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

MOTOMAN INSTRUCTIONS

MOTOMAN-EPX2900 INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 INSTRUCTIONS (PX□□□□ INSTRUCTIONS SUPPLEMENT)
NX100 OPERATOR’S MANUAL FOR PAINTING

The NX100 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.

Part Number: 154972-1CD
Revision: 2
MANDATORY

• This manual describes the specifications, precautions for operation and required items for maintenance or inspections, for proper application of the MOTOMAN-EPX2900. Read this manual carefully and be sure to understand its contents before handling the MOTOMAN.

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

• Refer to NX100 Operator's Manual for the operation methods.

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 MOTOMAN.

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".

**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 playback panel, the programming pendant, and supply cables. The MOTOMAN manipulator is the YASKAWA industrial robot product. 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 Playback Panel</td>
<td>Playback Panel</td>
</tr>
<tr>
<td>NX100 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
</tbody>
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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.

⚠️ WARNING

Install the MOTOMAN-EPX2900 in a location that meets the requirements of Area Classification 'Division I' prescribed in FM Approval Standard.
WARNING

• 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 safeguards 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.

PROHIBITED

Any modification of the MOTOMAN-EPX2900, and the following is strictly prohibited:
1. Explosion-proof devices and system installation
2. Safeguards 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-EPX2900 is designed for easy-handling and to consider safety first in operation.

2.1 Methods of Protection

The MOTOMAN-EPX2900 is evaluated as Type X Purged for use in Class I, Division 1, Groups C and D indoor hazardous (classified) locations T4, and appear in the Factory Mutual (FM) Research Approval Guide. They have the construction of protection as follows:

Method of Protection:
- The pressurized explosion-proof method 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 Intrinsic-safety explosion-proof method prevents explosive gas from igniting by electric spark and heat.

WARNING

Install the MOTOMAN-EPX2900 in a location that meets the requirements of Area Classification 'Division 1' prescribed in FM Approval Standard.

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 PC cards is provided as a standard feature of backup unit and enables data to be transmitted easily.
2.2 Teaching

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be sure to save the backup data for the controller, such as the data for jobs and constants, on a PC card. If not, the necessary data for the manipulator may be lost if an internal memory fault occurs in the controller.</td>
</tr>
</tbody>
</table>

- 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.
3 Installation

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>
<tbody>
<tr>
<td>1</td>
<td>Power supply</td>
<td>3-phase 200/220 VAC (+10 % to -15%)</td>
<td>(Option)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50/60 Hz (±2 Hz)</td>
<td>3-phase 240/480/575 VAC (+10% to -15%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 kVA</td>
<td>50/60 Hz (±2 Hz)</td>
</tr>
<tr>
<td>2</td>
<td>Air supply</td>
<td>Required pressure: 0.35 MPa to 0.65 MPa</td>
<td>Use dry air for the pressurized explosion-proof construction.</td>
</tr>
<tr>
<td></td>
<td>Pressurized explosion-proof construction</td>
<td>Capacity:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40Nl/min usually</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000Nl/min usually</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dryness: Freezing at -18 °C</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Grounding</td>
<td>Grounding resistance:</td>
<td>For the robot controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 ohm or less (Non I.S. GND)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 ohm or less (I.S. GND)</td>
<td></td>
</tr>
</tbody>
</table>

