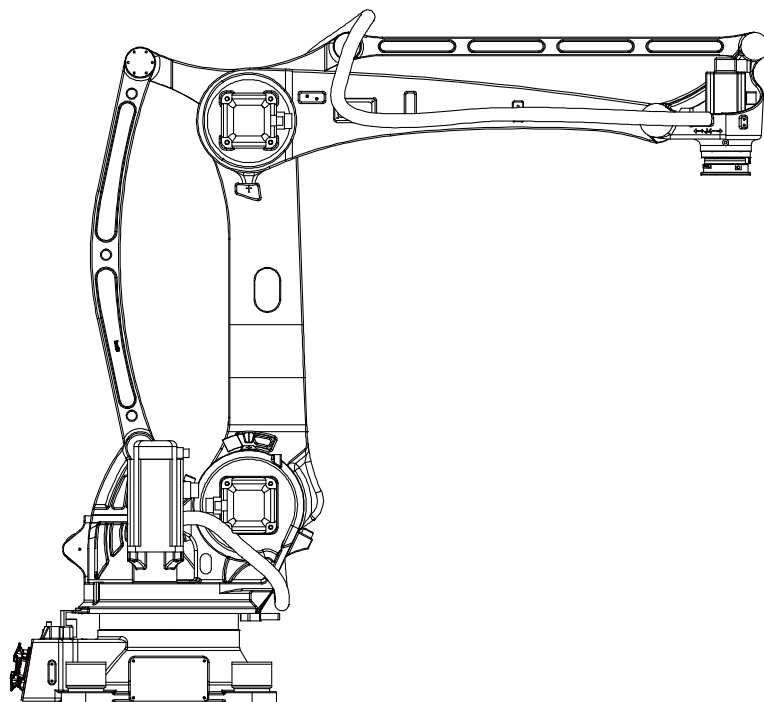


Fig 3.6 Zero point position



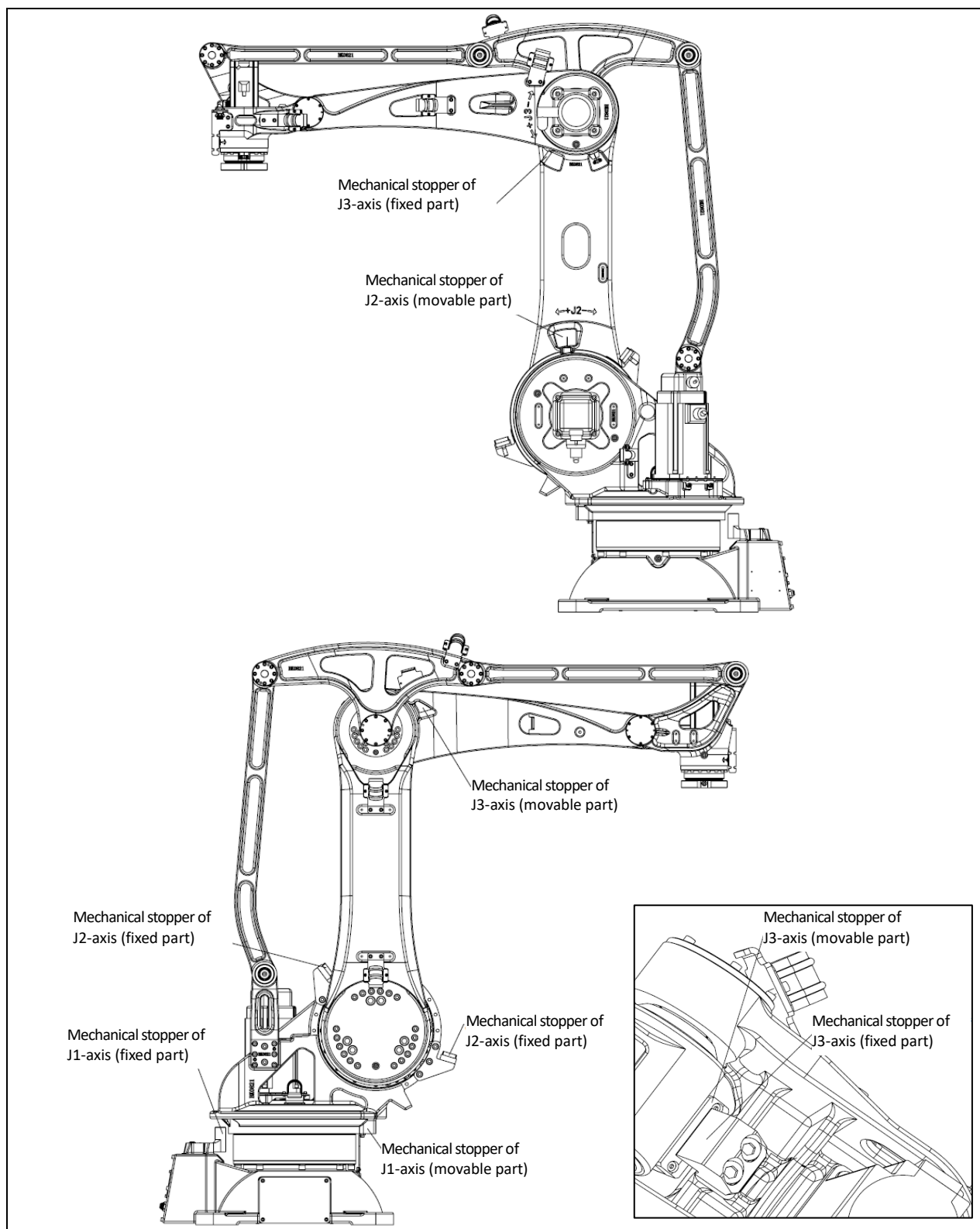


Fig 3.7 Mechanical stoppers (ER60-2000-PL)

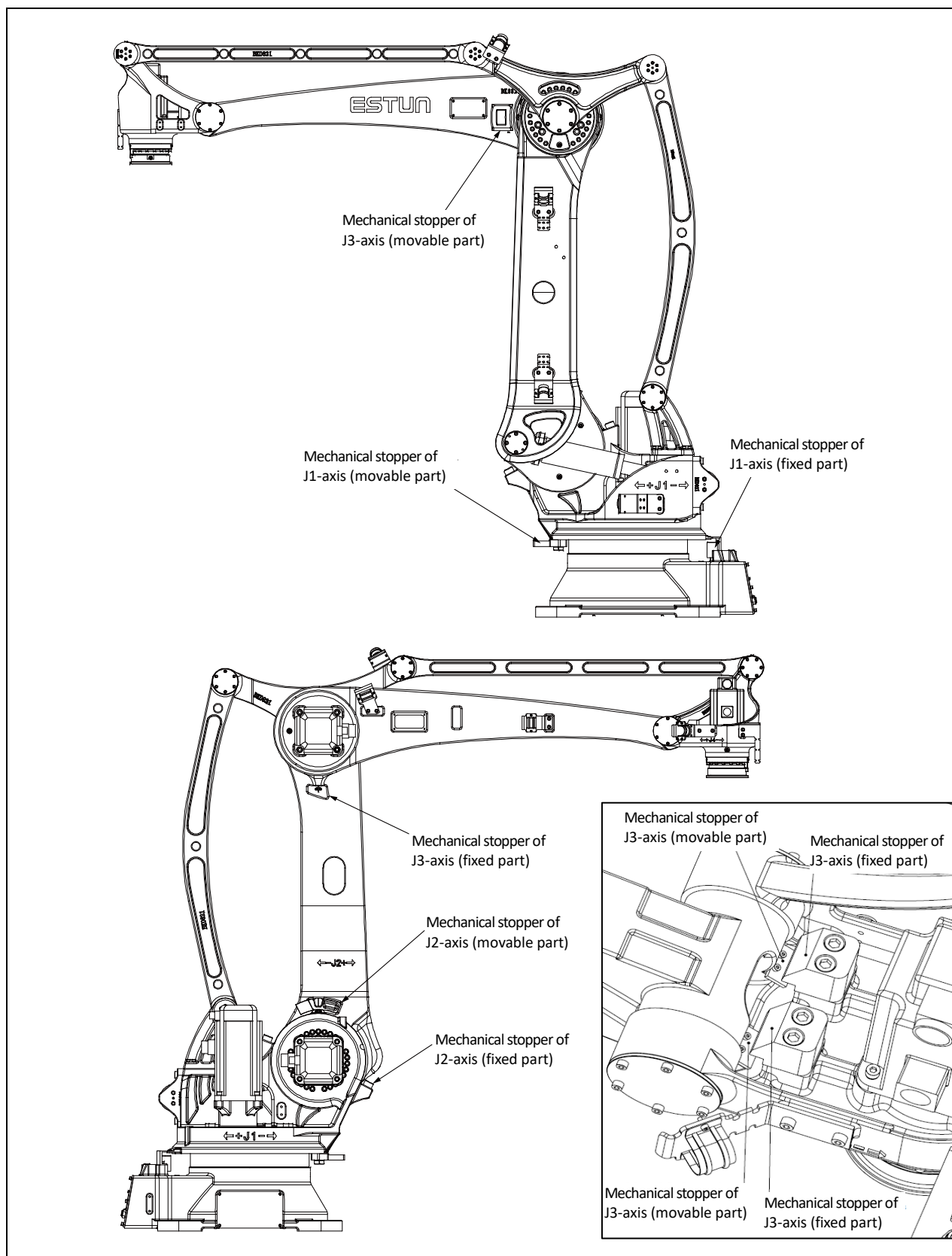


Fig 3.8 Mechanical stoppers (ER120-2400-PL, ER180-3100-PL)

Refer to system operation manual for more information about setting motion 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.



**Overload the robot may result in a worse movement performance on the robot or a reduction of service time on the reducer.**

**Payloads include total weight of tools such as grippers, welding guns, tool convertors, dampers, etc. If payload exceeds allowable value, it is necessary to consult ESTUN representatives.**

Refer to *ESTUN robot bearing capacity calculation table* when calculate load torque and load inertia. Contact ESTUN sales representatives for more detail.

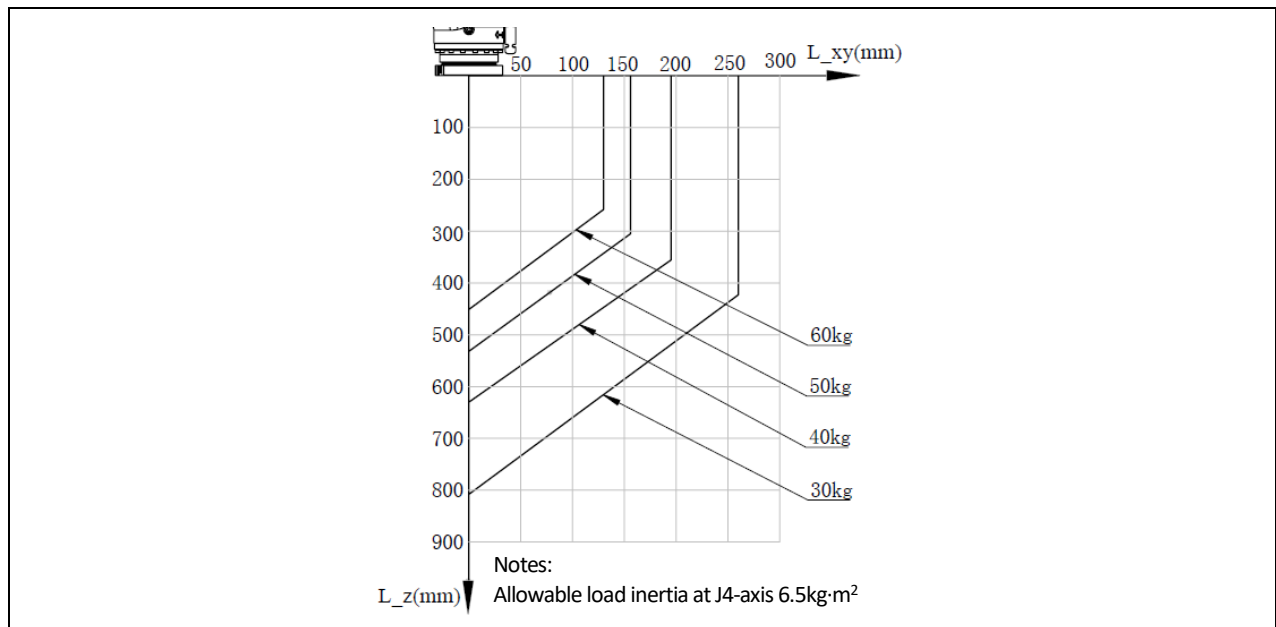


Fig 3.9 Load capacity at wrist (ER60-2000-PL)





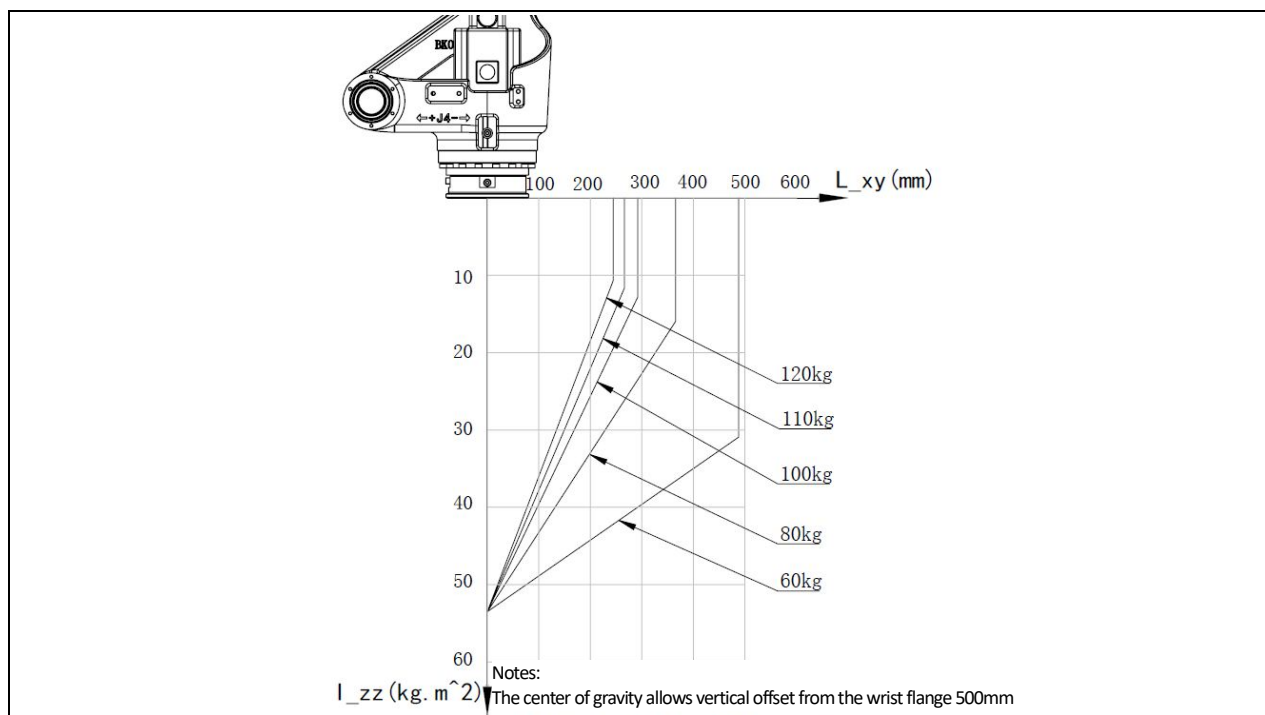


Fig 3.10 Load capacity at wrist (ER120-2400-PL)

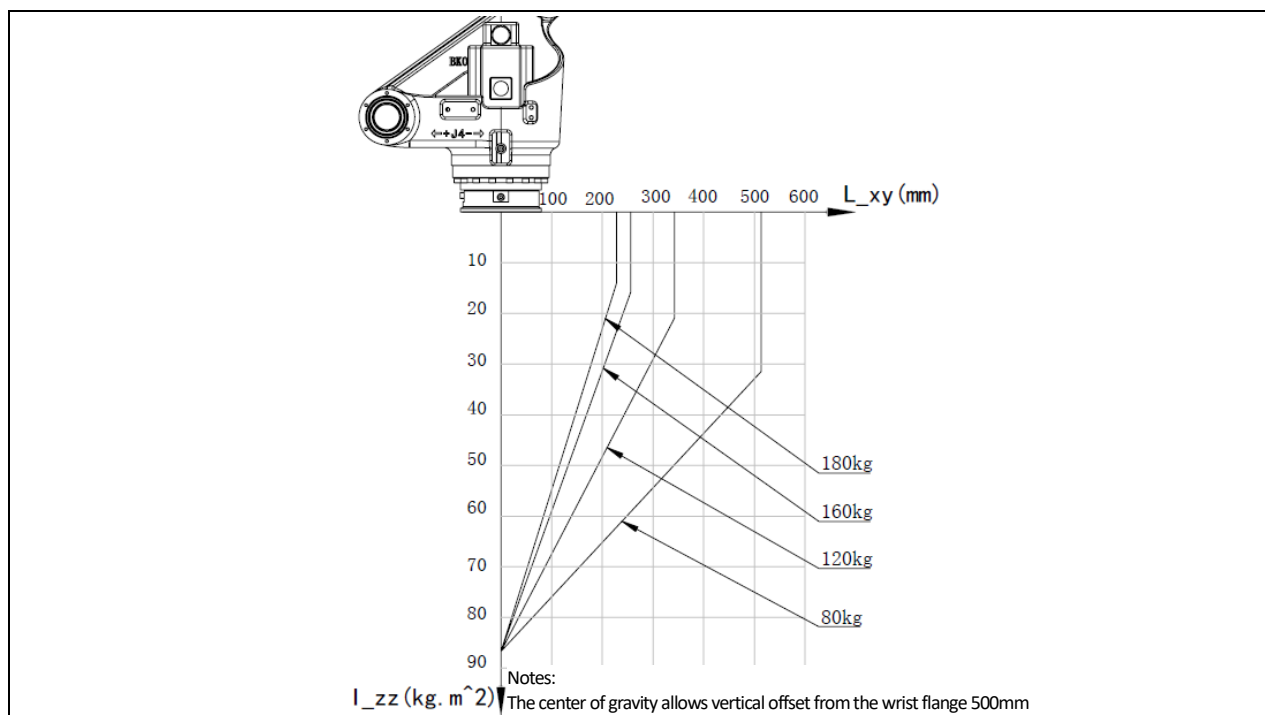


Fig 3.11 Load capacity at wrist (ER180-3100-PL)





## 4. EQUIPMENT INSTALLATION TO THE ROBOT

### 4.1. FLANGE DIMENSION

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.

