MOTOMAN-MPO10
INSTRUCTIONS
FOR EXPLOSION-PROOF SPECIFICATIONS

**TYPE:**
YR-MPO0010-00

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: 180371-1CD
Revision: 0
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.

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 DX100 (or DX200).

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

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

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

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

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

PROHIBITED
Must never be performed.

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

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

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “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 ™ 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).
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 Explosion-Proof Indication 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: Explosion-Proof Indication Label

Note1:
The place of production may be replaced with the following address in case it is the ATEX-approved one.

YASKAWA Europe GmbH
Yaskawastr.1, D-85391
Allershausen Germany

Note2:
This part may be replaced with the following one.

Note3:
A: TIIS specification
C: ATEX specification
1 Indications on Electric Equipment

1.1 Explosion-Proof Indication Label and Warning Label

Fig. 1-2: Warning Label

Battery Warning Label

WARNING
When replacing battery instruction manual details are to be followed. Battery only to be replaced when the area is known to be safe.

Warning Label A

WARNING
Moving parts may cause injury

Warning Label B

WARNING
Do not enter robot work area.

Explosion-Proof Indication Label

Battery Warning Label

-Battery type:
HW1470715-S (for S-, L-axes)
HW1470715-T (for U-axis)

-Battery manufacturer:
Yaskawa Electric Corporation

Nameplate

Pressure Switch Unit Warning Label

Battery Warning Label

-Battery type:
HW1470715-S (for S-, L-axes)
HW1470715-T (for U-axis)

-Battery manufacturer:
Yaskawa Electric Corporation

Warning Label A

WARNING
Moving parts may cause injury

Warning Label B

WARNING
Do not enter robot work area.
1.2 Standards

The manipulator meets the following requirements:

- Directive 94/9/EC for equipment and protective systems for proper use in hazardous areas
- IEC60079-0: 2011 for electrical apparatus for explosive gas atmospheres - Part 0: General requirements
- Machinery Directive 2006/42/EC
- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- EN 1127-1 and EN 13463-1 for hazardous areas

When classifying a manipulator environment as a hazardous area (zone), observe the “Guidelines for the Avoidance of Dangers due to Explosive Atmospheres with Collection of Examples - Explosion Protection Guidelines - (EX-Directives)".

In special cases, or if you are not sure about the specification of areas with the risk of explosion, contact the competent authorities or Yaskawa and have them decide.

1.3 Customer Service, Repairs and Modifications

Only have repairs to the manipulator carried out by the Yaskawa Customer Service responsible.

Use only genuine parts from Yaskawa for maintenance work.

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

Any modification of the MPO10 itself, and of the following system components is strictly prohibited:

- Explosion-proof devices and system installation
- Safeguards and the safety devices mounted on these safeguards
- Emergency stop button and other safety devices
- Manipulator control system such as the DX200, the manipulator handling drive section and the power transmission section
1.4 Use in Hazardous Areas

In hazardous areas (zones), only operate motor units of the corresponding equipment category and temperature class. The motor unit has the following explosion protection marking:

**Table 1-1: Explosion Protection Marking for Gas Hazards**

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Equipment group</td>
</tr>
<tr>
<td>2G</td>
<td>Equipment category for gas</td>
</tr>
<tr>
<td>px</td>
<td>Type of protection</td>
</tr>
<tr>
<td>IIC</td>
<td>Gas group</td>
</tr>
<tr>
<td>T4</td>
<td>Temperature class</td>
</tr>
<tr>
<td>Gb</td>
<td>Equipment protection level for gases</td>
</tr>
</tbody>
</table>

**Table 1-2: Explosion Protection Marking for Dust Hazards**

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Equipment group</td>
</tr>
<tr>
<td>p</td>
<td>Type of protection</td>
</tr>
<tr>
<td>2D</td>
<td>Equipment category for dust</td>
</tr>
<tr>
<td>IIIC</td>
<td>Dust group</td>
</tr>
<tr>
<td>T135°C</td>
<td>Maximum permissible surface temperature: 135°C</td>
</tr>
<tr>
<td>Db</td>
<td>Equipment protection level for dusts</td>
</tr>
</tbody>
</table>

1.4.1 Special Conditions For Safe Use

All equipment fitted to the enclosure shall be suitably ATEX certified and shall be installed in accordance with EN 60079-14.

Avoid the build up of dust on the enclosures.

