

Motoman NX100 Controller

ArcWorld[®] II-6000 System Manual

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Chapter 1

Introduction

1.1 About This Document

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

This System Manual contains the following chapters:

CHAPTER 1 – INTRODUCTION

This chapter provides general information about the ArcWorld®II-6000 and its components, a list of reference documents, and information on how you can contact Motoman Customer Support.

CHAPTER 2 – SAFETY

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

CHAPTER 3 – DESCRIPTION OF EQUIPMENT

This chapter provides a description of the major components of the ArcWorld®II-6000 system.

CHAPTER 4 – INSTALLATION

This chapter provides instructions for installation of ArcWorld®II-6000 system components.

CHAPTER 5 – OPERATION

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

CHAPTER 6 – MAINTENANCE

This chapter provides a listing of preventive maintenance requirements for certain components of the ArcWorld®II-6000 system.

APPENDIX A – ANCHORING

Appendix A gives foundation and anchoring suggestions for components of the ArcWorld®II-6000 system.

1.2 System Overview

The ArcWorld® II-6000 system provides a complete arc welding solution in a standardized configuration. The system is designed around one Motoman EA-Series six-axis arc welding robot, one NX100 controller, one RM2-250 STX positioner, and a complete welding package. The RM2-250 STX is an AC servo-driven headstock/tailstock (HS/TX) positioner that allows an operator to prepare and set up parts on one side of the positioner, while the robot welds previously loaded parts on the other side of the positioner. Control of an external axis is provided by a kit installed in the cabinet of the NX-100 controller.

The ArcWorld® II-6000 system features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06-1999 standard, and is designed to safeguard both personnel and equipment.

Figure 1 illustrates the layout and component location for the ArcWorld® II-6000 system.

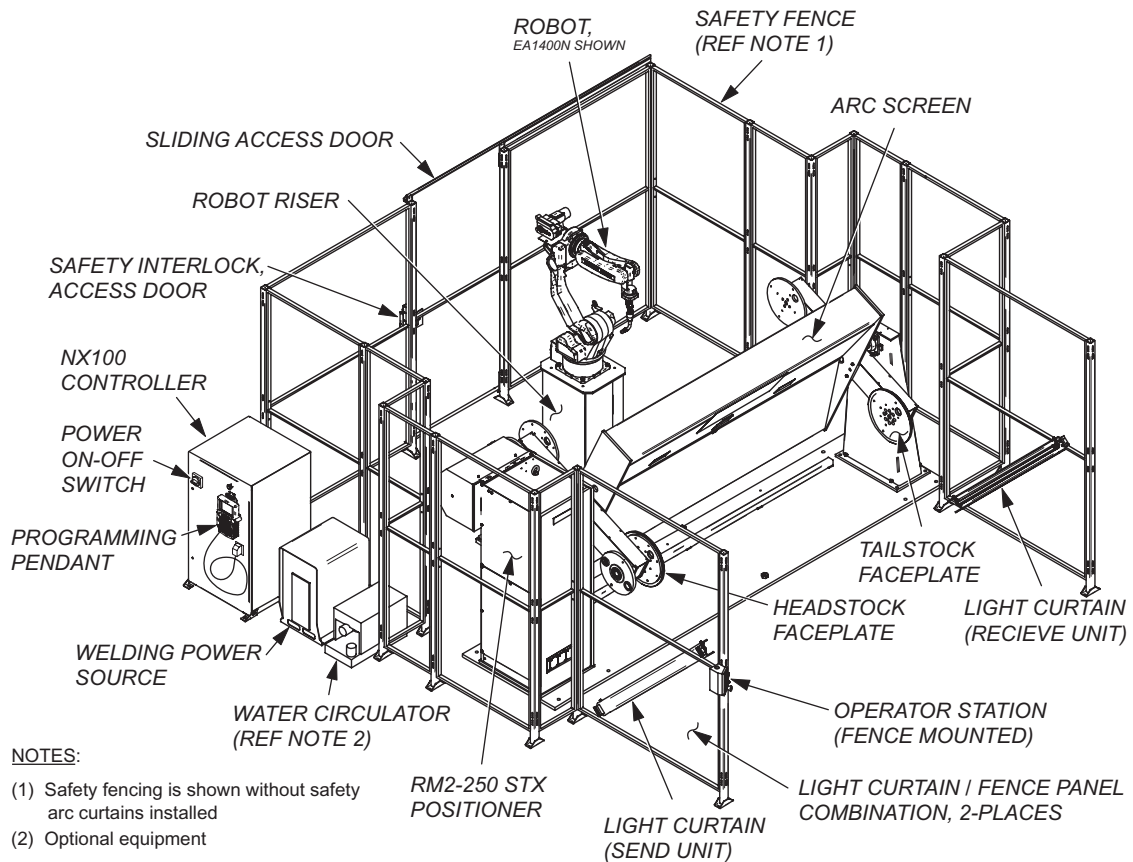


Figure 1 Overview and Component Location – ArcWorld® II-6000 System



Note: This manual is for a standard Motoman system. If your system is custom or modified, please use the drawings and Bill of Material (BOM) provided with your system documentation package for troubleshooting and spare parts provisioning.

1.2.1 System Layout

All components of the ArcWorld®II-6000 work cell are mounted individually to the floor. This system does not use common equipment bases. Heavy-gauge, wire mesh safety fencing is installed at the customer's site to completely surround the work cell. One safety-interlocked access door at the rear of the work cell is part of the safety fencing, and provides access to the work cell for programming and maintenance personnel. Both the NX100 controller and the welding power source are located outside of and to the side of the work cell. All system controls, including those on the Programming Pendant, NX100 controller, welding power supply, and Operator Station are safely accessible from outside the ArcWorld®II-6000 work cell.