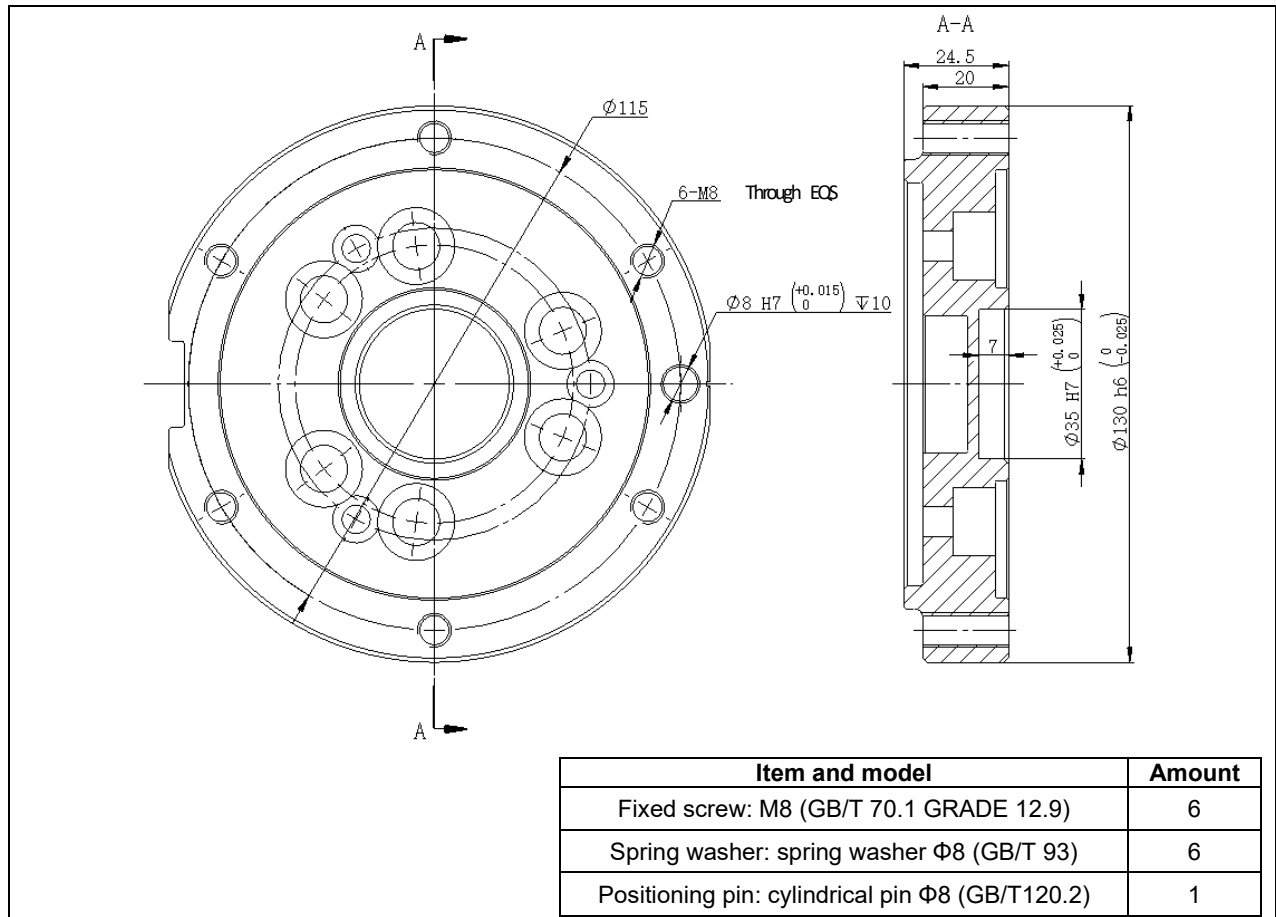


Fig 4.1 End flange mounting dimension (ER60-2000-PL)



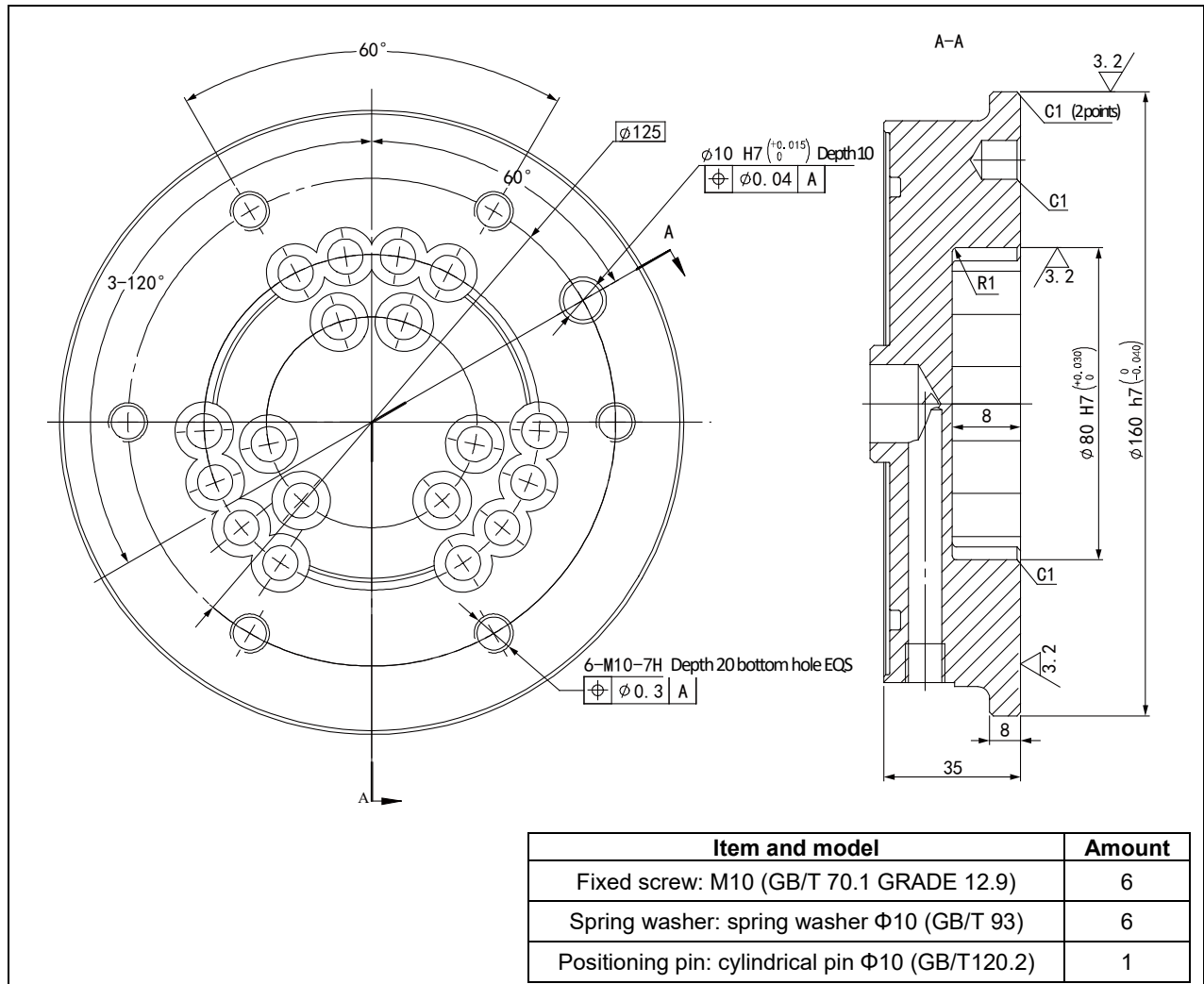


Fig 4.2 End flange mounting dimension (ER120-2400-PL, ER180-3100-PL)

## 4.2. TUBES AND PIPES

As shown in the figures below, tapped holes are provided to install equipment to the robot.

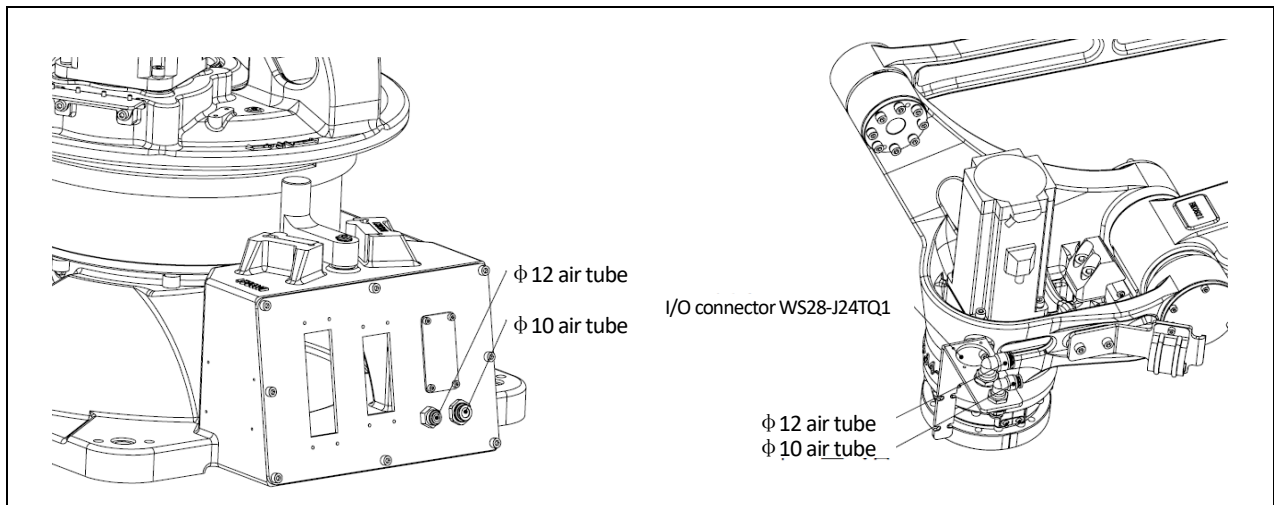


Fig 4.3 Pipes and tubes (ER60-2000-PL)

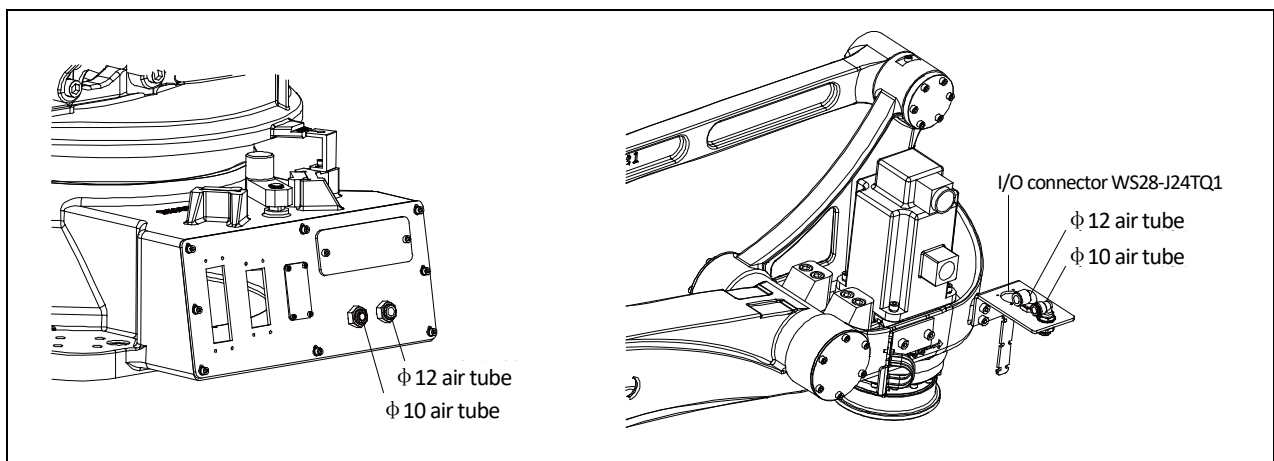


Fig 4.4 Pipes and tubes (ER120-2400-PL, ER180-3100-PL)



## 5. CHECK AND MAINTENANCE

Before performing any maintenance, be sure to read SAFETY PRECAUTIONS and understand the content.