Perform the following routine tests after the installation:

- Verify the operation of the safety devices (functional test).
- Confirm that on loss of purge and pressure the enclosure is electrically isolated.
- Record all tests.
1.5 Explanations Of Explosion Protection Marking

1.5.1 Equipment Groups

1.5.1.1 Equipment Group I

Equipment group I applies to products for use in underground plants of mines and their above-ground systems which can be endangered by methane and/or flammable dusts.

1.5.1.2 Equipment Group II

Equipment group II applies to products for use in the remaining areas which can be endangered by an explosive atmosphere.

1.5.2 Equipment Categories

The equipment category describes the frequency and duration of the occurrence of explosive atmospheres in an area.

Table 1-3: Equipment Categories for Gases

<table>
<thead>
<tr>
<th>Equipment category</th>
<th>Description (in accordance with EN 1127-1)</th>
<th>Design safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G</td>
<td>Areas in which it is to be expected that a mixture of air and flammable substances in the form of gas, vapor or mist will occur constantly, over longer periods or frequently (zone 0 area, equipment protection level Ga in accordance with IEC60079-0:2012).</td>
<td>Very high</td>
</tr>
<tr>
<td>2G</td>
<td>Areas in which it is to be expected that a mixture of air and flammable substances in the form of gas, vapor or mist will occur occasionally (zone 1 area, equipment protection level Gb in accordance with IEC60079-0:2012).</td>
<td>High</td>
</tr>
<tr>
<td>3G</td>
<td>Areas in which it is not to be expected that a mixture of air and flammable substances in the form of gas, vapor or mist will occur. However, if it does occur, then only seldom and only briefly (zone 2 area, equipment protection level Gc in accordance with IEC60079-0:2012).</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Table 1-4: Equipment Categories for Dusts or Flyings and Fibres

<table>
<thead>
<tr>
<th>Equipment category</th>
<th>Description (in accordance with EN 1127-1)</th>
<th>Design safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1D</td>
<td>Areas in which it is to be expected that a cloud of combustible dust in the air will occur constantly, over longer periods or frequently (zone20 area, equipment protection level Da in accordance with IEC60079-0:2012).</td>
<td>Very high</td>
</tr>
<tr>
<td>2D</td>
<td>Areas in which it is to be expected that a cloud of combustible dust in the air will occur occasionally (zone 21 area, equipment protection level Db in accordance with IEC60079-0:2012).</td>
<td>High</td>
</tr>
<tr>
<td>3D</td>
<td>Areas in which it is not to be expected that a cloud of combustible dust in the air will occur. However, if it does occur, then only seldom and only briefly (zone 22 area, equipment protection level Dc in accordance with IEC60079-0:2012).</td>
<td>Normal</td>
</tr>
</tbody>
</table>
1.5.3 Types of Protection

**Table 1-5: Types of Protection**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>Gas - Flameproof enclosures in accordance with IEC 60079-1</td>
</tr>
<tr>
<td>p</td>
<td>Gas - Pressurized enclosures in accordance with IEC 60079-2</td>
</tr>
<tr>
<td>q</td>
<td>Gas - Protection by powder filling in accordance with IEC 60079-5</td>
</tr>
<tr>
<td>0</td>
<td>Gas - Protection by oil immersion in accordance with IEC 60079-6</td>
</tr>
<tr>
<td>e</td>
<td>Gas - Increased safety in accordance with IEC 60079-7</td>
</tr>
<tr>
<td>i</td>
<td>Gas - Intrinsic safety in accordance with IEC 60079-11 and IEC 60079-27</td>
</tr>
<tr>
<td>n</td>
<td>Gas - Type of protection in accordance with IEC 60079-15 and IEC 60079-27</td>
</tr>
<tr>
<td>m</td>
<td>Gas and dust - Encapsulation in accordance with IEC 60079-18</td>
</tr>
<tr>
<td>s</td>
<td>Special protection in accordance with IEC 60079-33</td>
</tr>
</tbody>
</table>

The types of protection are subdivided into several sub-classes. Refer to the corresponding standards for detailed information.

1.5.4 Explosion Groups

1.5.4.1 Gas explosion Groups

Flammable gases and vapors are classified according to gas explosion groups (IIA, IIB, IIIC and I) and temperature classes. **Table 1-6 “Gas Explosion Groups”** shows the classification of the most common flammable gases and vapors.