1.2.2 Major Components

The ArcWorld®II-6000 system includes the following major components:

- One Motoman EA1400N or EA1900N arc welding robot
- One NX100 controller (with external axis kit installed)
- One RM2-250 STX positioner
- One Programming Pendant (located on the NX100 controller)
- One fence-mounted Operator Station (see Figure 1 for location)
- Welding equipment:
 - Welding power supply
 - Welding torch (air-cooled – standard; water-cooled – optional)
 - Wire feeder
 - Applicable welding interface
 - Torch mount
- Safety equipment:
 - Heavy gauge, wire-mesh safety fencing
 - Heavy gauge (14 mil) arc curtains (cover the safety fencing)
 - Dual-channel, interlocked safety light curtain system
 - Dual-channel, interlocked work cell entry door
 - Integral arc screen on the RM2-250 STX positioner

1.2.3 Optional Equipment

The following optional equipment is available for use with the ArcWorld®II-6000 system:

- Torch tender (cleaner)
- Wire cutter
- Water circulator (for water-cooled torch unit)
- TouchSense™ starting point detection unit
- ComArc™ seam-tracker

1.3 Reference Documentation

For additional information on individual components of the ArcWorld®II-6000 system, refer to the following documentation that is included with your delivered 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 Parameter Manual* (P/N 149230-1)
- Motoman *NX100 Independent/Coordinated Control Function Manual* (P/N 149648-1)
- Motoman *RM2-250 STX Positioner Manual* (P/N 148911-1)
- Motoman *INFORM User's Manual* (P/N 150078-1)
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Support Information

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

937.847.3200

Please have the following information ready before you call:

- System (ArcWorld®II-6000, NX-Series)
- Robot (EA1400N or EA1900N)
- Controller Type (NX100 with External Axis)
- Positioner Type (RM2-250 STX)
- Primary Application (welding)
- 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)
- Warranty ID Code (located on back of the Programming Pendant)

Chapter 2

Safety

2.1 Introduction

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

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

Robotic Industries Association

900 Victors Way

P.O. Box 3724

Ann Arbor, Michigan 48106

TEL: (734) 994-6088

FAX: (734) 994-3338

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 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 (E-STOP) palm buttons located on Operator Station, robot controller, and Programming Pendant

Check all safety equipment frequently for proper operation. Immediately repair or replace any non-functioning safety equipment.

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 EA-Series Robot

The ArcWorld®II-6000 system uses the Motoman EA1400N or EA1900N robot (depending upon customer order). Both robot types feature 6-axes of motion. Both robot types are specifically designed for arc welding applications.

Each robot has a payload capability of 3 kg (6.6 lbs.). The EA1400N robot features a horizontal reach of 1390 mm (54.7 inches) The EA1900N robot features a horizontal reach of 1904 mm (75 inches). Each robot features a relative positioning accuracy of ± 0.08 mm (± 0.003 inch).

The EA-series robots 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 access into 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 an expanded range of motion that improves 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 ± 360 degrees without cable interference or cable stress. Robot S-axis (Turning) hard stops provide a fail-safe limit to maximum robot travel.

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®II-6000 system documentation (refer to Section 1.3).

3.2 NX100 Controller

The ArcWorld®II-6000 system includes one NX100 controller (see Figure 2). The NX100 controller features a Programming Pendant that provides an interface with the ArcWorld®II-6000 system to operation, programming, and maintenance personnel (refer to Section 3.3).

In addition to controlling the movement of the robot, the NX100 also controls the welding power source, the RM2-250 STX positioner, and provides the signals necessary to operate the welding systems.

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® II-6000 system documentation (refer to Section 1.3).

For more detailed information on the NX100 controller, refer to the *NX100 Controller Manual* that is included with your ArcWorld® II-6000 system documentation (refer to Section 1.3).

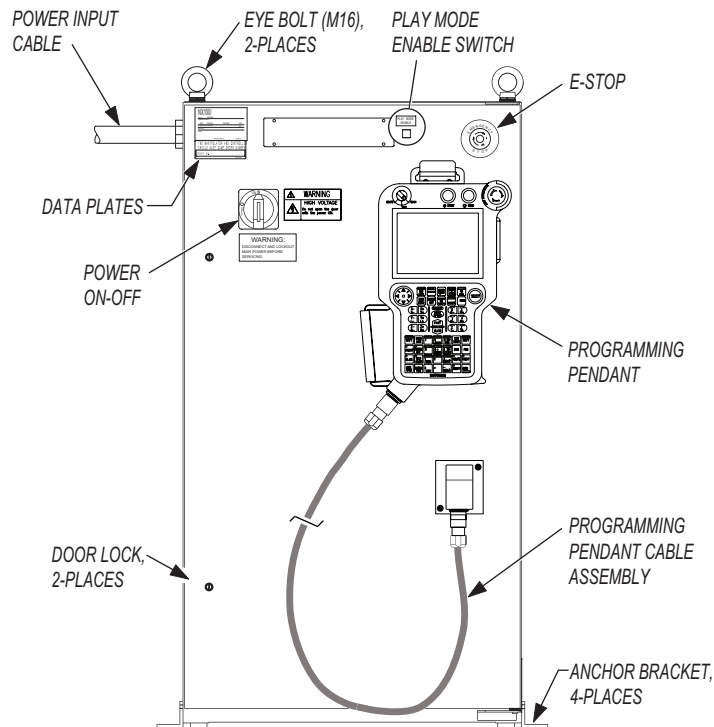




Figure 2 NX100 Controller

3.3 Programming Pendant

The Programming Pendant (see Figure 3) provides the primary means of interface with the ArcWorld® II-6000 system for programming, operation, and maintenance personnel. The pendant features the Windows® CE operating system, and displays information on a 6½ -inch color LCD touch-screen display (640 X 480 VGA). The pendant also incorporates a Compact Flash card slot for program and data backups. The pendant provides icon-driven system programming. It also features a menu-driven interface to simplify operator interaction with the ArcWorld® II-6000 system. Most operator controls are located on the pendant. This allows the NX100 controller cabinet to be mounted remotely. With the pendant, the operator can teach robot motion; perform programming, editing, maintenance, and diagnostic functions; and enable/disable Operator Station control of the ArcWorld® II-6000 system.

For detailed information on the Programming Pendant functions and displays, please refer to the *NX100 Operator's Manual for Arc Welding* that is included with your ArcWorld®II-6000 system documentation (refer to Section 1.3).

 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 “enable” or “disable” is accomplished with the Programming Pendant MODE SELECT SWITCH. To transfer control of the ArcWorld®II-6000 system to the Operator Station, set the Programming Pendant MODE SELECT SWITCH to REMOTE. Control of the ArcWorld®II-6000 system cannot be enabled or disabled at the Operator Station.

