Motoman® NX100 Controller

EPX2800R
Manipulator Manual

Part Number: 154971-1CD
Revision: 0

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Chapter 1
Introduction

1.1 About This Document

This manual provides information for the EPX2800R 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 - EPX2800R SUPPLEMENTARY INSTRUCTIONS
Provides supplementary information for the EPX2800R manipulator.

CHAPTER 4 - EPH130R INSTRUCTIONS
Provides detailed information for the EPH130R 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 (EPX2800R)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on back of controller)
Notes
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)
• Installation Safety (Section 2.5)
• Programming, Operation, and Maintenance Safety (Section 2.6)

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
MOTOMAN-EPX2800R INSTRUCTIONS
TYPE: YR-EPX2800R-Z000 (SHELF-MOUNT SPECIFICATION)

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS
MOTOMAN-EPX2800R INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 INSTRUCTIONS (INSTRUCTIONS SUPPLEMENT)
NX100 OPERATOR'S MANUAL FOR PAINTING

The NX100 operator's manuals above correspond to specific usage. Be sure to use the appropriate manual.
MANDATORY

• This manual describes the specifications, precautions for operation and required items for maintenance or inspections, for proper application of the MOTOMAN-EPX2800R. Read this manual carefully and be sure to understand its contents before handling the MOTOMAN.

• Refer to NX100 Operator’s Manual for the operation methods to ensure correct and safe operation.

CAUTION

• 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 ON the servo power.

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 check operations.
- 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 a problem. The emergency stop button is located on the right of front door of the NX100 and the programming pendant.
CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.

- Always return the programming pendant to the hook on the NX100 cabinet after use.

  The programming pendant can be damaged if it is left in the P-point maximum envelope of the manipulator, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the NX100 instructions before operating the manipulator.

### 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>
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<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.
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10 Recommended Spare Parts
1 Safety Precautions

• Respect the law, local regulations, and safety codes for connecting the painting robot.

• Specify the working regulations and the person in charge for the following operations:
  
  • Turning the power to the robot ON/OFF, and RUN/STOP operations
    To avoid any faulty operation, take measures such as putting up a notice to remind operators of procedures and precautions explained in the instruction manual.
  
  • Warning sign or signal to inform operator of the robot operation status
    Starting an operation while someone is in the manipulator’s working envelope or while someone is doing maintenance checks or repairs may cause a serious accident. When on standby, the manipulator can be moved by an external signal. To avoid these accidents caused by a lack of information, put up a board or indicator lamp to show the robot operation status.
  
• Action to be taken in case of a failure or an accident
  Appoint a person to be contacted and the action to be taken in case of a failure or an accident.

• Safety standards and the supervisor for safe operation
  Appoint a supervisor for the safe operation of the manipulator and establish the working regulations.

• Appoint a person to be in charge of teaching, maintenance and inspections and provide training or lectures on safety and the actions to be taken in case of an emergency.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
</table>

• **Select a location for the MOTOMAN-EPX2800R, a “Division 1 area” or “Division 2 area”. Do not select a location which can be classified as a “Division 0 area” or a more hazardous location.**

These divisions are prescribed in "Recommended Practice for Explosion-Protected Electrical Installations in General Industries 1979" in the “TECHNICAL RECOMMENDATIONS OF THE RESEARCH INSTITUTE OF INDUSTRIAL SAFETY” by the “Technical Institution of Industrial Safety". 
• **Take the following measures when teaching, correcting, inspecting, or adjusting the manipulator when the motor power supply is ON:**

(a) Appoint a personnel to stay beside the emergency stop button of the NX100. And perform the operations holding the programming pendant with the emergency stop button.
(b) Before the operation, verify the correct robot motion and that the emergency stop works.

• **Observe the following precautions during an automatic operation:**

(a) Do not enter inside the safeguarding during operation.
(b) Confirm the following before starting the operation:
   • No person is inside the manipulator working envelope.
   • No obstacles such as unnecessary workpieces and tools are inside the manipulator working envelope.
   • The manipulator is in its standby position.
(c) When any abnormality occurs, immediately press the emergency stop button to stop the manipulator.
(d) Before entering inside the manipulator working envelope, be sure to stop the manipulator and turn OFF the main power supply to the NX100.

• **Brake release (Option)**

A braking system is provided on each axis of the manipulator to hold the arm in its position when a failure or fault occurs. When the brake is activated, the manipulator cannot be moved manually even if the power is OFF. To change the posture of the manipulator after a failure or fault, the brake can be released by the operation from the controller. When the brake is released with the manipulator’s power OFF, each axis falls down because of the arm weight. While two or more people are holding the arm in position before releasing the brake, change the posture of the manipulator within the minimum motion range. Use the brake release function only when absolutely necessary.

---

**WARNING**

**PROHIBITED**

Any modification of the MOTOMAN-EPX2800R, and the following is strictly prohibited:
1. Explosion-proof devices and system installation
2. Safeguarding and the safety devices mounted on these safeguards
3. Emergency stop button, and other safety devices
4. Robot control system such as the NX100 robot controller, the manipulator drive section and the power transmission section
2 Features

The MOTOMAN-EPX2800R is designed for easy-handling and to consider safety first in operation.

2.1 Explosion-protected Structure

The MOTOMAN-EPX2800R with their explosion-protected construction (fi2G4/i2G4) meets the requirements for Explosion-protected ratings:

- **The pressurized explosion-proof enclosure** prevents explosive gas from entering the manipulator by supplying a protective gas, such as clean air or an inert gas, to keep the internal air pressure constant.
- **The explosion-proof/intrinsically safe enclosure** prevents explosive gas from igniting by electric spark and heat.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Select a location for the MOTOMAN-EPX2800R, a “Division 1 area” or “Division 2 area”. Do not select a location which can be classified as a “Division 0 area” or a more hazardous location.</strong></td>
</tr>
</tbody>
</table>

2.2 Teaching

The target positions, the motion speed, and the ON/OFF timing of the spray can be taught with the programming pendant while moving the manipulator, which shortens the time required for teaching. And, the data can be corrected at any time. Because the teaching function and the correction function are integrated, the operations such as forward/reverse run, position modification, addition/deletion of points can be performed during teaching. And the management function, which manages the parameter settings, enables you to monitor the actual status during teaching. The on-screen guidance and the interactive system on the pull-down menus lead the operator through the operation procedures.

