MOTOMAN-MH225 MAINTENANCE MANUAL

TYPE:
YR-MS210/MH225-A00 (STANDARD SPECIFICATIONS)

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

MOTOMAN INSTRUCTIONS
MOTOMAN-MH225 INSTRUCTIONS
DX200 INSTRUCTIONS
DX200 OPERATOR’S MANUAL (for each purpose)
DX200 MAINTENANCE MANUAL

The DX200 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.

Part Number: 167108-1CD
Revision: 3
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1 Introduction

MANDATORY

- This maintenance manual is intended to explain maintenance procedures primarily for the MOTOMAN-MH225.
- General items related to safety are listed in Chapter 1: Safety of the DX200 Instructions. To ensure correct and safe operation, carefully read the DX200 instructions before reading this manual.

CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating and maintenance 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.
1.1 National Safety Standard for Industrial Robots and Robot System

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

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

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
1.2 Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the DX200.

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

- **DANGER**: Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.
- **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 “DANGER”, “WARNING” and “CAUTION”.

**DANGER**

- 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 these safety precautions may result in death or serious injury from unexpected turning of the manipulator’s arm.
1 Introduction

1.2 Notes for Safe Operation

**WARNING**

- Before maintenance, inspection, or wiring, 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.

- After maintenance, check the home position before operating the manipulator.

Injury may result from unexpected manipulator motion.

- Before operating the manipulator, check that servo power is turned OFF by pressing the emergency stop buttons on the front door of the DX200 and the programming pendant.

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.

*Fig. : 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.

Turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

*Fig. : Release of Emergency Stop*

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Keep in mind the emergency response measures against the manipulator’s unexpected motion toward you.
  - 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 person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:

  - Turning ON the power for the DX200.
  - 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.
1.3 Definition of Terms Used Often in This Manual

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

In this manual, the equipment is defined as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX200 controller</td>
<td>Controller</td>
</tr>
<tr>
<td>DX200 programming pendant</td>
<td>Programming Pendant</td>
</tr>
<tr>
<td>MS210</td>
<td>Manipulator</td>
</tr>
<tr>
<td>Cable between the manipulator and the DX200</td>
<td>Manipulator cable</td>
</tr>
<tr>
<td>Positioner</td>
<td>Positioner</td>
</tr>
</tbody>
</table>

1.4 Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or bland names for each company or corporation. The indications of ® and ™ are omitted.
1.5 **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.

Note: Taking the maintenance-relevant trainings offered by Yaskawa is indispensable for replacing the L-axis of the balancer-equipped manipulator.

*Fig. 1-1: Warning Label Locations*

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**WARNING Label B**
*Moving parts may cause injury*

**WARNING Label A**
*Do not enter robot work area.*

**WARNING Label C**
*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 arm. Please contact your Yaskawa representative.*

---

**Nameplate:**
- Model: N13878
- Type: MOTOMAN
- Payload: kg
- Mass: kg
- Order No.: 
- Date: 
- Serial No.: 

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**Nameplate:**
- (On the manipulator manufactured by May 2014)

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**Nameplate:**
- (On the manipulator manufactured after June 2014)
1.6 Safeguarding Tips

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

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this equipment, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this equipment.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
- The system must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-2012, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

1.7 Mechanical Safety Devices

The safe operation of this equipment is ultimately the users responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-2012 safety standards, and other local codes that may pertain to the installation and use of this equipment.

Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety barriers
- Door interlocks
- EMERGENCY STOP button

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
1.8 Programming, Operation, and Maintenance Safety

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

All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the equipment to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.

- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.

- Check the EMERGENCY STOP buttons for proper operation before programming. The equipment must be placed in the Emergency Stop (E-Stop) mode whenever it is not in use.

- Back up all programs and jobs onto suitable media before making program changes. To avoid loss of information, programs, or jobs, a backup must always be made before performing any service procedures or making any changes to options, accessories, or equipment.

- Any modifications to the Controller can cause severe personal injury or death, as well as damage to the Manipulator! Do not make any modifications to the Controller unit. Making any changes without written permission from Yaskawa will void the warranty.

- Some operations require a standard passwords and some require special passwords.

- The equipment allows modifications of the software for maximum performance. Use Care when making these modifications. All modifications made to the software will change the way the equipment operates and can cause severe personal injury or death, as well as damage parts of the system. Double check all modifications under every mode of operation to ensure changes do not create a hazard or dangerous situation.

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

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

- Use proper replacement parts.

- Improper connections can damage equipment. All connections must be made within the standard voltage and current ratings of the equipment.
1.9 Maintenance Safety

Turn power OFF and disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

Perform only the maintenance described in this manual. Maintenance other than specified in this manual should be performed only by Yaskawa-trained, qualified personnel.

1.10 Summary of Warning Information

This manual is provided to help users establish safe conditions for operating the equipment. Specific considerations and precautions are also described in the manual, but appear in the form of DANGERS, WARNINGS, CAUTIONS, and Notes.

It is important that users operate the equipment in accordance with this instruction manual and any additional information which may be provided by Yaskawa. Address any questions regarding the safe and proper operation of the equipment to Customer Support.
1.11 Customer Support Information

If you need assistance with any aspect of your MH225 system, please contact Customer Support at the following 24-hour telephone number:

(937) 847-3200

For routine technical inquiries, you can also contact Customer Support at the following e-mail address:

techsupport@motoman.com

When using e-mail to contact Customer Support, please provide a detailed description of the issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response.

Please use e-mail for routine inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, contact Customer Support at the telephone number shown above.

Please have the following information ready before you call Customer Support:

- **System**
  - MH225
- **Primary Application**
- **Controller**
  - DX200
- **Software Version**

Access this information on the Programming Pendant’s LCD display screen by selecting [MAIN MENU] - [SYSTEM INFO] - [VERSION]

- **Manipulator Serial Number**
  - Located on the Manipulator data plate
- **Manipulator Sales Order Number**
  - Located on the Controller data plate
- **Positioner**
2 Notes for Maintenance

2.1 Battery Pack Connection for Motor

The connectors (crimped contact-pin) for the battery backup are installed at the end point of the encoder cables for the motor (BAT and OBT are marked).

Connect the battery pack according to the following procedure.

1. Remove the caps attached to the battery backup connectors of the motor.

2. Connect the battery pack (HW9470932-A) with the battery backup connectors located at the end point of the encoder cable. (Under this condition, remove the encoder connector and carry out the maintenance checks.)

3. After the maintenance check, confirm that all the connectors are connected, then remove the battery pack. Install the caps attached to the battery backup connectors of the motor.

**NOTE**

*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. 2-1 “Battery Pack Connection”.

**NOTE**

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

Fig. 2-1: Battery Pack Connection

![Diagram of Battery Pack Connection](image)

Motor

Motor power connector

Connector for the encoder

Battery Pack: HW9470932-A

Connector for the battery backup

a: Insertion-type pin terminal (Pin)
b: Insertion-type pin terminal (Socket)
3 Home Position Return

3.1 Home Position Return after Motor Replacement

3.1.1 Home Position Return by Zeroing Function

The zeroing function is an optional function which automatically allows the restoration of the home position data when the manipulator's home position data disappears.

For the details of this function, refer to “INSTRUCTIONS FOR ZEROING FUNCTION”.

3.1.2 Home Position Return by Robot Calibration (MOTOCALV EG)

The MOTOCALV EG allows the home position reset by teaching the five-point-in-five-posture.

Refer to “MOTOCALV EG for Windows Operator’s Manual” for details on the operation.
3.1.3 Home Position Return by Setting Teaching Point for Home Position Setting before Motor Replacement

The DX200 holds the position data of the job program (hereinafter called JOB) as the pulse number from the home position of each axis. Thus, by adjusting the home position precisely, the JOB used before motor replacement can be used after the replacement without correction. This section explains how to set the DX200.

3.1.3.1 Preparation before Motor Replacement

- Refer to the Fig. 3-1 “Preparation before Motor Replacement (Example)”. Before motor replacement, create the standard position (hereinafter called the check-point) for home position adjustment after the replacement. The check-point must satisfy the conditions below. Furthermore, create the JOB so that the manipulator safely moves to the check-point from the standby position. (The JOB created in this manner will be hereinafter called the check-JOB.)

1. The position should not be deviated by turning the power ON or OFF, or lowering air pressure. Do not create the check point in the working part of the tool (end effector) or the jigs (related unit including the rotary table). It is recommended to use a specific jig if necessary.

2. Use pointed jigs to create the position so that the deviation is easily found. Keep a distance as long as possible from the rotational center of the replacing axis.

3. Considering the moving direction of the replacing axis, create the position at the point where any deviation is easily found and the axis will not interfere with jigs even if it is deviated.
Example of Check-Point Creation when Replacing U-Axis’s Motor of MOTOMAN-MH225

- The check-point cannot be created unless each axis operates. Thus, the check-point cannot be created if the axis does not move because of failure. Therefore, it is recommended to create the check-point for each axis under normal operating conditions.

Next, check the home position of the axis whose motor will be replaced. Refer to the position screen, and move the axis to the 0-pulse position, the home position. Then, check the position of the home position mark. If it is deviated, adjust it.

The U-axis of MOTOMAN-MH225 is shown below as an example.

Fig. 3-1: Preparation before Motor Replacement (Example)
3.1.3.2 Motor Replacement

- Refer to the Fig. 3-2 “Motor Replacement (Example)”.

CAUTION

- Since the motor is removed, the manipulator cannot keep its posture during motor replacement. When replacing the motor, hold the manipulator arm with the chain block, etc.

Failure to observe this caution may cause a hazardous condition. Replace the motor with due care.

The U-axis of MOTOMAN-MH225 is shown below as an example.

Fig. 3-2: Motor Replacement (Example)

Remove the motor and replace it.
3.1.3.3 Home Position Adjustment

After motor replacement, move the axis to the position of the home position mark. Perform the home position calibration only to the axis whose motor was replaced.
(For more information, refer to “DX200 INSTRUCTIONS”.

Move the axis to the check-point by the check-JOB. (Be careful when moving the axis so that the manipulator does not interfere with jigs.) Move only the axis whose motor was replaced to correct the deviation from the check-point created before calibration.

Display the position screen (COMMAND POSITION).

The values of the U-axis is shown below as an example.

```
DATA  EDIT  DISPLAY  UTILITY

COMMAND POSITION

U -3067  -2989  -78
```

By using the above values, calculate the amount of deviation. (Subtract the CMD (command value) from the CURR (current value).)

CURR - CMD = the amount of deviation

U (-3067) - (-2989) = -78

Perform stepping back, etc. of the check JOB to move the axis whose motor was replaced to the position where the axis will not interfere with jigs when it moves to the home position. (Be careful when moving the axis so that the manipulator does not interfere with jigs.) Refer to the position screen, and move the axis to the pulse position equal to the amount of deviation.

An example is shown below.

```
DATA  EDIT  DISPLAY  UTILITY

COMMAND POSITION

U -11780  -11780
```

At this position, perform the home position calibration only for the axis whose motor was replaced.
(For more information, refer to “DX200 INSTRUCTIONS”.

Move the axis again to the check-point by the check-JOB. Check if the axis is at the check-point created before the operation. (If it is deviated, repeat the adjustment procedures.)

Perform an operation check by using the JOB used before motor replacement. If no problem is found, write down the modified home position data (ABSO data) and the date in the label on the inside of the DX200.
4 L-Axis Fixing Jig

4.1 Fixing Jig

In the MOTOMAN-MH225, the “Linkless mechanism with the balancer” is adopted. Therefore, releasing L-axis holding power (for removing the L-axis motor and releasing the brake, etc.) is seriously dangerous since it will cause a L-arm rotation which is different from the conventional model, depending on the edge load, the wrist load posture, the U-axis posture, and the L-axis posture. (For outlined mechanism, refer to section 4.2 “Mechanism” in this chapter.) When releasing the L-axis holding power, be sure to hold the L-arm with the fixing jigs specified in this manual by following the procedure.

---

DANGER

- The maintenance operation should be carried out by a specified person.
- Execute disassembly and reassembly of the L-axis motor after mounting the L-axis fixing jig on the balancer. Also, be sure to confirm that the L-axis is firmly fixed by releasing the L-axis motor brake. Failure to observe this leads unexpected L-arm rotation at the moment when the L-axis motor is removed and it may result in damage to machinery or death or serious injury.
4.2 Mechanism

• Refer to Fig. 4-1 “The L-arm Rotation Direction”.

The L-arm rotational direction of when L-axis holding power is released depends on the extent of the torque Tb generated by the balancer, and the load torque TL generated around the L-axis.

When no force is applied to the front edge, the torque Tb generated by the balancer is always generated toward the direction which makes the L-arm posture be +40°, and the extent of the torque Tb varies depending on the L-axis angle. Also, the load torque TL which is generated around the L-axis works around the center of the L-axis rotation, and its direction and extent vary depending on the edge load, posture of the wrist, the U-arm, and the L-arm.

When no load is applied to the edge, for the L-arm rotational direction, 3 patterns are assumed as described in the Fig. 4-1 “The L-arm Rotation Direction”.

It is quite difficult to accurately compare the extent of the torque which works around the L-axis and the extent of the torque which is generated by the balancer on the actual work site, and also, the rotational direction cannot be identified in this unit. Therefore, handling this unit in the same way as other manipulators is seriously dangerous, as the L-arm may rotate in an unexpected direction.

Fig. 4-1: The L-arm Rotation Direction
4.3 Fixing Jig Installation

L-axis fixing jig needs to be installed to each specified position depending on the L-axis posture; -60° to +20° or +20° to +76°. The following explains how to fix the L-arm at the posture shown in the Fig. 4-2 “L-axis Posture (-60° to +20°) Exterior View” and at the posture shown in the Fig. 4-3 “L-axis Posture (+20° to +76°) Exterior View”. The angle of L-axis posture can be checked by the L-axis pulse with a programming pendant. Judge the L-axis posture angle whether it is in the positive side or in the negative side in comparison with +20° by the amount of pulse. The +20° is equal to 61252 in the L-axis pulse, so if the amount of L-axis pulse is less than 61252, use the fixing jigs in the procedure shown in the section 4.3.1 “Installation Posture and Position of L-axis Fixing Jig (L-axis Posture: -60° to +20°)”. If the amount of L-axis pulse is 61252 or more, use the fixing jigs in the procedure shown in the section 4.3.2 “Installation Posture and Position of L-axis Fixing Jig (L-axis Posture: +20° to +76°)”.

Before installing jigs, rotate the U-arm so that the relative angle between the L-axis and the U-axis can be minimized. When releasing the brake of L-axis motor after installing the L-axis fixing jigs, the L-arm rotates 5° maximum at conversion rate on output-side. This is because of the “looseness” of L-axis fixing jigs, bearings, or speed reducers, and also the effect caused by the gas pressure. This rotation angle is equal to the P-point moving distance of about 210 mm when the L-arm is aligned with the U-arm, or the P-point moving distance of about 165 mm when the L-arm and the U-arm form a right angle. To minimize the P-point moving distance is the reason for rotating the U-arm so that the relative angle of the L-axis and U-axis can be minimized.

4.3.1 Installation Posture and Position of L-axis Fixing Jig (L-axis Posture: -60° to +20°)

As mentioned in the section 4.3 “Fixing Jig Installation”, rotate the U-arm so that the relative angle between the L-axis and the U-axis can be minimized. At this time, care must be taken so that the arm may not interfere with the peripheral devices including the work and hand, and the main unit of the manipulator.

Install the L-axis fixing jig to the section A and B shown in the Fig. 4-2 “L-axis Posture (-60° to +20°) Exterior View”. For avoidance of the wrong installation, jig for section B can be installed only when the L-axis posture is -60° to +20°.
4.3 Fixing Jig Installation

Fig. 4-2: L-axis Posture (-60° to +20°) Exterior View

4.3.2 Installation Posture and Position of L-axis Fixing Jig (L-axis Posture: +20° to +76°)

As mentioned in the section 4.3 “Fixing Jig Installation”, rotate the U-arm so that the relative angle between the L-axis and U-axis can be minimized. At this time, care must be taken so that the arm may not interfere with the peripheral devices including the work and hand, and the main unit of the manipulator.

Install the L-axis fixing jig to the section A and C shown in the Fig. 4-3 “L-axis Posture (+20° to +76°) Exterior View”. For avoidance of the wrong installation, jig for section C can be installed only when the L-axis posture is +20° to +76°.

Fig. 4-3: L-axis Posture (+20° to +76°) Exterior View
4.3.3 Recommended Mounting Posture

When using this fixing jig, operating the manipulator in the posture shown in Fig. 4-4 “Recommended Posture” is recommended, if it is possible. Avoid operating the manipulator in the posture shown in Fig. 4-5 “Avoided Posture” as much as possible. If it is unavoidable, be sure to secure a distance of 300mm or more from the surroundings.

**Fig. 4-4: Recommended Posture**

Fold the U-arm whenever possible.

It is not necessary to remove the edge load, however assure enough distance from the surroundings.

**Fig. 4-5: Avoided Posture**

Because the edge may move greatly, be sure to assure a distance of 300mm or more from the surroundings.
4.4 Assembly and Disassembly

- Gross weight of L-axis fixing jig is 62.5 kg. (One part weighs 8.7 kg maximum.) This operation must be performed by more than two workers. Failure to observe this caution may result in an injury.

- To disassemble L-axis fixing jigs, confirm that the brake of the L-axis motor is not released, then operate in the opposite way to the assembly procedure. If the brake of the L-axis motor is released, L-arm may rotate because of the balancer torque.

- When removing the internal wiring harness, do not apply any forces to the internal wiring harness while the operation. Failure to observe this caution may result in damage to the internal wiring harness.

- Do not operate the manipulator with the fixing jigs on it. Failure to observe this caution may result in damage to the devices.

4.4.1 Assembly and Disassembly (L-axis Posture: -60° to +20°)

When assembling, refer to the following procedures and operate in order.

