NOTES FOR SAFE OPERATION

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

MOTOMAN INSTRUCTIONS

CD-ROM: NX100 INSTRUCTIONS
NX100 OPERATOR’S MANUAL
NX100 MAINTENANCE MANUAL

The NX100 operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.

Read this manual and all the electrical data in attached CD-ROM carefully before installation, operation, maintenance, or inspection of the NX100.

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

Note, however, this instruction manual does not sufficiently provide all the safety precautions. For your safety, be sure to ensure safety measures or management before the operation.

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.

Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product. The manipulator usually consists of the controller, the programming pendant, and manipulator cable. In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX100 Controller</td>
<td>NX100</td>
</tr>
<tr>
<td>NX100 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator Cable</td>
</tr>
</tbody>
</table>

Notes for Safe Operation

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

- **DANGER**: Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.
- **WARNING**: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
- **CAUTION**: Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
- **MANDATORY**: Always be sure to follow explicitly the items listed under this heading.
- **PROHIBITED**: Must never be performed.

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

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

Part Number: 170537-1CD
Revision: 1
Manual No: R-AN-A303
1.1 For Your Safety

Robots generally have requirements which are different from other manufacturing equipment, such as larger working areas, high-speed operation, rapid arm movements, etc., which can pose safety hazards. Read and understand the instruction manuals and related documents, and observe all precautions in order to avoid the risk of injury to personnel and damage to equipment. It is the user's responsibility to ensure that all local, state, and national codes, regulations rules, or laws relating to safety and safe operating conditions are met and followed.

1 Safety

1.1 For Your Safety

The following warning labels are attached to the manipulator and NX100. Fully comply with the precautions on the warning labels.

**DANGER**

- The label described below is attached to the manipulator.
  - Observe the precautions on the warning labels.
  - Failure to observe this caution may result in injury or damage to equipment.

**WARNING**

- Moving parts may cause injury.
- Do not enter robot work area.

- The following warning labels are attached to NX100.
  - Observe the precautions on the warning labels.
  - Failure to observe this warning may result in injury or damage to equipment.

**WARNING**

- High Voltage
  - Do not open the door with power ON.
  - Do not open the cover.

Refer to the NX100 INSTRUCTIONS for the warning label location.

1.2 Special Training

**MANDATORY**

- Teaching maintenance of the robot must conform to:
  - Industrial Safety and Health Law
  - Enforcement Order of Industrial Safety and Health Law
  - Ordinance of Industrial Safety and Health Law

Other related laws are:
- Occupational Safety and Health Act in USA
- Factory Act (Gewerbeordnung) in Germany
- Health and Safety at Work, etc. Act in UK
- EC Directive 89/392 Machinery and 91/368 EEC

- Prepare
  - SAFETY WORK REGULATIONS
    - Based on concrete policies for safety management complying with related laws.

- Observe the
  - MANIPULATING INDUSTRIAL ROBOTS-SAFETY (ISO 10218)

  - for safe operation of the robot. (Japan Only) (JIS B 8433)

- Reinforce the
  - SAFETY MANAGEMENT SYSTEM
    - By designating authorized workers and safety managers, as well as giving continuing safety education.

- Teaching and maintaining the robot are specified as "Hazardous Operations" in the Industrial Safety and Health Law (Japan only). Workers employed in these above operations are requested to attend special training offered by YASKAWA.

- Persons who teach or inspect the manipulator must undergo required training before using the manipulator.
- For more information on training, inquire at the nearest YASKAWA branch office.
1.3 Motoman Manual List

**MANDATORY**

- It is important to have and be familiar with all manuals concerning the MOTOMAN.
  
  You should have the four manuals listed below:
  - MOTOMAN INSTRUCTIONS
  - NX100 INSTRUCTIONS
  - NX100 MAINTENANCE MANUAL
  - NX100 OPERATOR’S MANUAL
  
  Confirm that you have all these manuals on hand. If any manuals are missing, contact your salesman from YASKAWA’s local branch office.

1.4 Personnel Safety

The entire manipulator P-point maximum envelope is potentially dangerous.

All personnel working with the MOTOMAN (safety administration, installation, operation, and maintenance personnel) must always be prepared and “Safety First” minded, to ensure the safety of all personnel.

**WARNING**

- Avoid any dangerous actions in the area where the MOTOMAN is installed.
  
  There is a danger of injury if there is contact with the manipulator or peripheral equipment.

