



Safety Manual for GR Painting Robot Series.

Version No.: ZL-GR-001-V1

Issue Date: January 2020

The copyright is reserved for CMA (WUHU) Robotics Company Limited and any unauthorized use of this manual is strictly prohibited.

CMA (WUHU) Robotics Company Limited

Address:No.96, East Wanchun Road, Jiujiang Economic
Development District, Wuhu, Anhui Province

TEL: 400-052-8877

CMA

CMA (WUHU) Robotics Company Limited

Supplier of Intelligent Painting Robots

Statement

Thank you for purchasing the painting robots designed by CMA (WUHU) Robotics Company Limited (CMA, in short). The contents stated in the manual are directly related to your safety, lawful rights and responsibilities. Please ensure to read through the manual and correctly set the operation parameters before use. Any operation that does not strictly follow the instructions or the warnings of the manual might lead to physical injury or property damage. All rights for explanation are reserved by CMA.

This manual is intended for technical reference only which makes no warranty to the entire application of the robot system. Therefore, CMA accepts no responsibility for any accident, damage or industrial copyright dispute that follows the use of the application system. It is strongly recommended that all the professionals involved in operation, teaching, maintenance, and inspection should take CMA special training before being authorized to use the robots.

Copyright and Brand name

The copyright of the manual is fully reserved by CMA and is intended for CMA users only. Neither can the manual be reproduced nor should it be revealed to a third party without the written consent of CMA.

The manual should be well kept during the life circle of the robot. An optional copy can be ordered from CMA if the original one is damaged or lost. The address of the new owner is required to be reported to CMA if the robot is resold or transferred.

This manual is an indispensable part of the whole manual collection and all the professionals involved in operation, teaching, maintenance, and inspection are required take CMA special training on the knowledge instructed by the following manuals:

- ☒ ZL-GR-001-V1: Safety Manual for GR Painting Robot Series.
- ☐ ZL-GR-002-V1: Maintenance Manual for GR Painting Robot Series.
- ☐ ZL-GR-003-V1: Explosion Protection Manual for GR Painting Robot Series.
- ☐ ZL-GR-004-V1: Remote Assistance Manual for GR Painting Robot Series.
- ☐ ZL-GR-005-V1: IO Communication Instruction Manual GR Painting Robot Series.
- ☐ ZL-GR-006-V1: Program Editor Instruction Manual for GR Painting Robot Series
- ☐ ZL-GR6150-001-V1 Installation and Connection Instruction Manual for GR6150 Painting Robot.
- ☐ ZL-GR6150-002-V1 Mechanical Operation and Maintenance Manual for GR6150 Painting Robot.
- ☐ ZL-GR6150-003-V1 Electrical Operation and Maintenance Manual for GR6150 Painting Robot.
- ☐ ZL-GR6150-004-V1: Electrical Schematic Diagram for GR6150 Painting Robot.

All rights reserved by CMA. The manual and the relevant manuals re subject to change without prior notice for the purpose of product improvement, specification change and instruction update. Please visit the following website for the latest updates: www.cmarobot.com.cn

About the Manual

The target readers of the manual include professionals involved in robot operation, maintenance and technical service. This manual intends to explain how to use the program editor for all the GR painting robots designed by CMA. The warning pictograms are classified into four categories, “danger”, “caution”, “attention” and “important” respectively. These warnings are relevant to safety and must be observed.

 Danger	Danger! This warning means death might occur, if an operation is not properly performed.
 Caution	Caution! This warning means death or server physical injury might occur, if an operation is not properly performed.
 Attention	Attention! This warning means minor physical injury or minor material damage may occur, if an operation is not properly performed.
 Important	Important! This warning means special attention should be paid to a certain operation.

Warnings titled by “attention” might also lead to severe consequence in different cases. Therefore it is strongly recommended that anything titled by “attention” should be handled with extreme caution.

- Please read the manual and the files attached carefully and master all the required knowledge about the robot and the safety instructions before use.
 - A cover or safety shield is taken out only for the purpose of illustration. Please ensure to restore the cover or safety shield before any operation.
 - The figures and photos contained in this manual are for the purpose of illustration only and they might be different from the product purchased.
 - The manual is subject to change without prior notice for the purpose of product improvement, specification change and instruction update.
- CMA (WUHU) Robotics Company Limited

- The manual will be reissued and a new version number will be specified if the contents are renewed.
- Contact the service department with the information printed on the back cover to purchase a new manual if the present one is damaged or lost.
- CMA is not responsible for any consequence caused by any unauthorized modification or change of the robot.

