MOTOMAN-MFL1200D-1600
INSTRUCTIONS

TYPE:
YR-MFL020D-D10 (1600ST, MOTOMAN-MFL1200D-1600)

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

MOTOMAN INSTRUCTIONS
MOTOMAN-MFL1200D-1600 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: 179713-1CD
Revision: 0
MANDATORY

• This instruction manual is intended to explain mainly on the mechanical part of the MOTOMAN-MFL1200D for the application to the actual operation and for proper maintenance and inspection. It describes on safety and handling, details on specifications, necessary items on maintenance and inspection, to explain operating instructions and maintenance procedures. Be sure to read and understand this instruction manual thoroughly before installing and operating the manipulator.

• 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 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.
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.
## 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".

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="DANGER" /></td>
<td>Indicates a imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.</td>
</tr>
<tr>
<td><img src="image" alt="WARNING" /></td>
<td>Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.</td>
</tr>
<tr>
<td><img src="image" alt="CAUTION" /></td>
<td>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.</td>
</tr>
<tr>
<td><img src="image" alt="MANDATORY" /></td>
<td>Always be sure to follow explicitly the items listed under this heading.</td>
</tr>
<tr>
<td><img src="image" alt="PROHIBITED" /></td>
<td>Must never be performed.</td>
</tr>
</tbody>
</table>

Even items described as “CAUTION” may result in a serious accident in some situations.

At any rate, be sure to follow these important items.

![NOTE](image) To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “WARNING” and “CAUTION”.

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance and inspection must be performed by specified personnel.</td>
</tr>
<tr>
<td>Failure to observe this caution may result in electric shock or injury.</td>
</tr>
<tr>
<td>For disassembly or repair, contact your YASKAWA representative.</td>
</tr>
<tr>
<td>Do not remove the motor, and do not release the brake.</td>
</tr>
<tr>
<td>Failure to observe these safety precautions may result in death or serious injury from unexpected turning of the manipulator's arm.</td>
</tr>
</tbody>
</table>
WARNING

• Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the front door of the DX200 and programming pendant are pressed. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

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

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. Then turn ON the servo power.

Injury may result from unintentional or unexpected manipulator motion.

• Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - 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 persons are present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning ON the DX200 power.
  - Moving the manipulator with the programming pendant.
  - Running check operations.
  - Performing automatic operations.

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

The emergency stop button is located on the right of front door of the DX200 and the programming pendant.
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 supply cables.

In this manual, the equipment is designated as follows:

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

Description of the Operation Procedure

In the explanation of the operation procedure, the expression "Select • • •" means that the cursor is moved to the object item and the SELECT key is pressed, or that the item is directly selected by touching the screen.

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 (R) and TM are omitted.
**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.

*Fig. : Warning Label Locations*
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).

Mechanical Safety Devices

The safe operation of this equipment is ultimately the user’s responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-2012 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 palm buttons located on operator station

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
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 E-Stop button on the operator station for proper operation before programming. The equipment must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- Any modifications to the controller unit can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the controller unit. Making any changes without the 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. Care must be taken 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 that the changes have not created hazards or dangerous situations.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Use proper replacement parts.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
Maintenance Safety

Turn the 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.

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 YASKAWA Customer Support.
Customer Support Information

If you need assistance with any aspect of your MFL1200D-1600 system, please contact YASKAWA Customer Support at the following 24-hour telephone number:

(937) 847-3200

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

techsupport@motoman.com

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

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

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

- **System**
  - MFL1200D-1600

- **Primary Application**

- **Controller**
  - DX200

- **Software Version**
  - Access this information on the Programming Pendant’s LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION}

- **Robot Serial Number**
  - Located on the robot data plate

- **Robot Sales Order Number**
  - Located on the DX200 controller data plate
# Table of Contents

1 Receiving ........................................................................................................................................ 1-1
   1.1 Checking Package Contents ..................................................................................................... 1-1
   1.2 Checking the Order Number .................................................................................................. 1-2
   1.3 Precautions on Unpacking .................................................................................................... 1-2

2 Transportation.................................................................................................................................... 2-1
   2.1 Transporting Method .............................................................................................................. 2-1
      2.1.1 Using a Crane .............................................................................................................. 2-1
      2.1.2 Using a Forklift ........................................................................................................... 2-3
      2.1.3 Eyebolts for Transportation ....................................................................................... 2-4

3 Installation....................................................................................................................................... 3-1
   3.1 Safeguard Installation ............................................................................................................. 3-1
   3.2 Mounting Procedures for Manipulator Base ......................................................................... 3-2
      3.2.1 When the Manipulator and Mounting Fixture Are Installed on a Common Installation Base .................................................................................. 3-2
      3.2.2 When the Manipulator Is Mounted Directly on the Floor ........................................... 3-3
   3.3 Installation Method ................................................................................................................ 3-4
   3.4 Location ................................................................................................................................ 3-4
   3.5 Required Space for Installation ............................................................................................ 3-5

4 Wiring.............................................................................................................................................. 4-1
   4.1 Grounding ............................................................................................................................. 4-1
   4.2 Manipulator Cable Connection .............................................................................................. 4-2
      4.2.1 Connection to the Manipulator .................................................................................. 4-2
      4.2.2 Connection to the DX200 ......................................................................................... 4-2
      4.2.3 Cable Laying ............................................................................................................... 4-4

5 Basic Specifications ....................................................................................................................... 5-1
   5.1 Basic Specifications ................................................................................................................ 5-1
   5.2 Manipulator Clean Specifications ........................................................................................ 5-2
   5.3 Part Names and Working Axes ............................................................................................. 5-2
   5.4 Manipulator Base Dimensions .............................................................................................. 5-3
   5.5 Dimensions and Working Envelope ..................................................................................... 5-4
   5.6 Limitations of the Movement of the S- and U-Axes .............................................................. 5-5
5.7 Limitations on the L- and R-Axes Movement ......................................................... 5-6

6 Allowable Load for Wrist Axis and Wrist Flange ......................................................... 6-1
   6.1 Allowable Wrist Load .......................................................................................... 6-1
   6.2 Wrist Flange ...................................................................................................... 6-2