**Assembly procedure (For L-axis posture: -60° to +20°)**

1. Disconnecting internal wiring harness  
   (Common for L-axis posture: -60° to +20°/+20° to +76°)

2. Assembling fixing jigs of section A  
   (Common for L-axis posture: -60° to +20°/+20° to +76°)

3. Assembling fixing jigs of section B  
   (For L-axis posture: -60° to +20°)

4. Assembling fixing jigs between section A and B  
   (For L-axis posture: -60° to +20°)

5. Assembling brake release unit  
   (Common for L-axis posture: -60° to +20°/+20° to +76°)

When disassembling, refer to the following procedures and operate in order.

**Disassembly procedure (For L-axis posture: -60° to +20°)**

1. Disassembling brake release unit  
   (Common for L-axis posture: -60° to +20°/+20° to +76°)

2. Disassembling fixing jigs between section A and B  
   (For L-axis posture: -60° to +20°)

3. Disassembling fixing jigs of section B  
   (For L-axis posture: -60° to +20°)

4. Disassembling fixing jigs of section A  
   (Common for L-axis posture: -60° to +20°/+20° to +76°)

5. Connecting internal wiring harness  
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
Assembly Procedure (For L-axis Posture: -60° to +20°)

1. Disconnecting internal wiring harness
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   • Refer to Fig. 4-6 “Disconnecting Internal Wiring Harness (Common for L-axis Posture: -60° to +20°/+20° to +76°)” and Fig. 4-11 “Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)”.

   (1) Remove the plate and GT-SA bolts M5 (length: 12 mm) (2 places each) from the support attached to section A.

   (2) Remove the support and hexagon socket head cap screws M8 (length: 12 mm).

Fig. 4-6: Disconnecting Internal Wiring Harness
(Common for L-axis Posture: -60° to +20°/+20° to +76°)
2. Assembling fixing jig of section A
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   * Refer to Fig. 4-7 "Assembling Fixing Jig of Section A (Common for L-axis Posture: -60° to +20°/+20° to +76°)" and Fig. 4-11 "Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)".

   (1) Install the shaft  to the shaft  on the upper part of the balancer, with hexagon socket head cap screws  M12 (length: 30 mm) (tightening torque: 84 N-m).

   (2) Install the cover  to the shaft , then install the shaft  to the block  with hexagon socket head cap screws  M12 (length: 35 mm) (tightening torque: 84 N-m). (It is possible to perform this procedure in advance.)

   (3) Insert the shaft  to the shaft .

   (4) Install the cover  to the shaft  with hexagon socket head cap screws  M10 (length: 25 mm) (tightening torque: 48 N-m).

**Fig. 4-7: Assembling Fixing Jig of Section A**
(Common for L-axis Posture: -60° to +20°/+20° to +76°)

![](image)
3. Assembling fixing jigs of section B (For L-axis posture: -60° to +20°)

- Refer to Fig. 4-8 “Assembling Fixing Jig of Section B (For L-axis Posture: -60° to +20°)” and Fig. 4-11 “Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)”.

(1) Install the bracket 13 to the side face of the S-head with hexagon socket head cap screws 14 M20 (length: 180 mm) (tightening torque: 402 N·m).

(2) Install the cover 9 to the shaft 8, then install the shaft 15 to the block 16 with hexagon socket head cap screws 11 M12 (length: 35 mm) (tightening torque: 84 N·m). (It is possible to perform this procedure in advance.)

(3) Insert the shaft 15 to the bracket 13.

(4) Install the cover 9 to the bracket 13 with hexagon socket head cap screws 12 M10 (length: 25 mm) (tightening torque: 48 N·m).

Fig. 4-8: Assembling Fixing Jig of Section B (For L-axis Posture: -60° to +20°)
4. Assembling fixing jigs between section A and B
(For L-axis posture: -60° to +20°)

- Refer to Fig. 4-9(a “Detail of Screw”, Fig. 4-9/b “Detail of Measuring Point”, Fig. 4-9(c “Assembling Fixing Jig Between A and B (For L-axis Posture: -60° to +20°)” and Fig. 4-11 “Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)”.

1. Insert the long side of the screw to the block from its bottom side, and install the plate to the screw from its top side. At this time, be sure to pass the screw through the plate. Also, adjust the position of holes of the plate (4 places) to come on the tapped holes of the block.

2. Install the joint to the screw. At this time, engage the thread of the joint with the thread of the screw 30 mm or more. Measure the distance from the groove edge of the screw to the edge of the joint, and if the distance is 90 mm or less, the thread of the joint and the thread of the screw are engaged 30 mm or more.

3. Insert the long side of the screw to the block from its top side. At this time, engage the thread of the joint with the thread of the screw 30 mm or more. Measure the distance from the edge of the joint to the groove edge of the screw, and if the distance is 90 mm or less, the thread of the joint and the thread of the screw are engaged 30 mm or more.

4. Install the plate to the screw from its bottom side. At this time, engage all the thread of the plate with the thread of the screw. Also, adjust the position of holes of the plate (4 places) to come on the tapped holes of the block.

5. Tighten the plate of section A and the block with the hexagon socket head cap screws M12 (length: 50 mm) (tightening torque: 84 N·m).

6. Tighten the plate of section B and the block with the hexagon socket head cap screws M12 (length: 50 mm) (tightening torque: 84 N·m). When the tapped hole does not fit or there is space between the plate and the block, rotate the joint to adjust the space.

7. To reduce the rotation amount at the time of releasing the brake, the followings are recommended.

   (If the servo monitor window does not appear because of the power malfunction etc. or there is enough space from the surroundings, the followings are not necessary to perform.)

   While confirming the torque command value at the servo monitor window, rotate the joint.

   The joint should be rotated in the direction where the torque command value is down.

   Because the rotating direction varies depending on the edge load, the wrist posture and the U-arm posture, be careful about the direction.

   (For the servo monitor, refer to section 7.9 “Servo Monitoring” of the DX200 Maintenance manual.)
4 L-Axis Fixing Jig

4.4 Assembly and Disassembly

**Fig. 4-9(a): Detail of Screw**

![Diagram of screw detail]

- **Thread part 115 mm**
- **Thread part 375 mm**
- **Mark**
- M45 (Pitch: 4.5 mm) (coarse thread)

**Fig. 4-9(b): Detail of Measuring Point**

![Diagram of measuring point detail]

- **Measuring Point:** 90 mm or less
- **Joint part:** 30 mm or more
- **Schrink in this direction**

| HW1304148-5 | Right screw | Mark: R |
| HW1304148-6 | Left screw  | Mark: L |
Fig. 4-9(c): Assembling Fixing Jig Between A and B
(For L-axis Posture: -60° to +20°)
5. Assembling brake release unit
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   - Refer to Fig. 4-10 “Assembling brake release unit (Common for L-axis Posture: -60° to +20°/+20° to +76°”).

   1) Turn OFF the DX200 power supply.
   2) Disconnect the manipulator side connector of 2BC power supply cable, which is installed between the manipulator and the controller, and connect the brake release unit cable to the 2BC connector.
   3) Connect the brake release unit cable to the 2CN connector of brake release unit.
   4) Connect the 1PC of the brake release unit to the 100 V receptacle.
   5) Turn ON the 1CP of the brake release unit, then turn ON the brake release switch.
   6) After ensuring safety of surroundings, press the L-axis brake release button bit by bit and repeatedly. Then confirm that the L-axis cannot move at all.

The brake is released only while the button is pressed. At this time, do not press any other buttons than L-axis brake release button. L-axis fixing jig corresponds only to release the brake unit of L-axis motor. If the brake of other axis motor is released, it is very dangerous because the other axis can be rotated depending on the condition of front edge load, wrist axis posture, U-axis posture, and L-axis posture.

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**Fig. 4-10: Assembling brake release unit**
*(Common for L-axis Posture: -60° to +20°/+20° to +76°)*
L-Axis Fixing Jig

4.4 Assembly and Disassembly

Disassembly Procedure (For L-axis Posture: -60° to +20°)

1. Disassembling brake release unit
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   • Refer to Fig. 4-10 “Assembling brake release unit (Common for L-axis Posture: -60° to +20°/+20° to +76°)”.
   (1) Turn OFF the brake release switch of brake release unit \( \text{27} \), then turn the 1CP OFF.
   (2) Disconnect the 1PC of the brake release unit \( \text{27} \) from the 100 V receptacle.
   (3) Disconnect the brake release unit cable \( \text{28} \) connected to the manipulator from the 2BC connector, then connect the 2BC power supply cable to the 2BC connector of manipulator side.

2. Disassembling fixing jigs between section A and B
   (For L-axis posture: -60° to +20°)
   • Refer to Fig. 4-9(c “Assembling Fixing Jig Between A and B (For L-axis Posture: -60° to +20°)” and Fig. 4-11 “Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)”.
   (1) Remove the hexagon socket head cap screws \( \text{21} \) M12 (length: 50 mm) installed to the section A and B, then remove the plate \( \text{18} \) of section B.
   (2) Remove the screw \( \text{20} \) from the joint \( \text{19} \), then remove the joint \( \text{19} \) from the screw \( \text{17} \).
   (3) Remove the plate \( \text{18} \) of section A from the screw \( \text{17} \).

3. Disassembling fixing jigs of section B (For L-axis posture: -60° to +20°)
   • Refer to Fig. 4-8 “Assembling Fixing Jig of Section B (For L-axis Posture: -60° to +20°)” and Fig. 4-11 “Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)”.
   (1) Remove the hexagon socket head cap screws \( \text{12} \) M10 (length: 25 mm), then remove the cover \( \text{9} \).
   (2) Remove the block \( \text{16} \) and the shaft \( \text{15} \).
   (3) Remove the hexagon socket head cap screws \( \text{14} \) M20 (length: 180 mm), then remove the bracket \( \text{13} \).
4. Disassembling fixing jigs of section A
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   • Refer to Fig. 4-7 “Assembling Fixing Jig of Section A (Common for L-axis Posture: -60° to +20°/+20° to +76°)” and Fig. 4-11 “Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)”.

   (1) Remove the hexagon socket head cap screws  M10 (length: 25 mm), then remove the cover.
   (2) Remove the block and the shaft.
   (3) Remove the hexagon socket head cap screws  M12 (length: 50 mm), then remove the shaft.

5. Connecting internal wiring harness
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   • Refer to Fig. 4-6 “Disconnecting Internal Wiring Harness (Common for L-axis Posture: -60° to +20°/+20° to +76°)” and Fig. 4-11 “Assembly/Disassembly of L-axis Fixing Jig (For L-axis Posture: -60° to +20°)”.

   (1) Install the support to section A with the hexagon socket head cap screws  M8 (length: 20 mm) (tightening torque: 24.5 N·m).
   (2) Install the plate to the support with the GT-SA bolts  M5 (length: 12 mm) (tightening torque: 6 N·m).
Fig. 4-11: Assembly/Disassembly of L-axis Fixing Jig
(For L-axis Posture: -60° to +20°)
## Table 4-1: Parts Check List of L-Axis Fixing Jig (For L-axis Posture: -60° to +20°)

<table>
<thead>
<tr>
<th>No.</th>
<th>DWG No.</th>
<th>Name</th>
<th>Pcs</th>
<th>Common parts for L-axis posture: -60° to +20°/ +20° to +76°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HW1303711-A</td>
<td>Support</td>
<td>1</td>
<td>o</td>
</tr>
<tr>
<td>2</td>
<td>HW0403915-1</td>
<td>Plate</td>
<td>2</td>
<td>o</td>
</tr>
<tr>
<td>3</td>
<td>M5×12</td>
<td>GT-SA bolt</td>
<td>4</td>
<td>o</td>
</tr>
<tr>
<td>4</td>
<td>M8×20 2H-8</td>
<td>Hexagon socket head cap screw Conical spring washer</td>
<td>4</td>
<td>o</td>
</tr>
<tr>
<td>5</td>
<td>HW1304620-1</td>
<td>Shaft</td>
<td>1</td>
<td>o</td>
</tr>
<tr>
<td>6</td>
<td>HW1304771-1</td>
<td>Shaft</td>
<td>1</td>
<td>o</td>
</tr>
<tr>
<td>7</td>
<td>M12×50 2H-12</td>
<td>Hexagon socket head cap screw Conical spring washer</td>
<td>Section A: 4 each</td>
<td>o</td>
</tr>
<tr>
<td>8</td>
<td>HW1404929-1</td>
<td>Shaft</td>
<td>1</td>
<td>o</td>
</tr>
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<td>9</td>
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<td>Cover</td>
<td>2</td>
<td>o</td>
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<td>10</td>
<td>HW1405123-1</td>
<td>Block</td>
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<td>o</td>
</tr>
<tr>
<td>11</td>
<td>M12×35 2H-12</td>
<td>Hexagon socket head cap screw Conical spring washer</td>
<td>Section A: 4 each Section B: 3 each</td>
<td>o</td>
</tr>
<tr>
<td>12</td>
<td>M10×25 2H-10</td>
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</tr>
<tr>
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<td>2</td>
<td>o</td>
</tr>
<tr>
<td>15</td>
<td>HW1405121-1</td>
<td>Shaft</td>
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<td>o</td>
</tr>
<tr>
<td>16</td>
<td>HW1405126-1</td>
<td>Block</td>
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<td>o</td>
</tr>
<tr>
<td>17</td>
<td>HW1304148-5</td>
<td>Screw</td>
<td>1</td>
<td>o</td>
</tr>
<tr>
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<td>o</td>
</tr>
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<td>o</td>
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<td>o</td>
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<tr>
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<td>8</td>
<td>o</td>
</tr>
<tr>
<td>22</td>
<td>HS1370337-A</td>
<td>Brake release unit cable</td>
<td>1</td>
<td>o</td>
</tr>
<tr>
<td>23</td>
<td>HE0301921-A</td>
<td>Brake release unit</td>
<td>1</td>
<td>o</td>
</tr>
</tbody>
</table>
4.4.2 Assembly and Disassembly (For L-axis Posture: +20° to +76°)

When assembling, refer to the following procedures and operate in order.

Assembling procedure (For L-axis posture: +20° to +76°)
1. Disconnecting internal wiring harness
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
2. Assembling fixing jigs of section A
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
3. Assembling fixing jigs of section C
   (For L-axis posture: +20° to +76°)
4. Assembling fixing jigs between section A and C
   (For L-axis posture: +20° to +76°)
5. Assembling brake release unit
   (Common for L-axis posture: -60° to +20°/+20° to +76°)

When disassembling, refer to the following procedures and operate in order.

Disassembling procedure (For L-axis posture: +20° to +76°)
1. Disassembling brake release unit
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
2. Disassembling fixing jigs between section A and C
   (For L-axis posture: +20° to +76°)
3. Disassembling fixing jigs of section C
   (For L-axis posture: +20° to +76°)
4. Disassembling fixing jigs of section A
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
5. Connecting internal wiring harness
   (Common for L-axis posture: -60° to +20°/+20° to +76°)

Assembly Procedure

1. Disconnecting internal wiring harness
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   • Refer to Fig. 4-12 "Disconnecting Internal Wiring Harness (Common for L-axis Posture: -60° to +20°/+20° to +76°)" and Fig. 4-17 "Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)".

   (1) Remove the plate② and GT-SA bolts③ M5 (length: 12 mm) (2 places each) from the support① attached to section A.

   (2) Remove the support① and hexagon socket head cap screws④ M8 (length: 12 mm).
Fig. 4-12: Disconnecting Internal Wiring Harness
(Common for L-axis Posture: -60° to +20°/+20° to +76°)
2. Assembling fixing jig of section A
   (Common for L-axis posture: -60° to +20°/+20° to +76°)
   • Refer to Fig. 4-13 “Assembling Fixing Jig of Section A (Common for L-axis Posture: -60° to +20°/+20° to +76°)” and Fig. 4-17 “Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)”.

(1) Install the shaft(5) to the shaft(3) on the upper part of the balancer, with hexagon socket head cap screws(7) M12 (length: 50 mm) (tightening torque: 84 N-m).

(2) Install the cover(9) to the shaft(8), then install the shaft(8) to the block(10) with hexagon socket head cap screws(11) M12 (length: 35 mm) (tightening torque: 84 N-m). (It is possible to perform this procedure in advance.)

(3) Insert the shaft(6) to the shaft(6).

(4) Install the cover(9) to the shaft(8) with hexagon socket head cap screws(12) M10 (length: 25 mm) (tightening torque: 48 N-m).

Fig. 4-13: Assembling Fixing Jig of Section A
(Common for L-axis Posture: -60° to +20°/+20° to +76°)
3. Assembling fixing jigs of section C (For L-axis posture: +20° to +76°)
   • Refer to Fig. 4-14 “Assembling Fixing Jig of Section C (For L-axis Posture: +20° to +76°)” and Fig. 4-17 “Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)”.

   (1) Remove the cover installed to section C, then remove hexagon socket head cap screws M5 (length: 10 mm).

   (2) Install the shaft to the shaft of section C with hexagon socket head cap screws M12 (length: 50 mm) (tightening torque: 84 N-m).

   (3) Pass the cover through the shaft, then install the shaft to the block with hexagon socket head cap screws M12 (length: 35 mm) (tightening torque: 84 N-m). (It is possible to perform this procedure in advance.)

   (4) Insert the shaft and the block to the shaft.

   (5) Install the cover to the shaft with hexagon socket head cap screws M10 (length: 25 mm) (tightening torque: 48 N-m).
L-Axis Fixing Jig

4.4 Assembly and Disassembly

4. Assembling fixing jigs between section A and C
(For L-axis posture: +20° to +76°)

- Refer to Fig. 4-15(a “Detail of Screw”, Fig. 4-15(b “Detail of Measuring Point”, Fig. 4-15(c “Assembling Fixing Jig Between A and C (For L-axis Posture: +20° to +76°)” and Fig. 4-17 “Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)”.