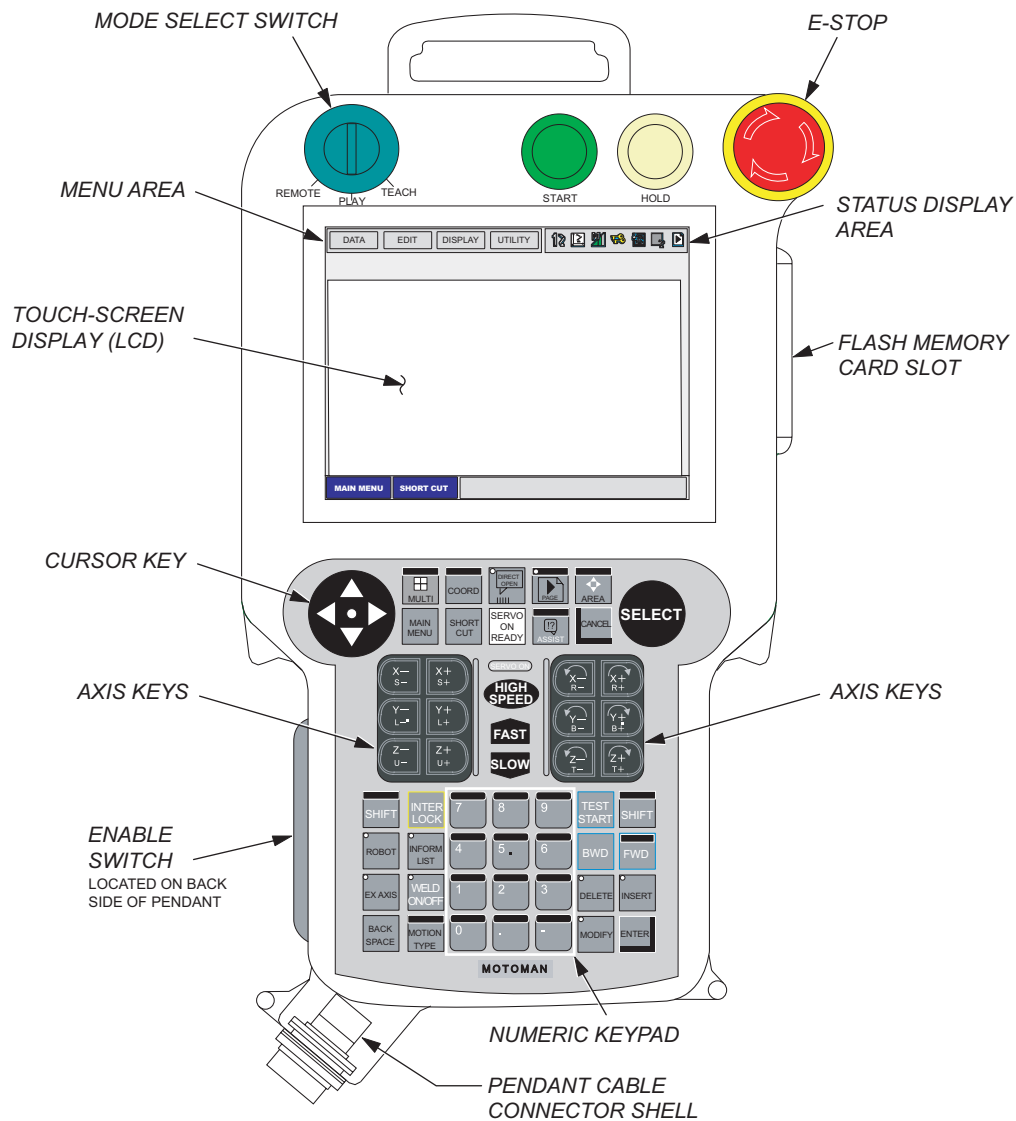


Figure 3 NX100 Programming Pendant

3.4 Operator Station

The Operator Station (see Figure 4) is packaged in a NEMA enclosure that is mounted on a safety light curtain fence panel (see Figure 1).

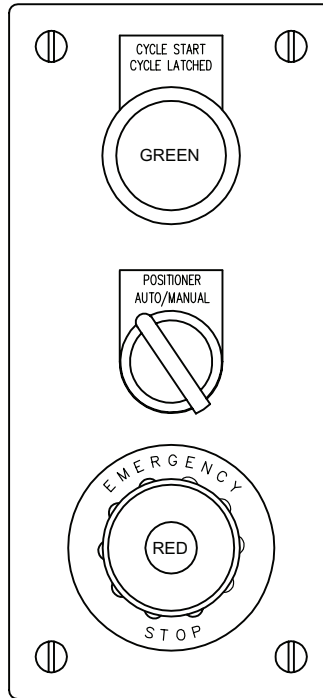


Figure 4 Operator Station Controls

3.4.1 Operator Station 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.

The green **CYCLE START/CYCLE LATCHED** button, located on the Operator Station, initiates a positioner sweep if the robot is in Home position. If the **CYCLE START** button is pressed while the robot is **NOT** in Home position, the **CYCLE START** command does not execute, and the positioner does not sweep until the robot returns to Home position.

The green **CYCLE LATCHED** lamp illuminates when the **CYCLE START** button is pressed during operation. When the lamp is illuminated, the positioner will sweep. The robot will begin to weld immediately after the current weld cycle is complete, and the robot has returned to the Home position. It is not necessary to wait for the robot to finish welding and return to Home position before pressing the **CYCLE START** button to operate the positioner. Pressing the **CYCLE START** button, while the robot is still in motion, latches the **CYCLE START** command into the controller. If a person or object enters the safety zone created by the safety light curtain system, the **CYCLE START** command will

unlatch and the positioner will not sweep. A pulse instruction prevents the operator from holding the button down to continuously cycle the positioner.

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

Pressing an E-STOP button stops all system operation. The Operator Station E-STOP circuitry is connected to the Emergency Stop circuitry in the NX100 controller. Upon activation of the E-STOP button, brakes are applied to the robot and all servo power is removed from the system. The system E-STOP lights illuminate and all positioner motion stops.

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 RM2-250 STX Positioner

The Motoman RM2-250 STX is an AC servo-driven headstock/tailstock (HS/TS) positioner. This type of positioner is often referred to as a “Ferris wheel” positioner because of the operational dynamics of the positioner.

All of the RM2-series positioners are 3-axes. However, since the RM2-250 STX uses only a single servo motor, only one of the three axes can be driven at any time.

A fixture frame is typically mounted between the headstock and tailstock face plates (see Figure 1). Fixtures are either mounted on, or integrated into, these frames for positioning and clamping of production parts. Pneumatic and electrical signals can be routed to the fixtures, if required.

The RM2-250 STX positioner has a load capacity of 250 kg (551 lbs) per side, a 1,170 mm (46 in) maximum part diameter, and a “Side A to Side B Sweep Time” of 2 seconds. The standard distance between the headstock/tailstock face plates is 2600 mm (102 in.) with 1600 mm (63 in) available as an option (see Figure 6). Positioning accuracy for the RM2-250 STX is ± 0.1 mm (± 0.004 in).