Contents

Chapter One	Safety Instructions	1
Chapter Two	Five Principles of Safe Operation for GR Robot Series.....	2
Chapter Three	General Principles of Safety Prevention	4
Chapter Four	Safety precautions in working process	6
4.1	Safety of robot installation and connection	6
4.2	Safety before robot start	7
4.3	Safety of robot starting	7
4.4	Test run safety.....	8
4.5	Safety in teaching process	8
4.6	Security in autorun	9
4.7	Safety during maintenance	10
4.8	Safety during spot check and maintenance	11
Chapter Five	Emergency Safety Information	14
5.1	Stop system.....	14
5.1.1	Emergency stop.....	14
5.1.2	Safe stop	14



5.2 Emergency release robot arm 14

5.3 Rescue workers controlled by robot arm..... 15

Chapter One Safety Instructions

According to the relevant national and local laws, regulations and regulations, safety is the most basic concern when using industrial systems including robots.

In the accidents of personal injury and property loss caused by the use of robots, the factories using robots are responsible. Therefore, in addition to understanding this manual and its related materials, we must understand all relevant health and safety regulations and standards, and be sure to comply with them.

For the sake of safety, it is only a minimum requirement to comply with the provisions of this manual and other CMA manuals. As a general rule, the safety related information recorded in this manual does not cover all aspects of robot application system. Therefore, when using the robot, we should take necessary safety measures according to the actual situation of the system and its application environment, and strictly abide by them.

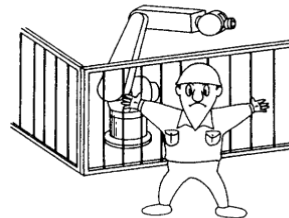
In this manual, special attention should be paid to the following symbols.

In order to ensure the correct and safe operation of the robot and prevent personal injury and property damage, please observe the safety information expressed by the following symbols in the box.

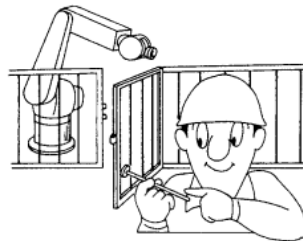
 Danger	Danger! This warning means death might occur, if an operation is not properly performed.
 Caution	Caution! This warning means death or severe physical injury might occur, if an operation is not properly performed.
 Attention	Attention! This warning means minor physical injury or minor material damage may occur, if an operation is not properly performed.
 Important	Important! This warning means special attention should be paid to a certain operation.

Chapter Two Five Principles of Safe Operation for GR Robot Series

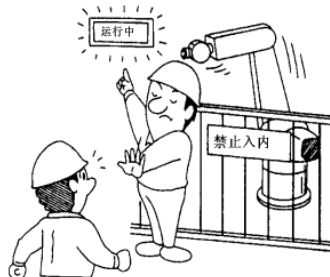
1. The robot is installed in a safe fence without holes, so that people can be effectively prevented from entering the robot working area during the operation of the robot.



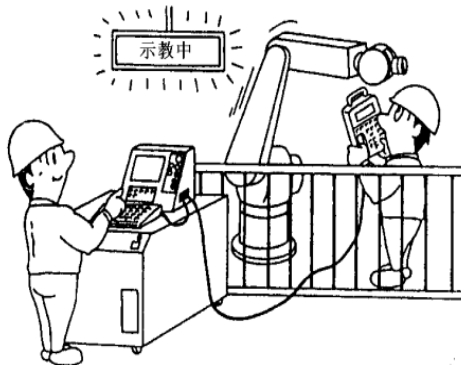
2. The safety door on the fence shall be equipped with safety latch and its locking mechanism. The safety door must be opened only by pulling out the pin, and pulling out the latch must cause the robot to stop automatically and safely.



3. In the operation or waiting of the robot, it is not allowed to enter the range of motion of the robot.



4. When a robot needs to be taught / checked and entered into the safety fence, the operator must take the safety plug with him to enter the robot so as to avoid any unexpected operation of the robot. At the same time, please assign an inspector in front of the controller to monitor each operation and press the emergency stop button at any time. The inspector must also be an employee who has completed the special training course.



