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Chapter 1
Introduction

1.1 About This Document

This manual provides information for the EC1700 manipulator and contains the following sections:

CHAPTER 1 - INTRODUCTION
Provides general information about the structure of this manual, a list of reference documents, and customer service information.

CHAPTER 2 - SAFETY
This section provides information regarding the safe use and operation of Motoman products.

CHAPTER 3 - EC1700 INSTRUCTIONS
Provides detailed information for the EC1700 manipulator.

1.2 Reference to Other Documentation

For additional information refer to the following:

- NX100 Controller Manual (P/N 149201-1)
- Concurrent I/O Manual (P/N 149230-1)
- Operator's Manual for your application
- Vendor manuals for system components not manufactured by Motoman

1.3 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (SP800N)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on back of controller)
Chapter 2

Safety

2.1 Introduction

It is the purchaser’s responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06-1999. The address is as follows:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338
INTERNET: www.roboticsonline.com

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. The robot must not be operated by personnel who have not been trained!

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system. This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
2.2 Standard Conventions

This manual includes the following alerts – in descending order of severity – that are essential to the safety of personnel and equipment. As you read this manual, pay close attention to these alerts to insure safety when installing, operating, programming, and maintaining this equipment.

DANGER!
Information appearing in a DANGER concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

WARNING!
Information appearing in a WARNING concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

CAUTION!
Information appearing in a CAUTION concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

Note: Information appearing in a Note provides additional information which is helpful in understanding the item being explained.
2.3 **General Safeguarding Tips**

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 **Mechanical Safety Devices**

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-1999 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety fences and barriers
- Light curtains and/or safety mats
- Door interlocks
- Emergency stop palm buttons located on operator station, robot controller, and programming pendant

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06-1999 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming, Operation, and Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to program, operate, and maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
- Check the E-STOP button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
• Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!

• Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.

• The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.

• Check and test any new or modified program at low speed for at least one full cycle.

• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

• Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.

• Use proper replacement parts.

• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
Notes
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

The Nx100 operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
This instruction manual is intended to explain operating instructions and maintenance procedures primarily for the MOTOMAN-EC1700.

General items related to safety are listed in the Section 1: Safety of the NX100 Instructions. To ensure correct and safe operation, carefully read the NX100 Instructions before reading this manual.

Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Notes for Safe Operation
Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.
In this manual, the Notes for Safe Operation are classified as "WARNING," "CAUTION," "MANDATORY," or "PROHIBITED."

!! WARNING  Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

!! CAUTION  Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

!! MANDATORY  Always be sure to follow explicitly the items listed under this heading.

!! PROHIBITED  Must never be performed.

Even items described as "CAUTION" may result in a serious accident in some situations. At any rate, be sure to follow these important items.

NOTE  To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as "CAUTION" and "WARNING."
Before operating the manipulator, check that servo power is turned OFF when the emergency stop buttons on the front door of the NX100 and programming pendant are pressed. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
- View the manipulator from the front whenever possible.
- Always follow the predetermined operating procedure.
- Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

Confirm that no persons are present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
- Turning ON the NX100 power.
- Moving the manipulator with the programming pendant.
- Running the system in the check mode.
- Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is any problem. The emergency stop buttons are located on the right of the front door of the NX100 and the programming pendant.
Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product. The manipulator usually consists of the controller, the programming pendant, and supply cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX100 Controller</td>
<td>NX100</td>
</tr>
<tr>
<td>NX100 Programming Pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>
Explanation of Warning Labels

The following warning labels are attached to the manipulator.
Always follow the warnings on the labels.
Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.

![Warning label A](image1)

Nameplate

Warning label A

![Nameplate](image2)

Warning Label A:

**WARNING**
Moving parts may cause injury

Warning Label B:

**WARNING**
Do not enter robot work area.
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1 Product Confirmation

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Confirm that the manipulator and the NX100 have the same order number. Special care must be taken when more than one manipulator is to be installed.</td>
</tr>
<tr>
<td>If the numbers do not match, manipulators may not perform as expected and cause injury or damage.</td>
</tr>
</tbody>
</table>

1.1 Contents Confirmation

Confirm the contents of the delivery when the product arrives.
Standard delivery includes the following four items (Information for the content of optional goods is given separately):

- Manipulator
- NX100
- Programming pendant
- Manipulator cables between the NX100 and the manipulator
1.2 Order Number Confirmation

Check that the order number of the manipulator corresponds to the NX100. The order number is located on a label as shown below.

---

Fig. 1 Location of Order Number Labels

---
2 Transport

2.1 Transporting Method

CAUTION

- Sling and crane or forklift operations must be performed by authorized personnel only.

Failure to observe this caution may result in injury or damage.

- Avoid excessive vibration or shock during transport.

The system consists of precision components. Failure to observe this caution may adversely affect performance.

NOTE

- Check that the eyebolts are securely fastened.
- The mass of the manipulator is approximately 385 kg including the shipping bolts and brackets. Use a wire rope strong enough to withstand the mass.
- The attached eyebolts are designed to support the manipulator mass. Never use them for anything other than transporting the manipulator.
- Mount the shipping bolts and brackets before transporting the manipulator. (Refer to "Fig. 2 Transporting Position ".)
- With any transportation equipment, make sure to avoid external force on the arm or motor unit when transporting the manipulator.

2.1.1 Using a Crane

As a rule, when uncrating the manipulator and moving it, a crane should be used. Lift the manipulator with a two-leg bridle sling using the attached eyebolts. Make sure to fix the manipulator with the shipping bolts and a bracket before transport, and lift it in the posture as shown in "Fig. 2 Transporting Position ".

WARNING
2.1 Transporting Method

Fig. 2 Transporting Position

Eyebolt M16 (2 eyebolts) Fixed to the manipulator before shipment
2.1.2 Using a Forklift

When using a forklift, the manipulator should be fixed on a pallet with shipping bolts and brackets as shown in "Fig. 3 Using a Forklift". Use a pallet strong enough to support the manipulator. Insert forklift claws under the pallet and lift it together with the manipulator, and slowly transport the manipulator with due caution to avoid overturn or slippage.

