Motoman® NX100 Controller
ArcWorld® IV 6000 Series
System Manual
with MRM2-250/750M3X

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Chapter 1

Introduction

1.1 About This Document

This System Manual provides an overview of the complete Motoman ArcWorld® IV 6000 Series system. For detailed information on any specific system component listed in this document, please refer to the documentation package that is included with your system documentation package (refer to Section 1.3).

Note: This manual documents a standard Motoman system. If your system is custom or modified, please use this manual in conjunction with the drawings, schematics, and parts listing (Bill of Material) for your specific system. The drawings, schematics, and parts listing are included in the documentation package supplied with your Motoman system.

This System Manual contains the following chapters –

CHAPTER 1 – INTRODUCTION

This chapter provides general information about the ArcWorld® IV 6000 Series system and its components, a list of reference documents, and customer support contact information.

CHAPTER 2 – SAFETY

This chapter provides general information regarding the safe installation, maintenance, and operation of the ArcWorld® IV 6000 Series system.

CHAPTER 3 – EQUIPMENT DESCRIPTION

This chapter provides a description of the major components of the ArcWorld® IV 6000 Series system.

CHAPTER 4 – INSTALLATION

This chapter provides installation procedures for the ArcWorld® IV 6000 Series system.

CHAPTER 5 – OPERATION

This chapter provides an overview of ArcWorld® IV 6000 Series system operation, including start-up, loading, normal operations, fault recovery, and system shutdown.

CHAPTER 6 – MAINTENANCE

This chapter provides preventive maintenance requirements for certain components of the ArcWorld® IV 6000 Series system.

APPENDIX A – ANCHORING

Appendix A gives foundation and anchoring suggestions for ArcWorld® IV 6000 Series system components that require anchoring.
1.2 System Overview

The ArcWorld® IV 6000 Series family of fully integrated arc welding solutions utilizes the latest robotic and positioner technology in the industry. The Motoman ArcWorld IV 6000 is designed around a single Motoman EA1400N or EA1900N robot, a NX100 controller package, and a welding power source. The Motoman ArcWord IV 6200 is designed around a dual Motoman EA1400N or EA1900N robots, a NX100-DRC controller package, and a welding power source. The Motoman ArcWord IV 6300 is designed around a triple Motoman EA1400N robot, a NX100-TRC controller package, and a welding power source. The entire ArcWorld® IV 6000 Series family uses either the MRM2-250M3X or MRM2-750M3X positioner.

Refer to Section 3.2.1 for a description of features and advantages of the NX100 controller configuration used with the AWIV-6000.

Refer to Section 3.2.2 for a description of features and advantages of the NX100-DRC controller configuration used with the AWIV-6200.

Refer to Section 3.2.3 for a description of features and advantages of the NX100-TRC controller configuration used with the AWIV-6300.

Refer to Section 3.5 for a description of the MRM2-250M3X and MRM2-750M3X positioners.

The ArcWorld® IV 6000 Series system features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06 Robot Safety standard, and is designed to safeguard both personnel and equipment. Heavy-gauge wire mesh safety fencing prevents unintended entry of personnel into the work cell. Arc curtains cover the wire mesh fencing to reduce the amount of arc radiation that escapes the work cell during welding operations. A dual-channel, interlocked access door, at the rear of the work cell, allows personnel access to the interior of the work cell, while it provides a safety interlock to disable all equipment should the access door be opened while the robots are active. A dual-channel, safety light curtain system provides a “sensing field” in front of the positioner to protect the operator. Positioner movement is prevented whenever an operator is in a position to interrupt the sensing field of the light curtain system. In addition, maximum robot travel is physically limited by an S-axis “hard stop” at the base of each robot.
1.2.1 System Layout

The robot(s) are mounted to a common equipment base. The positioner is mounted to a separate equipment base. These two equipment bases are joined with threaded fasteners during installation (refer to Section 4.3 and Section 4.4). Wire mesh safety fencing completely surrounds the ArcWorld®IV 6000 Series work cell. The safety fencing is anchored to the floor during system installation (refer to Section 4.5). The controller assembly is mounted to a common equipment base that is located outside the work cell. The welding power source and a single common equipment table also share a common equipment base that is located outside of the work cell (see Figure 1 and Figure 15). This arrangement allows most of the component interconnects to be pre-wired at the factory, thus reducing the amount of point-to-point wiring required of the customer. All operator controls are accessible from outside the work cell.
1.2.2 Major Components

The ArcWorld® IV 6000 Series system includes the following major components –

- Motoman manipulators (robots)
  - One EA1400N or EA1900N for AWIV-6000
  - Two EA1400N or EA1900N for AWIV-6200
  - Three EA1400N for AWIV-6300
- One controller assembly –
  - NX100 for AWIV-6000
  - NX100-DRC for AWIV-6200
  - NX100-TRC for AWIV-6300
- MRM2-250M3X or MRM2-750M3X positioner
- One Programming Pendant (see Figure 5)
- Operator Station Pedestal (see Figure 6)
- Welding equipment (for each robot) –
  - Welding power supply
  - Welding torch (air-cooled)
  - HyperFeed II wire feeder
  - Applicable welding interface
  - Torch mount
- Safety equipment –
  - Heavy gauge, wire-mesh safety fencing
  - Arc curtains (cover the safety fencing)
  - Dual-channel, interlocked safety light curtain system
  - Dual-channel, interlocked work cell entry door
  - Positioner arc screen (see Figure 1)

1.2.3 Optional Equipment

The following optional equipment is available for each robot of the ArcWorld® IV 6000 Series system –

- Torch cleaner
- Wire cutter
- Water-cooled torch (with water circulator)
- TouchSense™ (starting point detection)
- ComArc™ (seam tracking)
1.3 Reference Documentation

For additional information on individual components of the ArcWorld® IV 6000 Series system, refer to the following documentation that is included with your system –

- Motoman EA1400N Manipulator Manual (P/N 149208-1)
- Motoman EA1900N Manipulator Manual (P/N 149894-1)
- Motoman NX100 Controller Manual (P/N 149201-1)
- Motoman NX100 Maintenance Manual (P/N 150133-1)
- Motoman NX100 Operator's Manual for Arc Welding (P/N 149235-1)
- Motoman NX100 Concurrent I/O Manual (P/N 149230-1)
- Motoman MRM2-250-M3X Sigma III Positioner Manual (P/N 152565-1)
- Motoman MRM2-750-M3X Sigma III Positioner Manual (P/N 152565-2)
- Motoman NX100 Independent/Coordinated Control Function Manual (P/N 149648-1)
- Motoman INFORM User's Manual (P/N 150078-1)
- Motoman HyperFeed II with MWII HyperFeed II EA with MW II System Manual (P/N 151116-1)
- Vendor manuals for supplied system components and assemblies that are not manufactured by Motoman

1.4 Customer Support Information

If you need assistance with any aspect of your ArcWorld® IV 6000 Series system, please contact Motoman Customer Support at the following 24-hour telephone number –

