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Chapter 1
Introduction

1.1 About This Document

This System Manual provides an overview of the complete Motoman ArcWorld® IV-4200 DRC system. For detailed information on any specific system component listed in this document, please refer to the documentation package that is included with your ArcWorld® IV-4200 DRC system (refer to Section 1.3).

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

This System Manual contains the following chapters –

CHAPTER 1 – INTRODUCTION
This chapter provides general information about the ArcWorld® IV-4200 DRC system and its components, a list of reference documents, and customer support contact information.

CHAPTER 2 – SAFETY
This chapter provides general information regarding the safe installation, maintenance, and operation of the ArcWorld® IV-4200 DRC system.

CHAPTER 3 – DESCRIPTION OF EQUIPMENT
This chapter provides a description of the major components of the ArcWorld® IV-4200 DRC system.

CHAPTER 4 – INSTALLATION
This chapter provides installation procedures for the ArcWorld® IV-4200 DRC system.

CHAPTER 5 – OPERATION
This chapter provides an overview of ArcWorld® IV-4200 DRC system operation, including start-up, loading, normal operations, fault recovery, and system shutdown.

CHAPTER 6 – MAINTENANCE
This chapter provides preventive maintenance requirements for certain components of the ArcWorld® IV-4200 DRC system.

APPENDIX A – ANCHORING
Appendix A gives foundation and anchoring suggestions for ArcWorld® IV-4200 DRC system components that require anchoring.
1.2 System Overview

The ArcWorld® IV-4200 DRC system provides a complete arc welding solution in a standardized configuration (see Figure 1). The system is designed around two Motoman EA-series robots (EA1400N or EA1900N), an NX100 controller assembly, two welding power sources, and one positioner (MSR2S-500).

Refer to Section 3.2 for a description of features and advantages of the NX100 controller configuration.

Refer to Section 3.4 for a description of the MSR2S-500 positioner.

The ArcWorld® IV-4200 DRC system features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06 Robot Safety standard, and is designed to safeguard both personnel and equipment. Heavy-gauge wire mesh safety fencing prevents unintended entry of personnel into the work cell while it is in operation. Arc curtains cover the wire mesh fencing to attenuate the amount of arc radiation that escapes the work cell during welding operations. A dual-interlocked access door, at the rear of the work cell, provides convenient access to equipment while providing a safety interlock to disable all equipment should the access door be opened while the robots are active. A dual-channel, safety light curtain system provides a “sensing field” in front of the positioner to protect the operator. Positioner movement is prevented whenever an operator is in a position that disrupts the sensing field of the light curtain system. In addition, maximum robot travel is physically limited by an S-axis “hard stop” at the base of each robot.
1.2.1 System Layout

Two EA-series robots are mounted on risers and lagged to the customers floor (refer to Section 4.4). Wire mesh safety fencing completely surrounds the ArcWorld® IV-4200 DRC work cell. The safety fencing is anchored to the floor during system installation (refer to Section 4.7). The NX100-DRC robot controller and two welding power sources share a Common Equipment Base that is located outside of the work cell (see Figure 1, Figure 2, and Figure 6). This arrangement allows most of the component interconnects to be pre-wired at the factory, thus reducing the amount of point-to-point wiring required of the customer. All operator controls, including those on the Programming Pendant, NX100-DRC controller, welding power supplies, and Operator Station are accessible from outside the ArcWorld® IV-4200 DRC work cell.

1.2.2 Major Components

The ArcWorld® IV-4200 DRC system includes the following major components –

- Two Motoman EA1400N or EA1900N manipulators (robots)
- One NX100-DRC controller assembly
- One MSR2S-500 positioner
- One Programming Pendant (located on NX100-DRC controller)
- One Operator Station
- Welding equipment (for each robot) –
  - Welding power supply
  - Welding torch (air-cooled)
  - Wire feeder
  - Applicable welding interface
  - Torch mount
- Safety equipment –
  - Heavy gauge, wire-mesh safety fencing
  - Arc curtains (cover the safety fencing)
  - Dual-channel, interlocked safety light curtain system
  - Dual-channel, interlocked work cell entry door
  - Steel arc screen on the positioner
1.2.3 Optional Equipment

The following optional equipment is available for use with the ArcWorld® IV-4200 DRC system –

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

1.3 Reference Documentation

For additional information on individual components of the ArcWorld® IV-4200 DRC system, refer to the following documentation that is included with your system –

