

YAMAHA SINGLE-AXIS ROBOT FLIP-X series

# C8/C8L/C8LH

**User's Manual**

ENGLISH 

**YAMAHA MOTOR CO., LTD.**

**IM Operations**

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## Before using the C8/C8L/C8LH single-axis robots (Be sure to read the following notes.)

Thank you for purchasing this YAMAHA single-axis robot C8/C8L/C8LH.  
Before using this robot, read the following notes and set the origin position.

The C8/C8L/C8LH single-axis robots use absolute position detectors that do not require return-to-origin after turning on the controller power. However, when the controller power is turned on in the following cases, return-to-origin must be performed just the very first time.

- (1) When robot cable was first connected after delivery from YAMAHA.
- (2) When robot cable was disconnected from the controller and then reconnected.
- (3) When no absolute battery is connected.
- (4) When a motor or cable was replaced.

At this point, any of the following errors is issued immediately after controller power is turned on, **but this is not a malfunction**. The controller will operate normally by restarting.

### When using an SR1 controller:

- 15 : FEEDBACK ERROR 2
- 23 : ABS.BAT.L-VOLTAGE
- 24 : ABS.DATA.ERROR
- ... etc.

### When using an RCX240, RCX222 controller:

- 17.81 : D?.ABS.battery wire breakage
- 17.92 : D?.Resolver disconnected during power off
- 17.93 : D?.Position backup counter overflow
- ... etc.

### When using an TS-X controller:

- 82 ENCODER ERROR
- 83 ABS. ENCODER ERR.
- 8A ABS. BATTERY ERR.
- 8B ABS. COUNT ERROR
- 8D ABS. OVERFLOW ERR.
- ... etc.

## Setting the origin position

Set the origin position by referring to the following section in the robot controller user's manual.

### When using an SR1 controller:

See "9.1.1 Return-to-origin by the search method" in Chapter 9 of the "HPB Operation Guide" section.

### When using an RCX240 controller:

See "11.9 Absolute reset" in Chapter 4.

### When using an RCX222 controller:

See "11.8 Absolute reset" in Chapter 4.

### When using an TS-X controller:

See "6.2 Origin search (return-to-origin)" in "6. Operating the robot" of the "HT1 Operation Guide" section.



### CAUTION

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Changing the origin position to the opposite side of the initial position may cause a position shift or robot breakdowns, so use caution.

Avoid changing the origin detection method since it is dangerous in some cases. If the origin position must be changed, please consult our sales office or dealer.

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# MEMO



## Introduction

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The YAMAHA single-axis robots C8/C8L/C8LH is an industrial robot that uses the absolute positioning method as standard and has improved ease of use, resistance to environmental conditions, and maintenance work. A wide variety of product lineup allows you to select the desired robot model that best matches your application.

This user's manual describes the safety measures, handling, adjustment and maintenance of the C8/C8L/C8LH robots for correct, safe and effective use.

Be sure to read this manual carefully before installing the C8/C8L/C8LH robots. Even after you have read this manual, keep it in a safe and convenient place for future reference.

- This user's manual should be used with the robot and considered an integral part of it. When the robot is moved, transferred or sold, send this manual to the new user along with the robot. Be sure to explain to the new user the need to read through this manual.
- Specifications of robot models other than standard models may be omitted in this manual if they are common to those of standard models. In this case, refer to the specifications of standard models.
- For details on specific operation of the robot, refer to the separate user's manual for the robot controller being used.

### NOTES

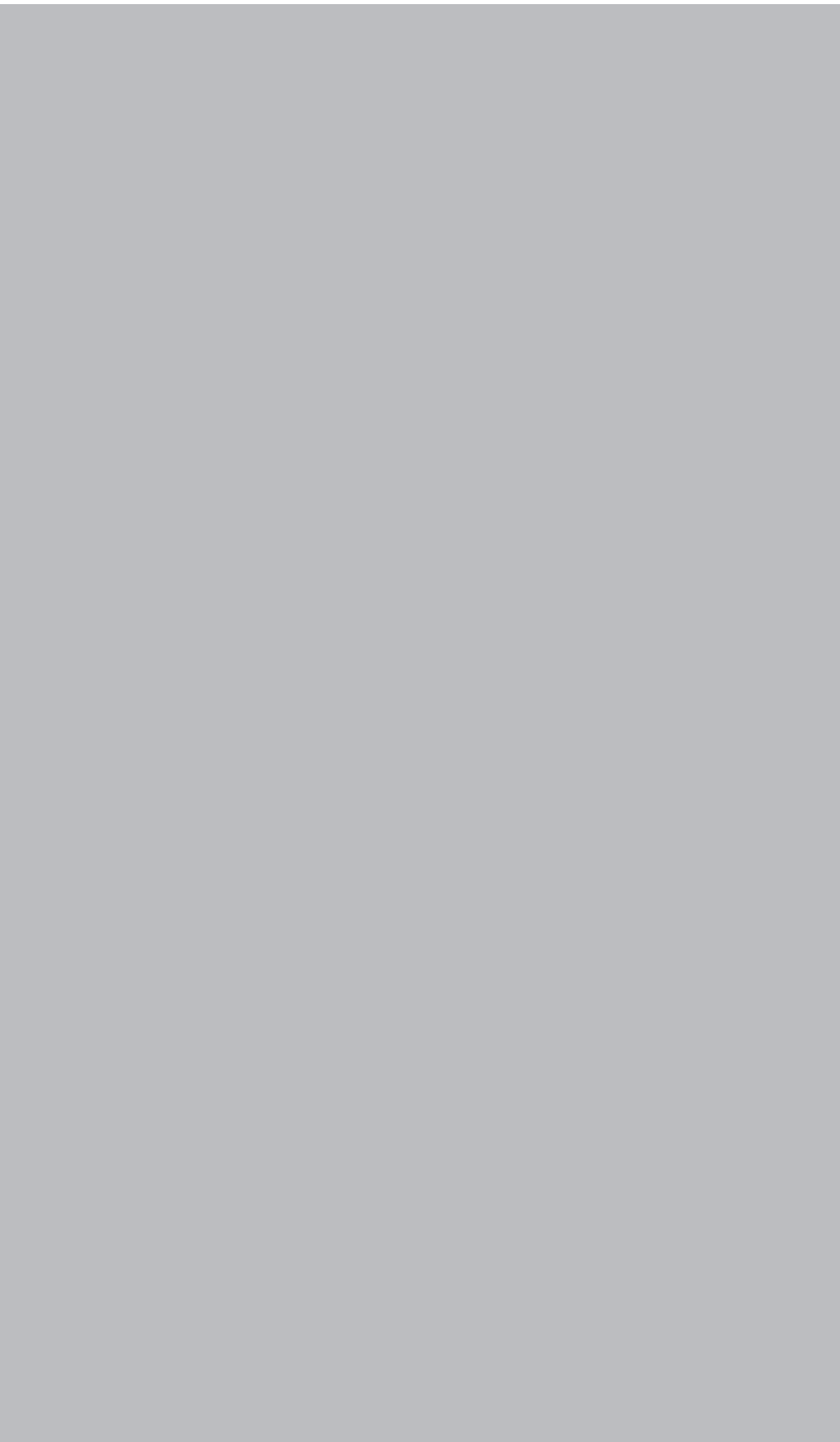
- ◆ The contents of this manual are subject to change without prior notice.
- ◆ While every effort has been made to ensure the contents of this manual are correct, please contact us if you find any part of this manual to be unclear, confusing or inaccurate.

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IM Operations

# MEMO

## Contents

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## 1-1 Safety information

Industrial robots are highly programmable, mechanical devices that provide a large degree of freedom when performing various manipulative tasks. To ensure correct and safe use of YAMAHA industrial robots, carefully read this manual and make yourself well acquainted with the contents. FOLLOW THE WARNINGS, CAUTIONS AND INSTRUCTIONS included in this manual. Failure to take necessary safety measures or mishandling due to not following the instructions in this manual may result in trouble or damage to the robot and injury to personnel (robot operator or service personnel) including fatal accidents.

Warning symbols and signal words used in this manual are classified as explained below. Make sure that you fully understand the meaning of each symbol and comply with the instructions.



### **DANGER**

**FAILURE TO FOLLOW DANGER INSTRUCTIONS WILL RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS INSPECTING OR REPAIRING THE ROBOT.**



### **WARNING**

**FAILURE TO FOLLOW WARNING INSTRUCTIONS COULD RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS INSPECTING OR REPAIRING THE ROBOT.**



### **CAUTION**

**Failure to follow CAUTION instructions may result in injury to the robot operator, bystanders or persons inspecting or repairing the robot, or damage to the robot and/or robot controller.**



### **NOTE**

Explains the key point in the operation in a simple and clear manner.

### **Reference**

Gives useful information related to the robot operation.



Refer to the user's manual by any of the following methods to operate or adjust the robot safely and correctly.

1. Operate or adjust the robot while referring to the printed version of the user's manual (available for an additional fee).
2. Operate or adjust the robot while viewing the CD-ROM version of the user's manual on your computer screen.
3. Operate or adjust the robot while referring to a printout of the necessary pages from the CD-ROM version of the user's manual.

*It is not possible to list all safety items in detail within the limited space of this manual. So it is essential that the user have a full knowledge of basic safety rules and also that the operator makes correct judgments on safety procedures during operation.*

*For specific safety information and standards, refer to the applicable local regulations and comply with the instructions. This manual and warning labels supplied with or attached to the robot are written in English. Unless the robot operators or service personnel understand English, do not permit them to handle the robot.*

- \* Cautions regarding the official language of EU countries  
For equipment that will be installed in EU countries, the language used for the user's manuals, CE declarations, and operation screen characters is English only. Warning labels only have pictograms or else include warning messages in English. In the latter case, Japanese messages might be added.

## 1-2 Essential precautions

Particularly important cautions for handling or operating the robot are described below. In addition, precautions during installation, operation, inspection and maintenance are also provided in each chapter. Be sure to comply with these instructions to ensure safe use of the robot.

### (1) Observe the following cautions during automatic operation.

- Install a safeguard (safety enclosure) to keep any person from entering within the movement range of the robot and suffering injury due to being struck by moving parts.
- Install a safety interlock that triggers emergency stop when the door or panel is opened.
- Install a safety enclosure so that no one can enter inside except from doors or panels equipped with safety interlocks.
- Warning labels 1 are supplied with the robot and should be affixed to conspicuous spots on doors or panels equipped with safety interlocks.



#### **DANGER**

**SERIOUS INJURY OR DEATH WILL RESULT FROM IMPACT WITH MOVING ROBOT.**

- **KEEP OUTSIDE OF GUARD DURING OPERATION.**
- **LOCK OUT POWER BEFORE APPROACHING ROBOT.**

Warning label 1



### (2) Use caution to prevent hands or fingers from being pinched or crushed.

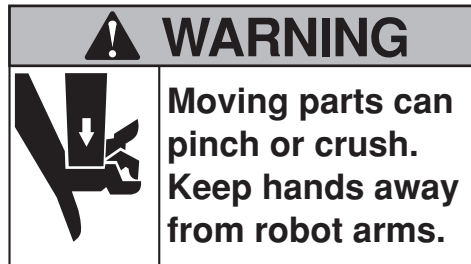
- Use caution to prevent hands or fingers from being pinched or crushed by the moving parts when carrying the robot or during teaching.
- Affix the 2 warning labels (packed with the robot) on or near the robot, in conspicuous locations.



#### **WARNING**

**MOVING PARTS CAN PINCH OR CRUSH.  
KEEP HANDS AWAY FROM ROBOT ARMS.**

## Warning label 2



## (3) Follow the instructions on warning labels and in this manual.

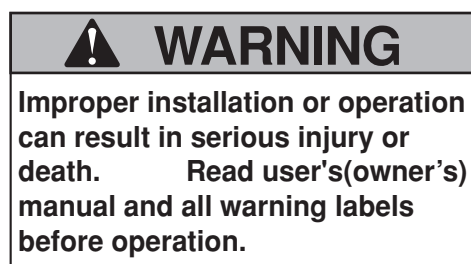
- Be sure to read the warning labels and this manual carefully and make sure you thoroughly understand their contents before attempting installation and operation of the robot.
- Before starting robot operation, be sure to reread the procedures and cautions relating to your work as well as descriptions in this chapter (Chapter 1, "Using the Robot Safely").
- Never install, adjust, inspect or service the robot in any manner that does not comply with the instructions in this manual.
- The warning labels 3 are supplied with the robot and should be affixed to the robot or conspicuous spots near the robot.

**WARNING**

**IMPROPER INSTALLATION OR OPERATION CAN RESULT IN SERIOUS INJURY OR DEATH.**

**READ THE USER'S MANUAL AND ALL WARNING LABELS BEFORE OPERATION.**

## Warning label 3





- (4) Do not remove, alter or stain the warning labels.

**WARNING**

IF WARNING LABELS ARE REMOVED OR DIFFICULT TO SEE, THEN ESSENTIAL PRECAUTIONS MIGHT NOT BE TAKEN, RESULTING IN ACCIDENTS.

- DO NOT REMOVE, ALTER OR STAIN THE WARNING LABELS ON THE ROBOT.
- DO NOT ALLOW THE WARNING LABELS TO BE HIDDEN BY DEVICES INSTALLED ONTO THE ROBOT BY THE USER.
- PROVIDE PROPER LIGHTING SO THAT THE SYMBOLS AND INSTRUCTIONS ON THE WARNING LABELS CAN BE CLEARLY SEEN EVEN FROM OUTSIDE THE SAFETY ENCLOSURE.

- (5) Do not use the robot in environments containing inflammable gas, etc.

**WARNING**

- THIS ROBOT WAS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OR EXPLOSIVE SUBSTANCES ARE PRESENT.
- DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS. EXPLOSIONS OR FIRE MIGHT OTHERWISE RESULT.

- (6) Do not use the robot in locations possibly subject to electromagnetic interference, etc.

**WARNING**

AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MIGHT OTHERWISE OCCUR.

- (7) Use caution when releasing the brake of a vertical use robot.

**WARNING**

THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION.

- PRESS THE EMERGENCY STOP BUTTON AND PROP UP THE VERTICAL AXIS WITH A SUPPORT STAND BEFORE RELEASING THE BRAKE.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.

(8) Provide safety measures for end effector (gripper, etc.).



**WARNING**

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- END EFFECTORS MUST BE DESIGNED AND MANUFACTURED SO THAT THEY CREATE NO HAZARDS (FOR EXAMPLE, A WORKPIECE THAT COMES LOOSE) EVEN IF POWER (ELECTRICITY, AIR PRESSURE, ETC.) IS SHUT OFF OR POWER FLUCTUATIONS OCCUR.
  - IF THERE IS A POSSIBLE DANGER THAT THE OBJECT GRIPPED BY THE END EFFECTOR MAY FLY OFF OR DROP, THEN PROVIDE APPROPRIATE SAFETY PROTECTION TAKING INTO ACCOUNT THE OBJECT SIZE, WEIGHT, TEMPERATURE AND CHEMICAL PROPERTIES.
- 

(9) Use caution when removing the motor. (Vertical use robots)



**WARNING**

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- THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE MOTOR IS RELEASED, CAUSING A HAZARDOUS SITUATION.
- TURN OFF THE ROBOT CONTROLLER AND PROP UP THE VERTICAL AXIS WITH A SUPPORT STAND BEFORE REMOVING THE MOTOR.
  - BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS PARTS AND INSTALLATION BASE.
- 

(10) Be careful not to touch the motor and peripheral parts when hot.



**WARNING**

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- The motor and speed reduction gear casing are extremely hot after automatic operation, so burns may occur if these are touched. Before handling these parts during inspection or servicing, turn off the controller, wait for a while and check that the parts have cooled.
- 

(11) Take the following safety precautions during inspection of controller.



**WARNING**

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- WHEN YOU NEED TO TOUCH THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER DURING INSPECTION, ALWAYS FIRST TURN OFF THE CONTROLLER POWER SWITCH AND ALSO THE POWER SOURCE IN ORDER TO PREVENT POSSIBLE ELECTRICAL SHOCK.
  - NEVER TOUCH ANY INTERNAL PARTS OF THE CONTROLLER.
  - REFER TO THE "YAMAHA ROBOT CONTROLLER USER'S MANUAL" FOR PRECAUTIONS ON HANDLING THE CONTROLLER.
-

**(12) Use caution not to touch the controller cooling fan.****WARNING**

- BODILY INJURY MAY OCCUR FROM COMING INTO CONTACT WITH THE COOLING FAN WHILE IT IS ROTATING.
- WHEN REMOVING THE FAN COVER FOR INSPECTION, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THE FAN HAS STOPPED.

**(13) Consult us for corrective action when the robot is damaged or malfunctions occur.****WARNING**

IF ANY PART OF THE ROBOT IS DAMAGED OR ANY MALFUNCTION OCCURS, CONTINUING THE OPERATION MAY BE VERY DANGEROUS. PLEASE CONSULT YOUR YAMAHA SALES OFFICE OR DEALER FOR CORRECTIVE ACTION.

Damage or Trouble	Possible Danger
Damage to machine harness or robot cable	Electrical shock, malfunction of robot
Damage to exterior of robot	Flying outwards of damaged parts during robot operation
Abnormal operation of robot (positioning error, excessive vibration, etc.)	Malfunction of robot
Z-axis brake trouble	Dropping of load

**(14) Protective bonding****WARNING**

BE SURE TO GROUND THE ROBOT AND CONTROLLER TO PREVENT ELECTRICAL SHOCK.

**(15) Be sure to make correct parameter settings.****CAUTION**

The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If these are not correct, drive unit service life may end prematurely, and damage to robot parts or residual vibration during positioning may result.

**(16) Follow the specified procedures when installing, adjusting or inspecting the robot.****WARNING**

ALWAYS FOLLOW THE SPECIFIED PROCEDURES WHEN INSTALLING, ADJUSTING OR INSPECTING THE ROBOT. NEVER ATTEMPT ANY PROCEDURE NOT DESCRIBED IN THIS MANUAL.

**(17) Do not attempt any repair, parts replacement and modification.****WARNING**

**DO NOT ATTEMPT ANY REPAIR, PARTS REPLACEMENT AND MODIFICATION UNLESS DESCRIBED IN THIS MANUAL.**

**THESE WORKS REQUIRE TECHNICAL KNOWLEDGE AND SKILL, AND MAY ALSO INVOLVE WORK HAZARDS.**

**(18) Location for installing the controller and the programming box or Handy Terminal**

The robot controller, programming box, and Handy Terminal should be installed at a location that is outside the robot movement range yet where it is easy to operate and view the robot performing tasks.

**(19) Protect electrical wiring and hydraulic/pneumatic hoses as needed.**

Install a cover or similar item to protect the electrical wiring and hydraulic/pneumatic hoses from possible damage.

**(20) Install an operation status light.**

Install an operation status light (signal light tower, etc.) at an easy-to-see position so the operator will know whether the robot is merely stopped or is in emergency-error stop.

**(21) Clean work tools, etc.**

Work tools such as welding guns and paint nozzles which are mounted in the robot arm will preferably be cleaned automatically.

**(22) Provide adequate lighting.**

Make sure to provide enough lighting to ensure safety during work.

**(23) Prevent the gripped object from flying outwards.**

If the object or workpiece gripped by the robot might fly outward or drop and create a hazard to the operator, then protective equipment should be installed by taking the size, weight, temperature and chemical properties of the object into account.

**(24) Draw up "work instructions" and makes sure the operator learns them well.**

Decide on "work instructions" for the following items in cases where personnel must work within the robot movement range to perform teaching, maintenance or inspection. Make sure the workers know these "work instructions" well.

- (1) Robot operating procedures needed for tasks such as startup procedures and handling switches
- (2) Robot speeds used during tasks such as teaching
- (3) Methods for workers to signal each other when two or more workers perform tasks
- (4) Steps that the worker should take when a problem or emergency occurs

- (5) Steps to take after the robot has come to a stop when the emergency stop device was triggered, including checks for cancelling the problem or error state and safety checks in order to restart the robot.
- (6) In cases other than above, the following actions should be taken as needed to prevent hazardous situations due to sudden or unexpected robot operation or faulty robot operation, as listed below.
  1. Show a display on the operator panel
  2. Ensure the safety of workers performing tasks within the robot movement range
  3. Clearly specify position and posture during work  
Position and posture where worker can constantly check robot movements and immediately move to avoid trouble if an error/problem occurs
  4. Install noise prevention measures
  5. Use methods for signaling operators of related equipment
  6. Use methods to decide that an error has occurred and identify the type of error

Implement the "work instructions" according to the type of robot, installation location, and type of work task.

When drawing up the "work instructions", make an effort to include opinions from the workers involved, equipment manufacture's technicians, and workplace safety consultants, etc.

#### **(25) Display a sign on operation panel during work**

Display an easy to understand sign or message on the programming box, Handy Terminal, and operation panel during the job task, to prevent anyone other than the operators for that job task from mistakenly operating a start or selector switch. If needed, take other measures such as locking the cover on the operation panel.