⚠️ CAUTION

Use dry air for the pressurized explosion-proof enclosure. Moisture in the air supply may damage the electronic parts.
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>
<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>O</td>
<td>-</td>
<td>0 to 45 °C</td>
<td>80 %RH</td>
</tr>
<tr>
<td>Controller (not explosion-proof)</td>
<td>x</td>
<td>O</td>
<td>0 to 45 °C</td>
<td>90 %RH</td>
</tr>
<tr>
<td>Pneumatic unit (not explosion-proof)</td>
<td>x</td>
<td>O</td>
<td>0 to 45 °C</td>
<td>85 %RH</td>
</tr>
<tr>
<td>Programming pendant (not explosion-proof)</td>
<td>x</td>
<td>O</td>
<td>0 to 40 °C</td>
<td>85 %RH</td>
</tr>
<tr>
<td>Programming pendant (explosion-proof) (Option)</td>
<td>O</td>
<td>O</td>
<td>0 to 40 °C</td>
<td>85 %RH</td>
</tr>
<tr>
<td>Conveyor speed detector (not explosion-proof)</td>
<td>x</td>
<td>O</td>
<td>0 to 50 °C</td>
<td>90 %RH</td>
</tr>
<tr>
<td>Conveyor speed detector (explosion-proof)</td>
<td>O</td>
<td>-</td>
<td>0 to 50 °C</td>
<td>90 %RH</td>
</tr>
<tr>
<td>Conveyor switch (explosion-proof)</td>
<td>O</td>
<td>-</td>
<td>0 to 50 °C</td>
<td>90 %RH</td>
</tr>
<tr>
<td>Workpiece supplier (explosion-proof)</td>
<td>O</td>
<td>O</td>
<td>0 to 50 °C</td>
<td>85 %RH</td>
</tr>
<tr>
<td>Control panel for workpiece supplier (not explosion-proof)</td>
<td>x</td>
<td>O</td>
<td>0 to 45 °C</td>
<td>90 %RH</td>
</tr>
<tr>
<td>Safety devices</td>
<td>Selected according to the requirements of the customer. Refer to the appropriate instruction manual provided separately.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Box for emergency stop switches</td>
<td>x : Not acceptable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety plugs</td>
<td>O : Acceptable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flashing light</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicator lamps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photoelectric switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3-2
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 Handling and Installation

Read “MOTOMAN Setup Manual” thoroughly before handling and installing the MOTOMAN system, and then 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 and Handling

1) When the package arrives, check the contents.
   Are the items and quantities in accordance with your order sheet?
   Was any damage incurred during shipment?
2) Use a forklift, a pallet truck to carry the manipulator. Take measures to prevent the manipulator from falling down.

⚠️ 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.
4.3 Installation of MOTOMAN

**WARNING**

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

- **Install the manipulator in a location where the fully extended arm and tool will not reach the wall, safeguards, and the NX100.**
  Failure to observe this warning may result in injury or damage.

- **Do not turn ON the power before the manipulator is firmly anchored.**
  The manipulator may turn over, and cause injury or damage.

- **Lifting the manipulator**
  The manipulator must be lifted only by qualified and authorized personnel. The manipulator weighs approximately 1030 kg. Use a wire, belt, or chain block strong enough to support the weight.
  Carefully check the length and the tension of the wire and belt to maintain the equilibrium of the manipulator while lifting.
  <Lifting method>
  Attach the jigs in two locations on the manipulator base. Slowly lift the manipulator to form the posture shown in Fig 1 using wire through the eyebolts. Eyebolts are provided prior to shipment.

![Diagram of Lifting EPX2900](image)

*Fig. 1 Lifting the EPX2900*
4.3 Installation of MOTOMAN

CAUTION

- Do not install or operate a manipulator that is damaged or lacking parts.
  Failure to observe this caution may result in injury or damage.

- Do not install the painting 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 supply, check to be sure that the shipping bolts and jigs have been removed.
  Failure to observe this caution may result in damage to the driving parts.

4.3.1 Safeguard Installation

To ensure safety, be sure to install safeguards. They prevent unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance (ISO 10218).

Responsibility for Safeguarding
The user of a manipulator or robot system shall ensure that safeguards are provided and used in accordance with Section 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.

4.3.2 Installation of Manipulator

The manipulator should be firmly mounted on a base or foundation strong enough to support the manipulator and jigs, and withstand repulsion forces during acceleration and deceleration. Construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator as shown in "table 3 Maximum Repulsion Forces of the Manipulator".