7 System Application .................................................................................................... 7-1
   7.1 Internal User I/O Wiring Harness and Air Line ..................................................... 7-1

8 Electrical Equipment Specifications ............................................................................... 8-1
   8.1 Location of Broken-Belt Detection Sensor ......................................................... 8-1
   8.2 Internal Connections .......................................................................................... 8-2

9 Maintenance and Inspection ....................................................................................... 9-1
   9.1 Inspection Schedule .......................................................................................... 9-1
   9.2 Notes on Maintenance Procedures ..................................................................... 9-5
      9.2.1 Battery Pack Replacement ..................................................................... 9-5
   9.3 Notes on Maintenance Procedures ..................................................................... 9-7
      9.3.1 Grease Replenishment/Exchange for U-Axis Speed Reducer ..................... 9-7
      9.3.2 Grease Replenishment/Exchange for S-Axis Speed Reducer ..................... 9-12
      9.3.3 Grease Replenishment/Exchange for L- and R-Axes Speed Reducers ........ 9-14
      9.3.4 Notes on Maintenance ............................................................................. 9-17
   9.4 Battery Pack Connection .................................................................................... 9-18

10 Recommended Spare Parts ....................................................................................... 10-1
1 Receiving

1.1 Checking Package Contents

When the package arrives, check the contents for the following standard items. (Any additional options ordered should be checked as well.):

- Manipulator
- DX200
- Programming pendant
- Power supply cable between the DX200 and the manipulator
- Accessories for installation

<table>
<thead>
<tr>
<th>Name</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-corrosive hexagon socket head cap screw M6</td>
<td>4</td>
</tr>
<tr>
<td>Anti-corrosive conical spring washer M16</td>
<td>4</td>
</tr>
<tr>
<td>Flat washer M16 (thickness: 5mm, nickel-plated)</td>
<td>4</td>
</tr>
<tr>
<td>Flat washer M16 (thickness: 3mm, nickel-plated)</td>
<td>2</td>
</tr>
<tr>
<td>Cap CP-30-BC-16</td>
<td>4</td>
</tr>
<tr>
<td>Stainless steel cover B</td>
<td>1</td>
</tr>
<tr>
<td>Stainless steel cover C</td>
<td>1</td>
</tr>
<tr>
<td>Nickel-plated grease zerk A-M6X1</td>
<td>5</td>
</tr>
<tr>
<td>Nickel-plated grease zerk A-PT1/8</td>
<td>1</td>
</tr>
</tbody>
</table>

CAUTION

- Confirm that the manipulator and the DX200 have the same order number. Special care must be taken when more than one manipulator is to be installed.

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

Check that the order number of the manipulator corresponds to the DX200. The order number is located on a label as shown below.

*Fig. 1-1: Location of Order Number Labels*

1.3 Precautions on Unpacking

Unpack the equipment in the clean room.

If in any place other than a clean room, unpack the manipulator after removing dust with an air blower.

*NOTE*

Operating the manipulator in an environmental clean room of a lower class may lower the cleanliness of the manipulator.
2 Transportation

2.1 Transporting Method

2.1.1 Using a Crane

As a rule, when removing the manipulator from the package and moving it, a crane should be used.

The manipulator should be lifted using a four-leg bridle sling threaded through attached eyebolts.

Be sure the manipulator is fixed with the shipping bolts and brackets before transporting, and lift it in the posture as shown in Fig. 2-1 “Transporting Position (MFL1200D-1600)”.

Fig. 2-1: Transporting Position (MFL1200D-1600)
2 Transportation

2.1 Transporting Method

- Check that the eyebolts are securely fastened.
- The weight of the manipulator is approx. 700kg for MFL1200D-1600 including the shipping bolts and brackets. Use a wire rope strong enough to withstand the weight.
- Attached eyebolts are designed to support the manipulator weight. Do not use them for anything other than transporting the manipulator.
- Avoid external force on the arm or motor unit when transporting, use caution when using transporting equipment other than a crane or forklift, as injury may occur.
2.1.2 Using a Forklift

When using a forklift, the manipulator should be fixed on a pallet with shipping bolts and brackets as shown in Fig. 2-2 “When Using a Forklift”. Insert forks under the pallet and lift the manipulator with the pallet. The pallet must be strong enough to support the manipulator.

Transport the manipulator slowly in order to avoid overturning or slippage.

Fig. 2-2: When Using a Forklift
2.1.3 Eyebolts for Transportation

The manipulator is provided with four eyebolts M16 for transportation.

Before turning ON the power, check to be sure that the eyebolts have been removed.

The eyebolts then must be stored for future use, in the event that the manipulator must be moved again.

After having removed the eyebolts, the unpainted surfaces and tapped holes must be protected with the covers and caps as shown in Fig. 2-3 "Cover and Cap Mounting Positions".

Fig. 2-3: Cover and Cap Mounting Positions
3 Installation

3.1 Safeguard Installation

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

(ISO 10218)

Responsibility for Safeguarding

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

WARNING

• Install the safeguards.
Failure to observe this warning may result in injury or damage.

• Install the manipulator in a location where the fully extended arm and tool will not reach the wall, safeguards, or the DX200.
Failure to observe this warning may result in injury or damage.

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

CAUTION

• Do not install or operate the manipulator that is damaged or lacking in parts.
Failure to observe this caution may cause injury or damage.
3 Installation

3.2 Mounting Procedures for Manipulator Base

The manipulator should be firmly mounted on a base or foundation strong enough to support the manipulator and jigs, and withstand reaction forces during acceleration and deceleration.

Refer to Table 3-1 "Maximum Reaction Force of Manipulator" below to construct a solid foundation with the appropriate thickness to withstand maximum reaction forces of the manipulator. During installation, if the flatness is not right, the manipulator shape may change and its functional ability may be compromised.

The flatness for installation must be kept at 0.5 mm or less. Mount the manipulator base in either of the following ways: section 3.2.1 "When the Manipulator and Mounting Fixture Are Installed on a Common Installation Base" or section 3.2.2 "When the Manipulator Is Mounted Directly on the Floor".

