ESTUN
ROBOTICS

OPERATION INSTRUCTIONS

ESTUN Extra Large Payloads Series Robot Body Operation Instructions

ALL MADE BY ESTUN
ESTUN AUTOMATION

ESTUN Extra Large Payloads Series

Robot Body Operation Instructions

EBM05101-EN-10

PREFACE

This manual describes the following manipulators.

Robot type	Load capacity
ER220-3200	220kg
ER280-3200	280kg
ER280-3200-LI	280kg
ER350-3200	350kg
ER350-3300	350kg
ER420-3300	420kg
ER500-2800	500kg
ER600-2800	600kg
ER700-2800	700kg

Related manuals

ESTUN Robot Mechanical Unit Operator’s Manual
ESTUN Robot S3P Series Cabinet Operator’s Manual
ESTUN Robot S3E Series Cabinet Operator’s Manual
ESTUN RCS2 System Operator’s Manual
ESTUN CP System Operator’s Manual

Thank you for purchasing ESTUN robots.

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

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

In this manual, all specifications and information are checked on a regular basis. Nevertheless, discrepancies cannot be precluded, for which reason we are not able to guarantee total conformity. ESTUN assumes no responsibility for any direct or indirect losses arising from use of this manual and products described herein.

Keep this manual handy for easy access at all times.

Service Line: 400-025-3336

ADD: No.1888, Jiyin Road, Jiangning Area, Nanjing, China Post Code: 211102

TEL: 025-85097068

WEB: www.estun.com

E-mail: robot@estun.com

SAFETY

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

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

DEFINITION OF USERS

The personnel can be 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

  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
DANGER	**Danger notation** Death or serious injury will be expected to occur if the user fails to follow the approved procedure.
CAUTION	**Caution notation** Minor or moderate injury of the user or equipment damage will be expected to occur if the user fails to follow the approved procedure.
INFO	**Information** A supplementary explanation helps users operating the robot more efficiently.

SAFETY OF USERS

(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.

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

CAUTION	**Make sure there is a CO_2 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.**

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

CAUTION	**Emergency button is used in case of emergency only. 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.

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

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

- Be sure that the enable switch is effective at any time.

- 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.

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

(2) 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.

CAUTION	**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 grease or reducer.
- Open the grease chamber with caution and keep away from the opening. Grease may spray due to grease pressure.
- Feed the grease according to required quantity and never fill up the grease chamber. Check the grease indicator when finished.
- Never mix different types of grease into one reducer. Clean the grease chamber thoroughly before changing grease type.
- Grease draining must be performed thoroughly. Check the grease indicator when finished.

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

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 in 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

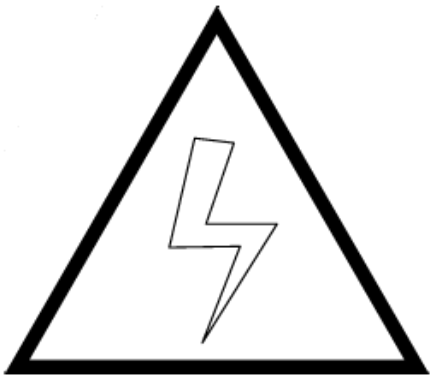


Fig 0.1 Electric Shock Warning

This label indicates hazardous voltage or electric shock.

(2) High-temperature Warning

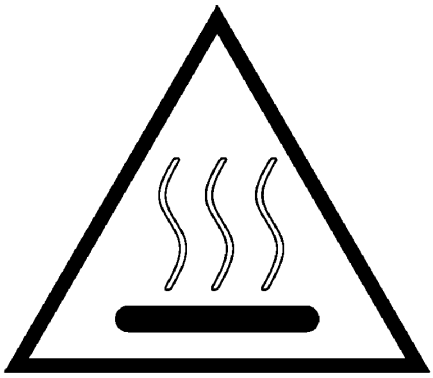


Fig 0.2 High-temperature Warning

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

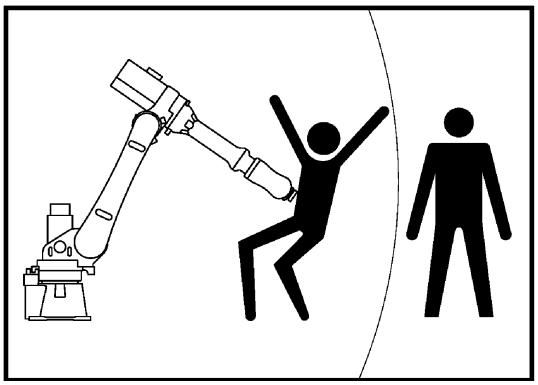


Fig 0.4 Personal Injury Warning

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 without permission where the warning is affixed. Contact ESTUN for disassembly.

(6) Energy Storage Warning

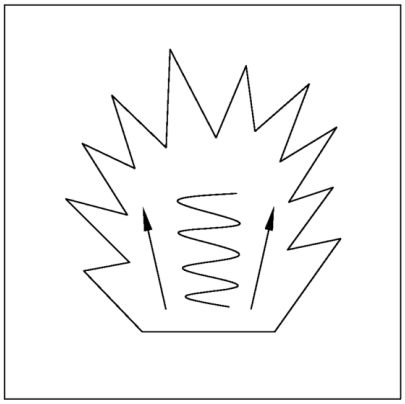


Fig 0.6 Energy storage warning

There are springs, gas or liquid with high pressure in the balance cylinder. Disassembly without permission is forbidden.

CONTENTS

1. TRANSPORTATION AND INSTALLATION

1.1. TRANSPORTATION

DANGER	**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	J5-axis	J6-axis
ER220-3200 ER280-3200 ER280-3200-LI ER350-3200	0°	-58°	+66°	0°	+82°	0°
ER350-3300 ER420-3300 ER500-2800 ER600-2800 ER700-2800	0°	-58°	+67°	0°	0°	0°

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

Parts	Weight (kg)					
	ER220-3200 ER280-3200 ER280-3200-LI	**ER350-3200**	**ER350-3300**	**ER420-3300**	**ER500-2800**	**ER600-2800 ER700-2800**
Robot	1550	1850	2605	3050	2555	2930
Big arm casting	207	194	281	280.9	281	281
Base assembly (including rotation base)	592	625	925	931.6	925	925
Small arm assembly (including motor casting and motor of J4-axis)	297	297	510	520	475	475
Wrist (including joint and	60	88	114	116.3	114	114

motors of J5, J6 axes)						

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

A support plate is needed for transporting ER500-2800 robot, as shown in the figure below. Remove the plate before installing the robot.

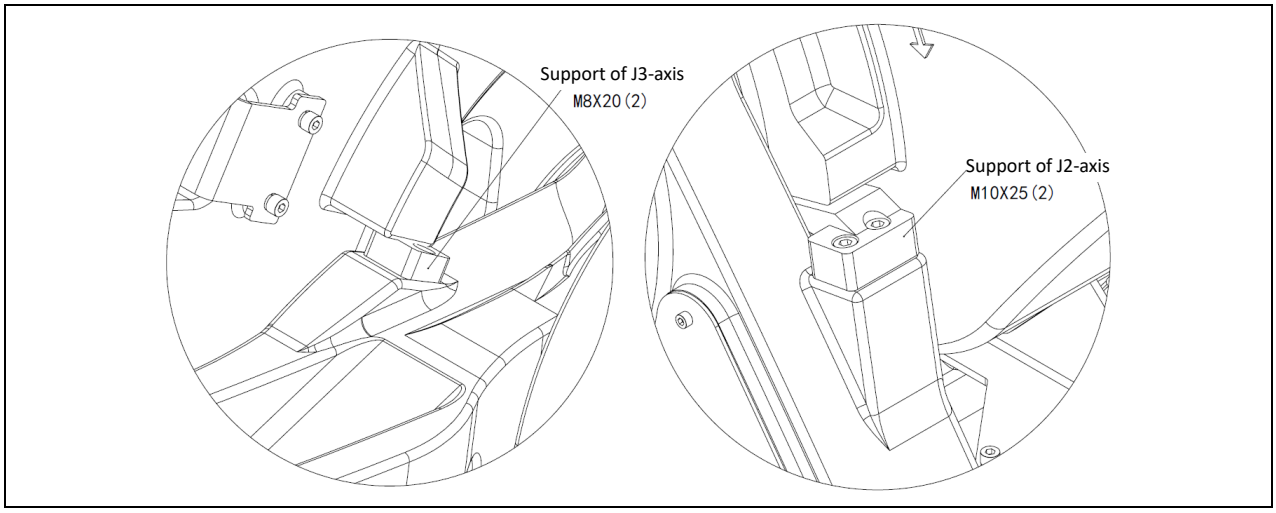


Fig 1.1 Support plate for transportation

1.1.1. Transport by a forklift

This model of robot can be handled by forklift. Before handling, install the screws of the forklift fixing plate on the robot transfer seat (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200 robot 4 forklift fixing plates, 8 M16X45 screws; ER350-3300, ER500-2800, ER420-3300, ER600-2800, ER700-2800 robot 2 forklift fixed plates, 8 M16X40 screws), forklift forks 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. After handling, remove the forklift fixing plate.

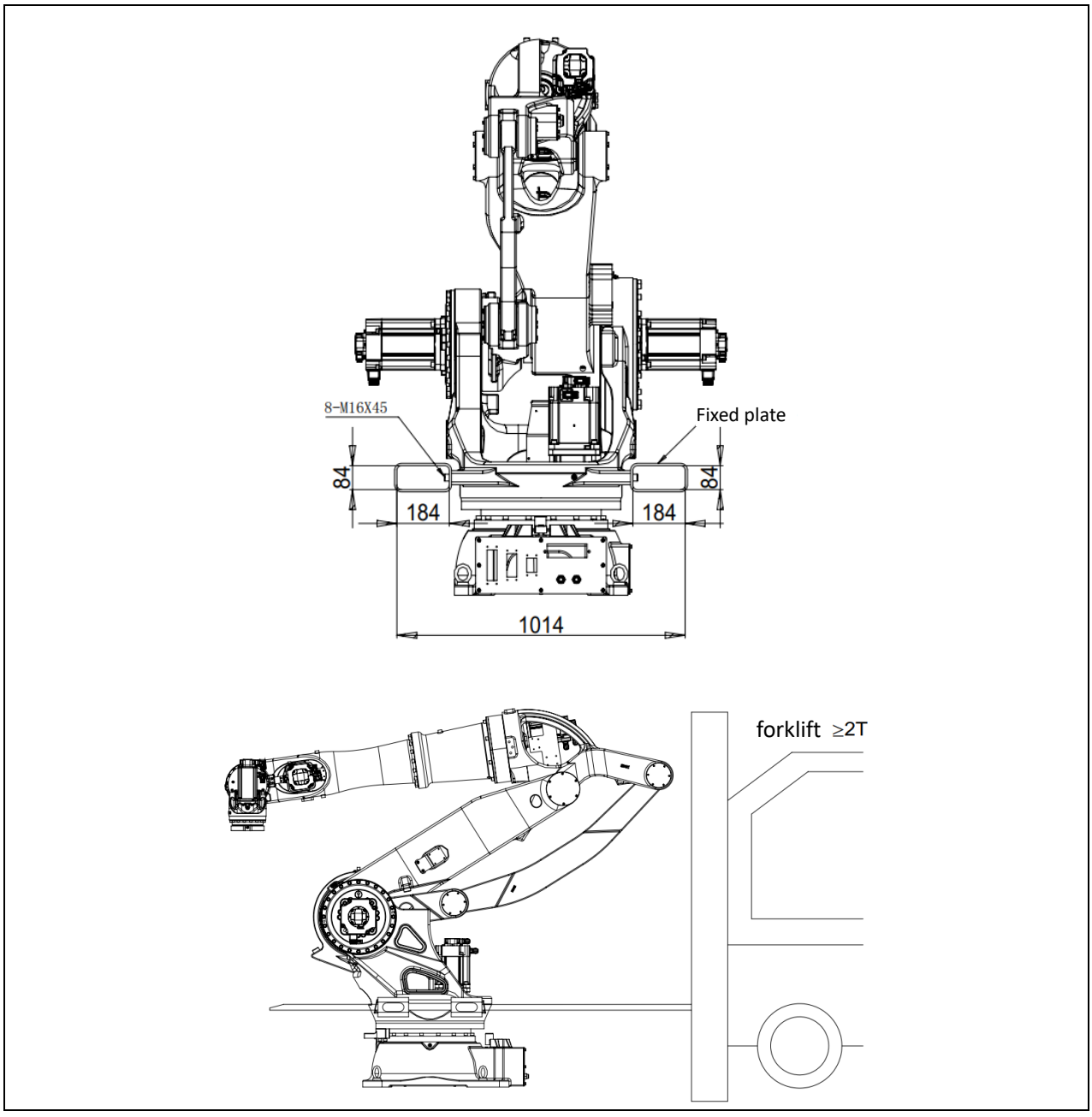


Fig 1.2 Use a forklift to transport the robot (ER220-3200, ER280-3200, ER280-3200-LI)

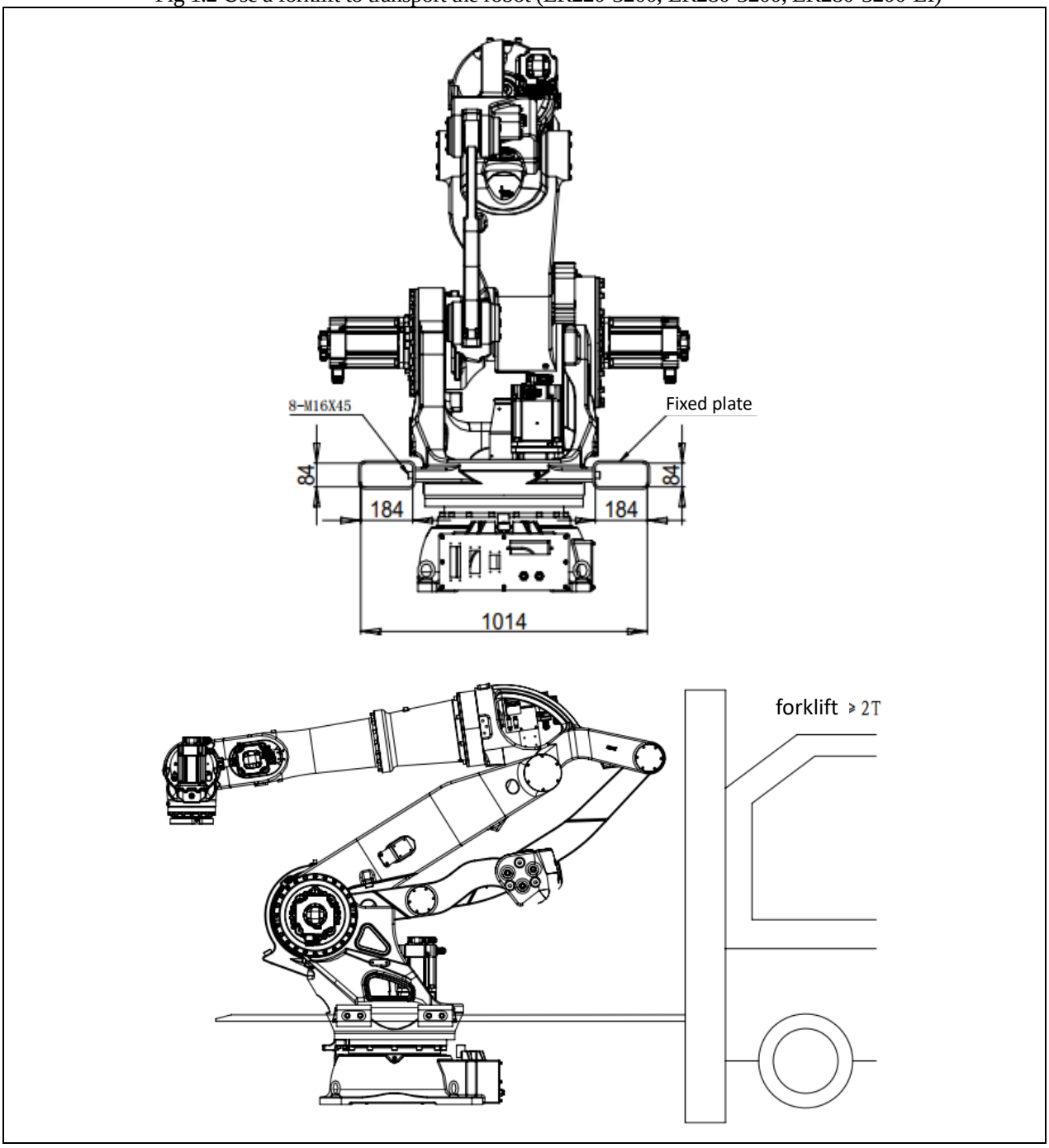


Fig 1.3 Use a forklift to transport the robot (ER350-3200)

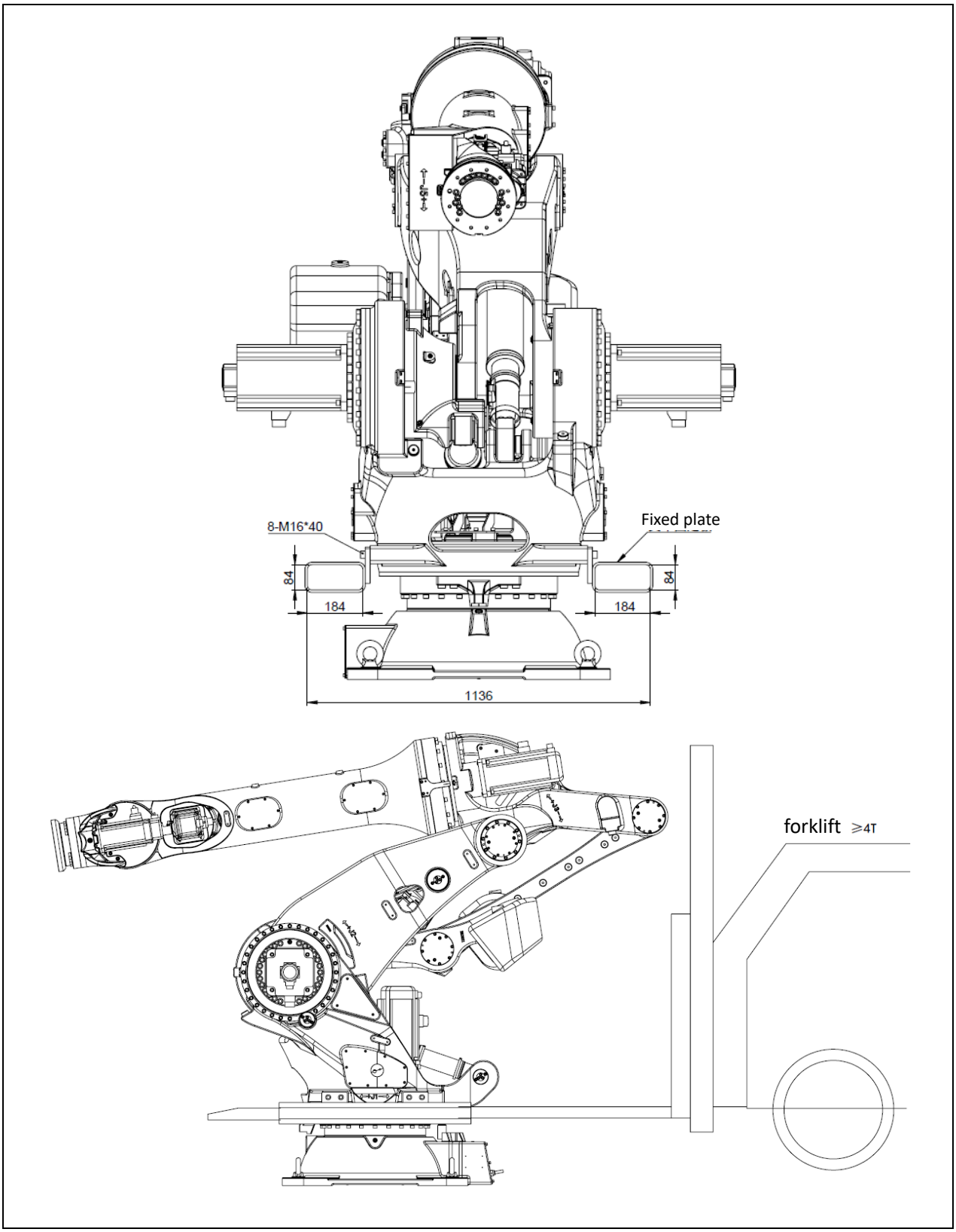


Fig 1.4 Use a forklift to transport the robot (ER420-3300)

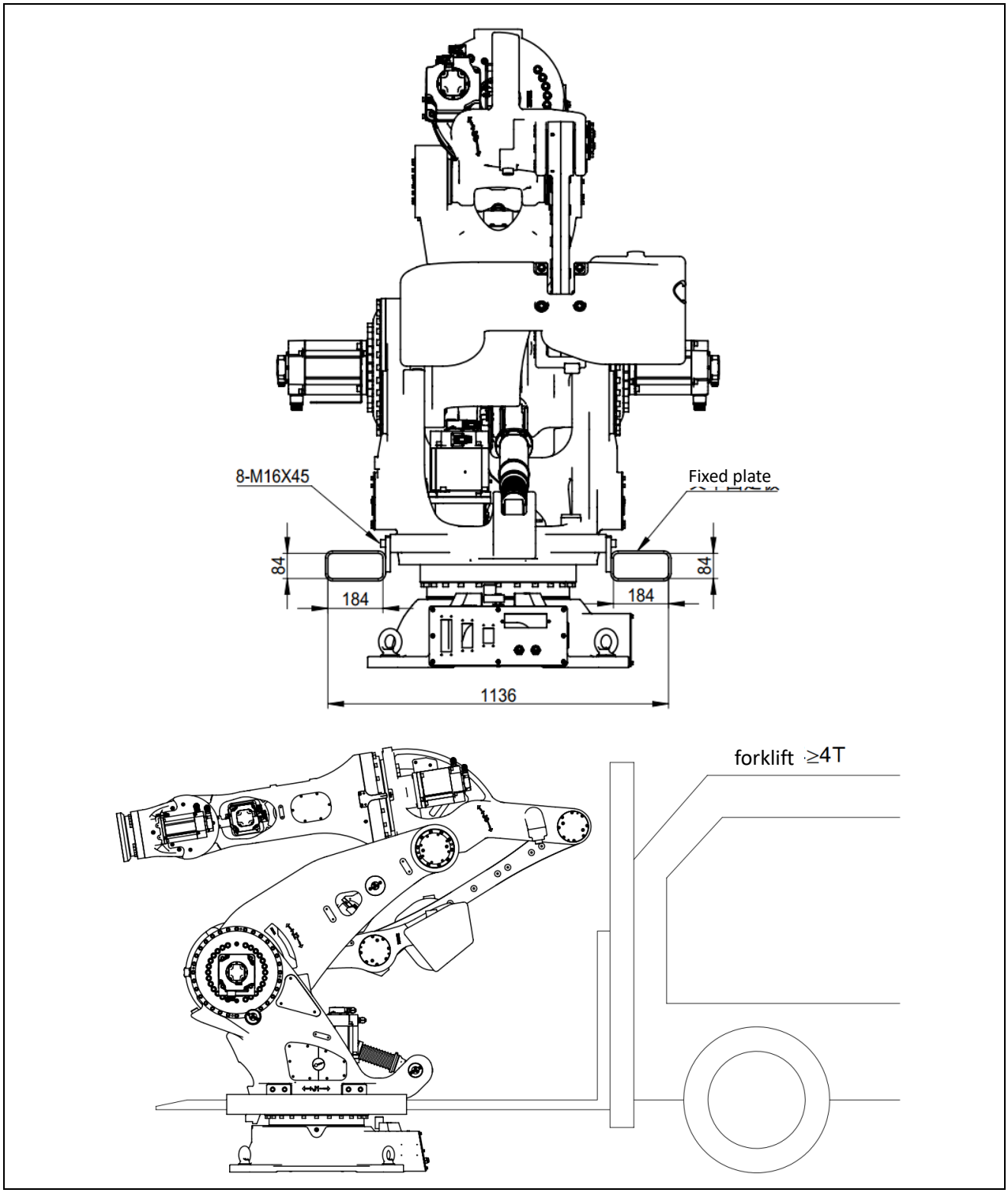

8-M16X45
Fixed plate
84
84
184
184
1136
forklift ≥4T

Fig 1.5 Use a forklift to transport the robot (ER500-2800, ER600-2800, ER700-2800)

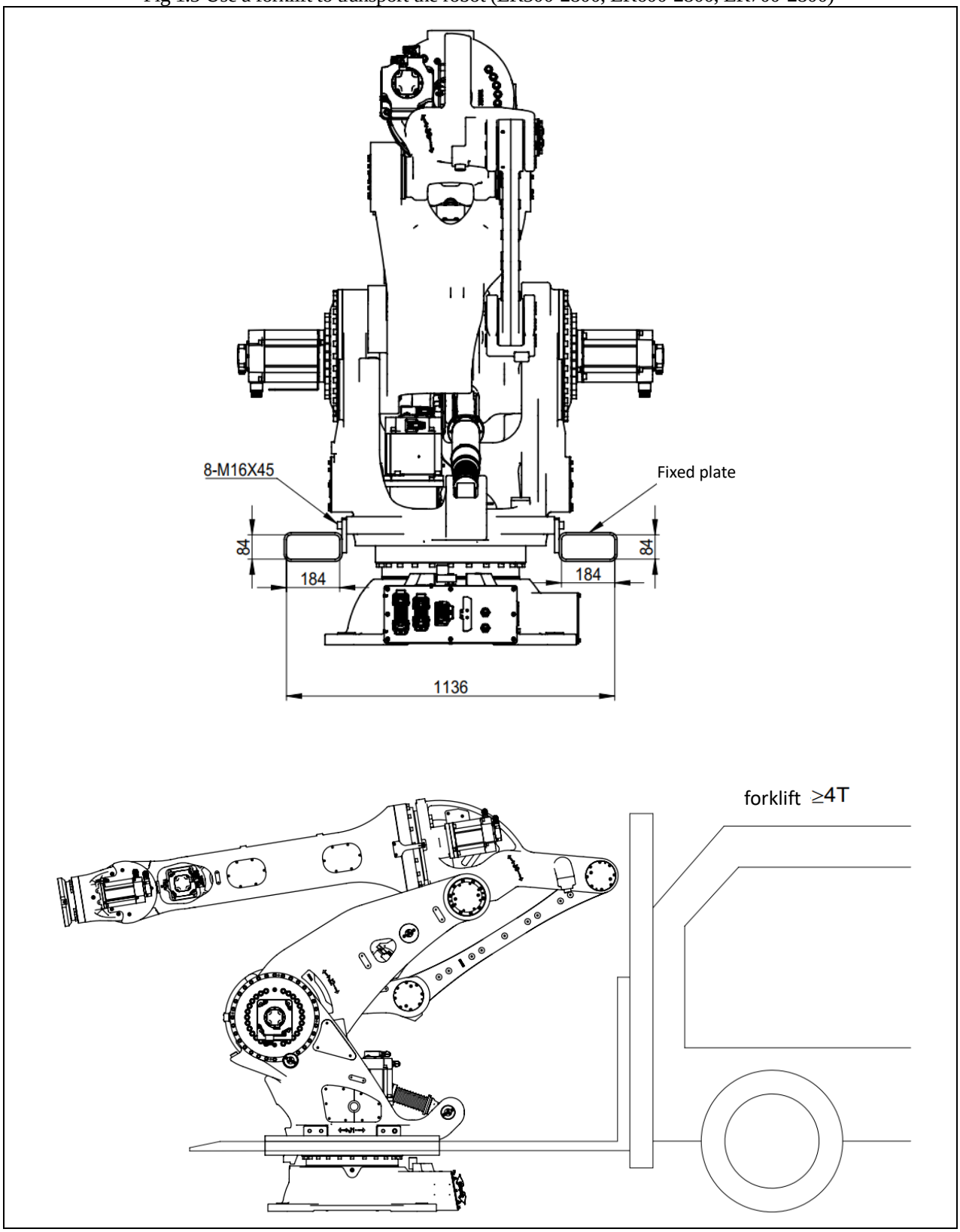


Fig 1.6 Use a forklift to transport the robot (ER350-3300)

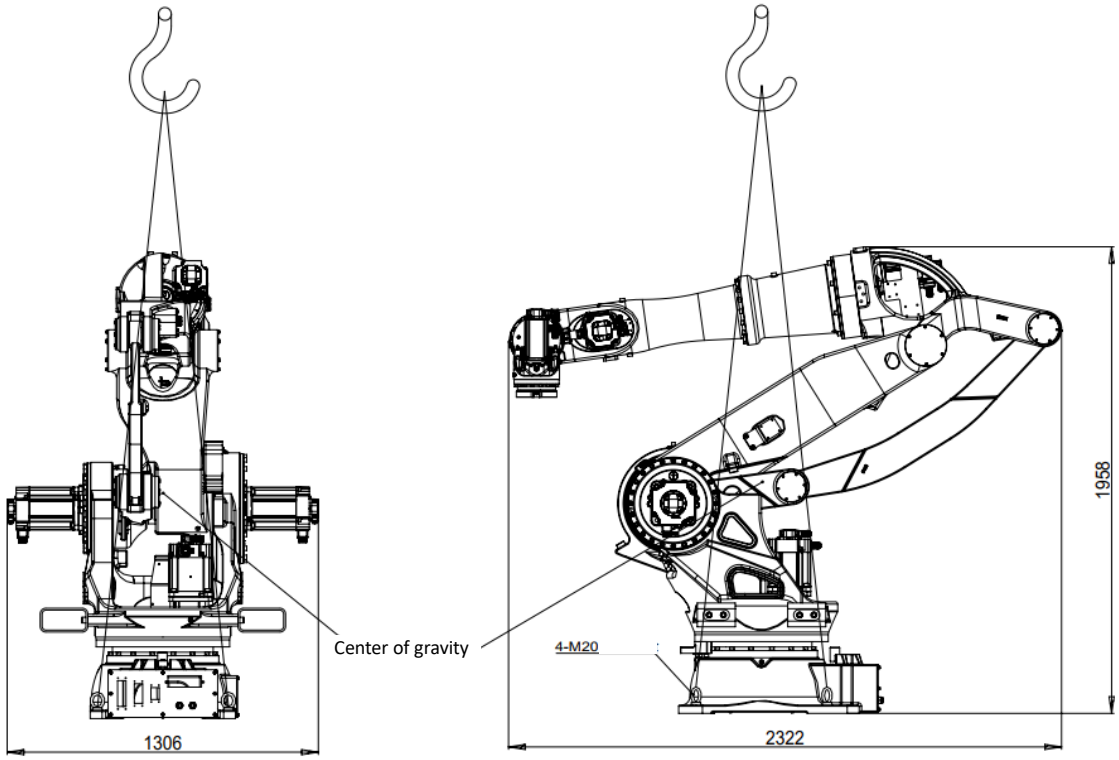
CAUTION

Forklift fixed plate and screws are supplied by the customer or purchased as an option when placing and order.

1.1.2. Transport by a crane

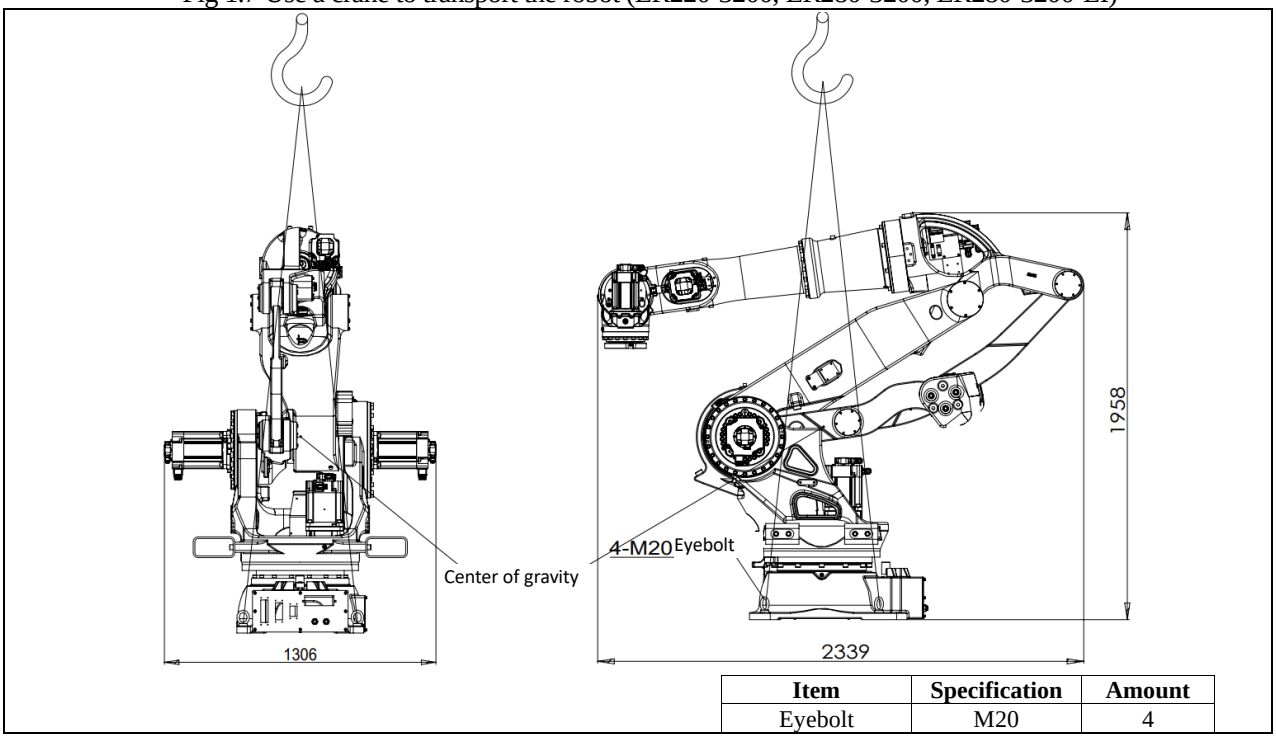
The robot described in this manual can be transported by a crane. Fix four M24 rings on the robot rotation base, use a crane and strings to heave the robot. Make sure that the strings are fixed as shown in the figure below. Take necessary measures to avoid paint peeling due to collision between the strings and the robot.