937. 847. 3200

For routine technical inquiries, you can also contact Motoman Customer Support at the following e-mail address –

techsupport@motoman.com

When using e-mail to contact Motoman Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

Note: Use e-mail for routine inquiries, only. If you have an urgent or emergency need for service, replacement parts, or information, please contact Motoman Customer Support at the telephone number shown above.
Please have the following information ready before you call –

- **System**
  AWIV-6000, AWIV-6200, or AWIV-6300

- **Robots**
  EA1400N or EA1900N (AWIV-6000)
  EA1400N or EA1900N (AWIV-6200)
  EA1400N (AWIV-6300)

- **Positioner**
  MRM2-250M3X or MRM2-750M3X

- **Primary Application**
  Arc Welding

- **Controller**
  NX100 (AWIV-6000)
  or
  NX100-DRC (AWIV-6200)
  or
  NX100-TRC (AWIV-6300)

- **Software Version**
  Access this information on the Programming Pendant LCD display screen by accessing **MAIN MENU ➔ SYSTEM INFO ➔ VERSION**

- **Robot Serial Number**
  Located on robot data plate

- **Robot Sales Order Number**
  NX100 (AWIV-6000) Located on front door of controller
  or
  NX100-DRC/TRC (AWIV-6200/AWIV-6300) Located on controller (R1) data plate
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 (ANSI/RIA R15.06-1999). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

RoboticIndustriesAssociation
900VicctorsWay
P.O.Box3724
AnnArbor,Michigan48106
TEL:(734)994-6088
FAX:(734)994-3338
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the robot system. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the robot cell. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE ROBOT SYSTEM!

We recommend approved Motoman training courses for all personnel involved with the operation, programming, or repair of the robot system. This training is designed to familiarize personnel with the safe and correct operation of the robot 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 Important Advisory Information

Throughout this manual you will find advisory paragraphs (denoted by graphic symbols and bold typeface). All of these (except “NOTE”) direct the reader’s attention to information and procedures that are essential to the safety of personnel or protection of equipment.

The type of information contained in the various advisories is described below. These are listed here in descending order of importance to the safety of personnel and protection of equipment.

**DANGER!**

Information appearing under the DANGER caption concerns the protection of personnel from an 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 that can be 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
• Light curtains and/or safety mats
• 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 ArcWorld® IV 6000 Series system can utilize two types of Motoman robots. The AWIV-6000/AWIV-6200 uses one or two EA1400N or EA1900N robot(s) respectively, each have a payload capability of 3 kg. The EA1400N features a horizontal reach of 1388 mm, the EA1900N reach is 1904 mm. Relative positioning accuracy for both robots is ±0.08 mm. The AWIV-6300 uses three EA1400N robots with the same payload and reach capabilities. The robot also features an internal cable routing configuration that provides high flexibility and streamlines the robot profile, thus allowing access into confined spaces. The robot’s B-axis (Pitch/Yaw) features an expanded range of motion that improves circumferential welding on cylindrical work pieces. The T-axis (Twist) can rotate the welding torch ±360° without cable interference.

For additional information on the Motoman EA-Series robots, please refer to the EA1400N Manipulator Manual or the EA1900N Manipulator Manual that are included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

3.2 Controllers

The single or multiple robot ArcWorld® IV 6000 Series is controlled by a master NX100 controller. In addition to controlling the movement of the single or multiple robots, the NX100 also controls the welding power source, the positioner, and provides the signals necessary to operate the welding systems.
3.2.1 **NX100 – AWIV-6000 System**

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 AWIV-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 main logic functions, servo control, program and constant data memory, and power distribution.

For additional information on the your NX100 controller, please refer to the *NX100 Controller Manual*, that was included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

![Figure 2 NX100 Controller for AWIV-6000](image-url)
3.2.2 **NX100-DRC – AWIV-6200 System**

The AWIV-6200 features one NX100-DRC controller assembly that consists of one NX100 controller mated to an expansion cabinet (see Figure 3). This combination provides the same functionality of two full-size controllers, while reducing the overall width by 250 mm when compared to two, full-size NX100 controllers. This configuration also reduces the cost to the operator by eliminating certain redundant components and circuit assemblies.

Through specific internal cable interconnections, the NX100-DRC is configured as controller R1 and controller R2 (see Figure 3). This configuration allows the two robots to operate as a dual system that takes advantage of all the unique functions available only in a dual system configuration. With the AWIV-6200, the full-size NX100 controller cabinet is designated R1, while the smaller, expansion cabinet is designated R2.

The NX100-DRC controller features an embedded real-time operating system (RTOS) and is programmed with the Motoman INFORM programming language.

For additional information on the your NX100-DRC controller and the INFORM program language, please refer to the **NX100 Controller Manual** and the **INFORM User's Manual**, that was included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

![Figure 3 NX100-DRC Controller for AWIV-6200](image)
3.2.3 NX100-TRC – AWIV-6300 System

The AWIV-6300 system features the NX100-TRC controller assembly. The NX100-TRC assembly consists of one “full size” NX100 controller plus two, smaller, expansion cabinets (see Figure 4). This combination provides the functionality of three full-size NX100 controllers, while significantly reducing required installation area. The TRC configuration also reduces the cost to the customer by eliminating redundant components and assemblies inside the controller.

Through specific cable interconnections (internal to the NX100-TRC), the NX100-TRC is configured as controller R1, R2, and R3 (see Figure 4). This configuration allows the three robots to operate as a triple system that takes advantage of all the unique functions available only in a triple system configuration. With the AWIV-6300 system, the full-size NX100 controller cabinet is designated R1, while the smaller, expansion cabinets are designated R2 and R3.

The NX100-TRC controller features an embedded real-time operating system (RTOS) and is programmed with the Motoman INFORM programming language.

For additional information on the your NX100-DRC controller and the INFORM program language, please refer to the NX100 Controller Manual and the INFORM User’s Manual, that was included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).
3.3 Programming Pendant

The Programming Pendant (see Figure 5) provides the primary means of programmer/operator interaction with the ArcWorld® IV 6000 Series system. The pendant features the Windows® CE operating system and displays information on a 6½ -in. touch-screen display. The pendant also incorporates a CompactFlash® card slot for program backups and software updates. The Programming Pendant provides icon-driven system programming. It also features a menu-driven interface to simplify operator interaction with the robots. Most operator controls are located on the Programming Pendant. This allows remote installation of the NX100 controller. By using the Programming Pendant, the operator can teach robot motion; perform programming, editing, maintenance, and diagnostic functions; and enable / disable Operator Station Pendant control of the ArcWorld® IV 6000 Series system. For detailed information on the pendant programming keys, programming functions, and display functions, please refer to the NX100 Operator’s Manual for Arc Welding that is included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).
Figure 5 NX100 Programming Pendant

Note: The Programming Pendant touch screen display goes dark after a few minutes of inactivity. Press any key to restore screen.