5. Clear display operation mode, such as automatic mode, teaching in progress, emergency stop in progress, etc. This allows everyone to see the current operation status of the robot.

Chapter Three General Principles of Safety Prevention

1. The conduct of robot teaching and maintenance must fully comply with national and international laws, local regulations and industrial standards. The safety function of the robot is designed according to the safety requirements for robots in industrial environment (GB 11291.1-2011 / ISO10218-1:2006).

2. It is suggested that all personnel engaged in the installation, operation, teaching, spot inspection, maintenance and repair of robots should participate in the targeted robot training courses prepared by Efort Company. For training courses, please contact CMA Company.

3. Before installing, operating, teaching, spot checking, maintaining and repairing the robot, please fully understand the contents of "safety manual" and other relevant manuals and documents, and strictly follow them, so as to avoid accidents or take preventive measures before accidents.

4. The relevant departments of the factory must formulate and abide by the safety rules and regulations to ensure safe work.

5. The relevant departments of the factory must appoint a full-time operator and a safety supervisor, who is responsible for formulating and implementing safety rules and regulations, including safety education.

6. In order to prevent robot accidents, the safety supervisor must provide the following safety measures according to the specific situation. In addition, all staff must fully comply with it all the time. Always put the robot in the safety protection device (protective device, fence, equipment, etc.), so that the robot arm cannot come out. At the same time, set the emergency stop device in the place easy for the operator to reach. The scope of safety protection (the place enclosed by safety fence) must be able to effectively prevent the robot from going out or extending out of the fence due to mistakes or broken arms. Please try to minimize the number of doors on the safety guard (preferably only one). The door must be equipped with a safety plug, which must be removed manually when the door is closed or opened. Then set the motor power supply: if pull out the safe plug in the automatic mode a, motor power supply will cut off immediately. Before entering the safety device, make sure that the safety device, such as emergency stop button and safety plug, works normally. Then, the operator must set the teaching lock on the teach pendant to the **ON** position to avoid someone accidentally switching to the automatic mode. At the same time, the operator must keep the safety plug with him. On the safety protection device (fence), the status information of the robot can be clearly displayed, such as: automatic mode, teaching in progress, emergency stop in progress, etc., so that everyone can see the current status of the robot. Develop safety regulations for the production line and its surrounding equipment. The administrator must provide relevant training for the personnel who operate, teach, spot-check, maintain and repair the system. At the same time, operators must be educated so that they can obtain skilled work experience in their work process, including various measures to ensure safe work. The operators of robots are limited to those who have completed the formal training of CMA and its authorized companies.

7. Before starting the robot, always remember to confirm the safety conditions and remove all obstacles within the range of motion of the robot. At the same time, remember never to try to do dangerous actions, such as using your body or tools to block the movement of the robot. Remember, to stop the robot immediately, press the emergency stop button.

8. Don't operate the robot beyond its rated capacity, including: load, speed, range of motion, environment, etc.

9. Please mark the dangerous area on the ground with paint, including the action range of robot or peripheral equipment. In addition, enough space (safety area) should be reserved around the equipment for the operators and

safety protection device should be installed for the operator to use in case of abnormal operation or emergency. At the same time, the dangerous area and safe area must be clearly known.

10. The robot can move in an uncertain way in a large range. Please take preventive measures to prevent the dropping of the workpiece in the robot gripper and the collision and extrusion between the robot arm and peripheral equipment. At the same time, operators must be careful that there will be extrusion between fixed and mobile devices, and ensure that these dangerous areas are eliminated.

11. The safety fence must be strong enough to withstand the impact and pressure from inside and outside. The position of the safety fence must be fixed and immovable to prevent the operator from easily removing or breaking the safety fence. At the same time, the safety fence must be free of any sharp corners, sharp edges or spines, and no potentially dangerous parts.

12. Please verify the position and function of the emergency stop switch. Never use any means (mechanical or electrical) to jump off the safety device.

13. Properly install comprehensive safety protection devices to prevent hazards, and make plans for regular maintenance of safety protection devices.

14. For safety, please design and install fail-safe electromechanical interface between system devices. Fail-safe: a standard for the construction of a device, which can ensure that: 1) even if any part of the device fails, it can also ensure that personnel will not be injured; 2) in case of failure, the system will automatically enter a safe state.

