MOTOMAN-HP20
INSTRUCTIONS

TYPE: YR-HP20-A00 (STANDARD SPECIFICATIONS)
YR-HP20-A01 (WITH SLU-AXES LIMIT SWITCHES)

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

MOTOMAN INSTRUCTIONS
MOTOMAN-HP20 INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR’S MANUAL
NX100 MAINTENANCE MANUAL

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

Please have the following information available when contacting Yaskawa Customer Support:
- System
- Primary Application
- Software Version (Located on Programming Pendant by selecting: (Main Menu) - (System Info) - (Version))
- Robot Serial Number (Located on robot data plate)
- Robot Sales Order Number (Located on controller data plate)

Part Number: 149615-1CD
Revision: 2
This instruction manual is intended to explain operating instructions and maintenance procedures primarily for the MOTOMAN-HP20.

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

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

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

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

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

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

Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.
In this manual, the Notes for Safe Operation are classified as "WARNING," "CAUTION," "MANDATORY," or "PROHIBITED."

- **WARNING**: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
- **CAUTION**: Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
- **MANDATORY**: Always be sure to follow explicitly the items listed under this heading.
- **PROHIBITED**: Must never be performed.

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

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

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

Emergency Stop Button

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

Injury may result from unintentional or unexpected manipulator motion.

Release of Emergency Stop

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

Improper or unintended manipulator operation may result in injury.

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

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem.

The emergency stop buttons are located on the right of the front door of the NX100 and the programming pendant.
Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product. The manipulator usually consists of the controller, the programming pendant, and supply cables. In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX100 Controller</td>
<td>NX100</td>
</tr>
<tr>
<td>NX100 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
<tr>
<td>Cable between the Manipulator and the Controller</td>
<td>Manipulator Cable</td>
</tr>
</tbody>
</table>

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 manipulator, on the floor, or near fixtures.
- Read and understand the Explanation of the Warning Labels in the NX100 Instructions before operating the manipulator.
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.

![Diagram of warning labels and nameplate]
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1 Product Confirmation

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>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.</strong></td>
</tr>
<tr>
<td>If the numbers do not match, manipulators may not perform as expected and cause injury or damage.</td>
</tr>
</tbody>
</table>

1.1 Contents Confirmation

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

- Manipulator
- NX100
- Programming pendant
- Manipulator cable
1.2 Order Number Confirmation

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

Label (Enlarged View)

![Label](image)

Check that the manipulator and the NX100 have the same order number.

(a) NX100 (Front View)
(b) Manipulator (Top View)

Fig. 1 Location of Order Number Labels
2.1 Transporting Method

2.1.1 Using a Crane

As a rule, when removing the manipulator from the package and moving it, a crane should be used. The manipulator should be lifted using wire rope threaded through attached eyebolts. Be sure the manipulator is fixed with shipping bolts and brackets before transportation, and lift it in the posture as shown in "Fig. 2  Transporting Position".

- Check that the eyebolts are securely fastened.
- The mass of the manipulator is approximately 280 kg including the shipping bolts and brackets. Use a wire rope strong enough to withstand the mass.
- Attached eyebolts are designed to support the manipulator mass. Do not use them for anything other than transporting the manipulator.
- Be sure to mount the shipping bolts and brackets before transporting the manipulator. (Refer to "Fig. 2  Transporting Position").
- Avoid external force on the arm or motor unit when transporting the manipulator. Use caution when using transporting equipment other than a crane or forklift to avoid injury.
2.1 Transporting Method

Fig. 2  Transporting Position

Eyebolt M12 (2 eyebolts)
(delivered with the manipulator)
2.1 Transporting Method

2.1.2 Using a Forklift

When using a forklift, the manipulator should be fixed on a pallet with shipping bolts and brackets as shown in "Fig. 3 Using the Forklift." Insert claws under the pallet and lift it. The pallet must be strong enough to support the manipulator. Transportation of the manipulator must be performed slowly in order to avoid overturning or slippage.

Fig. 3 Using the Forklift
2.2 Shipping Bolts and Brackets

The manipulator is provided with shipping bolts and brackets at sections A and B. ("Fig. 2 Transporting Position")

- The brackets in the sections A and B are painted yellow.
- The section A is fixed with a hexagon socket head cap screw M8, and the section B is fixed with two hexagon socket head cap screws M6.
- A rubber cushion is respectively wedged at the sections C and D.