#### **(26) Make daily and periodic inspections.**

- (1) Always make sure that daily and periodic inspections are performed, and make a pre-work check to ensure there are no problems with the robot or related equipment. If a problem or abnormality is found, then promptly repair it or take other measures as necessary.
- (2) When you make periodic inspections or repairs, make a record and store it for at least 3 years.

## 1-3 Industrial robot operating and maintenance personnel



Operators or persons who handle the robot such as for teaching, programming, movement check, inspection, adjustment, and repair must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must read the user's manual carefully to understand its contents before attempting the robot operation.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and safety standards for industrial robots.

## 1-4 Robot safety functions

### (1) Overload detection

This function detects an overload applied to the motor and shuts off the servo power.

### (2) Overheat detection

This detects an abnormal temperature rise in the controller driver and shuts off the servo power.

If an overload or overheat error occurs, take the following measures.

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

### (3) Soft limits

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation.

Note: The working envelope is the area limited by soft limits.



#### **WARNING**

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**SOFT LIMITS MUST BE SET WITHIN THE MOVEMENT RANGE (MECHANICAL STOPPER). IF THE SOFT LIMIT IS SET OUTSIDE THE MOVEMENT RANGE, THE ROBOT AXIS MAY COLLIDE WITH THE MECHANICAL STOPPER AT HIGH SPEED, CAUSING THE OBJECT GRIPPED BY THE END EFFECTOR TO FLY OR DROP AND THE ROBOT TO MALFUNCTION.**

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### (4) Mechanical stoppers

If the servo power is suddenly shut off during high-speed operation by emergency stop or safety functions, these mechanical stoppers prevent the axis from exceeding the movement range.

Note: The movement range is the area limited by mechanical stoppers.

**WARNING**

**ROBOT MOVEMENT WILL NOT STOP IMMEDIATELY AFTER THE SERVO POWER SUPPLY IS SHUT OFF BY EMERGENCY STOP OR OTHER SAFETY FUNCTIONS.**

**(5) Vertical axis brake**

An electromagnetic brake is installed on the vertical use robot to prevent the vertical axis from sliding down when servo power is turned off. This brake is working when the controller is off or the vertical axis servo power is off even when the controller is on.

The vertical axis brake can be released with the programming box or Handy Terminal or in the program when the controller power is turned on.

**WARNING**

**THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CREATING A HAZARDOUS SITUATION.**

- **PRESS THE EMERGENCY STOP BUTTON AND PROP THE VERTICAL AXIS WITH A SUPPORT STAND BEFORE RELEASING THE BRAKE.**
- **USE CAUTION NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.**

## 1-5 Safety measures for the system

Since the robot is commonly used in conjunction with an automated system, dangerous situations are more likely to occur from the automated system than from the robot itself. Accordingly, appropriate safety measures must be taken on the part of the system manufacturer according to the individual system. The system manufacturer should provide a proper instruction manual for safe, correct operation and servicing of the system.

## 1-6 Trial operation

After making installations, adjustments, inspections, or maintenance or repairs to the robot, make a trial run using the following procedures.

- (1) If a safety enclosure has not yet been provided right after installation of the robot, rope off or chain off around the movement area of the manipulator in place of the safety enclosure, and observe the following points.**
  1. Use sturdy, stable posts which will not fall over easily.
  2. The rope or chain should be easily visible by everyone around the robot.
  3. Place a sign to keep the operator or other personnel from entering the movement range of the manipulator.

**(2) Check the following points before turning on the controller.**

1. Is the robot securely and correctly installed?
2. Are the electrical connections to the robot correct?
3. Are items such as air pressure correctly supplied?
4. Is the robot correctly connected to peripheral equipment?
5. Have safety measures (safety enclosure, etc.) been taken?
6. Does the installation environment meet the specified standards.

**(3) After the controller is turned on, check the following points from outside the safety enclosure.**

1. Does the robot start and stop as intended? Can the operation mode be selected correctly?
2. Does each axis move as intended within the soft limits?
3. Does the end effector move as intended?
4. Are the signal transmissions to the end effector and peripheral equipment correct?
5. Does emergency stop work?
6. Are the teaching and playback functions normal?
7. Are the safety enclosure and interlock working as intended?
8. Does the robot move correctly during automatic operation?

## 1-7 Work within the safety enclosure

---

**(1) Work within the safety enclosure**

When work is required inside the safety enclosure, always turn off the controller and place a sign indicating that the robot is being adjusted or serviced in order to keep any other person from touching the controller switch or operation panel, except for the following cases.

- 1) Soft limit settings
- 2) Teaching

For item 1), follow the precautions and procedure for each section. To perform item 2), refer to the description in (2) below.

**(2) Teaching**

When performing teaching within the safety enclosure, comply with the instructions listed below.

- 1) Check or perform the following points from outside the safety enclosure.
  1. Make sure that no hazards are present within the safety enclosure by a visual check.
  2. Check that the programming box or Handy Terminal operates correctly.



3. Check that no failures are found in the robot.
  4. Check that emergency stop works correctly.
  5. Select teaching mode and prohibit automatic operation.
- 2) Never enter the movement range of the manipulator while within the safety enclosure.

## 1-8 Automatic operation

---

Automatic operation described here includes all operations in AUTO mode.

**(1) Check the following before starting automatic operation.**

1. No one is within the safety enclosure.
2. The programming box, Handy Terminal and tools are placed in their specified positions.
3. The alarm or error lamps on the robot and peripheral equipment do not flash.
4. The safety enclosure is securely installed with safety interlocks actuated.

**(2) Observe the following during automatic operation or in cases where an error occurs.**

- 1) After automatic operation has started, check the operation status and signal light to ensure that the robot is in automatic operation.
- 2) Never enter the safety enclosure during automatic operation.
- 3) If an error occurs in the robot or peripheral equipment, observe the following procedure before entering the safety enclosure.
  1. Press the emergency stop button to set the robot to emergency stop.
  2. Place a sign on the start switch, indicating that the robot is being inspected in order to keep any other person from touching the start switch and restarting the robot.

## 1-9 Warranty

The YAMAHA robot and/or related product you have purchased are warranted against the defects or malfunctions as described below.

**Warranty description** : If a failure or breakdown occurs due to defects in materials or workmanship in the genuine parts constituting this YAMAHA robot and/or related product within the warranty period, then YAMAHA will repair or replace those parts free of charge (hereafter called "warranty repair").

**Warranty Period** : The warranty period ends when any of the following applies:

- (1) After 18 months (one and a half year) have elapsed from the date of shipment
- (2) After one year has elapsed from the date of installation
- (3) After 2,400 hours of operation

**Exceptions to the Warranty** : This warranty will not apply in the following cases:

- (1) Fatigue arising due to the passage of time, natural wear and tear occurring during operation (natural fading of painted or plated surfaces, deterioration of parts subject to wear, etc.)
- (2) Minor natural phenomena that do not affect the capabilities of the robot and/or related product (noise from computers, motors, etc.).
- (3) Programs, point data and other internal data that were changed or created by the user.

Failures resulting from the following causes are not covered by warranty repair.

- 1) Damage due to earthquakes, storms, floods, thunderbolt, fire or any other natural or man-made disasters.
- 2) Troubles caused by procedures prohibited in this manual.
- 3) Modifications to the robot and/or related product not approved by YAMAHA or YAMAHA sales representatives.
- 4) Use of any other than genuine parts and specified grease and lubricants.
- 5) Incorrect or inadequate maintenance and inspection.
- 6) Repairs by other than authorized dealers.

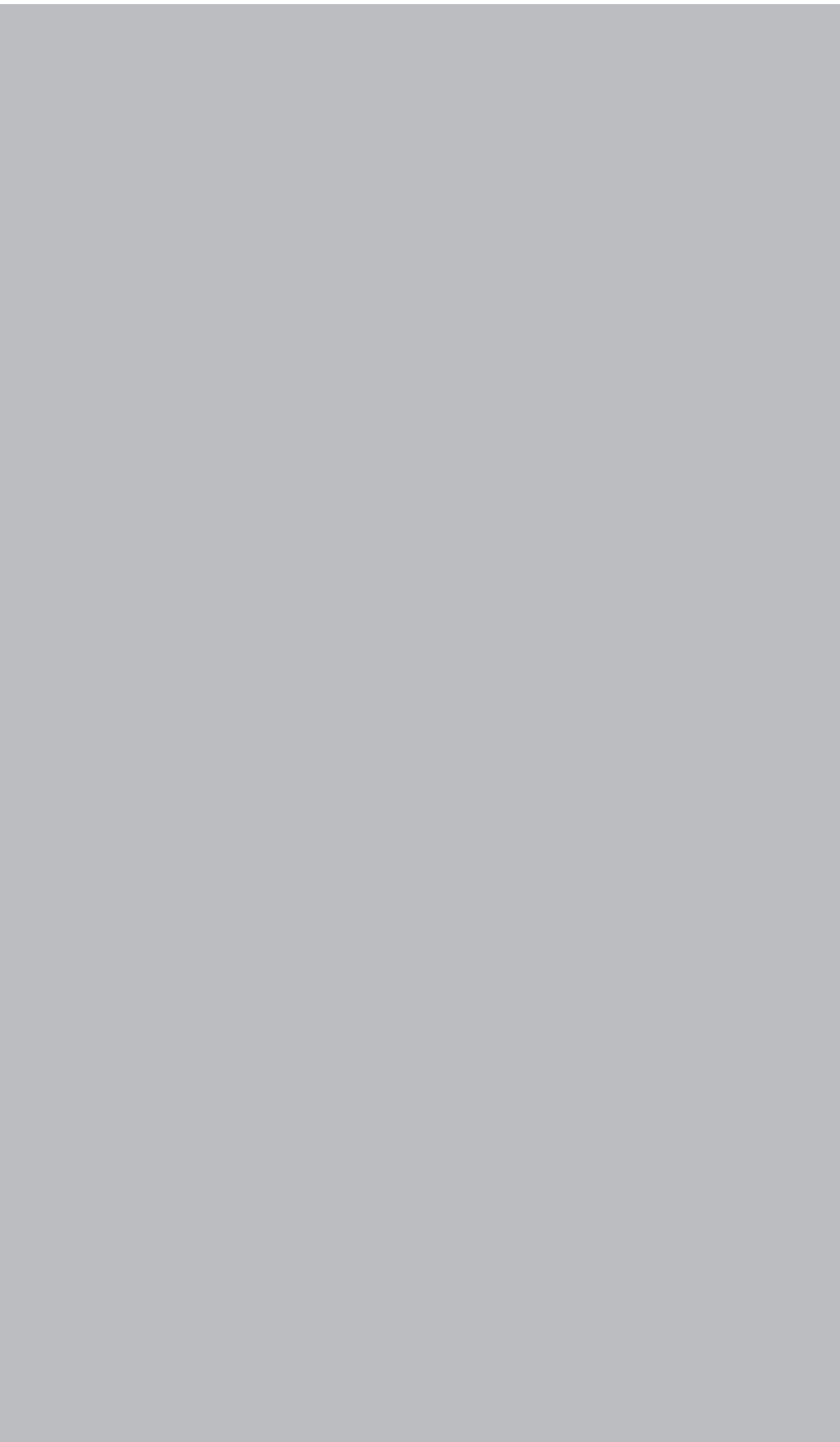
YAMAHA MOTOR CO., LTD. MAKES NO OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. THE WARRANTY SET FORTH ABOVE IS EXCLUSIVE AND IS IN LIEU OF ALL EXPRESSED OR IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE.

YAMAHA MOTOR CO., LTD. SOLE LIABILITY SHALL BE FOR THE DELIVERY OF THE EQUIPMENT AND YAMAHA MOTOR CO., LTD. SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES (WHETHER ARISING FROM CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY). YAMAHA MOTOR CO., LTD. MAKES NO WARRANTY WHATSOEVER WITH REGARD TO ACCESSORIES OR PARTS NOT SUPPLIED BY YAMAHA MOTOR CO., LTD.

**MEMO**

## Contents

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2-2	Robot part names	2-1



## 2-1 Checking the product

After unpacking, make sure that all components and accessories are included (as specified in your order). Also check the product for any damage on the exterior which might have occurred during shipping.

If there are any missing parts or damage due to shipping, please notify your YAMAHA sales office or representative immediately.

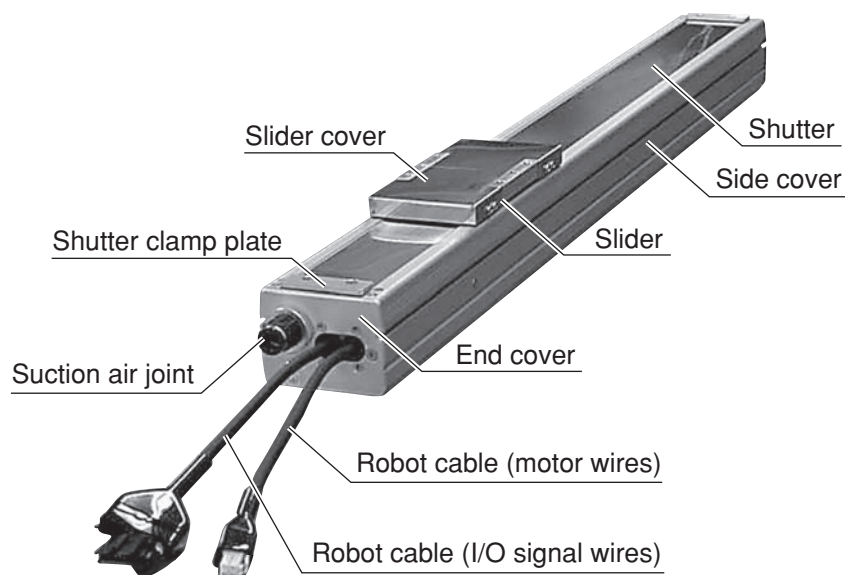


### WARNING

- ALWAYS USE TWO OR MORE PEOPLE TO TAKE THE ROBOT UNIT OUT OF THE PACKAGE. EACH PERSON SHOULD GRIP THE ROBOT UNIT NEAR ONE END FROM THE LOWER SIDE. CARRY WITH THE ROBOT FACING UPWARD (SLIDER SIDE UPWARDS).
- WHEN UNPACKING, CAREFULLY HOLD THE ROBOT NOT TO DROP IT. IF THE ROBOT FALLS, SERIOUS INJURY MAY OCCUR OR THE ROBOT MAY BE DAMAGED.

## 2-2 Robot part names

### Robot part names

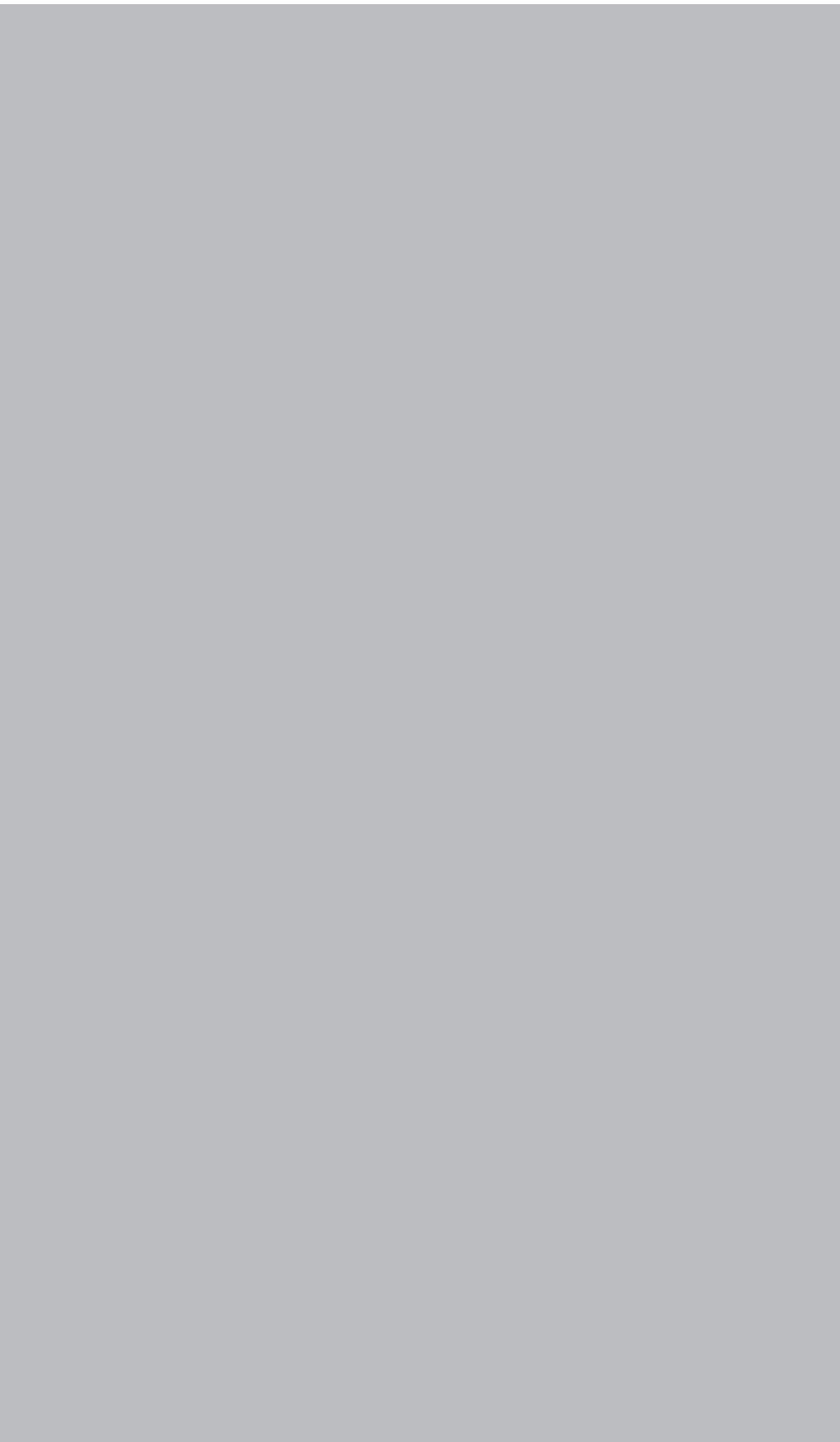


# MEMO



## Contents

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## 3-1 Carrying the robot

---

Always use two people to carry the robot unit. Each person should grip the robot unit near one end from the lower side and carry with the load well balanced. Carry with the robot facing upward (slider side upwards).



### **WARNING**

---

**ALWAYS OBSERVE THE FOLLOWING PRECAUTIONS WHEN CARRYING THE ROBOT.**

- REMOVE ANY AND ALL OBJECTS SUCH AS HANDS AND GRIPPERS ATTACHED TO THE ROBOT SLIDER BEFORE MOVING THE ROBOT. THE SLIDER WILL LOSE BALANCE IF MOVED WITH OBJECTS STILL ATTACHED AND CAUSE INJURIES.
  - KEEP THE ROBOT BALANCED AND DON'T LET IT TILT WHILE MOVING IT. IF THE ROBOT TILTS, THE SLIDER MAY MOVE UNDER ITS OWN WEIGHT CAUSING SERIOUS INJURIES SUCH AS CRUSHED FINGERS.
  - MOVE THE SLIDER SO THAT BALL NUT SECTION IS POSITIONED IN THE NEAR CENTER OF THE ROBOT BEFORE CARRYING THE ROBOT. FAILURE TO DO SO MAY CAUSE THE BALL SCREW TO SWING OR VIBRATE LARGELY WHILE CARRYING THE ROBOT.
  - NEVER ATTEMPT TO HOLD THE ROBOT IN ANY OF THE FOLLOWING MANNERS.  
[Never try this when moving!]
    - DO NOT CARRY BY HOLDING THE SLIDER.
    - DO NOT CARRY BY HOLDING THE CABLE.
    - DO NOT CARRY BY GRIPPING THE END COVER.
    - DO NOT CARRY BY HOLDING THE SLIDER COVER.
-

## 3-2 Robot installation conditions

### 3-2-1 Installation environments

Be sure to install the robot in the following environments.

Items	Specifications
Allowable ambient temperature	0 to 45°C
Allowable ambient humidity	35 to 85% RH (no condensation)
Altitude	0 to 1000 meters above sea level
Ambient environments	Avoid installing near water, cutting water, oil, dust, metallic chips and organic solvent.
	Avoid installation near corrosive gas and corrosive materials.
	Avoid installation in atmosphere containing inflammable gas, dust and liquid.
	Avoid installation near objects causing electromagnetic interference, electrostatic discharge and radio frequency interference.
Vibration	Do not subject to impacts or vibrations.
Working space	Allow sufficient space margin to perform jobs (teaching, inspection, repair, etc.)

For detailed information on how to install the robot controller, refer to the separate "YAMAHA Robot Controller User's Manual".



