

ArcWorld[®] II-50 Series SYSTEM MANUAL

Upon receipt of the product and prior to initial operation, read these instructions thoroughly and retain for future reference.

MOTOMAN INSTRUCTIONS

MOTOMAN XXXXXX INSTRUCTIONS
DX100 INSTRUCTIONS
DX100 OPERATOR'S MANUAL
DX100 MAINTENANCE MANUAL


The DX100 operator's manual above corresponds to specific usage.
Be sure to use the appropriate manual.

Part Number: 156730-1CD
Revision: 1



YASKAWA

MANUAL NO.

156730-1CD 



MANDATORY

- This system manual provides an overview of the Motoman ArcWorld® II-50 Series system. It gives general information about the system, a description of its major components, and the procedures for installation, system operation, and preventive and repair maintenance. Be sure to read and understand this manual thoroughly before installing and operating the ArcWorld® II-50 Series system.
- General items related to safety are listed in Section 2 of the *DX100 Controller Manual*. To ensure correct and safe operation, carefully read the *DX100 Controller Manual* before reading this manual.



CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure that all covers and shields are replaced before operating this product.
- The drawings and photos in this manual are representative examples, and differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications.
- If such a modification is made, the manual number will also be revised.
- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.
- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the Motoman ArcWorld® II-50 Series system.

In this manual, the Notes for Safe Operation are classified as "WARNING," "CAUTION," "MANDATORY," or "PROHIBITED."



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.



CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.



MANDATORY

Always be sure to follow explicitly the items listed under this heading.



PROHIBITED

Must never be performed

Even items described as "CAUTION" may result in a serious accident in some situations. At any rate, be sure to follow these important items.



To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as "CAUTION" and "WARNING."



WARNING

- Before operating the manipulator, check that servo power is turned OFF by pressing the EMERGENCY STOP buttons on the operator station or Programming Pendant (refer to *Figure 1*). When servo power is turned OFF, the SERVO ON LED on the Programming Pendant is turned OFF.

Injury or damage to machinery may result if the Emergency Stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the EMERGENCY STOP buttons do not function.

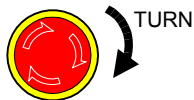
Figure 1: EMERGENCY STOP Button



- Release the EMERGENCY STOP button (refer to *Figure 2*). Once this button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Figure 2 : Release of EMERGENCY STOP Button



- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
 - View the manipulator from the front whenever possible.
 - Always follow the predetermined operating procedure.
 - Ensure that you have a safe place to retreat to in case of emergency.

Improper or unintended manipulator operation may result in injury.

- Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
 - Turning on the power for the DX100 controller.
 - Moving the manipulator with the Programming Pendant.
 - Running the system in the check mode.
 - Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an EMERGENCY STOP button immediately if there is a problem. The EMERGENCY STOP buttons are located on the operator station and on the Programming Pendant.



CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately and be sure that all other necessary processing has been performed.
 - Check for problems in manipulator movement.
 - Check for damage to insulation and sheathing of external wires.
- Always return the Programming Pendant to the hook on the cabinet of the DX100 controller after use.

The Programming Pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the *DX100 Controller Manual* before operating the ArcWorld® II-50 Series system.

Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product.

The manipulator usually consists of the controller, the Programming Pendant, and supply cables.

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
DX100 controller	DX100
DX100 Programming Pendant	Programming Pendant
Cable between the manipulator and the controller	Manipulator cable

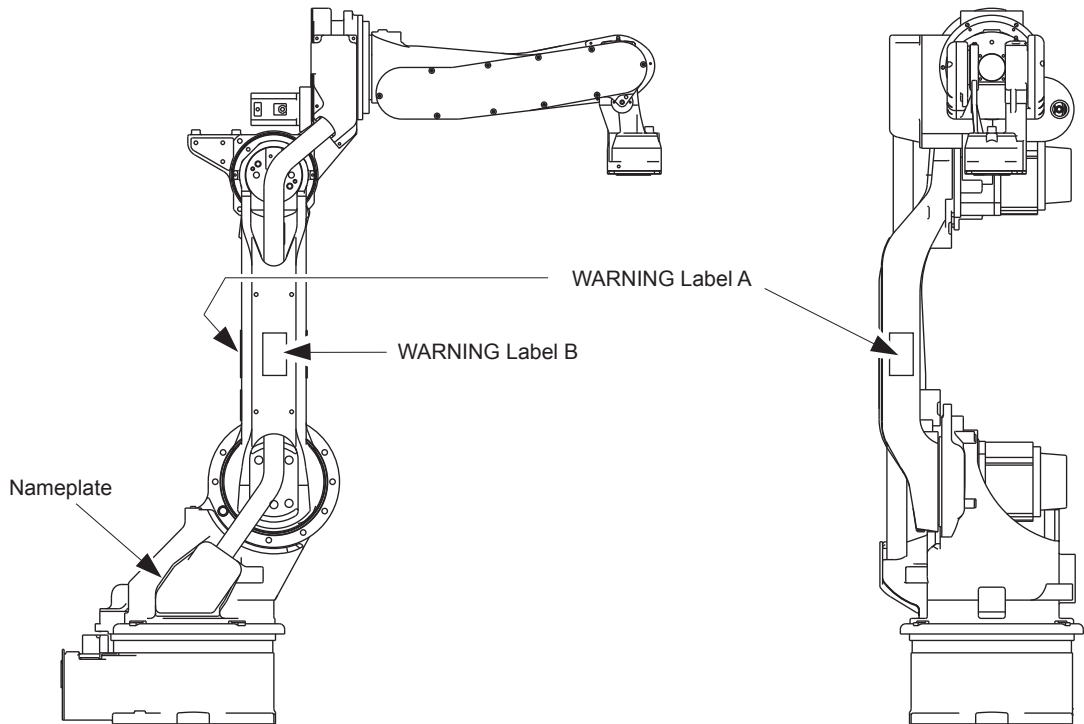
Explanation of Warning Labels

The following warning labels are attached to the manipulator (refer to *Figure 3*).

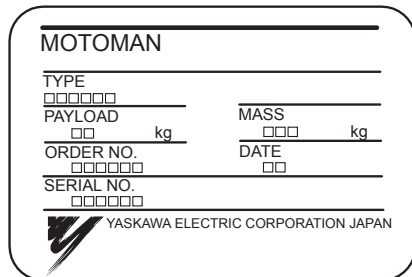
Always follow the warnings on the labels.

Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.

Figure 3: Warning Labels Location



Nameplate:



WARNING Label A:



WARNING Label B:



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ArcWorld® II-50 Series	1	Introduction
	1.1	About This Document

1 Introduction

The ArcWorld® II-50 Series is part of the ArcWorld family of standardized arc-welding solutions. Each cell is a fully integrated welding system that is supported from wire to weld by Motoman, Inc. The ArcWorld® II-50 Series consists of the following cells:

- ArcWorld II-50
- ArcWorld II-52
- ArcWorld II-50S
- ArcWorld II-52S

1.1 About This Document

This manual is intended as an introduction and overview for personnel who have received operator training from Motoman and are familiar with the operation of the Motoman ArcWorld® II-50 Series systems. For more detailed information, refer to the manuals listed in *Section 1.3*. This manual contains the following sections:

Section 1 – Introduction

This section provides general information about the ArcWorld® II-50 Series and its components, a list of reference documents, and customer service information.

Section 2 – Equipment Description

This section provides a detailed description of the major components of the ArcWorld® II-50 Series systems. This section also includes a table of component specifications.

Section 3 – Installation

This section provides instructions for the setup and installation of the ArcWorld® II-50 Series systems.

Section 4 – Operation

This section provides instructions for basic operation of the ArcWorld® II-50 Series systems. It also provides procedures for start-up, loading, normal operation, fault recovery, and shutdown.

Section 5 – Maintenance

This section contains a table listing periodic maintenance requirements for the components of the ArcWorld® II-50 Series cells.

Section 6 – Anchoring

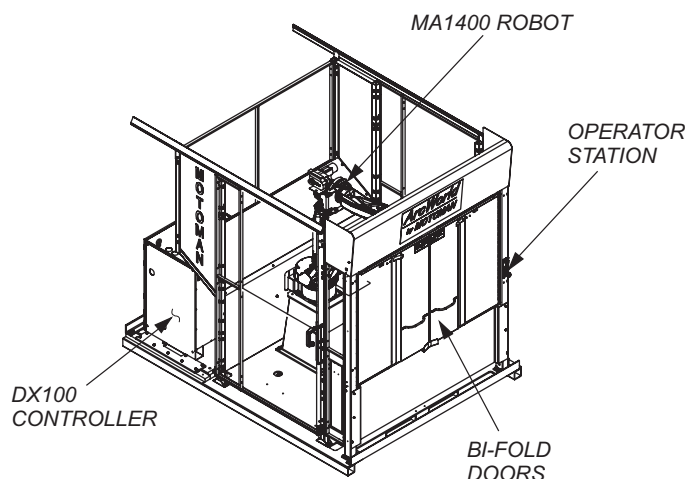
This section gives foundation and anchoring suggestions for components of the ArcWorld® II-50 Series system.

