

**Motoman® NX100 Controller**

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# ArcWorld® V-1000 System Manual

Part Number: 151757-1CD  
Revision 0

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# NOTES

## Chapter 1

# Introduction

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### 1.1 About This Document

This System Manual provides an overview of the Motoman ArcWorld® V-1000 system. For detailed information on any specific system component referenced in this document, please refer to your ArcWorld® V-1000 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 ArcWorld® V-1000 system.*

This System Manual contains the following chapters –

#### **CHAPTER 1 – INTRODUCTION**

This chapter provides general information about the ArcWorld® V-1000 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® V-1000 system.

#### **CHAPTER 3 – DESCRIPTION OF EQUIPMENT**

This chapter provides a description of the major components of the ArcWorld® V-1000 system.

#### **CHAPTER 4 – INSTALLATION**

This chapter provides installation procedures for the ArcWorld® V-1000 system.

#### **CHAPTER 5 – OPERATION**

This chapter provides an overview of ArcWorld® V-1000 system operation, including start-up, loading, normal operations, fault recovery, and system shutdown.

#### **CHAPTER 6 – MAINTENANCE**

This chapter provides preventive maintenance suggestions for certain components of the ArcWorld® V-1000 system.

#### **APPENDIX A – ANCHORING**

Appendix A gives foundation and anchoring suggestions for ArcWorld® V-1000 system components that require anchoring.

## 1.2 System Overview

The ArcWorld® V-1000 system features a Common Equipment Structure weldment (see Figure 1 and Figure 2) that provides integral mounting points for most of the ArcWorld® V-1000 system components. The safety fence assembly is the only ArcWorld® V-1000 system component that does not mount directly to the Common Equipment Structure weldment.

The ArcWorld® V-1000 system features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06-1999 Robot Safety standard, as well as the CAN/CSA-Z434-94 Canadian standard. Heavy-gauge wire mesh safety fencing encloses the robot side of the ArcWorld® V-1000 work cell to prevent unintended entry of personnel while the robot is performing a welding task. Arc curtains cover the wire mesh fencing to reduce the levels of arc radiation that escape the interior of the work cell during welding operations. A sliding access door is part of the safety fence assembly, and provides access to the work cell (see Figure 1). The access door incorporates a dual-channel (redundant circuitry) tamper-proof safety interlock to disable all equipment, should the access door be opened while the robot is active. A dual-channel (redundant circuitry) safety light curtain system protects the operator from positioner movement by establishing an infrared light field between the send unit and the receive unit in front of the positioner (see Figure 1). In effect, the light field defines a protected zone in front of the positioner. Positioner movement is prevented (or stopped) whenever a person or object interrupts (breaks) the light field.

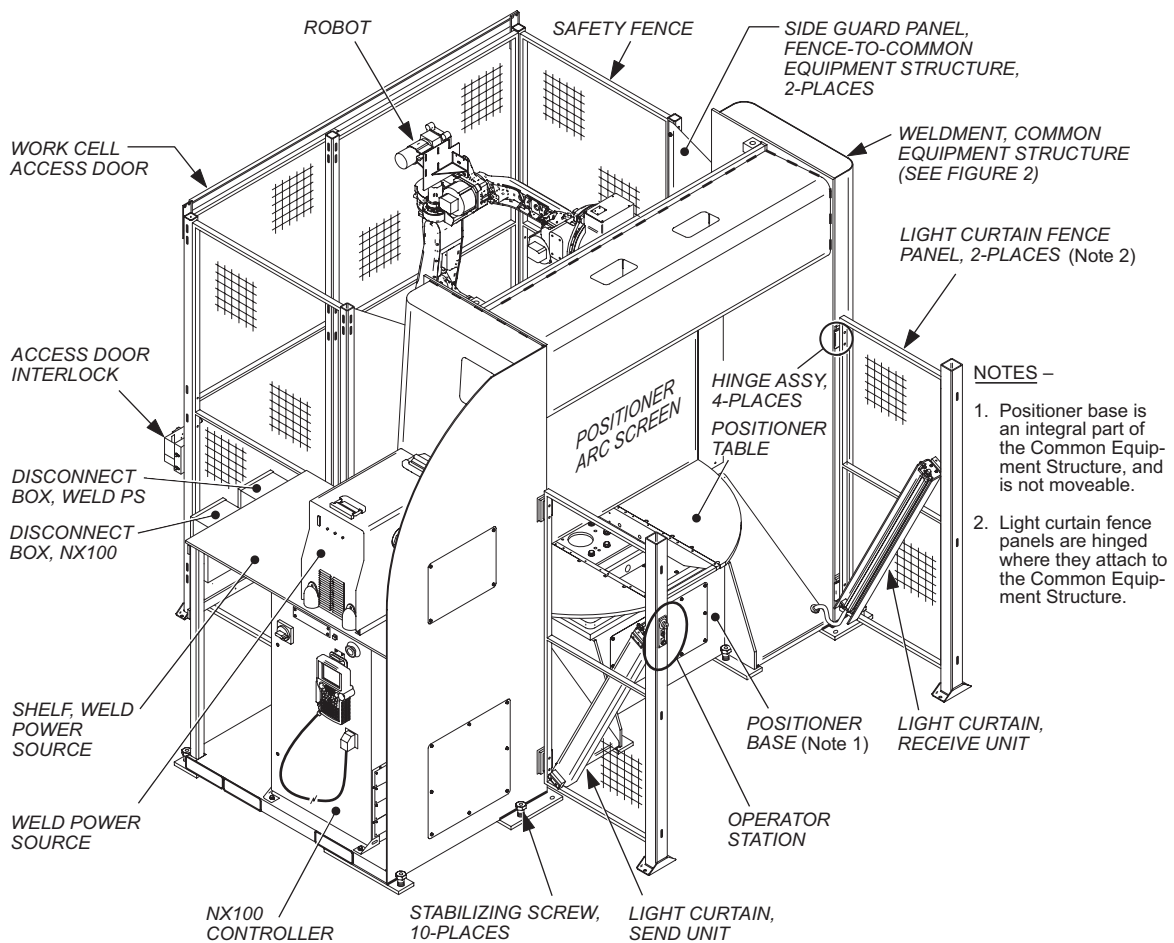
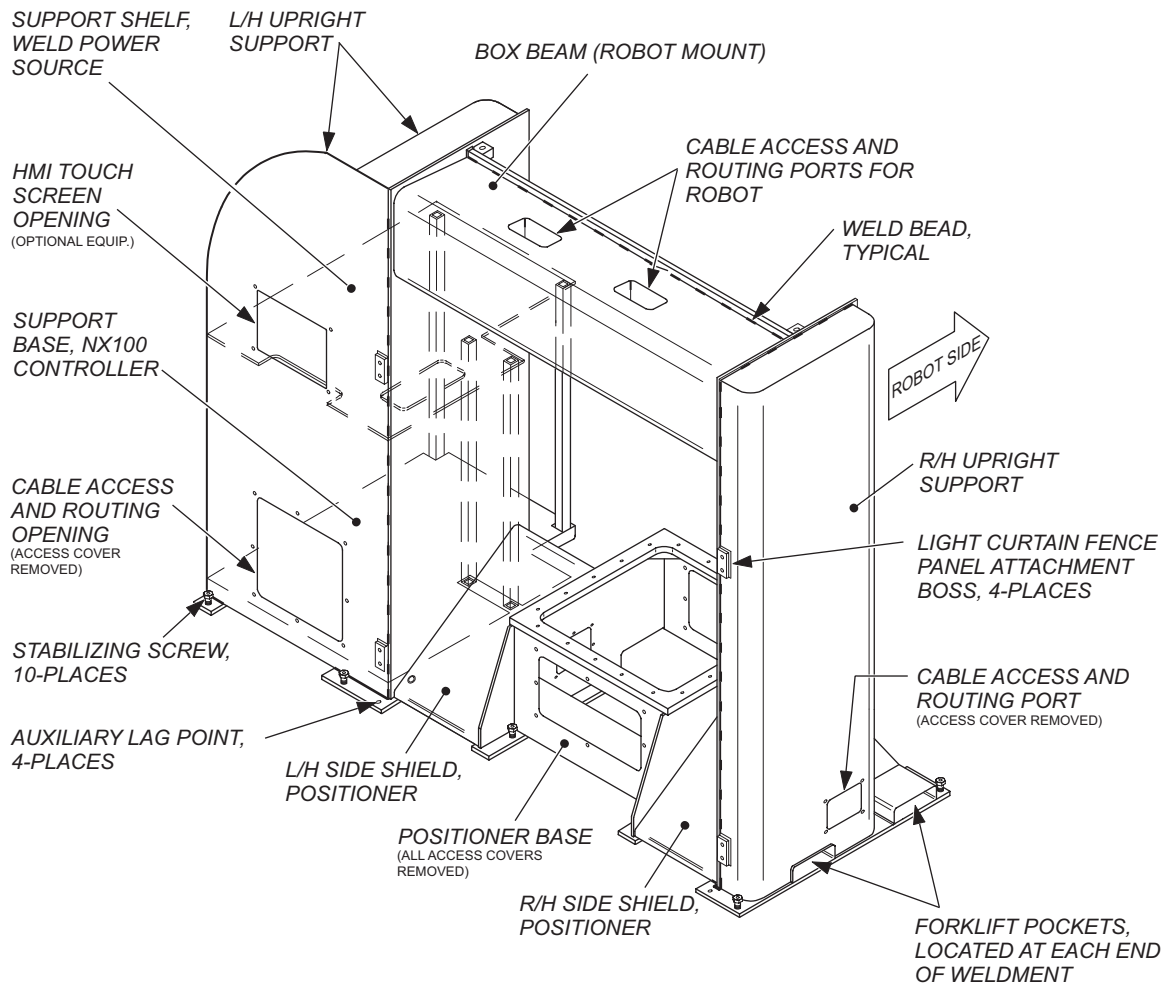