Note: Operator Station enable or disable is accomplished with the Programming Pendant MODE SELECT SWITCH. To transfer control of the ArcWord® IV 6000 Series system to the Operator Station, set the Programming Pendant MODE SELECT SWITCH to REMOTE.
3.4 Operator Station Pedestal

The Operator Station Pedestal controls (see Figure 6) includes a NEMA enclosure on a stand-alone pedestal. See Figure 1 and Figure 15 for location of the Operator Station Pedestal in relation to other components of the ArcWorld® IV 6000 Series system.

![Operator Station Pedestal Controls](image)

**Figure 6** Operator Station Pedestal Controls

3.4.1 Operator Station Pedestal Function – Cycle Start/Cycle Latched

**WARNING!**

The operation of the CYCLE START button is dependent on the structure of the Master Job. Any alteration of the Master Job could result in injury to personnel or damage to equipment.

Pushing the green CYCLE START/CYCLE LATCHED push button, located on the Operator Station Pedestal, initiates a positioner sweep cycle if the robot is in the HOME (Safe) position. If the CYCLE START/CYCLE LATCHED push button is pressed while the robot is still welding, or otherwise not in the HOME (Safe) position, the CYCLE START command is “latched” into (stored in) the controller circuitry. When the robot returns to the HOME (Safe) position, the “latched” CYCLE START command is executed and the positioner sweeps. Circuitry in the controller prevents the positioner from continuously cycling, should the operator depress and hold the CYCLE START/CYCLE LATCHED push button.

3.4.2 Operator Station Pedestal Function – Emergency Stop (E-Stop)

Pressing the Operator Station Pedestal E-Stop push button initiates an emergency stop (E-Stop). Refer to Section 3.7.4 for a discussion of the E-Stop function, and procedures for recovering the ArcWorld® IV 6000 Series system from the E-Stop condition.
3.4.3  **Operator Station Pedestal Function – Robot Hold**

Pressing the red ROBOT HOLD button stops robot operation and interrupts the job until the operator presses the green START button to resume operation. Operation resumes at the point in the program where the ROBOT HOLD state was initiated.

3.4.4  **Operator Station Pedestal Function – Alarm**

A red ALARM lamp illuminates to indicate that the controller has encountered an alarm condition. See Section 5.4.1 for levels of alarms and errors.

3.4.5  **Operator Station Pedestal Function – Positioner Auto/Manual**

The POSITIONER AUTO/MANUAL switch is used to select AUTO or MANUAL mode for the positioner. With the switch set to the AUTO, the robots weld parts immediately after the positioner sweeps. With the switch set to the MANUAL, the robots do not immediately start to weld after the positioner sweeps. The robots remains in the HOME position.

*Note: The POSITIONER AUTO/MANUAL signal depends upon the structure of the Master job.*

3.4.6  **Operator Station Pedestal Function – Start**

Pressing the green START button starts the current, active job. The Programming Pendant MODE SELECT SWITCH must be set to REMOTE, and servo power must be ON, for the Operator Station Pedestal START button to function.

3.4.7  **Operator Station Pedestal Function – Reset**

The black RESET button is used to clear a minor alarm or error condition.

3.4.8  **Operator Station Pedestal Function – Servo ON**

The green SERVO ON push button turns servo power ON if the Programming Pendant MODE SELECT SWITCH is set to REMOTE.

3.4.9  **Operator Station Pedestal Function – Joystick Control**

The Joystick controls positioner rotation and user defined load positions. Moving the joystick to the right (FWD) indexes the operator tooling in a clockwise direction at 30-degree intervals. Moving the joystick to the left (REV) indexes the operator tooling in a counter-clockwise direction at 30-degree intervals. Moving the joystick forward (HOME) moves the positioner headstock to zero degrees (home position).
3.5 Positioner

Depending on customer preference and the original customer order, the ArcWorld® IV 6000 Series system incorporates either the medium-duty MRM2-250M3X or heavy-duty MRM2-750M3X positioner (see Figure 1).

Both positioners, MRM2-250M3X and MRM2-750M3X, use a reciprocating motion that sweeps each side of the “ferris wheel” type positioners 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 labeled 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.

The ArcWorld® IV 6000 Series is capable of synchronized motion between various components depending on the job configuration. Synchronized robot(s) move at the same time during operation. For example: 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 workpiece if the tasks are symmetrical.

The MRM2-250M3X positioner features a 250 kg load capacity per side and can index in 1.5 seconds when fully loaded. The MRM2-750M3X positioner features a 750 kg load capacity per side and can index in 2.25 seconds when fully loaded. The standard distance between headstock and tailstock face plates is 3.0 meters. Positioning accuracy is ±0.1 mm.

Note: The tooling fixture that rotates under is limited to a depth of 450 mm.

The sweep axis and both tooling orbital axes are rotated by individual SIGMA III servomotors (working through gear reduction units) that are controlled by circuitry in the NX100 controller. All three axes are driven simultaneously during a sweep motion. Movement of the positioner can be coordinated with the robot to allow complex jobs such as the welding of circumferential joints.

Features of the positioners are – a tooling plate multiple angle control that allows the programmer to define the angle of the tooling presented to the operator; a Light Emitting Diode (LED) installed at each end of the tooling drive swing arm to indicate that the associated tooling plate has reached the desired, operator-selected rotation angle; both are fitted with the MotoMount™ flexible tool mounting system; and include a Lithium-Ion “keep alive” battery that maintains servo positioning data in memory, should the main cables between the positioner and the NX100 controller be disconnected.

For detailed positioner information, including illustrated parts lists, load capabilities, leveling procedures, and dimensions, refer to the MRM2-250-M3X Sigma Positioner Manual or the MRM2-750-M3X Sigma Positioner Manual that are included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

Note: The customer shall supply all tooling and fixtures for the positioner.

Note: Motoman recommends application of a corrosion/rust preventive compound to tooling and fixtures located in a high-humidity environment.
3.6 Welding Equipment

In the standard configuration, the ArcWorld® IV 6000 Series system includes a welding power source, wire feeder, torch, and torch mount for each of the EA1400N or EA1900N robot. Optional equipment may be included with your ArcWorld® IV 6000 Series system (refer to Section 1.2.3).

3.6.1 Welding Power Sources

Motoman offers various brands and types of welding power sources. The actual welding power source supplied with the ArcWorld® IV 6000 Series system depends on your specific application and preference. For specific information on the welding power sources supplied with your ArcWorld® IV 6000 Series system, refer to the welding power source manual that is included with your system documentation package (refer to Section 1.3). Figure 7 (AWIV-6000), Figure 8 (AWIV-6200), and Figure 9 (AWIV-6300) show the arrangement of the welding power sources on a common equipment base.

