MOTOMAN-DX1350D INSTRUCTIONS

TYPE: YR-DX1350D-A00 (STANDARD SPECIFICATION)
      YR-DX1350D-A01 (WITH LIMIT SWITCHES FOR S-, L-, U-AXES)

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

MOTOMAN INSTRUCTIONS
MOTOMAN-DX1350D INSTRUCTIONS
DX100 INSTRUCTIONS
DX100 OPERATOR’S MANUAL
DX100 MAINTENANCE MANUAL

The DX100 operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.

Part Number: 158454-1CD
Revision: 0
MANDATORY

• This instruction manual is intended to explain mainly on the mechanical part of the MOTOMAN-DX1350D 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 DX100 Instructions. To ensure correct and safe operation, carefully read the DX100 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.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the MOTOMAN-DX1350D.

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

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

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

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

🚫 PROHIBITED
Must never be performed.

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

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as "CAUTION" and "WARNING".
WARNING

• Before operating the manipulator, check that servo power is turned OFF pressing the emergency stop buttons on the front door of the DX100 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. Then 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:
  – 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 DX100.
  – Moving the manipulator with the programming pendant.
  – Running the system in the check mode.
  – Performing automatic operations.

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

The emergency stop buttons are located on the right of front door of the DX100 and the programming pendant.
CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the cabinet of the DX100 after use.
  The programming pendant can be damaged if it is left in the manipulator’s work area, on the floor, or near fixtures.
- Read and understand the Explanation of Warning Labels in the DX100 Instructions before operating the manipulator:

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 designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX100 controller</td>
<td>DX100</td>
</tr>
<tr>
<td>DX100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>
Explanation of Warning Labels

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

Fig. : Warning Label Locations
1 Product Confirmation
   1.1 Contents Confirmation
   1.2 Order Number Confirmation

2 Transport
   2.1 Transport Method
      2.1.1 Using a Crane
      2.1.2 Using a Forklift
   2.2 Shipping Bolts and Brackets

3 Installation
   3.1 Safeguarding Installation
   3.2 Mounting Procedures for Manipulator Base
      3.2.1 Mounting Example
   3.3 Installation Method
      3.3.1 S-axis Operating Range
      3.3.2 Fixing the Manipulator Base
      3.3.3 Precautions to Prevent the Manipulator from Falling
   3.4 Location

4 Wiring
   4.1 Grounding
   4.2 Cable Connection
      4.2.1 Connection to the Manipulator
      4.2.2 Connection to the DX100

5 Basic Specifications
   5.1 Basic Specifications
   5.2 Part Names and Working Axes
   5.3 Manipulator Base Dimensions
   5.4 Dimensions and P-point Maximum Envelope
   5.5 Alterable Operating Range

6 Allowable Load for Wrist Axis and Wrist Flange
   6.1 Allowable Wrist Load
   6.2 Wrist Flange
7 System Application.................................................................7-1
  7.1 Peripheral Equipment Mounts...............................................7-1
  7.2 Internal User I/O Wiring Harness and Air Line.....................7-2
8 Electrical Equipment Specification...........................................8-1
  8.1 Position of Limit Switch.....................................................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.......................................9-6
    9.2.1 Battery Pack Replacement.............................................9-6
  9.3 Notes on Grease Replenishment/Exchange Procedures.............9-7
    9.3.1 Grease Replenishment/Exchange for S-Axis Speed Reducer...9-8
      9.3.1.1 Grease Replenishment (Refer to fig. 9-4 “S-Axis Speed Reducer
                  Diagram”).........................................................................9-8
      9.3.1.2 Grease Exchange (Refer to fig. 9-4 “S-Axis Speed Reducer
                  Diagram” at page 9-8)..........................................................9-9
    9.3.2 Grease Replenishment/Exchange for L-Axis Speed Reducer...9-10
      9.3.2.1 Grease Replenishment (Refer to fig. 9-5 “L-Axis Speed Reducer
                  Diagram”).........................................................................9-10
      9.3.2.2 Grease Exchange (Refer to fig. 9-5 “L-Axis Speed Reducer
                  Diagram” at page 9-10)..........................................................9-11
    9.3.3 Grease Replenishment/Exchange for U-Axis Speed Reducer...9-12
      9.3.3.1 Grease Replenishment (Refer to fig. 9-6 “U-Axis Speed Reducer
                  Diagram”).........................................................................9-12
      9.3.3.2 Grease Exchange (Refer to fig. 9-6 “U-Axis Speed Reducer
                  Diagram” at page 9-12)..........................................................9-13
    9.3.4 Grease Replenishment/Exchange for R-Axis Speed Reducer...9-14
      9.3.4.1 Grease Replenishment (Refer to fig. 9-7 “R-Axis Speed Reducer
                  Diagram”).........................................................................9-14
      9.3.4.2 Grease Exchange (Refer to fig. 9-7 “R-Axis Speed Reducer
                  Diagram” at page 9-14)..........................................................9-15
    9.3.5 Grease Replenishment for B- and T-Axis Speed Reducers...9-16
    9.3.6 Grease Replenishment for T-Axis Gear..............................9-17
    9.3.7 Notes for Maintenance...................................................9-18
      9.3.7.1 Wrist Unit.......................................................................9-18
      9.3.7.2 Battery Pack Connection.................................................9-18
      9.3.7.3 Battery Pack Connection for S-, L-, and U-Axis Motors....9-18
      9.3.7.4 Battery Pack Connection for R-, B-, and T-Axis Motors....9-19
9.4 Home Position Return (Calibration) ................................................................. 9-20
  9.4.1 Calibration by Using Key .............................................................................. 9-20
  9.4.2 Calibration Procedure .................................................................................. 9-21
    9.4.2.1 S-Axis Positioning .................................................................................. 9-21
    9.4.2.2 L-Axis Positioning .................................................................................. 9-22
    9.4.2.3 U-Axis Positioning .................................................................................. 9-22
    9.4.2.4 R-Axis Positioning .................................................................................. 9-23
    9.4.2.5 B-Axis Positioning .................................................................................. 9-23
    9.4.2.6 T-Axis Positioning .................................................................................. 9-24

10 Recommended Spare Parts .................................................................................. 10-1
1  Product Confirmation

1.1  Contents Confirmation

Confirm the contents of the delivery when the product arrives.