Figure 1 Overview and Component Location — ArcWorld® V-1000 System



**Figure 2** Weldment – Common Equipment Structure

## 1.2.1 System Layout

One EA1400TN (or optional EA1900TN) robot is mounted to an overhead box beam that is an integral part of the Common Equipment Structure (see Figure 1 and Figure 2). This mounting position places the robot directly over the positioner to provide improved reach. This mounting position also reduces required work cell floor space by approximately 39% when compared to systems that use a floor-mounted robot.

One NX100 controller and one welding power source are also mounted to the Common Equipment Structure (see Figure 1 and Figure 3). Because of the unique design of the Common Equipment Structure, both the NX100 controller and welding power source are located outside of the ArcWorld® V-1000 work cell, even though they are mounted directly to the Common Equipment Structure.



## 1.2.2 Major Components

The ArcWorld® V-1000 system includes the following major components –

- One EA1400TN (or optional EA1900TN) robot
- One NX100 controller
- One Common Equipment Structure
- One MR-300 Positioner Module (positioner base is integral part of Common Equipment Structure)
- One Programming Pendant (located on door of NX100 controller)
- One Operator Station
- Welding equipment –
  - Welding power source
  - Welding torch (air-cooled)
  - Wire feeder
  - Applicable welding interface
  - Torch mount
- Safety equipment –
  - Heavy gauge, wire-mesh safety fencing with arc curtains.
  - Dual-channel, interlocked safety light curtain system
  - Dual-channel, tamper-proof, interlocked work cell entry door
  - Steel arc screen on the MR-300 positioner
  - Sheet steel arc screens that surround the positioner arc screen (see Figure 6)

## 1.2.3 Optional Equipment

The following optional equipment is available for the ArcWorld® V-1000 system –

- Torch cleaner
- Wire cutter
- Water-cooled torch (with water circulator)
- TouchSense™ (starting point detection)
- ComArc™ (seam tracking)
- Motoman® touch screen HMI panel (see Figure 2)

## 1.3 Reference Documentation

For additional information on individual components of the ArcWorld® V-1000 system, refer to the following documentation that is included with your system –

- Motoman *EA1400N Manipulator Manual* (P/N 149208-1) or 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 *NX100 Independent/Coordinated Control Function Manual* (P/N 149648-1)
- Motoman *MR-300 Positioner Manual* (P/N 147585-1)
- Motoman *INFORM User's Manual* (P/N 150078-1)
- Vendor manuals for ArcWorld® V-1000 system components not manufactured by Motoman

## 1.4 Customer Support Information

If you need immediate assistance with any aspect of your ArcWorld® V-1000 system, please contact Motoman Customer Support at the following 24-hour telephone number –

+1.937.847.3200

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

[techsupport@motoman.com](mailto:techsupport@motoman.com)

For **routine** non-technical inquiries, such as ordering replacement parts, checking order status, etc., you can also contact Motoman Customer Support at the following e-mail address –

[customerservice@motoman.com](mailto:customerservice@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 ArcWorld® V-1000
- Robot EA1400TN (standard)  
EA1900TN (optional)
- Positioner MR-300
- Primary Application Arc Welding
- Controller NX100
- 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 Located on NX100 controller data plate

# NOTES

## Chapter 2

# Safety

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### 2.1 Introduction

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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.

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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 the ANSI/RIA R15.06-1999 Robot Safety standard. The address is as follows –

**Robotic Industries Association**  
900 Victors Way  
P.O. Box 3724  
Ann Arbor, Michigan 48106  
+1.734.994.6088 (voice)  
+1.734.994.3338 (fax)  
[www.roboticsonline.com](http://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 chapter 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 –

- 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 Programming 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 the ANSI/RIA R15.06-1999 Robot Safety standard, 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, the ANSI/RIA R15.06-1999 Robot Safety standard, 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 safety suggestions –

- Be sure that only qualified personnel, who are familiar with national codes, local codes, and the ANSI/RIA R15.06-1999 Robot Safety standard, 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).

## Chapter 3

# Equipment Description

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### 3.1 EA-Series Robot

The ArcWorld®V-1000 system is equipped with a Motoman EA1400TN or optional EA1900TN robot (depending upon customer's order and preference). Both robot models are 6-axis units that are specifically designed for arc welding applications. The "T" designator in the robot model number indicates that the robot is configured for horizontal mounting.

The robot is secured to an overhead box beam that is an integral part of the Common Equipment Structure weldment (see Figure 1 and Figure 2). This mounting position places the robot directly over the positioner to provide improved reach. This mounting position also reduces required work cell floor space by approximately 39% when compared to systems that use a floor-mounted robot.

Both robot models have a payload capability of 3 kg (6.6 lbs.). The EA1400TN robot features a horizontal reach of 1390 mm (54.7 inches). The EA1900TN robot features a horizontal reach of 1904 mm (75.0 inches). Each robot features a relative positioning accuracy of  $\pm 0.08$  mm ( $\pm 0.003$  inch).

Both robot models incorporate an internal cable routing design that makes use of the unique hollow upper and lower robot arms. This design feature provides enhanced flexibility and streamlines the robot profile, thus allowing improved access to confined spaces. This design feature also increases welding cable life by maintaining an optimal cable bend radius and reducing cable torsional stress throughout the robot's range of motion.

Robot B-axis (Pitch/Yaw) features a large range of motion that allows full circumferential welding on cylindrical work pieces. The welding torch cable connects to a torch mount in the center of the hollow wrist flange (T-axis). This feature allows the robot to rotate the welding torch  $\pm 360^\circ$  without cable interference or cable stress.

Hard stops in the base of both robot models are factory-set to limit the robot S-axis to  $\pm 30^\circ$  rotation. This is done to accommodate the robot configuration and overhead mounting location on the Common Equipment Structure.

For additional information on the Motoman EA-series robots, please refer to the *EA1400N Manipulator Manual* or the *EA1900N Manipulator Manual* that is included with your ArcWorld®V-1000 system documentation package (refer to Section 1.3).



## 3.2 NX100 Controller

The ArcWorld<sup>®</sup>V-1000 system includes one NX100 controller (see Figure 3). The controller includes a Programming Pendant that provides a single point of system control in compliance with the ANSI/RIA R15.06-1999 Robot Safety standard (refer to Section 3.3).

In addition to controlling robot movement, the NX100 also controls the welding power source, the MR-300 positioner, and provides the signals necessary to operate the welding systems.

In the ArcWorld<sup>®</sup>V-1000 system, the MR-300 positioner interface assembly, usually located within the positioner base, is located inside the NX100 controller cabinet. For additional details, please refer to the system drawings that are part of the ArcWorld<sup>®</sup>V-1000 documentation package (refer to Section 1.3).

The NX100 controller uses a real-time operating system (RTOS) that is programmed with the Motoman INFORM programming language.

For more information on INFORM, please refer to the *INFORM User's Manual* that is included with your ArcWorld<sup>®</sup>V-1000 system documentation package (refer to Section 1.3).

For more detailed information on the NX100 controller, refer to the various NX100 manuals that are included with your ArcWorld<sup>®</sup>V-1000 system documentation package (refer to Section 1.3).