- Motoman EA1400N Manipulator Manual (P/N 149208-1)
- Motoman EA1900N Manipulator Manual (P/N 149894-1)
- Motoman NX100 Controller Manual (P/N 149201-1)
- Motoman NX100 Maintenance Manual (P/N 150133-1)
- Motoman NX100 Operator's Manual for Arc Welding (P/N 149235-1)
- Motoman NX100 Concurrent I/O Manual (P/N 149230-1)
- Motoman MSR25-Series Positioner Manual (P/N 149160-1)
- Motoman NX100 Independent/Coordinated Control Function Manual (P/N 149648-1)
- Motoman INFORM User's Manual (P/N 150078-1)
- Vendor manuals for system components and assemblies not manufactured by Motoman

1.4 Customer Support Information

If you need assistance with any aspect of your ArcWorld® IV-4200 DRC system, please contact Motoman Customer Support at the following 24-hour telephone number –

937. 847. 3200

e-mail address –

techsupport@motoman.com

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

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

- System: ArcWorld® IV-4200 DRC
- Robots: Two EA-Series (EA1400N or EA1900N)
- Positioner: MSR2S-500
- Primary Application: Arc Welding
- Controller: NX100-DRC
- 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 (R1) data plate
NOTES
Chapter 2
Safety

2.1 Introduction

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

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-1999). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

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

We recommend approved Motoman training courses for all personnel involved with the operation, programming, or repair of the robot system. This training is designed to familiarize personnel with the safe and correct operation of the robot system.
This safety section addresses the following:

• Standard Conventions (Section 2.2)
• General Safeguarding Tips (Section 2.3)
• Mechanical Safety Devices (Section 2.4)
• Installation Safety (Section 2.5)
• Programming, Operation, and Maintenance Safety (Section 2.6)

2.2 Important Advisory Information

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

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

DANGER!
Information appearing under the DANGER caption concerns the protection of personnel from an immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

WARNING!
Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

CAUTION!
Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

Note: Information appearing in a Note caption provides additional information that can be helpful in understanding the item being explained.

2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

• Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
• Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
• The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
• In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-1999 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety fences and barriers
- Light curtains and/or safety mats
- Door interlocks
- Emergency stop palm buttons located on operator station, robot controller, and programming pendant

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06-1999 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
• Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
• Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming, Operation, and Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to program, operate, and maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

• Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.

• Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.

• Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.

• Check the E-Stop button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.

• Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.

• Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!

• Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.

• The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.

• Check and test any new or modified program at low speed for at least one full cycle.
• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

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

• Use proper replacement parts.

• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
NOTES
Chapter 3

Equipment Description

3.1 Robot Description

The Motoman six-axis EA1400N and EA1900N “Expert Arc” robots are specifically designed for arc welding applications. The EA1400N has a payload of 3 kg and features a horizontal reach of 1388 mm and a relative positioning accuracy of ±0.08 mm. The EA1900N has a payload of 3 kg and features a horizontal reach of 1904 mm and a relative positioning accuracy of ±0.08 mm. The EA-series robots have a patented internal cabling design that provides high flexibility and streamlines the robot profile, allowing access into confined spaces. The robot’s B-axis features an expanded range of motion which improves circumferential welding on cylindrical work pieces. The T-axis can rotate the torch ±360 degrees without cable interference.

The robot can be mounted on the floor, wall, or ceiling with minor modifications. The S-axis has been restricted by hard stops for use in this system. For more information, refer to the manipulator manual that came with your system.

3.2 NX100-DRC Controller

The ArcWorld® IV-4200 DRC system features one NX100-DRC controller assembly that consists of one NX100-DRC controller mated to an expansion cabinet (see Figure 2). This combination provides the same functionality of two full-size controllers, while reducing the overall width by 250 mm when compared with two, full-size NX100-DRC controllers. This configuration also reduces the cost to the customer by eliminating redundant components and circuitry.

Through specific cable interconnections (internal to the NX100-DRC), the NX100-DRC is configured as controller R1 and controller R2 (see Figure 2). This configuration allows the two robots to operate as a dual system that takes advantage of all the unique functions available only in a dual system configuration. With the ArcWorld® IV-4200 DRC system, the full-size NX100-DRC controller cabinet is designated R1, while the expansion cabinet is designated R2.

In addition to controlling the movement of the two robots, the NX100-DRC also controls the two welding power sources, the positioner, and provides the signals necessary to operate the two welding systems.
The NX100-DRC features an embedded real-time operating system (RTOS) and is programmed with the Motoman INFORM programming language.

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

The NX100-DRC coordinates the operation of the ArcWorld® IV-4200 DRC system. It controls manipulator movement, welding power supplies, processes input and output signals, and provides the signals to operate the welding system. It maintains variable data and performs numeric processing to convert to and from different coordinate systems. In addition, the controller provides main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the controller manual that came with your system.

