MOTOMAN-ES80R
INSTRUCTIONS
TYPE: YR-ES80R-A0A (STANDARD SPECIFICATION)

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

MOTOMAN INSTRUCTIONS
MOTOMAN-ES80R INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR'S MANUAL
NX100 MAINTENANCE MANUAL

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

Part Number: 155951-1CD
Revision: 0
• This instruction manual is intended to explain operating instructions and maintenance procedures primarily for the MOTOMAN-ES80R.

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

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

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

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

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

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.

In this manual, the Notes for Safe Operation are classified as "WARNING", "CAUTION", "MANDATORY", or "PROHIBITED".

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

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

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

- **PROHIBITED**
  Must never be performed.

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

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

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

Nameplate Warning Label B

WARNING

Do not enter robot work area.

Warning Label A

WARNING

Moving parts may cause injury

Warning Label B

WARNING

Do not enter robot work area.
1  Product Confirmation
   1.1  Contents Confirmation ........................................... 1-1
   1.2  Order Number Confirmation ................................. 1-2

2  Transport
   2.1  Transporting Method ........................................... 2-1
   2.1.1  Using a Crane ................................................. 2-2
   2.1.2  Using a Forklift ............................................. 2-4
   2.2  Shipping Bolts and Brackets ................................ 2-5

3  Installation
   3.1  Installation of Safeguarding ................................. 3-2
   3.2  Mounting Procedures for Manipulator Base ............... 3-2
       3.2.1  When the Manipulator and Mounting Fixture are Installed
               on a Baseplate ........................................... 3-3
       3.2.2  Mounting the Manipulator on the Floor ................... 3-4
   3.3  Types of Mounting .............................................. 3-5
       3.3.1  Affixing the Manipulator Base .................................. 3-5
       3.3.2  Precautions to Prevent the Manipulator from Falling .... 3-5
   3.4  Notes in Mounting the Manipulator on the Ceiling .. 3-6
   3.5  IP (International Protection)for Main Part of the
        Manipulator ..................................................... 3-7
   3.6  Location .......................................................... 3-7

4  Wiring
   4.1  Grounding .......................................................... 4-1
   4.2  Manipulator Cable Connection .................................. 4-2
       4.2.1  Connection to the Manipulator ............................ 4-2
       4.2.2  Connection to the NX100 .................................. 4-2

5  Basic Specifications
   5.1  Basic Specifications ............................................... 5-1
   5.2  Part Names and Working Axes .................................. 5-2
   5.3  Manipulator Base Dimensions ................................ 5-2
5.4 Dimensions and P-Point Maximum Envelope ............. 5-3
5.5 Alterable Operating Range ................................. 5-4

6 Allowable Load for Wrist Axis and Wrist Flange
   6.1 Allowable Wrist Load ....................................... 6-1
   6.2 Wrist Flange .................................................. 6-3

7 System Application
   7.1 Peripheral Equipment Mounts ............................ 7-1
   7.2 Internal User I/O Wiring Harness and Air Lines .... 7-2

8 Electrical Equipment Specification
   8.1 Location of Limit Switches ................................. 8-1
   8.2 Internal Connections ......................................... 8-2

9 Maintenance and Inspection
   9.1 Inspection Schedule ........................................... 9-1
      9.2.1 Battery Pack Replacement ............................. 9-5
   9.3 Notes on Grease Replenishment/Exchange Procedures ........................................... 9-7
      9.3.1 Grease Replenishment/Exchange for S-Axis Speed Reducer ........................................... 9-7
         ▪ Grease Replenishment (Refer to "Fig. 25 S-Axis Speed Reducer "). ................................. 9-7
         ▪ Grease Exchange (Refer to "Fig. 25 S-Axis Speed Reducer "). ......................................... 9-8
      9.3.2 Grease Replenishment/Exchange for L-Axis Speed Reducer ........................................... 9-9
         ▪ Grease Replenishment (Refer to "Fig. 26 L-Axis Speed Reducer "). ................................. 9-9
         ▪ Grease Exchange (Refer to "Fig. 26 L-Axis Speed Reducer "). ......................................... 9-10
      9.3.3 Grease Replenishment/Exchange for U-Axis Speed Reducer ........................................... 9-11
         ▪ Grease Replenishment (Refer to "Fig. 28 U-Axis Speed Reducer "). ................................. 9-12
9.3.4 Grease Replenishment/Exchange for R-Axis Speed Reducer .............................. 9-13
9.3.5 Grease Replenishment/Exchange for B- and T-Axis Speed Reducers and Gears ......................... 9-15
9.3.6 Notes for Maintenance ............................................. 9-17

10  Recommended Spare Parts
1.1 Contents Confirmation

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

- Manipulator
- NX100
- Programming Pendant
- Manipulator cables (3 cables, between the NX100 and the manipulator)

**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.
1.2 Order Number Confirmation

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

Fig. 1 Location of Order Number Labels
2.1 Transporting Method

2 Transport

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sling and crane or forklift operations must be performed by authorized personnel only. Failure to observe this caution may result in injury or damage.</td>
</tr>
<tr>
<td>• Avoid excessive vibration or shock during transport. The system consists of precision components. Failure to observe this caution may adversely affect performance.</td>
</tr>
</tbody>
</table>

