Motoman XRC 2001 Controller

ArcWorld 6000
System Manual
for UP-Series Robots

Part Number: 146029-1
Release Date: September 5, 2002
Document Version: 2
Document Status: Final
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF FIGURES</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>1 INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>1.1 About this Document</td>
<td>1-1</td>
</tr>
<tr>
<td>1.2 System Overview</td>
<td></td>
</tr>
<tr>
<td>1.2.1 System Layout</td>
<td>1-3</td>
</tr>
<tr>
<td>1.2.2 Major Components</td>
<td>1-3</td>
</tr>
<tr>
<td>1.2.3 Optional Equipment</td>
<td>1-3</td>
</tr>
<tr>
<td>1.3 Reference to Other Documentation</td>
<td>1-3</td>
</tr>
<tr>
<td>1.4 Customer Service Information</td>
<td>1-4</td>
</tr>
<tr>
<td>2 SAFETY</td>
<td></td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>2-1</td>
</tr>
<tr>
<td>2.2 Standard Conventions</td>
<td>2-2</td>
</tr>
<tr>
<td>2.3 General Safeguarding Tips</td>
<td>2-3</td>
</tr>
<tr>
<td>2.4 Mechanical Safety Devices</td>
<td>2-3</td>
</tr>
<tr>
<td>2.5 Installation Safety</td>
<td>2-4</td>
</tr>
<tr>
<td>2.6 Programming Safety</td>
<td>2-4</td>
</tr>
<tr>
<td>2.7 Operation Safety</td>
<td>2-5</td>
</tr>
<tr>
<td>2.8 Maintenance Safety</td>
<td>2-6</td>
</tr>
<tr>
<td>3 EQUIPMENT DESCRIPTION</td>
<td></td>
</tr>
<tr>
<td>3.1 UP-series Robot Description</td>
<td>3-1</td>
</tr>
<tr>
<td>3.2 XRC 2001 Controller</td>
<td>3-1</td>
</tr>
<tr>
<td>3.2.1 Playback Panel</td>
<td>3-2</td>
</tr>
<tr>
<td>3.2.2 Programming Pendant</td>
<td>3-3</td>
</tr>
<tr>
<td>3.2.3 Brake Release</td>
<td>3-6</td>
</tr>
<tr>
<td>3.3 Operator Station</td>
<td>3-6</td>
</tr>
<tr>
<td>3.3.1 Cycle Start</td>
<td>3-6</td>
</tr>
<tr>
<td>3.3.2 Emergency Stop (E-STOP)</td>
<td>3-7</td>
</tr>
<tr>
<td>3.3.3 Hold</td>
<td>3-7</td>
</tr>
<tr>
<td>3.3.4 Cycle Latched</td>
<td>3-7</td>
</tr>
<tr>
<td>3.3.5 Alarm</td>
<td>3-7</td>
</tr>
<tr>
<td>3.3.6 Positioner Auto/Manual</td>
<td>3-7</td>
</tr>
<tr>
<td>3.3.7 Start</td>
<td>3-7</td>
</tr>
<tr>
<td>3.3.8 Operator Station Enable/Disable</td>
<td>3-8</td>
</tr>
<tr>
<td>3.3.9 Reset</td>
<td>3-8</td>
</tr>
<tr>
<td>3.3.10 Servo On</td>
<td>3-8</td>
</tr>
<tr>
<td>3.4 MRM2-Series Positioners</td>
<td>3-8</td>
</tr>
<tr>
<td>3.4.1 Welding Ground System</td>
<td>3-9</td>
</tr>
<tr>
<td>3.4.2 Locking Pins</td>
<td>3-9</td>
</tr>
<tr>
<td>3.4.3 Arc Shield</td>
<td>3-10</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------</td>
</tr>
<tr>
<td>3.5 Welding Equipment</td>
<td>3-10</td>
</tr>
<tr>
<td>3.5.1 Wire Feeder</td>
<td>3-10</td>
</tr>
<tr>
<td>3.5.2 Universal Welding Interface (UWI)</td>
<td>3-10</td>
</tr>
<tr>
<td>3.5.3 GMAW Torch</td>
<td>3-10</td>
</tr>
<tr>
<td>3.5.4 Motoman Torch Mount</td>
<td>3-10</td>
</tr>
<tr>
<td>3.5.5 Power Sources</td>
<td>3-11</td>
</tr>
<tr>
<td>3.6 Safety Features</td>
<td>3-12</td>
</tr>
<tr>
<td>3.6.1 Arc Screens</td>
<td>3-12</td>
</tr>
<tr>
<td>3.6.2 Fencing</td>
<td>3-12</td>
</tr>
<tr>
<td>3.6.3 Safety Light Curtains</td>
<td>3-12</td>
</tr>
<tr>
<td>3.6.4 Emergency Stops (E-STOPS)</td>
<td>3-12</td>
</tr>
<tr>
<td>3.6.5 Safety PLC – Programmable Logic Controller</td>
<td>3-13</td>
</tr>
<tr>
<td>3.6.6 ENABLE Switch</td>
<td>3-14</td>
</tr>
<tr>
<td>3.6.7 Interlocked Cell Door</td>
<td>3-14</td>
</tr>
<tr>
<td>3.6.8 Interference Cubes</td>
<td>3-14</td>
</tr>
<tr>
<td>3.6.9 Brake Release</td>
<td>3-14</td>
</tr>
<tr>
<td>4 INSTALLATION</td>
<td></td>
</tr>
<tr>
<td>4.1 Materials Required</td>
<td>4-1</td>
</tr>
<tr>
<td>4.1.1 Customer-Supplied Items</td>
<td>4-1</td>
</tr>
<tr>
<td>4.1.2 List of Tools</td>
<td>4-1</td>
</tr>
<tr>
<td>4.1.3 Cell Components</td>
<td>4-2</td>
</tr>
<tr>
<td>4.2 Site Preparation</td>
<td>4-3</td>
</tr>
<tr>
<td>4.3 Installing the Robot Common Base</td>
<td>4-4</td>
</tr>
<tr>
<td>4.3.1 Removing the Shipping Brackets</td>
<td>4-5</td>
</tr>
<tr>
<td>4.4 Installing the Programming Platforms</td>
<td>4-6</td>
</tr>
<tr>
<td>4.5 Installing the Positioner</td>
<td>4-7</td>
</tr>
<tr>
<td>4.6 Installing the Fencing</td>
<td>4-8</td>
</tr>
<tr>
<td>4.6.1 Installing the Cell Door</td>
<td>4-11</td>
</tr>
<tr>
<td>4.7 Installing the Arc Curtains</td>
<td>4-12</td>
</tr>
<tr>
<td>4.8 Installing the Auxiliary Equipment Common Base</td>
<td>4-12</td>
</tr>
<tr>
<td>4.9 Installing the Operator Station</td>
<td>4-14</td>
</tr>
<tr>
<td>4.10 Connecting the Cables</td>
<td>4-15</td>
</tr>
<tr>
<td>4.10.1 Connecting the Earth Ground</td>
<td>4-15</td>
</tr>
<tr>
<td>4.10.2 Connecting the Welding Ground</td>
<td>4-16</td>
</tr>
<tr>
<td>4.10.3 Connecting the Robot Cables</td>
<td>4-17</td>
</tr>
<tr>
<td>4.10.4 Connecting the Positioner Pneumatic Air Line</td>
<td>4-17</td>
</tr>
<tr>
<td>4.11 Connecting the Power</td>
<td>4-18</td>
</tr>
<tr>
<td>4.12 Conducting a Safety/Operation Check</td>
<td>4-19</td>
</tr>
<tr>
<td>4.13 Installation of Tooling and Fixtures</td>
<td>4-19</td>
</tr>
</tbody>
</table>
# Section 5  OPERATION