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

### 5.1. DAILY CHECKS

Check the items below before daily operation as occasion demands.

| Item | Check item                      | 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 if there is vibration or abnormal noises in each transmission mechanism. If there is vibration or abnormal noises, perform measures referring to section 7.2.                              |
| 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 unexpected warnings occur in the alarm screen on the teach pendant. If unexpected warnings occur, perform measures as described in the ALARM DISPLAY in Cabinet Operator's manual. |

### 5.2. PERIODIC CHECKS AND MAINTENANCE

Check the items at the intervals recommended below based on the total time or the accumulated operating time, whichever comes first. Periodic checks keep the performance of the robot. The items below can be performed by yourself, or you can contact ESTUN for maintenance service.

| Check and maintenance intervals<br>(Operating time,<br>Accumulated operating time) |                     |                    |                       |                      |                      | Check and<br>maintenance item                    | Check points, management and maintenance method                                             |
|------------------------------------------------------------------------------------|---------------------|--------------------|-----------------------|----------------------|----------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1<br>Month<br>320h                                                                 | 3<br>Months<br>960h | 1<br>Year<br>3840h | 1.5<br>Years<br>5760h | 3<br>Years<br>11520h | 4<br>Years<br>15360h |                                                  |                                                                                             |
| ○<br>Only<br>1st<br>check                                                          | ○                   |                    |                       |                      |                      | Cleaning the<br>controller ventilation<br>system | Confirm the controller ventilation system is not dusty. If dust has accumulated, remove it. |
|                                                                                    | ○                   |                    |                       |                      |                      | Check the external                               | Check whether the robot has external damage or peeling paint                                |





|                     |                     |   |  |  |  |                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|---------------------|---|--|--|--|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     |                     |   |  |  |  | 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.                                                                                                                                                                                                                               |
| ○<br>Only 1st check | ○                   |   |  |  |  | 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.                                                                                                                                                                                            |
|                     | ○                   |   |  |  |  | Inspection of gas spring                                                                                 | Check if the gas spring cylinder contains normal pressure and if the piston rod shows any sign of wear.                                                                                                                                                                                                                                                                                                                                                            |
|                     | ○                   |   |  |  |  | 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.                                                                                                                                                                                                                                                                                                                                        |
|                     | ○<br>Only 1st check | ○ |  |  |  | Check for damages to the teach pendant cable, the cabinet connection cable or the robot connection cable | Check whether the cable connected to the teach pendant, cabinet and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.                                                                                                                                                                                                                                                                                                         |
| ○<br>Only 1st check |                     | ○ |  |  |  | Check for damage to the mechanical unit cable (movable part)                                             | Observe the movable part of the mechanical unit cable, and check for damage. Also, check whether the cables are excessively bent or unevenly twisted.                                                                                                                                                                                                                                                                                                              |
|                     | ○<br>Only 1st check | ○ |  |  |  | Check for damage to the end effector (hand) connection cable                                             | Check whether the end effector connection cables are unevenly twisted or damaged. If damage is found, replace the damaged cables.                                                                                                                                                                                                                                                                                                                                  |
|                     | ○<br>Only 1st check | ○ |  |  |  | Check the connection of each axis motor and other exposed connectors                                     | Check the connection of each axis motor and other exposed connectors.                                                                                                                                                                                                                                                                                                                                                                                              |
|                     | ○<br>Only 1st check | ○ |  |  |  | Retightening the end effector mounting bolts                                                             | Retightening the end effector mounting bolts.                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                     | ○<br>Only 1st check | ○ |  |  |  | Retightening the external main bolts                                                                     | Retighten the robot installation bolts, bolts to be removed for inspection, and bolts exposed to the outside. Refer to the recommended bolt tightening torque guidelines at Appendix A. An adhesive to prevent bolts from loosening is applied to some bolts. If the bolts are tightened with greater than the recommended torque, the adhesive might be removed. Therefore, follow the recommended bolt tightening torque guidelines when retightening the bolts. |
|                     | ○<br>Only 1st check | ○ |  |  |  | Check the mechanical stopper                                                                             | Check that there is no evidence of a collision on the mechanical stopper, and check the looseness of the stopper                                                                                                                                                                                                                                                                                                                                                   |





|  |                           |   |  |   |   |                                                                                                                                                                                                                                                                                                                                       |
|--|---------------------------|---|--|---|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |                           |   |  |   |   | mounting bolts.                                                                                                                                                                                                                                                                                                                       |
|  | ○<br>Only<br>1st<br>check | ○ |  |   |   | Clean spatters,<br>sawdust and dust<br><br>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, the balancer rod, the support part of in front and behind of the balancer, and the cable protection sheaths). |
|  | ○<br>Only<br>1st<br>check | ○ |  |   |   | Check the<br>operation of the<br>cooling fan<br><br>(When cooling fans are installed on the each axis motor)<br>Check whether the cooling fans are operating correctly. If the cooling fans do not operate, replace them.                                                                                                             |
|  |                           | ○ |  |   |   | Replacing the<br>mechanical unit<br>battery<br><br>Replace the mechanical unit battery.                                                                                                                                                                                                                                               |
|  |                           |   |  | ○ |   | Replacing the<br>grease of each axis<br>reducer<br><br>Replace the grease of each axis reducer.                                                                                                                                                                                                                                       |
|  |                           |   |  |   | ○ | Replacing the<br>mechanical unit<br>cable<br><br>Replace the mechanical unit cable. Contact ESTUN representative for information regarding replacing the cable                                                                                                                                                                        |



## 5.2.1. Inspection of gas spring



**Before checking the gas spring, be sure to disconnect the controller and external power source. Set up an eye-catching sign to prevent any personnel turn on the power unintentionally, or avoid unpredictable shock accident. Replace the gas spring when the pressure is not maintained or when wear occurs on the piston pin. Contact ESTUN for more details about replacing the gas spring.**

There are two methods to check the gas spring.

**Method I: check the gas pressure of the spring by measure the static load rate of J2-axis motor.**

Tab 5.1 Static load rate of J2-axis

| Model         | Gesture                        | Load rate<br>(zero load) | Load rate<br>(50kg) | Load rate<br>(full load) |
|---------------|--------------------------------|--------------------------|---------------------|--------------------------|
| ER120-2400-PL | J2=50°                         | 18%~28%                  | 35%~45%             | 62%~72%                  |
| ER180-3100-PL | J3 in the horizontal direction | 20%~30%                  | 40%~50%             | 75%~85%                  |

**Method II: check with a gas-pressure meter.**

This robot needs a gas-pressure meter (model GA3500) to check the gas spring.

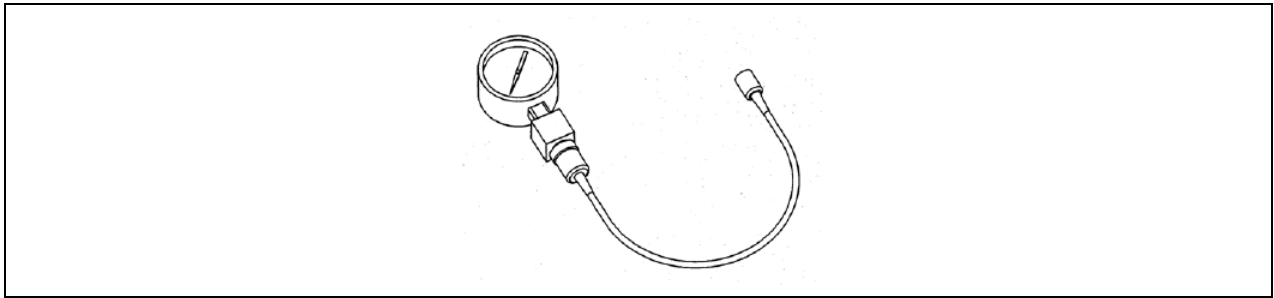


Fig 5.1 Gas-pressure meter

1. Procedures of checking the gas spring pressure of ER120.
  - a) Adjust J2-axis to -5° and then turn off the power supply.
  - b) Remove the cover and screw of the gas spring inlet.

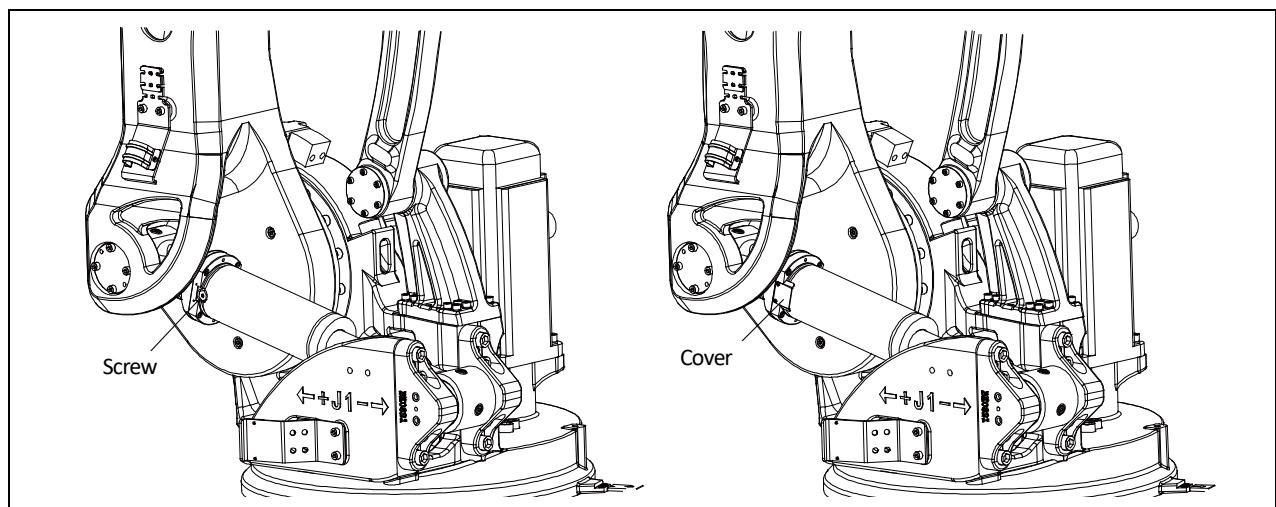


Fig 5.2 Inspection of gas spring

- c) A gas pressure detection device is mounted at the air inlet and specified pressure is listed in



the table below.

- d) After confirming the air pressure, remove the detection device and reinstall the screw and cover.

Tab 5.2 Gas-pressure corresponding to the surface temperature of the gas spring (ER120-2400-PL)

| Surface temp<br>J2-axis angle | 0℃      | 5℃       | 10℃      | 15℃      | 20℃     | 25℃      | 30℃      | 35℃      | 40℃      |
|-------------------------------|---------|----------|----------|----------|---------|----------|----------|----------|----------|
| -5°                           | 7.64MPa | 7.78 MPa | 7.92 MPa | 8.06 MPa | 8.2 MPa | 8.34 MPa | 8.48 MPa | 8.62 MPa | 8.76 MPa |

2. Procedures of checking the gas spring pressure of ER180
  - a) Adjust J2-axis to -35° and then turn off the power supply.
  - b) Remove the cover and screw of the gas spring inlet.
  - c) A gas pressure detection device is mounted at the air inlet and specified pressure is listed in the table below.
  - d) After confirming the air pressure, remove the detection device and reinstall the screw and cover.

Tab 5.3 Gas-pressure corresponding to the surface temperature of the gas spring (ER180-3100-PL)

| Surface temp<br>J2-axis angle | 5℃        | 10℃       | 15℃       | 20℃       | 25℃       | 30℃       | 35℃      | 40℃       | 45℃       |
|-------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|
| -35°                          | 13.72 MPa | 13.97 MPa | 14.21 MPa | 14.46 MPa | 14.71 MPa | 14.95 MPa | 15.2 MPa | 15.45 MPa | 15.69 MPa |



**When confirming the gas-pressure, the internal pressure will decrease by 0.05MPa. Fill in gas when confirmation is up to six times.**

## 5.3. REPLACING THE BATTERY

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

Procedures of replacing the battery:

1. Press the emergency stop button to avoid any dangerous situation.
2. Remove the cover of the battery box.
3. Take out the old battery from the box.
4. Fix the new battery into the battery box. Make sure the direction is correct.
5. Fix the cover of the battery box.

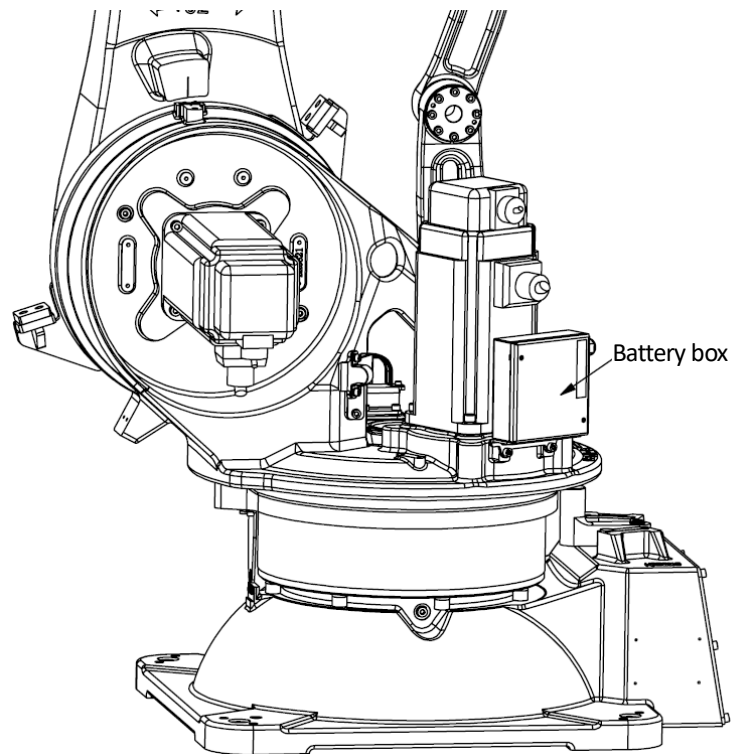


Fig 5.3 Battery replacing (ER60-2000-PL)

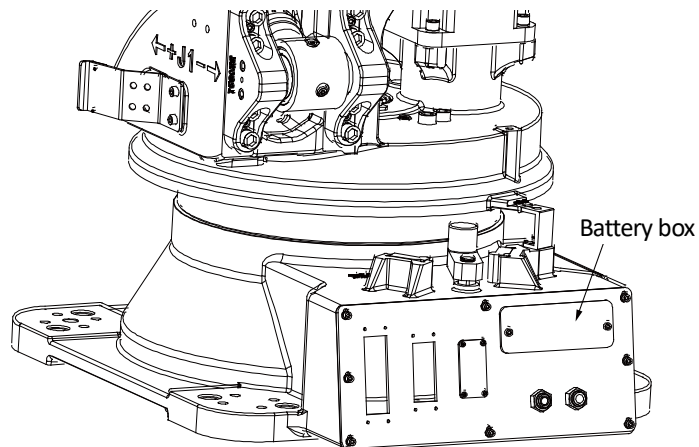


Fig 5.4 Battery replacing (ER120-2400-PL, ER180-3100-PL)



CAUTION

**Be sure to keep the power on. If the power is cut off during replacing, the position data will lost. Therefore, calibration will be required again.**

## 5.4. GREASING

Greasing is required to each part every 3 years, or for a cumulative operation time of 11520 hours, whichever occurs first, according to the following steps. Refer to the table below for the brand and quantities of the grease applied to each joint.





**Reduce greasing period when the robot is subject to extreme conditions.**

Tab 5.4 Replacing the grease periodically

| Model                | Position        | Quantity |
|----------------------|-----------------|----------|
| <b>ER60-2100-PL</b>  | J1-axis reducer | 3680 ml  |
|                      | J2-axis reducer | 1610 ml  |
|                      | J3-axis reducer | 1150 ml  |
|                      | J4-axis reducer | 230 ml   |
| <b>ER120-2400-PL</b> | J1-axis reducer | 4200 ml  |
|                      | J2-axis reducer | 1420 ml  |
|                      | J3-axis reducer | 1380 ml  |
|                      | J4-axis reducer | 450 ml   |
| <b>ER180-3100-PL</b> | J1-axis reducer | 4200 ml  |
|                      | J2-axis reducer | 2000 ml  |
|                      | J3-axis reducer | 1380 ml  |
|                      | J4-axis reducer | 450 ml   |

Recommend greasing gesture is list below.