CAUTION	**Eyebolt and sling should be prepared by customers. Remove the rings before use the robot.** **The load capacity of the crane is 4000kg. The load capacity of the string is 4000kg. The ring confirms to ISO 3266:1984.**



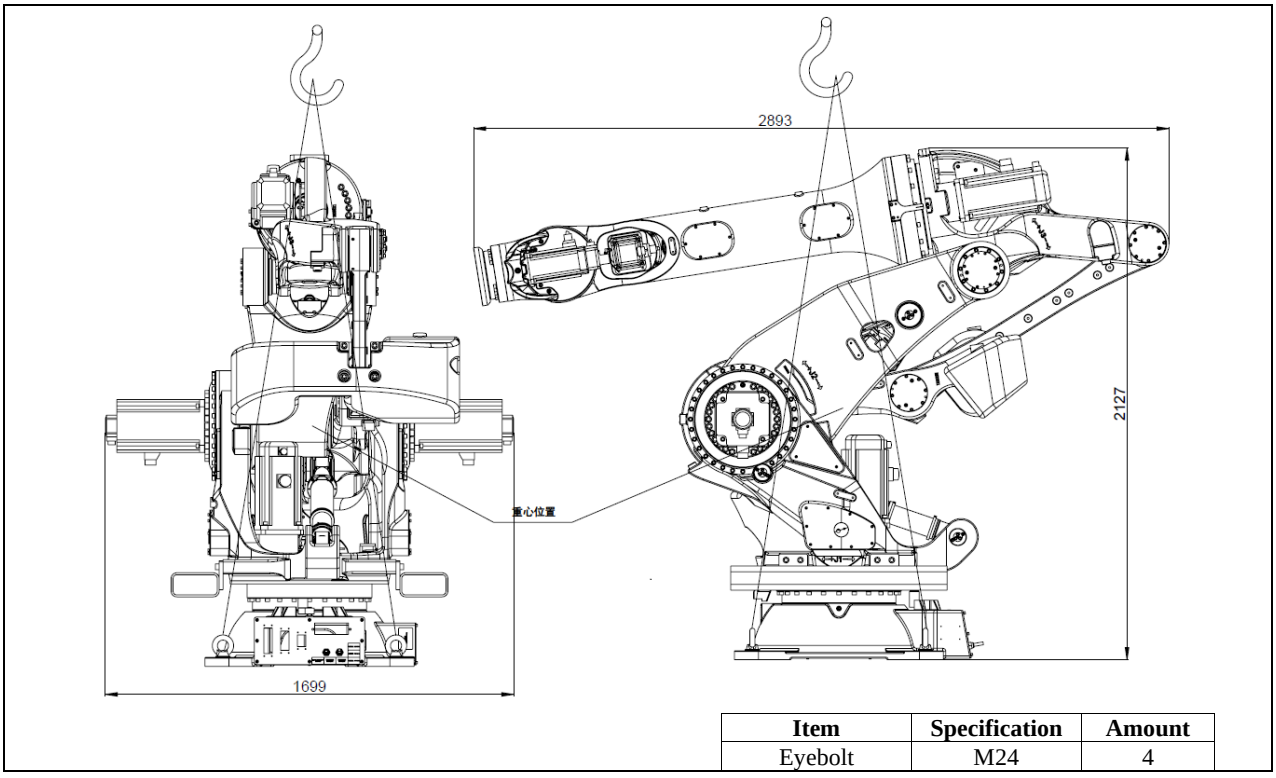
Item	Specification	Amount
Eyebolt	M20	4

Fig 1.7 Use a crane to transport the robot (ER220-3200, ER280-3200, ER280-3200-LI)



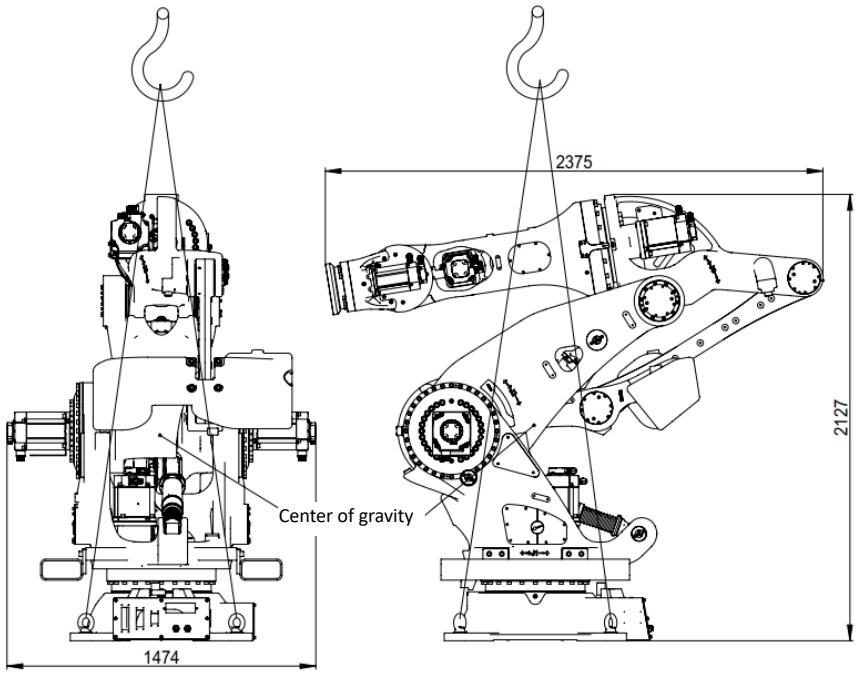
Item	Specification	Amount
Eyebolt	M20	4

Fig 1.8 Use a crane to transport the robot (ER350-3200)



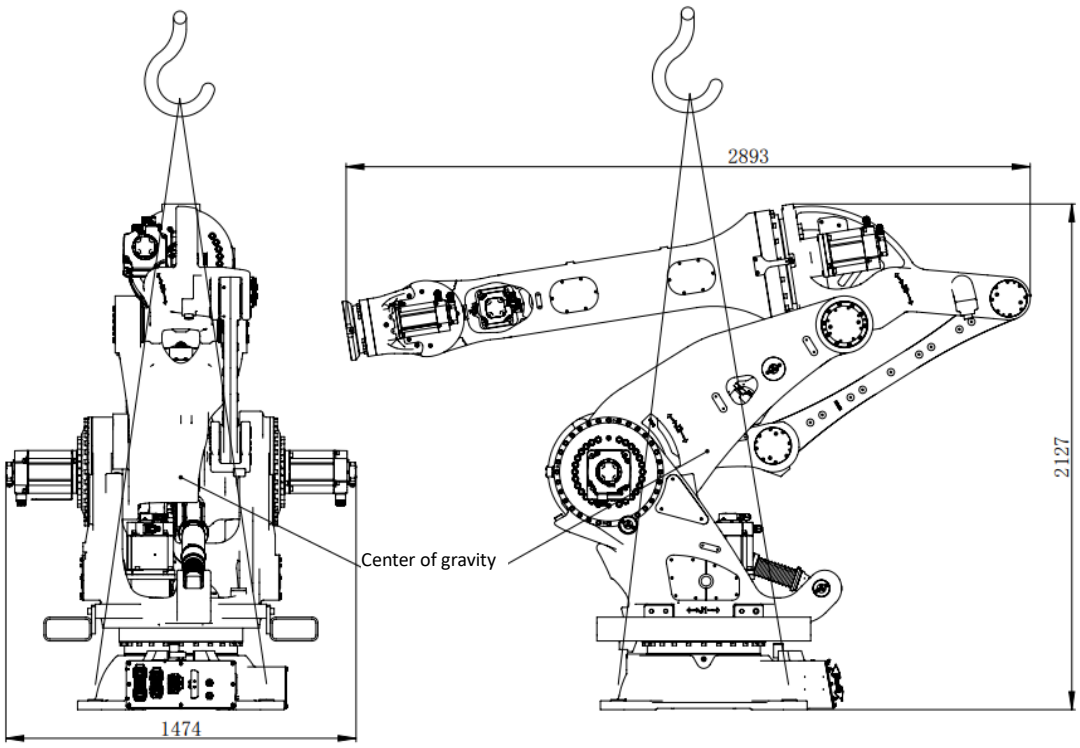
Item	Specification	Amount
Eyebolt	M24	4

Fig 1.9 Use a crane to transport the robot (ER420-3300)



Item	Specification	Amount
Eyebolt	M24	4

Fig 1.10 Use a crane to transport the robot (ER500-2800, ER600-2800, ER700-2800)

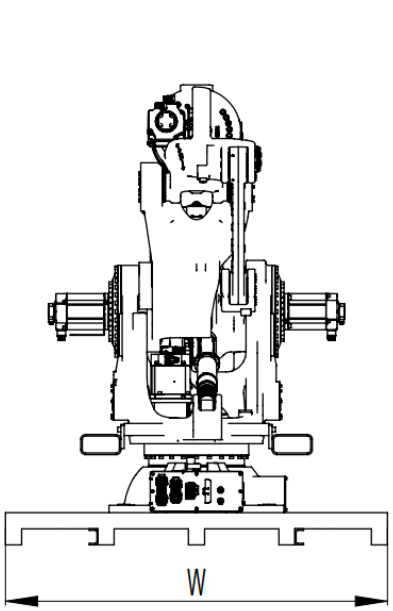


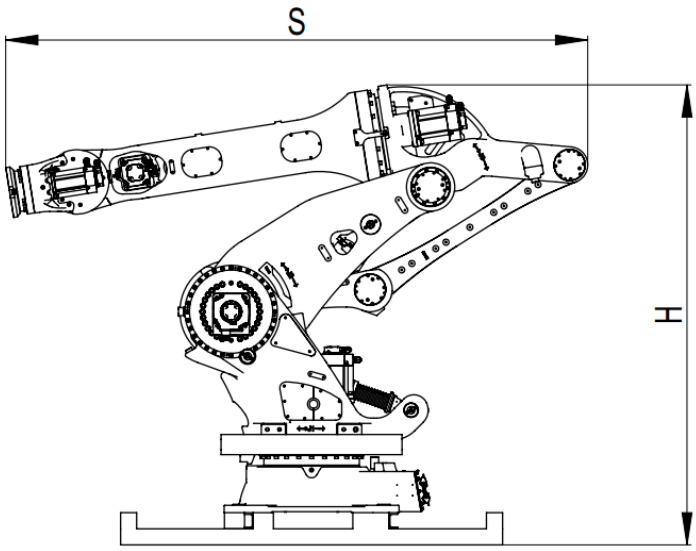
Item	Specification	Amount
Eyebolt	M24	4

Fig 1.11 Use a crane to transport the robot (ER350-3300)

1.2. Storage

This series of robots is usually transported on wooden pallets, and its storage space requirements are as follows:





Model	H(mm)	S(mm)	W(mm)
ER220-3200	2088	2322	1500
ER280-3200	2088	2322	1500
ER280-3200-LI	2088	2322	1500
ER350-3200	2088	2322	1500
ER420-3300	2287	2893	1900
ER500-2800	2287	2375	1900
ER600-2800 ER700-2800	2287	2375	1900
ER350-3300	2287	2893	1900

Fig 1.12 Robot base force

1.3. Installation

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

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

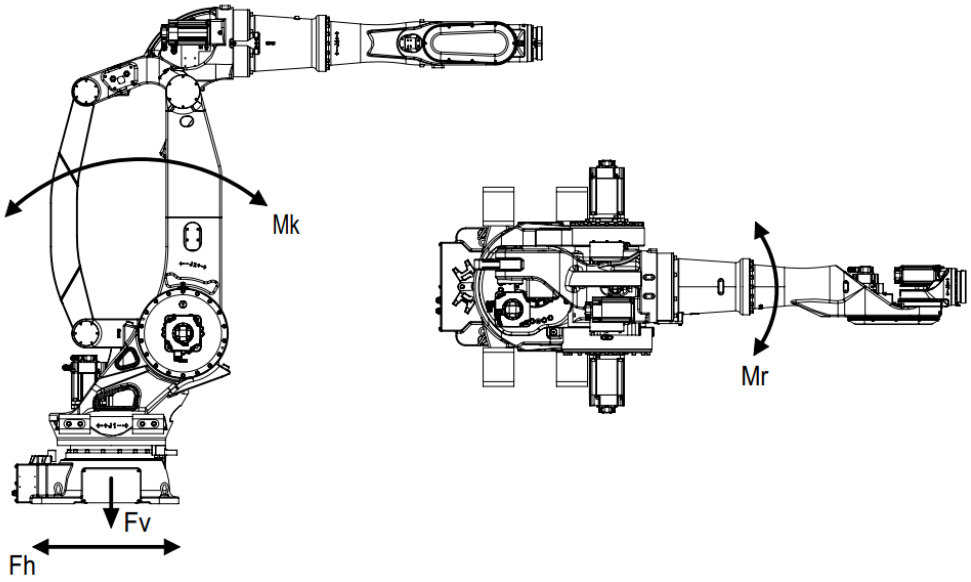
- Be sure to read and understand SAFETY chapter thoroughly.
- ESTUN robots must be transported, mounted and operated by authorized person, and in accordance with the applicable national laws, regulations and standards.

- 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.

CAUTION

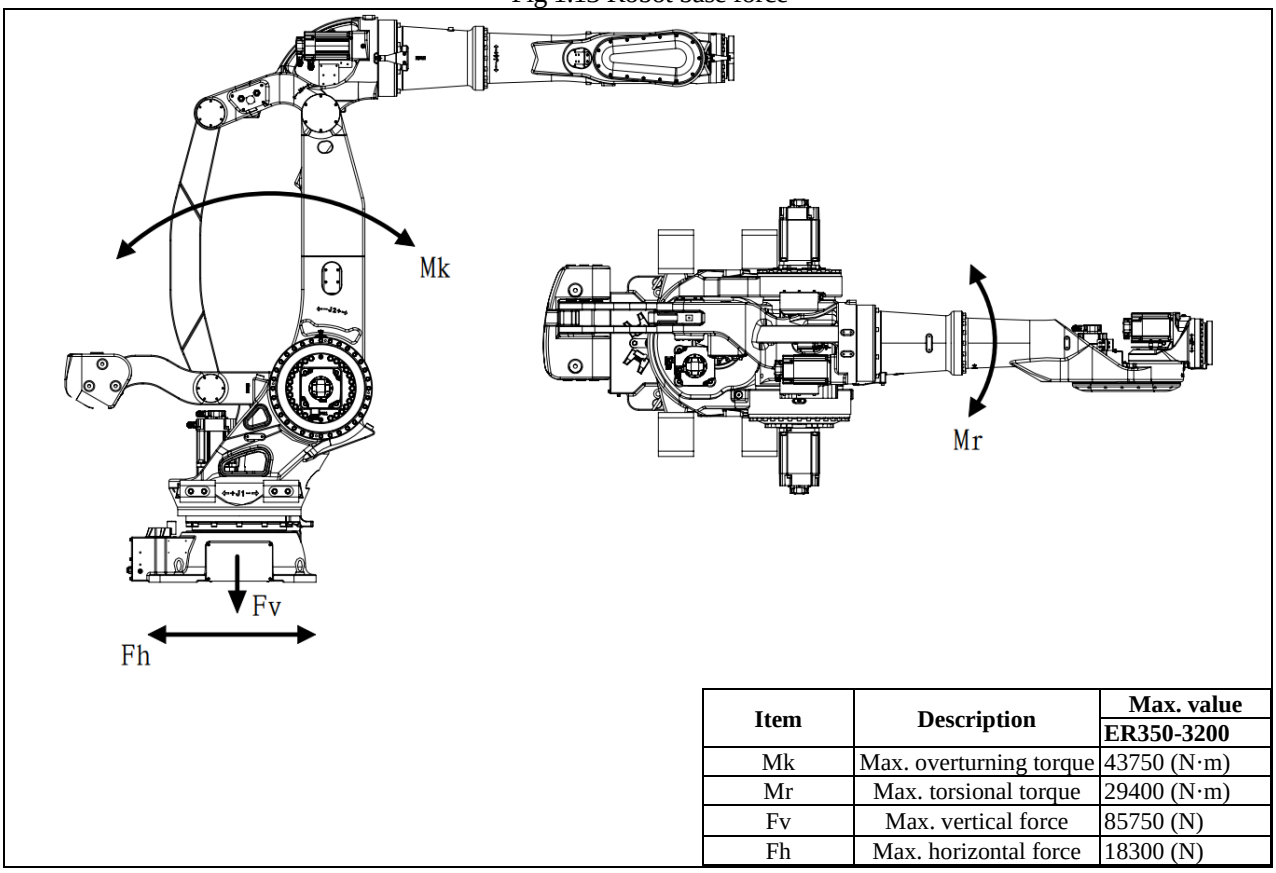
When mounting the robot base, consider its structure and the force upon it. Concrete on the base may not have any crack and conform to the specified codes. The bearing capacity and compaction of the concrete foundation should be in accordance with the design guideline. Concrete strength level C20/C25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

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



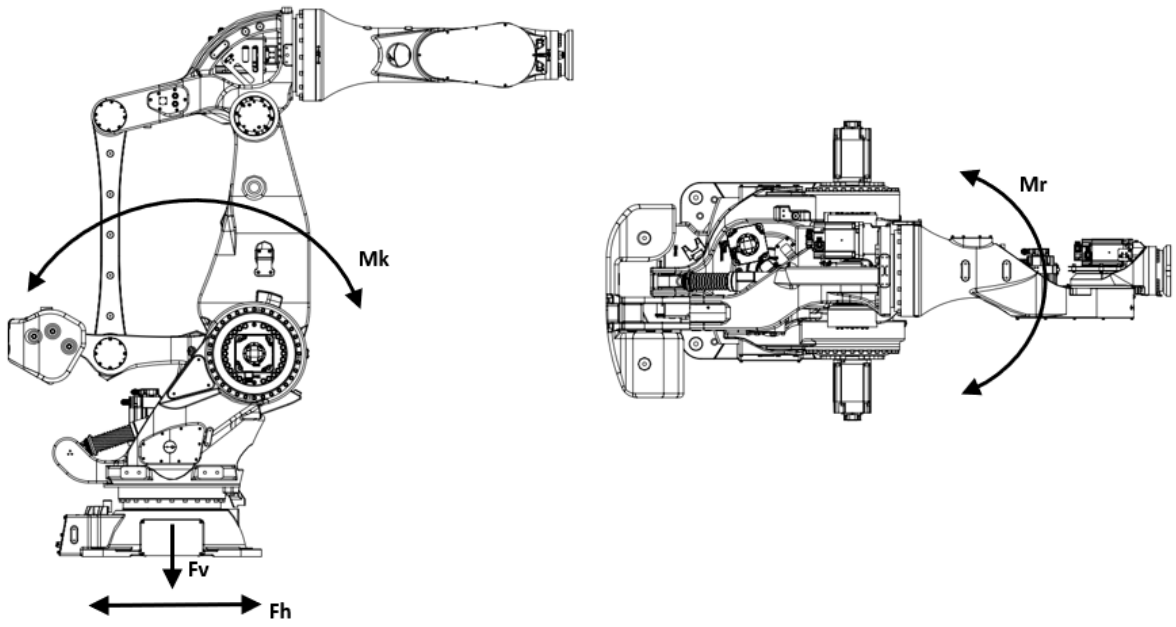
Item	Description	Max. value		
		ER220-3200	ER280-3200	ER280-3200-LI
Mk	Max. overturning torque	31250（N·m）	31250（N·m）	30625（N·m）
Mr	Max. torsional torque	30000（N·m）	30000（N·m）	29400（N·m）
Fv	Max. vertical force	61500（N）	59250（N）	58500（N）
Fh	Max. horizontal force	20100（N）	18900（N）	18600（N）

Fig 1.13 Robot base force



Item	Description	Max. value
		ER350-3200
Mk	Max. overturning torque	43750 (N·m)
Mr	Max. torsional torque	29400 (N·m)
Fv	Max. vertical force	85750 (N)
Fh	Max. horizontal force	18300 (N)

Fig 1.14 Robot base force



Item	Description	Max. value				
		ER420-3300	ER500-2800	ER600-2800	ER350-3300	ER700-2800
Mk	Max. overturning torque	37500 (N·m)	37500 (N·m)	37500 (N·m)	37500 (N·m)	37500 (N·m)
Mr	Max. torsional torque	36750 (N·m)	36750 (N·m)	36750 (N·m)	36750 (N·m)	36750 (N·m)
Fv	Max. vertical force	86750 (N)	94750 (N)	102250 (N)	89500 (N)	105250 (N)
Fh	Max. horizontal force	18300 (N)	20400 (N)	20400 (N)	19800 (N)	18300 (N)

Fig 1.3 Robot base force

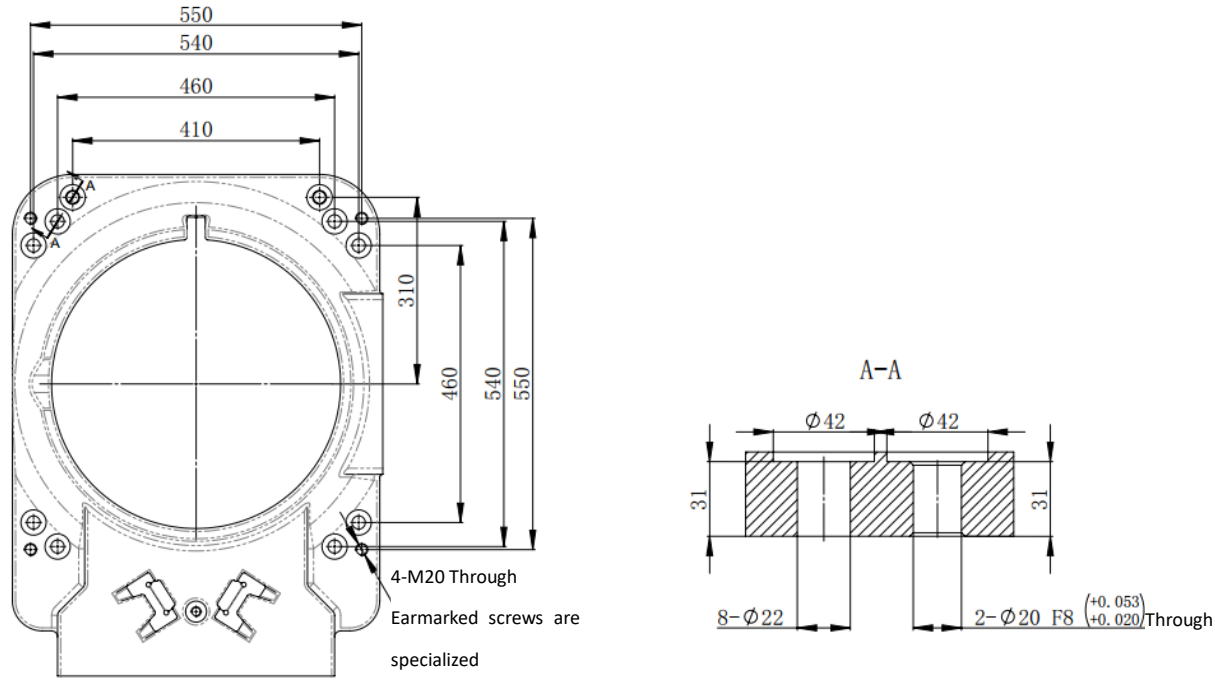


Fig 1.4 Robot base mounting dimension (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

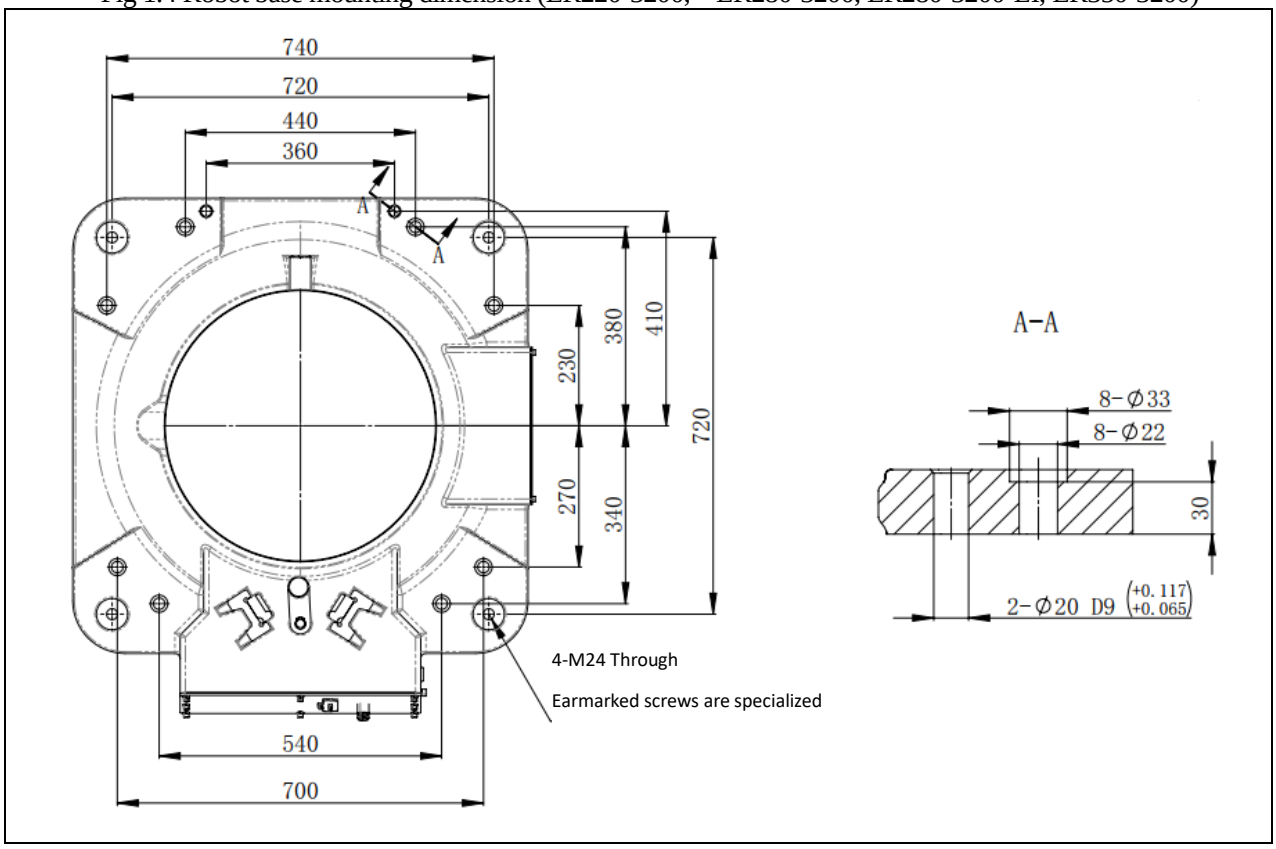
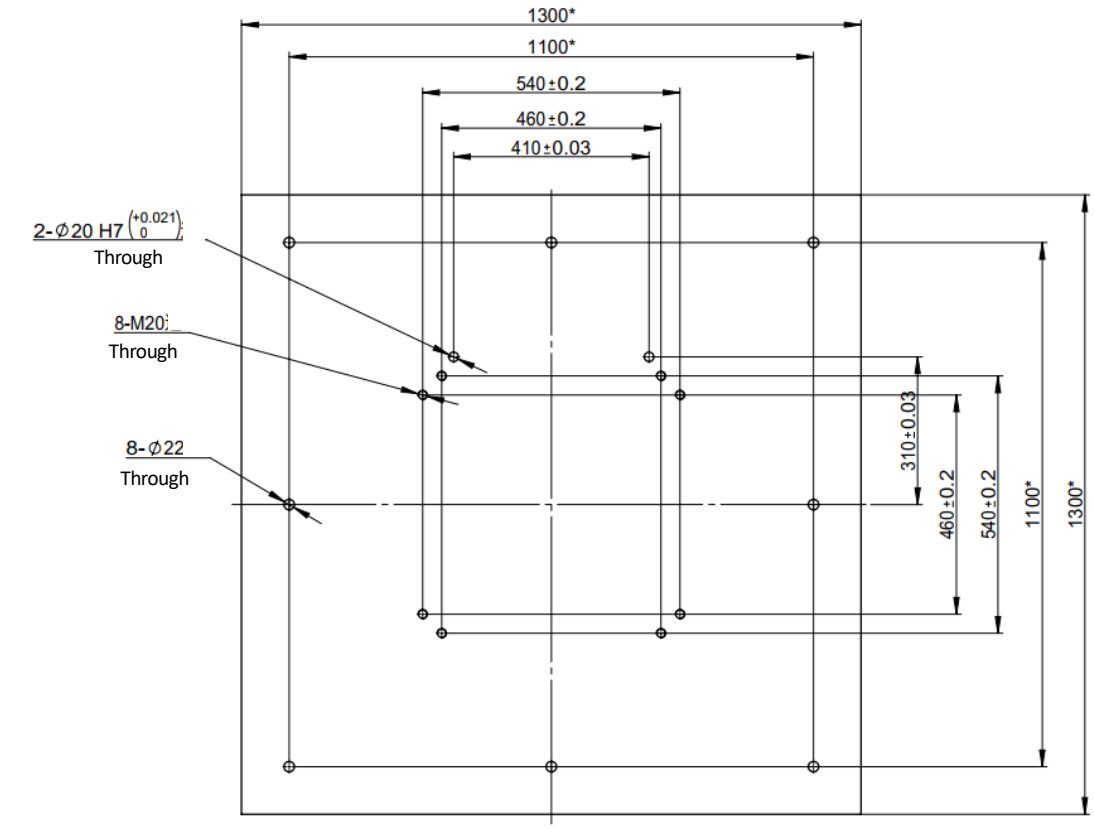


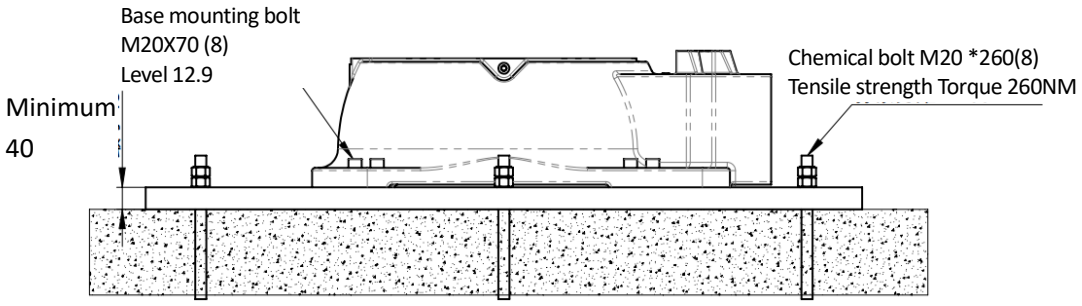
Fig 1.5 Robot base mounting dimension (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

Tab 1.1 Robot fixing components

Item and model	Amount
Fixed screw: M20X70 (ISO4762 12.9 level)	8
Spring washer: spring washer 20 (DIN 7880-1987)	8
Positioning pin: cylindrical pin 20X80 (ISO 8735)	2

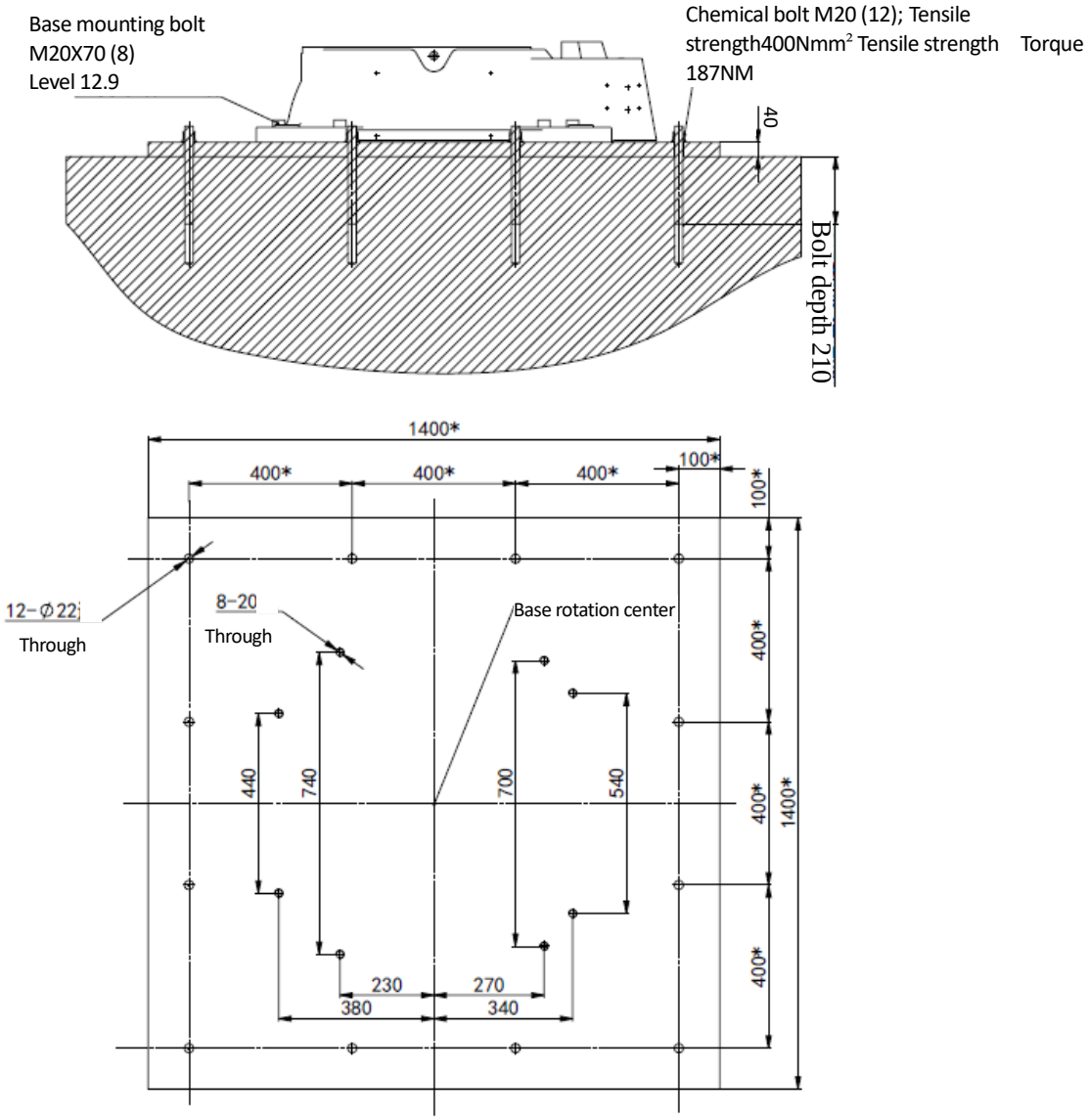
INFO **Positioning pin can reduce the influence on current program caused by re-installation or replacement of the robot. If the recovery of programmed path is needed, perform adjustment. If not, positioning pin can be eliminated.**





Note: use eight M20X260 chemical bolts to fix the mounting plate on the concrete floor. The thickness of the concrete should be no less than 190mm, the effective area no less than 1300mmx1300mm. Fix the robot base with parts shown in the table below. The dimension with a * is recommended. A strict calculation based on the force upon the base and the structure of the base must be performed before any change of these dimensions.

Fig 1.6 Robot mounting plate dimension and mounting method (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)



Note: use twelve M20X290 chemical bolts to fix the mounting plate on the concrete floor. The thickness of the concrete should be no less than 300mm, the effective area no less than 1500mmx1500mm. Fix the robot base with parts shown in the table below.

The dimension with a * is recommended. A strict calculation based on the force upon the base and the structure of the base must be performed before any change of these dimensions.

Fig 1.7 Robot mounting plate dimension and mounting method (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

1.4. Installation conditions

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

Foundation	
Max. surface roughness	0.5mm
Max. inclination angle	5°
Storage condition	
Min. ambient temperature	-25℃
Max. ambient temperature	+55℃
Max. ambient humidity	95%RH
Protection level	
ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200	Main part: IP54 Wrist: IP65
ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800	IP54

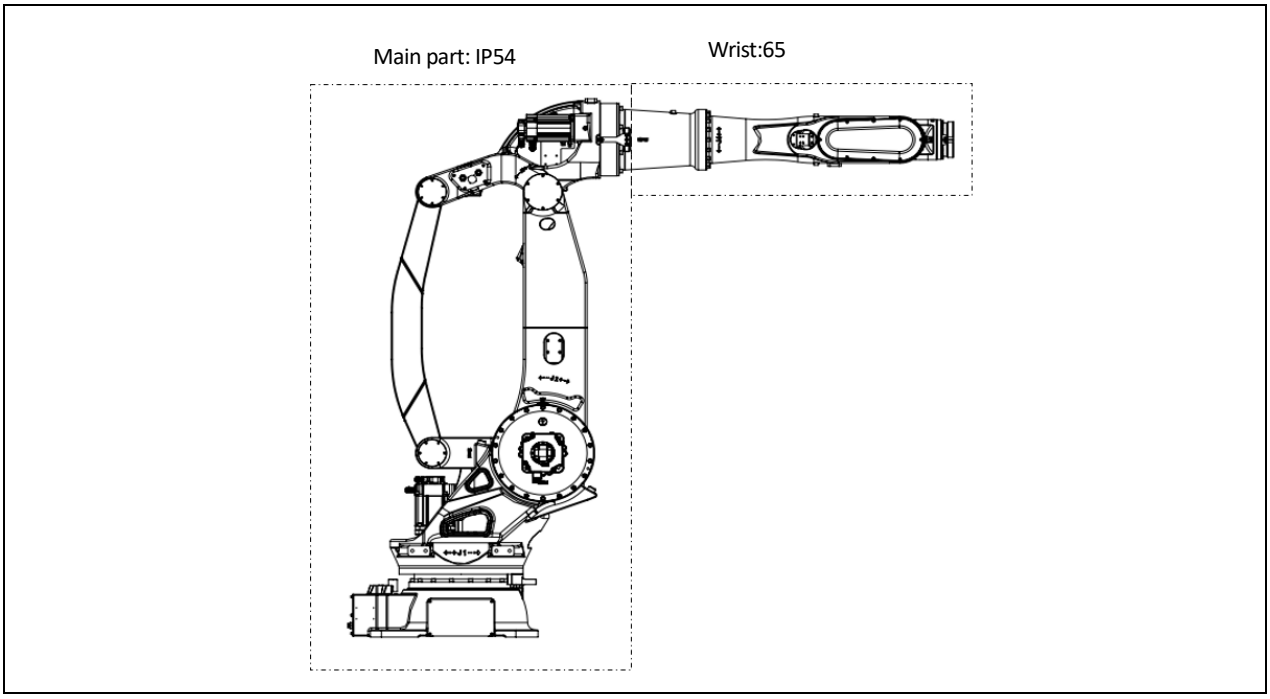


Fig 1.20 Schematic diagram of the protection level of the robot

Performance of resistant chemicals and resistant solvents.

(1) The robot cannot be used with the following liquids. Potentially these liquids will cause irreversible damage to the rubber parts (such as gaskets, grease seal, O-rings, etc.) (As exception to this only liquids approved by ESTUN can be used with the robot).

(a)organic solvents

(b)cutting grease 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 robot works in the environment using water or liquid, complete draining of J1 base must be done. Incomplete draining of J1 base 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.

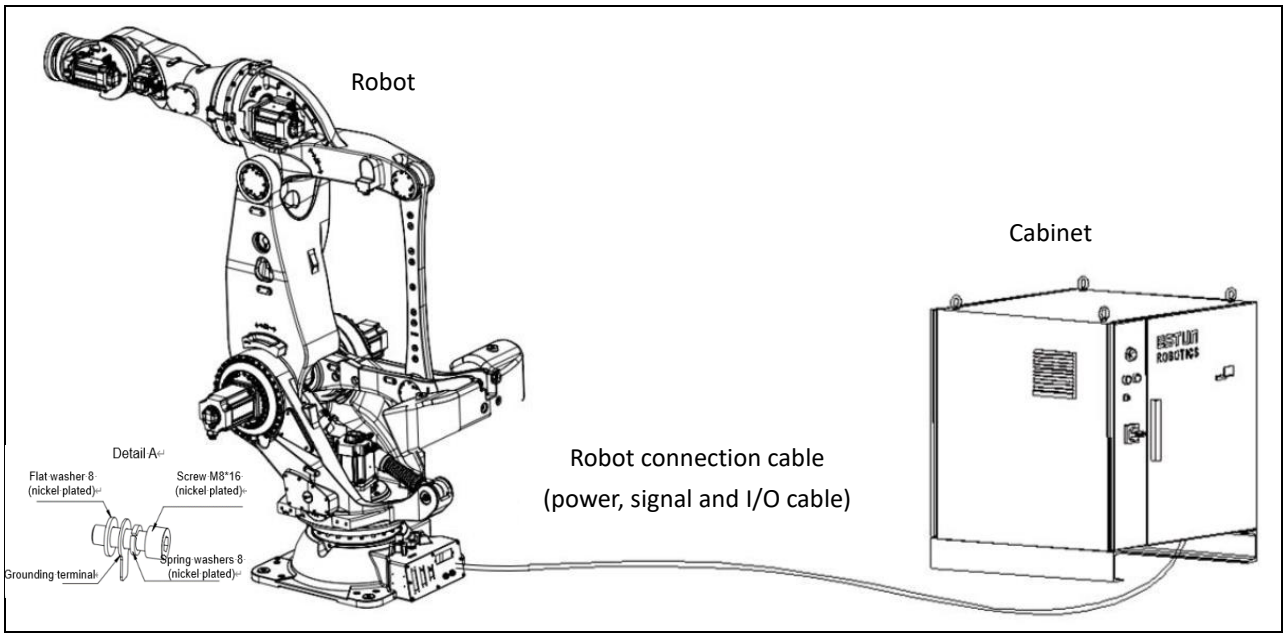


Fig 2.1 Cable connection

CAUTION

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

3. SPECIFICATIONS

3.1. ROBOT CONFIGURATION

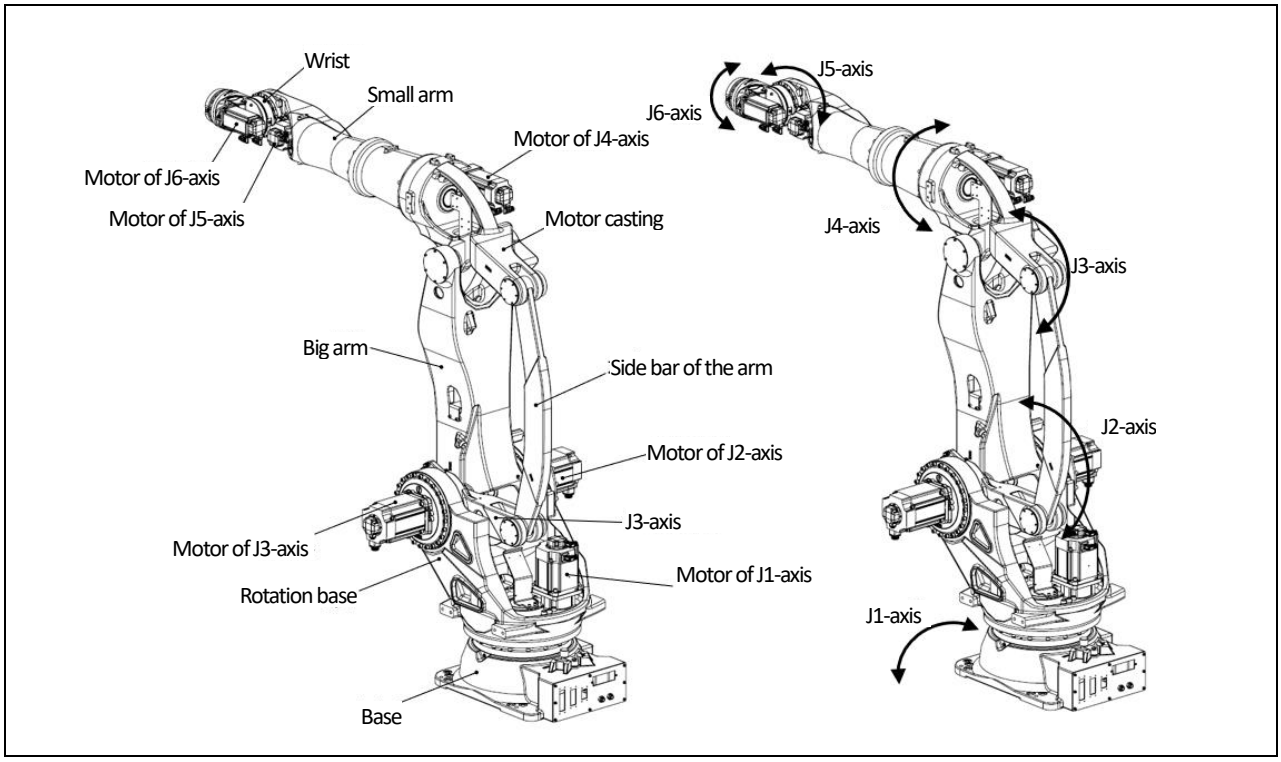


Fig 3.1 Robot Configuration (ER220-3200, ER280-3200, ER280-3200-LI)