#### WARNING

**AVOID INSTALLING THE ROBOT IN LOCATIONS WHERE THE AMBIENT CONDITIONS MAY EXCEED THE ALLOWABLE TEMPERATURE OR HUMIDITY, OR IN ENVIRONMENTS WHERE EXCESSIVE MOISTURE, CORROSIVE GASES, METALLIC POWDER OR DUST ARE GENERATED. MALFUNCTIONS, FAILURES OR SHORT CIRCUITS MAY OTHERWISE RESULT.**



#### WARNING

- THIS ROBOT WAS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OR EXPLOSIVE SUBSTANCES ARE PRESENT.
- DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS. EXPLOSIONS OR FIRE COULD OTHERWISE RESULT.

**WARNING**

AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MAY OTHERWISE OCCUR.

**WARNING**

DO NOT USE THE ROBOT IN LOCATIONS SUBJECT TO EXCESSIVE VIBRATION. ROBOT INSTALLATION BOLTS MAY OTHERWISE BECOME LOOSE CAUSING THE ROBOT TO FALL OVER.

### 3-2-2 Installation base

To mount the robot, use an installation base that satisfies the following conditions.

- (1) The installation base is subjected to a great deal of stress while the robot is in operation. Prepare a sufficiently rigid and stable installation base, taking into account the robot weight including the end effector (gripper) and workpiece.

**WARNING**

IF THE INSTALLATION BASE IS NOT SUFFICIENTLY RIGID AND STABLE, VIBRATION (RESONANCE) MAY OCCUR DURING OPERATION, CAUSING ADVERSE EFFECTS ON THE ROBOT WORK.

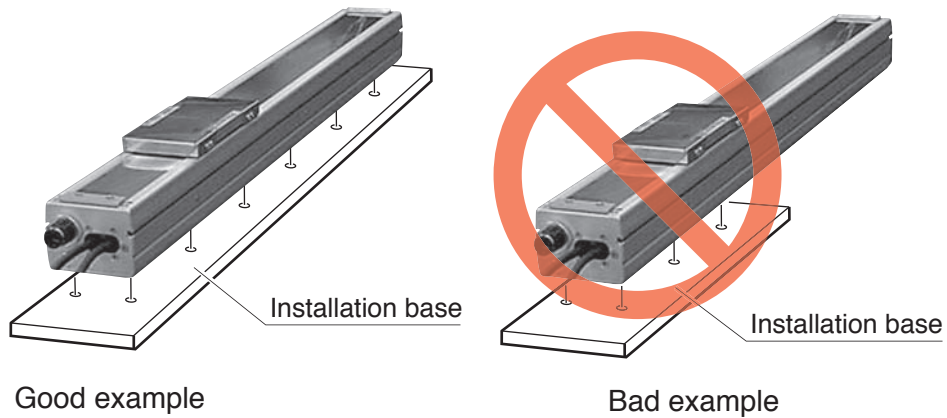
- (2) The installation base surface must be machined within a flatness of  $\pm 0.05\text{mm}/500\text{mm}$ .

**CAUTION**

The robot positioning accuracy or the service life might be reduced if the installation surface precision is insufficient.

- (3) Use an installation base of sufficient size to match the robot body so that the robot can be installed with the specified number of bolts. Avoid installing the robot with less than the specified number of bolts or installing the robot closer to one end as shown at the lower right.

**Robot installation example**



**WARNING**

WHEN INSTALLING THE ROBOT, ALWAYS USE ALL M5 TAPPED HOLES DRILLED IN THE BOTTOM OF THE ROBOT. USING LESS THAN THE SPECIFIED NUMBER OF BOLTS TO INSTALL THE ROBOT MAY CAUSE VIBRATION AND POOR POSITIONING ACCURACY. THIS MAY ALSO RESULT IN POSITIONING ERRORS AND REDUCED SERVICE LIFE IN THE WORST CASES.



**NOTE**

Positions of robot mounting holes differ according to the stroke length of each robot. Refer to the dimensional outlines shown in "6-1 Main unit specifications".

## 3-3 Installing the robot

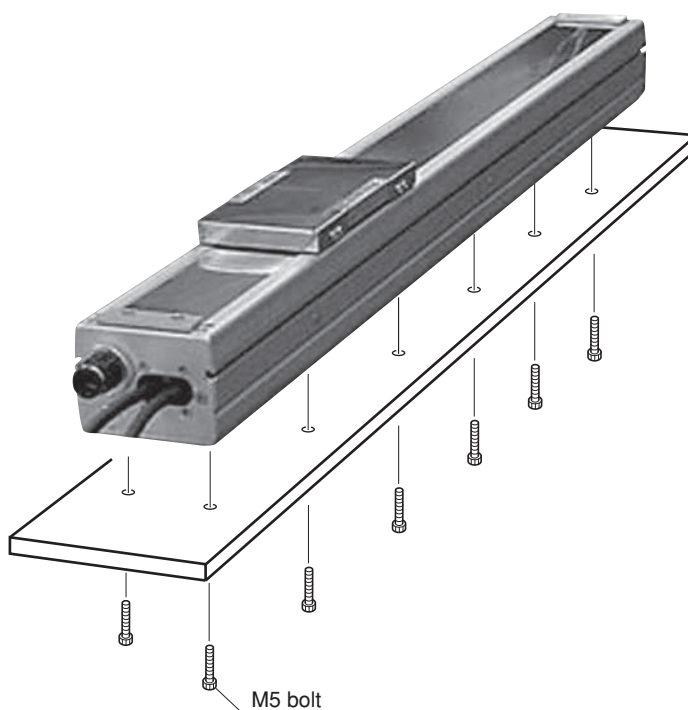


### WARNING

- BEFORE INSTALLING THE ROBOT, ALWAYS MAKE SURE THAT THE ROBOT CONTROLLER IS NOT CONNECTED TO THE ROBOT OR THE POWER TO THE CONTROLLER IS OFF. SERIOUS ACCIDENTS MAY OCCUR IF THE ROBOT STARTS TO OPERATE DURING INSTALLATION.
- BE SURE TO USE THE BOLTS OF THE SPECIFIED SIZE AND LENGTH AND TIGHTEN THEM SECURELY TO THE CORRECT TORQUE IN THE CORRECT POSITIONS. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE ROBOT VIBRATIONS, POSITION ERRORS AND SERIOUS ACCIDENTS.
- DO NOT USE A BOLT LONGER THAN THE SPECIFIED LENGTH SINCE IT MAY INTERFERE WITH THE INTERNAL PARTS OF THE ROBOT AND CAUSE MALFUNCTIONS.

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the bottom. The bolts and tightening torque are shown below.

<b>Bolt</b>	Hex socket-head M5 bolt, strength: 8.8T, length: installation base thickness + 9mm (maximum)
<b>Tightening torque</b>	60kgf·cm to 90kgf·cm



### CAUTION

The robot frame is made of aluminum so be careful not to damage the screw threads when tightening the bolts.

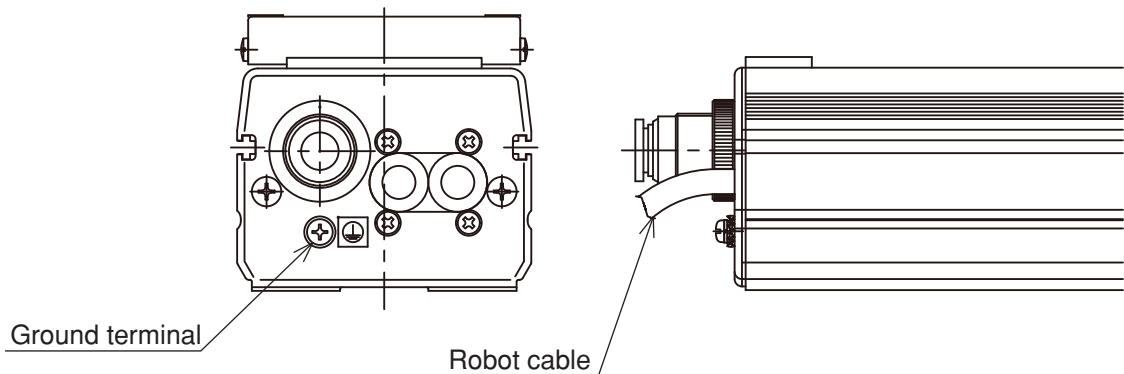
#### ● Protective bonding



#### WARNING

**ALWAYS GROUND THE ROBOT AND CONTROLLER UNIT TO PREVENT ELECTRICAL SHOCK.**

Always use the ground terminal (M4 screw) on the robot unit to make ground connection. The ground terminal location is shown below.



#### CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm<sup>2</sup>) as the ground wire.



#### WARNING

**ALWAYS TURN OFF THE POWER TO THE CONTROLLER BEFORE MAKING THE GROUND CONNECTION.**

Provide a terminal marked "PE" as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.



(Symbol 417-IEC-5019)



## 3-4 Connecting the robot to the controller

Connect the robot cables to the mating connectors on the controller as shown. Refer to the robot controller user's manual for the controller connectors.



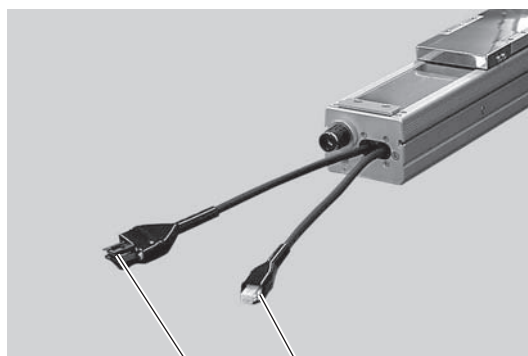
### WARNING

- BEFORE CONNECTING THE CABLES, CHECK THAT THERE ARE NO BENDS OR BREAKS IN THE ROBOT CABLE CONNECTOR PINS AND THAT THE CABLES ARE NOT DAMAGED. CONTACT FAILURE MAY CAUSE ROBOT MALFUNCTIONS.
- ALWAYS MAKE SURE THAT THE POWER TO THE ROBOT CONTROLLER IS OFF BEFORE CONNECTING THE ROBOT CABLES TO THE CONTROLLER.



### CAUTION

After connecting the robot cable intermediate connectors together, fit the connector hoods together securely.

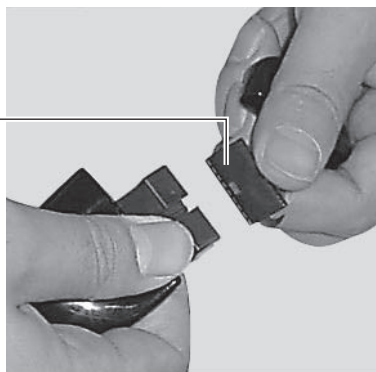


Intermediate connector (motor wire)

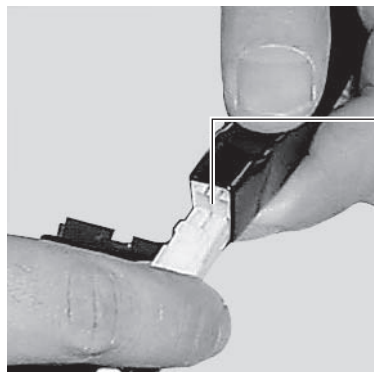
Intermediate connector (signal wire)

- 1) Connect the robot cables (motor and signal wires) to the mating connectors coming out from the robot.

Robot cable connector (signal wire)

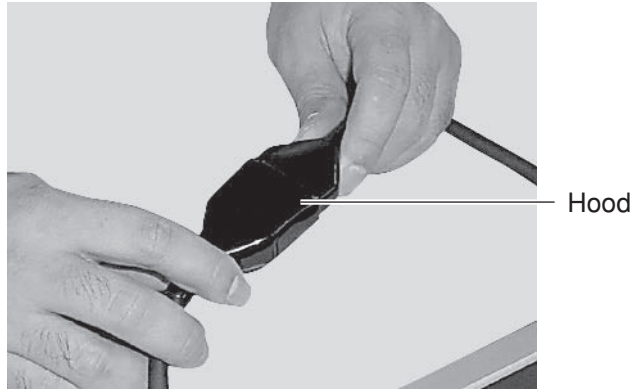


Robot cable connector (motor wire)

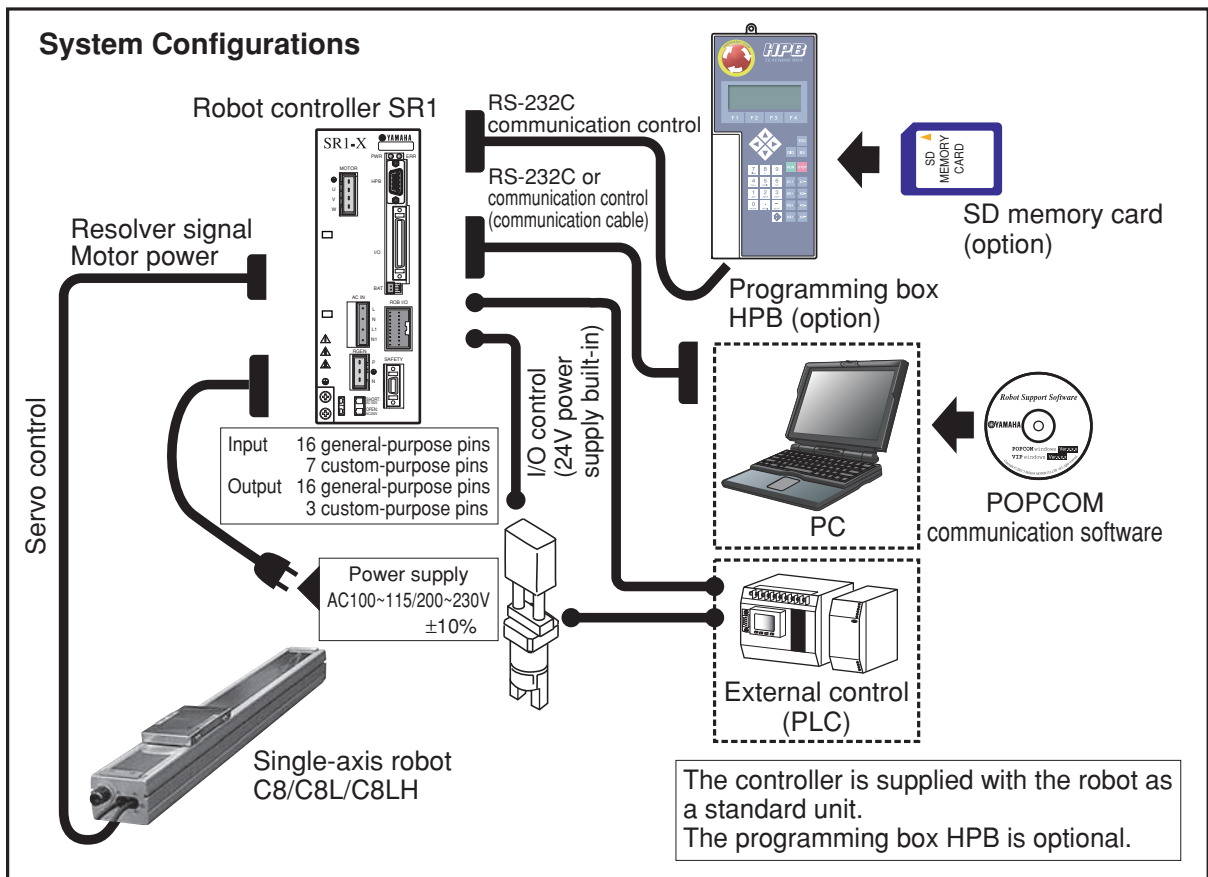
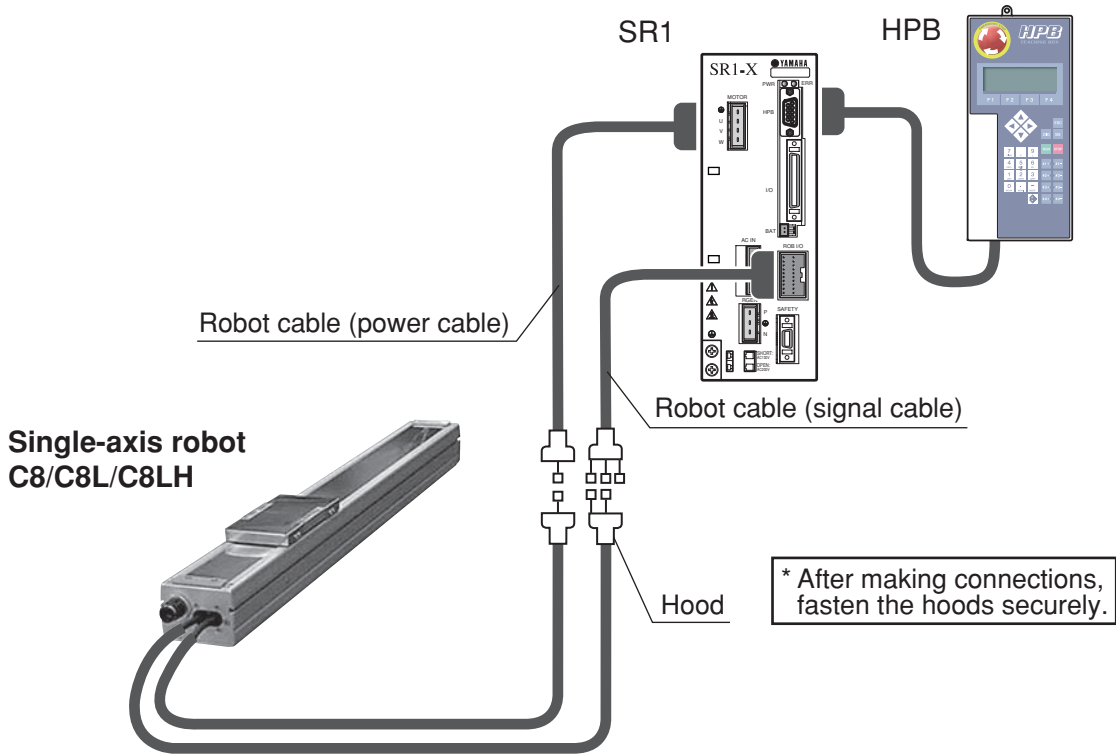


## 3-4 Connecting the robot to the controller

- 2) After making the connections, fit the connector hoods together securely.



● Robot cable connections (when connected to SR1)



## 3-5 Suction hoses connection

---

The FLIP-X Type C series robots are designed to connect to an air unit that suctions air inside the robot to maintain cleanliness.

When using the robot in a clean room, adjust the suction air to the following flow rate.

Hose outside diameter :  $\phi 10$

Number of hoses : 1

Suction rate : 90 N $\ell$ /min.



### CAUTION

---

**Avoid excessive bends in the air hoses. Lay out the air hoses to keep the hose length to the air unit as short as possible. Too long of a hose may prevent obtaining the specified suction flow rate.**

---



### NOTE

---

An effective flow rate can be obtained by using a 8mm inner diameter hose from the suction source and then connecting that hose to a 10mm outer diameter hose at a position 50mm away from the robot.

---

## 3-6 Setting the operating conditions

### 3-6-1 Payload

Optimal acceleration for the C8, C8L and C8LH single-axis robots is automatically determined by setting the controller payload parameters. Set the total weight of the workpiece and the end effectors such as grippers attached to the robot slider in the payload parameter as shown below.



#### CAUTION

Be sure to enter an accurate value when making this setting, since a mistake will cause troubles such as vibration or a shorter machine service life span.

#### ● To set the payload parameter

Use the following method when setting the payload parameter on a single-axis robot controller (SR1). If other controllers (RCX240, RCX222, TS-X) are used, refer to their respective user's manual.

- 1) Connect the HPB to the SR1 controller and turn on the controller power. The initial menu then appears on the HPB.

- 2) Press **[F3]** (SYS) on the initial menu screen.

The SYS (system) mode screen appears.

```
[MENU]
select menu
1EDIT 2OPRT 3SYS 4MON
```

- 3) Press **[F1]** (PRM) to enter the parameter setting mode.

The SYS-PRM mode screen appears.

```
[SYS]
select menu
1PRM 2B. UP 3INIT 4next
```

- 4) Select the parameter group.

Press **[F1]** (AXIS) to select the axis parameter.



The current setting for PRM100 (Robot type) appears on the screen.

```
[SYS-PRM]
select menu
1AXIS 2DATA 3SYS 1 4SYS 2
```

```
[SYS-PRM-AXIS]
PRM100 = 4150
robot type
read only
```


The robot type No. displayed on the screen shows an example of model C6.

- 5) Display PRM112 (payload).

Press the   keys to scroll up or down the parameter list and select the parameter you want to set.

```
[SYS-PRM-AXIS]
PRM112 = 10_ [Kg]
payload
range 0→MAX
```

- 6) Set the parameter.

Enter the parameter value with the number keys and press .