The RM2-250 STX positioner is capable of synchronized motion between various components depending on the job configuration. Synchronized components move at the same time during welding operations. The robot can be synchronized with the RM2-250 STX positioner. The RM2-250 STX positioner is also capable of true coordinated motion, where linear, circular, or spline motion can be coordinated between the robot and the positioner. Coordinated motion allows the robot to weld while the positioner rotates the parts.

The RM2-250 STX positioner is equipped with fixture locking pins that prevent the headstock and tailstock face plates from turning when the servo motor disengages. The fixture locking pins are spring-loaded, to ensure pin engagement when the servo motor retracts. Each headstock face plate incorporates two locking pins.

For additional information on coordinated motion, refer to the *NX100 Independent/Coordinated Control Function Manual* included with your ArcWorld® II-6000 system documentation (refer to Section 1.3).

For detailed positioner information, including illustrated parts lists, load capabilities, and dimensions, refer to the *RM2-250 STX Positioner Manual* that is included with your ArcWorld® II-6000 system documentation (refer to Section 1.3).



Note: The customer shall supply all tooling and fixtures for the RM2-250 STX 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 its standard configuration, the ArcWorld® II-6000 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, and a torch tender (cleaner) – may also be included with your ArcWorld® II-6000 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® II-6000 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® II-6000 system documentation (refer to Section 1.3).

3.6.2 Wire Feeder

A welding wire feeder is mounted on the upper arm (U-Axis) of the robot. The wire feeder is the “4-roll” type and provides reliable wire feeding at rates up to 750 inches per minute (ipm). An integral gas valve provides fast shielding gas response time. 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® II-6000 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®II-6000 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 5.4.2 and Section 5.4.3). 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®II-6000 system (refer to Section 1.3).

3.7 Safety Features

The ArcWorld®II-6000 system includes a total safety environment that complies with the ANSI/RIA R15.06-1999 safety standard.



Note: Users are responsible for determining that the safeguards provided with the ArcWorld®II-6000 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®II-6000 system –

- a steel arc screen that is an integral part of the RM2-250 STX positioner
- heavy gauge (14 mil) arc curtains that cover the steel mesh safety fencing

The positioner's integral steel arc screen 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 welding arc without protective eye wear.

Heavy gauge (14 mil) arc curtains can be attached to the steel mesh safety fencing that surrounds the entire work cell. The curtains provide protection from arc flash and reduce the amount of ultra-violet radiation that escapes from the work cell during welding operations.

3.7.2 Safety Fencing

The heavy-gauge steel mesh safety fencing provided with the ArcWorld®II-6000 system encloses the entire robotic work cell. It forms a physical barrier that prevents the unintentional movement of personnel or objects into the work cell during automatic operation. A safety 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 RM2-250 STX 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 5.4.2). The safety light curtain system incorporates a dual-channel safety feature that provides redundant operation to ensure a continuous field of coverage for the protected area in front of the positioner.

For additional information on the safety light curtain system, refer to the vendor documentation that is included with your ArcWorld®II-6000 system documentation (refer to Section 1.3).

3.7.4 Emergency Stops (E-STOPS)

The ArcWorld®II-6000 system incorporates large, red, E-STOP push button switches, that are placed in accessible locations. When any E-STOP push button is activated (pushed in), an E-STOP condition is created that immediately stops all system operation, activates the robot braking system, and disables all system servo power.

E-STOP push button switches are found at the following locations:

- The door of the NX100 controller
- The Programming Pendant
- The Operator Station

3.7.5 Programming Pendant ENABLE Switch

The ENABLE switch is part of the Programming Pendant, and provides a safety feature that controls servo power while the system is in TEACH mode (see Figure 3 and Figure 5). When pressed in, this switch allows the operator to enable servo power. However, should the operator release the switch or grasp it too tightly, servo power 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®II-6000 system documentation (refer to Section 1.3).

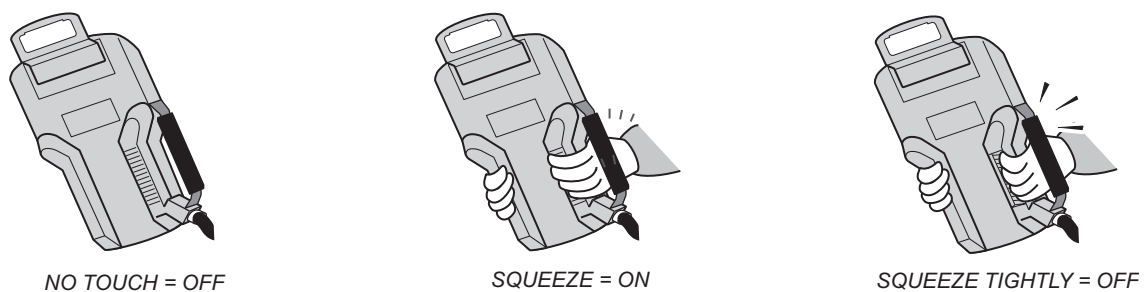


Figure 5 Programming Pendant ENABLE Switch – Location and Operation

3.7.6 Robot Braking System

The 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 redundant circuit safety interlock is installed on the sliding work cell access door (see Figure 1). If the work cell door is opened while the robot is in PLAY mode, all servo power is removed from the ArcWorld®II-6000 system, and robot brakes are applied to hold robot axes in place.

NOTES

Chapter 4

Installation



CAUTION!

Assign ArcWorld®II-6000 system installation to qualified technicians who are familiar with the installation and set-up of a robotic system.



CAUTION!

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

The ArcWorld®II-6000 system can be installed in a short amount of time by two or three qualified technicians. 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®II-6000 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 for foundation and anchoring suggestions).

4.1.1 Customer-Supplied Items

- Shielding gas for the welding torch
- Wire for connection of system components to the low-resistance earth ground
- Ground rods and/or buried copper sheeting (quantity and type 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 (15 scfm @ 90 psig) for torch tender or wire cutter options
- Stepladder
- 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 (large and small)
- 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 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 needed for the ArcWorld[®] II-6000 system (see Figure 6). Allow an additional 1.2 - 1.5 m (4 to 5 ft) on all sides of the work cell to provide the room needed for installation.
2. Gather all customer-supplied items and required tools (refer to Section 4.1).