## 5.1 Programming
- 5.1.1 I/O Assignment ................................................................. 5-2  
- 5.1.2 Sweeping the Positioner ...................................................... 5-3  
- 5.1.3 Rotating the Headstock ...................................................... 5-4  
- 5.1.4 Programming Specific Jobs ................................................ 5-4  
- 5.1.5 Converting Programs from Side A to Side B ..................... 5-6

## 5.2 Daily Operation ........................................................................ 5-6
- 5.2.1 Start-Up ............................................................................. 5-6  
- 5.2.2 Robot Safe (Cube 24) Position ........................................... 5-7  
- 5.2.3 Starting the Master Job ...................................................... 5-7  
- 5.2.4 Operation Cycle .............................................................. 5-7  
- 5.2.5 Shutdown ......................................................................... 5-8

## 5.3 System Recovery ..................................................................... 5-8
- 5.3.1 Alarms and Errors ............................................................ 5-8  
- 5.3.2 E-STOP Recovery ............................................................ 5-9  
- 5.3.3 Shock Sensor Recovery .................................................... 5-10  
- 5.3.4 Using the Brake Release .................................................. 5-10

# Section 6  MAINTENANCE

## 6.1 Periodic Maintenance ............................................................. 6-1

INDEX
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1-1</td>
<td>System Layout</td>
<td>1-2</td>
</tr>
<tr>
<td>Figure 3-1</td>
<td>XRC 2001 Controller</td>
<td>3-1</td>
</tr>
<tr>
<td>Figure 3-2</td>
<td>XRC 2001 Playback Panel</td>
<td>3-2</td>
</tr>
<tr>
<td>Figure 3-3</td>
<td>Programming Pendant</td>
<td>3-3</td>
</tr>
<tr>
<td>Figure 3-4</td>
<td>RS-232C Serial Port</td>
<td>3-5</td>
</tr>
<tr>
<td>Figure 3-5</td>
<td>Enable Switch</td>
<td>3-5</td>
</tr>
<tr>
<td>Figure 3-6</td>
<td>Operator Station</td>
<td>3-6</td>
</tr>
<tr>
<td>Figure 3-7</td>
<td>Available Power Sources</td>
<td>3-11</td>
</tr>
<tr>
<td>Figure 3-8</td>
<td>Safety PLC Location</td>
<td>3-13</td>
</tr>
<tr>
<td>Figure 4-1</td>
<td>System Components</td>
<td>4-2</td>
</tr>
<tr>
<td>Figure 4-2</td>
<td>Area Needed for Installation</td>
<td>4-3</td>
</tr>
<tr>
<td>Figure 4-3</td>
<td>Unbolting System Components</td>
<td>4-4</td>
</tr>
<tr>
<td>Figure 4-4</td>
<td>Location of Shipping Brackets</td>
<td>4-5</td>
</tr>
<tr>
<td>Figure 4-5</td>
<td>Install Programming Platforms</td>
<td>4-6</td>
</tr>
<tr>
<td>Figure 4-6</td>
<td>Positioner Alignment</td>
<td>4-7</td>
</tr>
<tr>
<td>Figure 4-7</td>
<td>Crated Fencing Skid</td>
<td>4-8</td>
</tr>
<tr>
<td>Figure 4-8</td>
<td>Fencing Placed on Floor Around the Robot and Positioner</td>
<td>4-8</td>
</tr>
<tr>
<td>Figure 4-9</td>
<td>Right Fence Wall Assembly – Steps A through E</td>
<td>4-9</td>
</tr>
<tr>
<td>Figure 4-10</td>
<td>Fence/Post Connections</td>
<td>4-10</td>
</tr>
<tr>
<td>Figure 4-11</td>
<td>Left Fence Wall Assembly – Steps F through J</td>
<td>4-10</td>
</tr>
<tr>
<td>Figure 4-12</td>
<td>Install Top Door Rail</td>
<td>4-11</td>
</tr>
<tr>
<td>Figure 4-13</td>
<td>Install Final Door Rail</td>
<td>4-11</td>
</tr>
<tr>
<td>Figure 4-14</td>
<td>Securing the Arc Curtains</td>
<td>4-12</td>
</tr>
<tr>
<td>Figure 4-15</td>
<td>Unbolting Auxiliary Equipment Common (AEC) Base</td>
<td>4-13</td>
</tr>
<tr>
<td>Figure 4-16</td>
<td>AEC Installation Location</td>
<td>4-13</td>
</tr>
<tr>
<td>Figure 4-17</td>
<td>Pedestal Type Operator Station</td>
<td>4-14</td>
</tr>
<tr>
<td>Figure 4-18</td>
<td>Ground Welding Cable on Positioner</td>
<td>4-16</td>
</tr>
<tr>
<td>Figure 4-19</td>
<td>Positive and Negative Terminals on Welding Power Source</td>
<td>4-16</td>
</tr>
<tr>
<td>Figure 4-20</td>
<td>Robot Cables Connecting the XRC 2001 to the Robot</td>
<td>4-17</td>
</tr>
<tr>
<td>Figure 4-21</td>
<td>Incoming Power Connections</td>
<td>4-18</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 3-1</td>
<td>MRM2-250 Positioner Specifications</td>
<td>3-9</td>
</tr>
<tr>
<td>Table 4-1</td>
<td>Incoming Power Specifications (Decal)</td>
<td>4-18</td>
</tr>
<tr>
<td>Table 5-1</td>
<td>XRC 2001 User Inputs</td>
<td>5-2</td>
</tr>
<tr>
<td>Table 5-2</td>
<td>XRC 2001 User Outputs</td>
<td>5-3</td>
</tr>
<tr>
<td>Table 6-1</td>
<td>Periodic Maintenance</td>
<td>6-1</td>
</tr>
</tbody>
</table>
SECTION 1
INTRODUCTION

The ArcWorld 6000 is part of the ArcWorld family of standardized arc welding solutions. It is a fully integrated welding system, and is supported from wire to weld by Motoman, Inc.

The ArcWorld 6000 features a Motoman arc welding robot and XRC 2001 controller with menu-driven arc welding application software, complete welding package, 180-degree reciprocating plane positioner, operator interface, and a total safety environment.

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 ArcWorld 6000 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 ArcWorld 6000 system.

SECTION 3 - DESCRIPTION OF EQUIPMENT
This section provides a detailed description of the major components of the ArcWorld 6000 system. This section also includes a table of component specifications.

SECTION 4 - INSTALLATION
This section provides instructions for set up and installation of the ArcWorld 6000 system.

SECTION 5 - OPERATION
This section provides instructions for basic operation of the ArcWorld 6000 system. This section also provides procedures for startup, loading, normal operation, fault recovery, and shutdown.

SECTION 6 - MAINTENANCE
This section contains a table listing periodic maintenance requirements for the components of the ArcWorld 6000 cell.
1.2 **System Overview**

The ArcWorld 6000 provides a complete arc welding solution in a standardized configuration. The system is designed around a Motoman arc welding robot and an XRC 2001, and includes a complete welding package. A dual-station 180-degree reciprocating positioner with rotating headstock allows an operator to prepare and set up parts on one side while the robot welds on the other side. 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 ArcWorld 6000 cell.

![System Layout Diagram](image.png)

**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

The XRC 2001 and welding power source share a common base. Additional options, such as the water circulator and the Com-Arc seam tracking unit, can be located on this auxiliary equipment common base. The robotic cell is fully enclosed by safety fencing and an interlocking door. If the operator stands in the path of the light curtain, the positioner will not cycle. All operator controls, including those on the XRC 2001 controller and welding power supply, are accessible from outside of the robotic enclosure.

NOTE: Positioner arc screen and arc curtains not shown for clarity.

