Safety Instructions for Use of Robot

Product series: Whole series of STEP robot
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Foreword

Before using the robot, read carefully the instruction manual of the STEP Robot and use the robot on the base of understanding this manual.

Abstract

This safety instructions provides complete and comprehensive description about the installation, use, parameter setting and maintenance of STEP series robot. This manual can be used as the reference document by system integrators when they use our company's SR series robot for the system design of user workstation or as the guidance for system installation, commissioning and maintenance.

In order to ensure proper installation and use of STEP series robot, you shall read this manual carefully before using the robot.

Target Readers

System integrator

Onsite technical support staff

Equipment maintenance personnel

After sales service personnel

Contents

This manual is subject to supplementation and change. Check our website for any updates. Our website: www.steprobots.com.

Descriptions of safety-related marks

This document includes relevant safety notes for ensuring personal safety and preventing system damage. They are labeled with "Danger", "Caution" or "Important" based on their importance. Before using the robot, the user shall be familiar with the safety notes and strictly follow them.

Danger

It may cause hazardous conditions or personal death if it is used improperly.

Caution

It may cause danger, minor or serious personal injury and equipment damage if it is used improperly.

Important

The part that the user needs to observe and pay attention.

Table of Contents

Chapter I Notice for Use

1.1 Scope of Application

The robot is mainly used in welding, handling, stacking and other applications where manual operation is replaced totally or partially.

1.2 Unpacking Inspection

Caution

◎ **The robot with damage or missing parts shall not be installed.**

Otherwise there is danger for major accident or personal injury.

Caution

◎ **Read "Safety Instructions for Use of Robot" before using the robot.**

Otherwise there is danger for major accident or personal injury.

During unpacking, check if there is any damage from shipping and the model and specifications on the nameplate are consistent with the order requirements. If any model discrepancy or parts missing is found, contact the manufacturer or supplier immediately.

1.3 Safety precautions

Danger

Do not use the robot in the following conditions. Otherwise it may not only cause adverse effect to the robot and the peripheral equipment, but serious injury to the operators.

◎ Flammable environment.
◎ Explosive environment.
◎ Environment with massive radiation.
◎ Water or high temperature environment.
◎ Environment for the transportation of people or animal.
◎ Used as the feet lug (climb on the robot or hang below it).

Danger

The operator can normally operate the robot only after using the following safety equipment

◎ Work clothes suitable for the operation.
◎ Safety shoes
◎ Safety helmet

Important

◎ The operator for programming and maintenance can normally attend to his job only after obtaining the formal training from STEP,

Danger

◎ When handling or installing the robot, be sure to correctly execute it according to the method indicated by STEP. If the operation is done in a wrong method, it may cause injury to the operator because of robot overturning.

Caution

◎ After installation, the robot must run at low speed when it is used for the first time. Then gradually increase the speed and check if there is anything abnormal.

Danger

◎ During application of the robot, be sure that no person is inside the safety barrier prior to operation. In addition, examine whether there is any potential danger. If so, be sure to eliminate it before operation.

Caution

◎ Do not wear gloves in application of the operation panel and teaching operating panel, otherwise it may cause operation error.

Important

◎ Program and system variable can be saved in the floppy disk (option).In order to avoid data loss due to unexpected accident, the user shall save the data regularly.

Danger

Programming shall be done outside the safety barrier, if possible. If it has to be done inside the safety barrier, pay attention to the following instructions:

◎ Carefully examine the conditions inside the safety barrier, enter it only after it is free of any danger.

◎ The emergency button can be pressed at any time.

◎ Run the robot at low speed.

◎ Execute the operation after confirmation of the status of the whole system to avoid the operator being put into a danger due to operation command and action of the peripheral equipment.

Caution

◎ After completion of programming, test run shall be done according to the steps specified. Now, the operator must carry out operation outside the safety barrier.

Important

◎ The programming personnel must obtain proper training from STEP.

Danger

◎ Execute the operation when the robot and the system is powered off. When the power is on, there is a danger of electric shock. Additionally, it shall be locked as required, ensuring that other personnel cannot power it on. Even if the operation has to be done when the robot is powered on, the operation can begin only when the emergency button is pushed, if possible.

Danger

◎ Read the maintenance manual beforehand when replacing the mechanical parts and carry out the operation on the basis of understanding the operation procedure. Unexpected accident may be caused if the operation is done with wrong procedure, leading to robot damage or operator injury.