During installation, if the flatness is not right, the manipulator shape may change and its functional ability may be compromised. The flatness for installation must be kept at 0.5 mm or less. Mount the manipulator base in either of the following ways: "4.3.3 When the Manipulator and Mounting Fixture are Installed on a Common Base" and "4.3.4 When the Manipulator is Mounted Directly on the Floor."
### Table. 3 Maximum Repulsion Forces of the Manipulator

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal rotating</td>
<td>23400N × m</td>
<td>(5980kgf-</td>
</tr>
<tr>
<td>maximum torque (S-</td>
<td></td>
<td>m)</td>
</tr>
<tr>
<td>axis moving direction)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical rotating</td>
<td>45000N × m</td>
<td>(9100kgf-</td>
</tr>
<tr>
<td>maximum torque (L-</td>
<td></td>
<td>m)</td>
</tr>
<tr>
<td>and U-axis moving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>direction)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 4.3.3 When the Manipulator and Mounting Fixture are Installed on a Common Base

The common installation base should be rugged and durable to prevent shifting of the manipulator or the mounting fixture. It is recommended that the thickness of the common installation base is 40 mm or more and the anchor bolt is M20 or more. There are four mounting holes in the manipulator base. Affix the manipulator securely with hexagon socket head bolts M20 (60 mm long recommended). Tighten the bolts securely so that they will not work loose during operation. See "Fig. 2 Mounting on the Common Installation Base" for the method. The flatness for the manipulator installation face must be 0.5 mm or less.

![Diagram of the manipulator installation](image)

**Fig. 2 Mounting on the Common Installation Base**
4.3.4 When the Manipulator is Mounted Directly on the Floor

The floor should be strong enough to support the manipulator. Construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator. As a rough standard, when there is a concrete thickness (floor) of 150 mm or more, the manipulator base can be fixed directly on the floor with anchor bolts M20. Make the floor surface even and repair all the cracks. A non-concrete floor or a concrete floor less than 150 mm thick is insufficient to install the manipulator directly.
4.3.5 Location

Install the manipulator in a location that has the following ambient conditions:

- Ambient operating temperature: 0 to +45 °C
- 20 to 80 %RH (no moisture, non-condensation)
- Free from dust, dirt, oil mist, and water drop
- Free from excessive impact or vibration (less than 4.9 m/s² (0.5 G))
- Free from large electrical noise (TIG welder, etc.)
- The flatness for installation is 0.5 mm or less.

4.3.6 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.

4.3.7 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. (Non I.S.GND)
  10 Ω or less. (I.S.GND)

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 power cable between the manipulator and the NX100 with a highly adiathermic material, and separate the cable from the other cables.

The heat radiating from the cable will be trapped, and the accumulated heat may cause burns and injury.

5.1.1 Grounding

Follow the local regulations for ground line size. A line of 5.5 mm² or more is recommended. Refer to Fig.4

NOTE

- Do not use this line in common with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.

- When metal ducts, metallic conduits, or distributing racks are used for cable laying, ground in accordance with Electric Equipment Technical Standards.
5.2 Cable Connection

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

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.
5.2.1 Connection to the Manipulator

For 2BC, 3BC:
- Grounding line connecting tap

For 1BC, 4BC, 5BC, 6BC:
- Grounding line connecting tap

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

(Mounting bolt for plate B)
Hexagon socket head cap screw M6
(length: 25 mm) (6 screws)
Hexagon socket head cap screw M6
(length: 20 mm) (2 screws) (locking parts)
Tightening torque 10 N·m (1.0 kgf-m)

(Mounting bolt for plate A)
Hexagon socket head cap screw M6
(length: 25 mm) (6 screws)
Hexagon socket head cap screw M6
(length: 20 mm) (2 screws) (locking parts)
Tightening torque 10 N·m (1.0 kgf-m)

(Mounting bolt for plate C)
Hexagon socket head cap screw M6
(length: 16 mm) (6 screws)
Tightening torque 10 N·m (1.0 kgf-m)

(Mounting bolt for plate D)
Hexagon socket head cap screw M6
(length: 25 mm) (6 screws)
Hexagon socket head cap screw M6
(length: 20 mm) (2 screws) (locking parts)
Tightening torque 10 N·m (1.0 kgf-m)

(Mounting bolt for plate E)
Hexagon socket head cap screw M6
(length: 25 mm) (6 screws)
Hexagon socket head cap screw M6
(length: 20 mm) (2 screws) (locking parts)
Tightening torque 10 N·m (1.0 kgf-m)

Note)
- Cross Recessed Head Screws M6
- Plain Washers
- Spring Lock Washers

Fig. 4 Manipulator Internal Cable Connection
5.2 Cable Connection

Fig. 12 Air Hose Connection

Notes:
1) Intrinsically safe cable
   - Cable type: CVV-SB (or CVV-S), 1.25 mm², Z-core
   - Cable connection

2) Crimped terminals
   For connecting the intrinsically safe cable to the intrinsically safe terminal block

3) Crimped terminals
   For connecting the intrinsically safe cable to the controller internal contact barrier

Fig. 7 Connection to the Pressure Switch Unit
5.2.2 Power Cable Construction Method Example

The construction example is shown as follows.

