MOTOMAN-MPO10 INSTRUCTIONS FOR EXPLOSION-PROOF SPECIFICATIONS

TYPE:
YR-MPO0010-B00

This instruction explains necessary conditions for explosion-proof specifications.

MOTOMAN INSTRUCTIONS FOR EXPLOSION-PROOF SPECIFICATIONS

MOTOMAN-MPO10 INSTRUCTIONS EXPLOSION-PROOF SPECIFICATIONS
DX200 INSTRUCTIONS FOR EXPLOSION-PROOF SPECIFICATIONS

Part Number: 180372-1CD
Revision: 0
MANDATORY

• This instruction manual is intended to explain mainly the mechanical part of the MPO10 Explosion-Proof 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”.

![DANGER]
Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.

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

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

![MANDATORY]
Always be sure to follow explicitly the items listed under this heading.

![PROHIBITED]
Must never be performed.

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

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

**NOTE**
To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “CAUTION” and “WARNING”.

---

**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.
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 the 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>DX200 controller</td>
<td>Controller</td>
</tr>
<tr>
<td>DX200 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the DX200</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>

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.

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

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

- Safety barriers
- Door interlocks
- Emergency stop 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 MPO10 Explosion-Proof 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: MPO10 Explosion-Proof
• 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
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1 Indications on Electric Equipment

1.1 FM APPROVED Label and Warning Label

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

Fig. 1-1: FM APPROVED Label

<table>
<thead>
<tr>
<th>Type</th>
<th>aa</th>
<th>bb</th>
<th>cc</th>
<th>dd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axes 3</td>
<td>HW1281441</td>
<td>HW1384352</td>
<td>YR-MPO0010-B00</td>
<td>2</td>
</tr>
</tbody>
</table>
1 Indications on Electric Equipment

1.1 FM APPROVED Label and Warning Label

Fig. 1-2: Warning Label

- Battery Warning Label
  - Battery type:
    - HW1470715-AA (for S-, L-axes)
    - HW1470715-AB (for U-axis)
  - Battery manufacturer:
    - Yaskawa Electric Corporation

- Pressure Switch Unit Warning Label

- Electrostatic Charging Warning Label

WARNING
AVERTISSEMENT

Explosion-proof safety Device
Dispositif de sécurité antideflagrant ne change pas aucune Paramètre.

WARNING
AVERTISSEMENT

Moving parts may cause injury
Les pièces mobiles peuvent causer des blessures.

WARNING
AVERTISSEMENT

Do not enter robot work area.
Ne pas entrer dans la zone de travail du robot.
1.2 Standards

The manipulator meets the following requirements and related standards:

**Table 1-1: United States Standards**

<table>
<thead>
<tr>
<th>Title</th>
<th>Number</th>
<th>Issue Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements</td>
<td>FM Class 3600</td>
<td>2011</td>
</tr>
<tr>
<td>Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II &amp; III, Division I, Hazardous (Classified) Locations</td>
<td>FM Class 3610</td>
<td>2010</td>
</tr>
<tr>
<td>Purged and Pressurized Electrical Equipment for Hazardous (Classified) Locations</td>
<td>FM Class 3620</td>
<td>2014</td>
</tr>
<tr>
<td>Electrical Equipment for Measurement, Control and Laboratory Use</td>
<td>FM Class 3810</td>
<td>2005</td>
</tr>
<tr>
<td>Explosive atmospheres - Part 0: Equipment - General Requirements</td>
<td>ANSI/ISA 60079-0</td>
<td>2013</td>
</tr>
<tr>
<td>Explosive atmospheres - Part 2: Equipment protection by pressurized enclosures “p”</td>
<td>ANSI/ISA 60079-2</td>
<td>2010</td>
</tr>
<tr>
<td>Explosive atmospheres - Part 11: Equipment protection by intrinsic safety “i”</td>
<td>ANSI/ISA 60079-11</td>
<td>2014</td>
</tr>
</tbody>
</table>

**Table 1-2: Canadian Standards**

<table>
<thead>
<tr>
<th>Title</th>
<th>Number</th>
<th>Issue Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard for Purged and Pressurized Enclosures for Electrical Equipment</td>
<td>NFPA-496</td>
<td>2013</td>
</tr>
<tr>
<td>Bonding of Electrical Equipment</td>
<td>CAN/CSA C22.2 No. 0.4</td>
<td>2013</td>
</tr>
<tr>
<td>Intrinsically Safe and Non-Incendive Equipment for use in Hazardous Locations</td>
<td>CAN/CSA C22.2 No. 157</td>
<td>2012</td>
</tr>
<tr>
<td>Explosive atmospheres - Part 0: Equipment - General requirements</td>
<td>CAN/CSA C22.2 No. 60079-0</td>
<td>2015</td>
</tr>
<tr>
<td>Explosive atmospheres - Part 2: Equipment protection by pressurized enclosure “p”</td>
<td>CAN/CSA C22.2 No. 60079-2</td>
<td>2012</td>
</tr>
<tr>
<td>Explosive atmospheres - Part 11: Equipment protection by intrinsic safety “i”</td>
<td>CAN/CSA C22.2 No. 60079-11</td>
<td>2014</td>
</tr>
<tr>
<td>Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements</td>
<td>CAN/CSA C22.2 No. 61010-1</td>
<td>2004</td>
</tr>
</tbody>
</table>
2 System Configuration

The Fig. 2-1 "System Configuration" shows the system configuration of the MOTOMAN-MPO10.