- Check that the eyebolts are securely fastened.
- The mass of the manipulator is approximately 360 kg including the shipping bolts and brackets. Use a wire rope strong enough to withstand the mass.
- Attached eyebolts are designed to support the manipulator mass. Do not use them for anything other than transporting the manipulator.
- Be sure to mount the shipping bolts and brackets before transporting the manipulator. (Refer to "Fig. 2 Transporting Position."
- Avoid external force on the arm or motor unit when transporting the manipulator. Use caution when using transporting equipment other than a crane or forklift to avoid injury.
2.2 Shipping Bolts and Brackets

To protect the driving units of the manipulator from various external force during transport, a shipping bracket "A" (in " Fig. 2 Transporting Position ") is attached to the manipulator.

- The shipping bracket (A) is painted yellow, and fixed with two hexagon socket head cap screws M6.
- A rubber cushion is wedged at point B and C.

Before turning ON the power, check to be sure that the shipping bolts, bracket, and rubber cushion have been removed. They must be stored for future use, in the event that the manipulator must be moved again for relocation.
3  Installation

**WARNING**

- **Install the safeguarding.**
  Failure to observe this warning may result in injury or damage.

- **Install the manipulator in a location where the manipulator's tool or the workpiece held by the manipulator will not reach the wall, safeguarding, or NX100 when the arm is fully extended.**
  Failure to observe this warning may result in injury or damage.

- **Do not start the manipulator or even turn ON the power before it is firmly anchored.**
  The manipulator may overturn and cause injury or damage.

- **When mounting the manipulator on the ceiling or wall, the base section must have sufficient strength and rigidity to support the mass of the manipulator. Also, it is necessary to consider countermeasures to prevent the manipulator from falling.**
  Failure to observe these warning may result in injury or damage.

**CAUTION**

- **Do not install or operate the manipulator that is damaged or lacks parts.**
  Failure to observe this caution may cause injury or damage.

- **Before turning ON the power, check to be sure that the shipping bolts and brackets explained in "2.2 Shipping Bolts and Brackets " are removed.**
  Failure to observe this caution may result in damage to the driving parts.
3.1 Installation of Safeguarding

To insure safety, be sure to install the safeguarding. It prevents unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance.

Responsibility for Safeguarding (ISO10218)
The user of a manipulator or robot system shall ensure that the safeguarding is provided and used in accordance with Sections 6, 7, and 8 of this standard. The means and degree of safeguarding, including any redundancies, shall correspond directly to the type and level of hazard presented by the robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.

3.2 Mounting Procedures for Manipulator Base

The manipulator should be firmly mounted on a base or foundation strong enough to support the manipulator and withstand repulsion forces during acceleration and deceleration. Refer to "Table. 1 Maximum Repulsion Force of the Manipulator at Emergency Stop" and "Table. 2 Endurance Torque in Operation" to construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator. A baseplate flatness must be kept at 0.5 mm or less; insufficient flatness of installation surface may deform the manipulator shape and affect its functional abilities. For installation, refer to "3.2.1 Installation Example".

<table>
<thead>
<tr>
<th>Table. 1 Maximum Repulsion Force of the Manipulator at Emergency Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum torque in horizontal rotation (S-axis moving direction)</td>
</tr>
<tr>
<td>Maximum torque in vertical rotation (LU-axes moving direction)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table. 2 Endurance Torque in Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurance torque in horizontal operation (S-axis moving direction)</td>
</tr>
<tr>
<td>Endurance torque in vertical operation (LU-axes moving direction)</td>
</tr>
</tbody>
</table>
3.2 Mounting Procedures for Manipulator Base

3.2.1 Installation Example

1. Fix the base plate to the floor with anchor bolts. The base plate should be rugged and durable. It is recommended to prepare a base plate of 40 mm or more thick, and anchor bolts of size M16 or larger size.

2. Fix the manipulator base to the base plate with four hexagon head screws M16 (recommended length: 60 mm) using the mounting holes on the manipulator base.

**NOTE**

Tighten the anchor bolts and the hexagon head screws securely so that they will not work loose during operation. For details, refer to “Fig. 4 Manipulator Installation Example”.

---

**Fig. 4 Manipulator Installation Example**
3.3 Installation Method

The MOTOMAN-EC1700 can be mounted in three different ways: floor-mounted (standard), wall-mounted, and ceiling-mounted types are available. For wall- and ceiling-mounted types, the three points listed below are different from the floor-mounted types.

- S-axis Operating Range
- Fixing the Manipulator Base
- Precautions to Prevent the Manipulator from Falling

3.3.1 S-axis Operating Range

For the wall-mounted type, the S-Axis operating range must be ±30°. (Adjusted prior to the shipment.)

3.3.2 Fixing the Manipulator Base

For the wall- or ceiling-mounted types, be sure to use 4 hexagon socket head cap screws M16 (tensile strength: 1200 N/mm² or more) to fix the manipulator base. Use a torque of 206 N·m in tightening the screws.

3.3.3 Precautions to Prevent the Manipulator from Falling

For the wall- or ceiling-mounted types, take appropriate measures to avoid the falling of the manipulator in case of emergency. Refer to "Fig. 5 Precautions to Prevent from Falling Location" for details.
3.4 Location

When the manipulator is installed, it is necessary to satisfy the under mentioned environmental conditions:

• 0° to +45°C (ambient temperature)
• 20 to 80%RH (no moisture, at constant temperature)
• Free from dust, soot, or water
• Free from corrosive gases or liquid, or explosive gases
• Free from excessive impact or vibration (vibration acceleration: 4.9 m/s² [0.5 G] or less)
• Free from large electrical noise (plasma)
• The flatness for installation is 0.5 mm or less.

In case of using the wall-/ceiling-mounted type, inform Yaskawa of the matter when placing an order. Be sure to contact Yaskawa representative (listed on the back cover of this instruction manual) to execute a wall/ceiling installation on site.
4  Wiring

WARNING

• Ground resistance must be 100 Ω or less.
  Failure to observe this warning may result in fire or electric shock.