1.2.2 Major Components

The ArcWorld 6000 includes the following major components:

- Motoman UP6, or UP20 manipulator and XRC 2001 controller
- MRM2-250 dual-station 180 degree reciprocating positioner
- Master operator station
- Welding equipment, including the following:
  - Welding power source
  - Motoman torch (water-cooled or air-cooled)
  - Wire feeder
  - Torch mount
- Safety equipment, including the following:
  - Safety fencing with arc curtains
  - Interlocked light curtains
  - Interlocked cell door
  - Positioner arc screen

1.2.3 Optional Equipment

The following optional equipment is available for use with the ArcWorld 6000:

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

1.3 Reference to Other Documentation

For additional information refer to the following:

- Motoman UP6 Manipulator Manual (P/N 145886-1)
- Motoman UP20 Manipulator Manual (P/N 145887-1)
- Motoman Operator's Manual for Arc Welding (P/N 142098-1)
- Motoman Concurrent I/O Parameter Manual (P/N 142102-1)
- 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
1.4 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 (UP6 or UP20)
- Application Type (welding)
- System Type (ArcWorld 6000)
- Software Version (3.74A)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of XRC 2001 controller)
SECTION 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.
SAFETY

• 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 and UP20 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 inch) reach and has a relative positioning accuracy of ± 0.08 mm (0.004 inch). The six-axis UP20 robot has a payload of 20 kg (44.09 lbs). It features a 1658 mm (65.2 inch) reach and has a relative positioning accuracy of ± 0.1 mm (0.004 inch).

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 S-axis has been restricted by hardstops 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, shown in Figure 3-1, is the next generation of controllers that has dual channel safety circuitry. The XRC 2001 coordinates the operation of the ArcWorld 6000 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 Controller](image-url)
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)**
The E-STOP button on the playback panel is connected in series with the system Emergency Stop circuit. Pressing E-STOP ceases all system operation.

**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.

![Programming Pendant Diagram]

**Figure 3-3 Programming Pendant**

**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 XRC 2001 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 cannot be applied in TEACH mode unless TEACH LOCK is ON.

**RS-232C Serial Port**
This 9-pin serial port is used for data communication between the XRC 2001 and a floppy disk controller (FC1 or FC2), FDE (Floppy Disk Emulator) software, or other form of communication (see Figure 3-4).

![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 the operator 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 XRC 2001 controller cabinet (see Figure 3-1).

3.3 Operator Station

The operator station (see Figure 3-6) includes a NEMA enclosure on a stand-alone pedestal. The following paragraphs describe the operator station controls.

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

3.3.1 Cycle Start

**WARNING!**
The operation of the CYCLE START 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 button, located on the operator station, initiates 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 XRC 2001. Once the robot returns to Cube 24 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.
3.3.2 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.

3.3.3 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 button to sweep the positioner. Pressing the Cycle Start button while either robot is still in motion locks the CYCLE START command into the XRC 2001. The CYCLE LATCHED light comes on, indicating CYCLE START latching. The positioner sweeps once the robot finish the current job and return to the Safe position (Cube 24). If a person enters the safety zone created by the light curtains, the CYCLE START command will be unlatched from the XRC 2001 controller.

3.3.5 Alarm

The ALARM lamp is connected to the robot SERVO ON and ALARM OCCURRENCE outputs. The ALARM lamp turns on when the robot encounters an alarm condition or when servo power is cut.

3.3.6 Positioner Auto/Manual

The POSITIONER AUTO/MANUAL selector switch is used to select AUTOMATIC or MANUAL mode for the positioner. The selector switch is connected to robot Input #2. When the selector switch is in the AUTOMATIC position, the robot processes the part after the positioner sweeps. In MANUAL mode, the robot does not process the part after the positioner sweeps, but remains in the Safe position.

NOTE: The Positioner Auto/Manual command is dependent on the structure of the Master job.

3.3.7 Start

The START button is connected to the robot external start input. The robot will start the current active job when MASTER JOB START is pressed. The operator station must be enabled and servo power ON for the MASTER JOB 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 XRC 2001 controller to operator station. The REMOTE MODE button on XRC 2001 controller playback panel lights when the operator station is enabled. Most programming pendant functions are disabled while in REMOTE.

3.3.9 **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.

3.3.10 **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.

3.4 **MRM2-Series Positioners**

The ArcWorld 6000 cell uses the MRM2-250 reciprocating positioner. The MRM2-250 positioner is AC-servomotor controlled by the XRC 2001 to provide coordinated motion. The standard distance between the headstock and tailstock faceplates on the MRM2-250 positioner is 2.6 meters (approximately 102 inches).

Table 3-1 provides specifications for the MRM2-250 positioner. The load side of the positioner is fixed for loading and unloading parts. The patented servo motor is used to sweep the positioner workstations into and out of the robot envelope, and also to rotate the weld side of the positioner during welding.

A fixture frame is typically mounted between the headstock and tailstock faceplates to provide a highly flexible system. Fixtures are either mounted on, or integrated into, these frames for positioning and clamping of production parts. Pneumatic and electrical signals can be routed to the fixtures if required. Depending on part size(s)/weights(s), you can mount single, multiple, or any parts combination to the fixture frame.

The ArcWorld 6000 system is capable of synchronized motion between various components depending on the job configuration. Synchronized components move at the same time during operation. The robot (R1) can be synchronized with the positioner. The ArcWorld 6000 system is also capable of true coordinated motion, where linear, circular, or spline motion can be coordinated between R1 and the positioner. Coordinated motion allows the robot to weld while the positioner rotates the parts. For additional information on coordinated motion, refer to the Coordinated Motion for Multi-Axes Systems manual (Part Number 139418-1).

*NOTE:* In high humidity areas, use surface protection to prevent corrosion of the tooling plates.
### Table 3-1  MRM2-250 Positioner Specifications

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td>250 kg (550 lbs) combined part/fixture weight per side</td>
</tr>
<tr>
<td></td>
<td>500 kg (1100 lbs) total</td>
</tr>
<tr>
<td><strong>Maximum Weight Differential</strong></td>
<td>190.6 kg (375 lbs)</td>
</tr>
<tr>
<td><strong>per Side (Offset Load)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Swing Diameter</strong></td>
<td>0.98 m (37.4 inch)</td>
</tr>
<tr>
<td><strong>Temperature Operating Range</strong></td>
<td>4–43°C (40–110°F)</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>Non-condensing 10–90% relative humidity</td>
</tr>
<tr>
<td><strong>Shock Rating</strong></td>
<td>Less than 0.5 G</td>
</tr>
<tr>
<td><strong>Sweep Speed (Torque/Time)</strong></td>
<td>1000 N•m in 5 to 7 seconds</td>
</tr>
<tr>
<td><strong>Servo Head Stock Speed</strong></td>
<td>1050 N•m @ 0–16.8 rpm</td>
</tr>
<tr>
<td><strong>Air Requirements</strong></td>
<td>586 to 689.5 kPa (85 to 100 psi)</td>
</tr>
<tr>
<td><strong>Electrical Requirements</strong></td>
<td>24V DC for interface</td>
</tr>
<tr>
<td></td>
<td>208V AC, 10 amp</td>
</tr>
<tr>
<td></td>
<td>3-phase power supplied by the XRC 2001 controller</td>
</tr>
<tr>
<td><strong>Welding Current Rating</strong></td>
<td>700 amperes at 100% duty cycle</td>
</tr>
</tbody>
</table>

### 3.4.1  Welding Ground System

The welding ground system consists of a spring-loaded copper brush that contacts the large gear inside the positioner gear housing. The ground cable to the welding power source is connected to the ground stud located on the right side of the positioner base as you face the back of the ArcWorld 6000 cell.

*NOTE:* The connection ground cable between to the insulated ground bar must be tight. If the connection is loose, arcing can occur and cause the insulator to melt.

