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Industrial Robot

工业机器人

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Mechanical use and maintenance manual

机械使用维护手册

The first edition

第一版

CMA (WuHu) Robotics CO.,LTD

希美埃（芜湖）机器人技术有限公司

CMA (WuHu) Robotics co., Ltd

希美埃（芜湖）机器人技术有限公司



CMA(WuHu) Robotics co., ltd is a Joint-Venture company specialized for painting robots. In 2015, it is established by Anhui Efort Intelligent Equipment co., Ltd and Italy CMA Robotics spa. The company is located in National Robots Industry Park-Wuhu City.

希美埃（芜湖）机器人技术有限公司是一家专业从事喷涂机器人研发、制造和应用的的中外合资企业。2015年由安徽埃夫特智能装备有限公司与意大利 CMA 机器人技术有限公司共同创立。公司位于国家级机器人产业聚集区——国家(芜湖)机器人产业园。

CMA Robotics spa is established in 1994, and the headquarter is located in North Italy Udine City. As the first supplier that has proposed painting robots self-learning function, CMA has a great influence in Italy and European market for automobile and the components, metals, mechanical, furniture, wood, ceramics, sanitary ware and plastic products

意大利 CMA 机器人技术有限公司成立于 1994 年，总部位于意大利北部的乌迪内市，是全球第一家提出机器人自学习功能的喷涂机器人供应商。CMA 在意大利乃至欧洲的汽车及零部件、五金、机械、家具、木材、陶瓷、卫浴、塑料制品等喷涂机器人市场有着重要的影响力。

Anhui Efort Intelligent Equipment co., Ltd is one of the first enterprises engaged in the development and application of industry robots in China. It is established in 2007, Efort has experienced an eight-year continued development, currently has been an advanced manufacturer of national Robots. The company has led some important scientific and technological projects of national class, and has accumulated fruitful achievements in robot industry field.

安徽埃夫特智能装备有限公司是国内较早从事工业机器人的研发和应用企业之一。公司于 2007 年成立，经过 8 年多的发展，目前已跻身于国产机器人的第一梯队。公司先后牵头承担国家重大科技项目，在中国机器人产业领域硕果累累。

The company is based on the goal of recover equipment production industry, with a long-term prospect, sustainable innovation and development.

公司以振兴装备制造业为目标，立足长远，不断创新，永续发展。

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Chapter 1-Safety

第一章安全

1.1 For safe use of the robot

1.1 机器人安全使用须知

Read this section carefully prior to installation, operation, maintenance, or inspection and use equipment correctly. Use the robot only after fully understanding the equipment, all safety points, and comments/suggestions. The following table shows the importance of the following tags/marks in this Operation manual.

实施安装、运转、维修保养、检修作业前，请务必熟读本书及其它附属文件，正确使用本产品。请在充分掌握设备知识、安全信息以及全部注意事项后，再行使用本产品。本说明书采用下列记号表示各自的重要性。



DANGER

Case where a mistake made in handling is likely to cause the user to be exposed to the danger of death or serious injury and where the degree of the urgency (imminence) of the warning.



危险

表示处理有误时，会导致使用者死亡或者负重伤，且危险性非常高的情形。



WARNING

Given for the danger to occur is at the high end of the scales (including high-level danger).



警告

表示处理有误时，会导致使用者死亡或者负重伤的情形。



CAUTION

Cases where a mistake made in handling is likely to cause the user to be exposed to the danger of death or serious injury.



注意

表示处理有误时，会导致使用者轻伤或发生财产损失的情形。

1.1.1 Precautions when performing adjustment, operation or maintenance

1.1.1 进行调整、操作、保全等作业时的安全注意事项

1). Operators must be involved in industrial robot operating professional training, and must

wear overalls, helmets, safety glasses and safety shoes.

- 1) 作业人员须经过工业机器人操作专业培训，须穿戴工作服、安全帽、安全鞋等。
- 2). Make sure there is no one in the robot work area when the power is turned ON. Take off gloves when operating, save the data on a regular basis; Please confirm that the axial limited block be intact and effective.
- 2) 投入电源时，请确认机器人的动作范围内没有作业人员，操作时摘下手套，定期保存数据；请确认各轴限位块完好有效。
- 3). Only perform work within the robot work area after making sure the motor power is OFF.
- 3) 必须切断电源后，方可进入机器人的动作范围内进行作业。
- 4). In cases where inspection or maintenance work has to be done with motor power ON, perform the work in pairs. One person must stand guard and ready to press an emergency stop button. The other person must work quickly and carefully within the robot operating area. Always allocate, confirm and know an escape route prior to beginning work.
- 4) 有时，检修、维修保养等作业必须在通电状态下进行。此时，应2人1组进行作业。1人保持可立即按下紧急停止按钮的姿势，另1人则在机器人的动作范围内，保持警惕并迅速进行作业。此外，应确认好撤退路径后再行作业。
- 5). Ensure payload on the wrist and forearm is within specifications. Excessive loads may cause poor robot operation and eventually damage the robot.
- 5) 手腕部位及机械臂上的负荷必须控制在允许搬运重量以内。如果不遵守允许搬运重量的规定，会导致异常动作发生或机械构件提前损坏。
- 6). Please read carefully the instructions of robot electrical maintenance manual "safety notes" section.
- 6) 请仔细阅读使用说明书《机器人电气维护手册》的“安全注意事项”章节的说明。
- 7). Do not disassemble or operate any part that is not explained in the Maintenance manuals.
- 7) 禁止进行维修手册未涉及部位的拆卸和作业。

It is possible the robot will make an emergency/safe stop if an abnormal situation occurs, this is due to various self diagnostic functions and abnormality detecting functions provided. However, the robot is not 100% safe.

机器人配有各种自我诊断功能及异常检测功能，即使发生异常也能安全停止。即便

如此，因机器人造成的事故仍然时有发生。

Robot accidents that occurred in the past were mostly due to the following situations:

机器人事故以下列情况居多：



1、Auto operation started without confirming there were no workers within the robot operating area.

2、People being within the robot operating area when the robot was in auto operationmode and the robot unexpectedly started.

3、People carefully watching one robot but forgetting another one was operating withinreach of them.



1、未确认机器人的动作范围内是否有人，就执行了自动运转。

2、自动运转状态下进入机器人的动作范围内，作业期间机器人突然起动作。

3、只注意到眼前的机器人，未注意别的机器人。

We can summarize the above as unsafe activities caused by human error such as “careless mistakes” and “not following the established procedures.” Workers not be able to take appropriate actions, such as “emergency stop” or “escape from the danger”, when unexpected robot motion occurs which may result in disastrous accidents. Unexpected robot motion includes:

上述事故都是由于“疏忽了安全操作步骤”、“没有想到机器人会突然动作”的相同原因而造成的。换句话说，都是由于“一时疏忽”、“没有遵守规定的步骤”等人为的不安全行为而造成的事故。“突发情况”使作业人员来不及实施“紧急停止”、“逃离”等行为避开事故，极有可能导致重大事故发生。“突发情况”一般有以下几种。

- 1) Sudden change of movement from low speed to high speed.
- 2) Manipulation by other workers.
- 3) Robot operated by a different program due to program mistakes or faulty peripheral equipment.
- 4) Abnormal behavior due to noise, faults or errors.
- 5) Mishandling.
- 6) Operation at a high speed in spite of intended low speed playback.

- 7) Work-piece being handled by the robot is dropped or thrown.
- 8) Work-piece is suddenly released during a stop waiting for interlocking.
- 9) Adjacent or rear robots started operation unexpectedly.
- 1) 低速动作突然变成高速动作。
- 2) 其他作业人员执行了操作。
- 3) 因周边设备等发生异常和程序错误，启动了不同的程序。
- 4) 因噪声、故障、缺陷等原因导致异常动作。
- 5) 误操作。
- 6) 原想以低速执行动作，却执行了高速动作。
- 7) 机器人搬运的工件掉落、散开。
- 8) 工件处于夹持、联锁待命的停止状态下，突然失去控制。
- 9) 相邻或背后的机器人执行了动作。

The above are a few examples; there are of course many other unexpected robot motion patterns. It may be impossible to stop a robot or escape from a robot that started unexpectedly. The best way to avoid such accidents is;

上述仅为一部分示例，还有很多形式的“突发情况”。大多数情况下，不可能“停止”或“逃离”突然动作的机器人，因此应执行下列最佳对策，避免此类事故发生。



“Do not get near the robot as much as possible”.



小心，勿靠近机器人。



The robot is not used, should be taken to "press the emergency stop button", "power off" measures, such as making robots unable to action.



不使用机器人时，应采取“按下紧急停止按钮”、“切断电源”等措施，使机器人无法动作。



Robot movement during configuration, please immediately press the emergency stop button on the monitor (third party), monitor the security situation.

机器人动作期间，请配置可立即按下紧急停止按钮的监视人（第三者），



监视安全状况。



During the robot movement, should be immediately press the emergency stop button for homework.



机器人动作期间，应以可立即按下紧急停止按钮的态势进行作业。

In order to comply with these principles, must fully understand the above notice, and actually do.

为了遵守这些原则，必须充分理解后述注意事项，并切实遵行。

1.1.2 Safety measures for robot

1.1.2 机器人本体的安全对策



The robot is of such design that no unnecessary protrusions or sharp corners exist. It is made of suitable material for use in the environment for which it was designed and has fail-safe construction to minimize damage or accidents during operation. The robot maintains a good level of safety because various safety functions exist; such as those to detect incorrect operation and stop the robot, or to make emergency stops, inter-locking with peripheral equipment, when either device threatens to damage the other.



重要

机器人的设计应去除不必要的突起或锐利的部分，使用适应作业环境的材料，采用动作中不易发生损坏或事故的故障安全防护结构。

此外，应配备在机器人使用时的误动作检测停止功能和紧急停止功能，以及周边设备发生异常时防止机器人危险性的联锁功能等，保证安全作业。



The robot is of multi-articular arm construction, thus each articular angle varies all the time with robot movement. Take care and avoid getting pinched in various articulations, especially when teaching. Pay careful

attention to the stopper blocks mounted on the moving tip of the articulations. The arm may fall under its own weight when motors are removed or brakes are released. Therefore take action to prevent dropping and check that conditions are safe before starting work.



警告

机器人主体为多关节的机械臂结构，动作中的各关节角度不断变化。

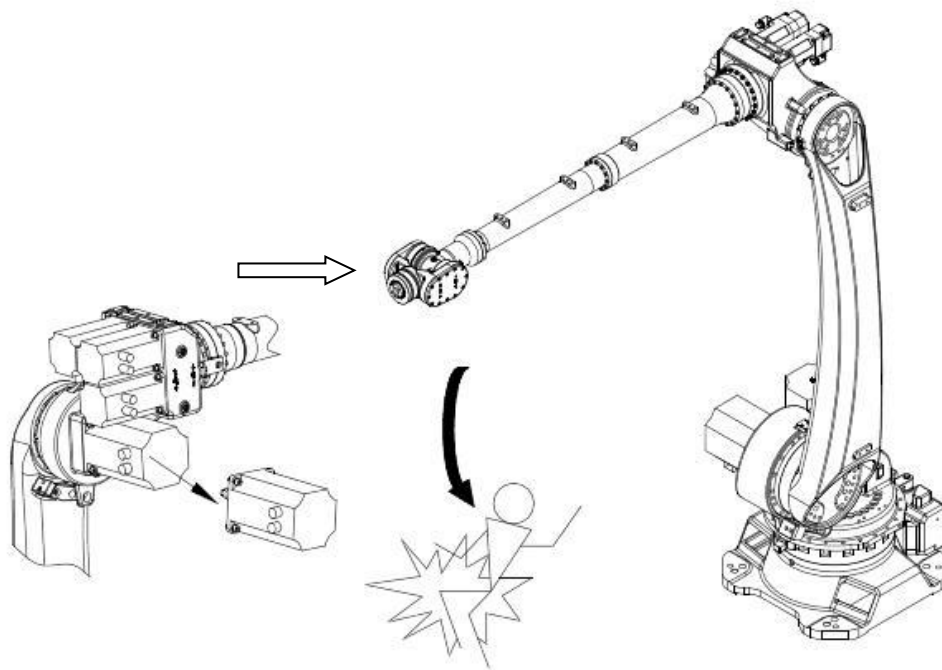
进行示教等作业，必须接近机器人时，请注意不要被关节部位夹住。各关节动作端设有机械挡块，被夹住的危险性很高，尤其需要注意。

此外，若拆下马达或解除制动器，机械臂可能会因自重而掉落或朝不定方向乱动。因此必须实施防止掉落的措施，并确认周围的安全情况后，再行作业。



The motors in this robot have built-in brakes to hold the robot arm in position. As such, when a motor is removed without supporting the arm properly, the arm may drop or move forward or backward. **PROPERLY SUPPORT THE ARM BEFORE REMOVING THE MOTOR.**

没有固定机械臂便拆除马达，机械臂有可能会掉落，或前后移动。请先固定机械臂，然后再拆卸马达。



To prevent the arm from dropping, use a wooden block, nylon sling, crane or other means to support the arm securely before removing the motor. The zeroing pins and zeroing blocks are used for zero position alignment and not for supporting the arm. And, do not support the robot arm by a human's hand.



插入零点栓后，用木块或起重机固定机械臂以防掉落，然后再拆除马达。

（零点栓和挡块用于对准原位置，不可以用来固定机械臂。）

此外，请勿在人手支撑机械臂的状态下拆除马达。



Use specified bolt sizes and number. Tighten them to specified torque with a torque wrench when fitting equipment onto the end effector flange or arms. Use clean rust-free bolts. When transportation it should be fixed on the end executor and accessory machine or remove the end executor and auxiliary machines.

Otherwise bolts may loosen during operation causing serious accidents and injuries.

在末端执行器及机械臂上安装附带机器时，应严格遵守本书规定尺寸、数量的螺栓，使用扭矩扳手按规定扭矩紧固，运输时应固定牢末端执行器及附属机器或拆下末端执行器及附属机器。



此外，不得使用生锈或有污垢的螺栓。

规定外的紧固和不完善的方法会使螺栓出现松动，导致重大事故发生。



When fabricating the end effector, set its weight, static torque and the moment of inertia within the range of the permissible load levels of the robot wrist.



设计、制作末端执行器时，控制在机器人手腕部位的负荷容许值范围内。



Provide a failsafe construction which will ensure that the work gripped will not be released or scattered even when the power or air supply to the end actuator is cut off. Also remove any sharp edges or protrusions in its construction to prevent injury to personnel and damage to property.



应采用故障安全防护结构，即使末端执行器的电源或压缩空气的供应被切断，也不致发生把持物被放开或飞出的事故，并对边角部或突出部进行处理，防止对人、对物造成损害。



In order to operate the robot, services such as electric power, plant air and cooling water for welding should be supplied. However, services out of

specification may affect the robot performance and cause abnormal behavior, errors, or damage, resulting in dangerous situations.

Never use unspecified resources.



严禁供应规格外的电力、压缩空气、焊接冷却水，会影响机器人的动作性能，引起异常动作或故障、损坏等危险情况发生。



It is not possible to eliminate electromagnetic interference completely using the technology available today although the extent of its elimination depends on the type and strength of the interference concerned. In terms of what action to take while the robot is operating and while the power is ON, follow the precautions to be observed during operation. In some cases, electromagnetic waves, other forms of noise or defective circuit boards may erase the recorded work programs. As a safeguard, make backups of the programs, constants, etc. on a Compact flash card or other media.



电磁波干扰虽与其种类或强度有关，但以当前的技术尚无完善对策。机器人操作中、通电中等情况下，应遵守操作注意事项规定。由于电磁波、其它噪声以及基板缺陷等原因，会导致所记录的数据丢失。

因此请将程序或常数备份到闪存卡（Compact flash card）等外部存储介质内。



Consider method to communicate with other workers such as hand signals when conversation takes place between a numbers of workers positioned separately, in a large system (plant) for example. Accidents are likely to occur due to misinterpreted intentions in a noisy site.

Examples of hand signals for industrial robot operation



大型系统中由多名作业人员进行作业，必须在相距较远处作交谈时，应通过使用手势等方式正确传达意图。

环境中的噪音等因素会使意思无法正确传达，而导致事故发生。

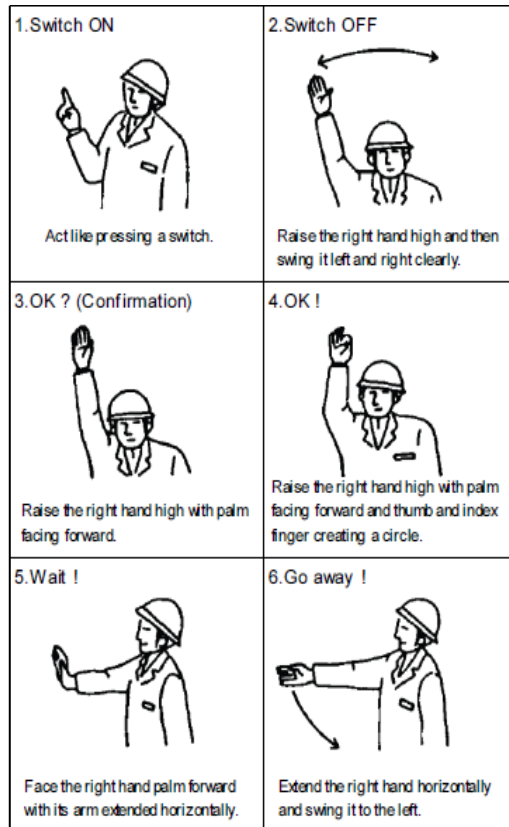
产业用机器人手势法（示例）



CAUTION



注意



CAUTION



注意

Keep a safe place (escape route) in mind at all times to quickly escape on an emergency.

作业人员在作业中，也应随时保持逃生意识。必须确保在紧急情况下，可以立即逃生。



CAUTION



注意

Pay attention to the robot's movement at all times and never work with your back toward the robot. An operator may not notice the start of robot if he/she is not facing it resulting in an accident.

时刻注意机器人的动作，不得背向机器人进行作业。
对机器人的动作反应缓慢，也会导致事故发生。



WARNING

Press the emergency stop button immediately if you notice any abnormality. Make this practice very clear to every operator. A sudden movement may be imminent if you are watching something abnormal.



发现有异常时，应立即按下紧急停止按钮。
必须彻底贯彻执行此规定。



Prepare an appropriate working code and checklists for start up of the robot, how to operate it and what actions to take in an emergency. Proceed with operation according to the working code. Accidents are likely to occur due to forgetfulness and error of operators if relying on memory alone.



应根据设置场所及作业内容，编写机器人的起动方法、操作方法、发生异常时的解决方法等相关的作业规定和核对清单。并按照该作业规定进行作业。仅凭作业人员的记忆和知识进行操作，会因遗忘和错误等原因导致事故发生。



Proceed with work with the robot's power OFF when operation or manipulation of the robot is not necessary. It can never run with its power OFF.



不需要使机器人动作和操作时，请切断电源后再执行作业。



When teaching, always check the program number and step number before operating the robot. Editing of incorrect programs or steps may cause accidents



示教时，应先确认程序号码或步骤号码，再进行作业。
错误地编辑程序和步骤，会导致事故发生。



Protect completed programs from accidental editing by using the memory protect function.



对于已经完成的程序，使用存储保护功能，防止误编辑。



Check robot movement at a low speed using the check go/back function and the velocityoverride function after completing teaching. Accidents due to collision are likely to occur if a program containing a mistake is run at a 100% of full speed in the playback mode.



示教作业完成后，应以低速状态手动检查机器人的动作。
如果立即在自动模式下，以100%速度运行，会因程序错误等因素导致事故发生。



Clean the area within the guard fence and check that tools, etc. are not left there after teaching is complete. A workplace fouled with oil or grease and tools is a hazardous place and may lead to an accident due to stumbling.



“Cleaning the workplace” is a step toward safety.
示教作业结束后，应进行清扫作业，并确认有无忘记拿走工具。作业区被油污染，遗忘了工具等原因，会导致摔倒等事故发生。
确保安全首先从整理整顿开始。

1.2 Movement, alienation and selling of the robot

1.2 机器人的转移、转让、变卖



Hand over all manuals and documents received when purchasing the robot to the new owner when moving, alienating or selling a robot. In particular, if the robot is to be moved, transferred or sold overseas, the user is responsible for preparing and supplying the operating maintenance manuals in the appropriate language, amending the language used for the labels and displays and complying with the laws of the country concerned. Accidents may occur if the new robot owner (operator) operates the robot incorrectly or performs unsafe work tasks due to not receiving and reading the operating instructions.

机器人转移、转让、变卖时，必须确保编程手册、维修保养手册等机器人

附属文件类移交给新的使用者。



注意

转移、转让、变卖到国外时，客户必须负责准备适当语言的操作维修保养说明书，修改显示语言，并保证符合当地法律规定。

新使用者由于没有阅读使用说明书而进行错误操作或不安全作业，会导致事故发生。



CAUTION

When the robot is moved, transferred or sold (either in the country or overseas) by the user, whatever was agreed upon at the time of the robot's initial sale inclusive of the safety related items is not transferable to the new owner unless a special agreement has been concluded. The user must conclude a new agreement with the new owner.