2.1 Transporting Method

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The mass of the manipulator is approximately 580 kg including the shipping bolts and brackets. Use a wire rope strong enough to withstand the mass.</td>
</tr>
<tr>
<td>• The attached eyebolts are designed to support the manipulator mass. Never use them for anything other than transporting the manipulator.</td>
</tr>
<tr>
<td>• Mount the shipping bolts and brackets before transporting the manipulator.</td>
</tr>
<tr>
<td>• With any transportation equipment, make sure to avoid external force on the arm or motor unit when transporting the manipulator.</td>
</tr>
</tbody>
</table>
2.1 Transporting Method

2.1.1 Using a Crane

As a rule, when uncrating the manipulator and moving it, a crane should be used. Lift the manipulator with a two-leg bridle sling using the attached eyebolts. Make sure to fix the manipulator with the shipping bolts and a bracket before transport, and lift it in the posture as shown in "Fig. 2 (a) Transport Using a Crane (For Manipulator without External Cables)" and "Fig. 2 (b) Transport Using a Crane (For Manipulator with External Cables)".

Fig. 2 (a) Transport Using a Crane (For Manipulator without External Cables)
2.1 Transporting Method

Fig. 2 (b) Transport Using a Crane (For Manipulator with External Cables)
2.1.2 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 (a) Transport Using a Forklift (For Manipulator without External Cables)" and "Fig. 3 (b) Transport Using a Forklift (For Manipulator with External Cables)". 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 (a) Transport Using a Forklift (For Manipulator without External Cables)

Fig. 3 (b) Transport Using a Forklift (For Manipulator with External Cables)
2.2 Shipping Bolts and Brackets

The manipulator is provided with shipping bolts and brackets at positions as shown in the figures in "2.1 Transporting Method", 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.
# 3 Installation

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Install the safeguarding.</td>
</tr>
<tr>
<td>Failure to observe this warning may result in injury or damage.</td>
</tr>
<tr>
<td>• 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.</td>
</tr>
<tr>
<td>Failure to observe this warning may result in injury or damage.</td>
</tr>
<tr>
<td>• Do not start the manipulator or even turn ON the power before it is firmly anchored.</td>
</tr>
<tr>
<td>The manipulator may overturn and cause injury or damage.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Do not install or operate a manipulator that is damaged or lacks parts.</td>
</tr>
<tr>
<td>Failure to observe this caution may cause injury or damage.</td>
</tr>
<tr>
<td>• Before turning ON the power, check to be sure that the shipping bolts and brackets explained in &quot;2.2 Shipping Bolts and Brackets&quot; are removed.</td>
</tr>
<tr>
<td>Failure to observe this caution may result in damage to the driving parts.</td>
</tr>
</tbody>
</table>
3.1 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.

3.2 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 1 Maximum Repulsion Force of the Manipulator at Emergency Stop" and "Table 2 Endurance Torque in Operation").

A baseplate flatness must be kept at 0.5 mm or less; insufficient flatness of installation surface may deform the manipulator shape and affect its functional abilities.

For installation, refer to "3.2.1 When the Manipulator and Mounting Fixture are Installed on a Baseplate" or "3.2.2 Mounting the Manipulator on the Floor".

<table>
<thead>
<tr>
<th>Table 1</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>19600 N·m (2000 kgf·m)</td>
</tr>
<tr>
<td>Maximum torque in vertical rotation (LU-axis moving direction)</td>
<td>47100 N·m (4800 kgf·m)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Endurance Torque in Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurance torque in horizontal operation</td>
<td>5900 N·m (600 kgf·m)</td>
</tr>
<tr>
<td>Endurance torque in vertical operation</td>
<td>14100 N·m (1440 kgf·m)</td>
</tr>
</tbody>
</table>
3.2.1 When the Manipulator and Mounting Fixture are Installed on a Baseplate

The baseplate should be rugged and durable to prevent shifting of the manipulator or the mounting fixture. The thickness of the baseplate is 50 mm or more and a size of the anchor bolt of M20 or larger is recommended. The manipulator base is tapped for eight hexagon socket head cap screws M20. Fix the manipulator by fastening the manipulator base to the baseplate with the eight hexagon socket head cap screws M20 (Tensile strength: 1200 N/mm² or more) (70 mm length is recommended). Tighten the screws to a tightening torque of 400 N·m (41 kgf·m). Tighten the screws and the anchor bolts securely so that they will not work loose during operation. See "Fig. 4 Mounting the Manipulator on the Baseplate" for the method.

![Fig. 4 Mounting the Manipulator on the Baseplate](image-url)
3.2 Mounting Procedures for Manipulator Base

3.2.2 Mounting the Manipulator 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 force of the manipulator shown in "Table 1 Maximum Repulsion Force of the Manipulator at Emergency Stop". As a rough standard, if there is a concrete thickness (floor) of 200 mm or more, the manipulator base can be fixed directly to the floor with anchor bolts M20. Before mounting the manipulator, however, check that the floor is level and that all cracks, etc. are repaired. Any thickness less than 200 mm is insufficient for mounting, even if the floor is concrete.