### 3.4.2  Locking Pins

The MRM2-series positioners are equipped with fixture locking pins that prevent the headstock/tailstock faceplates from turning when the servo motor retracts. The fixture locking pins are spring loaded, so when the servo motor withdraws, the pins engage. Each headstock faceplate on the MRM2-series positioners has two locking pins.
3.4.3 Arc Shield

**WARNING!**
Do not operate this equipment unless the arc screen is in place or eye damage can occur!

The MRM2-series positioners are equipped with a sheet metal screen that runs the length of the positioner table and visually separates the loading zone from the welding zone. This screen acts as a shield to protect the operator from the arc radiation and sparks produced by the welding operation. Do not operate this equipment unless the arc screen is in place.

3.5 Welding Equipment

In its standard configuration, the ArcWorld system includes a power source, wire feeder, torch, and torch mount. Optional equipment including water circulators, Com-Arc units, and torch tenders may be included to enhance performance.

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. The wire feeder has 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. A Shock Sensor Override switch located on the front of the feeder is used to recover from torch impact.

3.5.2 Universal Welding Interface (UWI)

The UWI provides microprocessor control to the wire feeder for the MotoArc series power source. It scales the signals from the XRC 2001 controller to the appropriate levels required for control of the welding components. It also provides isolation of the power source analog signals.

*NOTE:* Some power sources available with the ArcWorld 6000 system do not use the UWI. For more information specific to your system, refer to the vendor manuals shipped with your system.

3.5.3 GMAW Torch

The ArcWorld 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 ArcWorld 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, brakes are applied to the robot, and all positioner motion is also stopped.
3.5.5 Power Sources

Motoman offers several different power sources for use with the ArcWorld 6000 system depending on your system’s application. The following are some of the more common power sources used (see Figure 3-7). 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 3-7 Available Power Sources
3.6 Safety Features

The ArcWorld 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 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 Screens

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

Two arc screens are used on the ArcWorld system. The first is a metal arc screen on the positioner. This screen blocks arc radiation and sparks from the welding operation.

The material used to cover the safety fencing of the entire robotic cell acts as the second 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 ArcWorld 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 help prevent serious injury to anyone entering the positioner area during the sweeping process. In PLAY mode, if the positioner is sweeping and the safety light curtain is activated, servo power is removed from the system and all positioner motion stops. Servo power can be reapplied by pressing SERVO ON. However, the positioner will only continue its motion after it is reset by pressing the reset button on the operator station.

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

3.6.4 Emergency Stops (E-STOPS)

In addition to the safety features described above, the ArcWorld 6000 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 playback box on the controller
- The programming pendant
- The operator station
3.6.5 **Safety PLC – Programmable Logic Controller**

The ArcWorld 6000 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 gate interlock 1, gate interlock 2, safety light curtains, operator station E-stop, and the In-position signals of the positioner. (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.
3.6.6 **ENABLE Switch**

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

3.6.7 **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 Gate Interlock Error. Brakes are applied to the robot and all servo power is removed from the system, the E-Stop lights come on, and all positioner motion is stopped.

3.6.8 **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 the 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 ArcWorld 6000 uses interference cubes to interlock robot position with positioner motion. The robot Home or Safe position (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.

3.6.9 **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 XRC 2001 cabinet (see Figure 3-1). Refer to Section 5 for the proper operation of the brake release.
SECTION 4
INSTALLATION

The ArcWorld 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 ArcWorld System is not a task for the novice. The ArcWorld 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 ArcWorld system is included with the system, except for the air line fitting on the filter/regulator/lubricator (FRL). This section identifies customer-supplied items and tools required to complete installation.

4.1.1 Customer-Supplied Items
- Gas bottles for the welding torches
- Incoming power supply
- Two earth ground cables with two earth ground stakes
- Weld wire
- Incoming air supply: 0.04 cmm at 620.5 kPa (1.5 scfm at 90 psi)
- 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
- Air-impact gun with 3/4-inch socket
- Open-end wrench set
- Two socket-head (Allen)
- Wrench sets (standard and metric)
4.1.3 Cell Components

There are five major components that make up the ArcWorld 6000 cell (see Figure 4-1). The component names and quantities are as follows:

<table>
<thead>
<tr>
<th>Qty</th>
<th>Component Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Robot Common Base</td>
</tr>
<tr>
<td>1</td>
<td>Auxiliary Equipment Base</td>
</tr>
<tr>
<td>1</td>
<td>Positioner</td>
</tr>
<tr>
<td>2</td>
<td>Programming Base</td>
</tr>
</tbody>
</table>

![Figure 4-1 System Components](image-url)
4.2 Site Preparation

To prepare your site, proceed as follows:

1. Clear floor space needed for unit (see Figure 4-2).

Figure 4-2  Area Needed for Installation

NOTE: It is recommended to keep an additional 2 to 3 m (8 to 10 ft.) of clear area on all sides of your system.

2. Gather all customer-supplied items and required tools listed in Section 4.1.
4.3 Installing the Robot Common Base

The robot common base is shipped on a wooden shipping skid. To install the robot common base, proceed as follows:

**CAUTION!**
*Handle ArcWorld 6000 components carefully to avoid damage.*

1. Unbolt robot common base from shipping skid using a 3/4-inch socket (see Figure 4-3).

![Figure 4-3 Unbolting System Components](image)

**WARNING!**
*The robot common base weighs 1380 kg (3042 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. Using a forklift, remove the common base from wooden shipping skid.
3. Place the robot common base in position, as shown in Figure 4-1.
4. Carefully remove protective plastic wrapping from robot and torch.
5. Inspect robots, torches, and positioner for shipping damage.

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

6. Remove operator station from skid and set it safely aside.
4.3.1 Removing the Shipping Brackets

**CAUTION!**

*Failure to remove shipping brackets from robot before operating the ArcWorld 6000 may result in damage to the robot drive mechanisms.*

Three yellow brackets (see Figure 4-4) prevent the robot from moving during shipping. Two rod brackets secure the lower arm assembly to the S-axis housing. The smaller bracket on the rear of the robot prevents the S-axis housing from pivoting. After the robot is in place, remove the shipping brackets.

*Figure 4-4 Location of Shipping Brackets*
4.4 Installing the Programming Platforms

WARNING!
The total weight of the platforms and accessories is 120 kg (264.5 lbs). Make sure the lifting device used to move this object are capable of safely handling this much weight.

A programming platform must now be installed on the left and right side of the robot common base. Both programming platforms are shipped together with other parts on a wood shipping skid. The programming bases are lagged into the concrete (see Figure 4-5).

1. Unbolt programming platforms from the shipping skid using a 3/4-inch socket.
2. Using a forklift, remove the programming platforms from the shipping skid.
3. Separate the platforms and accessories.
4. Place a programming platform on the left and the right side of the robot base with the leveling bolts oriented to the rear. Use the supplied system drawings to ensure that they are properly aligned.
4.5 Installing the Positioner

**WARNING!**
The positioner weighs 2000 kg (4400 lbs), make sure the lifting device used to move these objects are capable of safely handling this much weight.

The positioner (see Figure 4-6) is lagged into the concrete in front of the cell and bolted to the robot base.

1. Unbolt positioner from the shipping skid using a 3/4-inch socket.
2. Using two forklifts, one on each end, remove the positioner from the shipping skid.
3. Move the positioner in front of the cell. Use the supplied system drawings to ensure that it is properly aligned. The positioner base is installed beneath the lip on the front of the robot base (see Figure 4-6).
4. Use the supplied hardware to fasten the positioner to the robot base and both programming platforms.
4.6 Installing the Fencing

The fencing that makes up the welding cell’s protective walls is shipped on its own skid with all the hardware needed for the fencing (see Figure 4-7).

**NOTE:** The rear wall is the wall behind the robot. The right wall is on the right as you are facing the front of the cell, and the left wall is on the left as you are facing the front of the cell.

