Motoman NX100 Controller

Modular FabWorld System Manual

Part Number: 149533-1CD
Revision 0

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Chapter 1
Introduction

The Modular FabWorld system is part of the FabWorld family of standardized arc welding solutions. It is a fully integrated welding system, and is supported from wire to weld by Motoman, Inc.

1.1 About This Document

This manual is intended as an introduction and overview for personnel who have received operator training from Motoman, and who are familiar with the operation of this Motoman robot model. For more detailed information, refer to the manuals listed in Section 1.3. This manual contains the following sections:

SECTION 1 - INTRODUCTION
This section provides general information about the Modular FabWorld and its components, a list of reference documents, and customer service information.

SECTION 2 - SAFETY
This section provides information regarding the safe use and operation of the Modular FabWorld system.

SECTION 3 - DESCRIPTION OF EQUIPMENT
This section provides a detailed description of the major components of the Modular FabWorld system. This section also includes a table of component specifications.

SECTION 4 - INSTALLATION
This section provides instructions for set up and installation of the Modular FabWorld system.

SECTION 5 - OPERATION
This section provides instructions for basic operation of the Modular FabWorld system. This section also provides procedures for start-up, loading, normal operation, fault recovery, and shutdown. Sample robot programs are also included in this section.

SECTION 6 - MAINTENANCE
This section contains a table listing periodic maintenance requirements for the components of the Modular FabWorld cell.
1.2 System Overview

The Modular FabWorld provides a complete, customizable, arc welding solution with multiple robot and station kit configurations. The system is designed around either a single or dual Motoman arc welding robot, NX100 controller, and includes a complete welding package. Two MHT-series positioners comprise the work stations and allow the robot to weld in synchronous motion with each positioner. The cell can also be purchased with a stationary weld table instead of the headstock/tailstock combination. The cell also includes a full complement of safety features designed to protect both personnel and equipment.

Figure 1-1 illustrates a typical system layout for the Modular FabWorld cell.

Figure 1 System Layout

Note: This manual is for a standard Motoman system. If your system is a custom or modified system, please use the drawings and Bill of Material (BOM) provided with your system for troubleshooting and spares provisioning.
1.2.1 System Layout

The Modular FabWorld provides multiple configuration options for different application requirements. Several robot options are available for different applications and weld lengths. Single robot EA1900N or UP20MN cells are available as well as dual EA1900N configurations. The robot manipulators are mounted directly to the floor at the center of the cell for easy access to both stations. Several MHT-series positioners are available from 450 kg to 3000 kg capacities to comprise the two work stations. Each positioner is equipped with Motoman’s patent-pending MotoMount flexible fixture system, allowing the positioners to be mounted directly to the floor. Robot controllers and welding power sources share a common base outside the welding cell. The robotic cell is fully enclosed by safety fencing with an interlocking door. S-axis zone rings and light curtains provide reliable safeguarding. All operator controls, including those on the controller and welding power supply, are accessible from outside the safety fencing.

1.2.2 Major Components

The Modular FabWorld is made up of the following major components:

- Motoman EA1900N, or UP20MN manipulator and NX100 controller
- MHT-Series positioner
- Operator station
- Welding equipment, including the following:
  - Welding power source
  - Welding torch (water-cooled or air-cooled)
  - Wire feeder
  - Applicable welding interface
  - Torch mount
- Safety equipment, including the following:
  - Safety fencing with arc curtains
  - Interlocked light curtains
  - Interlocked cell door

1.2.3 Optional Equipment

The following optional equipment is available for use with the Modular FabWorld:

- Torch cleaner
- Wire cutter
- Water circulator
- Touch Sense-Starting Point detection unit
1.3 Reference to Other Documentation

For additional information refer to the following:

- Motoman EA1900N Manipulator Manual (P/N 149894-1)
- Motoman UP20MN Manipulator Manual (P/N 149467-1)
- Motoman NX100 Controller Manual (P/N 149201-1)
- Motoman NX100 Maintenance Manual (P/N 150133-1)
- Motoman Operator's Manual for Arc Welding (P/N 149235-1)
- Motoman Concurrent I/O Parameter Manual (P/N 149230-1)
- Motoman MH-Series Positioner Manual w/ MotoMount (PN 146703-1)
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (EA1900N, or UP20MN)
- Application Type (welding)
- System Type (Modular FabWorld)
- Software Version (access using MAIN MENU, SYSTEM INFO, VERSION on programming pendant)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on front door of NX100 controller)
Chapter 2
Safety

2.1 Introduction

It is the purchaser’s responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06. The address is as follows:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. The robot must not be operated by personnel who have not been trained!

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.
This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming Safety (Section 2.6)
- Operation Safety (Section 2.7)
- Maintenance Safety (Section 2.8)

2.2 Standard Conventions

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

DANGER!

WARNING!

CAUTION!

NOTE:

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).

⚠️ DANGER!
Information appearing under the DANGER caption concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

⚠️ WARNING!
Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

⚠️ CAUTION!
Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

📢 Note: Information appearing in a Note caption provides additional information which is helpful in understanding the item being explained.
2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot 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 robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06, section 6.13.4 and 6.13.5, 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).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's 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 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

• Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06 safety standards are permitted to install the equipment.

• Identify the work envelope of each robot with floor markings, signs, and barriers.

• Position all controllers outside the robot work envelope.

• Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.

• Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).

• Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

Any modifications to PART 1 of the controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!

Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.

Back up all programs and jobs onto a floppy disk whenever 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.

The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.

• 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 robot should be permitted to operate the system.
• Inspect the robot and work envelope 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 the E-STOP button on the teach pendant for proper operation before programming.

• Carry the teach pendant with you when you enter the workcell.

• Be sure that only the person holding the teach pendant enters the workcell.

• Test any new or modified program at low speed for at least one full cycle.

### 2.7 Operation Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

• Be sure that only trained personnel familiar with the operation of this robot, the operator’s manuals, the system equipment, and options and accessories are permitted to operate this robot system.

• Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.

• Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.