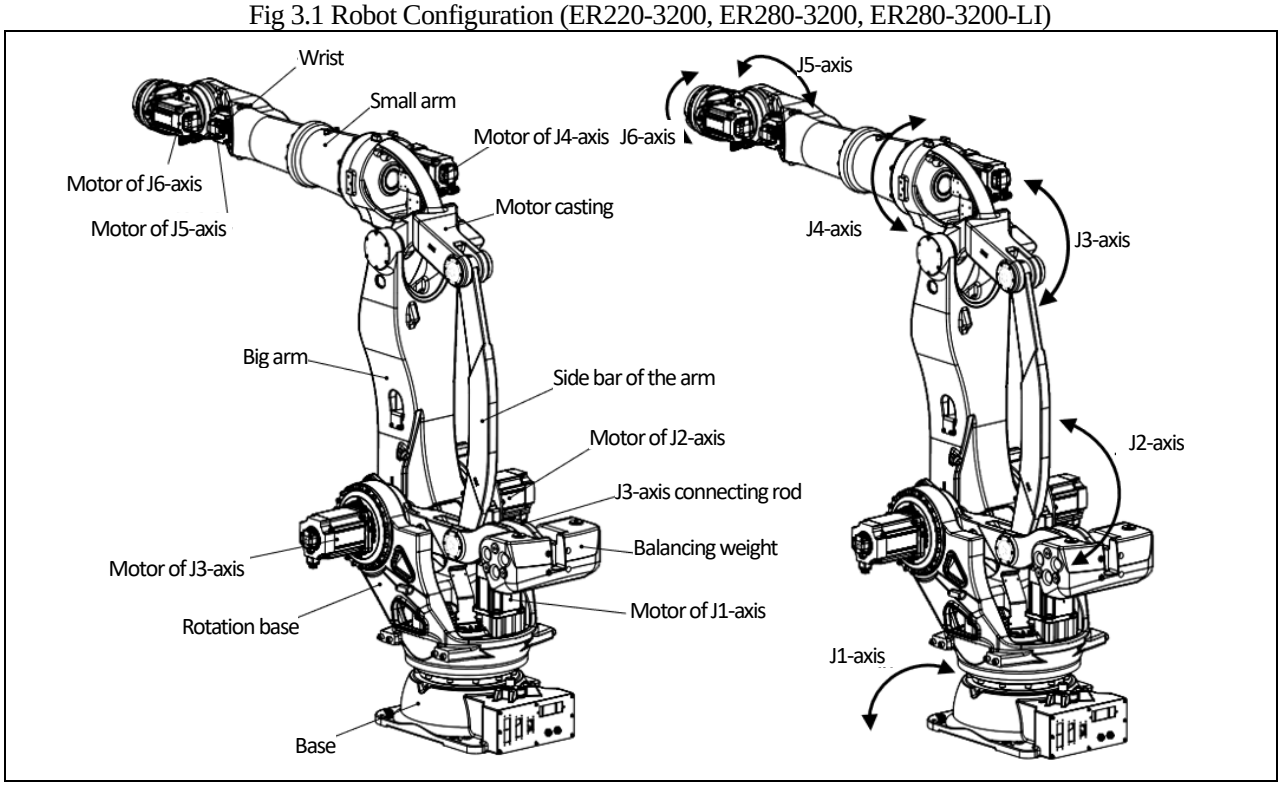


Fig 3.2 Robot Configuration (ER350-3200)

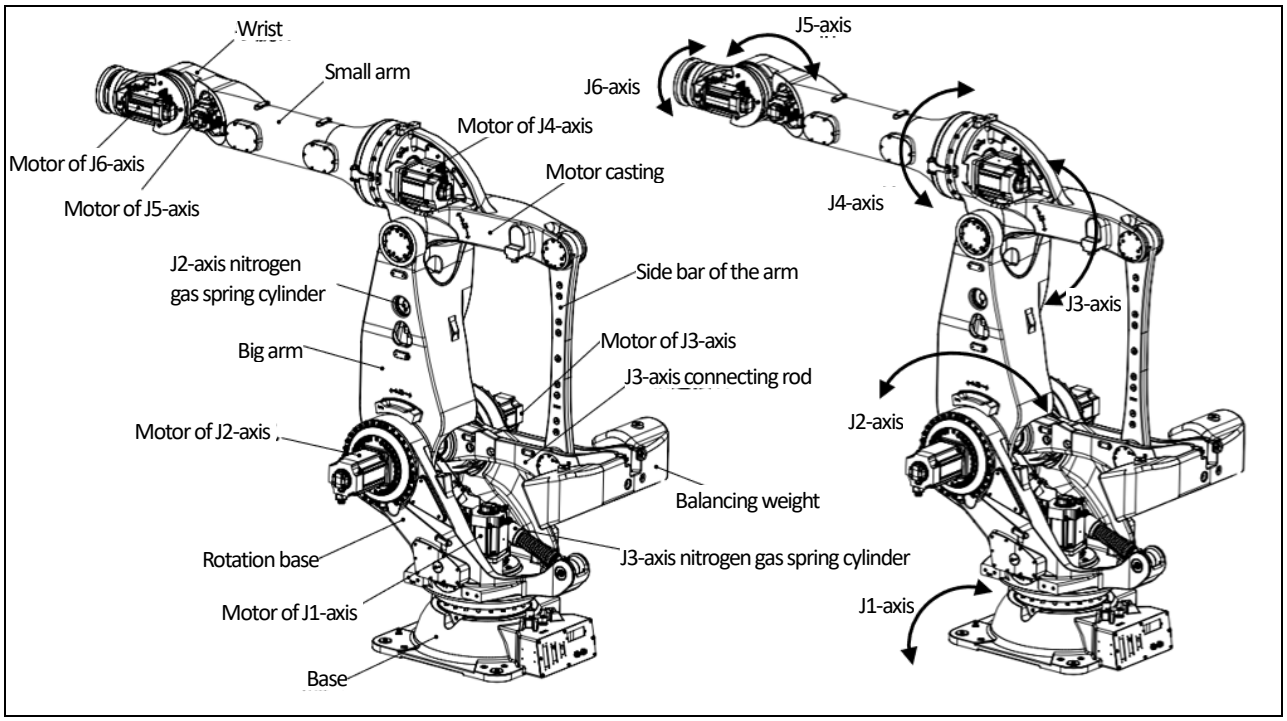


Fig 3.3 Robot Configuration (ER420-3300)

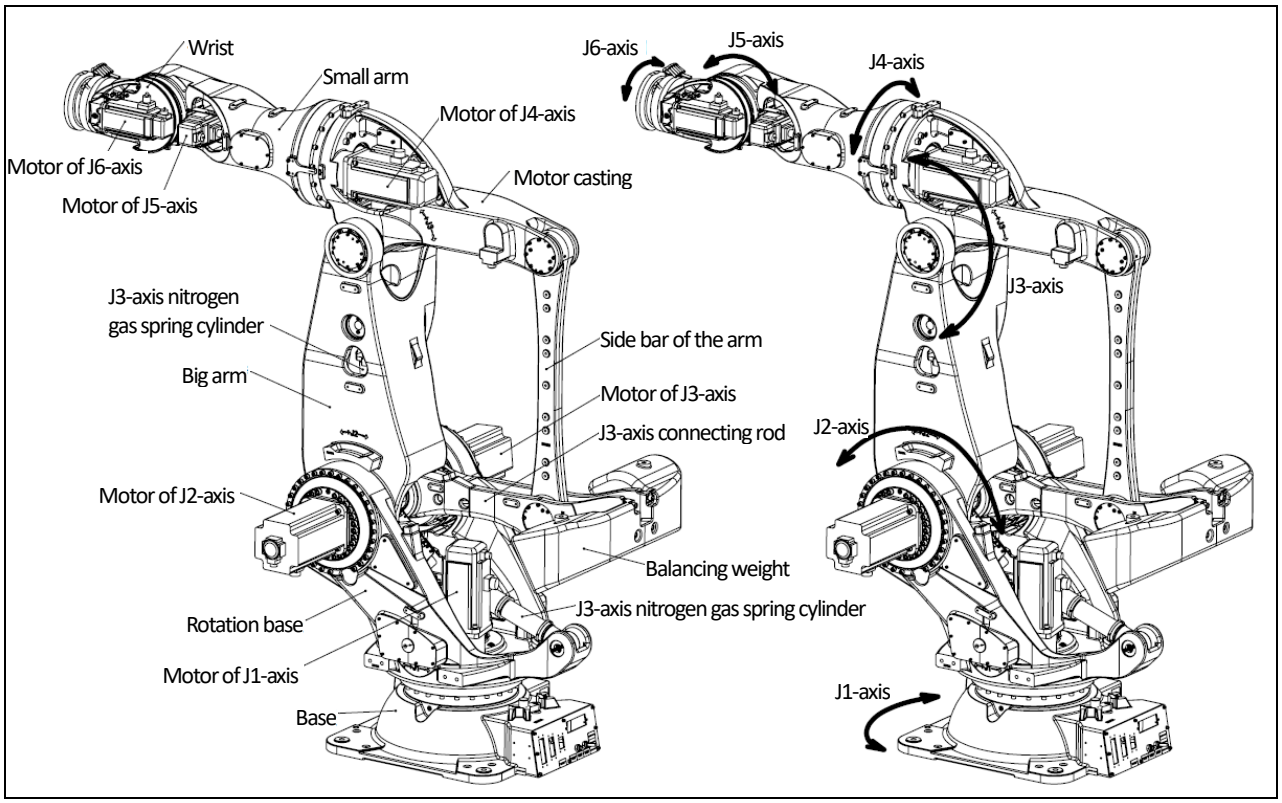


Fig 3.4 Robot Configuration (ER600-2800, ER700-2800, ER500-2800 No counterweights)

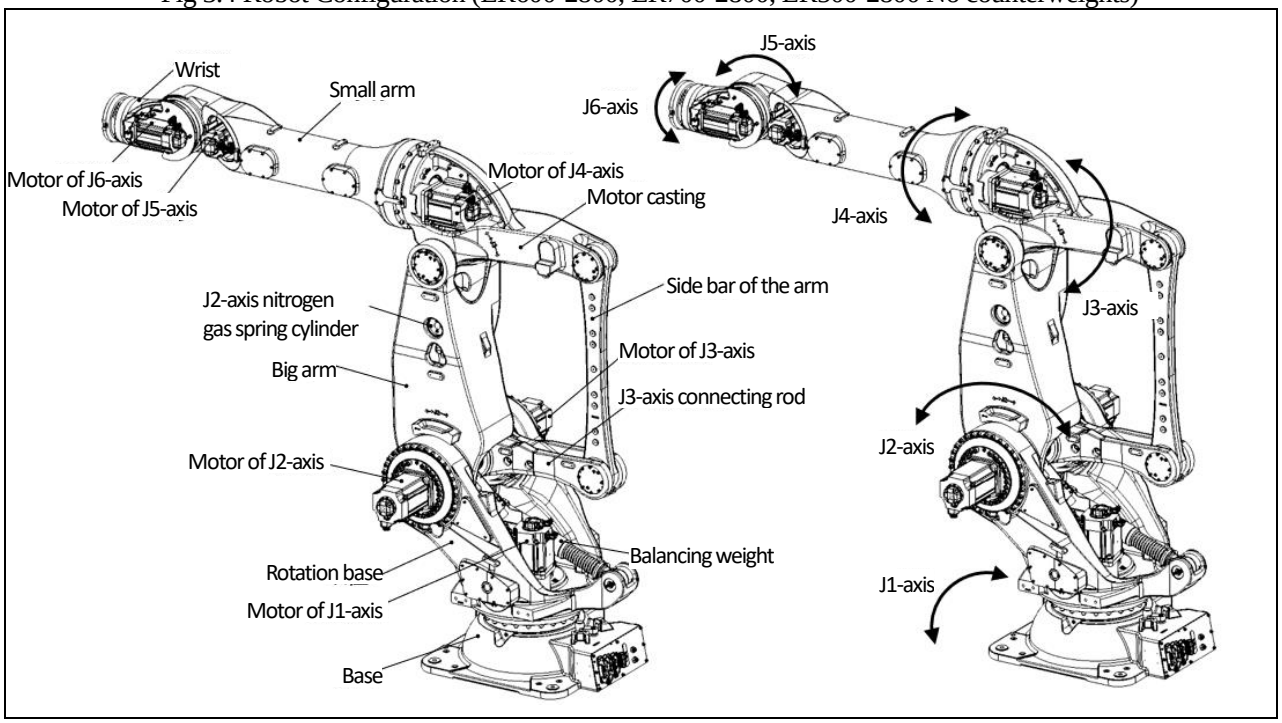


Fig 3.5 Robot Configuration (ER350-3300)

Tab 3.1 Specifications

Model		ER220-3200	ER280-3200	ER280-3200-LI	ER350-3200	ER350-3300
Type			Articulated robot			
Controlled axes			6 axes			
Installation			Floor			
Motion range	J1-axis	±180°	±180°	±180°	±180°	±180°
	J2-axis	-60°~ +90°	-60°~ +90°	-60°~ +90°	-60°~ +90°	-60°~ +105°
	J3-axis	-30°~ +125°	-30°~ +125°	-30°~ +125°	-65°~ +68°	-30°~ +125°
	J4-axis	±200°	±200°	±200°	±200°	±200°
	J5-axis	±125°	±125°	±125°	±125°	±115°
	J6-axis	±360°	±360°	±360°	±360°	±360°
Max. speed (Note 1)	J1-axis	110°/s	110°/s	110°/s	118°/s	80°/s
	J2-axis	100°/s	100°/s	100°/s	100°/s	100°/s
	J3-axis	100°/s	100°/s	100°/s	100°/s	100°/s
	J4-axis	170°/s	170°/s	170°/s	180°/s	110°/s
	J5-axis	145°/s	145°/s	145°/s	126°/s	80°/s
	J6-axis	200°/s	200°/s	200°/s	224°/s	150°/s
Max payload	Wrist	220kg	280kg	280kg	350kg	350kg
Allowable load inertia at wrist	J4-axis	174kg·m²	240kg·m²	240kg·m²	340kg·m²	500.6kg·m²
	J5-axis	174kg·m²	240kg·m²	240kg·m²	340kg·m²	500.6kg·m²
	J6-axis	105kg·m²	140kg·m²	140kg·m²	260kg·m²	300.4kg·m²
Allowable load	J4-axis	1427N·m	1727N·m	1727N·m	2210N·m	2612N·m
	J5-axis	1427N·m	1727N·m	1727N·m	2210N·m	2612N·m

torque at wrist	J6-axis	783N·m	887N·m	887N·m	1200N·m	1217N·m
Drive method			Electric servo drive by AC servo motor			
Repeatability		±0.06mm				0.1mm
Reach		3200mm	3200mm	3200mm	3200mm	3300mm
Weight		1550kg	1550kg	1550kg	1850kg	2605kg
Installation environment			Ambient temperature: 0～40℃ (Note 2) Ambient humidity: 20~80%RH Height: up to 1000 meters above the sea level required Vibration acceleration: 4.9m/s² (0.5G) or less Free of corrosive gases (Note 3)			

Tab 3.2 Specifications

Model		**ER420-3300**	**ER500-2800**	**ER600-2800**	**ER700-2800**
Type		Articulated robot			
Controlled axes		6 axes			
Installation		Floor			
Motion range	J1-axis	±180°	±180°	±180°	±180°
	J2-axis	-60°~ +105°	-60°~ +105°	-60°~ +105°	-60°~ +105°
	J3-axis	-30°~+125°	-30°~ +140°	-30°~ +140°	-30°~ +140°
	J4-axis	±200°	±200°	±200°	±200°
	J5-axis	±115°	±115°	±115°	±115°
	J6-axis	±360°	±360°	±360°	±360°
Max. speed (Note 1)	J1-axis	80°/s	80°/s	80°/s	80°/s
	J2-axis	100°/s	100°/s	100°/s	100°/s
	J3-axis	100°/s	100°/s	100°/s	100°/s
	J4-axis	114°/s	110°/s	110°/s	110°/s
	J5-axis	87°/s	80°/s	70°/s	70°/s
	J6-axis	158°/s	150°/s	150°/s	150°/s
Max payload	Wrist	420kg	500kg	600kg	700kg
Allowable load inertia at wrist	J4-axis	500kg·m²	500.6kg·m²	580kg·m²	1100kg·m²
	J5-axis	500kg·m²	500.6kg·m²	580kg·m²	1100kg·m²
	J6-axis	300kg·m²	300.4kg·m²	300kg·m²	450kg·m²
Allowable load torque at wrist	J4-axis	3015 N·m	3103N·m	4672N·m	4050N·m
	J5-axis	3015 N·m	3103N·m	4672N·m	4050N·m
	J6-axis	1450 N·m	1357N·m	1700N·m	2070N·m
Drive method		Electric servo drive by AC servo motor			
Repeatability		±0.1mm			
Reach		3300mm	2800mm	2800mm	2800mm
Weight		2980kg	2555kg	2930kg	2930kg
Installation environment		Ambient temperature: 0～40℃ (Note 2) Ambient humidity: 20~80%RH			

	Height: up to 1000 meters above the sea level required Vibration acceleration: 4.9m/s^2 (0.5G) or less 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 grease 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.

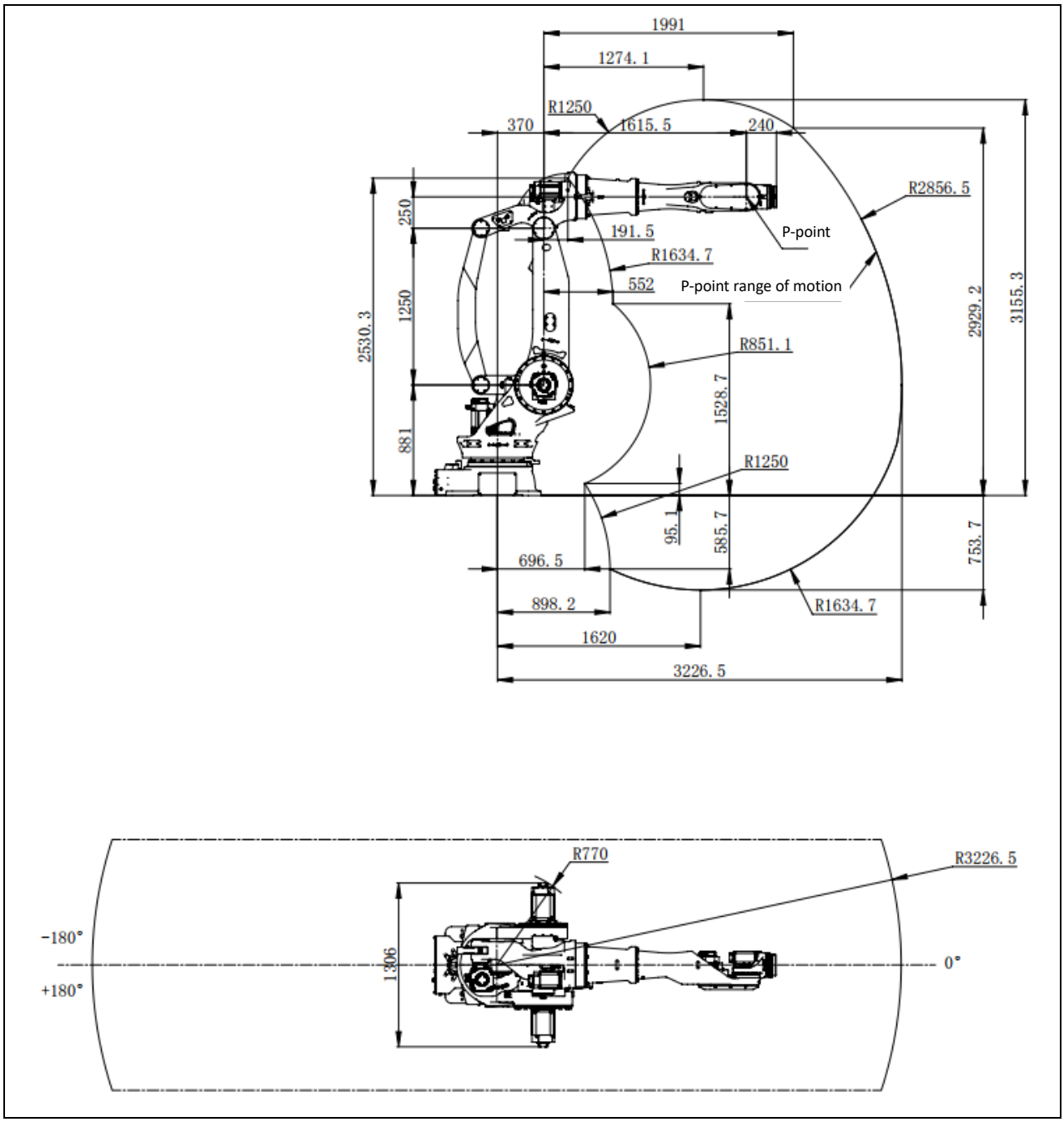


Fig 3.6 Motion range (ER220-3200, ER280-3200, ER280-3200-LI)

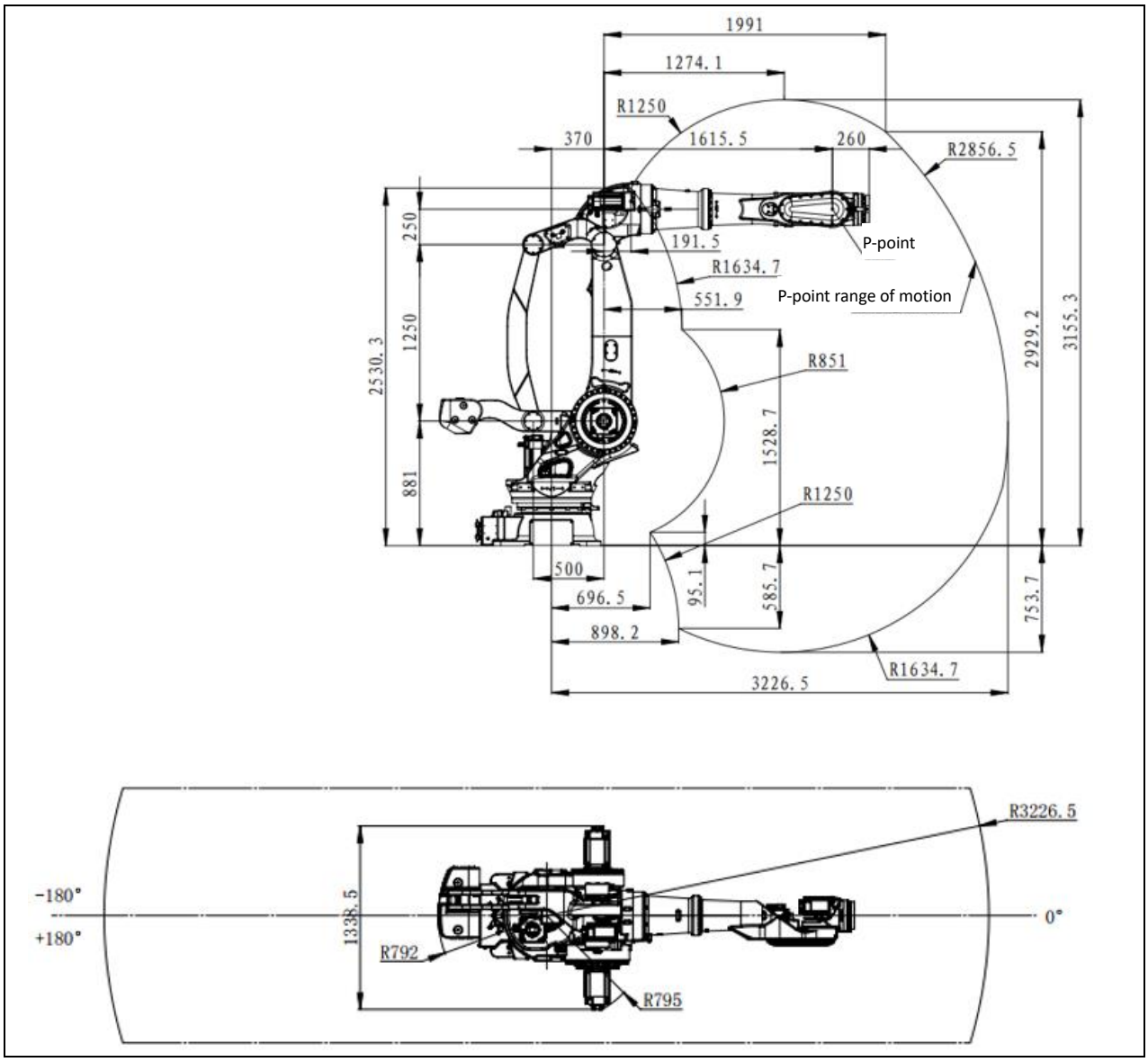


Fig 3.7 Motion range (ER350-3200)

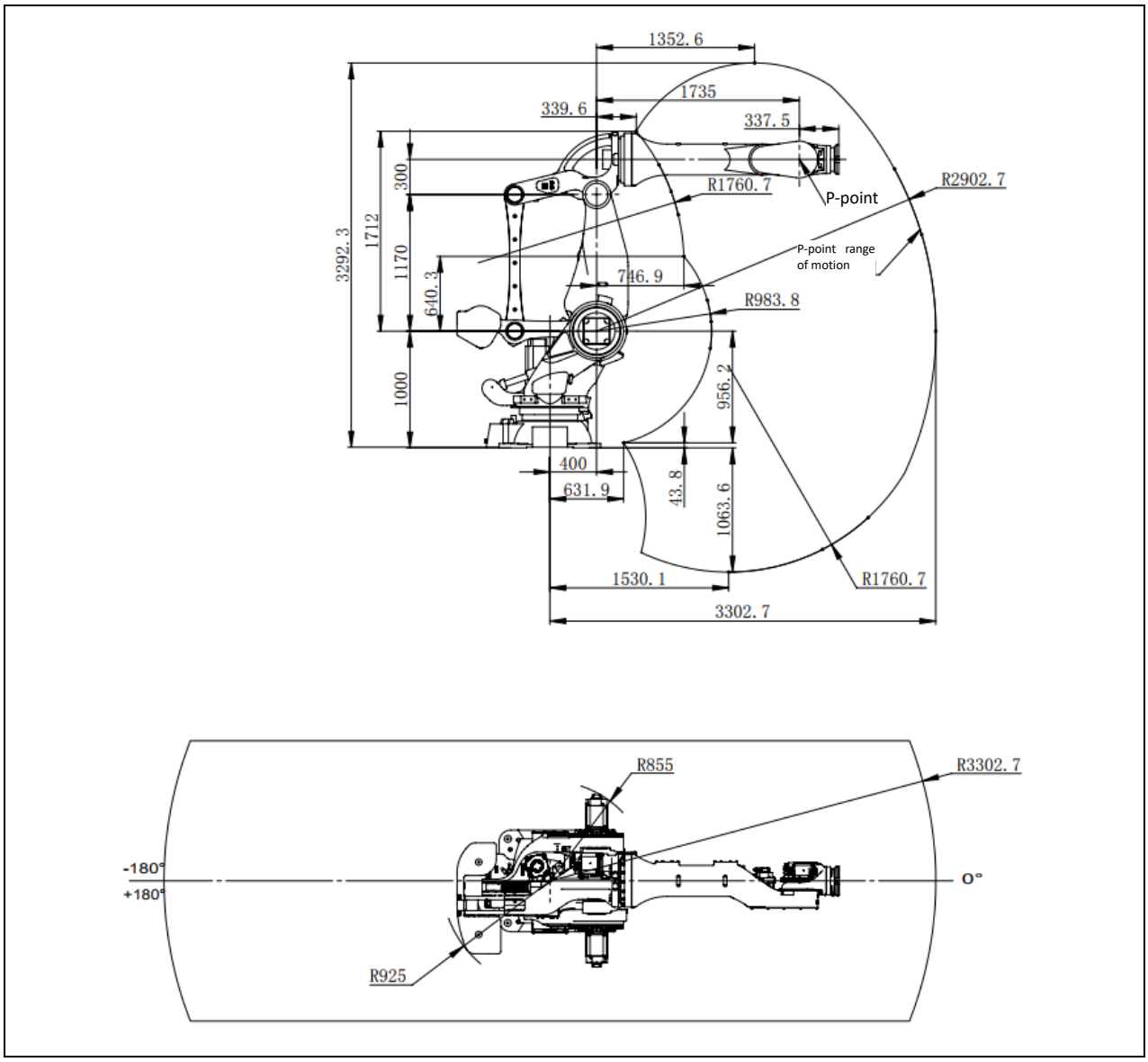


Fig 3.8 Motion range (ER420-3300)

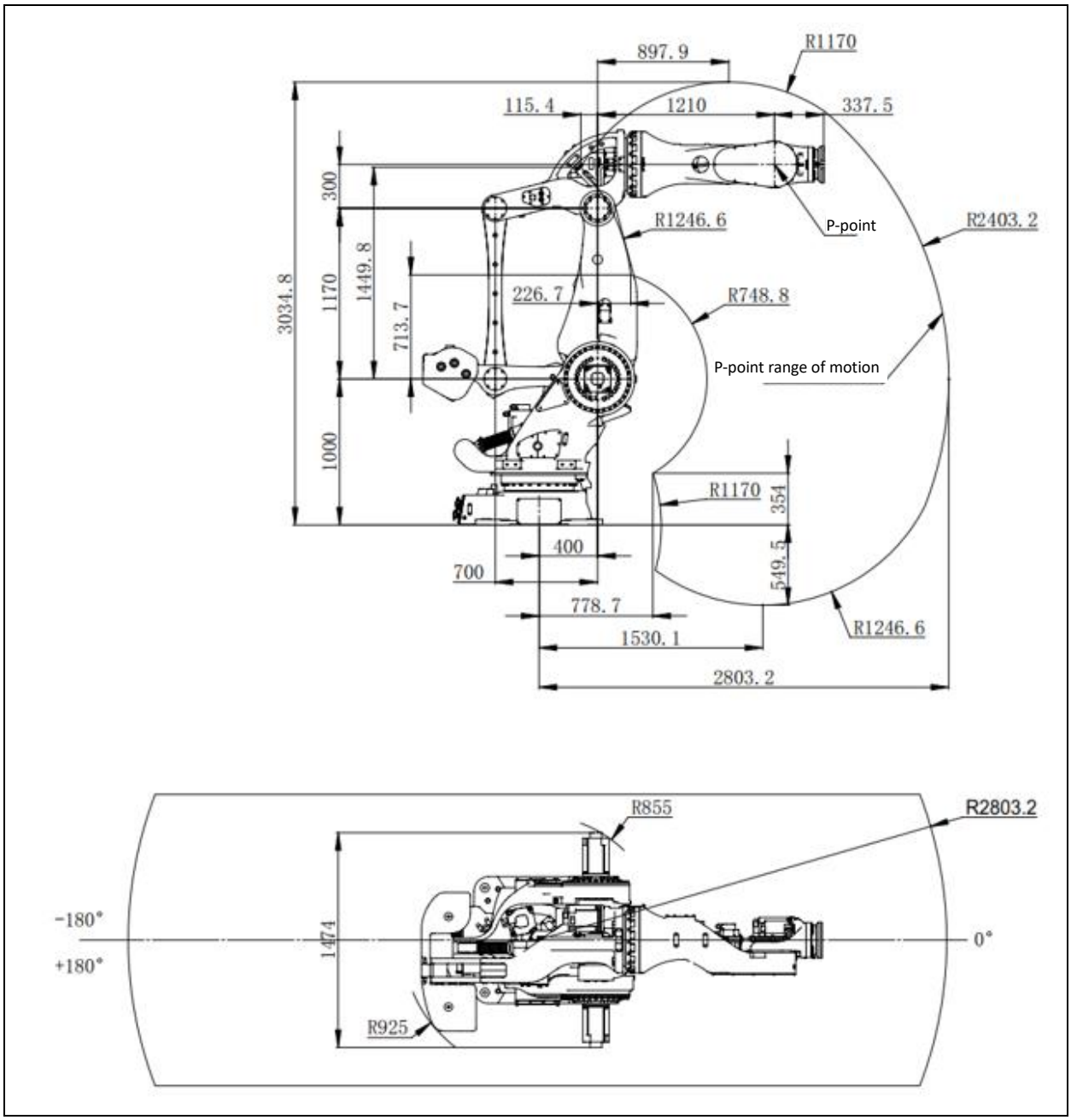


Fig 3.9 Motion range (ER600-2800, ER700-2800)

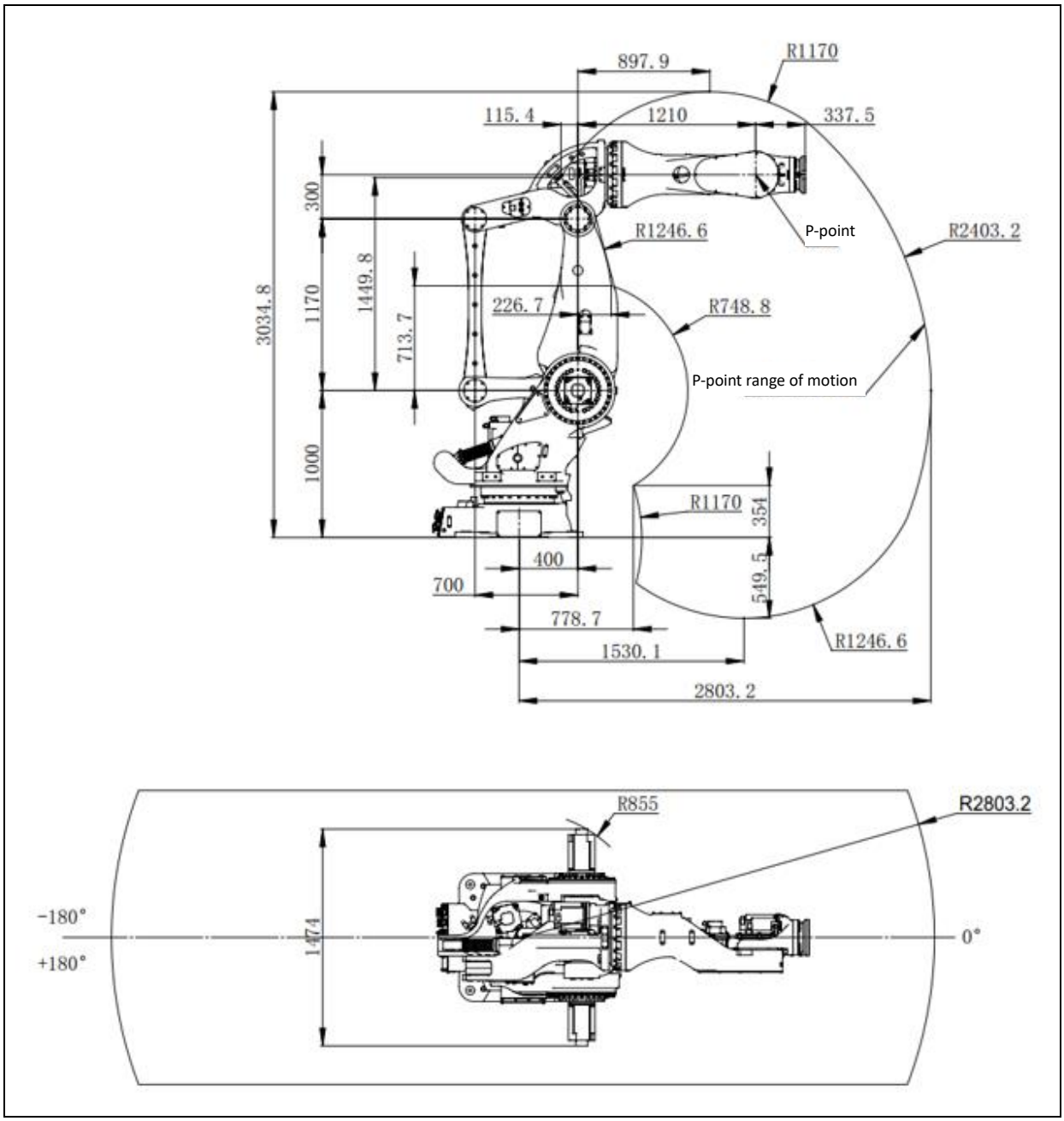


Fig 3.10 Motion range (ER500-2800)

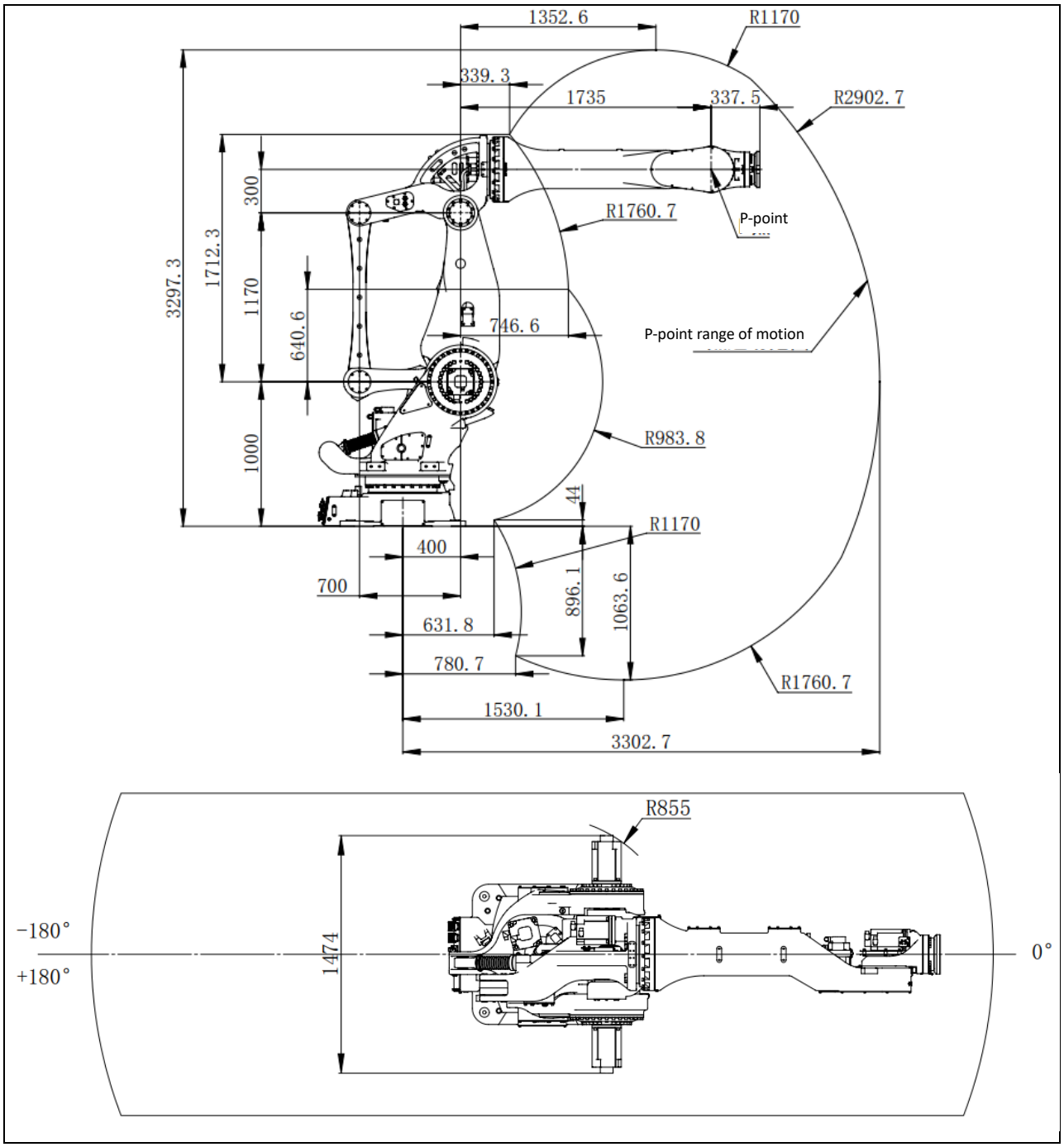


Fig 3.11 Motion range (ER350-3300)

