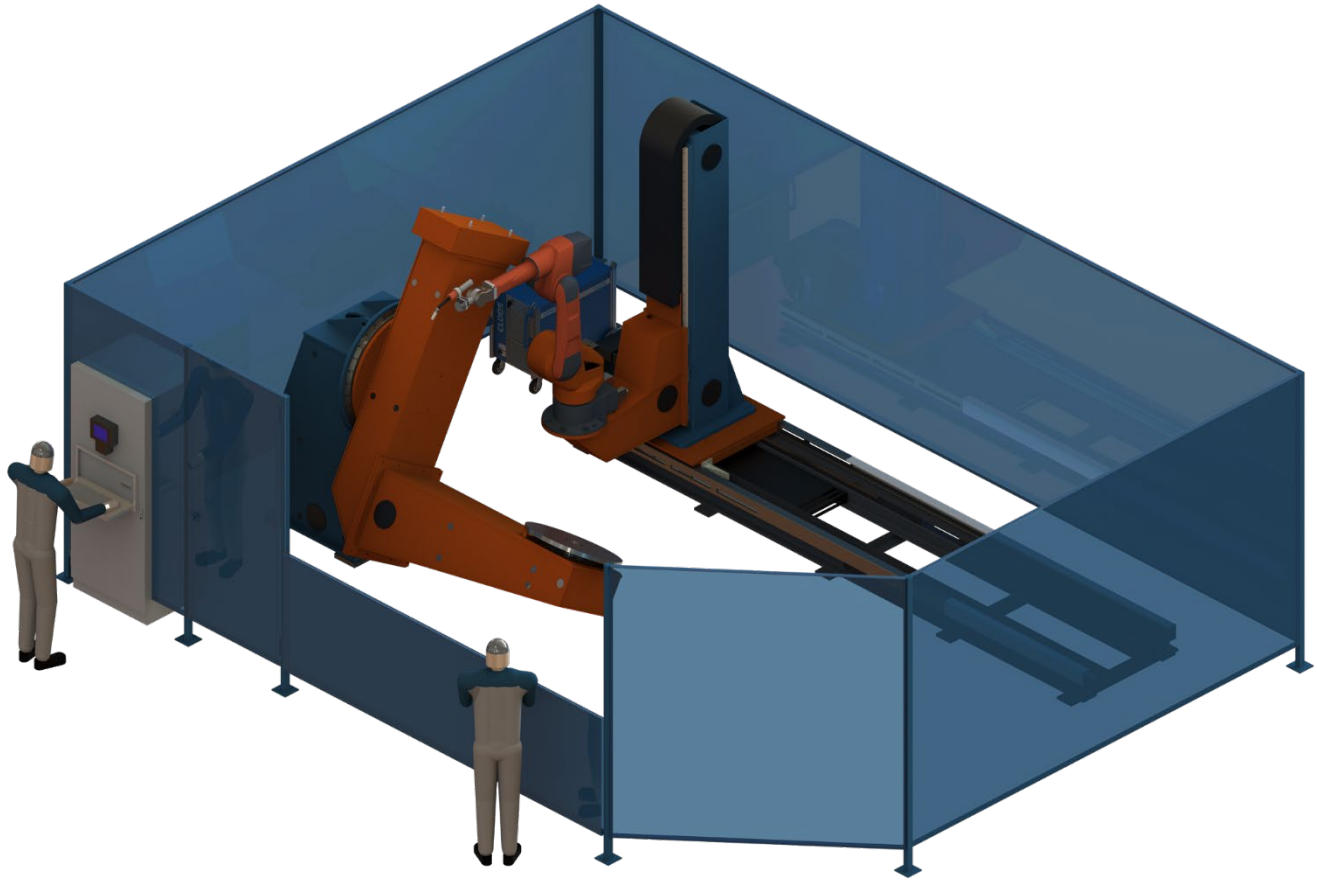
CLOOS

Weld your way.

CLOOS Robotics Arc Welding Series
Robot Body Operation Instructions



Thank you for purchasing CLOOS robots.

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

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

All statements, information, and advice provided in this manual have been carefully processed, but no guarantee is given for their complete accuracy. We shall not be held liable for any direct or indirect losses arising from the use of this manual.

Users are solely responsible for the application of any products and should exercise caution when using this manual and the associated products.

The interpretation of all content in this manual belongs to CARL CLOOS Robotics & Welding Technology (China)Co., Ltd.

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List of Chapters

CONTENTS

Instructions for Safe Use

This Chapter describes the content to be observed for the safe use of the robot. Before using, be sure to read and understand the content in this Chapter.

Companies and individuals using CLOOS Robotics should be familiar with the local and national standards and laws. Appropriate safety facilities shall be provided to protect users. Before use (installation, operation, maintenance and repair), please be sure to read and understand this Manual as well as other ancillary materials thoroughly, and use it after being familiar with all knowledge on equipment, safety and precautions. However, CLOOS would not guarantee that the user will absolutely not be injured even if he follows completely all the safety information given in the Manual.

DEFINITION OF USER

The personnel can be defined as follows.

- Operator
  - To turn the robot power ON/OFF.
  - To start the robot program from the panel.
- Programmer
  - To operate the robot.
  - To teach the robot in a safe area.
- Maintenance engineer
  - To operate the robot.
  - To teach the robot in a safe area.
  - To carry out the robot maintenance (repair, adjustment, replacement).
  - Operator must not work in a safe area.
  - Programmer and maintenance engineer can work in a safe 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.
- Work clothes suitable for the work
- Safety footwear
- Helmet

SPECIAL TRAINING

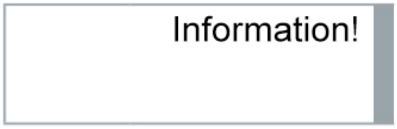
Tasks in the safe area including transportation, setting, teaching, adjustment, maintenance, etc.

Training course must be performed before operating the robot.

For more information about training course, contact CLOOS.

Safety Symbols

If the manual contains instructions marked as follows, users must read them carefully and follow strictly.

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

Safety precautions for users

(1) The robot should be transported and installed as procedures recommended by CLOOS. 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.

Under any circumstances, do not stand under any robot arm to prevent abnormal motion of the robot or connection with other people.

Caution!

A carbon dioxide fire extinguisher needs to be placed on site to prevent the robot system from catching fire.

Operators:

(1) Before operate the robot, you should press E-stop button, which is on the teach pendant or the upper right of electric cabinet, in order to check whether the indicator of Servo Ready is not light, and make sure the power of the indicator is turnoff.

(2) In course of operation, never allow the non-work personnel to touch the control cabinet. Otherwise, the robot might bring some unexpected movements, which can cause personal injury or equipment damage.

(3) When you install a device on the robot, the power supplies of the control cabinet and the device must be cut off (OFF), and then hang a caution sign. If you power on in your installation, it

might cause the danger of electric shock, or the robot might bring some unexpected movements, which can cause personal injury.

(4) E-stop

The E-stop is independent of the electrical control of all robots, and it can stop all robot motions;

E-stop means that all power supplies to the robot are disconnected, but the power to the brake on the servomotor is not disconnected. The robot can work again after releasing E-stop button and re-starting the robot.

There're several buttons for emergency stopping the robot. On the teach pendant and at the upper right of control cabinet, each of these places has one red button, as shown in the left side. Certainly, users can also set the E-stop button as required.

The E-stop button must be installed in an accessible position so that the robot can be stopped in an emergency.

Caution!

E-stop is just used for stopping the robot in the case of an emergency. That is to say, it cannot be used in the normal stop.

Danger!

Operators shall pay attention to the high-voltage danger of the power line of the servomotor, as well as the power line connecting the fixture and other devices.

Programmers:

While teaching the robot, and in some cases, the programmer needs to enter the range of the robots movement, so be sure to keep himself safe

Caution!

ON/OFF enabling is done by operating a Mot button on the teach pendant. When pressing this button, the servomotor is enabled, and disabled when releasing it.

To ensure the safe use of the teach pendant, the following rules must be observed:

- Ensure that the enable button works at all times.
- Disconnect the enabling timely when temporarily stopping the robot, programming or testing.

- When entering the robot working space, the demonstrator shall bring the teach pendant to avoid other people operating the robot without the programmer is informed.
- The teach pendant must not be placed within the working space of the robot to prevent abnormal actions in case of collision between the robot and the teach pendant.

Maintenance personnel:

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

Some parts of the robot in normal operation will become hot, especially the servomotor and reducer, which may cause burns when being approached or touched. When it is inevitable, protective equipment such as heat-resistant gloves should be worn.

Caution!	**Before touching these parts with your hands, try to feel the temperature of these parts by approaching with your hand, in case you are scalded.** **Wait for enough time after machine halt, so that the hot parts can be cooled down, and then you can carry out the maintenance work.**

(2) Safety precautions on removing parts

Ensure that the internal parts such as the gears are no longer rotating, and then you can open the lid or the protection device. You shall not open the protection device when the gears and bearings are rotating. If necessary, use the auxiliary device to make the internal unfixed parts remains its original position.

The initial test upon repair, installation and maintenance shall be carried out by following the steps below:

a) Clean up the robot and all maintenance and installation tools in the working space of the robot.
b) Install all the protective measures.
c) Ensure that people are standing outside the safe range of the robot.
d) Pay special attention to the working conditions of the parts repaired during testing.

In case of robot repair, do not use the robot as a ladder, and do not climb on the robot to avoid falling.

(3) Safety precautions on pneumatic/hydraulic components

After turning off the air source or hydraulic pump, a few residual gas or liquid exists in the pneumatic system or hydraulic system. Beware these gases or liquid, which have a certain energy; we must take some measures to prevent the residual energy from damaging to the human body and equipment. Therefore, it is necessary to release the residual energy in the system before maintaining the pneumatic or hydraulic components.

Caution!

Mount a safety valve to avoid accidents.

(4) The power supply need be opened in many cases of fault diagnosis, but it must be shut when the maintenance or repair is carried, moreover, you should cut off other power supply connections.

(5) Brake detection

In general, the brake can be worn in the normal operation. Therefore, the brake detection is necessary by following the steps below.

a) Move each joint to a position, where the joint can bear the maximum load.

b) Shut down the robot and brake.

c) Mark every joint of the robot.

d) Examine whether any joint moves after waiting for a moment.

(6) Safety precautions for adding lubricating oil

When add lubricating oil to the reducer, it might do harm to the person and the equipment. Therefore, you must obey the below safety information before adding lubricating oil.

- Wear the protective measures (e.g. gloves, etc.) when refueling or draining oil to prevent damage to maintenance personnel caused by high-temperature oil or reducer.
- Be cautious when opening the oil chamber cover. Keep away from the opening as there may be pressure in the oil chamber to cause splashing.
- Oil filling shall be made according to the fuel gauge, which shall be not too full. Check the oil indicator port after oil filling.
- Oil of different designations cannot be added to the same reducer, and the remaining oil must be cleaned up before using the oil of different designation.
- Drain the oil completely or check the oil indicator port after oil filling.

Information!

Before emptying the oil in the reducer, you can run the robot for a period of time to heat the oil, to allow easier draining.

Safety precautions for tools and peripheral equipment

The external equipment of the robot may still be running after the robot is turned off, so damage to the power cord or power cable of the external equipment may also cause bodily injury.

Safety precautions for robot

In an emergency, any arm of the robot that clips the operator shall be removed. Please ask our technicians for details to ensure the safe removal.

Small robot arms can be removed manually, but for large robots, cranes or other small equipment may be required.

Before releasing the joint brake, the mechanical arm needs to be fixed first to ensure that the mechanical arm will not cause damage again to the person trapped under the action of gravity.

Ways to stop robot

The stopping of robots has the following three ways.

Power-Off Stop

Servo power is turned off and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion 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, and the robot operation is stopped immediately.
- Execution of the program is paused.

For the robot in motion, frequent power-off operations through E-stop buttons will cause robot failure. The system configuration for daily power-off stop should be avoided.

Alarm Stop

The motion of the robot is decelerated and stopped through a control command after the robot system issues an alarm (except for the power failure alarm).

The following processing is performed at Controlled stop:

- The robot system issues an alarm due to overload, failure, etc. (except for power failure alarms).
- The servo system sends a command “Control Stop” along with a decelerated stop. Execution of the program is paused.
- The servo power is turned 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.

Warning and Caution Signs

(1) Electric shock

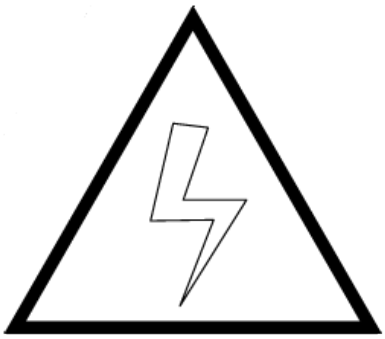


Figure 0.1 Electric shock warning sign

Attention should be paid to the danger of high voltage and electric shock at the place where this sign is affixed.

(2) High temperature

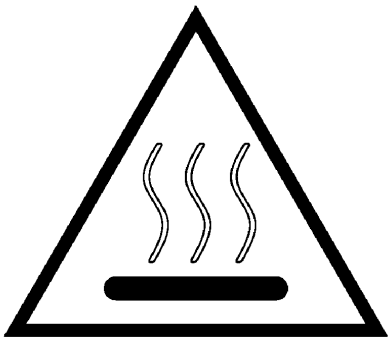


Figure 0.1 High temperature warning sign

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 protective provision such as heat-resistant gloves.

(3) No stepping

Figure 0.2 No stepping warning sign

Do not step on or climb the robot as it may adversely affect the equipment, and cause the bodily injury to operators.

(4) Wounding by robot

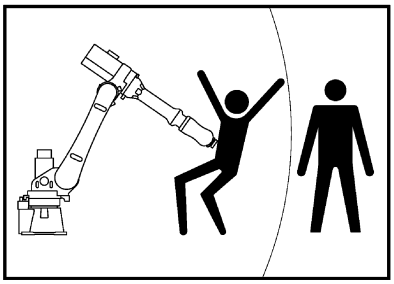


Figure 0.4 Wounding by robot warning sign

There is a danger of wounding by robot when working within the motion range of robot.

(5) No disassembly

Figure 0.3 No disassembly warning sign

Users are prohibited from disassembling the part affixed with this sign. Disassembly shall be carried out by professionals using professional tools.

(6) Handling

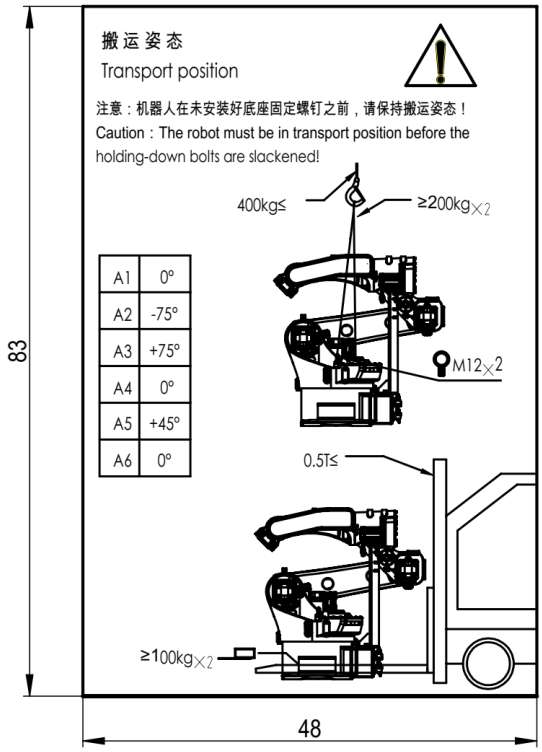


Fig 0.4 Handling (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

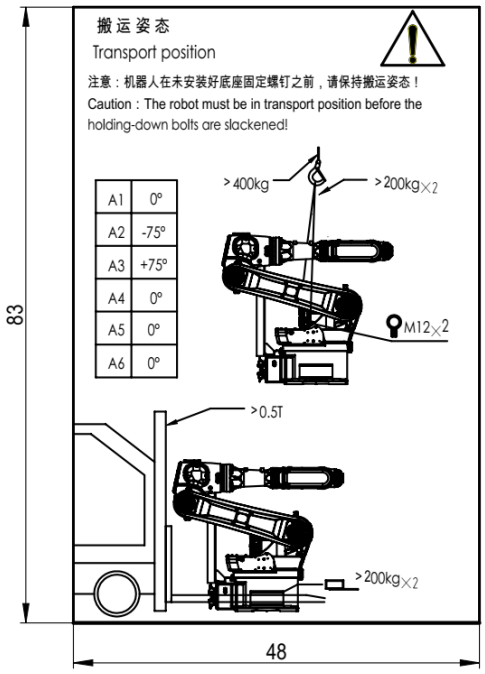


Fig 0.5 QRC 305 Eco Handling

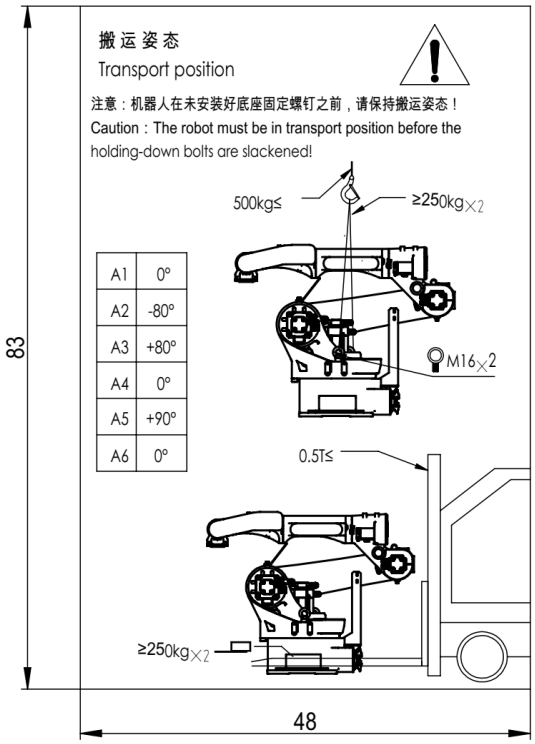


Fig 0.6 Handling (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

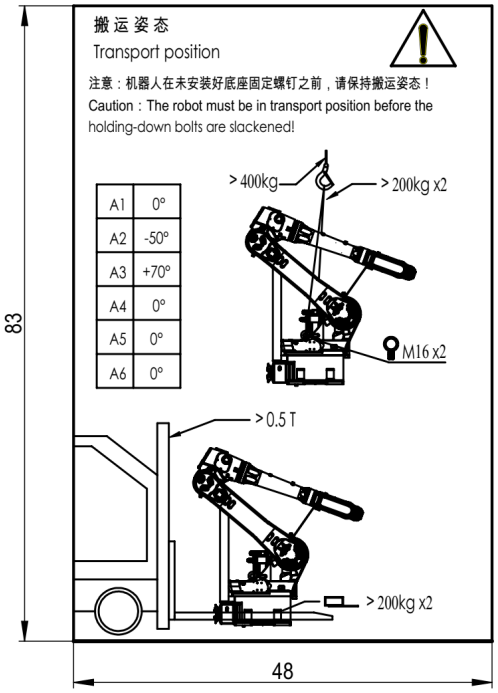


Fig 0.7 Handling (QRC-405 Eco)

Preface

This manual is applicable to the following robot type.

Robot type	Load capacity
QRH-295	8kg
QRH-405	8kg
QRH-295 Eco	8kg
QRH 295 Eco-S	8kg
QRC 305 Eco	8kg
QRH-405 Eco	8kg
QRH-405 Eco-S	8kg
QRC-405 Eco	8kg

1. Transportation & Installation

1.1. Transportation

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

Before moving the robot, position each joint of the robot into the handling position to ensure that the robot remains in the handling position without any movement or displacement during transportation. The robot should maintain the handling position until it is fully installed and secured. The angular rotation of each axis in the handling position is as follows, and it is crucial to handle the robot according to the specified angles in the table. Failure to do so may result in safety accidents or equipment malfunctions.

Angle	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
QRH-295 QRH-295 Eco QRH 295 Eco-S	0°	-75°	+75°	0°	+45°	0°
QRC-305 Eco	0°	-75°	+75°	0°	0°	0°
QRH-405 QRH-405 Eco QRH-405 Eco-S	0°	-80°	+80°	0°	+90°	0°
QRC-405 Eco	0°	-50°	+70°	0°	0°	0°

During the installation, disassembly, and transportation of the robot, the weight of the robot is a critical parameter. The table below lists the theoretical weight of the main components of the robot.

Component	Weight (kg)			
	QRH-295 QRH-295 Eco QRH 295 Eco-S	**QRC 305 Eco**	**QRH-405 QRH-405 Eco QRH-405 Eco-S**	**QRC-405 Eco**
Complete robot (KG)	170	165	286	281
Big arm casting	19.1	19	39.7	38.4
Base assembly (Including rotation base)	111.3	99	178.3	177.8
Small arm assembly (Including motor casing and motors of J3-axis,J4-axis and J5-axis)	34.2	25	45	32.4

Component	Weight (kg)			
	QRH-295 QRH-295 Eco QRH 295 Eco-S	QRC 305 Eco	QRH-405 QRH-405 Eco QRH-405 Eco-S	QRC-405 Eco
Wrist	3.4	11	11.8	11

Information!

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

Fixed bracket should be mounted before transport the robot and be removed before install the robot. Refer to the following figures when remove the bolts on fixed bracket.

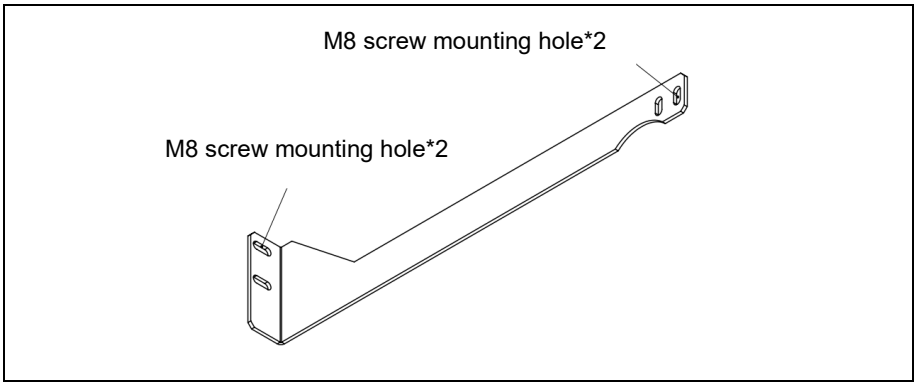


Fig 1.1 Robot fixed bracket (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

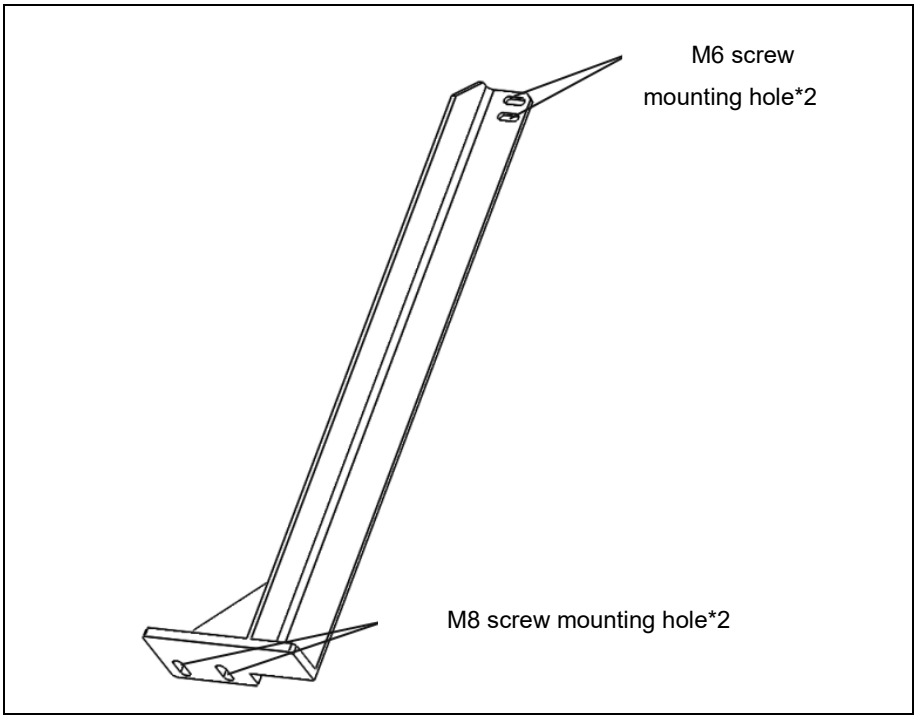


Fig. 1.2 Robot fixed bracket (QRC 305 Eco)

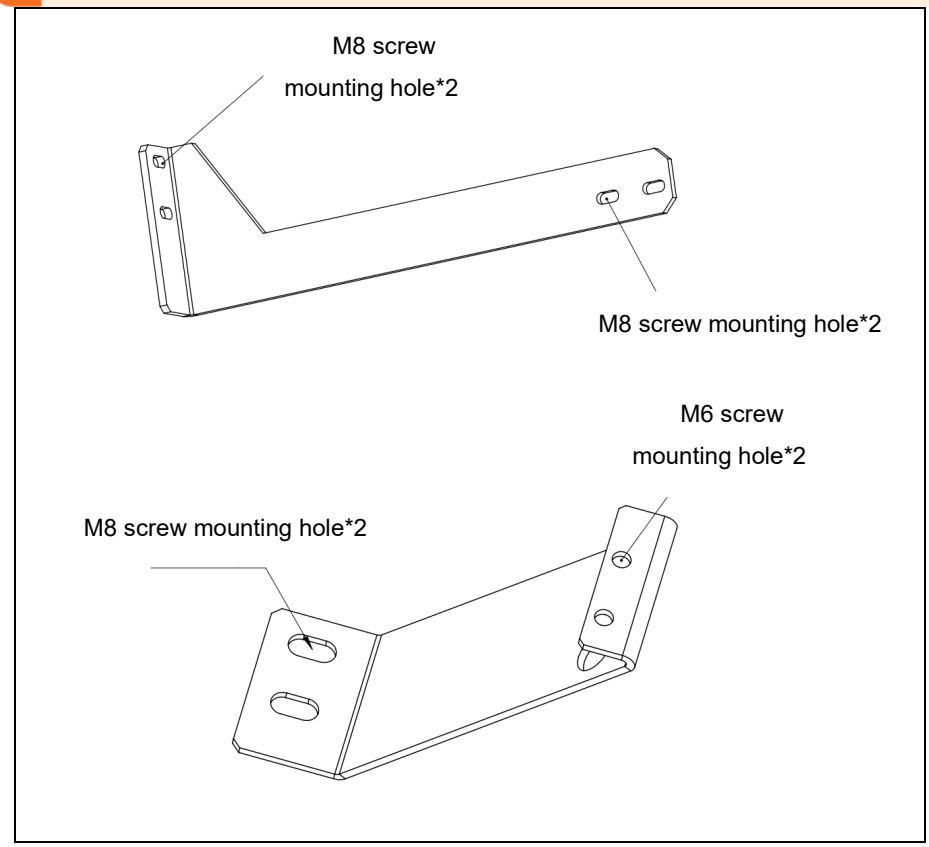


Fig. 1.3 Robot fixed bracket (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

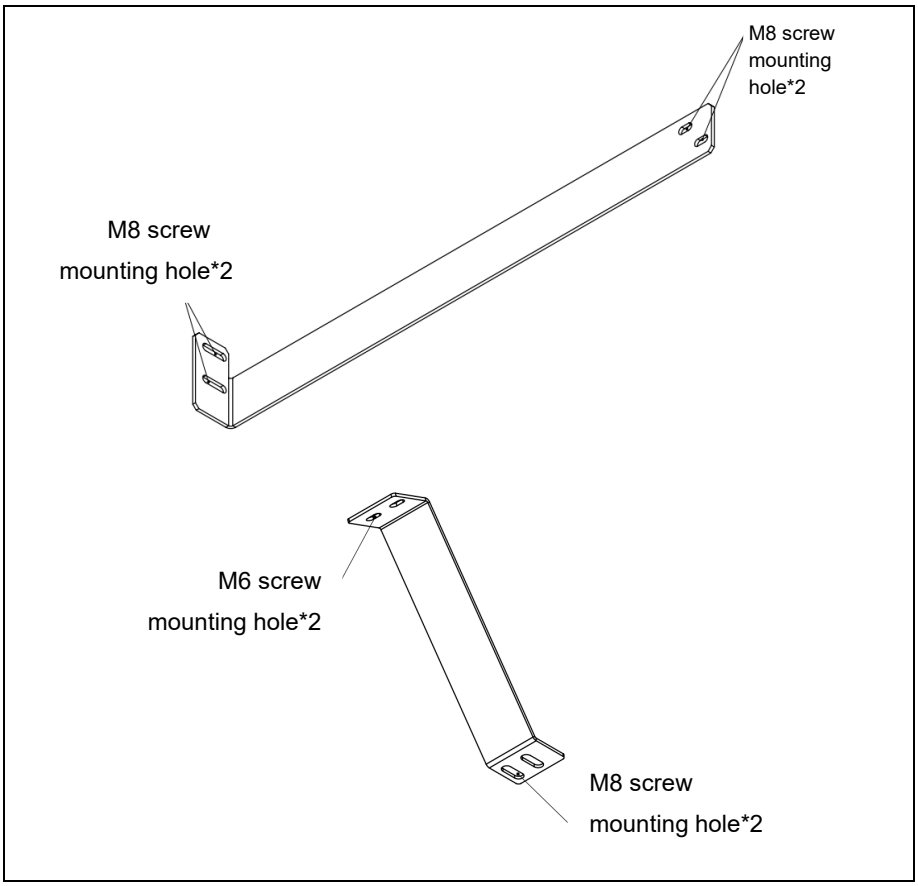


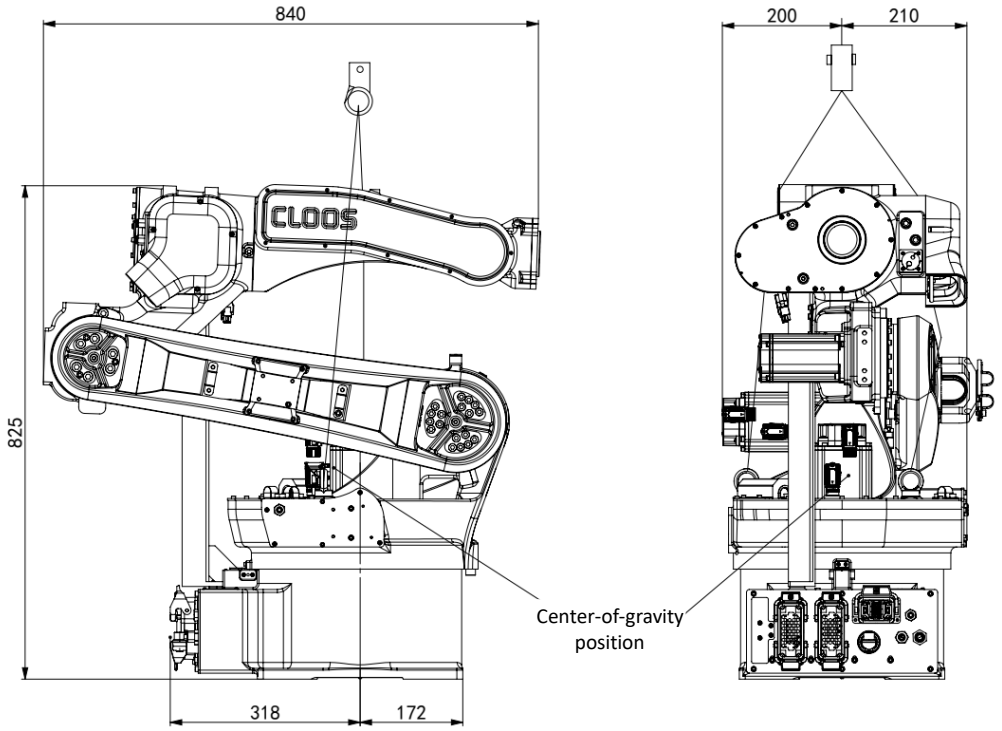
Fig. 1.4 Robot fixed bracket (QRC-405 Eco)

1.1.1. Transport by a crane

This series of robots can also be transported using a crane. Install lifting eye bolts on the robots 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 robots surface where the slings come in contact to prevent any paint damage.