1. Insert the long side of the screw to the block from its bottom side, and install the plate to the screw from its top side. At this time, be sure to pass the screw through the plate. Also, adjust the position of holes of the plate (4 places) to come on the tapped holes of the block.

2. Install the joint to the screw. At this time, engage the thread of the joint with the thread of the screw 30 mm or more. Measure the distance from the groove edge of the screw to the edge of the joint, and if the distance is 90 mm or less, the thread of the joint and the thread of the screw are engaged 30 mm or more.

3. Insert the long side of the screw to the block from its top side. At this time, engage the thread of the joint with the thread of the screw 30 mm or more. Measure the distance from the edge of the joint to the groove edge of the screw, and if the distance is 90 mm or less, the thread of the joint and the thread of the screw are engaged 30 mm or more.

4. Install the plate to the screw from its bottom side. At this time, engage all the thread of the plate with the thread of the screw. Also, adjust the position of holes of the plate (4 places) to come on the tapped holes of the block.

5. Tighten the plate of section A and the block with the hexagon socket head cap screws M12 (length: 50 mm) (tightening torque: 84 N·m).

6. Tighten the plate of section B and the block with the hexagon socket head cap screws M12 (length: 50 mm) (tightening torque: 84 N·m). When the tapped hole does not fit or there is space between the plate and the block, rotate the joint to adjust that.

7. To reduce the rotation amount at the time of releasing the brake, the followings are recommended.
(If the servo monitor window does not appear because of the power malfunction etc. or there is enough space from the surroundings, the followings are not necessary to perform.)
While confirming the torque command value at the servo monitor window, rotate the joint.
The joint should be rotated in the direction where the torque command value is down.
Because the rotating direction varies depending on the edge load, the wrist posture and the U-arm posture, be careful about the direction.
(For the servo monitor, refer to section 7.9 “Servo Monitoring” of the DX200 Maintenance manual.)
4 L-Axis Fixing Jig
4.4 Assembly and Disassembly

Fig. 4-15(a): Detail of Screw

- Thread part 115 mm
- Thread part 375 mm
- M45 (Pitch: 4.5mm)
  - (coarse thread)
- Mark

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Right screw</th>
<th>Mark : R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HW1304148-5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Left screw</th>
<th>Mark : L</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>HW1304148-6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4-15(b): Detail of Measuring Point

- Measuring Point: 90 mm or less
- Joint part: 30 mm or more
- Schrink in this direction
Fig. 4-15(c): Assembling Fixing Jig Between A and C
(For L-axis Posture: +20° to +76°)
5. Assembling brake release unit  
(Common for L-axis posture: -60° to +20° to +76°)  

- Refer to Fig. 4-16 “Assembling brake release unit (L-axis Posture: -60° to +20°/+20° to +76°)”.

(1) Turn OFF the DX200 power supply.

(2) Disconnect the manipulator side connector of 2BC power supply cable, which is installed between the manipulator and the controller, and connect the brake release unit cable to the 2BC connector.

(3) Connect the brake release unit cable to the 2CN connector of brake release unit.

(4) Connect the 1PC of the brake release unit to the 100 V receptacle.

(5) Turn ON the 1CP of the brake release unit, then turn ON the brake release switch.

(6) After ensuring safety of surroundings, press the L-axis brake release button bit by bit and repeatedly. Then confirm that the L-axis cannot move at all. The brake is released only while the button is pressed. At this time, do not press any other buttons than L-axis brake release button. L-axis fixing jig corresponds only to release the brake unit of L-axis motor. If the brake of other axis motor is released, it is very dangerous because the other axis can be rotated depending on the condition of front edge load, wrist axis posture, U-axis posture, and L-axis posture.

Fig. 4-16: Assembling brake release unit  
(L-axis Posture: -60° to +20°/+20° to +76°)
Disassembly Procedure (For L-axis Posture: +20° to +76°)

1. Disassembling brake release unit  
(Common for L-axis posture: -60° to +20°/+20° to +76°)
   • Refer to Fig. 4-16 “Assembling brake release unit (L-axis Posture: -60° to +20°/ +20° to +76°)”.
   (1) Turn OFF the brake release switch of brake release unit, then turn the 1CP OFF.
   (2) Disconnect the 1PC of the brake release unit from the 100 V receptacle.
   (3) Disconnect the brake release unit cable connected to the manipulator from the 2BC connector, then connect the 2BC power supply cable to the 2BC connector of manipulator side.

2. Disassembling fixing jigs between section A and C  
(For L-axis posture: +20° to +76°)
   • Refer to Fig. 4-15(c “Assembling Fixing Jig Between A and C (For L-axis Posture: +20° to +76°)” and Fig. 4-17 “Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)”.
   (1) Remove the hexagon socket head cap screws M12 (length: 50 mm) installed to the section A and C, then remove the plate of section C.
   (2) Remove the screw from the joint, then remove the joint from the screw.
   (3) Remove the plate of section A from the screw.

3. Disassembling fixing jigs of section C  
(For L-axis posture: +20° to +76°)
   • Refer to Fig. 4-14 “Assembling Fixing Jig of Section C (For L-axis Posture: +20° to +76°)” and Fig. 4-17 “Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)”.
   (1) Remove the hexagon socket head cap screws M10 (length: 25 mm) installed to section C, then remove the cover.
   (2) Remove the block and the shaft.
   (3) Remove the hexagon socket head cap screws M12 (length: 50 mm), then remove the shaft.
   (4) Install the cover to the shaft with hexagon socket head cap screws M5 (length: 10 mm) (tightening torque: 6 N-m).
4. Disassembling fixing jigs of section A  
(Common for L-axis posture: -60° to +20°/+20° to +76°)

- Refer to Fig. 4-13 “Assembling Fixing Jig of Section A (Common for L-axis Posture: -60° to +20°/+20° to +76°)” and Fig. 4-17 “Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)”.

1. Remove the hexagon socket head cap screws M10 (length: 25 mm), then remove the cover.
2. Remove the block and the shaft.
3. Remove the hexagon socket head cap screws M12 (length: 50 mm), then remove the shaft.

5. Connecting internal wiring harness  
(Common for L-axis posture: -60° to +20°/+20° to +76°)

- Refer to Fig. 4-12 “Disconnecting Internal Wiring Harness (Common for L-axis Posture: -60° to +20°/+20° to +76°)” and Fig. 4-17 “Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)”.

1. Install the support to section A with the hexagon socket head cap screws M8 (length: 20 mm) (tightening torque: 24.5 N-m).
2. Install the plate to the support with the GT-SA bolts M5 (length: 12 mm) (tightening torque: 6 N-m).
4.4 Assembly and Disassembly

Fig. 4-17: Assembly/Disassembly of L-axis fixing jig (For L-axis Posture: +20° to +76°)
### Table 4-2: Parts Check List of L-Axis Fixing Jig (For L-axis Posture: +20° to +76°)

<table>
<thead>
<tr>
<th>No.</th>
<th>DWG No.</th>
<th>Name</th>
<th>Pcs</th>
<th>Common Parts for L-axis posture: -60° to +20°/+20° to +76°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HW1303711-A</td>
<td>Support</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>2</td>
<td>HW0403915-1</td>
<td>Plate</td>
<td>2</td>
<td>○</td>
</tr>
<tr>
<td>3</td>
<td>M5×12</td>
<td>GT-SA bolt</td>
<td>4</td>
<td>○</td>
</tr>
<tr>
<td>4</td>
<td>M8×20 2H-8</td>
<td>Hexagon socket head cap screw</td>
<td>4</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conical spring washer</td>
<td>4</td>
<td>○</td>
</tr>
<tr>
<td>5</td>
<td>HW1304620-1</td>
<td>Shaft</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>6</td>
<td>HW1304771-1</td>
<td>Shaft</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>7</td>
<td>M12×50 2H-12</td>
<td>Hexagon socket head cap screw</td>
<td>Section A: 4 each</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conical spring washer</td>
<td>Section C: 3 each</td>
<td>○</td>
</tr>
<tr>
<td>8</td>
<td>HW1404929-1</td>
<td>Shaft</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>9</td>
<td>HW1404917-1</td>
<td>Cover</td>
<td>2</td>
<td>○</td>
</tr>
<tr>
<td>10</td>
<td>HW1405123-1</td>
<td>Block</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>11</td>
<td>M12×35 2H-12</td>
<td>Hexagon socket head cap screw</td>
<td>Section A: 4 each</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conical spring washer</td>
<td>Section C: 3 each</td>
<td>○</td>
</tr>
<tr>
<td>12</td>
<td>M10×25 2H-10</td>
<td>Hexagon socket head cap screw</td>
<td>8</td>
<td>○</td>
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<td></td>
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<td>Conical spring washer</td>
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<td>○</td>
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<td>13</td>
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<td>Shaft</td>
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<td>14</td>
<td>HW1405126-1</td>
<td>Block</td>
<td>1</td>
<td>○</td>
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<tr>
<td>15</td>
<td>HW1304148-5</td>
<td>Screw</td>
<td>1</td>
<td>○</td>
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<td>16</td>
<td>HW1405124-3</td>
<td>Plate</td>
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<td>○</td>
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<tr>
<td>17</td>
<td>HW1304147-3</td>
<td>Joint</td>
<td>1</td>
<td>○</td>
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<tr>
<td>18</td>
<td>HW1304148-6</td>
<td>Screw</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>19</td>
<td>M12×50 2H-12</td>
<td>Hexagon socket head cap screw</td>
<td>8</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conical spring washer</td>
<td>8</td>
<td>○</td>
</tr>
<tr>
<td>20</td>
<td>HW1405158-1</td>
<td>Cover</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>21</td>
<td>M5×10 2H-5</td>
<td>Hexagon socket head cap screw</td>
<td>2</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conical spring washer</td>
<td>2</td>
<td>○</td>
</tr>
<tr>
<td>22</td>
<td>HW1304620-2</td>
<td>Shaft</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>23</td>
<td>HW1304771-2</td>
<td>Shaft</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>24</td>
<td>HS1370337-A</td>
<td>Brake release unit cable</td>
<td>1</td>
<td>○</td>
</tr>
<tr>
<td>25</td>
<td>HE0301921-A</td>
<td>Brake release unit</td>
<td>1</td>
<td>○</td>
</tr>
</tbody>
</table>
5 Grease Filling/Exchange

5.1 Notes on Grease Filling/Exchange Procedures

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

- If grease is injected without removing the plug from the grease exhaust port, the grease will leak inside a motor, or an oil seal of a speed reducer will come off. Make sure to remove the plug or it may result in a failure. Also, when using a tube, the length must be 150 mm or shorter and the inside diameter must be 6 mm or longer. If the tube is too long, the exhaust resistance at the tube part is increased, and the inner pressure of the grease bath is raised. It may result in coming off of an oil seal.

- Make sure to use a grease pump to inject grease. Set the grease injection rate to 7 g/s or less. (Air supply pressure to the grease pump: 0.3 MPa or less (example)) If not, an oil seal of a speed reducer will come off, and it may result in a failure.

- When using extrusion air for discharging the grease, set air supply pressure at 0.025 MPa or less. If not, an oil seal of a speed reducer will come off, and it may result in a failure.

- Make sure to fill the hose on the grease inlet with grease beforehand to prevent air from leaking into the speed reducer.

- After injecting grease, discharge the specified amount of grease. If insufficient, the inner pressure is raised during the operation, and grease may leak. When discharged too much, the speed reducer is not lubricated sufficiently during the operation, and it may cause the early failure of the speed reducer.

- When filling/exchanging grease, the grease may flow out from the grease inlet or the grease exhaust port. Prepare a container to receive the grease and a waste cloth to wipe the grease in advance.

- After mounting a speed reducer or a motor, leave it 30 minutes or more and inject grease. If grease is filled before the sealing bond is solidified, it may cause the grease leakage.

**WARNING**

- When operating the manipulator, do not enter into the working area of the manipulator. Injury may result if anyone enter into the working area during operation.

**CAUTION**

- When using extrusion air for discharging the grease, the grease may be vigorously discharged from the exhaust port. Perform an operation such as using a tube at the grease exhaust port to pour into an appropriate container.
### 5.2 List of Necessary Items

Prepare necessary items as indicated in Table 5-1 “List of Necessary Items”. "S", "L", "U", "R", and "BT" in the table mean grease filling/exchange to each axis, and "Casing" means grease filling/exchange to the R-, B-, and T-gear in a casing.

**Table 5-1: List of Necessary Items**

<table>
<thead>
<tr>
<th>Items</th>
<th>When filling/exchanging the grease of each axis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Grease zerk A-PT1/4</td>
<td>Ø</td>
</tr>
<tr>
<td>Grease zerk A-PT1/8</td>
<td></td>
</tr>
<tr>
<td>Hexagon bit tool, width across flat: 5</td>
<td>Ø</td>
</tr>
<tr>
<td>Hexagon bit tool, width across flat: 6</td>
<td></td>
</tr>
<tr>
<td>Hexagon bit tool, width across flat: 8</td>
<td>Ø</td>
</tr>
<tr>
<td>Torque wrench (Range of use: 4.9 N•m - 23 N•m)</td>
<td></td>
</tr>
<tr>
<td>Torque wrench, Extension bar for hexagon bit (30 mm or longer)</td>
<td>Ø</td>
</tr>
<tr>
<td>ThreeBond 1206C</td>
<td>Ø</td>
</tr>
<tr>
<td>Recommended grease lubricator: Powerlube P3C by Macnaught</td>
<td>Ø</td>
</tr>
<tr>
<td>Air supply (air supply pressure: 0.3 MPa or less)</td>
<td>Ø</td>
</tr>
<tr>
<td>Joint and hose for grease discharging (Approx. 150 mm)</td>
<td>Ø</td>
</tr>
<tr>
<td>Container for grease discharging (Checking the cubical content (cc) inside this container should be available.)</td>
<td>Ø</td>
</tr>
<tr>
<td>Regulator for grease discharging (Recommendation: ARP30-02G by SMC)</td>
<td>Ø</td>
</tr>
<tr>
<td>Weight scale (Minimum display should be 1 g. Range of use: 0 g - 2,000 g)</td>
<td>Ø</td>
</tr>
</tbody>
</table>
5.3 Grease Filling/Exchange

5.3.1 Grease Filling/Exchange for S-, L-, U-, R-, B-, and T-axis Speed Reducer

1. Make the posture as indicated in Fig. 5-1 “Recommended Posture of Each Axis While Injecting” to remove the plugs of the grease inlets and the grease exhaust ports. (Refer to Fig. 5-2 “Plug Position of S- and L-axis Speed Reducer”, Fig. 5-3 “Plug Position of U-axis Speed Reducer and R-, B-, and T-gear in a casing”, and Fig. 5-4 “Plug Position of R-, B-, and T-axis”.) If it is difficult to make the recommended posture because of external cabling or etc., adjust the posture as much as possible to make the position of grease inlet located in the lower part and the position of exhaust port located in the upper part. Thus, grease can be filled/exchanged more properly as the recommended posture.

Fig. 5-1: Recommended Posture of Each Axis While Injecting
Fig. 5-2: Plug Position of S- and L-axis Speed Reducer

Fig. 5-3: Plug Position of U-axis Speed Reducer and R-, B-, and T-gear in a casing

Fig. 5-4: Plug Position of R-, B-, and T-axis
2. Install the grease zerk to the grease inlet. (Refer to Fig. 5-2 “Plug Position of S- and L-axis Speed Reducer”, Fig. 5-3 “Plug Position of U-axis Speed Reducer and R-, B-, and T-gear in a casing”, and Fig. 5-4 “Plug Position of R-, B-, and T-axis”.) (The grease zerk is delivered with the manipulator.)

3. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Recommended grease lubricator: Powerlube P3C by Macnaught
   - Grease injection rate: 7 g/s or less
     When the grease is discharged at 2 times/s from the lubricator, set the discharge amount as 3.5 g/time or less. (Rough standard)
   - Air supply pressure of grease pump: 0.3 MPa or less
     (Rough standard)
   - Grease injection rate (Rough standard):
     Refer to Table 5-2 “Amount of Grease to Inject (as a guide only)”.

Table 5-2: Amount of Grease to Inject (as a guide only)

<table>
<thead>
<tr>
<th>Grease filling/exchanging point</th>
<th>Amount of Grease to Inject (as a guide only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-axis</td>
<td>4350 g</td>
</tr>
<tr>
<td>L-axis</td>
<td>2180 g</td>
</tr>
<tr>
<td>U-axis</td>
<td>2180 g</td>
</tr>
<tr>
<td>R/B/T-gear in the casing</td>
<td>2260 g</td>
</tr>
<tr>
<td>R-axis</td>
<td>1910 g</td>
</tr>
<tr>
<td>B/T-axis</td>
<td>1130 g</td>
</tr>
</tbody>
</table>

4. When replacing the speed reducer

   4-A. Stop injection when grease appears from the grease exhaust port.
     * For injecting grease to the L-axis, U-axis, gear in the casing, R-axis, and B/T-axis, proceed to the step 5.
     * For injecting the grease to the S-axis, proceed to the step 8.

4-B. The grease is discharged from the grease exhaust port. At this time, stop injection when the mixture of the used grease and the new grease in an equal ratio is seen.

   * For injecting the grease to the L-axis, U-axis, R/B/T-gear in the casing, R-axis, and B/T-axis, proceed to the step 7.
   * For injecting the grease to the S-axis, proceed to the step 8.

5. Perform the teaching operation for each axis indicated in Table 5-3 “Teaching Operation of Each Axis” approximately 5 times.
5 Grease Filling/Exchange
5.3 Grease Filling/Exchange

6. Inject the grease again. When the grease is overflowed from the grease exhaust port, injection is completed.

7. Discharge the specified amount of grease from the grease inlet or exhaust port (Refer to Table 5-4 “Amount of Grease Discharged from Each Axis.”) In order to exhaust the specified amount of grease, discharge the grease into a container, and measure it with a weighing scale each time.