- Metal Pipe Construction

![Diagram showing Metal Pipe Construction example]

**NOTE**
- Construction the signal cable and the peripheral device coupling cable as mentioned above.
- The metal pipe must have enough strength.
- For the explosion-proof approved parts, use neither sealing fitting nor sealing compound other than the above-mentioned model. (Manufacturer: Cooper Industrial Inc., or equivalent)
### 5.2.3 The Cables & Air-tubing Connection (procedure)

Cables and tubes necessary for construction are tables below. The customer needs to prepare the power supply cable, the grounding cable, the cables for optional equipment, and the air tube.

<table>
<thead>
<tr>
<th>Use</th>
<th>Connection to.</th>
<th>Type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power source cable.</td>
<td>Power source to/from Controller.</td>
<td>CVV-3.5SQ-4C</td>
</tr>
<tr>
<td>Intrinsically-safe signal line Cable.</td>
<td>Manipulator to/from Controller.</td>
<td>CVV-1.25SQ-2Cx2</td>
</tr>
<tr>
<td>Cable for the Conveyor-speed detection device.</td>
<td>To/from Controller.</td>
<td>CVV-SB-1.25SQ-3C</td>
</tr>
<tr>
<td>Cable for optional equipment.</td>
<td>To/from Controller.</td>
<td>CVV-SB-1.25SQ</td>
</tr>
<tr>
<td>Air tube for pressurized explosion-proofness.</td>
<td>Manipulator to/from pneumatics unit</td>
<td>φ16/13, φ6/4 nylon tube (each line)</td>
</tr>
<tr>
<td>Air tube for air supply</td>
<td>Air supply source to/from pneumatics unit</td>
<td>φ16/13 nylon tube</td>
</tr>
</tbody>
</table>
5.3 Internal Connections

Figs. 9(a), (b) and (c) show the internal wiring.
6 System Configuration

"Fig. 10 System Configuration" shows the system configuration of the MOTOMAN-EPX2900.

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 Working Envelopes" shows the dimensions and the working envelopes of the EPX2900. 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 6 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 working envelope shown in "Fig. 11 Dimensions and Working Envelopes" is that of the wrist axis center point P that is made by the combination of the motions of the three main axes.

⚠️ WARNING

When taking safety precautions, consider the working envelope of the manipulator shown in "Fig. 11 Dimensions and Working Envelopes".
Fig. 10 System Configuration
6.1 Manipulator

View A
Manipulator Base Dimensions

Fig. 11 Dimensions and Working Envelopes
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.
CAUTION

Manufacturer is requested to strictly observe that the supply air is between 0.35 MPa to 0.65 MPa. The pressurized explosion-proof will not operate properly without the required amount of air pressure, if air pressure is low. If increase the air pressure, the pneumatics equipment for the pressurized explosion-proof system will be caused for equipment damage.
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 in the Wrist