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.**

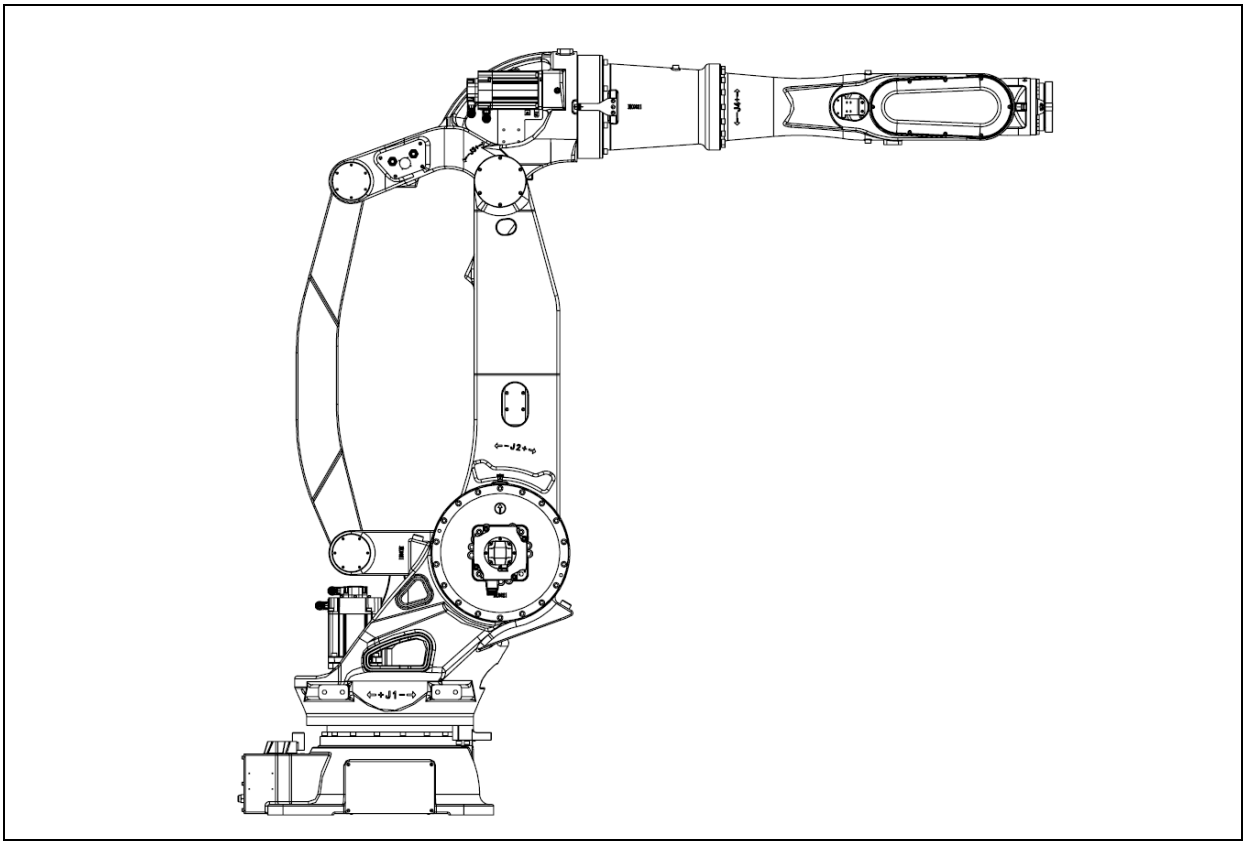


Fig 3.12 Zero point position (ER220-3200, ER280-3200, ER280-3200-LI)

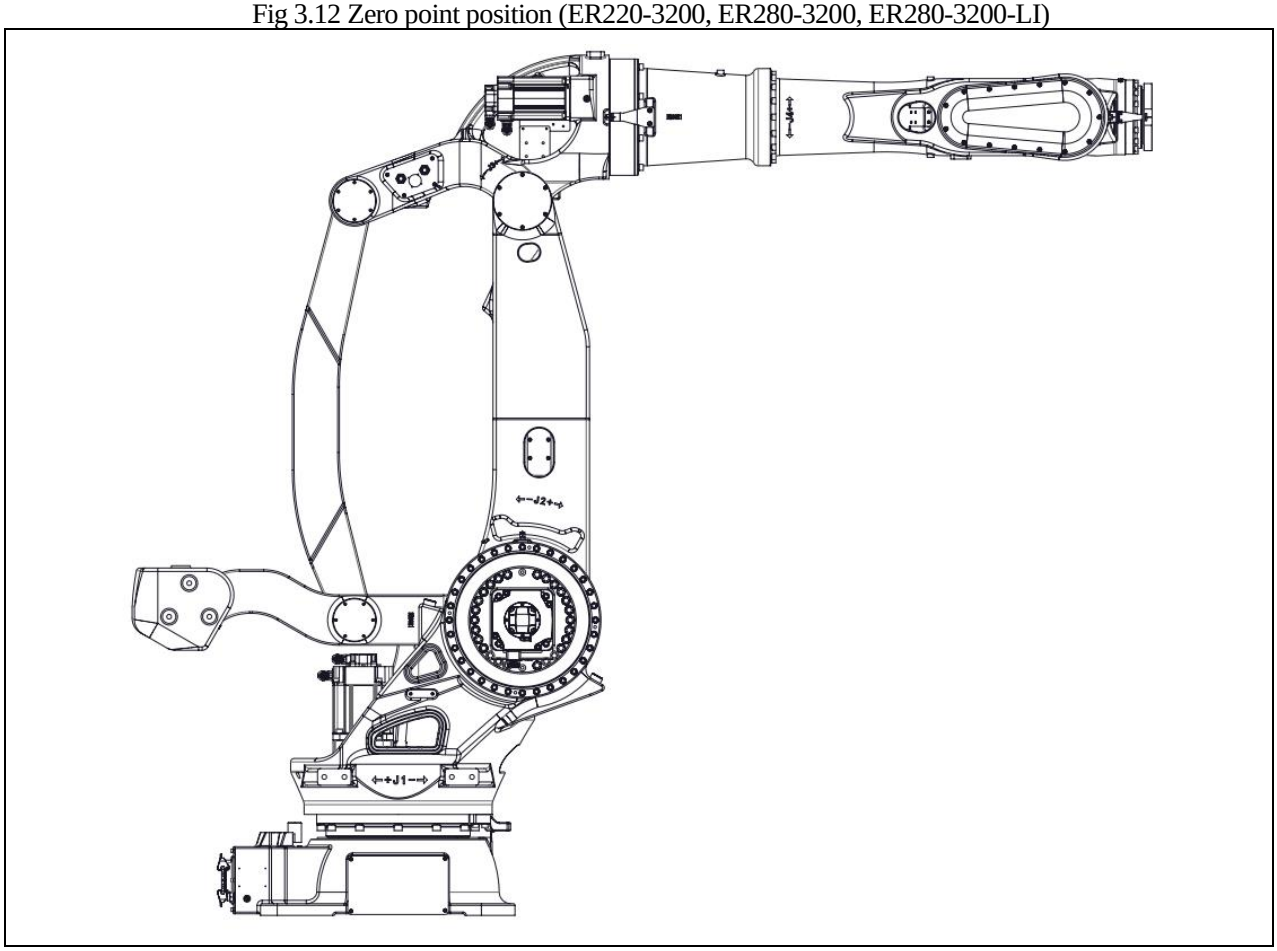


Fig 3.13 Zero point position (ER350-3200)

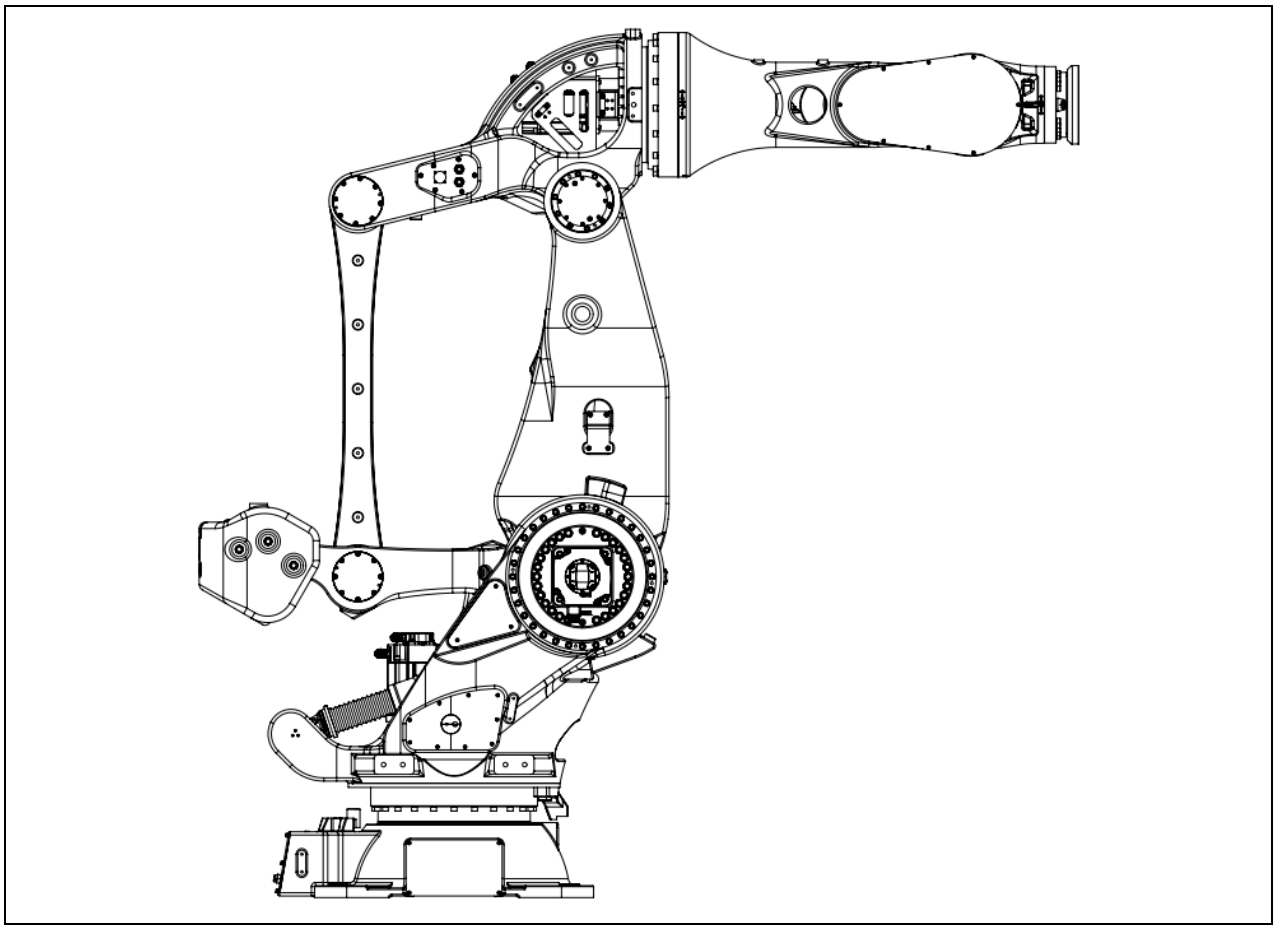


Fig 3.14 Zero point position (ER350-3300)

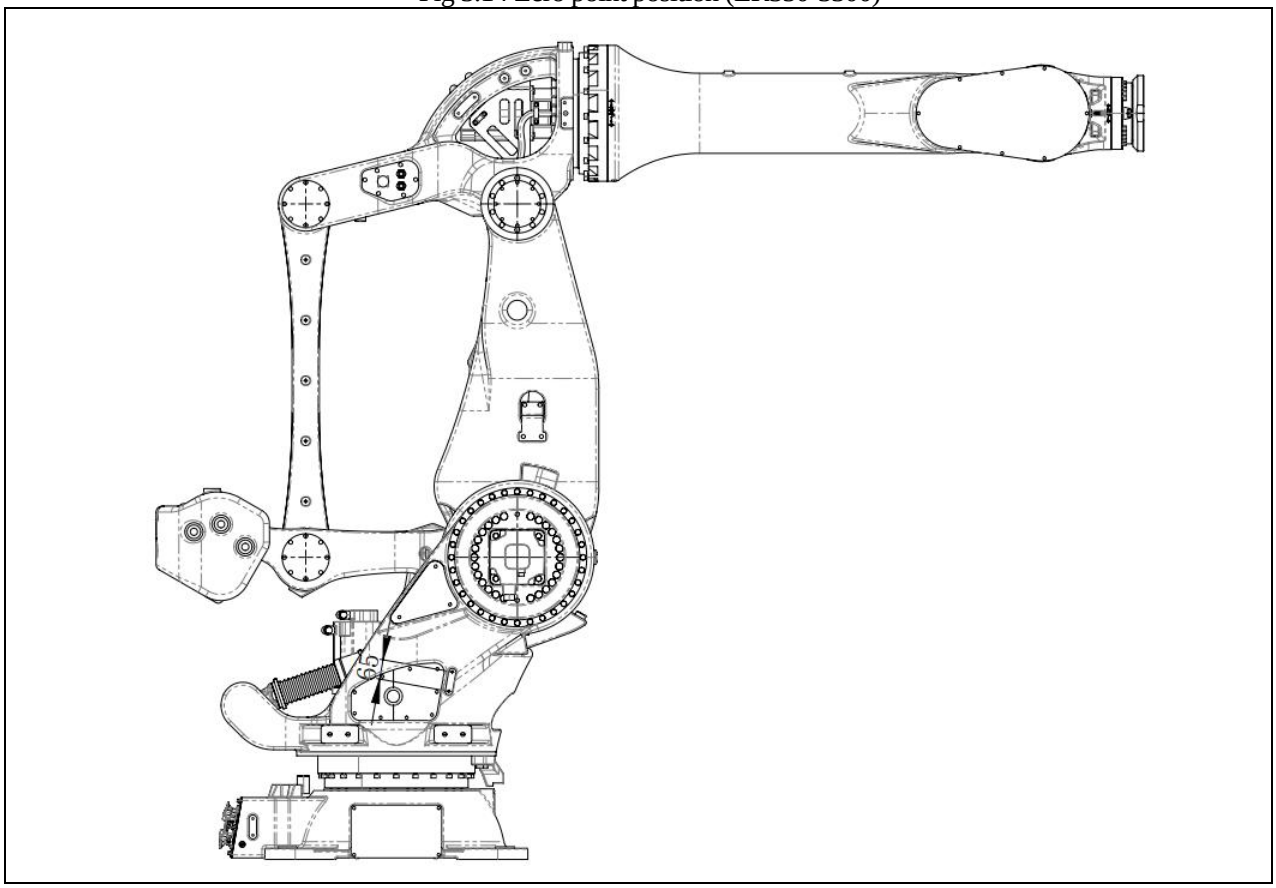


Fig 3.15 Zero point position (ER420-3300)

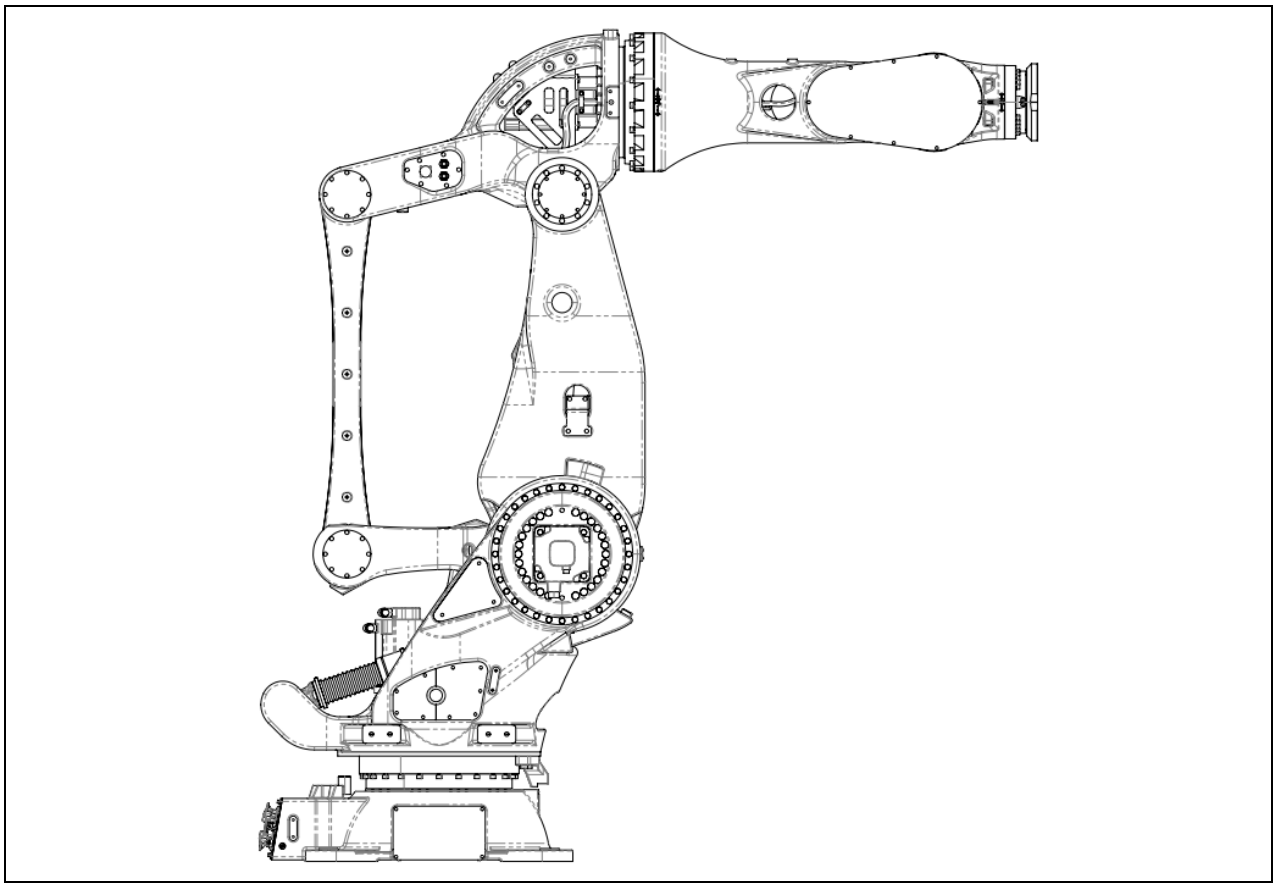


Fig 3.16 Zero point position (ER500-2800)

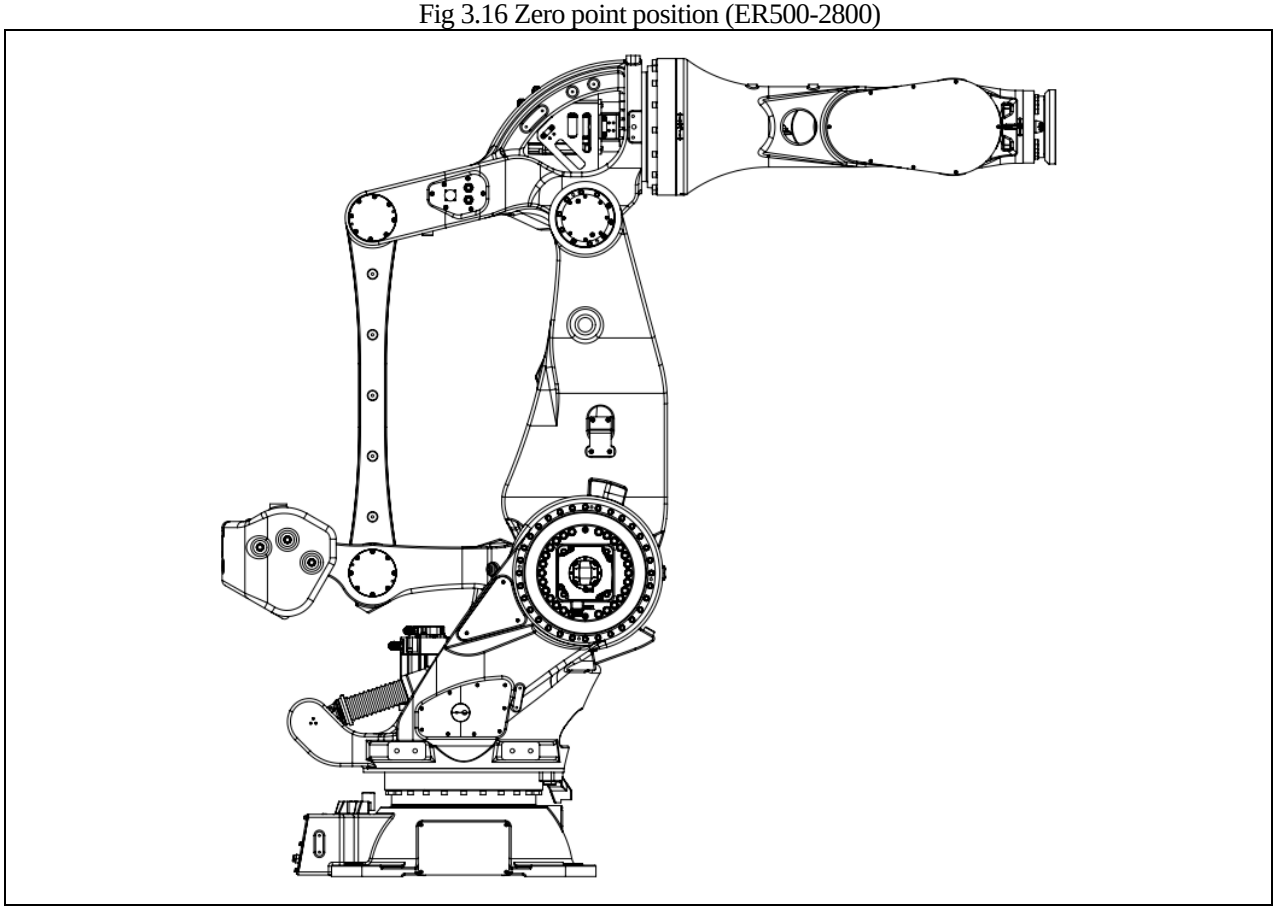


Fig 3.17 Zero point position (ER600-2800, ER700-2800)

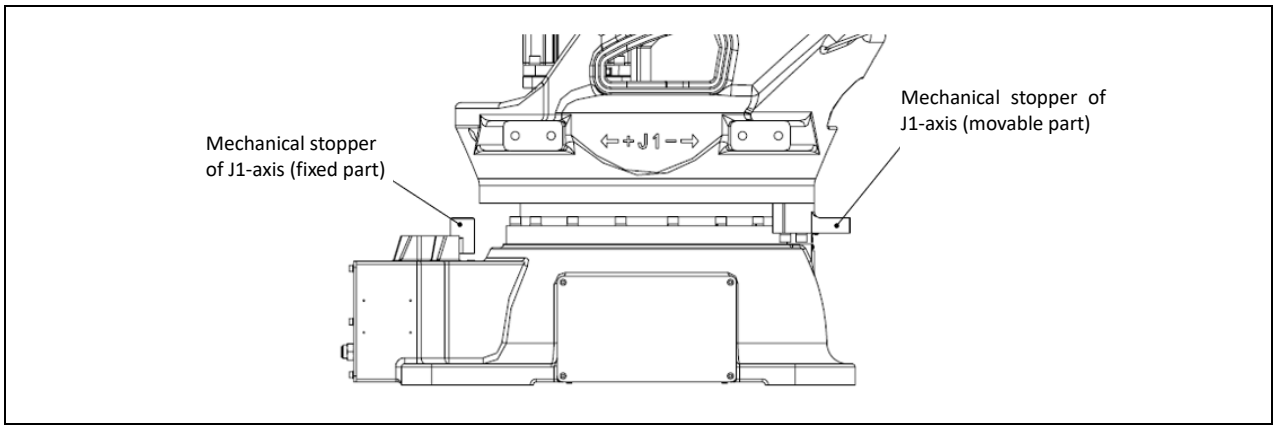


Fig 3.2 J1-axis mechanical stoppers (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

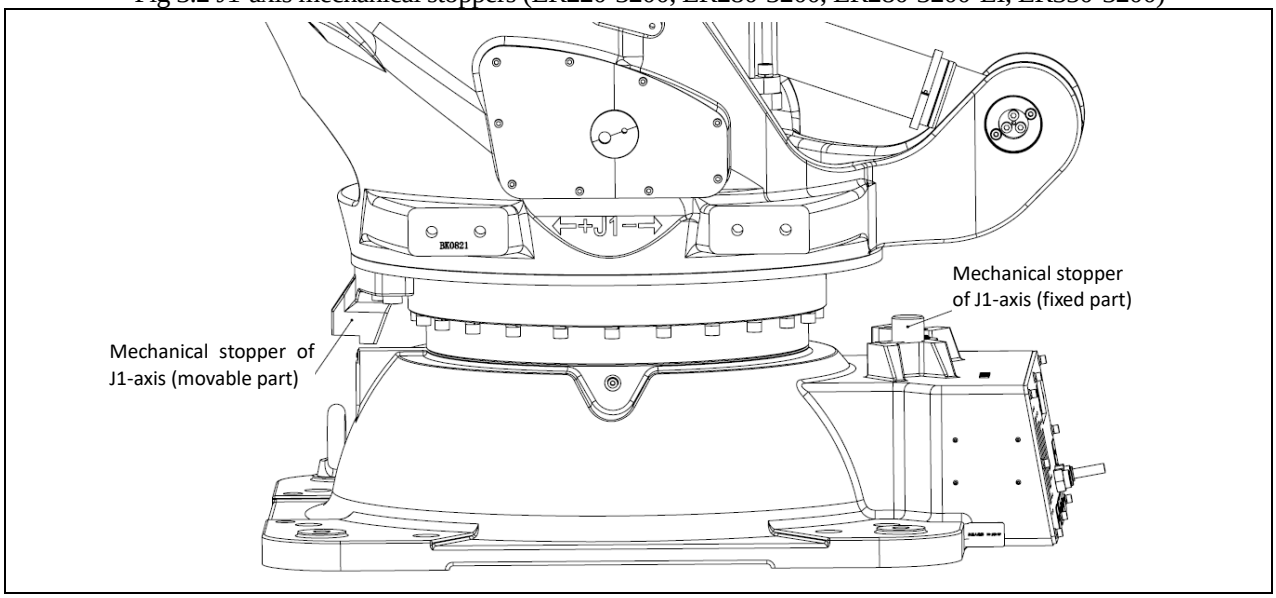


Fig 3.3 J1-axis mechanical stoppers (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

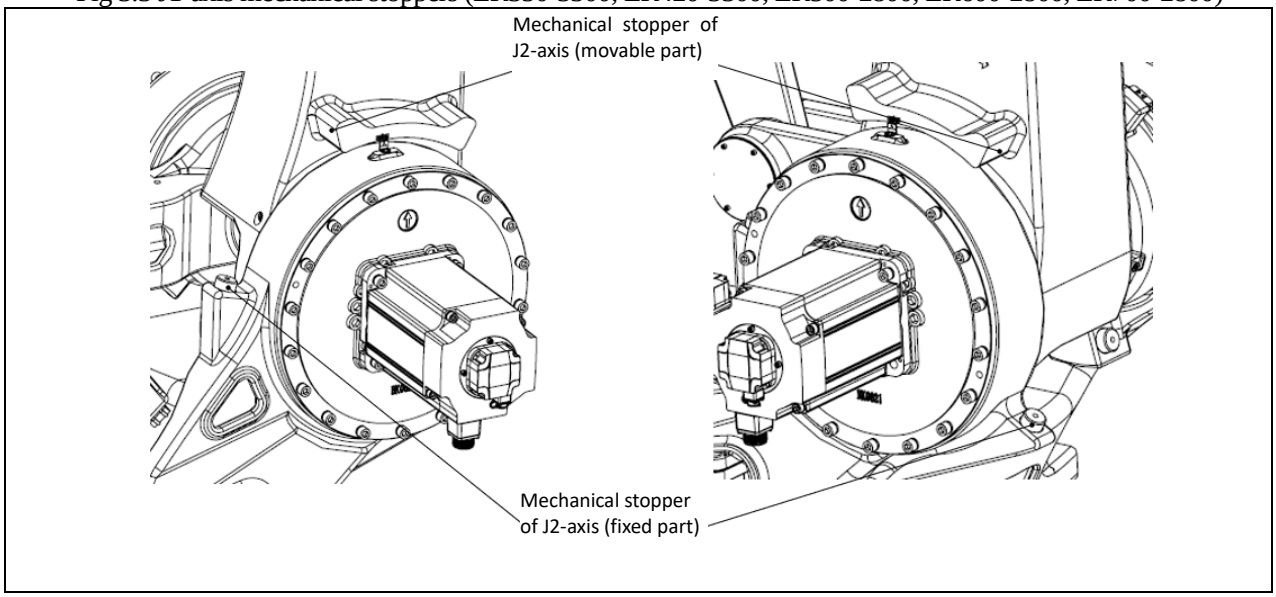


Fig 3.20 J1-axis mechanical stoppers (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

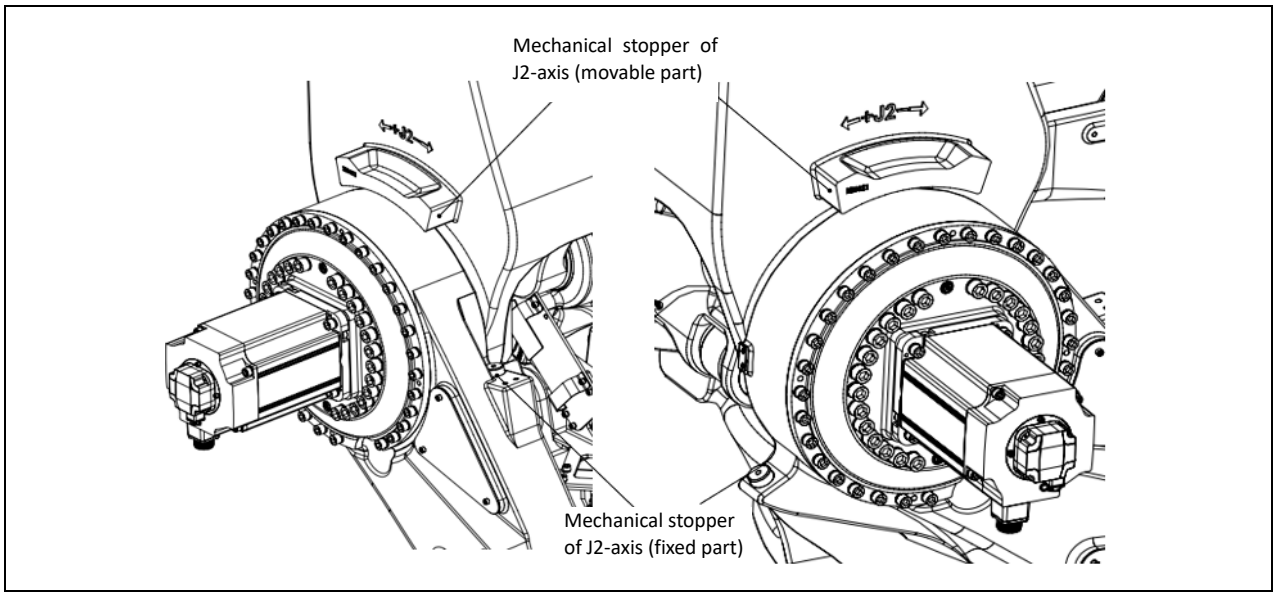


Fig 3.21 J1-axis mechanical stoppers (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

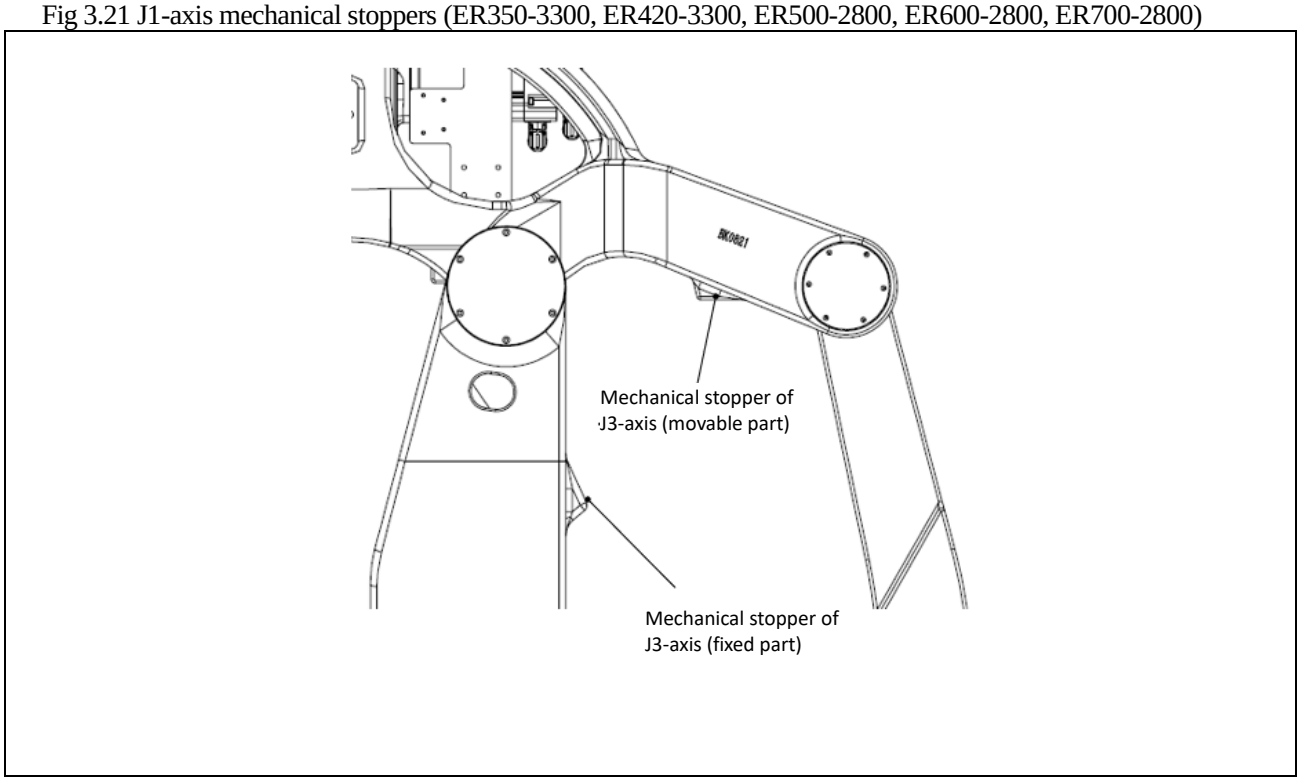


Fig 3.22 J3-axis mechanical stoppers (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

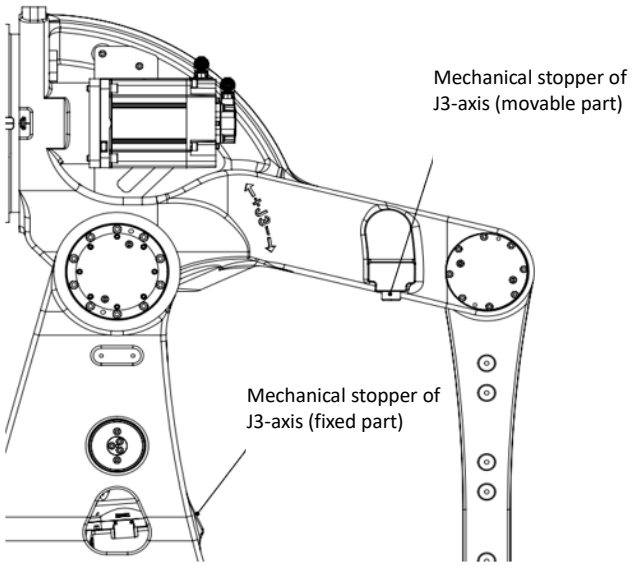


Fig 3.23 J3-axis mechanical stoppers (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

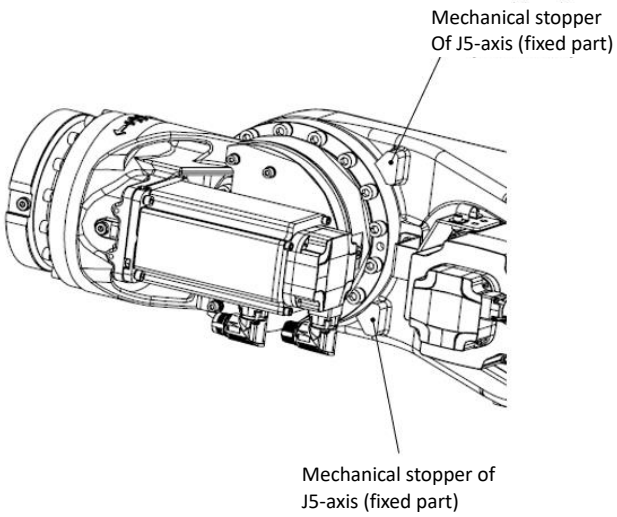


Fig 3.24 J5-axis mechanical stoppers (ER220-3200, ER280-3200, ER280-3200-LI)

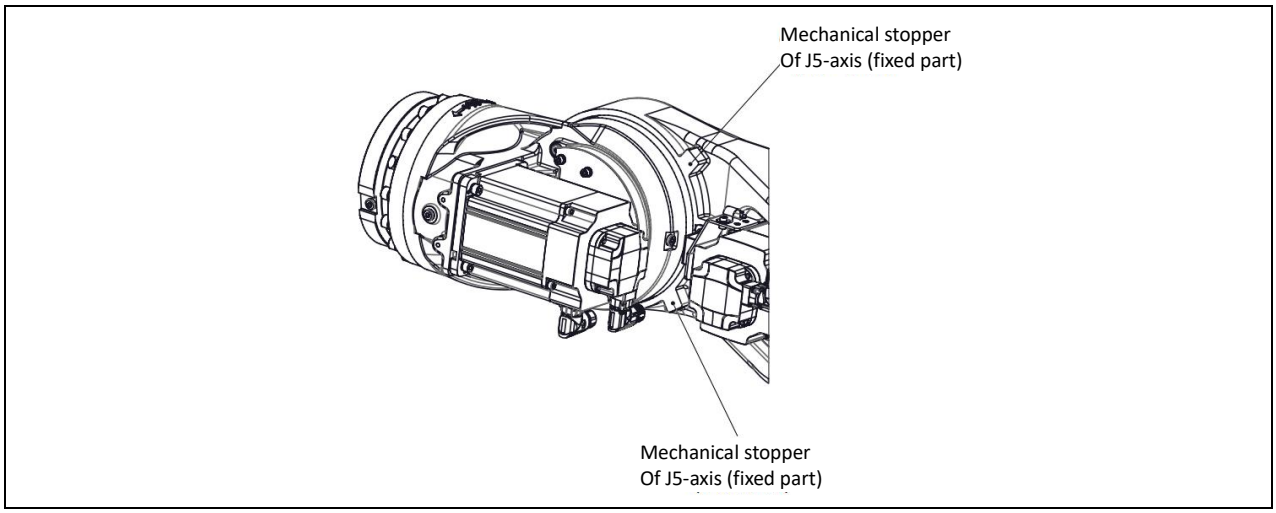


Fig 3.25 J5-axis mechanical stoppers (ER350-3200)

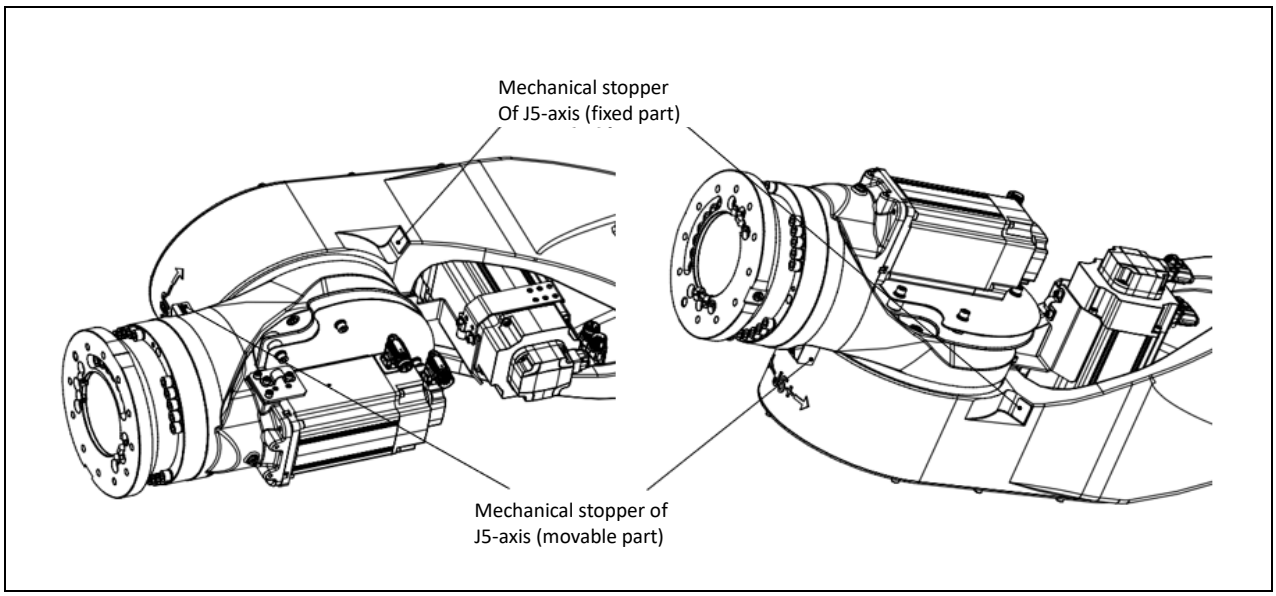


Fig 3.26 J5-axis mechanical stoppers (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

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.