- Large-capacity backup as a standard
  - A large-capacity drive for CF cards is provided as a standard feature of backup unit and enables data to be transmitted easily.
2.2 Teaching

- High reliability
  - The built-in microcomputer continuously checks the I/O data and the manipulator motion to ensure high-reliability.
  - Can detect power supply faults and software faults with its self-diagnosis functions.
  - When an error such as an operation error or a controller fault occurs, the alarm code and message are displayed, and the date and time of the error occurrence with its explanation are stored in the alarm history to help you take a quick, corrective action.

**CAUTION**

Be sure to save the backup data for the controller, such as the data for jobs and constants, on a CF card. If not, the necessary data for the manipulator may be lost if an internal memory fault occurs in the controller.
3.1 Requirements

Prepare the power supply, the air supply, and the grounding according to the following specifications.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Specifications</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| 1   | Power supply                 | 3-phase 200/220 VAC  
(\(+10\% \text{ to } -15\%)  
50/60 Hz (±2 Hz)  
6 kVA (at peak) |                                                                              |
| 2   | Air supply                   | Required pressure: 0.35 MPa to 0.65 MPa  
Capacity:  
For pressurized type of explosion  
protected construction  
20 Nl/min usually  
1000 Nl/min at purging  
Dryness: Freezing at -18 °C | Use dry air for the pressurized explosion-proof construction. |
| 3   | Grounding                    | Grounding resistance: 100 ohm or less                                         | For the robot controller                     |
This section describes the conditions of the installation site for the robot system. Only devices that are approved as explosion-proof can be installed in hazardous locations. Refer to the local regulations and safety codes for the definition of a hazardous location. Install the controller and control panels in a location free from water drops, dust, and dirt.

Table 2: Installation Site

<table>
<thead>
<tr>
<th>System Components</th>
<th>Hazardous Location (Inside Painting Booth)</th>
<th>Non-hazardous location (Outside Painting Booth)</th>
<th>Ambient Temperature</th>
<th>Maximum Ambient Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manipulator (explosion-proof)</td>
<td>○</td>
<td>-</td>
<td>0 to 45 °C</td>
<td>80%RH</td>
</tr>
<tr>
<td>Controller (not explosion-proof)</td>
<td>×</td>
<td>○</td>
<td>0 to 45 °C</td>
<td>90%RH</td>
</tr>
<tr>
<td>Pneumatic unit (not explosion-proof)</td>
<td>×</td>
<td>○</td>
<td>0 to 45 °C</td>
<td>85%RH</td>
</tr>
<tr>
<td>Programming pendant (not explosion-proof)</td>
<td>×</td>
<td>○</td>
<td>0 to 40 °C</td>
<td>85%RH</td>
</tr>
<tr>
<td>Programming pendant (explosion-proof)</td>
<td>○</td>
<td>○</td>
<td>0 to 40 °C</td>
<td>85%RH</td>
</tr>
<tr>
<td>Conveyer speed detector (not explosion-proof)</td>
<td>×</td>
<td>○</td>
<td>0 to 50 °C</td>
<td>90%RH</td>
</tr>
<tr>
<td>Conveyer speed detector (explosion-proof)</td>
<td>○</td>
<td>-</td>
<td>0 to 50 °C</td>
<td>90%RH</td>
</tr>
<tr>
<td>Conveyer switch (explosion-proof)</td>
<td>○</td>
<td>-</td>
<td>0 to 50 °C</td>
<td>90%RH</td>
</tr>
<tr>
<td>Workpiece supplier (explosion-proof)</td>
<td>○</td>
<td>○</td>
<td>0 to 50 °C</td>
<td>85%RH</td>
</tr>
<tr>
<td>Control panel for workpiece supplier (not explosion-proof)</td>
<td>×</td>
<td>○</td>
<td>0 to 45 °C</td>
<td>90%RH</td>
</tr>
<tr>
<td>Safety devices</td>
<td></td>
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<td></td>
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<tr>
<td>Box for emergency stop switches</td>
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<td></td>
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<tr>
<td>Safety plugs</td>
<td></td>
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<tr>
<td>Limit switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flashing light</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Indicator lamps</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Photoelectric switches</td>
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</tbody>
</table>

Selected according to the requirements of the customer. Refer to the appropriate instruction manual provided separately.

×: Not acceptable
○: Acceptable

WARNING

Devices that are not explosion-proof must not be installed in hazardous locations. Failure to observe this warning may result in a fire.
4 Transport and Installation

Carry out the operation safely observing the following precautions.

1) Signs indicating prohibitions such as, “The lighting of fires is prohibited”
2) Clean working place that is clearly defined and free of obstacles
3) Appointment of personnel in charge
4) Company working regulations for safe operation

4.1 Preparation

Before installing the MOTOMAN, do the following:

1) Confirm the installation layout and the dimensions of each device to ensure the transportation route and the installation space.
2) Check if the transportation route can support the weight of each device. If necessary, reinforce the route.
3) To lift the manipulator, use the appropriate machinery such as a forklift.
4.2 Receiving

When the package arrives, check the contents. Are the items and quantities in accordance with your order sheet? Was any damage incurred during shipment?

CAUTION

- 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.

If the numbers do not match, manipulators may not perform as expected and cause injury or damage.

Fig. 1 Location of Order Number Labels
4.3 Transport

**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.

### 4.3.1 Transporting Method

- The mass of the manipulator is approximately 1000 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.
- With any transportation equipment, make sure to avoid external force on the arm or motor unit when transporting the manipulator.
Using a Crane

As a rule, when uncrating the manipulator and moving it, a crane should be used. Lift the manipulator with a wire rope using the attached eyebolts. Make sure to fix the manipulator with shipping bolts and brackets before transport, and lift it in the posture as shown in "Fig. 2 Transport Using a Crane".