注意

机器人转移、转让、变卖到国外时，最初出售时的合同条款若无特别规定，则包含与安全有关的条款不得由新承受人继承。

原客户与新承受人之间，必须重新签订合同。

1.3 Abandon the robot

1.3 机器人的废弃



CAUTION

Do not disassemble, heat or burn batteries used in the controller and robot as they may catchfire, burst or burn.



注意

请勿分解、加热、焚烧用于控制装置、机器人主体的电池。否则会发生起火、破裂、燃烧事故。



CAUTION

Do not disassemble the controller in detail smaller than PCBs or units.

Sharp edges or electric wire of small disassembled pieces may cause injury.



注意

请勿将控制装置的基板、组件等分解后再废弃。破裂或切口等尖锐部分及电线等可能会造成伤害。



Do not disassemble wire harnesses or manipulator wiring further than disconnecting wiring from connectors or terminal blocks. Disassembled pieces, e.g. conductors, etc., may cause injury to hands or eyes.



电缆线、外部接线从连接器、接线盒拆除后，请勿作进一步分解再废弃。否则可能因导体等导致手或眼受伤。



Use extreme care when scrapping so as to avoid accidents and injury such as pinching hands or fingers.



进行废弃作业时，请充分注意不要被夹伤。



Discard scrapped items safely to avoid injury.



废弃品应在安全状态下废弃。

Chapter 2-Basic specifications

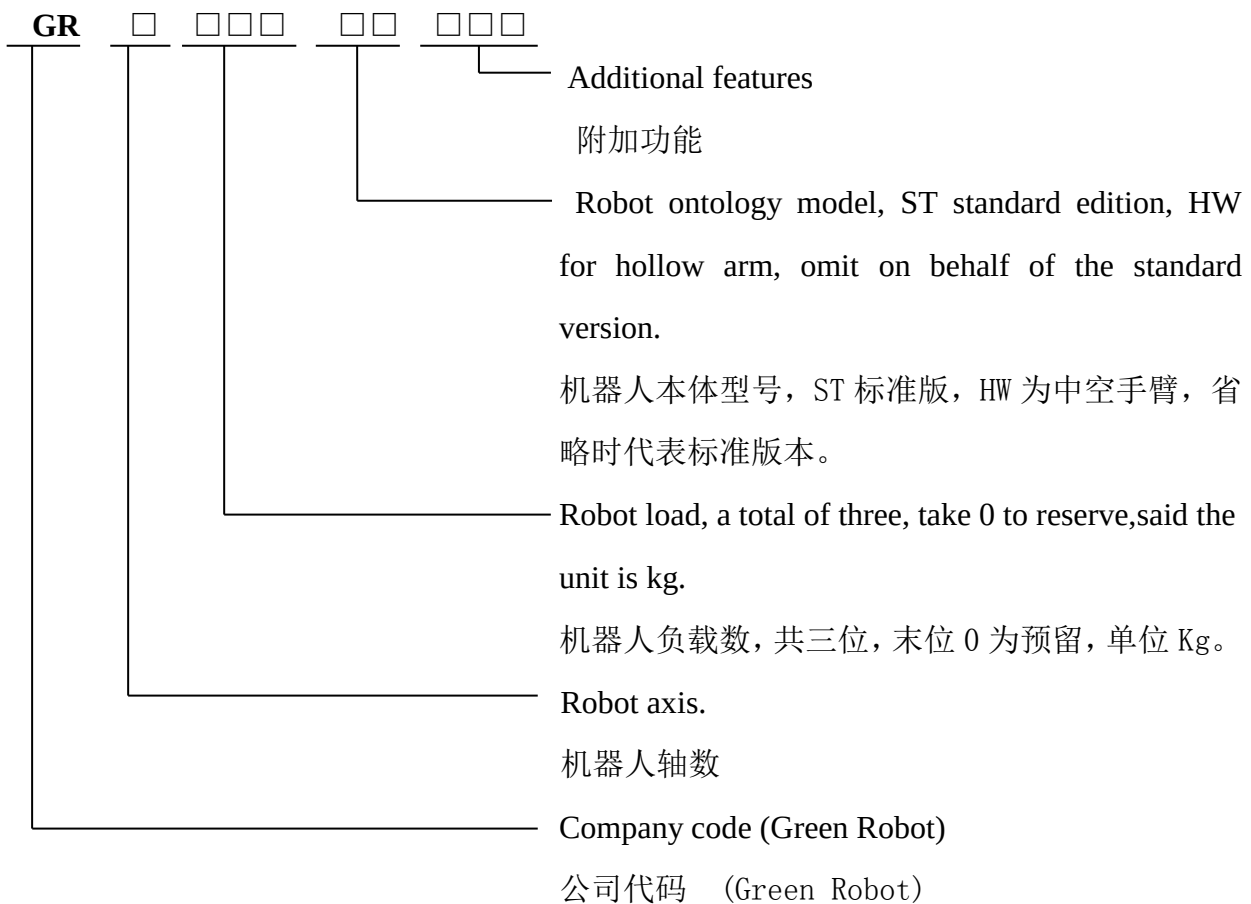
第二章基本说明

2.1 Robot model and nameplate details

2.1 型号规格说明

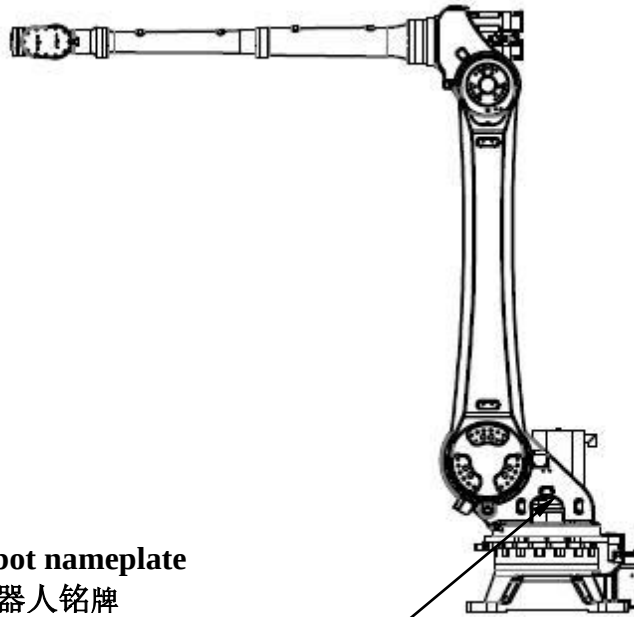
The robot model is stated below:

机器人型号说明如下：



For example: GR6160 refers to the maximum load of 16 kg, 6 degrees of freedom , CMArobot.

例：GR6160 是指 6 轴, 最大负载为 16Kg 的 CMA 机器人。



GR6160 robot nameplate
GR6160 机器人铭牌

C M A			
希美埃（芜湖）机器人技术有限公司 CMA (WuHu) Robotics Co.,Ltd			
产品名称 Product Name		产品型号 Model-Type	
生产日期 Manufacturing Date		生产编号 Manufacturing No.	
臂长 Arm Length		载荷 Payload	
功率 Power		重量 Weight	
中国安徽省芜湖市鸠江经济开发区万春东路96号 No. 96 East Wanchun Road, Jiujiang Zone, Wuhu, Anhui Province, P. R. China			

2.2 Mechanical system

2.2 机械系统组成

Robot mechanical system refers to the machinery of ontology, ontology consists of the base station, the big arm, forearm, forearm extended part, wrist components and ontology of package parts, a total of six motor can drive the six joints movement for different forms of exercise. Figure 2.1 marks each part of the robot and the movement joints.

机器人机械系统是指机械本体组成，机械本体由底座部分、大臂、小臂部分、小臂加长部分、手腕部件和本体管线包部分组成，共有 6 个马达可以驱动 6 个关节的运动实现不同的运动形式。图 2.1 标示了机器人各个组成部分及各运动关节的规定。

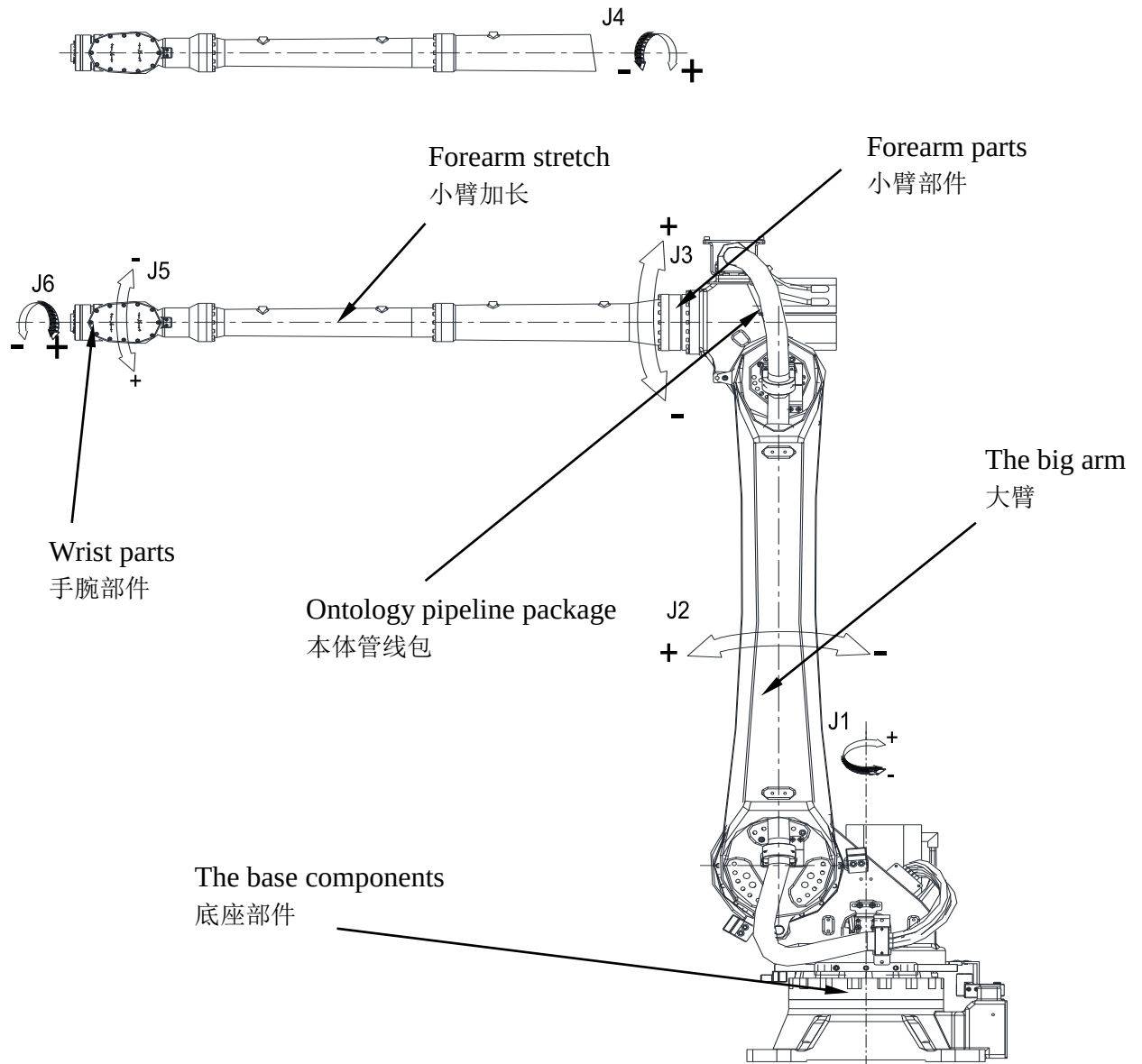


Fig 2.1 Robot mechanical system diagram

图 2.1 机器人机械系统组成图

2.3 The mechanical performance parameters

2.3 机械性能参数

2.3.1 The definition of performance parameters

2.3.1 性能参数定义

The performance parameters of robot mainly includes working space, the robot load, the robot movement speed, the robot's maximum motion range and repeat positioning accuracy.

机器人性能参数主要包括工作空间、机器人负载、机器人运动速度、机器人最大动作范围和重复定位精度。

1)The robot working space

Reference GB (GB/T 12643) industrial robot vocabulary, define the working space for robot wrist when motion reference point (J4 axis and J5 axis intersection of) a collection of all points can achieve.

1) 机器人工作空间

参考国标工业机器人词汇（GB/T 12643），定义工作空间为机器人运动时手腕参考点（J4 轴线与 J5 轴线的交点）所能达到的所有点的集合。

2)Robot load setting

Reference GB industrial robot vocabulary (GB/T 12643), define the maximum load at the end of the robot in the work within the scope of any posture can withstand the maximum quality.

2) 机器人负载设定

参考国标工业机器人词汇（GB/T 12643），定义末端最大负载为机器人在工作范围内的任何位姿上所能承受的最大质量。

3) The robot movement speed

Reference GB industrial robot performance testing method (GB/T 12645), define a maximum rate of movement joint robot the maximum speed of single joint movement.

3) 机器人运动速度

参考国标工业机器人性能测试方法（GB/T 12645），定义关节最大运动速度为机器人单关节运动时的最大速度。

4) The maximum operating range of the robot

Reference GB industrial robot acceptance rules (JB/T 8896), define the scope of work for the biggest robot motion can achieve maximum Angle of each joint.Robot each axis has soft and hard limit, the movement of the robot cannot exceed the soft limit, if beyond, called super trip, by the hard limit to complete the mechanical constraints of the axis.

4) 机器人最大动作范围

参考国标工业机器人验收规则（JB/T 8896），定义最大工作范围为机器人运动时各关节所能达到的最大角度。机器人的每个轴都有软、硬限位，机器人的运动无法超出软限位，如果超出，称为超行程，由硬限位完成对该轴的机械约束。

5)Repeat positioning accuracy

Reference GB industrial robot performance testing method (GB/T 12642), defines repeat positioning accuracy refers to the robot to the same command position, repeat the response from the same direction after N times, actually realized the position and posture to spread the

degree of inconsistency.

5) 重复定位精度

参考国标工业机器人性能测试方法（GB/T 12642），定义重复定位精度是指机器人对同一指令位姿，从同一方向重复响应 N 次后，实到位置和姿态散布的不一致程度。

2.3.2 The performance parameters of the robot

2.3.2 机器人性能参数

1) Robot performance parameters of the table as shown in table 2.1 GR6160 robot performance parameters of the table

机器人性能参数表如表 2.1 所示 GR6160 机器人性能参数表

Table 2.1 performance parameters of the table

表 2.1 性能参数表

Robot model 型号		GR6160
Action type 动作类型		Joint type 关节型
Degrees of freedom 控制轴		6 Axis
Placement 放置方式		Mounted 地装
Maximum operating speed 最大动作速度	axis/J1 轴	140° /sec
	axis/J2 轴	140° /sec
	axis/J3 轴	165° /sec
	axis/J4 轴	500° /sec
	axis/J5 轴	350° /sec
	axis/J6 轴	900° /sec
Maximum operating range 最大动作范围	axis/J1 轴	± 180°
	axis/J2 轴	+135° /-70°
	axis/J3 轴	+175° /-80°
	axis/J4 轴	± 360°
	axis/J5 轴	± 120°
	axis/J6 轴	± 360°
The maximum operating radius 最大活动半径		3240mm
Wrist maximum load 手腕部最大负载		Maximum 16kg 最大 16kg
Installation conditions 安装条件		Floor mounting Shelf mounting

	地面安装、支架安装
Protection grade 防护等级	IP65(Dust-proof, drip-proof) IP65(防尘、防滴)
Repeat positioning accuracy 重复定位精度	$\pm 0.15\text{mm}$
Robot mass 本体重量	600kg

2) The robot working space diagram as shown in figure 2.2

2)机器人工作空间图如图 2.2

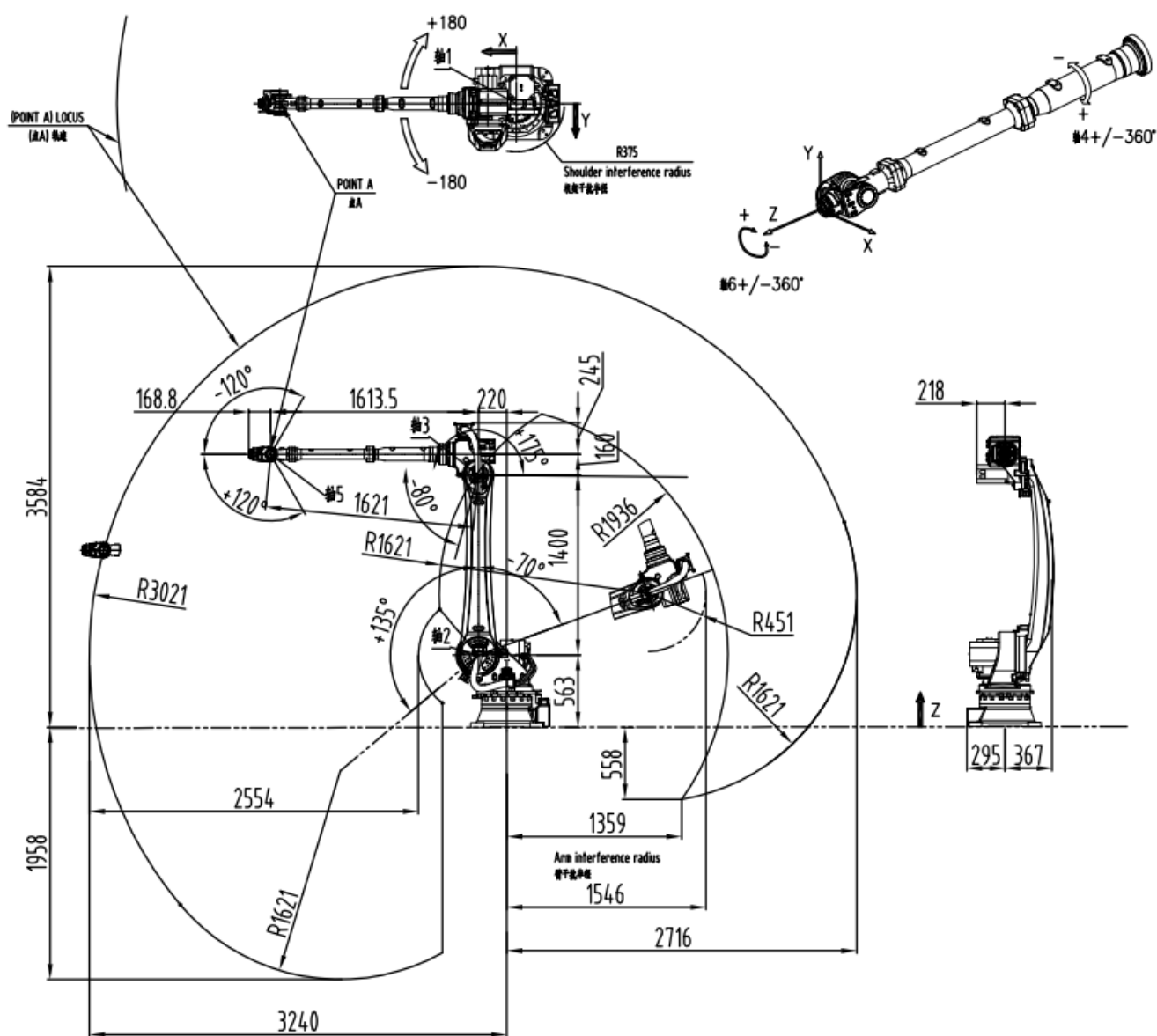


Fig 2.2 the robot working space

图 2.2 机器人工作空间

3) J1-axis adjustable stopper (option)

3) J1 轴可变范围图

Mounting the standard stopper and the additional stopper (option) of the same shape as that of the standard stopper makes it possible to adjust the operating angle of the J1 axis in steps of 30° . In this case, a maximum operating range of the J1 axis comes to $\pm 180^\circ$.

J1 轴最大动作范围 $\pm 180^\circ$ ，但是在设计时，增加了控制运动范围的部件，通过移动 J1 轴限位块可以实现每隔 30° 的范围变动。

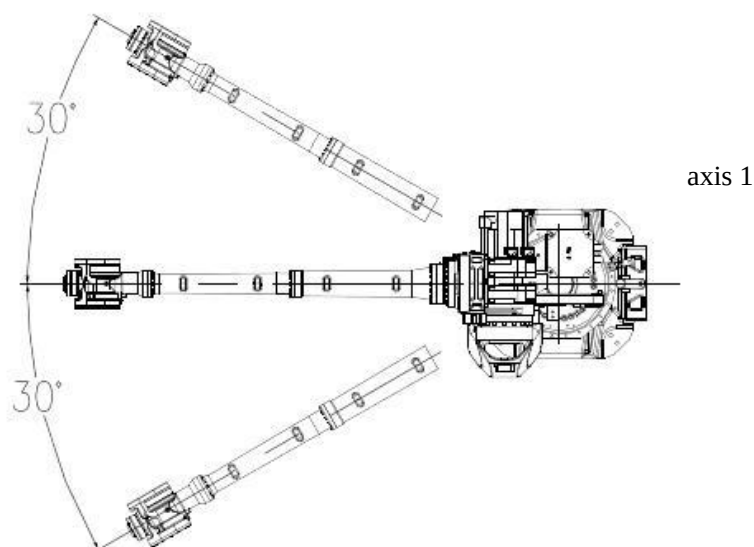


Fig 2.3 Operating Area of J1-axis

图 2.3 J1 动作范围图

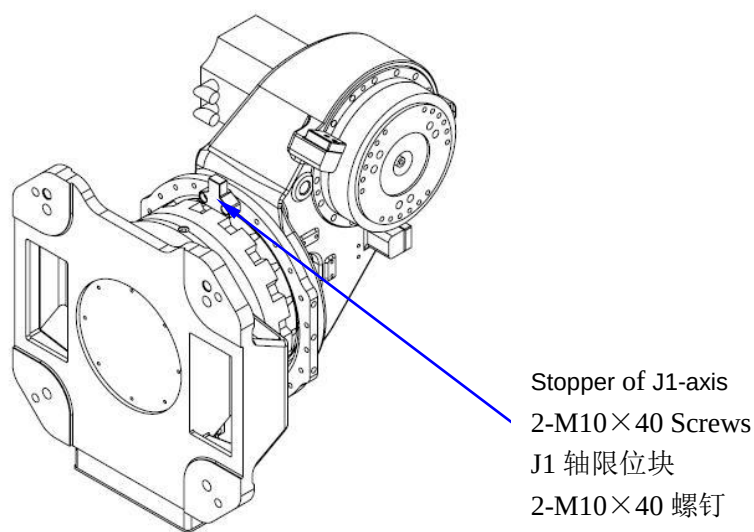


Fig 2.4 J1-axis Adjustable Stopper (Option)

图 2.4 J1 动作范围更换部件图

2.4 Home position adjustment

2.4 零点校对

The home position adjustment is an operation to adjust the reference configuration of the robot, in order to link the angle of each axis with encoder value. The purpose of the operation is to get the count value of the encoder corresponding to the home position. The home position adjustment is done in the factory; it is not required in usual operation.