**Figure 2** NX100-DRC Controller Assembly, Welding Power Sources, and Common Base
3.2.1 Programming Pendant

The Programming Pendant (see Figure 3) provides the primary means of programmer/operator interaction with the ArcWorld® IV-4200 DRC system. The pendant features the Windows® CE operating system and displays information on a 6½ in., color LCD touch-screen display (640 X 480 VGA). The pendant also incorporates a CompactFlash® card slot for program backups. The Programming Pendant provides icon-driven system programming. It also features a menu-driven interface to simplify operator interaction with the robots. Most operator controls are located on the Programming Pendant. This allows remote installation of the controller. By using the Programming Pendant, the operator can teach robot motion; perform programming, editing, maintenance, and diagnostic functions; and enable/disable Operator Station control of the ArcWorld® IV-4200 DRC system. For detailed information on the pendant programming keys, programming functions, and display functions, please refer to the NX100 Operator's Manual for Arc Welding that is included with your ArcWorld® IV-4200 DRC system (refer to Section 1.3).

![Figure 3 NX100-DRC Programming Pendant](image-url)
Note: The Programming Pendant LCD display goes dark after a few minutes of inactivity. Press any key to restore screen.

Note: Operator Station ENABLE/DISABLE is accomplished with the Programming Pendant MODE SELECT SWITCH. To transfer control of the ArcWorld® IV-4200 DRC system to the Operator Station, set the Programming Pendant MODE SELECT SWITCH to REMOTE.

3.3 Operator Station

The Operator Station (see Figure 4) includes a NEMA enclosure on a stand-alone pedestal. The following paragraphs describe the Operator Station controls.

![Figure 4 Operator Station](image)

3.3.1 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.

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-DRC 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-DRC controller prevents the positioner from continuously cycling, should the operator depress and hold the CYCLE START/CYCLE LATCHED push button.
3.3.2 Operator Station Function – Emergency Stop (E-Stop)

Pressing the Operator Station E-Stop push button initiates an emergency stop (E-Stop). Refer to Section 3.6.4 for a discussion of the E-Stop function, and procedures for recovering the ArcWorld® IV-4200 DRC system from the emergency stop (E-Stop) condition.

3.3.3 Operator Station Function – Robot Hold

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

3.3.4 Operator Station Function – Alarm

A red ALARM lamp illuminates to indicate that the NX100-DRC controller has encountered an alarm condition.

3.3.5 Operator Station Function – Positioner Auto / Manual

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

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

3.3.6 Operator Station Function – Start

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

3.3.7 Operator Station Function – Reset

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

3.3.8 Operator Station Function – Servo ON

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

3.3.9 Operator Station Function – Joystick Control of Orbital Axis Rotation

The MSR2S-500 positioner has the ability to position the operator load axis (orbital axis) ±360° in 2.5° increments for better part loading/unloading ergonomics. This rotation of the orbital axis in 2.5° increments (also known as “jogging”) is accomplished with a “joystick” control located on the Operator Station (see Figure 4).
3.4 MSR2S-500 Positioner

The MSR2S-500 is a high-speed, high-performance, three-axis “turn-table” positioner. The MSR2S-500 features a 500 kg capacity per side. The ArcWorld® IV-4200 DRC system is capable of synchronized motion between various components depending on the job configuration. Synchronized robots move at the same time during operation. R1 and R2 can be synchronized with the positioner, and R1 can be synchronized with R2. Dual robots can work simultaneously on a rotating work piece. For additional information on independent control and coordinated motion, refer to the NX100 Independent / Coordinated Control Function Manual that is included in the ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

For additional positioner information, including specifications, illustrated parts lists, load capabilities, and dimensions, refer to the MSR2S Series Positioner Manual that is included with your ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

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

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

3.5 Welding Equipment

In its standard configuration, the ArcWorld® IV-4200 DRC system includes a welding power source, wire feeder, torch, and torch mount for each of the two EA-series robots. Optional equipment – water-cooled torch, water circulators, ComArc seam tracking units, and torch tenders – may also be included with your ArcWorld® IV-4200 DRC system.

3.5.1 Welding Power Sources

Motoman offers various brands and types of welding power sources. The actual brand and type of welding power source supplied with the ArcWorld® IV-4200 DRC system depends on the customer’s specific application and preference. For specific information on the welding power sources supplied with your ArcWorld® IV-4200 DRC system, refer to the welding power source manual that is included with your system documentation package (refer to Section 1.3.).