Tab 5.5 Robot joint greasing angle(ER60-2000-PL)

| Position        | Gesture |     |     |     |
|-----------------|---------|-----|-----|-----|
|                 | J1      | J2  | J3  | J4  |
| J1-axis reducer | Any     | Any | Any | Any |
| J2-axis reducer |         | 0°  |     |     |
| J3-axis reducer |         |     |     |     |
| J4-axis reducer |         | Any | Any |     |

Tab 5.6 Robot joint greasing angle(ER120-2400-PL, ER180-3100-PL)

| Position        | Gesture |     |     |     |
|-----------------|---------|-----|-----|-----|
|                 | J1      | J2  | J3  | J4  |
| J1-axis reducer | Any     | Any | Any | Any |
| J2-axis reducer |         | 0°  |     |     |
| J3-axis reducer |         |     |     |     |
| J4-axis reducer |         | Any | Any | 0°  |

#### 5.4.1.Position of oil inlet/outlet on each axis



**Follow the instructions in the safety chapter when greasing the reducer.**



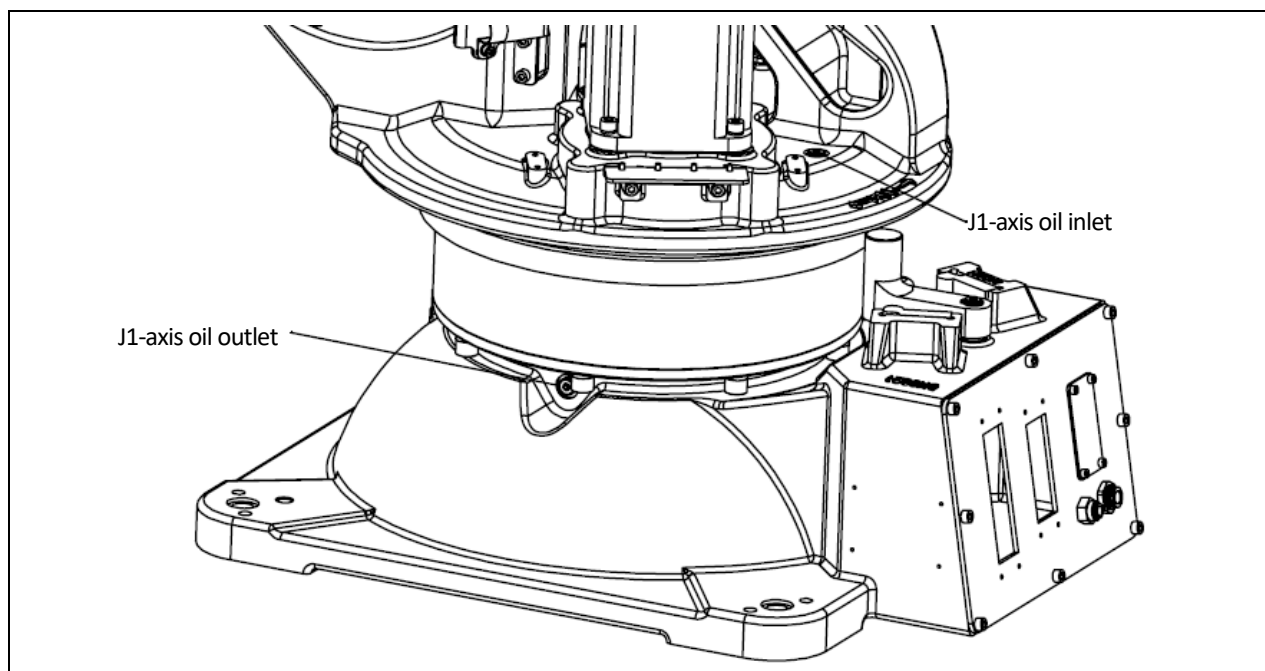


Fig 5.5 J1-axis oil inlet/outlet(ER60-2000-PL)

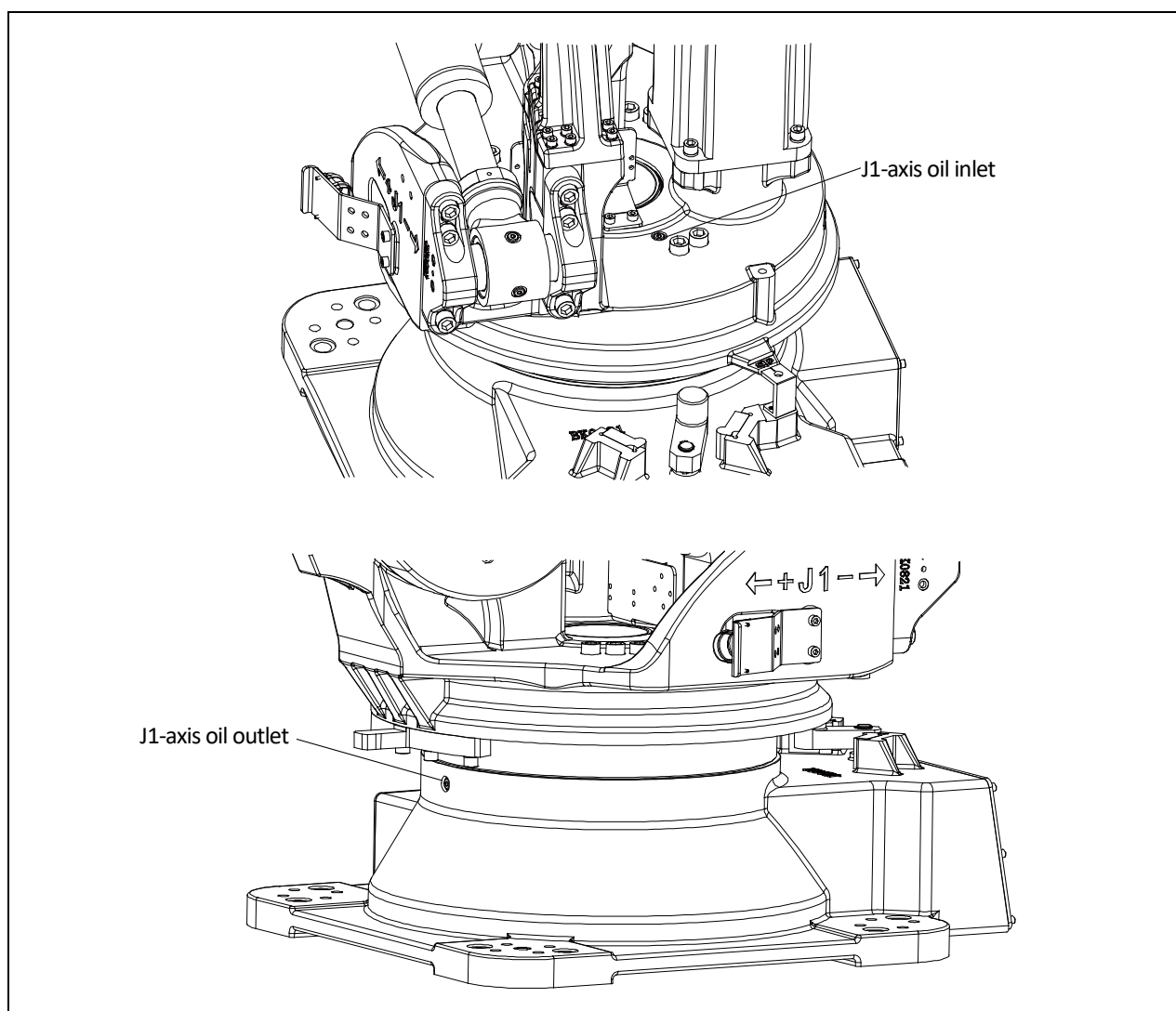


Fig 5.6 J1-axis oil inlet/outlet(ER120-2400-PL, ER180-3100-PL)

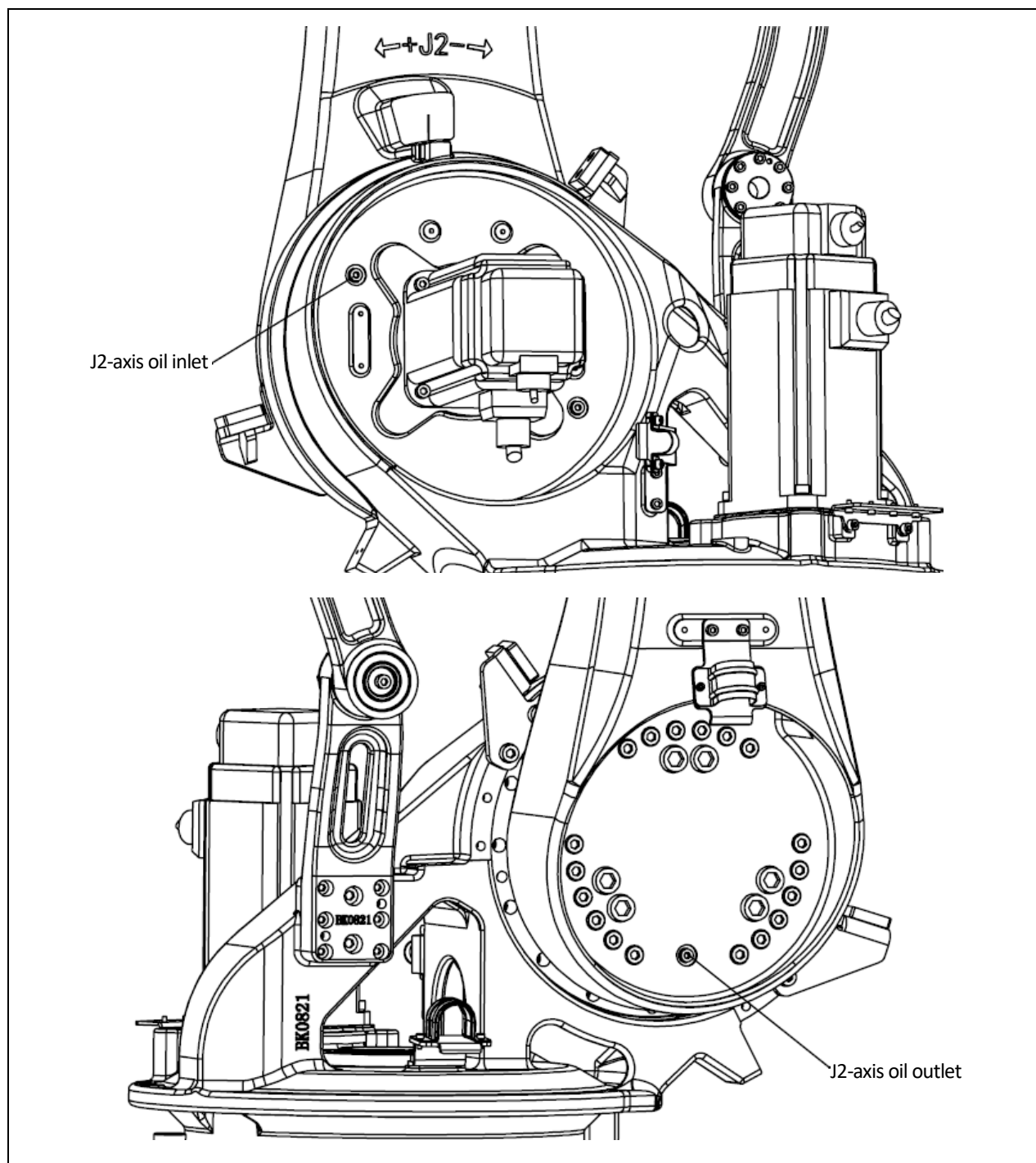


Fig 5.7 J2-axis oil inlet/outlet(ER60-2000-PL)

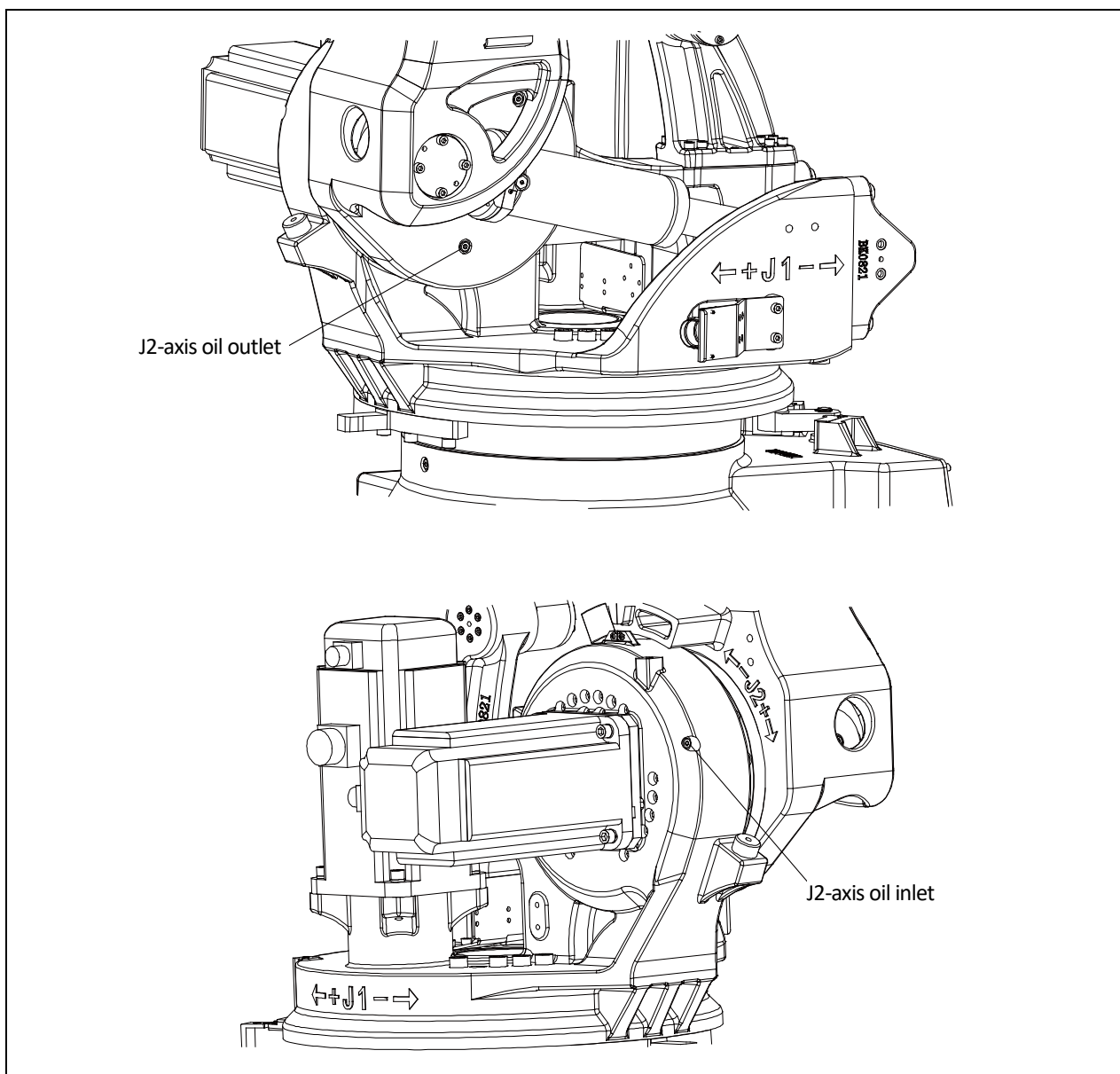


Fig 5.8 J2-axis oil inlet/outlet(ER120-2400-PL, ER180-3100-PL)





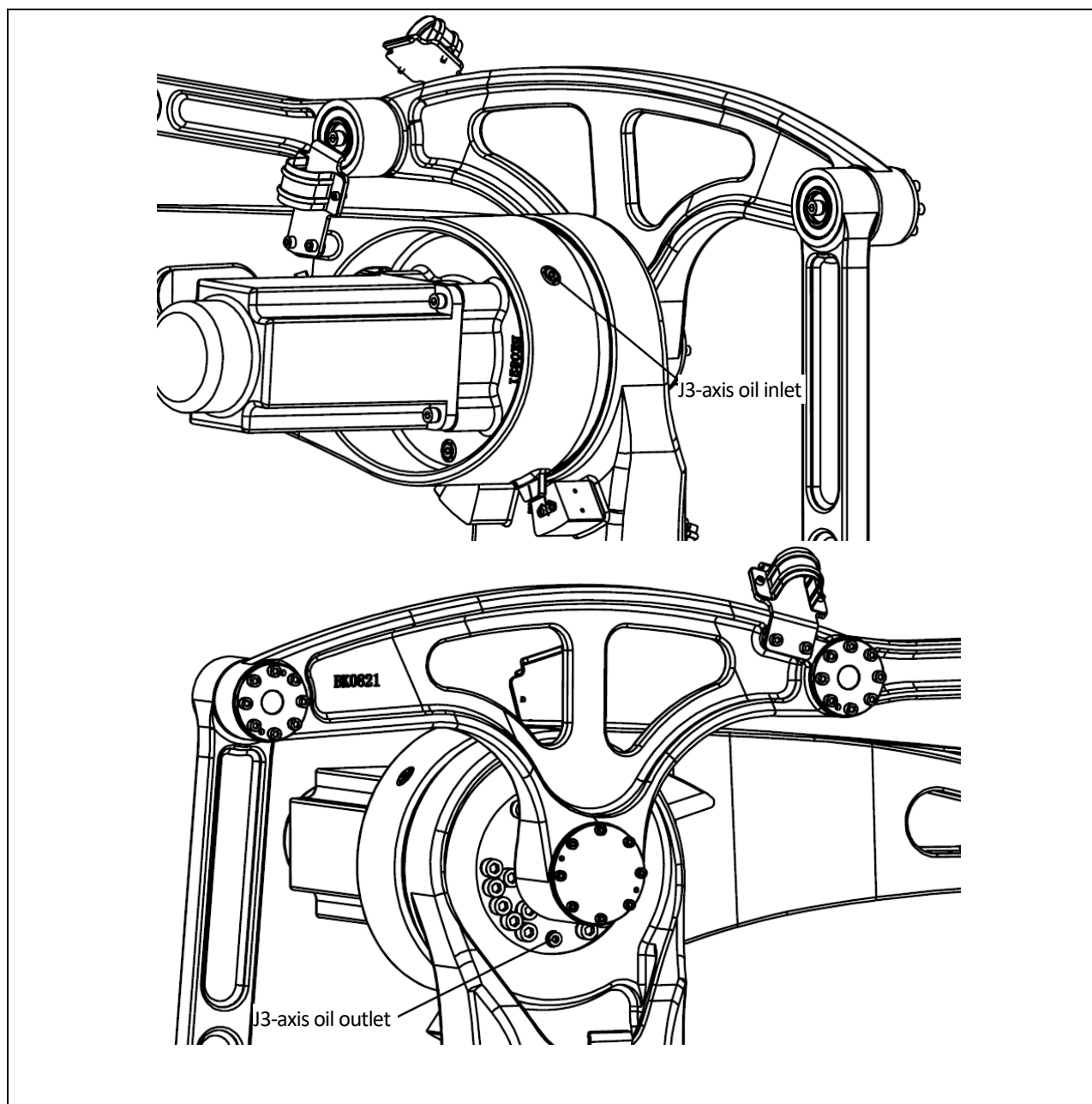


Fig 5.9 J3-axis oil inlet/outlet(ER60-2000-PL)