**Table 1-6: Gas Explosion Groups**

<table>
<thead>
<tr>
<th>Type</th>
<th>IIA</th>
<th>IIB</th>
<th>IIC</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Acetone, Ethane, Ethyl acetate, Ammonia, Ethyl chloride, Benene, Acetic acid, Carbon monoxide, Methanol, Methyl chloride, Naphthalene, Phenol, Propane, Toluene</td>
<td>Natural gas</td>
<td>Hydrogen</td>
<td>Methane</td>
</tr>
<tr>
<td>T2</td>
<td>i-Amyl acetate, n-Butane, n-Butyl alcohol, Cyclohexanon, 1.2-Dichloroethane, Acetic acid-anhydride</td>
<td>Ethylene, Ethyl alcohol</td>
<td>Acetylene</td>
<td>-</td>
</tr>
<tr>
<td>T3</td>
<td>Gasoline, Diesel fuel, Jet fuel, Heating oil, n-Hexane</td>
<td>Hydrogen sulfide</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T4</td>
<td>Acetaldehyde</td>
<td>Ethyl ether</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T6</td>
<td>-</td>
<td>-</td>
<td>Carbon disulfide</td>
<td>-</td>
</tr>
</tbody>
</table>
1.5.4.2 Dust Explosion Groups

Explosive dust atmospheres are classified according to dust explosion groups (IIIA, IIIB and IIC):

Table 1-7: Dust Explosion Groups

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIA</td>
<td>Combustible flyings</td>
</tr>
<tr>
<td>IIIB</td>
<td>Non-conductive dust</td>
</tr>
<tr>
<td>IIC</td>
<td>Conductive dust</td>
</tr>
</tbody>
</table>

1.5.5 Temperature Classes

1.5.5.1 Maximum Surface Temperature

The maximum surface temperature is the highest temperature reached by a manipulator’s surface under the most unfavorable conditions.

1.5.5.2 Ignition Temperature

The maximum manipulator surface temperature must always be lower than the lowest ignition temperature of the gas or vapor-air mixture in which it is used.

1.5.5.3 Temperature Class

The maximum surface temperature results from the manipulator’s design and is specified as the temperature class.

Table 1-8: Temperature Classes

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>450 (°C)</td>
</tr>
<tr>
<td>T2</td>
<td>300 (°C)</td>
</tr>
<tr>
<td>T3</td>
<td>200 (°C)</td>
</tr>
<tr>
<td>T4</td>
<td>135 (°C)</td>
</tr>
<tr>
<td>T5</td>
<td>100 (°C)</td>
</tr>
<tr>
<td>T6</td>
<td>85 (°C)</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.

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.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>When taking safety precautions, consider the range of motion of the manipulator shown in Fig. 2-2.</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>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”.</td>
</tr>
</tbody>
</table>
2 System Configuration

2.1 Manipulator

MPO10 Explosion-Proof

Fig. 2-1: System Configuration

Non-Hazardous Location

1. Program selector (optional)
2. Standard unit
3. Paint unit
4. Conveyor switch (optional)

Hazardous Location

1. Manipulator
2. Explusion-proof parts
3. Pressure switch unit
4. Intrinsically safe cable (optional)

Air supply

Air tube (16 dia.)

D-class grounding with ground resistance of 100Ω or less

Power cable (whole unit)

Explosion-proof pendant (explosion-proof: optional)

Intrinsically safe cable (1 or 2 cables)

A-class grounding with ground resistance of 10Ω or less (Note)

Programming Pendant (not explosion proof)

Power supply

3-phase AC 200/220V
50/60Hz

D-class grounding with ground resistance of 10Ω or less

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

Intrinsically safe cable

When explosion-proof programming pendant is used.

Ground resistance of 10 or less (Note)
2.1.1 Basic Specifications

Table 2-1: Basic Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
<th>YR-MPO0010-*00</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</td>
<td>245N (25 kgf)</td>
<td></td>
</tr>
<tr>
<td>Vertical Load</td>
<td>245N (25 kgf)</td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 0.15 mm</td>
<td></td>
</tr>
<tr>
<td>S-axis (Lower arm)</td>
<td>Standard (S)Type</td>
<td></td>
</tr>
<tr>
<td>(L) Type</td>
<td>- 150° − +150°</td>
<td></td>
</tr>
<tr>
<td>(R) Type</td>
<td>- 60° − +200°</td>
<td></td>
</tr>
<tr>
<td>L-axis (Upper arm)</td>
<td>- 165° − +200°</td>
<td></td>
</tr>
<tr>
<td>U-axis (Vertical arm)</td>
<td>0 ~ 350 mm</td>
<td></td>
</tr>
<tr>
<td>Allowable Moment</td>
<td>Flange part$$^1$$ (Vertical direction)</td>
<td>27 N•m (2.75 kgf•m)</td>
</tr>
<tr>
<td>Allowable Inertia (GD$$^2$$/4)</td>
<td>Flange part$$^4$$ (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
2 System Configuration

2.1 Manipulator

Fig. 2-3(a): Horizontal Force

Fig. 2-3(b): Vertical Force

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.