Table 3-1: Maximum Reaction Force of Manipulator

<table>
<thead>
<tr>
<th>Component</th>
<th>Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal rotating torque</td>
<td>2940 N•m (300 kgf•m)</td>
</tr>
<tr>
<td>Vertical rotating torque</td>
<td>23500 N•m (2400 kgf•m)</td>
</tr>
</tbody>
</table>

3.2.1 When the Manipulator and Mounting Fixture Are Installed on a Common Installation Base

The common installation base should be rugged and durable to prevent shifting of the manipulator or the mounting fixture. It is recommended that the thickness of the common installation base is 30 mm or more, the anchor bolt is M16 or more. There are four mounting holes on the manipulator base. Affix the manipulator securely with hexagon socket head cap screws M16 (50 mm long recommended). Tighten the screws and bolts securely so that they will not work loose during operation. See "Fig. 3-1 "Mounting on the Common Installation Base" for the method.

Fig. 3-1: Mounting on the Common Installation Base
3.2.2 When the Manipulator Is Mounted Directly on the Floor

The floor should be strong enough to support the manipulator. Construct a solid foundation with the appropriate thickness to withstand maximum reaction forces of the manipulator. As a rough standard, when there is a concrete thickness (floor) of 150 mm or more, the manipulator base can be fixed directly to the floor with anchor bolts M16. Before mounting the manipulator, however, check that the floor is leveled and all cracks, etc., are repaired. A non-concrete floor or a floor less than 150 mm thick is insufficient for mounting, even if the floor is concrete.

Fig. 3-2: Direct Mounting on the Floor
The MOTOMAN-MFL1200D-1600 manipulators can be mounted on the floor only.

The MOTOMAN-MFL1200D-1600 manipulators are used in the clean room. It is required to satisfy the undermentioned environmental conditions:

- +15° to +35°C (ambient temperature)
- 20 to 80%RH (no moisture, non-condensing)
- Free from water
- Free from corrosive gases or liquid, or explosive gases or liquid
- Free from excessive impact or vibration (less than 4.9 m/s² (0.5 G))
- Free from large electrical noise
- The flatness for installation is 0.5 mm or less
3.5 Required Space for Installation

When installing the manipulator, reserve some space around the manipulator as shown in Fig. 3-3 “Installation Space”. To connect the power supply cables, the cable bend radius \( R \) must be 170 mm or more as shown in Fig. 3-3.

The S-axis rotation center is marked on the manipulator base to be used as a reference for installation. Refer to section 5.4 “Manipulator Base Dimensions”.

Fig. 3-3: Installation Space
4  Wiring

4.1 Grounding

Follow the local regulations for grounding line size. A line of 5.5 mm² or more is recommended.

Refer to “Fig. 4-1 ‘Grounding Method’” to connect the ground wire directly to the manipulator.

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

**WARNING**
- Ground resistance must be 100 Ω or less.
- Before wiring, make sure to turn the primary power supply OFF, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)

**CAUTION**
- Wiring must be performed by authorized or certified personnel.
- Do not cover the cable or allow it to tangle. Keep the cable as straight as possible.

**NOTE**
- Provided at factory

**View A**

5.5 mm² or more

*Fig. 4-1: Grounding Method*
4.2 Manipulator Cable Connection

There are three cables for the power supply; one signal cable for detection (1BC) and two power cables (2BC and 3BC). (Refer to Fig. 4-2(a) "Manipulator Cables (MOTOMAN-MFL1200D-1600)".) Connect these cables to the manipulator base connectors and the DX200, respectively. For the connection method, refer to Fig. 4-2(b) "Manipulator Cable Connection (Manipulator Side)" and Fig. 4-2(c) "Manipulator Cable Connection (DX200 Side)".

4.2.1 Connection to the Manipulator

Before connecting the cables to the manipulator, verify the numbers on both cables and the manipulator base connectors. When connecting, adjust the cable connector positions to the main key positions of the manipulator, and insert cables in the order of 3BC, 2BC and 1BC. After inserting the cables, depress each lever until it clicks.

4.2.2 Connection to the DX200

Connect the cables in the order of X22, X21, then X11. Before connecting the cables to the DX200, verify the numbers on both manipulator cables and the DX200 board connectors that are located below the side of the DX200.

Fig. 4-2(a): Manipulator Cables (MOTOMAN-MFL1200D-1600)
4 Wiring
4.2 Manipulator Cable Connection

Fig. 4-2(b): Manipulator Cable Connection (Manipulator Side)

Fig. 4-2(c): Manipulator Cable Connection (DX200 Side)
4.2.3 Cable Laying

**PROHIBITED**

- For cable laying, avoid coiling or looping the manipulator cables (encoder and power cables) even if the cable length is too long. Failure to observe this caution may result in cable burnt due to heat generation in the power cable.

When you place the encoder and power cables in a cable duct, put them separately in the cable duct with compartment or in separate cable ducts.

When you do not use a cable duct, lay down the encoder and power cables with keeping one cable away from the other cable. The distance between the encoder cable and the power cable should be 50 mm or more as a rough standard.
## 5 Basic Specifications