3.5.2 Wire Feeder

A welding wire feeder is mounted on the upper arm (U-Axis) of each EA-series robot. The wire feeder is the “4-roll” type and provides reliable wire feeding at rates up to 750 in. per minute (ipm). An electronically controlled gas valve provides fast welding 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 wire feeder documentation that is included with your ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).
3.5.3 GMAW Torch

The ArcWorld® IV-4200 DRC system uses either an air-cooled or a water-cooled robotic / automatic GMAW torch for each robot. These are heavy-duty torches designed for quick replacement and minimum robot reprogramming. The GMAW torch is installed at the end of the robot wrist flange. For applications that use the optional water-cooled torch, the ArcWorld® IV-4200 DRC system includes a water circulator kit for each robot. For additional information on the torches that are supplied with your system, refer to the vendor documentation that is included with your ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

3.6 Safety Features

The ArcWorld® IV-4200 DRC system includes a total safety environment. If you comply with all standard safety precautions, the safety equipment helps to ensure safe operation of the robot work cell.

Note: Users are responsible for determining that the safeguards provided with the ArcWorld® IV-4200 DRC system are adequate for their plant conditions. Users must also ensure that all safeguards are maintained in working order.

3.6.1 Welding Arc Protection

One by-product of the welding arc is an intense level of ultraviolet light. The ultraviolet light radiates outwardly (equal strength in all directions) from the weld point whenever an arc is established. If not attenuated, the radiated ultraviolet light can present a health risk to personnel near the welding arc.

Two forms of welding arc protection are part of the ArcWorld® IV-4200 DRC system –

- a steel arc screen on the positioner
- arc curtains (attached to the steel mesh safety fencing)

The steel arc screen on the positioner is always positioned between the welding arc and the operator. This protects the operator from intense ultraviolet light, and the arc curtains protect other personnel who are near the work cell.

WARNING!

Although safety fence arc curtains block the radiation of ultraviolet light, never look directly at the welding arc without protective eye wear.

The arc curtains filter (or “block”) most of the ultraviolet light radiation that would otherwise escape the work cell. Just as the arc screen on the positioner protects the operator from intense ultraviolet light, the arc curtains protect other personnel who are near the work cell.

3.6.2 Safety Fencing

The heavy-gauge steel mesh safety fencing that is provided with the ArcWorld® IV-4200 DRC system encloses the entire work cell. It forms a physical barrier that prevents personnel from entering the work cell during automatic operation.
3.6.3 Safety Light Curtains

Infrared light curtains provide a safe area for the operator. The positioner will not sweep while any of the light paths are obstructed. Should any person or object enter this zone during a positioner sweep from A to B (or B to A) an E-Stop will occur (refer to Section 3.6.4).

For additional information on the safety light curtain system, refer to the vendor documentation that is included with your ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

3.6.4 Emergency Stop (E-Stop)

E-Stop is a primary safety feature of the ArcWorld® IV-4200 DRC system. A work cell access door interlock, a safety light curtain system, robot welding torch impact (collision) detection circuitry (refer to Section 3.5.3), and E-Stop push buttons can all trigger an E-Stop condition. An E-Stop condition immediately de-energizes the control system and activates the robot braking system (refer to Section 3.6.6). The E-Stop push buttons are used for an intentional shutdown of the ArcWorld® IV-4200 DRC system, and are installed at the following locations –

- Programming Pendant
- NX100-DRC controller (R1)
- 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).

3.6.5 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 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 the ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

![Figure 5 Programming Pendant ENABLE Switch – Location and Operation](image)
3.6.6 **Emergency 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, even if drive power is disabled. Brake release is accomplished with the Programming Pendant (refer to Section 5.4.4).

3.6.7 **Interlocked Work Cell Door**

The work cell access door features a safety interlock (see Figure 1). Any attempt to open the access door while the robots are in PLAY mode triggers an E-Stop condition (refer to Section 3.6.4).
NOTES
Chapter 4
Installation

CAUTION!
The ArcWorld® IV-4200 DRC system should be installed by qualified personnel who are familiar with the installation and set-up of a robotic system.

Two to three qualified technicians can install the ArcWorld® IV-4200 DRC system in a reasonable amount of time. Always comply with established safety procedures throughout the installation process (refer to Chapter 2).

