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# Table of Contents

## Chapter 1
**Introduction** ................................................................. 1
  1.1 About This Document ..................................................... 1
  1.2 System Overview ............................................................ 2
    1.2.1 System Layout ....................................................... 3
    1.2.2 Major Components .................................................. 3
    1.2.3 Optional Equipment ................................................ 3
  1.3 Reference to Other Documentation ...................................... 4
  1.4 Customer Service Information .......................................... 4

## Chapter 2
**Safety** ............................................................................. 5
  2.1 Introduction ...................................................................... 5
  2.2 Standard Conventions ...................................................... 6
  2.3 General Safeguarding Tips ................................................. 7
  2.4 Mechanical Safety Devices ............................................... 7
  2.5 Installation Safety ............................................................ 8
  2.6 Programming, Operation, and Maintenance Safety .................... 8

## Chapter 3
**Equipment Description** .................................................. 11
  3.1 Robot Description ............................................................ 11
  3.2 NX100 Controller ............................................................. 11
    3.2.1 Programming Pendant ............................................... 12
  3.3 Operator Station .............................................................. 16
  3.4 MRM2-1200 M3X Positioner .............................................. 17
  3.5 Welding Equipment ........................................................... 19
    3.5.1 Power Sources ......................................................... 19
    3.5.2 Wire Feeder .............................................................. 21
    3.5.3 GMAW Torch ............................................................ 21
  3.6 Safety Features ............................................................... 21
    3.6.1 Arc Screens ............................................................. 21
    3.6.2 Fencing ................................................................... 21
    3.6.3 Light Curtains .......................................................... 22
    3.6.4 Emergency Stops (E-STOPS) ....................................... 22
    3.6.5 ENABLE Switch ......................................................... 22
    3.6.6 Brake Release ........................................................... 22
    3.6.7 Interlocked Cell Door ................................................. 22
Chapter 4  
Installation ................................................................. 23
  4.1 Materials Required .................................................. 23
    4.1.1 Customer-Supplied Items .................................. 23
    4.1.2 List of Tools .................................................... 24
  4.2 Site Preparation .................................................... 24
  4.3 Installing the Positioner ............................................ 25
  4.4 Installing the Robot Common Base ............................... 27
    4.4.1 Installing the Controller Base .............................. 28
    4.4.2 Installing the Auxiliary Equipment Common Base ........ 31
  4.5 Connecting the Cables ............................................. 32
    4.5.1 Cable Routing .................................................. 32
    4.5.2 Connecting the Earth Ground ................................. 32
    4.5.3 Connecting the Programming Pendant Cable ................ 33
    4.5.4 Connecting the Welding Cables .............................. 33
    4.5.5 Connecting the Robot Cables ................................ 35
    4.5.6 Connecting the Positioner Cables ........................... 36
    4.5.7 Removing the Shipping Bracket .............................. 37
  4.6 Installing the Safety Light Curtains ............................ 38
    4.6.1 Installation .................................................... 38
  4.7 Installing the Operator Station ................................ 40
  4.8 Connecting Power .................................................. 40
  4.9 Conducting a Safety/Operation Check ............................ 41
  4.10 Installation of Tooling and Fixtures ........................... 41

Chapter 5  
Operation ................................................................. 43
  5.1 Programming ........................................................ 43
    5.1.1 Sweeping the Positioner ................................... 44
    5.1.2 Rotating the Headstock ..................................... 45
    5.1.3 Programming Specific Jobs .................................. 45
  5.2 Daily Operation .................................................... 48
    5.2.1 Start-Up ....................................................... 48
    5.2.2 Safety Circuit Check ........................................ 49
    5.2.3 Robot Home Position ................................ ....... 49
    5.2.4 Selecting Weld Job (Initial Setup Only) .................... 50
    5.2.5 Starting the Master Job ..................................... 50
    5.2.6 Perform Operation Cycle .................................... 51
    5.2.7 Shutdown ...................................................... 51
  5.3 System Recovery .................................................... 51
    5.3.1 Alarms and Errors .......................................... 51
      5.3.1.1 Error Messages ....................................... 52
5.3.1.2 Minor Alarms ................................................................. 52
5.3.1.3 Major Alarms ................................................................. 52
5.3.2 E-STOP Recovery ............................................................... 52
5.3.3 Shock Sensor Recovery ...................................................... 53
5.3.4 Brake Release ................................................................. 53

Chapter 6
Maintenance ............................................................................. 55

Appendix A
Anchor Requirements ............................................................... 57
Notes
Chapter 1

Introduction

The ArcWorld IV-6300 XHD system 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.

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 IV-6300 XHD 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 IV-6300 XHD system.

SECTION 3 - DESCRIPTION OF EQUIPMENT
This section provides a detailed description of the major components of the ArcWorld IV-6300 XHD 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 IV-6300 XHD system.

SECTION 5 - OPERATION
This section provides instructions for basic operation of the ArcWorld IV-6300 XHD system. This section also provides procedures for start-up, loading, normal operation, fault recovery, and shutdown. Sample robot programs are also included in this section.