CAUTION	**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.

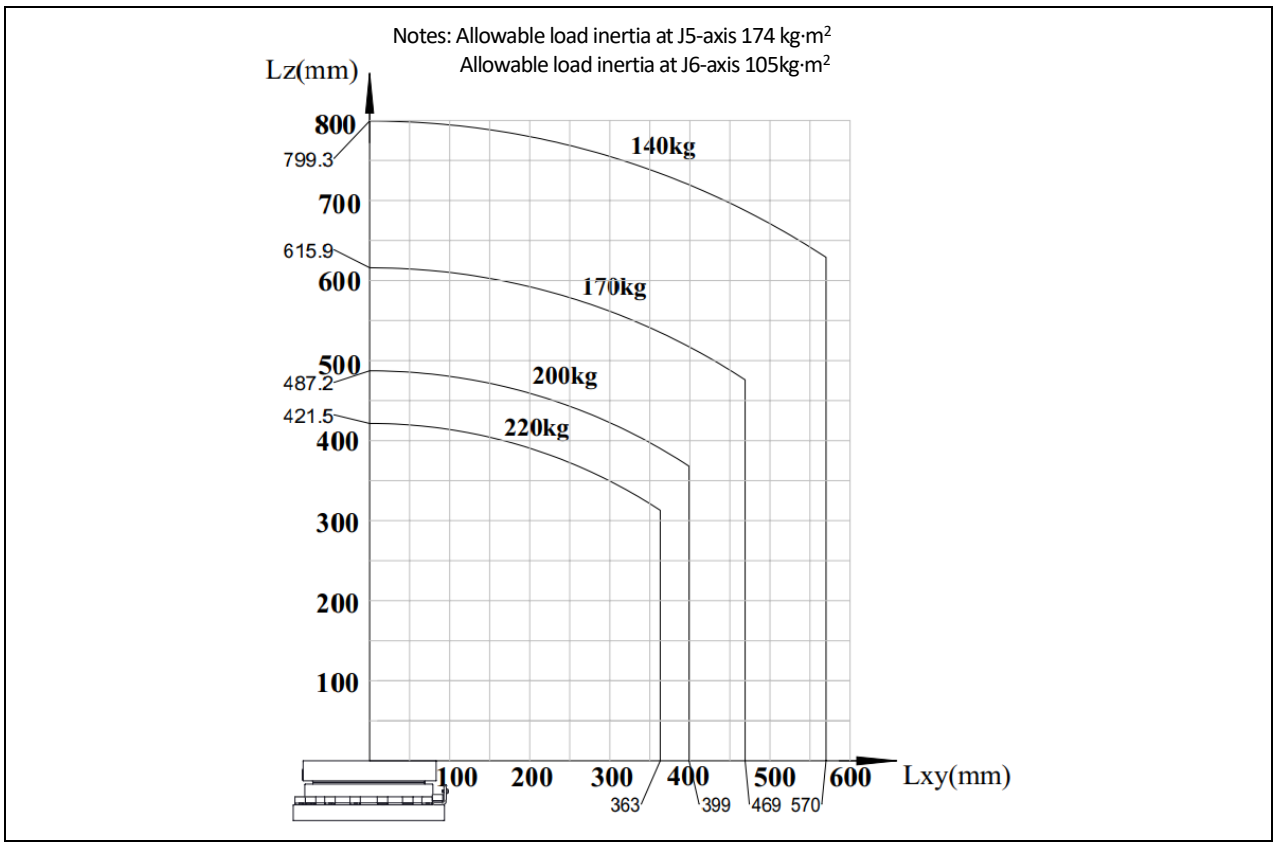


Fig 3.27 Load capacity at wrist (ER220-3200)

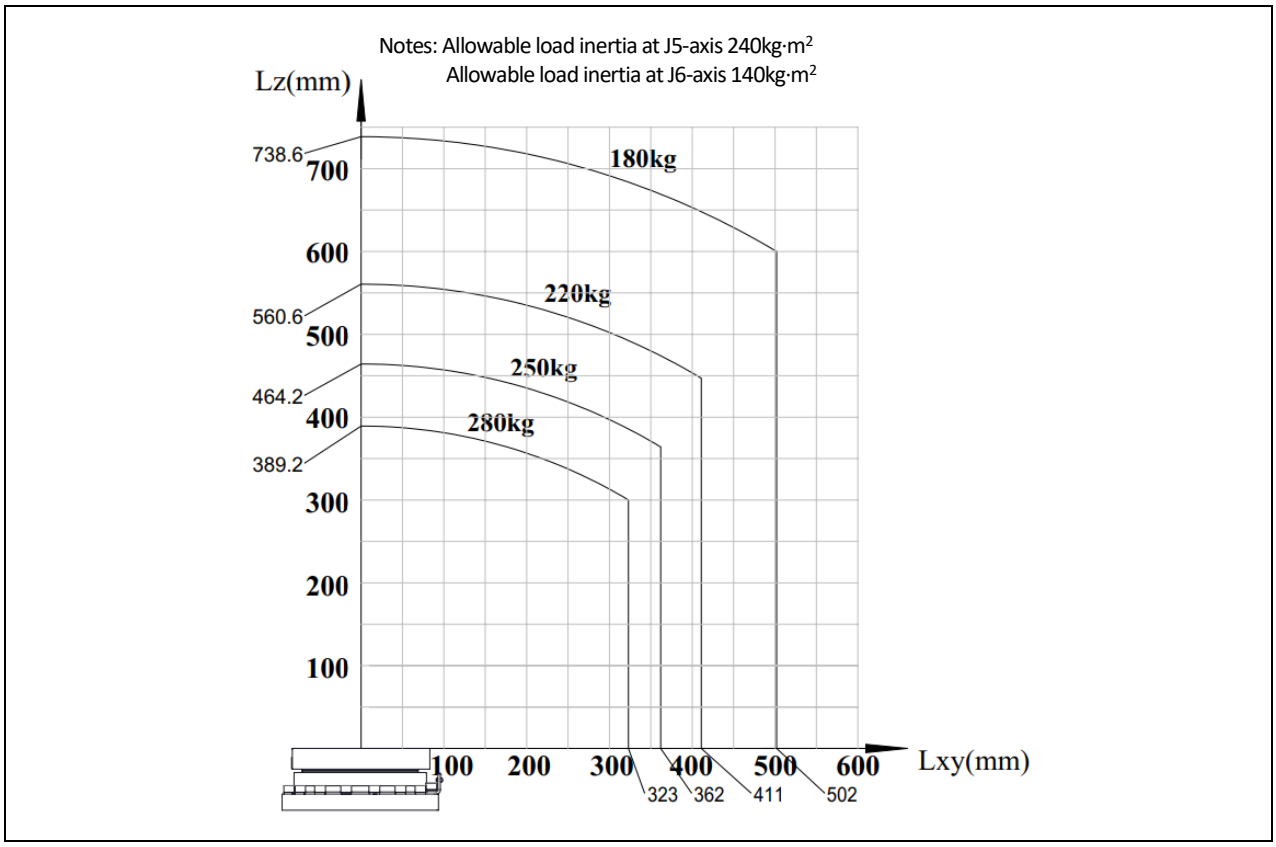


Fig 3.28 Load capacity at wrist (ER280-3200, ER280-3200-LI)

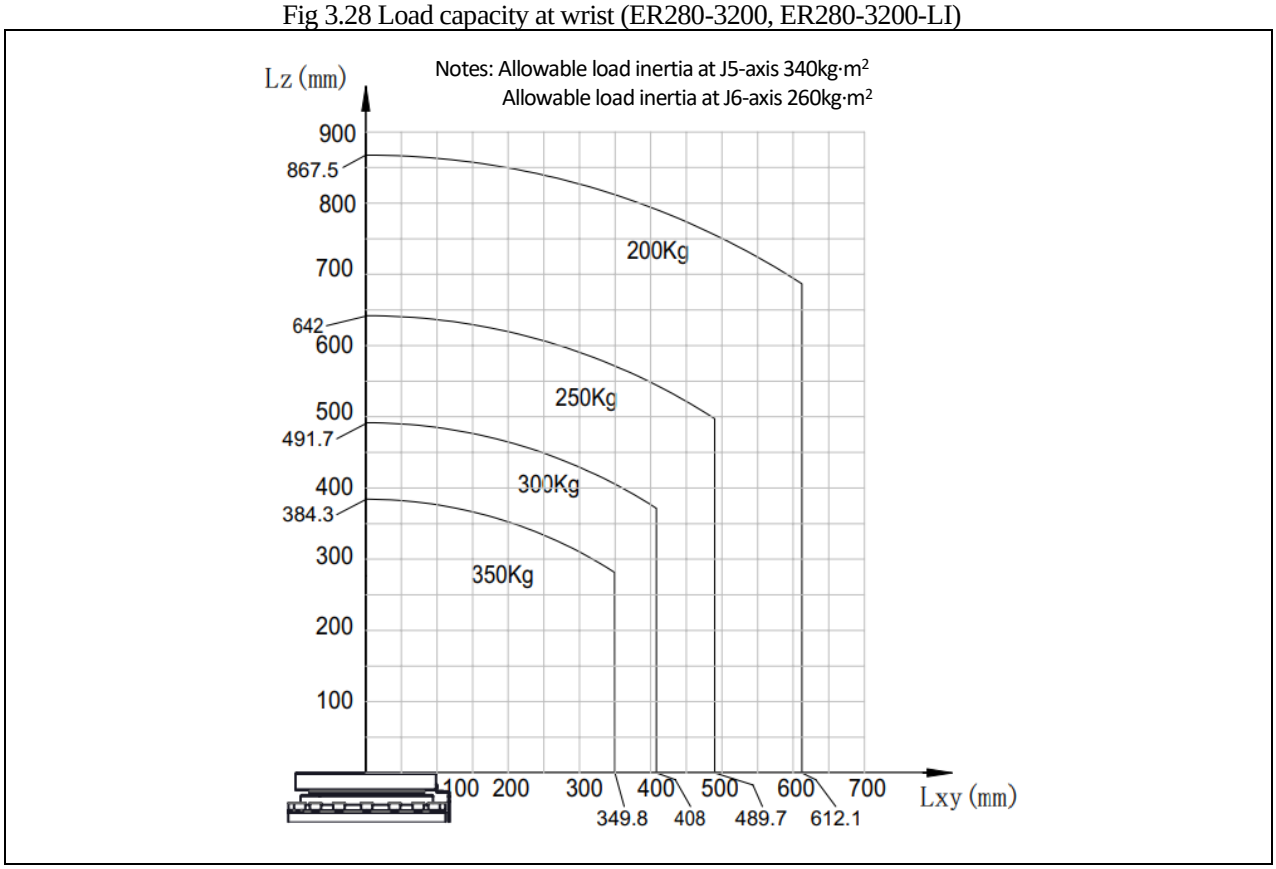


Fig 3.29 Load capacity at wrist (ER350-3200)

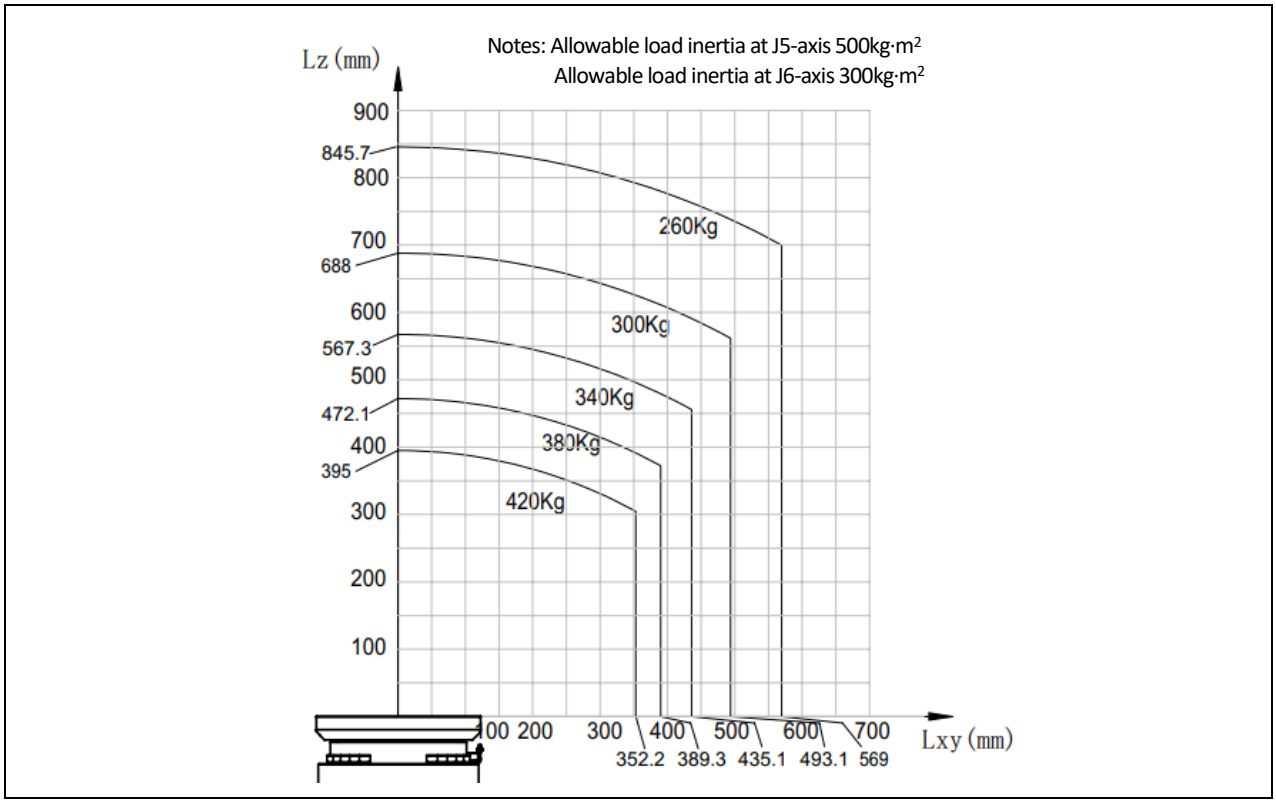


Fig 3.29 Load capacity at wrist (ER420-3300)

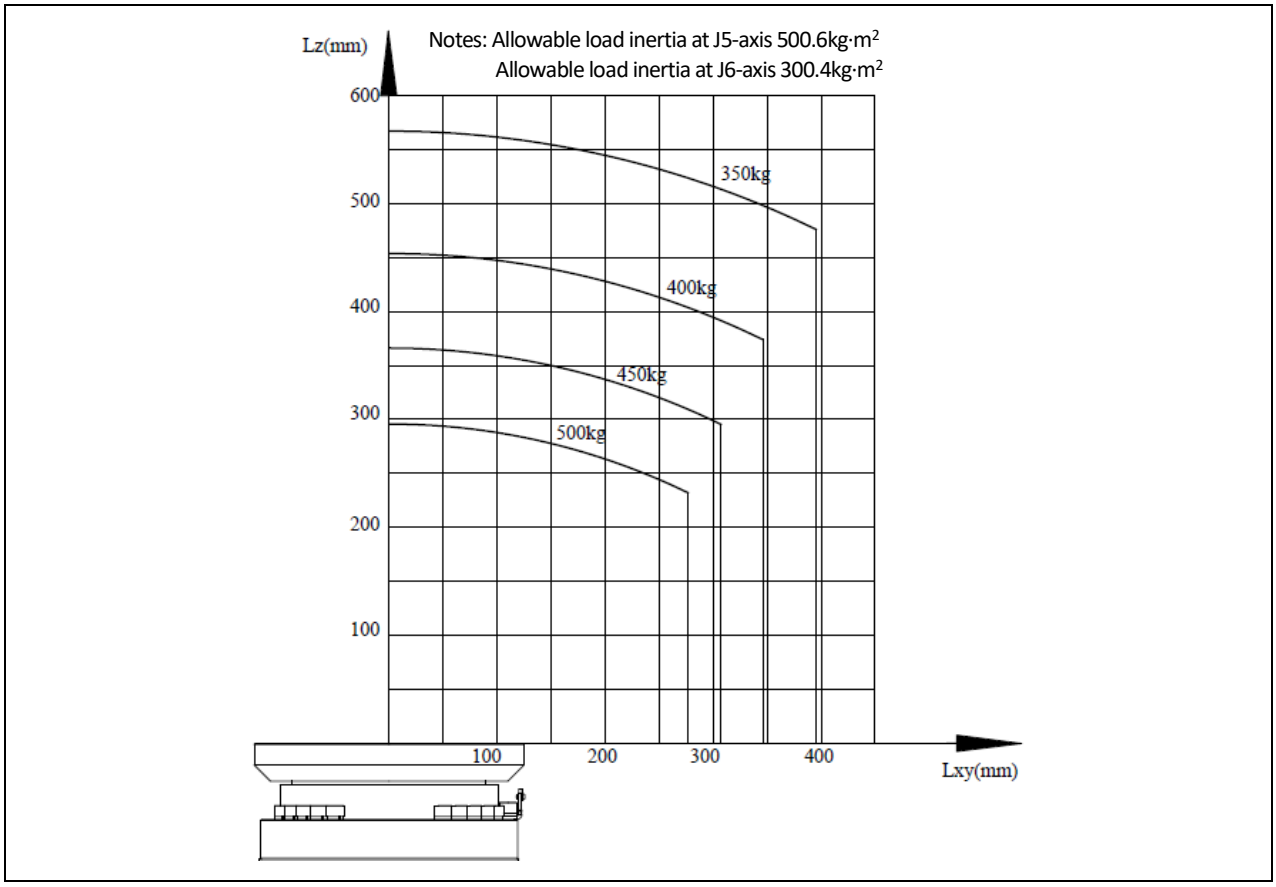


Fig 3.31 Load capacity at wrist (ER500-2800)

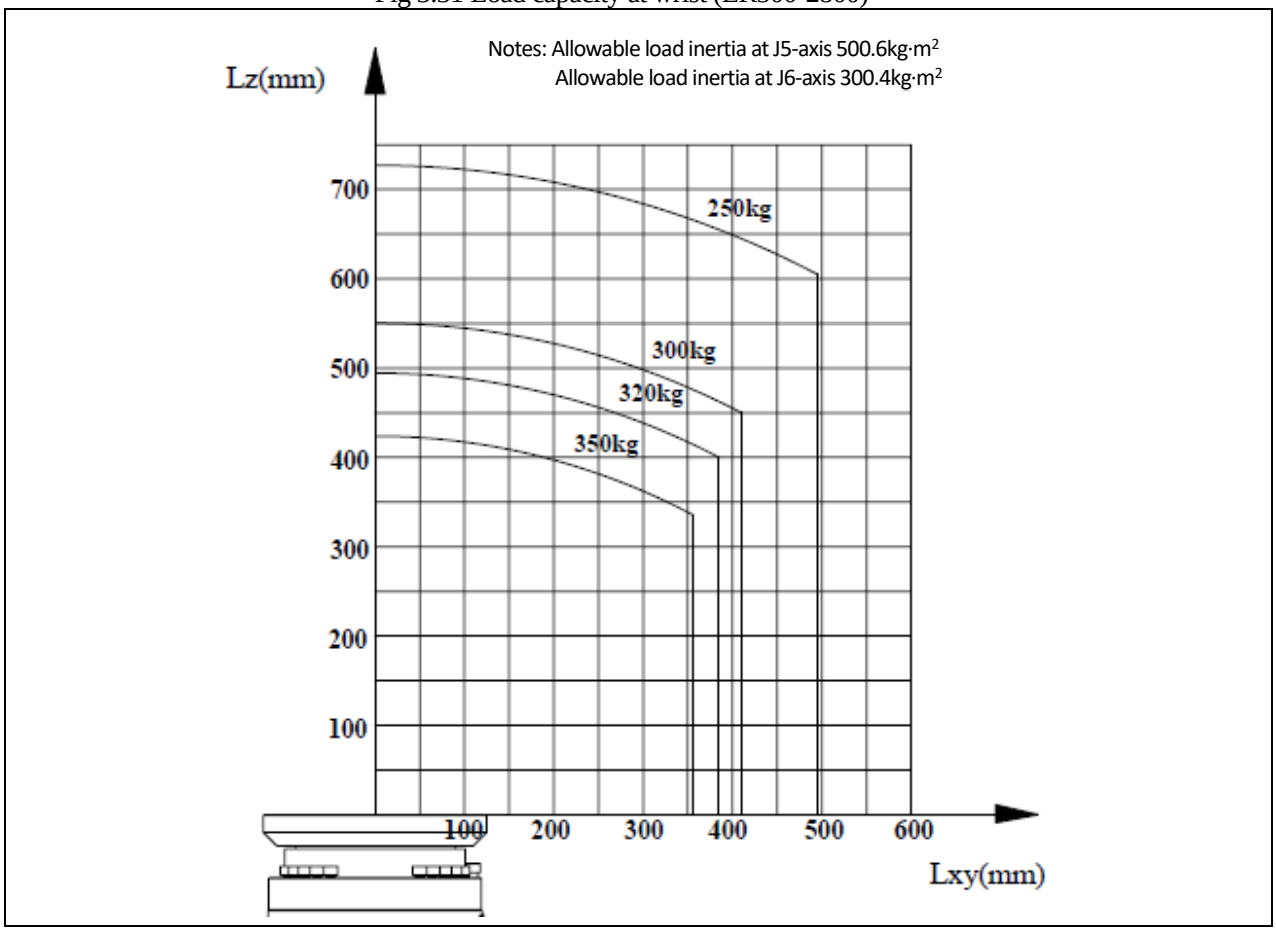


Fig 3.32 Load capacity at wrist (ER350-3300)

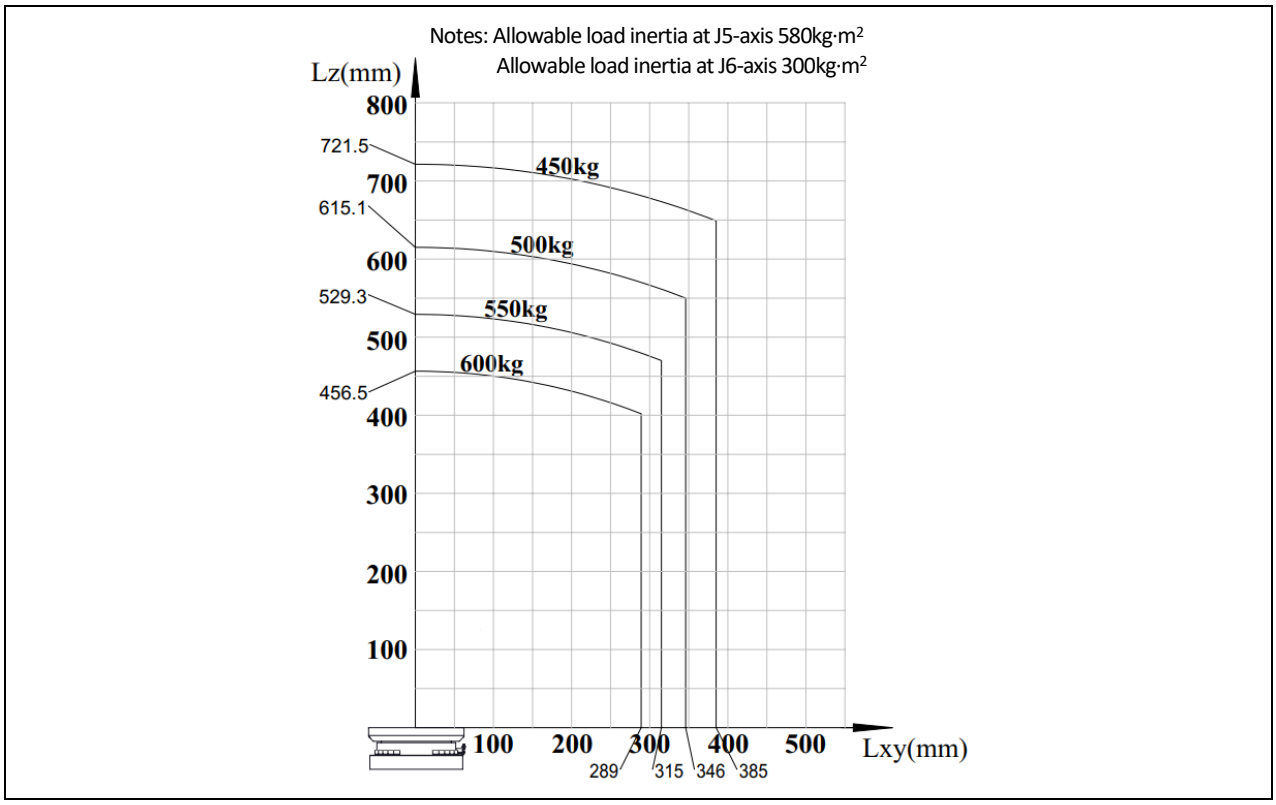


Fig 3.33 Load capacity at wrist (ER600-2800)

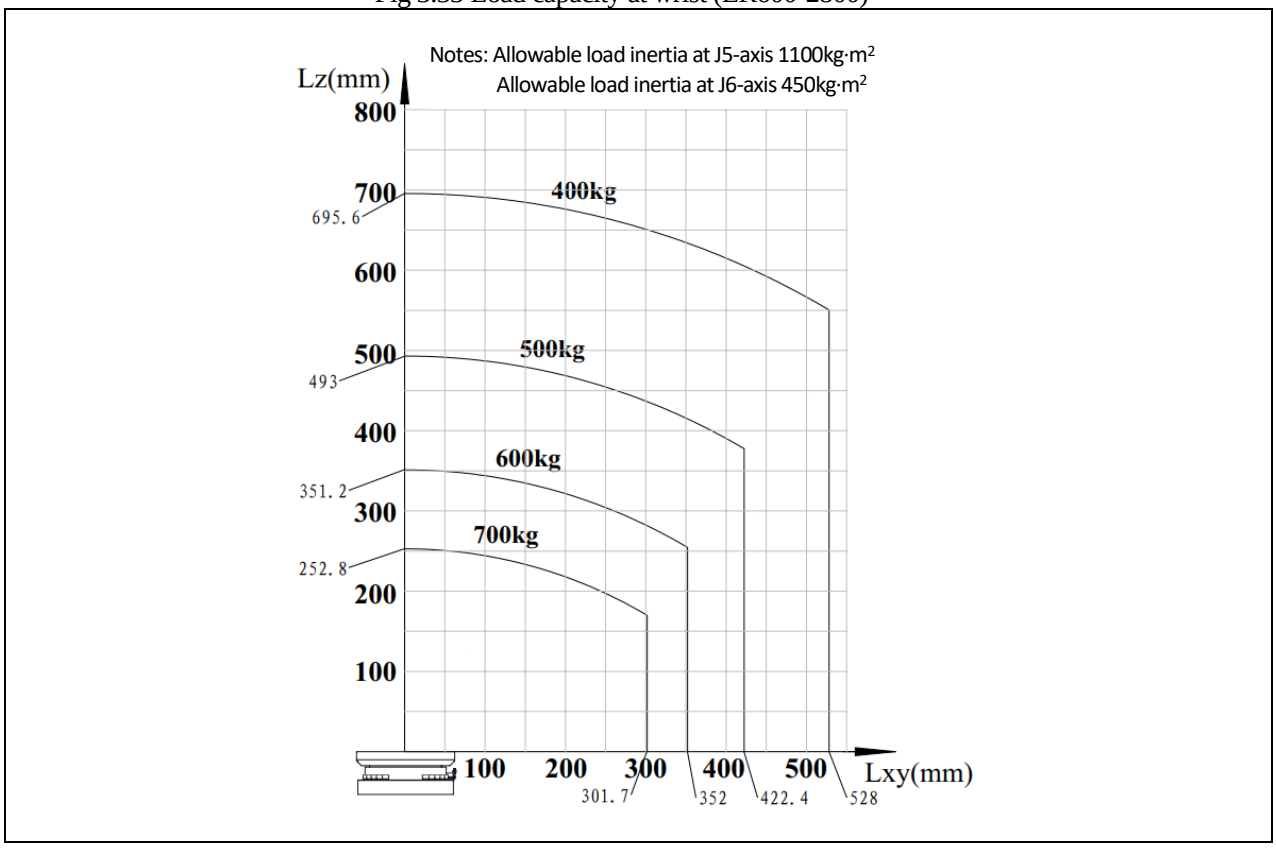
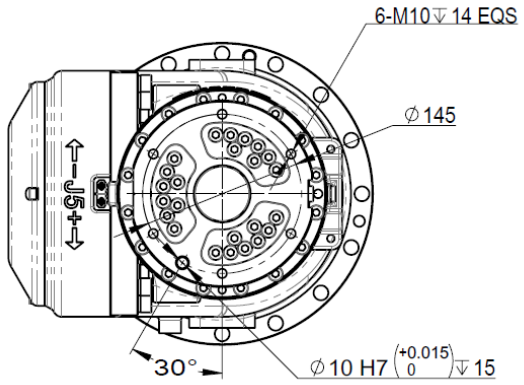


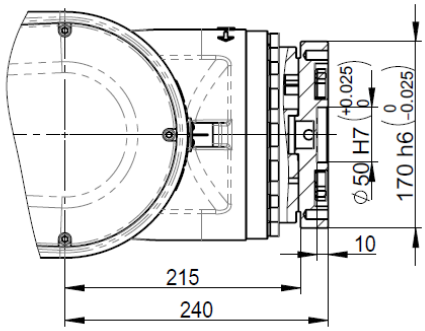
Fig 3.34 Load capacity at wrist (ER700-2800)

4. EQUIPMENT INSTALLATION TO THE ROBOT

4.1. FLANGE DIMENSION

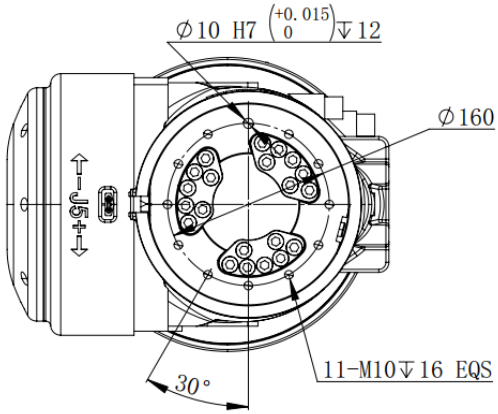
This section describes the mounting face dimension of the end effector. Consider the depth of the screw holes and pin holes sufficiently before choose the length of the bolts and pins. Antirust measures of screws, grippers, etc., should be considered as well.

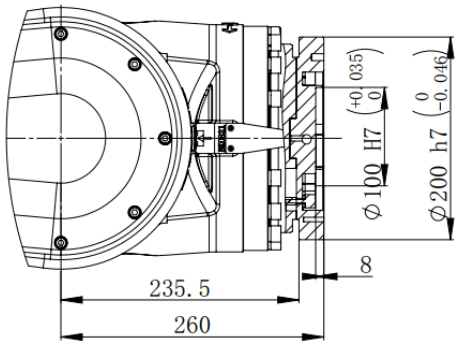




Item and model	Amount
Fixed screw: M10 (ISO4762 12.9 level)	6
Spring washer: spring washer Φ10 (DIN 7880-1987)	6
Positioning pin: cylindrical pin Φ10 (ISO 8735)	1

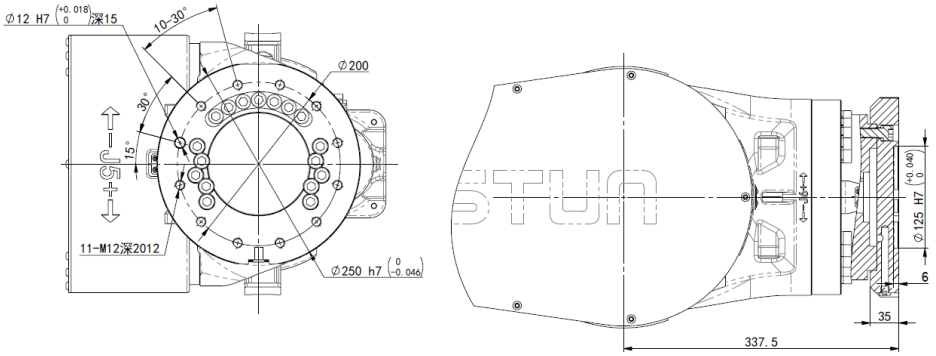
Fig 4.1 End flange mounting dimension (ER220-3200, ER280-3200, ER280-3200-LI)





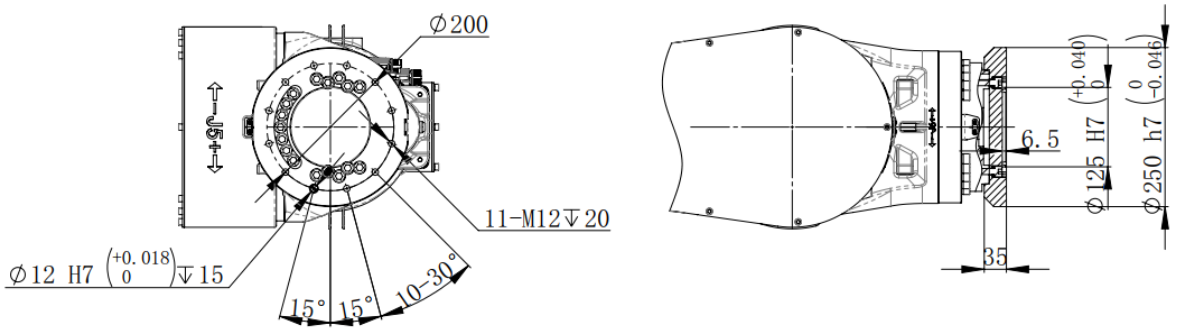
Item and model	Amount
Fixed screw: M10 (ISO4762 12.9 level)	11
Spring washer: spring washer Φ10 (DIN 7880-1987)	11
Positioning pin: cylindrical pin Φ10 (ISO 8735)	1

Fig 4.2 End flange mounting dimension (ER350-3200)



Item and model	Amount
Fixed screw: M12 (ISO4762 12.9 level)	11
Spring washer: spring washer Φ12 (DIN 7880-1987)	11
Positioning pin: cylindrical pin Φ12 (ISO 8735)	1

Fig 4.3 End flange mounting dimension (ER420-3300)



Item and model	Amount
Fixed screw: M12 (ISO4762 12.9 level)	11
Spring washer: spring washer Φ12 (DIN 7880-1987)	11
Positioning pin: cylindrical pin Φ12 (ISO 8735)	1

Fig 4.4 End flange mounting dimension (ER350-3300, ER500-2800, ER600-2800, ER700-2800)

4.2. EQUIPMENT MOUNTING FACE

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

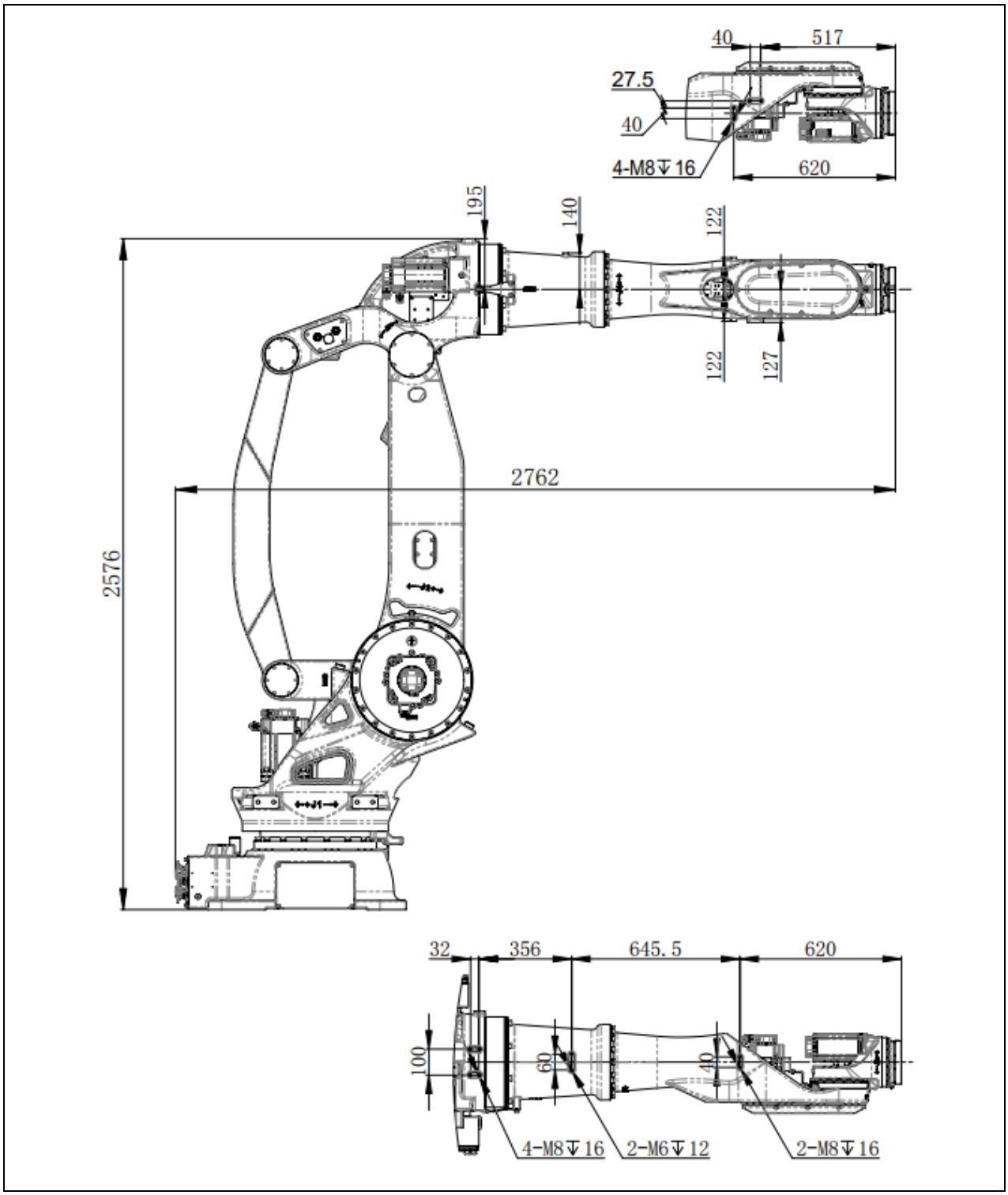


Fig 4.5 Equipment mounting face (ER220-3200, ER280-3200)