4.1 Required Materials

All system components and most hardware items required for installation of the ArcWorld® IV-4200 DRC 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 the robots, the NX100-DRC 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 m³/min (15 cfm)
  - Pressure 620 kPa, gage (90 psi, gage)
- Forklift(s)
- 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-in. hex socket)
- Adjustable wrench
- Hammer drill with appropriate concrete bits
- Phillips and flat-blade screwdrivers
- Hammer (dead-blow and steel)
- Hammer (non-marring)
- Socket set (SAE and Metric)
- Air-impact gun (with 3/4-in. hex socket)
- Open-end wrench set (SAE and Metric)
- “Allen” wrench set (SAE and Metric)

4.2 Site Preparation

**WARNING!**
Be sure to provide sufficient room for access to the work cell door, Operator Station, 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 and overhead space needed for the ArcWorld® IV-4200 DRC system (see Figure 6 and Figure 7). Allow an additional 1.2 m – 1.5 m on all sides of the work cell to provide the clearances needed for installation.

2. Gather all customer-supplied items and required tools (refer to Section 4.1).

![Figure 6 ArcWorld® IV-4200 DRC — Plan View](image)
4.3 Positioner

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

1. Carefully remove protective plastic wrapping from the positioner.
2. Inspect for shipping damage.
3. Using a socket wrench, remove all bolts from the positioner shipping skid (see Figure 8).

Figure 7 ArcWorld® IV-4200 DRC — Elevation View

Figure 8 Location of Shipping Bolts
Mount the positioner on a foundation rigid and strong enough to support the positioner and withstand dynamic repulsion forces. If the foundation surface is not level and even, grind the swell to flatten the surface. Refer to Appendix A for suggested minimum foundation thickness and strength.

**WARNING!**
The positioner weighs approximately 2070 kg. Be sure that your lifting device is rated to safely handle this load.

4. Use a forklift to lift the positioner from the shipping pallet and place in position on the prepared floor surface. Ensure there is adequate room for tooling installation and part positioning. See Figure 8 for forklift points.

> Note: A forklift is required to lift or move the MSR2S-500 positioner.

### 4.4 Installing the Robot/Riser Base

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

1. Unbolt robot/riser base from the wooden shipped skid using a 3/4-in. socket.

**WARNING!**
The robot with riser weights approximately 390 kg. Be sure that your crane or forklift is capable of handling this weight or damage to the equipment or injury to personnel can result.

2. Using an overhead crane, remove robot/riser base from wooden shipping skid.
3. Place robot/riser base in position.

> Note: Make sure there is adequate room on all sides of the robot for the fencing, the operator station, the positioner, and the auxiliary equipment common base.

4. Carefully remove protective plastic wrapping from robot and torch.
5. Inspect robot, torch, and base for shipping damage.

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

7. Anchor robot/riser securely in place (refer to Appendix A for anchor requirements).
4.5 **Removal — Robot Shipping Bracket**

**CAUTION!**
Failure to remove shipping brackets from robot before operating the ArcWorld® IV-4200 DRC may result in damage to the robot drive mechanisms.

A yellow shipping bracket (see Figure 9) prevents the robot from moving during shipping. The shipping bracket secures the lower arm assembly to the S-axis housing. After the robot is in place, remove the shipping bracket.

![Figure 9 Location of Shipping Brackets](image)

4.6 **NX100-DRC / Weld PS Common Base**

The NX100-DRC controller, two welding power sources, two electrical service disconnect boxes (one for each welding power source), and a common equipment table for the welding power sources are mounted on a common base (see Figure 2).

**WARNING!**
The NX100-DRC / Weld PS common base (with equipment) weighs approximately 2000 kg. Be sure that your lifting device is rated to safely handle this load.

**Procedure –**

1. Place the common base in position next to the ArcWorld® IV-4200 DRC work cell (Figure 6).
2. Remove protective plastic wrapping, cardboard, and other protective shipping material from the NX100-DRC/Weld PS common base and associated components.
3. Inspect the NX100-DRC/Weld PS common base and all attached components for shipping damage.

\textit{Note: Notify your shipping contractor if you notice any shipping damage.}

\textbf{CAUTION!}

\textit{Be absolutely certain of the correct location for the NX100-DRC / Weld PS common base before securing it with anchor (lag) bolts.}

4. Using the dimensions and location shown in Figure 6, position the NX100-DRC/Weld PS common base next to the work cell.

5. Secure the common base to the floor. Use a suitable concrete drill bit and special anchor (lag) bolts (refer to Appendix A for suggested drill bit and anchor bolt). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.

\textit{Note: The lag bolts use the same holes in the NX100-DRC / Weld PS common base as did the previously removed shipping bolts.}

\textbf{4.7 Safety Fence Assembly}

See Figure 1, Figure 6, and Figure 10 for general arrangement and positioning of the safety fence assembly. Refer to the safety fence manufacturer instructions for details of safety fence placement, erection, and anchoring. The safety fence instructions are included in the ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

\textbf{Figure 10  Safety Fence and Arc Curtain Installation Details}
4.8 Arc Curtains

The arc curtains are packaged in an accessories box that is shipped with the ArcWorld® IV-4200 DRC system.