SECTION 6 - MAINTENANCE
This section contains a table listing periodic maintenance requirements for the components of the ArcWorld IV-6300 XHD cell.
1.2 System Overview

Motoman’s classic ArcWorld IV-6300 XHD robotic solution is a high-performance, pre-engineered workcell ideal for smaller part fabrication at medium to high volumes. The system is designed around three high-performance EA-1400N Motoman robots and NX100 controllers, and includes integrated welding packages, operator interface and total safety environment. A ferris-wheel type reciprocating positioner with two orbital axes, capable of rotation in conjunction with the primary axis (trunnion) allows an operator to prepare and set up parts on one side while the robot welds on the other side. Safety features include load station(s) interlocked with dual-channel safeguards, interlocked access doors, and safety fencing.

Figure 1 System Layout

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

The robot manipulators and positioner are mounted to a common programming platform. The NX100 controllers and welding power sources share a common base and are located at the side of the cell. The robotic cell is fully enclosed by safety fencing and an interlocking door. Light curtains provide a safety zone to prevent the positioner from cycling while anyone is standing within the zone. All operator controls, including those on the controllers and welding power supplies, are accessible from outside of the robotic enclosure.

1.2.2 Major Components

The ArcWorld IV-6300 XHD includes the following major components:

- Three Motoman EA-1400N manipulators and NX100 controllers
- MRM2-1200M3X positioner
- Operator station
- Welding equipment, including the following:
  - Welding power source
  - Motoman torch (water-cooled or air-cooled)
  - Wire feeder
  - Applicable welding interface
  - Torch mount
- Safety equipment, including the following:
  - Safety fencing with arc curtains
  - Interlocked light curtains
  - Interlocked cell door
  - Positioner arc screen

1.2.3 Optional Equipment

The following optional equipment is available for use with the ArcWorld IV-6300 XHD:

- Torch tender
- Wire cutter
- Com-Arc III seam tracking unit
- Water circulator
- Touch Sense-Starting Point detection unit
1.3 **Reference to Other Documentation**

For additional information refer to the following:

- Motoman EA1400N Manipulator Manual (P/N 149209-1)
- Motoman NX100 Controller Manual (P/N 149201-1)
- Motoman Operator's Manual for Arc Welding (P/N 149235-1)
- Motoman Concurrent I/O Parameter Manual (P/N 149230-1)
- 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 (EA1400N)
- Application Type (welding)
- System Type (ArcWorld IV-6300 XHD)
- Software Version (access using MAIN MENU, SYSTEM INFO, VERSION on programming pendant)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on front door of NX100 controller)
Chapter 2

Safety

2.1 Introduction

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

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06-1999. 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
INTERNET: www.roboticsonline.com

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, Operation, and Maintenance Safety (Section 2.6)

2.2 Standard Conventions

This manual includes the following alerts – in descending order of severity – that are essential to the safety of personnel and equipment. As you read this manual, pay close attention to these alerts to insure safety when installing, operating, programming, and maintaining this equipment.

**DANGER!**
Information appearing in a DANGER 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 in a WARNING 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 in a CAUTION 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 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 R15.06-1999, section 4.2.5, Sources of Energy, 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 R15.06-1999 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 equipment is provided as standard:

- Safety fences and barriers
- Door interlocks
- Emergency stop palm buttons located on operator station, robot controller, and programming pendant

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 R15.06-1999 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, Operation, and 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. 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 program, operate, and maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- 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 all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
- Check the E-STOP button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before 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.
• Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. 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.

• The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. 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 and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.

• Check and test any new or modified program at low speed for at least one full cycle.

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

• Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.

• Use proper replacement parts.

• 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).
NOTES
Chapter 3

Equipment Description

3.1 Robot Description

The Motoman six-axis EA1400N “Expert Arc” robot is specifically designed for arc welding applications. The robot payload is 3 kg (6.6 lbs.) and it features a horizontal reach of 1388-mm (54.6 inch) and a relative positioning accuracy of ±0.08 mm (±0.003 inch). The EA1400N has a patented internal cabling design that provides high flexibility and streamlines the robot profile, allowing access into confined spaces. The robot’s B-axis features an expanded range of motion which improves circumferential welding on cylindrical work pieces. The T-axis can rotate the torch ±360 degrees without cable interference.

The robot can be mounted on the floor, wall, or ceiling with minor modifications. 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 NX100 Controller

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

The NX100 coordinates the operation of the ArcWorld IV-6300 XHD system. It controls manipulator movement and welding power supply, processes input and output signals, and provides the signals to operate the welding system. It maintains variable data and performs numeric processing to convert to and from different coordinate systems. In addition, the controller provides main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the controller manual that came with your system.
3.2.1 Programming Pendant

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Figure 4 Enable Switch
3.3 Operator Station

The operator station (see Figure 5) includes a NEMA enclosure on a stand-alone pedestal. The following paragraphs describe the operator station controls.

![Figure 5 Operator Station](image)

**Cycle Start/Cycle Latched**

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

The green CYCLE START/CYCLE LATCHED button, located on the operator station, initiates a positioner sweep cycle if the robot is in the Safe or Home position (Cube 24). If the CYCLE START/CYCLE LATCHED button is pressed while the robot is outside Cube 24, the CYCLE START command is latched into the controller. 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.