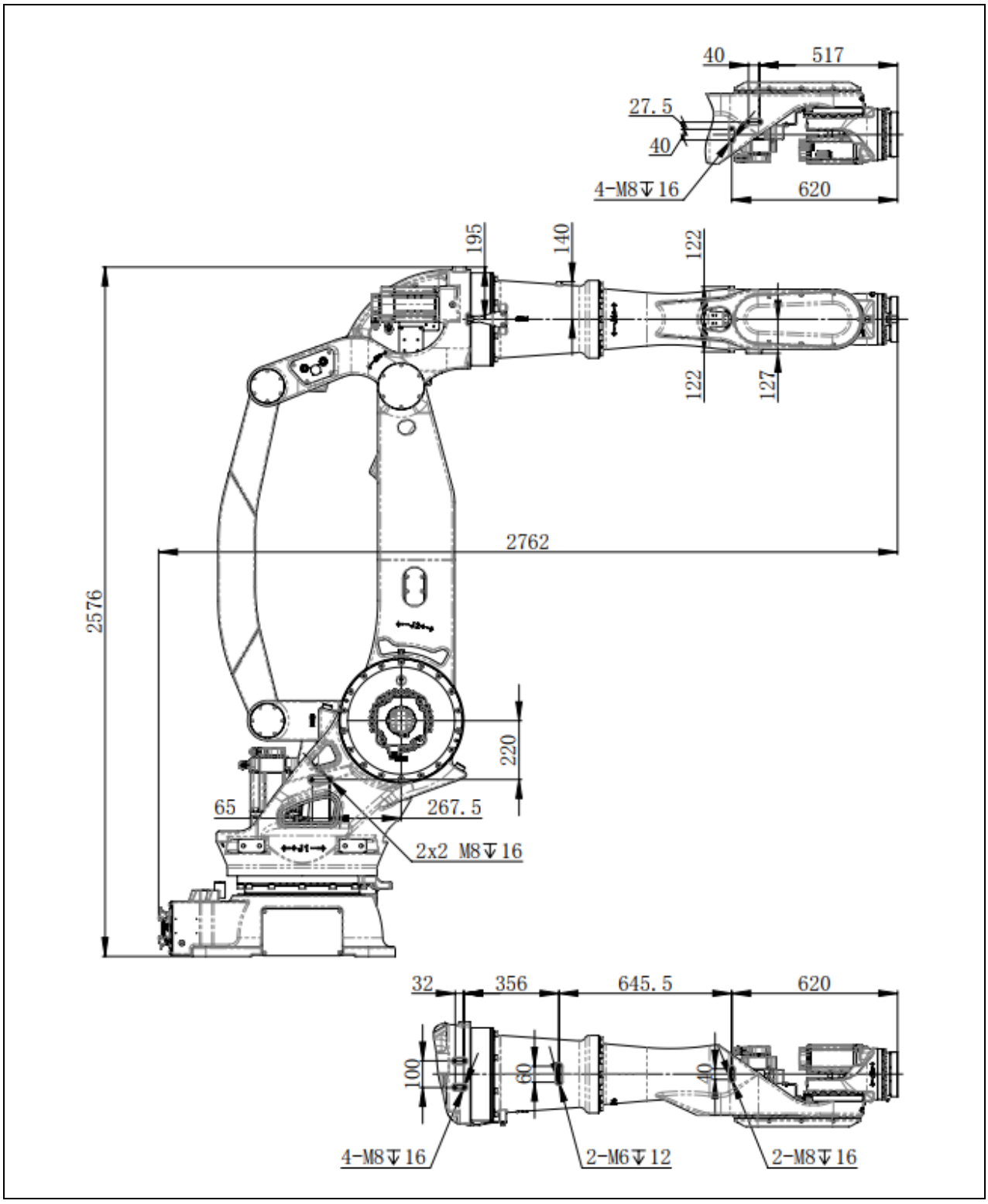


Fig 4.6 Equipment mounting face (ER280-3200-LI)

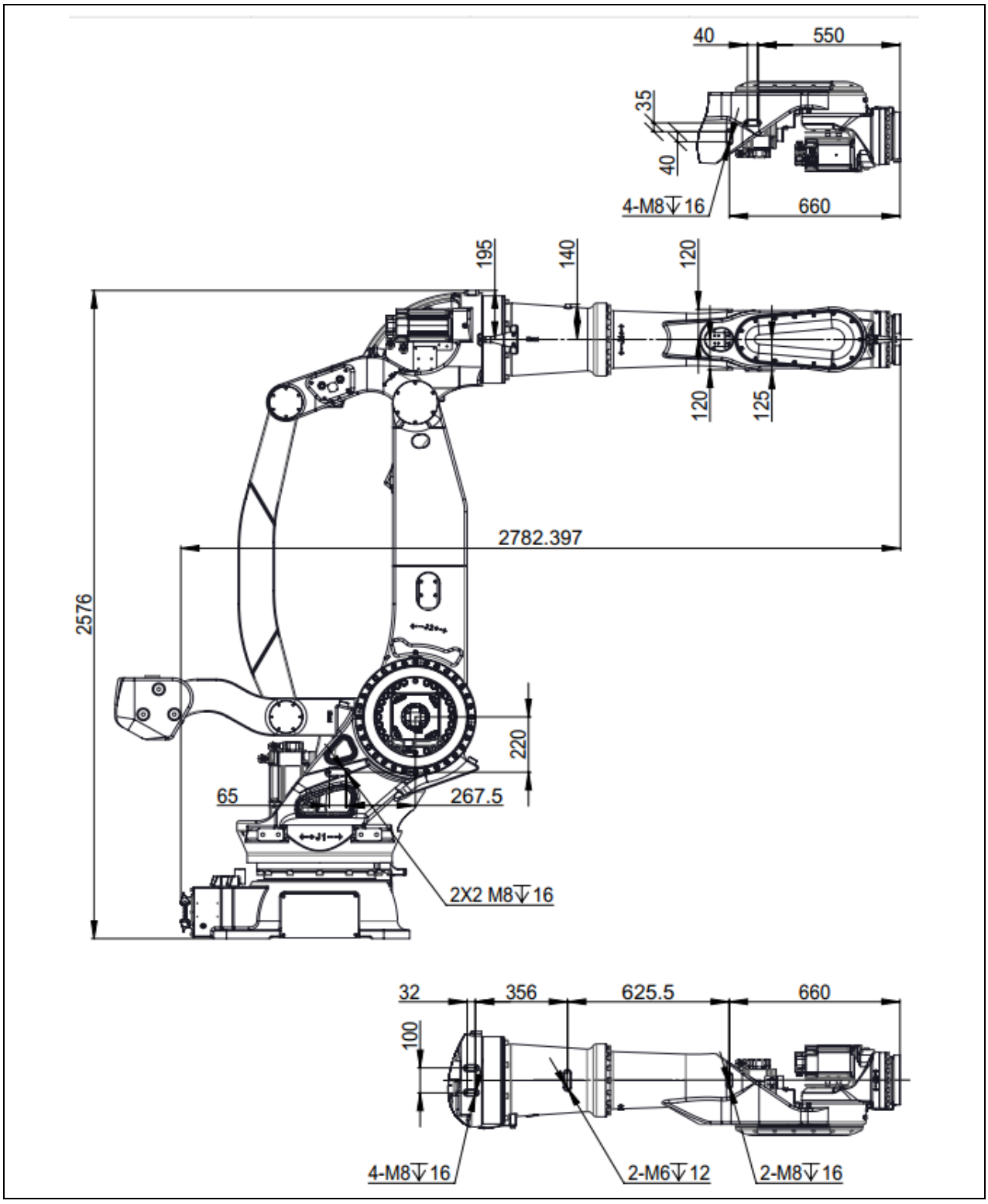


Fig 4.7 Equipment mounting face (ER350-3200)

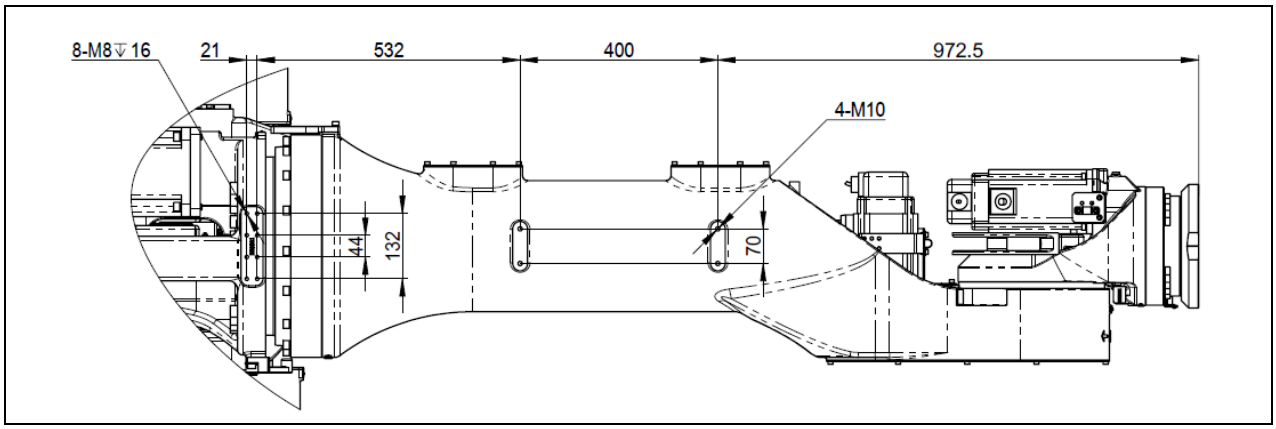


Fig 4.8 Equipment mounting face (ER420-3300)

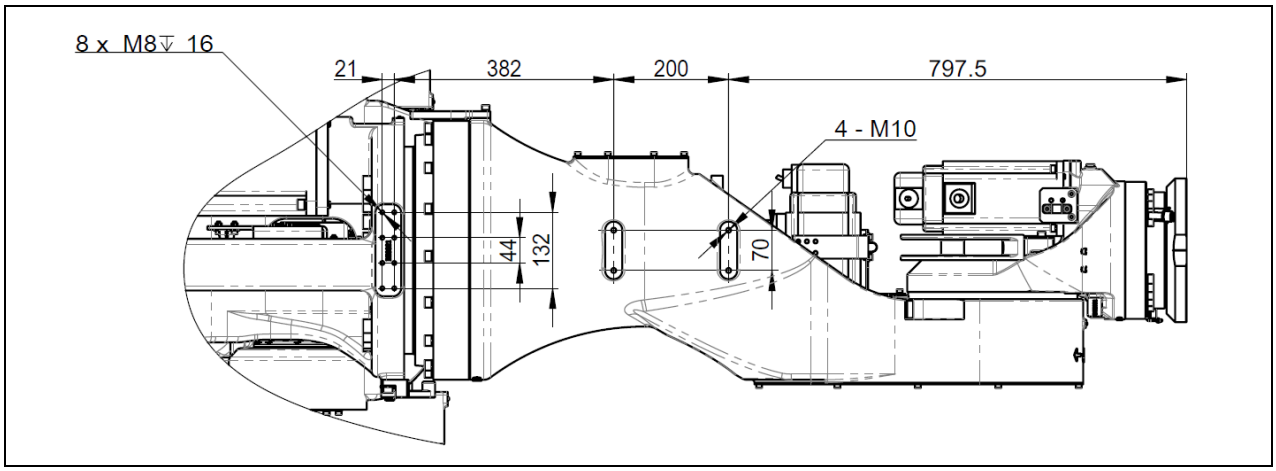


Fig 4.9 Equipment mounting face (ER500-2800, ER600-2800, ER700-2800)

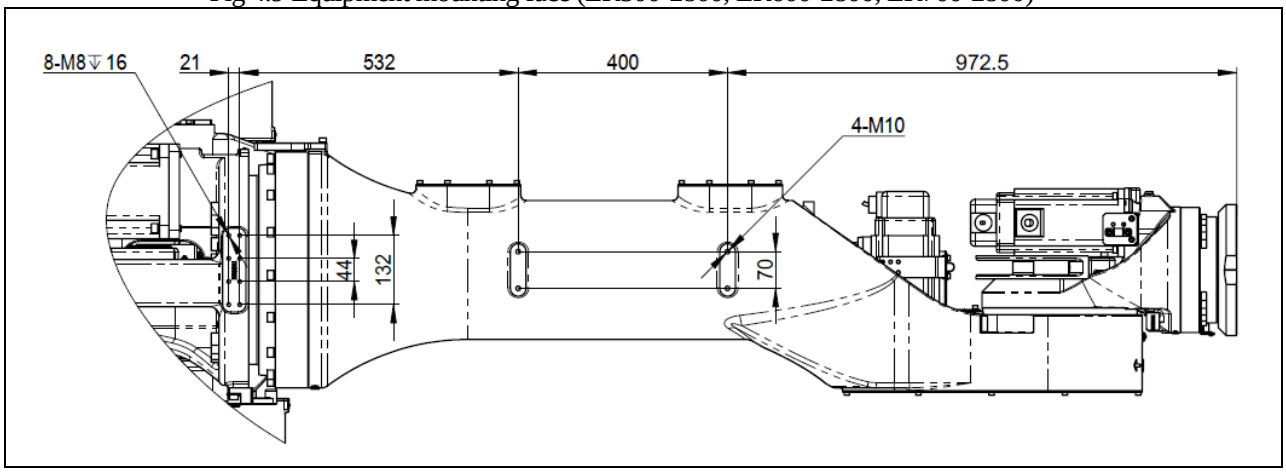


Fig 4.10 Equipment mounting face (ER350-3300)

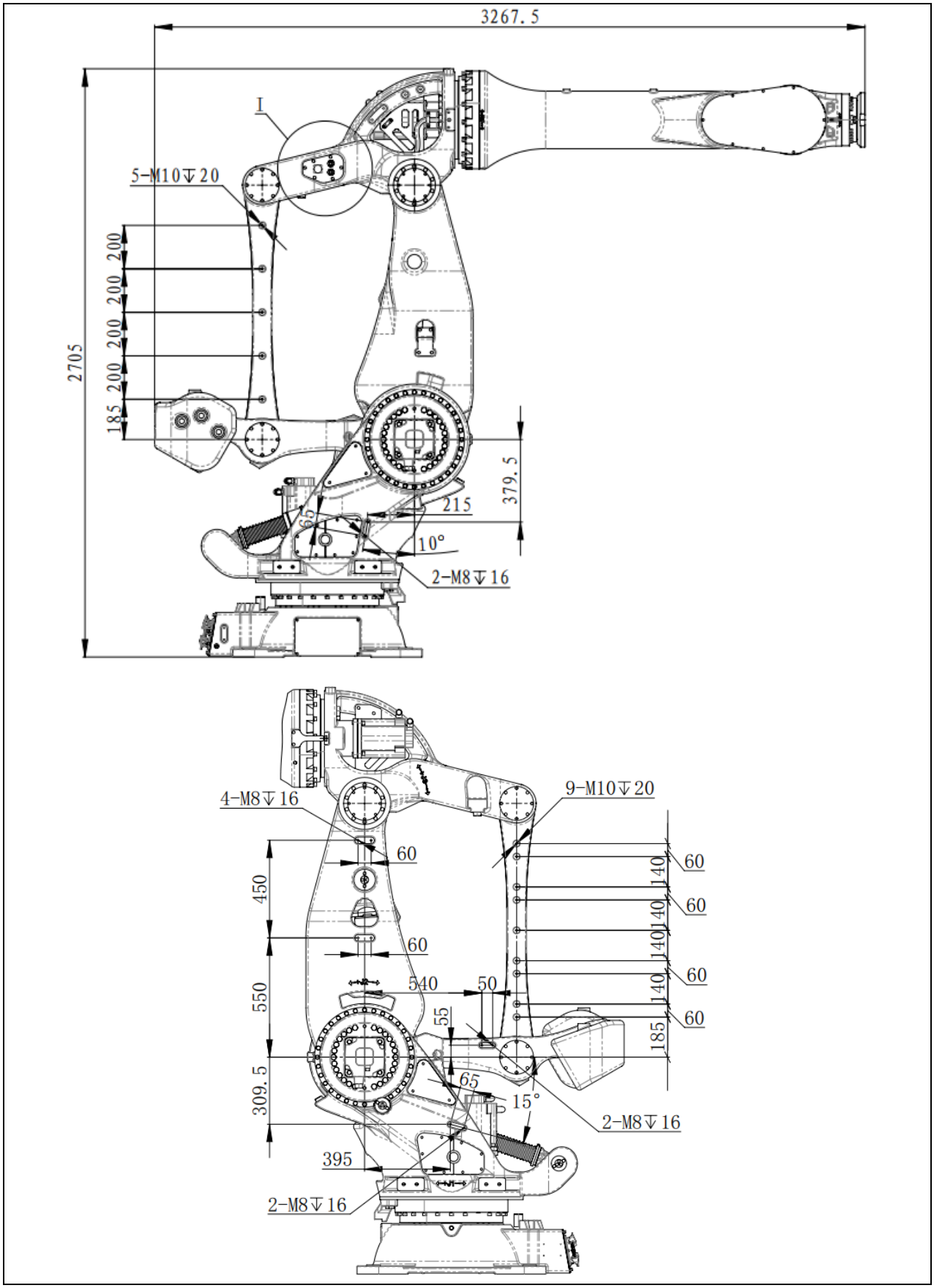


Fig 4.10 Equipment mounting face (ER420-3300)

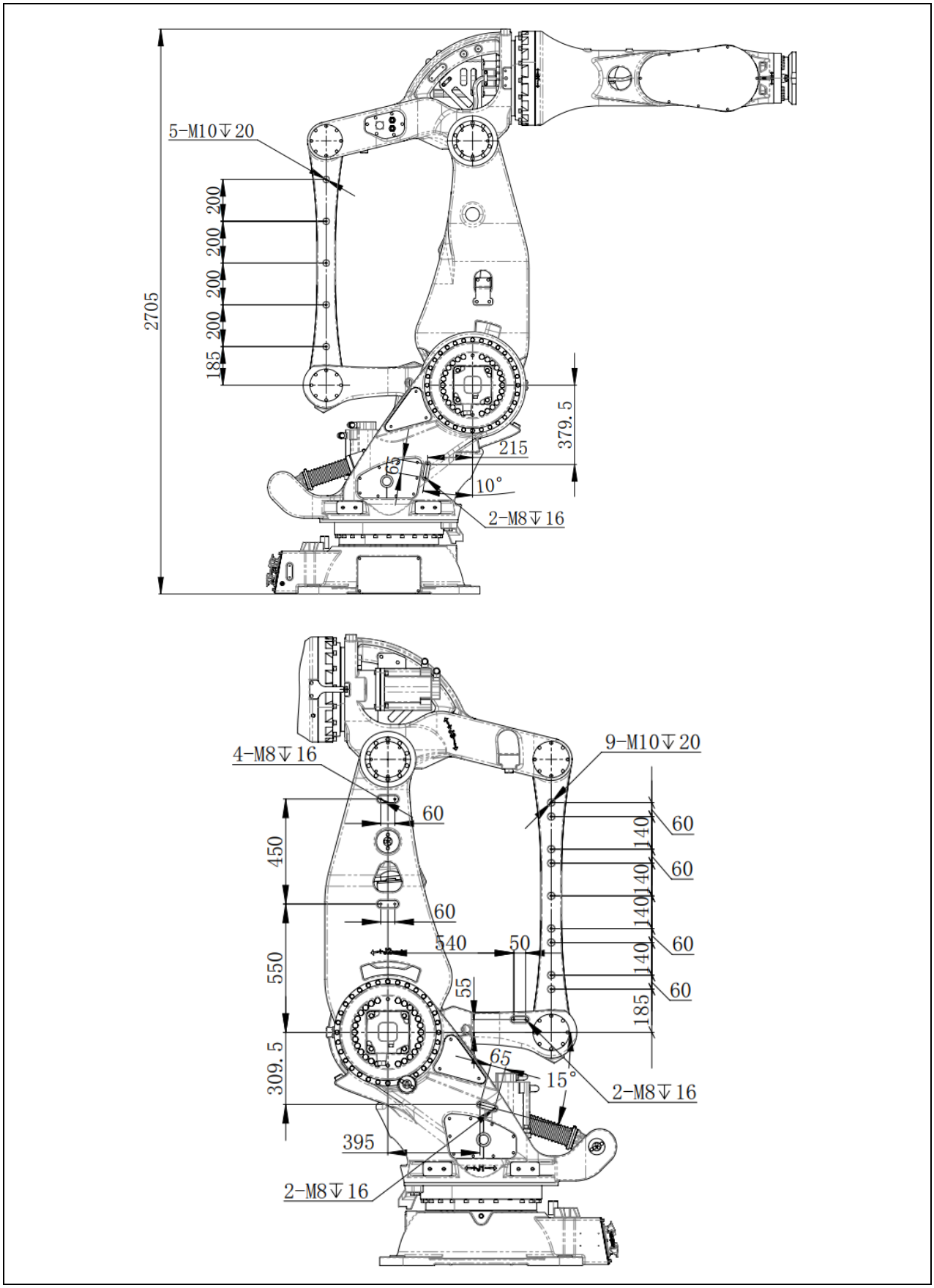


Fig 4.12 Equipment mounting face (ER350-3300, ER500-2800)

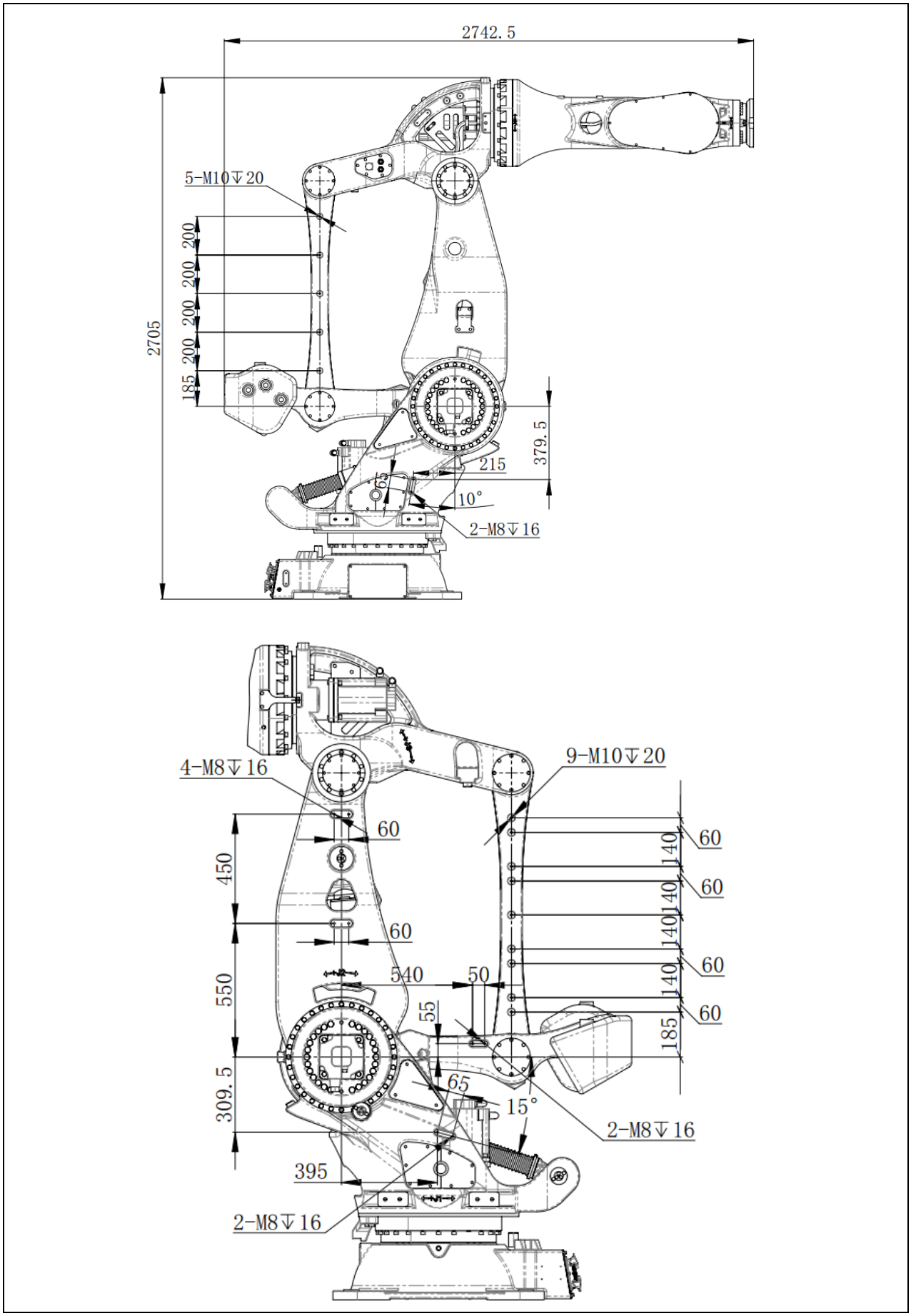


Fig 4.13 Equipment mounting face (ER600-2800, ER700-2800)

CAUTION **Take precautions to avoid interference between peripheral device and the robot.**

4.3. PIPES AND TUBES

The robot has inlets and outlets openings to supply air or hydraulic pressure to the end effector.

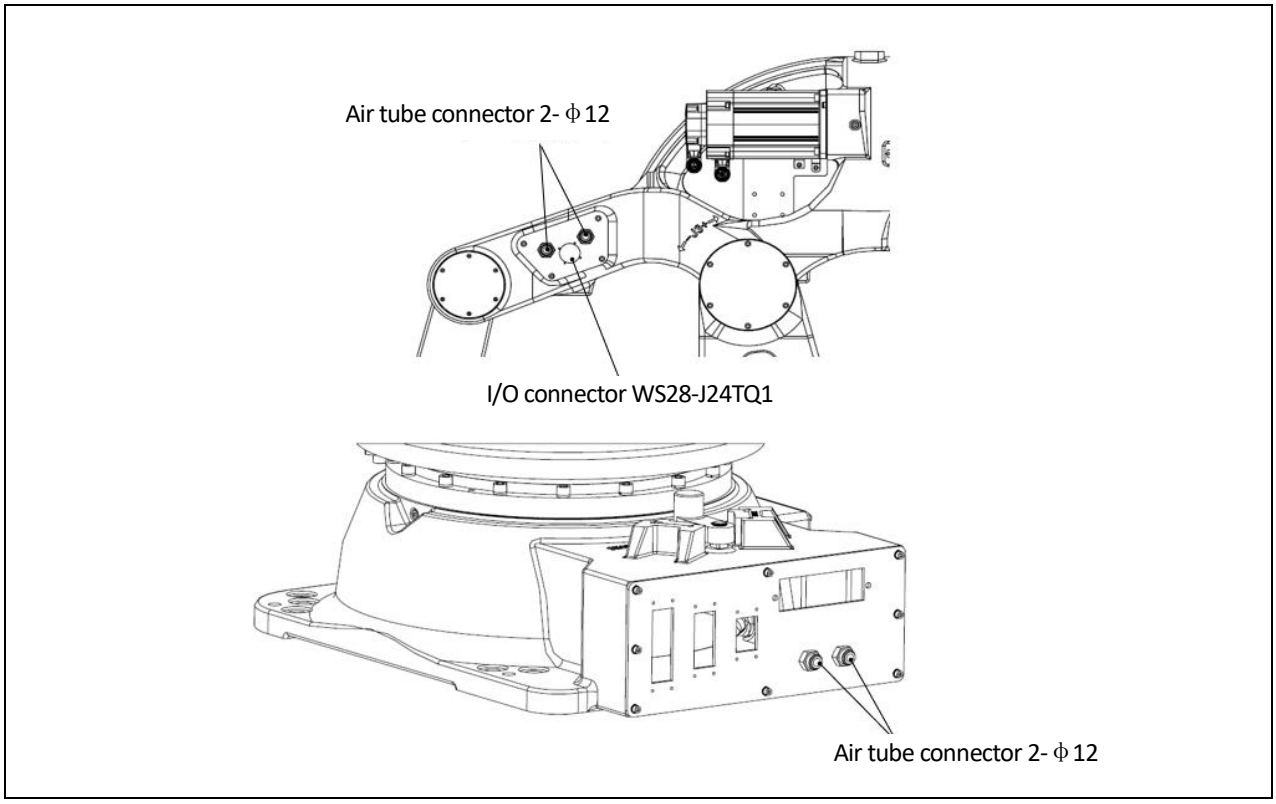


Fig 4.14 Pipes and tubes (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

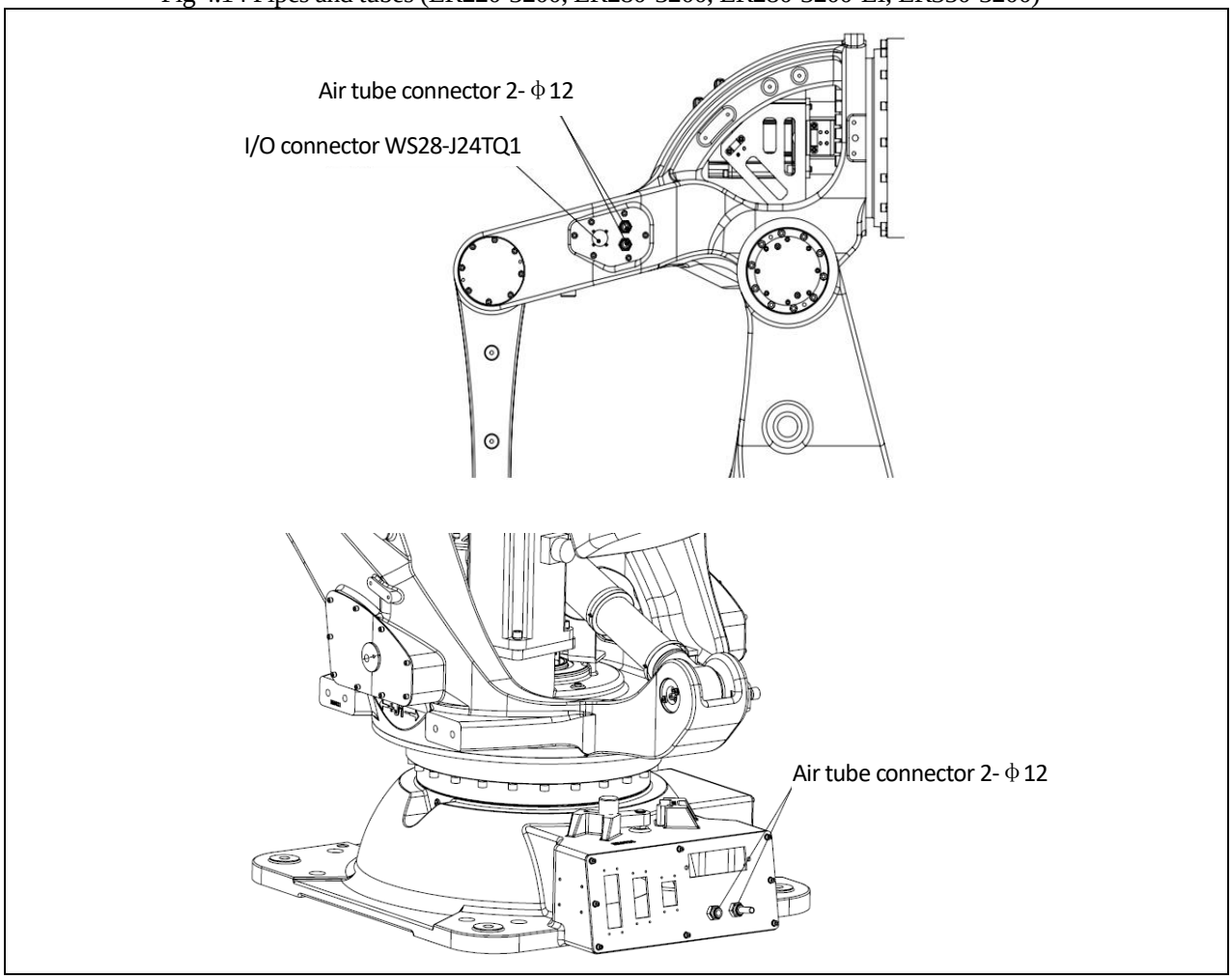


Fig 4.2 Pipes and tubes (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

5. CHECK AND MAINTENANCE

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

CAUTION	**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	Grease seepage	Check if there is grease on the sealed part. If there is an grease 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 if there is a deviation between the current stop position and the previous taught position.
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 (Operating time, Accumulated operating time)							Check and maintenance item	Check points, management and maintenance method
1 month 320h	3 months 960h	0.5 year 1920h	1 year 3840h	1.5 years 5760h	3years 11520h	4years 15360h		
○ Only 1st check	○						Cleaning the controller ventilation system	Confirm the ventilation system is not dusty. If dust has accumulated, remove it.
	○						Check the external damage or peeling	Check whether the robot has external damage or peeling 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.
○ Only 1st check	○						Check the 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.
		○					Check for gas spring	Check if the gas spring cylinder has normal gas pressure and if the piston robs shows any sign of wear.
	○						Check for water	Check if there is water or cut grease on the robot. If there is water or cut grease, eliminate the cause and clean it.
	○ Only 1st check		○				Check for damages to the teach pendant cable, cabinet connection cable and robot connection cable.	Check whether the teach pendant cable, cabinet connection cable or the robot connection cable are unevenly twisted or damaged. If damage occurs, replace the damaged cables.
○ Only 1st check			○				Check for damage to the robot cable (movable part).	Observe the movable part of the robot cable, and check for damage to the sheath. Also, check whether the cables are excessively bent or twisted.
	○ 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 occurs, replace the damaged cables.
	○ 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.
	○ Only 1st check		○				Retightening the end effector mounting bolts	Retightening the end effector mounting bolts.
	○ Only 1st check		○				Retightening the external main bolts	Retightening the robot installation bolts, bolts to be removed for inspection, and bolts exposed to the outside. Refer to APPENDIX A for recommended tightening torque. An adhesive is applied to some bolts. If the bolts are retightened with a torque greater than the recommended value, the adhesive might be removed. Therefore, follow the recommended torque when retightening the bolts.
	○ Only 1st check		○				Check for mechanical stoppers	Check whether the mechanical stoppers have evidence of collision such as external damage or deformation. Also, check the looseness of the stopper mounting bolts.
	○ Only 1st check		○				Clean spatters, sawdust and dust	Check that spatters, sawdust and 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 the balancer, and the cable protection sheaths).
	○ Only 1st check		○				Check the operation of the cooling fan	(When cooling fans are installed on the each axis motor) Check whether the cooling fans are operating correctly. If the cooling fans do not operate, replace them.
			○				Replacing the mechanical	Replace the mechanical unit battery.

							unit battery	
					○		Replacing the grease of each axis reducer	Replace the grease of each axis reducer.
						○	Replacing the mechanical unit cable	Replace the mechanical unit cable. Contact ESTUN representative for information regarding replacing the cable.

5.2.1. Check the gas spring

CAUTION	**Before checking the gas spring, be sure to disconnect the controller power supply and external power source. Set up eye-catching signs to prevent operators or other personnel from switching on the power supply unintentionally in order to avoid unpredictable electric shock accidents.** **To replace the nitrogen spring when pressure is not maintained by the nitrogen spring or when wear occurs to the piston pin of the nitrogen spring. Please contact ESTUN if replacement is needed.**

Method 1: Check by gas-pressure meter

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

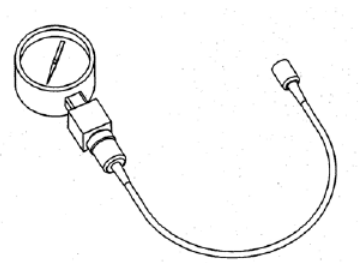


Fig 5.1 Gas-pressure meter

Procedures of checking the gas spring is shown below:

a) Adjust J2 joint to +20°, J3 joint to -20°, and then turn off the power supply.

b) Remove the cover plate and screw plug of the gas spring inlet.

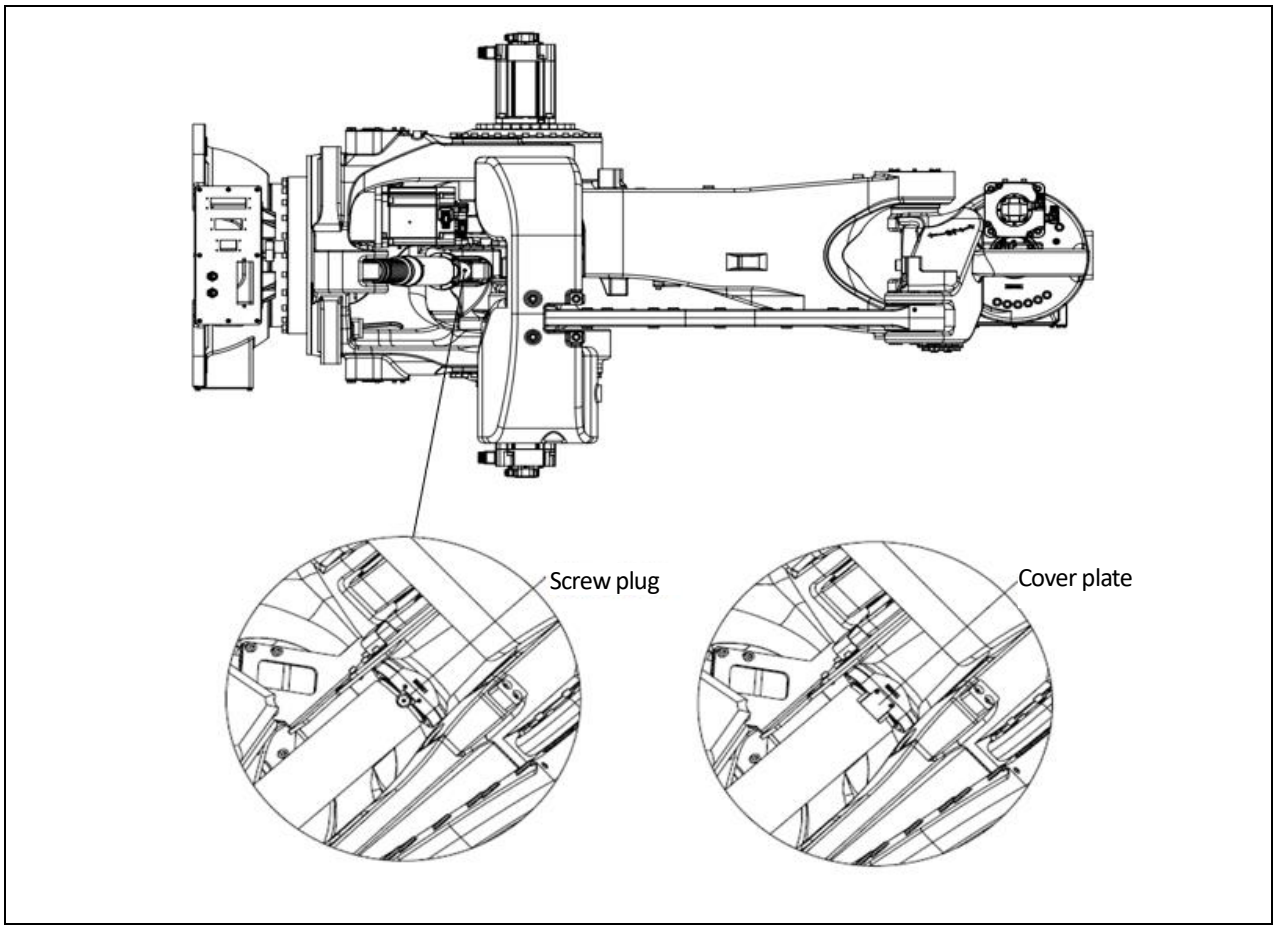


Fig 5.2 check for gas spring (ER350-3300, ER500-2800, ER600-2800, ER700-2800)

c) A gas pressure detection device is mounted at the air inlet and the specified air pressure is given in the table below.