2.1 Manipulator

The explosion-proof manipulator should be installed in hazardous locations such as in the painting booth. This manipulator opens/closes a door of a workpiece using a special fixture mounted at the U-axis tip flange.

Figure Fig. 2-2 “Dimensions and P-point Maximum Envelope for each Type” shows the dimensions and the range of motion of the MPO10.

On the manipulator base, the manipulator is driven by the servo motor in horizontally articulated operation with three degrees of freedom.

And positions of the jig are made by the three main axes operations; S-axis (lower-rotating-axis), L-axis (Upper-rotating-axis), and U-axis (vertically-moving tip-axis).

Ranges of motion shown in Fig. 2-2 show the operable range of P-point, which is the center of U-axis rotation, for each type (S-, L-, and R-type) by the combination of the motions made by above mentioned three main axes.

WARNING

When taking safety precautions, consider the range of motion of the manipulator shown in Fig. 2-2.

The range of motion for each type; (S) Type, (L)-Type and (R)-Type, can be set by changing the stopper locations (two stoppers each) as shown in “Section A-A” in Fig. 2-2 “Dimensions and P-point Maximum Envelope for each Type”.

• Stoppers are attached at (S)Type location when the manipulator is shipped.

• Necessary bolts and washers for setting the stoppers are as follows. (delivered with the manipulator)
  – Hexagon socket head cap screw M6 (2 screws, length: 30 mm)
  – Spring washer 2H-6 (2 washers)
  – Tightening torque: 13.7 N·m (1.4 kgf·m)

CAUTION

In case the range of motion is modified, modification of the DX200 parameter is required. Please refer to “MOTOMAN-MPO10 INSTRUCTIONS FOR MODIFYING THE RANGE OF MOTION.”
Fig. 2-1: System Configuration

1. Manipulator
2. Standard unit
3. Paint unit
4. Intrinsic safety cable (1 or 2 cables)
5. Intrinsically safe terminal box (optional)
6. AIR TUBE (16 dia.)
7. Air supply (0.35MPa -0.65MPa)
8. Pressure switch unit
9. Intrinsically safe cable (optional)
10. Air tube (16 dia. x 2 tubes)
11. D-class grounding with ground resistance of 100Ω or less
12. Certified terminal box (optional)
13. Power cable (whole unit)
15. Intrinsically safe terminal box (optional)

Non-Hazardous Location

Hazardous Location

- A-class grounding with ground resistance of 10Ω or less (Note)
- Part of relay-connector (optional)
- Programming Pendant (not explosion proof)
- Power supply 3-phase AC200/220V 50/60Hz
- Manipulator
- Intrinsically safe terminal box (optional)
- Pressure switch unit
- Certified terminal box (optional)
- Power cable (whole unit)
- Programming Pendant (explosion-proof: optional)

(Note) When explosion-proof programming pendant is used.
2.1.1 Basic Specifications

Table 2-1: Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
<th>YR-MPO0010-B00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Horizontally articulated</td>
<td></td>
</tr>
<tr>
<td>Degree of Freedom</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Payload</td>
<td>10 kg</td>
<td></td>
</tr>
<tr>
<td>Horizontal Load(^2)</td>
<td>245N (25 kgf)</td>
<td></td>
</tr>
<tr>
<td>Vertical Load(^2)</td>
<td>245N (25 kgf)</td>
<td></td>
</tr>
<tr>
<td>Repeatability(^3)</td>
<td>± 0.15 mm</td>
<td></td>
</tr>
<tr>
<td>Range of Motion</td>
<td>S-axis (Lower arm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard (S) Type</td>
<td>-150° to +150°</td>
</tr>
<tr>
<td></td>
<td>(L) Type</td>
<td>-200° to +60°</td>
</tr>
<tr>
<td></td>
<td>(R) Type</td>
<td>-60° to +200°</td>
</tr>
<tr>
<td></td>
<td>L-axis (Upper arm)</td>
<td>-165° to +165°</td>
</tr>
<tr>
<td></td>
<td>U-axis (Vertical arm)</td>
<td>0 to 350 mm</td>
</tr>
<tr>
<td>Allowable Moment</td>
<td>Flange part(^4) (Vertical direction)</td>
<td>27 N•m (2.75 kgf•m)</td>
</tr>
<tr>
<td>Allowable Inertia (GD(^2)/4)</td>
<td>Flange part(^5) (Horizontal direction)</td>
<td>1.00 kg•m²</td>
</tr>
<tr>
<td>Approx. Mass</td>
<td>350 kg</td>
<td></td>
</tr>
<tr>
<td>Protective Structure</td>
<td>Basic axis: IP4X</td>
<td></td>
</tr>
<tr>
<td>Ambient Conditions</td>
<td>Temperature</td>
<td>0 to +40 °C</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>20 to 80%RH (non-condensing)</td>
</tr>
<tr>
<td></td>
<td>Vibration Acceleration</td>
<td>Less than 4.91 m/s² (0.5 G)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Free from excessive electrical noise (plasma).</td>
</tr>
<tr>
<td>Power Capacity</td>
<td>1.25 kVA(^5)</td>
<td></td>
</tr>
</tbody>
</table>