   Use one of the following methods to discharge the grease.

   Discharging method 1: Extruding the grease by air injected from the exhaust port.
   - Connect the joint and the hose to the grease inlet.
   - Connect the regulator to the grease exhaust port.
   - Extrude the grease by injecting the air from the exhaust port.
     (Extrusion air pressure: 0.025 MPa or less)

   If the grease is not discharged enough by extruding air, operate the manipulator again as shown in Table 5-3 “Teaching Operation of Each Axis”.

   Discharging method 2: Sucking out the grease from the exhaust port.
   - Leave the inlet open and insert the tube into the exhaust port.
   - Discharge the grease by suction using the tube.
     (Suction pressure: 0.025 MPa or less)
   - If the grease is not discharged enough by suction, operate the manipulator again as shown in Table 5-3.

<table>
<thead>
<tr>
<th>Grease filling/exchanging point</th>
<th>Operation angle at teaching operation</th>
<th>Teaching speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-axis</td>
<td>L-axis ±45°</td>
<td></td>
</tr>
<tr>
<td>U-axis</td>
<td>U-axis ±45°</td>
<td>Arbitrary</td>
</tr>
<tr>
<td>R/B/T-gear in the casing, R-axis, and B/T-axis</td>
<td>R-axis ±90°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-axis ±45°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-axis ±90°</td>
<td></td>
</tr>
</tbody>
</table>

6. Inject the grease again. When the grease is overflowed from the grease exhaust port, injection is completed.

7. Discharge the specified amount of grease from the grease inlet or exhaust port (Refer to Table 5-4 “Amount of Grease Discharged from Each Axis.”) In order to exhaust the specified amount of grease, discharge the grease into a container, and measure it with a weighing scale each time.

   Use one of the following methods to discharge the grease.

   Discharging method 1: Extruding the grease by air injected from the exhaust port.
   - Connect the joint and the hose to the grease inlet.
   - Connect the regulator to the grease exhaust port.
   - Extrude the grease by injecting the air from the exhaust port.
     (Extrusion air pressure: 0.025 MPa or less)

   If the grease is not discharged enough by extruding air, operate the manipulator again as shown in Table 5-3 “Teaching Operation of Each Axis”.

   Discharging method 2: Sucking out the grease from the exhaust port.
   - Leave the inlet open and insert the tube into the exhaust port.
   - Discharge the grease by suction using the tube.
     (Suction pressure: 0.025 MPa or less)
   - If the grease is not discharged enough by suction, operate the manipulator again as shown in Table 5-3.

<table>
<thead>
<tr>
<th>Grease filling/exchanging point</th>
<th>Amount of exhausted grease [g]</th>
<th>[cc]</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-axis</td>
<td>0 [Unnecessary]</td>
<td>0 [Unnecessary]</td>
</tr>
<tr>
<td>L-axis</td>
<td>240±30</td>
<td>275±35 (240 to 310)</td>
</tr>
<tr>
<td>U-axis</td>
<td>250±30</td>
<td>285±35 (250 to 320)</td>
</tr>
<tr>
<td>R/B/T-gear in the casing, R-axis, and B/T-axis</td>
<td>115±15</td>
<td>130±15 (115 to 145)</td>
</tr>
<tr>
<td>R-axis</td>
<td>95±10</td>
<td>110±15 (95 to 125)</td>
</tr>
<tr>
<td>B/T-axis</td>
<td>55±5</td>
<td>65±10 (55 to 75)</td>
</tr>
</tbody>
</table>
8. For the point where the grease is filled/exchanged, perform a playback operation indicated in Table 5-5 “Running-in Operation of Each Axis” for running-in the speed reducer with the grease. At this time, in case the grease is discharged during the operation, remove the grease zerk from the grease inlet, clean and degrease the thread part and the tap part of the plug. And then, apply ThreeBond 1206C to the thread part of the plug to mount the plug to the grease inlet. Tighten the plug with the tightening torque indicated in Table 5-6 “Plug Type and Tightening Torque of Each Axis”. Also, discharge the excess grease not to increase the inner pressure of the speed reducer. Attach a bag to collect grease such as indicated in Fig. 5-5 “Grease Receiving Bag (Rough Standard)”, and then perform the running-in operation.

Table 5-5: Running-in Operation of Each Axis

<table>
<thead>
<tr>
<th>Grease filling/exchanging point</th>
<th>Running-in operation</th>
<th>Operation angle</th>
<th>Operation speed</th>
<th>Timer after each operation</th>
<th>Operation time</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-axis</td>
<td>S-axis ±90°</td>
<td>MOVJ VJ= 50.00</td>
<td>1.0s</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td>L-axis</td>
<td>L-axis ±45°</td>
<td>MOVJ VJ= 50.00</td>
<td>1.0s</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td>U-axis</td>
<td>U-axis ±45°</td>
<td>MOVJ VJ= 50.00</td>
<td>1.0s</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td>R-, B-, and T-axis in the casing</td>
<td>R-axis ±90°</td>
<td>MOVJ VJ= 50.00</td>
<td>1.0s</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B-axis ±45°</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-axis ±90°</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5-6: Plug Type and Tightening Torque of Each Axis

<table>
<thead>
<tr>
<th>Grease filling/exchanging point</th>
<th>Plug for grease inlet</th>
<th>Plug for grease exhaust port</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plug type</td>
<td>Tightening torque</td>
</tr>
<tr>
<td>S-axis</td>
<td>PT1/4</td>
<td>12.0 N•m (1.2 kgf•m)</td>
</tr>
<tr>
<td>L-axis</td>
<td>PT1/8</td>
<td>4.9 N•m (0.5 kgf•m)</td>
</tr>
<tr>
<td>U-axis</td>
<td>PT1/8</td>
<td>4.9 N•m (0.5 kgf•m)</td>
</tr>
<tr>
<td>R-, B-, and T-gear in the casing</td>
<td>PT1/8</td>
<td>4.9 N•m (0.5 kgf•m)</td>
</tr>
</tbody>
</table>
9. Wipe the discharged grease using a waste cloth. After cleaning and degreasing the thread part and the tap part of the plug, apply ThreeBond 1206C to the thread part of the plug. Mount the plug to the grease exhaust port, and tighten it with the tightening torque indicated in Table 5-6 “Plug Type and Tightening Torque of Each Axis”.

Fig. 5-5: Grease Receiving Bag (Rough Standard)
5.3.2 Grease Replenishment for Gas Balancer Link Part

*Fig. 5-6: Gas Balancer Link Part*

1. Remove the plugs from the grease inlet and from the grease exhaust port of the link ① and ②.

2. Inject grease through the grease inlet of the link ① and ② using a grease gun.
   - Grease type: Alvania EP Grease 2
   - Amount of grease: to the link ①: 8 cc (30 cc for 1st supply) to the link ②: 8 cc (30 cc for 1st supply)

3. Wipe the discharged grease with a cloth at the grease exhaust port and reinstall the plug to the exhaust port of the link ① and ②. Apply ThreeBond 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).

4. Reinstall the plug to the grease inlet of the link ① and ②. Apply ThreeBond 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 Gas Maintenance Procedure in the Gas Balancer

6.1 Notes on Gas in the Gas Balancer Maintenance Procedure

Be sure to read the following precautions thoroughly and understand the contents before performing gas inspections or discharging/injecting gas. Failure to observe this may cause malfunctions of the gas balancer or occurrence of accidents or injury.

**DANGER**

- This gas balancer uses high-pressure nitrogen gas.
- Do not inject other gas than nitrogen gas to this gas balancer. Failure to observe this may cause malfunctions of the gas balancer or occurrence of accidents or injury.
- There is a possibility of suffocation accident in the high-density nitrogen gas environment. For this reason, enough ventilation is required when performing the operations.
- Before inspecting the gas pressure in the gas balancer or discharging/filling the gas from/into the gas balancer, confirm that the L-axis motor brake is appropriately functioning and L-axis is firmly fixed so that it will not rotate. Failure to observe this may cause very dangerous situation due to releasing of the L-axis motor brake. Because the L-axis without retaining force leads the L-arm to rotate by the lengthened or shortened gas balancer.

**CAUTION**

- When handling high-pressure gas, sufficient caution and observing of the related laws and local government regulations are required.
- For gas filling devices, contact your YASKAWA service representative.

**NOTE**

To maintain the sealing performance, small quantity of oil used may leak from the bottom part of the gas balancer.
6.2 Gas Pressure Inspection

**MANDATORY**

- Perform the gas pressure inspection every 6000H.
- Operation of the manipulator with inadequate gas pressure gas balancer may cause failure or breakage.

6.2.1 Adequate Gas Pressure

Adequate nitrogen gas pressure in the gas balancer varies depending on the temperature. Refer to Table 6-1 “Adequate Gas Pressure per Gas Balancer Surface Temperature”.

Table 6-1: Adequate Gas Pressure per Gas Balancer Surface Temperature

<table>
<thead>
<tr>
<th>Gas balancer surface temperature</th>
<th>-10º</th>
<th>-5º</th>
<th>0º</th>
<th>5º</th>
<th>10º</th>
<th>15º</th>
<th>20º</th>
<th>25º</th>
<th>30º</th>
<th>35º</th>
<th>40º</th>
<th>45º</th>
<th>50º</th>
<th>55º</th>
<th>60º</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate gas pressure (MPa)</td>
<td>10.5</td>
<td>10.8</td>
<td>11.1</td>
<td>11.4</td>
<td>11.6</td>
<td>11.9</td>
<td>12.2</td>
<td>12.4</td>
<td>12.7</td>
<td>13.0</td>
<td>13.2</td>
<td>13.5</td>
<td>13.8</td>
<td>14.1</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Fig. 6-1: Adequate Gas Pressure per Gas Balancer Surface Temperature
6.2 Necessary Devices

Prepare following devices when checking the gas pressure.

- Gas filling device: HW1485204
  The device includes:
  - Digital pressure gauge: GC64-173
  - Quick connector: 10-358-6297
- Thermometer (for measuring the gas balancer surface)

6.2.3 Inspection Procedures

1. Move the manipulator to the home position and turn OFF the power supply of the DX200.
2. Remove the cover and the hexagon socket head screw plug with flange, which are mounted to the gas inlet, and insert the quick connector.
3. Connect the gas filling device to the quick connector after confirming that the blowdown valve, needle valve, and gate valve of the gas filling device are firmly closed.
4. Check the temperature of the gas balancer surface.
5. Slowly open the needle valve of the gas filling device, and then check that the pressure indicated on the digital pressure gauge is satisfying the value shown in Table 6-1 "Adequate Gas Pressure per Gas Balancer Surface Temperature". Depending on the value, procedures after this are subject to change.
   
   Case 1: When the value is exceeding the adequate value
   → Discharge the gas till the value satisfies the adequate value.
   (Refer to section 6.3 “Gas Discharging Procedures”)
   
   Case 2: When the value is lower than the adequate value by 0.5 MPa or more.
   → Inject the gas till the value satisfies the adequate value.
   (Refer to section 6.4 “Gas Injecting Procedure”)
   
   Other than Case 1 and 2:
   → Proceed to Step 5
6. Close the needle valve of the gas filling device, and then remove the gas filling device from the quick connector.

DANGER

Before inspecting the gas pressure in the gas balancer or discharging/filling the gas from/into the gas balancer, confirm that the L-axis motor brake is appropriately functioning and L-axis is firmly fixed so that it will not rotate.

Failure to observe this may cause very dangerous situation due to releasing of the L-axis motor brake. Because the L-axis without retaining force leads the L-arm to rotate by the lengthened or shortened gas balancer.
6. Gas Maintenance Procedure in the Gas Balancer

6.2 Gas Pressure Inspection

7. Remove the quick connector and mount the cover, then tighten the hexagon socket head screw plug with flange by using a tightening torque of 4.9 N•m (0.5 kgf•m).

8. Mount the cover and tighten the hexagon socket head cap screws M4 (length: 6mm) with a tightening torque of 2.8 N•m (0.29 kgf•m.)

9. Turn ON the power supply of the DX200.

Fig. 6-2: Gas in Gas Balancer Pressure Inspection
6.3 Gas Discharging Procedures

**MANDATORY**

- Discharge all gas from the gas balancer when in the following cases.
  - When dismounting the gas balancer from the manipulator.
  - When air-flight the gas balancer.
  (When the gas balancer is air-flight with gas filled, it is treated as a hazardous material and a large amount of money is required.)

### 6.3.1 Necessary Devices

Prepare following devices when discharging gas

- Gas filling device: HW1485204
  The device includes:
  - Digital pressure gauge: GC64-173
  - Quick connector: 10-358-6297
  - Valve of the service gauge: SS-1KS4
- Thermometer (for measuring the gas balancer surface)

### 6.3.2 Gas Discharging Procedure

**DANGER**

Before discharging/filling the gas from/into the gas balancer, confirm that the L-axis motor brake is appropriately functioning and L-axis is firmly fixed so that it will not rotate. Failure to observe this may cause very dangerous situation. Failure to observe this may cause very dangerous situation due to releasing of the L-axis motor brake. Because the L-axis without retaining force leads the L-arm to rotate by the lengthened or shortened gas balancer.

**MANDATORY**

- When discharging the gas, the blowdown valve must not be fully opened. Take time and discharge gas little by little. If the blowdown valve is fully opened with high internal pressure, the non-return valve in the gas balancer can be damaged.
6.3.2.1 When Discharging All Gas

1. Move the manipulator to the home position and turn OFF the power supply of the DX200.
2. Remove the cover and the hexagon socket head screw plug M6 with flange, which are mounted to the gas inlet, and insert the quick connector.
3. Connect the gas filling device to the quick connector after confirming that the blowdown valve, needle valve, and gate valve of the gas filling device are firmly closed.
4. Slowly open the needle valve.
5. Discharge gas a small amount at a time by slowly releasing the blowdown valve.
6. Close the needle valve and blowdown valve, and then remove the gas filling device from the quick connector.
7. Remove the quick connector and mount the cover, then tighten the hexagon socket head screw plug M6 with flange by using a tightening torque of 4.9 N•m (0.5 kgf•m).
8. Mount the cover and tighten the hexagon socket head cap screws M4 (length: 6mm) with a tightening torque of 2.8 N•m (0.29 kgf•m.)
9. Turn ON the power supply of the DX200.
6.3.2.2 When Discharging Gas for Adjusting Pressure

1. Move the manipulator to the home position and turn OFF the power supply of the DX200.

2. Remove the cover and the hexagon socket head screw plug M6 with flange, which are mounted to the gas inlet, and insert the quick connector.

3. Connect the gas filling device to the quick connector after confirming that the blowdown valve, needle valve, and gate valve of the gas filling device are firmly closed.

4. Check the temperature of the gas balancer surface.

5. Slowly open the needle valve.

6. Discharge gas by slowly releasing the blowdown valve until the gas pressure is the value shown in Table 6-1 “Adequate Gas Pressure per Gas Balancer Surface Temperature”.

7. Close the needle valve and blowdown valve, and then remove the gas filling device from the quick connector.

8. Remove the quick connector and mount the cover, then tighten the hexagon socket head screw plug M6 with flange by using a tightening torque of 4.9 N•m (0.5 kgf•m).

9. Mount the cover and tighten the hexagon socket head cap screws M4 (length: 6mm) with a tightening torque of 2.8 N•m (0.29 kgf•m.)

10. Turn ON the power supply of the DX200.

After discharging/injecting gas, wait for a few minutes to stabilize the gas pressure, and then measure the gas pressure.

Fig. 6-3: Gas Discharging Operation

- Gas inlet/gas exhaust port
- Hexagon socket head cap screw M4 (length: 6 mm) (2 pieces)
- Conical spring washer 2H-4 (2 pieces)
- Cover (HW1405134-1)
- Surface temperature measuring point
- Hexagon socket head screw plug M6 with flange
- A part

Measure on the surface of the gas balancer after removing the cover.

Enlarged figure
6 Gas Maintenance Procedure in the Gas Balancer

6.4 Gas Injecting Procedure

6.4.1 Necessary Devices

Prepare following devices when injecting gas

- Nitrogen gas cylinder
- Gas filling device: HW1485204
  The device includes:
  - Digital pressure gauge: GC64-173
  - Quick connector: 10-358-6297
- Thermometer (for measuring the gas balancer surface)

6.4.2 Gas Injecting Procedures

DANGER

Before discharging/filling the gas from/into the gas balancer, confirm that the L-axis motor brake is appropriately functioning and L-axis is firmly fixed so that it will not rotate. Failure to observe this may cause very dangerous situation. Failure to observe this may cause very dangerous situation due to releasing of the L-axis motor brake. Because the L-axis without retaining force leads the L-arm to rotate by the lengthened or shortened gas balancer.

1. Move the manipulator to the home position and turn OFF the power supply of the DX200.
2. Remove the cover and the hexagon socket head screw plug M6 with flange, which are mounted to the gas inlet, and insert the quick connector.
3. Connect the gas filling device to the quick connector after confirming that the blowdown valve, needle valve, and gate valve of the gas filling device are firmly closed.
4. Check the temperature of the gas balancer surface.
5. Connect the nitrogen gas cylinder to the gas filling device.
6. Release the valve of the nitrogen gas cylinder, and then set the gas pressure slightly higher than the adequate pressure shown in Table 6-1 “Adequate Gas Pressure per Gas Balancer Surface Temperature” by rotating the regulator handle of the gas filling device.
7. Slowly open the needle valve of the gas filling device.
8. Release the gate valve of the gas filling device to inject gas until the gas pressure indicated by the digital pressure gauge is slightly higher than the adequate pressure shown in Table 6-1.
9. Close the gate valve of the gas filling device, wait for the gas pressure in the gas balancer to stabilize, and then confirm that the gas pressure is the adequate pressure shown in Table 6-1 “Adequate Gas Pressure per Gas Balancer Surface Temperature”. If the pressure is higher than the adequate pressure, discharge the gas gradually and stabilize the gas pressure, then confirm that the gas pressure finally reached the adequate value.