However, in the following cases, you need to perform home position adjustment.

- 1) Replace the motor.
- 2) Replace the encoder.
- 3) Replacing reducer.
- 4) Replace the cable.

零点校对指的是一种执行的操作，用于将每个机器人轴的角度与编码器计数值关联起来。零点校对操作目的是获得对应于零位置的编码器计数值。

“零点校对”是在出厂前完成的。在日常操作中，一般没有必要执行零点校对操作。但是，在下述情况下，需要执行零点校对操作。

- 1) 更换马达。
- 2) 更换编码器。
- 3) 更换减速机。
- 4) 更换电缆。

2.4.1 Home position adjustment method

2.4.1 零点校对方法

Home position adjustment is a complex process, according to the actual condition and objective condition now, below zero calibration tools and methods as well as some common problems and the ways to solve these problems.

零点校对是一个比较复杂的过程，根据现在实际的情况和客观的条件，下面介绍零点标定的工具及方法以及一些常见的问题和解决这些问题的方法。

1) Home position adjustment software

Need to build a robot with a laser tracker coordinates of each joint. Systematic encoder readings zero. Calibration software is more complex. It should be operated by our

professional engineers

1) 软件零点标定

需要采用激光跟踪仪建立机器人各关节坐标系，进行系统编码器读数置零，软件标定较为复杂，需要由本公司专业人员进行操作。

2) Mechanical zero revision(The dial calibration)

Labelled zero block scale line turn to completely align the zero point.

2) 机械零点校订(对线标定)

将零标块刻线转动到完全对齐状态即零点。

2.4.2 Mechanical home position adjustment of all axes

2.4.2 各轴机械零点校对

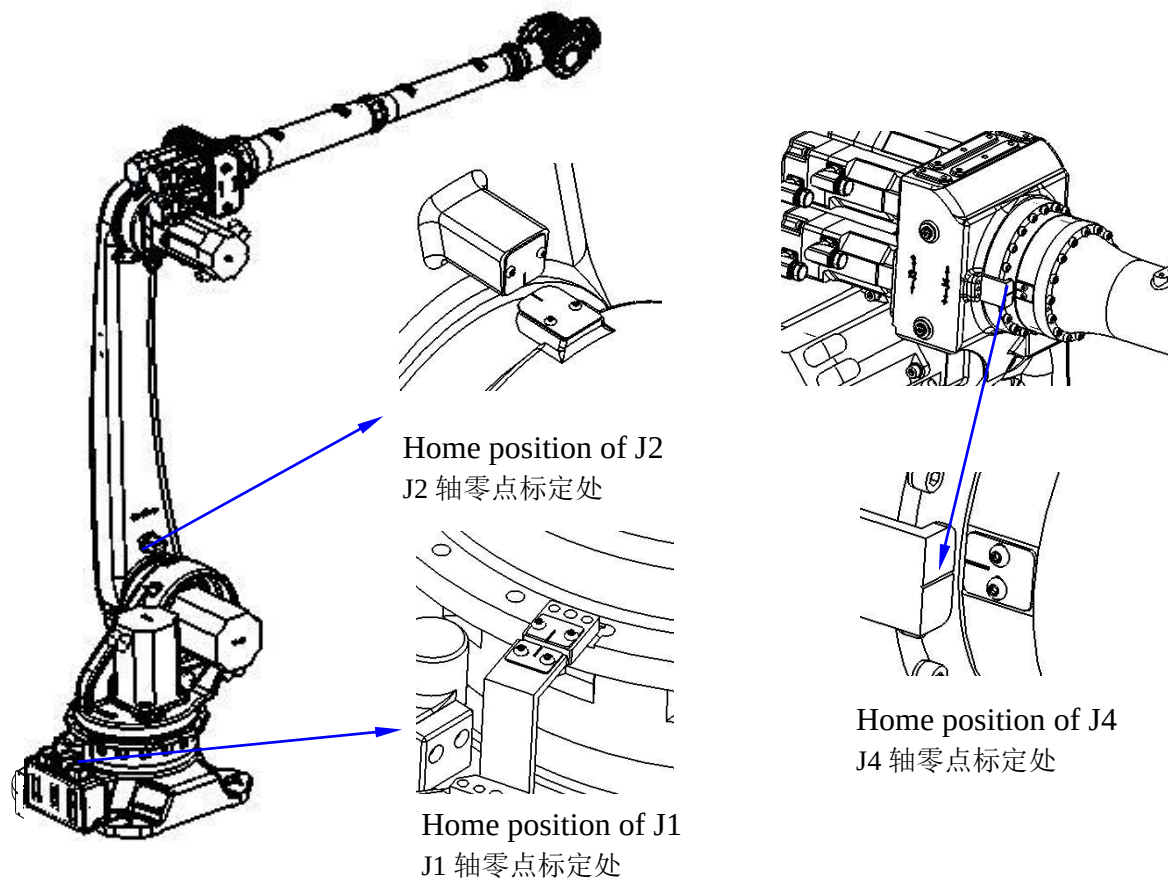


Fig 2.6 Home position of J1/J2/J4

图 2.6 J1/J2/J4 零点标定处

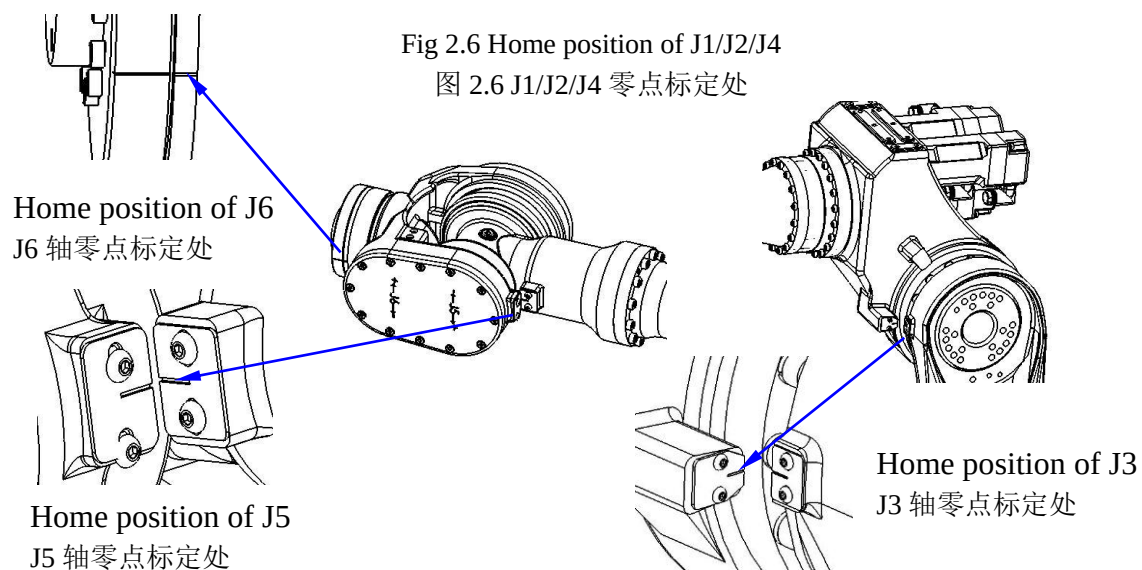


Fig 2.7 Home position of J3/J5/J6

图 2.7 J3/J5/J6 零点标定处

2.5 Allowable wrist load

2.5 手腕部分负荷允许值



A load fixed to the tip of the robot wrist is regulated by the allowable pay load mass, allowable static load torque, and allowable moment of inertia. Furthermore, the allowable load torque varies with the actual load inertia moment. Strictly keep the wrist load within each allowable value. If wrist load exceeds the allowable value, this robot is out of guarantee.



机器人手腕前端的安装负荷受手腕容许可搬重量、容许负荷扭矩值、容许惯性矩值影响，容许负荷扭矩值根据实际负荷惯性矩的不同而发生变化。手腕负荷应严格控制在各容许值以内。安装容许值以外的手腕负荷使用机器人时，不能保证正常动作。

2.5.1 Allowable pay load mass

2.5.1 可允许搬运重量

Table 2.2 Allowable pay load mass

表 2.2 容许可搬重量

Robot Model 机器人型号	Allowable pay load mass 容许可搬重量
GR6160	16kg Not more than 16kg

2.5.2 Allowable maximum static load torque

2.5.2 容许最大静态负荷扭矩

Table 2.3 Allowable maximum static load torque

表 2.3 容许最大静态负荷扭矩

Robot Model 机器人型号	Allowable static load torque 容许静态负荷扭矩		
	Around J4 axis J4 轴转动	Around J5 axis J5 轴转动	Around J6 axis J6 轴转动
GR6160	41N.M Not more than 41N.M	41 N.M Not more than 41 N.M	23 N.M Not more than 23 N.M

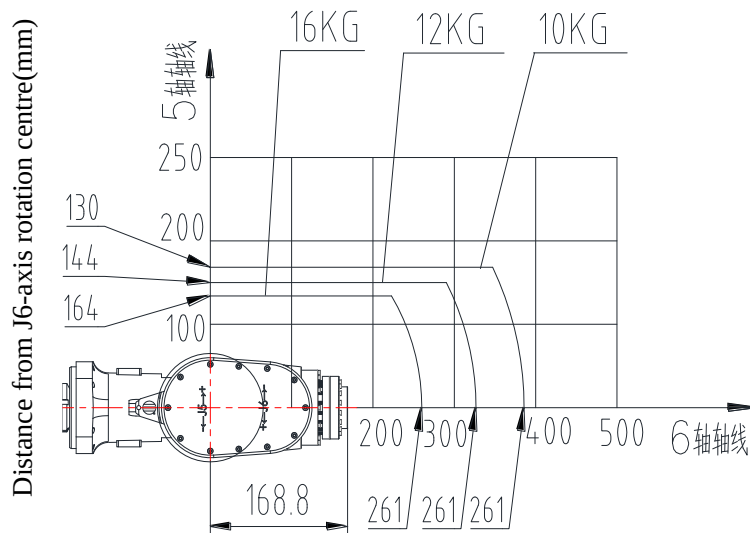
2.5.3 Allowable maximum inertia moment

2.5.3 容许最大惯性矩

Table 2.4 Allowable maximum inertia moment

表 2.4 容许最大惯性矩

Robot Model 机器人型号	Allowable inertia moment 容许惯性矩		
	Around J4 axis J4 轴转动	Around J5 axis J5 轴转动	Around J6 axis J6 轴转动
GR6160	1.6kg.m ² Not more than 1.6kg.m ²	1.6kg.m ² Not more than 1.6kg.m ²	0.3kg.m ² Not more than 0.3 kg.m ²



Distance from J5-axis rotation center (mm)

Fig 2.8 GR6160 Wrist axis torque map

图 2.8 GR6160 手腕轴扭矩图

Chapter3-Inspection and maintenance

第三章检修及维护

The inspection should be performed in order to maintain the high performance of the robot for an extended period of time.

The inspection includes daily inspection and periodical inspection. According to the basic inspection periods shown in following tables, personnel who are engaged in the inspection must create and implement the inspection program.

Furthermore, perform overhauls every 40,000 operating hours or every eight years, whichever comes earlier.

The inspection periods have been examined for Spraying. For high frequency of works such as Spraying, it is recommended to perform inspections at approximately 1/2 of the periods specified.

Should you have any questions about the inspection and adjustment methods, contact the service department of CMA.

为了使机器人能够长期保持较高的性能，必须进行维修检查。

检修分为日常检修和定期检修，检查人员必须编制检修计划并切实进行检修。关于检修项目及检修周期请参阅下表。

另外，必须以每工作 40,000 小时或每 8 年为周期进行大修（哪种方式来的早）。检修周期是按喷涂作业为基础制定。喷涂作业等使用频率较高的作业建议按照约 1/2 的周期实施检修及大修。

此外，检修和调整方法不明时，请联系本公司服务部门。

3.1 Preventive inspection

3.1 预防性维护

The inspection show in this chapter should be performed in order to maintain the high performance of the robot.

按照本章介绍的方法，执行定期维护步骤，能够保持机器人的最佳性能。

3.1.1 Daily inspection

3.1.1 日常检查

Table 3.1 Daily inspection Items

No.	Inspection Item	Inspection method
1	Abnormal noise	Check by hearing for any abnormal noise
2	Transmission mechanism	Visual check for any vibration or shaking
3	Ventilation effectiveness	Visual check of the vent in the back of the control box for jam
4	Related to internal wirings	Visual check of cables for integrity ,damage Visual check of fixer for integrity ,damage and rust
5	Related to external wirings	Visual check of cables and button for integrity ,damage
6	Grease	Visual check of lubrication port for grease leak

表 3.1 日常检查表

序号	检查项目	检查点
1	异响检查	检查各传动机构是否有异常噪音
2	干涉检查	检查各传动机构是否运转平稳，有无异常抖动
3	风冷检查	检查控制柜后风扇是否通风顺畅
4	管线附件检查	是否完整齐全，是否磨损, 有无锈蚀
5	外围电气附件检查	检查机器人外部线路, 按钮是否正常
6	泄漏检查	检查润滑油供排油口处有无泄漏润滑油

3.1.2 Quarterly inspection

3.1.2 每季度检查

Table 3.2 Quarterly inspection Items

No.	inspection Item	Inspection method
1	Cables in teaching box	Visual check of cables in teaching box for damage and tortuosity
2	Ventilation effectiveness	Visual check of the vent in the back of the control box and clean it after turn off the power supply if necessary
3	Cables and connectors in robot	Visual check of the cables in the robot for damage and tortuosity and connectors for damage and soundness
4	Parts	Visual check of the parts for damage and clean and fix or clean if necessary
5	External fixing bolts	Visual check of the fixing bolts in the robot and end actuator. Refasten the fixing bolts if necessary.

表 3.2 季度检查表

序号	检查项目	检查点
1	控制单元电缆	检查示教器电缆是否存在不恰当扭曲
2	控制单元的通风单元	如果通风单元脏了，切断电源，清理通风单元
3	机械单元中的电缆	检查机械单元插座是否损坏，弯曲是否异常，检查马达连接器和航插是否连接可靠
4	各部件的清洁和检修	检查部件是否存在问题，并处理
5	外部主要螺钉的紧固	上紧末端执行器螺钉、外部主要螺钉

3.1.3 Annual inspection

3.1.3 每年检查

Table 3.3 Annual inspection Items

No.	inspection Item	Inspection method
1	Parts	Visual check of the parts for damage and clean and fix or clean if necessary
2	External fixing bolts	Visual check of the fixing bolts in the robot and end actuator. Refasten the fixing bolts if necessary.

表 3.3 年检查表

序号	检查项目	检查点
1	各部件的清洁和检修	检查部件是否存在问题，并处理
2	外部主要螺钉的紧固	上紧末端执行器螺钉、外部主要螺钉

3.1.4 Inspection every two years

3.1.4 每 2 年检查

Table 3.4 Inspection Items every two years

No.	inspection Item	Inspection method
1	Replace reducer, gear box oil	Replace the grease in gear boxes and redactors according to the requirements
2	Wrist replacement parts Lubricants	

表 3.4 每 2 年检查表

序号	检查项目	检查点
1	更换减速机、齿轮箱的润滑油	按照润滑要求进行更换
2	更换手腕部件润滑油	按照润滑要求进行更换

Notices:

- 1) The main place to clean is around the lubrication port to insurance no dust would enter grease.
- 2) The bolts need to be check include the bolts in end actuator, robot base, and bolts that ever been disassembled or outside the body. What's more, sealant and Fastening glue is needed

while refastening. Recommended torque is shown in the appendix below.

注释:

- 1) 关于清洁部位，主要是机械手腕油封处，清洁切屑和飞溅物。
- 2) 关于紧固部位，应紧固末端执行器安装螺钉、机器人本体安装螺钉、因检修等而拆卸的螺钉。应紧固露出于机器人外部的所有螺钉。有关安装力矩，请参阅附录的螺钉拧紧力矩表。并涂相应的紧固胶或者密封胶。

3.2 Inspection on major bolts

3.2 主要螺栓的检修

Table 3.5 Inspection Items of bolts

No.	Main function of the bolts	No.	Main function of the bolts
1	Fix the whole robot	6	Fix the motor of J5
2	Fix the motor of J1	7	Fix the motor of J6
3	Fix the motor of J2	8	Fix the wrist
4	Fix the motor of J3	9	Fix the end actuator
5	Fix the motor of J4		

表 3.5 主要螺钉检查部位

序号	检查部位	序号	检查部位
1	机器人安装用	6	J5 轴马达安装用
2	J1 轴马达安装用	7	J6 轴马达安装用
3	J2 轴马达安装用	8	手腕部件安装用
4	J3 轴马达安装用	9	末端负载安装用
5	J4 轴马达安装用		



CAUTION

Please refer to Chapter 4.4 for the detail of how to replace and refasten bolts. Be sure to use a torque wrench to fasten the bolts to proper torque, and then apply a coating of paint lock to them. Furthermore, be careful not to needlessly refasten bolts that are not unfastened.



注意

根据章节 4.4 更换零部件内容进行螺钉的拧紧和更换，必须用扭矩扳手以正确扭矩紧固后，再行涂漆固定，此外，应注意未松动的螺栓不得以所需扭矩以上的扭矩进行紧固。

3.3 Inspection of grease

3.3 润滑油的检查

It is recommended to perform examination of density of steel dust in the grease at Every 5,000 operating hours or every 1 year (In case of material handling application, every 2,500 hours or every half year). If the measurement result exceeds this value, please contact our service center for grease replacement or reduction gear replacement.

每运转 5,000 小时或每隔 1 年（装卸用途时则为每运转 2,500 小时或每隔半年），请测量减速机的润滑油铁粉浓度。超出标准值时，有必要更换润滑油或减速机，请联系本公司服务中心。

Required tools

- Grease steel dust meter

Recommended grease steel dust meter

OM-810 (Idemitsu Kosan Ltd.)

Grease gun (Lubrication amount counter function, A nozzle of less than 17 mm in diameter.)

- Seal tape

必需的工具：

- 润滑油铁粉浓度计

推荐润滑油铁粉浓度计：出光兴产制造、型号：OM-810(出光兴产株式会社)

- 润滑油枪（喷嘴直径 ϕ 17mm 以下，带供油量确认计数功能）
- 密封胶带



CAUTION

If the grease leaks out too much when inspecting the steel dust density, lubricate grease using a grease gun. For lubrication, use a grease gun with a nozzle of less than 17 mm in diameter.

Note that lubricating grease more than the recommended amount may result in leakage of grease or faulty robot locus.

After the completion of lubrication, in order to prevent the leakage of grease, be sure to wind sealing tape around the grease nipples and socket head plug.



检修时，如果必要数量以上的润滑油流出了机体外时，请使用润滑油枪对流出部分进行补充。此时，所使用的润滑油枪的喷嘴直径应为 $\phi 17\text{mm}$ 以下。补充的润滑油量比流出量更多时，可能会导致润滑油渗漏或机器人动作时的轨迹不良等，应加以注意。



A grease gun that has a capacity to measure the lubrication amount is recommended. If a grease gun like this cannot be prepared, please measure the weight of the grease can before/after the lubrication work to confirm the amount.



检修或加油完成后，为了防止漏油，在润滑油管接头及带孔插塞处务必缠上密封胶带再进行安装。

建议使用能明确加油量的润滑油枪。无法准备到能明确加油量的油枪时，通过测量加油前后润滑油重量的变化，对润滑油的加油量进行确认。



Immediately after removing the drain plug, grease may splash, because internal pressure is still high, for example soon after robot stops. So lubricate grease after the pressure in reducer is on a normal value.



机器人刚刚停止的短时间内等情况下，减速机腔内部压力上升时，在拆下检修口螺塞的一瞬间，润滑油可能会喷出，应缓慢将减速机内部压力释放后再行加油。



Lubricate the mechanical sections of the robot with grease at regular intervals of time according to the follow section.