• Before wiring, make sure to turn OFF the primary power supply, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)
  Failure to observe this warning may result in fire or electric shock.

CAUTION

• Wiring must be performed by authorized or certified personnel.
  Failure to observe this caution may result in fire or electric shock.
4.1 Grounding

Follow local regulations for grounding line size. A line of 5.5 mm² or more is recommended. Refer to "Fig. 6 Grounding Method" to connect the ground line directly to the manipulator.

- Never use this line sharing with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.
- Where metal ducts, metallic conduits, or distributing racks are used for cable laying, ground in accordance with Electric Equipment Technical Standards.

![Fig. 6 Grounding Method](image)

4.2 Manipulator Cable Connection

There are three manipulator cables: one encoder cable for detection (1BC), and two power cables (2BC and 3BC). (Refer to "Fig. 7 Manipulator Cables ".) For each connection, refer to "Fig. 8 (a) Manipulator Cable Connection (To the Manipulator) " and "Fig. 8 (b) Manipulator Cable Connection (To the NX100) ".

NOTE

- 5.5 mm² or more
- Bolt M8 (for grounding) (Attached to the manipulator)
4.2.1 Connection to the Manipulator

Before connecting the manipulator cables to the manipulator, verify the connector numbers: both the cables and the connectors on the manipulator base are marked with 1BC, 2BC, and 3BC. Connect the cables in the order of 3BC, 2BC, 1BC, referring to "Fig. 8 (a) Manipulator Cable Connection (To the Manipulator)". When connecting, insert each cable connector adjusting its position to the main keys on the connector base of the manipulator, and set the lever low until it clicks.

4.2.2 Connection to the NX100

Before connecting the manipulator cables to the NX100, verify the connector numbers: both the cables and the connectors on the NX100 are marked with X11, X21, and X22. Connect the cables in the order of X22, X21, X11, referring to "Fig. 8 (b) Manipulator Cable Connection (To the NX100)". When connecting, insert each cable connector adjusting its position to the main keys on the NX100, and then set the lever low until it clicks.

Fig. 7 Manipulator Cables
4.2 Manipulator Cable Connection

Fig. 8 (a) Manipulator Cable Connection (To the Manipulator)

Fig. 8 (b) Manipulator Cable Connection (To the NX100)
5 Basic Specifications

5.1 Basic Specifications

Table 3  Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model MOTOMAN-EC1700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Vertically Articulated</td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>6</td>
</tr>
<tr>
<td>Payload</td>
<td>20 kg</td>
</tr>
<tr>
<td>Repeatability&lt;sup&gt;2&lt;/sup&gt;</td>
<td>±0.08 mm</td>
</tr>
<tr>
<td>Range of Motion</td>
<td></td>
</tr>
<tr>
<td>S-axis (turning)</td>
<td>±180°</td>
</tr>
<tr>
<td>L-axis (lower arm)</td>
<td>+155°, -100°</td>
</tr>
<tr>
<td>U-axis (upper arm)</td>
<td>+210°, -175°</td>
</tr>
<tr>
<td>R-axis (wrist roll)</td>
<td>±200°</td>
</tr>
<tr>
<td>B-axis (wrist pitch/yaw)</td>
<td>+230°, -50°</td>
</tr>
<tr>
<td>T-axis (wrist twist)</td>
<td>±360°</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td></td>
</tr>
<tr>
<td>S-axis</td>
<td>3.40 rad/s, 195×/s</td>
</tr>
<tr>
<td>L-axis</td>
<td>2.96 rad/s, 170×/s</td>
</tr>
<tr>
<td>U-axis</td>
<td>3.05 rad/s, 175×/s</td>
</tr>
<tr>
<td>R-axis</td>
<td>6.20 rad/s, 355×/s</td>
</tr>
<tr>
<td>B-axis</td>
<td>6.02 rad/s, 345×/s</td>
</tr>
<tr>
<td>T-axis</td>
<td>9.16 rad/s, 525×/s</td>
</tr>
<tr>
<td>Allowable Moment&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>39.2 N·m (4.0 kgf·m)</td>
</tr>
<tr>
<td>B-axis</td>
<td>39.2 N·m (4.0 kgf·m)</td>
</tr>
<tr>
<td>T-axis</td>
<td>19.6 N·m (2.0 kgf·m)</td>
</tr>
<tr>
<td>Allowable Inertia (GD&lt;sup&gt;2&lt;/sup&gt;/4)&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>0.9 kgf·m&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>B-axis</td>
<td>0.9 kgf·m&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>T-axis</td>
<td>0.25 kgf·m&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Approx. Mass</td>
<td>360 kg</td>
</tr>
<tr>
<td>Ambient Conditions&lt;sup&gt;4&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>0 to 45°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>20 to 80% RH (non-condensing)</td>
</tr>
<tr>
<td>Vibration Acceleration</td>
<td>4.9 m/s&lt;sup&gt;2&lt;/sup&gt; (0.5 G) or less</td>
</tr>
<tr>
<td>Others</td>
<td>• Free from corrosive gasses or liquids, or explosive gasses</td>
</tr>
<tr>
<td></td>
<td>• Clean and dry</td>
</tr>
<tr>
<td></td>
<td>• Free from excessive electrical noise (plasma)</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>5.0 kVA</td>
</tr>
</tbody>
</table>

<sup>1</sup> SI units are used in this table. However, gravitational unit is used in ( ).
<sup>2</sup> Conformed to ISO9283
<sup>3</sup> Refer to "6.1 Allowable Wrist Load" for details on the allowable moment and inertia.
5.2 Part Names and Working Axes

![Diagram showing part names and working axes]

5.3 Manipulator Base Dimensions

![Diagram showing manipulator base dimensions]