1 SI units are used in this table. However, gravitational unit is used in ( ).
2 Refer to Fig. 2-3(a) “Horizontal Force” and Fig. 2-3(b) “Vertical Force” for each horizontal and vertical force.
3 Conformed to ISO9283.
4 Refer to Fig. 2-4 “Moment of Arm Rating” for the flange part allowable moment and allowable inertia.
5 Differs depending on the motion pattern.
Fig. 2-2: Dimensions and P-point Maximum Envelope for each Type

- **(R) Type**
  - Stopper position:
    - (R) Type:
      - Stopper position for each range of motion (S-, L-, and R-type)
      - Bolt/washer used:
        - Hexagon socket head cap screw M6
        - Spring washer 2H-6
        - Tightening torque 13.7 N·m (1.4 kgf·m)
  - Units: mm
    - R1400
    - R600

- **(L) Type**
  - Stopper position:
  - R600

- **(S) Type: Standard**
  - Stopper position:
  - R600

P-point maximum envelope
- +150°
- -150°
- +200°
- -200°
- +60°
- -60°
- +270°
- -270°
2 System Configuration
2.1 Manipulator

Fig. 2-3(a): Horizontal Force

![Horizontal Force Diagram]

F: Horizontal load applied to tool

F1

\[
\begin{array}{c}
0 \\
20 \\
25 \\
400, 500 [\text{mm}]
\end{array}
\]

Note: Only downward force is applicable

Fig. 2-3(b): Vertical Force

![Vertical Force Diagram]

F: Vertical load applied to tool

F2

\[
\begin{array}{c}
0 \\
25 \\
500 [\text{mm}]
\end{array}
\]

Note: Only downward force is applicable
2.2 DX200

The DX200 has a built-in microcomputer that controls all motion of the manipulator by saving motion signals when teaching and sending these signals to the manipulator. The power unit that supplies power to the manipulator is also built into the DX200.

![moment of arm rating diagram]

2.3 Pressure Switch Unit

The pressure switch unit supplies protective air or gas to the manipulator to prevent explosive gas from entering the manipulator. Usually, the unit is installed aside from the DX200.

The circuit diagram and dimensions are shown in Fig. 2-5 “Electrical/Air Circuit of the Pressure Switch Unit” and Fig. 2-6 “Pressure Switch Unit External View”.

Set the air pressure so that the pressure shown on the pressure gauge of each pressure reducing valve to be within the pressure ranges shown in Fig. 2-5.

As shown in the Fig. 2-7 “Connection Overview”, the distance of up to 20 m is allowed between the manipulator and the pressure switch unit. Adjust the length of the air tube (16 dia.) to be as same length as the distance between them.

---

**DANGER**

- The power supply of the DX200 is 200/220 VAC. Be sure to turn OFF the primary power supply of the DX200 before starting maintenance.

Failure to observe this warning may result in electric shock.
It is very dangerous to disassemble/remodel the pressure switch unit or to operate a manipulator in the explosive environment after removing the pressure switch unit.

It should be kept free of obstacles around the pressure switch unit when purging.
2 System Configuration
2.3 Pressure Switch Unit

Fig. 2-5: Electrical/Air Circuit of the Pressure Switch Unit

Fig. 2-6: Pressure Switch Unit External View
2 System Configuration

2.3 Pressure Switch Unit

*Fig. 2-7: Connection Overview*

This unit can be installed at any points within 20 m between the manipulator and the unit.
3 Installation

3.1 Requirements

Prepare the power supply, the air supply, and the grounding according to the following specifications.

Table 3-1: Specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Specifications</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply</td>
<td>3-phase 200 VAC (-15 to +10%) 50/60 Hz 220 VAC (-15 to +10%) 60 Hz 1.25 kVA (at peak)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Air supply</td>
<td>Required pressure: 0.35 MPa to 0.65 MPa  Capacity:</td>
<td>Use dry air for the pressurized explosion-proof construction.</td>
</tr>
<tr>
<td></td>
<td>Pressurized</td>
<td>For pressurized type of explosion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>explosion-proof</td>
<td>protected construction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>construction</td>
<td>50 NI/min during operation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 NI/min when purging</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dryness: Freezing at -18 °C</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Grounding</td>
<td>Grounding resistance: 100 ohm or less</td>
<td>For the DX200</td>
</tr>
</tbody>
</table>

CAUTION

Use dry air for the pressurized explosion-proof enclosure. Moisture in the air supply may damage the electronic parts.
3.2 Installation Site

This section describes the conditions of the installation site for the manipulator system. Only devices that are approved as explosion-proof can be installed in hazardous locations. Refer to the local regulations and safety codes for the definition of a hazardous location. Install the DX200 and control panels in a location free from water drops, dust, and dirt.