• Ensure that all safeguards are in place.

• 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 robot should be permitted to operate the system.

• Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.

• The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.

• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

• All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage to the robot. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
2.8 Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- 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 robot should be permitted to operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
Chapter 3

Equipment Description

3.1 Robot Description

The Motoman six-axis EA1900N “Expert Arc” robot is specifically designed for arc welding applications. The EA1900N has a payload of 3 kg (6.6 lbs.) and features a horizontal reach of 1904-mm (74.96 inch) and a relative positioning accuracy of ±0.08 mm (±0.003 inch). The EA1900N features a patented internal cabling design that provides high flexibility and streamlines the robot profile, allowing access into confined spaces. The robot’s B-axis features an expanded range of motion which improves circumferential welding on cylindrical work pieces. The T-axis can rotate the torch ±360 degrees without cable interference. The UP20MN has a payload of 20 kg (44.1 lbs.) and features an extended horizontal reach of 3106-mm (122.3 inch) and a relative positioning accuracy of ±0.08 mm (±0.003 inch).

Each robot can be mounted on the floor, wall, or ceiling with minor modifications. For more information, refer to the manipulator manual that came with your system.

3.2 NX100 Controller

The NX100 robotic controller, shown in Figure 2, features a Windows® CE programming pendant with color touch screen, high-speed processing, built-in Ethernet, and a robust PC architecture. The NX100 easily handles multiple tasks and can control up to four robots (up to 36 axes, including robots and external axes), and I/O devices. Advanced Robot Motion (ARM) control provides high-performance path accuracy and vibration control.

The NX100 coordinates the operation of the Modular FabWorld system. It controls manipulator movement and welding power supply, processes input and output signals, and provides the signals to operate the welding system. It maintains variable data and performs numeric processing to convert to and from different coordinate systems. In addition, the controller provides main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the controller manual that came with your system.
3.2.1 Programming Pendant

The programming pendant (see Figure 3) is the primary user interface for the system and features a cross-shaped navigation cursor that reduces teaching time by 30 percent. The pendant has a 6.5-inch full color touch screen display (640 x 480 VGA) and provides a convenient Compact Flash slot for easy memory back-ups. The system uses the INFORM III robot language and a menu-driven interface to simplify operator interaction with the robot.

Most operator controls are located on the pendant, allowing the control cabinet to be mounted remotely. An optional on-line troubleshooting guide for expert system maintenance is also available on the pendant. By using the pendant, the operator can teach robot motion, and perform programming, editing, maintenance, and diagnostic functions. For more information, refer to the operator’s manual that came with your system.

Note: The programming pendant display goes into screen saver mode after a few minutes of inactivity. Press any key to restore screen.
Figure 3  Programming Pendant

Mode Selector Switch
The Mode Selector Switch allows the operator to select Remote, Play or Teach mode. In Remote mode, control of the system is transferred to the operator station. When Play or Teach is selected, the programming pendant controls system operation. When Play mode is selected on the programming pendant, the operator must also press the PLAY ENABLE button on the controller door to initiate Play mode.

Menu Area
The Menu Area contains menu selections for the currently selected screen.

General Purpose Display Area
The General Purpose Display Area displays the currently selected menu choice.

Emergency Stop (E-STOP)
Pressing the E-STOP button puts the controller in Emergency Stop and stops all system operation.
Keypad
The user keypad on the programming pendant serves as an input device. The keys are grouped into different functional sections to simplify operator use.

Status Area
The Status Area shows system status via the following symbols:

- Active Robot, External Axis, or Base Axis
  R1, R2, R3, S1, S2, etc.; or B1, B2, etc.
- Coordinate System
  Joint, World, Cylindrical, Tool, or User Frame
- Manual Speed Setting
  Inching, Low, Medium, or High
- Cycle Mode
  Step, 1-Cycle, or Auto
- System Status
  E-Stop, Stop, Running/Start, Hold, or Alarm
- Additional Pages (when applicable)

MAIN MENU Key
The MAIN MENU key returns the pendant display to the initial start-up menu. Use the cursor key or the touch screen to choose from the following menu options:

- JOB
  This option accesses job selections including: Master Job, Select Job, Job Capacity, and Create New Job while in TEACH mode.
- ARC WELDING, GENERAL, HANDLING, and SPOT WELDING
  This option allows you to select the applications available to the controller.
- VARIABLE
  This option accesses the display and editing menu for the arithmetic variables and display of position variables.
- IN/OUT
  This option accesses DETAIL and SIMPLE displays of all I/O signals. In EDITING or MAINT. mode, Universal Outputs can be forced ON or OFF.
- ROBOT
  This option accesses robot information including: CURR.POS, POWER ON/OFF, POS, COMMAND POS, SECOND HOME POS, OPE ORIGIN POS, and TOOL and USER COORDINATE.
- SYSTEM INFO
  This option provides Version information for both hardware and software, Alarm History, and Monitoring Time.
- FD/CF
  This option accesses menu choices for FD (floppy disk) or CF (compact flash) program backup.
- SETUP
  This allows the user to set up system conditions and assign hot keys.
AREA Key
The Area key moves the cursor to the different areas of the display screen.

CURSOR Key
The Cursor key is an 8-way, directional key that moves the up, down, left or right to highlight a desired item that can then be chosen using the SELECT key.

SELECT Key
The SELECT key is used to choose the item currently highlighted by the cursor.

FLASH MEMORY Slot
The compact FLASH MEMORY card slot allows for easy memory backups.

ENABLE Switch
The ENABLE switch (see Figure 4) is a three-position switch located on the left rear of the programming pendant. It is a safety feature that controls servo power while in TEACH mode. When pressed in, this switch enables servo power to be turned on. However, should the operator release the switch, or grasp it too tightly, servo power is immediately removed, preventing further robot movement.

SERVO ON Key
When the pendant is in TEACH mode, The SERVO ON key turns servo power ON when the ENABLE switch is activated. When the pendant is in PLAY mode, the SERVO ON key turns servo power on.