Periodically replace the O-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-EPX2900-B***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Vertically articulated</td>
<td></td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Payload</td>
<td></td>
<td>20 kg</td>
</tr>
<tr>
<td>Repeatability*2</td>
<td></td>
<td>± 0.5 mm</td>
</tr>
<tr>
<td>Range of Motion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-axis (turning)</td>
<td>± 150°</td>
<td></td>
</tr>
<tr>
<td>L-axis (lower arm)</td>
<td>+110°, -50°</td>
<td></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>
<tr>
<td>Maximum Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-axis</td>
<td>2.7 rad/s, 155 °/S</td>
<td></td>
</tr>
<tr>
<td>L-axis</td>
<td>2.2 rad/s, 125 °/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>7.9 rad/s, 450 °/S</td>
<td></td>
</tr>
<tr>
<td>B-axis</td>
<td>9.6 rad/s, 550 °/S</td>
<td></td>
</tr>
<tr>
<td>T-axis</td>
<td>11.3 rad/s, 650 °/S</td>
<td></td>
</tr>
<tr>
<td>Allowable Moment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>72.0 N·m (7.3 kgf·m)</td>
<td></td>
</tr>
<tr>
<td>B-axis</td>
<td>51.5 N·m (5.2 kgf·m)</td>
<td></td>
</tr>
<tr>
<td>T-axis</td>
<td>19.6 N·m (2.0 kgf·m)</td>
<td></td>
</tr>
<tr>
<td>Approx. Mass</td>
<td></td>
<td>1030 kg</td>
</tr>
<tr>
<td>Ambient Conditions</td>
<td>Temperature</td>
<td>0 to + 45 °C</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>20 to 80 %RH (non-condensing)</td>
</tr>
<tr>
<td></td>
<td>Vibration</td>
<td>Less than 4.91 m/s² (0.5 G)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Free from excessive electrical noise (plasma).</td>
</tr>
<tr>
<td></td>
<td>Power Capacity</td>
<td>5 kVA*3</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.
The wrist flange dimensions are shown in "Fig. 14 Wrist Flange". Fitting depth of inside and outside fittings must be 21mm or less.
7.3 System Application

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

- Maximum allowable load: 30 kg
- Mounting position: Refer to "Fig. 15 Device Mounting Position".

![Diagram of device mounting position]

Fig. 15 Device Mounting Position

Moment applied on U-axis:
132 N·m (13.5 kgf·m)
# 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>
<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>O</td>
<td></td>
<td><strong>WARNING</strong> 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>O</td>
<td></td>
<td><strong>WARNING</strong> 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>O</td>
<td>O</td>
<td><strong>CAUTION</strong> Use a pair of protective glasses to protect your eyes against paint or thinner that is being removed.</td>
</tr>
<tr>
<td></td>
<td><strong>Manipulator</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>CAUTION</strong> 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>4</td>
<td>Air leakage</td>
<td>No excessive air leakage from the fitting of the motor case.</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Dried paint</td>
<td>Remove the dried paint on the robot.</td>
<td>O</td>
<td>O</td>
<td>Replace the sheet. <strong>WARNING</strong> When removing the paint with a tool, be careful not to damage the robot.</td>
</tr>
</tbody>
</table>

|     | **Pneumatic Unit**    |                                               |       |        |                                                                 |
| 1   | Water drained from the air filter |                                                                 | O     |        |                                                                 |
| 2   | Pressure set value    | The pressure of the pressure reducing valve is within the specified range                      |       | O      |                                                                 |
### 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>
</table>
| 1   | Operation of emergency stop button and safety plug. Dried paint | 1. The manipulator stops immediately when the emergency stop button is pressed. | O     |        | ⚠️ CAUTION  
Inspect the robot while it is in its standby position and not in motion. |
|     |                       | 2. The manipulator stops immediately when the safety plug is pulled out. | O     |        |
|     |                       | 3. Remove the dried paint on the emergency stop button and the safety plug. | O     |        |
| 2   | Operation of the photoelectric intrusion detecting switch Dried paint | 1. The manipulator stops when the photoelectric switch is turned OFF. | O     |        |
|     |                       | 2. Remove the dried paint on the light beam detector. | O     |        |
| 3   | Operation of limit switch Dried paint | 1. Normal operation of the limit switch | O     | O      |
|     |                       | 2. Remove the dried paint on the limit switch. | O     | O      |
| 1   | Operation of the gun tilt switching | The gun tilt changes correctly when air is supplied. | O     | O      |
| 2   | Operation of the shear pin system | 1. The manipulator stops immediately when the shear pin is sheared. | O     | O      |
|     |                       | 2. The test valve is closed and the tube is not broken. | O     | O      |
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 safeguards 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.
8.2 Daily Inspections