15. When the robot is powered on, it is forbidden to plug in or pull out any electrical connector on any printed circuit board.

16. The teach pendant (hanging board) is a precise instrument, so protective measures should be taken to prevent it from being impacted or dropped.

17. If the robot arm is marked with a warning sign, please observe the safety information represented by the sign and protect the sign from damage and contamination. When the logo becomes illegible, please contact Efort.

18. Please do not step on the robot arm or control box. Otherwise, the following accidents may occur, which will cause not only component deformation / property loss, but also personal injury (1) slip (2) accidental release of axle brake, sudden movement of robot arm, (3) if the control box caster is released, it will cause the control box to move or overturn, etc.

19. Please do not wear loose clothes, ties, scarves, watches and jewelry. In addition, according to the working environment or requirements, please wear the specified protective device, safety glasses, helmet and safety shoes.

20. If anyone finds that unsafe working conditions occur, he must immediately report to the safety supervisor or factory safety department, so as to eliminate all unsafe factors and develop safety habits.

Chapter Four Safety precautions in working process

4.1 Safety of robot installation and connection

The safety function of the robot is designed according to the safety requirements for robots in industrial environment (GB 11291.1-2011/ISO10218-1:2006)

1. When transporting robots, avoid exceeding the specified height.
2. If you need to lift the robot, you need to hook the lifting ring with wire rope, and make sure that the lifting ring is not loose before operation.
3. When using wire rope to lift the control cabinet, please remove the teach pendant and its bracket, so as to avoid the cable hooking other equipment.
4. Before transporting the robot, please remove all unnecessary objects and clean the passage to the installation position.
5. If it is handled by forklift, the control cabinet can tilt. To prevent the controller from tilting, use a strap to hold the controller firmly to the forklift.
6. As the robot is composed of precision components, please protect the robot from collision and impact.
7. When the main power supply of the installation site is on, do not connect the power cable of the control cabinet. Otherwise, it will be extremely dangerous and may cause electric shock. When connecting the input power cable, make sure that the main power is off. At the same time, in order to prevent the input power supply or circuit breaker from being closed by mistake, please put clear- off signs on all power supply units and circuit breakers to indicate that the inspection / maintenance and repair are in progress, and lock or place the collet to clamp the main power switch.
8. When the wiring work is finished, be sure to cover the cover plate of the input power connection end. Otherwise, it will be extremely dangerous. If the terminal is touched by mistake, it may lead to electric shock accident.
9. Please place the power / signal cable connecting the robot in the cable tray to prevent damage. In addition, please take measures to avoid pressure on them.

 Danger	Only people with forklift and crane operation qualification are allowed to move / transport robot arm, control cabinet and walking axle. During transportation, never approach or walk under the lifted robot parts, control cabinet or walking axle. Do not stay on the robot arm, control cabinet and walking axle during transportation, and do not touch or support them manually.
 Caution	Do not connect the power supply until the connection between the control cabinet and the robot is completed. Otherwise, it is very dangerous and may lead to electric shock and other accidents.
 Important	Please read and understand all manuals, specifications and other relevant documents provided by CMA before operation. In addition, a complete understanding of the operation, teaching, maintenance and other processes. At the same time, confirm that

	all safety measures are in place and effective.
--	--

4.2 Safety before robot start

1. Make sure that the control box, operation panel and all other control devices of the robot are installed outside the safety protection device (fence). Only in this way can the whole movement range of the robot be monitored.
2. Confirm that there are no personnel, packaging materials, fixtures or other obstacles within the range of motion of the robot arm.
3. Eliminate any area between the fixed device and the mobile device that may trap people.
4. Before connecting the power cable, please confirm whether the voltage, frequency and cable specification of the power supply meet the requirements.
5. Ensure that the control box and surrounding equipment are properly grounded. The ground wire of robot control box and the ground wire of peripheral equipment should be grounded separately, not connected together. At the same time, if the external equipment is equipped with electromagnetic switch, contactor and other devices, please install power filter or equivalent device on the power incoming line adjacent to the robot control box.
6. Before turning **ON** the "power" of the robot, please confirm that the installation of the robot meets the requirements of robot installation.
7. When the operator operates the robot, he must be equipped with an observer for monitoring, and the observer must also complete the corresponding training of CMA company.
8. For application projects (water, compressed air, protective gas, etc.), the system must be equipped with monitoring instruments, so as to automatically detect the abnormal situation of water supply and gas supply in time.
9. If the robot will produce the largest amount of waste, metal dust particles, fine particles, etc. in the process of working, please cover the robot, robot control box and peripheral devices with appropriate covers.

