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SECTION 1

INTRODUCTION

The FabWorld II DR2C (dual robot, two controller) 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.

The FabWorld II DR2C features two Motoman arc welding robots, two XRC 2001 controllers with menu-driven arc welding application software, two complete welding packages, rotary plane positioner, operator interface, and a total safety environment. The DR2C can be reconfigured from a dual robot system with the Master XRC 2001 controlling system operation to two separate robotic systems with independent control. For more information, please call the Motoman service staff at (937) 847-3200.

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 1.4. This manual contains the following sections:

SECTION 1 - INTRODUCTION

Provides general information about the FabWorld II DR2C 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 FabWorld II DR2C system.

SECTION 3 - DESCRIPTION OF EQUIPMENT

This section provides a detailed description of the major components of the FabWorld II DR2C system. This section also includes a table of component specifications.

SECTION 4 - INSTALLATION

This section provides instructions for set up and installation of the FabWorld II DR2C system.

SECTION 5 - OPERATION

This section provides instructions for basic operation of the FabWorld II DR2C system. This section also provides procedures for start-up, loading, normal operation, fault recovery, and shutdown.

SECTION 6 - MAINTENANCE

This section contains a table listing periodic maintenance requirements for the components of the FabWorld II DR2C cell.
1.2 System Overview

The FabWorld II DR2C provides a complete arc welding solution in a standardized configuration. The system is designed around two Motoman arc welding robots, two XRC 2001 controllers functioning as one, and includes two complete welding packages. Two rotary plane servo driven positioners 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 provides a full complement of safety features designed to protect both personnel and equipment. Figure 1-1 illustrates the system layout of the FabWorld II cell.

**Figure 1-1  System Layout**

*NOTE:* This manual is for a standard Motoman system. If your system is a custom or modified system, please use the drawing and Bill of Material (BOM) provided with the system for troubleshooting and spares provisioning.

1.2.1 System Layout

Both robot manipulators share a common base with each positioner for ease of installation and to help maintain proper alignment between the components. Both controllers and welding power sources also share a common base next to the welding cell. The robotic cell is fully enclosed by safety fencing with an interlocking door. Standing in the safety zone prevents robot or positioner motion. All operator controls, including those on the controllers and welding power supplies, are accessible from outside the safety fencing.
1.3 **Major Components**

The FabWorld II DR2C includes the following major components:

- Motoman UP6, UP20, or UP20-6 manipulators and XRC 2001 controllers
- Rotary plane positioner module
- Two operator stations
- Welding equipment, including the following:
  - Two welding power sources
  - Motoman torches (water-cooled or air-cooled)
  - Wire feeders
  - Torch mounts
- Safety equipment, including the following:
  - Safety fencing with arc curtains
  - Interlocked safety light curtains
  - Interlocked cell door
  - Positioner arc screen

1.3.1 **Optional Equipment**

The following optional equipment is available for use with the FabWorld II DR2C:

- Torch cleaner
- Com-Arc III seam tracking unit
- Water circulator

1.4 **Reference to Other Documentation**

For additional information refer to the following:

- Motoman UP6 Manipulator Manual (P/N 145960-1)
- Motoman UP20 Manipulator Manual (P/N 145965-1)
- Motoman UP20-6 Manipulator Manual (P/N 145962-1)
- Motoman Operator's Manual for Arc Welding (P/N 142098-1)
- Motoman Concurrent I/O Parameter Manual (P/N 142102-1)
- MH-series Positioner Manual with MotoMount and Drive Assemblies (P/N 146703-1)
- Com-Arc III Instruction Manual (P/N 132753-1)
- Coordination Instructions for Multi-axes Systems (P/N 139418-1)
- Vendor manuals for system components not manufactured by Motoman
1.5 **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 (UP6, UP20, or UP20-6)
- Application Type (welding)
- System Type (FabWorld II DR2C)
- Software Version (access using TOP KEY/SYSTEM INFO/VERSION/SYSTEM on the programming pendant)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of controller)
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 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).
SECTION 3  
EQUIPMENT DESCRIPTION

3.1  UP-series Robot Description
The Motoman UP6, UP20, and UP20-6 robots and XRC 2001 robotic controller represent state-of-the-art technology in robotics today. The six-axis UP6 robot has a payload of 6 kg (13.2 lbs). It features a 1,373 mm (54.05 in.) reach and has a relative positioning accuracy of ± 0.08 mm (0.004 in.). The six-axis UP20-6 robot has a payload of 6 kg (13.2 lbs). It features a 1885 mm (74.21 in.) reach and has a relative positioning accuracy of ± 0.06 mm (0.0023 in.). The six-axis UP20 robot has a payload of 20 kg (44.09 lbs). It features a 1658 mm (65.2 in.) reach and has a relative positioning accuracy of ± 0.1 mm (0.004 in.).

Each robot can reach below its own base as well as behind itself and can be mounted on the floor, wall, or ceiling with few modifications. However, the L and U-axis have been restricted by limiting devices for use in this system. For more information, refer to the manipulator manual that came with your system.

3.2  XRC 2001 Controller
The XRC 2001 robotic controller (see Figure 3-1) coordinates the operation of the FabWorld II DR2C 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 the following: main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the manipulator manual that came with your system.

Figure 3-1  XRC 2001 DR2C Controller
3.2.1 Playback Panel

The playback panel (see Figure 3-2) contains the primary system controls and consists of the features described below. For more information, refer to the manipulator manual that came with your system.