**Figure 4** Enable Switch.
3.3 Operator Stations

The operator stations (see Figure 5) includes a NEMA enclosure and fence mounting brackets. The following paragraphs describe the operator station controls.

![Operator Station Diagram]

**Figure 5 Operator Station**

**Start**
The START button is connected to the robot external start input. The robot will start the current active job when START is pressed. The operator station must be enabled and servo power ON for the START button to work.

**Servo On**
The SERVO-ON pushbutton turns servo power ON. In TEACH mode, the SERVO ON pushbutton operates only when the ENABLE switch on the programming pendant is held in.

**Alarm**
The ALARM lamp is connected to the robot SERVO ON and ALARM OCCURRENCE outputs. The ALARM lamp lights red when the robot encounters an alarm condition or when servo power is cut.

**Cycle Start/Cycle Latched**
The operation of the CYCLE START/CYCLE LATCHED button is dependent on the structure of the Master job. Altering the Master job could result in injury to personnel or damage to the equipment.

The green CYCLE START/CYCLE LATCHED button, located on the operator station, initiates a positioner sweep cycle if the robot is in the Safe or Home position. If the CYCLE START/CYCLE LATCHED button is pressed while the robot is outside Home, the CYCLE START command is latched into the controller. Once the robot returns to Home and Output #1 is on, the CYCLE START command is executed and the positioner sweeps. A pulse instruction prevents the operator from holding the button down and continuously cycling the positioner.
Home (Three Position Joystick)
The Home joystick controls positioner rotation and user defined load positions. Moving the joystick to the right (FWD) indexes the positioner headstock toward the robot(s) at 30-degree intervals. Moving the joystick to the left (REV) indexes the positioner headstock away from the robot(s) at 30-degree intervals. Home position resets the positioner headstock to zero degrees.

Reset
The RESET button is connected to the robot alarm reset input. A minor alarm or error condition is cleared when this button is pressed. The positioner only needs to be reset after initial power-up and after an emergency stop while in Play mode.

Note: Resetting the positioner may cause some positioner motion. You must be careful when you reset the positioner with the robot close to tooling. If an Emergency Stop occurs during programming, be sure to reset the positioner before resuming programming.

Robot Hold
The ROBOT HOLD button is a normally closed, momentarily actuated switch. Pressing ROBOT HOLD stops the operation of the manipulator until another START signal is sent. The indicator light stays ON only while the ROBOT HOLD button is pressed. Operation resumes at the point in the program where the ROBOT HOLD state was initiated. Refer to the manipulator manual for more information.

Emergency Stop (E-STOP)
Pressing an E-STOP button or interrupting a door interlock stops all system operation. The operator station E-STOP, the robot E-STOP, and the sliding door interlocks are connected to a safety PLC and the Emergency Stop circuit. Brakes are applied to the robot and all servo power is removed from the system. The system E-STOP lights come on and all positioner motion is stopped.
3.4 MHT-Series Positioner

The MHT-series positioner consists of the following Motoman positioners – MHT 450, MHT 1500 and MHT 3000. These positioner systems include a headstock drive assembly, tailstock column, and the MotoMount tool mounting system. Parts fixturing is mounted between the headstock and tailstock faceplates providing a highly versatile work area.

Refer to the MH-series Positioner Manual with MotoMount and Drive Assemblies (P/N 146703-1) for MotoMount and MH450/MH1500 technical details.

For additional information on independent control and coordinated motion, refer to the Independent/Coordinated Function manual (Part Number 142969-1). This system is also capable of true coordinated motion, where linear, circular, or spline motion can be coordinated between the robot and positioner. Coordinated motion allows the robot to weld while the positioner rotates the parts. For additional information on coordinated motion, refer to the Independent/Coordinated Motion manual (Part Number 149648-1)

3.5 Welding Equipment

In its standard configuration, the Modular FabWorld system includes a welding power source, wire feeder, torch, and torch mount. Optional equipment - including water circulator, Com-Arc unit, and torch tender - may also be included with your system.

3.5.1 Wire Feeder

The wire feeder mounts on the robot arm. This 4-roll wire feeder provides reliable wire feeding at rates up to 750 inches per minute (ipm). An integral gas valve provides fast gas response time. Interchangeable feed rolls are used to accommodate different types and sizes of wire.

3.5.2 GMAW Torch

The Modular FabWorld system uses either an air-cooled or a water-cooled robotic/automatic GMAW torch. These are heavy-duty torches designed for quick replacement and minimum robot reprogramming. The GMAW torch is installed at the end of the robot wrist. For applications that use the water-cooled torch, the Modular FabWorld system includes a water circulator kit.

3.5.3 Power Sources

Motoman offers several different power sources for use with the Modular FabWorld system, depending on the system’s application. Figure 6 shows some of the more common power sources used. However, the power source your system uses may be different. For more specific information, refer to the vendor manual that came with your system.
Figure 6  Available Power Sources
3.6 Safety Features

The Modular FabWorld system includes a total safety environment. When all standard safety precautions are taken, the safety equipment helps to ensure safe operation of the robotic cell. The ANSI/RIA R15.06-1999 Robot Safety Standard stipulates the user is responsible for safeguarding.

Note: Users are responsible for determining whether the provided safeguards are adequate for plant conditions. Users must also ensure that safeguards are maintained in working order.

3.6.1 Arc Screen

WARNING!
Although the arc curtain blocks dangerous arc radiation, never look directly at the arc without protective eyewear!

The material used to cover the safety fencing of the entire robotic cell acts as an arc screen. This material reduces the amount of ultra-violet radiation that escapes from the robotic cell.

3.6.2 Fencing

The safety fencing provided with the Modular FabWorld system encloses the entire robotic cell. It forms a physical barrier preventing entry into the robot operating envelope during automatic operation.

3.6.3 Safety Light Curtains

The safety light curtains work in conjunction with the robot zone rings to help prevent serious injury to anyone entering a station safety zone while the robot is working in that area. In PLAY mode, if the robot is at station 1 and the operator steps into the station 1 safety zone, servo power is removed from the system and all positioner motion stops. Servo power can be re-applied and the operation resumed by pressing SERVO ON and START.