### 5.1 Basic Specifications

Table 5-1: Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>MOTOMAN-MFL1200D-1600</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>YR-MFL020D-D10</td>
</tr>
<tr>
<td><strong>Operation Mode</strong></td>
<td>Horizontally Articulated</td>
</tr>
<tr>
<td><strong>Degree of Freedom</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>Payload</strong></td>
<td>30 kg</td>
</tr>
<tr>
<td><strong>Repetitive Positioning Accuracy</strong></td>
<td>±0.1 mm</td>
</tr>
<tr>
<td><strong>Motion Range</strong> U-axis (upper/lower)</td>
<td>1600 mm</td>
</tr>
<tr>
<td><strong>Motion Range</strong> S-axis (rotation)</td>
<td>-305° ~ +35°</td>
</tr>
<tr>
<td><strong>Motion Range</strong> L- and R-axes (lateral)</td>
<td>-1175 mm ~ +1175 mm</td>
</tr>
<tr>
<td><strong>Maximum Speed</strong> U-axis</td>
<td>Max. 1220 mm/s</td>
</tr>
<tr>
<td><strong>Maximum Speed</strong> S-axis</td>
<td>3.14 rad/ (180°/s)</td>
</tr>
<tr>
<td><strong>Maximum Speed</strong> L- and R-axes</td>
<td>2700 mm/s</td>
</tr>
<tr>
<td><strong>Allowable Moment L- and R-axes</strong></td>
<td>100 N•m (10.2 kgf•m)</td>
</tr>
<tr>
<td><strong>Allowable Moment of Inertia (GD²/4)</strong></td>
<td>15 kgm²</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>700 kg</td>
</tr>
<tr>
<td><strong>Standard painting color</strong></td>
<td>Munsell value N 9.5 or equivalent</td>
</tr>
<tr>
<td><strong>Cleanliness Class</strong></td>
<td>ISO Class 4</td>
</tr>
<tr>
<td><strong>Ambient Conditions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>15 ~ 35°C</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>20 ~ 80 %RH (non-condensing)</td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
<td>4.9 m/s² (0.5 G) or less</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td>Free from corrosive gases or liquids, or explosive gases</td>
</tr>
<tr>
<td></td>
<td>Free from water or dust</td>
</tr>
<tr>
<td></td>
<td>Free from excessive electrical noise</td>
</tr>
<tr>
<td></td>
<td>The flatness for installation 0.5 mm or less</td>
</tr>
<tr>
<td><strong>Power Capacity</strong></td>
<td>4.0 kVA</td>
</tr>
</tbody>
</table>

1. SI units are used in this table. However, gravitational unit is used in (l).
2. Conformed to ISO9283.
3. Refer to section 6.1 “Allowable Wrist Load” for details on the allowable moment of inertia.
5.2 Manipulator Clean Specifications

The manipulator conforms to ISO cleanliness Class 4\(^1\).

1. Under the condition that the manipulator is in the downflow of 0.4 m/s or more in a vertically rectified state. The parts higher than the wrist flange are applicable.

5.3 Part Names and Working Axes

*Fig. 5-1: Part Names and Working Axes*
5.4 Manipulator Base Dimensions

Fig. 5-2: Manipulator Base Dimensions

- S-axis rotation center reference mark
- S-axis rotation center reference mark
- S-axis rotation center reference mark
- View A

Measurements:
- 18 dia.holes (4 holes)
- 12 dia. reamed holes (2 holes)
- 18 dia.holes (4 holes)
- 720 ± 0.2
- 55
- 225
- 630 ± 0.2
- 335
- 325
- 580 ± 0.2
- 35
5.5 Dimensions and Working Envelope

Fig. 5-3: Dimensions and Working Envelope MOTOMAN-MFL1200D-1600
5.6 Limitations of the Movement of the S- and U-Axes

The MOTOMAN-MFL1200D limits the movement of the S- and U-axes according to the positions of the L- or R-axis. Basically, for high-speed movement of the S- and U-axes, move these axes after moving the L- and R-axes to the home position (0 pulse position) or behind the home position where the pulse is negative.

If either the L- or R-axis is ahead of the home position where the pulse is positive, the S- and U-axes cannot move faster than the specified speed limit. The following alarm occurs if an attempt is made to use a move instruction to move the axes faster than the speed limit.

<At playback operation, forward/backward operation, or test run>
Alarm 4617: SU IMPOSSIBLE MOVE (L/R POS) [1]

<At axis operation>
Special soft limit: MAX [ ]

If any of the above alarms occur, add another teaching position before the move instruction where the alarm has occurred, change the teaching position immediately before the instruction, or return the L- and R-axes to the home position.

<table>
<thead>
<tr>
<th>L- and R-Axes Posture</th>
<th>S- and U-Axes Posture</th>
</tr>
</thead>
<tbody>
<tr>
<td>No limitation</td>
<td>No limitation</td>
</tr>
<tr>
<td></td>
<td>Enabled at a speed lower than the speed limit. Alarm occurs at a speed exceeding the speed limit.</td>
</tr>
<tr>
<td></td>
<td>4617: SU IMPOSSIBLE MOVE (L/R POS) [1]</td>
</tr>
<tr>
<td></td>
<td>&lt;At axis operation&gt; Special soft limit: MAX [ ]</td>
</tr>
</tbody>
</table>
5.7 Limitations on the L- and R-Axes Movement

The MOTOMAN-MFL1200D limits the movement of either the L- or R-axis according to the position of the other (e.g. The movement of the L-axis is limited according to the position of the R-axis, and vice versa.).

To move either the L- or R-axis, move first the other axis backward from the limited position.

Then start moving the L- or R-axis from the position.

The following alarm occurs if an attempt is made to execute a move instruction to move the L- or R-axis beyond the limited position when the other axis is in the “+” direction from the limited position.

<At playback operation, forward/backward operation, or test run>
Alarm 4617: SU-Axes MOTION IMPOSSIBILITY (LR-Axes pose error) [Decimal Data]

<At axis operation>
Alarm 4421: SPECIAL SOFTLIMIT (MAX.) Robot/Station [Axis Data]
5.7 Limitations on the L- and R-Axes Movement

<table>
<thead>
<tr>
<th>L- and R-Axes Posture</th>
<th>S- and U-Axes Posture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either the L- or R-axis can be moved without limitations when the other axis is in the backward position from the limited position.</td>
<td></td>
</tr>
<tr>
<td>The L-axis cannot be moved when the R-axis is in the &quot;+&quot; direction from the limited position.</td>
<td></td>
</tr>
<tr>
<td>The R-axis cannot be moved when the L-axis is in the &quot;+&quot; direction from the limited position.</td>
<td></td>
</tr>
</tbody>
</table>
6 Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable wrist load is 30 kg/arm. If force is applied to the wrist instead of the load, force on L- and R-Axes should be within the value shown in Table 6-1 "Allowable Wrist Load".

Contact your YASKAWA representative for further information or assistance.