![Figure 3-2 XRC 2001 Playback Panel](image)

**Servo On Ready**
The SERVO ON READY pushbutton turns servo power ON. The switch lights when servo power is on. In TEACH mode, the SERVO ON READY pushbutton operates only when the TEACH LOCK button on the programming pendant is ON and the ENABLE switch on the programming pendant is held in.

**Mode**
The Mode push buttons (PLAY, TEACH and REMOTE) set the robot’s mode of operation.

*NOTE:* Changing modes from PLAY to TEACH, during playback, will cause the program to cease execution (similar to HOLD); to resume operation, press PLAY and then START.

**Alarm/Error**
The ALARM/ERROR indicator light turns ON whenever an alarm or error condition occurs.

**Emergency Stop (E-STOP)**
Pressing E-STOP ceases all system operation. The E-STOP button on the playback panel is connected in series with the system Emergency Stop circuit.

**Start**
Pressing the START button while in PLAY mode with servo power on, causes playback execution of the current job to begin.

**Hold**
The HOLD button is a normally closed, momentarily actuated switch. Pressing HOLD halts operation of the manipulator until another Start signal is sent.
3.2.2 Programming Pendant

The programming pendant (see Figure 3-3) is the primary user interface for the system. The pendant has a 4x5-inch, 12-line, 40-character LCD display and keypad. The system uses the INFORM II robot language and a menu-driven interface to simplify operator interaction with the robot. By using the pendant, the operator can teach robot motion, and perform programming, editing, maintenance, and diagnostic functions. The programming pendant consists of the items described below. For more information, refer to the manipulator manual that came with your system.

NOTE: The programming pendant LCD display goes dark after a few minutes of inactivity. Press any key to restore screen.

![Figure 3-3 Programming Pendant](image)

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

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

Emergency Stop (E-STOP)
The E-STOP button on the programming pendant is connected in series with the system Emergency Stop circuit. Pressing the E-STOP button interrupts this circuit 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)

**TOP MENU Key**

The TOP MENU key returns the pendant display to the initial start-up menu. The cursor key can then be used to choose from the following menu icons:

- **JOB**
  This icon 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 icon allows you to select the applications available to the controller.

- **VARIABLE**
  This icon accesses the display and editing menu for the arithmetic variables and display of position variables.

- **IN/OUT**
  This icon accesses DETAIL and SIMPLE displays of all controller I/O signals. In EDITING or MAINT. mode, Universal Outputs can be forced ON or OFF.

- **ROBOT**
  This icon 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 icon provides Version information for both hardware and software, Alarm History, and Monitoring Time.

**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.

**TEACH LOCK Key**
The TEACH LOCK key locks operation of the robot with the programming pendant. Operation is not possible from the playback panel or operator station. Servo power can not be applied in TEACH mode unless TEACH LOCK is ON.

**RS-232C Serial Port**
This 9-pin serial port (see Figure 3-4) is used for data communication between the controller and a floppy disk controller (FC1 or FC2), FDE (Floppy Disk Emulator) software, or other form of communication.

![Figure 3-4 RS-232C Serial Port](image)

**ENABLE Switch**
The ENABLE switch (see Figure 3-5) 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 disabled, preventing further robot movement.

![Figure 3-5 Enable Switch](image)
### 3.2.3 Brake Release

![WARNING!](#)

**Releasing brakes could cause personal injury or machine damage. Always support the axis to be released BEFORE you release it.**

The Brake Release Control is a safety feature that allows you to release the automatic brakes on the robot in case of an emergency or robot failure. The Brake Release Control is mounted on the front of the controller cabinet (see Figure 3-1).

Provide adequate support for axis to be released. Support should be able to withstand the payload and the approximate weight of robot.

### 3.3 Operator Stations

Both operator stations (see Figure 3-6) include a NEMA enclosure on a standalone pedestal. The following paragraphs describe the operator station controls.

![Figure 3-6 Operator Station](#)

#### 3.3.1 Cycle Start

![WARNING!](#)

**The operation of the CYCLE START palm buttons 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 palm button, located on the operator station, initiate a positioner sweep cycle if the robot is in the Safe or Home position (Cube 24). If the CYCLE START button is pressed while the robot is outside Cube 24, the CYCLE START command is latched into the controller. Once the robot returns to Safe of Home position Cube 24 and CYCLE LATCHED lamp is on, the CYCLE START command is executed and the positioner sweeps.
3.3.2 **Emergency Stop (E-STOP)**

The operator station E-STOP button is connected to the system Emergency Stop circuit. Pressing the E-STOP button interrupts this circuit and stops all system operation. Brakes are applied to the robot and all servo power is removed from the system.

3.3.3 **Hold**

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

3.3.4 **Cycle Latched**

CYCLE LATCHED indicates that the positioner will sweep and begin to weld immediately after the current weld cycle is complete. The CYCLE LATCHED lamp operates illuminates when positioner CYCLE START command has been latched. It is not necessary to wait for the robot to finish welding and return to the Safe position (Cube 24) before pressing the CYCLE START palm buttons to sweep the positioner. Pressing the Cycle Start palm button while the robot is still in motion locks the CYCLE START command into the controller. The CYCLE LATCHED light comes on, indicating CYCLE START latching. The positioner sweeps once the robot finishes the current job and return to the Safe position (Cube 24). Stepping in the safe guarded area will unlatch the CYCLE START command from the controller.

3.3.5 **Alarm**

The ALARM lamp is connected to the robot ALARM OCCURRENCE outputs. The ALARM lamp turns on when the robot encounters an alarm condition.