Standard delivery includes the following four items (information for the
content of optional goods are given separately):

• Manipulator
• DX100
• Programming pendant
• Manipulator cables (cables between the DX100 and the manipulator)

CAUTION

• Confirm that the manipulator and the DX100 have the same order
  number. Special care must be taken when more than one
  manipulator is to be installed.

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

Check that the order number of the manipulator corresponds to the DX100. The order number is located on a label as shown below.

Fig. 1-1: Location of Order Number Labels
2 Transport

2.1 Transport Method

**CAUTION**

- Sling applications and crane or forklift operations must be performed by authorized personnel only. Failure to observe this caution may result in injury or damage.
- Avoid excessive vibration or shock during transport. The system consists of precision components. Failure to observe this caution may adversely affect performance.

**NOTE**

- Check that the eyebolts are securely fastened.
- The weight of the manipulator is approximately 275 kg 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.
- Mount the shipping bolts and brackets for transporting the manipulator.
- Avoid putting external force on the arm or motor unit when transporting by a crane, forklift, or other equipment. Failure to observe this instruction may result in injury.
2.1 Transport Method

2.1.1 Using a Crane

As a rule, when removing the manipulator from the package and moving it, a crane should be used. The manipulator should be lifted using wire ropes threaded through the attached eyebolts. Be sure that the manipulator is fixed with the shipping bolts and brackets before transport, and lift it in the posture as shown in fig. 2-1 “Transport Using a Crane”.

Fig. 2-1: Transport Using a Crane

2.1.2 Using a Forklift

When using a forklift, the manipulator should be fixed on a pallet as shown in fig. 2-2 “Transport Using a Forklift”. Insert claws under the pallet and lift it. The pallet must be strong enough to support the manipulator. Transport the manipulator slowly with due caution in order to avoid overturning or slippage.

Fig. 2-2: Transport Using a Forklift
2.2 Shipping Bolts and Brackets

The manipulator is provided with shipping bolts and brackets at the part A. (fig. 2-1 “Transport Using a Crane” at page 2-2)

- The shipping brackets are painted yellow.
- The part A is fixed with two hexagon socket head cap screws M12.

**NOTE**

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

WARNING

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

• Install the manipulator in a location where the tool or the workpiece held by its fully extended arm will not reach the wall, safeguarding, or controller. Failure to observe this warning may result in injury or damage.

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

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

CAUTION

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

• Before turning ON the power, check to be sure that the shipping bolts and brackets explained in chapter 2.2 “Shipping Bolts and Brackets” at page 2-3 are removed. Failure to observe this caution may result in damage to the driving parts.
3 Installation

3.1 Safeguarding Installation

To insuire safety, be sure to install safeguarding. It prevents unforeseen accidents with personnel and damage to equipment. Refer to the quoted clause for your information and guidance.

Responsibility for Safeguarding (ISO10218)

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.

3.2 Mounting Procedures for Manipulator Base

The manipulator should be firmly mounted on a baseplate or foundation strong enough to support the manipulator and withstand repulsion forces during acceleration and deceleration.

Construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator referring to table 3-1 “Maximum Repulsion Forces of the Manipulator at Emergency Stop” and table 3-2 “Endurance Torque in Operation”.

A baseplate flatness must be kept at 0.5 mm or less: insufficient flatness of installation surface may deform the manipulator shape and affect its functional abilities. Mount the manipulator base as instructed in chapter 3.2.1 “Mounting Example”.

Table 3-1: Maximum Repulsion Forces of the Manipulator at Emergency Stop

| Maximum torque in horizontal rotation (S-axis moving direction) | 9800 N•m (1000 kgf•m) |
| Maximum torque in vertical rotation (L-, U-axes moving direction) | 10600 N•m (1070 kgf•m) |

Table 3-2: Endurance Torque in Operation

| Endurance torque in horizontal operation (S-axis moving direction) | 1243 N•m (127 kgf•m) |
| Endurance torque in vertical operation (L-, U-axes moving direction) | 815 N•m (83 kgf•m) |
3.2.1 Mounting Example

For the first process, anchor the baseplate firmly to the ground. The baseplate should be rugged and durable to prevent shifting of the manipulator or the mounting fixture. It is recommend to prepare a baseplate of 40 mm or more thick, and anchor bolts of M16 or larger size.

The manipulator base is tapped for four mounting holes; securely fix the manipulator base to the baseplate with four hexagon head bolts M16 (60 mm long is recommended). Next, fix the manipulator base to the baseplate. Tighten the hexagon head bolts and anchor bolts firmly so that they will not work loose during the operation.

Refer to fig. 3-1 "Mounting the Manipulator on Baseplate".

Fig. 3-1: Mounting the Manipulator on Baseplate
3.3 Installation Method

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

- S-axis Operating Range
- Fixing the Manipulator Base
- Precautions to Prevent the Manipulator from Falling

3.3.1 S-axis Operating Range

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

3.3.2 Fixing the Manipulator Base

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

3.3.3 Precautions to Prevent the Manipulator from Falling

For the wall- or ceiling-mounted way, take appropriate measures to avoid the falling of the manipulator in case of emergency. Refer to fig. 3-2 "Fall Prevention" for details.