**WARNING!**

Ensure that the work cell safety fence is anchored in place before installing the arc curtains. Unanchored fence panels can fall and injure personnel or damage 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 11).

   ![Diagram of arc curtain installation](image)

   **Figure 11** Arc Curtain Installation on Typical Safety Fence Panel

   **Note:** The arc curtains are precut 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 work cell door arc curtain on the inside of the door panel, using the supplied plastic cable ties and the eyelets in the arc curtain (see Figure 11).
4.9 Light Curtain System

Note: Light curtain components (send unit, receive unit) are mounted to safety fence panels at the factory and then secured for shipment to the customer.

Procedure –

1. Unpack both light curtain fence panels from their shipping position and move into position. The light curtain units are oriented properly when their status lights are located near the base of the positioner.
2. Unpack the light curtain cables and connect them to the matching connectors on the light curtain send and receive units.
3. Align the send unit with the receive unit. Refer to the light curtain manufacturer’s literature that is included in the ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).
4. After the light curtain units are installed and aligned, anchor the light curtain fence panel posts to the foundation (refer to Appendix A for suggested anchor drills and bolts).
5. Check the alignment of the light curtain send and receive units after the fence posts are anchored to the foundation. If indicated, readjust alignment of the light curtain send unit and receive unit.

4.10 Operator Station

Procedure –

1. Unload operator station.
2. Remove protective plastic wrapping from Operator Station.
3. Inspect Operator Station for shipping damage.

Note: Notify your shipping contractor if you notice any shipping damage.
4. Place Operator Station outside fence to front of positioner (see Figure 1 and Figure 6).

CAUTION!
Be absolutely certain of the correct location for Operator Station before securing it with anchor (lag) bolts.

5. Anchor the Operator Station to the foundation (refer to Appendix A for suggested drill bits and anchor bolts).
4.11  **Cable Connections**

After the ArcWorld® IV-4200 DRC 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/schematics included in the ArcWorld® IV-4200 DRC 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.*

### 4.11.1 Connection to Earth Ground

**WARNING!**

Do not use the ArcWorld® IV-4200 DRC 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 robots and NX100-DRC controller must be connected to a low-resistance earth ground. If a ground stake is used, it should be driven at least 2.43 m into the soil. The soil surrounding the driven ground stake should be treated with a chemical that increases the soil conductivity in the vicinity of the driven ground stake. This is often referred to as a “low-resistance earth ground” and may require more than a single driven ground rod, depending on soil conditions. Often, multiple ground rods (bonded together) or even a bonded network of buried copper sheeting (plus conduction-enhancing chemicals) may be required, depending on local soil condition. In any event, the “low-resistance earth ground” must indicate a resistance of **100 ohms or less** (when measured directly between grounded equipment and the earth ground system). Be advised that specialized measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.

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

Connect both EA-series robots and NX100-DRC 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 robot (R1). Connect the other end of the earth ground wire to the low-resistance earth ground. See Figure 1 for location of robot (R1).

2. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the connector panel of robot (R2). Connect the other end of the earth ground wire to the low-resistance earth ground. See Figure 1 for location of robot (R2).
3. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside NX100-DRC R1 controller (Figure 2). Connect the other end of the earth ground wire to the low-resistance earth ground.

4. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside NX100-DRC R2 expansion cabinet (Figure 2). Connect the other end of the earth ground wire to the low-resistance earth ground.

4.11.2 Connection to Local Electrical Service

**DANGER!**

Local electrical service connection to the ArcWorld® IV-4200 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® IV-4200 DRC 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-DRC controller and welding power sources (refer to Section 4.11.2.1 and Section 4.11.2.2).

4.11.2.1 NX100-DRC Controller

For detailed electrical service interconnect procedures for the NX100-DRC controller, refer to the NX100 Controller Manual and ArcWorld® IV-4200 DRC system drawings/schematics that are included with your system documentation package (refer to Section 1.3).

4.11.2.2 Welding Power Sources

Refer to the welding power source documentation and ArcWorld® IV-4200 DRC system drawings/schematics for electrical service connection procedures and diagrams for the welding power sources.