3.3.6 **Three-position Joystick**

A spring loaded joystick controls positioner rotation to access the user defined load position(s). Moving the joystick right (forward) and letting go rolls the fixturing into the robot at 30-degree intervals. Moving the joystick left (reverse) and letting go rolls the fixturing away from the robot at 30-degree intervals. Home position on the joystick resets the headstock to zero degrees.

3.3.7 **Start**

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

3.3.8 **Operator Station Enable/Disable**

The OPERATOR STATION ENABLE/DISABLE selector switch transfers primary control of the ArcWorld cell from the controller to operator station. The REMOTE MODE button on controller playback panel lights when the operator station is enabled. Most programming pendant functions are disabled while in REMOTE.
3.3.9  **Reset**

A minor alarm or error condition is cleared when the RESET button is pressed. The RESET button is connected to the robot alarm reset input. A minor alarm or error condition is cleared when this button is pressed.

3.3.10  **Servo On**

The SERVO-ON pushbutton enables servo power. In remote PLAY mode, the SERVO ON pushbutton operates the same as the SERVO READY push button on the front of the controller.

3.4  **Positioner Module**

Because the FabWorld II DR2C cell has two welding stations it may be equipped with two stationary flat table positioners, two MHT-series positioners, or a combination of each.

3.4.1  **MHT-series Positioner**

There are three headstock and tailstock positioner systems available with the FabWorld II DR2C: MHT340, MHT450, and the MHT1500. These positioner systems include a headstock drive assembly, tailstock column, and the MotoMount tool mounting system. The MHT340 and MHT450 both provide 2925 mm (115.16 in.) nominal pin to pin tooling span, and 1542 mm (60 in.) tooling diameter. The MHT1500 provides 2912 mm (114.64 in.) nominal pin to pin tooling span, and 1542 mm (60 in.) tooling diameter.

Refer to the MH-series Positioner Manual with MotoMount and Drive Assemblies (P/N 146703-1) for MotoMount and MH450/MH1500 technical details. Refer to Table 3-1 for MHT340 technical details.

**NOTE:** In high humidity areas, use surface protection to prevent corrosion of the tooling plates.

### Table 3-1  MH340/680 Positioner Specifications

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated Load Capacity</strong></td>
<td></td>
</tr>
<tr>
<td>MH only</td>
<td>340 kg (750 lbs) load, center of gravity, 152 mm (6 in.) turning off-center. 152 mm (6 in.) overhang</td>
</tr>
<tr>
<td>MHT</td>
<td>680 kg (1500 lbs.), center of gravity at 76 mm (2.99 in.).</td>
</tr>
<tr>
<td><strong>Max. Load Capacity</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>515 kg at 150 (5.90 in.) center of gravity off-center. 152 mm (6 in.) overhang</td>
</tr>
<tr>
<td></td>
<td>1000 kg at 88 mm (3.46 in.) center of gravity off-center.</td>
</tr>
<tr>
<td><strong>Rotation</strong></td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>0 to 12.4 RPM variable speed.</td>
</tr>
<tr>
<td>Sweep Time</td>
<td>3 seconds for 180-degree sweep</td>
</tr>
<tr>
<td>Rated Load Inertia</td>
<td>75 kg·m²</td>
</tr>
<tr>
<td>Max. Load Inertia</td>
<td>140 kg·m²</td>
</tr>
<tr>
<td><strong>Temperature Operating Range</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4–43°C (40–110°F)</td>
</tr>
</tbody>
</table>
3.4.2 Stationary Flat Plane Module

The stationary flat plane module is a steel table with a ground flat steel top.

Table 3-2  Stationary Flat Plane Specifications

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work Surface</strong></td>
<td><strong>907.2kg (2000 lbs)</strong></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>3599.94mm L x 609.6mm W x 899.92mm H x 12.7mm thick</strong></td>
</tr>
<tr>
<td><strong>(141.73 in.L x 24 in.W x 35.43 in.H x 3/4 in. thick)</strong></td>
<td></td>
</tr>
</tbody>
</table>

3.5 Welding Equipment

In its standard configuration, the FabWorld II DR2C system includes two power sources, wire feeders, torches, and torch mounts. Optional equipment including water circulators, Com-Arc units, and torch cleaners may be included to enhance performance.

3.5.1 Power Sources

Motoman offers several different power sources for use with the FabWorld II DR2C system depending on your system’s application. Figure 3-7 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.
3.5.2 **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. The wire feeder may have an inch forward button to help simplify set-up and reduce change-over time. Interchangeable feed rolls are used to accommodate different types and sizes of wire.

Figure 3-7  Available Power Sources
3.5.3 **GMAW Torch**

The FabWorld II DR2C system uses either an air-cooled or a water-cooled robotic/automatic GMAW torch. These are heavy-duty torches designed for quick replacement while requiring minimum robot reprogramming. The GMAW torch is installed at the end of the robot wrist. For applications that use the water-cooled torch, the FabWorld II DR2C system includes a water circulator kit.

3.5.4 **Motoman Torch Mount**

The Motoman Torch Mount protects the robot, workpiece, fixture, and positioner. It provides multi-directional impact detection, including Z-axis collisions. Torch impact causes a system E-STOP and immediately stops all system operation. Servo power is removed from the system and brakes are applied to the robot. All positioner motion is also stopped.

3.6 **Safety Features**

The FabWorld II DR2C system incorporates a host of safety equipment. When all standard safety precautions are taken, the safety equipment helps to ensure safe operation of the robotic cell.

**ANSI/RIA R15.06 Robot Safety Standard**

This standard stipulates that the user is responsible for safeguarding.

ANSI/RIA R15.06: 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.