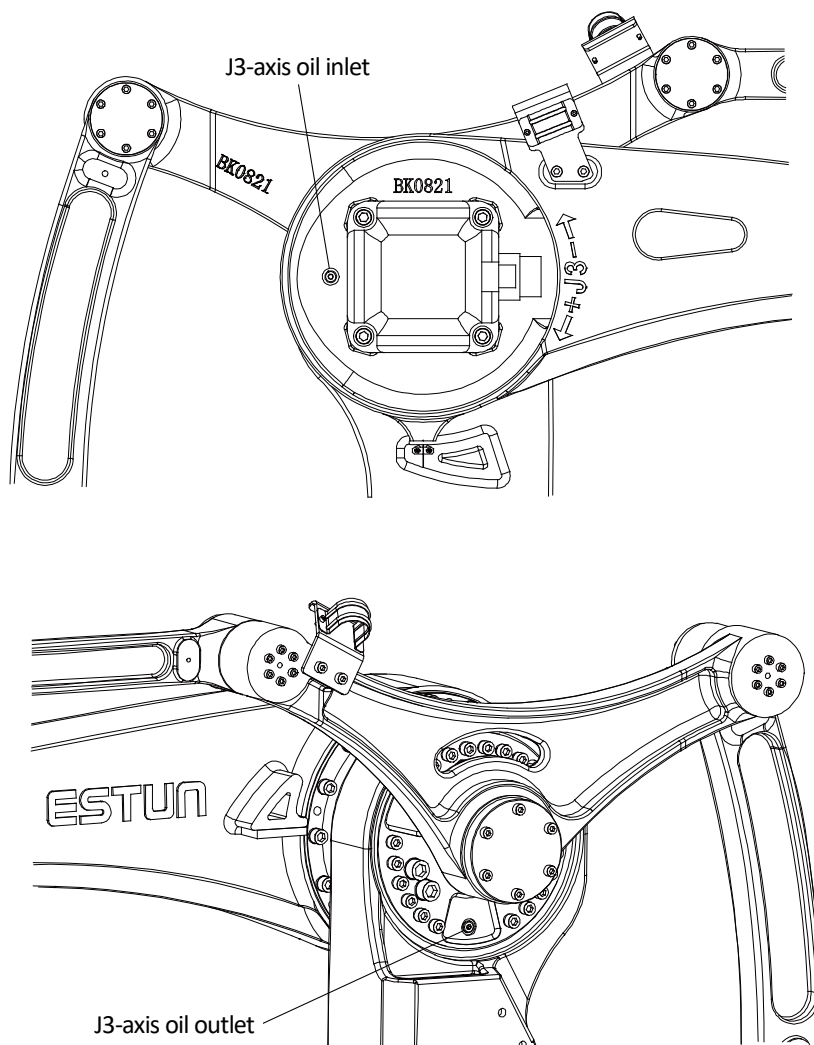


Fig 5.10 J3-axis oil inlet/outlet(ER120-2400-PL, ER180-3100-PL)

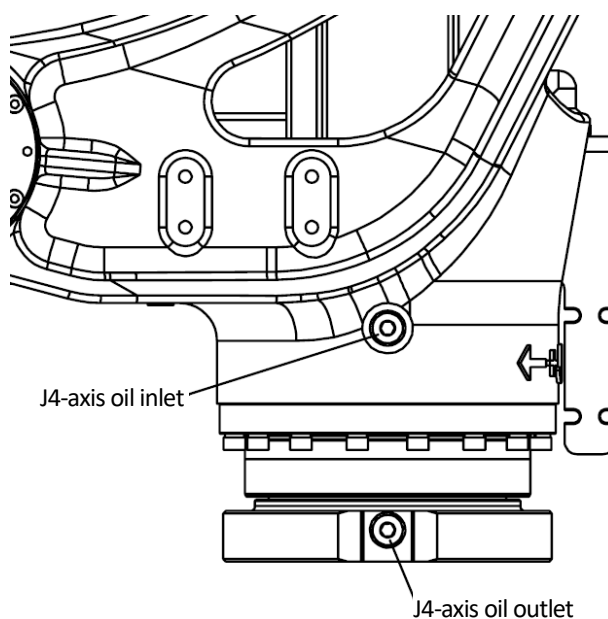


Fig 5.11 J4-axis oil inlet/outlet(ER60-2000-PL)



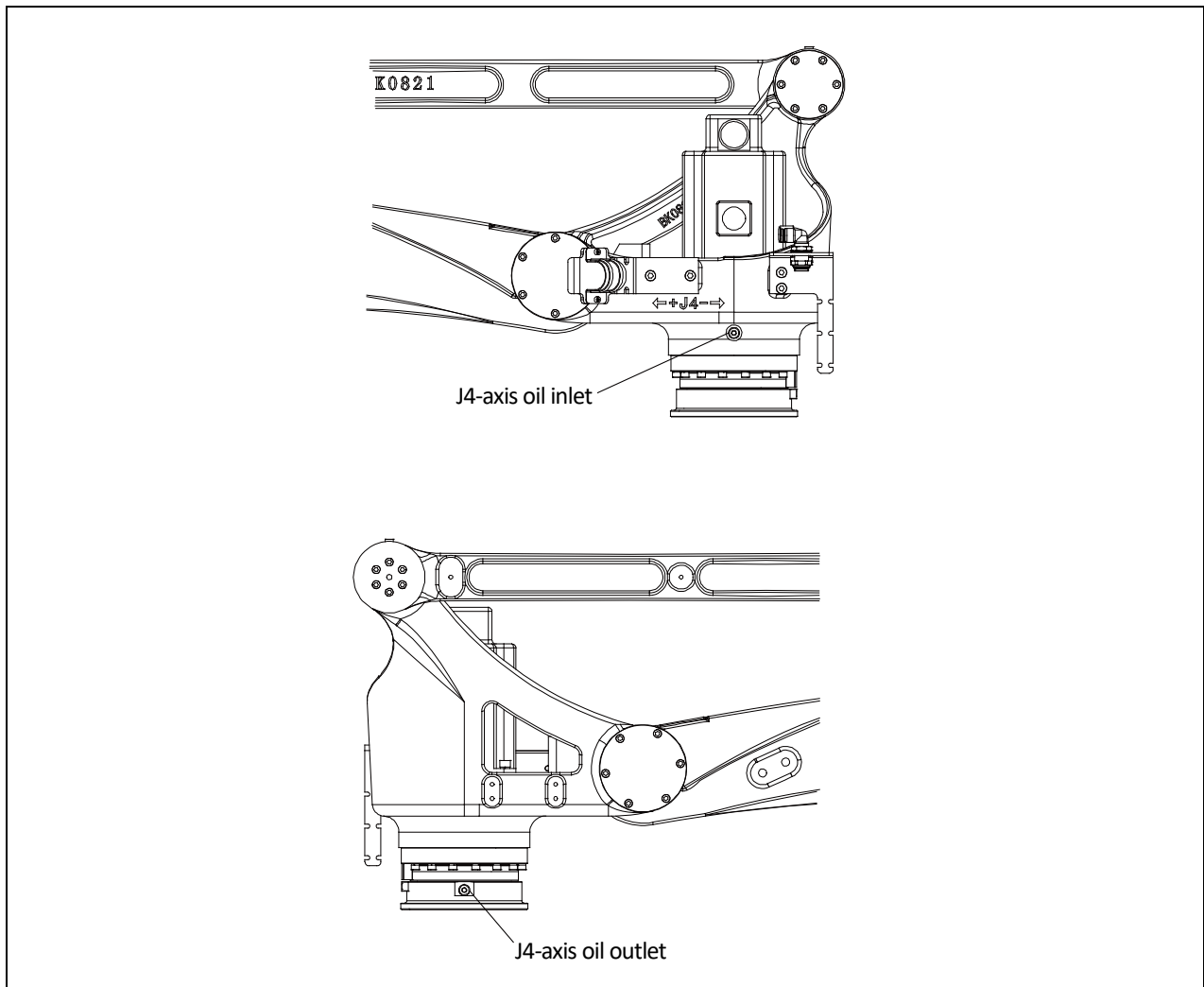


Fig 5.12 J4-axis oil inlet/outlet(ER120-2400-PL, ER180-3100-PL)

### 5.4.2.Procedures of greasing

The following steps only applied to operation of reducers of J1, J2, J3, and J4 axes.

- Teach each joint to run at a speed of 100% for 10-20min, to make the grease into oil with low viscosity.
- Move the robot to the gesture of greasing, then turn off the power supply.
- Put an oil recycle container beneath the grease outlet.
- Remove the screw on the inlet and outlet of each joint.
- Inject new grease via the oil inlet until new grease goes out of the outlet. The amount of oil injected should be equal to the amount that is discharged (including those discharged after warming up the machine).
- Release the residual pressure in the grease groove according to section 5.5.3.
- Install the screw to oil inlet and outlet with a torque of 13.7N·m.

If greasing is not performed properly, the internal pressure inside the grease bath may increase suddenly, which will damage the seal part, resulting in oil leakage and abnormal operation. Therefore, when performing greasing, observe the following precautions.





- Open the grease bath vent (remove the screw on the oil outlet) before greasing.
- Inject the grease/oil slowly without excessive force.
- Avoid compressed gas pump (powered by factory gas source) whenever possible.
- Use specified model of grease/oil. Unauthorized model of grease may cause damage to the reducer or other problems.
- When greasing is completed, make sure that there is no oil/grease leakage outside the outlet. and the grease bath is not pressurized. Then close the outlet.
- Clean the excess oil/grease on the floor to avoid accidents such as slipping or fire.

### 5.4.3.Procedure for releasing remaining pressure within the grease bath

Release remaining pressure with the following procedures. Attach bags under the oil outlet to prevent spilled oil/grease from splattering.

- a) Power the robot, and operate at a 100% speed with full load for 4 hours continuously.
- b) Stop the running program of the robot at zero position, turn off the servo power with the teach pendant.
- c) Disassemble the screw at oil inlet of each axis after safety confirmation. Do not face the screw when removing it, in case that oil with high pressure and high temperature ejects, resulting personnel injury.

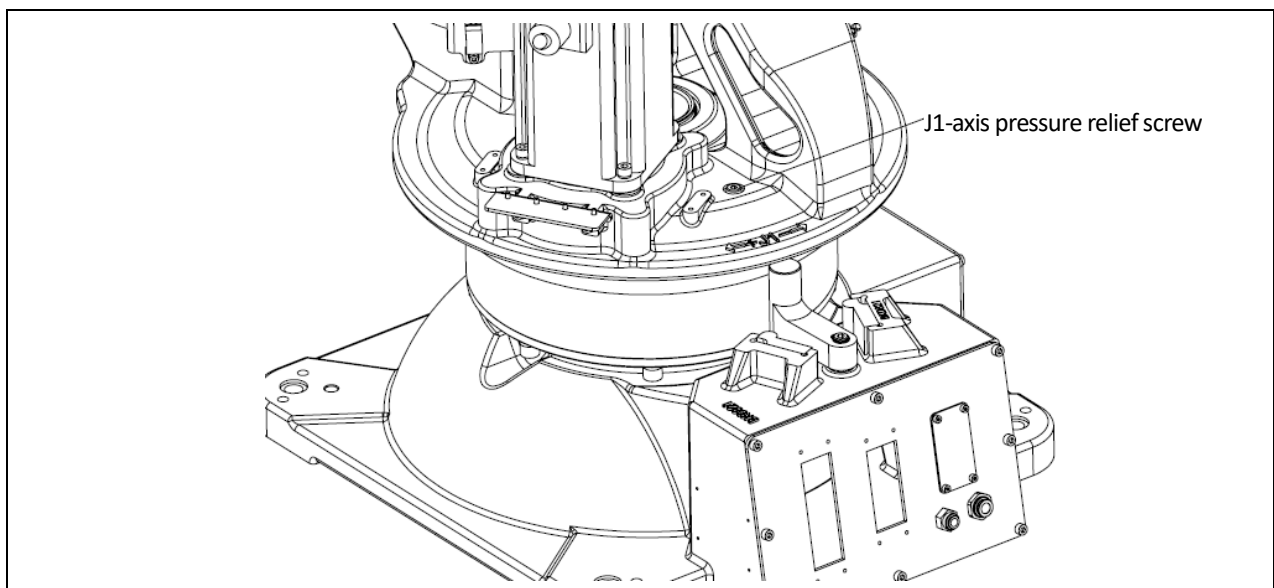


Fig 5.13 Releasing remaining pressure of J1 axis(ER60-2000-PL)



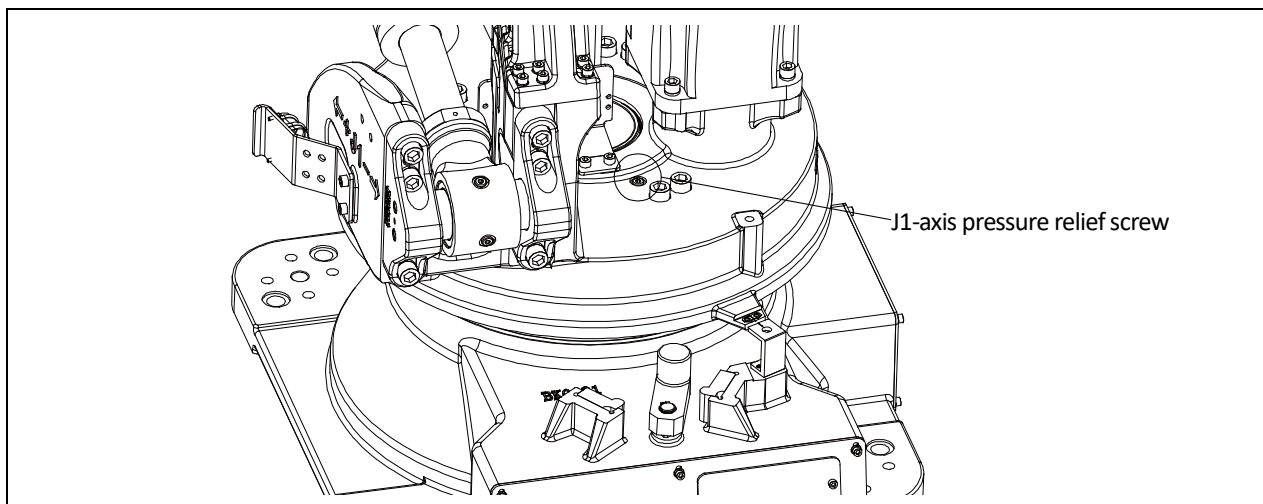


Fig 5.14 Releasing remaining pressure of J1 axis(ER120-2400-PL, ER180-3100-PL)