<table>
<thead>
<tr>
<th>System Components</th>
<th>Hazardous Location (Inside Painting Booth)</th>
<th>Non-hazardous location (Outside Painting Booth)</th>
<th>Ambient Temperature</th>
<th>Maximum Ambient Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manipulator (explosion-proof)</td>
<td>●</td>
<td>×</td>
<td>0 to +40 °C</td>
<td>80%RH</td>
</tr>
<tr>
<td>DX200 (not explosion-proof)</td>
<td>×</td>
<td>●</td>
<td>0 to +45 °C</td>
<td>90%RH</td>
</tr>
<tr>
<td>Pressure Switch unit (explosion-proof)</td>
<td>●</td>
<td>×</td>
<td>0 to +40 °C</td>
<td>85%RH</td>
</tr>
<tr>
<td>Programming pendant (not explosion-proof)</td>
<td>×</td>
<td>●</td>
<td>0 to +40 °C</td>
<td>85%RH</td>
</tr>
<tr>
<td>Programming pendant (explosion-proof) (Option)</td>
<td>●</td>
<td>●</td>
<td>0 to +40 °C</td>
<td>85%RH</td>
</tr>
<tr>
<td>Conveyor speed detector (explosion-proof)</td>
<td>●</td>
<td>×</td>
<td>0 to +50 °C</td>
<td>90%RH</td>
</tr>
<tr>
<td>Conveyor switch (explosion-proof)</td>
<td>●</td>
<td>×</td>
<td>0 to +50 °C</td>
<td>90%RH</td>
</tr>
</tbody>
</table>

●: Acceptable
×: Not acceptable

WARNING

Devices that are not explosion-proof must not be installed in hazardous locations. Failure to observe this warning may result in a fire.
3.3 Transport and Installation

Carry out the operation safely observing the following precautions.

I) Signs indicating prohibitions such as, “The lighting of fires is prohibited”

II) Clean working place that is clearly defined and free of obstacles

III) Appointment of personnel in charge

IV) Company working regulations for safe operation

3.3.1 Preparation

Before installing the MOTOMAN, do the following:

I) Confirm the installation layout and the dimensions of each device to ensure the transportation route and the installation space.

II) Check if the transportation route can support the weight of each device. If necessary, reinforce the route.

III) To lift the manipulator, use the appropriate machinery such as a forklift.
3.3 Transport and Installation

3.3.2 Receiving

When the package arrives, check the contents. Check the items and quantities in accordance with the order sheet or any damages incurred during shipment, etc.

**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.

*Fig. 3-1: Location of Order Number Labels*

(a) DX200 (Front View)  (b) Manipulator (Tpp View)
3.3.3 Installation

**WARNING**

- Install the safeguarding. Failure to observe this warning may result in injury or damage.
- Install the manipulator in a location where the manipulator’s tool or the workpiece held by the manipulator will not reach the wall, safeguarding, or DX200 when the arm is fully extended. Failure to observe this warning may result in injury or damage.
- Do not start the manipulator or even turn ON the power before it is firmly anchored. The manipulator may overturn and cause injury or damage.

**CAUTION**

- Do not install or operate a 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 are removed. Failure to observe this caution may result in damage to the driving parts.
MPO10 Explosion-Proof

3 Installation

3.3 Transport and Installation

Fig. 3-2: Mounting the Manipulator on the Baseplate

- Spring washer (delivered with the manipulator)
- Hexagon head cap screw M16 (4 screws, length: 60 mm) (delivered with the manipulator) (Tensile strength: 1200 N/mm² or more) Tightening torque: 289 N-m (29.5 Kgf-m)

- Washer (delivered with the manipulator)

- Manipulator base

- Baseplate

- Anchor bolt M16 or larger

- Oval hole (15 mm)

- Y Part Enlarged View

- Mouting surface

- Same level as mouting surface

- View X

- Unit:mm
3.3.1 Installation of Safeguarding

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

**Responsibility for Safeguarding (ISO 10218)**

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

3.3.2 Mounting Procedures for Manipulator Base

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

Construct a solid foundation with the appropriate thickness to withstand maximum reaction force of the manipulator. (Refer to Table 3-3 “Manipulator Reaction Force and Torque”.)

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

For installation, refer to section 3.3.3.3 “Installation”.

3.3.3 Mounting the Manipulator on the Baseplate

The baseplate should be rugged and durable to withstand maximum reaction force of the manipulator and to ensure that the manipulator and fixture are in the correct relative position.

The thickness of the baseplate is 32mm or more and an M16 size or larger anchor bolt is recommended.

There are four tapped holes for fixing the base plate on the floor. Fix the manipulator base to the baseplate with the hexagon socket head cap screws M16 (recommended length: 60 mm, delivered with the manipulator) using mounting holes on the manipulator base.

Tighten the hexagon socket head cap screws and anchor bolts securely so that they will not work loose during operation.