4.3 Safety of robot starting

1. When starting the robot, it is not allowed to enter the safety fence unless the power supply of the robot is cut off. At the same time, before starting the robot, please make sure that all safety protection devices function normally.
2. When starting the robot and recovering from the fault state, please put your hand on the emergency stop switch after turning on the power supply of the motor, so that you can cut off the power supply of the motor immediately in case of abnormal conditions.
3. The following items should be confirmed when the robot starts up:
 - (1) Confirm that the functions of hold / run and manual / automatic mode selection switches are normal.
 - (2) Confirm that each axis of the robot moves normally in the limited range and speed.
 - (3) Confirm that the functions of emergency stop lines and safety devices on the control cabinet, teach pendant and peripheral system are normal when the robot operates in manual / automatic mode.

- (4) Please confirm that the function of limit switch (option) in teaching mode is normal.
- (5) Confirm that the safety circuit function is normal, and in the automatic mode of robot operation, the robot can be stopped by pulling out the safety plug.
- (6) Confirm that in the teaching mode, the robot can be stopped by releasing or fully pressing the enable switch.
- (7) Confirm that the warning signal label is not damaged or contaminated, and that all safety devices including alarm lights and safety protection devices are functioning properly.
- (8) Confirm that the external power source including control power supply and air source can be cut off.
- (9) Confirm that the manual and automatic functions are normal.
- (10) Confirm that the axis of the robot can move normally and perform work.
- (11) Confirm that the robot can operate correctly in the automatic mode and execute the planned action according to the specified speed and load.

4.4 Test run safety

During test run, there may be design error, teaching error and work error in teaching program, fixture, logic controller and other elements. Therefore, the safety awareness must be further improved during the test run.

The following points should be noted during the test run:

1. First, confirm whether the emergency stop button, hold / run switch and other buttons, switches and signals used to stop the robot are normal. Once a dangerous situation occurs, if the robot cannot be stopped, it will not be able to prevent the accident.
2. During the test run of the robot, the operation speed of the robot is set to low speed (about 5% - 10%) to confirm the teaching action. Confirm the action repeatedly with about 2-3 cycles. If any problem is found, stop the robot immediately and correct it. After ensuring that there is no problem, gradually increase the speed (50% → 70% → 100%), and repeat the confirmation action again with about 2-3 cycles.

4.5 Safety in teaching process

1. Efort recommends that teaching should be completed outside the safety fence. However, if it is necessary to enter the safety fence, please strictly abide by the following items, and refer to the following safety standards (GB 11291.1-2011/ISO10218-1:2006).
 2. Before starting the robot, please confirm that all safety guards (safety fences) are working properly.
 3. Before entering the safety fence, the instructor must set the teaching switch on the teach pendant to the manual position to prevent the control cabinet mode switch to the automatic mode and cause accidents. Once the robot makes any abnormal movement, press the emergency stop button immediately.
 4. Emergency stop switch and exit the robot workspace immediately from the preset retreat path.
 5. Please install an emergency stop switch for the observer outside the safety fence and where the whole robot can be monitored. Once the robot is moving improperly, the observer must be able to press the switch very easily to stop the robot immediately. In addition, if you need to restart the robot after an emergency stop, reset and restart manual operation outside the safety fence. It is indicated that the instructor and observer must be qualified personnel who have been specially trained.
 6. Please clearly mark that the teaching work of robot is in progress, so as to avoid any robot system device
- CMA (WUHU) Robotics Company Limited

being misoperated by the controller, operation panel, teach pendant, etc.

7. After completing the teaching work, before confirming the teaching movement track and teaching data, please clear all personnel and obstacles left in the safety fence and around the robot. After confirming that there are no personnel and obstacles left in the safety fence, please perform the confirmation work outside the safety fence. At this time, the speed of the robot shall be less than or equal to the safe speed (250mm/s), until the movement is confirmed to be normal.

8. If you need to restart the robot after an emergency stop, reset and restart manually outside the safety fence. Meanwhile, confirm all safety conditions and confirm that there are no personnel and obstacles left around the robot and in the safety fence.