Fig. 3-2: Fall Prevention

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

When installing a manipulator, it is necessary to satisfy the following environmental conditions:

- Ambient temperature: 0°C to +45°C
- Humidity: 20 to 80%RH (no-condensing)
- Free from dust, soot, oil, or water
- Free from corrosive gas or liquid, or explosive gas or liquid
- Free from excessive vibration (Vibration acceleration: 4.9 m/s² [0.5 G] or less)
- Free from large electrical noise (plasma)
- Flatness for installation: 0.5 mm or less
4 Wiring

4.1 Grounding

Follow electrical installation standards and wiring regulations for grounding. A ground wire of 5.5 mm² or more is recommended. Refer to fig 4-1 “Grounding Method” at page 4-2 to connect the ground line directly to the manipulator.

- Never use this line sharing with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.
- Where metal ducts, metallic conduits, or distributing racks are used for cable laying, ground in accordance with electrical installation standards.

WARNING

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

CAUTION

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

NOTE

Never use this line sharing with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.
4.2 Cable Connection

Two manipulator cables are delivered with the manipulator; an encoder cable for detection (1BC) and a power cable (2BC). (Refer to fig. 4-2 "Manipulator Cables" at page 4-3.)

Connect these cables to the manipulator base connectors and to the DX100. Refer to fig. 4-3(a) "Manipulator Cable Connectors (Manipulator Side)" at page 4-4 and fig. 4-3(b) "Manipulator Cable Connection (DX100 Side)" at page 4-4.

4.2.1 Connection to the Manipulator

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

4.2.2 Connection to the DX100

Before connecting cables to the DX100, verify the numbers on both manipulator cables and the connectors on the DX100. When connecting, insert the cables in the order of X21, then X11, and depress each lever until it clicks.
4 Wiring
4.2 Cable Connection

Fig. 4-2: Manipulator Cables

DX100 side

Manipulator side

Encoder cable

DX100 side

Manipulator side

Power cable
4 Wiring

DX1350D

4.2 Cable Connection

Fig. 4-3(a): Manipulator Cable Connectors (Manipulator Side)

Fig. 4-3(b): Manipulator Cable Connection (DX100 Side)
## 5 Basic Specifications

### 5.1 Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>Vertically Articulated</td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>6</td>
</tr>
<tr>
<td>Payload</td>
<td>35 kg</td>
</tr>
<tr>
<td>Repetitive Positioning Accuracy</td>
<td>±0.06 mm</td>
</tr>
</tbody>
</table>

**Range of Motion**

- S-Axis (turning): $-180°$ to $+180°$
- L-Axis (lower arm): $-50°$ to $+145°$
- U-Axis (upper arm): $-140°$ to $+220°$
- R-Axis (wrist roll): $-200°$ to $+200°$
- B-Axis (wrist pitch/yaw): $-125°$ to $+125°$
- T-Axis (wrist twist): $-360°$ to $+360°$

**Maximum Speed**

- S-Axis: 2.97 rad/s, 170°/s
- L-Axis: 2.97 rad/s, 170°/s
- U-Axis: 2.97 rad/s, 170°/s
- R-Axis: 4.71 rad/s, 270°/s
- B-Axis: 4.71 rad/s, 270°/s
- T-Axis: 8.02 rad/s, 460°/s

**Allowable Moment**

- R-Axis: 82 N•m (8.4 kgf•m)
- B-Axis: 82 N•m (8.4 kgf•m)
- T-Axis: 41 N•m (4.2 kgf•m)

**Allowable Inertia (GD²/4)**

- R-Axis: 2.0 kg•m²
- B-Axis: 2.0 kg•m²
- T-Axis: 0.5 kg•m²

**Mass**

- 275 kg

**Ambient Conditions**

- Temperature: 0° C to 45° C
- Humidity: 20 to 80% RH (non-condensing)
- Vibration Acceleration: 4.9 m/s² or less (0.5 G)
- Others: Free from corrosive gasses or liquids, or explosive gasses
- Free from exposure to water, oil, or dust
- Free from excessive electrical noise (plasma)

**Power Requirements**

- 4 kVA

---

1 SI units are used in this table. However, gravitational unit is used in ( ).
2 Conformed to ISO9283
3 Refer to table chapter 6 "Allowable Load for Wrist Axis and Wrist Flange" at page 6-1 for details on the permissible moment of inertia.
5.2 Part Names and Working Axes

Fig. 5-1: Part Names and Working Axes

- U-arm
- Wrist
- Wrist flange
- Rotary head
- Manipulator base

5.3 Manipulator Base Dimensions

Fig. 5-2: Manipulator Base Dimensions

Units: mm
5.4 Dimensions and P-point Maximum Envelope

Fig. 5-3: Dimensions and P-Point Maximum Envelope
5.5 Alterable Operating Range

The operating range of the S-axis can be altered in accordance with the operating conditions as shown in table 5-2 "S-Axis Operating Range". If alteration is necessary, contact your Yaskawa representative in advance.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-Axis Operating Range</td>
<td>-180° - +180° (standard)</td>
</tr>
<tr>
<td></td>
<td>-150° - +150°</td>
</tr>
<tr>
<td></td>
<td>-120° - +120°</td>
</tr>
<tr>
<td></td>
<td>-90° - +90°</td>
</tr>
<tr>
<td></td>
<td>-60° - +60°</td>
</tr>
<tr>
<td></td>
<td>-30° - +30°</td>
</tr>
</tbody>
</table>
Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable wrist load is 35 kg maximum. If force is applied to the wrist instead of the load, force on R-, B-, and T-axes should be within the value shown in Table 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>GD(^2) Total Moment of Inertia kgf-m(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-Axis</td>
<td>82 (8.4)</td>
<td>2.0</td>
</tr>
<tr>
<td>B-Axis</td>
<td>82 (8.4)</td>
<td>2.0</td>
</tr>
<tr>
<td>T-Axis</td>
<td>41 (4.2)</td>
<td>0.5</td>
</tr>
</tbody>
</table>

1 ( ): Gravitational unit

When the volume load is small, refer to the moment arm rating shown in Fig. 6-1 “Moment Arm Rating”.