Caution!

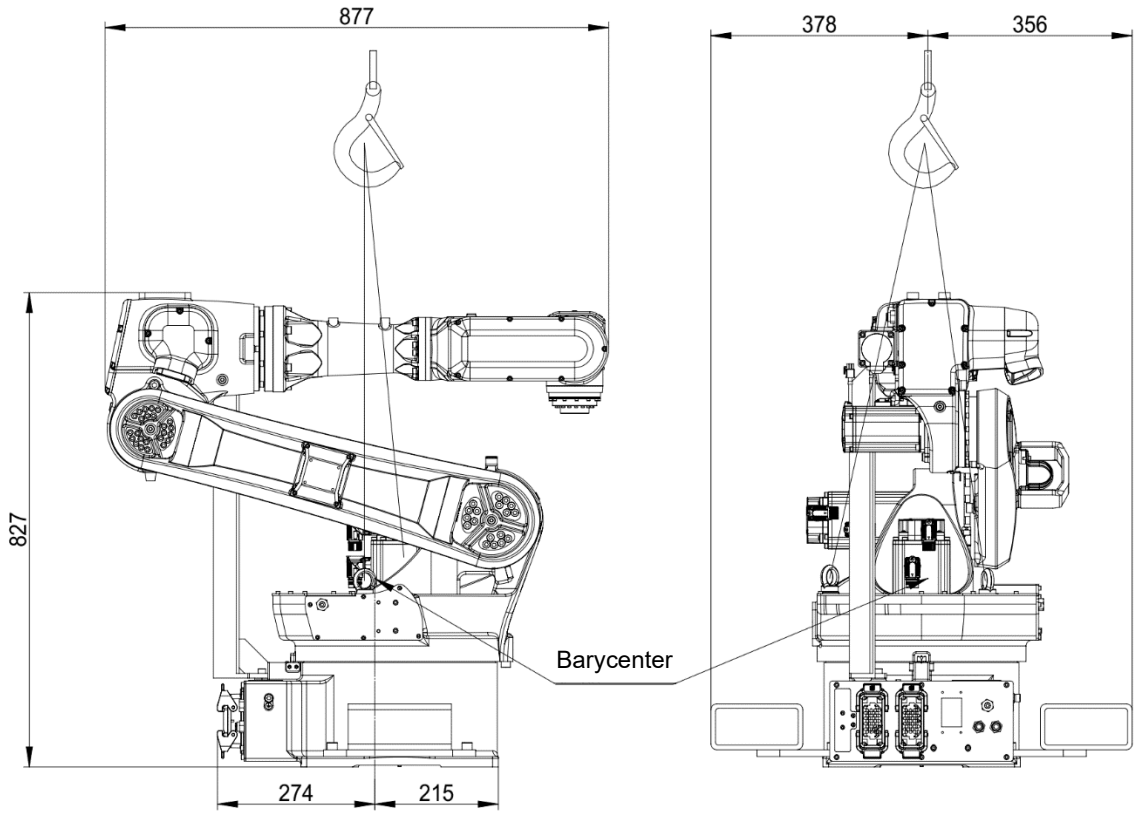
The eyebolts and slings are to be provided by the customer. Please remove the eyebolts before operating the equipment.



Note: Handling requirements:

① A minimum 1-ton capacity crane is required; ② The rope can handle a weight of 500kg; ③ The equipment should comply with the GB/T825-1988 standard; ④ M12 bolts should be used.

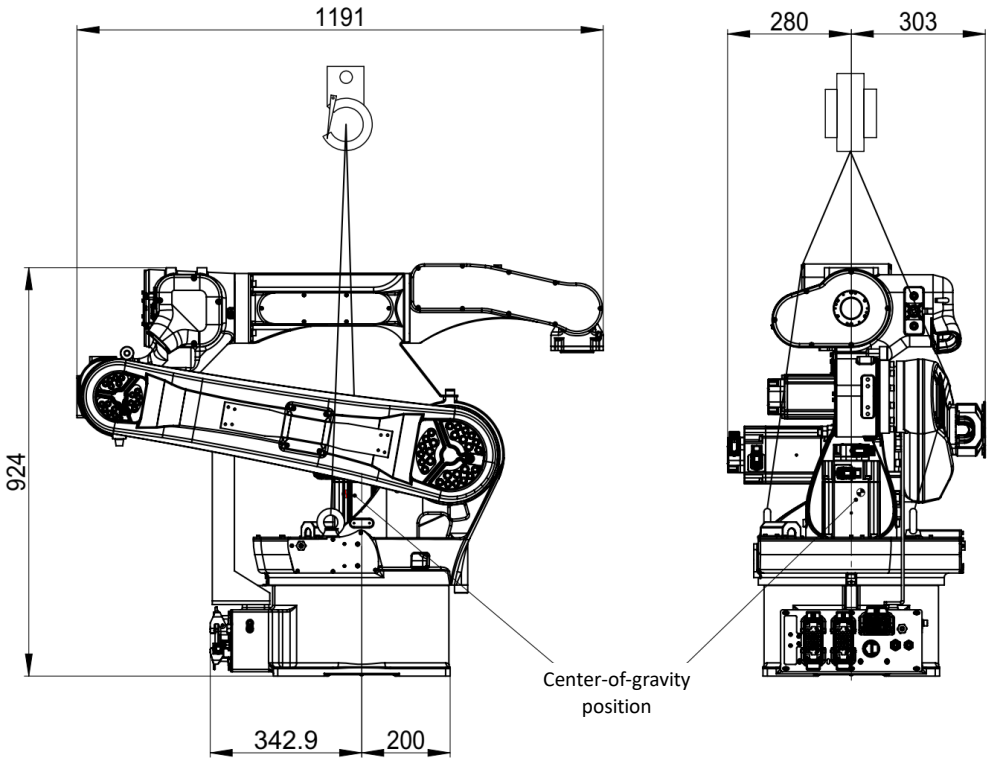
Fig. 1.5 Use a crane to transport the robot (QRH-295, QRH-295 Eco, QRH 295 Eco-S)



Note: Handling requirements:

① A minimum 1-ton capacity crane is required; ② The rope can handle a weight of 500kg; ③ The equipment should comply with the GB/T825-1988 standard; ④ M16 bolts should be used.

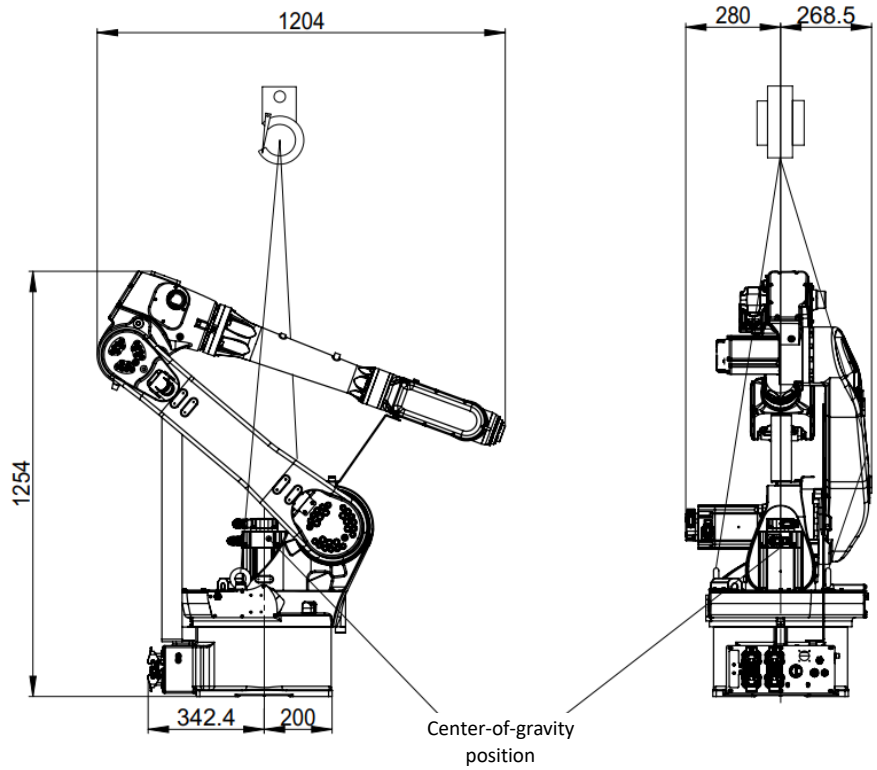
Fig. 1.6 Use a crane to transport the robot (QRC 305 Eco)



Note: Handling requirements:

① A minimum 1-ton capacity crane is required; ② The rope can handle a weight of 500kg; ③ The equipment should comply with the GB/T825-1988 standard; ④ M16 bolts should be used.

Fig. 1.7 Use a crane to transport the robot (QRH-405, QRH-405 Eco, QRH-405 Eco-S)



Note: Handling requirements:

① A minimum 1-ton capacity crane is required; ② The rope can handle a weight of 500kg; ③ The equipment should comply with the GB/T825-1988 standard; ④ M16 bolts should be used.

Fig. 1.8 Use a crane to transport the robot (QRC-405 Eco)

1.2. Installation

Caution!

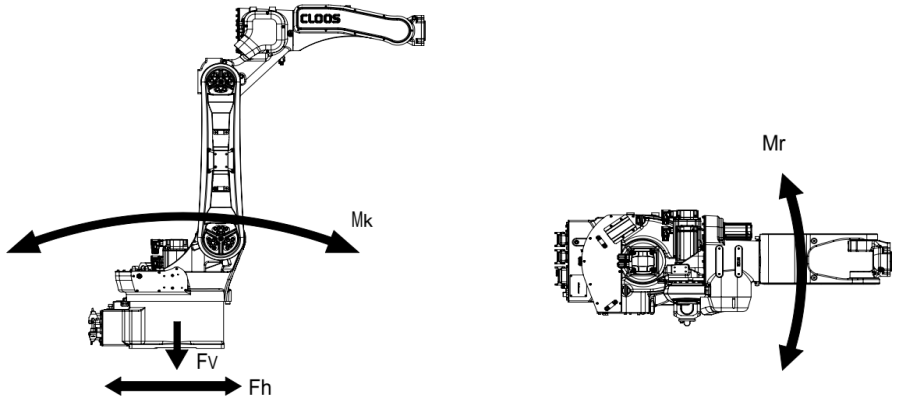
Before starting any installation work with the robot connected to the power supply, ensure that the robot's grounding wire is properly grounded.

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.

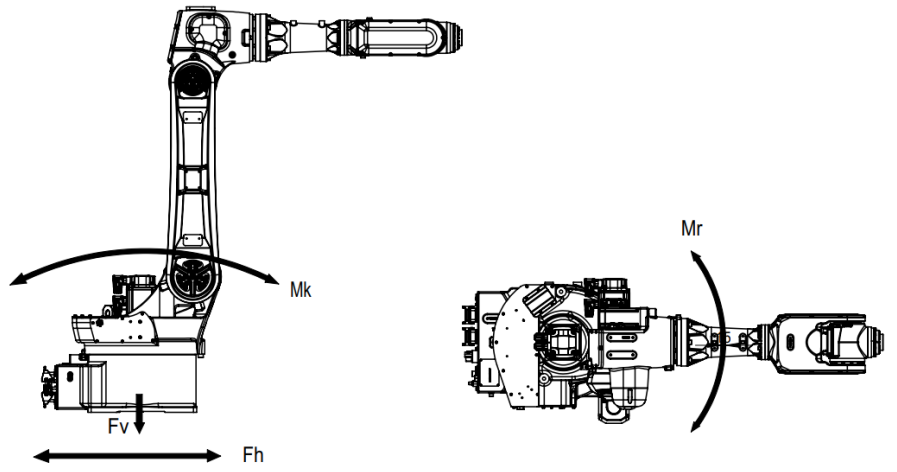
When mounting the robot base, consider its structure and the force upon it. Concrete on the base may not have any crack and conform to the specified codes. The bearing capacity and compaction of the concrete foundation should be in accordance with the design guideline. Concrete strength level C20/C25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



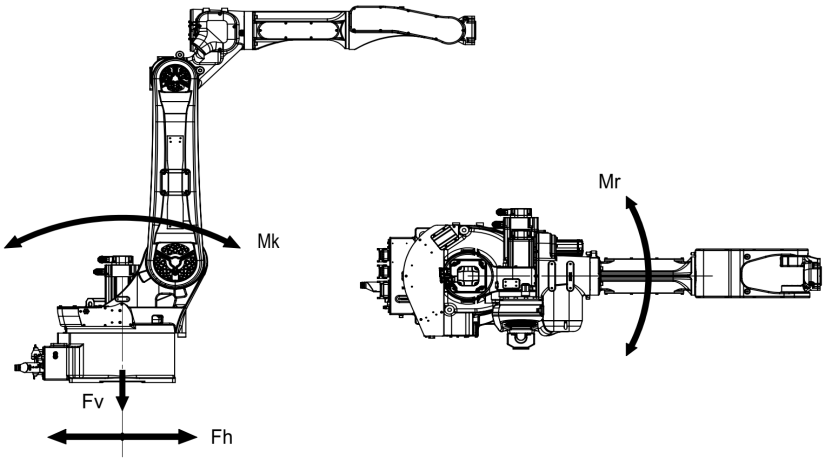
	Horizontal rotation by robot		Vertical rotation by robot	
	Structural reaction, Fh	Torque, Mr	Structural reaction, Fv	Torque, Mk
E-stop	4200 N	3087 N·m	5000 N	4150 N·m
Acceleration/deceleration	1400 N	1029 N·m	2000 N	1660 N·m

Fig. 1.9 Robot base force (QRH-295, QRH-295 Eco, QRH 295 Eco-S)



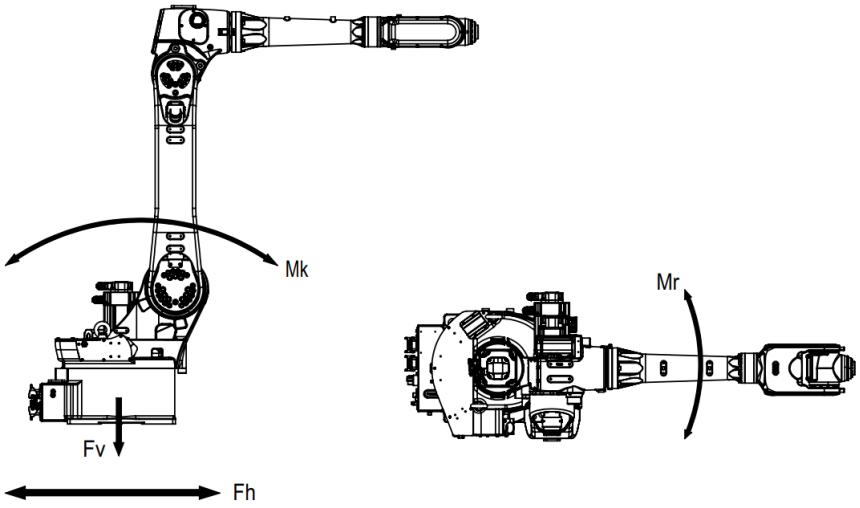
	Horizontal rotation by robot		Vertical rotation by robot	
	Structural reaction, Fh	Torque, Mr	Structural reaction, Fv	Torque, Mk
E-stop	4800 N	3750 N·m	5500 N	4165 N·m
Acceleration/deceleration	1600 N	1250 N·m	2200 N	1666 N·m

Fig. 1.10 Robot base force (QRC 305 Eco)



	Horizontal rotation by robot		Vertical rotation by robot	
	Structural reaction, Fh	Torque, Mr	Structural reaction, Fv	Torque, Mk
E-stop	11700 N	9900 N·m	11750 N	8575 N·m
Acceleration/deceleration	3900 N	3300 N·m	4700 N	3430 N·m

Fig. 1.11 Robot base force (QRH-405, QRH-405 Eco, QRH-405 Eco-S)



	Horizontal rotation by robot		Vertical rotation by robot	
	Structural reaction, Fh	Torque, Mr	Structural reaction, Fv	Torque, Mk
E-stop	10800 N	9900 N·m	11500 N	8575 N·m
Acceleration/deceleration	3600 N	3300 N·m	4600 N	3430 N·m

Fig. 1.12 Robot base force (QRC-405 Eco)

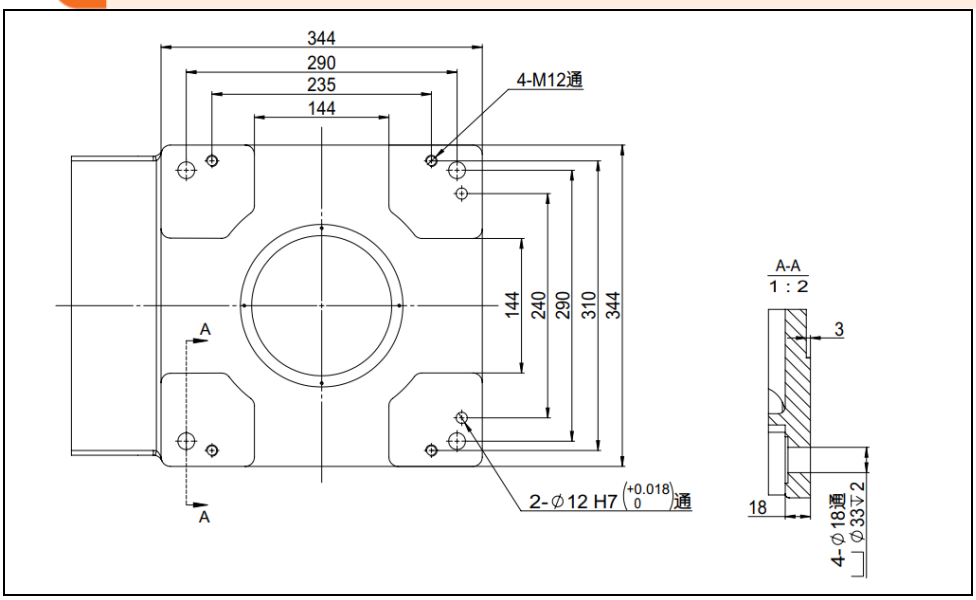


Fig. 1.13 Robot base mounting dimension (QRH-295, QRH-295 Eco, QRH 295 Eco-S, QRC 305 Eco)

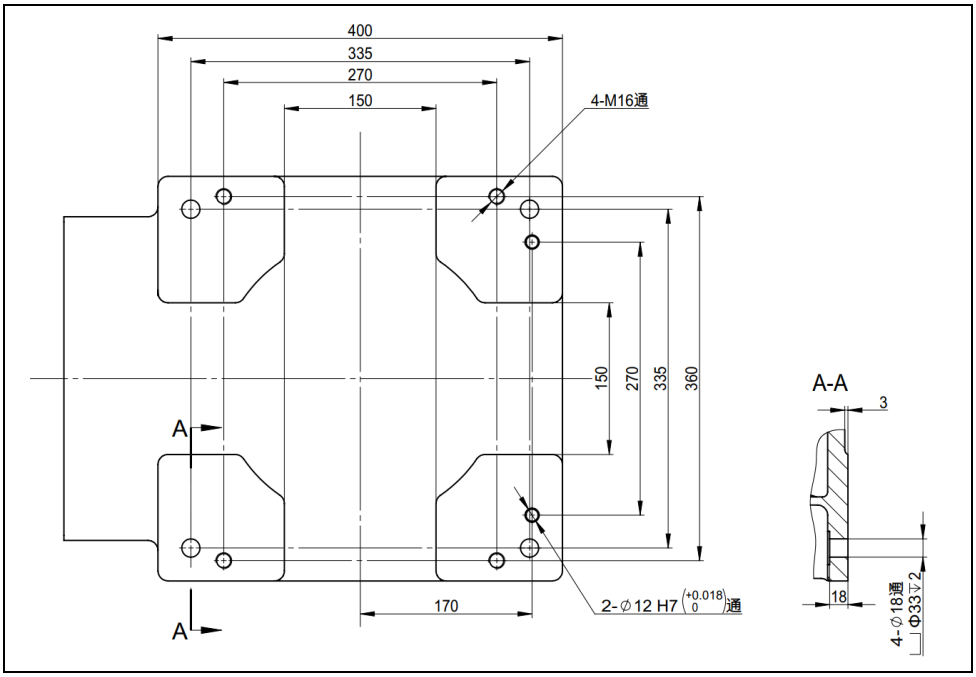


Fig. 1.14 Robot base mounting dimension (QRH-405, QRH-405 Eco, QRH-405 Eco-S, QRC-405 Eco)

Tab. 1.1 Robot fixing components (QRH-295, QRH-295 Eco, QRH 295 ECO-S, QRC 305 ECO)

Name & model	Qty.
Fixed screw: M16X40 (GB/T 70.1, grade 12.9)	4
Spring washer: Spring washer 16 (GB/T 93)	4
Flat gasket: flat washer 16(GB/T 97.1)	4
Positioning pin: Cylindrical pin 12X45 (GB/T120.2)	2

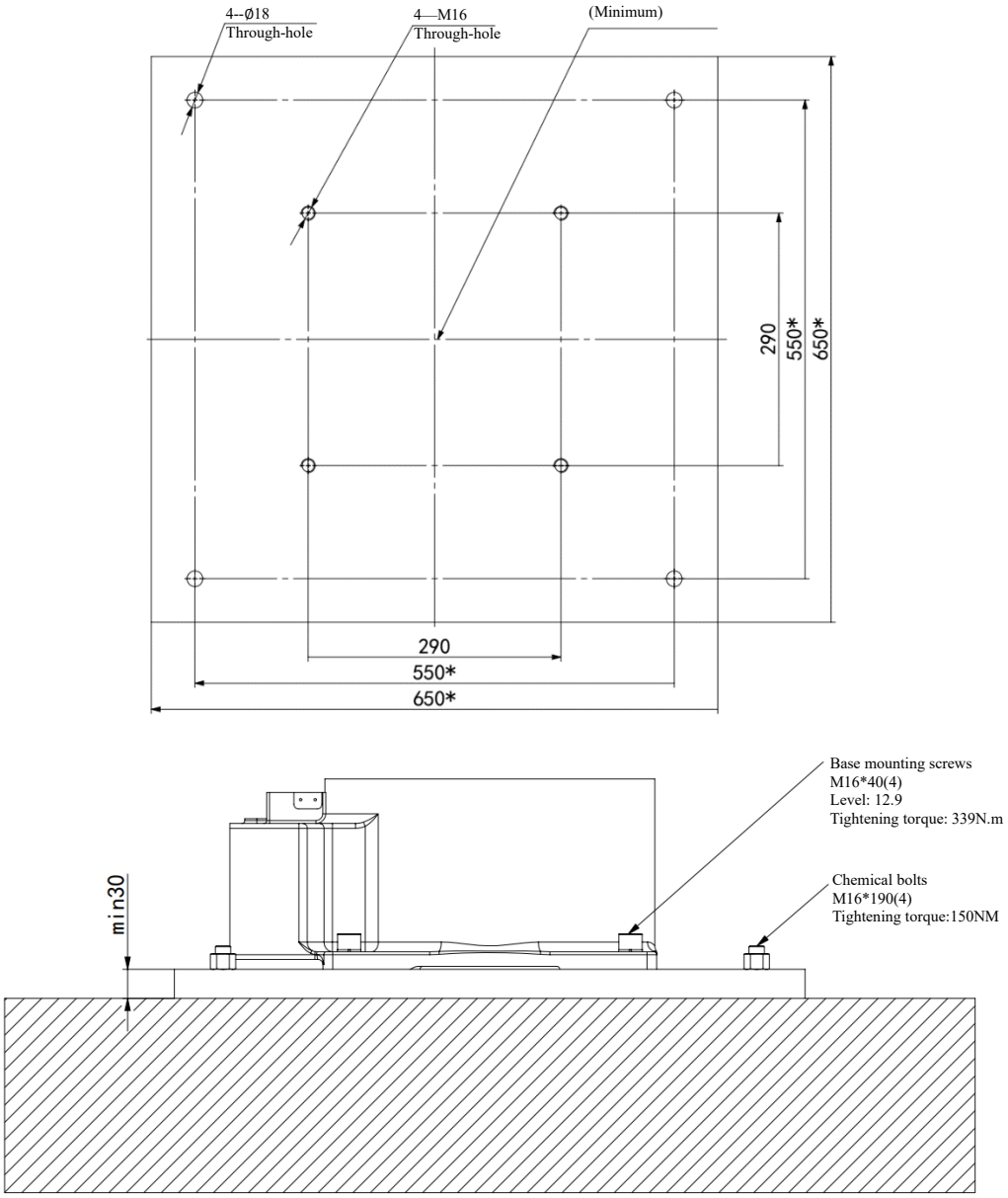
Tab. 1.2 Robot fixing components (QRH-405, QRH-405 Eco, QRH-405 Eco-S, QRC-405 Eco)

Name & model	Qty.

Fixed screw: M16X45 (GB/T 70.1, Grade 12.9)	4
Spring washer: Spring washer 16 (GB/T 93)	4
Flat gasket: flat washer 16(GB/T 97.1)	4
Positioning pin: Cylindrical pin 12X45 (GB/T120.2)	2

Information!

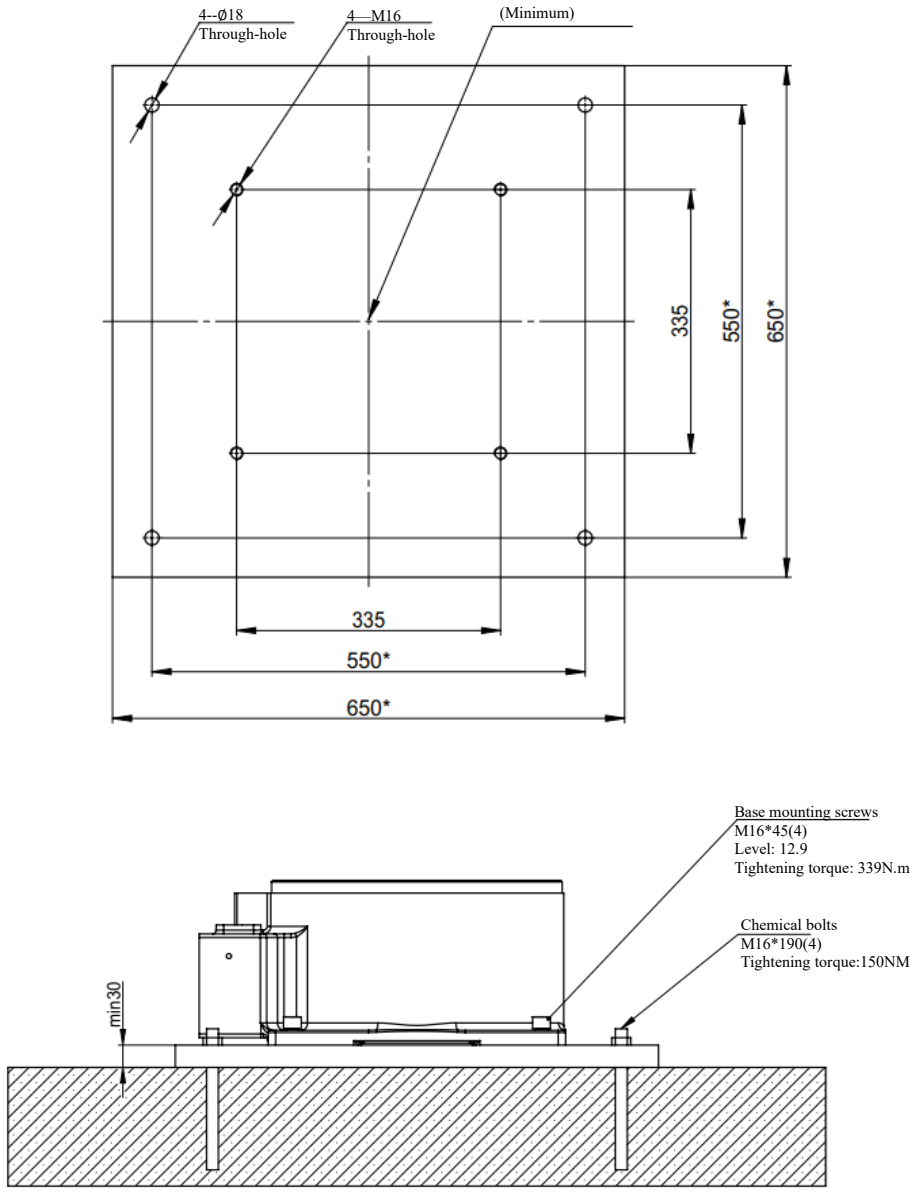
Installing positioning pins can greatly minimize the impact on the existing robot's program trajectory caused by reinstalling or replacing the robot. It only requires slight adjustments to the running program to restore the robot's normal operating path. If you do not need to consider this aspect, you may choose to omit the installation of positioning pins.



Note: When installing the iron plate on the ground, secure the robot mounting plate to the concrete floor using four M16X190 chemical bolts. The concrete thickness should be at least 160mm, with an effective area of 1000mmx1000mm. The base is fixed to the iron plate using the parts listed in the table.

The dimensions marked with * in the figure are recommended dimensions. If the user wishes to make changes, they should consider the forces exerted by the robot on the base and the structure of the base

Fig 1.15 Dimensions of the robot mounting iron plate and floor mounting diagram (QRH-295, QRH-295 Eco, QRH 295 Eco-S, QRC 305 Eco)



Note: When installing the iron plate on the ground, secure the robot mounting plate to the concrete floor using four M16X190 chemical bolts. The concrete thickness should be at least 160mm, with an effective area of 1000mmx1000mm. The base is fixed to the iron plate using the parts listed in the table.

The dimensions marked with an asterisk (*) in the figure are recommended dimensions. If the user wishes to make changes, they should consider the forces exerted by the robot on the base and the structure of the base. Any changes should be made only after rigorous calculations.