Refer to Fig. 3-2 “Mounting the Manipulator on the Baseplate”

**Table 3-3: Manipulator Reaction Force and Torque**

<table>
<thead>
<tr>
<th></th>
<th>Horizontal rotation</th>
<th>Vertical rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reaction force F_H</td>
<td>Torque M_H</td>
</tr>
<tr>
<td>Emergency stop</td>
<td>15680 N (1600 kgf)</td>
<td>7840 N•m (800 kgf•m)</td>
</tr>
<tr>
<td>Acceleration/deceleration</td>
<td>5880 N (600 kgf)</td>
<td>2940 N•m (300 kgf•m)</td>
</tr>
</tbody>
</table>
3.3.3.4 Location

When installing the manipulator, satisfy the following environmental conditions.

- Ambient temperature: 0° to 40°C
- Humidity: 20 to 80%RH at constant temperature
- Free from exposure to water, oil, or dust
- Free from excessive vibration (Vibration acceleration: 4.9 m/s² [0.5 G] or less)
- Free from large electrical noise (plasma)
- Flatness for installation is 0.5 mm or less

3.3.3.5 DX200 and Programming Pendant

- The DX200 and the programming pendant are not explosion-proof (the explosion-proof programming pendant is available as an option). Never install the DX200 and the programming pendant that are not explosion-proof in a hazardous location.
- Secure a space around the DX200 for maintenance. When the sufficient space is not available, provide equipment for maintenance such as a drawing-out system.
- Do not install the DX200 and programming pendant close to any noise source such as the power supply for other devices.
- Install the DX200 in a location where the optimum atmosphere, temperature, and humidity are assured and provide protection against water drops or thinner. If necessary, install a control room to supply clean and temperature-controlled air.

3.3.3.6 Safety Devices

The standard safety devices are listed below. Refer to the instructions for connecting safety devices required for your system application.

Install each device considering each function.

- Emergency stop switches
- Safety plugs
- Limit switches
- Flashing lights
- Indicator lamps
- Photoelectric intrusion detecting switches

**NOTE**

During winter or when the ambient temperature is low (15°C or lower), break-in the manipulator at 40% of the maximum speed for at least five minute until it is warmed up before the actual operation.
4 Connection

4.1 Wiring

WARNING

• Ground resistance must be 100 Ω or less.
Failure to observe this warning may result in fire or electric shock.
• Before wiring, make sure to turn 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.
• Do not cover the cable with heat insulating material, and avoid multiple cabling.
Failure to observe this caution may result in burn caused by cable heat emission failure.
4.1.1 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(a) “Grounding Method (Manipulator)” and Fig. 4-1(b) “Grounding Method (Pressure Switch Unit)” to connect the ground line directly to the manipulator.

MANDATORY

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

Fig. 4-1(a): Grounding Method (Manipulator)

Fig. 4-1(b): Grounding Method (Pressure Switch Unit)
4.2 Cable Connection

Refer to the DX200 INSTRUCTION Manual (165292-1CD) for the connection of the power cable and the intrinsically safe cable to the DX200. (The air tube for the pressure switch, the intrinsically safe cable, and the crimped terminals should be prepared by the customer.)

Furthermore, inside the painting booth, the power supply cables are required to be protected by the wire blade prepared by YASKAWA (length should be specified), accommodated through the metal pipe, or put in the ditch on the floor and covered with the metal plate.

Refer to Fig. 4-2 “Power Cable Connection (to the DX200)"

1. Remove the cover from the upper part of the base part.
2. Connect the power cable connector to the connector base.
   (Check the reference name plate.)
3. Connect the grounding cable of the power cable to the grounding cable connecting tap.
4. Connect the air tube (12 dia.) to the joint which is attached at IN side of the power cable.
5. Attach the gasket side of the power cable to the base after checking that no air tubes are bent, and then tighten it with the hexagon socket head cap screws (delivered with the manipulator)
6. Check that no bent or tension are found on the connected power cable, air tubes and power cables inside the manipulator, and then re-install the cover.

---

**DANGER**

For the cable gland, it is required to use the specified one for the explosion-proof certification manipulator.
It is highly recommend to use the cable gland prepared by YASKAWA which is the exclusive one.
Also, please do not detach, reassemble or remodel the cable gland since it is already an assembled parts.
Contact your YASKAWA representatives when any abnormalities are found.
**Fig. 4-2: Power Cable Connection (to the DX200)**

- **(S) Type**
  - Standard Type

- **(L) Type**
  - Left Type

- **(R) Type**
  - Right Type

- **Connector base**
- **Cover at the upper base part**
- **Gasket**
- **Name plate**

**Section X-X**

- **Connectors base**
- **Gasket**
- **Grounding cable connecting tap (3 taps)**
  - Use cross-recessed head machine screws M5 (10 screws)
  - Delivered with the manipulator

**Use cross-recessed head machine screws**
- **M5 (10 screws)**
- **Hexagon socket head cap screw M6**
  - Length: 18 mm
  - (18 screws, 18 washers)
  - Tightening torque 10 N m (1.0 kgf m)
- **Grounding cable connecting tap (3 taps)**