1.2 System Overview

Motoman's classic ArcWorld® II-50 Series robotic solutions are high-performance, pre-engineered work cells that are ideal for smaller part fabrication at medium to high volumes. The system is designed around a high-performance MA-series Motoman robot and DX100 controller and includes an integrated welding package, operator interface, and total safety environment. Safety features include load station(s) interlocked with dual-channel safeguards, interlocked access doors, and safety fencing.

Two manually operated bi-fold doors provide access to the cell for loading and unloading of production parts. The ArcWorld II-50 has one robot work area, while the ArcWorld II-52 has two robot work areas. The two work areas enable the operator to load and unload parts from one station while the robot is working at the other. Stationary weld tables are standard for the ArcWorld II-50/52. The "S" designation indicates that the system includes MH180 servo-driven headstocks for positioning of parts. *Figure 1-1* illustrates the layout and component locations for the ArcWorld® II-50 Series system.

Figure 1-1: System Layout (Shown with Optional Common Base)



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

ArcWorld® II-50 Series	1	Introduction
	1.2	System Overview

1.2.1 System Layout

All components of the ArcWorld® II-50 Series are mounted to the floor or optional common equipment base. The robotic cell is fully enclosed by safety fencing and an interlocking door. The interlocked station doors allow the operator to load parts. All operator controls, including those on the controller and welding power supply, are accessible from outside of the robotic enclosure.

1.2.2 Major Components

The ArcWorld® II-50 Series includes the following major components:

- Motoman MA1400 manipulator and DX100 controller
- Two stationary weld tables (ArcWorld II-50/52)
- MH180 servo-driven headstock(s) (ArcWorld II-50S/52S)
- Operator Station
- Welding equipment, including the following:
 - Welding power source
 - Motoman torch (water-cooled or air-cooled)
 - Wire feeder
 - Applicable welding interface
 - Torch mount
- Safety equipment, including the following:
 - Safety fencing with arc curtains
 - Interlocked cell door
 - Locking bi-fold doors
 - L-axis in position switch

1.2.3 Optional Equipment

The following optional equipment is available for use with the ArcWorld® II-50 Series systems:

- Torch tender
- Wire cutter
- ComArc III™ seam tracking unit
- Water circulator
- Touch Sense™ Starting Point detection unit
- Common Equipment Base

1.3 Reference Documentation

For additional information, refer to the following:

- Motoman *MA1400 Manipulator Manual* (P/N 155557-1CD)
- Motoman *Brake Release Manual* (P/N 156239-1CD)
- Motoman *DX100 Controller Manual* (P/N 155494-1CD)
- Motoman *Maintenance Manual for DX100* (P/N 155492-1CD)
- Motoman *Operator's Manual for Arc Welding* (P/N 155490-1CD)
- Motoman *DX100 Concurrent I/O Manual* (P/N 155491-1CD)
- Motoman *MH-Series Positioner Manual* (P/N 156488-1CD)
- Motoman *INFORM User's Manual* (P/N 155493-1CD)
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Service Information

If you are in need of technical assistance, contact the Motoman Customer Service staff at (937) 847-3200. Please have the following information ready before you call:

- | | |
|----------------------------|--|
| • Robot Type | MA1400 |
| • Application Type | Welding |
| • System Type | ArcWorld® II-50 Series |
| • Software Version | Access this information on the Programming Pendant's LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION} |
| • Robot Serial Number | Located on the back side of the robot's arm |
| • Robot Sales Order Number | Located on the front door of the DX100 controller |

	2	Equipment Description
ArcWorld® II-50 Series	2.1	Robot Description

2 Equipment Description

2.1 Robot Description

The ArcWorld® II-50 Series system uses the Motoman MA1400 six-axis robot(s). The MA1400 robot is specifically designed for arc-welding applications. The robot has a payload capability of 3 kg and features a horizontal reach of 1434 mm. The MA1400 robot also features a relative positioning accuracy of ± 0.08 mm. The MA1400 robot has an internal cabling design that provides high flexibility and streamlines the robot profile, thus allowing access into confined spaces. The robot's B-axis (Pitch/Yaw) features an expanded range of motion that improves circumferential welding on cylindrical work pieces. The T-axis (Twist) can rotate the welding torch ± 200 degrees without cable interference.

For additional information on the Motoman MA1400 robot, please refer to the *MA1400 Manipulator Manual* that is included with your ArcWorld® II-50 Series system (refer to *Section 1.3*).

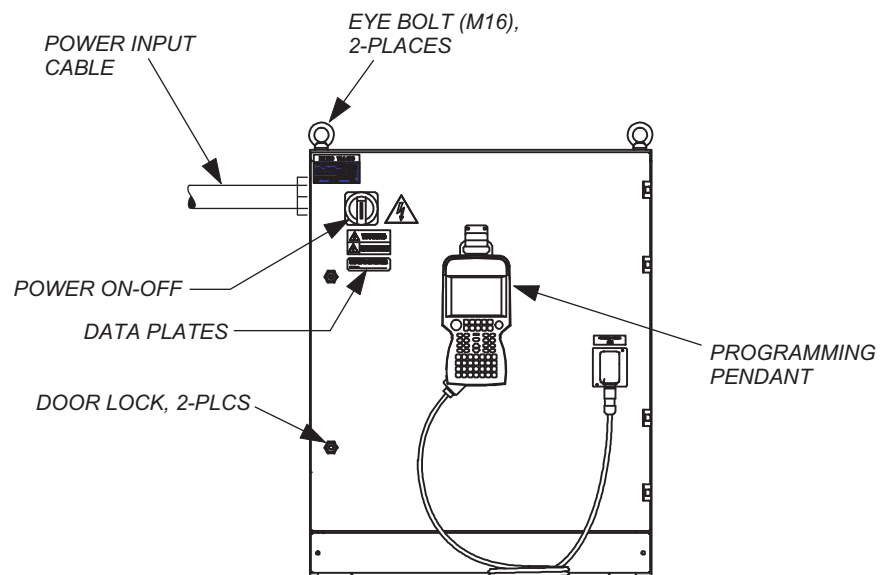
2.2 DX100 Controller

The DX100 robotic controller (see *Figure 2-1*) includes a Windows® CE Programming Pendant with a color touch screen, high-speed processing, built-in Ethernet, and a robust PC architecture. The DX100 easily handles multiple tasks and can control up to eight robots (up to 72 axes, including robots and external axes) and input/output (I/O) devices. Advanced Robot Motion (ARM) control provides high-performance path accuracy and vibration control.

The DX100 coordinates the operation of the ArcWorld® II-50 Series system. It controls manipulator movement and welding power supply, processes input and output signals, and provides the signals to operate the welding system.

For additional information on the Motoman DX100 controller, please refer to the *DX100 Controller Manual* that is included with your ArcWorld® II-50 Series documentation package (see *Section 1.3*).