**NOTE**

After discharging/injecting gas, wait for a few minutes to stabilize the gas pressure, and then measure the gas pressure.

10. Close needle valve of the gas filling device and the valve of the nitrogen gas cylinder.

11. Disconnect the gas filling device from the quick connector.

12. Remove the quick connector and mount the cover, then tighten the hexagon socket head screw plug M6 with flange by using a tightening torque of 4.9 N•m (0.5 kgf•m).

13. Mount the cover and tighten the hexagon socket head cap screws M4 (length: 6mm) with a tightening torque of 2.8 N•m (0.29 kgf•m.)

14. Release the blowdown valve of the gas filling device and regulator, and then discharge the gas in the hose.

15. Disconnect the gas filling device from the nitrogen gas cylinder.

16. Turn ON the power supply of the DX200.

*Fig. 6-4: Gas Injecting Operation*
7 Removing, Applying, Assembling of Sealing Bond

7.1 Removing Sealing Bond from Sealing Surface and Cleaning

1. Remove the sealing bond of the sealing surface of the manipulator on which the speed reducer or the motor was mounted with using a spatula etc.

2. In order to remove dust, dirt, foreign objects, and oil, wipe whole surface of the speed reducer or motor for replacement using a waste cloth. (Refer to Fig. 7-1 “Wiping Whole Surface of Speed Reducer”.)

   If not wiping whole surface of the speed reducer, the rust preventive oil adhered to the speed reducer gradually flows out to the outside of the manipulator, and a phenomenon considered as oil leakage occurs (mis-recognition as oil leakage).

3. Saturate a clean cloth with the degreasing and cleaning agent, and sufficiently degrease the sealing surface of the manipulator side and the sealing surface of the speed reducer or the motor to be replaced.

**NOTE**

Do not pour the degreasing and cleaning agent directly to the sealing surface. When the agent remains inside and at the concave part of the speed reducer, the sealing bond would no be solidified and this may cause grease leakage.

Fig. 7-1: Wiping Whole Surface of Speed Reducer
7.2 Applying Sealing Bond to Sealing Surface

1. Check that the degreasing and cleaning agent of the sealing surface is dried. (Refer to Fig. 7-2 “Checking the Dryness”.) If not dried, wipe the agent with a new cloth. (Refer to the fig. Fig. 7-3 “Wiping the Agent”.) For the part where wiping cannot be performed such as the concave part, use air to blow off.

2. Apply sealing bond (ThreeBond 1206C) to the sealing surface.

The points to apply sealing bond depend on the axes. When applying sealing bond, make sure to refer to Chapter 8 “Disassembly and Reassembly of Motors” and Chapter 9 “Disassembly and Reassembly of Speed Reducer” of each axis.

Fig. 7-2: Checking the Dryness

Fig. 7-3: Wiping the Agent
7.3 Assembling After Applying Sealing Bond

1. After applying sealing bond, pay attention to the following and immediately perform assembling.
   - Remove any dust, dirt, foreign objects, and oil on the sealing surface.
   - Align the screw hole positions etc. before applying the sealing bond, and then contact the surfaces. Without this procedure, unevenness of the sealing bond on the sealing surface may decline the sealing efficiency. And it may cause grease leakage.
   - The rust preventive oil is applied inside of the speed reducer. Immediately perform assembling so that the rust preventive oil does not flow out to the sealing surface.

2. After assembling, fix them with screws as soon as possible. For tightening the screws, tighten them with the tightening torque indicated in Chapter 8 “Disassembly and Reassembly of Motors” and Chapter 9 “Disassembly and Reassembly of Speed Reducer”.

3. With a waste cloth, wipe the exceeded sealing bond after assembling. (Refer to Fig. 7-4 “Wiping Stray Sealing Bond”.)

**NOTE**

If grease is filled before the sealing bond is solidified, it may cause the grease leakage. After tightening the screws, leave it 30 minutes or more, and then fill it with grease.

*Fig. 7-4: Wiping Stray Sealing Bond (Following Photos are Typical Example)*
8 Disassembly and Reassembly of Motors

8.1 Disassembly and Reassembly of S-Axis Motor

- Refer to Fig. 8-1(a) “Assembling View of S-axis (Disassembly and Reassembly of Motors)”, Table 8-1 “S-Axis Motor Parts Checklist”.

### Disassembly

1. Turn OFF the DX200 power supply.
2. Remove the connector (encoder, brake, power) connected to the S-axis motor. When disconnecting the connector for power, nip the connector on the cable side with using a pair of plastic pliers, etc. to remove it.
3. Remove the hexagon socket head cap screws, and insert the stud bolts M6 (thread part length: 50 mm or more) into 2 tapped holes for the motor on the motor-flange face. As a rough standard, screw the stud bolts into the tapped holes to make 30 mm or more clearance between the motor and the contact surface.
4. Install 2 eye bolts to the thread part M8 (2 places) of the motor. Use the eye bolts to remove the S-axis motor and the spacer vertically from the S head.
5. Remove the GT-SA bolts from the spacer and insert the stud bolts M6 (thread part length: 50 mm or more) into 2 tapped holes M6. As a rough standard, screw the stud bolts into the tapped holes to make 5 mm or more clearance between the motor and the contact surface.
6. Remove the hexagon socket head cap screw. Remove the unit [the input gear, the retaining ring, the bearing, the flywheel], and the key.
7. Remove the spacer form the S-axis motor.
8 Disassembly and Reassembly of Motors

8.1 Disassembly and Reassembly of S-Axis Motor

Reassembly

For removing/applying of sealing bond and assembling the motor after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

1. Apply sealing bond (ThreeBond 1206C) to the contact surface of the S-axis motor 1 and the spacer 5. For the points to apply sealing bond, refer to Fig. 8-1(b) “Surface to Apply Sealing Bond on the Part of S-axis Motor Part”.

2. Mount the flywheel 7 to the S-axis motor 1.

3. Mount the unit [the input gear 3, the retaining ring 6, the bearing 9] to the S-axis motor 1 and the spacer 5, and then mount the key 4 to the S-axis motor 1. Apply Loctite 243 to the thread part of the hexagon socket head cap screw 6, and tighten it with a tightening torque of 40.0 N•m.

4. Apply sealing bond ThreeBond 1206C to the contact surface of the S-head and the spacer 5. For the points to apply sealing bond, refer to Fig. 8-1(c) “Surface to Apply Sealing Bond on the Part of S-axis Space Part”.

5. Mount the spacer 5 to the S-head, and then tighten the hexagon socket head cap screws 2 with the tightening torque of 84.0 N•m.

6. Connect the internal wiring harness connectors (encoder, brake, power) to the S-axis motor 1. When connecting the connector for power, nip the connector on the cable side by using a pair of plastic pliers, etc. to mount it.

7. Turn ON the DX200 power supply.

Table 8-1: S-Axis Motor Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S-axis motor HW0388670-A</td>
<td>1</td>
<td>SGMRV-37ANA-YR1*</td>
</tr>
<tr>
<td>2</td>
<td>Hexagon socket head cap screw M12</td>
<td>4 each</td>
<td>Tightening torque: 84.0 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 60 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Input gear HW1303369-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Key</td>
<td>1</td>
<td>Delivered with the S-axis motor 1</td>
</tr>
<tr>
<td>5</td>
<td>Spacer HW1303371-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hexagon socket head cap screw M8</td>
<td>1 each</td>
<td>Tightening torque: 40.0 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 70 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Flywheel HW1404226-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Hexagon socket head plug PT3/8</td>
<td>1</td>
<td>Tightening torque 23.0 N•m</td>
</tr>
<tr>
<td></td>
<td><em>Stainless</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>GT-SA bolts M6 (length: 30 mm)</td>
<td>2</td>
<td>Tightening torque 10 N•m</td>
</tr>
<tr>
<td>10</td>
<td>Retaining ring STW-50</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Bearing 6310</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
8 Disassembly and Reassembly of Motors
8.1 Disassembly and Reassembly of S-Axis Motor

Fig. 8-1(a): Assembling View of S-axis (Disassembly and Reassembly of Motors)

Fig. 8-1(b): Surface to Apply Sealing Bond on the Part of S-axis Motor

Apply sealing bond here

Apply sealing bond evenly to whole surface.
8 Disassembly and Reassembly of Motors
8.1 Disassembly and Reassembly of S-Axis Motor

Fig. 8-1(c): Surface to Apply Sealing Bond on the Part of S-axis Space Part

Apply sealing bond evenly to whole surface.
8.2 Disassembly and Reassembly of L-Axis Motor

**DANGER**

- Execute disassembly and reassembly of the L-axis motor after mounting the L-axis fixing jig on the balancer. Also, be sure to confirm that the L-axis is firmly fixed by releasing the L-axis motor brake.

Failure to observe this leads unexpected L-arm rotation at the moment when the L-axis motor is removed and it may result in damage to machinery or death or serious injury.

- Refer to Chapter 4 “L-Axis Fixing Jig” in this manual on how to fix the balancer.

- Refer to Fig. 8-2(a) “Assembling View of L-axis (Disassembly and Reassembly of Motors)”, Table 8-2 “L-Axis Motor Parts Checklist”.

**Disassembly**

1. Turn OFF the DX200 power supply.

2. Support the U-arm with a chain block, etc.

3. Attach the L-axis fixing jig and fix it firmly to avoid the L-arm from rotating. (Refer to Chapter 4 “L-Axis Fixing Jig”)

4. Remove the connector (encoder, brake, power) connected to the L-axis motor ①. When disconnecting the connector for power, nip the connector on the cable side with using a pair of plastic pliers, etc. to remove it.

5. Confirm that the DX200 power supply is OFF, and disconnect the cables (encoder, brake cables, and power) of the L-axis motor ① with the internal wiring harness.

6. Install the brake releasing devices, and release the brake.

7. Before removing L-axis motor ①, confirm again that the L-arm is firmly supported by L-axis fixing jig to avoid the L-arm from rotating.

8. Remove the GT-SA bolts ② and the hexagon socket head plug ⑥, and insert the stud bolts M6 (length: 30 mm or more) into 4 tapped holes M6 on the motor-flange face. As a rough standard, screw the stud bolts into the tapped holes so that the clearance between the motor and the contact surface is 5 mm or more.

**CAUTION**

When removing the motor of the L-arm, a lot of grease comes out from the outlet of the motor. Make sure to protect peripheral equipment in advance.
8 Disassembly and Reassembly of Motors
8.2 Disassembly and Reassembly of L-Axis Motor

9. Remove the L-axis motor ① from the S-head in a horizontally position. Be careful not to damage the oil seal in the S-head when removing the L-axis motor ①.

10. Remove the hexagon socket head cap screw ⑤, then remove the input gear ③ and the key ④.

**Reassembly**

For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

1. Mount the key ④ on the L-axis motor ①. (The key ④ comes with the L-axis motor ①.)
2. Apply sealing bond ThreeBond 1206C to the contact surface of the L-axis motor ① and the input gear ③. For the points to apply sealing bond, refer to "Surface to apply sealing bond 1" in Fig. 8-2(b) “Surface to Apply Sealing Bond on the Part on L-axis Motor Part”.
3. Mount the input gear ③ to the L-axis motor ①. Apply Loctite 243 to the thread part of the hexagon socket head cap screws ⑤, and tighten them with a tightening torque of 40.0 N•m.
4. Apply sealing bond ThreeBond 1206C to the contact surface of the L-axis motor ① and the S-head. For the points to apply sealing bond, refer to "Surface to apply sealing bond 2" in Fig. 8-2(b).
5. Mount the L-axis motor ① to the S-head, and tighten the GT-SA bolts ② with the tightening torque of 84.0 N•m. At this time, be careful not to damage the oil seal inside the S-head.
6. Connect the internal wiring harness connectors (encoder, brake, power) to the L-axis motor ①. When connecting the connector for power, nip the connector on the cable side by using a pair of plastic pliers, etc. to mount it.
7. Remove the L-axis fixing jig. (Refer to Chapter 4 “L-Axis Fixing Jig”)
8. Remove the chain block.
9. Turn ON the DX200 power supply.

**Table 8-2: L-Axis Motor Parts Checklist**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>L-axis motor HW0388670-A</td>
<td>1</td>
<td>SGMRV-37ANA-YR1*</td>
</tr>
<tr>
<td>②</td>
<td>GT-SA bolt M12 (length: 35 mm)</td>
<td>4</td>
<td>Tightening torque: 84.0 N•m</td>
</tr>
<tr>
<td>③</td>
<td>Input gear HW1303372-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>④</td>
<td>Key</td>
<td>1</td>
<td>Delivered with the L-axis</td>
</tr>
<tr>
<td>⑤</td>
<td>Hexagon socket head cap screw M8 (length: 145 mm)</td>
<td>1 each</td>
<td>Tightening torque: 40 N•m</td>
</tr>
<tr>
<td>⑥</td>
<td>Hexagon socket head plug PT3/8 <em>Stainless</em></td>
<td>1</td>
<td>Tightening torque: 23.0 N•m</td>
</tr>
</tbody>
</table>
8 Disassembly and Reassembly of Motors
8.2 Disassembly and Reassembly of L-Axis Motor

Fig. 8-2(a): Assembling View of L-axis (Disassembly and Reassembly of Motors)

Fig. 8-2(b): Surface to Apply Sealing Bond on the Part on L-axis Motor Part
8 Disassembly and Reassembly of Motors
8.3 Disassembly and Reassembly of U-Axis Motor

- Refer to Fig. 8-3(a) “Assembling View of U-axis (Disassembly and Reassembly of Motors)”, Table 8-3 “U-Axis Motor Parts Checklist”.

### Disassembly

1. Turn OFF the DX200 power supply.
2. Remove the connectors (encoder, brake, power) connected to the U-axis motor.
   - When disconnecting the connector for power, nip the connector on the cable side with using a pair of plastic pliers, etc. to remove it.
3. For fall protection, hold the U-arm by using a chain block, etc. before removing the U-axis motor.
4. Release the brake.
5. Remove the GT-SA bolts, and insert the stud bolts M6 (length: 30 mm or more) into 4 tapped holes M6 on the motor-flange face. As a rough standard, screw the stud bolts into the tapped holes so that the clearance between the motor and the contact surface is 5 mm or more.
6. Remove the U-axis motor vertically from the casing. At this time, be careful not to damage the oil seal inside the casing.

### Reassembly

1. Mount the key on the U-axis motor. (The key comes with the U-axis motor.)
2. Apply sealing bond ThreeBond 1206C to the contact surface of the U-axis motor and the shaft. For the points to apply sealing bond, refer to "Surface to apply sealing bond 1" in Fig. 8-3(b) “Surface to Apply Sealing Bond on the Part of L-axis Motor Part”.
3. Mount the input gear, the shaft, and the pipe to the U-axis motor. Apply Loctite 243 to the thread part of the hexagon socket head cap screw, and tighten it with a tightening torque of 40.0 N•m.
4. Apply sealing bond ThreeBond 1206C to the contact surface of the U-axis motor and the casing. For the points to apply sealing bond, refer to "Surface to apply sealing bond 2" in Fig. 8-3(b).
5. Mount the U-axis motor to the casing, and tighten the GT-SA bolts with the tightening torque of 84.0 N•m. At this time, be careful not to damage the oil seal inside the casing.

---

**CAUTION**

When removing the motor of the L-arm, a lot of grease comes out from the casing. Make sure to protect peripheral equipment in advance.

7. Remove the hexagon socket head cap screw, then remove the input gear, the key, the shaft and the pipe.

---

**NOTE**

For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

1. Mount the key on the U-axis motor. (The key comes with the U-axis motor.)
2. Apply sealing bond ThreeBond 1206C to the contact surface of the U-axis motor and the shaft. For the points to apply sealing bond, refer to "Surface to apply sealing bond 1" in Fig. 8-3(b) “Surface to Apply Sealing Bond on the Part of L-axis Motor Part”.
3. Mount the input gear, the shaft, and the pipe to the U-axis motor. Apply Loctite 243 to the thread part of the hexagon socket head cap screw, and tighten it with a tightening torque of 40.0 N•m.
4. Apply sealing bond ThreeBond 1206C to the contact surface of the U-axis motor and the casing. For the points to apply sealing bond, refer to "Surface to apply sealing bond 2" in Fig. 8-3(b).
5. Mount the U-axis motor to the casing, and tighten the GT-SA bolts with the tightening torque of 84.0 N•m. At this time, be careful not to damage the oil seal inside the casing.
6. Connect the internal wiring harness connectors (encoder, brake, power) to the U-axis motor. When connecting the connector for power, nip the connector on the cable side by using a pair of plastic pliers, etc. to mount it.

7. Turn ON the DX200 power supply.

---

**Table 8-3: U-Axis Motor Parts Checklist**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>U-axis motor HW0388670-A</td>
<td>1</td>
<td>SGMRV-37ANA-YR1*</td>
</tr>
<tr>
<td>2</td>
<td>GT-SA bolt M12 (length: 35 mm)</td>
<td>4</td>
<td>Tightening torque: 84.0 N•m</td>
</tr>
<tr>
<td>3</td>
<td>Input gear HW1303631-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Key</td>
<td>1</td>
<td>Delivered with the U-axis motor</td>
</tr>
<tr>
<td>5</td>
<td>Hexagon socket head cap screw M8</td>
<td>1</td>
<td>Tightening torque: 40.0 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 140 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-8</td>
<td>each</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat washer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Shaft HW1404554-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Shaft HW1303630-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Pipe HW9405902-2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

---

**Fig. 8-3(a): Assembling View of U-axis (Disassembly and Reassembly of Motors)**

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**Fig. 8-3(b): Surface to Apply Sealing Bond on the Part of L-axis Motor Part**

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8 Disassembly and Reassembly of Motors
8.4 Disassembly and Reassembly of R-, B-, T-Axis Motor

8.4 Disassembly and Reassembly of R-, B-, T-Axis Motor

- Make the U-arm point downwards as much as possible at disassembly or reassembly of the R-, B-, T-axis. If the U-arm points upwards when removing the motor, a lot of grease comes out, which makes disassembly or reassembly difficult.
- Fix the wrist part with a base, etc. before removing the R-, B-, T-axis motor. Otherwise, the wrist part may rotate unexpectedly.