**Delivered with the manipulator**
- **Flange M6**
  - (6 washers)
  - Tightening torque 24.5 N•m (2.5 kgf•m)
Fig. 4-3(a): Power Cable Connection to the DX200 (In the Case of Rigid Cable: Constructing Example)

Non Hazardous Location

Hazardous Location

DX200 Side

Relay Connector Box (option)

Rigid Steel Conduits

Sealing fitting

Rigid Steel Conduits

Sealing fitting

Rigid Steel Conduits

Sealing fitting

Gasket

Cover

Manipulator Side

Rigid Steel Conduits Connect to the grounding tap

Note1:
Construction method (and parts) in a penetration part from hazardous location to non-hazardous location are end user scope.
4.2 Cable Connection

Fig. 4-3(b): Power Cable Connection to the DX200 (In the Case of Robot Moving Cable: Constructing Example)

Non Hazardous Location  Hazardous Location

Relay Connector Box (option)  Cable gland

Cover  Gasket

Cable gland

1BC-4  Connect to the grounding tap

1BC-1,2,3  Connect to the grounding tap

2BC-1,2,3,4

Note 1: Construction method (and parts) in a penetration part from hazardous location to non-hazardous location are end user scope.
Fig. 4-3(c): Power Cable Connection to the DX200 (In the Case of Robot Cart Cable: Constructing Example)
Fig. 4-4(a): Power Cable Connection (When Relaying the Cables)

- **Non Hazardous Location**
  - Relay Connector Box (option)
  - Flexible Tube
  - Cable Ground
  - Sealing fitting

- **Hazardous Location**
  - Certified Terminal Box (option)
  - Cable Ground
  - Sealing fitting
  - Rigid Steel Conduits

- **Manipulator Side**
  - Connect to the grounding tap
  - Flexible Tube
  - Cable Ground

**Wiring detail**
(Layout that can ensure a sufficient distance between cables.)
**Fig. 4-4(b): Power Cable Connection (When Relaying the Cables)**

- **Non-Hazardous Location**
  - Relay Connector Box (option)
  - Rigid Steel Conduits
  - Sealing fitting
  - Cable tie
  - Sealing fitting
- **Hazardous Location**
  - Certified Terminal Box (option)
  - Flexible Tube
  - Cable Ground
  - Connector
- **Manipulator Side**
  - Connect to the grounding tap

**Wiring detail**

- Between intrinsically safe cables and non-intrinsically safe cables:
  - Less than 50mm
  - 0.9mm or more

**Note:**
1. It shows an example of the cable wiring for XP terminal box.
2. Fix the cable by cable tie.
3. Do not cross the cable.
4. Case of "less than 50mm", use the partition for separation of cables.
5. Wiring conforms to [ANSI/ISA and CSA C22.2 60079-11].
4 Connection

4.2 Cable Connection

Fig. 4-5: Air Hose Connection

- Joint for power cable at IN side
- Insert
- Air tube inside the manipulator (12 dia.)
- Base
- (S) Type [Standard Type]
- (L) Type [Left Type]
- (R) Type [Right Type]
Fig. 4-6: Pressure Switch Unit Connection to Intrinsically Safe Terminal Block and Barrier

1) Intrinsically safe cable
   ① Cable type
      For the cable, be sure to use the intrinsically safe cable.
      -The cable to be connected with terminal blocks P1 to N3, and 1 to 2 are different.
      -The group of terminal blocks P1 to N3, and 1 to 2 are bound with shield separately.

   ② Cable connection
<table>
<thead>
<tr>
<th>Intrinsically safe terminal block</th>
<th>Controller (DX200)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>P1</td>
</tr>
<tr>
<td>N1</td>
<td>N1</td>
</tr>
<tr>
<td>P2</td>
<td>P2</td>
</tr>
<tr>
<td>N2</td>
<td>N2</td>
</tr>
<tr>
<td>P3</td>
<td>P3</td>
</tr>
<tr>
<td>N3</td>
<td>N3</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

   Note: P2 and N2 relay barrier connectors are short circuited inside the DX200 by a cable. Do not remove the cable. However, they are not short circuited inside the manipulator. Also, each P2 and N2 connector at manipulator and DX200 side are not connected each other.

2) Manipulator side: Crimped terminals
   For connecting the intrinsically safe cable to the intrinsically safe terminal block
   - For terminal block P1 to 2

3) DX200 side: Crimped terminals
   For connecting the intrinsically safe cable to the relay barrier in the DX200
   - For terminal block P1 to N3

  3.5 min  4 max

  3.7 dia. min

Wiring diagrams are shown in Fig. 4-7(a) “Circuit for Manipulator’s Electrical Device” and Fig. 4-7(b) “Electrical Circuit for Manipulator’s Electrical Device”.