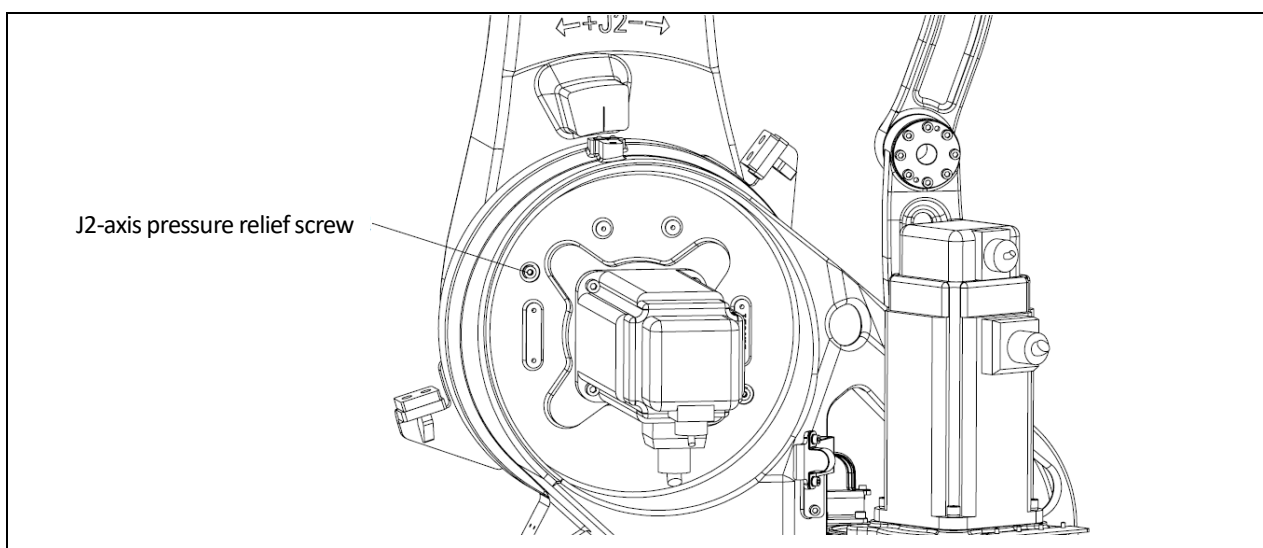


Fig 5.15 Releasing remaining pressure of J2 axis(ER60-2000-PL)

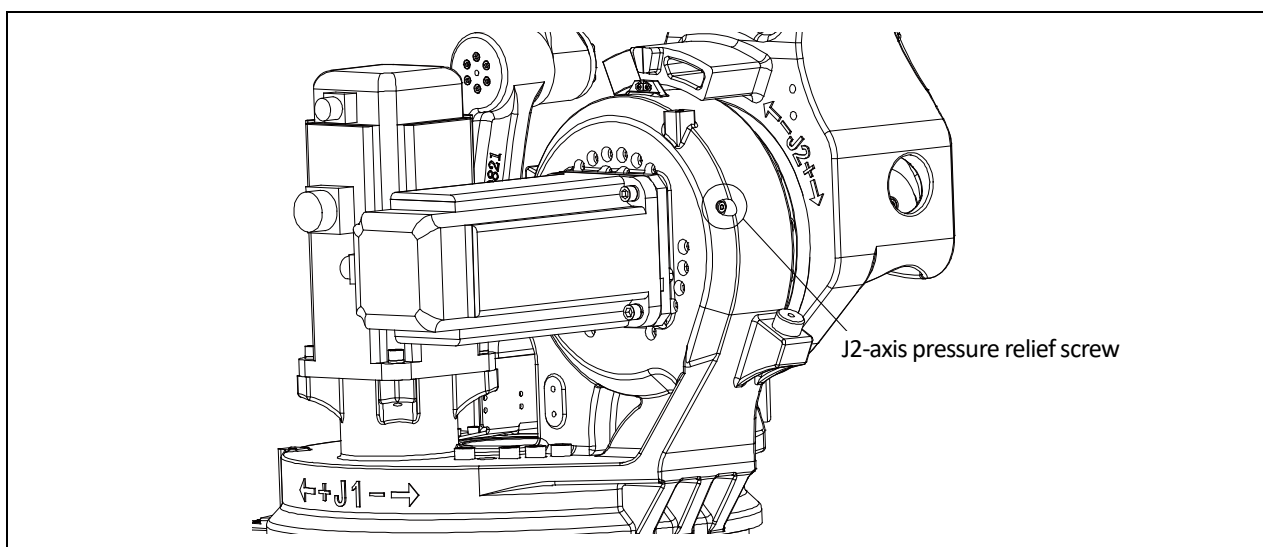


Fig 5.16 Releasing remaining pressure of J2 axis(ER120-2400-PL, ER180-3100-PL)

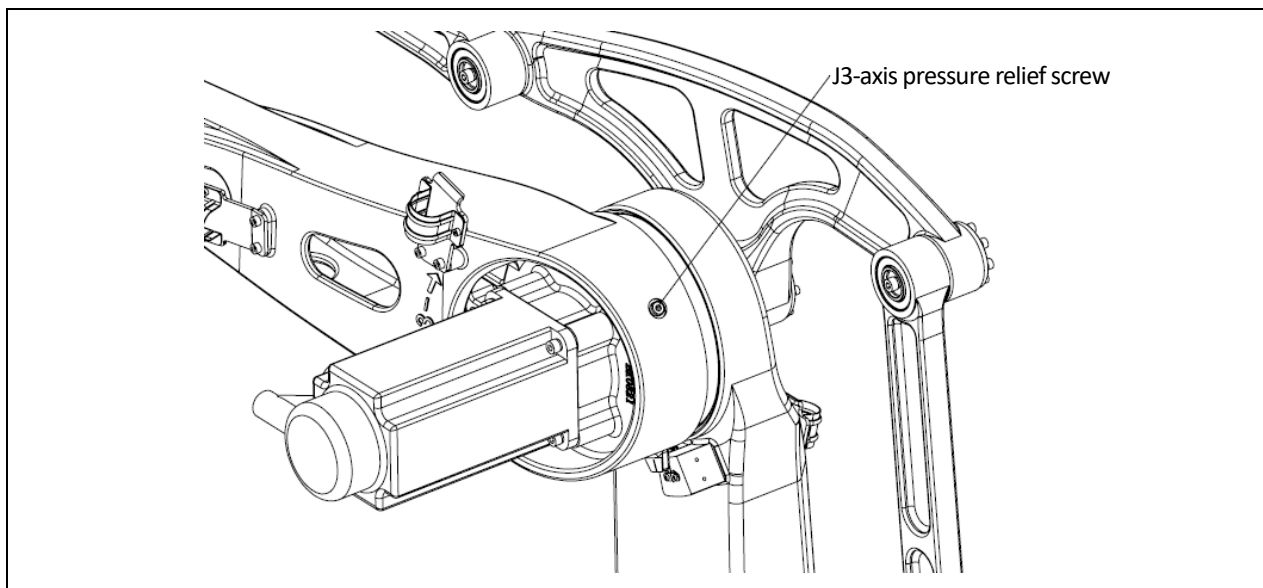


Fig 5.17 Releasing remaining pressure of J3 axis(ER60-2000-PL)

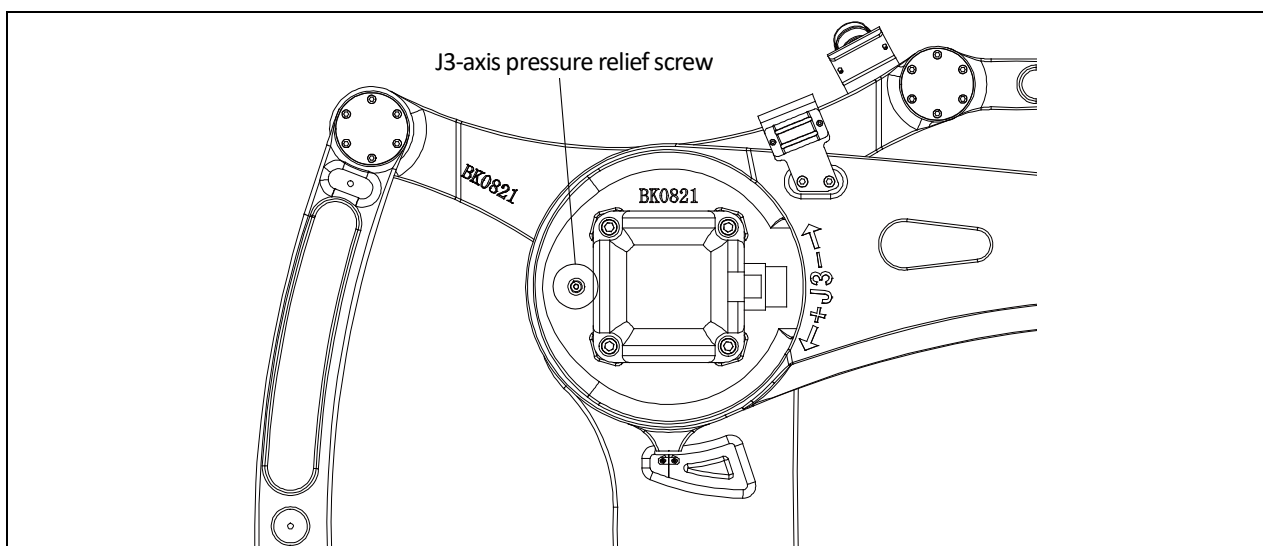


Fig 5.18 Releasing remaining pressure of J3 axis(ER120-2400-PL, ER180-3100-PL)

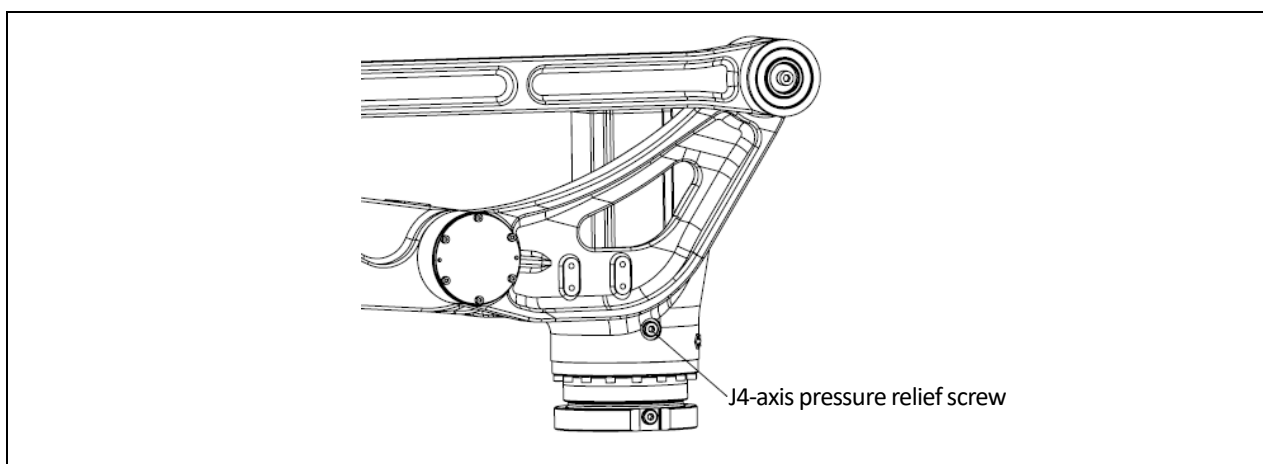


Fig 5.19 Releasing remaining pressure of J4 axis(ER60-2000-PL)

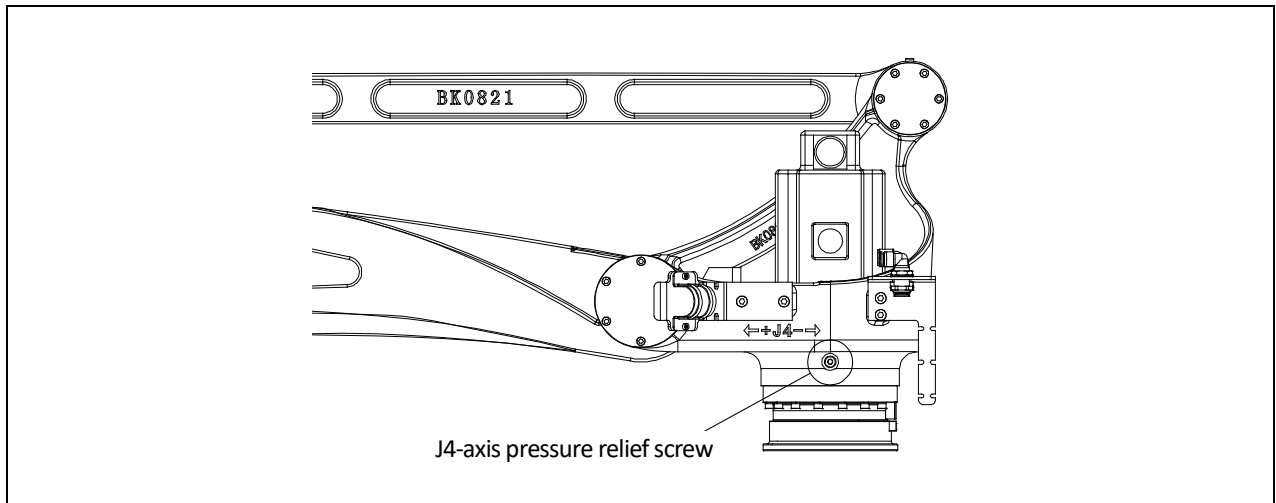


Fig 5.20 Releasing remaining pressure of J4 axis(ER120-2400-PL, ER180-3100-PL)

- d) Retighten the screw 3~5 seconds later after removing it, and clean up the oil around the screw with a clean cloth.
- e) Be sure to complete pressure releasing of a robot (step c and step d) in 15 minutes. Otherwise, it should be repeated from step.





## 6. CALIBRATING

### 6.1. INTRODUCTION

Calibration associates the angle of each robot axis with the pulse count value supplied from the absolute Pulse coder connected to the corresponding axis motor. To be specific, calibration is an operation for obtaining the pulse count value, corresponding to the zero position.

Calibration is factory-performed. It is unnecessary to perform calibration in daily operation. However, calibration becomes necessary after:

- Motor replacement
- Pulse coder replacement
- Reducer replacement
- Cable replacement
- Backup batteries for pulse count in the mechanical unit has run out



**Robot data (including calibration data) and pulse coder data are backed up by their respective backup batteries. Data will be lost if the batteries die. Replace the batteries in the controller and mechanical units periodically. An alarm will occur when battery voltage is low.**

### 6.2. QUICK ZERO POSITION CALIBRATION

Quick zero calibration is performed at factory with all loads uninstalled using special apparatus. Based on the robot parameter, this method provides the most precise zero position calibration.

Quick zero position calibration can reload zero position data that stored in the controller, when zero position data lost due to electrical or software faults. If the zero position data lost due to disassembly or maintenance, this method cannot be used.

ESTUN robot uses encoder data as an auxiliary of calibration. Procedures are shown below.

- a) Jog the robot manually to the place where the calibration marks are align.
- b) Display the encoder information screen. Jog the axis at a low speed to make the real single loop value close to the reference value.
- c) Calibrate the zero position of the axis. Create a new program, then create a new instruction "RefRobotAxis", and run it.
- d) Run PTP instruction to move each axis to its zero position.
- e) Input current single loop value at administrator's authorization. The data will be saved automatically.