Fig. 2 Transport Using a Crane
### 4.3 Transport

#### Using a Forklift

When using a forklift, the manipulator should be fixed on a pallet with shipping bolts and bracket as shown in "Fig. 3 Transport Using a Forklift". Insert claws under the pallet and lift it. The pallet must be strong enough to support the manipulator.

Transport the manipulator slowly with due caution in order to avoid overturn or slippage.

![Fig. 3 Transport Using a Forklift](image)

#### Shipping Bolts and Brackets

The manipulator is provided with shipping bolts and brackets at positions as shown in the figures in "Fig. 2 Transport Using a Crane", to protect its driving units from various external force during transport.

The shipping brackets are painted yellow.

**NOTE**

Before turning ON the power, check to be sure that the shipping bolts and brackets have been removed. The shipping bolts and brackets then must be stored for future use, in the event that the manipulator must be moved again for relocation.
## 4.4 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.

### CAUTION

- **Do not install or operate a manipulator that is damaged or lacks parts.**

  Failure to observe this caution may cause injury or damage.

- **Do not install the paint gun and the gun brackets until the manipulator is firmly anchored.**

  Any contact to the unstable manipulator may cause injury or damage.

- **Before turning ON the power, check to be sure that the shipping bolts and brackets explained in "Fig. 2 Transport Using a Crane " are removed.**

  Failure to observe this caution may result in damage to the driving parts.
4.4.1 Installation of Safeguarding

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

Responsibility for Safeguarding (ISO 10218)
The user of a manipulator or robot system shall ensure that 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.

4.4.2 Mounting Procedures for Manipulator Base

The manipulator should be firmly mounted on a baseplate or foundation strong enough to support the manipulator and withstand repulsion forces during acceleration and deceleration. Construct a solid foundation with the appropriate thickness to withstand maximum repulsion force of the manipulator. (Refer to "Table. 3 Maximum Repulsion Force of the Manipulator at Emergency Stop").

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 "4.4.3 Mounting the Manipulator on the Common Base".

<table>
<thead>
<tr>
<th>Table. 3</th>
<th>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>
<td>31400 N·m (3200 kgf·m)</td>
</tr>
<tr>
<td>Maximum torque in vertical rotation (L-, U-axes moving direction)</td>
<td>59800 N·m (6100 kgf·m)</td>
</tr>
</tbody>
</table>

4.4.3 Mounting the Manipulator on the Common Base

The common base should be rugged and durable to withstand maximum repulsion force of the manipulator and to ensure that the manipulator and fixture are in the correct relative position. The thickness of the common base is 40 mm or more and an M20 size or larger anchor bolt is recommended.

Fix the manipulator base to the common base with the hexagon head screw M20 (4 screws, length of 60 mm or more is recommended) using mounting holes on the manipulator base. Tighten the hexagon head screws and anchor bolts securely so that they will not work loose during operation.
4.4 Installation

Fig. 4 Mounting the Manipulator on the Common Base
4.4.4 Location

When installing the manipulator, satisfy the following environmental conditions.

- Ambient temperature: 0° to 45°C
- Humidity: 20 to 80%RH at constant temperature
- Free from exposure to water, oil, or dust
- Free from corrosive gas or liquid, or explosive gas or liquid
- Free from excessive vibration (Vibration acceleration: 4.9 m/s² [0.5 G] or less)
- Free from large electrical noise (plasma)
- Flatness for installation is 0.5 mm or less

4.4.5 Controller and Programming Pendant

- The controller and the programming pendant are not explosion-proof (the explosion-proof programming pendant is available as an option). Never install the controller and the programming pendant that are not explosion-proof in a hazardous location.
- Keep a minimum space of 60 cm around the controller for maintenance. When the sufficient space is not available, provide equipment for maintenance such as a drawing-out system.
- An exhaust fan is provided on the back of the controller. Keep enough space behind the controller so that air can be exhausted properly.
- Do not install the controller and programming pendant close to any noise source such as the power supply for other devices.
- Install the controller in a location where the optimum atmosphere, temperature, and humidity are assured and provide protection against water drops or thinner. If necessary, install a control room to supply clean and temperature-controlled air.

4.4.6 Safety Devices

The standard safety devices are listed below. Refer to the instructions for connecting safety devices required for your system application.

Install each device considering each function.

- Emergency stop switches
- Safety plugs
- Limit switches
- Flashing lights
- Indicator lamps
- Photoelectric intrusion detecting switches
5 Connection

5.1 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 the primary power supply OFF, 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.

- **Do not cover the cable with heat insulating material, and avoid multiple cabling.**
  Failure to observe this caution may result in burn caused by cable heat emission failure.
5.1.1 Grounding

Follow the local regulations for ground line size. A line of 5.5 mm\(^2\) or more is recommended. Refer to "Fig. 5 Grounding Method".

- Do not 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.

The grounding methods differ depending on the system application. Refer to the connection instructions that are provided separately.

Fig. 5 Grounding Method
5.2 Cable Connection

Refer to the NX100 Instruction Manual for the connection of the power cable and the intrinsically safe cable to the NX100. The air hose for the pressure switch, the intrinsically safe cable, and the crimped terminals should be prepared by the customer.

![Diagram of cable connection](image)

**Note:**
Grounding line connecting tap

**Overview:**
- For 1BC, 2BC, 3BC, 4BC

**Base Connector**

**Hexagon socket head cap screw M6**
(length: 25 mm) (10 screws)
Conical spring washer 2H (6 washers)
Tightening torque 10 N·m (1.0 kgf·m)

**Hexagon socket head cap screw M6**
(length: 16 mm) (2 screws)
Conical spring washer 2H (6 washers)
Tightening torque 10 N·m (1.0 kgf·m)

**Enlarged View (A)**

**Fig. 6 (a) Manipulator Internal Cable Connection**

<table>
<thead>
<tr>
<th>1BC-1</th>
<th>2BC-1</th>
<th>3BC-1</th>
<th>4BC-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1BC-2</td>
<td>2BC-2</td>
<td>3BC-2</td>
<td>4BC-2</td>
</tr>
<tr>
<td>1BC-3</td>
<td>2BC-3</td>
<td>3BC-3</td>
<td>4BC-3</td>
</tr>
<tr>
<td>1BC-4</td>
<td>2BC-4</td>
<td>3BC-4</td>
<td>4BC-4</td>
</tr>
<tr>
<td>1BC-5</td>
<td>2BC-5</td>
<td>3BC-5</td>
<td>4BC-5</td>
</tr>
<tr>
<td>1BC-6</td>
<td>2BC-6</td>
<td>3BC-6</td>
<td>4BC-6</td>
</tr>
</tbody>
</table>