Fig. 9 Part Names and Working Axes

Fig. 10 Manipulator Base Dimensions
5.4 Dimensions and P-Point Maximum Envelope

Fig. 11 Dimensions and P-Point Maximum Envelope
5.5 Alterable Operating Range

The working range of the S-axis can be altered according to the operating conditions as shown in "Table. 4 S-axis Operating Range". If alteration is necessary, contact your Yaskawa representative in advance.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-axis Operating Range</td>
<td>±180° (standard)</td>
</tr>
<tr>
<td></td>
<td>±150°</td>
</tr>
<tr>
<td></td>
<td>±120°</td>
</tr>
<tr>
<td></td>
<td>±90°</td>
</tr>
<tr>
<td></td>
<td>±60°</td>
</tr>
<tr>
<td></td>
<td>±30°</td>
</tr>
</tbody>
</table>
6.1 Allowable Wrist Load

6. Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable wrist load is 20 kg. If force is applied to the wrist instead of the load, force on R-, B-, and T-axes should be within the value shown in "Table. 5 Allowable Moment and Inertia." Contact your Yaskawa representative for further information or assistance.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Moment N•m (kgf•m)*1</th>
<th>Inertia kg•m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-axis</td>
<td>39.2 (4)</td>
<td>0.9</td>
</tr>
<tr>
<td>B-axis</td>
<td>39.2 (4)</td>
<td>0.9</td>
</tr>
<tr>
<td>T-axis</td>
<td>19.6 (2)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

*1 ( ): Gravitational unit

When the volume load is small, refer to the moment arm rating shown in "Fig. 12 Moment Arm Rating."
The allowable inertia is calculated when the moment is at the maximum. Contact your Yaskawa representative when only load inertia, or load moment is small and inertia is large. Also, when the load is combined as a force but a mass, contact your Yaskawa representative.

Fig. 12 Moment Arm Rating
6.2 Wrist Flange

The wrist flange dimensions are shown in "Fig. 13 Wrist Flange". In order to see the alignment marks, it is recommended that the attachment be mounted inside the fitting. Fitting depth of inside and outside fittings must be 5 mm or less.

• Wash off anti-corrosive paint (yellow color) on the wrist flange surface with thinner or light oil before mounting the tools.
• Mount the attachment with the mounting bolts (length: 10 mm or less). Failure to observe this instruction may affect the manipulator performance.
7 System Application

7.1 Peripheral Equipment Mounts

The peripheral equipment mounts are fixed on the upper arm for easier installation of the user's system application as shown in "Fig. 14 Installing Peripheral Equipment". Observe the conditions in the following sections and the figure in mounting the peripheral equipment on the U-axis.

7.1.1 Allowable Mass

The allowable mass loaded on the U-Axis is a maximum of 31 kg, including the mass on the wrist. For instance, when the mass installed in the wrist point is 20 kg, the allowable mass on the upper arm would be 11 kg or less. The allowable mass on the S-head (the rotary head) is a maximum of 20 kg. Mount the peripheral equipment on the S-head so that the moment of inertia (GD²/4) from the S-axis rotation center would be 1.25 kg·m² or less.

7.1.2 Installation Position

There is a limitation on the installation position. "Fig. 15 Allowable Load On U-Axis" shows the distance between the center of U-axis rotation and the load gravity.
7.1 Peripheral Equipment Mounts

Fig. 14 Installing Peripheral Equipment

Tapped holes M6
(depth: 10)
( pitch: 1.0) (4 holes)

Fig. 15 Allowable Load On U-Axis

Limited Dimension of Z-coordinate:
400 at a maximum

W coordinate direction

Z coordinate direction

Center of U-axis rotation

Tapped holes M10
(depth: 10)
( pitch: 1.0) (4 holes)

Weight W2

<table>
<thead>
<tr>
<th>Weight W2 (kg)</th>
<th>Distance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>300</td>
</tr>
<tr>
<td>1</td>
<td>400</td>
</tr>
</tbody>
</table>

Distance between Center of U-axis Rotation and Load Gravity (X direction)

*1 In this case, unbalanced moment is not permitted.
### 7.2 Internal User I/O Wiring Harness and Air Line

Internal user I/O wiring harness (0.2 mm² x 8 wires and 1.25 mm² x 6 wires) and an air line are built into the manipulator for the drive of peripheral devices mounted on the upper arm as shown in "Fig. 16 Internal User I/O Wiring Harness and Air Line".

The connector pins (1 to 16) are assigned as shown in "Fig. 17 Details of Connector Pin Numbers". Perform wiring referring to the figure and the conditions below.

- **The Allowable Current for Internal User I/O Wiring Harness**
  - 3 A or less for each cable
  - The total current value for pins 1 to 16 shall be 40 A or less.

- **The Maximum Pressure for the Air Line**
  - 490 kPa (5 kgf/cm²) or less
  - Inside diameter: 6.5 mm
The same pin number (1-16) of two connectors is connected by the lead wire of single 0.2 mm² or 1.25 mm².
8.1 Location of Limit Switches

Limit switches are optional. For each location, refer to "Fig. 18 Location of Limit Switch". A manipulator type with the S- or L-axis overrun limit switch or the LU-axis interference limit switch is YR-EC1700-Z01.

Fig. 18 Location of Limit Switch
8.2 Internal Connections

Highly reliable connectors that enable easy removal and installation for maintenance and inspection are equipped to each connection part of the manipulator. For the numbers, types, and locations of the connectors, refer to " Fig. 19 Location of Connectors " , " Fig. 20 (a) Internal Connection Diagram " and " Fig. 20 (b) Internal Connection Diagram ".

![Diagram of internal connections]

Table 6 Connector Types

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector for internal user I/O wiring harness on connector base</td>
<td>JL05-2A20-29PC (JL05-6A20-29S: Optional)</td>
</tr>
<tr>
<td>Connector for internal user I/O wiring harness on U-arm</td>
<td>JL05-2A20-29SC (JL05-6A20-29P: Optional)</td>
</tr>
</tbody>
</table>
Note:
For the limit switch specification, the connection of the section A is changed as follows:

Optional Specification: SLU-axes with Limit Switches
Fig. 20 (b) Internal Connection Diagram
9 Maintenance and Inspection

### WARNING

- Before maintenance or inspection, be sure to turn OFF the main power supply, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)

Failure to observe this warning may result in electric shock or injury.