![Mounting the Manipulator on the Floor](image)

- **Screw A**: Screw M20 (length: 70) (8 screws); spring washer, flat washer
- **Screw B**: Screw M24 (length: 70) (4 screws); spring washer

The fixing screws and bases are to be prepared by the customer.

Fig. 5 Mounting the Manipulator on the Floor
3.3 Types of Mounting

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

- Affixing the Manipulator Base
- Precautions to Prevent the Manipulator from Falling
- IP (International Protection) for Main Part of the Manipulator (Refer to "3.5 IP (International Protection) for Main Part of the Manipulator ")

3.3.1 Affixing the Manipulator Base

When performing a ceiling installation, be sure to use eight hexagon socket head cap screws M20 (tensile strength: 1200N/mm² or more). Use a torque of 402N·m (41kgf·m) when screwing in the screws.

3.3.2 Precautions to Prevent the Manipulator from Falling

When performing a ceiling installation, for safety purposes, take measures to keep the manipulator from falling. Refer to "Fig. 6 When Using Ceiling-mounted Type" for details.

![Fig. 6 When Using Ceiling-mounted Type](image)

**NOTE**

When using ceiling mounted type, contact your Yaskawa representative.
In the case if the manipulator shipped is the floor-mounted type, yet is to be mounted on the ceiling, mounting positions of the union, hexagon socket head plug PT1/8, grease cap, and air breezer installed in the LU-axes motor base should be changed after installing the manipulator on the ceiling, to prevent a grease leakage from an air breezer. Change the mounting positions of the parts as shown in the figure below.

After installing the manipulator on the ceiling, replace the positions of the parts installed in the LU-axes motor base, by switching the positions of the union and the hexagon socket head plug PT 1/8, and the positions of the grease cap and the air breezer.

Replace the positions of the grease cap and the air breezer promptly, to prevent the grease leakage from a hole where a grease cap is to be installed.

Fig. 7 Parts Positions for Ceiling Mounted Manipulator
3.5 IP (International Protection) for Main Part of the Manipulator

For standard type, environmental resistance for main part of the manipulator conforms to IP54. However, for ceiling mounted type, it does not conform to IP54. Environmental resistance for IP65 is optional.

For wrist part of any mounted type, the resistance conforms to IP67.

**NOTE** When using ceiling mounted type, contact your Yaskawa representative.

3.6 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 Wiring

**WARNING**

- **Ground resistance must be 100 Ω or less.**
  Failure to observe this warning may result in fire or electric shock.
- **Before wiring, make sure to turn OFF the primary power supply, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)**
  Failure to observe this warning may result in fire or electric shock.

**CAUTION**

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

4.1 Grounding

Follow local regulations for grounding line size. A line of 5.5 mm² or more is recommended. Refer to "Fig. 8 Grounding Method" to connect the ground line directly to the manipulator.

**NOTE**

- 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.
4.2 Manipulator Cable Connection

Three manipulator cables are delivered with the manipulator: an encoder cable (1BC) and two power cables (2BC and 3BC). Refer to *Fig. 9 Manipulator Cables*. Connect these cables to the connectors on the manipulator connector base and the NX100 board connectors.

4.2.1 Connection to the Manipulator

Before connecting the manipulator cables to the manipulator, verify the connector numbers: both the cables and the connectors on the manipulator base are marked with 1BC, 2BC, and 3BC. Connect the cables in the order of 2BC, 3BC, 1BC, referring to *Fig. 10 (a) Manipulator Cable Connection (To the Manipulator)*. When connecting, insert each cable connector adjusting its position to the main keys on the connector base of the manipulator, and then set the lever low until it clicks.

4.2.2 Connection to the NX100

Before connecting the manipulator cables to the NX100, verify the connector numbers: both the cables and the connectors on the NX100 are marked with X11, X21, and X22. Connect the cables in the order of X21, X22, X11, referring to *Fig. 10 (b) Manipulator Cable Connection (To the NX100)*. When connecting, insert each cable connector adjusting its position to the main keys on the NX100, and then set the lever low until it clicks.
4.2 Manipulator Cable Connection

Fig. 9 Manipulator Cables
4.2 Manipulator Cable Connection

Fig. 10 (a) Manipulator Cable Connection (To the Manipulator)