⚠️ WARNING

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

⚠️ CAUTION

Paint stuck on the manipulator rotating parts prevents them from turning normally and smoothly. Periodically remove the paint on the manipulator. A cloth that is soaked in paint thinner can be used for cleaning the inside of the wrist, because an anti-thinner enclosure is provided. But, be careful not to remove the original coat of paint on 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*</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 Cycle</td>
</tr>
<tr>
<td>2.</td>
<td>Base mounting bolts</td>
<td>O</td>
<td>Spanner Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
</tr>
<tr>
<td>3.</td>
<td>Cover mounting screws</td>
<td>O</td>
<td>Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
</tr>
<tr>
<td>5.</td>
<td>Air seals for internal pressure</td>
<td>O</td>
<td>Visual</td>
<td>Check for wear or tear. Replace if necessary. See Par. 9.2.3.</td>
</tr>
<tr>
<td>6.</td>
<td>S-axis internal cables</td>
<td>O</td>
<td>Visual Multimeter</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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O</td>
<td></td>
<td>Replace the cables.</td>
</tr>
<tr>
<td>7.</td>
<td>L-arm internal cables</td>
<td>O</td>
<td>Visual Multimeter</td>
<td>Check the conduction between terminals. Check for wear on the protective spring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O</td>
<td></td>
<td>Replace the cables.</td>
</tr>
<tr>
<td>8.</td>
<td>Battery in manipulator</td>
<td>O</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>
</tr>
<tr>
<td>Item</td>
<td>Schedule</td>
<td>Method</td>
<td>Operation</td>
<td>Inspection Charge</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>--------</td>
<td>-----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>③ S-, L-, and U- axes speed reducer</td>
<td>1000H Cycle: O</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Replenish grease<em>3 (6000H cycle). (See Par. 9.2.1.) Replace grease</em>3 (12000H cycle). (See Par. 9.2.1.)</td>
<td>O</td>
</tr>
<tr>
<td>③ R-, B-, and T- axes speed reducer</td>
<td>6000H Cycle: O</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Replenish grease*3 (6000H cycle). (See Par. 9.2.1.)</td>
<td>O</td>
</tr>
<tr>
<td>② Wrist gear</td>
<td>12000H Cycle: O</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Replenish grease*3 (6000H cycle). (See Par. 9.2.1.)</td>
<td>O</td>
</tr>
<tr>
<td>③ Explosion-proof devices</td>
<td>24000H Cycle: O</td>
<td></td>
<td>Confirm that the pressure switch, the master valve, and the explosion-proof system operate correctly. (Replace if necessary.) See Par 9.4.</td>
<td>O</td>
</tr>
<tr>
<td>④ Pneumatic unit</td>
<td>36000H Cycle: O</td>
<td></td>
<td>Confirm that the solenoid valve and the pressure reducing valve operate correctly. (Replace if necessary.) Replace the filter (6000H cycle). See Par 9.3.</td>
<td>O</td>
</tr>
<tr>
<td>⑤ Overhaul</td>
<td></td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

*1 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 ".)

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

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

*4 Inspection No. correspond to the numbers in "Fig. 18 Inspection Parts and Inspection Numbers ".

*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.
9.1 Inspection Schedule

Fig. 18 Inspection Parts and Inspection Numbers

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>☀</td>
<td>VIGO grease RE No. 00</td>
<td>S-, L-, U-, R-, B-, and T-axes speed reducer</td>
</tr>
<tr>
<td>☀</td>
<td>Alvania EP grease 2</td>
<td>Wrist gear</td>
</tr>
<tr>
<td>☀</td>
<td></td>
<td>S-axis cross roller bearing</td>
</tr>
</tbody>
</table>
9.2 Maintenance for Manipulator

9.2.1 Grease Replenishment/Replacement

"Fig. 18 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.

---

Fig. 19 Wrist Gears
## S-axis Gear

### Grease Replenishment

1. Remove the plug on the SGo grease exhaust port.

   **NOTE**
   
   If grease is injected with the plug (SGo) on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug (SGo) before the grease injection.
   
   If a hose is connected to the grease exhaust port, it is recommended to use the hose whose inner diameter is larger than 8mm and the length is less than 15cm. Otherwise, the grease goes inside of the motor and may cause the failure.