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.

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.
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.

**WARNING**

Explosion-proof safety Device
Do not change any Parameters.

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

2.3 Pressure Switch Unit

Purging air pressure: 0.26 - 0.28 [MPa]

Operation pressure: 0.01 - 0.02 [MPa]

Industrial compressed air: 0.35 - 0.65 [MPa]

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>
<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</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>220 VAC (-15 to +10%) 60 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>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</td>
<td>Use dry air for the pressurized explosion-proof construction.</td>
</tr>
<tr>
<td></td>
<td>Pressurized explosion-proof</td>
<td>Capacity:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>construction</td>
<td>For pressurized type of explosion</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>protected construction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 Nl/min during operation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 Nl/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 3-2: Installation Site

<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>

×: Not acceptable  
●: 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.
3 Installation

3.3 Transport and Installation

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

- **Manipulator base**
- **Spring washer** (delivered with the manipulator)
- **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)**

- **Baseplate**
- **Anchor bolt** M16 or larger

- **Washer** (delivered with the manipulator)
- **Spring washer** (delivered with the manipulator)

- **Manipulator base**
- **Y part**
- **Baseplate**

**Dimensions in mm**:
- **410 ± 0.1**
- **193 ± 0.1**
- **520 ± 0.1**
- **320**
- **210**
- **220**
- **230**
- **212**
- **300**
- **350 ± 0.1**
- **283 ± 0.1**

- **Oval hole** (15 mm)

- **Unit: mm**
3.3 Transport and Installation

3.3.3 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.

3.3.3.2 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 force of the manipulator. (Refer to Table 3-3 “Maximum Repulsion Force”.)

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”.

<table>
<thead>
<tr>
<th>Table 3-3: Maximum Repulsion Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated/ Decelerated</td>
</tr>
<tr>
<td>Maximum torque in horizontal rotation</td>
</tr>
<tr>
<td>Maximum repulsion in horizontal rotation</td>
</tr>
<tr>
<td>Maximum repulsion in vertical direction</td>
</tr>
</tbody>
</table>
3.3.3.3 Mounting the Manipulator on the Baseplate

The baseplate should be rugged and durable to withstand maximum repulsion 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”

3.3.3.4 Location

When installing the manipulator, satisfy the following environmental conditions.

- Ambient temperature: 0°C 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

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 minutes until it is warmed up before the actual operation.

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
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.
4 Connection
4.2 Cable Connection

Fig. 4-2: Power Cable Connection (to the DX200)

- Hexagon socket head cap screw M8
  (6 screws, length: 20 mm.)
- Washer M8 (6 washers)
- Tightening torque 24.5 N m (2.5 kgf m)
Delivered with the manipulator

- Hexagon socket head cap screw M6
  (18 screws, length: 18 mm)
- Flat washer M6 (18 washers)
- Tightening torque 10 N m (1.0 kgf m)
Delivered with the manipulator

Grounding cable connecting tap (3 taps)
Use cross-recessed head machine screws
M5 (10 screws)
Delivered with the manipulator
4 Connection
4.2 Cable Connection

Fig. 4-3: Power Cable Connection (to the Manipulator)
Fig. 4-4: Air Hose Connection

1. **Air Tube Connection: Back Side**
   - Joint for power cable at IN side
   - Insert
   - Air tube inside the manipulator (12 dia.)

2. **Air Tube Connection: L-Side**
   - Joint for power cable at IN side
   - Insert
   - Air tube inside the manipulator (12 dia.)

3. **Air Tube Connection: R-Side**
   - Joint for power cable at IN side
   - Insert
   - Air tube inside the manipulator (12 dia.)
4 Connection

4.3 Wiring Diagram

**Fig. 4-5: Pressure Switch Unit Connection to Intrinsically Safe Terminal Block and Barrier**

1) Intrinsically safe cable
   - Cable type (recommended):
     - UL2586-SB, 1.25 mm² (SUMIDEN HITACHI CABLE Ltd.)
   - 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 binned with shield separately.

2) Cable connection

<table>
<thead>
<tr>
<th>Manipulator side 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 manipulator side
     - For terminal block P1 to 2

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

**Cable type (Recommended)**

- UL2586-SB, 1.25 mm²

- SUMIDEN HITACHI CABLE Ltd.