**Note:**
Used following parts for grounding the power cable:
- Cross Recessed Head Screws M6
- Plain Washers
- Spring Lock Washers
5.2 Cable Connection

Fig. 6 (b) Power Supply Cable Connection to the NX100

- Connect to the grounding tap.
- Connect to the grounding tap.
- Connect to the grounding tap.
- Connect to the grounding tap.
Fig. 7 Air Hose Connection
5.3 Internal Connections

Figs. 9 (a) and (b) show the internal connections.
Fig. 9 (a) Internal Connection Diagram
5.3 Internal Connections

Fig. 9 (b) Internal Connection Diagram

Note:
1. This connection diagram is for DeviceNet.
6 System Configuration

"Fig. 10 System Configuration" shows the system configuration of the MOTOMAN-EPX2800R.

6.1 Manipulator

The explosion-proof manipulator can be installed in hazardous locations such as in the painting booth. For painting, a spray gun is mounted on the end of the wrist with special fixtures.

"Fig. 11 Dimensions and P-point Maximum Envelope" shows the dimensions and the range of motion of the EPX2800R. The manipulator is driven by the servo motors in vertically articulated operation mode with 6 degrees of freedom on the manipulator base. The motion of the manipulator is made by six axes:
- The three main axes are used for positioning the spray gun: the S-axis which turns the arm, the L-axis which moves the arm left and right, and the U-axis which moves the arm up and down.
- The three wrist axes are used for changing the direction of the spray gun: the R-, B-, and T-axes.

The range of motion shown in "Fig. 11 Dimensions and P-point Maximum Envelope" is that of the wrist axis center P-point that is made by the combination of the motions of the three main axes.

WARNING

When taking safety precautions, consider the range of motion of the manipulator shown in "Fig. 11 Dimensions and P-point Maximum Envelope".
6.1 Manipulator

Fig. 10 System Configuration
Fig. 11  Dimensions and P-point Maximum Envelope
6.2 Robot Controller

The robot controller has a built-in microcomputer that controls all motion of the robot by saving motion signals when teaching and sending these signals to the manipulator. The power unit that supplies power to the manipulator is also built into the robot controller.

**WARNING**

- **The power supply of the robot controller is 200/220 VAC. Be sure to turn OFF the primary power supply of the controller before starting maintenance.**

Failure to observe this warning may result in electric shock.

6.3 Pneumatic Unit

The pneumatic unit supplies protective air or gas to the manipulator to prevent explosive gas from entering the manipulator. Usually, the unit is attached to the side of the robot controller. The circuit diagram and dimensions are shown in "Fig. 12 Pneumatic Unit Air Circuit" and "Fig. 13 Pneumatic Unit External View". Set the air pressure so that the pressure shown on the pressure gauge of each pressure reducing valve will be within the pressure ranges shown in "Fig. 12 Pneumatic Unit Air Circuit".

**CAUTION**

The pneumatic unit is used to provide a pressurized explosion-proof barrier for the manipulator. Because the barrier is only ensured when the air supply is within the recommended pressure range, a lower air pressure will reduce the barrier's efficiency, and a higher air pressure will damage the pneumatic unit. Be sure to keep the air pressure within the specified range.
Air inlet 1 (16 dia.)
(Tube external diameter)

Air inlet 2 (16 dia.)
(Tube external diameter)

Air for the internal pressure 1
(16 dia.) (Tube external diameter)

Air for the internal pressure 2
(16 dia.) (Tube external diameter)

For the purging valve (6 dia.)

Pressure reducing valve for the set pressure
P1
(the set pressure)
0.01 to 0.03 MPa

P2
(Purging air pressure)
0.15 to 0.35 MPa

P0
(controlled pressure)
0.35 to 0.65 MPa

Filter

Pressure reducing valve for purging air

Pressure reducing valve for the controlled pressure

Fig. 12 Pneumatic Unit Air Circuit

Fig. 13 Pneumatic Unit External View
6.4 Tubes

Daily inspection is requested for the tubes used for supplying paints, thinner, and air (excluding the tube for supplying protective gas into the manipulator). Replace them periodically.

6.5 O-ring and X-ring in the Wrist

Periodically replace the O-ring and X-ring in the wrist. Contact your Yaskawa representative to replace the ring.
## 7 Basic Specifications

### 7.1 Basic Specifications

#### Table. 4 Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
<th>MOTOMAN-EPX2800R-Z000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Vertically articulated</td>
<td></td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Payload</td>
<td>15 kg</td>
<td></td>
</tr>
<tr>
<td>Repeatability(^2)</td>
<td>± 0.5 mm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Range of Motion</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S-axis (turning)</td>
<td>± 120°</td>
<td></td>
</tr>
<tr>
<td>L-axis (lower arm)</td>
<td>+180°, - 40°</td>
<td>(S-axis + 90°)</td>
</tr>
<tr>
<td></td>
<td>+120°, - 40°</td>
<td>(S-axis + 90°, + 120°)</td>
</tr>
<tr>
<td></td>
<td>+120°, - 40°</td>
<td>(S-axis - 90°, - 120°)</td>
</tr>
<tr>
<td>U-axis (upper arm)</td>
<td>+90°, - 70°</td>
<td></td>
</tr>
<tr>
<td>R-axis (wrist roll)</td>
<td>± 360°</td>
<td></td>
</tr>
<tr>
<td>B-axis (wrist pitch/yaw)</td>
<td>± 360°</td>
<td></td>
</tr>
<tr>
<td>T-axis (wrist twist)</td>
<td>± 360°</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Speed</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S-axis</td>
<td>2.7 rad/s, 150 °/s</td>
<td></td>
</tr>
<tr>
<td>L-axis</td>
<td>2.1 rad/s, 120 °/s</td>
<td></td>
</tr>
<tr>
<td>U-axis</td>
<td>2.7 rad/s, 155 °/s</td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>3.1 rad/s, 360 °/s</td>
<td></td>
</tr>
<tr>
<td>B-axis</td>
<td>3.1 rad/s, 360 °/s</td>
<td></td>
</tr>
<tr>
<td>T-axis</td>
<td>3.1 rad/s, 360 °/s</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Allowable Moment</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R-axis</td>
<td>45.8 N•m(4.67 kgf•m)</td>
<td></td>
</tr>
<tr>
<td>B-axis</td>
<td>33.8 N•m(3.45 kgf•m)</td>
<td></td>
</tr>
<tr>
<td>T-axis</td>
<td>10.8 N•m(1.1 kgf•m)</td>
<td></td>
</tr>
</tbody>
</table>