Fig 1.16 Dimensions of the robot mounting iron plate and floor mounting diagram (QRH-405, QRH-405 Eco, QRH-405 Eco-S, QRC-405 Eco)

1.3. Installation conditions

Caution!	**Damage of the cable jacket can cause water intrusion. Take care when installing the cable and exchange 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. humidity	95%RH
Protection level	
QRH-295 QRH-405 QRH-405 Eco QRH-405 Eco-S QRH-295 Eco QRH 295 Eco-S QRC 305 Eco QRC-405 Eco	IP54

The robot body exhibits excellent resistance to chemicals and solvents, as described below:

(1) The following liquids may cause aging or corrosion of rubber components (seals, gaskets, O-rings, etc.) on the robot. Please refrain from using them, except for products approved by ESTUN.
   (a)Organic solvents
   (b)Cutting fluid including chlorine/gasoline
   (c)Amine type detergent
   (d)Acid, alkali and liquid causing rust
   (e) Other liquids or aqueous solutions, such as nitrile rubber (NBR), lack resistance to them

(2) When using the robot in environments where liquids such as water may splash onto it, special attention should be given to the drainage of the base. Inadequate drainage that results in frequent water immersion of the base can cause robot malfunctions.

(3) Do not use cutting fluids or cleaning solutions with unclear properties.

(4) The robot should not be immersed in water for prolonged periods or used in environments prone to getting wet. For example, if the motor surface is exposed and remains wet for an extended period, liquid can infiltrate the motor and cause malfunctions.

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.

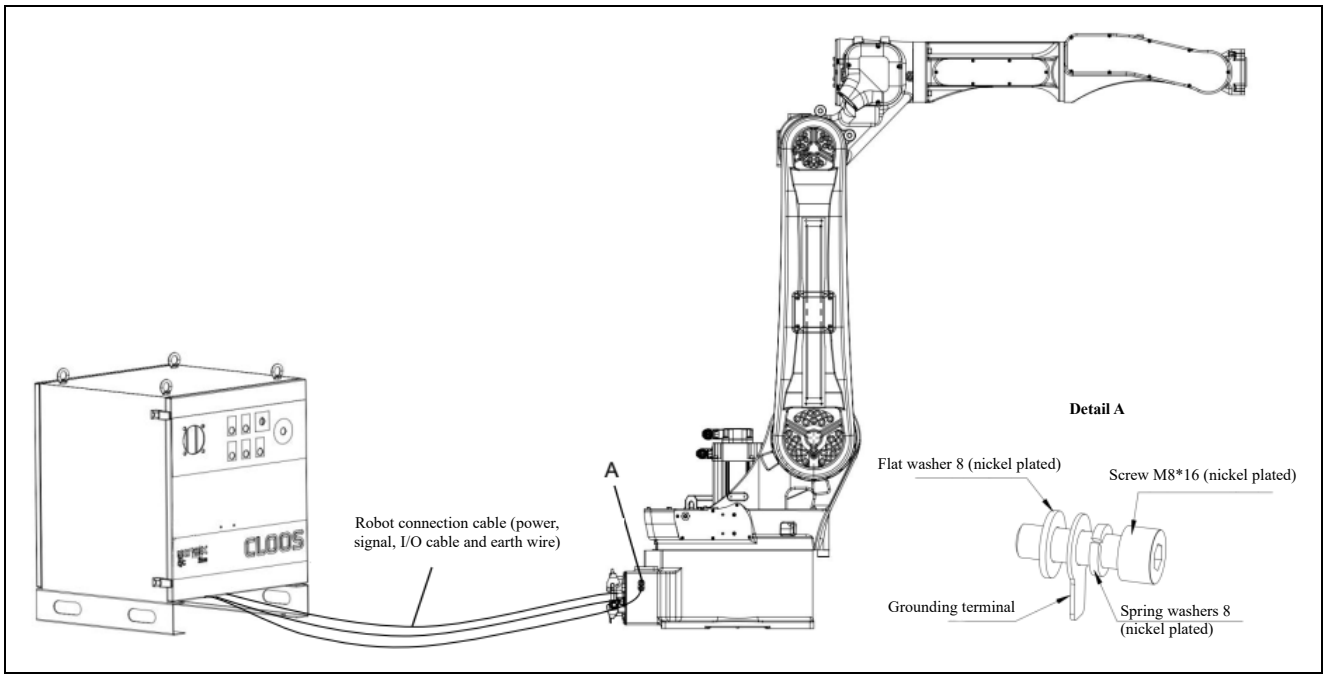


Fig. 2.1 Cable connection

Caution!

- **It is essential to ensure that the serial number of the robot body matches the serial number of the control cabinet. Mismatched serial numbers can result in deviation in robot accuracy.**
- **Before turning on the power supply to the control device, please connect the robot and the control device with a grounding wire. There is a risk of electric shock if the grounding wire is not connected.**
- **Install the grounding terminal between the flat washer and the spring washer. The grounding position of the robot may have a small amount of anti-rust oil, so please clean it properly before grounding. It is recommended to use a core wire diameter of 5.5mm² or above for the grounding wire. Please pay attention to the dimensions of the grounding wire terminal (ID larger than 8mm, OD smaller than 18mm).**

3. Specification

3.1. Robot configuration

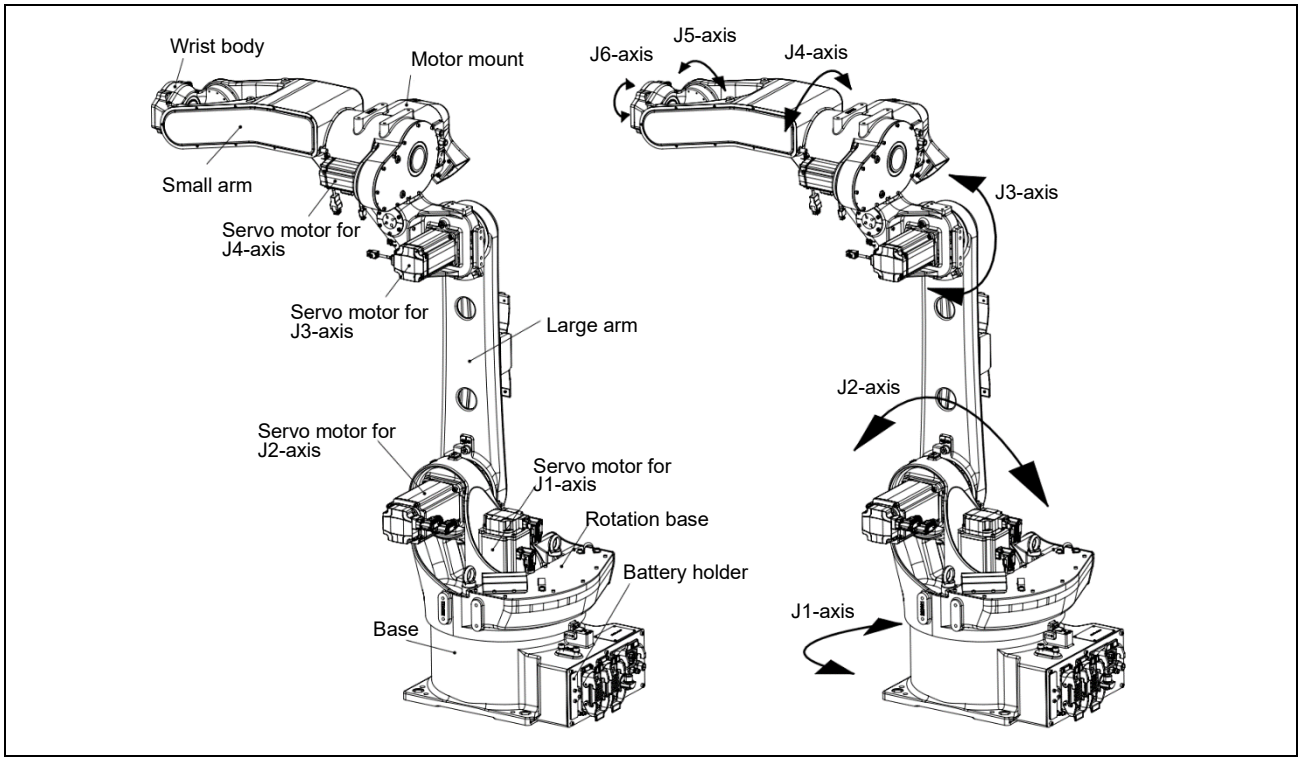


Fig. 3.1 Robot configuration (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

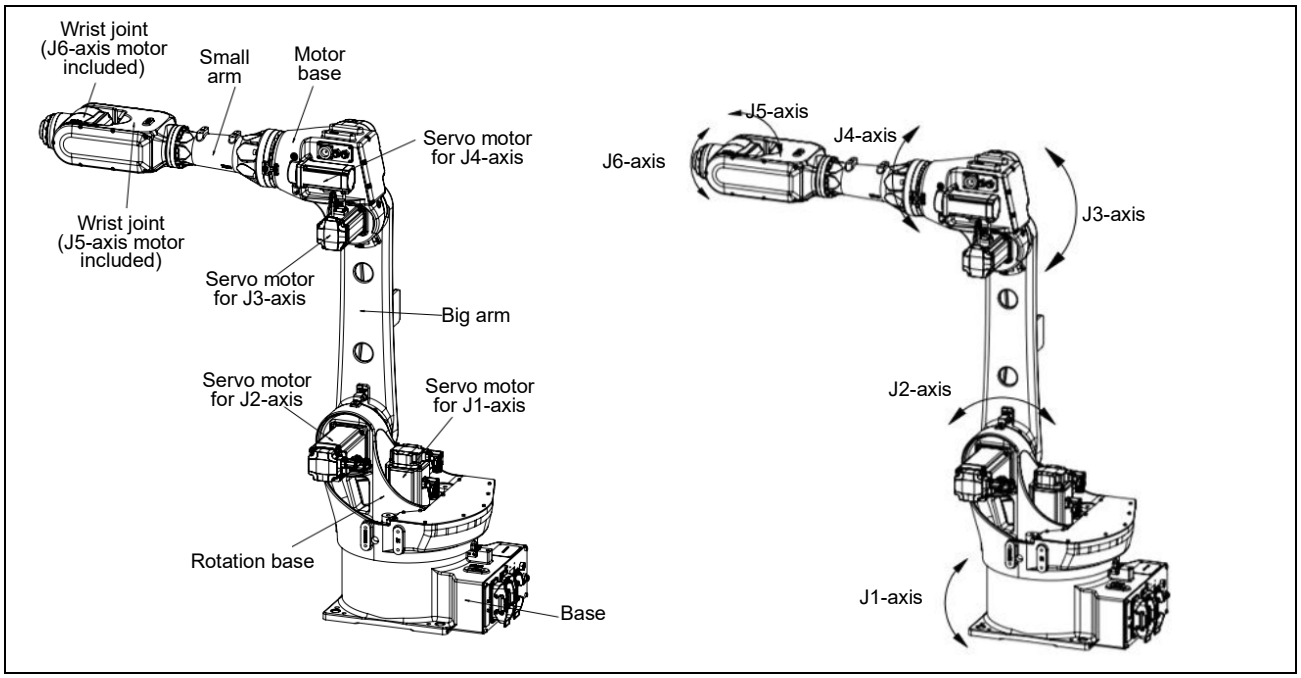


Fig. 3.2 Robot configuration (QRC 305 Eco)

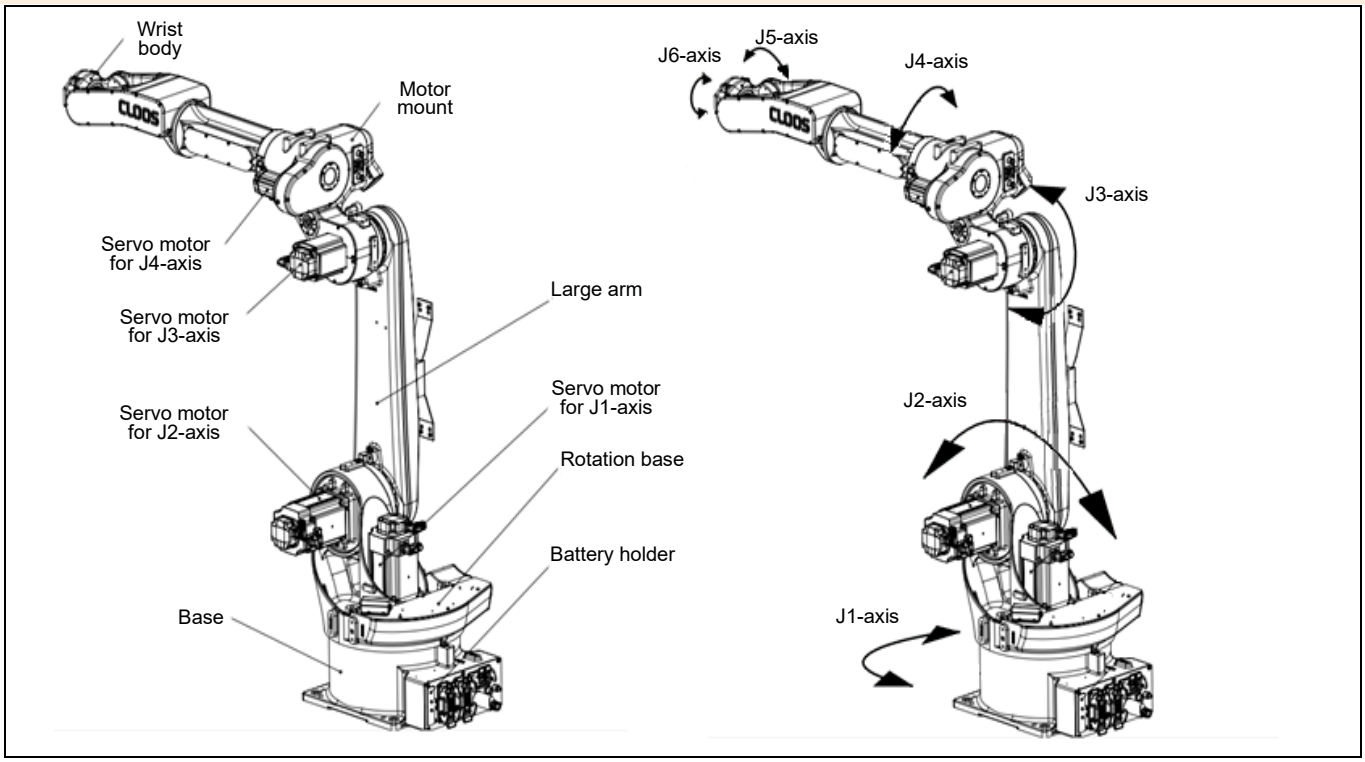


Fig. 3.3 Robot configuration (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

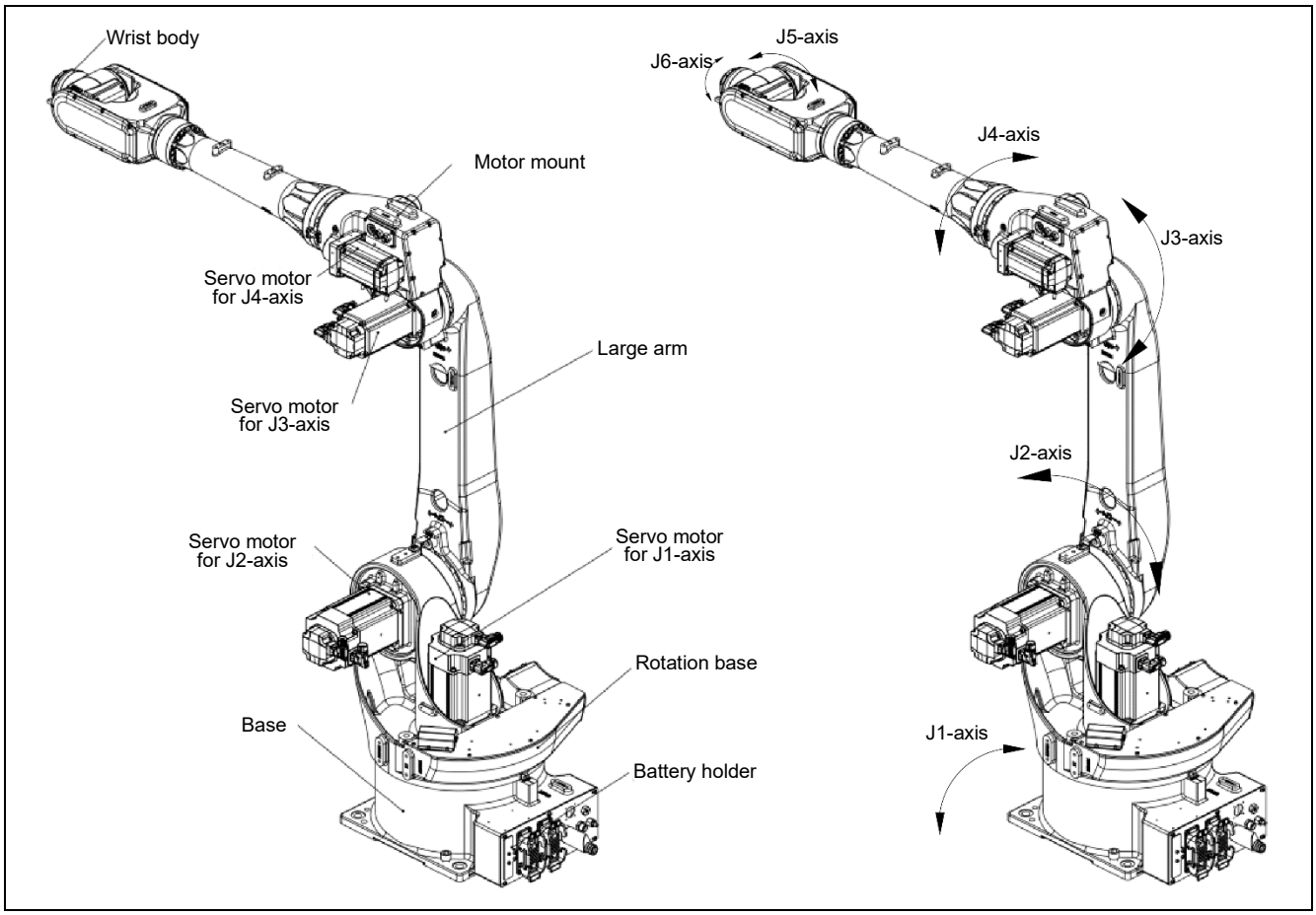


Fig. 3.4 Robot configuration (QRC-405 Eco)

Table 3.1 Robot specifications

Model	**QRH-295**	**QRH-295 Eco**	**QRC-405 Eco**

Type		Articulated robot		
Controlled axis		6-axis (J1, J2, J3 J4, J5, J6)		
Installation		Floor / Top		
Allowable handling weight		8kg	8kg	8kg
Motion range	J1-axis	±170°	±170°	±170°
	J2-axis	-90°~ +155°	-90°~ +155°	-100°~ +155°
	J3-axis	-150°~ +85°	-150°~ +85°	-160°~ +86°
	J4-axis	±170°	±150°	±170°
	J5-axis	±180°	±135°	±135°
	J6-axis	±360°	±210°	±360°
Max. speed (Note 1)	J1-axis	212°/s	212°/s	180°/s
	J2-axis	212°/s	212°/s	180°/s
	J3-axis	285°/s	285°/s	242°/s
	J4-axis	440°/s	482°/s	480°/s
	J5-axis	400°/s	417°/s	412°/s
	J6-axis	640°/s	700°/s	705°/s
Allowable load inertia at wrist	J4-axis	0.38 kg · m^2	0.38 kg · m^2	0.46 kg · m^2
	J5-axis	0.38 kg · m^2	0.38 kg · m^2	0.46 kg · m^2
	J6-axis	0.08 kg · m^2	0.08 kg · m^2	0.08 kg · m^2
Allowable torque at wrist	J4-axis	15.5 (N.m)	15.5 (N.m)	17.4 (N.m)
	J5-axis	15.5 (N.m)	15.5 (N.m)	17.4 (N.m)
	J6-axis	6.3 (N.m)	6.3 (N.m)	6.04 (N.m)
Drive method		Electric servo drive by AC servo motor		
Repeatability		±0.07mm	±0.07mm	±0.05mm
Max. reach		1445mm	1445mm	2010mm
Weight		170kg	170kg	281kg
Installation environment		Ambient temperature: 0～45℃ (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)		

Continued Table 3.2 Robot specifications

Model		**QRH-405**	**QRH-405 Eco**	**QRH-405 Eco-S**
Type		Articulated robot		
Controlled axis		6-axis (J1, J2, J3 J4, J5, J6)		
Installation		Floor/ Top		
Allowable handling weight		8kg	8kg	8kg
Motion range	J1-axis	±170°	±170°	±170°
	J2-axis	-100°~ +155°	-100°~ +155°	-100°~ +155°
	J3-axis	-160°~ +86°	-160°~ +86°	-160°~ +86°
	J4-axis	±150°	±150°	±150°
	J5-axis	±135°	±135°	±135°

	J6-axis	±210°	±210°	±210°
Max. speed (Note 1)	J1-axis	180°/s	206°/s	180°/s
	J2-axis	180°/s	206°/s	180°/s
	J3-axis	241°/s	238°/s	241°/s
	J4-axis	430°/s	442°/s	430°/s
	J5-axis	400°/s	417°/s	400°/s
	J6-axis	640°/s	700°/s	640°/s
Allowable load inertia at wrist	J4-axis	0.38 kg・m^2	0.38 kg・m^2	0.38 kg・m^2
	J5-axis	0.38 kg・m^2	0.38 kg・m^2	0.38 kg・m^2
	J6-axis	0.08 kg・m^2	0.08 kg・m^2	0.08 kg・m^2
Allowable torque at wrist	J4-axis	15.5 (N.m)	15.5 (N.m)	15.5 (N.m)
	J5-axis	15.5 (N.m)	15.5 (N.m)	15.5 (N.m)
	J6-axis	6.3 (N.m)	6.3 (N.m)	6.3 (N.m)
Drive method		Electric servo drive by AC servo motor		
Repeatability		±0.08mm	±0.08mm	±0.08mm
Max. reach		2015mm	2015mm	2015mm
Weight		286kg	286kg	286kg
Installation environment		Ambient temperature: 0～45℃ (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)		

Continued Table 3.3 Robot specifications

Model		**QRH 295 Eco-S**	**QRC-305 Eco**
Type		Articulated robot	
Controlled axis		6-axis (J1, J2, J3 J4, J5, J6)	
Installation		Floor / Top	
Allowable handling weight		8kg	8kg
Motion range	J1-axis	±170°	±170°
	J2-axis	-90°~ +155°	-90°~ +155°
	J3-axis	-150°~ +85°	-145°~ +85°
	J4-axis	±150°	±170°
	J5-axis	±135°	±135°
	J6-axis	±210°	±360°
Max. speed (Note 1)	J1-axis	240°/s	242°/s
	J2-axis	240°/s	242°/s
	J3-axis	283°/s	283°/s
	J4-axis	442°/s	476°/s
	J5-axis	417°/s	412°/s
	J6-axis	700°/s	685°/s
Allowable load inertia at wrist	J4-axis	0.38 kg・m^2	0.38 kg・m^2
	J5-axis	0.38 kg・m^2	0.38 kg・m^2
	J6-axis	0.08 kg・m^2	0.08 kg・m^2

Allowable torque at wrist	J4-axis	15.5 (N.m)	15.6 (N.m)
	J5-axis	15.5 (N.m)	15.6 (N.m)
	J6-axis	6.3 (N.m)	6.3 (N.m)
Drive method	Electric servo drive by AC servo motor		
Repeatability	±0.07mm		±0.05mm
Max. reach	1445mm		1527mm
Weight	170kg		165kg
Installation environment	Ambient temperature: 0～45˚C (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)		

(Note 1) Short-distance movements may not reach the maximum speed of each axis. The maximum range of motion for each axis is measured when the robot is in the zero position, but the actual motion may be limited by the position of other axes.
(Note 2) When using the robot in low-temperature environment that is near 0°C, or when leaving the robot stopped in environments below 0°C during rest days or overnight, collision detection alarms may occur due to high resistance in the movable parts during the initial startup. In such cases, it is recommended to perform several minutes of warm-up operation.
(Note 3) For usage in high-temperature, low-temperature, vibrating, dusty, or environments with high concentrations of cutting oil, please consult CLOOS for guidance.

3.2. External dimensions and operating space

The following figures illustrate the range of motion of the robot and serves as a reference for selecting and setting up the robots installation position. When installing peripheral devices, it is important to ensure they do not interfere with the main body of the robot and its range of motion.

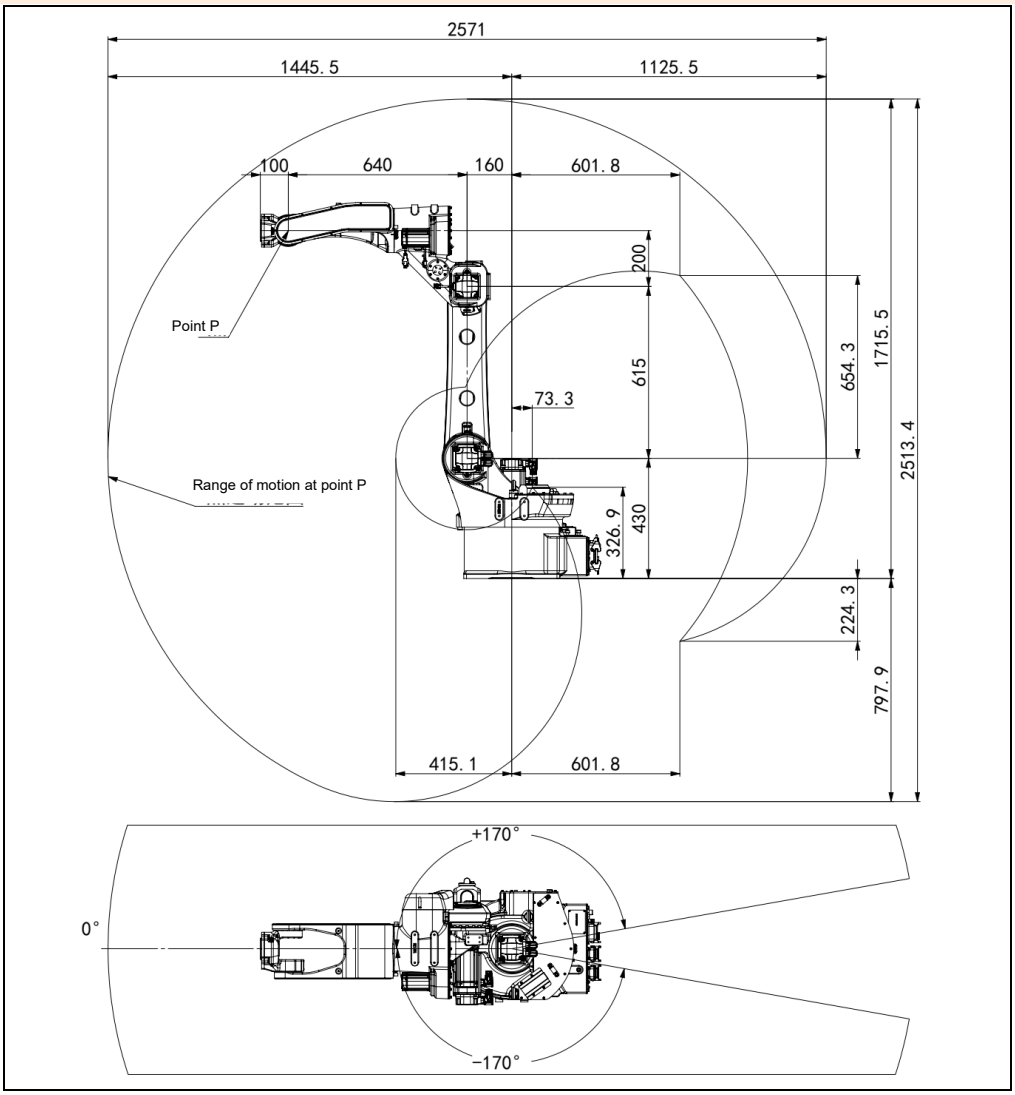


Fig. 3.5 Motion range (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

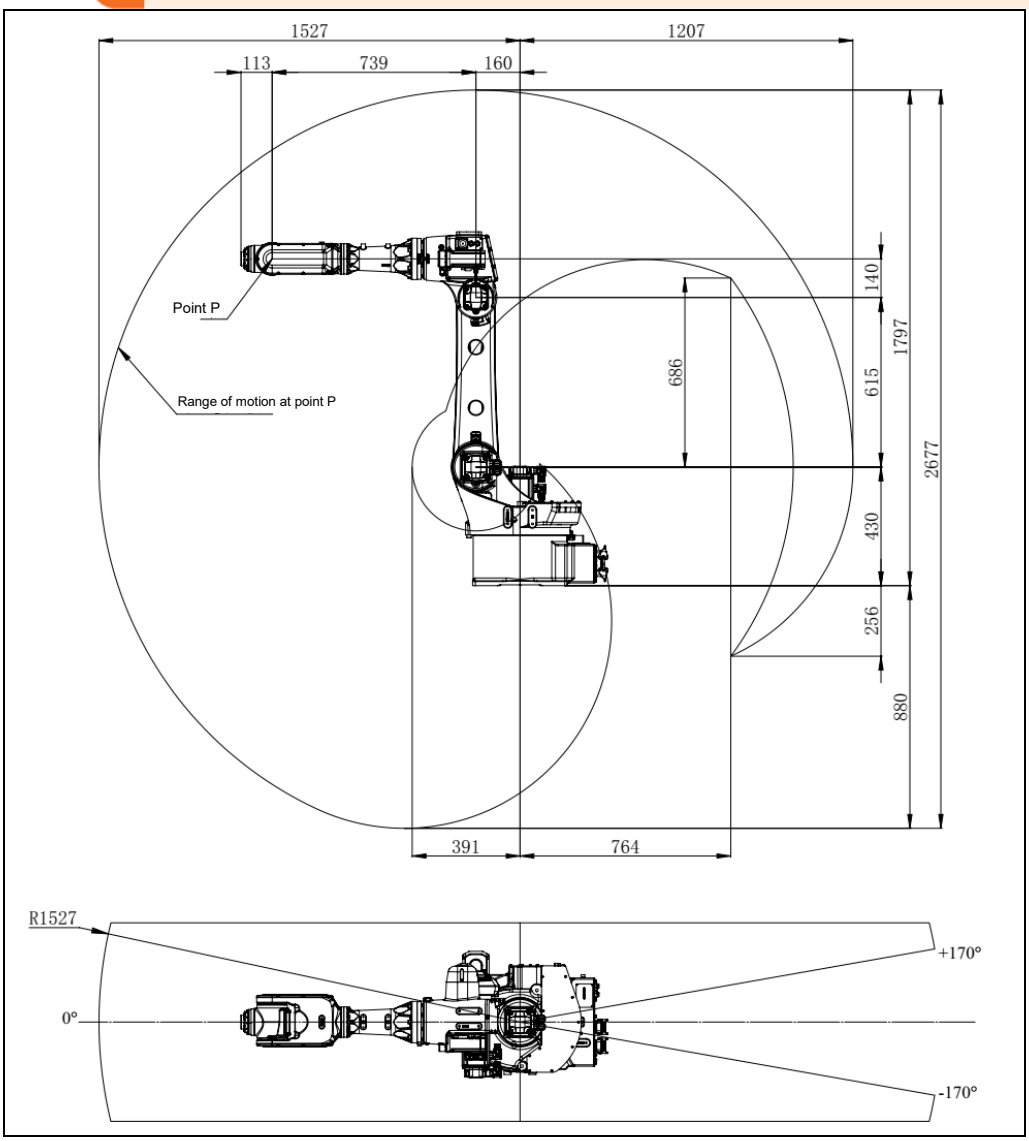


Fig. 3.6 Motion range (QRC 305 Eco)