- The cable to be connected with terminal blocks P1 to N3, and 1 to 2 are binned with shield separately.

**Cable connection**

- For terminal block P1 to N3
- For terminal block P1 to N3
- For terminal block 1 to 2

**Cable type (Recommended terminal)**

- 1.25AF2.3B (JST Made)

**Cable connection**

- Manipulator side Intrinsically safe terminal block
- Controller (DX200)

**4.3 Wiring Diagram**

Wiring diagrams are shown in Fig. 4-6(a) “Circuit for Manipulator’s Electrical Device” and Fig. 4-6(b) “Electrical Circuit for Manipulator’s Electrical Device”.
Fig. 4-6(a): Circuit for Manipulator's Electrical Device
Fig. 4-6(b): Electrical Circuit for Manipulator's Electrical Device
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

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

Inspected

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
   - Check on the facility prepared by user

Confirmed

Turn ON the breaker of the D200 by manual.
Purging mode is simultaneously ready to start by turning the power ON.
5 Operation (Initial start-up Included)

5.1 Enclosure Protection Sequence.

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

---

1. Switch the operation pressure to the purging pressure
2. Release the master valve

- Does the flow rate reach 340 l/min with 20 kPa or more of purging air pressure?
  - Yes
    - Start counting the purging time (two minutes)
  - No
    - Is the flow rate keeping 340 l/min with 20 kPa or more of purging air pressure?
      - No
        - Two minutes passed since the beginning of purging time start counting
      - Yes
        - Switch the operation pressure to the purging pressure

- Did two minutes pass since the purging mode started?
  - Yes
    - 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.
  - No
    - Start Purging Mode

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

---

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.
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.
   In case the abnormal pressure (LOW) occurs during the purging mode, the master valve is automatically shut OFF to prevent the dangerous gas from inflowing.
   “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>
<tbody>
<tr>
<td><strong>Manipulator</strong></td>
<td>1</td>
<td>Exterior</td>
<td>No deformations or cracks to the pressurized explosion-proof enclosure. Covers are appropriately mounted. No other exterior abnormality.</td>
<td>•</td>
<td></td>
<td><strong>DANGER</strong> If any deformations or cracks are found, immediately stop the operation and contact your Yaskawa representatives.</td>
</tr>
<tr>
<td>2 Motion</td>
<td></td>
<td></td>
<td>Smooth tuning, horizontal, and vertical motions of each arm. The manipulator’s home position does not change.</td>
<td>•</td>
<td></td>
<td><strong>WARNING</strong> Do not enter the manipulator working envelope.</td>
</tr>
<tr>
<td>3 Noise and vibration during operation</td>
<td></td>
<td></td>
<td>No abnormal noise and vibration during manipulator operation.</td>
<td>•</td>
<td></td>
<td><strong>WARNING</strong> Do not enter the manipulator working envelope.</td>
</tr>
<tr>
<td>4 Tubes</td>
<td></td>
<td></td>
<td>Off or no severe wear and tear on paint and air supply tubes.</td>
<td>• •</td>
<td></td>
<td><strong>CAUTION</strong> Use a pair of protective glasses to protect your eyes against paint or thinner that is being removed.</td>
</tr>
<tr>
<td>5 Air leakage</td>
<td></td>
<td></td>
<td>No excessive air leakage from the fitting of the motor case.</td>
<td>• •</td>
<td></td>
<td><strong>CAUTION</strong> Make sure that the air tube is firmly inserted in the joint. Accidental disconnection of the air tube may cause injury.</td>
</tr>
<tr>
<td>6 Dried paint</td>
<td></td>
<td></td>
<td>Remove the dried paint on the manipulator.</td>
<td>• •</td>
<td></td>
<td><strong>CAUTION</strong> When removing the paint with a tool, be careful not to damage the manipulator.</td>
</tr>
<tr>
<td><strong>Pressure Switch Unit</strong></td>
<td>1</td>
<td>Pressure set value</td>
<td>The pressure of the pressure reducing valve is within the specified range</td>
<td>•</td>
<td></td>
<td><strong>WARNING</strong> The pressure switch unit is a safety device for explosion-proof specification.</td>
</tr>
<tr>
<td>2 Air leakage</td>
<td></td>
<td></td>
<td>No air leakage from the pressure switch unit.</td>
<td>•</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 6-1: Frequent Inspections (Sheet 2 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>
<tbody>
<tr>
<td>Safety Devices</td>
<td>1</td>
<td>Operation of emergency stop button and safety plug. Dried paint</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></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></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 intrusion detecting switch Dried paint</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></td>
<td>2. Remove the dried paint on the light beam detector.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Operation of limit switch. Dried paint</td>
<td>1. Normal operation of the limit switch</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></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>
### 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>1. Base mounting bolts</td>
<td>Daily</td>
<td>Spanner Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td>Stop the manipulator for this inspection.</td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>2. Cover mounting screws</td>
<td>1000H Cycle</td>
<td>Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td>Stop the manipulator for this inspection.</td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>3. Motor connectors</td>
<td>6000H Cycle</td>
<td>Manual</td>
<td>Check for loose connectors.</td>
<td></td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>4. Motor part</td>
<td>12000H Cycle</td>
<td>Visual</td>
<td>Check for filter clogging.</td>
<td></td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>5. Gasket for internal pressure</td>
<td>24000H Cycle</td>
<td>Visual</td>
<td>Replace if necessary.</td>
<td></td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>6. U-axis timing belt</td>
<td>36000H Cycle</td>
<td>Manual</td>
<td>Check for belt tension and wear and tear.</td>
<td></td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>7. Internal cables (S)</td>
<td>1 Base mounting bolts - inside the lower arm (S)</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>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>8. Internal cables (L)</td>
<td>Inside the lower arm (S) - inside the upper arm (L)</td>
<td>Visual</td>
<td>Check for conduction between connectors Check for wear on the protective spring.</td>
<td></td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>9. Internal cables (U)</td>
<td>Inside the upper arm (L) - flange tip</td>
<td>Visual</td>
<td>Check for conduction between the connectors</td>
<td></td>
<td>Specified personnel (Customer)</td>
</tr>
<tr>
<td>Item</td>
<td>Schedule</td>
<td>Method</td>
<td>Operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>--------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.2</td>
<td>Daily</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1000H Cycle</td>
<td>• •</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>6000H Cycle</td>
<td>• •</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>12000H Cycle</td>
<td>• •</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>24000H Cycle</td>
<td>•</td>
<td>Replace the battery pack when the battery alarm occurs or when the manipulator has been operated for 36000H.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>36000H</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 7.1: Inspection Schedule**