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

The wrist flange dimensions are shown in fig. 6-2 “Wrist Flange”. In order to see the alignment mark, it is recommended that the attachment be mounted inside the fitting. Fitting depth of inside and outside must be 5 mm or less.

**Fig. 6-2: Wrist Flange**

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

7.1 Peripheral Equipment Mounts

The peripheral equipment mounts are provided on the U-axis (upper arm) as shown in fig. 7-1 "Peripheral Equipment Mounts" for easier installation of the user’s system applications. The following conditions shall be observed to attach or install peripheral equipment.

**Fig. 7-1: Peripheral Equipment Mounts**

<table>
<thead>
<tr>
<th>Units: mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>View A</td>
</tr>
<tr>
<td>Center of U-axis rotation</td>
</tr>
<tr>
<td>X-coordinate direction</td>
</tr>
<tr>
<td>Z-coordinate direction</td>
</tr>
<tr>
<td>Hole M8 (4 holes, pitch: 1.25, depth: 16)</td>
</tr>
</tbody>
</table>

**Table 7-1: Conditions for Installation**

<table>
<thead>
<tr>
<th>Application</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve, etc. mounting</td>
<td>Up to 10 kg</td>
</tr>
</tbody>
</table>
Internal user I/O wiring harness (0.75 mm² x 23 wires), and an air line are incorporated in the manipulator for the drive of peripheral devices mounted on the upper arm as shown in fig. 7-2 “Connectors for Internal User I/O Wiring Harness and Air Line”.

The connector pins 1 to 23 are assigned as shown in fig. 7-3 “Details of the Connector Pin Numbers” at page 7-3. Wiring must be performed by users.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The allowable current for internal user I/O wiring harness</td>
<td>6.6 A or less for each wire (The total current value for pins 1 to 23 must be 60 A or less.)</td>
</tr>
<tr>
<td>The maximum pressure for the air line</td>
<td>490 kPa (5 kgf/cm²) or less (The air line inside diameter: 6.5 mm)</td>
</tr>
</tbody>
</table>

Fig. 7-2: Connectors for Internal User I/O Wiring Harness and Air Line

- Air inlet: tapped hole PT3/8 with pipe plug
- Connector for internal user I/O wiring harness: JL05-2A24-28SC (socket connector with a cap)
- Prepare pin connector JL05-6A24-28P.

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

Air inlet: tapped hole PT3/8 with pipe plug
The same numbered pins (1 to 23) of the two connectors are connected with a single lead wire of 0.75 mm².
8 Electrical Equipment Specification

8.1 Position of Limit Switch

The limit switches are optional. Refer to fig. 8-1 "Location of Limit Switches" for location. The manipulator with limit switches is the type YR-DX1350D-A01.

Fig. 8-1: Location of Limit Switches
8.2 Internal Connections

Highly reliable connectors are equipped on each connection part of the manipulator to enable easy removal and installation for maintenance and inspection. For the number and location of connectors, see fig. 8-2 “Locations and Numbers of Connectors”.

Diagrams for internal connections of the manipulator are shown in fig. 8-3(a) “Internal Connection Diagram” at page 8-3 and fig. 8-3(b) “Internal Connection Diagram” at page 8-4.

Fig. 8-2: Locations and Numbers of Connectors

Table 8-1: List of Connector Types

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector Base</td>
<td>Connector for internal user I/O wiring harness</td>
</tr>
<tr>
<td></td>
<td>JL05-2A24-28PC (JL05-6A24-28S: Optional)</td>
</tr>
<tr>
<td>U-arm</td>
<td>Connector for internal user I/O wiring harness</td>
</tr>
<tr>
<td></td>
<td>JL05-2A24-28SC (JL05-6A24-28P: Optional)</td>
</tr>
</tbody>
</table>
Fig. 8-3(a): Internal Connection Diagram

Notes:
1. This is the internal connection diagram for MOTOMAN-DX1350D.
2. For the limit switch specification, the connection of the sections [A] and [B] are changed.
3. When performing the wiring of the overrun limit switch, pay attention to the color of wires. The letters marked on the marker tubes at [LB1 and LD1] are the same.

With Limit Switches for S-, L-, and U-Axes

S-AXIS
- L-AXIS
- U-AXIS
- R-AXIS
- T-AXIS

FOR LAMP (OPTION)

HW1480271
Fig. 8-3(b): Internal Connection Diagram
Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation. Inspection intervals are classified into several levels as shown in Table 9-1 “Inspection Items” at page 9-2.

In Table 9-1 “Inspection Items” at page 9-2, the inspection items are categorized by three types of operations: operations which can be performed by personnel authorized by the user, operations to be performed by trained personnel, and operations to be performed by service company personnel. Only specified personnel shall perform the inspection work.

- The inspection interval depends on the total servo operation time.
- The following inspection schedule is based on the case where the manipulator is used for arc welding application. If the manipulator is used for other application or if it is used under special conditions, a case-by-case examination is required.
- For axes which are used very frequently (in handling applications, etc.), it is recommended that inspections be conducted at shorter intervals. Contact your Yaskawa representative.

**WARNING**

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

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

**CAUTION**

• Maintenance and inspection must be performed by specified personnel.

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

• For disassembly or repair, contact your Yaskawa representative.

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

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

**NOTE**

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

• The following inspection schedule is based on the case where the manipulator is used for arc welding application. If the manipulator is used for other application or if it is used under special conditions, a case-by-case examination is required.