**NOTE**
Before turning ON the power, check to be sure that the shipping bolts, brackets, and rubber cushions have been removed. The shipping bolts, brackets, and rubber cushions then must be stored for future use, in the event that the manipulator must be moved again.
3 Installation

**WARNING**

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

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

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

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

**CAUTION**

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

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

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

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

3.2 Mounting Procedures for Manipulator Base

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

<table>
<thead>
<tr>
<th>Table. 1 Maximum Repulsion Forces of the Manipulator at Emergency Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal rotating maximum torque</strong></td>
</tr>
<tr>
<td><strong>Vertical rotating maximum torque</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table. 2 Endurance Torque in Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endurance torque in horizontal operation</strong></td>
</tr>
<tr>
<td><strong>Endurance torque in vertical operation</strong></td>
</tr>
</tbody>
</table>
3.2 Mounting Procedures for Manipulator Base

3.2.1 Installation Example

For the first process, anchor the baseplate firmly on the floor. The baseplate should have enough rigidity, which is 32 mm or more in thickness. The size of the anchor bolt recommended for the baseplate fixation is M16 or larger.

Next, fix the manipulator base to the baseplate. There are 4 mounting holes on the manipulator base: securely fix the manipulator to the baseplate using 4 hexagon head screws M16 (60 mm long is recommended). Tighten the hexagon head screws and anchor bolts firmly so that they will not be loosened during the operation. See "Fig. 4 Manipulator Installation Example" for the method.
3.3 Installation Method

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

- S-axis Operating Range
- Fixing the Manipulator Base
- Precautions to Prevent the Manipulator from Falling
- IP (International Protection) for Main Part of the Manipulator

3.3.1 S-axis Operating Range

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

3.3.2 Fixing the Manipulator Base

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

3.3.3 Precautions to Prevent the Manipulator from Falling

For the wall- or ceiling-mounted types, take appropriate measures to avoid the falling of the manipulator in case of emergency. Refer to "Fig. 5 When Using Ceiling and Wall-mounted Types" for details.

![Fig. 5 When Using Ceiling and Wall-mounted Types](image-url)
3.4 Location

### 3.3.4 IP (International Protection) for Main Part of the Manipulator

For wall-mounted or ceiling mounted types, environmental resistance for main part of the manipulator does not conform to IP54; environmental resistance for IP65 is optionally available. However, the wrist part conforms to IP67.

**NOTE**

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

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### 3.4 Location

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

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

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Ground resistance must be 100 Ω or less.</strong></td>
</tr>
<tr>
<td>Failure to observe this warning may result in fire or electric shock.</td>
</tr>
<tr>
<td>• <strong>Before wiring, make sure to turn the primary power supply OFF, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)</strong></td>
</tr>
<tr>
<td>Failure to observe this warning may result in fire or electric shock.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Wiring must be performed by authorized or certified personnel.</strong></td>
</tr>
<tr>
<td>Failure to observe this caution may result in fire or electric shock.</td>
</tr>
</tbody>
</table>
4.1 Grounding

Follow the local regulations and electrical installation standards for grounding. The recommended grounding wire size is 5.5 mm² at minimum. For grounding, connect the ground wire directly to the manipulator as shown in "Fig. 6 Grounding Method".

- Do not use this line in common with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.
- Where metal ducts, metallic conduits, or distributing racks are used for cable laying, ground in accordance with Electric Equipment Technical Standards.

Fig. 6  Grounding Method

4.2 Manipulator Cable Connection

There are two manipulator cables; an encoder cable for detection (1BC) and power cable (2BC). (Refer to "Fig. 7 Manipulator Cables (1BC and 2BC).") Connect these cables respectively to the connectors at the manipulator base and the NX100. Refer to " Fig. 8 (a) Manipulator Cable Connection to the Manipulator ", and " Fig. 8 (b) Manipulator Cable Connection to the NX100 ".

Bolt M8 (for grounding) (delivered with the manipulator)
4.2 Manipulator Cable Connection

4.2.1 Connection to the Manipulator

Before connecting the manipulator cables to the manipulator, verify the numbers: 1BC and 2BC on both the cables and the connectors of the manipulator. Connect 2BC first, and then connect 1BC. After inserting the cables, lower each lever until it clicks.