<table>
<thead>
<tr>
<th>Item</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1</td>
<td>Daily</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>10.2</td>
<td>1000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>10.3</td>
<td>6000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>10.4</td>
<td>12000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>10.5</td>
<td>24000H Cycle</td>
<td>•</td>
<td>Replace the battery pack when the battery alarm occurs or when the manipulator has been operated for 36000H.</td>
</tr>
<tr>
<td>10.6</td>
<td>36000H</td>
<td>•</td>
<td></td>
</tr>
</tbody>
</table>

**Maintenance and Inspection**

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-axes) in 24000H cycle.

- **Grease gun**
- **Grease**
- **Check for malfunction** (Replace if necessary)
- **Replace grease** (12000H cycle)
- **Replace grease** (24000H cycle)
- **Check for malfunction** (12000H cycle)
- **Replace grease** (36000H cycle)
- **Check for malfunction** (Replace if necessary)
- **Replace the battery pack when the battery alarm occurs or when the manipulator has been operated for 36000H.**

---

**Table 7.1: Inspection Schedule**

<table>
<thead>
<tr>
<th>Item</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1</td>
<td>Daily</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>14.2</td>
<td>1000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>14.3</td>
<td>6000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>14.4</td>
<td>12000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>14.5</td>
<td>24000H Cycle</td>
<td>•</td>
<td>Replace the battery pack when the battery alarm occurs or when the manipulator has been operated for 36000H.</td>
</tr>
<tr>
<td>14.6</td>
<td>36000H</td>
<td>•</td>
<td></td>
</tr>
</tbody>
</table>

**Table 7.1: Inspection Schedule**

<table>
<thead>
<tr>
<th>Item</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1</td>
<td>Daily</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td>15.2</td>
<td>1000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>15.3</td>
<td>6000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>15.4</td>
<td>12000H Cycle</td>
<td>• •</td>
<td></td>
</tr>
<tr>
<td>15.5</td>
<td>24000H Cycle</td>
<td>•</td>
<td>Replace the battery pack when the battery alarm occurs or when the manipulator has been operated for 36000H.</td>
</tr>
<tr>
<td>15.6</td>
<td>36000H</td>
<td>•</td>
<td></td>
</tr>
</tbody>
</table>