![Figure 7 Welding Power Sources — AWIV-6000](image-url)
3.6.2 HyperFeed II Wire Feeder

A welding wire feeder is mounted on the upper arm (U-Axis) of the EA1400N or EA1900N robot. The wire feeder is the “4-roll” type and provides reliable wire feeding at rates up to 750 inches per minute (ipm). Interchangeable feed rolls are used to accommodate different wire gauges and wire types. For additional information on how the wire feeder is mounted to the robot upper arm, including allowable load and installation position, refer to the HyperFeed II with MWII HyperFeed II EA with MW II System Manual that is included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).
3.6.3 GMAW Torch

The ArcWorld® IV 6000 Series system uses either an air-cooled or a water-cooled robotic/automatic GMAW torch for each robot. 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 flange. For applications that use the optional water-cooled torch, the ArcWorld® IV 6000 Series system includes a water circulator kit for each robot. For additional information on the torches that are supplied with your system, refer to the vendor manuals that are included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

3.7 Safety Features

The ArcWorld® IV 6000 Series system includes a total safety environment. If operators comply with all standard safety precautions, the safety equipment helps to ensure safe operation of the robot work cell.

Note: Users are responsible for determining that the safeguards provided with the ArcWorld® IV 6000 Series system are adequate for their plant conditions. Users must also ensure that all safeguards are maintained in working order.

3.7.1 Welding Arc Protection

Two forms of welding arc protection are part of the ArcWorld® IV 6000 Series system –

- a steel arc screen on the positioner
- arc curtains that attach to the steel-mesh safety fencing

The steel arc screen on the positioner protects the operator from arc radiation and sparks that result from the welding operation (see Figure 1).

**WARNING!** Although safety fence arc curtains block dangerous arc radiation, never look directly at the arc without protective eye wear.

Arc curtains cover the steel mesh safety fencing that surrounds the entire work cell. The curtains reduce the amount of ultraviolet radiation that escapes from the work cell during welding operations.

3.7.2 Safety Fencing

Heavy-gauge steel-mesh safety fencing is provided with your ArcWorld® IV 6000 Series system. During installation (refer to Chapter 4) the safety fencing is setup to enclose the entire work cell. This forms a physical barrier that prevents personnel or objects from inadvertently entering the workcell during automatic operation.

3.7.3 Safety Light Curtains

The safety light curtain system consist of two units (a SEND unit and a RECEIVE unit) that create a protective infrared light field in front of the positioner (see Figure 1). If an object or person penetrates the protective light field while the positioner is sweeping, the light curtain system triggers an E-Stop.
condition (refer to Section 3.7.4). The safety light curtain system incorporates dual-channel circuit redundancy to ensure a continuous protective field in front of the positioner.

For additional information on the safety light curtains, refer to the vendor manuals that are included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

### 3.7.4 Emergency Stop (E-Stop)

E-Stop is a primary safety feature of the ArcWorld® IV 6000 Series system. A dual-channel workcell access door interlock, a dual-channel safety light curtain system, robot welding torch impact (collision) detection circuitry (refer to Section 3.6.3), and E-Stop push buttons can all trigger an E-Stop condition. An E-Stop condition immediately de-energizes the control system and activates the robot braking system (refer to Section 3.7.6). The E-Stop push buttons are used for an intentional shutdown of the ArcWorld® IV 6000 Series system, and are installed at the following locations –

- Programming Pendant
- NX100 controller (R1 on the AWIV-6200 and AWIV-6300)
- Operator Station Pedestal

To resume operation after an E-Stop system shutdown, clear and reset the action that caused the E-Stop condition (refer to Section 5.4.2).

### 3.7.5 Programming Pendant ENABLE Switch

The ENABLE switch is a safety feature of the Programming Pendant. The ENABLE switch provides fail-to-safe control of servo power while the ArcWorld® IV 6000 Series system is in TEACH mode (see Figure 5 and Figure 10). When pressed in, this switch allows the operator to activate SERVO POWER. However, should the operator release the switch or grasp it too tightly, SERVO POWER is immediately removed, thus preventing further robot movement. For detailed information about the operation of the ENABLE switch, refer to the NX100 Operator’s Manual for Arc Welding that is included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

![Figure 10 Programming Pendant ENABLE Switch – Location and Operation](image-url)
3.7.6 Emergency Braking System

Each robot incorporates a braking system that protects personnel from injury and prevents equipment damage if SERVO POWER is removed. Upon loss of SERVO POWER, the brake system activates to hold all robot axes in place. The brake system incorporates a feature that allows the operator to release the brake of a specific robot axis when drive power has been removed from the system. Brake release is accomplished with the Programming Pendant (refer to Section 5.4.4).

3.7.7 Interlocked Work Cell Door

A dual-channel, tamper-proof interlock is installed on the sliding work cell access door (see Figure 1). Opening the work cell access door while the robot is in PLAY mode creates an E-Stop condition (refer to Section 3.7.4).
Chapter 4
Installation

CAUTION!
The ArcWorld® IV 6000 Series system should be installed by qualified personnel who are familiar with the installation and set-up of a robotic system.

CAUTION!
The ArcWorld® IV 6000 Series system is not extremely fragile. It is, however, a sophisticated robotic system that can be damaged by rough handling. Be sure to handle all system components with care.

Two to three qualified technicians can install the ArcWorld® IV 6000 Series system in a reasonable amount of time. Always comply with established safety procedures throughout the installation process (refer to Chapter 2).

4.1 Required Materials

All system components and most hardware items required for installation of the ArcWorld® IV 6000 Series system are included with your shipment. There are, however, some required items that the customer must supply, such as typical installation and maintenance tools (refer to Section 4.1.2) and special anchor bolts (refer to Appendix A).

4.1.1 Customer-Supplied Items

- Shielding gas for the welding torches
- Local electrical service
- Earth ground wires for each robot, NX100 controller, and peripheral equipment
- Earth ground rods and/or buried copper panels (quantity and placement depth as required to achieve specified resistance-to-ground reading of 100 ohms or less)
- Chemical (optional) to increase conductivity of soil in the vicinity of the earth ground system
- Welding wire
- Clean, dry air supply (for torch tender or wire cutter options) –
  - Flow Rate 0.425 m$^3$/min (15 cfm)
  - Pressure 620 kPa gage (90 psi gage)
- Forklift(s) and/or overhead crane
- Special anchor bolts and drill bits (refer to Appendix A for suggested anchoring hardware)
4.1.2 **Recommended List of Hand Tools and Equipment**

- Safety glasses
- Face shield
- Gloves (heavy-duty leather recommended)
- Level (short and long)
- Ratchet Handle (with ¾-in. hex socket)
- Adjustable wrench
- Hammer drill with appropriate concrete bits
- Phillips and flat-blade screwdrivers
- Hammer (dead-blow and steel)
- Hammer (non-marring)
- Socket set (SAE and Metric)
- Air-impact gun (with ¾-in. hex socket)
- Open-end wrench set (SAE and Metric)
- “Allen” wrench set (SAE and Metric)

4.2 **Site Preparation**

**WARNING!**
Be sure to provide sufficient room for access to the work cell door, Operator Station Pedestal, and system components that are exterior to the work cell. Failure to observe this precaution could result in injury to personnel during system operation and maintenance.

To prepare your site, proceed as follows –

1. Clear floor space and overhead area needed for the ArcWorld® IV 6000 Series system (see Figure 11 through Figure 16 for your specific AWIV model). Allow an additional 1.2 - 1.5 m on all sides of the work cell to provide the clearances needed for installation.