2. Install the grease zerk PT1/8 on the SGi grease inlet, and inject grease. (The grease zerk PT1/8 is delivered with the manipulator.)

<table>
<thead>
<tr>
<th>Grease type: Alvania EP grease 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease: Approx. 800 cc (1500 cc for the 1st supply)</td>
</tr>
</tbody>
</table>

3. Wipe the discharged grease with a cloth and reinstall the plugs on the SGo grease exhaust port and SGi grease inlet.

   (Apply seal tape on the screwed parts of the each plug.)

### Grease Replacement

1. Remove the plug on the SGo grease exhaust port.

   **NOTE**
   
   If grease is injected with the plug (SGo) on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug (SGo) before the grease injection.
   
   If a hose is connected to the grease exhaust port, it is recommended to use the hose whose inner diameter is larger than 8mm and the length is less than 15cm. Otherwise, the grease goes inside of the motor and may cause the failure.

2. Install the grease zerk PT1/8 on the SGi grease inlet, and inject grease. (The grease zerk PT1/8 is delivered with the manipulator.)

<table>
<thead>
<tr>
<th>Grease type: Alvania EP grease 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease: Approx. 2000 cc</td>
</tr>
</tbody>
</table>

3. The grease replacement is completed when new grease appears in the SGo grease exhaust port. The new grease can be distinguished from the old grease by color.

4. Reinstall the plugs on the SGo grease exhaust port and SGi grease inlet.

   (Apply seal tape on the screwed parts of the each plug.)

   **NOTE**
   
   If the plug (SGo, SGi) is installed while the grease is being exhausted, the grease will leak from the oil seal and result in malfunction. Ensure that the grease has been completely exhausted before installing the plug (SGo, SGi).
9.2 Maintenance for Manipulator

- **S-, L-, and U-axis 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.

   In the case of L-axis, the grease may overflow from the hole of the motor base. Therefore, it is necessary to check the inside of the motor cover. If the extra grease overflows there, please remove it (wipe it out).

   If a hose is connected to the grease exhaust port, it is recommended to use the hose whose inner diameter is larger than 8mm and the length is less than 15cm. Otherwise, the grease goes inside of the motor and may cause the failure.

   If a grease pomp is used to inject VIGO grease, the first pressure have to be set 0.1MPa. (recommended pomp : Macnaught USA, Inc. Model No.P3)

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.

   **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.

   In the case of L-axis, the grease may overflow from the hole of the motor base. Therefore, it is necessary to check the inside of the motor cover. If the extra grease overflows there, please remove it (wipe it out).

   If a hose is connected to the grease exhaust port, it is recommended to use the hose whose inner diameter is larger than 8mm and the length is less than 15cm. Otherwise, the grease goes inside of the motor and may cause the failure. If a grease pump is used to inject VIGO grease, the first pressure has to be set 0.1MPa. (recommended pump: Macnaught USA, Inc. Model No.P3)

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.

   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.

   ![NOTE]

   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. 21  S-axis Speed Reducer

Grease exhaust port (S-axis head)
(Hexagon socket head plug PT3/8)

Grease inlet (S-axis base)
(Hexagon socket head plug PT3/8)

Fig. 22  L-axis Speed Reducer

Grease exhaust port (S-axis head)
(Hexagon socket head plug PT3/8)

Grease inlet (L-arm)
(Hexagon socket head plug PT1/8)
9.2 Maintenance for Manipulator

**R-, B-, and T-axes Speed Reducer**

**Grease Replenishment**

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

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.

   **Grease type:** VIGO grease RENo.00  
   **Amount of grease:**  
   - 50 cc for R- and B-axis (100 cc for the 1st supply)  
   - 40 cc for T-axis (80 cc for the 1st supply)

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.

**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.
- If a hose is connected to the grease exhaust port, it is recommended to use the hose whose inner diameter is larger than 8mm and the length is less than 15cm. Otherwise, the grease goes inside of the motor and may cause the failure.
- If a grease pomp is used to inject VIGO grease, the first pressure has to be set 0.1MPa. (recommended pomp : Macnaught USA, Inc. Model No.P3)

Fig. 23 U-axis Speed Reducer
9.2 Maintenance for Manipulator

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.