**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 **Brake Release**

**WARNING!**

*Releasing brakes could cause personal injury or machine damage.*

*Always support the axis to be released BEFORE you release it.*

The Brake Release Control is a safety feature that releases the automatic brakes on the robot in case of an emergency or robot failure. The Brake Release Control is mounted on the front of the controller cabinet (see Figure 3-1). Refer to Section 5.3.4 for the proper operation of the brake release.
3.6.2 Safety PLC – Programmable Logic Controller

The FabWorld II DR2C system comes with a safety PLC (see Figure 3-8). The PLC monitors a large portion of the cell’s safety components. These cell components are first interfaced into the PLC and then into the XRC 2001 Controller. The safety PLC is responsible for monitoring the gate interlock, safety light curtains, operator station E-stops, and the In-position signals generated from the positioners. (Refer to system prints for additional signals that may be interfaced to the PLC.) The PLC monitors the status of the safety devices and is dependant on the status of the inputs. The PLC determines if an E-stop condition should occur. Refer to the safety PLC manual provided with the system for more details on the operation of the PLC and its associated fault codes.

- Due to the boot-time of the safety PLC, a Safety Gate Fault condition will occur each time power is applied to the system. Once the safety PLC is fully booted, the Safety Gate Fault condition will clear if all other conditions are met.
- Modifications to the PLC program without prior approval could cause personnel injury or invalidate the system warranty.
- All safety-related function blocks used in the ladder program, resident in the safety PLC, have been created and tested by the PLC manufacturer.
- The safety PLC will auto-reset itself in the event of a predictable error (for example: breaking light beams while sweeping, opening safety gate while in PLAY). In some instances, a nonauto-resetting error may occur. In this case, either cycle power to the whole system or simply toggle the switch on the front of the safety PLC from RUN to STOP back to RUN. If the fault occurs again after resetting, consult the safety PLC manual and the system prints.

![Figure 3-8 Safety PLC Location](image-url)
### 3.6.3 Arc Screens

**WARNING!**

*Cite* 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.

### 3.6.4 Fencing

The safety fencing provided with the FabWorld II DR2C system encloses the entire robotic cell. It forms a physical barrier preventing entry into the robot operating envelope during automatic operation.

### 3.6.5 Light Curtains

The FabWorld II DR2C light curtains help prevent serious injury to anyone entering the positioner area during the sweeping process. In PLAY mode, if the positioner is sweeping and a light curtain is activated, servo power is removed from the system and all positioner/robot motion stops. Servo power is reapplied by pressing SERVO ON.

If the positioner is not in motion but the CYCLE START input has been latched (indicated by the CYCLE START light), the CYCLE START input is unlatched and the CYCLE START light turns off when the light curtain is activated. Servo power remains ON.

### 3.6.6 Emergency Stops (E-STOPs)

In addition to the safety features described above, the FabWorld II DR2C 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 robot and positioner motion is stopped. The following is a list of their locations:

- playback box on the controller
- programming pendant
- operator stations

### 3.6.7 Safety Gate Stop

Servo power is removed and brakes are applied during a safety gate stop, however the operator can still turn servo power on to move the robot or positioner by using TEACH MODE on the teach pendant.

A safety gate stop will occur on the following conditions:

- Safety gate open
- Operator steps into light curtains when robot is in station
- Operator steps into light curtains when positioner is not on in-position switches
- Robot trips L or U axis over travel switches

The teach pendant will display SAFETY GATE on all of the above conditions.
3.6.8 **Teach Pendant ENABLE Switch**

The ENABLE switch is a safety feature which controls servo power while in TEACH mode. When pressed, this switch allows the operator to turn servo power ON the robot. 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 XRC 2001 section in the manipulator manual that came with your system.

3.6.9 **Interlocked Cell Door**

A safety interlock on the cell entrance door prevents entry into the cell during PLAY mode. Opening the cell door with the robot in PLAY causes a SAFETY GATE STOP. Brakes are applied to the robot and all servo power is removed from the system.

3.6.10 **Welding Ground System**

The welding ground system consists of a spring-loaded, copper brush block that contacts the backside of the faceplate. The ground cable to the welding power source is connected to this brush block.

*NOTE:* The ground cable connection to the brush block must be secure. If the connection is loose, arcing can occur and cause the insulator to melt.

3.6.11 **Interference Cubes**

Cubic interference zones prevent interference between multiple manipulators or a manipulator and peripheral devices. The XRC 2001 controller monitors the robot tool center point (TCP) during operation. If the TCP enters one of these software-defined interference zones, an output is turned on in the XRC 2001. These outputs can be used to interlock the activity of other manipulators or peripheral devices. The XRC 2001 controller has eight possible cubes available. These cubes are internally tied to the following **Specified Outputs**:

\[ R1 = SOUT \#081 - 104 \]

The FabWorld II DR2C uses interference cubes to interlock robot position with positioner motion. The robot Home or Safe position (Cube 23 and Cube 24) is defined behind the positioner, clear of the sweep zone. Before the positioner can sweep, the robot must be in this safe position.
SECTION 4
INSTALLATION

The FabWorld II DR2C 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.

**CAUTION!**
Installation of the FabWorld II DR2C system is not a task for the novice. The FabWorld II DR2C 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 FabWorld II DR2C system is included with the system. This section identifies customer-supplied items and tools required to perform installation.

4.1.1 Customer-supplied Items

- Gas for the welding torches
- Incoming power supply
- Two earth ground cables with two earth ground stakes
- Weld wire
- Stepladder
- Forklift and/or overhead crane

4.1.2 List of Tools

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

To prepare your site, proceed as follows:

1. Clear the floor space needed for the unit (see Figure 4-1).

   **NOTE:** When clearing space for the cell, Motoman recommends an additional 2.5 to 3.0 m (8 to 10 ft) on all sides after installation.