3.6.4 Emergency Stops (E-STOPS)

In addition to the safety features described above, the Modular FabWorld has strategically placed E-STOPS. These are operator actuated devices that, when activated, immediately stop all system operation. Brakes are applied to the robot and all servo power is removed from the system. The system E-STOP lights come on and all positioner motion is stopped. The following is a list of their locations:

- The controller
- The programming pendant
- The operator station
3.6.5 **ENABLE Switch**

The ENABLE switch is a safety feature which controls servo power while in TEACH mode. When pressed in, this switch allows the operator to turn servo power ON and initializes the system. However, should the operator release the switch or grasp it too tightly, servo power is immediately disabled, preventing further robot movement. For detailed information about the operation of the ENABLE switch, refer to the controller manual that came with your system.

3.6.6 **Brake Release**

The robot brakes are designed to protect the robot and other system components from damage in event of a system or robot failure. The brake release is a safety feature that allows the operator to release the brake of a specific robot axis when drive power has been removed from the system. Use the programming pendant to access the brake release function. Refer to paragraph 5.3.4 for brake release procedures.

3.6.7 **Interlocked Cell Door**

A safety interlock on the cell entrance door prevents entry into the cell during PLAY mode. Brakes are applied to the robot, servo power is removed from the system, and all positioner motion is stopped.
Notes
Chapter 4

Installation

The Modular FabWorld system can be installed easily in just a short time by three workers. The more people involved (within reason), the more quickly installation can be completed. Follow established safety procedures at all times throughout the installation process. Failure to use safe work practices can result in damage to the equipment and injury to the workers. Because this system is modular, it is not possible for us to give you specific installation instructions for your particular system. Use the following instructions as guidelines along with your specific system drawings.

⚠️ CAUTION!
Installation of the FabWorld system is not a task for the novice. The FabWorld system is not fragile, but it is a highly sophisticated robotic system. Handle components with care. Rough handling can damage system electronic components.

4.1 Materials Required

All system hardware necessary for installing the Modular FabWorld system is included with the system. This section identifies customer-supplied items and tools required to complete installation.

4.1.1 Customer-Supplied Items

- Gas for welding torches
- Incoming power
- Two earth ground cables with two earth ground stakes
- Weld wire
- Incoming air supply: 0.04cmm at 620.5 kPa (1.5scfm at 90 psi) for torch tender or wire cutter options
- Stepladder
- Forklift and/or overhead crane
4.1.2 **List of Tools**

- Safety glasses
- Face shields
- Gloves
- Level
- Ratchet with 3/4-inch socket
- Adjustable wrench set
- Hammer drill with appropriate concrete bits
- Phillips and flat screwdrivers
- Hammer
- Socket set
- Forklift and/or overhead crane
- Air-impact gun with 3/4-inch socket
- Open-end wrench set
- Two socket-heads (Allen)
- Wrench sets (standard and metric)

4.2 **Site Preparation**

To prepare your site, proceed as follows:

1. Clear floor space needed for unit (refer to your specific system prints).

   **Note:** To make installation easier, allow an additional 1.2 to 1.5 m (4 to 5 ft) on all sides of cell.

2. Gather all customer-supplied items and required tools listed in Section 4.1.
4.3 Installing the Robot(s)

The robot(s) should be firmly mounted on a base plate or foundation rigid enough to support the robot(s) and withstand repulsion forces. The surface of the floor should be level and even. The concrete thickness of the floor must be at least 150 mm.

**WARNING!**
Each robot weighs approximately 250 kg (551.3 lbs). Make sure lifting devices used to move the robots are capable of safely handling this much weight, or damage to equipment or injury to personnel can result.

1. Move robot(s) in place according to system drawings.
2. Remove shipping bracket(s) (Section 4.3.1).
3. Carefully remove protective plastic wrapping from robots and torches.
4. Inspect each robot for shipping damage.
5. Anchor each robot securely in place (refer to Appendix A for anchor requirements).

4.3.1 Removing the Robot Shipping Bracket

**CAUTION!**
Failure to remove shipping brackets from robot before operating the Modular FabWorld may result in damage to the robot drive mechanisms.

A yellow bracket (see Figure 8) prevents the robot from moving during shipping. The bracket secures the lower arm assembly to the S-axis housing. After the robot is in place, remove the shipping bracket.

*Figure 8  Location of Shipping Brackets*
4.3.2 Installing the Positioner Modules

Using the drawings for your system, place each positioner module on either side of the robot(s). Refer to the Motoman MHT-Series Positioner manual (PN 146703-1) for detailed installation instructions.

4.3.3 Installing the Controller Base

The Modular FabWorld uses a separate controller base mounted on the outside of the system fencing. The controller base contains the robot controller, welders, service disconnects, and optional water circulators. The base is shipped on wood blocks. To install the controller base, proceed as follows:

1. Unbolt each controller base by removing four shipping bolts using a 3/4-inch socket.

![Figure 9 Unbolting Controller Bases](image)

**WARNING!**
Each controller base weighs approximately 1600 kg (3520 lbs). Be sure that your lifting device is capable of handling this much weight or damage to the equipment or injury to personnel can result.

2. Carefully remove plastic wrapping and cardboard from controller bases.
3. Inspect base components for any shipping damage.

*Note: If damage is found, notify shipper immediately.*

4. Using a forklift, lift the controller base and remove wood blocks.
5. Using the dimensions in your system drawings, place the controller base in position.
6. Anchor the base securely in place (refer to Appendix A for anchor requirements).
4.4 Connecting the Cables

After components are level and securely in place, unwrap the cables and connect them according to the cable diagram included in the system drawing package. All cables are labeled to match the labels at the connection points. Using cable trays, route cables between system components.

CAUTION!
Route wires in cable trays to avoid wire breakage and unnecessary interruption of cell operation.

