DX200
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

DX200 NOTES FOR SAFE OPERATION
DX200 INSTRUCTIONS
DX200 OPERATOR’S MANUAL (for each purpose)
DX200 MAINTENANCE MANUAL

Part Number: 165841-1CD
Revision: 3
1 Safety Information

MANDATORY

- Read this manual and other related documents 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."
- 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.

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.

1.1 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>DX200 Controller</td>
<td>DX200</td>
</tr>
<tr>
<td>DX200 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator Cable</td>
</tr>
</tbody>
</table>
1 Safety Information

1.2 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.

**NOTE**
To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as "DANGER", "WARNING" and "CAUTION".
### Explanation of Warning Labels

The following warning labels are attached to the manipulator and DX200. 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**
  - Do not enter robot work area.
  - Moving parts may cause injury.

- **WARNING**
  - Do not open the door with power ON.

- **WARNING**
  - High Voltage
  - Do not open the cover.

- **WARNING**
  - High Voltage
  - May cause electric shock.
  - Ground the earth terminal based on local and national electric code.

### 1.3 Safety

#### 1.3.1 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.
1.3.2 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 Machinery Directive 98/37/EC
  • Prepare
    – SAFETY WORK REGULATIONS
      based on concrete policies for safety management complying with related laws.
  • Observe
    – INDUSTRIAL ROBOT- SAFETY REQUIREMENTS
      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.

1.3.2 Special Training

MANDATORY

• 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.

The telephone numbers are listed on the back cover of instructions.
1.3.3 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
  - DX200 INSTRUCTIONS
  - DX200 MAINTENANCE MANUAL
  - DX200 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.

The relevant telephone numbers are listed on the back cover.
1.3.4 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 protective safety equipment such as helmets, safety shoes (with slip-proof soles), face shields, safety glasses, and gloves as necessary.
  - Always wear approved work clothes (no loose-fitting clothes).
  - Do not wear gloves soiled with chemicals, oils, organic solvents, etc. when operating the MOTOMAN.
  - Do not allow underwear, shirts, or neckties to hang out from the work clothes.
  - Do not wear large jewelry, such as earrings, rings, or pendants.

  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 DX200, controller, the workpiece, the positioner, etc.
CAUTION

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

• Never lean on DX200 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 DX200 during operation.
Failure to observe this caution may result in injury or damage resulting from unexpected movement of the manipulator.
1.4 Motoman Safety

1.4.1 Transporting

CAUTION

- Crane, sling, and forklift operations must be performed only by authorized personnel.

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

- Avoid jarring, dropping, or hitting the controller during handling.

Excessive vibration or impacting the DX200 may adversely affect the performance of the DX200.

- 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 or damage to equipment.

1.4.1.1 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

Fig. : Transporting Position (An example: MOTOMAN-MA1440)
1.4.1.2 Transportation of the DX200

**CAUTION**

- When lifting the DX200, please check the following:
  - As a rule, handling of DX200 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 DX200.

<table>
<thead>
<tr>
<th>Models Available for DX200</th>
<th>Approx. Weight (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small capacity model</td>
<td>100</td>
</tr>
<tr>
<td>Medium / Large capacity model</td>
<td>100</td>
</tr>
</tbody>
</table>

- Be sure the eyebolts are securely fastened.

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

### Table: Approx. Weight of DX200

1.4.2 Installation

Refer to the MOTOMAN-□□□ Instructions manual and DX200 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:

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.
1.4.2.1 *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.
CAUTION

- Do not install or operate the manipulator that is damaged or lacks parts.
Failure to observe this caution may cause injury or damage.
- Before turning ON the power, check to be sure that the shipping bolts and brackets are removed.
Failure to observe this caution may result in damage to the driving parts.
- Install the manipulator using bolts of the size and type specified for each MOTOMAN in the MOTOMAN INSTRUCTION MANUAL.
Failure to observe this caution may result in injury or damage to equipment.
1.4.2.2 Installation of the DX200

**CAUTION**

- Be sure there is sufficient room for maintenance on the manipulator, DX200, 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 DX200 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 DX200. Failure to observe this caution could lead to injury or mechanical failure.