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

<table>
<thead>
<tr>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Daily</td>
<td>Visual</td>
<td>Check alignment mark accordance and damage at the home position</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Daily</td>
<td>Visual</td>
<td>Check for damage and deterioration of leads</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Daily</td>
<td>Visual</td>
<td>Clean the work area if dust or spatter is present. Check for damage and outside cracks.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Daily</td>
<td>Visual</td>
<td>Check for grease leakage.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Spanner, Wrench</td>
<td></td>
<td>Tighten loose bolts. Replace if necessary</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Screwdriver, Wrench</td>
<td></td>
<td>Tighten loose bolts. Replace if necessary</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Manual</td>
<td></td>
<td>Check for loose connectors</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Phillips screwdriver, Wrench</td>
<td></td>
<td>Drain condensation from the manipulator.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Manual</td>
<td></td>
<td>Check for belt tension and wear</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Visual, Multimeter</td>
<td></td>
<td>Check for conduction between the main connector of base and intermediate connector with manually shaking the wires. Check for wear of protective spring</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Visual, Multimeter</td>
<td></td>
<td>Check for connection between terminals</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>Replace. Replace if necessary</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Manual</td>
<td></td>
<td>Replace the battery pack when the battery alarm occurs or the manipulator drove for 36000H. See chapter 9.3.1 at page 9-8</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>Replace grease5) (12000H cycle). See chapter 9.3.1 at page 9-8</td>
<td></td>
</tr>
</tbody>
</table>

*Specified Personnel: Licensee, Service Company*
Table 9-1: Inspection Items (Sheet 2 of 2)

<table>
<thead>
<tr>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Daily</td>
<td>Grease Gun</td>
<td>Check for malfunction. (Replace if necessary.)</td>
<td>Specified Personnel</td>
</tr>
<tr>
<td></td>
<td>1000HCycle</td>
<td></td>
<td>Supply grease5) (6000H cycle). See chapter 9.3.2 at page 9-10 and chapter 9.3.3 at page 9-12.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6000HCycle</td>
<td></td>
<td>Replace grease5) (12000H cycle). See chapter 9.3.2 at page 9-10 and chapter 9.3.3 at page 9-12.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24000HCycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36000HCycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Daily</td>
<td>Grease Gun</td>
<td>Check for malfunction. (Replace if necessary.)</td>
<td>Specified Personnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supply grease5) (6000H cycle). See chapter 9.3.4 at page 9-14 and chapter 9.3.5 at page 9-16.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Replace grease5) (12000H cycle). See chapter 9.3.4 at page 9-14 and chapter 9.3.5 at page 9-16.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Daily</td>
<td>Grease Gun</td>
<td>Check for malfunction. (Replace if necessary.)</td>
<td>Specified Personnel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supply grease5) (6000H cycle). See chapter 9.3.6 at page 9-17.</td>
<td></td>
</tr>
</tbody>
</table>

1. Item numbers correspond to the numbers in fig. 9-1 “Inspection Items” at page 9-4.
2. The occurrence of a grease leakage indicates the possibility that grease has seeped into the motor. This can cause a motor breakdown. Contact your Yaskawa representative.
3. When checking for conduction with multimeter, connect the battery to “BAT” and “OBT” of connectors on the motor side for each axis, and then remove connectors on detector side for each axis from the motor. Otherwise, the home position may be lost. (Refer to chapter 9.3.7 “Notes for Maintenance” at page 9-18)
4. Wire harness in manipulator to be replaced at 24000H inspection.
5. For the grease, refer to table 9-2 “Inspection Parts and Grease Used” at page 9-5.
Fig. 9-1: Inspection Items

Note: The manipulator is in the home position.

- B-axis
- T-axis
- S-axis
- L-axis (When ceiling-mounted)
- R-axis
- U-axis (When ceiling-mounted)
## Table 9-2: Inspection Parts and Grease Used

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>13, 14</td>
<td>Molywhite RE No. 00</td>
<td>Speed reducers for S-, L-, U-, and R-axes</td>
</tr>
<tr>
<td>15, 16</td>
<td>Harmonic Grease 4B No.2</td>
<td>Speed reducers for B- and T-axes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T-axis gear</td>
</tr>
</tbody>
</table>

The numbers in the above table correspond to the numbers in table 9-1 "Inspection Items" at page 9-2.
9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

The battery packs are installed in the position shown in fig. 9-2 “Battery Location”. If the battery alarm occurs in the DX100, replace the battery in accordance with the following procedure.

Fig. 9-2: Battery Location

Fig. 9-3: Battery Connection
9 Maintenance and Inspection

9.3 Notes on Grease Replenishment/Exchange Procedures

1. Turn OFF the DX100 main power supply.
2. Remove the plate fixing screws and the plate on the connector base, then pull the battery pack out to replace it with the new one.
3. Remove the battery pack from the battery holder.
4. Connect the new battery pack to the unoccupied connector on the board.
5. Remove the old battery pack from the board.

**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 holder.
7. Reinstall the plate.

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

9.3 Notes on Grease Replenishment/Exchange Procedures

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

**NOTE**
- If grease is added without removing the plug/screw from the grease exhaust port, grease will leak 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/screw.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.
- Make sure to use a grease pump to inject grease. Set air supply pressure to the grease pump at 0.3 MPa or less, and the grease injection rate at 8 g/s or less.
- Make sure to fill hoses, which are joined to the grease inlet, with grease beforehand to prevent air from intruding into the speed reducer.
9.3.1 Grease Replenishment/Exchange for S-Axis Speed Reducer

Fig. 9-4: S-Axis Speed Reducer Diagram

1. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.
2. Install a grease zerk PT1/8 to the grease inlet.
   (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
   - Amount of grease: 70 cc
     (150 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. Move the S-axis for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth, and reinstall the plugs PT1/8 to the grease inlet and grease exhaust port. Before installing the plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

For ceiling mounted manipulators, the exhaust port and the grease inlet are inverted.