The parameter setting range is shown on the bottom line of the screen.

When setting is complete, the cursor moves back to the beginning of the parameter data.

```
[SYS-PRM-AXIS]
PRM112 = 10 [Kg]
payload
range 0→MAX
```

### 3-6-2 Maximum speed setting

In operation of a single-axis robot with a long stroke ball screw, resonance of the ball screw may occur. In this case, the maximum speed must be reduced to an appropriate level. The maximum speed can be reduced by lowering the SPEED setting in automatic operation or by programming. Use the desired method that matches your application. Refer to Chapter 6, "Specifications" for information on how to set the maximum speed according to the stroke length.

If the maximum speed does not reach a hazardous level, reducing the speed is unnecessary even when a robot has a long stroke axis.



#### CAUTION

**Do not operate the robot if the ball screw is vibrating. The ball screw may otherwise wear out prematurely.**

### 3-6-3 Duty

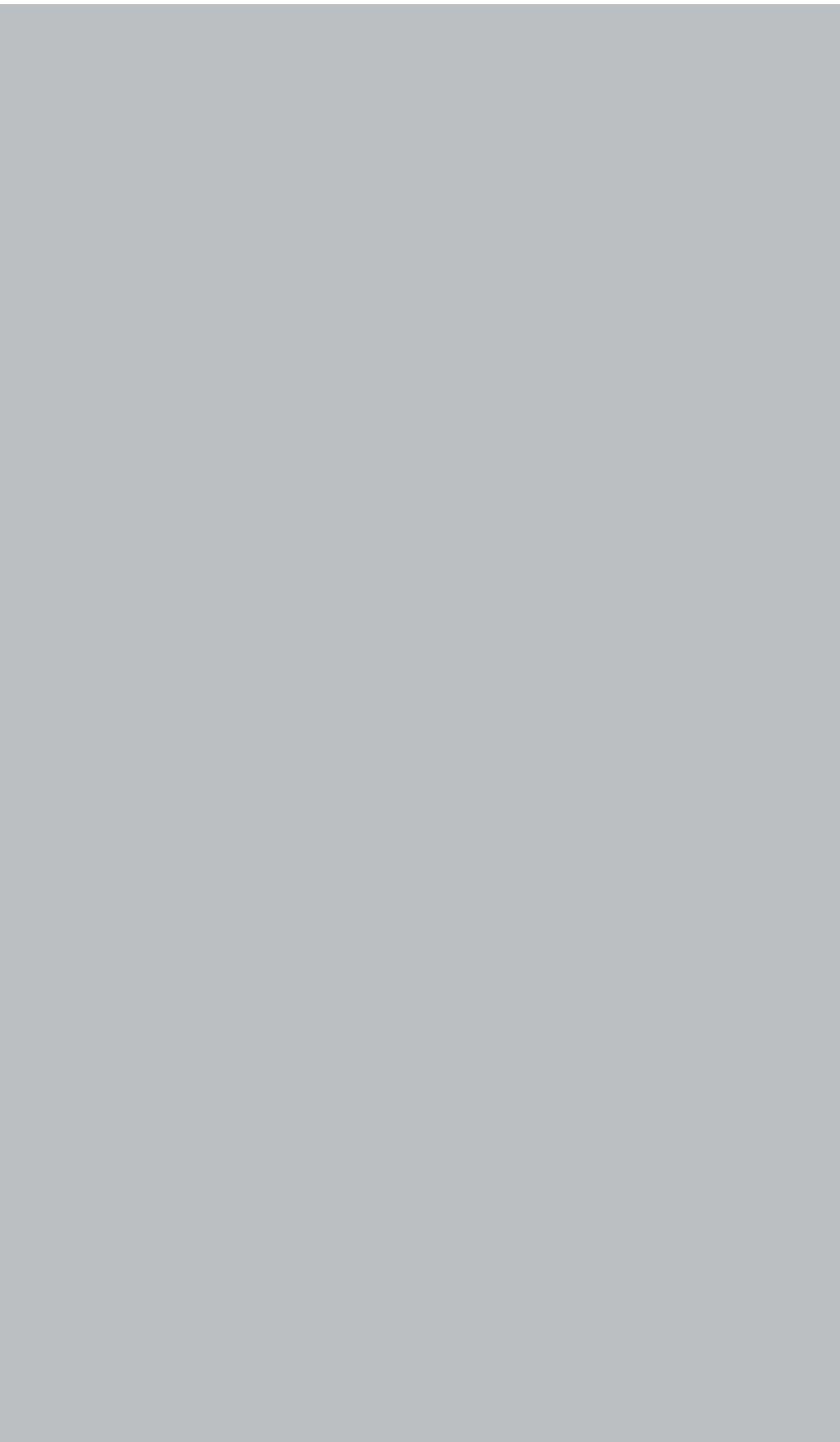
To achieve maximum service life for the C8, C8L and C8LH single-axis robots, it is recommended to operate the robot within the allowable duty (50%). The duty is calculated as follows:

$$\text{Duty (\%)} = \frac{\text{Operation time}}{\text{Operation time} + \text{Non-operation time}} \times 100$$

If the robot duty is too high, an error such as "overload" or "overheat" may occur. In this case, increase the stop time to reduce the duty.

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## 4-1 Before beginning work

Periodic inspection and maintenance are essential to ensure safe and efficient operation of YAMAHA robots. This chapter describes periodic inspection items and procedures for the C8/C8L/C8LH. Before beginning work, read the precautions below and also in Chapter 1 "Using the Robot Safely" and follow the instructions.



### **DANGER**

---

**IF THE INSPECTION OR MAINTENANCE PROCEDURE CALLS FOR OPERATION OF THE ROBOT, STAY OUT OF THE WORKING AREA OF THE ROBOT DURING OPERATION. DO NOT TOUCH ANY PARTS INSIDE THE CONTROLLER. KEEP WATCHING THE ROBOT MOVEMENT AND SURROUNDING AREA SO THAT THE OPERATOR CAN PRESS THE EMERGENCY STOP BUTTON IF ANY DANGER OCCURS.**

---



### **WARNING**

- **WHEN THE ROBOT DOES NOT NEED TO BE OPERATED DURING ADJUSTMENT OR MAINTENANCE, ALWAYS TURN OFF THE CONTROLLER AND THE EXTERNAL SWITCH BOARD.**
  - **DO NOT TOUCH INTERNAL PARTS OF THE CONTROLLER FOR 10 MINUTES AFTER THE CONTROLLER HAS BEEN TURNED OFF.**
  - **WHEN ONLY MAKING ELECTRICAL INSPECTIONS AND REQUIRING NO MECHANICAL MOVEMENT OF THE ROBOT, KEEP THE EMERGENCY STOP BUTTON PRESSED.**
  - **USE ONLY LUBRICANT AND GREASES SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE.**
  - **USE ONLY PARTS SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE. TAKE SUFFICIENT CARE NOT TO ALLOW ANY FOREIGN MATTER TO CONTAMINATE THEM DURING ADJUSTMENT, PARTS REPLACEMENT OR REASSEMBLY.**
  - **DO NOT MODIFY ANY PARTS ON THE ROBOT OR CONTROLLER. MODIFICATION MAY RESULT IN UNSATISFACTORY SPECIFICATIONS OR THREATEN OPERATOR SAFETY.**
  - **WHEN ADJUSTMENT OR MAINTENANCE IS COMPLETE, RETIGHTEN THE BOLTS AND SCREWS SECURELY.**
  - **DURING ROBOT ADJUSTMENT OR MAINTENANCE, PLACE A SIGN INDICATING THAT THE ROBOT IS BEING ADJUSTED OR SERVICED TO PREVENT OTHERS FROM TOUCHING THE CONTROL KEYS OR SWITCHES. PROVIDE A LOCK ON THE SWITCH KEYS OR ASK SOMEONE TO KEEP WATCH AS NEEDED.**
-

When applying grease to the ball screw and linear guide, take the following precautions.



### **WARNING**

---

#### **PRECAUTIONS WHEN HANDLING GREASE:**

- INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES.  
BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.
- INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.
- DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)
- HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE GREASE CONTAINER, SO USE PROTECTIVE GLOVES.
- KEEP OUT OF THE REACH OF CHILDREN.
- DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.

#### **EMERGENCY TREATMENT:**

- IF GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.
  - IF GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.
  - IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR PROPER TREATMENT.
-

## 4-2 Periodic inspection

### 4-2-1 Daily inspection

Check the following points on a daily basis, before and after robot operation.

Checkpoints	Check items	Notes
Cables and shutter	Check for scratches, dents, and excessively tight bends. Stain or grime on the shutter surface *1	Replace if necessary.
Ball screws and bearings	Check for unusual vibration and noise.	
Motor	Check for unusual vibration and noise, and for abnormal temperature rise.	

\*1: Depending on robot operating conditions, stain or grime may appear in a stripe pattern near the slider stop point on the shutter surface. If this is found, use cloth moistened with alcohol or detergent to wipe away the stain or grime.

## 4-2-2 Three-month inspection

Take the following precautions when performing 3-month inspection.



### WARNING

THE SLIDER OF VERTICAL USE ROBOT WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION. DO NOT RELEASE THE BRAKE WHEN LUBRICATING VERTICAL USE ROBOT PARTS.

When applying grease to the ball screws and linear guide, take the following precautions.



### WARNING

PRECAUTIONS WHEN HANDLING GREASE:

- INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES.  
BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.
- INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.
- DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)
- HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE CONTAINER, SO USE PROTECTIVE GLOVES.
- KEEP OUT OF THE REACH OF CHILDREN.
- DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.

EMERGENCY TREATMENT:

- IF GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.
- IF GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.
- IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR PROPER TREATMENT.



### WARNING

DISPOSING OF GREASE AND THE CONTAINER:

- PROPER DISPOSAL IS COMPULSORY UNDER FEDERAL, STATE AND LOCAL REGULATIONS. TAKE APPROPRIATE MEASURES IN COMPLIANCE WITH LEGAL REGULATIONS IN YOUR COUNTRY.
- DO NOT PRESSURIZE THE EMPTY CONTAINER. PRESSURIZING MAY CAUSE THE CONTAINER TO RUPTURE.
- DO NOT ATTEMPT TO WELD, HEAT UP, DRILL HOLES OR CUT THIS CONTAINER. THIS MIGHT CAUSE THE CONTAINER TO EXPLODE AND THE REMAINING MATERIALS INSIDE IT TO IGNITE.

Check the following points every 3 months and apply grease if needed.

Checkpoints	Check items	Notes
Ball screw, linear guide, ball bushing	<ul style="list-style-type: none"> <li>• Check for dust buildup or debris. Clean if necessary. Apply grease after cleaning.</li> <li>• Check to see if the ball screw, linear guide and ball bushing are lubricated (not dry). Apply grease if necessary. Clean room robots: LG2 (NSK)</li> </ul>	See "4-4" in this chapter.
Shutter	<ul style="list-style-type: none"> <li>• Check for looseness or slack. Adjust if necessary.</li> </ul>	See "4-3" in this chapter.



**CAUTION** \_\_\_\_\_  
 Failing to use YAMAHA-recommended grease can shorten the life of the ball screw and the linear guide.

---

### 4-2-3 Six-month inspection

Take the following precautions when performing 6-month inspection.



#### WARNING

THE SLIDER OF VERTICAL USE ROBOT WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION. DO NOT RELEASE THE BRAKE WHEN LUBRICATING THE VERTICAL USE ROBOT PARTS.

When applying grease to the ball screws and linear guide, take the following precautions.



#### WARNING

##### PRECAUTIONS WHEN HANDLING GREASE:

- INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES. BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.
- INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.
- DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)
- HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE CONTAINER, SO USE PROTECTIVE GLOVES.
- KEEP OUT OF THE REACH OF CHILDREN.
- DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.

##### EMERGENCY TREATMENT:

- IF GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.
- IF GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.
- IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR PROPER TREATMENT.



#### WARNING

##### DISPOSING OF GREASE AND THE CONTAINER:

- PROPER DISPOSAL IS COMPULSORY UNDER FEDERAL, STATE AND LOCAL REGULATIONS. TAKE APPROPRIATE MEASURES IN COMPLIANCE WITH LEGAL REGULATIONS IN YOUR COUNTRY.
- DO NOT PRESSURIZE THE EMPTY CONTAINER. PRESSURIZING MAY CAUSE THE CONTAINER TO RUPTURE.
- DO NOT ATTEMPT TO WELD, HEAT UP, DRILL HOLES OR CUT THIS CONTAINER. THIS MIGHT CAUSE THE CONTAINER TO EXPLODE AND THE REMAINING MATERIALS INSIDE IT TO IGNITE.

Check the following points every 6 months and adjust or replace parts if needed.

Checkpoints	Check items	Notes
Major bolts and screws on robot	Check for looseness. Tighten if loose.	
Ball screw, linear guide	<ul style="list-style-type: none"> <li>• Check the ball screw and linear guide for backlash. Tighten if necessary.</li> <li>• Check for vibration during operation. Tighten bolts if necessary to secure drive unit and/or shaft.</li> <li>• Check for backlash due to wear.</li> </ul>	Consult us if problem cannot be solved or there is backlash due to wear.
Controller	<ul style="list-style-type: none"> <li>• Check if terminals are loose.</li> <li>• Check if connectors are loose</li> </ul>	
Greasing to ball screw/nut section and linear guide	Apply LG2 grease (NSK) to the ball screw nut section and linear guide every 6 months.	See "4-4" in this chapter.
Slider	On long-stroke (750mm or more) robots, check the slider inside the top cover for wear or damage every 6 months.	
Shutter	Check for looseness or slack. Adjust if necessary.	See "4-3" in this chapter.



#### CAUTION

Failing to use YAMAHA-recommended grease can shorten the life of the ball screw and the linear guide.

### 4-2-4 Three-year inspection

Check the following points every 3 years or more often if the robot is used frequently.

Checkpoints	Check items	Notes
Ball screw/nut section and linear guide	Check ball screw/nut and linear guide for backlash due to wear.	Consult us if abnormal condition is found.

## 4-3 Adjusting shutter looseness

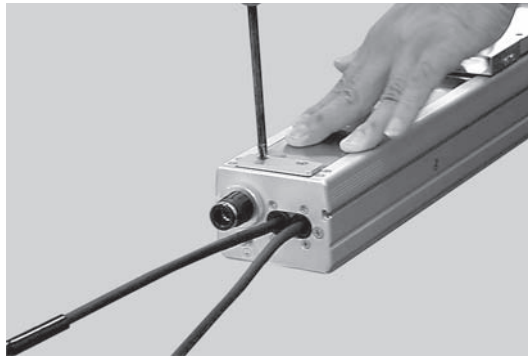
The shutter may elongate or develop a slight stretch after long-term use. Continuous operation with a stretched shutter may cause a "slack" (or a gap between the shutter and the cover of the robot) and degrade the degree of cleanliness. In such cases, adjust looseness in the shutter as explained below.

- 1) Prepare the required tools and grease.
  - Phillips-head screwdriver
- 2) Turn off the controller.
- 3) Place a sign indicating that the robot is being inspected, to keep others from operating the controller switch.
- 4) Enter the safety enclosure.
- 5) While moving the slider back and forth by hand, find the position where the shutter is loosest.  
When a vertical installation model is used, slowly move the robot in jog before entering the safety enclosure and find the position of maximum shutter looseness.
- 6) Loosen the screws (2 places) securing the shutter clamp plate on the side where the shutter is loose.



- 7) While pulling (pressing down) on both ends of the shutter with your fingers, tighten the two screws to secure the shutter clamp plate.  
At this point, alternately tighten the two screws a little at a time.





- 8) While moving the slider back and forth by hand a few times, check that no looseness or slack occurs in the shutter and also that the shutter does not sway right or left. If any abnormality is found, repeat the adjustment in steps 6) and 7).
- 9) Go outside the safety enclosure.
- 10) Check that no one is inside the safety enclosure and then turn on the controller.

**NOTE**

---

When securing the shutter clamp plate, tighten the screws equally on left and right a little at a time, so that the shutter surface does not protrude or bulge above the slider.

---

## 4-4 Applying grease

When applying grease to the ball screw according to periodic inspection, follow the procedure below. Grease can be applied to the ball screw nut section using the grease nipples. Prepare a grease gun in this case.

- 1) Prepare the required tools and grease.
  - Phillips-head screwdriver
  - Grease gun
  - Recommended grease: NSK LG2
- 2) Turn off the controller.
- 3) Place a sign indicating that the robot is being inspected, to keep others from operating the controller switch.
- 4) Enter the safety enclosure.
- 5) Apply grease using the following procedures.
  - **Greasing the ball screw**
    1. Remove the two screws securing the shutter clamp plate on one side of the robot.

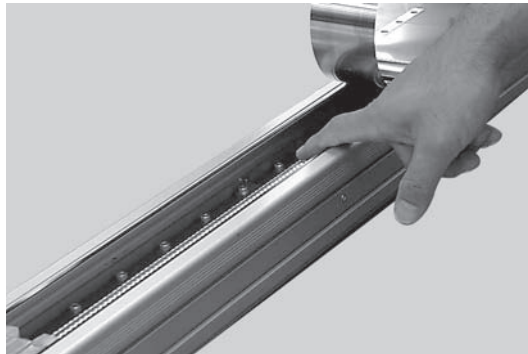


2. Open the shutter by pulling it up from the side where the screws were removed.

**CAUTION**

**When opening the shutter, be careful not to scratch the shutter surface.**

3. Wipe away old grease with a clean cloth. Then apply grease by hand to the ball screw threads and move the slider back and forth to spread the grease.



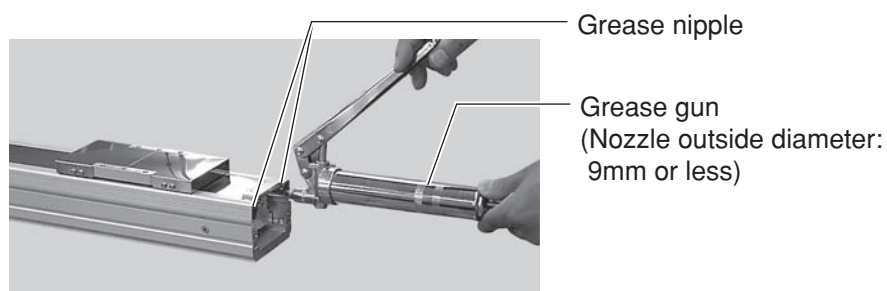
#### ● Greasing the linear guide

There are two methods of greasing the linear guide.

- (1) Remove only the end cover to grease the linear guide
- (2) Open the cover by pulling it up to grease the linear guide.

Method (1) : Remove only the end cover to grease the linear guide

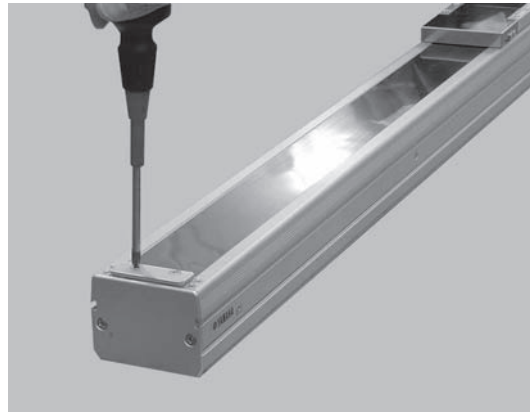
1. Remove the 2 screws securing the end cover on the motor side, and remove the end cover.  
(For how to remove the end cover, refer to "4-6 Replacing the motor".)
2. Wipe away old grease with a clean cloth. Then use a grease gun to inject new grease into the two grease nipples on the right and left of the ball guide bearing.



## 4-4 Applying grease

Method (2) : When opening the shutter by pulling it up to grease the linear guide

1. Remove the 2 screws securing the shutter clamp plate on the non-motor side.



2. Open the shutter by pulling it up from the side where the screws were removed.

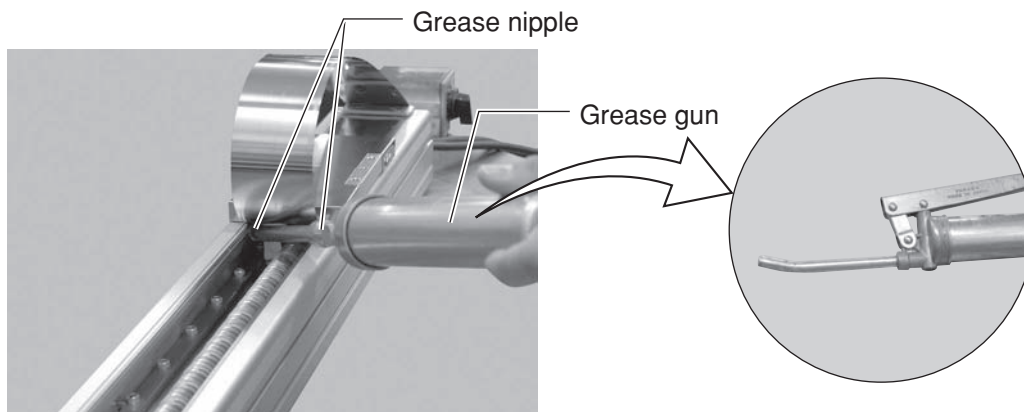


### CAUTION

**When opening the shutter, be careful not to scratch the shutter surface.**

3. Wipe away old grease with a clean cloth.

Then use a grease gun to inject new grease into the two grease nipples on the right and left of the ball guide bearing. In this case, use a grease gun with a bent nozzle as shown.