2. Gather all customer-supplied items and required tools (see Section 4.1.2).

---

**Figure 4-1 Area Needed for Installation**
4.3 **Installing the Robot /Positioner Common Base**

The robot/positioner common base and the operator station are shipped on a wooden shipping skid. To install the common base, proceed as follows:

**CAUTION!**

*Handle FabWorld II DR2C components carefully to avoid damage.*

1. Unbolt the robot/positioner common base from wooden shipping skid using a 3/4 in. socket (see Figure 4-2).

**WARNING!**

*The robot/positioner common base weighs 1905kg (4200 lbs). Be sure that your crane or forklift is capable of handling this much weight or damage to the equipment or injury to personnel can result.*

2. Using a forklift, remove common base from wooden shipping skid.

3. Place robot/positioner common base in position.

**NOTE:** Make sure there is adequate room on all sides of the positioner for the operator station, safety mats, and auxiliary equipment common base.

4. Carefully remove protective plastic wrapping from robot and torch.

5. Inspect robot, torch, and positioner for shipping damage.

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

6. Remove operator station from skid and set safely aside.
4.4 Installing the Auxiliary Equipment Common Base

The auxiliary equipment common (AEC) base contains the XRC 2001 controller and the welding power source. It may also include the optional water circulator and/or ComArc III unit. The AEC base is shipped on a separate wooden shipping skid. The accessories box is secured to the top of the welding power source. To install the AEC base, proceed as follows:

1. Unbolt AEC base by removing four shipping bolts (see Figure 4-3).

**WARNING!**

*The AEC base weighs 1600 kg (3520 lbs). Be sure that your crane or forklift is capable of handling this much weight or damage to the equipment or injury to personnel can result.*

2. Using a forklift, lift base and remove it from wooden shipping skid.

![Figure 4-3 Unbolting Auxiliary Equipment Common (AEC) Base](image)

3. Place AEC base approximately 0.6 m (2 ft) beside FabWorld II DR2C cell (see Figure 4-4).
4. Carefully remove plastic wrapping and cardboard from AEC base.
5. Remove accessories box from welding power source and set safely aside.
6. Inspect AEC base for any shipping damage.

**NOTE:** If damage is found, notify shipper immediately.
4.5 Positioner Location Adjustment

Both the headstock and tailstock are moved inward on the common base for shipping purposes. The welding cell can be safely operated with these components shifted in, however, moving the headstock/tailstock out will allow larger parts to be fixed to the positioner. To move each piece, simply remove the four bolts at the base and carefully slide (see Figure 4-5) the headstock/tailstock forward to the next set of predrilled holes. Then insert the bolts to reattach the headstock/tailstock components.
4.6 Installing the Operator Station

To install the operator station, 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 shipper immediately.

4. Place operator station outside fence to front of positioner (see Figure 4-4).
5. Insert a 1/4 in. 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.

4.7 Leveling and Securing the Equipment

After everything is in position, level the equipment and secure it to the floor. The lag bolts are shipped in the accessories box. To level and secure the equipment, proceed as follows:

1. Level robot/positioner base by adjusting leveling bolts (see Figure 4-6).
2. Insert a 1/2-in. concrete drill bit through center of leveling bolts and drill holes for lag bolts.
3. Vacuum concrete dust from holes.
4. Lag robot/positioner common base to floor.
5. Level AEC base by adjusting leveling bolts (see Figure 4-6).
6. Insert a 1/2-inch concrete drill bit through center of leveling bolts and drill holes for lag bolts.
7. Vacuum concrete dust from holes.
8. Lag auxiliary equipment common base to floor.
Figure 4-6  Robot/Positioner Base Leveling Bolts
4.8 Connecting the Cables

After components are level and securely in place, the cables should be unwrapped from around the equipment and laid out according to the cable diagram included in the system drawing package. Each cable connection is clearly identified for ease of installation.

**CAUTION!**

*Route wires and cables away from hazardous work areas to avoid wire breakage and unnecessary interruption of cell operation.*

4.8.1 Connecting the Earth Ground

The robot and the controller must each be connected to an earth ground. An earth ground is a ground in which the equipment is connected to a ground stake driven into the earth. The ground stake must be driven a minimum of 2.4 m (8 ft) into the earth, and the earth must be treated with chemicals in order to reduce resistance to the ground stake. Deeper ground stakes may be required depending on area soil conditions. A maximum of 100 ohms ground resistance is recommended. To ground the robot and the controller, proceed as follows:

**WARNING!**

- If proper earth grounds cannot be provided, do not use the equipment! Serious injury or death can occur.
- Do not place the MIG system within 15.2 m (50 ft) of other sources of noise (i.e., GTAW arc starters, plasma cutters, induction furnaces, high-power-resistance spot welders, dielectric heaters, etc.). Equipment that generates impulse or high-frequency noise can cause unexpected equipment operation and failure, which can result in serious injury or death.

**NOTE:** If the robot and the controller are within 4.5 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 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.
### 4.8.2 Connecting the Robot Cables

Two cables, 1BC and 2BC, connect the robot to the controller. The 2BC cable supplies power to the robot servo motors. The 1BC cable provides communication between the controller and the robot.

**CAUTION!**

Route wires and cables inside robot/positioner common base to avoid wire breakage and unnecessary interruption of cell operation (see Figure 4-7).