---

**CAUTION!**

*Metal bands are under tension and, when cut, may cause injury. Be cautious when cutting the metal bands.*

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 (see Figure 4-8).
**WARNING!**

*This procedure requires at least two people to accomplish safely.*

**Right Side Wall**

1. Connect and tighten fence posts to both sides of the rear wall, right section (see Figure 4-9, Step A).
2. Connect and tighten right panel and rear wall and connect both together (see Figure 4-9, Step B).
3. Have an assistant hold the fencing in place while you connect right and tighten positioner panel to right panel end post (see Figure 4-9, Step C).
4. Raise tailstock panel and bolt to end post on the right panel wall (see Figure 4-9, Step D). Tighten these pieces together.
5. Fasten and tighten post to tailstock panel (see Figure 4-9, Step E).
6. Measure to ensure cell walls are square and adjust and necessary.
7. Fasten and tighten the completed right wall assembly including right side rear wall post to base (see Figure 4-9). Holes are provided on the panel ends that match up with the fencing posts. Do not fasten the fence post located in front of positioner (see Figure 4-11, Step J). This will be anchored into the cement after the light curtains are installed.

*Figure 4-9 Right Fence Wall Assembly – Steps A through E*
**Figure 4-10 Fence/Post Connections**

**Left Side Wall**

1. Connect fence posts to each section of the left sides of rear wall, (see Figure 4-11, Step F).
2. Raise left panel and rear wall and connect them together (see Figure 4-11, Step G).
3. Have an assistant hold the fencing in place while you connect left positioner panel to left panel post (see Figure 4-11, Step H).
4. Raise tailstock panel and bolt to end post on the left panel wall (see Figure 4-11, Step I).
5. Fasten post to end of tailstock panel (see Figure 4-11, Step J).
6. Ensure cell walls are square.
7. Fasten the completed left wall assembly, including left side rear wall post, to base (see Figure 4-11). Holes are provided on the panel ends that match up with the fencing posts. Install but do not tighten down the posts and fencing located beyond the positioner (see Figure 4-11, Step J). This must be anchored into the cement after the light curtains are installed.

**Figure 4-11 Left Fence Wall Assembly – Steps F through J**
4.6.1 Installing the Cell Door

1. Steady the rear wall and install top door rail across door opening, with the clamps provided (see Figure 4-12).

![Figure 4-12 Install Top Door Rail](image)

2. Raise cell door and slide it into position on door rail.
3. Close door and install remaining door rail clamp (see Figure 4-13).

![Figure 4-13 Install Final Door Rail](image)

4. Install stop bolt and tighten clamp.
5. Ensure cell walls are square.
4.7 Installing the Arc Curtains

DANGER!
Do not install the arc curtains until after the cell walls have been secured to the base. 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 (see Figure 4-14).

![Figure 4-14 Securing the Arc Curtains](image)

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.

4.8 Installing the Auxiliary Equipment Common Base

The auxiliary equipment common (AEC) base contains one XRC 2001 controller and one primary cell disconnect. The common base may also contain optional water circulators and Com-Arc III seam tracking units. The auxiliary equipment common base is shipped on a wooden shipping skid. To install the AEC base, proceed as follows:

1. Unbolt the AEC base by removing four shipping bolts using a 3/4-inch deep well socket (see Figure 4-15).
WARNING!
The AEC base weighs 454 kg (1000 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. Using a forklift, lift the AEC base and remove from the shipping skid.
3. Place the AEC base next to the programming platform (see Figure 4-16).
4. Carefully remove plastic wrapping and cardboard from AEC bases.
5. Inspect AEC base components for any shipping damage.

NOTE: If any equipment is damaged, notify shipper immediately.
4.9 Installing the Operator Station

To install the operator station, proceed as follows:

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

NOTE: If any equipment is damaged, notify shipper immediately.

4. Place operator station outside the fence in front of the positioner (see Figure 4-17).

5. Insert a 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.

Figure 4-17 Pedestal Type Operator Station
4.10 Connecting the Cables

After components are level and securely in place, unwrap the cables according to the cable diagram included in the system drawing package.

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

4.10.1 Connecting the Earth Ground

Each robot and XRC 2001 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 2.43 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 robots and XRC 2001, 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 15.24 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 may result in serious injury or death.

**NOTE:** If the robot and XRC 2001 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 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 XRC 2001.
4. Connect other end of second earth ground cable to earth ground stake.
4.10.2 Connecting the Welding Ground

The welding ground cable is shipped in an accessories box. To connect the ground welding cable, proceed as follows:

1. Remove the welding ground cable from the accessories box.
2. Connect one end of the welding ground cable to the grounding bolt located on the side of the positioner cabinet (see Figure 4-18).

3. Connect the other end of the ground welding cable to the negative (-) terminal on the welding power source (see Figure 4-19).

Figure 4-18 Ground Welding Cable on Positioner

Figure 4-19 Positive and Negative Terminals on Welding Power Source
### 4.10.3 Connecting the Robot Cables

Two cables, 1BC and 2BC, connect the robot to the XRC 2001 controller. The 1BC cable supplies power to the robot servo motors. The 2BC cable provides communication between the controller and the robot. To connect the robot cables, proceed as follows:

**NOTE:** The right side of the XRC 2001 is on your right as you are facing the front of it.

1. Unpack programming pendant and plug connector into receptacle on right side of XRC 2001 controller.
2. Unpack two large black manipulator cables, connected to XRC 2001 controller, and route to back of robot.
3. Carefully engaging connectors, connect two cables (labeled 1BC and 2BC) to 1BC and 2BC connections on back of robot (see Figure 4-20).

![Figure 4-20 Robot Cables Connecting the XRC 2001 to the Robot](image)

### 4.10.4 Connecting the Positioner Pneumatic Air Line

The positioner air line is regulated by the filter/regulator/lubricator (FRL) and is installed on the side of the positioner cabinet, as shown in Figure 4-18. The customer is responsible for providing and installing the air line connector fitting to the FRL. After the fitting is installed, connect the air line to the fitting. The incoming air supply should be 0.04 cmm at 620.5 kPa (1.5 scfm at 90 psi).
### 4.11 Connecting the Power

After all of the system components have been properly installed, connect the power to the ArcWorld 6000.

**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.*

To connect incoming power to the ArcWorld 6000, proceed as follows:

1. Install 3-phase power wiring to circuit breaker located inside left wall of each XRC 2001 cabinet (see Figure 4-21). Table 4-1 shows size and type of wire needed.
2. Tighten screws to torque indicated in Table 4-1.
3. Install an M5 lug on the incoming ground wire.
4. Terminate ground wire to frame ground stud with M5 hardware provided.

![Figure 4-21  Incoming Power Connections](image-url)

**Table 4-1  Incoming Power Specifications (Decal)**

<table>
<thead>
<tr>
<th>Lug 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, #12-8 Aluminum</td>
</tr>
<tr>
<td>Torque</td>
<td>#14-7, 4.0 N•m (35 lb.-inch)</td>
</tr>
</tbody>
</table>
4.12 Conducting a Safety/Operation Check

Before installing the tooling and fixtures for your application, perform a safety/operation check as follows:

1. Check that all three yellow shipping brackets have been removed from the robot (see Section 4.3.1).
2. Be sure the safety light curtain is placed correctly.
3. Check that the cell door is closed and latched.
4. Check that all cable connections are tight.
5. Check air line connections to the positioner air line regulator and to the optional torch tender and wire cutter.
6. Be sure that the welding power source is set correctly (see the welding power source vendor's manual).
7. Verify that incoming line power matches the input power specified on the sticker on the front of the XRC 2001.

Your ArcWorld 6000 is now ready for power-up. The ArcWorld 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.