该机器人保养需按照以下规定定期进行润滑和检修以保证效率。

3.4 Grease replacement

3.4 更换润滑油

3.4.1 Lubrication amount

3.4.1 润滑油供油量

Applicable grease and lubrication in the reducers, gear boxes, and wrist according to the following procedure every 20,000 operating hours or every 4 years (If the application type is material handling, every 10,000 operating hours or every 2 years). Table 3.6 shows the grease and Lubrication amount.

J1/J2/J3/J4 轴减速机、马达座齿轮箱和手腕部件润滑油，必须按照如下步骤每运转 20,000 小时或每隔 4 年（用于装卸时则为每运转 10,000 小时或每隔 2 年）应更换润滑油。表 3.6 示出指定润滑油和供油量。

Table 3.6 grease and Lubrication amount

Replacement point	Lubrication	Applicable grease	comment
J1-axis reduction gear	3400cc	MolyWhiteRE No.00	Lubricating grease with a high speed may result in high pressure in gear boxes with damage of seal and grease leak. So Lubricating speed should be under 40cc/10s
J2-axis reduction gear	2200cc		
J3-axis reduction gear	1400cc		
Gear box of motor base	2000cc		
J5-axis reduction gear	370cc		
J6-axis reduction gear	240cc		

表 3.6 更换润滑油油量表

提供位置	加油量	润滑油名称	备注
J1 轴减速机	3400cc	MolyWhite RE No.00	急速上油会引起油腔内的压力上升，使密封圈开裂，而导致润滑油渗漏，供油速度应控制在40cc/10秒以下。
J2 轴减速机	2200cc		
J3 轴减速机	1400cc		
马达座齿轮箱	2000cc		
J5 轴减速机	370cc		
J6 轴减速机	240cc		

3.4.2 Robot orientation of lubricate grease

3.4.2 润滑的空间方位

It is recommend replacing or lubricating grease with the orientation list in the following table.

对于润滑油更换或补充操作，建议使用下面给出的方位。

Table 3.7 Robot orientation of lubricate grease

Replacement point	Robot orientation					
	J1	J2	J3	J4	J5	J6
J1-axisreducer	unbending	unbending	unbending	unbending	unbending	unbending
J2-axisreducer		0°				
J3-axisreducer		0°	0°			
Gear box of motor base		0°	0°			
J4-axisreducer		unbending	unbending			
Wrist				0°	0°	0°

表 3.7 润滑方位

供给位置	方位					
	J1	J2	J3	J4	J5	J6
J1 轴减速机	任意	任意	任意	任意	任意	任意
J2 轴减速机		0°				
J3 轴减速机		0°	0°			
马达座齿轮箱		0°	0°			
J4 轴减速机		任意	任意			
手腕体				0°	0°	0°
手腕连接体						

3.4.3 Procedure of grease replacement in reducer of J1,J2,J3,J4 and gear box of motor base

3.4.3 J1/J2/J3/J4 轴减速机、马达座齿轮箱的润滑油更换步骤

- 1) Move robot for lubrication to orientation according to table 3.7.
 - 2) Turn off the power supply.
 - 3) Remove the inner hexagon bolts in lubrication ports.(M10X1), see fig.3.1-3.3.
 - 4) Lubricate until new grease leaks out through the lubrication ports.
 - 5) Install the inner hexagon bolts back to lubrication ports.
 - 6) After lubrication, release the remnants pressure in grease according to chapter 3.4.5.
- 1) 将机器人移动到表 3.7 所介绍的润滑位置。
 - 2) 切断电源。
 - 3) 移去润滑油供排口的内六角螺塞 M10X1，见图 3.1-3.3。
 - 4) 提供新的润滑油，直至新的润滑油从排油口流出。
 - 5) 将内六角螺塞装到润滑油供排口上。
 - 6) 供油后，按照 3.4.5 项的步骤释放润滑油腔内残压。

3.4.4 Procedure of grease replacement in wrist

3.4.4 手腕部件的润滑油更换步骤

- 1) Move robot for lubrication to orientation according to table 3.7.
 - 2) Turn off the power supply.
 - 3) Remove the inner hexagon bolts(M10X1) in lubrication ports of wrist , see fig.3.3.
 - 4) Remove the inner hexagon bolt(M10X1) in lubrication ports of wrist-link(axis J5/J6).
 - 5) Lubricate until new grease leaks out through the lubrication ports.(axis J5/J6).
 - 6) Install the inner hexagon bolts back to lubrication ports of wrist(J5/J6) and end actuator.
 - 7)Install the inner hexagon bolts back to lubrication ports of wrist-link(J5/J6) and end actuator.
- 1) 将机器人移动到表 3.7 所介绍的润滑位置。
 - 2) 切断电源。
 - 3) 移去手腕体（J5/J6 轴）润滑油供油口的内六角螺塞 M10x1，见图 3.3。
 - 4) 移去手腕连接体（J5/J6 轴）润滑油排油口的内六角螺塞 M10x1。

5) 通过手腕体（J5/J6 轴）润滑油供油口提供新的润滑油脂，直至新的润滑油从排油口流出。

6) 将内六角螺塞装到手腕体（J5/J6 轴）润滑油供油口上。

7) 将内六角螺塞装到手腕连接体（J5/J6 轴）润滑油排油口上。

Lubricate disobedient to the accurate requirement may result in Immediate rise of grease pressure, damage of seal and grease leak. To avoid this, please obey the following requirement while lubricating. Open the lubrication ports by removing the inner hexagon bolts before lubricating.

如果未能正确执行润滑操作，润滑腔体的内部压力可能会突然增加，有可能损坏密封部分而导致润滑油泄漏和异常操作。因此，在执行润滑操作时，请遵守下述事项：

执行润滑操作前，打开排油口（移去排油的插头或螺塞）。

- (1) Slowly provide lubricating oil, oil supply speed should be controlled in 40 cc/under 10 seconds, don't be too hard, it is recommended to use can be clearly pitted lubricating oil gun. Cannot clearly pitted oil gun, by measuring the oil lubricating oil before and after weight changes, the amount of lubricating oil.
- (2) If the quantity of oil supply not up to par, available supply with precision regulator to oil gas during extrusion cavity pressure regulator control should be used under the maximum 0.025 MPa.
- (3) Use only the specified type of lubricating oil. If you use other lubricant outside of the specified type, it might damage the reducer or cause other problems.
- (4) Oil supply after besmear when install socket head screw thread sealant, lest the in and out of the oil spill
- (5) In order to avoid accidents caused by slip, redundant oil on the ground and the robot should be completely removed.
- (6) Oil supply, follow the steps in item 3.4.5 release lubricating oil cavity the Allen screw in the residual pressure again after installation note winding sealing tape, so as to avoid grease for the discharge of oil mouth leaks.

- (1) 缓慢地提供润滑油，供油速度应控制在40cc/10秒以下，不要过于用力，建议使用可明确加油量的润滑油枪。没有能明确加油量的油枪时，应通过测量加油前后的

润滑油重量的变化，对润滑油的加油量进行确认。

- (2) 如果供油没有达到要求的量，可用供气用精密调节器挤出腔中气体再进行供油，气压应使用调节器控制在最大0.025MPa以下。
- (3) 仅使用指定类型的润滑油。如果使用了指定类型之外的其它润滑油，可能会损坏减速机或导致其它问题。
- (4) 供油后安装内六角螺塞时注意涂螺纹密封胶，以免在进出油口处漏油
- (5) 为了避免因滑倒导致的意外，应将地面和机器人上的多余润滑油彻底清除。
- (6) 供油后，按照3.4.5项的步骤释放润滑油腔内残压后再安装内六角螺塞，注意缠绕密封胶带，以免油脂供排油口处泄漏。

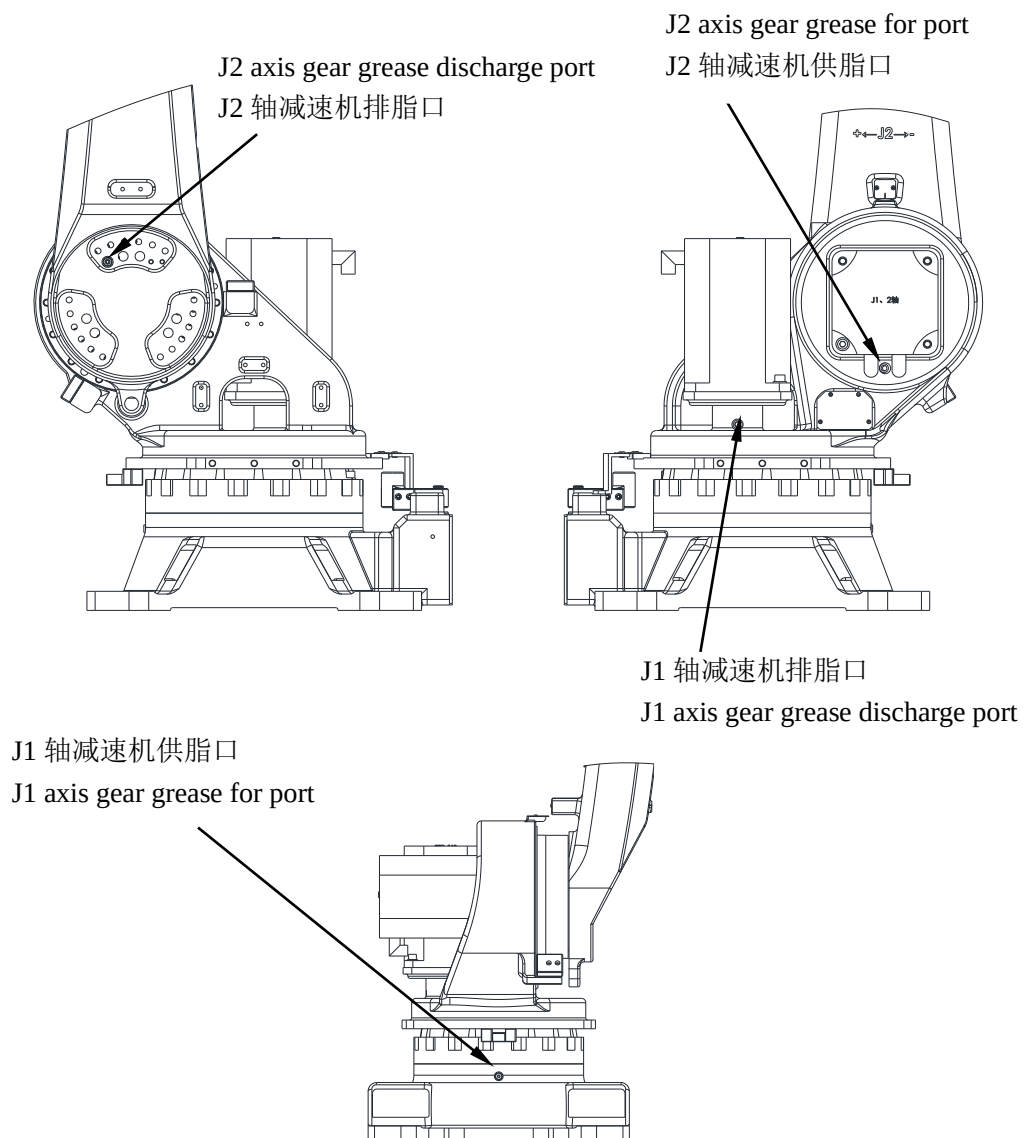


Fig3.1Oil change, J1 / J2 axis reducer
图 3.1 更换润滑油，J1/J2 轴减速机

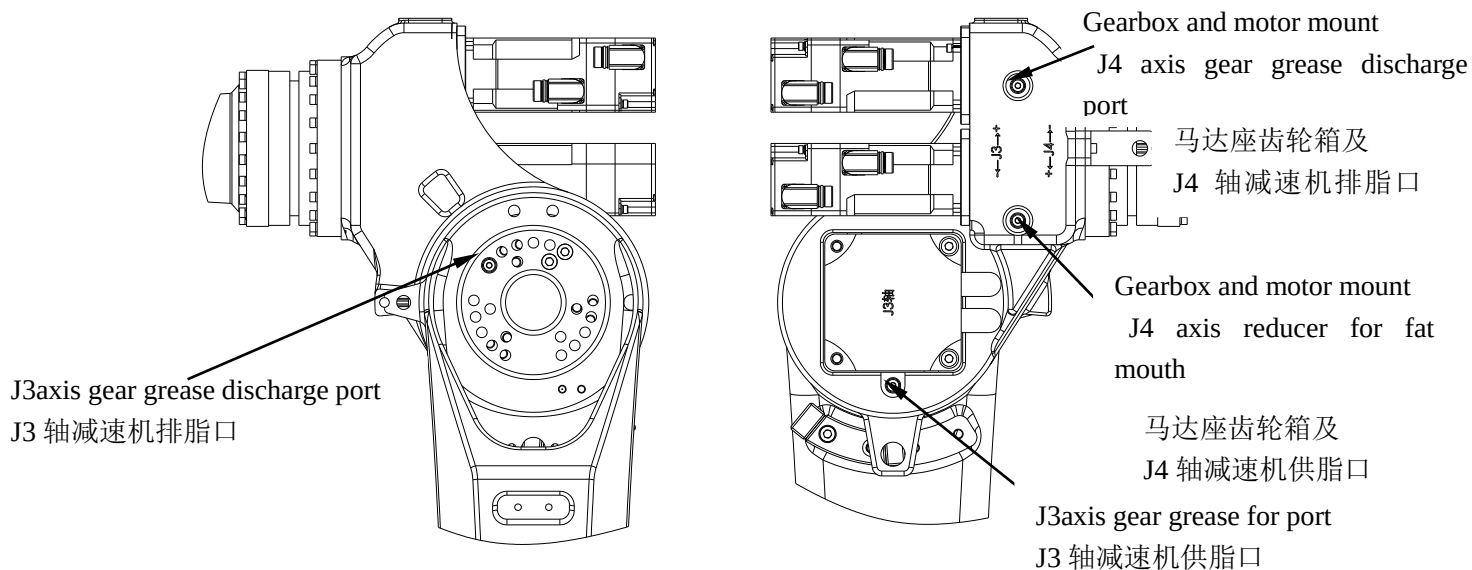


Fig3.2 Oil change, J3 / J4 axis reducer gearbox and motor mount
图 3.2 更换润滑油，J3/J4 轴减速机和马达座齿轮箱

Wrist body (J5, J6 axis) for fat mouth
手腕体（J5、J6 轴）供脂口

Wrist connector (J5, J6 axis) the fat mouth
手腕连接体（J5、J6 轴）排脂口

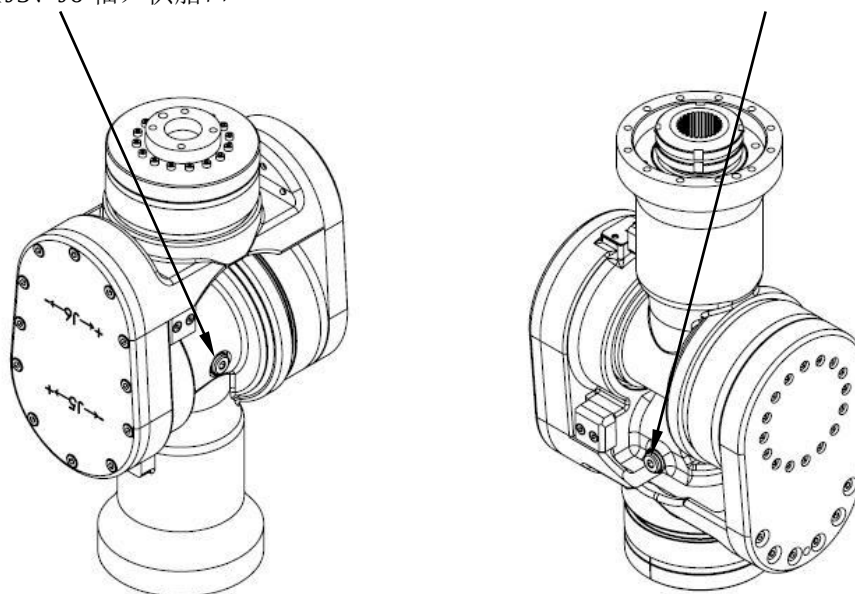


Fig 3.3 Replacement parts lubricants wrist
图 3.3 更换手腕部件润滑油

Note: Required tools

Lubricants gun (with fuel supply check counting function)

Oil Joints [M10x1] (1piece)

Oil hose [ϕ 8x1m] (1)

Precision gas regulator (1) (MAX0.2MPa, you can fine-tune the scale 0.01MPa)

Gas source

Weight (weight measurement lubricants)

Thread Sealant

注释：所需工具

润滑油枪（带供油量检查计数功能）

供油用接头[M10x1]（1 个）

供油用软管[ϕ 8x1m]（1 根）

供气用精密调节器（1 个）（MAX0.2MPa,可以 0.01MPa 刻度微调）

气源

重量计（测量润滑油重量）

螺纹密封胶

3.4.5Residual pressure release lubricant chamber

3.4.5 释放润滑油腔内残压

After the oil supply, in order to release the residual oil cavity pressure, should be appropriate operating robot.At this point, for lubricating oil in import and export, the installation will recycle bags, to avoid the out of the lubricating oil splash.

供油后，为了释放润滑油腔内的残压，应适当操作机器人。此时，在供润滑油进出口下安装回收袋，以避免流出来的润滑油飞溅。

In order to release the residual pressure, in the condition of open mouth of the discharge of oil, J1 axis within plus or minus 30 °; J2 / J3 axis within + / - 5 °; J4 axis and J5 / J6 axis within plus or minus 30 ° repeatedly more than 20 minutes, speed control in the low speed motion state.

为了释放残压，在开启排油口的状态下，J1 轴在 $\pm 30^\circ$ 范围内，J2/J3 轴在 $\pm 5^\circ$ 范

围内, J4 轴及 J5/J6 轴在 $\pm 30^\circ$ 范围内反复动作 20 分钟以上, 速度控制在低速运动状态。

Cannot perform the action due to the situation around, should take the robot run the same frequency (for example, takes only half of the cases, the axis Angle should take the robot run 2 times), after the end of the action, would be installed on the oil discharge port sealing plug (thread sealant coating).

由于周围的情况而不能执行上述动作时, 应使机器人运转同等次数 (例如, 轴角度只能取一半的情况下, 应使机器人运转原来的 2 倍时间), 上述动作结束后, 将排油口上安装好密封螺塞 (涂螺纹密封胶)。

Chapter 4-Maintenance

第四章 故障处理

4.1 Investigate the cause of the failure method

4.1 调查故障原因的方法

Robot design must achieve even if an exception occurs, also can detect the abnormal immediately, and immediately stop running. Even so, the risk is still in the state, is absolutely forbidden to continue running.

机器人设计上必须达到即使发生异常情况，也可以立即检测出异常，并立即停止运行。即便如此，由于仍然处于危险状态下，绝对禁止继续运行。

The robot's failure has the following situations.

- 1) In the event of failure, until completion of the repair cannot run the fault.
- 2) After failure occurs, placed after a period of time, and can restore operation failure.
- 3) even if the failure happens, as long as the electricity again after power off, and can run the fault.
- 4) Not the robot itself, but the side of the system fault lead to abnormal motion of the robot's fault.
- 5) Due to the robot side of the fault, lead to abnormal action of system failure.

机器人的故障有如下各种情况。

- 1) 一旦发生故障，直到修理完毕不能运行的故障。
- 2) 发生故障后，放置一段时间后，又可以恢复运行的故障。
- 3) 即使发生故障，只要关闭电源后再重新上电，则又可以运行的故障。
- 4) 即使发生故障，立即就可以再次运行的故障。
- 5) 非机器人本身，而是系统侧的故障导致机器人异常动作的故障。
- 6) 因机器人侧的故障，导致系统异常动作的故障。

Especially 2) 3) 4), the fault will certainly happen again. Moreover, in complex systems, even experienced engineers often cannot easily find the cause of the fault. Therefore, in case of failure, do not continue to operate, you should immediately contact the provisions have received training in the preservation of workers, the implementation of the reasons for its

failure to identify and repair. In addition, these elements should be placed in the job requirements, and establish overall security system can effectively perform. Otherwise, it will cause an accident.

尤其是 2)3)4)的情况，肯定会再次发生故障。而且，在复杂的系统中，即使老练的工程师也经常不能轻易找到故障原因。因此，在出现故障时，请勿继续运转，应立即联系接受过规定培训的保全作业人员，由其实施故障原因的查明和修理。此外，应将这些内容放入作业规定中，并建立可以切实执行的安整体系。否则，会导致事故发生。

Robot motion, running some kind of exception occurs, if not abnormal control device should be considered abnormal because of damage caused by the mechanical parts. For rapid troubleshooting, you first need a clear grasp the phenomenon and determine what is abnormal due to problems caused by parts.

机器人动作、运转发生某种异常时，如果不是控制装置出现异常，就应考虑是因机械部件损坏所导致的异常。为了迅速排除故障，首先需要明确掌握现象，并判断是因什么部件出现问题而导致的异常。

1) Step 1: what is a shaft appeared abnormal

Must first understand what a shaft appear abnormal phenomenon. If there is no obvious abnormal action and difficult to judge, to deal with:

- presence of abnormal sound
- presence of abnormal hot parts
- Parts such as the presence or absence of a gap to investigate the situation.