If grease is injected with the plug on, grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
9.3.1.2 Grease Exchange (Refer to fig. 9-4 “S-Axis Speed Reducer Diagram” at page 9-8.)

1. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.

2. Install a grease zerk PT1/8 to the grease inlet.
   (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
   – Amount of grease: approx. 1500 cc
   – Air supply pressure of grease pump: 0.3 MPa or less
   – Grease injection rate: 8 g/s or less

4. The grease exchange is completed when new grease appears in the grease exhaust port. (The new grease can be distinguished from the old grease by color.)

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

6. Wipe the discharged grease with a cloth, and reinstall the plugs to the grease inlet and grease exhaust port. Before installing the plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

**NOTE**
If grease is injected with the plug on, grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
9.3.2 Grease Replenishment/Exchange for L-Axis Speed Reducer

Fig. 9-5: L-Axis Speed Reducer Diagram

9.3.2.1 Grease Replenishment (Refer to fig. 9-5 “L-Axis Speed Reducer Diagram”.)

1. Set the L-arm to the position as shown in fig. 9-5 “L-Axis Speed Reducer Diagram”.
2. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.
3. Install a grease zerk A-PT1/8 to the grease inlet. (The grease zerk is delivered with the manipulator.)
4. Inject grease through the grease inlet using a grease gun
   - Grease type: Molywhite RE No. 00
   - Amount of grease: 50 cc (100 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
5. Move the L-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth, and reinstall the plugs PT1/8 to the grease inlet and grease exhaust port. Before installing the plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

NOTE
For ceiling mounted manipulators, the exhaust port and the grease inlet are inverted.

NOTE
If grease is injected with the plug on, grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
9.3.2.2 Grease Exchange (Refer to fig. 9-5 “L-Axis Speed Reducer Diagram” at page 9-10.)

1. Set the L-arm to the position as shown in fig. 9-5 “L-Axis Speed Reducer Diagram” at page 9-10.

2. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.

3. Install a grease zerk A-PT1/8 to the grease inlet. (The grease zerk is delivered with the manipulator.)

4. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No. 00
   - Amount of grease: approx. 850 cc
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

5. The grease exchange is completed when new grease appears in the grease exhaust port. (The new grease can be distinguished from the old grease by color.)

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

7. Wipe the discharged grease with a cloth, and reinstall the plugs to the grease inlet and grease exhaust port. Before installing the plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

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

47/63
9.3.3 Grease Replenishment/Exchange for U-Axis Speed Reducer

Fig. 9-6: U-Axis Speed Reducer Diagram

1. Set the U-arm to the position as shown in fig. 9-6 “U-Axis Speed Reducer Diagram”.

2. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.

3. Install a grease zerk A-PT1/8 to the grease inlet. (The grease zerk is delivered with the manipulator.)

4. Inject grease through the grease inlet using a grease gun
   - Grease type: Molywhite RE No. 00
   - Amount of grease: 100 cc
   (200 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

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

6. Wipe the discharged grease with a cloth, and reinstall the plugs PT1/8 to the grease inlet and grease exhaust port. Before installing the plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

For ceiling mounted manipulators, the exhaust port and the grease inlet are inverted.

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

NOTE
If grease is injected with the plug on, grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
9.3.3.2 Grease Exchange (Refer to fig. 9-6 “U-Axis Speed Reducer Diagram” at page 9-12.)

1. Set the U-arm to the position as shown in fig. 9-6 “U-Axis Speed Reducer Diagram” at page 9-12.

2. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.

3. Install a grease zerk A-PT1/8 to the grease inlet. (The grease zerk is delivered with the manipulator.)

4. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No. 00
   - Amount of grease: approx. 1100 cc
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

5. The grease exchange is completed when new grease appears in the grease exhaust port. (The new grease can be distinguished from the old grease by color.)

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

7. Wipe the discharged grease with a cloth, and reinstall the plugs to the grease inlet and grease exhaust port. Before installing the plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

---

NOTE

If grease is injected with the plug on, grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
9.3.4 Grease Replenishment/Exchange for R-Axis Speed Reducer

Fig. 9-7: R-Axis Speed Reducer Diagram

9.3.4.1 Grease Replenishment (Refer to fig. 9-7 "R-Axis Speed Reducer Diagram").

1. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.

2. Install a grease zerk PT1/8 to the grease inlet.
   (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
   - Amount of grease: 20 cc
     (40 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

4. Move the R-axis for a few minutes to discharge excess grease.

5. Wipe the discharged grease with a cloth, and reinstall the plugs PT1/8
to the grease inlet and grease exhaust port. Before installing the
plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then
tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

NOTE
If grease is injected with the plug on, grease will leak inside
the motor and may cause a damage. Make sure to remove
the plug before the grease injection.
9.3.4.2 Grease Exchange (Refer to fig. 9-7 “R-Axis Speed Reducer Diagram” at page 9-14.)

1. Remove the plugs PT1/8 from the grease inlet and grease exhaust port.
2. Install a grease zerk PT1/8 to the grease inlet. (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
   - Amount of grease: approx. 200 cc
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. The grease exchange is completed when new grease appears in the grease exhaust port. (The new grease can be distinguished from the old grease by color.)
5. Move the R-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth, and reinstall the plugs to the grease inlet and grease exhaust port. Before installing the plugs, apply ThreeBond 1206C on the thread parts of the plugs. Then tighten the plugs with a tightening torque of 5 N•m (0.51 kgf•m).