![Fig. 24 R-, B-, and T-axis Speed Reducer](image)

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.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
</table>

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. 25  S-axis Motor Gasket
9.2 Maintenance for Manipulator

Fig. 26 L-axis Motor Gasket

- Hexagon socket head cap screw M6 (length: 35 mm) (13 screws)
- Conical spring washer 2H (6 washers)
- Tightening torque 10 N-m (1.0 kgf·m)

Fig. 27 U-axis Motor Gasket

- Hexagon socket head cap screw M6 (length: 30 mm) (17 screws)
- Conical spring washer 2H (6 washers)
- Tightening torque 10 N·m (1.0 kgf·m)

- Hexagon socket head cap screw M6 (length: 30 mm) (12 screws)
- Conical spring washer 2H (6 washers)
- Tightening torque 10 N·m (1.0 kgf·m)

- Hexagon socket head cap screw M6 (length: 20 mm) (11 screws)
- Conical spring washer 2H (6 washers)
- Tightening torque 10 N·m (1.0 kgf·m)

- Hexagon socket head cap screw M6 (length: 25 mm) (15 screws)
- Conical spring washer 2H (6 washers)
- Tightening torque 10 N·m (1.0 kgf·m)
Fig. 28  U-arm Motor Gasket
(b) Base
Remove the cover on the backside of the base, and check for wear and tears on the rubber gaskets.
9.2.4 Battery Board Replacement

Two battery boards are installed in the locations shown in "Fig. 30 Battery Board Location".
- Battery board: JARCR-XIS01

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

![Battery Board Location Diagram](image1)

![Battery Board Connection Diagram](image2)

- Hexagon socket head cap screw M6 (length: 20 mm) (6 screws)
- Conical spring washer 2H (6 washers)
- Tightening torque 10 N·m (1.0 kgf·m)

See step 4 below

Battery for S-, L-, U-axes before replacement

See step 6 below

Battery for R-, B-, T-axes before replacement

See step 7 below

New battery board

a: Crimped contact-pin (pin)
b: Crimped contact-pin (socket)
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](image)

- 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.
Fig. 32 Backup Battery Connection for S- and L-axes Motors

Fig. 33 Backup Battery Connection for U-, R-, B-, and T-axes Motors
Connect battery to encoder to save the data before removing connector.

Fig. 34 Connection Diagram

Fig. 35 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-EPX2900. The spare parts list for the MOTOMAN-EPX2900 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

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

Table 6 Spare Parts for the MOTOMAN-EPX2900-B000

<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-1000</td>
<td>Dioson Industries Co., Ltd.</td>
<td>200 ml</td>
<td>-</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>15 kg</td>
<td>-</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. 50</td>
<td>Yaskawa Electric Corporation</td>
<td>16 kg</td>
<td>-</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>HW0380054-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
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<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>
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<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>
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<tr>
<td>B</td>
<td>9</td>
<td>R-, B-, and T-axes speed reducer</td>
<td>HW0386188-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>3</td>
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<td>B</td>
<td>10</td>
<td>Wrist unit</td>
<td>HW0173484-A</td>
<td>Yaskawa Electric Corporation</td>
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<td>1</td>
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<td>C</td>
<td>11</td>
<td>S-axis AC servomotor</td>
<td>HW03865387-A</td>
<td>Yaskawa Electric Corporation</td>
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<td>C</td>
<td>12</td>
<td>L-axis AC servomotor</td>
<td>HW0386610-A</td>
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<tr>
<td>C</td>
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<tr>
<td>C</td>
<td>14</td>
<td>R-, B-, and T-axes AC servomotors</td>
<td>HW0388815-A</td>
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<td>1</td>
<td>3</td>
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<tr>
<td>C</td>
<td>15</td>
<td>Switch unit</td>
<td>HW0272024-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td>Pressure switch</td>
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<tr>
<td>C</td>
<td>16</td>
<td>Internal cable</td>
<td>HW0173713-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>HW0173714-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td>In L-arm</td>
</tr>
</tbody>
</table>
Specifications are subject to change without notice for ongoing product modifications and improvements.