9. During the teaching process, please confirm the range of motion of the robot, never be close to the robot or enter the lower part of the robot arm. Special attention: when there is a workpiece in the robot's claw, never enter the lower part of it, because the workpiece may suddenly fall due to misoperation at any time.

10. For safety, in teaching or inspection mode, the maximum speed of the robot is limited to 250mm / S (safe operation speed). However, when the operator verifies the teaching data after the teaching or error recovery is completed, please set the speed of inspection operation as low as possible.

11. During the teaching process, whether the instruction operator or supervisor, the robot must be monitored for abnormal movement, possible collision and extrusion points around the robot. Also, please confirm the safety passage for the operator to retreat in case of emergency.

12. After movement teaching of the robot is completed, please set the software limit of the robot a little beyond the teaching range of the robot. How to set the software limit, please refer to the software manual.

 Danger	Please make sure that the function of the emergency stop switch is normal before teaching!
--	--

4.6 Security in autorun

1. Never enter or partially enter the safety fence during automatic operation. At the same time, please make sure there are no people or obstacles left in the safety fence before starting the robot.

2. In automatic operation, the robot looks like it has stopped when waiting for timer delay or external signal input. But at this time do not get close to the robot, because when the timer reaches the time or external signal receives the input,, the robot will immediately resume operation.

3. In the automatic operation, this situation will be extremely dangerous: if the grip of the workpiece is not enough, the workpiece may be thrown off in the movement of the robot. Please make sure that the workpiece is firmly grasped.. When the workpiece is grasped by pneumatic gripper, electromagnetic mechanism method, etc., please use the failure-prevention safety system to ensure that once the driving force of the mechanism is suddenly disconnected, the workpiece will not be ejected. Even in the case of error, the possibility of the workpiece out is the smallest, please also install protective fence, such as mesh cover, etc.

4. Display the sign of "automatic operation in progress" on the safety fence and do not enter the work area. At the same time, please confirm the safe passage for the operator to withdraw in case of emergency.

5. If the robot stops in automatic operation due to the fault, please check the fault information displayed, and

recover and restart the robot according to the correct fault recovery sequence.

6. Before restarting the robot, please confirm that the safe working conditions are met after the fault recovery sequence and that there are no personnel, fixtures, peripheral devices or obstacles left in the safety protection device or around the robot.



Danger

Before automatic operation, please make sure that the emergency stop switch functions normally.

4.7 Safety during maintenance

1. Before entering the security fence, please make sure that all necessary security measures are ready and functioning well.

2. Before entering the security fence, please cut off the control power until the main power supply. Clear signal display should be placed to show that the power is off and maintenance is in progress, and the main power switch should be locked or clamped to prevent someone from turning on the power by mistake.

3. The maintenance work is limited to the personnel who have completed the special training of the corresponding type of robot.

4. Before maintenance, make sure there is enough space around the robot to avoid interference with peripheral equipment. At the same time, the peripheral devices are fixed to prevent any sudden action.

5. Be sure to turn off the automatic operation function before entering the safety fence. If the robot has any abnormal movement, it should immediately press the emergency stop switch and withdraw from the specified evacuation route.

6. In addition to the emergency stop switch of the teach pendant in the hands of the operator, please install another emergency stop switch for the inspector outside the safety bar, where it is convenient to observe the movement range of all robots. In case of abnormal action of the robot during maintenance, the switch must be easily pressed by the inspector. After the emergency stop, please reset and restart the robot from outside the fence. In addition, both operators and inspectors must be personnel who have completed special training courses.

7. During the operation, both the operator and the inspector must pay attention to the abnormal movement, the possible collision point and the surrounding of the robot.

8. When replacing, please use only the parts provided by CMA company.

9. Support the robot arm with a suitable lifting device before removing the servo motor of any joint axis. If the motor is removed, the brake mechanism of the axis will fail. If there is no reliable support, the arm will fall.

10. If compressed air or water is supplied, please cut off the supply source and remove any residual pressure in the pipeline before maintenance.

11. When the robot expands the additional axis, make sure that the emergency stop signal of the additional axis is connected in series to the emergency stop circuit of the control cabinet.

12. When changing the robot parts, it is necessary to confirm the matching degree of the changing parts and the original parts, and carefully check the schematic diagram, so as to prevent the wrong wiring from causing damage to the robot control cabinet components or external components.