1) 第 1 步是哪一个轴出现了异常

首先要了解是哪一个轴出现异常现象。如果没有明显异常动作而难以判断时，应对

- 有无发出异常声音的部位
- 有无异常发热的部位
- 有无出现间隙的部位等情况进行调查。

2) Step 2: which one parts have damage

After ascertain axis abnormality occurs, should investigate which component is the cause of the exception. A phenomenon that may be caused by a plurality of members. Symptoms and causes follows page form.

2) 第 2 步哪一个部件有损坏情况

判明发生异常的轴后，应调查哪一个部件是导致异常发生的原因。一种现象可能是由多个部件导致的。故障现象和原因如下页表格所示。

3) Step 3 :issue processing components

Ascertain problems member after processing by the method as shown in 4.3. The user can deal with some problems, but the problem is difficult to deal with, please contact our service department.

3) 第 3 步问题部件的处理

判明出现问题的部件后，按 4.3 所示方法进行处理。有些问题用户可以自行处理，但对于难于处理的问题，请联系本公司服务部门。

4.2 The fault and the reason

4.2 故障现象和原因

As shown in Table 4.1, a breakdown phenomenon may be due to a number of different components lead. Therefore, in order to ascertain which component is damaged, refer to the contents shown in this table.

如表 4.1 所示，一种故障现象可能是因多个不同部件导致。因此，为了判明是哪一个部件损坏，请参考此表所示的内容。

Table 4.1 fault phenomenon and reason

Faultdescription The reasonparts	reducer	The motor
Overload[Note 1]	○	○
Position deviation	○	○
Theoccurrenceof abnormal sound	○	○
When motion vibration[Note 2]	○	○
When to stop shaking[Note 3]		○
Shaft fall naturally	○	○
Abnormal fever	○	○
Misoperation, out of control		○

[Note 1]: When load is beyond the scope motor rated specifications.

[Note 2]: Action of vibration phenomena.

[Note 3]: When stop shaking around the stop location repeatedly several times.

表 4.1 故障现象和原因

故障说明 原因部件	减速机	马达
过载[注 1]	○	○
位置偏差	○	○
发生异响	○	○
运动时振动[注 2]	○	○
停止时晃动[注 3]		○
轴自然掉落	○	○
异常发热	○	○
误动作、失控		○

[注 1]: 负载超出马达额定规格范围时出现的现象。

[注 2]: 动作时的振动现象。

[注 3]: 停机时在停机位置周围反复晃动数次的现象。

4.3 Checking and processing method of every parts and components

4.3 各个零部件的检查方法及处理方法

4.3.1 Reducer

4.3.1 减速机

Will produce vibration, abnormal sound gear damage. At this point, it will impede the normal operation, resulting in overload, deviation error, and abnormal heating phenomenon. In addition, there will be completely unable to movement and position deviation.

减速机损坏时会产生振动、异常声音。此时，会妨碍正常运转，导致过载、偏差异常，出现异常发热现象。此外，还会出现完全无法动作及位置偏差。

1) Inspection method

Check the oil amount of fe powder: increase the amount of iron powder in the lubricating oil concentration around for more than 1000 PPM has the possibility of internal damage. At 1 year (or in their operating 5000 hours each (< the purpose in loading and unloading operation for every 2500 hours or every six months), please measure the reducer of the lubricating oil iron concentration. Beyond the standard, it is necessary to replace lubricating oil or reducer, please relate this company service center.)

Check reducer temperature: temperature is normally run up 10 °basic judgment reducer has been damaged.

1) 检查方法

检查润滑油中铁粉量: 润滑油中的铁粉量增加浓度约在 1000ppm 以上时则有内部破损的可能性。(每运转 5, 000 小时或每隔 1 年 (<装卸用途时则为每运转 2, 500 小时或每隔半年), 请测量减速机的润滑油铁粉浓度。超出标准值时, 有必要更换润滑油或减速机, 请联系本公司服务中心。)

检查减速机温度: 温度较通常运转上升 10° 时基本可判断减速机已损坏。

2) Processing method

Please replace the reducer. When change due to the speed reducer is complicated, need to change please relate this company service.

J5 / J6 shaft speed reducer failure please replace the wrist components overall see 4.4.1.

2) 处理方法

请更换减速机。由于更换减速机比较复杂, 需更换时请联系本公司服务部门。

J5/J6 轴减速机故障请更换手腕部件整体见 4.4.1 说明。

4.3.2 Motor

4.3.2 马达

Motor abnormalities, stop shaking and vibration during operation action occurs anomaly. In addition, there will be abnormal fever and abnormal sound, and so on and so forth. Due to the same machine of decelerate of phenomenon and damage phenomenon, it is difficult to determine because of where, therefore, should be at the same time, the examination of the reducer and motor.

马达异常时, 停机时会出现晃动、运转时振动等动作异常现象。此外, 还会出现异常发热和异常声音等情况。由于出现的现象与减速机损坏时的现象相同, 很难判定原因出在哪里, 因此, 应同时进行减速机和马达的检查。

1) Inspection method

for abnormal sound, abnormal fever phenomenon.

2) processing method

Reference to "4.4.2 replacement motors", replace the motor.

1) 检查方法

检查有无异常声音、异常发热现象。

2) 处理方法

参照“4.4.2 更换马达”的说明，更换马达。

4.4replaceparts

4.4 更换零部件

When transporting and replacing the assembly parts, pay attention to the weight of components.

搬运和组装更换零部件时，注意各零部件重量。

Table 4.2 Main part weight

The robot model	The motor weight			The wrist unit weight
	J1/J2	J3	J4/J5/J6	
GR6160	43kg	19.6kg	3.8kg	18.13kg

表 4.2 主要部件重量

机器人型号	马达重量			手腕部件重量
	J1/J2	J3	J4/J5/J6	
GR6160	43kg	19.6kg	3.8kg	18.13kg

Maintenance tools

Dial gauge 1/100 mm (used to measure the positioning accuracy, reverse clearance)

Vernier calipers 150 mm

Phillips screwdriver large, medium and small

Blade screwdriver large, medium and small

Allen wrench suite M3 ~ M16

Torque wrench

Jaw puller

Lifting bolt M8 ~ M16

Purple copper bar

Grease gun

维修用工具

千分表

1/100mm（用来测量定位精度、反向间隙）

游标卡尺	150mm
十字形螺丝刀大、中、小	
一字形螺丝刀大、中、小	
内六角扳手套件	M3～M16
扭矩扳手	
三抓拉马	
吊环螺钉	M8～M16
紫铜棒	
注油枪	

4.4.1 Replace the wrist parts

4.4.1 更换手腕部件

Disassembly

- 1) Removed from manipulator wrist manipulator and artifacts such as load.
- 2) Remove the wrist part (4) screws and cooperate with the gasket (2) and (3).(note that this process with a crane or other lifting device to lift the wrist part)
- 3) Will leave robot manipulator wrist part translation.

拆卸

- 1) 从机械手腕上移除机械手和工件等的负载。
- 2) 拆下手腕部件（4）螺钉及配合的垫圈（2）、（3）（见图 4.1）。（注意此过程要用吊车或其它起吊装置吊起手腕部件）
- 3) 将手腕部件平移离开机器人机械本体。

Assembly

- 1) Remove the installation surface impurities, scrape off with tools apply glue in with the plane, the fitting surface with cleaner dry cleaning

Net.

- 2) Coating on the surface of the flange installation THREEBOND 1110 F planar sealant.
- 3) Lifting the wrist unit, so the wrist unit to maintain the level and slowly moves closer to the connecting portion, slowly rotating the wrist unit complete with J5 / J6 shaft splinefit.
- 4) After being assembly flange joint, wrist component mounting screw (2), washer (3) to

tighten the wrist, with a torque spanner adjustable torque was $73.5 \pm 3.43 \text{ Nm}$.

5) Apply lubricating oil.

6) Perform checking operations.

装配

- 1) 除去安装面杂质，用工具刮掉敷在配合面的平面胶，用清洗剂将配合面清洗干净。
- 2) 在安装法兰面上涂 THREEBOND1110F 平面密封胶。
- 3) 吊起手腕部件，使手腕部件保持水平，慢慢移动靠近连接部分，缓慢转动手腕部件完成与 J5/J6 轴花键的配合。
- 4) 待装配法兰面贴合后，转动手腕部件安装螺钉2、垫圈3上紧手腕件，用可调扭力扳手打扭矩为 $73.5 \pm 3.43 \text{ Nm}$ 。
- 5) 施加润滑油。
- 6) 执行校对操作。

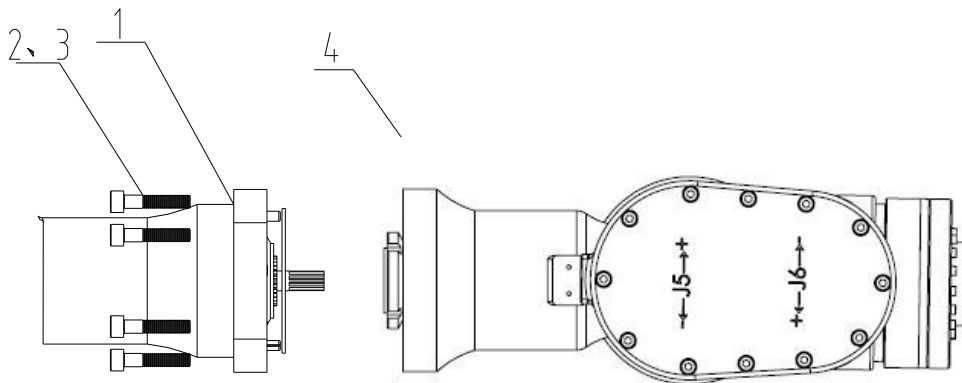


Fig 4.1 Replace the wrist parts in figure

图 4.1 更换手腕部件

Table 4.3 replacement wrist parts list

Name	Specifications Model	Quantity	Torque (Nm)
1: Arm extension rod assembly	/	1	
2: Socket head cap screws M6x30	GB/T70.1-2000, 12.9 magnitude	12	15.6 ± 0.78
3: Spring washer 6	GB/T93-1987	12	
4: Wrist parts	/	1	

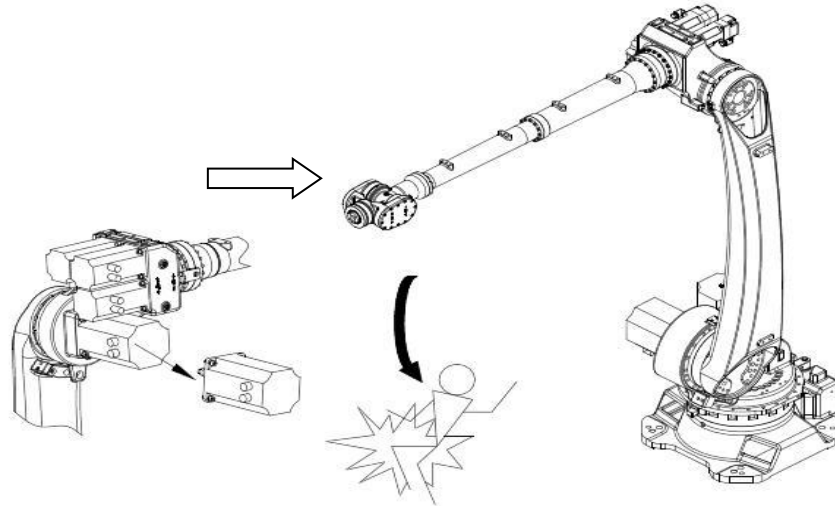
表 4.3 更换手腕部件清单

名称	规格型号	数量	力矩（牛顿米）
1: 小臂加长杆部件	/	1	
2: 内六角螺钉 M6x30	GB/T70.1-2000, 12.9 级	12	15.6 ± 0.78

3: 弹簧垫圈 6	GB/T93-1987	12	
4: 手腕部件	/	1	

4.4.2 Replace the motor

4.4.2 更换马达



No fixed mechanical arm to dismantle the motor and mechanical arm is likely to fall, or move. Please first fixed mechanical arm, and then remove the motor.



CAUTION

After inserting zero point bolt, with wood or crane fixed mechanical arm to prevent falling, then dismantle the motor. (zero point bolt and the block is used to aim at the original position, cannot be used to fixed mechanical arm.)

In addition, please do not dismantle the motor under the condition of mechanical arm in the manpower support.

没有固定机械臂便拆除马达，机械臂有可能会掉落，或前后移动。请先固定机械臂，然后再拆卸马达。



注意

插入零点栓后，用木块或起重机固定机械臂以防掉落，然后再拆除马达。

（零点栓和挡块用于对准原位置，不可以用来固定机械臂。）

此外，请勿在人手支撑机械臂的状态下拆除马达。



Applying pressure on motor encoder connectors is prohibited. Larger pressure can damage the connector. If you need touch just stop after motor, should confirm that the motor is a high temperature state, careful operation.



禁止对马达的编码器连接器施力。施加较大压力会损坏连接器。如需触摸刚刚停止后的马达，应确认马达为非高温状态，小心操作。

(1) Change the J1 axis motor

(1) 更换 J1 轴马达

Disassembly

- 1) Cut off power supply.
- 2) Disconnect the J1 shaft (1) on the connecting cable of the motor.
- 3) Remove the J1 axis motor mounting screw (2) and washer (3).
- 4) The motor vertical pull out from the base, at the same time, is careful not to hurt gear surface.
- 5) Remove the screws from the J1 shaft motor shaft (6), washers (5).
- 6) From the J1 pull shaft motor shaft gear (4).

拆卸

- 1) 切断电源。
- 2) 拆掉 J1 轴马达（1）上连接线缆。
- 3) 拆卸 J1 轴马达安装螺钉（2）以及垫圈（3）。
- 4) 将马达从底座中垂直拉出，同时小心不要挂伤齿轮表面。
- 5) 从 J1 轴马达的轴上拆卸螺钉（6）、垫圈（5）。
- 6) 从 J1 轴马达的轴上拉出齿轮（4）。

Assembly

- 1) Remove the motor flange surface impurities, ensure clean.
- 2) Install the gear (4) to the J1 shaft on the motor.
- 3) With screw (6) and washer (5) will be a fixed axis gear on the motor.
- 4) Coating on the surface of the motor installation THREEBOND 1110 F planar sealant, J1 shaft motor vertical installation pedestal, at the same time, be careful not to hurt gear

surface.

5) To install the motor set screw (2) (coated in thread sealant LOCTITE 577) and washer (3).

6) Install the J1 shaft connection cable of the motor.

7) Proofreading operation.

装配

1) 除去马达法兰面杂质，确保干净。

2) 将齿轮（4）安装到 J1 轴马达上。

3) 用螺钉（6）、垫圈（5）将一轴齿轮固定在马达上。

4) 在马达安装面上涂 THREEBOND1110F 平面密封胶，将 J1 轴马达垂直安装到底座上，同时小心不要挂伤齿轮表面。

5) 安装马达固定螺钉（2）(螺纹处涂螺纹密封胶 LOCTITE577)以及垫圈（3）。

6) 安装 J1 轴马达连接线缆。

7) 进行校对操作。

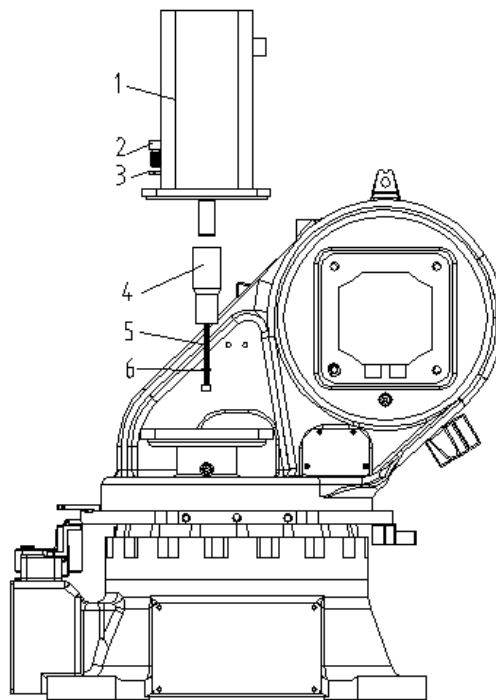


Fig 4.2 Replacing the J1 axis motor

图 4.2 更换 J1 轴马达

Table 4.4 Replacing J1 axis motor parts list

Name	Specification	Quantity	Sealant	Torque (Nm)
1: Motor	140201025	1		
2: Socket head cap screws M12*30	GB/T70.1-2000, 12.9 magnitude	4	LOCTITE 577	128.4±6.37
3: Spring washer 12	GB/T93-1987	4		
4: J1 axis input gear	/	1		
5: Spring washer 8	GB/T93-1987	1		
6: Socket head cap screws M8*75	GB/T70.1-2000, 12.9 magnitude	1		37.2±1.86

表 4.4 更换 J1 轴马达零部件清单

名称	规范	数量	密封胶	力矩 (牛顿米)
1: 电机	140201025	1		
2: 内六角螺钉 M12*30	GB/T70.1-2000, 12.9 级	4	LOCTITE 577	128.4±6.37
3: 弹簧垫圈 12	GB/T93-1987	4		
4: 1 轴输入齿轮	/	1		
5: 弹簧垫圈 8	GB/T93-1987	1		
6: 内六角螺钉 M8*80	GB/T70.1-2000, 12.9 级	1		37.2±1.86

(2) The replacement of J2 axis motor

(2) 更换 J2 轴马达

Disassembly

1) The robot placed in position shown in Figure 4.4 attitude, As shown in Figure 4.4 with rope hanging from the robot can also be made in diameter bolt 25 is inserted into the arm and J2 axis base hole, but with a rope hanging more insurance.

A robot by wire rope is as shown in figure 4.4 suspended also can insert the homemade 25 of the bolt diameter and J2 shaft base hole big arm, but rope hanging more insurance.

2) Cut off the power, remove the motor (1) the connecting cable.

3) The demolition of the motor of the flange plate mounting screw (2) and washer (3).

4) Levels of horse (1), at the same time, be careful not to damage the surface of the gear

5) Demolition of screw (7) and washer (6), and then remove the input gear (5).

6) To dismantle the motor flange end face sealing ring (4).

拆卸

1) 将机器人置于图 4.4 所示位姿，用钢丝绳如图 4.4 悬起机器人也可将自制直径为 25 的插销插入大臂与 J2 轴基座孔处，不过用绳索悬吊更为保险。

- 2) 切断电源，拆卸马达（1）的连接线缆。
- 3) 拆除马达法兰盘上的安装螺钉（2）和垫圈（3）。
- 4) 水平拉出马达（1），同时小心不要损坏齿轮的表面
- 5) 拆除螺钉（7）和垫圈（6），然后拆除输入齿轮（5）。
- 6) 拆除马达法兰端面密封圈（4）。

Assembly

- 1) Remove the motor flange surface impurities, ensure clean.
- 2) Install the sealing ring (4) to the J2 shaft base.
- 3) With screw (7) and washer (6) the input gear (5) is installed on the motor (1) the input shaft.
- 4) Coated on the surface of the motor flange THREEBOND 1110 f planar sealant.
- 5) Horizontal motor (1), at the same time, should be careful not to damage the gear surface.
- 6) Use the screw (2) (coated in thread thread sealant LOCTITE 577) and washer (3) install the motor (1) tighten to J2 shaft seat.
- 7) Will connect cables installed onto the motor (1).
- 8) Lubricating oil.
- 9) Perform checking operations.