4.3 Wiring Diagram
Note 1. Part of relay-connector is an option.
Note 2. Part of FM Approved box is an option.
Note 3. When the cable for paining is mounted, this cable connected to independent barrier (tested and passed).
Fig. 4-7(b): Electrical Circuit for Manipulator’s Electrical Device

Note 1. Part of relay-connector is an option.
Note 2. Part of FM Approved box is an option.
5 Operation (Initial start-up Included)

5.1 Enclosure Protection Sequence.

Fig. 5-1(a): Enclosure Protection Flow Chart

Flow Chart on Enclosure Protection Sequence
Our enclosure protection sequence is composed of the following four modes.
1. Preparation Mode
2. Purging Mode
3. Operation Mode
4. Abnormal pressure Mode

Start Preparation Mode

Supply the protective gas after the following inspections.
-Loosen bolts to enclosures
-Any damages to the enclosures.

Inspected

Start supplying the protective gas into the pressure switch unit.
The protective gas is regulated in proper values by the reducer valve for operation, then supplied to the manipulator.

Inspected

Check the pressure switch unit.
-Troubles on devices such as master valves.
-Air leakage at relief valve or connected parts

Repair

Re-connect the tubes.
Tighten the bolts for covers.
Change the enclosure.

Change the pressure switch unit

Confirmed

Turn ON the breaker of the D200 by manual.
Purging mode is simultaneously ready to start by turning the power ON.

Check the setting values of the pressure switch unit:
1. Purging pressure reducing valve: 0.26 to 0.28 Mpa
2. Operating pressure reducing valve: 0.01 to 0.02 Mpa
3. Primary pressure into the pressure switch unit: 0.35 to 0.65 Mpa

Reset

Change the setting values within the values shown in the left.
5. Operation (Initial start-up Included)

5.1 Enclosure Protection Sequence.

---

**Fig. 5-1(b): Enclosure Protection Flow Chart**

- **Start Purging Mode**
  1. Switch the operation pressure to the purging pressure
  2. Release the master valve

- **Abnormal Pressure Mode**
  - Execute abnormal pressure mode (Abnormal purging)
  - The power sources for the servo unit and encoder are automatically shut down and the master valve starts releasing the protective gas to release the pressure.
  - "Abnormal Purging" appears on the programming pendant and the alarm lamp on the DX200 is lit.

- **Turn the breaker OFF by manual. Stop supplying the protective gas into the pressure switch unit**

---

**Purging Mode**

- **Does the flow rate reach 340 l/min with 20 kPa or more of purging air pressure?**
  - **Y:** Does two minutes pass since the purging mode started?
  - **N:** Inspected

  - **Inspected**
    - Start counting the purging time (two minutes)

- **Is the flow rate keeping 340 l/min with 20 kPa or more of purging air pressure?**
  - **N:** Two minutes passed since the beginning of purging time start counting
  - **Y:** Switch purging mode to operation mode after executing the following steps.
    1. Switch the pressure from purging to operation.
    2. Close the master valve.
    3. “Purging Completion” message appears on the programming pendant.
    4. Supplying of the power becomes available to motors and brakes.
   
 After these steps, the mode is switched to operation mode.

---

** хозяйственный:**

*Fig. 5-1(b): Enclosure Protection Flow Chart*
5 Operation (Initial start-up Included)

5.1 Enclosure Protection Sequence.

*Abnormal Pressure Mode*

1. Abnormal pressure (LOW)
   - In case the pressure in the protective gas line drops and the contact point of the detector (PS1) is opened, the hardware circuit (power control circuit, purging control relay, and encoder separation board) are turned OFF and the servo unit- and encoder-power sources are automatically shut down.
   - “Abnormal Pressure (LOW)” appears on the programming pendant and the alarm lamp on the DX200 is lit.

2. Abnormal purging
   - During the purging, if the pressure in the protective gas line drops and the contact point of the detector (PS3) is opened, the hardware circuit (power control circuit, purging control relay, and encoder separation board) is turned OFF. And then, the servo unit- and encoder-power sources are automatically shut down. Also, the master valve automatically releases the protective gas, then the pressure is released.
   - “Abnormal Purging” appears on the programming pendant and the alarm lamp on the DX200 is lit.
# 6 Frequent Inspections