• Refer to Fig. 8-4(a) “Assembling View of R-, B-, T-axis (Disassembly and Reassembly of Motors)”, Table 8-4 “R-, B-, T-Axis Motor Parts Checklist”.

- Disassembly
  1. Turn OFF the DX200 power supply.
  2. Remove the connectors (encoder, brake, power) connected to the R-, B-, T-axis motor.
     When disconnecting the connector for power, nip the connector on the cable side with using a pair of plastic pliers, etc. to remove it.
  3. Before removing R-, B-, T-axis motor support the U-arm with a chain block, etc. to avoid the U-arm from rotating.
  4. Release the brake.
  5. Remove the GT-SA bolts, and insert the stud bolts M4 (length: 20 mm or more) into 2 tapped holes M4 on the motor-flange face. As a rough standard, screw the stud bolts into the tapped holes so that the clearance between the motor and the contact surface is 6 mm or more.
  6. For R-axis:
     Remove the retaining ring. Remove the collar and the inner ring of bearing. Remove the hexagon socket head cap screw.
     Remove the key, the input gear and the plate from the motor.
     For B-axis:
     Remove the hexagon socket head cap screw. Remove the key, input gear, and the plate from the motor.
     For T-axis:
     Remove the hexagon socket head cap screw. Remove the key, input gear and plate from the motor.

For the removal of the key and the input gear, refer to Fig. 8-4(c) “Removal procedures of Key and Input gear”.
Reassembly

For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 "Removing, Applying, Assembling of Sealing Bond".

1. Apply sealing bond ThreeBond 1206C on the contact surface of both sides of the plate ⑩. For the points to apply sealing bond, refer to "Surface to apply sealing bond 1" in Fig. 8-4(b) "Surface to Apply Sealing Bond on the Part on R-, B-, and T-axis Motor Part".

2. Mount the plate ⑩ on each R-, B-, T-axis motor ①. Make sure that bigger side of internal chamfer of the plate ⑩ is faced to the root of the motor axis.

3. Mount the key ③ on each R-, B-, T-axis motor ①.

4. For R-axis:
   Mount the input gear ④ on the motor ①. Apply Loctite 243 to the threading part of the hexagon socket head cap screw ⑤ and tighten it with a tightening torque of 16.5 N•m. Mount the inner ring of bearing ⑨ and the collar ⑧ on the input gear ④, and fix them with the retaining ring ⑦. When mounting the collar ⑧, the collar’s part with a larger external diameter must face to the body of the motor ①.

   For B-axis:
   Mount the gear ④ on the B-axis motor ①. Apply Loctite 243 to the thread part of the hexagon socket head cap screws ⑤, and tighten it with a tightening torque of 16.5 N•m.

   For T-axis:
   Mount the gear ④ on the T-axis motor ①. Apply Loctite 243 to the thread part of the hexagon socket head cap screws ⑤, and tighten it with a tightening torque of 16.5 N•m.

5. Apply sealing bond ThreeBond 1206C to the contact surface of the R-, B-, T-axis motor ① and the casing. For the points to apply sealing bond, refer to "Surface to apply sealing bond 2" in Fig. 8-4(b).

6. Mount the R-, B-, T-axis motor ① to the casing ⑥, and tighten the GT-SA bolts ② with the tightening torque of 24.5 N•m.

7. Connect the internal wiring harness connectors (encoder, brake, power) to each R-, B-, T-axis motor ①. When connecting the connector for power, nip the connector on the cable side by using a pair of plastic pliers, etc. to mount it.

8. Turn ON the DX200 power supply.
### 8.4 Disassembly and Reassembly of R-, B-, T-Axis Motor

Table 8-4: R-, B-, T-Axis Motor Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motor R-, B- and T-axis HW0388933-A</td>
<td>1 for each axis</td>
<td>SGMRV-13ANA-YR1*</td>
</tr>
<tr>
<td>2</td>
<td>GT-SA bolt M8 (length: 25 mm)</td>
<td>3 for each axis</td>
<td>Tightening torque: 24.5 N•m</td>
</tr>
<tr>
<td>3</td>
<td>Key</td>
<td>1</td>
<td>Delivered with the R-, B- and T-axis motor</td>
</tr>
<tr>
<td>4</td>
<td>Gear R-axis HW1303515-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gear B-axis HW1303377-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gear T-axis HW1303378-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hexagon socket head cap screw M6 (length: 25 mm)</td>
<td>1 for each axis</td>
<td>Tightening torque: 16.5 N•m</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Casing HW1100523-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Retaining ring ISTW-36</td>
<td>1</td>
<td>(for R-axis only)</td>
</tr>
<tr>
<td>8</td>
<td>Collar HW0402390-1</td>
<td>1</td>
<td>(for R-axis only)</td>
</tr>
<tr>
<td>9</td>
<td>Bearing TAFI405520</td>
<td>1</td>
<td>(for R-axis only)</td>
</tr>
<tr>
<td>10</td>
<td>Plate HW0401506-1</td>
<td>1 for each axis</td>
<td>For R-, B-, T-axis</td>
</tr>
<tr>
<td>11</td>
<td>Hexagon socket head plug <em>Stainless</em></td>
<td>1</td>
<td>Tightening torque: 23.0 N•m</td>
</tr>
</tbody>
</table>
8 Disassembly and Reassembly of Motors
8.4 Disassembly and Reassembly of R-, B-, T-Axis Motor

Fig. 8-4(a): Assembling View of R-, B-, T-axis (Disassembly and Reassembly of Motors)

Apply sealing bond here
R-axis
T-axis
B-axis

Fig. 8-4(b): Surface to Apply Sealing Bond on the Part on R-, B-, and T-axis Motor Part

Apply sealing bond evenly to whole surface.
8 Disassembly and Reassembly of Motors
8.4 Disassembly and Reassembly of R-, B-, T-Axis Motor

Fig. 8-4(c): Removal procedures of Key and Input gear

1. Put the flat head screw driver into the hole of the side of the gear and tilt it in the direction of the arrow mark to make a space between the gear and the motor.

2. Put the flat head screw driver into a space between the gear and the motor, and tilt it in the direction of the arrow mark to remove the gear.
9 Disassembly and Reassembly of Speed Reducer

When disassembling and reassembling the speed reducer, the arm of the manipulator and the speed reducer should be lifted.

For the operation in a place without a ceiling crane, the following jigs are prepared.
Contact your YASKAWA representative when necessary.

Replacing the S-axis speed reducer

When disassembling the S-axis

Replacing the L-, U-axis speed reducer

When disassembling the L-axis

Refer to Chapter 3 “Home Position Return”, Chapter 5 “Grease Filling/Exchange”, Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

NOTE
9 Disassembly and Reassembly of Speed Reducer
9.1 Disassembly and Reassembly of S-Axis Speed Reducer

**Disassembly**

1. Turn OFF the DX200 power supply.
2. Disconnect the internal wiring harness, only for the rotation part of S-axis. Refer to Chapter 10 “Cable Wiring”.
3. Remove the S-axis motor and the input gear. (Refer to section 8.1 “Disassembly and Reassembly of S-Axis Motor”.)
4. Remove the hexagon socket head cap screws, and insert the stud bolts M10 (length: 50 mm or more) into 2 tapped holes M10 on the S-head. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the S-head and the speed reducer.
5. Lift up the upper part of the manipulator including the S-head, and put it down next to the base. Be sure not to lose the pin.
6. Remove the hexagon socket head cap screws, and insert the stud bolts M12 (length: 35 mm or more) into 2 tapped holes M12 on the speed reducer. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the base and the speed reducer.
7. Install eye bolts diagonally to the tapped holes M16 (2 places) on the base. Use the eye bolts to remove the speed reducer vertically. At this time, also remove the O-ring.
8. Remove the pins from the speed reducer.
9.1 Disassembly and Reassembly of S-Axis Speed Reducer

Reassembly

For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

1. Apply sealing bond ThreeBond 1206C to the contact surface of the base and the speed reducer (1). For the points to apply sealing bond, refer to Fig. 9-1(b) “Surface to Apply Sealing Bond on the Part of S-axis Speed Reducer Part”.

2. Mount the O-ring (4) to the speed reducer (1), and mount the pins (3) to the base (2 places: View B-B, C-C). While aligning the pin hole positions of the speed reducer, mount the unit [the speed reducer (1), the O-ring (4)] to the base. Make sure that the O-ring (4) is not stuck between the speed reducer (1) and the base.

3. Tighten the hexagon socket head cap screws (2) with the tightening torque of 142 N•m.

4. Apply sealing bond ThreeBond 1206C to the contact surface of the speed reducer (1) and the S-head. For the points to apply sealing bond, refer to “S-head side” in Fig. 9-1(b).

5. Mount the S-head to the speed reducer (1). At this time, match the pin holes on the speed reducer (1) and the S-head as shown in the figure (section A-A’) below, and mount the pin (3).

6. Tighten the hexagon socket head cap screws (5) with the tightening torque of 348 N•m.

7. Assemble the S-axis motor (6), and mount the S-axis motor (6) to the S-head. (Refer to Chapter 8 “Disassembly and Reassembly of Motors”.)

8. Connect the internal wiring harness. (Refer to Chapter 10 “Cable Wiring”.)

9. Remove the hexagon socket head plugs at grease inlets and the grease exhaust ports, and then replenish grease (Molywhite RE No.00) from the grease inlets. After replenishment, mount the hexagon socket head plugs at the grease inlets and the grease exhaust ports. Refer to Chapter 5 “Grease Filling/Exchange” (S-axis).

If the grease is filled before the sealing bond is solidified, it may cause the grease leakage. After tightening a bolt, leave it 30 minutes or more, and then fill the grease.

10. Turn ON the DX200 power supply.
9 Disassembly and Reassembly of Speed Reducer

9.1 Disassembly and Reassembly of S-Axis Speed Reducer

Table 9-1: S-Axis Speed Reducer Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed reducer HW0388208-B</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hexagon socket head cap screw M12 (length: 50 mm) Conical spring washer 2H-12</td>
<td>16 each</td>
<td>Tightening torque: 142 N•m</td>
</tr>
<tr>
<td>3</td>
<td>Pin MSTH12-30</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>O-ring G415</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hexagon socket head cap screw M16 (length: 55 mm) Washer GT-SH-16</td>
<td>12 each</td>
<td>Tightening torque: 348 N•m</td>
</tr>
<tr>
<td>6</td>
<td>S-axis motor</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Input gear HW1303369-1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 9-1(a): Assembling View of S-axis (Disassembly and Reassembly of Speed Reducer)
Fig. 9-1(b): Surface to Apply Sealing Bond on the Part of S-axis Speed Reducer Part

Apply sealing bond evenly to whole surface.

S-head side

Apply sealing bond evenly to whole surface.

Base side
9 Disassembly and Reassembly of Speed Reducer
9.2 Disassembly and Reassembly of L-Axis Speed Reducer

9.2 Disassembly and Reassembly of L-Axis Speed Reducer

**NOTE**

Refer to Chapter 12 “Gas Balancer Replacement”.

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
</table>

Make sure that the L-arm motor brake function is functioning and it is supported by a chain block, etc. to keep it from rotating before releasing gas from the gas balancer.

It is seriously dangerous in case the gas is released while the L-axis is supported only by the gas balancer, the arm may rotate after the release.

- Refer to Fig. 9-2(a) “Assembling View of L-axis (Disassembly and Reassembly of Speed Reducer)”, Table 9-2 “L-Axis Speed Reducer Parts Checklist”.

### Disassembly

1. Turn OFF the DX200 power supply.
2. Support and fix the L-arm and the upper part of the manipulator to keep the L-arm from falling off or rotating.
3. Remove the gas balancer ⑧. (Refer to Chapter 12 “Gas Balancer Replacement”.)
4. Remove the L-axis motor ⑦ and the input gear ⑨. (Refer to Table 8-2(a) “Assembling View of L-axis (Disassembly and Reassembly of Motors)”.)
5. Remove the hexagon socket head cap screws ⑤, then insert the stud bolts M12 (length: 75 mm or more) into 2 tapped holes M12 on the L-arm ⑥. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the L-arm ⑥ the speed reducer ①.
6. Remove the L-arm ⑥ from the speed reducer ①.
7. Remove the hexagon socket head cap screws ② and ③, and insert the stud bolts M12 (length: 35 mm or more) into 2 tapped holes M12 on the S-head. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the S-head and the speed reducer ①.
8. Install the jig diagonally to the tapped holes M12 (2 places) on the speed reducer ①. Use the jig to remove the speed reducer ① to a horizontal level. At this time, also remove the O-ring ④.
Reassembly

For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

1. Mount the O-ring 1 on the speed reducer 1.

2. Apply sealing bond ThreeBond 1206C to the contact surface of the S-head and the speed reducer 1. For the points to apply sealing bond, refer to “S-head side” in Fig. 9-1(b) “Surface to Apply Sealing Bond on the Part of S-axis Speed Reducer Part”

3. Mount the speed reducer 1 to the S-head. Tighten the hexagon socket head cap screws 2 with the tightening torque of 348 N•m, and tighten the hexagon socket head cap screws 3 with the tightening torque of 142 N•m.

4. Apply sealing bond ThreeBond 1206C to the contact surface of the speed reducer 1 and the L-arm. For the points to apply sealing bond, refer to "L-arm side" in Fig. 9-1(b).

5. Mount the O-ring 4 on the speed reducer 1, and then mount the L-arm 6 to the speed reducer 1. When mount the O-ring 4, make sure that the O-ring 4 is not stuck between the speed reducer 1 and the L-arm 6. Tighten the hexagon socket head cap screws 5 with the tightening torque of 142 N•m.

6. Assembly the L-axis motor 7, and mount the L-axis motor 7 to the S-head. (Refer to section 8.2 “Disassembly and Reassembly of L-Axis Motor”.)

7. Remove the hexagon socket head plugs at grease inlets and the grease exhaust ports, and then replenish grease (Molywhite RE No.00) from the grease inlets. After replenishment, mount the hexagon socket head plugs at the grease inlets and the grease exhaust ports. Refer to Chapter 5 “Grease Filling/Exchange” (L-axis).

If the grease is filled before the sealing bond is solidified, it may cause the grease leakage. After tightening a bolt, leave it 30 minutes or more, and then fill the grease.

8. Reinstall the gas balancer 8. (Refer to Chapter 12 “Gas Balancer Replacement”.)

9. Turn ON the DX200 power supply.
### 9.2 Disassembly and Reassembly of L-Axis Speed Reducer

#### Table 9-2: L-Axis Speed Reducer Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed reducer HW1382455-B</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hexagon socket head cap screw M16 (length: 35 mm) Conical spring washer 2H-16</td>
<td>6 each</td>
<td>Tightening torque: 348 N•m</td>
</tr>
<tr>
<td>3</td>
<td>Hexagon socket head cap screw M12 (length: 30 mm) Conical spring washer 2H-12</td>
<td>23 each</td>
<td>Tightening torque: 142 N•m</td>
</tr>
<tr>
<td>4</td>
<td>O-ring AS(ARP)568-275</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hexagon socket head cap screw M12 (length: 75 mm) Conical spring washer 2H-12</td>
<td>25 each</td>
<td>Tightening torque: 142 N•m</td>
</tr>
<tr>
<td>6</td>
<td>L-arm</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>L-axis motor</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Gas balancer HW1382567-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Input gear HW1303372-1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 9-2(a): Assembling View of L-axis (Disassembly and Reassembly of Speed Reducer)**

![Diagram of L-axis Speed Reducer Parts](image_url)
Fig. 9-2(b): Surface to Apply Sealing Bond on the Part of L-axis Speed Reducer Part

- **L-arm side**
- **S-head side**

- **ThreeBond 1206C**
- **Border line for applying sealing bond**
- **Edge surface of sealing bond contacting part**
- **Apply sealing bond evenly from the edge surface of sealing bond contacting part to the border line for applying sealing bond without any break.**
9.3 Disassembly and Reassembly of U-Axis Speed Reducer

- Refer to Fig. 9-3(a) “Assembling View of U-axis (Disassembly and Reassembly of Speed Reducer)”, Table 9-3 “U-Axis Speed Reducer Parts Checklist”.

**Disassembly**

1. Turn OFF the DX200 power supply.
2. For fall protection, hold the U-arm unit by using a chain block, etc. before removing the U-axis motor.
3. Remove the U-axis motor and input gear. (Refer to section 8.3 “Disassembly and Reassembly of U-Axis Motor”)
4. Remove the hexagon socket head cap screws and , and insert the stud bolts M8 (length: 45 mm or more) into 2 tapped holes M8 on the L-arm. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the L-arm and the speed reducer.
5. Remove the U-arm unit from the manipulator main body.
6. Remove the hexagon socket head cap screws , and insert the stud bolts M8 (length: 55 mm or more) into 3 tapped holes M8 on the speed reducer. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the casing and the speed reducer.
7. Install eye bolts diagonally to the tapped holes M12 (2 places) on the speed reducer. Use the eye bolts to remove the speed reducer vertically. At this time, also remove the O-ring.
Reassembly

1. Mount the O-ring ⑤ on the speed reducer ①.

2. Apply sealing bond ThreeBond 1206C to the contact surface of the speed reducer ① and the casing in the U-arm unit ④. For the points to apply sealing bond, refer to “Casing side” in Fig. 9-3(b) “Surface to Apply Sealing Bond on the Part of U-axis Speed Reducer Part”.