4.12 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 4.5).
2. Ensure correct alignment and operation of the safety light curtain system (refer to safety light curtain documentation that is included with the ArcWorld® IV-4200 DRC system).
3. Check the security and integrity of all cable connections.
4. Ensure that the work cell sliding access door is closed and that the door interlock is engaged.
5. Verify the correct settings for the welding power sources (refer to the welding power source documentation that is included with your ArcWorld® IV-4200 DRC system).
6. Verify that local electrical service complies with the power requirements for your ArcWorld® IV-4200 DRC system.

7. Verify that local electrical service is correctly wired into the NX100-DRC controller and the welding power sources (refer to Section 4.11.2).

**CAUTION!**

The ArcWorld® IV-4200 DRC 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 POWER ON-OFF switch on the NX100-DRC R1 controller to ON (Figure 2).

**Note:** An electrical service disconnect box for the NX100-DRC controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld® IV-4200 DRC system shipment.

9. Set the service disconnect boxes for the welding power sources to ON (Figure 2).

10. Set POWER ON-OFF switch on welding power source (R2) to ON.

11. Set POWER ON-OFF switch on welding power source (R1) to ON.

**WARNING!**

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

12. Check for correct operation of all E-Stop push buttons (refer to Section 3.6.4).

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® IV-4200 DRC system after completion of the safety/operation check.

### 4.13 Installation of Tooling and Fixtures

Your ArcWorld® IV-4200 DRC system is now ready for installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the ArcWorld® IV-4200 DRC system should do the installation. After tooling installation, test the positioner for correct operation.

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

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

This chapter provides a brief overview of the operating procedures and precautions for your ArcWorld® IV-4200 DRC system. For more detailed operating information, refer to specific component manuals that are part of the ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

The ArcWorld® IV-4200 DRC system is a fully integrated robotic GMAW welding cell.

Two Motoman EA-series robots weld parts on one side of the positioner, while the operator loads the opposite side with parts to be welded. When the robots complete the welding process, they return 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 robots then move 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-DRC controller documentation that is included with your ArcWorld® IV-4200 DRC system documentation package (refer to Section 1.3).

Any changes made to your system configuration and/or job structure will alter the operation of the system. Motoman recommends that you DO NOT modify the original jobs and system configuration of your ArcWorld® IV-4200 DRC system. If you determine a need to modify the original jobs and system configuration, make any modifications to a copy of the original. Keep the original as a backup. Do not modify the original. Modifications must be performed by trained and experienced personnel, who are familiar with the operation of the ArcWorld® IV-4200 DRC system. If you have questions concerning the configuration of your ArcWorld® IV-4200 DRC system, please contact Motoman 24 hour Customer Support (refer to Section 1.4).
5.2 Sweeping the Positioner

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

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

1. Place the robots in Home position (refer to Section 5.3.2).
2. Make sure that the Operator Station 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 robots will not move out of Home position when the POSITIONER AUTO/MANUAL switch is set to MANUAL (this depends on job structure).

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

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

5.3 Daily Operation

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

- Perform start-up procedures (refer to Section 5.3.1).
- Move robots to Home position (refer to Section 5.3.2).
- Select Master job (refer to Section 5.3.3).
- Perform operation cycle (refer to Section 5.3.4)
- Perform shutdown procedures (refer to Section 5.3.5)

5.3.1 Start-Up

To start up the ArcWorld® IV-4200 DRC work cell from a power-off condition, proceed as follows:

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

Note: Electrical service disconnect box for the NX100-DRC controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld® IV-4200 DRC system shipment.

2. Set POWER ON-OFF switch on NX100-DRC controller (R1) to ON (see Figure 2).
3. Switch both welding power source electrical service disconnect boxes to ON (see Figure 2).
4. Set POWER ON-OFF switch on each welding power source to ON (ON-OFF indicator lamp on each 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. E-Stop buttons are installed at the following locations –
   - Programming Pendant
   - NX100-DRC controller (R1)
   - Operator Station

8. Select TEACH mode on the Programming Pendant.

9. Place robots in Home position (refer to Section 5.3.2).

5.3.2 Robot Home Position

To move the robots to the Home position –

1. Select TEACH mode on the Programming Pendant.

2. Select MAIN MENU on Programming Pendant touch screen.


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

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

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

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

8. Use the navigation cursor key to move the cursor to R2 SAFE job and press SELECT (the job appears on the display screen).

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

10. Use the FWD button on Programming Pendant to jog robot (R2) to Home position.

5.3.3 Master Job

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

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. Select PLAY mode on Programming Pendant and press the PLAY ENABLE button on the NX100-DRC controller (R1) door (job playback operation is enabled). See Figure 2 for location of the PLAY ENABLE button on the controller.

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® IV-4200 DRC work cell is now ready for operation.