2. Gather all customer-supplied items and required tools (refer to Section 4.1)
Figure 11 AWIV-6000 – Plan View

Figure 12 AWIV-6000 – Elevation View
Figure 13  AWIV-6200 – Plan View

Figure 14  AWIV-6200 – Elevation View
Figure 15  AWIV-6300 – Plan View

Figure 16  AWIV-6300 – Elevation View
4.3 Positioner Placement and Installation

**WARNING!**
Ensure that your lifting device is capable of safely handling the positioner. The positioner weighs approximately 2550 kg.

1. Loosen and remove the lag bolts that secure the Positioner to the wooden shipping skid.
2. Loosen and remove the lag bolts that secure the Operator Station Pedestal to the wooden shipping skid.
3. Carefully remove all protective packaging materials and discard or recycle.
4. Carefully inspect the Operator Station Pedestal for shipping damage.

*Note: Notify your shipping contractor if you notice any shipping damage.*

5. Put the Operator Station Pedestal aside in a secure location for later installation.
6. Carefully inspect the positioner for shipping damage.

*Note: Notify your shipping contractor if you notice any shipping damage.*

7. Using two forklifts, one on each end of the positioner, lift the positioner from the shipping skid (forklift pockets are located at each end of the positioner base).
8. Place the positioner in desired operating location to define the front of the work cell (see Figure 11, Figure 13 or Figure 15 for your specific AWIV model).

*Note: Do not attempt to level or secure the positioner at this time. You will perform these steps in Section 4.4 of this chapter.*

4.4 Robot Equipment Base Placement and Installation

**WARNING!**
Ensure that your lifting device is capable of safely handling the robot equipment base. The robot equipment base (with the maximum amount of robots) weighs approximately 1380 kg.

1. Loosen and remove the lag bolts that secure the robot equipment base and associated panels to the wooden shipping skid.
2. Carefully remove all protective packaging materials and discard or recycle.
3. Carefully inspect the robot(s), robot equipment base, and associated panels for shipping damage.

*Note: Notify your shipping contractor if you notice any shipping damage.*

4. Use a forklift to lift the robot equipment base away from the wooden shipping skid (forklift pockets are located at each end of the equipment base).
5. Use a forklift to carefully place the robot equipment base in a position that will allow it to be joined to the positioner base with supplied hardware (see Figure 17).
6. After aligning the robot equipment base with the positioner base, fasten the robot equipment base and programming platforms to the positioner base with the supplied hardware (see Figure 17).

**CAUTION!**
Be absolutely certain of the correct location and orientation of the joined robot equipment base / positioner before levelling and anchoring the unit.

**WARNING!**
Be sure to wear protective eye wear during the anchoring process. Failure to observe this precaution could result in eye injury for the installation technician.

7. Adjust levelling screws (see Figure 17) as required to level the joined robot equipment base / positioner assembly.

8. Insert a drill bit through the center of a levelling bolt on the joined robot equipment base / positioner assembly, and drill a hole into the foundation to accept an anchor bolt (refer to Appendix A for foundation and anchoring suggestions).

9. Repeat the drilling process for each levelling bolt associated with the joined robot equipment base / positioner (see Figure 17).

10. Use compressed air to remove all concrete dust from each drilled hole.

11. At each drilled location, install and secure a suitable anchor bolt (refer to Appendix A for foundation and anchoring suggestions).
4.5 Safety Fence Placement and Installation

1. Interconnect the safety fence panels and place them in position so that they enclose the work cell (see Figure 15, Figure 18, and refer to the fence installation documentation that is supplied with your ArcWorld®IV 6000 Series System).

   Note: Do not install the arc curtains to the fence panels at this time. The arc curtains will be attached to the work cell fence panels after the fencing system has been anchored to the foundation.

2. Ensure that the final placement of the assembled safety fence conforms to the placement dimensions shown in Figure 11, Figure 13, or Figure 15 for your specific AWIV model and Figure 18.
3. Install the work cell sliding door to the safety fencing (refer to the safety fence documentation that is supplied with the ArcWorld® IV 6000 Series system).

4. Remove both safety light curtain fence panels from their shipping position and attach each to the safety fence with the supplied hardware. The light curtains are oriented properly when the status lights are located near the base of the positioner (see Figure 1).

![Figure 18 Safety Fence and Arc Curtain Installation Details]

5. After the light curtain fence panels are correctly attached to the safety fencing, ensure that the safety fence is correctly spaced around equipment bases and other system components (see Figure 11, Figure 13, or Figure 15 for your specific AWIV model and Figure 18).

**CAUTION!**
Be absolutely certain of the correct location and orientation of the safety fence panels and light curtain fence panels before anchoring these system components to the foundation.

6. Anchor the fence posts to the foundation (refer to Appendix A for foundation and anchoring suggestions).
4.6 Attach Arc Curtains to Work Cell Fence Panels

The arc curtains are packaged in an accessories box that is shipped with your ArcWorld® IV 6000 Series system.

**WARNING!**
Ensure that the work cell safety fence is anchored in place before installing the arc curtains. Unanchored fence panels can fall and cause injury to personnel or damage to equipment.

Install the arc curtains as follows –

1. Unfold each arc curtain and install one arc curtain on the inside of each work cell safety fence panel, using supplied plastic cable ties and the eyelets in each arc curtain (see Figure 18 and Figure 19).

   Note: Each arc curtain is cut slightly smaller than the fence panel it is designed to cover. This allows correct coverage and tensioning during installation.

   Note: Each arc curtain shipping bag contains documentation that gives the arc curtain dimensions. If necessary, use these dimensions to match the arc curtain to the correct work cell fence panel.

2. Make sure there are no gaps between the arc curtains.

3. Install the door panel arc curtain on the inside of the door panel, using the supplied plastic cable ties and the eyelets in the arc curtain (see Figure 18 and Figure 19).

![Arc Curtain Installation](image.png)

**Figure 19** Arc Curtain Installation on Typical Safety Fence Panel
4.7 Robot Shipping Bracket Removal

CAUTION!

Be sure to remove the shipping bracket from each robot prior to power-up or operation. Operation of a robot, without first removing the shipping bracket, can damage the robot drive components.

A bracket is installed on each robot at the factory to prevent undesired movement during shipping (see Figure 20). The bracket is painted bright yellow for easy location and identification. The bracket secures the lower arm of the robot to the S-axis housing. In addition, the bracket provides the correct attachment points for a hoisting sling, should the robots need to be lifted or moved. Upon bracket removal, be sure to keep both brackets and attaching hardware in a safe location, should they be needed in the future.

Figure 20  Robot Shipping Bracket

4.8 Cable Connections

After the ArcWorld® IV 6000 Series system components and peripherals are anchored in their correct locations, locate the interconnect cables for the system components and route them according to the system drawings and schematics included in the ArcWorld® IV 6000 Series system documentation package. All cables and connectors are labelled to ensure correct connection to the mating connectors on the applicable system component.