**Danger**

Please make sure that the emergency stop switch is working properly before maintenance.

4.8 Safety during spot check and maintenance

In order to prevent system failure, please clean, inspect, maintain or replace the parts of the robot in strict accordance with the following terms. At the same time, refer to the relevant international and domestic safety standards.

Before inspection and maintenance, please make sure that all emergency stop switches function normally.

1. Before inspection and maintenance, remove unwanted objects and clear the passage to the installation position.
2. The spot inspection and maintenance work is limited to the personnel who have completed the special training of the robot or the same type of robot.
3. Before spot check and maintenance, please make sure there is enough space around the robot to avoid interference with peripheral equipment. At the same time, set the peripheral equipment to a fixed state to ensure that they will not suddenly move.
4. Before entering the safety fence, please cut off the power supply of the whole line or robot according to the work needs, and cut off the power supply until the total power supply. Clear signal shall be placed to show that the power is off, inspection / maintenance is in progress, and the main power switch shall be locked or clamped by lock, so as to avoid someone turning on the power by mistake. If the whole line cannot stop, install a temporary safety fence between the target robot and any adjacent robots.
5. When carrying out spot inspection and maintenance of interlocking signal line, please turn off the power supply of all signal associated equipment to ensure safety. Do not enter the safety fence during this work. After the completion of spot inspection and maintenance, please confirm that the safety protection devices (safety fence, safety bolt, emergency stop switch, etc.), peripheral equipment, interlocking lines and other safety devices work normally.
6. In addition to the emergency stop switch held by the operator, please install another emergency stop switch for the supervisor outside the safety fence. The installation position should be selected where all the robot motion ranges can be monitored. If the robot moves abnormally during maintenance / spot inspection, the supervisor must easily press the switch. After the emergency stop, the recovery and restart of the robot must be carried out outside the safety fence. In addition, operators and supervisors must be personnel who have completed special training courses.
7. Before entering the safety fence, the instructor must turn the teaching mode switch on the teach pendant to the manual mode, so as to prevent accidents caused by turning the cabinet mode switch to the automatic mode. Once the robot makes any abnormal movement, immediately press the emergency stop switch and exit the robot working area from the preset retreat path.
8. In the process of spot inspection / maintenance, both operators and supervisors must always monitor whether the robot has abnormal movement, possible collision, extrusion, etc. At the same time, please confirm the operator's safe passage for emergency evacuation.

9. If it is inevitable to remove the safety fence in the process of spot inspection / maintenance, please provide sufficient safety measures:

(1) Park the robot and peripherals in the right place.

(2) Lock / calibrate the power supply and switch. It must be avoided that anyone turns on the power supply by mistake or sets the switch to automatic mode by mistake.

(3) After the completion of spot inspection / maintenance, the safety fence shall be installed again, and all safety measures and safety functions shall be confirmed to be the same as the original.

10. Please use only the parts approved by Efort company for replacement. In addition, in the spot inspection / maintenance, please use the teaching mode and move the robot as low as possible.

11. If the robot must maintain the same pose and attitude before and after maintenance, please record the pose and attitude data of the robot before replacing parts.

12. At the beginning of the replacement process, when the printed circuit board or cable is removed, check and record their position, connector number, installation method, setting data, etc., so that they can be restored as they are. After the connector is inserted, its locking mechanism must be locked firmly. Also, never touch the connector pin.

13. When the application devices (water, compressed air, protective gas, etc.) are used, please shut down their supply sources and remove the residual pressure in the pipeline before spot inspection / maintenance.

14. After repair / maintenance, please make sure that all safety protection devices are working properly

15. Do not change or modify the robot without permission of the company. In case of unauthorized modification, Efort will not be responsible.

16. In the robot arm and control cabinet, a variety of data backup batteries are built in. If the wrong battery is used, it will cause combustion, overheating, explosion, corrosion, leakage and so on. Therefore, the following requirements must be strictly observed.

17. When the robot expands the additional axis, make sure that the emergency stop signal of the additional axis is connected in series to the emergency stop link of the control cabinet. After connecting to the extension axis, it is necessary to test the safety function of the emergency stop link to ensure that it conforms to the safety control logic. After changing the safety related components, it is necessary to test the safety function of the emergency stop link to ensure that it meets the safety control logic.