| Approx. Mass          | 820 kg        |                        |

<table>
<thead>
<tr>
<th>Ambient Conditions</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>0 to + 45 °C</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>20 to 80 %RH (non-condensing)</td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>Less than 4.91 m/s² (0.5 G)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>Free from excessive electrical noise (plasma).</td>
<td></td>
</tr>
</tbody>
</table>

\(^{*1}\) SI units are used in this table. However, gravitational unit is used in ( ).

\(^{*2}\) Conformed to ISO9283.

\(^{*3}\) Differs depending on the motion pattern.
7.2 Part Names and Working Axes

Fig. 14 Part Names and Working Axes

7.3 Wrist Flange

The wrist flange dimensions are shown in "Fig. 15 Wrist Flange". Fitting depth of inside and outside fittings must be 21 mm or less.

Fig. 15 Wrist Flange
7.4 System Application

The device required for the system application can be mounted on the horizontal arm. Observe the following restrictions.

- Maximum allowable load: 10 kg
- Mounting position: Refer to "Fig. 16 Device Mounting Position".

![Device Mounting Position Diagram]

Fig. 16 Device Mounting Position
8 Frequent Inspections

8.1 Frequent Inspections

The painting robot is a precision device using advanced technology. It is important to frequently inspect the robot and remove any dried paint. Conduct the daily and weekly inspections listed in "Table. 5 Frequent Inspections" to ensure the long life of the robot and its performance. For more information about the inspection items, refer to "8.2 Daily Inspections".

Table. 5 Frequent Inspections

<table>
<thead>
<tr>
<th>No.</th>
<th>Items to be Inspected</th>
<th>Inspection</th>
<th>Daily</th>
<th>Weekly</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motion</td>
<td>Smooth tuning, horizontal, and vertical motions of each arm. The robot's home position does not change.</td>
<td>○</td>
<td></td>
<td>![WARNING] Do not enter the robot working envelope.</td>
</tr>
<tr>
<td>2</td>
<td>Noise and vibration during operation</td>
<td>No abnormal noise and vibration during robot operation.</td>
<td>○</td>
<td></td>
<td>![WARNING] Do not enter the robot working envelope.</td>
</tr>
<tr>
<td>3</td>
<td>Tubes</td>
<td>No severe wear and tear on paint and air supply tubes.</td>
<td>○</td>
<td>○</td>
<td>![CAUTION] Use a pair of protective glasses to protect your eyes against paint or thinner that is being removed.</td>
</tr>
<tr>
<td>4</td>
<td>Air leakage</td>
<td>No excessive air leakage from the fitting of the motor case.</td>
<td>○</td>
<td>○</td>
<td>![CAUTION] Make sure that the air tube is firmly inserted in the joint. Accidental disconnection of the air tube may cause injury.</td>
</tr>
<tr>
<td>5</td>
<td>Dried paint</td>
<td>Remove the dried paint on the robot.</td>
<td>○</td>
<td>○</td>
<td>Replace the sheet. ![WARNING] When removing the paint with a tool, be careful not to damage the robot.</td>
</tr>
<tr>
<td>1</td>
<td>Water drained from the air filter</td>
<td></td>
<td>○</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pressure set value</td>
<td>The pressure of the pressure reducing valve is within the specified range</td>
<td>○</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.1 Frequent Inspections

<table>
<thead>
<tr>
<th>No.</th>
<th>Items to be Inspected</th>
<th>Inspection</th>
<th>Daily</th>
<th>Weekly</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operation of emergency stop button and safety plug. Dried paint</td>
<td>1. The manipulator stops immediately when the emergency stop button is pressed.</td>
<td>☑</td>
<td></td>
<td>CAUTION Inspect the robot while it is in its standby position and not in motion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. The manipulator stops immediately when the safety plug is pulled out.</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Remove the dried paint on the emergency stop button and the safety plug.</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Operation of the photoelectric intrusion detecting switch Dried paint</td>
<td>1. The manipulator stops when the photoelectric switch is turned OFF.</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Remove the dried paint on the light beam detector.</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Operation of limit switch. Dried paint</td>
<td>1. Normal operation of the limit switch</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Remove the dried paint on the limit switch.</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Operation of the gun tilt switching</td>
<td>The gun tilt changes correctly when air is supplied.</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Operation of the shear pin system</td>
<td>1. The manipulator stops immediately when the shear pin is sheared.</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. The test valve is closed and the tube is not broken.</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
</tbody>
</table>

Table. 5  Frequent Inspections
8.2 Daily Inspections

Inspect the robot daily to ensure its high performance and early detection of any abnormalities.

8.2.1 Manipulator

■ Visual inspection

Before turning ON the power to the manipulator, check if any abnormality can be found on the manipulator. Remove the jacket if it is attached.

■ Manipulator motions and noise/vibration during operation

Check if the manipulator home posture does not change when turning ON the power supply using the eye mark. Also, check for abnormal noise and vibration during operation.

WARNING

Never enter inside the safeguarding and the manipulator working envelope after turning ON the power supply.

■ Tubes and Air leakage

Check for excessive air leakage from the tubes, the couplings, and the joint fittings of the motor on each axis when the air is supplied in the manipulator to form the anti-explosion barrier. The actual amount of air leakage is not important if a fault in the internal air pressure does not occur. However, if internal air pressure faults occur frequently, check if the pressure of the air source and the pressure setting of the pressure reducing valve are correct and if excessive air is leaking.