### CAUTION

- Maintenance and inspection must be performed by specified personnel.
- For disassembly or repair, contact your Yaskawa representative.
- When performing maintenance and inspection, make sure to connect the battery pack before removing the encoder connector.

Failure to observe this caution may result in the loss of home position data.

### 9.1 Inspection Schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation. Inspection intervals are classified into six levels as shown in "Table 7 Inspection Items". Conduct periodical inspections according to the inspection schedule in this table.

In Table 7, the inspection items are categorized by three types of operations: operations to be performed by personnel authorized by the user; operations to be performed by trained personnel; and operations to be performed by service company personnel. Only specified personnel are allowed to perform the inspection work.

- The inspection interval depends on the total servo operation time.
- The inspection intervals in Table 7 have been calculated based on the condition where the manipulator is used for the arc welding application. For any different or special applications, the inspection intervals shall be calculated on an case-by-case basis. If the manipulator will be used very frequently (for handling applications, etc.), inspections may be required at shorter intervals. Contact your Yaskawa representative.
## Inspection Schedule

### Table. 7 Inspection Items

<table>
<thead>
<tr>
<th>Items*4</th>
<th>Schedule</th>
<th>Method</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000 H Cycle</td>
<td>6000 H Cycle</td>
<td>12000 H Cycle</td>
</tr>
<tr>
<td>1 Alignment mark</td>
<td>○</td>
<td>Visual</td>
<td>Check alignment mark accordance and damage at the home position.</td>
</tr>
<tr>
<td>2 External cabling</td>
<td>○</td>
<td>Visual</td>
<td>Check for damage and deterioration.</td>
</tr>
<tr>
<td>3 Working area and whole exterior of manipulator</td>
<td>○</td>
<td>Visual</td>
<td>Clean the work area if dust or spatter is present. Check for damage and exterior cracks.</td>
</tr>
<tr>
<td>4 Motors for SLU-axes</td>
<td>○</td>
<td>Visual</td>
<td>Check for grease leakage.</td>
</tr>
<tr>
<td>5 Manipulator base mounting screws</td>
<td>○</td>
<td>Wrench</td>
<td>Tighten loose screws. Replace if necessary.</td>
</tr>
<tr>
<td>6 Caster mounting screws</td>
<td>○</td>
<td>Phillips screwdriver, wrench</td>
<td>Tighten loose screws. Replace if necessary.</td>
</tr>
<tr>
<td>7 Connector base</td>
<td>○</td>
<td>Manual</td>
<td>Check for loose connectors.</td>
</tr>
<tr>
<td>8 BT-axis timing belts</td>
<td>○</td>
<td>Manual</td>
<td>Check for belt tension and wear.</td>
</tr>
<tr>
<td>9 Wire harness in manipulator (for SLU-axes and for RBT-axes)</td>
<td>○</td>
<td>Visual, multimeter</td>
<td>Check for connection between the main connector of connector base and intermediate connector by manually shaking the wire. Check for wear of protective spring.</td>
</tr>
<tr>
<td>10 Wire harness in manipulator (for BT-axes)</td>
<td>○</td>
<td>Visual, multimeter</td>
<td>Check for connection between terminals.</td>
</tr>
<tr>
<td>11 Battery pack in manipulator</td>
<td>○</td>
<td></td>
<td>Replace.</td>
</tr>
<tr>
<td>12 S-axis speed reducer</td>
<td>○</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Supply grease (20000H cycle). See section 9.3.1.</td>
</tr>
<tr>
<td>13 L-axis speed reducer</td>
<td>○</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Supply grease (20000H cycle). Exchange grease (12000H cycle). See section 9.3.2.</td>
</tr>
</tbody>
</table>
9.1 Inspection Schedule

When checking for conduction with multimeter, connect the battery pack to “BAT” and “OBT” of encoder connectors on the motor, and then remove the encoder connector for each axis from motor. Otherwise, the home position may be lost. (Refer to 9.3.9.)

Internal cables are to be replaced at 24000 H inspection.

For the grease, refer to Table 8 Inspection Parts and Grease Used.

Inspection numbers correspond to the numbers in “Fig. 21 Inspection Parts and Inspection Numbers (Manipulator in the Home Position)”

The occurrence of a grease leakage indicates the possibility that grease has seeped into the motor; this can cause a motor breakdown. Contact your Yaskawa representative.

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily 1000 H Cycle</td>
<td>Grease gun</td>
<td>Specified Personnel</td>
</tr>
<tr>
<td>6000 H Cycle</td>
<td>Check for malfunction. (Replace if necessary.)</td>
<td></td>
</tr>
<tr>
<td>12000 H Cycle</td>
<td>Supply grease (6000H cycles)</td>
<td>License Company</td>
</tr>
<tr>
<td>24000 H Cycle</td>
<td>Exchange grease (12000H cycles)</td>
<td></td>
</tr>
<tr>
<td>36000 H Cycle</td>
<td>See section 9.3.3.</td>
<td></td>
</tr>
<tr>
<td>14 U-axis speed reducer</td>
<td>Grease gun</td>
<td></td>
</tr>
<tr>
<td>15 RBT-axis speed reducer</td>
<td>Grease gun</td>
<td></td>
</tr>
<tr>
<td>16 T-axis gear</td>
<td>Grease gun</td>
<td></td>
</tr>
<tr>
<td>17 R-axis cross roller bearing</td>
<td>Grease gun</td>
<td></td>
</tr>
<tr>
<td>18 Overhaul</td>
<td>Grease gun</td>
<td></td>
</tr>
</tbody>
</table>

*1 When checking for conduction with multimeter, connect the battery pack to “BAT” and “OBT” of encoder connectors on the motor, and then remove the encoder connector for each axis from motor. Otherwise, the home position may be lost. (Refer to 9.3.9.)