Note: A small gap exists between the bottom of the work cell safety fence and the floor. This gap provides a passage for cables that must run between components that are outside the work cell and those that are inside the work cell.
4.8.1 Connection to Earth Ground

**WARNING!**
Do not use the ArcWorld®IV 6000 Series system unless specified components are connected to a low-resistance earth ground. Do not connect the earth ground wire with the wires for the electric power source, welder, etc. The low-resistance earth ground must be a “dedicated” ground that is a direct connection between a component and the earth ground point. Operator injury or death, as well as equipment damage, can result from an inadequate or defective earth ground system.

The robot(s) and NX100 controller must be connected to a low-resistance earth ground. If a ground stake is used, it should be driven at least 2.43 m into the soil. The soil surrounding the driven ground stake should be treated with a chemical that increases the soil conductivity in the vicinity of the driven ground stake. This is often referred to as a “low-resistance earth ground” and may require more than a single driven ground rod, depending on soil conditions. Often, multiple ground rods (bonded together) or even a bonded network of buried copper sheeting (plus conduction-enhancing chemicals) may be required, depending on local soil condition. In any event, the “low-resistance earth ground” must indicate a resistance of **100 ohms or less** (when measured directly between grounded equipment and the earth ground system). Be advised that specialized measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.

*Note: The customer shall supply all wires associated with the earth ground. The customer is responsible for establishing the correct gauge of all wires associated with the earth ground and maintaining an adequate earth ground (measured resistance of 100 ohms or less).*

4.8.1.1 System Connection

*Note: If the robot and the NX100 controller are within 4.57 m of each other, a common earth ground may be used. Otherwise, separate earth grounds must be used.*

1. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the grounding lug of robot.
2. Connect other end of robot earth ground cable to earth ground stake.
3. Connect one end of second earth ground cable to common ground bus bar inside the controller.
4. Connect other end of second earth ground cable to earth ground stake.
4.8.2 Connection to Local Electrical Service

**DANGER!**
Local electrical service connection to the ArcWorld®IV 6000 Series system must be performed by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC), as well as all local electrical codes.

Note: The ArcWorld®IV 6000 Series system is configured for 3-phase 460/480V AC primary power. For additional information, refer to the electrical drawings and schematics that are included with your system documentation package (refer to Section 1.3).

After all of the system components have been properly installed and interconnected, connect local electrical service to the NX100 Controller and welding power sources (refer to Section 4.8.2.1 and Section 4.8.2.2).

4.8.2.1 NX100 Controller

For detailed electrical service interconnect procedures for the NX100 controller, refer to the NX100 Controller Manual and ArcWorld®IV 6000 Series system drawings/schematics that are included with your system documentation package (refer to Section 1.3).

4.8.2.2 Welding Power Sources

Refer to the welding power source documentation and ArcWorld®IV 6000 Series system drawings/schematics for electrical service connection procedures and diagrams for the welding power sources.

4.9 Safety/Operation Check

Before installing the tooling and fixtures for your application, take a few minutes to perform the following safety/operation check then process to your specific ArcWorld model –

1. Ensure that the shipping bracket is removed from each robot (refer to Section 4.7).
2. Ensure correct alignment and operation of the safety light curtain system (refer to safety light curtain documentation that is included with the ArcWorld®IV 6000 Series system).
3. Check the integrity and security of all cable connections.
4. Ensure that the work cell sliding access door is closed and that the door interlock is engaged.
5. Verify the correct settings for the welding power sources (refer to the welding power source documentation that is included with your ArcWorld®IV 6000 Series system).
6. Verify that local electrical service complies with the power requirements for your ArcWorld®IV 6000 Series system.
7. Verify that local electrical service is correctly wired into the NX100 controller and the welding power sources (refer to Section 4.8.2).
CAUTION!
The ArcWorld®IV 6000 Series system is now ready for power-up. Qualified, trained personnel, who are familiar with this system, should perform the power-up sequence.

4.9.1 ArcWorld®IV 6000 Series Safety/Operation Check

1. Set POWER ON-OFF switch on the NX100 controller to ON (see Figure 3).
2. Switch ON the electrical service disconnect box for each welding power source. These are located on the NX100/Welding Power Sources common base (see Figure 3).

WARNING!
Before operating the robots, verify that each E-Stop push button disables servo power when activated (pushed in). Each E-Stop push button must immediately stop robot and positioner movement when activated (pushed in).

3. Check for correct operation of all E-Stop push buttons (refer to Section 3.7.4).
4. Check for correct operation of the system HOLD button on the Operator Station Pedestal and Programming Pendant.
5. Check for correct action of the work cell access door safety interlock.
6. Remove power from the ArcWorld®IV 6000 Series system after completion of the safety / operation check.

4.10 Installation of Tooling and Fixtures

Your ArcWorld®IV 6000 Series system is now ready for installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the ArcWorld®IV 6000 Series system should do the installation. After tooling installation, test the positioner for correct operation.

Note: All tooling and fixtures for the positioner shall be supplied by the customer.

Note: Motoman recommends application of a corrosion/rust preventive compound to tooling and fixtures located in a high-humidity environment.
Chapter 5

Operation

This chapter provides a brief overview of the operating procedures and precautions for the ArcWorld® IV 6000 Series system. For more in depth operating information, refer to specific component manuals that are part of the ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

The ArcWorld® IV 6000 Series system is a fully integrated robotic GMAW welding cell. One, two, or three Motoman EA1400N or EA1900N robots (depending upon your system) weld parts on one side of the positioner. After the operator loads the opposite side of the positioner with parts to be welded the CYCLE START/CYCLE LATCHED button can be pressed, while the robot(s) are still welding. When the robot(s) complete the welding process, they return to a Home (Safe) position. The positioner will sweep moving the previously loaded parts into the robot work area, where the robot(s) will then move from the Home (Safe) position to complete the next welding cycle and the operator can then remove the welded pieces.

Note: The customer shall supply all tooling fixtures for the positioner.

5.1 Programming

The operation of the ArcWorld® IV 6000 Series 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 procedures and information, refer to the NX100 controller documentation that is included with the system documentation package (refer to Section 1.3).

Any changes made to your system configuration and/or job structure will alter the operation of the system. Motoman recommends that you DO NOT modify the original jobs and system configuration of your ArcWorld® IV 6000 Series system. If you determine a need to modify the original jobs and system configuration, make any modifications to a copy of the original. Keep the original as a backup. Do not modify the original. Modifications must be performed by trained and experienced personnel, who are familiar with the operation of the ArcWorld® IV 6000 Series system. If you have questions concerning the configuration, please contact Motoman 24 hour Customer Support (refer to Section 1.4).
5.2 Sweeping the Positioner

Note: The robots must be in the Home position before you can sweep the positioner.