Figure 2-1: DX100 Controller

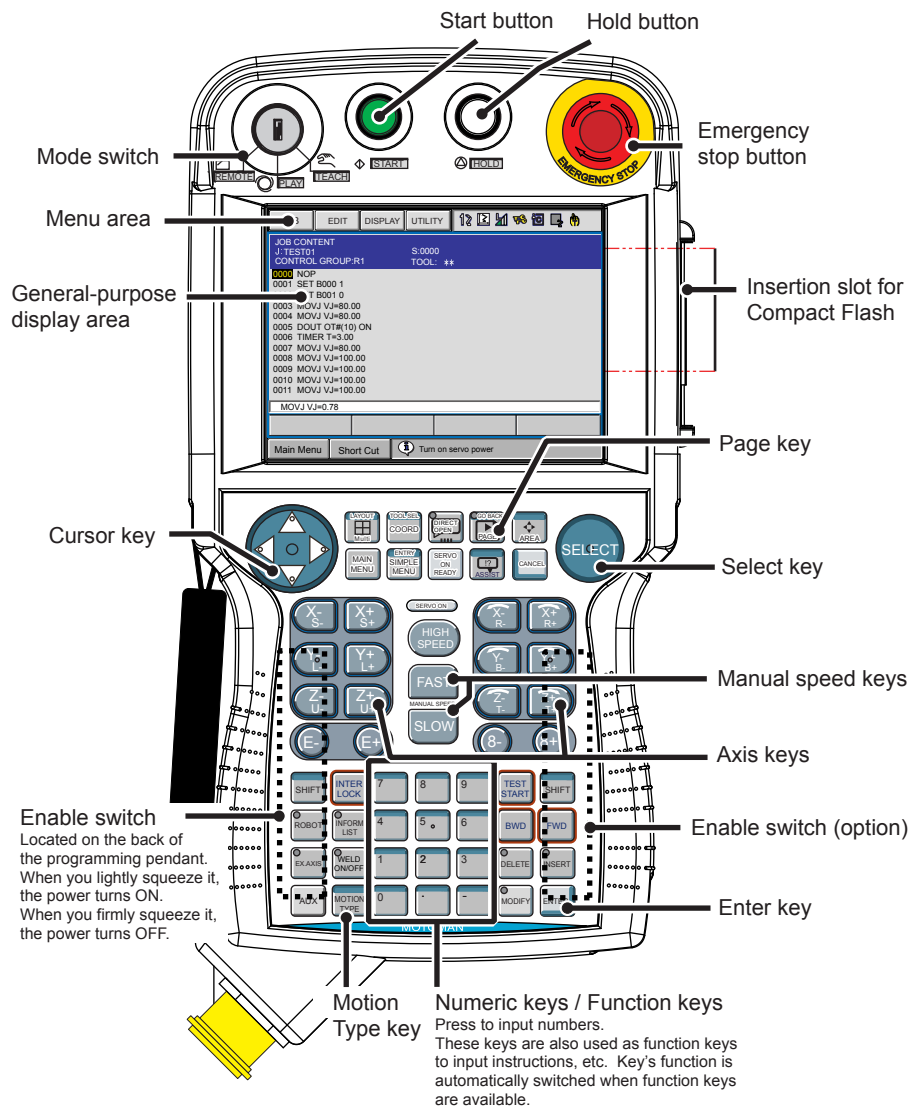


2.2.1 Programming Pendant

The Programming Pendant (see *Figure 2-2*) is the primary user interface for the system and features a cross-shaped navigation cursor that reduces teaching time by 30 percent. The pendant has a 5.7-inch color touch-screen display (640 x 480 VGA) and provides a CompactFlash card slot and USB port for data backups. The system uses the INFORM robot programming language and a menu-driven interface to simplify operator interaction with the robot.

Most operator controls are located on the Programming Pendant, allowing the controller cabinet to be mounted remotely. By using the pendant, the operator can teach the robot motion and perform programming, editing, maintenance, and diagnostic functions. For detailed information on the pendant's programming keys, programming functions, and display functions, refer to the *Operator's Manual for Arc Welding* that came with your system (see *Section 1.3*).

Figure 2-2: Programming Pendant

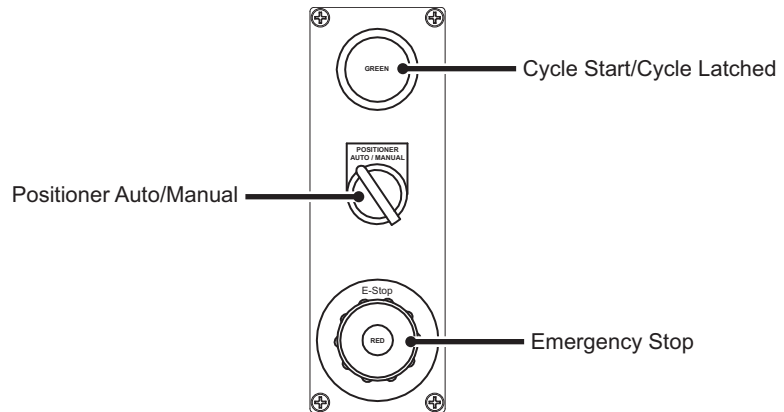


The Programming Pendant's display goes into screen saver mode after a few minutes of inactivity. Press any key to restore the screen.

2.3 Operator Station

The Operator Station (see *Figure 2-3*) includes a NEMA enclosure that is mounted onto the fence. The following paragraphs describe the Operator Station controls.

Figure 2-3: Operator Station



2.3.1 CYCLE START/CYCLE LATCHED Button

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

The green CYCLE START/CYCLE LATCHED button initiates a job cycle when the robot is in HOME position. If the CYCLE START/CYCLE LATCHED button is pressed while the robot is outside HOME position, the Cycle Start command does not execute until the robot returns to HOME position.

The Cycle Latched lamp illuminates when the CYCLE START/CYCLE LATCHED button is pressed during operation. When the lamp is illuminated, the positioner will sweep and the robot will begin to weld immediately after the current job cycle is complete. It is not necessary to wait for the robot to finish welding and return to HOME position before pressing the CYCLE START/CYCLE LATCHED button. Pressing this button while the robot is still in motion latches the Cycle Start command into the controller.

2.3.2 EMERGENCY STOP (E-STOP) Button

Pressing the red EMERGENCY STOP (E-STOP) button removes servo power and stops all system operation. Brakes are applied to the robot, and all positioner motion is stopped.

2.3.3 POSITIONER AUTO/MANUAL (ArcWorld II-50S/52S Only)

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



The POSITIONER AUTO/MANUAL signal depends upon the structure of the Control Master job.

2.4 Work Stations

Each ArcWorld® II-50 Series work cell comes with positioner support posts for weld table or MH-series headstock mounting. *Table 2-1* shows the optional weld tables and headstocks available for each work cell. Motoman does not supply weld tables with any standard cell.

Table 2-1: Work Cell Options

System	Weld Table Mount	MH-series Headstock
ArcWorld II-50	1	N/A
ArcWorld II-50S	N/A	1
ArcWorld II-52	2	N/A
ArcWorld II-52S	N/A	2

2.4.1 Stationary Weld Tables

Optional weld tables are available to secure production parts using customer-supplied tooling fixtures. See *Table 2-2* for weld table specifications.

Table 2-2: Weld Table Specifications

Conditions	Specifications
Part/Fixture Rating	Each optional table can support up to 300 kg.
Temperature Operating Range	4-43°C (40 to 110° F)
Humidity	Non-condensing 10 - 90% relative humidity is acceptable (see note below).
Welding Current Rating	600 amperes at 100% duty cycle



In high humidity areas, the weld table tooling plates may rust or corrode. Use surface protection to prevent corrosion of unpainted tooling surfaces.

2.4.2 MH180 Headstock (ArcWorld II-50S/52S Only)

The Motoman MH180 drive assembly provides precision-controlled rotary motion and can be mounted in any orientation. The standard configuration utilizes an AC servo motor, a high-ratio gear reducer with integral output bearing, faceplate, and a cast iron housing. It also includes dual integral position switches and one or more weld ground brushes rated at 400 amps per brush.

For detailed positioner specifications for the MH180 headstock, including a parts lists breakdown, refer to the *MH-Series Positioner Manual with MotoMount and Drive Assemblies* (see *Section 1.3*).



In high humidity areas, use surface protection to prevent corrosion of the tooling plates.

ArcWorld® II-50 Series	2	Equipment Description
	2.5	Welding Equipment

2.5 Welding Equipment

In its standard configuration, the ArcWorld® II-50 Series system includes a welding power source, wire feeder, torch, and torch mount. Optional equipment — including water circulators, ComArc™ units, and torch tenders — may also be included with your system.

2.5.1 Power Sources

Motoman offers several different power sources for use with the ArcWorld® II-50 Series system, depending on the customer's specific application. For additional information, refer to the welding power source vendor manual that is included with the ArcWorld® II-50 Series documentation package (see *Section 1.3*).

2.5.2 Wire Feeder

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

2.5.3 GMAW Torch

The ArcWorld® II-50 Series system uses either an air-cooled or water-cooled robotic/automatic GMAW torch. These are heavy-duty torches 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's wrist. 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 Emergency Stop condition (refer to *Section 4.3.2* and *Section 4.3.3*). For applications that use the water-cooled torch, the ArcWorld® II-50 Series system includes a water circulator kit.

2.6 Safety Features

The ArcWorld® II-50 Series system includes a total safety environment. When all standard safety precautions are taken, the safety equipment helps to ensure safe operation of the robotic cell. The ANSI/RIA R15.06-1999 Robot Safety Standard stipulates that the user is responsible for safeguarding.



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

2.6.1 Interlocked Bi-fold Doors



WARNING

Do not operate this equipment unless the access doors are in place and working properly or eye damage can occur!

The ArcWorld® II-50 Series features two independent, manually operated bi-fold doors that provide access to the loading and unloading areas of the work cell. These doors act as a shield to protect the operator from the arc radiation and sparks produced by the welding operation. Both doors slide in rails and utilize electromagnetic safety interlocks to deny cell access during the welding process. Adjustments to let the doors open or close easier are made using spring detents.

2.6.2 Arc Screens



WARNING

Never look directly at the welding arc without protective eye wear. The welding arc can cause permanent eye damage if viewed without protective shielding or eye wear.

Two types of arc screens are part of the ArcWorld® II-50 Series system:

- The operator doors: These steel screens protect the operator by blocking ultraviolet radiation, sparks, and other welding by-products that result from the welding operation.
- Safety fence covering: The orange-colored sheeting that covers the safety fence composes the second arc screen. This material reduces the amount of ultraviolet radiation that escapes the ArcWorld® II-50 Series work cell during welding operations.