*2 Internal cables are to be replaced at 24000 H inspection.

*3 For the grease, refer to Table 8 Inspection Parts and Grease Used

*4 Inspection numbers correspond to the numbers in “Fig. 21 Inspection Parts and Inspection Numbers (Manipulator in the Home Position)”

*5 The occurrence of a grease leakage indicates the possibility that grease has seeped into the motor; this can cause a motor breakdown. Contact your Yaskawa representative.
The manipulator is in the home position.

Fig. 21 Inspection Parts and Inspection Numbers (Manipulator in the Home Position)
### Table 8 Inspection Parts and Grease Used

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>12, 13, 14</td>
<td>VIGO Grease RE No. 0</td>
<td>S-, L-, and U-axis speed reducers</td>
</tr>
<tr>
<td>15, 16</td>
<td>Grease SK-1A</td>
<td>R,B,T-axis speed reducer,T-axis gear</td>
</tr>
<tr>
<td>17</td>
<td>Alvania EP Grease 2</td>
<td>R-axis cross roller baring</td>
</tr>
</tbody>
</table>

The numbers in the above table correspond to the numbers in "Table. 7 Inspection Items"
9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

The battery packs are attached in the two positions indicated in "Fig. 22 Battery Pack Location". If the battery alarm occurs in the NX100, replace the battery pack according to the following procedure:

1. Turn OFF the NX100 main power supply.
2. Remove the cover plate fixing screws from the connector base and pull out the battery pack.
3. Replace the battery pack with a new one.
4. Reconnect the battery pack to the connector base.
5. Reinstall the cover plate fixing screws.

Fig. 22 Battery Pack Location

Fig. 23 Battery Pack Connection
pack to replace with a new one.
3. Remove the battery pack from the battery holder.
4. Connect the new battery pack to an unconnected connector on the circuit board.
5. Remove the old battery pack from the circuit board.

**NOTE** Make sure to connect the new battery pack before removing the old one so that the encoder absolute data will not disappear.

6. Mount the new battery pack to the battery holder.
7. Reinstall the cover plate and fix it with the plate fastening screws.

**NOTE** Do not allow plate to pinch the cables when reinstalling the plate.
9.3 Notes on Grease Replenishment/Exchange Procedures

Make sure to follow the instructions listed below at grease replenishment/exchange. Failure to observe the following notes may result in damage to motor and speed reducer.

**NOTE**
- If grease is added without removing the plug/screw from the grease exhaust port, the grease will go inside a motor or an oil seal of a speed reducer will come off, which may result in damage to the motor. Make sure to remove the plug.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.
- Make sure to use a grease pump to inject grease. Set air supply pressure to the grease pump at 0.3 MPa or less, and the grease injection rate at 8 g/s or less.
- Make sure to fill the hose on the grease inlet with grease beforehand to prevent air from leaking into the speed reducer.

9.3.1 Grease Replenishment/Exchange for S-axis Speed Reducer

Fig. 24 S-axis Speed Reducer

- Grease Replenishment (Refer to "Fig. 24 S-axis Speed Reducer")
  1. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.

**NOTE**
- If grease is injected with the plug on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.
2. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)

3. Inject grease from the grease inlet using a grease gun.

4. Move the S-axis for a few minutes to discharge excess grease.

5. Wipe the discharged grease with a cloth, and remove the grease zerk from the grease inlet. Reinstall the plug PT1/8 on the grease inlet and the grease exhaust port. Apply Three Bond 1206C to the thread part of the plugs, and tighten each plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

**Grease Exchange (Refer to "Fig. 24 S-axis Speed Reducer")**

1. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.

2. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)

3. Inject grease into the grease inlet using a grease gun.

4. The grease exchange is completed when new grease appears in the exhaust port. The new grease can be distinguished from the old grease by color.

5. Move the S-axis for a few minutes to discharge excess grease.

6. Wipe the discharged grease with a cloth, and remove the grease zerk from the grease inlet. Reinstall the plug PT1/8 on the grease inlet and the grease exhaust port. Apply Three Bond 1206C to the thread part of the plugs, and tighten each plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
9.3 Notes on Grease Replenishment/Exchange Procedures

9.3.2 Grease Replenishment/Exchange for L-axis Speed Reducer

- Grease Replenishment (Refer to "Fig. 25 L-axis Speed Reducer")

1. Posture the L-arm vertical to the ground.
2. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.
   - If grease is injected with the plug on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
   - Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.
3. Remove the hexagon socket head cap screw M6 from the grease inlet and install the grease zerk A-MT6 x 1. (The grease zerk is delivered with the manipulator.)
4. Inject grease from the grease inlet using a grease gun.

Grease type: VIGO Grease RE No. 0
Amount of grease: 150 cc
(300 cc for 1st supply)
Air supply pressure of grease pump: 0.3 MPa or less
Grease injection rate: 8 g/s or less

Fig. 25 L-axis Speed Reducer
9.3 Notes on Grease Replenishment/Exchange Procedures

5. Move the L-axis for a few minutes to discharge the excess grease.
6. Wipe the discharged grease with a cloth and reinstall the plug PT1/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
7. Remove the grease zerk from the grease inlet and reinstall the screw M6. Apply Three Bond 1206C to the thread part of the screw, and tighten the screw with a tightening torque of 10 N·m (1.0 kgf·m).

**Grease Exchange (Refer to "Fig. 25 L-axis Speed Reducer")**

1. Posture the L-arm vertical to the ground.
2. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.
3. Remove the hexagon socket head cap screw M6 from the grease inlet and install the grease zerk A-MT6 x 1. (The grease zerk is delivered with the manipulator.)
4. Inject the grease into the grease inlet using a grease gun.
5. The grease exchange is completed when new grease appears in the exhaust port. The new grease can be distinguished from the old grease by color.
6. Move the L-axis for a few minutes to discharge excess grease.
7. Wipe the discharged grease with a cloth and reinstall the plug PT1/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
8. Remove the grease zerk from the grease inlet and reinstall the screw M6. Apply Three Bond 1206C to the thread part of the screw, and tighten the screw with a tightening torque of 10 N·m (1.0 kgf·m).