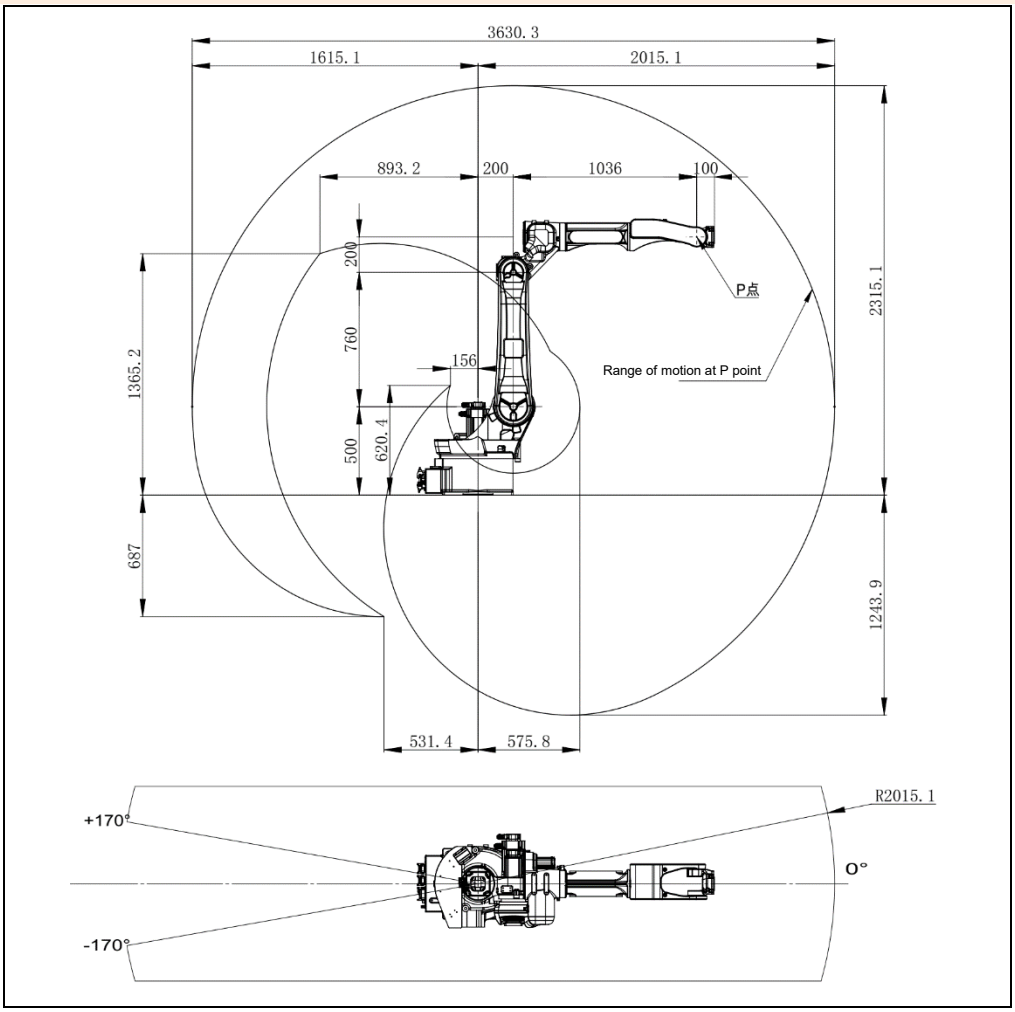


Fig. 3.7 Motion range (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

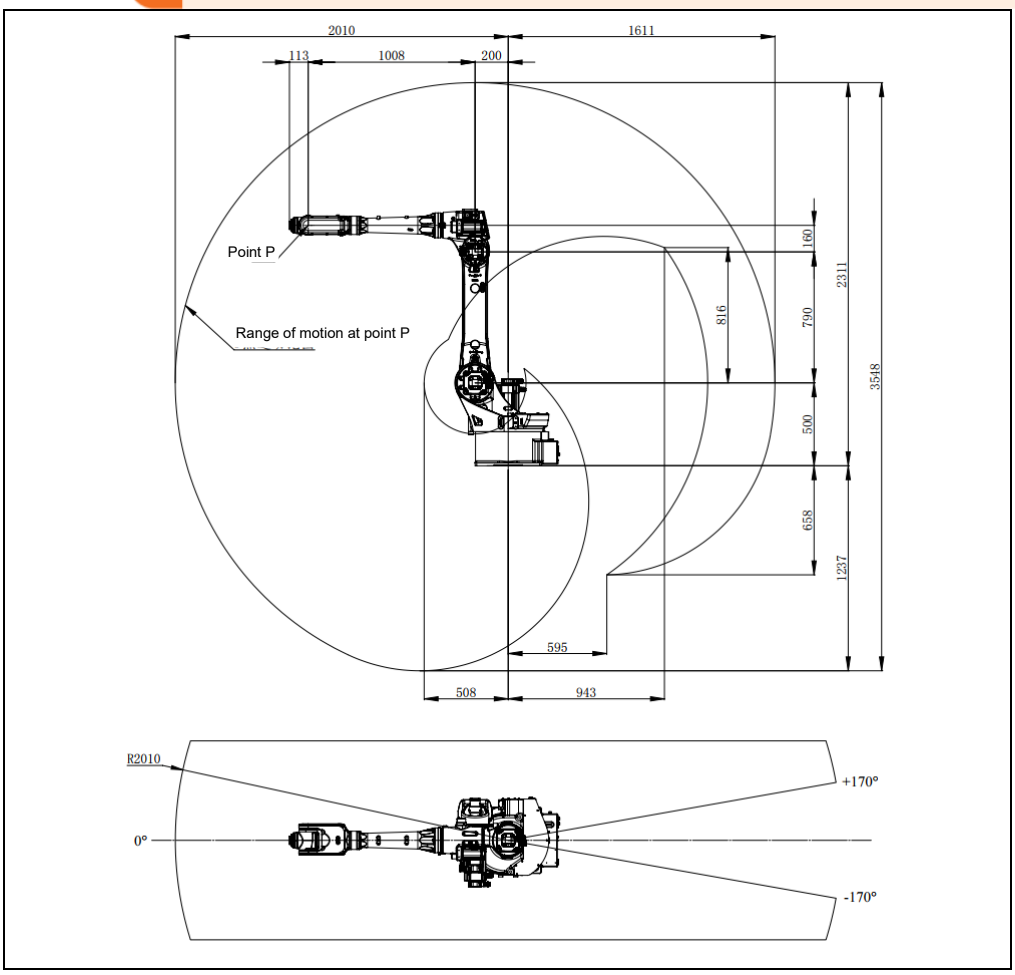


Fig. 3.8 Motion range (QRC-405 Eco)

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.

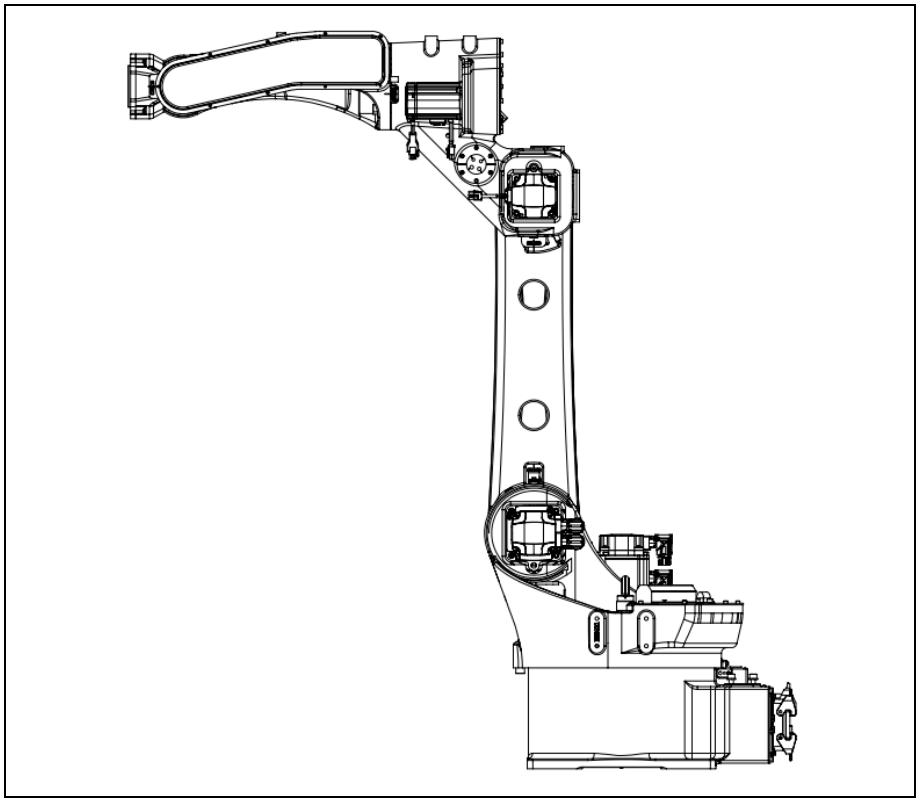


Fig. 3.9 Zero point position of robot (QRH-295, QRH-295 Eco, QRH 295 ECO-S)

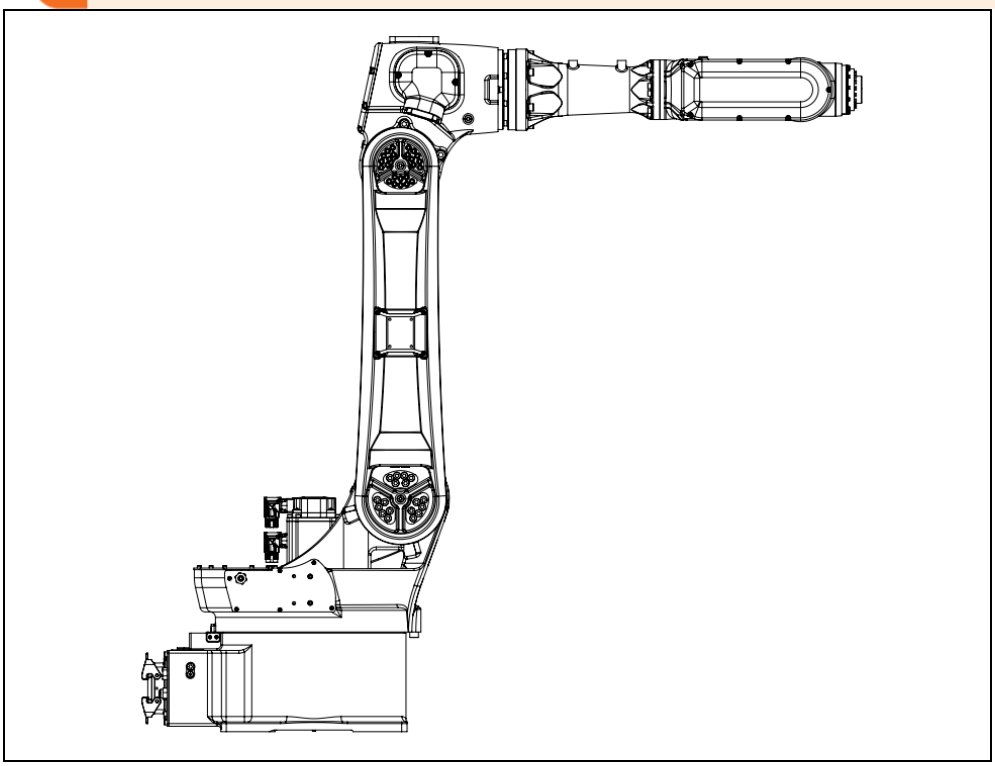


Fig. 3.10 Zero point position of robot (QRC 305 ECO)

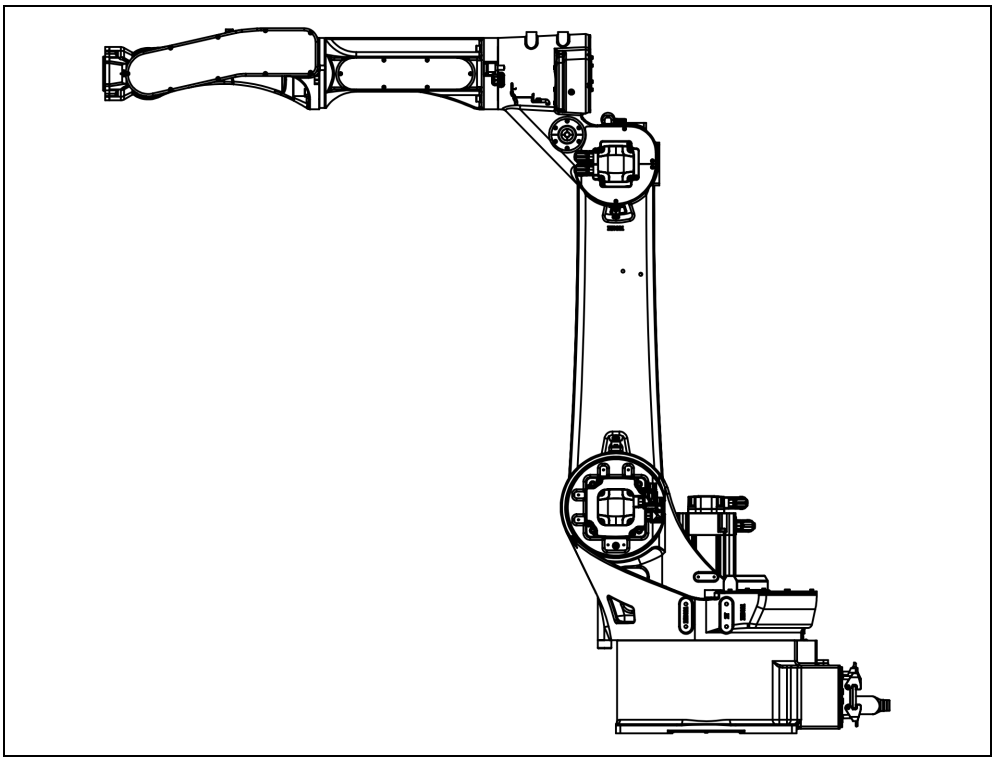


Fig. 3.11 Zero point position of robot
(QRH-405, QRH-405 Eco, QRH-405 Eco-S)

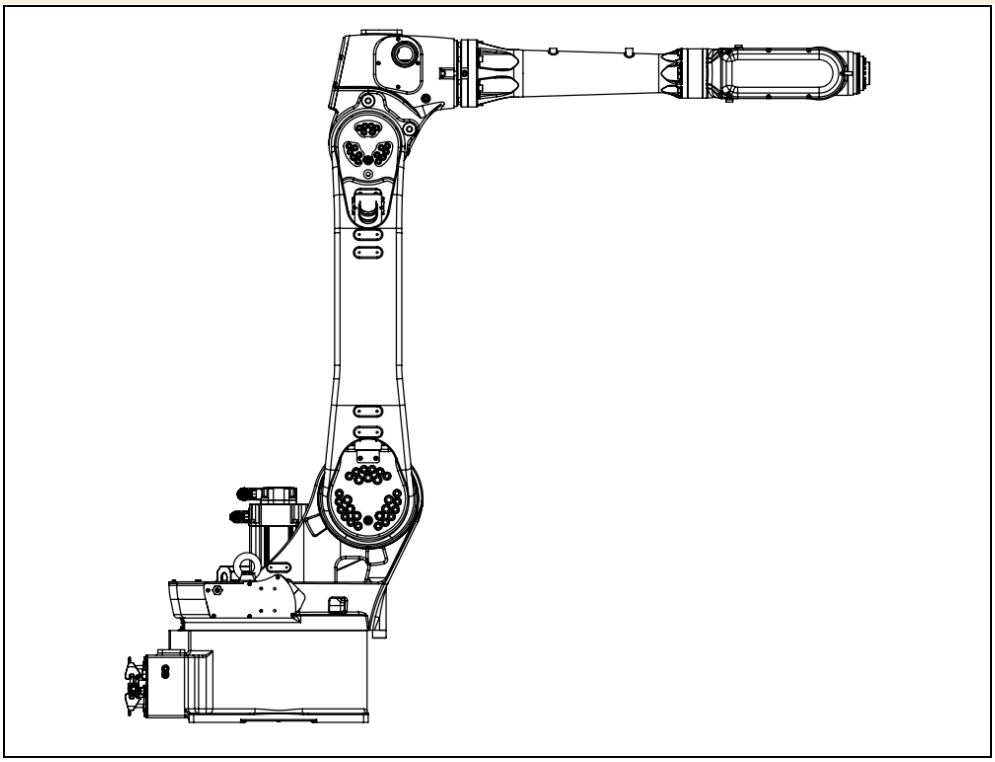


Fig. 3.12 Zero point position of robot (QRC-405 Eco)

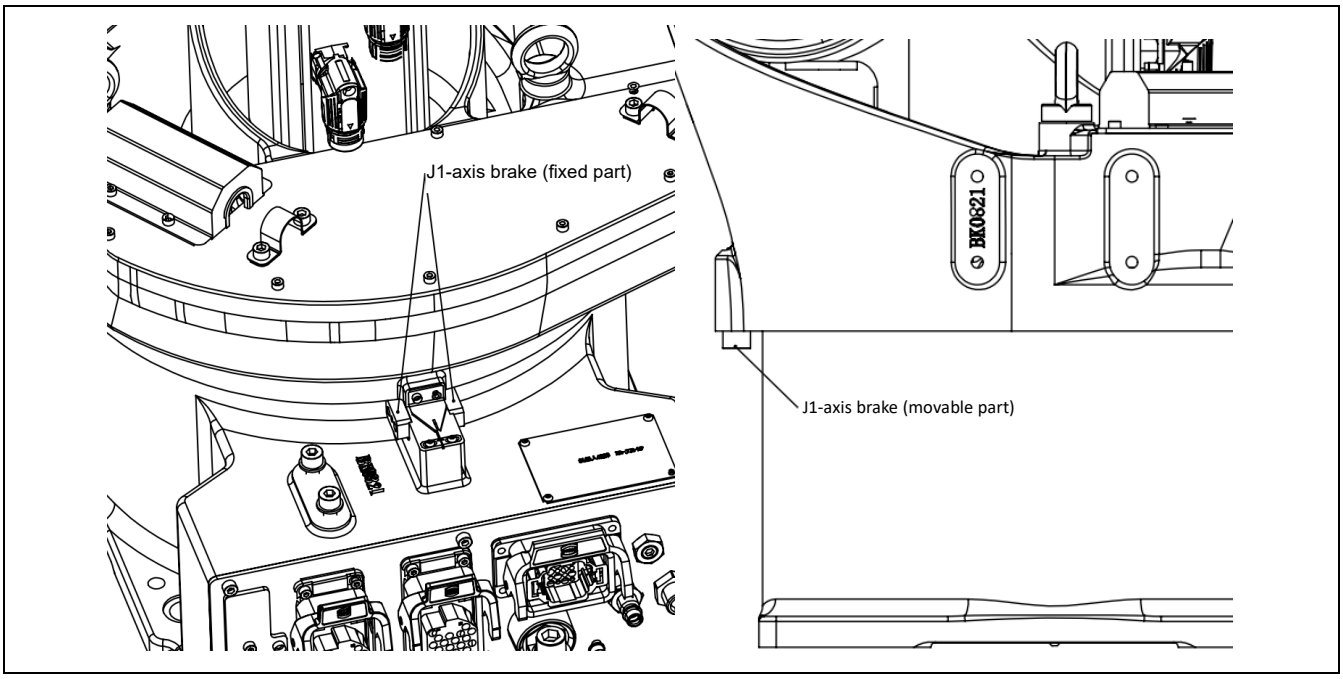


Fig. 3.13 J1-axis Mechanical stopper position (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

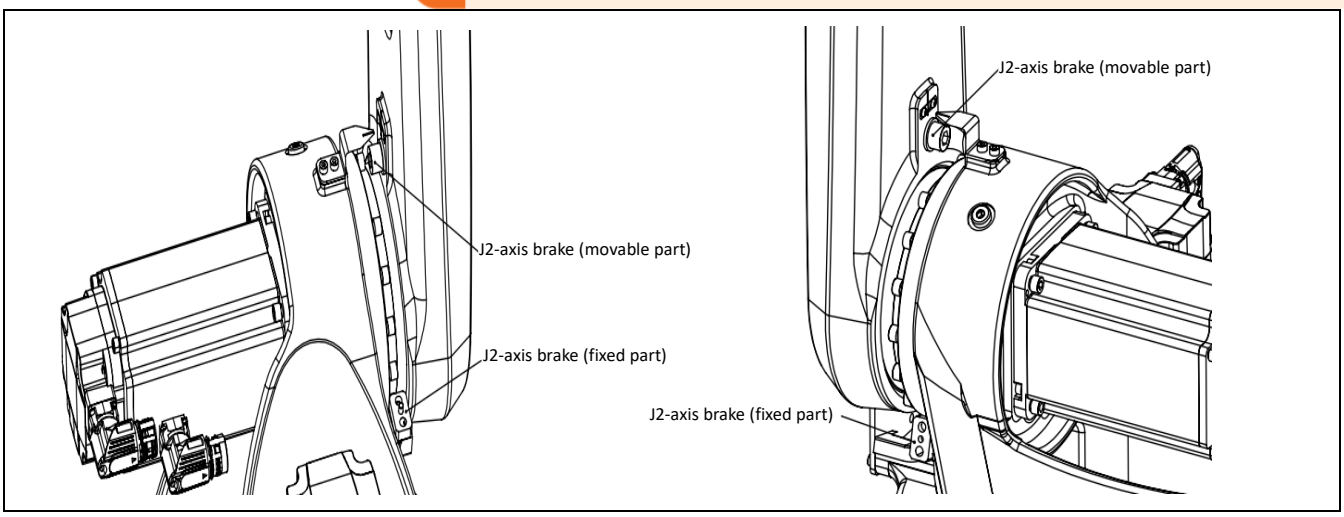


Fig. 3.14 J2-axis Mechanical stopper position (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

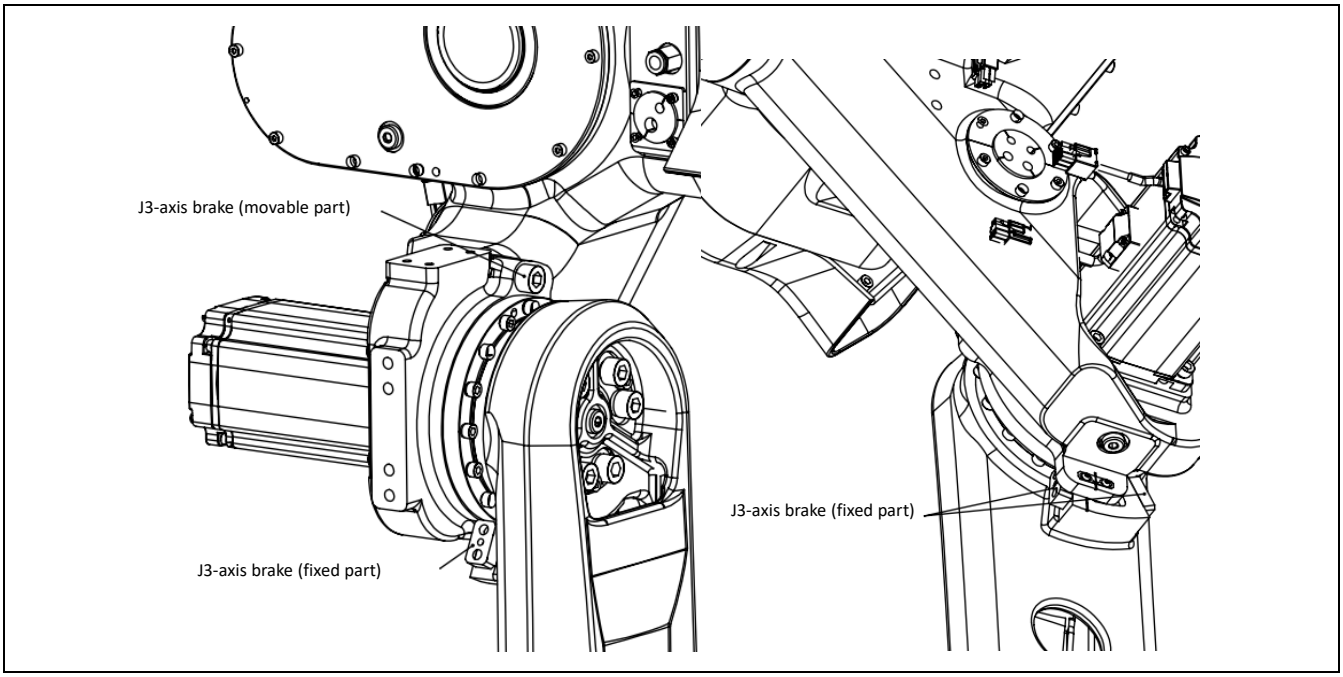


Fig. 3.15 J3-axis Mechanical stopper position (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

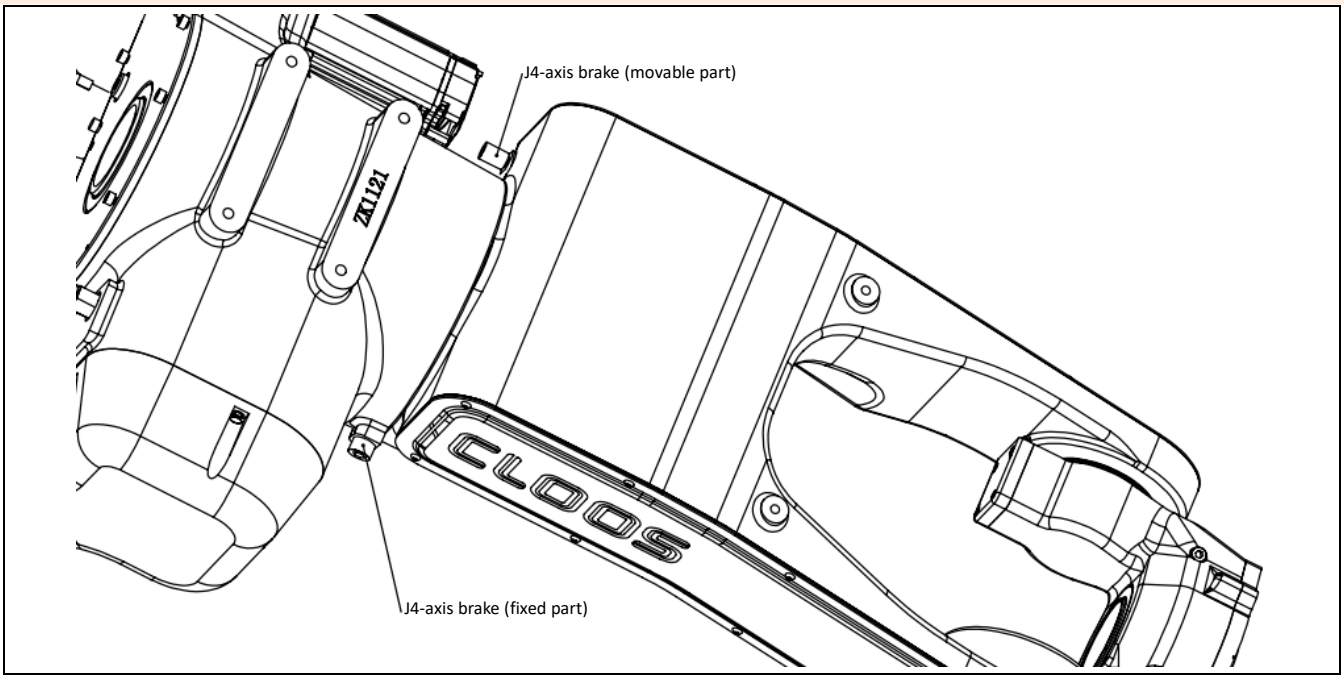


Fig. 3.16 J4-axis Mechanical stopper position (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