**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.

**Robot Hold**

The ROBOT HOLD button is a normally closed, momentarily actuated switch. Pressing ROBOT HOLD stops the operation of the manipulator until another START signal is sent. The indicator light stays ON only while the ROBOT HOLD button is pressed. Operation resumes at the point in the program where the ROBOT HOLD state was initiated. Refer to the manipulator manual for more information.
### Alarm
The ALARM lamp is connected to the robot SERVO ON and ALARM OCCURRENCE outputs. The ALARM lamp lights red when the robot encounters an alarm condition or when servo power is cut.

### 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.*

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

### Operator Station Enable/Disable
The OPERATOR STATION ENABLE/DISABLE selector switch transfers primary control of the ArcWorld cell from the controller to operator station.

### 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.

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

#### 3.4 MRM2-1200 M3X Positioner

The MRM2-1200 M3X positioner uses a reciprocating motion that sweeps each side of the “ferris wheel” type positioner from the operator’s loading zone, into the robot’s work zone, and back to the operator again. A metal arc screen divides the positioner into two work areas labelled Side A and Side B. When Side A is in the robot’s welding zone, Side B is facing the operator and ready to be loaded or unloaded with parts, and vice versa. Loading fixtures are supplied by the customer. For positioner specifications, refer to Table 1. Refer to the positioner manual for maintenance procedures.

The ArcWorld IV-6300 XHD system is capable of synchronized motion between various components depending on the job configuration. Synchronized robots move at the same time during operation. R1 can be synchronized with the positioner; R2 can be synchronized with the positioner; and R1 can be synchronized with R2. Dual robots can work simultaneously on a rotating work piece if the tasks are symmetrical.

*Note: In high humidity areas, use surface protection to prevent corrosion of the tooling plates.*
Table 1  Technical Specifications

<table>
<thead>
<tr>
<th>Model P/N</th>
<th>148706-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated PayLoad</td>
<td>2x 1200 kg</td>
</tr>
<tr>
<td>Load Height (from floor to centerline)</td>
<td>910 mm</td>
</tr>
<tr>
<td>Programming Height</td>
<td>1141 mm</td>
</tr>
<tr>
<td>Max Cg Offset</td>
<td>76 mm</td>
</tr>
<tr>
<td>Max. Load Imbalance (Side A vs. Side B)</td>
<td>300 kg</td>
</tr>
<tr>
<td>Number of Motors</td>
<td>3</td>
</tr>
<tr>
<td>Index Motor Power</td>
<td>4.5 kW</td>
</tr>
<tr>
<td>Tooling Motor Power</td>
<td>2.2 kW</td>
</tr>
<tr>
<td>Side A to Side B Sweep Time 2</td>
<td>3.25 seconds</td>
</tr>
<tr>
<td>Index Axis Speed</td>
<td>0-12.8 rpm</td>
</tr>
<tr>
<td>Index Torque</td>
<td>5800 N•m</td>
</tr>
<tr>
<td>Tooling Index Time1</td>
<td>2.25 seconds</td>
</tr>
<tr>
<td>Tooling Axis Speed</td>
<td>0-20.7 rpm</td>
</tr>
<tr>
<td>Tooling Torque</td>
<td>895 N•m</td>
</tr>
<tr>
<td>Total Index Time</td>
<td>3.25 seconds</td>
</tr>
<tr>
<td>Maximum Fixture Diameter 3</td>
<td>13002 mm</td>
</tr>
<tr>
<td>Standard Fixture Length 4</td>
<td>3000 mm</td>
</tr>
<tr>
<td>Position Accuracy</td>
<td>+/- 0.1 mm</td>
</tr>
<tr>
<td>Standard Tooling Air Size</td>
<td>2 x 10 mm ID</td>
</tr>
<tr>
<td>Standard Tooling Air Location</td>
<td>Headstock</td>
</tr>
<tr>
<td>E-Stop Time</td>
<td>0.3163 seconds</td>
</tr>
<tr>
<td>E-Stop Angle</td>
<td>14.24 degrees</td>
</tr>
<tr>
<td>Tooling Axis Weld Ground Capacity (100% Duty Cycle) 5</td>
<td>1200 Amps</td>
</tr>
<tr>
<td>Positioner Weight</td>
<td>4100 kg</td>
</tr>
</tbody>
</table>

1 Signal-to-signal time for 180 degrees of tool rotation.
2 Includes Side A to Side B Sweep time plus the Tooling Index time.
3 The fixture diameter of the side that sweeps under is limited to 450 mm in depth to clear the floor. This results in a “D” shaped tooling envelope.
4 Pin to pin dimension is 2920 +/- 7.5 mm
5 The tooling axis weld ground capacity can be increased to 1600 Amps with 149291-1 Block Kit.

For additional information on independent control and coordinated motion, refer to the Independent/Coordinated Function manual (Part Number 149648-1). This system is also capable of...
true coordinated motion, where linear, circular, or spline motion can be coordinated between R1 and
the positioner, between R2 and the positioner, and between R1 and R2. Coordinated motion allows
the robots to weld while the positioner rotates the parts. For additional information on coordinated
motion, refer to the Independent/Coordinated Function manual (Part Number 149648-1).

3.5 Welding Equipment

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

3.5.1 Power Sources

Motoman offers several different power sources for use with the ArcWorld IV-6300 XHD system,
depending on the system’s application. Figure 6 shows some of the more common power sources
used. However, the power source your system uses may be different. For more specific information,
refer to the vendor manual that came with your system.
Figure 6  Available Power Sources
3.5.2 Wire Feeder

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

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.