- 6) Wipe away excess grease with a clean cloth.

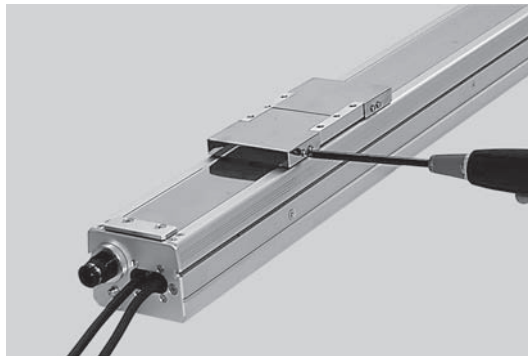
When a vertical installation model is used, go outside the safety enclosure, check no one is inside the safety enclosure, and turn on the controller. Then slowly move the slider back and forth a few times in MANUAL mode to spread the grease. Next, turn off the controller and re-enter the safety enclosure to continue the job.

- 7) Reattach the end cover and shutter.

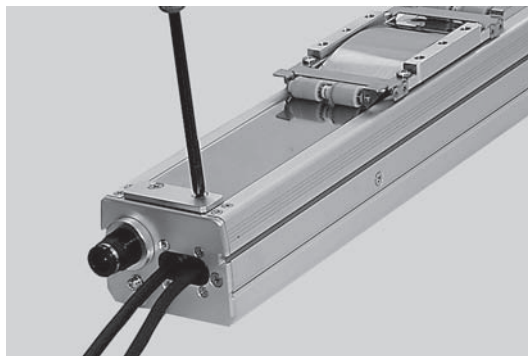
(For how to adjust the shutter, refer to "4-3 Adjusting shutter looseness".)

## 4-5 Replacing the shutter

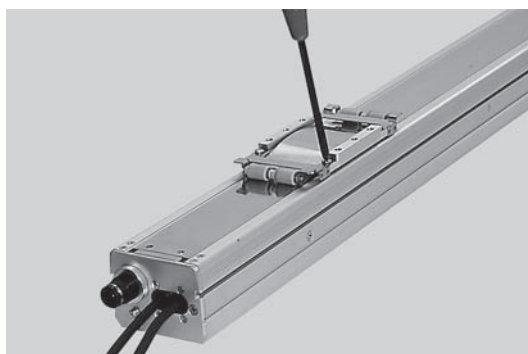
- 1) Turn off the controller.
- 2) Place a sign indicating that the robot is being inspected, to keep others from operating the controller switch.
- 3) Enter the safety enclosure.
- 4) Remove the 8 screws (4 screws on each side) securing the slider cover and remove the cover.



- 5) Remove the screws securing the shutter clamp plates (2 screws on each clamp plate, a total of 4 screws) at both ends of the robot.

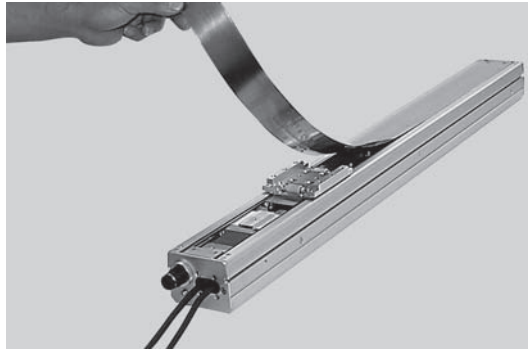


- 6) Remove the 4 screws securing the roller and remove the roller.



## 4-5 Replacing the shutter

7) Remove the shutter.



8) Attach the new shutter in place.



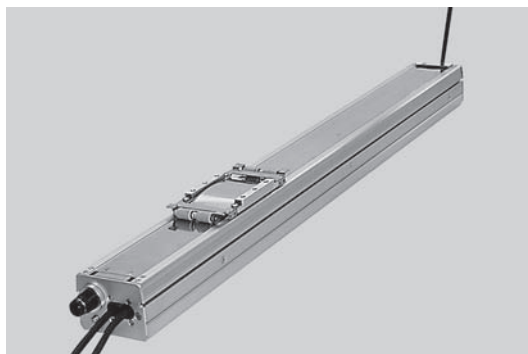
NOTE

Attach the shutter so it is positioned in the center of the cover.

9) Reattach the roller that was removed in step 6).



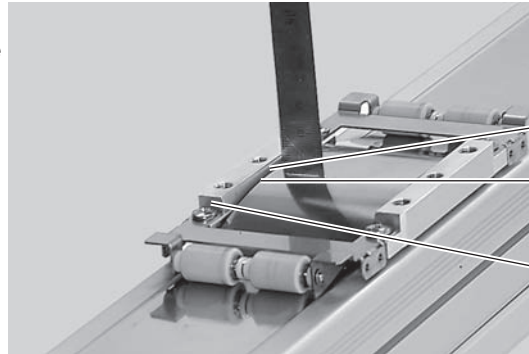
10) Reattach the shutter clamp plates that were removed in step 5. Finger-tighten the screws (do not tighten securely).



- 11) Move the slider back and forth by hand a few times so that the shutter fits in the center of the cover.

**NOTE**

As a general guide, the shutter tension is appropriate when the shutter surface is approximately 1mm below the upper step in the slider.



Step

Approx. 1mm  
below step

Slider

- 12) Move the slider to one end, and while pressing down on the shutter in the center of the slider, tighten the shutter clamp plate screws (finger-tightened in step 10) alternately a little at a time.

**NOTE**

When securing the shutter clamp plate, tighten the screws equally on left and right a little at a time, so that the shutter surface does not protrude or bulge above the slider.

- 13) Use the same procedure to tighten the screws on the other shutter clamp plate, alternately a little at a time. After tightening, check that the shutter does not protrude (or bulge) above the slider, If the shutter is protruding, loosen the screws on the shutter clamp plates on both ends and repeat the adjustment in steps 11) and 12).

**CAUTION**

**If the shutter protrudes (bulges) above the slider, the shutter surface might rub against the slider cover creating dust or grit. This will also shorten the shutter service life.**

- 14) While moving the slider back and forth by hand a few times, check that the shutter does not slacken or sway right or left. If slack or sway occurs in the shutter, repeat the adjustment from step 11) to step 13).

When a vertical installation model is used, go outside the safety enclosure, check no one is inside the safety enclosure, and turn on the controller. Then slowly move the slider back and forth a few times in MANUAL mode to check the movement. After checking, turn off the controller and re-enter the safety enclosure to continue the job.

- 15) Reattach the slider cover.

- 16) Go outside the safety enclosure.

- 17) Check no one is inside the safety enclosure and then turn on the controller.

## 4-6 Replacing the motor



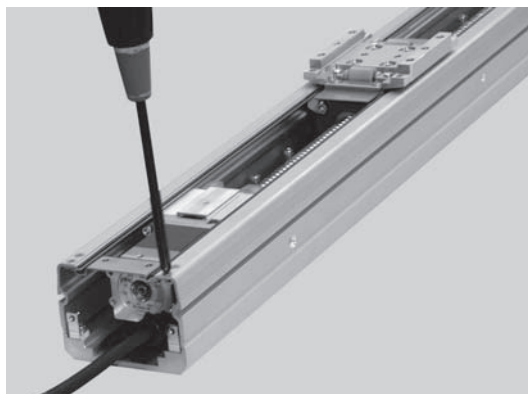
### CAUTION

A positional shift occurs by replacing the motor. It is therefore necessary to perform return-to-origin and set point data again after replacing the motor. When removing the parts, note their positional relation and assembly order.

- 1) Turn off the controller.
- 2) Place a sign indicating that the robot is being inspected, to keep others from operating the controller switch.
- 3) Enter the safety enclosure.
- 4) Remove the 6 screws (2 screws on the sides and 4 screws for the cable) securing the end cover on the motor side, and remove the end cover. Likewise, remove the 2 screws securing the end cover on the non-motor side and remove the end cover.

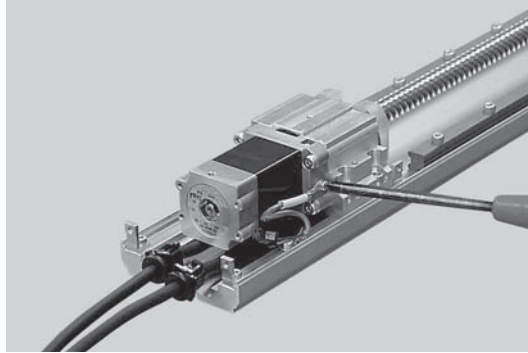


- 5) Remove the shutter.  
(For how to remove the shutter, refer to "4-5 Replacing the shutter".)
- 6) Remove the screws securing the side covers (5 screws on each side) and remove both side covers.  
(For how to remove the side covers, refer to "4-4 Applying grease".)

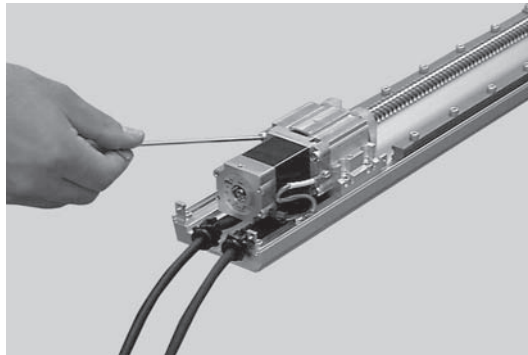




7) Remove the ground wire.



8) Remove the 4 bolts securing the motor and remove the motor.

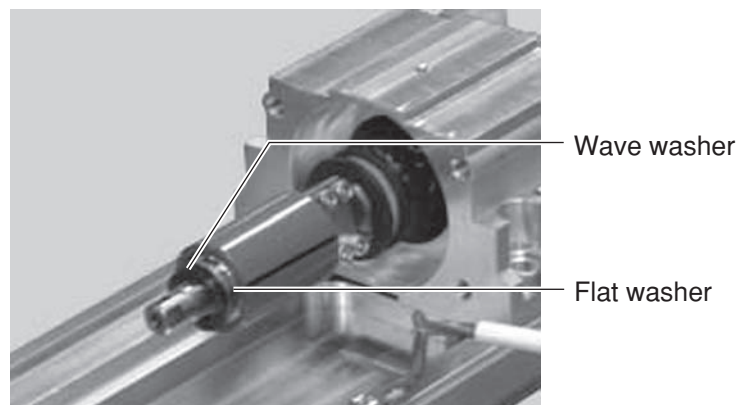


9) Remove the wave washer and flat washer.



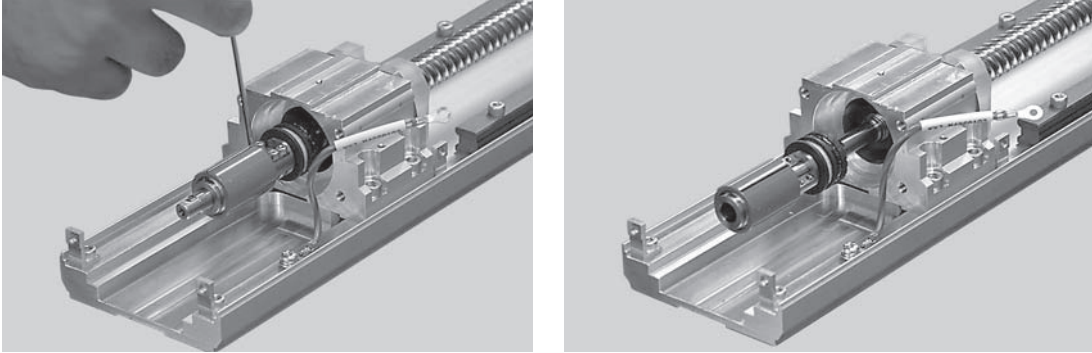
**CAUTION**

When removing the motor, the flat washer might be left in the bearing inside the motor, so use caution.



## 4-6 Replacing the motor

10) Remove the 4 bolts securing the rotor and pull out the rotor.



11) Install the new rotor.

12) Install the wave washer and flat washer in the correct order.

13) Install the new motor.

14) Reassemble in the reverse order (steps 12 to 4).

# 4

## Periodic Inspection and Maintenance

### ● Checking the grid position (for SR1)

1) Press **F2** (OPRT) on the initial menu screen.

```
[MENU]
select menu
1EDIT 2OPRT 3SYS 4MON
```

2) Press **F1** (ORG).

```
[OPRT]
select menu
1ORG 2STEP 3AUTO
```

3) Press **F1** (yes) to perform return-to-origin.

To cancel the operation, press **F2** (no).

```
[OPRT-ORG-SEARCH]
ORG search OK ?
1yes 2no
```

4) This screen appears during return-to-origin.

Pressing **STOP** during operation stops the robot and displays a message. Then pressing **ESC** returns to the screen of 2).

```
[OPRT-ORG-SEARCH]
searching ...
```

5) When return-to-origin ends normally, the machine reference value appears on the bottom right of the screen.

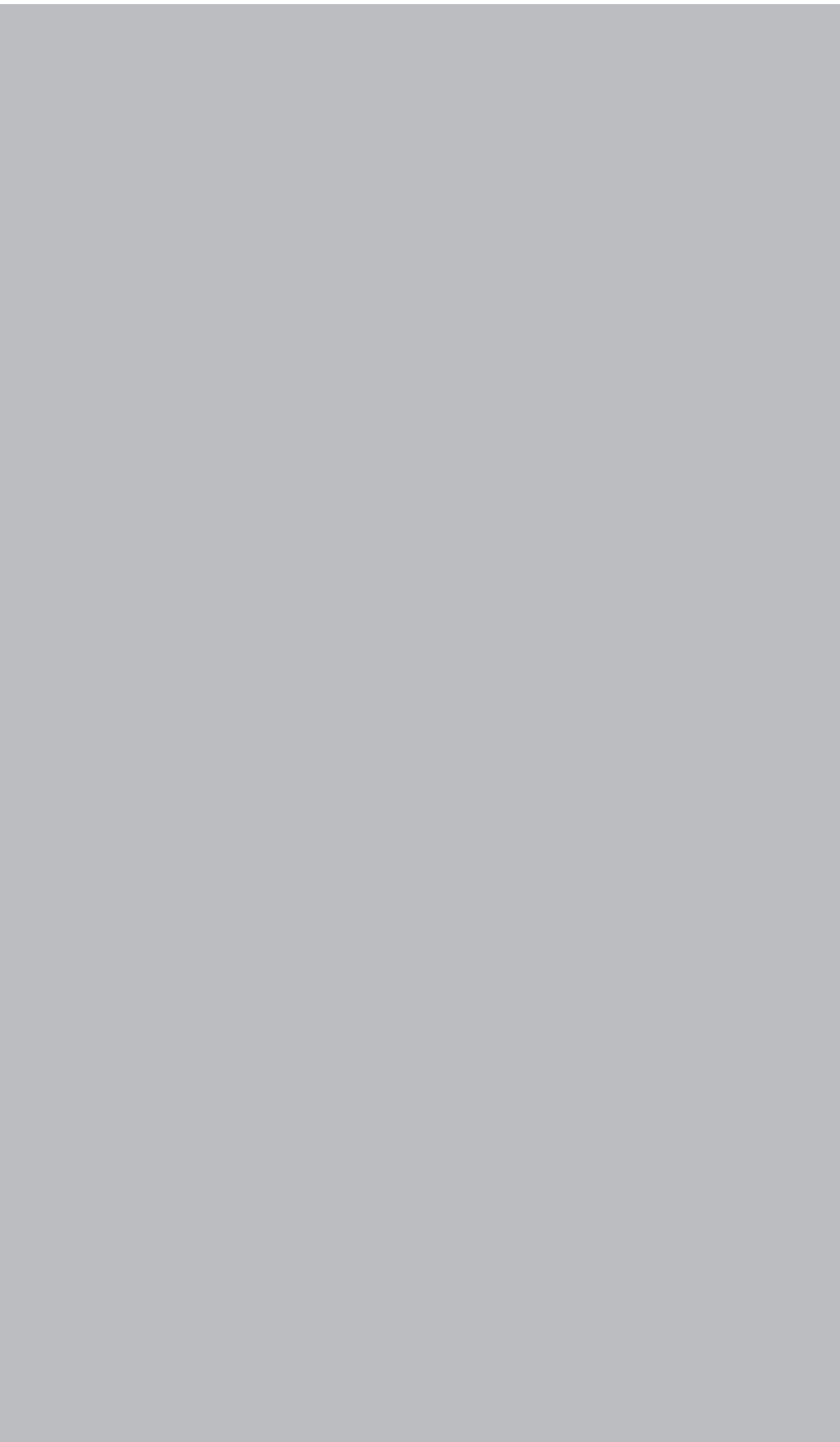
```
[OPRT-ORG-SEARCH]
origin complete
grid position 50%
```

6) Press **BS** to display the grid position.

# MEMO

## Contents

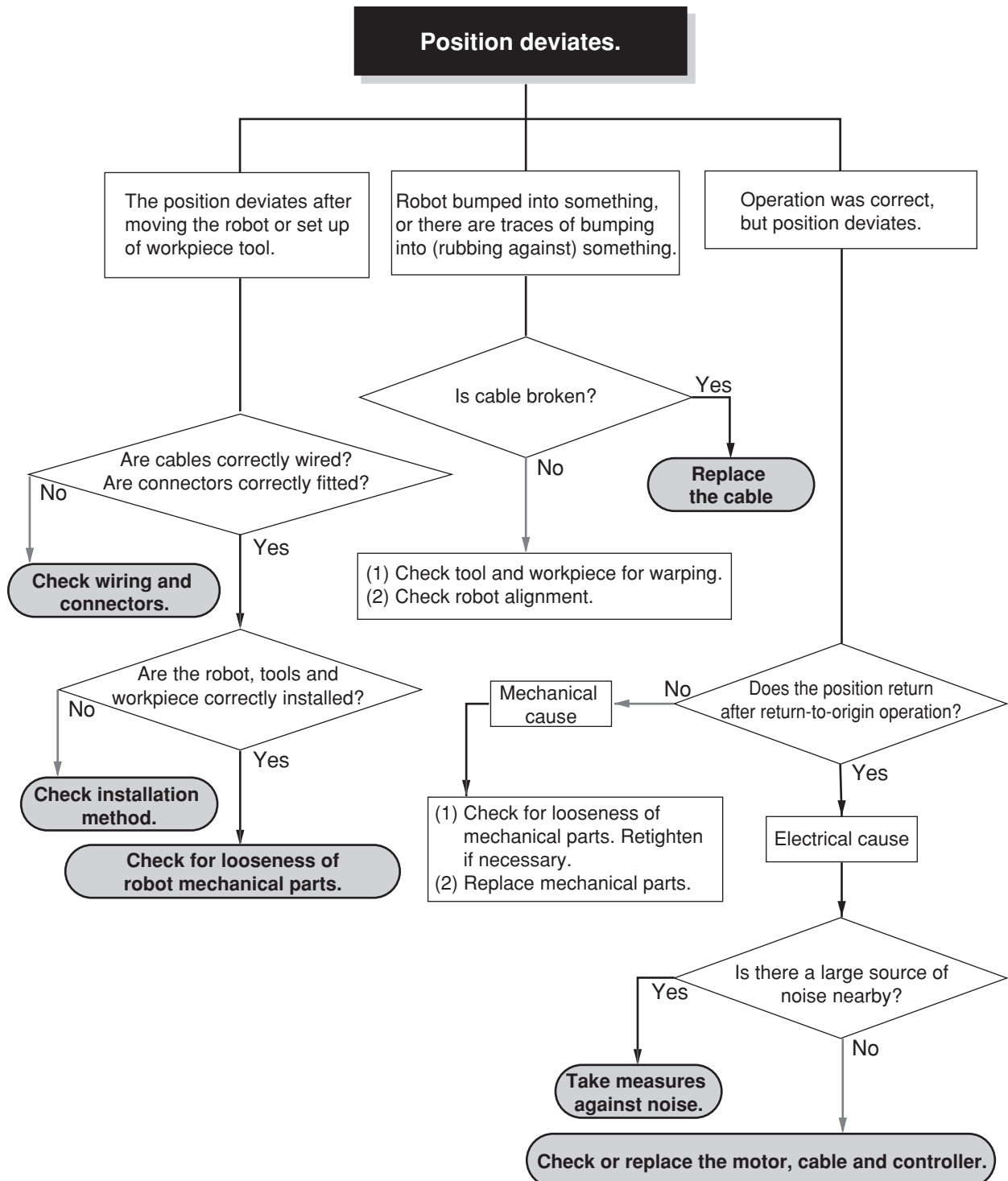
<b>5-1</b>	<b>If you suspect trouble</b>	<b>5-1</b>
5-1-1	Positioning error	5-1
5-1-2	Feedback error	5-2