- Please take strict safety precautions by placing signs such as “Flammable”, “High Voltage”, “Waiting”, and “Off-limits to Unauthorized Personnel” in necessary areas in the factory.
  
  Failure to observe these cautions may result in fire, electric shock, or injury due to contact with the manipulator and other equipment.

- Strictly observe the following items:
  - Always wear approved work clothes (no loose-fitting clothes).
  - Do not wear gloves when operating the MOTOMAN.
  - Do not wear underwear, shirts, or neckties to hang out from the work clothes.
  - Do not wear large jewelry, such as earrings, rings, or pendants.
  
  Always wear protective safety equipment such as helmets, safety shoes (with slip-proof soles), face shields, safety glasses, and gloves as necessary.
  
  Improper clothing may result in injury.

- Unauthorized persons should not approach the manipulator or associated peripheral equipment.
  
  Failure to observe this caution may result in injury due to contact with NX100, controller, the workpiece, the positioner, etc.

1.5 Motoman Safety

1.5.1 Transporting

**CAUTION**

- Never forcibly move the manipulator axes.
  
  Failure to observe this caution may result in injury or equipment damage.

- Never lean on NX100 or other controllers, and avoid inadvertently pushing buttons.
  
  Failure to observe this caution may result in injury or damage by unexpected movement of the manipulator.

- Never allow unauthorized personnel to touch the NX100 during operation.
  
  Failure to observe this caution may result in injury or damage resulting from unexpected movement of the manipulator.

- Operation of the crane, sling, or forklift should only be performed by authorized personnel.
  
  Failure to observe this precaution may result in injury or equipment damage.

- Avoid jarring, dropping, or hitting the controller during handling.
  
  Excessive vibration or impacting the NX100 may adversely affect the performance of the NX100.

- If storing the manipulator temporarily before installation, be sure to place it on a stable and flat surface and take precautions to prevent unauthorized personnel from touching it.
  
  Failure to observe this precaution may result in injury of damage to equipment.
1.5 Motoman Safety

### Transportation of the manipulator

**CAUTION**

- As a rule, when removing the manipulator from the package and moving it, a crane should be used. The manipulator should be lifted using wire rope threaded through attached eyebolts. Be sure the manipulator is fixed with shipping bolts and brackets before transporting, and lift it in the posture as shown in the figures below.
- Be sure to use wire that is strong enough to handle the weight of the manipulator

**Transportation posture of the manipulator**

- Be sure the eyebolts are securely fastened.
  Failure to observe this caution may result in injury or damage to equipment.

### Transportation of the NX100

**CAUTION**

- When lifting the NX100, please check the following:
  - As a rule, handling of NX100 must be performed using a crane with wire rope threaded through attached eyebolts.
  - Be sure to use wire that is strong enough to handle the weight of the NX100.

### Installation

Refer to the MOTOMAN-□□□□ Instructions manual and NX100 Instructions for details on installation and wiring.

In planning installation, adapt an easy to observe arrangement to ensure safety. Take safety into consideration when planning the installation. Observe the following when installing the manipulator:

**NOTE**

To ensure safety, be sure to install the safeguarding. It prevents unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance. (ISO10218)

#### Responsibility for Safeguarding

The user of a manipulator or robot system shall ensure that the 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 robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.

### The Weight of Manipulator (approx.)

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Approx. weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small size</td>
<td>HP3</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>HP6, EA1400N</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>HP20, EA1900N</td>
<td>280</td>
</tr>
<tr>
<td>Large size</td>
<td>ES165N, ES200N</td>
<td>1200</td>
</tr>
</tbody>
</table>

### The Weight of NX100 (approx.)

<table>
<thead>
<tr>
<th>NX100 equivalent model</th>
<th>Approx. weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP6, HP20, EA1400N</td>
<td>100</td>
</tr>
<tr>
<td>EH50, HP165, ES165N</td>
<td>150</td>
</tr>
</tbody>
</table>

To insure safety, be sure to install the safeguarding. It prevents unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance. (ISO10218)

#### Responsibility for Safeguarding

The user of a manipulator or robot system shall ensure that the 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 robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.
### Installation of the manipulator

**WARNING**

- **Select an area such as that described below to install the manipulator:**
  Confirm that the area is large enough so that the fully extended manipulator arm with tool will not reach a side wall, safeguarding, or the controller.
  Failure to observe this caution may result in injury or damage resulting from unexpected movement of the manipulator.