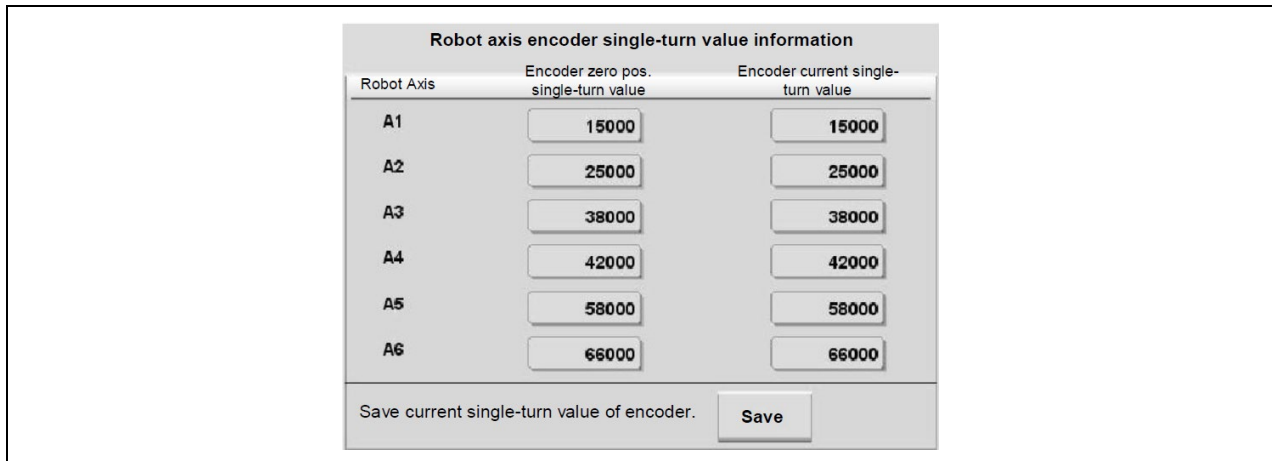


Fig 6.1 Single loop value of quick zero position calibration (CP)

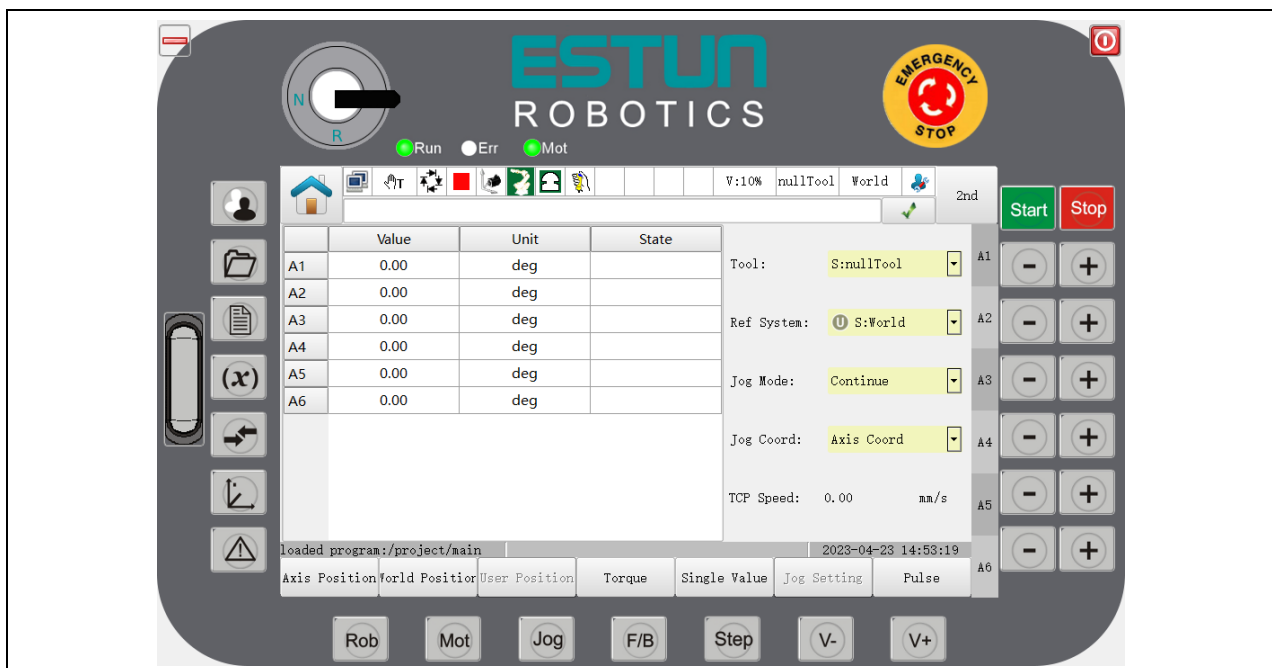


Fig 6.2 Single loop value of quick zero position calibration (RCS2)

## 6.3. MECHANICAL ZERO POSITION CALIBRATION

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

### 6.3.1. J1-axis calibration

Take J1-axis for example of zero position calibration. As shown in the figure below, there are witness marks on the base and rotation base. Move the axis to align the marks as the procedures below.

- Move J1-axis with teach pendant to align two witness marks.
- Set this position as the zero position of J1-axis with the teach pendant.

Perform calibration for each axis with procedures recommended above. If calibration for all axes has been performed and recorded, zero position for each axis can be set with teach pendant. Figures in



this section are reference for calibration of other axes.

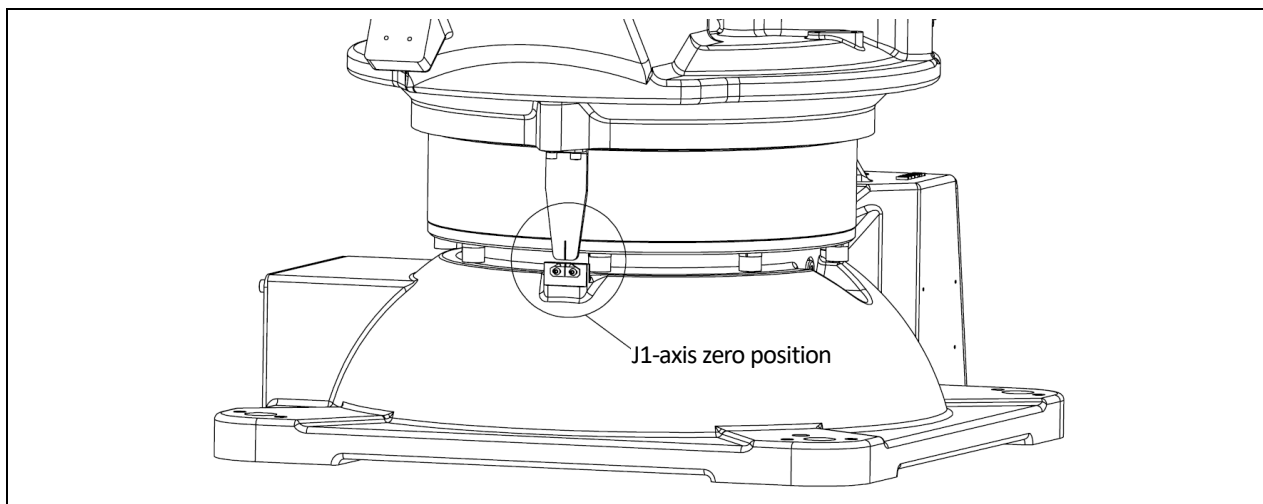


Fig 6.3 Calibration for J1-axis(ER60-2000-PL)

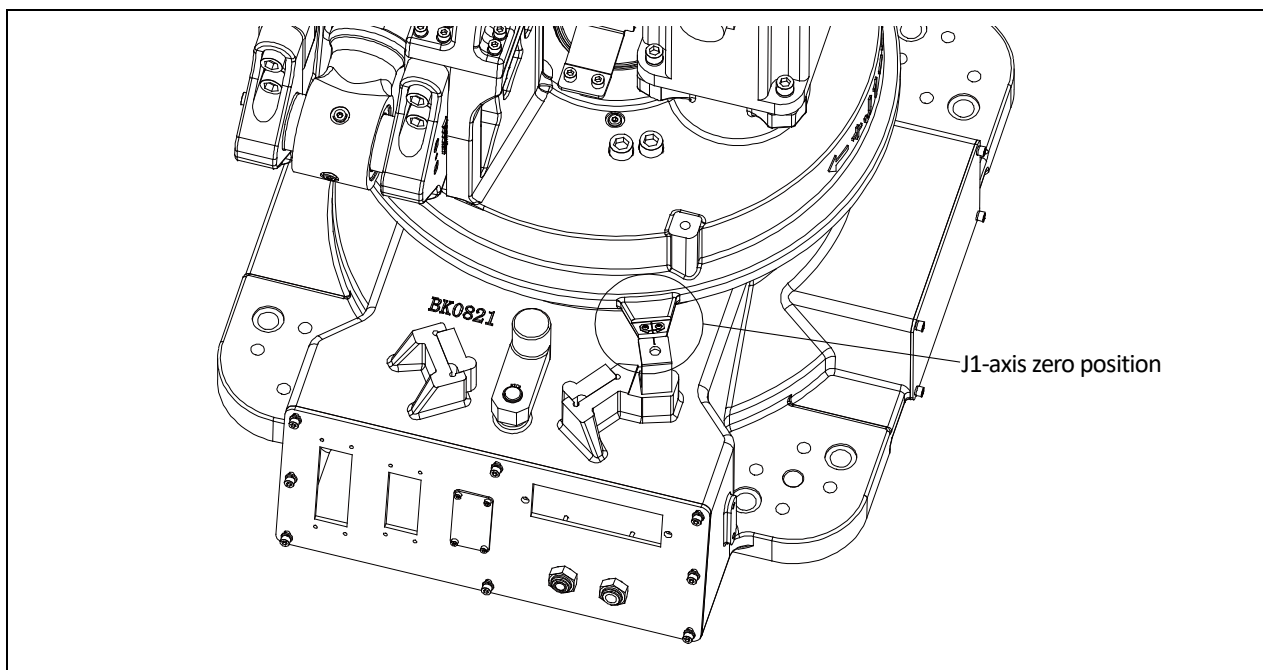


Fig 6.4 Calibration for J1-axis(ER120-2400-PL, ER180-3100-PL)



## 6.3.2.J2-axis calibration

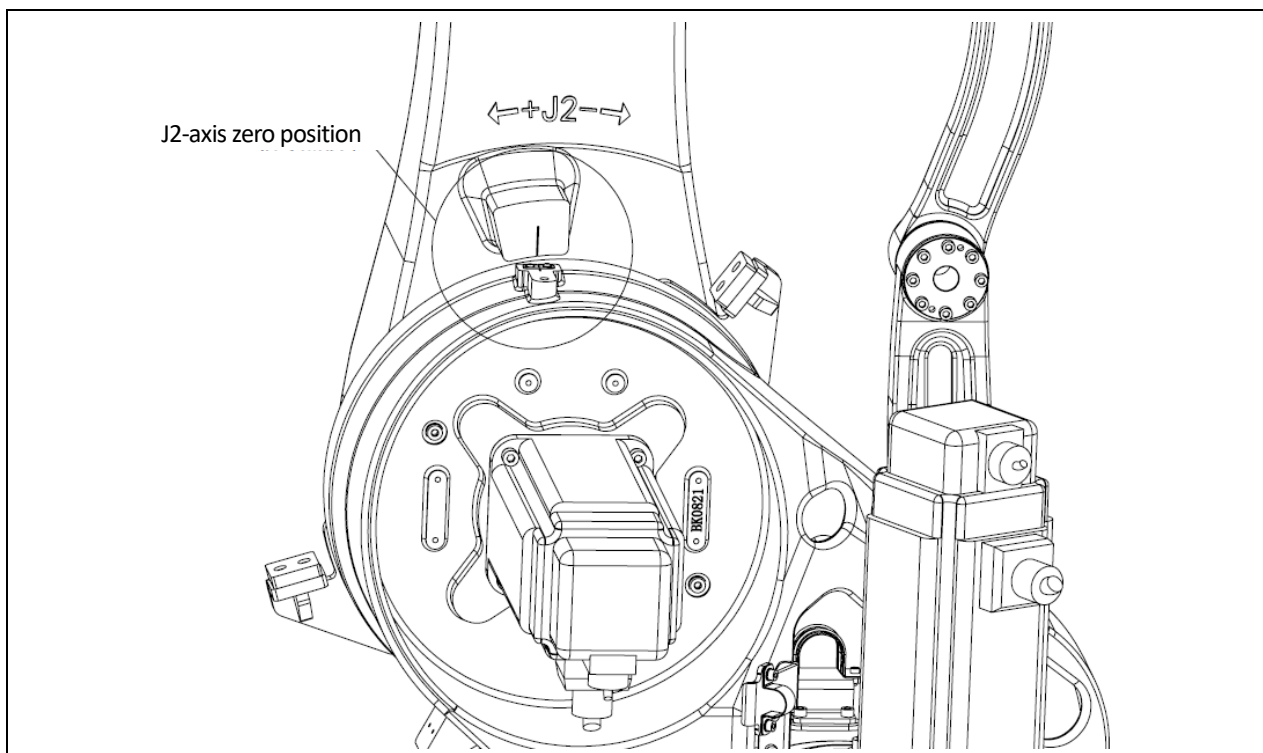


Fig 6.5 Calibration for J2-axis(ER60-2000-PL)

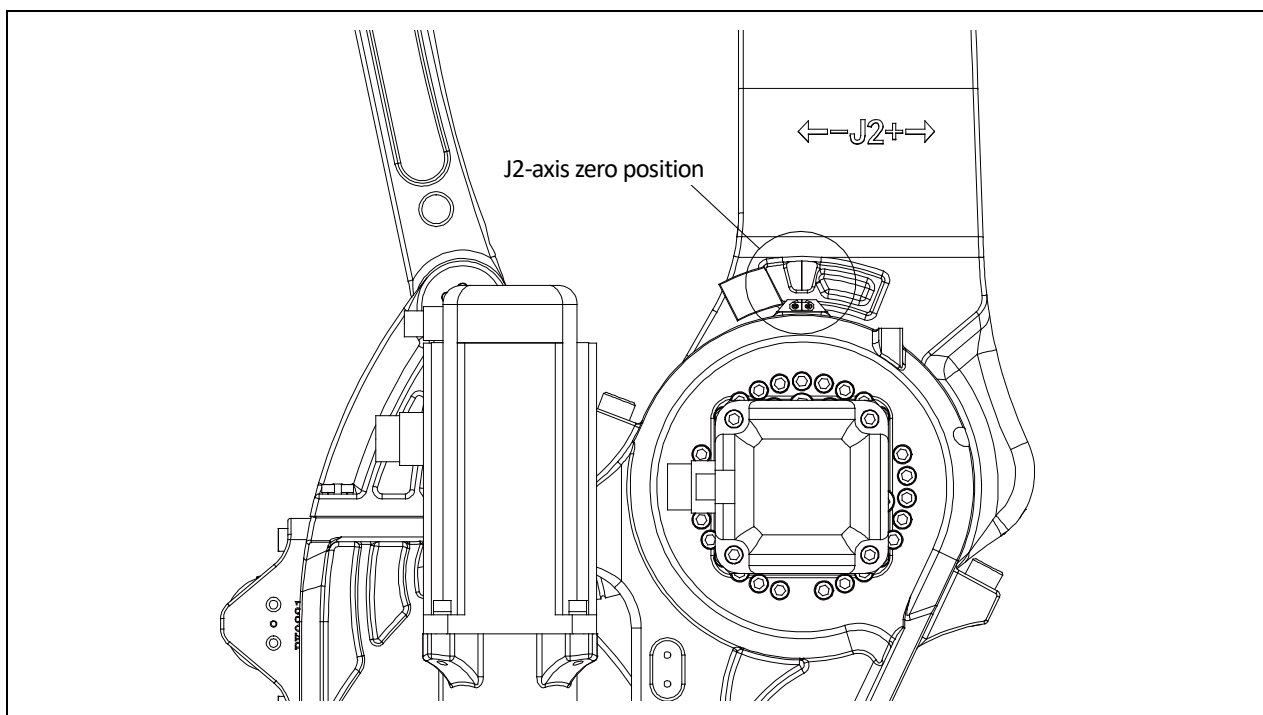


Fig 6.6 Calibration for J2-axis(ER120-2400-PL, ER180-3100-PL)

### 6.3.3.J3-axis calibration

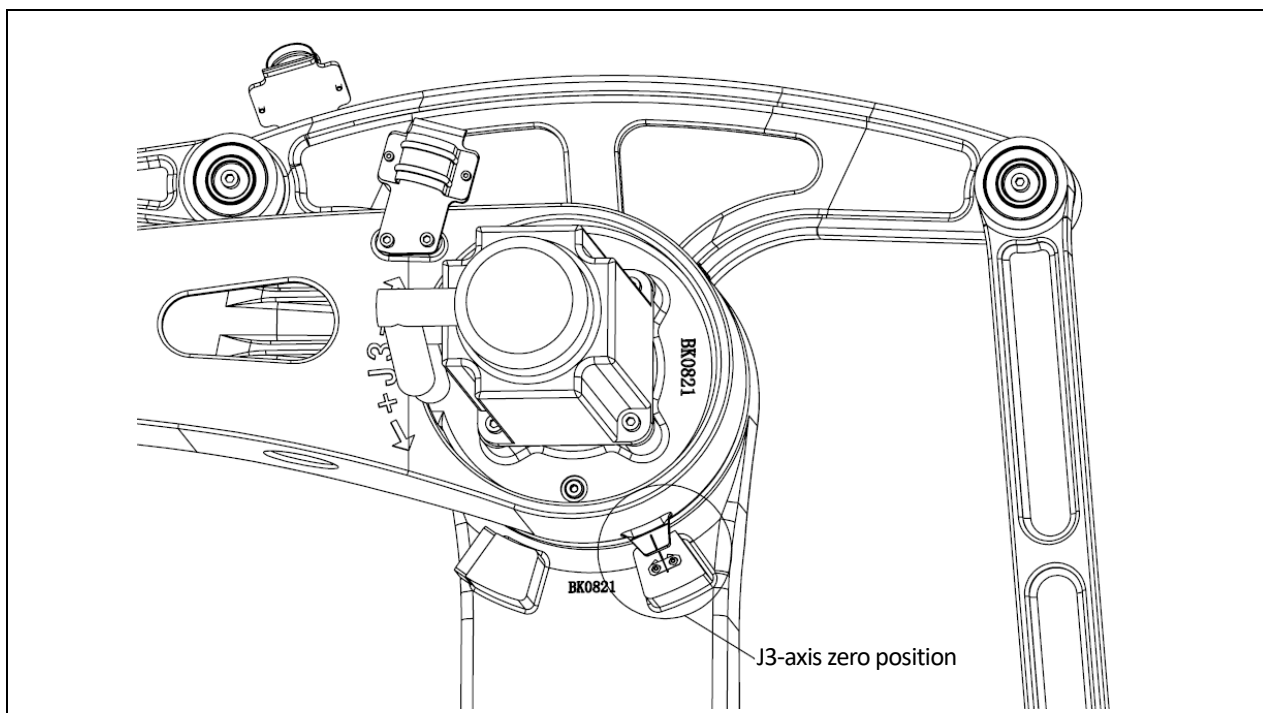


Fig 6.7 Calibration for J3-axis(ER60-2000-PL)