4.2.2 Connection to the NX100

Before connecting the manipulator cables to the NX100, verify the numbers: 1BC and 2BC on both the cables and the NX100 connectors. Connect 2BC first, and then connect 1BC. After inserting the cables, lower each lever until it clicks.

Fig. 7 Manipulator Cables (1BC and 2BC)
4.2 Manipulator Cable Connection

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

Fig. 8 (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-HP20</td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>6</td>
</tr>
<tr>
<td>Payload</td>
<td>20 kg</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±0.06 mm</td>
</tr>
<tr>
<td>Range of Motion</td>
<td></td>
</tr>
<tr>
<td>S-axis (turning)</td>
<td>±180°</td>
</tr>
<tr>
<td>L-axis (lower arm)</td>
<td>±155°, -110°</td>
</tr>
<tr>
<td>U-axis (upper arm)</td>
<td>±255°, -185°</td>
</tr>
<tr>
<td>R-axis (wrist roll)</td>
<td>±200°</td>
</tr>
<tr>
<td>B-axis (wrist pitch/yaw)</td>
<td>±235°, -80°</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>2.96 rad/s, 170°/s</td>
</tr>
<tr>
<td>L-axis</td>
<td>2.96 rad/s, 170°/s</td>
</tr>
<tr>
<td>U-axis</td>
<td>3.05 rad/s, 175°/s</td>
</tr>
<tr>
<td>R-axis</td>
<td>6.20 rad/s, 365°/s</td>
</tr>
<tr>
<td>B-axis</td>
<td>6.02 rad/s, 345°/s</td>
</tr>
<tr>
<td>T-axis</td>
<td>9.16 rad/s, 525°/s</td>
</tr>
<tr>
<td>Allowable Moment</td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>39.2 N·m (0.9 kgf·m)</td>
</tr>
<tr>
<td>B-axis</td>
<td>39.2 N·m (0.9 kgf·m)</td>
</tr>
<tr>
<td>T-axis</td>
<td>19.6 N·m (0.25 kgf·m)</td>
</tr>
<tr>
<td>Allowable Inertia (GD²/A²)</td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>0.9 kg·m²</td>
</tr>
<tr>
<td>B-axis</td>
<td>0.9 kg·m²</td>
</tr>
<tr>
<td>T-axis</td>
<td>0.25 kg·m²</td>
</tr>
<tr>
<td>Mass</td>
<td>280 kg</td>
</tr>
<tr>
<td>Ambient Conditions</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>0 to 45°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>20 to 80% RH (at constant temperature)</td>
</tr>
<tr>
<td>Vibration Acceleration</td>
<td>4.9 m/s² (0.5G) or less</td>
</tr>
<tr>
<td>Others</td>
<td>• Free from corrosive gasses or liquids, or explosive gasses</td>
</tr>
<tr>
<td></td>
<td>• Clean and dry</td>
</tr>
<tr>
<td></td>
<td>• Free from excessive electrical noise (plasma)</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>2.8 kVA</td>
</tr>
</tbody>
</table>

*1 SI units are used in this table. However, gravitational unit is used in ( ).
*2 Conformed to ISO9283
*3 Refer to *6.1 Allowable Wrist Load * for details on the allowable moment and inertia.
*4 Conformed to IP54 for the main part of the manipulator (floor-mounted type only). Conformed to IP67 for the Wrist part (IP65 for the main part is optional.)
Fig. 9 Part Names and Working Axes
Fig. 10  Manipulator Base Dimensions

Units: mm
5.4 Dimensions and P-Point Maximum Envelope

Fig. 11 Dimensions and P-point Maximum Envelope

Units: mm
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 Working Range." If alteration is necessary, contact your Yaskawa representative in advance.

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

6 Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

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

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

*1 ( ): Gravitational unit

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

![Fig. 12 Moment Arm Rating](image-url)
6.2 Wrist Flange

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

- Wash off anti-corrosive paint (yellow color) on the wrist flange surface with thinner or light oil before mounting the tools.
- Mount the attachment with the mounting bolts (length: 10 mm or less).

Failure to observe this instruction may affect the manipulator performance.
7 System Application

7.1 Peripheral Equipment Mounts

The peripheral equipment mounts are fixed on the upper arm for easier installation of the user’s system application as shown in "Fig. 14 Installing Peripheral Equipment Mounts". When peripheral equipment is attached to the U-axis, the following conditions should be observed.