Danger

◎ Carefully check the whole system when entering the safety barrier, enter it only when confirming there is not any danger. If any person has to enter it when there is any danger, the status of the whole system must be known and it shall be done carefully and cautiously.

Danger

◎ The parts to be replaced shall use the parts specified by STEP. If the parts beyond the specified ones are used, it may cause mis-operation and damage of the robot. In particular, do not use the fuse outside of the specified types to avoid fire.

Danger

◎ When removing the motor and the brake, a crane must be used for lifting to avoid the arm falling off.

Danger

If the robot has to be moved during maintenance, pay attention to the following:

◎ Be sure of the escape route. Execute the operation after grasping the operation of the whole system to avoid route being blocked by the robot and peripheral equipment.

◎ Mind whether there is danger and get prepared, so as to press the emergency button at any time if needed.

Danger

◎When using the motor and decelerator with a certain weight, the auxiliary device such as crane shall be used, to avoid causing too much operation burden to the operator. It should note that wrong operation may cause serious injury to the operator.

Caution

◎ Be careful not to slip on the lubricant spilled on the ground. Wipe off the lubricant spilled on the ground as soon as possible, to remove the possible danger.

Caution

◎ Do not put the feet on some part of the robot. Do not climb the robot during operation. Otherwise it may cause adverse effect to the robot, also personal injury when the operator misses his steps.

Caution

◎ Pay attention to the following parts because they will hot. In case of contact with the equipment in hot state, prepare the heat-proof gloves.

◎ Servo motor.

◎ Inside the control cabinet.

Caution

◎ The parts (bolt) removed during replacement must be correctly put back to its original position. If the parts are insufficient or surplus, please re-confirm and properly install it.

Caution

◎ Be sure to release the supply air pressure during the maintenance of pneumatic system to reduce the pressure inside the pipeline to 0.

Caution

◎ Be sure to execute the test run as per the method specified after replacement. At this time, the operator must execute the operation outside the safety barrier.

Caution

◎ Thoroughly clean the lubricant, water and debris around the robot or scattered on the ground inside the safety barrier after maintenance.

Caution

◎ Prevent the dust or dirt from entering the robot during replacement of the parts.

Important

◎ The operators for maintenance and overhaul must obtain form training from STEP.

Important

◎ Prepare proper lighting fixtures during maintenance. It should note that the lighting fixtures shall not become new danger source.

Important

◎ Be sure to carry out regular repair (see the Maintenance Manual).Otherwise, it may not only influence the service life of the robot, but lead to unexpected accident.

Caution

◎ If the robot experiences a serious crash accident, it must be troubleshot by the professional technical. The robot can be used properly only after return-to-zero, otherwise the zero point may be lost and cause a risk.

Caution

◎If the cable between the control cabinet and the main robot body shall be plugged during maintenance, return-to-zero must be done firstly after the robot is restarted, then the robot can be used normally, otherwise the zero point will be lost and cause a risk.

Caution

◎ If the main robot body and the motor, decelerator and its related transmission parts of the peripheral equipment need to be removed during maintenance, they must be executed with return-to-zero processing by the professional technician after troubleshooting, then the robot can be used normally, otherwise the zero point will be lost and cause a risk.

Important

◎The working space reflects the zero point of the mechanical system and the scope of operation, which is slightly different from those defined in the operation instructions of control system. The user must be subject to those defined in the operation instructions of control system when he operates the robot, otherwise the system will report an error.

Chapter II Troubleshooting

It is difficult to thoroughly find out the cause because fault in the main mechanical body is caused by different reasons overlapped together. In addition, if the wrong measures are taken, the fault may be worsen further, therefore it is important to analyze the problem and find out the real cause.

The primary fault of the mechanical system and the cause is listed below. When the cause cannot be identified and you have no idea what measures shall be taken, please contact our company.

Symptom	Classification	Cause	Measures
Vibration Abnormal noise	◎ cannot determine the cause from the floor, stand or the mechanical body.	[Control device, cable, motor] ◎When the connecting cable between the mechanical body and the control device is breaking, the robot vibration may be caused.	◎ Verify whether the connecting cable between the mechanical body and the control device is damaged externally. If so, please replace it, then verify if the vibration still exists.
	◎ Mechanical action near the robot is related to the robot vibration.	[Electric and mechanical noise near the robot.] ◎The ground wire is not connected securely, so the electric noise may mix with it, leading to vibration because the command value cannot be correctly transferred. ◎Unstable grounding may be caused when the ground wire conditions are unsuitable, therefore the robot will vibrate because the electric noise can easily mix with it.	◎ Securely connect the ground wire, to avoid collision grounding and prevent the electric noise from entering it from other places.
	◎Abnormal noise after replacement of lubricant. ◎Abnormal noise occurs when the robot is restarted after long time shutdown. ◎Abnormal noise occurs when the robot is running at low speed.	◎Abnormal noise may be caused if the lubricant is not the specified type. ◎Even the specified lubricant is used, abnormal noise may be caused when the robot is running at low speed after replacement or restart after long time shutdown.	◎ Please use the lubricant specified. ◎ If abnormal noise still exists after the specified lubricant is used, please observe the robot's running state for 1-2 days. Typically the abnormal noise may disappear.