Fig. 10 (b) Manipulator Cable Connection (To the NX100)
5.1 Basic Specifications

### Table 3 Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>MOTOMAN-ES80R</td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>6</td>
</tr>
<tr>
<td>Payload</td>
<td>80 kg</td>
</tr>
<tr>
<td>Repeatability 1</td>
<td>±0.07 mm</td>
</tr>
<tr>
<td>S-axis (turning)</td>
<td>±150°</td>
</tr>
<tr>
<td>L-axis (lower arm)</td>
<td>+65°, -140°</td>
</tr>
<tr>
<td>U-axis (upper arm)</td>
<td>+240°, -180°</td>
</tr>
<tr>
<td>R-axis (wrist roll)</td>
<td>±360°</td>
</tr>
<tr>
<td>B-axis (wrist pitch/yaw)</td>
<td>±125°</td>
</tr>
<tr>
<td>T-axis (wrist twist)</td>
<td>±360°</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td></td>
</tr>
<tr>
<td>S-axis</td>
<td>2.27 rad/s, 130°/s</td>
</tr>
<tr>
<td>L-axis</td>
<td>2.44 rad/s, 140°/s</td>
</tr>
<tr>
<td>U-axis</td>
<td>2.79 rad/s, 160°/s</td>
</tr>
<tr>
<td>R-axis</td>
<td>4.01 rad/s, 230°/s</td>
</tr>
<tr>
<td>B-axis</td>
<td>4.01 rad/s, 230°/s</td>
</tr>
<tr>
<td>T-axis</td>
<td>6.11 rad/s, 350°/s</td>
</tr>
<tr>
<td>Allowable Moment 2</td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>372.4 N•m (38 kgf•m)</td>
</tr>
<tr>
<td>B-axis</td>
<td>372.4 N•m (38 kgf•m)</td>
</tr>
<tr>
<td>T-axis</td>
<td>196 N•m (20 kgf•m)</td>
</tr>
<tr>
<td>Allowable Inertia (GD²/4)</td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>20 kg•m²</td>
</tr>
<tr>
<td>B-axis</td>
<td>20 kg•m²</td>
</tr>
<tr>
<td>T-axis</td>
<td>8 kg•m²</td>
</tr>
<tr>
<td>Approx. Mass</td>
<td>Approx. 570 kg</td>
</tr>
<tr>
<td>Ambient Conditions</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>0°C to 40°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>20 to 80% RH at constant temperature</td>
</tr>
<tr>
<td>Vibration Acceleration</td>
<td>Less than 4.9 m/s² (0.5 G)</td>
</tr>
<tr>
<td>Others</td>
<td>• Free from corrosive gas or liquid.</td>
</tr>
<tr>
<td></td>
<td>• Free from water, oil, or dust.</td>
</tr>
<tr>
<td></td>
<td>• Free from excessive electrical noise (plasma).</td>
</tr>
<tr>
<td>Power Capacity</td>
<td>5.0 kVA</td>
</tr>
</tbody>
</table>

1. Conformed to ISO9283
2. Refer to "6.1 Allowable Wrist Load" for details on the allowable moment of inertia.

Note: SI units are used in this table. However, gravitational unit is used in ( ).

5.1 Basic Specifications
5.2 Part Names and Working Axes

![Diagram showing part names and working axes with labels for S+, S-, L-, L+, R+, T+, B+, U+, and U-]

Fig. 11 Part Names and Working Axes

5.3 Manipulator Base Dimensions

![Diagram showing manipulator base dimensions with labels for S+ and S- at the top, and dimensions for various parts labeled with units in mm.]

Fig. 12 Manipulator Base Dimensions
5.4 Dimensions and P-Point Maximum Envelope

Fig. 13 Dimensions and P-Point Maximum Envelope
5.5 Alterable Operating Range

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

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

6   Allowable Load for Wrist Axis and Wrist Flange

6.1   Allowable Wrist Load

The allowable wrist load is 80 kg.
As shown in " Table 5  Allowable Total Moment of Wrist ", the moment of each axis is restricted. Observe the conditions described in this section in applying load on the wrist.

Table 5   Allowable Total Moment of Wrist

<table>
<thead>
<tr>
<th>Axis</th>
<th>Moment Nm (kgf·m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-axis</td>
<td>372.4 (38)</td>
</tr>
<tr>
<td>B-axis</td>
<td>372.4 (38)</td>
</tr>
<tr>
<td>T-axis</td>
<td>196 (20)</td>
</tr>
</tbody>
</table>

*1 ( ): Gravitational unit

The allowable total moment of inertia changes according to the load moment as shown in the " Fig. 14 (a) Allowable Total Moment of Inertia on R-, B-axes " and " Fig. 14 (b) Allowable Total Moment of Inertia on T-axis ". The manipulator shall be operated fulfilling the conditions in these charts. For example, when the load moment on the T-axis is 20 kgf·m, the allowable total moment of inertia is 8 kg·m²; the allowable total moment of inertia becomes 19 kg·m² if the load moment is 0 kgf·m.

When the volume load is small, refer to the moment arm rating shown in " Fig. 15 Moment Arm Rating ".

The allowable total inertia is calculated when the moment is at the maximum. Contact your Yaskawa representative when only inertia, or load moment is small and inertia is large. Also, when the load mass is combined with an outside force, contact your Yaskawa representative.
6.1 Allowable Wrist Load

Fig. 15 Moment Arm Rating
6.2 Wrist Flange

The wrist flange dimensions are shown in "Fig. 16 Wrist Flange". To make the alignment mark visible and to enable an easy grease exchange for the B- and T-axis gears, mount the attachment inside the fitting. Fitting depth of inside and outside fittings must be 5 mm or less.