18. When changing the robot parts, the matching degree between the changing parts and the original parts must be confirmed, and the schematic diagram must be checked carefully to prevent the wrong wiring from causing damage to the robot control cabinet components or external components.



Danger

Before inspection and maintenance, please make sure that the emergency stop switch functions normally.



Danger

After the completion of spot inspection and maintenance, please confirm that the safety protection devices (safety fence, safety bolt, emergency stop switch, etc.), peripheral equipment, interlocking lines and other safety devices work normally.



Caution

1. Only use batteries specified by CMA;
2. The battery can not be recharged, disassembled, changed and heated;
3. Do not discard the battery in water or fire;
4. The battery with damaged surface may have been short circuited inside and must

	not be used again; 5. Do not use metal, such as wires, to short circuit the positive and negative poles of the battery.
 Attention	The waste batteries should not be discarded in the garbage of incineration, landfill and dumping to the ground. When discarding batteries, wrap them in bags to prevent them from contacting other metals, and handle them correctly according to local regulations.

Chapter Five Emergency Safety Information

5.1 Stop system

5.1.1 Emergency stop

Emergency stop is a state beyond the control of any other manipulator. Emergency stop means that all power supplies are disconnected from the manipulator. To return to normal operation, a recovery procedure, i.e. reset the emergency stop button, must be performed.

An emergency stop can result in:

- Uncontrolled stop, quickly stop the manipulator operation by disconnecting the motor power supply.
- Controlled stop, power is supplied to the motor so that the path of the manipulator is maintained and the manipulator operation is stopped.

controlling category	stop category
uncontrolled	category 0 (zero)
controlled	category 1

5.1.2 Safe stop

Safe stop means that only the motor is powered off. Therefore, no recovery steps need to be performed. Simply reconnect the motor power supply to return to normal operation from the safe stop state. Safety stop is also called protective stop.

Because the manipulator system is configurable, stopping can cause:

- Uncontrolled stop, quickly stop the operator operation by disconnecting the motor power supply.
- Controlled stop, power is supplied to the motor so that the path of the manipulator is maintained and the manipulator operation is stopped.
- After operation, the power is disconnected from the motor.

controlling category	stop category
uncontrolled	category 0 (zero)
controlled	category 1

5.2 Emergency release robot arm

1. In case of emergency, click the brake release function to release any axis of the robot.
2. For smaller robot models, the robot arm can be moved manually, but moving larger models may require the use of overhead cranes or similar equipment. Before releasing the brake, make sure that the weight of the arm does not increase the pressure on the trapped person, thereby increasing any risk of injury!
3. When the brake is released, the axis of the robot may move very fast, and sometimes its movement mode

cannot be predicted! Make sure there is no one near or under the robot arm.

5.3 Rescue workers controlled by robot arm

Before releasing the holding brake, make sure that the weight of the arm will not increase the pressure on the trapped person, thus increasing any risk of injury.

1. Press the emergency stop button to confirm the personnel status and dial 120 in time.
2. After ensuring that the trapped person will not be further injured by rescue operation, the gravity arm of the robot will be lifted by the lifting device. And let the sling tighten up.
3. Release the holding brake, start the lifting device, move the robot gravity arm and leave the trapped person safely, and observe the status of the scene, so as to rescue the trapped person from the robot area in case of other accidents.
4. Rescue the trapped and give medical treatment.
5. Ensure that the robot workspace is empty and adjusted to a safe posture to ensure that there is no risk of other personnel injury.



Caution

For no special purposes, it is strictly forbidden to touch the manual release brake function, otherwise the robot axis will fall, causing serious consequences !



Attention

Before using the brake release function, the axis of the brake should be prepared for hoisting to avoid the robot falling after the brake is released. Make sure that the weight of the robot arm does not increase the pressure on the trapped person, thereby increasing the degree of injury!



**Efort Intelligent Equipment Company
Limited**

No.96, East Wanchun Road, Jiujiang Economic
Development District, Wuhu, Anhui Province

www.efort.com.cn

Service hotline: 400-052-8877

**CMA (WUHU) Robotics Company
Limited**

No.96, East Wanchun Road, Jiujiang
Economic Development District, Wuhu, Anhui
Province

www.cmarobot.com.cn

Service hotline: 400-052-8877