装配

- 1) 除去马达法兰面杂质，确保干净。
- 2) 将密封圈（4）安装到 J2 轴基座上。
- 3) 用螺钉（7）和垫圈（6）将输入齿轮（5）安装紧固到马达（1）输入轴上。
- 4) 在马达法兰面上涂上 THREEBOND1110F 平面密封胶。
- 5) 水平安装马达（1），同时应小心不要损坏齿轮表面。
- 6) 使用螺钉（2）（螺纹处涂螺纹密封胶 LOCTITE577）和垫圈（3）将马达（1）安装紧固到 J2 轴转座上。
- 7) 将连接线缆安装到马达（1）上。
- 8) 施加润滑油。
- 9) 执行校对操作。

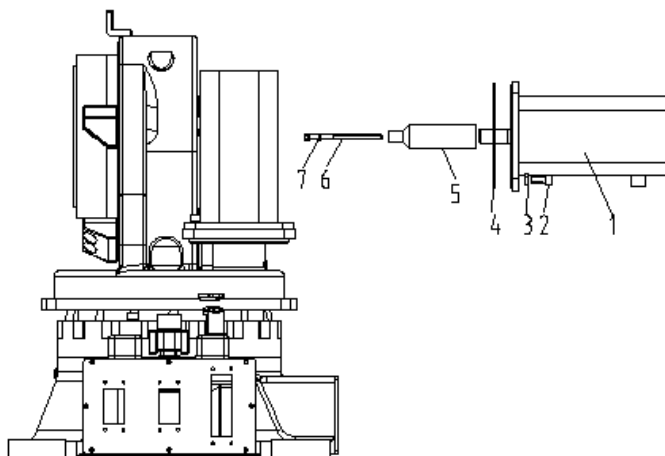


Figure 4.3 Replacing J2 axis motor

图 4.3 更换 J2 轴马达

Table 4.5 Replace the J2 axis motor parts list

Name	Standard	Quantity	Seal Gum	Torque(N.M)
1: Motor	140201025	1		
2: Hexagon socket head cap screws M12*30	GB/T70.1-2000, 12.9	4	LOCTITE 577	128.4±6.37
3: Spring washer 12	GB/T93-1987	4		
4: O ring seal 170*3.55	GB/T3452.1-2005	1		
5: 2-axis input gear	/	1		
6: Spring washer 8	GB/T93-1987	1		
7: Hexagon socket head cap screws M8*125	GB/T70.1-2000, 12.9	1		37.2±1.86

表 4.5 更换 J2 轴马达零部件清单

名称	规范	数量	密封胶	力矩(牛 顿米)
1: 电机	140201025	1		
2: 内六角螺钉 M12*30	GB/T70.1-2000, 12.9 级	4	LOCTITE 577	128.4±6.37
3: 弹簧垫圈 12	GB/T93-1987	4		
4: O 形橡胶密封圈 170*3.55	GB/T3452.1-2005	1		
5: 2 轴输入齿轮	/	1		
6: 弹簧垫圈 8	GB/T93-1987	1		
7: 内六角螺钉 M8*125	GB/T70.1-2000, 12.9 级	1		37.2±1.86

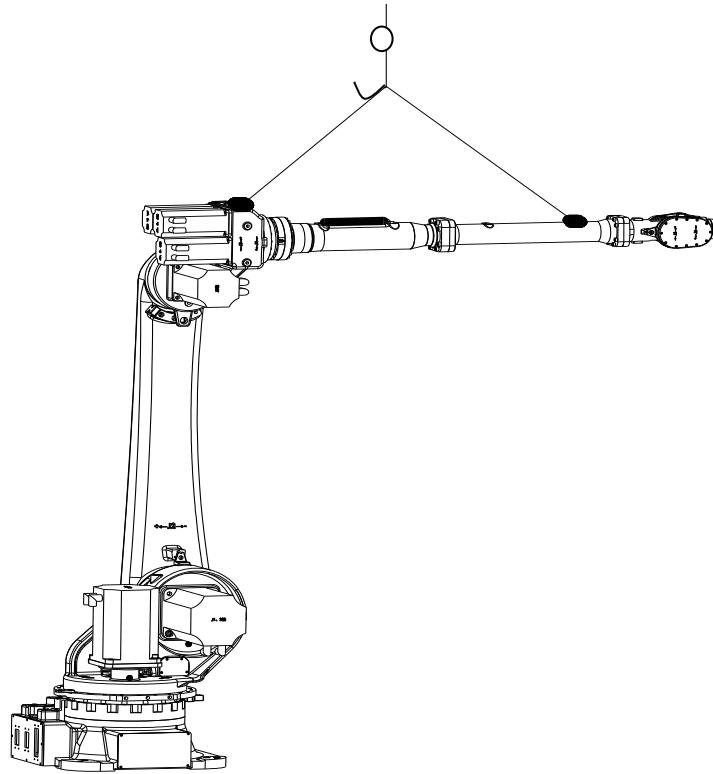


Fig.4.4 J2 motor replacement Pose

图 4.4 J2 马达更换位姿

(3) J3 axis motor replacement

(3) 更换 J3 轴马达

Disassembly

- 1) The motor is placed in an appropriate location, with a sling hanging from it;
- 2) Power dump;
- 3) Removing the motor (1) of the connection cable;
- 4) Removing the motor mounting screws (2) and the washer (3), O-ring seal (7) out of the motor;
- 5) Pull motor (1) level, At the same time, be careful not to damage the surface of the gear;
- 6) Remove the screw (6) and the washer (5), Then remove the input gear (4)。

拆卸

- 1) 将马达置于合适位置，用吊索悬起它。
- 2) 切断电源。
- 3) 拆卸马达（1）的连接线缆

- 4) 移去马达安装螺钉（2）和垫圈（3），取出马达 O 型密封圈（7）。
- 5) 水平拉出马达（1），同时小心不要损坏齿轮的表面。
- 6) 移去螺钉（6）和垫圈（5），然后拆卸输入齿轮（4）。

Assembly

- 1) Remove the motor flange surface impurities, ensuring clean;
- 2) Install the O- ring seal（7）;
- 3) With washer (5) and screws (6) fixed input gear;
- 4) Horizontally mounted motor（1）（Flat top coat sealant installation THREEBOND 1110F），At the same time, be careful not to damage the surface of the gear;
- 5) With screws (2)（The threads coated with thread sealant LOCTITE 577)and spring washers (3) fixed the motor;
- 6) Connect the cables to the motor (1);
- 7) Applying lubricants;
- 8) Perform proofreading operation;

装配

- 1) 除去马达法兰面杂质，确保干净。
- 2) 安装 O 型密封圈（7）。
- 3) 用垫圈（5）和螺钉（6）安装并上紧输入齿轮。
- 4) 水平安装马达（1）（安装面涂平面密封胶 THREEBOND 1110F），同时应小心不要损坏齿轮表面。
- 5) 安装马达安装螺钉（2）（螺纹处涂螺纹密封胶 LOCTITE577）和垫圈（3）。
- 6) 将连接线缆安装到马达（1）上。
- 7) 施加润滑油。
- 8) 执行校对操作。

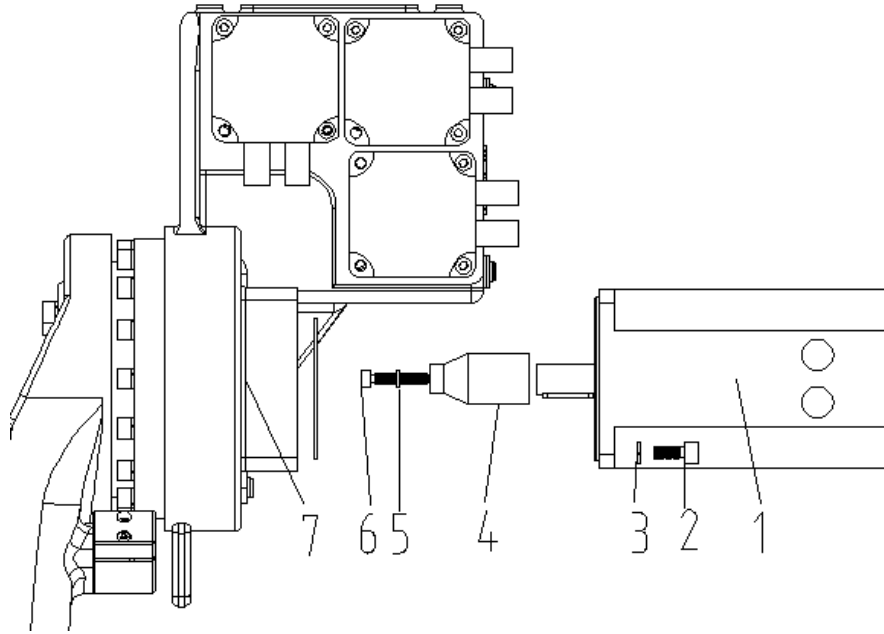


Fig.4.5 J3 axis motor replacement

图 4.5 更换 J3 轴马达

Table 4.6 Replace the J3 axis motor parts list

Name	Standard	Quantity	Torque(N.M)
1: Motor	140201115	1	
2 : Hexagon socket head cap screws M10*25	GB/T70.1-2000, 12.9	4	73.5±3.43
3: Spring washer 10	GB/T93-1987	4	
4: 3-axis input gear	/	1	
5: Spring washer 8	GB/T93-1987	1	
6 : Hexagon socket head cap screws M8*45	GB/T70.1-2000, 12.9	1	37.2±1.86
7: O ring seal 122*2.65	GB/T3452.1-1992	1	

表 4.6 更换 J3 轴马达零部件清单

名称	规范	数量	力矩（牛顿米）
1: 电机	140201115	1	
2: 内六角螺钉 M10*25	GB/T70.1-2000, 12.9 级	4	73.5±3.43
3: 弹簧垫圈 10	GB/T93-1987	4	
4: 3 轴输入齿轮	/	1	
5: 弹簧垫圈 8	GB/T93-1987	1	
6: 内六角螺钉 M8*45	GB/T70.1-2000, 12.9 级	1	37.2±1.86
7: 0 形橡胶密封圈 122*2.65	GB/T3452.1-1992	1	

(4) Replace 4/5/6 shaft motor parts

(4) 更换 4/5/6 轴马达

Disassemble (J4, J5 axis motor)

1) The wrist member placed in a specific location, so there is no load applied to the wrist

member axis;

2) Power dump;

3) Removing the motor (1) of the connection cable;

4) Remove the motor mounting board screws (7) and spring washers (8);

5) Pull motor (1), At the same time, be careful not to damage the surface of the gear;

6) Loosen the screw (2) and spring washers (3), remove 4/5 shaft mounting board and the gear (11)

拆卸（J4、J5 轴马达）

1) 将手腕部件置于特定的位置，使得在手腕部件轴上没有施加的负载。

2) 切断电源。

3) 拆卸马达（1）的连接线缆。

4) 移去电机安装板安装螺钉（7）和垫圈（8）。

5) 拉出马达（1），同时小心不要损坏齿轮的表面。

6) 移去螺钉（2）和垫圈（3），拆卸 4/5 轴安装板与齿轮（11）。

Assembly

1) Remove the motor flange and mounting plates impurities, ensuring clean;

2) Install the bearing and the elastic ring to the correct position, Then bearing gear connected with the body and the mounting plate, install rubber O-ring;

3) Horizontally mounted motor (1) (Flat top coat sealant installation THREEBOND 1110F) and motor mounting board assembly, At the same time, be careful not to damage the surface of the gear, The installation process to ensure that rubber O-ring (4) and (6) in the correct position, And to ensure that the correct direction of motor (1) ;

4) With screws (7) (The threads coated with thread sealant LOCTITE 577) and spring washers (8) fixed the motor;

5) Connect the cables to the motor (1);

6) Applying lubricants;

7) Perform proofreading operation;

装配

1) 除去马达法兰面以及安装板杂质，确保干净。

- 2) 对于马达（1），将轴承以及弹性挡圈安装到位，然后将轴承齿轮连接体与安装板配合，安装 O 型密封圈。
- 3) 安装马达（1）（安装面涂平面密封胶 THREEBOND 1110F）与电机安装板组件，同时应小心不要损坏齿轮表面。安装时，确保 O 型密封圈（4）（6）位于规定的位置。此外应保证马达（1）的方向正确。
- 4) 安装马达安装螺钉（7）（螺纹处涂螺纹密封胶 LOCTITE 577）和垫圈（8）。
- 5) 将连接线缆安装到马达（1）上。
- 6) 施加润滑油。
- 7) 执行校对操作。

Note: the replacement steps of the J4/J5 motors are basically the same, the replacement and spare partslist see below chart

注：J4/J5 马达更换步骤基本相同，更换图及零部件清单见下图表所示。

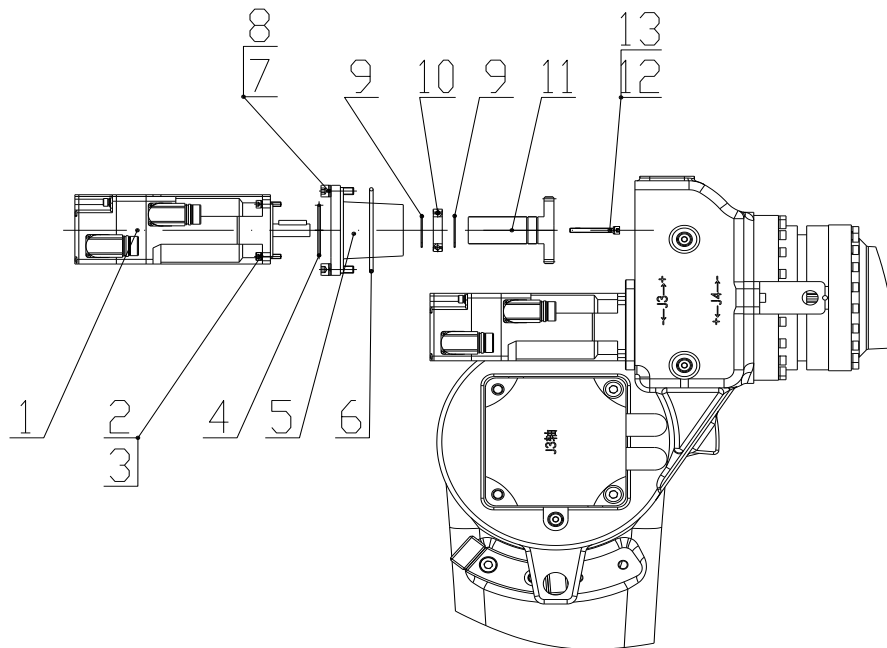


Fig.4.6 J4 axis motor replacement

图 4.6 更换 J4 轴马达

Table 4.7 Replace the J4 axis motor parts list

Name	Standard	Quantity	Torque(N.M)
1: Motor	140201042	1	
2: Spring washer 5	GB/T70.1-2000	1	
3: Hexagon socket head cap screws M5*20	GB/T70.1-2000	4	9.01±0.49
4: O ring seal 53*2.65	GB/T3452.1-1992	1	
5: 4-axis mounting plate	/	1	

6: O ring seal 87.5*2.65	GB/T3452.1-1992	1	
7: Hexagon socket head cap screws M8*25	GB/T70.1-2000	4	37.2±1.86
8: Spring washer 8	GB/T93-1987	4	
9: A type shaft circlip 30	GB/T894.1-1987	2	
10: Deep groove ball bearing 61906	GB/T276-1994	1	
11: 4-axis input gear	/	1	
12: Spring washer 5	GB/T93-1987	1	
13: Hexagon socket head cap screws M5*45	GB/T93-1987	1	9.01±0.49

表 4.7 更换 J4 轴马达零部件清单

名称	规范	数量	力矩（牛顿米）
1: 电机	140201042	1	
2: 弹簧垫圈 5	GB/T70.1-2000	4	
3: 内六角螺钉 M5*20	GB/T93-1987	4	9.01±0.49
4: O 型橡胶密封圈 53*2.65	GB/T3452.1-1992	1	
5: 4 轴安装板	ER16L-C20-03-01A	1	
6: O 型橡胶密封圈 87.5*2.65	GB/T3452.1-1992	1	
7: 内六角螺钉 M8*25	GB/T70.1-2000	4	37.2±1.86
8: 弹簧垫圈 8	GB/T93-1987	4	
9: 轴用弹性挡圈 30	GB/T894.1-1987	2	
10: 深沟球轴承 61906	GB/T276-1994	1	
11: 4 轴电机齿轮	ER16L-C20-03-04A	1	
12: 弹簧垫圈 5	GB/T70.1-2000	1	
13: 内六角螺钉 M5*45	GB/T93-1987	1	9.01±0.49

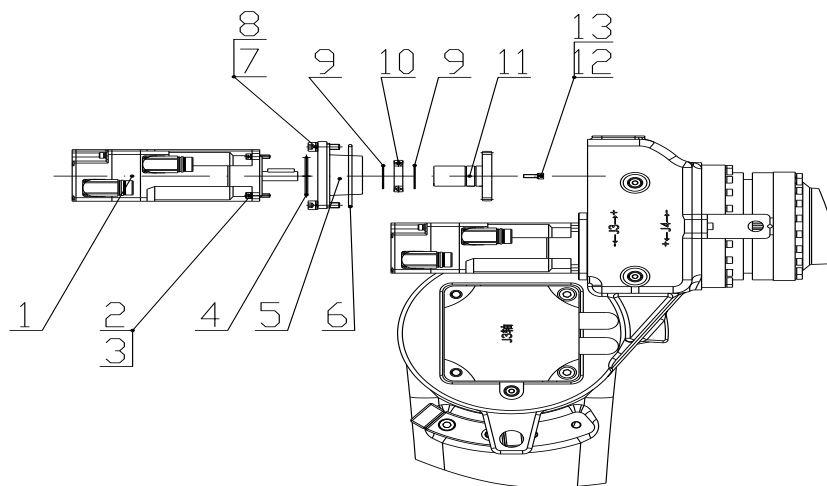


Fig.4.7 J5 axis motor replacement

图 4.7 更换 J5 轴马达

Table 4.8 Replace the J5 axis motor parts list

Name	Standard	Quantity	Torque(N.M)
1: Motor	140201042	1	
2: Spring washer 5	GB/T70.1-2000	1	

3: Hexagon socket head cap screws M5*20	GB/T70.1-2000	4	9.01±0.49
4: O ring seal 53*2.65	GB/T3452.1-1992	1	
5: 5-axis mounting plate	/	1	
6: O ring seal 87.5*2.65	GB/T3452.1-1992	1	
7: Hexagon socket head cap screws M8*25	GB/T70.1-2000	4	37.2±1.86
8: Spring washer 8	GB/T93-1987	4	
9: A type shaft circlip 30	GB/T894.1-1987	2	
10: Deep groove ball bearing 61906	GB/T276-1994	1	
11: 5-axis input gear	/	1	
12: Spring washer 5	GB/T93-1987	1	
13: Hexagon socket head cap screws M5*16	GB/T93-1987	1	9.01±0.49

表 4.8 更换 J5 轴马达零部件清单

名称	规范	数量	力矩（牛顿米）
1: 电机	140201042	1	
2: 弹簧垫圈 5	GB/T70.1-2000	4	
3: 内六角螺钉 M5*20	GB/T93-1987	4	9.01±0.49
4: O 型橡胶密封圈 53*2.65	GB/T3452.1-1992	1	
5: 5 轴安装板	ER16L-C20-03-02A	1	
6: O 型橡胶密封圈 87.5*2.65	GB/T3452.1-1992	1	
7: 内六角螺钉 M8*25	GB/T70.1-2000	4	37.2±1.86
8: 弹簧垫圈 8	GB/T93-1987	4	
9: 轴用弹性挡圈 30	GB/T894.1-1987	2	
10: 深沟球轴承 61906	GB/T276-1994	1	
11: 5 轴电机齿轮	ER16L-C20-03-05A	1	
12: 弹簧垫圈 5	GB/T70.1-2000	1	
13: 内六角螺钉 M5*16	GB/T93-1987	1	9.01±0.49

（5）J6 axis motor replacement

（5）J6 轴马达更换

- 1) The wrist member placed in a specific location, so there is no load applied to the wrist member axis;
- 2) Power dump;
- 3) Removing the motor (1) of the connection cable;
- 4) Remove the motor mounting board screws (6) and spring washers (7);
- 5) Pull motor (1), At the same time, be careful not to damage the surface of the gear;
- 6) Loosen the screw (2) and spring washers (3), remove the gear (9) and mounting board(5);
- 1) 将手腕部件置于特定的位置，使得在手腕部件轴上没有施加的负载。

- 2) 切断电源。
- 3) 拆卸马达（1）的连接线缆。
- 4) 移去电机安装板的安装螺钉（6）和垫圈（7）。
- 5) 拉出马达（1），同时小心不要损坏齿轮的表面。
- 6) 移去螺钉（2）和垫圈（3），拆卸齿轮（9）及安装板（5）。

Assembly

- 1) Remove the motor flange and mounting plates impurities, ensuring clean;
- 2) For motor (1), correctly installed rubber O-ring (4) and install the fixed gear (5);
- 3) Horizontally mounted motor (1) and mounting board(5) (Flat top coat sealant installation THREEBOND 1110F) , With screws(2)and spring washers(3)fixed(1)and(5).The installation process to ensurethat rubber O-ring (4)in the correct position.With screws(10)and spring washers(11)fixed gear(9)and motor(1),The installation process to ensurethat rubber O-ring (8)in the correct position. At the same time, be careful not to damage the surface of the gear.
- 4) With screws (2) (The threads coated with thread sealant LOCTITE 577)and spring washers (3) fixed the motor;
- 5) Connect the cables to the motor (1);
- 6) Applying lubricants;
- 7) Perform proofreading operation;

装配

- 1) 除去马达法兰面杂质，确保干净。
- 2) 对于马达（1），安装 O 型密封圈（4）并安装齿轮（5）。
- 3) 安装马达（1）与安装板（5）（安装面涂平面密封胶 THREEBOND 1110F），用螺钉（2）与弹簧垫圈（3）拧紧，确保 O 型密封圈（4）位于规定的位置。安装齿轮（9），用螺钉（10）与弹簧垫圈（11）将齿轮（9）紧固在电机轴头上，确保 O 型密封圈（8）位于规定的位置，同时应小心不要损坏齿轮表面。
- 4) 安装马达安装螺钉（2）（螺纹处涂螺纹密封胶 LOCTITE 577）和垫圈（3），此外应保证马达（1）的方向正确。
- 5) 将连接线缆安装到马达（1）上。

6) 施加润滑油。

7) 执行校对操作。

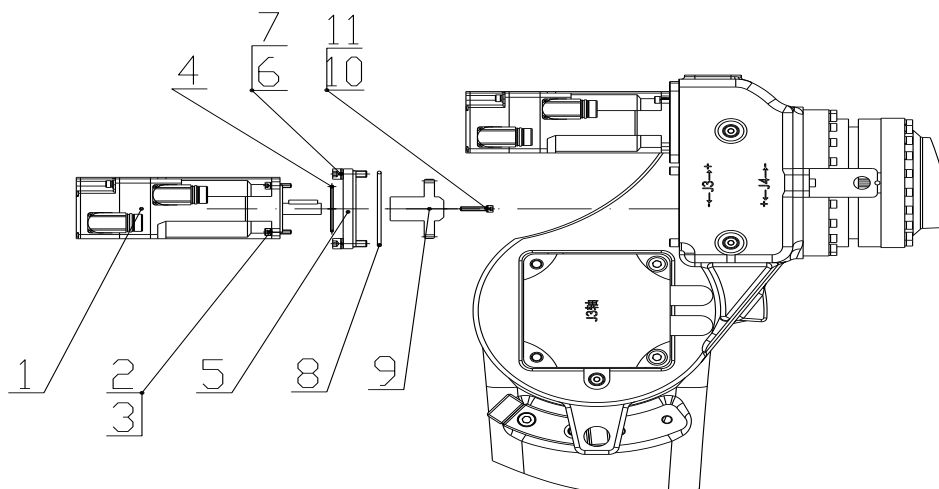


Fig.4.8 J6 axis motor replacement

图 4.8 更换 J6 轴马达

Table 4.9 Replace the J6 axis motor parts list

Name	Standard	Quantity	Torque(N.M)
1: Motor	140201042	1	
2 : Hexagon socket head cap screws M8*25	GB/T70.1-2000	4	37.2±1.86
3: Spring washer 8	GB/T93-1987	4	
4: O ring seal 87.5*2.65	GB/T3452.1-1992	1	
5: 6-axis input gear	/	1	
6: Spring washer 5	GB/T70.1-2000	1	
7 : Hexagon socket head cap screws M5*16	GB/T93-1987	1	9.01±0.49

表 4.9 更换 J6 轴马达零部件清单

名称	规范	数量	力矩（牛顿米）
1: 电机	140201042	1	
2: 内六角螺钉 M5*20	GB/T93-1987	4	9.01±0.49
3: 弹簧垫圈 5	GB/T70.1-2000	4	
4: O 型橡胶密封圈 53*2.65	GB/T3452.1-1992	1	
5: 6 轴安装板	ER16L-C20-03-10	1	
6: 内六角螺钉 M8*25	GB/T70.1-2000	4	37.2±1.86
7: 弹簧垫圈 8	GB/T93-1987	4	
8: O 型橡胶密封圈 87.5*2.65	GB/T3452.1-1992	1	
9: 6 轴电机齿轮	ER16L-C20-03-06A	1	
10: 弹簧垫圈 5	GB/T70.1-2000	1	
11: 内六角螺钉 M5*25	GB/T93-1987	1	9.01±0.49

4.4.3 Sealant Application

4.4.3 密封胶应用

1) Surfaces to be sealed for cleaning and drying

- (1) the surfaces to be sealed by blowing gas, dust removal.
- (2) In order to seal the mounting surface degreasing, use a cloth dampened with a cleaning agent or direct spray cleaners.
- (3) with a dry gas.