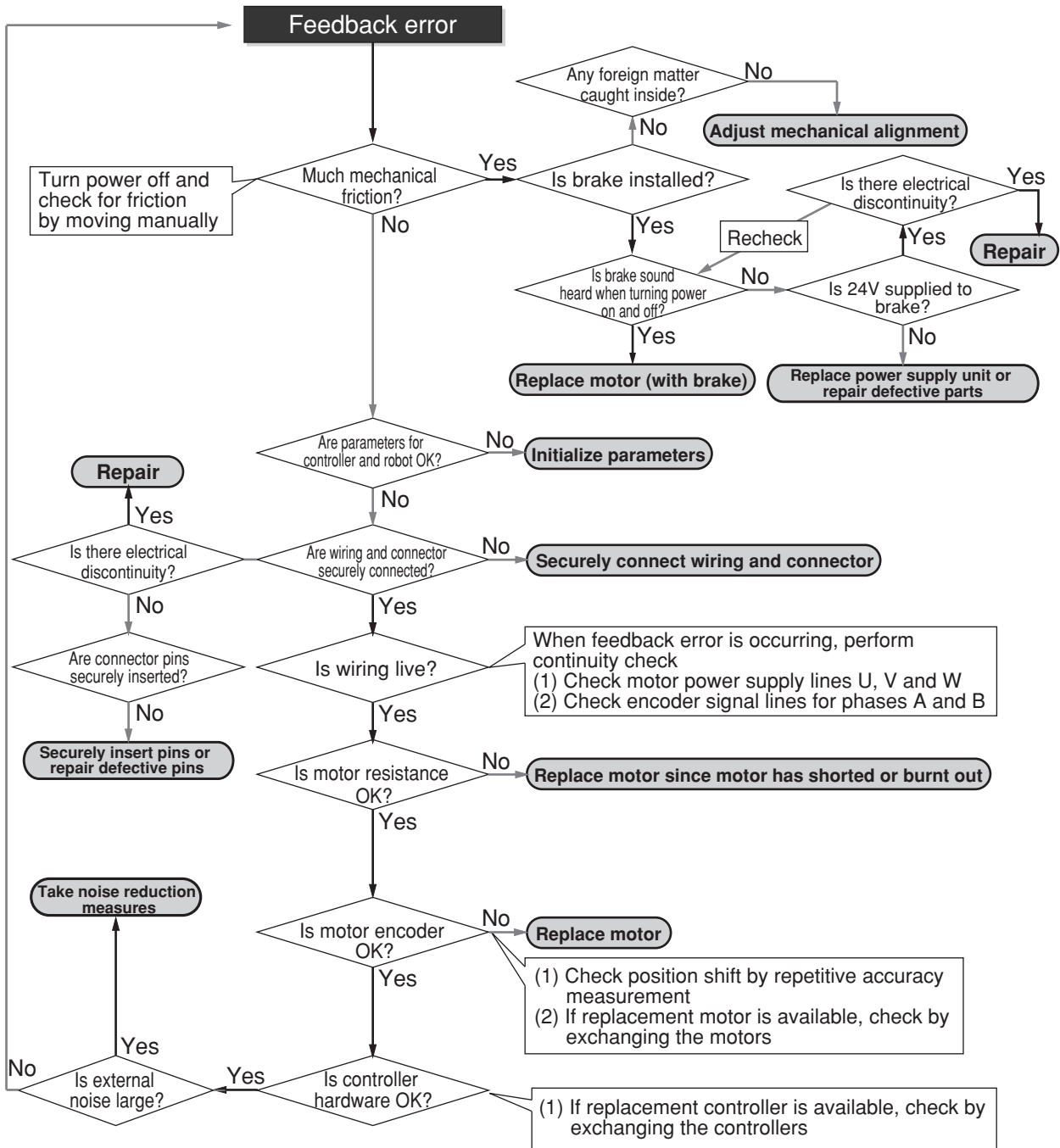
## 5-1 If you suspect trouble

If an error such as a positioning error or feedback error occurs, check the following points to find the solution before you determine the robot or controller has malfunctioned. If the trouble still exists even after checking these points, please contact us with a detailed description of the trouble.

### 5-1-1 Positioning error



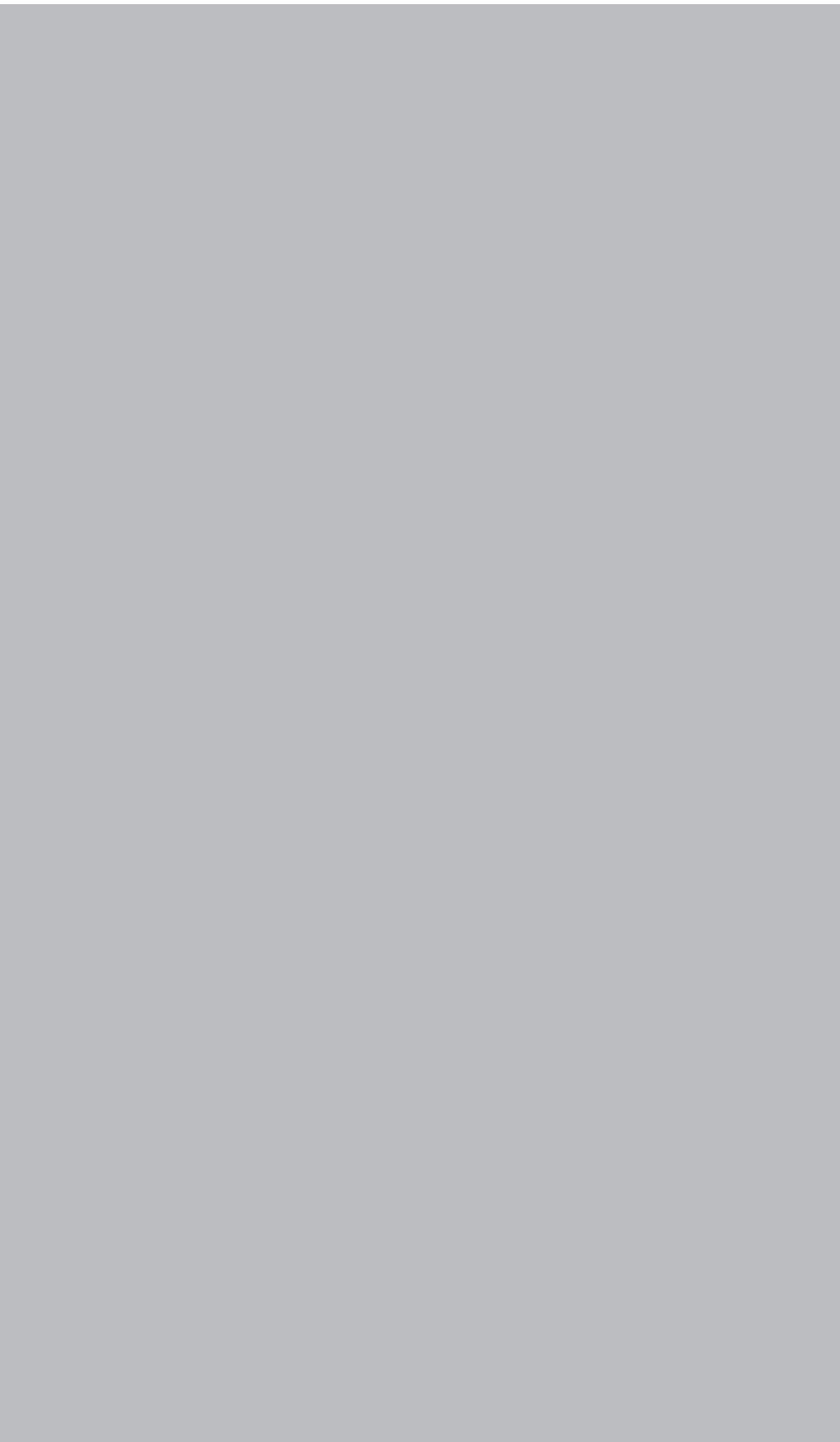
### 5-1-2 Feedback error





## Contents

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<b>6-2</b>	<b>AC servo motor specifications</b>	<b>6-11</b>
6-2-1	AC servo motor termination	6-11
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6-3-4	Robot cables (RDX)	6-17



## 6-1 Main unit specifications

### 6-1-1 C8

#### ● Basic specifications

Motor output AC (W)		100		
Repeated positioning accuracy (mm) *1		±0.02		
Deceleration mechanism		Ball screw φ12(Class C10)		
Ball screw lead (mm)		20	12	6
Maximum speed (mm/sec) *4		1000	720	360
Maximum payload (kg)	Horizontal installation	12	20	40
	Vertical installation	–	4	8
Rated thrust (N)		84	141	283
Stroke (mm)		150 to 800 (50 pitch)		
Total length (mm)	Horizontal installation	Stroke length + 320		
	Vertical installation	Stroke length + 355		
Maximum cross-section outside dimensions (mm)		W80×H75		
Cable length (m)		Standard : 3.5 Option: 5/10		
Controller	Horizontal installation	SR1-X, TS-X, RCX222, RCX240		
	Vertical installation	SR1-X, TS-X, RCX222, RCX240		
Robot driver	Horizontal installation	RDX-05-RBR1		
	Vertical installation	RDX-05-RBR1		
Cleanliness class		Class 10 *2		
Amount of suction air (Nℓ/min)		30 to 90 *3		

\*1: Positioning repeatability in one direction

\*2: Degree of cleanliness per 1 cf (0.1μm base) when suction blower is used

\*3: The required amount of suction air differs depending on the usage and environment, so it is recommended to set the suction rate at the upper limit of the listed values.

However, if, for example, the operation speed is determined and will not be changed after the robot operation has started, you can set an appropriate suction rate by referring to the table below. In that case, refer to the suction rates which are higher than the rate applicable for the operation speed.

Speed (mm/s)	Amount of suction air (Nℓ/min)
100	30
250	40
500	60
800	80
1000	90

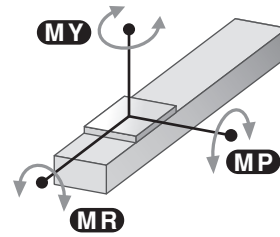
\*4: When the stroke is longer than 600mm, the ball screw may resonate depending on the moving range (critical speed). In this case, adjust to reduce the operating speed by referring to the maximum speeds shown in the table below.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800	
Maximum speed (mm/sec)	Lead 20	1000										950	800	700	650	
	Speed setting	–										95%	80%	70%	65%	
	Lead 12	720										648	540	468	432	360
	Lead 6	360										324	270	234	216	180
	Speed setting	–										90%	75%	65%	60%	50%

● Static loading moment

(Unit: N·m)

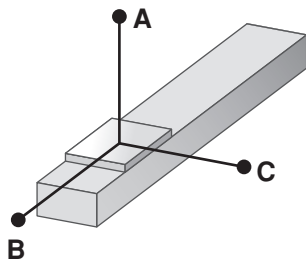
MY	MP	MR
70	95	110



● Allowable overhang\*

\* Distance from the center on the top face of slider to the gravity center of the item being carried. (This is calculated assuming that the service life of the guide is 10,000km.)

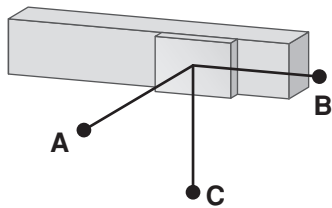
■ Horizontal installation



Horizontal installation (Unit: mm)

		A	B	C
Lead 20	5kg	245	85	146
	10kg	131	39	69
	12kg	115	31	57
Lead 12	5kg	364	92	192
	10kg	207	43	92
	15kg	144	26	41
	20kg	112	18	40
Lead 6	10kg	406	47	124
	20kg	225	20	54
	30kg	162	11	31
	40kg	168	7	20

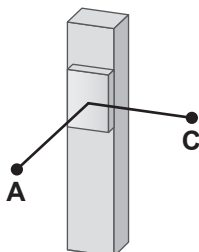
■ Wall installation



Wall installation (Unit: mm)

		A	B	C
Lead 20	5kg	121	71	211
	10kg	42	24	88
	12kg	29	16	66
Lead 12	5kg	164	78	328
	10kg	62	29	158
	15kg	26	12	83
	20kg	7	4	32
Lead 6	10kg	87	33	353
	20kg	18	6	127
	30kg	0	0	0
	40kg	0	0	0

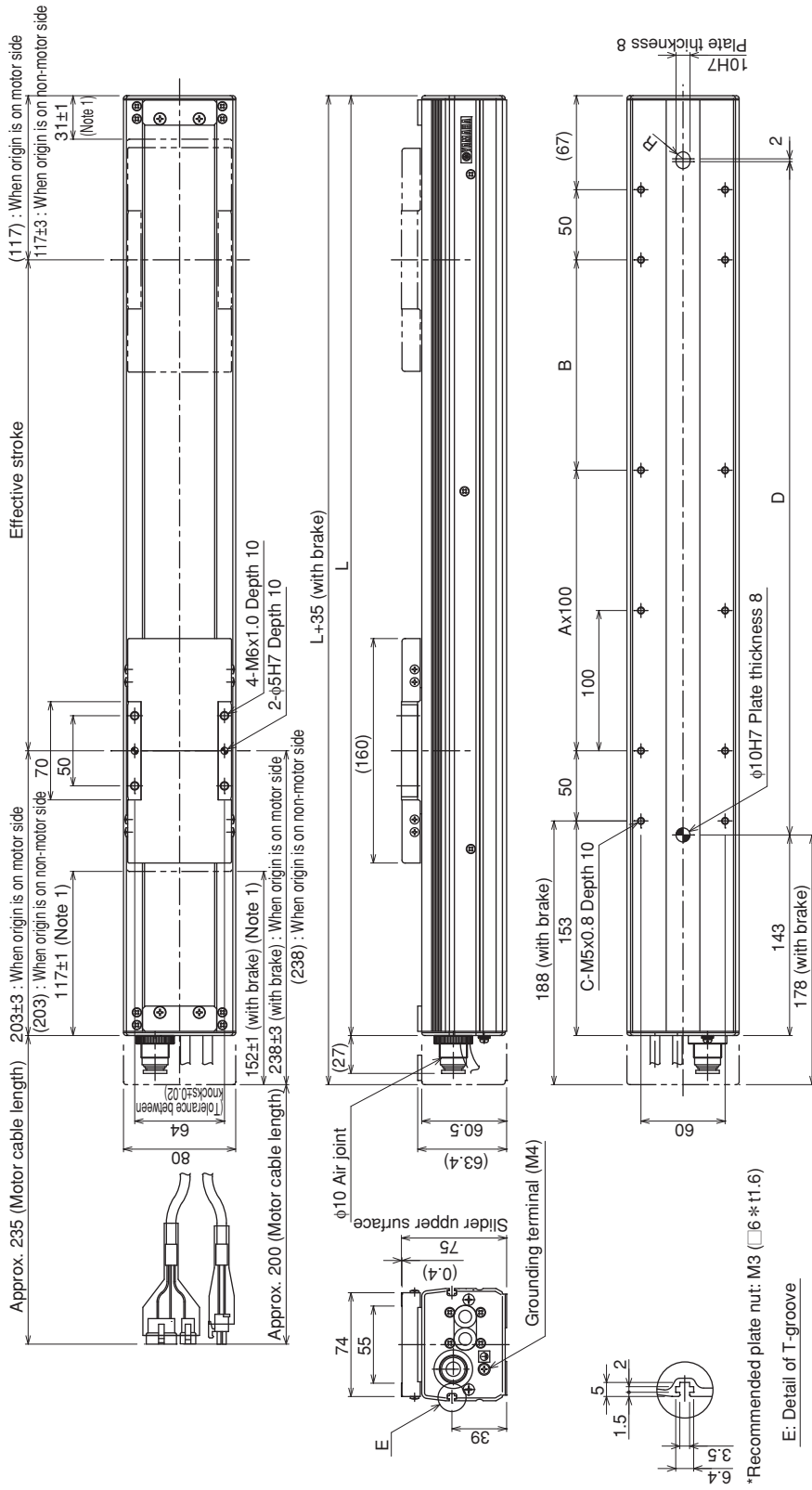
■ Vertical installation



Vertical installation (Unit: mm)

		A	C
Lead 12	1kg	440	442
	2kg	207	209
	3kg	130	132
	4kg	91	92
Lead 6	2kg	237	238
	4kg	106	96
	6kg	62	62
	8kg	34	40

● C8 Dimensions



Note 1. Distance from both ends to the mechanical stopper.

Note 2. Minimum bend radius of motor cable is R50 (50mm).

Note 3. Weight excluding brake. Weight of brake-equipped robots is 0.3kg heavier than the weight of robots with no brake (shown in the table).

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800
L	470	520	570	620	670	720	770	820	870	920	970	1020	1070	1120
A	0	1	1	2	2	3	3	4	4	5	5	6	6	7
B	150	100	150	100	150	100	150	100	150	100	150	100	150	100
C	8	10	10	12	12	14	14	16	16	18	18	20	20	22
D	280	330	380	430	480	530	580	630	680	730	780	830	880	930
Weight (kg) Note 3	3.6	3.9	4.1	4.4	4.7	5.0	5.3	5.6	5.9	6.2	6.4	6.7	7.0	7.3

## 6-1-2 C8L

## ● Basic specifications

Motor output AC (W)		100		
Repeated positioning accuracy (mm) *1		±0.01		
Deceleration mechanism		Ball screw φ15(Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) *4		1000	600	300
Maximum payload (kg)	Horizontal installation	20	40	50
	Vertical installation	4	8	16
Rated thrust (N)		84	169	339
Stroke (mm)		150 to 1050 (50 pitch)		
Total length (mm)	Horizontal installation	Stroke length + 325		
	Vertical installation	Stroke length + 360		
Maximum cross-section outside dimensions (mm)		W80×H75		
Cable length (m)		Standard : 3.5 Option: 5/10		
Controller	Horizontal installation	SR1-X, TS-X, RCX222, RCX240		
	Vertical installation	SR1-X, TS-X, RCX222, RCX240		
Robot driver	Horizontal installation	RDX-05-RBR1		
	Vertical installation	RDX-05-RBR1		
Cleanliness class		Class 10 *2		
Amount of suction air (Nℓ/min)		30 to 90 *3		

\*1: Positioning repeatability in one direction

\*2: Degree of cleanliness per 1 cf (0.1μm base) when suction blower is used

\*3: The required amount of suction air differs depending on the usage and environment, so it is recommended to set the suction rate at the upper limit of the listed values.

However, if, for example, the operation speed is determined and will not be changed after the robot operation has started, you can set an appropriate suction rate by referring to the table below. In that case, refer to the suction rates which are higher than the rate applicable for the operation speed.

Speed (mm/s)	Amount of suction air (Nℓ/min)
100	30
250	40
500	60
800	80
1000	90

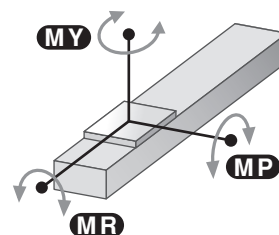
\*4: When the stroke is longer than 700mm, the ball screw may resonate depending on the moving range (critical speed). In this case, adjust to reduce the operating speed by referring to the maximum speeds shown in the table below.

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	
Maximum speed (mm/sec)	Lead 20	1000											900	800	700	650	600	550	500	
	Speed setting	-											90%	80%	70%	65%	60%	55%	50%	
	Lead 10	600											510	450	390	360	330	300	270	240
	Lead 5	300											255	225	195	180	165	150	135	120
	Speed setting	-											85%	75%	65%	60%	55%	50%	45%	40%

● Static loading moment

(Unit: N•m)

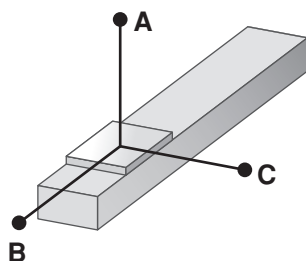
MY	MP	MR
70	95	110



● Allowable overhang\*

\* Distance from the center on the top face of slider to the gravity center of the item being carried. (This is calculated assuming that the service life of the guide is 10,000km.)