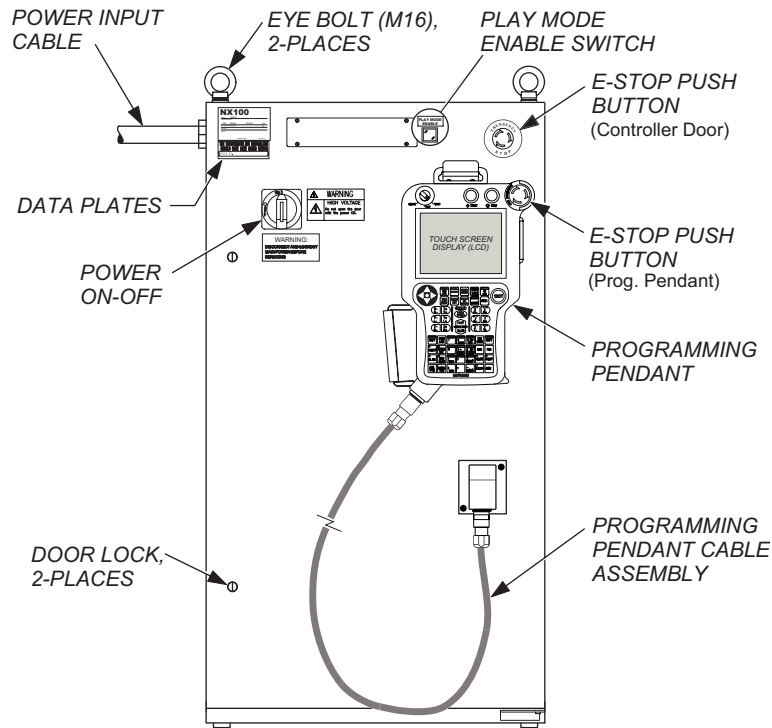


Figure 3 NX100 Controller

### 3.3 Programming Pendant

The Programming Pendant (see Figure 4) provides the primary interface with the ArcWorld®V-1000 system to programming, operation, and maintenance personnel. The Programming Pendant is packaged in a 200 mm (7.9 in) W × 300 mm (11.8 in) H × 60 mm (2.4 in) D reinforced thermoplastic enclosure and weighs 1.38 kg (3 lbs). The Programming Pendant features the Windows® CE operating system, and displays information on a 6½ -inch TFT color LCD touch screen display. A Compact Flash® card slot is provided for program and data backups. The Programming Pendant provides icon-driven system programming, and features a menu-driven interface to simplify operator interaction with the ArcWorld®V-1000 system. Most operator controls are located on the Programming Pendant, thus allowing the NX100 controller cabinet to be mounted remotely. The Programming Pendant enables the operator to teach robot motion; perform programming, editing, maintenance, and diagnostic functions; and enable/disable Operator Station control of the ArcWorld®V-1000 system. Standard cable length for the Programming Pendant is 8 m (26 ft). Maximum cable length is 36 m (118 ft).

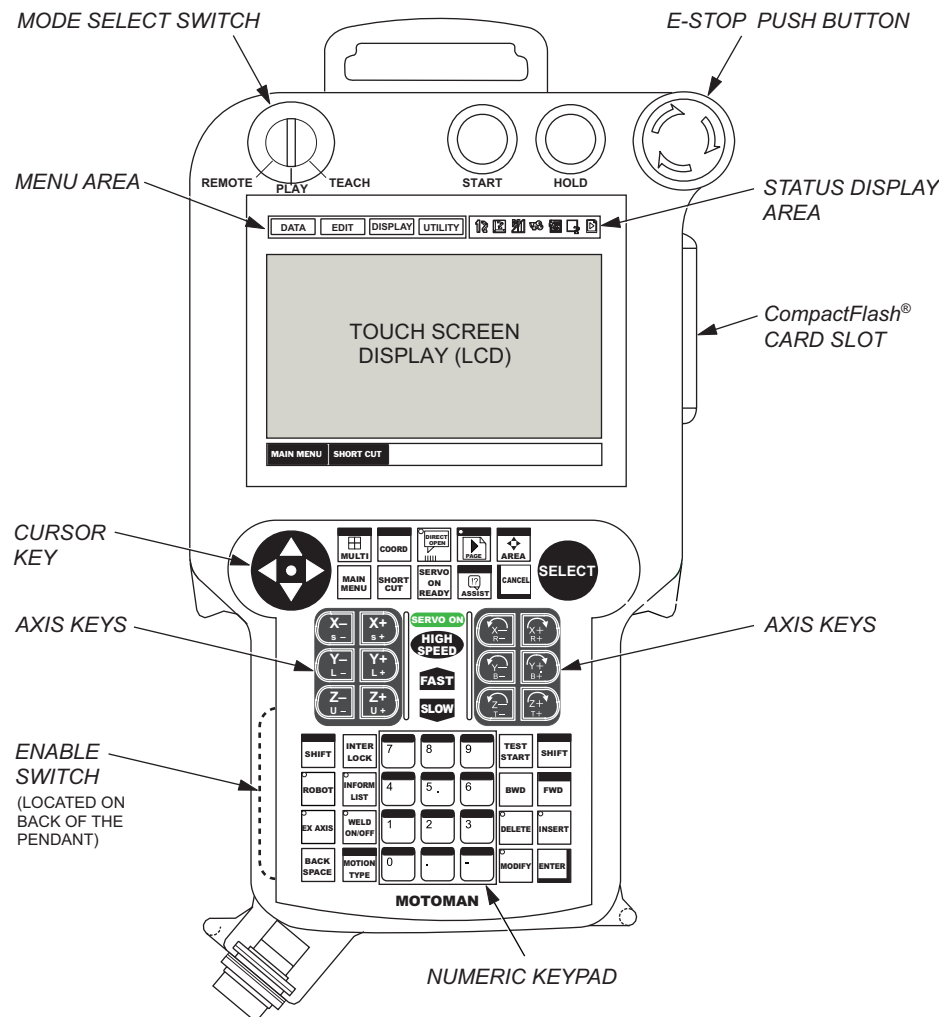


Figure 4 NX100 Programming Pendant

For detailed information on Programming Pendant functions, screen icons, and display, please refer to the *NX100 Operator's Manual for Arc Welding* that is included with your ArcWorld® V-1000 system documentation package (refer to Section 1.3).



**CAUTION!**

**Always return the Programming Pendant to its hook mount on the front of the NX100 controller. The Programming Pendant can be damaged if it is not returned to its proper storage position after use.**



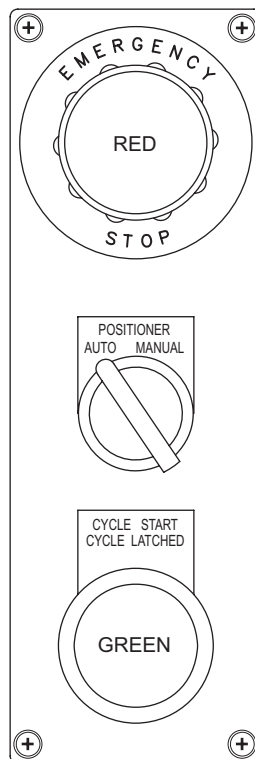
*Note: The Programming Pendant LCD touch screen display features a “screen saver” that causes the screen to go dark after a few minutes of inactivity. Press any key to restore screen.*



*Note: Operator Station (refer to Section 3.4) “enable” or “disable” is accomplished with the Programming Pendant MODE SELECT SWITCH. To transfer control of the ArcWorld® V-1000 system to the Operator Station, set the Programming Pendant MODE SELECT SWITCH to REMOTE. Control of the ArcWorld® V-1000 system cannot be enabled or disabled at the Operator Station.*

### 3.4 Operator Station

The Operator Station is a compact unit that is integrated into the fence post near the light curtain send unit (see Figure 1 and Figure 5).



**Figure 5** Operator Station

### 3.4.1 Operator Station Function – Cycle Start/Cycle Latched

**WARNING!**

The operation of the **CYCLE START / CYCLE LATCHED** push 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, 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 NX100 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 NX100 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 Function – Emergency Stop (E-Stop)

Pressing the Operator Station 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®V-1000 system from the emergency stop (E-Stop) condition.

### 3.4.3 Operator Station Function – Positioner Auto/Manual

The **POSITIONER AUTO/MANUAL** selector switch is used to select **AUTO** or **MANUAL** mode for the positioner. When the selector switch is in the **AUTO** position, the robot welds parts immediately after the positioner sweeps. In **MANUAL** mode, the positioner sweeps but the robot does not weld parts until the operator selects **AUTO** mode.



*Note: The **POSITIONER AUTO/MANUAL** command depends upon the structure of the Master Job.*

## 3.5 MR-300 Positioner

The MR-300 reciprocating positioner is part of the ArcWorld®V-1000 system. The positioner base is an integral part of the Common Equipment Structure weldment and is not movable (see Figure 2). The interface assembly, normally installed inside the base of a standard MR-300 positioner, is now located inside the NX100 controller cabinet. All other characteristics of the positioner are identical to a standard MR-300 positioner with moveable base.

The MR-300 features controlled rotary motion and a 300 kg (600 lb) payload capacity per side. Total sweep time is 4 seconds. The positioner utilizes a brushless AC drive motor plus gear reducer, and a 1525 mm (60-inch) circular table top. A steel arc screen divides the table top, providing two semicircular work areas (Side A and Side B). The steel arc screen (along with auxiliary shield panels attached to the Common Equipment Structure weldment) creates a barrier that safeguards the operator from arc radiation and sparks produced during the welding operation (see Figure 6). The MR-300 uses a rotary motion to sweep each side of the circular turntable 180° from the operator's

loading zone, into the robot's work zone, and back to the operator again. The positioner can accept optional external axis control for coordinated motion between the positioner and the robot.