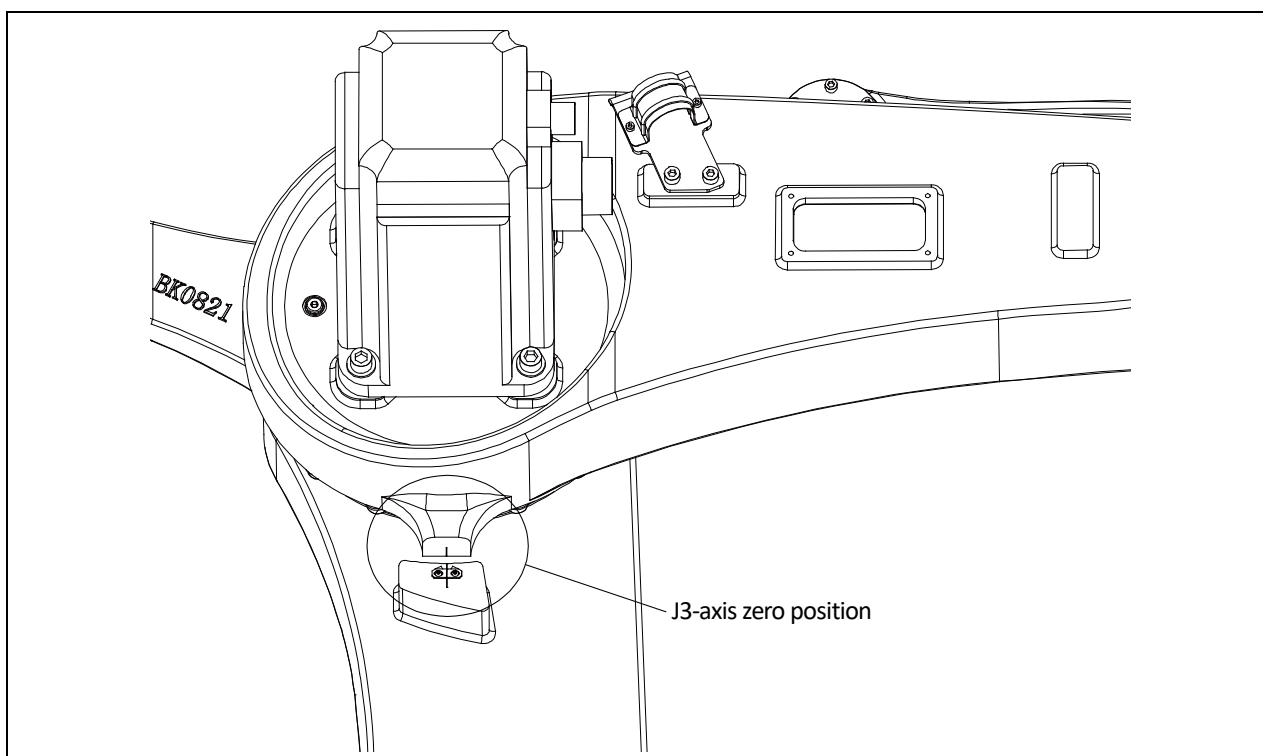


Fig 6.8 Calibration for J3-axis(ER120-2400-PL, ER180-3100-PL)

### 6.3.4.J4-axis calibration

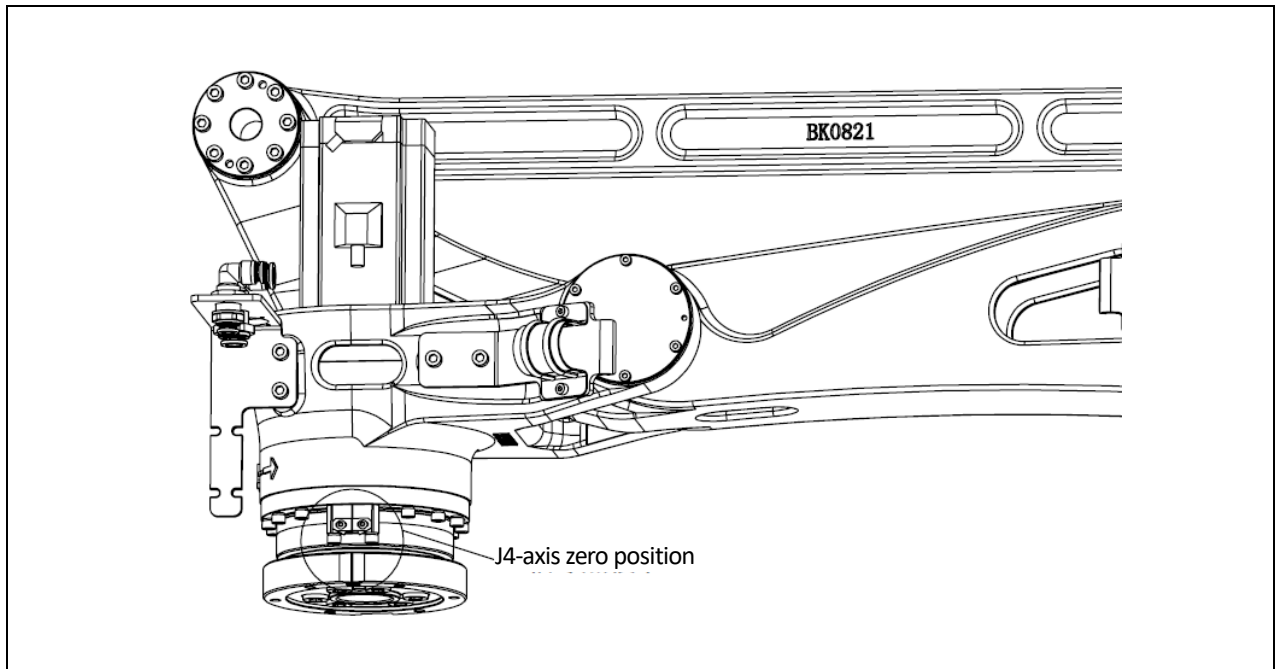


Fig 6.9 Calibration for J4-axis(ER60-2000-PL)

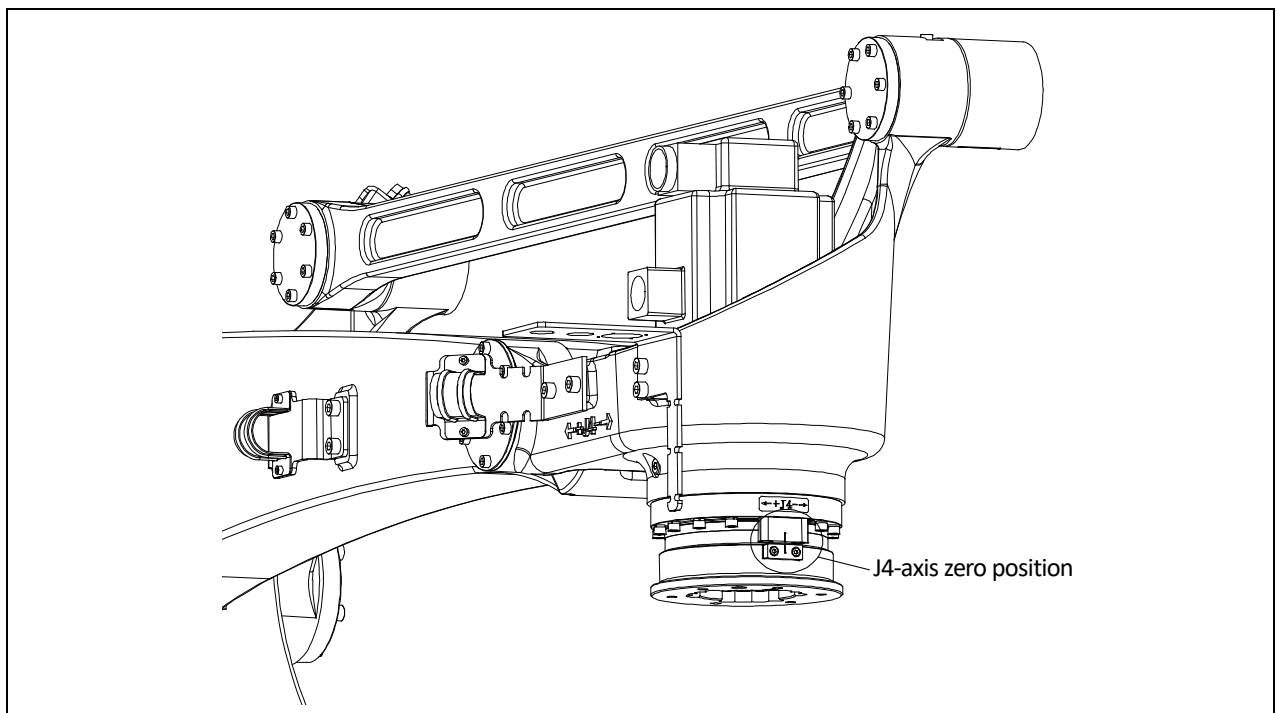


Fig 6.10 Calibration for J4-axis(ER120-2400-PL, ER180-3100-PL)



## 7. TROUBLESHOOTING

Be sure to read SAFETY PRECAUTIONS and understand its contents before any maintenance.



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

### 7.1. TOOLS

Troubleshooting tools includes travelling crane, forklift, internal hexagonal wrench, monkey wrench and special tools for removing the bearings.

### 7.2. TROUBLESHOOTING

| Symptom             | Description                                                                                   | Cause                                                                                                                                | Measure                                                       |
|---------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Vibration and noise | Unfirm connection between base and floor.                                                     | Frequent vibration due to robot operation causes unfirm connection.                                                                  | 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 is at a certain speed.                               | The robot control program is too demanding for the robot hardware.                                                                   | Modify the control program.                                   |
|                     | 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 occurs after the robot collided with an object or was overloaded for a long period. | The reducer or the joint structure was damaged due to collision or overload.                                                         | Replace the reducer or structure where the vibration occurs.  |
|                     | Some relationship may occur between the robot and the machine near it.                        | The robot resonates with the machine near it.                                                                                        | Change the distance between the robot and the other machines. |





| Symptom                        | Description                                                                                    | Cause                                                                                 | Measure                                                                                                                                                     |
|--------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Click                          | The robot wobbles due to push by hand when turn off it.                                        | Bolts in the robot joint loosen due to overload or collision.                         | Check tightness of motor retaining bolt, reducer retaining bolt, reducer retaining bolt and mounting bolt of each joint. If any bolt is loose, re-tight it. |
| Motor<br>overheat              | The motor overheated due to the ambient temperature rose or a cover was attached to the motor. | Ambient temperature rises or the motor is overheated, and could not release the heat. | Reduce the ambient temperature, make ventilation well and remove the cover of the motor.                                                                    |
|                                | Changing the robot control program or the load.                                                | Program or load is too demanding for the robot.                                       | Modify the program and reduce the load.                                                                                                                     |
|                                | Parameters imported to the controller are changed, the motor overheated.                       | Parameters imported are not correct with the robot.                                   | Import correct parameters.                                                                                                                                  |
| Gear case<br>grease<br>leakage | Grease leakage from the joint.                                                                 | Prolonged usage of the robot leads to a damage of the oil seal.                       | Replace the oil seal and O-ring.                                                                                                                            |
|                                |                                                                                                | There is a gap on the surface of the seal.                                            | Re-mount and tighten the oil seal.                                                                                                                          |
|                                |                                                                                                | There is a problem with the oil inlet or outlet.                                      | Replace the oil inlet or the bolt.                                                                                                                          |
| Dropping<br>joint              | The robot axis cannot stop at a certain position, or drops in standstill due to gravity.       | There is a problem with the servo motor brake.                                        | Replace the servo motor.                                                                                                                                    |

## 7.3. REPLACING THE SERVO MOTOR

Contact ESTUN representative if servo motor replacement is needed.



**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 be performed by authorized person.**



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





# APPENDIX

## APPENDIX A BOTL TORQE LIST

| Bolt Models<br>(GB/T 70.1)             | M3 | M4 | M5            | M6            | M8            | M10           | M12          | M14          | M16          | M18        |
|----------------------------------------|----|----|---------------|---------------|---------------|---------------|--------------|--------------|--------------|------------|
| Tightening Torque<br>/N.m (Level 12.9) | 2  | 4  | 9.01<br>±0.49 | 15.6<br>±0.78 | 37.2<br>±1.86 | 73.5<br>±3.43 | 129<br>±6.37 | 205<br>±10.2 | 319<br>±15.9 | 441<br>±22 |

## APPENDIX B SPECIFICATION OF BOLT

| Nominal<br>diameter | Screw<br>dimension | Drill<br>diameter | Anchor<br>depth(mm) | Max. anchor<br>thickness(mm) | Designed<br>pulling<br>force(kN) | Designed<br>shearing<br>force(kN) | Anti-pull<br>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 Part list for ER60-2000-PL

| No. | SAP         | Name                       | Amount | Note |
|-----|-------------|----------------------------|--------|------|
| 1   | 31521100006 | Lithium battery ER34615M/2 | 3      |      |
| 2   | 12500000020 | Servo motor (J1/J2 axis)   | 2      |      |
| 3   | 12501232008 | Servo motor (J3 axis)      | 1      |      |
| 4   | 12700000062 | Servo motor (J2 axis)      | 1      |      |

## APPENDIX D Part list for ER120-2400-PL

| No. | SAP         | Name                       | Amount | Note |
|-----|-------------|----------------------------|--------|------|
| 1   | 31521100006 | Lithium battery ER34615M/2 | 3      |      |
| 2   | 12503231001 | Servo motor (J1/J3 axis)   | 2      |      |
| 3   | 12503231002 | Servo motor (J2 axis)      | 1      |      |
| 4   | 12507231002 | Servo motor (J4 axis)      | 1      |      |
| 5   | 48300000722 | Nitrogen spring            | 1      |      |

## APPENDIX E Part list for ER180-3100-PL

| No. | SAP         | Name                       | Amount | Note |
|-----|-------------|----------------------------|--------|------|
| 1   | 31521100006 | Lithium battery ER34615M/2 | 3      |      |
| 2   | 12503231001 | Servo motor (J1/J3 axis)   | 2      |      |
| 3   | 12503231002 | Servo motor (J2 axis)      | 1      |      |
| 4   | 12507231002 | Servo motor (J4 axis)      | 1      |      |
| 5   | 48300000974 | Nitrogen spring            | 1      |      |





## REVISION RECORD

| Revision | Date    | Contents                                                                                                                                                                                                             |
|----------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01       | 2018.01 | New edition.                                                                                                                                                                                                         |
| 02       | 2018.06 | Update transportation gesture and part list. Modification of errors.                                                                                                                                                 |
| 03       | 2019.05 | Update the spare parts list. Modify the error description.                                                                                                                                                           |
| 04       | 2019.12 | Update the range of motion graph.                                                                                                                                                                                    |
| 05       | 2020.07 | ER60-2100-PL robot added.                                                                                                                                                                                            |
| 06       | 2022.01 | Modify 5.4 Robot lubrication attention.                                                                                                                                                                              |
| 07       | 2022.02 | Modify Table 3.1 Allowable load moment of inertia for wrist and 3.4 Wrist load condition diagram in robot specification table                                                                                        |
| 08       | 2022.10 | Update the crane handling method, robot specification table, and connection with the control device; Delete the description of the installation conditions, the grease name column, the spare parts list grease row. |







## **NANJING ESTUN ROBOT ENGINEERING CO., LTD.**

📍 1888 Jiyin Avenue, Jiangning Economic Development Zone, Nanjing City  
☎ +86-25-58328532 🏠 [www.estun.com](http://www.estun.com)  
📠 +86-25-52785576 ✉ [export@estun.com](mailto:export@estun.com)