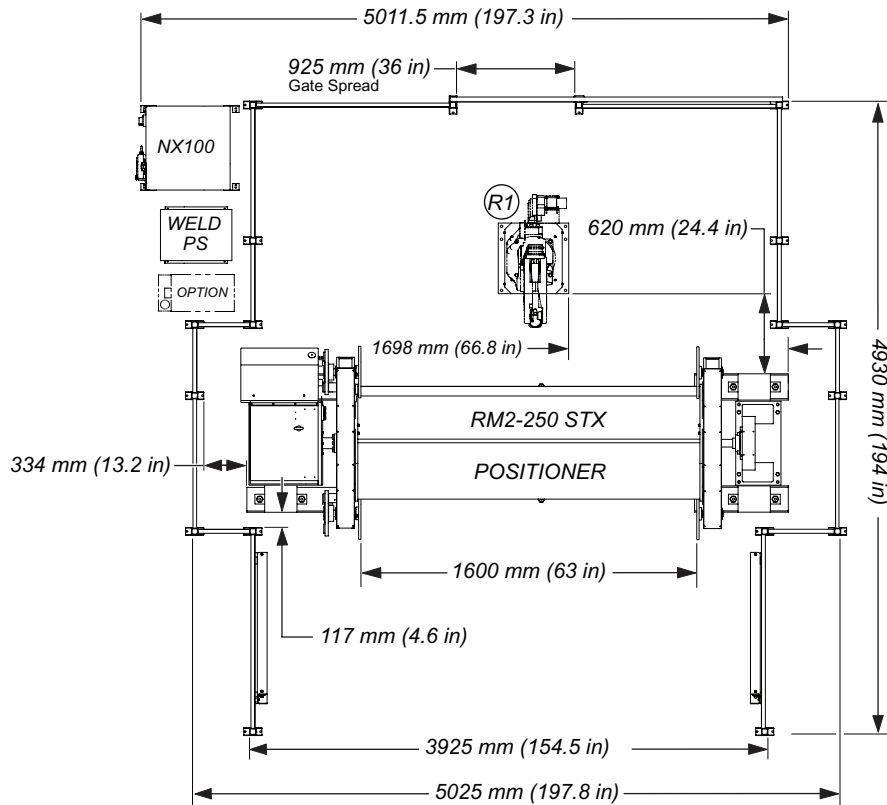


Figure 6 Installation Dimensions for the ArcWorld[®] II-6000 System

4.3 Removal of System Components from Shipping Skids

System components are attached to shipping skids at the factory, prior to shipment to the customer. The customer is responsible for removing the components from the skids and inspecting the components for shipping damage.



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

1. Unbolt each component from its shipping skid using a $\frac{3}{4}$ -inch socket (see Figure 7).
2. Use forklift or overhead crane to lift each component away from its shipping skid.
3. Discard or recycle the shipping skids.

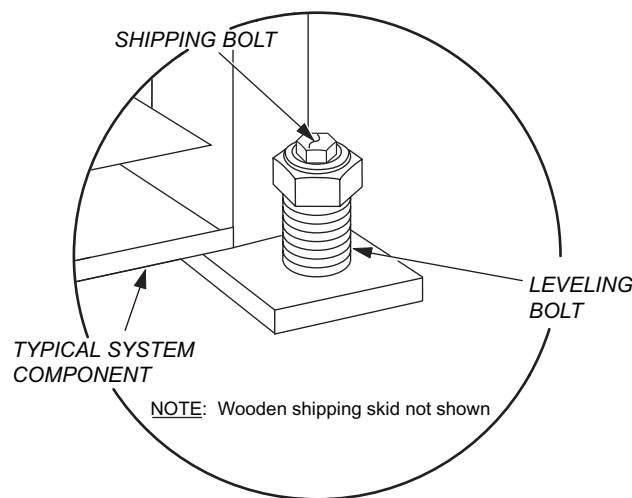


Figure 7 Typical Shipping Bolt Removal

4.4 Component Installation

To make sure the ArcWorld®II-6000 work cell is complete and to verify the correct amount of floor space for the installation, Motoman recommends that all system components (except the safety arc curtains) be set in place prior to anchoring the components to the foundation. See Figure 6 and the system drawings (supplied with your ArcWorld®II-6000 system) to correctly place system components.



Note: The safety arc curtains are attached to the work cell fence panels after the fencing has been assembled and anchored to the foundation (refer to Section 4.4.3).

4.4.1 Place System Components

Before permanently anchoring the cell components to the floor, set all pieces in place in the following order:

1. Place the RM2-250 STX positioner to define the front of the cell (see Figure 6).
2. Place the robot (with riser) in the specified location relative to the positioner (see Figure 6).

3. Assemble and place the safety fencing around the work cell (see Figure 6 and refer to fence installation documentation that is supplied with the ArcWorld®II-6000 system).



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

4. Ensure that the final placement of the assembled safety fence conforms to the placement dimensions shown in Figure 6.
5. Install the work cell sliding door (refer to Figure 6 and the safety fencing documentation that is supplied with the ArcWorld®II-6000 system).
6. 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).



Note: The light curtain components – the send unit and receive unit – are each pre-attached to a safety fence panel at the factory (see Figure 1).

7. Place the NX100 controller and welding power source (see Figure 6 and the ArcWorld®II-6000 system drawings for the correct location for these components).



Note: Do not place the NX100 controller or welding power source any closer than 152.4 mm (6 in) to the work cell safety fencing.

4.4.2 Level and Secure System Components

When all ArcWorld®II-6000 system components are in correct position, proceed with the following steps in this section to level system components (if required) and anchor them to the foundation (refer to Appendix A for foundation and anchoring suggestions).



CAUTION!

Be absolutely certain of the correct location for each ArcWorld®II-6000 system component before anchoring it to the foundation.



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.

1. If required, level a system component by adjusting levelling bolts (see Figure 8).



Note: Refer to the RM2-250 STX Positioner Manual for detailed levelling information for the positioner (refer to Section 1.3).

2. After positioning and levelling (if required) a system component, insert a drill bit through the center of each levelling bolt for that component and drill a hole into the foundation to accept an anchor bolt (refer to Appendix A for foundation and anchoring suggestions)

3. Use compressed air to remove all concrete dust from each drilled hole.
4. Anchor the system component to the foundation with suitable anchor bolts (refer to Appendix A for foundation and anchoring suggestions).
5. Repeat all steps in this section for each system component that requires anchoring to the foundation.