**DANGER!**

**Do not operate the MR-300 positioner unless the positioner arc screen and the auxiliary shield panels are securely in place (see Figure 6). Operation of the positioner without the positioner arc screen and auxiliary shield panels in place can result in burns or serious eye damage for the operator.**

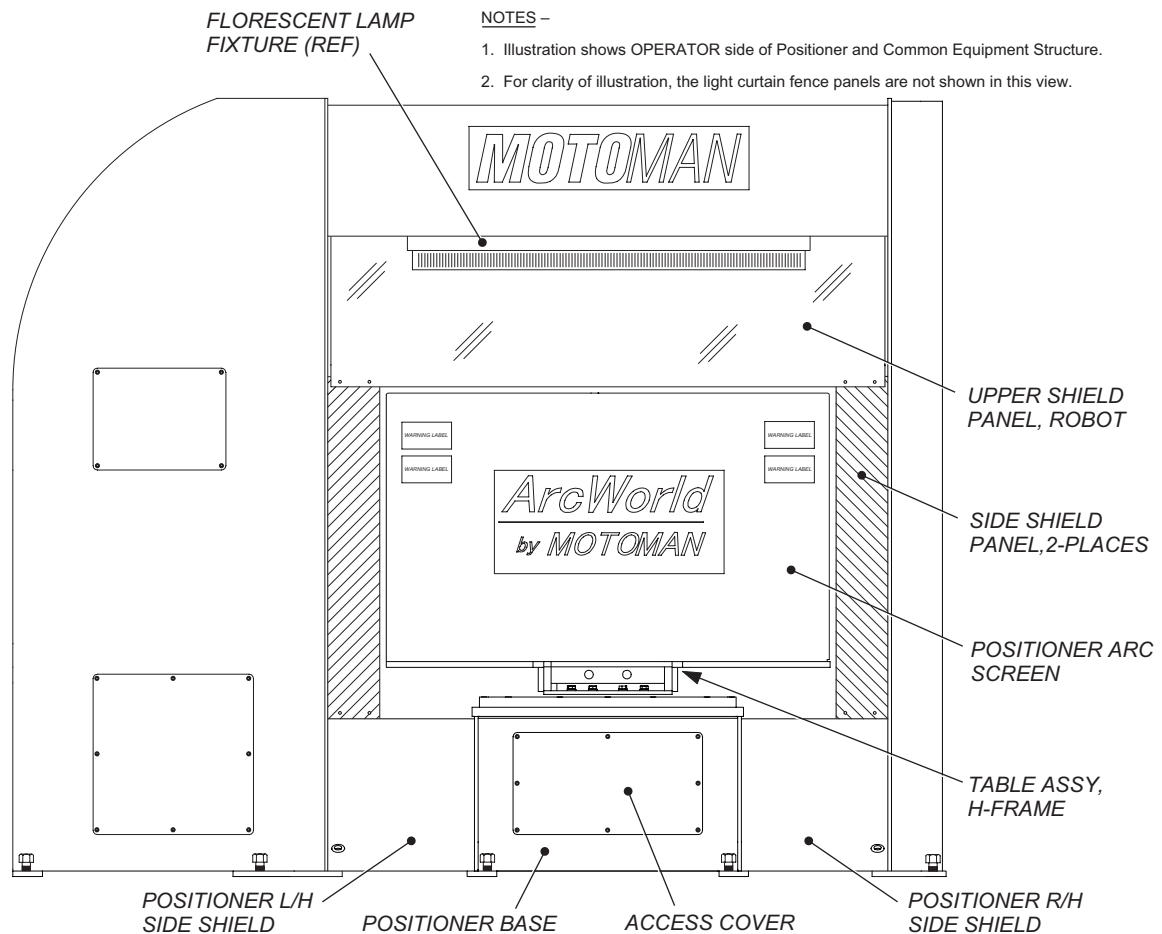
For detailed positioner information, including illustrated parts lists, load capabilities, and dimensions, refer to the *MR-300 Positioner Manual* that is included with your ArcWorld® V-1000 system documentation package (Refer to Section 1.3).



*Note: The customer shall supply all tooling and fixtures for the MR-300 positioner.*



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



**Figure 6** MR-300 Positioner and Related ArcWorld® V-1000 System Components

## 3.6 Welding Equipment

In its standard configuration, the ArcWorld®V-1000 system includes a welding power source, wire feeder, torch, and torch mount for the robot. Optional equipment – a water-cooled torch, water circulator, ComArc™ seam tracking unit, TouchSense™ starting point detection unit, and a torch tender (cleaner) – may also be included with your ArcWorld®V-1000 system.

### 3.6.1 Welding Power Source

Motoman offers various brands and types of welding power sources. The actual brand and type of welding power source supplied with the ArcWorld®V-1000 system depends on the customer's specific application and preference. For specific information on the welding power source supplied with your system, refer to the welding power source vendor manual that is included with your ArcWorld®V-1000 system documentation package (refer to Section 1.3.).

### 3.6.2 Wire Feeder

A welding wire feeder is mounted on the upper arm (U-Axis) of the EA-series 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 *EA1400N Manipulator Manual* or *EA1900N Manipulator Manual* that is included with your ArcWorld®V-1000 system documentation (refer to Section 1.3).

### 3.6.3 GMAW Torch

The EA-series robots are fitted with an air-cooled or (optional) water-cooled GMAW torch. For applications that use the optional water-cooled torch, the ArcWorld®V-1000 system includes a water circulator. Both torch types are heavy-duty and designed for quick replacement and a minimum of robot reprogramming.

The GMAW torch is installed in a torch mount at the end of the robot wrist flange. The torch mount provides multi-dimensional impact (collision) detection to protect the robot, torch, fixture, positioner, and work piece from damage in the event of a collision. Any torch impact (collision) triggers an E-Stop condition (refer to Section 3.7.4). For additional information on the torch/mount combination that is supplied with your system, refer to the torch vendor documentation that is included with your ArcWorld®V-1000 system (refer to Section 1.3).

## 3.7 Safety Features

The ArcWorld®V-1000 system includes a total safety environment that complies with the ANSI/RIA R15.06-1999 Robot Safety standard.



*Note: Users are responsible for determining that the safeguards provided with the ArcWorld®V-1000 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

Three forms of welding arc protection are part of the ArcWorld®V-1000 system –

- a steel arc screen that is an integral part of the MR-300 positioner
- additional shield panels attached to the Common Support Structure (see Figure 6)
- heavy gauge (14 mil) arc curtains that cover the steel mesh safety fencing

The positioner's arc screen and the additional shield panels, protect the operator from arc radiation and sparks that result from the welding operation (see Figure 1 and Figure 6).



#### **WARNING!**

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

The arc curtains provide protection from arc flash and reduce the amount of ultraviolet radiation that escapes the work cell during welding operations.

### 3.7.2 Safety Fencing

A heavy-gauge steel mesh safety fence assembly provided with the system encloses the robot side of the work cell (see Figure 1). It forms a physical barrier that prevents the unintentional movement of personnel or objects into the work cell during automatic operation. A dual-channel, 'interlocked sliding door, at the rear of the work cell, provides a work cell point-of-entry for programming and maintenance personnel (refer to Section 3.7.7).

### 3.7.3 Safety Light Curtains

The safety light curtain system consist of two units (a SEND unit and a RECEIVE unit) that emit and receive infrared light to create an invisible protective field in front of the MR-300 positioner (see Figure 1). If an object or person penetrates the protective field while the positioner is sweeping, the light curtain system creates an E-Stop condition (refer to Section 3.7.4). The safety light curtain system incorporates a dual-channel safety feature that provides redundant circuitry to ensure continued operation of the light curtains should one of the control channels fail.

For additional information on the safety light curtain system, refer to the vendor documentation that is included with your ArcWorld®V-1000 system (refer to Section 1.3).

### 3.7.4 Emergency Stop (E-Stop)

E-Stop is a primary protection method for the ArcWorld®V-1000 system. A work cell access door interlock, a 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. The E-Stop condition immediately de-energizes the control system and activates the robot braking system (refer to Section 3.7.6).