![Figure 4-7 Robot Cable and Hose Routing](image)

If the robot has a water-cooled torch, two cables and three hoses must be connected to various components. If the robot has an air-cooled torch, two cables and one hose must be connected to various components. These cables and hoses are enclosed in a leather casing. In addition to these cables, the robot I/O and power cables must be connected to the robot. To connect the robot and system cables and hoses, proceed as follows:

1. Unpack programming pendant and plug connector into receptacle on right side of the controller.
2. Unpack two large black manipulator cables, connected to the controller, and route to back of robot (see Figure 4-7).
3. Carefully engaging connectors, connect two cables (labeled 1BC and 2BC) to 1BC and 2BC connections on back of robot (see Figure 4-8).
4.8.3 Connecting Water Circulator (Optional)

If your system uses the water-cooled welding torch, it is necessary to connect the Motoman water circulator. To connect the water circulator, proceed as follows:

1. Connect two water hoses for weld torch to connections on water circulator marked WATER-IN and WATER-OUT (see Figure 4-9).

2. Plug power cable into electrical outlet on back of power source.
4.9 Connecting the Power

After all of the system components have been properly installed, connect the power to the FabWorld II DR2C. To connect incoming power to the FabWorld II DR2C, proceed as follows:

**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 or damage could occur.*

1. Install 3-phase power wiring to the circuit breaker located inside the left wall of the controller cabinet (see Figure 4-10).
2. Tighten screws to the torque indicated on the engineering layout drawings.

![Diagram of power connections](image)

**Figure 4-10 Incoming Power Connections**

3. Install an M5 lug on the incoming ground wire.
4. Terminate the ground wire to the frame ground M5 threaded stud with M5 hardware provided.

**NOTE:** The FabWorld II DR2C is configured for three-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 and electrical diagrams that came with your system.
4.10 Conducting a Safety/Operation Check

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

1. Be sure the safety light curtains are placed correctly.
2. Check that the cell door is closed and latched.
3. Check that all cable connections are tight.
4. Check air line connections to the optional torch cleaner and wire cutter.
5. Be sure that the welding power source is set correctly (refer to the welding power source vendor’s manual).
6. Verify that incoming line power matches the input power specified on the sticker on the front of the controller.

Your FabWorld II DR2C 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 system. Turn the main power ON, and continue the safety/operation check.

7. Check operation of all system E-STOPS (pendant, operator station, breakaways, playback panel).
8. Check operation of system Hold buttons.

4.11 Installation of Tooling and Fixtures

Your FabWorld II DR2C 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.
SECTION 5
OPERATION

The FabWorld II DR2C is a fully integrated robotic GMAW welding cell. The robot welds parts on the active station. Once the robots are finished with this process, they return to the safe position. The operator is then able to enter the safety zone and safely process the parts.

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.

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. The application programs may assign values to memory locations in the controller. Consult your system documentation before modifying your system. If you need to modify existing jobs, make copies of originals first. This way you will always be able restore your systems to the original configuration. 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 1.5).

5.1.1 I/O Assignment

The FabWorld II DR2C uses the following user and dedicated inputs and outputs

<table>
<thead>
<tr>
<th>XRC 2001 Dedicated Inputs</th>
<th>XRC 2001 Dedicated Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo On</td>
<td>Servo Power ON</td>
</tr>
<tr>
<td>External Job Start</td>
<td>TEACH mode</td>
</tr>
<tr>
<td>Alarm Reset</td>
<td>Cube 23</td>
</tr>
<tr>
<td>REMOTE mode ON</td>
<td>Cube 24</td>
</tr>
<tr>
<td>Hold</td>
<td>Alarm Occurrence</td>
</tr>
<tr>
<td>External Emergency Stop</td>
<td></td>
</tr>
</tbody>
</table>

For more information on user and dedicated I/O, refer to the XRC Concurrent I/O Parameters Manual (P/N 142102-1).

5.1.2 Programming the Positioner

The rotation axis of the positioner(s) is controlled by the controller external axis function. The motion points for the external axes are taught and recorded in the program in the same manner as any of the robot axes. The speed and position are controlled by the controller. Pressing the EXT AXIS button on the teach pendant changes the motion keys from robot axis keys to positioner axis keys. Refer to the Independent/Coordinated function instruction more information P/N 142969-1 for programming the positioner and robot.
5.2 **Daily Operation**

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

- Perform Start-up Procedures.
- Move robots to Safe position.
- Select master job.
- Perform Operation Cycle.
- Perform Shutdown Procedures.

### 5.2.1 Start-Up

To start up the FabWorld II DR2C cell from a Power-Off condition, proceed as follows:

1. Turn on welding power source disconnect.
2. Set MAIN POWER switch on controller to ON.
3. Set INPUT POWER switch on welding power source to ON.
4. Open regulator valve on welding gas supply.
5. Make sure enclosure door is closed and securely latched.
6. Disable operator station.
7. Press TEACH mode button on controller playback panel.
8. Place robots in Safe position (Cube 23 and Cube 24).

### 5.2.2 Robot Safe (Cube 23 and Cube 24) Position

To move the robots to the Safe position (Cube 23 and Cube 24), proceed as follows:

1. Press TEACH mode button on controller playback panel.
2. Press TOP 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. The Safe job appears on display screen.
6. Turn servo power ON by pressing SERVO ON, pressing TEACH LOCK and holding in ENABLE switch.
7. Use INTERLOCK and FWD buttons on programming pendant to jog robots to Safe (Cube 23 and Cube 24) position.