8. Check all system E-STOPS (pendant, op-station, breakaways, playback box).
9. Check system Hold buttons.

4.13 Installation of Tooling and Fixtures

Your ArcWorld 6000 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:

**WARNING!**

When loading fixturing and/or tooling on the positioner weighing over 90.7 kg (200 lbs) per side, the arcscreen must be removed and the fixturing loaded on the robot side. Do not sweep the positioner to load the robot side!

- Verify that the air line FRL is set for 620.5 kPa (90 psi).
- Positioner achieves full sweep time (4 to 8 seconds).
SECTION 5
OPERATION

The ArcWorld 6000 is a fully integrated robotic gas metal arc welding (GMAW) cell. The Master job setup, and the sub-jobs programmed within it, determine how the robot performs the welding operation or other tasks. The robot welds parts on one side of the 180-degree reciprocating positioner, while the operator loads or unloads parts on the opposite side. Once the robot is finished with the welding process, it returns to the Safe position. The operator then sweeps the positioner 180 degrees to the opposite side, enabling the robot to start welding on the next set of parts.

The MRM2-250 positioner uses a 180-degree reciprocating motion that sweeps the positioner from the operator’s loading zone, into the robot’s work zone, and back. The positioner screen visually divides the positioner table into two rectangular halves, labeled Side A and Side B. As the positioner reciprocates, Side A moves under the primary axis and Side B moves over the primary axis. When Side A is in the robot’s welding zone, Side B is facing the operator, ready to be loaded or unloaded, and vice versa. Additionally, the headstock/tailstock on both Sides A and B rotate, which provides two welding surfaces per side. Loading fixtures and pneumatic or electric lines can be attached to the headstock and tailstock on both sides. *Loading fixtures must be supplied by the customer.*

5.1 Programming

The operation of this system is programming dependent. The operating instructions included in this section 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. 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 ArcWorld 6000 system is its high degree of flexibility. The operator can fine tune the movement of the robot and the positioner according to the parts configuration. The MRM2-series positioner, with its programmable primary axis and headstocks, proves highly versatile when configured with the UP6 or UP20 robot. The robot can be programmed to weld a part with the headstock stationary, or the robot and headstock can move simultaneously to weld a part while the headstock is turning. The robot 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 robot. You can program the robot independently (R1 job), the station axis independently (S1 job), or the robot and station axis together (R1 + S1 job combinations). You must select the axis combination when teaching the job initially. Motoman recommends programming the robot and station axis together (R1 + S1 jobs) to reduce the risk of interference. Refer to the independent control manual for full description.

5.1.1 I/O Assignment

The ArcWorld 6000 uses the following user and dedicated inputs and outputs (see Tables 5-1 and 5-2).

**XRC 2001 Dedicated Inputs**
- Servo On
- External Job Start
- Alarm Reset
- REMOTE mode ON
- Hold
- External Emergency Stop

**XRC 2001 Dedicated Outputs**
- Servo Power ON
- TEACH mode
- Cube 24
- Alarm Occurrence

For more information on user and dedicated I/O’s, refer to the Concurrent I/O & Parameter Manual (Part Number 142102-1).

**Table 5-1 XRC 2001 User Inputs**

<table>
<thead>
<tr>
<th>Input</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN#001</td>
<td>CYCLE START</td>
<td>Cycle start input from op-station</td>
</tr>
<tr>
<td>IN#002</td>
<td>AUTO/MANUAL</td>
<td>Auto/Manual mode from op-station</td>
</tr>
<tr>
<td>IN#003 thru 008</td>
<td>NOT USED</td>
<td></td>
</tr>
<tr>
<td>IN#009</td>
<td>FIXTURE A LOCK ON</td>
<td>Fixture A Is Locked</td>
</tr>
<tr>
<td>IN#010</td>
<td>FIXTURE B LOCK ON</td>
<td>Fixture B Is Locked</td>
</tr>
<tr>
<td>IN#011</td>
<td>SERVO DRIVE RETURNED</td>
<td></td>
</tr>
<tr>
<td>IN#012</td>
<td>SERVO DRIVE FORWARD</td>
<td></td>
</tr>
<tr>
<td>IN#013</td>
<td>IN POSITION</td>
<td></td>
</tr>
<tr>
<td>IN#014 thru 015</td>
<td>NOT USED</td>
<td></td>
</tr>
<tr>
<td>IN#016</td>
<td>AIR PRESSURE LOW</td>
<td></td>
</tr>
</tbody>
</table>
5.1.2 Sweeping the Positioner

**NOTE:** In order to sweep the positioner, the robot must be in the Safe position in Cube 24.

MANUAL mode allows you to sweep the positioner without activating the robot. Parts can be loaded onto the fixture to achieve the most efficient configuration and then swept into the welding zone, before teaching the robot a series of moves. To sweep Side A or Side B of the positioner into the robot’s welding zone, proceed as follows:

1. Move robot into Safe position (see Section 5.2.2).
2. Set operator station POSITIONER switch to MANUAL mode and start Master Control job (see Section 5.2.3). Robot will not move out of Safe position when POSITIONER switch is in MANUAL. (This normally depends on job structure.)

**NOTE:** Cycle Start latching is not operative in Manual mode.

3. Press CYCLE START palm buttons on operator station. XRC 2001 sweeps positioner each time CYCLE START buttons are pressed.

When the positioner sweeps Side A into the robot’s work area, the drive unit engages the headstock. Input #9 turns off. Side B faces the operator. Input #10 “FIXTURE B LOCK ON” turns on, indicating the fixture on Side B is locked.

When the positioner sweeps Side B into the robot’s work area, the drive unit engages the headstock and Input #10 turns off. Side A faces the operator. Input #9 “FIXTURE A LOCK ON” turns on, indicating the fixture on Side A is locked.

**NOTE:** The Cube function is a software feature that turns on an output when the robot tool center point is within established boundaries. If the robot moves outside of Cube 24, the output is lost and the positioner will not sweep. The cube position is factory set to be clear of the positioner. For more information on basic cube setup, refer to the manipulator manual.

---

### Table 5-2 XRC 2001 User Outputs

<table>
<thead>
<tr>
<th>Output</th>
<th>Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT#001</td>
<td>CYCLE LATCHED</td>
<td>Cycle Start latched</td>
</tr>
<tr>
<td>OUT#002 thru 008</td>
<td>NOT USED</td>
<td></td>
</tr>
<tr>
<td>OUT#009</td>
<td>WITHDRAW SERVO</td>
<td></td>
</tr>
<tr>
<td>OUT#010</td>
<td>ADVANCE SERVO</td>
<td></td>
</tr>
<tr>
<td>OUT#011 thru 16</td>
<td>NOT USED</td>
<td></td>
</tr>
</tbody>
</table>
5.1.3 Rotating the Headstock

To program a rotation of the Motoman MRM2 positioner headstock, proceed as follows:

1. With XRC 2001 in TEACH mode, turn servo power ON by holding in the ENABLE switch on programming pendant.
2. Press ENABLE soft key on programming pendant to enable robot motion control from programming pendant. Indicator light in button turns ON.
3. Press GROUP AXIS key.
4. Press X+ or X- motion keys on programming pendant to move headstock. Jog speed is set on programming pendant.

**NOTE:**
- The GROUP AXIS LED lights when pressed only when R1 + S1 is selected and S1 (Station 1) is the Master control device. The Status line indicates which GROUP AXIS is selected.
- The GROUP AXIS key must be turned OFF to move the robot with the motion keys.
- The ArcWorld 6000 robot S-axis is restricted by hard stops on the robot base and internal soft stops.

**WARNING!**
If the robot is working on a part and the headstock is not turning, DO NOT assume that the headstock will not turn. The robot is executing programmed steps which could index the headstock at any time.