3. Mount the O-ring ⑤ to the speed reducer ①, and then mount the speed reducer ① on the U-arm unit ④.

4. Tighten the hexagon socket head cap screws ⑦ with the tightening torque of 142 N•m. When mount the O-ring ⑤, make sure that the O-ring ⑤ is not stuck between the speed reducer ① and the U-arm unit ④.

5. Apply sealing bond ThreeBond 1206C to the contact surface of the speed reducer ① and the L-arm which is at the main body side. For the points to apply sealing bond to the U-axis speed reducer, refer to “L-arm side” in Fig. 9-3(b). For the points to apply sealing bond to the L-arm, refer to Fig. 9-3(c) “Surface to Apply Sealing Bond Between U-axis Speed Reducer and L-arm (L-arm Side)”.

6. Mount the speed reducer ① to the L-arm, and tighten the hexagon socket head cap screws ② with the tightening torque of 348 N•m, and tighten the hexagon socket head cap screws ③ with the tightening torque of 142 N•m.

7. Assembly the U-axis motor ⑥, and mount the U-axis motor ⑥ to the casing. (Refer to section 8.3 “Disassembly and Reassembly of U-Axis Motor”.)

8. Remove the hexagon socket head plugs at grease inlets and the grease exhaust ports, and then replenish grease (Molywhite RE No.00) from the grease inlets. After replenishment, mount the hexagon socket head plugs at the grease inlets and the grease exhaust ports. Refer to Chapter 5 “Grease Filling/Exchange” (U-axis).

9. Turn ON the DX200 power supply.

NOTE

For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

If the grease is filled before the sealing bond is solidified, it may cause the grease leakage. After tightening a bolt, leave it 30 minutes or more, and then fill the grease.
9 Disassembly and Reassembly of Speed Reducer
9.3 Disassembly and Reassembly of U-Axis Speed Reducer

Table 9-3: U-Axis Speed Reducer Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed reducer HW1382456-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hexagon socket head cap screw M16 (length: 35 mm) Conical spring washer 2H-16</td>
<td>9 each</td>
<td>Tightening torque: 348 N•m</td>
</tr>
<tr>
<td>3</td>
<td>Hexagon socket head cap screw M12 (length: 30 mm) Conical spring washer 2H-12</td>
<td>18 each</td>
<td>Tightening torque: 142 N•m</td>
</tr>
<tr>
<td>4</td>
<td>U-arm unit</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>O-ring AS(ARP)568-275</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>U-axis motor</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Hexagon socket head cap screw M12 (length: 75 mm) Conical spring washer SW-2H-12</td>
<td>32 each</td>
<td>Tightening torque: 142 N•m</td>
</tr>
<tr>
<td>8</td>
<td>Input gear HW1303631-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Shaft HW1404554-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Shaft HW1303630-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Pipe HW9405902-2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 9-3(a): Assembling View of U-axis (Disassembly and Reassembly of Speed Reducer)
Fig. 9-3(b): Surface to Apply Sealing Bond on the Part of U-axis Speed Reducer Part

Part A

Especially for the part A, apply sealing bond evenly without any break.

L-arm side

Casing side

Fig. 9-3(c): Surface to Apply Sealing Bond Between U-axis Speed Reducer and L-arm (L-arm Side)

Apply in the bead shape

Bead cross-section

(Indicated in the figure, the bead height should be 1 mm, and the width 3 mm.)
9.4 Disassembly and Reassembly of R-Axis Speed Reducer

• Refer to Fig. 9-4(a) “Assembling View of R-axis (Disassembly and Reassembly of Speed Reducer)”, Table 9-4 “R-Axis Speed Reducer Parts Checklist”.

Disassembly

1. Turn OFF the DX200 power supply.
2. Remove the wrist unit ① from the speed reducer ①. (Refer to Chapter 11 “Disassembly and Reassembly of Wrist Unit”)
3. Remove the hexagon socket head bolts ②, and insert the stud bolts M10 (length: 30 mm or more) into 2 tapped holes M8 on the speed reducer ①. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the U-arm ⑤ and the speed reducer ①.
4. Remove the speed reducer ① from the U-arm ⑤.

Reassembly

1. Apply sealing bond ThreeBond 1206C to the contact surface of the U-arm ⑤ and the speed reducer ①. For the points to apply sealing bond, refer to "U-arm side" in Fig. 9-4(b) “Surface to Apply Sealing Bond on the Part of R-axis Speed Reducer Part”.
2. Mount the speed reducer ① to the U-arm ⑤, and tighten the hexagon socket head bolts ② with the tightening torque of 82.0 N-m.
3. Apply sealing bond ThreeBond 1206C to the contact surface of the wrist unit ④ and the speed reducer ①. For the points to apply sealing bond, refer to "Wrist base side" in Fig. 9-4(b).
4. Mount the O-ring ⑥ on the wrist unit ④, and then mount the wrist unit ④ on the speed reducer ①. Refer to Chapter 11 “Disassembly and Reassembly of Wrist Unit”. Make sure that the O-ring ⑥ is not stuck between the speed reducer ① and the wrist unit ④.
5. Tighten the hexagon socket head bolts ③ with the tightening torque of 142 N-m.
6. Remove the hexagon socket head plugs at grease inlets and the grease exhaust ports, and then replenish grease (Molywhite RE No.00) from the grease inlets. After replenishment, mount the hexagon socket head plugs at the grease inlets and the grease exhaust ports. Refer to Chapter 5 “Grease Filling/Exchange” (R-axis).

NOTE: For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

7. Turn ON the DX200 power supply.

NOTE: If the grease is filled before the sealing bond is solidified, it may cause the grease leakage. After tightening a bolt, leave it 30 minutes or more, and then fill the grease.
9 Disassembly and Reassembly of Speed Reducer
9.4 Disassembly and Reassembly of R-Axis Speed Reducer

Table 9-4: R-Axis Speed Reducer Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed reducer W0390046-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hexagon socket head bolt M10 (length: 45 mm)</td>
<td>16</td>
<td>Each 82.0 N•m</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hexagon socket head bolt M12 (length: 30 mm)</td>
<td>12</td>
<td>Each 142 N•m</td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Wrist unit HW1171144-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>U-arm</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>O-ring G140</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 9-4(a): Assembling View of R-axis (Disassembly and Reassembly of Speed Reducer)
Fig. 9-4(b): Surface to Apply Sealing Bond on the Part of R-axis Speed Reducer Part

Apply sealing bond evenly to whole surface.

Wristbase side

U-arm side
9.5 Disassembly and Reassembly of B-Axis Speed Reducer

- Refer to Fig. 9-5(a) “Assembling View of B-axis (Disassembly and Reassembly of Speed Reducer)”, Table 9-5 “B-Axis Speed Reducer Parts Checklist”.

### Disassembly

1. Turn OFF the DX200 power supply.
2. Remove the hexagon socket head bolts ③, and remove the cover ②.
3. Before removing the speed reducer ①, fix the B-axis so that it does not rotate when removing the speed reducer ①.
4. Remove the hexagon socket head bolts ④ and ⑥, and insert the stud bolts M10 (length: 25 mm or more) into 2 tapped holes M10 on the speed reducer ①. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the wrist ⑩ and the speed reducer ①.
5. Remove the speed reducer ①, shim ⑧, gear ⑨, and bearing ⑪ altogether from the wrist ⑩.
6. Remove the hexagon socket head bolts ⑦, and remove the shim ⑧, gear ⑨, and the bearing ⑪ from the speed reducer ①.

### Reassembly

For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 “Removing, Applying, Assembling of Sealing Bond”.

1. Adjust the shims before mounting the gear ⑨.
2. Mount the bearing ①, the shim ⑧, and the gear ⑨ to the speed reducer ①, and then tighten the hexagon socket head bolts ⑦ with the tightening torque of 82.0 N•m.
3. Apply sealing bond ThreeBond 1206C to the contact surface of the speed reducer ① and the wrist ⑩. For the points to apply sealing bond, refer to “Wrist base side” in Fig. 9-5(b) “Surface to Apply Sealing Bond of the B-axis Speed Reducer”.
4. Mount the speed reducer ① to the wrist ⑩, and tighten the hexagon socket head bolts ④, ⑥ with the tightening torque of 82.0 N•m.
5. Apply sealing bond ThreeBond 1206C to the contact surface of the speed reducer ① and the cover ②. For the points to apply sealing bond, refer to “Speed reducer side” in Fig. 9-5(b).
6. Mount the O-ring ⑤, and the cover ② to the speed reducer ①, and tighten the hexagon socket head bolts ③ with the tightening torque of 82.0 N•m.
7. Remove the hexagon socket head plugs at grease inlets and the grease exhaust ports, and then replenish grease (Molywhite RE No.00) from the grease inlets. After replenishment, mount the hexagon socket head plugs at the grease inlets and the grease exhaust ports. Refer to Chapter 5 “Grease Filling/Exchange” (B-axis).

**NOTE**

If the grease is filled before the sealing bond is solidified, it may cause the grease leakage. After tightening a bolt, leave it 30 minutes or more, and then fill the grease.

8. Turn ON the DX200 power supply.

---

**Table 9-5: B-Axis Speed Reducer Parts Checklist**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed reducer HW0390047-B</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cover HW1303671-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hexagon socket head bolt M10</td>
<td>6 each</td>
<td>Tightening torque: 82.0 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 45 mm) Conical spring washer 2L-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Hexagon socket head bolt M10</td>
<td>8 each</td>
<td>Tightening torque: 82.0 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 40 mm) Conical spring washer 2L-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>O-ring G195</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hexagon socket head bolt M10</td>
<td>21 each</td>
<td>Tightening torque: 82.0 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 25 mm) Conical spring washer 2L-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Hexagon socket head bolt M10</td>
<td>3 each</td>
<td>Tightening torque: 82.0 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 20 mm) Conical spring washer 2L-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Shim HW0402205</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Gear HW0306792-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Wrist HW1100526-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Bearing 6009</td>
<td>1 each</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C-type retaining ring STW-45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 9-5(a): Assembling View of B-axis (Disassembly and Reassembly of Speed Reducer)

Apply sealing bond here

Shim adjustment:
When installing the gear 9, measure the space indicated with "*" mark, and select a shim to meet the dimensions in this figure.*
Fig. 9-5(b): Surface to Apply Sealing Bond of the B-axis Speed Reducer

- Apply sealing bond evenly to whole surface.
- Apply sealing bond here
9.6 Disassembly and Reassembly of T-Axis Speed Reducer

- Refer to Fig. 9-6(a) "Assembling View of T-axis (Disassembly and Reassembly of Speed Reducer)". Table 9-6 "T-Axis Speed Reducer Parts Checklist".

**Disassembly**

1. Turn OFF the DX200 power supply.
2. Remove the hexagon socket head cap screws ①, and remove the flange ③ and the spacer⑨.
3. Remove the hexagon socket head cap screws ①, and insert the stud bolts M8 (length: 20 mm or more) into 2 tapped holes M8 on the speed reducer ①. Screw the stud bolts into the tapped holes until clearance is made between the contact surfaces of the wrist ⑨ and the speed reducer ①.
4. Remove the speed reducer ①, gear ⑤ and shim ⑥ altogether from the wrist ⑨.
5. Remove the fine U-nut ⑥. Remove the gear ⑤, shim ⑥ and washer ⑧ from the speed reducer ①.

**Reassembly**

**NOTE**
For removing/applying of sealing bond and assembling after applying sealing bond, refer to Chapter 7 "Removing, Applying, Assembling of Sealing Bond".

1. Adjust the shim before mounting the gear ⑤.
2. Mount the gear ⑤, the shim ⑥, and the washer ⑧ to the speed reducer ①, and tighten the fine U-nut ⑥ with the tightening torque of 176 N•m.
3. Apply sealing bond ThreeBond 1206C to the contact surface of the speed reducer ① and the wrist ⑩. For the points to apply sealing bond, refer to "Wrist side of the speed reducer" Fig. 9-6(b) "Surface to Apply Sealing Bond on the Part of T-axis Speed Reducer Part (Speed Reducer, Spacer)".
4. Refer to Fig. 9-6(a), mount the speed reducer ① to the wrist ⑩ with paying attention to mounting direction of the speed reducer, and tighten the hexagon socket head cap screw ④ with the tightening torque of 40.0 N•m.
5. Apply sealing bond ThreeBond 1206C to the contact surfaces between the speed reducer ① and spacer ⑨, and between spacer ⑨ and the flange ③. For the points to apply sealing bond, refer to "Spacer side" in Fig. 9-6(b) and Fig. 9-6(c) "Surface to Apply Sealing Bond of the Part of T-axis Speed Reducer Part (Spacer, Flange)".
6. Mount the spacer ⑨ and the flange ③ on the speed reducer ①. When mounting the spacer ⑨, it should match with the grease holes on the flange ③.
7. For mounting the spacer ⑨, the flange ③, and the speed reducer ①, tighten the hexagon socket head cap screws ② with the tightening torque of 40.0 N•m.
8. Remove the hexagon socket head plugs at grease inlets and the grease exhaust ports, and then replenish grease (Molywhite RE
No.00) from the grease inlets. After replenishment, mount the hexagon socket head plugs at the grease inlets and the grease exhaust ports. Refer to Chapter 5 “Grease Filling/Exchange” (T-axis).

If the grease is filled before the sealing bond is solidified, it may cause the grease leakage. After tightening a bolt, leave it 30 minutes or more, and then fill the grease.

9. Turn ON the DX200 power supply.

Table 9-6: T-Axis Speed Reducer Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Speed reducer HW1382458-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hexagon socket head cap screw M8 (length: 20 mm) Conical spring washer 2L-8</td>
<td>20 each</td>
<td>Tightening torque: 40 N•m</td>
</tr>
<tr>
<td>3</td>
<td>Flange HW1303385-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Hexagon socket head cap screw M8 (length: 30 mm) Conical spring washer 2L-8</td>
<td>14 each</td>
<td>Tightening torque: 40.0 N•m</td>
</tr>
<tr>
<td>5</td>
<td>Gear HW1303520-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Shim HW1404235</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Fine U-nut FU00SC</td>
<td>1</td>
<td>Tightening torque: 17.6 N•m</td>
</tr>
<tr>
<td>8</td>
<td>Washer</td>
<td>1</td>
<td>Delivered with the speed reducer.</td>
</tr>
<tr>
<td>9</td>
<td>Spacer HW1303386-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Wrist HW1100526-1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Shim adjustment:
When installing the gear \( \text{5} \), select a shim to meet the dimensions as shown in this figure.

Apply sealing bond evenly to whole surface.

Wrist side of the speed reducer

Spacer side
Fig. 9-6(c): Surface to Apply Sealing Bond of the Part of T-axis Speed Reducer Part (Spacer, Flange)

Flange side of the spacer

Apply sealing bond here

Apply sealing bond evenly to whole surface.
10 Cable Wiring

10.1 Cable Disconnection

1. Remove the GT-SA bolt M6 (four bolts) (length: 15 mm) attached to the side face of U-arm, and remove the cover.

2. Remove the pan-head sems screw M3 (four screws) (length: 16 mm) and the pan-head sems screw M4 (two screws) (length: 16 mm), then remove the connector.

3. Remove the air horse connected to the back side of union from the cover.

Before disconnecting the connector of the internal wiring harness which is connected to the motor, install the backup battery to all motors to prevent the absolute data from disappearing. (Refer to Chapter 2 “Notes for Maintenance”.)
4. Attach the battery for backup to each motor of U-, R-, B-, T-axes. Then disconnect the internal wiring harness connected to each motor.
5. Cut off cable ties and remove the GT-SA bolts M5 (two bolts) (length: 12 mm) and remove the plate.
6. Attach the backup battery to each motor of S- and L-axes, and disconnect the internal wiring harness of each motor. Then cut off the cable ties T120S (six pieces) on the S head, and remove the GT-SA bolt M5 (two bolts) (length: 16 mm) and remove the plate.

7. Remove the cross head APS bolts (10 bolts) which are fixing the connector base, and pull the connector base little bit and disconnect the tube which is connected to the back side of the grease inlet. Be careful so that grease doesn’t leak from the tube.
10 Cable Wiring
10.1 Cable Disconnection

8. Pull the connector base more and remove the GT-SA bolts M6 (four bolts) (length: 15 mm), then remove the support from the connector base.

9. Remove the pan-head sems screw M4 (two bolts) (length: 16 mm) attached to the connector base and remove the S1 connector. Disconnect the internal wiring harnesses connected to the back side of 1BC connector and the 2BC connector.

10. Remove the hexagon socket head cap screw M6 (13 screws) (length: 12 mm), then remove the ground wirings.

11. Remove the GT-SA bolt M6 (two bolts) (length: 15 mm) and remove the plate.

12. Detach the connectors [X], [S], [L], [U], [R], [B], [T], and [7] from the connector base box, and remove the internal wiring harness from the S-head. Make sure again that the backup battery is attached to the motor before detaching the connectors.
10.1 Cable Disconnection

**Plastic Cover Detail View**
- T30L(cable tie) (2 pieces)
- X.S.L.U.R.B.T (Universal MATE-N-LOK connectors)
- Waterproof tape
- HW9404942-A (plastic cover)

**S1 Connector Detail View**
- Nut M4 (2 nuts) (stainless)
- HW9481087-E (Gasket)
- Pan-head sems screw M4 (2 screws) (length: 16 mm) (stainless)

- CD-42 (Saddle)
- GT-SA bolt M6 (2 bolts) (length: 15 mm)
- Washer M6 (stainless)
- Tightening torque: 10 N • m (0.98 kgf • m)

- HW9470921-A (Lead assy) (2 pieces)

- Hexagon socket head cap screw M6 (length: 12 mm)
- Conical spring washer 2H-6

- GT-SA bolt M6 (4 bolts) (length: 15 mm)
- Tightening torque: 10 N • m (0.98 kgf • m)
10.2 Cable Connection

1. Pass the internal wiring harness through the top of the S head.

2. Connect the connectors [X], [S], [L], [U], [R], [B], [T], and [7] in the connector base box, then wrap the connectors with waterproof tape surely so that no water can come into the connectors.