2.6.3 Safety Fencing

The safety fencing provided with the ArcWorld® II-50 Series system encloses the entire robotic cell. It forms a physical barrier preventing entry into the cell during automatic operation.

2.6.4 EMERGENCY STOP (E-STOP) Buttons

In addition to the safety features described above, the ArcWorld® II-50 Series has strategically placed EMERGENCY STOP (E-STOP) buttons. These are operator-actuated devices that, when activated, immediately stop all system operation. Brakes are applied to the robot, and all servo power is removed from the system. The following is a list of E-STOP locations:

- Programming Pendant
- Operator Station

ArcWorld® II-50 Series	2	Equipment Description
	2.6	Safety Features

2.6.5 ENABLE Switch

The ENABLE switch (see *Figure 2-2*) is a three-position switch located on the left rear of the Programming Pendant. It is a safety feature that controls servo power while the pendant is in TEACH mode. When pressed in, this switch enables the operator to turn servo power on. Should the operator release the switch or grasp it too tightly, however, servo power is immediately removed, preventing further robot movement. For detailed information about the operation of the ENABLE switch, refer to the *DX100 Controller Manual* and the *Operator's Manual for Arc Welding* that came with your system (see *Section 1.3*).

2.6.6 Robot Braking System

The robot brakes are designed to protect the robot and other system components from damage in the event of, for example, a system or robot failure or a loss of drive power. The brake release allows the operator to release the brake of a specific robot axis when drive power has been removed from the system. The Programming Pendant is used to access the brake release function. Refer to the *Brake Release Manual* that came with your system (see *Section 1.3*).

2.6.7 Interlocked Work-cell Door

A safety interlock on each of the ArcWorld® II-50 Series robotic work-cell access doors prevents entry into the work cell during PLAY mode. Opening either work-cell door while the ArcWorld® II-50 Series system is in PLAY mode immediately triggers an E-STOP condition. Brakes are applied to the robot, all servo power is removed, and all positioner motion stops. To continue operation of the ArcWorld® II-50 Series system, the operator must reset these safety interlocks. Refer to *Section 4.3.2* for E-STOP reset procedures.

ArcWorld® II-50 Series	3	Installation
	3.1	Materials Required

3 Installation

The ArcWorld® II-50 Series system can be installed easily in just a short amount of time. Comply with all the safety instructions and precautions given throughout this manual during the installation process. Failure to use safe work practices can result in damage to the equipment and injury to the workers.

It is the purchaser's responsibility to determine and supply all anchoring and foundation requirements for their installation. Before installing your ArcWorld® II-50 Series cell, refer to *Section 6* to determine the anchor and foundation requirements for all the equipment used in your cell.

The instructions given in this sections are general guidelines for installing the ArcWorld® II-50 Series system. Refer to your system drawings and relevant system component manuals for specific installation information (see *Section 1.3*).



CAUTION

Installation of the ArcWorld® II-50 Series system is not a task for the novice. The ArcWorld system is not fragile, but it is a highly sophisticated robotic system. Handle components with care. Rough handling can damage the system's electronic components.

3.1 Materials Required

All hardware necessary for installing the ArcWorld® II-50 Series is included with the system. This section identifies the customer-supplied items and tools required to complete installation.

3.1.1 Customer-supplied Items

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

ArcWorld® II-50 Series	3	Installation
	3.2	Site Preparation

3.1.2 List of Tools

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

3.2 Site Preparation

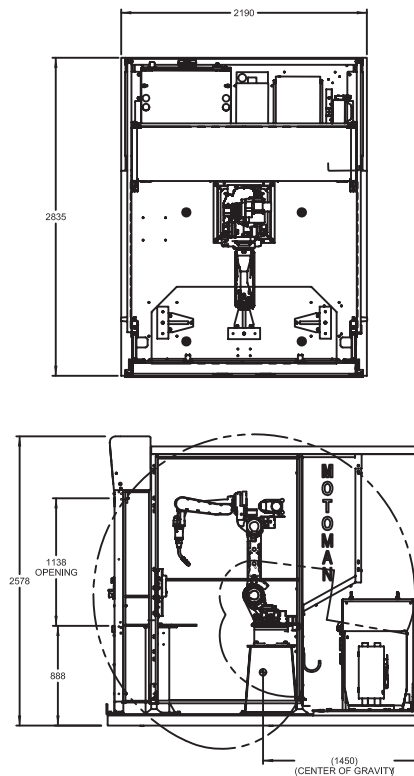
To prepare your site, proceed as follows:

1. Clear the floor space needed for the ArcWorld® II-50 Series system work cell (see *Figure 3-1*).



To make installation easier, allow an additional 1.2 to 1.5 m on all sides of the work cell.

Figure 3-1: Area Needed for Installation (optional common base shown)



2. Gather all the customer-supplied items and required tools listed in Section 3.1.

If your system includes the optional common equipment base, proceed to Section 3.9 "Installing the Common Equipment Base (Option)" for installation instructions.

3.3 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.

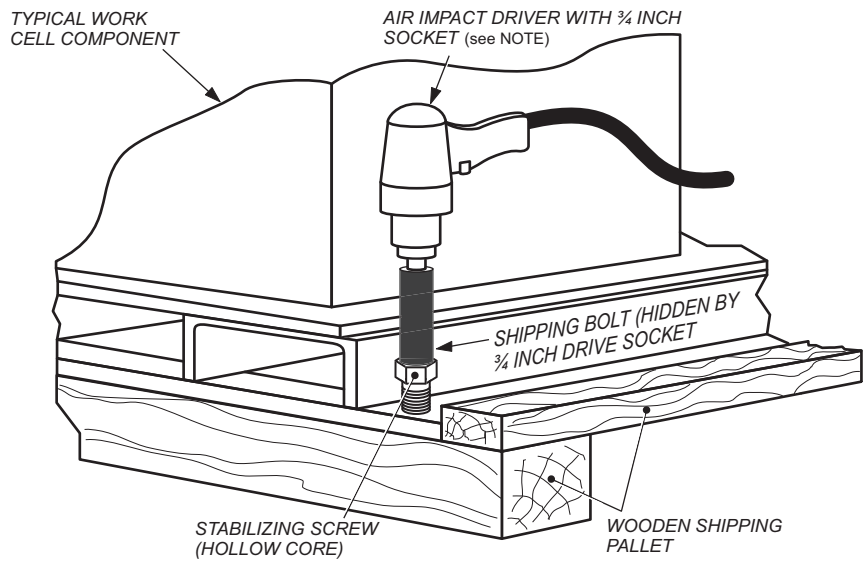


If you notice any equipment damage, notify your shipping contractor as soon as possible.

1. Unbolt each component from its shipping skid using a 3/4-inch socket (see Figure 3-2).
2. Use a forklift(s) or overhead crane to lift each component away from its shipping skid.

Figure 3-2: Typical Stabilizing Screw and Removal of A Shipping Lag Bolt

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



3. Remove and discard or recycle all shipping materials, including the shipping skids.

3.4 Installing the Robot/Riser Base



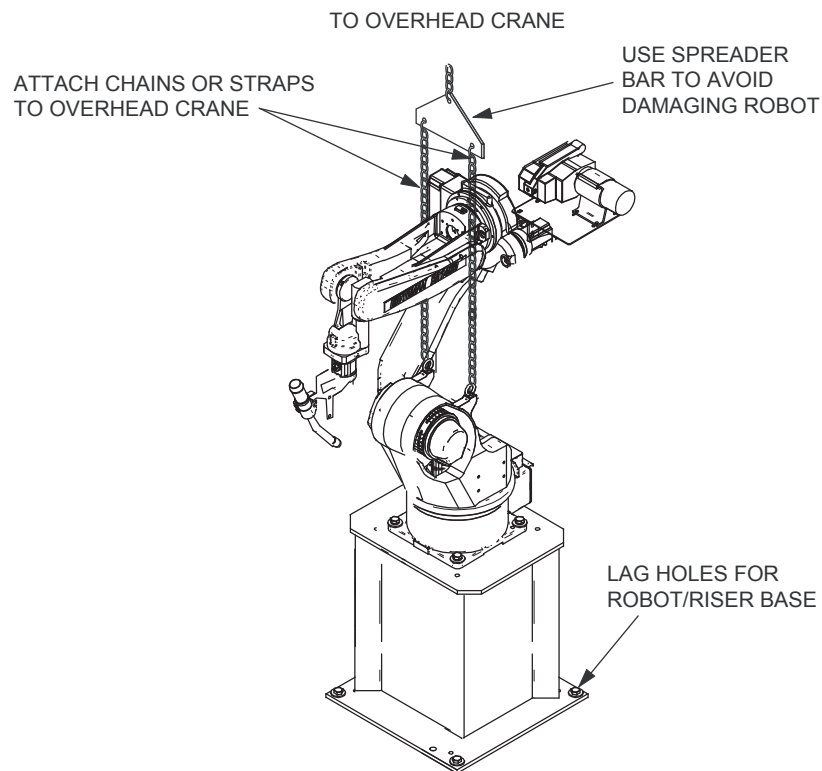
WARNING

The robot/riser weighs 450 kg. Be sure that your crane or forklift is capable of handling this much weight, or damage to the equipment or injury to personnel can result.