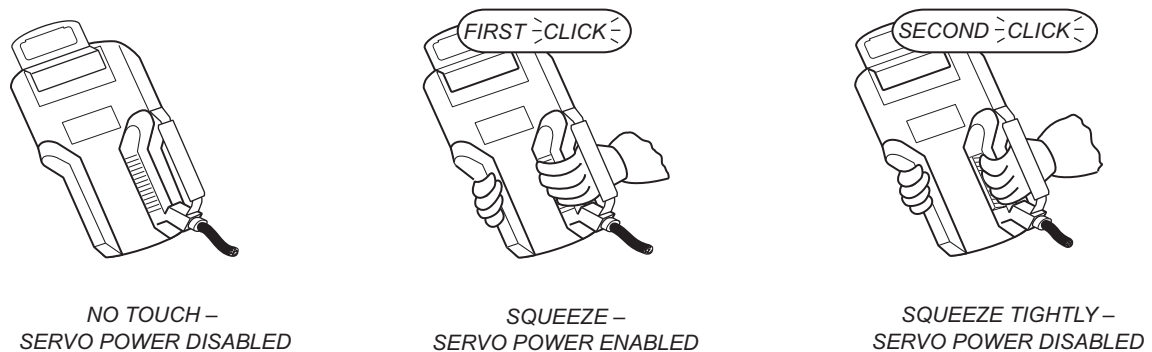
The E-Stop push buttons are used for an intentional shutdown of the ArcWorld®V-1000 system, and are installed at the following locations –

- Programming Pendant
- NX100 Controller
- Operator Station

To resume operation after an E-Stop system shutdown, the operator must 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 Programming Pendant is equipped with a three-position safety switch that controls power to the robot servo drive motors (see Figure 4 and Figure 7). This feature is designed to protect the operator who is using the Programming Pendant to “teach” the robot. When using the Programming Pendant, the operator must depress the ENABLE switch to the middle position (first click), and hold it in this position, to enable servo power. If the operator releases the ENABLE switch, or depresses it past the middle position (second click), power to the robot servo drive motors is immediately disabled, 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®V-1000 system documentation package (refer to Section 1.3).



**Figure 7** Programming Pendant ENABLE Switch – Location and Operation

### 3.7.6 Robot Braking System

The EA-series 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).



# NOTES

## Chapter 4

# Installation

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### CAUTION!

The ArcWorld®V-1000 system should be installed by qualified personnel who are familiar with the installation and set-up of a robotic system.



### CAUTION!

The ArcWorld®V-1000 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®V-1000 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®V-1000 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 robots, NX100 controller, and peripheral equipment
- Earth ground rods and/or buried copper sheeting (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<sup>3</sup>/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 3/4-inch 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 driver (with 3/4-inch 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, 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<sup>®</sup>V-1000 system (see Figure 8 and Figure 9). Allow an additional 1.2 - 1.5 m (4 to 5 ft) 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)

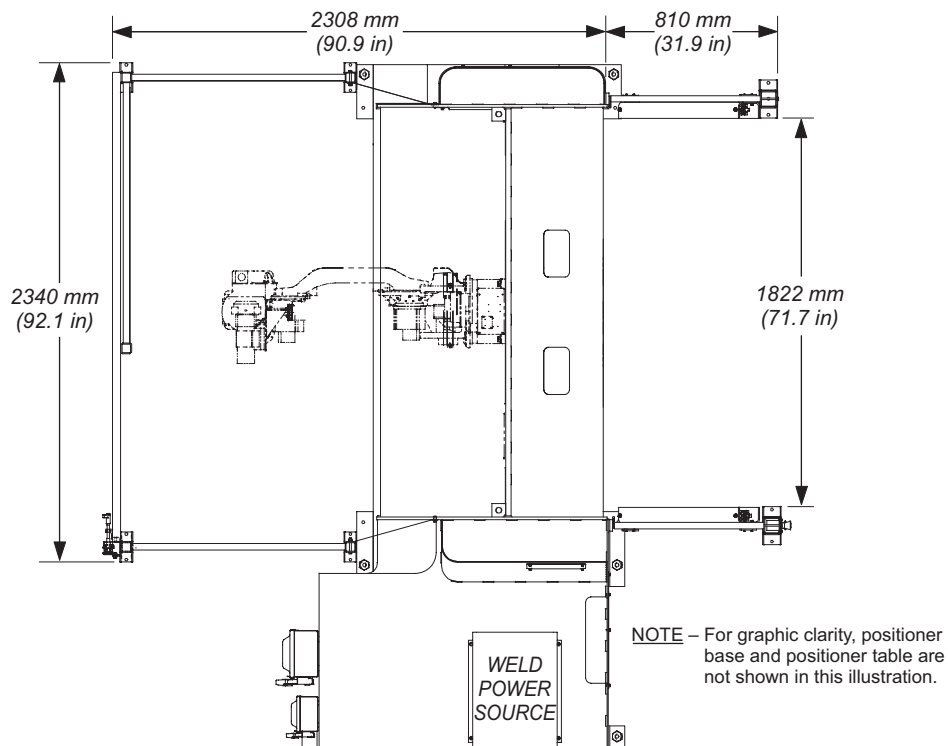


Figure 8 Plan View — ArcWorld<sup>®</sup>V-1000

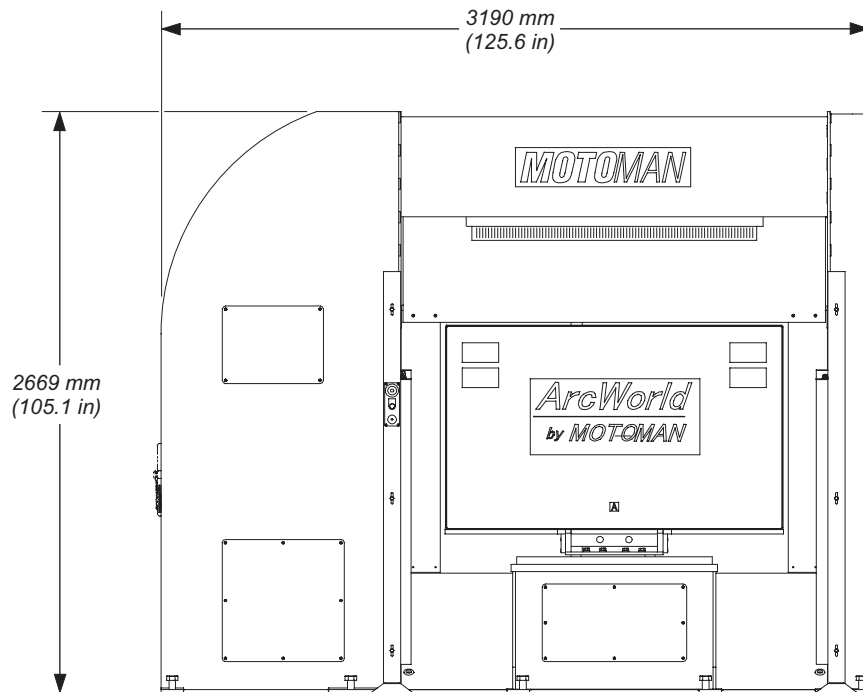


Figure 9 Elevation View — ArcWorld®V-1000

### 4.3 Common Equipment Structure — Placement



**WARNING!**

Make sure that your lifting device is capable of safely handling the Common Equipment Structure. The Common Equipment Structure and attached components weighs approximately 3250 kg (7165 lb).

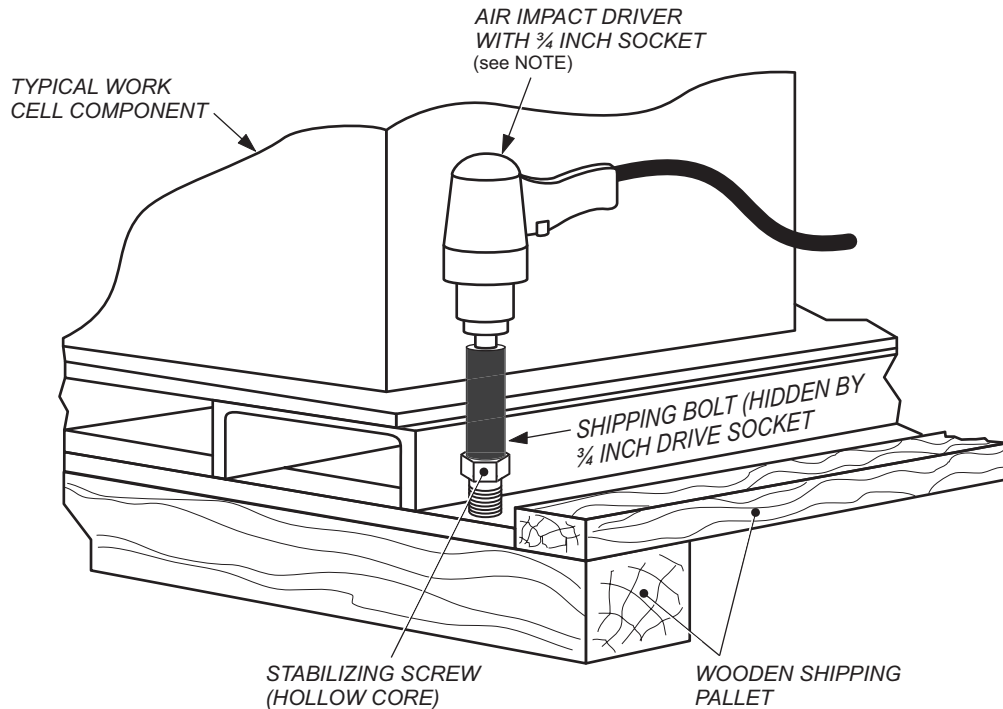
1. Using a 3/4 inch socket and air-impact driver, loosen and remove the bolts that secure the Common Equipment Structure to the wooden shipping skid (see Figure 10).
2. Carefully remove protective plastic, paper, and cardboard packaging materials from the Common Equipment Structure and system components.
3. Discard or recycle the protective packaging materials.
4. Carefully inspect all components for shipping damage.