4.4.1 Connecting the Earth Ground

Each robot and controller must each be connected to an earth ground. The ground stake must be driven a minimum of 2.43 m (8 ft) into the earth, and the earth must be treated with chemicals in order to reduce resistance to the ground stake. A maximum of 100 ohms ground resistance is recommended. Deeper ground stakes may be required depending on area soil conditions. To ground the robots and controller, proceed as follows:

DANGER!
If proper earth grounds cannot be provided, do not use the equipment! Serious injury or death can occur.

Note: If the robot and controller are within 4.57 m (15 ft) of each other, a common earth ground may be used. Otherwise, separate earth grounds must be used.

1. Connect one end of each robot earth ground cable to lug marked EARTH GROUND on bottom back of robot.
2. Connect other end of robot earth ground cable to earth ground stake.
3. Connect one end of second earth ground cable to common ground bus bar inside the controller.
4. Connect other end of second earth ground cable to earth ground stake.

4.4.2 Connecting the Programming Pendant Cable

Unwrap the programming pendant and place it on the pendant holder located on the R1 controller. Connect the pendant cable to the R1 controller at the connector labeled PROGRAMMING PENDANT.
4.4.3 Connecting the Robot Cables

Two cables, 1BC and 2BC, connect the robot to the controller. The 1BC cable provides position feedback from the robot to the controller. The 2BC cable provides power to the robot servo motors. To connect the robot cables, proceed as follows:

Note: The right side of the NX100 controller is on your right as you are facing the front of it.

1. Unpack programming pendant and plug connector into receptacle on front door of controller.
2. Unpack two large black manipulator cables and route to controller and back of robot.
3. Carefully engaging connectors, connect one end of each cable (labeled 1BC and 2BC) to 1BC and 2BC connections on back of robot (see Figure 10). Connect other ends of 1BC and 2BC cables to the 1BC and 2BC connections on side of controller.

![Diagram of NX100 controller and robot with cables connected]

Figure 10 Connecting Robot to Controller

4.5 Installing the Safety Fencing

The fencing that makes up the welding cell’s protective walls is shipped on its own skid with all hardware needed for the installation.

\[\text{CAUTION!}\]
\text{Metal bands are under tension and, when cut, may cause injury. Be cautious when cutting the metal bands.}\n
To install the fencing, proceed as follows:

1. Cut bands securing metal fencing and remove all items from skid.
2. Place fence components on floor around positioner according to system prints.
WARNING!
This procedure requires at least two people to accomplish safely.

1. Connect and tighten fence posts to panels according to fence instructions.
2. Have an assistant hold the fencing in place while you attach each additional panel.
3. Measure to ensure cell walls are square and adjust and necessary.
4. Anchor the fence posts to the floor (refer to Appendix A for anchor requirements).

4.5.1 Installing the Cell Door

1. Steady the rear wall and install top door rail across door opening, with the clamps provided.
2. Raise cell door and slide it into position on door rail.
3. Close door and install remaining door rail clamp.
4. Install stop bolt and tighten clamp.
5. Connect the gate interlock cable between the controller and gate interlock.

4.5.2 Installing the Arc Curtains

DANGER!
Do not install the arc curtains until after the cell walls have been secured. Unsecured cell walls can fall and injure personnel and damage equipment.

The arc curtains are shipped in an accessories box. To install the arc curtains:

1. Unfold arc curtains and install one curtain on inside of each cell wall section, using supplied wire ties and eyelets in curtain or velcro depending on your design.

Note: The arc curtains have been pre-cut to match the cell walls. Each arc curtain bag contains documentation that includes the arc curtain’s dimensions. If necessary, these dimensions can be used to match the arc curtain to the correct cell wall.

2. Make sure there are no gaps between arc curtains.
3. Install door panel arc curtain on inside of door panel using supplied wire ties and eyelets in curtain or velcro depending on your design.

4.6 Installing the Safety Light Curtains

The three light curtain components, the emitter, collector, and safety fence come pre-assembled.

1. Move fences into position according to system drawings. The light curtains are oriented properly with the status lights located at the bottom.
2. The wiring connections are located on the controller. Unpack the light curtain cables and connect them to the matching connectors on the light curtains.
3. The emitter and collector must be aligned properly. Refer to the light curtain manufacture’s literature that accompanies the robot cell for exact alignment procedures.

4. Once the light curtains have been properly aligned, anchor the fence posts to the floor (refer to Appendix A for anchor requirements).

5. Check the alignment of the light curtains again after fence posts have been anchored. Readjust as necessary.

4.7 Installing the Operator Stations

To install the operator stations, proceed as follows:

1. Unload operator station.
2. Carefully remove protective plastic wrapping from operator station.
3. Inspect operator station for shipping damage.

Note: If damage is found, notify the shipper immediately.

4. Place operator station outside fence to front of positioner.
5. Insert 1/4-inch concrete drill bit through center of lag holes in operator station and drill holes for lag bolts.
6. Vacuum concrete dust from holes.
7. Lag operator station to floor.

4.8 Connecting Power

After all of the system components have been properly installed, connect the power to the Modular FabWorld.

DANGER!
Power should be connected only by a qualified electrician. Electrical and grounding connections must comply with applicable portions of the national electrical code and/or local electrical codes.

1. Install 3-phase power wiring to main service disconnect located on the controller base. Table 5 shows size and type of wire needed.
2. Make sure the service disconnect switch is set to the OFF position.
3. Route incoming power cable into disconnect box. Knock-out holes are provided.
4. Using a cord grip, secure incoming power cable to service disconnect housing.
5. Strip the three incoming power wires and secure them to the power disconnect connections inside. Use a phillips screwdriver to tighten.
6. Strip the ground wire and secure it to the ground lug inside the service disconnect box. A ring-tongue terminal will be needed. Nut and lock-washer are provided.
7. Turn service disconnect switch to the ON position.

8. Using a volt/ohm meter, verify incoming voltage and amperage values. Refer to label on service disconnect box and system prints for correct voltage.

Note: The Modular FabWorld is configured for 3-phase 460/480V AC, unless other voltage was requested. If other voltage is required for your plant, you must make the necessary modifications to the transformer. For more information, refer to the manipulator manual that came with your system.