Table 6-1: Allowable Wrist Load

<table>
<thead>
<tr>
<th>Axis</th>
<th>Moment N•m (kgf•m)1)</th>
<th>GD²/4 Total Moment of Inertia kg•m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>L- and R-axes</td>
<td>100 (10.2)</td>
<td>15</td>
</tr>
</tbody>
</table>

1 ( ) : Gravitational unit
6.2 Wrist Flange

The wrist flange dimensions are shown in Fig. 6-1 "Wrist Flange".
Fitting depth of inside and outside must be 8 mm or less.

Fig. 6-1: Wrist Flange
7 System Application

7.1 Internal User I/O Wiring Harness and Air Line

User cables (0.2 mm² × 14 cables for L- and R-axes each) and two air hoses for L- and R-axes each are used in the manipulator for the drives of the peripheral devices mounted on the upper arm as shown in "Fig. 7-1 Connectors for Internal Use I/O Wiring and Air Line".

The connector pins (1 to 14) are assigned as shown in Fig. 7-2 "Details of the Connector Pin Numbers". Wiring must be performed by user.

- The allowable current for cables: 3 A or less for each cable
  (The total current value for pins 1 to 14 must be 30 A or less.)
- The maximum pressure for the air hose: 490 kPa (5 kgf/cm²) or less
  (The air hose inside diameter: 4.0 mm for 2 cables)

Fig. 7-1: Connectors for Internal Use I/O Wiring and Air Line
The same numbered pins (1 to 14) of the two connectors are connected with a single lead wire of 0.2 mm².
8 Electrical Equipment Specifications

8.1 Location of Broken-Belt Detection Sensor

The broken-belt detection sensors are installed only on the U-axis. Refer to Fig. 8-1 "Location of the Broken-Belt Detection Sensor".

Fig. 8-1: Location of the Broken-Belt Detection Sensor

If a message for a broken belt appears, remove the cover on the U-arm, and check if the belt is broken. If this message appears, take the same corrective action as for an overrun recovery as described in the DX200 Operator's Manual. Replace the belt with the new one promptly in the event that the belt is broken.
8.2 Internal Connections

High reliability connectors which can be easily removed are used with each connector part.

For the number and location of connectors, see Fig. 8-2 “Locations and Numbers of Connectors”.

Diagrams for internal connections of the manipulator and for connections between the manipulator and DX200 are shown in Fig. 8-3(a) “Internal Connection Diagram (MFL1200D-1600)” and Fig. 8-3(b) “Internal Connection Diagram (MFL1200D-1600)”.

Table 8-1: List of Connector Types

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector for the internal user I/O wiring harness on the connector base</td>
<td>JL05-6A20-29S: Optional</td>
</tr>
</tbody>
</table>
Fig. 8-3(a): Internal Connection Diagram (MFL1200D-1600)
Fig. 8-3(b): Internal Connection Diagram (MFL1200D-1600)
9 Maintenance and Inspection

9.1 Inspection Schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation.

Inspection intervals are displayed in the levels shown in Table 9-1 “Inspection Items”.

Conduct periodical inspections according to the inspection schedule in Table 9-1.

In Table 9-1, the inspection items are classified into three types of operation: operations which can be performed by personnel authorized of the user, operations which can be performed by personnel being trained, and operations which can be performed by service company personnel. Only specified personnel are to do inspection work.

- The inspection interval must be based on the servo power supply on time.
- For axes which are used very frequently (in handling applications, etc.), it is recommended that inspections be conducted at shorter intervals. Contact your YASKAWA representative.

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.

WARNING

- Before maintenance or inspection, be sure to turn the main power supply OFF, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)
  Failure to observe this warning may result in electric shock or injury.

CAUTION

- The battery pack must be connected before removing detection connector when maintenance and inspection.
  Failure to observe this caution may result in the loss of home position data.
## Table 9-1: Inspection Items (Sheet 1 of 2)

<table>
<thead>
<tr>
<th>Items 1)</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment mark name plate (NP)</td>
<td>Daily</td>
<td>Visual</td>
<td>Check tram mark accordance at the home position. Reattach if tram and the name plate are damage or unstuck.</td>
<td>License</td>
</tr>
<tr>
<td>External lead</td>
<td>100 H Cycle</td>
<td>Visual</td>
<td>Check for damage and deterioration of leads.</td>
<td>Service Company</td>
</tr>
<tr>
<td>Working area and manipulator</td>
<td>600 H Cycle</td>
<td>Visual</td>
<td>Clean the dust and the surface.</td>
<td></td>
</tr>
<tr>
<td>3 Base mounting bolts</td>
<td>12000 H Cycle</td>
<td>Spanner Wrench</td>
<td>Tighten loose bolts.</td>
<td></td>
</tr>
<tr>
<td>4 Cover mounting screws</td>
<td>18000 H</td>
<td>Screwdriver, Wrench</td>
<td>Tighten loose bolts.</td>
<td></td>
</tr>
<tr>
<td>5 Base connectors</td>
<td>24000 H</td>
<td>Manual</td>
<td>Check for loose connectors.</td>
<td></td>
</tr>
<tr>
<td>USLR-axes timing belt</td>
<td>Manual</td>
<td>Visual</td>
<td>Check for belt tension and wear.</td>
<td></td>
</tr>
<tr>
<td>Internal user i/O wiring harness and airline</td>
<td>Visual</td>
<td>Multimeter</td>
<td>Check for conduction between the main connector of base and intermediate connector with manually shaking the cable. Check for wear of protective spring.</td>
<td></td>
</tr>
<tr>
<td>Battery pack in manipulator</td>
<td></td>
<td>Manual</td>
<td>Replace.</td>
<td></td>
</tr>
<tr>
<td>U-axis speed reducer</td>
<td></td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.)</td>
<td></td>
</tr>
</tbody>
</table>

1) Charge
2) See section 9.3.1.
4) Replace. (Replace if necessary.)
5) Supply grease (6000H cycle). See section 9.3.1.
9.1 Inspection Schedule

- **5)** Grease gun Check for malfunction. (Replace if necessary.)
  - Supply grease (6000H cycle). See section 9.3.2.
  - Exchange grease (12000H cycle). See section 9.3.2.