### 5.2.3 Starting the Master Job

With the system powered up and in TEACH mode, call up the Master job, then proceed as follows:

1. Press TOP MENU key on programming pendant.
2. Select JOB icon using cursor keys and press SELECT.
3. Cursor to SELECT JOB and press SELECT key. Job list appears on display screen.
4. Using cursor keys, move cursor to “Master” job and press SELECT. Master job appears on display screen.
5. Make sure the enclosure door is closed and securely latched.
6. Press PLAY mode button on controller playback panel. Job playback operation is enabled.
7. Press SERVO ON button on playback panel.
8. Place ENABLE/DISABLE switch on operator station in ENABLE position. The controller is placed in REMOTE mode and system control is transferred to operator station.
9. Press START button on operator station. The job cycles, waiting for a Cycle Start input from an operator station.

The FabWorld II DR2C cell is now ready for operation.

### 5.2.4 Sample Jobs

This system has arrived with numerous jobs already programmed as an example for cell operation. The system has been tested prior to shipment with these jobs for proper operation and changing the jobs will change the operation of the system.

**Adding a User Job**

To add a user job into the system, the following steps should be followed:

1. Create a robot job that contains the operation to be completed by the robot. This job can be created on either side and shifted to other side using the mirror shift function. Refer to the Independent/coordinated Function Manual for further instructions regarding mirror shifting.
2. Determine a 2-digit number that refers to the job. This number will be used to call the job from the thumb wheel located on the operator station.
3. Using the examples provided in the “Work 1” or “Work 2” job, add the created job into that structure. Refer to the Independent/coordinated Function Manual for information regarding PSTART and PWAIT instructions.
4. The system will now run the programmed job when the 2-digit number is displayed on the thumb switch.

A list should be maintained to inform the operator of the job/number relationship to prevent inadvertent operation of the incorrect job during operation.

### 5.2.5 Perform Operation Cycle

1. Load parts onto the fixture in station 1. Check the thumb wheel is selected to the correct number for the parts loaded.
2. Press the CYCLE START palm button on operator station. CYCLE LATCHED light comes on and robots begins welding parts at station 1.
3. During station 1 welding process, load station 2 fixture with parts on both sides and press CYCLE START palm button.
4. When the robots finishes welding, it returns to Home position then begins welding in station 2. This allows the operator to enter station 1 and process parts.

**NOTE:** Before sweeping at first power up, make sure the correct job has been loaded.

### Daily operation

Upon completion of the start up procedure, with the master job selected and operating, the jog switches on the operator station are active. The fixture can now be rotated to facilitate part loading. After loading the fixture the positioner must be returned to the home position.
**CAUTION!**  
*The positioner will move to the start position.*

The operator should be clear of the safety light curtains or the servo power will immediately be removed as the headstock moves off the in-position switches.

**NOTE:**  
*Before sweeping at first power up, make sure the correct job has been loaded.*

**Loading the Positioner**

The headstock tooling plate can be rotated from the home position (zero degrees) using the three-position joystick at the operator station. Moving the joystick **FORWARD** rotates the headstock tooling plate clockwise while moving it to **REVERSE** rotates the tooling plate counterclockwise.

As the tooling plate rotates, a factory installed screw located at home position, activates a limit switch. When activated, the limit switch overrides the safety light curtain functions. That allows operator access to the positioner without disrupting cycle time in the other station.

Safety light curtain functions are active during rotation of the headstock because the next tooling plate screw has not yet reached the limit switch.

Five user defined load positions (see Figure 5-1) are available on the tooling plate at 30-degree intervals.

**NOTE:**  
*Do not enter the work area to load parts until the positioner has stopped moving. Failure to wait will remove servo power.*

**Home Position**

Once the positioner is loaded properly, step out of the safety light curtain and select **HOME POSITION** on the joystick. The headstock will rotate back to zero degrees position with the screw(s) activating the limit switch to allow **CYCLE START**.

Depress the **CYCLE START** push button now to permit the robots to sweep the positioner and begin to weld when ready.
Figure 5-1   MH-340/450 – Home/User Defined Load Positions

NOTE: Locating the user-defined home position for the MHT450 is found in the MH-series Positioner Manual with MotoMount and Drive Assemblies.

5.2.6 Shutdown

Use the following procedure to shut down the FabWorld II DR2C cell after operation is complete:

1. Make sure the robots are in the Safe position (Cube 23 and Cube 24).
2. Turn off system servo power by pressing E-STOP button on operator station, programming pendant, or playback panel.
3. Press TEACH mode button on playback panel.
4. Set controller Main Power switch to OFF position.
5. Set Main Power switch on welding power source to OFF position.

The FabWorld II DR2C cell is now shut down.
5.3 System Recovery

Under certain conditions you will be required to clear an alarm or error. Clearing an alarm or error requires different operator actions depending on the type. 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.

Error Messages

These are simple errors such as pressing the START button when the robot(s) is not in PLAY mode, or enabling the programming pendant without the servo power being live. Errors like these are cleared by pressing the CANCEL button on the programming pendant.

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. These alarms are cleared by pressing the RESET (F5) soft key on the programming pendant.

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 or Safety Gate Recovery

An E-STOP or Safety Gate Recovery can occur under any of the following conditions:

- Pressing the E-STOP button on the operator station, programming pendant, or playback panel.
- Opening sliding door on robot enclosure when robot(s) is in PLAY mode.
- Stepping into safety light curtains when positioner is sweeping.
- Actuating shock sensor on torch mount.

To restart the FabWorld II DR2C system after an E-STOP condition occurs, follow the procedure below.