3.6 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 R15.06-1999 Robot Safety Standard stipulates the user is responsible for safeguarding.

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

3.6.1 Arc Screens

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

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 cell during automatic operation.
3.6.3 **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 operator steps into the safety zone, servo power is removed from the system and all positioner motion stops. Servo power can be reapplied and the operation resumed by pressing SERVO ON and START.

3.6.4 **Emergency Stops (E-STOPS)**

In addition to the safety features described above, the ArcWorld IV-6300 XHD 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 following is a list of E-STOP locations:

- The controller door
- The programming pendant
- The operator station

3.6.5 **ENABLE Switch**

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

3.6.6 **Brake Release**

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

3.6.7 **Interlocked Cell Door**

**WARNING!**

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

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

The ArcWorld IV-6300 XHD system can be installed easily in just a short amount of time. 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 hardware necessary for installing the ArcWorld IV-6300 XHD is included with the system. This section identifies customer-supplied items and tools required to complete installation.

4.1.1 Customer-Supplied Items

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

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

4.2 Site Preparation

To prepare your site, proceed as follows:

1. Clear floor space needed for unit (see Figure 7).

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

2. Gather all customer-supplied items and required tools listed in Section 4.1.

Figure 7 Area Needed for Installation
4.3 Installing the Positioner

The positioner should be firmly mounted on a base plate or foundation rigid enough to support the positioner and withstand repulsion forces. The surface of the floor should be level and even. If it is uneven, grind the swell and flatten the surface. The concrete thickness of the floor must be at least 150 mm.

**WARNING!**
The positioner weighs 4100 kg (9038 lbs). Make sure lifting devices used to move the positioner are capable of safely handling this much weight, or damage to equipment or injury to personnel can result.

1. Move the positioner in place for operation.
2. Anchor positioner securely in place (refer to Appendix A for anchor requirements).

**Note:** It is important that both the headstock and tailstock are anchored to the floor prior to the removal of the shipping brackets. This prevents misalignment between the headstock and tailstock.

3. Use a M24 socket/wrench to remove the eight screws securing the shipping bracket to the positioner.
Figure 9  Positioner Shipping Brackets

4. Remove shipping bracket.

Note: Positioner shipping bracket are required to move the positioner. Be sure to keep the positioner shipping brackets for future use.

5. Anchor positioner securely in place (refer to Appendix A for anchor requirements).

Note: The MRM2-1200 S3X positioner does not require leveling. The leveling bolts are designed to eliminate instability or “rock” caused by imperfections in the mounting surface.
4.4 Installing the Robot Common Base

**DANGER!**
The robot common base weighs 1630 kg (3593.6 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.

![Diagram of the Robot Common Base](image)

**Figure 10** Robot Common Base Installation
1. Using a forklift, place the robot common base in position as shown in system prints.

2. Fasten spanners to the positioner and robot common base using the hardware provided.

**WARNING!**

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

3. Cut bands securing the floor cover plate and remove it from the robot common base. The cover plate will be replaced after cables have been routed beneath the common base and programming platform.

4. Using an M36 socket to turn each leveling bolt, level the robot common base.

![Figure 11 Robot Common Base Leveling Points](image)

5. Anchor base securely in place (refer to Appendix A for anchor requirements).

6. Carefully remove protective plastic wrapping from robots and torches.

7. Inspect robots, torches, and positioner for shipping damage.

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

### 4.4.1 Installing the Controller Base

The controller base contains the three controllers and main service disconnect. The base is shipped on wood blocks. To install the controller base, proceed as follows:
1. Unbolt the controller base by removing four shipping bolts using a 3/4-inch socket.

![SHIPPING BOLT](image)

**Figure 12** Unbolting Controller Base

**WARNING!**

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

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

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

4. Using a forklift, lift the controller base and remove both wood blocks.
5. Using the dimensions in Figure 13, place the controller base next to the robot common base closest to the positioner headstock.
6. Anchor base securely in place (refer to Appendix A for anchor requirements).
4.4.2 Installing the Auxiliary Equipment Common Base

The Auxiliary Equipment Common (AEC) base contains the three welders and service disconnects, optional water circulators, and Com-Arc seam tracking units. The base is shipped on wood blocks. To install the AEC base, proceed as follows:

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

![Figure 14 Controller Base Location]

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

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

Note: If damage is found, notify shipper immediately.

4. Using a forklift, lift the AEC base and remove both wood blocks.
5. Using the dimensions in Figure 14, place the AEC base next to the robot common base closest to the positioner tailstock.
6. Anchor base securely in place (refer to Appendix A for anchor requirements).
4.5 Connecting the Cables

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

4.5.1 Cable Routing

It is important to keep cables covered/hidden as much as possible. Figure 15 shows the recommended cable routings to avoid cable damage. Cables leading to the robots must be routed under the floor cover plate. Other cables must be routed close to equipment when possible.