- Secure the position of the DX200 after setting up. Attach the DX200 to the floor or rack, etc., using the screw holes on the bottom of the DX200. Failure to observe this caution could lead to injury or equipment damage if the DX200 should shift or fall.

- Be familiar with the connection diagram before wiring the DX200, and perform the wiring in accordance with the connection diagram. There is a danger of equipment damage or injury due to miswiring and unexpected movement of the equipment.
1.4.3 Work Area Safety

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

- **CAUTION**
  - Take precautions when wiring and piping between the DX200, manipulator, and peripheral equipment. Run the piping, wiring, or cables through a pit or use a protective cover, so that they are not stepped on by personnel or run over by the forklift.

  Operators and other personnel may stumble on exposed wiring or piping. Cable damage can cause unexpected manipulator motion resulting in injury or property damage.

  *CAUTION*
  - 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, DX200, or welding fixture, etc., as injury or damage to equipment can occur if the manipulator comes in contact with objects or equipment left in the work area.

- **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.
1.4.4 Operation Safety

MANDATORY

• Persons operating or inspecting the manipulator should be trained as required by applicable laws and company policies. (chapter 1.3 “Safety”)

WARNING

• When attaching a tool such as the welding torch to the manipulator, be sure to turn OFF the power supply of the DX200 and the tool, lock the switch, and display a warning sign.

Turning the power ON during tool installation may cause 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.

• 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.
1 Safety Information
1.4 Motoman Safety

WARNING

• Before operating the manipulator, check that the SERVO ON lamp on the programming pendant goes out when the emergency stop buttons are pressed. And confirm that the servo lamp is turned OFF. Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

Fig. : Emergency Stop Button

• Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON. Injury may result from unintentional or unexpected manipulator motion.

Fig. : Release of Emergency Stop

• 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 DX200 power
  – Moving the manipulator with the programming pendant
  – Running the system in the 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.
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 DX200 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.
1.4.5 Connection

**WARNING**

- The system must be grounded. Failure to ground equipment may result in injury from fire or electric shock.
- Before wiring, make sure to turn OFF the primary power supply, and put up a warning sign.
  (ex. DO NOT TURN THE POWER ON)
Failure to observe this caution may result in injury and electric shock.
- Do not touch the inside of the panel for 5 minutes after the power is tuned OFF. The remaining changed voltage in the capacitor may cause an electric shock or an injury.
- Be sure to close the door and install the protection cover while the power is tuned on.
Failure to observe this warning may result in fire or an electric shock.
- Any occurrence during wiring while the DX200 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.

1.4.5.1 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.
1.4.5.2 Connecting the Manipulator Cable

For more information on connecting the manipulator cable, please refer to the Instruction Manual which corresponds to the particular DX200 model.

Close the door of the controller (DX200) securely to prevent dust from entering.

1.4.6 Turning ON the Main Power Supply

**WARNING**

- Confirm that nobody is present in the P-point maximum envelope of the manipulator when turning ON the DX200 power supply.

Failure to observe this caution could result in injury caused by accidental contact with the manipulator.

Press the emergency stop button immediately if any problems occur.

The emergency stop buttons are located on the right side of the front door of the DX200 and on the right side of the programming pendant.

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.
1.5 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 1.3.3 “Motoman Manual List” for a complete list of manuals.

  If any manuals are missing, contact your Yaskawa representative.

- If the warning labels on the manipulator and DX200 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.
1.6 Notes on MOTOMAN Disposal

**DANGER**

- Do not modify the manipulator or the DX200.
Failure to observe this instruction may cause fire, mechanical failure, or malfunction, which may result in personal injury and/or equipment damage.

**WARNING**

- Take precautionary measures to prevent the manipulator from overturning, such as anchoring it firmly, etc., even when temporarily storing it before disposal.
Failure to observe this instruction may cause overturning of the manipulator, which may result in personal injury.

**MANDATORY**

When disposing of or recycling the MOTOMAN, follow the applicable national/local laws and regulations.