Selecting MANUAL mode on the Operator Station Pedestal POSITIONER AUTO/MANUAL switch allows the operator 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 a series of moves. To sweep Side A or Side B of the positioner into the robot’s welding zone, proceed as follows:

1. Place the robots in Home position (refer to Section 5.3.2).
2. Make sure that the Operator Station Pedestal is enabled (Programming Pendant MODE SELECT SWITCH set to REMOTE).
3. Set the Operator Station Pedestal POSITIONER AUTO/MANUAL switch to MANUAL and start Master job (refer to Section 5.3.4). Normally, the robots will not move out of Home position when the POSITIONER AUTO/MANUAL switch is set to MANUAL (this depends on job structure).

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

4. Press the CYCLE START button on Operator Station Pedestal (the positioner sweeps each time the CYCLE START button is pressed).

5.3 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 (refer to Section 5.3.1).
- Move robots to Home position (refer to Section 5.3.2).
- Select Master job (refer to Section 5.3.3).
- Perform Operation cycle (refer to Section 5.3.4)
- Perform Shutdown procedures (refer to Section 5.3.5)

5.3.1 Start-Up

To start up the work cell from a power-off condition, proceed as follows:

1. Set POWER ON-OFF switch on NX100 controller to ON (see Figure 3).
2. Switch each welding power source electrical service disconnect boxes to ON (see Figure 3).
3. Set POWER ON-OFF switch on each welding power source to ON (ON-OFF indicator lamp on each welding power source will illuminate).
4. Open regulator valve on welding gas supply.
5. Make sure that the work cell door is closed and door safety interlocks engaged.
6. Ensure E-Stop buttons on Programming Pendant, controller door, and Operator Station Pedestal are released.

7. Select TEACH mode on the Programming Pendant.

8. Move robots to HOME position (refer to Section 5.3.2).

5.3.2 Robot Home Position

To move the robots to the Home position –

1. Select TEACH mode on the Programming Pendant.

2. Select MAIN MENU on Programming Pendant touch screen.


4. Select SELECT JOB on Programming Pendant touch screen (a job list appears on the screen).

5. Use the navigation cursor key to move the cursor to R1 SAFE job and press SELECT (the job appears on the display screen).

6. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.

7. Use the FWD button on Programming Pendant to jog robot (R1) to Home position.

8. For AWIV-6200 and AWIV-6300 systems, repeat steps 5 through 7 for robots R2 and R3.

5.3.3 Master Job

With the system powered up and in TEACH mode, call up the Master job –

1. Select MAIN MENU on Programming Pendant touch screen.

2. Select JOB on Programming Pendant touch screen.


4. Select PLAY mode on Programming Pendant and press the PLAY MODE ENABLE button on the controller door. Job playback operation is enabled.

5. Press SERVO ON button on the Programming Pendant.


The ArcWorld® IV 6000 Series work cell is now ready for operation.
5.3.4 **Operation Cycle**

The following is the typical sequence of operation for the ArcWorld® IV 6000 Series work cell after start-up –

1. Operator loads the fixture (on operator side of positioner) with parts to be welded.
2. Operator steps out of safety zone created by the safety light curtain system, and moves to the Operator Station Pedestal.
3. Operator presses the green CYCLE START button on Operator Station Pedestal. The positioner sweeps, thus placing parts to be welded into the robot work area. The robots then begin to weld the parts (if the Operator Station Pedestal POSITIONER AUTO/MANUAL switch is set to AUTO).
4. While the robots are welding, the operator loads the operator side of the positioner with the next group of parts to be welded.
5. The operator again moves to the Operator Station Pedestal and presses the green CYCLE START button (CYCLE LATCHED light illuminates). When the robots are finished welding, they return to Home position. The positioner then sweeps again to return completed, welded parts to the operator position, while moving the next group of parts into the robot work area.
6. Operator moves back to the operator side of the positioner and unloads completed, welded parts.

5.3.5 **Shutdown**

Use the following procedure to perform a normal shut down of the ArcWorld® IV 6000 Series system –

1. Make sure the robot(s) are in Home position.
2. Turn off system servo power by pressing the E-Stop button on Operator Station Pedestal or Programming Pendant.
3. Select TEACH mode on the Programming Pendant.
4. Set NX100 controller POWER ON-OFF switch to OFF position, (R1) on the AWIV-6200 and AWIV-6300.
5. Set ALL welding power source POWER ON-OFF switches to OFF position.

The ArcWorld® IV 6000 Series system is now shut down.

5.4 **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 clear them.
5.4.1 Alarms and Errors

Alarms and errors will stop the program. There are three levels –

• Error Messages
• Minor Alarms
• Major Alarms

When an alarm or error occurs the red ALARM button will illuminate on the Operator Station Pedestal and a message will appear in the Touch-Screen Display area of the Programming Pendant describing the type of error. For more detailed information on alarm and error recovery, refer to the maintenance and NX100 controller documentation that is included with your ArcWorld® IV 6000 Series system documentation package (refer to Section 1.3).

5.4.1.1 Error Messages

Error messages are usually the result of simple, easily-cleared operation errors. An example could include:

• Pressing the START button when the robots are not in PLAY mode

Clear errors of this type by pressing the CANCEL button on the Programming Pendant.

5.4.1.2 Minor Alarms

Minor alarms usually involve programming errors. Clear alarms of this type by pressing the RESET button on the Operator Station Pedestal or the CANCEL button on the Programming Pendant.

5.4.1.3 Major Alarms

Major alarms usually involve hardware failures. Examples could include –

• An overload condition
• An abnormal speed

Clear alarms of this type by cycling the NX100 controller, (R1) for the AWIV-6200 and AWIV-6300. Cycling involves setting the POWER ON-OFF switch to OFF for 10 seconds, then back to ON.

5.4.2 E-Stop Recovery

An E-Stop (emergency stop) will occur under any of the following conditions –

• An E-Stop push button switch is pushed in (activated)
• The work cell access door is opened while the robots are not in TEACH mode
• The safety light curtain system is triggered while the positioner is sweeping
• A collision triggers a shock sensor output
After an E-Stop condition, restart the ArcWorld® IV 6000 Series system as follows –

1. To clear the E-Stop condition, perform any of the following actions that apply –
   • Release the activated E-Stop push button
   • Close and secure work cell access door
   • Clear the area (in front of the positioner) that is protected by the safety light curtain system
   • Clear shock sensor condition (refer to Section 5.4.3).

   **CAUTION!**

   If an E-Stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the ArcWorld® IV 6000 Series system is restarted.

2. Select REMOTE mode on the Programming Pendant MODE SELECT SWITCH to transfer control of the system to the Operator Station Pedestal.

3. Press the SERVO ON button on the Operator Station Pedestal.

4. Press the green START button on the Operator Station Pedestal.

The ArcWorld® IV 6000 Series system is now ready to continue operation.