The following are general guidelines for transporting and installing the robot/riser base. For more detailed information, refer to your system drawings and to the manipulator manual (see *Section 1.3*).

1. Unbolt the robot/riser base from its shipping skid using a 3/4-inch socket wrench.
2. Using an overhead crane, remove the robot/riser from the shipping skid (see *Figure 3-3*).

Figure 3-3: Robot/Riser Base



3. Place the robot/riser in position according to the system drawings.
4. Carefully remove all protective packaging materials and discard.
5. Inspect the robot, torch, and riser for shipping damage.



If damage is found, notify the shipper immediately.

6. Anchor the robot/riser securely in place (refer to *Section 6* for anchor requirements).

3.5 Installing the Weld Stations

The following are general guidelines for installing the weld stations. For more detailed information, refer to your system drawings.

1. Unbolt and remove the weld table(s) or MH180 headstock(s) from its shipping skid.
2. Place the weld table(s) or headstock(s) in position according to your system drawings.
3. Carefully remove any protective plastic wrapping and inspect for shipping damage.



If damage is found, notify the shipper immediately.

ArcWorld® II-50 Series	3	Installation
	3.6	Installing the Safety Fence Assembly

4. Anchor the weld table(s) or MH180 headstock(s) securely in place (refer to *Section 6* for anchor requirements).



For information on leveling and securing the MH180 headstock, refer to the *MH-series Positioner Manual With MotoMount and Drive Assemblies* (see *Section 1.3*).

3.6 Installing the Safety Fence Assembly

The fencing that surrounds the workcell and completes the welding cell's protective walls is shipped on its own skid with all the hardware needed for installation.



CAUTION

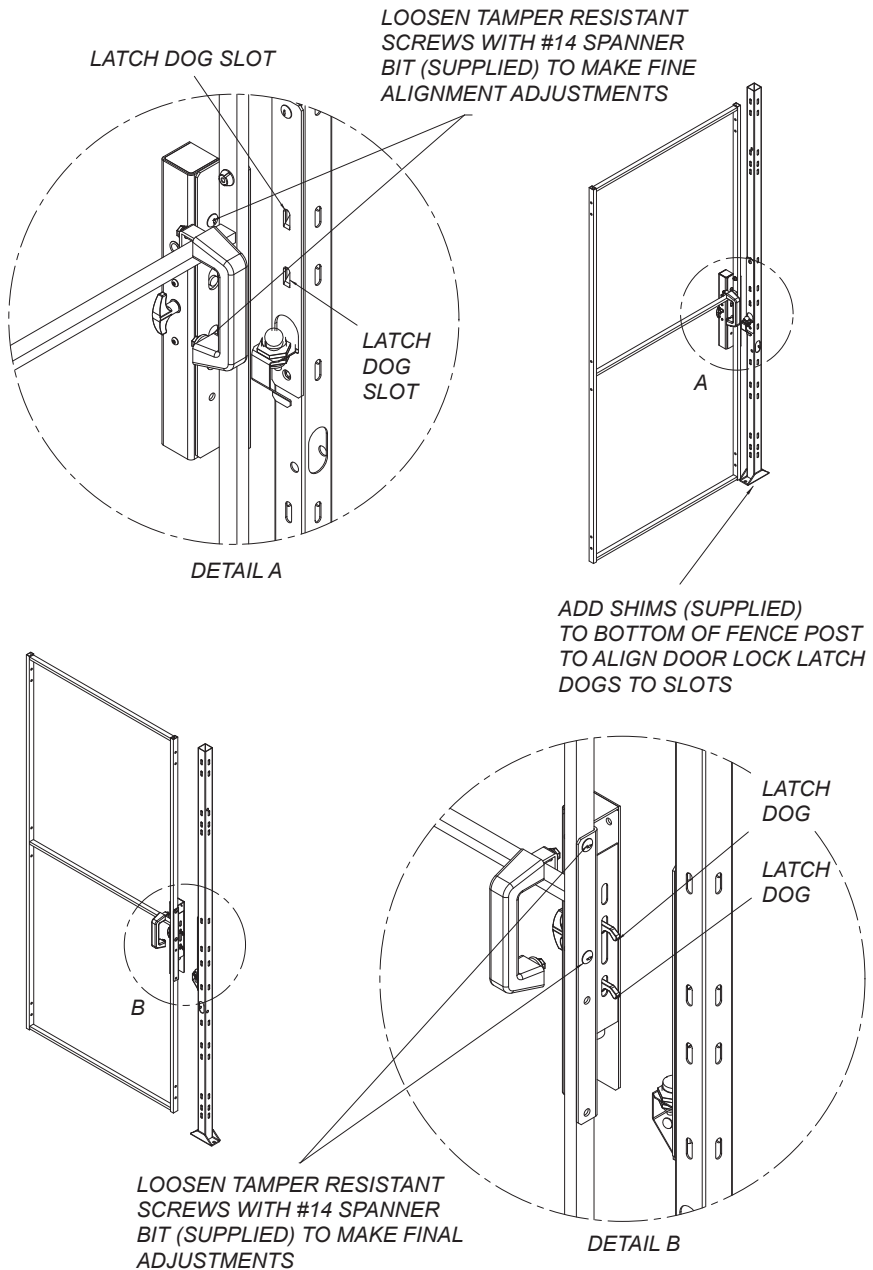
Be careful when cutting the metal bands and wear protective gloves. The metal bands are under tension and may cause injury to anyone near the bands when cut.

See *Figure 1-1* and *Figure 3-1* for the 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® II-50 Series system documentation package (refer to *Section 1.3*).

3.6.1 Door Latch Alignment

Adjust the location of the door latch as necessary to provide smooth operation of the door assembly. A #14 spanner bit is provided to loosen and adjust the location of the latch assembly. Metal shims are also provided and can be placed beneath the fence posts to make gross adjustments. See Figure 3-4.

Figure 3-4: Door Latch Alignment



3.7 Installing the Arc Curtains

The arc curtains are packaged in an accessories box that is shipped with the ArcWorld® II-50 Series system.



WARNING

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

Install the arc curtains as follows:

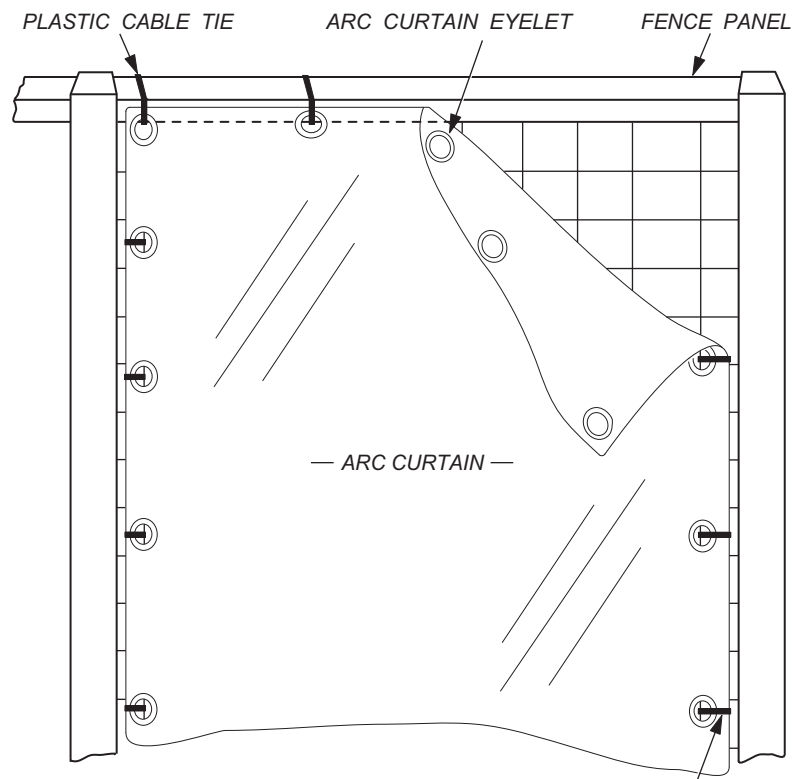
1. Unfold each arc curtain and install one on the **inside** of each work-cell safety fence panel using the supplied plastic cable ties and the eyelets in each arc curtain (see *Figure 3-5*).



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 that 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 3-5*).