■ Dried paint, dust, and dirt

Remove any dried paint on the manipulator and other devices. Replace the vinyl sheet if any. Replace the jacket if it is dirty.

WARNING

When using a tool to remove the dried paint, be careful not to damage the manipulator.
8.2.2 Pneumatic Unit

- Drained water from air filter
  Empty the water drained from the air filter on the pneumatic unit.

- Pressure
  Before moving the manipulator, check if the gauges of the pressure reducing valves on the pneumatic unit show the pressure to be within the specified range.

8.2.3 Safety Devices

- Emergency stop button and safety plug
  Before operating the manipulator, check the following to make sure that the emergency stop button and the safety plug operate correctly:
  - The manipulator stops immediately when the emergency stop button is pressed.
  - The manipulator stops immediately when the safety plug is pulled out.
  - Inspect the manipulator while it is in the standby posture and not in motion with the power supply turned ON. Repeated sudden stops while the manipulator is in motion will damage the braking system.
  - Remove any dried paint on the emergency stop button and the safety plug.

- Photoelectric intrusion detecting switch
  Make sure that the photoelectric intrusion detecting switch operates correctly.
  - Remove any dried paint on the light beam receiving section on the switch.
  - When the air is purging, check the air for purging.

- Limit switch
  Make sure that the limit switches for positioning workpieces, starting the robot, and return the robot to home operate correctly.
  - Remove any dried paint that may obstruct the robot motion.
8.2.4 Options

- Gun tilt switching

Check if the gun changes its tilt smoothly when compressed air is supplied. If excessive shock is applied on both ends, reduce the pressure supplied to the actuator.

- Shear pin

Disconnect the air supply tube, and check if the shear pin breaks immediately to shut off the power supply to the manipulator. Also, make sure that the air tube is not bent or crushed.
9 Maintenance and Inspection

### WARNING

- **Before maintenance or inspection, be sure to turn the main power supply OFF, and put up a warning sign such as “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 the specified personnel**.

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

- **For disassembly or repair, contact your Yaskawa representative**.

- **Do not disconnect the motor, and do not release the brake**.

  Unexpected arm motion may cause injury or damage to the equipment.

- **Be sure to connect the battery board before disconnecting the connectors for detection at maintenance and inspection**.

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

#### 9.1 Inspection Schedule

Conduct daily and periodic inspections to ensure the long life of the robot and its performance. 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 given in the levels shown in “Table 6  Inspection Schedule”. In Table 6, the inspection items are classified into three types of operation: operations which can be performed by personnel authorized of the user, operations which can be performed by personnel being trained, and operations which can be performed by service company personnel.

Only specified personnel are to do inspection work.
The inspection interval must be based on the servo power supply ON time.

Table. 6 Inspection Schedule

<table>
<thead>
<tr>
<th>Item*4</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000H Cycle</td>
<td>6000H Cycle</td>
<td>12000H Cycle</td>
<td>24000H</td>
</tr>
<tr>
<td>① S-, L-, and U-axis motors</td>
<td>Visual</td>
<td>Check for grease leakage.*2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>② Base mounting bolts</td>
<td>Spanner Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>③ Cover mounting screws</td>
<td>Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>④ Motor connectors</td>
<td>Manual</td>
<td>Check for loose connectors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑤ Air seals for internal pressure</td>
<td>Visual</td>
<td>Check for wear or tear. Replace if necessary. See Par. 9.2.3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑥ S-axis internal cables</td>
<td>Visual Multi-meter</td>
<td>Check for conduction between the main connector of the base and the intermediate connector with manually shaking the wire. Check for wear on the protective spring.*4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑦ L-arm internal cables</td>
<td>Visual Multi-meter</td>
<td>Check the conduction between terminals. Check for wear on the protective spring.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑧ Battery in manipulator</td>
<td>Manual Visual</td>
<td>Replace the battery unit when the battery alarm occurs or the manipulator drove for 36000H. See Par. 9.2.4.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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When checking for conduction with multimeter, connect the battery to “BAT” and “OBT” of connectors on the motor side for each axis, and then remove connectors on detector side for each axis from the motor. Otherwise, the home position data may be lost. (Refer to "9.5.1 Encoder Connector with Warning Label ".)

Internal cables to be replaced at 24000H inspection.

For the grease, refer to " Table. 7 Inspection Parts and Grease Used ".

Inspection No. correspond to the numbers in " Fig. 17 Inspection Parts and Inspection Numbers ".

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. 7 Inspection Parts and Grease Used

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>VIGO grease RE No. 00</td>
<td>S-, L-, U-, R-, B-, and T-axes speed reducer</td>
</tr>
<tr>
<td>②</td>
<td>Alvania EP grease 2</td>
<td>Wrist gear</td>
</tr>
</tbody>
</table>

Fig. 17 Inspection Parts and Inspection Numbers
9.2 Maintenance for Manipulator

9.2.1 Grease Replenishment/Replacement

"Fig. 17 Inspection Parts and Inspection Numbers" shows the location of the components of the manipulator.

Replenish or replace the grease for the following sections:

1) Wrist gear
2) S-, L-, and U-axes speed reducer
3) R-, B-, and T-axes speed reducer

Wrist gears

Remove the tube and apply Alvania EP grease 2 on the gear teeth of gears B1, T1, and T2 by using a grease gun. Apply seal tape on the screwed part of each plug.
### S-, L-, and U-axes Speed Reducer

#### Grease Replenishment

1. Remove the plug on the So (Lo, Uo) exhaust port.

   **NOTE**
   
   If grease is injected with the plug (So, Lo, Uo) on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug (So, Lo, Uo) before the grease injection.

2. Remove the plug 1/8 on the Si (Li, Ui) grease inlet and install the grease zerk A-PT1/8. Inject grease by using a grease gun.