7.1.1 Allowable Load

The allowable load on the U-axis is a maximum of 31 kg, including the wrist load. For instance, when the mass installed in the wrist point is 20 kg, the mass which can be installed on the upper arm is 11 kg.

7.1.2 Installation Position

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

Fig. 14 Installing Peripheral Equipment Mounts
7.2 Internal User I/O Wiring Harness and Air Line

14 wires (0.2 mm² x 8 wires and 1.25 mm² x 6 wires) and an air line are used in the manipulator for the drives of the peripheral devices mounted on the upper arm as shown in "Fig. 16 Internal User I/O Wiring Harness and Air Line ". The connector pins (1 to 16) are assigned as shown in "Fig. 17 Detailed Drawing of Connector Pin Numbers." Wiring must be performed by users, following the conditions below:

- The allowable current for cables: 3 A or less for each cable (the total current value for pins 1 to 16 must be 40 A or less)
- The maximum pressure for the air line: 490 kPa (5 kgf/cm²) or less (the inside diameter: 6.5 mm)
The 7th pin and 8th pin of 3BC connector on the U-arm are respectively connected with the shock sensor power supply and shock sensor signal input port of the NX100 controller.

- The 7th pins and 8th pins of respective 3BC connectors are not connected with each other.
- For the wiring, refer to "Fig. 20 (a) Internal Connection Diagram" on page 8-3.

The same pin number (1-16) of two connectors is connected by the lead wire of single 0.2 mm² or 1.25 mm².
8 Electrical Equipment Specification

8.1 Position of Limit Switch

Limit switches are optional. Refer to Fig. 18 Location of Limit Switch for location. A manipulator type with the S- or L-axis overrun limit switch or the LU-axes interference limit switch is YR-HP20-A01.

![Diagram of Limit Switches](image-url)
8.2 Internal Connections

High reliability connectors which can be easily put on and removed are used with each connector part. For the numbers, types, and locations of connectors, refer to "Fig. 19 Location and Numbers of Connectors." Diagrams for internal connections of the manipulator are shown in "Fig. 20 (a) Internal Connection Diagram" and in "Fig. 20 (b) Internal Connection Diagram".

![Internal Connection Diagram](image)

Table 6 List of Connector Types

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector for internal user I/O wiring harness on connector base</td>
<td>JL05-2A20-29PC (JL05-6A20-29S: Optional)</td>
</tr>
<tr>
<td>Connector for internal user I/O wiring harness on U-arm</td>
<td>JL05-2A20-29SC (JL05-6A20-29P: Optional)</td>
</tr>
</tbody>
</table>

Fig. 19 Location and Numbers of Connectors
8.2 Internal Connections

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

- The pins No.7 and No.8 of 3BC connector on the U-arm are respectively connected with the shock sensor power supply and shock sensor signal input port of the NX100 controller.

- In case of connecting the pin No.7 and No.8 of respective 3BC connectors on the U-arm and connector base, the connection in the section B should be changed as shown in the section C below. (Contact your Yaskawa representative in case of modifying the wiring before use.)

Fig. 20 (a) Internal Connection Diagram
Fig. 20 (b) Internal Connection Diagram
9 Maintenance and Inspection

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. Conduct periodical inspections according to the inspection schedule in "Table 7 Inspection Items".

In "Table 7 Inspection Items", the inspection items are categorized by three types of operations: 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 the inspection work.

- The inspection interval must be based on the servo power supply ON time.
- These inspections were developed for applications where the manipulator is used for arc welding work. For any different or special applications, the inspection process should be developed on an case-by-case basis.
- For axes which are used very frequently (in handling applications, etc.), it is recommended that inspections be conducted at shorter intervals. Contact your Yaskawa representative.

WARNING

• Before maintenance or inspection, be sure to turn the main power supply OFF, 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.

• The battery pack must be connected before removing detection connector when maintenance and inspection.

Failure to observe this caution may result in the loss of home position data.
## 9.1 Inspection Schedule

### Table 7: 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</td>
<td>1000 H Cycle</td>
<td>6000 H Cycle</td>
<td>12000 H Cycle</td>
</tr>
<tr>
<td>① Alignment mark</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>② External lead</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>③ Working area and whole exterior of manipulator</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>④ SLU-axis motors</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑤ Manipulator base mounting bolts</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑥ Cover mounting screws</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑦ Connector base</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑧ BT-axis timing belts</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑨ Wire harness in manipulator (for SLU-axis) (for RBT-axis)</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑩ Wire harness in manipulator (for BT-axis)</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑪ Battery pack in manipulator</td>
<td>○</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>⑫ S-axis speed reducer</td>
<td>○</td>
<td>○</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9.1 Inspection Schedule

When checking for conduction with multimeter, connect the battery pack 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 “9.2.9 Notes for Maintenance.”)