1. To clear E-STOP or Safety Gate Recovery condition, perform any of the following actions that apply:
   - Release the E-STOP button on the operator station, programming pendant, or controller playback panel.
   - Close sliding door.
   - Step out of safety light curtain.
   - Clear Shock Sensor condition (see Section 5.3.3).
5.3.3 Shock Sensor Recovery

The FabWorld II DR2C 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(s) 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 TOP 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.

**NOTE:**
- NOTE:TEACH LOCK must be ON to turn servo power on in TEACH mode.
- NOTE:Robot motion type must be JOINT motion.

The FabWorld II DR2C cell is now ready to continue operation.

5.3.4 Using the Brake Release

The brake release control panel is located on front of the controller. Each axis brake is controlled by a brake release button. Simultaneously pressing the ENABLE button and one of these axis buttons releases the indicated axis. To release the brakes, proceed as follows:

1. Press E-STOP button on programming pendant, playback panel, or operator station, to be sure servo power is OFF.
2. Provide adequate support for axis to be released. Support should withstand payload of robot and approximate weight of robot. Listed below is the weight of each robot available:
   - UP6 – 135 kg (297 lb)
   - UP20 – 280 kg (614 lb)
   - UP20-6 – 260 kg (628 lb)

**WARNING!**

*Releasing brakes could cause personal injury or machine damage. Always support the axis to be released BEFORE you release it.*

3. Release specific axis brake by pressing and holding corresponding axis button and ENABLE button at same time.

**NOTE:**  You must hold both the axis and ENABLE buttons down for the axis to remain released. Releasing either button will automatically lock the brakes again.
SECTION 6
MAINTENANCE

NOTE: For all issues regarding MotoMount and the MH450/MH1500 positioners, refer to the MH-series Positioner Manual with MotoMount and Drive Assemblies, P/N 146703-1.

6.1 Periodic Maintenance

Table 6-1 provides periodic maintenance items and intervals for the FabWorld II DR2C system. 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 FabWorld II DR2C, refer to the manipulator and additional manuals that came with your system.

6.2 Maintenance Schedule

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

Table 6-1 Periodic Maintenance

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Component</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>Water circulator (For water-cooled torch applications 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>Weekly</td>
<td>Wire Cutter (option)</td>
<td>Clean the unit with detergent machine cleaner. Apply grease to the wire cutting mechanism through the grease zerk provided.</td>
</tr>
<tr>
<td>6 Months</td>
<td>Wire Feeder</td>
<td>Clean feed roll grooves with industrial machine cleaner. Replace feed rolls as required.</td>
</tr>
<tr>
<td>Annually</td>
<td>Water Circulator Kit (option)</td>
<td>Flush the system completely. Refill as needed.</td>
</tr>
</tbody>
</table>
### 6.2.1 MH-series Positioners

See Table 6-2 for the periodic maintenance schedule.

**Table 6-2 Maintenance Schedule**

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Frequency</th>
<th>Inspection Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical damage</td>
<td>Daily</td>
<td>Check for physical damage; this indicates a load collision and is evidence of misuse.</td>
</tr>
<tr>
<td>Excessive or unusual noise</td>
<td>Daily</td>
<td>Listen for grinding, excessive or irregular noise. Contact Motoman Service Department at (937) 847-3200.</td>
</tr>
<tr>
<td>Weld Brushes</td>
<td>First Week</td>
<td>Check for dirt and ensure full contact with faceplate.</td>
</tr>
<tr>
<td></td>
<td>Weekly</td>
<td>Check for dirt and ensure full contact with faceplate.</td>
</tr>
<tr>
<td>Cleaning</td>
<td>As required</td>
<td>Clean with dry cloth or compressed air.</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Every 20,000 hours or 5 years</td>
<td>Flush and relubricate using Molywhite grease.</td>
</tr>
</tbody>
</table>

### 6.3 Troubleshooting

#### 6.3.1 MH-series Positioners

**Table 6-3 Troubleshooting**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor does not start</td>
<td>Loose connection</td>
<td>Check all wire connections.</td>
</tr>
<tr>
<td></td>
<td>Incorrect wiring</td>
<td>Check that system has been wired correctly.</td>
</tr>
<tr>
<td></td>
<td>Overload</td>
<td>Reduce load or use larger rated motor.</td>
</tr>
<tr>
<td>Motor overheats</td>
<td>Excessive ambient temperature</td>
<td>Reduce ambient temperature below 40° C (104° F). Positioner has an operating range of 0 to 45° C (32 to 113°F).</td>
</tr>
<tr>
<td></td>
<td>Motor surface is dirty</td>
<td>Clean motor surface.</td>
</tr>
<tr>
<td></td>
<td>Motor overloaded</td>
<td>Reduce load or use larger rated motor.</td>
</tr>
<tr>
<td>Unusual noise</td>
<td>Motor loosely mounted</td>
<td>Tighten mounting bolts.</td>
</tr>
<tr>
<td></td>
<td>Positioners misaligned</td>
<td>Realign headstock/tailstock</td>
</tr>
<tr>
<td></td>
<td>Noisy bearing</td>
<td>Check alignment, noise of bearing, lubrication. Call Motoman Service.</td>
</tr>
<tr>
<td>Weld quality bad</td>
<td>Brushes misaligned</td>
<td>Remove brush(s) and reinstall them properly. Recheck as needed.</td>
</tr>
</tbody>
</table>
6.4 **Fuse and Circuit Breaker Protection**

In most cases, spare fuses are placed in the accessory bag with the controller.

**WARNING!**

Replace fuses with those of the same type and rating. Replacement with fuses of higher amperage rating or lower voltage will damage the robot controller and/or auxiliary equipment, necessitating costly replacement.
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