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

Method 2: Through the software reminder function on the teach pendant

Fig. 5.3 Reminder of gas spring inspection software

Tab 5.1 Specified pressure corresponding to the surface temperature (ER350-3300, ER420-3300,ER500-2800)

Surface temperature			0°	5°	10°	15°	20°	25°	30°	35°	40°
J2-axis angle	+20°	J2-axis nitrogen gas cylinder pressure	11.7MPa	12MPa	12.2MPa	12.4MPa	12.6MPa	12.8MPa	13MPa	13.2MPa	13.5MPa
J3-axis angle	0°	J3-axis nitrogen gas cylinder pressure	10.7MPa	10.9MPa	11.1MPa	11.3MPa	11.5MPa	11.7MPa	11.9MPa	12.1MPa	12.3MPa

Tab 5.2 Specified pressure corresponding to the surface temperature (ER600-2800)

Surface temperature			0°	5°	10°	15°	20°	25°	30°	35°	40°
J2-axis angle	+20°	J2-axis nitrogen gas cylinder pressure	11.7MPa	12MPa	12.2MPa	12.4MPa	12.6MPa	12.8MPa	13MPa	13.2MPa	13.5MPa
J3-axis angle	0°	J3-axis nitrogen gas cylinder pressure	6.2MPa	6.4MPa	6.5MPa	6.6MPa	6.7MPa	6.8MPa	6.9MPa	7MPa	7.2MPa

Tab 5.3 Specified pressure corresponding to the surface temperature (ER700-2800)

Surface temperature			0°	5°	10°	15°	20°	25°	30°	35°	40°
J2-axis angle	+20°	J2-axis nitrogen gas cylinder pressure	14.7MPa	15.0MPa	15.3MPa	15.5MPa	15.8MPa	16.1MPa	16.3MPa	16.6MPa	16.9MPa
J3-axis angle	0°	J3-axis nitrogen gas cylinder pressure	10.7MPa	10.9MPa	11.1MPa	11.3MPa	11.5MPa	11.7MPa	11.9MPa	12.1MPa	12.3MPa

CAUTION

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

5.3. ADJUST THE BELT

J5 axis of ER500-2800 is drove by timing belt. The belt tense tends to reduce after a period of operation. This section describes how to strain the belt.

WARNING

A loose timing belt may cause a reduction of robot repeatability and a shortness of the belt lifetime. Use a proper force when straining the timing belt. Excessive tense may shorten the belt lifetime.

Procedures of straining J5-axis timing belt are shown below.

1. Disassemble the hexagon flat round head screw M6X12 under the cover on the right side of the small arm. Remove the cover and keep it in a proper place.
2. Unscrew the hexagon screw M8X30 on the mounting plate of J5-axis.
3. Adjust the device underneath the mounting plate (mainly adjust the M4 nut), make the screw firmly against to the mounting plate of J5-axis motor.
4. Test the tense on the side of the timing belt. Proper tense value is list in the table below.
5. Tighten the hexagon screw M8X30 on the mounting plate to remount the plate.
6. Use hexagon flat round head screw to fix the right side cover of the small arm. Tighten the screw.

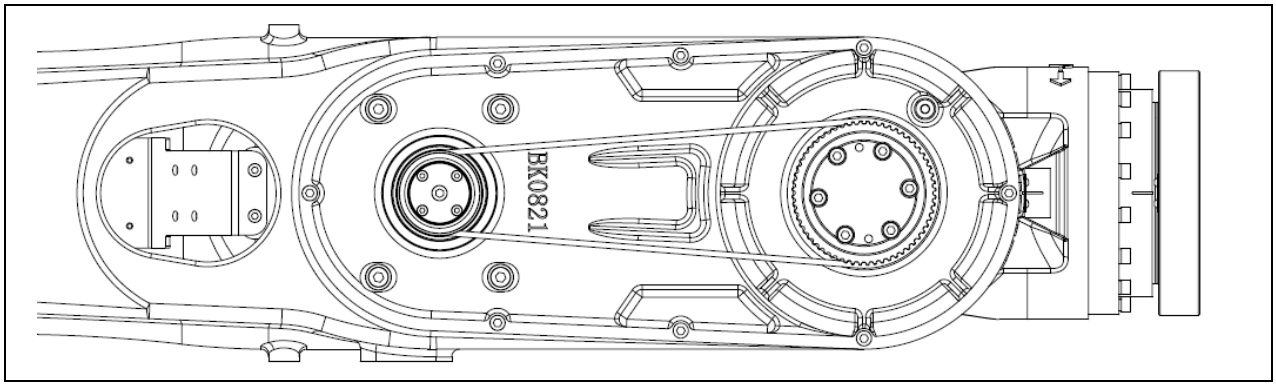


Fig 5.4 Straining the timing belt (ER220-3200, ER280-3200, ER280-3200-LI)

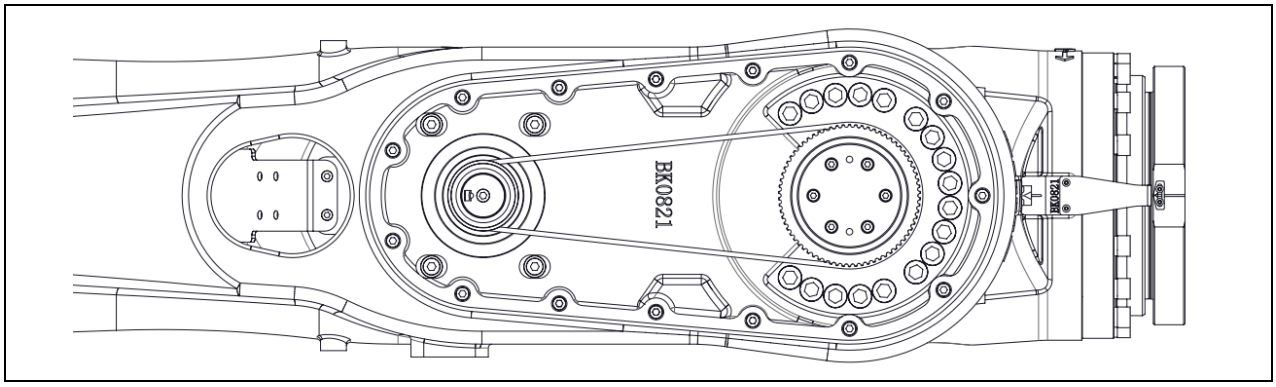


Fig 5.5 Straining the timing belt (ER350-3200)

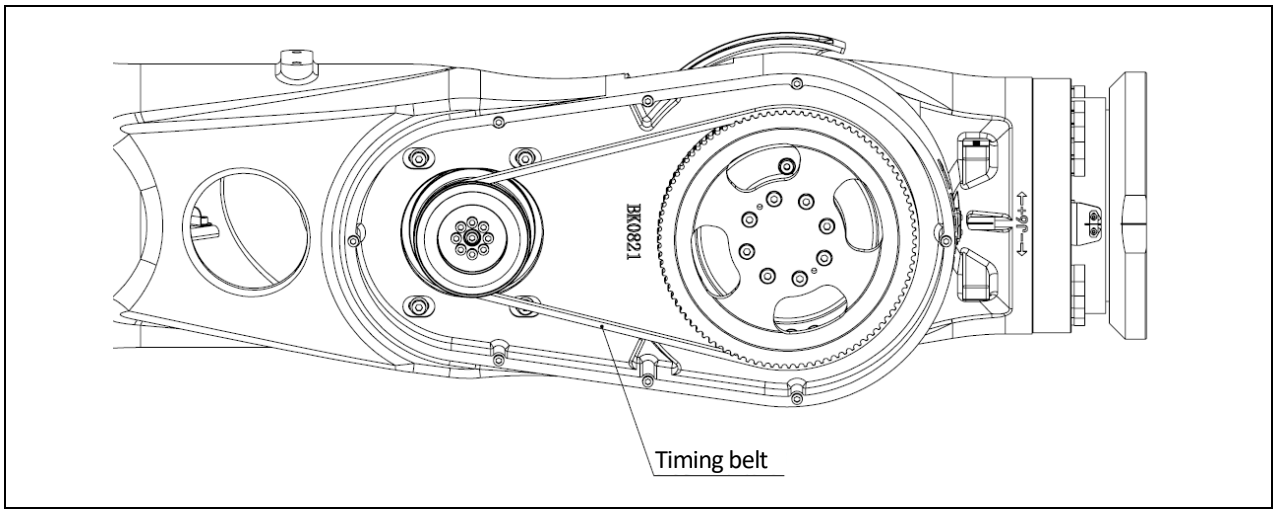


Fig 5.6 Straining the timing belt (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

Tab 5.4 Timing belt tense/frequency value reference (ER220-3200, ER280-3200, ER280-3200-LI)

Mode		Range of belt tense	Range of frequency
Belt	new belt	187～206N	79.2～83.1Hz
	used belt	131～150N	66.3～70.9Hz

Tab 5.5 Timing belt tense/frequency value reference (ER350-3200)

Mode		Range of belt tense	Range of frequency
Belt	new belt	334～368N	100～105Hz
	used belt	234～267N	84.5～90.3Hz

Tab 5.6 Timing belt tense/frequency value reference（ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800）

Mode		Range of belt tense	Range of frequency
Belt	new belt	185～204N	67.5～70.8Hz
	used belt	129～148N	56.4～60.3Hz

Measure the belt tense according to frequency, as internal parameter set is not required.

5.4. REPLACING THE BATTERIES

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

Procedures of replacing the battery are shown below.

1. Press the emergency stop button before replacing the battery to prevent any accident.
2. Remove the cover of the battery case.
3. Take out the old batteries from the battery case.
4. Insert the new batteries into the battery case while observing the correct direction.
5. Re-mount the cover after replacing the batteries.

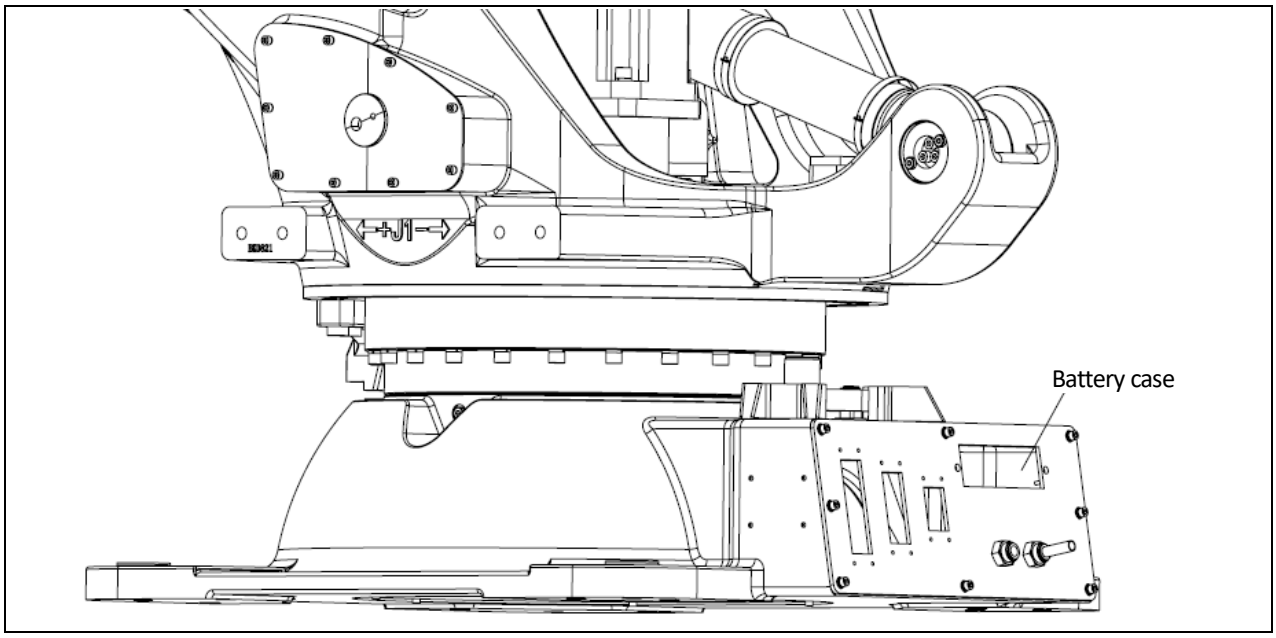


Fig 5.7 Battery replacement

CAUTION

Be sure to keep the power on. Replacing the batteries with the power off may cause all current position data to be lost. Therefore, calibration will be required again.

5.5.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.

CAUTION	**When the robot operates in a harsh environment, is frequently used at a small angle, or runs at a high frequency for a long time, please shorten the grease replacement cycle of the corresponding joint to 3,000 hours.**

Tab 5.7 Replacing the grease periodically

Model	Position	Quantity
ER220-3200 **ER280-3200**	J1-axis reducer	3050g
	J2-axis reducer	2200g
	J3-axis reducer	3100g
	J4-axis reducer	3300g
	J5-axis reducer	400g
	J6-axis reducer	480g
ER280-3200-LI	J1-axis reducer	6550g
	J2-axis reducer	2200g
	J3-axis reducer	3100g
	J4-axis reducer	3300g
	J5-axis reducer	400g
	J6-axis reducer	480g
ER350-3200	J1-axis reducer	6550g
	J2-axis reducer	2500g
	J3-axis reducer	3100g
	J4-axis reducer	3250g
	J5-axis reducer	700g
	J6-axis reducer	900g
ER350-3300 **ER420-3300** **ER500-2800** **ER600-2800** **ER700-2800**	J1-axis reducer	8100g
	J2-axis reducer	3400g
	J3-axis reducer	4200g
	J4-axis reducer	5100g
	J5-axis reducer	1300g
	J6-axis reducer	1300g

Recommend greasing gesture is list below.

Tab 5.8 Robot joint greasing angle (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

Position	Gesture					
	J1	**J2**	**J3**	**J4**	**J5**	**J6**
J1-axis reducer	Any	Any	Any	Any	Any	Any

J2-axis reducer						
J3-axis reducer			0°			
J4-axis reducer		0°	+20°	0°		
J5-axis reducer			0°	+90°	+90°	
J6-axis reducer			0°	0°	+90°	

Tab 5.9 Robot joint greasing angle (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

Position	**Gesture**					
	J1	**J2**	**J3**	**J4**	**J5**	**J6**
J1-axis reducer	Any	Any	Any	Any	Any	Any
J2-axis reducer		-50°	-50°			
J3-axis reducer		+60°	+60°			
J4-axis reducer[2]		0°	+10°	0°		
J5-axis reducer		0°	0°	0°	0°	
J6-axis reducer		0°	0°	0°	0°	

5.5.1. Position of grease inlet/outlet on each axis

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

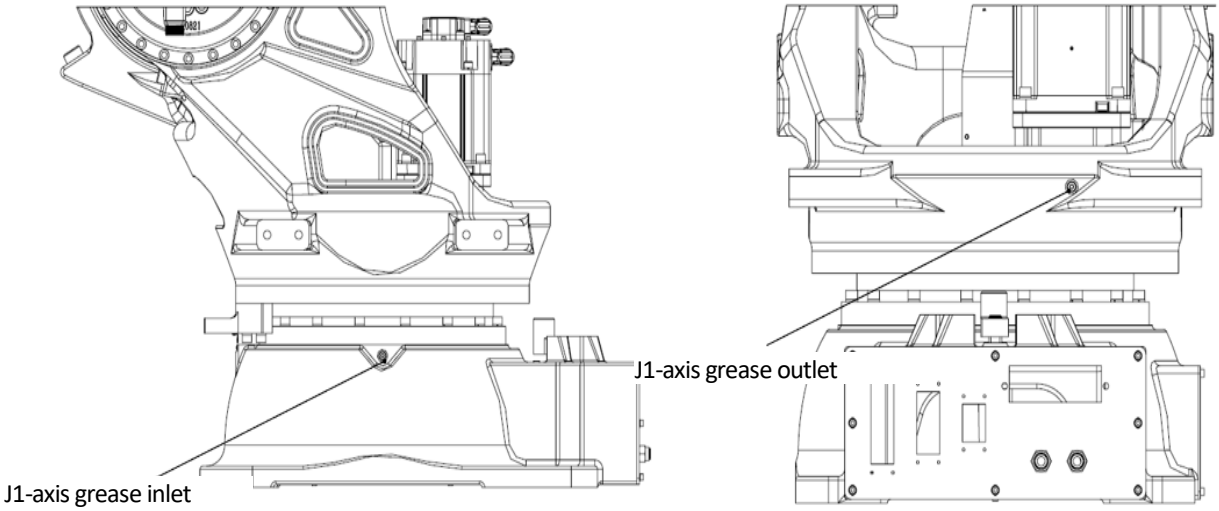


Fig 5.8 J1-axis grease inlet/outlet (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

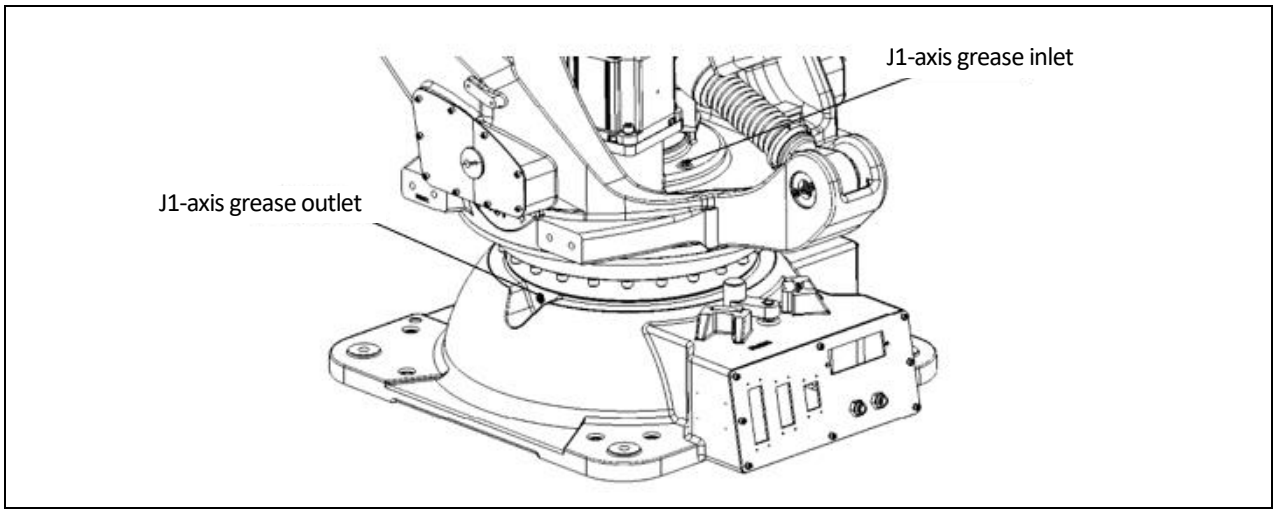


Fig 5.9 J1-axis grease inlet/outlet (ER350-3300, ER500-2800, ER600-2800, ER700-2800)

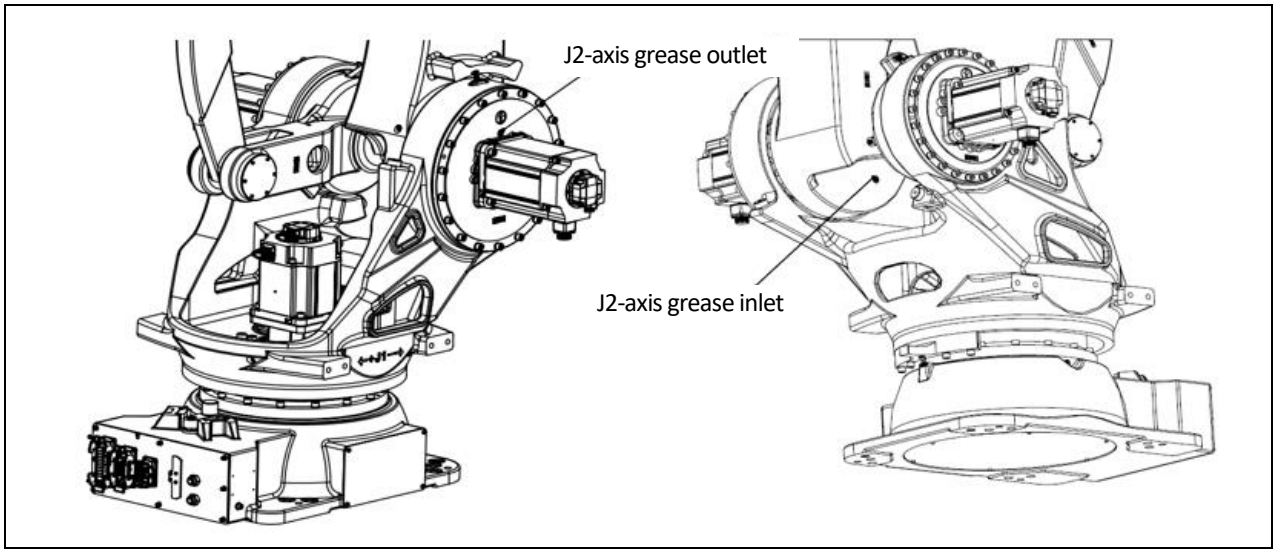


Fig 5.10 J2 axis grease inlet/outlet (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

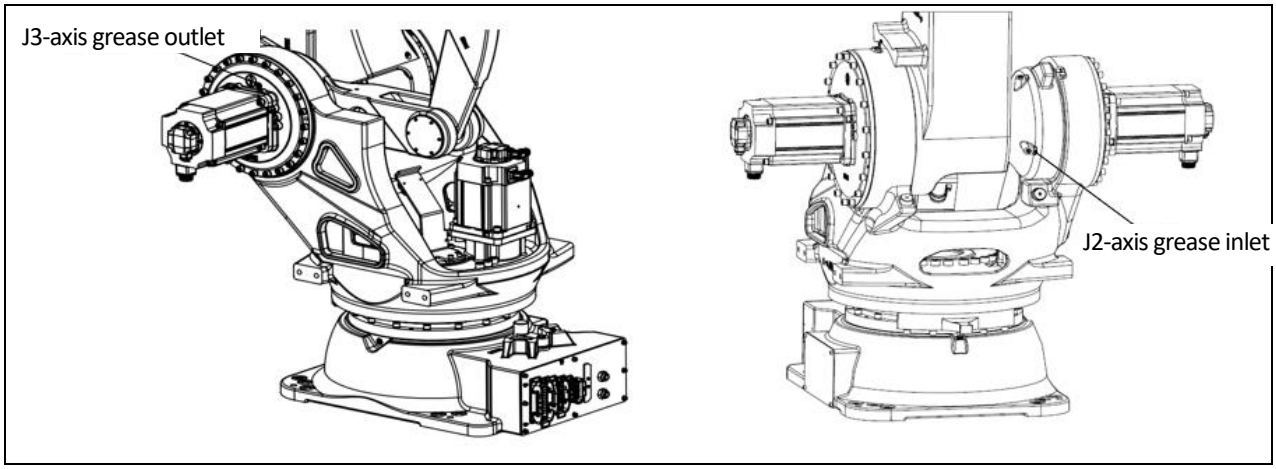


Fig 5.11 J3 axis grease inlet/outlet (ER220-3200,ER280-3200, ER280-3200-LI, ER350-3200)

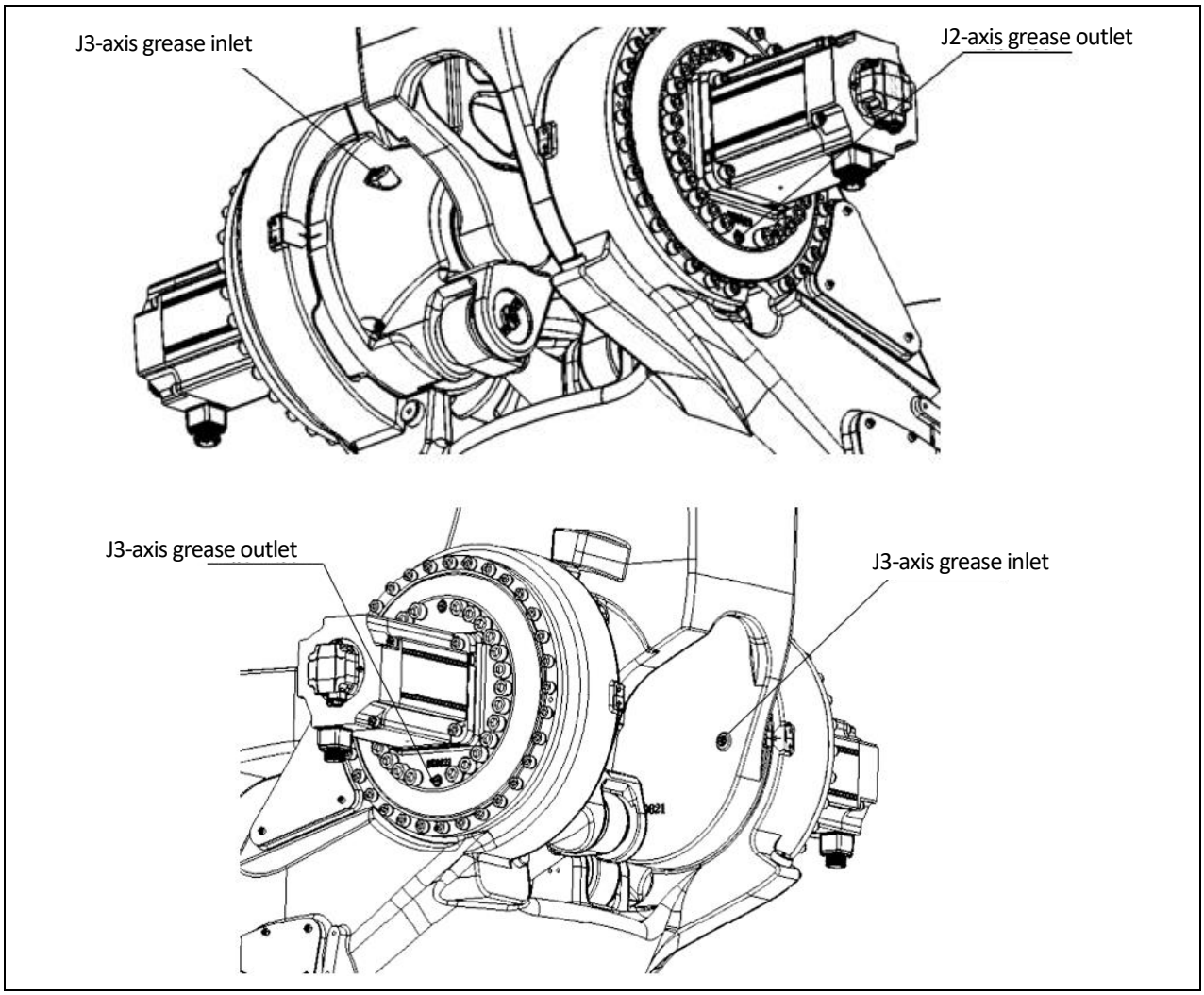


Fig 5.3 J2/J3 axis grease inlet/outlet (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

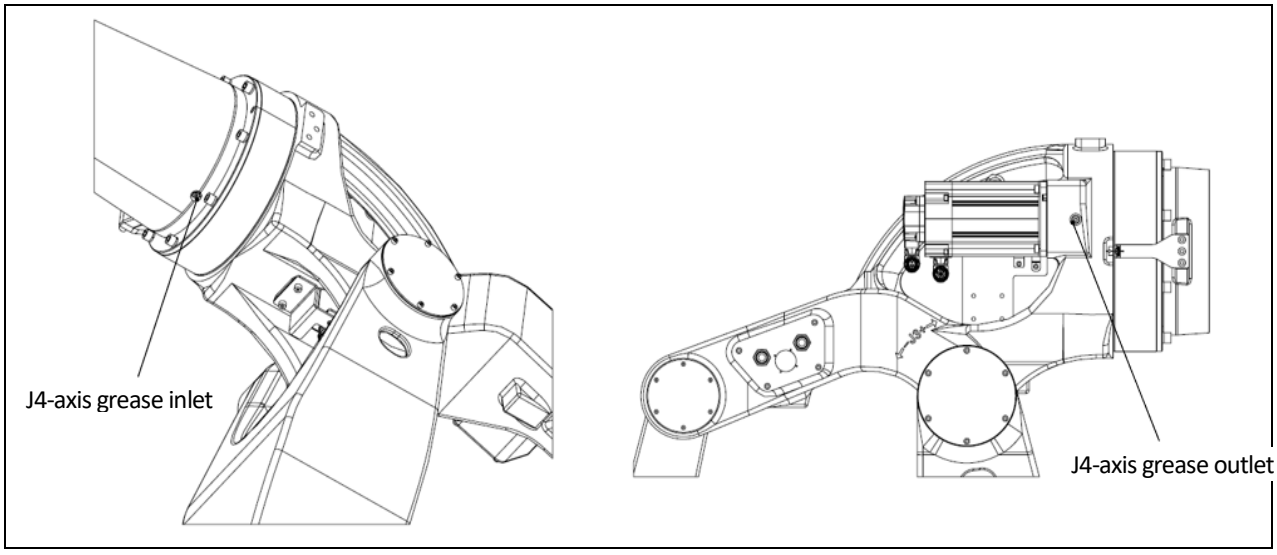


Fig 5.4 J4-axis grease inlet/outlet (ER220-3200,ER280-3200, ER280-3200-LI, ER350-3200)

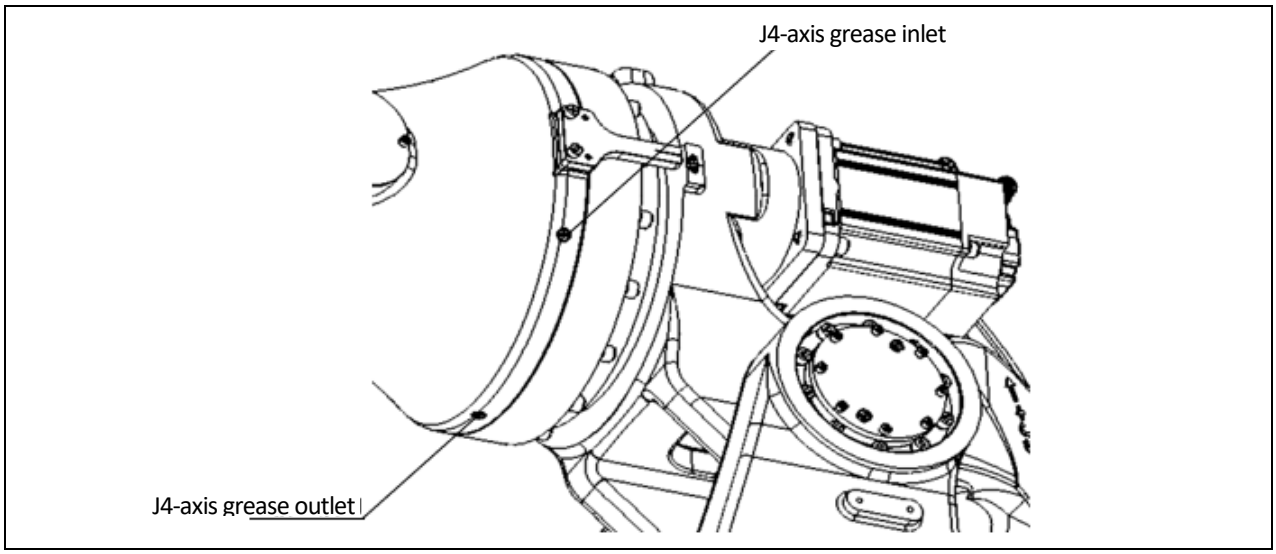


Fig 5.5 J4-axis grease inlet/outlet (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

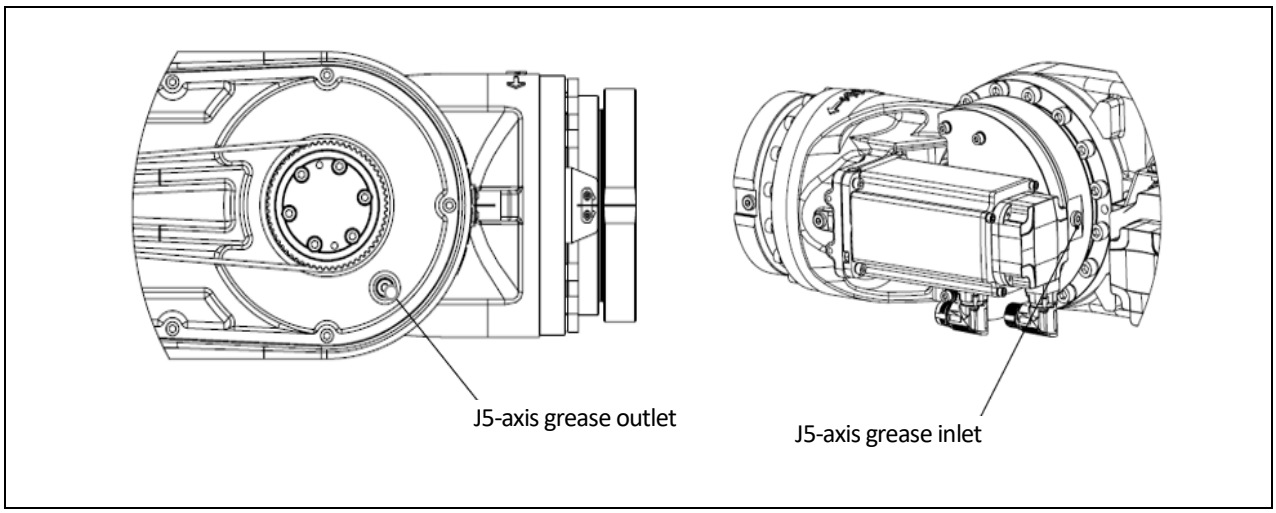


Fig 5.6 J5-axis grease inlet/outlet (ER220-3200, ER280-3200, ER280-3200-LI)

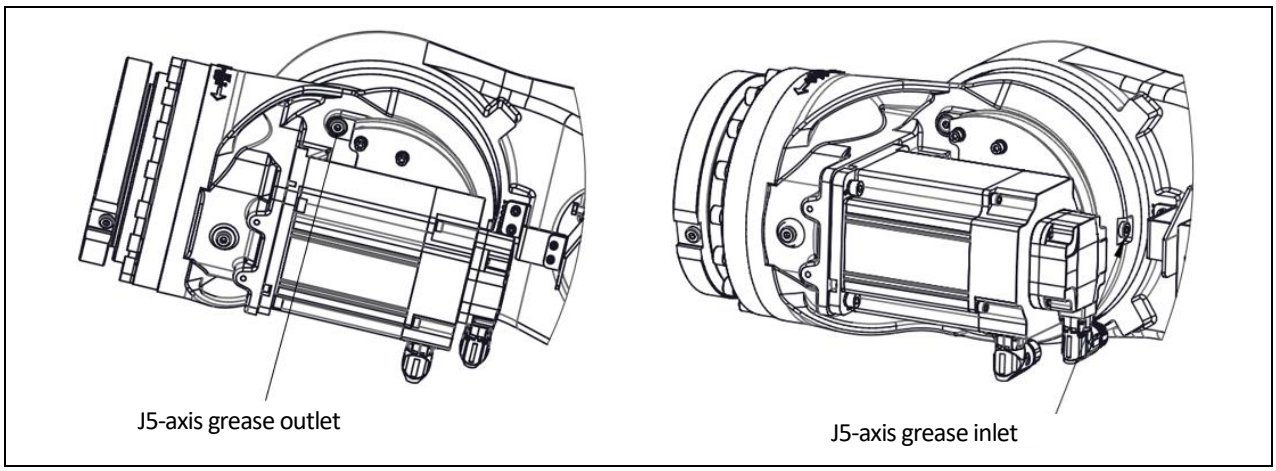


Fig 5.16 J5-axis grease inlet/outlet (ER350-3200)

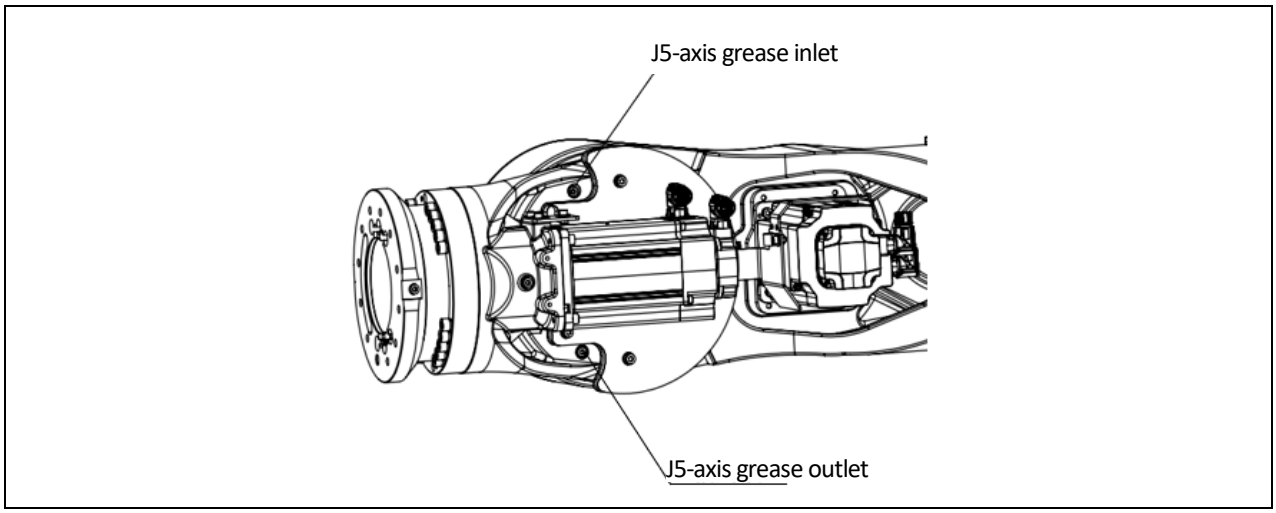


Fig 5.7 J5-axis grease inlet/outlet (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

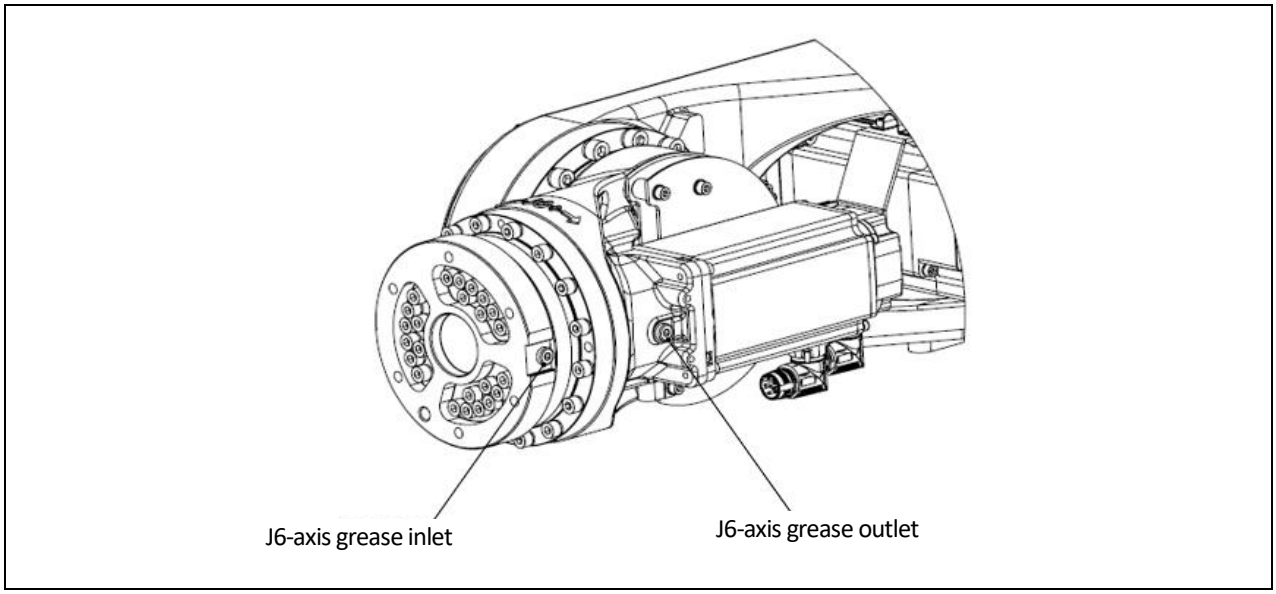


Fig 5.8 J6-axis grease inlet/outlet (ER220-3200, ER280-3200, ER280-3200-LI)

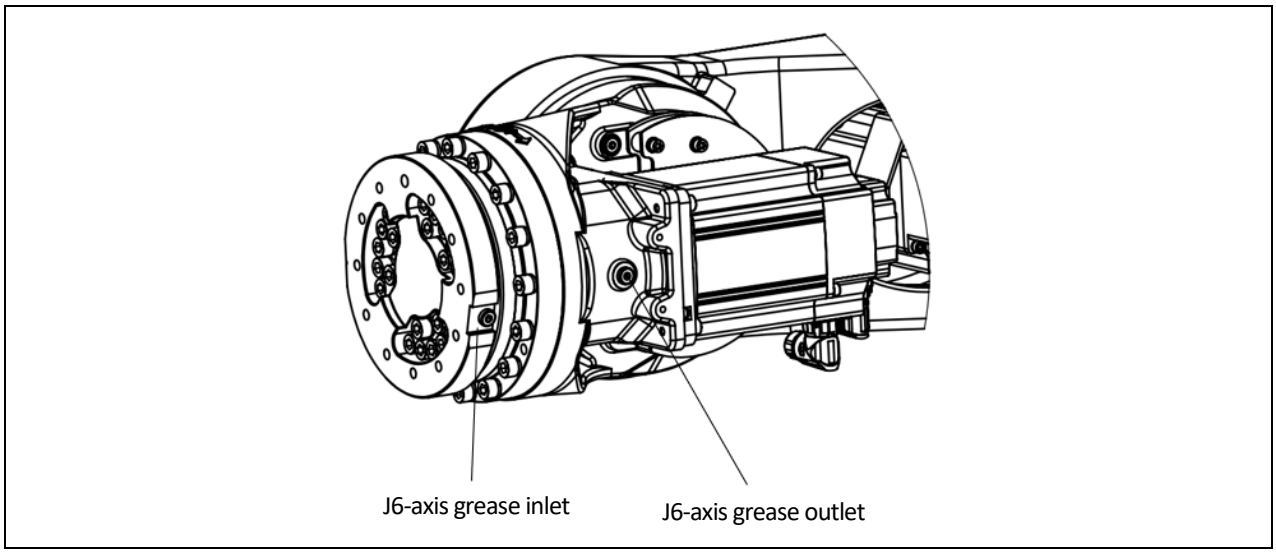


Fig 5.19 J6-axis grease inlet/outlet (ER350-3200)

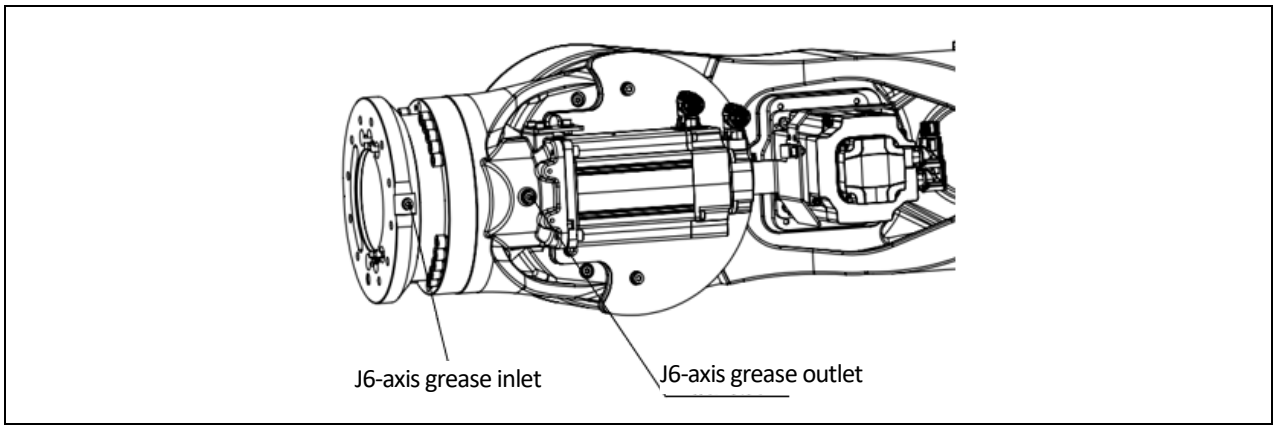


Fig 5.20 J6-axis grease inlet/outlet (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

5.5.2. Procedures of greasing

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

a) Teach each joint to run at a speed of 100% for 10-20min, to make the grease into grease with low viscosity.
b) Move the robot to the gesture of greasing, then turn off the power supply.
c) Put an grease recycle container beneath the grease outlet.
d) Remove the screw on the inlet and outlet of each joint.
e) Inject new grease via the grease inlet until new grease goes out of the outlet. The amount of grease injected should be equal to the amount that is discharged (including those discharged after warming up the machine).
f) Release the residual pressure in the grease groove according to section 5.5.3.
g) Install the screw to grease 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 grease leakage and abnormal operation. Therefore, when performing greasing, observe the following precautions.