5.1.4 Programming Specific Jobs

You can program three types of moves:

- Rotation of positioner during air-cut moves
- Robot motion with positioner stationary
- Rotation of positioner 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 (R1 + S1). The last type of move is called station synchronous and should be programmed with a station-plus-robot group axis specification (R1 + S1 S1) with S1 (Station 1) as the Master control device.

**CAUTION!**
Remember that the robot knows only where the Tool Center Point (TCP) is, and if not programmed carefully, the robot arm could still interfere with the loading fixture.

**NOTE:**
Refer to your system's Coordination Instructions for Multi-axes Systems Manual for information on Coordinated motion, selecting synchronization, group axes, and tooling calibration.
**Rotation of the Positioner During Air-Cut Moves**

1. Teach robot to desired position.
2. Rotate positioner to desired position.
   
a. Press GROUP AXIS button on programming pendant.

**NOTE:** The GROUP AXIS LED lights only when S1 control is selected and the job Group Axis is R1 + S1 with S1 as the Master device.

b. Press MAN SPEED button to select desired axis speed while teaching.

c. Press first set of motion keys, +X or -X, to move axis in desired direction.
3. Record step after designating motion type and playback speed.
4. Check path with STEP FWD/BWD keys. The position for robot or positioner may need to be altered to prevent torch interference.

---

**WARNING!**

The positioner axis operates as another robot axis and has the potential for hazardous motion.

**NOTE:**

- Press GROUP AXIS key until R1 is selected on the Status line in order to move the robot.
- Normally, air-cut moves are taught at joint moves. The speed for joint moves is specified as a percentage of maximum speed (VJ=0.01 to VJ=100.00). The axis which takes the longest time to complete the programmed motion automatically determines the speed of the system. This might be a wrist axis, a major robot axis, or the positioner axis. Cycle times can be reduced by changing wrist orientation, robot position, and headstock position simultaneously between program points rather than making the moves independently. Setting the speed at 100.00 will normally establish the quickest time between steps.

**Robot Motion with the Positioner Stationary**

1. Program robot position without moving positioner axis.
2. Set motion type and speeds in normal fashion;
   
   OR

3. Select GROUP AXIS as R1 only.

**Rotation of the Positioner During Welding**

The XRC 2001 controller can coordinate motion with the external axis. This requires calibration of the headstock and robot at the time of installation. Jobs programmed for coordinated motion must be taught as R1 + S1 jobs. Move instructions for coordinated motion are registered using the following format:

\[
\text{COORDINATED MOTION INSTRUCTION} \left\{ \begin{array}{l}
\text{SMOVL}=138 \\
+\text{MOVl} \\
\end{array} \right. \quad \text{SLAVE DEVICE (Manipulator with Torch)} \\
\text{SLAVE DEVICE (Manipulator with Workpiece)} \\
\text{MASTER DEVICE (Positioner with Workpiece)}
\]
5.1.5 Converting Programs from Side A to Side B

**CAUTION!**
Child jobs are not automatically converted. Be sure to convert all child jobs after converting the parent job.

By converting programs from Side A to Side B (or vice versa), you can develop duplicate jobs on opposite sides of the positioner. The positioner uses the external axis to sweep the positioner in addition to driving the headstock. This results in the external axis position being 180-degrees offset from the other side. This offset amount can be determined from the difference in the external axis pulse counts at the two sweep positions. Software can be used to modify the position of the external axis in a job copied to run on the opposite side.

1. Determine pulse count difference of external axis between Side A and B. To do this, display the position (POSN) screen.
2. Set the pulse count offset amount into an EX variable.
3. Make copy of original job. Designate proper side in original and copied job name.
4. Use Modify Position (MODPOS) function to change position of external axis in the program.
5. Step through the new program to verify the path.

*NOTE:* Position variables will not be changed. These must be defined by the operator.

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 (see Section 5.2.1).
- Move robot to Safe 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**

To start up ArcWorld 6000 cell from a Power-Off condition, proceed as follows:

1. Turn on welding power source disconnect.
2. Set MAIN POWER switch on XRC 2001 to ON.
3. Set INPUT POWER switch on welding power source to ON. The pilot light on power source turns on.
4. Open regulator valve on welding gas supply.
5. Open air supply valve.
6. Make sure enclosure door is closed.
7. Disable operator station.
8. Press TEACH mode button on XRC 2001 playback panel. The indicator light in switch turns on.
5.2.2 Robot Safe (Cube 24) Position

To move the robot to the Safe position (cube 24) proceed as follows:

1. Press TEACH mode button on XRC 2001 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 R1Safe job and press SELECT. Cube 24 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 robot to Safe position.

5.2.3 Starting the Master Job

With the system powered up and in TEACH mode, call up Master job 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 both enclosure doors are closed and securely latched.
6. Press PLAY mode button on playback panel. Playback operation is enabled.
7. Press SERVO ON button on playback panel.
8. Reset positioner by simultaneously pressing RESET and right CYCLE START buttons on operator station.
9. Place ENABLE/DISABLE switch on operator station in ENABLE position. XRC 2001 is placed in REMOTE mode and system control is transferred to operator station.

The ArcWorld 6000 cell is now ready for operation.

5.2.4 Operation Cycle

1. Load production parts on fixtures located on operator side of positioner.
2. Step out of safety curtains.

NOTE: • Before sweeping at first power up, make sure the correct job has been loaded.
• Before sweeping, make sure the weight of the parts and fixtures is approximately equal on Sides A and B of the positioner (refer to Section 3.4).

3. Press the CYCLE START palm button on operator station to sweep positioner. The positioner sweeps, placing unwelded parts in robot’s welding area and turning empty side to operator’s loading area. The sweep can range from 90 to 180 degrees, and consist of a single move or a series of smaller moves.
4. After positioner sweeps, robot begins welding sequence on parts. Coordinated motion capabilities allow positioner to rotate parts on positioner, while robot moves and welds at same time.
5. Load more parts to be welded into fixture on operator’s side of positioner.
6. Press the CYCLE START palm button on operator station. The positioner sweeps, returning welded parts outside cell and placing newly loaded, unwelded parts in robot’s work area.
7. Unload welded parts from fixture.

5.2.5 Shutdown

Use the following procedure to shut down the ArcWorld 6000 cell after operation is complete:

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

The ArcWorld 6000 cell is now shut down.

5.3 System Recovery

Under certain conditions you will be required to clear an alarm or error. 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 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 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 sliding 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.
- Loss of air system pressure.

To restart the ArcWorld 6000 cell after an E-STOP condition occurs, follow the procedure below.

1. To clear E-STOP condition, perform any of the following actions that apply:
   - Release E-STOP button on operator station, programming pendant, or XRC 2001 playback panel.
   - Close sliding door.
   - Step out of light curtain.
   - Clear Shock Sensor condition (refer to Section 5.3.3).
   - Restore operating air pressure.

2. Press SERVO ON button on operator station, programming pendant, or playback panel.
3. Press RESET button and right CYCLE START button on operator station to initialize system.
4. Ensure operator station is enabled.
5. Press MASTER JOB START button on the operator station.

The ArcWorld 6000 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!](image)

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


The ArcWorld 6000 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 XRC 2001. Each axis brake is controlled by an individual axis 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 the robot. Listed below are weights of each robot available:
   - UP6 – 135 kg (297 lb)
   - UP20 – 280 kg (617 lb)

![WARNING!](image)

*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

6.1 Periodic Maintenance

For periodic maintenance procedures and schedules for the UP6 and UP20 robot and the XRC 2001, refer to the manipulator manual or to the XRC 2001 Controller Maintenance Manual that came with your system. For additional maintenance information about the reciprocating positioner, refer to your positioner manual.

For maintenance information about the welding power source, refer to your Owner’s Manual.

Table 6-1 provides a list of periodic maintenance to be performed on the ArcWorld 6000 cell. Keep in mind that the maintenance intervals given serve as guidelines only. You should adjust the frequency of maintenance to suit your specific work conditions.