1) 对要密封的表面进行清洗和干燥

- (1)用气体吹要密封的表面，除去灰尘。
- (2)为要密封的安装表面脱脂，可使用蘸有清洗剂的布或直接喷清洗剂。
- (3)用气体吹干。

2) Applying sealant

- (1) Make sure the mounting surface is dry (no residual cleaning agent). If water or oil, dry or blow dry it.
- (2) Applying a sealant to the surface, waiting for the sealant to soften (about 10 minutes). Use spatula, spread evenly softened sealant.

2) 施加密封胶

- (1) 确保安装表面是干燥的(无残留清洗剂)。如果有水或油脂，将其擦干或吹干。
- (2) 在表面上施加密封胶，等待密封胶软化（约 10 分钟）。使用抹刀，涂抹均匀软化的密封胶。

3) Assembly

- (1) In order to prevent dust from falling part sealant applied after sealant application components should be installed as soon as possible. Be careful not to contact the sealant is applied. If you accidentally erase a sealant, should be re-applied.
- (2) After installing the parts, screws and washers to fix it fast, so that the surface is completely match fit.
- (3) Prior to application of sealant, not the oil, this is because, the lubricant may leak. Should wait at least one hour after the installation of the gear and then add the oil.

3) 装配

- (1) 为了防止灰尘落在施加密封胶的部分，在密封胶应用后，应尽快安装零部件。注意，不要接触施加的密封胶。如果不小心擦除了密封胶，应重新施加。
- (2) 安装完零部件后，用螺钉和垫圈快速固定它，使匹配表面完全贴合。
- (3) 施加密封胶之前，不要上润滑油，这是因为，润滑油可能会泄漏。应在安装了减速机后等待至少 1 小时后再添加润滑油。

Table 4.10 sealant Model

Name	Specifications Model
Thread Sealant	LOCTITE577
Screw fastening plastic	THREEBOND1374
Plane sealant	THREEBOND1110F
Cleaner	THREEBOND6602T

表 4.10 密封胶型号

名称	规格型号
螺纹密封胶	LOCTITE577
螺纹紧固胶	THREEBOND1374
平面密封胶	THREEBOND1110F
清洗剂	THREEBOND6602T

4.5 Pipeline maintenance package

4.5 本体管线包的维护

This part for the base to the motor city, pipeline package motion amplitude is small, and the big arm and motor connection, this part with the movement of the robot, pipeline package has the relative motion and ontology, if piping bag and ontologies periodically contact friction, can add collision ball or anti friction in friction parts package cloth to ensure pipeline package torn or not in a short time is craze, add collision ball position by field application personnel according to the specific location to install.

对于底座到马达座这一部分，管线包运动幅度比较小，而大臂和马达座连接处，这一部分随着机器人的运动，管线包会和本体有相对运动，如果管线包和本体周期性的接触摩擦，可添加防撞球或者在摩擦部分包裹防摩擦布来保证管线包不在短时间内磨破或者是开裂，添加防撞球位置由现场应用人员根据具体工位来安装。

Pipeline replacement package

管线包的更换：

Pipeline package after a long and mechanical friction of ontology, will inevitably lead to

the situation of the corrugated pipe rupture or is going to broken, in the work of the robot, this kind of situation is not allowed. If the above situation, we'd better change the corrugated tube early (can be replaced without production), replace the steps of: (1) identify the pipes to replace all the cables in the package, loosen the cable joint or the joint; (2) to loosen the pipe clamp, remove the bellows (at this time to pay attention to pipe clamp fixed to mark corrugated pipe), the cable from the line in the package; (3) the interception of the same length of the same specifications of the pipeline, also be mark in the same position, the purpose is to convenient installation; (4) will wear all cables into the pipeline of new replacement; (5) to wear into the cable line package installed to the machine (note that the location of the marking on the body; (6) to do all kinds of wire connection and fixed connection.

管线包经过长时间的与机械本体摩擦，势必会导致波纹管出现破裂的情况或者是即将破损的情况，在机器人的工作中，这种情况是不允许的。如果出现上述的情况，最好提前更换波纹管（可在不生产时更换），更换步骤为：（1）确定所要更换的管线包里的所有线缆，松开这些线缆的接头或者是连接处；（2）松开所用管夹，取下波纹管（这时要注意对管夹固定的波纹管处要做好标记），将线缆从管线包中抽出；（3）截取相同长度的同样规格的管线，同样在相同的位置做好标记，目的是为了安装方便；（4）将所有线缆穿入新替换的管线中；（5）将穿入线缆的管线包安装到机械本体上（注意做标记的位置）；（6）做好各种线缆接头并连接固定。

4.6 Maintenance area

4.6 机器人维护和使用区域

In figure 4.9 shows the mechanical unit maintenance area; it leaves enough area for proofreading the robot.

在图 4.9 中给出了机械单元的维护区域及使用区域，机器人使用区域根据用户工作环境可自行调整。

1) Using area should possess the following safety conditions:

(1) Security fence and safety door must be installed around the robot, if you don't open the door, the operator can't enter the security fence, interlock switch and safety pin is set on the safety door, the robot will stop when the door is open.

(2) Security carpet or photoelectric switch should be set on the floor, so that when operators come into the scope of the robot's motion , the buzzer and photoelectric switch sounds alarm to allow the robot stop movement, in order to ensure the safety of the operator.

(3) Height of Securityfenceshould be not less than 2 meters.

1、使用区域需具备以下安全条件

(1) 必须在机器人周围安装安全栅栏和安全门，如果不打开安全门，操作人员就无法进入安全栅栏内，安全门上设置互锁开关，安全插销等，打开安全门后机器人就停止。

(2) 应在地板上设置安全地毯或安装光电开关，以便当操作人员进入机器人的动作范围时，通过蜂鸣器和光电开关发出警报，使机器人停止运动，以确保操作人员的安全。

(3) 安全栅栏高度不低于 2 米。

2 Qualification requirements of maintenance person and matters need attention

(1) The people who enter the security fence must go through professional training.

(2) Into the robot work scope, the power must be turned off and locked.

2、维护人员的资质要求及注意事项：

(1) 进入安全栅栏，必须经过专业培训。

(2) 进入机器人作业范围时，必须断电上锁。

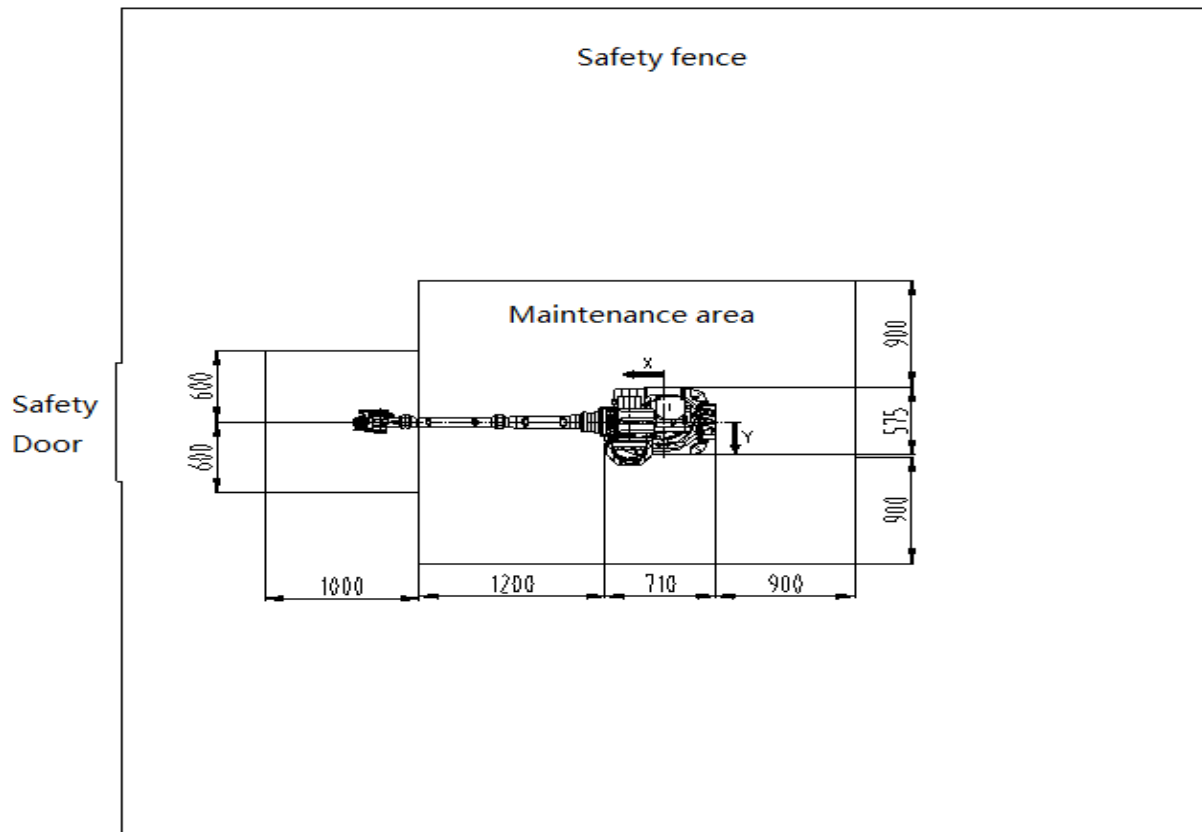


Fig 4.9 maintenance area

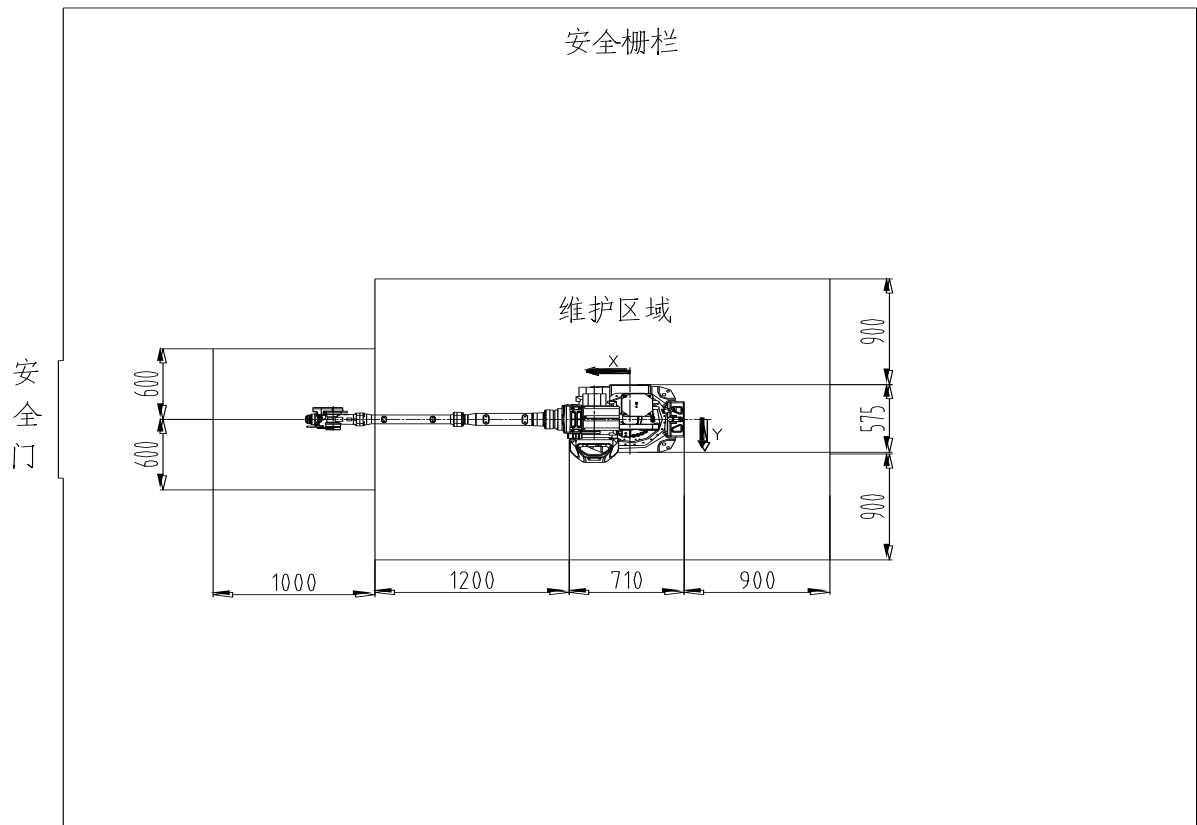


图 4.9 维护及使用区域

Chapter 5-Handling and installation

第五章搬运及安装

5.1 Handling Robot

5.1 机器人搬运

5.1.1 Handling Precautions

5.1.1 搬运注意事项

The following content is the robotic handling operations precautions. Please be aware of the following, the security operation:

下述内容是机器人搬运作业中的注意事项。请充分了解以下内容后，安全作业：



Robots and handling operations must be carried out by personnel with control devices linked to the lifting operation, forklifts and other job qualifications. By not master the correct implementation of the skills of workers handling operations may result in tipping, falling and other accidents occur.



必须由具有挂钩、起重作业、叉车等作业资格的人员进行机器人和控制装置的搬运作业。由未掌握正确技能的作业人员实施搬运作业，可能导致翻倒、掉落等事故发生。



When handling robot and control unit, press the maintenance methods described in the manual, make sure the weight and steps before making a job. If you cannot conduct operations in accordance with the specified method, the robot and the control unit may tip over or fall in the handling process, resulting in accidents.



搬运机器人和控制装置时，请按维护手册中记载的方法，确认重量和步骤后再行作业。如不能按照指定方法进行作业，可能使机器人和控制装置在搬运过程中翻倒或掉落，从而导致事故发生。



CAUTION

When handling and installation operations, should be taken to avoid damage to the wiring. In addition, after the end of the device is mounted, it should be taken stamped shields and other protective measures to avoid workers, forklifts and other damage to the wiring.



进行搬运和安装作业时，应注意避免损坏配线。此外，在装置装配结束后，应采取加盖防护罩等防护措施，而避免作业人员、叉车等损坏配线。

5.1.2 TransportMethod

5.1.2 搬运方法

1) Handling Method

After using a forklift robot posture to figure 5.1, the fork legs were moving.

1) 搬运方法

将机器人设为图5.1所示姿势，使用叉车进行搬运

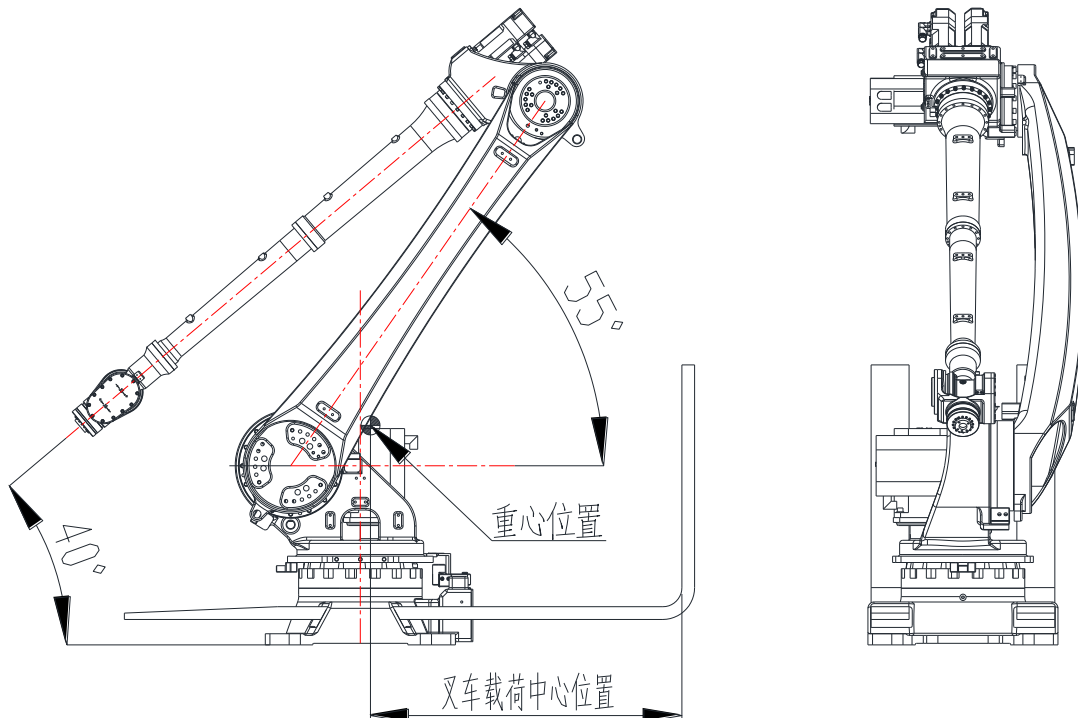


Fig 5.1 forklift robot posture

图 5.1 叉车搬运机器人姿势

5.2 Installation

5.2 安装

5.2.1 External Interface Dimensions

5.2.1 外部接口尺寸图

In figure 5.3 shows the robot base installation size, load is given in figure 5.4 5.5 installed flange size, figure 5.6 -5.9 is part of the installation size chart for external accessories.