- **5) L-and R-axes speed reducers**
  - Grease gun Check for malfunction. (Replace if necessary.)
  - Supply grease (6000H cycle). See section 9.3.3.
  - Exchange grease (12000H cycle). See section 9.3.3. (14, 15, 14', 15')

1. **Overhaul**

Table 9-1: Inspection Items (Sheet 2 of 2)

<table>
<thead>
<tr>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Daily</td>
<td>100 H Cycle</td>
<td>Grease gun</td>
</tr>
<tr>
<td>14, 15, 16, 14', 15'</td>
<td>600 H Cycle</td>
<td>Grease gun</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>24000 H Cycle</td>
<td>Overhaul</td>
<td></td>
</tr>
</tbody>
</table>

**Specified Person**
- Licensee
- Service Company

---

1. Inspection No. correspond to the numbers in Fig. 9-1 "Inspected Parts and Numbers".
2. If a grease leakage occurs, contact your YASKAWA representative as soon as possible. (Perform cleaning if the amount of grease found on the surface is small.)
3. When checking for conduction with multimeter, connect the battery to "BAT" and "OBT" of connectors on the motor side for each axis, and then remove connectors on detector side for each axis from the motor. Otherwise, the home position may be lost.
4. The U-, S-, L-, and R-axes internal cables are to be replaced at 18000H inspection.
5. If the amount of movement of an axis is small (e.g. when the U-axis only picks up and puts down glass substrates), its inspection and replacement may have to be conducted at shorter intervals. Contact your YASKAWA representative.
6. For the grease, refer to Table 9-2 "Inspections Parts and Grease used".
9 Maintenance and Inspection
9.1 Inspection Schedule

Fig. 9-1: Inspected Parts and Numbers

Table 9-2: Inspections Parts and Grease used

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Molywhite RE No.00</td>
<td>U-axis speed reducer</td>
</tr>
<tr>
<td>13</td>
<td>Molywhite RE No.00</td>
<td>S-axis speed reducer</td>
</tr>
<tr>
<td>16</td>
<td>Harmonic Grease</td>
<td>L-axis speed reducer</td>
</tr>
<tr>
<td></td>
<td>SK-1A</td>
<td></td>
</tr>
<tr>
<td>14, 15</td>
<td>Molywhite RE No.00</td>
<td></td>
</tr>
<tr>
<td>16'</td>
<td>Harmonic Grease</td>
<td>R-axis speed reducer</td>
</tr>
<tr>
<td></td>
<td>SK-1A</td>
<td></td>
</tr>
<tr>
<td>14', 15'</td>
<td>Molywhite RE No.00</td>
<td></td>
</tr>
</tbody>
</table>

The numbers in the above table correspond to those in Table 9-1 “Inspection Items”.

Table 9-1: Inspection Items

<table>
<thead>
<tr>
<th>No.</th>
<th>Inspection Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>U-axis speed reducer</td>
</tr>
<tr>
<td>2</td>
<td>S-axis speed reducer</td>
</tr>
<tr>
<td>3</td>
<td>L-axis speed reducer</td>
</tr>
<tr>
<td>4</td>
<td>R-axis speed reducer</td>
</tr>
<tr>
<td>5</td>
<td>Harmonic Grease SK-1A</td>
</tr>
</tbody>
</table>
9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

Two battery packs are mounted on the position indicated in Fig. 9-2 "Battery Pack Location".

If a battery alarm occurs in the DX200, replace the battery according to the following procedure:

Fig. 9-2: Battery Pack Location

![Battery Pack Location Diagram]

Fig. 9-3: Battery Pack Connection

![Battery Pack Connection Diagram]

1. Turn OFF the DX200 main power supply.
2. Remove the plate on the connector base on the base connector section.
3. Remove the bolts fixing the battery pack on the connector base.
4. Remove the plastic tape (insulation tape) protecting the battery pack connection inside the manipulator.
5. Connect a new battery pack.
6. Remove the old battery pack.

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

7. Protect the battery pack connections inside the manipulator with the vinyl tape (insulation tape).
8. Mount the battery pack to the connector base, and then install the connector base. Insert a gasket between the connector base and the base.
9.3 Notes on Maintenance Procedures

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

- If grease is added without removing the plug from the grease exhaust port, the grease will go inside a motor or an oil seal of a speed reducer will come off, which may result in damage to the motor. Make sure to remove the plug.
- When attaching a joint and a hose to the grease exhaust port, make sure to use the hose whose inside diameter is 6 mm or more with the length of 100 mm or less. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.
- Make sure to use a grease pump to inject grease. Set air supply pressure to the grease pump at 0.3 MPa or less, and the grease injection rate at 8 g/s or less.
- Make sure to fill the hose on the grease inlet with grease beforehand to prevent air from leaking into the speed reducer.

### 9.3.1 Grease Replenishment/Exchange for U-Axis Speed Reducer

_Fig. 9-4: U-axis Posture for Grease Replenishment/Exchange_

_Fig. 9-5: U-axis Speed Reducer_
9 Maintenance and Inspection
9.3 Notes on Maintenance Procedures

- Grease Replenishment
  (Refer to Fig. 9-5 "U-axis Speed Reducer").
  Use the following procedure to replenish grease.

Lower part of U-Axis

1. Posture the U-axis as shown in Fig. 9-4 "U-axis Posture for Grease Replenishment/Exchange".
2. Remove the hexagon socket head plug PT1/8 from the Uo grease exhaust port and the plug with an o-ring from the Ui grease inlet. In this case, remove the cover on the side of the base, and then remove the plug. The cover is mounted with eight stainless steel hexagon socket head cap screws M4 (length: 12 mm).