**PROHIBITED**

- This symbol is applicable for various areas.
The wheelie bin symbol on this product, manual or its packaging indicates that at the end of life the product should enter the recycling system. It must be disposed at an appropriate collection point for electrical and electronic equipment (EEE) and should not be put in the normal waste stream.
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
- DX200
- Programming Pendant
- Manipulator Cable (between manipulator and DX200)
- Complete Set of Manuals (in the USB port-connecting CD-ROM)

Fig. 2-1: Contents of the 5-piece set for the standard specification

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

2.2 Order Number Confirmation

Confirm that the order number pasted on the manipulator and DX200 are the same. The order number plates are affixed to the figure below.

<Example>
2.2 Order Number Confirmation

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.
3 Product Warranty Information

MANDATORY

- Read this manual and other related documents 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.”
- 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.

- Individual Contract (including specifications)
  When it's different from following contents with individual contract (including specifications), the contents of the individual contract give priority.

- Warranty Period
  Yaskawa product(s) are guaranteed for a period of 12 months from the date of delivery to the customer, or 18 months from the date of shipment from the Yaskawa factory, whichever comes first.

- Scope of Warranty
  ► Preliminary Investigation into Cases of Failure
  The preliminary investigation into cases of failure is to be conducted by the customer. This preliminary investigation can be conducted by Yaskawa or by its authorized service representative upon request from the customer. If Yaskawa or its authorized service representative conducts the preliminary investigation upon request from the customer, and finds that the failure of the Yaskawa product(s) was not due to Yaskawa workmanship or materials, Yaskawa shall charge the customer for the investigation fee.
  Such an investigation by Yaskawa or its authorized service representative, obtainable upon request from the customer, is only available within Japan.
  A customer who requests after-sales service, including such preliminary investigations, outside of Japan can apply in the context of the separately concluded overseas after-sales service agreement.
  ► Repairs
  If a product failure occurs within the warranty period due to Yaskawa workmanship or materials, Yaskawa will provide, free of charge, repair and shipping of the repaired product back to the customer, or a new product to replace the defective product and shipping of the new product to the customer.
  If Yaskawa or its designated company repairs the defective product(s), and if the warranty period has expired or the remaining effective warranty period is 6 months or less from the date of repair, the period of warranty for the repaired part(s) of the product will be extended for another 6 months from the date of repair.
The warranty does not apply to the following cases, where Yaskawa shall charge the customer for total fees and for the cost of repair or new product(s).

- Failure due to improper maintenance or handling, or carelessness, by the customer.
- Failure due to the customer's system design
- Failure due to modifications made to a Yaskawa product without Yaskawa's full agreement
- Failure due to the use of a Yaskawa product under conditions that fall outside the recommended specifications
- Problems due to force major events such as natural disaster and fire
- Failures after the free warranty period has elapsed
- Replenishment or replacement of consumables and expendables such as lubricants, batteries, bearings, cooling fans, and electrolytic capacitors
- Defective products caused by packaging, fumigation, or transportation that are made or arranged by the customer
- Malfunction or failure caused by program(s), such as run command(s), that have been made by the customer
- Requests for supplemental or replacement copies of manuals and/or warning labels because the originals have become dirty or damaged
- Causes that were not foreseeable with the scientific and technological understanding at the time of shipment from Yaskawa
- Other problems not due to defects in Yaskawa workmanship or materials

► Limitations of Liability

Regardless of the time period of the occurrence, Yaskawa is not liable for any opportunity loss to the customer caused by the failure of Yaskawa product(s), for compensation towards other operations, or for damage to products that are not manufactured by Yaskawa.

[Examples]

- Opportunity loss (including unobtained profit during operation delays or interruptions)
- Damage to objects to be processed (such as raw materials, materials, and semi-finished products of end-user)
- Damage to any equipment
- Costs for investigation into the causes of failure paid by the customer (including fees for an external analysis facility engaged by the customer)
- The customer's expenses incurred in investigating the causes of failure (such as personal costs for holding meetings)
- Costs paid by the customer to external facilities for restoration of a system line (such as the cost of labor, transportation, and trial operation/adjustments)
3 Product Warranty Information

► Delivered Terms

Standard products that do not entail trial operations or adjustments are regarded as having been received by the customer upon delivery to the customer. Yaskawa is not responsible for local adjustments or trial operations.
DX200
NOTES FOR SAFE OPERATION

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