Figure 3-5: Arc Curtain Installation on Typical Safety Fence Panel



NOTE – Arc curtain is installed on the fence panel side that faces the **INTERIOR** of the robotic work cell

PLASTIC CABLE TIE

3.8 Installing the Controller and Power Source

The DX100 controller and power source are shipped on a separate wooden shipping skid. To install the controller and power source, refer to the controller manual and system drawings that came with your ArcWorld® II-50 Series system and proceed as follows (see *Section 1.3*):

1. Unbolt the controller from the wooden shipping skid by removing the four shipping bolts using a 3/4-inch deep well socket.



WARNING

The controller can weigh as much as 150 kg. Be sure that your crane or forklift is capable of handling this much weight, or damage to the equipment or injury to personnel can result.

2. Using a forklift, lift the controller and remove it from the wooden shipping skid.
3. Place the controller approximately 0.6 m from and beside the ArcWorld® II-50 Series work cell (see *Figure 3-1*).
4. Unbolt the power source from the wooden shipping skid and place it beside the ArcWorld® II-50 Series work cell.
5. Carefully remove the protective plastic wrapping and cardboard from the controller and power source.
6. Inspect the controller and power source for shipping damage.



If damage is found, notify the shipper immediately.

7. Anchor the controller and power source securely in place (refer to *Section 6* for anchor requirements).

3.9 Installing the Common Equipment Base (Option)

If your system includes the optional common equipment base, use the following instructions for installation.

The common base is shipped on a wooden platform. To install the common base, refer to your system drawings and proceed as follows:



CAUTION

Handle system components carefully. Some components can be damaged if dropped or otherwise handled roughly.

1. Unbolt the common base from the platform. The bolts that secure the common base to the wooden platform go down through the hollow leveling screws and are threaded into the wooden platform (see

Figure 3-2). It may be necessary to hold the leveling screws in place with a suitable open-end wrench while removing the shipping bolts.



WARNING

As shipped, the common base (with equipment) weighs approximately 1856 kg. Use a forklift that is rated for this amount of weight load.

2. Using a forklift, lift the common base from the wooden platform. Discard or recycle the wooden shipping skid.
3. Place the common base in position (see *Figure 3-1*).



Make sure that there is adequate room on all sides of the robot/positioner common base for the Operator Station, the light curtains, and the auxiliary equipment common bases (see *Figure 3-1*).

4. Carefully remove the protective plastic wrapping from the robot(s), torches, and rotary positioner.
5. Inspect the robots, torches, and rotary positioner for shipping damage.



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

6. Use an M36 socket to loosen or tighten each leveling bolt to level the common base (see *Figure 3-2*).



CAUTION

Be absolutely certain of the correct location for the common base before securing the base with anchor (lag) bolts.

7. Secure the common base to the floor. Use a suitable concrete drill bit and special anchor (lag) bolts (refer to *Section 6* for the correct drill bit and anchor bolt). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.

3.10 Cable Connections

After the ArcWorld® II-50 Series system is anchored in its correct location, locate the interconnect cables for the system components and route them according to the system drawings and schematics included in the ArcWorld® II-50 Series system documentation package. All cables and connectors are labeled to ensure correct connection to the mating connectors on the applicable system component.



A small gap exists between the bottom of the work-cell safety fence and the floor. This gap provides a passage for cables that run between the components outside the work cell and those inside the work cell.

3.10.1 Connection to Earth Ground



WARNING

Do not use the ArcWorld® II-50 Series system unless specified components are connected to a low-resistance earth ground. Do not connect the earth ground wire with the wires for the electric power source, welder, etc. The low-resistance earth ground must be a “dedicated” ground that is a direct connection between a component and the earth ground point. Operator injury or death, as well as equipment damage, can result from an inadequate or defective earth ground system.

The robot and DX100 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. 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 conditions. 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.

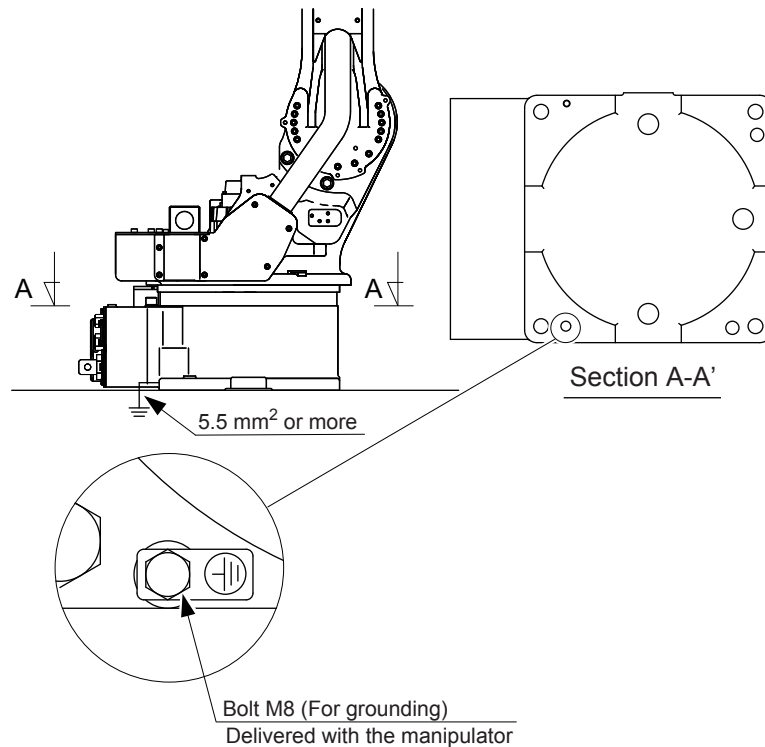


The customer shall supply all wires associated with the earth ground. The customer is responsible for establishing the correct gauge of all wires associated with the earth ground and maintaining an adequate earth ground (measured resistance of 100 ohms or less).

Connect the robots and controller assembly 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 1-1* for the location of robot R1.
2. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside DX100 controller (see *Figure 2-1*). Connect the other end of the earth ground wire to the low-resistance earth ground.

Fig. 3-6: Grounding Method



3.10.2 Connecting the Robot Cables

Two cables, 1BC and 2BC, connect the robot to the controller. The 1BC cable provides position feedback from the robot to the controller. The 2BC cable provides power to the robot's servo motors. To connect the robot cables, proceed as follows:



CAUTION

Use care when attaching the cable connectors to the mating connectors on the robot(s) and controller(s). Do not use excessive force. Make sure that the cable connectors are correctly aligned with the mating connectors. The connectors are of the "multi-pin" type and are easily damaged if forced into position.

1. Unpack the Programming Pendant and plug its connector into the receptacle on the front door of the controller.
2. Unpack the two large black manipulator cables and route one to the controller and the other to the back of the robot.
3. Connect one end of each cable (labeled 1BC and 2BC) to the 1BC and 2BC connections on the back of the robot (see *Figure 3-7*). Connect the other ends of the 1BC and 2BC cables to the 1BC and 2BC connections on the side of the controller.

Fig. 3-7: Manipulator Cables

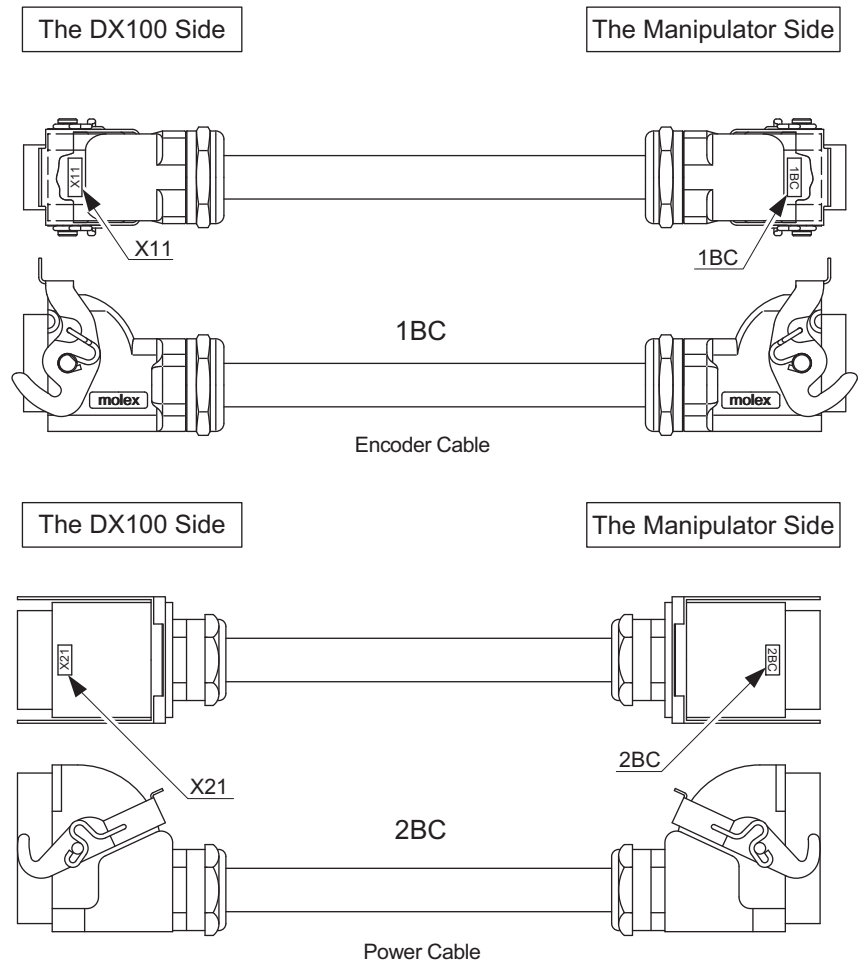


Fig. 3-8(a): Manipulator Cable Connectors (Manipulator Side)