Internal cables to be replaced at 24000H inspection.

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

Inspection No. correspond to the numbers in “Fig. 21 Inspection Parts and Inspection Numbers (Manipulator in Home Position).”

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

---

### Table. 7 Inspection Items

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LU-axes speed reducers</td>
<td>Daily 1000 H Cycle</td>
<td>Grease Gun</td>
<td>O O O</td>
</tr>
<tr>
<td></td>
<td>RBT-axes speed reducers</td>
<td>Daily 1000 H Cycle</td>
<td>Grease Gun</td>
<td>O O O</td>
</tr>
<tr>
<td></td>
<td>T-axis gear</td>
<td>Daily 12000 H Cycle</td>
<td>Grease Gun</td>
<td>O O O</td>
</tr>
<tr>
<td></td>
<td>R-axis cross roller bearing</td>
<td>Daily 24000 H Cycle</td>
<td>Grease Gun</td>
<td>O O O</td>
</tr>
<tr>
<td></td>
<td>Overhaul</td>
<td>Daily 36000 H Cycle</td>
<td>Grease Gun</td>
<td>O O O</td>
</tr>
</tbody>
</table>

*1 When checking for conduction with multimeter, connect the battery pack 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 “9.2.9 Notes for Maintenance.”)

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

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

*4 Inspection No. correspond to the numbers in “Fig. 21 Inspection Parts and Inspection Numbers (Manipulator in Home Position).”

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

### Table. 8 Inspection Parts and Grease Used

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>5, 6</td>
<td>Molywhite RE No. 00</td>
<td>S-, L-, and U-axes speed reducers</td>
</tr>
<tr>
<td>5, 6</td>
<td>Harmonic Grease SK-1A</td>
<td>R-, B- and T-axes speed reducers, T-axis gear</td>
</tr>
<tr>
<td>6</td>
<td>Alvania EP Grease 2</td>
<td>R-axis cross roller bearing</td>
</tr>
</tbody>
</table>

The numbers in the above table correspond to the numbers in “Table 7 Inspection Items.”
Note: The manipulator is in the home position.

Fig. 21 Inspection Parts and Inspection Numbers (Manipulator in Home Position)
9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

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

![Battery Pack Location Diagram]

Fig. 22 Battery Pack Location
9.2 Notes on Maintenance Procedures

1. Turn the NX100 main power supply OFF.
2. Remove the mounting screws for the battery pack on the support.
3. Remove the battery pack from the holder.
4. Connect the new battery pack to an unconnected connector.
5. Remove the old battery pack from the circuit board.
6. Mount the new battery pack to the battery holder.
7. Reinstall the plate.

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

**NOTE** Do not pinch the cable when the plate is installed.
9.2 Notes on Maintenance Procedures

9.2.2 Grease Replenishment/Exchange for S-axis Speed Reducer

**Fig. 24  S-axis Speed Reducer Diagram**

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

Replenish the grease in accordance with the following procedure:

1. Remove plugs from exhaust port and grease inlet.

**NOTE**: If grease is injected with the plug on, the grease will go inside the motor and may damage it. Never fail to remove the plug before the grease injection.

For ceiling mounted manipulators, the exhaust port and the grease inlet are inverted.
9.2 Notes on Maintenance Procedures

2. Install the grease zerk PT1/8 to the grease inlet. (The grease zerk PT1/8 is delivered with the manipulator.)
3. Inject the grease into the grease inlet using a grease gun.

<table>
<thead>
<tr>
<th>Grease type: Molywhite RE No.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease: 30 cc</td>
</tr>
<tr>
<td>(60 cc for the 1st supply)</td>
</tr>
</tbody>
</table>

4. Move the S-axis for a few minutes to discharge the excess grease.
5. Remove the grease zerk and reinstall the plug on the grease inlet. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C (listed on table9) on the thread part of the plug.
6. Wipe the grease exhaust port with a cloth and reinstall the plug. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the plug.