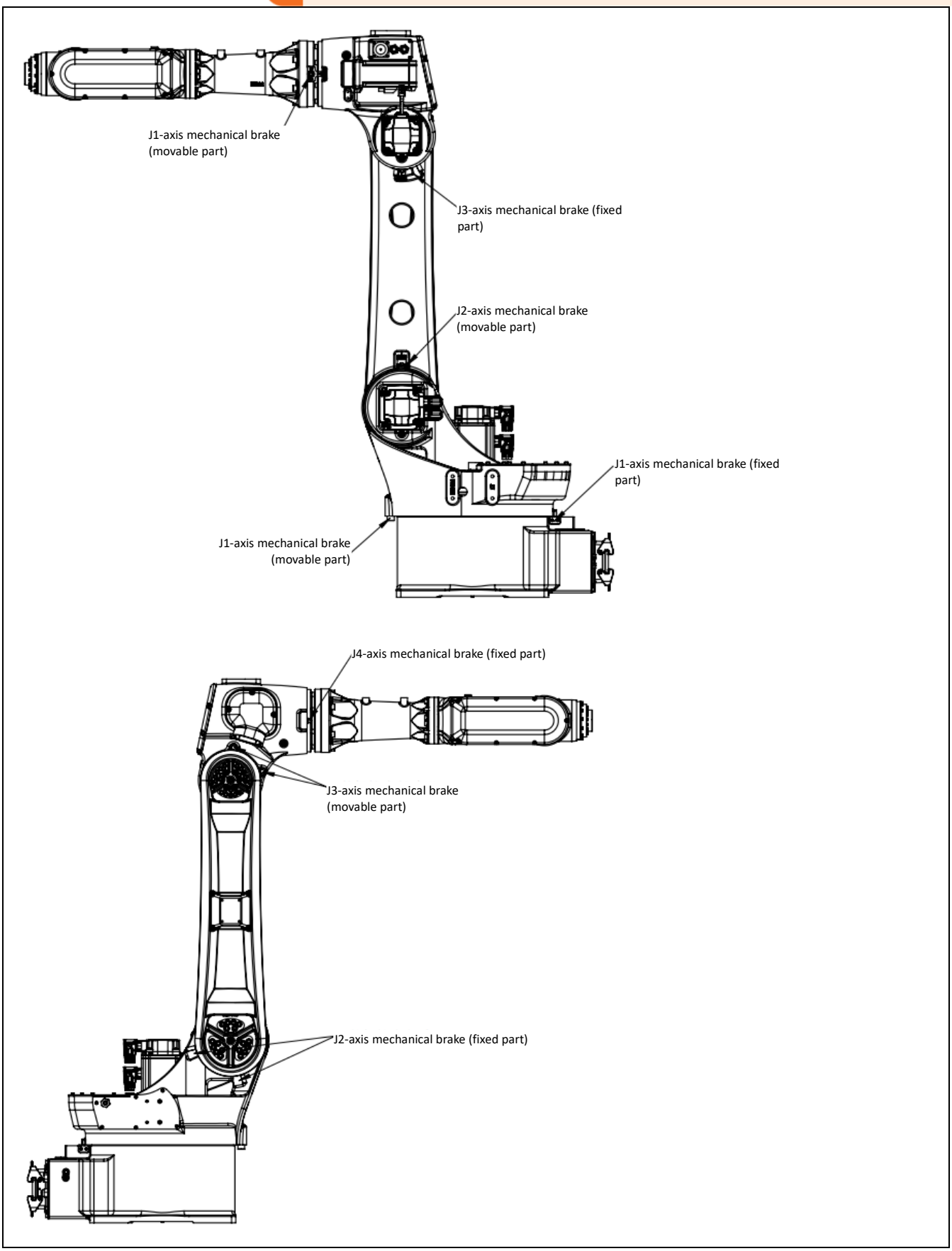


Fig. 3.17 Mechanical stopper position（QRC 305 Eco）

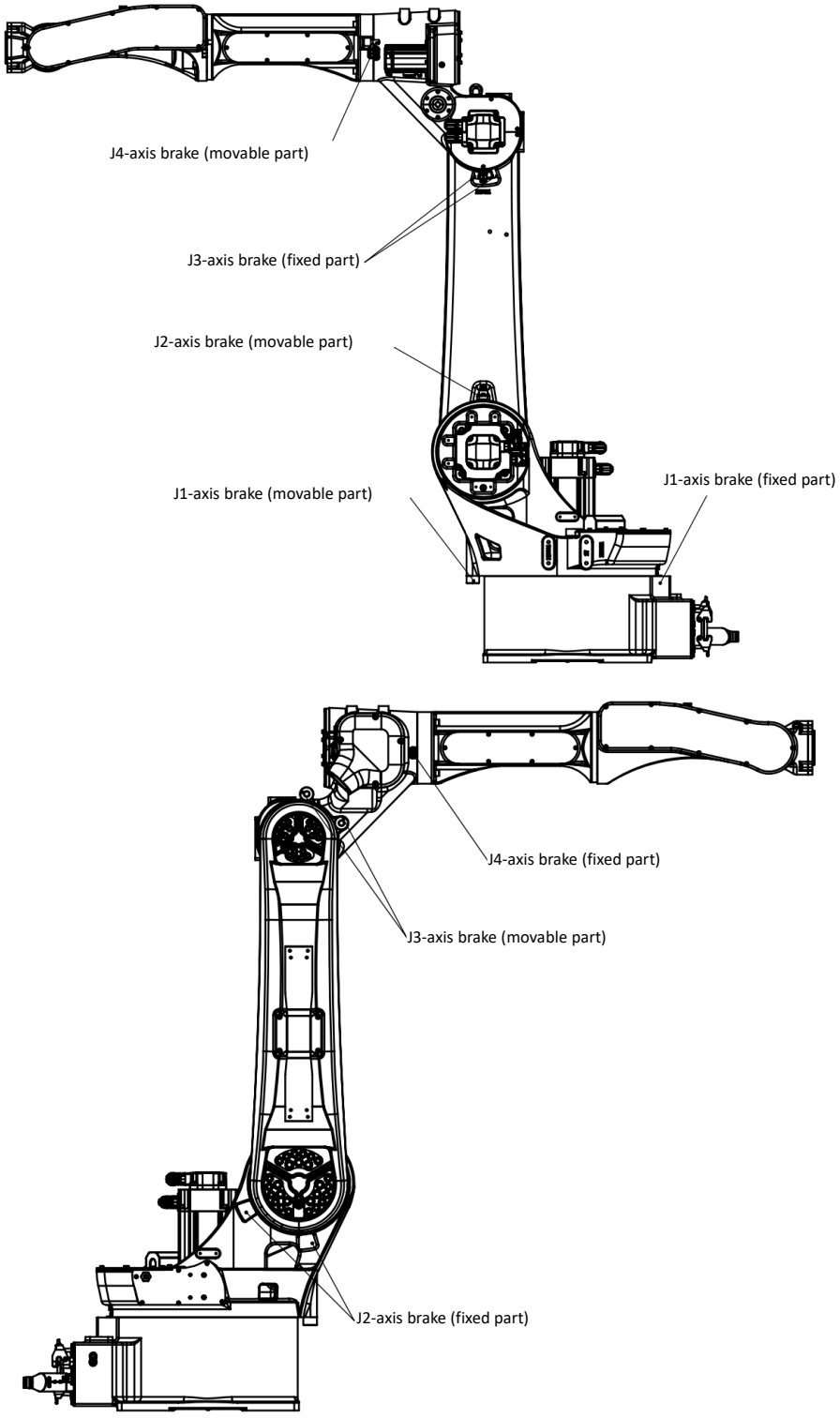


Fig. 3.18 Mechanical stopper position (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

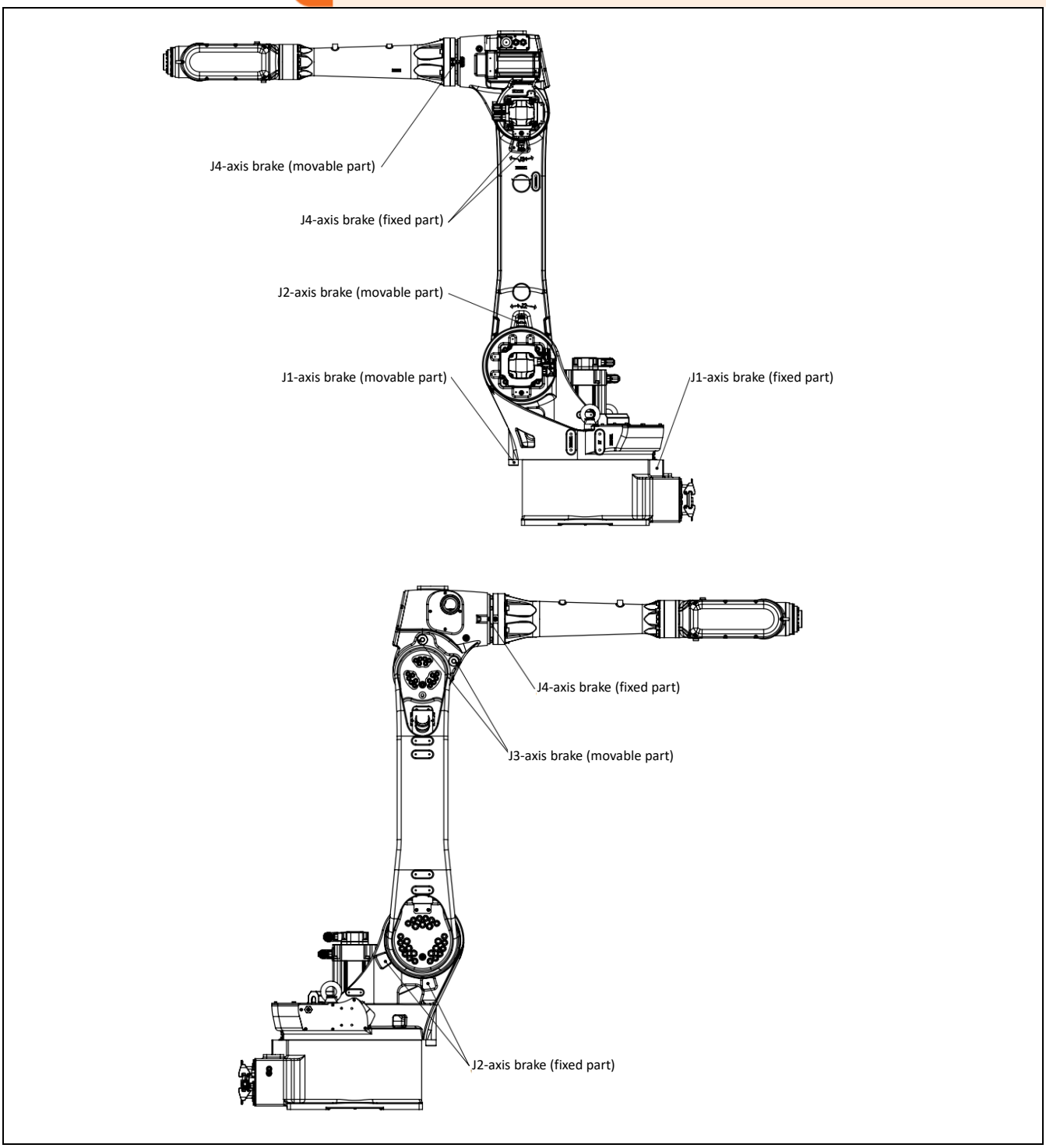


Fig. 3.19 Mechanical stopper position (QRC-405 Eco)

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 CLOOS representatives.

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

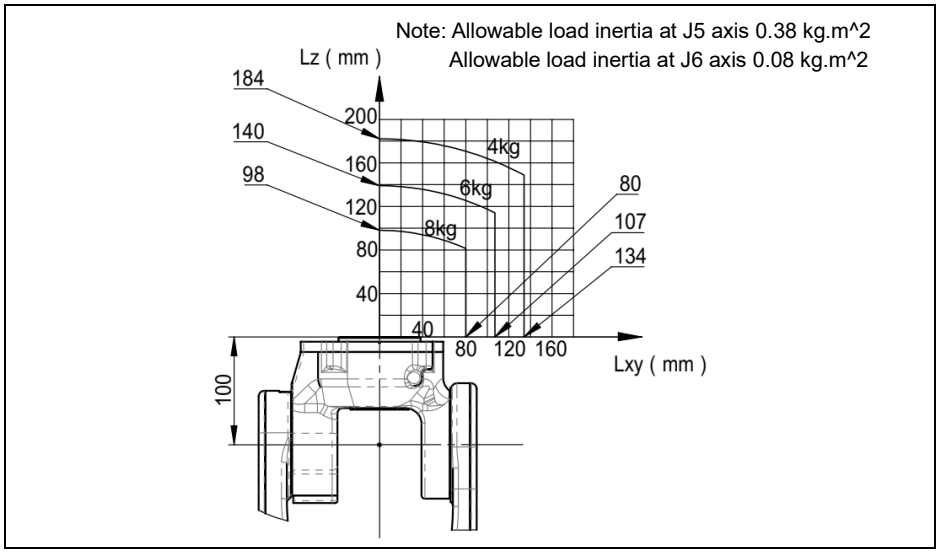


Fig. 3.20 Load capacity at wrist
(QRH-295, QRH-295 Eco, QRH 295 Eco-S)

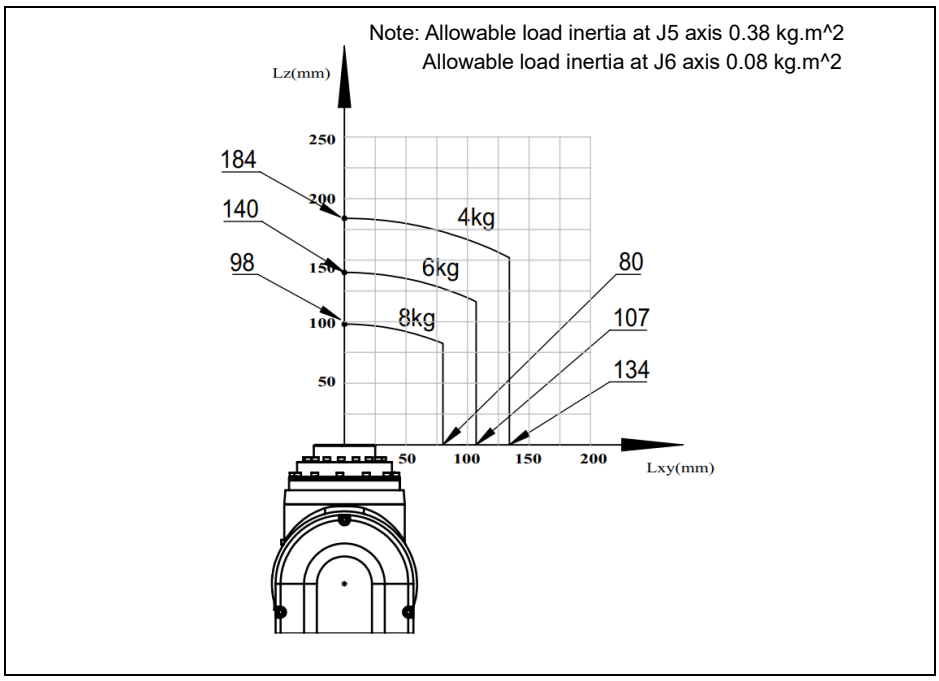


Fig. 3.21 Load capacity at wrist (QRC 305 Eco)

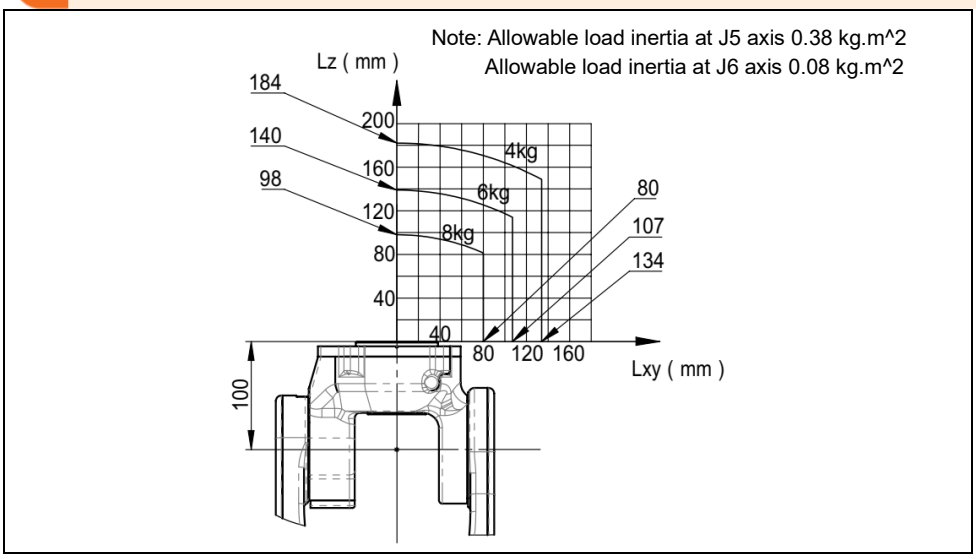


Fig. 3.22 Load capacity at wrist (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

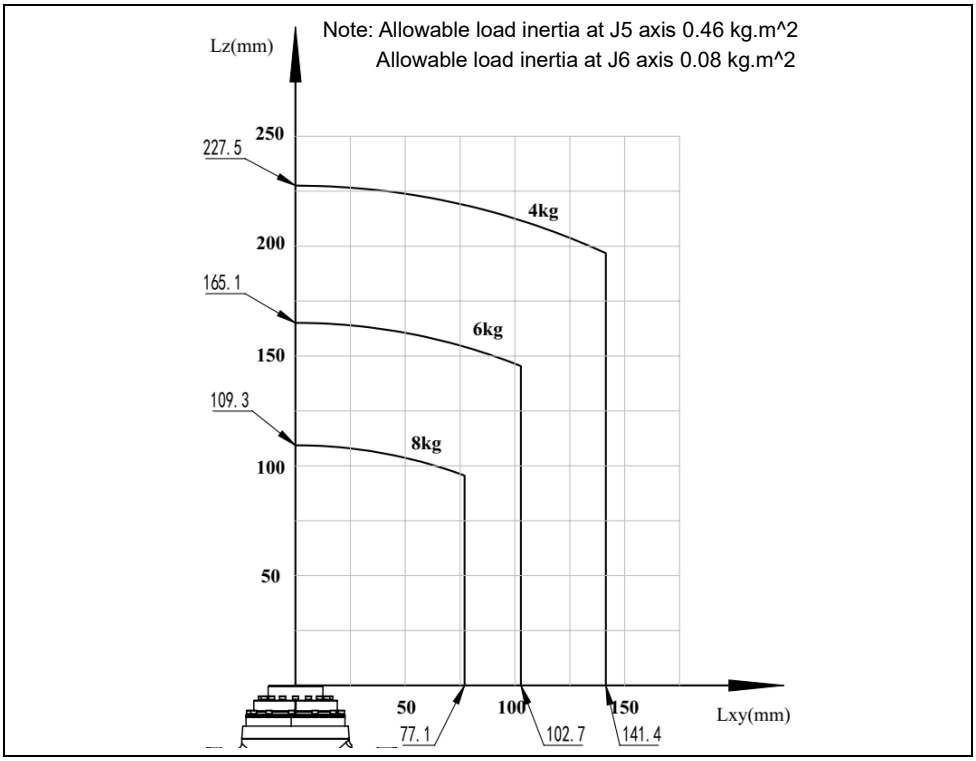
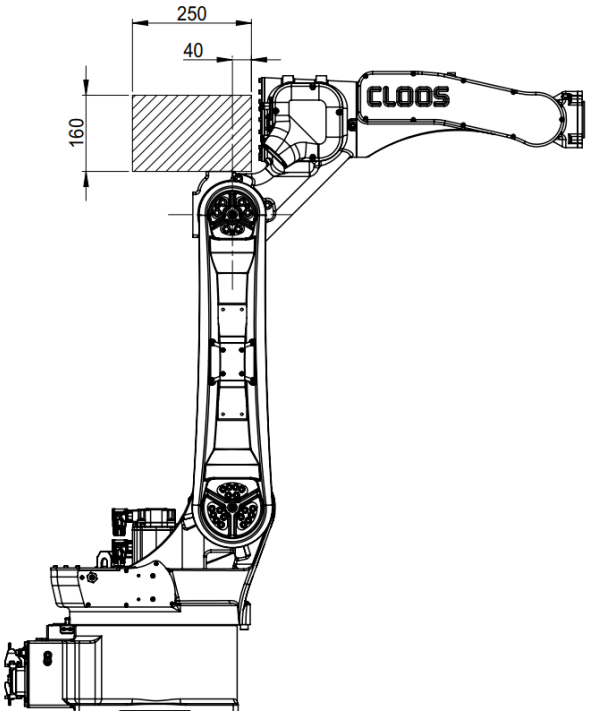


Fig. 3.23 Load capacity at wrist (QRC-405 Eco)

3.5. Additional load conditions

The robot may have additional loads. Additional load condition is shown as below.

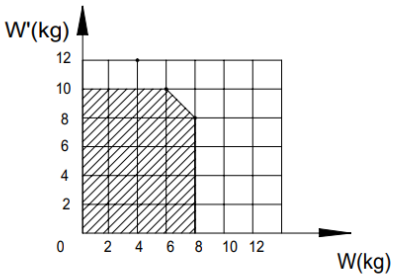


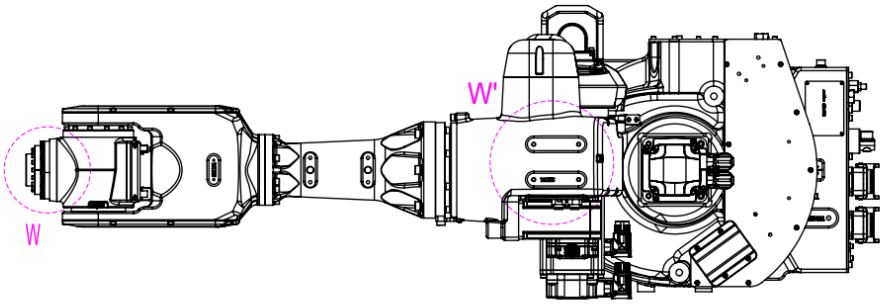
Notes:
1. The origin of the coordinate system is at the midpoint of the centerline of the mounting hole in the body, measured in millimeters (mm);
2. The center of gravity of the additional load should be within the shaded area in the diagram and should not exceed 10kg.

Fig. 3.24 Additional load condition (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

W: Loadable weight of the end flange mounting surface

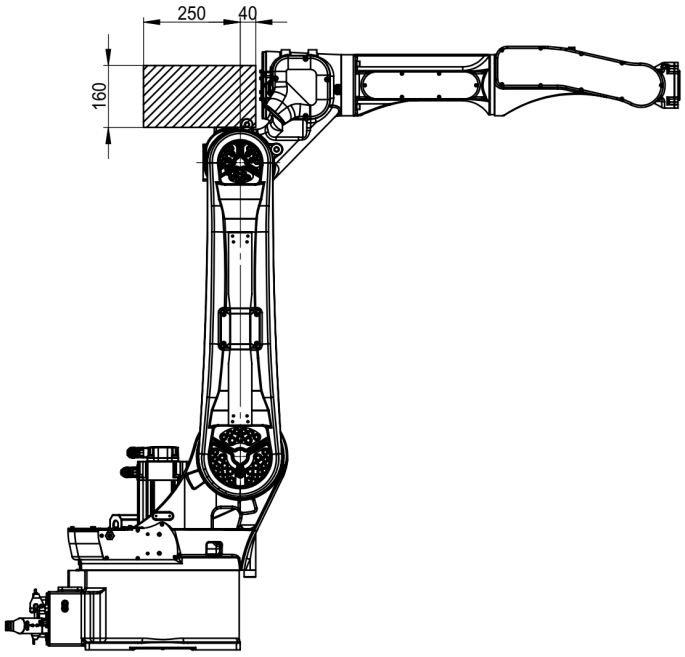
W: Loadable weight on motor mount surface





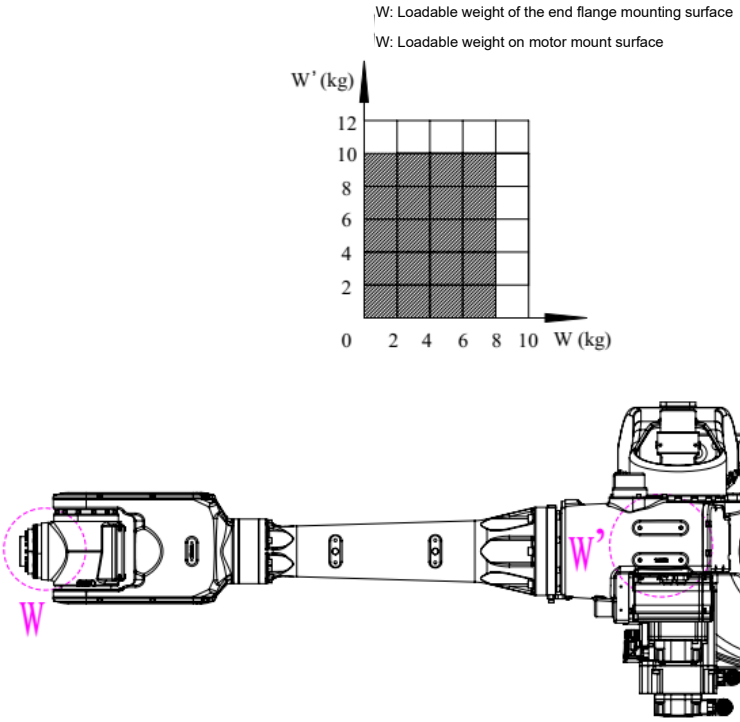
Notes:
1. The origin of the coordinate system is at the midpoint of the centerline of the mounting hole in the body, measured in millimeters (mm);
2. The center of gravity of the additional load should be within the shaded area in the diagram and should not exceed 10kg.

Fig. 3.25 Additional load condition（QRC 305 Eco)



Notes:
1. The origin of the coordinate system is at the midpoint of the centerline of the mounting hole in the body, measured in millimeters (mm);
2. The center of gravity of the additional load should be within the shaded area in the diagram and should not exceed 10kg.

Fig. 3.26 Additional load condition
(QRH-405, QRH-405 Eco, QRH-405 Eco-S)



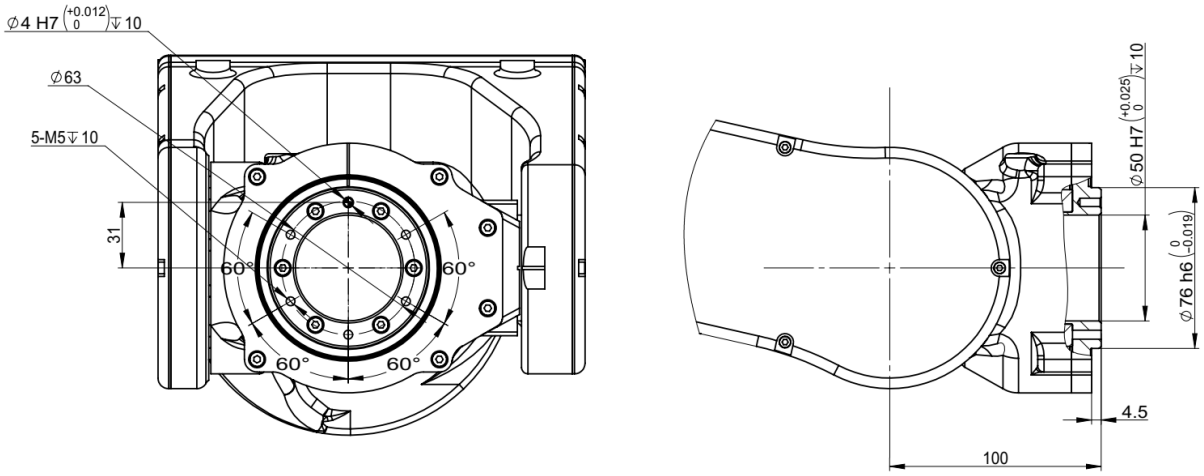
Notes:
1. The origin of the coordinate system is at the midpoint of the centerline of the mounting hole in the body, measured in millimeters (mm);
2. The center of gravity of the additional load should be within the shaded area in the diagram and should not exceed 10kg.

Fig. 3.27 Additional load condition (QRC-405 Eco)

4. Equipment Installation

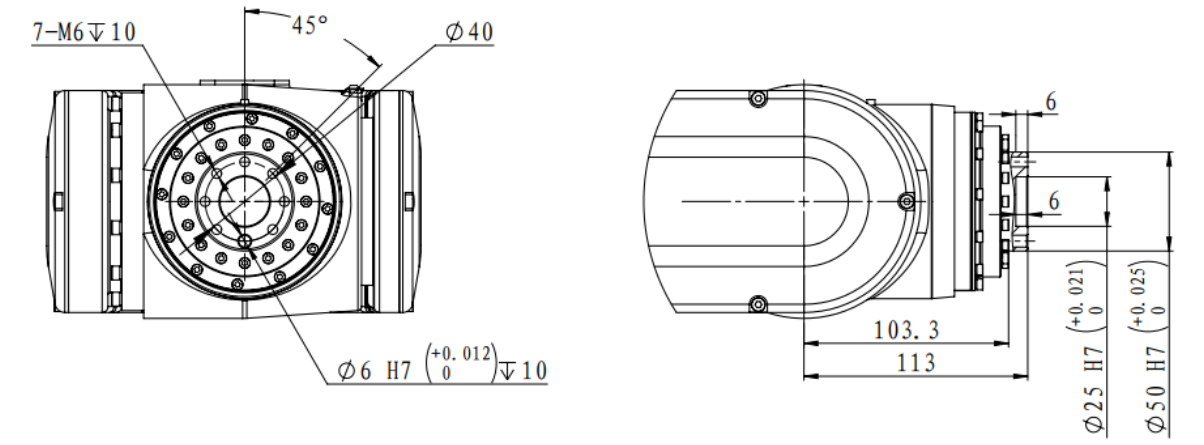
4.1. End flange mounting interface

This section describes the mounting face dimension of the end flange. 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.



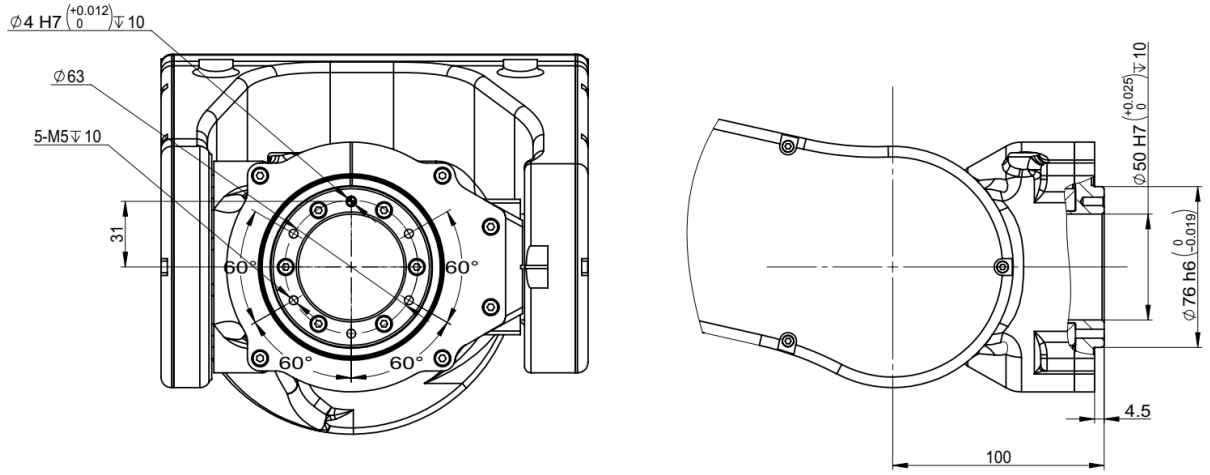
Item and model	Amount
Fixed screw: M5 (GB/T 70.1, Grade 12.9)	5
Spring washer: spring washerΦ5 (GB/T 93)	5
Positioning pin: cylindrical pinΦ4 (GB/T120.2)	1

Fig. 4.1 End flange mounting interface (QRH-295, QRH-295 Eco, QRH 295 Eco-S)



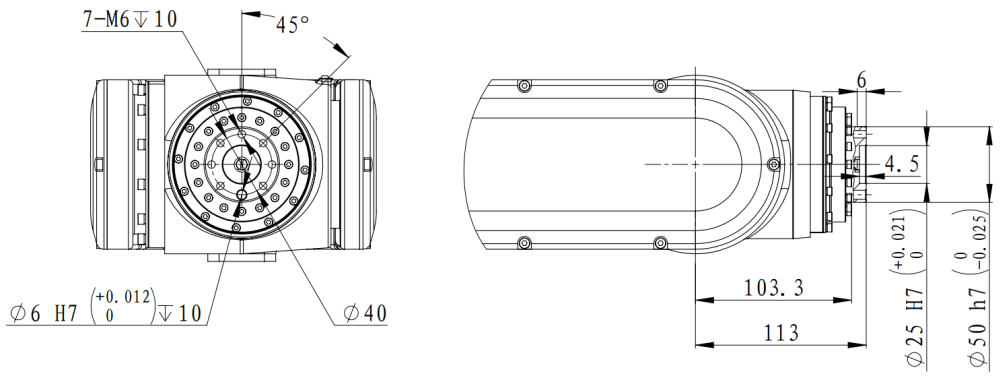
Item and model	Amount
Fixed screw: M5 (GB/T 70.1, Grade 12.9)	5
Spring washer: spring washerΦ5 (GB/T 93)	5
Positioning pin: cylindrical pinΦ4 (GB/T120.2)	1

Fig. 4.2 End flange mounting interface (QRC 305 Eco)



Item and model	Amount
Fixed screw: M5 (GB/T 70.1, Grade 12.9)	5
Spring washer: spring washerΦ5 (GB/T 93)	5
Positioning pin: cylindrical pinΦ4 (GB/T120.2)	1

Fig. 4.3 End flange mounting interface (QRH-405, QRH-405 Eco, QRH-405 Eco-S)



Item and model	Amount
Fixed screw: M6 (GB/T 70.1, Grade 12.9)	7
Spring washer: spring washerΦ6 (GB/T 93)	7
Positioning pin: cylindrical pinΦ6 (GB/T120.2)	1

Fig. 4.4 End flange mounting interface (QRC-405 Eco)

4.2. Equipment mounting face

The figure indicates the locations of the screw holes for equipment installation. The robot has external device mounting threaded holes located on the top of the small arm component.