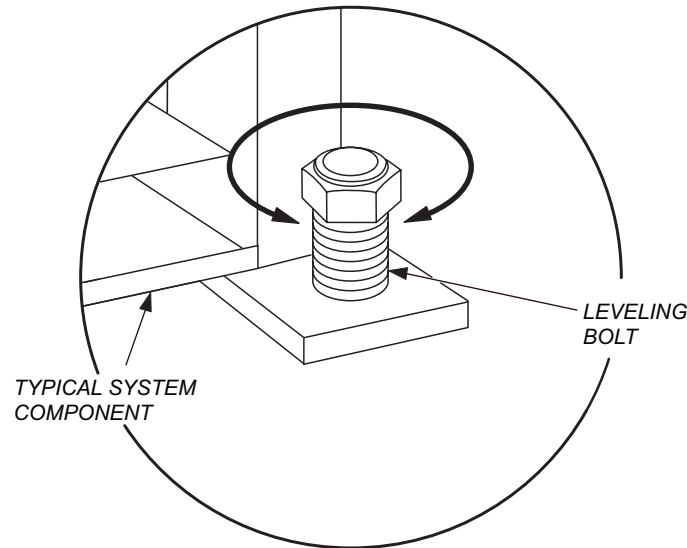


Figure 8 Typical Levelling Bolt

4.4.3 Attach Arc Curtains to Work Cell Fence Panels

The arc curtains are packaged in an accessories box that is shipped with your ArcWorld®II-6000 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 9 and Figure 10).



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 wire ties and the eyelets in the arc curtain (see Figure 9 and Figure 10).

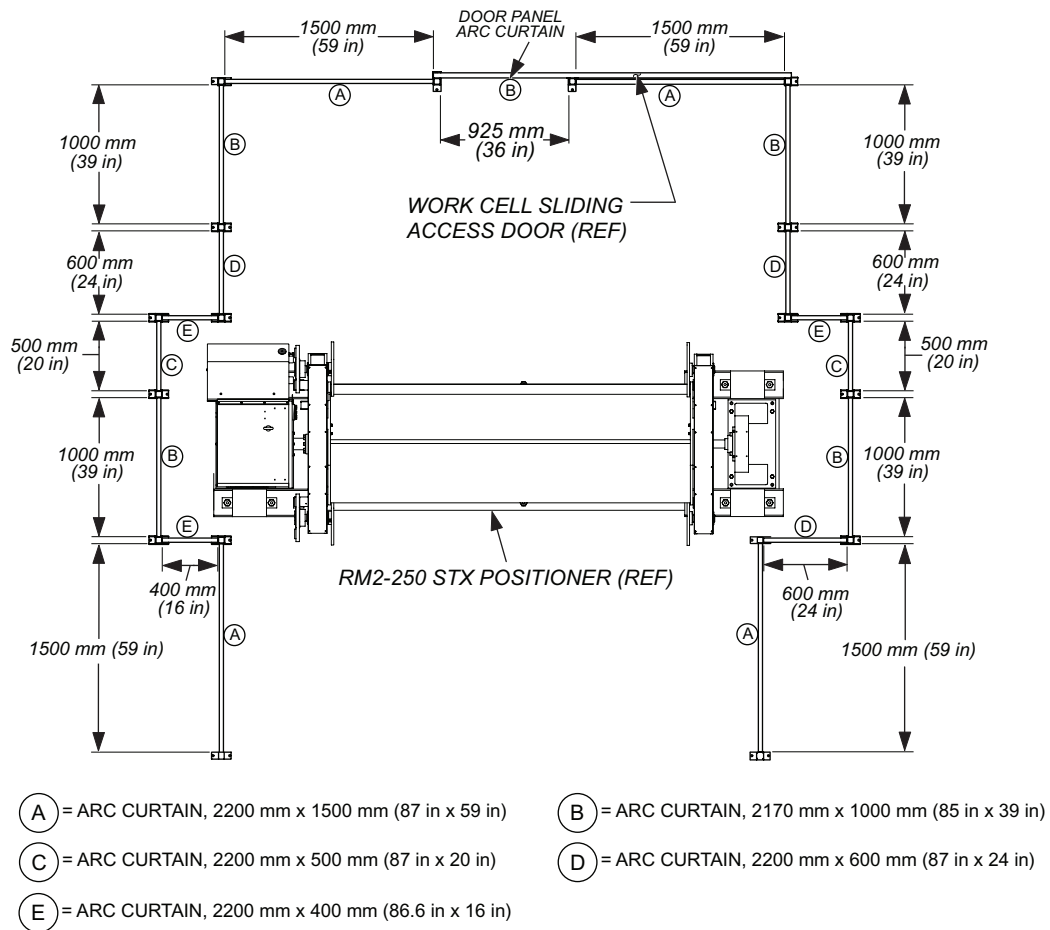


Figure 9 Safety Fence Panel Dimensions and Arc Curtain Installation Locations

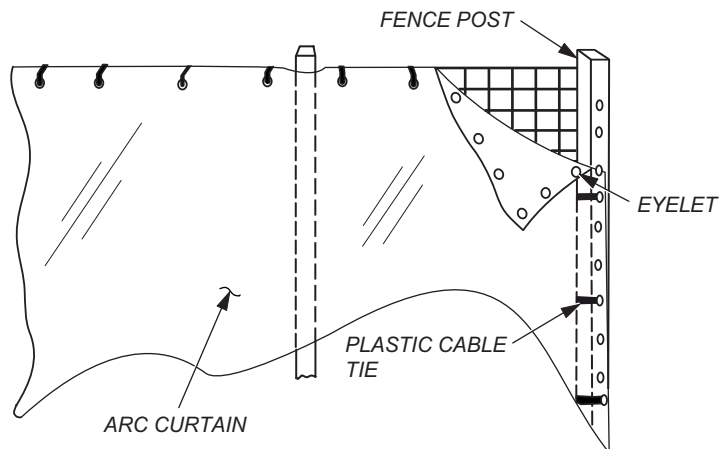


Figure 10 Arc Curtain Installation on Typical Work Cell Safety Fence Panel

4.5 Removal of Robot Shipping Bracket



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 11). The bracket is painted a bright yellow color for easy location and identification. The bracket secures the lower arm (L-axis) 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 both brackets and attaching hardware in a safe location, should they be needed in the future.