*Note: If you discover any equipment damage, notify your shipping contractor as soon as possible.*

5. Using two forklifts (one on each end of the Common Equipment Structure), lift the Common Equipment Structure from the shipping skid.
6. Place the Common Equipment Structure in the desired operating location (see Figure 8 and Figure 9).

**NOTE** – An air-powered tool is not required for removal of the shipping bolts, as these fasteners can be removed with ordinary hand tools. However, the air-powered tool does make quick work of the task.



**Figure 10** Typical Shipping Bolt Removal

## 4.4 Common Equipment Structure — Installation



### CAUTION!

Be absolutely certain of the desired location and orientation of the Common Equipment Structure before stabilizing and anchoring the unit.



### WARNING!

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

1. Adjust stabilizing screws (see Figure 2 and Figure 8) as required to stabilize the Common Equipment Structure.



*Note: The Common Equipment Structure does not require levelling. Adjust the stabilizing screws just enough to give the Common Equipment Structure a solid stance on the foundation, with no indication of “rocking” or other instability.*

2. Insert a drill bit through the center of a stabilizing screw on the Common Equipment Structure, and drill a hole into the foundation to accept an anchor bolt (refer to Appendix A for foundation and anchoring suggestions).

3. Repeat the drilling process at each stabilizing screw location (see Figure 2 and Figure 8).
4. Repeat the drilling process at each auxiliary stabilizing location (see Figure 2 and Figure 8).
5. Use compressed air to remove all concrete dust from each drilled hole.
6. 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

All safety fencing materials (including hardware and auxiliary panels) are bundled together and secured to a wooden skid for shipment from the factory.



### CAUTION!

**Be cautious when cutting the metal bands that secure fencing materials to the shipping skid. Always wear protective gloves and safety glasses. The metal bands are under tension and, when cut, can cause injury to anyone near the bands.**

To install the safety fencing, proceed as follows –

1. Cut the bands that secure the fencing materials to the shipping skid.
2. Remove all items from the skid.
3. Place fence components on the floor around the Common Equipment Structure, according to the system prints that are supplied with your ArcWorld®V-1000 system documentation package (refer to Section 1.3).



### WARNING!

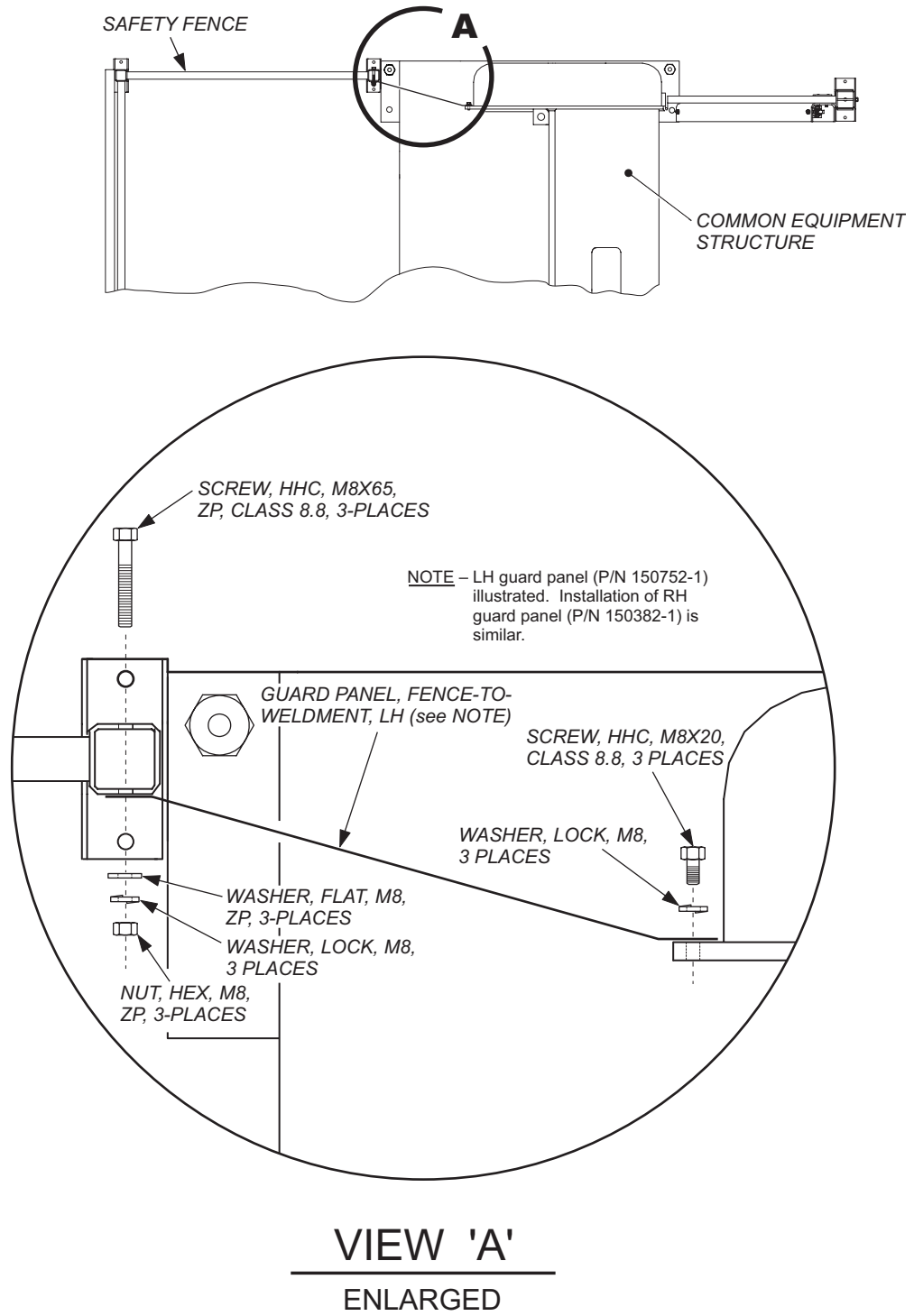
**At least two people are required for safe accomplishment of the remaining fence installation steps.**

4. Connect and tighten fence posts to panels according to fence instructions.
5. Have an assistant hold the fencing in place while you attach each panel.
6. Measure to ensure that the cell walls are square (adjust as necessary).



*Note: Do not install the arc curtains to the fence panels at this time. You will install the arc curtains after the safety fence assembly is attached to the Common Support Structure and anchored to the foundation*

7. Attach the LH and RH Side Guard Panels to the safety fence and the Common Equipment Structure (Figure 1 and Figure 11).
8. Ensure that the final placement of the assembled safety fence conforms to the layout shown in the ArcWorld®V-1000 system prints and fence documentation.
9. Install the work cell sliding door to the safety fencing. Refer to the safety fence documentation that is supplied with your ArcWorld®V-1000 system documentation package (refer to Section 1.3).
10. Anchor the fence posts to the foundation (refer to Appendix A for foundation and anchoring suggestions).



**Figure 11** Installation — Side Guard Panels to Safety Fence and Common Equipment Structure

## 4.6 Arc Curtain Installation

The arc curtains are packaged in an accessories box that is shipped with your ArcWorld®V-1000 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 12).



*Note: The arc curtains are pre-cut to match the work cell fence panels. Each arc curtain bag contains documentation that includes the arc curtain dimensions. If necessary, these dimensions can be used 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 12).

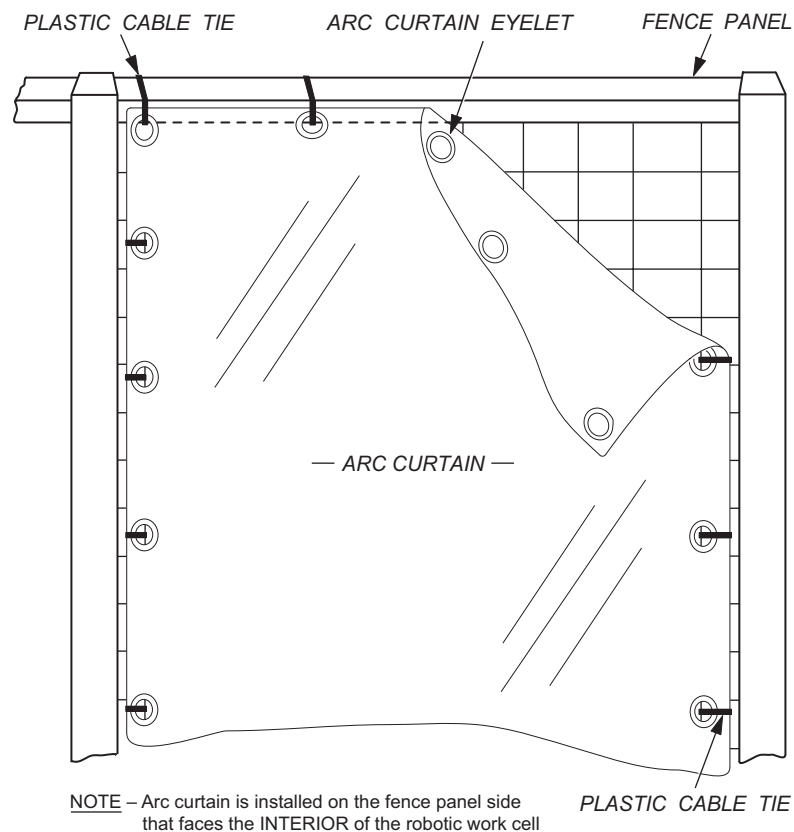


Figure 12 Arc Curtain Installation on Typical Safety Fence Panels



## 4.7 Robot Shipping Bracket Removal



### CAUTION!

Be sure to remove the shipping bracket from the 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 the robot at the factory to prevent undesired movement during shipping (see Figure 13). 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 robot need to be lifted or moved. Upon bracket removal, be sure to keep the bracket and attaching hardware in a safe location, should it be needed in the future.