![Diagram of Wrist Flange]

Fig. 16 Wrist Flange

**NOTE**
Wash off anti-corrosive paint (Yellow) on the wrist flange surface with thinner or light oil before mounting the tools.
7 System Application

7.1 Peripheral Equipment Mounts

The peripheral equipment mounts are fixed on the upper arm for easier installation of the user's system application as shown in "Fig. 17 Installing Peripheral Equipment". Observe the conditions in the figure and table below in mounting the peripheral equipment on the U-axis.

Fig. 17 Installing Peripheral Equipment

<table>
<thead>
<tr>
<th>Section A:</th>
<th>Tapped hole M8 (depth: 15) (pitch: 1.25) (4 holes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section B:</td>
<td>Tapped hole M8 (depth: 15) (pitch: 1.25) (4 holes)</td>
</tr>
<tr>
<td>Section C:</td>
<td>Tapped hole M12 (depth: 18) (pitch: 1.75) (4 holes)</td>
</tr>
</tbody>
</table>
Internal User I/O Wiring Harness and Air Lines

7.2 Internal User I/O Wiring Harness and Air Lines

Internal user I/O wiring harness (0.75 mm$^2$ x 4 wires, 0.5 mm$^2$ x 3 wires and 0.2 mm$^2$ x 14 wires) and one air line are incorporated in the manipulator for the drive of peripheral devices mounted on the upper arm as shown in "Fig. 18 Connectors for Internal User I/O Wiring Harness and Air Lines."

The Fig. 18 also shows the connector pin assignment. Perform wiring referring to the figure and the conditions below.

<table>
<thead>
<tr>
<th>Items</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The allowable current for internal user I/O wiring harness</td>
<td>11 A or less per wire. (0.75 mm$^2$)</td>
</tr>
<tr>
<td></td>
<td>9 A or less per wire. (0.5 mm$^2$)</td>
</tr>
<tr>
<td></td>
<td>3 A or less per wire. (0.2 mm$^2$)</td>
</tr>
<tr>
<td></td>
<td>The total current value for pins 1 to 16 must be 44.2 A or less.</td>
</tr>
<tr>
<td>The maximum pressure for the air line</td>
<td>490 kPa (5 kgf/cm$^2$) or less</td>
</tr>
<tr>
<td></td>
<td>(The air line inside diameter: 8 mm.)</td>
</tr>
</tbody>
</table>
7.2 Internal User I/O Wiring Harness and Air Lines

Fig. 18 Connectors for Internal User I/O Wiring Harness and Air Lines

Connector for internal user I/O wiring harness: JL05-2A20-29SC (socket connector with a cap)
Prepare pin connector JL05-6A20-29P.

Connector for internal user I/O wiring harness: JL05-2A24-28PC (socket connector with a cap)
Prepare pin connector JL05-6A24-28S.

Connector for internal user I/O wiring harness: JL05-2A18-1SC (socket connector with a cap)
Prepare pin connector JL05-6A18-1P.

Pin Details for Internal User I/O Wiring Harness

- Internal user I/O wiring harness: 0.75 mm², 4 wires.
- Internal user I/O wiring harness: 0.2 mm², 14 wires.
- Internal user I/O wiring harness: 0.5 mm², 3 wires.
8.1 Location of Limit Switches

Limit switches are optional. For location, refer to "Fig. 19 Location of Limit Switches".

Fig. 19 Location of Limit Switches
8.2 Internal Connections

Highly reliable connectors are equipped on each connection part of the manipulator to enable easy removal and installation for maintenance and inspection. For the numbers, types, and locations of connectors, see "Fig. 20 Location of Connectors" and "Table 7 List of Connector Types".

![Fig. 20 Location of Connectors]

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Connector</th>
</tr>
</thead>
</table>
| Connector for internal user I/O wiring harness on connector base | JL05-2A24-28PC  
Prepare JL05-6A24-28S (optional) |
| Connector for internal user I/O wiring harness on U-arm               | JL05-2A20-29SC  
Prepare JL05-6A20-29P (optional) |
|                                                | JL05-2A18-1SC  
Prepare JL05-6A18-1P (optional) |
Note:

For the limit switch specification, the connection of the section A is changed as follows:

Optional Specification: SLU-axes with Limit Switches

Fig. 21 (a) Internal Connection Diagram (CSL2500D-1800/2400: Standard Specification Board)
Fig. 21 (b) Internal Connection Diagram (CSL2500D-1800/2400: Standard Specification Board)
9 Maintenance and Inspection

**WARNING**

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

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

**CAUTION**

- Maintenance and inspection must be performed by specified personnel.

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

- For disassembly or repair, contact your Yaskawa representative.

- Do not remove the motor, and do not release the brake.

Failure to observe this caution may result in injury from unexpected turning of the manipulator’s arm.

- The battery pack must be connected before removing encoder connector when maintenance and inspection.

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

### 9.1 Inspection Schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation. Inspection intervals are classified into six levels as shown in "Table 8 Inspection Items". Conduct periodical inspections according to the inspection schedule in the table.

In Table 8, the inspection items are categorized by three types of operations: operations which can be performed by personnel authorized by 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 the inspection work.

- The inspection interval depends on the total servo operation time.