在图 5.3 中给出了机器人底座安装尺寸，在图 5.4-5.5 中给出负载安装法兰的尺寸，图 5.6-5.9 则为外部附件部分的安装尺寸图。

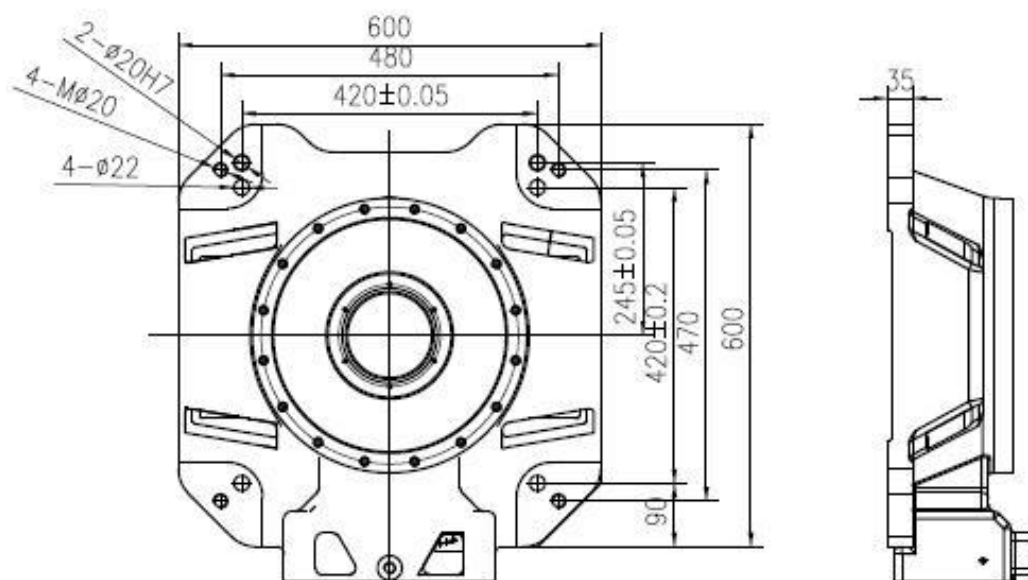


Fig 5.3 robot base size
图 5.3 机器人底座尺寸

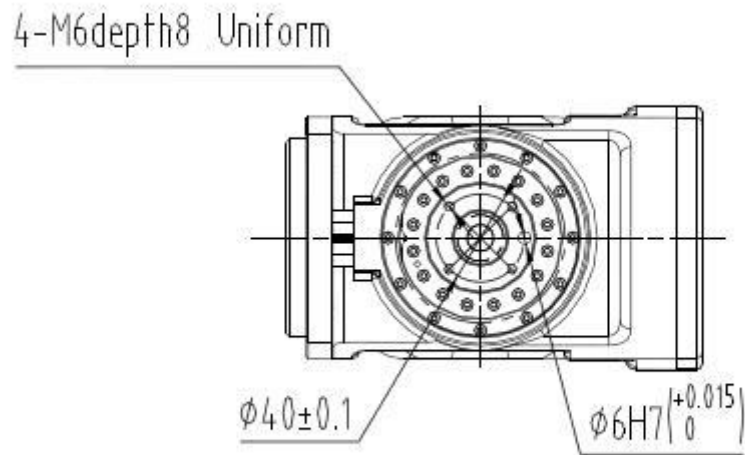


Fig 5.4 end load mounting flange dimensions (一)

图 5.4 末端负载安装法兰尺寸（一）

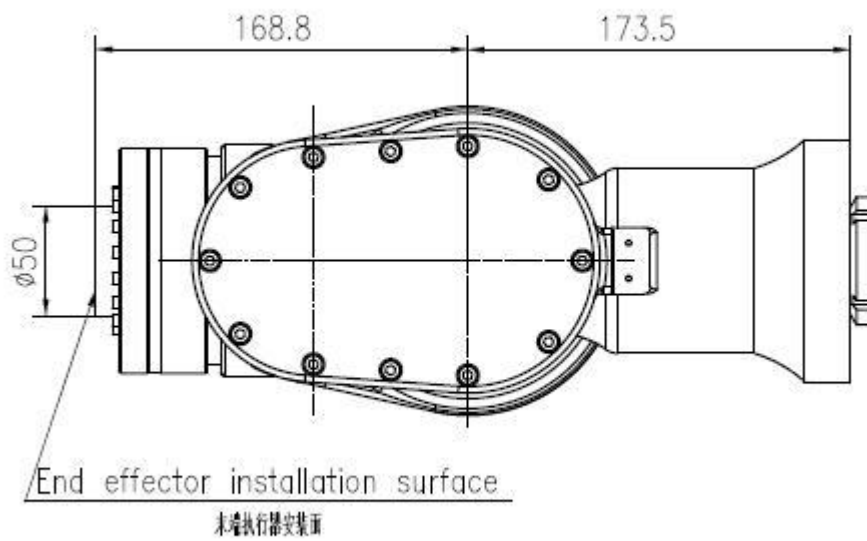


Fig 5.5 end load mounting flange dimensions (二)

图 5.5 末端负载安装法兰尺寸（二）

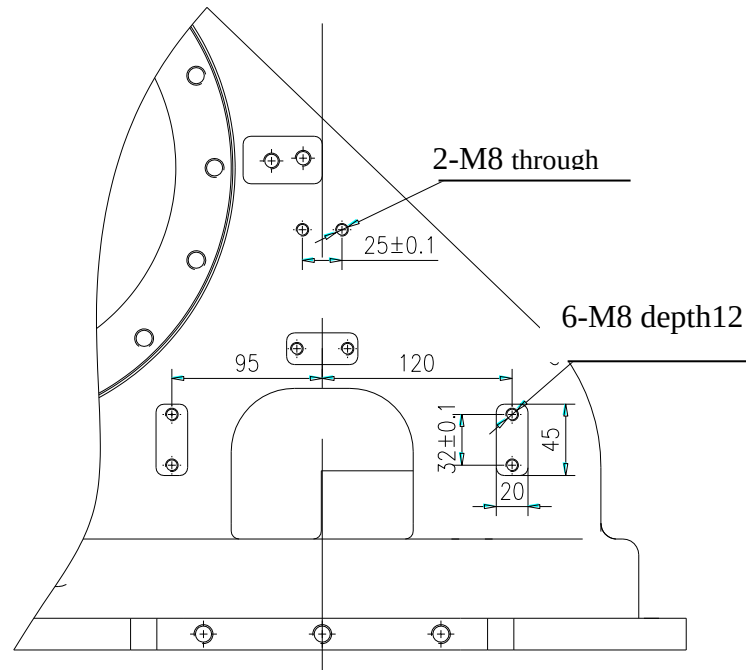


Fig 5.6 the base part of J2 shaft assembly base on external dimension drawing
图 5.6 底座部分 J2 轴基座上安装外部件尺寸图

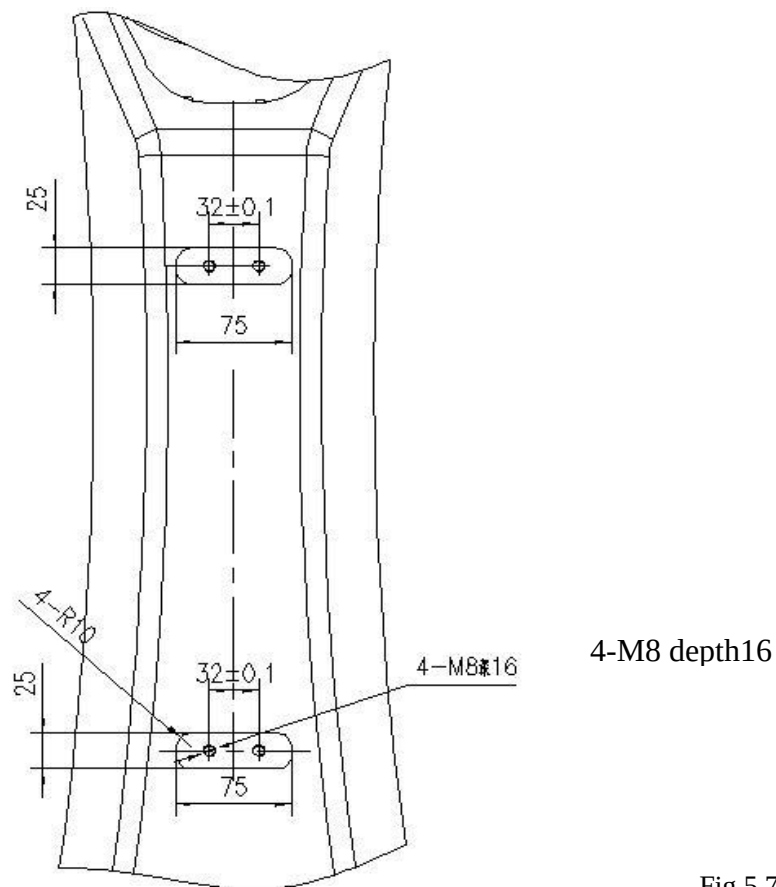


Fig 5.7 big arms are
installed on the external size chart
图 5.7 大臂上安装外部件尺寸图

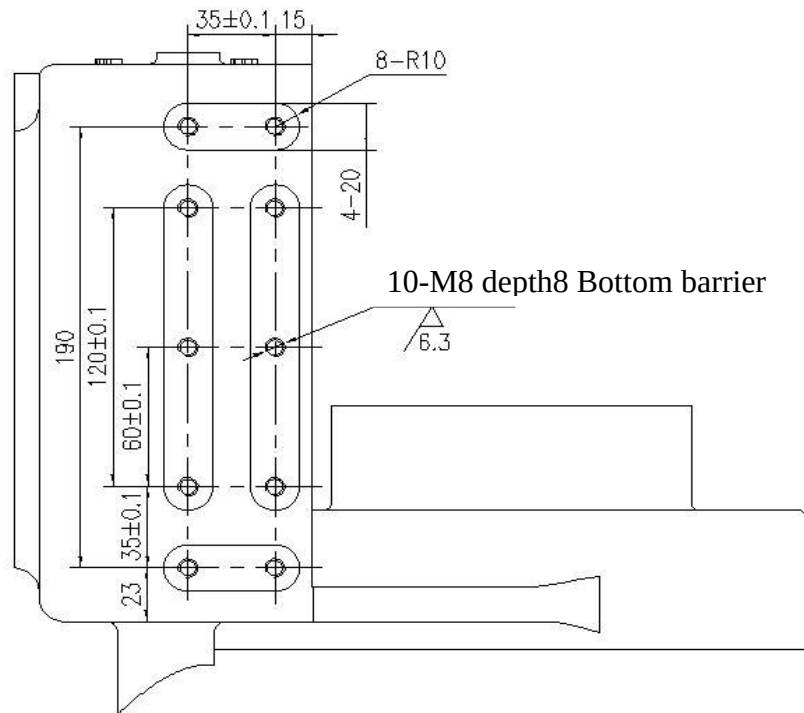


Fig 5.8 motor block installed on the external size chart

图 5.8 电机座上安装外部件尺寸图

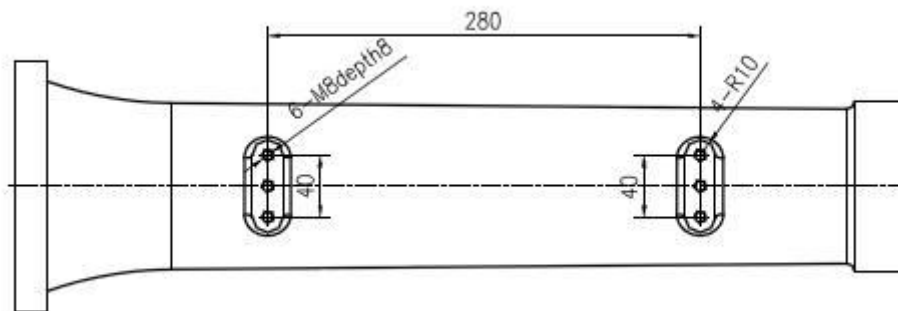


Fig 5.9 lower lever installed on the external dimension drawing

图 5.9 小臂杆上安装外部件尺寸图

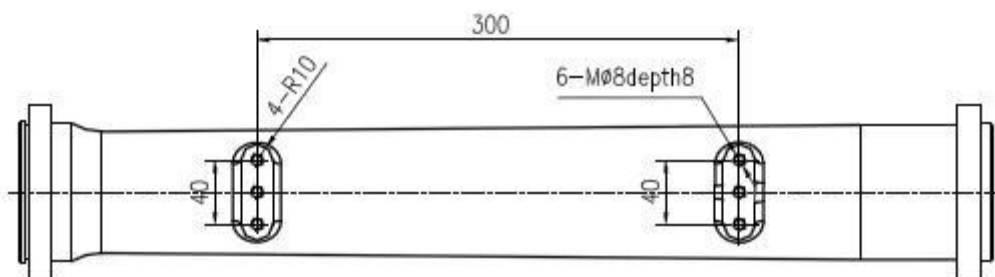


Fig 5.10 forearm extension rod is installed on the external size chart

图 5.10 小臂加长杆上安装外部件尺寸图

Table 5.1 External interface size table

External Interface size robot	As shown in FIG.	Remark
Robot base size	Figure 5.3	robot base size
End load mounting flange dimensions	Figure 5.4、 5.5	End load mounting flange dimensions
The base part of J2 shaft assembly base on external dimension drawing	Figure 5.6	External mounting dimensions
Big arms are installed on the external size chart	Figure 5.7	External mounting dimensions
Motor block installed on the external size chart	Figure 5.8	External mounting dimensions
Lower lever installed on the external dimension drawing	Figure 5.9	External mounting dimensions
Forearm extension rod is installed on the external size chart	Figure 5.10	External mounting dimensions

5.1 对外接口尺寸表

机器人对外接口尺寸	图中所示	备注
底部安装尺寸	图 5.3	底座安装尺寸
末端负载安装法兰尺寸	图 5.4、 5.5	末端负载安装尺寸
底座部分 J2 轴基座上安装外部件尺寸	图 5.6	外部件安装尺寸
大臂上安装外部件尺寸图	图 5.7	外部件安装尺寸
电机座上安装外部件尺寸图	图 5.8	外部件安装尺寸
小臂杆上安装外部件尺寸图	图 5.9	外部件安装尺寸
小臂加长杆上安装外部件尺寸图	图 5.10	外部件安装尺寸

Remark:

1) Robots have the two interfaces, one is the base installation interface, the second is the external interface; Robot itself only provide this two interface interface model and installed base drawings, please users should bring along their own joint, connecting screws, tools, and related links.

2) Robot wrist end flange is reference standards of the state of the interface, the interface to the robot itself only provides interface size. (user, please contact our related links insulations between the soldering tweezers end fittings factory)

3) Pipeline robot package for a robot itself only provide motor cable line package and encoder, water pipe sections, application, etc., please user application scheme according to design assembly or other payment provided by us.

备注:

1) 机器人对外有两处接口，一是底座安装接口，二是外部件接口；此两处接口机器人本身只提供接口型号以及安装底座图纸，请用户自备接头、连接螺钉、工具等进行相关连接。

2) 机器人手腕末端法兰是参考国家标准的标准接口，此处接口机器人本身只提供接口尺寸。（请用户自行联系末端连接件如焊钳厂家进行相关连接）

3) 机器人管线包对于机器人本身只提供马达电缆线和编码器线管线包，水气管部分、应用部分等请用户根据应用方案进行设计装配或另付费由我方提供。

5.3 Installation specifications and environmental conditions

5.3 安装规范及环境条件

Table 5.2 Installation Specification

		Specification
Air pressure	pressure	0.49-0.69MPA
	Airflow	Maximum peak: 150N1/min
Weight machines		About 600KG
Gas copies		Non-corrosive gases
Vibration		Less than 0.5G, 4.9m/s ²

表 5.2 安装规范

条目		规范
气压	压力	0.49-0.69MPA
	气流	最大峰值: 150N1/min
机械单元的重量		约 600KG
气氛		无腐蚀性气体（注释）
振动		低于 0.5G, 4.9m/s ²

5.3.1 Environment and climate adaptation should meet the requirements of

Table 2.

5.3.1 环境气候适应性应符合表 2 的规定

Robots at ambient conditions specified in Table 5.2.1 of use, transport and storage should be able to maintain a normal, its performance should meet the requirements.

机器人在表 5.2.1 的规定的的环境条件下使用、运输和贮存时应能保持正常，其性能应符合要求。

Table 5.2.1 : Robots environmental conditions

Environmental conditions	Working conditions	Storage and transportation conditions
Ambient temperature	0℃～40℃	－40℃～＋55℃
Relative humidity	40%～90%（40℃）	≤93%（40℃）
Atmospheric pressure	86kPa～106kPa	

表 5.2.1 : 机器人环境条件

环境条件	工作条件	贮存、运输条件
环境温度	0℃～40℃	－40℃～＋55℃

相对湿度	40%~90% (40℃)	≤93% (40℃)
大气压力	86kPa~106kPa	

NOTE: For a robot to be used, if there is a strong environment of use vibration, dust a lot, cutting oil splash, or other object, please contact your service personnel robot sets or other means to protect the robot parts.

注释：对于要使用的机器人，如果在使用环境中有较强的振动，灰尘很多，切削油飞溅，或其它物体，请与服务人员联系，用机器人套或其它方式，保护机器人部件。

Appendix

附录

A Screw tightening torque table

A 螺钉上紧力矩表

Screws	Tightening torque (N-m)	螺钉	紧固扭矩 (N-m)
M3	2 ± 0.18	M3	2 ± 0.18
M4	4.5 ± 0.33	M4	4.5 ± 0.33
M5	9.01 ± 0.49	M5	9.01 ± 0.49
M6	15.6 ± 0.78	M6	15.6 ± 0.78
M8	37.2 ± 1.86	M8	37.2 ± 1.86
M10	73.5 ± 3.43	M10	73.5 ± 3.43
M12	128.4 ± 6.37	M12	128.4 ± 6.37
M14	204.8 ± 10.2	M14	204.8 ± 10.2
M16	318.5 ± 15.9	M16	318.5 ± 15.9

Note: Due to the special motor flange material tightening torque cannot be too large, please refer to the table annotation applied.

注释：由于电机法兰材质特殊拧紧力矩不能过大，请参照表格中注释施加。

B Spare parts list

B 备件清单

Table 1 Motor

Name	Model Specifications	Number of single	Remark
J1 axis motor	10900018806	1	
J2 axis motor	10900018807	1	
J3 axis motor	10900018808	1	
J4, J5 ,J6axis motor	10900018809	3	

表 1 马达

名称	型号规格	单台数量	备注
J1 轴马达	10900018806	1	
J2 轴马达	10900018807	1	
J3 轴马达	10900018808	1	
J4, J5, J6 轴马达	10900018809	3	

Table 2Seals and plugs, etc.

Name	Model Specifications	Number of single	Use the site
Rubber O-ring	170*3.55	1	J2 axis motor
Rubber O-ring	122*2.65	1	J3 axis motor
Rubber O-ring	87.5*2.65	6	J4、J5、J6 axis motor
Hexagon plug	M10*1	15	Overall
Combination gaskets	10	15	Overall
Rubber O-ring	180*2.65	1	J1 axis motor

表 2 密封圈及螺塞等

名称	型号规格	单台数量	使用部位
O 型橡胶密封圈	170*3.55	1	J2 轴马达
O 型橡胶密封圈	122*2.65	1	J3 轴马达
O 型橡胶密封圈	87.5*2.65	6	J4、J5、J6 轴马达
内六角螺塞	M10*1	15	整体
组合密封垫圈	10	15	整体
O 型橡胶密封圈	180*2.65	1	J1 轴马达

Table 3 Gear

Name	Drawing No.	Number of single	Use the site
J1axis motor gear	SN60AL107AA0	1	The base unit
J2axis motor gear	SN65AE107AA0	1	The base unit
J3axis motor gear	SN60AN107AA0	1	Arm parts
J4axis motor gear	ER16LA-C20-03-04A	1	Arm parts
J5axis motor gear	ER16LA-C20-03-05A	1	Wrist parts
J6axis motor gear	ER16LA-C20-03-06A	1	Wrist parts

表 3 齿轮

名称	图号	单台数量	使用部位
J1 轴马达齿轮	SN60AL107AA0	1	底座部件
J2 轴马达齿轮	SN65AE107AA0	1	底座部件
J3 轴马达齿轮	SN60AN107AA0	1	小臂部件
J4 轴马达齿轮	ER16LA-C20-03-04A	1	小臂部件
J5 轴马达齿轮	ER16LA-C20-03-05A	1	手腕部件
J6 轴马达齿轮	ER16LA-C20-03-06A	1	手腕部件

Table 4 Part

Name	Drawing No.	Number of single	Use the site
Wrist parts	ER16LA-C20-04	1	Wrist parts

表 4 部件

名称	型号规格	单台数量	使用部位
手腕部件	ER16LA-C20-04	1	手腕部件

Table 5 Sealants and other

Name	Model Specifications	Number of single	Use the site
Lubricating oil	MOLYWHITE RENO.00	5.5Kg	Overall
Plane sealant	THREEBOND 1110F	85g	
Thread locking compound	THREEBOND 1374	15g	
Cleaner	THREEBOND 6602T	600ml	
Thread Sealant	LOCTITE577	100ml	

表 5 密封剂及其它

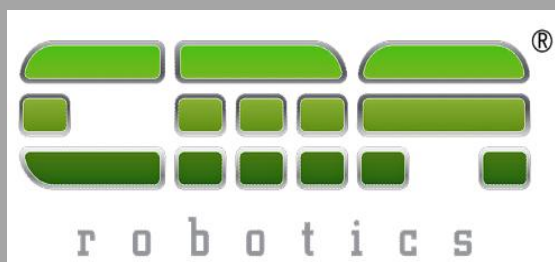
名称	型号规格	单台数量	使用部位
润滑油	MOLYWHITE RENO. 00	5.5 公斤	整体
平面密封胶	THREEBOND 1110F	85g	
螺纹紧固剂	THREEBOND 1374	15g	
清洗剂	THREEBOND 6602T	600ml	
螺纹密封胶	LOCTITE577	100ml	

Table 6 Reducer

Name	Model Specifications	Number of single	Use the site
J1axis Reducer	10800000005	1	The base unit
J2 axis Reducer	10800000006	1	The base unit
J3 axis Reducer	10800000007	1	Arm parts
J4 axis Reducer	10800000008	1	Arm parts
J5 axis Reducer	10800010475	1	Wrist parts
J6 axis Reducer	10800010476	1	Wrist parts

表 6 减速机

名称	型号规格	单台数量	使用部位
J1 轴减速机	10800000005	1	底座部件
J2 轴减速机	10800000006	1	底座部件
J3 轴减速机	10800000007	1	小臂部件
J4 轴减速机	10800000008	1	小臂部件
J5 轴减速机	10800010475	1	手腕部件
J6 轴减速机	10800010476	1	手腕部件



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