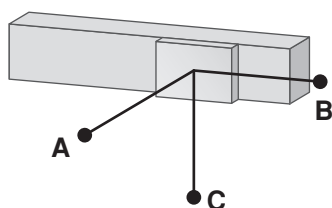
■ Horizontal installation



Horizontal installation (Unit: mm)

		A	B	C
Lead 20	5kg	259	122	179
	10kg	149	55	89
	15kg	100	33	56
	20kg	95	22	41
Lead 10	10kg	251	61	130
	20kg	127	25	55
	30kg	90	14	31
	40kg	69	8	18
Lead 5	20kg	256	29	76
	30kg	188	16	43
	40kg	96	10	28
	50kg	33	6	18

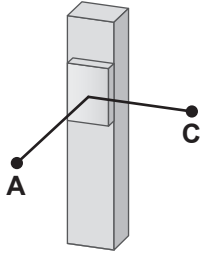
■ Wall installation



Wall installation (Unit: mm)

		A	B	C
Lead 20	5kg	147	100	220
	10kg	53	32	97
	15kg	17	10	39
	20kg	0	0	0
Lead 10	10kg	87	41	197
	20kg	10	4	37
	30kg	0	0	0
	40kg	0	0	0
Lead 5	20kg	24	9	152
	30kg	0	0	0
	40kg	0	0	0
	50kg	0	0	0

■ Vertical installation

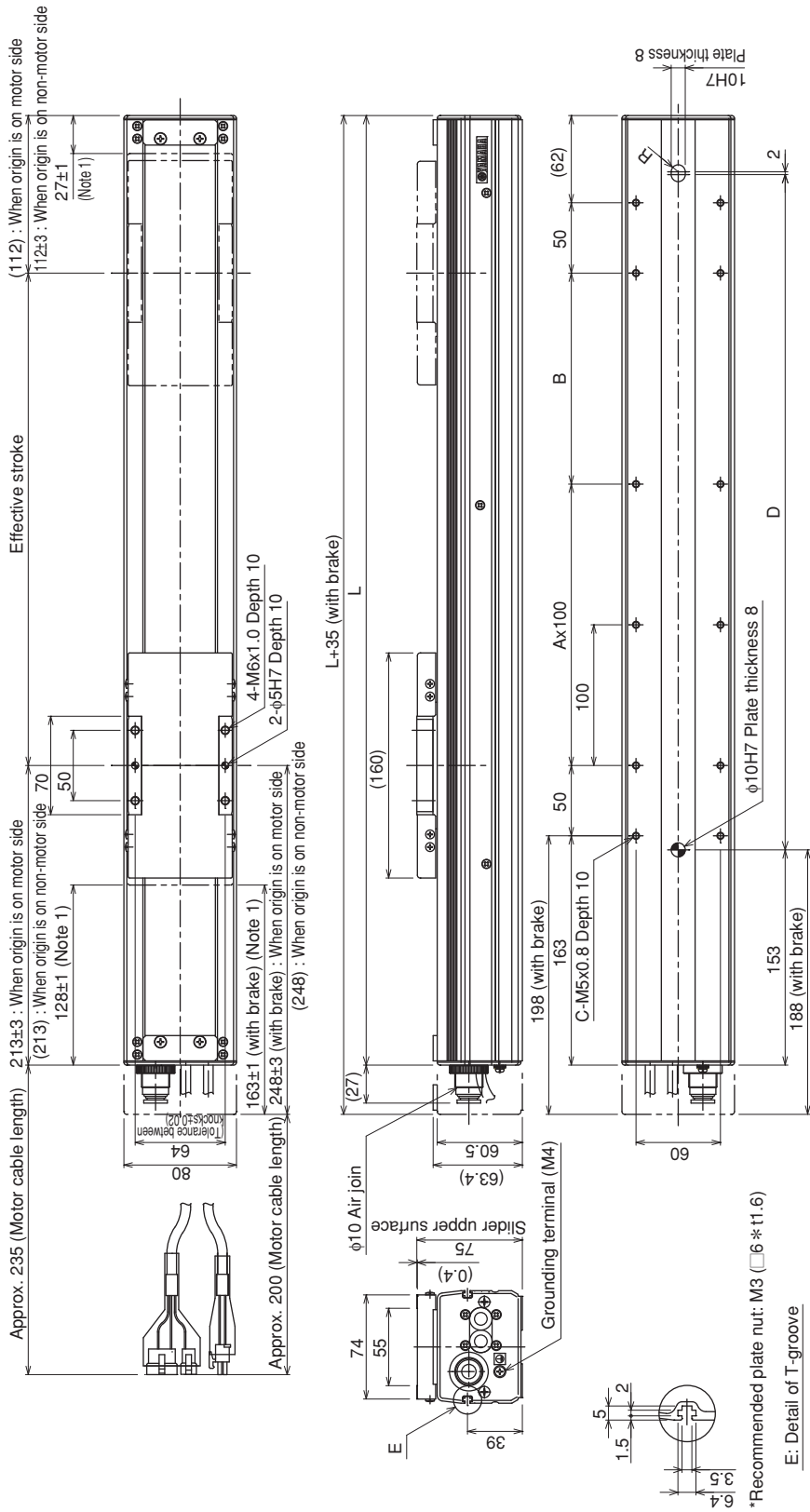


Vertical installation (Unit: mm)

		A	C
Lead 20	2kg	255	260
	4kg	111	115
Lead 10	2kg	300	302
	4kg	131	133
	6kg	75	77
	8kg	47	49
Lead 5	5kg	113	114
	10kg	37	38
	15kg	12	12
	16kg	9	9



## ● C8L Dimensions



Note 1. Distance from both ends to the mechanical stopper.

Note 2. Minimum bend radius of motor cable is R50 (50mm).

Note 3. Weight excluding brake. Weight of brake-equipped robots is 0.3kg heavier than the weight of robots with no brake (shown in the table).

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L	475	525	575	625	675	725	775	825	875	925	975	1025	1075	1125	1175	1225	1275	1325	1375
A	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9
B	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150
C	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26
D	280	330	380	430	480	530	580	630	680	730	780	830	880	930	980	1030	1080	1130	1180
Weight (kg) Note 3	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6.0	6.4	6.7	7.0	7.3	7.6	7.9	8.2	8.5	8.8	9.2	9.5

## 6-1-3 C8LH

## ● Basic specifications

Motor output AC (W)		100		
Repeated positioning accuracy (mm) *1		±0.01		
Deceleration mechanism		Ball screw φ15(Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) *4		1000	600	300
Maximum payload (kg)	Horizontal installation	30	60	80
	Vertical installation	84	169	339
Rated thrust (N)		84	169	339
Stroke (mm)		150 to 1050 (50 pitch)		
Total length (mm)		Stroke length + 389		
Maximum cross-section outside dimensions (mm)		W80×H75		
Cable length (m)		Standard : 3.5 Option: 5/10		
Controller	Horizontal installation	SR1-X, TS-X, RCX222, RCX240		
	Vertical installation	SR1-X, TS-X, RCX222, RCX240		
Robot driver	Horizontal installation	RDX-05-RBR1		
	Vertical installation	RDX-05-RBR1		
Cleanliness class		Class 10 *2		
Amount of suction air (Nℓ/min)		30 to 90 *3		

\*1: Positioning repeatability in one direction

\*2: Degree of cleanliness per 1 cf (0.1μm base) when suction blower is used

\*3: The required amount of suction air differs depending on the usage and environment, so it is recommended to set the suction rate at the upper limit of the listed values. However, if, for example, the operation speed is determined and will not be changed after the robot operation has started, you can set an appropriate suction rate by referring to the table below. In that case, refer to the suction rates which are higher than the rate applicable for the operation speed.

Speed (mm/s)	Amount of suction air (Nℓ/min)
100	30
250	40
500	60
800	80
1000	90

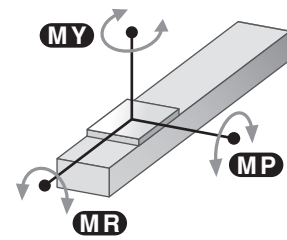
\*4: When the stroke is longer than 650mm, the ball screw may resonate depending on the moving range (critical speed). In this case, adjust to reduce the operating speed by referring to the maximum speeds shown in the table below.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	
		Maximum speed (mm/sec)	Lead 20	1000											900	800	700	650	600	550	500
Speed setting	-											90%	80%	70%	65%	60%	55%	50%	45%		
Lead 10	600											510	450	390	360	330	300	270	240	210	
Lead 5	300											255	225	195	180	165	150	135	120	105	
Speed setting	-											85%	75%	65%	60%	55%	50%	45%	40%	35%	

● Static loading moment

(Unit: N•m)

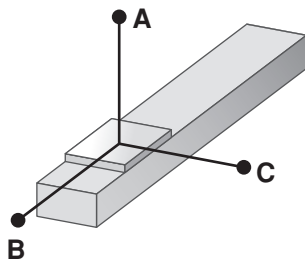
MY	MP	MR
128	163	143



● Allowable overhang\*

\* Distance from the center on the top face of slider to the gravity center of the item being carried. (This is calculated assuming that the service life of the guide is 10,000km.)

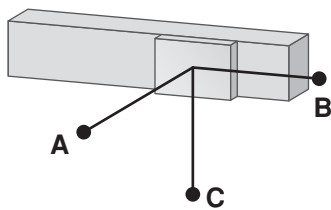
■ Horizontal installation



Horizontal installation (Unit: mm)

		A	B	C
Lead 20	10kg	687	274	200
	20kg	401	125	92
	30kg	338	76	57
Lead 10	20kg	622	137	111
	40kg	472	57	47
	60kg	375	30	25
Lead 5	20kg	1087	148	127
	40kg	844	63	54
	60kg	707	34	29
	80kg	594	20	17

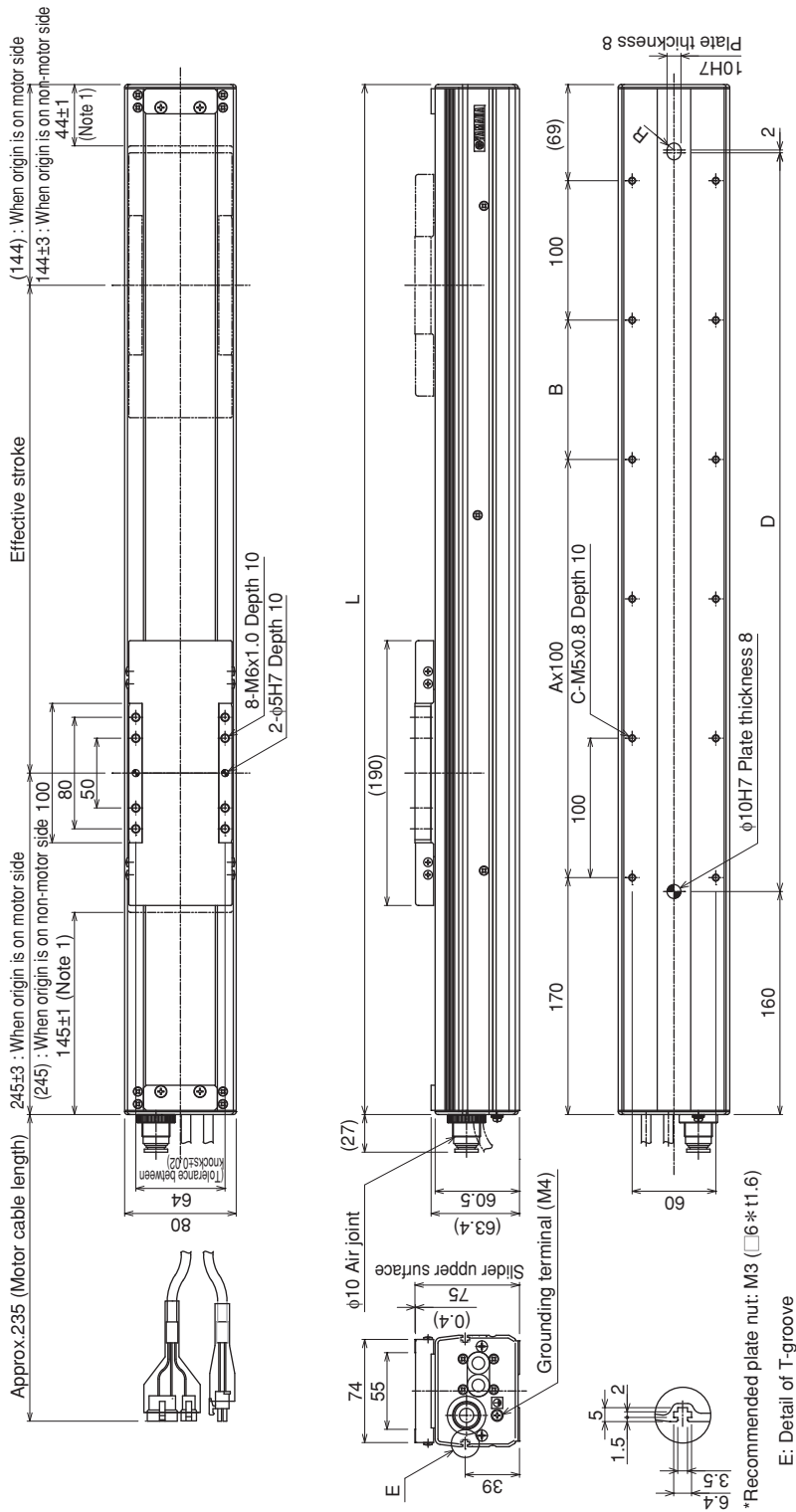
■ Wall installation



Wall installation (Unit: mm)

		A	B	C
Lead 20	10kg	163	225	617
	20kg	56	76	302
	30kg	20	27	182
Lead 10	20kg	74	90	517
	40kg	8	11	196
	60kg	0	0	0
Lead 5	20kg	89	104	974
	40kg	15	18	505
	60kg	0	0	0
	80kg	0	0	0

## ● C8LH Dimensions



Note 1. Distance from both ends to the mechanical stopper.

Note 2. Minimum bend radius of motor cable is R50 (50mm).

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L	539	589	639	689	739	789	839	889	939	989	1039	1089	1139	1189	1239	1289	1339	1389	1439
A	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10
B	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100
C	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26
D	330	380	430	480	530	580	630	680	730	780	830	880	930	980	1030	1080	1130	1180	1230
Weight (kg)	4.7	5.0	5.3	5.6	5.9	6.2	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.7	10.0	10.3

## 6-2 AC servo motor specifications

### 6-2-1 AC servo motor termination

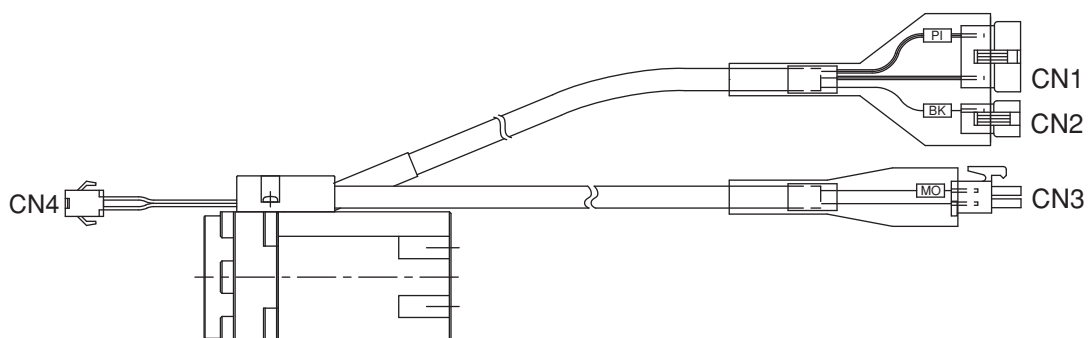
#### ■ Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	BYM-001T-P0.6	JST	9	CN1, CN2
4	Plug housing	176273-1	AMP	1	CN3 (4 polarities)
5	Receptacle	175156-2	AMP	4	CN3
6	Receptacle housing	SMR-02V-B	JST	1	CN2 (2 polarities)
7	Plug housing	SMR-02V-BC	JST	1	CN4 (2 polarities)
8	Socket contact	BHF-001T-0.8BS	JST	2	CN4
9	Round terminal	1.25-M4		1	

#### ■ Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow		Motor
	2	S4	Blue		
	3	S1	Red		
	4	S3	Black		
	5	R1	White		
	6	R2	Green		
	7	Shield	Black *1		
CN2	1	BK	Brown		1
	2	BK	Gray		2
CN3	1	U	Red		Motor
	2	V	White		
	3	W	Black		
	4	CG	Yellow/Green		

\*1: Heat shrinkable tube



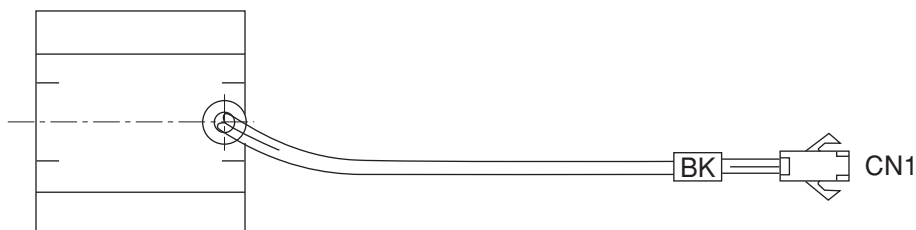
## 6-2-2 Brake cable specifications

### ■ Connector specifications

No.	Parts	Type No.	Maker	Qty	Note
1	Brake parts			1	
2	Receptacle housing	SMR-02V-B	JST	1	CN1
3	Pin contact	BYM-001T-P0.6	JST	9	CN1

### ■ Connector wiring

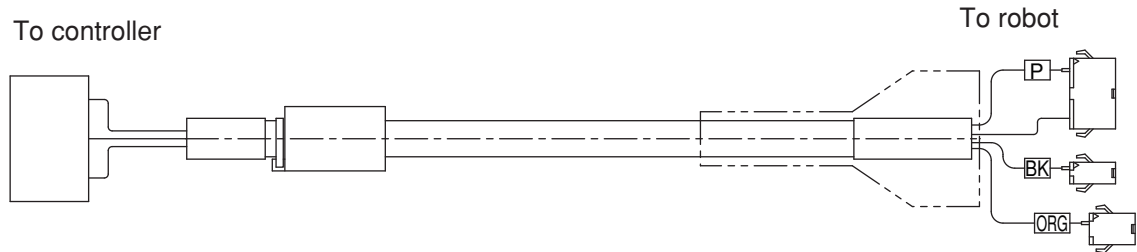
Connector	Pin No.	Signal	Wire Color
CN1	1	S1	Yellow (black)
	2	S2	Yellow (black)



## 6-3 Robot cables

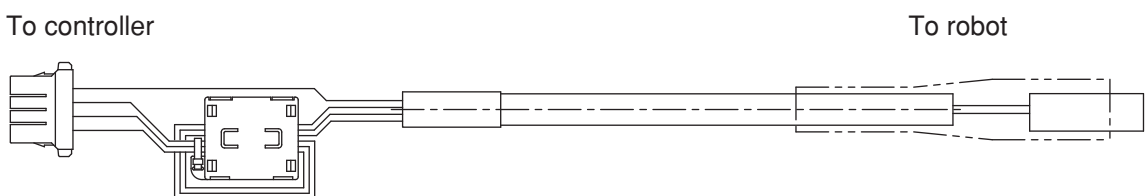
### 6-3-1 Robot cables (SR1)

#### ■ Signal cable



Parts	Signal	PIN	Connection	PIN	Parts	Wire		
Controller CN1	S2	1		1	Resolver	0.3sq	Blue	SPMCU-14K
	S4	2		2			Orange	
	S1	3		3			Green	
	S3	4		4			Brown	
	R1	5		5			Grey	
	R2	6		6			Red	
	D.G	9		7			Clear	Shield
	BK+	17		1	Brake		Black	
	BK-	18		2			Yellow	
	ORG	12		2	ORG		Pink	
	24V	13		1			White	
	GND24	15		3			Blue/Red	

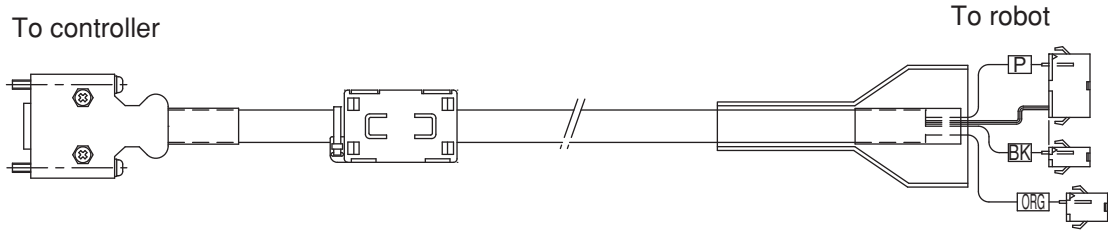
#### ■ Power cable



Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	FG	1		4		0.75sq Yellow/Green
	U	2		1		0.75sq Red
	V	4		2		0.75sq White
	W	3		3		0.75sq Black