- If grease is injected with the plug on, the grease will go inside the motor and may cause damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

<table>
<thead>
<tr>
<th>Grease type: VIGO Grease RE No. 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease: approx. 1000 cc</td>
</tr>
<tr>
<td>Air supply pressure of grease pump: 0.3 MPa or less</td>
</tr>
<tr>
<td>Grease injection rate: 8 g/s or less</td>
</tr>
</tbody>
</table>
9.3.3 Grease Replenishment/Exchange for U-axis Speed Reducer

- Grease Replenishment (Refer to "Fig. 26 U-axis Speed Reducer")

1. Posture the U-arm horizontal to the ground.
2. Remove the hexagon socket head cap screw M6 from the grease exhaust port.
   - If grease is injected with the screw on, the grease will go inside the motor and may cause a damage. Make sure to remove the screw before the grease injection.
   - Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.
3. Remove the hexagon socket head cap plug PT1/8 from the grease inlet.
4. Install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
5. Inject the grease from the grease inlet using a grease gun.
   - Grease type: VIGO Grease RE No. 0
   - Amount of grease: 65 cc
     (130 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
6. Move the U-axis for a few minutes to discharge the excess grease.
7. Wipe the discharged grease with a cloth and reinstall the screw M6 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the screw, and tighten the screw with a tightening torque of 10 N·m (1.0 kgf·m).
8. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
Grease Exchange (Refer to “Fig. 26 U-axis Speed Reducer”)

1. Posture the U-arm horizontal to the ground.
2. Remove the hexagon socket head cap screw M6 from the grease exhaust port.
3. Remove the hexagon socket head cap plug PT1/8 from the grease inlet.
4. Install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
5. Inject the grease from the grease inlet using a grease gun.
6. The grease exchange is completed when new grease appears in the exhaust port. The new grease can be distinguished from the old grease by color.
7. Move the U-axis for a few minutes to discharge excess grease.
8. Wipe the discharged grease with a cloth and reinstall the screw M6 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the screw, and tighten the screw with a tightening torque of 10 N·m (1.0 kgf·m).
9. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
9.3 Notes on Grease Replenishment/Exchange Procedures

9.3.4 Grease Replenishment for R-axis Speed Reducer

1. Remove the hexagon socket head cap screw M6 on the exhaust port as shown in "Fig. 27 R-axis Speed Reducer".
2. Inject the grease into the grease inlet using a grease gun.

   Grease type: Grease SK-1A
   Amount of grease: 8cc
   (16cc for the 1st supply)

   **Note** The exhaust port is used for air flow. Do not inject excessive grease into the grease inlet.

3. Reinstall the hexagon socket head cap screw on the exhaust port. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the screw.
9.3.5 Grease Replenishment for B-, T-axes Speed Reducers

1. Remove the plug on the exhaust port for B-axis or the hexagon socket set screw on the exhaust port for T-axis.

   **NOTE:** Remove the cover for the B-axis speed reducer.

2. Remove the hexagon socket head cap screw on the grease inlet and install the grease zerk A-MT6X1. (Refer "Fig. 28 B-, T-axes Speed Reducers Diagram".)

3. Inject the grease into the grease inlet using a grease gun.

   Grease type: Grease SK-1A
   Amount of grease:
   - For B-axis: 10 cc (20 cc for the 1st supply)
   - For T-axis: 5 cc (10 cc for the 1st supply)

   **NOTE:** The exhaust port is used for air flow. Do not inject excessive grease into the grease inlet.

4. Reinstall the plug on the exhaust port for B-axis or the hexagon socket set screw on the exhaust port for T-axis. Apply Three Bond 1206C on the thread parts.
5. Remove the grease zerk on the grease inlet and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 6 N·m (0.6 kgf·m). Apply Three Bond 1206C on the thread part.

**NOTE** Mount the cover for the B-axis speed reducer. (Refer to "Fig. "18)

### 9.3.6 Grease Replenishment for T-axis Gear

1. Remove the plug on the exhaust port.
2. Remove the hexagon socket head cap screw on the grease inlet and install the grease zerk A-MT6X1. (Refer "Fig. 29 T-axis Gear Diagram".)
3. Inject the grease into the gear grease inlet using a grease gun.

**NOTE** The exhaust port is used for air flow. Do not inject excessive grease into the gear grease inlet.

4. Reinstall the plug on the exhaust port. Apply Three Bond 1206C on the thread part of the plug.
5. Remove the grease zerk on the gear grease inlet and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 6 N·m (0.6 kgf·m). Apply Three Bond 1206C on the thread part of the screw.
9.3 Notes on Grease Replenishment/Exchange Procedures

9.3.7 Grease Replenishment for R-axis Cross Roller Bearing

1. Remove the plug on the exhaust port.
2. Remove the hexagon socket head cap screw from the grease inlet and install the grease zerk A-MT6X1. (Refer "Fig. 30  R-axis Cross Roller Bearing Diagram").
3. Inject grease into the grease inlet using a grease gun.

<table>
<thead>
<tr>
<th>Grease type: Alvania EP grease 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease: 8 cc</td>
</tr>
<tr>
<td>(16 cc for the 1st supply)</td>
</tr>
</tbody>
</table>

**NOTE** The exhaust port is used for air flow. Do not inject excessive grease into the grease inlet.

4. Reinstall the plug on the exhaust port. Apply Three Bond 1206C on the thread part of the plug.
5. Remove the grease zerk on the gear grease inlet and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 6 N·m (0.6 kgf·m). Apply Three Bond 1206C on the thread part of the screw.
9.3 Notes on Grease Replenishment/Exchange Procedures

## 9.3.8 Notes for Maintenance

### Wrist Axes

The motor and encoder units are provided with the wrist unit. To prevent fumes from penetrating into the wrist unit, the matched parts are sealed with sealing bond. Therefore, if the wrist cover is disassembled, reseal with sealing bond (Three Bond 1206C). Refer to "Fig. 9 Spare Parts for the MOTOMAN-EC1700-Z00, -Z01"

![Fig. 31 Sealing Part of Wrist Unit](image)

## 9.3.9 Encoder Connector (with CAUTION Label)

### Battery Pack Connection (for S-, L-, U-axes Motors)

The connectors (crimped contact-pin) for the battery backup are installed at the end point of the motors (marked as BAT and OBT). Connect the battery pack according to the following procedure.