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

Exchange the grease in accordance with the following procedure:

1. Remove plugs from exhaust port and grease inlet.

<table>
<thead>
<tr>
<th><strong>NOTE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>If grease is injected with the plug on, the grease will go inside the motor and may damage it. Never fail to remove the plug before the grease injection.</td>
</tr>
</tbody>
</table>

2. Install the grease zerk PT1/8 to the grease inlet. (The grease zerk PT1/8 is delivered with the manipulator.)
3. Inject the grease into the grease inlet using a grease gun.

<table>
<thead>
<tr>
<th>Grease type: Molywhite RE No.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of grease: Approx. 1440 cc</td>
</tr>
</tbody>
</table>

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.
4. Move the S-axis for a few minutes to discharge the excess grease.
5. Remove the grease zerk and reinstall the plug on the grease inlet. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the plug.
6. Wipe the grease exhaust port with a cloth and reinstall the plug. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the plug.
9.2 Notes on Maintenance Procedures

9.2.3 Grease Replenishment/Exchange for L-axis Speed Reducer

![Diagram of L-axis Speed Reducer]

**Grease Replenishment**

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

Replenish the grease in accordance with the following procedure:

1. Posture the L-axis vertical to the ground.
2. Remove the plug and the screw from grease exhaust port and grease inlet respectively.
3. Install the grease zerk A-MT6X1 on the grease inlet. (The grease zerk A-MT6X1 is delivered with the manipulator.)
4. Inject the grease into the grease inlet using a grease gun.
5. Move the L-axis for a few minutes to discharge the excess grease.
6. Remove the grease zerk and reinstall the hexagon socket head cap screw M6 on the grease inlet. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the screw.

**NOTE**

The exhaust port and the grease inlet are inverted in case of ceiling installation.

**NOTE**

If grease is injected with the plug on, the grease will go inside the motor and may damage it. Never fail to remove the plug before the grease injection.

**Grease type:** Molywhite RE No.00

**Amount of grease:** 30 cc

(60 cc for the 1st supply)
7. Wipe the grease exhaust port with a cloth and reinstall the plug. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the plug.

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

Exchange the grease according to the following procedure:

1. Posture the L-arm vertical to the ground.
2. Remove the plug and the screw from grease exhaust port and grease inlet respectively.
3. Install the grease zerk A-MT6X1 on the grease inlet. (The grease zerk A-MT6X1 is delivered with the manipulator.)
4. Inject the grease into the grease inlet using a grease gun.

   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.
5. Move the L-axis for a few minutes to discharge the excess grease.
6. Remove the grease zerk on the grease inlet and reinstall the hexagon socket head cap screw M6. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the screw.
7. Wipe the grease exhaust port with a cloth and reinstall the hexagon socket head plug. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the plug.

---

If grease is injected with the plug on, the grease will go inside the motor and may damage it. Never fail to remove the plug before the grease injection.
9.2.4 Grease Replenishment/Exchange for U-axis Speed Reducer

Fig. 26  U-axis Speed Reducer Diagram

The exhaust port and the grease inlet are inverted in case of ceiling installation.

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

Replenish the grease in accordance with the following procedure:

1. Posture the U-arm as shown in "Fig. 26  U-axis Speed Reducer Diagram".
2. Remove the screw and the plug from grease exhaust port and grease inlet respectively.
3. Install the grease zerk A-MT6X1 on the grease inlet. (The grease zerk A-MT6X1 is delivered with the manipulator.)
4. Inject the grease into the grease inlet using a grease gun.
5. Move the U-axis for a few minutes to discharge the excess grease.
6. Remove the grease zerk and reinstall the hexagon socket head plug on the grease inlet. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the plug.
7. Wipe the grease exhaust port with a cloth and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the screw.

Grease type: Molywhite RE No.00
Amount of grease: 30 cc
(60 cc for the 1st supply)
9.2 Notes on Maintenance Procedures

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

Exchange the grease according to the following procedure:

1. Posture the U-arm as shown in "Fig. 26 U-axis Speed Reducer Diagram".
2. Remove the hexagon socket head cap screw on the grease exhaust port.

3. Remove the hexagon socket head plug PT1/8 on the grease inlet and install the grease zerk A-MT6X1.
4. Inject the grease into the grease inlet using a grease gun.

If grease is injected with the screw on, the grease will go inside the motor and may damage it. Never fail to remove the screw before the grease injection.