- **Install a safeguarding around the manipulator to prevent any accidental contact with the manipulator while the power is on.**
- **Equipped with a safety interlock. Be sure the interlock operates correctly before use.**
- **Perform grounding in accordance with all applicable electrical codes.**
  Failure to observe this caution may result in fire or electric shock.
- **Do not start the manipulator or even turn ON the power before it is firmly anchored.**
  The manipulator may overturn and cause injury or damage.
- **When mounting the manipulator on the ceiling or wall, the base section must have sufficient strength and rigidity to support the mass of the manipulator. Also, it is necessary to consider countermeasures to prevent the manipulator from falling.**
  Failure to observe these warning may result in injury or damage.

### Installation of the NX100

**CAUTION**

- **Be sure there is sufficient room for maintenance on the manipulator, NX100, and other peripheral equipment.**
  Failure to observe this precaution could result in injury during maintenance.

- **To ensure safety, be sure to operate the controller from a location where the manipulator is easily visible.**
  Operation by unauthorized personnel may result in injury or equipment damage.

- **Install the NX100 outside the safeguarding of the manipulator’s safety enclosure.**
  Failure to observe this precaution may result in injury or damage to equipment resulting from contact with the manipulator.

- **Do not climb on top of the NX100.**
  Failure to observe this caution could lead to injury or mechanical failure.
1.5 Motoman Safety

1.5.3 Work Area Safety
Carelessness contributes to serious accidents in the work area. To ensure safety, enforce the following precautions:

**WARNING**
- Install a safeguarding around the manipulator to prevent any accidental contact with the manipulator while the power is on. Post a warning sign stating "Off-limits During Operation" at the entrance of the enclosure. The gate of the safeguarding must be equipped with a safety interlock. Be sure the interlock operates correctly before use.

Failure to observe this caution may result in a serious accident due to contact with the manipulator.

- Store tools and similar equipment in proper locations outside of the enclosure. Tools and loose equipment should not be left on the floor around the manipulator, NX100, or welding fixture, etc., as damage to equipment can occur if the manipulator comes in contact with objects or equipment left in the work area, or injury may result in if the hit objects jump toward you.

**MANDATORY**
- Persons operating or inspecting the manipulator should be trained as required by applicable laws and company policies. (Refer to section 1.2 Special Training)

- When attaching a tool such as the welding torch to the manipulator, be sure the power supply of the NX100 and the tool is off, lock the switch, and display a warning sign.

Turning the power on during tool installation may case electric shock or injury due to unexpected movement of the manipulator.

- Never exceed the rated capacity of the manipulator (capacity can be found in the specifications section of the manipulator manual.)

Failure to observe this caution may result in injury or damage to equipment.

- Teach jobs from outside the manipulator’s work area whenever possible.
1.5 Motoman Safety

**WARNING**

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - Always view the manipulator from the front.
  - Always follow the predetermined operating procedure.
  - Always have an escape plan in mind in case the manipulator comes toward you unexpectedly.
  - Ensure that you have a place to retreat to in case of emergency.

Improper or unintentional manipulator operation can result in injury.

- Before operating the manipulator, check that the SERVO ON lamp goes out when the emergency stop button on the right of the front door of the NX100 and the programming pendant are pressed. Confirm that the servo lamp is turned off.

Emergency Stop Button

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

- Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Release of Emergency Stop

**WARNING**

- Prior to performing the following operations, be sure that no one is in the P-point maximum envelope of the manipulator when:
  - Turning ON the NX100 power
  - Moving the manipulator with the programming pendant.
  - Running the system in check mode
  - Performing automatic operations

Injury may result from contact with the manipulator if persons enter the P-point maximum envelope of the manipulator.

Press the emergency stop button immediately if there are problems.
The emergency stop buttons are located on the right side of the front door of the NX100 and the programming pendant.

**CAUTION**

- Perform the following inspection procedures prior to teaching the manipulator. If problems are found, correct them immediately, and be sure that all other necessary tasks have been performed.
  - Check for problems in manipulator movement.
  - Check for damage to the insulation and sheathing of external wires.

- Always return the programming pendant to its hook on the NX100 cabinet after use.