3. Install the grease zerk A-MT6x1 on the Ui grease inlet, and inject grease through the grease inlet using a grease gun. (The grease zerk is delivered with the manipulator.)
   - Grease type: Molywhite RE No.00
   - Amount of grease: 500 g (Base side) (900 g for only 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. Before reinstalling the hexagon socket head plug PT1/8 on the Uo grease exhaust port, move the U-axis for a few minutes to discharge the excess grease.
5. Wipe the discharged grease with a cloth and remove the grease zerk from the inlet. Reinstall the hexagon socket head plug PT1/8 on the Uo grease exhaust port and the plug with an o-ring on the Ui grease inlet.

If grease is added without removing the plug PT1/8, the internal pressure will increase and may cause a damage. Make sure to remove the plug before injecting grease.
Upper part of U-Axis

1. Posture the U-axis as shown in "Fig. 9-4 "U-axis Posture for Grease Replenishment/Exchange". 
2. Remove the plug with an o-ring from the Uo grease exhaust port and remove the hexagon socket head plug PT1/8 from the Ui grease inlet.

   **NOTE**
   If grease is added without removing the plug with an o-ring, the internal pressure will increase and may cause a damage. Make sure to remove the plug before injecting grease.

3. Install the grease zerk A-PT1/8 on the Ui grease inlet, and inject grease through the grease inlet using a grease gun. (The grease zerk is delivered with the manipulator.)
   - Grease type: Molywhite RE No.00
   - Amount of grease: 300 g (600 g for only 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

4. Before reinstalling the plug with an o-ring on the Uo grease exhaust port, move the U-axis for a few minutes to discharge the excess grease.

5. Wipe the discharged grease with a cloth and remove the grease zerk from the inlet. Reinstall the plug with an o-ring on the Uo grease exhaust port and reinstall hexagon socket head the plug PT1/8 on the Ui grease inlet.
Grease Exchange
(Refer to "Fig. 9-5 U-axis Speed Reducer").
Use the following procedure to exchange grease.

Lower part of U-Axis
1. Posture the U-axis as shown in Fig. 9-4 "U-axis Posture for Grease Replenishment/Exchange".
2. Remove the hexagon socket head plug PT1/8 from the Uo grease exhaust port and the plug with an o-ring from the Ui grease inlet. In this case, remove the cover on the side of the base, and then remove the plug. The cover is mounted with eight stainless steel hexagon socket head cap screws M4 (length: 12 mm).
3. Install the grease zerk A-MT6x1 on the Ui grease inlet, and inject grease through the grease inlet using a grease gun. (The grease zerk is delivered with the manipulator.)
   - Grease type: Molywhite RE No.00
   - Amount of grease: 1800 g
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. The grease exchange is completed when new grease appears from the Uo grease exhaust port. (The new grease is distinguished from the old grease by color. Refer to the table above for the amount of grease to inject.)
5. Before reinstalling the hexagon socket head plug PT1/8 on the Uo grease exhaust port, move the U-axis for a few minutes to discharge the excess grease.
6. Wipe the discharged grease with a cloth and remove the grease zerk from the inlet. Reinstall the hexagon socket head plug PT1/8 on the Uo grease exhaust port and the plug with an o-ring on the Ui grease inlet.

If grease is added without removing the plug PT1/8, the internal pressure will increase and may cause a damage. Make sure to remove the plug before injecting grease.
Upper part of U-Axis

1. Posture the U-axis as shown in "Fig. 9-4 "U-axis Posture for Grease Replenishment/Exchange".

2. Remove the plug with an o-ring from the Uo grease exhaust port and the hexagon socket head plug PT1/8 from the Ui grease inlet.

3. Install the grease zerk A-PT1/8 on the Ui grease inlet, and inject grease through the grease inlet using a grease gun. (The grease zerk is delivered with the manipulator.)

   - Grease type: Molywhite RE No.00
   - Amount of grease: 1000 g
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

4. The grease exchange is completed when new grease appears from the Uo grease exhaust port. (The new grease is distinguished from the old grease by color. Refer to the table above for the amount of grease to inject.)

5. Before reinstalling the plug with an o-ring on the Uo grease exhaust port, move the U-Axis for a few minutes to discharge the excess grease.

6. Wipe the discharged grease with a cloth and remove the grease zerk from the inlet. Reinstall the plug with an o-ring on the Uo grease exhaust port and the hexagon socket head plug PT1/8 on the Ui grease inlet.

If grease is added without removing the plug with an o-ring, the internal pressure will increase and may cause a damage. Make sure to remove the plug before injecting grease.

NOTE
9.3.2 Grease Replenishment/Exchange for S-Axis Speed Reducer

**Fig. 9-6: S-Axis Speed Reducer (After the Cover Removal)**

- **Grease Replenishment**
  
  (Refer to Fig. 9-6 "S-Axis Speed Reducer (After the Cover Removal)."

  Use the following procedure to replenish grease.

  1. Posture the L- and R-axes as shown in Fig. 9-6 and remove the cover.
     
     The cover is fixed with 10 anti-corrosive hexagon socket head cap screws M4 (length: 12 mm).

  2. Remove the plugs with o-rings from the So grease exhaust port and the Si grease inlet.

  3. Install the grease zerk A-MT6x1 on the Si grease inlet, and inject grease through the grease inlet using a grease gun.
     
     (The grease zerk is delivered with the manipulator.)
     
     - Grease type: Molywhite RE No.00
     - Amount of grease: 300 g (500 g for only 1st supply)
     - Air supply pressure of grease pump: 0.3 MPa or less
     - Grease injection rate: 8 g/s or less

  4. Before reinstalling the plug with an o-ring on the So grease exhaust port, move the S-axis for a few minutes to discharge excess grease.

  5. Wipe the discharged grease with a cloth and remove the grease zerk from the inlet.
     
     Reinstall the plugs with o-rings on the So grease exhaust port and the Si grease inlet.

- **NOTE**
  
  If grease is added without removing the plug with an o-ring, the internal pressure will increase and may cause a damage. Make sure to remove the plug before injecting grease.
Grease Exchange

(Refer to Fig. 9-6 “S-Axis Speed Reducer (After the Cover Removal)”.)

Use the following procedure to exchange grease.