- If axes are used very frequently (in handling applications, etc.), inspections may be required at shorter intervals. Contact your Yaskawa representative.
### Table 8 Inspection Items

<table>
<thead>
<tr>
<th>Items†</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily H Cycle</td>
<td>1000</td>
<td>6000</td>
<td>12000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 H Cycle</td>
<td>6000 H Cycle</td>
<td>12000 H Cycle</td>
</tr>
<tr>
<td>1</td>
<td>Alignment marks</td>
<td>O</td>
<td>Visual</td>
<td>Check alignment mark according to the home position.</td>
</tr>
<tr>
<td>2</td>
<td>External cables</td>
<td>O</td>
<td>Visual</td>
<td>Check for damage and deterioration.</td>
</tr>
<tr>
<td>3</td>
<td>Working area and whole exterior of manipulator</td>
<td>O</td>
<td>Visual</td>
<td>Clean the work area if dust or spatter is present. Check for damage and outside cracks.</td>
</tr>
<tr>
<td>4</td>
<td>SLU-axis motors</td>
<td>O</td>
<td>Visual</td>
<td>Check for grease leakage.</td>
</tr>
<tr>
<td>5</td>
<td>Baseplate mounting bolts</td>
<td>O</td>
<td>Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
</tr>
<tr>
<td>6</td>
<td>Cover mounting screws</td>
<td>O</td>
<td>Screwdriver, Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
</tr>
<tr>
<td>7</td>
<td>SLU-axis motor connectors</td>
<td>O</td>
<td>Manual</td>
<td>Check for loose connectors and tighten if necessary.</td>
</tr>
<tr>
<td>8</td>
<td>Connector base</td>
<td>O</td>
<td>Manual</td>
<td>Check for loose connectors.</td>
</tr>
<tr>
<td>9</td>
<td>RB-axis timing belts</td>
<td>O</td>
<td>Manual</td>
<td>Check for belt tension or wear.</td>
</tr>
<tr>
<td>10</td>
<td>Wire harness in manipulator</td>
<td>O</td>
<td>Visual, Multimeter</td>
<td>Check for conduction between the main connector of base and intermediate connector by manually shaking the wires. Check for wear of protective spring.</td>
</tr>
<tr>
<td>11</td>
<td>Battery pack in manipulator</td>
<td>O</td>
<td></td>
<td>Replace the battery pack when the battery alarm occurs or when the manipulator has been operated for 36000H.</td>
</tr>
<tr>
<td>12</td>
<td>S-axis speed reducer</td>
<td>O</td>
<td>Grease Gun</td>
<td>Check for malfunction. (Replace if necessary) Supply grease™ (6000H cycle). Exchange grease™ (12000H cycle).</td>
</tr>
</tbody>
</table>


9.1 Inspection Schedule

**Table 8 Inspection Items**

<table>
<thead>
<tr>
<th>Items*1</th>
<th>Schedule</th>
<th>Method</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>LU-axis speed reducers</td>
<td>Daily</td>
<td>1000 H Cycle</td>
<td>Grease Gun</td>
</tr>
<tr>
<td></td>
<td>6000 H Cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12000 H Cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24000 H Cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36000 H Cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-axis speed reducer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BT-axis speed reducers and gears</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhaul</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 9 Inspection Parts and Grease Used**

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>12, 13, 14, 15</td>
<td>VIGO Grease RE No. 0</td>
<td>Speed reducers for all axes B-, T-axis gears</td>
</tr>
</tbody>
</table>

- *1 Inspection No. corresponds to the numbers in *Fig. 22 Inspection Parts and Inspection Numbers*.
- *2 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.
- *3 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 may be lost. (Refer to 9.3.6.)
- *4 For the grease, refer to *Table 9 Inspection Parts and Grease Used*.
- *5 The application that requires highly frequent operation such as handling may cause grease leakage of air breather or the internal pressure rise of speed reducer. Contact your Yaskawa representative.

Inspection numbers correspond to the numbers in *Table 8 Inspection Items*.
9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

The battery packs (type: HW0470360-A) are attached in the two locations as shown in "Fig. 23 Battery Location".

(a) Back View

(b) Front View

Fig. 23 Battery Location
9.2 Notes on Maintenance Procedures

Fig. 24 Battery Connection

1. Turn OFF the NX100 main power supply.
2. Remove the cover plate fastening screws M4 and from the connector base and pull out the battery pack to replace with a new battery pack.
3. Remove the old battery pack from the battery holder.
4. Connect the new battery pack to the unoccupied connector on the board.
5. Remove the old battery pack from the board.
6. Mount the new battery pack to the battery holder.
7. Reinstall the plate and fix it with the plate fastening screws M4.

**NOTE**
Connect the new battery pack before removing the old one so that the encoder absolute data does not disappear.

**NOTE**
Be sure not to pinch the cable when putting the plate back into place.
9.3 Notes on Grease Replenishment/Exchange Procedures

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

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

9.3.1 Grease Replenishment/Exchange for S-Axis Speed Reducer

Grease Replenishment (Refer to "Fig. 25  S-Axis Speed Reducer ".)

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

   - If grease is injected with the plug on, the grease will go inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.

2. Remove the hexagon socket head plug PT1/4 from the grease inlet and install the grease zerk PT1/4. (The grease zerk is delivered with the manipulator.)
3. Inject grease into the grease inlet using a grease gun.