**Table 6-1: Frequent Inspections**  
*(Sheet 1 of 2)*

<table>
<thead>
<tr>
<th>Item</th>
<th>No.</th>
<th>Items to be Inspected</th>
<th>Inspection</th>
<th>Daily</th>
<th>Weekly</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| Manipulator | 1 | Exterior | No deformations or cracks to the pressurized explosion-proof enclosure. Covers are appropriately mounted. No other exterior abnormality. | • | | ![DANGER](https://via.placeholder.com/15)  
If any deformations or cracks are found, immediately stop the operation and contact your YASKAWA representatives. |
| | 2 | Motion | Smooth tuning, horizontal, and vertical motions of each arm. The manipulator’s home position does not change. | • | | ![WARNING](https://via.placeholder.com/15)  
Do not enter the manipulator working envelope. |
| | 3 | Noise and vibration during operation | No abnormal noise and vibration during manipulator operation. | • | | ![WARNING](https://via.placeholder.com/15)  
Do not enter the manipulator working envelope. |
| | 4 | Tubes | Off or no severe wear and tear on paint and air supply tubes. | • | • | ![CAUTION](https://via.placeholder.com/15)  
Use a pair of protective glasses to protect your eyes against paint or thinner that is being removed. |
| | 5 | Air leakage | No excessive air leakage from the fitting of the motor case. | • | • | ![CAUTION](https://via.placeholder.com/15)  
Make sure that the air tube is firmly inserted in the joint. Accidental disconnection of the air tube may cause injury. |
| | 6 | Dried paint | Remove the dried paint on the manipulator. | • | • | ![CAUTION](https://via.placeholder.com/15)  
When removing the paint with a tool, be careful not to damage the manipulator. |
| Pressure Switch Unit | 1 | Pressure set value | The pressure of the pressure reducing valve is within the specified range. | • | | ![WARNING](https://via.placeholder.com/15)  
The pressure switch unit is a safety device for explosion-proof specification. |
<p>| | 2 | Air leakage | No air leakage from the pressure switch unit. | • | |</p>
<table>
<thead>
<tr>
<th>Item</th>
<th>No.</th>
<th>Items to be Inspected</th>
<th>Inspection</th>
<th>Daily</th>
<th>Weekly</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Devices</td>
<td>1</td>
<td>Operation of emergency stop button</td>
<td>1. The manipulator stops immediately when the emergency stop button is pressed.</td>
<td>✔</td>
<td></td>
<td>CAUTION: Inspect the manipulator while it is in its standby position and not in motion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and safety plug.</td>
<td>2. The manipulator stops immediately when the safety plug is pulled out.</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dried paint</td>
<td>3. Remove the dried paint on the emergency stop button and the safety plug.</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Operation of the photoelectric</td>
<td>1. The manipulator stops when the photoelectric switch is turned OFF.</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>intrusion detecting switch</td>
<td>2. Remove the dried paint on the light beam detector.</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dried paint</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Operation of limit switch.</td>
<td>1. Normal operation of the limit switch.</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dried paint</td>
<td>2. Remove the dried paint on the limit switch.</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Options</td>
<td>1</td>
<td>Operation of the gun tilt switching</td>
<td>The gun tilt changes correctly when air is supplied.</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Operation of the shear pin system</td>
<td>1. The manipulator stops immediately when the shear pin is sheared.</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. The test valve is closed and the tube is not broken.</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
## 7 Maintenance and Inspection

### Table 7-1: Inspection Schedule

<table>
<thead>
<tr>
<th>Item</th>
<th>Schedule</th>
<th>Method</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>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Base mounting bolts</td>
<td>Specified personnel (Customer)</td>
<td>Spanner Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cover mounting screws</td>
<td>Licensee (Person who is qualified by YASKAWA)</td>
<td>Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td>Stop the manipulator for this inspection.</td>
</tr>
<tr>
<td>4</td>
<td>Motor part</td>
<td></td>
<td>Visual</td>
<td>Check for filter clogging.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gasket for internal pressure</td>
<td></td>
<td>Visual</td>
<td>Replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>U-axis timing belt</td>
<td></td>
<td>Manual</td>
<td>Check for belt tension and wear and tear.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Internal cables (S) Base part - inside the lower arm (S)</td>
<td></td>
<td>Visual</td>
<td>Check for conduction between the main connectors of the base and the intermediate connector by manually shaking the wire. Check for wear on the protective spring.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Internal cables (L) Inside the lower arm (S) - inside the upper arm (L)</td>
<td></td>
<td>Visual</td>
<td>Check for conduction between connectors Check for wear on the protective spring.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Internal cables (U) Inside the upper arm (L) - flange tip</td>
<td></td>
<td>Visual</td>
<td>Check for conduction between the connectors</td>
<td></td>
</tr>
</tbody>
</table>

---

1) Check for wear on the protective spring.

2) Replace the cables.

3) Replace the cables.

4) Replace the cables.
### Table 7-1: Inspection Schedule

<table>
<thead>
<tr>
<th>Item</th>
<th>Schedule</th>
<th>Method</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>1000H Cycle</td>
<td>6000H Cycle</td>
<td>12000H Cycle</td>
<td>24000H Cycle</td>
</tr>
<tr>
<td>Battery pack</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>Grease gun</td>
<td>Replace the battery pack when the battery alarm occurs or when the manipulator has been operated for 36000H.</td>
</tr>
<tr>
<td>U-axis ball screw actuator</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Replenish grease (1000H cycle).</td>
</tr>
<tr>
<td>S-axis speed reducer</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Replenish grease (6000H cycle). Replace grease (12000H cycle).</td>
</tr>
<tr>
<td>L-axis speed reducer</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>Grease gun</td>
<td>Check for malfunction. (Replace if necessary.) Replenish grease (6000H cycle). Replace grease (12000H cycle).</td>
</tr>
<tr>
<td>Pressure switch unit</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>Grease gun</td>
<td>Confirm that the pressure switch, flow switch, solenoid valve and the pressure reducing valve operate correctly. Contact your YASKAWA representatives.</td>
</tr>
<tr>
<td>Overhaul</td>
<td></td>
<td>○</td>
<td>●</td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

1. 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 data may be lost.
2. Replace internal cables and power cables (for S-, L-, U-axis) in 24000H cycle.