   **NOTE**
   
   Grease type: VIGO grease RE No.00
   Amount of grease:
   - S-axis: 800 cc (1500 cc for the 1st supply)
   - L-axis: 1000 cc (2000 cc for the 1st supply)
   - U-axis: 300 cc (500 cc for the 1st supply)

3. Move S-axis (L-axis, U-axis) for a few minutes to discharge excessive grease.

4. Remove the grease zerk on the Si (Li, Ui) grease inlet. Wipe the So (Lo, Uo) exhaust port and the Si (Li, Ui) grease inlet. Apply seal tape on the screwed parts of each plug, and reinstall the plugs on the So (Lo, Uo) exhaust port and the Si (Li, Ui) grease inlet. Reinstall the cover on each axis motor.

#### Grease Replacement

1. Remove the plug on the So (Lo) grease exhaust port.

   **NOTE**
   
   If grease is injected with the plug (So, Lo, Uo) on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug (So, Lo, Uo) before the grease injection.

2. Remove the plug 1/8 on the Si (Li, Ui) grease inlet and install the grease zerk A-PT1/8. Inject grease by using a grease gun.

   **NOTE**
   
   Grease type: VIGO grease RE No.00
   Amount of grease:
   - 2000 cc for S-axis
   - 2700 cc for L-axis
   - 700 cc for U-axis

3. The grease replacement is completed when new grease appears in the So (Lo, Uo) exhaust port. The new grease can be distinguished from the old grease by color.

4. Move S-axis (L-axis, U-axis) for a few minutes to discharge excessive grease.

5. Remove the grease zerk on the Si (Li, Ui) grease inlet. Wipe the So (Lo, Uo) exhaust port and the Si (Li, Ui) grease inlet. Apply seal tape on the screwed part of each plug, and reinstall the plugs on the So (Lo, Uo) exhaust port and the Si (Li, Ui) grease inlet. Reinstall the cover on each axis motor side.
If the plug (So, Lo, Uo) is installed while the grease is being exhausted, the grease will go inside the motor and may cause a damage. Ensure that the grease has been completely exhausted before installing the plug (So, Lo, Uo).

Fig. 19 S-axis Speed Reducer

Fig. 20 L-axis Speed Reducer
**R-, B-, and T-axes Speed Reducer**

**Grease Replenishment**

1. Remove the cover.
2. Remove the plug on the Ro (Bo, To) exhaust port.

![NOTE]

*If grease is injected with the plug (Ro, Bo, To) on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug (Ro, Bo, To) before the grease injection.*

*Note that grease replacement is not necessary for R-, B-, and T-axes.*

3. Remove the plug on the Ri (Bi, Ti) grease inlet, and install the grease zerk PT1/4.
   Inject grease by using a grease gun.

<table>
<thead>
<tr>
<th>Grease type: VIGO grease RENo.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease:</td>
</tr>
<tr>
<td>50 cc for R- and B-axis (100 cc for the 1st supply)</td>
</tr>
<tr>
<td>40 cc for T-axis (80 cc for the 1st supply)</td>
</tr>
</tbody>
</table>

4. Move R-axis (B-axis, T-axis) for a few minutes to discharge excessive grease.
5. Remove the grease zerk on the Ri (Bi, Ti) grease inlet. Wipe the Ro (Bo, To) exhaust port and the Ri (Bi, Ti) grease inlet. Apply seal tape on the screwed part of each plug, and reinstall the plugs on the Ro (Bo, To) exhaust port and the Ri (Bi, Ti) grease inlet.
6. Install the cover and tighten the bolts with the specified tightening torque.
9.2 Maintenance for Manipulator

9.2.2 Inspection of Wrist Gear and Bearing

Check if three wrist axes move smoothly. If any of the axes does not move smoothly, the wrist should be removed and disassembled for investigation of the cause such as detective bearing, gear or sealing. Contact your Yaskawa representative.

CAUTION

To remove the wrist from the U-arm, firmly hold the wrist and remove the fixing bolt. If not, the wrist may fall down when the fixing bolt is removed.

9.2.3 Inspection of Air Sealings for Internal Air Pressure

- Gasket on the motor case

  (a) S-, L-, and U-axes
  Remove the mounting bolts on the motor case and check the gasket where the case is mounted. Remove the cover for the cable inlet in the motor case and check the gasket where the cover is attached.
  Excessive oil in the air that is used for the internal air pressure can damage the gasket, which result in air leakage. Replace the gasket if air leakage is found.
Fig. 23 S-axis Motor Gasket
9.2 Maintenance for Manipulator

Fig. 24  L-axis Motor Gasket

Fig. 25  U-, R-, B-, and T-axes Motor Gasket
(b) Base
Remove the cover on the backside of the base, and check for wear and tears on the rubber gaskets.

Fig. 26 Rubber Gaskets on the Base
9.2.4 Battery Board Replacement

Two battery boards are installed in the locations shown in "Fig. 27 Battery Board Location".

- Battery board: JARCR-XIS01

If a battery alarm occurs in the NX100, replace the battery board in the following procedure.

![Diagram of Battery Board Connection]

- **Hexagon socket head cap screw M6**:
  - Length: 20 mm (2 screws)
  - Tightening torque: 10 N·m (1.0 kgf·m)

- **Conical spring washer 2H**:
  - 6 washers

- **New battery board**

- **Battery board**

- **View A-A**

- **Battery board mounting screw M3**

- **Gasket**

- **Cover**

- **Fig. 27 Battery Board Location**

- **Fig. 28 Battery Board Connection**

- **Hexagon socket head cap screw M6**:
  - Length: 25 mm (9 screws)
  - Tightening torque: 10 N·m (1.0 kgf·m)

- **Hexagon socket head cap screw M6**:
  - Length: 20 mm (2 screws)
  - Tightening torque: 10 N·m (1.0 kgf·m)

- **See step 6 below**

- **See step 7 below**

- **See step 4 below**

- **Battery for S-, L-, U-axes**
  - Before replacement

- **Battery for R-, B-, T-axes**
  - Before replacement

- **New battery board**

- **See step 5 below**

- **a**: Crimped contact-pin (pin)

- **b**: Crimped contact-pin (socket)
9.3 Inspection of the Pneumatic Unit

1. Turn OFF the power to the NX100.
2. Detach and pull out the connector base from the base.
3. Remove the battery board mounting screws.
4. Remove the electrical tape protecting connection part of the battery board in the manipulator.
5. Connect two new battery boards.
6. Remove the old battery boards.