CAUTION!
Use only the antifreeze provided by Motoman. Automotive antifreezes contain stop-leak additives that will clog the small torch water-cooling ports in water torch applications. Damage to the gaskets in the water circulator pump can also occur.

Table 6-1 Periodic Maintenance

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Component</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>MRM2-250 servo head-stock RV drive unit</td>
<td>Check for proper grease levels and quality. Use Epinoc APO grease (Motoman P/N 132434-1) as required.</td>
</tr>
<tr>
<td>Daily</td>
<td>Water circulator (For 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>Air system water trap on the rear of the MRM2 positioner.</td>
<td>Check water trap and empty if required.</td>
</tr>
<tr>
<td>Monthly</td>
<td>MRM2 weld grounds</td>
<td>Inspect for damage from overheating. Replace if necessary. Check all power source connections for proper torque.</td>
</tr>
<tr>
<td>Monthly</td>
<td>Robot weld cable</td>
<td>Inspect for damage and replace if necessary.</td>
</tr>
<tr>
<td>• 500 Hours</td>
<td>MRM2 drive pins and locking pins</td>
<td>Spray the drive and locking pins with a Molycote BR2 grease or equivalent.</td>
</tr>
<tr>
<td>• 1000 Hours</td>
<td>MRM2 positioner gears</td>
<td>Lubricate with Shell 1029 or equivalent.</td>
</tr>
<tr>
<td>• 20,000 Hours</td>
<td>MRM2-250 servo head-stock RV drive</td>
<td>Change the grease in the drive unit. Use Epinoc APO grease (Motoman P/N 132434-1).</td>
</tr>
<tr>
<td>Numerics</td>
<td>E (continued)</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1-Cycle, Symbol, 3-4</td>
<td>Error Messages, 5-9</td>
<td></td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>E-STOP Recovery, 5-9</td>
<td></td>
</tr>
<tr>
<td>About this Document, 1-1</td>
<td>E-Stop, Symbol, 3-4</td>
<td></td>
</tr>
<tr>
<td>Alarm, 3-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm/Error, 3-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarms and Errors, 5-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANSI/RIA, 2-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc Curtains, Installation, 4-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc Screens, 3-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARC WELDING, GENERAL, HANDLING, and SPOT WELDING, Icon, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brake Release, 3-6, 3-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell Components, 4-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell Door, Installation, 4-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting the Cables, 4-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting the Positioner Pneumatic Air Line, 4-17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting the Power, 4-18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting the Welding Ground, 4-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Converting Programs from Side A to Side B, 5-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinated Motion, 3-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinated motion, 5-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Service Information, 1-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer-Supplied Items, 4-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle Start, 3-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylindrical, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>D</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily Operation, 5-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicated Inputs, 5-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicated Outputs, 5-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display, 3-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Ground, Connecting, 4-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Stop (E-STOP), 3-2, 3-3, 3-7, 3-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENABLE Function Key, 3-4, 3-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENABLE Switch, 3-5, 3-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Description, 3-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>F</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing, 3-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing, Installation, 4-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>G</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Safeguarding Tips, 2-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GMAW Torch, 3-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hold, 3-2, 3-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hold, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O Assignment, 5-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN/OUT, Icon, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inching, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation, 4-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation Safety, 2-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation, Operator Station, 4-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installing the Auxiliary Equipment Common Base, 4-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installing the Robot and Positioner, 4-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interference Cubes, 3-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interlocked Cell Door, 3-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction, 1-1, 2-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>J</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOB, Icon, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>K</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keypad, 3-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>L</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Side Wall, Fence Installation, 4-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>List of Tools, 4-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low, Symbol, 3-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>M</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance, 6-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance Safety, 2-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major Alarms, 5-9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
INDEX

M (continued)
Major Components, 1-3
Master Job Start, 3-7
Materials Required, 4-1
Mechanical Safety Devices, 2-3
Medium, Symbol, 3-4
Minor Alarms, 5-9
Mode Select, 3-2

O
Operation, 5-1
Operation Safety, 2-5
Operator Station, 3-6
    Alarm, 3-7
    Cycle Latched, 3-7
    Cycle Start, 3-6
    Emergency Stop (E-STOP), 3-7
    Hold, 3-7
    Operator Station Enable/Disable, 3-8
    Positioner Auto/Manual, 3-7
    Reset, 3-8
    Servo On, 3-8
    Start, 3-7
Optional Equipment, 1-3

P
Payload, Robot, 3-1
Periodic Maintenance, 6-1
PLAY, Mode, 3-2
Playback Box, 3-2
Playback Panel
    Alarm/Error, 3-2
    Emergency Stop (E-STOP), 3-2
    Hold, 3-2
    Mode, 3-2
    Servo On Ready, 3-2
    Start, 3-2
PLC, Safety Feature, 3-13
Positioner
    Arc Shield, 3-10
    Installation, 4-7
    Locking Pins, 3-9
    Welding Ground System, 3-9
    Positioner Auto/Manual, 3-7
    Positioner Specifications, 3-9
    MRM2-250, 3-9

P (continued)
Positioner, MRM2-series, 3-8
Positioning Accuracy, Robot, 3-1
Power Sources, 3-11
Programming, 5-1
Programming Pendant, 3-3
    Area Key, 3-4
    Cursor Key, 3-4
    Display, 3-3
    Emergency Stop (E-STOP), 3-3
    ENABLE Switch, 3-5
    Keypad, 3-3
    Menu Area, 3-3
    RS-232C Serial Port, 3-5
    Select Key, 3-5
    Status Area, 3-4
    TEACH LOCK Key, 3-5
    Top Menu Key, 3-4
Programming Platforms, Installation, 4-6
Programming Safety, 2-4

R
Reference to Other Documentation, 1-3
REMOTE, Mode, 3-2
Removing the Shipping Brackets, 4-5
Reset, 3-8
Right Side Wall, Installation, 4-9
Robot Description, UP-series, 3-1
Robot Motion with the Positioner Stationary, 5-5
Robot Safe (Cube 24) Position, 5-7
ROBOT, Icon, 3-4
Robotic Industries Association, 2-1
Rotating the Headstock, 5-4
Rotation of the Positioner During Air-Cut Moves, 5-5
Rotation of the Positioner During Welding, 5-5
Running/Start, Symbol, 3-4

S
Safety, 2-1
Safety Features, 3-12
Safety Light Curtains, 3-12
Safety/Operation Check, 4-19
Selecting the Master Job, 5-7
Serial Number, Robot, 1-4
Servo Power, 3-2
Shock Sensor Recovery, 5-10
INDEX

S (continued)
Shutdown, 5-8
Site Preparation, 4-2, 4-3
Software Version, Reference, 1-4
Specified Outputs, 3-14
Standard Conventions, 2-2
Start-Up, 5-6
Station Ready, 3-7
Step, Symbol, 3-4
Stop, Symbol, 3-4
Sweeping the Positioner, 5-3
Symbols, 3-4
Synchronized Motion, 3-8
SYSTEM INFO, Icon, 3-4
System Layout, 1-3
System Overview, 1-2
System Recovery, 5-8

T
TEACH, Mode, 3-2
Tool, Symbol, 3-4
Tooling and Fixtures, 4-19
Torch Mount, 3-10

U
Universal Welding Interface (UWI), 3-10
User Frame, Symbol, 3-4
Using the Brake Release, 5-10

V
VARIABLE, Icon, 3-4

W
Welding Equipment, 3-10
Welding Ground System, 3-9
Wire Feeder, 3-10
World, Symbol, 3-4

X
XRC 2001 Controller, 3-1
XRC 2001 User Inputs, 5-2
XRC 2001 User Outputs, 5-3