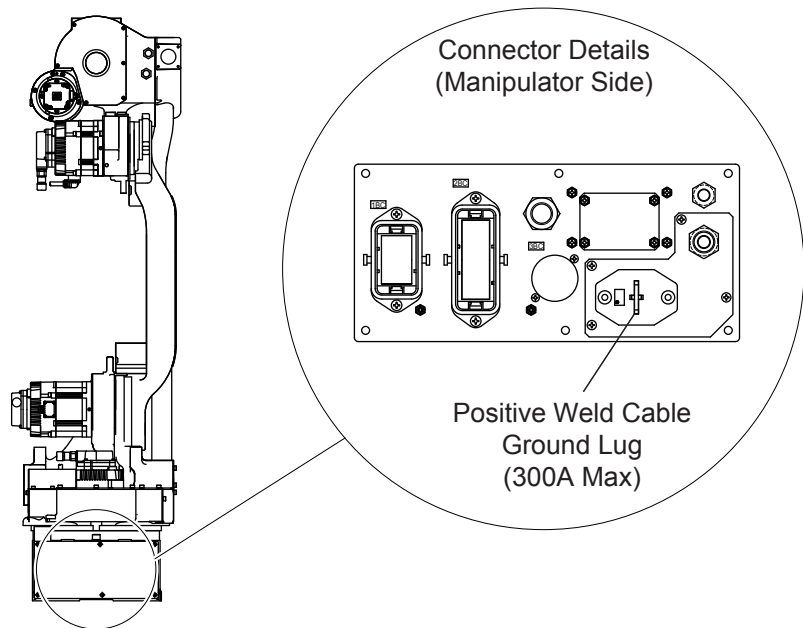
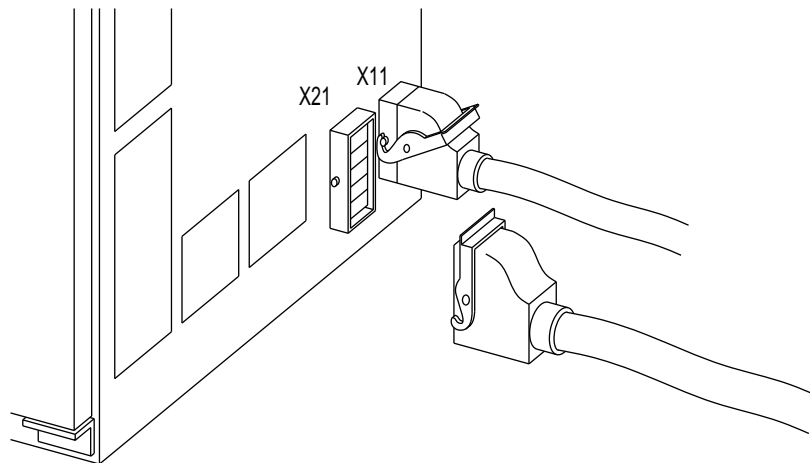


Fig. 3-8(b): Manipulator Cable Connection to the DX100



3.10.3 Connection to Local Electrical Service



WARNING

Local electrical service connection to the ArcWorld® II-50 Series system must be performed by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC), as well as all local electrical codes.



The ArcWorld® II-50 Series system is configured for three-phase 460/480V AC primary power. For additional information, refer to the electrical drawings and schematics that are included with your system documentation package (see *Section 1.3*).

After all the system components have been properly installed and interconnected, connect local electrical service to the DX100 controller and welding power source (refer to *chapter 3.10.3.1* and *chapter 3.10.3.2*).

3.10.3.1 DX100 Controller

For detailed electrical service interconnect procedures for the DX100 controller, refer to the *DX100 Controller Manual* and ArcWorld® II-50 Series system drawings and schematics that are included with your system documentation package (see *Section 1.3*).

3.10.3.2 Welding Power Sources

Refer to the welding power source documentation and ArcWorld® II-50 Series system drawings and schematics for electrical service connection procedures and diagrams for the welding power sources.

3.11 Safety/Operation Check

Before installing the tooling and fixtures for your application, take a few minutes to perform the following safety/operation check:

1. Check that station door is closed and door interlock is engaged.
2. Check the security and integrity of all cable connections.
3. Ensure that the work-cell sliding access door is closed and the door interlock is engaged.
4. Verify the correct settings for the welding power sources (refer to the welding power source documentation that is included with your ArcWorld® II-50 Series system).
5. Verify that local electrical service complies with the power requirements for your ArcWorld® II-50 Series system.
6. Verify that local electrical service is correctly wired into the DX100 controller assembly and the welding power sources (refer to *Section 3.10.1*).



CAUTION

The ArcWorld® II-50 Series system is now ready for power-up. Qualified, trained personnel who are familiar with this system should perform the power-up sequence.

7. Set the power ON-OFF switch on the DX100 controller to ON (see *Figure 2-1*).



An electrical service disconnect box for the DX100 controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld® II-50 Series system shipment.

8. Set the service disconnect boxes for the welding power sources to ON (see *Figure 2-1*).
9. Set the power ON-OFF switch on the welding power sources 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).

10. Check for correct operation of all E-STOP push buttons (refer to *Section 2.6.4*).

11. Check for correct operation of the system HOLD buttons on the Programming Pendant. Refer to the *Operator's Manual for Arc Welding* for more information on the pendant's HOLD button (see *Section 1.3*).
12. Check for correct operation of the work-cell access door safety interlock.
13. Remove power from the ArcWorld® II-50 Series system after completion of the safety/operation check.

3.12 Installation of Tooling and Fixtures

Your ArcWorld® II-50 Series system is now ready for installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the ArcWorld® II-50 Series system should perform this installation. After tooling installation, test the positioner for correct operation. Refer to the positioner manual for information on how to test that the positioner is operating correctly (see *Section 1.3*).



- All tooling and fixtures for the positioner shall be supplied by the customer.
- Motoman recommends application of a corrosion/rust preventive compound to tooling and fixtures located in a high-humidity environment.

4 Operation

This section provides a brief overview of the operating procedures and precautions for your ArcWorld® II-50 Series system. For more detailed operating information, refer to the specific component manuals that are part of the ArcWorld® II-50 Series system documentation package (see *Section 1.3*).

The ArcWorld II-50 system is a single station welding cell that uses a Motoman MA-Series robot to weld parts. When the robot completes the welding process, it returns to HOME (Safe) position. The operator then unloads the welded parts and loads new parts for processing. Once the new parts have been loaded and the door closed, the operator can initiate another cycle from the Operator Station.

The ArcWorld II-52 is two station welding cell. The ArcWorld II-52 uses a Motoman MA-Series robot to weld parts on one station while the operator loads the other station with parts. When the robot completes the welding process, it returns to the HOME (Safe) position. The operator can then initiate another cycle from the Operator Station. This moves the robot to the next station, where the robot then moves from the HOME (Safe) position to complete another welding cycle.



The customer shall supply all tooling fixtures for the positioner.

4.1 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 DX100 controller documentation that is included with your ArcWorld® II-50 Series system documentation package (see *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® II-50 Series system. **If you determine a need to modify the original jobs and system configuration, make any modifications to a copy of the original. Keep the original as a backup. Do not modify the original.** Modifications must be performed by trained and experienced personnel who are familiar with the operation of the ArcWorld® II-50 Series system. If you have questions concerning the configuration of your system, please contact Motoman's 24-hour Customer Support (refer to *Section 1.4*).

4.2 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 the start-up procedure (see *Section 4.2.1*).
- Move the robot to HOME position (see *Section 4.2.2*).
- Start the Control Master job (see *Section 4.2.3*).
- Perform the operation cycle (see *Section 4.2.4*).
- Perform the shutdown procedure (see *Section 4.2.5*).

4.2.1 Start-up Procedure

To start up the ArcWorld® II-50 Series work cell from a power-off condition, proceed as follows:

1. If installed, switch the DX100 controller electrical service disconnect box to ON.



An electrical service disconnect box for the DX100 controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld® II-50 Series system shipment.