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

![Figure 15 Cable Routing](image)

4.5.2 Connecting the Earth Ground

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

**DANGER!**

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

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 controller are within 4.57 m (15 ft) of each other, a common earth ground may be used. Otherwise, separate earth grounds must be used.*

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

### 4.5.3 Connecting the Programming Pendant Cable

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

### 4.5.4 Connecting the Welding Cables

**Negative (Ground) Cables**

The MRM2-1200 M3X positioner has a welding ground bar located inside the headstock housing. The welding ground cables are connected to this ground bar from the welders. The welding ground cables are shipped in an accessories box. To connect the ground welding cables, use your system prints and proceed as follows:

1. Unpack the negative ground cables and check for damage.

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

2. Connect one end of the welding ground cable to the Welder 1 negative terminal (see Figure 17). Check that the connection is tight.

**CAUTION!**

Poor arc performance and cable overheating may result if both welding cables share the same ground. All ground connections must be tight. If connections are loose, arcing can occur and cause the insulator to melt.
3. Connect the other end of the Welder 1 ground cable to the ground bar located inside the headstock housing (see Figure 16). Verify connection is tight.

4. Connect one end of second welding ground cable to the Welder 2 negative terminal (see Figure 17). Check that the connection is tight.

5. Connect the other end of the Welder 2 ground cable to the ground bar located inside the headstock housing (see Figure 16). Verify connection is tight.

6. Connect one end of third welding ground cable to the Welder 3 negative terminal (see Figure 17). Check that the connection is tight.

7. Connect the other end of the Welder 3 ground cable to the ground bar located inside the headstock housing (see Figure 16). Verify connection is tight.

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**Figure 16** Ground Bar Inside Headstock Housing

**Figure 17** Weld Cable Connections on Power Supply
**Positive Cables**

The positive welding cables (R1, R2, and R3) are wrapped in leather and wire-tied to each robot. One end of each positive cable is properly connected to the robot.

**CAUTION!**

*Do not remove the leather wrapping or damage to the cables could result.*

To connect the positive welding cables, use your system prints and proceed as follows:

1. Cut the wire-ties and unwrap the positive weld cables from each robot.
2. Check cables for damage.

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

3. Route the R1 positive welding cable beneath the robot common base to Welder 1.
4. Connect the R1 positive welding cable to the Welder 1 positive (+) terminal (see Figure 17). Check that the connection is tight.
5. Route the R2 positive welding cable beneath the robot common base to Welder 2.
6. Connect the R2 positive welding cable to the Welder 2 positive (+) terminal. Check that the connection is tight.

**4.5.5 Connecting the Robot Cables**

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

To connect the robot cables, proceed as follows:

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

1. Unpack the manipulator cables and wire feeder cable, connected to each controller, and route beneath the robot common base to the back of each robot.
2. Carefully engaging connectors, connect two cables (labeled 1BC and 2BC) to 1BC and 2BC connections on back of each robot.
3. Connect wire feeder control cable (3BC-A) to the matching connection on back of each robot.
4. Replace floor cover plate on robot common base. Make sure all cables leading to the robots are fed through the three slots in the plate (see Figure 15).
4.5.6 Connecting the Positioner Cables

Three cables CA24, CA25, and CA26, connect the positioner to the controller. The CA26 cable supplies power to the positioner servo motors. The CA24, and CA25 cables provide communication between the controller and the positioner. To connect the robot cables, proceed as follows:
1. Unpack positioner cables CA24, CA25, and CA26 from the R1 controller and route to the positioner headstock.

Connect the CA24 cable to the CA24 connector on the positioner headstock.

Connect the CA25 cable to the CA25 connector on the positioner headstock.

Connect the CA26 cable to the CA26 connector on the positioner headstock.

4.5.7 Removing the Shipping Bracket

**CAUTION!**
Failure to remove shipping brackets from robot before operating the ArcWorld IV-6300 XHD may result in damage to the robot drive mechanisms.

A yellow bracket (see Figure 20) prevents the robot from moving during shipping. The bracket secures 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 bracket.
4.6 Installing the Safety Light Curtains

4.6.1 Installation

The three light curtain components, the emitter, collector, and safety fence come pre-assembled and fastened inside the cell for shipping.

1. Unfasten both fences from their shipping position and move into position. The light curtains are oriented properly with the status lights located near the base of the positioner.

2. Use the three bolt holes (see Figure 21) located on the positioner housing to mount the light curtain/fence assemblies.
3. The wiring connections are packaged on the positioner base. Unpack the light curtain cables and connect them to the matching connectors on the light curtains.

4. The emitter and collector must be aligned properly. Refer to the light curtain manufacturer’s literature that accompanies the robot cell for exact alignment procedures.

5. Once the light curtains have been properly installed, anchor the fence posts to the floor.

6. Anchor fencing securely in place (refer to Appendix A for anchor requirements).

7. Check the alignment of the light curtains again after fence posts have been anchored. Readjust as necessary.
4.7 Installing the Operator Station

To install the operator station, proceed as follows:

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

*Note: If damage is found, notify the shipper immediately.*
4. Place operator station outside fence to front of positioner.
5. Insert 1/4-inch concrete drill bit through center of lag holes in operator station and drill holes for lag bolts.
6. Vacuum concrete dust from holes.
7. Lag operator station to floor.

4.8 Connecting Power

After all of the system components have been properly installed, connect the power to the ArcWorld IV-6300 XHD.