**NOTE**

If grease is injected with the plug on, grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
9.3.5 Grease Replenishment for B- and T-Axis Speed Reducers

**Fig. 9-8: B- and T-Axis Speed Reducers Diagram**

1. Remove the plugs M6 from the grease inlet and exhaust port.

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

2. Install a grease zerk A-MT6 x 1 to the grease inlet. (The grease zerk is delivered with the manipulator.)

3. Inject grease through the grease inlet using a grease gun. (See fig. 9-8 “B- and T-Axis Speed Reducers Diagram”.)
   - Grease type: Harmonic Grease 4B No.2
   - Amount of grease: 10 cc for Bi part (20 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
   - 5 cc for Ti part (10 cc for 1st supply)
   - The exhaust port is for air flow: Grease is not exhausted from the exhaust port.
   - Do not inject excessive grease through the grease inlet.

4. Reinstall the plug to the exhaust port. Before installing the plug, apply ThreeBond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 5 N•m (0.51 kgf•m).

5. Reinstall the plug to the grease inlet. Before installing the plug, apply ThreeBond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 5 N•m (0.51 kgf•m).

   **NOTE**
   Mount the cover for the B-axis speed reducer. (Refer to chapter 9.3.7 “Notes for Maintenance” at page 9-18.)
9.3.6 Grease Replenishment for T-Axis Gear

**Fig. 9-9: T-Axis Gear Diagram**

1. Remove the plugs M6 from the gear grease inlet and exhaust port.
2. Install a grease zerk A-MT6 x 1 to the gear grease inlet. (The grease zerk is delivered with the manipulator.)
3. Inject grease through the grease inlet using a grease gun. (See fig. 9-9 “T-Axis Gear Diagram”,)
   - **Grease type:** Harmonic Grease 4B No.2
   - **Amount of grease:**
     - 5 cc
     - (10 cc for 1st supply)
   - **Air supply pressure of grease pump:** 0.3 MPa or less
   - **Grease injection rate:** 8 g/s or less

**NOTE**
The exhaust port is for air flow: Grease is not exhausted from the exhaust port.
Do not inject excessive grease through the gear grease inlet.

4. Reinstall the plug to the exhaust port. Before installing the plug, apply ThreeBond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 5 Nm (0.51 kgf•m).
5. Reinstall the plug to the gear grease inlet. Before installing the plug, apply ThreeBond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 5 Nm (0.51 kgf•m).
9.3.7 Notes for Maintenance

9.3.7.1 Wrist Unit

The motor and encoder units are provided with the wrist unit. To prevent fumes from penetrating into the wrist unit, the matched parts are sealed with sealing bond. Thus, if the wrist cover is disassembled, make sure to reseal it with sealing bond (ThreeBond 1206C, refer to table 10-1 “Spare Parts for the YR-DX1350D-A00, -A01” at page 10-1.

Fig. 9-10: Sealing Part of Wrist Unit

9.3.7.2 Battery Pack Connection

9.3.7.2.1 Battery Pack Connection for S-, L-, and U-Axis Motors

The connectors for the battery backup (crimped contact-pins, marked as BAT and OBT) are attached to the S-, L-, or U-axis motor. Connect the battery pack according to the following procedure.

1. Remove the cap of the battery backup connector attached to the motor.
2. Connect the battery pack (HW9470932-A) to the battery backup connectors. (Under this condition, remove the encoder connector and carry out the maintenance inspections).
3. After the maintenance inspections, check if all the connectors are connected, then remove the battery pack. Reinstall the cap of the battery backup connector.

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

NOTE
When performing maintenance such as replacement of a wire harness in the manipulator, the encoder connector (with CAUTION label) may have 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. 9-11 “Encoder Connector Diagram” at page 9-19.
9.3.7.4 Battery Pack Connection for R-, B-, and T-Axis Motors

The connectors for the battery backup (crimped contact-pins, marked as BAT and OBT) are attached to the end of the encoder cable of the R-, B-, or T-axis motor.

Connect the battery pack according to the following procedure.

1. Connect the battery pack (HW9470932-A) to the battery backup connectors at the end of the encoder cable. (Under this condition, remove the encoder connector and carry out the maintenance inspections).

2. After the maintenance inspections, check if all the connectors are connected, then remove the battery pack.

**NOTE**

Do not remove the battery pack in the connector base.

---

**Fig. 9-11: Encoder Connector Diagram**

- **S-, L-, U-axis motor**
  - Motor
  - Motor power connector
  - Encoder connector
  - Battery pack (HW9470932-A)
  - Connector for the battery backup
  - a: Crimped contact-pin (pin)
  - b: Crimped contact-pin (socket)

- **R-, B-, T-axis motor**
  - Motor
  - Encoder
  - Power connector
  - Motor cable, etc.
  - Wire harness in manipulator
  - Battery pack (HW9470932-A)
  - a: Crimped contact-pin (pin)
  - b: Crimped contact-pin (socket)

---

**CAUTION**

Connect battery to encoder to save the data before removing connector.
### 9.4 Home Position Return (Calibration)

Perform calibration and set the manipulator position in one of the following cases:

- The combination of the MOTOMAN and the control unit is changed.
- The motor or absolute encoder is replaced.
- Stored memory is cleared.
- The home position is deviated by hitting the MOTOMAN against a workpiece, etc.
- The main parts of the speed reducer, etc. are replaced or disassembled and reassembled.

When performing calibration, be sure to satisfy the following conditions:

- No external force is applied to the manipulator.
- The hand and the other parts of the wrist unit are removed.

### 9.4.1 Calibration by Using Key

Calibration by using the key requires a differential pulse between the home position pulse set prior to shipment and the position pulse of the manipulator posture specified by using the key. Read this paragraph carefully before using the MOTOMAN and record the above-mentioned differential value.

When the home position has disappeared, use the key slot provided in the manipulator (see fig. 9-12 “Positions of Key Slots”) and the keys to set the home position. Prepare the tools listed in table 9-3 “Tools for Calibration” at page 9-21 required for the operation.

**Fig. 9-12: Positions of Key Slots**

U-axis B- and T-axes

L-axis

R-axis

S-axis

When the home position has disappeared, use the key slot provided in the manipulator (see fig. 9-12 “Positions of Key Slots”) and the keys to set the home position. Prepare the tools listed in table 9-3 “Tools for Calibration” at page 9-21 required for the operation.