Symptom	Classification	Cause	Measures
vibration Abnormal noise	◎ J1 axis foundation floats up from the base when the robot is running. ◎ Clearance between J1 axis foundation and the base. ◎Fixing bolt of J1 axis foundation becomes loose	[fixing of J1 axis foundation.] ◎J1 axis foundation of the robot is not securely fixed to the base. ◎It may be caused by the loose bolt, insufficient flatness of the base or the foreign object mixed. ◎When J1 axis foundation of the robot is not securely fixed to the base, it will float up from the base when the robot is running, at this time vibration may be caused due to the impact incurred.	◎ Tighten the bolt using the bolt tightener with the proper torque. ◎Change the flatness of the base, making it within the tolerance range. ◎Verify whether there is any foreign object mixed, if any , remove it.
	◎ The stand or the ground vibrates when the robot is running.	[the stand or the ground] ◎It may be caused by the insufficient rigidity of the stand or the ground. ◎When the rigidity of the stand or the ground is insufficient, the stand or the ground will experiences deformation due to the counter force when the robot is running, leading to vibration.	◎ Reinforce the stand and the ground to improve its rigidity. ◎ When it is difficult to reinforce the stand or the ground, vibration can be relieved by changing the action program.
	◎ Vibrates in a special condition when the robot is running. ◎ No vibration occurs when speed of action slows down. ◎ Vibration increases during acceleration. ◎ Several axes vibrate simultaneously.	[overload ◎It may be caused by the overload installed on the robot. ◎It may be caused by the too strict regulations set for the robot by the action program. ◎Unsuitable value may be input during acceleration.	◎Verify the permissible load of the robot. Reduce the load when the permissible load is exceeded, or change the action program. ◎ Control the influence caused by the total circulation time within a minimum scope by reducing the speed and the acceleration. Alleviate the vibration of the special part by changing the action program.
	◎ Vibration may be caused after the robot is collided or used for a long time in overload condition. ◎ Axis vibration caused by no replacement of the lubricant for a long time.	[damage of the gear, bearing and decelerator] ◎Gearing surface or rolling surface of the gear, bearing and decelerator face may be damaged due to collision and overload, which will produce too much force exerting on the drive system. ◎Gearing surface or rolling surface of the gear, bearing and decelerator peels off because they are used under overload state for a long time. ◎Gearing surface or rolling surface of the gear, bearing and decelerator is damaged possibly because the foreign object is bitten inside them. ◎Gearing surface or rolling surface of the gear, bearing and decelerator peels off because they are used in a condition of no replacement of the lubricant for a long time. Periodic vibration or abnormal noise may be caused because of the above reasons.	◎Verify how many axes may produce vibration if the robot is running with single axis. ◎ It is necessary to remove the motor and replace the gear, bearing and decelerator parts. Please contact us for the specification of the parts to be replaced and replacement method. ◎ Drive system fault will be avoided if they aren't used in overload state. ◎ Replace the specified lubricant according to each period specified, to prevent fault.

Symptom	Classification	Cause	Measures
Shake	◎ Press the robot after the robot power is cut off, part of the main mechanical body will shake. ◎ There is clearance on connecting surface of the main mechanical body.	[connecting bolt of the main mechanical body] ◎It may be caused by the loose connecting bolt of the main mechanical body due to overload or collision.	◎Verify whether the following components of each axis become loose. If any, tighten it using the bolt tightener with the proper torque. ● Fixing bolt of the motor ● Fixing bolt of the decelerator casing ● Fixing bolt of the decelerator ● Fixing bolt of the base ● fixing screw ● Fixing bolt of the casing ● Fixing bolt of the end actuator.
	◎ Reverse clearance is greater than the permissible value recorded in the manual.	[increase of the reverse clearance] ◎Internal damage of the decelerator may be caused by too much external force exerting on the drive system due to collision or overload, leading to increase of the reverse clearance. ◎The reverse clearance is increased because the gear and the gear surface of the decelerator is worn when they are used under a state of overload for a long time. ◎The reverse clearance is increased because the gear and the gear surface of the decelerator is worn when they are used with the lubricant not replaced for a long time.	◎ Verify whether the reverse clearance of several axes are increased when the robot is running with single axis. ◎Remove the motor to verify whether the gear is damaged. If any, replace the gear. ◎ Verify whether other gears of the drive system are normal. If not, replace the decelerator. ◎ When the decelerator is damaged or the gear falls off, drain all lubricant inside the grease groove and clean it during component replacement. ◎Inject the proper amount of grease after replacement of the gear and the decelerator. ◎ Avoid using it under overload condition and the drive system fault can be avoided. ◎ Replace the specified grease according to each specified period to avoid fault.