<table>
<thead>
<tr>
<th>Grease type: VIGO Grease RE No. 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease: 700 cc</td>
</tr>
<tr>
<td>(1400 cc for 1st supply)</td>
</tr>
<tr>
<td>Air supply pressure of grease pump: 0.3 MPa or less</td>
</tr>
<tr>
<td>Grease injection rate: 8 g/s or less</td>
</tr>
</tbody>
</table>

4. Move the S-axis for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth and reinstall the plug PT1/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
6. Remove the grease zerk from the grease inlet and reinstall the plug PT1/4. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 12 N·m (1.2 kgf·m).

7. Remove the grease zerk from the grease inlet and reinstall the plug PT1/4. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 12 N·m (1.2 kgf·m).

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

If the plug 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.
9.3.2 Grease Replenishment/Exchange for L-Axis Speed Reducer

- **Grease Replenishment (Refer to "Fig. 26  L-Axis Speed Reducer ")**

1. Tilt the L-arm vertical to the ground.
2. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.

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

3. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
4. Inject grease into the grease inlet using a grease gun.

   - **Grease type:** VIGO Grease RE No. 0
   - **Amount of grease:** 250 cc  
     (500 cc for 1st supply)
   - **Air supply pressure of grease pump:** 0.3 MPa or less
   - **Grease injection rate:** 8 g/s or less

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

- Grease Exchange (Refer to "Fig. 26 L-Axis Speed Reducer").

1. Tilt the L-arm vertical to the ground.
2. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.

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

3. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
4. Inject grease into the grease inlets using a grease gun.

**Grease type:** VIGO Grease RE No. 0  
**Amount of grease:** approx. 1650 cc  
**Air supply pressure of grease pump:** 0.3 MPa or less  
**Grease injection rate:** 8 g/s or less

5. The grease exchange is completed when new grease appears in the exhaust port. The new grease can be distinguished from the old grease by color.
6. Move the L-axis for a few minutes to discharge excess grease.
7. Wipe the discharged grease with a cloth and reinstall the plug PT1/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

**NOTE**
If the plug 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.

8. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
9.3.3 Grease Replenishment/Exchange for U-Axis Speed Reducer

Fig. 27 U-Arm Posture in Grease Replenishment/Exchange for U-Axis Speed Reducer

Fig. 28 U-Axis Speed Reducer
9.3 Notes on Grease Replenishment/Exchange Procedures

**Grease Replenishment (Refer to " Fig. 28 U-Axis Speed Reducer ").**

1. Tilt the U-arm horizontal to the ground. (Refer to " Fig. 27 U-Arm Posture in Grease Replenishment/Exchange for U-Axis Speed Reducer ".)
2. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.

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

3. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
4. Inject grease into the grease inlet using a grease gun.

   | Grease type: VIGO Grease RE No. 0 |
   | Amount of grease: 170 cc          |
   | (340 cc for 1st supply)           |
   | Air supply pressure of grease pump: 0.3 MPa or less |
   | Grease injection rate: 8 g/s or less |

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

**Grease Exchange (Refer to " Fig. 28 U-Axis Speed Reducer ").**

1. Tilt the U-arm horizontal to the ground. (Refer to " Fig. 27 U-Arm Posture in Grease Replenishment/Exchange for U-Axis Speed Reducer ".)
2. Remove the hexagon socket head plug PT1/8 from the grease exhaust port.

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

3. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
4. Inject grease into the grease inlet using a grease gun.

   | Grease type: VIGO Grease RE No. 0 |
   | Amount of grease: 850 cc          |
   | Air supply pressure of grease pump: 0.3 MPa or less |
   | Grease injection rate: 8 g/s or less |
5. The grease exchange is completed when new grease appears in the grease exhaust port. The new grease can be distinguished from the old grease by color.

6. Move the U-axis for a few minutes to discharge excess grease.

7. Wipe the discharged grease with a cloth and reinstall the plug PT1/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

8. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

9.3.4 Grease Replenishment/Exchange for R-Axis Speed Reducer

---

**NOTE**

If the plug 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.

8. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

9.3.4 Grease Replenishment/Exchange for R-Axis Speed Reducer

- Grease Replenishment (Refer to "Fig. 29 R-Axis Speed Reducer ").

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

**NOTE**

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

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

![Grease type: VIGO Grease RE No. 0
Amount of grease: 90 cc
(180 cc for 1st supply)
Air supply pressure of grease pump: 0.3 MPa or less
Grease injection rate: 8 g/s or less]

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

**Grease Exchange (Refer to "Fig. 29 R-Axis Speed Reducer").**

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

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

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

   ![Grease type: VIGO Grease RE No. 0
   Amount of grease: 410 cc
   Air supply pressure of grease pump: 0.3 MPa or less
   Grease injection rate: 8 g/s or less]

4. The grease exchange is completed when new grease appears from the grease exhaust port. The new grease is distinguished from the old grease by color.
5. Move the R-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth and reinstall the plug PT1/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

   ![NOTE
   If the plug 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.]

7. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
9.3.5 Grease Replenishment/Exchange for B- and T-Axis Speed Reducers and Gears

- Grease Replenishment (Refer to "Fig. 30 B- and T-Axis Speed Reducers and Gears ")

1. Remove the hexagon socket head set screw M6 from the grease exhaust port.

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

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

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

   **NOTE**

   - Grease type: VIGO Grease RE No. 0
   - Amount of grease: 300 cc
     (600 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. Move the B-axis for a few minutes to discharge excess grease.

5. Wipe the discharged grease with a cloth and reinstall the set screw M6 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the set screw, and tighten the set screw with a tightening torque of 3.9 N·m (0.4 kgf·m).

6. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

### Grease Exchange (Refer to "Fig. 30  B- and T-Axis Speed Reducers and Gears ")

1. Remove the hexagon socket head set screw M6 from the grease exhaust port.

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

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

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

   - **Grease type:** VIGO Grease RE No. 0
   - **Amount of grease:** 1500 cc
   - **Air supply pressure of grease pump:** 0.3 MPa or less
   - **Grease injection rate:** 8 g/s or less

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

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

6. Wipe the discharged grease with a cloth and reinstall the set screw M6 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the set screw, and tighten the set screw with a tightening torque of 3.9 N·m (0.4 kgf·m).

   **NOTE**
   If the plug 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.

7. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
9.3.6 Notes for Maintenance

When performing maintenance such as replacement of a wire harness in the manipulator, the encoder connector may be necessary to be removed. In this case, be sure to connect the battery pack to the battery backup connector before removing the encoder connector. Removing the encoder connector without connecting the battery pack leads to disappearance of the encoder absolute data.

For the battery pack connection, refer to "Fig. 31 Battery Pack Connection for Motors".

Battery Pack Connection for Motors

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

1. Remove a cap attached to battery backup connectors of the motor.
2. Connect a battery pack (HW9470932-A) to the battery backup connectors (BAT and OBT are marked) located at the end point of an encoder cable. With the battery pack connected to the battery backup connectors, perform maintenance check.
3. After the maintenance check, confirm all connectors are connected and remove the battery pack. Reinstall the cap onto the battery backup connectors of the motor.

Do not remove battery pack in the connector base.

Fig. 31 Battery Pack Connection for Motors
10 Recommended Spare Parts

It is recommended to keep the parts and components in the following table in stock as spare parts for the MOTOMAN-ES80R. 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 Unit

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

Table 10 Spare Parts for the MOTOMAN-ES80R

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty per Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Grease</td>
<td>VIGO Grease RE No. 0</td>
<td>Yaskawa Electric Corporation</td>
<td>16 kg</td>
<td>For all axis speed reducers and wrist units</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>Liquid Gasket</td>
<td>Three Bond 1206C</td>
<td>ThreeBond Co., Ltd.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Battery Pack</td>
<td>HW9470932-A</td>
<td>Yaskawa Electric Corporation</td>
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<td>1</td>
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<td>A</td>
<td>4</td>
<td>Battery Pack</td>
<td>HW9470390-A</td>
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<td>B</td>
<td>5</td>
<td>R-axis Timing Belt</td>
<td>25055M520</td>
<td>Bando Chemical Industries, Ltd.</td>
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<td>B</td>
<td>6</td>
<td>B-axis Timing Belt</td>
<td>25055M475</td>
<td>Bando Chemical Industries, Ltd.</td>
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<td>B</td>
<td>7</td>
<td>S-axis Speed Reducer</td>
<td>HW9381671-A</td>
<td>Yaskawa Electric Corporation</td>
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<td>B</td>
<td>8</td>
<td>S-axis Input Gear</td>
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<td>9</td>
<td>L-axis Speed Reducer</td>
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<td>Yaskawa Electric Corporation</td>
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<td>10</td>
<td>L-axis Input Gear</td>
<td>HW040904-1</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>
</tr>
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<td>B</td>
<td>11</td>
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<td>B</td>
<td>15</td>
<td>T-axis Speed Reducer</td>
<td>HW9381635-D</td>
<td>Yaskawa Electric Corporation</td>
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<td>C</td>
<td>16</td>
<td>AC Servomotor for S-axis</td>
<td>SGMRS-30A2A-YR1*</td>
<td>Yaskawa Electric Corporation</td>
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<td>1</td>
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<tr>
<td>C</td>
<td>17</td>
<td>AC Servomotor for L-axis</td>
<td>SGMRS-44A2A-YR2*</td>
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<td>C</td>
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<td>AC Servomotor for U-axis</td>
<td>SGMRS-20A2A-YR2*</td>
<td>Yaskawa Electric Corporation</td>
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<td>1</td>
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<tr>
<td>C</td>
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<td>AC Servomotors for R-, B-, and T-axes</td>
<td>SGMRS-12A2B-YR1*</td>
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<td>Wire Harness in Manipulator</td>
<td>HW0174096-A</td>
<td>Yaskawa Electric Corporation</td>
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<td>21</td>
<td>Wire Harness in Manipulator</td>
<td>HW0372351-C</td>
<td>Yaskawa Electric Corporation</td>
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</tbody>
</table>
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