**NOTE** Be sure to connect the new battery boards before disconnecting the old one so that the data does not disappear.

7. Protect the connection part of the battery board in the manipulator with electrical tape.
8. Insert the battery board screws in the mounting holes on the connector base, and fix the connector base on the base.

9.3 Inspection of the Pneumatic Unit

9.3.1 Solenoid Valve

Check if the air purge starts a few seconds after turning ON the power to the NX100 and if it ends approximately 2 minutes later.

9.3.2 Pressure Reducing Valve

Measure the air pressure for the pneumatic unit with a pressure gauge. Remove the test plug or the relief valve on the pneumatic unit and connect the gauge. The air pressure must always be from 0.01 MPa to 0.03 MPa under normal conditions and from 0.15 MPa to 0.35 MPa when purging.
9.4 Inspection of Explosion-proof Devices

9.4.1 Pressure Switch

Remove the front cover of the pneumatic unit box and check the conduction of the pressure switches. The two pressure switches must be ON when the air is being supplied and OFF when the air is not being supplied.

CAUTION

- Be sure to turn OFF the power to the NX100 before inspecting the pressure switch.
- Do not touch the pressure setting dial on the pressure switch during an inspection. Changing the setting prevents the correct pressure from being detected.

9.4.2 Master Valve

While the air is being supplied from the pneumatic unit, check if the air purge starts a few seconds after the power to the NX100 is turned ON. Also, check if the air goes out of the two air outlets for the master valve during the air purge.

9.4.3 Pressurized Anti-explosion Barrier

While the air is being supplied from the pneumatic unit, check if the air purge starts a few seconds after the power to the NX100 is turned ON and if it ends approximately 2 minutes later. Also, check the following:

(a) The alarm “AIR PRESSURE ERROR” occurs immediately after the air supply from the pneumatic unit is stopped and the power supply to the NX100 is turned ON.

(b) The alarm “AIR PRESSURE ERROR” occurs when the air supply from the pneumatic unit is stopped during air purging.
9.5 Notes for Maintenance

9.5.1 Encoder Connector with Warning Label

Remove the old battery after connecting the new one so that the encoder absolute data does not disappear.

■ S-, L-axes Motors

The connector for the battery is attached to the main body of the S-, L-axes motors. Connect the battery according to the following procedure.

1. To remove the cap on the slot of the motor’s encoder, remove the mounting bolts.
2. Insert the battery (JARCR-XIS01) in the connector (crimped contact-pin terminal) as a backup inside the cap.
3. Confirm all connectors connection after the maintenance check ends, and remove the battery.

■ U-, R-, B-, and T-axes Motors

The connector for the battery backup is installed in the end point of the cable for the encoder of the U-, R-, B-, and T-axes motors (BAT and OBT are marked). Connect the battery according to the following procedure.

1. Connect the battery (JARCR-XIS01) with the backup connector for the motor encoder.
2. Confirm all connectors connection after the maintenance check ends, and remove the battery.

**NOTE** Do not remove the battery pack in the connector base.
9.5 Notes for Maintenance

Fig. 29 Backup Battery Connection for S- and L-axes Motors

Fig. 30 Backup Battery Connection for U-, R-, B-, and T-axes Motors
Fig. 31 Connection Diagram

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

Fig. 32 Caution Label
10 Recommended Spare Parts

It is recommended that the following parts and components be kept in stock as spare parts for the MOTOMAN-EPX2800R. The spare parts list for the MOTOMAN-EPX2800R is shown below. Product performance cannot 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 units

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

Table 8  Spare Parts for the MOTOMAN-EPX2800R-Z000

<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>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Battery board</td>
<td>JARCR-XIS01</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>Sealing compound</td>
<td>DB-1600</td>
<td>Diabond Industries Co., Ltd.</td>
<td>200</td>
<td>ml</td>
<td>For gasket</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Seal tape</td>
<td>TB-4501</td>
<td>Three Bond Co., Ltd.</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>Grease</td>
<td>Alvania EP grease 2</td>
<td>Showa Oil Co., Ltd.</td>
<td>16</td>
<td>kg</td>
<td>For bearing, gear in the wrist</td>
</tr>
<tr>
<td>A</td>
<td>5</td>
<td>Grease</td>
<td>VIGO grease RE No. 00</td>
<td>Yaskawa Electric Corporation</td>
<td>16</td>
<td>kg</td>
<td>For S-,L-,U-,R-,B- and T-axes speed reducers</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>S-axis speed reducer</td>
<td>HW03800936-C</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>7</td>
<td>L-axis speed reducer</td>
<td>HW9381442-D</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>U-axis speed reducer</td>
<td>HW0380024-F</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>9</td>
<td>R-, B-, and T-axes</td>
<td>HW0386187-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>U-arm unit</td>
<td>HW0173711-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td>Wrist unit (HW0173480-A) included</td>
</tr>
<tr>
<td>C</td>
<td>11</td>
<td>S-axis AC servomotor</td>
<td>HW0386387-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>12</td>
<td>L-axis AC servomotor</td>
<td>HW0386816-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
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<tr>
<td>C</td>
<td>13</td>
<td>U-axis AC servomotor</td>
<td>HW0386389-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
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<td></td>
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<td>Rank</td>
<td>Parts No.</td>
<td>Name</td>
<td>Type</td>
<td>Manufacturer</td>
<td>Qty</td>
<td>Qty per Unit</td>
<td>Remarks</td>
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<td>-----</td>
<td>--------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>C</td>
<td>14</td>
<td>R-, B-, and T-axes AC servomotors</td>
<td>HW0386815-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>15</td>
<td>Switch unit</td>
<td>HW0272394-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td>Pressure switch</td>
</tr>
<tr>
<td>C</td>
<td>16</td>
<td>Internal cable</td>
<td>HW0173129-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td>For signal cable in S-axis</td>
</tr>
<tr>
<td>C</td>
<td>17</td>
<td>Internal cable</td>
<td>HW0173128-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td>In L-arm</td>
</tr>
</tbody>
</table>
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