1. Posture the L- and R-axes as shown in “Fig. 9-6 “S-Axis Speed Reducer (After the Cover Removal)”, and remove the cover. The cover is fixed with ten anti-corrosive hexagon socket head cap screws M4 (length: 12 mm).

2. Remove the plugs with o-rings from the So grease exhaust port and the Si grease inlet.

3. Install the grease zerk A-MT6x1 on the Si grease inlet, and inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: approx. 800 g
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

4. The grease exchange is completed when new grease appears from the So grease exhaust port. The new grease is distinguished from the old grease by color. Refer to the table above for the amount of grease to inject.

5. Before reinstalling the plug with an o-ring on the So grease exhaust port, move the S-axis for a few minutes to discharge the excess grease.

6. Wipe the discharged grease with a cloth and remove the grease zerk from the inlet. Reinstall the plugs with o-rings on the So grease exhaust port and the Si grease inlet.

If grease is added without removing the plug with an o-ring, the internal pressure will increase and may cause a damage. Make sure to remove the plug before injecting grease.
9.3.3 Grease Replenishment/Exchange for L- and R-Axes Speed Reducers

Fig. 9-7(a): L- and R-Axes Speed Reducers

Fig. 9-7(b): L- and R-Axes Speed Reducers (Sections A, B and C)
Grease Replenishment

(Refer to Fig. 9-7(a) “L- and R-Axes Speed Reducers” and Fig. 9-7(b) “L- and R-Axes Speed Reducers (Sections A, B and C)”.)

Use the following procedure to replenish grease.

**Section A**

1. Posture the L- and R-axes as shown in Fig. 9-7(a).
2. Remove the plugs with o-rings from the Lo and Ro grease exhaust ports and the Li and Ri grease inlets.
3. Install the grease zerk A-MT6x1 on the Li and Ri grease inlets, and inject grease through each grease inlet using a grease gun.
   - Grease type: Harmonic Grease SK-1A
   - Amount of grease: approx. 10 g
4. Before reinstalling the plugs with o-rings on the Lo and Ro grease exhaust ports, move the L- and R-axes for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth and remove the grease zerk from each inlet.
   Reinstall the plugs with o-rings on the Lo and Ro grease exhaust ports and the Li and Ri grease inlets.

**Section B and C**

1. Posture the L- and R-axes as shown in Fig. 9-7(a).
2. Remove the plugs with o-rings from the Lo and Ro grease exhaust ports and the Li and Ri grease inlets.
3. Install the grease zerk A-MT6x1 on the Li and Ri grease inlets, and inject grease through each grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: 200 g (Section C)  
     (250 g for only 1st supply)  
     (100 g (Section B)  
     (150 g for only 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. Before reinstalling the plugs with o-rings on the Lo and Ro grease exhaust ports, move the L- and R-axes for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth and remove the grease zerk from each inlet.
   Reinstall the plugs with o-rings on the Lo and Ro grease exhaust ports and the Li and Ri grease inlets.
9.3 Notes on Maintenance Procedures

Grease Exchange
(Refer to Fig. 9-7(a) “L- and R-Axes Speed Reducers”.)

Use the following procedure to exchange grease.

Note that grease exchange shall be performed on the sections B and C in Fig. 9-7(b) “L- and R-Axes Speed Reducers (Sections A, B and C).”
1. Posture the L- and R-axes as shown in Fig. 9-7(a).
2. Remove the plugs with o-rings from the Lo and Ro grease exhaust ports and the Li and Ri grease inlets.
3. Install the grease zerk A-MT6x1 on the Li and Ri grease inlets, and inject grease through each grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: approx. 350 g (Section C) approx. 250 g (Section B)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. The grease exchange is completed when new grease appears from the Lo and Ro grease exhaust ports. The new grease is distinguished from the old grease by color.
5. Before reinstalling the plugs with o-rings on the Lo and Ro grease exhaust ports, move the L- and R-axes for a few minutes to discharge the excess grease.
6. Wipe the discharged grease with a cloth and remove the grease zerk from each inlet.
   Reinstall the plugs with o-rings on the Lo and Ro grease exhaust ports and the Li and Ri grease inlets.

If grease is added without removing the plugs with o-rings, the internal pressure will increase and may cause a damage. Make sure to remove the plugs before injecting grease.

60 of 66
9.3.4 Notes on Maintenance

- Inspecting Broken-belt Detection Sensor
  Remove the cover and check if any foreign matter adhere to the projector or the photodetector of the broken-belt detection sensor.
  If any dirt is found, wipe the part with wipes for cleaning.

*Fig. 9-8: Broken-Belt Detection Sensor*
9.4 Battery Pack Connection

Before removing the encoder connector (with CAUTION label), connect the battery pack referring to the following figures.

**Fig. 9-9(a): Encoder Connector Diagram (for U-Axis)**

When performing maintenance such as replacement of a wire harness in the manipulator, the encoder connector (with CAUTION label) will 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. 9-9(a) “Encoder Connector Diagram (for U-Axis)” and Fig. 9-9(b) “Encoder Connector Diagram (for S-, L-, and R-Axes).”
9 Maintenance and Inspection

9.4 Battery Pack Connection

**Fig. 9-9(b): Encoder Connector Diagram (for S-, L-, and R-Axes)**

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

**CAUTION label (Enlarged view)**

- Crimped contact-pin (socket)
- Crimped contact-pin (pin)
10 Recommended Spare Parts

It is recommended that the following parts and components be kept in stock as spare parts for the MOTOMAN-MFL1200D-1600.

The spare parts list for the MOTOMAN-MFL1200D-1600 is shown below. Product performance cannot be guaranteed when using spare parts from any company other than YASKAWA.

The spare parts are ranked as follows:

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

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

![Fig. 10-1: Spare Parts for MOTOMAN-MFL1200D-1600 (YR-MFL020D-D10)](image)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacture</th>
<th>Qty</th>
<th>Qty per Unit</th>
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<td>Molywhite RE No.00</td>
<td>YASKAWA Electric Corporation</td>
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<td>Grease</td>
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<td>3</td>
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<td>6</td>
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<td>B350S8M2240</td>
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