Table 4 Incoming Power Specifications (Decal)

<table>
<thead>
<tr>
<th>Lag Data</th>
<th>60/75°C wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalog No.</td>
<td>TCAL14</td>
</tr>
<tr>
<td>Wire Size</td>
<td>#14-7 Copper</td>
</tr>
<tr>
<td></td>
<td>#12-8 Aluminium</td>
</tr>
<tr>
<td>Torque</td>
<td>#14-7, 4.0 N·m (35 lb-in.)</td>
</tr>
</tbody>
</table>

4.9 Conducting a Safety/Operation Check

Before installing tooling and/or fixtures for your application, take a few minutes to perform a safety/operation check. To conduct a safety/operation check:

1. Check that all three yellow shipping brackets have been removed from each robot (see Section 4.3.1).
2. Be sure safety light curtains are aligned correctly.
3. Check that cell door is closed and latched.
4. Check that all cable connections are tight.
5. Be sure welding power source is set correctly (see welding power source vendor's manual).
6. Verify incoming line power matches the input power specified on the front of the controller.

Your Modular FabWorld is now ready for power-up. The FabWorld system should be operated only by personnel who have received operator training from Motoman and who are familiar with the operation of this Motoman robot model. Turn the main power ON, and continue the safety/operation check.

7. Check all system E-STOPS (pendant, op-station, breakaways, playback box).
8. Check system Hold buttons.
4.10 **Installation of Tooling and Fixtures**

Your Modular FabWorld system is now ready for the installation of tooling and fixtures for your application. Installation of tooling and fixtures should be performed by personnel who are familiar with the operation of this system. Tooling and fixtures are supplied by the customer. After tooling is installed, test the positioner for proper operation.
Chapter 5

Operation

The Modular FabWorld is a fully integrated robotic arc welding cell. The Master job setup, and the sub-jobs programmed within it, determine how the system performs welding operation and other tasks. The robot(s) weld parts on the active station, while the operator loads or unloads parts on the opposite side. Once the robot(s) are finished with the welding process, they return to the Home position. The operator is then able to enter the safety zone and safely process the parts while the robot works at the opposite station.

The Modular FabWorld offers two workstations containing any combination of the following station kits: MHT-450 kg capacity, MHT 1500 kg capacity, and MHT 3000 kg capacity.

Note: All tooling and fixtures are supplied by the customer.

5.1 Programming

The operation of this system is programming dependent. The following operating instructions are based on one possible configuration of this system. Your system configuration and job structure may differ slightly from that presented here; however, basic operation will be the same. For additional programming instructions, refer to the controller manual that came with your system.

Any changes made to your system configuration and/or job structure will alter the operation of this cell. Motoman recommends you do not modify the original jobs and system configuration that came with your system. If modifications need to be made, they should be made to copies of these jobs and not to the originals. Modifications should only be performed by personnel who have received operator training from Motoman, and who are familiar with the operation of this Motoman system. If you have questions concerning the configuration of your system please contact the 24 hour Service Hotline, at (937) 847-3200 (see Section 1.4).
A major advantage of the Modular FabWorld system is its high degree of flexibility. The operator can fine tune the movement of both the robots and positioners according to parts configuration. The robots can be programmed to weld parts with the headstock stationary, or the robots and headstock can move simultaneously. The robots can be programmed to weld different seams on the same part and to move from part to part to continue welding.

With the programming pendant, the operator can develop a series of jobs for the robots. You can program the robots independently, the station axis independently, or the robots and station axis together. You must select the axis combination when teaching the job initially (see Section 5.1.4). Motoman recommends programming the robots and station axis together to reduce the risk of interference.

\[\text{Note: Refer to your system’s Independent/Coordinated Motion Manual (P/N 149235-1) for information on coordinated motion, selecting synchronization, group axes, and tooling calibration.}\]

\[\text{CAUTION!}\]
Remember that only the Tool Center Point (TCP) location on the robot is recognized by the controller. Without careful programming, the robot arm can still damage other equipment.

5.1.1 Programming Specific Jobs

For more detailed information on programming user jobs, refer to Motoman Operator's Manual for Arc Welding (P/N 149235-1).

You can program three types of moves:
- Rotation of headstock during air-cut moves
- Robot motion with headstock stationary
- Rotation of headstock during welding

The job you create may consist of a combination of the above. The first two types of moves assume a robot-plus-station group axis specification. The last type of move is called station synchronous and should be programmed with a station-plus-robot group axis specification with the station as the Master control device.

\[\text{CAUTION!}\]
Remember, only the Tool Center Point (TCP) location on the robot is recognized by the controller. Without careful programming, the robot arm could still damage other equipment.

\[\text{Note: Refer to your system’s Independent/Coordinated Motion Manual (P/N 142969-1) for information on coordinated motion, selecting synchronization, group axes, and tooling calibration.}\]
5.2  Daily Operation

The procedures below represent the typical operating sequence from power up to shutdown. Yours basic operating procedures may vary depending on your situation.

- Perform Start-up Procedures (see Section 5.2.1).
- Move robot to Home position (see Section 5.2.2).
- Select master job (see Section 5.2.3).
- Perform Operation Cycle (see Section 5.2.4)
- Perform Shutdown Procedures (see Section 5.2.5)

5.2.1  Start-Up

Note: Due to the configuration of the Modular FabWorld system, the slave controllers (R2) must be energized before the primary controller (R1) or an alarm condition will occur during power up.

To start the cell from a Power-Off condition, proceed as follows:

1. Make sure the enclosure door is closed and securely latched.
2. Turn ON main service disconnect switch.
3. Dual Robot Systems - Set MAIN POWER switch on R2 controller to ON first.
4. Set MAIN POWER switch on R1 controller to ON.
5. Set INPUT POWER switch on welding power sources to ON.
6. Turn on welding gas supply.
7. Disable operator station.
8. Make sure E-STOP buttons on programming pendant and operator station are released.
9. Select TEACH mode on programming pendant; indicator light turns on.
10. Place robot(s) in Home position.