**Fig. 9-12: Positions of Key Slots**

U-axis B- and T-axes

L-axis

R-axis

S-axis
9.4.2 Calibration Procedure

Perform the calibration in accordance with the following procedure:

1. Using the key, perform the following positioning operations on the axis of which the home position has disappeared.

2. After completion of positioning, move the manipulator for the differential distance between the position pulse at the manipulator posture specified by using the key and the home position pulse recorded prior to shipment.

3. Set the position obtained after moving the manipulator as the home position. For the setting method of the home position, refer to “8.1 Home Position Calibration” in the “DX100 INSTRUCTIONS (RE-CTO-A215)”. 

9.4.2.1 S-Axis Positioning

As shown in fig. 9-13 “S-Axis Positioning”, insert the pin (MSTH12-120) into the slot of the rotary head. Perform the positioning with the programming pendant so that the pin fits in the slot of the manipulator base.

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Quantity</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSTH12-120</td>
<td>Pin</td>
<td>1</td>
<td>For the S-, L-, and U-axes</td>
</tr>
<tr>
<td>HW0403409-1</td>
<td>Key</td>
<td>1</td>
<td>For the R-, B-, and T-axes</td>
</tr>
</tbody>
</table>

Fig. 9-13: S-Axis Positioning
9.4.2.2 L-Axis Positioning

As shown in fig. 9-14 “L-Axis Positioning”, insert the pin (MSTH12-120) into the slot of the L-arm. Perform the positioning with the programming pendant so that the pin fits in the slot of the rotary head.

Fig. 9-14: L-Axis Positioning

9.4.2.3 U-Axis Positioning

As shown in fig. 9-15 “U-Axis Positioning”, insert the pin (MSTH12-120) into the pin hole (12 mm dia. +0.018 -0 ) of the casing. Perform the positioning with the programming pendant so that the pin fits in the slot of the L-arm.

Fig. 9-15: U-Axis Positioning
9.4.2.4 R-Axis Positioning

As shown in fig. 9-16 "R-Axis Positioning", insert the key (HW0403409-1) into the slot of the casing. Perform the positioning with the programming pendant so that the pin fits in the slot of the U-arm.

Fig. 9-16: R-Axis Positioning

9.4.2.5 B-Axis Positioning

As shown in fig. 9-17 "B-Axis Positioning", insert the key (HW0403409-1) into the slot of the U-arm. Perform the positioning with the programming pendant so that the pin fits in the slot of the wrist.

Fig. 9-17: B-Axis Positioning
9.4.2.6 T-Axis Positioning

As shown in fig. 9-18 "T-Axis Positioning", insert the key (HW0403409-1) into the slot of the wrist. Perform the positioning with the programming pendant so that the pin fits in the slot of the wrist flange.

Fig. 9-18: T-Axis Positioning
10 Recommended Spare Parts

It is recommended to keep the parts and components in the following table in stock as spare parts for the MOTOMAN-DX1350D. 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.

Note: For replacing parts in Rank B or Rank C, contact your Yaskawa representative.

Table 10-1: Spare Parts for the YR-DX1350D-A00, -A01 (Sheet 1 of 2)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name Type</th>
<th>Manufacturer</th>
<th>Qty</th>
<th>Qty per Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 1</td>
<td></td>
<td>Grease</td>
<td>Yaskawa Electric Corporation</td>
<td>16 kg</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A 2</td>
<td></td>
<td>Grease</td>
<td>Harmonic Drive Systems Inc.</td>
<td>2.5 kg</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A 3</td>
<td></td>
<td>Liquid Gasket</td>
<td>ThreeBond Co., Ltd.</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>A 4</td>
<td></td>
<td>Battery Pack</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td>For replacing the wire harness in the manipulator</td>
</tr>
<tr>
<td>B 6</td>
<td></td>
<td>R-Axis Timing Belt</td>
<td>Mitsuboshi Belting Ltd.</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 7</td>
<td></td>
<td>B-Axis Timing Belt</td>
<td>Mitsuboshi Belting Ltd.</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 8</td>
<td></td>
<td>T-Axis Timing Belt</td>
<td>Mitsuboshi Belting Ltd.</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 9</td>
<td></td>
<td>S-Axis Speed Reducer</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 10</td>
<td></td>
<td>S-Axis Input Gear</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 11</td>
<td></td>
<td>L-Axis Speed Reducer</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 12</td>
<td></td>
<td>L-Axis Input Gear</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 13</td>
<td></td>
<td>U-Axis Speed Reducer</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 14</td>
<td></td>
<td>U-Axis Input Gear</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 15</td>
<td></td>
<td>R-Axis Speed Reducer</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B 16</td>
<td></td>
<td>B-Axis Speed Reducer</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Rank</td>
<td>Parts No.</td>
<td>Name Type</td>
<td>Manufacturer</td>
<td>Qty</td>
<td>Qty per Unit</td>
<td>Remarks</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
<td>-----</td>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>B</td>
<td>17</td>
<td>T-Axis Speed Reducer HW0380903-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>Wire Harness in Manipulator HW0175444-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>19</td>
<td>Wire Harness in Manipulator for B- and T-Axes HW0371440-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>20</td>
<td>AC Servo Motor for S- and L-Axes HW0382156-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>21</td>
<td>AC Servo Motor for U-Axis HW0382155-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>22</td>
<td>AC Servo Motor for R-, B-, and T- Axes HW0383366-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>23</td>
<td>Limit Switch Unit HW0370602-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>24</td>
<td>Wrist Unit HW0170775-B</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
MOTOMAN-DX1350D
INSTRUCTIONS

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

© Printed in Japan April 2011 11-04

YASKAWA ELECTRIC CORPORATION