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

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

*Note: The ArcWorld IV-6300 XHD is configured for 3-phase 460/480V AC, unless other voltage was requested. If other voltage is required for your plant, you must make the necessary modifications to the transformer. For more information, refer to the manipulator manual that came with your system.*
4.9 Conducting a Safety/Operation Check

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

1. Check that all three yellow shipping brackets have been removed from each robot (see Section 4.5.7).
2. Be sure there is a clearance of at least 2.5 cm (1 in.) on either side of the positioner.
3. Be sure the safety light curtains are aligned correctly.
4. Check that the cell door is closed and latched.
5. Check that all cable connections are tight.
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 front of the controller.

Your ArcWorld IV-6300 XHD 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.

4.10 Installation of Tooling and Fixtures

Your ArcWorld IV-6300 XHD 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.
Notes
Chapter 5

Operation

The ArcWorld IV-6300 XHD is a fully integrated robotic arc welding cell. The Master job setup, and the sub-jobs programmed within it, determine how the robot performs the welding operation or other tasks. The robots weld parts on one side of the 180-degree reciprocating positioner, while the operator loads or unloads parts on the opposite side. Once the robots are finished with the welding process, they return to the Home position. The operator then sweeps the positioner 180 degrees placing the unwelded parts into the robot work area and the finished parts into the operator area for unloading.

The MRM2-1200 M3X positioner uses a 180-degree reciprocating motion that sweeps the parts tooling and fixtures from the operator's loading zone, into the robot's work zone, and back. The positioner arc shield visually divides the positioner into two separate 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.

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

5.1 Programming

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

Any changes made to your system configuration and/or job structure will alter the operation of this cell. Motoman recommends you do not modify the original jobs and system configuration that came with your system. If modifications need to be made, they should be made to copies of these jobs and not to the originals. Modifications should only be performed by personnel who have received operator training from Motoman, and who are familiar with the operation of this Motoman system. If you have questions concerning the configuration of your system please contact the 24 hour Service Hotline, at (937) 847-3200 (see Section 1.4).
A major advantage of the ArcWorld IV-6300 XHD system is its high degree of flexibility. The operator can fine tune the movement of both the robots and positioner according to part configuration. The MRM2-1200 M3X positioner, with its programmable primary axis and headstocks, proves highly versatile when configured with the EA1400N robot. The robots can be programmed to weld parts with the headstock stationary, or the robots and headstock can move simultaneously. The robots can be programmed to weld different seams on the same part and to move from part to part to continue welding.

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

Note: Refer to your system’s Independent/Coordinated Motion Manual (P/N 149648-1) for information on coordinated motion, selecting synchronization, group axes, and tooling calibration.

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

5.1.1 Sweeping the Positioner

WARNING!
Sweeping the positioner manually from the pendant may result in the fixtures/tooling hitting the ground. Care must be taken to avoid damaging fixtures and/or tooling.

Note: In order to sweep the positioner, the robots must be in the Home position.

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

1. Place robots in Home position (see Section 5.2.2).
2. Set the op-station POSITIONER switch to MANUAL mode and start the Master Control job (see Section 5.2.3). Normally, robots will not move out of Safe position when POSITIONER switch is in MANUAL. (This may vary with job structure).

Note: Cycle Start latching is not operative in Manual mode.

3. Press the CYCLE START button on operator station. Positioner sweeps each time CYCLE START button is pressed.

Note: The Home position turns on an output when the robot tool center point is within established boundaries. If the robot moves outside the Home position, the output is lost and the positioner will not sweep. The Home position is factory set to be clear of the positioner.
5.1.2 Rotating the Headstock

To program rotation of the Motoman MRM2-750 S3X positioner headstock, proceed as follows:

**WARNING!**
If the robots are 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.

The following preconditions must be met:

- The controller must be in TEACH mode.
- The Servo On Ready key must flashing. If the Servo On Ready key is not flashing, press it.

To move headstock:

1. Press EX. AXIS key on programming pendant to display proper axis of operation.

**WARNING!**
Do Not use S1 or S4 for any reason. Use S2 for Side A or S3 for Side B. Misuse will create a SERVO TRACKING ERROR.

2. Check status screen to ensure S2 for Side A or S3 for Side B is displayed.
3. Press S+ or S- (X+ or X-) motion keys on programming pendant to move headstock. Jog speed is set on programming pendant.

Note: The EX. AXIS key must be turned OFF, and the robot LED ON, to move the robots with the motion keys. The S-axis on each robot is restricted by hard stops on the robot base and internal soft stops.

5.1.3 Programming Specific Jobs

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

You can program three types of moves:

- Rotation of headstock during air-cut moves
- Robot motion with headstock stationary
- Rotation of headstock during welding

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

**CAUTION!**
Remember, only the Tool Center Point (TCP) location on the robot is recognized by the controller. Without careful programming, the robot arm could still damage other equipment.
Note: Refer to your system’s Independent/Coordinated Motion Manual (P/N 149648-1) for information on coordinated motion, selecting synchronization, group axes, and tooling calibration.