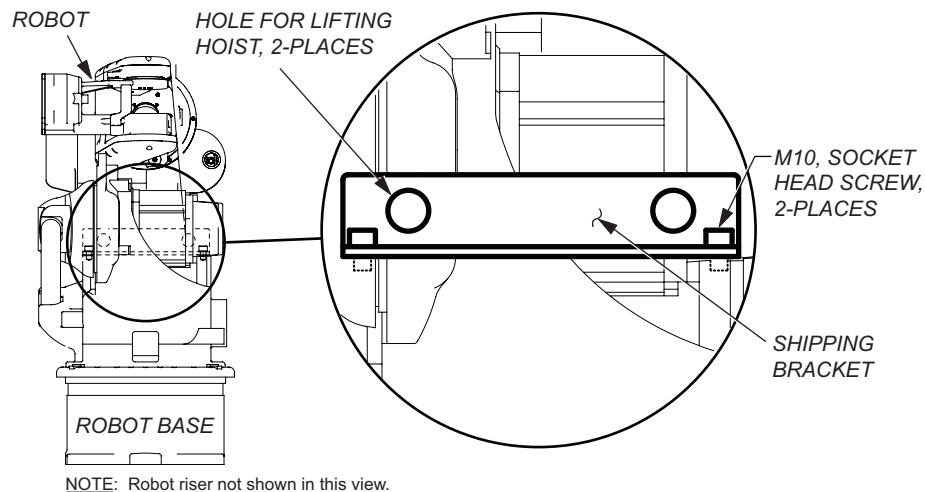


Figure 11 Robot Shipping Bracket

4.6 Cable Connections

After the ArcWorld®II-6000 components and peripherals are anchored in their correct locations, locate the interconnect cables for the system components and route them according to the system cable diagrams included in the documentation supplied with your ArcWorld®II-6000 system. All cables and connectors are labelled at each end to match the labelling on system components for ease of installation.



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.

4.6.1 Connection to Earth Ground



WARNING!

Do not use the ArcWorld®II-6000 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 the 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 quite a bit more than a single driven ground rod, depending on soil conditions. Often, multiple ground stakes (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).

Connect the EA-series 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 EA-series robot. Connect the other end of the earth ground wire to the low-resistance earth ground.
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.

4.6.2 Connection to Local Electrical Service



DANGER!

Local electrical service connection to the ArcWorld®II-6000 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.

After all of the system components have been properly installed and interconnected, connect local electrical service to the NX100 controller and welding power source.

Electrical power enters the NX100 controller through a plate on the left side of the controller (see Figure 2). For detailed electrical service interconnect procedures for the NX100, refer to the *NX100 Controller Manual* that is included with the ArcWorld®II-6000 system documentation (refer to Section 1.3).

For local electrical service connection procedures for the welding power source, refer to the welding power source documentation that is included with the ArcWorld®II-6000 system.



Note: The ArcWorld®II-6000 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 ArcWorld®II-6000 system.

4.7 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 the EA-series robot (refer to Section 4.5).
2. Ensure correct alignment and operation of the safety light curtain system (refer to safety light curtain documentation that is included with the ArcWorld®II-6000 system).
3. Check the torque and security of all cable connections.
4. Ensure that the work cell sliding access door is closed and that door interlock is engaged.
5. Ensure the correct setting of the welding power source (refer to the welding power source documentation that is included with your ArcWorld®II-6000 system).
6. Verify that local electrical service is correctly wired into the NX100 controller and the welding power source (refer to Section 4.6.2).
7. Verify that local electrical service complies with the power requirements for your ArcWorld®II-6000 system.



CAUTION!

The ArcWorld®II-6000 system is now ready for power-up. Ensure that qualified, trained operators, who are familiar with the ArcWorld®II-6000 system, perform the power-up sequence.

8. Set POWER ON-OFF switch on NX100 controller to ON (see Figure 2).
9. Set 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).

10. Check for correct operation of the E-STOP push buttons.
11. Check for correct operation of the system HOLD buttons.
12. Check for correct action of work cell access door safety interlock.
13. Remove power from the ArcWorld®II-6000 system after completion of the safety / operation check.

4.8 Installation of Tooling and Fixtures

Your ArcWorld[®] II-6000 system is now ready for installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the ArcWorld[®] II-6000 system should do the installation. After tooling installation, test the RM2-250 STX positioner for correct operation.



Note: All tooling and fixtures for the RM2-250 STX 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 your ArcWorld®II-6000 system. For more in depth operating information, refer to specific component manuals that are part of the ArcWorld®II-6000 system documentation package (refer to Section 1.3).

The ArcWorld®II-6000 system is a fully integrated robotic GMAW welding cell.

One Motoman EA-series robot welds parts on one side of an RM2-250 STX reciprocating positioner, while the operator loads the opposite side with parts to be welded. When the robot completes the parts welding process, it returns to a Home (Safe) position. The operator can then initiate another positioner sweep cycle from an 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 parts welding cycle.

5.1 Programming

Programmer interaction with the ArcWorld®II-6000 system is accomplished with a Programming Pendant that is connected directly to the NX100 controller (refer to Section 3.3 and Figure 3).

The operation of the ArcWorld®II-6000 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 in depth programming procedures and requirements, refer to the NX100 controller documentation that is included with your ArcWorld®II-6000 system (refer to Section 1.3).



CAUTION!

Programming modifications to original job structure and/or system configuration must be performed by trained and experienced personnel who are familiar with the operation and programming of this type of robotic welding system.

Any programming changes made to your system configuration or job structure will alter the operation of the system. Motoman recommends that you DO NOT modify the original job structure or system configuration. **If you determine a need to modify the original job structure or system**

configuration, make the modifications to a COPY of the original. Keep the original in a secure location. DO NOT modify the original.

If you have questions about the configuration of your ArcWorld®II-6000 system or a need to discuss proposed programming changes to job structure or system configuration, 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 you can sweep the positioner.

MANUAL mode allows you to sweep the RM2-250 STX reciprocating positioner without activating the robot. Parts can be loaded onto the fixture to achieve the most efficient configuration and then swept into the welding zone, before teaching the 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 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 switch to MANUAL mode and start Master job (refer to Section 5.3.3). Normally, the robot will not move out of Home position when the POSITIONER switch is in 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 (the RM2-250 STX 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®II-6000 work cell from a power-off condition, proceed as follows:

1. Set POWER ON-OFF switch on NX100 controller to ON (see Figure 2).
2. Set POWER ON-OFF switch on welding power source to ON (ON-OFF indicator lamp on welding power source will illuminate).
3. Open regulator valve on welding gas supply.
4. Make sure that work cell door is closed and door safety interlock engaged.
5. Make sure all E-STOP buttons are released. E-STOP buttons are installed at the following locations:
 - Programming Pendant
 - Door of the NX100 controller
 - Operator Station
6. Select TEACH mode on the Programming Pendant.
7. Place 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. Select TEACH mode on the Programming Pendant.
2. Select MAIN MENU on Programming Pendant touch screen display.
3. Select JOB on Programming Pendant touch screen display.
4. Select SELECT JOB on Programming Pendant touch screen display (a job list appears on the touch screen display).
5. Use the navigation cursor key to move the cursor to robot SAFE job and press SELECT (the job appears on the touch screen display).
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 the robot to Home position.
8. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.