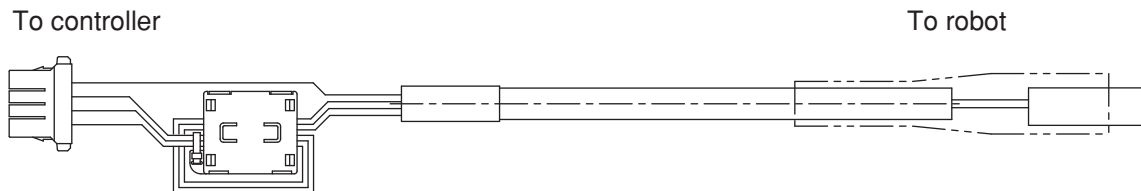
### 6-3-2 Robot cables (TS-X)

■ Signal cable



Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Controller CN1	S2	1		1	Resolver	0.3sq Blue	SPMCU-14(K)
	S4	2		2		Orange	
	S1	3		3		Green	
	S3	4		4		Brown	
	R1	5		5		Grey	
	R2	6		6		Red	
	FG	7		7			Drain wire
	BK+	13		1	Brake	Black	
	BK-	14		2		Yellow	
	ORG	12		2	ORG	Pink	
	24V	11		1		White	
	GND24	10		3		Blue/Red	

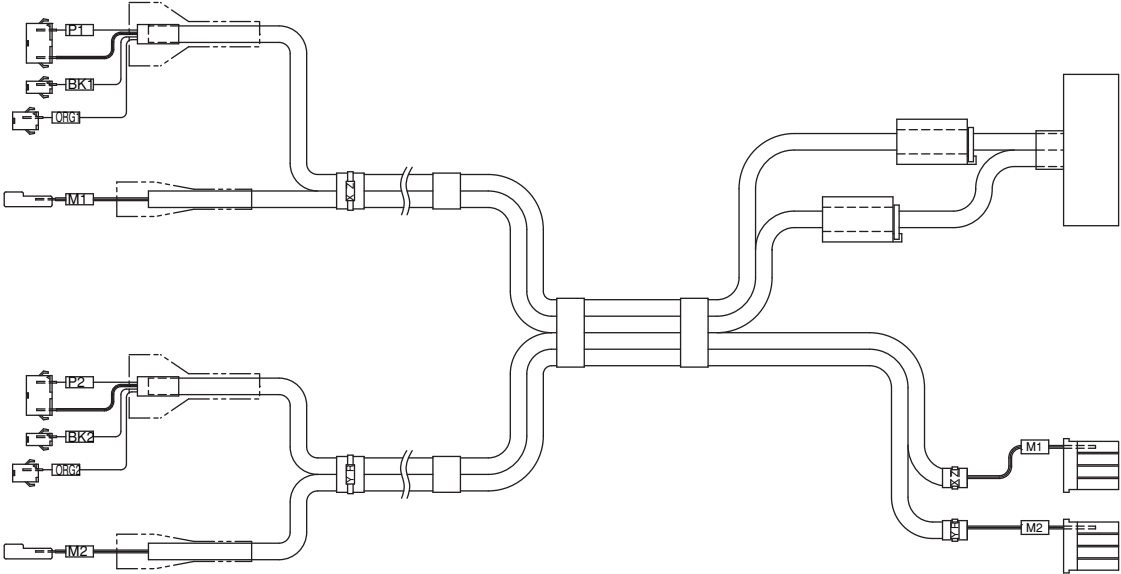
■ Power cable



Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	FG	1		4		0.75sq Yellow/Green
	U	2		1		0.75sq Red
	V	4		2		0.75sq White
	W	3		3		0.75sq Black



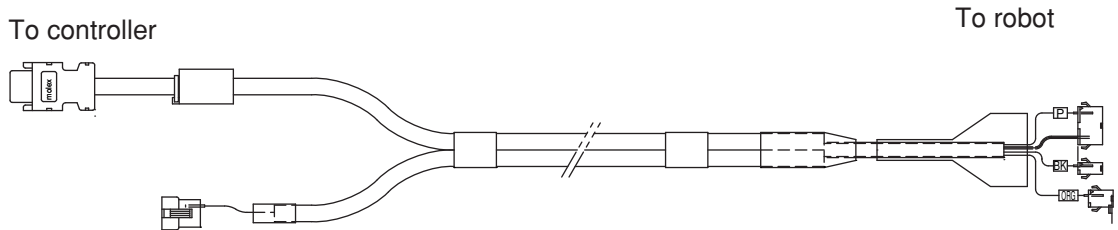
### 6-3-3 Robot cables (RCX222/240)



Signal		Connector	No.	Connection	No.	Connector	Wire		
Resolver	S2	P1	1		1		0.3sq	Red	
	S4		2		2		Twisted pair	White	
	S1		3		3		0.3sq	Twisted pair	Green
	S3		4		4				White
	R1		5		5		0.3sq	Twisted pair	Yellow
	R2		6		6				White
	DG		7		7		Drain wire		
Brake	MB+	BK1	1		14		0.3sq	Blue	
	MB-		2		16		Twisted pair	White	
Sensor	24V	ORG1	1		9		0.3sq		
	ORG		2		12		0.3sq	Blue	
	GND24		3		13		Twisted pair	Brown	
Resolver	S2	P2	1		19		0.3sq	Red	
	S4		2		20		Twisted pair	White	
	S1		3		21		0.3sq	Twisted pair	Green
	S3		4		22				White
	R1		5		23		0.3sq	Twisted pair	Yellow
	R2		6		24				White
	DG		7		25		Drain wire		
Brake	MB+	BK2	1		32		0.3sq	Blue	
	MB-		2		34		Twisted pair	White	
Sensor	24V	ORG2	1		27		0.3sq		
	ORG		2		30		0.3sq	Blue	
	GND24		3		31		Twisted pair	Brown	
HLIM					10			Green	
GND24					11				
HLIM					28			Green	
GND24					29				
U	M1	1		2	M1	0.75sq	Red		
V		2		3		0.75sq	White		
W		3		4		0.75sq	Black		
FG		4		1		0.75sq	Yellow/ Green		
U	M2	1		2	M2	0.75sq	Red		
V		2		3		0.75sq	White		
W		3		4		0.75sq	Black		
FG		4		1		0.75sq	Yellow/ Green		

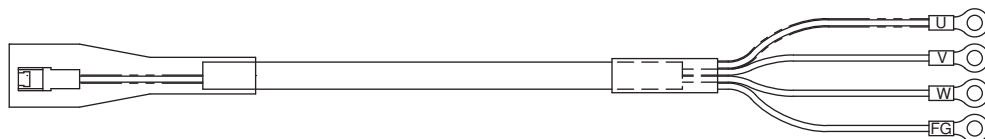
### 6-3-4 Robot cables (RDX)

■ Signal cable



Signal	Connector	No.	Connection	No.	Connector	Wire	
Encoder	S2	5		1	P	0.3sq Twisted pair	Blue
		6		2			Orange
		7		3			Green
		8		4			Brown
		1		5			Grey
		2		6			Red
		F.G.				7	Drain wire
Brake	BK+	1		1	BK	0.3sq Twisted pair	Blue
		2		2			Orange
	24V	3	1	ORG	Green		
	ORG	4	2		Grey		
	GND24	5	3		Red		

■ Power cable



Signal	Connector	No.	Connection	Connector	Wire Color	
Motor wire	U	M		Round terminal	Red	
	V				2	White
	W				4	Black
	FG				3	Yellow/Green

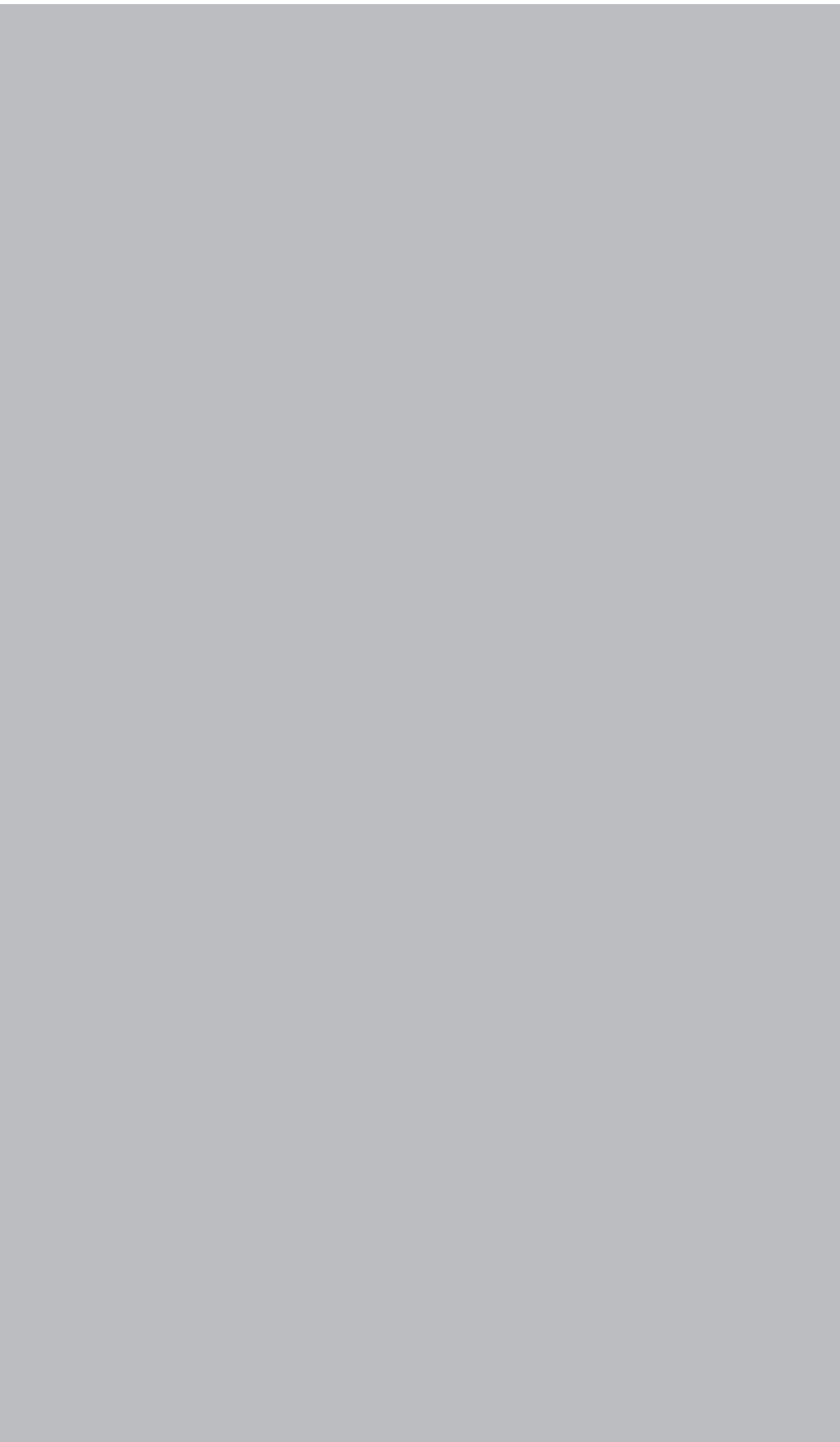
# MEMO



# Appendix

## Contents

About machine reference	i
Moment of inertia calculation	ii



## About machine reference

The position detector built into the motor issues a "0" pulse each time the motor rotates 1/4th of one turn. When return-to-origin is performed, a difference in distance occurs between the position where the origin signal is detected and the point at which the next "0" pulse is received. This is called the machine reference and is usually expressed as a percent, with 100% being equal to 1/4th of one turn of the motor. (See the figure below.)

The machine reference value must be within the allowable range (25 to 75%) to maintain axis movement repeatability.

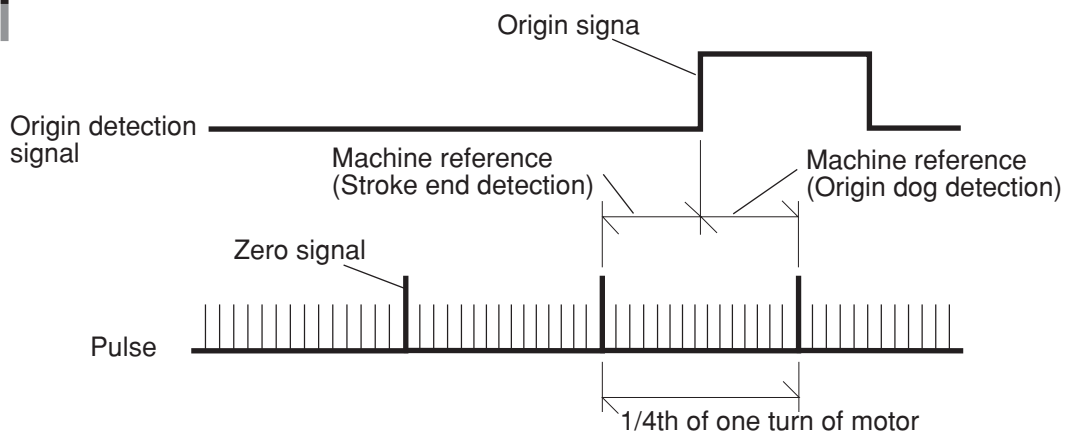
The optional programming box (HPB or RPB) or Handy Terminal (HT1) is needed to check the machine reference value. The machine reference value is displayed on the LCD screen of the programming box or Handy Terminal when return-to-origin is complete. (See the figure below.)



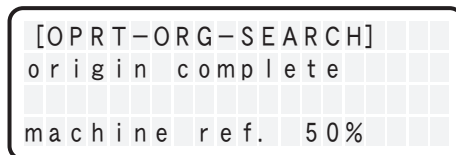
### NOTE

The C8/C8L/C8LH robots use an absolute type position detector. There is no need to perform return-to-origin each time the robot controller is turned on and readjust the machine reference value. If for some reason the machine reference adjustment becomes necessary, please contact YAMAHA sales office or dealer.

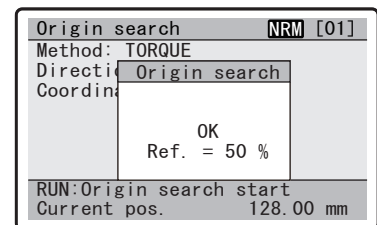
### Machine reference



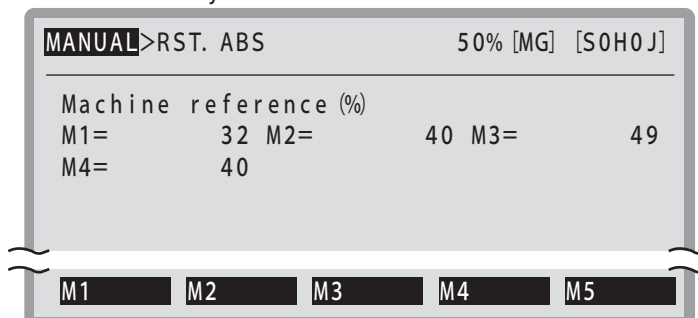
### Machine reference value display examples



SR1 \* In the screen illustration below, a section of the screen shown by the ≈ marks is omitted.



TS-X



RCX Series (Multiple FLIP-X control)

# Moment of inertia calculation



## CAUTION

The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If this is not observed, premature end to the life of the drive units, damage to the robot parts or residual vibration during positioning may result.

Usually the R axis load is not a simple form, and the calculation of the moment of inertia is not easy.

As a method, the load is replaced with several factors that resemble a simple form for which the moment of inertia can be calculated. The total of the moment of inertia for these factors is then obtained.

The objects and equations often used for the calculation of the moment of inertia are shown below.

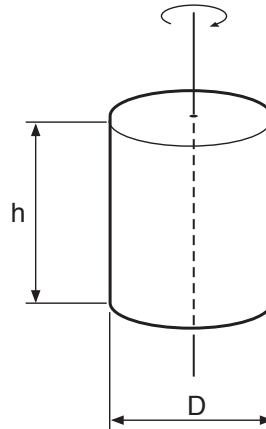
### 1. Moment of inertia for cylinder

The moment of inertia (J) for a cylinder having a rotation center such as shown below is given by

$$J = \frac{\rho \pi D^4 h}{32g} = \frac{WD^2}{8g} \quad (\text{kgf}\cdot\text{cm}\cdot\text{sec}^2)$$

$$= \frac{mD^2}{8} \quad (\text{kgm}^2)$$

$\rho$  : Density ( $\text{kg}/\text{cm}^3$ )  
 $g$  : Gravitational acceleration ( $\text{cm}/\text{sec}^2$ )  
 $W$  : Weight of cylinder (kgf)  
 $m$  : Mass of cylinder (kg)



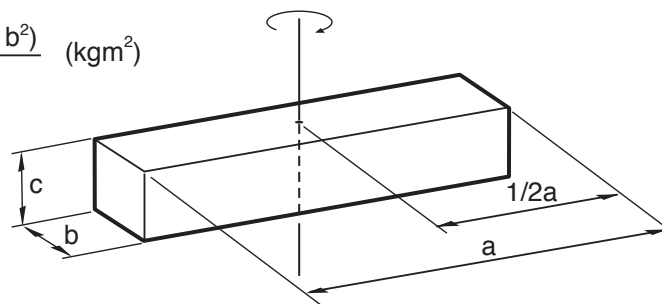
### 2. Moment of inertia for rectangular parallelepiped

The moment of inertia (J) for a rectangular parallelepiped having a rotation center as shown below is given by

$$J = \frac{\rho abc (a^2 + b^2)}{12g} = \frac{W (a^2 + b^2)}{12g} \quad (\text{kgf}\cdot\text{cm}\cdot\text{sec}^2)$$

$$= \frac{m (a^2 + b^2)}{12} \quad (\text{kgm}^2)$$

$\rho$  : Density ( $\text{kg}/\text{cm}^3$ )  
 $g$  : Gravitational acceleration ( $\text{cm}/\text{sec}^2$ )  
 $W$  : Weight of prism (kgf)  
 $m$  : Mass of prism (kg)



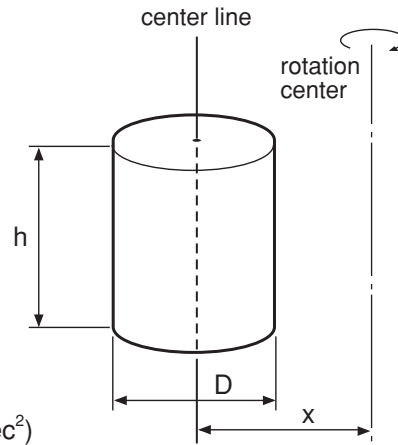


**3. When the object's center line is offset from the rotation center.**

The moment of inertia (J) when the center of the cylinder is offset by a distance "x" from the rotation center as shown below is given by

$$\begin{aligned}
 J &= \frac{\rho\pi D^4 h}{32g} + \frac{\rho\pi D^2 hx^2}{4g} \\
 &= \frac{WD^2}{8g} + \frac{Wx^2}{g} \text{ (kgf}\cdot\text{cm}\cdot\text{sec}^2\text{)} \\
 &= \frac{mD^2}{8} + mx^2 \text{ (kgm}^2\text{)}
 \end{aligned}$$

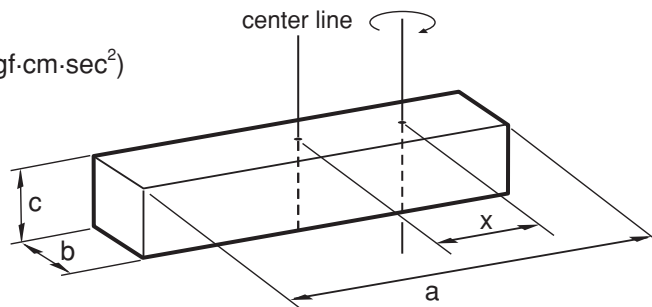
- W : Weight of cylinder (kgf)
- m : Mass of cylinder (kg)
- e : Density (kg/cm<sup>3</sup>)
- g : Gravitational acceleration (cm/sec<sup>2</sup>)



In the same manner, the moment of inertia (J) of a prism as shown below is given by

$$\begin{aligned}
 J &= \frac{\rho abc (a^2 + b^2)}{12g} + \frac{\rho abcx^2}{g} \\
 &= \frac{W (a^2 + b^2)}{12g} + \frac{Wx^2}{g} \text{ (kgf}\cdot\text{cm}\cdot\text{sec}^2\text{)} \\
 &= \frac{m (a^2 + b^2)}{12} + mx^2 \text{ (kgm}^2\text{)}
 \end{aligned}$$

- W : Weight of prism (kgf)
- m : Mass of prism (kg)



## Revision record

Manual version	Issue date	Description
Ver. 2.01	Jun. 2009	Clerical error corrections.
Ver. 2.02	Dec. 2009	Some explanations were corrected or added in "Chapter 1 Using the Robot Safely".
Ver. 2.03	Aug. 2010	Clerical error corrections, etc.

**User's Manual**

**YAMAHA** FLIP-X series  
Single-axis Robot **C8/C8L/C8LH**

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IM Operations

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