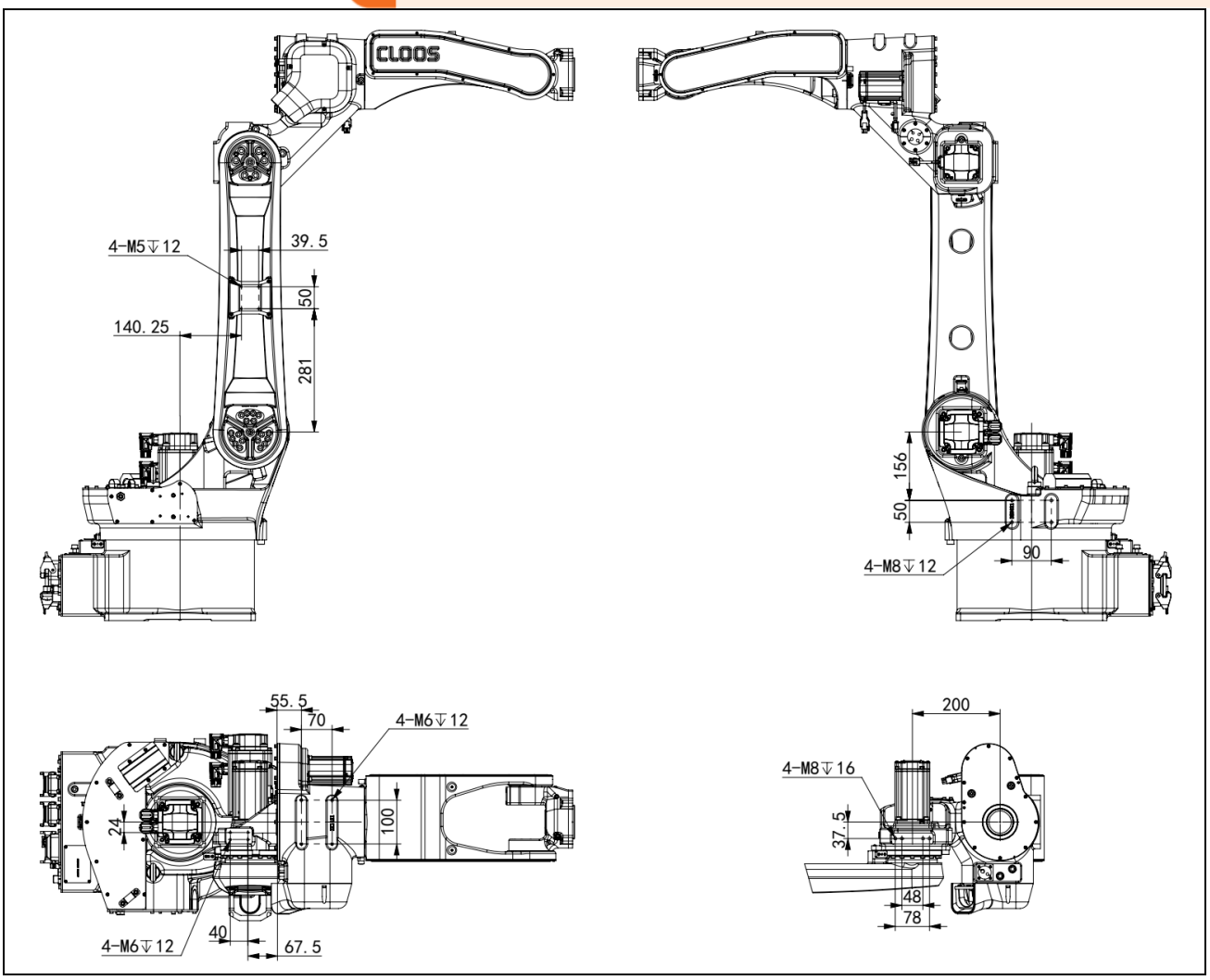


Fig. 4.5 Equipment mounting face (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

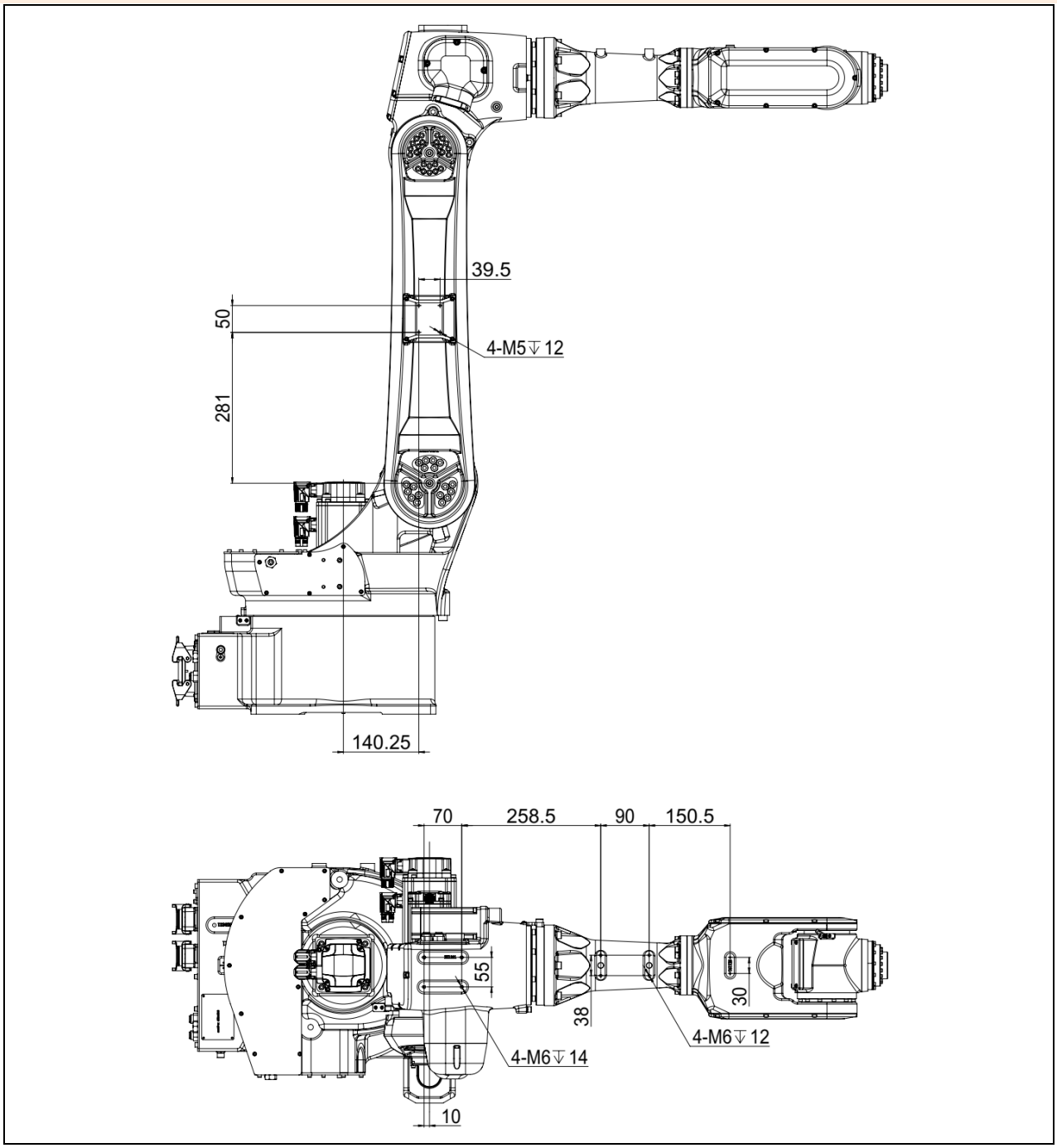


Fig. 4.6 Equipment mounting face (QRC 305 Eco)

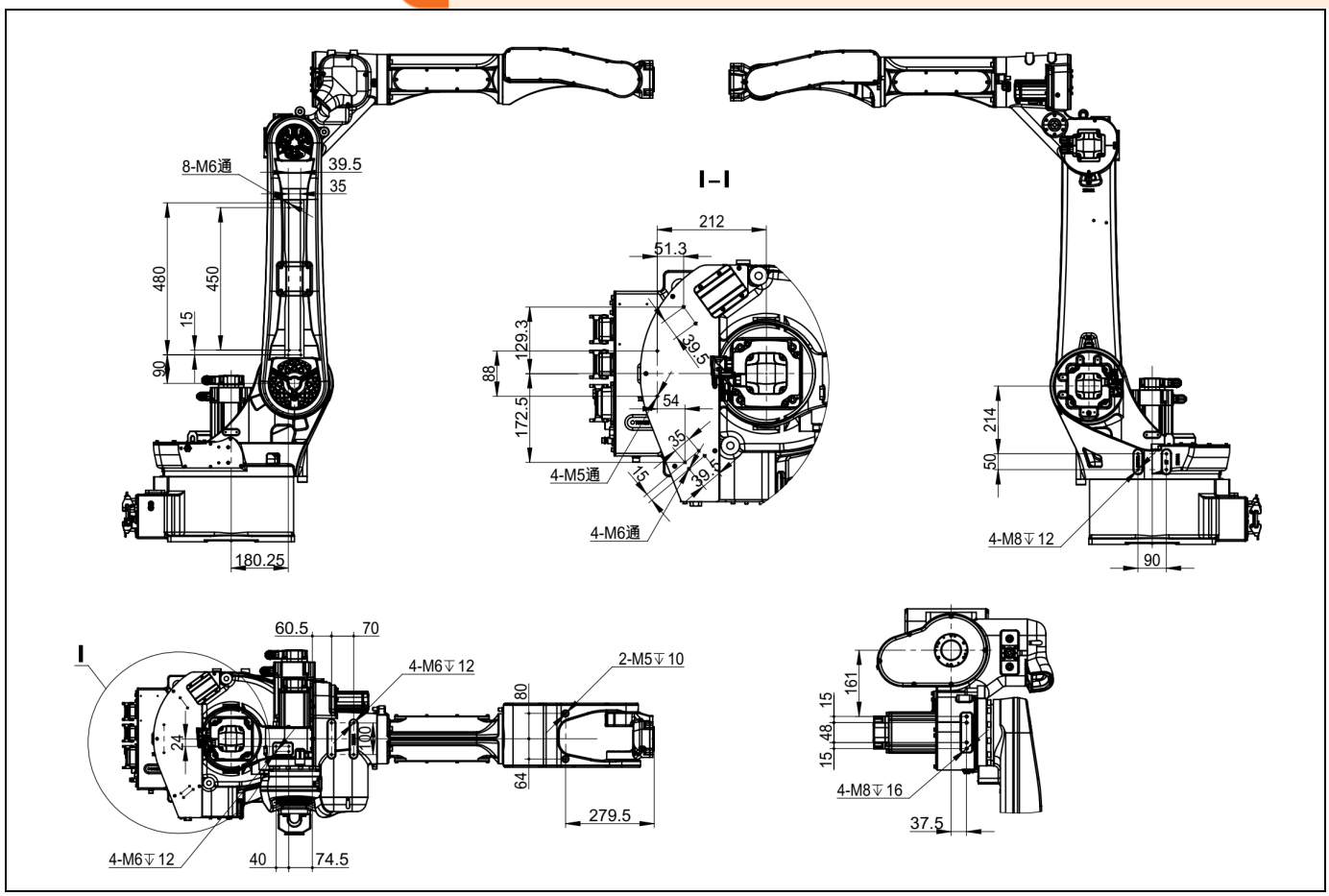


Fig. 4.7 Equipment mounting face (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

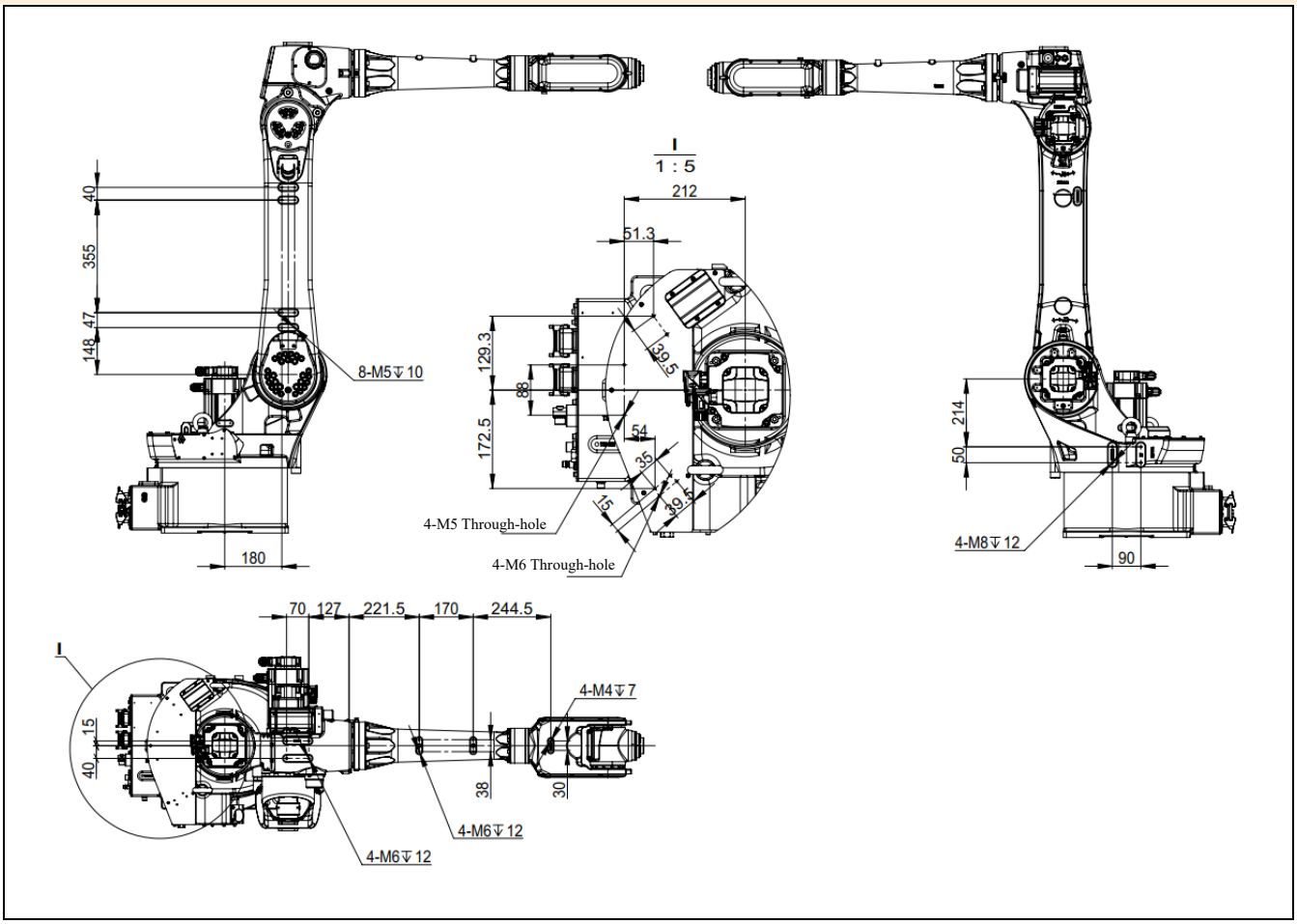


Fig. 4.8 Equipment mounting face (QRC-405 Eco)

Caution!	**When installing external equipment, it is important to ensure that there is no interference with the robot body to prevent any accidents. The external interface of J3 axis should not be subjected to a load exceeding 10kg.**

4.3. External pipelines

Arc Welding Series provides pathways for supplying pneumatic or hydraulic pressure to the end effector mechanism.

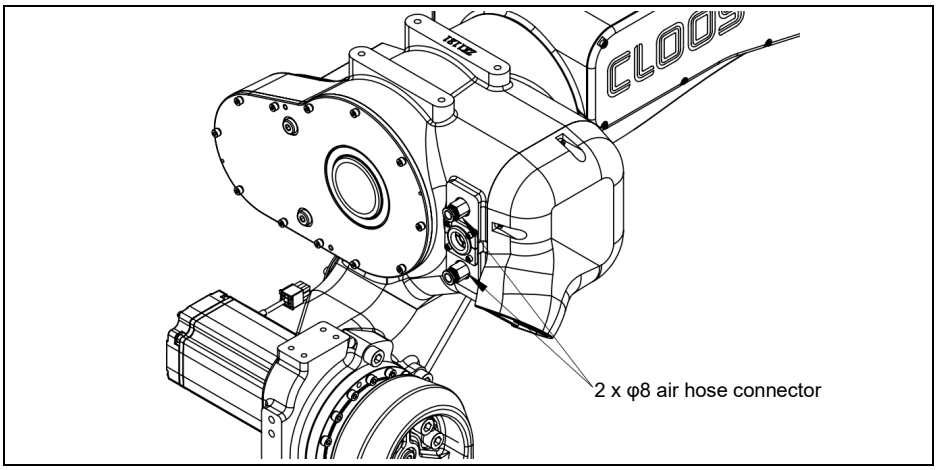


Fig. 4.9 External pipelines (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

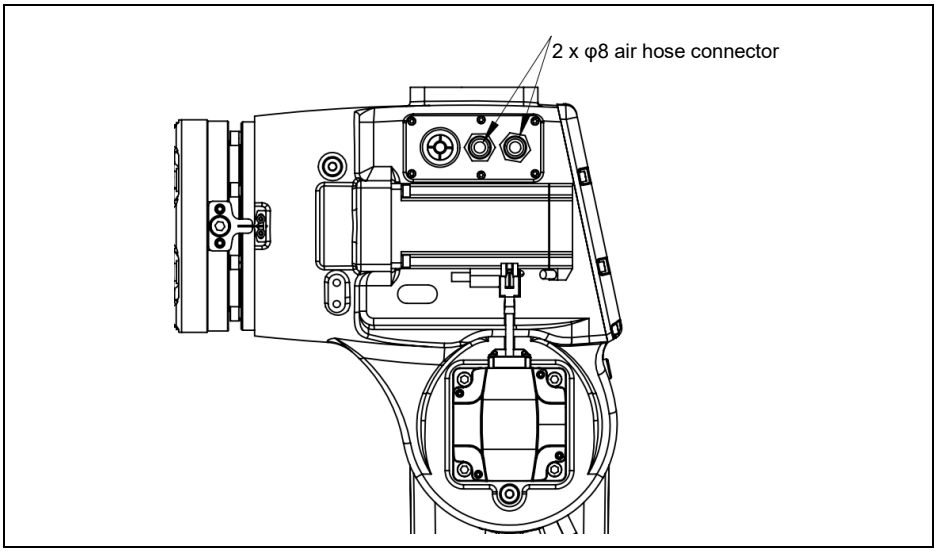


Fig. 4.10 External pipelines (QRC 305 Eco)

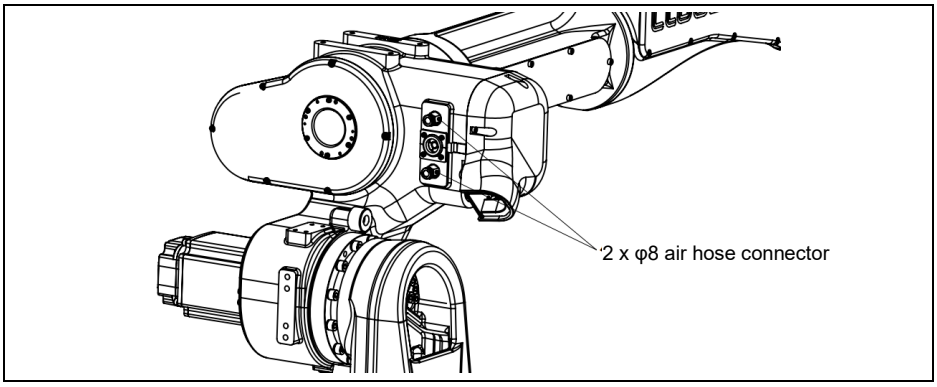


Fig. 4.11 External pipelines (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

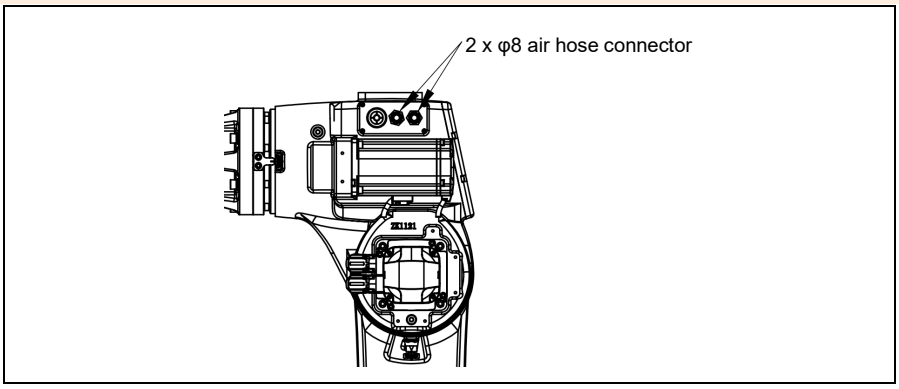


Fig. 4.12 External pipelines (QRC-405 Eco)

5. Check and Maintenance

Before performing any maintenance, be sure to read SAFETY PRECAUTIONS in Chapter 1 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.

S/N	Check item	Requirements
1	Oil seepage	Please check for any oil leakage from the robot product. If present, please wipe it clean.
2	Vibration, abnormal noises	Inspect each transmission mechanism for vibrations and abnormal noises. If detected, refer to section 7.2 for troubleshooting methods.
3	Positioning accuracy	Check if the current position deviates from the last taught position and if there are any deviations in the stop positions.
4	Cooling fan in the cabinet	Inspect the ventilation of the rear fan in the control cabinet for smooth airflow and any abnormal sounds.
5	Peripheral cable set part	Check for completeness, integrity, wear, and rust.
6	Peripheral electrical equipment	Verify the proper functioning of external circuit connections, check for any damages, and ensure the buttons are working correctly.
7	Warnings	Check if any warnings appear on the teaching pendant screen. If there are any, refer to the alarm code list for appropriate actions.

5.2. Periodic checks and maintenance

Perform maintenance and repairs at approximate intervals based on the specified operating cycle or cumulative operating time. By following the regular maintenance steps, the robots optimal performance can be maintained. Users can carry out scheduled inspections and maintenance according to the table below, or they can contact CLOOSs professionals for service.

Check and maintenance intervals (Operating time, Accumulated operating time)						Item	Guidelines for check, disposal and maintenance
1 month 320h	3 months 960h	1 year 3840h	1.5 years 5760h	3 years 11520h	4 years 15360h		
○ Only 1st check	○					Cleaning the controller ventilation system	Confirm the controller 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 paint due to the interference with the peripheral equipment. If an

						paint	interference occurs, eliminate the cause. Also, if the external damage is serious, and causes a problem in which the robot will not operate, replace the damaged parts.
	○					Check damages of the cable protection sheaths	Check whether the cable protection sheaths of the mechanical unit cable have holes or tears. If damage is found, replace the cable protection sheath. If the cable protection sheath is damaged due to the interference with peripheral equipment, eliminate the cause.
	○					Check for water	Check whether the robot is subjected to water or cutting oils. If water is found, remove the cause and wipe off the liquid.
	○ Only 1st check	○				Check for damages to the teach pendant cable, the operation box connection cable or the robot connection cable	Check whether the cable connected to the teach pendant, operation box and robot are unevenly twisted or damaged. If damage is found, replace the damaged cables.
	○ Only 1st check	○				Check for damage to the mechanical unit cable (movable part)	Observe the movable part of the mechanical unit cable, and check for damage. Also, check whether the cables are excessively bent or unevenly 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 is found, 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	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 the end of the manual. 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.
	○ 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.
	○ Only 1st check	○				Clean spatters, sawdust and dust	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).
	○ 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.
		○				Replace the mechanical unit battery	Replace the controller battery.
				○		Replace the grease of each axis reducer	Replace the grease of each axis reducer.
					○	Replace the mechanical unit cable	Replace the mechanical unit cable. Contact CLOOS representative for information regarding replacing the cable.

5.3. Replacement of batteries

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

Procedure of replacing the battery is shown below.

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

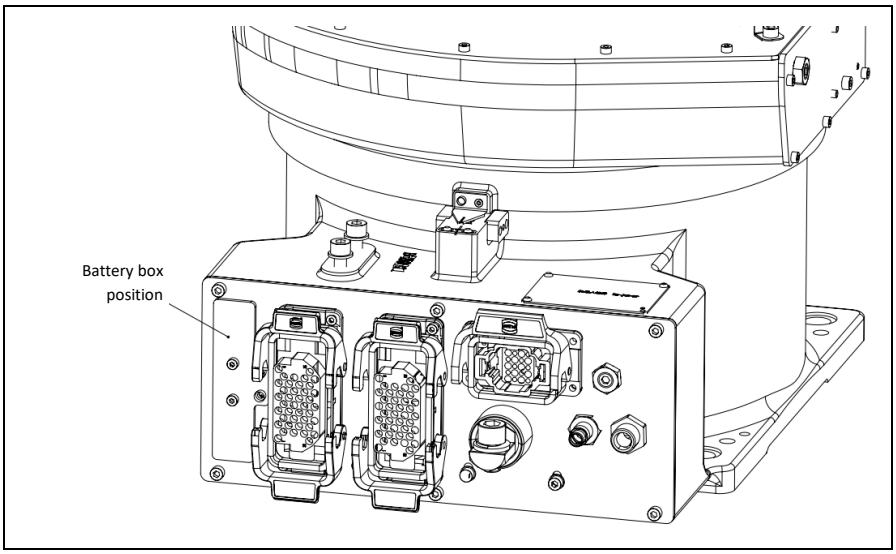


Fig. 5.1 Battery position (QRH-295, QRH-295 Eco, QRH 295 Eco-S, QRC 305 Eco)

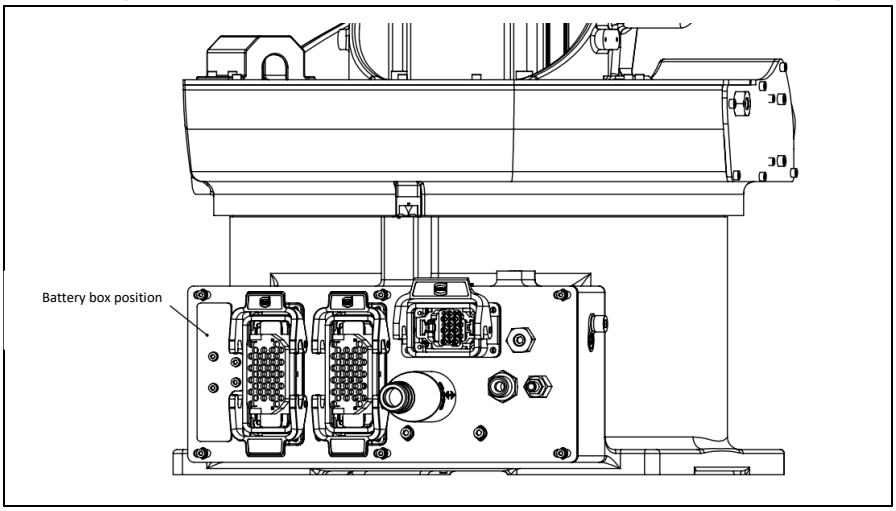


Fig. 5.2 Battery position (QRH-405, QRH-405 Eco, QRH-405 Eco-S, QRC-405 Eco)

5.4. Robot greasing

The oil chambers in this series of robots, the grease and oil should be replaced at intervals of every 3 years or when the cumulative operating time reaches 11,520 hours, whichever is shorter. The lubricant types and grease quantities for each joint are listed in the table below.

Caution!

When the robot operates in harsh environments, experiences frequent small-angle movements, or runs continuously at high frequencies for extended periods, it is recommended to shorten the lubricant replacement interval for the corresponding joints to 3000 hours.

Tab. 5.1 Regular replacement of grease every three years

Model	Position	Quantity
QRH-295 QRH-295 Eco	J1-axis reducer	395g
	J2-axis reducer	355g
	J3-axis reducer	285g
	J4-axis reducer	330g
QRH 295 Eco-S	J1-axis reducer	330g
	J2-axis reducer	325g
	J3-axis reducer	230g
QRC 305 Eco	J1-axis reducer	330g
	J2-axis reducer	310g
	J3-axis reducer	230g
	J4-axis reducer	245g
QRH-405 QRH-405 Eco-S	J1-axis reducer	1050g
	J2-axis reducer	1410g
	J3-axis reducer	340g
QRH-405 Eco	J1-axis reducer	900g
	J2-axis reducer	1460g
	J3-axis reducer	370g
QRC-405 Eco	J1-axis reducer	1050g
	J2-axis reducer	1410g
	J3-axis reducer	340g
	J4-axis reducer	280g

The following table provides the recommended azimuth angles for lubricant replacement or replenishment operations.

Table 5.2 Robot joint greasing angle (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

Position	**Azimuth**					
	J1	**J2**	**J3**	**J4**	**J5**	**J6**
J1-axis reducer	Any	0°	Any	Any	Any	Any

J2-axis reducer						
J3-axis reducer			0°			
J4-axis reducer						

Table 5.3 Robot joint greasing angle (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

Position	**Azimuth**					
	J1	**J2**	**J3**	**J4**	**J5**	**J6**
J1-axis reducer	Any	0°	Any	Any	Any	Any
J2-axis reducer						
J3-axis reducer			0°			

Table 5.4 Robot joint greasing angle (QRC-405 Eco, QRC 305 Eco)

Position	**Azimuth**					
	J1	**J2**	**J3**	**J4**	**J5**	**J6**
J1-axis reducer	Any	0°	Any	Any	Any	Any
J2-axis reducer						
J3-axis reducer			0°			
J4-axis reducer				0°		

5.4.1. Position of oil inlet/outlet on each axis

Caution!

When lubricating the reducer, it is important to follow the instructions outlined in the Safety Precautions for proper usage.