5.3.3 Master Job

With the ArcWorld®II-6000 system powered up and in TEACH mode, call up the Master job:

1. Select JOB on Programming Pendant touch screen display.
2. Select CTRL MASTER on Programming Pendant touch screen display. Press SELECT twice to activate the Master job.
3. Select PLAY mode on Programming Pendant and press the PLAY ENABLE button on the NX100 controller door (job playback operation is enabled).
4. Press SERVO ON button on the Programming Pendant.

5. Press START 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 selecting REMOTE on the Programming Pendant MODE SELECT SWITCH.

The ArcWorld®II-6000 work cell is now ready for operation.

5.3.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld®II-6000 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 (mounted on safety light curtain fence panel).
3. Operator presses the green CYCLE START button on Operator Station. The RM2-250 STX 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 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 weld operation, it returns 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®II-6000 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 position.
5. Set welding power source POWER ON-OFF switch to OFF position.
6. Close regulator valve on welding gas supply.

The ArcWorld®II-6000 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 manuals and EA-1400N or EA-1900N robot manual that is included with your ArcWorld®II-6000 system (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 robot is 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 (rotate the controller POWER ON-OFF switch to OFF, 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 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 collision triggers a shock sensor output

After the triggering of an E-Stop condition, restart the ArcWorld®II-6000 system as follows:

1. Clear the E-STOP condition by performing any of the following actions that apply:
 - Release the activated E-STOP push button(s)
 - Close the work cell access door
 - Clear the safety light curtain protection zone
 - 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®II-6000 system is restarted.

2. Press the SERVO ON button on the Programming Pendant.
3. Ensure that the Programming Pendant is in REMOTE mode (Programming Pendant MODE SELECT SWITCH set to REMOTE).
4. Press the green CYCLE START button on the Operator Station.

The ArcWorld®II-6000 system is now ready to continue operation.

5.4.3 Shock Sensor Recovery

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

1. Select MAIN MENU on Programming Pendant touch screen.
2. Select ROBOT on Programming Pendant touch screen.
3. Select OVERRUN-S.SENSOR 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®II-6000 system is now ready to continue operation.

5.4.4 Brake Release

The emergency braking system is designed to protect the robot 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 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 pendant touch screen display.
3. Select the BRAKE RELEASE option.
4. Select the control group (R1, S1).
5. While pressing in on the pendant ENABLE switch, hold down the minus key for the axis to be released (S-, L-, U-, etc.).
6. The brake for the selected axis will release.

NOTES

Chapter 6

Maintenance

Assign ArcWorld®II-6000 system maintenance only to technicians who are trained in the operation and repair of a modern robotic system (preferably the ArcWorld®II-6000 system). Be sure to read and understand the documentation for a particular component before doing any type of maintenance on that component.

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

For maintenance procedures and schedules for individual components of the system, refer to the component manuals that are supplied with the ArcWorld®II-6000 system (refer to Section 1.3).

Table 1 Periodic Maintenance

FREQUENCY	COMPONENT	PROCEDURE
Daily	Water Circulator (optional) (see NOTE below)	Check level of coolant / antifreeze. If necessary, add a mixture of Motoman coolant / antifreeze (P/N 131224-1) and distilled water. Mix antifreeze and distilled water in proportions shown on the antifreeze container.
Daily	All safeguard items – work cell door interlock, 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.
On Condition	ArcWorld®II-6000 work cell	Remove accumulated dirt, grease, and debris from inside and outside the work cell.
Monthly	EA-Series Robot RM2-250 STX Positioner	Check integrity and security of anchor hardware in accordance with HILTI® documentation. Check torque of hold-down nuts in accordance with HILTI® documentation (refer to Appendix A).
<p>NOTE: If your system uses a water-cooled torch, use only Motoman-specified antifreeze. Typical automotive antifreeze contains additives that can clog the small cooling ports in the torch, and can damage sealing gaskets in the water circulator pump</p>		

NOTES

Appendix A

Anchoring

The customer must determine all anchoring and foundation requirements, and supply the appropriate anchoring hardware and foundation for a particular installation. Table A.1 gives anchoring and foundation suggestions for the ArcWorld®II-6000 system components.



WARNING!

Do not mount robots directly to the floor without the indicated floor plate. Failure to follow floor plate requirements can result in equipment damage or injury to personnel.

Table A.1 Minimum Suggested Equipment Anchor Specifications

EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIAMETER AND TYPE	MINIMUM FLOOR PLATE REQUIREMENTS	MINIMUM FOUNDATION REQUIREMENTS
ROBOTS: UP6, UP20 UP20-6 EA1400N EA1900N	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

Table A.1 Minimum Suggested Equipment Anchor Specifications

EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIAMETER AND TYPE	MINIMUM FLOOR PLATE REQUIREMENTS	MINIMUM FOUNDATION REQUIREMENTS
<u>ROBOTS:</u> UP350, UP500, SK300X	7/8" HVA Chemical Anchor <i>(Note 3) (Note 5) (Note 6)</i>	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
<u>POSITIONER:</u> Rotary	5/8" HVA Chemical Anchor <i>(Note 3) (Note 6)</i>	Not Applicable	Refer to Applicable Positioner Manual
<u>POSITIONER:</u> Reciprocating	7/8" HVA Chemical Anchor <i>(Note 3) (Note 6)</i>	Not Applicable	Refer to Applicable Positioner Manual
Peripheral Equipment:	1/2" Kwik Bolt II Expansion Anchor <i>(Note 4) (Note 6)</i>	Not Applicable	3" min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete
Work Cell Fence Posts:	3/8" Kwik Bolt II Expansion Anchor <i>(Note 4) (Note 6)</i>	Not Applicable	3" min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete
<p><u>NOTES:</u></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 $\pm 2^\circ$. 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 <u>drill bit</u> to use with each anchor type.</p> <p>Go to http://us.hilti.com or http://ca.hilti.com for additional information.</p>			

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