### 5.4.3 Shock Sensor Recovery

Each robot includes a Motoman gun mount. This mount is designed to protect the torch from damage in case of a crash (collision). A slight deflection of the torch (during a collision) activates a SHOCK SENSOR signal that triggers an E-Stop condition. To clear the E-Stop condition, you must override the shock sensor and move the affected robot clear of the impact. To override the shock sensor, proceed as follows –

1. Select MAIN MENU on Programming Pendant touch screen.

2. Select ROBOT on Programming Pendant touch screen.


4. Select RELEASE to release shock sensor.

5. Turn servo power ON (press in on the pendant ENABLE switch while pressing SERVO ON READY).

6. Move the affected robot clear of the impact position.

The ArcWorld® IV 6000 Series system is now ready to continue operation.
5.4.4 Brake Release

The robot braking system is designed to protect the robots and other system components from damage in the event of a system/robot failure or loss of drive power. If a system or robot failure occurs, you must release the brakes on the affected robot in order to move it.

To release the brakes, proceed as follows –

**WARNING!**

Always support the robot axis to be released BEFORE you release it. Without adequate robot axis support, brake release could cause personal injury or machine damage.

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 BRAKE RELEASE option.
4. Use the CURSOR key to select desired robot axis for release.
5. Press and hold the Programming Pendant ENABLE switch in the “first click” position (refer to Figure 10), press and hold down the INTERLOCK key and the SELECT key.
6. The brake for the selected axis will release.
Chapter 6
Maintenance

Maintenance of the ArcWorld® IV 6000 Series system and components must be performed by authorized personnel who are familiar with the ArcWorld® IV 6000 Series system. Perform the procedures given in this chapter only as needed (on condition). Be sure to read and understand the documentation for a particular component before doing repair maintenance or preventive maintenance on that component. Be sure that you understand the maintenance procedures, have the proper tools at hand, and comply with safety precautions given in Chapter 2.

Maintenance intervals given in this chapter are recommendations, only. Adjust the frequency and level of repair maintenance and preventive maintenance to suit your specific equipment schedules and shop environment.

For periodic maintenance procedures and schedules for the individual components of your ArcWorld® IV 6000 Series system, refer to the documentation package that is included with your system (refer to Section 1.3).

**CAUTION!**
If your system uses water-cooled torches, use only Motoman-specified antifreeze. Typical automotive antifreeze contains additives that can clog the small cooling ports in the torches, and can damage sealing gaskets in the water circulator pumps.

Table 1 Periodic and Preventive Maintenance

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>COMPONENT</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily (or on condition)</td>
<td>Water Circulators (water-cooled torch application, only)</td>
<td>Add a mixture of Motoman antifreeze (P/N 131224-1) and distilled water, as required. Mix antifreeze and distilled water in proportions shown on the antifreeze container.</td>
</tr>
<tr>
<td></td>
<td>All safeguard items – work cell door interlocks, E-Stop push buttons, safety light curtains, arc curtains, etc.</td>
<td>Check physical condition of safeguard item and ensure that the safeguard item is working correctly</td>
</tr>
<tr>
<td>Monthly (or on condition)</td>
<td>ArcWorld® IV 6000 Series work cell</td>
<td>Remove accumulated dirt, grease, and debris from inside and outside the work cell.</td>
</tr>
<tr>
<td>6 Months (or on condition)</td>
<td>Robot Equipment Base Positioner Equipment Base</td>
<td>Check torque of threaded hardware securing robot equipment base to positioner equipment base (see Figure 17).</td>
</tr>
</tbody>
</table>
NOTES
Appendix A

Anchoring

The customer must determine all anchoring and foundation requirements, and supply the appropriate anchoring hardware and foundation for a particular system installation. Table A.1 gives anchoring and foundation suggestions.

Table A.1  Suggested Anchor, Floor Plate, and Foundation Specifications

<table>
<thead>
<tr>
<th>SYSTEM EQUIPMENT</th>
<th>MINIMUM HILTI® ANCHOR ROD DIAMETER AND TYPE</th>
<th>MINIMUM FLOOR PLATE</th>
<th>MINIMUM FOUNDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOTS UP6, UP20, UP20-6 EA1400N EA1900N</td>
<td>5/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>600 mm (24 in.) Length 600 mm (24 in.) Width 38.1 mm (1.5 in.) Thick</td>
<td>762 mm (30 in.) Length 762 mm (30 in.) Width 178 mm (7 in.) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS UP20M, UP50 SP80 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>900 mm (35 in.) Length 900 mm (35 in.) Width 50.8 mm (2 in.) Thick</td>
<td>1524 mm (60 in.) Length 1524 mm (60 in.) Width 229 mm (9 in.) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS UP120, UP130 UP165, SP100 SP160, SP250 SP400 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>1200 mm (47 in.) Length 1200 mm (47 in.) Width 50.8 mm (2 in.) Thick</td>
<td>1828 mm (72 in.) Length 1828 mm (72 in.) Width 229 mm (9 in.) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS UP200</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>1200 mm (47 in.) Length 1200 mm (47 in.) Width 50.8 mm (2 in.) Thick</td>
<td>1828 mm (72 in.) Length 1828 mm (72 in.) Width 229 mm (9 in.) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS UP350, UP500, SK300X</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>1500 mm (59 in.) Length 1500 mm (59 in.) Width 50.8 mm (2 in.) Thick</td>
<td>1828 mm (72 in.) Length 1828 mm (72 in.) Width 229 mm (9 in.) Thick 4000 psi Reinforced Concrete</td>
</tr>
</tbody>
</table>
### Table A.1  Suggested Anchor, Floor Plate, and Foundation Specifications (Continued)

<table>
<thead>
<tr>
<th>SYSTEM EQUIPMENT</th>
<th>MINIMUM HILTI® ANCHOR ROD DIAMETER AND TYPE</th>
<th>MINIMUM FLOOR PLATE</th>
<th>MINIMUM FOUNDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSITIONER</td>
<td>5/8&quot; HVA Chemical Anchor <em>(Note 3) (Note 6)</em></td>
<td>Not Applicable</td>
<td>Refer to Applicable Positioner Manual</td>
</tr>
<tr>
<td>Table type (360° rotary or 180° recip.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POSITIONER</td>
<td>7/8&quot; HVA Chemical Anchor <em>(Note 3) (Note 6)</em></td>
<td>Not Applicable</td>
<td>Refer to Applicable Positioner Manual</td>
</tr>
<tr>
<td>Ferris wheel type (HS/TS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERIPHERAL EQUIPMENT</td>
<td>1/2&quot; Kwik Bolt II Expansion Anchor <em>(Note 4) (Note 6)</em></td>
<td>Not Applicable</td>
<td>3” min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>WORK CELL FENCE POSTS</td>
<td>3/8” Kwik Bolt II Expansion Anchor <em>(Note 4) (Note 6)</em></td>
<td>Not Applicable</td>
<td>3” min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete</td>
</tr>
</tbody>
</table>

**NOTES** –

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 to ± 2°. 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. Cast-in anchors are specified in some robot manuals. The Hilti® HVA Chemical Anchors listed in this table can be substituted for the cast-in anchors.
6. Refer to Hilti® Product Technical Guide for suggestions on the correct size and type of drill bit to use with each anchor type.

**HILTI** Contact Information –
1-800-879-8000 (USA)  [http://us.hilti.com](http://us.hilti.com)
1-800-363-4458 (CAN)  [http://ca.hilti.com](http://ca.hilti.com)
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