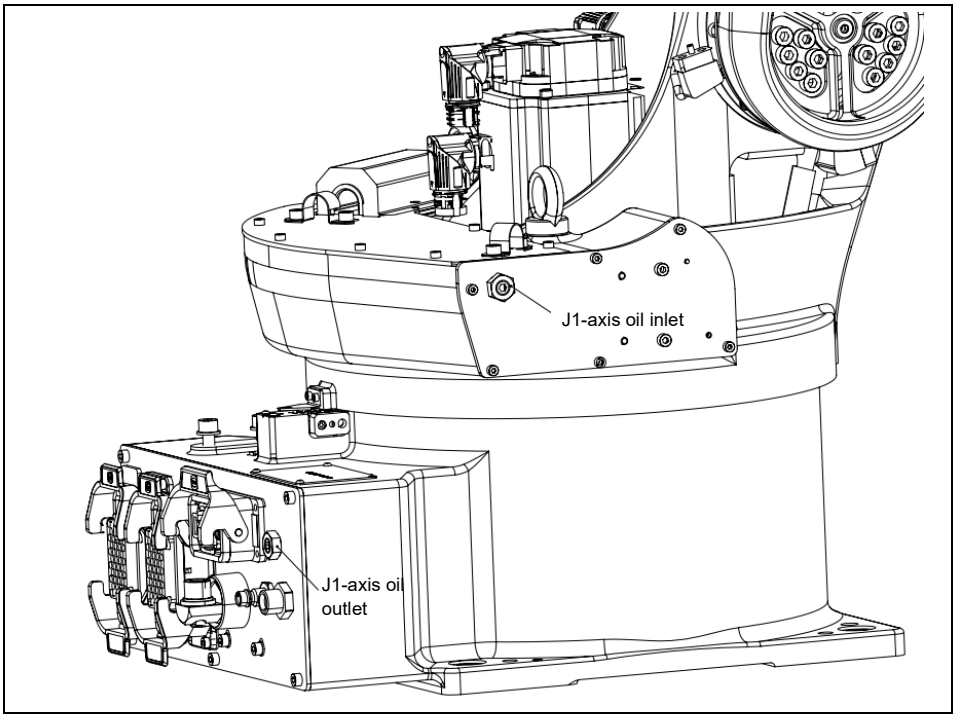


Fig. 5.3 J1-axis oil inlet/outlet (QRH-295, QRH-295 Eco, QRH 295 Eco-S, QRC 305 Eco)

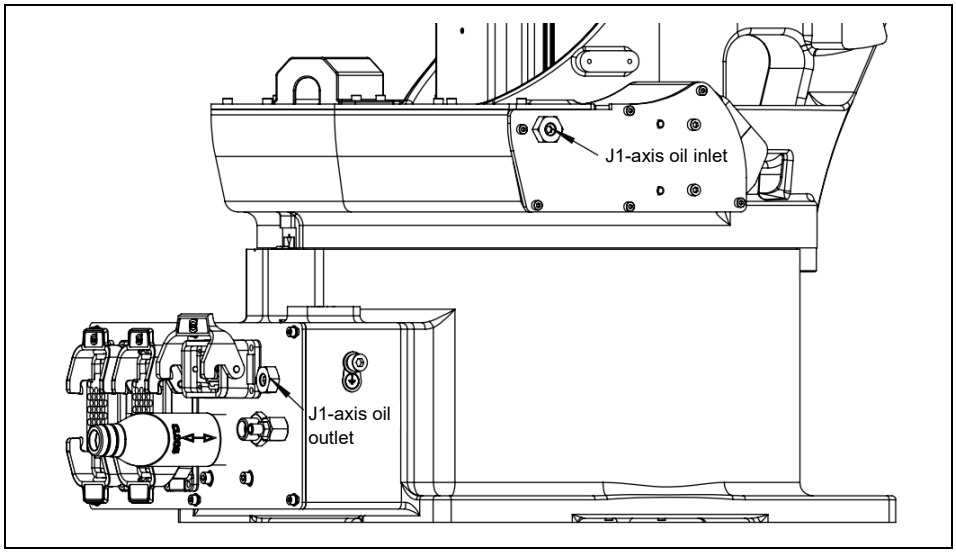


Fig. 5.4 J1 J1-axis oil inlet/outlet (QRH-405, QRH-405 Eco, QRH-405 Eco-S, QRC-405 Eco)

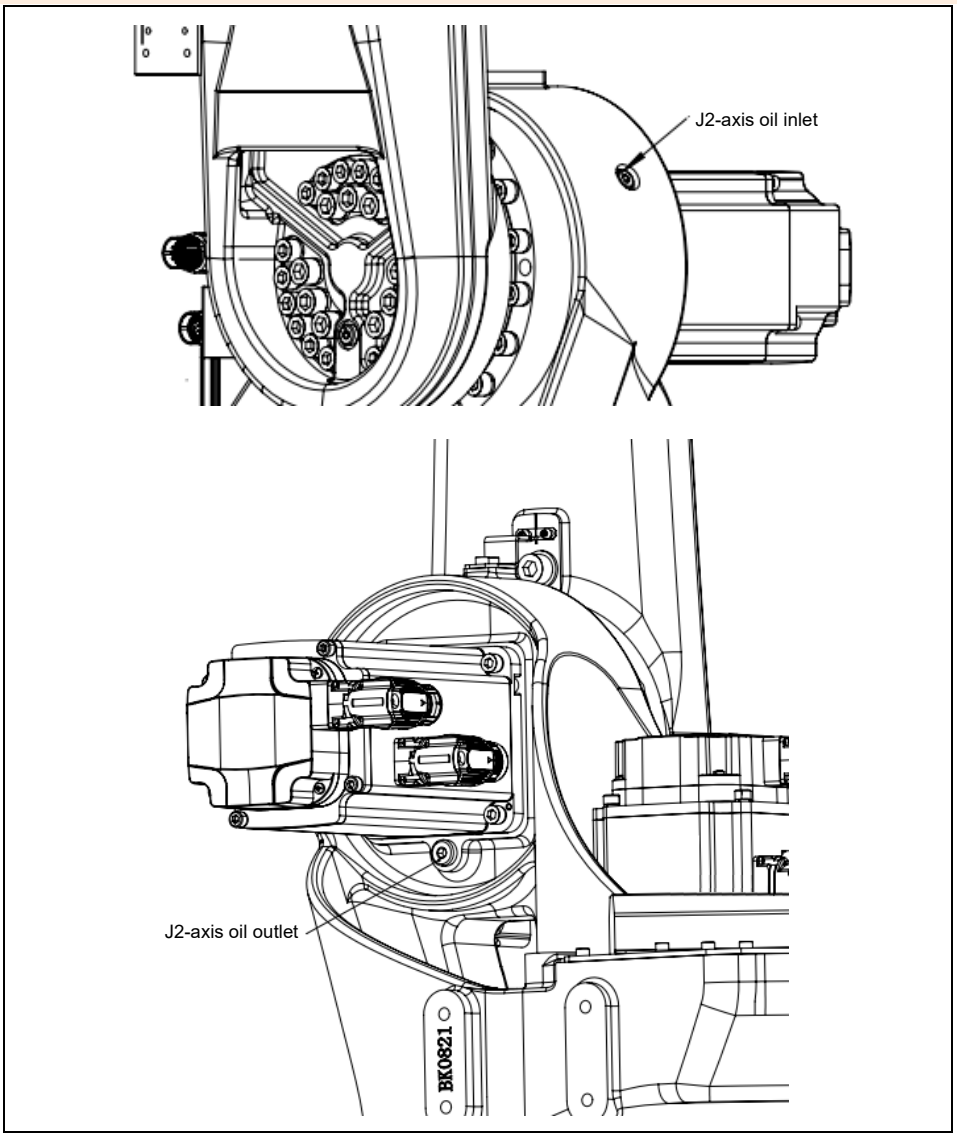


Fig. 5.5 J2-axis oil inlet/outlet (QRH-295, QRH-295 Eco, QRH 295 Eco-S, QRC 305 Eco)

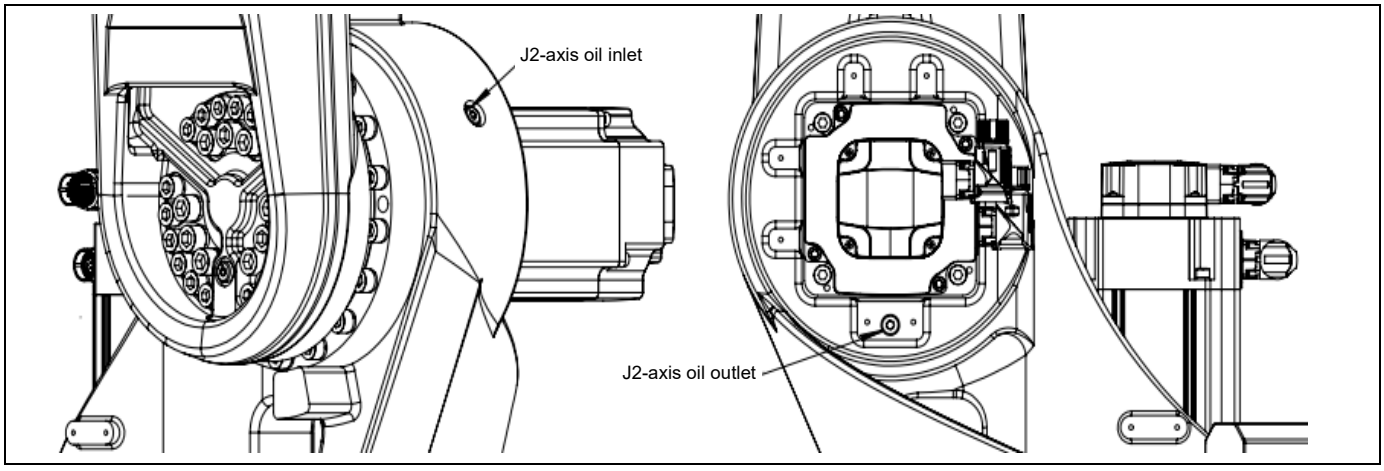


Fig. 5.6 J2-axis oil inlet/outlet (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

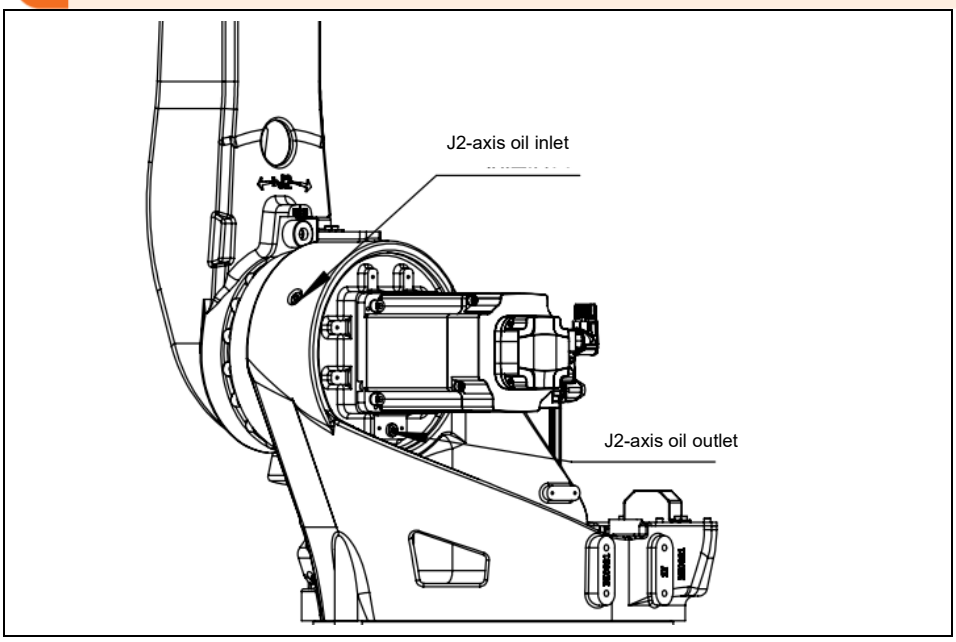


Fig. 5.7 J2-axis oil inlet/outlet (QRC-405 Eco)

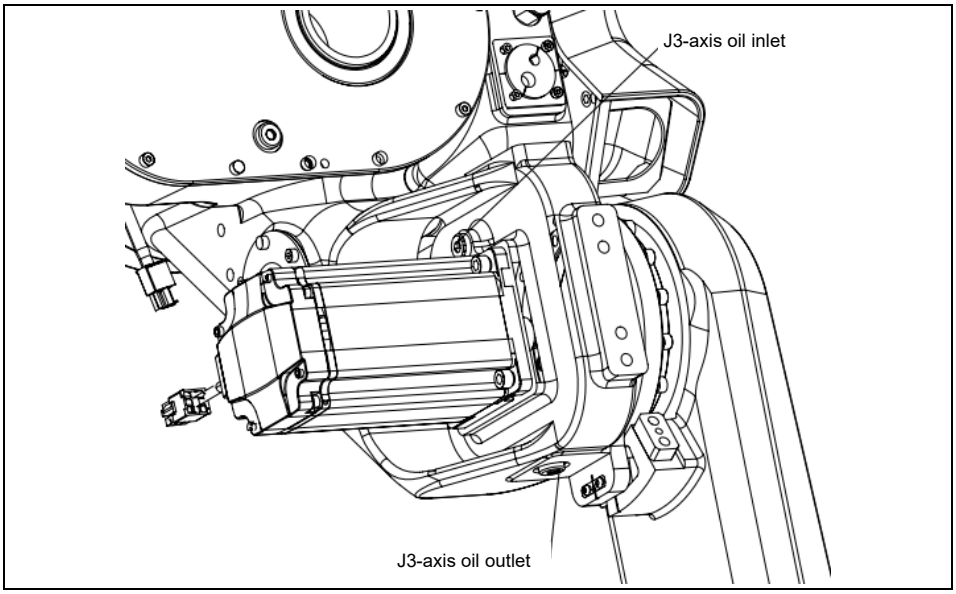


Fig. 5.8 J3-axis oil inlet/outlet (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

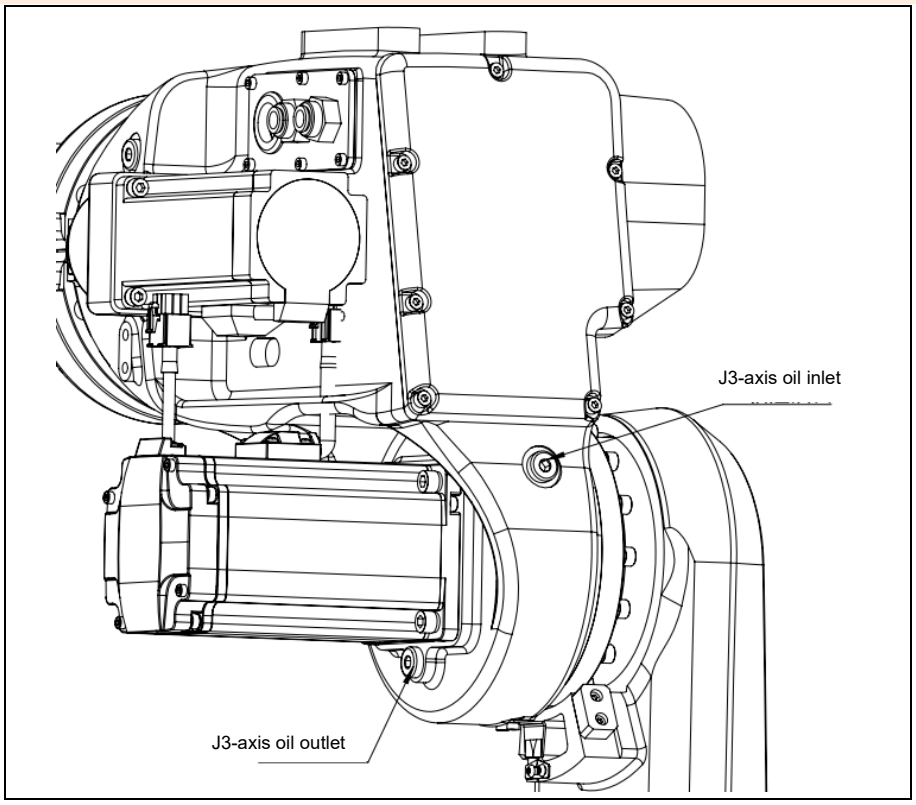


Fig. 5.9 J3-axis oil inlet/outlet (QRC 305 Eco)

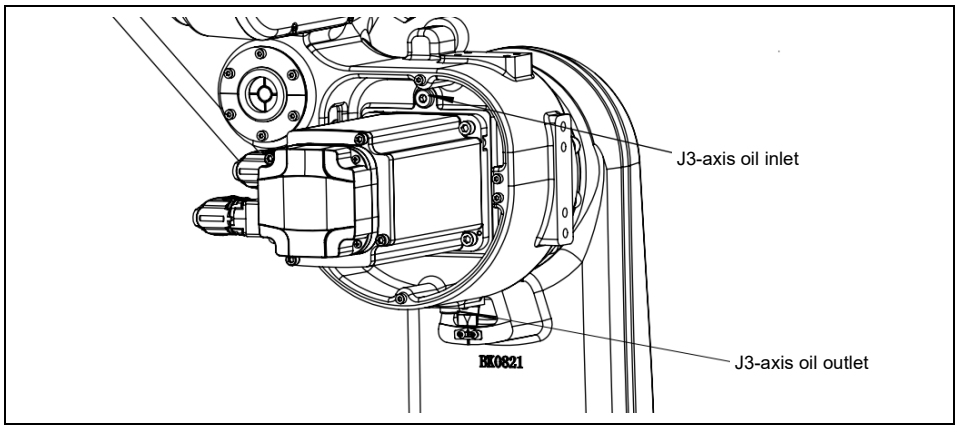


Fig. 5.10 J3-axis oil inlet/outlet (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

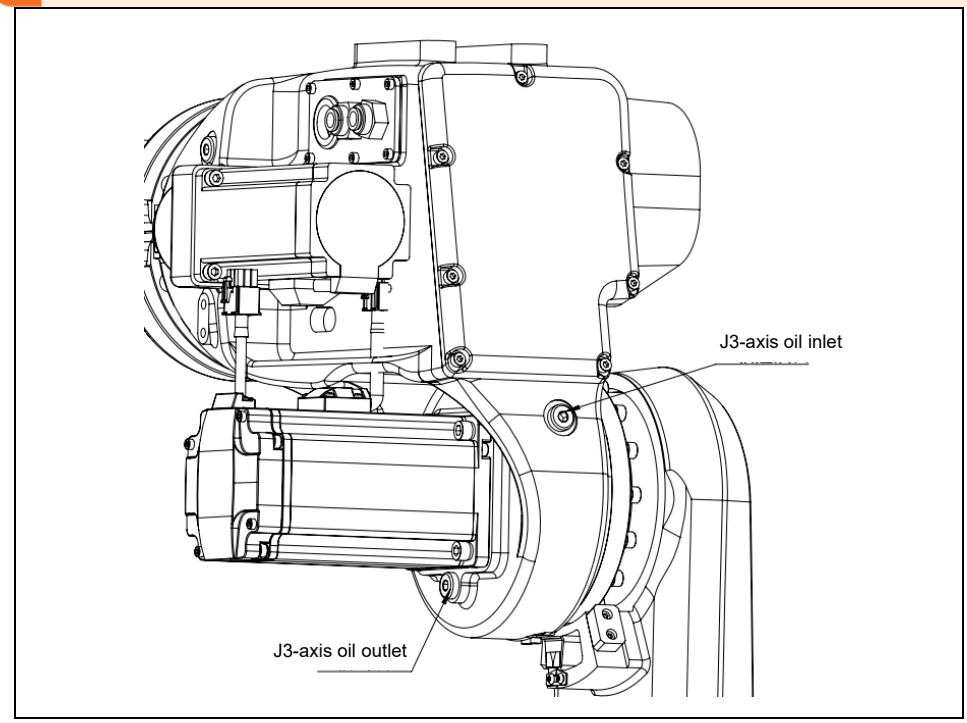


Fig. 5.11 J3-axis oil inlet/outlet (QRC-405 Eco)

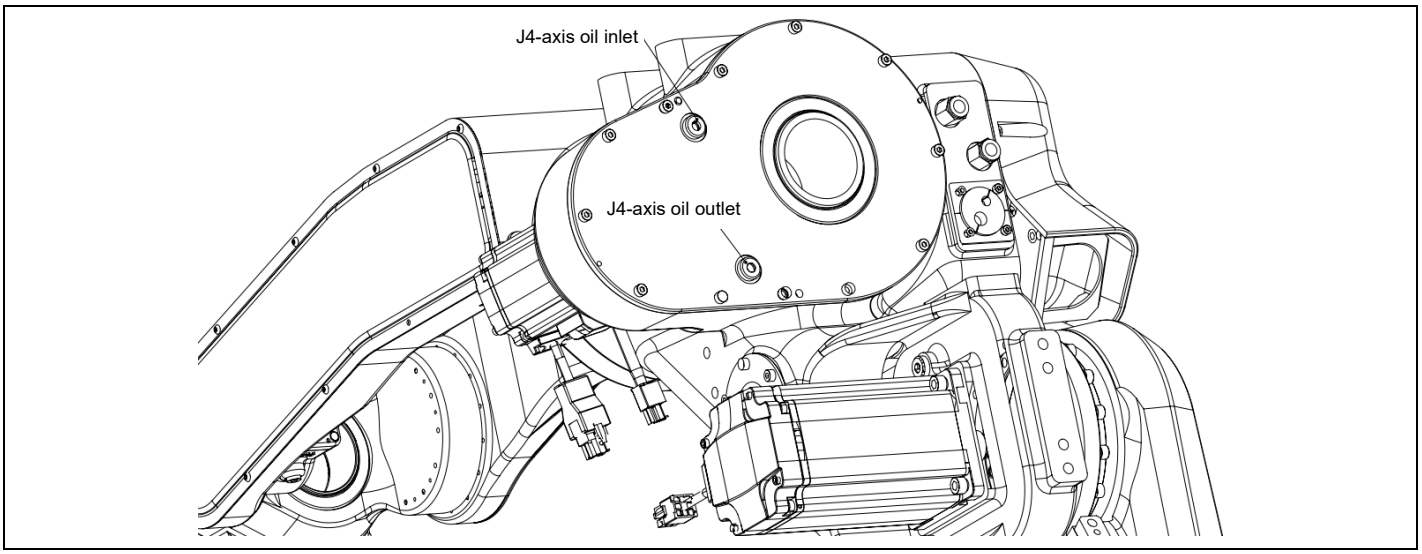


Fig. 5.12 J4-axis oil inlet/outlet (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

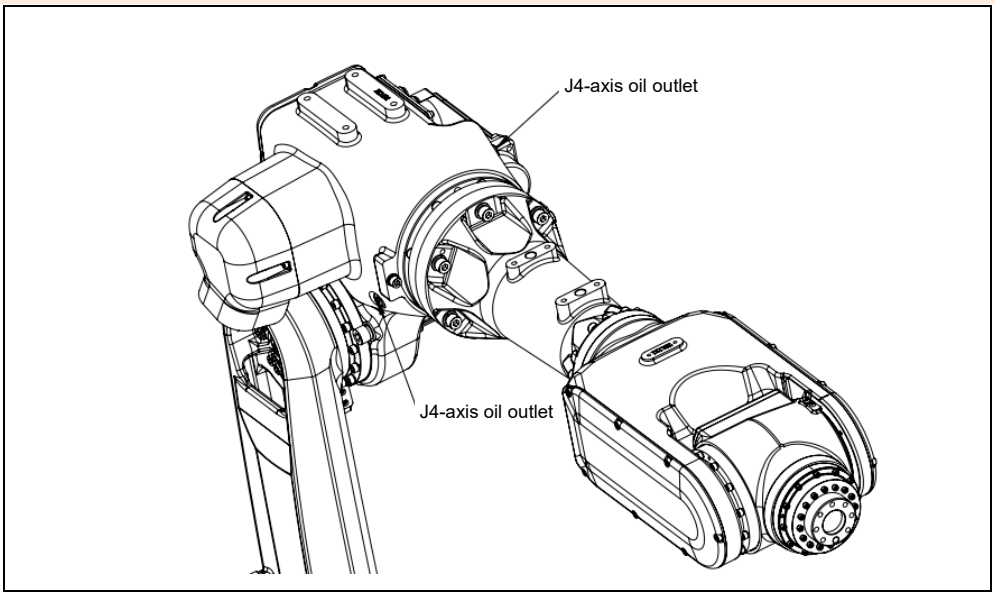


Fig. 5.13 J4-axis oil inlet/outlet (QRC 305 Eco)

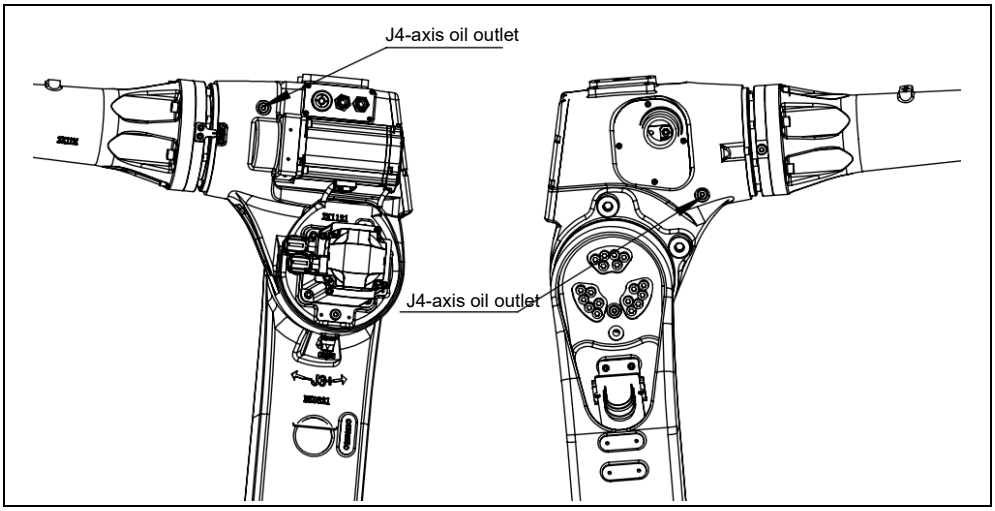


Fig. 5.14 J4-axis oil inlet/outlet (QRC-405 Eco)

5.4.2. Procedure for lubricant replacement

The following steps are specifically for the operation and maintenance of the J1, J2, J3, and J4 axis gearboxes. Please follow the instructions below:

a) Teach the robot to run at 100% speed for 10-20 minutes to allow the internal lubricant to become a low-viscosity oil;
b) Move the robot to the lubricating joint angles and turn off the power;
c) Place an oil collection container below the oil drain outlet;
d) Remove the plugs from the corresponding oil drain and lubricant inlet ports;
e) Inject new lubricant through the lubricant inlet port until the lubricant flowing out from the oil drain outlet becomes the same as the newly added lubricant. Adjust the injection amount using

a measuring tool to ensure consistency between the added and drained lubricant quantities (including the hot machine discharge);

f) Release the residual pressure from the lubricant reservoir following the steps in 1.4.2;

g) Install and tighten the plugs on the lubricant inlet and oil drain ports with a torque of 13.7N·m.

Failure to perform the lubrication procedure correctly may result in a sudden increase in internal pressure in the lubricating chamber, potentially damaging the sealing parts and leading to lubricant leakage and abnormal operation. Therefore, please adhere to the following precautions when performing lubrication:

- Before injecting lubricant, open the lubricant vent (remove the plug from the lubricant outlet).
- Inject the lubricant /grease slowly and avoid excessive force.
- If possible, avoid using compressed air pumps (driven by factory air supply).
- Only use the specified type of lubricating oil/grease. Using any other type of lubricant may damage the gearbox or cause other issues.
- After lubrication, check for any lubricant leakage from the outlet and ensure that the lubricating chamber is not pressurized before closing the lubricant outlet.
- Thoroughly clean any excess lubricating oil/grease from the floor and robot to prevent accidents such as slipping or fire hazards.

5.4.3. Procedure for releasing residual pressure from the lubricant reservoir

Please follow the steps below to release the residual pressure. During this process, install a recovery bag below the oil outlet to prevent the lubricating grease from splattering.

1. Start the robot and load the robot running-in program to run continuously for 4 hours under full load and at 100% speed;

2. Stop the robot running program and bring the robot to the zero position for each axis (i.e., the home position of the robot). Disable the teach pendant;

3. After ensuring safety, remove the specified plugs as indicated below. When removing the plugs, do not face them directly to prevent high-pressure and high-temperature oil spray causing injury to personnel;

4. After removing the plugs, wait for 3 to 5 seconds and then tighten them back. Clean the area around the plugs with a clean cloth to remove any oil;

5. Please make sure to complete the pressure relief process (steps 3 and 4) for one unit within 15 minutes. Otherwise, restart from step 1.

6. Zero Calibration

6.1. Introduction

Zero 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, zero calibration is an operation for obtaining the pulse count value, corresponding to the zero position.

- “Zero 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
- Batteries for pulse count backup in the mechanical unit have gone dead

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. Calibration with instrumentation

During the factory setup, all loads on the robot need to be removed, and instrumentation is used for calibration. This calibration method is based on the complete set of robot parameters and utilizes instrumentation and software to achieve the most precise zero-point calibration.

In case of electrical or software issues resulting in the loss of zero-point data, restoring the previously stored zero-point data serves as a quick teaching and debugging reference. However, if mechanical disassembly or repairs lead to the loss of robot zero-point data, this method cannot be applied.

CLOOS employs robot encoder information to assist in zero-point calibration, following these steps:

a) Manually operate the robot and align the axis with two zero reference marks.

b) Open the encoder information display interface and compare the current actual single-turn data with the previously calibrated reference single-turn data. Adjust the axis at a lower speed to make the current single-turn data closely match the reference single-turn data.

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

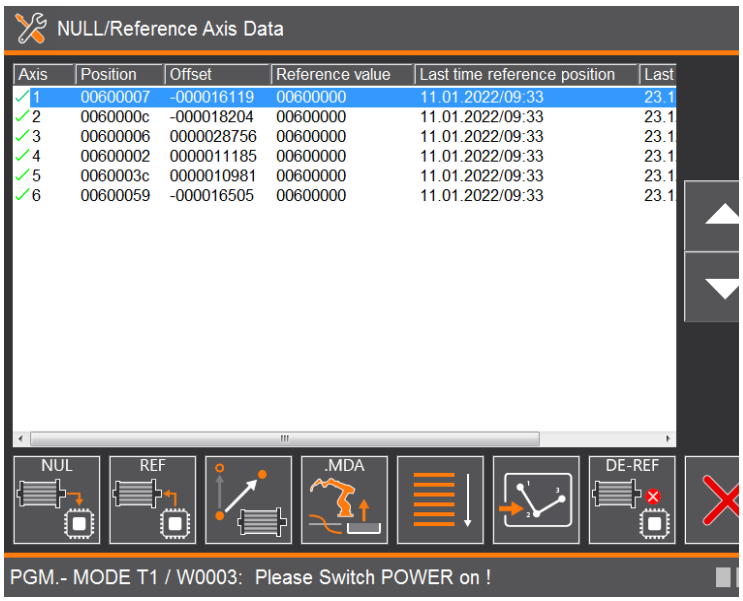


Fig. 6.1 Quick zero calibration single-turn value

6.3. Mechanical zero calibration

6.3.1. Zero calibration method

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

The zero calibration for each robot axis is carried out using the zero-mark alignment method.

6.3.1.1. Zero-mark alignment calibration

The zero-point calibration is performed using the zero-mark alignment method, which involves aligning the joint mark with the middle mark on the zero-mark sticker by visual inspection. Adjust the robot to align with the scale line.

Using the J1 axis as an example, the calibration steps are described below. There is a mark on both the base and the turntable, and the calibration should be conducted as follows:

a) Use teach pendant to move J1-axis to the position where two marks are aligned.

b) Set this position as zero position of J1-axis with the teach pendant.

Perform zero position 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.