2. Set the power ON-OFF switch on the DX100 controller to ON (see *fig. 2-1*).
3. Switch the welding power source electrical service disconnect box to ON (see *fig. 2-1*).
4. Set the power ON-OFF switch on the welding power source to ON (the ON-OFF indicator lamp on each welding power source illuminates).
5. Open the regulator valve for the welding gas supply.
6. Make sure that the work-cell doors are closed and operating properly and safety interlocks are engaged.
7. Make sure all E-STOP buttons are released. E-STOP buttons are installed at the following locations:
 - Programming Pendant
 - Operator Station
8. Select TEACH mode on the Programming Pendant.
9. Place the robot in HOME position (see *Section 4.2.2*).

4.2.2 Robot HOME Position

To move the robot to HOME position:

1. Select TEACH mode on the Programming Pendant.
2. Select MAIN MENU on the Programming Pendant's touch screen.
3. Select JOB on the Programming Pendant's touch screen.
4. Select SELECT JOB on the Programming Pendant's touch screen. A job list appears on the screen.
5. Use the navigation cursor key to move the cursor to SAFE job and then press SELECT (the job appears on the display screen).

ArcWorld® II-50 Series	4	Operation
	4.2	Daily Operation

6. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.
7. Use the FWD button on the Programming Pendant to jog the robot to HOME position.

4.2.3 Master Job

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

1. Select JOB on the Programming Pendant's touch screen.
2. Select CTRL MASTER on the Programming Pendant's touch screen.
3. Press SELECT twice to activate the Master job.
4. Select PLAY mode on the Programming Pendant (job playback operation is enabled).
5. Press the SERVO ON button on the Programming Pendant.
6. Press the START button on the Programming Pendant (the Control Master job cycles, waiting for a Cycle Start input from the Operator Station).

The ArcWorld® II-50 Series work cell is now ready for operation.

4.2.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld II-52 work cell after start-up:

1. Load the fixture with parts to be welded.
2. Close the bi-fold access door.



Before operating at first power-up, make sure that the correct job has been loaded.

3. Press the CYCLE START/CYCLE LATCHED button on the Operator Station. The robot begins the job sequence.
4. While the robot is welding at Station 1, load Station 2 with parts to be welded.
5. After the parts are loaded, close the station door and press the CYCLE START/CYCLE LATCHED button on the Operator station; the Cycle Latched light comes on. When the robot has finished welding at Station 1, it returns to HOME position, then proceeds to Station 2.
6. Unload the welded parts from Station 1.

4.2.5 Shutdown Procedure

Use the following procedure to perform a normal shutdown of the ArcWorld® II-50 Series system:

1. Make sure that the robot is in HOME position.
2. Turn off servo power by pressing the E-STOP button on the Operator Station or Programming Pendant.
3. Select TEACH mode on the Programming Pendant.
4. Set the DX100 controller power ON-OFF switch to the OFF position.

5. Set the main power switch on the welding power source to the OFF position.
6. Close the regulator valve for the welding gas supply.
7. Switch the DX100 controller disconnect box (if installed) to OFF.



An electrical service disconnect box for the DX100 controller shall be supplied (if desired) by the customer. It is not part of the ArcWorld® II-50 Series system shipment.

8. Switch the welding power source disconnect box to OFF (see *fig. 2-1*).
The ArcWorld® II-50 Series cell is now shut down.

4.3 System Recovery

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

4.3.1 Alarms and Errors

There are three levels of alarms and errors that will stop the program:

- Error messages
- Minor alarms
- Major alarms

For more detailed information on alarm and error recovery, refer to the maintenance and DX100 controller documentation that is included with your ArcWorld® II-50 Series system (refer to *Section 1.3*).

4.3.1.1 Error Messages

Error messages are usually the result of simple, easily cleared operation errors. One example of this type of error is 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.

4.3.1.2 Minor Alarms

Minor alarms usually involve programming errors. Clear alarms of this type by pressing the CANCEL button on the Programming Pendant.

4.3.1.3 Major Alarms

Major alarms usually involve hardware failures. Examples of this type of error include an overload condition and abnormal speed.

Clear alarms of this type by cycling the DX100 controller in accordance with the following steps:

1. Rotate the DX100 controller's power ON-OFF switch to OFF.
2. Allow the controller's power ON-OFF switch to remain in the OFF position for approximately 10 seconds.
3. Rotate the controller's power ON-OFF switch to ON.

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	4.3	System Recovery

4.3.2 Emergency Stop (E-STOP) Recovery

An Emergency Stop (E-STOP) can occur under any of the following conditions:

- Pressing the E-STOP button on the Operator Station, Programming Pendant, or controller door.
- Opening the access door when the robot is not in TEACH mode.
- Actuating the shock sensor on the torch mount (refer to *Section 2.5.3*).

After an E-STOP condition occurs, restart the ArcWorld® II-50 Series system as follows:

1. To clear the E-STOP condition, perform any of the following actions that apply:
 - Release the activated E-STOP push button
 - Close the work-cell access door
 - Clear the shock sensor condition (refer to *Section 4.3.3*).



CAUTION

If an Emergency Stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when system is restarted.

2. Press the SERVO ON button on the Programming Pendant.
3. Press the green START button on the Operator Station.

The ArcWorld® II-50 Series work cell is now ready to continue operation.

4.3.3 Shock Sensor Recovery

The ArcWorld® II-50 Series welding package includes a Motoman gun mount. This mount is designed to protect the torch from damage in case of a crash. A slight deflection of the torch activates a SHOCK SENSOR message 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 the Programming Pendant's touch screen.
2. Select ROBOT on the Programming Pendant's touch screen.
3. Select OVERRUN-S.SENSOR on the Programming Pendant's touch screen.
4. Select RELEASE to release the shock sensor.
5. Turn servo power ON (press in on the pendant's ENABLE switch while pressing SERVO ON READY).
6. Move the robot clear of the impact position.

The ArcWorld® II-50 Series cell is now ready to continue operation.

5 Maintenance

Maintenance must be performed by authorized personnel who are familiar with the ArcWorld® II-50 Series 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 all the safety instructions and precautions given throughout this manual.

The maintenance intervals given in *table 5-1* 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® II-50 Series 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 damage sealing gaskets in the water circulator pumps.

Table 5-1: Periodic Maintenance

FREQUENCY	COMPONENT	PROCEDURE
Daily (or on condition)	Water Circulators (water-cooled torch application only)	Add a mixture of Motoman antifreeze (P/N 131224-1) and distilled water, as required. Mix antifreeze and distilled water in proportions shown on the antifreeze container.
	All safeguard items – work-cell door interlocks, E-STOP push buttons, safety light curtains, arc curtains, etc.	Check the physical condition of the safeguard item and ensure that it is working correctly.
One Month (or on condition)	ArcWorld® II-50 Series Work Cell	Remove accumulated dirt, grease, and debris from inside and outside the work cell.
Six Months (or on condition)	Spanner Plates	Check the integrity and torque of the hardware that secures the spanner plates to the robot equipment base and positioner (see <i>fig. 3-2</i>).

6 Anchoring

The purchaser must determine all anchoring and foundation requirements and supply the appropriate anchoring hardware for a particular installation. Always use chemical anchors for equipment with dynamic loads. Use appropriate sized anchors, relative to the clearance holes, to anchor equipment to the floor. *Table 6-1* provides sample anchor and foundation requirements for peripheral equipment. Refer to equipment manuals included with your system documentation package (Section 1.3) for anchoring requirements.



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 6-1: Minimum Recommended Equipment Anchor Requirements

EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIAMETER/TYPE	MINIMUM FLOOR-PLATE REQUIREMENTS	MINIMUM FOUNDATION REQUIREMENTS
ROBOTS	Refer to the manipulator manual included with your system documentation package (Section 1.3) for anchoring requirements. Always use chemical anchors for equipment with dynamic loads. Use appropriate sized anchors, relative to the clearance holes, to anchor equipment to the floor.		
POSITIONER	Refer to the positioner manual included with your system documentation package (Section 1.3) for anchoring requirements. Always use chemical anchors for equipment with dynamic loads. Use appropriate sized anchors, relative to the clearance holes, to anchor equipment to the floor.		
PERIPHERAL EQUIPMENT	1/2-inch Kwik Bolt II Style Anchor (Note 1)	Not Applicable	3-inch minimum thickness or 1.3 embedment depth (whichever is larger) 4000 psi Reinforced Concrete
WORK-CELL FENCE POSTS	3/8-inch Kwik Bolt II Style Anchor (Note 1)	Not Applicable	3-inch minimum thickness or 1.3 embedment depth (whichever is larger) 4000 psi Reinforced Concrete
OPERATOR STATION PEDESTAL	1/4-inch Kwik Bolt II Style Anchor (Note 1)	Not Applicable	3-inch minimum thickness or 1.3 embedment depth (whichever is larger) 4000 psi Reinforced Concrete
NOTES: (1) Reference source: <i>Hilti® Product Technical Guide</i> (Section 4.3.3) for hardware specifications or equivalent. Refer to http://us.hilti.com or http://ca.hilti.com for further information.			

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