3. Earth the ground wirings with the hexagon socket head cap screw M6 (13 screws) (length: 12 mm).

4. Attach the saddle CD42 to the support and fix it with the GT-SA bolt M6 (two bolts) (length: 15 mm).

5. Attach the plastic cover around the internal wiring harness, then attach the S1 connector to the connector base and fix it with the pan-head sems screw M4 (two bolts) (length: 16 mm). Connect the grease horse, the 1BC connector, and the 2BC connector to the back side of the connector base. The 1BC connectors are 1, 2, 3, 4, 5, and 6 from the top to the bottom. The 2BC connectors are A, B, C, D, E, and F from the bottom to the top.

6. Attach the cross head APS bolts M6 (10 bolts) (length: 10 mm), then install the connector base to the manipulator main body.

7. Install the internal wiring harness to the plate in the S-head, then fix with the GT-SA bolt M5 (two bolts) (length: 16 mm) and fix the internal wiring harness with cable ties (six pieces) on the white marked part.

8. Set the protection tubing alongside the L-arm. At this time, make the Velcro tape part of the protection tubing toward the L-arm.
   - Protective tubing type: MTK-50FR
10 Cable Wiring
10.2 Cable Connection

Protective tubing direction of Velcro tape

Keep the Velcro fastened as shown between B2 and B3.

Protective tubing description

Velcro of protective tubing

L-arm
9. Connect the internal wiring harness to S- and L-axes motors, and fix the internal wiring harness around the S-head with cable ties T120S (six pieces).

10. Install the plate between B2 and B3 of L-arm, then fix the internal wiring harness.

11. Pass the internal wiring harness through the upper part of U-arm, and fix with cable ties T120S (four pieces).

12. Connect the internal wiring harness to the motors of U-, R-, B-, and T-axes.

13. Install the connector to the cover, and fix with the pan-head sems screw M3 (four screws) (length: 16 mm) and the pan-head sems screw M4 (two screws) (length: 16 mm). Attach the connector key so that the position of the key comes to the top. Connect the ground wiring as shown in the figure below.

14. Connect the air line to the union from the back side of the cover.

15. Install the cover to the side face of the U-arm and tighten with the GT-SA bolt M6 (four bolts) (length: 15 mm).

16. Remove the backup battery attached to all motors, then install the cover.
Disassembly and Reassembly of Wrist Unit

- Refer to Fig. 11-1 “Disassembly and Reassembly of Wrist Unit”.

**NOTE**
- Refer to Chapter 3 “Home Position Return”.
- Remove old sealing bond on each part completely before reassembly.

### Disassembly

1. Make the wrist vertical to the U-arm (refer to Fig. 11-1 “Disassembly and Reassembly of Wrist Unit”). Then, turn OFF the DX200 power supply.

2. Remove the hexagon socket head cap screws. Remove the wrist unit from the speed reducer by using the tapped holes on the wrist base.

### Reassembly

1. Apply sealing bond ThreeBond 1206C to the contact surface of the wrist unit and the speed reducer, then mount the wrist unit on the speed reducer. At this time, be careful not to pinch the O ring, which is delivered with the wrist unit, between the wrist unit and the speed reducer.

2. Tighten the hexagon socket head cap screws with the tightening torque shown in Table 11-1 “Wrist Unit Parts Checklist”.

3. Turn ON the DX200 power supply.
Table 11-1: Wrist Unit Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wrist unit HW1171444-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wrist base</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hexagon socket head cap screw M12</td>
<td>8</td>
<td>Tightening torque: 142 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 30 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2H-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>each</td>
</tr>
<tr>
<td>4</td>
<td>Speed reducer HW0390046-A</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 11-1: Disassembly and Reassembly of Wrist Unit
12  Gas Balancer Replacement

CAUTION

• Maintenance and inspection must be performed by specified personnel.
Failure to observe this warning may result in electric shock or injury.

NOTE

• Refer to Chapter 6 “Gas Maintenance Procedure in the Gas Balancer”.
• Although the gas balancer position would not deviate, create checkpoints before replacement just in case.
12.1 Replacing the Gas Balancer

Follow the instructions below when replacing the gas balancer.

**PROHIBITED**

- Do not damage the rod part of the gas balancer.
- Do not apply any horizontal forces to the rod part.
- When lifting the gas balancer, do not attach lifting jigs to the rod or to the tip of the rod part.
- Do not use the gas balancer with foreign substances at the rod part or the entry of the rod to the cylinder.

Failure to observe this may damage the sealing inside the gas balancer and this may cause the gas leakage.

**DANGER**

Be sure to discharge all the gas from the gas balancer when dismounting it from the manipulator or disassembling it. Should unscrew the fixing bolt without discharging the gas, the gas balancer rod can unexpectedly extends and may cause injury or accidents.

**DANGER**

Before disassembling the gas balancer or discharging the gas from the gas balancer, confirm that the L-axis motor brake is appropriately functioning and L-axis is firmly fixed so that it will not rotate.

Failure to observe this may cause very dangerous situation due to releasing of the L-axis motor brake. Because the L-axis without retaining force leads the L-arm to rotate by the lengthened or shortened gas balancer.

*Fig. 12-1: Notes when Replacing the Gas Balancer*

Prevent foreign substances from attaching

![Diagram of gas balancer rod part](image-url)
12 Gas Balancer Replacement

12.2 Necessary Parts

Table 12-1: Gas Balancer Parts Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Qty</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gas balancer HW1382567-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>GT-SA bolt M5 (length: 12 mm)</td>
<td>2\times 2</td>
<td>Tightening torque: 6.0 N•m</td>
</tr>
<tr>
<td>3</td>
<td>Plate HW0404915-1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Hexagon socket head cap screw M8</td>
<td>4 each</td>
<td>Tightening torque: 24.5 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 20 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Support HW1303711-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hexagon socket head cap screw M6</td>
<td>3 each</td>
<td>Tightening torque: 10 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 16 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-6</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Washer M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Cover HW1304135-1</td>
<td>1</td>
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<tr>
<td>8</td>
<td>Spacer HW1405133-1</td>
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<tr>
<td>9</td>
<td>Cover HW1304136-A</td>
<td>1</td>
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<tr>
<td>10</td>
<td>Hexagon socket head cap screw M8</td>
<td>4 each</td>
<td>Tightening torque: 24.5 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 20 mm)</td>
<td></td>
<td></td>
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<td></td>
<td>Conical spring washer 2L-8</td>
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<td>11</td>
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<td>Tightening torque: 24.5 N•m</td>
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<tr>
<td></td>
<td>(length: 20 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-8</td>
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<td></td>
</tr>
<tr>
<td>13</td>
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<td>Tightening torque: 10 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 16 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Washer M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Hexagon socket head cap screw M8</td>
<td>4 each</td>
<td>Tightening torque: 24.5 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 20 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-8</td>
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<td></td>
</tr>
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<td>15</td>
<td>Spacer HW1304162-1</td>
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<tr>
<td>16</td>
<td>Spacer HW1304161-1</td>
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<td></td>
</tr>
<tr>
<td>17</td>
<td>Hexagon socket head cap screw M8</td>
<td>4 each</td>
<td>Tightening torque: 24.5 N•m</td>
</tr>
<tr>
<td></td>
<td>(length: 20 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conical spring washer 2L-8</td>
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<td></td>
</tr>
<tr>
<td>18</td>
<td>Pin MSTH6-20</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Shaft HW1305071-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Dust seal</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Others:

- Chain block and wire rope (4900 N or more payload)
- Torque wrench
- Grease (Alvania EP Grease 2)
- Sealing bond (ThreeBond 1206C)
- Screws for removal
12 Gas Balancer Replacement
12.2 Necessary Parts

Prepare following devices when injecting gas

- Nitrogen gas cylinder
- Gas filling device: HW1485204
- Thermometer (for measuring the gas balancer surface)
12.3 Disassembling the Gas Balancer

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
</table>
| Be sure to discharge all the gas from the gas balancer when
dismounting it from the manipulator or disassembling it. Should
unscrew the fixing bolt without discharging the gas, the gas balancer
rod can unexpectedly extends and may cause injury or accidents. |

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
</table>
| Before disassembling the gas balancer or discharging the gas from the
gas balancer, confirm that the L-axis motor brake is appropriately
functioning and L-axis is firmly fixed with fixing jigs so that the L-arm will
not rotate.
Failure to observe this may cause very dangerous situation due to
releasing of the L-axis motor brake. Because the L-axis without
retaining force leads the L-arm to rotate by the lengthened or shortened
gas balancer. |

<table>
<thead>
<tr>
<th>MANDATORY</th>
</tr>
</thead>
</table>
| • When discharging the gas, the blowdown valve must not be fully
opened. Take time and discharge gas little by little. If the blowdown
valve is fully opened with high internal pressure, the non-return
valve in the gas balancer can be damaged. |

Refer to Fig. 12-2 “Gas Balancer Replacing Procedures”.
1. Make the L-arm vertical to the ground.
2. Turn OFF the power supply of the DX200.
3. Discharge all the nitrogen gas from the gas balancer. (Refer to section 6.3 “Gas Discharging Procedures”.)
4. Unscrew the GT-SA bolts and remove the plate to which the lead is fixed.
5. Unscrew the hexagon socket head cap screws and remove the support.
6. Unscrew the hexagon socket head cap screws and remove the cover from the spacer, then fix the cover temporarily to the cover of L-arm side with adhesive tape.
7. Unscrew the hexagon socket head cap screws and remove the spacer from the clevis.
8. Unscrew the hexagon socket head cap screws and remove the spacer from the gas balancer. At this time, apply bolts to the tapped holes M6 around the spacer and fix them with a T-handle wrench, etc. to avoid the spacer from rotating.
9. Remove the adhesive tape attached for temporary fixing, and remove the cover gently not to damage the rod.

10. Unscrew the hexagon socket head cap screws and remove the cover gently not to damage the rod.

11. Unscrew the hexagon socket head cap screws, and remove the gas balancer and the spacer from the spacer. The total weight of the gas balancer and the spacer is 18 kg. Remove them carefully.

12. Unscrew the hexagon socket head cap screws and remove the pin, and then remove the spacer from the gas balancer.
12 Gas Balancer Replacement
12.3 Disassembling the Gas Balancer

Fig. 12-2: Gas Balancer Replacing Procedures

View A (Enlarged)

View B (Enlarged)

View C (Enlarged)

D (cross-section view)

*  is a component of  

120 of 145
12.4 Reassembling the Gas Balancer

**DANGER**

- Do not fill the gas to the gas balancer before mounting it on the manipulator. When the gas balancer is filled with the gas, it becomes impossible to mount the gas balancer by flexibly extending the rod or the rod can unexpectedly extends and may cause injury or accidents.

**DANGER**

Before disassembling the gas balancer or discharging the gas from the gas balancer, confirm that the L-axis motor brake is appropriately functioning and L-axis is firmly fixed so that it will not rotate.

Failure to observe this may cause very dangerous situation due to releasing of the L-axis motor brake. Because the L-axis without retaining force leads the L-arm to rotate by the lengthened or shortened gas balancer.

Refer to Fig. 12-2 “Gas Balancer Replacing Procedures”.

1. When unpacking the gas balancer, confirm that the rod has not fallen into the cylinder and check that there is no damage on the rod.

2. Apply the spacer  to the gas balancer , and tighten the hexagon socket head cap screws  with the tightening torque shown in Table 12-1 “Gas Balancer Parts Checklist”.

3. Discharge the gas from the gas balancer . (Refer to the procedure 2 to 6 of section 6.3 “Gas Discharging Procedures”.) When discharging gas, operate just before installation so that the rod doesn’t fall into the cylinder. When inserting, make the visible length of the rod to half or less.

4. Mount the spacer and the gas balancer to the spacer, then tighten the hexagon socket head cap screws with the tightening torque shown in Table 12-1.

5. Mount the cover gently not to damage the rod. Then tighten the hexagon socket head cap screws with the tightening torque shown in Table 12-1.

6. Insert the cover gently not to damage the rod, and fix the cover to the cover temporarily with adhesive tape.

7. Remove the protection net delivered with the rod.
8. Apply the spacer\(^8\) to the gas balancer\(^1\), and tighten the hexagon socket head cap screws\(^2\) with the tightening torque shown in Table 12-1 "Gas Balancer Parts Checklist". At this time, apply bolts to the tapped holes M6 around the spacer\(^8\) and fix them with a T-handle wrench, etc. to avoid the spacer from rotating.

9. Apply the spacer\(^8\) to the clevis\(^11\), and tighten the hexagon socket head cap screws\(^6\) with the tightening torque shown in Table 12-1. When applying, make sure that fingers are not stuck between spacer\(^8\) and the clevis\(^11\). Also, give attention to the phase of hole position (three places) for applying the gas balancer cover. When tightening, be careful so that the torque wrench head doesn’t touch the rod.

10. Inject nitrogen gas into the gas balancer\(^1\). (Refer to section 6.4 “Gas injecting Procedure”.)

11. Make sure the dust seal is properly mounted. If there is any space between the dust seal and the place to mount, adjust the position of the dust seal. (Refer to )

12. Remove the adhesive tape used for temporary fixing, and apply the cover\(^7\) to the spacer\(^8\) and tighten the hexagon socket head cap screws\(^5\) with the tightening torque shown in Table 12-1.

13. Apply the support\(^5\) to the shaft\(^18\), and tighten the hexagon socket head cap screws\(^4\) with the tightening torque shown in Table 12-1.

14. Apply the plate\(^3\) to the support\(^5\) to which the lead is fixed, and tighten the hexagon socket head cap screws\(^2\) with the tightening torque shown in Table 12-1.
12.5 Procedures for Mounting the Dust Seal

Refer to Fig. 12-3 “Procedures for Mounting the Dust seal to Gas balancer”.

1. Mount the dust seal by equally pushing the circumference of the dust seal by hand.
2. Make sure all the circumference of the dust seal is mounted to the position which is deeper than the top surface of the balancer.

Fig. 12-3: Procedures for Mounting the Dust seal to Gas balancer
13 Battery Pack Replacement

The battery packs are installed in the position shown in Fig. 13-1(a) “Battery Pack Location (Back View)” and Fig. 13-1(b) “Battery Pack Location (Top View)”: If the battery alarm occurs in the DX200, replace the battery in accordance with the following procedure:

*Fig. 13-1(a): Battery Pack Location (Back View)*

*Fig. 13-1(b): Battery Pack Location (Top View)*
1. Turn OFF the DX200 main power supply.
2. Remove the plate from the connector base, then pull the battery pack out to replace it with a new one.
3. Remove the battery pack from the battery holder.
4. Connect the new battery pack to an unconnected connector on the board.
5. Remove the old battery pack from the board.

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

6. Mount the new battery pack to the battery holder.
7. Reinstall the plate.

**NOTE** Do not allow the plate to pinch the cables when reinstalling the plate.
14 Parts List

14.1 S-Axis Unit

Fig. 14-1: S-Axis Unit
### Table 14-1: S-Axis Unit

<table>
<thead>
<tr>
<th>No.</th>
<th>DWG No.</th>
<th>Name</th>
<th>Pcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>HW0388208-B</td>
<td>Speed reducer</td>
<td>1</td>
</tr>
<tr>
<td>1002</td>
<td>SGMRV-37ANA-YR12</td>
<td>Motor</td>
<td>1</td>
</tr>
<tr>
<td>1003</td>
<td>TC12015014</td>
<td>Oil seal</td>
<td>1</td>
</tr>
<tr>
<td>1004</td>
<td>STW-50</td>
<td>Retaining rings C-type</td>
<td>1</td>
</tr>
<tr>
<td>1005</td>
<td>6310</td>
<td>Bearing</td>
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<tr>
<td>1006</td>
<td>HW1303369-1</td>
<td>Gear</td>
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<tr>
<td>1007</td>
<td>HW1100520-1</td>
<td>Base</td>
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<td>1008</td>
<td>HW1100521-1</td>
<td>S head</td>
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<td>1009</td>
<td>HW1303370-1</td>
<td>Pipe</td>
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<td>1010</td>
<td>HW9404863-1</td>
<td>Stopper</td>
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<td>1011</td>
<td>HW9404486-1</td>
<td>Shaft</td>
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<td>1012</td>
<td>MSTH12-30</td>
<td>Pin</td>
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<td>MSTH12-30</td>
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<td>KQ2L10-01S</td>
<td>Union</td>
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<td>1015</td>
<td>PT3/8 (STAINLESS)</td>
<td>Hexagon socket head plug</td>
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<tr>
<td>1016</td>
<td>G415</td>
<td>O ring</td>
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<td>1017</td>
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<td>1018</td>
<td>M12X50</td>
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<td>SW2H-12</td>
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<td>1020</td>
<td>M8X45</td>
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<td>1021</td>
<td>2H-8</td>
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<td>M6X16</td>
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<td>M16X55</td>
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<td>GT-SH-16</td>
<td>Washer</td>
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<td>M12X60</td>
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<td>M6X12 (TRIVALENT CHROMATE)</td>
<td>Cross head APS bolt</td>
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<td>1034</td>
<td>HW1404239-1</td>
<td>Cover</td>
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14.2 L-Axes Unit

Fig. 14-2: L-Axes Unit
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## Table 14-2: L-Axes Unit (Sheet 2 of 2)

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14.3 URBT-Axes Unit

Fig. 14-3: URBT-Axes Unit
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14.4 U-Arm Unit

Fig. 14-4: U-Arm Unit
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14.5 Wrist Unit

Fig. 14-5: Wrist Unit
### Table 14-5: Wrist Unit (Sheet 1 of 2)

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Table 14-5: Wrist Unit (Sheet 2 of 2)

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Specifications are subject to change without notice for ongoing product modifications and improvements.