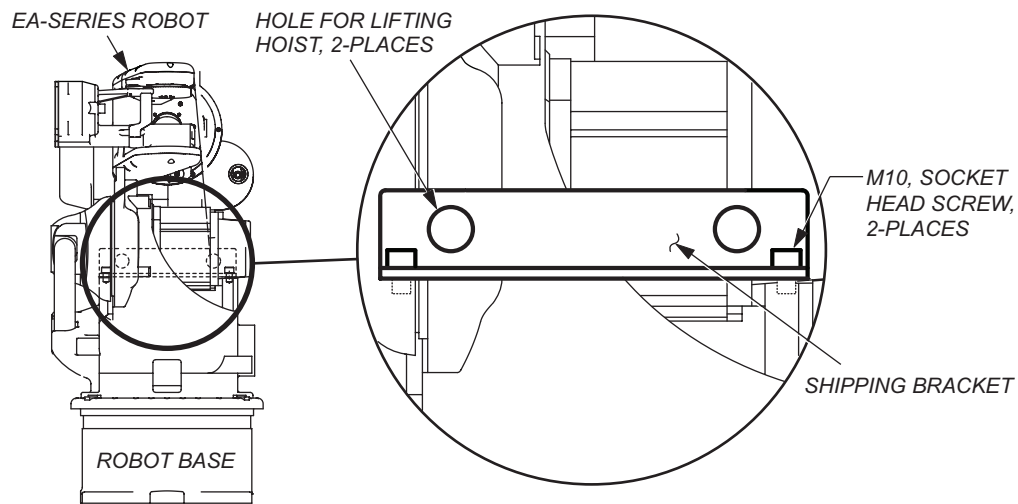


Figure 13 Robot Shipping Bracket

## 4.8 Cable Connections

After the ArcWorld®V-1000 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®V-1000 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® V-1000 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 EA-Series robot 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 (8 ft) 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). Specialized measuring equipment is sometimes 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).*

Connect the robot and NX100 controller to the earth ground as follows –

1. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the connector panel of the robot. Connect the other end of the earth ground wire to the low-resistance earth ground. See Figure 1 for location of robot.
2. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside the NX100 controller. Connect the other end of the earth ground wire to the low-resistance earth ground.

## 4.8.2 Connection to Local Electrical Service



### DANGER!

**Local electrical service connection to the ArcWorld®III-6200 HD/XHD DRC 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® V-1000 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 source (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<sup>®</sup>V-1000 system drawings / schematics that are included with your system documentation package (refer to Section 1.3).

#### 4.8.2.2 Welding Power Source

For detailed electrical service interconnect procedures for the welding power source, refer to the welding power source documentation and ArcWorld<sup>®</sup>V-1000 system drawings / schematics that are included with your system documentation package (refer to Section 1.3).

### 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 –

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 light curtain documentation that is included with the ArcWorld<sup>®</sup>V-1000 system documentation package).
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 source (refer to the welding power source documentation that is included with your ArcWorld<sup>®</sup>V-1000 system documentation package).
6. Verify that local electrical service complies with the power requirements for your ArcWorld<sup>®</sup>V-1000 system.
7. Verify that local electrical service is correctly wired into the NX100 controller and the welding power source (refer to Section 4.8.2).



#### **CAUTION!**

**The ArcWorld<sup>®</sup>V-1000 system is now ready for power-up. Qualified, trained personnel, who are familiar with this system, should perform the power-up sequence.**

8. Set the NX100 power disconnect box to ON (see Figure 1).
9. Set the NX100 POWER ON-OFF switch to ON (see Figure 3).
10. Set the welding power source power disconnect box to ON (see Figure 1).
11. Set the POWER ON-OFF switch on welding power source to ON.



#### **WARNING!**

**Before operating the robot, 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).**

12. Check for correct operation of all E-Stop push buttons (refer to Section 3.7.4).
13. Check for correct operation of the system HOLD button on the Programming Pendant and Operator Station.
14. Check for correct action of the work cell access door safety interlock.
15. Remove power from the ArcWorld®V-1000 system after completion of the safety / operation check.

## 4.10 Installation of Tooling and Fixtures

Your ArcWorld®V-1000 system is now ready for installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the ArcWorld®V-1000 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.*

# NOTES

## Chapter 5

# Operation



### CAUTION!

**The customer is responsible for providing trained operators to run the equipment. The customer is also responsible for making sure that the equipment is operated in accordance with the ANSI/RIA R15.06-1999 Robot Safety standard, as well as any other local or state standards.**

This chapter provides a brief overview of the operating procedures and precautions for your ArcWorld®V-1000 system. For more in depth operating information, refer to specific component manuals that are part of your ArcWorld®V-1000 system documentation package (refer to Section 1.3).

The ArcWorld®V-1000 system is a fully integrated robotic GMAW welding cell.

One EA1400TN (or optional EA1900TN) robot welds parts on one side of the MR-300 reciprocating positioner, while the operator loads the opposite side with parts to be welded. When the robot completes the welding process, it returns to a Home (Safe) position. The operator can then initiate another positioner sweep cycle from the Operator Station. This moves the previously loaded parts into the robot work area, where the robot then moves from the Home (Safe) position to complete another welding cycle.



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

## 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 procedures and information, refer to the NX100 controller documentation that is included with your ArcWorld®V-1000 system (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®V-1000 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®V-1000 system. If you have questions concerning the configuration of your ArcWorld®V-1000 system, please contact Motoman 24 hour Customer Support (refer to Section 1.4).

## 5.2 Sweeping the Positioner



*Note: The robot must be in the Home position before the operator can sweep the positioner.*

Selecting MANUAL mode on the Operator Station POSITIONER AUTO/MANUAL switch allows the operator to sweep the positioner without activating the robot (see Figure 5). Parts can be loaded onto the fixture to achieve the most efficient configuration, and then swept into the welding zone before teaching the robot a series of moves. To sweep Side A or Side B of the positioner into the robot's welding zone, proceed as follows:

1. Place the robot in Home position (refer to Section 5.3.2).
2. Make sure that the Operator Station is enabled (Programming Pendant MODE SELECT SWITCH set to REMOTE).
3. Set the Operator Station POSITIONER AUTO/MANUAL switch to MANUAL and start Master job (refer to Section 5.3.3). Normally, the robot 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 green CYCLE START / CYCLE LATCHED button on Operator Station (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 robot 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 ArcWorld<sup>®</sup>V-1000 work cell from a power-off condition, proceed as follows –

1. If installed, switch the NX100 controller electrical service disconnect box to ON.



*Note: Electrical service disconnect box for the NX100 controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld<sup>®</sup>V-1000 system shipment.*

2. Set POWER ON-OFF switch on NX100 controller to ON (see Figure 3).
3. Switch the welding power source electrical service disconnect box to ON (see Figure 3).

4. Set POWER ON-OFF switch on the welding power source to ON (ON-OFF indicator lamp on the welding power source will illuminate).
5. Open regulator valve on welding gas supply.
6. Make sure that the work cell access door is closed and door safety interlock is engaged.
7. Make sure all E-Stop buttons are released (see Figure 9). E-Stop buttons are installed at the following locations –
  - Programming Pendant
  - NX100 controller door panel
  - Operator Station
8. Select TEACH mode on the Programming Pendant.
9. Place the robot in Home position (refer to Section 5.3.2).

### 5.3.2 Robot Home Position

To move the robot to the Home position –

1. Turn the Programming Pendant MODE SELECT SWITCH to TEACH.
2. Select MAIN MENU on Programming Pendant touch screen.
3. Select JOB on the Programming Pendant touch screen.
4. Select SELECT JOB on Programming Pendant touch screen (a job list appears on the screen).
5. Use the Programming Pendant 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 grasping and holding the Programming Pendant ENABLE switch in the middle position (see Figure 7), then pressing the SERVO ON button on the Programming Pendant.
7. Use the FWD button on Programming Pendant to jog the robot to HOME position.