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

5.5.3. Procedure for releasing remaining pressure within the grease bath

Release remaining pressure with the following procedures. Attach bags under the grease outlet to prevent spilled grease/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 grease inlet of each axis after safety confirmation. Do not face the screw when removing it, in case that grease with high pressure and high temperature ejects, resulting personnel injury.

d) Retighten the screw 3% seconds later after removing it, and clean up the grease 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 1.

5.6. Grease leakage inspection

Maintenance Area

Insert a cloth or similar material into the gaps of each joint to check for any grease leakage from the grease seals. If grease leakage is observed, please wipe it clean.

- Depending on the operating conditions and surrounding environment, grease may leak from the outer lip of the grease seals. When accumulated grease forms droplets, it may drip during certain movements. Prior to operating the robot, please wipe off any grease accumulation on the underside of the grease seals.
- Additionally, if the temperature during operation is excessively high, the internal pressure in the joint chambers may increase. In such cases, after the operation, please open the grease filling port once to restore the internal pressure. (Do not open or close the grease filling port while the machine is in a cooled state)
- If grease leakage persists even after frequent wiping, please refer to 7.2 Troubleshooting.

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

6. CALIBRATING

6.1. INTRODUCTION

Calibration associates the angle of each robot axis with the pulse count value supplied from the absolute Pulsecoder 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
- Pulsecoder replacement
- Reducer replacement
- Cable replacement
- Backup batteries for pulse count in the mechanical unit has run out

CAUTION

Robot data (including calibration data) and pulsecoder 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.

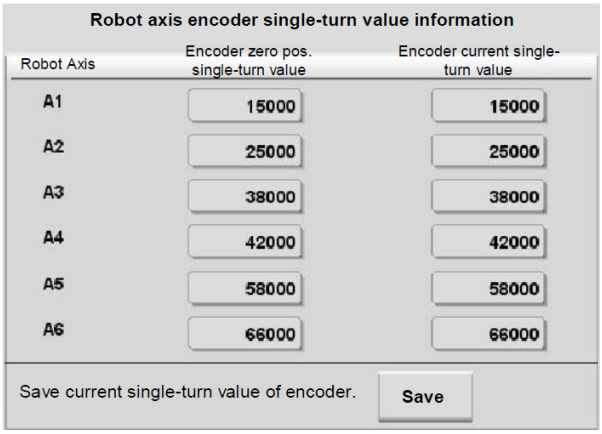


Fig 6.1 Single loop value of quick zero position calibration (CP)

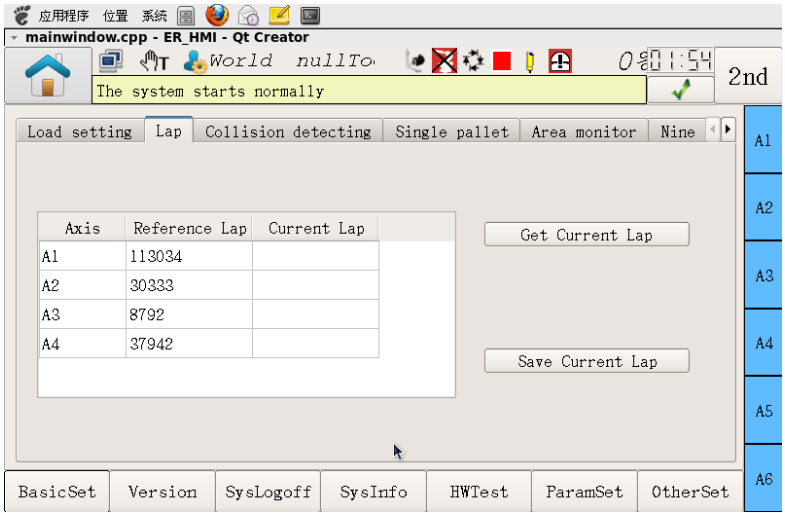


Fig 6.2 Single loop value of quick zero position calibration (ERC)

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.

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.

a) Move J1-axis with teach pendant to align two witness marks.

b) 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.

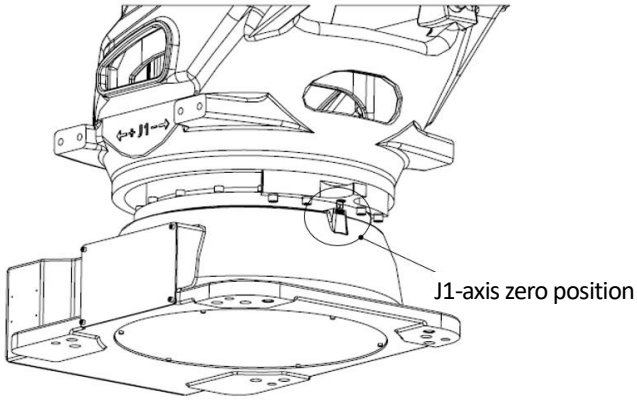


Fig 6.3 Calibration for J1-axis (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

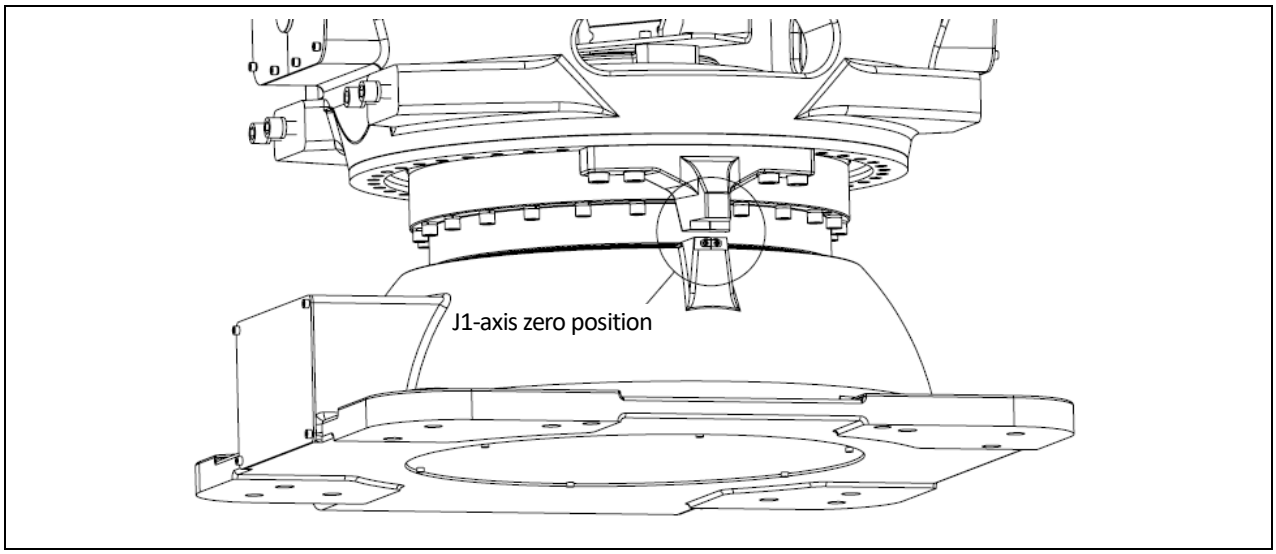


Fig 6.4 Calibration for J1-axis (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

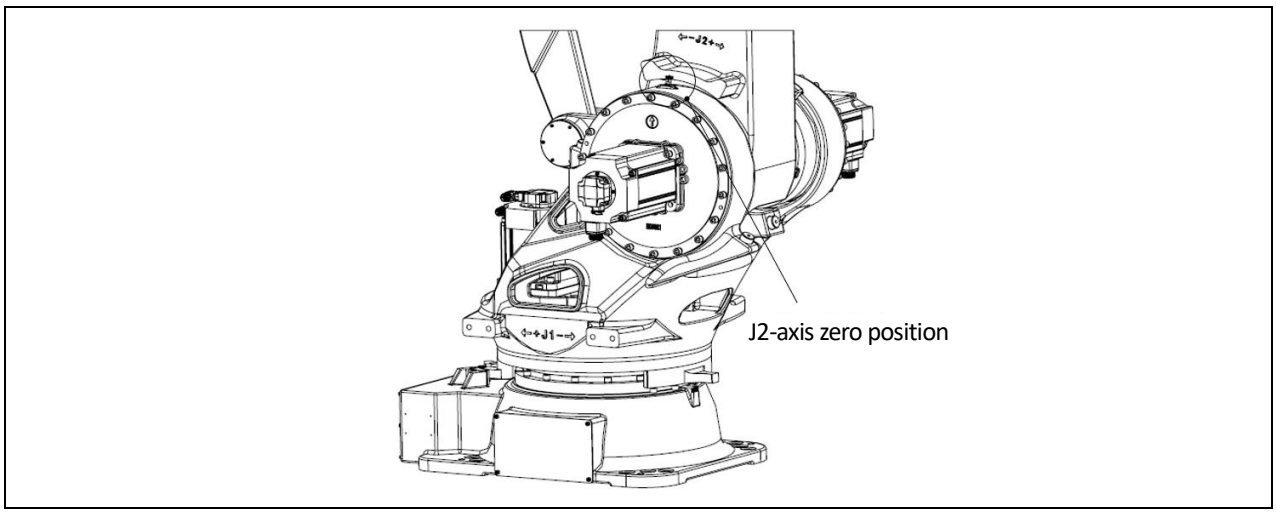


Fig 6.5 Calibration for J2-axis (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

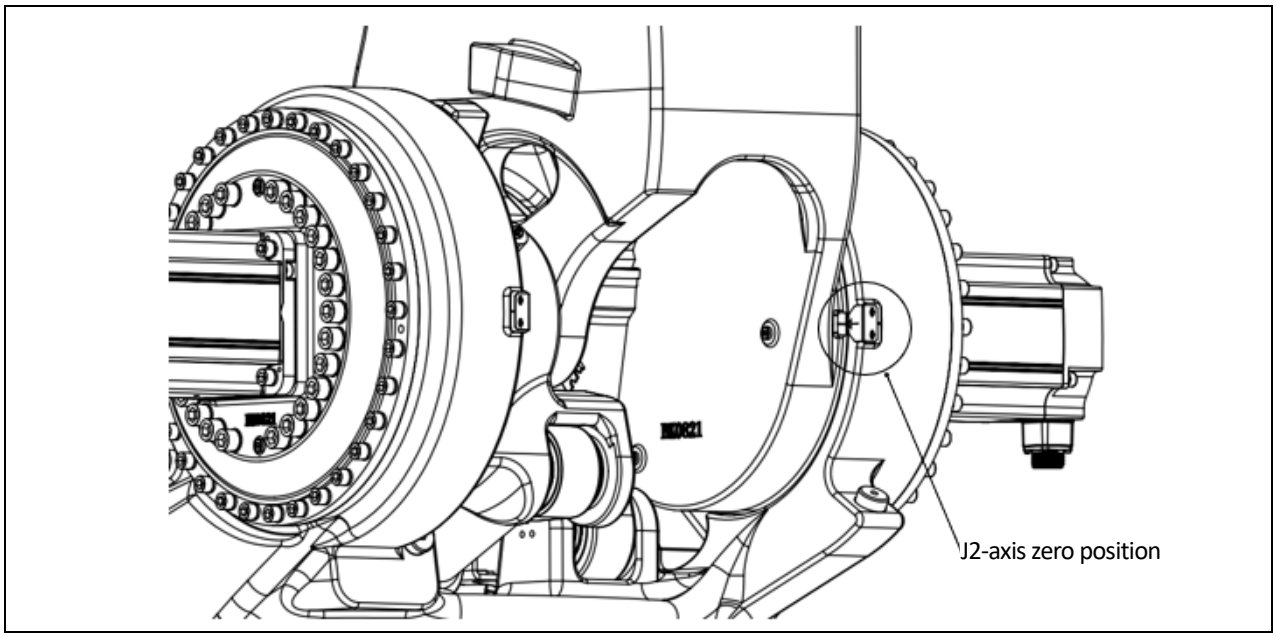


Fig 6.6 Calibration for J2-axis (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

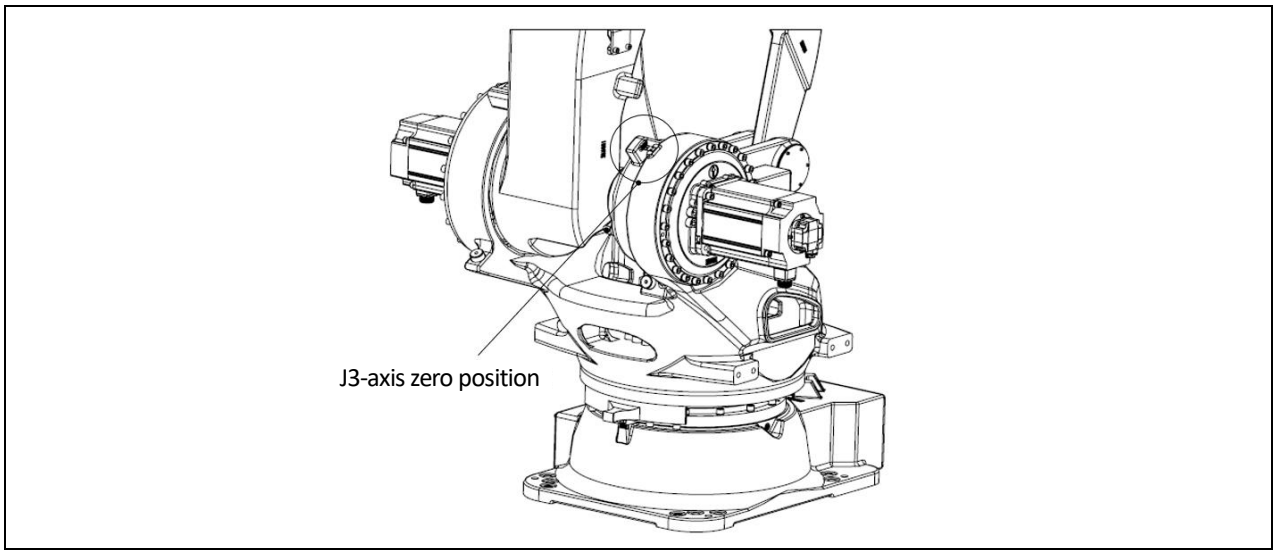


Fig 6.7 Calibration for J3-axis (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

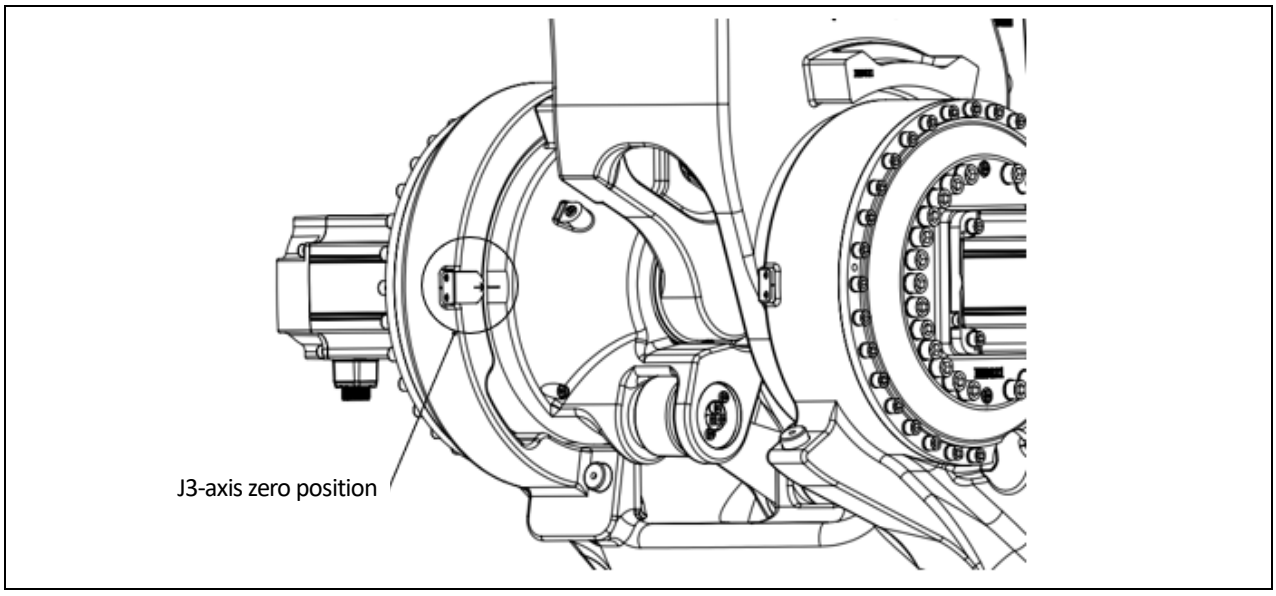


Fig 6.8 Calibration for J3-axis (ER350-3300, ER420-3300, ER500-2800, ER600-2800)

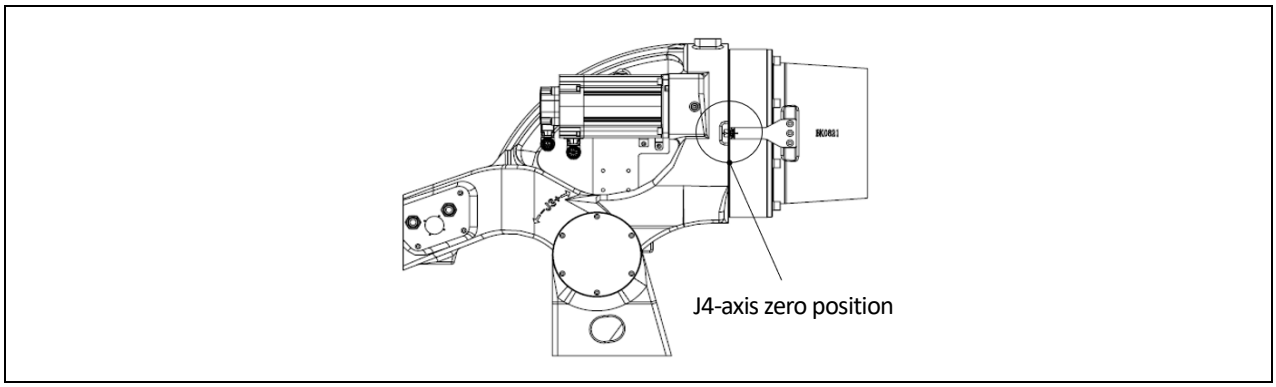


Fig 6.9 Calibration for J4-axis (ER220-3200, ER280-3200, ER280-3200-LI, ER350-3200)

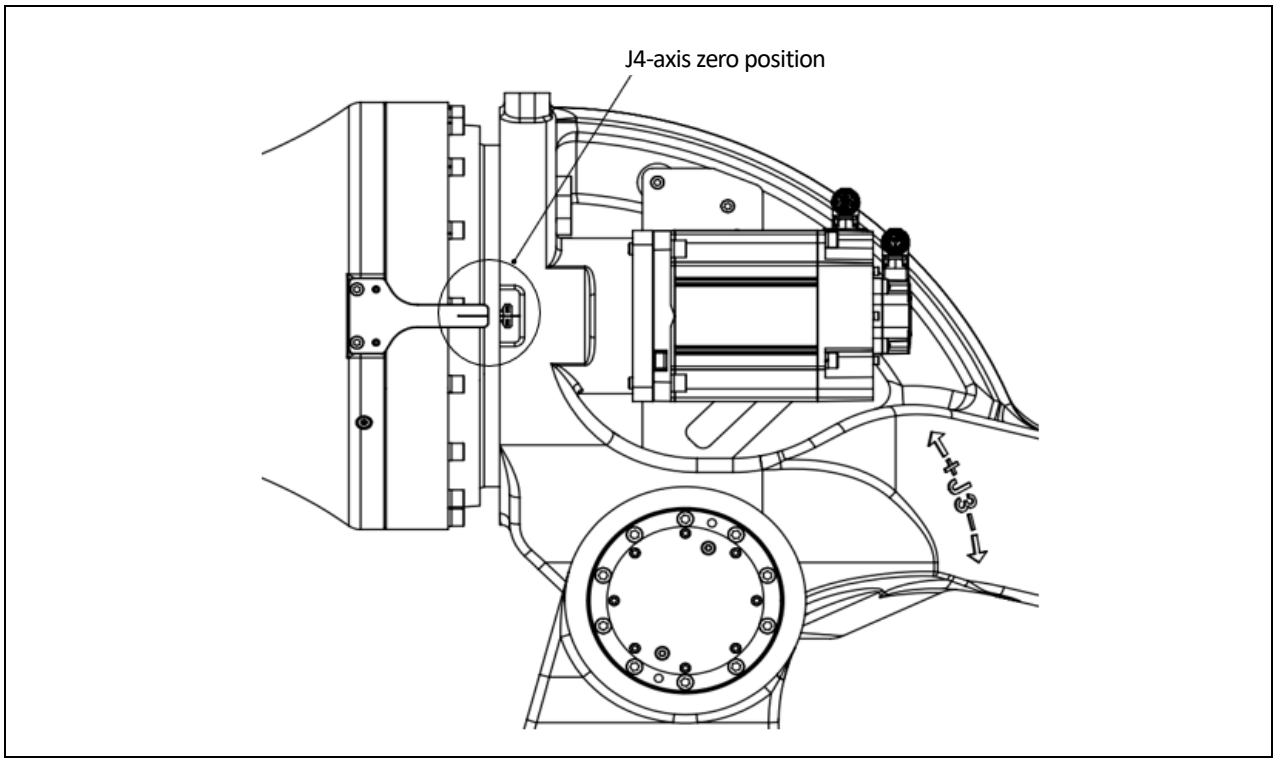


Fig 6.10 Calibration for J4-axis (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

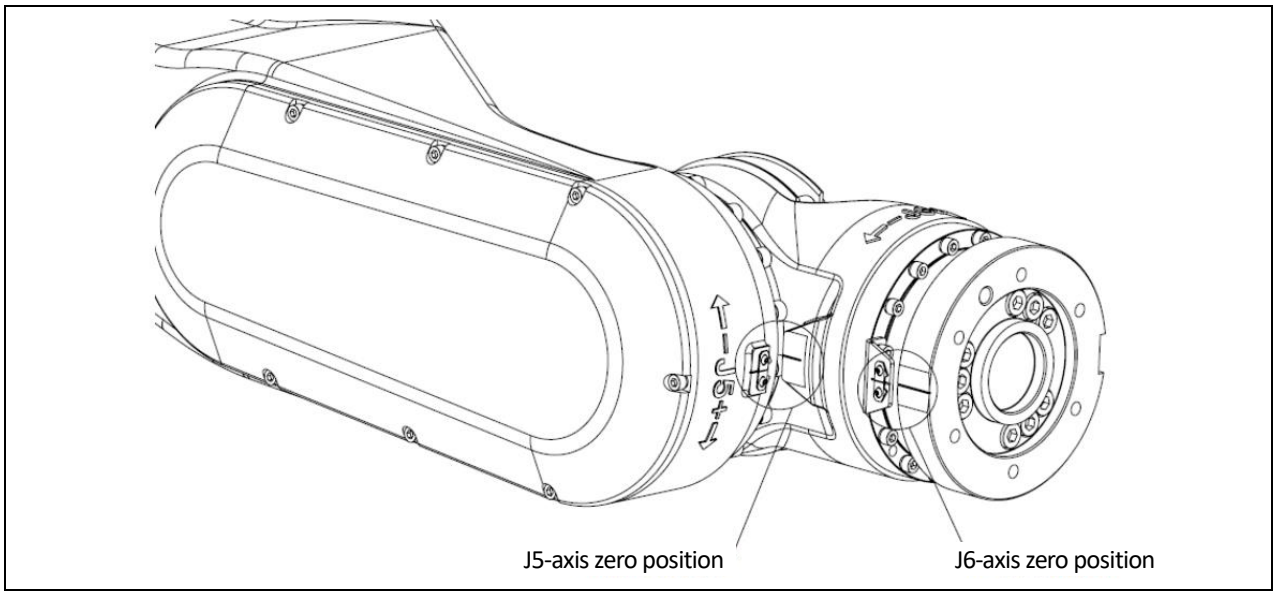


Fig 6.11 Calibration for J5&J6-axis (ER220-3200, ER280-3200, ER280-3200-LI)

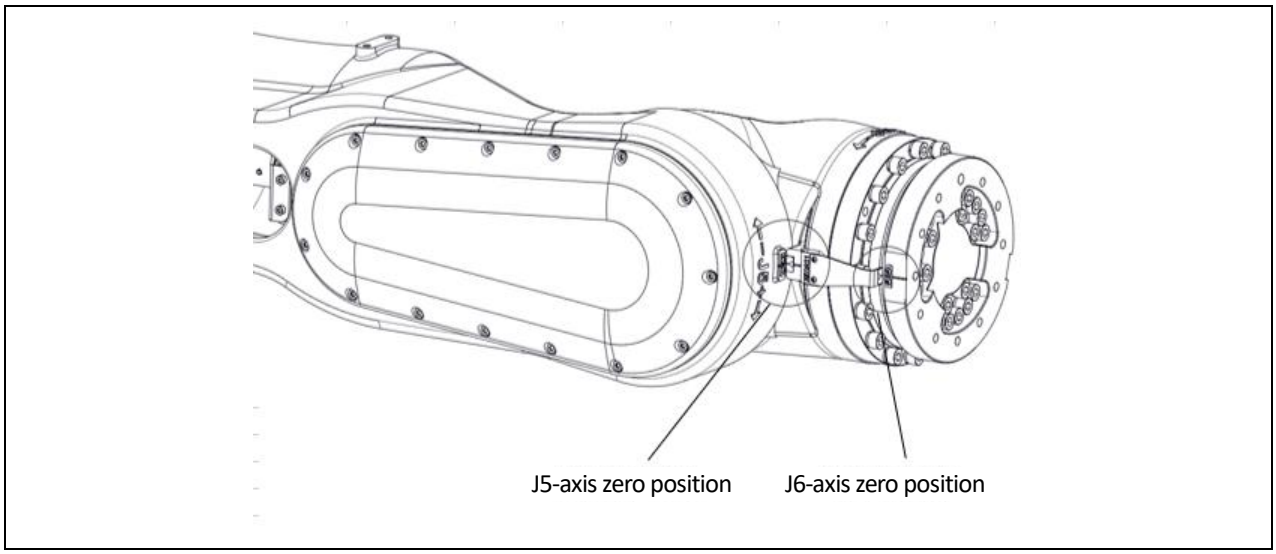


Fig 6.12 Calibration for J5&J6-axis (ER350-3200)

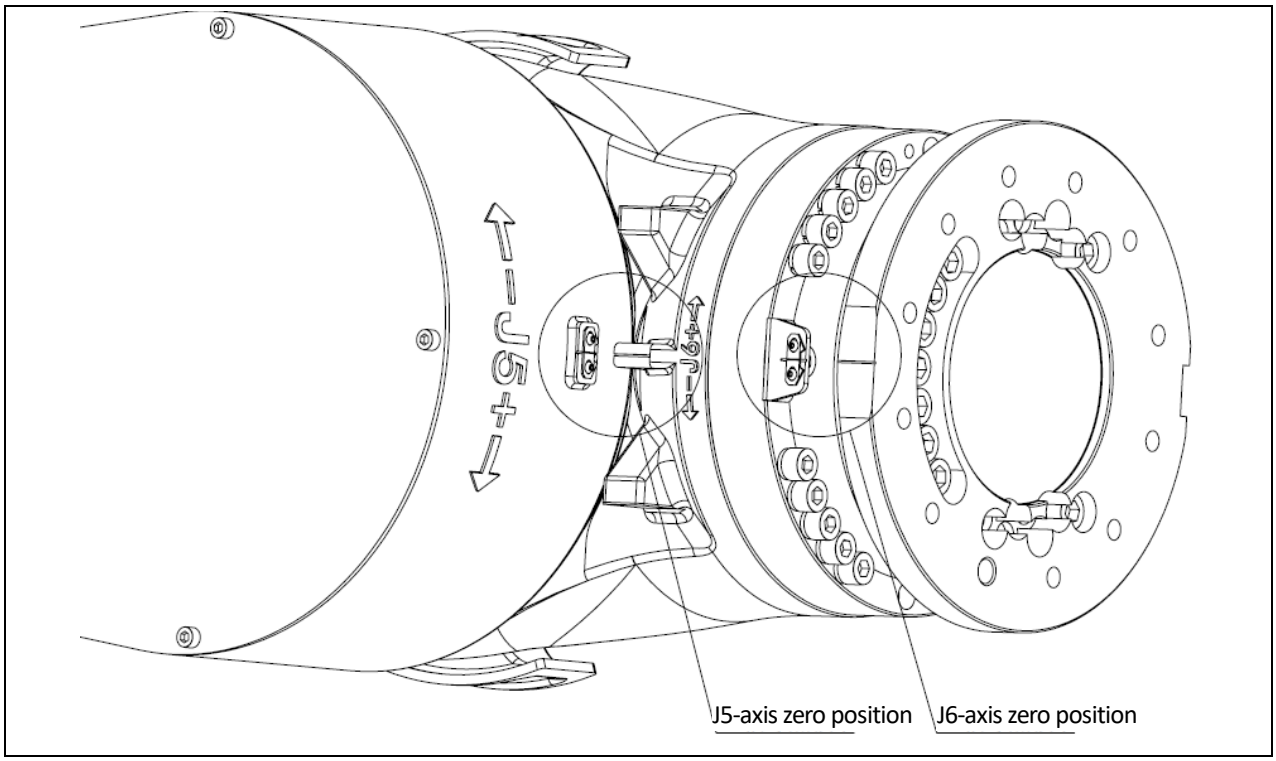


Fig 6.12 Calibration for J5&J6-axis (ER350-3300, ER420-3300, ER500-2800, ER600-2800, ER700-2800)

7. TROUBLESHOOTING

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

CAUTION	**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 overheat	The motor overheated due to the ambient temperature rose or a cover was attached to the motor.	Ambient temperature roses 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 grease leakage	Grease leakage from the joint.	Prolonged usage of the robot leads to a damage of the grease seal.	Replace the grease seal and O-ring.
		There is a gap on the surface of the seal.	Re-mount and tighten the grease seal.
		There is a problem with the grease inlet or outlet.	Replace the grease inlet or the bolt.
Dropping 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.

WARNING

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

CAUTION

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

APPENDIX

APPENDIX A BOLT TORQUE LIST

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

APPENDIX B SPECIFICATIONS OF CHEMICAL BOLTS

Nominal diameter	**Screw dimension**	**Drill diameter**	**Anchor depth(mm)**	**Max. anchor thickness(mm)**	**Designed pulling force(kN)**	**Designed shearing force(kN)**	**Anti-pull force(kN)**
M8	φ8×110	φ10	80	13	10.3	12.3	⩾20KN
M10	φ10×130	φ12	90	20	12.3	14.2	⩾30KN
M12	φ12×160	φ14	110	25	16.8	17.5	⩾40KN
M16	φ16×190	φ18	125	35	28.9	35	⩾60KN
M20	φ20×260	φ25	170	65	50.1	51.5	⩾90KN
M24	φ24×300	φ28	210	65	75.5	80	⩾140KN
M30	φ30×380	φ35	280	70	121.3	163.7	⩾200KN
M33	φ33×420	φ38	300	90	135	182	⩾260KN

APPENDIX C Part list for ER220-3200/ER270-2850/ER280-3200/ER280-3200-LI

No.	SAP	Name	Amount	Note
1	31521100006	Lithium battery ER34615M/2	1	
2	12800000014	Servo motors (J1 axes)	1	
3	12800000072	Servo motors (J2, J3 axes)	2	
4	12700000361	Servo motors (J4 axes)）	1	
5	12700000362	Servo motors (J5 axes)	1	
6	12700000326	Servo motors (J6axes)	1	
7	G5400000096	Arc tooth Timing belt	1	

APPENDIX D Part list for ER350-3200

No.	SAP	Name	Amount	Note
1	31521100006	Lithium battery ER34615M/2	1	
2	12800000014	Servo motors (J1 axes)	1	
3	12800000073	Servo motors (J1 axes)	1	
4	12800000072	Servo motors (J1 axes)	1	
5	12700000361	Servo motors (J1 axes)	1	
6	12700000362	Servo motors (J1 axes)	1	
7	12700000298	Servo motors (J1 axes)	1	
8	G5400000506	Arc tooth Timing belt	1	

APPENDIX E Part list for ER500-2800/ ER350-3300/ ER420-3300

No.	SAP	Name	Amount	Note
1	12800000014	Servo motors (J1, J4 axes)	2	
2	12800000073	Servo motors (J2, J3 axes)	2	
3	12700000361	Servo motors (J5, J6 axes)	2	
4	G5400000075	Timing belt	1	
5	31521100006	Lithium battery ER34615M/2	1	
6	48300000140	Nitrogen spring	1	
7	48300000141	Nitrogen spring	1	

APPENDIX F Part list for ER600/ER700-2800

No.	SAP	Name	Amount	Note
1	12800000014	Servo motors (J1, J4 axes)	2	

2	12800000073	Servo motors (J2, J3 axes)	2	
3	12700000361	Servo motors (J5, J6 axes)	2	
4	G5400000477	Timing belt	1	
5	31521100006	Lithium battery ER34615M/2	1	
6	48300000140	Nitrogen spring	1	
7	48300000141	Nitrogen spring	1	

REVISION RECORD

Revision	Date	Contents
02	2019.04	New edition.
03	2019.07	Modify the spare parts list. Modify the error description.
04	2019.12	Modify the spare parts list. Modify the screw tightening torque table.
05	2020.03	Add ER500-2800-5.
06	2022.01	Add ER350-3300.
07	2022.05	Add ER220-3200,ER270-2850,ER280-3200, ER350-3300-5,ER600-2800 Delete ER500-2800-5.
08	2022.12	Added ER280-3200-LI robot, new storage chapter; Update the connection with the control device, ambient temperature, update robot drawings, specifications; Delete the Grease Name column, and Spare Parts List grease column.
09	2023.12	Delete ER350-3300-5, ER270-2850; Add ER700-2800 and Grease leakage inspection.
10	2024.05	Add ER350-3200, ER420-3300.

NANJING ESTUN ROBOT ENGINEERING CO., LTD.

1888 Jiyin Avenue, Jiangning Economic Development Zone, Nanjing City

+86-25-58328532 www.estun.com

+86-25-52785576 export@estun.com