Symptom	Classification	Cause	Measures
Grease leakage	◎ The grease leaks from the main mechanical body.	[poor seal] ◎ It may be caused by casting cracking, O ring damage, oil seal damage and the loose sealing bolt. ◎ Casting cracking may be caused by the excessive force due to collision. ◎ O ring will be engaged in or cut when removing or reassembling it, which will produce its damage. ◎ The dust will enter the body due to oil seal damage, leading to lip scratch. ◎ The grease will leak out when the sealing bolt becomes loose. ◎ Possibly due to the grease gun nozzle damage.	◎ When casting cracking occurs, sealant will be used as the emergency measures to stop the grease from leaking out. But considering further expansion of the cracking in future, please replace the part as soon as possible. ◎ The O ring is used at the following positions. ● connecting position of the motor ● connecting position of the decelerator (box side and shaft side) ● connecting position of J3 shaft arm ● inside the mechanical wrist ◎ Oil seal is used at the following positions. ● cable duct of J1 shaft ● inside the decelerator ● inside the mechanical wrist ◎ Sealing bolt is used at the following positions. ● Grease drain port ◎ Replace the grease gun nozzle.
Position offset	◎ The robot is running at a place offset from the teaching position. ◎ Position repetition accuracy is greater than the permissible value.	[fault of the main mechanical body] When the position repetition accuracy is unstable, it may be caused by the abnormal drive system and loose bolts on the main mechanical body. ◎ Connecting surface of the setting surface of the base, each shaft arm and the decelerator will slide by too much load due to collision when position repetition accuracy is stable after offset. ◎ It may be caused by the abnormal phenomenon of the pulse encoder.	◎ Please refer to Vibration, Abnormal Noise and Loose when position repetition accuracy is unstable, to eliminate the fault. ◎ Please modify the demonstration program when position repetition accuracy is stable. Position offset won't appear if no collision repeated any longer. ◎ Replace the motor or pulse encoder when the pulse encoder is abnormal.
	◎ Position offset only for the peripheral equipment.	[position offset of the peripheral equipment] ◎ It may be caused by the external force exerting on the peripheral equipment.	◎ Please change the set position of the peripheral equipment. ◎ Please modify the demonstration program.
	◎ Position offset occurs after parameter change.	[Parameter] ◎ Origin loss due to change of the calibration data.	◎ Re-enter the previous correct calibration data. ◎ Re-calibrate the data if the correct calibration data is undefined.

Chapter III Notice to Customers

1. The installation, operation, maintenance and repair personnel of the robot must read, understand and observe the provisions in this manual. If any loss or shutdown is caused by violation of the provisions, the company shall not bear any responsibility for it.
2. Maintenance work must be carefully executed by the qualified personnel after training.
3. Prepare the base with good rigidity or the secure stand to install the robot. In addition, it shall fully consider that position of each assembled component will not change even the maximum load is exerted.
4. Be sure to observe the notes attached to the robot, such as nameplate and direction arrow. No dust or paint shall be found on the nameplate and marks.
5. If any abnormal condition occurs during running, the robot shall be stopped for check.
6. It is forbidden to clean the robot with high pressure cleaning equipment.
7. Overhaul, maintenance and installation for the robot must be done when it stops.
8. Unless otherwise specified in the order contract, the robot shall not be stored in the places with strong acid, strong alkali, high & low temperature, severe air pollution, moisture and chemicals.
9. The user shall regularly carry out mechanical maintenance for the robot, regularly examine the state of the lubricant, clean the dust and foreign object on the robot surface, to keep its cleanness and normal running.
10. The company shall not be responsible for any performance and safety problems incurred by removing the robot or reassembling the robot product arbitrarily without prior notice.