If the programming pendant is inadvertently left on the manipulator, a fixture, or on the floor, the manipulator or a tool could collide with it during manipulator movement, possibly causing injury or equipment damage.
1.6 Notes for Moving and Transferring the MOTOMAN

1.5.5 Connection

**WARNING**

- **The system must be grounded.**
  Failure to ground equipment may result in injury from fire or electric shock.
- **Before grounding the system, turn off the power supply and lock the main power switch.**
  Failure to observe this caution may result in injury and electric shock.
- **Do not touch any board inside the controller for five minutes after turning off the power supply.**
  Capacitors inside the controller store electricity after power is turned off. Exercise caution whenever handling circuit boards. Failure to observe this caution may cause electrical shock.
- **Power cannot be turned on unless the door is closed. Interlocks prevent power from being turned on.**
  Failure to observe this caution may result in fire and electric shock.
- **Any occurrence during wiring while the NX100 is in the emergency stop mode is the user's responsibility.**
  Do an operation check once the wiring is completed.
  Failure to observe this caution could lead to injury or mechanical failure.
- **Wiring must be performed only by authorized personnel.**
  Incorrect wiring may cause fire and electric shock.
- **Perform wiring in accordance with the rated capacity as specified in the Instructions.**
  Incorrect wiring may cause fire or mechanical breakdown.
- **Be sure the power circuit screws are securely tightened.**
  Loose power circuit wires can cause fire and electric shock.
- **Do not handle the circuit board directly by hand.**
  The IC board may malfunction due to electrostatics.

### Connecting the Primary Power Supply

- **NOTE**
  - Don’t connect the grounding wire with the wires for the electric power source, the welder, etc.
  - Ground in accordance with all relevant governmental regulations when using metallic ducts, metallic conduits, and cable tray to construct the cable.

### Connecting the Manipulator Cable

- **NOTE**
  - For more information on connecting the manipulator cable, please refer to the Instruction Manual which corresponds to the particular NX100 model.
  - Close the door of the controller (NX100) securely to prevent dust from entering.

1.5.6 Turning ON the Main Power Supply

**WARNING**

- **Confirm that nobody is present in the P-point maximum envelope of the manipulator when turning on NX100 power supply.**
  Failure to observe this caution could result in injury caused by accidental contact with the manipulator.
  Push the emergency stop button immediately if any problems occur.
  The emergency stop button is located in the upper left of the door on the NX100 and on the right side of the programming pendant.

### NOTE

Be sure to remove all items from the area before moving the manipulator.
Refer to the INSTRUCTION MANUAL for the appropriate position of the fixture.

1.6 Notes for Moving and Transferring the MOTOMAN

When moving or transferring the Motoman, observe the following safety precautions:

**CAUTION**

- **Attach the instructions to the controller cabinet so that all users have access to necessary manuals.**
  See Section 1.3 for a complete list of manuals.
  If any manuals are missing, contact your Yaskawa representative.

- **If the warning labels on the manipulator and NX100 are illegible, clean the labels so that they can be read clearly. Note that some local laws may prohibit equipment operation if safety labels are not in place.**
  Contact your YASKAWA representative if you require new warning labels.

- **When the MOTOMAN is transferred, it is recommended to check with Yaskawa Engineering Co. which is listed on back cover of this manual.**
  Incorrect installation or wiring may result in personal injury and property damage.
1.7 Notes on MOTOMAN Disposal

- **PROHIBITED**
  - Never modify the manipulator or NX100. Failure to observe this precaution could result in injury or damage resulting from fire, power failure, or operation error.

- **CAUTION**
  - When disposing of the MOTOMAN, follow the applicable national/local laws and regulations.
  - Anchor the manipulator well, even when temporarily storing it before disposal. Failure to observe this precaution may result in injury due to the manipulator falling down.

2 Product Confirmation

2.1 Contents Confirmation

Confirm the contents of the delivery when the product arrives. Standard delivery includes the following five items (Information for the content of optional goods is given separately):
- Manipulator
- NX100
- Programming Pendant
- Manipulator Cable (Between Manipulator and NX100)
- Complete Set of Manuals

A Complete Set of Manuals (CD-ROM included)

The CD-ROM is not included in the set in case of ordering the manuals in printed material.

Contents of the 5-piece set for the standard specification

2.2 Order Number Confirmation

Confirm that the order number pasted on the manipulator and NX100 match. The order number plates are affixed to the figure below.

- Confirm that the manipulator and the NX100 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.

Example

ORDER NO. 0001
NOTES FOR SAFE OPERATION

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