5. Move the U-axis for a few minutes to discharge the excess grease.
6. Remove the grease zerk and reinstall the hexagon socket head plug on the grease inlet. Tighten the plug with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the plug.
7. Wipe the grease exhaust port with a cloth and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the screw.

Grease type: Molywhite RE No.00
Amount of grease: approx. 320 cc
9.2.5 Grease Replenishment for R-axis Speed Reducer

1. Remove the hexagon socket head cap screw M6 on the exhaust port.
2. Inject the grease into the grease inlet using a grease gun.
   
   **Grease type:** Harmonic grease SK-1A  
   **Amount of grease:** 8cc  
   (16cc for the 1st supply)

3. Reinstall the hexagon socket head cap screw on the exhaust port. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1208C on the thread part of the screw.

**NOTE** The exhaust port is used for air flow. Do not inject excessive grease into the grease inlet.
9.2.6 Grease Replenishment for B-, T-axes Speed Reducers

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

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

2. Remove the hexagon socket head cap screw on the grease inlet and install the grease zerk A-MT6X1.

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

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

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

4. Reinstall the plug on the exhaust port for B-axis or the hexagon socket set screw on the exhaust port for T-axis. Apply Three Bond 1206C on the thread parts.

5. Remove the grease zerk on the grease inlet and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part.

   **NOTE** Mount the cover for the B-axis speed reducer. (Refer to "9.2.9 Notes for Maintenance.")
9.2 Notes on Maintenance Procedures

9.2.7 Grease Replenishment for T-axis Gear

1. Remove the plug on the exhaust port.
2. Remove the hexagon socket head cap screw on the grease inlet and install the grease zerk A-MT6X1.
3. Inject the grease into the gear grease inlet using a grease gun.

| Grease type: Harmonic grease SK-1A |
| Amount of grease: 5 cc |
| (10cc for the 1st supply) |

4. Reinstall the plug on the exhaust port. Apply Three Bond 1206C on the thread part of the plug.
5. Remove the grease zerk on the gear grease inlet and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the screw.

The exhaust port is used for air flow. Do not inject excessive grease into the gear grease inlet.
9.2 Notes on Maintenance Procedures

9.2.8 Grease Replenishment for R-axis Cross Roller Bearing

1. Remove the plug on the exhaust port.
2. Remove the hexagon socket head cap screw from the grease inlet and install the grease zerk A-MT6X1.
3. Inject grease into the grease inlet using a grease gun.
4. Reinstall the plug on the exhaust port. Apply Three Bond 1206C on the thread part of the plug.
5. Remove the grease zerk on the gear grease inlet and reinstall the hexagon socket head cap screw. Tighten the screw with a tightening torque of 5 N·m (0.51 kgf·m). Apply Three Bond 1206C on the thread part of the screw.

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

Grease type: Alvania EP grease 2
Amount of grease: 8 cc
(16 cc for the 1st supply)

Fig. 30 R-axis Cross Roller Bearing Diagram
9.2.9 Notes for Maintenance

- **Wrist Axes**

  The motor and encoder units are provided with the wrist unit. To prevent fumes from penetrating into the wrist unit, the matched parts are sealed with sealing bond. Therefore, if the wrist cover is disassembled, reseal with sealing bond (Three Bond 1206C). Refer to "Table 9 Spare Parts for the MOTOMAN-HP20".

![Sealing Part of Wrist Unit](image)

**Fig. 31 Sealing Part of Wrist Unit**

9.2.10 Encoder Connector (with CAUTION Label)

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

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

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

**NOTE** Do not remove the battery pack in the connector base.

![Diagram](image)

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

**Fig. 32 (a) Encoder Connector for S-, L-, U-axes**
9.2 Notes on Maintenance Procedures

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

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

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

**NOTE**

Do not remove the battery pack in the connector base.

**CAUTION**

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

---

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

It is recommended that the following parts and components be kept in stock as spare parts for the MOTOMAN-HP20. The spare parts list for the MOTOMAN-HP20 is shown below. Check the serial number and contact your Yaskawa representative for preparing lead wires for internal wiring, etc.

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

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

**NOTE** To replace parts in Rank B or Rank C, be sure to contact your Yaskawa representative.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty per Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Grease</td>
<td>Molywhite RE No. 00</td>
<td>Yaskawa Electric Corporation</td>
<td>16kg</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>Grease</td>
<td>Harmonic Grease SK-1A</td>
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## 11.3 U-axis Driving Unit

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