Job Configurations

S1 = Main Trunnion
S2 = A-side headstock
S3 = B-side headstock
S4 = Positioner sweeping (all axes on positioner)

Job axis combinations must be set up as follows:

Valid Axes Combinations for Synchronous Motion

R1 + S3 (S3) = Robot 1 + B-side headstock with B-side headstock as master
R2 + S3 (S3) = Robot 2 + B-side headstock with B-side headstock as master
R3 + S3 (S3) = Robot 3 + B-side headstock with B-side headstock as master
R1 + S2 (S2) = Robot 1 + A-side headstock with A-side headstock as master
R2 + S2 (S2) = Robot 2 + A-side headstock with A-side headstock as master
R3 + S2 (S2) = Robot 3 + A-side headstock with A-side headstock as master

Valid Axes Combinations for Non-synchronous Motion

R1 + S2 = Robot 1 + A-side headstock
R1 + S3 = Robot 1 + B-side headstock
R2 + S2 = Robot 2 + A-side headstock
R2 + S3 = Robot 2 + B-side headstock
R3 + S2 = Robot 3 + A-side headstock
R3 + S3 = Robot 3 + B-side headstock

Non-Valid Axes Combinations

S1 + S4 = Main Trunnion + Positioner sweeping (all axes on positioner)
S2 + S4 = A-side headstock + Positioner sweeping (all axes on positioner)
S3 + S4 = B-side headstock + Positioner sweeping (all axes on positioner)
R1 + S4 = Robot 1 + Positioner sweeping (all axes on positioner)
R2 + S4 = Robot 2 + Positioner sweeping (all axes on positioner)
R3 + S4 = Robot 3 + Positioner sweeping (all axes on positioner)
R1 + S1 = Robot 1 + Main Trunnion
R2 + S1 = Robot 2 + Main Trunnion
R3 + S1 = Robot 3 + Main Trunnion

Rotation of the Headstock During Air-Cut Moves – Non-synchronous Motion

1. Teach robot to desired position.
2. Rotate positioner headstock or station to desired position.
3. Press and hold SHIFT key, then press EX. AXIS key on programming pendant.

⚠️ CAUTION!
Do not use S1 or S4 for any reason. Use S2 for Side A or S3 for Side B. Misuse will cause a Servo Tracking Error.

4. Press MAN SPEED key to select desired axis speed while teaching.
5. Press S+ or S- (X+ or X-) motion keys on programming pendant to move headstock. Jog speed is set on programming pendant.
6. Record each step after designating motion type and playback speed.
7. 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: To move the robot, press and hold the SHIFT key, then the ROBOT key until R1 is selected on the Status line.

Normally, air-cut moves are taught as 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 to 100.00 will normally establish the quickest time between steps.

Robot Motion with the Headstock Stationary – Non-synchronous Motion

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 Headstock During Welding – Synchronous Motion

The 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 Robot + Station with Station as master [R1 + S (2 or 3): S (2 or 3)], depending on positioner side during playback. Move instructions for coordinated motion are registered using the following format:

```plaintext
COORDINATED MOTION INSTRUCTION
COORDINATED MOTION INSTRUCTION
SMOV=1.38 SLOW EDGE(Manipulator with Torch)
+1OVL
SMOV=1.38 SLOW EDGE(Manipulator with Torch)
MASTER DEV(Manipulator with Workpiece)
```
5.2 Daily Operation

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

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

5.2.1 Start-Up

Note: Due to the configuration of the ArcWorld IV-6300 XHD system, the slave controllers (R2 & R3) must be energized before the primary controller (R1) or an alarm condition will occur during power up.

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

1. Make sure the enclosure door is closed and securely latched.
2. Turn ON main service disconnect switch.
3. Set MAIN POWER switch on R2 controller to ON.
4. Set MAIN POWER switch on R3 controller to ON.
5. Set MAIN POWER switch on R1 controller to ON.
6. Set INPUT POWER switch on welding power sources to ON.
7. Turn on welding gas supply.
8. Disable operator station.
9. Make sure E-STOP buttons on programming pendant and operator station are released.
10. Select TEACH mode on programming pendant; indicator light turns on.
11. Place robots in Home position.

Robot Safe (Cube 24) Position

To place the robots in the Home position, proceed as follows:

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

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

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

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

Headstock (side A/B) In-position Switch
1. Place controller in TEACH mode.
2. Turn servo power ON.
3. Rotate headstock (side A/B) out of Home position.
4. Block the light curtain. Verify that servo power goes off.
5. Turn servo power ON.
6. Return positioner to the programmed position.

Trunnion In-position Switch
1. Put controller in TEACH mode.
2. Turn servo power on.
3. Rotate trunnion out of Home position.
4. Block the light curtain. Verify that servo power goes off.
5. Turn servo power on.
6. Return positioner to the programmed position.

5.2.3 Robot Home Position

To move the robots to the Home position, proceed as follows:
1. Press TEACH mode button on controller playback panel.
2. Press TOP MENU on programming pendant.
3. Select JOB icon using cursor keys and press SELECT.
4. Cursor to SELECT JOB and press SELECT key.
5. Using cursor keys, move cursor to SAFEPOS Safe job and press SELECT. The R1R2 Safe job appears on display screen.
6. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.
7. Use INTERLOCK and FWD keys on programming pendant to jog each robot to Safe position.
5.2.4 Selecting Weld Job (Initial Setup Only)

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

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

5.2.5 Starting the Master Job

With the system powered up and in TEACH mode:

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

The ArcWorld IV-6300 XHD cell is now ready for operation.
5.2.6 Perform Operation Cycle

The following is the typical sequence of operation for the ArcWorld IV-6300 XHD cell after start-up:

1. Load fixture on operator side of positioner table with parts to be welded.
2. Step out of safety light curtain.
3. Press the CYCLE START button on the operator station. STATION READY light comes on and positioner sweeps, placing unwelded parts into the robot work area. The robots then begin welding parts.
4. While the robots are welding, load the operator side.
5. When parts are loaded, press the CYCLE START button on the operator station; CYCLE LATCHED light comes on. When the robots are finished welding, they return to Home position and the positioner sweeps, returning welded parts outside the cell and placing newly loaded, unwelded parts into the robot work area.
6. Unload welded parts from the fixture.