Robot Home Position

To place the robot(s) in the Home position, proceed as follows:

1. Select TEACH mode button on the programming pendant.
2. Press MAIN MENU on programming pendant.
3. Select JOB icon using cursor keys and press SELECT.
4. Cursor to SELECT JOB and press SELECT key.
5. Using cursor keys, move cursor to SAFE job and press SELECT.
6. Turn servo power ON by pressing SERVO ON, pressing TEACH LOCK and holding in the ENABLE switch.
7. Using the INTERLOCK and FWD buttons on the programming pendant, jog the robot(s)
   to the Home position.
5.2.2  Safety Circuit Check

Test each of the following safety circuit items daily for proper operation. If any of these items does not work as instructed, contact Motoman service staff at (937) 847-3200 before operating the cell.

Gate Interlock
Open gate interlock while robot is in PLAY mode with servo power ON. Verify that servo power goes off.

Emergency Stop (E-Stop) Buttons
Press each E-Stop button with the robot in PLAY mode and the servo power ON. After each button is pressed, verify that servo power goes off and the programming pendant reads “Robot is Stopped.”

5.2.3  Selecting Weld Job (Initial Setup Only)

⚠️ CAUTION!
Selecting the wrong job can cause unexpected robot motion. Care must be taken to ensure that the proper job is selected.

1. In the Sweep A (or B) Job, select the following line: “PStart Job:Test A (or B) sub 2.”
2. Move the cursor to highlight this line “PStart Job:Test A (or B) sub 2.” This command line appears at the bottom of the display screen.
3. Cursor to the TestA (or B) job and push SELECT. The job list is displayed.
4. Select the desired job using the cursor and press ENTER to change the job and modify the PStart command in the sweep job.

5.2.4  Starting the Master Job

With the system powered up and in TEACH mode:

1. Press the MAIN MENU key on the programming pendant.
2. Select the JOB icon using the cursor keys and press SELECT.
3. Cursor to SELECT JOB and press the SELECT key. The job list appears on display screen.
4. Using cursor keys, cursor to the Master job and press SELECT. The Master job appears on display screen.
5. Press the PLAY mode button on controller playback panel. Job playback operation is enabled.
6. Press the SERVO ON button on the programming pendant.
7. Reset the positioner by pressing the RESET button on the operator station.
8. Press the START button on operator station. The Master job cycles, waiting for a Cycle Start input from operator station.

The Modular FabWorld cell is now ready for operation.
5.2.5 Perform Operation Cycle

The following is the typical sequence of operation for the Modular FabWorld cell after start-up:

1. Load fixture in station 1.
2. Step out of safety light curtain.
3. Press the CYCLE START button on the operator station. The CYCLE LATCHED light comes on and the robots begin welding parts.
4. While the robots are welding, load station 2.
5. When parts are loaded, press the CYCLE START button on operator station; CYCLE LATCHED light comes on. When the robots are finished welding at station 1, they return to Home position allowing the operator to process parts at station 1.
6. Unload welded parts from the station 1.

Note: Before starting at first power up, make sure the correct job has been loaded.

5.2.6 Shutdown

Use the following procedure to shut down the Modular FabWorld cell after operation is complete:

1. Make sure robots are in the Home position.
2. Turn off system servo power by pressing E-STOP button on operator station or programming pendant.
3. Select TEACH mode on the programming pendant.
4. Set the main service disconnect switch to the OFF position.
5. Close welding gas supply.

The Modular FabWorld cell is now shut down.

5.3 System Recovery

When a system error or alarm occurs, you must clear the error or alarm to return the system to normal operation. The paragraphs below describe the different types of alarms and errors you may encounter and how to remedy them when you do.

5.3.1 Alarms and Errors

Alarms and errors will cause the program to stop. There are three levels of alarms and errors: Error Messages, Minor Alarms, and Major Alarms. For more detailed information about alarm recovery, refer to manipulator manual that came with your system.
5.3.1.1 Error Messages

These are simple errors such as pressing the START button when the robot is not in PLAY mode, or enabling the programming pendant when servo power is off. Clear these errors by pressing the CANCEL button on the programming pendant.

5.3.1.2 Minor Alarms

Minor alarms are usually programming errors. Minor alarms might occur if a circle has been programmed with fewer than three circular points, etc. Clear these errors by pressing the RESET (F5) soft key on the programming pendant.

5.3.1.3 Major Alarms

Major alarms are hardware failures. Major alarms might occur because of a servo tracking error or an abnormal speed and are usually associated with crashes. To clear these alarms, you must turn off the controller and then turn it on again.

5.3.2 E-STOP Recovery

An E-STOP can occur under any of the following conditions:

- Pressing E-STOP button on the operator station, programming pendant, or the playback panel.
- Opening the cell door on robot enclosure when robot is not in TEACH mode.
- Stepping into light curtain when positioner is sweeping.
- Actuating shock sensor on torch mount.

To restart the Modular FabWorld cell after an E-STOP condition occurs, proceed as follows:

1. To clear E-STOP condition, perform any of the following actions that apply:
   - Release E-STOP button on op, programming pendant, or controller playback panel.
   - Close cell door.
   - Step out of safety curtain.
   - Clear Shock Sensor condition (refer to Section 5.3.3).

CAUTION!
If an emergency stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when system is re initialized.

2. Press SERVO ON button on operator station or programming pendant.
3. Ensure robot is in remote mode.
4. Press START button on the operator station.

The Modular FabWorld cell is now ready to continue operation.
5.3.3 Shock Sensor Recovery

The ArcWorld welding package includes a Motoman gun mount. This mount is designed to protect the torch from damage in case of a crash. A slight deflection of the torch activates a SHOCK SENSOR message which triggers an E-STOP condition. To clear the E-STOP condition, you must override the shock sensor and move the robot clear of the impact. To override the shock sensor, proceed as follows:

⚠️ CAUTION!