5.3.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld® IV-4200 DRC 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 robots then begin to weld the parts (if the Operator Station POSITIONER AUTO/MANUAL switch is set to AUTO).

4. While the robots are welding, the operator loads the operator side of the positioner with the next group of parts to be welded.

5. The operator again moves to the Operator Station and presses the green CYCLE START button (CYCLE LATCHED light illuminates). When the robots are finished welding, they return to Home position. The positioner then sweeps again to return completed, welded parts to the operator position, while moving the next group of parts into the robot work area.

6. Operator moves back to the operator side of the positioner and unloads completed, welded parts.

5.3.5 Shutdown

Use the following procedure to perform a normal shut down of the ArcWorld® IV-4200 DRC system –

1. Make sure the robots are 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-DRC controller (R1) POWER ON-OFF switch to OFF position.

5. Set both welding power source POWER ON-OFF switches to OFF position.

7. Switch NX100-DRC controller disconnect box (if installed) to OFF.

*Note: Electrical service disconnect box for the NX100-DRC controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld® IV-4200 DRC system shipment.*

8. Switch welding power source disconnect boxes to OFF (see Figure 2).

The ArcWorld® IV-4200 DRC system is now shut down.

5.4 System Recovery

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

5.4.1 Alarms and Errors

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

- Error Messages
- Minor Alarms
- Major Alarms

When an alarm or error occurs the red ALARM button will illuminate on the Operator Station Pedestal and a message will appear in the Touch-Screen Display area of the Programming Pendant describing the type of error. For more detailed information on alarm and error recovery, refer to the maintenance and NX100-DRC controller documentation that is included with your ArcWorld® IV-4200 DRC 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 robots are not in PLAY mode

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

5.4.1.2 Minor Alarms

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

Major alarms usually involve hardware failures. Examples could include –

- An overload condition
- An abnormal speed

Clear alarms of this type by cycling the NX100-DRC controller (switch the POWER ON-OFF switch on the controller 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 activated (pushed in)
- The work cell access door is opened while the robots are not in TEACH mode
- The safety light curtain system is triggered while the positioner is sweeping
- A collision triggers a shock sensor output

After an E-Stop condition, restart the ArcWorld® IV-4200 DRC system as follows –

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

   **CAUTION!**

   If an E-Stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the ArcWorld® IV-4200 DRC system is restarted.

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

The ArcWorld® IV-4200 DRC system is now ready to continue operation.
5.4.3 Shock Sensor Recovery

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

1. Select MAIN MENU on Programming Pendant touch screen.
2. Select ROBOT on Programming Pendant touch screen.
4. Select RELEASE to release shock sensor.
5. Turn servo power ON (press in on the pendant ENABLE switch while pressing SERVO ON READY).
6. Move the affected robot clear of the impact position.

The ArcWorld® IV-4200 DRC 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 equipment damage.

1. On the Programming Pendant, select TEACH mode and turn servo power OFF.
2. Select ROBOT on the pendant display (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.
NOTES
Chapter 6
Maintenance

Maintenance of the ArcWorld® IV-4200 DRC system and components must be performed by authorized personnel who are familiar with the ArcWorld® IV-4200 DRC system. Be sure to read and understand the documentation for a particular component before doing repair maintenance or preventive maintenance on that component. Be sure that you understand the maintenance procedures, have the proper tools at hand, and comply with safety precautions given in Chapter 2.

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

For periodic maintenance procedures and schedules for the individual components of your ArcWorld® IV-4200 DRC system, refer to the documentation that is included with your system documentation package (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 Maintenance

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>COMPONENT</th>
<th>PROCEDURE</th>
</tr>
</thead>
</table>
| 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 |
| 1 Month (or on condition) | ArcWorld® IV- 4200 DRC work cell | Remove accumulated dirt, grease, and debris from inside and outside the work cell. |
Appendix A

Anchoring

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

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

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

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

**NOTES –**

1. Minimum robot lagging requirements are based on maximum repulsion forces and *Hilti® Anchor Design Program* (v3.3b).
2. SP series robots require base plates and/or risers to be level to ± 2°. Grout if necessary.
3. Reference source: *Hilti® Product Technical Guide* (Section 4.2.1) for hardware specifications or equivalent.
4. Reference source: *Hilti® Product Technical Guide* (Section 4.3.3) for hardware specifications or equivalent.
5. Cast-in anchors are specified in some robot manuals. The Hilti® HVA Chemical Anchors listed in this table can be substituted for the cast-in anchors.
6. Refer to *Hilti® Product Technical Guide* for suggestions on the correct size and type of drill bit to use with each anchor type.

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