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

5.2.7 Shutdown

Use the following procedure to shut down the ArcWorld IV-6300 XHD cell after operation is complete:

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

The ArcWorld IV-6300 XHD cell is now shut down.

5.3 System Recovery

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

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

5.3.1.1 **Error Messages**

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

5.3.1.2 **Minor Alarms**

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

5.3.1.3 **Major Alarms**

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

5.3.2 **E-STOP Recovery**

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

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

To restart the ArcWorld IV-6300 XHD cell after an E-STOP condition occurs, proceed as follows:

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

   **CAUTION!**

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

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

The ArcWorld IV-6300 XHD cell is now ready to continue operation.

### 5.3.3 Shock Sensor Recovery

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

**CAUTION!**

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

1. Press MAIN MENU on programming pendant.
2. Select ROBOT icon using cursor keys and press SELECT.
3. Cursor to OVERRUN-SSENSOR 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 IV-6300 XHD cell is now ready to continue operation.

### 5.3.4 Brake Release

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

**WARNING!**

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

1. On the programming pendant, select TEACH mode and turn servo power OFF.
2. Select ROBOT on the programming pendant touch screen.
3. Select the MANUAL BRAKE RELEASE option.
4. A Warning dialog appears. Select YES in the warning dialog box.
5. Select the axis to be released using the cursor key.
6. Engage the ENABLE switch and press the Interlock and Select keys.
7. The brake for the selected axis releases.
Table 3 provides periodic maintenance items and intervals for the ArcWorld IV-6300 XHD cell. Keep in mind that the maintenance intervals serve as guidelines only. You should adjust the frequency of maintenance to suit your specific work conditions.

For periodic maintenance procedures and schedules for the individual components of your ArcWorld IV-6300 XHD, including the MRM2-1200 M3X positioner, refer to the additional manuals that came with your system.

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

Table 3 Periodic Maintenance

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

H=Hours of operation
Notes
Appendix A

Anchor Requirements

It is the purchaser’s responsibility to determine and supply all anchoring and foundation requirements for their installation. Before installing your ArcWorld IV-6300 XHD cell, refer to Table 4 to determine the anchor and foundation requirements for all the equipment used in your cell.

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

### Table 4 Minimum Recommended Equipment Anchor Requirements

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

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

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

A
Alarm 17
Alarms 51
Anchor Requirements 57
Arc Screens 21
AREA Key 15
Auto/Manual 17
Auxiliary Equipment Common Base 31
Axes Combinations 46
B
Brake Release 22
C
Cable Routing 32
Cables 32
Components 3
Controller Base 28
CURSOR Key 15
Customer-Supplied Items 23
Cycle Start 16
D
Documentation 4
E
Earth Ground 32
Emergency Stop 16
Emergency Stop (E-STOP) 13
Emergency Stops (E-STOPS) 22
ENABLE Switch 15, 22
Enable/Disable 17
Error Messages 52
Errors 51
E-STOP 52
F
Fencing 21
Fixtures 41
FLASH MEMORY Slot 15
G
Gate Interlock 49
General Purpose Display Area 13
General Safeguarding Tips 7
GMAW Torch 21
Ground 32
H
Headstock 45, 49
Hold 16
Home Position 49
I
Installation 23
Installation Safety 8
Interlocked Cell Door 22
J
Job Configurations 46
Jobs 45
K
Keypad 14
L
Layout 2, 3
Light Curtains 22, 38
M
MAIN MENU Key 14
Maintenance 55
Major Alarms 52
Master Job 50
Materials Required 23
Mechanical Safety Devices 7
Menu Area 13
Minor Alarms 52
Mode Selector Switch 13
MRM2-1200 M3X Positioner 17
N
Non-synchronous Motion 46
NX100 Controller 11
O
Operation 43, 48
Operation Cycle 51
Operator Station 16, 40
Options 3
Overview 2
P
Positioner 17, 25, 44
Positioner Cables 36
Power 40
Power Sources 19
Programming 43, 45
Programming Pendant 12, 33
Programming, Operation, and Maintenance Safety 8
R
Reset 17
Robot Cables 35
Robot Common Base 27
Robot Description 11

S
Safety 5
Safety Circuit 49
Safety Features 21
Safety/Operation Check 41
SELECT Key 15
Service 4
Servo On 17
SERVO ON Key 15
Shipping Bracket 37
Shock Sensor 53
Shutdown 51
Site Preparation 24
Specific Jobs 45

Standard Conventions 6
Start 17
Start-Up 48
Status Area 14
Synchronous Motion 46
System Recovery 51

T
Tooling 41
Tools 24
Trunnion 49

W
Weld Job 50
Welding Cables 33
Welding Equipment