It is possible to crash the robot with the Shock Sensor Override Switch left in the “Override” position. Always remember to reactivate the Shock Sensor before continuing system operation.

1. Press MAIN MENU on programming pendant.
2. Select ROBOT icon using cursor keys and press SELECT.
3. Cursor to OVERRUN-S.SENSOR and press SELECT key.
4. Select RELEASE to release shock sensor.
5. Turn servo power ON by holding ENABLE switch on the programming pendant and pressing SERVO ON.

icism: TEACH LOCK must be ON to turn servo power on in TEACH mode.


The Modular FabWorld cell is now ready to continue operation.

5.3.4 Brake Release

The robot brakes are designed to protect the robot and other system components from damage in the event of a system or robot failure and loss of drive power. If a system or robot failure occurs, it is often necessary to release the brakes on the robot to remove it from the crash site. To release the brakes, proceed as follows:

⚠️ WARNING!

Releasing brakes can cause personal injury or machine damage. Make sure the axis to be released is properly supported BEFORE proceeding.

1. On the programming pendant, select TEACH mode and turn servo power OFF.
2. Select ROBOT on the programming pendant touch screen.
3. Select the MANUAL BRAKE RELEASE option. A Warning dialog appears.
4. Select YES in the warning dialog box.
5. Select the axis to be released using the cursor key.
6. Engage the ENABLE switch and press the Interlock and Select keys.
7. The brake for the selected axis releases.
Notes
Chapter 6

Maintenance

Table 8 provides periodic maintenance items and intervals for the Modular FabWorld cell. Keep in mind that the maintenance intervals serve as guidelines only. You should adjust the frequency of maintenance to suit your specific work conditions.

For periodic maintenance procedures and schedules for the individual components of your Modular FabWorld, including the MH-Series positioners, refer to the additional manuals that came with your system.

CAUTION!
Use only the antifreeze provided by Motoman. Automotive antifreezes contain stop-leak additives that will clog small torch water-cooling ports and damage gaskets in water circulator pump.

Table 5 Periodic Maintenance

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Component</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>Water Circulator (Water-cooled Torch Application only)</td>
<td>Check the fluid in the water circulator. Add fluid as required. Use only distilled water and approved antifreeze (Motoman P/N 131224-1).</td>
</tr>
<tr>
<td>Daily</td>
<td>Safety Circuit Check</td>
<td></td>
</tr>
</tbody>
</table>

H=Hours of operation
Notes
Appendix A

Anchor Requirements

It is the purchaser's responsibility to determine and supply all anchoring and foundation requirements for their installation. Before installing your Modular FabWorld cell, refer to Table 16 to determine the anchor and foundation requirements for all the equipment used in your cell.

WARNING!
Do not mount robots directly to the floor without the indicated floor plate. Failure to follow floor plate requirements can result in severe damage or personal injury.

Table 6 Minimum Recommended Equipment Anchor Requirements

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Minimum &quot;Hilti&quot; Anchor Rod Diameter and Type</th>
<th>Minimum Floor Plate Requirements</th>
<th>Minimum Foundation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robots: UP6, UP20, UP20-6, EA1400, EA1900</td>
<td>(4) 5/8&quot; HVA Chemical Style anchor (See Note 3)</td>
<td>600 x 600 x 38.1</td>
<td>30&quot; x 30&quot; x 7&quot; thick, 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>Robots: UP20M, UP50, SP80 (See Note 2)</td>
<td>(4) 7/8&quot; HVA Chemical Style anchor (See Note 3)</td>
<td>900 x 900 x 50.8</td>
<td>60&quot; x 60&quot; x 9&quot; thick, 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>Robots: UP120, UP130, UP165, SP100, SP160, SP250, SP400 (See Note 2)</td>
<td>(4) 7/8&quot; HVA Chemical Style anchor (See Note 3)</td>
<td>1200 x 1200 x 50.8</td>
<td>72&quot; x 72&quot; x 9&quot; thick, 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>Robots: UP200</td>
<td>(8) 7/8&quot; HVA Chemical Style anchor (See Note 3)</td>
<td>1200 x 1200 x 50.8</td>
<td>72&quot; x 72&quot; x 9&quot; thick, 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>Robots: UP350, UP500, SK300X</td>
<td>(8) 7/8&quot; HVA Chemical Style anchor (See Note 3)</td>
<td>1500 x 1500 x 50.8</td>
<td>72&quot; x 72&quot; x 9&quot; thick, 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>Rotary Turntable Positioners:</td>
<td>5/8&quot; HVA Chemical Style anchor (See Note 3)</td>
<td>Not Applicable</td>
<td></td>
</tr>
</tbody>
</table>
## Table 6 Minimum Recommended Equipment Anchor Requirements

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Minimum &quot;Hilti&quot; Anchor Rod Diameter and Type</th>
<th>Minimum Floor Plate Requirements</th>
<th>Minimum Foundation Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunnion Style Positioners</td>
<td>7/8&quot; HVA Chemical Style anchor (See Note 3)</td>
<td>Not Applicable</td>
<td></td>
</tr>
<tr>
<td>Peripheral Equipment</td>
<td>1/2&quot; Kwik Bolt II Style anchor (See Note 4)</td>
<td>Not Applicable</td>
<td>3&quot; min Thick or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>Cell Fence Posts</td>
<td>3/8&quot; Kwik Bolt II Style anchor (See Note 4)</td>
<td>Not Applicable</td>
<td>3&quot; min Thick or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete</td>
</tr>
</tbody>
</table>

Note: (1) Minimum Robot Lagging Requirements are based on Maximum Repulsion Forces and Hilti Anchor Design Program V3.3b. (2) SP series robots require base plates and/or risers to be level within 2 degrees. Grout if necessary. (3) Reference source: Hilti Product Technical Guide Section 4.2.1 for hardware specifications or equivalent. (4) Reference source: Hilti Product Technical Guide Section 4.3.3 for hardware specifications or equivalent. (5) Robot manual requirements calling for cast-in anchors may be substituted with the recommendations listed. See also us.hilti.com or ca.hilti.com for further information.
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