6.3.2. Zero calibration for J1-axis

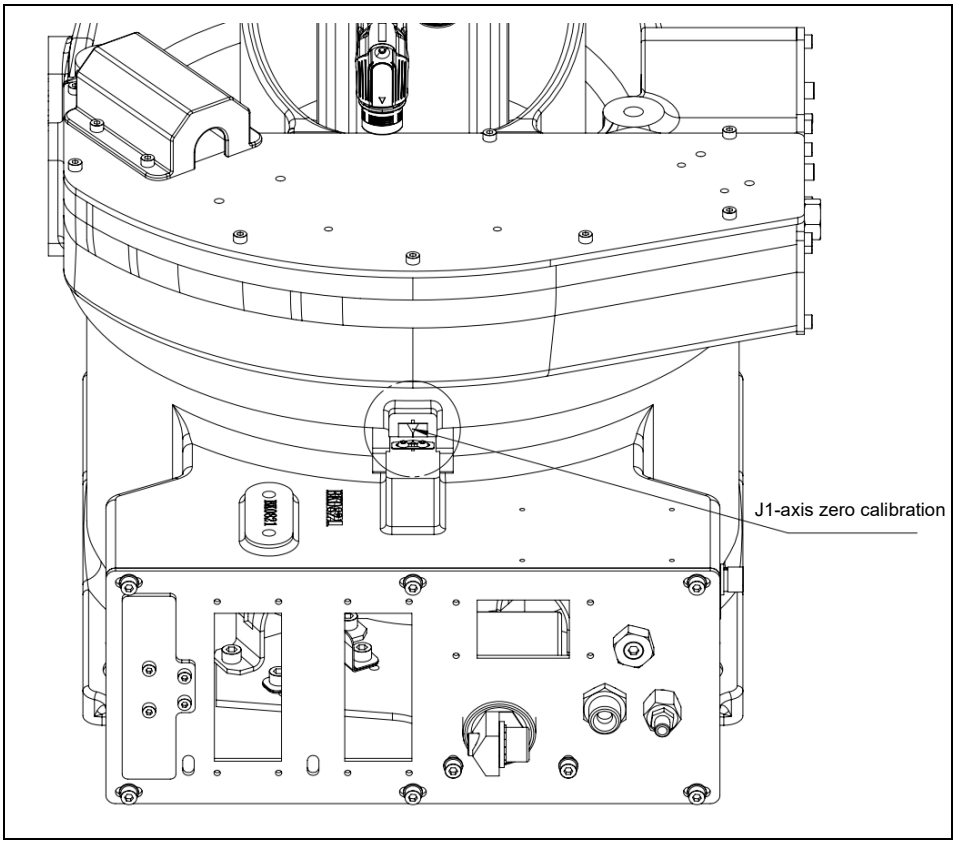


Fig. 6.2 Calibration for J1-axis (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

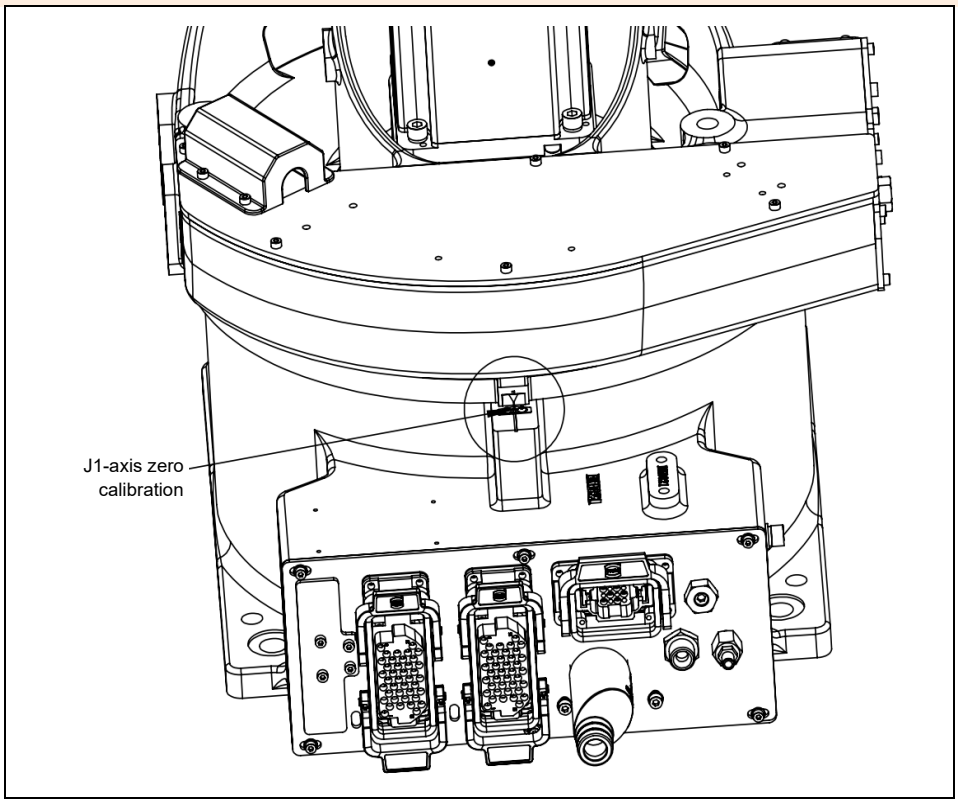


Fig. 6.3 Calibration for J1-axis (QRC 305 Eco, QRH-405, QRH-405 Eco, QRH-405 Eco-S, QRC-405 Eco)

6.3.3. Zero calibration for J2-axis

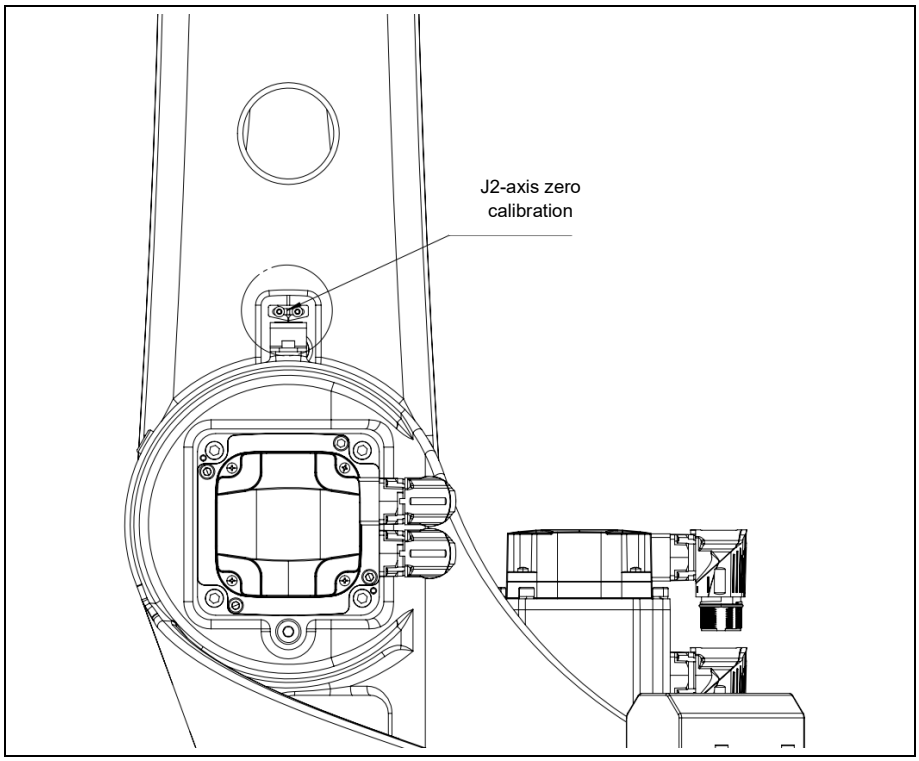


Fig. 6.4 Calibration for J2-axis (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

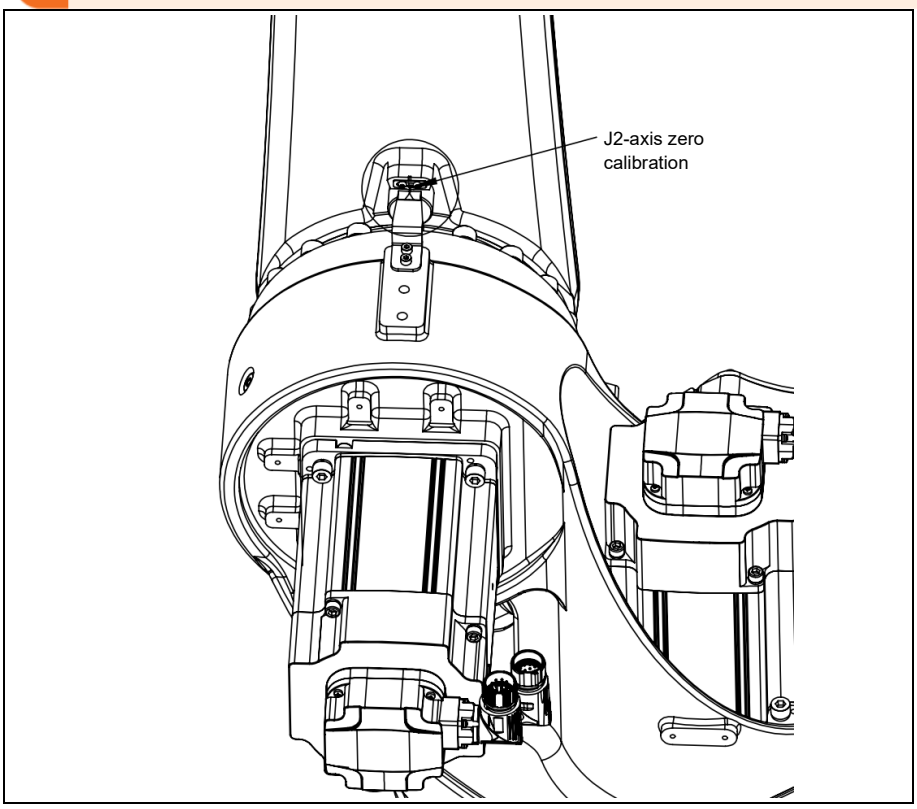


Fig. 6.5 Calibration for J2-axis (QRC 305 Eco, QRH-405, QRH-405 Eco, QRH-405 Eco-S, QRC-405 Eco)

6.3.4. Zero calibration for J3-axis and J4-axis

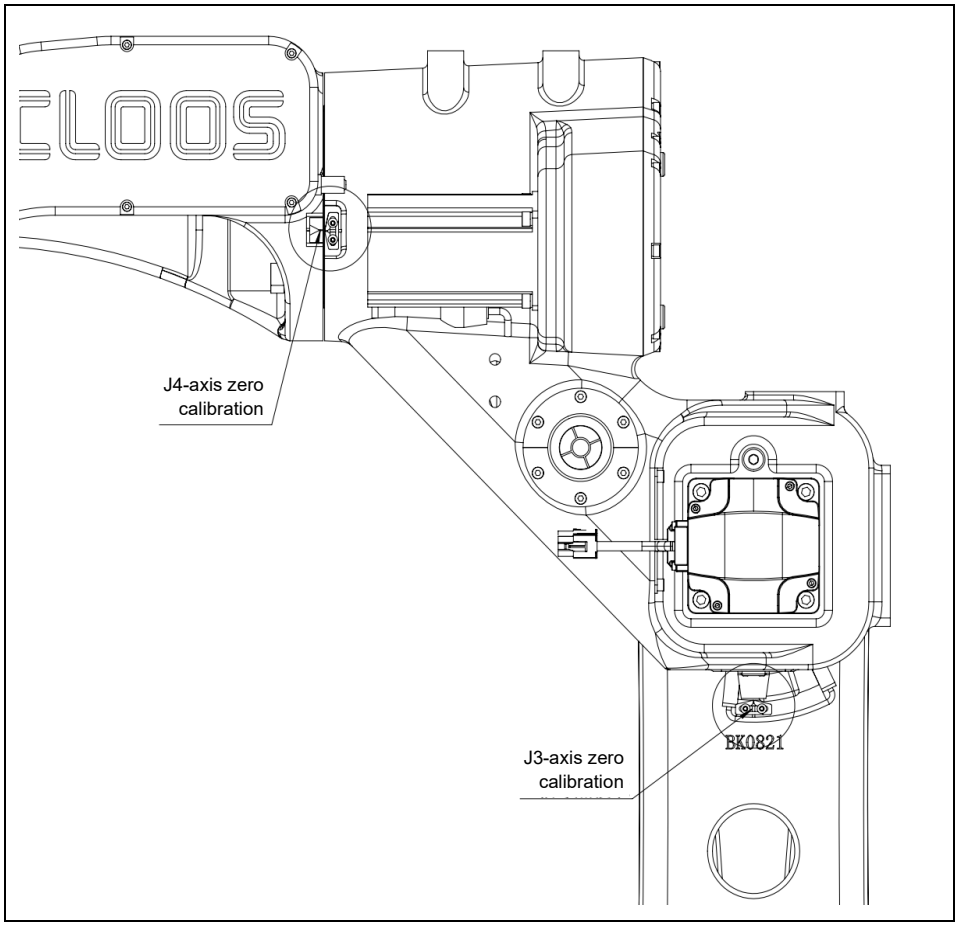


Fig. 6.6 Calibration for J3-axis and J4-axis (QRH-295, QRH-295 Eco, QRH 295 Eco-S)

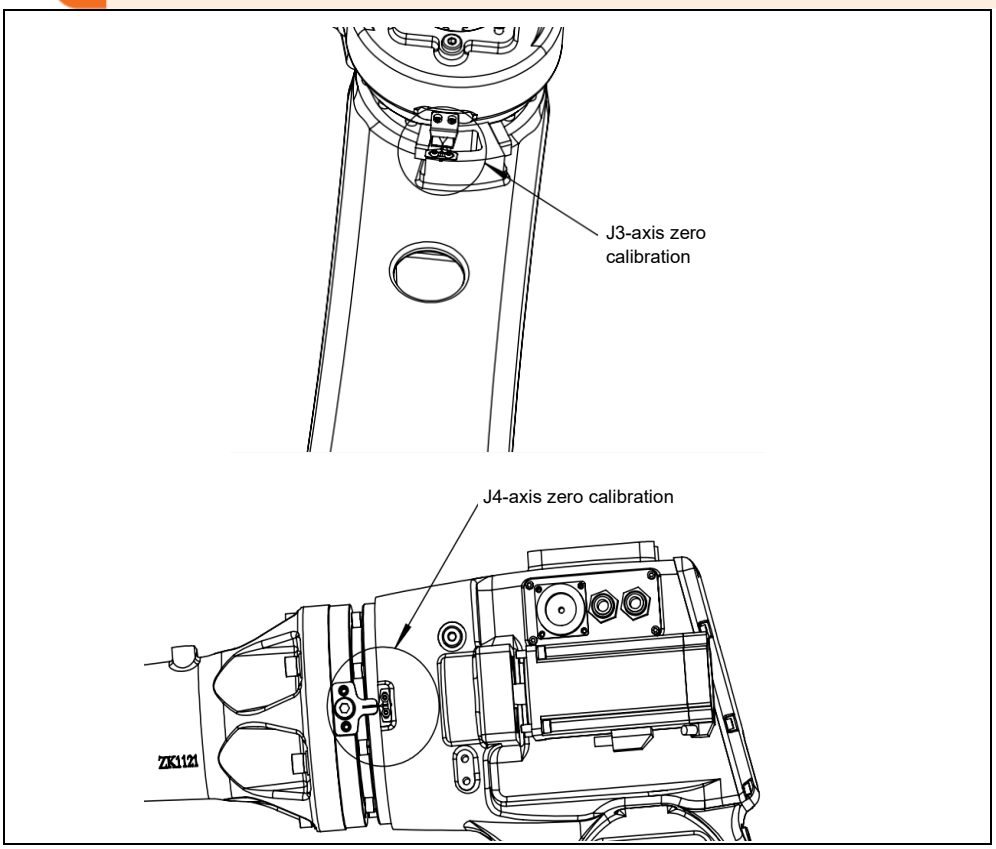


Fig. 6.7 Calibration for J3-axis and J4-axis (QRC 305 Eco)

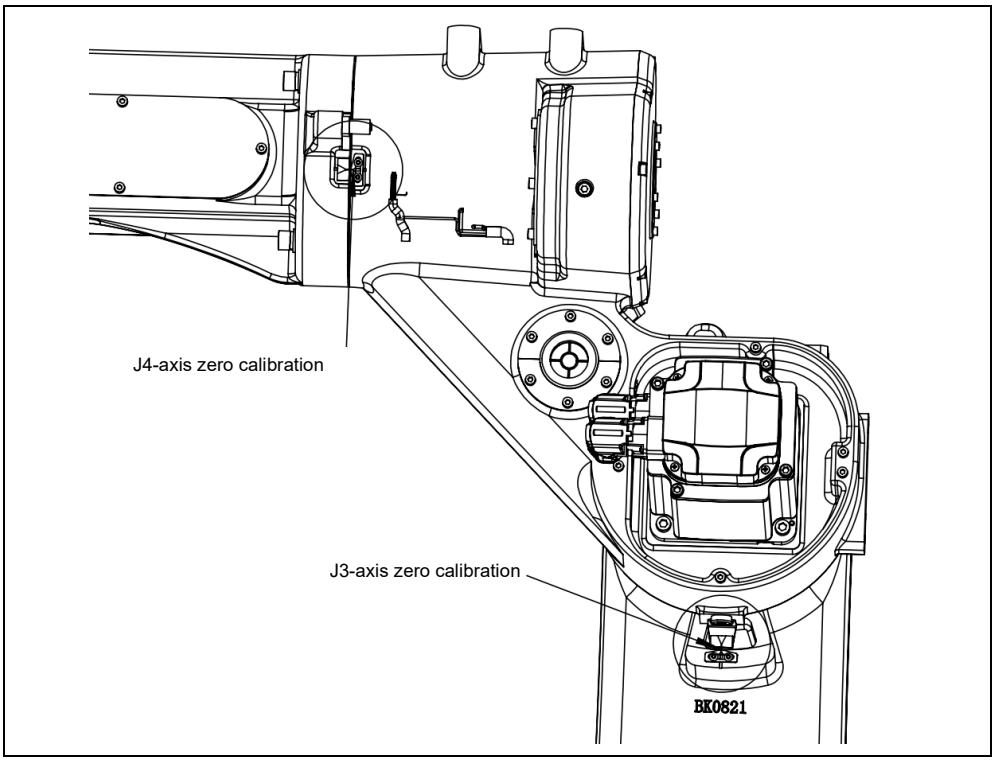


Fig. 6.8 Calibration for J3-axis and J4-axis (QRH-405, QRH-405 Eco, QRH-405 Eco-S)

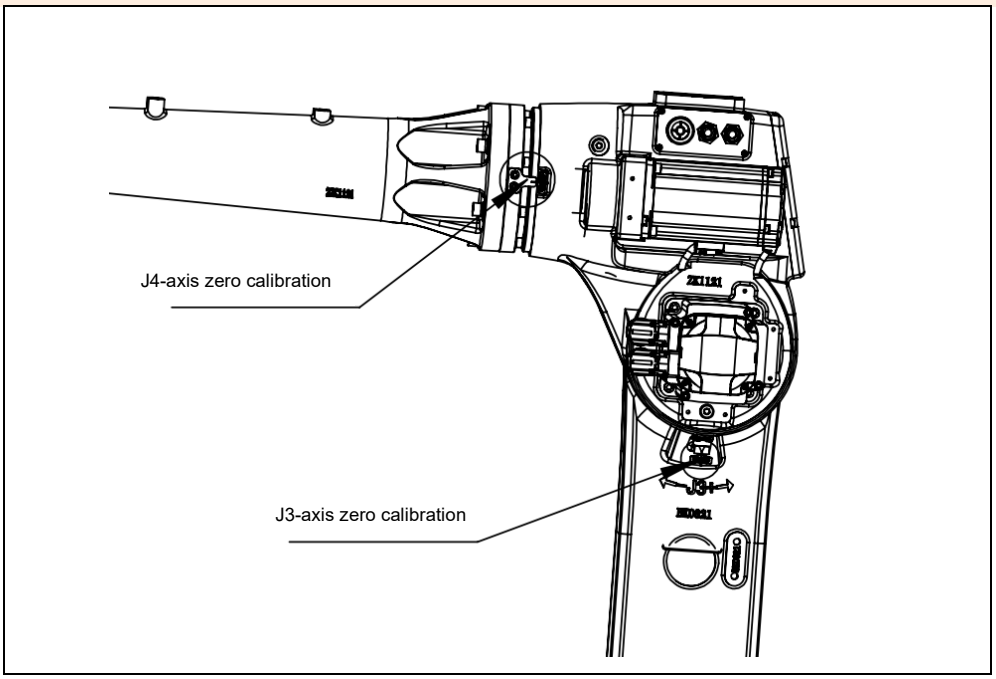


Fig. 6.9 Calibration for J3-axis and J4-axis (QRC-405 Eco)

6.3.5. Zero calibration for J5-axis and J6-axis

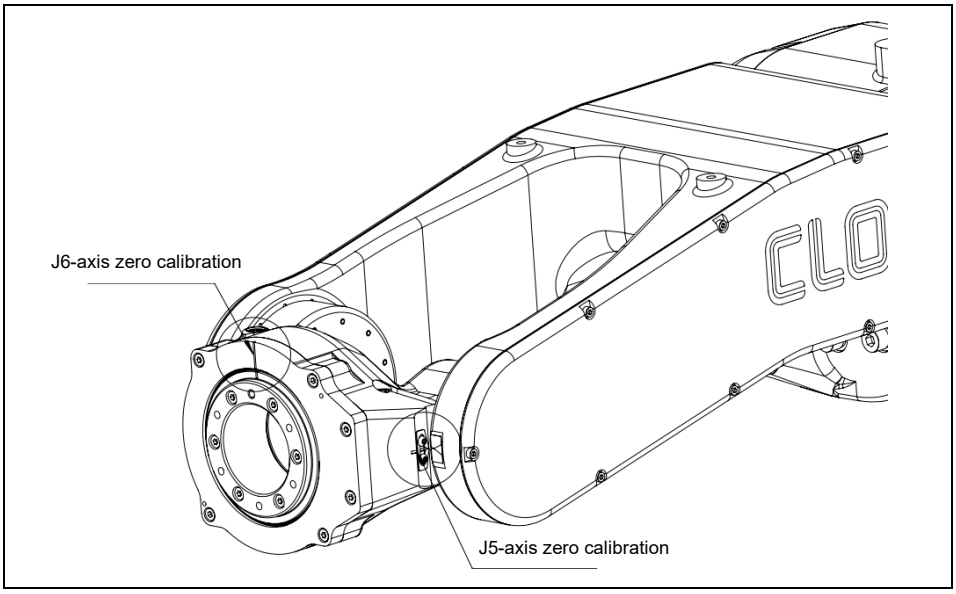


Fig. 6.10 Calibration for J5-axis and J6-axis (QRH-295, QRH-295 Eco, QRH 295 Eco-S, QRH-405, QRH-405 Eco, QRH-405 Eco-S)

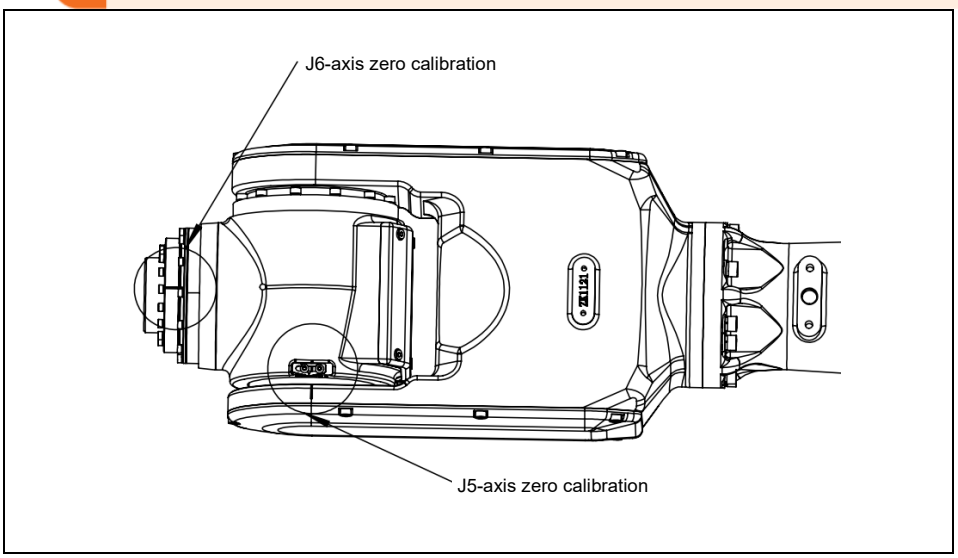


Fig. 6.11 Calibration for J5-axis and J6-axis (QRC 305 Eco)

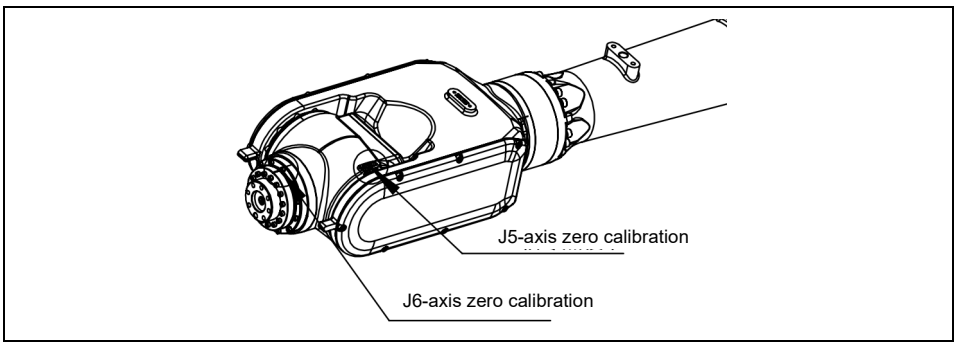


Fig. 6.12 Calibration for J5-axis and J6-axis (QRC-405 Eco)

7. Troubleshooting

Safety tips: Be sure to read SAFETY PRECAUTIONS in Chapter 1 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	Solution
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.
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.

Symptom	Description	Cause	Solution
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 oil seal.	Replace the damaged sealing oil seal or O-ring.
		There are gaps present on the sealing surface.	Tighten the installation screws to ensure a tight fit between the mating surfaces.
		There are issues with the oil nozzle or plug.	Replace the faulty oil nozzle or plug with a new one.
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. Replacement of servo motor components

Contact CLOOS technical representative if servo motor replacement is needed.

Caution!

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

Danger!

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.

Appendix

Appendix A Screw tightening 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 and technical parameters 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 List of recommended spare parts for QRH-295

S/N	Material code	Name	Qty.	Remark
1	12700000274	Robot servo motor (J1/J2-axis)	2	
2	12700000265	Robot servo motor (J3-axis)	1	
3	12700000368	Robot servo motor (J4-axis)	1	
4	12700000369	Robot servo motor (J5/J6-axis)	2	
5	51200000103	Sunmoon_3.6V/AA/ER14505_Wuhan Zhongyuan	6	
6	G5400000306	Timing belt (J5-axis)	1	
7	G5400000307	Timing belt (J6-axis)	1	

Appendix D List of recommended spare parts for QRH-295 Eco

S/N	Material code	Name	Qty.	Remark
1	12700000274	Robot servo motor (J1/J2-axis)	2	

2	12700000265	Robot servo motor (J3-axis)	1	
3	12700000368	Robot servo motor (J4-axis)	1	
4	12700000369	Robot servo motor (J5/J6-axis)	2	
5	51200000103	Sunmoon_3.6V/AA/ER14505_ Wuhan Zhongyuan	6	
6	G5400000306	Timing belt (J5-axis)	1	
7	G5400000307	Timing belt (J6-axis)	1	

Appendix E List of recommended spare parts for QRH 295 Eco-S

S/N	Material code	Name	Qty.	Remark
1	12700000800	Robot servo motor (J1/J2-axis)	2	
2	12700000799	Robot servo motor (J3-axis)	1	
3	12700000794	Robot servo motor (J4-axis)	1	
4	12700000793	Robot servo motor (J5/J6-axis)	2	
5	51200000103	Sunmoon_3.6V/AA/ER14505_ Wuhan Zhongyuan	6	
6	G5400000306	Timing belt (J5-axis)	1	
7	G5400000307	Timing belt (J6-axis)	1	

Appendix F List of recommended spare parts for QRC 305 Eco

S/N	Material code	Name	Qty.	Remark
1	12700000523	Robot servo motor (J1/J2-axis)	2	
2	12700000521	Robot servo motor (J3-axis)	1	
3	12700000810	Robot servo motor (J4-axis)	1	
4	12700000617	Robot servo motor (J5-axis)	1	
5	12700000368	Robot servo motor (J6-axis)	1	
6	51200000103	Sunmoon_3.6V/AA/ER14505_ Wuhan Zhongyuan	6	
7	G5400000306	Timing belt (J5-axis)	1	
8	G5400000307	Timing belt (J6-axis)	1	

Appendix G List of recommended spare parts for QRH-405

S/N	Material code	Name	Qty.	Remark
1	12700000412	Robot servo motor (J1/J2-axis)	2	
2	12700000410	Robot servo motor (J3-axis)	1	
3	12700000413	Robot servo motor (J4-axis)	1	
4	12700000369	Robot servo motor (J5/J6-axis)	2	
5	51200000103	Sunmoon_3.6V/AA/ER14505_ Wuhan Zhongyuan	6	
6	G5400000306	Timing belt (J5-axis)	1	
7	G5400000307	Timing belt (J6-axis)	1	

Appendix H List of recommended spare parts for QRH-405 Eco

S/N	Material code	Name	Qty.	Remark
1	12700000675	Robot servo motor (J1/J2-axis)	2	
2	12700000523	Robot servo motor (J3-axis)	1	
3	12700000413	Robot servo motor (J4-axis)	1	
4	12700000369	Robot servo motor (J5/J6-axis)	2	
5	51200000103	Sunmoon_3.6V/AA/ER14505_ Wuhan Zhongyuan	6	
6	G5400000306	Timing belt (J5-axis)	1	
7	G5400000307	Timing belt (J6-axis)	1	

Appendix I List of recommended spare parts for QRH-405 Eco-S

S/N	Material code	Name	Qty.	Remark
1	12700000412	Robot servo motor (J1/J2-axis)	2	
2	12700000410	Robot servo motor (J3-axis)	1	
3	12700000413	Robot servo motor (J4-axis)	1	
4	12700000369	Robot servo motor (J5/J6-axis)	2	
5	51200000103	Sunmoon_3.6V/AA/ER14505_ Wuhan Zhongyuan	6	
6	G5400000306	Timing belt (J5-axis)	1	
7	G5400000307	Timing belt (J6-axis)	1	

Appendix J List of recommended spare parts for QRC-405 Eco

S/N	Material code	Name	Qty.	Remark
1	12700000675	Robot servo motor (J1/J2-axis)	2	
2	12700000523	Robot servo motor (J3-axis)	1	
3	12700000623	Robot servo motor (J4-axis)	1	
4	12700000617	Robot servo motor (J5-axis)	1	
5	12700000619	Robot servo motor (J6-axis)	1	

Revision Record

Revision	Date	Contents
01	2021.09	New edition.
02	2022.03	Add the models of QRH-405, QRH-405 Eco and QRH-405 Eco-S.
03	2022.07	Add the models of QRH-295 Eco and QRC-405 Eco; update the drawings; modify the robot models.
04	2022.09	Add the models of QRH-405 Eco and QRH-405 Eco-S; update the connection to the control unit.
05	2022.12	Add the models of QRH 295 Eco-S and QRC 305 Eco.

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