1. Remove the cap attached to the battery backup connector of the motors.
2. Connect the battery packs (HW9470932-A) with the battery backup connectors located at the end point of the cables for the encoder. (Under this condition, remove the encoder connector and carry out the maintenance checks).
3. After the maintenance check, verify that all the connectors are connected and remove the battery pack. Install the caps attached to the battery backup connector of the motor.

**NOTE** Do not remove the battery pack in the connector base.
9.3 Notes on Grease Replenishment/Exchange Procedures

Fig. 32 (a) Encoder Connector for S-, L-, U-axes

- **Encoder connector**
- **Motor**
- **Motor power connector**
- **Battery pack (HW9470932-A)**
- **Connector for the battery backup**

**CAUTION**

Connect battery to encoder to save the data before removing connector.

**CAUTION label (Enlarged view)**

a: Crimped contact-pin (pin)
b: Crimped contact-pin (socket)
9.3 Notes on Grease Replenishment/Exchange Procedures

- **Battery Pack Connection (for R-, B-, T-axes Motors)**

The connectors (crimped contact-pin) for the battery backup are installed at the end point of the motors (marked as BAT and OBT). Connect the battery pack according to the following procedure.

1. Connect the battery packs (HW9470932-A) with the battery backup connectors located at the end point of the cables for the encoder. (Under this condition, remove the encoder connector and carry out the maintenance checks).
2. After the maintenance check, verify that all the connectors are connected and remove the battery pack. Install the caps attached to the battery backup connector of the motor.

**NOTE**

Do not remove the battery pack in the connector base.

![Diagram of Battery Pack Connection](image)

**CAUTION**

Connect battery to encoder to save the data before removing connector.

Fig. 32 (b) Encoder Connector for R-, B-, T-axis
10 Recommended Spare Parts

It is recommended to keep the parts and components in the following table in stock as spare parts for the MOTOMAN-EA1800N.

For preparing lead wires for internal wiring, etc., check the serial number and contact your Yaskawa representative.

Product performance can not be guaranteed when using spare parts from any company other than Yaskawa. The spare parts are ranked as follows:

- **Rank A**: Expendable and frequently replaced parts
- **Rank B**: Parts for which replacement may be necessary as a result of frequent operation
- **Rank C**: Drive unit

To replace parts in Rank B or Rank C, contact your Yaskawa representative.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty per Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Grease VIGO Grease RE No. 0</td>
<td>Yaskawa Electric Corporation</td>
<td>16 kg</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>Grease SK-1A</td>
<td>Harmonic Drive Systems Inc.</td>
<td>2.5 kg</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Grease Alvania EP Grease 2</td>
<td>Showa Shell Sekiyu K.K.</td>
<td>16 kg</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>Liquid Gasket Three Bond 1206C</td>
<td>Three Bond Co., Ltd.</td>
<td>-</td>
<td>-</td>
<td></td>
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<tr>
<td>A</td>
<td>5</td>
<td>Battery Pack HW0470360-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
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<td>A</td>
<td>6</td>
<td>Battery Pack HW0470932-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>-</td>
<td></td>
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<tr>
<td>B</td>
<td>7</td>
<td>B-axis Timing Belt 80S4SM653</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>B</td>
<td>8</td>
<td>T-axis Timing Belt 80S4SM518</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
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<td>B</td>
<td>9</td>
<td>B-axis Speed Reducer HW0384526-B</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
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<tr>
<td>B</td>
<td>10</td>
<td>L-axis Speed Reducer HW0381641-D</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
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<td>B</td>
<td>11</td>
<td>L-axis Input Gear HW0309830-1</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
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</table>
Table 9  Spare Parts for the MOTOMAN-EC1700-Z00, -Z01

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty</th>
<th>Qty per Unit</th>
<th>Remarks</th>
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<tr>
<td>B</td>
<td>12</td>
<td>U-axis Speed Reducer</td>
<td>HW0385640-A</td>
<td>Yaskawa Electric Corporation</td>
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<tr>
<td>B</td>
<td>13</td>
<td>U-axis Input Gear</td>
<td>HW0309857-2</td>
<td>Yaskawa Electric Corporation</td>
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<tr>
<td>B</td>
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<td>R-axis Speed Reducer</td>
<td>HW0381463-A</td>
<td>Yaskawa Electric Corporation</td>
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<tr>
<td>B</td>
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<td>B-axis Speed Reducer</td>
<td>HW0381633-A</td>
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<td>B</td>
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<td>T-axis Speed Reducer</td>
<td>HW0382140-A</td>
<td>Yaskawa Electric Corporation</td>
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<tr>
<td>B</td>
<td>17</td>
<td>Wire Harness in Manipulator</td>
<td>HW0173862-A</td>
<td>Yaskawa Electric Corporation</td>
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<tr>
<td>B</td>
<td>18</td>
<td>Wire Harness in Manipulator for B- and T-axes</td>
<td>HW0270954-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
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<tr>
<td>C</td>
<td>19</td>
<td>AC Servomotor for S- and L-axes</td>
<td>HW0385669-A (SGMRS-20A2A-YR2*)</td>
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<td>C</td>
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<td>HW0382155-A (SGMRS-12A2B-YR1*)</td>
<td>Yaskawa Electric Corporation</td>
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<td>C</td>
<td>21</td>
<td>AC Servomotor for R-, B-, and T-axes</td>
<td>HW0382152-A (SGMPH-02A2A-YR1*)</td>
<td>Yaskawa Electric Corporation</td>
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<td>3</td>
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</table>