### 5.3.3 Master Job

To call up the Master Job –

1. Ensure that the ArcWorld®V-1000 system is powered (refer to Section 5.3.1).
2. Set the Programming Pendant MODE SELECT SWITCH to TEACH.
  1. Select JOB on Programming Pendant touch screen.
  2. Select CTRL MASTER on Programming Pendant touch screen. Press SELECT twice to activate the Master job.
  3. Set the Programming Pendant MODE SELECT SWITCH to PLAY, then press the PLAY MODE ENABLE SWITCH (located on the NX100 controller door). See Figure 3 for location of the PLAY ENABLE button on the NX100 controller door.
  4. Press SERVO ON button on the Programming Pendant.
  5. Press the START push button on Programming Pendant (the Master job cycles, waiting for a CYCLE START input from Operator Station).
  6. Transfer control to the Operator Station by rotating the Programming Pendant MODE SELECT SWITCH to REMOTE.

The ArcWorld®V-1000 work cell is now ready for operation.



### 5.3.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld<sup>®</sup>V-1000 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.
3. Operator presses the green CYCLE START button on Operator Station. The positioner sweeps, thus placing parts to be welded into the robot work area. The robot then begins to weld the parts (if the Operator Station POSITIONER AUTO/MANUAL switch is set to AUTO).
4. While the robot is 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 and presses the green CYCLE START button (CYCLE LATCHED light illuminates). When the robot completes the welding process, it 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 positioner and unloads completed, welded parts.

### 5.3.5 Shutdown

Use the following procedure to perform a normal shut down of the ArcWorld<sup>®</sup>V-1000 system –

1. Make sure the robot is in Home position.
2. Turn off system servo power by pressing the E-Stop button on Operator Station or Programming Pendant.
3. Select TEACH mode on the Programming Pendant.
4. Set NX100 controller POWER ON-OFF switch to OFF (see Figure 3).
5. Set the welding power source POWER ON-OFF switch to OFF.
6. Close regulator valve on welding gas supply.
7. Switch NX100 controller disconnect box (if installed) to OFF.



*Note: Electrical service disconnect box for the NX100 controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld<sup>®</sup>V-1000 system shipment.*

8. Switch welding power source disconnect box to OFF (see Figure 3).

The ArcWorld<sup>®</sup>V-1000 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

For more detailed information on alarm and error recovery, refer to the NX100 controller and EA-Series robot documentation that is included with your ArcWorld®V-1000 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 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 in accordance with the following steps –

1. Rotate the NX100 POWER ON-OFF switch to OFF.
2. Allow the NX100 POWER ON-OFF switch to remain in the OFF position for approximately 10 seconds.
3. Rotate the NX100 POWER ON-OFF switch to ON.

## 5.4.2 E-Stop Recovery

An E-Stop (emergency stop) condition is triggered by any of the following conditions –

- An E-Stop switch is pushed in (activated)
- The work cell access door is opened while the robot is not in TEACH mode
- The safety light curtain system is triggered while the positioner is sweeping
- A welding torch collision triggers a shock sensor output (refer to Section 5.4.3)

If an E-Stop condition is triggered, restart the ArcWorld®V-1000 system as follows –



### CAUTION!

**If an E-Stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the ArcWorld®V-1000 system is restarted.**

1. Press the SERVO ON button on the Programming Pendant.
2. Select REMOTE mode on the Programming Pendant MODE SELECT SWITCH to transfer control of the system to the Operator Station.
3. Press the green START button on the Operator Station.

The ArcWorld®V-1000 system is now ready to continue operation.

## 5.4.3 Shock Sensor Recovery

The ArcWorld®V-1000 welding package includes a Motoman gun mount. This mount is designed to protect the torch from damage in case of an impact (collision). A slight deflection of the torch activates a SHOCK SENSOR signal that triggers a system E-Stop condition. To clear the E-Stop condition, you must override the shock sensor and move the robot clear of the impact.

Refer to Figure 4 and the following procedures to override the shock sensor –



### CAUTION!

**Always remember to reactivate the Shock Sensor before continuing system operation. The robot can be damaged if the Shock Sensor Override Switch is left in the “Override” position.**

1. Press MAIN MENU on the Programming Pendant.
2. Use the Programming Pendant CURSOR KEY to select the ROBOT icon, then press SELECT.
3. Use the Programming Pendant CURSOR KEY to select OVERRUN-S.SENSOR, then press the SELECT key.
4. Select RELEASE to release the shock sensor.
5. Turn servo power ON (depress and hold the Programming Pendant ENABLE switch while pressing the SERVO ON / READY push button).
6. Move manipulator clear of impact position.

The ArcWorld®V-1000 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. While pressing in on the pendant ENABLE switch, hold down the INTERLOCK key plus the SELECT key.
6. The brake for the selected axis will release.

The brake for the selected robot axis releases.

# NOTES

## Chapter 6

# Maintenance

Maintenance of the ArcWorld®V-1000 system and components must be performed by authorized personnel who are familiar with the ArcWorld®V-1000 system. Be sure to read and understand the documentation for a particular component before doing actual 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®V-1000 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

FREQUENCY	COMPONENT	PROCEDURE
Daily (or on condition)	Water Circulators (water-cooled torch application, only)	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.
	All safeguard items – work cell door interlocks, E-Stop push buttons, safety light curtains, arc curtains, etc.	Check physical condition of safeguard item and ensure that the safeguard item is working correctly
Monthly (or on condition)	ArcWorld® V-1000 work cell	Remove accumulated dirt, grease, and debris from inside and outside the work cell.
Every 6 months (or on condition)	Robot base (at mounting location on Common Equipment Structure)	Check robot mounting hardware for integrity and correct torque –190 N·m (140 lbf·ft).

# 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

SYSTEM EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIAMETER AND TYPE	MINIMUM FLOOR PLATE	MINIMUM FOUNDATION
ROBOTS UP6, UP20 UP20-6	5/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6)	600 mm (24 in) Length 600 mm (24 in) Width 38.1 mm (1.5 in) Thick	762 mm (30 in) Length 762 mm (30 in) Width 178 mm (7 in) Thick 4000 psi Reinforced Concrete
ROBOTS UP20M, UP50 SP80 (Note 2)	7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6)	900 mm (35 in) Length 900 mm (35 in) Width 50.8 mm (2 in) Thick	1524 mm (60 in) Length 1524 mm (60 in) Width 229 mm (9 in) Thick 4000 psi Reinforced Concrete
ROBOTS UP120,UP130 UP165,SP100 SP160,SP250 SP400 (Note 2)	7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6)	1200 mm (47 in) Length 1200 mm (47 in) Width 50.8 mm (2 in) Thick	1828 mm (72 in) Length 1828 mm (72 in) Width 229 mm (9 in) Thick 4000 psi Reinforced Concrete
ROBOTS UP200	7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6)	1200 mm (47 in) Length 1200 mm (47 in) Width 50.8 mm (2 in) Thick	1828 mm (72 in) Length 1828 mm (72 in) Width 229 mm (9 in) Thick 4000 psi Reinforced Concrete
ROBOTS UP350, UP500, SK300X	7/8" HVA Chemical Anchor (Note 3) (Note 5) (Note 6)	1500 mm (59 in) Length 1500 mm (59 in) Width 50.8 mm (2 in) Thick	1828 mm (72 in) Length 1828 mm (72 in) Width 229 mm (9 in) Thick 4000 psi Reinforced Concrete



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

SYSTEM EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIAMETER AND TYPE	MINIMUM FLOOR PLATE	MINIMUM FOUNDATION
<u>COMMON EQUIPMENT STRUCTURE</u> (see Figure 2)	5/8" HVA Chemical Anchor (Note 3) (Note 6)	Not Applicable	3" min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete
<u>PERIPHERAL EQUIPMENT</u>	1/2" Kwik Bolt II Expansion Anchor (Note 4) (Note 6)	Not Applicable	3" min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete
<u>WORK CELL FENCE POSTS</u>	3/8" Kwik Bolt II Expansion Anchor (Note 4) (Note 6)	Not Applicable	3" min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete
<p><b>NOTES –</b></p> <p>(1) Minimum robot lagging requirements are based on <u>maximum repulsion forces</u> and <i>Hilti® Anchor Design Program</i> (v3.3b).</p> <p>(2) SP series robots require base plates and/or risers to be level to <math>\pm 2^\circ</math>. Grout if necessary.</p> <p>(3) Reference source: <i>Hilti® Product Technical Guide</i> (section 4.2.1) for hardware specifications or equivalent.</p> <p>(4) Reference source: <i>Hilti® Product Technical Guide</i> (section 4.3.3) for hardware specifications or equivalent.</p> <p>(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.</p> <p>(6) Refer to <i>Hilti® Product Technical Guide</i> for suggestions on the correct size and type of drill bit to use with each anchor type.</p> <p> Contact Information –</p> <p>1-800-879-8000 (USA)      <a href="http://us.hilti.com">http://us.hilti.com</a></p> <p>1-800-363-4458 (CAN)      <a href="http://ca.hilti.com">http://ca.hilti.com</a></p>			

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